

SIEMENS



Operating instructions

SINAMICS

SINAMICS G120 and G120P

Low voltage converters
Built-in and wall mounting units with
CU230P-2 Control Units

Edition

04/2018

www.siemens.com/drives

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SINAMICS

SINAMICS G120, SINAMICS G120P Converter with the CU230P-2 Control Units

Operating Instructions

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Edition 04/2018, Firmware V4.7 SP10

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.

Changes in the current edition

Essential changes with respect to Edition 09/2017





New hardware

- PM240-2 Power Module, FSG
 -  Power module for the SINAMICS G120 (Page 39)
 -  Dimensioned drawings, drilling dimensions for the PM240-2 Power Module, IP20 (Page 76)
 -  Specific technical data, 400 V inverters (Page 494)
 -  Specific technical data, 690 V inverters (Page 504)

New functions

-  Firmware version 4.7 SP10 (Page 517)

Corrections

- Article number of the PM240-2 PT Power Module, 132 kW, corrected.
 -  Technical data, PM240-2 Power Module (Page 482)
- Dimensions of the PM240-2 Power Module corrected.
 -  Dimensioned drawings, drilling dimensions for the PM240-2 Power Module, IP20 (Page 76)
- Setting the feedback signal for the line contactor control corrected.
 -  Line contactor control (Page 373)
- Technical data of analog input AI 2 has been amended.
 -  Technical data for CU230P-2 (Page 441)

Revised descriptions


- Only commissioning using the Startdrive PC-based tool is described. Commissioning with STARTER has been removed.
Exceptions: Write and know-how protection.
You can find information on commissioning with STARTER on the Internet:
 -  Operating Instructions, 09/2017 Edition (<https://support.industry.siemens.com/cs/ww/en/view/109751316>)

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Fundamental safety instructions

1.1 General safety instructions



! WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following six steps apply when establishing safety:

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

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



! WARNING

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

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

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



⚠ WARNING

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

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

- Ensure that the prospective short-circuit current at the line terminal of the inverter does not exceed the breaking capacity (SCCR or I_{cc}) of the protective device used.



⚠ WARNING

Electric shock if there is no ground connection

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

- Ground the device in compliance with the applicable regulations.



⚠ WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage that might result in serious injury or death.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.



⚠ WARNING

Electric shock due to equipment damage

Improper handling may cause damage to equipment. For damaged devices, hazardous voltages can be present at the enclosure or at exposed components; if touched, this can result in death or severe injury.

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



⚠ WARNING

Electric shock due to unconnected cable shield

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

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



⚠ WARNING

Arcing when a plug connection is opened during operation

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

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



⚠ WARNING

Electric shock due to residual charges in power components

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

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

NOTICE

Property damage due to loose power connections

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

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

⚠ WARNING

Spread of fire from built-in devices

In the event of fire outbreak, the enclosures of built-in devices cannot prevent the escape of fire and smoke. This can result in serious personal injury or property damage.

- Install built-in units in a suitable metal cabinet in such a way that personnel are protected against fire and smoke, or take other appropriate measures to protect personnel.
- Ensure that smoke can only escape via controlled and monitored paths.

 **WARNING**

Active implant malfunctions due to electromagnetic fields

Inverters generate electromagnetic fields (EMF) in operation. People with active implants in the immediate vicinity of this equipment are at particular risk.

- As the operator of an EMF-emitting installation, assess the individual risks of persons with active implants. The following clearances are usually adequate:
 - No clearance to closed control cabinets and shielded MOTION-CONNECT supply cables
 - Forearm length (approx. 35 cm clearance) to distributed drive systems and open control cabinets

 **WARNING**

Unexpected movement of machines caused by radio devices or mobile phones

When radio devices or mobile phones with a transmission power > 1 W are used in the immediate vicinity of components, they may cause the equipment to malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- If you come closer than around 2 m to such components, switch off any radios or mobile phones.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

NOTICE

Damage to motor insulation due to excessive voltages

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

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

 **WARNING**

Fire due to inadequate ventilation clearances

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

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

 WARNING**Unrecognized dangers due to missing or illegible warning labels**

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

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

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

Incorrect voltage/insulation tests can damage the device.

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

 WARNING**Unexpected movement of machines caused by inactive safety functions**

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

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

Note**Important safety notices for Safety Integrated functions**

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

 **WARNING**

Malfunctions of the machine as a result of incorrect or changed parameter settings

As a result of incorrect or changed parameterization, machines can malfunction, which in turn can lead to injuries or death.

- Protect the parameterization (parameter assignments) against unauthorized access.
- Handle possible malfunctions by taking suitable measures, e.g. emergency stop or emergency off.

1.2 Equipment damage due to electric fields or electrostatic discharge

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



NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

1.3 Warranty and liability for application examples

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

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

1.4 Industrial security

Note

Industrial security

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

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

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

For additional information on industrial security measures that may be implemented, please visit:

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


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

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

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

Further information is provided on the Internet:

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

 WARNING
Unsafe operating states resulting from software manipulation
Software manipulations (e.g. viruses, trojans, malware or worms) can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.
<ul style="list-style-type: none">• Keep the software up to date.• Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.• Make sure that you include all installed products into the holistic industrial security concept.• Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.• Protect the drive against unauthorized changes by activating the "know-how protection" drive function.

1.5 Residual risks of power drive systems

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

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
 - Hardware and/or software errors in the sensors, control system, actuators, and cables and connections
 - Response times of the control system and of the drive
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - Parameterization, programming, cabling, and installation errors
 - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
 - External influences/damage
 - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
 - Component failure
 - Software errors
 - Operation and/or environmental conditions outside the specification
 - External influences/damage
3. Hazardous shock voltages caused by, for example:
 - Component failure
 - Influence during electrostatic charging
 - Induction of voltages in moving motors
 - Operation and/or environmental conditions outside the specification
 - Condensation/conductive contamination
 - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

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

Introduction

2.1 About the Manual

Who requires the operating instructions and what for?

These operating instructions primarily address fitters, commissioning engineers and machine operators. The operating instructions describe the devices and device components and enable the target groups being addressed to install, connect-up, set, and commission the converters safely and in the correct manner.


What is described in the operating instructions?


These operating instructions provide a summary of all of the information required to operate the converter under normal, safe conditions.


The information provided in the operating instructions has been compiled in such a way that it is sufficient for all standard applications and enables drives to be commissioned as efficiently as possible. Where it appears useful, additional information for entry level personnel has been added.

The operating instructions also contain information about special applications. Since it is assumed that readers already have a sound technical knowledge of how to configure and parameterize these applications, the relevant information is summarized accordingly. This relates, e.g. to operation with fieldbus systems and safety-related applications.

What is the meaning of the symbols in the manual?

 Reference to further information in the manual

 Download from the Internet

 DVD that can be ordered








End of a handling instruction.





Examples of inverter function symbols



2.2 Guide through the manual

Section	In this section you will find answers to the following questions:
 Description (Page 29)	<ul style="list-style-type: none"> • How is the inverter marked? • Which components make up the inverter? • Which optional components are available for the inverter? • What is the purpose of the optional components? • Which motors can be fed from the inverter? • Which commissioning tools are there?
 Installing (Page 59)	<ul style="list-style-type: none"> • Which sequence is recommended when installing the inverter? • What does EMC-compliant installation actually mean? • Which options are available to install optional components below the inverter? • What are the inverter dimensions? • Which mounting and installation materials are required when installing the inverter? • To which line supplies can the inverter be connected? • How is the inverter connected to the line supply? • How is the braking resistor connected to the inverter? • Which terminals and fieldbus interfaces does the inverter have? • What are the interface functions?
 Commissioning (Page 151)	<ul style="list-style-type: none"> • Which motor data is required for commissioning • How is the inverter set in the factory? • What is the commissioning procedure? • How do you restore the inverter factory settings?
 Advanced commissioning (Page 195)	<ul style="list-style-type: none"> • Which functions are included in the inverter firmware? • How do the functions interoperate with one another? • How are the functions set?
 Saving the settings and series commissioning (Page 379)	<ul style="list-style-type: none"> • Why is it necessary to back up the inverter settings? • Which options are available to back up the settings? • How does the data backup function? • How do you prevent the inverter settings from being changed? • How do you prevent the inverter settings from being read out?
 Corrective maintenance (Page 421)	<ul style="list-style-type: none"> • How are inverter components replaced? • How do you change the firmware version of the inverter?
 Alarms, faults and system messages (Page 401)	<ul style="list-style-type: none"> • What is the meaning of the LEDs provided on the inverter? • How does the system runtime respond? • How does the inverter save alarms and faults? • What do the inverter alarms and faults mean? • How are inverter faults resolved? • Which I&M data is saved in the inverter?

Section	In this section you will find answers to the following questions:
 Technical data (Page 441)	<ul style="list-style-type: none">• What is the inverter technical data?• What do "High Overload" and "Low Overload" mean?
 Appendix (Page 517)	<ul style="list-style-type: none">• What are the new functions of the current firmware?• What are the most important inverter parameters?• How is the inverter operated using the BOP-2 Operator Panel?• How does the device trace function in STARTER?• How can signal interconnections be changed in the inverter firmware?• What does "BiCo technology" mean?• Where can you find additional manuals and information about the inverter?

Description

Use for the intended purpose

The inverter described in this manual is a device to control a three-phase motor. The inverter is designed for installation in electrical installations or machines.

It has been approved for industrial and commercial use on industrial networks. Additional measures have to be taken when connected to public grids.

The technical specifications and information about connection conditions are indicated on the rating plate and in the operating instructions.

Use of third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

Use of OpenSSL

This product contains software developed in the OpenSSL project for use within the OpenSSL toolkit.

This product contains cryptographic software created by Eric Young.

This product contains software developed by Eric Young.

Further information is provided on the Internet:

 OpenSSL (<https://www.openssl.org/>)

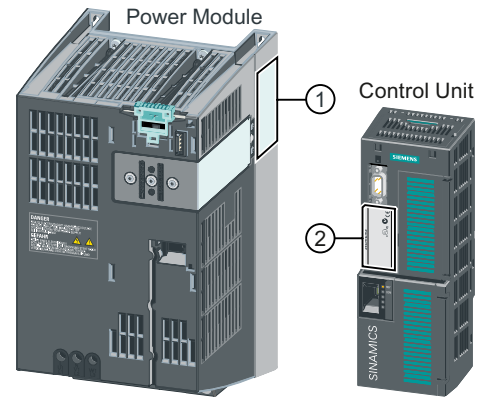
 Cryptsoft (<mailto:eay@cryptsoft.com>)

3.1 Identifying the converter

Main components of the inverter

Each SINAMICS G120 inverter comprises a Control Unit and a Power Module.

- The Control Unit controls and monitors the connected motor.
- The Power Module provides the connections for line supply and motor.



The following data is provided on the Power Module type plate (①):







- Designation, e.g. PM240-2 Power Module
- Technical specifications: voltage and current
- Article number, e.g. 6SL3210-1PE21-1UL0
- Version, e.g. A02

The following data can be found on the Control Unit type plate (②):

- Designation, e.g. Control Unit CU240E-2 DP-F
- Article number, e.g. 6SL3244-0BB13-1PA0
- Version, e.g. A02 (hardware), 4.7 (firmware)

Further inverter components

The following components are available so that you can adapt the inverter to different applications and ambient conditions:

-  Line filter (Page 42)
-  Line reactor (Page 44)
-  Output reactor (Page 46)
-  Sine-wave filter (Page 53)
-  dv/dt filter (Page 54)
-  Braking Module and braking resistor (Page 55)

3.2 Directives and standards

Relevant directives and standards

The following directives and standards are relevant for the inverters:



European Low Voltage Directive

The inverters fulfil the requirements stipulated in the Low-Voltage Directive 2014/35/EU, if they are covered by the application area of this directive.

European Machinery Directive

The inverters fulfil the requirements stipulated in the Machinery Directive 2006/42/EU, if they are covered by the application area of this directive.

However, the use of the inverters in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

Directive 2011/65/EU

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

European EMC Directive

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

Underwriters Laboratories (North American market)

Inverters provided with one of the test symbols displayed fulfil the requirements stipulated for the North American market as a component of drive applications, and are appropriately listed.



EMC requirements for South Korea

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

Eurasian conformity

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



Australia and New Zealand (RCM formerly C-Tick)

The inverters showing the test symbols fulfil the EMC requirements for Australia and New Zealand.





Immunity to voltage drop of semiconductor process equipment.

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

Quality systems

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

Certificates for download

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

Standards that are not relevant



China Compulsory Certification

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

3.3 Control Units



The Control Units differ with regard to the type of fieldbus.

Designation	Article number	Fieldbus
CU230P-2 HVAC	6SL3243-0BB30-1HA3	USS, Modbus RTU, BACnet MS/TP, P1
CU230P-2 DP	6SL3243-0BB30-1PA3	PROFIBUS DP
CU230P-2 PN	6SL3243-0BB30-1FA0	PROFINET IO, EtherNet/IP
CU230P-2 BT ¹⁾	6SL3243-6BB30-1HA3	USS, Modbus RTU, BACnet MS/TP, P1

¹⁾ Exclusive version for Siemens IC BT

Shield connection kit for the Control Unit

The shield connection kit is an optional component. The shield connection kit comprises the following components:


- Shield plate
- Elements for optimum shield support and strain relief of the signal and communication cables

Table 3-1 Article Nos.

Shield connection kit 1 for the CU230P-2 Control Units with all fieldbus interfaces except for PROFINET.	6SL3264-1EA00-0FA0
Shield connection kit 3 for the CU230P-2 and CU240E-2 Control Units with PROFINET interface.	6SL3264-1EA00-0HB0

3.4 Power Module

Important data on the Power Modules is provided in this section. Further information is contained in the Hardware Installation Manual of the Power Module.

 Overview of the manuals (Page 538)

All power data refers to rated values or to power for operation with low overload (LO).

Which Power Module can I use with the Control Unit?

Power module for the SINAMICS G120P

- PM230
- PM240P-2
- PM330

Power module for the SINAMICS G120

- PM240-2
- PM250

3.4.1 Power module for the SINAMICS G120P



Figure 3-1 PM230, 3-phase 400 VAC, degree of protection IP55 / UL Type 12

PM230 for pumps and fan applications

The PM230 Power Module is suitable for cabinet-free installation.

Table 3-2 3-phase 380 VAC ... 480 VAC, article number 6SL3223-0DE...

Frame size		FSA	FSB	FSC	FSD	FSE	FSF
Power (kW)	Filter Class A	0.37 ... 3	4 ... 7.5	11 ... 18.5	22 ... 30	37 ... 45	55 ... 90
	Filter Class B	0.37 ... 3	4 ... 7.5	11 ... 15	18.5 ... 30	37 ... 45	55 ... 90



Figure 3-2 Examples of Power Modules with IP20 degree of protection

PM230, 3-phase 400 VAC in IP20 degree of protection for pump and fan applications

The PM230 Power Module in IP20 degree of protection is available without a filter or with an integrated class A line filter.

Table 3-3 3-phase 380 VAC ... 480 VAC, article numbers: 6SL3210-1NE...

Frame size	FSA	FSB	FSC	FSD	FSE	FSF
Power (kW)	0.37 ... 3	4 ... 7.5	11 ... 18.5	22 ... 37	45 ... 55	75 ... 90

PM240P-2 for pump and fan applications

The PM240P-2 Power Module is available without a filter or with an integrated class A line filter.

Table 3-4 3-phase 380 VAC ... 480 VAC, article number 6SL3210-1RE...

Frame size	FSD	FSE	FSF
Power (kW)	22 ... 37	45 ... 55	75 ... 132

Table 3-5 3-phase 500 VAC ... 690 VAC, article number 6SL3210-1RH...

Frame size	FSD	FSE	FSE
Power (kW)	11 ... 37	45 ... 55	75 ... 132

PM330 for pump, fan and compressor applications

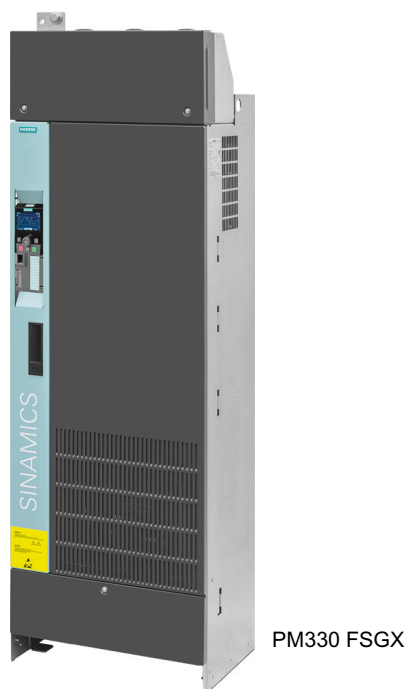


Figure 3-3 PM330 for pump and fan applications

The PM330 Power Module is available as an unfiltered device. External line filters are available as an option, see Section

Table 3-6 3-phase 380 VAC ... 480 VAC, article numbers: 6SL3310-1PE...

Frame size	GX	HX	JX
Power (kW)	160 ... 250	315 ... 400	450 ... 560

Table 3-7 3-phase 500 VAC ... 690 VAC, article numbers: 6SL3310-1PG...

Frame size	HX	JX
Power (kW)	315 ... 450	500 ... 630

3.4 Power Module



Figure 3-4 Examples of Power Modules with Push-Through technology FSA ... FSC

PM230 in Push-Through technology for pump and fan applications

The PM230 Power Module is available without a filter or with integrated class A line filter.

Table 3-8 3-phase 380 VAC ... 480 VAC, article number 6SL3211-1NE...

Frame size	FSA	FSB	FSC
Power (kW)	3	7.5	18.5

3.4.2 Power module for the SINAMICS G120

PM240-2 for standard applications

The PM240-2 Power Module is available without a filter or with an integrated class A line filter. The PM240-2 permits dynamic braking via an external braking resistor.

Table 3-9 1-phase/3-phase 200 VAC ... 240 VAC, article number 6SL3210-1PB... and 6SL3210-1PC...

Frame size	FSA	FSB	FSC	FSD	FSE	FSF
Power (kW)	0.55 ... 0.75	1.1 ... 2.2	3.0 ... 4.0	11 ... 18.5	22 ... 30	37 ... 55

Table 3-10 3-phase 380 VAC ... 480 VAC, article number 6SL3210-1PE...

Frame size	FSA	FSB	FSC	FSD	FSE	FSF	FSG
Power (kW)	0.55 ... 3.0	4.0 ... 7.5	11 ... 15	18.5 ... 37	45 ... 55	75 ... 132	160 ... 250

Table 3-11 3-phase 500 VAC ... 690 VAC, article number 6SL3210-1PH...

Frame size	FSD	FSE	FSF	FSG
Power (kW)	11 ... 37	45 ... 55	75 ... 132	160 ... 250

PM240-2 with Push-Through technology for standard applications

The PM240-2 Power Module is available with Push-Through technology without a filter or with an integrated class A line filter. The PM240-2 allows dynamic braking using an external braking resistor.

Table 3-12 1-phase/3-phase 200 VAC ... 240 VAC, article number 6SL3211-1PB...

Frame size	FSA	FSB	FSC	FSD	FSE	FSF
Power (kW)	0.75	2.2	4.0	18.5	30	55

Table 3-13 3-phase 380 VAC ... 480 VAC, article number 6SL3211-1PE...

Frame size	FSA	FSB	FSC	FSD	FSE	FSF
Power (kW)	3.0	7.5	15	37	55	132

Table 3-14 3 AC 500 V ... 690 V, Article No. 6SL3211-1PH...

Frame size	FSD	FSE	FSF
Power (kW)	37	55	132

PM250 for standard applications with energy recovery

The PM250 Power Module is available without a filter or with integrated class A line filter. The PM250 permits dynamic braking with energy recovery into the line supply.

Table 3-15 3-phase 380 VAC ... 480 VAC, article number 6SL3225-0BE...

Frame size	FSC	FSD	FSE	FSF
Power (kW)	7.5 ... 15	18.5 ... 30	37 ... 45	55 ... 90

3.5 Components for the Power Modules

3.5.1 Accessories for shielding

Shield connection kit

Establish the shield and strain relief for the power connections using the shield connection kit.

The shield connection kit comprises a shield plate and serrated strips with screws.

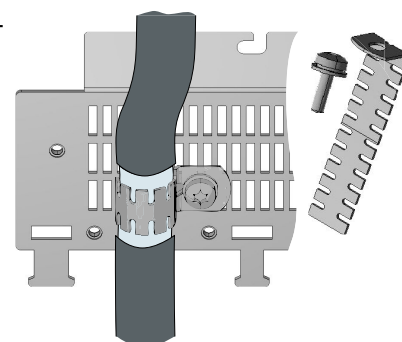


Table 3-16 Article numbers for the shield connection kit

Frame size	PM250 Power Module	PM230, PM240-2	PM240P-2
FSA	6SL3262-1AA00-0BA0	The shield connection kit is included in the scope of delivery	---
FSB	6SL3262-1AB00-0DA0		
FSC	6SL3262-1AC00-0DA0		
FSD	6SL3262-1AD00-0DA0		The lower shield connection kit is included in the scope of delivery
FSE	6SL3262-1AD00-0DA0		
FSF	6SL3262-1AF00-0DA0		

3.5.2 Line filter

With a line filter, the inverter can achieve a higher radio interference class.

NOTICE
<p>Overloading the line filter when connected to line supplies that are not permissible</p> <p>The line filter is only suitable for operation on TN or TT line supplies with a grounded neutral point. If operated on other line supplies, the line filter will be thermally overloaded and will be damaged.</p> <ul style="list-style-type: none"> For inverters equipped with line filter, only connect to TN or TT line supplies with a grounded neutral point.

External line filters for PM230, 380 V ... 480 V (IP20)

Power Module		Power	Line filter according to EN 61800-3 Category C1
FSA	6SL3210-1NE11-3UG1, 6SL3210-1NE11-7UG1, 6SL3210-1NE12-2UG1, 6SL3210-1NE13-1UG1, 6SL3210-1NE14-1UG1, 6SL3210-1NE15-8UG1, 6SL321 . -1NE17-7UG1 .	0.37 kW ... 3 kW	6SL3203-0BE17-7BA0
FSB	6SL3210-1NE21-0UG1, 6SL3210-1NE21-3UG1, 6SL321 . -1NE21-8UG1	4 kW ... 7.5 kW	6SL3203-0BE21-8BA0
FSC	6SL3210-1NE22-6UG1, 6SL3210-1NE23-2UG1, 6SL321 . -1NE23-8UG1	11 kW ... 18.5 kW	6SL3203-0BE23-8BA0
FSD	6SL3210-1NE24-5UL0, 6SL3210-1NE26-0UL0	22 kW ... 30 kW	6SL3203-0BE27-5BA0
FSE	6SL3210- 1NE27-5UL0, 6SL3210- 1NE28-8UL0	37 kW ... 45 kW	6SL3203-0BE31-1BA0
FSF	6SL3210-1NE31-1UL0, 6SL3210-1NE31-5UL0	55 kW ... 75 kW	6SL3203-0BE31-8BA0

External line filters for PM330, 380 V ... 480 V

Power Module		Power	Line filter according to EN 61800-3 Category C2
GX	6SL3310-1PE33-0AA0, 6SL3310-1PE33-7AA0	160 kW ... 200 kW	6SL3000-0BE33-1AA0
	6SL3310-1PE34-6AA0	250 kW	6SL3000-0BE35-0AA0

Power Module		Power	Line filter according to EN 61800-3 Category C2
HX	6SL3310-1PE35-8AA0, 6SL3310-1PE36-6AA0, 6SL3310-1PE37-4AA0	315 kW ... 400 kW	6SL3760-0MR00-0AA0
JX	6SL3310-1PE38-4AA0, 6SL3310-1PE38-8AA0, 6SL3310-1PE41-0AA0	450 kW ... 560 kW	

External line filters for the PM330 Power Module, 500 V ... 690 V

Power Module		Power	Line filter according to EN 61800-3 Category C2
HX	6SL3310-1PG33-7AA0, 6SL3310-1PG34-0AA0, 6SL3310-1PG34-5AA0, 6SL3310-1PG35-2AA0	315 kW ... 450 kW	6SL3760-0MS00-0AA0
JX	6SL3310-1PG35-8AA0, 6SL3310-1PG36-5AA0, 6SL3310-1PG37-2AA0	500 kW ... 630 kW	6SL3760-0MS00-0AA0

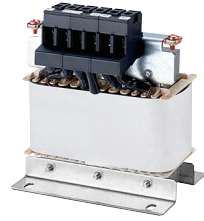
External line filters for PM250

Power Module		Power	Class B line filter according to EN55011: 2009
FSC	6SL3225-0BE25-5AA0, 6SL3225-0BE27-5AA0, 6SL3225-0BE31-1AA0	7.5 kW ... 15.0 kW	6SL3203-0BD23-8SA0


3.5.3 Line reactor

The line reactor supports the overvoltage protection, smoothes the harmonics in the line supply and bridges commutation dips. For the Power Modules subsequently listed, a line reactor is suitable in order to dampen the specified effects.

The figure on the right-hand side shows as example the line reactors for the PM240-2 Power Modules, FSB.



The line requirements for deployment of a line reactor depends on the Power Module:

 Technical data (Page 441)

Line reactors for PM330, 380 V ... 480 V

Power Module		Power	Line reactor
GX	6SL3310-1PE33-0AA0	160 kW	6SL3000-0CE33-3AA0
	6SL3310-1PE33-7AA0	200 kW	6SL3000-0CE35-1AA0
	6SL3310-1PE34-6AA0	250 kW	
HX	6SL3310-1PE35-8AA0	315 kW	6SL3000-0CE36-3AA0
	6SL3310-1PE36-6AA0	355 kW	6SL3000-0CE37-7AA0
	6SL3310-1PE37-4AA0	400 kW	
JX	6SL3310-1PE38-4AA0	450 kW	6SL3000-0CE38-7AA0
	6SL3310-1PE38-8AA0, 6SL3310-1PE41-0AA0	500 kW ... 560 kW	6SL3000-0CE41-0AA0

Line reactors for PM330 Power Modules, 500 V ... 690 V

Power Module		Power	Line reactor
HX	6SL3310-1PG33-7AA0, 6SL3310-1PG34-0AA0, 6SL3310-1PG34-5AA0	315 kW ... 400 kW	6SL3000-0CH34-8AA0
	6SL3310-1PG35-2AA0	450 kW	6SL3000-0CH36-0AA0
JX	6SL3310-1PG35-8AA0	500 kW	6SL3000-0CH36-0AA0
	6SL3310-1PG36-5AA0, 6SL3310-1PG37-2AA0	560 kW ... 630 kW	6SL3000-0CH38-4AA0

Line reactors for PM240-2 Power Modules

A line reactor is not required.

Line reactors for PM240-2, 380 V ... 480 V

Power Module		Power	Line reactor
FSA	6SL3210-1PE11-8 . L1, 6SL3210-1PE12-3 . L1, 6SL3210-1PE13-2 . L1	0.55 kW ... 1.1 kW	6SL3203-0CE13-2AA0
FSB	6SL3210-1PE14-3 . L1, 6SL321 . -1PE16-1 . L1, 6SL321 . -1PE18-0 . L1	1.5 kW ... 3 kW	6SL3203-0CE21-0AA0
FSC	6SL3210-1PE21-1 . L0, 6SL3210-1PE21-4 . L0, 6SL321 . -1PE21-8 . L0	4 kW ... 7.5 kW	6SL3203-0CE21-8AA0
	6SL3210-1PE22-7 . L0, 6SL321 . -1PE23-3 . L0	11 kW ... 15 kW	6SL3203-0CE23-8AA0

FSD ... FSG: A line reactor is not required.

Line reactors for PM240-2 Power Module, 500 V ... 690 V

A line reactor is not required.

Line reactors for PM240-2, 200 V ... 240 V

Power Module		Power	Line reactor
FSA	6SL3210-1PB13-0 . L0, 6SL3210-1PB13-8 . L0	0.55 kW ... 0.75 kW	6SL3203-0CE13-2AA0
FSB	6SL3210-1PB15-5 . L0, 6SL3210-1PB17-4 . L0, 6SL321 . -1PB21-0 . L0	1.1 kW ... 2.2 kW	6SL3203-0CE21-0AA0
FSC	6SL3210-1PB21-4 . L0, 6SL321 . -1PB21-8 . L0	3 kW ... 4 kW	6SL3203-0CE21-8AA0
	6SL321 . -1PC22-2 . L0, 6SL3210-1PC22-8 . L0	5.5 kW ... 7.5 kW	6SL3203-0CE23-8AA0

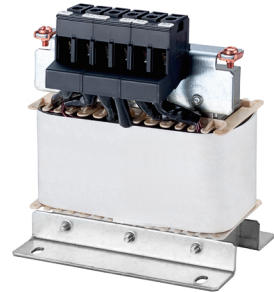
FSD ... FSF: A line reactor is not required.

3.5.4 Output reactor

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

An output reactor is required for the following motor cable lengths:

- For PM330 Power Module:
 - ≥ 100 m shielded
 - ≥ 200 m unshielded
- All other Power Modules:
 - ≥ 50 m shielded
 - ≥ 100 m unshielded



The figure on the right-hand side shows as example the output reactors for PM240-2 Power Modules, FSB and FSC.

NOTICE

The output reactor is damaged if the inverter pulse frequency is too high

The output reactors are designed for a specific pulse frequency. The output reactor can overheat if the inverter is operated with excessive pulse frequencies. Excessively high temperatures damage the output reactor.

- Operate the inverter only with an output reactor with the permissible pulse frequencies:
 - PM330 Power Modules HX and JX: Pulse frequency ≤ 2.5 kHz
 - All other Power Modules: Pulse frequency ≤ 4 kHz

Output reactors for PM230 Power Modules (IP55/UL Type 12)

Power Module	Power	Output reactor
FSA	0.37 kW ... 2.2 kW	6SL3202-0AE16-1CA0
	3.0 kW	6SL3202-0AE18-8CA0
FSB	4.0 kW ... 7.5 kW	6SL3202-0AE21-8CA0
FSC	11.0 kW ... 18.5 kW	6SL3202-0AE23-8CA0
FSD	22 kW	6SE6400-3TC03-8DD0
	30 kW	6SE6400-3TC05-4DD0
FSE	37 kW	6SE6400-3TC08-0ED0
	45 kW	6SE6400-3TC07-5ED0

Power Module		Power	Output reactor
FSF	6SL3223-0DE35-5 . A0	55 kW	6SE6400-3TC14-5FD0
	6SL3223-0DE37-5 . A0	75 kW	6SE6400-3TC15-4FD0
	6SL3223-0DE38-8 . A0	90 kW	6SE6400-3TC14-5FD0

Output reactors for PM230 Power Modules (IP20)

Power Module		Power	Output reactor
FSA	6SL3210-1NE11-3 . G1	0.37 kW ... 2.2 kW	6SL3202-0AE16-1CA0
	6SL3210-1NE11-7 . G1		
	6SL3210-1NE12-2 . G1		
	6SL3210-1NE13-1 . G1		
	6SL3210-1NE14-1 . G1		
	6SL3210-1NE15-8 . G1		
	6SL3210-1NE17-7 . G1	3.0 kW	6SL3202-0AE18-8CA0
FSB	6SL3210-1NE21-0 . G1	4.0 kW ... 7.5 kW	6SL3202-0AE21-8CA0
	6SL3210-1NE21-3 . G1		
	6SL3210-1NE21-8 . G1		
FSC	6SL3210-1NE22-6 . G1	11.0 kW ... 18.5 kW	6SL3202-0AE23-8CA0
	6SL3210-1NE23-2 . G1		
	6SL3210-1NE23-8 . G1		
FSD	6SL3210-1NE24-5 . L0	22 kW	6SE6400-3TC03-8DD0
	6SL3210-1NE26-0 . L0	30 kW	6SE6400-3TC05-4DD0
FSE	6SL3210-1NE27-5 . L0	37 kW	6SE6400-3TC08-0ED0
	6SL3210-1NE28-8 . L0	45 kW	6SE6400-3TC07-5ED0
FSF	6SL3210-1NE31-1 . L0	55 kW	6SE6400-3TC14-5FD0
	6SL3210-1NE31-5 . L0	75 kW	6SE6400-3TC15-4FD0

Output reactors for PM230 push-through Power Modules

Power Module		Power	Output reactor
FSA	6SL3211-1NE17-7 . G1	3.0 kW	6SL3202-0AE18-8CA0
FSB	6SL3211-1NE21-8 . G1	7.5 kW	6SL3202-0AE21-8CA0
FSC	6SL3211-1NE23-8 . G1	18.5 kW	6SL3202-0AE23-8CA0

Output reactors for PM240-2 Power Modules, 380 V ... 480 V

Power Module		Power	Output reactor
FSA	6SL3210-1PE11-8 . L1, 6SL3210-1PE12-3 . L1, 6SL3210-1PE13-2 . L1, 6SL3210-1PE14-3 . L1, 6SL3210-1PE16-1 . L1	0.55 kW ... 2.2 kW	6SL3202-0AE16-1CA0
	6SL321 . -1PE18-0 . L1	3 kW	6SL3202-0AE18-8CA0

3.5 Components for the Power Modules

Power Module		Power	Output reactor
FSB	6SL3210-1PE21-1 . L0, 6SL3210-1PE21-4 . L0, 6SL321 . -1PE21-8 . L0	4 kW ... 7.5 kW	6SL3202-0AE21-8CA0
FSC	6SL3210-1PE22-7 . L0, 6SL321 . -1PE23-3 . L0	11 kW ... 15 kW	6SL3202-0AE23-8CA0
FSD	6SL3210-1PE23-8 . L0 6SL3210-1PE24-5 . L0 6SL3210-1PE26-0 . L0 6SL3210-1PE27-5 . L0	18.5 kW ... 37 kW	6SE6400-3TC07-5ED0
FSE	6SL3210-1PE28-8 . L0, 6SL3210-1PE31-1 . L0, 6SL3210-1PE31-5 . L0, 6SL3210-1PE31-8 . L0	45 kW ... 90 kW	6SE6400-3TC14-5FD0
FSF	6SL3210-1PE32-1 . L0	110 kW	6SL3000-2BE32-1AA0
	6SL3210-1PE32-5 . L0	132 kW	6SL3000-2BE32-6AA0
FSG	6SL3210-1PE33-0 . L0	160 kW	6SL3000-2BE33-2AA0
	6SL3210-1PE33-7 . L0	200 kW	6SL3000-2BE33-8AA0
	6SL3210-1PE34-8 . L0	250 kW	6SL3000-2BE35-0AA0

Output reactors for PM240-2 Power Modules, 500 V ... 690 V

Power Module		Power	Output reactor
FSF	6SL3210-1PH28-0 . L0, 6SL3210-1PH31-0 . L0	75 kW ... 90 kW	6SL3000-2AH31-0AA0
	6SL3210-1PH31-2 . L0, 6SL3210-1PH31-4 . L0	110 kW ... 132 kW	6SL3000-2AH31-5AA0
FSG	6SL3210-1PH31-7CLO	160 kW	6SL3000-2AH31-8AA0
	6SL3210-1PH32-1CLO	200 kW	6SL3000-2AH32-4AA0
	6SL3210-1PH32-5CLO	250 kW	6SL3000-2AH32-6AA0

Output reactors for PM240-2 Power Modules, 200 V ... 240 V

Power Module		Power	Output reactor
FSA	6SL3210-1PB13-0 . L0, 6SL321 . -1PB13-8 . L0	0.55 kW ... 0.75 kW	6SL3202-0AE16-1CA0
FSB	6SL3210-1PB15-5 . L0	1.1 kW	
	6SL3210-1PB17-4 . L0	1.5 kW	6SL3202-0AE18-8CA0
FSB	6SL321 . -1PB21-0 . L0	2.2 kW	6SL3202-0AE21-8CA0
FSC	6SL3210-1PB21-4 . L0, 6SL321 . -1PB21-8 . L0	3 kW ... 4 kW	
	6SL321 . -1PC22-2 . L0, 6SL3210-1PC22-8 . L0	5.5 kw ... 7.5 kW	6SL3202-0AE23-8CA0
FSD	6SL3210-1PC24-2ULO, 6SL3210-1PC25-4ULO, 6SL3210-1PC26-8ULO	11 kW ... 18.5 kW	6SE6400-3TC07-5ED0

Power Module		Power	Output reactor
FSE	6SL3210-1PC28-0UL0, 6SL3210-1PC31-1UL0	22 kW ... 55 kW	6SE6400-3TC14-5FD0
FSF	6SL3210-1PC31-3UL0, 6SL3210-1PC31-6UL0, 6SL3210-1PC31-8UL0		

Output reactors for PM330 Power Modules, 380 V ... 480 V

Power Module		Power	Output reactor
GX	6SL3310-1PE33-0AA0	160 kW	6SL3000-2BE33-2AA0
	6SL3310-1PE33-7AA0	200 kW	6SL3000-2BE33-8AA0
	6SL3310-1PE34-6AA0	250 kW	6SL3000-2BE35-0AA0
HX	6SL3310-1PE35-8AA0	315 kW	6SL3000-2AE36-1AA0
	6SL3310-1PE36-6AA0	355 kW	6SL3000-2AE38-4AA0
	6SL3310-1PE37-4AA0	400 kW	
JX	6SL3310-1PE38-4AA0, 6SL3310-1PE38-8AA0	450 kW ... 500 kW	6SL3000-2AE41-0AA0
	6SL3310-1PE41-0AA0	560 kW	6SL3000-2AE41-4AA0

Output reactors for PM330 Power Modules, 500 V ... 690 V

Power Module		Power	Output reactors
JX	6SL3310-1PG35-8AA0, 6SL3310-1PG36-5AA0, 6SL3310-1PG37-2AA0	500 kW ... 630 kW	6SL3000-2AE41-0AA0

Output reactors for PM240P-2 Power Modules, 380 V ... 480 V

Power Module		Power	Output reactor	
FSD	6SL3210-1RE24-5 . L0	22 kW	6SE6400-3TC03-8DD0	
	6SL3210-1RE26-0 . L0	30 kW	6SE6400-3TC07-5ED0	
	6SL3210-1RE27-5 . L0	37 kW		
FSE	6SL3210-1RE28-8 . L0	45 kW	6SE6400-3TC14-5FD0	
	6SL3210-1RE31-1 . L0	55 kW		
FSF	6SL3210-1RE31-5 . L0	75 kW		
	6SL3210-1RE31-8 . L0	90 kW		
	6SL3210-1RE32-1 . L0	110 kW		6SL3000-2BE32-1AA0
	6SL3210-1RE32-5 . L0	132 kW		6SL3000-2BE32-6AA0

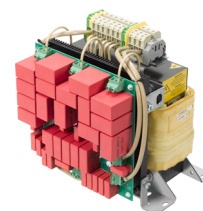
Output reactors for PM250 Power Module

Power Module		Power	Output reactor
FSC	6SL3225-0BE25-5 . A0, 6SL3225-0BE27-5 . A0, 6SL3225-0BE31-1 . A0	7.5 kW ... 15.0 kW	6SL3202-0AJ23-2CA0
FSD	6SL3225-0BE31-5 . A0	18.5 kW	6SE6400-3TC05-4DD0
	6SL3225-0BE31-8 . A0	22 kW	6SE6400-3TC03-8DD0
	6SL3225-0BE32-2 . A0	30 kW	6SE6400-3TC05-4DD0
FSE	6SL3225-0BE33-0 . A0	37 kW	6SE6400-3TC08-0ED0
	6SL3225-0BE33-7 . A0	45 kW	6SE6400-3TC07-5ED0
FSF	6SL3225-0BE34-5 . A0	55 kW	6SE6400-3TC14-5FD0
	6SL3225-0BE35-5 . A0	75 kW	6SE6400-3TC15-4FD0
	6SL3225-0BE37-5 . A0	90 kW	6SE6400-3TC14-5FD0


3.5.5 du/dt filter plus VPL

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

When using the du/dt filter plus VPL, the output frequency must not exceed 150 Hz. The pulse frequency may not exceed 4 kHz.



Further information is provided on the Internet:

 Sales Release and Operating Instructions (<https://support.industry.siemens.com/cs/ww/en/view/109756054>)

du/dt filters plus VPL for PM240-2 Power Modules, 380 V ... 480 V

Power Module		Power	du/dt filter plus VPL
FSA	6SL3210-1PE11-8 . L1, 6SL3210-1PE12-3 . L1, 6SL3210-1PE13-2 . L1, 6SL3210-1PE14-3 . L1, 6SL3210-1PE16-1 . L1, 6SL321 . -1PE18-0 . UL1	0.55 kW ... 3.0 kW	JTA:TEF1203-0GB
FSB	6SL3210-1PE21-1 . L0, 6SL3210-1PE21-4 . L0, 6SL321 . -1PE21-8 . L0	4.0 kW ... 7.5 kW	JTA:TEF1203-0GB
FSC	6SL3210-1PE22-7 . L0, 6SL321 . -1PE23-3 . L0	11 kW ... 15 kW	JTA:TEF1203-0HB
FSD	6SL3210-1PE23-8 . L0	18.5 kW	JTA:TEF1203-0HB
	6SL3210-1PE24-5 . L0, 6SL3210-1PE26-0 . L0	22 kW, 30 kW	JTA:TEF1203-0JB
FSD FSE	6SL321 . -1PE27-5 . L0, 6SL3210-1PE28-8 . L0	37 kW, 45 kW	JTA:TEF1203-0KB
FSE FSF	6SL321 . -1PE31-1 . L0, 6SL3210-1PE31-5 . L0	55 kW, 75 kW	JTA:TEF1203-0LB
FSF	6SL3210-1PE31-8 . L0, 6SL3210-1PE32-1 . L0, 6SL321 . -1PE32-5 . L0	90 kW ... 132 kW	JTA:TEF1203-0MB

du/dt filters plus VPL for PM240-2 Power Modules, 500 V ... 690 V

Power Module		Power	du/dt filter plus VPL
FSD	6SL3210-1PH21-4 . L0 6SL3210-1PH22-0 . L0 6SL3210-1PH22-3 . L0	11 kW ... 18.5 kW	JTA:TEF1203-0GB
	6SL3210-1PH22-7 . L0 6SL3210-1PH23-5 . L0 6SL3210-1PH24-2 . L0	22 kW ... 37 kW	JTA:TEF1203-0HB

Description

3.5 Components for the Power Modules

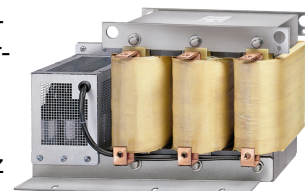
Power Module		Power	du/dt filter plus VPL
FSE	6SL3210-1PH25-2 . L0 6SL3210-1PH26-2 . L0	45 kW, 55 kW	JTA:TEF1203-0JB
FSF	6SL3210-1PH28-0 . L0 6SL3210-1PH31-0 . L0	75 kW, 90 kW	JTA:TEF1203-0KB
	6SL3210-1PH31-2 . L0 6SL3210-1PH31-4 . L0	110 kW, 132 kW	JTA:TEF1203-0LB
FSG	6SL3210-1PH31-7CLO 6SL3210-1PH32-1CLO 6SL3210-1PH32-5CLO	160 kW ... 250 kW	JTA:TEF1203-0MB

3.5.6 Sine-wave filter

The sine-wave filter at the inverter output limits the voltage rate-of-rise and the peak voltages at the motor winding. The maximum permissible length of motor feeder cables is increased to 300 m.

The following applies when using a sine-wave filter:

- Operation is only permissible with pulse frequencies from 4 kHz to 8 kHz.
From 110 kW power rating of the Power Modules (according to the type plate) only 4 kHz is permissible.
- The inverter power is reduced by 5%.
- The maximum output frequency of the inverter is 150 Hz at 380 V to 480 V.
- Operation and commissioning may only be performed with the motor connected, as the sine-wave filter is not no-load proof.
- An output reactor is superfluous.



Sine-wave filter for PM250 Power Module

Power Module		Power	Sine-wave filter
FSC	6SL3225-0BE25-5 . A0	7.5 kW	6SL3202-0AE22-0SA0
	6SL3225-0BE27-5 . A0, 6SL3225-0BE31-1 . A0	11.0 kW ... 15.0 kW	6SL3202-0AE23-3SA0
FSD	6SL3225-0BE31-5 . A0, 6SL3225-0BE31-8 . A0	18.5 kW ... 22 kW	6SL3202-0AE24-6SA0
	6SL3225-0BE32-2 . A0	30 kW	6SL3202-0AE26-2SA0
FSE	6SL3225-0BE33-0 . A0, 6SL3225-0BE33-7 . A0	37 kW ... 45 kW	6SL3202-0AE28-8SA0
FSF	6SL3225-0BE34-5 . A0, 6SL3225-0BE35-5 . A0	55 kW ... 75 kW	6SL3202-0AE31-5SA0
	6SL3225-0BE37-5 . A0	90 kW	6SL3202-0AE31-8SA0

Sine-wave filter for PM240P-2 Power Module, 380 V ... 480 V

Power Module		Power	Sine-wave filter
FSD	6SL3210-1RE24-5 . L0	22 kW	6SL3202-0AE26-2SA0
	6SL3210-1RE26-0 . L0	30 kW	6SL3202-0AE28-8SA0
	6SL3210-1RE27-5 . L0	37 kW	
FSE	6SL3210-1RE28-8 . L0	45 kW	6SL3202-0AE31-5SA0
	6SL3210-1RE31-1 . L0	55 kW	
FSF	6SL3210-1RE31-5 . L0	75 kW	6SL3202-0AE31-8SA0
	6SL3210-1RE31-8 . L0	90 kW	6SL3000-2CE32-3AA0
	6SL3210-1RE32-1 . L0	110 kW	
	6SL3210-1RE32-5 . L0	132 kW	6SL3000-2CE32-8AA0

3.5.7 dv/dt filter

du/dt filters for the PM330 Power Module, 380 V ... 480 V

A du/dt filter plus VPL (Voltage Peak Limiter) limits the voltage rate of rise du/dt and the voltage peaks at the motor. A du/dt filter plus VPL allows standard motors with standard insulation and without insulated bearings to be operated at the inverter.

Power Module		Power	du/dt filter plus VPL	du/dt filter compact plus VPL
GX	6SL3310-1PE33-0AA0, 6SL3310-1PE33-7AA0, 6SL3310-1PE34-6AA0	160 kW ... 250 kW	6SL3000-2DE35-0AA0	6SL3000-2DE35-0EA0
HX	6SL3310-1PE35-8AA0, 6SL3310-1PE36-6AA0, 6SL3310-1PE37-4AA0	315 kW ... 400 kW	6SL3000-2DE38-4AA0	6SL3000-2DE38-4EA0
JX	6SL3310-1PE38-4AA0, 6SL3310-1PE38-8AA0, 6SL3310-1PE41-0AA0	450 kW ... 560 kW	6SL3000-2DE41-4AA0	6SL3000-2DE41-4EA0

du/dt filters for the PM330 Power Module, 500 V ... 690 V

Power Module		Power	du/dt filter plus VPL	du/dt filter compact plus VPL
JX	6SL3310-1PG35-8AA0, 6SL3310-1PG36-5AA0, 6SL3310-1PG37-2AA0	500 kW ... 630 kW	6SL3000-2DH38-1AA0	6SL3000-2DG38-1EA0

3.5.8 Braking Module and braking resistor

The braking resistor allows loads with a high moment of inertia to be quickly braked. Inverters with power up to 132 kW have an integrated Braking Module that controls the braking resistor.

A Braking Module is available as option for inverters with more power.

An example for a braking resistor is shown at the side.



Braking Modules and braking resistors for PM330

Power Module		Power	Braking Module	Power	Braking resistor
GX	6SL3310-1PE33-0AA0, 6SL3310-1PE33-7AA0, 6SL3310-1PE34-6AA0	160 kW ... 250 kW	6SL3760- 1AE32-6AA0	50 kW	6SE7032- 5FS87-2DC0
HX	6SL3310-1PE35-8AA0, 6SL3310-1PE36-6AA0, 6SL3310-1PE37-4AA0	315 kW ... 400 kW			
JX	6SL3310-1PE38-4AA0, 6SL3310-1PE38-8AA0, 6SL3310-1PE41-0AA0	450 kW ... 560 kW			

Braking resistors for PM240-2, 380 V ... 480 V

Power Module		Power	Braking resistor
FSA	6SL3210-1PE11-8 . L1, 6SL3210-1PE12-3 . L1, 6SL3210-1PE13-2 . L1, 6SL3210-1PE14-3 . L1	0.55 kW ... 1.5 kW	6SL3201-0BE14-3AA0
	6SL321 . -1PE16-1 . L1, 6SL321 . -1PE18-0 . L1	2.2 kW ... 3.0 kW	6SL3201-0BE21-0AA0
FSB	6SL3210-1PE21-1 . L0, 6SL3210-1PE21-4 . L0, 6SL321 . -1PE21-8 . L0	4 kW ... 7.5 kW	6SL3201-0BE21-8AA0
FSC	6SL3210-1PE22-7 . L0, 6SL321 . -1PE23-3 . L0	11 kW ... 15 kW	6SL3201-0BE23-8AA0
FSD	6SL3210-1PE23-8 . L0, 6SL3210-1PE24-5 . L0	18.5 kW ... 22 kW	JJY:023422620001
	6SL3210-1PE26-0 . L0, 6SL3210-1PE27-5 . L0	30 kW ... 37 kW	JJY:023424020001
FSE	6SL3210-1PE28-8 . L0, 6SL3210-1PE31-1 . L0	45 kW ... 55 kW	JJY:023434020001

3.5 Components for the Power Modules

Power Module		Power	Braking resistor
FSF	6SL3210-1PE31-5 . L0, 6SL3210-1PE31-8 . L0,	75 kW ... 90 kW	JJY:023454020001
	6SL3210-1PE32-1 . L0, 6SL3210-1PE32-5 . L0	90 kW ... 132 kW	JJY:023464020001
FSG	6SL3210-1PE33-0AL0, 6SL3210-1PE33-7AL0, 6SL3210-1PE34-8AL0	160 kW ... 250 kW	6SL3000-1BE32-5AA0

Braking resistors for PM240-2, 500 V ... 690 V

Power Module		Power	Braking resistor	
FSD	6SL3210-1PH21-4 . L0, 6SL3210-1PH22-0 . L0, 6SL3210-1PH22-3 . L0, 6SL3210-1PH22-7 . L0, 6SL3210-1PH23-5 . L0, 6SL3210-1PH24-2 . L0	11 kW ... 37 kW	JJY:023424020002	
	6SL3210-1PH25-2 . L0, 6SL3210-1PH26-2 . L0	45 kW ... 55 kW	JJY:023434020002	
	6SL3210-1PH28-0 . L0, 6SL3210-1PH31-0 . L0,	75 kW ... 90 kW	JJY:023464020002	
		6SL3210-1PH31-2 . L0, 6SL3210-1PH31-4 . L0	110 kW ... 132 kW	JJY:023464020002
	FSG	6SL3210-1PH31-7CLO, 6SL3210-1PH32-1CLO, 6SL3210-1PH32-5CLO	160 kW ... 250 kW	6SL3000-1BH32-5AA0

Braking resistors for PM240-2, 200 V ... 240 V

Power Module		Power	Braking resistor
FSA	6SL3210-1PB13-0 . L0, 6SL321 . -1PB13-8 . L0	0.55 kW ... 0.75 kW	JJY:023146720008
FSB	6SL3210-1PB15-5 . L0, 6SL3210-1PB17-4 . L0, 6SL321 . -1PB21-0 . L0	1.1 kW ... 2.2 kW	JJY:023151720007
FSC	6SL3210-1PB21-4 . L0, 6SL321 . -1PB21-8 . L0	3 kW ... 4 kW	JJY:02 3163720018
	6SL3210-1PC22-2 . L0, 6SL3210-1PC22-8 . L0	5.5 kW ... 7.5 kW	JJY:023433720001
FSD	6SL3210-1PC24-2ULO, 6SL3210-1PC25-4ULO, 6SL3210-1PC26-8ULO	11 kW ... 18.5 kW	JJY:023422620002
FSE	6SL3210-1PC28-0ULO, 6SL3210-1PC31-1ULO	22 kW ... 30 kW	JJY:023423320001
FSF	6SL3210-1PC31-3ULO, 6SL3210-1PC31-6ULO, 6SL3210-1PC31-8ULO	37 kW ... 55 kW	JJY:023434020003

3.6 Motors and multi-motor drives that can be operated

Siemens motors that can be operated

You can connect standard induction motors to the inverter.

You can find information on further motors on the Internet:

 Motors that can be operated (<https://support.industry.siemens.com/cs/ww/en/view/100426622>)

Third-party motors that can be operated

You can operate standard asynchronous motors from other manufacturers with the inverter:

NOTICE
Insulation failure due to unsuitable third-party motor
A higher load occurs on the motor insulation in inverter mode than with line operation. Damage to the motor winding may occur as a result.
<ul style="list-style-type: none">• Please observed the notes in the System Manual "Requirements for third-party motors"

Further information is provided on the Internet:

 Requirements for third-party motors (<https://support.industry.siemens.com/cs/ww/en/view/79690594>)

Multi-motor operation

Multi-motor operation involves simultaneously operating several motors from one inverter. For standard induction motors, multi-motor operation is generally permissible.

Additional preconditions and restrictions relating to multi-motor operation are available on the Internet:

 Multi-motor drive (<http://support.automation.siemens.com/WW/view/en/84049346>)

Description

3.6 Motors and multi-motor drives that can be operated

4.1 EMC-compliant setup of the machine or plant

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

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

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

EMC zones

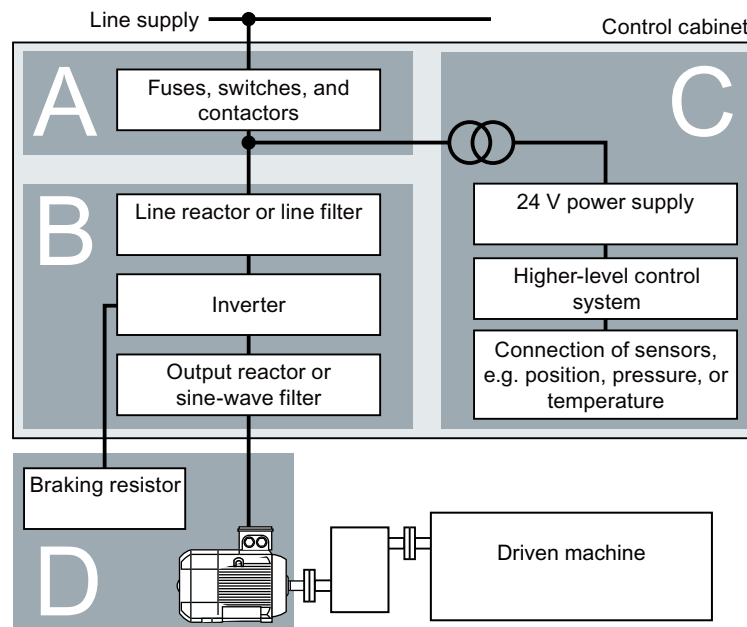


Figure 4-1 Example of the EMC zones of a plant or machine

Inside the control cabinet

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

Outside the control cabinet

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

4.1.1 Control cabinet

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

Control cabinet assembly

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

Measures required for several control cabinets

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

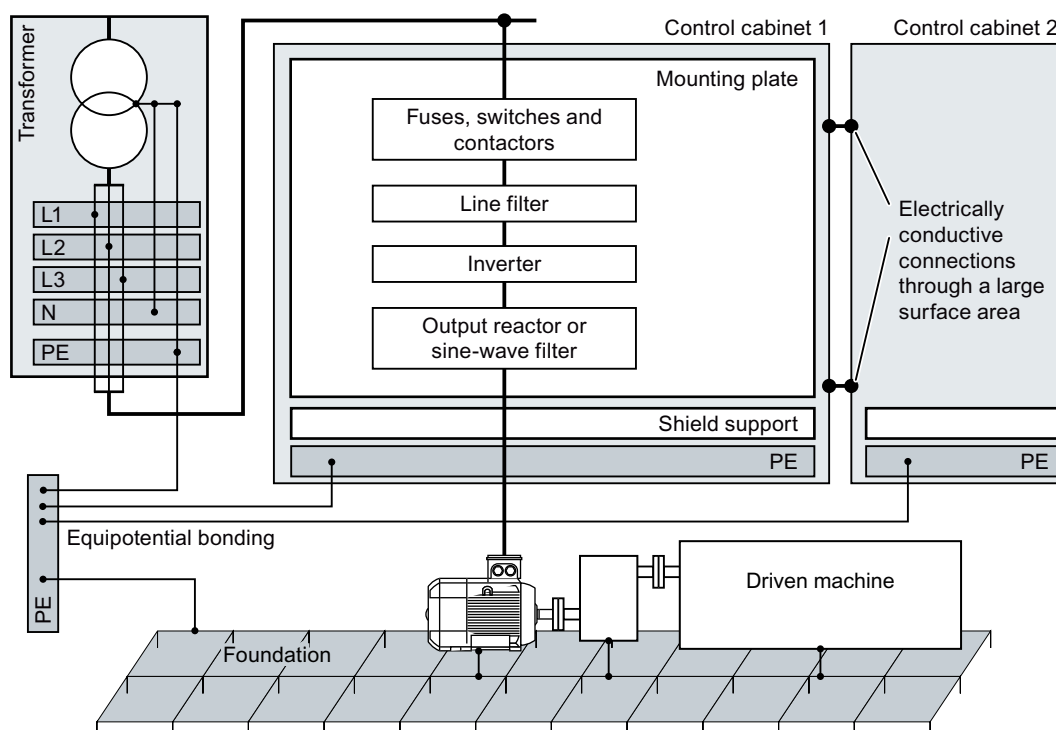


Figure 4-2 Grounding and high-frequency equipotential bonding measures in the control cabinet and in the plant/system

Further information

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

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

4.1.2 Cables

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

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

Cable routing inside the cabinet

- Route the power cables with a high level of interference so that there is a minimum clearance of 25 cm to cables with a low level of interference.
If the minimum clearance of 25 cm is not possible, insert separating metal sheets between the cables with a high level of interference and cables with a low level of interference. Connect these separating metal sheets to the mounting plate to establish a good electrical connection.
- Cables with a high level of interference and cables with a low level of interference may only cross over at right angles:
- Keep all of the cables as short as possible.
- Route all of the cables close to the mounting plates or cabinet frames.
- Route signal and data cables - as well as the associated equipotential bonding cables - parallel and close to one another.
- Twist incoming and outgoing unshielded individual conductors. Alternatively, you can route incoming and outgoing conductors in parallel, but close to one another.
- Ground any unused conductors of signal and data cables at both ends.
- Signal and data cables must only enter the cabinet from one side, e.g. from below.
- Using shielded cables for the following connections:
 - Cable between the inverter and line filter
 - Cable between the inverter and output reactor or sine-wave filter

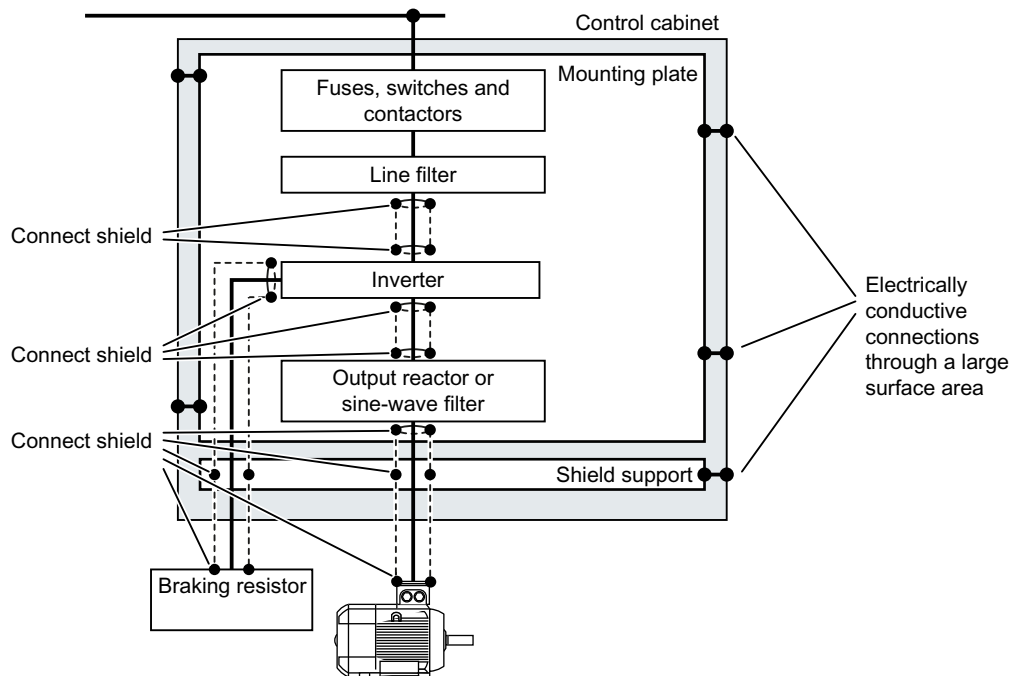


Figure 4-3 Routing inverter cables inside and outside a control cabinet

Routing cables outside the control cabinet

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

Requirements relating to shielded cables

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

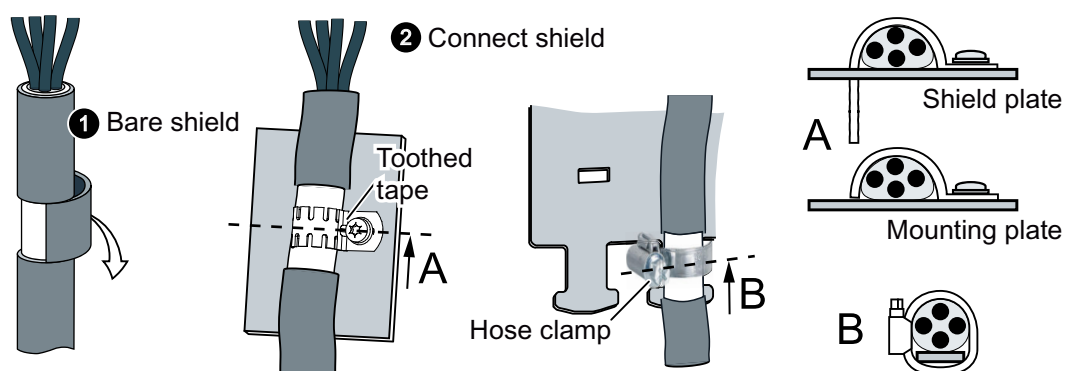


Figure 4-4 Examples for EMC-compliant shield support

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

4.1.3 Electromechanical components

Surge voltage protection circuit

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

4.2 Installing reactors, filters and braking resistors

Installing reactors, filters and braking resistors

The following supplementary components may be required depending on the Power Modules and the particular application:

- Line reactors
- Filter
- Braking resistors
- Brake Relay

Installing these components is described in the documentation provided.

4.3 Installing Power Modules

4.3.1 Basic installation rules for built-in units

Protection against the spread of fire

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

Wall mounting units may be operated outside the control cabinet.

Protection against condensation or electrically conductive contamination

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

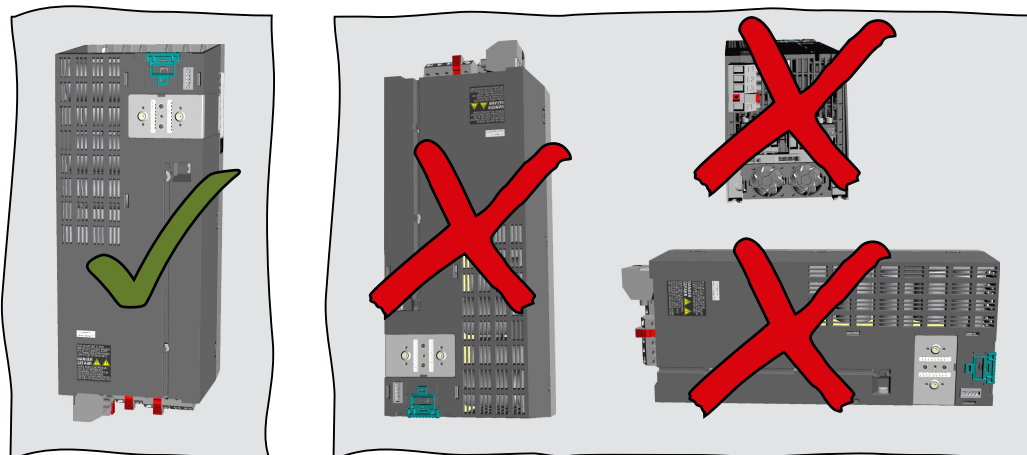
If condensation or conductive pollution can be excluded at the installation site, a lower degree of control cabinet protection may be permitted.

Installing

NOTICE
Overheating due to inadmissible mounting
If mounted in an inadmissible fashion, the Power Module can overheat and therefore be damaged.
<ul style="list-style-type: none">• Follow the mounting instructions.

Rules for admissible mounting:

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



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

4.3.2 Dimension drawings, drilling dimensions for the PM230 Power Module, IP55

The following dimension drawings are not to scale.

Frame sizes FSA ... FSC

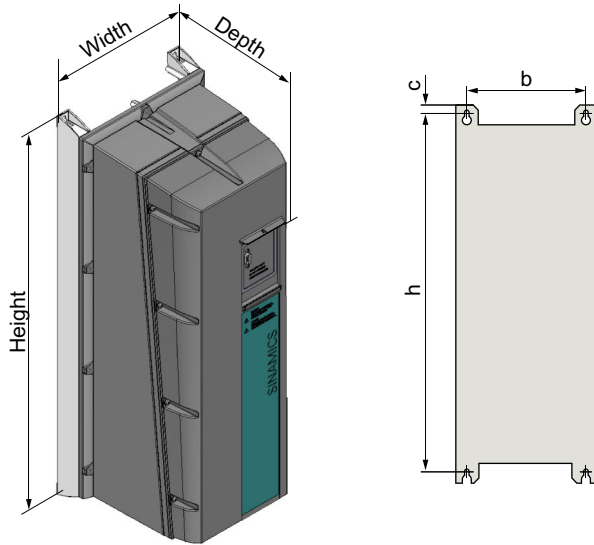


Figure 4-5 Dimension drawing, PM230 Power Module IP55, FSA ... FSC

Table 4-1 Dimensions

Frame size	Width [mm]	Height [mm]	Depth [mm]	
			Without operator panel	With BOP-2, IOP-2 operator panel or blanking cover
FSA	154	460	249	256
FSB	180	540	249	256
FSC	230	620	249	256

Table 4-2 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm]			Screws/torque [Nm]
	b	h	c	Top	Bottom	Lateral	
FSA	132	445	11	100	100	0 ¹⁾	4 x M4 / 2.5
FSB	158	524	11	100	100	0 ¹⁾	4 x M4 / 2.5
FSC	208	604	11	125	125	0 ¹⁾	4 x M5 / 3.0

¹⁾ You can mount the Power Modules without any lateral cooling air clearance. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

Frame sizes FSD ... FSF

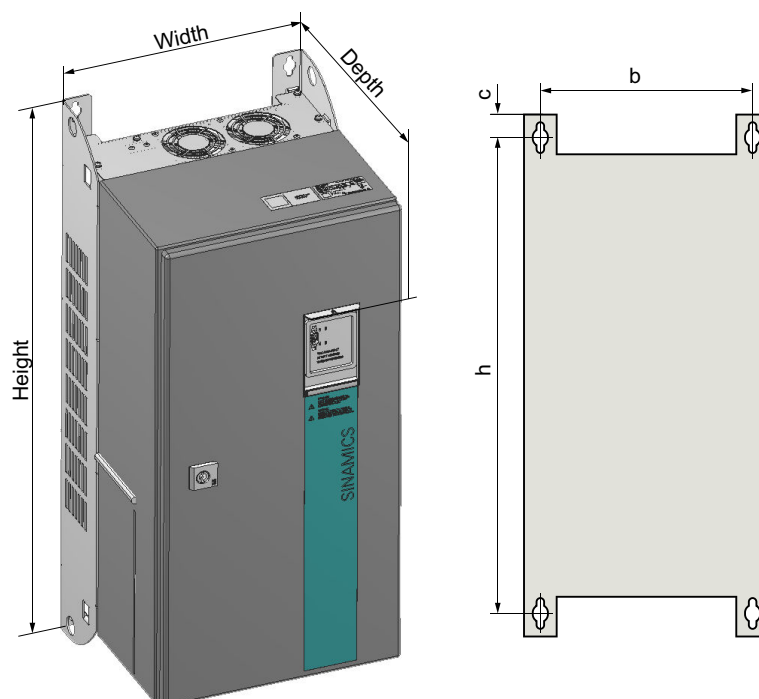


Figure 4-6 Dimension drawing, PM230 Power Module IP55 FSD ... FSF

Table 4-3 Dimensions

Frame size	Width [mm]	Height [mm]	Depth [mm]	
			Without operator panel	With BOP-2, IOP-2 operator panel or blanking cover
FSD	320	640	329	336
FSE	320	751	329	336
FSF	410	915	416	423

Table 4-4 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm]			Screws/torque [Nm]
	b	h	c	Top	Bottom	Lateral	
FSD	285	600	17.5	300	300	50	4 x M8 / 13
FSE	285	710	17.5	300	300	50	4 x M8 / 13
FSF	370	870	17.5	350	350	50	4 x M8 / 13

4.3.3 Dimension drawings, drilling dimensions for the PM230 Power Module, IP20

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

Frame sizes FSA ... FSC

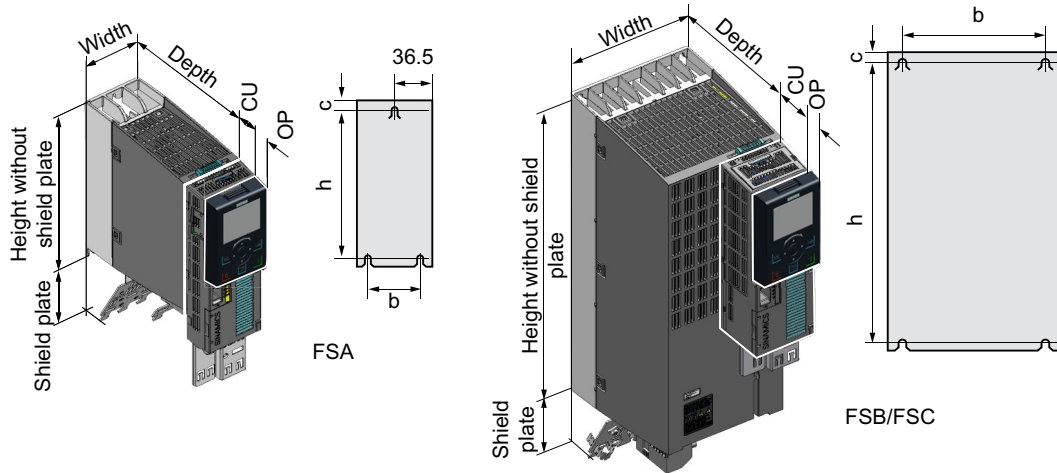


Table 4-5 Dimensions depend on the operator panel (OP) that is inserted

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm] ²⁾	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSA	73	196	276	224	235
FSB	100	292	370	224	235
FSC	140	355	432	224	235

1) BOP-2, IOP-2 or blanking cover

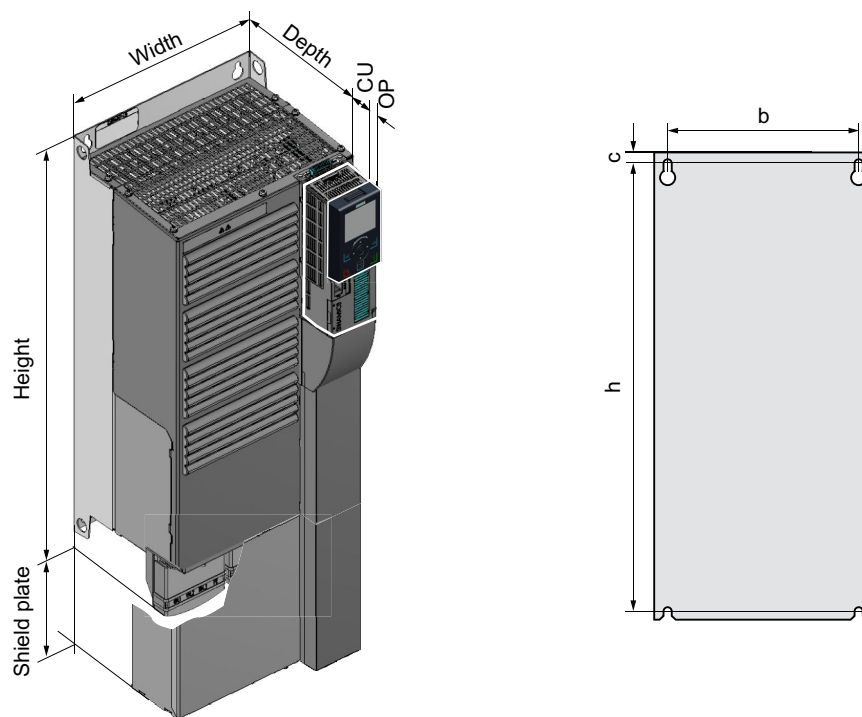
2) Power Module depth without Control Unit: 165 mm

Table 4-6 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	b	h	c	Top	Bottom	Front	
FSA	62.3	186	6	80	100	---	2 x M4 / 2.5
FSB	80	281	6	80	100	---	4 x M4 / 2.5
FSC	120	343	6	80	100	---	4 x M5 / 3.0

1) You can mount the Power Modules without any lateral cooling air clearance. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

Frame sizes FSD ... FSF

Table 4-7 Dimensions depend on the operator panel (OP) that is inserted ¹⁾

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm] ²⁾	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSD without filter	275	419	542	263	274
FSD with filter	275	512	635	263	274
FSE without filter	275	499	622	263	274
FSE with filter	275	635	758	263	274
FSF without filter	350	634	792	375	386
FSF with filter	350	934	1092	375	386

¹⁾ BOP-2, IOP-2 or blanking cover

²⁾ Power Module depth without Control Unit: FSD, FSE 237 mm, FSF 357 mm

4.3 Installing Power Modules

Table 4-8 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	b	h	c	Top	Bottom	Front	
FSD without filter	235	325	11	300	300	100	4 x M6 / 6.0
FSD with filter	235	419	11	300	300	100	4 x M6 / 6.0
FSE without filter	235	405	11	300	300	100	4 x M6 / 10
FSE with filter	235	451	11	300	300	100	4 x M6 / 10
FSF without filter	300	598	11	350	350	100	4 x M8 / 13
FSF with filter	300	899	11	350	350	100	4 x M8 / 13

¹⁾ You can mount the Power Modules without any lateral cooling air clearance. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

4.3.4 Dimension drawings, drilling dimensions for PM240P-2 Power Modules, IP20

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

Frame sizes FSD ... FSF

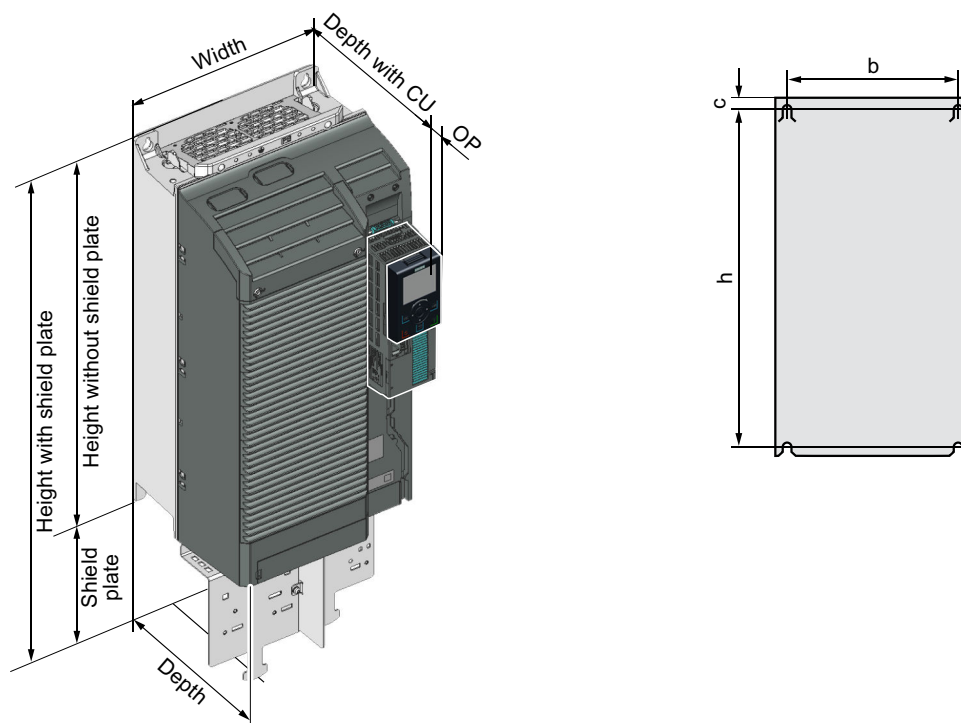


Table 4-9 Dimensions depend on the operator panel (OP) that is inserted ¹⁾

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm] ²⁾	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSD	200	472	624	253	264
FSE	275	551	728	253	264
FSF	305	709	965	373	384

¹⁾ BOP-2, IOP-2 or blanking cover

²⁾ Power Module depth without Control Unit: FSD, FSE 237 mm, FSF 357 mm

Table 4-10 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	h	b	c	Top	Bottom	Front	
FSD	430	170	7	300	350	100	4 x M5 / 6.0
FSE	509	230	8.5	300	350	100	4 x M6 / 10
FSF	680	270	13	300	350	100	4 x M8 / 25

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

4.3.5 Dimension drawings, drilling dimensions for the Power Module PM330, IP20

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

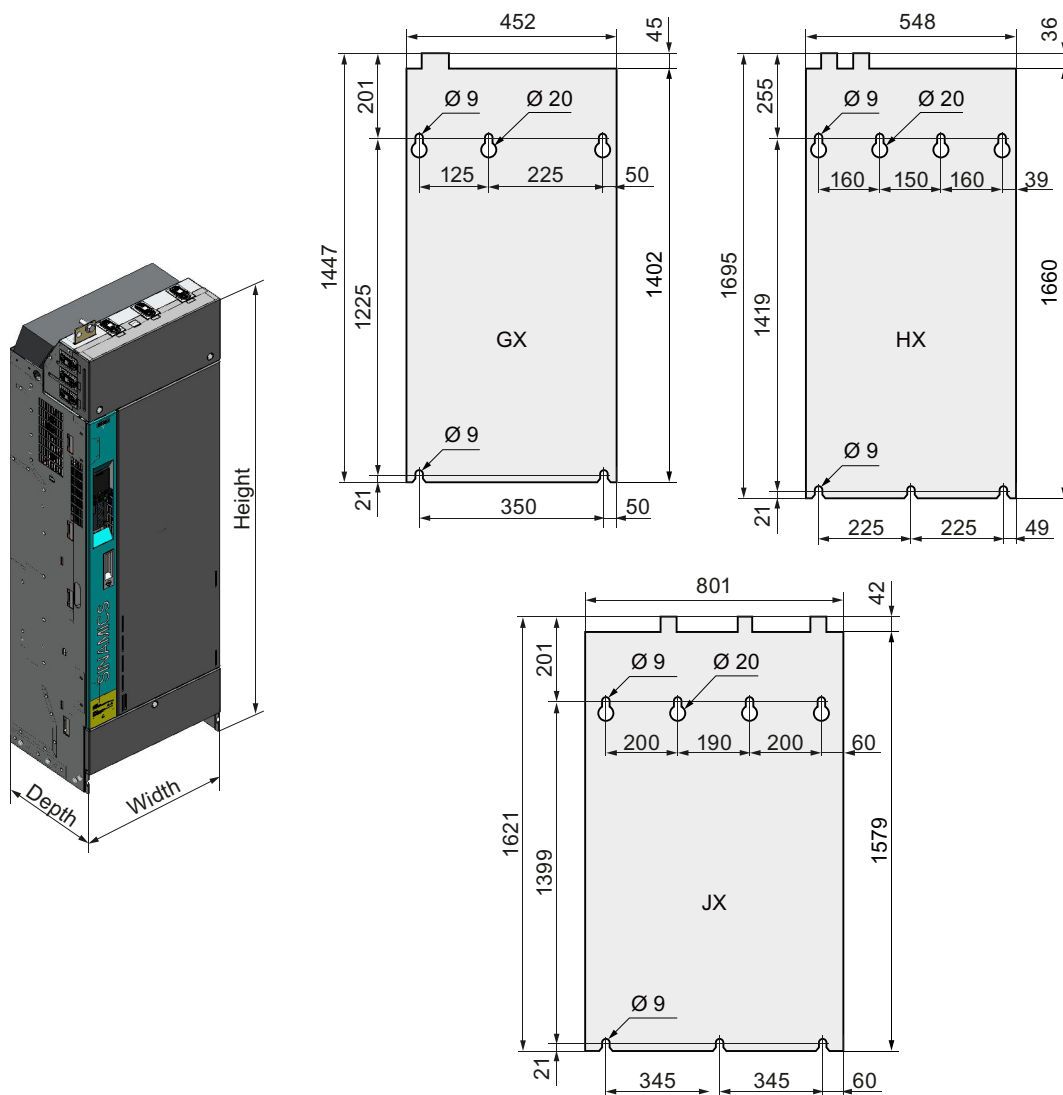


Table 4-11 Dimensions, cooling air clearances [mm] and fastening [Nm]

Frame size	Dimensions			Cooling air clearances				Mounting
	Depth	Height	Width	Top	Bottom	Lateral	Front	Screws/torque
GX	328	1402	452	200	200	30	30	5 x M8 / 25
HX	393	1660	548	200	250	30	100	7 x M8 / 25
JX	393	1579	801	200	250	30	100	7 x M8 / 25

4.3.6 Dimensioned drawings, drilling dimensions for the PM240-2 Power Module, IP20

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

Frame sizes FSA ... FSC

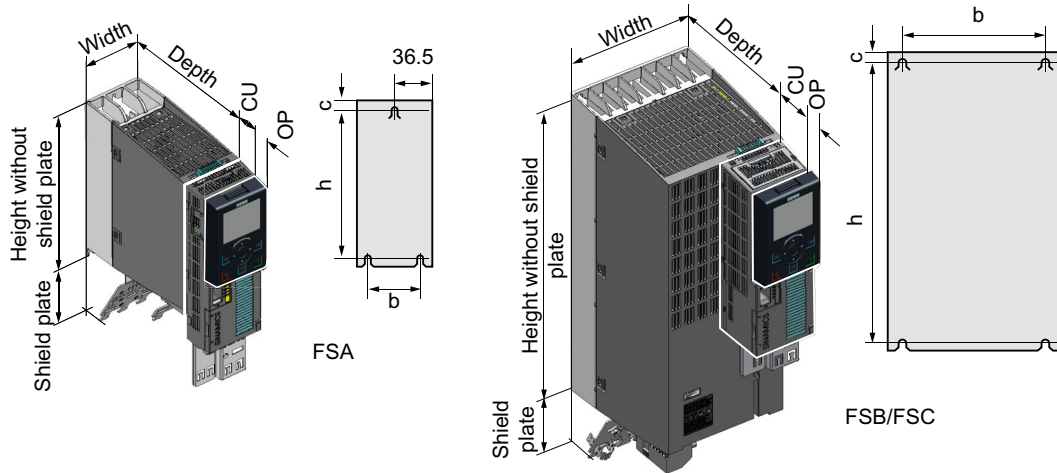


Table 4-12 Dimensions depend on the operator panel (OP) that is inserted

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm] ²⁾	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSA	73	196	276	224	235
FSB	100	292	370	224	235
FSC	140	355	432	224	235

1) BOP-2, IOP-2 or blanking cover

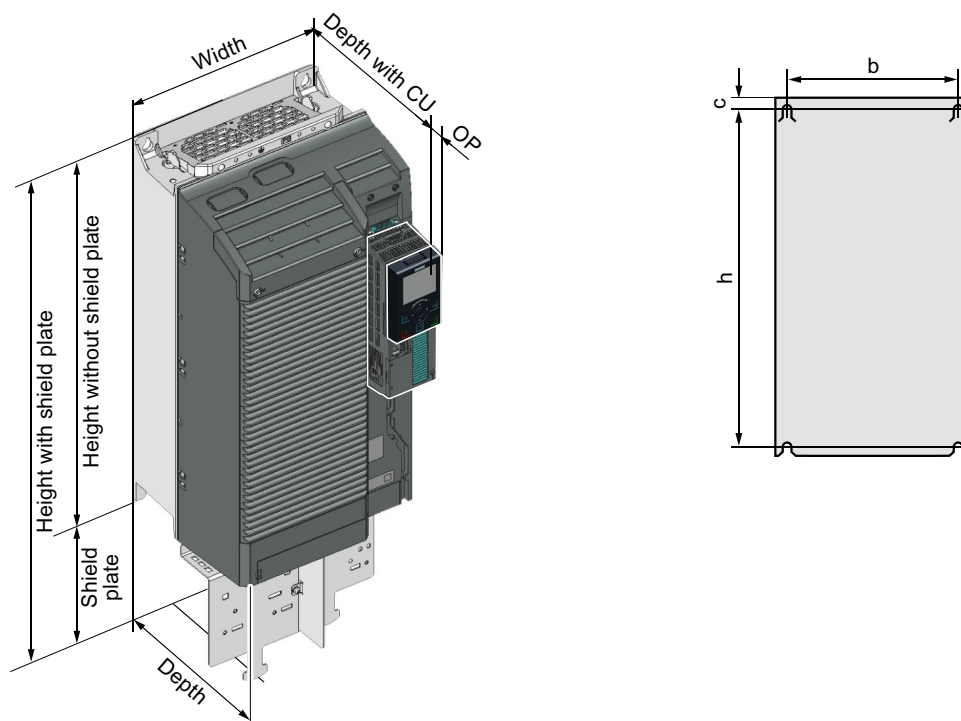
2) Power Module depth without Control Unit: 165 mm

Table 4-13 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	h	b	c	Top	Bottom	Front	
FSA	186	62.3	6	80	100	100	3 x M4 / 2.5
FSB	281	80	6	80	100	100	4 x M4 / 2.5
FSC	343	120	6	80	100	100	4 x M5 / 3.5

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

Frame sizes FSD ... FSF

Table 4-14 Dimensions depend on the operator panel (OP) that is inserted ¹⁾

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm] ²⁾	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSD	200	472	624	253	264
FSE	275	551	728	253	264
FSF	305	709	965	373	384
FSG	305	1000	1286	373	384

¹⁾ BOP-2, IOP-2 or blanking cover

²⁾ Power Module depth without Control Unit: FSD, FSE 237 mm, FSF 357 mm, FSG 358 mm

Table 4-15 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	h	b	c	Top ²⁾	Bottom ²⁾	Front	
FSD	430	170	7	300	350	100	4 x M5 / 6.0
FSE	509	230	8.5	300	350	100	4 x M6 / 10

4.3 Installing Power Modules

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	h	b	c	Top ²⁾	Bottom ²⁾	Front	
FSF	680	270	13	300	350	100	4 x M8 / 25
FSG	970.5	265	15	300	350	100	4 x M8 / 25

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

2) The top and bottom cooling air clearances refer to the Power Module without shield plate

4.3.7 Dimensioned drawings, drilling dimensions for the PM250 Power Module

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

Frame size FSC

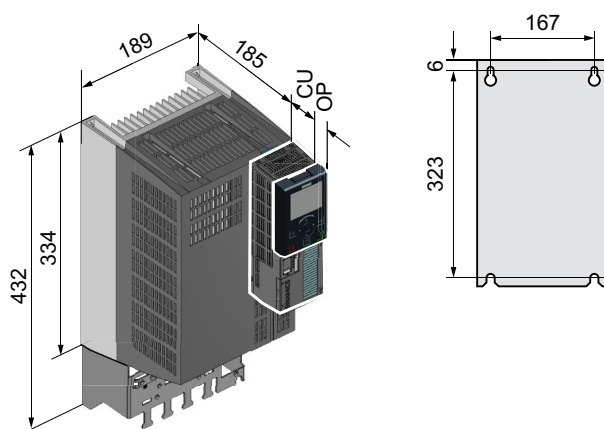


Table 4-16 Dimensions depend on the operator panel (OP) that is inserted

Frame size	Mounting depth in the cabinet with Control Unit (CU) [mm]	
	without OP	with OP ¹⁾
FSC	224	235

¹⁾ BOP-2, IOP-2 or blanking cover

Table 4-17 Cooling air clearances and fastening

Frame size	Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	Top	Bottom	Front	
FSC	125	125	65	4 x M5 / 3

¹⁾ You can mount the Power Modules without any lateral cooling air clearance. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

Frame sizes FSD ... FSF

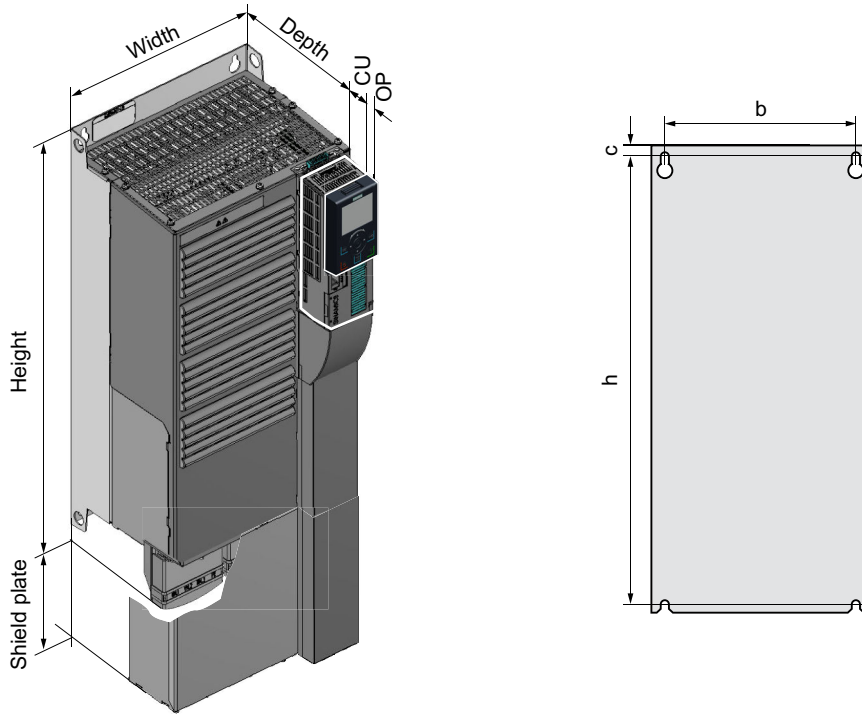


Table 4-18 Dimensions depend on the operator panel (OP) that is inserted ¹⁾

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm] ²⁾	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSD without filter	275	419	542	263	274
FSD with filter	275	512	635	263	274
FSE without filter	275	499	622	263	274
FSE with filter	275	635	758	263	274
FSF without filter	350	634	792	375	386
FSF with filter	350	934	1092	375	386

¹⁾ BOP-2, IOP-2 or blanking cover

²⁾ Power Module depth without Control Unit: FSD, FSE 204 mm, FSF 316 mm

Table 4-19 Drilling dimensions, cooling clearances and fixing

Frame size	Drilling dimensions [mm]			Cooling air clearances [mm] ¹⁾			Fixing/torque [Nm]
	b	h	c	Top	Bottom	Front	
FSD without filter	235	325	11	300	300	65	4 x M6 / 6
FSD with filter	235	419	11	300	300	65	4 x M6 / 6
FSE without filter	235	405	11	300	300	65	4 x M6 / 6
FSE with filter	235	541	11	300	300	65	4 x M6 / 6
FSF without filter	300	598	11	350	350	65	4 x M8 / 13
FSF with filter	300	898	11	350	350	65	4 x M8 / 13

¹⁾ You can mount the Power Modules without any lateral cooling air clearance. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

4.3.8 Dimension drawings, drilling dimensions for PM230 and PM240-2 Power Modules utilizing push-through technology

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

Frame sizes FSA ... FSC

Panel thickness of the control cabinet ≤ 3.5 mm

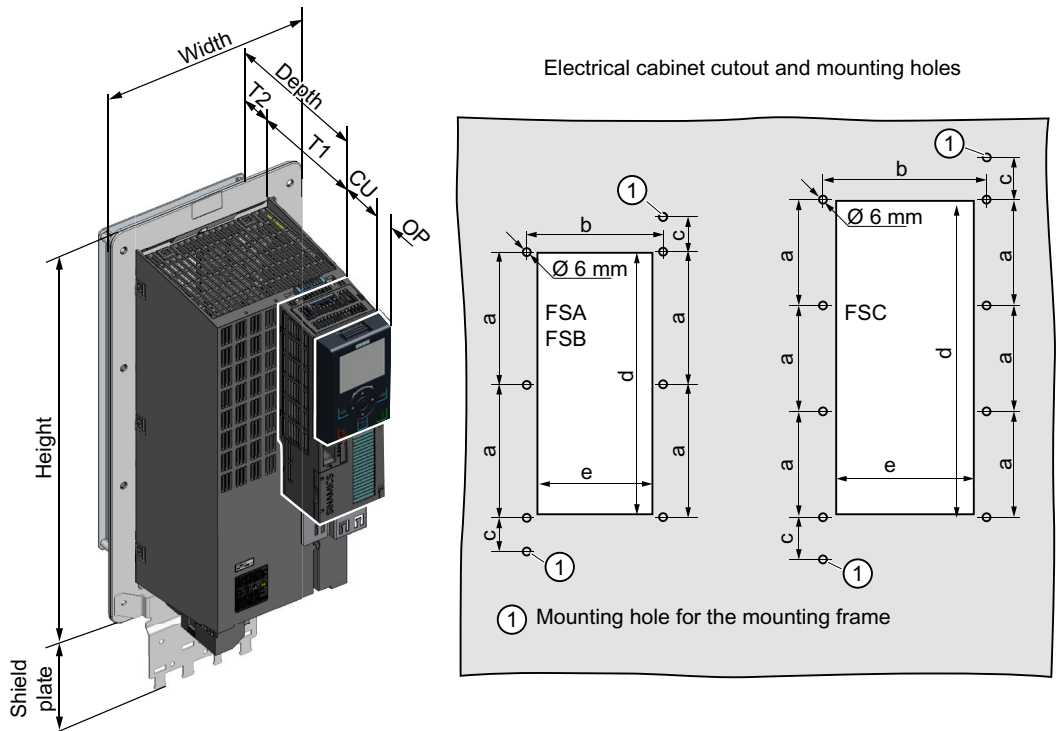


Figure 4-7 Dimension drawing and drilling dimensions for frame sizes FSA ... FSC

Table 4-20 Dimensions depend on the operator panel (OP) that is inserted

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm]	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSA	126	238	322	177	188
FSB	154	345	430	177	188
FSC	200	411	500	177	188

¹⁾ BOP-2, IOP-2 or blanking cover

Table 4-21 Cooling air clearances and additional dimensions

Frame size	Power Module depth [mm]	T1	T2	Cooling air clearances [mm] ¹⁾		
				Top	Bottom	Front
FSA ... FSC	171	118	53	80	100	100

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

Table 4-22 Electrical cabinet cutout and mounting holes

Frame size	Control cabinet cutout [mm]					Fixing/torque [Nm]
	a	b	c	d	e	
FSA	103	106	27	198	88	8 × M5 / 3.5
FSB	148	134	34.5	304	116	8 × M5 / 3.5
FSC	123	174	30.5	365	156	10 × M5 / 3.5

Frame sizes FSD ... FSF

Panel thickness of the control cabinet ≤ 3.5 mm

Cutouts of the control cabinet and mounting holes

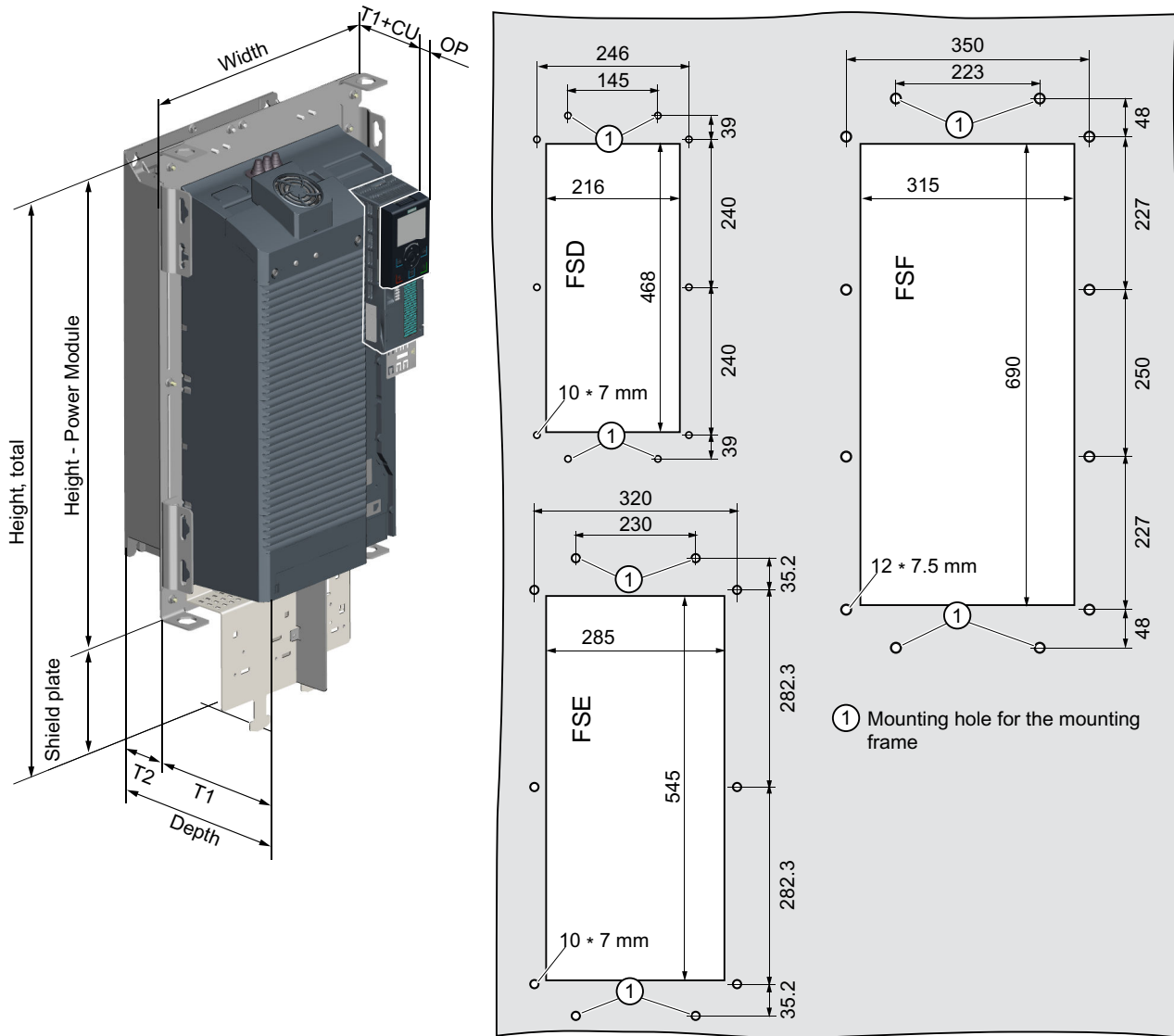


Figure 4-8 Dimension drawing and drilling dimensions for frame sizes FSD ... FSF

Table 4-23 Dimensions depend on the operator panel (OP) that is inserted ¹⁾

Frame size	Width [mm]	Height [mm]		Mounting depth in the cabinet with Control Unit (CU) [mm]	
		without shield plate	with shield plate	without OP	with OP ¹⁾
FSD	276	517	650	155	166
FSE	355	615	722	155	166
FSF	385	754	1021	193	204

¹⁾ BOP-2, IOP-2 or blanking cover

Table 4-24 Cooling air clearances and additional dimensions

Frame size	Power Module depth [mm]	T1	T2	Cooling air clearances [mm]		
				Top	Bottom	Front
FSD, FSE	237	141	97.5	350	350	29
FSF	358	177.5	180.5	80	100	100

Table 4-25 Mounting

Frame size	Fixing/torque [Nm]
FSD, FSE	10 × M5 / 3.5
FSF	12 × M6 / 5.9

4.4 Connecting the line supply and motor



WARNING

Electric shock when the motor terminal box is open

As soon as the inverter is connected to the line supply, the motor connections of the inverter may carry dangerous voltages. When the motor is connected to the inverter, there is danger to life through contact with the motor terminals if the motor terminal box is open.

- Close the motor terminal box before connecting the inverter to the line supply.

Note

Fault protection for the motor circuit


The electronic overcurrent trip complies with the requirements laid down in IEC 60364-3-2:2005/AMD1:- Section 411 for protection against electric shock.

- Observe the installation specifications provided in this manual.
- Observe the applicable installation standards.
- Ensure the continuity of the protective conductor.

4.4.1 Permissible line supplies

Restrictions for installation altitudes above 2000 m

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

 Restrictions for special ambient conditions (Page 515)

Screw for functional grounding on the converter, frame size FSG

If you wish to use the inverters with integrated C3 line filter, please note the information in the sections "TN line system", "TT line system" and "IT system" below.

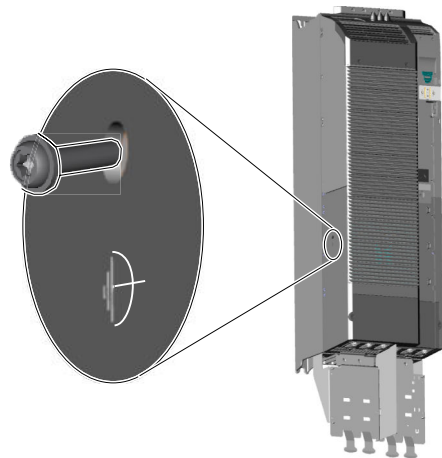


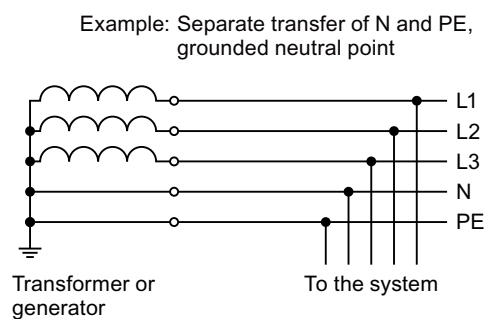
Figure 4-9 Remove screw for functional grounding

4.4.1.1 TN line system

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

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

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




Inverter connected to a TN system

- Inverters with integrated line filter:
 - Operation on TN line systems with grounded neutral point permissible.
 - Operation on TN line systems with grounded line conductor not permissible.
-

Note

Special feature of FSG inverters

FSG inverters with integrated C3 line filter can be operated in TN line systems ≤ 600 V with a grounded line conductor if you remove the screw for functional grounding.

 Permissible line supplies (Page 86)

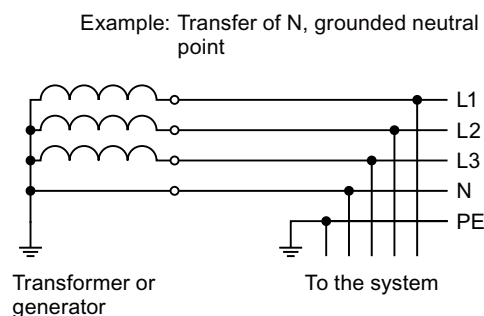
If you remove the screw for functional grounding, the EMC properties deteriorate and the requirements of Class C3 are no longer met.

- Inverters with external line filter:
 - Operation on TN line systems with grounded neutral point permissible.
 - Operation on TN line systems with grounded line conductor not permissible.
- Inverter without line filter:
 - Operation on all TN line systems ≤ 600 V permissible
 - Operation on TN line systems > 600 V and grounded neutral point permissible.
 - Operation on TN line systems > 600 V and grounded line conductor not permissible.

4.4.1.2 TT line system

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

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



Note

Operation in IEC or UL systems

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

Inverter connected to a TT system

- Inverters with integrated line filter:
 - Operation on TT line systems with grounded neutral point permissible.
 - Operation on TT line systems without grounded neutral point not permissible.

Note

Special feature of FSG inverters

FSG inverters with integrated C3 line filter can be operated in TT line systems without a grounded neutral point if you remove the screw for functional grounding.

 Permissible line supplies (Page 86)

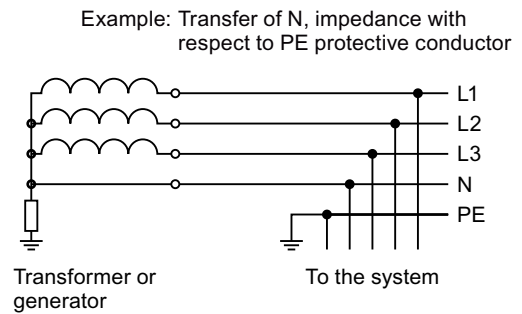
If you remove the screw for functional grounding, the EMC properties deteriorate and the requirements of Class C3 are no longer met.

- Inverters with external line filter:
 - Operation on TT line systems with grounded neutral point permissible.
 - Operation on TT line systems without grounded neutral point not permissible.
- Inverter without line filter:
 - Operation on all TT line systems permissible.

4.4.1.3 IT system

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

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



Inverter connected to an IT line system - FSA ... FSF

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

Note


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

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

Inverter with PM330 Power Module operated on an IT line system

When connected to an IT line supply, you must open the connection to the basic interference suppression board of the Power Module.

Further information is provided on the Internet:

 Hardware installation manual for PM330 Power Modules (<https://support.industry.siemens.com/cs/ww/en/view/109742506>)

Inverter with PM240-2 FSG Power Module operated on an IT line system

The inverters have an integrated C3 line filter. Operation on IT line systems is only permissible if you remove the grounding screw at the inverter.

 Permissible line supplies (Page 86)

Behavior of the inverter when a ground fault occurs

You must install an output reactor if the inverter is to remain operational even when a ground fault occurs at the inverter output. This output reactor prevents an overcurrent trip or damage to the inverter.

4.4.2 Protective conductor



⚠ WARNING

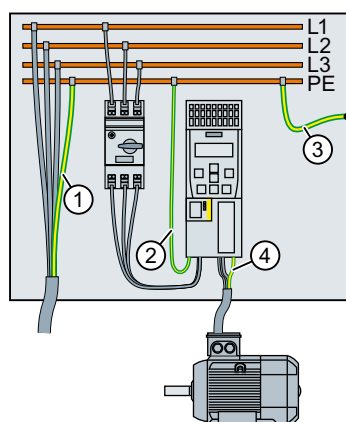
Electric shock due to interrupted protective conductor

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

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

Dimensioning the protective conductor

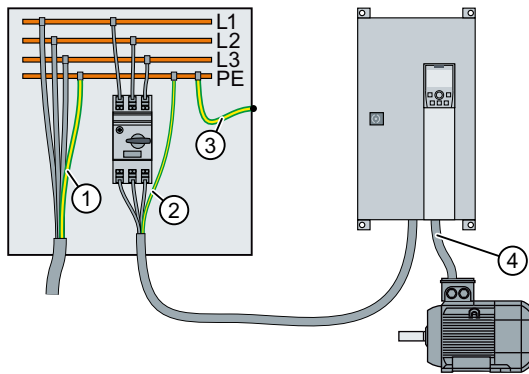
Observe the local regulations for protective conductors subject to an increased leakage current at the site of operation.



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

Figure 4-10 Protective conductors for inverters with IP20 degree of protection

4.4 Connecting the line supply and motor



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

Figure 4-11 Protective conductors for inverters with IP55 degree of protection

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

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

Additional requirements placed on the protective conductor ①:

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

4.4.3 Connecting the inverter with the PM230 Power Module IP55

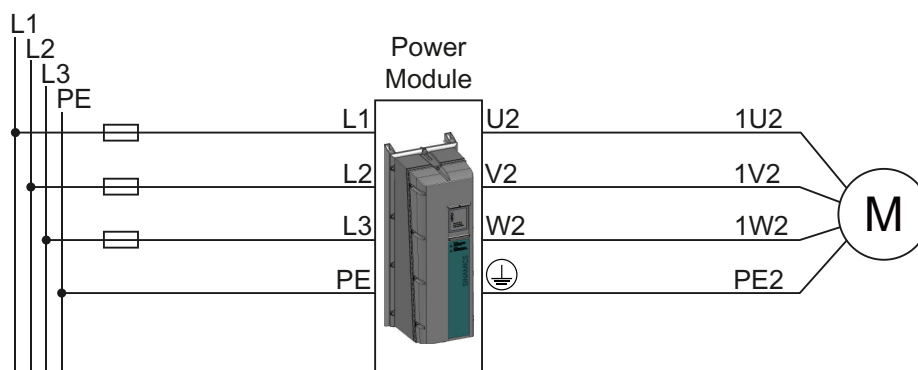


Figure 4-12 PM230 Power Module IP55 connection overview

Table 4-26 Connection types, maximum conductor cross-sections and tightening torques

Inverters	Connection	Cross-section / tightening torque	
FSA	Terminal	1 ... 2.5 mm ² / 0.5 Nm	18 ... 14 AWG / 4.4 lbf in
FSB	Terminal	2.5 ... 6 mm ² / 0.6 Nm	14 ... 10 AWG, 5.3 lbf in
FSC	Terminal	6 ... 16 mm ² / 1.5 Nm	10 ... 5 AWG / 13.3 lbf in
FSD	Cable lug	10 ... 35 mm ² / 6 Nm	5 ... 2 AWG / 53 lbf in
FSE	Cable lug	25 ... 50 mm ² / 6 Nm	3 ... 2 AWG / 53 lbf in
FSF	Cable lug	35 ... 120 mm ² / 13 Nm	2 ... 4/0 AWG, 115 lbf in

EMC cable glands

To meet the requirements of degree of protection IP55/UL, type 12, and to fulfill EMC requirements, adhere to the following:

- Use EMC cable glands for the control cables.
- Make sure that the cable glands match the drill holes in the plate.



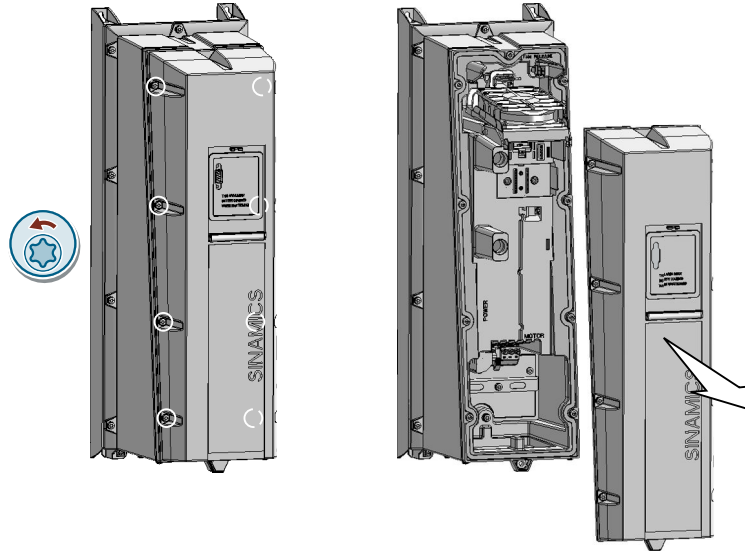
Figure 4-13 Example of an EMC cable gland (Blueglobe)

The EMC cable glands are not included in the scope of supply of the inverter. Rubber sleeves for unused drill holes in the cable cover plate are included in the scope of supply.

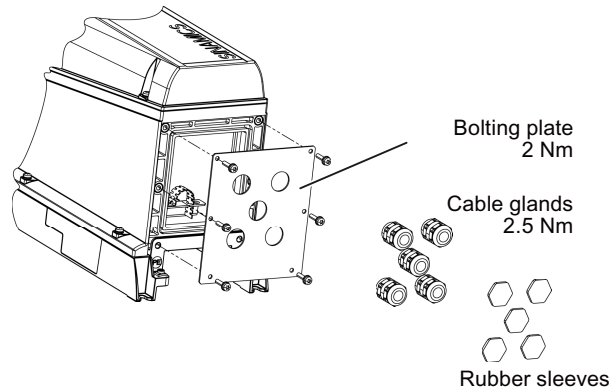
Connecting the mains supply and motor, frame sizes FSA ... FSC

Procedure

1. Remove the front cover of the Power Module.



2. Remove the gland plate from the bottom of the inverter.



Diameter of the holes in the gland plate:

- | | |
|---------|-----------------------------|
| 20.5 mm | Control cables |
| 20.5 mm | Mains and motor cables, FSA |
| 25.5 mm | Mains and motor cables, FSB |
| 32.5 mm | Mains and motor cables, FSC |

3. Prepare the mains and motor cables for connection in accordance with the table below.

Inverter	Connection	Dimensions				Explanation
		A	B	C ¹⁾	D	
FSA	Mains cable	10 mm	60 mm	-	90 mm	
	Motor cable	10 mm	60 mm	10 mm	60 mm	
FSB	Mains cable	10 mm	60 mm	-	50 mm	
	Motor cable	10 mm	50 mm	10 mm	40 mm	
FSC	Mains cable	10 mm	50 mm	-	70 mm	
	Motor cable	10 mm	50 mm	10 mm	40 mm	

¹⁾ Cable shield

① Gland plate

4. Assemble the cable glands with the prepared cables and EMC cable glands for the control cables.
5. Seal any unused bushings with a rubber sleeve.
6. Secure the gland plate to the inverter enclosure. Tightening torque: 2 Nm
Make sure that the seal of the gland plate is not damaged.
7. Where necessary, fit the supplied ferrite ring onto the motor cable.
Ferrite rings are required to be able to comply with the limit values of IEC 61800-3, Category C1 with reference to grid-bound interference voltages when using Power Modules with integrated line filters.
If you use cables > 25 m, the requirements of Category C1 are no longer satisfied.

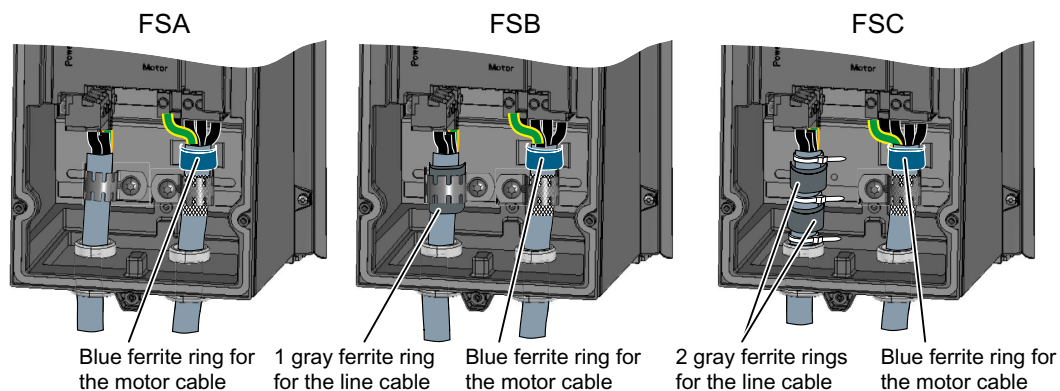
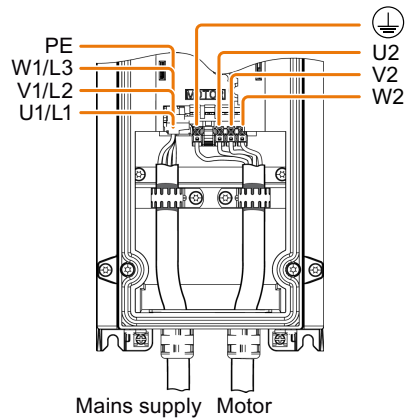


Figure 4-14 Ferrite rings for the mains and motor cables

4.4 Connecting the line supply and motor

8. Connect the mains supply and the motor.



The Power Modules are equipped with removable plug connectors that cannot be inadvertently interchanged. To remove the connectors, press the red lever to release the interlock.

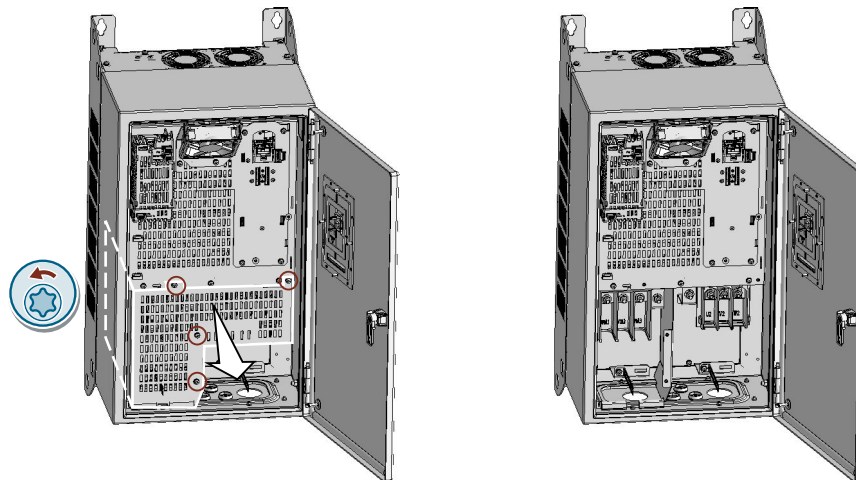
9. Fit the front cover of the Power Module.
Make sure that the seal of the front cover is not damaged.

Line supply and motor are connected to the FSA ... FSC Power Modules.

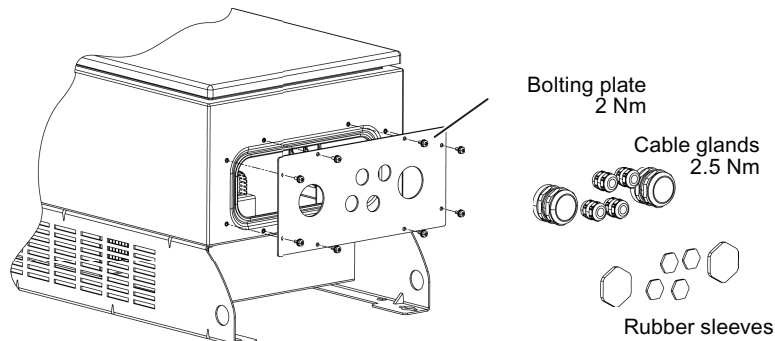
Connecting the mains supply and motor, frame sizes FSD ... FSF

Procedure

1. Open the door of the Power Module.
2. Remove the terminal cover.



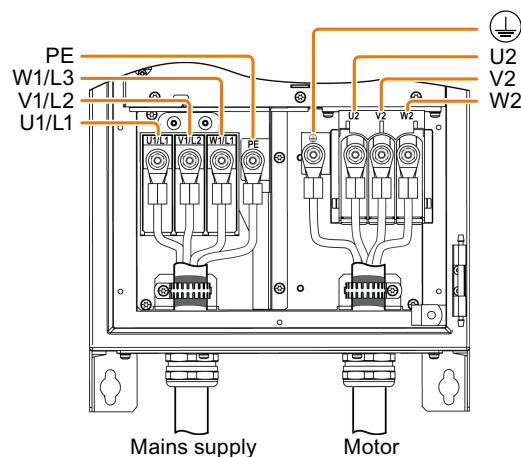
- Remove the gland plate from the bottom of the inverter.



Diameter of the holes in the gland plate:

20.5 mm	Control cables
40.5 mm	Mains and motor cables, FSD
50.5 mm	Mains and motor cables, FSE
63.5 mm	Mains and motor cables, FSF

- Assemble the cable glands with the prepared cables and EMC cable glands for the control cables.
- Seal any unused bushings with a rubber sleeve.
- Secure the gland plate to the inverter enclosure. Tightening torque 2 Nm. Make sure that the seal of the gland plate is not damaged.
- Connect the mains supply and the motor.



- Close the door of the Power Module. Make sure that the door seal of the Power Module is not damaged.

Line supply and motor are connected to the FSD ... FSF Power Modules.



4.4.4 Connecting the inverter with the PM230 Power Module

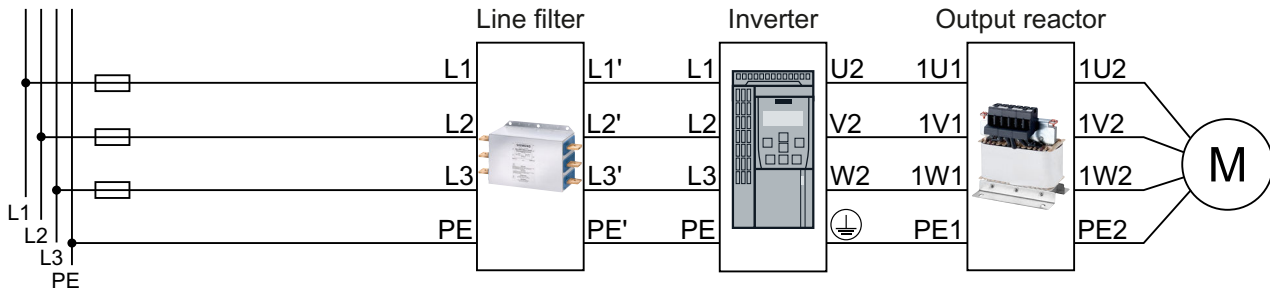


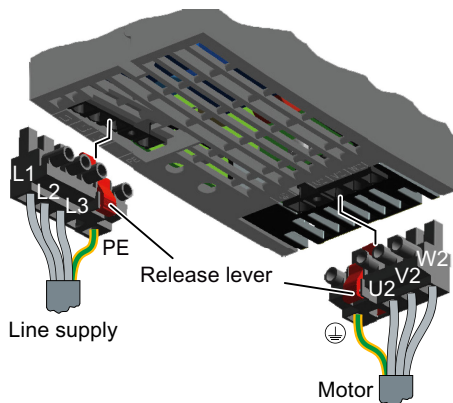


Figure 4-15 PM230 Power Module connection overview

Table 4-27 Connection, cross-section and tightening torque for PM230 Power Modules

Inverter	Connection		Cross-section, tightening torque		Stripped insulation length
			Metric	Imperial	
FSA	Line supply, motor	 Plug connector with screw terminals	1 ... 2.5 mm ² , 0.5 Nm	16 ... 14 AWG, 4.5 lbf in	8 mm
FSB			1.5 ... 6 mm ² , 0.6 Nm	16 ... 10 AWG, 5.5 lbf in	8 mm
FSC			6 ... 16 mm ² , 1.3 Nm	10 ... 6 AWG, 12 lbf in	10 mm
FSD	Line supply, motor	 Cable lug	10 ... 35 mm ² , 6 Nm	7 ... 2 AWG, 53 lbf in	--
FSE			25 ... 50 mm ² , 6 Nm	3 ... 1 AWG, 53 lbf in	--
F5F			35 ... 120 mm ² , 13 Nm	2 ... 4/0 AWG, 115 lbf in	--

Connections for frame sizes FSA ... FSC

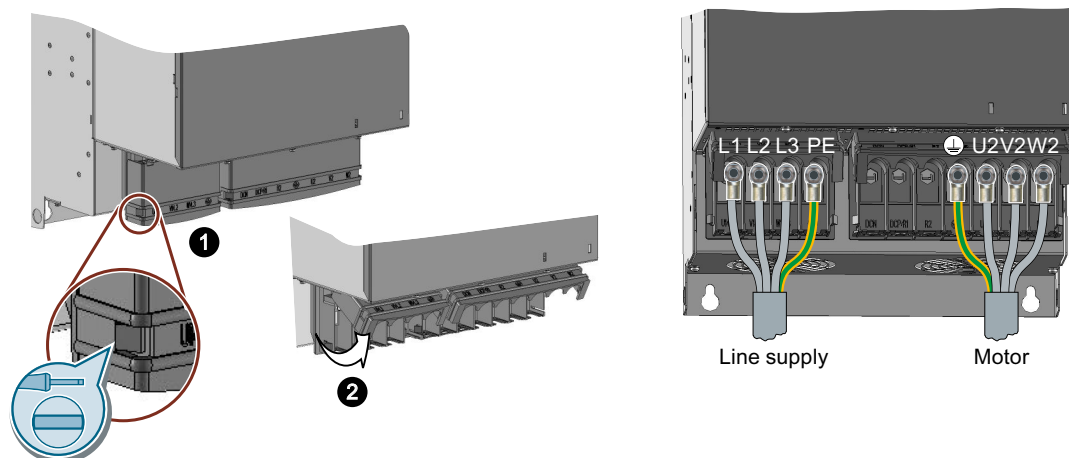


The Power Modules are equipped with withdrawable plug connectors that cannot be inadvertently interchanged.

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

Connections for frame sizes FSD ... FSF

The line and motor connections have covers to prevent them from being touched.



You must open the cover to connect the line and motor:

1. Release the catches on both sides of the covers using a screwdriver.
2. Swivel the covers upwards.

Close the covers once you have connected the line and motor.

4.4.5 Connecting the inverter with the PM330 Power Module

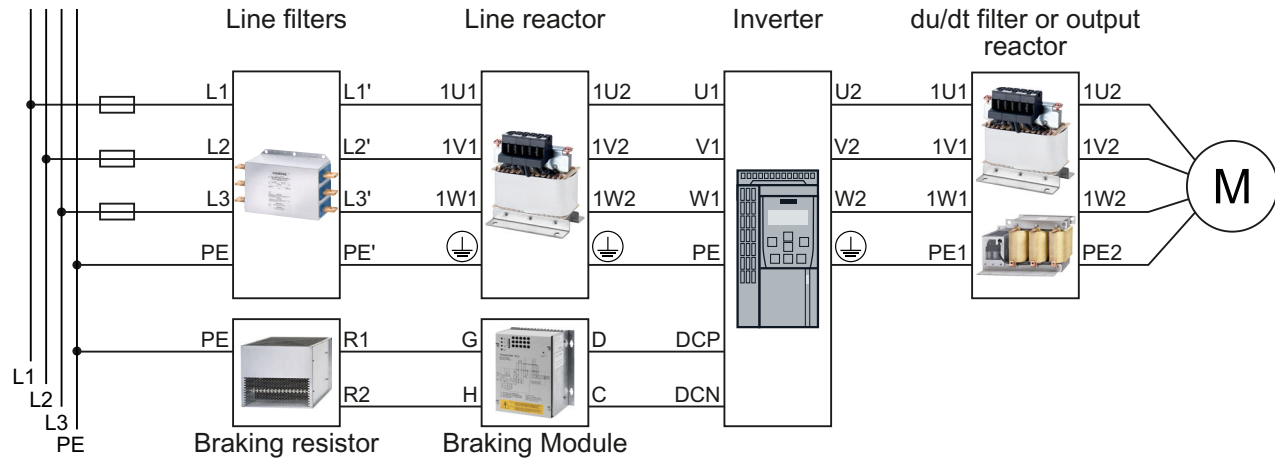



Figure 4-16 Connecting the PM330 Power Module

You will find additional information about the PM330 Power Module in the Internet:

 Hardware installation manual for PM330 Power Modules (<https://support.industry.siemens.com/cs/ww/en/view/109742506>)

4.4.6 Connecting the inverter with the PM240P-2 Power Module

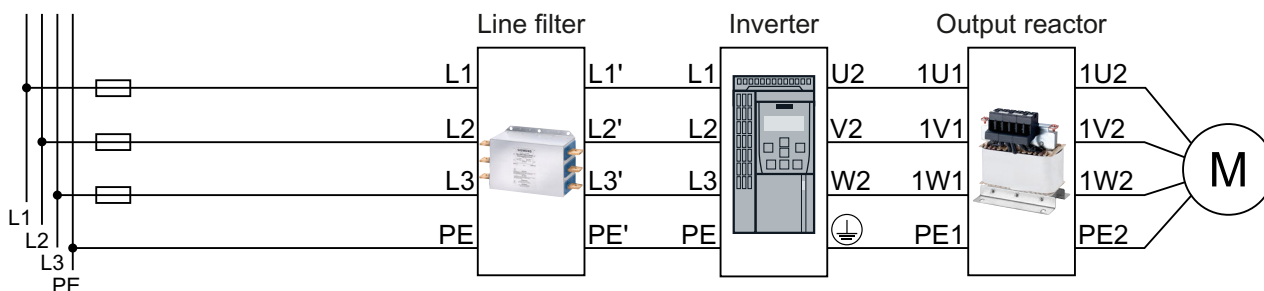


Figure 4-17 PM240P-2 Power Module connection overview

Table 4-28 Connection, cross-section and tightening torque for PM240P-2 Power Modules

Inverter	Connection		Cross-section, tightening torque		Stripped insulation length
			Metric	Imperial	
FSD	Line supply, motor	Screw-type terminal	10 ... 35 mm ² , 2.5 ... 4.5 Nm		18 mm
			20 ... 10 AWG, 22 lbf in 8 ... 2 AWG, 40 lbf in		
FSE			25 ... 70 mm ² , 8 ... 10 Nm		25 mm
FSD	Line supply, motor	Cable lug according to SN71322	35 ... 2 × 120 mm ² , 22 ... 25 Nm		--
FSE			1 ... 2 × 4/0 AWG, 210 lbf in		

Connections, frame sizes FSD ... FSF

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

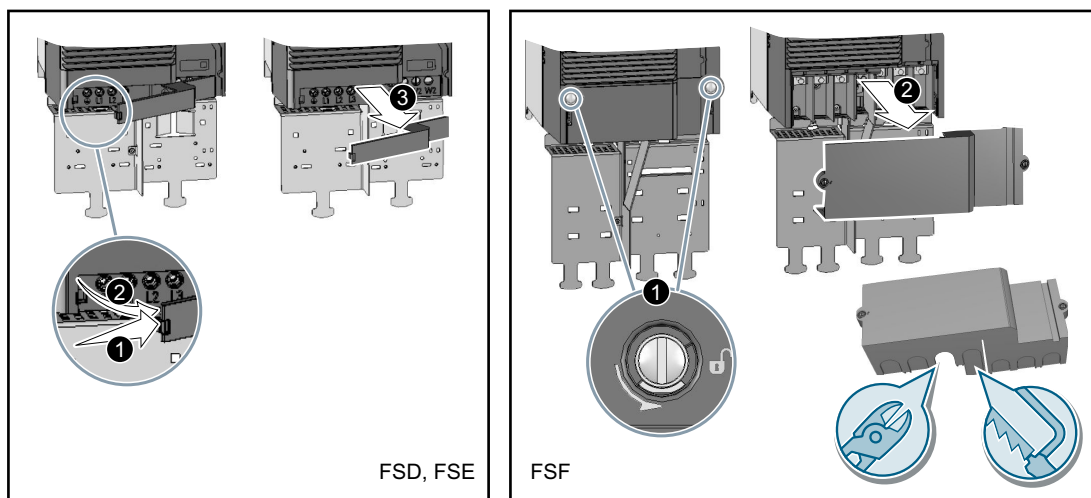


Figure 4-18 Remove the connection covers

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

4.4 Connecting the line supply and motor

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

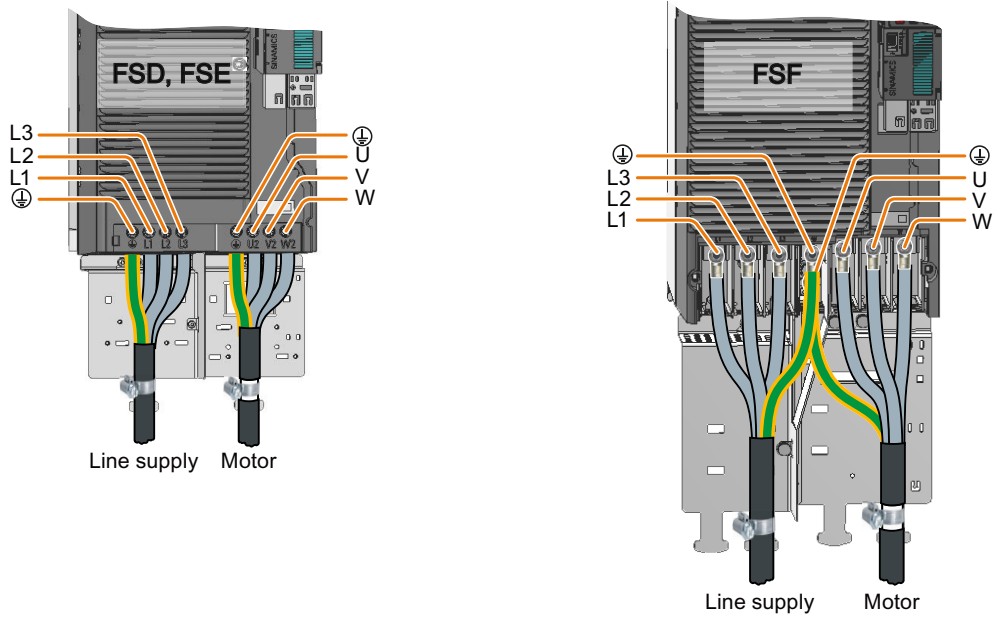


Figure 4-19 Line and motor connections

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

4.4.7 Connecting an inverter with the PM240-2 Power Module

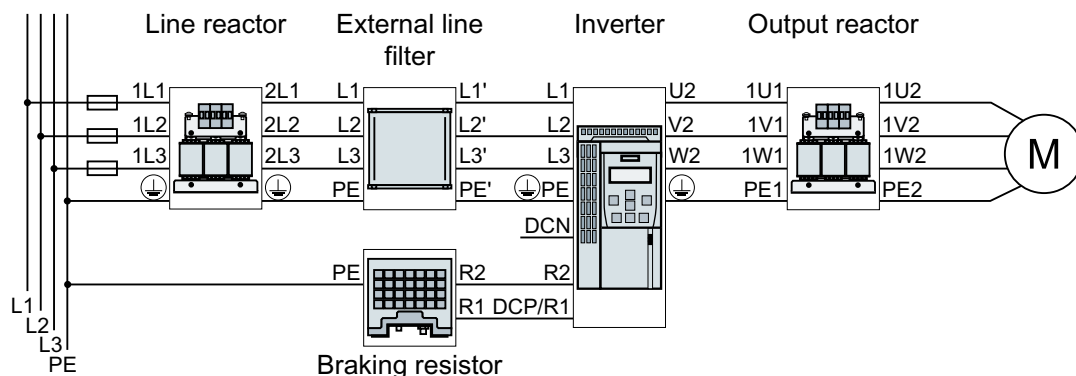


Figure 4-20 Connection of the PM240-2 Power Module, 3 AC, FSA ... FSC

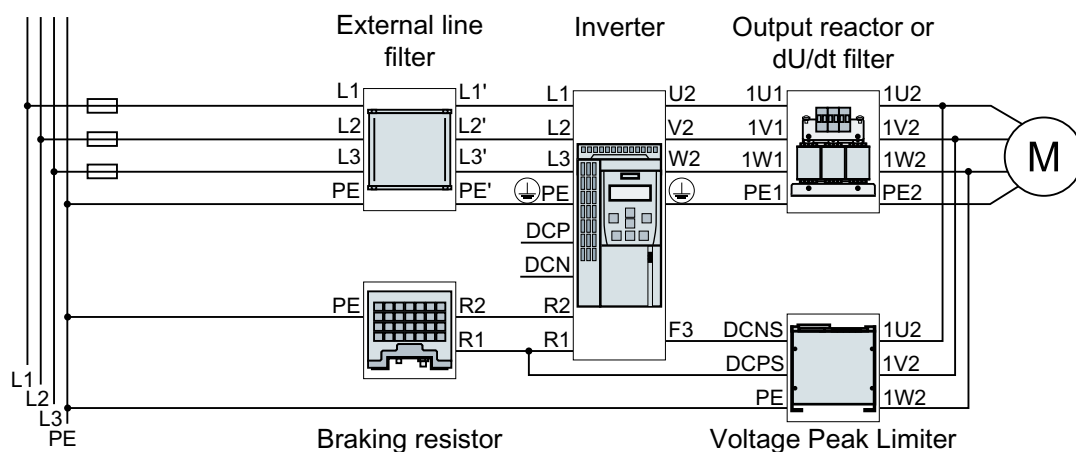


Figure 4-21 Connection of the PM240-2 Power Module, 3 AC, FSD ... FSF

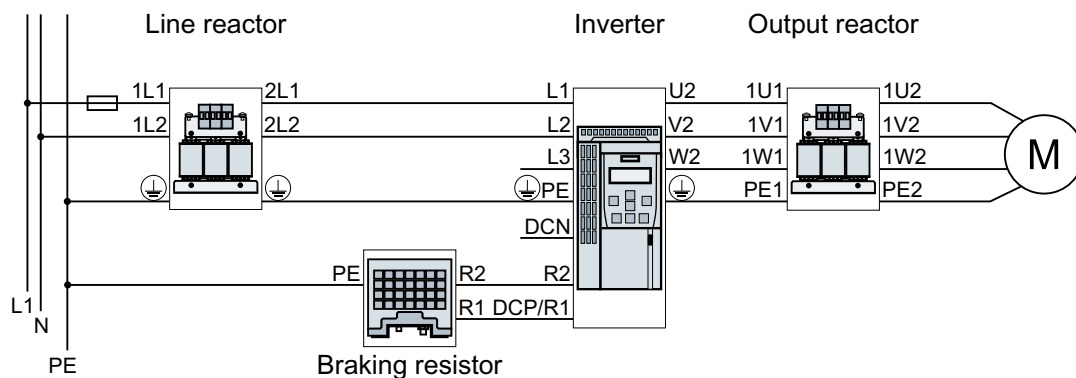


Figure 4-22 Connection of the PM240-2 Power Module, 1 AC 200 V, FSA ... FSC

4.4 Connecting the line supply and motor

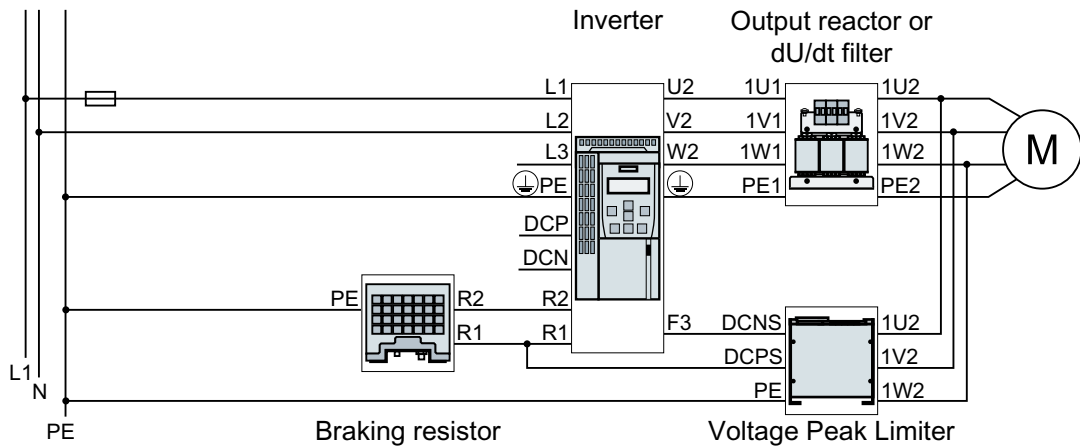



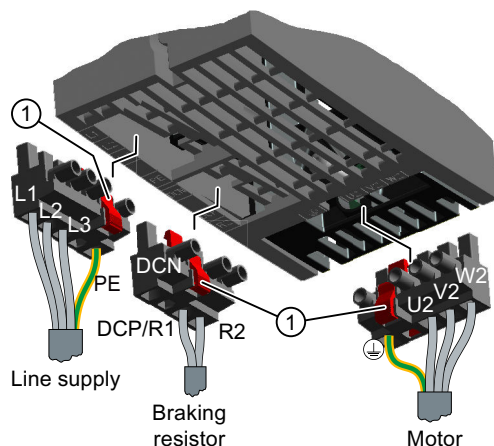


Figure 4-23 Connection of the PM240-2 Power Module, 1 AC 200 V, FSD ... FSF

Table 4-29 Connection, cross-section and tightening torque for PM240-2 Power Modules

Inverter	Connection		Cross-section, tightening torque		Stripped insulation length
			Metric	Imperial	
FSA	Line system, motor and braking resistor		1.5 ... 2.5 mm ² , 0.5 Nm	16 ... 14 AWG, 4.5 lbf in	8 mm
FSB			1.5 ... 6 mm ² , 0.6 Nm	16 ... 10 AWG, 5.5 lbf in	8 mm
FSC			6 ... 16 mm ² , 1.3 Nm	10 ... 6 AWG, 12 lbf in	10 mm
FSD	Line and motor	Screw-type terminal	10 ... 35 mm ² , 2.5 ... 4.5 Nm	8 ... 2 AWG, 22 ... 40 lbf in	18 mm
	Braking resistor		2.5 ... 16 mm ² , 1.2 ... 1.5 Nm	20 ... 6 AWG, 10.5 ... 13 lbf in	10 mm
FSE	Line and motor	Screw-type terminal	25 ... 70 mm ² , 8 ... 10 Nm	6 ... 3/0 AWG, 71 ... 88.5 lbf in	25 mm
	Braking resistor		10 ... 35 mm ² , 2.5 ... 4.5 Nm	8 ... 2 AWG, 22 ... 40 lbf in	18 mm
FSF	Line and motor		35 ... 2 × 120 mm ² , 22 ... 25 Nm	1 AWG ... 2 × 4/0 AWG, 195 ... 221 lbf.in	--
	Braking resistor	Screw-type terminal	25 ... 70 mm ² , 8 ... 10 Nm	6 ... 3/0 AWG, 71 ... 88.5 lbf in	25 mm
FSG	Line and motor		35 ... 2 × 185 mm ² , 22 ... 25 Nm	1 AWG ... 2 × 350 MCM, 195 ... 221 lbf.in	--
	Braking resistor	Screw-type terminal	25 ... 70 mm ² , ... 10 Nm	6 ... 3/0 AWG, 71 ... 88.5 lbf in	25 mm

Connections for frame sizes FSA ... FSC



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

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

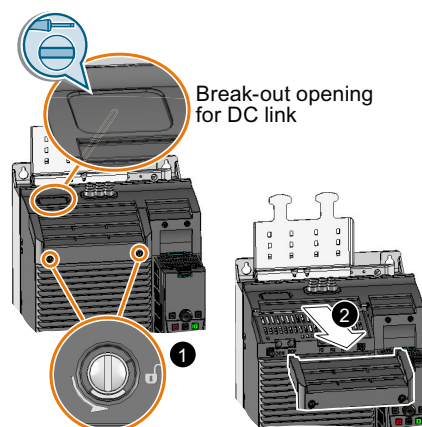
- ① Release lever

Connections for frame sizes FSD ... FSG

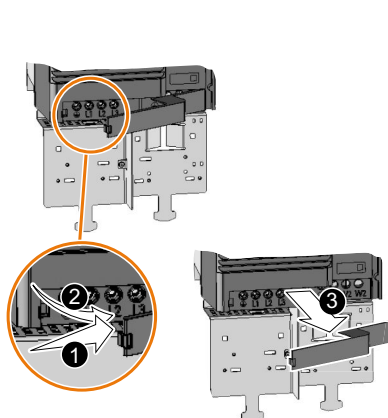
You must remove the covers from the connections in order to connect the line supply, braking resistor and motor to the inverter.

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

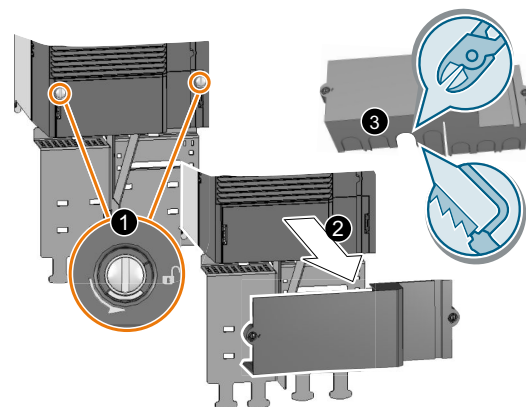
For frame sizes FSF and FSG, you must breakout the openings from the connection cover for the power connections. Use side cutters or a fine saw blade.



FSD ... FSG: Remove the top covers



FSD, FSE: Remove the lower cover



FSF, FSG: Remove the lower cover

4.4 Connecting the line supply and motor

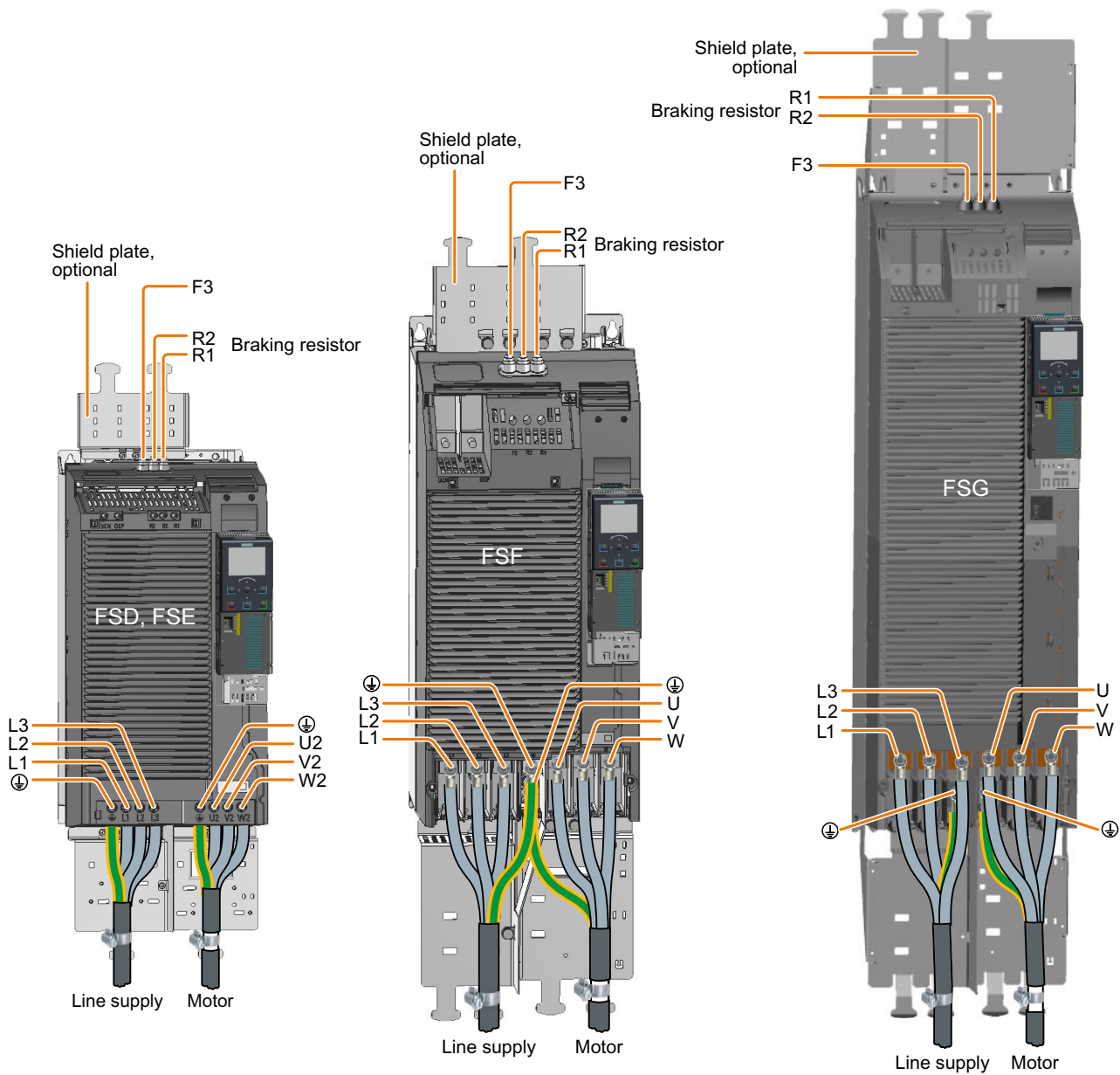


Figure 4-24 Connections for the line supply, motor and braking resistor

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

Additional information when connecting FSG inverters

Note

Conductor cross-section 240 mm²

Cable lugs for M10 bolts according to SN71322 are suitable for cables with cross-sections of 35 mm² ... 185 mm² (1 AWG ... 2 × 350 MCM).

If you wish to establish connections with cables of 240 mm² (500 MCM), you must use narrow cable lugs, e.g. Klauke 12SG10. Other cable lugs are not suitable due to the narrow design of the inverter.

The maximum permissible width of the cable lugs is 37 mm (1.45 inches).

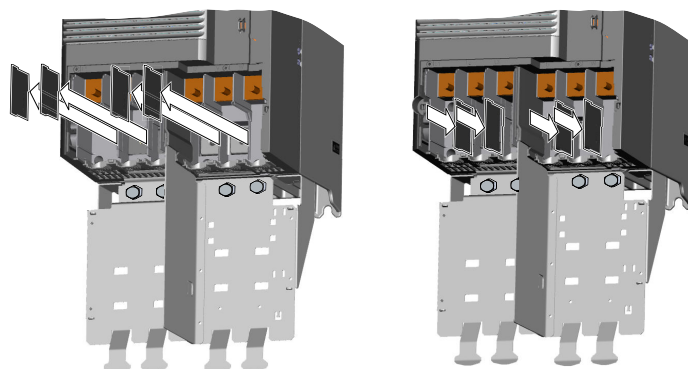
Remove the plastic insulating plate as shown below to gain better access to the terminals for the power connections.

WARNING

Damage to inverter as a result of operation without insulating plates

Without the insulating plates, voltage flashovers may occur between the phases.

- Replace the insulating plates after connecting the cables.



4.4.8 Connecting the inverter with the PM250 Power Module

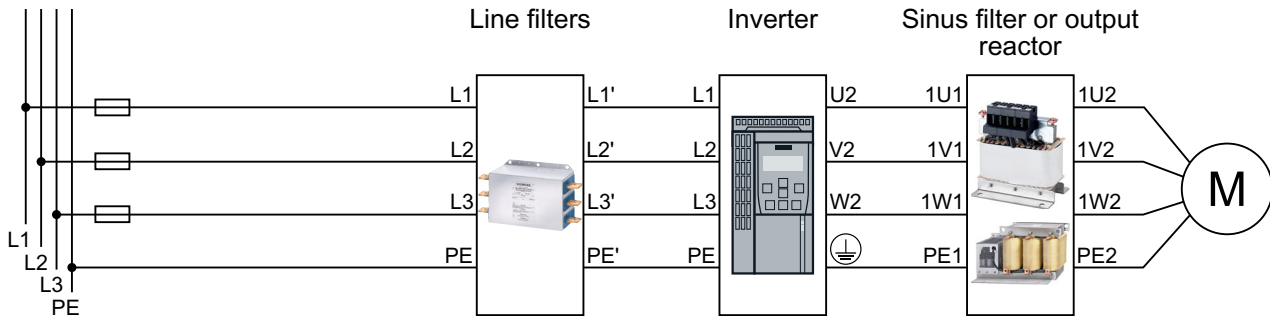

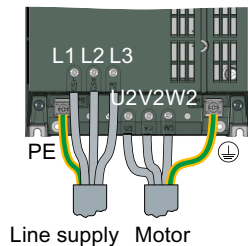


Figure 4-25 Connecting the PM250 Power Module

Table 4-30 Connection, cross-section and tightening torque for PM250 Power Modules

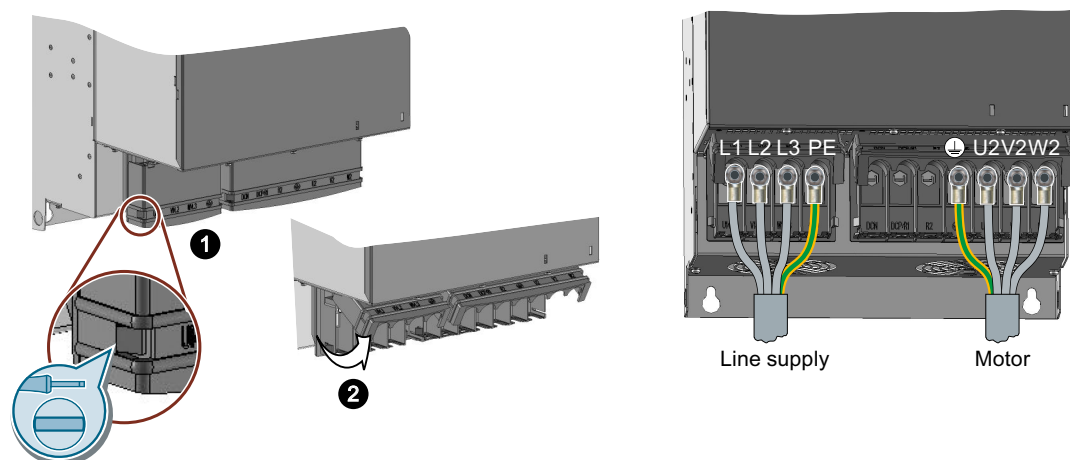
Inverter	Line supply and motor connection	Cross-section and tightening torque		Stripped insulation length
		Metric	Imperial	
FSC	Screw-type terminal	4 ... 10 mm ² , 2.3 Nm	12 ... 8 AWG, 20 lbf in	10 mm
FSD	 Cable lug	10 ... 35 mm ² , 6 Nm	7 ... 2 AWG, 53 lbf in	--
FSE		25 ... 50 mm ² , 6 Nm	3 ... 1 AWG, 53 lbf in	--
FSF		35 ... 120 mm ² , 13 Nm	2 ... 4/0 AWG, 115 lbf in	--

Connections for frame size FSC



Connections for frame sizes FSD ... FSF

The line and motor connections have covers to prevent them from being touched.



You must open the cover to connect the line and motor:

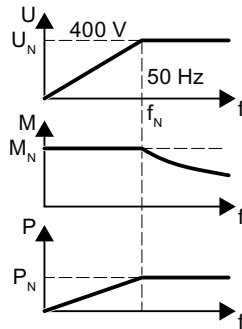
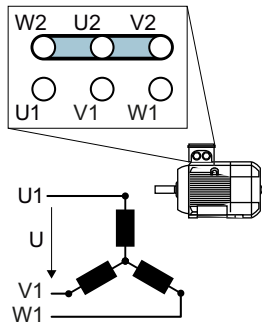
1. Release the catches on both sides of the covers using a screwdriver.
2. Swivel the covers upwards.

Close the covers once you have connected the line and motor.

4.4.9 Connecting the motor to the inverter in a star or delta connection

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

Operating the motor in a star connection

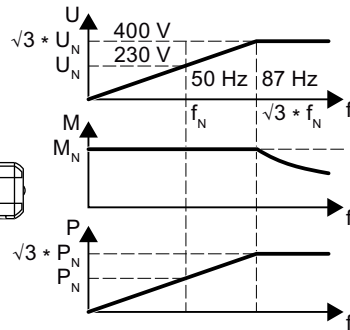
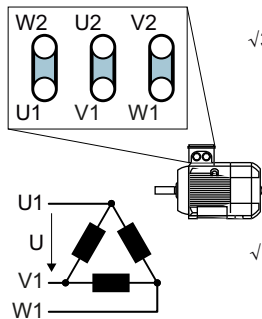


In a star connection, the motor can provide its rated torque M_N in the range 0 ... rated frequency f_N .

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

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

Operating the motor in a delta connection with 87 Hz characteristic



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

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

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

The motor only goes into field weakening above 87 Hz.

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

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

4.5 Connecting the interfaces for the inverter control

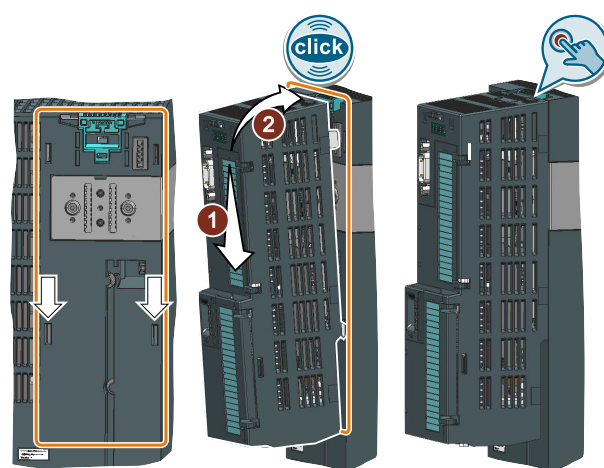
4.5.1 Plugging the Control Unit onto the Power Module

The Power Module has a holder for the Control Unit and a release mechanism.

There are different release mechanisms depending on the particular Power Module.

Inserting the Control Unit

Procedure



1. Place the two catches of the Control Unit in the matching grooves of the Power Module.
2. Press the Control Unit onto the Power Module until you hear that it latches.

The Control Unit is plugged onto the Power Module.

□

Removing the Control Unit

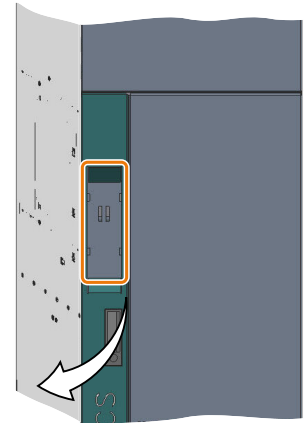
Procedure

Remove the Control Unit from the Power Module by pressing the release mechanism.

Special features for the PM330 Power Module

To insert or detach the Control Unit, you must open the left-hand cover of the Power Module.

Close the cover before you commission the inverter.

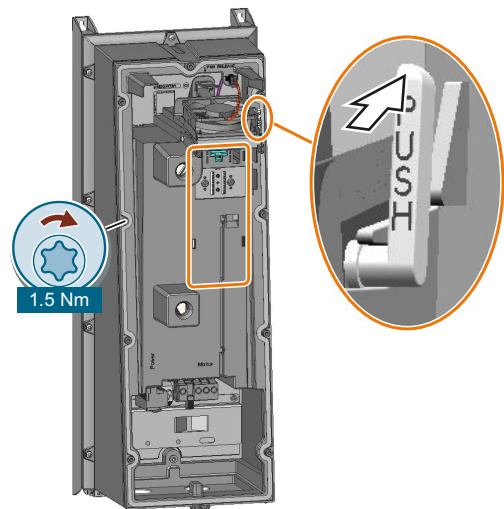


Special features for the PM230 Power Module IP55, FSA ... FSC

To insert or detach the Control Unit, you must release eight or ten fixing screws of the cover and then remove the cover.

The Power Module release mechanism is shown in the diagram.

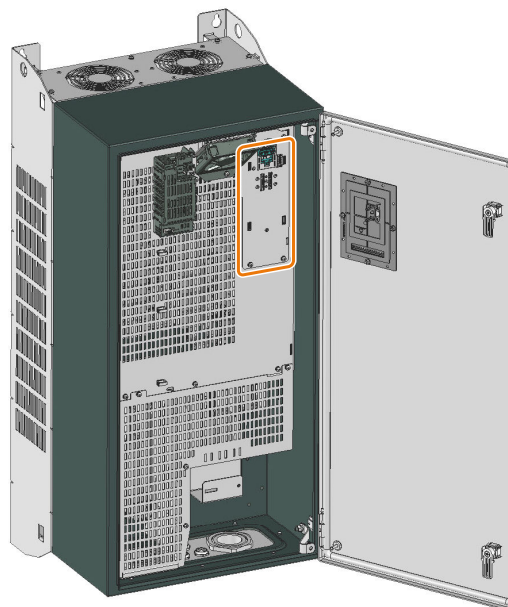
Attach the cover again before you commission the inverter. Do not damage the seal of the cover when attaching it.



Installing the Control Unit, PM230 IP55 - FSD ... FSF

To insert or detach the Control Unit, you must open the front door of the Power Module.

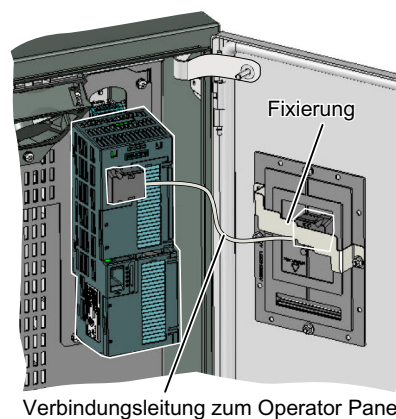
Close the door before you commission the inverter. Check to ensure that the seals are not damaged.



Operation with operator panel

To connect the operator panel to the Control Unit, you have to plug in the supplied connecting cable to the Control Unit and the operator panel.

Fasten the plug connector in the door with the supplied clamp.



4.5.2 Overview of the interfaces

Interfaces at the front of the Control Unit

To access the interfaces at the front of the Control Unit, you must lift the Operator Panel (if one is being used) and open the front doors.

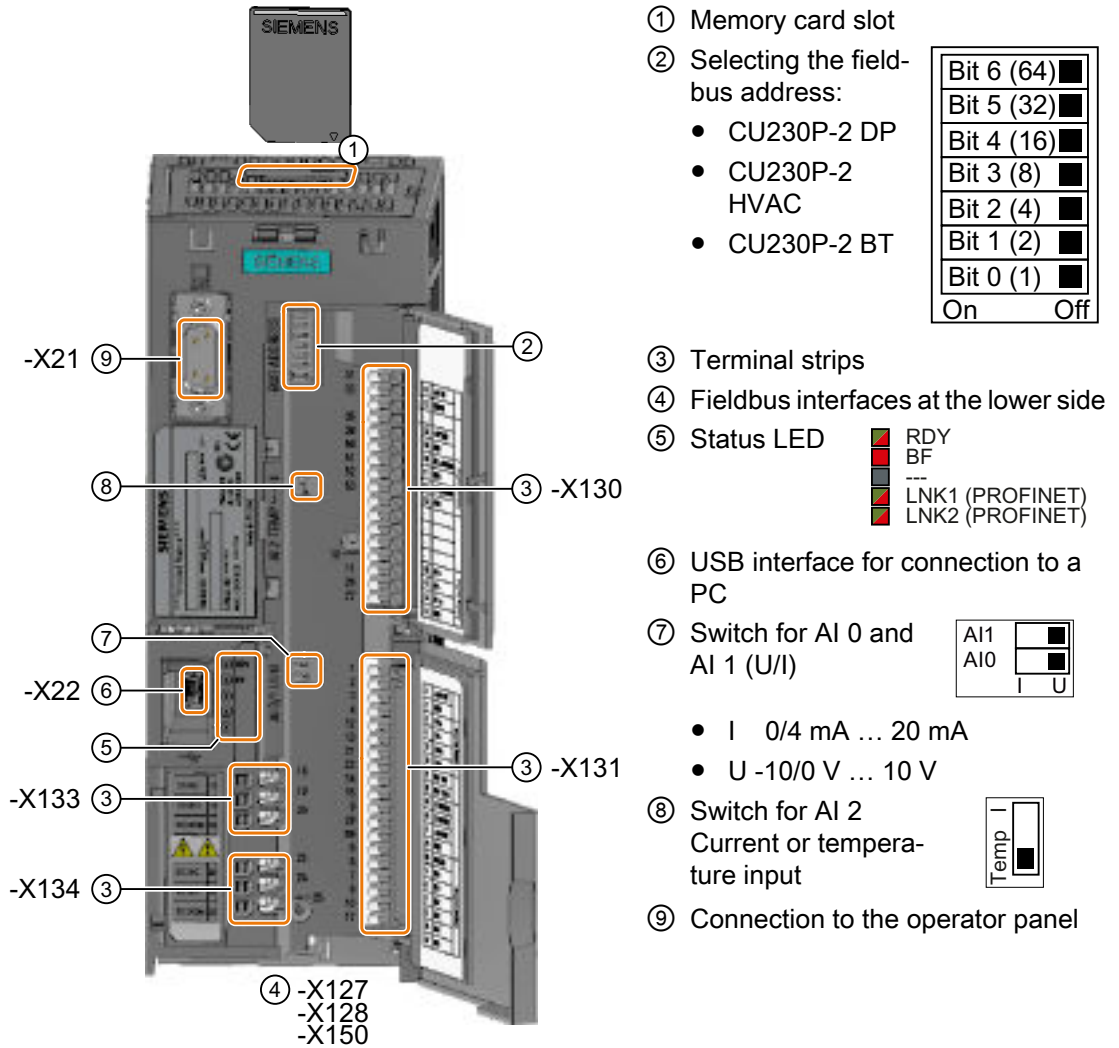
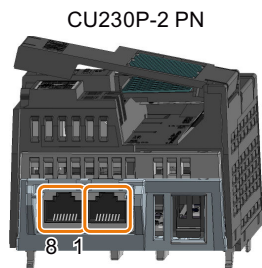


Table 4-31 Number of inputs and outputs

Digital inputs DI	Digital outputs DO	Analog inputs AI	Analog outputs AO	Input for motor temperature sensor
6	3	4	2	1

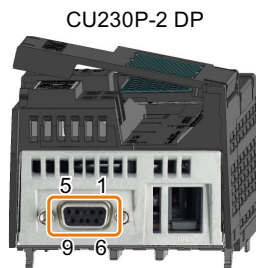
4.5.3 Fieldbus interface allocation

Interfaces at the lower side of the CU230P-2 Control Unit



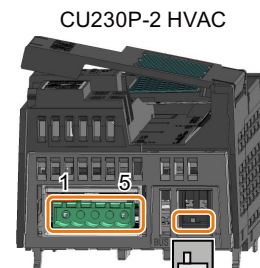
X150 X150
P1 P2

- Pin
- 1 RX+, receive data +
 - 2 RX-, receive data -
 - 3 TX+. Transmit data +
 - 4 ---
 - 5 ---
 - 6 TX-, transmit data -
 - 7 ---
 - 8 ---



X127
Socket

- Pin
- 1 Shield, ground connection
 - 2 ---
 - 3 RxD/TxD-P, receive and transmit (B/B')
 - 4 CNTR-P, control signal
 - 5 DGND, reference potential for data (C/C')
 - 6 VP, supply voltage
 - 7 ---
 - 8 RxD/TxD-N, receive and transmit (A/A')
 - 9 ---

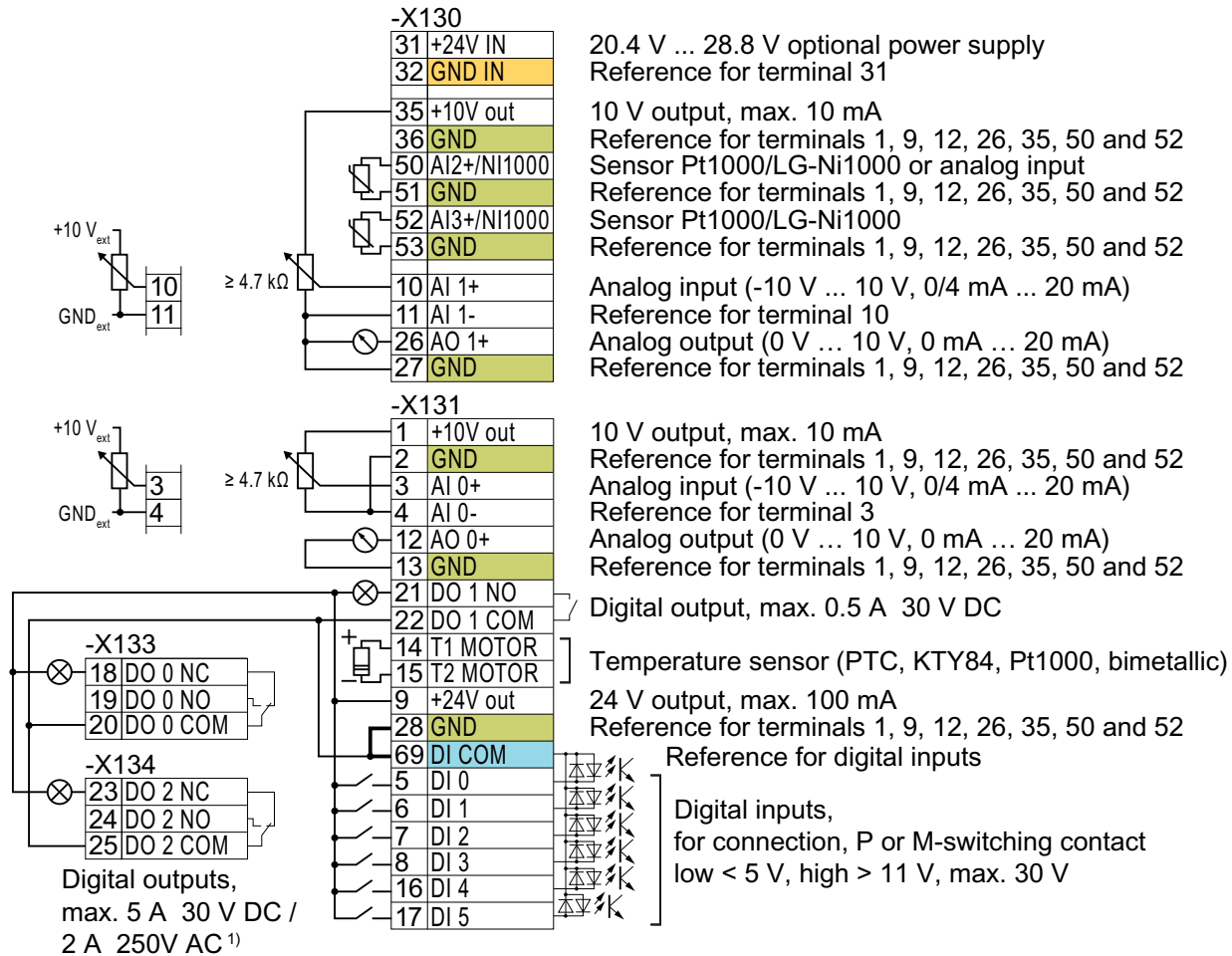


X128 OFF ON
Bus termination

- Pin
- 1 0 V, reference potential
 - 2 P+, RS485P, receive and transmit
 - 3 N-, RS485N, receive and transmit
 - 4 Cable shield
 - 5 ---

4.5.4 Terminal strips

Terminal strips with wiring example



¹⁾ The following applies to systems compliant with UL: Maximum current, 3 A 30 VDC or 2 A 250 VAC

Figure 4-26 Wiring the digital inputs with p-switching contacts and an internal 24 V power supply (terminal 9)

GND All terminals labelled with reference potential "GND" are connected internally in the inverter.

DI COM Reference potential "DI COM" is electrically isolated from "GND". The Control Unit is delivered with a jumper between terminals 28 and 69.
 → If, as shown above, you wish to use the 24-V supply from terminal 9 as supply for the digital inputs, then it is mandatory that this jumper is used.

31+24 V IN
32 GND IN When an optional 24 V power supply is connected at terminals 31, 32, even when the Power Module is disconnected from the line supply, the Control Unit remains in operation. The Control Unit thus maintains fieldbus communication, for example.

→ for terminals 31, 32 only use a 24 VDC power supply with PELV (Protective Extra Low Voltage).

→ for applications in the USA and Canada: Use a 24 VDC power supply, NEC Class 2.

4.5 Connecting the interfaces for the inverter control

- connect the 0 V of the power supply with the protective conductor.
- if you also wish to use the power supply at terminals 31, 32 for the digital inputs, then you must connect "DI COM" and "GND IN" with one another at the terminals.

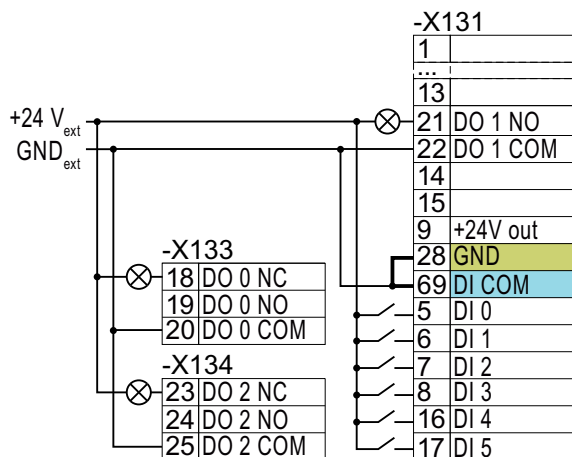
10	AI 1+
11	AI 1-

You may use the internal 10 V power supply or an external power supply for the analog inputs.

3	AI 0+
4	AI 0-

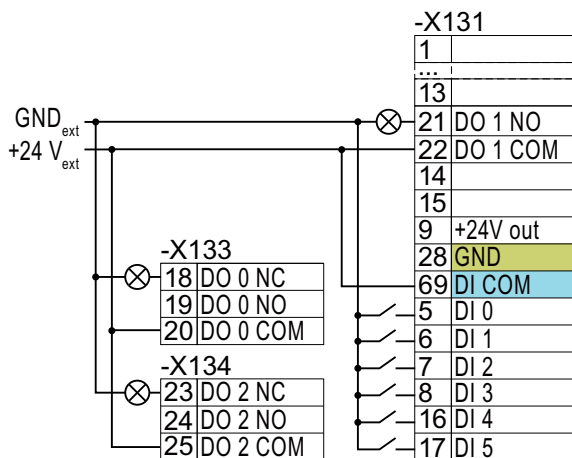
→ When you use the internal 10 V power supply, you must connect AI 0 or AI 1 with "GND".

Additional options for wiring the digital inputs



You must remove the jumper between terminals 28 and 69 if it is necessary to have electrical isolation between the external power supply and the internal inverter power supply.

Connecting P-switching contacts with an external power supply



Remove the jumper between terminals 28 and 69.

Connecting M-switching contacts with an external power supply

Note

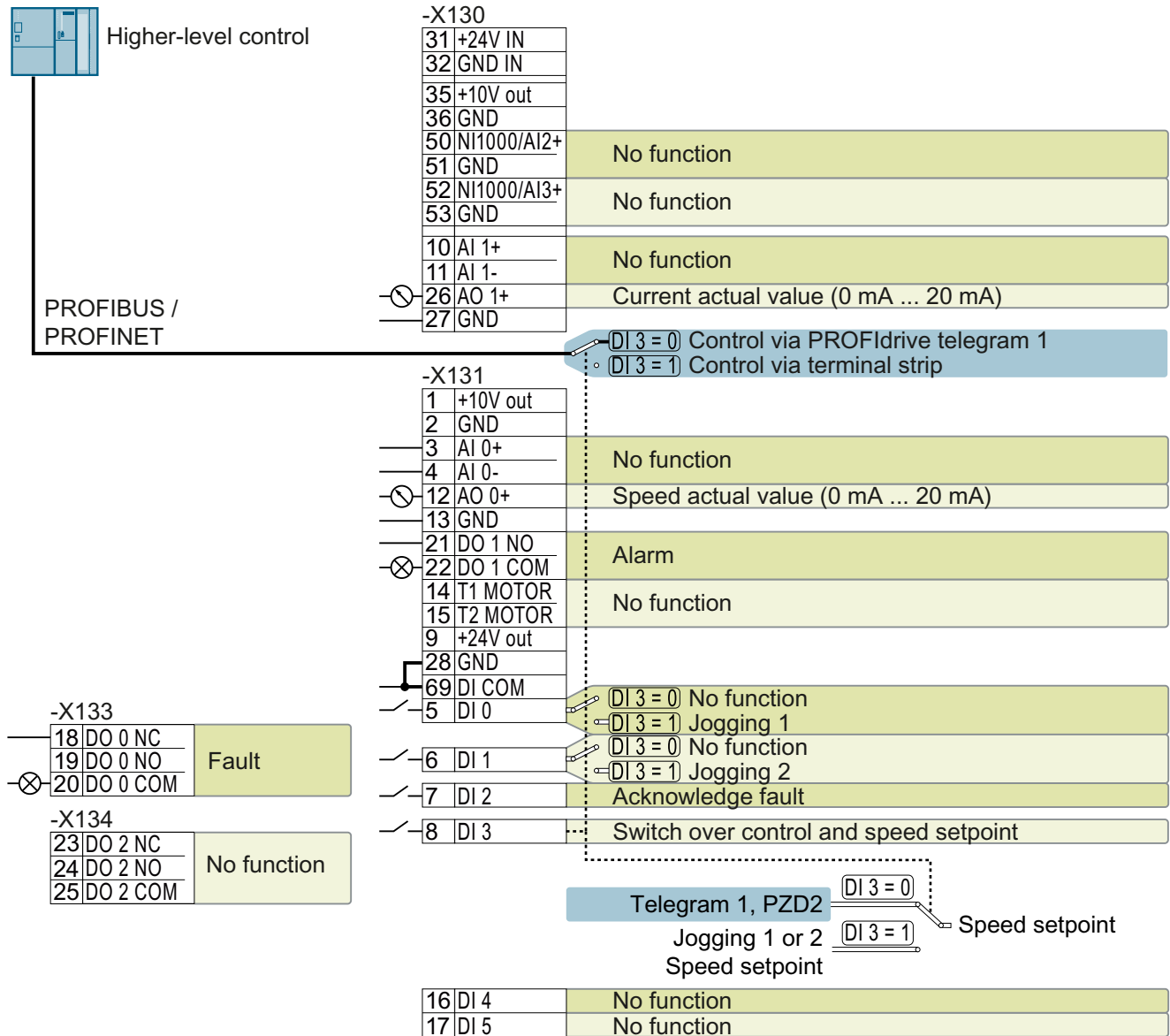
When a contact switching to M is connected, a ground fault at the digital input can lead to the input being unintentionally controlled.

4.5.5 Factory interface settings

The factory setting of the interfaces depends on the Control Unit.

Control Units with PROFIBUS or PROFINET interface

The function of the fieldbus interface and digital inputs DI 0, DI 1 depends on DI 3.



DO x: p073x

AO 0: p0771[0]

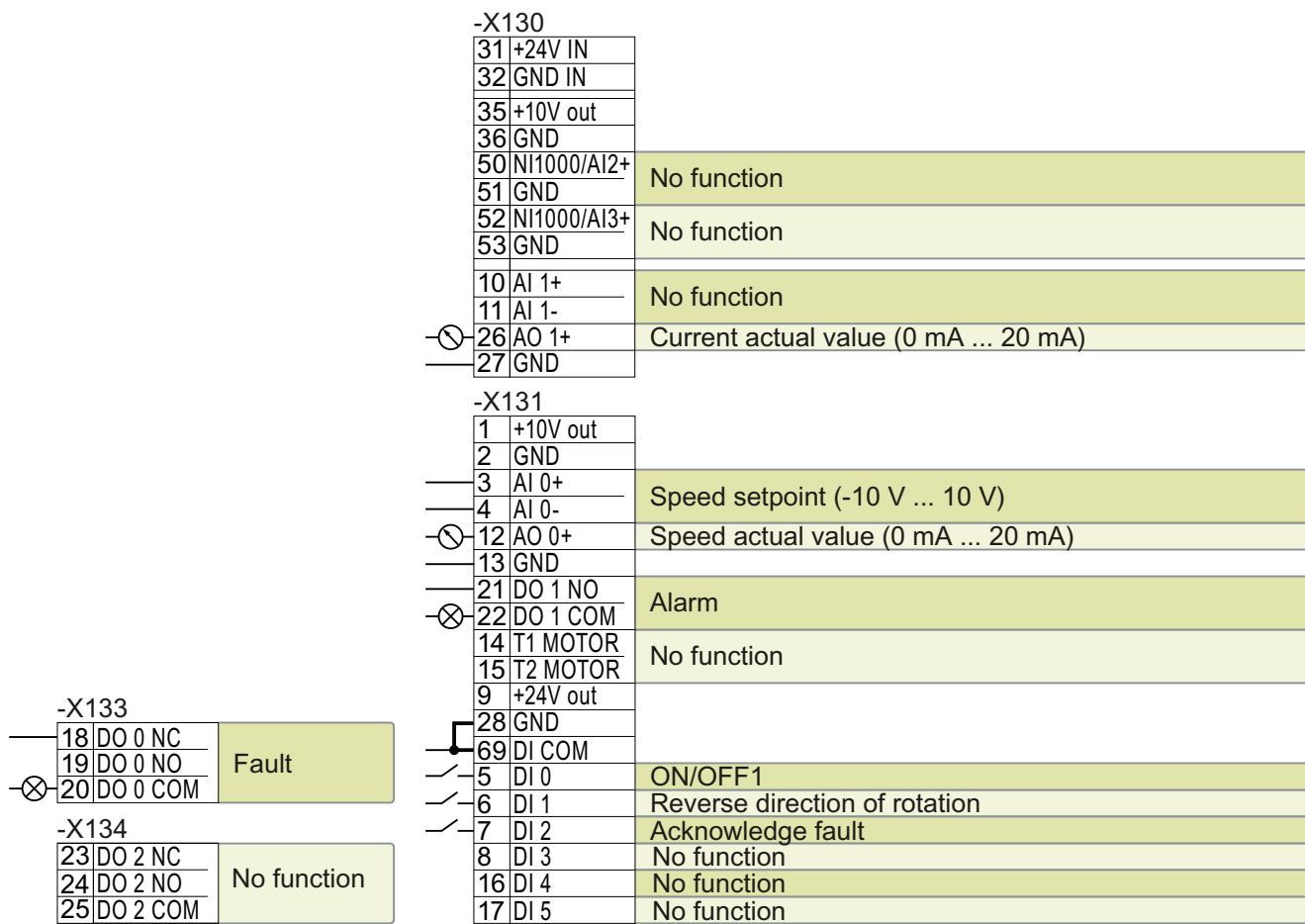
DI x: r0722.x

Speed setpoint (main setpoint): p1070[0] = 2050[1]

Figure 4-27 Factory setting of the CU230P-2 DP and CU230P-2 PN Control Units

Control Units with USS interface

The fieldbus interface is not active.



DO x: p073x

AO 0: p0771[0]

DI x: r0722.x

AI 0: r0755[0]

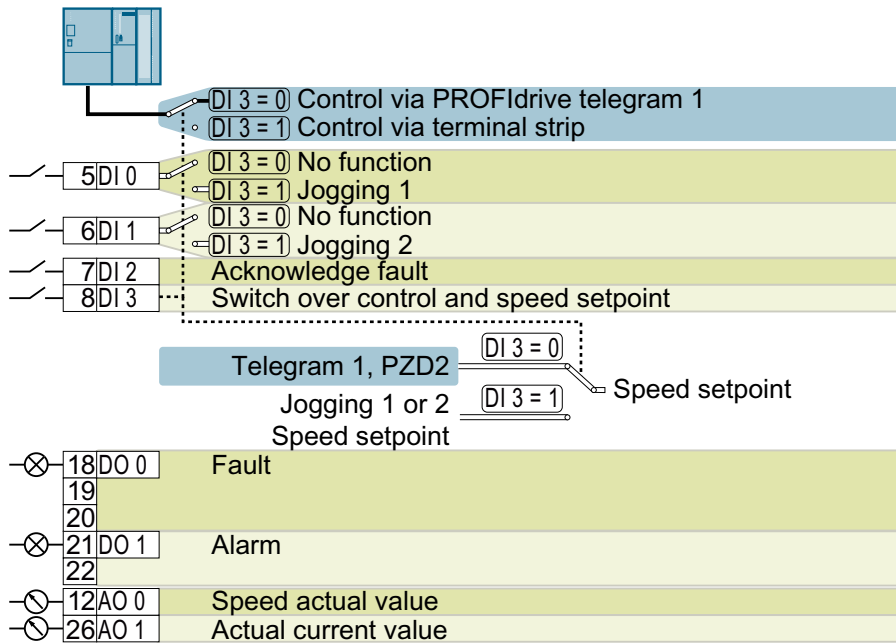
Speed setpoint (main setpoint): p1070[0] = 755[0]

Figure 4-28 Factory setting of CU230P-2 HVAC Control Units

4.5.6 Default setting of the interfaces

Default setting 7: "Fieldbus with data set switchover"

Factory setting for inverters with PROFIBUS or PROFINET interface



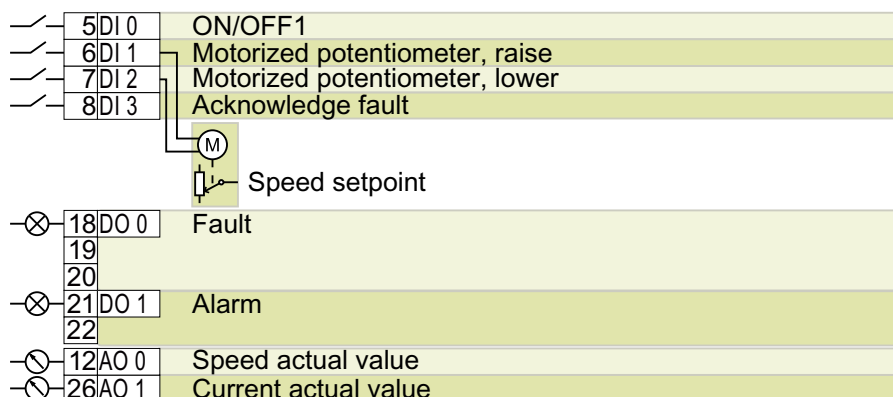
DO 0: p0730, DO 1: p0731 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0, ..., DI 3: r0722.3

Speed setpoint (main setpoint): p1070[0] = 2050[1]

Jog 1 speed setpoint: p1058, factory setting: 150 rpm

Jog 2 speed setpoint: p1059, factory setting: -150 rpm

Designation in the BOP-2: FB cdS

Default setting 9: "Standard I/O with MOP"

DO 0: p0730, DO 1: p0731 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0, ..., DI 3: r0722.3

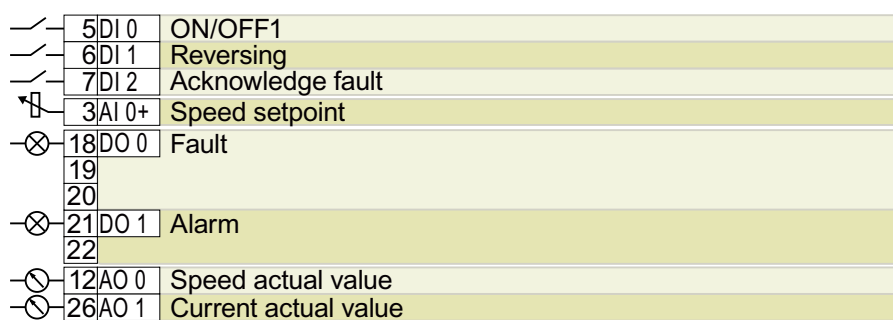
Motorized potentiometer setpoint after ramp-function generator: r1050

Speed setpoint (main setpoint): p1070[0] = 1050

Designation in the BOP-2: Std MoP

Default setting 12: "Standard I/O with analog setpoint"

Factory setting for inverters with USS, Modbus, BACnet, MS/TP or P1 interface

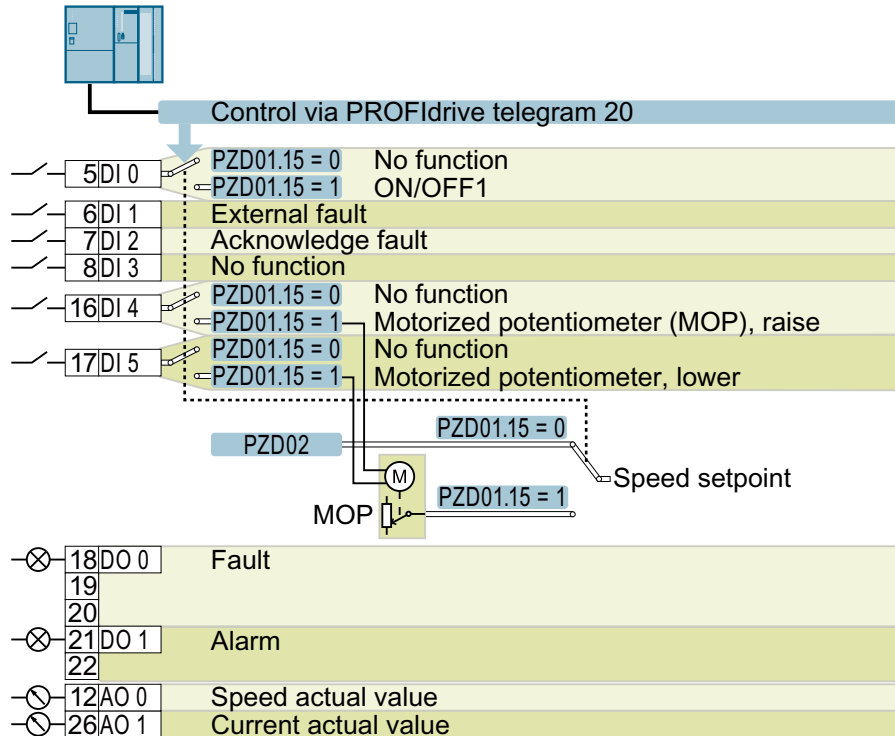


DO 0: p0730, DO 1: p0731 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0, ..., DI 2: r0722.2 AI 0: r0755[0]

Speed setpoint (main setpoint): p1070[0] = 755[0]

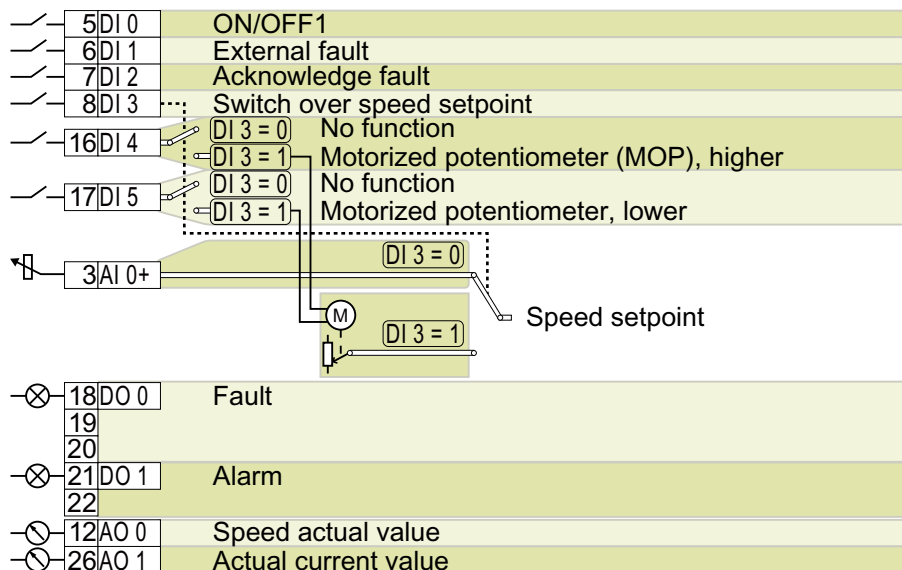
Designation in the BOP-2: Std ASP

Default setting 14: "Process industry with fieldbus"



DO 0: p0730, DO 1: p0731 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0, ..., DI 5: r0722.5
 Motorized potentiometer setpoint after ramp-function generator: r1050
 Speed setpoint (main setpoint): p1070[0] = 2050[1], p1070[1] = 1050
 Switch controller via PZD01, bit 15: p0810 = r2090.15
 Designation in the BOP-2: Proc Fb

Default setting 15: "Process industry"



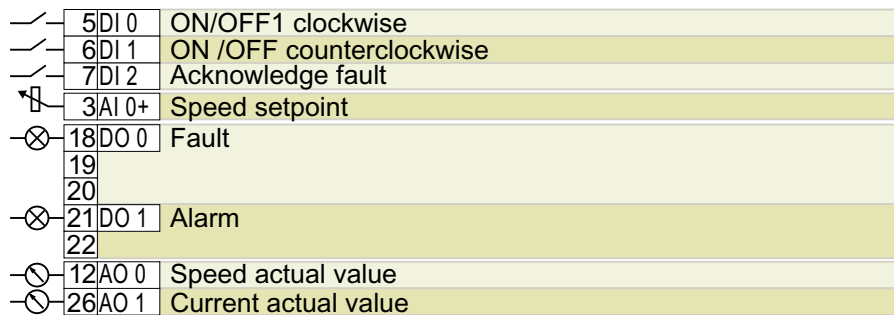
DO 0: p0730, DO 1: AO 0: p0771[0], DI 0: r0722.0, ..., DI 5: r0722.5 AI 0: r0755[0]
p0731 AO 1: p0771[1]

Motorized potentiometer setpoint after ramp-function generator: r1050

Speed setpoint (main setpoint): p1070[0] = 755[0], p1070[1] = 1050

Designation in the BOP-2: Proc

Default setting 17: "2-wire (forw/backw1)"



DO 0: p0730, DO 1: AO 0: p0771[0], DI 0: r0722.0, ..., DI 2: r0722.2 AI 0: r0755[0]
p0731 AO 1: p0771[1]

Speed setpoint (main setpoint): p1070[0] = 755[0]

Designation in the BOP-2: 2-wlrE 1

4.5 Connecting the interfaces for the inverter control

Default setting 18: "2-wire (forw/backw2)"

5	DI 0	ON/OFF1 clockwise
6	DI 1	ON /OFF counterclockwise
7	DI 2	Acknowledge fault
3	AI 0+	Speed setpoint
18	DO 0	Fault
19		
20		
21	DO 1	Alarm
22		
12	AO 0	Speed actual value
26	AO 1	Current actual value

DO 0: p0730, DO 1: AO 0: p0771[0], DI 0: r0722.0, ..., DI 2: r0722.2 AI 0: r0755[0]
 p0731 AO 1: p0771[1]
 Speed setpoint (main setpoint): p1070[0] = 755[0]
 Designation in the BOP-2: 2-wlrE 2

Default setting 19: "3-wire (enable/forw/backw)"

5	DI 0	Enable / OFF1
6	DI 1	ON clockwise
7	DI 2	ON counterclockwise
16	DI 4	Acknowledge fault
3	AI 0+	Speed setpoint
18	DO 0	Fault
19		
20		
21	DO 1	Alarm
22		
12	AO 0	Speed actual value
26	AO 1	Current actual value

DO 0: p0730, DO 1: AO 0: p0771[0], DI 0: r0722.0, ..., DI 4: r0722.4 AI 0: r0755[0]
 p0731 AO 1: p0771[1]
 Speed setpoint (main setpoint): p1070[0] = 755[0]
 Designation in the BOP-2: 3-wlrE 1

Default setting 20: "3-wire (enable/on/reverse)"

5	DI 0	Enable / OFF1
6	DI 1	ON
7	DI 2	Reversing
16	DI 4	Acknowledge fault
3	AI 0+	Speed setpoint
18	DO 0	Fault
19		
20		
21	DO 1	Alarm
22		
12	AO 0	Speed actual value
26	AO 1	Current actual value

DO 0: p0730, DO 1: AO 0: p0771[0], DI 0: r0722.0, ..., DI 4: r0722.4 AI 0: r0755[0]
 p0731 AO 1: p0771[1]

Speed setpoint (main setpoint): p1070[0] = 755[0]

Designation in the BOP-2: 3-wlrE 2

Default setting 21: "USS fieldbus"

USS (38400 baud, 2 PZD, PKW variable)

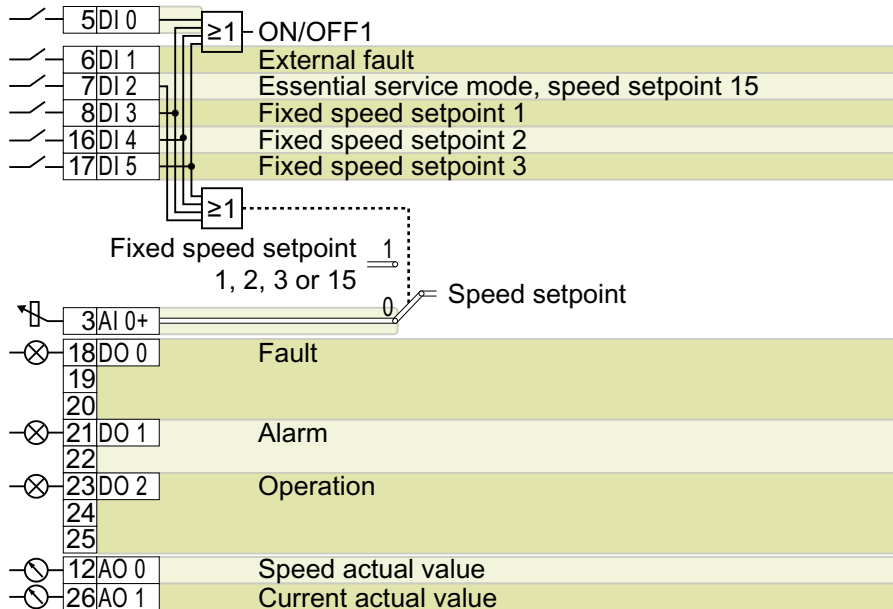
7	DI 2	Acknowledge fault
18	DO 0	Fault
19		
20		
21	DO 1	Alarm
22		
12	AO 0	Speed actual value
26	AO 1	Current actual value

DO 0: p0730, DO 1: p0731 AO 0: p0771[0], AO 1: p0771[1] DI 2: r0722.2

Speed setpoint (main setpoint): p1070[0] = 2050[1]

Designation in the BOP-2: FB USS

Default setting 101: "Universal application"



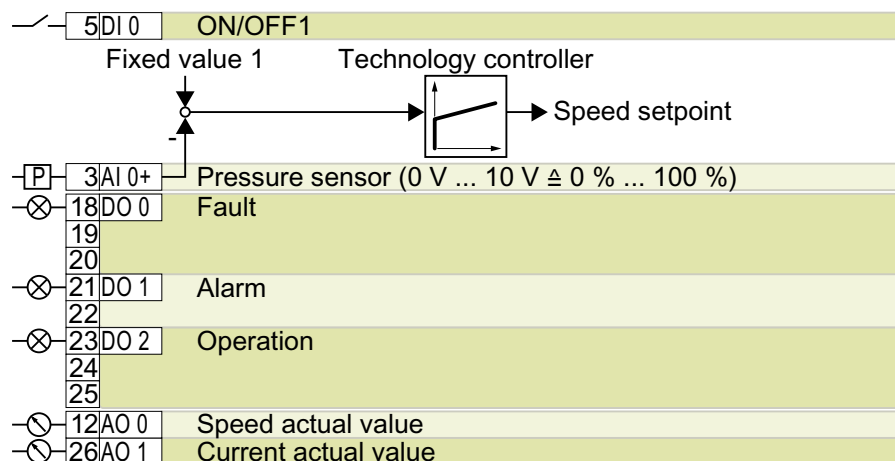
DO 0: p0730, ..., AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0, ..., DI 5: r0722.5 AI 0: r0755[0]
 DO 2: p0732

Additional settings:

- Fixed speed setpoint 1: p1001 = 800 rpm
- Fixed speed setpoint 2: p1002 = 1000 rpm
- Fixed speed setpoint 3: p1003 = 1200 rpm
- If several of the DI 3 ... DI 5 = high, the inverter adds the corresponding fixed speeds.
- Fixed speed setpoint 15 for essential service mode (ESM): p1015 = 1500 rpm
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F 6PA

Default setting 103: "Pump pressure control"



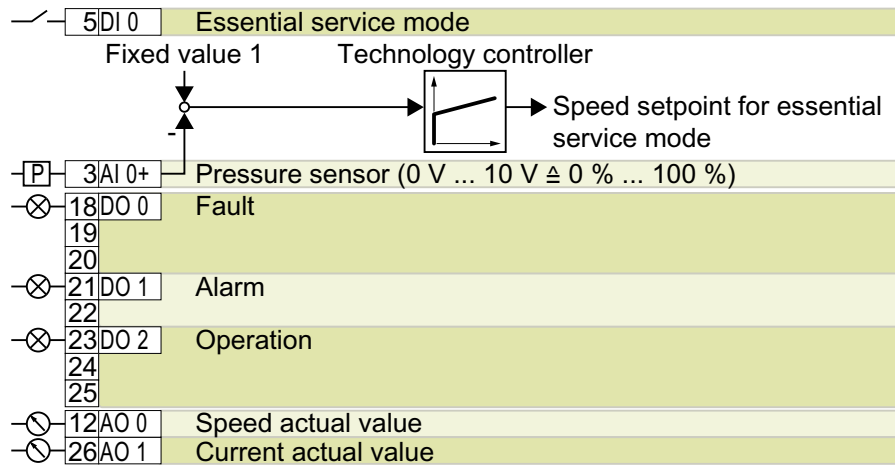
DO 0: p0730, ..., DO 2: p0732 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0 AI 0: r0755[0]

Additional settings:

- Differential pressure control using the technology controller
- Technological unit: p0595 = 1 (%), reference variable: p0596 = 1
- Default setting of the technology controller:
 - Enable: p2200 = 1
 - Fixed value 1: p2201 = 50 %
 - Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
 - Ramp-up/down time for controller output: p2293 = 30 s
 - Upper and lower limits, actual value: p2267 = 120 %, p2268 = -10 %
 - Actual value filter time constant: p2265 = 10 s
 - Proportional gain K_p , integral time T_i , differentiation time constant T_D : p2280 (K_p) = 1, p2285 (T_i) = 30 s, p2274 (T_D) = 0 s
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F dPc

Default setting 104: "ESM stairwell pressure control"



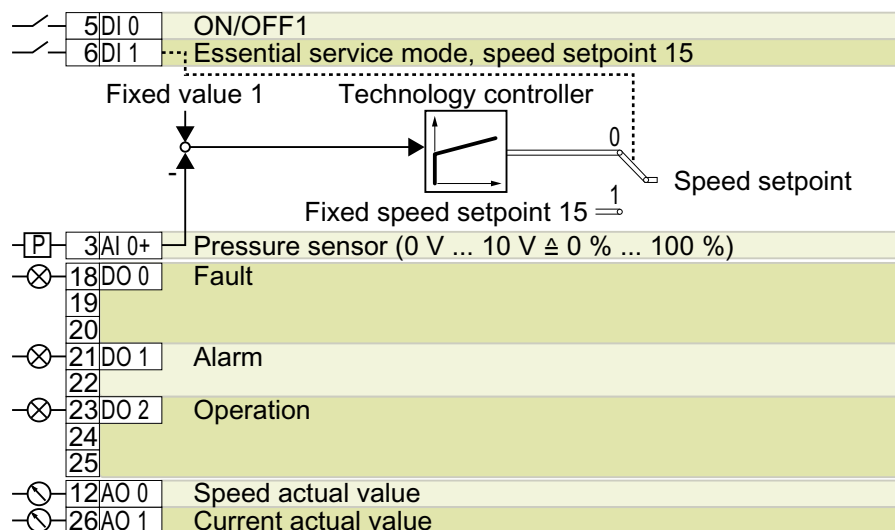
DO 0: p0730, ..., DO 2: p0732 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0 AI 0: r0755[0]

Additional settings:

- Pressure control using the technology controller
- Analog inputs smoothing time constant: p0753 = 500 ms
- Technological unit: p0595 = 1 (%), reference variable: p0596 = 1
- Default setting of the technology controller:
 - Enable: p2200 = 1
 - Fixed value 1: p2201 = 40 %
 - Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
 - Ramp-up/down time for controller output: p2293 = 30 s
 - Upper and lower limits, actual value: p2267 = 120 %, p2268 = -10 %
 - Actual value filter time constant: p2265 = 10 s
 - Proportional gain K_p , integral time T_I , differentiation time constant T_D : p2280 (K_p) = 1.2, p2285 (T_I) = 25 s, p2274 (T_D) = 0 s
 - Technology controller minimum limiting p2292 = 30 %
 - Technology controller output signal start value p2302 = 35 %
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F Stw

Default setting 105: "Fan pressure control + ESM with fixed setpoint"



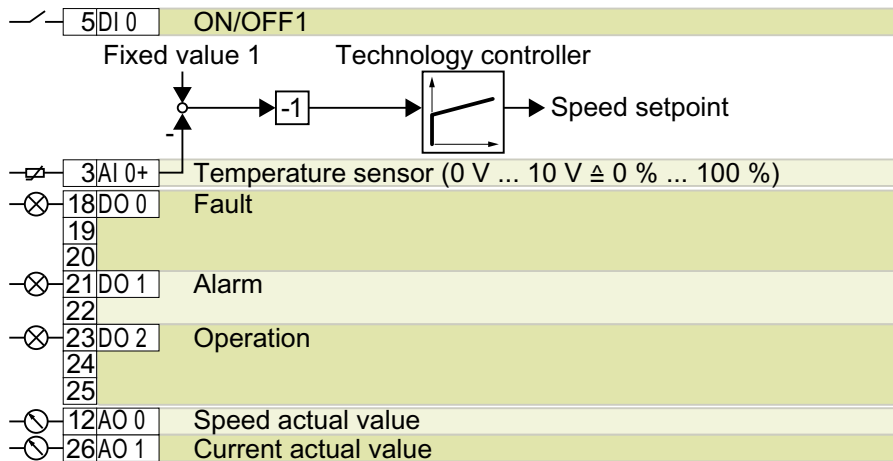
DO 0: p0730, ..., AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0, DI 1: r0722.1 AI 0: r0755[0]
DO 2: p0732

Additional settings:

- Pressure control using the technology controller
- Analog inputs smoothing time constant: p0753 = 500 ms
- Technological unit: p0595 = 1 (%), reference variable: p0596 = 1
- Fixed speed setpoint 15 for essential service mode (ESM): p1015 = 1350 rpm
- Default setting of the technology controller:
 - Enable: p2200 = 1
 - Fixed value 1: p2201 = 40 %
 - Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
 - Ramp-up/down time for controller output: p2293 = 30 s
 - Upper and lower limits, actual value: p2267 = 120 %, p2268 = -10 %
 - Actual value filter time constant: p2265 = 10 s
 - Proportional gain K_p , integral time T_i , differentiation time constant T_D : p2280 (K_p) = 1.1, p2285 (T_i) = 35 s, p2274 (T_D) = 0 s
 - Technology controller minimum limiting p2292 = 20 %
 - Technology controller output signal start value p2302 = 50 %
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F Pc5

Default setting 106: "Cooling tower with active sensor + hibernation"



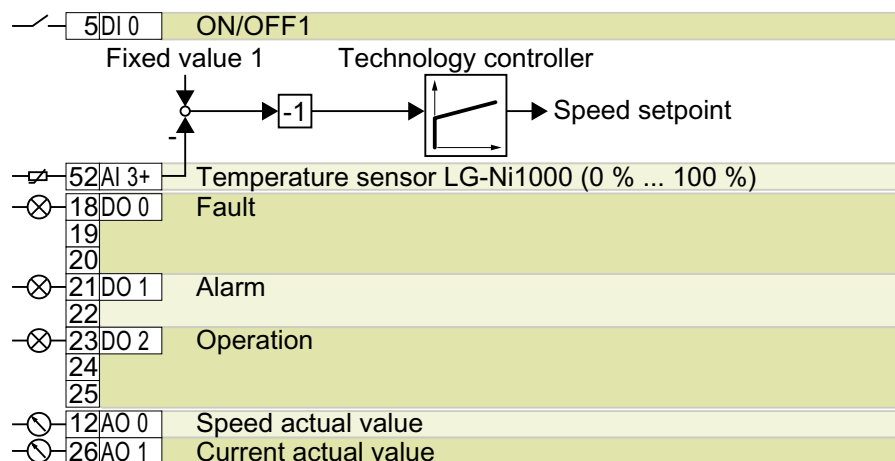
DO 0: p0730, ..., DO 2: p0732 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0 AI 0: r0755[0]

Additional settings:

- Temperature control using the technology controller
- Analog inputs smoothing time constant: p0753 = 100 ms
- Technological unit: p0595 = 1 (%), reference variable: p0596 = 1
- Default setting of the technology controller:
 - Enable: p2200 = 1
 - Fixed value 1: p2201 = 26 %
 - Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
 - Ramp-up/down time for controller output: p2293 = 30 s
 - Upper and lower limits, actual value: p2267 = 120 %, p2268 = -10 %
 - Actual value filter time constant: p2265 = 10 s
 - Proportional gain K_p , integral time T_I , differentiation time constant T_D : p2280 (K_p) = 1.2, p2285 (T_I) = 25 s, p2274 (T_D) = 0 s
 - Technology controller system deviation inversion: p2306 = 1
- Default setting hibernation mode:
 - Activated: p2398 = 1
 - Start speed: p2390 = 50 rpm
 - Delay time: p2391 = 60 s
 - Restart value with technology controller: p2392 = 1 %
 - Restart speed relative w/o technology controller: p2393 = 100 rpm
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F ctF1

Default setting 107: "Cooling tower with LG-Ni1000 sensor + hibernation"



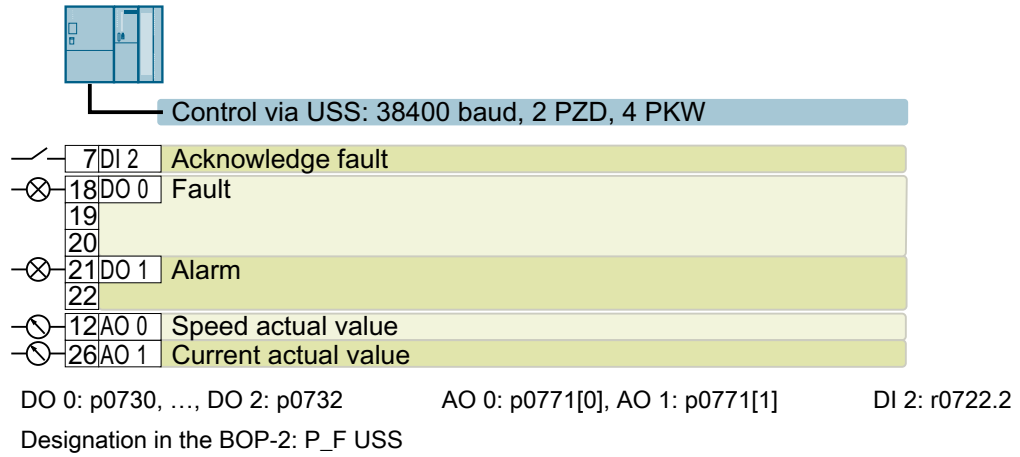
DO 0: p0730, ..., DO 2: p0732 AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0 AI 3: r0755[3]

Additional settings:

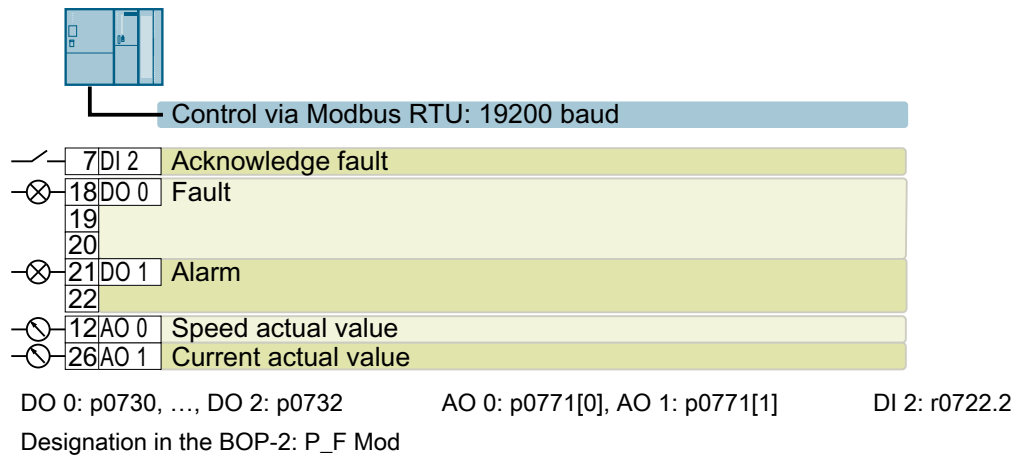
- Temperature control using the technology controller
- Analog inputs smoothing time constant: p0753 = 100 ms
- Technological unit: p0595 = 1 (%), reference variable: p0596 = 1
- Default setting of the technology controller:
 - Enable: p2200 = 1
 - Fixed value 1: p2201 = 26 %
 - Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
 - Ramp-up/down time for controller output: p2293 = 30 s
 - Upper and lower limits, actual value: p2267 = 120 %, p2268 = -100 %
 - Actual value filter time constant: p2265 = 10 s
 - Proportional gain K_p , integral time T_i , differentiation time constant T_D : p2280 (K_p) = 1.2, p2285 (T_i) = 25 s, p2274 (T_D) = 0 s
 - Technology controller minimum limiting p2292 = 20 %
 - Technology controller system deviation inversion: p2306 = 1
- Default setting hibernation mode:
 - Activated: p2398 = 1
 - Start speed: p2390 = 50 rpm
 - Delay time: p2391 = 60 s
 - Restart value with technology controller: p2392 = 1 %
 - Restart speed relative w/o technology controller: p2393 = 100 rpm
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F ctF2

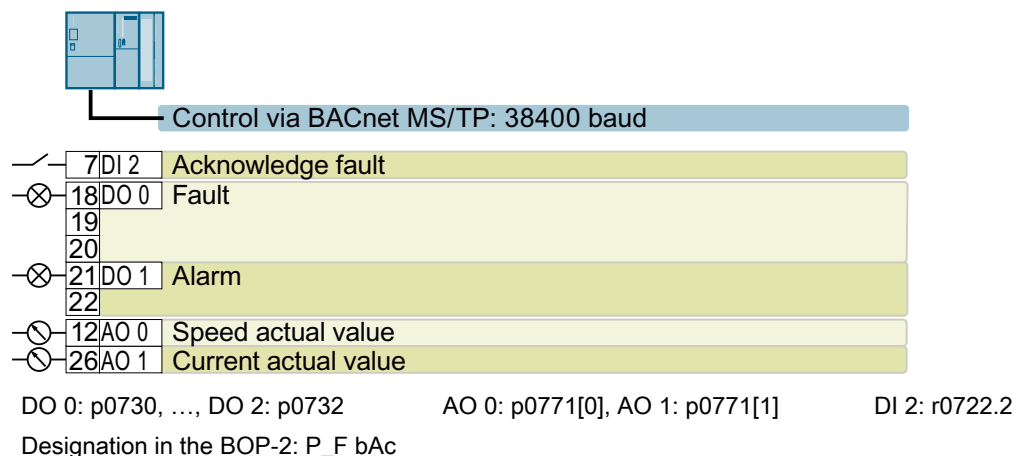
Default setting 108: "USS fieldbus"



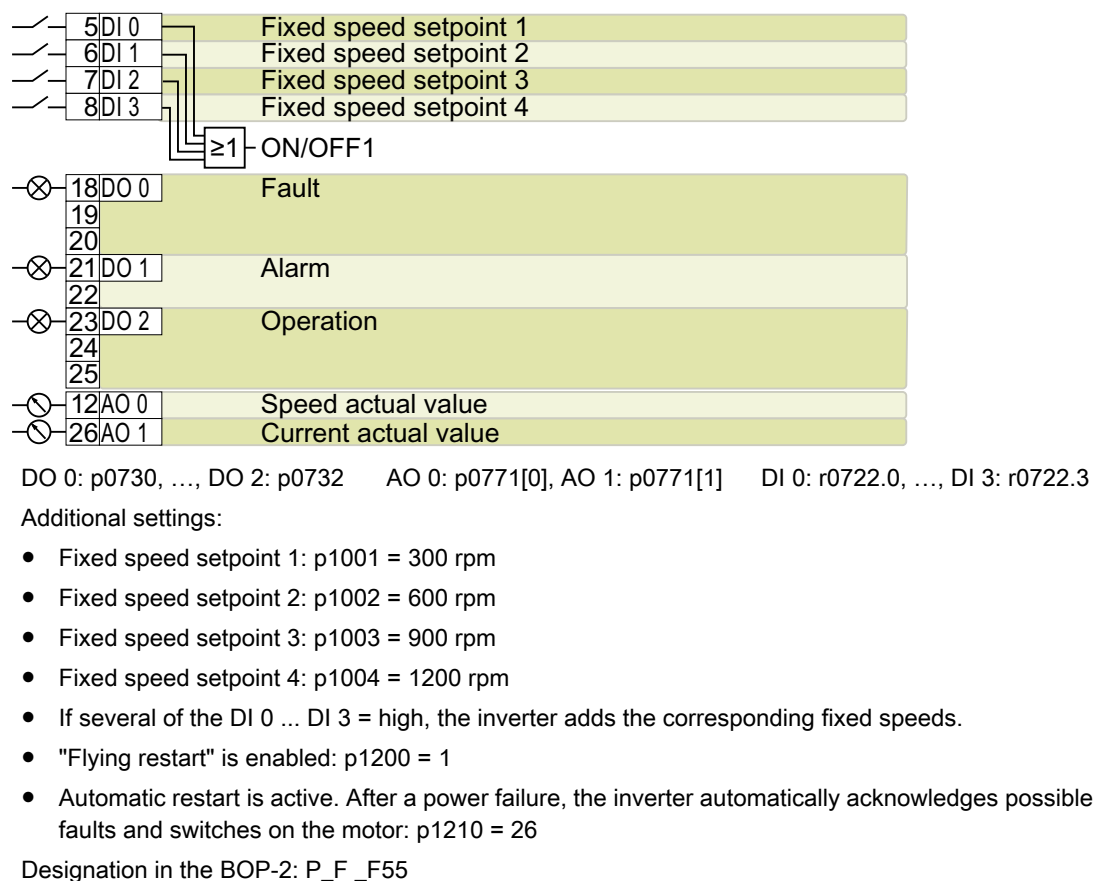
Default setting 109: "Modbus RTU field"



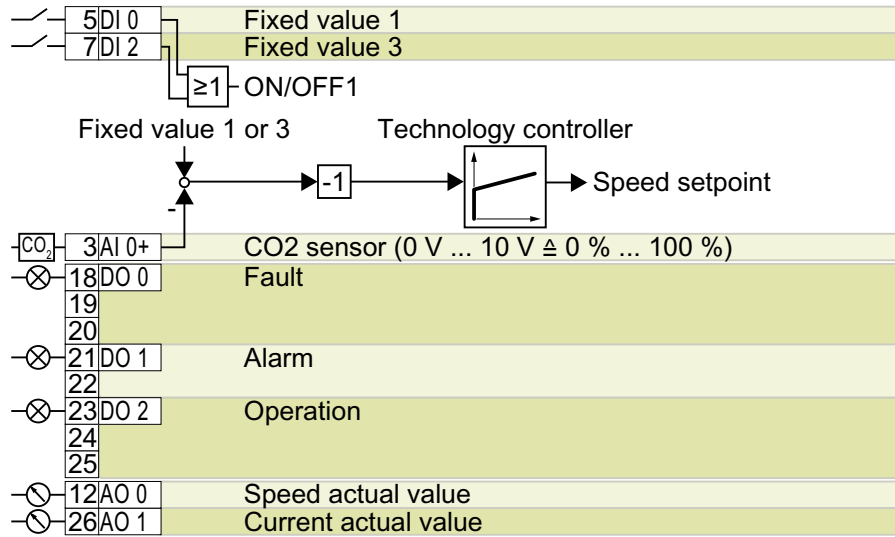
Default setting 110: "BACnet MS/TP fieldbus"



Default setting 111: "Fixed setpoints"



Default setting 112: "CO2 sensor, 2 PID setpoints"



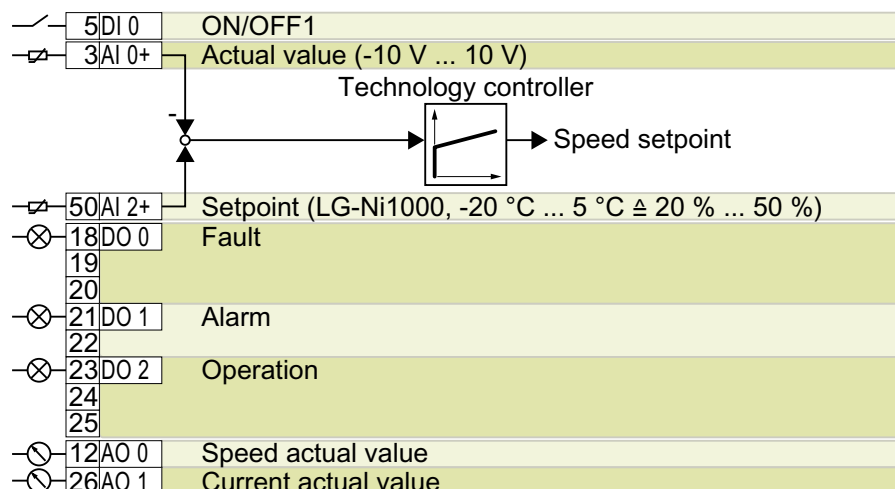
DO 0: p0730, ..., AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0, DI 2: r0722.2 AI 0: r0755[0]
 DO 2: p0732

Additional settings:

- CO₂ control using the technology controller
- Analog inputs smoothing time constant: p0753 = 500 ms
- Technological unit: p0595 = 1 (%), reference variable: p0596 = 1
- Default setting of the technology controller:
 - Enable: p2200 = 1
 - Fixed value 1: p2201 = 50 %
 - Fixed value 3: p2203 = 10 %
 - Technology controller setpoint 1: p2253 = r2224 (active fixed value)
 - Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
 - Upper and lower limits, actual value: p2267 = 120 %, p2268 = -10 %
 - Actual value filter time constant: p2265 = 10 s
 - Technology controller system deviation inversion: p2306 = 1
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F_CO2

Default setting 113: "Temperature-dependent pressure setpoint"



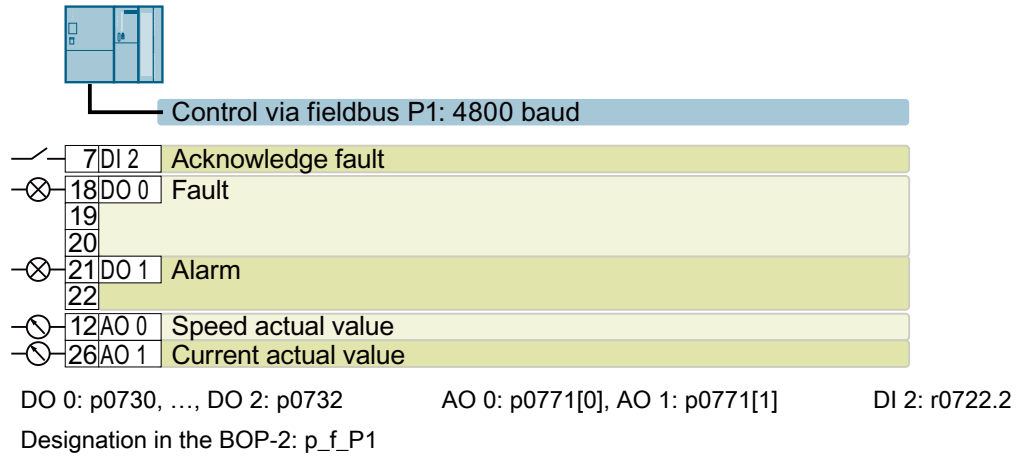
DO 0: p0730, ..., AO 0: p0771[0], AO 1: p0771[1] DI 0: r0722.0 AI 0: r0755[0], AI 2: r0755[2]
DO 2: p0732

Additional settings:

- Temperature control using the technology controller
- Technological unit: p0595 = 1 (%), reference variable: p0596 = 1
- Default setting of the technology controller:
 - Enable: p2200 = 1
 - Upper and lower limits, setpoint: p20229 = 0.5 , p20230 = 0.2
 - Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
 - Ramp-up/down time for controller output: p2293 = 30 s
 - Upper and lower limits, actual value: p2267 = 120 % , p2268 = -10 %
 - Actual value filter time constant: p2265 = 10 s
 - Technology controller minimum limiting p2292 = 20 %
- "Flying restart" is enabled: p1200 = 1
- Automatic restart is active. After a power failure, the inverter automatically acknowledges possible faults and switches on the motor: p1210 = 26

Designation in the BOP-2: P_F_tP5

Default setting 114: "P1 fieldbus"



Default setting 120: "PID settings for pumps and fans"

The default setting restores the function of the terminal strip to the factory setting.

Technology controller setting:

- Ramp-up/down time for setpoint: p2257 = p2258 = 30 s
- Ramp-up/down time for controller output: p2293 = 30 s
- Actual value upper limit: p2267 = 120%
- Actual value filter time constant: p2265 = 10 s

Designation in the BOP-2: P_F_PID

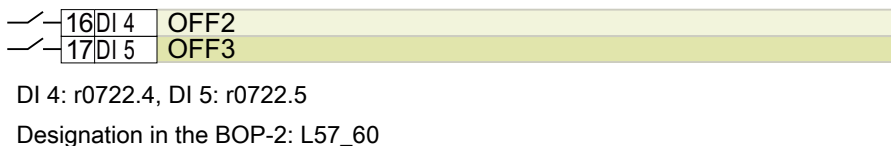
Default setting 200: "Option L13, main contactor"

The macro is intended for the G120P Cabinet with option L13 (main contactor).



Default setting 201: "Option L57, L59, L60, Emergency Stop"

The macro is intended for the G120P Cabinet with options L57, L59 and L60 (Emergency Stop).



Default setting 202: "Option L83, L84, L86, ext. alarm/fault"

The macro is intended for the G120P Cabinet with options L83, L84 and L86 (external alarm or fault).

—	7	DI 2	External alarm
—	8	DI 3	External fault

DI 2: r0722.2, DI 3: r0722.3

Designation in the BOP-2: L83_86

Additional information on the default settings 200 ... 202

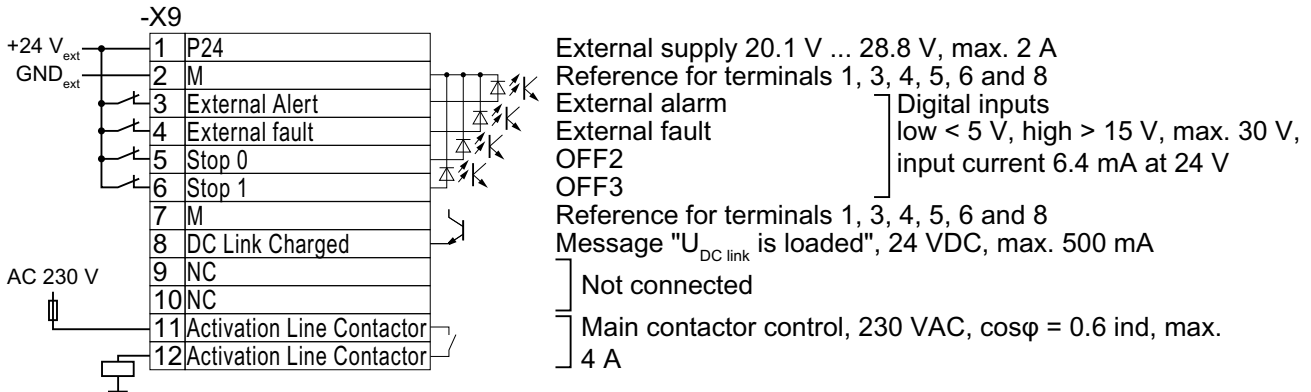
Additional information on the default settings 200 ... 202 is provided on the Internet.

 G120P Cabinet operating instructions (<https://support.industry.siemens.com/cs/ww/en/view/109749009>)

4.5.7 Digital inputs and outputs on the PM330 Power Module

The PM330 Power Module has 4 digital inputs and 2 digital outputs on terminal strip X9.

External 24 V supply of the terminal strip X9



Connection cross-section: 0.2 mm² ... 2.5 mm², tightening torque: 0.5 Nm (5 lb.in)

Use insulated end sleeves according to DIN 46228-4.

Terminals Remark

- 3 ... 6 The function of the digital inputs is shown in the factory setting.
You can change the function of the digital inputs subsequently.
The digital inputs are low-active in the factory setting. If you do not use one of the digital inputs, you must connect the digital input with 24 V.
- 8, 11, 12 The function of the digital outputs cannot be changed.
- 8 The digital output signals a fully charged DC link of the inverter. A charged DC link is the prerequisite for the "operation" inverter state.
- 11, 12 A device to protect against overload and short-circuit is required for the power supply to the line contactor control, e.g. a 4 A / 250 V fuse.
Connect the excitation coil of the line contactor to a surge suppressor, e.g. an RC element.

Figure 4-29 Terminal strip X9 on the PM330 power module with an external 24 V supply

Internal 24 V supply of the terminal strip X9

As from function version 04 (FS04) of the power module, the terminal strip X9 has an internal 24 V supply. The load of the internal 24 V supply is however limited.

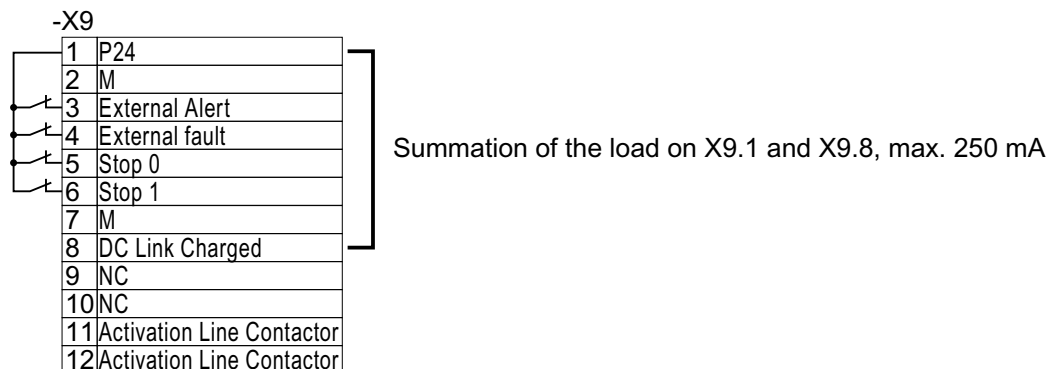


Figure 4-30 Terminal strip X9 on the PM330 power module with an internal 24 V supply

Terminal strip -X41

As from function version 04 (FS04), the power module has terminal strip X41. Terminal strip X41 is used for controlling the Safe Torque Off (STO) safety function.

You will find further information about connecting the terminal strip X41 to the PM330 power module in the Internet:

PM330 Hardware Installation Manual (<https://support.industry.siemens.com/cs/ww/en/view/109748647>)

4.5.8 Wiring terminal strips



⚠ WARNING

Electric shock due to unsuitable power supply

Death or serious injury can result when live parts are touched in the event of a fault.

- For all connections and terminals of the electronic boards, only use power supplies that provide PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage) output voltages.



⚠ WARNING

Electric shock due to unsuitable motor temperature evaluation system

Voltage flashovers to the electronics of the inverter can occur in motors without safe electrical separation of the temperature sensors in accordance with IEC 61800-5-1 when the motor develops a fault.

- Install a temperature monitoring relay 3RS1... or 3RS2...
- Evaluate the temperature monitoring relay output using a digital input of the inverter, e.g. using the "External fault" function.

You can find additional information about the temperature monitoring relay on the Internet:

 Manual 3RS1 / 3RS2 temperature monitoring relays (<https://support.industry.siemens.com/cs/ww/en/view/54999309>)

Note

Malfunction caused by incorrect switching states as the result of diagnostic flows in the off state (logical state "0")

In contrast to mechanical switching contacts, e.g. emergency stop switches, diagnostic flows can also flow with semiconductor switches in the off state. If interconnection with digital inputs is faulty, the diagnostic flows can lead to incorrect switching states and thus to a malfunction of the drive.

- Observe the conditions for digital inputs and digital outputs specified in the relevant manufacturers documentation.
- Check the conditions of the digital inputs and digital outputs in regard to the flows in off state. If applicable, connect the digital inputs with suitably dimensioned, external resistors to protect against the reference potential of the digital inputs.

In order to install the inverter in compliance with UL, you may only connect the DO 0 and DO 2 relay outputs of the Control Unit using copper wires approved for 75 °C.



⚠ DANGER

Danger to life as a result of a hazardous voltage at the Control Unit

If the insulation is damaged on the lines that are connected to the terminals DO 0 and DO 2, parts of the Control Unit may still be connected to the power supply. When connecting higher voltages at terminals DO 0 and DO 2, there is a risk of electric shock when touching the Control Unit.

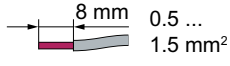
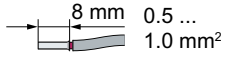
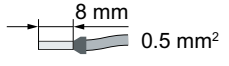
- Only connect dangerous voltages using cables with double insulation at relay outputs DO 0 and DO 2 of the Control Unit.

NOTICE**Overvoltages for long signal cables**

Using long cables at the inverter's digital inputs and 24 V power supply can lead to overvoltage during switching operations. Overvoltages can damage the inverter.

- If you use cables of more than 30 m at the digital inputs and 24 V power supply, connect an overvoltage protection element between the terminal and the associated reference potential.
We recommend using the Weidmüller overvoltage protection terminal with designation MCZ OVP TAZ DIODE 24VDC.

Table 4-32 Permissible cables and wiring options

Solid or finely stranded conductor	Finely stranded conductor with non-insulated conductor end sleeve	Finely stranded conductor with partially insulated conductor end sleeve
 8 mm 0.5 ... 1.5 mm ²	 8 mm 0.5 ... 1.0 mm ²	 8 mm 0.5 mm ²
Cables with twin end sleeves are not permissible.		

Wiring the terminal strip in compliance with EMC

- If you use shielded cables, then you must connect the shield to the mounting plate of the control cabinet or with the shield support of the inverter through a good electrical connection and a large surface area.

Further information about EMC-compliant wiring is available on the Internet:

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

- Use the shield connection plate of the Control Unit to connect the shield as strain relief.
 Control Units (Page 33)

4.5.9 Connecting the temperature contact of the braking resistor



WARNING

Fire caused by an unsuitable or incorrectly installed braking resistor

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

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

Procedure

1. Connect the temperature monitoring system of the braking resistor (terminals T1 and T2 on the braking resistor) to a free digital input on the inverter.

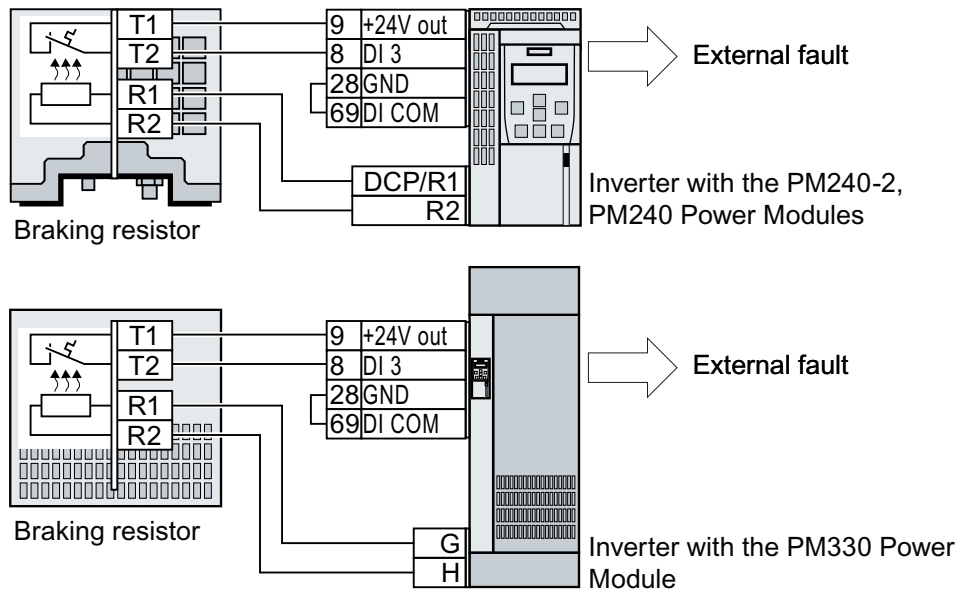


Figure 4-31 Example: Temperature monitoring of the braking resistor via digital input DI 3 on the Control Unit

2. Define the function of the digital input used as an external fault with p2106. As an example with temperature monitoring via digital input DI 3: p2106 = 722.3.

The inverter monitors the braking resistor temperature.


□

Fieldbus interfaces of the Control Units

The Control Units are available in different versions for communication with higher-level controls with the fieldbus interfaces listed as follows:

Fieldbus	Profiles		S7 communication ¹⁾	Control Unit
	PROFIdrive	PROFIenergy ¹⁾		
PROFINET	✓	✓	✓	CU230P-2 PN
EtherNet/IP ¹⁾	---	---	---	
PROFIBUS	✓	---	✓	CU230P-2 DP
USS ¹⁾	---	---	---	CU230P-2 HVAC
Modbus RTU ¹⁾	---	---	---	
BACnet MS/TP ¹⁾	---	---	---	
P1 ¹⁾	---	---	---	

¹⁾ Information about these fieldbuses, profiles and communication types can be found in the Fieldbus function manual.

 Overview of the manuals (Page 538)

4.5.10 Connecting the inverter to PROFINET

4.5.10.1 Communication via PROFINET IO and Ethernet

You can either integrate the inverter in a PROFINET network or communicate with the inverter via Ethernet.

The inverter in PROFINET IO operation

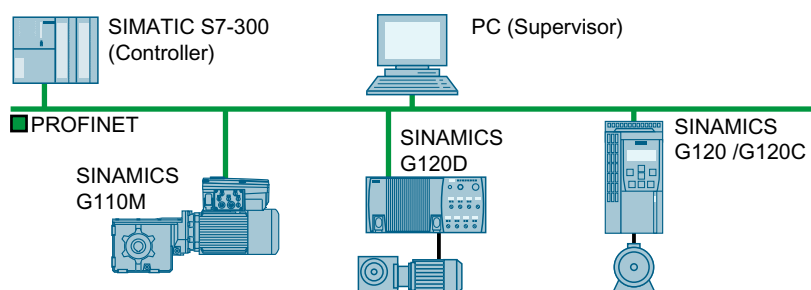


Figure 4-32 The inverter in PROFINET IO operation

The inverter supports the following functions:

- RT
- IRT: The inverter forwards the clock synchronism, but does not support clock synchronism.
- MRP: Media redundancy, impulsed with 200 ms. Requirement: Ring topology
- MRPD: Media redundancy, bumpless. Requirement: IRT and the ring topology created in the control

4.5 Connecting the interfaces for the inverter control

- Diagnostic alarms in accordance with the error classes specified in the PROFIdrive profile.
- Device replacement without removable data storage medium
- Shared Device for Control Units with fail-safe functions

The inverter as Ethernet node

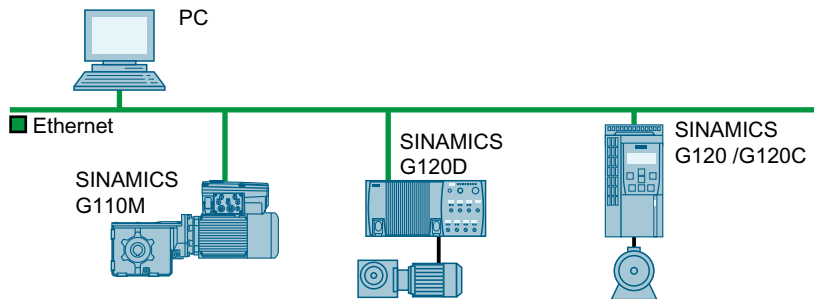





Figure 4-33 The inverter as Ethernet node

Further information on the operation as Ethernet nodes can be found in the Function Manual "Fieldbuses".

 Overview of the manuals (Page 538)


Further information on PROFINET

Further information on PROFINET can be found on the Internet:

-  PROFINET – the Ethernet standard for automation (<http://w3.siemens.com/mcms/automation/en/industrial-communications/profinet/Pages/Default.aspx>)
-  PROFINET system description (<https://support.industry.siemens.com/cs/ww/en/view/19292127>)

4.5.10.2 Connecting the PROFINET cable to the inverter

Procedure

1. Integrate the inverter in the bus system (e.g. ring topology) of the control using PROFINET cables and the two PROFINET sockets X150-P1 and X150-P2.
 Overview of the interfaces (Page 114)
 The maximum permitted cable length from the previous station and to the next one is 100 m.
2. Externally supply the inverter with 24 VDC through terminals 31 and 32.
 The external 24 V supply is only required if communications with the control should also run when the line voltage is switched off.

You have now connected the inverter to the control system via PROFINET DP.

Communication with the controller even when the supply voltage on the Power Module is switched off

You must supply the Control Unit with 24 V DC at terminals 31 and 32 if you wish to maintain communication with the control system when the line voltage is switched off.

In the case of brief interruptions of the 24 V power supply, the inverter may signal a fault without communications with the control system being interrupted.

4.5.10.3 What do you have to set for communication via PROFINET?

Configuring PROFINET communication in the I/O controller

You require the appropriate engineering system to configure PROFINET communication in the IO controller.

If required, load the GSDML file of the inverter into the engineering system.

 Installing GSDML (Page 146)

Device name

In addition to the MAC address and IP address, PROFINET also uses the device name to identify PROFINET devices (Device name). The device name must be unique across the PROFINET network.

To assign the device name, you need an engineering software, e.g. HW-Config or STARTER.

The inverter saves the device name on the inserted memory card.

IP address

In addition to the device name, PROFINET also uses an IP address.

You have the following options to specify the IP address of the inverter:

- You specify the IP address via an engineering software, e.g. via HW-Config or STARTER.
- The IO Controller assigns an IP address to the inverter.


Telegram


Set the same telegram in the inverter as in the IO Controller. Interconnect the telegrams in the control program of the IO Controller with the signals of your choosing.

 Drive control via PROFIBUS or PROFINET (Page 223)

Application examples


You can find application examples for PROFINET communication on the Internet:

 Controlling the speed of a SINAMICS G110M/G120/G120C/G120D with S7-300/400F via PROFINET or PROFIBUS, with Safety Integrated (via terminal) and HMI (<https://support.industry.siemens.com/cs/ww/en/view/60441457>)

 Controlling the speed of a SINAMICS G110M / G120 (Startdrive) with S7-1500 (TO) via PROFINET or PROFIBUS, with Safety Integrated (via terminal) and HMI (<https://support.industry.siemens.com/cs/ww/en/view/78788716>)

4.5.10.4 Installing GSDML

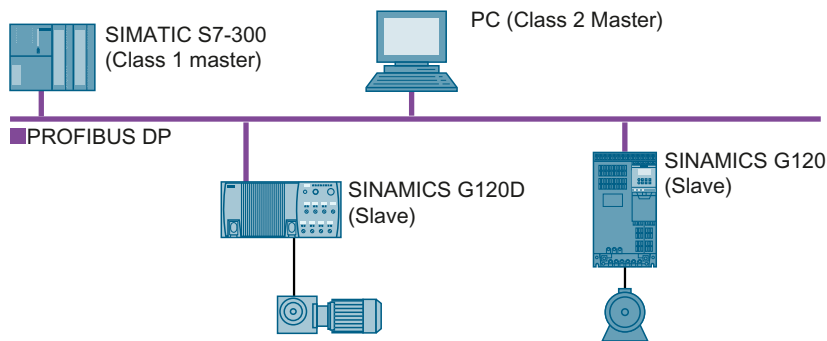
Procedure

1. Save the GSDML to your PC.
 - With Internet access:
 GSDML (<https://support.industry.siemens.com/cs/ww/en/view/26641490>)
 - Without Internet access:
Insert a memory card into the inverter.
Set p0804 = 12.
The inverter writes the GSDML as zipped file (*.zip) into directory /SIEMENS/SINAMICS/ DATA/CFG on the memory card.
2. Unzip the GSDML file on your computer.
3. Import the GSDML into the engineering system of the controller.

You have now installed the GSDML in the engineering system of the controller.

□

4.5.11 Connecting the inverter to PROFIBUS



The PROFIBUS DP interface has the following functions:


- Cyclic communication
- Acyclic communication
- Diagnostic alarms

General information on PROFIBUS DP can be found in the Internet:

-  Information about PROFIBUS DP (http://www.automation.siemens.com/net/html_76/support/printkatalog.htm)
-  PROFIBUS user organization (<http://www.profibus.com/downloads/installation-guide/>)

4.5.11.1 Connecting the PROFIBUS cable to the inverter

Procedure

1. Integrate the inverter into the bus system (e.g. line topology) of the control using PROFIBUS cables via socket X126.
 Overview of the interfaces (Page 114)
The maximum permitted cable length to the previous station and the subsequent one is 100 m at a baud rate of 12 Mbit/s.
2. Externally supply the inverter with 24 VDC through terminals 31 and 32.
The external 24 V supply is only required if communications with the control should also run when the line voltage is switched off.

You have now connected the inverter to the control system using PROFIBUS DP.



Communication with the controller even when the supply voltage on the Power Module is switched off

You must supply the Control Unit with 24 V DC at terminals 31 and 32 if you wish to maintain communication with the control system when the line voltage is switched off.


In the case of brief interruptions of the 24 V power supply, the inverter may signal a fault without communications with the control system being interrupted.

4.5.11.2 What do you have to set for communication via PROFIBUS?

Configuring PROFIBUS communication


You require the appropriate engineering system to configure PROFIBUS communication in the PROFIBUS master.

If required, load the GSD file of the inverter into the engineering system.

 Installing the GSD (Page 148)

Setting the address

Set the address of the PROFIBUS slave.

 Setting the address (Page 148)

Setting the telegram


Set the telegram in the inverter as in the PROFIBUS master. Interconnect the telegrams in the control program of the PROFIBUS master with the signals of your choosing.


 Drive control via PROFIBUS or PROFINET (Page 223)

Application examples

You can find application examples for PROFIBUS communication on the Internet:


4.5 Connecting the interfaces for the inverter control

 Controlling the speed of a SINAMICS G110M/G120/G120C/G120D with S7-300/400F via PROFINET or PROFIBUS, with Safety Integrated (via terminal) and HMI (<https://support.industry.siemens.com/cs/ww/en/view/60441457>)

 Controlling the speed of a SINAMICS G110M / G120 (Startdrive) with S7-1500 (TO) via PROFINET or PROFIBUS, with Safety Integrated (via terminal) and HMI (<https://support.industry.siemens.com/cs/ww/en/view/78788716>)

4.5.11.3 Installing the GSD

Procedure

1. Save the GSD on your PC via one of the following methods.
 - With Internet access:
 -  GSD (<http://support.automation.siemens.com/WW/view/en/22339653/133100>)
 - Without Internet access:
 - Insert a memory card into the inverter.
 - Set p0804 to 12.
 - The inverter writes the GSD as zipped file (*.zip) into directory /SIEMENS/SINAMICS/DATA/CFG on the memory card.
2. Unzip the GSD file on your computer.
3. Import the GSD in the engineering system of the controller.

You have now installed the GSD file in the engineering system of the controller.



4.5.11.4 Setting the address

Valid address area: 1 ... 125

You have the following options for setting the address:

- Using the address switch on the Control Unit:

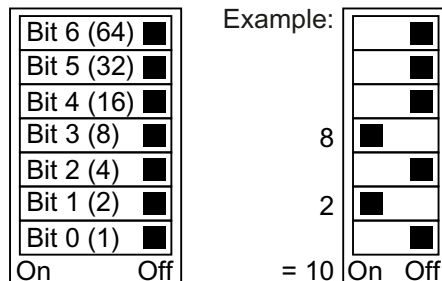



Figure 4-34 Address switch with example for bus address 10

The address switch has priority over the other settings.

- Using Startdrive or an operator panel via parameter p0918 (default setting: p0918 = 126)
It is only possible to change p0918 if an invalid address is set in the address switch.
If you are working with Startdrive, back up the settings so they are not lost if the power fails.

 Overview of the interfaces (Page 114)

Setting the bus address

Procedure

1. Set the address using one of the subsequently listed options:
 - Via the address switch
 - On an operator panel via p0918
 - With Startdrive
Confirm the prompt for saving your settings (copy RAM to ROM).
2. Switch off the inverter power supply.
3. Wait until all LEDs on the inverter are dark.
4. Switch on the inverter power supply again.
Your settings become effective after switching on.

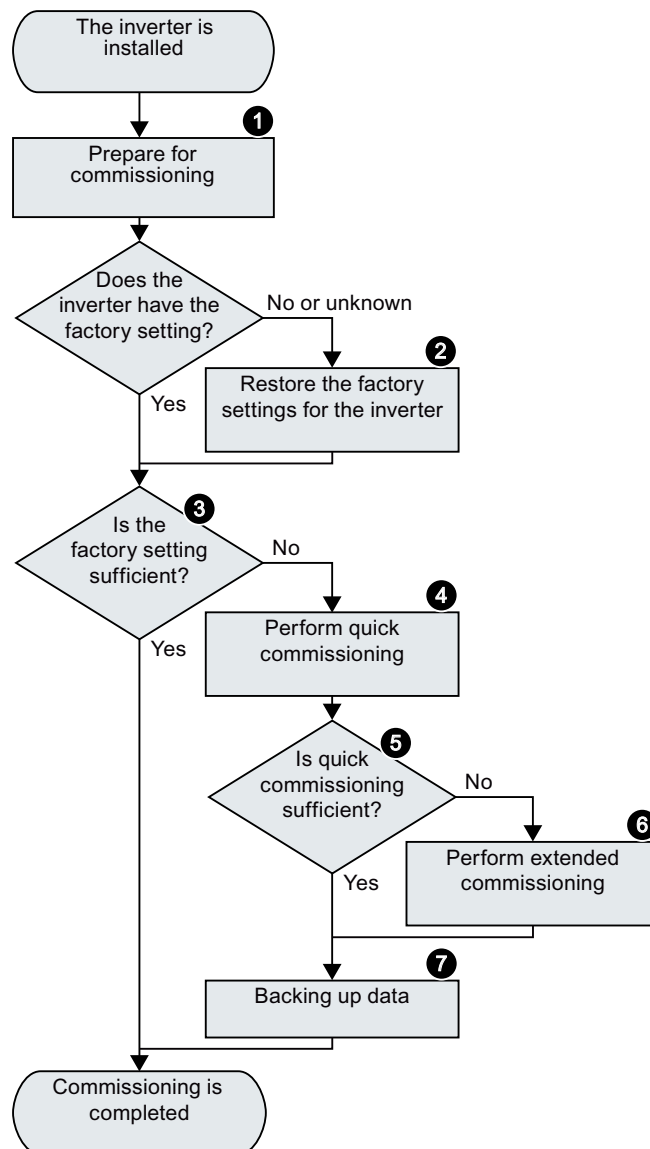
The PROFIBUS address is set.



Commissioning

5.1 Commissioning guidelines

Overview



1. Define the requirements to be met by the drive for your application. (Page 153)
2. Restore the factory settings of the inverter if necessary. (Page 193)
3. Check if the factory setting of the inverter is sufficient for your application. (Page 157)
4. Set the following for quick commissioning of the drive:
 - The closed-loop motor control
 - The inputs and outputs
 - The fieldbus interface (Page 159)
5. Check if additional inverter functions are required for the application. (Page 195)
6. If necessary, adapt the drive. (Page 195)
7. Save your settings. (Page 379)

5.2 Tools to commission the inverter

Operator panel

An operator panel is used to commission, troubleshoot and control the inverter, as well as to back up and transfer the inverter settings.



The **Intelligent Operator Panel (IOP-2)** can either be snapped onto an inverter, or is available as handheld device with a connecting cable to the inverter. The graphics-capable plain text display of the IOP-2 enables intuitive inverter operation.


Additional information on the IOP-2 is available in the Internet:

 SINAMICS IOP-2 release for sale (<https://support.industry.siemens.com/cs/ww/en/view/109747625>)



The **Operator Panel BOP-2** for snapping onto the inverter has a two-line display for diagnostics and operating the inverter.

Operating Instructions of the BOP-2 and IOP-2 operator panels:

 Overview of the manuals (Page 538)

Smart Access

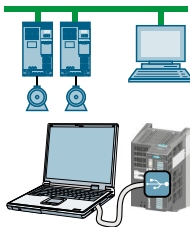


The Smart Access for snapping onto the inverter is a web server-based operating unit with wireless connection to a PC, tablet, or smartphone. The Smart Access serves commissioning and maintenance of the inverter.

Additional information on Smart Access is available in the Internet:


 SINAMICS V20 Operating Instructions (<https://support.industry.siemens.com/cs/ww/en/view/109751304>)


PC tools




STARTER and **Startdrive** are PC tools that are used to commission, troubleshoot and control the inverter, as well as to back up and transfer the inverter settings. You can connect the PC with the inverter via USB or via the PROFIBUS / PROFINET fieldbus.

Connecting cable (3 m) between PC and inverter: Article number 6SL3255-0AA00-2CA0

 STARTER DVD: Article number 6SL3072-0AA00-0AG0

 Startdrive DVD: Article number 6SL3072-4CA02-1XG0

 Startdrive, system requirements and download (<https://support.industry.siemens.com/cs/ww/en/view/109752254>)

 STARTER, system requirements and download (<http://support.automation.siemens.com/WW/view/en/26233208>)

 Startdrive tutorial (<http://support.automation.siemens.com/WW/view/en/73598459>)

 STARTER videos (<http://www.automation.siemens.com/mcms/mc-drives/en/low-voltage-inverter/sinamics-g120/videos/Pages/videos.aspx>)

5.3 Preparing for commissioning

5.3.1 Collecting motor data

Data for a standard induction motor

Before starting commissioning, you must know the following data:

- **Which motor is connected to the inverter?**
Note down the Article No. of the motor and the motor's nameplate data. If available, note down the motor code on the motor's nameplate.

Article No.

SIEMENS		IE3		H		CE			
Made in Czech Rep.									
3-Mot.		1AV3094A		1LE10430EA422AA0-Z		UD 1410/1410842-001-001			
IEC/EN 60034		90L		IMB3		IP55			
20kg		Th.Cl.155(F)		-20°C<=TAMB<=40°C					
		Bearing							
○ DE		6205-2ZC3							
○ NE		6004-2ZC3							
	V	Hz	A	kW	cos φ	NOM.EFF	1/min	IE-CL	Code
IEC	230 Δ	50	7.3	2.20	0.88	85.9	2910	IE3	
IEC	400 Y	50	4.20	2.20	0.88	85.9	2910	IE3	
NEMA	460 Y	60	4.20	2.55	0.88	86.5	3510	IE3	
NEMA	460 Y	60	3.65	2.20	0.87	86.5	3530	IE3	

Voltage Current Power Speed

Figure 5-1 Example of the rating plate for a standard induction motor

- **In which region of the world is the motor to be used?**
 - Europe IEC: 50 Hz [kW]
 - North America NEMA: 60 Hz [hp] or 60 Hz [kW]
- **How is the motor connected?**
Pay attention to the connection of the motor (star connection [Y] or delta connection [Δ]). Note the appropriate motor data for connecting.

Data for a synchronous reluctance motor

Before starting commissioning, you must know the following data:

- **Which motor is connected to the inverter?**
Note down the motor code on the type plate of the motor.



SIEMENS										 	
Made in Germany											
3-Mot. 1RV4205B 1FP10042AB521AF4 E XXX/XXXXXXXX XX 001											
IEC/EN 60034 200L			IMB3			IP55					
167 kg		Th.Cl. 155(F)		-20°C<=TAMB<=40°C							
○		Bearing								○	
DE		6212-ZC3									
NE		6212-ZC3									
INVERTER DUTY ONLY											
										VPWM SINAMICS NMAX 4500 1/min	
V	Hz	A	kW	cos φ	Nm	1/min	EFF			Code 60007	
380	Y 50	68	30.0	0.71	191	1500	94.9				
220	Δ 50	117	30.0	0.71	191	1500	94.9				
440	Y 60	66	34.5	0.72	183	1800	95.9				
380	Δ 87	118	52.0	0.71	191	2610	94.4				

Figure 5-2 Example of a type plate for a reluctance motor

- **In which region of the world is the motor to be used?**
- Europe IEC: 50 Hz [kW]
- North America NEMA: 60 Hz [hp] or 60 Hz [kW]
- **How is the motor connected?**
Pay attention to the connection of the motor (star connection [Y] or delta connection [Δ]).
Note the appropriate motor data for connecting.

5.3.2 Forming DC link capacitors

Description

You may have to reform the DC link capacitors if the power module has been stored for more than one year. When the converter is operational, DC link capacitors that have not been formed can be damaged.

Table 5-1 The forming duration depends on how long the inverter was stored for

Storage time from the date of manufacture	Recommended forming duration
1 – 2 years	1 hour
2 – 3 years	2 hours
>3 years	8 hours

The production date of the power module is coded in the 3rd and 4th digit of the serial number on the rating plate: "S X -- ③ ④ X X X..."

Table 5-2 Production year and month

Digit ③	Year of manufacture	Digit ④	Month of manufacture
D	2013	1 ... 9	January ... September
E	2014	O	October
F	2015	N	November
H	2016	D	December
J	2017		
K	2018		
L	2019		
M	2020		

Form DC Link of the PM330 power module

The "Forming the DC link" firmware function is only possible for the PM330 power module.

Procedure

1. Set p0010 = 2.
2. Set the forming duration p3380.
For p3380 > 0, with alarm A07391, the inverter signals that at the next on command, DC link forming starts.
3. Switch on the motor, e.g. from an inserted operator panel.
4. Wait for the forming time to elapse. r3381 indicates the remaining time.
If the line voltage is switched off before forming has been completed, then you must again form the DC link.
5. The inverter sets p3380 = 0.
6. Set p0010 = 0.

You have formed the DC link.



Parameter

Parameter	Description	
p0010	Drive commissioning parameter filter (factory setting: 0) 0: Ready 2: Power unit commissioning	
p3380	DC link forming, forming duration (factory setting: 0 h) p3380 = 0 deactivates the function. If the forming duration is changed while forming, then forming restarts with the modified forming duration.	
r3381	DC link forming, remaining time [h] Remaining forming time.	
r3382	DC link forming, status word	
	.00	1 signal: Forming activated
	.01	1 signal: Forming active
	.02	1 signal: Forming completed
	.03	1 signal: Forming faulty The inverter signals fault F07390

Forming the DC link of PM240-2 and PM240P-2 Power Modules

You form the DC link capacitors by supplying the inverter with a line voltage of $\leq 100\%$ of the rated voltage for a defined time.

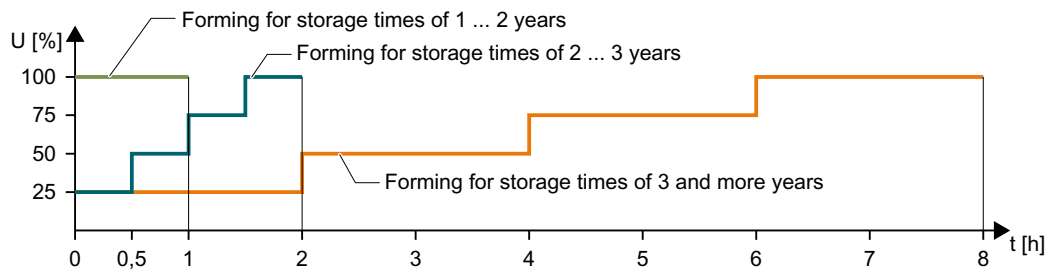


Figure 5-3 Forming the DC-link capacitors

Form DC Link of other power modules

Formation of the DC link capacitors is not required for the following power modules even after a lengthy period of storage.

- PM230
- PM250

5.3.3 Inverter factory setting

Motor

In the factory, the inverter is set for an induction motor matching the rated power of the Power Module.

Inverter interfaces

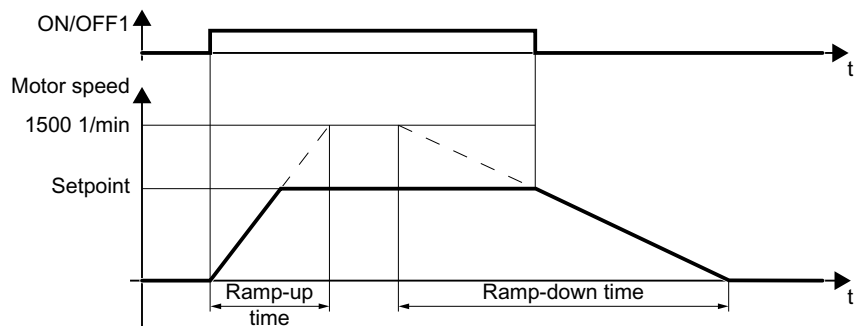
The inputs and outputs and the fieldbus interface of the inverter have specific functions when set to the factory settings.

 Factory interface settings (Page 118)

Switching the motor on and off

The inverter is set in the factory as follows:

- After the ON command, the motor accelerates within the ramp-up time (referred to 1500 rpm) to its speed setpoint.
- After the OFF1 command, the motor brakes down to standstill with the ramp-down time.
- The negative direction of rotation is inhibited



- Ramp-up time:
- With PM330 Power Modules: 20 s
 - For all other Power Modules: 10 s
- Ramp-down time:
- With PM230 and PM330 Power Modules: 30 s
 - For all other Power Modules: 10 s

Figure 5-4 Switching on, switching off and reversing the motor in the factory setting

The ramp-up and ramp-down times define the maximum motor acceleration when the speed setpoint changes. The ramp-up and ramp-down times are derived from the time between motor standstill and the maximum speed, or between the maximum speed and motor standstill.

Traverse the motor in the jog mode

For an inverter with PROFIBUS or PROFINET interface, operation can be switched over using digital input DI 3. The motor is either switched on and off via the fieldbus – or operated in the jog mode via its digital inputs.

For a control command at the respective digital input, the motor rotates with ± 150 rpm. The same ramp-up and ramp-down times as described above apply.

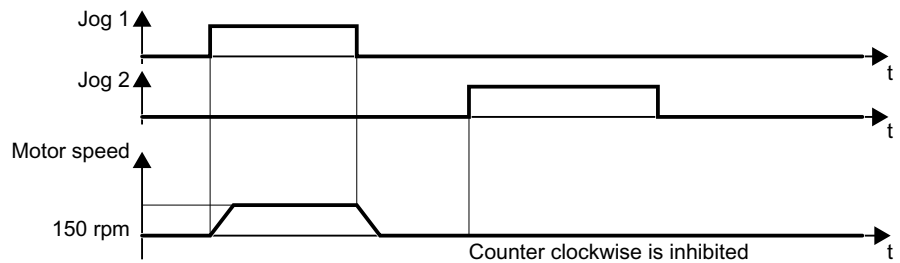


Figure 5-5 Jogging the motor in the factory setting

Minimum and maximum speed

- Minimum speed - factory setting 0 [rpm]
After the selection of a motor, during the quick commissioning, the inverter sets the minimum speed to 20% of the rated speed.
The minimum speed is the lowest speed of the motor independent of the speed setpoint.
- Maximum speed - factory setting 1500 [rpm]
The inverter limits the motor speed to this value.

Operate the motor in the factory setting

We recommend that you execute quick commissioning. For quick commissioning, you must adapt the inverter to the connected motor by setting the motor data in the inverter.

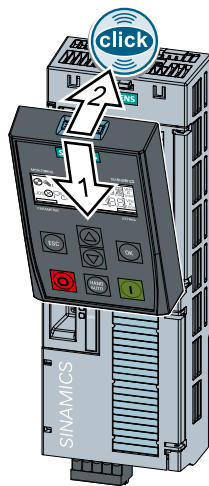
For basic applications, you can try to operate the drive with a rated power < 18.5 kW without any other commissioning steps. Check whether the control quality of the drive without commissioning is adequate for the requirements of the application.

5.4 Quick commissioning using the BOP-2 operator panel

5.4.1 Inserting the BOP-2

Plugging on an operator panel

Procedure



1. Locate the lower edge of the Operator Panel into the matching recess of the Control Unit.
2. Plug the Operator Panel onto the inverter until the latch audibly engages.

The operator panel is plugged onto the Control Unit.

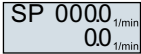
□

The operator panel is ready for operation when you connect the inverter to the power supply.

5.4.2 Start quick commissioning and select the application class

Starting quick commissioning

Preconditions



- The power supply is switched on.
- The operator panel displays setpoints and actual values.

Procedure



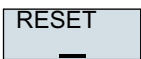
Press the ESC key.



Press one of the arrow keys until the BOP-2 displays the "SETUP" menu.



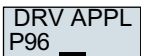
To start quick commissioning, in the "SETUP" menu, press the OK key.



If you wish to restore all of the parameters to the factory setting before the quick commissioning, proceed as follows:

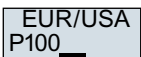
1. Press the OK key.
2. Switchover the display using an arrow key: nO → YES
3. Press the OK key.

Selecting the application class



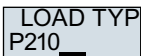
Whether the inverter offers the selection of the application class, depends on the Power Module being used:

- PM230 or PM250 Power Modules:
The inverter skips step DRV APPL.
- PM240-2, PM240P-2 or PM330 Power Modules:
select the application class:
 Quick commissioning with application classes (Page 166)



Select the motor standard:

- KW / 50HZ: IEC
- HP / 60HZ: NEMA
- KW / 60HZ: IEC 60 Hz



Specify the overload capability of the inverter:

- HIGH OVL: Load cycle with "High Overload"
- LOW OVL: Load cycle with "Low Overload"

Overload capability of the inverter (Page 444)

INV VOLT
P210__

Set the supply voltage of the inverter.

MOT TYPE
P300__

Select the motor type. If a 5-digit motor code is stamped on the motor rating plate, select the corresponding motor type with motor code.

Motors without motor code stamped on the rating plate:

- INDUCT: Third-party induction motor
- 1L... IND: 1LE1, 1LG6, 1LA7, 1LA9 induction motors

Motors with motor code stamped on the rating plate:

- 1LE1 IND 100: 1LE1 . 9
- 1PC1 IND: 1PC1
- 1PH8 IND: Induction motor
- 1FP1: Reluctance motor

Depending on the inverter, the motor list in BOP-2 can deviate from the list shown above.

MOT CODE
P301__

If you have selected a motor type with motor code, you must now enter the motor code. The inverter assigns the following motor data corresponding to the motor code.

If you do not know the motor code, then you must set the motor code = 0, and enter motor data from p0304 and higher from the rating plate.

87 HZ
__

87 Hz motor operation The BOP-2 only indicates this step if you selected IEC as the motor standard (EUR/USA, P100 = KW 50HZ).

MOT VOLT
P304__

Rated motor voltage

MOT CURR
P305__

Rated motor current

MOT POW
P307__

Rated motor power

MOT FREQ
P310__

Rated motor frequency

MOT RPM
P311__

Rated motor speed

MOT COOL
P335__

Motor cooling:

- SELF: Natural cooling
- FORCED: Forced-air cooling
- LIQUID: Liquid cooling
- NO FAN: Without fan

5.4 Quick commissioning using the BOP-2 operator panel

TEC APPL
P500

Select the appropriate application:

- VEC STD: In all applications, which do not fit the other setting options.
- PUMP FAN: Applications involving pumps and fans
- SLVC 0HZ: Applications with short ramp-up and ramp-down times. However, this setting is not suitable for hoisting gear and cranes/lifting gear.
- PUMP 0HZ: Applications involving pumps and fans with optimized efficiency. The setting only makes sense for steady-state operation with slow speed changes. We recommend setting VEC STD if load surges in operation cannot be ruled out.
- V LOAD: Applications with high breakaway torques, e.g. extruders, compressors and mills

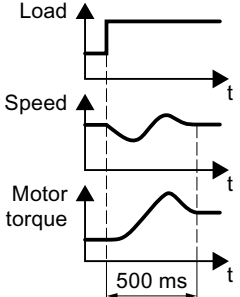
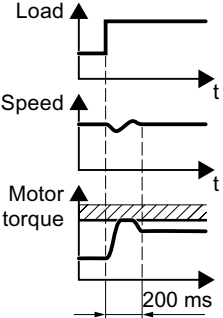
The selection option depends on the Power Module being used. There is no selection option for PM230 Power Modules.

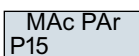
CTRL MOD
P1300

Select the control mode:

- VF LIN: U/f control with linear characteristic
- VF LIN F: Flux current control (FCC)
- VF QUAD: U/f control with square-law characteristic
- SPD N EN: Encoderless vector control

Select a suitable control mode

Control mode	U/f control with linear or square-law characteristic Flux current control (FCC)	Encoderless vector control
Closed-loop control characteristics	<ul style="list-style-type: none"> • Typical settling time after a speed change: 100 ms ... 200 ms • Typical settling time after a load surge: 500 ms  <ul style="list-style-type: none"> • The control mode is suitable to address the following requirements: <ul style="list-style-type: none"> – Motor power ratings < 45 kW – Ramp-up time 0 → rated speed (depending on the motor power rating): 1 s (0.1 kW) ... 10 s (45 kW) – Applications with increasing load torque without load surges • The control mode is insensitive with respect to imprecise setting of the motor data 	<ul style="list-style-type: none"> • Typical settling time after a speed change: < 100 ms • Typical settling time after a load surge: 200 ms  <ul style="list-style-type: none"> • The vector control controls and limits the motor torque • Torque accuracy that can be achieved: ± 5% for 15 % ... 100 % of the rated speed • We recommend vector control for the following applications: <ul style="list-style-type: none"> – Motor power ratings > 11 kW – For load surges 10 % ... >100 % of the rated motor torque • The vector control is necessary for a ramp-up time 0 → Rated speed (dependent on the rated motor power): < 1 s (0.1 kW) ... < 10 s (250 kW).
Application examples	<ul style="list-style-type: none"> • Pumps, fans, and compressors with flow characteristic 	<ul style="list-style-type: none"> • Pumps and compressors with displacement machines
Motors that can be operated	Induction motors	Induction, synchronous and reluctance motors
Power Modules that can be operated	No restrictions	
Max. output frequency	550 Hz	240 Hz 150 Hz with PM330 Power Module
Commissioning	<ul style="list-style-type: none"> • Contrary to vector control, no speed controller has to be set 	



Select the default setting for the interfaces of the inverter that is suitable for your application.



Default setting of the interfaces (Page 120)

5.4 Quick commissioning using the BOP-2 operator panel

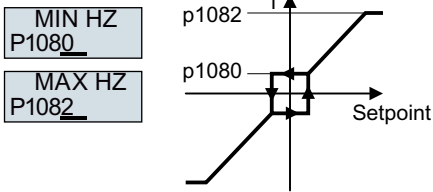


Figure 5-6 Minimum and maximum motor frequency

CAUTION

Material damage caused by unexpected acceleration of the motor

Depending on the Power Module, the inverter sets the minimum frequency p1080 to 20% of the maximum frequency. Also for setpoint = 0, the motor accelerates for p1080 > 0 to the minimum frequency after switching on the motor. An unexpected acceleration of the motor can cause material damage.

- If the application requires a minimum frequency = 0, then set p1080 = 0.

AI SCALE
P758

Scaling of analog input 0

RAMP UP
P1120

RAMP DWN
P1121

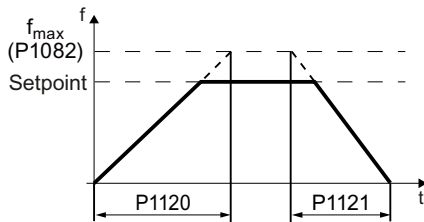


Figure 5-7 Ramp-up and ramp-down time of the motor

OFF3 RP
P1135

Ramp-down time for the OFF3 command

MOT ID
P1900

Motor data identification: Select the method which the inverter uses to measure the data of the connected motor:

- OFF: Motor data is not measured.
- STIL ROT: Recommended setting: Measure the motor data at standstill and with the motor rotating. The inverter switches off the motor after the motor data identification has been completed.
- STILL: Measure the motor data at standstill. The inverter switches off the motor after the motor data identification has been completed.
Select this setting if one of the following cases is applicable:
 - You have selected control mode "SPD N EN", however, the motor cannot freely rotate - for a mechanically limited travel range, for example.
 - You have selected U/f control as control mode, e.g. "VF LIN" or "VF QUAD".
- ROT: Measure the motor data while the motor is rotating. The inverter switches off the motor after the motor data identification has been completed.

FINISH
—

Complete quick commissioning:

Switchover the display using an arrow key: nO → YES

Press the OK key.

You have entered all of the data that is necessary for the quick commissioning of the inverter.

□

5.4.3 Quick commissioning with application classes

5.4.3.1 Overview of quick commissioning

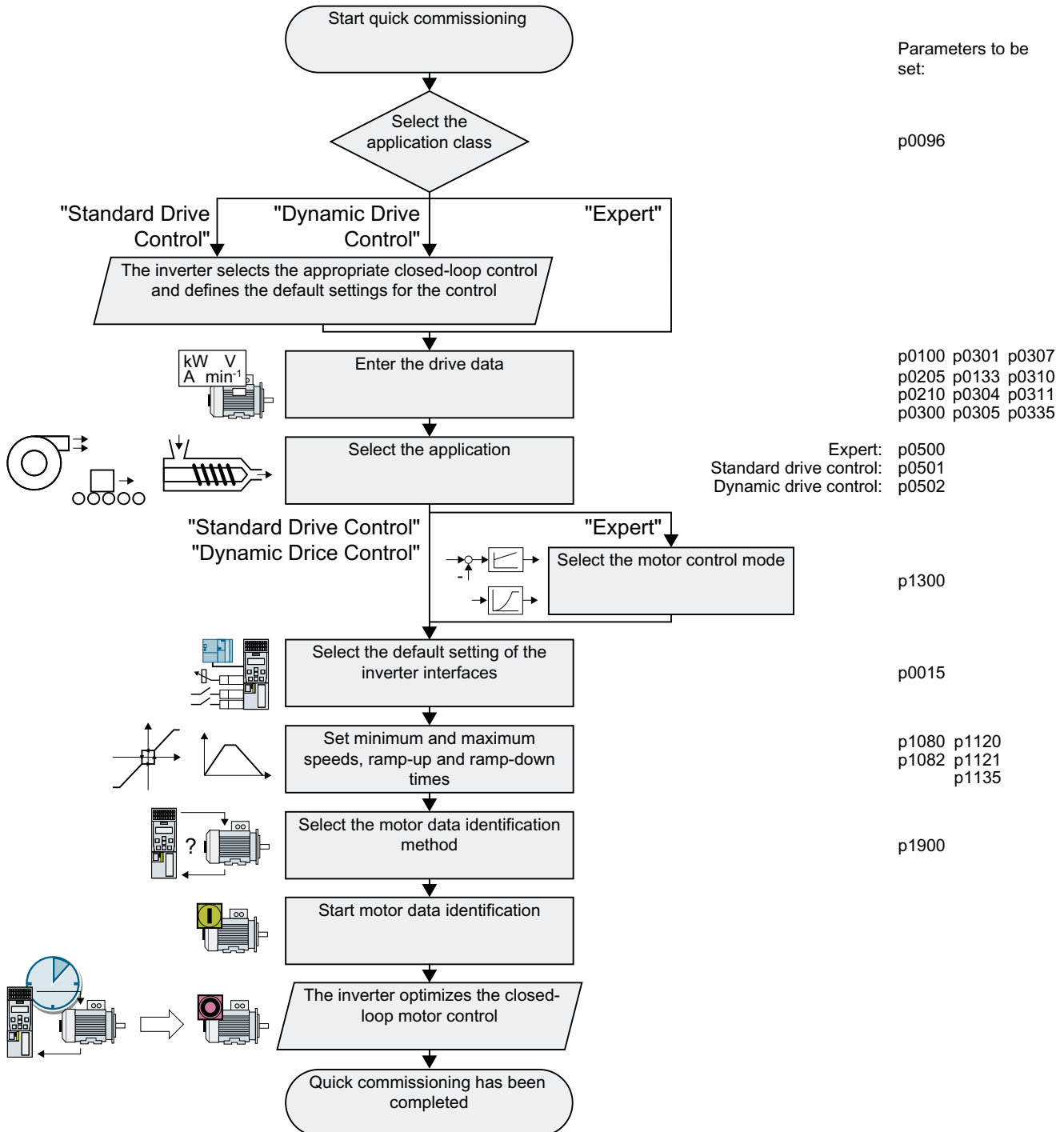





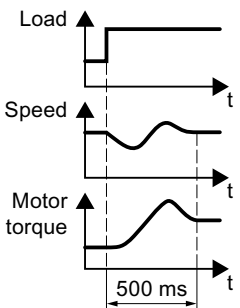
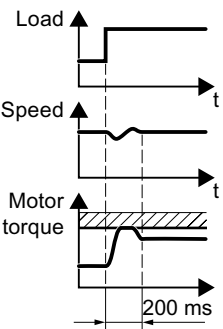
Figure 5-8 Quick commissioning using the BOP-2 operator panel

DRV APPL
P96

When selecting an application class, the inverter assigns the motor control with the appropriate default settings:

-  Standard Drive Control (Page 168)
-  Dynamic Drive Control (Page 170)
-  Start quick commissioning and select the application class (Page 160)

Depending on the particular Power Module, the inverter skips selecting the application class. If the BOP-2 does not display step DRV APPL, then continue commissioning as described under "Expert".

Application class	Standard Drive Control	Dynamic Drive Control		
Properties	<ul style="list-style-type: none"> • Typical settling time after a speed change: 100 ms ... 200 ms • Typical settling time after a load surge: 500 ms  <ul style="list-style-type: none"> • "Standard Drive Control" is suitable to address the following requirements: <ul style="list-style-type: none"> – Motor power ratings < 45 kW – Ramp-up time 0 → rated speed (depending on the motor power rating): 1 s (0.1 kW) ... 10 s (45 kW) – Applications with increasing load torque without load surges • "Standard Drive Control" is insensitive with respect to imprecise setting of the motor data 	<ul style="list-style-type: none"> • Typical settling time after a speed change: < 100 ms • Typical settling time after a load surge: 200 ms  <ul style="list-style-type: none"> • "Dynamic Drive Control" controls and limits the motor torque • Torque accuracy that can be achieved: ± 5% for 15 % ... 100 % of the rated speed • We recommend "Dynamic Drive Control" for the following applications: <ul style="list-style-type: none"> – Motor power ratings > 11 kW – For load surges 10 % ... >100 % of the rated motor torque • "Dynamic Drive Control" is necessary for a ramp-up time 0 → rated speed (dependent on the rated motor power): < 1 s (0.1 kW) ... < 10 s (132 kW). 		
Application examples	<ul style="list-style-type: none"> • Pumps, fans, and compressors with flow characteristic 	<ul style="list-style-type: none"> • Pumps and compressors with displacement machines 		
Power Modules that can be operated	PM240-2, PM240P-2	PM240-2, PM240P-2	PM330	
Max. output frequency	550 Hz	240 Hz	150 Hz	

Application class	Standard Drive Control	Dynamic Drive Control
Motors that can be operated	Induction motors	Induction, synchronous and reluctance motors
Commissioning	<ul style="list-style-type: none"> • Unlike "Dynamic Drive Control," no speed controller needs to be set • When compared to "Expert": <ul style="list-style-type: none"> – Simplified commissioning using predefined motor data – Reduced number of parameters • "Standard Drive Control" is preset for Power Modules, frame size A ... frame size C 	<ul style="list-style-type: none"> • Reduced amount of parameters when compared to "Expert" • "Dynamic Drive Control" is preset for Power Modules frame size D ... frame size JX

5.4.3.2 Standard Drive Control

EUR/USA
P100__

Select the motor standard:

- KW 50HZ: IEC
- HP 60HZ: NEMA
- KW 60HZ: IEC 60 Hz

INV VOLT
P210__

Set the inverter supply voltage.

MOT TYPE
P300__

Select the motor type. If a 5-digit motor code is stamped on the motor rating plate, select the corresponding motor type with motor code.

Motors without motor code stamped on the rating plate:

- INDUCT: Third-party induction motor
- 1L... IND: 1LE1, 1LG6, 1LA7, 1LA9 induction motors

Motors with motor code stamped on the rating plate:

- 1LE1 IND 100: 1LE1 . 9
- 1PC1 IND: 1PC1
- 1PH8 IND: Induction motor
- 1FP1: Reluctance motor

Depending on the inverter, the motor list in BOP-2 can deviate from the list shown above.

MOT CODE
P301__

If you have selected a motor type with motor code, you must now enter the motor code. The inverter assigns the following motor data corresponding to the motor code.

If you do not know the motor code, then you must set the motor code = 0, and enter motor data from p0304 and higher from the rating plate.

87 HZ
__

87 Hz motor operation The BOP-2 only indicates this step if you selected IEC as the motor standard (EUR/USA, P100 = KW 50HZ).

MOT VOLT
P304__

Rated motor voltage

MOT CURR
P305__

Rated motor current

MOT POW
P307__

Rated motor power

MOT FREQ
P310__

Rated motor frequency

MOT RPM
P311__

Rated motor speed

MOT COOL
P335__

Motor cooling:

- SELF: Natural cooling
- FORCED: Forced-air cooling
- LIQUID: Liquid cooling
- NO FAN: Without fan

TEC APPL
P501__

Select the basic setting for the motor control:

- VEC STD: Constant load; typical applications include conveyor drives
- PUMP FAN: Speed-dependent load; typical applications include pumps and fans

MAc PAr
P15__

Select the default setting for the interfaces of the inverter that is suitable for your application.



Default setting of the interfaces (Page 120)

MIN HZ
P1080__

MAX HZ
P1082__



CAUTION

Material damage caused by unexpected acceleration of the motor

Depending on the Power Module, the inverter sets the minimum frequency p1080 to 20% of the maximum frequency. Also for setpoint = 0, the motor accelerates for p1080 > 0 to the minimum frequency after switching on the motor. An unexpected acceleration of the motor can cause material damage.

- If the application requires a minimum frequency = 0, then set p1080 = 0.

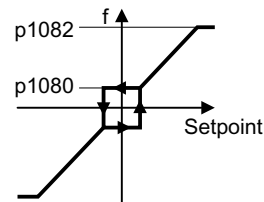


Figure 5-9 Minimum/maximum frequency of the motor

AI SCALE
P758__

Scaling of analog input 0

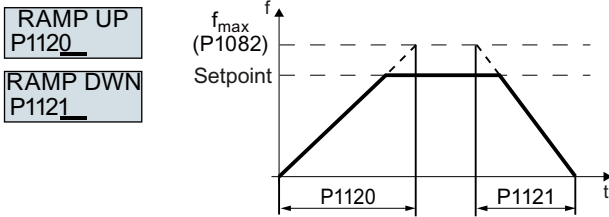


Figure 5-10 Ramp-up and ramp-down time of the motor

OFF3 RP
P1135

Ramp-down time after the OFF3 command

MOT ID
P1900

Motor data identification: Select the method which the inverter uses to measure the data of the connected motor:

- OFF: No motor data identification
- STIL ROT: Measure the motor data at standstill and with the motor rotating. The inverter switches off the motor after the motor data identification has been completed.
- STILL: Recommended setting: Measure the motor data at standstill. The inverter switches off the motor after the motor data identification has been completed. Select this setting if the motor cannot freely rotate, e.g. for a mechanically limited traversing range.
- ROT: Measure the motor data while the motor is rotating. The inverter switches off the motor after the motor data identification has been completed.
- ST RT OP: setting same as STIL ROT. The motor accelerates to the currently set setpoint after the motor data identification.
- STILL OP: setting same as STILL. The motor accelerates to the currently set setpoint after the motor data identification.

FINISH

Complete the basic commissioning:

Switchover the display using an arrow key: nO → YES

Press the OK key.

You have entered all of the data that is necessary for the quick commissioning of the inverter.

5.4.3.3 Dynamic Drive Control

EUR/USA
P100

Select the motor standard:

- KW 50HZ: IEC
- HP 60HZ: NEMA
- KW 60HZ: IEC 60 Hz

INV VOLT
P210

Set the inverter supply voltage.

MOT TYPE
P300

Select the motor type. If a 5-digit motor code is stamped on the motor rating plate, select the corresponding motor type with motor code.

Motors without motor code stamped on the rating plate:

- INDUCT: Third-party induction motor
- 1L... IND: 1LE1, 1LG6, 1LA7, 1LA9 induction motors

Motors with motor code stamped on the rating plate:

- 1LE1 IND 100: 1LE1 . 9
- 1PC1 IND: 1PC1
- 1PH8 IND: Induction motor
- 1FP1: Reluctance motor

Depending on the inverter, the motor list in BOP-2 can deviate from the list shown above.

MOT CODE
P301__

If you have selected a motor type with motor code, you must now enter the motor code. The inverter assigns the following motor data corresponding to the motor code.

If you do not know the motor code, then you must set the motor code = 0, and enter motor data from p0304 and higher from the rating plate.

87 HZ
__

87 Hz motor operation The BOP-2 only indicates this step if you selected IEC as the motor standard (EUR/USA, P100 = KW 50HZ).

MOT VOLT
P304__

Rated motor voltage

MOT CURR
P305__

Rated motor current

MOT POW
P307__

Rated motor power

MOT FREQ
P310__

Rated motor frequency

MOT RPM
P311__

Rated motor speed

MOT COOL
P335__

Motor cooling:

- SELF: Natural cooling
- FORCED: Forced-air cooling
- LIQUID: Liquid cooling
- NO FAN: Without fan

TEC APPL
P502__

Select the application:


- OP LOOP: Recommended setting for standard applications.
- CL LOOP: Recommended setting for applications with short ramp-up and ramp-down times.
- HVY LOAD: Recommended setting for applications with a high break loose torque.

The BOP-2 does not display this step for a PM330 Power Module.

5.4 Quick commissioning using the BOP-2 operator panel

MAc PAR
P15

Select the default setting for the interfaces of the inverter that is suitable for your application.

 Default setting of the interfaces (Page 120)

MIN HZ
P1080

MAX HZ
P1082

⚠ CAUTION

Material damage caused by unexpected acceleration of the motor

Depending on the Power Module, the inverter sets the minimum frequency p1080 to 20% of the maximum frequency. Also for setpoint = 0, the motor accelerates for p1080 > 0 to the minimum frequency after switching on the motor. An unexpected acceleration of the motor can cause material damage.

- If the application requires a minimum frequency = 0, then set p1080 = 0.

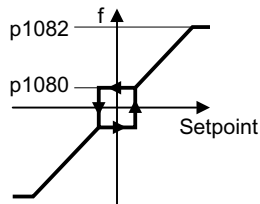


Figure 5-11 Minimum/maximum frequency of the motor

AI SCALE
P758

Scaling of analog input 0

RAMP UP
P1120

RAMP DWN
P1121

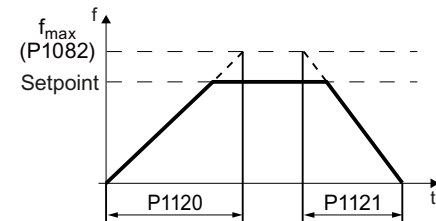


Figure 5-12 Ramp-up and ramp-down time of the motor

OFF3 RP
P1135

Ramp-down time for the OFF3 command

MOT ID
P1900

Motor data identification: Select the method which the inverter uses to measure the data of the connected motor:

- OFF: No motor data identification
- STIL ROT: Recommended setting: Measure the motor data at standstill and with the motor rotating. The inverter switches off the motor after the motor data identification has been completed.
- STILL: Default setting: Measure the motor data at standstill. The inverter switches off the motor after the motor data identification has been completed. Select this setting if the motor cannot freely rotate, e.g. for a mechanically limited traversing range.
- ROT: Measure the motor data while the motor is rotating. The inverter switches off the motor after the motor data identification has been completed.

- ST RT OP: setting same as STIL ROT.
The motor accelerates to the currently set setpoint after the motor data identification.
- STILL OP: setting same as STILL.
The motor accelerates to the currently set setpoint after the motor data identification.

FINISH

Complete the basic commissioning:

Switch over the display using an arrow key: nO → YES

Press the OK key.

You have entered all of the data that is necessary for the quick commissioning of the inverter.



5.4.3.4 Expert

EUR/USA
P100

Select the motor standard:

- KW / 50HZ: IEC
- HP / 60HZ: NEMA
- KW / 60HZ: IEC 60 Hz

LOAD TYP
P210

Specify the overload capability of the inverter:

- HIGH OVL: Load cycle with "High Overload"
- LOW OVL: Load cycle with "Low Overload"



Overload capability of the inverter (Page 444)

INV VOLT
P210

Set the supply voltage of the inverter.

MOT TYPE
P300

Select the motor type. If a 5-digit motor code is stamped on the motor rating plate, select the corresponding motor type with motor code.

Motors without motor code stamped on the rating plate:

- INDUCT: Third-party induction motor
- 1L... IND: 1LE1, 1LG6, 1LA7, 1LA9 induction motors

Motors with motor code stamped on the rating plate:

- 1LE1 IND 100: 1LE1 . 9
- 1PC1 IND: 1PC1
- 1PH8 IND: Induction motor
- 1FP1: Reluctance motor

Depending on the inverter, the motor list in BOP-2 can deviate from the list shown above.

MOT CODE
P301

If you have selected a motor type with motor code, you must now enter the motor code. The inverter assigns the following motor data corresponding to the motor code.

If you do not know the motor code, then you must set the motor code = 0, and enter motor data from p0304 and higher from the rating plate.

5.4 Quick commissioning using the BOP-2 operator panel

87 HZ
—

87 Hz motor operation The BOP-2 only indicates this step if you selected IEC as the motor standard (EUR/USA, P100 = KW 50HZ).

MOT VOLT
P304 —

Rated motor voltage

MOT CURR
P305 —

Rated motor current

MOT POW
P307 —

Rated motor power

MOT FREQ
P310 —

Rated motor frequency

MOT RPM
P311 —

Rated motor speed

MOT COOL
P335 —

Motor cooling:

- SELF: Natural cooling
- FORCED: Forced-air cooling
- LIQUID: Liquid cooling
- NO FAN: Without fan

TEC APPL
P500 —

Select the appropriate application:

- VEC STD: In all applications, which do not fit the other setting options.
- PUMP FAN: Applications involving pumps and fans
- SLVC 0HZ: Applications with short ramp-up and ramp-down times. However, this setting is not suitable for hoisting gear and cranes/lifting gear.
- PUMP 0HZ: Applications involving pumps and fans with optimized efficiency. The setting only makes sense for steady-state operation with slow speed changes. We recommend setting VEC STD if load surges in operation cannot be ruled out.
- V LOAD: Applications with high breakaway torques, e.g. extruders, compressors and mills

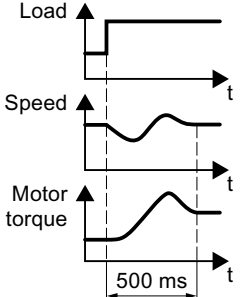
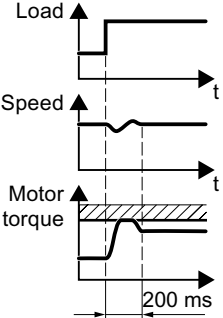
The selection option depends on the Power Module being used. There is no selection option for PM230 Power Modules.

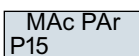
CTRL MOD
P1300 —

Select the control mode:

- VF LIN: U/f control with linear characteristic
- VF LIN F: Flux current control (FCC)
- VF QUAD: U/f control with square-law characteristic
- SPD N EN: Encoderless vector control

Select a suitable control mode

Control mode	U/f control with linear or square-law characteristic Flux current control (FCC)	Encoderless vector control
Closed-loop control characteristics	<ul style="list-style-type: none"> • Typical settling time after a speed change: 100 ms ... 200 ms • Typical settling time after a load surge: 500 ms  <ul style="list-style-type: none"> • The control mode is suitable to address the following requirements: <ul style="list-style-type: none"> – Motor power ratings < 45 kW – Ramp-up time 0 → rated speed (depending on the motor power rating): 1 s (0.1 kW) ... 10 s (45 kW) – Applications with increasing load torque without load surges • The control mode is insensitive with respect to imprecise setting of the motor data 	<ul style="list-style-type: none"> • Typical settling time after a speed change: < 100 ms • Typical settling time after a load surge: 200 ms  <ul style="list-style-type: none"> • The vector control controls and limits the motor torque • Torque accuracy that can be achieved: $\pm 5\%$ for 15 % ... 100 % of the rated speed • We recommend vector control for the following applications: <ul style="list-style-type: none"> – Motor power ratings > 11 kW – For load surges 10 % ... >100 % of the rated motor torque • The vector control is necessary for a ramp-up time 0 → Rated speed (dependent on the rated motor power): < 1 s (0.1 kW) ... < 10 s (250 kW).
Application examples	<ul style="list-style-type: none"> • Pumps, fans, and compressors with flow characteristic 	<ul style="list-style-type: none"> • Pumps and compressors with displacement machines
Motors that can be operated	Induction motors	Induction, synchronous and reluctance motors
Power Modules that can be operated	No restrictions	
Max. output frequency	550 Hz	240 Hz 150 Hz with PM330 Power Module
Commissioning	<ul style="list-style-type: none"> • Contrary to vector control, no speed controller has to be set 	



Select the default setting for the interfaces of the inverter that is suitable for your application.



Default setting of the interfaces (Page 120)

5.4 Quick commissioning using the BOP-2 operator panel

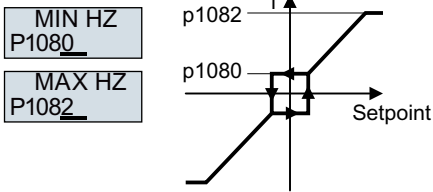


Figure 5-13 Minimum and maximum motor frequency

CAUTION

Material damage caused by unexpected acceleration of the motor

Depending on the Power Module, the inverter sets the minimum frequency p1080 to 20% of the maximum frequency. Also for setpoint = 0, the motor accelerates for p1080 > 0 to the minimum frequency after switching on the motor. An unexpected acceleration of the motor can cause material damage.

- If the application requires a minimum frequency = 0, then set p1080 = 0.

AI SCALE
P758

Scaling of analog input 0

RAMP UP
P1120

RAMP DWN
P1121

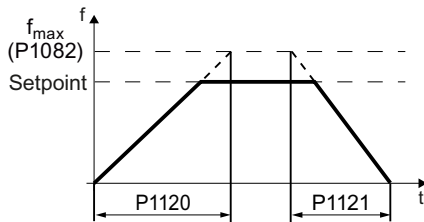


Figure 5-14 Ramp-up and ramp-down time of the motor

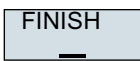
OFF3 RP
P1135

Ramp-down time for the OFF3 command

MOT ID
P1900

Motor data identification: Select the method which the inverter uses to measure the data of the connected motor:

- OFF: Motor data is not measured.
- STIL ROT: Recommended setting: Measure the motor data at standstill and with the motor rotating. The inverter switches off the motor after the motor data identification has been completed.
- STILL: Measure the motor data at standstill. The inverter switches off the motor after the motor data identification has been completed.
Select this setting if one of the following cases is applicable:
 - You have selected control mode "SPD N EN", however, the motor cannot freely rotate - for a mechanically limited travel range, for example.
 - You have selected U/f control as control mode, e.g. "VF LIN" or "VF QUAD".
- ROT: Measure the motor data while the motor is rotating. The inverter switches off the motor after the motor data identification has been completed.



Complete quick commissioning:

Switchover the display using an arrow key: nO → YES

Press the OK key.

You have entered all of the data that is necessary for the quick commissioning of the inverter.



5.4.4 Identifying the motor data and optimizing the closed-loop control

Overview

Using the motor data identification, the inverter measures the data of the stationary motor. In addition, based on the response of the rotating motor, the inverter can determine a suitable setting for the vector control.

To start the motor data identification routine, you must switch-on the motor via the terminal strip, fieldbus or from the operator panel.

Identifying the motor data and optimizing the closed-loop control

Preconditions

- You have selected a method of motor data identification during quick commissioning, e.g. measuring motor data while the motor is stationary.
When quick commissioning is complete, the inverter issues alarm A07991.
- The motor has cooled down to the ambient temperature.
An excessively high motor temperature falsifies the motor data identification results.



WARNING

Unexpected machine motion while the motor data identification is in progress

For the stationary measurement, the motor can make several rotations. The rotating measurement accelerates the motor up to the rated speed. Secure dangerous machine parts before starting motor data identification:

- Before switching on, ensure that nobody is working on the machine or located within its working area.
- Secure the machine's work area against unintended access.
- Lower suspended loads to the floor.

Procedure



Press the HAND/AUTO key.



The BOP-2 displays the symbol indicating manual operation.



Switch on the motor.



During motor data identification, "MOT-ID" flashes on the BOP-2.



If the inverter again outputs alarm A07991, then it waits for a new ON command to start the rotating measurement.

If the inverter does not output alarm A07991, switch off the motor as described below, and switch over the inverter control from HAND to AUTO.



Switch on the motor to start the rotating measurement.



During motor data identification, "MOT-ID" flashes on the BOP-2.

The motor data identification can take up to 2 minutes depending on the rated motor power.



Depending on the setting, after motor data identification has been completed, the inverter switches off the motor - or it accelerates it to the setpoint.

If required, switch off the motor.



Switch the inverter control from HAND to AUTO.

You have completed the motor data identification.



Quick commissioning has been completed once the motor data identification has been successfully completed.

5.5 Quick commissioning with a PC

The screen forms that are shown in this manual show generally valid examples. The number of setting options available in screen forms depends on the particular inverter type.

Overview

To be able to perform quick commissioning using a PC, you need to do the following:

1. Creating a project
2. Integrating the inverter into the project
3. Go online and start the quick commissioning

5.5.1 Creating a project

Creating a new project

Procedure

1. Start the Startdrive commissioning software.
2. In the menu, select "Project" → "New...".
3. Specify a name of your choice for the project.

You have created a new project.

□

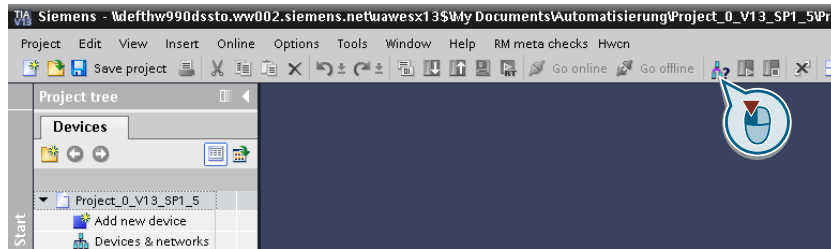
5.5.2 Transfer inverters connected via USB into the project

Integrating the inverter into the project

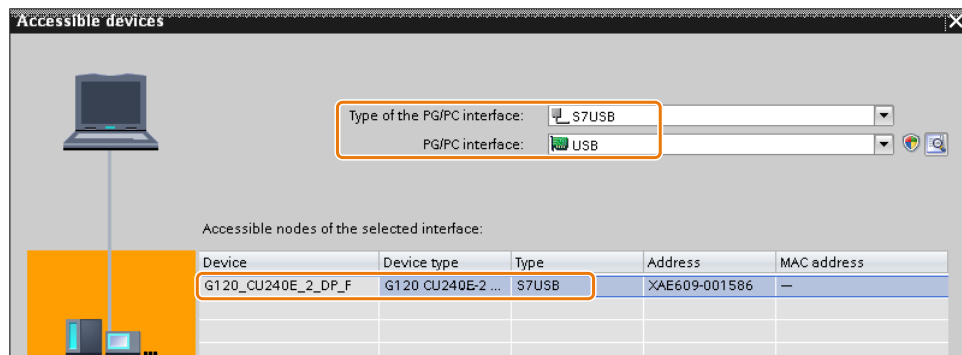
Procedure

1. Switch on the inverter power supply.
2. First insert a USB cable into your PC and then into the inverter.
3. The PC operating system installs the USB driver when you are connecting the inverter and PC together for the first time.

4. Press the "Accessible nodes" button.



5. When the USB interface is appropriately set, then the "Accessible nodes" screen form shows the inverters that can be accessed.



If you have not correctly set the USB interface, then the following "No additional nodes found" message is displayed. In this case, follow the description below.

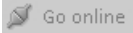
6. Transfer the inverter into the project using the menu: "Online - Upload device as new station (hardware and software)".

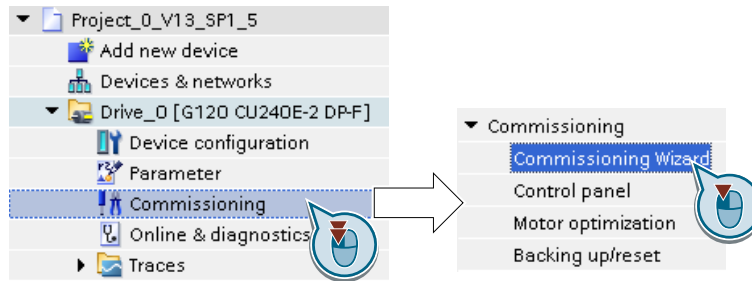
You have transferred an inverter accessible via the USB interface into your project.



5.5.3 Go online and start the commissioning Wizard

Procedure

1. Select your project and go online: 
2. In the following screen form, select the inverter with which you wish to go online.
3. Once you are online, select "Commissioning" → "Commissioning Wizard":



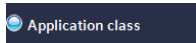
You have started the commissioning Wizard of the inverter.






5.5.4 Commissioning wizard

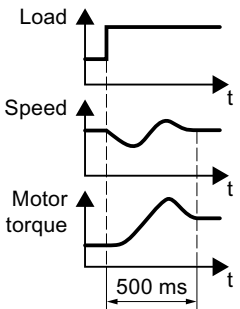
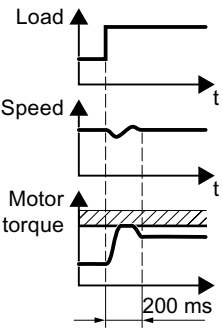
Select the application class

Procedure



When selecting an application class, the inverter assigns the motor control with the appropriate default settings:

- [1]  Standard Drive Control (Page 184)
- [2]  Dynamic Drive Control (Page 186)
- [0] Expert - or if no application class is listed:
 Expert (Page 188)

Application class	Standard Drive Control	Dynamic Drive Control	
Properties	<ul style="list-style-type: none"> • Typical settling time after a speed change: 100 ms ... 200 ms • Typical settling time after a load surge: 500 ms  <ul style="list-style-type: none"> • "Standard Drive Control" is suitable to address the following requirements: <ul style="list-style-type: none"> – Motor power ratings < 45 kW – Ramp-up time 0 → rated speed (depending on the motor power rating): 1 s (0.1 kW) ... 10 s (45 kW) – Applications with increasing load torque without load surges • "Standard Drive Control" is insensitive with respect to imprecise setting of the motor data 	<ul style="list-style-type: none"> • Typical settling time after a speed change: < 100 ms • Typical settling time after a load surge: 200 ms  <ul style="list-style-type: none"> • "Dynamic Drive Control" controls and limits the motor torque • Torque accuracy that can be achieved: $\pm 5\%$ for 15 % ... 100 % of the rated speed • We recommend "Dynamic Drive Control" for the following applications: <ul style="list-style-type: none"> – Motor power ratings > 11 kW – For load surges 10 % ... >100 % of the rated motor torque • "Dynamic Drive Control" is necessary for a ramp-up time 0 → rated speed (dependent on the rated motor power): < 1 s (0.1 kW) ... < 10 s (132 kW). 	
Application examples	<ul style="list-style-type: none"> • Pumps, fans, and compressors with flow characteristic 	<ul style="list-style-type: none"> • Pumps and compressors with displacement machines 	
Power Modules that can be operated	PM240-2, PM240P-2	PM240-2, PM240P-2	PM330
Max. output frequency	550 Hz	240 Hz	150 Hz
Motors that can be operated	Induction motors	Induction, synchronous and reluctance motors	
Commissioning	<ul style="list-style-type: none"> • Unlike "Dynamic Drive Control," no speed controller needs to be set • When compared to "Expert": <ul style="list-style-type: none"> – Simplified commissioning using predefined motor data – Reduced number of parameters • "Standard Drive Control" is preset for Power Modules, frame size A ... frame size C 	<ul style="list-style-type: none"> • Reduced amount of parameters when compared to "Expert" • "Dynamic Drive Control" is preset for Power Modules frame size D ... frame size JX 	

5.5.5 Standard Drive Control

Procedure for application class [1]: Standard Drive Control

Setpoint specification


Select whether the inverter is connected to a higher-level control via the fieldbus.

Select whether the ramp-function generator for the speed setpoint is implemented in the higher-level control or in the inverter.

Defaults of the setpoi...

Select the I/O configuration to preassign the inverter interfaces.

 Factory interface settings (Page 118)

 Default setting of the interfaces (Page 120)

Drive setting

Set the applicable motor standard and the inverter supply voltage.

Drive options

If an optional component is installed between inverter and motor, the corresponding setting must be performed.

If a braking resistor is installed, you set the maximum braking power to which the braking resistor will be subjected.

Motor

Select your motor.


Enter the motor data according to the rating plate of your motor.

If you have selected a motor based on its article number, the data has already been entered.

Select the temperature sensor for monitoring of the motor temperature.

Important parameters

Set the most important parameters to suit your application.

 CAUTION
<p>Material damage caused by unexpected acceleration of the motor</p> <p>Depending on the Power Module, the inverter sets the minimum frequency p1080 to 20% of the maximum frequency. Also for setpoint = 0, the motor accelerates for p1080 > 0 to the minimum frequency after switching on the motor. An unexpected acceleration of the motor can cause material damage.</p> <ul style="list-style-type: none"> • If the application requires a minimum frequency = 0, then set p1080 = 0.

Drive functions

Select the application:

- [0] Constant load: Typical applications include conveyor drives
- [1] Speed-dependent load: Typical applications include pumps and fans

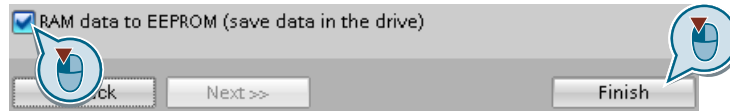
Motor data identification (not all the following settings may be visible in Startdrive):

- [0]: No motor data identification
- [2]: Recommended setting. Measure the motor data at standstill. The inverter switches off the motor after the motor data identification has been completed.
Select this setting if the motor cannot freely rotate, e.g. for a mechanically limited traversing range.
- [12]: The same setting as [2]. The motor accelerates to the currently set setpoint after the motor data identification.

Summary

Set the check mark for "RAM data to EEPROM (save data in the drive)" to save your data in the inverter so that it is not lost if the power fails.

Press the "Finish" button.



You have entered all of the data that is necessary for the quick commissioning of the inverter.



5.5.6 Dynamic Drive Control

Procedure for application class [2]: Dynamic Drive Control

Setpoint specification


Select whether the inverter is connected to a higher-level control via the fieldbus.

Select whether the ramp-function generator for the speed setpoint is implemented in the higher-level control or in the inverter.

Defaults of the setpoi...

Select the I/O configuration to preassign the inverter interfaces.

 Factory interface settings (Page 118)

 Default setting of the interfaces (Page 120)

Drive setting

Set the applicable motor standard and the inverter supply voltage.

Drive options

If an optional component is installed between inverter and motor, the corresponding setting must be performed.

If a braking resistor is installed, you set the maximum braking power to which the braking resistor will be subjected.

Motor

Select your motor.

Enter the motor data according to the rating plate of your motor.

If you have selected a motor based on its article number, the data has already been entered.

Select the temperature sensor for monitoring of the motor temperature.

Important parameters

Set the most important parameters to suit your application.

 **CAUTION**

Material damage caused by unexpected acceleration of the motor

Depending on the Power Module, the inverter sets the minimum frequency p1080 to 20% of the maximum frequency. Also for setpoint = 0, the motor accelerates for p1080 > 0 to the minimum frequency after switching on the motor. An unexpected acceleration of the motor can cause material damage.

- If the application requires a minimum frequency = 0, then set p1080 = 0.

Drive functions

Application:

- [0]: Recommended setting for standard applications.
- [1]: Recommended setting for applications with ramp-up and ramp-down times < 10 s. This setting is not suitable for hoisting gear and cranes.
- [5] Recommended setting for applications with a high break loose torque.

Motor data identification:

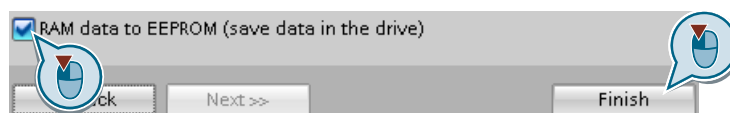
- [0]: No motor data identification
- [1]: Recommended setting. Measure the motor data at standstill and with the motor rotating. The inverter switches off the motor after the motor data identification has been completed.

- [2]: Measure the motor data at standstill. The inverter switches off the motor after the motor data identification has been completed.
Select this setting if the motor cannot freely rotate, e.g. for a mechanically limited traversing range.
- [3]: Measure the motor data while the motor is rotating. The inverter switches off the motor after the motor data identification has been completed.
- [11]: The same setting as [1]. The motor accelerates to the currently set setpoint after the motor data identification.
- [12]: The same setting as [2]. The motor accelerates to the currently set setpoint after the motor data identification.

Summary

Set the check mark for "RAM data to EEPROM (save data in the drive)" to save your data in the inverter so that it is not lost if the power fails.

Press the "Finish" button.



You have entered all of the data that is necessary for the quick commissioning of the inverter.



5.5.7 Expert

Procedure without application class or for the application class [0]: Expert

- Setpoint specification

Select whether the inverter is connected to a higher-level control via the fieldbus.

Select whether the ramp-function generator for the speed setpoint is implemented in the higher-level control or in the inverter.
- Open-loop/closed-loop ...

Select the control mode.

Additional information can be obtained at the end of the section.
- Defaults of the setpoi...

Select the I/O configuration to preassign the inverter interfaces.

Factory interface settings (Page 118)

Default setting of the interfaces (Page 120)
- Drive setting

Set the applicable motor standard and the inverter supply voltage.

Application:

 - "[0] Load cycle with high overload for applications requiring a high dynamic performance, e.g. conveyor systems.
 - "[1] Load cycle with low overload ..." for applications that do not require a high dynamic performance, e.g. pumps or fans.
 - [6], [7]: Load cycles for applications with encoderless 1FK7 synchronous motors. The respective power module being used determines whether or not the selection is displayed by the commissioning wizard.
- Drive options

If an optional component is installed between inverter and motor, the corresponding setting must be performed.

If a braking resistor is installed, you set the maximum braking power to which the braking resistor will be subjected.
- Motor

Select your motor.

Enter the motor data according to the rating plate of your motor.

If you have selected a motor based on its article number, the data has already been entered.

Select the temperature sensor for monitoring of the motor temperature.
- Important parameters

Set the most important parameters to suit your application.

CAUTION

Material damage caused by unexpected acceleration of the motor

Depending on the Power Module, the inverter sets the minimum frequency p1080 to 20% of the maximum frequency. Also for setpoint = 0, the motor accelerates for p1080 > 0 to the minimum frequency after switching on the motor. An unexpected acceleration of the motor can cause material damage.

- If the application requires a minimum frequency = 0, then set p1080 = 0.

Drive functions

Application:

- [0]: In all applications that do not fall under [1] ... [3]
- [1]: Applications involving pumps and fans
- [2]: Applications with short ramp-up and ramp-down times. However, this setting is not suitable for hoisting gear and cranes/lifting gear.
- [3]: Setting only for steady-state operation with slow speed changes. We recommend setting [1] if load surges in operation cannot be ruled out.

Motor identification:

- [1]: Recommended setting. Measure the motor data at standstill and with the motor rotating. The inverter switches off the motor after the motor data identification has been completed.
- [2]: Measure the motor data at standstill. The inverter switches off the motor after the motor data identification has been completed.

Recommended setting for the following cases:

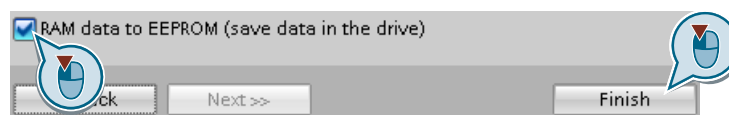
- You have selected "Speed control" as control mode, however the motor cannot freely rotate, e.g. for mechanically limited traversing sections.
- You have set "V/f control" as control mode.
- [3]: Measure the motor data while the motor is rotating. The inverter switches off the motor after the motor data identification has been completed.
- [11]: The same setting as [1]. The motor accelerates to the currently set setpoint after the motor data identification.
- [12]: The same setting as [2]. The motor accelerates to the currently set setpoint after the motor data identification.

Calculating the motor parameters: Select "Complete calculation".

Summary

Set the check mark for "RAM data to EEPROM (save data in the drive)" to save your data in the inverter so that it is not lost if the power fails.

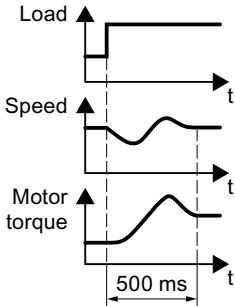
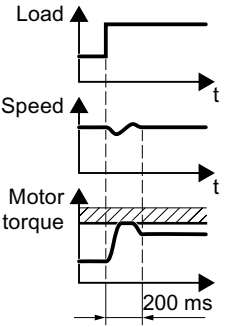
Press the "Finish" button.



You have entered all of the data that is necessary for the quick commissioning of the inverter.

□

Select a suitable control mode

Control mode	U/f control with linear or square-law characteristic Flux current control (FCC)	Encoderless vector control
<p>Closed-loop control characteristics</p>	<ul style="list-style-type: none"> • Typical settling time after a speed change: 100 ms ... 200 ms • Typical settling time after a load surge: 500 ms  <ul style="list-style-type: none"> • The control mode is suitable to address the following requirements: <ul style="list-style-type: none"> – Motor power ratings < 45 kW – Ramp-up time 0 → rated speed (depending on the motor power rating): 1 s (0.1 kW) ... 10 s (45 kW) – Applications with increasing load torque without load surges • The control mode is insensitive with respect to imprecise setting of the motor data 	<ul style="list-style-type: none"> • Typical settling time after a speed change: < 100 ms • Typical settling time after a load surge: 200 ms  <ul style="list-style-type: none"> • The vector control controls and limits the motor torque • Torque accuracy that can be achieved: ± 5% for 15 % ... 100 % of the rated speed • We recommend vector control for the following applications: <ul style="list-style-type: none"> – Motor power ratings > 11 kW – For load surges 10 % ... >100 % of the rated motor torque • The vector control is necessary for a ramp-up time 0 → Rated speed (dependent on the rated motor power): < 1 s (0.1 kW) ... < 10 s (250 kW).
<p>Application examples</p>	<ul style="list-style-type: none"> • Pumps, fans, and compressors with flow characteristic 	<ul style="list-style-type: none"> • Pumps and compressors with displacement machines
<p>Motors that can be operated</p>	<p>Induction motors</p>	<p>Induction, synchronous and reluctance motors</p>
<p>Power Modules that can be operated</p>	<p>No restrictions</p>	
<p>Max. output frequency</p>	<p>550 Hz</p>	<p>240 Hz 150 Hz with PM330 Power Module</p>
<p>Commissioning</p>	<ul style="list-style-type: none"> • Contrary to vector control, no speed controller has to be set 	

5.5.8 Identify motor data

Overview

Using the motor data identification, the inverter measures the data of the stationary motor. In addition, based on the response of the rotating motor, the inverter can determine a suitable setting for the vector control.

To start the motor data identification routine, you must switch on the motor.

Identifying the motor data and optimizing the closed-loop control

Preconditions

- You have selected a method of motor data identification during quick commissioning, e.g. measurement of the motor data while the motor is stationary.
When quick commissioning is complete, the inverter issues alarm A07991.
- The motor has cooled down to the ambient temperature.
An excessively high motor temperature falsifies the motor data identification results.
- The PC and inverter are connected to each other online.

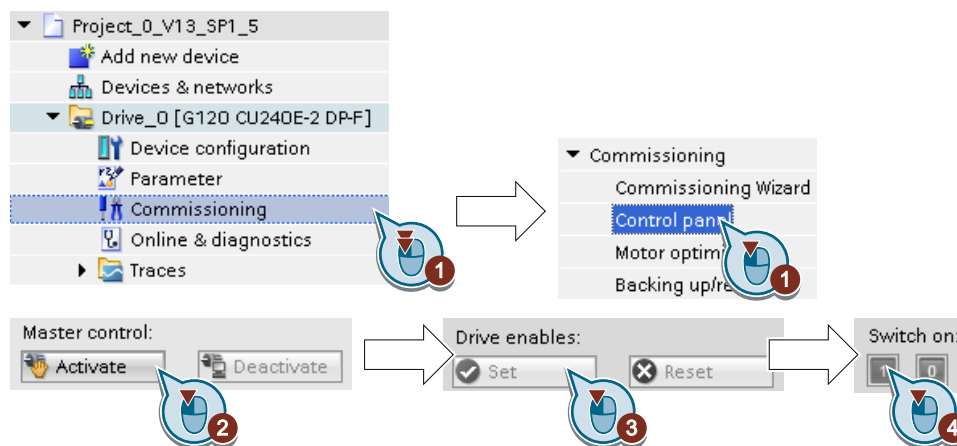
⚠ WARNING

Unexpected machine motion while the motor data identification is in progress

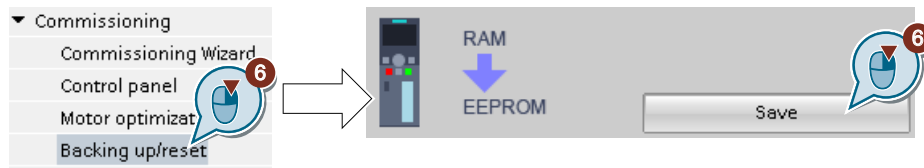
For the stationary measurement, the motor can make several rotations. The rotating measurement accelerates the motor up to the rated speed. Secure dangerous machine parts before starting motor data identification:

- Before switching on, ensure that nobody is working on the machine or located within its working area.
- Secure the machine's work area against unintended access.
- Lower suspended loads to the floor.

Procedure



1. Open the control panel.
2. Assume master control for the inverter.
3. Set the "Drive enables"
4. Switch on the motor.
The inverter starts the motor data identification. This measurement can take several minutes.
Depending on the setting, after motor data identification has been completed, the inverter switches off the motor - or it accelerates it to the currently set setpoint.
5. If required, switch off the motor.
6. Relinquish the master control after the motor data identification.
7. Save the settings in the inverter (RAM → EEPROM):



You have completed the motor data identification.
□

Self-optimization of the speed control

If you have not only selected motor data identification with the motor stationary, but also rotating measurement with self-optimization of the speed control, you must switch on the motor again as described above and wait for the optimization run to finish.

Quick commissioning has been completed once the motor data identification has been successfully completed.

5.6 Restoring the factory setting

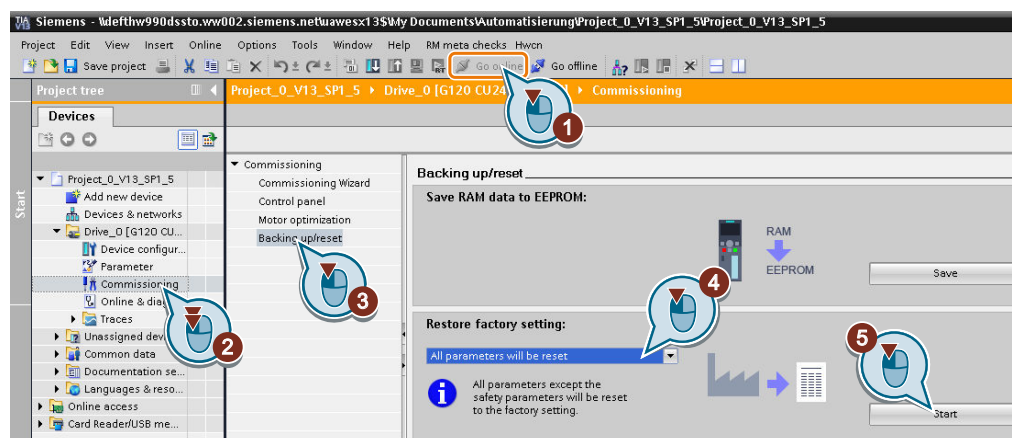
Why restore the factory setting?

Reset the inverter to the factory settings in the following cases:

- You do not know the inverter settings.
- The line voltage was interrupted during commissioning and you were not able to complete commissioning.

Restore the factory inverter settings

Procedure with Startdrive



1. Go online.
2. Select "Commissioning".
3. Select "Backing up/reset".
4. Select "All parameters are reset".
5. Press the "Start" button.
6. Wait until the inverter has been reset to the factory setting.

You have reset the inverter to the factory settings.



Procedure with the BOP-2 operator panel

1. In the "Options" menu, select the "DRVRESET" entry
2. Confirm the reset using the OK key.
3. Wait until the inverter has been reset to the factory setting.

You have reset the inverter to the factory settings.



Advanced commissioning

6.1 Overview of the inverter functions

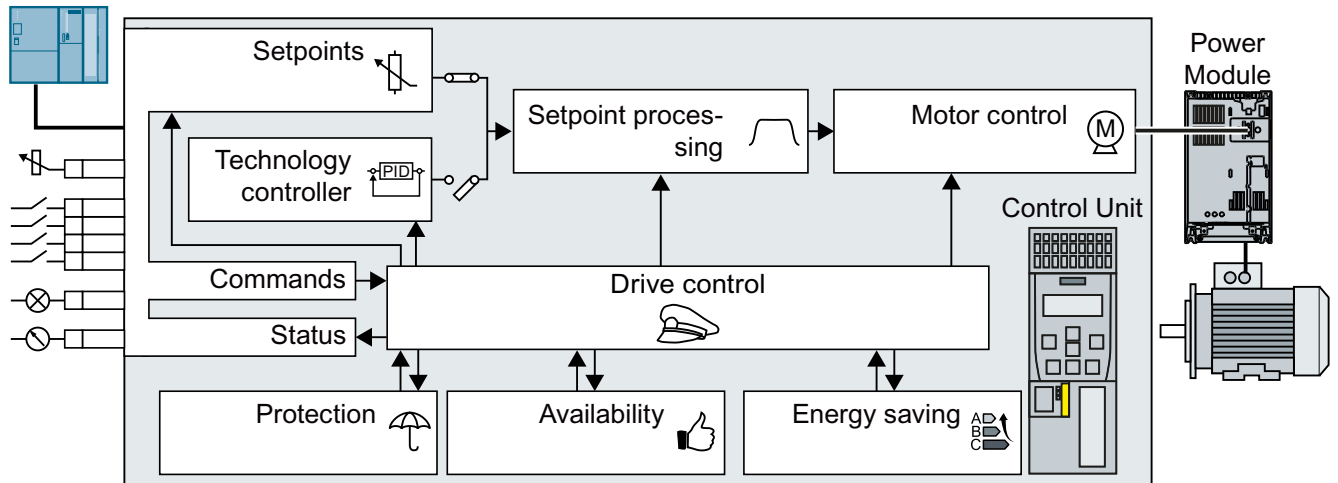












Figure 6-1 Overview of inverter functions

Drive control




The inverter receives its commands from the higher-level control via the terminal strip or the fieldbus interface of the Control Unit. The drive control defines how the inverter responds to the commands.

-  Sequence control when switching the motor on and off (Page 199)
-  Adapt the default setting of the terminal strip (Page 202)
-  Controlling clockwise and counter-clockwise rotation via digital inputs (Page 216)
-  Drive control via PROFIBUS or PROFINET (Page 223)
-  Drive control via USS (Page 239)
-  Drive control via Modbus RTU (Page 242)
-  Drive control via Ethernet/IP (Page 245)
-  Drive control via BACnet MS/TP (Page 246)
-  Drive control via P1 (Page 249)
-  Jogging (Page 250)


The inverter can switch between different settings of the drive control.

-  Switching over the drive control (command data set) (Page 252)

The free function blocks permit configurable signal processing within the inverter.

-  Free function blocks (Page 254)

You can select in which physical units the inverter represents its associated values.

 Physical units (Page 255)

Setpoints and setpoint conditioning




The setpoint generally determines the motor speed.

 Setpoints (Page 259)




The setpoint processing uses a ramp-function generator to prevent speed steps occurring and to limit the speed to a permissible maximum value.

 Setpoint calculation (Page 270)


Technology controller




The technology controller controls process variables, e.g. pressure, temperature, level or flow. The motor closed-loop control either receives its setpoint from the higher-level control - or from the technology controller.

 PID technology controller (Page 278)


The inverter has three additional technology controllers that operate independently of each other.

 Free technology controllers (Page 289)

The multi-zone control offers various procedures to process multiple setpoints or actual values with only one technology controller.


 Multi-zone control (Page 291)

The cascade control is ideal for applications in which, for example, significantly fluctuating pressures or flow rates are equalized.

 Cascade control (Page 295)

The "time switch", together with the real-time clock, offers the option of controlling when signals are switched on and off.

 Real time clock (RTC) (Page 300)

 Time switch (DTC) (Page 302)

Motor control



The motor closed-loop control ensures that the motor follows the speed setpoint. You can choose between various control modes.

 Motor control (Page 303)






The inverter has various methods to electrically brake the motor. When electrically braking, the motor develops a torque, which reduces the speed down to standstill.

 Electrically braking the motor (Page 318)


Protection of the drive and the driven load



The protection functions prevent damage to the motor, inverter and driven load.

-  Overcurrent protection (Page 328)
-  Inverter protection using temperature monitoring (Page 329)
-  Motor protection with temperature sensor (Page 332)
-  Motor protection by calculating the temperature (Page 335)
-  Motor and inverter protection by limiting the voltage (Page 338)


The monitoring of the driven load prevents impermissible operating modes, e.g. dry-running of a pump.

-  Monitoring the driven load (Page 340)


Increasing the drive availability



The kinetic buffering converts the kinetic energy of the load into electrical energy to buffer short-term power failures.

-  Flying restart – switching on while the motor is running (Page 347)

The "Flying restart" function permits the fault-free switching on of the motor while it is still turning.

-  Automatic restart (Page 349)

For active automatic restart, after a power failure, the inverter attempts to automatically restart the motor and to acknowledge any faults that occur.

-  Kinetic buffering (V_{dc} min control) (Page 353)


In an emergency, the inverter deactivates its protection functions in order to maintain drive operation as long as possible.

-  Essential service mode (Page 355)

Energy saving




For standard induction motors, the efficiency optimization reduces the motor losses in the partial load range.

-  Efficiency optimization (Page 359)


The "Bypass" function switches the motor between inverter and line operation.

-  Bypass (Page 362)

If the plant/system conditions permit, the inverter switches off the motor temporarily.

-  Hibernation mode (Page 368)

If necessary, the main contactor control disconnects the inverter from the power system and so reduces the inverter losses.

-  Line contactor control (Page 373)

The inverter calculates how much energy controlled inverter operation saves when compared to mechanical flow control (e.g. throttle).



Calculating the energy saving for fluid flow machines (Page 375)

6.2 Sequence control when switching the motor on and off

Overview



The sequence control defines the rules for switching the motor on and off.

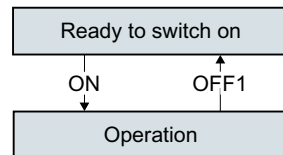


Figure 6-2 Simplified representation of the sequence control

After switching the supply voltage on, the inverter normally goes into the "ready to start" state. In this state, the inverter waits for the command to switch on the motor.

The inverter switches on the motor with the ON command. The inverter changes to the "Operation" state.

After the OFF1 command, the inverter brakes the motor down to standstill. The inverter switches off the motor once standstill has been reached. The inverter is again "ready to start".

Requirement

Functions

In order to be able to respond to external commands, you must set the command interface so that it fits your specific application.

Tools

To change the function settings, you can use an operator panel or a PC tool, for example.

Function description

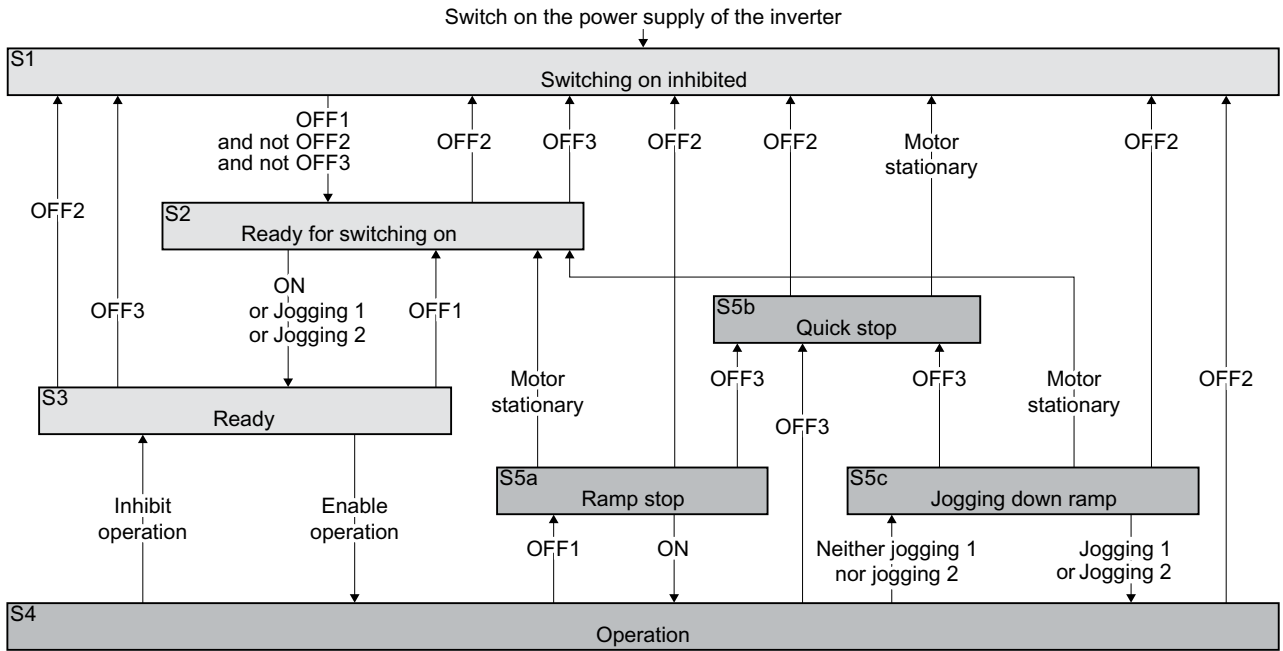


Figure 6-3 Sequence control of the inverter when the motor is switched on and off

Inverter states S1 ... S5c are defined in the PROFIdrive profile. The sequence control defines the transition from one state to another.

Table 6-1 Inverter states

The motor is switched off		The motor is switched on	
Current does not flow in the motor and the motor does not generate any torque		Current flows in the motor and the motor generates a torque	
S1	The inverter waits for a new ON command. The ON command is currently active. You must activate the ON command again in order that the inverter exits the state.	S4	The motor is switched on.
S2	The inverter waits for a new command to switch on the motor.	S5a, S5c	The motor is still switched on. The inverter brakes the motor with the ramp-down time of the ramp-function generator.
S3	The inverter waits for "Enable operation". The "Enable operation" command is always active in the inverter factory setting.	S5b	The motor is still switched on. The inverter brakes the motor with the OFF3 ramp-down time.

Table 6-2 Commands for switching the motor on and off

ON Jogging 1 Jogging 2 Enable operation	The inverter switches the motor on.
OFF1, OFF3	The inverter brakes the motor. The inverter switches off the motor once it comes to a standstill. The motor is considered to be stationary if the speed is less than a defined minimum speed.
OFF2 Inhibit operation	The inverter switches off the motor immediately without first braking it.

Parameter

Parameter	Description	Setting	
p1226	Standstill detection, speed threshold [rpm]	Factory setting: 20.00 rpm	The inverter identifies that the motor is at a standstill after OFF1 or OFF3 when at least one of the following conditions has been satisfied: <ul style="list-style-type: none"> • The speed actual value falls below the threshold in p1226 and the time started in p1228 has expired. • The speed setpoint falls below the threshold in p1226, and the time subsequently started in p1227 has expired.
p1227	Standstill detection monitoring time [s]	Factory setting: 300.00 s	
p1228	Pulse cancellation delay time [s]	Factory setting: 0.01 s	

Further information

You will find additional information in function diagram 2610 of the List Manual.

6.3 Adapt the default setting of the terminal strip



In the inverter, the input and output signals are interconnected with specific inverter functions using special parameters. The following parameters are available to interconnect signals:

- Binectors BI and BO are parameters to interconnect binary signals.
- Connectors CI and CO are parameters to interconnect analog signals.

This chapter describes how you adapt the function of individual inverter inputs and outputs using binectors and connectors.

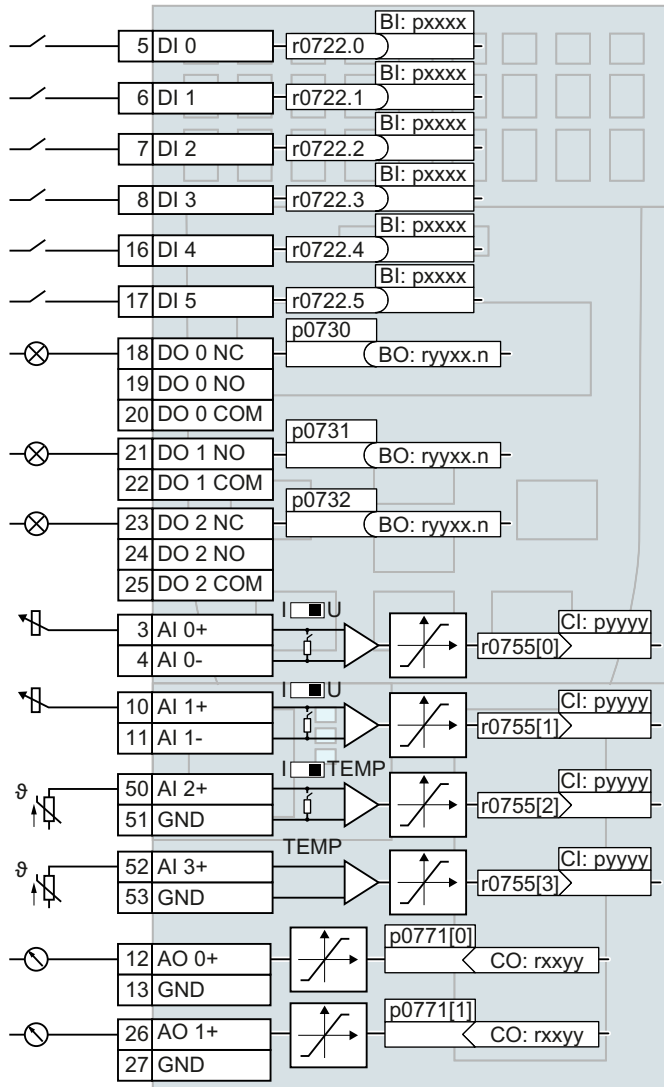


Figure 6-4 Internal interconnection of the inputs and outputs on the Control Unit

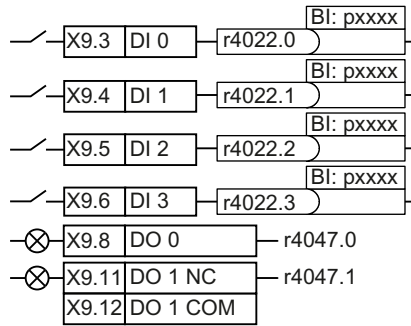
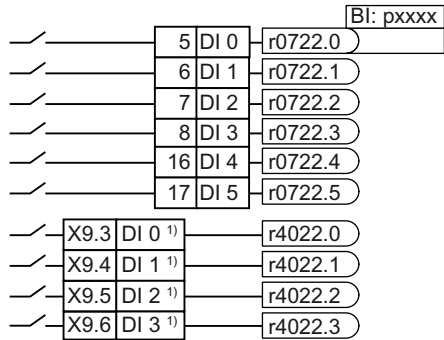


Figure 6-5 Internal interconnection of the inputs and outputs on the PM330 Power Module

When using the PM330 Power Module, in addition to the terminals on the Control Unit, the inverter has 4 digital inputs DI and 2 digital outputs DO on the Power Module.


6.3.1 Digital inputs

Changing the function of a digital input



To change the function of a digital input, you must interconnect the status parameter of the digital input with a binector input of your choice.

Binector inputs are marked with "BI" in the parameter list of the List Manual.


 Interconnecting signals in the converter (Page 534)

¹⁾When using the PM330 Power Module, the inverter has 4 additional digital inputs.

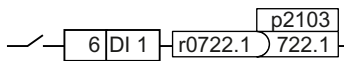
Table 6-3 Binector inputs (BI) of the inverter (selection)

BI	Meaning	BI	Meaning
p0810	Command data set selection CDS bit 0	p1055	Jog bit 0
p0840	ON/OFF1	p1056	Jog bit 1
p0844	OFF2	p1113	Setpoint inversion
p0848	OFF3	p1201	Flying restart enable signal source
p0852	Enable operation	p2103	1. Acknowledge faults
p1020	Fixed speed setpoint selection bit 0	p2106	External fault 1
p1021	Fixed speed setpoint selection bit 1	p2112	External alarm 1
p1022	Fixed speed setpoint selection bit 2	p2200	Technology controller enable
p1023	Fixed speed setpoint selection bit 3	p3330	Two/three-wire control, control command 1
p1035	Motorized potentiometer setpoint higher	p3331	Two/three-wire control, control command 2
p1036	Motorized potentiometer setpoint lower	p3332	Two/three-wire control, control command 3

A complete list of the binector outputs is provided in the List Manual.

 Overview of the manuals (Page 538)

Application example: Changing the function of a digital input




To acknowledge inverter fault messages, using digital input DI 1 you must interconnect DI 1 with the command to acknowledge faults (p2103).

Set p2103 = 722.1.

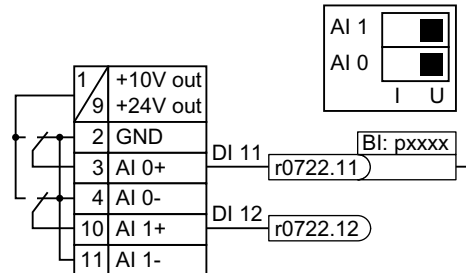
Advanced settings

You can debounce the digital input signal using parameter p0724.

For more information, please see the parameter list and the function block diagrams 2220 f of the List Manual.

 Overview of the manuals (Page 538)

Analog inputs as digital inputs



To use an analog input as additional digital input, you must interconnect the corresponding status parameter r0722.11 or r0722.12 with a binector input of your choice.

You may operate the analog input as digital input with 10 V or with 24 V.

NOTICE

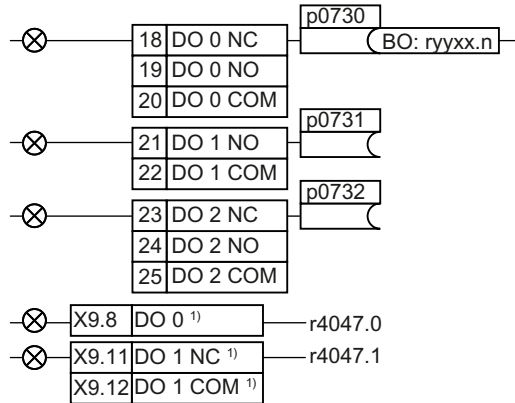
Overcurrent at an analog input

If the analog input switch is set to "Current input" (I), a 10V or 24V voltage source results in an overcurrent at the analog input. An overcurrent condition destroys the analog input.

- If you use an analog input as a digital input, then you must set the analog input switch to "Voltage" (U).

6.3.2 Digital outputs

Changing the function of a digital output



To change the function of a digital output, you must interconnect the digital output with a binector output of your choice.

Interconnecting signals in the converter (Page 534)

Binector outputs are marked with "BO" in the parameter list of the List Manual.

¹⁾When using the PM330 Power Module, the inverter has 2 additional digital outputs. The function of the two additional digital outputs is fixed and cannot be modified:

- DO 0 (X9.8): Inverter DC link is charged
- DO 1 (X9.11, X9.12): Close main contactor

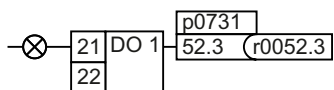
Table 6-4 Frequently used binector outputs (BO) of the inverter

0	Deactivating digital output	r0052.08	0 signal: Deviation, setpoint/actual speed
r0052.00	1 signal: Ready for switching on	r0052.09	1 signal: Control requested
r0052.01	1 signal: Ready	r0052.10	1 signal: Maximum speed (p1082) reached
r0052.02	1 signal: Operation enabled	r0052.11	0 signal: I, M, P limit reached
r0052.03	1 signal: Fault active The inverter inverts signal r0052.03 if it is interconnected to a digital output.	r0052.13	0 signal: Alarm overtemperature motor
		r0052.14	1 signal: Motor CW rotation
r0052.04	0 signal: OFF2 active	r0052.15	0 signal: Alarm inverter overload
r0052.05	0 signal: OFF3 active	r0053.00	1 signal: DC braking active
r0052.06	1 signal: Switching on inhibited active	r0053.02	1 signal: Speed > minimum speed (p1080)
r0052.07	1 signal: Alarm active	r0053.06	1 signal: Speed ≥ setpoint speed (r1119)

The complete list of binector outputs is provided in the List Manual.

Overview of the manuals (Page 538)

Application example: Changing the function of a digital output



To output inverter fault messages via digital output DO 1, you must interconnect DO1 with these fault messages.

Set p0731 = 52.3

Advanced settings

You can invert the signal of the digital output using parameter p0748.

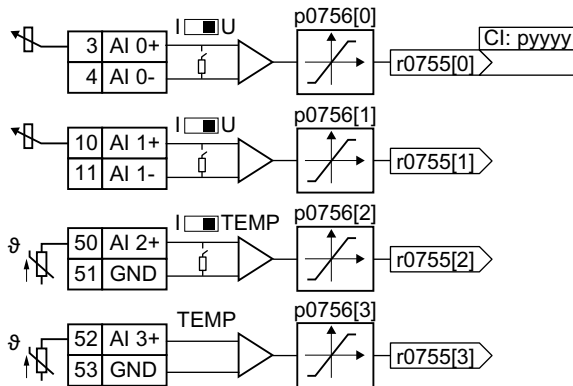
For more information, please see the parameter list and the function diagrams 2230 f of the List Manual.




Overview of the manuals (Page 538)

6.3.3 Analog inputs

Overview



The parameter p0756[x] and the switch on the inverter specify the analog input type. You define the analog input function by interconnecting parameter p0755[x] with a connector input CI of your choice.

 Interconnecting signals in the converter (Page 534)

Define the analog input type

When you use an analog input, you must set the analog input type with parameter p0756[x] and a switch on the inverter.

Table 6-5 Default settings via parameter p0756

AI 0	Unipolar voltage input	0 V ... +10 V	p0756[0] =	0
	Unipolar voltage input monitored	+2 V ... +10 V		1
	Unipolar current input	0 mA ... +20 mA		2
	Unipolar current input monitored	+4 mA ... +20 mA		3
	Bipolar voltage input (factory setting)	-10 V ... +10 V		4
AI 1	Unipolar voltage input	0 V ... +10 V	p0756[1] =	0
	Unipolar voltage input monitored	+2 V ... +10 V		1
	Unipolar current input	0 mA ... +20 mA		2
	Unipolar current input monitored	+4 mA ... +20 mA		3
	Bipolar voltage input (factory setting)	-10 V ... +10 V		4
AI 2	Unipolar current input (factory setting)	0 mA ... +20 mA	p0756[2] =	2
	Unipolar current input monitored	+4 mA ... +20 mA		3
	LG-Ni1000 temperature sensor			6
	Pt1000 temperature sensor			7
	No sensor connected			8
	DIN-Ni1000 temperature sensor (6180 ppm / K)			10
AI 3	LG-Ni1000 temperature sensor		p0756[3] =	6
	Pt1000 temperature sensor			7
	No sensor connected (factory setting)			8
	DIN-Ni1000 temperature sensor (6180 ppm / K)			10

The switch that belongs to the analog input is located behind the front doors of the Control Unit.

- The switches for AI 0 and AI 1 (current/voltage) are located behind the lower front door of the Control Unit.
- The switch for AI 2 (temperature/current) is located behind the upper front door of the Control Unit.



Permissible measuring range of the temperature sensors

LG-Ni1000, DIN-Ni1000	- 88 °C ... 165 °C
Pt1000	- 88 °C ... 240 °C

For values outside the permissible measuring range, the inverter outputs Alarm A03520 "Temperature sensor fault".

Characteristics

If you change the analog input type using p0756, then the inverter automatically selects the appropriate scaling of the analog input. The linear scaling characteristic is defined using two points (p0757, p0758) and (p0759, p0760). Parameters p0757 ... p0760 are assigned to an analog input via their index, e.g. parameters p0757[0] ... p0760[0] belong to analog input 0.

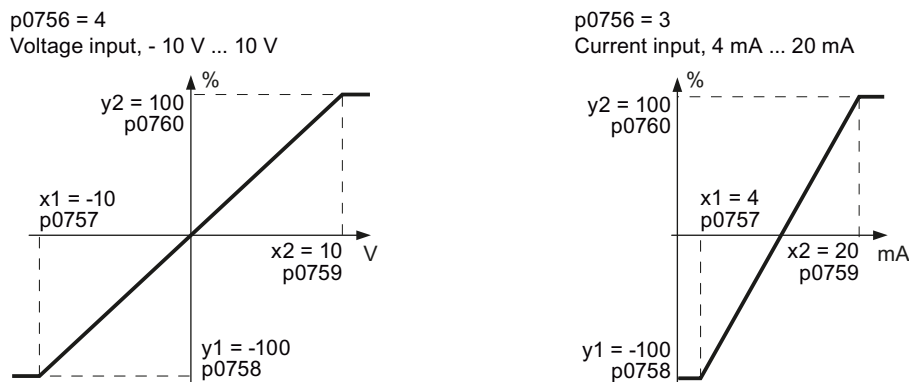


Figure 6-6 Examples for scaling characteristics

Parameter	Description
p0757	x coordinate of the 1st characteristic point [p0756 defines the unit]
p0758	y coordinate of the 1st characteristic point [% of p200x] p200x are the parameters of the reference variables, e.g. p2000 is the reference speed
p0759	x coordinate of the 2nd point characteristic point [p0756 defines the unit]
p0760	y coordinate of the 2nd characteristic point [% of p200x]
p0761	Wire breakage monitoring response threshold

Adapting the characteristic

You must define your own characteristic if none of the default types match your particular application.

Application example

The inverter should convert a 6 mA ... 12 mA signal into the value range -100 % ... 100 % via analog input 0. The wire break monitoring of the inverter should respond when 6 mA is fallen below.

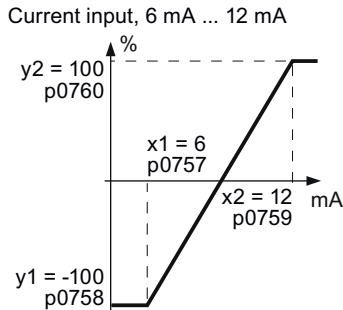


Figure 6-7 Characteristic for the application example

Procedure

1. Set the DIP switch for analog input 0 on the Control Unit to current input ("I"):



2. set `p0756[0] = 3`
You have defined analog input 0 as current input with wire break monitoring.
3. Set `p0757[0] = 6.0 (x1)`
4. Set `p0758[0] = -100.0 (y1)`
5. Set `p0759[0] = 12.0 (x2)`
6. Set `p0760[0] = 100.0 (y2)`
7. Set `p0761[0] = 6`
An input current < 6 mA results in fault F03505.

The characteristic for the application example is set.

□


Defining the function of an analog input

You define the analog input function by interconnecting a connector input of your choice with parameter p0755. Parameter p0755 is assigned to the particular analog input based on its index, e.g. parameter p0755[0] is assigned to analog input 0.

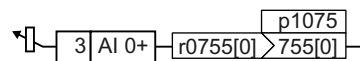
Table 6-6 Frequently used connector inputs (CI) of the inverter

CI	Significance	CI	Significance
p1070	Main setpoint	p2253	Technology controller setpoint 1
p1075	Supplementary setpoint	p2264	Technology controller actual value

A complete list of the connector inputs is provided in the List Manual.

 Overview of the manuals (Page 538)

Defining the function of an analog input - example



In order to enter the supplementary setpoint via analog input AI 0, you must interconnect AI 0 with the signal source for the supplementary setpoint.


Set p1075 = 755[0].

Advanced settings

Signal smoothing

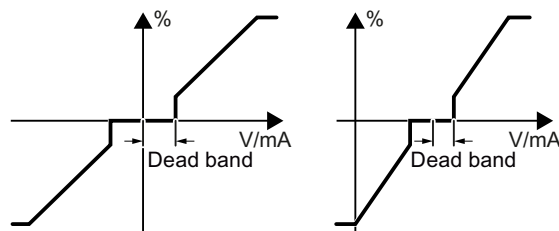
When required, you can smooth the signal, which you read-in via an analog input, using parameter p0753.

You can find more information in the parameter list and in function diagram 2251 of the List Manual.

 Overview of the manuals (Page 538)

Dead band

With the control enabled, electromagnetic interference on the signal cable can cause the motor to slowly rotate in one direction in spite of a speed setpoint = 0.




The dead band acts on the zero crossover of the analog input characteristic. Internally, the inverter sets its speed setpoint = 0, even if the signal at the analog input terminals is slightly positive or negative. This prevents the inverter from rotating the motor at a speed setpoint = 0.

p0764[0]	Analog inputs dead zone, AI 0 (factory setting: 0)
p0764[1]	Analog inputs dead zone, AI 1 (factory setting: 0)

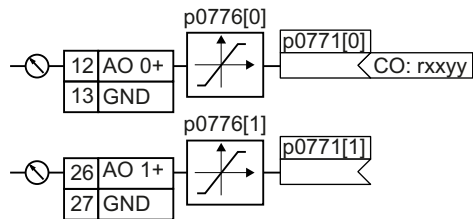
Using an analog input as digital input

An analog input can also be used as digital input.

 Digital inputs (Page 204)

6.3.4 Analog outputs


Overview



Define the analog output type using parameter p0776.

You define the analog output function by interconnecting parameter p0771 with a connector output CO of your choice.

Connector outputs are marked with "CO" in the parameter list of the List Manual.

 Interconnecting signals in the converter (Page 534).

Defining the analog output type

The inverter offers a series of default settings, which you can select using parameter p0776:

AO 0	Current output (factory setting)	0 mA ... +20 mA	p0776[0] =	0
	Voltage output	0 V ... +10 V		1
	Current output	+4 mA ... +20 mA		2
AO 1	Current output (factory setting)	0 mA ... +20 mA	p0776[1] =	0
	Voltage output	0 V ... +10 V		1
	Current output	+4 mA ... +20 mA		2

Characteristics

If you change the analog output type, then the inverter automatically selects the appropriate scaling of the analog output. The linear scaling characteristic is defined using two points (p0777, p0778) and (p0779, p0780).

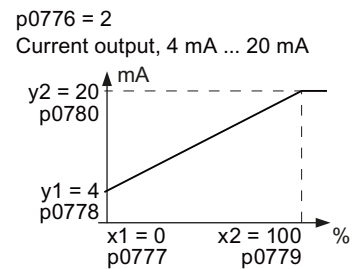
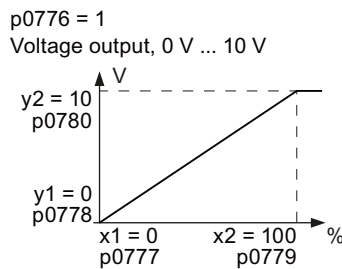


Figure 6-8 Examples for scaling characteristics

6.3 Adapt the default setting of the terminal strip

Parameters p0777 ... p0780 are assigned to an analog output via their index, e.g. parameters p0777[0] ... p0770[0] belong to analog output 0.

Table 6-7 Parameters for the scaling characteristic

Parameter	Description
p0777	x coordinate of the 1st characteristic point [% of p200x] p200x are the parameters of the reference variables, e.g. p2000 is the reference speed.
p0778	y coordinate of the 1st characteristic point [V or mA]
p0779	x coordinate of the 2nd characteristic point [% of p200x]
p0780	y coordinate of the 2nd characteristic point [V or mA]

Setting the characteristic

You must define your own characteristic if none of the default types match your particular application.

Application example

Via analog output 0, the inverter should convert a signal in the value range 0 % ... 100 % into an output signal 6 mA ... 12 mA.

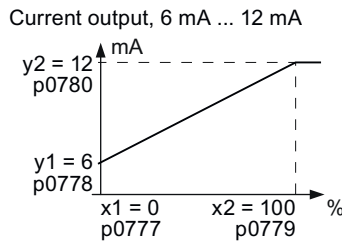


Figure 6-9 Characteristics for the application example

Procedure

1. Set p0776[0] = 2
This defines analog output 0 as a current output.
2. Set p0777[0] = 0.0 (x1)
3. Set p0778[0] = 6.0 (y1)
4. Set p0779[0] = 100.0 (x2)
5. Set p0780[0] = 12.0 (y2)

The characteristic for the application example is set.

□

Defining the function of an analog output


You define the analog output function by interconnecting parameter p0771 with a connector output of your choice. Parameter p0771 is assigned to the particular analog output via its index, e.g. parameter p0771[0] is assigned to analog output 0.

Table 6-8 Connector outputs (CO) of the inverter (selection)

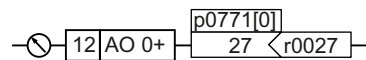
CO	Significance	CO	Significance
r0021	Actual speed smoothed	r0026	DC link voltage smoothed
r0024	Output frequency, smoothed	r0027	Absolute actual current smoothed
r0025	Output voltage smoothed		

A complete list of the connector outputs is provided in the List Manual.

Additional information is provided in the parameter list and in function diagram 2261 of the List Manual.

 Overview of the manuals (Page 538)

Application example: Defining the function of an analog output



To output the inverter output current via analog output 0, you must interconnect AO 0 with the signal for the output current. Set p0771 = 27.

Advanced settings

You can manipulate the signal that you output via an analog output, as follows:

- Absolute-value generation of the signal (p0775)
- Signal inversion (p0782)

Additional information is provided in the parameter list of the List Manual.

6.4 Controlling clockwise and counter-clockwise rotation via digital inputs



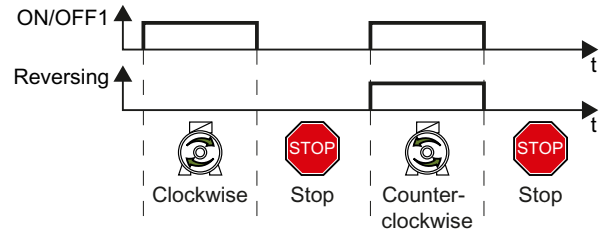
The inverter has a different methods for controlling the motor using two or three commands.

Overview

Two wire control, method 1

ON/OFF1:
Switches the motor on or off

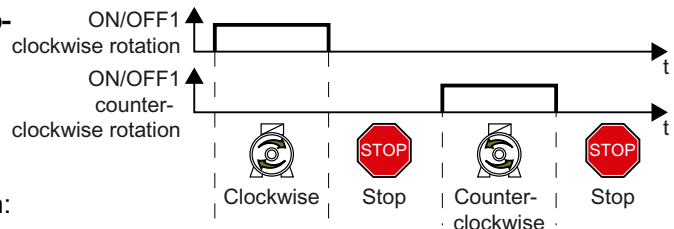
Reversing:
Reverses the motor direction of rotation



Two wire control, method 2 - and two-wire control, method 3

ON/OFF1 clockwise rotation:
Switches the motor on or off, clockwise rotation

ON/OFF1 counter-clockwise rotation:
Switches the motor on or off, counter-clockwise rotation

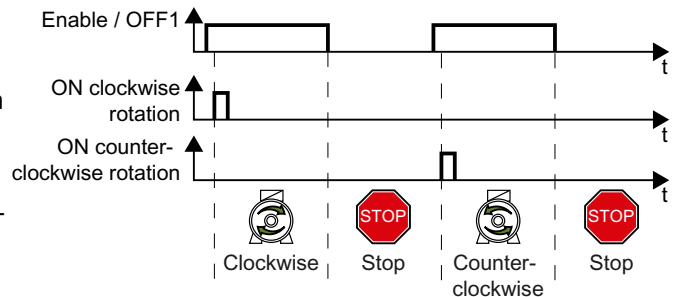


Three wire control, method 1

Enable/OFF1:
Enables the motor to be switched on or switched off

ON clockwise rotation:
Switches on the motor, clockwise rotation

ON counter-clockwise rotation:
Switches on the motor, counter-clockwise rotation

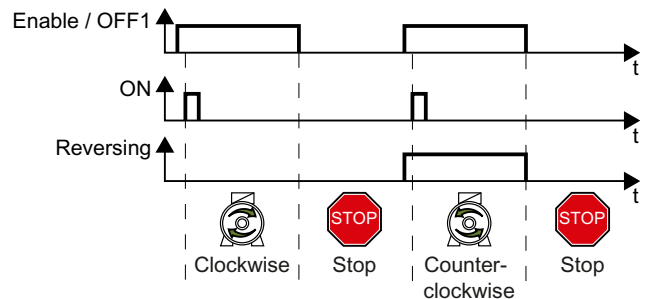


Three wire control, method 2


Enable/OFF1:
Enables the motor to be switched on or switched off

ON:
Switches on the motor

Reversing:
Reverses the motor direction of rotation



Reversing is disabled in the factory setting. To use the "Reverse" function, you must release the negative rotational direction.

 Enable direction of rotation (Page 272)

6.4.1 Two-wire control, method 1

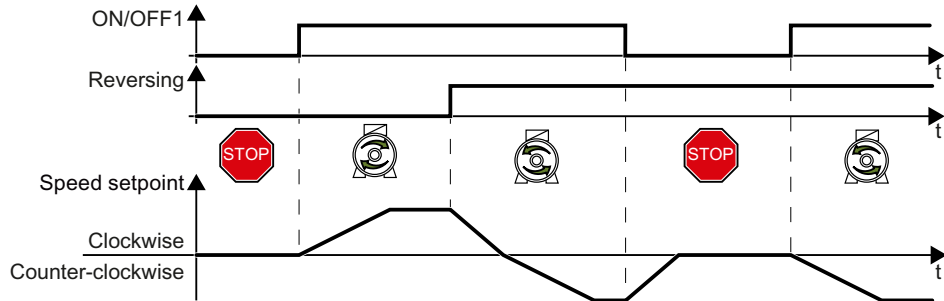


Figure 6-10 Two-wire control, method 1

Command "ON/OFF1" switches the motor on and off. The "Reversing" command inverts the motor direction of rotation.

Table 6-9 Function table

ON/OFF1	Reversing	Function
0	0	OFF1: The motor stops
0	1	
1	0	ON: Clockwise motor rotation
1	1	ON: Counter-clockwise motor rotation

Table 6-10 Select two-wire control, method 1

Parameter	Description
p0015 = 12	<p>Macro drive unit</p> <p>You must carry out quick commissioning in order to set parameter p0015.</p> <p>Assigning digital inputs DI to the commands:</p> <p>DI 0: ON/OFF1</p> <p>DI 1: Reversing</p>

Table 6-11 Changing the assignment of the digital inputs

Parameter	Description
p0840[0 ... n] = 722.x	<p>BI: ON/OFF1 (ON/OFF1)</p> <p>Example: p0840 = 722.3 ⇒ DI 3: ON/OFF1</p>
p1113[0 ... n] = 722.x	BI: Setpoint inversion (reversing)

6.4.2 Two-wire control, method 2

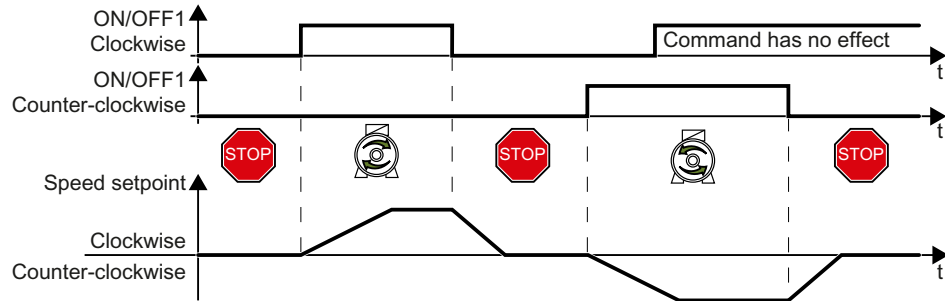


Figure 6-11 Two-wire control, method 2

Commands "ON/OFF1 clockwise rotation" and "ON/OFF1 counter-clockwise rotation" switch on the motor - and simultaneously select a direction of rotation. The inverter only accepts a new command when the motor is at a standstill.

Table 6-12 Function table

ON/OFF1 clockwise rotation	ON/OFF1 counter-clockwise rotation	Function
0	0	OFF1: The motor stops.
1	0	ON: Clockwise motor rotation.
0	1	ON: Counter-clockwise motor rotation.
1	1	ON: The motor direction of rotation is defined by the command that first reaches state "1".

Table 6-13 Select two-wire control, method 2

Parameter	Description
p0015 = 17	Macro drive unit You must carry out quick commissioning in order to set parameter p0015. Assigning digital inputs DI to the commands: DI 0: ON/OFF1 clockwise rotation DI 1: ON/OFF1 counter-clockwise rotation

Table 6-14 Changing the assignment of the digital inputs

Parameter	Description
p3330[0 ... n] = 722.x	BI: 2/3 wire control command 1 (ON/OFF1 clockwise rotation)
p3331[0 ... n] = 722.x	BI: 2/3 wire control command 2 (ON/OFF1 counter-clockwise rotation) Example: p3331 = 722.0 → DI 0: ON/OFF1 counter-clockwise rotation

6.4.3 Two-wire control, method 3

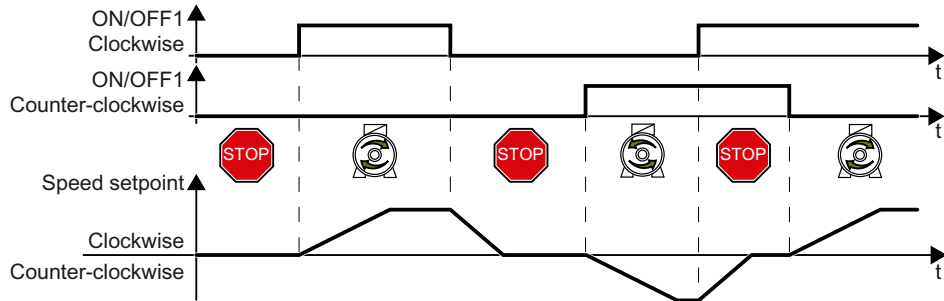


Figure 6-12 Two-wire control, method 3

Commands "ON/OFF1 clockwise rotation" and "ON/OFF1 counter-clockwise rotation" switch on the motor - and simultaneously select a direction of rotation. The inverter accepts a new command at any time, independent of the motor speed.

Table 6-15 Function table

ON/OFF1 clockwise rotation	ON/OFF1 counter-clockwise rotation	Function
0	0	OFF1: The motor stops.
1	0	ON: Clockwise motor rotation.
0	1	ON: Counter-clockwise motor rotation.
1	1	OFF1: The motor stops.

Table 6-16 Select two-wire control, method 3

Parameter	Description
p0015 = 18	<p>Macro drive unit</p> <p>You must carry out quick commissioning in order to set parameter p0015.</p> <p>Assigning digital inputs DI to the commands:</p> <p>DI 0: ON/OFF1 clockwise rotation</p> <p>DI 1: ON/OFF1 counter-clockwise rotation</p>

Table 6-17 Changing the assignment of the digital inputs

Parameter	Description
p3330[0 ... n] = 722.x	BI: 2/3 wire control command 1 (ON/OFF1 clockwise rotation)
p3331[0 ... n] = 722.x	BI: 2/3 wire control command 2 (ON/OFF1 counter-clockwise rotation) Example: p3331 = 722.0 ⇒ DI 0: ON/OFF1 counter-clockwise rotation

6.4.4 Three-wire control, method 1

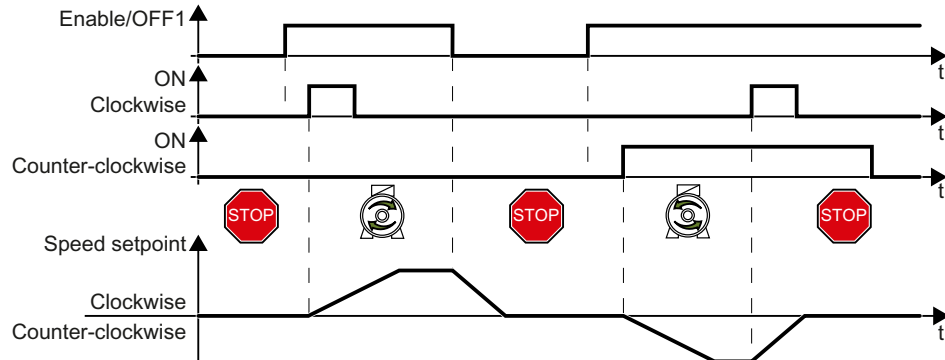


Figure 6-13 Three-wire control, method 1

The "Enable" command is a precondition for switching on the motor. Commands "ON clockwise rotation" and "ON counter-clockwise rotation" switch on the motor - and simultaneously select a direction of rotation. Removing the enable switches the motor off (OFF1).

Table 6-18 Function table

Enable / OFF1	ON clockwise rotation	ON counter-clockwise rotation	Function
0	0 or 1	0 or 1	OFF1: The motor stops.
1	0→1	0	ON: Clockwise motor rotation.
1	0	0→1	ON: Counter-clockwise motor rotation.
1	1	1	OFF1: The motor stops.

Table 6-19 Select three-wire control, method 1

Parameter	Description
p0015 = 19	Macro drive unit You must carry out quick commissioning in order to set parameter p0015. Assigning digital inputs DI to the commands: DI 0: Enable / OFF1 DI 1: ON clockwise rotation DI 2: ON counter-clockwise rotation

Table 6-20 Changing the assignment of the digital inputs

Parameter	Description
p3330[0 ... n] = 722.x	BI: 2/3 wire control command 1 (enable/OFF1)
p3331[0 ... n] = 722.x	BI: 2/3 wire control command 2 (ON clockwise rotation)
p3332[0 ... n] = 722.x	BI: 2/3 wire control command 3 (ON counter-clockwise rotation) Example: p3332 = 722.0 ⇒ DI 0: ON counter-clockwise rotation

6.4.5 Three-wire control, method 2

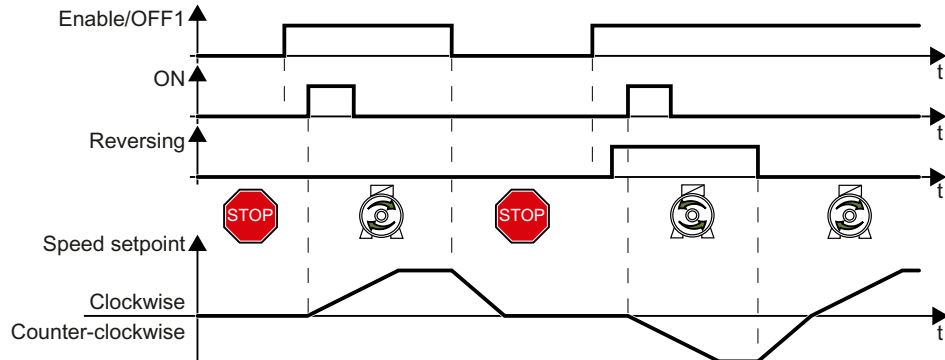


Figure 6-14 Three-wire control, method 2

The "Enable" command is a precondition for switching on the motor. The "ON" command switches the motor on. The "Reversing" command inverts the motor direction of rotation. Removing the enable switches the motor off (OFF1).

Table 6-21 Function table

Enable / OFF1	ON	Reversing	Function
0	0 or 1	0 or 1	OFF1: The motor stops.
1	0→1	0	ON: Clockwise motor rotation.
1	0→1	1	ON: Counter-clockwise motor rotation.

Table 6-22 Select three-wire control, method 2

Parameter	Description
p0015 = 20	<p>Macro drive unit</p> <p>You must carry out quick commissioning in order to set parameter p0015.</p> <p>Assigning digital inputs DI to the commands:</p> <p>DI 0: Enable / OFF1</p> <p>DI 1: ON</p> <p>DI 2: Reversing</p>

Table 6-23 Changing the assignment of the digital inputs

Parameter	Description
p3330[0 ... n] = 722.x	BI: 2/3 wire control command 1 (enable/OFF1)
p3331[0 ... n] = 722.x	BI: 2/3 wire control command 2 (ON) Example: p3331 = 722.0 ⇒ DI 0: ON command
p3332[0 ... n] = 722.x	BI: 2/3 wire control command 3 (reversing)

6.5 Drive control via PROFIBUS or PROFINET

6.5.1 Receive data and send data

Cyclic data exchange



The inverter receives cyclic data from the higher-level control - and returns cyclic data to the control.

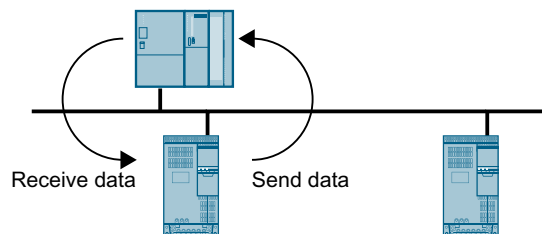


Figure 6-15 Cyclic data exchange

Inverter and control system pack their data in telegrams.

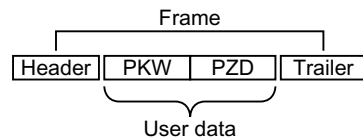


Figure 6-16 Telegram structure

Every telegram for cyclic data exchange has the following basic structure:

- Header and trailer form the protocol frame.
- User data is located within the frame:
 - PKW: The control can read or change every parameter in the inverter via "PKW data". Not every telegram has a "PKW range".
 - PZD: The inverter receives control commands and setpoints from the higher-level control - and sends status messages and actual values via "PZD data".

PROFIdrive and telegram numbers

For typical applications, certain telegrams are defined in the PROFIdrive profile and are assigned a fixed PROFIdrive telegram number. As a consequence, behind a PROFIdrive telegram number, there is a defined signal composition. As a consequence, a telegram number uniquely describes cyclic data exchange.

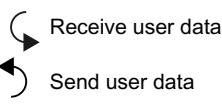
The telegrams are identical for PROFIBUS and PROFINET.

6.5.2 Telegrams

Telegrams that are available

The user data of the telegrams that are available are described in the following.

Telegram 1

PZD01	PZD02	
STW1	NSOLL_A	
ZSW1	NIST_A	

16-bit speed setpoint

Telegram 20

PZD01	PZD02	PZD03	PZD04	PZD05	PZD06
STW1	NSOLL_A				
ZSW1	NIST_A GLATT	IAIST_ GLATT	MIST_ GLATT	PIST_ GLATT	MELD_ NAMUR

16-bit speed setpoint for VIK-Namur

Telegram 350

PZD01	PZD02	PZD03	PZD04
STW1	NSOLL_A	M_LIM	STW3
ZSW1	NIST_A GLATT	IAIST_ GLATT	ZSW3

16-bit speed setpoint with torque limiting

Telegram 352

PZD01	PZD02	PZD03	PZD04	PZD05	PZD06
STW1	NSOLL_A	Process data for PCS7			
ZSW1	NIST_A GLATT	IAIST_ GLATT	MIST_ GLATT	WARN_ CODE	FAULT_ CODE

16-bit speed setpoint for PCS7

Telegram 353

	PZD01	PZD02
PKW	STW1	NSOLL_A
	ZSW1	NIST_A GLATT

16-bit speed setpoint with reading and writing to parameters

Telegram 354

	PZD01	PZD02	PZD03	PZD04	PZD05	PZD06
PKW	STW1	NSOLL_A	Process data for PCS7			
	ZSW1	NIST_A GLATT	IAIST_ GLATT	MIST_ GLATT	WARN_ CODE	FAULT_ CODE

16-bit speed setpoint for PCS7 with reading and writing to parameters

Telegram 999

PZD01	PZD02	PZD03	PZD04	PZD05	PZD06	PZD07	PZD08	PZD09	PZD10	PZD11	PZD12	PZD13 ... PZD17
STW1	Telegram length for the receive data											
ZSW1	Telegram length for the transmit data											

Unassigned interconnection and length

Table 6-24 Explanation of the abbreviations

Abbreviation	Explanation	Abbreviation	Explanation
PZD	Process data	PKW	Parameter channel
STW	Control word	MIST_GLATT	Actual smoothed torque
ZSW	Status word	PIST_GLATT	Actual smoothed active power
NSOLL_A	Speed setpoint	M_LIM	Torque limit value
NIST_A	Speed actual value	FAULT_CODE	Fault code
NIST_A_GLATT	Smoothed actual speed value	WARN_CODE	Alarm code
IAIST_GLATT	Smoothed current actual value	MELD_NAMUR	Message according to the VIK-NAMUR definition

Interconnection of the process data

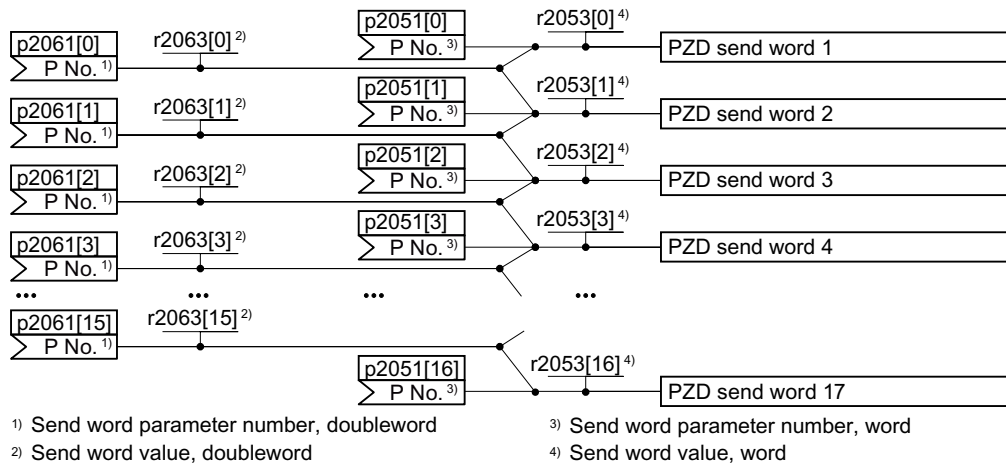


Figure 6-17 Interconnection of the send data

In the inverter, the send data are available in the "Word" format (p2051) - and in the "Double word" format (p2061). If you set a specific telegram, or you change the telegram, then the inverter automatically interconnects parameters p2051 and p2061 with the appropriate signals.

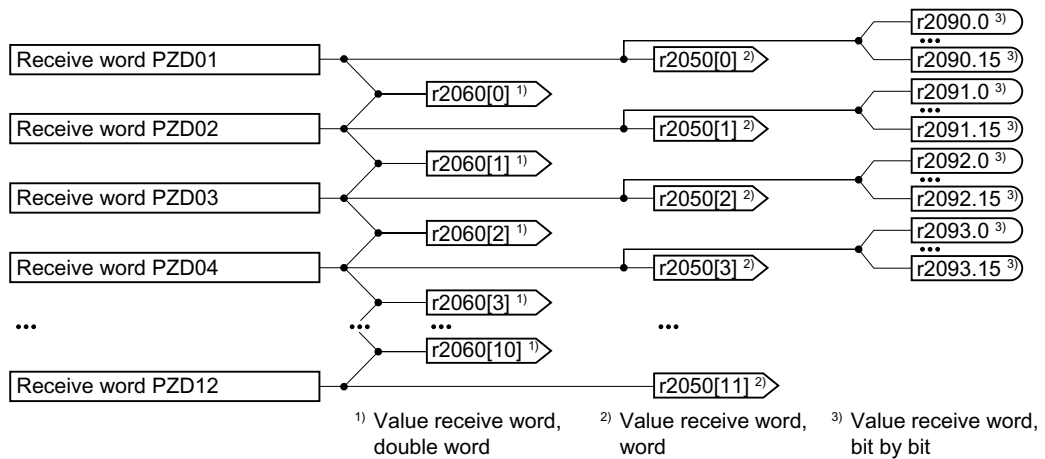


Figure 6-18 Interconnection of the receive data

The inverter saves the receive data in the "Word" format (r2050), in the "Double word" format (r2060) and bit by bit (r2090 ...r2093). If you set a specific telegram, or you change the telegram, then the inverter automatically interconnects parameters r2050, r2060 and r2090 ... r2093 with the appropriate signals.

If you wish to adapt a predefined telegram, then you must interconnect the send and receive data with the appropriate signals. To facilitate manual interconnection of send and receive data, you must first adapt parameters p0922 and p2079.

Extending the telegram (Page 237)

For additional details relating to freely interconnecting process data, refer to the List Manual, function diagrams 2420 and 2472.

Overview of the manuals (Page 538)

6.5.3 Control and status word 1

Control word 1 (STW1)

Bit	Significance		Explanation	Signal inter-connection in the inverter
	Telegram 20	All other telegrams		
0	0 = OFF1		The motor brakes with the ramp-down time p1121 of the ramp-function generator. The inverter switches off the motor at standstill.	p0840[0] = r2090.0
	0 → 1 = ON		The inverter goes into the "ready" state. If, in addition bit 3 = 1, then the inverter switches on the motor.	
1	0 = OFF2		Switch off the motor immediately, the motor then coasts down to a standstill.	p0844[0] = r2090.1
	1 = No OFF2		The motor can be switched on (ON command).	

Bit	Significance		Explanation	Signal inter-connection in the inverter
	Telegram 20	All other telegrams		
2	0 = Quick stop (OFF3)		Quick stop: The motor brakes with the OFF3 ramp-down time p1135 down to standstill.	p0848[0] = r2090.2
	1 = No quick stop (OFF3)		The motor can be switched on (ON command).	
3	0 = Inhibit operation		Immediately switch-off motor (cancel pulses).	p0852[0] = r2090.3
	1 = Enable operation		Switch-on motor (pulses can be enabled).	
4	0 = Disable RFG		The inverter immediately sets its ramp-function generator output to 0.	p1140[0] = r2090.4
	1 = Do not disable RFG		The ramp-function generator can be enabled.	
5	0 = Stop RFG		The output of the ramp-function generator stops at the actual value.	p1141[0] = r2090.5
	1 = Enable RFG		The output of the ramp-function generator follows the setpoint.	
6	0 = Inhibit setpoint		The inverter brakes the motor with the ramp-down time p1121 of the ramp-function generator.	p1142[0] = r2090.6
	1 = Enable setpoint		Motor accelerates with the ramp-up time p1120 to the setpoint.	
7	0 → 1 = Acknowledge faults		Acknowledge fault. If the ON command is still active, the inverter switches to the "switching on inhibited" state.	p2103[0] = r2090.7
8, 9	Reserved			
10	0 = No control via PLC		Inverter ignores the process data from the fieldbus.	p0854[0] = r2090.10
	1 = Control via PLC		Control via fieldbus, inverter accepts the process data from the fieldbus.	
11	1 = Direction reversal		Invert setpoint in the inverter.	p1113[0] = r2090.11
12	Not used			
13	--- ¹⁾	1 = MOP up	Increase the setpoint saved in the motorized potentiometer.	p1035[0] = r2090.13
14	--- ¹⁾	1 = MOP down	Reduce the setpoint saved in the motorized potentiometer.	p1036[0] = r2090.14
15	CDS bit 0	Reserved	Changes over between settings for different operation interfaces (command data sets).	p0810 = r2090.15

¹⁾ If you change over from another telegram to telegram 20, then the assignment of the previous telegram is kept.

Status word 1 (ZSW1)

Bit	Significance		Remarks	Signal inter-connection in the inverter
	Telegram 20	All other telegrams		
0	1 = Ready for switching on		Power supply switched on; electronics initialized; pulses locked.	p2080[0] = r0899.0
1	1 = Ready		Motor is switched on (ON/OFF1 = 1), no fault is active. With the command "Enable operation" (STW1.3), the inverter switches on the motor.	p2080[1] = r0899.1
2	1 = Operation enabled		Motor follows setpoint. See control word 1, bit 3.	p2080[2] = r0899.2
3	1 = Fault active		The inverter has a fault. Acknowledge fault using STW1.7.	p2080[3] = r2139.3
4	1 = OFF2 inactive		Coast down to standstill is not active.	p2080[4] = r0899.4
5	1 = OFF3 inactive		Quick stop is not active.	p2080[5] = r0899.5
6	1 = Switching on inhibited active		It is only possible to switch on the motor after an OFF1 followed by ON.	p2080[6] = r0899.6
7	1 = Alarm active		Motor remains switched on; no acknowledgement is necessary.	p2080[7] = r2139.7
8	1 = Speed deviation within the tolerance range		Setpoint / actual value deviation within the tolerance range.	p2080[8] = r2197.7
9	1 = Master control requested		The automation system is requested to accept the inverter control.	p2080[9] = r0899.9
10	1 = Comparison speed reached or exceeded		Speed is greater than or equal to the corresponding maximum speed.	p2080[10] = r2199.1
11	1 = current or torque limit reached	1 = torque limit reached	Comparison value for current or torque has been reached or exceeded.	p2080[11] = r0056.13 / r1407.7
12	--- ¹⁾	1 = Holding brake open	Signal to open and close a motor holding brake.	p2080[12] = r0899.12
13	0 = Alarm, motor overtemperature		--	p2080[13] = r2135.14
14	1 = Motor rotates clockwise		Internal inverter actual value > 0	p2080[14] = r2197.3
	0 = Motor rotates counter-clockwise		Internal inverter actual value < 0	
15	1 = CDS display	0 = Alarm, inverter thermal overload		p2080[15] = r0836.0 / r2135.15

¹⁾ If you change over from another telegram to telegram 20, then the assignment of the previous telegram is kept.

6.5.4 Control and status word 3

Control word 3 (STW3)

Bit	Significance	Explanation	Signal interconnection in the inverter ¹⁾
	Telegram 350		
0	1 = fixed setpoint bit 0	Selects up to 16 different fixed setpoints.	p1020[0] = r2093.0
1	1 = fixed setpoint bit 1		p1021[0] = r2093.1
2	1 = fixed setpoint bit 2		p1022[0] = r2093.2
3	1 = fixed setpoint bit 3		p1023[0] = r2093.3
4	1 = DDS selection bit 0	Changes over between settings for different motors (drive data sets).	p0820 = r2093.4
5	1 = DDS selection bit 1		p0821 = r2093.5
6	Not used		
7	Not used		
8	1 = enable technology controller	--	p2200[0] = r2093.8
9	1 = enable DC braking	--	p1230[0] = r2093.9
10	Not used		
11	1 = enable droop	Enable or inhibit speed controller droop.	p1492[0] = r2093.11
12	Not used		
13	1 = no external fault 0 = external fault is active (F07860)	--	p2106[0] = r2093.13
14	Not used		
15	1 = CDS bit 1	Changes over between settings for different operation interfaces (command data sets).	p0811[0] = r2093.15

¹⁾ If you switch from telegram 350 to a different one, then the inverter sets all interconnections p1020, ... to "0". Exception: p2106 = 1.

Status word 3 (ZSW3)

Bit	Significance	Description	Signal interconnection in the inverter
0	1 = DC braking active	--	p2051[3] = r0053
1	1 = $ n_{act} > p1226$	Absolute current speed > stationary state detection	
2	1 = $ n_{act} > p1080$	Absolute actual speed > minimum speed	
3	1 = $i_{act} \geq p2170$	Actual current \geq current threshold value	
4	1 = $ n_{act} > p2155$	Absolute actual speed > speed threshold value 2	
5	1 = $ n_{act} \leq p2155$	Absolute actual speed < speed threshold value 2	
6	1 = $ n_{act} \geq r1119$	Speed setpoint reached	
7	1 = DC-link voltage $\leq p2172$	Actual DC-link voltage \leq threshold value	
8	1 = DC-link voltage > p2172	Actual DC-link voltage > threshold value	
9	1 = ramp-up or ramp-down completed	Ramp-function generator is not active.	
10	1 = technology controller output at the lower limit	Technology controller output $\leq p2292$	
11	1 = technology controller output at the upper limit	Technology controller output > p2291	
12	Not used		
13	Not used		
14	Not used		
15	Not used		

6.5.5 NAMUR message word

Fault word according to the VIK-NAMUR definition (MELD_NAMUR)

Table 6-25 Fault word according to the VIK-NAMUR definition and interconnection with parameters in the inverter

Bit	Significance	P no.
0	1 = Control Unit signals a fault	p2051[5] = r3113
1	1 = line fault: Phase failure or inadmissible voltage	
2	1 = DC link overvoltage	
3	1 = Power Module fault, e.g. overcurrent or overtemperature	
4	1 = inverter overtemperature	
5	1 = ground fault/phase fault in the motor cable or in the motor	
6	1 = motor overload	
7	1 = communication error to the higher-level control system	
8	1 = fault in a safety-relevant monitoring channel	
10	1 = fault in the internal inverter communication	
11	1 = line fault	
15	1 = other fault	

6.5.6 Parameter channel

Structure of the parameter channel

The parameter channel consists of four words. The 1st and 2nd words transfer the parameter number, index and the type of task (read or write). The 3rd and 4th words contain the parameter content. The parameter contents can be 16-bit values (such as baud rate) or 32-bit values (e.g. CO parameters).

Bit 11 in the 1st word is reserved and is always assigned 0.

Parameter channel					
PKE (1st word)		IND (2nd word)		PWE (3rd and 4th words)	
15...12;11;	10...0	15...8	7...0	15...0	15...0
AK	S; PNU	Subindex	Page index	PWE 1	PWE 2
	P				
	M				

You can find application examples relating to the parameter channel at the end of this section.

AK: Request and response IDs

Bits 12 ... 15 of the 1st The parameter channel words contain the request and response identifier AK.

Table 6-26 Request identifiers, control → inverter

AK	Description	Response identifier	
		positive	negative
0	No request	0	7 / 8
1	Request parameter value	1 / 2	7 / 8
2	Change parameter value (word)	1	7 / 8
3	Change parameter value (double word)	2	7 / 8
4	Request descriptive element ¹⁾	3	7 / 8
6 ²⁾	Request parameter value (field) ¹⁾	4 / 5	7 / 8
7 ²⁾	Change parameter value (field, word) ¹⁾	4	7 / 8
8 ²⁾	Change parameter value (field, double word) ¹⁾	5	7 / 8
9	Request number of field elements	6	7 / 8

¹⁾ The required element of the parameter is specified in IND (2nd word).

²⁾ The following request IDs are identical: 1 ≡ 6, 2 ≡ 7 3 ≡ 8.

We recommend that you use identifiers 6, 7, and 8.

Table 6-27 Response identifiers, inverter → control

AK	Description
0	No response
1	Transfer parameter value (word)
2	Transfer parameter value (double word)

AK	Description
3	Transfer descriptive element ¹⁾
4	Transfer parameter value (field, word) ²⁾
5	Transfer parameter value (field, double word) ²⁾
6	Transfer number of field elements
7	Inverter cannot process the request. In the most significant word of the parameter channel, the inverter sends an error number to the control, refer to the following table.
8	No master controller status / no authorization to change parameters of the parameter channel interface

¹⁾ The required element of the parameter is specified in IND (2nd word).

²⁾ The required element of the indexed parameter is specified in IND (2nd word).

Table 6-28 Error numbers for response identifier 7

No.	Description
00 hex	Illegal parameter number (access to a parameter that does not exist)
01 hex	Parameter value cannot be changed (change request for a parameter value that cannot be changed)
02 hex	Lower or upper value limit exceeded (change request with a value outside the value limits)
03 hex	Incorrect subindex (access to a subindex that does not exist)
04 hex	No array (access with a subindex to non-indexed parameters)
05 hex	Incorrect data type (change request with a value that does not match the data type of the parameter)
06 hex	Setting not permitted, only resetting (change request with a value not equal to 0 without permission)
07 hex	Descriptive element cannot be changed (change request to a descriptive element error value that cannot be changed)
0B hex	No master control (change request but with no master control, see also p0927.)
0C hex	Keyword missing
11 hex	Request cannot be executed due to the operating state (access is not possible for temporary reasons that are not specified)
14 hex	Inadmissible value (change request with a value that is within the limits but which is illegal for other permanent reasons, i.e. a parameter with defined individual values)
65 hex	Parameter number is currently deactivated (depending on the mode of the inverter)
66 hex	Channel width is insufficient (communication channel is too small for response)
68 hex	Illegal parameter value (parameter can only assume certain values)
6A hex	Request not included / task is not supported (the valid request identifications can be found in table "Request identifications controller → inverter")
6B hex	No change access for a controller that is enabled. (The operating state of the inverter prevents a parameter change)
86 hex	Write access only for commissioning (p0010 = 15) (operating state of the inverter prevents a parameter change)
87 hex	Know-how protection active, access locked
C8 hex	Change request below the currently valid limit (change request to a value that lies within the "absolute" limits, but is however below the currently valid lower limit)

No.	Description
C9 hex	Change request above the currently valid limit (example: a parameter value is too large for the inverter power)
CC hex	Change request not permitted (change is not permitted as the access code is not available)

PNU (parameter number) and page index

The parameter number is located in value PNU in the 1st word of the parameter channel (PKE).

The page index is located in the 2nd word of the parameter channel (IND bit 7 ... 0).

Parameter number	PNU	Page index
0000 ... 1999	0000 ... 1999	0 hex
2000 ... 3999	0000 ... 1999	80 hex
6000 ... 7999	0000 ... 1999	90 hex
8000 ... 9999	0000 ... 1999	20 hex
10000 ... 11999	0000 ... 1999	A0 hex
20000 ... 21999	0000 ... 1999	50 hex
30000 ... 31999	0000 ... 1999	F0 hex
60000 ... 61999	0000 ... 1999	74 hex

Subindex

For indexed parameters, the parameter index is located in subindex (IND Bit 15 ... 8) as hexadecimal value.

PWE: Parameter value or connector

Parameter values or connectors can be located in the PWE.

Table 6-29 Parameter value or connector

	PWE 1	PWE 2	
Parameter value	Bit 15 ... 0	Bit 15 ... 8	Bit 7 ... 0
	0	0	8-bit value
	0	16-bit value	
	32-bit value		
Connector	Bit 15 ... 0	Bit 15 ... 10	Bit 9 ... 0
	Number of the connector	3F hex	The index or bit field number of the connector

6.5.7 Examples for using the parameter channel

Read request: Read out serial number of the Power Module (p7841[2])

To obtain the value of the indexed parameter p7841, you must fill the telegram of the parameter channel with the following data:

- **PKE, Bit 12 ... 15 (AK): = 6** (request parameter value (field))
- **PKE, Bit 0 ... 10 (PNU): = 1841** (parameter number without offset)
Parameter number = PNU + offset (page index)
(7841 = 1841 + 6000)
- **IND, bit 8 ... 15 (subindex): = 2** (index of parameter)
- **IND, bit 0 ... 7 (page index): = 90 hex** (offset 6000 corresponds to 90 hex)
- Because you want to read the parameter value, words 3 and 4 in the parameter channel for requesting the parameter value are irrelevant. They should be assigned a value of 0, for example.

Parameter channel																																							
PKE, 1st word		IND, 2nd word		PWE1 - high, 3rd word	PWE2 - low, 4th word																																		
15...12	11	10 ... 0		15 ... 8	7 ... 0		15 ... 0																																
AK		Parameter number	Subindex	Page index	Parameter value		Drive object Index																																
0	1	1	1	0	1	1	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 6-19 Telegram for a read request from p7841[2]

Write request: Change restart mode (p1210)

The restart mode is inhibited in the factory setting (p1210 = 0). In order to activate the automatic restart with "acknowledge all faults and restart for an ON command", p1210 must be set to 26:

- **PKE, bit 12 ... 15 (AK): = 7** (change parameter value (field, word))
- **PKE, bit 0 ... 10 (PNU): = 4BA hex** (1210 = 4BA hex, no offset, as 1210 < 1999)
- **IND, bit 8 ... 15 (subindex): = 0 hex** (parameter is not indexed)
- **IND, bit 0 ... 7 (page index): = 0 hex** (offset 0 corresponds to 0 hex)
- **PWE1, bit 0 ... 15: = 0 hex**
- **PWE2, Bit 0 ... 15: = 1A hex** (26 = 1A hex)

Parameter channel																																							
PKE, 1st word		IND, 2nd word		PWE1 - high, 3rd word	PWE2 - low, 4th word																																		
15...12	11	10 ... 0		15 ... 8	7 ... 0		15 ... 0																																
AK		Parameter number	Subindex	Page index	Parameter value (bit 16 ... 31)		Parameter value (bit 0 ... 15)																																
0	1	1	1	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0

Figure 6-20 Telegram, to activate the automatic restart with p1210 = 26

Write request: Assign digital input 2 with the function ON/OFF1 (p0840[1] = 722.2)

In order to link digital input 2 with ON/OFF1, you must assign parameter p0840[1] (source, ON/OFF1) the value 722.2 (DI 2). To do this, you must populate the telegram of the parameter channel as follows:

- **PKE, bit 12 ... 15 (AK): = 7 hex** (change parameter value (field, word))
- **PKE, bit 0 ... 10 (PNU): = 348 hex** (840 = 348 hex, no offset, as 840 < 1999)
- **IND, bit 8 ... 15 (subindex): = 1 hex** (CDS1 = Index 1)
- **IND, bit 0 ... 7 (page index): = 0 hex** (offset 0 corresponds to 0 hex)
- **PWE1, Bit 0 ... 15: = 2D2 hex** (722 = 2D2 hex)
- **PWE2, Bit 10 ... 15: = 3F hex** (drive object - for SINAMICS G120, always 63 = 3f hex)
- **PWE2, Bit 0 ... 9: = 2 hex** (Index of Parameter (DI 2 = 2))

Parameter channel																																																																							
PKE, 1st word					IND, 2nd word					PWE1 - high, 3rd word					PWE2 - low, 4th word																																																								
15...12		11			10 ... 0			15 ... 8			7 ... 0		15 ... 0					15 ... 10		9 ... 0																																																			
AK		Parameter number			Subindex			Page index		Parameter value					Drive Object		Index																																																						
0	1	1	1	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0

Figure 6-21 Telegram, to assign DI 2 with ON/OFF1

6.5.8 Extending the telegram

Overview

When you have selected a telegram, the inverter interconnects the corresponding signals with the fieldbus interface. Generally, these interconnections are locked so that they cannot be changed. However, with the appropriate setting in the inverter, the telegram can be extended or even freely interconnected.

Extending the telegram

Procedure

1. Set p0922 = 999.
2. Set parameter p2079 to the value of the corresponding telegram.
The interconnections contained in the telegram are locked.
3. Extend the telegram by "attaching" additional signals.
Interconnect additional PZD send words and PZD receive words with signals of your choice via parameters r2050 and p2051.

You have extended the telegram.



Freely interconnecting signals in the telegram

Procedure

1. Set p0922 = 999.
2. Set p2079 = 999.
The interconnections contained in the telegram are enabled.
3. Interconnect additional PZD send words and PZD receive words with signals of your choice via parameters r2050 and p2051.

You have freely interconnected the signals transferred in the telegram.



Parameter

Parameter	Description
p0922	PROFIdrive telegram selection
	999: Free telegram (message frame) configuration

Parameter	Description
p2079	PROFIdrive PZD telegram selection extended
	1: Standard telegram 1, PZD-2/2
	20: Standard telegram 20, PZD-2/6
	350: SIEMENS telegram 350, PZD-4/4
	352: SIEMENS telegram 352, PZD-6/6
	353: SIEMENS telegram 353, PZD-2/2, PKW-4/4
	354: SIEMENS telegram 354, PZD-6/6, PKW-4/4
999: Free telegram configuring	
r2050[0...11]	PROFIdrive PZD receive word Received PZD (setpoints) in the word format
p2051[0...16]	PROFIdrive PZD send word Sent PZD (actual values) in the word format


For further information refer to the function diagrams 2468 and 2470 of the List Manual.

6.5.9 Slave-to-slave communication

Overview

"Direct data exchange" is sometimes called "slave-to-slave communication" or "data exchange broadcast". With direct data exchange, slaves exchange data without any direct involvement of the master.

Further information about the "Direct data exchange" function is provided in the Fieldbus function manual.

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6.5.10 Acyclically reading and writing inverter parameters

Overview

The inverter supports the writing and reading of parameters via acyclic communication:

- For PROFIBUS: Up to 240 bytes per write or read request via data set 47
- For PROFINET: Write or read requests via B02E hex and B02F hex

Further information about acyclic communication is provided in the Fieldbus function manual.

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Application example, "Read and write to parameters"

Further information is provided on the Internet:

 Application examples (<https://support.industry.siemens.com/cs/ww/en/view/29157692>)

6.6 Drive control via USS



USS is used to transfer cyclic process data and acyclic parameter data between precisely one master and up to 31 slaves. The inverter is always the slave, and sends data when requested to do so by the master. Slave-to-slave communication is not possible.

Settings for USS

Parameter	Explanation		
p2020	Fieldbus interface baudrate (Factory setting: 8)	4: 2400 baud 5: 4800 baud 6: 9600 baud 7: 19200 baud 8: 38400 baud	9: 57600 baud 10: 76800 baud 11: 93750 baud 12: 115200 baud 13: 187500 baud
p2021	Fieldbus interface address (Factory setting: 0) Valid addresses: 0 ... 30. The parameter is only active if address 0 is set at the Control Unit address switch. A change only becomes effective after the inverter power supply has been switched off and switched on again.		
p2022	Fieldbus interface USS PZD number (Factory setting: 2)		
p2023	Fieldbus interface USS PKW number (Factory setting: 127)	0: PKW 0 words 3: PKW 3 words 4: PKW 4 words 127: PKW variable	
p2024	Fieldbus interface times (Factory setting: [0] 1000 ms, [1] 0 ms, [2] 0 ms)	[0] Maximum permissible telegram processing time of the Modbus slave [1] Character delay time [2] dead time between two telegrams	
r2029	Fieldbus interface error statistics	[0] number of error-free telegrams [1] number of rejected telegrams [2] number of framing errors [3] number of overrun errors	[4] number of parity errors [5] number of starting character errors [6] number of checksum errors [7] number of length errors
p2030 = 1	Fieldbus interface protocol selection: USS		
p2031	Fieldbus interface Modbus parity (Factory setting: 2)	0: No parity 1: Odd parity 2: Even parity	
p2040	Fieldbus interface monitoring time (Factory setting: 100 ms) p2040 = 0: The monitoring is deactivated		

Control word 1 (STW1)

Bit	Significance	Explanation	Signal inter-connection in the inverter
0	0 = OFF1	The motor brakes with the ramp-down time p1121 of the ramp-function generator. The inverter switches off the motor at standstill.	p0840[0] = r2090.0
	0 → 1 = ON	The inverter goes into the "ready" state. If, in addition bit 3 = 1, then the inverter switches on the motor.	
1	0 = OFF2	Switch off the motor immediately, the motor then coasts down to a standstill.	p0844[0] = r2090.1
	1 = No OFF2	The motor can be switched on (ON command).	
2	0 = Quick stop (OFF3)	Quick stop: The motor brakes with the OFF3 ramp-down time p1135 down to standstill.	p0848[0] = r2090.2
	1 = No quick stop (OFF3)	The motor can be switched on (ON command).	
3	0 = Inhibit operation	Immediately switch-off motor (cancel pulses).	p0852[0] = r2090.3
	1 = Enable operation	Switch-on motor (pulses can be enabled).	
4	0 = Disable RFG	The inverter immediately sets its ramp-function generator output to 0.	p1140[0] = r2090.4
	1 = Do not disable RFG	The ramp-function generator can be enabled.	
5	0 = Stop RFG	The output of the ramp-function generator stops at the actual value.	p1141[0] = r2090.5
	1 = Enable RFG	The output of the ramp-function generator follows the setpoint.	
6	0 = Inhibit setpoint	The inverter brakes the motor with the ramp-down time p1121 of the ramp-function generator.	p1142[0] = r2090.6
	1 = Enable setpoint	Motor accelerates with the ramp-up time p1120 to the setpoint.	
7	0 → 1 = Acknowledge faults	Acknowledge fault. If the ON command is still active, the inverter switches to the "switching on inhibited" state.	p2103[0] = r2090.7
8, 9	Reserved		
10	0 = No control via PLC	Inverter ignores the process data from the fieldbus.	p0854[0] = r2090.10
	1 = Control via PLC	Control via fieldbus, inverter accepts the process data from the fieldbus.	
11	1 = Direction reversal	Invert setpoint in the inverter.	p1113[0] = r2090.11
12	Reserved		
13	1 = MOP up	Increase the setpoint saved in the motorized potentiometer.	p1035[0] = r2090.13
14	1 = MOP down	Reduce the setpoint saved in the motorized potentiometer.	p1036[0] = r2090.14
15	Reserved		


Status word 1 (ZSW1)

Bit	Significance	Remarks	Signal inter-connection in the inverter
0	1 = Ready for switching on	Power supply switched on; electronics initialized; pulses locked.	p2080[0] = r0899.0
1	1 = Ready	Motor is switched on (ON/OFF1 = 1), no fault is active. With the command "Enable operation" (STW1.3), the inverter switches on the motor.	p2080[1] = r0899.1
2	1 = Operation enabled	Motor follows setpoint. See control word 1, bit 3.	p2080[2] = r0899.2
3	1 = Fault active	The inverter has a fault. Acknowledge fault using STW1.7.	p2080[3] = r2139.3
4	1 = OFF2 inactive	Coast down to standstill is not active.	p2080[4] = r0899.4
5	1 = OFF3 inactive	Quick stop is not active.	p2080[5] = r0899.5
6	1 = Switching on inhibited active	It is only possible to switch on the motor after an OFF1 followed by ON.	p2080[6] = r0899.6
7	1 = Alarm active	Motor remains switched on; no acknowledgment is necessary.	p2080[7] = r2139.7
8	1 = Speed deviation within the tolerance range	Setpoint / actual value deviation within the tolerance range.	p2080[8] = r2197.7
9	1 = Master control requested	The automation system is requested to accept the inverter control.	p2080[9] = r0899.9
10	1 = Comparison speed reached or exceeded	Speed is greater than or equal to the corresponding maximum speed.	p2080[10] = r2199.1
11	1 = Torque limit not reached	Comparison value for current or torque has been fallen below.	p2080[11] = r0056.13 / r1407.7
12	Reserved		p2080[12] = r0899.12
13	0 = Alarm, motor overtemperature	--	p2080[13] = r2135.14
14	1 = Motor rotates clockwise	Internal inverter actual value > 0	p2080[14] = r2197.3
	0 = Motor rotates counter-clockwise	Internal inverter actual value < 0	
15	0 = Alarm, inverter thermal overload		p2080[15] = r2135.15

¹⁾ If you change over from another telegram to telegram 20, then the assignment of the previous telegram is kept.

Further information

Further information about USS is provided in the "Fieldbus" function manual.

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6.7 Drive control via Modbus RTU



Modbus RTU is used to transfer cyclic process data and acyclic parameter data between precisely one master and up to 247 slaves. The inverter is always the slave, and sends data when requested to do so by the master. Slave-to-slave communication is not possible.

Settings for Modbus RTU

Parameter	Explanation		
p2020	Fieldbus interface baudrate (Factory setting: 7)	5: 4800 baud 6: 9600 baud 7: 19200 baud 8: 38400 baud 9: 57600 baud	10: 76800 baud 11: 93750 baud 12: 115200 baud 13: 187500 baud
p2021	Fieldbus interface address (Factory setting: 1) Valid addresses: 1 ... 247. The parameter is only active if address 0 is set at the Control Unit address switch. A change only becomes effective after the inverter power supply has been switched off and switched on again.		
p2024	Fieldbus interface times (Factory setting: [0] 1000 ms, [2] 0 ms)	[0] Maximum permissible telegram processing time of the Modbus slave [2] dead time between two telegrams	
r2029	Fieldbus interface error statistics	[0] number of error-free telegrams [1] number of rejected telegrams [2] number of framing errors [3] number of overrun errors	[4] number of parity errors [5] number of starting character errors [6] number of checksum errors [7] number of length errors
p2030 = 2	Fieldbus interface protocol selection: Modbus RTU		
p2031	Fieldbus interface Modbus parity (Factory setting: 2)	0: No parity 1: Odd parity 2: Even parity	
p2040	Fieldbus interface monitoring time (Factory setting: 10 s) p2040 = 0: The monitoring is deactivated		

Control word 1 (STW1)

Bit	Significance	Explanation	Signal inter-connection in the inverter
0	0 = OFF1	The motor brakes with the ramp-down time p1121 of the ramp-function generator. The inverter switches off the motor at standstill.	p0840[0] = r2090.0
	0 → 1 = ON	The inverter goes into the "ready" state. If, in addition bit 3 = 1, then the inverter switches on the motor.	

Bit	Significance	Explanation	Signal inter-connection in the inverter
1	0 = OFF2	Switch off the motor immediately, the motor then coasts down to a standstill.	p0844[0] = r2090.1
	1 = No OFF2	The motor can be switched on (ON command).	
2	0 = Quick stop (OFF3)	Quick stop: The motor brakes with the OFF3 ramp-down time p1135 down to standstill.	p0848[0] = r2090.2
	1 = No quick stop (OFF3)	The motor can be switched on (ON command).	
3	0 = Inhibit operation	Immediately switch-off motor (cancel pulses).	p0852[0] = r2090.3
	1 = Enable operation	Switch-on motor (pulses can be enabled).	
4	0 = Disable RFG	The inverter immediately sets its ramp-function generator output to 0.	p1140[0] = r2090.4
	1 = Do not disable RFG	The ramp-function generator can be enabled.	
5	0 = Stop RFG	The output of the ramp-function generator stops at the actual value.	p1141[0] = r2090.5
	1 = Enable RFG	The output of the ramp-function generator follows the setpoint.	
6	0 = Inhibit setpoint	The inverter brakes the motor with the ramp-down time p1121 of the ramp-function generator.	p1142[0] = r2090.6
	1 = Enable setpoint	Motor accelerates with the ramp-up time p1120 to the setpoint.	
7	0 → 1 = Acknowledge faults	Acknowledge fault. If the ON command is still active, the inverter switches to the "switching on inhibited" state.	p2103[0] = r2090.7
8, 9	Reserved		
10	0 = No control via PLC	Inverter ignores the process data from the fieldbus.	p0854[0] = r2090.10
	1 = Control via PLC	Control via fieldbus, inverter accepts the process data from the fieldbus.	
11	1 = Direction reversal	Invert setpoint in the inverter.	p1113[0] = r2090.11
12	Reserved		
13	1 = MOP up	Increase the setpoint saved in the motorized potentiometer.	p1035[0] = r2090.13
14	1 = MOP down	Reduce the setpoint saved in the motorized potentiometer.	p1036[0] = r2090.14
15	Reserved		

Status word 1 (ZSW1)


Bit	Significance	Remarks	Signal inter-connection in the inverter
0	1 = Ready for switching on	Power supply switched on; electronics initialized; pulses locked.	p2080[0] = r0899.0
1	1 = Ready	Motor is switched on (ON/OFF1 = 1), no fault is active. With the command "Enable operation" (STW1.3), the inverter switches on the motor.	p2080[1] = r0899.1

Bit	Significance	Remarks	Signal inter-connection in the inverter
2	1 = Operation enabled	Motor follows setpoint. See control word 1, bit 3.	p2080[2] = r0899.2
3	1 = Fault active	The inverter has a fault. Acknowledge fault using STW1.7.	p2080[3] = r2139.3
4	1 = OFF2 inactive	Coast down to standstill is not active.	p2080[4] = r0899.4
5	1 = OFF3 inactive	Quick stop is not active.	p2080[5] = r0899.5
6	1 = Switching on inhibited active	It is only possible to switch on the motor after an OFF1 followed by ON.	p2080[6] = r0899.6
7	1 = Alarm active	Motor remains switched on; no acknowledgment is necessary.	p2080[7] = r2139.7
8	1 = Speed deviation within the tolerance range	Setpoint / actual value deviation within the tolerance range.	p2080[8] = r2197.7
9	1 = Master control requested	The automation system is requested to accept the inverter control.	p2080[9] = r0899.9
10	1 = Comparison speed reached or exceeded	Speed is greater than or equal to the corresponding maximum speed.	p2080[10] = r2199.1
11	1 = Torque limit not reached	Comparison value for current or torque has been fallen below.	p2080[11] = r0056.13 / r1407.7
12	Reserved		p2080[12] = r0899.12
13	0 = Alarm, motor overtemperature	--	p2080[13] = r2135.14
14	1 = Motor rotates clockwise	Internal inverter actual value > 0	p2080[14] = r2197.3
	0 = Motor rotates counter-clockwise	Internal inverter actual value < 0	
15	0 = Alarm, inverter thermal overload		p2080[15] = r2135.15

¹⁾ If you change over from another telegram to telegram 20, then the assignment of the previous telegram is kept.

Further information

Further information about Modbus RTU is provided in the "Fieldbus" function manual.

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6.8 Drive control via Ethernet/IP



EtherNet/IP is an Ethernet-based fieldbus. EtherNet/IP is used to transfer cyclic process data as well as acyclic parameter data.

Settings for Ethernet/IP

Parameter	Explanation		
p2030 = 10	Fieldbus interface protocol selection: Ethernet/IP		
p8920	PN Name of Station		
p8921	PN IP address (Factory setting: 0)		
p8922	PN default gateway (factory setting: 0)		
p8923	PN Subnet Mask (Factory setting: 0)		
p8924	PN DHCP mode (Factory setting: 0)	0: DHCP off 2: DHCP on, identification based on MAC address 3: DHCP on, identification based on Name of Station	
p8925	PN interface configuration (Factory setting: 0)	0: No function 1: Reserved 2: Save the configuration and activate 3: Delete configuration	
p8980	Ethernet/IP profile (Factory setting: 0) A change only becomes effective after the inverter power supply has been switched off and switched on again.	0: SINAMICS 1: ODVA AC/DC	
p8982	Ethernet/IP ODVA speed scaling (Factory setting: 128) A change only becomes effective after the inverter power supply has been switched off and switched on again.		
	123: 32	127: 2	131: 0.125
	124: 16	128: 1	132: 0.0625
	125: 8	129: 0.5	133: 0.03125
	126: 4	130: 0.25	

Further information

Further information about USS is provided in the "Fieldbus" function manual.



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6.9 Drive control via BACnet MS/TP

Settings for BACnet MS/TP

Parameter	Explanation		
p2020	Fieldbus interface baudrate (Factory setting: 8)	6: 9600 baud 7: 19200 baud	8: 38400 baud 10: 76800 baud
p2021	Fieldbus interface address (Factory setting: 1) Valid addresses: 0 ... 127. The parameter is only active if address 0 is set at the Control Unit address switch. A change only becomes active after the inverter power supply is switched off and switched on again.		
p2024	Fieldbus interface times	[0] maximum permissible processing time (APDU timeout)	
p2025	Fieldbus SS BACnet settings	[0] = device object instance number [1] = info maximum number frames [2] = APDU number of retries [3] = maximum master address	
p2026	Fieldbus interface BACnet COV increment Change in value at which point the inverter sends and UnConfirmedCOVNotification or and ConfirmedCOVNotification.		
r2029	Fieldbus interface error statistics	[0] number of error-free telegrams [1] number of rejected telegrams [2] number of framing errors [3] number of overrun errors	[4] number of parity errors [5] number of starting character errors [6] number of checksum errors [7] number of length errors
p2030 = 5	Fieldbus interface protocol selection p0015 = 110 sets p2013 = 5 → BACnet MS/TP		
p2040	Fieldbus interface monitoring time (Factory setting: 10 s) p2040 = 0: Monitoring is deactivated		

Control word 1 (STW1)

Bit	Significance	Explanation	BACNet	Signal inter-connection in the inverter
0	0 = OFF1	The motor brakes with the ramp-down time p1121 of the ramp-function generator. The inverter switches off the motor at standstill.	BV20	p0840[0] = r2090.0
	0 → 1 = ON	The inverter goes into the "ready" state. If, in addition bit 3 = 1, then the inverter switches on the motor.		

Bit	Significance	Explanation	BACNet	Signal inter-connection in the inverter
1	0 = OFF2	Switch off the motor immediately, the motor then coasts down to a standstill.	BV27	p0844[0] = r2090.1
	1 = No OFF2	The motor can be switched on (ON command).		
2	0 = Quick stop (OFF3)	Quick stop: The motor brakes with the OFF3 ramp-down time p1135 down to standstill.	BV28	p0848[0] = r2090.2
	1 = No quick stop (OFF3)	The motor can be switched on (ON command).		
3	0 = Inhibit operation	Immediately switch-off motor (cancel pulses).	BV26	p0852[0] = r2090.3
	1 = Enable operation	Switch-on motor (pulses can be enabled).		
4	0 = Disable RFG	The inverter immediately sets its ramp-function generator output to 0.	BV26	p1140[0] = r2090.4
	1 = Do not disable RFG	The ramp-function generator can be enabled.		
5	0 = Stop RFG	The output of the ramp-function generator stops at the actual value.	BV26	p1141[0] = r2090.5
	1 = Enable RFG	The output of the ramp-function generator follows the setpoint.		
6	0 = Inhibit setpoint	The inverter brakes the motor with the ramp-down time p1121 of the ramp-function generator.	BV26	p1142[0] = r2090.6
	1 = Enable setpoint	Motor accelerates with the ramp-up time p1120 to the setpoint.		
7	0 → 1 = Acknowledge faults	Acknowledge fault. If the ON command is still active, the inverter switches to the "switching on inhibited" state.	BV22	p2103[0] = r2090.7
8, 9	Reserved		N/A	---
10	0 = No control via PLC	Inverter ignores the process data from the fieldbus.	BV93	p0854[0] = r2090.10
	1 = Control via PLC	Control via fieldbus, inverter accepts the process data from the fieldbus.		
11	1 = Direction reversal	Invert setpoint in the inverter.	BV21	p1113[0] = r2090.11
12	Reserved		N/A	---
13	1 = MOP up	Increase the setpoint saved in the motorized potentiometer.	N/A	p1035[0] = r2090.13
14	1 = MOP down	Reduce the setpoint saved in the motorized potentiometer.	N/A	p1036[0] = r2090.14
15	Reserved		N/A	---


Status word 1 (ZSW1)

Bit	Significance	Remarks	Signal interconnection in the inverter
0	1 = Ready for switching on	Power supply switched on; electronics initialized; pulses locked.	p2080[0] = r0899.0
1	1 = Ready	Motor is switched on (ON/OFF1 = 1), no fault is active. With the command "Enable operation" (STW1.3), the inverter switches on the motor.	p2080[1] = r0899.1
2	1 = Operation enabled	Motor follows setpoint. See control word 1, bit 3.	p2080[2] = r0899.2
3	1 = Fault active	The inverter has a fault. Acknowledge fault using STW1.7.	p2080[3] = r2139.3
4	1 = OFF2 inactive	Coast down to standstill is not active.	p2080[4] = r0899.4
5	1 = OFF3 inactive	Quick stop is not active.	p2080[5] = r0899.5
6	1 = Switching on inhibited active	It is only possible to switch on the motor after an OFF1 followed by ON.	p2080[6] = r0899.6
7	1 = Alarm active	Motor remains switched on; no acknowledgement is necessary.	p2080[7] = r2139.7
8	1 = Speed deviation within the tolerance range	Setpoint / actual value deviation within the tolerance range.	p2080[8] = r2197.7
9	1 = Master control requested	The automation system is requested to accept the inverter control.	p2080[9] = r0899.9
10	1 = Comparison speed reached or exceeded	Speed is greater than or equal to the corresponding maximum speed.	p2080[10] = r2199.1
11	1 = Torque limit not reached	Comparison value for current or torque has been fallen below.	p2080[11] = r0056.13 / r1407.7
12	Reserved		p2080[12] = r0899.12
13	0 = Alarm, motor overtemperature	--	p2080[13] = r2135.14
14	1 = Motor rotates clockwise	Internal inverter actual value > 0	p2080[14] = r2197.3
	0 = Motor rotates counter-clockwise	Internal inverter actual value < 0	
15	0 = Alarm, inverter thermal overload		p2080[15] = r2135.15

1) If you change over from another telegram to telegram 20, then the assignment of the previous telegram is kept.

Further information

You can find additional information about BACnet MS/TP in the "Fieldbus" function manual:

 Overview of the manuals (Page 538).

6.10 Drive control via P1

Settings for P1

Parameter	Explanation	
p2020	Fieldbus interface baudrate (Factory setting: 5)	5: 4800 baud 6: 9600 baud 7: 19200 baud
p2021	Fieldbus interface address (Factory setting: 99) Valid addresses: 1 ... 99. The parameter is only active if address 0 is set at the Control Unit address switch. A change only becomes effective after the inverter power supply has been switched off and switched on again.	
p2024	Fieldbus interface times (Factory setting: [0] 1000 ms, [1] 0 ms, [2] 0 ms)	[0] Maximum permissible telegram processing time of the Modbus slave [1] Character delay time [2] Dead time between two telegrams
r2029	Fieldbus interface error statistics	[0] number of error-free telegrams [1] number of rejected telegrams [2] number of framing errors [3] number of overrun errors [4] number of parity errors [5] number of starting character errors [6] number of checksum errors [7] number of length errors
p2030 = 8	Fieldbus interface protocol selection: P1	
p2040	Fieldbus interface monitoring time (Factory setting: 100 ms) p2040 = 0: The monitoring is deactivated	

Further information

Further information about P1 is provided in the "Fieldbus" function manual.

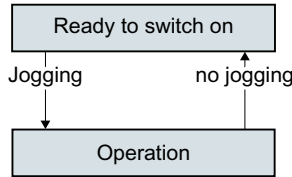


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6.11 Jogging



The "Jog" function is typically used to temporarily move a machine part using local control commands, e.g. a transport conveyor belt.



Commands "Jog 1" or "Jog: 2" switch the motor on and off.

The commands are only active when the inverter is in the "Ready for switching on" state.

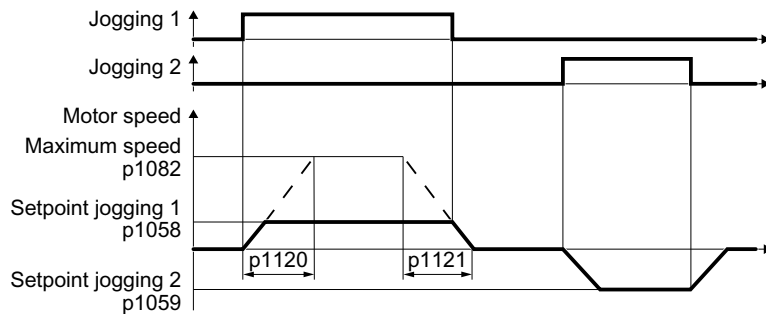


Figure 6-22 Behavior of the motor when "jogging"

After switching on, the motor accelerates to the setpoint, jog 1 or setpoint, jog 2. The two different setpoints can, for example, be assigned to motor clockwise and counter-clockwise rotation.

When jogging, the same ramp-function generator is active as for the ON/OFF1 command.

Jog settings

Parameter	Description	
p1058	Jogging 1 speed setpoint (factory setting 150 rpm)	
p1059	Jogging 2 speed setpoint (factory setting -150 rpm)	
p1082	Maximum speed (factory setting 1500 rpm)	
p1110	Inhibit negative direction	
	=0: Negative direction of rotation is enabled	=1: Negative direction of rotation is inhibited
p1111	Inhibit positive direction	
	=0: Positive direction of rotation is enabled	=1: Positive direction of rotation is inhibited
p1113	Setpoint inversion	
	=0: Setpoint is not inverted	=1: Setpoint is inverted
p1120	Ramp-function generator ramp-up time (factory setting 10 s)	
p1121	Ramp-function generator ramp-down time (factory setting 10 s)	

Parameter	Description
p1055 = 722.0	Jog bit 0: Select jogging 1 via digital input 0
p1056 = 722.1	Jog bit 1: Select jogging 2 via digital input 1

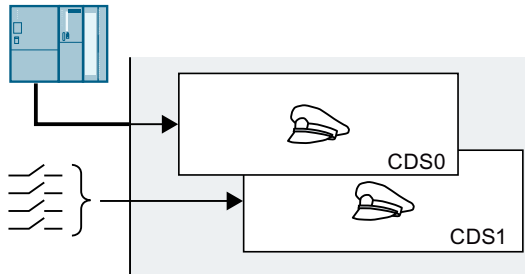
6.12 Switching over the drive control (command data set)



Several applications require the option of switching over the control authority to operate the inverter.

Example: The motor is to be operable either from a central control via the fieldbus or via the local digital inputs of the inverter.

Command data set (CDS)



This means that you can set the inverter control in various ways and toggle between the settings. For instance, as described above, the inverter can either be operated via a fieldbus or via its digital inputs.

The settings in the inverter, which are assigned to a specific master control, are termed the command data set.

You select the command data set using parameter p0810. To do this, you must interconnect parameter p0810 with a control command of your choice, e.g. a digital input.

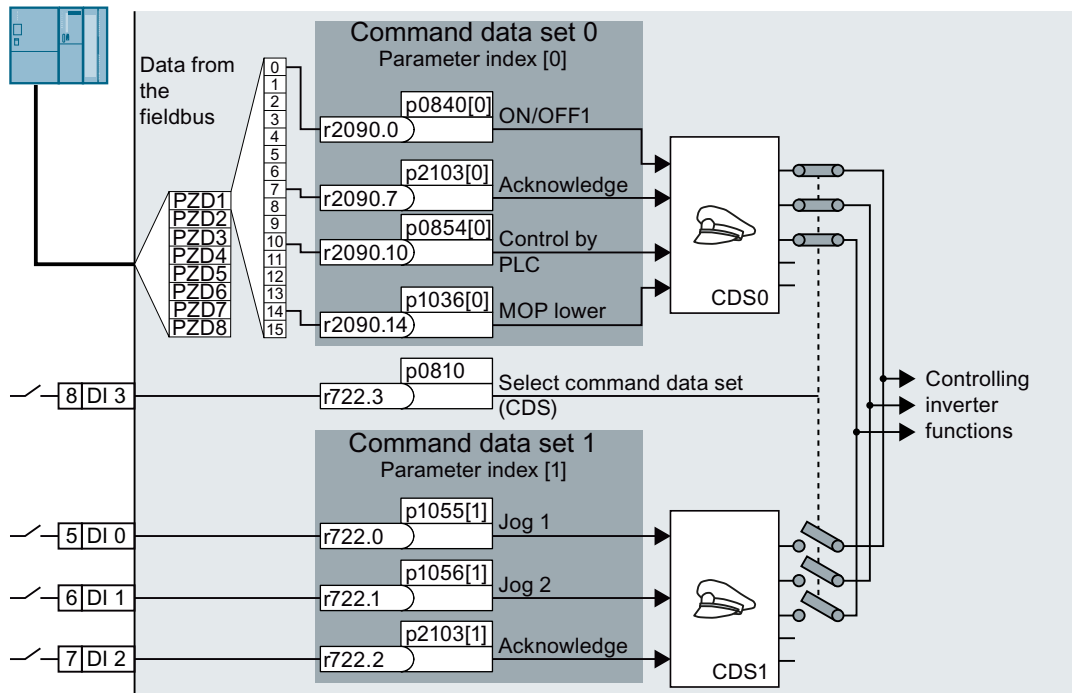


Figure 6-23 Example: Switching over the control via terminal strip to control via PROFIBUS or PROFINET

An overview of all the parameters that belong to the command data sets is provided in the List Manual.

Note

It takes approximately 4 ms to toggle between command data sets.

Changing the number of command data sets

Procedure

1. Set p0010 = 15.
2. The number of command data sets is configured with p0170.
3. Set p0010 = 0.

You have changed the number of command data sets.



Copying command data sets

Procedure

1. Set p0809[0] to the number of the command data set whose settings you wish to copy (source).
2. Set p0809[1] to the number of the command data set in which you wish to copy the settings.
3. Set p0809[2] = 1
4. The inverter sets p0809[2] = 0.

You have copied the settings of a command data set into another command data set.



Parameter

Parameter	Description
p0010	Drive commissioning parameter filter
r0050	Command data set CDS active Displays the number of the currently active command data set
p0170	Number of command data sets (CDS) (factory setting: 2) p0170 = 2, 3 or 4
p0809[0]	Copying the command data set CDS (factory setting: 0) [0] Source command data set [1] Target command data set [2] 0→1: Starts the copy operation
p0810	Command data set selection CDS bit 0
p0811	Command data set selection CDS bit 1

6.13 Free function blocks

6.13.1 Overview



The free function blocks permit configurable signal processing in the inverter.

The following free function blocks are available:

- AND, OR, XOR, and NOT logic
- RSR (RS flip-flop), DSR (D flip-flop) flip-flops
- Timers MFP (pulse generator), PCL (pulse shortening), PDE (ON delay), PDF (OFF delay), and PST (pulse stretching)
- ADD (adder), SUB (subtractor), MUL (multiplier), DIV (divider), AVA (absolute value generated), NCM (comparator), and PLI (polyline) arithmetic functions
- LIM (limiter), PT1 (smoothing), INT (integrator), DIF (differentiator) controllers
- NSW (analog) BSW (binary) switches
- LVM limit value monitoring

The number of free function blocks in the inverter is limited. You can only use a function block once. The inverter has 3 adders, for instance. If you have already configured three adders, then no other adders are available.

Application description for the free function blocks

Further information is provided on the Internet:

 FAQ (<http://support.automation.siemens.com/WW/view/en/85168215>)

6.14 Physical units

6.14.1 Motor standard

Selection options and parameters involved



The inverter represents the motor data corresponding to motor standard IEC or NEMA in different system units: SI units or US units.

Table 6-30 Parameters involved when selecting the motor standard

Parameter	Designation	Motor standard IEC/NEMA, p0100 =		
		0 ¹⁾ IEC motor 50 Hz, SI units	1 NEMA motor 60 Hz, US units	2 NEMA motor 60 Hz, SI units
r0206	Power Module rated power	kW	hp	kW
p0219	Braking resistor braking power	kW	hp	kW
p0307	Rated motor power	kW	hp	kW
p0316	Motor torque constant	Nm/A	lbf ft/A	Nm/A
r0333	Rated motor torque	Nm	lbf ft	Nm
p0341	Motor moment of inertia	kgm ²	lb ft ²	kgm ²
p0344	Motor weight	kg	Lb	kg
r0394	Rated motor power	kW	hp	kW
r1493	Total moment of inertia, scaled	kgm ²	lb ft ²	kgm ²

¹⁾ Factory setting

It is only possible to change the motor standard during quick commissioning.

6.14.2 System of units

Some physical units depend on the system of units selected (SI or US), for example the power [kW or hp] or the torque [Nm or lbf ft]. You can select in which system of units the converter represents its physical values.

Options when selecting the system of units

The following options apply when selecting the system of units:

- p0505 = 1: System of units SI (factory setting)
Torque [Nm], power [kW], temperature [°C or K]
- p0505 = 2: Referred system of units/SI
Represented as [%]

6.14 Physical units

- p0505 = 3: US system of units
Torque [lbf ft], power [hp], temperature [°F]
- p0505 = 4: System of units, referred/US
Represented as [%]

Special features

The values for p0505 = 2 and for p0505 = 4 - represented in the converter - are identical. However, the reference to SI or US units is required for internal calculations and to output physical variables.

For variables, which cannot be represented as [%], then the following applies:

p0505 = 1 \triangleq p0505 = 2 and p0505 = 3 \triangleq p0505 = 4.

In the case of variables whose units are identical in the SI system and US system, and which can be displayed as a percentage, the following applies:

p0505 = 1 \triangleq p0505 = 3 and p0505 = 2 \triangleq p0505 = 4.

Reference variables

There is a reference variable in the converter for most parameters with physical units. When the referred representation [%] is set, then the converter scales the physical variables based on the particular reference variable.

When the reference variable changes, then the significance of the scaled value also changes. Example:

- Reference speed = 1500 rpm \rightarrow fixed speed = 80 % \triangleq 1200 rpm
- Reference speed = 3000 rpm \rightarrow fixed speed = 80 % \triangleq 2400 rpm

For each parameter you can find the associated reference variable for scaling in the List Manual. Example: r0065 is scaled with reference variable p2000.

If scaling is not specified in the List Manual, then the converter always represents/displays the parameter unscaled (not normalized).

Groups of units

The parameters associated with the selection of a physical unit, belong to different groups of units.

You can find the associated group of units in the List Manual for each parameter. Example: r0333 belongs to unit group 7_4.

An overview of the unit groups and the possible physical units can also be found in the List Manual.

6.14.3 Technological unit of the technology controller

Options when selecting the technological unit

p0595 defines in which technological unit the input and output variables of the technology controller are calculated, e.g. [bar], [m³/min] or [kg/h].


Reference variable

p0596 defines the reference variable of the technological unit for the technology controller.

Unit group

Parameters involved with p0595 belong to unit group 9_1.

Further information on this topic is provided in the List Manual.

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Special features

You must optimize the technology controller after changing p0595 or p0596.

Additional technology controllers

You can set the technological unit for each additional technology controller.

	Technological unit	Reference variable for the technological unit	Unit group
Additional technology controller 0	p11026	p11027	9_2
Additional technology controller 1	p11126	p11127	9_3
Additional technology controller 2	p11226	p11227	9_4

You will find more information in the List Manual.

6.14.4 Setting the system of units and technology unit

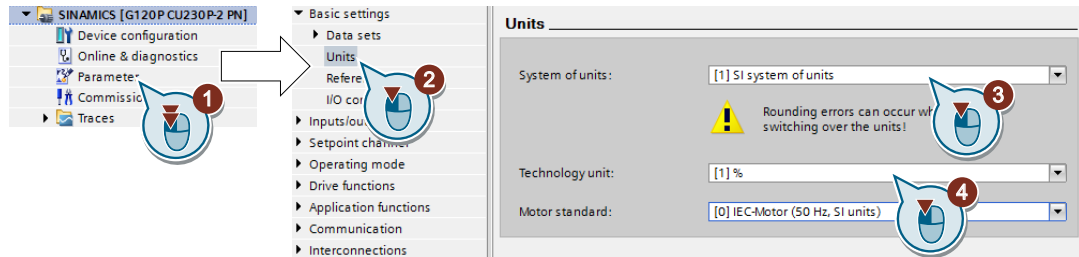
Setting using Startdrive

Precondition

You are offline with Startdrive.

Procedure

1. In the project, select "Parameter".
2. Select "Units".



3. Select the system of units.
4. Select the technological unit of the technology controller.
5. Save your settings.
6. Go online.
The inverter signals that offline, other units and process variables are set than in the inverter itself.
7. Accept these settings in the inverter.

You have selected the motor standard and system of units.

□

6.15 Setpoints

Overview



The inverter receives its main setpoint from the setpoint source. The main setpoint generally specifies the motor speed.

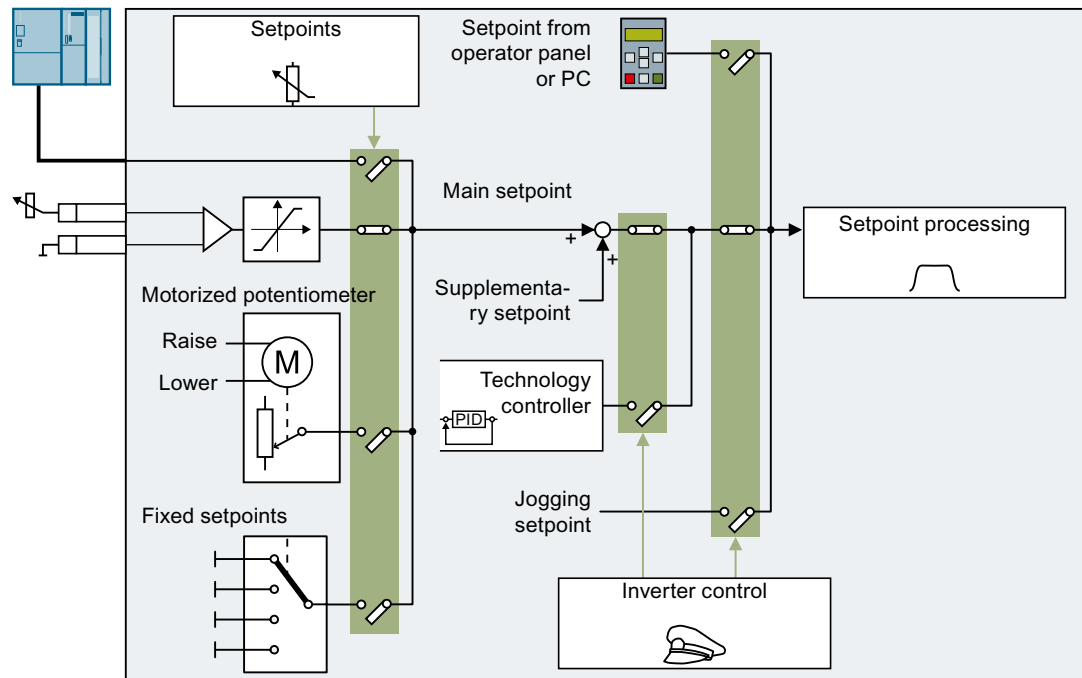


Figure 6-24 Setpoint sources for the inverter

You have the following options when selecting the source of the main setpoint:

- Inverter fieldbus interface
- Analog input of the inverter
- Motorized potentiometer emulated in the inverter
- Fixed setpoints saved in the inverter

You have the same selection options when selecting the source of the supplementary setpoint.

Under the following conditions, the inverter switches from the main setpoint to other setpoints:

- When the technology controller is active and appropriately interconnected, its output specifies the motor speed.
- When jogging is active
- When controlling from an operator panel or the STARTER PC tool.

Precondition

To change the function settings, you can use an operator panel or a PC tool, for example.

6.15.1 Analog input as setpoint source

Function description

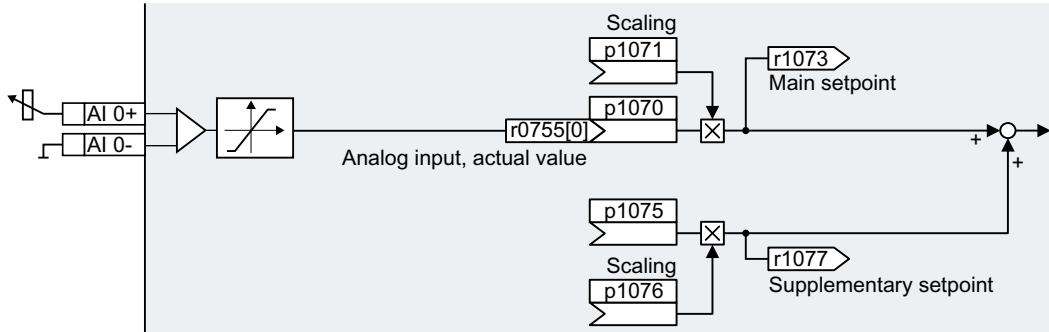


Figure 6-25 Example: Analog input 0 as setpoint source

In the quick commissioning, you define the preassignment for the inverter interfaces. Depending on what has been preassigned, after quick commissioning, the analog input can be interconnected with the main setpoint.

Example

Setting with analog input 0 as setpoint source:

Parameter	Description
p1070 = 755[0]	Interconnects main setpoint with analog input 0
p1075 = 755[0]	Interconnects supplementary setpoint with analog input 0

Parameter

Parameter	Description	Setting
r0755[0...1]	CO: CU analog inputs, actual value in percent	Displays the actual referenced input value of the analog inputs [0] = analog input 0 [1] = analog input 1
p1070[0...n]	CI: Main setpoint	Signal source for the main setpoint The factory setting depends on the inverter. Inverter with PROFIBUS or PROFINET interface: [0] 2050[1] Inverter without PROFIBUS or PROFINET interface: [0] 755[0]
p1071[0...n]	CI: Main setpoint scaling	Signal source for scaling the main setpoint Factory setting: 1
r1073	CO: Main setpoint active	Displays the active main setpoint
p1075[0...n]	CI: Supplementary setpoint	Signal source for the supplementary setpoint Factory setting: 0
p1076[0...n]	CI: Supplementary setpoint scaling	Signal source for scaling the supplementary setpoint Factory setting: 0

Further information

For further information refer to the function diagrams 2250 ff and 3030 of the List Manual.

6.15.2 Specifying the setpoint via the fieldbus

Function description

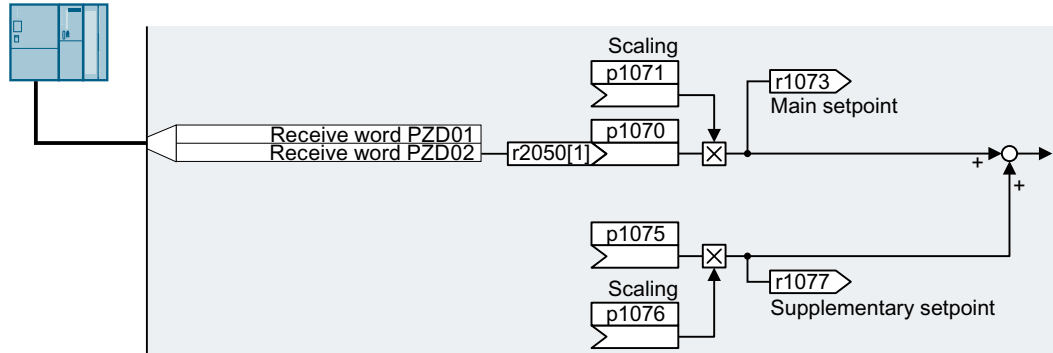


Figure 6-26 Fieldbus as setpoint source

In the quick commissioning, you define the preassignment for the inverter interfaces. Depending on what has been preassigned, after quick commissioning, the receive word PZD02 can be interconnected with the main setpoint.

Example

Setting with receive word PZD02 as setpoint source:

Parameter	Description
p1070 = 2050[1]	Interconnects the main setpoint with the receive word PZD02 from the fieldbus.
p1075 = 2050[1]	Interconnects the supplementary setpoint with receive word PZD02 from the fieldbus.

Parameter

Parameter	Description	Setting
p1070[0...n]	CI: Main setpoint	Signal source for the main setpoint The factory setting depends on the Control Unit. With PROFIBUS or PROFINET interface: [0] 2050[1] Without PROFIBUS or PROFINET interface: [0] 755[0]
p1071[0...n]	CI: Main setpoint scaling	Signal source for scaling the main setpoint Factory setting: 1
r1073	CO: Main setpoint active	Displays the active main setpoint
p1075[0...n]	CI: Supplementary setpoint	Signal source for the supplementary setpoint Factory setting: 0

Parameter	Description	Setting
p1076[0...n]	CI: Supplementary setpoint scaling	Signal source for scaling the supplementary setpoint Factory setting: 0
r2050[0...11]	CO: PROFIdrive PZD receive word	Connector output to interconnect the PZD received from the fieldbus controller in the word format. [1] Most standard telegrams receive the speed setpoint as receive word PZD02.

Further information

For further information refer to the function diagrams 2468, 9360 and 3030 of the List Manual.

6.15.3 Motorized potentiometer as setpoint source

Function description

The "Motorized potentiometer" function emulates an electromechanical potentiometer. The output value of the motorized potentiometer can be set with the "higher" and "lower" control signals.

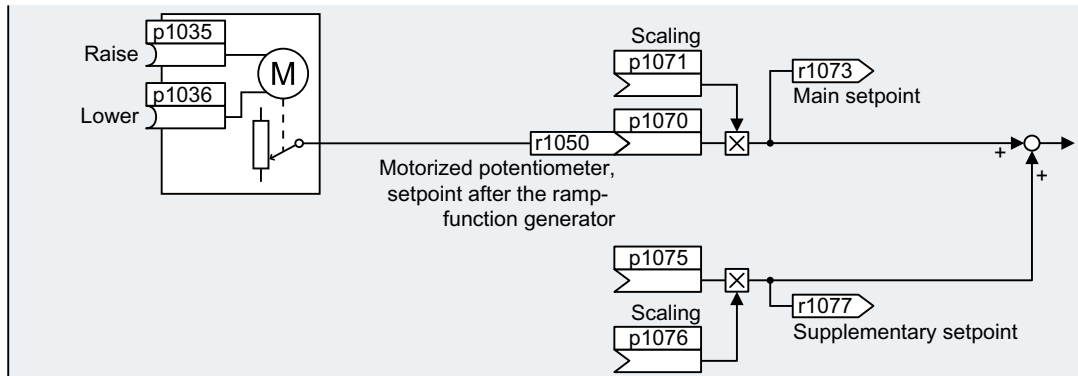


Figure 6-27 Motorized potentiometer as setpoint source

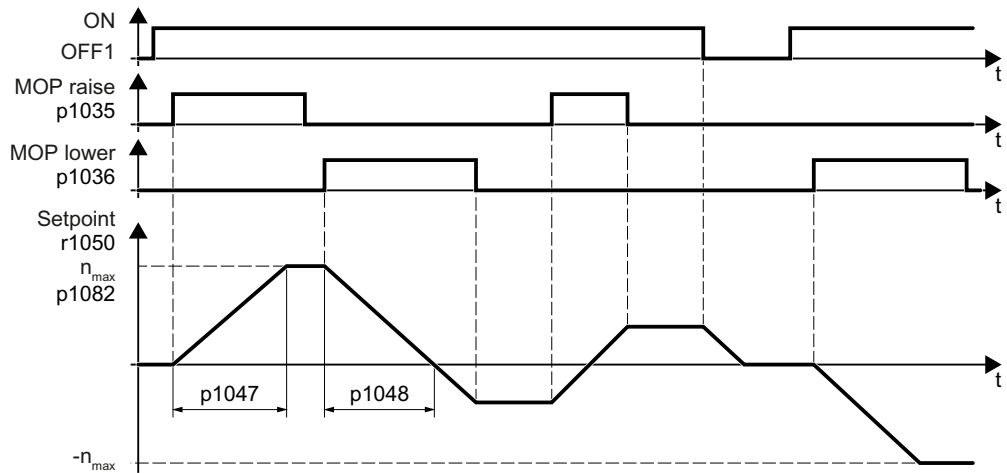


Figure 6-28 Function chart of the motorized potentiometer

Example

Setting with the motorized potentiometer as setpoint source:

Parameter	Description
p1070 = 1050	Interconnects the main setpoint with the motorized potentiometer output.

Parameter

Table 6-31 Basic setup of motorized potentiometer

Parameter	Description	Setting
p1035[0...n]	BI: Motorized potentiometer setpoint higher	Signal source to continuously increase the setpoint The factory setting depends on the inverter. Inverters with PROFIBUS or PROFINET interface: [0] 2090.13 [1] 0 Inverters without PROFIBUS or PROFINET interface: 0
p1036[0...n]	BI: Motorized potentiometer setpoint lower	Signal source to continuously decrease the setpoint The factory setting depends on the inverter. Inverters with PROFIBUS or PROFINET interface: [0] 2090.14 [1] 0 Inverters without PROFIBUS or PROFINET interface: 0
p1040[0...n]	Motorized potentiometer start value [rpm]	Start value that is effective when the motor is switched on. Factory setting: 0 rpm
p1047	MOP ramp-up time [s]	MOP ramp-up time Factory setting: 10 s
p1048	MOP ramp-down time [s]	MOP ramp-down time: Factory setting: 10 s
r1050	Motorized potentiometer, setpoint after the ramp-function generator	Motorized potentiometer, setpoint after the ramp-function generator
p1070[0...n]	CI: Main setpoint	Signal source for the main setpoint The factory setting depends on the Control Unit. With PROFIBUS or PROFINET interface: [0] 2050[1] Without PROFIBUS or PROFINET interface: [0] 755[0]
p1071[0...n]	CI: Main setpoint scaling	Signal source for scaling the main setpoint Factory setting: 1
r1073	CO: Main setpoint active	Displays the active main setpoint
p1075[0...n]	CI: Supplementary setpoint	Signal source for the supplementary setpoint Factory setting: 0
p1076[0...n]	CI: Supplementary setpoint scaling	Signal source for scaling the supplementary setpoint Factory setting: 0

Table 6-32 Extended setup of motorized potentiometer

Parameter	Description	Setting
p1030[0...n]	Motorized potentiometer configuration	<p>Configuration for the motorized potentiometer</p> <p>Factory setting: 00110 bin</p> <p>.00</p> <p>Storage active</p> <p>= 0: After the motor has been switched on, the setpoint = p1040</p> <p>= 1: After the motor has switched off, the inverter saves the setpoint. After the motor has switched on, the setpoint = the stored value</p> <p>.01</p> <p>Automatic mode, ramp-function generator active (1-signal via BI: p1041)</p> <p>= 0: Ramp-up/ramp-down time = 0</p> <p>= 1: With ramp-function generator</p> <p>In manual mode (p1041 = 0), the ramp-function generator is always active.</p> <p>.02</p> <p>Initial rounding active</p> <p>1: With initial rounding. Using the initial rounding function it is possible to enter very small setpoint changes</p> <p>.03</p> <p>Storage in NVRAM active</p> <p>1: If bit 00 = 1, the setpoint is retained during a power failure</p> <p>.04</p> <p>Ramp-function generator always active</p> <p>1: The inverter also calculates the ramp-function generator when the motor is switched off</p>
p1037[0...n]	Motorized potentiometer maximum speed [rpm]	<p>The inverter limits the motorized potentiometer output to p1037.</p> <p>Factory setting: 0 rpm</p> <p>After quick commissioning, the inverter sets the parameter to the appropriate value.</p>
p1038[0...n]	Motorized potentiometer minimum speed [rpm]	<p>The inverter limits the motorized potentiometer output to p1038.</p> <p>Factory setting: 0 rpm</p> <p>After quick commissioning, the inverter sets the parameter to the appropriate value.</p>
p1043[0...n]	BI: Motorized potentiometer, accept setting value	<p>Signal source for accepting the setting value. The motorized potentiometer accepts the setting value p1044 on signal change p1043 = 0 → 1.</p> <p>Factory setting: 0</p>
p1044[0...n]	CI: Motorized potentiometer, setting value	<p>Signal source for the setting value</p> <p>Factory setting: 0</p>

Further information

For more information about the motorized potentiometer, refer to function diagram 3020 in the List Manual.

6.15.4 Fixed speed setpoint as setpoint source

Function description

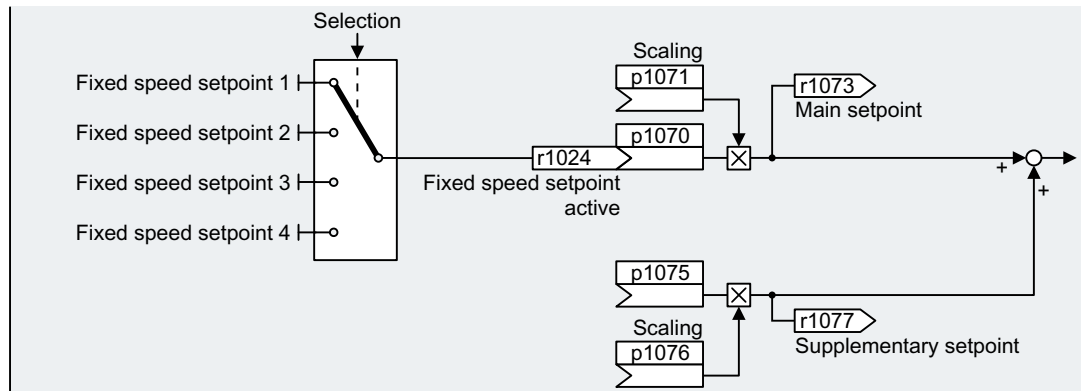


Figure 6-29 Fixed speed setpoint as setpoint source

The inverter makes a distinction between two methods when selecting the fixed speed setpoints:

Directly selecting a fixed speed setpoint

You set 4 different fixed speed setpoints. Up to 16 different setpoints are obtained by adding one or several of the four fixed speed setpoints.

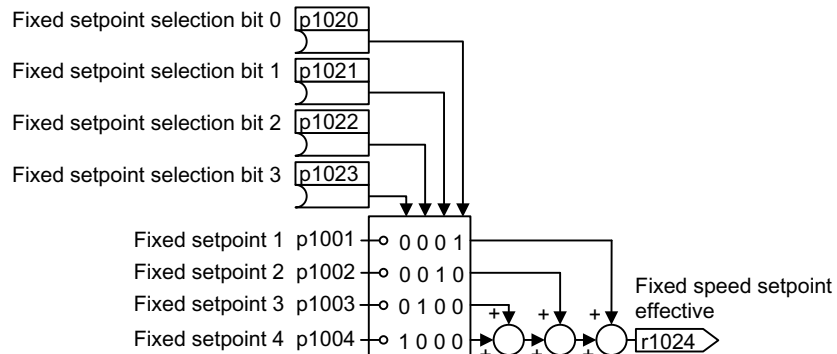


Figure 6-30 Direct selection of the fixed speed setpoint

Selecting the fixed speed setpoint, binary

You set 16 different fixed speed setpoints. You precisely select one of these 16 fixed speed setpoints by combining four selection bits.

6.15 Setpoints

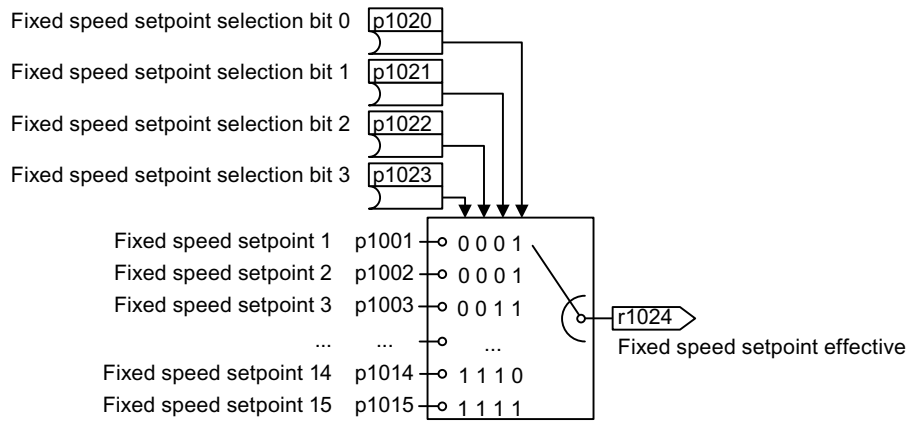


Figure 6-31 Binary selection of the fixed speed setpoint

Example

After it has been switched on, a conveyor belt only runs with two different velocities. The motor should now operate with the following corresponding speeds:

- The signal at digital input 0 switches the motor on and accelerates it up to 300 rpm.
- The signal at digital input 1 accelerates the motor up to 2000 rpm.
- With signals at both digital inputs, the motor accelerates up to 2300 rpm.

Table 6-33 Settings for the application example

Parameter	Description
p1001[0] = 300.000	Fixed speed setpoint 1 [rpm]
p1002[0] = 2000.000	Fixed speed setpoint 2 [rpm]
p0840[0] = 722.0	ON/OFF1: Switches on the motor with digital input 0
p1070[0] = 1024	Main setpoint: Interconnects the main setpoint with a fixed speed setpoint.
p1020[0] = 722.0	Fixed speed setpoint selection, bit 0: Interconnects fixed speed setpoint 1 with digital input 0 (DI 0).
p1021[0] = 722.1	Fixed speed setpoint selection, bit 1: Interconnects fixed speed setpoint 2 with digital input 1 (DI 1).
p1016 = 1	Fixed speed setpoint mode: Directly selects fixed speed setpoints.

Table 6-34 Resulting fixed speed setpoints for the application example

Fixed speed setpoint selected via	Resulting setpoint
DI 0 = 0	Motor stops
DI 0 = 1 and DI 1 = 0	300 rpm
DI 0 = 1 and DI 1 = 1	2300 rpm

Parameter

Parameter	Description	Setting
p1001[0...n]	Fixed speed setpoint 1 [rpm]	Fixed speed setpoint 1 Factory setting: 0 rpm
p1002[0...n]	Fixed speed setpoint 2 [rpm]	Fixed speed setpoint 2 Factory setting: 0 rpm
...
p1015[0...n]	Fixed speed setpoint 15 [rpm]	Fixed speed setpoint 15 Factory setting: 0 rpm
p1016	Fixed speed setpoint mode	Fixed speed setpoint mode Factory setting: 1 1: Direct 2: Binary
p1020[0...n]	Fixed speed setpoint selection, bit 0	Fixed speed setpoint selection, bit 0 Factory setting: 0
p1021[0...n]	Fixed speed setpoint selection, bit 1	Fixed speed setpoint selection, bit 1 Factory setting: 0
p1022[0...n]	Fixed speed setpoint selection, bit 2	Fixed speed setpoint selection, bit 2 Factory setting: 0
p1023[0...n]	Fixed speed setpoint selection, bit 3	Fixed speed setpoint selection, bit 3 Factory setting: 0
r1024	Fixed speed setpoint active	Fixed speed setpoint active
r1025.0	Fixed speed setpoint status	Fixed speed setpoint status 1 signal: Fixed speed setpoint is selected

Further information

Additional information about binary selection can be found in function diagram 3010 in the List Manual.

Additional information about direct selection can be found in function diagram 3011 in the List Manual.

6.16 Setpoint calculation

6.16.1 Overview

Overview



Setpoint processing influences the setpoint using the following functions:

- "Invert" inverts the motor direction of rotation.
- The "Inhibit direction of rotation" function prevents the motor from rotating in the incorrect direction; this function can make sense for conveyor belts, extruders, pumps and fans, for example.
- The "Skip frequency bands" prevent the motor from being continuously operated within these skip bands. This function avoids mechanical resonance effects by only permitting the motor to operate briefly at specific speeds.
- The "Speed limitation" function protects the motor and the driven load against excessively high speeds.
- The "Ramp-function generator" function prevents the setpoint from suddenly changing. As a consequence, the motor accelerates and brakes with a reduced torque.

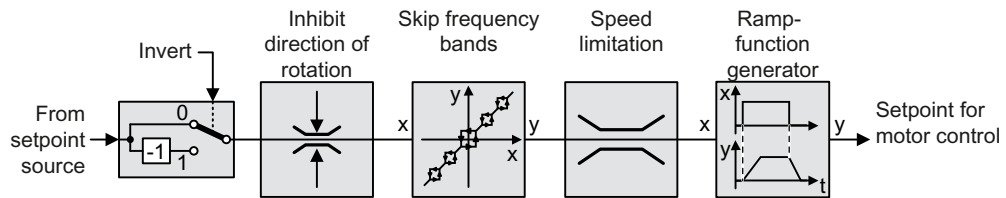
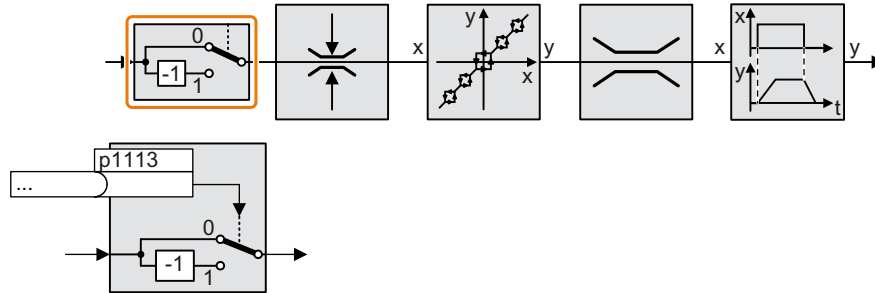


Figure 6-32 Setpoint processing in the inverter

6.16.2 Invert setpoint

Function description



The function inverts the sign of the setpoint using a binary signal.

Example

To invert the setpoint via an external signal, interconnect parameter p1113 with a binary signal of your choice.

Table 6-35 Application examples showing how a setpoint is inverted

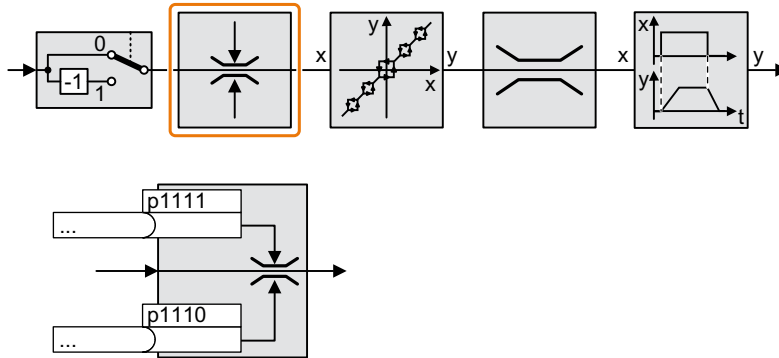
Parameter	Description
p1113 = 722.1	Digital input 1 = 0: Setpoint remains unchanged. Digital input 1 = 1: Inverter inverts the setpoint.
p1113 = 2090.11	Inverts the setpoint via the fieldbus (control word 1, bit 11).

Parameter

Parameter	Description	Setting
p1113[0...n]	BI: Setpoint inversion	Signal source for inverting the setpoint 1 signal: Invert setpoint The factory setting depends on the fieldbus interface.

6.16.3 Enable direction of rotation

In the factory setting of the inverter, the negative direction of rotation of the motor is inhibited.



If you want to permanently enable the negative direction of rotation, then set parameter p1110 to 0.

Set parameter p1111 = 1 to permanently inhibit the positive direction of rotation.


Table 6-36 Application examples for inhibiting and enabling the direction of rotation

Parameter	Remark
p1110	Inhibit negative direction (factory setting: 1) 0 signal: Direction of rotation is enabled 1 signal: Direction of rotation is locked
	p1110 = 0 Negative direction of rotation is permanently enabled.
	p1110 = 722.3 Digital input 3 = 0: Negative direction of rotation is enabled. Digital input 3 = 1: Negative direction of rotation is inhibited.
p1111	Inhibit positive direction (factory setting: 0) 0 signal: Direction of rotation is enabled 1 signal: Direction of rotation is locked

6.16.4 Skip frequency bands and minimum speed

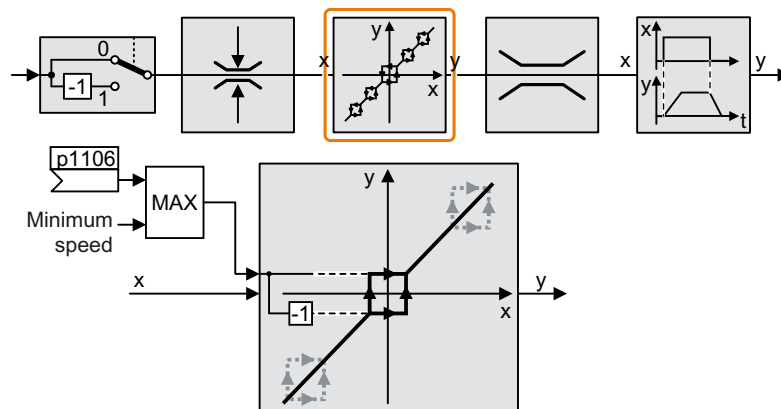
Skip frequency bands

The inverter has four skip frequency bands that prevent continuous motor operation within a specific speed range. Further information is provided in function diagram 3050 of the List Manual.

 Overview of the manuals (Page 538)

Minimum speed

The inverter prevents continuous motor operation at speeds $<$ minimum speed.



Speeds where the absolute value is less than the minimum speed are only possible during motor operation when accelerating or braking.

Table 6-37 Setting the minimum speed

Parameter	Description
p1080	Minimum speed (factory setting: 0 rpm)
p1106	CI: Minimum speed signal source (factory setting: 0) Dynamic specification of the minimum speed

NOTICE

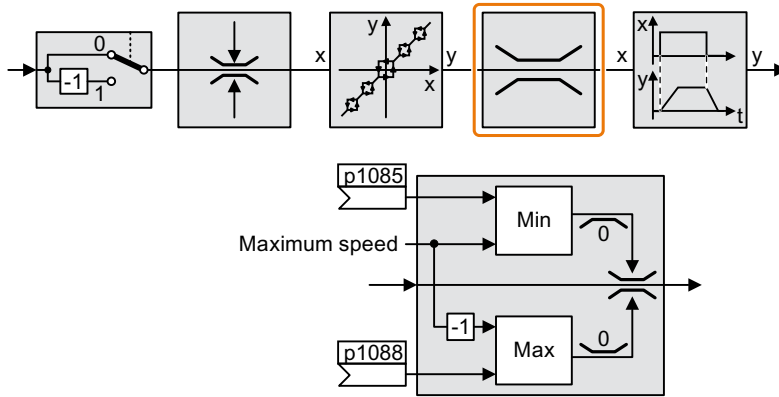
Incorrect direction of motor rotation if the parameterization is not suitable

If you are using an analog input as speed setpoint source, then for a setpoint = 0 V, noise voltages can be superimposed on the analog input signal. After the on command, the motor accelerates up to the minimum frequency in the direction of the random polarity of the noise voltage. A motor rotating in the wrong direction can cause significant material damage to the machine or system.

- Inhibit the motor direction of rotation that is not permissible.

6.16.5 Speed limitation

The maximum speed limits the speed setpoint range for both directions of rotation.



The converter generates a message (fault or alarm) when the maximum speed is exceeded.

If you must limit the speed depending on the direction of rotation, then you can define speed limits for each direction.

Table 6-38 Parameters for the speed limitation

Parameter	Description
p1082	Maximum speed (factory setting: 1500 rpm)
p1083	Speed limit, positive direction of rotation (factory setting: 210,000 rpm)
p1085	CI: Speed limit, positive direction of rotation (factory setting: 1083)
p1086	Speed limit, negative direction of rotation (factory setting: -210,000 rpm)
p1088	CI: Speed limit, negative direction of rotation (factory setting: 1086)

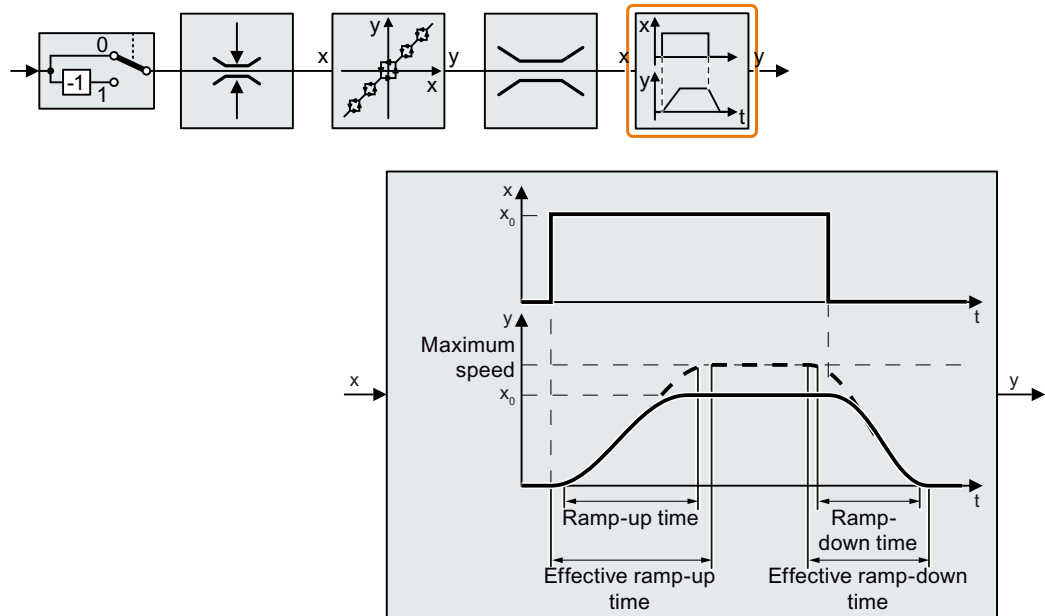
6.16.6 Ramp-function generator

The ramp-function generator in the setpoint channel limits the rate change of the speed setpoint (acceleration). A reduced acceleration reduces the accelerating torque of the motor. As a consequence, the motor reduces the stress on the mechanical system of the driven machine.

The extended ramp-function generator not only limits the acceleration, but by rounding the setpoint, also acceleration changes (jerk). This means that the motor does not suddenly generate a torque.

Extended ramp-function generator

The ramp-up and ramp-down times of the extended ramp-function generator can be set independently of each other. The optimum times that you select depend on your particular application in question and can range from just a few 100 ms (e.g. for belt conveyor drives) to several minutes (e.g. for centrifuges).



Initial and final rounding permit smooth, jerk-free acceleration and braking.

The ramp-up and ramp-down times of the motor are increased by the rounding times:

- Effective ramp-up time = $p1120 + 0.5 \times (p1130 + p1131)$.
- Effective ramp-down time = $p1121 + 0.5 \times (p1130 + p1131)$.

Table 6-39 Additional parameters to set the extended ramp-function generator

Parameter	Description
p1120	Ramp-function generator, ramp-up time (factory setting depends on the Power Module) Duration of acceleration (in seconds) from zero speed to maximum speed P1082
p1121	Ramp-function generator, ramp-down time (factory setting depends on the Power Module) Braking time in seconds from the maximum speed down to standstill

Parameter	Description	
p1130	Ramp-function generator initial rounding time (Factory setting depends on the Power Module) Initial rounding for extended ramp-function generator. The value applies for ramp up and ramp down.	
p1131	Ramp-function generator final rounding time (Factory setting depends on the Power Module) Final rounding for extended ramp-function generator. The value applies for ramp up and ramp down.	
p1134	Ramp-function rounding type (factory setting: 0) 0: Continuous smoothing 1: Discontinuous smoothing	
p1135	OFF3 ramp-down time (factory setting depends on the Power Module)	
p1136	OFF3 initial rounding time (Factory setting depends on the Power Module) Initial rounding time for OFF3 for an extended ramp-function generator.	
p1137	OFF3 final rounding time (factory setting: 0 s) Final rounding for OFF3 for the extended ramp-function generator	

You can find more information in function diagram 3070 and in the parameter list of the List Manual.

Setting the extended ramp-function generator

Procedure

1. Enter the highest possible speed setpoint.
2. Switch on the motor.
3. Evaluate your drive response.
 - If the motor accelerates too slowly, then reduce the ramp-up time.
An excessively short ramp-up time means that the motor will reach its current limiting when accelerating, and will temporarily not be able to follow the speed setpoint. In this case, the drive exceeds the set time.
 - If the motor accelerates too fast, then extend the ramp-up time.
 - Increase the initial rounding if the acceleration is jerky.
 - In most applications, it is sufficient when the final rounding is set to the same value as the initial rounding.
4. Switch off the motor.

5. Evaluate your drive response.

- If the motor decelerates too slowly, then reduce the ramp-down time.
The minimum ramp-down time that makes sense depends on your particular application. Depending on the Power Module used, for an excessively short ramp-down time, the inverter either reaches the motor current, or the DC link voltage in the inverter becomes too high.
- Extend the ramp-down time if the motor is braked too quickly or the inverter goes into a fault condition when braking.

6. Repeat steps 1 ... 5 until the drive behavior meets the requirements of the machine or plant.

You have set the extended ramp-function generator.



6.17 PID technology controller

Overview



The technology controller controls process variables, e.g. pressure, temperature, level or flow.

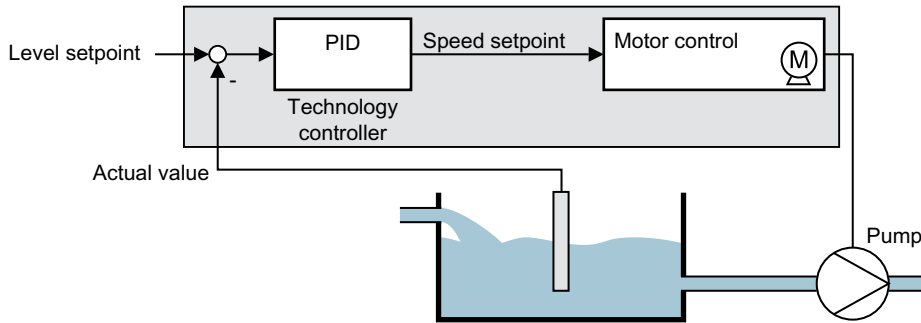


Figure 6-33 Example: Technology controller as a level controller

Precondition

Additional functions

The motor closed-loop control is set

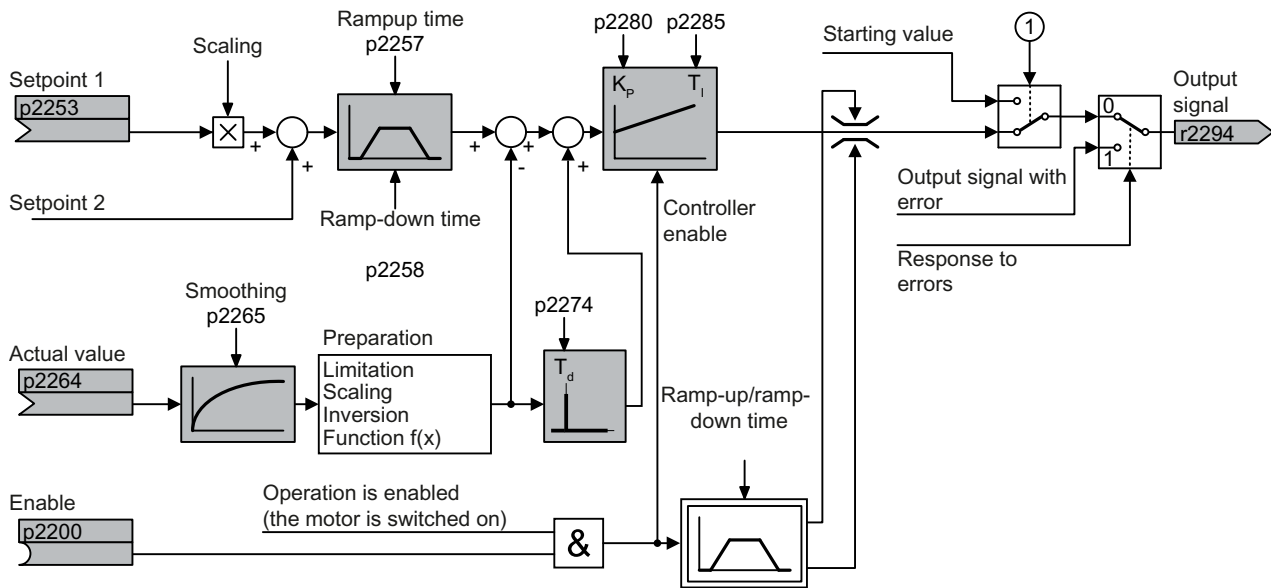
Tools

To change the function settings, you can use an operator panel or a PC tool, for example.

Function description

Function diagram

The technology controller is implemented as a PID controller (controller with proportional, integral, and derivative action).



- ① The inverter uses the start value when all the following conditions are simultaneously satisfied:
- The technology controller supplies the main setpoint (p2251 = 0).
 - The ramp-function generator output of the technology controller has not yet reached the start value.

Figure 6-34 Simplified representation of the technology controller

Basic settings

The settings required as a minimum are marked in gray in the function diagram:

- Interconnect setpoint and actual values with signals of your choice
- Set ramp-function generator and controller parameters K_p , T_i and T_d .

Set controller parameters K_p , T_i and T_d .

Procedure

1. Temporarily set the ramp-up and ramp-down times of the ramp-function generator (p2257 and p2258) to zero.
2. Enter a setpoint step and monitor the associated actual value, e.g. with the trace function of STARTER.
The slower the response of the process to be controlled, the longer you must monitor the controller response. Under certain circumstances (e.g. for a temperature control), you need to wait several minutes until you can evaluate the controller response.

	<p>Optimum controller response for applications that do not permit any overshoot. The actual value approaches the setpoint without any significant overshoot.</p>
	<p>Optimum controller behavior for fast correction and quick compensation of disturbance components. The actual value approaches the setpoint and slightly overshoots, maximum 10% of the setpoint step.</p>
	<p>The actual value only slowly approaches the setpoint.</p> <ul style="list-style-type: none"> • Increase the proportional component K_p (p2280) and reduce the integration time T_i (p2285).
	<p>The actual value only slowly approaches the setpoint with slight oscillation.</p> <ul style="list-style-type: none"> • Increase the proportional component K_p (p2280) and reduce the rate time T_d (p2274)
	<p>The actual value quickly approaches the setpoint, but overshoots too much.</p> <ul style="list-style-type: none"> • Decrease the proportional component K_p (p2280) and increase the integration time T_i (p2285).

3. Set the ramp-up and ramp-down times of the ramp-function generator back to their original value.

You have manually set the technology controller.



Limiting the output of the technology controller

In the factory setting, the output of the technology controller is limited to \pm maximum speed. You must change this limit, depending on your particular application.

Example: The output of the technology controller supplies the speed setpoint for a pump. The pump should only run in the positive direction.

Parameter

Table 6-40 Basic settings

Parameter	Description	Setting
p2200	BI: Technology controller enable	1 signal: Technology controller is enabled. Factory setting: 0
r2294	CO: Technology controller output signal	To interconnect the main speed setpoint with the technology controller output, set p1070 = 2294.
p2253	CI: Technology controller setpoint 1	Setpoint for the technology controller. Example: p2253 = 2224: Fixed setpoint p2201 is interconnected with the setpoint of the technology controller. p2220 = 1: The fixed setpoint p2201 is selected. Factory setting: 0
p2264	CI: Technology controller actual value	Technology controller actual value. Factory setting: 0
p2257, p2258	Technology controller ramp-up time and ramp-down time [s]	Factory setting: 0.0 s
p2274	Technology controller differentiation time constant T_d [s]	The differentiation improves the rise time for very slow controlled variables, e.g. a temperature control. Factory setting: 0.0 s
p2280	Technology controller proportional gain K_p	Factory setting: 1.0
p2285	Technology controller integration time (integral time) T_i	Factory setting: 30 s

Table 6-41 Limiting the output of the technology controller

Parameter	Description	Setting
p2297	CI: Technology controller maximum limiting signal source	Factory setting: 1084
p2298	CI: Technology controller minimum limiting signal source	Factory setting: 2292
p2291	CO: Technology controller maximum limiting [%]	Factory setting: 100 %
p2292	CO: Technology controller minimum limiting [%]	Factory setting: 0 %

Table 6-42 Adapting the actual value of the technology controller

Parameter	Description	Setting
p2267	Technology controller upper limit actual value [%]	Factory setting: 100 %
p2268	Technology controller lower limit actual value [%]	Factory setting: -100 %
p2269	Technology controller gain actual value [%]	Factory setting: 100 %
p2271	Technology controller actual value inversion	Technology controller actual value inversion If the actual value decreases with increasing motor speed, then p2271 must be set = 1. 0: no inversion 1: actual value signal is inverted Factory setting: 0
p2270	Technology controller actual value function	Technology controller actual value function 0: no function 1: \sqrt{x} 2: x^2 3: x^3 Factory setting: 0

Further information





For additional information refer to the function diagrams 7950 ff of the List Manual.




You will find additional information on the following PID controller components in the Internet at:

- Setpoint input: Analog value or fixed setpoint
- Setpoint channel: Scaling, ramp-function generator and filter
- Actual value channel: Filter, limiting and signal processing
- PID controller Principle of operation of the D component, inhibiting the I component and the control sense
- Enable, limiting the controller output and fault response

 FAQ (<http://support.automation.siemens.com/WW/view/en/92556266>)

Additional information for setting the technology controller in certain applications is provided on the Internet:

-  Closed-loop air intake control (<https://support.industry.siemens.com/cs/ww/en/view/43296889>)
-  Closed-loop air discharge control (<https://support.industry.siemens.com/cs/ww/en/view/77490904>)
-  Closed-loop fan control for a stairwell (<https://support.industry.siemens.com/cs/ww/en/view/77491576>)
-  Closed-loop fan control for a parking garage or a tunnel (<https://support.industry.siemens.com/cs/ww/en/view/77491575>)

-  Pressure-controlled pump (<https://support.industry.siemens.com/cs/ww/en/view/43297279>)
-  Level-controlled pump (<https://support.industry.siemens.com/cs/ww/en/view/43297280>)
-  Closed-loop control for the cooling circuit (<https://support.industry.siemens.com/cs/ww/en/view/43297284>)

6.17.1 Autotuning the PID technology controller

Overview

Autotuning is an inverter function for the automatic optimization of the PID technology controller.

Precondition

Additional functions

- The motor closed-loop control is set
- The PID technology controller must be set the same as when used in subsequent operation:
 - The actual value is interconnected.
 - Scalings, filter and ramp-function generator have been set.
 - The PID technology controller is enabled (p2200 = 1 signal).

Tools

To change the function settings, you can use an operator panel or a PC tool, for example.

Function description

For active autotuning, the inverter interrupts the connection between the PID technology controller and the speed controller. Instead of the PID technology controller output, the autotuning function specifies the speed setpoint.

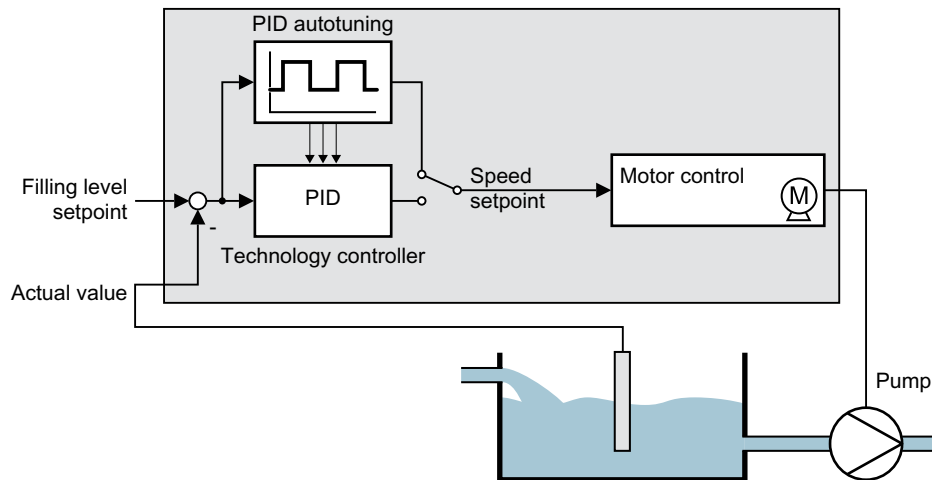


Figure 6-35 Autotuning using closed-loop level control as example

The speed setpoint results from the technology setpoint and a superimposed rectangular signal with amplitude p2355. If actual value = technology setpoint \pm p2355, the autotuning function switches the polarity of the superimposed signal. This causes the inverter to excite the process variable for an oscillation.

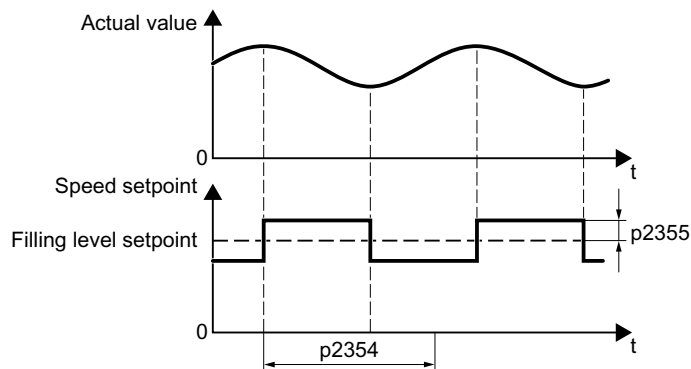


Figure 6-36 Example for speed setpoint and actual process value for autotuning

The inverter calculates the parameters of the PID controller from the determined oscillation frequency.

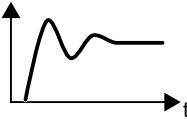
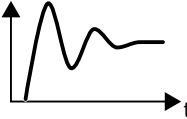

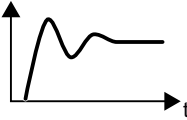
Executing autotuning

1. Select with p2350 the appropriate controller setting.
2. Switch on the motor.
The inverter signals Alarm A07444.
3. Wait until alarm A07444 goes away.
The inverter has recalculated parameters p2280, p2274 and p2285.
If the inverter signals fault F07445:
 - If possible, double p2354 and p2355.
 - Repeat the autotuning with the changed parameters.
4. Back up the calculated values so that they are protected against power failure, e.g. using the BOP-2: OPTIONS → RAM-ROM.

You have auto tuned the PID controller.

□

Parameter

Parameter	Description	Setting
p2350	Enable PID autotuning	<p>Automatic controller setting based on the "Ziegler Nichols" method. After completion of the autotuning, the inverter sets p2350 = 0.</p> <p>0: No function</p> <p>1: The process variable follows the setpoint after a sudden setpoint change (step function) relatively quickly, however with an overshoot.</p>  <p>2: Faster controller setting than for p2350 = 1 with larger overshoot of the controlled variable.</p>  <p>3: Slower controller setting than for p2350 = 1. Overshoot of the controlled variable is, to a large extent, avoided.</p>  <p>4: Controller setting after completion of the autotuning as for p2350 = 1. Optimize only the P and I action of the PID controller.</p>  <p>Factory setting: 0</p>
p2354	PID autotuning monitoring time	<p>Monitoring time for the process response</p> <p>p2354 must be greater than half the period of the process variable oscillation.</p> <p>Factory setting: 240 s</p>
p2355	PID autotuning offset	<p>Offset for autotuning</p> <p>p2355 must be sufficiently large so that the amplitude of the process variable oscillation signal can be differentiated from any superimposed noise.</p> <p>Factory setting: 5 %</p>

6.17.2 Adapting Kp and Tn

Overview

The function adapts the PID technology controller to the process, e.g. depending on the system deviation.

Function description

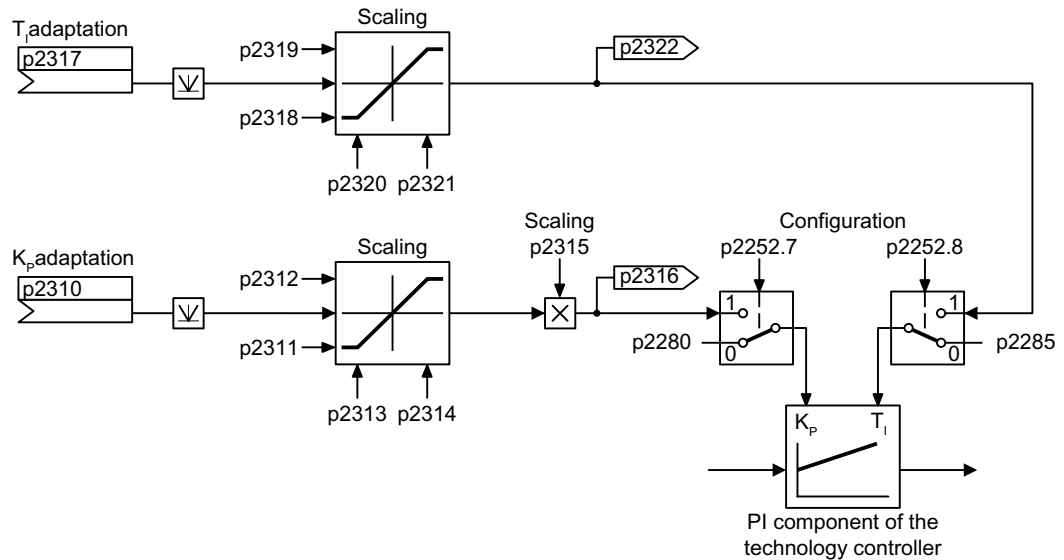


Figure 6-37 Controller adaptation

Parameter

Parameter	Remark
p2252	Technology controller configuration
	.07 1 signal: Activating Kp adaptation
	.08 1 signal: Activating Tn adaptation
p2310	Technology controller, Kp adaptation input value signal source (factory setting: 0)
p2311	Technology controller, lower Kp adaptation factor (factory setting: 1)
p2312	Technology controller, upper Kp adaptation factor (factory setting: 10)
p2313	Technology controller, lower Kp adaptation activation point (factory setting: 0 %)
p2314	Technology controller, upper Kp adaptation activation point (factory setting: 100 %)
p2315	Technology controller Tn adaptation scaling signal source (factory setting: 1)
r2316	Technology controller, Kp adaptation output
p2317	Technology controller Tn adaptation input value signal source (factory setting: 0)
p2318	Technology controller, lower Tn adaptation factor (factory setting: 3 s)
p2319	Technology controller, upper Tn adaptation factor (factory setting: 10 s)
p2320	Technology controller, lower Tn adaptation activation point (factory setting: 0 %)

Parameter	Remark
p2321	Technology controller, upper Tn adaptation activation point (factory setting: 100 %)
r2322	Technology controller, Tn adaptation output

For further information refer to the function diagrams 7958 and 7959 of the List Manual.

6.18 Free technology controllers

Additional PID technology controller

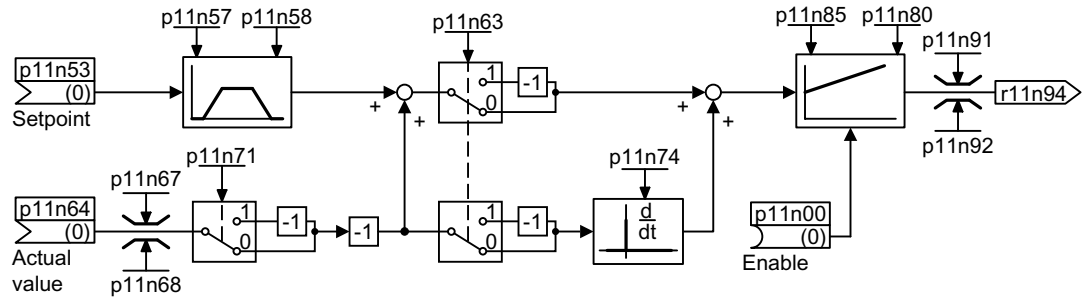


The inverter has three additional technology controllers.

The three "free technology controllers" have fewer setting options compared with the PID technology controller described above.



PID technology controller (Page 278)



- n = 0 Free technology controller 0
- n = 1 Free technology controller 1
- n = 2 Free technology controller 2

Figure 6-38 Simplified function chart of the additional PID technology controllers, n = 0 ... 2

You can find the complete function chart 7030 in the List Manual.

The additional technology controllers allow several process variables to be simultaneously controlled using one inverter. An example is a HVAC system with heating and cooling valves to process the air:

- The main controller controls the speed of the fan drive.
- The additional technology controllers control the cooling and heating via the two analog outputs available.

Parameters using the free technology controller 0 as example

Parameter	Remark
p11000	BI: Free tec_ctrl 0 enable (Factory setting: 0) 1 signal: Technology controller is enabled.
p11053	CI: Free tec_ctrl 0 setpoint signal source (Factory setting: 0)
p11057, p11058	Free tec_ctrl 0 setpoint ramp-up time and ramp-down time (Factory setting: 1 s)
p11063	Free tec_ctrl 0 error signal inversion (Factory setting: 0 s) 0: No inversion 1: Inversion p11063 must be set = 1 if the actual value decreases with increasing motor speed.
p11064	CI: Free tec_ctrl 0 actual value signal source (Factory setting: 0)
p11065	Free tec_ctrl 0 actual value smoothing time constant (Factory setting: 0 s)

Parameter	Remark
p11067	Free tec_ctrl 0 actual value upper limit (Factory setting: 100 %)
p11068	Free tec_ctrl 0 actual value lower limit (Factory setting: -100%)
p11071	Free tec_ctrl 0 actual value inversion (Factory setting: 0)
	0: No inversion
	1: Inversion
p11074	Free tec_ctrl 0 differentiation time constant (T_d) (Factory setting: 0 s)
p11080	Free tec_ctrl 0 proportional gain (K_p) (Factory setting: 1.0)
p11085	Free tec_ctrl 0 integral time (T_i) (Factory setting: 30 s)
p11091	CO: Free tec_ctrl 0 maximum limit (Factory setting: 100 %)
p11092	CO: Free tec_ctrl 0 minimum limit (Factory setting: 0 %)
r11094	CO: Free tec_ctrl 0 output signal

You can find the complete parameter list in the List Manual.

6.19 Multi-zone control



Multi-zone control is used to control quantities such as pressure or temperature via the technology setpoint deviation. The setpoints and actual values are fed in via the analog inputs as current (0 ... 20 mA) or voltage (0 ... 10 V) or as a percentage via temperature-dependent resistances (LG-Ni1000 / Pt1000 / DIN-Ni1000, 0° C = 0%; 100° C = 100%).

Control variants for multi-zone control

There are three control variants for multi-zone control, which are selected via p31021:

- **One setpoint and one, two or three actual values**

The actual value for the control can be calculated as average value, maximum value or minimum value by the inverter. You can find all of the setting options in the parameter list in parameter p31022.

 - Average value: The deviation from the setpoint of the average value of two or three actual values is controlled.
 - Minimum value: The deviation from the setpoint of the smallest actual value is controlled.
 - Maximum value: The deviation from the setpoint of the highest actual value is controlled.
- **Two setpoint / actual value pairs as maximum value control (cooling)**

The maximum value control compares two setpoint / actual value pairs and controls the actual value which has the largest deviation upwards from its associated setpoint. No control takes place if both actual values lie below their setpoints.
In order to avoid frequent changeover, the inverter only switches over if the deviation of the controlled setpoint / actual value pair is more than two percent lower than the deviation of the uncontrolled value pair.
- **Two setpoint / actual value pairs as minimum value control (heating)**

The maximum value control compares two setpoint / actual value pairs and controls the actual value which has the largest deviation upwards from its associated setpoint. The control pauses if both actual values lie above their setpoints.
The control only switches over if the deviation of the controlled setpoint / actual value pair is more than two percent lower than the deviation of the uncontrolled value pair.

Switching from day to night mode

You can modify the setpoints for day and night mode individually. You have the following opportunities to switch from day to night mode:

- Signal via the digital input DI 4
- via p31025 with the aid of free blocks and the real-time clock

Note

If you activate the multi-zone control, the inverter switches its analog inputs as sources for the setpoint and actual value of the technology controller (refer to table).

Parameter	Description	
p2200	Technology controller enable	
p2251	Set technology controller as main setpoint	
p31020	Multi-zone control interconnection (factory setting = 0) A subsequent parameterization is performed by activating or deactivating the multi-zone control.	
	Subsequent connection for p31020 = 1 (activate multi-zone control)	Subsequent connection for p31020 = 0 (deactivate multi-zone control)
	p31023[0] = 755[0] (AI0) p31023[2] = 755[1] (AI1) p31026[0] = 755[2] (AI2) p31026[1] = 755[3] (AI3) p2253 = 31024 (setpoint output technology controller) p2264 = 31027 (actual value output technology controller)	p31023[0] = 0 p31023[2] = 0 p31026[0] = 0 p31026[1] = 0 p2253 = 0 p2264 = 0
p31021	Configuration of multi-zone control <ul style="list-style-type: none"> • 0 = Setpoint 1 / several actual values (factory setting) • 1 = Two zones / maximum value setting • 2 = Two zones / minimum value setting 	
p31022	Processing of actual values for multi-zone control (only for p31021 = 0) Possible values: 0 ... 11 (factory setting = 0)	
p31023[0 ... 3]	Setpoints for multi-zone control Parameters for selecting the source for setpoints in multi-zone control (factory setting = 0)	
r31024	Multi-zone control setpoint output for technology controller CO parameters	
p31025	Switching from day to night mode for multi-zone control Parameters for selection of the source for switching between day and night operation by the multi-zone control (default setting = 0)	
p31026[0 ... 2]	Actual values for multi-zone control Parameters for selecting the source for actual values of the multi-zone control (factory setting = 0)	
r31027	Multi-zone control actual value output for the technology controller CO parameters	

Note

If you deactivate the multi-zone control, the inverter resets the interconnection of its analog inputs to the default setting.

Example

In an open plan office, temperature sensors (Lg-Ni1000) are installed in three different places. The inverter receives the measured values and temperature setpoint via its analog inputs. Temperature setpoints between 8° C ... 30° C are permissible. Overnight, the average temperature should be 16° C.

Parameter	Description
p2200[0] = 1	Technology controller enable
p2251 = 0	Technology closed-loop controller as main setpoint
p2900[0] = 16	Temperature setpoint overnight as a fixed percentage value
p31020 = 1	Activate multi-zone control
p31021 = 0	Multi-zone control with one setpoint and three actual values
p31022 = 7	Three actual values, one setpoint. The actual value of the closed-loop control is the average value of three actual values.
p31023[0] = 755[0]	Temperature setpoint via analog input AI 0
p0756[0] = 0	Select analog input type (voltage input 0 ... 10 V)
p0757[0] = 0	Lower value = 8° C (0 V \triangleq 8° C)
p0758[0] = 8	
p0759[0] = 10	Upper value = 30° C (10 V \triangleq 30° C)
p0760[0] = 30	
p31023[1] = 2900	Interconnect p31023[1] with the value from p2900 for the reduction overnight
p31026[0]= 755.2	Temperature actual value 1 via analog input 2 as a percentage value
p0756[2] = 6	Analog input type (temperature sensor LG-Ni1000)
p0757[2] = 0	Lower value of the scaling characteristic
p0758[2] = 0	
p31023[1] = 2900	Interconnect p31023[1] with the value from p2900 for the reduction overnight
p31026[0]= 755.2	Temperature actual value 1 via analog input 2 as a percentage value
p0756[2] = 6	Analog input type (temperature sensor LG-Ni1000)
p0757[2] = 0	Lower value of the scaling characteristic
p0758[2] = 0	
p0759[2] = 100	Upper value of the scaling characteristic
p0760[2] = 100	
p31026[1] = 755[3]	Temperature actual value 2 via analog input AI 3 in %
p0756[3] = 6	Select analog input type (temperature sensor LG-Ni1000)
p0757[3] = 0	Lower value of the scaling characteristic
p0758[3] = 0	
p0759[3] = 100	Upper value of the scaling characteristic
p0760[3] = 100	
p31026[2] = 755[1]	Temperature actual value 3 via a temperature sensor with current output (0 mA ... 20 mA) via analog input AI 1
p0756[1] = 2	Analog input type (current input 0 ... 20 mA)
p0757[1] = 0	Lower value of the scaling characteristic (0 mA \triangleq 0° C)
p0758[1] = 0	

Parameter	Description
p0759[1] = 20	Upper value of the scaling characteristic (20 mA \pm 100%)
p0760[1] = 100	
p31025 = 722.4	Switchover from day to night using digital input DI 4

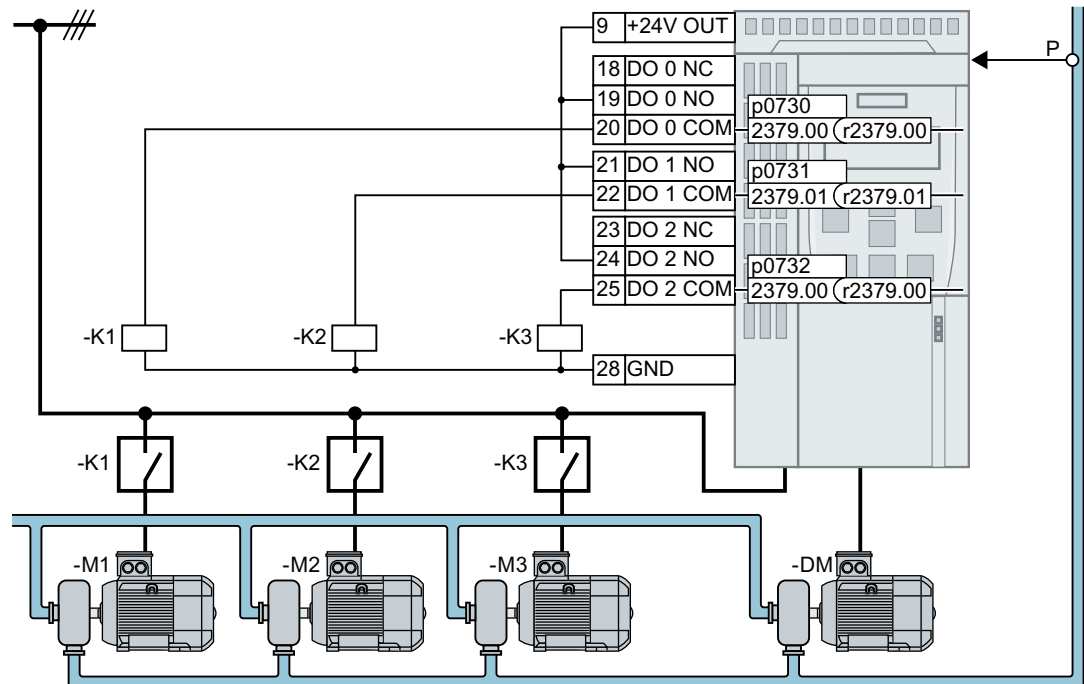
You will find more information about this multi-zone control in the parameter list and in function diagram 7032 of the List Manual.

6.20 Cascade control

Overview



The cascade control is ideal for applications in which, for example, significantly fluctuating pressures or flow rates are equalized.



DM Speed-controlled motor

M1 ... M3 Uncontrolled motors

P Pressure sensor. Interconnect the signal of the pressure sensor with the actual-value input of the technology controller.

Figure 6-39 Example: Cascade control for the pressure in a liquid pipe

To deploy the cascade control, you must activate the technology controller.

Depending on the set-actual variance of the technology controller, the cascade control of the inverter switches a maximum of three additional motors directly to the line supply via contactors.

Activating M1 ... M3 uncontrolled motors

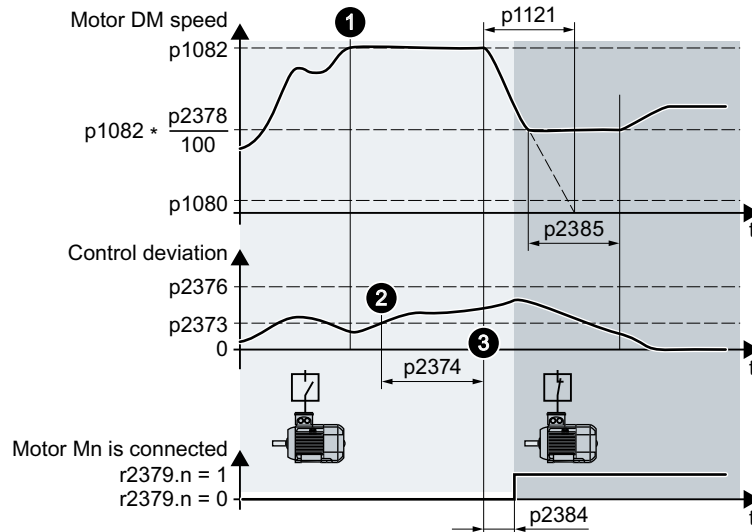


Figure 6-40 Conditions for connecting a motor

Procedure for connecting an uncontrolled motor:

1. The speed-controlled motor turns with maximum speed p1082.
2. The control deviation of the technology controller is greater than p2373.
3. Time p2374 has expired.
The inverter brakes the speed-controlled motor with ramp-down time p1121 to the activation/deactivation speed p2378. Until the activation/deactivation speed p2378 is attained, the inverter deactivates the technology controller temporarily.
4. After switch-on delay p2384, the inverter connects an uncontrolled motor.

Switching off M1 ... M3 uncontrolled motors

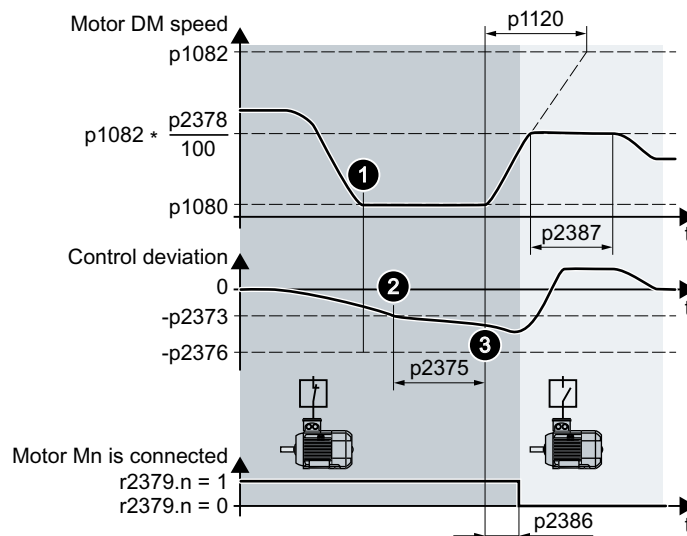


Figure 6-41 Conditions for switching off a motor

Procedure for switching off an uncontrolled motor:

1. The speed-controlled motor turns with minimum speed p1080.
2. The control deviation of the technology controller is less than -p2373.
3. Time p2375 has expired.
The inverter accelerates the speed-controlled motor with ramp-up time p1120 to the activation/deactivation speed p2378. Until the activation/deactivation speed p2378 is attained, the inverter deactivates the technology controller temporarily.
4. After shutdown delay p2386, the inverter disconnects an uncontrolled motor.

Sequence for activating and deactivating the M1 ... M3 motors

Table 6-43 p2371 specifies the sequence for activating and deactivating the motors

p2371	→ → → Sequence for activating motors → → →						Power of the activated M1 ... M3 motors compared with the speed-controlled DM motor		
	→ → → Sequence for deactivating motors → → →								
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	1 × DM	2 × DM	3 × DM
1	M1						M1	---	---
2	M1	M1+M2					M1, M2	---	---
3	M1	M2	M1+M2				M1	M2	---
4	M1	M1+M2	M1+M2+M3				M1, M2, M3	---	---
5	M1	M3	M1+M3	M1+M2+M3			M1, M2	M3	---
6	M1	M2	M1+M2	M2+M3	M1+M2+M3		M1	M2, M3	---
7	M1	M1+M2	M3	M1+M3	M1+M2+M3		M1, M2	---	M3
8	M1	M2	M3	M1+M3	M2+M3	M1+M2+M3	M1	M2	M3

Interaction with the "Hibernation mode" function

In order that the "Cascade control" and "Hibernation mode" functions operate together without any conflict, you must make the following settings in the cascade control:

- p2392 < p2373
The restart value of the hibernation mode (p2392) must be lower than the activation threshold for the cascade control (p2373).
- p2373 < p2376
The activation threshold for cascade control (p2373) must be lower than the overload threshold for the cascade control (p2376).
- It is not permissible that the main drive is in the hibernation mode.
- The actual speed must be higher than the restart speed for hibernation mode $(p1080 + p2390) \times 1.05$.
- The value for the activation delay of the cascade control (p2374) must be longer than the ramp-up time from hibernation mode (t_y).
 $t_y = [(p1080 + p2390) \times 1.05 \times p1120 \times p1139] / p1082$

Setting parameters and activating the cascade control

Parameter	Description
p2200	Technology controller enable (factory setting: 0) 1: Activate technology controller
p2251	Technology controller mode (factory setting: 0) 0: Technology controller as main speed setpoint
p2370	Cascade control enable (factory setting: 0) 1 signal: Cascade control is enabled
p2371	Cascade control configuration (factory setting: 0) See also p2372 and the above table.
p2372	Cascade control - motor selection mode (factory setting: 0) Specifying the motor connection sequence
	0: Fixed procedure as set in p2371
	1: Cascade control after absolute operating hours
	2: Automatic replacement after completed operating hours
	3: Automatic replacement after absolute operating hours
p2373	Cascade control - activation threshold (factory setting: 20%)
p2374	Cascade control - activation delay (factory setting: 30 s)
p2375	Cascade control - deactivation delay (factory setting: 30 s)
p2376	Cascade control - overload threshold (factory setting: 25%)
p2377	Cascade control - interlock time (factory setting: 0 s)
p2378	Cascade control - activation/deactivation speed (factory setting: 50 %)
r2379	Cascade control - status word
	.00 1 signal = start uncontrolled M1 motor
	.01 1 signal = start uncontrolled M2 motor
	.02 1 signal = start uncontrolled M3 motor
	.03 1 signal = activate motor
	.04 1 signal = activation/deactivation active
	.05 1 signal = all motors active
	.06 1 signal = automatic replacement not possible
.07 1 signal = alarm active	
p2380	Cascade control - operating hours (factory setting: 0 h)
	[00] M1 motor
	[01] M2 motor
	[02] M3 motor
p2381	Cascade control - maximum time for continuous mode (factory setting: 24 h) Time limit for continuous uninterrupted operation of uncontrolled motors
p2382	Cascade control - absolute operating time limit (factory setting: 24 h) Limit for the total operating time of the uncontrolled motors

Parameter	Description
p2383	Cascade control - deactivation sequence (factory setting: 0)
	0: Normal stop
	1: Sequential stop: For OFF1, the inverter deactivates the motors in the following sequence: M3 → M2 → M1 → controlled motor p2387 is the time between the deactivations.
p2384	Cascade control - motor switch-on delay (factory setting: 0 s)
p2385	Cascade control - stop time activation speed (factory setting: 0 s)
p2386	Cascade control - motor deactivation delay (factory setting: 0 s)
p2387	Cascade control - stop time deactivation speed (factory setting: 0 s) See p2383

For more information, see the parameter descriptions and function diagram 7036 in the List Manual.

6.21 Real time clock (RTC)



The real-time clock is the basis for time-dependent process controls, e.g.:

- To reduce the temperature of a heating control during the night
- To increase the pressure of a water supply at certain times during the day

Function and settings

The real-time clock starts as soon as the Control Unit power supply is switched on for the first time. The real-time clock comprises the time in a 24 hour format and the date in the "day, month, year" format.

After a Control Unit power supply interruption, the real-time clock continues to run for approx. five days.

If you wish to use the real-time clock, you must set the time and date once when commissioning.

If you restore the inverter factory setting, the inverter only resets parameters p8402 and p8405 of the real-time clock. P8400 and p8401 are not reset.

Parameter	Real-time clock (RTC)
p8400	RTC time (Factory setting: 0)
	[0] Hour (0 ... 23)
	[1] Minute (0 ... 59)
	[2] Second (0 ... 59)
p8401	RTC date (Factory setting: 1.1.1970)
	[0] Day: 1 ... 31.
	[1] Month 1 (January) ... 12 (December)
	[2] Year: 1970 ... 9999
p8402	RTC daylight saving time setting The factory setting corresponds to the changeover times for Central European Summer Time (CEST). To activate the CEST, only p8402[0] = 1 needs to be set.
	[0] Difference between daylight saving time and standard time (factory setting: 0 h)
	[1] Start of month (factory setting: 3), 1 (January) ... 12 (December)
	[2] Start of week of month (factory setting: 6) 1: Day 1 ... 7, 2: Day 8 ... 14, 3: Day 15 ... 21, 4: Day 22 ... 28, 6: Last seven days of the month
	[3] Start weekday (factory setting: 7), 1 (Monday) ... 7 (Sunday)
	[4] Start hour (factory setting: 2)
	[5] End month (factory setting: 10)
	[6] End week of month (factory setting: 6) 1: Day 1 ... 7, 2: Day 8 ... 14, 3: Day 15 ... 21, 4: Day 22 ... 28, 6: Last seven days of the month
	[7] End weekday (factory setting: 7), 1 (Monday) ... 7 (Sunday)
	[8] End hour (factory setting: 3)
r8403	RTC daylight saving time difference actual [hours] Displays the actual difference between standard time and daylight saving time.
r8404	RTC weekday , 1: Monday ... 7: Sunday

Parameter	Real-time clock (RTC)
p8405	RTC activate/deactivate alarm A01098 (Factory setting: 1) Alarm for non synchronous time, e.g. after a longer power supply interruption.
	0: No alarm
	1: Alarm A01098

Accept the real-time clock in the alarm and fault buffer

Using the real-time clock, you can track the sequence of alarms and faults over time. When an appropriate message occurs, the inverter converts the real-time clock into the UTC time format (Universal Time Coordinated):

Date, time ⇒ 01.01.1970, 0:00 + d (days) + m (milliseconds)

The inverter takes the number "d" of the days and the number "m" of the milliseconds in the alarm and fault times of the alarm and/or fault buffer.

 Alarms, faults and system messages (Page 401)

Converting UTC to RTC

An RTC can again be calculated in the UTC format from the saved fault or alarm time. In the Internet, you will find programs to convert from UTC to RTC, e.g.

 UTC to RTC (<http://unixtime-converter.com/>)

Example:

Saved as alarm time in the alarm buffer:

r2123[0] = 2345 [ms]

r2145[0] = 14580 [days]

Number of seconds = 2345 / 1000 + 14580 × 86400 = 1259712002

Converting this number of seconds to RTC provides the date: 02.12.2009, 01:00:02.

The times specified for alarms and faults always refer to standard time.

6.22 Time switch (DTC)



The "time switch" (DTC) function, along with the real-time clock in the inverter, offers the option of controlling when signals are switched on and off.

Examples:

- Switching temperature control from day to night mode.
- Switching a process control from weekday to weekend.

Principle of operation of the time switch (DTC)

The inverter has three independently adjustable time switches. The time switch output can be interconnected with every binector input of your inverter, e.g. with a digital output or a technology controller's enable signal.

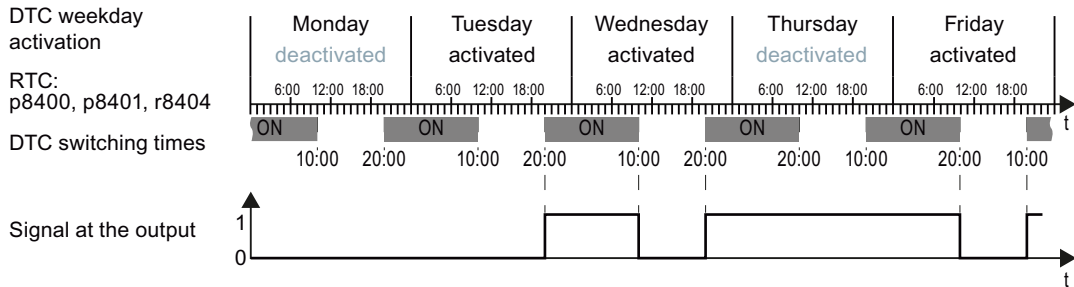


Figure 6-42 Example of the response of the time switch.

Settings for the example with DTC1

- Enable parameterization of the DTC: p8409 = 0.
As long as the parameterization of the DTC is enabled, the inverter holds the output of all three DTC (r84x3, x = 1, 2, 3; r84x3.0 normal, r84x3.1 inverted status message) at LOW.
- Activate/deactivate the weekday
 - p8410[0] = 0 Monday
 - p8410[1] = 1 Tuesday
 - p8410[2] = 1 Wednesday
 - p8410[3] = 0 Thursday
 - p8410[4] = 1 Friday
 - p8410[5] = 1 Saturday
 - p8410[6] = 0 Sunday
- Setting switching times:
 - ON: p8411[0] = 20 (hh), p8411[1] = 0 (MM)
 - OFF: p8412[0] = 10 (hh), p8412[1] = 0 (MM)
- Enable the setting: p8409 = 1.
The inverter re-enables the DTC output.

Additional information is provided in the parameter list of the List Manual.

6.23 Motor control



The inverter has two alternative methods to control (closed loop) the motor speed:

- U/f control
- Vector control

6.23.1 Reactor, filter and cable resistance at the inverter output

Correctly setting the components between the inverter and motor

Components between the inverter and the motor influence the closed-loop control quality of the inverter:

- Output reactor or sine-wave filter
In the factory setting, for the motor data identification, the inverter assumes that neither output reactor nor sine wave filter are connected at to the inverter output.
- Motor cable with unusually high cable resistance.
For the motor data identification, the inverter assumes a cable resistance = 20 % of the stator resistance of the cold motor.

You must correctly set the components between the inverter and motor to achieve an optimum closed-loop control quality

Setting the reactor, filter and cable resistance between the inverter and motor

Procedure

1. Set p0010 = 2.
2. Set the cable resistance in p0352.
3. Set p0230 to the appropriate value.
4. Set p0235 to the appropriate value.
5. Set p0010 = 0.
6. Carry out the quick commissioning and the motor identification again.



Commissioning (Page 151)

You have set the reactor, filter and cable resistance between the inverter and motor.



Parameter

Parameter	Description
p0010	Drive commissioning parameter filter (factory setting: 1) 0: Ready 2: Power unit commissioning
p0230	Drive filter type, motor side (factory setting: 0) 0: No filter 1: Output reactor 2: dv/dt filter 3: Siemens sine-wave filter 4: Sine wave filter, third-party manufacturer
p0235	Number of motor reactors in series (factory setting: 1) Number of reactors connected in series at the inverter output
p0350	Motor stator resistance, cold (factory setting: 0 Ω) When selecting a list motor (p0301), p0350 is preset (default setting) and is write protected.
p0352	Cable resistance (Factory setting: 0 Ω) If you set p0352 after the motor data identification, then you must subtract the difference that was changed with p0352, from the stator resistance p0350 or repeat the motor data identification.

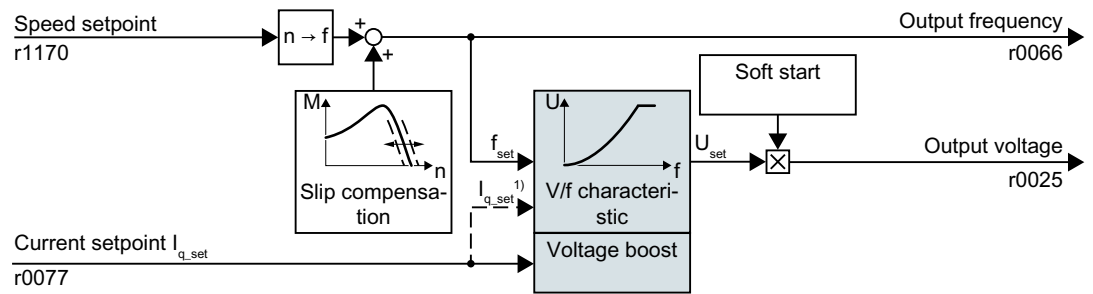
Additional information on the parameters is provided in the List Manual.

6.23.2 V/f control

Overview of the U/f control

The U/f control is a closed-loop speed control with the following characteristics:

- The inverter controls the output voltage using the V/f characteristic
- The output frequency is essentially calculated from the speed setpoint and the number of pole pairs of the motor
- The slip compensation corrects the output frequency depending on the load and thus increases the speed accuracy
- Not using a PI controller prevents the speed control from becoming unstable
- In applications in which greater speed accuracy is required, a closed-loop control with load-dependent voltage boost can be selected (flux current control, FCC)



- 1) In the U/f control variant, "flux current control (FCC)," the inverter controls the motor current (starting current) at low speeds

Figure 6-43 Simplified function diagram of the U/f control

One function not shown in the simplified function diagram is the resonance damping for damping mechanical oscillations. You will find the complete function diagrams 6300 et seq. in the List Manual.

For operation of the motor with U/f control, you must set at least the subfunctions shown with a gray background in the figure to adapt them to your application:

- V/f characteristic
- Voltage boost

Default setting after selecting the application class Standard Drive Control

Selecting application class Standard Drive Control in the quick commissioning adapts the structure and the setting options of the U/f control as follows:

- Starting current closed-loop control: At low speeds, a controlled motor current reduces the tendency of the motor to oscillate.
- With increasing speed, transition from closed-loop starting current control into U/f control with voltage boost depending on the load.
- The slip compensation is activated.
- Soft starting is not possible.
- Fewer parameters

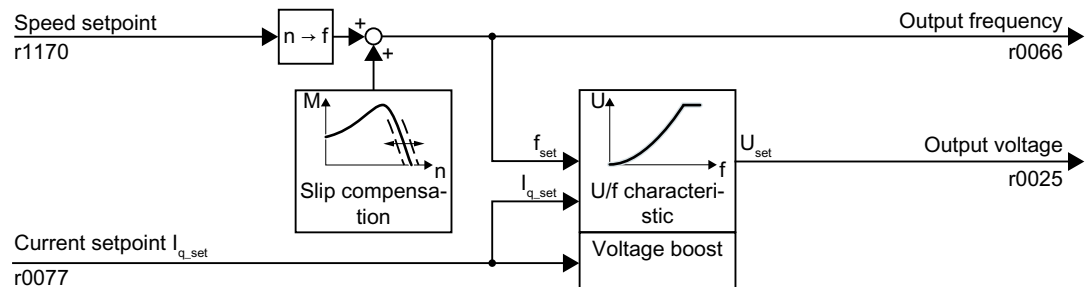
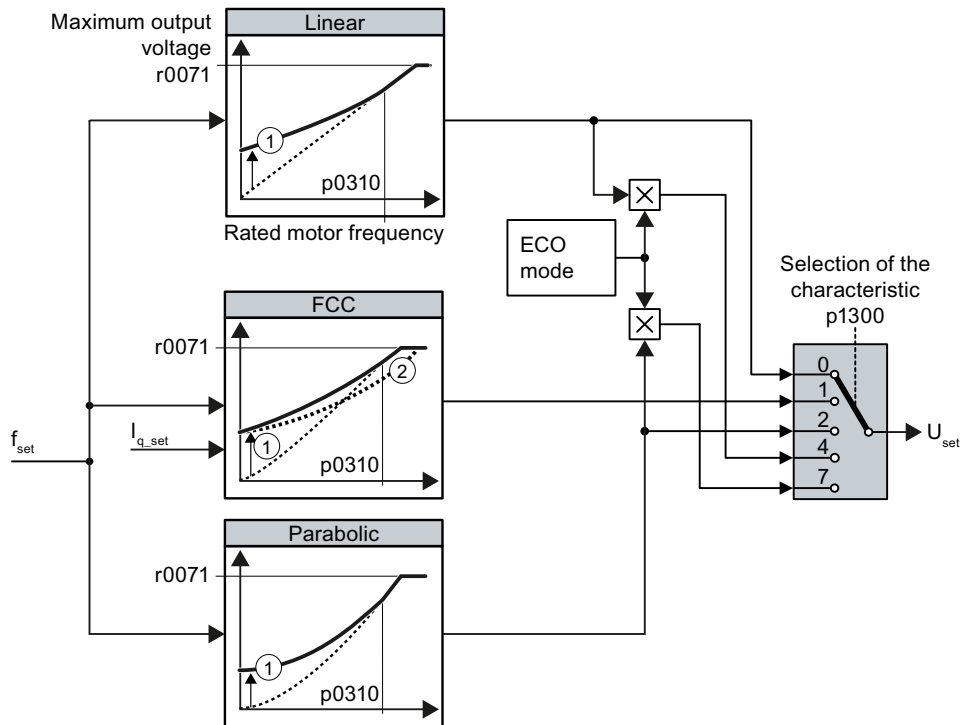


Figure 6-44 Default setting of the U/f control after selecting Standard Drive Control

The complete function diagrams 6850 ff. for application class Standard Drive Control are provided in the List Manual.

6.23.2.1 Characteristics of U/f control

The inverter has different V/f characteristics.



- ① The voltage boost of the characteristic optimizes motor starting
- ② With flux current control (FCC), the inverter compensates the voltage drop across the stator resistance of the motor

Figure 6-45 V/f characteristics of the inverter

The inverter increases its output voltage up to the maximum output voltage. The line voltage defines the maximum inverter output voltage.

If the inverter has reached its maximum output voltage, then it can only increase its output frequency. From this point onwards, the motor is operated in field weakening; this means that the available torque linearly decreases with increasing speed.

The value of the output voltage at the rated motor frequency also depends on the following variables:

- Ratio between the inverter size and the motor size
- Line voltage
- Line impedance
- Actual motor torque

The maximum possible output voltage as a function of the input voltage is provided in the technical data.

Technical data (Page 441)

Table 6-44 Linear and parabolic characteristics

Requirement	Application examples	Remark	Characteristic	Parameter
The required torque is independent of the speed	Eccentric-worm pump, compressor	-	Linear	p1300 = 0
		The inverter equalizes the voltage drops across the stator resistance. Recommended for motors less than 7.5 kW. Precondition: You have set the motor data according to the rating plate and have performed the motor identification after the basic commissioning.	Linear with Flux Current Control (FCC)	p1300 = 1
The required torque increases with the speed	Centrifugal pumps, radial fans, axial fans, compressors	Lower losses in the motor and inverter than for a linear characteristic.	Parabolic	p1300 = 2

Table 6-45 Characteristics for special applications

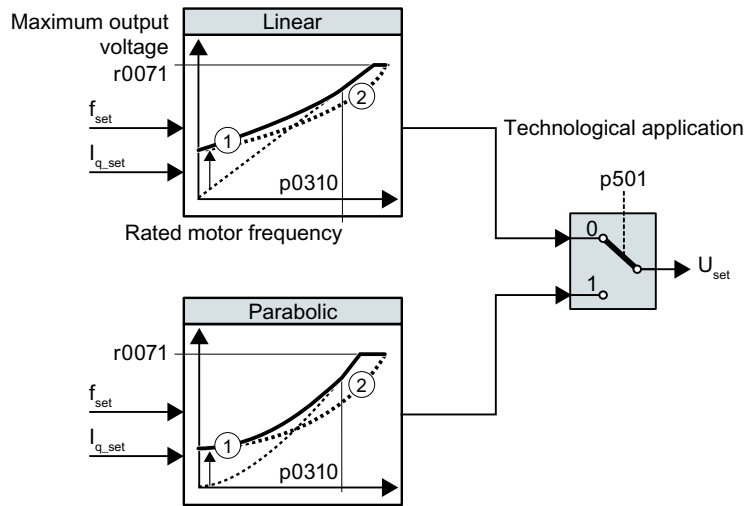
Requirement	Application examples	Remark	Characteristic	Parameter
Applications with a low dynamic response and constant speed	Centrifugal pumps, radial fans, axial fans	The ECO mode results in additional energy saving when compared to the parabolic characteristic. If the speed setpoint is reached and remains unchanged for 5 seconds, the inverter again reduces its output voltage.	ECO mode	p1300 = 4 (linear characteristic ECO) or p1300 = 7 (parabolic characteristic ECO)

Additional information on V/f characteristics can be found in the parameter list and in the function diagrams 6300 ff of the List Manual.

Characteristics after selecting the application class Standard Drive Control

Selecting application class Standard Drive Control reduces the number of characteristics and the setting options:

- A linear and a parabolic characteristic are available.
- Selecting a technological application defines the characteristic.
- The following cannot be set - ECO mode, FCC, the programmable characteristic and a specific voltage setpoint.



- ① The closed-loop starting current control optimizes the speed control at low speeds
- ② The inverter compensates the voltage drop across the motor stator resistance

Figure 6-46 Characteristics after selecting Standard Drive Control

Table 6-46 Linear and parabolic characteristics

Requirement	Application examples	Remark	Characteristic	Parameter
The required torque is independent of the speed	Conveyor belts, roller conveyors, chain conveyors, eccentric worm pumps, compressors, extruders, centrifuges, agitators, mixers	-	Linear	p0501 = 0
The required torque increases with the speed	Centrifugal pumps, radial fans, axial fans	Lower losses in the motor and inverter than for a linear characteristic.	Parabolic	p0501 = 1

Additional information on the characteristics can be found in the parameter list and in the function diagrams 6851 ff of the List Manual.

6.23.2.2 Optimizing motor starting

After selection of the U/f characteristic, no further settings are required in most applications. In the following circumstances, the motor cannot accelerate to its speed setpoint after it has been switched on:

- Load moment of inertia too high
- Load torque too large
- Ramp-up time p1120 too short

To improve the starting behavior of the motor, a voltage boost can be set for the U/f characteristic at low speeds.

Setting the voltage boost for U/f control

The inverter boosts the voltage corresponding to the starting currents p1310 ... p1312.

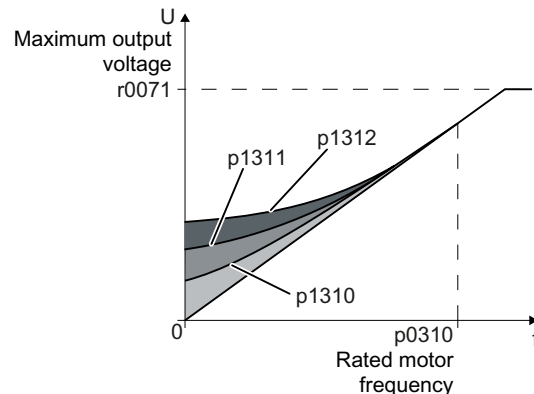


Figure 6-47 The resulting voltage boost using a linear characteristic as example

Preconditions

- Set the ramp-up time of the ramp-function generator to a value 1 s (< 1 kW) ... 10 s (> 10 kW), depending on the power rating of the motor.
- Increase the starting current in steps of $\leq 5\%$. Excessively high values in p1310 ... p1312 can cause the motor to overheat and switch off (trip) the inverter due to overcurrent. If message A07409 appears, it is not permissible that you further increase the value of any of the parameters.

Procedure

1. Switch on the motor with a setpoint of a few revolutions per minute.
2. Check whether the motor rotates smoothly.
3. If the motor does not rotate smoothly, or even remains stationary, increase the voltage boost p1310 until the motor runs smoothly.
4. Accelerate the motor to the maximum speed with maximum load.
5. Check that the motor follows the setpoint.
6. If necessary, increase the voltage boost p1311 until the motor accelerates without problem.

In applications with a high break loose torque, you must also increase parameter p1312 in order to achieve a satisfactory motor response.

You have set the voltage boost.



Parameter	Description
p1310	Starting current (voltage boost) permanent (factory setting 50%) Compensates for voltage drops caused by long motor cables and the ohmic losses in the motor.
p1311	Starting current (voltage boost) when accelerating (factory setting 0%) Provides additional torque when the motor accelerates.
p1312	Starting current (voltage boost) when starting (factory setting 0%) Provides additional torque, however, only when the motor accelerates for the first time after it has been switched on ("break loose torque").

You will find more information on this function in the parameter list and in function diagram 6301 in the List Manual.

6.23.2.3 Optimizing the motor startup for application class Standard Drive Control

After selecting application class Standard Drive Control, in most applications no additional settings need to be made.

At standstill, the inverter ensures that at least the rated motor magnetizing current flows. Magnetizing current p0320 approximately corresponds to the no-load current at 50% ... 80% of the rated motor speed.

In the following circumstances, the motor cannot accelerate to its speed setpoint after it has been switched on:

- Load moment of inertia too high
- Load torque too large
- Ramp-up time p1120 too short

The current can be increased at low speeds to improve the starting behavior of the motor.

Starting current (boost) after selecting the application class Standard Drive Control

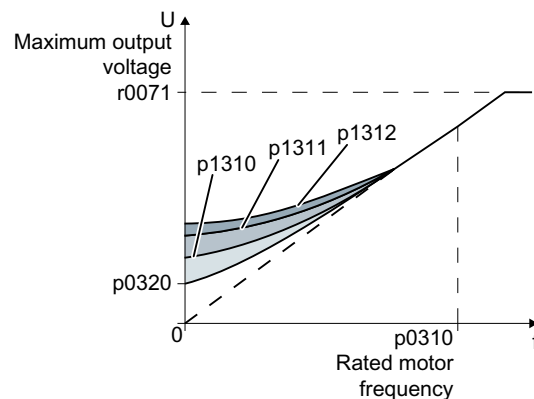


Figure 6-48 The resulting voltage boost using a linear characteristic as example

The inverter boosts the voltage corresponding to the starting currents p1310 ... p1312.

Preconditions

- Set the ramp-up time of the ramp-function generator to a value 1 s (< 1 kW) ... 10 s (> 10 kW), depending on the power rating of the motor.
- Increase the starting current in steps of $\leq 5\%$. Excessively high values in p1310 ... p1312 can cause the motor to overheat and switch off (trip) the inverter due to overcurrent. If message A07409 appears, it is not permissible that you further increase the value of any of the parameters.

Procedure

1. Switch on the motor with a setpoint of a few revolutions per minute.
2. Check whether the motor rotates smoothly.
3. If the motor does not rotate smoothly, or even remains stationary, increase the voltage boost p1310 until the motor runs smoothly.
4. Accelerate the motor to the maximum speed with maximum load.

- 5. Check that the motor follows the setpoint.
- 6. If necessary, increase the voltage boost p1311 until the motor accelerates without problem.

In applications with a high break loose torque, you must also increase parameter p1312 in order to achieve a satisfactory motor response.

You have set the voltage boost.



Parameter	Description
p1310	Starting current (voltage boost) permanent (factory setting 50%) Compensates for voltage drops caused by long motor cables and the ohmic losses in the motor. After commissioning, depending on the motor power rating and the technological application p0501, the inverter sets p1310.
p1311	Starting current (voltage boost) when accelerating (factory setting 0%) Provides additional torque when the motor accelerates. After commissioning, depending on the motor power rating and the technological application p0501, the inverter sets p1311.
p1312	Starting current (voltage boost) when starting (factory setting 0%) Provides additional torque, however, only when the motor accelerates for the first time after it has been switched on ("break loose torque").

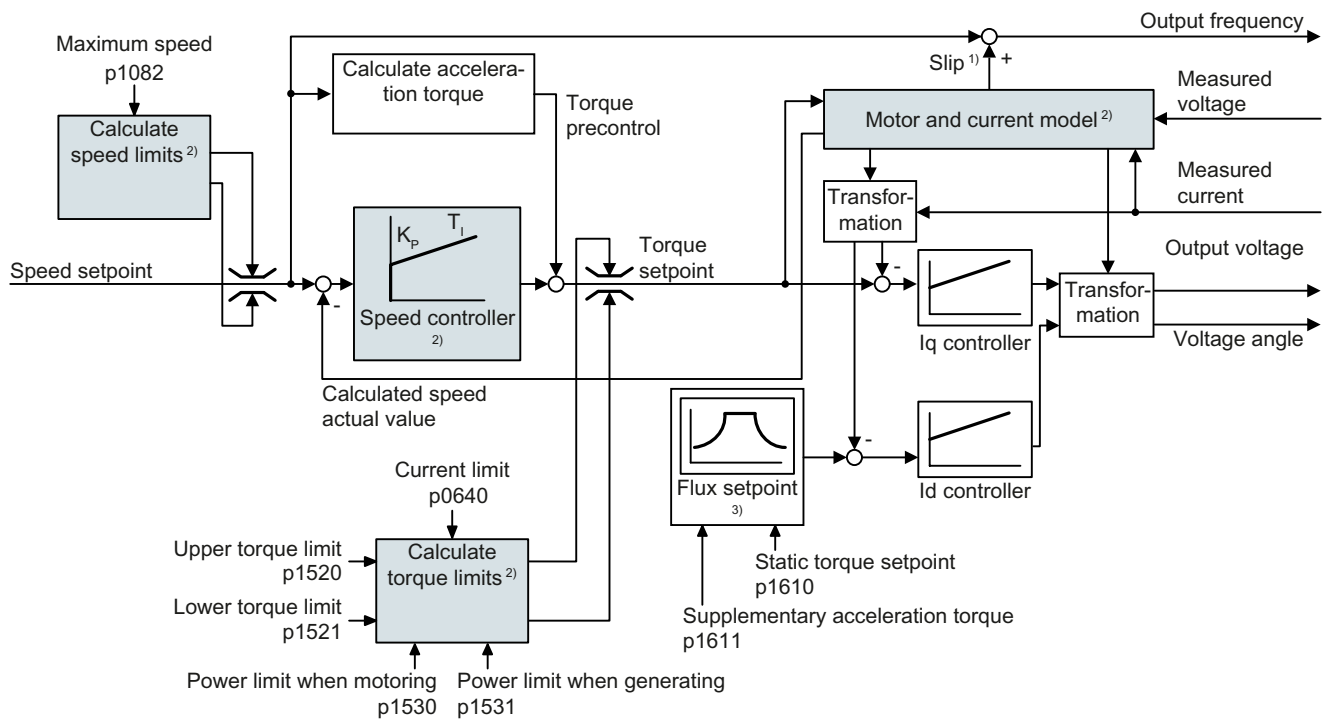
You can find more information about this function in the parameter list and in function diagram 6851 of the List Manual.

6.23.3 Encoderless vector control

6.23.3.1 Structure of vector control without encoder (sensorless)

Overview

The vector control comprises closed-loop current control and a higher-level closed-loop speed control.



¹⁾ for induction motors

²⁾ Settings that are required

Figure 6-49 Simplified function diagram for sensorless vector control with speed controller

Using the motor model, the inverter calculates the following closed-loop control signals from the measured phase currents and the output voltage:


- Current component I_q
- Current component I_d
- Speed actual value

The setpoint of the current component I_d (flux setpoint) is obtained from the motor data. For speeds above the rated speed, the inverter reduces the flux setpoint along the field weakening characteristic.

When the speed setpoint is increased, the speed controller responds with a higher setpoint for current component I_q (torque setpoint). The closed-loop control responds to a higher torque setpoint by adding a higher slip frequency to the output frequency. The higher output frequency also results in a higher motor slip, which is proportional to the accelerating torque. I_q and

I_d controllers keep the motor flux constant using the output voltage, and adjust the matching current component I_q in the motor.

All of the function diagrams 6020 ff. for vector control are provided in the List Manual.

 Overview of the manuals (Page 538)

Settings that are required

Select the vector control during to quick commissioning.

 Commissioning (Page 151)

In order to achieve a satisfactory control response, as a minimum you must set the partial functions – shown with gray background in the diagram above – to match your particular application:

- **Motor and current model:** In the quick commissioning, correctly set the motor data on the rating plate corresponding to the connection type (Y/Δ), and carry out the motor data identification routine at standstill.
- **Speed limits and torque limits:** In the quick commissioning, set the maximum speed (p1082) and current limit (p0640) to match your particular application. When exiting quick commissioning, the inverter calculates the torque and power limits corresponding to the current limit. The actual torque limits are obtained from the converted current and power limits and the set torque limits.
- **Speed controller:** Start the rotating measurement of the motor data identification. You must manually optimize the controller if the rotating measurement is not possible.

Default settings after selecting the application class Dynamic Drive Control

Selecting application class Dynamic Drive Control adapts the structure of the vector control and reduces the setting options:

	Vector control after selecting the application class Dynamic Drive Control	Vector control without selecting an application class
Hold or set the integral component of the speed controller	Not possible	Possible
Acceleration model for precontrol	Default setting	Can be activated
Motor data identification at standstill or with rotating measurement	Shortened, with optional transition into operation	Complete

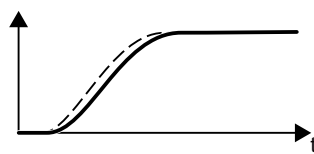
6.23.3.2 Optimizing the speed controller

Optimum control response - post optimization not required

Preconditions for assessing the controller response:

- The moment of inertia of the load is constant and does not depend on the speed
- The inverter does not reach the set torque limits during acceleration
- You operate the motor in the range 40 % ... 60 % of its rated speed

If the motor exhibits the following response, the speed control is well set and you do not have to adapt the speed controller manually:

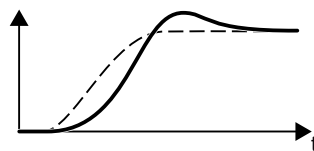


The speed setpoint (broken line) increases with the set ramp-up time and rounding.

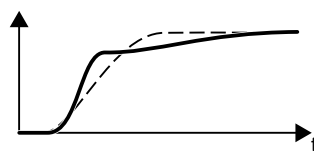
The speed actual value follows the setpoint without any overshoot.

Control optimization required

In some cases, the self optimization result is not satisfactory, or self optimization is not possible as the motor cannot freely rotate.



Initially, the speed actual value follows the speed setpoint with some delay, and then overshoots the speed setpoint.



First, the actual speed value increases faster than the speed setpoint. Before the setpoint reaches its final value, it passes the actual value. Finally, the actual value approaches the setpoint without any significant overshoot.

In the two cases describe above, we recommend that you manually optimize the speed control.

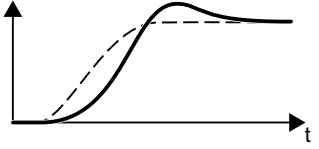

Optimizing the speed controller

Preconditions

- Torque precontrol is active: p1496 = 100 %.
- The load moment of inertia is constant and independent of the speed.
- The inverter requires 10 % ... 50 % of the rated torque to accelerate.
When necessary, adapt the ramp-up and ramp-down times of the ramp-function generator (p1120 and p1121).
- STARTER and Startdrive have trace functions that allow the speed setpoint and actual value to be recorded.

Procedure

1. Switch on the motor.
2. Enter a speed setpoint of approximately 40 % of the rated speed.
3. Wait until the actual speed has stabilized.
4. Increase the setpoint up to a maximum of 60 % of the rated speed.
5. Monitor the associated characteristic of the setpoint and actual speed.
6. Optimize the controller by adapting the ratio of the moments of inertia of the load and motor (p0342):

 <p>The graph shows speed on the y-axis and time on the x-axis. A dashed line represents the speed setpoint, which rises and then levels off. A solid line represents the actual speed, which starts later than the setpoint, reaches a peak above the setpoint's final value (overshoot), and then settles back to the setpoint's final value.</p>	<p>Initially, the speed actual value follows the speed setpoint with some delay, and then overshoots the speed setpoint.</p> <ul style="list-style-type: none"> • Increase p0342
 <p>The graph shows speed on the y-axis and time on the x-axis. A dashed line represents the speed setpoint, which rises and then levels off. A solid line represents the actual speed, which rises more steeply than the setpoint, crosses it before it reaches its final value, and then smoothly approaches the setpoint's final value without overshooting.</p>	<p>Initially, the speed actual value increases faster than the speed setpoint. The setpoint passes the actual value before reaching its final value. Finally, the actual value approaches the setpoint without any overshoot.</p> <ul style="list-style-type: none"> • Reduce p0342

7. Switch off the motor.
8. Set p0340 = 4. The inverter again calculates the speed controller parameters.
9. Switch on the motor.
10. Over the complete speed range check as to whether the speed control operates satisfactorily with the optimized settings.

You have optimized the speed controller.



When necessary, set the ramp-up and ramp-down times of the ramp-function generator (p1120 and p1121) back to the value before optimization.

Mastering critical applications

The drive control can become unstable for drives with a high load moment of inertia and gearbox backlash or a coupling between the motor and load that can possibly oscillate. In this case, we recommend the following settings:

- Increase p1452 (smoothing the speed actual value).
- Increase p1472 (integral time T_i): $T_i \geq 4 \cdot p1452$
- If, after these measures, the speed controller does not operate with an adequate dynamic performance, then increase p1470 (gain K_p) step-by-step.

The most important parameters

Table 6-47 Encoderless speed control

Parameter	Description
p0342	Moment of inertia ratio, total to motor (factory setting: 1.0)
p1496	Acceleration precontrol scaling (factory setting: 0 %) For the rotating measurement of the motor data identification the inverter sets the parameters to 100 %.
p1452	Speed controller speed actual value smoothing time (without encoder) (factory setting: 10 ms)
p1470	Speed controller operation without encoder P gain (factory setting: 0.3)
p1472	Speed controller operation without encoder integral action time (factory setting: 20 ms)

6.24 Electrically braking the motor

Braking with the motor in generating mode



If the motor brakes the connected load electrically, it will convert the kinetic energy of the motor to electrical energy. The electrical energy E released on braking the load is proportional to the moment of inertia J of the motor and load and to the square of the speed n . The motor attempts to pass the energy on to the inverter.

Main features of the braking functions

DC braking

DC braking prevents the motor from transferring braking energy to the inverter. The inverter impresses a DC current into the motor, therefore braking the motor. The motor converts braking energy E of the load into heat.

- *Advantage:* The motor brakes the load without the inverter having to process regenerative power.
- *Disadvantages:* significant increase in the motor temperature; no defined braking characteristics; no constant braking torque; no braking torque at standstill; braking energy is lost as heat; does not function when the power fails

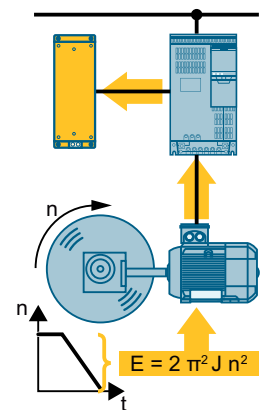
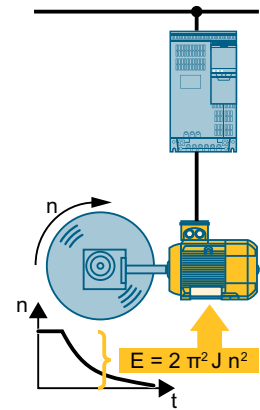
Compound braking

One version of DC braking. The inverter brakes the motor with a defined ramp-down time and superimposes a DC current on the output current.

Dynamic braking

Using a braking resistor, the inverter converts the electrical energy into heat.

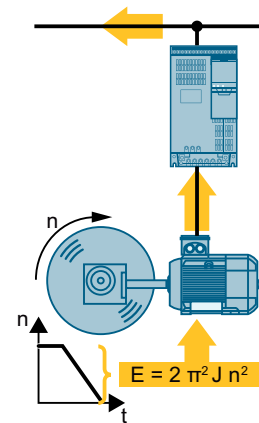
- *Advantages:* defined braking response; motor temperature does not increase any further; constant braking torque
- *Disadvantages:* Braking resistor required; braking energy E is lost in the form of heat



Braking with energy recovery into the line supply

The inverter feeds electrical energy back into the line supply (energy recovery).

- *Advantages:* Constant braking torque; the braking energy is not completely converted into heat, but regenerated into the line supply; is suitable for all applications; continuous regenerative operation is possible - e.g. when lowering a suspended load
- *Disadvantage:* Does not function for a power failure



Which Power Module permits which braking method?

Electrical braking methods	Power Modules that can be used
DC braking	PM230, PM240P-2, PM240-2, PM330
Compound braking	PM240P-2, PM240-2
Dynamic braking	PM240-2, PM330
Braking with energy recovery into the line supply	PM250

6.24.1 DC braking

DC braking is used for applications where the motor must be actively stopped; however, neither an inverter capable of energy recovery nor a braking resistor is available.

Typical applications for DC braking include:

- Centrifuges
- Saws
- Grinding machines
- Conveyor belts

DC braking is not permissible in applications involving suspended loads, e.g. lifting equipment/ cranes and vertical conveyors.

Function

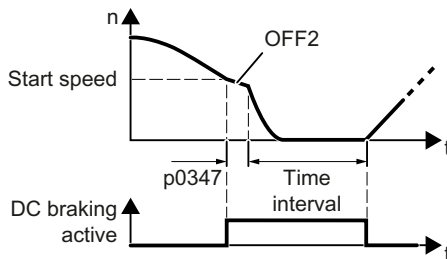
<p>NOTICE</p> <p>Motor overheating as a result of DC braking</p> <p>The motor will overheat if you use DC braking too frequently or use it for too long. This may damage the motor.</p> <ul style="list-style-type: none"> • Monitor the motor temperature. • Allow the motor to adequately cool down between braking operations. • If necessary, select another motor braking method.

With DC braking, the inverter outputs an internal OFF2 command for the time that it takes to de-energize the motor p0347 - and then impresses the braking current for the duration of the DC braking.

The DC-braking function is possible only for induction motors.

4 different events initiate DC braking

DC braking when falling below a starting speed



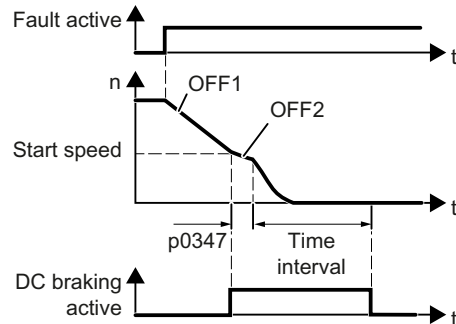
Requirement:

p1230 = 1 and p1231 = 14

Function:

1. The motor speed has exceeded the starting speed.
2. The inverter activates the DC braking as soon as the motor speed falls below the starting speed.

DC braking when a fault occurs



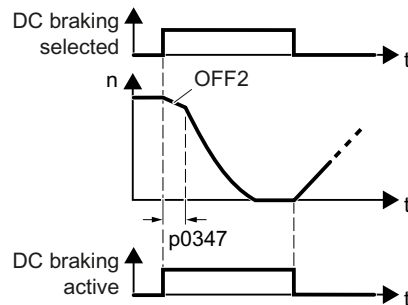
Requirement:

Fault number and fault response are assigned via p2100 and p2101.

Function:

1. A fault occurs, which initiates DC braking as response.
2. The motor brakes along the down ramp to the speed for the start of DC braking.
3. DC braking starts.

DC braking initiated by a control command



Requirement:

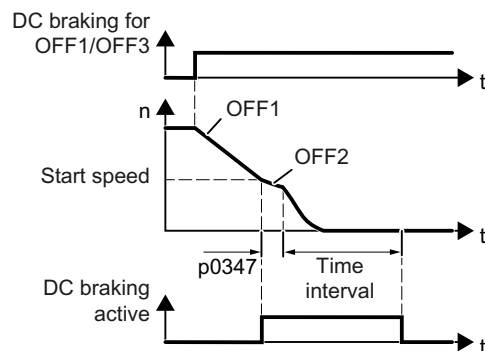
p1231 = 4 and p1230 = control command, e.g. p1230 = 722.3 (control command via DI 3)

Function:

1. The higher-level control issues the command for DC braking, e.g. using DI3: p1230 = 722.3.
2. DC braking starts.

If the higher-level control withdraws the command during DC braking, the inverter interrupts DC braking and the motor accelerates to its setpoint.

DC braking when the motor is switched off



Requirement:

p1231 = 5 or p1230 = 1 and p1231 = 14

Function:

1. The higher-level control switches off the motor (OFF1 or OFF3).
2. The motor brakes along the down ramp to the speed for the start of DC braking.
3. DC braking starts.

Settings for DC braking

Parameter	Description
p0347	Motor de-excitation time (calculated after quick commissioning) The inverter can trip due to an overcurrent during DC braking if the de-excitation time is too short.
p1230	DC braking activation (factory setting: 0) Signal source to activate DC braking <ul style="list-style-type: none"> • 0 signal: Deactivated • 1 signal: Active
p1231	Configuring DC braking (factory setting: 0)
	0 No DC braking
	4 General release for DC braking
	5 DC braking for OFF1/OFF3
14 DC braking below the starting speed	
p1232	DC braking braking current (factory setting 0 A)
p1233	DC braking duration (factory setting 1 s)
p1234	DC braking start speed (factory setting 210000 rpm)
r1239	DC braking status word
	.08 DC braking active
	.10 DC braking ready
	.11 DC braking selected
	.12 DC braking selection internally locked
	.13 DC braking for OFF1/OFF3

Table 6-48 Configuring DC braking as a response to faults

Parameter	Description
p2100	Set fault number for fault response (factory setting 0) Enter the fault number for which DC braking should be activated, e.g. p2100[3] = 7860 (external fault 1).
p2101 = 6	Fault response setting (factory setting 0) Assigning the fault response: p2101[3] = 6.
The fault is assigned an index of p2100. Assign the same index of p2100 or p2101 to the fault and fault response.	
The inverter's List Manual lists in the "Faults and alarms" list the possible fault responses for every fault. Entry "DCBRK" means that you may set DC braking as response for this fault.	

6.24.2 Compound braking

Compound braking is suitable for applications in which the motor is normally operated at a constant speed and is only braked down to standstill in longer time intervals.

Typically, the following applications are suitable for compound braking:

- Centrifuges
- Saws
- Grinding machines
- Horizontal conveyors

Compound braking is not permissible for applications with suspended loads, e.g. lifting equipment/cranes all vertical conveyors.

Principle of operation

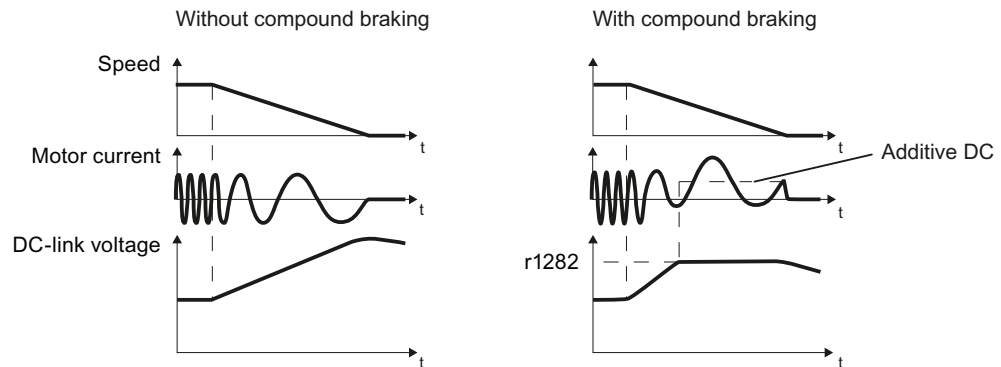


Figure 6-50 Motor brakes with and without active compound braking

Compound braking prevents the DC-link voltage increasing above a critical value. The inverter activates compound braking depending on the DC-link voltage. Above a DC-link voltage threshold (r1282), the inverter adds a DC current to the motor current. The DC current brakes the motor and prevents an excessive increase in the DC-link voltage.

Note

Compound braking is possible only with the U/f control.

Compound braking does not operate in the following cases:

- The "flying restart" function is active
- DC braking is active
- Vector control is selected

Setting and enabling compound braking

Parameter	Description
p3856	<p>Compound braking current (%)</p> <p>With the compound braking current, the magnitude of the DC current is defined, which is additionally generated when stopping the motor for operation with U/f control to increase the braking effect.</p> <p>p3856 = 0 Compound braking locked</p> <p>p3856 = 1 ... 250 Current level of the DC braking current as a % of the rated motor current (p0305)</p> <p>Recommendation: $p3856 < 100\% \times (r0209 - r0331) / p0305 / 2$</p>
r3859.0	<p>Compound-braking status word</p> <p>r3859.0 = 1: Compound braking is active</p>

<p>NOTICE</p> <p>Overheating of the motor due to compound braking</p> <p>The motor will overheat if you use compound braking too frequently or for too long. This may damage the motor.</p> <ul style="list-style-type: none"> • Monitor the motor temperature. • Allow the motor to adequately cool down between braking operations. • If necessary, select another motor braking method.

6.24.3 Dynamic braking

Typical applications for dynamic braking require continuous braking and acceleration operations or frequent changes of the motor direction of rotation:

- Horizontal conveyors
- Vertical and inclined conveyors
- Hoisting gear

Principle of operation

The DC link voltage increases as soon as the motor supplies regenerative power to the inverter when braking. The regenerative power means that the DC link voltage in the inverter increases. Depending on the DC link voltage, the inverter outputs the regenerative power to the braking resistor through the braking chopper. The braking resistor converts the regenerative power into heat, therefore preventing DC link voltages $> V_{dc_max}$.

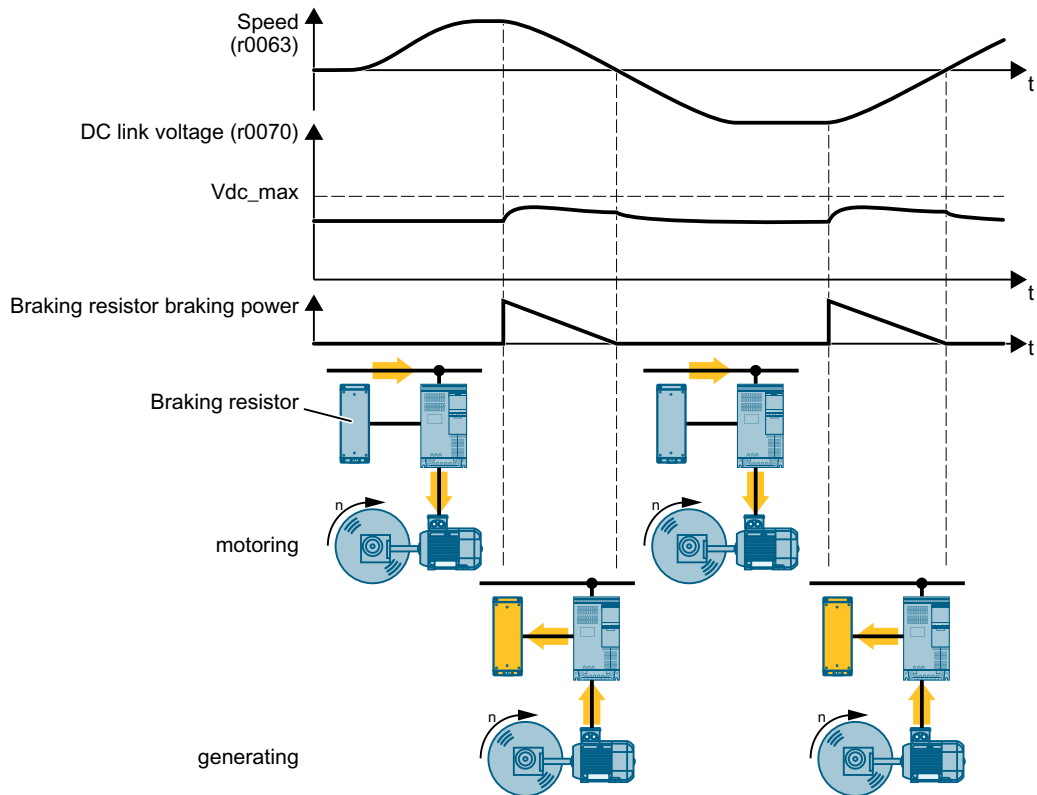







Figure 6-51 Simplified representation of dynamic braking with respect to time

Set dynamic braking

Parameter	Description
p0219	<p>Braking power of the braking resistor (factory setting: 0 kW)</p> <p>For p0219 > 0, the inverter deactivates the VDC_max controller.</p> <p>For vector control, p0219 specifies the regenerative power limit p1531.</p>  <p>Set with p0219 the maximum braking power that the braking resistor must handle. The inverter extends the ramp-down time of the motor when the braking power is too low. You can find the technical data of the braking resistor in the Power Module hardware installation manual.</p> <p> Overview of the manuals (Page 538)</p> <p>The SIZER PC tool provides support for calculating the braking power.</p> <p> Configuring support (Page 540)</p>
p2106	<p>BI: External fault 1</p> <p>p2106 = 722.x</p> <p>Monitor the signal for overtemperature of the braking resistor with digital input x of the inverter.</p> <p> Connecting the temperature contact of the braking resistor (Page 142)</p>

An example for configuring a drive with braking resistor is provided in the Internet:

 Engineering and commissioning series lifting equipment/cranes (<https://support.industry.siemens.com/cs/de/en/view/103156155>)

6.24.4 Braking with regenerative feedback to the line

The typical applications for braking with energy recovery (regenerative feedback into the line supply) are as follows:

- Hoist drives
- Centrifuges
- Unwinders

For these applications, the motor must brake for longer periods of time.

The inverter can feed back up to 100% of its rated power into the line supply (referred to "High Overload" base load).



Technical data, PM250 Power Module (Page 508)

Setting the braking with regenerative feedback to the line

Parameter	Description
Limiting the regenerative feedback for V/f control (p1300 < 20)	
p0640	Motor series overload factor (factory setting: 0.00 A, default for quick commissioning) It is only possible to limit the regenerative power with V/f control by limiting the motor current. If the current exceeds this value for longer than 10 s, the inverter shuts down the motor with fault F07806.
Limiting feedback with vector control (p1300 ≥ 20)	
p1531	Power limit generative (factory setting: -0.01 kW) The inverter calculates the parameter based on the quick commissioning or with p0340 = 5.

6.25 Overcurrent protection



The vector control ensures that the motor current remains within the set torque limits.

If you use U/f control, you cannot set any torque limits. The U/f control prevents too high a motor current by influencing the output frequency and the motor voltage (I-max controller).

I_max controller

Requirements

The torque of the motor must decrease at lower speeds, which is the case, for example, with fans.

The load must not drive the motor continuously, e.g. when lowering hoisting gear.

Function

The I-max controller influences the output frequency and the motor voltage.

If the motor current reaches the current limit during acceleration, the I-max controller extends the acceleration operation.

If the load of the motor is so large during stationary operation that the motor current reaches the current limit, the I-max controller reduces the speed and the motor voltage until the motor current is in the permissible range again.

If the motor current reaches the current limit during deceleration, the I-max controller extends the deceleration operation.

Settings

You only have to change the factory settings of the I-max controller if the drive tends to oscillate when it reaches the current limit or if it is shut down due to overcurrent.

Table 6-49 I-max controller parameters

Parameter	Description
p0305	Rated motor current
p0640	Motor current limit
p1340	Proportional gain of the I-max controller for speed reduction
p1341	Integral time of the I-max controller for speed reduction
r0056.13	Status: I-max controller active
r1343	Speed output of the I-max controller Shows the amount to which the I-max controller reduces the speed.

For more information about this function, see function diagram 6300 in the List Manual.

6.26 Inverter protection using temperature monitoring



The inverter temperature is essentially defined by the following effects:

- The ambient temperature
- The ohmic losses increasing with the output current
- Switching losses increasing with the pulse frequency

Monitoring types

The inverter monitors its temperature using the following monitoring types:

- I²t monitoring (alarm A07805, fault F30005)
- Measuring the chip temperature of the Power Module (alarm A05006, fault F30024)
- Measuring the heat sink temperature of the Power Module (alarm A05000, fault F30004)

Inverter response to thermal overload

Parameter	Description
r0036	<p>Power unit overload I²t [%]</p> <p>The I²t monitoring calculates the inverter utilization based on a current reference value defined in the factory.</p> <ul style="list-style-type: none"> • Actual current > reference value: r0036 becomes higher. • Actual current < reference value: r0036 becomes lower or remains = 0.
r0037	<p>Power unit temperatures [°C]</p>
p0290	<p>Power unit overload response</p> <p>Factory setting and the ability to be changed depends on the hardware. The dependency is described in the List Manual.</p> <p>A thermal overload is present if the inverter temperature is greater than that specified in p0292.</p> <p>You define how the inverter responds if there is a risk of thermal overload using this parameter. The details are described below.</p>
p0292	<p>Power unit temperature warning threshold (factory setting: Heat sink [0] 5 °C, power semiconductor [1] 15 °C)</p> <p>The value is set as a difference to the shutdown temperature.</p>
p0294	<p>Power unit warning at I²t overload (factory setting: 95 %)</p>

Overload response for p0290 = 0

The inverter responds depending on the control mode that has been set:

- In vector control, the inverter reduces the output current.
- In U/f control, the inverter reduces the speed.

Once the overload condition has been removed, the inverter re-enables the output current or speed.

If the measure cannot prevent an inverter thermal overload, then the inverter switches off the motor with fault F30024.

Overload response for p0290 = 1

The inverter immediately switches off the motor with fault F30024.

Overload response for p0290 = 2

We recommend this setting for drives with square-law torque characteristic, e.g. fans.

The inverter responds in two stages:

1. If you operate the inverter with increased pulse frequency setpoint p1800, then the inverter reduces its pulse frequency starting at p1800. In spite of the temporarily reduced pulse frequency, the base load output current remains unchanged at the value that is assigned to p1800.

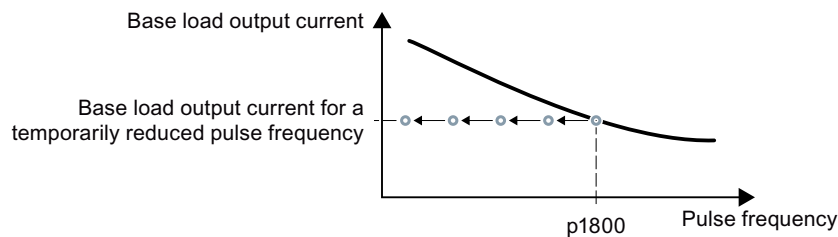


Figure 6-52 Derating characteristic and base load output current for overload

Once the overload condition has been removed, the inverter increases the pulse frequency back to the pulse frequency setpoint p1800.

2. If it is not possible to temporarily reduce the pulse frequency, or the risk of thermal overload cannot be prevented, then stage 2 follows:
 - In vector control, the inverter reduces its output current.
 - In U/f control, the inverter reduces the speed.

Once the overload condition has been removed, the inverter re-enables the output current or speed.

If both measures cannot prevent a power unit thermal overload, then the inverter switches off the motor with fault F30024.

Overload response for p0290 = 3

If you operate the inverter with increased pulse frequency, then the inverter reduces its pulse frequency starting at the pulse frequency setpoint p1800.

In spite of the temporarily reduced pulse frequency, the maximum output current remains unchanged at the value that is assigned to the pulse frequency setpoint. Also see p0290 = 2.

Once the overload condition has been removed, the inverter increases the pulse frequency back to the pulse frequency setpoint p1800.

If it is not possible to temporarily reduce the pulse frequency, or the measure cannot prevent a power unit thermal overload, then the inverter switches off the motor with fault F30024.

Overload response for p0290 = 12

The inverter responds in two stages:

1. If you operate the inverter with increased pulse frequency setpoint p1800, then the inverter reduces its pulse frequency starting at p1800.
There is no current derating as a result of the higher pulse frequency setpoint.
Once the overload condition has been removed, the inverter increases the pulse frequency back to the pulse frequency setpoint p1800.
2. If it is not possible to temporarily reduce the pulse frequency, or the risk of inverter thermal overload cannot be prevented, then stage 2 follows:
 - In vector control, the inverter reduces the output current.
 - In U/f control, the inverter reduces the speed.

Once the overload condition has been removed, the inverter re-enables the output current or speed.

If both measures cannot prevent a power unit thermal overload, then the inverter switches off the motor with fault F30024.

Overload response for p0290 = 13

We recommend this setting for drives with high starting torque, e.g. horizontal conveyors or extruders.

If you operate the inverter with increased pulse frequency, then the inverter reduces its pulse frequency starting at the pulse frequency setpoint p1800.

There is no current derating as a result of the higher pulse frequency setpoint.

Once the overload condition has been removed, the inverter increases the pulse frequency back to the pulse frequency setpoint p1800.

If it is not possible to temporarily reduce the pulse frequency, or the measure cannot prevent a power unit thermal overload, then the inverter switches off the motor with fault F30024.

Special feature for PM330

For PM330, the overload response is permanently set to p0290 = 2. It cannot be changed.

6.27 Motor protection with temperature sensor



The inverter can evaluate one of the following sensors to protect the motor against overtemperature:

- | | |
|--|---|
| | • KTY84 sensor |
| | • Temperature switch (e.g. bimetallic switch) |
| | • PTC sensor |
| | • Pt1000 sensor |

KTY84 sensor

NOTICE

Overheating of the motor due to KTY sensor connected with the incorrect polarity

If a KTY sensor is connected with incorrect polarity, the motor can become damaged due to overheating, as the inverter cannot detect a motor overtemperature condition.

- Connect the KTY sensor with the correct polarity.



Using a KTY sensor, the inverter monitors the motor temperature and the sensor itself for wire-break or short-circuit:

- Temperature monitoring:
 - The inverter uses a KTY sensor to evaluate the motor temperature in the range from -48°C ... $+248^{\circ}\text{C}$.
 - Use the p0604 or p0605 parameter to set the temperature for the alarm and fault threshold.
 - Overtemperature alarm (A07910):
 - motor temperature $>$ p0604 and p0610 = 0
 - Overtemperature fault (F07011):
 - The inverter responds with a fault in the following cases:
 - motor temperature $>$ p0605
 - motor temperature $>$ p0604 and p0610 \neq 0
- Sensor monitoring (A07015 or F07016):
 - Wire-break:
 - The inverter interprets a resistance $>$ 2120 Ω as a wire-break and outputs the alarm A07015. After 100 milliseconds, the inverter changes to the fault state with F07016.
 - Short-circuit:
 - The inverter interprets a resistance $<$ 50 Ω as a short-circuit and outputs the alarm A07015. After 100 milliseconds, the inverter changes to the fault state with F07016.

Temperature switch



The inverter interprets a resistance \geq 100 Ω as being an opened temperature switch and responds according to the setting for p0610.

PTC sensor



The inverter interprets a resistance $> 1650 \Omega$ as being an overtemperature and responds according to the setting for p0610.

The inverter interprets a resistance $< 20 \Omega$ as being a short-circuit and responds with alarm A07015. If the alarm is present for longer than 100 milliseconds, the inverter shuts down with fault F07016.

Pt1000 sensor



Using a Pt1000 sensor, the inverter monitors the motor temperature and the sensor itself for wire breakage and/or short-circuit:

- Temperature monitoring:
 - Using a Pt1000 sensor, the inverter evaluates the motor temperature in the range from $-48 \text{ }^\circ\text{C}$... $+248 \text{ }^\circ\text{C}$.
 - You set the temperature for the alarm and fault thresholds using parameters p0604 and p0605.
 - Overtemperature alarm (A07910):
 - motor temperature $> p0604$ and $p0610 = 0$
 - Overtemperature fault (F07011):
 - The inverter responds with a fault in the following cases:
 - motor temperature $> p0605$
 - motor temperature $> p0604$ and $p0610 \neq 0$
- Sensor monitoring (A07015 or F07016):
 - Wire-break:
 - The inverter interprets a resistance $> 2120 \Omega$ as a wire-break and outputs the alarm A07015. After 100 milliseconds, the inverter changes to the fault state with F07016.
 - Short-circuit:
 - The inverter interprets a resistance $< 603 \Omega$ as a short-circuit and outputs the alarm A07015. After 100 milliseconds, the inverter changes to the fault state with F07016.

Setting parameters for the temperature monitoring

Parameter	Description
p0335	Motor-cooling method (factory setting: 0) 0: Natural cooling - with fan on the motor shaft 1: Forced ventilation - with a separately driven fan 2: Liquid cooling 128: No fan
p0601	Motor temperature sensor type 0: No sensor (factory setting) 1: PTC 2: KTY84 4: Temperature switch 6: Pt1000
p0604	Mot_temp_mod 2 / sensor alarm threshold (factory setting $130 \text{ }^\circ\text{C}$) For monitoring the motor temperature using KTY84/Pt1000.

Parameter	Description
p0605	Mot_temp_mod 1/2 / sensor threshold and temperature value (factory setting: 145° C) For monitoring the motor temperature using KTY84/Pt1000.
p0610	Motor overtemperature response (factory setting: 12) Determines the inverter behavior when the motor temperature reaches the alarm threshold p0604.
	0: Alarm (A07910), no fault
	1: Alarm A07910 and fault F07011 The inverter reduces the current limit.
	2, 12: Alarm A07910 and fault F07011 The inverter does not reduce the current limit.
p0640	Current limit [A]

Additional information on the motor temperature monitoring can be found in function diagram 8016 of the List Manual.

6.28 Motor protection by calculating the temperature



The inverter calculates the motor temperature based on a thermal motor model.

The thermal motor model responds far faster to temperature increases than a temperature sensor.

If you are using the thermal motor model together with a temperature sensor, e.g. a Pt1000, then the inverter corrects the model based on the measured temperature.

Thermal motor model 2 for induction motors

The thermal motor model 2 for induction motors is a thermal 3-mass model, consisting of stator core, stator winding and rotor. Thermal motor model 2 calculates the temperatures - both in the rotor as well as in the stator winding.

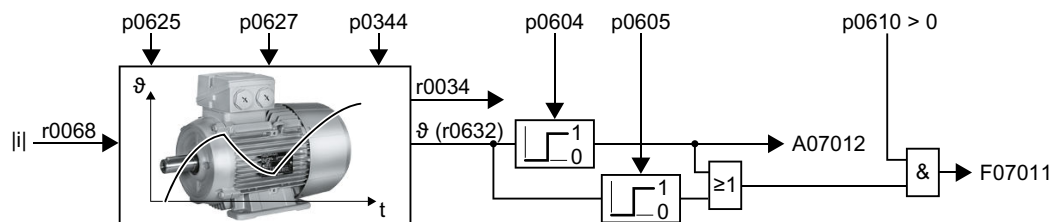


Figure 6-53 Thermal motor model 2 for induction motors

Table 6-50 Thermal motor model 2 for induction motors

Parameter	Description
r0068	CO: Absolute actual current value
p0610	Motor overtemperature response (factory setting: 12)
0:	Alarm A07012 The inverter does not reduce the current limit.
1:	Alarm A07012 and fault F07011 The inverter reduces the current limit.
2:	Alarm A07012 and fault F07011 The inverter does not reduce the current limit.
12:	Alarm A07012 and fault F07011 The inverter does not reduce the current limit. After switching off the supply voltage, the inverter saves the most-recently calculated difference to the ambient air temperature. After switching the supply voltage on again, the thermal motor model starts with 90 % of the previously saved difference temperature.

Parameter	Description	
p0344	Motor weight (for thermal motor type) (factory setting: 0.0 kg)	After selecting an induction motor (p0300) or a listed induction motor (p0301) during the commissioning, the inverter sets the parameters to values appropriate for the motor. The parameters are write-protected for listed motors (p0301 ≥ 0).
p0604	Mot_temp_mod 2/KTY alarm threshold (factory setting: 130.0° C) Motor temperature > p0604 ⇒ fault F07011.	
p0605	Mot_temp_mod 1/2 threshold (factory setting: 145.0° C) Motor temperature > p0605 ⇒ alarm A07012.	
p0612	Mot_temp_mod activation	
	.01	1 signal: Activate motor temperature model 2 for induction motors
	.09	1 signal: Activate motor temperature model 2 expansions The inverter sets bit 09 = 1 after commissioning. If you load the parameter settings for firmware version ≤ V4.6 into the inverter, bit 09 = 0 remains.
p0627	Motor overtemperature, stator winding (factory setting: 80 K)	
p0625	Motor ambient temperature during commissioning (factory setting: 20° C) Specification of the motor ambient temperature in °C at the instant of the motor data identification.	
r0632	Mot_temp_mod stator winding temperature [°C]	
p0640	Current limit [A]	

Further information is provided in the function charts 8016 and 8017 of the List Manual.

Thermal motor model 1 for synchronous reluctance motors

Thermal motor model 1 calculates the temperature of the stator winding from the motor current and the thermal time constant of the motor model.

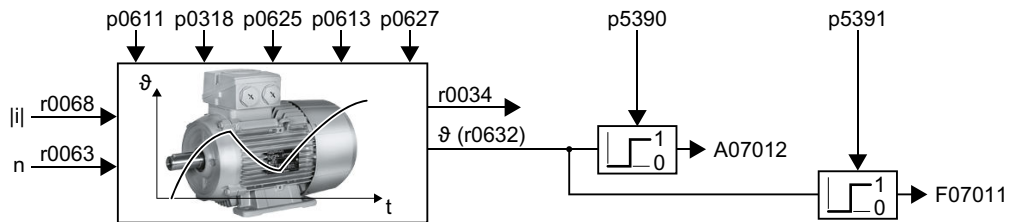


Figure 6-54 Thermal motor model 1 for reluctance motors

Table 6-51 Thermal motor model 1 for reluctance motors

Parameter	Description
r0034	CO: Thermal motor load [%]
r0068	CO: Absolute actual current value
p0610	Motor overtemperature response (factory setting: 12)
	0: No response, alarm only, no reduction of I_{max}
	1: Messages, reduction of I_{max}
	2: Messages, no reduction of I_{max}
	12: Messages, no reduction of I_{max} , temperature is saved

Parameter	Description	
p0318	Motor standstill current (factory setting: 0.0 A)	
p0611	I2t motor model thermal time constant (factory setting: 0 s)	
p0612	Mot_temp_mod activation	
	.00	1 signal: Activate motor temperature model 1
	.08	1 signal: Activate extended mode, overtemperature at rated load: p0627
	.12	0 signal: Ambient temperature = p0625 1 signal: Ambient temperature = p0613
p0627	Motor overtemperature, stator winding (factory setting: 80 K)	
p5390	Mot_temp_mod 1/3 alarm threshold (factory setting: 110.0° C) Motor temperature > p5390 ⇒ alarm A07012.	
p5391	Mot_temp_mod 1/3 fault threshold (factory setting: 120.0° C) Motor temperature > p5391 ⇒ fault F07011.	
p0613	Mot_temp_mod 1/3 ambient air temperature (factory setting: 20° C) Expected motor ambient temperature in °C for motor operation.	
p0625	Motor ambient temperature during commissioning (factory setting: 20° C) Motor ambient temperature in °C at the instant of the motor data identification.	
r0632	Mot_temp_mod stator winding temperature [°C]	

After selecting a synchronous reluctance motor (p0300 = 600) during the commissioning, the inverter sets the parameters to values appropriate for the motor type. The parameters are write-protected for listed motors (p0301 ≥ 0).

Further information is provided in the function charts 8016 and 8017 of the List Manual.

6.29 Motor and inverter protection by limiting the voltage

What causes an excessively high voltage?



To drive the load, an electric motor converts electrical energy into mechanical energy. If the motor is driven by its load, e.g. due to the load moment of inertia when braking, then the energy flow reverses: The motor temporarily operates as generator, and converts mechanical energy into electrical energy. The electrical energy flows from the motor to the inverter. If the inverter cannot output the electrical energy supplied by the motor, e.g. to a braking resistor, then the inverter stores the energy in its DC link capacitance. As a consequence, the DC link voltage V_{dc} in the inverter is higher.

An excessively high DC link voltage damages the inverter and also the motor. As a consequence, the inverter monitors its DC link voltage - and when necessary switches off the motor and outputs fault "DC link overvoltage".

Protecting the motor and inverter against overvoltage

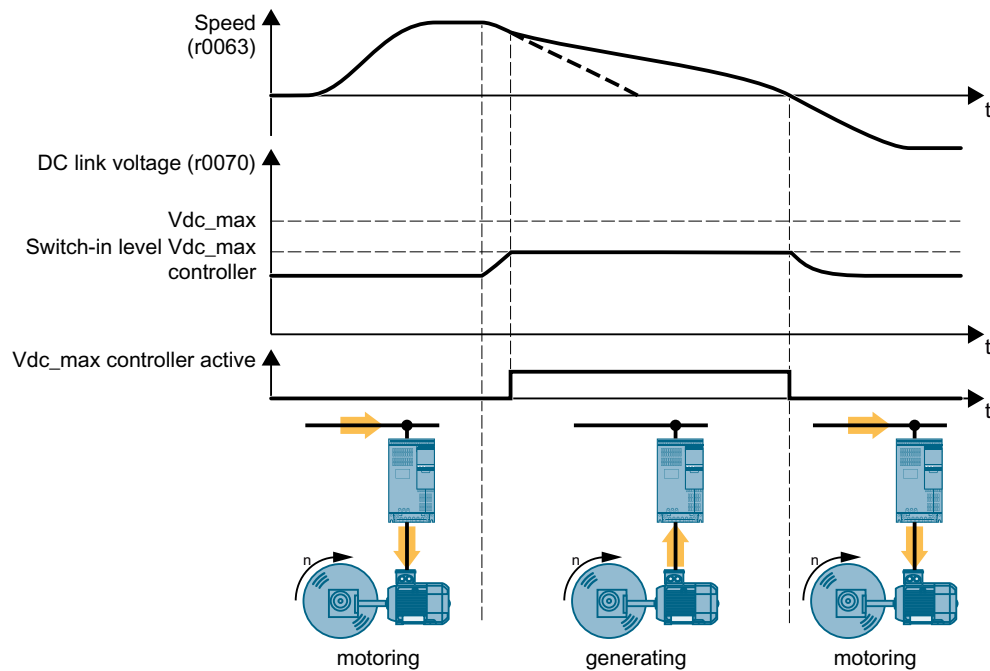


Figure 6-55 Simplified representation of the V_{dc_max} control

The V_{dc_max} control extends the motor ramp-down time when braking. The motor then only feeds so much energy into the inverter to cover the losses in the inverter. The DC link voltage remains in the permissible range.

The V_{dc_max} control is not suitable for applications where the motor is in continuous regenerative operation, e.g. as is the case for cranes and centrifuges.

Electrically braking the motor (Page 318)

The V_{dc_max} control can be used only with the PM230, PM240-2, PM240P-2 and PM330 Power Modules. The V_{dc_max} control is not required if you use a braking resistor.

PM250 Power Modules feed back regenerative energy into the line supply. Therefore, the Vdc_max control is not required for a PM250 Power Module.

Parameters of the Vdc_max control

The parameters differ depending on the motor control mode.

Parameter for V/f control	Parameter for vector control	Description
p1280 = 1	p1240 = 1	Vdc controller configuration (Factory setting: 1) 1: VDC controller is enabled
r1282	r1242	Vdc_max control activation level DC link voltage value above which the Vdc_max control is activated
p1283	p1243	Vdc_max control dynamic factor (factory setting: 100 %) Scaling control parameters p1290, p1291 and p1292
p1284	---	Vdc_max controller time threshold Setting the monitoring time of the Vdc_max controller.
p1290	p1250	Vdc_max control proportional gain (factory setting: 1)
p1291	p1251	Vdc_max control integral time (factory setting p1291: 40 ms, p1251: 0 ms)
p1292	p1252	Vdc_max control rate time (factory setting p1292: 10 ms, p1252: 0 ms)
p1294	p1254	Vdc_max control automatic ON level sensing (factory setting, dependent on the Power Module) Automatically sense switch-on levels of the Vdc_max control. 0: Automatic detection disabled 1: Automatic detection enabled
p0210	p0210	Unit supply voltage If p1254 or p1294 = 0, the inverter uses this parameter to calculate the switch-in thresholds of the Vdc_max control. Set this parameter to the actual value of the input voltage.

For more information about this function, see the List Manual (function diagrams 6320 and 6220).

6.30 Monitoring the driven load



In many applications, the speed and the torque of the motor can be used to determine whether the driven load is in an impermissible operating state. The use of an appropriate monitoring function in the inverter prevents failures and damage to the machine or plant.

Examples:

- For fans or conveyor belts, an excessively low torque can mean a broken drive belt.
- For pumps, insufficient torque can indicate a leakage or dry-running.
- For extruders and mixers, an excessive torque together with low speed can indicate machine blockage.

Functions for monitoring the driven load

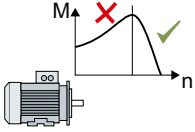
The inverter provides the following means to monitor the driven load via the torque of the motor:

	<p>The stall protection recognizes a stalled asynchronous motor.</p>
	<p>The no-load monitoring evaluates the motor current. Insufficient current indicates that the motor and the load are no longer mechanically connected with each other.</p>
	<p>The blocking protection triggers for a motor current that corresponds to the set current limit coupled with motor standstill.</p>
	<p>The torque monitoring assumes that a specific torque is associated with each speed for pumps and fans. Insufficient torque indicates that the motor and the load are no longer mechanically connected. An excessive torque can indicate problems in the mechanical system of the driven load, e.g. a mechanically blocked load.</p>
	<p>Blocking protection, leakage protection and dry-running protection are a monitoring method for pumps or fans. The monitoring combines a torque monitoring with a blocking protection.</p>

Monitoring the driven load with a binary signal:

	<p>The speed monitoring evaluates a periodic binary signal. A signal failure indicates that the motor and the load are no longer mechanically connected with each other.</p>
--	--

6.30.1 Breakdown protection



If the load of a standard induction motor exceeds the stall torque of the motor, the motor can also stall during operation on the inverter. A stalled motor is stationary and does not develop sufficient torque to accelerate the load.

If the "Motor model fault signal stall detection" r1746 for the time p2178 is present via the "Motor model error threshold stall detection" p1745, the inverter signals "Motor stalled" and fault F07902.

Parameter	Description
r1408	Current controller status word r1408.12 = 1: Motor stalled
p1745	Motor model fault threshold value stall detection (factory setting: 5%) If the motor stalls too early with this setting, then using the trace function you have the option of determining a better value. To do this, set p1745 = 100.
r1746	Motor model fault signal stall detection [%]
p2178	Motor stalled delay time (factory setting: 0.01 s)
r2198	Status word monitoring 2 r2198.07 = 1: Motor stalled

6.30.2 No-load monitoring



In applications with fans, compressors or conveyor belts, an insufficient motor current indicates that the power transmission from the motor to the load is interrupted.

If the motor current for the time p2180 lies below the current level p2179, the inverter signals "output load not available" and alarm A07929.

Parameters	Description
r0068	Actual current value [A] [0] = Unsmoothed [1] = Smoothed with p0045
p2179	Output load detection current limit (Factory setting: 0 A) p2179 = 0: No load detection deactivated
p2180	Output load detection delay time (factory setting: 2000 ms)
r2197	Status word, monitoring functions 1 r2197.11 = 1: Output load not available

6.30.3 Blocking protection

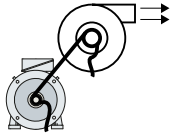


In applications with extruders or mixers, the motor can block for an excessive mechanical load. For a blocked motor, the motor current corresponds to the set current limit without the speed reaching the specified setpoint.

If the speed lies below the speed threshold p2175 for the time p2177 while the motor current reaches the current limit, the inverter signals "Motor blocked" and fault F07900.

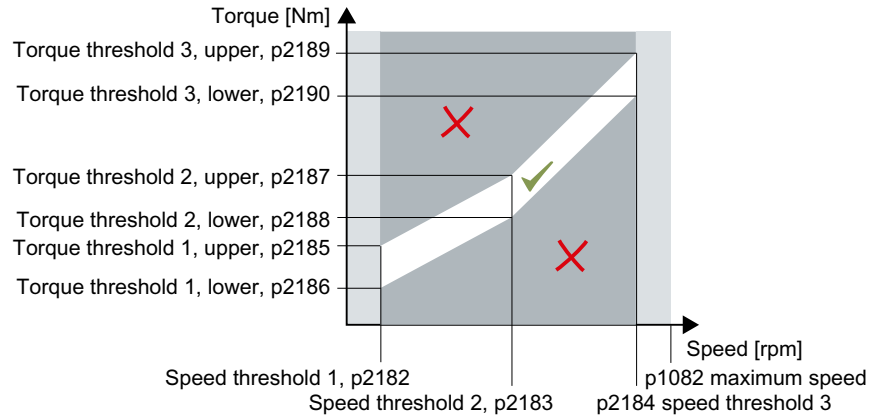
Parameter	Description
r0063	Actual speed value [rpm] [0] = Unsmoothed [1] = Smoothed with p0045
p2175	Motor blocked speed threshold (factory setting: 120 rpm) p2175 = 0: Blocking protection deactivated
p2177	Motor blocked delay time (factory setting: 3 s)
r2198	Status word monitoring 2 r2198.06 = 1: Motor blocked

6.30.4 Torque monitoring



In applications with fans, pumps or compressors with the flow characteristic, the torque follows the speed according to a specific characteristic. An insufficient torque for fans indicates that the power transmission from the motor to the load is interrupted. For pumps, insufficient torque can indicate a leakage or dry-running.

The inverter monitors the torque based on the envelope curve depending on the speed against a lower and upper torque.



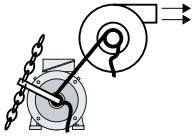
If the torque lies in the impermissible range longer than time p2192, the inverter reacts as specified in p2181.

The monitoring is not active below speed threshold 1 and above speed threshold 3.

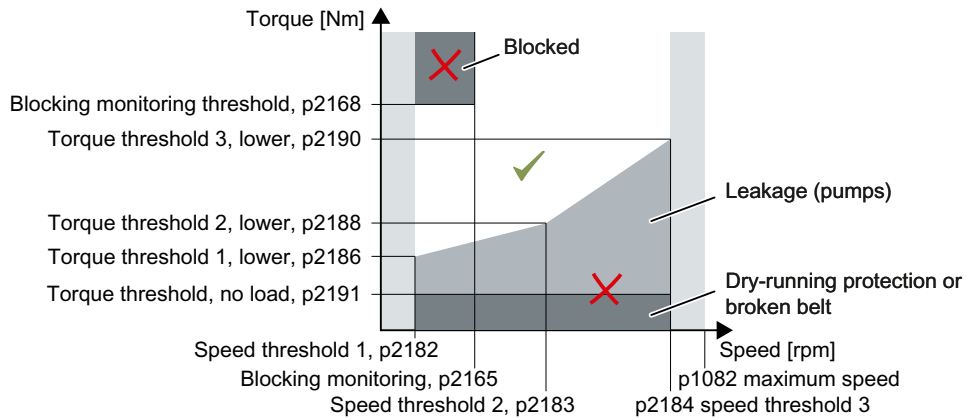
Parameters	Description
p2181	Load monitoring response 1: A07920 for torque too low 2: A07921 for torque too high 3: A07922 for torque outside tolerance 4: F07923 for torque too low 5: F07924 for torque too high 6: F07925 for torque outside tolerance
p2182	Load monitoring speed threshold 1
p2183	Load monitoring speed threshold 2
p2184	Load monitoring speed threshold 3
p2185	Load monitoring torque threshold 1, upper
p2186	Load monitoring torque threshold 1, lower
p2187	Load monitoring torque threshold 2, upper
p2188	Load monitoring torque threshold 2, lower
p2189	Load monitoring torque threshold 3, upper
p2190	Load monitoring torque threshold 3, lower
p2192	Load monitoring delay time Delay time for the message "Leave torque monitoring tolerance band"
p2193 = 1	Load monitoring configuration (factory setting: 1) 1: Monitoring torque and load drop

The inverter interpolates linearly between characteristic points.

6.30.5 Blocking protection, leakage protection and dry-running protection



In applications with fans, pumps or compressors with the flow characteristic, the torque follows the speed according to a specific characteristic. An insufficient torque for fans indicates that the power transmission from the motor to the load is interrupted. For pumps, insufficient torque can indicate a leakage or dry-running.



If the torque and speed lie in the impermissible range longer than time p2192, the inverter reacts as specified in p2181.

For applications with pumps (p2193 = 4), the inverter detects the following states of the driven load:

- Blocked
- Leakage
- Dry running

For applications with fans or compressors (p2193 = 5), the inverter detects the following states of the driven load:

- Blocked
- Torn belt

The monitoring is not active below speed threshold 1 and above speed threshold 3.

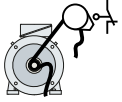
When using the control mode "U/f control" (p1300 < 10), the "Blocking protection" function becomes active when the current limit is reached.

Blocking protection (Page 342)

Parameter	Description
p2165	Load monitoring blocking monitoring threshold, upper
p2168	Load monitoring blocking monitoring torque threshold

Parameter	Description	
p2181	Load monitoring response	
	7:	A07891: Load monitoring, pump/fan blocked A07892: Load monitoring, pump/fan without load A07893: Load monitoring, pump leakage
	8:	F07894: Load monitoring, pump/fan blocked F07895: Load monitoring, pump/fan without load F07896: Load monitoring, pump leakage
p2182	Load monitoring speed threshold 1 <ul style="list-style-type: none"> • When using the control mode "U/f control" (p1300 < 10): p2182 > 10% of the rated speed • When using the control mode "encoderless vector control" (p1300 = 20): p2182 > p1755 (switchover speed, motor model) 	The inverter interpolates linearly between characteristic points.
p2183	Load monitoring speed threshold 2	
p2184	Load monitoring speed threshold 3	
p2186	Load monitoring torque threshold 1, lower	
p2188	Load monitoring torque threshold 2, lower	
p2190	Load monitoring torque threshold 3, lower	
p2191	Load monitoring torque threshold, no load	
p2192	Load monitoring delay time When using the control mode "encoderless vector control" (p1300 = 20): <ul style="list-style-type: none"> • For operation with an induction motor: Set p2192 < 1 s or p1750.6 = 1 (the closed-loop control does not change to open-loop controlled mode for blocked motor) • For operation with synchronous and reluctance motors, the inverter sometimes cannot detect a blocked motor. 	
p2193 = 4 or 5	Load monitoring configuration (factory setting: 1) 4: Pump monitoring: Differentiation between leakage and dry running 5: Fan monitoring: p2191 has no effect	

6.30.6 Rotation monitoring



The inverter monitors the speed or velocity of a machine component via an electromechanic or electronic encoder, e.g. a proximity switch. Examples of how the function can be used:

- Gearbox monitoring for traction drives and hoisting gear
- Drive belt monitoring for fans and conveyor belts
- Blocking protection for pumps and conveyor belts

The inverter checks whether the encoder consistently supplies a 24 V signal during motor operation. If the encoder signal fails for time p2192, the inverter signals fault F07936.

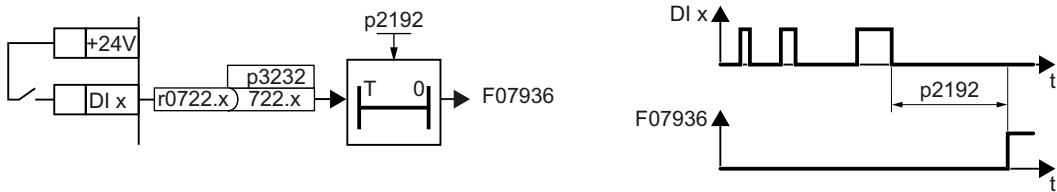


Figure 6-56 Function plan and time response of the speed monitoring

Parameter	Description
p2192	Load monitoring delay time (factory setting 10 s) After the motor is switched on, if the "LOW" signal is present at the associated digital input for longer than this time, the inverter signals a load failure (F07936).
p2193 = 3	Load monitoring configuration (factory setting: 1) 0: Monitoring switched off 1: Monitoring torque and load drop 2: Monitoring speed and load drop 3: Load failure monitoring
p3232	Load monitoring failure detection (factory setting: 1) Connect the load monitoring to a DI x digital input of your choice. p3232 = 722.x

For more information, see the List Manual (the parameter list and function diagram 8013).

6.31 Flying restart – switching on while the motor is running



If you switch on the motor while it is still rotating, without the "Flying restart" function, there is a high probability that a fault will occur as a result of overcurrent (F30001 or F07801). Examples of applications involving an unintentionally rotating motor directly before switching on:

- The motor rotates after a brief line interruption.
- A flow of air turns the fan impeller.
- A load with a high moment of inertia drives the motor.

Principle of operation

The "Flying restart" function comprises the following steps:

1. After the on command, the inverter impresses the search current in the motor and increases the output frequency.
2. When the output frequency reaches the actual motor speed, the inverter waits for the motor excitation build up time.
3. The inverter accelerates the motor to the actual speed setpoint.

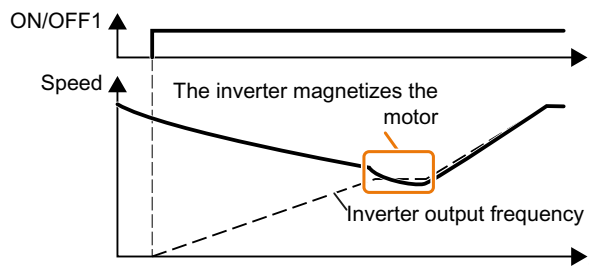


Figure 6-57 Principle of operation of the "flying restart" function

Setting "flying restart" function

Parameter	Description	
p1200	Flying restart operating mode (factory setting: 0)	
	0	Flying restart is disabled
	1	Flying restart is enabled, search for the motor in both directions, start in the direction of the setpoint
	4	Flying restart is enabled, search for the motor only in the direction of the setpoint

No "Flying restart" function for group drives

It is not permissible that you enable the "Flying restart" function if the inverter is simultaneously driving several motors.

6.31 Flying restart – switching on while the motor is running

Exception: a mechanical coupling ensures that all of the motors always operate with the same speed.

Table 6-52 Advanced settings

Parameter	Description
p0346	Motor excitation build up time Wait time between switching on the motor and enabling the ramp-function generator.
p0347	Motor de-excitation time Within the motor de-excitation time, after an OFF command, the inverter prevents the induction motor from being switched on again. When using a reluctance motor, the inverter ignores the motor de-excitation time.
p1201	Flying restart enable signal source (factory setting: 1) Defines a control command, e.g. a digital input, which enables the flying restart function.
p1202	Flying restart search current (Factory setting depends on the Power Module) Defines the search current with respect to the magnetizing current (r0331), which flows in the motor during the flying restart.
p1203	Flying restart search current factor (Factory setting depends on the Power Module) The value influences the speed with which the output frequency is changed during the flying restart. A higher value results in a longer search time. If the inverter does not find the motor, reduce the search speed (increase p1203).

6.32 Automatic restart



The automatic restart includes two different functions:

- The inverter automatically acknowledges faults.
- After a fault occurs or after a power failure, the inverter automatically switches-on the motor again.

The inverter interprets the following events as power failure:

- The inverter signals fault F30003 (undervoltage in the DC link), after the inverter line voltage has been briefly interrupted.
- All of the inverter power supplies have been interrupted - and all of the energy storage devices in the inverter have discharged to such a level that the inverter electronics fail.

Setting the automatic restart function



WARNING

Unexpected machine motion caused by the active automatic restart function

When the "automatic restart" function is active ($p1210 > 1$), the motor automatically starts after a line supply phase. Unexpected movement of machine parts can result in serious injury and material damage.

- Block off hazardous areas within the machine to prevent inadvertent access.

If it is possible that the motor is still rotating for a longer period of time after a power failure or after a fault, then you must also activate the "flying restart" function.



Flying restart – switching on while the motor is running (Page 347)

Using p1210, select the automatic restart mode that best suits your application.

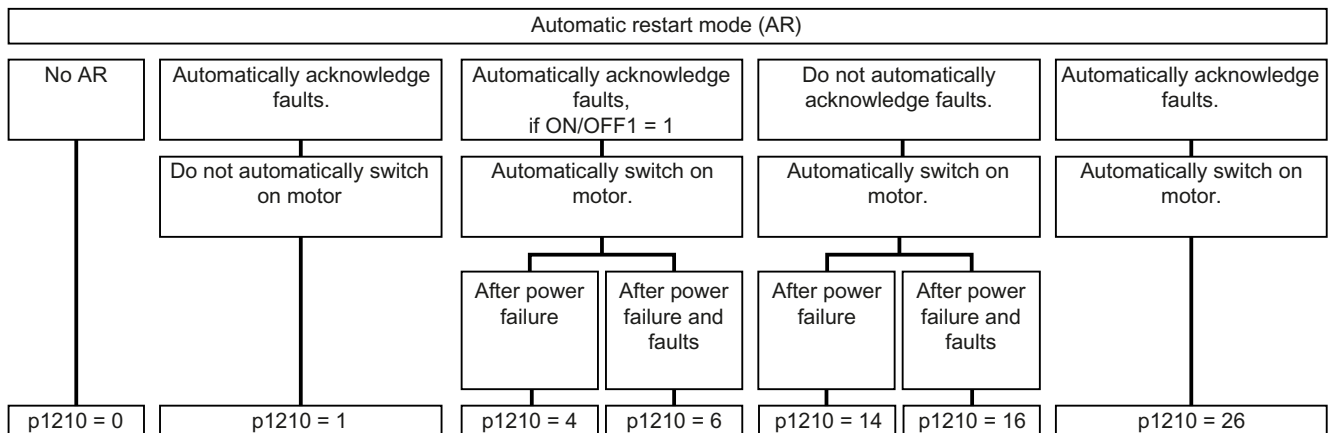
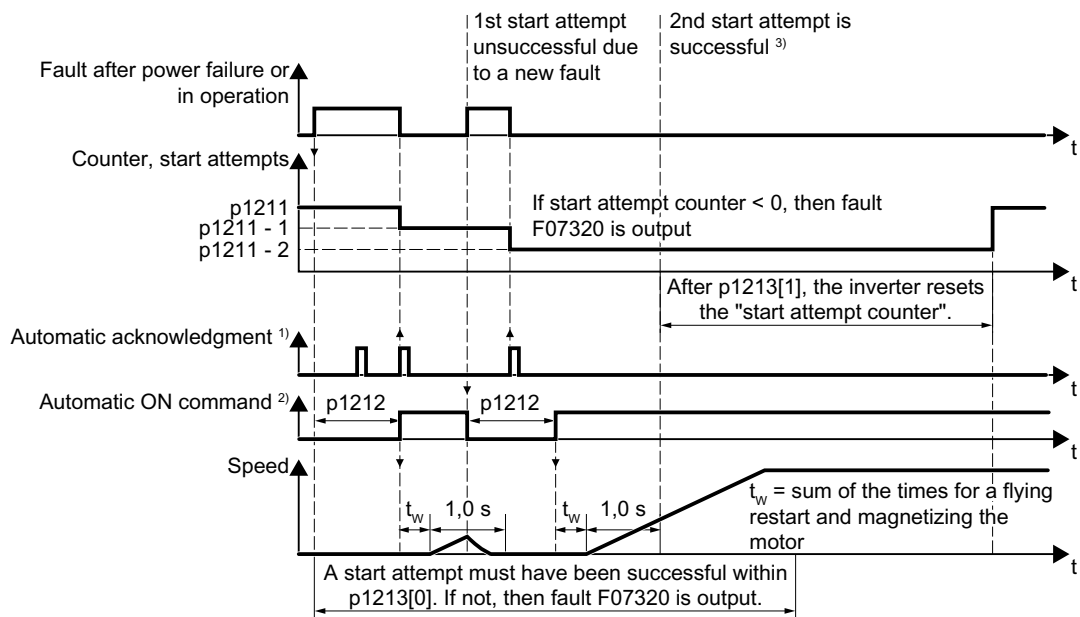


Figure 6-58 Automatic restart modes

The principle of operation of the other parameters is explained in the following diagram and in the table below.



¹⁾ The inverter automatically acknowledges faults under the following conditions:

- p1210 = 1 or 26: Always.
- p1210 = 4 or 6: If the command to switch-on the motor is available at a digital input or via the fieldbus (ON/OFF1 = 1).
- p1210 = 14 or 16: Never.

²⁾ The inverter attempts to automatically switch the motor on under the following conditions:

- p1210 = 1: Never.
- p1210 = 4, 6, 14, 16, or 26: If the command to switch-on the motor is available at a digital input or via the fieldbus (ON/OFF1 = 1).

³⁾ If, after a flying restart and magnetization (r0056.4 = 1) no fault occurs within one second, then the start attempt was successful.

Figure 6-59 Time response of the automatic restart

Parameter for setting the automatic restart

Parameter	Explanation
p1210	Automatic restart mode (factory setting: 0)
	0: Disable automatic restart.
	1: Acknowledge all faults without restarting.
	4: Restart after power failure without further restart attempts.
	6: Restart after fault with further restart attempts.
	14: Restart after power failure after manual acknowledgement.
	16: Restart after fault after manual acknowledgement.
	26: Acknowledgement of all faults and restart with ON/OFF1 = 1 command.

Parameter	Explanation
p1211	<p>Automatic restart start attempts (factory setting: 3)</p> <p>This parameter is only effective for the settings p1210 = 4, 6, 14, 16, 26.</p> <p>You define the maximum number of start attempts using p1211. After each successful acknowledgement, the inverter decrements its internal counter of start attempts by 1.</p> <p>p1211 = 0 or 1: The inverter only tries to start once. After an unsuccessful start attempt, the inverter issues fault F07320.</p> <p>p1211 = n, n > 1: The inverter tries to start n-times. The inverter outputs fault F07320 if the nth starting attempt was unsuccessful.</p> <p>The inverter sets the start attempt counter back again to the value of p1211, if one of the following conditions is fulfilled:</p> <ul style="list-style-type: none"> • After a successful start attempt, the time in p1213[1] has expired. • After fault F07320, switch off the motor (OFF1) and acknowledge the fault. • You change the start value p1211 or the mode p1210.
p1212	<p>Automatic restart wait time start attempt (factory setting: 1.0 s)</p> <p>This parameter is only effective for the settings p1210 = 4, 6, 26.</p> <p>Examples for setting this parameter:</p> <ol style="list-style-type: none"> 1. After a power failure, a certain time must elapse before the motor can be switched-on, e.g. because other machine components are not immediately ready. In this case, set p1212 longer than the time, after which all of the fault causes have been removed. 2. In operation, the inverter develops a fault condition. The lower you select p1212, then the sooner the inverter attempts to switch-on the motor again.
p1213[0]	<p>Automatic restart monitoring time for restart (factory setting: 60 s)</p> <p>This parameter is only effective for the settings p1210 = 4, 6, 14, 16, 26.</p> <p>With this monitoring function, you limit the time in which the inverter may attempt to automatically switch-on the motor again.</p> <p>The monitoring function starts when a fault is identified and ends with a successful start attempt. If the motor has not successfully started after the monitoring time has expired, fault F07320 is signaled.</p> <p>Set the monitoring time longer than the sum of the following times:</p> <ul style="list-style-type: none"> + p1212 + Time that the inverter requires to start the motor on the fly. + Motor magnetizing time (p0346) + 1 second <p>You deactivate the monitoring function with p1213 = 0.</p>
p1213[1]	<p>Automatic restart monitoring time to reset the fault counter (factory setting: 0 s)</p> <p>This parameter is only effective for the settings p1210 = 4, 6, 14, 16, 26.</p> <p>Using this monitoring time, you prevent that faults, which continually occur within a certain time period, are automatically acknowledged each time.</p> <p>The monitoring function starts with a successful start attempt and ends after the monitoring time has expired.</p> <p>If, during the monitoring time p1213[1], the inverter made more successful starting attempts than defined in p1211, the inverter interrupts the automatic restart function and signals fault F07320. To switch on the motor again you must acknowledge the fault and switch on the inverter (ON/OFFS1 = 1).</p>

Additional information is provided in the parameter list of the List Manual.

Advanced settings

If you wish to suppress the automatic restart function for certain faults, then you must enter the appropriate fault numbers in p1206[0 ... 9].

Example: p1206[0] = 07331 ⇒ No restart for fault F07331.

Suppressing the automatic restart only functions for the setting p1210 = 6, 16 or 26.

Note

Motor starts in spite of an OFF command via the fieldbus

The inverter responds with a fault if fieldbus communication is interrupted. For one of the settings p1210 = 6, 16 or 26, the inverter automatically acknowledges the fault and the motor restarts, even if the higher-level control attempts to send an OFF command to the inverter.

- In order to prevent the motor automatically starting when the fieldbus communication fails, you must enter the fault number of the communication error in parameter p1206.

Example for PROFINET:

Fault number F08501 means: Communication failure.

Set p1206[n] = 8501 (n = 0 ... 9).

6.33 Kinetic buffering (V_{dc} min control)



Kinetic buffering increases the drive availability. The kinetic buffering utilizes the kinetic energy of the load to buffer line dips and failures. During a line dip, the inverter keeps the motor in the switched-on state for as long as possible. One second is a typical, maximum buffer time.

Preconditions

The following prerequisites must be fulfilled to practically use the "kinetic buffering" function:

- The driven load has a sufficiently high inertia.
- The application allows a motor to be braked during a power failure.

The V_{dc}_min control is possible only with the PM240-2, PM240P-2 and PM330 Power Modules.

Function

When the line supply dips or is interrupted, the DC link voltage in the inverter decreases. At an adjustable threshold, kinetic buffering intervenes (V_{DC min} control). The V_{DC min} control forces the load to go into slightly regenerative operation. As a consequence, the inverter covers its power loss and the losses in the motor with the kinetic energy of the load. The load speed decreases; however, during kinetic buffering, the DC voltage remains constant. After the line supply returns, the inverter immediately resumes normal operation.

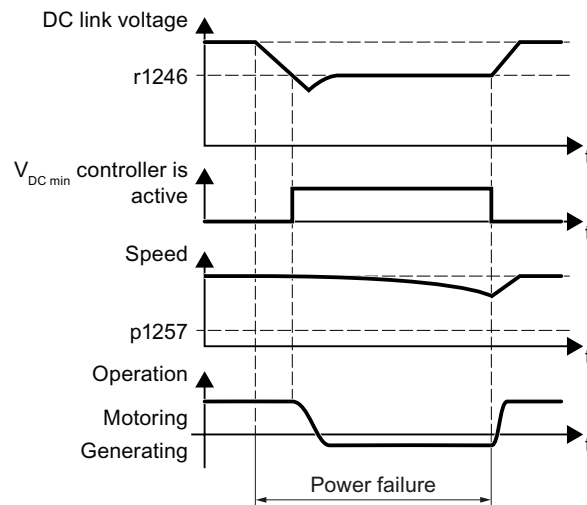


Figure 6-60 Principle mode of operation of kinetic buffering

Parameter	Description	
r0056.15	Status word closed-loop control	
	0 signal	V _{DC min} controller is not active
	1 signal	V _{DC min} controller is active (kinetic buffering)
p0210	Device supply voltage (factory setting: 400 V)	

Parameter	Description
p1240	V_{DC} controller configuration (factory setting: 1)
	0 Inhibit V_{DC} controller
	1 Enable $V_{DC\ max}$ controller
	2 Enable $V_{DC\ min}$ controller (kinetic buffering)
	3 Enable $V_{DC\ min}$ controller and $V_{DC\ max}$ controller
p1245	$V_{DC\ min}$ controller activation level (kinetic buffering) (factory setting depends on the Power Module, 73 % or 76 %)
r1246	$V_{DC\ min}$ controller activation level [V] $r1246 = p1245 \times \sqrt{2} \times p0210$
p1247	$V_{DC\ min}$ controller dynamic factor (factory setting: 300 %)
p1255	$V_{DC\ min}$ controller time threshold (factory setting: 0 s) Maximum duration of the kinetic buffering. If kinetic buffering lasts longer than that specified in the parameter value, the inverter outputs fault F7406. A value of 0 deactivates the monitoring.
p1257	$V_{DC\ min}$ controller speed threshold (factory setting: 50 rpm) When fallen below, the inverter outputs fault F7405.

6.34 Essential service mode



In essential service mode (ESM), the inverter attempts to operate the motor for as long as possible despite irregular ambient conditions.

The inverter logs the essential service mode and any faults that occur during essential service mode. The log is accessible only for the service and repair organization.

Note

Warranty is lost in the essential service mode

If you activate the essential service mode, all of the warranty claims associated with the inverter become null and void. The essential service mode can have the following effects:

- Exceptionally high temperatures inside and outside the inverter
 - Open fire inside and outside the inverter
 - Emissions of light, noise, particles or gases
-

Example

To improve the air circulation in the stairwells, the ventilation control creates an underpressure in the building. With this control, a fire would mean that flue gases enter into the stairwell. This would then mean that the stairs would be blocked as escape or evacuation route.

Using the essential service mode function, the ventilation switches over to the control of an overpressure. The essential service mode prevents the propagation of flue gas in the stairwell, thereby keeping the stairs free as an evacuation route as long as possible.

Special features of essential service mode

Activating and terminating essential service mode

Signal p3880 = 1 activates the essential service mode:

- If the motor was switched off by activating essential service mode, the inverter switches the motor on. The speed setpoint is die "ESM setpoint source".
- If the motor was switched on by activating essential service mode, the inverter switches the speed setpoint to "ESM setpoint source".

Signal p3880 = 0 deactivates the essential service mode:

- If one of the OFF1, OFF2 or OFF3 commands is active, the inverter switches off the motor.
- If neither OFF1, OFF2 nor OFF3 is active, the inverter switches the speed setpoint from the "ESM setpoint source" to the normal setpoint source.

Switch the motor on and off during active essential service mode via other signals

The OFF1, OFF2 and OFF3 commands for switching off the motor have no effect.

The inverter blocks all functions that switch off the motor to save energy, e.g. PROFInergy or hibernation mode.

 **WARNING**

Unexpected exiting of the essential service mode by selecting "Safe Torque Off"

The PM240-2 and PM240P-2, FSD ... FSF Power Modules provide terminals for selecting the "Safe Torque Off" (STO) safety function. An active STO function switches the motor off and so terminates essential service mode. The termination of essential service mode can cause severe injury or death, e.g. for the failure of a flue gas extraction.

- Set both STO switches to the "OFF" position on the PM240-2 or PM240P-2, FSD ... FSF Power Module.

Reaction to faults during active essential service mode

In "essential service mode", the inverter does not switch off the motor when faults develop, but rather reacts differently depending on the fault type:

- The inverter ignores faults, which do not directly result in the destruction of the inverter or the motor.
- The inverter attempts to automatically acknowledge faults, which cannot be ignored, using the automatic restart function.
- For faults that cannot be acknowledged, it is possible to switch over the motor to line operation using the bypass function.

Automatic restart during active essential service mode

The inverter ignores the settings in p1206 (faults without automatic restart) and works with the setting "restart after a fault with further start attempts" (p1210 = 6).

The inverter carries out the maximum number of restart attempts set in p1211 corresponding to the settings in p1212 and p1213. If these attempts are not successful, then the inverter goes into a fault condition with F07320.

Speed setpoint during active essential service mode


P3881 specifies the setpoint. If you have defined an analog input as setpoint source using p3881, then for wire breakage, the inverter can switch over to setpoint p3882.

Interaction for bypass and essential service mode

- If, when activating the essential service mode, bypass operation is active, inverter operation is selected internally in order to ensure that the setpoint is entered via the source intended for the essential service mode.
- If faults are still present after the number of start attempts parameterized in p1211, then the inverter goes into a fault condition with F07320. In this case, there is an option of switching over to bypass operation and then directly connecting the motor to the line supply.

Commissioning the extended service mode

Procedure

1. Interconnect a free digital input as signal source for the ESM activation.
You must use a negated digital input if the essential service mode should also be active for a ground fault – or if the control cable is interrupted.
Example for negated digital input DI 3: Set p3880 = 723.3.
It is not permissible to interconnect the digital input for ESM activation with other functions.
2. Set the ESM setpoint source via p3881.
3. Set the alternative ESM setpoint source via p3882.
4. Set the source to select the direction of rotation.
 - p3881 = 0, 1, 2, 3:
When you interconnect p3883 with a free digital input of your choice, p3883 inverts the direction of rotation during essential service mode.
For example, to interconnect p3883 with DI 4, set p3883 = 722.4.
 - p3881 = 4:
The technology setpoint direction of rotation is valid.
5. Optional switching to bypass mode
If the inverter is not able to acknowledge pending faults with automatic restart, it signals fault F07320 and does not make any other attempts to restart.
If the motor still continues to operate in this case, you must set the following:
 - Set p1266 = 3889.10. The inverter switches the motor to bypass mode with r3889.10 = 1.
 - Ensure that the direction of rotation does not change when switching over to bypass operation.
 - Set p1267.0 = 1. The inverter switches the motor to bypass mode independent of the speed with control signal p1266.
 - Commission the "Bypass" function.
 Bypass (Page 362)

You have commissioned the essential service mode.

□

Settings

Parameter	Description
p3880	BI: ESM activation signal source (factory setting 0) Set the signal source to activate essential service mode (ESM) via the digital input
p3881	ESM setpoint source (factory setting 0)
	0: Last known setpoint (r1078 smoothed)
	1: Fixed speed setpoint 15 (p1015)
	2: Control Unit analog input 0 (AI 0, r0755[0])
	3: Fieldbus
	4: Technology controller Set the ESM setpoint source via p3884.
	6: Enable OFF1 reaction
	7: Enable OFF2 reaction
p3882	Alternative ESM setpoint source (factory setting 0)
	0: Last known setpoint (r1078 smoothed)
	1: Fixed speed setpoint 15 (p1015)
	2: Maximum speed (p1082)
p3883	BI: ESM direction of rotation signal source (factory setting 0)
	0 signal: The direction of rotation of the setpoint configured for essential service mode is maintained 1 signal: Reversal of the direction of rotation of the setpoint configured for essential service mode.
p3884	CI: ESM technology controller setpoint (factory setting 0)
	Setpoint signal source for p3881 = 4. If you do not connect a setpoint in p3884, the inverter takes technology setpoint 1 (p2253).
r3889	Number of ESM activations/faults
	.00 1 signal: Essential service mode (ESM) activated
	.01 1 signal: Direction of rotation inverted
	.02 1 signal: Setpoint signal lost
	.03 1 signal: Technology controller actual value lost (p2264)
	.04 1 signal: Bypass active
	.05 1 signal: Technology controller setpoint parameterized (p3884)
	.06 1 signal: Technology controller active during essential service mode
	.09 1 signal: Reaction OFF1/OFF2 activated
	.10 1 signal: Automatic restart aborted (F07320)

Application example

An application example for the essential service mode can be found on the Internet:

 <http://support.automation.siemens.com/WW/view/en/63969509> (<http://support.automation.siemens.com/WW/view/en/63969509>)

6.35 Efficiency optimization

Overview



The efficiency optimization reduces the motor losses as far as possible.

Active efficiency optimization has the following advantages:

- Lower energy costs
- Lower motor temperature rise
- Lower motor noise levels

Active efficiency optimization has the following disadvantage:

- Longer acceleration times and more significant speed dips during torque surges.

The disadvantage is only relevant when the motor must satisfy high requirements relating to the dynamic performance. Even when efficiency optimization is active, the inverter closed-loop motor control prevents the motor from stalling.

Precondition

Efficiency optimization functions under the following preconditions:

- Operation with an induction motor
- Vector control is set in the inverter.

Function description

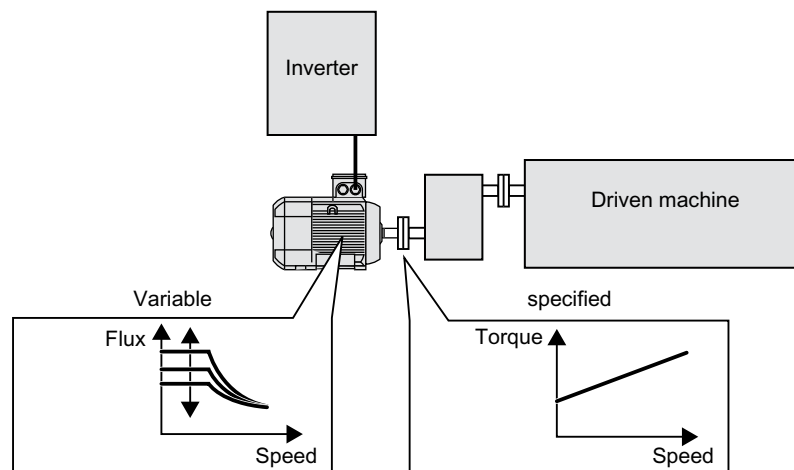


Figure 6-61 Efficiency optimization by changing the motor flux

The three variables that the inverter can directly set, which define efficiency of an induction motor, are speed, torque and flux.

However, in all applications, speed and torque are specified by the driven machine. As a consequence, the remaining variable for the efficiency optimization is the flux.

The inverter has two different methods of optimizing the efficiency.

Efficiency optimization, method 2

Generally, energy efficiency optimization method 2 achieves a better efficiency than method 1. We recommend that you set method 2.

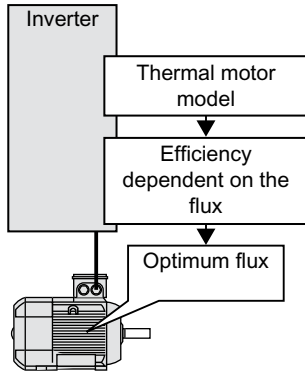


Figure 6-62 Determining the optimum flux from the motor thermal model

Based on its thermal motor model, the inverter continually determines - for the actual operating point of the motor - the interdependency between efficiency and flux. The inverter then sets the flux to achieve the optimum efficiency.

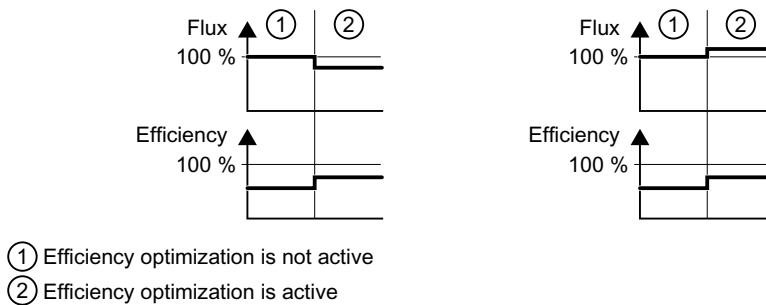


Figure 6-63 Qualitative result of efficiency optimization, method 2

Depending on the motor operating point, the inverter either decreases or increases the flux in partial load operation of the motor.

Efficiency optimization, method 1

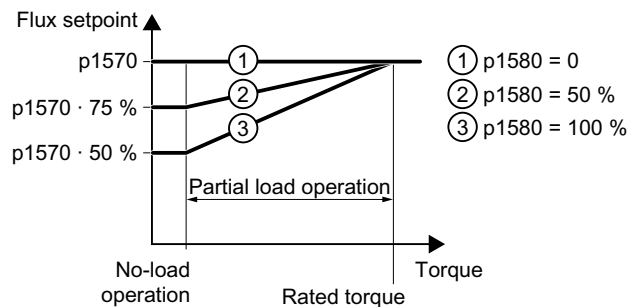


Figure 6-64 Reduce the flux setpoint in the partial load range of the motor

The motor operates in partial load mode between no-load operation and the rated motor torque. Depending on p1580, in the partial load range, the inverter reduces the flux setpoint linearly with the torque.

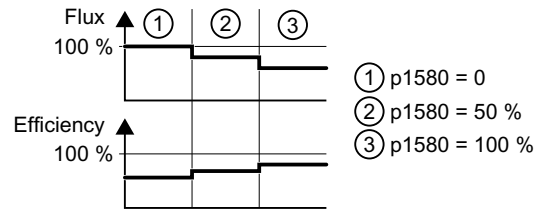


Figure 6-65 Qualitative result of efficiency optimization, method 1

The reduced flux in the motor partial load range results in higher efficiency.

Parameter

The inverter calculates the parameters for the thermal motor model based on the motor data that has been set – and the motor data identification.

Table 6-53 Efficiency optimization, method 2

Parameter	Description	Setting
p1401.14	Flux control configuration	1 signal: Efficiency optimization 2 active Factory setting: 0
p1570	Flux setpoint [%]	Factory setting: 100 %
p3315	Efficiency optimization 2 flux minimum limit value [%]	Minimum limit value for the calculated optimal flux Factory setting: 50 %
p3316	Efficiency optimization 2 maximum flux limit value [%]	Maximum limit value for the calculated optimal flux Factory setting: 110 %

Table 6-54 Efficiency optimization, method 1

Parameter	Description	Setting
p1570	Flux setpoint [%]	Factory setting: 100 %
p1580	Efficiency optimization [%]	0 %: Efficiency optimization is deactivated. 100 %: In no-load operation, the inverter reduces the flux setpoint to 50% of the rated motor flux. The factory setting depends on the inverter.

6.36 Bypass

Function



The "Bypass" function switches the motor between inverter and line operation. The "Bypass" function is supported only for induction motors.

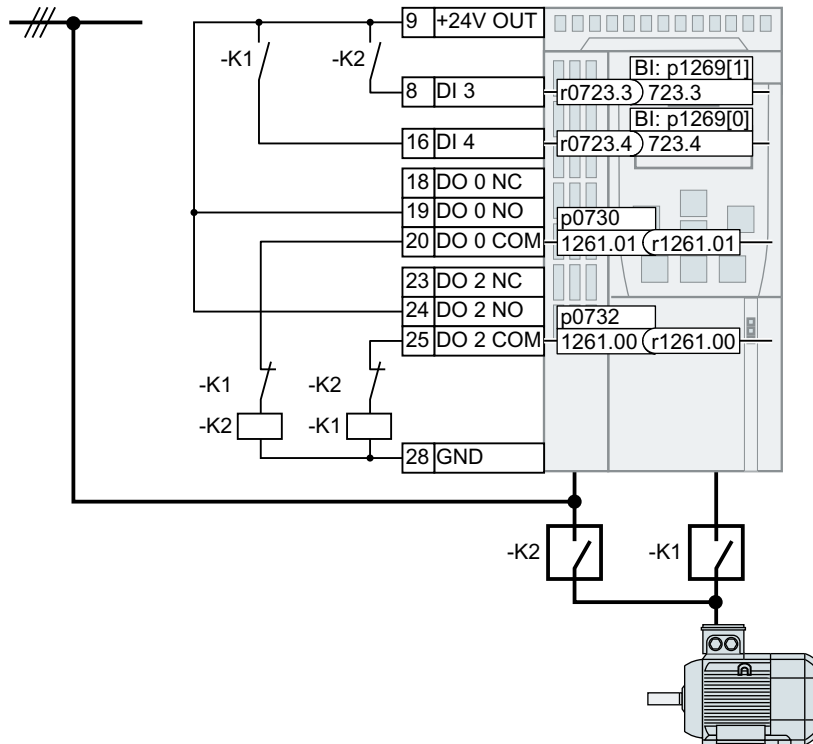


Figure 6-66 Bypass with control via the inverter

Requirements placed on the K1 inverter contactor and K2 line contactor:

- K1 and K2 are designed for switching under load.
- K2 is designed for switching an inductive load.
- K1 and K2 are interlocked against closing at the same time.

Switching between inverter operation and line operation

Switching from inverter operation to line operation

1. The inverter switches the motor OFF.
2. The inverter opens the K1 inverter contactor via a digital output.
3. The inverter waits for the unlocking time of the motor.
4. The inverter waits for the feedback that the K1 inverter contactor is open.
5. The inverter closes the K2 line contactor via a digital output.

The motor is now operated directly on the line supply. A multiple of the motor rated current can flow before the motor speed has reached the line frequency.

Switching from line operation to inverter operation

1. The inverter opens the K2 line contactor via a digital output.
2. The inverter waits for the unlocking time of the motor.
3. The inverter waits for the feedback that the K2 line contactor is open.
4. The inverter closes the K1 inverter contactor via a digital output.
5. The inverter switches the motor ON.
6. The inverter adjusts with the "Flying restart" function its output frequency to the speed of the motor.

The motor is now operated on the inverter.

How is the changeover triggered?

The following options are provided to switch between inverter operation and line operation:

- Changeover for activation via a control command
- Changeover depending on the speed

Changeover for activation via a control command

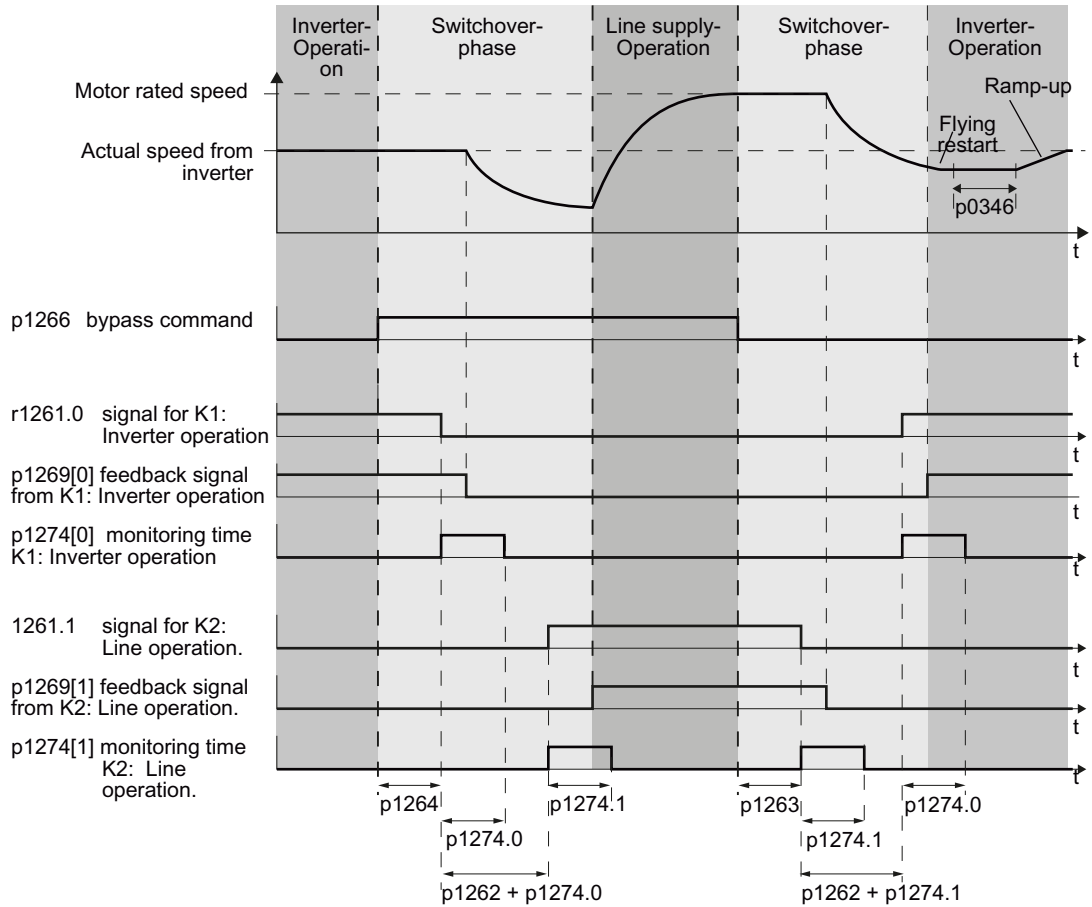


Figure 6-67 Changeover when activating via a control signal (p1267.0 = 1)

The inverter switches the motor between inverter operation and line operation depending on the bypass control command p1266.

Changeover depending on the speed

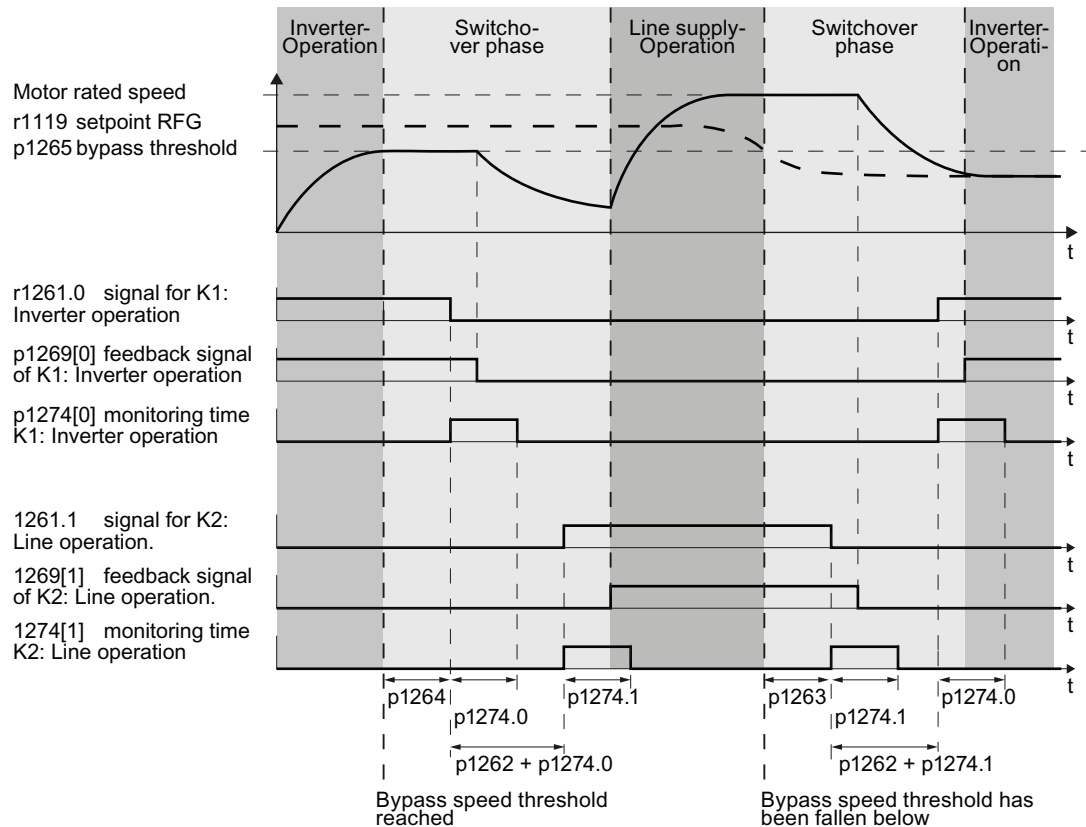




Figure 6-68 Changeover depending on the speed (p1267.1 = 1)


If the speed setpoint r1119 lies above the bypass speed threshold p1265, the inverter switches the motor to line operation.

If the speed setpoint falls below the bypass speed threshold, the inverter switches the motor to inverter operation.

Interaction with other functions

- Flying restart
The "Flying restart" function must be activated for the "Bypass" function (p1200 = 1 or 4).
 Flying restart – switching on while the motor is running (Page 347)
- Emergency operation
The activated "Essential service mode" function influences the "Bypass" function.
 Essential service mode (Page 355)
- Inverter control
For operation of the motor on the line supply, the inverter no longer responds to the OFF1 command, but rather only to OFF2 and OFF3.

6.36 Bypass

- Temperature monitoring for the motor
The inverter evaluates the temperature sensor in the motor, also for line operation of the motor.
 Motor protection with temperature sensor (Page 332)
- Disconnecting the inverter from the line supply
If for line operation of the motor, you disconnect the inverter from the line supply, the inverter opens the K2 contactor and the motor coasts down.
To operate the motor on the line supply also for deactivated inverter, the higher-level control must supply the signal for the K2 line contactor.

Setting parameters of the bypass function

Parameter	Description	
p0347	Motor de-excitation time	
p1260	Bypass configuration (factory setting: 0) 0: Bypass is deactivated 3: Bypass is activated	
r1261	Bypass control/status word	
	.00	1 signal: Close K1 inverter contactor command
	.01	1 signal: "Close K2 inverter contactor" command
	.05	1 signal: "K1 inverter contactor is closed" feedback
	.06	1 signal: "K2 line contactor is closed" feedback
	.07	1 signal: Bypass command (for p1266) is active
	.10	1 signal: Bypass in the process operation is active
	.11	1 signal: Bypass is enabled
p1262	Bypass dead time (factory setting: 1 s) Changeover time of the contactor. Setting condition: p1262 > p0347	
p1263	Bypass delay time (factory setting: 1 s) Delay time for switching from line operation to inverter operation.	
p1264	Bypass delay time (factory setting: 1 s) Delay time for switching from inverter operation to line operation.	
p1265	Bypass speed threshold (factory setting: 1480 rpm) Speed threshold for switching to line operation.	
p1266	BI: Bypass control command (factory setting: 0) Signal source for the "Bypass" function control command	
p1267	Bypass changeover source configuration (factory setting: 0000 bin) Changeover to bypass mode via the speed threshold or the control signal.	
	.00	1 signal: Changeover for activation via the control command p1266
	.01	1 signal: Bypass when reaching the speed threshold
p1269	BI: Bypass switch feedback Signal source for contactor feedback of the contactor.	
	[00]	K1 inverter contactor (factory setting: 1261.0)
	[01]	K2 line contactor (factory setting: 1261.1)

Parameter	Description
p1274	Bypass switch monitoring time (factory setting: 1000 ms) Setting the monitoring time of the bypass contactor. Monitoring is deactivated for p1274 = 0 ms.
	[00] K1 inverter contactor
	[01] K2 line contactor

For more information, see the parameter descriptions and function diagram 7035 in the List Manual.

6.37 Hibernation mode



The hibernation mode saves energy, reduces mechanical wear and noise.

Pressure and temperature controls involving pumps and fans are typical applications for the hibernation mode.

Function

If the plant/system conditions permit it, the inverter switches off the motor and switches it on again when there is a demand from the process.

The hibernation mode starts as soon as the motor speed drops below the hibernation mode start speed. The inverter switches off the motor after an adjustable time. If, during this time, the speed setpoint increases above the hibernation mode start speed due to pressure or temperature changes, the inverter exits the hibernation mode.

In the hibernation mode the motor is switched off, but the inverter continues to monitor the speed setpoint or technology controller deviation.

- **For an external setpoint input (without technology controller), the inverter monitors the speed setpoint** and switches on the motor again as soon as the setpoint increases above the restart speed.

In the factory setting, the inverter monitors the positive speed setpoint. The inverter switches on the motor as soon as the setpoint exceeds the restart speed.

If you also want to monitor the negative speed setpoint, you have to monitor the setpoint amount. To do this, set p1110 = 0.

Additional setting options are described in the List Manual, in function diagrams 3030 and 3040 as well as in the associated parameter descriptions.

- **When the setpoint is input from the technology controller, the inverter monitors the technology controller deviation (r2273)** and switches on the motor again if the deviation of the technology controller exceeds the hibernation mode restart value (p2392).

In the factory setting, the inverter monitors the positive deviation of the technology controller. The inverter switches on the motor as soon as the technology controller deviation is higher than the hibernation mode restart value (p2392).

You must monitor the absolute value of the deviation to switch on the motor again for a negative technology controller deviation.

Set p2298 = 2292 and set the minimum threshold in p2292.

Note

Hibernation mode after switching on the inverter

After switching the inverter on, a wait time starts in the inverter. The longest wait time is at the following times:

- p1120 (ramp-up time)
- p2391 (hibernation mode delay time)
- 20 s

If the motor does not reach the hibernation mode start speed within this wait time, the inverter activates the hibernation mode and switches off the motor.

Additional setting options are provided in the List Manual in function block diagram 7038 and in the associated parameter descriptions.


If you want to prevent frequent activation and deactivation, before deactivation you still have to set a short speed boost. The boost is deactivated with $p2394 = 0$.

To avoid tank deposits, particularly where liquids are involved, it is possible to exit the hibernation mode after an adjustable time ($p2396$) has expired and switch to normal operation.

The settings required for the respective variant can be found in the following tables.

Interaction of the function with the cascade control

It is not possible to activate the hibernation mode as long as a motor is directly operated from the line supply using the cascade control function.

 Cascade control (Page 295)

Activating the hibernation mode with setpoint input via the internal technology controller

With this operating mode you have to set the technology controller as the setpoint source ($p2200$) and use the output of the technology controller as the main setpoint ($p2251$). The boost can be deactivated.

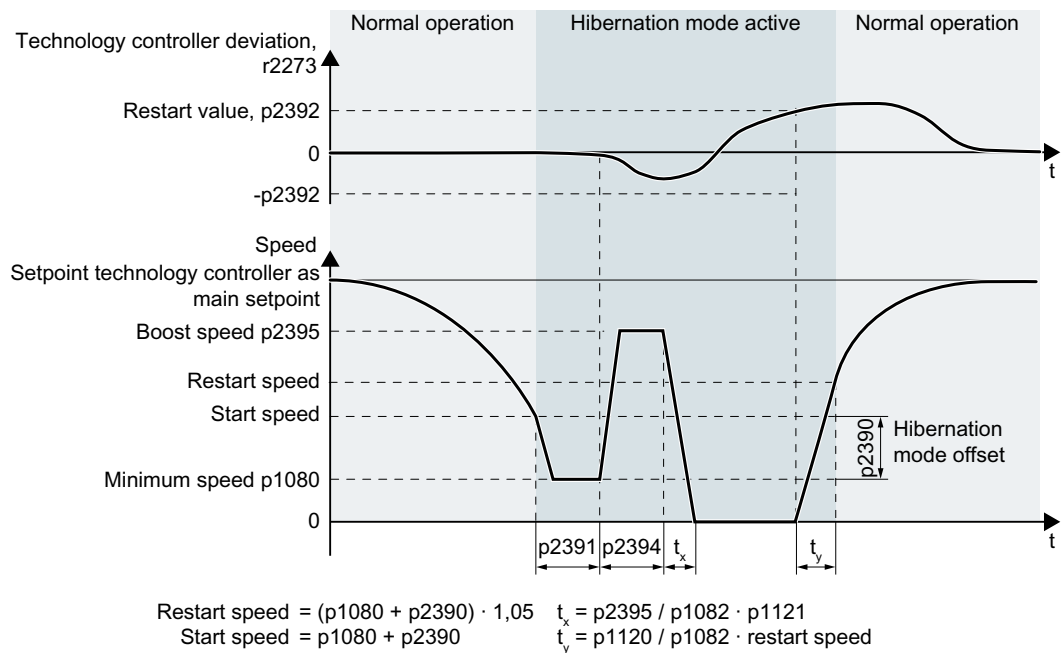
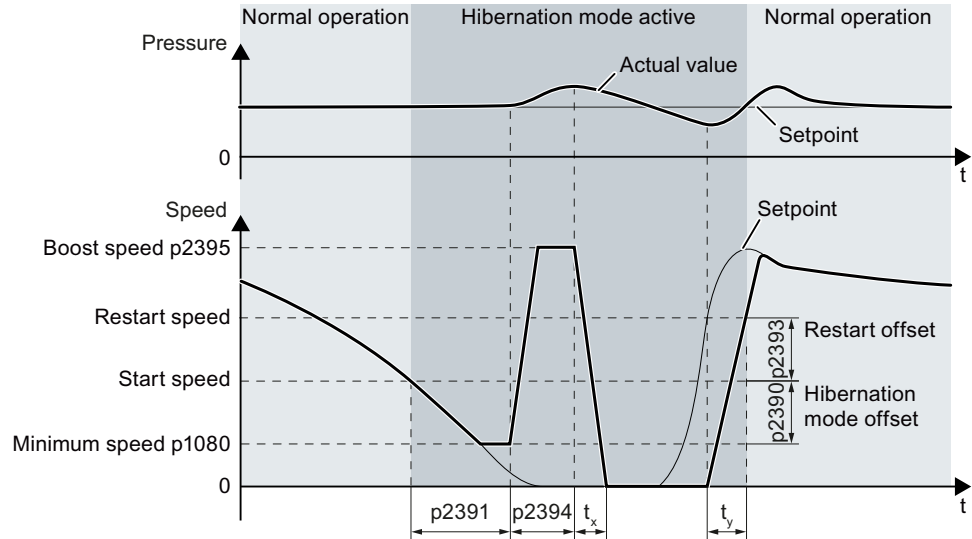


Figure 6-69 Hibernation mode using the technology setpoint as main setpoint with boost

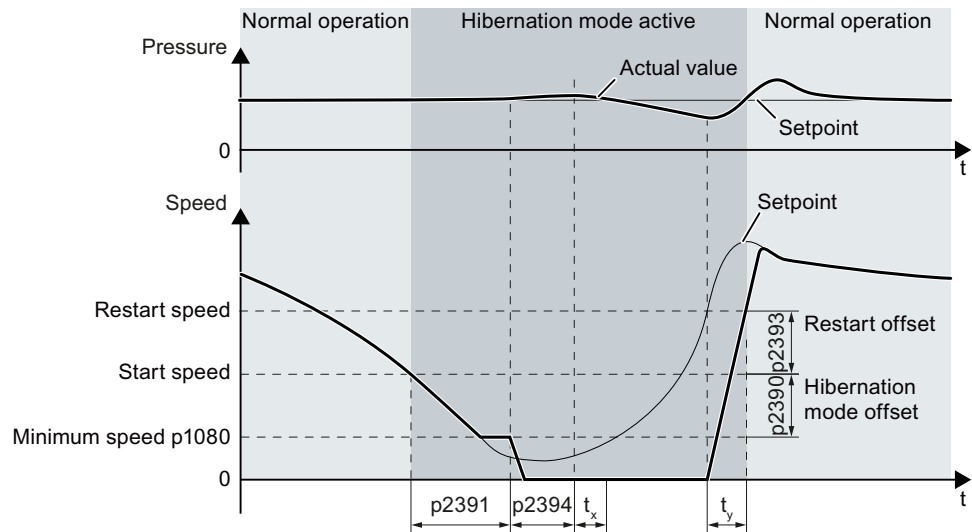
Activating the hibernation mode with external setpoint input

With this operating mode, an external source – e.g. a temperature sensor – inputs the main setpoint.



$$\begin{aligned} \text{Restart speed} &= p1080 + p2390 + p2393 & t_x &= p2395 / p1082 * p1121 \\ \text{Start speed} &= p1080 + p2390 & t_y &= \text{restart speed} / p1082 * p1120 \end{aligned}$$

Figure 6-70 Hibernation mode using an external setpoint with boost



$$\begin{aligned} \text{Restart speed} &= p1080 + p2390 + p2393 & t_x &= p2395 / p1082 * p1121 \\ \text{Start speed} &= p1080 + p2390 & t_y &= \text{restart speed} / p1082 * p1120 \end{aligned}$$

Figure 6-71 Hibernation mode using an external setpoint without boost

Setting the hibernation mode

Parameter	Description	Via tech. setpoint	Via external setpoint
p1080	Minimum speed 0 (factory setting) ... 19,500 rpm. Lower limit of the motor speed, independently of the speed target value.	✓	✓
p1110	Block negative direction Parameter to block the negative direction	-	✓
p2200	Technology controller enable 0: Technology controller deactivated (factory setting), 1: Technology controller activated	✓	-
p2251 = 1	Technology controller mode 0: Technology controller as main setpoint (factory setting), 1: Technology controller as supplementary setpoint	✓	-
p2298	Technology controller minimum limiting Parameter for the minimum limiting of the technology controller	✓	-
p2398	Hibernation mode 0: Hibernation mode inhibited (factory setting) 1: Hibernation mode enabled	✓	✓
p2390	Hibernation mode start speed 0 (factory setting) ... 21,000 rpm. As soon as this speed is fallen below, the hibernation mode delay time starts and switches off the motor once it expires. The hibernation mode start speed is calculated as follows: Start speed = p1080 + p2390 p1080 = minimum speed p2390 = hibernation mode start speed	✓	✓
p2391	Hibernation mode delay time 0 ... 3599 s (factory setting 120). The hibernation mode delay time starts as soon as the output frequency of the inverter drops below the hibernation mode start speed p2390. If the output frequency increases above this threshold during the delay time, the hibernation mode delay time is interrupted. Otherwise, the motor is switched off after the delay time has expired (if necessary, after a short boost).	✓	✓
p2392	Hibernation mode restart value (as a %) Is required if the technology controller is used as the main setpoint. As soon as the technology controller deviation (r2273) exceeds the hibernation restart value, the inverter switches to normal operation and the motor starts up with a setpoint of $1.05 * (p1080 + p2390)$. As soon as this value is reached, the motor continues to operate with the setpoint of the technology controller (r2260).	✓	-
p2393	Hibernation mode restart speed (rpm) Required for external setpoint input. The motor starts as soon as the setpoint exceeds the restart speed. The restart speed is calculated as follows: Restart speed = p1080 + p2390 + p2393 p1080 = minimum speed p2390 = hibernation mode start speed p2393 = hibernation mode restart speed	-	✓

6.37 Hibernation mode

Parameter	Description	Via tech. setpoint	Via external setpoint
p2394	Hibernation mode boost duration 0 (factory setting) ... 3599 s. Before the inverter switches over into the hibernation mode, the motor is accelerated for the time set in p2394 according to the acceleration ramp, however, as a maximum to the speed set in p2395.	✓	✓
p2395	Hibernation mode boost speed 0 (factory setting) ... 21,000 rpm. Before the inverter switches over to hibernation mode, the motor is accelerated for the time set in p2394 along the acceleration ramp, but not to more than the speed set in p2395. Caution: The boost may not result in any overpressure or overrun.	✓	✓
p2396	Maximum hibernation mode shutdown time 0 (factory setting) to 863,999 s. At the latest when this time expires, the inverter switches to normal operation and accelerates up to the start speed (p1080 + p2390). If the inverter is switched to normal operation in advance, the shutdown time is reset to the value set in this parameter. With p2396 = 0, automatic changeover to normal operation after a certain time is deactivated.	✓	✓

Note

Activate the motorized potentiometer as ramp-function generator to use the motorized potentiometer of the inverter as setpoint for the hibernation mode.

- Motorized potentiometer: p1030.4 = 1
- Technology motorized potentiometer: p2230. = 1.

Status of the hibernation mode

Parameter	Description
r2273	Display of the setpoint/actual value deviation of the technology controller
r2397	Actual hibernation mode output speed Actual boost speed before the pulses are inhibited or the actual start speed after restart.
r2399	Hibernation mode status word 00 Hibernation mode enabled (p2398 <> 0) 01 Hibernation mode active 02 Hibernation mode delay time active 03 Hibernation mode boost active 04 Hibernation mode motor switched off 05 Hibernation mode motor switched off, cyclic restart active 06 Energy-saving mode motor restarts 07 Hibernation mode supplies the total setpoint of the ramp-function generator 08 Hibernation mode bypasses the ramp-function generator in the setpoint channel

6.38 Line contactor control



A line contactor disconnects the inverter from the line supply, and therefore reduces the inverter losses when the motor is not operational.

The inverter can control its own line contactor using a digital output. You must supply the inverter with 24 V so that the line contactor control of the inverter also functions when disconnected from the line supply.

Activate line contactor control

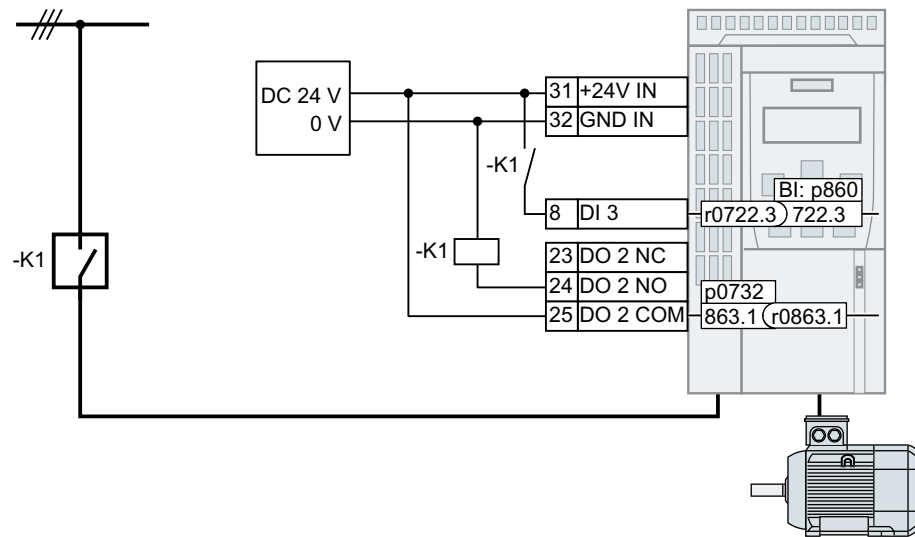


Figure 6-72 Line contactor control via DO 2 with feedback signal via DI 3

In order that the inverter controls line contactor K1 using one of its own digital outputs, you must interconnect the digital output with signal r0863.1 e.g. for DO 2: p0732 = 863.1.

Line contactor control with feedback signal

Interconnect p0860 with the signal of the corresponding digital input.

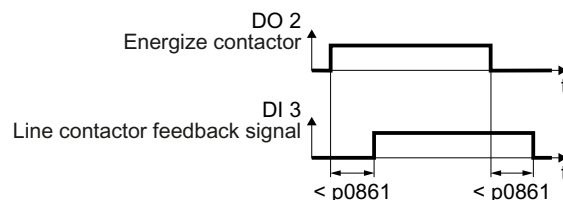


Figure 6-73 Line contactor control via DO 2 with feedback signal via DI 3


If the line contactor feedback signal is not available for longer than the time set in p0861, then the inverter signals fault F07300.

Setting the line contactor control

Parameter	Explanation
p0860	Line contactor feedback signal <ul style="list-style-type: none"> • p0860 = 863.1: no feedback signal (factory setting) • p0860 = 722.x Feedback signal of an NO contact via DIx • p0860 = 723.x: Feedback signal of an NC contact via DIx
p0861	Line contactor monitoring time (Factory setting: 100 ms) The inverter signals fault F07300 if, for an activated feedback signal, no feedback signal is received via the selected digital input after the time set here has expired.
r0863.1	Drive coupling status/control word Signal to activate the line contactor control
p0867	Line contactor holding time after OFF1 (factory setting: 50 ms) Time for which the line contactor must remain closed after an OFF1.
p0869	Sequence control configuration <ul style="list-style-type: none"> • p0689 = 0: line contactor immediately opens when the "Safe Torque Off" function becomes active (STO) • p0689 = 1: Line contactor opens when STO is active after the time in p0867 expires
p0870	Close main contactor (factory setting: 0) 1 signal: The line contactor also remains closed for an OFF command, or if the inverter has a fault condition.

Line contactor control for PM330 Power Modules

For a PM330, you can connect a line contactor without requiring any additional parameterization via terminals X9.11 and X9.12.

 Digital inputs and outputs on the PM330 Power Module (Page 138)

6.39 Calculating the energy saving for fluid flow machines



Fluid flow machines, which mechanically control the flow rate using valves or throttle flaps, operate with a constant speed corresponding to the line frequency.



Figure 6-74 Flow control with pump and throttle connected to a 50 Hz line supply

The lower the flow rate, the poorer the efficiency of the fluid flow machine (pump). The fluid flow machine (pump) has the poorest efficiency when the throttle or valve is completely closed. Further, undesirable effects can occur, for example the formation of vapor bubbles in liquids (cavitation) or the temperature of the medium being pumped can increase.

The inverter controls the flow rate by appropriately varying the speed of the fluid flow machine. As a consequence, the fluid flow machine has the optimum efficiency for each flow rate, and draws less electric power in the partial load range than for closed-loop control concepts based on valves and throttle flaps.

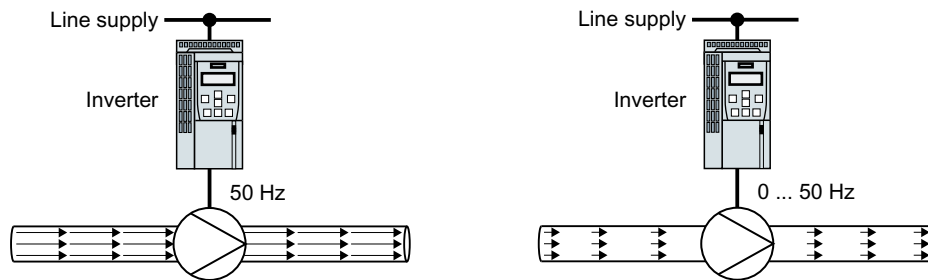
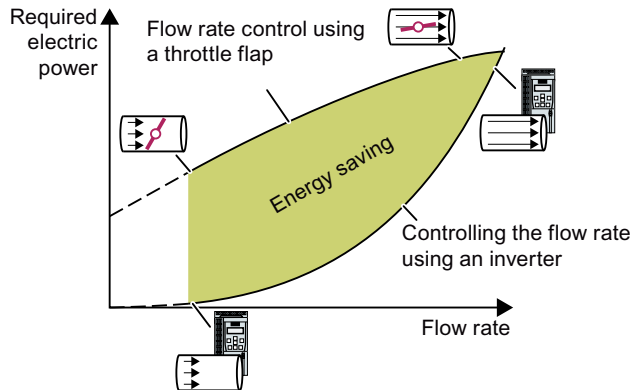


Figure 6-75 Flow control with pump and inverter

Function



The inverter calculates the energy saving from the flow characteristic associated with a mechanical flow control and the measured electric power that is drawn.

The calculation is suitable for centrifugal pumps, fans, radial and axial compressors, for instance.

Parameter	Description
r0039	Energy display [kWh]
	[0] Energy balance Energy usage since the last reset
	[1] Energy drawn since the last reset
	[2] Energy fed back since the last reset
p0040	Reset energy consumption display A signal change 0 → 1 sets r0039[0...2] = 0, r0041 = 0 and r0042 = 0.
r0041	Energy consumption saved (kWh) Energy saved referred to 100 operating hours. For less than 100 operating hours, the inverter interpolates the energy saving to 100 operating hours.
r0042	CO: Process energy display [1 ± 1 Wh] For display as process variable. Enable with p0043.
	[0] Energy balance Energy consumption since the last reset.
	[1] Energy drawn since the last reset
	[2] Energy fed back since the last reset.
p0043	BI: Enable energy usage display 1 signal: Process energy display is active in r0042.
p3320 ... p3329	<p>Flow characteristic</p> <p>(Speed, power)</p> <ul style="list-style-type: none"> ① (p3320, p3321) ② (p3322, p3323) ③ (p3324, p3325) ④ (p3326, p3327) ⑤ (p3328, p3329) <p>Factory setting of the flow characteristic</p> <p>To set the characteristic, you require the following data from the machine manufacturer for each speed interpolation point:</p> <ul style="list-style-type: none"> • The flow rate of the fluid-flow machine associated with the 5 selected inverter speeds • The power drawn at constant speed associated with the five flow rates corresponds to the line frequency and mechanical throttling of the flow rate.

6.40 Switchover between different settings

There are applications that require different inverter settings.

Example:

You connect different motors to one inverter. Depending on the particular motor, the inverter must operate with the associated motor data and the appropriate ramp-function generator.

Drive data sets (DDS)

You can set several inverter functions differently and then switch over between the different settings.

The associated parameters are indexed (index 0, 1, 2, or 3). Using control commands select one of the four indexes and therefore one of the four saved settings.

The settings in the inverter with the same index are called the drive data set.

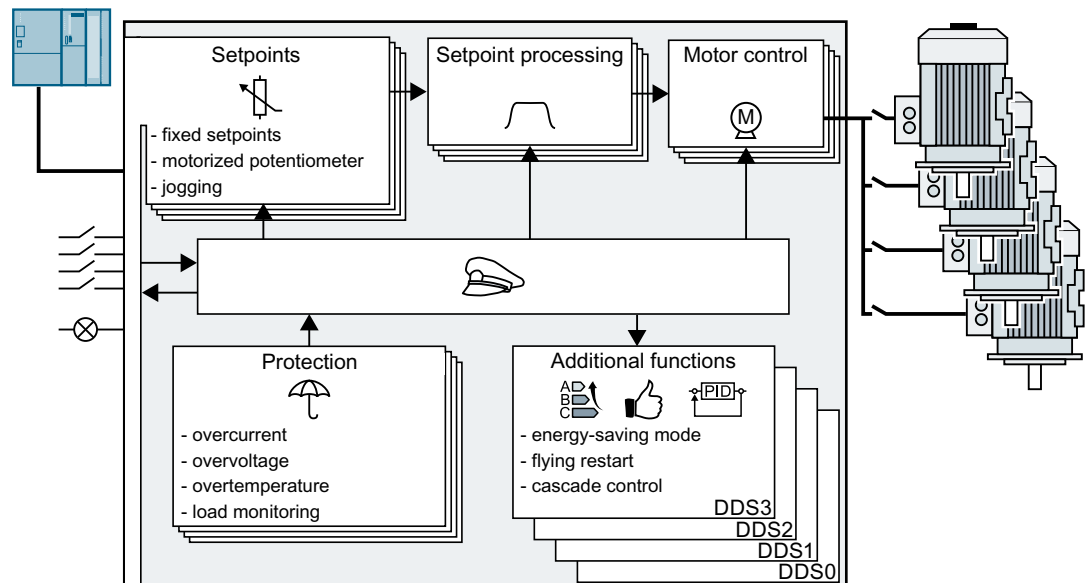


Figure 6-76 Switching over between different settings using drive data sets (DDS)

Using parameter p0180 you can define the number of drive data sets (1 ... 4).

Table 6-55 Selecting the number of **drive data sets**

Parameter	Description
p0010 = 15	Drive commissioning: Data sets
p0180	Drive data sets (DDS) number (factory setting: 1)
p0010 = 0	Drive commissioning: Ready

6.40 Switchover between different settings

Table 6-56 Parameters for switching the drive data sets:

Parameter	Description
p0820[0...n]	Drive data set selection DDS bit 0
p0821[0...n]	Drive data set selection DDS bit 1
	<p>If you use several command data sets CDS, then you must set this parameter for each CDS. The parameters are assigned to a CDS through their index:</p> <p>CDS0: p0820[0], p0821[0] CDS1: p0820[1], p0821[1] ...</p>
p0826	<p>Motor changeover, motor number</p> <p>Each drive data set is assigned a motor number: p0826[0] = motor number for drive data set 0. ... p0826[3] = motor number for drive data set 3.</p> <p>If you operate the same motor with different drive data sets, then you must enter the same motor number in every index of parameter p0826. In this particular case, you can also switch over between the different drive data sets in operation.</p> <p>If you operate different motors on one inverter, then you must number the motors in parameter p0826. In this case, you may only switch over the drive data sets in the "ready for operation" state with the motor switched-off. The switchover time is approx. 50 ms.</p>
r0051	Displaying the number of the DDS that is currently effective

For an overview of all the parameters that belong to the drive data sets and can be switched, see the List Manual.

Table 6-57 Parameters for copying the drive data sets

Parameter	Description
p0819[0]	Source drive data set
p0819[1]	Target drive data set
p0819[2] = 1	Start copy operation

For more information, see the List Manual (the parameter list and function diagram 8565).

Saving the settings and series commissioning

Saving settings outside the inverter

After commissioning, your settings are saved in the inverter so that they are protected against power failure.

We recommend that you additionally back up the settings on a storage medium outside the inverter. Without backup, your settings could be lost if the inverter develops a defect.

 Replace Control Unit (Page 425)

The following storage media are available for your settings:

- Memory card
- PG/PC
- Operator panel

Note

Data backup using Operator Panels with USB connection with the PG/PC is not possible

If the inverter is connected with a PG/PC via a USB cable, you cannot backup data to a memory card via an operator panel.

- Disconnect the USB connection between the PG/PC and inverter before you backup data to the memory card via an operator panel.
-

Carrying out series commissioning

Series commissioning is the commissioning of several identical drives.

Precondition

The Control Unit to which the settings are transferred has the same article number and the same or a higher firmware version as the source Control Unit.

Overview of the procedure

1. Commission the first inverter.
2. Back up the settings of the first inverter to an external storage medium.
3. Transfer the settings from the first inverter to an additional inverter via the data storage medium.

7.1 Backing up and transferring settings using a memory card

7.1.1 Memory cards

Recommended memory cards



Table 7-1 Memory cards to back up inverter settings

Scope of delivery	Article number
Memory card without firmware	6SL3054-4AG00-2AA0
Memory card with firmware V4.7	6SL3054-7EH00-2BA0
Memory card with firmware V4.7 SP3	6SL3054-7TB00-2BA0
Memory card with firmware V4.7 SP6	6SL3054-7TD00-2BA0
Memory card with firmware V4.7 SP9	6SL3054-7TE00-2BA0
Memory card with firmware V4.7 SP10	6SL3054-7TF00-2BA0

Using memory cards from other manufacturers

The inverter only supports memory cards up to 2 GB. SDHC cards (SD High Capacity) and SDXC cards (SD Extended Capacity) are not permitted.

If you use other SD or MMC memory cards, then you must format the memory card as follows:

- MMC: Format FAT 16
 - Insert the card into your PC's card reader.
 - Command to format the card:
format x: /fs:fat (x: Drive code of the memory card on your PC)
- SD: Format FAT 16 or FAT 32
 - Insert the card into your PC's card reader.
 - Command to format the card:
format x: /fs:fat or format x: /fs:fat32 (x: Drive code of the memory card on your PC.)

Functional restrictions with memory cards from other manufacturers

The following functions are either not possible – or only with some restrictions – when using memory cards from other manufacturers:

- Licensing functions is only possible using the recommended memory cards.
- Know-how protection is only possible with one of the recommended memory cards.
- Under certain circumstances, memory cards from other manufacturers do not support writing or reading data from/to the inverter.

7.1.2 Saving setting on memory card

We recommend that you insert the memory card before switching on the inverter. The inverter always also backs up its settings on an inserted card.

If you wish to back up the inverter settings on a memory card, you have two options:

Automatically backing up

Preconditions

- The inverter power supply has been switched off.
- No USB cable is inserted in the inverter.

Procedure



1. Insert an empty memory card into the inverter.
2. Switch on the power supply for the inverter.

After the power supply has been switched on, the inverter copies its changed settings to the memory card.

□

Note

Accidental damage to the inverter firmware

If the memory card contains inverter firmware, the inverter may perform an operating system update the next time the supply voltage is switched on. If you switch off the supply voltage during the operating system update, the inverter firmware may be incompletely loaded and damaged. The inverter cannot be operated with corrupt firmware.

- Before inserting the memory card, ascertain whether it also contains inverter firmware.
- Do not switch off inverter power supply during an operating system update.



[Firmware upgrade and downgrade \(Page 432\)](#)

Note

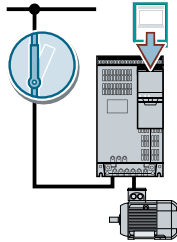
Accidental overwrite of the inverter settings

When the supply voltage is switched on, the inverter automatically accepts the settings already backed up on the memory card. If you use a memory card on which settings are already backed up, you will overwrite the settings of the inverter.

- To automatically backup your settings, use only a memory card that does not contain any other settings.

Manually backing up

Preconditions



- The inverter power supply has been switched on.
- No memory card is inserted in the inverter.

Procedure with Startdrive

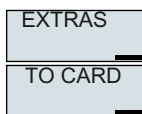
1. Go online.
2. Select "Online & diagnostics".
3. Select "Backing up/reset".
4. Back up the settings to the EEPROM of the inverter.
5. Select the settings as shown in the diagram.
6. Start data transfer
7. Wait until Startdrive reports that data backup has been completed.

You have backed up the inverter settings to a memory card.



Procedure with the BOP-2

1. Remove any USB cable that is inserted in the inverter.
2. In the "OPTIONS" menu, select "TO CARD".



7.1 Backing up and transferring settings using a memory card

PARAM SET
1

3. Set the number of your data backup. You can back up 99 different settings on the memory card.

ESC / OK

4. Start data transfer with OK.

SAVING
PARAS

5. Wait until the inverter has backed up the settings to the memory card.

CLONING
XXX-YYY

TO CARD
-dOnE-

You have backed up the settings of the inverter to the memory card.



7.1.3 Transferring the setting from the memory card

Automatically transferring

Precondition

The inverter power supply has been switched off.

Procedure



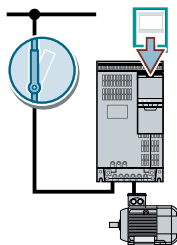
1. Insert the memory card into the inverter.
2. Then switch on the inverter power supply.

If there is valid parameter data on the memory card, then the inverter accepts the data from the memory card.

□

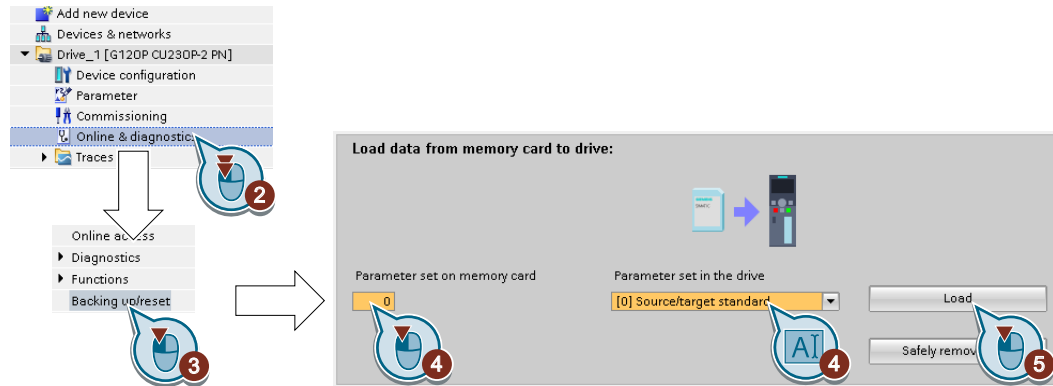
Manually transferring

Preconditions



- The inverter power supply has been switched on.
- No memory card is inserted in the inverter.

Procedure with Startdrive

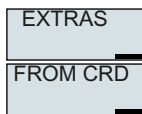


1. Go online.
2. Select "Online & diagnostics".
3. Select "Backing up/reset".
4. Select the settings as shown in the diagram.
5. Start data transfer
6. Wait until Startdrive has signaled that the data transfer has been completed.
7. Go offline.
8. Switch off the inverter power supply.
9. Wait until all LEDs on the inverter are dark.
10. Switch on the inverter power supply again.
Your settings become effective after switching on.

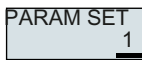
You have transferred your settings from a memory card to the inverter.

Procedure with the BOP-2

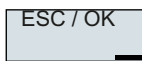
1. Remove any USB cable that is inserted in the inverter.



2. In the "OPTIONS" menu, select "FROM CRD".



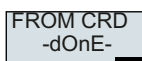
3. Set the number of your data backup. You can back up 99 different settings on the memory card.



4. Start data transfer with OK.



5. Wait until the inverter has transferred the settings from the memory card.



6. Switch off the inverter power supply.

7.1 Backing up and transferring settings using a memory card

- 7. Wait until all inverter LEDs are dark.
- 8. Switch on the inverter power supply again.

You have transferred the settings from the memory card to the inverter.



7.1.4 Safely remove the memory card

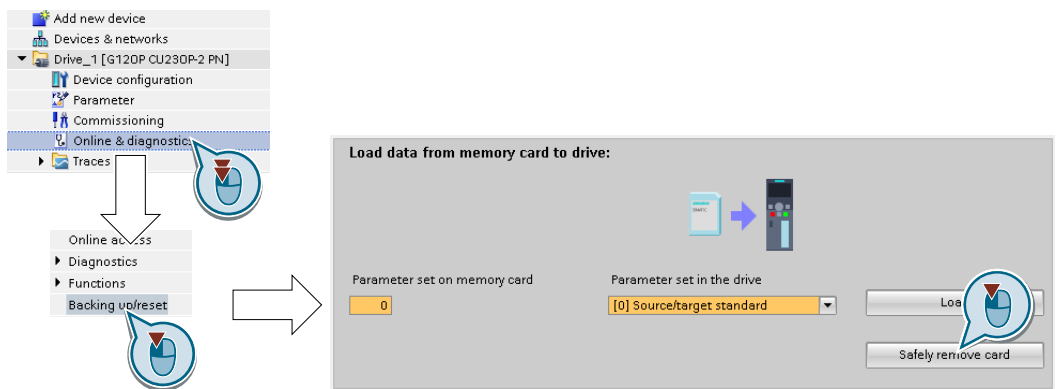
NOTICE

Data loss from improper handling of the memory card

If you remove the memory card when the converter is switched on without implementing the "safe removal" function you may destroy the file system on the memory card. The data on the memory card are lost. The memory card will only function again after formatting.

- Only remove the memory card using the "safe removal" function.

Procedure with Startdrive



1. In the Drive Navigator select the following screen form:
2. Click on the button to safely remove the memory card.
Startdrive will tell you whether you can remove the memory card from the inverter.

You have now safely removed the memory card from the inverter.



Procedure with the BOP-2

- | |
|-----------------|
| PARAMS |
| STANDARD FILTER |
| P9400 1⇒2 |
1. Set p9400 = 2.
If a memory card is inserted, p9400 = 1.
- | |
|-------------|
| P9400 3 ✓ |
| P9400 100 ⚠ |
2. The inverter sets p9400 = 3 or p9400 = 100.
 - p9400 = 3: You may remove the memory card from the inverter.
 - p9400 = 100: It is not permissible that you remove the memory card. Wait for several seconds and then set p9400 = 2 again.
- | |
|---------|
| P9400 0 |
|---------|
3. Remove the memory card. After removing the memory card, p9400 = 0.

You have now safely removed the memory card using BOP-2.



7.1.5 Activate message for a memory card that is not inserted

Function

The inverter identifies that a memory card is not inserted, and signals this state. The message is deactivated in the inverter factory setting.

Activate message

Procedure

1. Set p2118[x] = 1101, x = 0, 1, ... 19
2. Set p2119[x] = 2

Message A01101 for a memory card that is not inserted is activated.

To cyclically signal to a higher-level control that a memory card is not inserted, interconnect parameter r9401 to the send data of a PROFIdrive telegram of your choice.

Deactivate message

Procedure

1. Set p2118[x] = 1101, x = 0, 1, ... 19
2. Set p2119[x] = 3

Message A01101 for a memory card that is not inserted is deactivated.

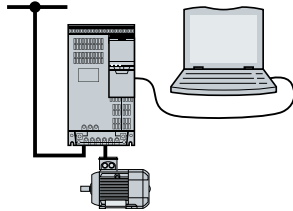
Parameter


Parameter	Explanation	
p2118[0 ... 19]	Change message type message number (factory setting: 0)	
p2119[0 ... 19]	Change message type (factory setting: 0) 1: Fault 2: Alarm 3: No message	
r9401	Safely remove memory card status	
	.00	1 signal: Memory card inserted
	.01	1 signal: Memory card activated
	.02	1 signal: SIEMENS memory card
	.03	1 signal: Memory card used as USB data storage medium from the PC

7.2 Saving the settings to a PC

You can transfer the inverter settings to a PG/PC, or vice versa, the data from a PG/PC to the inverter.

Requirements



- The inverter power supply has been switched on.
- The Startdrive commissioning tool is installed on the PG/PC.
 Tools to commission the inverter (Page 152)
- PC and inverter are connected with one another via a USB cable or the fieldbus.

Inverter → PC/PG

Procedure with Startdrive

1. Go online.
2. Select "Online" > "Upload device to PG/PC."
3. Back up the project with "Project" > "Save."
4. Wait until Startdrive reports that data backup has been completed.
5. Go offline.

You have backed up the settings with Startdrive.



PC/PG → inverter

Procedure with Startdrive without enabled safety functions

1. Go online.
2. Select "Load to device" > "Hardware and software" from the shortcut menu.
3. Wait until Startdrive reports that loading has been completed.
4. Go offline.
5. Confirm the dialog box that then opens by clicking "Yes" to save the data to the non-volatile memory of the inverter (Copy from RAM to ROM).

You have transferred the settings from the PG to the inverter with Startdrive.



7.3 Saving settings to an operator panel

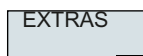
You can transfer the inverter settings to the Operator Panel BOP-2 or vice versa, the data from the BOP-2 to the inverter.

Precondition

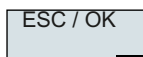
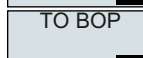
The inverter power supply has been switched on.

Inverter → BOP-2

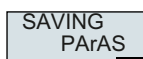
Procedure



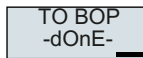

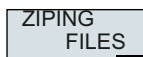
1. In the "OPTIONS" menu, select "TO BOP".



2. Start data transfer with OK.



3. Wait until the inverter has backed up the settings to the BOP-2.

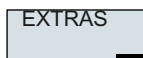


You have backed up the settings to the BOP-2.

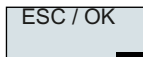
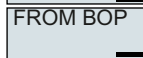


BOP-2 → inverter

Procedure



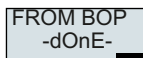
1. In the "OPTIONS" menu, select "FROM BOP".



2. Start data transfer with OK.



3. Wait until the inverter has written the settings to the memory card.



4. Switch off the inverter power supply.

5. Wait until all inverter LEDs are dark.

6. Switch on the inverter power supply again. Your settings become effective after switching on.


You have transferred the settings to the inverter.



7.4 Other ways to back up settings

In addition to the default setting, the inverter has an internal memory for backing up three other settings.

On the memory card, you can back up 99 other settings in addition to the default setting.

 Additional information is available on the Internet: Memory options (<http://support.automation.siemens.com/WW/view/en/43512514>).

7.5 Write protection

The write protection prevents unauthorized changing of the inverter settings. If you are working with a PC tool, such as STARTER, then write protection is only effective online. The offline project is not write-protected.

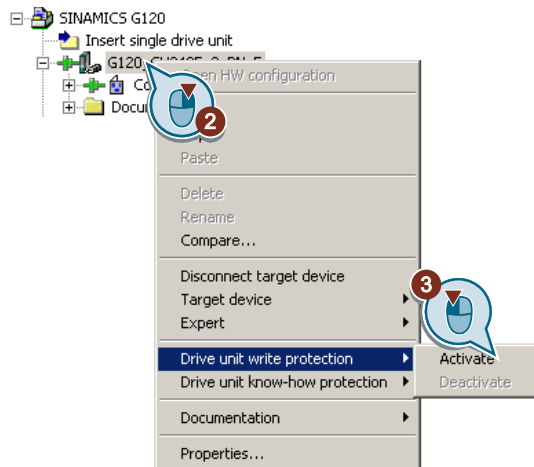
Write protection is applicable for all user interfaces:


- Operator Panel BOP-2 and IOP-2
- STARTER or Startdrive PC tool
- Parameter changes via fieldbus

No password is required for write protection.

Activate and deactivate write protection

Procedure with STARTER



1. Go online.
2. Open the shortcut menu of the required inverter.
3. Activate or deactivate write protection.
4. Press the "Copy RAM to ROM" button to retentively save the settings .

You have activated or deactivated write protection.

□

Active write protection can be identified as in the expert list the input fields of adjustable parameters p ... are shaded gray.

Parameter		
r7760	Write protection/know-how protection status	
	.00	1 signal: Write protection active
p7761	Write protection (factory setting: 0)	
	0:	Deactivate write protection
	1:	Activate write protection

Exceptions to write protection

Some functions are excluded from write protection, e.g.:

- Activating/deactivating write protection
- Changing the access level (p0003)
- Saving parameters (p0971)
- Safely removing the memory card (p9400)
- Restoring the factory setting
- Transfer the settings from an external data backup, e.g. upload into the inverter from a memory card.

The parameters that are not write protected are in the List Manual in Section "Parameters for write protection and know-how protection".

Note

Write protection for multimaster fieldbus systems

Via multimaster fieldbus systems, e.g. BACnet or Modbus RTU, in spite of write protection being activated, parameters can still be changed. So that write protection is also active when accessing via these fieldbuses, you must additionally set p7762 to 1.

In STARTER and Startdrive, this setting is only possible using the expert list.

7.6 Know-how protection



Overview

Know-how protection prevents unauthorized reading of the inverter settings.

To protect your inverter settings against unauthorized copying, in addition to know-how protection, you can also activate copy protection.

Precondition

Know-how protection requires a password.

Combination of know-how protection and copy protection	Is a memory card necessary?
Know-how protection without copy protection	The inverter can be operated with or without memory card.
Know-how protection with basic copy protection	 The inverter can only be operated with a SIEMENS memory card  Memory cards (Page 380)
Know-how protection with extended copy protection	

Function description

The active know-how protection provides the following:

- With just a few exceptions, the values of all adjustable parameters p ... are invisible. In STARTER, instead of the parameter values, the text "Know-how protection" is displayed.
 - Several adjustable parameters can be read and changed when know-how protection is active. You can find a list of the adjustable parameters that can be read and changed in the List Manual under "KHP_WRITE_NO_LOCK".
In addition, you can define an exception list of adjustable parameters, which end users may change.
 - Several adjustable parameters can be read but not changed when know-how protection is active. You can find a list of the adjustable parameters that can be read in the List Manual under "KHP_ACTIVE_READ".

You can hide know-how protected parameters in the expert list of STARTER using the "Without know-how protection" display filter.

- The values of monitoring parameters r ... remain visible.
- STARTER does not display any screen forms.
- Adjustable parameters cannot be changed using commissioning tools, e.g. an operator panel or Startdrive.

7.6 Know-how protection

- Locked functions:
 - Downloading inverter settings using STARTER or Startdrive
 - Automatic controller optimization
 - Stationary or rotating measurement of the motor data identification
 - Deleting the alarm history and the fault history
 - Generating acceptance documents for safety functions
- Executable functions:
 - Restoring factory settings
 - Acknowledging faults
 - Displaying faults, alarms, fault history, and alarm history
 - Reading out the diagnostic buffer
 - Controlling the inverter via the control panel in STARTER or Startdrive
 - Uploading adjustable parameters that can be changed or read when know-how protection is active.
 - Displaying acceptance documents for safety functions
 - Depending on the know-how protection settings, the trace function in STARTER can also be active when know-how protection is active.

When know-how protection is active, support can only be provided (from Technical Support) after prior agreement from the machine manufacturer (OEM).

Know-how protection without copy protection

You can transfer inverter settings to other inverters using a memory card, an operator panel, STARTER or Startdrive.



Know-how protection with basic copy protection

After replacing an inverter, to be able to operate the new inverter with the settings of the replaced inverter without knowing the password, the memory card must be inserted in the new inverter.

Know-how protection with extended copy protection

It is not possible to insert and use the memory card in another inverter without knowing the password.

Commissioning know-how protection

1. Check as to whether you must extend the exception list.
 -  List of exceptions (Page 397)
2. Activate the know-how protection.
 -  Know-how protection (Page 398)

7.6.1 Extending the exception list for know-how protection

In the factory setting, the exception list only includes the password for know-how protection.

Before activating know-how protection, you can additionally enter the adjustable parameters in the exception list, which must still be able to be read and changed by end users – even if know-how protection has been activated.

You do not need to change the exception list, if, with exception of the password, you do not require additional adjustable parameters in the exception list.




Absolute know-how protection

If you remove password p7766 from the exception list, it is no longer possible to enter or change the password for know-how protection.

You must reset the inverter to the factory settings in order to be able to gain access to the inverter adjustable parameters. When restoring the factory settings, you lose what you have configured in the inverter, and you must recommission the inverter.

Extending the exception list

Procedure with STARTER

1. Backup the inverter settings using the  button on the PC.
2. Go offline ()
3. Using p7763, in the expert list, define the required number of parameters n (n = 1 ... 500) of the exception list.
4. Save the project.
5. Go online.
6. Load the project using the  button in the inverter.
7. In p7764[0 ... n-1], assign the required parameter numbers to the indices of p7763.

You have extended the exception list for know-how protection.

Parameter

Parameter	Description
p7763	KHP OEM exception list number of indices for p7764 (factory setting 1)
p7764	KHP OEM exception list (factory setting [0] 7766, [1 ... 499] 0) p7766 is the password for know-how protection

7.6.2 Activating and deactivating know-how protection

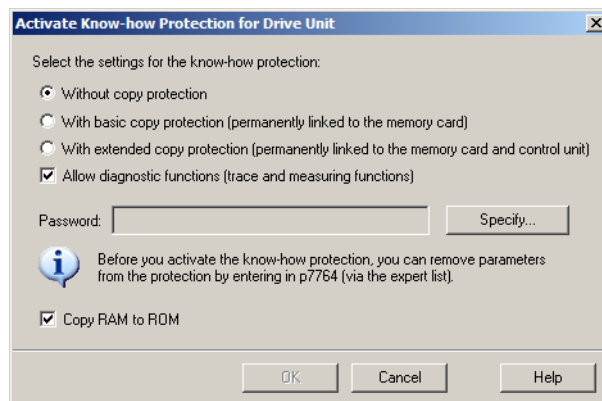
Activating know-how protection

Preconditions

- The inverter has now been commissioned.
- You have generated the exception list for know-how protection.
- To guarantee know-how protection, you must ensure that the project does not remain at the end user as a file.

Procedure with STARTER

1. Go online with STARTER.
If you have generated a project offline on your computer, you must load the project into the inverter and go online.
2. Select the required inverter in the project.
3. In the shortcut menu, select "Know-how protection drive unit/activating".



4. The "Without copy protection" option is active by default. If an appropriate memory card is inserted in the Control Unit, you can select one of two copy protection options:
 - With basic copy protection (permanently linked to the memory card)
 - With extended copy protection (permanently linked to the memory card and Control Unit)Select the required copy protection option.
5. If, in spite of active know-how protection, you wish to permit diagnostic functions, activate option "Allow diagnostic functions (trace and measuring functions)".
6. Click on "Define"

7. Enter your password. Length of the password: 1 ... 30 characters.
Recommendation for assigning a password:
 - Only use characters from the ASCII set of characters.
If you use arbitrary characters for the password, changing the windows language settings after activating know-how protection can result in problems when subsequently checking a password.
 - For an adequately secure password, the password must have a minimum length of 8 characters, and must include uppercase and lowercase letters as well as a combination of letters, numbers and special characters.
 8. The "Copy RAM to ROM" option is active as standard.
The option must be active in order that the inverter keeps the know-how protection settings after switching off and switching on the power supply.
 9. Click on "OK".
- You have activated know-how protection.

Preventing data reconstruction from the memory card

As soon as know-how protection has been activated, the inverter only backs up encrypted data to the memory card.

In order to guarantee know-how protection, after activating know-how protection, we recommend that you insert a new, empty memory card. For memory cards that have already been written to, previously backed up data that was not encrypted can be reconstructed.

Changing the password

Procedure with STARTER

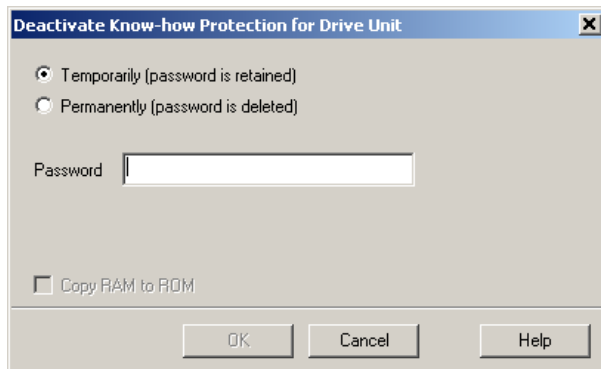
Select the inverter in the project and open the dialog screen form using the shortcut menu "Know-how protection drive unit → Change password ...".

Deactivating know-how protection, deleting a password

Procedure with STARTER

1. Go online with STARTER.
2. Select the required inverter in the project.

3. Using the right-hand mouse key, open the dialog window "Know-how protection drive unit → Deactivate...".



4. Select the required option:
 - Temporary status: Know-how protection is again active after switching off the power supply and switching on again.
 - Final status: Also select "Copy RAM to ROM". The inverter deletes the password. However, after switching off and switching on the power supply, the password remains deleted.
5. Enter the password for know-how protection.
6. Exit the screen form with OK.

You have deactivated know-how protection.

□

Parameter

Parameter	Description	
r7758[0...19]	KHP Control Unit serial number	
p7759[0...19]	KHP Control Unit reference serial number	
r7760	Write protection/know-how protection status	
	.01	1 signal: Know-how protection active
	.02	1 signal: Know-how protection temporarily unlocked
	.03	1 signal: Know-how protection cannot be deactivated
	.04	1 signal: Extended copy protection active
	.05	1 signal: Basic copy protection active
p7765	KHP configuration	
	p7766[0...29]	KHP password input
	p7767[0...29]	KHP password new
	p7768[0...29]	KHP password confirmation
	p7769[0...20]	KHP memory card reference serial number
	r7843[0...20]	Memory card serial number



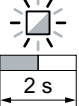
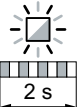

Alarms, faults and system messages

The inverter has the following diagnostic types:

- LED
The LEDs at the front of the inverter immediately inform you about the most important inverter states.
- System runtime
The system run time is the total time that the inverter has been supplied with power since the initial commissioning.
- Alarms and faults
Every alarm and every fault has a unique number.
The inverter signals alarms and faults via the following interfaces:
 - Fieldbus
 - Terminal strip with the appropriate setting
 - Interface to the BOP-2 or IOP-2 operator panel
 - Interface to STARTER or Startdrive
- Identification & maintenance data (I&M)
If requested, the inverter sends data to the higher-level control via PROFIBUS or PROFINET:
 - Inverter-specific data
 - Plant-specific data

8.1 Operating states indicated on LEDs

Table 8-1 Explanation of symbols for the following tables

	LED is ON
	LED is OFF
	LED flashes slowly
	LED flashes quickly
	LED flashes with variable frequency

Please contact Technical Support for LED states that are not described in the following.

Table 8-2 Basic states







RDY	Explanation
	Temporary state after the supply voltage is switched on.
	The inverter is free of faults
	Commissioning or reset to factory settings
	A fault is active
	Firmware update is active
	Inverter waits until the power supply is switched off and switched on again after a firmware update

Table 8-3 PROFINET fieldbus















LNK	Explanation
	Communication via PROFINET is error-free
	Device naming is active
	No communication via PROFINET













Table 8-4 Fieldbuses via RS 485 interface

BF	Explanation
	Data exchange between the inverter and control system is active
  	The fieldbus is active, however, the inverter is not receiving any process data RDY When LED RDY flashes simultaneously: Inverter waits until the power supply is switched off and switched on again after a firmware update
  	No fieldbus connection is available RDY When LED RDY flashes simultaneously: Incorrect memory card
	Firmware update failed
  	Firmware update is active

Communication via Modbus or USS:

If the fieldbus monitoring is deactivated with p2040 = 0, the BF-LED remains dark, independent of the communication state.

Table 8-5 PROFINET and PROFIBUS fieldbuses

BF	Explanation
	Data exchange between the inverter and control system is active
	Fieldbus interface is not being used
  	The fieldbus is improperly configured. RDY In conjunction with a synchronously flashing LED RDY: Inverter waits until the power supply is switched off and switched on again after a firmware update
  	No communication with higher-level controller RDY In conjunction with an asynchronously flashing LED RDY: Incorrect memory card
	Firmware update failed
  	Firmware update is active

8.2 System runtime

By evaluating the system runtime of the inverter, you can decide when you should replace components subject to wear in time before they fail - such as fans, motors and gear units.

Principle of operation

The system runtime is started as soon as the Control Unit power supply is switched-on. The system runtime stops when the Control Unit is switched off.

The system runtime comprises r2114[0] (milliseconds) and r2114[1] (days):

System runtime = r2114[1] × days + r2114[0] × milliseconds

If r2114[0] has reached a value of 86,400,000 ms (24 hours), r2114[0] is set to the value 0 and the value of r2114[1] is increased by 1.

Parameter	Description
r2114[0]	System runtime (ms)
r2114[1]	System runtime (days)

You cannot reset the system runtime.

8.3 Identification & maintenance data (I&M)

I&M data

The inverter supports the following identification and maintenance (I&M) data.

I&M data	Format	Explanation	Associated parameters	Example for the content
I&M0	u8[64] PROFIBUS u8[54] PROFINET	Inverter-specific data, read only	-	See below
I&M1	Visible String [32]	Plant/system identifier	p8806[0 ... 31]	"ak12- ne.bo2=fu1"
	Visible String [22]	Location code	p8806[32 ... 53]	"sc2+or45"
I&M2	Visible String [16]	Date	p8807[0 ... 15]	"2013-01-21 16:15"
I&M3	Visible String [54]	Any comment	p8808[0 ... 53]	-
I&M4	Octet String[54]	Check signature to track changes for Safety Integrated. This value can be changed by the user. The test signature is reset to the value generated by the machine is p8805 = 0 is used.	p8809[0 ... 53]	Values of r9781[0] and r9782[0]

When requested, the inverter transfers its I&M data to a higher-level control or to a PC/PG with installed STEP 7 or TIA Portal.

I&M0

Designation	Format	Example for the content	Valid for PRO-FINET	Valid for PRO-FIBUS
Manufacturer-specific	u8[10]	00 ... 00 hex	---	✓
MANUFACTURER_ID	u16	42d hex (=Siemens)	✓	✓
ORDER_ID	Visible String [20]	„6SL3246-0BA22-1FA0“	✓	✓
SERIAL_NUMBER	Visible String [16]	„T-R32015957“	✓	✓
HARDWARE_REVISION	u16	0001 hex	✓	✓
SOFTWARE_REVISION	char, u8[3]	„V“ 04.70.19	✓	✓
REVISION_COUNTER	u16	0000 hex	✓	✓
PROFILE_ID	u16	3A00 hex	✓	✓
PROFILE_SPECIFIC_TYPE	u16	0000 hex	✓	✓
IM_VERSION	u8[2]	01.02	✓	✓
IM_SUPPORTED	bit[16]	001E hex	✓	✓

8.4 Alarms, alarm buffer, and alarm history

Alarms

Alarms have the following properties:

- Incoming alarms have no direct influence on the inverter.
- Alarms disappear again when the cause is eliminated.
- Alarms do not have to be acknowledged.
- Alarms are displayed as follows:
 - Display via bit 7 in status word 1 (r0052)
 - Display on the operator panel with Axxxxx
 - Display in Startdrive or STARTER

Alarm code or alarm value describe the cause of the alarm.

Alarm buffer

Alarm code		Alarm value		Alarm time received		Alarm time removed		
		I32	float	Days	ms			
r2122[0]	r2124[0]	r2134[0]		r2145[0]	r2123[0]	old	r2146[0]	r2125[0]
[1]	[1]	[1]		[1]	[1]	↓ new	[1]	[1]
[2]	[2]	[2]		[2]	[2]		[2]	[2]
[3]	[3]	[3]		[3]	[3]		[3]	[3]
[4]	[4]	[4]		[4]	[4]		[4]	[4]
[5]	[5]	[5]		[5]	[5]		[5]	[5]
[6]	[6]	[6]		[6]	[6]		[6]	[6]
[7]	[7]	[7]		[7]	[7]		[7]	[7]

Figure 8-1 Alarm buffer

The inverter saves incoming alarms in the alarm buffer. An alarm includes an alarm code, an alarm value, and two alarm times:

- Alarm code: r2122
- Alarm value: r2124 in fixed-point format "I32", r2134 in floating-point format "Float"
- Alarm time received = r2145 + r2123
- Alarm time removed = r2146 + r2125

The inverter takes its internal time calculation to save the alarm times.

 Real time clock (RTC) (Page 300)

Up to 8 alarms can be saved in the alarm buffer.

In the alarm buffer, the warnings are sorted according to "Warning time received". If the alarm buffer is completely filled and an additional alarm occurs, then the inverter overwrites the values with Index [7].

Alarm history

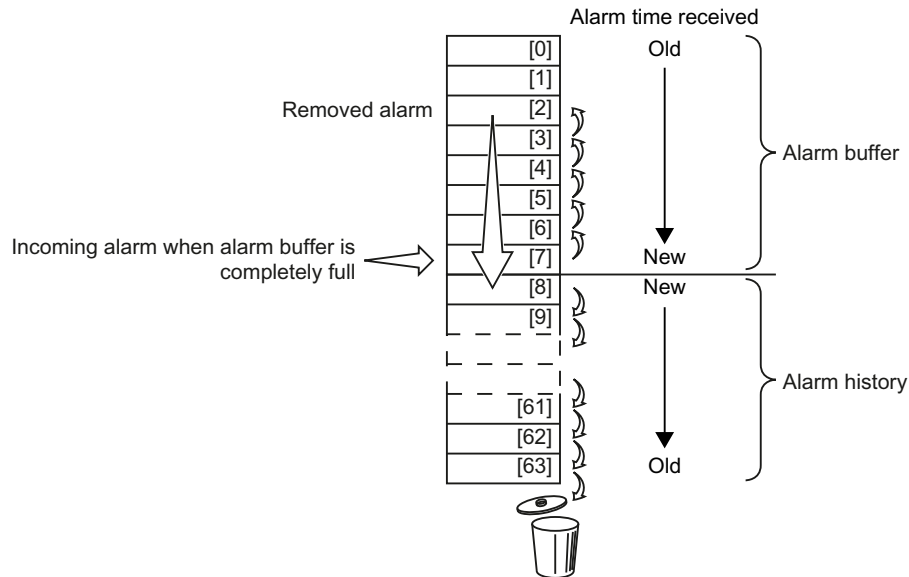


Figure 8-2 Shifting removed alarms into the alarm history

If the alarm buffer is completely filled and an additional alarm occurs, the inverter shifts all removed alarms into the alarm history. The following occurs in detail:

1. To create space after position [8] in the alarm history, the inverter shifts the alarms already stored in the alarm history "down" by one or more positions.
If the alarm history is completely full, the inverter will delete the oldest alarms.
2. The inverter moves the removed alarms from the alarm buffer to the now freed up positions of the alarm history.
Alarms that have not been removed remain in the alarm buffer.
3. The inverter closes gaps in the alarm buffer that occurred when the removed alarms were shifted in the alarm history by shifting the alarms that have not been removed "up".
4. The inverter saves the received alarm as the latest alarm in the alarm buffer.

The alarm history saves up to 56 alarms.

In the alarm history, alarms are sorted according to the "alarm time received". The latest alarm has Index [8].

Parameters of the alarm buffer and the alarm history

Parameter	Description
p2111	Alarm counter Number of alarms that have occurred after the last reset When setting p2111 = 0, all of the alarms that have been removed from the alarm buffer [0...7] are transferred into the alarm history [8...63]
r2122	Alarm code Displays the numbers of the alarms that have occurred

Parameter	Description
r2123	Alarm time received in milliseconds Displays the time in milliseconds when the alarm occurred
r2124	Alarm value Displays additional information about the alarm
r2125	Alarm time removed in milliseconds Displays the time in milliseconds when the alarm was removed
r2145	Alarm time received in days Displays the time in days when the alarm occurred
r2132	Actual alarm code Displays the code of the alarm that last occurred
r2134	Alarm value for float values Displays additional information about the alarm that occurred for float values
r2146	Alarm time removed in days Displays the time in days when the alarm was removed

Extended settings for alarms

Parameter	Description
You can change up to 20 different alarms into a fault or suppress alarms:	
p2118[0 ... 19]	Setting the message number for the message type Selection of the alarms for which the message type should be changed
p2119[0 ... 19]	Setting the message type Setting the message type for the selected alarm 1: Fault 2: Alarm 3: No message

You will find details in function diagram 8075 and in the parameter description of the List Manual.

8.5 Faults, alarm buffer and alarm history

Faults

Faults have the following properties:

- In general, a fault leads to the motor being switched off.
- A fault must be acknowledged.
- Faults are displayed as follows:
 - Display in bit 3 of status word 1 (r0052)
 - Display on the operator panel with Fxxxxx
 - Display on the inverter via the LED RDY
 - Display in Startdrive or STARTER

Fault buffer

Fault code	Fault value		Fault time received		Old ↓ New	Fault time removed	
	I32	float	Days	ms		Days	ms
r0945[0]	r0949[0]	r2133[0]	r2130[0]	r0948[0]	↓	r2136[0]	r2109[0]
[1]	[1]	[1]	[1]	[1]		[1]	[1]
[2]	[2]	[2]	[2]	[2]		[2]	[2]
[3]	[3]	[3]	[3]	[3]		[3]	[3]
[4]	[4]	[4]	[4]	[4]		[4]	[4]
[5]	[5]	[5]	[5]	[5]		[5]	[5]
[6]	[6]	[6]	[6]	[6]		[6]	[6]
[7]	[7]	[7]	[7]	[7]		[7]	[7]

Figure 8-3 Fault buffer

The inverter saves incoming faults in the fault buffer. A fault includes a fault code, a fault value, and two fault times:

- Fault code: r0945
The fault code and fault value describe the cause of the fault.
- Fault value: r0949 in fixed-point format "I32", r2133 in floating-point format "Float"
- Fault time received = r2130 + r0948
- Fault time removed = r2136 + r2109

The inverter takes its internal time calculation to save the fault times.

 Real time clock (RTC) (Page 300)

Up to 8 faults can be saved in the fault buffer.

In the fault buffer, the faults are sorted according to "Fault time received". If the fault buffer is completely filled and an additional fault occurs, then the inverter overwrites the values with Index [7].

Acknowledge fault

To acknowledge a fault, you have the following options:

- PROFIdrive control word 1, bit 7 (r2090.7)
- Acknowledging via a digital input
- Acknowledge via the Operator Panel
- Switch off the inverter power supply and switch on again

Faults detected during the inverter-internal monitoring of hardware and firmware can be acknowledged only by switching the supply voltage off and on again. In the list of faults in the List Manual, at the corresponding fault codes you may find the information on limitations when acknowledging.

Fault history

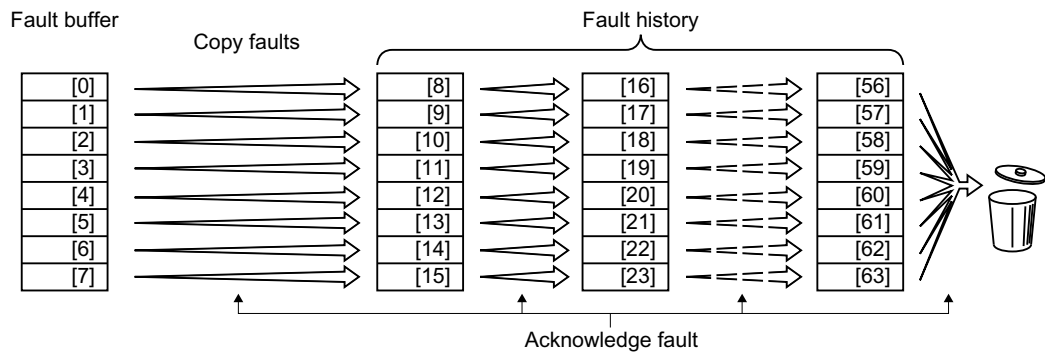


Figure 8-4 Fault history after acknowledging the faults

If at least one of the fault causes in the fault buffer has been removed and you acknowledge the faults, the following takes place:

1. The inverter shifts the values previously saved in the fault history by eight indexes. The inverter deletes the faults that were saved in the indexes [56 ... 63] before the acknowledgement.
2. The inverter copies the contents of the fault buffer to the memory locations [8 ... 15] in the fault history.
3. The inverter deletes the faults that have been removed from the fault buffer. The faults that have not been removed are now saved both in the fault buffer and in the fault history.
4. The inverter writes the time of acknowledgement of the removed faults to "Fault time removed". The "Fault time removed" of the faults that have not been removed retains the value = 0.

The fault history can contain up to 56 faults.

Deleting the fault history

To delete all faults from the fault history, set parameter p0952 to zero.

Parameters of the fault buffer and the fault history

Parameter	Description
r0945	Fault code Displays the numbers of the faults that have occurred
r0948	Fault time received in milliseconds Displays the time in milliseconds when the fault occurred
r0949	Fault value Displays additional information about the fault
p0952	Fault cases, counter A fault case can contain one or several faults. Number of fault cases that have occurred since the last acknowledgement. With p0952 = 0 you delete the fault buffer and the fault history.
r2109	Fault time removed in milliseconds Displays the time in milliseconds when the fault occurred
r2130	Fault time received in days Displays the time in days when the fault occurred
r2131	Actual fault code Displays the code of the oldest fault that is still active
r2133	Fault value for float values Displays additional information about the fault that occurred for float values
r2136	Fault time removed in days Displays the time in days when the fault was removed

Extended settings for faults

Parameter	Description
p2100[0 ... 19]	Setting the fault number for fault response Selecting the faults for which the fault response should be changed. You can modify the motor fault response for up to 20 different fault codes.
p2101[0 ... 19]	Setting, fault response Setting the fault response for the selected fault
p2118[0 ... 19]	Setting the message number for the message type Selection of the message for which the message type should be changed. You can change up to 20 different faults into an alarm, or suppress faults:
p2119[0 ... 19]	Setting the message type Setting the message type for the selected fault 1: Fault 2: Alarm 3: No message

Parameter	Description
p2126[0 ... 19]	Setting the fault number for the acknowledgement mode Selection of the faults for which the acknowledgement type should be changed. You can modify the acknowledgement type for up to 20 different fault codes.
p2127[0 ... 19]	Setting, acknowledgement mode Setting the acknowledgement type for the selected fault 1: Acknowledgement only using POWER ON 2: IMMEDIATE acknowledgement after removing the fault cause


You will find details in function diagram 8075 and in the parameter description of the List Manual.

8.6 List of alarms and faults

Axxxxx Alarm

Fyyyyy: Fault

Table 8-6 The most important alarms and faults

Number	Cause	Remedy
F01000	Software error in the CU	Replacing the Control Unit.
F01001	Floating point exception	Switch the Control Unit off and on again.
F01015	Software error in the CU	Upgrade firmware or contact technical support.
F01018	Power-up aborted more than once	<ol style="list-style-type: none"> 1. Switch the module off and on again. 2. After this fault has been output, the module is powered up with the factory settings. 3. Recommission the inverter.
A01028	Configuration error	<p>Explanation: Parameterization on the memory card has been created with a different type of module (Article number, MLFB).</p> <p>Check the module parameters and recommission if necessary.</p>
F01033	Switching over units: Reference parameter value invalid	Set the value of the reference parameter not equal to 0.0 (p0304, p0305, p0310, p0596, p2000, p2001, p2002, p2003, r2004).
F01034	Switching over units: Calculation of the parameter values after reference value change unsuccessful	Select the value of the reference parameter so that the parameters involved can be calculated in the per unit notation (p0304, p0305, p0310, p0596, p2000, p2001, p2002, p2003, r2004).
F01040	Parameters must be saved	<p>Save parameters (p0971).</p> <p>Switch the Control Unit off and on again.</p>
F01044	Error loading data from memory card	Replace the memory card or the Control Unit.
A01053	System overload measured	<p>The maximum computing power of the Control Unit was exceeded. The following measures reduce the load on the Control Unit:</p> <ul style="list-style-type: none"> • Use only one data record (CDS and DDS) • Only use the safety features of the basic functions • Deactivate the technology controller • Use the simple ramp-function generator rather than the extended ramp-function generator • Do not use any free function components • Reduce the sampling time of the free function blocks
F01054	System limit exceeded	
A01101	Memory card not available	<p>Insert a memory card or deactivate alarm A01101.</p> <p> Activate message for a memory card that is not inserted (Page 388)</p>
F01105	CU: Insufficient memory	Reduce number of data sets.
F01122	Frequency at the probe input too high	Reduce the frequency of the pulses at the probe input.
F01205	CU: Time slice overflow	Contact technical support.
F01250	CU hardware fault	Replacing the Control Unit.
F01512	An attempt has been made to establish a conversion factor for scaling which does not exist	Create scaling or check transfer value.

8.6 List of alarms and faults

Number	Cause	Remedy
A01590	Motor maintenance interval elapsed	Carry out maintenance and reset the maintenance interval (p0651).
F01662	Error, internal communications	<ul style="list-style-type: none"> • Check the electrical cabinet design and cable routing for EMC compliance. • Check whether an impermissible voltage is connected at one of the digital outputs. • Check whether a digital output is loaded with an impermissible current. If the checks are unsuccessful: <ul style="list-style-type: none"> • Switch off the inverter power supply and switch it on again • Upgrade the firmware • Contact technical support
A01900	PROFIBUS: Configuration telegram faulty	Explanation: A PROFIBUS master is attempting to establish a connection with a faulty configuration telegram. Check the bus configuration on the master and slave side.
A01910 F01910	Setpoint timeout	The alarm is generated when p2040 \neq 0 ms and one of the following causes is present: <ul style="list-style-type: none"> • The bus connection is interrupted • The Modbus master is switched off • Communications error (CRC, parity bit, logical error) • An excessively low value for the fieldbus monitoring time (p2040)
A01920	PROFIBUS: Cyclic connection interrupt	Explanation: The cyclic connection to PROFIBUS master is interrupted. Establish the PROFIBUS connection and activate the PROFIBUS master with cyclic operation.
F03505	Analog input, wire break	Check the wiring for interruptions. Check the level of the injected signal. The input current measured by the analog input can be read out in r0752.
A03520	Temperature sensor fault	Check that the sensor is connected correctly.
A05000 A05001 A05002 A05004 A05006	Power Module overtemperature	Check the following: <ul style="list-style-type: none"> - Is the ambient temperature within the defined limit values? - Are the load conditions and duty cycle configured accordingly? - Has the cooling failed?
F06310	Supply voltage (p0210) incorrectly set	Check the set supply voltage and if required change (p0210). Check the line voltage.
F07011	Motor overtemperature	Reduce the motor load. Check ambient temperature. Check the wiring and connection of the sensor.
A07012	I2t motor model overtemperature	Check and if necessary reduce the motor load. Check the motor's ambient temperature. Check the thermal time constant p0611. Check overtemperature fault threshold p0605.
A07015	Motor temperature sensor alarm	Check that the sensor is connected correctly. Check the parameter assignment (p0601).
F07016	Motor temperature sensor fault	Make sure that the sensor is connected correctly. Check the parameterization (p0601). Deactivate the motor temperature sensor fault evaluation (p0607 = 0).

Number	Cause	Remedy
F07086 F07088	Switching over units: Parameter limit violation	Check the adapted parameter values and if required correct.
F07320	Automatic restart aborted	Increase the number of restart attempts (p1211). The current number of start attempts is shown in r1214. Increase the wait time in p1212 and/or monitoring time in p1213. Connect an ON command (p0840). Increase the monitoring time of the power unit or switch off (p0857). Reduce the wait time for resetting the fault counter p1213[1] so that fewer faults are registered in the time interval.
A07321	Automatic restart active	Explanation: The automatic restart (AR) is active. During voltage recovery and/or when remedying the causes of pending faults, the drive is automatically switched back on.
F07330	Search current measured too low	Increase the search current (p1202), check the motor connection.
A07353	DC quantity control deactivated	The controller to suppress DC components in the motor current was at its limit and deactivated itself. <ul style="list-style-type: none"> • Increase the integral time p3858 of the DC quantity controller • Decrease the gain p3857 of the DC quantity controller
F07390	Forming the DC link capacitors was faulty	The inverter has canceled the "Forming the DC link capacitors" function (r3382.3 = 1). The expected DC link voltage is outside the tolerance. <ul style="list-style-type: none"> • Check the inverter, e.g. supply voltage and connecting terminals • Set the forming duration again (p3380 > 0), and restart forming.
A07391	Forming the DC link capacitors active	The "DC link forming" function is active. After forming has been completed, the inverter withdraws the alarm (r3382.2 = 1).
A07400	DC-link voltage maximum controller active	If the controller is not to intervene: <ul style="list-style-type: none"> • Increase the ramp-down times. • Deactivate the Vdc_max control (p1240 = 0 for vector control, p1280 = 0 for U/f control).
A07409	V/f control, current limiting controller active	The alarm automatically disappears after one of the following measures: <ul style="list-style-type: none"> • Increase the current limit (p0640). • Reduce the load. • Increase the ramp-up time to the speed setpoint.
F07426	Technology controller actual value limited	<ul style="list-style-type: none"> • Adapt the limits to the signal level (p2267, p2268). • Check the actual value scaling (p2264).
A07444	PID autotuning is activated	Automatic setting of the PID controller (autotuning) is active (p2350 > 0). The alarm disappears automatically after completion of the autotuning.
F07445	PID autotuning canceled	The inverter has canceled the automatic setting of the PID controller (autotuning) because of a fault. Remedy: Increase p2355 and restart autotuning.

8.6 List of alarms and faults

Number	Cause	Remedy
F07801	Motor overcurrent	<p>Check current limits (p0640).</p> <p>Vector control: Check current controller (p1715, p1717).</p> <p>V/f control: Check the current limiting controller (p1340 ... p1346).</p> <p>Increase the acceleration ramp (p1120) or reduce the load.</p> <p>Check the motor and motor cables for short-circuit and ground fault.</p> <p>Check the motor regarding the star/delta connection and rating plate parameterization.</p> <p>Check power unit / motor combination.</p> <p>Select the flying restart function (p1200) if switched to rotating motor.</p>
A07805	Drive: Power unit overload I2t	<ul style="list-style-type: none"> • Reduce the continuous load. • Adapt the load cycle. • Check the assignment of rated currents of the motor and power unit.
F07806	Regenerative power limit exceeded	<p>Increase the deceleration ramp.</p> <p>Reduce the driving load.</p> <p>Use a power unit with higher energy recovery capability.</p> <p>For vector control, the regenerative power limit in p1531 can be reduced until the fault is no longer activated.</p>
F07807	Short-circuit detected	<ul style="list-style-type: none"> • Check the inverter connection on the motor side for any phase-phase short-circuit. • Rule out that line and motor cables have been interchanged.
A07850 A07851 A07852	External alarm 1 ... 3	<p>The signal for "external alarm 1" has been triggered.</p> <p>Parameters p2112, p2116 and p2117 determine the signal sources for the external alarm 1... 3.</p> <p>Remedy: Remove the causes of these alarms.</p>
F07860 F07861 F07862	External fault 1 ... 3	Remove the external causes for this fault.
A07891	Load monitoring, pump/fan blocked	<ul style="list-style-type: none"> • Check the pump/fan for blockage and rectify if necessary. • Check the fan for sluggishness and rectify if necessary. • Adapt the parameterization depending on the load (p2165, p2168).
A07892	Load monitoring, pump/fan without load	<ul style="list-style-type: none"> • For a pump, check the conveyor medium and provide if necessary. • For a fan, check the belt and replace if necessary • If necessary, increase the torque threshold for detection (p2191).
A07893	Load monitoring, pump leakage	<ul style="list-style-type: none"> • Rectify the leakage in the pump circuit. • For a false tripping, reduce the torque thresholds of the leakage characteristic (p2186, p2188, p2190).
F07894	Load monitoring, pump/fan blocked	<ul style="list-style-type: none"> • Check the pump/fan for blockage and rectify if necessary. • Check the fan for sluggishness and rectify if necessary. • Adapt the parameterization depending on the load (p2165, p2168).
F07895	Load monitoring, pump/fan without load	<ul style="list-style-type: none"> • For a pump, check the conveyor medium and provide if necessary. • For a fan, check the belt and replace if necessary • If necessary, increase the torque threshold for detection (p2191).

Number	Cause	Remedy
F07896	Load monitoring, pump leakage	<ul style="list-style-type: none"> Rectify the leakage in the pump circuit. For a false tripping, reduce the torque thresholds of the leakage characteristic (p2186, p2188, p2190).
F07900	Motor blocked	<p>Check that the motor can run freely.</p> <p>Check the torque limits (r1538 and r1539).</p> <p>Check the parameters of the "Motor blocked" message (p2175, p2177).</p>
F07901	Motor overspeed	<p>Activate the precontrol for the speed limiting controller (p1401 bit 7 = 1).</p> <p>Increase the hysteresis for overspeed signal p2162.</p>
F07902	Motor stalled	<p>Check whether the motor data has been set correctly and perform a motor identification.</p> <p>Check the current limits (p0640, r0067, r0289). If the current limits are too low, the drive cannot be magnetized.</p> <p>Check whether motor cables are disconnected during operation.</p>
A07903	Motor speed deviation	<p>Increase p2163 and/or p2166.</p> <p>Increase the torque, current and power limits.</p>
A07910	Motor overtemperature	<p>Check the motor load.</p> <p>Check the motor's ambient temperature.</p> <p>Check the KTY84 or PT1000 sensor.</p> <p>Check the overtemperatures of the thermal model (p0626 ... p0628).</p>
A07920	Torque/speed too low	The torque deviates from the torque/speed envelope curve.
A07921	Torque/speed too high	<ul style="list-style-type: none"> Check the connection between the motor and the load.
A07922	Torque/speed out of tolerance	<ul style="list-style-type: none"> Adapt the parameterization corresponding to the load.
F07923	Torque/speed too low	<ul style="list-style-type: none"> Check the connection between the motor and the load.
F07924	Torque/speed too high	<ul style="list-style-type: none"> Adapt the parameterization corresponding to the load.
A07927	DC braking active	Not required
A07980	Rotary measurement activated	Not required
A07981	No enabling for rotary measurement	<p>Acknowledge pending faults.</p> <p>Establish missing enables (see r00002, r0046).</p>
A07991	Motor identification activated	Switch on the motor and identify the motor data.
F08501	Setpoint timeout	<ul style="list-style-type: none"> Check the PROFINET connection. Set the controller to RUN mode. If the fault occurs repeatedly, check the monitoring time set p2044.
F08502	Monitoring time, sign-of-life expired	<ul style="list-style-type: none"> Check the PROFINET connection.
F08510	Send configuration data not valid	<ul style="list-style-type: none"> Check the PROFINET configuration
A08511	Receive configuration data not valid	
A08526	No cyclic connection	<ul style="list-style-type: none"> Activate the control with cyclic operation. Check the parameters "Name of Station" and "IP of Station" (r61000, r61001).
A08565	Consistency error affecting adjustable parameters	<p>Check the following:</p> <ul style="list-style-type: none"> IP address, subnet mask or default gateway is not correct. IP address or station name used twice in the network. Station name contains invalid characters.

8.6 List of alarms and faults

Number	Cause	Remedy
F13100	Know-how protection: Copy protection error	The know-how protection and the copy protection for the memory card are active. An error occurred when checking the memory card. <ul style="list-style-type: none"> • Insert a suitable memory card and switch the inverter supply voltage temporarily off and then on again (POWER ON). • Deactivate the copy protection (p7765).
F13101	Know-how protection: Copy protection cannot be activated	Insert a valid memory card.
F30001	Overcurrent	Check the following: <ul style="list-style-type: none"> • Motor data, if required, carry out commissioning • Motor connection method (Y / Δ) • V/f operation: Assignment of rated currents of motor and Power Module • Line quality • Make sure that the line commutating reactor is connected properly • Power cable connections • Power cables for short-circuit or ground fault • Power cable length • Line phases If this doesn't help: <ul style="list-style-type: none"> • V/f operation: Increase the acceleration ramp • Reduce the load • Replace the power unit
F30002	DC-link voltage overvoltage	Increase the ramp-down time (p1121). Set the rounding times (p1130, p1136). Activate the DC-link voltage controller (p1240, p1280). Check the line voltage (p0210). Check the line phases.
F30003	DC-link voltage undervoltage	Check the line voltage (p0210).
F30004	Inverter overtemperature	Check whether the inverter fan is running. Check whether the ambient temperature is in the permissible range. Check whether the motor is overloaded. Reduce the pulse frequency.
F30005	I2t inverter overload	Check the rated currents of the motor and Power Module. Reduce the current limit p0640. When operating with V/f characteristic: Reduce p1341.
F30011	Line phase failure	Check the inverter's input fuses. Check the motor feeder cables.
F30015	Motor cable phase failure	Check the motor cables. Increase the ramp-up or ramp-down time (p1120).
F30021	Ground fault	<ul style="list-style-type: none"> • Check the power cable connections. • Check the motor. • Check the current transformer. • Check the cables and contacts of the brake connection (a wire might be broken).

Number	Cause	Remedy
F30022	Power Module: Monitoring U_{CE}	Check or replace Power Module.
F30027	Time monitoring for DC link pre-charging	Check the line voltage at the input terminals. Check the line voltage setting (p0210).
F30035	Overtemperature, intake air	<ul style="list-style-type: none"> • Check whether the fan is running. • Check the fan filter elements. • Check whether the ambient temperature is in the permissible range.
F30036	Overtemperature, inside area	
F30037	Rectifier overtemperature	
A30049	Internal fan defective	Check the internal fan and if required replace.
F30052	Incorrect Power Module data	Replace the Power Module or upgrade the Control Unit firmware.
F30053	Error in FPGA data	Replace the Power Module.
F30059	Internal fan defective	Check the internal fan and if required replace.
F30074	Communications error between Control Unit and Power Module	There is a communications fault between the Control Unit and the Power Module. Possible causes: <ul style="list-style-type: none"> • The Control Unit may have been removed or inserted incorrectly. • The external 24 V Control Unit power supply has dipped to $\leq 95\%$ of the rated voltage for ≤ 3 ms
A30502	DC-link overvoltage	<ul style="list-style-type: none"> • Check the device supply voltage (p0210). • Check the line reactor dimensioning
F30662	CU hardware fault	Switch the Control Unit off and on again, upgrade the firmware or contact technical support.
F30664	CU power up aborted	Switch the Control Unit off and on again, upgrade the firmware or contact technical support.
F30850	Software fault in the Power Module	Replace Power Module or contact technical support.
A30920	Temperature sensor fault	Check that the sensor is connected correctly.
A50001	PROFINET configuration error	A PROFINET control is attempting to establish a connection with an incorrect configuration telegram. Check whether "Shared Device" is activated (p8929 = 2).
A50010	PROFINET name of station invalid	Correct the name of station (p8920) and activate (p8925 = 2).
A50020	PROFINET: Second control missing	"Shared Device" is activated (p8929 = 2). However, only the connection to a PROFINET control is available.

For further information, please refer to the List Manual.



Overview of the manuals (Page 538)

Corrective maintenance

9.1 Spare parts compatibility

Continuous development within the scope of product maintenance

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

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

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

9.2 Replacing inverter components

⚠ WARNING

Fire or electric shock due to defective components

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

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

Repair

⚠ WARNING

Fire or electric shock due to improper repair

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

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

Recycling and disposal





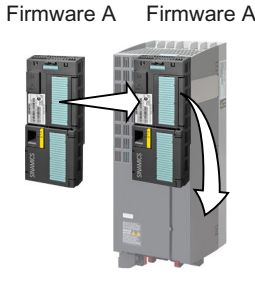

For environmentally-friendly recycling and disposal of your old device, please contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

9.2.1 Overview of replacing converter components

Permissible replacement of components

In the event of a long-term function fault, you must replace the Power Module or Control Unit. The inverter's Power Module and Control Unit can be replaced independently of each other.

In the following cases you will need to replace the inverter:

Replacing the Power Module		Replacing the Control Unit	
Replacement: <ul style="list-style-type: none"> • Same type • Same power rating 	Replacement: <ul style="list-style-type: none"> • Same type • Same frame size • <i>Higher</i> power rating 	Replacement: <ul style="list-style-type: none"> • Same type • Same firmware version 	Replacement: <ul style="list-style-type: none"> • Same type • <i>Higher</i> firmware version (e.g. replace FW V4.2 by FW V4.3)
			
	Power Module and motor must be adapted to one another (ratio of motor and Power Module rated power > 1/4)	After replacing the Control Unit, you must restore the inverter's settings.	

⚠ WARNING

Unexpected machine motion caused by incorrect/inappropriate inverter settings

Replacing inverters of different types can result in incomplete or incorrect/inappropriate inverter settings. As a consequence, unexpected machine motion, e.g. speed oscillation, overspeed or incorrect direction of rotation. Unexpected machine motion can result in death, injury or material damage.

- In all cases that are not permitted according to the table above, recommission the drive after replacing an inverter.

Special issue relating to communication via PROFINET: Device replacement without removable data storage medium

The inverter supports the PROFINET functionality, replacing the device without data storage medium. After replacing the Control Unit, the inverter is automatically assigned its device name from the IO controller.

Independent of this, after replacing the inverter, you must transfer the settings of the old inverter to the new inverter.

9.2 Replacing inverter components

Details of the device replacement without removable storage medium can be found in the Internet:

 PROFINET system description (<http://support.automation.siemens.com/WW/view/en/19292127>).

Replacing further components

The replacement of further components is described in the hardware installation manual of the associated Power Module.

9.2.2 Replace Control Unit

WARNING

Electric shock as a result of an autonomous voltage at the Control Unit that is independent of the device supply voltage

230 V AC may be in place on terminals DO 0 and DO 2 of the control unit's relay output independently of the voltage status of the power module. Touching the contacts may result in an electrical shock.

Comply with the protective measures before you replace the Control Unit

1. Switch the Control Unit contacts into a no-voltage condition.
2. Secure the power supply against being unintentionally switched on again.
3. Check that the cabinet is de-energized.

Replacing a Control Unit with data backup on a memory card

If you use a memory card with firmware, after the replacement, you obtain a precise copy (firmware and settings) of the replaced Control Unit.

Precondition

You have a memory card with the actual settings of the Control unit to be replaced.

Procedure

1. Disconnect the line voltage to the Power Module and (if installed) the external 24 V supply or the voltage for the digital outputs of the Control Unit.
2. Remove the signal cables from the Control Unit.
3. Remove the defective Control Unit.
4. Mount the new Control Unit on the Power Module. The new Control Unit must have the same article number and the same or higher firmware version as the Control Unit that was replaced.
5. Remove the memory card from the old Control Unit and insert it in the new Control Unit.
6. Reconnect the signal cables of the Control Unit.
7. Switch on the line voltage again.
8. The inverter loads the settings from the memory card.
9. After loading, check whether the inverter outputs Alarm A01028.
 - Alarm A01028:
The loaded settings are not compatible with the inverter.
Clear the alarm with p0971 = 1 and recommission the drive.
 - No alarm A01028:
The inverter accepts the settings that have been loaded.

You have successfully replaced the Control Unit.



Replacing a Control Unit with data backup in Startdrive

Precondition

You have backed up the actual settings of the Control Unit to be replaced to a PC using Startdrive.

Procedure

1. Switch off the line voltage to the Power Module and (if installed) the external 24 V supply or the voltage for the digital outputs of the Control Unit.
2. Remove the signal cables of the Control Unit.
3. Remove the defective Control Unit.
4. Mount the new Control Unit on the Power Module.
5. Reconnect the signal cables of the Control Unit.
6. Switch on the line voltage again.
7. Open the right project for the drive in the PC.
8. Select "Load to device".
9. Connect Startdrive online with the drive.
10. Confirm the prompt for saving your settings (copy RAM to ROM).
11. Disconnect the online connection.

You have replaced the Control Unit and transferred the settings from the PC to the new Control Unit.

□

Replacing the Control Unit with data backup in the operator panel

Precondition

You have backed up the actual settings of the Control Unit to be replaced to an operator panel.

Procedure

1. Disconnect the line voltage to the Power Module and (if installed) the external 24 V supply or the voltage for the digital outputs of the Control Unit.
2. Remove the signal cables of the Control Unit.
3. Remove the defective Control Unit.
4. Mount the new Control Unit on the Power Module.
5. Reconnect the signal cables of the Control Unit.
6. Switch on the line voltage again.
7. Plug the Operator Panel into the Control Unit or connect the Operator Panel handheld device with the inverter.
8. Transfer the settings from the operator panel to the inverter.
9. Wait until the transfer is complete.

10. After loading, check whether the inverter outputs Alarm A01028.

- Alarm A01028:
The loaded settings are not compatible with the inverter.
Clear the alarm with p0971 = 1 and recommission the drive.
- No alarm A01028: Proceed with the next step.

11. Back up the settings so they are not lost when the power fails:

- For BOP-2 in the menu "EXTRAS" - "RAM-ROM".
- For IOP-2 in the menu "SAVE RAM TO ROM".

You have replaced the Control Unit and transferred the safety function settings from the operator panel to the new Control Unit.

□

9.2.3 Replacing the Control Unit without data backup

If you do not backup the settings, then you must recommission the drive after replacing the Control Unit.

Procedure

1. Switch off the line voltage to the Power Module and (if installed) the external 24 V supply or the voltage for the digital outputs of the Control Unit.
2. Remove the signal cables of the Control Unit.
3. Remove the defective Control Unit.
4. Mount the new Control Unit on the Power Module.
5. Reconnect the signal cables of the Control Unit.
6. Switch on the line voltage again.
7. Recommission the drive.


The Control Unit replacement has been completed once the drive has been successfully commissioned.

□

9.2.4 Replacing the Control Unit with know-how protection active

Replacing devices with know-how protection without copy protection

In the case of know-how protection without copy protection, the inverter settings can be transferred to another inverter using a memory card.

 Saving setting on memory card (Page 381)

 Transferring the setting from the memory card (Page 384)

Replacing devices with know-how protection with copy protection



The know-how protection with copy protection hides the inverter settings and also prevents the duplication of the inverter settings.

If the inverter settings can neither be copied nor forwarded, a recommissioning is required after inverter replacement.

To avoid the recommissioning, you must use a Siemens memory card, and the machine manufacturer must have an identical prototype machine that it uses as sample.

There are two options for replacing the device:



Option 1: The machine manufacturer only knows the serial number of the new inverter

1. The end customer provides the machine manufacturer with the following information:
 - For which machine must the inverter be replaced?
 - What is the serial number (r7758) of the new inverter?
2. The machine manufacturer performs the following steps online on the prototype machine:
 - Deactivating know-how protection
 Activating and deactivating know-how protection (Page 398)
 - Enter the serial number of the new inverter in p7759.
 - Enter the serial number of the inserted memory card as reference serial number in p7769.
 - Activate know-how protection with copy protection. "Copy RAM to ROM" must be activated.
 Activating and deactivating know-how protection (Page 398)
 - Write the configuration with p0971 = 1 to the memory card.
 - Send the memory card to the end customer.
3. The end customer inserts the memory card and switches on the power supply for the inverter.

When powering up, the inverter checks the serial numbers of the card and when there is a match, the inverter goes into the "ready to start" state.

If the numbers do not match, then the inverter signals fault F13100 (no valid memory card).

Option 2: The machine manufacturer knows the serial number of the new inverter and the serial number of the memory card

1. The end customer provides the machine manufacturer with the following information:
 - For which machine must the inverter be replaced?
 - What is the serial number (r7758) of the new inverter?
 - What is the serial number of the memory card?
2. The machine manufacturer performs the following steps online on the prototype machine:
 - Deactivating know-how protection
 Activating and deactivating know-how protection (Page 398)
 - Enter the serial number of the new inverter in p7759.
 - Enter the serial number of the customer's memory card as reference serial number in p7769.
 - Activate know-how protection with copy protection. "Copy RAM to ROM" must be activated.
 Activating and deactivating know-how protection (Page 398)
 - Write the configuration with p0971 = 1 to the memory card.
 - Copy the encrypted project from the card to the associated PC.
 - Send the encrypted project to the end customer, e.g. via e-mail.
3. The end customer copies the project to the Siemens memory card that belongs to the machine, inserts it in the inverter and switches on the power supply for the inverter.

When powering up, the inverter checks the serial numbers of the card and when there is a match, the inverter goes into the "ready to start" state.

If the numbers do not match, then the inverter signals fault F13100 (no valid memory card).

9.2.5 Replacing a Power Module

Procedure

1. Switch off the supply voltage to the Power Module.
You do not have to switch off an external 24 V power supply for the Control Unit if one is being used.
2. Remove the connecting cables of the Power Module.
3. Remove the Control Unit from the Power Module.
4. Replace the old Power Module with the new Power Module.
5. Mount the Control Unit onto the new Power Module.
6. Connect up the new Power Module using the connecting cables.

NOTICE

Motor damage due to interchanged motor connecting cables

The direction in which the motor rotates switches if you exchange the two phases of the motor line. A motor with an incorrect direction of rotation can damage the machine or installation. Work machines with only one permissible direction of rotation include certain compressors, saws and pumps.

- Connect the three phases of the motor lines in the right order.
- After replacing the Power Module, check the direction of motor rotation.

7. Switch on the line supply and, if necessary, the 24 V supply of the Control Unit.


You have successfully replaced the Power Module.



9.3 Firmware upgrade and downgrade

Preparing a memory card for a firmware upgrade or downgrade

Procedure

1. Download the required firmware to your PC from the Internet.
 Download (<https://support.industry.siemens.com/cs/ww/en/view/67364620>)
2. Extract the files to a directory of your choice on your PC.
3. Transfer the unzipped files into the root directory of the memory card.

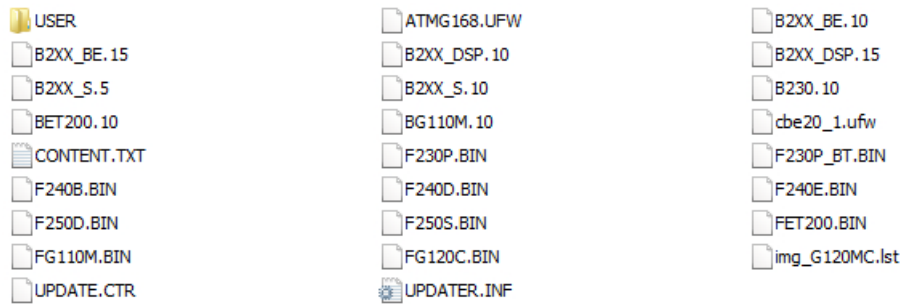


Figure 9-1 Example of memory card contents after the file transfer


Depending on the firmware, the filenames and the number of files may differ from the display above.

The "USER" directory does not exist on unused memory cards. After the memory card is plugged in for the first time, the inverter creates a new "USER" directory.

You have prepared the memory card for the firmware upgrade or downgrade.



Memory cards that can be ordered:

 Memory cards (Page 380)

Overview of firmware upgrades and downgrades

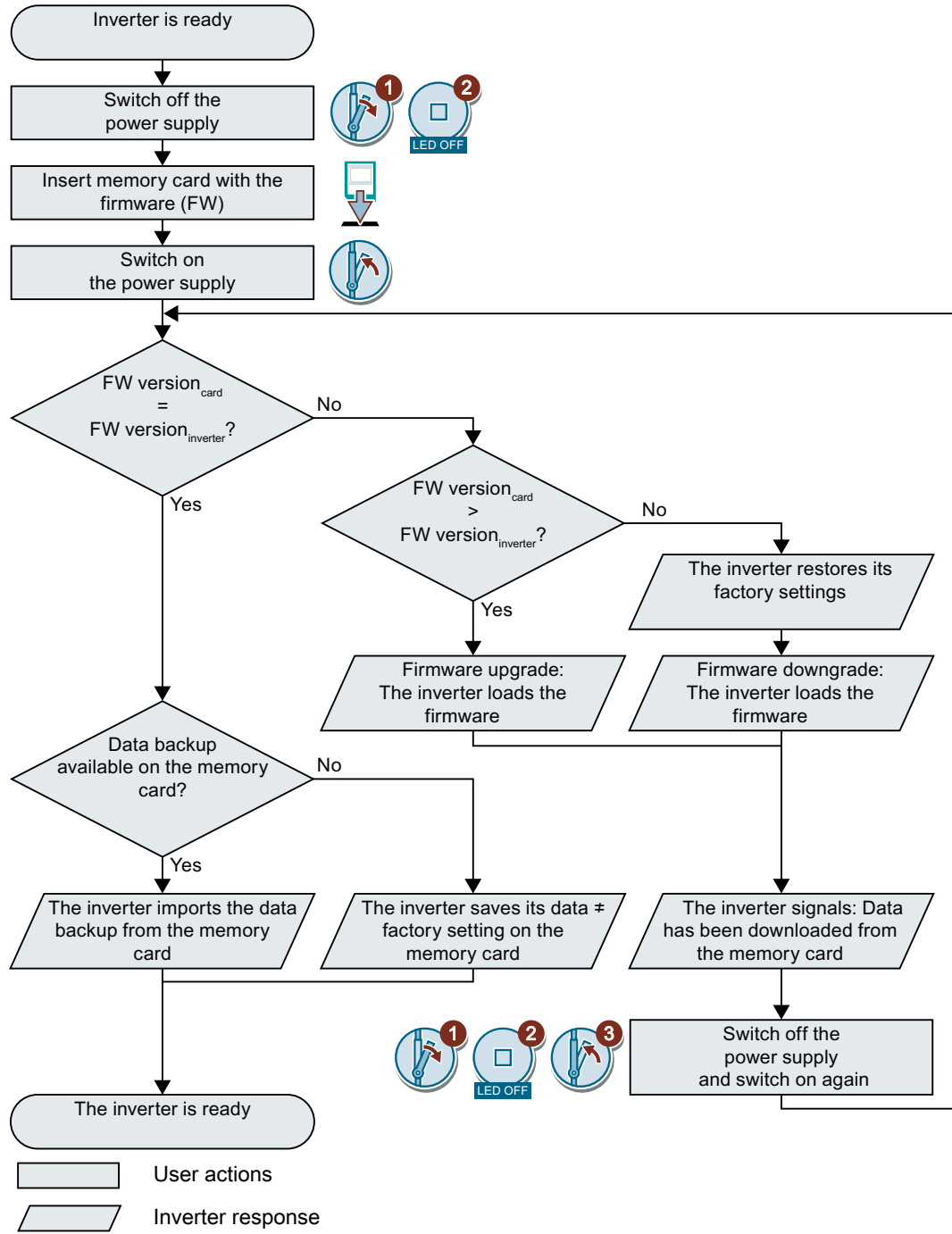


Figure 9-2 Overview of the firmware upgrade and firmware downgrade

9.3.1 Upgrading the firmware

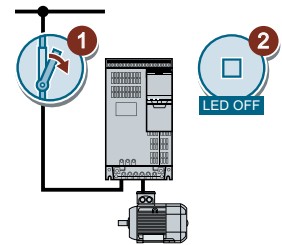
When upgrading the firmware, you replace the inverter firmware by a later version. Only update the firmware to a later version if you require the expanded functional scope of the newer version.

Precondition

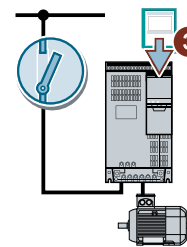
- The firmware version of your inverter is at least V4.5.
- Inverter and memory card have different firmware versions.

Procedure

1. Switch off the inverter power supply.
2. Wait until all LEDs on the inverter are dark.



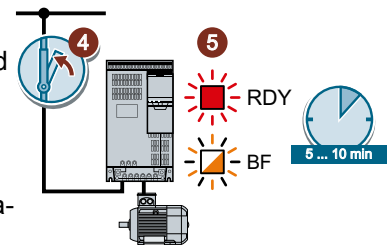
3. Insert the card with the matching firmware into the inverter slot until it latches into place.



4. Switch on the inverter power supply again.
5. The inverter transfers the firmware from the memory card into its memory.

The transfer takes approximately 5 ... 10 minutes.

While data is being transferred, the LED RDY on the inverter stays red. The LED BF flashes orange with a variable frequency.

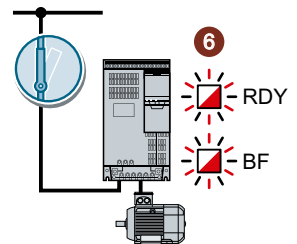


6. At the end of the transfer, the LED RDY and BF slowly flash red (0.5 Hz).

Power supply failure during transfer

The inverter firmware will be incomplete if the power supply fails during the transfer.

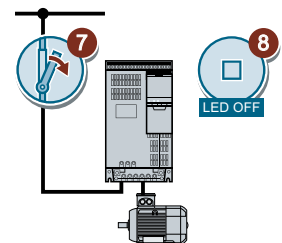
- Start again with step 1 of the instructions.



7. Switch off the inverter power supply.
8. Wait until all LEDs on the inverter are dark.

Decide whether you want to withdraw the memory card from the inverter:

- You remove the memory card:
⇒ The inverter keeps its settings.



- You leave the memory card in the inverter:
 - ⇒ If the memory card still does not have a data backup of the inverter settings, in step 9 the inverter writes its settings to the memory card.
 - ⇒ If the memory card already includes a data backup, the inverter imports the settings from the memory card in step 9.

9. Switch on the inverter power supply again.

10. If the firmware upgrade was successful, after several seconds the inverter LED RDY turns green.

If the memory card is still inserted, depending on the previous content of the memory card, one of the two following cases has occurred:

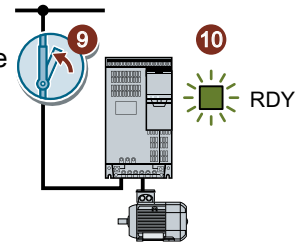
- The memory card contains a data backup:
 - ⇒ The inverter has taken the settings from the memory card.
- There was no data backup on the memory card:
 - ⇒ The inverter has written its settings to the memory card.

You have upgraded the inverter firmware.

□

Memory cards with license

If the memory card includes a license, e.g. for the basic positioner, then the memory card must remain inserted after the firmware has been updated.



9.3.2 Firmware downgrade

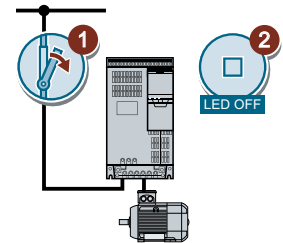
When downgrading the firmware, you replace the inverter firmware by an older version. Only downgrade the firmware to an older version if, after replacing an inverter, you require the same firmware in all of your inverters.

Precondition

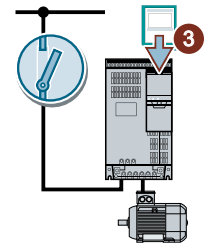
- The firmware version of your inverter is at least V4.6.
- Inverter and memory card have different firmware versions.
- You have backed up your settings on the memory card, in an Operator Panel or in a PC.

Procedure

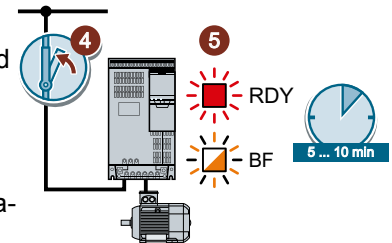
1. Switch off the inverter power supply.
2. Wait until all LEDs on the inverter are dark.



3. Insert the card with the matching firmware into the inverter slot until it latches into place.



4. Switch on the inverter power supply again.
5. The inverter transfers the firmware from the memory card into its memory.
The transfer takes approximately 5 ... 10 minutes.
While data is being transferred, the LED RDY on the inverter stays red. The LED BF flashes orange with a variable frequency.

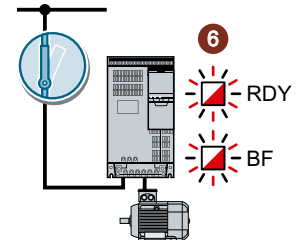


6. At the end of the transfer, the LED RDY and BF slowly flash red (0.5 Hz).

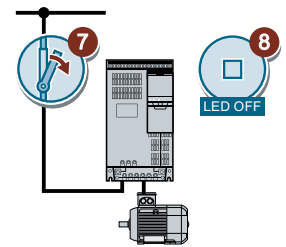
Power supply failure during transfer

The inverter firmware will be incomplete if the power supply fails during the transfer.

- Start again with Step 1 of these instructions.

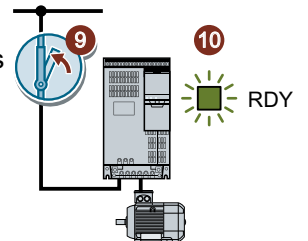


7. Switch off the inverter power supply.
8. Wait until all LEDs on the inverter are dark.
Decide whether you want to withdraw the memory card from the inverter:



- The memory card contains a data backup:
⇒ The inverter has taken the settings from the memory card.
- There was no data backup on the memory card:
⇒ The inverter has the factory setting.


9. Switch on the inverter power supply again.
10. If the firmware downgrade was successful, after several seconds the inverter LED RDY turns green.



If the memory card is still inserted, depending on the previous content of the memory card, one of the two following cases has occurred:

- The memory card contains a data backup:
⇒ The inverter has taken the settings from the memory card.
- There was no data backup on the memory card:
⇒ The inverter has the factory setting.

11. If the memory card did not contain a data backup of the inverter settings, then you must transfer your settings to the inverter from another data backup.

 Saving the settings and series commissioning (Page 379)

You have replaced the inverter firmware by an older version.

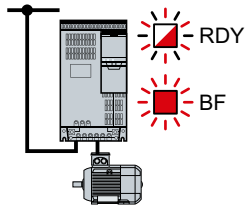
□

Memory cards with license

If the memory card includes a license, e.g. for the basic positioner, then the memory card must remain inserted after the firmware has been updated.

9.3.3 Correcting an unsuccessful firmware upgrade or downgrade

How does the inverter signal an unsuccessful upgrade or downgrade?



The inverter signals an unsuccessful firmware upgrade or downgrade by a quickly flashing LED RDY and the lit LED BF.

Correcting an unsuccessful upgrade or downgrade

You can check the following to correct an unsuccessful firmware upgrade or downgrade:

- Does the firmware version of your inverter fulfill the preconditions?
 - For an upgrade, as a minimum V4.5.
 - For a downgrade, as a minimum V4.6.
- Have you correctly inserted the card?
- Does the card contain the correct firmware?
- Repeat the appropriate procedure.

9.4 If the converter no longer responds

If the inverter no longer responds

For example, when loading an incorrect file from the memory card, the inverter can go into a state where it can no longer respond to commands from the operator panel or from a higher-level control system. In this case, you must reset the inverter to its factory setting and recommission it. This inverter state is manifested in two different ways:

Case 1

- The motor is switched off.
- You cannot communicate with the inverter, either via the operator panel or other interfaces.
- The LEDs flicker and after 3 minutes the inverter has still not powered up.

Procedure

1. Remove the memory card if one is inserted in the inverter.
2. Switch off the inverter power supply.
3. Wait until all LEDs on the inverter are dark. Then switch on the inverter power supply again.
4. Repeat steps 2 and 3 as often as required until the inverter outputs fault F01018.
5. Set p0971 = 1.
6. Switch off the inverter power supply.
7. Wait until all LEDs on the inverter are dark. Then switch on the inverter power supply again. The inverter now powers up with the factory settings.
8. Recommission the inverter.

You have restored the inverter factory settings.

□

Case 2

- The motor is switched off.
- You cannot communicate with the inverter, either via the operator panel or other interfaces.
- The LEDs flash and are dark - this process is continually repeated.

Procedure

1. Remove the memory card if one is inserted in the inverter.
2. Switch off the inverter power supply.
3. Wait until all LEDs on the inverter are dark. Then switch on the inverter power supply again.
4. Wait until the LEDs flash orange.
5. Repeat steps 2 and 3 as often as required until the inverter outputs fault F01018.
6. Now set p0971 = 1.
7. Switch off the inverter power supply.

9.4 If the converter no longer responds

8. Wait until all LEDs on the inverter are dark. Then switch on the inverter power supply again. The inverter now powers up with the factory settings.

9. Recommission the inverter.

You have restored the inverter factory settings.

The motor cannot be switched-on

If the motor cannot be switched-on, then check the following:

- Is a fault present?
If there is, then remove the fault cause and acknowledge the fault.
- Has the inverter been completely commissioned $p0010 = 0$?
If not, the inverter is e.g. still in a commissioning state.
- Is the inverter reporting the "ready to start" status ($r0052.0 = 1$)?
- Is the inverter missing some enable signals ($r0046$)?
- How does the inverter receive its setpoint and commands?
Digital inputs, analog inputs or fieldbus?


Technical data

10.1 Technical data for CU230P-2

Property	Data / explanation
Fieldbus interfaces	CU230P-2 HVAC With RS485 interface for the following protocols: CU230P-2 BT
	<ul style="list-style-type: none"> • USS • Modbus RTU • BACnet MS/TP • P1
	CU230P-2 DP With PROFIBUS interface
	CU230P-2 PN With PROFINET interface
Operating voltage	<p>You have two options for the Control Unit power supply:</p> <ul style="list-style-type: none"> • Supply from the Power Module • External 20.4 V ... 28.8 V DC supply via terminals 31 and 32.
Current consumption	<p>Max 0.5 A The current consumption can be higher if the Control Unit supplies external components.</p>
Power loss	5.0 W
Output voltages	+24 V out (terminal 9), 18 V ... 28.8 V, max. 100 mA
	+10 V out (terminals 1 and 35), 9.5 V ... 10.5 V, max. 10 mA
Setpoint resolution	0.01 Hz
Digital inputs	<p>6 (DI 0 ... DI 5)</p> <ul style="list-style-type: none"> • Electrically isolated • Voltage: ≤ 30 V • Voltage for "low" state: < 5 V • Voltage for "high" state: > 11 V • Current for 24 V input voltage: 2.7 mA ... 4.7 mA • Minimum current for the "high" state: 1.8 mA ... 3.9 mA • Compatible to SIMATIC outputs • Response time for debounce time p0724 = 0: 10 ms

Technical data

10.1 Technical data for CU230P-2

Property	Data / explanation
Analog inputs	4 (AI 0 ... AI 3) <ul style="list-style-type: none"> • Differential inputs • 12-bit resolution • 13 ms response time • AI 0 and AI 1 can be switched over: <ul style="list-style-type: none"> – 0 V ... 10 V or -10 V ... +10 V (typical power consumption: 0.1 mA, voltage < 35 V) – 0 mA ... 20 mA (120 Ω input resistance, voltage < 10 V, current < 80 mA) • If AI 0 and AI 1 are configured as supplementary digital inputs: Voltage < 35 V, low < 1.6 V, high > 4.0 V, 13 ms ± 1 ms response time for debounce time p0724 = 0. • AI 2 switchable: <ul style="list-style-type: none"> – 0 mA ... 20 mA (voltage < 10 V, current < 80 mA) – Temperature sensor Pt1000/LG-Ni1000/DIN-Ni1000 (characteristics: See below) • AI 3: Temperature sensor Pt1000/LG-Ni1000/DIN-Ni1000 (characteristics: See below)
Digital outputs /relay outputs	3 (DO 0 ... DO 2) <ul style="list-style-type: none"> • DO 0, DO 2: 30 VDC 5 A / 250 VAC, 2 A ¹⁾ • DO 1: 30 VDC 0.5 A • 2 ms update time
Analog outputs	2 (AO 0 ... AO 1) <ul style="list-style-type: none"> • 0 V ... 10 V or 0 mA ... 20 mA • Reference potential: "GND" • 16-bit resolution • 4 ms update time
Temperature sensor	PTC <ul style="list-style-type: none"> • Short-circuit monitoring < 20 Ω • Overtemperature 1650 Ω
	KTY84 <ul style="list-style-type: none"> • Short-circuit monitoring < 50 Ω • Wire-break: > 2120 Ω
	Pt1000 <ul style="list-style-type: none"> • Short-circuit monitoring < 603 Ω • Wire-break > 2120 Ω
	Temperature switch with NC contact
USB interface	Mini-B
Dimensions (W × H × D)	73 mm × 199 mm Depth when mounting on the Power Module × 50 mm
Memory card (optional)	Slot for SD or MMC memory cards.  Memory cards (Page 380)
Weight	0.61 kg

Property	Data / explanation
Operating temperature	-10 °C ... 60 °C CU230P-2 HVAC, CU230P-2 DP and CU230P-2 BT without inserted Operator Panel
	-10 °C ... 55 °C CU230P-2 PN without inserted Operator Panel
	0 °C ... 50 °C With inserted BOP-2 or IOP-2 operator panel
	Observe any possible restrictions regarding the operating temperature as a result of the Power Module.
Storage temperature	- 40 °C ... 70 °C
Relative humidity	< 95% Condensation is not permissible.

1) The following applies to systems compliant with UL: A maximum of 3 A 30 VDC or 2 A 250 VAC may be connected via terminals 18 / 20 (DO 0 NC) and 23 / 25 (DO 2 NC).

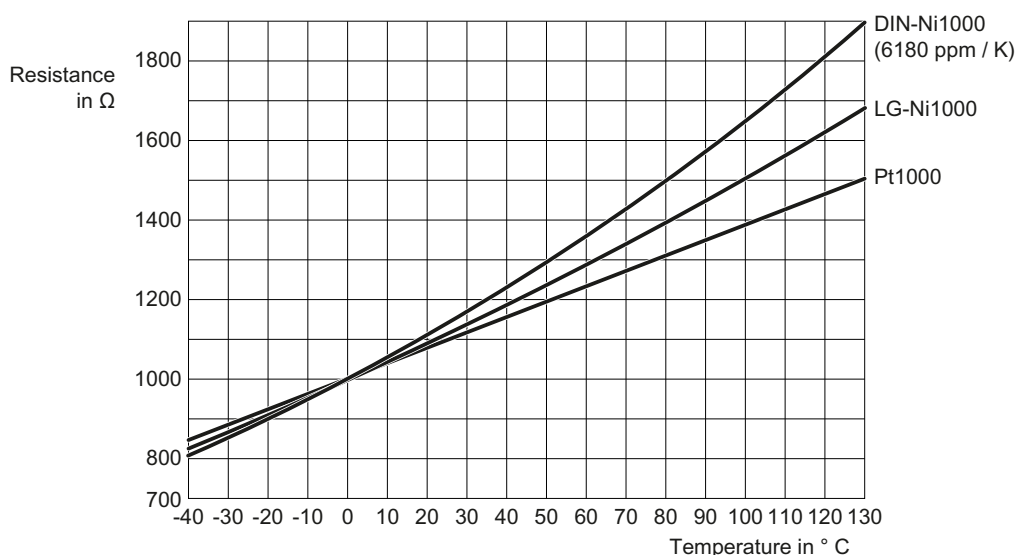


Figure 10-1 Temperature sensor characteristic of analog inputs AI 2 and AI 3

10.2 Overload capability of the inverter

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

Definitions

Base load

Constant load between the accelerating phases of the drive

Low Overload

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

High Overload

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

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

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

You can find additional information about SIZER on the Internet:

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

Load cycles and typical applications:

"Low Overload" load cycle

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

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

"High Overload" load cycle

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

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

10.3 Technical data, PM230 Power Module

Typical inverter load cycles

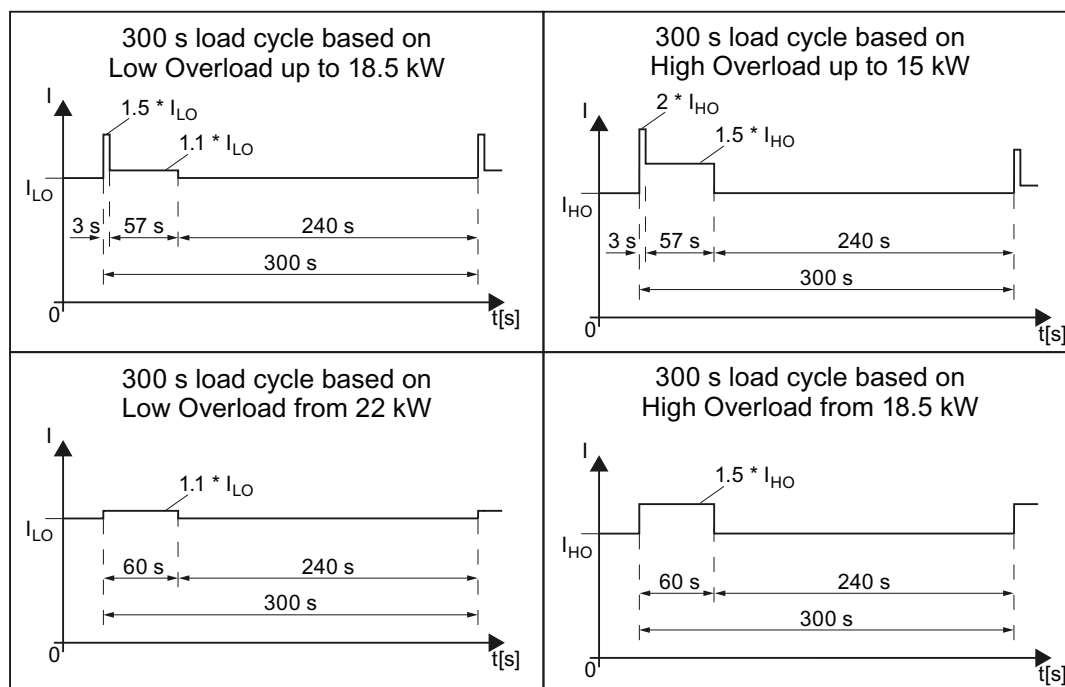




Figure 10-2 Duty cycles, "High Overload" and "Low Overload"


10.3.1 Ambient conditions

Property	Version
Ambient conditions for transport in the transport packaging	
Climatic ambient conditions	- 40 °C ... + 70 °C, according to Class 2K4 to EN 60721-3-2 maximum humidity 95 % at 40 °C
Mechanical ambient conditions	FSA ... FSC: Shock and vibration permissible according to 1M2 to EN 60721-3-2 FSD ... FSF: Shock and vibration permissible according to 2M3 to EN 60721-3-2
Protection against chemical substances	Protected according to Class 2C2 to EN 60721-3-2
Biological environmental conditions	Suitable according to Class 2B1 to EN 60721-3-2
Ambient conditions for long-term storage in the product packaging	
Climatic ambient conditions	- 25 °C ... + 55 °C, according to Class 1K3 to EN 60721-3-1
Protection against chemical substances	Protected according to Class 1C2 to EN 60721-3-1
Biological environmental conditions	Suitable according to Class 1B1 according to EN 60721-3-1

Property	Version
Ambient conditions in operation	
Installation altitude	Up to 1000 m above sea level without derating, > 1000 m  Restrictions for special ambient conditions (Page 515)
Climatic ambient conditions ¹⁾	<ul style="list-style-type: none"> • Temperature range without derating²⁾ <ul style="list-style-type: none"> – LO base load power: 0 °C...40 °C – HO base load power: 0 °C...40 °C <p>For higher temperatures.  Restrictions for special ambient conditions (Page 515)</p> <ul style="list-style-type: none"> • Relative humidity: 5 ... 95%, condensation not permitted • Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical ambient conditions	<p>FSA ... FSF: Vibration levels permissible according to Class 3M1 to EN 60721-3-3</p> <p>FSA ... FSC: Shock, permissible according to Class 3M2 to EN 60721-3-3</p> <p>FSD ... FSF: Shock permissible according to Class 3M1 to EN 60721-3-3</p>
Protection against chemical substances	Protected according to 3C2 to EN 60721-3-3
Biological environmental conditions	Suitable according to 3B1 to EN 60721-3-3
Pollution	Suitable for environments with degree of pollution 2 according to EN 61800-5-1
Cooling	Forced air cooling AF, according to EN 60146
Cooling air	clean and dry air

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

10.3.2 General technical data, PM230, IP55

Property	Version
Line voltage	380 ... 480 V 3 AC \pm 10%
Output voltage	0 V 3 AC ... input voltage x 0.95 (max.)
Input frequency	50 Hz ... 60 Hz, \pm 3 Hz
Output frequency	0 Hz ... 550 Hz, depending on the control mode
Power factor λ	0.9
Line impedance	UK \leq 1%, no line reactor permitted
Inrush current	Low LO base load input current
Pulse frequency (factory setting)	4 kHz The pulse frequency can be increased in 2 kHz steps up to 16 kHz (up to 8 kHz for 75 kW and 90 kW). An increase in the pulse frequency results in a lower output current.
Braking methods	DC braking
Degree of protection IP55	To comply with this degree of protection requires the following: <ul style="list-style-type: none"> • Operation with operator panel or dummy cover • Connections for control cables are made properly using EMC cable glands.  Restrictions for special ambient conditions (Page 515)
Rated short-circuit current	When fused using a type J or 3NE1 fuse, rated voltage 480 VAC with the rated current of the specific inverter. FSA ... FSC: 40 kA FSD ... FSF: 65 kA

10.3.3 Specific technical specifications PM230, IP55

Table 10-1 PM230, IP55, Frame Size A, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	6SL3223-0DE13-7AG1	6SL3223-0DE15-5AG	6SL3223-0DE17-5AG1
Article No. with filter, C1	6SL3223-0DE13-7BG1	6SL3223-0DE15-5BG1	6SL3223-0DE17-5BG1
LO base load power	0.37 kW	0.55 kW	0.75 kW
LO base load input current	1.3 A	1.8 A	2.3 A
LO base load output current	1.3 A	1.7 A	2.2 A
HO base load power	0.25 kW	0.37 kW	0.55 kW
HO base load input current	0.9 A	1.3 A	1.8 A
HO base load output current	0.9 A	1.3 A	1.7 A
Fuse according to IEC	3NA3803	3NA3803	3NA3803
Fuse according to UL, class J	10 A	10 A	10 A
Power loss	0.06 kW	0.06 kW	0.06 kW
Required cooling air flow	7 l/s	7 l/s	7 l/s
Weight	4.3 kg	4.3 kg	4.3 kg

Table 10-2 PM230, IP55, Frame Size A, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	6SL3223-0DE21-1AG1	6SL3223-0DE21-5AG1	6SL3223-0DE22-2AG1
Article No. with filter, C1	6SL3223-0DE21-1BG1	6SL3223-0DE21-5BG1	6SL3223-0DE22-2BG1
LO base load power	1.1 kW	1.5 kW	2.2 kW
LO base load input current	3.2 A	4.2 A	6.1 A
LO base load output current	3.1 A	4.1 A	5.9 A
HO base load power	0.75 kW	1.1 kW	1.5 kW
HO base load input current	2.3 A	3.2 A	4.2 A
HO base load output current	2.2 A	3.1 A	4.1 A
Fuse according to IEC	3NA3803	3NA3803	3NA3803
Fuse according to UL, class J	10 A	10 A	10 A
Power loss	0.07 kW	0.08 kW	0.1 kW
Required cooling air flow	7 l/s	7 l/s	7 l/s
Weight	4.3 kg	4.3 kg	4.3 kg

Table 10-3 PM230, IP55, Frame Size A, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	6SL3223-0DE23-0AG1
Article No. with filter, C1	6SL3223-0DE23-0BG1
LO base load power	3 kW
LO base load input current	8.0 A
LO base load output current	7.7 A
HO base load power	2.2 kW
HO base load input current	6.1 A
HO base load output current	5.9 A

Article No. with filter, C2	6SL3223-0DE23-0AG1
Article No. with filter, C1	6SL3223-0DE23-0BG1
Fuse according to IEC	3NA3803
Fuse according to UL, class J	10 A
Power loss	0.12 kW
Required cooling air flow	7 l/s
Weight	4.3 kg

Table 10-4 PM230, IP55, Frame Size B, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	6SL3223-0DE24-0AG1	6SL3223-0DE25-5AG1	6SL3223-0DE27-5AG1
Article No. with filter, C1	6SL3223-0DE24-0BG1	6SL3223-0DE25-5BG1	6SL3223-0DE27-5BG1
LO base load power	4 kW	5.5 kW	7.5 kW
LO base load input current	10.5 A	13.6 A	18.6 A
LO base load output current	10.2 A	13.2 A	18 A
HO base load power	3 kW	4 kW	5.5 kW
HO base load input current	8.0 A	10.5 A	13.6 A
HO base load output current	7.7 A	10.2 A	13.2 A
Fuse according to IEC	3NA3805	3NA3807	3NA3810
Fuse according to UL, class J	16 A	25 A	35 A
Power loss	0.14 kW	0.18 kW	0.24 kW
Required cooling air flow	9 l/s	9 l/s	9 l/s
Weight	6.3 kg	6.3 kg	6.3 kg

Table 10-5 PM230, IP55, Frame Size C, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	6SL3223-0DE31-1AG1	6SL3223-0DE31-5AG1	6SL3223-0DE31-8AG1
Article No. with filter, C1	6SL3223-0DE31-1BG1	6SL3223-0DE31-5BG1	---
LO base load power	11 kW	15 kW	18.5 kW
LO base load input current	26.9 A	33.1 A	39.2 A
LO base load output current	26 A	32 A	38 A
HO base load power	7.5 kW	11 kW	15 kW
HO base load input current	18.6 A	26.9 A	33.1 A
HO base load output current	18 A	26 A	32 A
Fuse according to IEC	3NA3814	3NA3820	3NA3820
Fuse according to UL, class J	40 A	50 A	50 A
Power loss	0.32 kW	0.39 kW	0.46 kW
Required cooling air flow	20 l/s	20 l/s	20 l/s
Weight	9.5 kg	9.5 kg	9.5 kg

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10.3 Technical data, PM230 Power Module

Table 10-6 PM230, IP55, Frame Size D, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	- 6SL3223-0DE31-8BG0	6SL3223-0DE32-2AG0	6SL3223-0DE33-0AG0
Article No. with filter, C1		6SL3223-0DE32-2BG0	6SL3223-0DE33-0BG0
LO base load power	18.5 kW	22 kW	30 kW
LO base load input current	39.2 A	42 A	56 A
LO base load output current	38 A	45 A	60 A
HO base load power	15 kW	18.5 kW	22 kW
HO base load input current	33.1 A	36 A	42 A
HO base load output current	32 A	38 A	45 A
Fuse according to IEC	3NA3820	3NA3822	3NA3824
Fuse according to UL, class J	50 A	63 A	80 A
Power loss	0.46 kW	0.52 kW	0.68 kW
Required cooling air flow	20 l/s	39 l/s	39 l/s
Weight	30.2 kg	30.2 kg	30.2 kg

Table 10-7 PM230, IP55, Frame Size E, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	6SL3223-0DE33-7AG0	6SL3223-0DE34-5AG0
Article No. with filter, C1	6SL3223-0DE33-7BG0	6SL3223-0DE34-5BG0
LO base load power	37 kW	45 kW
LO base load input current	70 A	84 A
LO base load output current	75 A	90 A
HO base load power	30 kW	37 kW
HO base load input current	56 A	70 A
HO base load output current	60 A	75 A
Fuse according to IEC	3NA3830	3NA3832
Fuse according to UL, class J	100 A	125 A
Power loss	0.99 kW	1.2 kW
Required cooling air flow	39 l/s	39 l/s
Weight	35.8 kg	35.8 kg



Table 10-8 PM230, IP55, Frame size F, 3-ph. AC 380 V ... 480 V

Article No. with filter, C2	6SL3223-0DE35-5AG0	6SL3223-0DE37-5AG0	6SL3223-0DE38-8AG0
Article No. with filter, C1	6SL3223-0DE35-5BG0	6SL3223-0DE37-5BG0	6SL3223-0DE38-8BG0
LO base load power	55 kW	75 kW	90 kW
LO base load input current	102 A	135 A	166 A
LO base load output current	110 A	145 A	178 A
HO base load power	45 kW	55 kW	75 kW
HO base load input current	84 A	102 A	135 A
HO base load output current	90 A	110 A	145 A
Fuse according to IEC	3NA3836	3NA3140	3NA3144
Fuse according to UL, class J	160 A	200 A	250 A

10.3 Technical data, PM230 Power Module

Article No. with filter, C2	6SL3223-0DE35-5AG0	6SL3223-0DE37-5AG0	6SL3223-0DE38-8AG0
Article No. with filter, C1	6SL3223-0DE35-5BG0	6SL3223-0DE37-5BG0	6SL3223-0DE38-8BG0
Power loss	1.4 kW	1.9 kW	2.3 kW
Required cooling air flow	117 l/s	117 l/s	117 l/s
Weight	70.0 kg	70.0 kg	70.0 kg

10.3.4 General technical data, PM230

Property	Version	
Line voltage	380 ... 480 V 3 AC \pm 10%	
Output voltage	3-phase 0 VAC ... input voltage x 0.95 (max.)	
Input frequency	50 Hz ... 60 Hz, \pm 3 Hz	
Output frequency	0 Hz ... 550 Hz, depending on the control mode	
Power factor λ	0.9	
Line impedance	Uk \leq 1%, line reactor not permissible	
Inrush current	< LO base load input current	
Pulse frequency (factory setting)	4 kHz The pulse frequency can be increased in 2 kHz steps up to 16 kHz (up to 8 kHz for 55 kW and 75 kW). An increase in the pulse frequency results in a lower output current.	
Electromagnetic compatibility	Devices with filters in compliance with EN 61800-3: 2004 are suitable for Category C2 environments.	
Braking methods	DC braking	
Degree of protection	IP20 built-in units PT devices	IP20 when mounted in a control cabinet IP54 on the control cabinet wall
Operating temperature at	LO base load power without derating	0° C ... +40° C
	HO base load power without derating	0° C ... +50° C
	LO/HO base load power with derating:	Up to 60° C
	 Restrictions for special ambient conditions (Page 515)	
Storage temperature	-40° C ... +70° C	
Relative humidity	< 95% - condensation not permissible	
Pollution	Protected according to pollution degree 2 according to EN 61800-5-1: 2007	
Ambient conditions	Protected against damaging chemical substances according to environmental class 3C2 according to EN 60721-3-3: 1995	
Shock and vibration	<ul style="list-style-type: none"> • Long-term storage in the transport packaging according to Class 1M2 according to EN 60721-3-1: 1997 • Transport in the transport packaging according to Class 2M3 according to EN 60721-3-2: 1997 • Vibration during operation according to Class 3M2 according to EN 60721-3-3: 1995 	
Installation altitude	without derating: up to 1000 m above sea level with derating: up to 4000 m above sea level	 Restrictions for special ambient conditions (Page 515)
Permissible short-circuit current	Frame size D ... F: 65 kA ¹⁾	
Overvoltage category	Supply circuits: Non-supply circuits:	Overvoltage category III Overvoltage category II
Standards	UL ^{1),2)} , CE, C-tick The drive only satisfies the UL requirements when UL-certified fuses are used.	

¹⁾ If fuse-protected with a listed Class J or 3NE1 fuse, rated voltage 600 VAC with the rated current of the specific inverter.

²⁾ UL available soon for frame sizes D ... F

10.3.5 Detailed technical data, PM230

Table 10-9 PM230, IP20, frame size A, 3 AC 380 V ... 480 V

Article number without filter	6SL3210-1NE11-3UG1	6SL3210-1NE11-7UG1	6SL3210-1NE12-2UG1
Article number with filter	6SL3210-1NE11-3AG1	6SL3210-1NE11-7AG1	6SL3210-1NE12-2AG1
LO base load power	0.37 kW	0.55 kW	0.75 kW
LO base load input current	1.3 A	1.8 A	2.3 A
LO base load output current	1.3 A	1.7 A	2.2 A
HO base load power	0.25 kW	0.37 kW	0.55 kW
HO base load input current	0.9 A	1.3 A	1.8 A
HO base load output current	0.9 A	1.3 A	1.7 A
Fuse according to IEC / UL	3NE1813-0	3NE1813-0	3NE1813-0
Fuse according to UL, Class J	2 A	4 A	4 A
Circuit breaker 3RV2711-1KD10	12.5 A	12.5 A	12.5 A
Power loss	0.04 kW	0.04 kW	0.05 kW
Required cooling air flow	1.5 l/s	1.5 l/s	4.5 l/s
Weight without filter	1.4 kg	1.4 kg	1.4 kg
Weight with filter	1.6 kg	1.6 kg	1.6 kg

Table 10-10 PM230, IP20, frame size A, 3 AC 380 V ... 480 V

Article number without filter	6SL3210-1NE13-1UG1	6SL3210-1NE14-1UG1	6SL3210-1NE15-8UG1
Article number with filter	6SL3210-1NE13-1AG1	6SL3210-1NE14-1AG1	6SL3210-1NE15-8AG1
LO base load power	1.1 kW	1.5 kW	2.2 kW
LO base load input current	3.2 A	4.2 A	6.1 A
LO base load output current	3.1 A	4.1 A	5.9 A
HO base load power	0.75 kW	1.1 kW	1.5 kW
HO base load input current	2.3 A	3.2 A	4.2 A
HO base load output current	2.2 A	3.1 A	4.1 A
Fuse according to IEC / UL	3NE1813-0	3NE1813-0	3NE1813-0
Fuse according to UL, Class J	6 A	6 A	10 A
Power loss	0.06 kW	0.07 kW	0.08 kW
Circuit breaker N3RV2711-1KD10	12.5 A	12.5 A	12.5 A
Required cooling air flow	4.5 l/s	4.5 l/s	4.5 l/s
Weight without filter	1.4 kg	1.4 kg	1.4 kg
Weight with filter	1.6 kg	1.6 kg	1.6 kg

Table 10-11 PM230, IP20, frame size A, 3 AC 380 V ... 480 V

Article number without filter	6SL3210-1NE17-7UG1
Article number with filter	6SL3210-1NE17-7AG1
LO base load power	3 kW
LO base load input current	8.0 A

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10.3 Technical data, PM230 Power Module

Article number without filter	6SL3210-1NE17-7UG1
Article number with filter	6SL3210-1NE17-7AG1
LO base load output current	7.7 A
HO base load power	2.2 kW
HO base load input current	6.1 A
HO base load output current	5.9 A
Fuse according to IEC / UL	3NE1813-0
Fuse according to UL, Class J	10 A
Circuit breaker N3RV2711-1KD10	12.5 A
Power loss	0.11 kW
Required cooling air flow	4.5 l/s
Weight without filter	1.4 kg
Weight with filter	1.6 kg

Table 10-12 PM230, PT, frame size A, 3 AC 380 V ... 480 V

Article number without filter	6SL3211-1NE17-7UG1
Article number with filter	6SL3211-1NE17-7AG1
LO base load power	3 kW
LO base load input current	8.0 A
LO base load output current	7.7 A
HO base load power	2.2 kW
HO base load input current	6.1 A
HO base load output current	5.9 A
Fuse according to IEC / UL	3NE1813-0
Fuse according to UL, Class J	10 A
Power loss	0.11 kW
Required cooling air flow	4.5 l/s
Weight without filter	1.7 kg
Weight with filter	1.9 kg

Table 10-13 PM230, IP20, frame size B, 3-phase 380 ... 480 VAC

Article number without filter	6SL3210-1NE21-0UG1	6SL3210-1NE21-3UG1	6SL3210-1NE21-8UG1
Article number with filter	6SL3210-1NE21-0AG1	6SL3210-1NE21-3AG1	6SL3210-1NE21-8AG1
LO base load power	4 kW	5.5 kW	7.5 kW
LO base load input current	10.5 A	13.6 A	18.6 A
LO base load output current	10.2 A	13.2 A	18 A
HO base load power	3 kW	4 kW	5.5 kW
HO base load input current	8.0 A	10.5 A	13.6 A
HO base load output current	7.7 A	10.2 A	13.2 A
Fuse according to IEC / UL	3NE1813-0	3NE1814-0	3NE1815-0
Fuse according to UL, Class J	15 A	20 A	25 A

Article number without filter	6SL3210-1NE21-0UG1	6SL3210-1NE21-3UG1	6SL3210-1NE21-8UG1
Article number with filter	6SL3210-1NE21-0AG1	6SL3210-1NE21-3AG1	6SL3210-1NE21-8AG1
Power loss	0.12 kW	0.15 kW	0.22 kW
Required cooling air flow	9.2 l/s	9.2 l/s	9.2 l/s
Weight without filter	2.8 kg	2.8 kg	2.8 kg
Weight with filter	3 kg	3 kg	3 kg

Table 10-14 PM230, PT, frame size B, 3 AC 380 V ... 480 V

Article number without filter	6SL3211-1NE21-8UG1
Article number with filter	6SL3211-1NE21-8AG1
LO base load power	7.5 kW
LO base load input current	18.6 A
LO base load output current	18 A
HO base load power	5.5 kW
HO base load input current	13.6 A
HO base load output current	13.2 A
Fuse according to IEC / UL	3NE1815-0
Fuse according to UL, Class J	25 A
Power loss	0.22 kW
Required cooling air flow	9.2 l/s
Weight without filter	3.4 kg
Weight with filter	3.6 kg

Table 10-15 PM230, IP20, frame size C, 3 AC 380 V ... 480 V

Article number without filter	6SL3210-1NE22-6UG1	6SL3210-1NE23-2UG1	6SL3210-1NE23-8UG1
Article number with filter	6SL3210-1NE22-6AG1	6SL3210-1NE23-2AG1	6SL3210-1NE23-8AG1
LO base load power	11 kW	15 kW	18.5 kW
LO base load input current	26.9 A	33.1 A	39.2 A
LO base load output current	26 A	32 A	38 A
HO base load power	7.5 kW	11 kW	15 kW
HO base load input current	18.6 A	26.9 A	33.1 A
HO base load output current	18 A	26 A	32 A
Fuse according to IEC / UL	3NE1803-0	3NE1817-0	3NE1817-0
Fuse according to UL, Class J	35 A	45 A	50 A
Power loss	0.3 kW	0.35 kW	0.45 kW
Required cooling air flow	18.5 l/s	18.5 l/s	18.5 l/s
Weight without filter	4.5 kg	4.5 kg	4.5 kg
Weight with filter	5.1 kg	5.1 kg	5.1 kg

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10.3 Technical data, PM230 Power Module

Table 10-16 PM230, PT, frame size C, 3 AC 380 V ... 480 V

Article number without filter	6SL3211-1NE23-8UG1
Article number with filter	6SL3211-1NE23-8AG1
LO base load power	18.5 kW
LO base load input current	39.2 A
LO base load output current	38 A
HO base load power	15 kW
HO base load input current	33.1 A
HO base load output current	32 A
Fuse according to IEC / UL	3NE1817-0
Fuse according to UL, Class J	50 A
Power loss	0.45 kW
Required cooling air flow	18.5 l/s
Weight without filter	5.4 kg
Weight with filter	6 kg

Table 10-17 PM230, IP20, frame size D, 3 AC 380 V ... 480 V

Article number without filter	6SL3210-1NE24-5UL0	6SL3210-1NE26-0UL0
Article number with filter	6SL3210-1NE24-5AL0	6SL3210-1NE26-0AL0
LO base load power	22 kW	30 kW
LO base load input current	42 A	56 A
LO base load output current	45 A	60 A
HO base load power	18.5 kW	22 kW
HO base load input current	36 A	42 A
HO base load output current	38 A	45 A
Fuse according to IEC / UL	3NE1818-0	3NE1820-0
Power loss	0.52 kW	0.68 kW
Required cooling air flow	80 l/s	80 l/s
Weight without filter	11 kg	11 kg
Weight with filter	14 kg	14 kg

Table 10-18 PM230, IP20, frame size E, 3 AC 380 V ... 480 V

Article number without filter	6SL3210-1NE27-5UL0	6SL3210-1NE28-8UL0
Article number with filter	6SL3210-1NE27-5AL0	6SL3210-1NE28-8AL0
LO base load power	37 kW	45 kW
LO base load input current	70 A	84 A
LO base load output current	75 A	90 A
HO base load power	30 kW	37 kW
HO base load input current	56 A	70 A
HO base load output current	60 A	75 A
Fuse according to IEC / UL	3NE1021-0	3NE1022-0

Article number without filter	6SL3210-1NE27-5UL0	6SL3210-1NE28-8UL0
Article number with filter	6SL3210-1NE27-5AL0	6SL3210-1NE28-8AL0
Power loss	0.99 kW	1.2 kW
Required cooling air flow	80 l/s	80 l/s
Weight without filter	15 kg	15 kg
Weight with filter	22 kg	22 kg

Table 10-19 PM230, IP20, frame size F, 3 AC 380 V ... 480 V

Article number without filter	6SL3210-1NE31-1UL0	6SL3210-1NE31-5UL0
Article number with filter	6SL3210-1NE31-1AL0	6SL3210-1NE31-5AL0
LO base load power	55 kW	75 kW
LO base load input current	102 A	135 A
LO base load output current	110 A	145 A
HO base load power	45 kW	55 kW
HO base load input current	84 A	102 A
HO base load output current	90 A	110 A
Fuse according to IEC / UL	3NE1224-0	3NE1225-0
Power loss	1.4 kW	1.9 kW
Required cooling air flow	150 l/s	150 l/s
Weight without filter	33 kg	33 kg
Weight with filter	48 kg	48 kg

10.3.6 Current reduction depending on pulse frequency

Current derating depending on the pulse frequency

LO base load	Output base-load current at a 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	--	1.3	1.11	0.91	0.78	0.65	0.59	0.52
0.55	--	1.7	1.45	1.19	1.02	0.85	0.77	0.68
0.75	--	2.2	1.87	1.54	1.32	1.10	0.99	0.88
1.1	--	3.1	2.64	2.17	1.86	1.55	1.4	1.24
1.5	--	4.1	3.49	2.87	2.46	2.05	1.85	1.64
2.2	--	5.9	5.02	4.13	3.54	2.95	2.66	2.36
3.0	--	7.7	6.55	5.39	4.62	3.85	3.47	3.08
4.0	--	10.2	8.67	7.14	6.12	5.1	4.59	4.08
5.5	--	13.2	11.22	9.24	7.92	6.6	5.94	5.28
7.5	--	18	15.3	12.6	10.8	9	8.1	7.2
11.0	--	26	22.1	18.2	15.6	13	11.7	10.4
15.0	--	32	27.2	22.4	19.2	16	14.4	12.8
18.5	--	38	32.3	26.6	22.8	19	17.1	15.2
22	--	45	38.25	31.5	27	22.5	20.25	18
30	--	60	51	42	36	30	27	24
37	--	75	63.75	52.5	45	37.5	33.75	30
45	--	90	76.5	63	54	45	40.5	36
55	--	110	93.5	77	66 ¹⁾	55 ¹⁾	49.5 ¹⁾	44 ¹⁾
75	--	145	123.3	101.5	--	--	--	--
90	--	178	151.3	124.6	--	--	--	--

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


¹⁾ Values apply to IP20 versions only.

10.4 Technical Data, PM240P-2 Power Module

Protective devices for the Power Module

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

Additional components for branch protection are available in the Internet:

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

Typical inverter load cycles

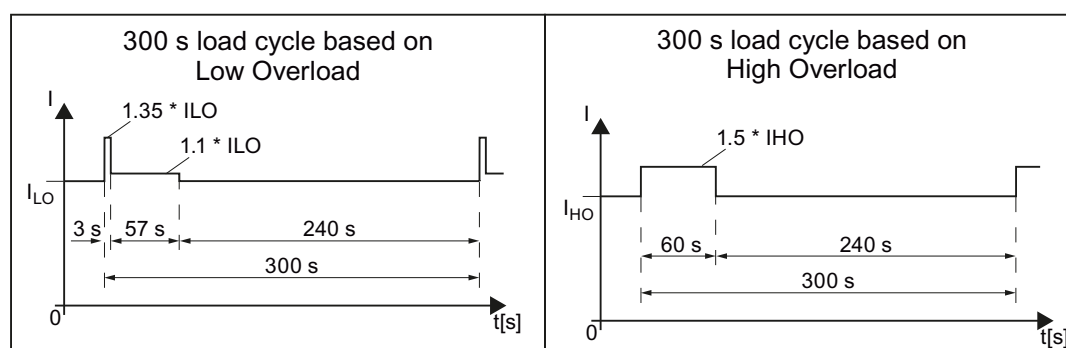




Figure 10-3 "Low Overload" and "High Overload" load cycles

10.4.1 Ambient conditions


Property	Version
Ambient conditions for transport in the transport packaging	
Climatic ambient conditions	- 40 °C ... + 70 °C, according to Class 2K4 to EN 60721-3-2 maximum humidity 95 % at 40 °C
Mechanical ambient conditions	Shock and vibration permissible according to 2M3 to EN 60721-3-2
Protection against chemical substances	Protected according to Class 2C2 to EN 60721-3-2
Biological environmental conditions	Suitable according to Class 2B1 to EN 60721-3-2
Ambient conditions for long-term storage in the product packaging	
Climatic ambient conditions	- 25 °C ... + 55 °C, according to Class 1K3 to EN 60721-3-1
Protection against chemical substances	Protected according to Class 1C2 to EN 60721-3-1
Biological environmental conditions	suitable according to class 1B1 to EN 60721-3-1
Ambient conditions in operation	

Property	Version
Installation altitude	Up to 1000 m above sea level without derating, > 1000 m  Restrictions for special ambient conditions (Page 515)
Climatic ambient conditions ¹⁾	<ul style="list-style-type: none"> • Frame sizes FSD ... FSF temperature range²⁾ <ul style="list-style-type: none"> – in operation acc. to LO: -20° C ... +40° C – in operation acc. to HO: -20° C ... +50° C – for higher temperatures  Restrictions for special ambient conditions (Page 515) • Relative humidity: 5 ... 95%, condensation not permitted • Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical ambient conditions	<ul style="list-style-type: none"> • Vibration levels permissible according to Class 3M1 to EN 60721-3-3 • Shock permissible according to Class 3M1 to EN 60721-3-3
Protection against chemical substances	Protected according to 3C2 to EN 60721-3-3
Biological environmental conditions	Suitable according to 3B1 to EN 60721-3-3
Pollution	Suitable for environments with degree of pollution 2 according to EN 61800-5-1
Cooling	Forced air cooling AF, according to EN 60146
Cooling air	Clean and dry air

¹⁾ Increased ruggedness regarding temperature range and relative humidity; therefore better than 3K3 according to EN 60721-3-3

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

10.4.2 General technical data, 400 V inverters

Property	Version
Line voltage	3 AC 380 V ... 480 V \pm 10% (in operation -20% < 1 min)
Line system configurations	Grounded TN/TT line systems or non-grounded IT line systems
Line impedance	$U_k < 4\%$, line reactor is not required
Power factor λ	> 0.9
Output voltage	3 AC 0 V ... 0.95 x input voltage (max.)
Input frequency	50 Hz ... 60 Hz, \pm 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	$< LO$ base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	<p>Factory setting</p> <ul style="list-style-type: none"> • 4 kHz for devices with an LO base load power < 75 kW • 2 kHz for devices with an LO base load power ≥ 75 kW <p>Can be adjusted in 2 kHz steps as follows:</p> <ul style="list-style-type: none"> • 2 kHz ... 16 kHz for devices with an LO base load power < 55 kW • 2 kHz ... 8 kHz for devices with an LO base load power ≥ 55 kW • 2 kHz ... 4 kHz for devices with an LO base load power ≥ 110 kW <p>If you increase the pulse frequency, the inverter reduces the maximum output current.</p>
Short-circuit current rating (SCCR) and branch protection	<p>≤ 100 kA rms</p> <p> Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)</p>
Braking methods	DC braking, compound braking
Degree of protection according to EN 60529	IP20 Must be installed in a control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF

10.4.3 Specific technical data, 400 V inverters

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

You can find additional suitable fuses in the Internet:

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

Table 10-20 PM240P-2, IP20, Frame Size D, 3-ph. AC 380 V ... 480 V

Article number without filter	6SL3210-1RE24-5UL0	6SL3210-1RE26-0UL0	6SL3210-1RE27-5UL0
Article number with filter	6SL3210-1RE24-5AL0	6SL3210-1RE26-0AL0	6SL3210-1RE27-5AL0
LO base load power	22 kW	30 kW	37 kW
LO base load input current	42 A	57 A	70 A
LO base load output current	45 A	60 A	75 A
HO base load power	18.5 kW	22 kW	30 kW
HO base load input current	38 A	47 A	62 A
HO base load output current	38 A	45 A	60 A
Siemens fuse according to IEC/UL	3NE1820-0 / 80 A	3NE1021-0 / 100 A	3NE1021-0 / 100 A
Fuse according to IEC/UL, Class J	70 A	90 A	100 A
Power loss without filter	0.68 kW	0.76 kW	1.01 kW
Power loss with filter	0.68 kW	0.77 kW	1.02 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	16 kg	17 kg	17 kg
Weight with filter	17.5 kg	18.5 kg	18.5 kg

Table 10-21 PM240P-2, IP20, Frame Size E, 3-ph. AC 380 V ... 480 V

Article number without filter	6SL3210-1RE28-8UL0	6SL3210-1RE31-1UL0
Article number with filter	6SL3210-1RE28-8AL0	6SL3210-1RE31-1AL0
LO base load power	45 kW	55 kW
LO base load input current	86 A	104 A
LO base load output current	90 A	110 A
HO base load power	37 kW	45 kW
HO base load input current	78 A	94 A
HO base load output current	75 A	90 A
Siemens fuse according to IEC/UL	3NE1022-0 / 125 A	3NE1224-0 / 160 A
Fuse according to IEC/UL, Class J	125 A	150 A
Power loss without filter	1.19 kW	1.54 kW
Power loss with filter	1.2 kW	1.55 kW
Required cooling air flow	83 l/s	83 l/s
Weight without filter	26 kg	26 kg
Weight with filter	28 kg	28 kg

Table 10-22 PM240P-2, IP20, Frame Size F, 3-ph. AC 380 V ... 480 V

Article number without filter	6SL3210-1RE31-5UL0	6SL3210-1RE31-8UL0	6SL3210-1RE32-1UL0
Article number with filter	6SL3210-1RE31-5AL0	6SL3210-1RE31-8AL0	6SL3210-1RE32-1AL0
LO base load power	75 kW	90 kW	110 kW
LO base load input current	140 A	172 A	198 A
LO base load output current	145 A	178 A	205 A
HO base load power	55 kW	75 kW	90 kW
HO base load input current	117 A	154 A	189 A
HO base load output current	110 A	145 A	178 A
Siemens fuse according to IEC/UL	3NE1225-0 / 200 A	3NE1227-0 / 250 A	3NE1230-0 / 315 A
Fuse according to IEC/UL, Class J	200 A	250 A	300 A
Power loss without filter	1.95 kW	2.54 kW	2.36 kW
Power loss with filter	1.97 kW	2.56 kW	2.38 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight without filter	57 kg	57 kg	61 kg
Weight with filter	63 kg	63 kg	65 kg

Table 10-23 PM240P-2, IP20, Frame Size F, 3-ph. AC 380 V ... 480 V

Article number without filter	6SL3210-1RE32-5UL0
Article number with filter	6SL3210-1RE32-5AL0
LO base load power	132 kW
LO base load input current	242 A
LO base load output current	250 A
HO base load power	110 kW
HO base load input current	218 A
HO base load output current	205 A
Siemens fuse according to IEC/UL	3NE1331-0 / 350 A
Fuse according to IEC/UL, Class J	350 A
Power loss without filter	3.09 kW
Power loss with filter	3.12 kW
Required cooling air flow	153 l/s
Weight without filter	61 kg
Weight with filter	65 kg


10.4.4 Current derating depending on the pulse frequency, 400 V inverters

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

*) Factory setting

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

10.4.5 General technical data, 690 V inverters

Property	Version
Line voltage	3 AC 500 V ... 690 V \pm 10% (in operation -20% < 1 min) with Class J fuses, maximum 600 V
Line system configurations	Grounded TN/TT line systems or non-grounded IT line systems
Line impedance	$U_k < 4\%$, line reactor is not required
Power factor λ	> 0.9
Output voltage	3 AC 0 V ... 0.95 \times input voltage (max.)
Input frequency	50 Hz ... 60 Hz, \pm 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	$<$ LO base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	2 kHz (factory setting), can be adjusted to 4 kHz If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current rating (SCCR) and branch protection	≤ 100 kA rms  Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)
Braking methods	DC braking, compound braking
Degree of protection according to EN 60529	IP20; must be installed in a control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF

10.4.6 Specific technical data, 690 V inverters

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

You can find additional suitable fuses in the Internet:


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

Table 10-24 PM240P-2, IP20, frame size D, 3 AC 500 V ... 690 V

Article number without filter	6SL3210-1RH21-4UL0	6SL3210-1RH22-0UL0	6SL3210-1RH22-3UL0
Article number with filter	6SL3210-1RH21-4AL0	6SL3210-1RH22-0AL0	6SL3210-1RH22-3AL0
LO base load power	11 kW	15 kW	18.5 kW
LO base load input current	14 A	18 A	22 A
LO base load output current	14 A	19 A	23 A
HO base load power	7.5 kW	11 kW	15 kW
HO base load input current	11 A	14 A	20 A
HO base load output current	11 A	14 A	19 A
Siemens fuse according to IEC/UL	3NE1815-0 / 25 A	3NE1815-0 / 25 A	3NE1803-0 / 35 A
Fuse according to IEC/UL, Class J	20 A	25 A	30 A
Power loss	0.32 kW	0.41 kW	0.48 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17 kg	17 kg	17 kg
Weight with filter	18.5 kg	18.5 kg	18.5 kg

Table 10-25 PM240P-2, IP20, frame size D, 3 AC 500 V ... 690 V

Article number without filter	6SL3210-1RH22-7UL0	6SL3210-1RH23-5UL0	6SL3210-1RH24-2UL0
Article number with filter	6SL3210-1RH22-7AL0	6SL3210-1RH23-5AL0	6SL3210-1RH24-2AL0
LO base load power	22 kW	30 kW	37 kW
LO base load input current	25 A	33 A	40 A
LO base load output current	27 A	35 A	42 A
HO base load power	18.5 kW	22 kW	30 kW
HO base load input current	24 A	28 A	36 A
HO base load output current	23 A	27 A	35 A
Siemens fuse according to IEC/UL	3NE1803-0 / 35 A	3NE1817-0 / 50 A	3NE1818-0 / 63 A
Fuse according to IEC/UL, Class J	35 A	50 A	60 A
Power loss without filter	0.56 kW	0.72 kW	0.88 kW
Power loss with filter	0.56 kW	0.73 kW	0.88 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17 kg	17 kg	17 kg
Weight with filter	18.5 kg	18.5 kg	18.5 kg

Table 10-26 PM240P-2, IP20, frame sizes E, 3 AC 500 V ... 690 V

Article number without filter	6SL3210-1RH25-2UL0	6SL3210-1RH26-2UL0
Article number with filter	6SL3210-1RH25-2AL0	6SL3210-1RH26-2AL0
LO base load power	45 kW	55 kW
LO base load input current	50 A	59 A
LO base load output current	52 A	62 A
HO base load power	37 kW	45 kW
HO base load input current	44 A	54 A
HO base load output current	42 A	52 A
Siemens fuse according to IEC/UL	3NA1820-0 / 80 A	3NE1820-0 / 80 A
Fuse according to IEC/UL, Class J	80 A	80 A
Power loss without filter	1.00 kW	1.21 kW
Power loss with filter	1.00 kW	1.22 kW
Required cooling air flow	83 l/s	83 l/s
Weight without filter	26 kg	26 kg
Weight with filter	28 kg	28 kg

Table 10-27 PM240-2, IP20, frame size F, 3 AC 500 V ... 690 V

Article number without filter	6SL3210-1RH28-0UL0	6SL3210-1RH31-0UL0	6SL3210-1RH31-2UL0
Article number with filter	6SL3210-1RH28-0AL0	6SL3210-1RH31-0AL0	6SL3210-1RH31-2AL0
LO base load power	75 kW	90 kW	110 kW
LO base load input current	78 A	97 A	111 A
LO base load output current	80 A	100 A	115 A
HO base load power	55 kW	75 kW	90 kW
HO base load input current	66 A	85 A	106 A
HO base load output current	62 A	80 A	100 A
Siemens fuse according to IEC/UL	3NE1021-0 / 100 A	3NE1022-0 / 125 A	3NE1224-0 / 160 A
Fuse according to IEC/UL, Class J	110 A	150 A	150 A
Power loss without filter	1.34 kW	1.71 kW	2 kW
Power loss with filter	1.35 kW	1.72 kW	2.02 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight without filter	60 kg	60 kg	60 kg
Weight with filter	64 kg	64 kg	64 kg

Table 10-28 PM240-2, IP20, frame size F, 3 AC 500 V ... 690 V

Article number without filter	6SL3210-1RH31-4UL0
Article number with filter	6SL3210-1RH31-4AL0
LO base load power	132 kW
LO base load input current	137 A
LO base load output current	142 A
HO base load power	110 kW

Technical data

10.4 Technical Data, PM240P-2 Power Module

Article number without filter	6SL3210-1RH31-4UL0
Article number with filter	6SL3210-1RH31-4AL0
HO base load input current	122 A
HO base load output current	115 A
Siemens fuse according to IEC/UL	3NE1225-0 / 200 A
Fuse according to IEC/UL, Class J	200 A
Power loss without filter	2.56 kW
Power loss with filter	2.59 kW
Required cooling air flow	153 l/s
Weight without filter	60 kg
Weight with filter	64 kg

10.4.7 Current derating depending on the pulse frequency, 690 V inverters

Article number	LO power [kW]	LO base load output current [A]	
		2	4
6SL3210-1RH21-4 . L0		14	8.4
6SL3210-1RH22-0 . L0		19	11.4
6SL3210-1RH22-3 . L0		23	13.8
6SL3210-1RH22-7 . L0		27	16.2
6SL3210-1RH23-5 . L0		35	21
6SL3210-1RH24-2 . L0		42	25.2
6SL3210-1RH25-2 . L0		52	31.2
6SL3210-1RH26-2 . L0		62	37.2
6SL3210-1RH28-0 . L0		80	48
6SL3210-1RH31-0 . L0		100	60
6SL3210-1RH31-2 . L0		115	69
6SL3210-1RH31-4 . L0		142	85.2

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

10.5 Technical data, PM330 Power Module

Permissible inverter overload

The inverters have different load capabilities, "High Overload" and "Low Overload", depending on the expected.

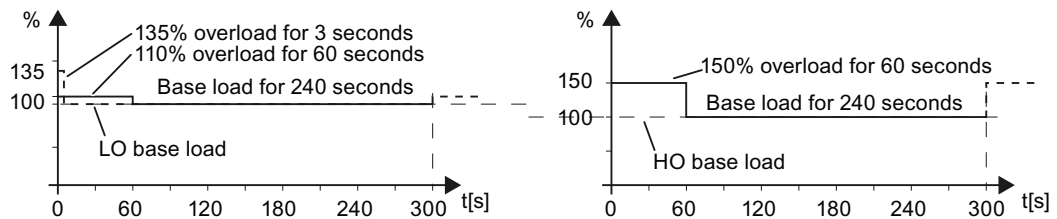


Figure 10-4 Load cycles, "Low Overload" and "High Overload"

10.5.1 General technical data, PM330

Table 10-29 General technical data

Electrical data	
Line system configurations	Grounded TN/TT systems or ungrounded IT systems (a grounded phase conductor is not permissible in 690 V line supplies)
Line requirement	A line reactor (2% u_k) must be connected in series
Line voltage	380 V (-10 %) ... 480 V (+10 %) 500 V (-10 %) ... 690 V (+10 %)
Line frequency	47 ... 63 Hz
Output frequency	0 ... 100 Hz
Displacement factor $\cos \varphi$ power factor λ	0.96 0.75 ... 0.93 (with line reactor $u_k = 2\%$)
Converter efficiency	> 98%
Short-circuit current rating according to IEC, in conjunction with the specified fuses	160 ... 630 kW: 100 kA
Short-circuit current rating according to UL61800-5-1 (up to 480 V AC or 600 V AC), in conjunction with the specified fuses	160 ... 630 kW: 100 kA Can be used on line supplies that cannot supply more than 100 kA symmetrically at a maximum voltage of 480 V AC or 600 V AC when they are protected with the semiconductor fuses specified in Chapter "Technical Data" of this manual.
Overvoltage category	III according to EN 61800-5-1
Mechanical data	
Degree of protection	IP20
Protection class	according to EN 61800-5-1: Class I (with protective conductor system) and Class III (PELV)
Cooling method	Forced air cooling AF according to EN 60146
Sound pressure level L_{pA} (1 ma)	≤ 74 dB(A) ¹⁾

Touch protection	according to EN 61800-5-1: For the intended purpose		
Compliance with standards			
Standards	EN 60146-1-1, EN 61800-2, EN 61800-3, EN 61800-5-1, EN 60204-1, EN 60529 UL61800-5-1, CSA 22.2 No. 274-13		
CE marking	In accordance with EMC Directive No. 2014/30/EU and Low-Voltage Directive No. 2014/35/EU		
Radio interference suppression	In accordance with the EMC product standard for variable-speed drives EN 61800-3, "second environment" ²⁾ . Application in "first environment" possible with line filters.		
Approval	cULus (File No.: E192450), CE, RCM, EAC, KC		
Ambient conditions	During storage ³⁾	During transport ³⁾	During operation
Ambient temperature	-25° ... +55° C	-25 ... +70 °C from -40 °C for 24 hours	0° ... +40° C up to + 50° C with derating
Relative humidity (no condensation) Corresponds to class	5 to 95% 1K4 according to EN 60721-3-1	5 ... 95% at 40° C 2K3 according to EN 60721-3-2	5 ... 95% 3K3 according to EN 60721-3-3
Environmental class / harmful chemical substances	1C2 according to EN 60721-3-1	2C2 according to EN 60721-3-2	3C2 according to EN 60721-3-3
Organic/biological influences	1B1 according to EN 60721-3-1	2B1 according to EN 60721-3-2	3B1 according to EN 60721-3-3
Pollution degree	2 according to EN 61800-5-1		
Installation altitude	up to 1000 m above sea level without derating, > 1000 m above sea level with derating (see Chapter Restrictions for special ambient conditions (Page 515))		
Mechanical strength	During storage ³⁾	During transport ³⁾	During operation
Vibrational load - Displacement - Acceleration	Fc test according to EN 60068-2-6 ±1.5 mm for 5 ... 9 Hz 0.5 g at 9 ... 200 Hz	Fc test according to EN 60068-2-6 ±1.5 mm for 5 ... 9 Hz 0.5 g at 9 ... 200 Hz	Fc test according to EN 60068-2-6 0.075 mm for 10 ... 58 Hz 9.81 ma/s ² (1 x g) at > 58 ... 200 Hz
Shock load - Displacement - Acceleration	Fc test according to EN 60068-2-6 ±1.5 mm for 5 ... 9 Hz 0.5 g for 9 ... 200 Hz	Fc test according to EN 60068-2-6 ±1.5 mm for 5 ... 9 Hz 0.5 g for 9 ... 200 Hz	Test according to EN 60068-2-27 (EA shock type) 49 ma/s ² (5 x g)/30 ms 147 m/s ² (15 x g)/11 ms

Deviations from the defined classes are shown in *italics*.

¹⁾ maximum sound pressure level, ascertained in the IP20 cabinet

²⁾ Standard construction: Devices installed in the control cabinet with installation in conformance with EMC regulations, line reactor uk = 2%, shielded motor cable (e.g. Prototflex EMC) with max. 100 m cable length, line harmonics according to EN 61000-2-4: Class 2, THD(U) total = 8% for typical line conditions (RSC > 30 ... 50); THD(I) total: typically 30 ... 45 % (15 < RSC < 50)

³⁾ in transport packaging

10.5.2 Power-dependent technical data, PM330

Note

Recommended connection cross-sections

The recommended connection cross-sections are determined for copper cables at 45 °C ambient temperature and cables with a permitted operating temperature at the conductor of 70 °C (routing type C - factor for bundling 0.75 considered) according to DIN VDE 0298-4/08.03).

Protective conductor cross-section (S: Cross-section of the supply connection phase conductor, MS: Cross-section of the external protective conductor):

Minimum cross-sections:

- $S < 16 \text{ mm}^2 \rightarrow MS = S$
- $16 \text{ mm}^2 \leq S \leq 35 \text{ mm}^2 \rightarrow MS = 16 \text{ mm}^2$
- $S > 35 \text{ mm}^2 \rightarrow MS = 0.5 \times S$

Recommended cross-sections:

- $MS \geq S$

Table 10-30 PM330 frame sizes GX, 3-phase 380 ... 480 VAC

Article No.	6SL3310-	1PE33-0AA0	1PE33-7AA0	1PE34-6AA0
Rated input current				
- at 380/400 V, 45° C		317 A	375 A	469 A
- at 480 V, 45° C		262 A	314 A	376 A
- at 380/400 V, 55° C		269 A	319 A	399 A
- at 480 V, 55° C		220 A	266 A	319 A
Rated input current DCP/DCN (for 2/3 of the inverter power)				
- at 510 V _{DC} , 45 °C		255 A	315 A	392 A
- at 650 V _{DC} , 45 °C		209 A	263 A	314 A
- at 510 V _{DC} , 55 °C		217 A	268 A	333 A
- at 650 V _{DC} , 55 °C		177 A	223 A	267 A
Rated output current I _N				
- at 380/400 V, 45° C		300 A	370 A	460 A
- at 480 V, 45° C		245 A	308 A	369 A
- at 380/400 V, 55° C		255 A	315 A	391 A
- at 480 V, 55° C		208 A	262 A	313 A
LO base load power		160 kW	200 kW	250 kW
LO base load input current at 400 V		307 A	365 A	459 A
LO base load output current at 400 V		290 A	360 A	450 A
HO base load power		132 kW	160 kW	200 kW
HO base load input current at 400 V		254 A	300 A	375 A
HO base load output current at 400 V		240 A	296 A	368 A

Article No.	6SL3310-	1PE33-0AA0	1PE33-7AA0	1PE34-6AA0
Fuse according to IEC manufacturer:		3NE1333-2 (450 A/690 V) Siemens AG	3NE1334-2 (500 A/690 V) Siemens AG	3NE1435-2 (560 A/690 V) Siemens AG
Maximum permissible line short-circuit current I_{kmax}		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I_{kmin} ¹⁾		> 3.5 kA	> 4.5 kA	> 7.0 kA
Fuse in compliance with UL ²⁾ Manufacturer:		3NE1333-2 (450 A/690 V) Siemens AG	3NE1334-2 (500 A/690 V) Siemens AG	3NE1435-2 (560 A/690 V) Siemens AG
Maximum permissible line short-circuit current I_{kmax}		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I_{kmin} ¹⁾		> 3.5 kA	> 4.5 kA	> 7.0 kA
max. power loss, at I_N , 45 °C, 400 V		3.642 kW	4.414 kW	5.125 kW
Required cooling air flow		210 l/s	210 l/s	210 l/s
Maximum connectable cross-section of the line, motor and DC-link cable		2 x 240 mm ² 2 x 500 kcmil	2 x 240 mm ² 2 x 500 kcmil	2 x 240 mm ² 2 x 500 kcmil
Recommended cable cross-section for 380 V/400 V				
- line cable		2 x 120 mm ²	2 x 120 mm ²	2 x 185 mm ²
- motor cable		2 x 95 mm ²	2 x 95 mm ²	2 x 150 mm ²
Recommended cable cross-section for 480 V				
- line cable		2 x 95 mm ²	2 x 120 mm ²	2 x 120 mm ²
- motor cable		2 x 70 mm ²	2 x 95 mm ²	2 x 120 mm ²
Recommended cable cross-section for 380 V/400 V				
- DC link infeed (2/3 inverter power)		2 x 120 mm ²	2 x 120 mm ²	2 x 150 mm ²
- Braking Module ³⁾		35 mm ²	35 mm ²	35 mm ²
Recommended cable cross-section for 480 V				
- DC link infeed (2/3 inverter power)		2 x 95 mm ²	2 x 95 mm ²	2 x 120 mm ²
- Braking Module ³⁾		35 mm ²	35 mm ²	35 mm ²
Tightening torque for line, motor, DC link, and ground cable		50 Nm / 443 lbf in	50 Nm / 443 lbf in	50 Nm / 443 lbf in
Dimensions: Width x height x depth [mm]		452 x 1447 x 327.5	452 x 1447 x 327.5	452 x 1447 x 327.5
Weight		98 kg	104 kg	109 kg

¹⁾ The line supply must be capable of supplying the minimum short-circuit current so that the fuses trigger and consequential damage is avoided.

Note: If the minimum short-circuit current is not reached, then the tripping time for the fuses increases, and this may result in consequential damage.

²⁾ When semiconductor fuses are used, they must be mounted in the same higher construction as the inverter.

³⁾ When connecting a Braking Module with rated power 50 kW, P_{20} power 200 kW.

10.5 Technical data, PM330 Power Module

Table 10-31 PM330, frame size HX, 3-phase 380 ... 480 VAC

Article No.	6SL3310-	1PE35-8AA0	1PE36-6AA0	1PE37-4AA0
Rated input current				
- at 380/400 V, 45° C		597 A	668 A	750 A
- at 480 V, 45° C		497 A	536 A	614 A
- at 380/400 V, 55° C		507 A	568 A	637 A
- at 480 V, 55° C		422 A	456 A	522 A
Rated input current DCP/DCN (for 2/3 of the inverter power)				
- at 510 V _{DC} , 45 °C		498 A	558 A	626 A
- at 650 V _{DC} , 45 °C		415 A	448 A	513 A
- at 510 V _{DC} , 55 °C		423 A	474 A	532 A
- at 650 V _{DC} , 55 °C		352 A	381 A	436 A
Rated output current I _N				
- at 380/400 V, 45° C		585 A	655 A	735 A
- at 480 V, 45° C		487 A	526 A	602 A
- at 380/400 V, 55° C		497 A	557 A	625 A
- at 480 V, 55° C		414 A	447 A	512 A
LO base load power		315 kW	355 kW	400 kW
LO base load input current at 400 V		581 A	653 A	734 A
LO base load output current at 400 V		570 A	640 A	720 A
HO base load power		250 kW	250 kW	315 kW
HO base load input current at 400 V		477 A	501 A	562 A
HO base load output current at 400 V		468 A	491 A	551 A
Fuse according to IEC		3NE1437-2 (710 A/690 V)	3NE1438-2 (800 A/690 V)	3NE1448-2 (850 A/690 V)
manufacturer:		Siemens AG	Siemens AG	Siemens AG
Maximum permissible line short-circuit current I _{kmax}		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I _{kmin} ¹⁾		> 10.0 kA	> 11.0 kA	> 13.0 kA
Fuse in compliance with UL ²⁾		3NE1437-2 (710 A/690 V)	3NE1438-2 (800 A/690 V)	3NE1448-2 (850 A/690 V)
Manufacturer:		Siemens AG	Siemens AG	Siemens AG
Maximum permissible line short-circuit current I _{kmax}		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I _{kmin} ¹⁾		> 10.0 kA	> 11.0 kA	> 13.0 kA
max. power loss, at I _N , 45 °C, 400 V		6.791 kW	7.687 kW	8.385 kW
Required cooling air flow		360 l/s	360 l/s	360 l/s
Maximum connectable cross-section of the line, motor and DC-link cable		4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil
Recommended cable cross-section for 380 V/400 V				
- line cable		2 x 240 mm ²	3 x 150 mm ²	3 x 185 mm ²
- motor cable		2 x 185 mm ²	2 x 240 mm ²	2 x 240 mm ²
Recommended cable cross-section for 480 V				
- line cable		2 x 185 mm ²	2 x 240 mm ²	2 x 240 mm ²
- motor cable		2 x 150 mm ²	2 x 185 mm ²	2 x 240 mm ²
Recommended cable cross-section for 380 V/400 V				
- DC link infeed (2/3 inverter power)		2 x 185 mm ²	2 x 240 mm ²	3 x 150 mm ²
- Braking Module ³⁾		35 mm ²	35 mm ²	35 mm ²
Recommended cable cross-section for 480 V				
- DC link infeed (2/3 inverter power)		2 x 150 mm ²	2 x 185 mm ²	2 x 240 mm ²
- Braking Module ³⁾		35 mm ²	35 mm ²	35 mm ²

Article No.	6SL3310-	1PE35-8AA0	1PE36-6AA0	1PE37-4AA0
Tightening torque for line, motor, DC link, and ground cable		50 Nm / 443 lbf in	50 Nm / 443 lbf in	50 Nm / 443 lbf in
Dimensions: Width x height x depth [mm]		548 x 1695 x 393	548 x 1695 x 393	548 x 1695 x 393
Weight		151 kg	157 kg	159 kg
Minimum control cabinet size for installation of the Power Module (width x height x depth)		800 mm x 2000 mm x 600 mm		

- 1) The line supply must be capable of supplying the minimum short-circuit current so that the fuses trigger and consequential damage is avoided.
Note: If the minimum short-circuit current is not reached, then the tripping time for the fuses increases, and this may result in consequential damage.
- 2) When semiconductor fuses are used, they must be mounted in the same higher construction as the inverter.
- 3) When connecting a Braking Module with rated power 50 kW, P₂₀ power 200 kW.

Table 10-32 PM330, frame size JX, 3-phase 380 ... 480 VAC

Article No.	6SL3310-	1PE38-4AA0	1PE38-8AA0	1PE41-0AA0
Rated input current				
- at 380/400 V, 45° C		870 A	945 A	1061 A
- at 480 V, 45° C		702 A	767 A	880 A
- at 380/400 V, 55° C		740 A	803 A	901 A
- at 480 V, 55° C		596 A	652 A	748 A
Rated input current DCP/DCN (for 2/3 of the inverter power)				
- at 510 V _{DC} , 45° C		715 A	775 A	870 A
- at 650 V _{DC} , 45° C		577 A	629 A	722 A
- at 510 V _{DC} , 55° C		608 A	659 A	739 A
- at 650 V _{DC} , 55° C		490 A	535 A	613 A
Rated output current I _N				
- at 380/400 V, 45° C		840 A	910 A	1021 A
- at 480 V, 45° C		677 A	739 A	847 A
- at 380/400 V, 55° C		714 A	774 A	868 A
- at 480 V, 55° C		576 A	628 A	720 A
LO base load power		450 kW	500 kW	560 kW
LO base load input current at 400 V		850 A	925 A	1039 A
LO base load output current at 400 V		820 A	890 A	1000 A
HO base load power		355 kW	400 kW	450 kW
HO base load input current at 400 V		696 A	756 A	816 A
HO base load output current at 400 V		672 A	728 A	786 A
Fuse according to IEC		2 x 3NE1334-2 // (2 x 500 A / 690 V)	2 x 3NE1435-2 // (2 x 560 A / 690 V)	2 x 3NE1436-2 // (2 x 630 A / 690 V)
manufacturer:		Siemens AG	Siemens AG	Siemens AG
Maximum permissible line short-circuit current I _{kmax}		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I _{kmin} ¹⁾		> 10.4 kA	> 14.0 kA	> 16.0 kA
Fuse in compliance with UL ²⁾		3NB3350-1KK26 (1000 A/690 V)	3NB3351-1KK26 (1100 A/690 V)	3NB3352-1KK26 (1250 A/690 V)
Manufacturer:		Siemens AG	Siemens AG	Siemens AG
Minimum line short-circuit current required I _{kmin} ¹⁾		8.6 kA	17.0 kA	18.0 kA
max. power loss, at I _N , 45° C, 400 V		10.418 kW	10.885 kW	12.495 kW

Technical data

10.5 Technical data, PM330 Power Module

Article No.	6SL3310-	1PE38-4AA0	1PE38-8AA0	1PE41-0AA0
Required cooling air flow		450 l/s	450 l/s	450 l/s
Maximum connectable cross-section of the power cable		6 x 240 mm ² 6 x 500 kcmil	6 x 240 mm ² 6 x 500 kcmil	6 x 240 mm ² 6 x 500 kcmil
Maximum connectable cross-section of the motor cable		4 x 240 mm ² 4 x 500 kcmil	8 x 240 mm ² 8 x 500 kcmil	8 x 240 mm ² 8 x 500 kcmil
Maximum connectable cross-section of the DC link cable		4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil
Recommended cable cross-section for 380 V/400 V				
- line cable		4 x 185 mm ²	4 x 185 mm ²	4 x 240 mm ²
- motor cable ³⁾		4 x 150 mm ²	4 x 185 mm ²	4 x 240 mm ²
Recommended cable cross-section for 480 V				
- line cable		4 x 120 mm ²	4 x 150 mm ²	4 x 185 mm ²
- motor cable ³⁾		4 x 120 mm ²	4 x 150 mm ²	4 x 150 mm ²
Recommended cable cross-section for 380 V/400 V				
- DC link infeed (2/3 inverter power)		4 x 120 mm ²	4 x 150 mm ²	4 x 185 mm ²
- Braking Module ⁴⁾		35 mm ²	35 mm ²	35 mm ²
Recommended cable cross-section for 480 V				
- DC link infeed (2/3 inverter power)		3 x 120 mm ²	3 x 150 mm ²	3 x 185 mm ²
- Braking Module ⁴⁾		35 mm ²	35 mm ²	35 mm ²
Tightening torque for line, motor, DC link, and ground cable		50 Nm / 443 lbf in	50 Nm / 443 lbf in	50 Nm / 443 lbf in
Dimensions: Width x height x depth [mm]		801 x 1621 x 393	801 x 1621 x 393	801 x 1621 x 393
Weight		235 kg	250 kg	250 kg

- ¹⁾ The line supply must be capable of supplying the minimum short-circuit current so that the fuses trigger and consequential damage is avoided.
Note: If the minimum short-circuit current is not reached, then the tripping time for the fuses increases, and this may result in consequential damage.
- ²⁾ When semiconductor fuses are used, they must be mounted in the same higher construction as the inverter.
- ³⁾ The motor cables must be evenly distributed at both connection chambers.
- ⁴⁾ For connection of the Braking Module with rated power of 50 kW, P₂₀ power of 200 kW.

Table 10-33 PM330, frame size HX, 3-phase 500 ... 690 VAC, Part 1

Article No.	6SL3310-	1PG33-7AA0	1PG34-0AA0	1PG34-5AA0
Rated input current				
- at 500 V, 45 °C		383 A	416 A	471 A
- at 600 V, 45 °C		367 A	412 A	459 A
- at 690 V, 45 °C		354 A	409 A	447 A
- at 500 V, 55 °C		326 A	354 A	400 A
- at 600 V, 55 °C		312 A	350 A	390 A
- at 690 V, 55 °C		301 A	348 A	380 A
Rated input current DCP/DCN (for 2/3 of the inverter power)				
- at 675 V _{DC} , 45 °C		314 A	341 A	385 A
- at 810 V _{DC} , 45 °C		301 A	337 A	376 A
- at 930 V _{DC} , 45 °C		290 A	335 A	366 A
- at 675 V _{DC} , 55 °C		267 A	290 A	328 A
- at 810 V _{DC} , 55 °C		255 A	287 A	319 A
- at 930 V _{DC} , 55 °C		246 A	284 A	311 A
Rated output current I_N				
- at 500 V, 45 °C		368 A	400 A	453 A
- at 600 V, 45 °C		353 A	396 A	441 A
- at 690 V, 45 °C		340 A	393 A	430 A
- at 500 V, 55 °C		313 A	340 A	385 A
- at 600 V, 55 °C		300 A	337 A	375 A
- at 690 V, 55 °C		289 A	334 A	366 A
LO base load power				
LO base load input current at 690 V		343 A	401 A	437 A
LO base load output current at 690 V		330 A	385 A	420 A
HO base load power				
HO base load input current at 690 V		283 A	327 A	362 A
HO base load output current at 690 V		272 A	314 A	348 A
Fuse according to IEC				
		3NE1333-2 (450 A/690 V)	3NE1334-2 (500 A/690 V)	3NE1435-2 (560 A/690 V)
manufacturer:		Siemens AG	Siemens AG	Siemens AG
Maximum permissible line short-circuit current I _{kmax}		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I _{kmin} ¹⁾		> 3.5 kA	> 4.5 kA	> 7.0 kA
Fuse in compliance with UL²⁾				
		3NE1333-2 (450 A/690 V)	3NE1334-2 (500 A/690 V)	3NE1435-2 (560 A/690 V)
Manufacturer:		Siemens AG	Siemens AG	Siemens AG
Maximum permissible line short-circuit current I _{kmax}		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I _{kmin} ¹⁾		> 3.5 kA	> 4.5 kA	> 7.0 kA
max. power loss, at I _N , 45 °C, 690 V		5.402 kW	6.191 kW	6.884 kW
Required cooling air flow		360 l/s	360 l/s	360 l/s
Maximum connectable cross-section of the line, motor and DC-link cable				
		4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil
Recommended cable cross-section for 500 V				
- line cable		2 x 120 mm ²	2 x 150 mm ²	2 x 185 mm ²
- motor cable		2 x 120 mm ²	2 x 120 mm ²	2 x 150 mm ²
Recommended cable cross-section for 690 V				
- line cable		2 x 120 mm ²	2 x 150 mm ²	2 x 185 mm ²
- motor cable		2 x 95 mm ²	2 x 120 mm ²	2 x 150 mm ²

Technical data

10.5 Technical data, PM330 Power Module

Article No.	6SL3310-	1PG33-7AA0	1PG34-0AA0	1PG34-5AA0
Recommended cable cross-section for 500 V - DC link infeed (2/3 inverter power)		2 x 95 mm ²	2 x 120 mm ²	2 x 150 mm ²
Recommended cable cross-section for 690 V - DC link infeed (2/3 inverter power)		2 x 95 mm ²	2 x 120 mm ²	2 x 150 mm ²
Tightening torque for line, motor, DC link, and ground cable		50 Nm / 443 lbf in	50 Nm / 443 lbf in	50 Nm / 443 lbf in
Dimensions: Width x height x depth [mm]		548 x 1695 x 393	548 x 1695 x 393	548 x 1695 x 393
Weight		158 kg	158 kg	162 kg
Minimum control cabinet size for installation of the Power Module (width x height x depth)		800 mm x 2000 mm x 600 mm		

- 1) The line supply must be capable of supplying the minimum short-circuit current so that the fuses trigger and consequential damage is avoided.
Note: If the minimum short-circuit current is not reached, then the tripping time for the fuses increases, and this may result in consequential damage.
- 2) When semiconductor fuses are used, they must be mounted in the same higher construction as the inverter.

Table 10-34 PM330, frame size HX, 3-phase 500 ... 690 VAC, Part 2

Article No.	6SL3310-	1PG35-2AA0
Rated input current		
- at 500 V, 45 °C		537 A
- at 600 V, 45 °C		517 A
- at 690 V, 45 °C		499 A
- at 500 V, 55 °C		456 A
- at 600 V, 55 °C		440 A
- at 690 V, 55 °C		425 A
Rated input current DCP/DCN (for 2/3 of the inverter power)		
- at 675 V _{DC} , 45 °C		439 A
- at 810 V _{DC} , 45 °C		423 A
- at 930 V _{DC} , 45 °C		409 A
- at 675 V _{DC} , 55 °C		373 A
- at 810 V _{DC} , 55 °C		360 A
- at 930 V _{DC} , 55 °C		347 A
Rated output current I _N		
- at 500 V, 45 °C		516 A
- at 600 V, 45 °C		497 A
- at 690 V, 45 °C		480 A
- at 500 V, 55 °C		438 A
- at 600 V, 55 °C		422 A
- at 690 V, 55 °C		408 A
LO base load power		450 kW
LO base load input current at 690 V		489 A
LO base load output current at 690 V		470 A
HO base load power		400 kW
HO base load input current at 690 V		410 A
HO base load output current at 690 V		394 A

Article No.	6SL3310-	1PG35-2AA0
Fuse according to IEC		3NE1436-2 (630 A/690 V)
manufacturer:		Siemens AG
Maximum permissible line short-circuit current I_{kmax}		≤ 100 kA
Minimum line short-circuit current required I_{kmin} ¹⁾		> 8.5 kA
Fuse in compliance with UL ²⁾		3NE1436-2 (630 A/690 V)
Manufacturer:		Siemens AG
Maximum permissible line short-circuit current I_{kmax}		≤ 100 kA
Minimum line short-circuit current required I_{kmin} ¹⁾		> 8.5 kA
max. power loss, at I_N , 45 °C, 690 V		7.716 kW
Required cooling air flow		360 l/s
Maximum connectable cross-section of the line, motor and DC-link cable		4 x 240 mm ² 4 x 500 kcmil
Recommended cable cross-section for 500 V		
- line cable		3 x 120 mm ²
- motor cable		3 x 95 mm ²
Recommended cable cross-section for 690 V		
- line cable		3 x 120 mm ²
- motor cable		3 x 95 mm ²
Recommended cable cross-section for 500 V - DC link infeed (2/3 inverter power)		2 x 150 mm ²
Recommended cable cross-section for 690 V - DC link infeed (2/3 inverter power)		2 x 150 mm ²
Tightening torque for line, motor, DC link, and ground cable		50 Nm / 443 lbf in
Dimensions: Width x height x depth [mm]		548 x 1695 x 393
Weight		162 kg
Minimum control cabinet size for installation of the Power Module (width x height x depth)		800 mm x 2000 mm x 600 mm

1) The line supply must be capable of supplying the minimum short-circuit current so that the fuses trigger and consequential damage is avoided.

Note: If the minimum short-circuit current is not reached, then the tripping time for the fuses increases, and this may result in consequential damage.

2) When semiconductor fuses are used, they must be mounted in the same higher construction as the inverter.

Table 10-35 PM330, frame size JX, 3 AC 500 V ... 690 V

Article No.	6SL3310-	1PG35-8AA0	1PG36-5AA0	1PG37-2AA0
Rated input current				
- at 500 V, 45 °C		596 A	679 A	753 A
- at 600 V, 45 °C		578 A	647 A	720 A
- at 690 V, 45 °C		555 A	618 A	690 A
- at 500 V, 55 °C		506 A	577 A	640 A
- at 600 V, 55 °C		492 A	550 A	612 A
- at 690 V, 55 °C		472 A	525 A	587 A
Rated input current DCP/DCN (for 2/3 of the inverter power)				
- at 675 V _{DC} , 45 °C		495 A	557 A	617 A
- at 810 V _{DC} , 45 °C		474 A	531 A	590 A
- at 930 V _{DC} , 45 °C		456 A	507 A	566 A
- at 675 V _{DC} , 55 °C		420 A	473 A	525 A
- at 810 V _{DC} , 55 °C		403 A	451 A	502 A
- at 930 V _{DC} , 55 °C		387 A	431 A	481 A
Rated output current I _N				
- at 500 V, 45 °C		581 A	654 A	725 A
- at 600 V, 45 °C		557 A	623 A	693 A
- at 690 V, 45 °C		535 A	595 A	665 A
- at 500 V, 55 °C		494 A	555 A	616 A
- at 600 V, 55 °C		473 A	530 A	589 A
- at 690 V, 55 °C		455 A	506 A	565 A
LO base load power				
		500 kW	560 kW	630 kW
LO base load input current at 690 V				
		540 A	602 A	675 A
LO base load output current at 690 V				
		520 A	580 A	650 A
HO base load power				
		450 kW	500 kW	560 kW
HO base load input current at 690 V				
		461 A	494 A	552 A
HO base load output current at 690 V				
		444 A	476 A	532 A
Fuse according to IEC				
		3NE1437-2 (710 A/690 V)	3NE1438-2 (800 A/690 V)	3NE1448-2 (850 A/690 V)
manufacturer:				
		Siemens AG	Siemens AG	Siemens AG
Maximum permissible line short-circuit current I _{kmax}				
		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I _{kmin} ¹⁾				
		> 10.0 kA	> 11.0 kA	> 13.0 kA
Fuse in compliance with UL ²⁾				
		3NE1437-2 (710 A/690 V)	3NE1438-2 (800 A/690 V)	3NE1448-2 (850 A/690 V)
Manufacturer:				
		Siemens AG	Siemens AG	Siemens AG
Maximum permissible line short-circuit current I _{kmax}				
		≤ 100 kA	≤ 100 kA	≤ 100 kA
Minimum line short-circuit current required I _{kmin} ¹⁾				
		> 10.0 kA	> 11.0 kA	> 13.0 kA
max. power loss, at I _N , 45 °C, 690 V				
		8.134 kW	8.828 kW	9.937 kW
Required cooling air flow				
		450 l/s	450 l/s	450 l/s
Maximum connectable cross-section of the power cable				
		6 x 240 mm ² 6 x 500 kcmil	6 x 240 mm ² 6 x 500 kcmil	6 x 240 mm ² 6 x 500 kcmil
Maximum connectable cross-section of the motor cable				
		4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil
Maximum connectable cross-section of the DC link cable				
		4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil	4 x 240 mm ² 4 x 500 kcmil

Article No.	6SL3310-	1PG35-8AA0	1PG36-5AA0	1PG37-2AA0
Recommended cable cross-section for 500 V				
- line cable		2 x 240 mm ²	3 x 185 mm ²	3 x 185 mm ²
- motor cable ³⁾		2 x 185 mm ²	2 x 240 mm ²	2 x 240 mm ²
Recommended cable cross-section for 690 V				
- line cable		2 x 240 mm ²	3 x 150 mm ²	3 x 185 mm ²
- motor cable ³⁾		2 x 185 mm ²	2 x 240 mm ²	2 x 240 mm ²
Recommended cable cross-section for 500 V				
- DC link infeed (2/3 inverter power)		2 x 185 mm ²	2 x 185 mm ²	2 x 240 mm ²
Recommended cable cross-section for 690 V				
- DC link infeed (2/3 inverter power)		2 x 150 mm ²	2 x 185 mm ²	2 x 185 mm ²
Tightening torque for line, motor, DC link, and ground cable		50 Nm / 443 lbf in	50 Nm / 443 lbf in	50 Nm / 443 lbf in
Dimensions: Width x height x depth [mm]		801 x 1621 x 393	801 x 1621 x 393	801 x 1621 x 393
Weight		236 kg	236 kg	246 kg

- 1) The line supply must be capable of supplying the minimum short-circuit current so that the fuses trigger and consequential damage is avoided.
 Note: If the minimum short-circuit current is not reached, then the tripping time for the fuses increases, and this may result in consequential damage.
- 2) When semiconductor fuses are used, they must be mounted in the same higher construction as the inverter.
- 3) The motor cables must be evenly distributed at both connection chambers.

10.6 Technical data, PM240-2 Power Module

Protective devices for the Power Module

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

Additional components for branch protection are available in the Internet:

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

Typical inverter load cycles

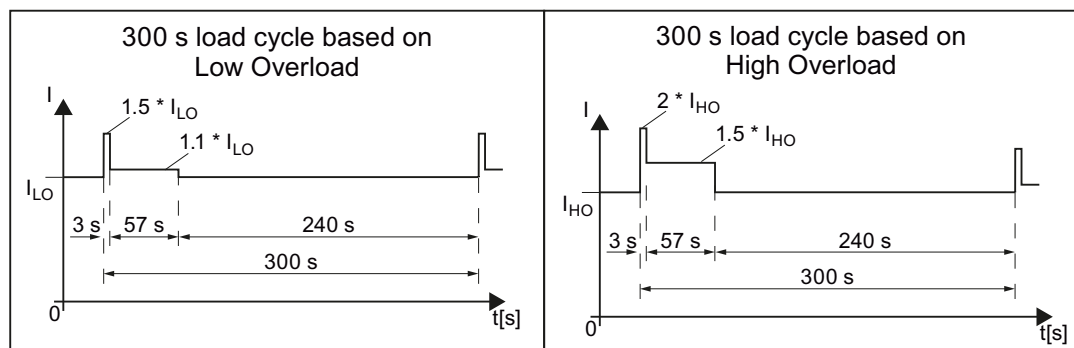





Figure 10-5 "Low Overload" and "High Overload" load cycles

10.6.1 Ambient conditions




Property	Version
Ambient conditions for transport in the transport packaging	
Climatic ambient conditions	- 40 °C ... + 70 °C, according to Class 2K4 to EN 60721-3-2 maximum humidity 95% at 40 °C
Mechanical ambient conditions	Shock and vibration permissible according to 1M2 to EN 60721-3-2
Protection against chemical substances	Protected according to Class 2C2 to EN 60721-3-2
Biological ambient conditions	Suitable according to Class 2B1 to EN 60721-3-2
Ambient conditions for long-term storage in the product packaging	
Climatic ambient conditions	- 25 °C ... + 55 °C, according to Class 1K3 to EN 60721-3-1
Protection against chemical substances	Protected according to Class 1C2 to EN 60721-3-1
Biological ambient conditions	Suitable according to class 1B1 to EN 60721-3-1
Ambient conditions in operation	

Property	Version
Installation altitude	Up to 1000 m above sea level without limitations  Restrictions for special ambient conditions (Page 515)
Climatic ambient conditions ¹⁾	<ul style="list-style-type: none"> • FSA ... FSC ambient operating temperature²⁾ <ul style="list-style-type: none"> – For operation according to Low Overload: -10 °C ... +40 °C – For operation according to High Overload: -10 °C ... +50 °C –  Restrictions for special ambient conditions (Page 515) • FSD ... FSG ambient operating temperature²⁾ <ul style="list-style-type: none"> – For operation according to Low Overload: -20 °C ... +40 °C – For operation according to High Overload: -20 °C ... +50 °C –  Restrictions for special ambient conditions (Page 515) • Relative humidity: 5 ... 95%, condensation not permitted • Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical ambient conditions	Vibration test during operation according to IEC 60068-2-6 Test Fc (sinusoidal) <ul style="list-style-type: none"> • 0 ... 57 Hz: 0.075 mm deflection amplitude • 57 ... 150 Hz: 1 g acceleration amplitude • 10 frequency cycles per axis Shock test according to IEC 60068-2-27 Test Ea (half-sine) <ul style="list-style-type: none"> • 5 g peak acceleration • 30 ms duration • 3 shocks in all three axes in both directions
Protection against chemical substances	<ul style="list-style-type: none"> • FSA ... FSC: Protected according to 3C2 to EN 60721-3-3 • FSD ... FSG: 3C3 protection according to EN 60721-3-3
Biological ambient conditions	Suitable according to 3B1 to EN 60721-3-3
Pollution	Suitable for environments with degree of pollution 2 according to EN 61800-5-1
Cooling	Forced air cooling AF, according to EN 60146
Cooling air	Clean and dry air
Noise emission	Maximum 75 db(A)

¹⁾ Increased ruggedness regarding temperature range and relative humidity; therefore better than 3K3 according to EN 60721-3-3

²⁾ Observe the permissible ambient operating temperatures for the Control Unit and the Operator Panel (IOP-2 or BOP-2).

10.6.2 General technical data, 200 V inverters

Property	Version
Line voltage	FSA ... FSC 200 V ... 240 V 1 AC ± 10% 0.55 kW ... 4 kW - LO 0.37 kW ... 3 kW - HO
	200 V ... 240 V 3 AC ± 10% 0.55 kW ... 7.5 kW - LO 0.37 kW ... 5.5 kW - HO
	FSD ... FSF 200 V ... 240 V 3 AC ± 10% (in operation -20% < 1 min)
Line supply configurations	Grounded TN/TT line supplies or non-grounded IT line supplies  Connecting the line supply and motor (Page 86)
Line impedance	FSA ... FSC 2% ≤ Uk < 4%. For Uk < 2%, we recommend a line reactor, or a Power Module with the next higher power rating.
	FSD ... FSF No restrictions
Power factor λ	FSA ... FSC 0.7 without line reactor for Uk ≥ 2% 0.85 with line reactor for Uk < 2%
	FSD ... FSF > 0.9
Output voltage	0 V 3 AC ... 0.95 × input voltage
Input frequency	50 Hz ... 60 Hz, ± 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	< LO base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	4 kHz (factory setting), Adjustable in steps of 2 kHz.
	 Current reduction as a function of the pulse frequency (Page 492) If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current (SCCR) and branch protection	Maximum permissible line short-circuit current ≤ 100 kA rms Minimum required short-circuit current ≥ 5 kA rms
	The length of the connecting cable from the line to the inverter may not reduce the minimum short-circuit current
	 Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper
Degree of protection according to EN 60529	IP20
	IP55 PT devices outside the control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF

10.6.3 Specific technical data, 200 V inverters

Table 10-36 PM240-2, IP20, frame size A, 200 V ... 240 V 1 AC / 3 AC

Article No. without filter	6SL3210-1PB13-0UL0	6SL3210-1PB13-8UL0
Article No. with filter	6SL3210-1PB13-0AL0	6SL3210-1PB13-8AL0
LO base load power	0.55 kW	0.75 kW
1 AC LO base load input current	7.5 A	9.6 A
3 AC LO base load input current	4.2 A	5.5 A
LO base load output current	3.2 A	4.2 A
HO base load power	0.37 kW	0.55 kW
1 AC HO base load input current	6.6 A	8.4 A
3 AC HO base load input current	3.0 A	4.2 A
HO base load output current	2.3 A	3.2 A
Fuse according to IEC	3NA3805 (16 A)	3NA3805 (16 A)
Fuse according to UL, class J	15 A	15 A
Power loss	0.04 kW	0.04 kW
Required cooling air flow	5 l/s	5 l/s
Weight without filter	1.4 kg	1.4 kg
Weight with filter	1.6 kg	1.6 kg

Table 10-37 PM240-2, PT, frame size A, 200 V ... 240 V 1 AC / 3 AC

Article No. without filter	6SL3211-1PB13-8UL0
Article No. with filter	6SL3211-1PB13-8AL0
LO base load power	0.75 kW
1 AC LO base load input current	9.6 A
3 AC LO base load input current	5.5 A
LO base load output current	4.2 A
HO base load power	0.55 kW
1 AC HO base load input current	8.4 A
3 AC HO base load input current	4.2 A
HO base load output current	3.2 A
Fuse according to IEC	3NA3 805 (16 A)
Fuse according to UL, class J	15 A
Power loss	0.04 kW
Required cooling air flow	5 l/s
Weight without filter	1.8 kg
Weight with filter	2.0 kg

Technical data

10.6 Technical data, PM240-2 Power Module

Table 10-38 PM240-2, IP20, frame size B, 200 V ... 240 V 1 AC / 3 AC

Article No. without filter	6SL3210-1PB15-5ULO	6SL3210-1PB17-4ULO	6SL3210-1PB21-0ULO
Article No. with filter	6SL3210-1PB15-5ALO	6SL3210-1PB17-4ALO	6SL3210-1PB21-0ALO
LO base load power	1.1 kW	1.5 kW	2.2 kW
1 AC LO base load input current	13.5 A	18.1 A	24.0 A
3 AC LO base load input current	7.8 A	9.7 A	13.6 A
LO base load output current	6 A	7.4 A	10.4 A
HO base load power	0.75 kW	1.1 kW	1.5 kW
1 AC HO base load input current	11.8 A	15.8 A	20.9 A
3 AC HO base load input current	5.5 A	7.8 A	9.7 A
HO base load output current	4.2 A	6 A	7.4 A
Fuse according to IEC	3NA3812 (32 A)	3NA3812 (32 A)	3NA3812 (32 A)
Fuse according to UL, class J	35 A	35 A	35 A
Power loss	0.05 kW	0.07 kW	0.12 kW
Required cooling air flow	9.2 l/s	9.2 l/s	9.2 l/s
Weight without filter	2.8 kg	2.8 kg	2.8 kg
Weight with filter	3.1 kg	3.1 kg	3.1 kg

Table 10-39 PM240-2, PT, frame size B, 200 V ... 240 V 1 AC / 3 AC

Article No. without filter	6SL3211-1PB21-0ULO
Article No. with filter	6SL3211-1PB21-0ALO
LO base load power	2.2 kW
1 AC LO base load input current	24.0 A
3 AC LO base load input current	13.6 A
LO base load output current	10.4 A
HO base load power	1.5 kW
1 AC HO base load input current	20.9 A
3 AC HO base load input current	9.7 A
HO base load output current	7.4 A
Fuse according to IEC	3NA3812 (32 A)
Fuse according to UL, class J	35 A
Power loss	0.12 kW ¹⁾
Required cooling air flow	9.2 l/s
Weight without filter	3.4 kg
Weight with filter	3.7 kg

¹⁾ approx. 0.08 kW through the heat sink

Table 10-40 PM240-2, IP 20, frame size C, 200 V ... 240 V 1 AC / 3 AC

Article No. without filter Article No. with filter	6SL3210-1PB21-4UL0 6SL3210-1PB21-4AL0	6SL3210-1PB21-8UL0 6SL3210-1PB21-8AL0
LO base load power	3 kW	4 kW
1 AC LO base load input current	35.9 A	43.0 A
3 AC LO base load input current	17.7 A	22.8 A
LO base load output current	13.6 A	17.5 A
HO base load power	2.2 kW	3 kW
1 AC HO base load input current	31.3 A	37.5 A
3 AC HO base load input current	13.6 A	17.7 A
HO base load output current	10.4 A	13.6 A
Fuse according to IEC Fuse according to UL, class J	3NA3820 (50 A) 50 A	3NA3820 (50 A) 50 A
Power loss	0.14 kW	0.18 kW
Required cooling air flow	18.5 l/s	18.5 l/s
Weight without filter	5.0 kg	5.0 kg
Weight with filter	5.2 kg	5.2 kg

Table 10-41 PM240-2, PT, frame size C, 200 V ... 240 V 1 AC / 3 AC

Article No. without filter Article No. with filter	6SL3211-1PB21-8UL0 6SL3211-1PB21-8AL0
LO base load power	4 kW
1 AC LO base load input current	43.0 A
3 AC LO base load input current	22.8 A
LO base load output current	17.5 A
HO base load power	3 kW
1 AC HO base load input current	37.5 A
3 AC HO base load input current	17.7 A
HO base load output current	13.6 A
Fuse according to IEC Fuse according to UL, class J	3NA3820 (50 A) 50 A
Power loss	0.18 kW ¹⁾
Required cooling air flow	18.5 l/s
Weight without filter	5.9 kg
Weight with filter	6.2 kg

¹⁾ approx. 0.09 kW through the heat sink

Technical data

10.6 Technical data, PM240-2 Power Module

Table 10-42 PM240-2, IP 20, frame size C, 200 V ... 240 V 3 AC

Article No. without filter	6SL3210-1PC22-2UL0	6SL3210-1PC22-8UL0
Article No. with filter	6SL3210-1PC22-2AL0	6SL3210-1PC22-8AL0
LO base load power	5.5 kW	7.5 kW
LO base load input current	28.6 A	36.4 A
LO base load output current	22.0 A	28.0 A
HO base load power	4 kW	5.5 kW
HO base load input current	22.8 A	28.6 A
HO base load output current	17.5 A	22.0 A
Fuse according to IEC	3NA3820 (50 A)	3NA3820 (50 A)
Fuse according to UL, class J	50 A	50 A
Power loss	0.2 kW	0.26 kW
Required cooling air flow	18.5 l/s	18.5 l/s
Weight without filter	5.0 kg	5.0 kg
Weight with filter	5.2 kg	5.2 kg

Table 10-43 PM240-2, PT, frame size C, 200 V ... 240 V 3 AC

Article No. without filter	6SL3211-1PC22-2UL0	6SL3211-1PC22-8UL0
Article No. with filter	6SL3211-1PC22-2AL0	6SL3211-1PC22-8AL0
LO base load power	5.5 kW	7.5 kW
LO base load input current	28.6 A	36.4 A
LO base load output current	22.0 A	28.0 A
HO base load power	4 kW	5.5 kW
HO base load input current	22.8 A	28.6 A
HO base load output current	17.5 A	22.0 A
Fuse according to IEC	3NA3820 (50 A)	3NA3820 (50 A)
Fuse according to UL, class J	50 A	50 A
Power loss	0.2 kW ¹⁾	0.26 kW ²⁾
Required cooling air flow	18.5 l/s	18.5 l/s
Weight without filter	5.9 kg	5.9 kg
Weight with filter	6.2 kg	6.2 kg

¹⁾ approx. 0.2 kW through the heatsink

²⁾ approx. 0.25 kW through the heatsink

Table 10-44 PM240-2, IP20, frame size D, 200 V ... 240 V 3 AC

Article No. without filter	6SL3210-1PC24-2UL0	6SL3210-1PC25-4UL0	6SL3210-1PC26-8UL0
LO base load power	11 kW	15 kW	18.5 kW
LO base load input current	40 A	51 A	64 A
LO base load output current	42 A	54 A	68 A
HO base load power	7.5 kW	11 kW	15 kW
HO base load input current	36 A	43 A	56 A
HO base load output current	35 A	42 A	54 A
Fuse according to IEC	3NA3822 (63 A)	3NA3824 (80 A)	3NA3830 (100 A)
Fuse according to UL, class J	60 A	70 A	90 A
Power loss	0.45 kW	0.61 kW	0.82 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight	17 kg	17 kg	17 kg

Table 10-45 PM240-2, PT, frame size D, 200 V ... 240 V 3 AC

Article No. without filter	6SL3211-1PC26-8UL0
LO base load power	18.5 kW
LO base load input current	64 A
LO base load output current	68 A
HO base load power	15 kW
HO base load input current	56 A
HO base load output current	54 A
Fuse according to IEC	3NA3830 (100 A)
Fuse according to UL, class J	90 A
Power loss	0.82 kW ¹⁾
Required cooling air flow	55 l/s
Weight	19.5 kg

¹⁾ approx. 0.72 kW through the heatsink

Technical data

10.6 Technical data, PM240-2 Power Module

Table 10-46 PM240-2, IP20, frame size E, 200 V ... 240 V 3 AC

Article No. without filter	6SL3210-1PC28-0UL0	6SL3210-1PC31-1UL0
LO base load power	22 kW	30 kW
LO base load input current	76 A	98 A
LO base load output current	80 A	104 A
HO base load power	18.5 kW	22 kW
HO base load input current	71 A	83 A
HO base load output current	68 A	80 A
Fuse according to IEC	3NA3830 (100 A)	3NA3836 (160 A)
Fuse according to UL, class J	100 A	150 A
Power loss	0.92 kW	1.28 kW
Required cooling air flow	83 l/s	83 l/s
Weight	26 kg	26 kg

Table 10-47 PM240-2, PT, frame size E, 200 V to 240 V 3 AC

Article No. without filter	6SL3211-1PC31-1UL0
LO base load power	30 kW
LO base load input current	98 A
LO base load output current	104 A
HO base load power	22 kW
HO base load input current	83 A
HO base load output current	80 A
Fuse according to IEC	3NA3836 (160 A)
Fuse according to UL, class J	150 A
Power loss	1.28 kW ¹⁾
Required cooling air flow	83 l/s
Weight	29 kg

¹⁾ approx. 1.1 kW through the heatsink

Table 10-48 PM240-2, IP20, frame size F, 200 V ... 240 V 3 AC

Article No. without filter	6SL3210-1PC31-3UL0	6SL3210-1PC31-6UL0	6SL3210-1PC31-8UL0
LO base load power	37 kW	45 kW	55 kW
LO base load input current	126 A	149 A	172 A
LO base load output current	130 A	154 A	178 A
HO base load power	30 kW	37 kW	45 kW
HO base load input current	110 A	138 A	164 A
HO base load output current	104 A	130 A	154 A
Fuse according to IEC	3NA3140 (200 A)	3NA3140 (200 A)	3NA3142 (224 A)
Fuse according to UL, class J	175 A	200 A	250 A
Power loss	1.38 kW	1.72 kW	2.09 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight	57 kg	57 kg	57 kg

Table 10-49 PM240-2, PT, frame size F, 200 V to 240 V 3 AC

Article No. without filter	6SL3211-1PC31-8UL0
LO base load power	55 kW
LO base load input current	172 A
LO base load output current	178 A
HO base load power	45 kW
HO base load input current	164 A
HO base load output current	154 A
Fuse according to IEC	3NA3142 (224 A)
Fuse according to UL, class J	250 A
Power loss	2.09 kW ¹⁾
Required cooling air flow	153 l/s
Weight	60 kg

¹⁾ approx. 1.9 kW through the heatsink




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

Article number	LO power [kW]	Pulse frequency [kHz]							
		2	4 *)	6	8	10	12	14	16
		LO base load output current [A]							
6SL3210-1PB13-0 . LO	0.55	3.2	3.2	2.7	2.2	1.9	1.6	1.4	1.3
6SL321 . -1PB13-8 . LO	0.75	4.2	4.2	3.6	2.9	2.5	2.1	1.9	1.7
6SL3210-1PB15-5 . LO	1.1	6	6	5.1	4.2	3.6	3	2.7	2.4
6SL3210-1PB17-4 . LO	1.5	7.4	7.4	6.3	5.2	4.4	3.7	3.3	3
6SL321 . -1PB21-0 . LO	2.2	10.4	10.4	8.8	7.3	6.2	5.2	4.7	4.2
6SL3210-1PB21-4 . LO	3	13.6	13.6	11.6	9.5	8.2	6.8	6.1	5.4
6SL321 . -1PB21-8 . LO	4	17.5	17.5	14.9	12.3	10.5	8.8	7.9	7
6SL3210-1PC22-2 . LO	5.5	22	22	18.7	15.4	13.2	11	9.9	8.8
6SL3210-1PC22-8 . LO	7.5	28	28	23.8	19.6	16.8	14	12.6	11.2
6SL3210-1PC24-2UL0	11	42	42	35.7	29.4	25.2	21	18.9	16.8
6SL3210-1PC25-4UL0	15	54	54	45.9	37.8	32.4	27	24.3	21.6
6SL321 . -1PC26-8UL0	18.5	68	68	57.8	47.6	40.8	34	30.6	27.2
6SL3210-1PC28-0UL0	22	80	80	68	56	48	40	36	32
6SL321 . -1PC31-1UL0	30	104	104	88.4	72.8	62.4	52	46.8	41.6
6SL3210-1PC31-3UL0	37	130	130	110.5	91	---	---	---	---
6SL3210-1PC31-6UL0	45	154	154	130.9	107.8	---	---	---	---
6SL321 . -1PC31-8UL0	55	178	178	151.3	124.6	---	---	---	---

*) Factory setting

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

10.6.5 General technical data, 400 V inverters

Property	Version
Line voltage	FSA ... FSC 380 V ... 480 V 3 AC ± 10%
	FSD ... FSG 380 V ... 480 V 3 AC ± 10% (in operation -20% < 1 min)
Line supply configurations	Grounded TN/TT line supplies or non-grounded IT line supplies  Connecting the line supply and motor (Page 86)
Line impedance	FSA ... FSC 1% ≤ Uk < 4%, for values smaller than 1%, we recommend a line reactor, or a Power Module with the next higher power rating.
	FSD ... FSG No restrictions
Power factor λ	FSA ... FSC 0.7 without line reactor for Uk ≥ 1% 0.85 with line reactor for Uk < 1%
	FSD ... FSG > 0.9
Output voltage	0 V 3 AC ... 0.95 x input voltage (max.)
Input frequency	50 Hz ... 60 Hz, ± 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	< LO base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	Factory setting
	<ul style="list-style-type: none"> • 4 kHz for devices with an LO base load power < 110 kW • 2 kHz for devices with an LO base load power ≥ 110 kW Can be adjusted in 2 kHz steps as follows: <ul style="list-style-type: none"> • 2 kHz ... 16 kHz for devices with an LO base load power < 55 kW • 2 kHz ... 8 kHz for devices with an LO base load output of 55 kW ... 90 kW and ≥ 160 kW • 2 kHz ... 4 kHz for devices with an LO base load power of 110 kW ... 132 kW  Current reduction as a function of the pulse frequency (Page 502) If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current (SCCR) and branch protection	Maximum permissible line short-circuit current ≤ 100 kA rms
	Minimum required short-circuit current ≥ 18 kA rms The length of the connecting cable from the line to the inverter may not reduce the minimum short-circuit current  Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper
Degree of protection according to EN 60529	IP20
	IP55 PT devices outside the control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF

10.6.6 Specific technical data, 400 V inverters

Table 10-50 PM240-2, IP20, frame size A, 380 V ... 480 V 3 AC

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

Table 10-51 PM240-2, IP20, frame size A, 380 V ... 480 V 3 AC

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

Table 10-52 PM240-2, PT, frame size A, 380 V ... 480 V 3 AC

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

1) approx. 0.1 kW through the heatsink

Table 10-53 PM240-2, IP20, frame size B, 380 V ... 480 V 3 AC

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

Technical data

10.6 Technical data, PM240-2 Power Module

Table 10-54 PM240-2, PT, frame size B, 380 V ... 480 V 3 AC

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

1) approx. 0.16 kW through the heatsink

Table 10-55 PM240-2, IP20, frame size C, 380 V ... 480 V 3 AC

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

Table 10-56 PM240-2, PT, frame size C, 380 V ... 480 V 3 AC

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

1) approx. 0.3 kW through the heatsink

Table 10-57 PM240-2, IP20, frame size D, 380 V ... 480 V 3 AC

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

Technical data

10.6 Technical data, PM240-2 Power Module

Table 10-58 PM240-2, IP20, frame size D, 380 V ... 480 V 3 AC

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

Table 10-59 PM240-2, PT, frame size D, 380 V ... 480 V 3 AC

Article No. without filter	6SL3211-1PE27-5UL0
Article No. with filter	6SL3211-1PE27-5AL0
LO base load power	37 kW
LO base load input current	70 A
LO base load output current	75 A
HO base load power	30 kW
HO base load input current	62 A
HO base load output current	60 A
Fuse according to IEC	3NA3830 (100 A)
Fuse according to UL, class J	100 A
Power loss without filter	1.09 kW ¹⁾
Power loss with filter	1.10 kW ¹⁾
Required cooling air flow	55 l/s
Weight without filter	20 kg
Weight with filter	21.5 kg

¹⁾ Approx. 1 kW through the heatsink

Table 10-60 PM240-2, IP20, frame size E, 380 V ... 480 V 3 AC

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

Table 10-61 PM240-2, PT, frame size E, 380 V ... 480 V 3 AC

Article No. without filter	6SL3211-1PE31-1UL0
Article No. with filter	6SL3211-1PE31-1AL0
LO base load power	55 kW
LO base load input current	104 A
LO base load output current	110 A
HO base load power	45 kW
HO base load input current	94 A
HO base load output current	90 A
Fuse according to IEC	3NA3836 (160 A)
Fuse according to UL, class J	150 A
Power loss without filter	1.65 kW ¹⁾
Power loss with filter	1.67 kW ¹⁾
Required cooling air flow	83 l/s
Weight without filter	30.5 kg
Weight with filter	32 kg

¹⁾ Approx. 1.4 kW through the heatsink

Technical data

10.6 Technical data, PM240-2 Power Module

Table 10-62 PM240-2, IP20, frame size F, 380 V ... 480 V 3 AC

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

Table 10-63 PM240-2, IP20, frame size F, 380 V ... 480 V 3 AC

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

Table 10-64 PM240-2, PT, frame size F, 380 V ... 480 V 3 AC

Article No. without filter	6SL3211-1PE32-5ULO
Article No. with filter	6SL3211-1PE32-5ALO
LO base load power	132 kW
LO base load input current	242 A
LO base load output current	250 A
HO base load power	110 kW
HO base load input current	218 A
HO base load output current	205 A
Fuse according to IEC	3NA3252 (315 A)
Fuse according to UL, class J	350 A
Power loss without filter	2.98 kW ¹⁾
Power loss with filter	3.02 kW ¹⁾
Required cooling air flow	153 l/s
Weight without filter	63.5 kg
Weight with filter	68 kg

¹⁾ Approx. 2.6 kW through the heatsink

Table 10-65 PM240-2, frame size G, 380 V ... 480 V 3 AC

Article No. with filter class C3	6SL3210-1PE33-0CLO	6SL3210-1PE33-7CLO	6SL3210-1PE34-8CLO
Article No. with filter class C2	6SL3210-1PE33-0ALO	6SL3210-1PE33-7ALO	6SL3210-1PE34-8ALO
LO base load power	160 kW	200 kW	250 kW
LO base load input current	300 A	365 A	470 A
LO base load output current	302 A	370 A	477 A
HO base load power	132 kW	160 kW	200 kW
HO base load input current	275 A	330 A	400 A
HO base load output current	250 A	302 A	370 A
Fuse according to IEC	3NA3254 (355 A)	3NA3260 (400 A)	3NA3372 (630 A)
Fuse according to UL, class J	400 A	500 A	600 A
Fuse according to IEC/UL	3NE1334-2 (500A)	3NE1334-2 (500A)	3NE1436-2 (630A)
Power loss with filter class C3	3.67 kW	4.62 kW	6.18 kW
Power loss with filter class C2	3.67 kW	4.62 kW	6.18 kW
Required cooling air flow	210 l/s	210 l/s	210 l/s
Weight with filter class C3	105 kg	113 kg	120 kg
Weight with filter class C2	107 kg	114 kg	120 kg




10.6.7 Current derating depending on the pulse frequency, 400 V inverters

Article number	LO power [kW]	Pulse frequency [kHz]							
		2	4 *)	6	8	10	12	14	16
		LO base load output current [A]							
6SL3210-1PE11-8 . L1	0.55	1.7	1.7	1.4	1.2	1	0.9	0.8	0.7
6SL3210-1PE12-3 . L1	0.75	2.2	2.2	1.9	1.5	1.3	1.1	1	0.9
6SL3210-1PE13-2 . L1	1.1	3.1	3.1	2.6	2.2	1.9	1.6	1.4	1.2
6SL3210-1PE14-3 . L1	1.5	4.1	4.1	3.5	2.9	2.5	2.1	1.8	1.6
6SL3210-1PE16-1 . L1	2.2	5.9	5.9	5	4.1	3.5	3	2.7	2.4
6SL321 . -1PE18-0 . L1	3	7.7	7.7	6.5	5.4	4.6	3.9	3.5	3.1
6SL3210-1PE21-1 . L0	4	10.2	10.2	8.7	7.1	6.1	5.1	4.6	4.1
6SL3210-1PE21-4 . L0	5.5	13.2	13.2	11.2	9.2	7.9	6.6	5.9	5.3
6SL321 . -1PE21-8 . L0	7.5	18	18	15.3	12.6	10.8	9	8.1	7.2
6SL3210-1PE22-7 . L0	11	26	26	22.1	18.2	15.6	13	11.7	10.4
6SL321 . -1PE23-3 . L0	15	32	32	27.2	22.4	19.2	16	14.4	12.8
6SL3210-1PE23-8 . L0	18.5	38	38	32.3	26.6	22.8	19	17.1	15.2
6SL3210-1PE24-5 . L0	22	45	45	38.3	31.5	27	22.5	20.3	18
6SL3210-1PE26-0 . L0	30	60	60	51	42	36	30	27	24
6SL321 . -1PE27-5 . L0	37	75	75	63.8	52.5	45	37.5	33.8	30
6SL3210-1PE28-8 . L0	45	90	90	76.5	63	54	45	40.5	36
6SL321 . -1PE31-1 . L0	55	110	110	93.5	77	---	---	---	---
6SL3210-1PE31-5 . L0	75	145	145	123.3	101.5	---	---	---	---
6SL3210-1PE31-8 . L0	90	178	178	151.3	124.6	---	---	---	---
Article number		Pulse frequency [kHz]							
		2 *)	4	6	8	10	12	14	16
		LO base load output current [A]							
6SL3210-1PE32-1 . L0	110	205	143.5	---	---	---	---	---	---
6SL321 . -1PE32-5 . L0	132	250	175	---	---	---	---	---	---
6SL3210-1PE33-0AL0	160	302	211.4	151	120.8	---	---	---	---
6SL3210-1PE33-7AL0	200	370	259	185	148	---	---	---	---
6SL3210-1PE34-8AL0	250	477	333.9	238.5	190.8	---	---	---	---

*) Factory setting

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

10.6.8 General technical data, 690 V inverters

Property	Version
Line voltage	<ul style="list-style-type: none"> for systems according to IEC: 500 V ... 690 V 3 AC \pm 10% (in operation -20% < 1 min) for systems according to UL 500 V ... 600 V 3 AC \pm 10% (in operation -20% < 1 min) filtered devices only with Slash Rating (600Y/347V AC)
Line supply configurations	Grounded TN/TT line supplies or non-grounded IT line supplies  Connecting the line supply and motor (Page 86)
Line impedance	No restrictions
Power factor λ	> 0.9
Output voltage	0 V 3 AC ... 0.95 x input voltage (max.)
Input frequency	50 Hz ... 60 Hz, \pm 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Inrush current	< LO base load input current
Overvoltage category according to EN 61800-5-1	III for line supplies
Pulse frequency	2 kHz (factory setting), can be adjusted to 4 kHz Adjustable in steps of 2 kHz.  Current reduction as a function of the pulse frequency (Page 507) If you increase the pulse frequency, the inverter reduces the maximum output current.
Short-circuit current (SCCR) and branch protection	Maximum permissible line short-circuit current \leq 100 kA rms Minimum required short-circuit current \geq 10 kA rms The length of the connecting cable from the line to the inverter may not reduce the minimum short-circuit current  Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/view/109479152)
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper
Degree of protection according to EN 60529	IP20; must be installed in a control cabinet
Protection class according to EN 61800-5-1	The inverters are devices with protection class I
Touch protection according to EN 50274	DGUV regulation 3 when used for the intended purpose
Cooling in compliance with EN 60146	Forced air cooling AF

10.6.9 Specific technical data, 690 V inverters

Table 10-66 PM240-2, IP20, frame size D, 500 V ... 690 V 3 AC

Article No. - without filter	6SL3210-1PH21-4UL0	6SL3210-1PH22-0UL0	6SL3210-1PH22-3UL0
Article No. - with filter	6SL3210-1PH21-4AL0	6SL3210-1PH22-0AL0	6SL3210-1PH22-3AL0
LO base load power	11 kW	15 kW	18.5 kW
LO base load input current	14 A	18 A	22 A
LO base load output current	14 A	19 A	23 A
HO base load power	7.5 kW	11 kW	15 kW
HO base load input current	11 A	14 A	20 A
HO base load output current	11 A	14 A	19 A
Fuse according to IEC	3NA3807-6 (20 A)	3NA3810-6 (25 A)	3NA3812-6 (32 A)
Fuse according to UL, class J	20 A	25 A	30 A
Power loss without filter	0.35 kW	0.44 kW	0.52 kW
Power loss with filter	0.35 kW	0.45 kW	0.52 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17 kg	17 kg	17 kg
Weight with filter	18.5 kg	18.5 kg	18.5 kg

Table 10-67 PM240-2, IP20, frame size D, 500 V ... 690 V 3 AC

Article No. - without filter	6SL3210-1PH22-7UL0	6SL3210-1PH23-5UL0	6SL3210-1PH24-2UL0
Article No. - with filter	6SL3210-1PH22-7AL0	6SL3210-1PH23-5AL0	6SL3210-1PH24-2AL0
LO base load power	22 kW	30 kW	37 kW
LO base load input current	25 A	33 A	40 A
LO base load output current	27 A	35 A	42 A
HO base load power	18.5 kW	22 kW	30 kW
HO base load input current	24 A	28 A	36 A
HO base load output current	23 A	27 A	35 A
Siemens fuse according to IEC	3NA3817-6KJ (40 A)	3NA3820-6KJ (50 A)	3NA3822-6 (63 A)
Fuse according to UL, class J	35 A	45 A	60 A
Power loss without filter	0.60 kW	0.77 kW	0.93 kW
Power loss with filter	0.60 kW	0.78 kW	0.94 kW
Required cooling air flow	55 l/s	55 l/s	55 l/s
Weight without filter	17 kg	17 kg	17 kg
Weight with filter	18.5 kg	18.5 kg	18.5 kg

Table 10-68 PM240-2, IP20, frame size E, 500 V ... 690 V 3 AC

Article No. - without filter	6SL3210-1PH25-2UL0	6SL3210-1PH26-2UL0
Article No. - with filter	6SL3210-1PH25-2AL0	6SL3210-1PH26-2AL0
LO base load power	45 kW	55 kW
LO base load input current	50 A	59 A
LO base load output current	52 A	62 A
HO base load power	37 kW	45 kW
HO base load input current	44 A	54 A
HO base load output current	42 A	52 A
Siemens fuse according to IEC	3NA3824-6 (80A)	3NA3824-6 (80A)
Fuse according to UL, class J	80 A	80 A
Power loss without filter	1.07 kW	1.30 kW
Power loss with filter	1.08 kW	1.31 kW
Required cooling air flow	83 l/s	83 l/s
Weight without filter	26 kg	26 kg
Weight with filter	28 kg	28 kg

Table 10-69 PM240-2, IP20, frame size F, 500 V ... 690 V 3 AC

Article No. - without filter	6SL3210-1PH28-0UL0	6SL3210-1PH31-0UL0	6SL3210-1PH31-2UL0
Article No. - with filter	6SL3210-1PH28-0AL0	6SL3210-1PH31-0AL0	6SL3210-1PH31-2AL0
LO base load power	75 kW	90 kW	110 kW
LO base load input current	78 A	97 A	111 A
LO base load output current	80 A	100 A	115 A
HO base load power	55 kW	75 kW	90 kW
HO base load input current	66 A	85 A	106 A
HO base load output current	62 A	80 A	100 A
Siemens fuse according to IEC	3NA3830-6 (100 A)	3NA3132-6 (125 A)	3NA3136-6 (160 A)
Fuse according to UL, class J	100 A	125 A	150 A
Power loss without filter	1.37 kW	1.74 kW	1.95 kW
Power loss with filter	1.38 kW	1.76 kW	1.97 kW
Required cooling air flow	153 l/s	153 l/s	153 l/s
Weight without filter	60 kg	60 kg	60 kg
Weight with filter	64 kg	64 kg	64 kg

Technical data

10.6 Technical data, PM240-2 Power Module

Table 10-70 PM240-2, IP20, frame size F, 500 V ... 690 V 3 AC

Article No. - without filter	6SL3210-1PH31-4UL0
Article No. - with filter	6SL3210-1PH31-4AL0
LO base load power	132 kW
LO base load input current	137 A
LO base load output current	142 A
HO base load power	110 kW
HO base load input current	122 A
HO base load output current	115 A
Siemens fuse according to IEC	3NA3140-6 (200 A)
Fuse according to UL, class J	200 A
Power loss without filter	2.48 kW
Power loss with filter	2.51 kW
Required cooling air flow	153 l/s
Weight without filter	60 kg
Weight with filter	64 kg

Table 10-71 PM240-2, frame size G, 500 V ... 690 V 3 AC

Article No. with filter	6SL3210-1PH31-7CLO	6SL3210-1PH32-1CLO	6SL3210-1PH32-5CLO
LO base load power	160 kW	200 kW	250 kW
LO base load input current	170 A	205 A	250 A
LO base load output current	171 A	208 A	250 A
HO base load power	132 kW	160 kW	200 kW
HO base load input current	160 A	185 A	225 A
HO base load output current	144 A	171 A	208 A
Fuse according to the IEC/UL	3NE1227-0 (250A)	3NE1230-0 (315A)	3NE1331-0 (350A)
Power loss	2.94 kW	3.70 kW	4.64 kW
Required cooling air flow	210 l/s	210 l/s	210 l/s
Weight	114 kg	114 kg	114 kg

10.6.10 Current derating depending on the pulse frequency, 690 V inverters

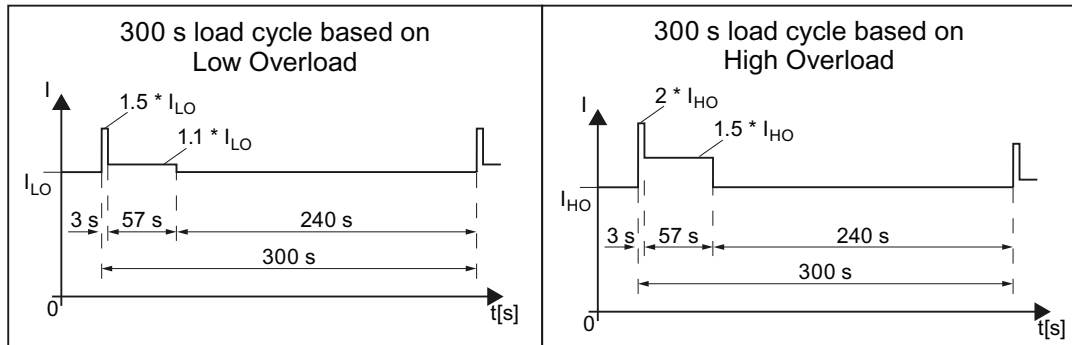
Article number	LO power [kW]	Pulse frequency [kHz]	
		2 *)	4
		LO base load output current [A]	
6SL3210-1PH21-4 . L0	11	14	8.4
6SL3210-1PH22-0 . L0	15	19	11.4
6SL3210-1PH22-3 . L0	18.5	23	13.8
6SL3210-1PH22-7 . L0	22	27	16.2
6SL3210-1PH23-5 . L0	30	35	21
6SL321 . -1PH24-2 . L0	37	42	25.2
6SL3210-1PH25-2 . L0	45	52	31.2
6SL321 . -1PH26-2 . L0	55	62	37.2
6SL3210-1PH28-0 . L0	75	80	48
6SL3210-1PH31-0 . L0	90	100	60
6SL3210-1PH31-2 . L0	110	115	69
6SL3210-1PH31-4 . L0	132	142	85.2
6SL3210-1PH31-7CLO	160	171	102.6
6SL3210-1PH32-1CLO	200	208	124.8
6SL3210-1PH32-5CLO	250	250	150

*) Factory setting

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


10.7 Technical data, PM250 Power Module


Typical inverter load cycles



10.7.1 Ambient conditions

Ambient conditions during operation


Property	Version
Ambient conditions for transport in the transport packaging	
Climatic ambient conditions	- 40° C ... + 70° C, according to Class 2K4 to EN 60721-3-2 maximum humidity 95% at 40° C
Mechanical ambient conditions	FSC: Shock and vibration permissible according to 1M2 to EN 60721-3-2 FSD ... FSF: Shock and vibration permissible according to 2M3 to EN 60721-3-2
Protection against chemical substances	Protected according to Class 2C2 to EN 60721-3-2
Biological ambient conditions	Suitable according to Class 2B1 to EN 60721-3-2
Ambient conditions for long-term storage in the product packaging	
Climatic ambient conditions	- 25° C ... + 55° C, according to Class 1K3 to EN 60721-3-1
Protection against chemical substances	Protected according to Class 1C2 to EN 60721-3-1
Biological ambient conditions	Suitable according to class 1B1 to EN 60721-3-1
Ambient conditions in operation	
Installation altitude	Up to 1000 m above sea level without limitations  Restrictions for special ambient conditions (Page 515)

Property	Version
Climatic ambient conditions 1)	<ul style="list-style-type: none"> • Ambient operating temperature 2) <ul style="list-style-type: none"> – For operation according to Low Overload: 0° C ... +40° C – For operation according to High Overload: 0° C ... +50° C –  Restrictions for special ambient conditions (Page 515) • Relative humidity: 5 ... 95%, condensation not permitted • Oil mist, salt mist, ice formation, condensation, dripping water, spraying water, splashing water and water jets are not permitted
Mechanical ambient conditions	<ul style="list-style-type: none"> • FSC ... FSF: Vibration levels permissible according to Class 3M1 to EN 60721-3-3 • FSC: Shock, permissible according to Class 3M2 to EN 60721-3-3 • FSD ... FSF: Shock permissible according to Class 3M1 to EN 60721-3-3
Protection against chemical substances	Protected according to 3C2 to EN 60721-3-3
Biological ambient conditions	Suitable according to 3C2 to EN 60721-3-3
Pollution	Suitable for environments with degree of pollution 2 according to EN 61800-5-1, condensation not permitted
Cooling	Forced air cooling AF, according to EN 60146
Cooling air	Clean and dry air

1) Increased ruggedness regarding temperature range and relative humidity; therefore better than 3K3 according to EN 60721-3-3

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

10.7.2 General technical data, PM250

Property	Version
Line voltage	3-phase 380 ... 480 VAC \pm 10%
Output voltage	3-phase 0 VAC ... input voltage x 0.87 (max.)
Input frequency	50 Hz ... 60 Hz, \pm 3 Hz
Output frequency	0 ... 550 Hz, depending on the control mode
Power factor λ	0.9
Inrush current	< LO base load input current
Pulse frequency (factory setting)	4 kHz The pulse frequency can be adjusted up to 16 kHz in 2 kHz steps. The higher the pulse frequency, the lower the available output current.  Restrictions for special ambient conditions (Page 515)
Electromagnetic compatibility	The devices comply with EN 61800-3: 2004 suitable for Category C2 and C3 environments.
Braking methods	DC braking, energy recovery (up to 100% of the output power)
Degree of protection	IP20 built-in devices (they must be installed in a switch cabinet)

10.7.3 Specific technical data, PM250

Note

The values for Low Overload (LO) are identical with those of the rated values.

Table 10-72 PM250, IP20, Frame Size C, 3-ph. AC 380 V ... 480 V

Article no.	6SL3225-0BE25-5AA1	6SL3225-0BE27-5AA1	6SL3225-0BE31-1AA1
LO base load output	7.5 kW	11 kW	15 kW
LO base load input current	18 A	25 A	32 A
LO base load output current	18 A	25 A	32 A
HO base load output	5.5 kW	7.5 kW	11 kW
HO base load input current	13.2 A	19 A	26 A
HO base load output current	13.2 A	19 A	26 A
Fuse	20 A, Class J	32 A, Class J	35 A, Class J
Power loss	0.24 kW	0.30 kW	0.31 kW
Required cooling air flow	38 l/s	38 l/s	38 l/s
Weight	7.5 kg	7.5 kg	7.5 kg

Table 10-73 PM250, IP20, Frame Size D, 3-ph. AC 380 V ... 480 V

Article no.	6SL3225-0BE31-5AA0	6SL3225-0BE31-8AA0	6SL3225-0BE32-2AA0
LO base load output	18.5 kW	22 kW	30 kW
LO base load input current	36 A	42 A	56 A
LO base load output current	38 A	45 A	60 A
HO base load output	15 kW	18.5 kW	22 kW
HO base load input current	30 A	36 A	42 A
HO base load output current	32 A	38 A	45 A
Fuse according to IEC	3NA3820	3NA3822	3NA3824
Fuse according to UL	50 A, Class J 3NE1817-0	63 A, Class J 3NE1818-0	80 A, Class J 3NE1820-0
Power loss	0.44 kW	0.55 kW	0.72 kW
Required cooling air flow	22 l/s	22 l/s	39 l/s
Weight	15 kg	15 kg	16 kg

Table 10-74 PM250, IP20, Frame Size E, 3-ph. AC 380 V ... 480 V

Article no.	6SL3225-0BE33-0AA0	6SL3225-0BE33-7AA0
LO base load output	37 kW	45 kW
LO base load input current	70 A	84 A
LO base load output current	75 A	90 A

Technical data

10.7 Technical data, PM250 Power Module

Article no.	6SL3225-0BE33-0AA0	6SL3225-0BE33-7AA0
HO base load output	30 kW	37 kW
HO base load input current	56 A	70 A
HO base load output current	60 A	75 A
Fuse according to IEC	3NA3830	3NA3832
Fuse according to UL	100 A, Class J 3NE1821-0	125 A, Class J 3NE1822-0
Power loss	1.04 kW	1.2 kW
Required cooling air flow	22 l/s	39 l/s
Weight	21 kg	21 kg

Table 10-75 PM250, IP20, Frame size F, 3-ph. AC 380 V ... 480 V

Article no.	6SL3225-0BE34-5AA0	6SL3225-0BE35-5AA0	6SL3225-0BE37-5AA0
LO base load output	55 kW	75 kW	90 kW
LO base load input current	102 A	135 A	166 A
LO base load output current	110 A	145 A	178 A
HO base load output	45 kW	55 kW	75 kW
HO base load input current	84 A	102 A	135 A
HO base load output current	90 A	110 A	145 A
Fuse according to IEC	3NA3836	3NA3140	3NA3144
Fuse according to UL	160 A, Class J 3NE1824-0	200 A, Class J 3NE1825-0	250 A, Class J 3NE1827-0
Power loss	1.5 kW	2.0 kW	2.4 kW
Required cooling air flow	94 l/s	94 l/s	117 l/s
Weight	51 kg	51 kg	51 kg

10.7.4 Current reduction depending upon pulse frequency

Relationship between pulse frequency and current reduction

Table 10-76 Current reduction depending on pulse frequency

Rated Power (LO)	Base load current (LO)	Base load current (LO) at pulse frequency of					
		4 kHz	6 kHz	8 kHz	10 kHz	12 kHz	14 kHz
kW	A	A	A	A	A	A	A
0,55	1,7						
0,75	2,2						
1,1	3,1						
1,5	4,1						
2,2	5,9						
3	7,7						
4	10,2						
5,5	13,2						
7,5	18,0	12,5	11,9	10,6	9,20	7,90	6,60
11	25,0	18,1	17,1	15,2	13,3	11,4	9,50
15	32,0	24,7	23,4	20,8	18,2	15,6	12,8
18,5	38,0	32,3	26,6	22,8	19,0	17,1	15,2
22	45,0	38,3	31,5	27,0	22,5	20,3	18,0
30	60,0	51,0	42,0	36,0	30,0	27,0	24,0
37	75,0	63,8	52,5	45,0	37,5	33,8	30,0
45	90,0	76,5	63,0	54,0	45,0	40,5	36,0
55	110	93,5	77,0	--	--	--	--
75	145	123	102	--	--	--	--
90	178	151	125	--	--	--	--

10.8 Data regarding the power loss in partial load operation

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

 Partial load operation (<http://support.automation.siemens.com/WW/view/en/94059311>)

10.9 Restrictions for special ambient conditions

10.9.1 Permissible line supplies dependent on the installation altitude

Permissible line supplies dependent on the installation altitude

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

Note

Using Power Modules connected to TN line supplies with voltages ≥ 600 V for installation altitudes 2000 m ... 4000 m

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

Current derating as a function of the installation altitude

The permissible inverter output current is reduced above an installation altitude of 1000 m.

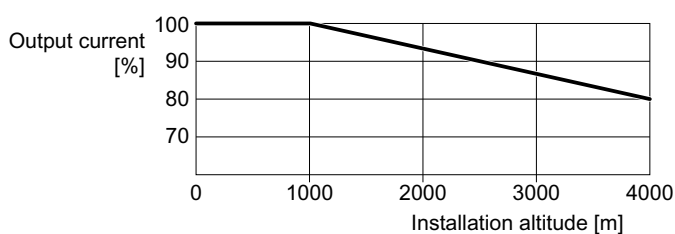


Figure 10-6 Characteristic for PM230 Power Modules, PM250 Power Modules and PM330 Power Modules, HX and JX

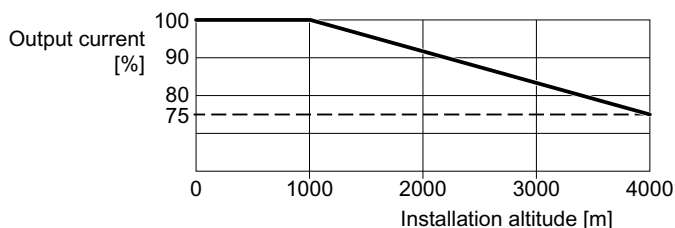


Figure 10-7 Characteristic for the PM330 GX Power Module

10.9 Restrictions for special ambient conditions

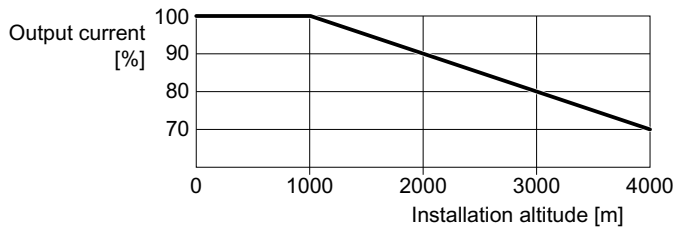


Figure 10-8 Characteristic for PM240-2 Power Modules and PM240P-2 Power Modules

Current derating depending on the ambient air temperature

The Control Unit and Operator Panel can restrict the maximum permissible operating ambient temperature of the Power Module.

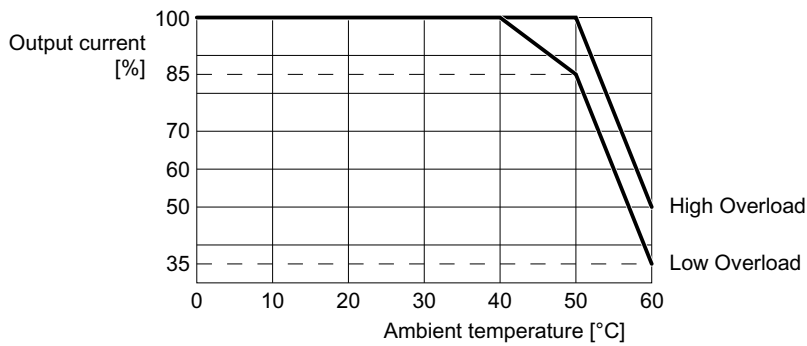


Figure 10-9 Characteristic for the PM230 Power Module

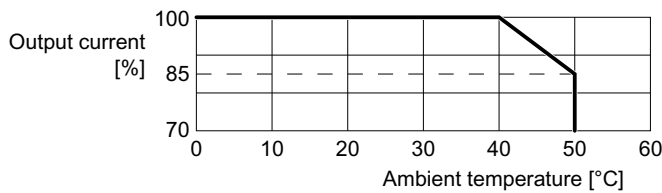


Figure 10-10 Characteristic for the PM330 Power Module

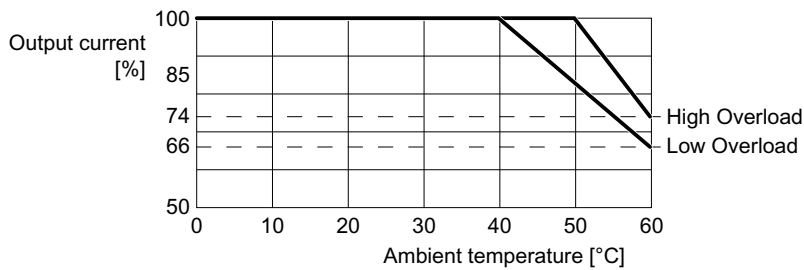


Figure 10-11 Characteristic for the PM250 Power Module

Appendix

A.1 New and extended functions

A.1.1 Firmware version 4.7 SP10

Table A-1 New functions and function changes in firmware 4.7 SP10

	Function	SINAMICS								
		G120						G120D		
		G110M	G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2	CU250D-2	ET 200pro FC-2
1	New parameter r7844 [1] for displaying the firmware version in plain text. "04070901" is equivalent to firmware version V4.7 SP9 HF1, for example	✓	✓	✓	✓	✓	✓	✓	✓	✓
2	Modbus RTU <ul style="list-style-type: none"> The factory setting of parameter p2040 was increased to provide more robust inverter operation. Monitoring time for data failure at the Modbus interface: p2040 = 10 s r2057 indicates how the address switch on the inverter is set 	✓	✓	✓	✓	✓	✓	-	-	-
3	BACnet MS/TP: <ul style="list-style-type: none"> New factory setting for more robust inverter operation: <ul style="list-style-type: none"> Baud rate p2020 = 38.4 kBd Monitoring time for data failure at the BACnet interface was increased: p2040 = 10 s Factory setting for the maximum number of info frames p2025 [1] = 5 Factory setting for the maximum number of master addresses p2025 [3] = 32 r2057 indicates how the address switch on the inverter is set 	-	-	✓	-	-	-	-	-	-
4	Further technological unit kg/cm ² for unit switchover	✓	✓	✓	✓	✓	✓	✓	✓	✓

	Function	SINAMICS								
		G120				G120D				
5	Further technological unit kg/cm ² for additional technology controllers	-	-	✓	-	-	-	-	-	-
6	Commissioning with predefined motor data for SIMOTICS GP/SD synchronous-reluctance motors: <ul style="list-style-type: none"> • Second generation: 1FP1 . 04 → 1FP1 . 14 • Further frame sizes: <ul style="list-style-type: none"> – 1.1 kW ... 3 kW, 1500 1/min, 1800 1/min, 2810 1/min – 0.75 kW ... 4 kW, 3000 1/min, 3600 1/min • In planning: <ul style="list-style-type: none"> – 37 kW ... 45 kW, 1500 1/min, 1800 1/min, 2810 1/min – 5.5 kW ... 18.5 kW, 3000 1/min, 3600 1/min – 45 kW, 3000 1/min, 3600 1/min – The predefined motor data is already included in the firmware 	✓	-	✓	-	✓ ¹⁾	-	✓	-	-

¹⁾ Installation with PM240-2 or PM240P-2 Power Modules

A.1.2 Firmware version 4.7 SP9

Table A-2 New functions and function changes in firmware 4.7 SP9

	Function	SINAMICS								ET 200pro FC-2
		G120				G120D				
		G110M	G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2	CU250D-2	
1	Support of PM240-2 FSG Power Modules	-	-	✓	✓	✓	✓	-	-	-
2	Support of PM240-2 Power Modules in push-through technology, frame sizes FSD ... FSF, for the following voltages: <ul style="list-style-type: none"> • 3 AC 200 V ... 240 V • 3 AC 380 V ... 480 V • 3 AC 500 V ... 690 V 	-	-	✓	✓	✓	✓	-	-	-
3	Shortened switch-on time for PM330 Power Modules	-	-	✓	-	-	-	-	-	-
4	Expansion of the support for 1FP1 synchronous-reluctance motor with the following inverters: <ul style="list-style-type: none"> • SINAMICS G110M • SINAMICS G120D • SINAMICS G120 with CU240B-2 or CU240E-2 Control Unit A PM240-2 Power Module is required to operate a 1FP1 synchronous-reluctance motor with SINAMICS G120	✓	-	✓	✓	✓	-	✓	-	-
5	Support of 1FP3 synchronous-reluctance motors A PM240-2 Power Module is required to operate a 1FP3 synchronous-reluctance motor along with a selective release from SIEMENS	-	-	✓	-	-	-	-	-	-
6	Support of 1LE5 induction motors	-	✓	✓	✓	✓	✓	-	-	-
7	The inverter supports forming of the PM330 Power Module DC link capacitors	-	-	✓	-	-	-	-	-	-
8	Setting option for two output reactors using parameter p0235 at the SINAMICS G120C and SINAMICS G120 with PM240-2 FSD ... FSF Power Module	-	✓	✓	✓	✓	✓	-	-	-
9	Efficiency-optimized operation of induction motors Improved method "Efficiency optimization 2"	✓	✓	✓	✓	✓	✓	✓	✓	✓
10	New setting option for the "Technology application" p0500 = 5 during quick commissioning	✓	✓	✓	✓	✓	✓	✓	✓	✓
11	Expansion of the available PROFIdrive telegrams in the SINAMICS G120C to include telegram 350	-	✓	✓	✓	✓	✓	-	-	-
12	An SSI encoder can be parameterized as motor encoder	-	-	-	-	-	✓	-	✓	-
13	Expansion of the "Basic positioner" function to include the feedback signal from traversing blocks to the higher-level control system	-	-	-	-	-	✓	-	✓	-


	Function	SINAMICS								
		G110M	G120C	G120			G120D			ET 200pro FC-2
CU230P-2	CU240B-2			CU240E-2	CU250S-2	CU240D-2	CU250D-2			
14	Expansion to include a feedback signal if a memory card is not inserted in the inverter: <ul style="list-style-type: none"> Parameter r9401 as BiCo parameter for the optional feedback signal to the higher-level control system. New alarm A01101 	✓	✓	✓	✓	✓	✓	✓	✓	✓
15	Expansion of the "End stop control" function on the following inverters: <ul style="list-style-type: none"> SINAMICS G120 SINAMICS G120C SINAMICS G120D 	✓	✓	✓	✓	✓	✓	✓	✓	-
16	Expansion of the technology controller to include the following functions: <ul style="list-style-type: none"> Gain K_p and integral time T_N can be adapted. The system deviation can be used as adaptation signal 	-	-	✓	-	✓	-	-	-	-
17	Expansion to the torque limiting for SINAMICS G120 inverters with CU230P-2 Control Unit	✓	✓	✓	✓	✓	✓	✓	✓	✓
18	The inverter displays the state "PROFenergy pause" as follows: <ul style="list-style-type: none"> LED RDY "green on": 0.5 s LED RDY off: 3 s 	✓	✓	✓	✓	✓	✓	✓	✓	✓




Changes in the current edition (Page 3)

A.1.3 Firmware version 4.7 SP6


Table A-3 New functions and function changes in firmware 4.7 SP6

	Function	SINAMICS								
		G120				G120D				
		G110M	G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2	CU250D-2	ET 200pro FC-2
1	Support for the Power Module PM240-2, FSF frame sizes	-	-	✓	✓	✓	✓	-	-	-
	Support of PM240P-2 Power Modules frame sizes FSD ... FSF	-	-	✓	✓	✓	-	-	-	-
	Support of safety function Safe Torque Off (STO) via the terminals of the PM240-2 Power Module, frame size FSF and PM240P-2 Power Module FSD ... FSF You can find additional information in the "Safety Integrated" function manual.  Overview of the manuals (Page 538)	-	-	-	-	✓	✓	-	-	-
2	Support for Power Module PM330 JX frame size	-	-	✓	-	-	-	-	-	-
3	Support for 1PC1 induction motors	✓	✓	✓	✓	✓	✓	✓	✓	✓
4	The control of synchronous reluctance takes into account the inductance of the output reactor.	-	-	✓	-	-	-	-	-	-
5	Support of motor temperature sensor Pt1000	✓	✓	✓	✓	✓	✓	✓	✓	✓
6	New p4621 parameter for disabling PTC short-circuit monitoring	-	-	-	-	-	-	✓	✓	✓
7	Revision of the thermal motor model for protecting the motor against damage due to overheating in the stator or rotor	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Changing the quick commissioning in the "Standard Drive Control" application class: The motor data identification is no longer permanently set to p1900 = 12; instead, users select the appropriate motor data identification. Factory setting: p1900 = 2.	-	✓	✓	✓	✓	✓	-	-	-
9	The free function blocks are also available in the SINAMICS G120C.	✓	✓	✓	✓	✓	✓	✓	-	-

 Changes in the current edition (Page 3)

A.1.4 Firmware version 4.7 SP3

Table A-4 New functions and function changes in firmware 4.7 SP3

	Function	SINAMICS								
		G120					G120D		ET 200pro FC-2	
		G110M	G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2		CU250D-2
1	PM240-2 Power Modules, frame sizes FSD and FSE are supported	-	-	✓	✓	✓	✓	-	-	-
	The Safety Integrated Basic Function Safe Torque Off (STO) is supported via the terminals of the PM240-2 Power Module, frame sizes FSD and FSE	-	-	-	-	✓	✓	-	-	-
2	Revised PM230 Power Module with new article numbers supported: <ul style="list-style-type: none"> IP55 degree of protection: 6SL3223-0DE G . IP20 degree of protection and Push Through: 6SL321 . -1NE G . You can find additional information in the "Safety Integrated" function manual.  Overview of the manuals (Page 538)	-	-	✓	✓	✓	-	-	-	-
	The Safety Integrated Basic Function Safe Torque Off (STO) is supported with the revised PM230 Power Module	-	-	-	-	✓	-	-	-	-
3	PM330 Power Module, frame size HX is supported	-	-	✓	-	-	-	-	-	-
4	Support of 1FP1 synchronous-reluctance motors	-	-	✓	-	-	-	-	-	-
5	Encoderless 1FG1 geared synchronous motors are supported	-	-	-	-	-	-	✓	-	-
6	Selection list for 1PH8 induction motors in the STARTER and Startdrive commissioning wizard	-	✓	✓	✓	✓	✓	-	-	-
7	Updated selection list for 1LE1 induction motors in the STARTER and Startdrive commissioning wizard	✓	✓	✓	✓	✓	✓	✓	✓	✓
8	Motor support expanded with 1LE1, 1LG6, 1LA7 and 1LA9 induction motors	✓	-	-	-	-	-	-	-	-
9	Speed and position control obtain their respective actual value from an SSI encoder with incremental tracks. The output signals of the encoder are available as encoder 2 for position control and timer 1 for speed control.	-	-	-	-	-	✓	-	✓	-
10	Power Module with temperature-controlled fan	✓	-	-	-	-	-	-	-	-

	Function	SINAMICS								
		G120						G120D		
		G110M	G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2	CU250D-2	ET 200pro FC-2
11	SINAMICS "Standard Drive Control" and "Dynamic Drive Control" application classes to simplify commissioning and increase the degree of ruggedness of the closed-loop motor control. The SINAMICS application classes are available with the following inverters: <ul style="list-style-type: none"> • SINAMICS G120C • SINAMICS G120 with PM240, PM240-2 and PM330 Power Modules 	-	✓	✓	✓	✓	✓	-	-	-
12	Moment of inertia estimator with moment of inertia precontrol to optimize the speed controller in operation	✓	✓	-	✓	✓	✓	✓	✓	✓
13	Friction torque characteristic with automatic plotting to optimize the speed controller	✓	✓	-	✓	✓	✓	✓	✓	✓
14	Automatic optimization of the technology controller	-	-	✓	✓	✓	-	-	-	-
15	The sign of the system deviation for the additional, free technology controller can be switched over. A new parameter defines the sign of the system deviation matching the particular application, e.g. for cooling or heating applications.	-	-	✓	-	-	-	-	-	-
16	The technology controller output can be enabled and disabled during operation	-	✓	✓	✓	✓	✓	-	-	-
17	Ramp-function generator remains active with enabled technology controller	-	-	✓	-	-	-	-	-	-
18	Line contactor control using a digital output of the inverter to save energy when the motor is switched off	✓	✓	✓	✓	✓	✓	✓	✓	-
19	Fast flying restart for PM330 Power Modules: The "Flying restart" function does not have to wait for the motor demagnetization time, and identifies the motor speed without requiring a search operation.	-	-	✓	-	-	-	-	-	-
20	Load torque monitoring extended to include the following functions: <ul style="list-style-type: none"> • Protection against blocking, leakage and dry running operation in pump applications • Protection against blocking and broken belts in fan applications 	✓	-	✓	✓	✓	-	-	-	-
21	Automatic switchover of the real time clock from daylight saving time (summer time) to standard time (winter time).	-	-	✓	-	-	-	-	-	-
22	New or revised default settings of the interfaces: p0015 macros 110, 112 and 120	-	-	✓	-	-	-	-	-	-

	Function	SINAMICS								
		G110M	G120C	G120			G120D			ET 200pro FC-2
CU230P-2	CU240B-2			CU240E-2	CU250S-2	CU240D-2	CU250D-2			
23	Expansion of the temperature sensors to include DIN-Ni1000 for analog inputs AI 2 and AI 3	-	-	✓	-	-	-	-	-	-
24	Communication via AS-Interface. Default setting of the communication via AS-i: p0015 macros 30, 31, 32 and 34	✓	-	-	-	-	-	-	-	-
25	Communication expansion via Modbus: Adjustable parity bit, access to parameters and analog inputs	✓	✓	✓	✓	✓	✓	-	-	-
26	Extending communication via BACnet: Access to parameters and analog inputs	-	-	✓	-	-	-	-	-	-
27	The bus error LED for communication via USS and Modbus can be switched off	✓	✓	✓	✓	✓	✓	-	-	-
28	Default of the minimum speed to 20% of the rated motor speed	-	-	✓	-	-	-	-	-	-
29	For commissioning with an operator panel, the inverter automatically backs up the measured data retentively in the ROM after identification of the motor data.	✓	✓	✓	✓	✓	✓	✓	✓	✓
30	The result of the energy savings calculation for flow machines is available as a connector	✓	✓	✓	✓	✓	✓	✓	✓	✓
31	New "ppm" unit (parts per million) for unit switching	✓	✓	✓	✓	✓	✓	✓	✓	✓
32	Displaying speeds during commissioning via operator panel in units of Hz instead of rpm. Conversion from Hz to rpm via p8552	-	-	✓	-	-	-	-	-	-
33	Voltage-dependent current limit for 600V devices of Power Module PM330 and PM240-2	-	-	✓	✓	✓	✓	-	-	-

A.1.5 Firmware version 4.7

Table A-5 New functions and function changes in Firmware 4.7

	Function	SINAMICS							
		G120					G120D		
		G110M	G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2	CU250D-2
1	Supporting the identification & maintenance datasets (I&M1 ... 4)	✓	✓	✓	✓	✓	✓	✓	✓
2	Fall in pulse rate with increased drive power required by the motor <ul style="list-style-type: none"> The inverter temporarily lowers the pulse frequency if required when the motor is started up, and simultaneously increases the current limit. 	✓	✓	✓	✓	✓	✓	✓	✓
3	S7 communication <ul style="list-style-type: none"> Direct data exchange between the inverter and human-machine interface (HMI). Increase in communication performance with the engineering tools and support of the S7 routing 	✓	✓	✓	✓	✓	✓	✓	✓
4	The basic functions of Safety Integrated are unrestrictedly available in all control types with 1FK7 encoderless permanent-field synchronous motors	-	-	-	-	-	-	✓	-
5	Encoderless 1FK7 synchronous motors are supported <ul style="list-style-type: none"> Direct motor selection based on the article number with associated code number It is not necessary to input individual motor data 	-	-	-	-	-	-	✓	-
6	Pulse input as source of setpoint value <ul style="list-style-type: none"> The inverter calculates its speed setpoint from a sequence of pulses at the digital input. 	-	-	-	-	-	✓	-	-
7	Dynamic IP address assignment (DHCP) and temporary device names for PROFINET	✓	✓	✓	-	✓	✓	✓	✓
8	PROFInergy Slave profile 2 and 3	✓	✓	✓	-	✓	✓	✓	✓
9	Uniform behavior for component replacement <ul style="list-style-type: none"> After a component is replaced, an inverter with activated Safety Integrated will report what type of component has been replaced using a unique code. 	✓	✓	-	-	✓	✓	✓	✓
10	Improved direct-component control in PM230 <ul style="list-style-type: none"> Optimized efficiency for pump and fan applications 	-	-	✓	-	-	-	-	-
11	Rounding down of BACnet and macros	-	-	✓	-	-	-	-	-

A.1.6 Firmware version 4.6 SP6

Table A-6 New functions and function changes in firmware 4.6 SP6

	Function	SINAMICS						
			G120			G120D		
		G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2	CU250D-2
1	Support for the new Power Modules <ul style="list-style-type: none"> PM330 IP20 GX 	-	✓	-	-	-	-	-

A.1.7 Firmware version 4.6

Table A-7 New functions and function changes in Firmware 4.6

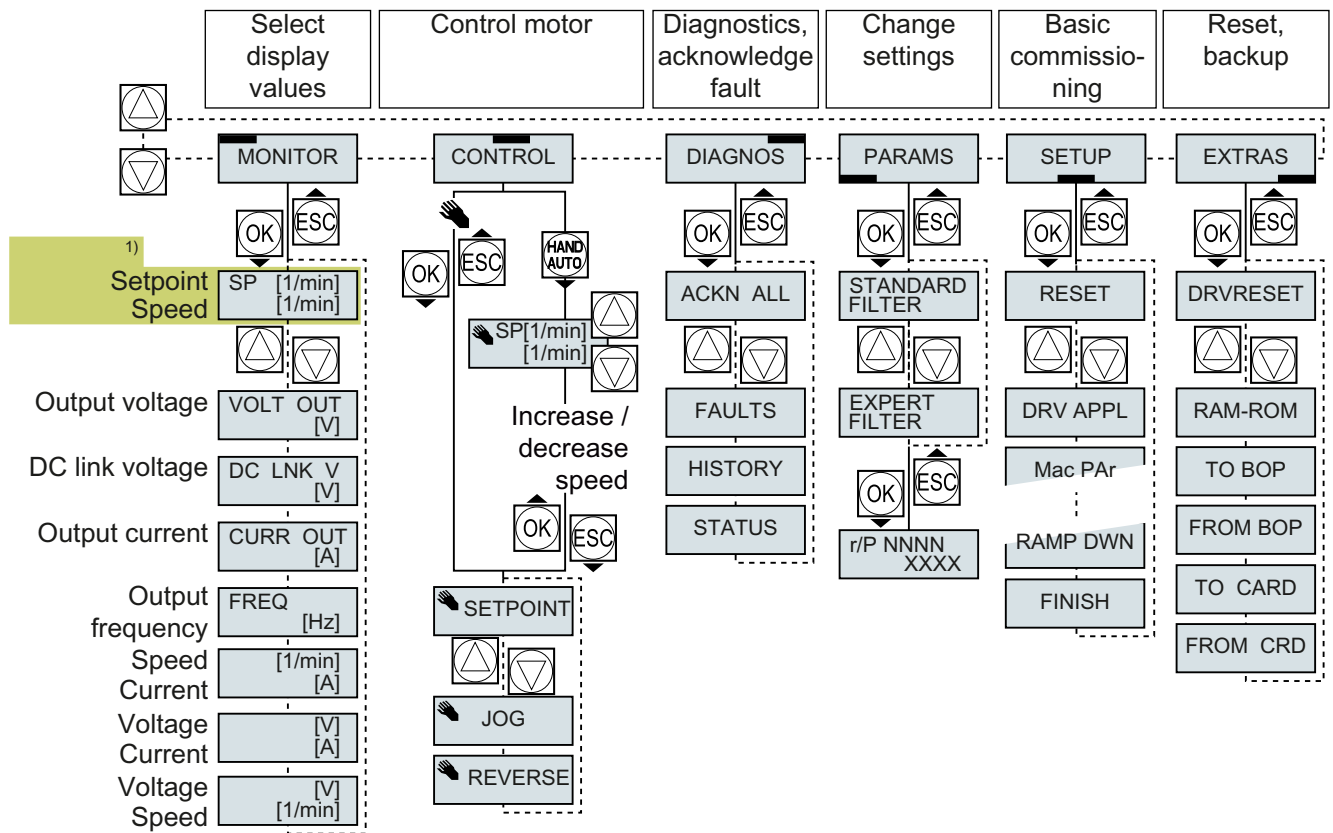
	Function	SINAMICS						
		G120				G120D		
		G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2	CU240D-2	CU250D-2
1	Support for the new Power Modules <ul style="list-style-type: none"> PM240-2 IP20 FSB ... FSC PM240-2 in through-hole technology FSB ... FSC 	-	✓	✓	✓	✓	-	-
2	Support for the new Power Modules <ul style="list-style-type: none"> PM230 in through-hole technology FSD ... FSF 	-	✓	✓	✓	-	-	-
3	Motor data preassignment for the 1LA/1LE motors via code number <ul style="list-style-type: none"> During quick commissioning with the operator panel, set the motor data using a code number 	✓	✓	✓	✓	✓	✓	✓
4	Extension to communication via CANopen <ul style="list-style-type: none"> CAN velocity, ProfilTorque, SDO channel for each axis, system test with CodeSys, suppression of ErrorPassiv alarm 	✓	✓	-	-	✓	-	-
5	Extension to communication via BACnet <ul style="list-style-type: none"> Multistate value objects for alarms, commandable AO objects, objects for configuring the PID controller 	-	✓	-	-	-	-	-
6	Communication via EtherNet/IP	✓	✓	-	✓	✓	✓	✓
7	Skip frequency band for analog input <ul style="list-style-type: none"> A symmetrical skip frequency band can be set for each analog input around the 0 V range. 	✓	✓	✓	✓	✓	✓	-
8	Changing the control of the motor holding brake	✓	-	✓	✓	✓	✓	-
9	Safety function SBC (Safe Brake Control) <ul style="list-style-type: none"> Secure control of a motor holding brake when using the "Safe Brake Module" option 	-	-	-	-	✓	-	-
10	Safety function SS1 (Safe Stop 1) without speed monitoring	-	-	-	-	✓	-	-
11	Straightforward selection of standard motors <ul style="list-style-type: none"> Selection of 1LA... and 1LE... motors with an operator panel using a list containing code numbers 	✓	✓	✓	✓	✓	✓	✓
12	Firmware update via memory card	✓	✓	✓	✓	✓	✓	✓
13	Safety info channel <ul style="list-style-type: none"> BICO source r9734.0...14 for the status bits of the extended safety functions 	-	-	-	✓	✓	✓	✓
14	Diagnostic alarms for PROFIBUS	✓	✓	✓	✓	✓	✓	✓

A.1.8 Firmware version 4.5

Table A-8 New functions and function changes in Firmware 4.5

	Function	SINAMICS					
		G120				G120D	
		G120C	CU230P-2	CU240B-2	CU240E-2	CU240D-2	CU250D-2
1	Support for the new Power Modules: <ul style="list-style-type: none"> • PM230 IP20 FSA ... FSF • PM230 in a push-through FSA ... FSC 	-	✓	✓	✓	-	-
2	Support for the new Power Modules: <ul style="list-style-type: none"> • PM240-2 IP20 FSA • PM240-2 in push-through FSA 	-	✓	✓	✓	-	-
3	New Control Units with PROFINET support	✓	✓	-	✓	✓	✓
4	Support of the PROFlenergy profile	✓	✓	-	✓	✓	✓
5	Shared device support via PROFINET	✓	✓	-	✓	✓	✓
6	Write protection	✓	✓	✓	✓	✓	✓
7	Know-how protection	✓	✓	✓	✓	✓	✓
8	Adding a second command data set (CDS0 → CDS0 ... CDS1) (All other inverters have four command data sets)	✓	-	-	-	-	-
9	Position control and basic positioner	-	-	-	-	-	✓
10	Support of an HTL encoder	-	-	-	-	✓	✓
11	Support of an SSI encoder	-	-	-	-	-	✓
12	Fail-safe digital output	-	-	-	-	✓	✓

A.2 Handling the BOP 2 operator panel



¹⁾ Status display once the power supply for the inverter has been switched on.

Figure A-1 Menu of the BOP-2

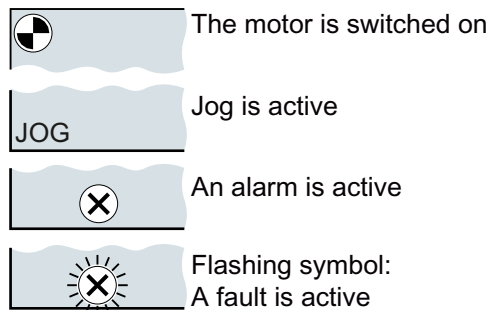






Figure A-2 Other keys and symbols of the BOP-2

Procedure for switching the motor on and off via the operator panel:

1. Press MANUAL AUTO 
2. Master control of the inverter is released via the BOP-2 
3. Switch on motor 
4. Switch off the motor 

A.2.1 Changing settings using BOP-2

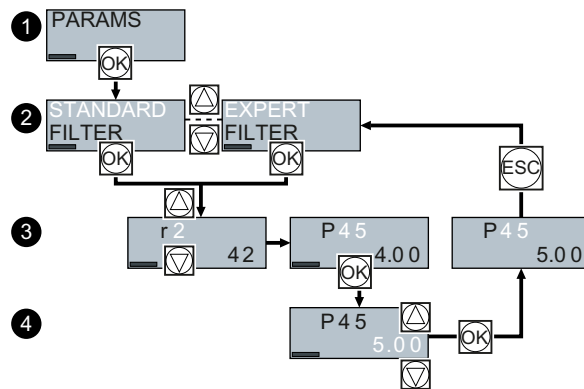
Changing settings using BOP-2

You can modify the settings of your inverter by changing the values of the its parameters. The inverter only permits changes to "write" parameters. Write parameters begin with a "P", e.g. P45.

The value of a read-only parameter cannot be changed. Read-only parameters begin with an "r", for example: r2.

The inverter retentively saves all the changes made using the BOP-2 so that they are protected against power failure.

Procedure



1. Select the menu to display and change parameters.
Press the OK key.
2. Select the parameter filter using the arrow keys.
Press the OK key.
 - STANDARD: The inverter only displays the most important parameters.
 - EXPERT: The inverter displays all of the parameters.
3. Select the required number of a write parameter using the arrow keys.
Press the OK key.
4. Select the value of the write parameter using the arrow keys.
Accept the value with the OK key.

You have now changed a write parameter using the BOP-2.

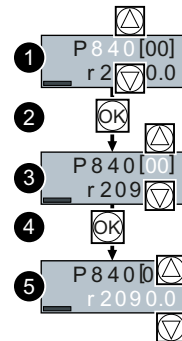
□

A.2.2 Changing indexed parameters

Changing indexed parameters

For indexed parameters, several parameter values are assigned to a parameter number. Each of the parameter values has its own index.

Procedure



1. Select the parameter number.
2. Press the OK key.
3. Set the parameter index.
4. Press the OK key.
5. Set the parameter value for the selected index.

You have now changed an indexed parameter.



A.2.3 Directly entering the parameter number and value

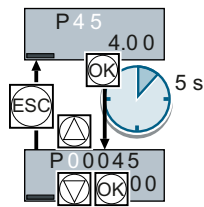
Directly select the parameter number

The BOP-2 offers the possibility of setting the parameter number digit by digit.

Precondition

The parameter number is flashing in the BOP-2 display.

Procedure



1. Press the OK button for longer than five seconds.
2. Change the parameter number digit-by-digit.
If you press the OK button then the BOP-2 jumps to the next digit.
3. If you have entered all of the digits of the parameter number, press the OK button.

You have now entered the parameter number directly.



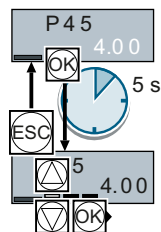
Entering the parameter value directly

The BOP-2 offers the option of setting the parameter value digit by digit.

Precondition

The parameter value flashes in the BOP-2 display.

Procedure



1. Press the OK button for longer than five seconds.
2. Change the parameter value digit-by-digit.
If you press the OK button then the BOP-2 jumps to the next digit.
3. If you have entered all of the digits of the parameter value, press the OK button.

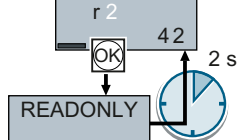
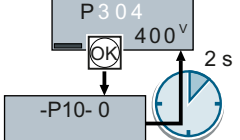
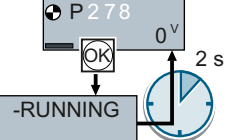
You have now entered the parameter value directly.



A.2.4 A parameter cannot be changed

When cannot you change a parameter?

The inverter indicates why it currently does not permit a parameter to be changed:

Read parameters cannot be adjusted	The parameter can only be adjusted during quick commissioning.	A parameter can only be adjusted when the motor is switched off
		

The operating state in which you can change a parameter is provided in the List Manual for each parameter.

A.3 Interconnecting signals in the converter

A.3.1 Fundamentals

The following functions are implemented in the inverter:

- Open-loop and closed-loop control functions
- Communication functions
- Diagnosis and operating functions

Every function comprises one or several blocks that are interconnected with one another.

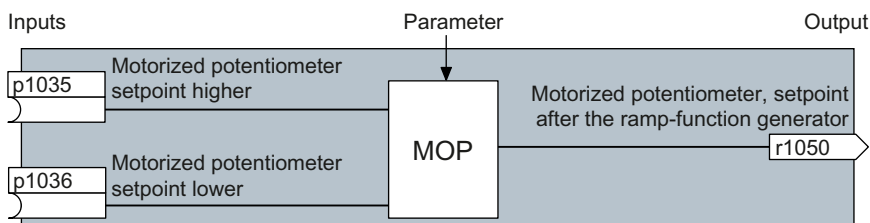


Figure A-3 Example of a block: Motorized potentiometer (MOP)

Most of the blocks can be adapted to specific applications using parameters.

You cannot change the signal interconnection within the block. However, the interconnection between blocks can be changed by interconnecting the inputs of a block with the appropriate outputs of another block.

The signal interconnection of the blocks is realized, contrary to electric circuitry, not using cables, but in the software.

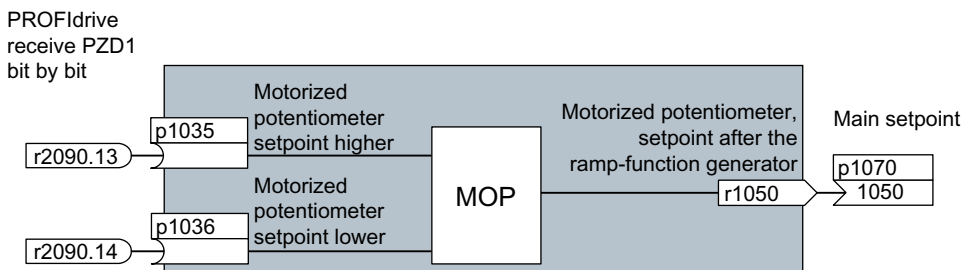


Figure A-4 Example: Signal interconnection of two blocks for digital input 0

Binectors and connectors

Connectors and binectors are used to exchange signals between the individual blocks:

- Connectors are used to interconnect "analog" signals (e.g. MOP output speed)
- Binectors are used to interconnect digital signals (e.g. "Enable MOP up" command)

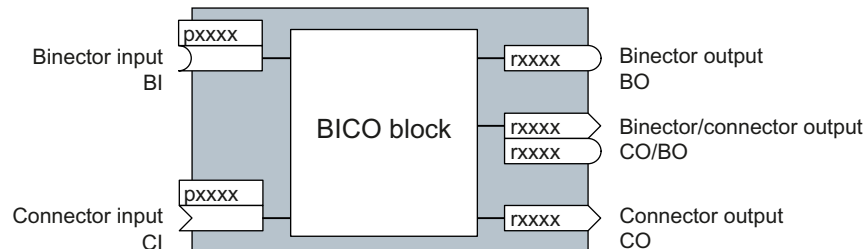


Figure A-5 Symbols for binector and connector inputs and outputs

Binector/connector outputs (CO/BO) are parameters that combine more than one binector output in a single word (e.g. r0052 CO/BO: status word 1). Each bit in the word represents a digital (binary) signal. This summary reduces the number of parameters and simplifies parameter assignment.

Binector or connector outputs (CO, BO or CO/BO) can be used more than once.

Interconnecting signals

When must you interconnect signals in the inverter?

If you change the signal interconnection in the inverter, you can adapt the inverter to a wide range of requirements. This does not necessarily have to involve highly complex functions.

Example 1: Assign a different function to a digital input.

Example 2: Switch the speed setpoint from the fixed speed to the analog input.

Principle when connecting BICO blocks using BICO technology

When interconnecting the signal, the following principle applies: **Where does the signal come from?**

An interconnection between two BICO blocks consists of a connector or a binector and a BICO parameter. The input of a block must be assigned the output of a different block: In the BICO parameters, enter the parameter numbers of the connector/binector that should supply its output signal to the BICO parameter.

How much care is required when you change the signal interconnection?

Note which changes you make. A subsequent analysis of the set signal interconnections is possible only by evaluating the parameter list.

We recommend that you use the STARTER and Startdrive commissioning tools for setting the signal interconnections.

Where can you find additional information?

- This manual suffices for assigning a different meaning to the digital inputs.
- The parameter list in the List Manual is sufficient for more complex signal interconnections.
- The function diagrams in the List Manual provide a complete overview of the factory setting for the signal interconnections and the setting options.

A.3.2 Application example

Shift the control logic into the inverter

It is only permissible that a conveyor system starts when two signals are present simultaneously. These could be the following signals, for example:

- The oil pump is running (the required pressure level is not reached, however, until after 5 seconds)
- The protective door is closed

To implement this task, you must insert free function blocks between digital input 0 and the command to switch on the motor (ON/OFF1).

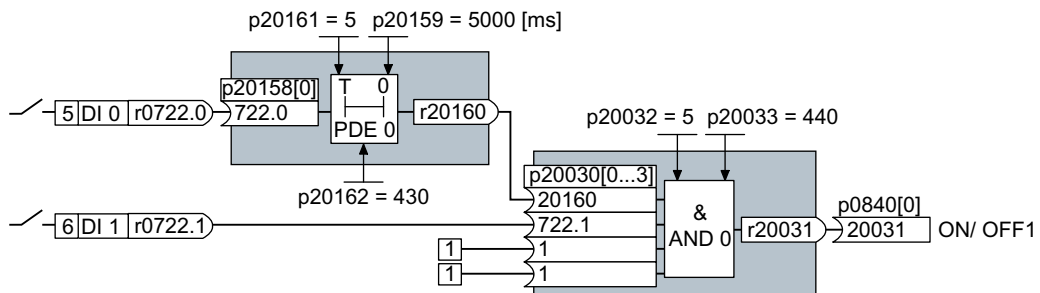


Figure A-6 Signal interconnection for control logic

The signal of digital input 0 (DI 0) is fed through a time block (PDE 0) and is interconnected with the input of a logic block (AND 0). The signal of digital input 1 (DI 1) is interconnected to the second input of the logic block. The logic block output issues the ON/OFF1 command to switch-on the motor.

Setting the control logic

Parameter	Description
p20161 = 5	The time block is enabled by assigning to runtime group 5 (time slice of 128 ms)
p20162 = 430	Run sequence of the time block within runtime group 5 (processing before the AND logic block)
p20032 = 5	The AND logic block is enabled by assigning to runtime group 5 (time slice of 128 ms)
p20033 = 440	Run sequence of the AND logic block within runtime group 5 (processing after the time block)
p20159 = 5000.00	Setting the delay time [ms] of the time module: 5 seconds

Parameter	Description
p20158 = 722.0	Connect the status of DI 0 to the input of the time block r0722.0 = Parameter that displays the status of digital input 0.
p20030[0] = 20160	Interconnecting the time block to the 1st AND input
p20030[1] = 722.1	Interconnecting the status of DI 1 to the 2nd AND input r0722.1 = Parameter that displays the status of digital input 1.
p0840 = 20031	Interconnect the AND output to ON/OFF1

Explanation of the application example using the ON/OFF1 command

Parameter p0840[0] is the input of the "ON/OFF1" block of the inverter. Parameter r20031 is the output of the AND block. To interconnect ON/OFF1 with the output of the AND block, set p0840 = 20031.

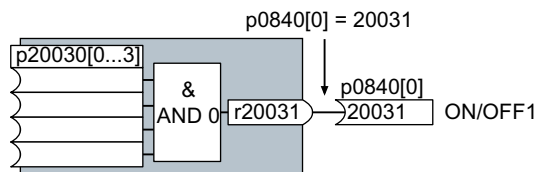


Figure A-7 Interconnecting blocks by setting p0840[0] = 20031

A.4 Manuals and technical support

A.4.1 Overview of the manuals

Manuals with additional information that can be downloaded:

-  CU230P-2 operating instructions (<https://support.industry.siemens.com/cs/ww/en/view/109751316>)
Installing, commissioning and maintaining the inverter. Advanced commissioning (this manual)

-  G120P Cabinet operating instructions (<https://support.industry.siemens.com/cs/ww/en/view/109749009>)
Installing, commissioning, operating and maintaining inverter cabinet units

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

-  CU230P-2 Compact Operating Instructions (<https://support.industry.siemens.com/cs/ww/en/view/109744767>)
Commissioning the inverter.

-  "Safety Integrated" function manual (<https://support.industry.siemens.com/cs/ww/en/view/109751320>)
Configuring PROFIsafe. Installing, commissioning and operating failsafe functions of the inverter

-  "Fieldbus" function manual (<https://support.industry.siemens.com/cs/ww/en/view/109751350>)
Configuring fieldbuses.

-  CU230P-2 List Manual (<https://support.industry.siemens.com/cs/ww/en/view/109751313>)
Parameter list, alarms and faults. Graphic function diagrams

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

-  PM330 Hardware Installation Manual (<https://support.industry.siemens.com/cs/ww/en/view/109748647>)
Installing Power Modules, reactors and filters. Technical data, maintenance

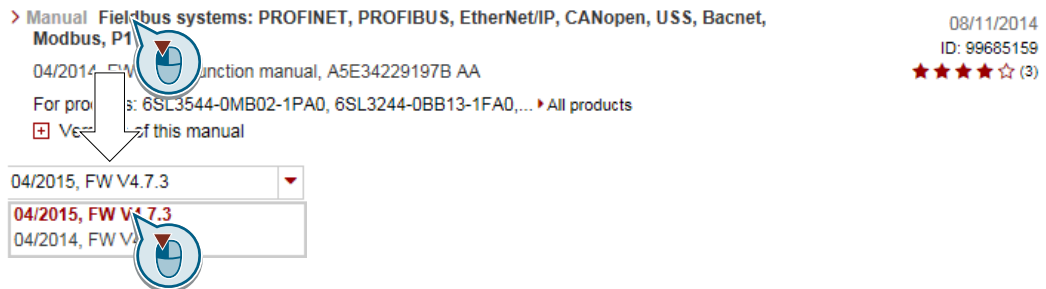

-  BOP-2 operating instructions (<https://support.industry.siemens.com/cs/ww/en/view/109483379>)
 Using the Operator Panel.

-  Operating instructions IOP-2 (<https://support.industry.siemens.com/cs/ww/en/view/109752613>)
 Using the operator panel, door mounting kit for mounting an IOP-2.

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


Finding the most recent edition of a manual

If there are multiple editions of a manual, select the latest edition:

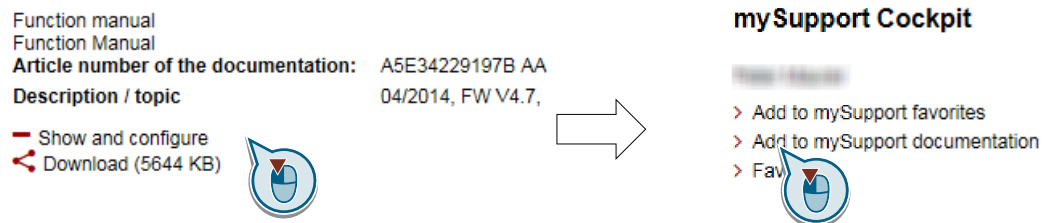


Configuring a manual

Further information about the configurability of manuals is available in the Internet:

 MyDocumentationManager (<https://www.industry.siemens.com/topics/global/en/planning-efficiency/documentation/Pages/default.aspx>).

Select "Display and configure" and add the manual to your "mySupport-documentation":



Not all manuals can be configured.

The configured manual can be exported in RTF, PDF or XML format.

A.4.2 Configuring support

Catalog

Ordering data and technical information for SINAMICS G inverters.



Catalogs for download or online catalog (Industry Mall):

 SINAMICS G120P (www.siemens.com/sinamics-g120p)

SIZER

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



 SIZER on DVD:

Article number: 6SL3070-0AA00-0AG0

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

EMC (electromagnetic compatibility) technical overview

Standards and guidelines, EMC-compliant control cabinet design



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

EMC Guidelines configuration manual

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



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

Safety Integrated for novices technical overview

Application examples for SINAMICS G drives with Safety Integrated



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

A.4.3 Product Support

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



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

This URL provides the following:

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

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Further information

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