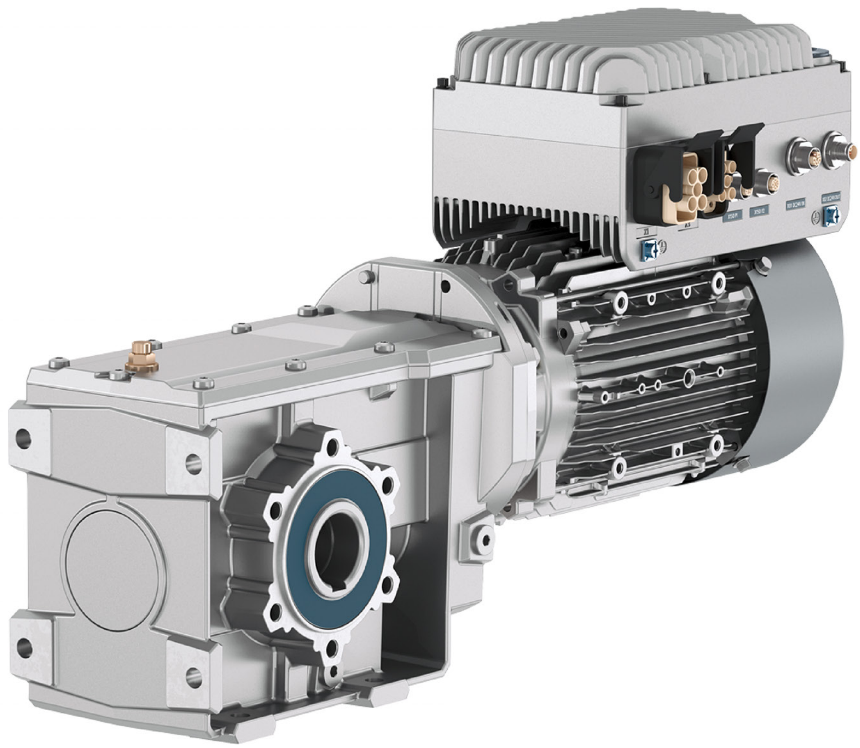

Edition 08/2024

OPERATING INSTRUCTIONS

SINAMICS

G115D

Motor-mounted converter for conveyor applications
www.siemens.com

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SINAMICS G115D
SINAMICS G115D Motor-mounted Converter

Operating Instructions

Edition 08/2024, Firmware V4.7 SP14

08/2024, FW V4.7 SP14

A5E52808111A AC

Legal information

Warning notice system

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

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

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

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

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

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GERMANY

A5E52808111A AC
Ⓟ 07/2024 Subject to change

Preface

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 the information required to operate the drive 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

Example of converter function symbols

❒ End of a handling instruction

About the device

Use for the intended purpose

The device 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)

Table of contents

1 Changes in the manual

Changes in the manual - 08/2024 Edition

- Removed description of SINAMICS G115D Wall Mounted Drive
- Removed description of SIMOGEAR geared motor
- Updated the pin definition of the M12 L-coding connector to include the functional earth connection

Changes in the manual - 07/2023 Edition

There are no changes to this manual

Fundamental safety instructions 2

2.1 General safety instructions

WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following steps apply when establishing safety:

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

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

WARNING

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

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

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

WARNING

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

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

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

WARNING

Electric shock if there is no ground connection

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

- Ground the device in compliance with the applicable regulations.

WARNING

Electric shock due to connection to an unsuitable power supply

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

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

WARNING

Electric shock due to damaged motors or devices

Improper handling of motors or devices can damage them.

Hazardous voltages can be present at the enclosure or at exposed components on damaged motors or devices.

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

WARNING

Electric shock due to unconnected cable shield

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

- Attach the cable shields at least on one side to the grounded housing potential.

WARNING

Arcing when a plug connection is opened during operation

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

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

WARNING

Electric shock due to residual charges in power components

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

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

NOTICE

Damage to equipment due to unsuitable tightening tools.

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

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

WARNING

Active implant malfunctions due to electromagnetic fields

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

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

WARNING

Unexpected machine movement caused by radio devices or cellphones

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

- Avoid operating radio devices, cellphones and mobile WLAN devices in the direct vicinity of converters and operating units.
- Scan the machine readable code, e.g. a QR code, from a greater distance or switch off the converter power supply before scanning.
- Only operate built-in devices with the control cabinet doors closed.
- When control cabinet doors are open, only qualified electrical personnel are allowed to carry out service and maintenance work.

CAUTION

Radio frequency interference in residential areas

When you operate EMC category C2 devices in residential areas, the devices can cause radio frequency interference.

When you operate EMC category C3 or C4 devices in residential areas, it is to be expected that the devices will cause radio frequency interference.

- Do not operate EMC category C2 devices in residential areas.
- Do not operate EMC category C3 or C4 devices in public low-voltage networks supplying residential buildings.

NOTICE

Damage to motor insulation due to excessive voltages

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

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

WARNING

Electric shock due to unsuitable motor temperature evaluation system

Voltage flashovers to the electronics of the converter 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 converter, e.g. using the "External fault" function.

WARNING

Fire due to inadequate ventilation clearances

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

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

NOTICE

Overheating due to inadmissible mounting position

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

- Only operate the device in admissible mounting positions.

NOTICE

Device damage caused by incorrect insulation resistance tests

High test voltages can damage the device.

- Measure the insulation resistance of low voltage circuits of machines or systems only with ≤ 500 V DC.
- Measure the insulation resistance of SELV circuits of machines or systems only with ≤ 250 V DC.

NOTICE

Device damage caused by incorrect voltage tests

High test voltages can damage the device. Capacitive leakage currents can distort the test results.

- Disconnect the components before carrying out a voltage test on the machine. 1)

1) The components are voltage tested in accordance with the IEC 61800-5-1 product standard and must be disconnected during testing in accordance with IEC 60204-1:2021 Section 18.4.

WARNING

Unexpected movement of machines caused by inactive safety functions

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

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

Note

Important Safety instructions for Safety Integrated

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

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 against unauthorized access.
- Handle possible malfunctions by taking suitable measures, e.g. emergency stop or emergency off.

WARNING

Injury caused by moving or ejected parts

Contact with moving motor parts or drive output elements and the ejection of loose motor parts (e.g. feather keys) out of the motor enclosure can result in severe injury or death.

- Remove any loose parts or secure them so that they cannot be flung out.
- Do not touch any moving parts.
- Safeguard all moving parts using the appropriate safety guards.

WARNING

Fire due to incorrect operation of the motor

When incorrectly operated and in the case of a fault, the motor can overheat resulting in fire and smoke. This can result in severe injury or death. Further, excessively high temperatures destroy motor components and result in increased failures as well as shorter service lives of motors.

- Operate the motor according to the relevant specifications.
- Only operate the motors in conjunction with effective temperature monitoring.
- Immediately switch off the motor if excessively high temperatures occur.

CAUTION

Burns and thermal damage caused by hot surfaces

Temperatures above 100 °C may occur on the surfaces of motors, converters, and other drive components.

Touching hot surfaces may result in burns. Hot surfaces may damage or destroy temperature sensitive parts.

- Ensure that temperature-sensitive parts do not come into contact with hot surfaces.
- Mount drive components so that they are not accessible during operation.

Measures when maintenance is required:

- Allow drive components to cool off before starting any work.
- Use appropriate personnel protection equipment, e.g. gloves.

2.2 Equipment damage due to electric fields or electrostatic discharge

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

NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

2.3 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 customer-specific solutions, but merely serve to provide assistance with 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.

2.4 Cybersecurity information

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

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

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

For additional information on industrial cybersecurity measures that may be implemented, please visit
https://www.siemens.com/cybersecurity-industry.

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

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

Further information is provided on the Internet:

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

⚠ WARNING

Unsafe operating states resulting from software manipulation

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

- Keep the software up to date.
- Incorporate the automation and drive components into a state-of-the-art, integrated industrial cybersecurity concept for the installation or machine.
- Make sure that you include all installed products in the integrated industrial cybersecurity concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- Carefully check all cybersecurity-related settings once commissioning has been completed.

2.5 Residual risks of power drive systems

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

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

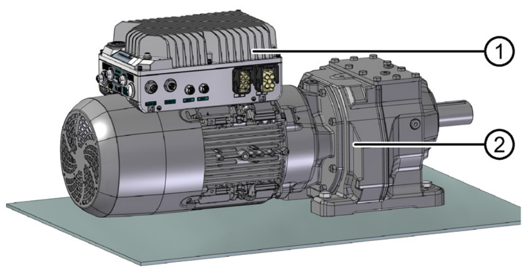
   When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

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

Description 3

The SINAMICS G115D motor-mounted converter is designed to provide an adaptable solution to conveyor technology applications.

You can operate an Innomotics standard geared motor with the G115D motor-mounted converter.



① SINAMICS G115D motor-mounted converter

② Innomotics standard geared motor for SINAMICS G115D

3.1 Scope of delivery

The delivery of the SINAMICS G115D motor-mounted converter comprises at least the following:

- A ready-to-run converter with loaded firmware.

  Options for upgrading and downgrading the firmware can be found on the Internet:

  Firmware (https://support.industry.siemens.com/cs/ww/en/view/67364620)
- Open-source software (OSS) with license terms saved in the converter

Explanation on article number (example)

6 S L 3 5 5 0 - 0 X A 2 0 - 3 A F 0

Interconnection types

A0 Glanded variant, I/O control
A2 Glanded variant, fieldbus communication, converter side left
A4 Glanded variant fieldbus, communication, converter side right
A6 Glanded variant, I/O + fieldbus communication on M12, converter side left
A8 Glanded variant, I/O + fieldbus communication on M12, converter side right
B0 Connector variant without daisy chain (Q4/2 + 7/8"), converter side left
B2 Connector variant without daisy chain (Q4/2 + 7/8"), converter side right
B4 Connector variant without daisy chain (Q4/2 + M12), converter side left
B6 Connector variant without daisy chain (Q4/2 + M12), converter side right
C0 Connector variant without daisy chain (QUICKON + M12), converter side left
C2 Connector variant without daisy chain (QUICKON + M12), converter side right
D0 Connector variant without daisy chain (MQ15 + M12), converter side left
D2 Connector variant without daisy chain (MQ15 + M12), converter side right
E0 Connector variant with daisy chain (Q4/2 + 7/8"), converter side left
E2 Connector variant with daisy chain (Q4/2 + 7/8"), converter side right
E4 Connector variant with daisy chain (Q4/2 + M12), co nverter side left
E6 Connector variant with daisy chain (Q4/2 + M12), converter side right
H0 Glanded variant, I/O control, 24V DC power supply unit integrated, converter side left
H1 Glanded variant, I/O control, 24V DC power supply unit integrated, converter side right
H2 Glanded variant, fieldbus communication, 24V DC power supply unit integrated, converter side left
H4 Glanded variant, fieldbus communication, 24V DC power supply unit integrated, converter side right
H6 Glanded variant, I/O + fieldbus communication on M12, 24V DC power supply unit integrated, converter side left
H8 Glanded variant, I/O + fieldbus communication on M12, 24V DC power supply unit integrated,converter side right
K0 Connector variant without daisy chain (Q4/2), 24V DC power supply unit integrated, converter side left
K2 Connector variant without daisy chain (Q4/2), 24V DC power supply unit integrated, converter side right
L0 Connector variant without daisy chain (QUICKON), 24V DC power supply unit integrated, converter side left
L2 Connector variant without daisy chain (QUICKON), 24V DC power supply unit integrated, converter side right
M0 Connector variant without daisy chain (MQ15), 24V DC power supply unit integrated, converter side left
M2 Connector variant without daisy chain (MQ15), 24V DC power supply unit integrated, converter side right
N0 Connector variant with daisy chain (Q4/2), 24V DC power supply unit integrated, converter side left
N2 Connector variant with daisy chain (Q4/2), 24V DC power supply unit integrated, converter side right
R1 Glanded variant, I/O + fieldbus on M12, M12 for 24V DC power connection, converter side left *
R2 Glanded variant, I/O + fieldbus on M12, M12 for 24V DC power connection, converter side right *

Rated output power

0-3	0.37 kW
0-5	0.55 kW
0-7	0.75 kW
1-1	1.1 kW
1-5	1.5 kW
2-2	2.2 kW
3-0	3.0 kW
4-0	4.0 kW

EMC filter type

A Filter C2

Communications

A AS-Interface
B I/O control
F PROFInet, Ethernet / IP

*The interconnection Type R1 and R2 support daisy-chain connections of the 24 V power supply

Compatible motors

The SINAMICS G115D motor-mounted converters are compatible with Innomotics 2KJ8 geared motors from frame size 71 to frame size 112.

Motor frame size		Motor rated power (kW)	Converter rated power (kW)							
			FSA					FSB		
IE2/IE3	IE4		0.37	0.55	0.75	1.1	1.5	2.2	3.0	4.0
71	-	0.37	Y	Δ	Δ					
80	80	0.55		Y	Δ	Δ				
		0.75			Y	Δ	Δ			
90	90	1.1				Y	Δ	Δ		
		1.5					Y	Δ	Δ	
100	112	2.2						Y	Δ	Δ
		3.0							Y	Δ
112		4.0								Y

- Motor speed range:

300 rpm ... 1500 rpm (2KJ8...-.....-3...-.)
300 rpm ... 3000 rpm (2KJ8...-.....-4...-.)
300 rpm ... 2610 rpm (2KJ8...-.....-5...-.)

- Motor connection type:

Y: star connection
Δ: delta connection

3.2 Directives and standards

The following directives and standards shown in this section are explanatory only and do not confirm compliance of the product with the respective directives and standards. Compliance to a given directive or standard is given only if the certification mark is shown on the product.

European Low Voltage Directive

The converters fulfill 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 converters fulfill the requirements stipulated in the Machinery Directive 2006/42/EC, if they are covered by the application area of this directive.

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

Directive 2011/65/EU

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

European Directive on Waste Electrical and Electronic Equipment (WEEE)

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

European EMC Directive

The compliance of the converters with the regulations of the Directive 2014/30/EU has been demonstrated by full compliance with the IEC/EN 61800-3.

UK Declaration of Conformity

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

EMC requirements for South Korea

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

Underwriters Laboratories (North American market)

Converters provided with the test symbol displayed fulfill the requirements stipulated for the North American market as a component of drive applications, and are appropriately listed.

Eurasian conformity

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

Australia and New Zealand (RCM formerly C-Tick)

The converters showing the test symbols fulfill the EMC requirements for Australia and New Zealand.

China RoHS

The converters comply with the requirements of China RoHS. You can find additional information on the Internet:

China RoHS (https://support.industry.siemens.com/cs/ww/en/view/109738656)

Quality systems

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

Standards that are not relevant

China Compulsory Certification

The SINAMICS G115D converters do not fall in the area of validity of the China Compulsory Certification (CCC).

Certificates for download

You can find all relevant certificates for download on the Internet:

Certificates (https://support.industry.siemens.com/cs/us/en/ps/27867/cert)

3.3 Optional components

3.3.1 External braking resistor

The optional external braking resistor can be used to convert the regenerative energy produced by the motor into heat, thus giving greatly improved braking and deceleration capabilities.

Article number

Article number	Resistance	Continuous braking power	Converter frame Size
6SL3501-1BE32-0AA0	210 Ω	200 W	FSA
6SL3501-1BE32-4AA0	220 Ω	240 W	
6SL3501-1BE34-8AA0	200 Ω	480 W	
6SL3501-1BE32-0BA0	160 Ω	200 W	FSB
6SL3501-1BE32-4BA0	150 Ω	240 W	
6SL3501-1BE36-0BA0	150 Ω	600 W	

Further information

For more information about the external braking resistor, refer to the following chapters:

- Mounting the external braking resistor (Page 37)
- Connecting the external braking resistor (Page 86)
- Dynamic braking (Page 295)
- Technical data of braking resistors (Page 384)

3.3.2 Connectors

QUICKON connector

The QUICKON connector is used for line supply connection to the connector variant (QUICKON) of the G115D converter.

Article number	Illustration	Interface	Quantity	Tightening torque
6SL3566-4MA00-0GA0		Line supply (IN) - X1	1	7 Nm (62.0 lbf.in)

QUICKON nut

The QUICKON nut is used for line supply connection to the connector variant (QUICKON) of the G115D converter.

Article number	Illustration	Interface	Quantity	Tightening torque
6SL3566-4NA00-0GA0		Line supply (IN) - X1	1	7 Nm (62.0 lbf.in)

3.3.3 Glanded installation kit

Article number	Illustration	Interface	Cable gland	Quantity	Tightening torque
6SL3566-2GM00-0GA0		Line supply - X1/X3	M25 × 1.5	2	12 Nm (106.2 lbf.in)
		24 V power supply - X01/X02	M20 × 1.5	2	12 Nm (106.2 lbf.in)
		Digital inputs/outputs - X07/X08/X05	M16 × 1.5	3	10 Nm (88.5 lbf.in)

3.3.4 Connector cover kit

Connector cover kit for G115D converter with daisy chain

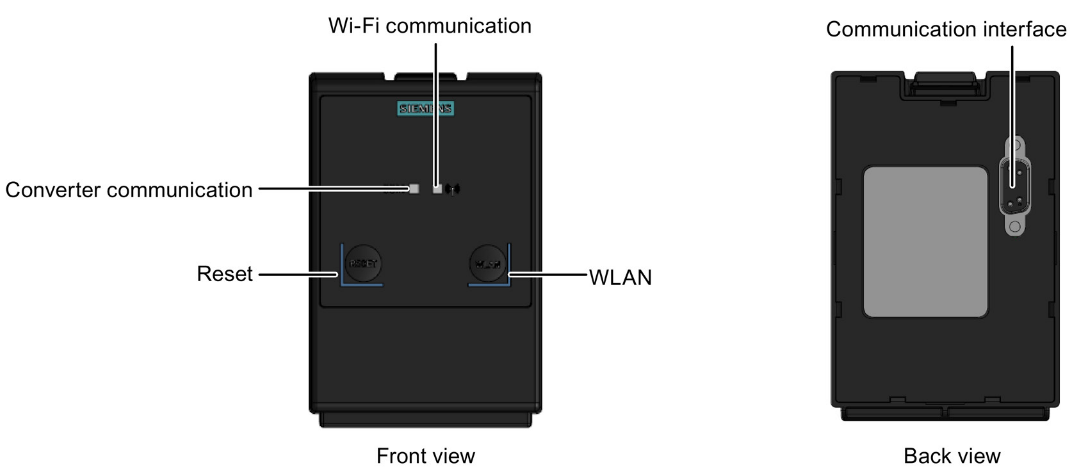
For the connector variant of the G115D converter with daisy chain, if you don’t use daisy chain connection, cover the unused connectors with the optional connector cover kit to maintain the IP rating of the system.

Article number	Illustration	Interface	Connector caps	Quantity
6SL3566-2GA00-0GA0		Line supply (OUT) - X3	Q4/2 connector sealing cap	1
		24 V power supply (OUT) - X02	7/8" connector sealing cap	1
			M12 L-code connector sealing cap	1

3.3.5 SINAMICS G120 Smart Access

The SINAMICS G120 Smart Access is a Wi-Fi based Web server module and an engineering tool. It has been designed for quick setup, parameterization, and diagnostics of the supported SINAMICS G120 converter or SINAMICS G115D converter.

Article number: 6SL3255-0AA00-5AA0



Further information

For more information about the SINAMICS G120 Smart Access, see the SINAMICS G120 Smart Access Operating Instructions.

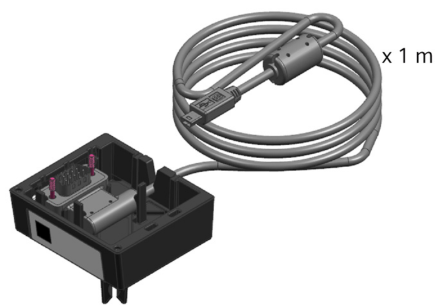
Overview of the manuals (Page 404)

3.3.6 SAM interface kit

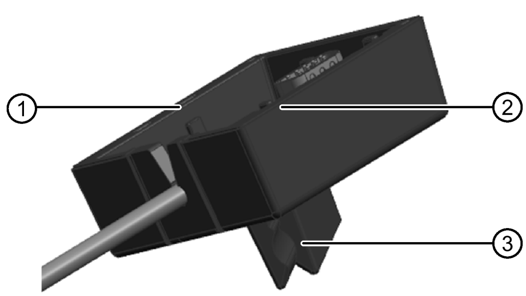
Functionality

The SAM interface kit is used to connect the SINAMICS G120 Smart Access to the SINAMICS G115D converter, thus realizing Web-based access to the converter from a device connected to the G120 Smart Access.

Article number: 6SL3555-0XA00-0AA0



The SAM interface kit is designed with a rubber support and magnets, which allows you to easily mount the SINAMICS G120 Smart Access to the converter or remove it from the converter. The permissible operating temperature range for the SAM interface kit is from -10 °C to +60 °C. Vibration in operation fulfills Class 3M1 according to EN60721-3-3: 1995.



①, ②	Magnetic side
③	Rubber support

Scope of delivery

- SAM interface kit for the SINAMICS G115D converter
- Compact Installation Instructions in English, Chinese, and German

Further information

For more information about mounting the G120 Smart Access to the G115D converter via the optional SAM interface kit, see the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

Mounting

4

WARNING

Risk of burns and fire due to high temperatures

During operation and for a short time after switching the converter off, the surfaces reach temperatures that can inflict burns or start fires.

- Before attempting to touch the surfaces of the converter, ensure that enough time is given to allow the converter to cool down to a safe temperature to avoid personal injury.
- Remove any flammable materials from around the converter to reduce the risk of fire.

NOTICE

Converter damage due to misusage as a step or ledge

The converter is not designed to support a substantial weight. Substantial weight placed on the system could cause severe damage to the converter.

- Don't use the converter as a step or ledge.

4.1 Installation notes

Vibration severity

Due to the influencing variables listed below, the vibration response of the system at the location of use can lead to increased vibration severity on the drive unit:

- Transmission elements
- Installation conditions
- Alignment and installation
- Effects of external and internal oscillation

The vibration severity values specified in accordance with ISO 20816-1 must not be exceeded at any point on the surface of the drive. This ensures problem-free operation and a long service life.

Maximum permissible vibration severity

Observe the values for the maximum permissible radial and axial oscillation vibration severity in the following table. Radial/axial refers to the motor axes.

Maximum permissible radial vibration levels

Vibration frequency	Vibration value
< 6.3 Hz	Vibration displacement $s \leq 0.16$ mm
6.3 Hz to 250 Hz	Vibration velocity $v_{rms} \leq 4.5$ mm/s
> 250 Hz	Vibration acceleration $a_{peak} \leq 10$ m/s^2

Maximum permissible axial vibration severity

Vibration velocity	Vibration acceleration
Vibration velocity $v_{rms} \leq 4.5$ mm/s	Vibration acceleration $a_{peak} \leq 10$ m/s^2

Resonant frequencies

Resonance can occur in the speed range of the geared motor depending on the machine to be driven.

Operation in resonance causes increased noise and vibration levels.

Adherence to the maximum permissible vibration severity is always required.

Operation in the resonant frequency leads to a reduced service life of the geared motor, irrespective of adherence to the maximum vibration severity.

Continuous operation in the resonant frequency must be avoided.

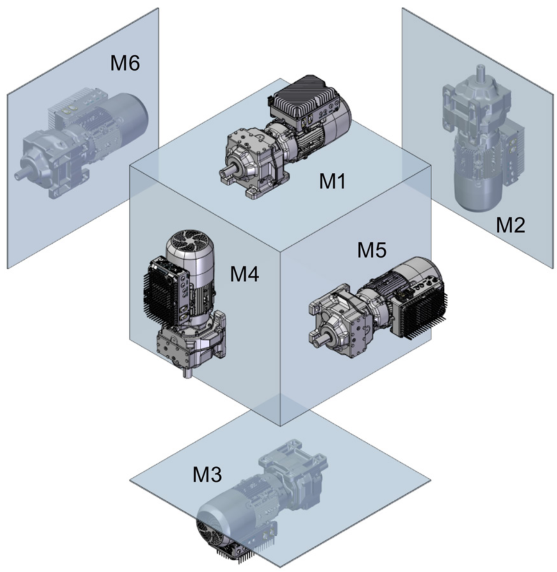
4.2 Mounting the converter

Note that the SINAMICS G115D motor-mounted converter is mounted on the geared motor when delivered.

Mounting positions

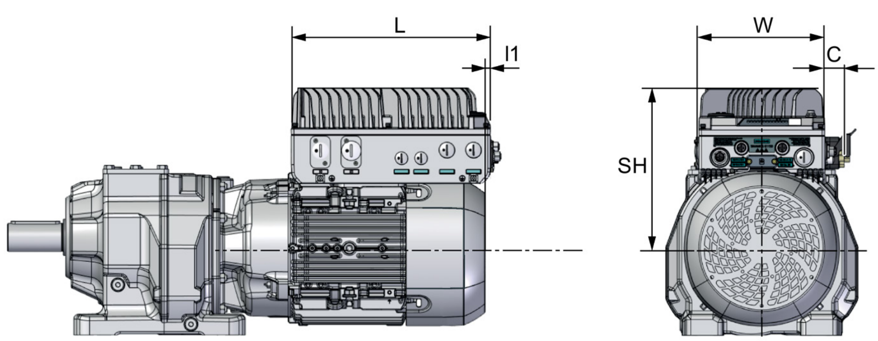
The SINAMICS G115D motor-mounted converter supports mounting positions M1 to M6 based on the desired mounting configuration for the geared motor.

The figure below shows the SINAMICS G115D motor-mounted converter with Innomotics geared motor in mounting positions M1 to M6:



Mounting dimensions

All dimensions are specified in millimeters (inches).

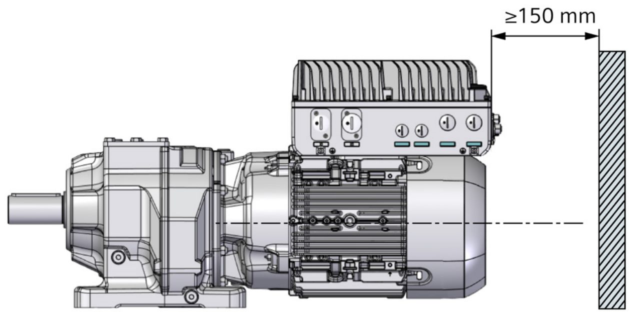


Converter frame size	Motor frame size	Length L	Length l1	Width W	Height SH	Additional width[1)] C
FSA	71	240 (9.4)	53.5 (2.11)	146 (5.7)	177.5 (7.0)	Connector variant: +30 (1.18) Glanded variant and Q8/0 variant: +30 (1.18) Converter with 24 V PSU: +60 (2.36)
	80		25 (0.98)		196 (7.7)	
	90		0.5 (0.02)		201 (7.9)	
FSB	90	285 (11.2)	27 (1.06)	180 (7.1)	206 (8.1)	
	100		5 (0.2)		217.5 (8.6)	
	112		-3 (-0.12)		228.5 (9.0)	

1) The glanded variant of the converter provides no cable gland when delivered. The dimension data of glanded variant applies to the drive installed with the optional glanded installation kit.

Mounting clearance

Maintain a minimum clearance distance of 150 mm (5.9 in) from the converter to the wall.



Dimensions of the geared motor

For further information on the dimensions of the geared motors, refer to the following documentation:

- The relevant catalog

  Catalog D 31.2 (https://support.industry.siemens.com/cs/ww/en/view/109750324)

- Drive Technology Configurator (DT Configurator)

  DT Configurator (http://www.siemens.com/dt-configurator)

  You can generate and download data sheets, 2D dimension drawings and 3D CAD models of the geared motors.

4.3 Mounting the optional components

4.3.1 Mounting the external braking resistor

⚠ **WARNING**

Risk of fire due to improper installation

Resistor surfaces reach high temperature during operation. A braking resistor which is not properly mounted can cause components overheat with associated risk of fire.

- Mount the resistor on non-flammable and heat-resistant surfaces only.
- Ensure that there are no flammable or combustible objects or materials close to the resistor.

⚠ **CAUTION**

Risk of burn due to high surface temperature

The braking resistor can reach a temperature of 300 °C in normal operation. Ratings given are absolute maximum and must not be exceeded. In the event of operation beyond specification or a fault, the resistor can reach a temperature of up to 600 °C. You can get burnt when touching the hot surface.

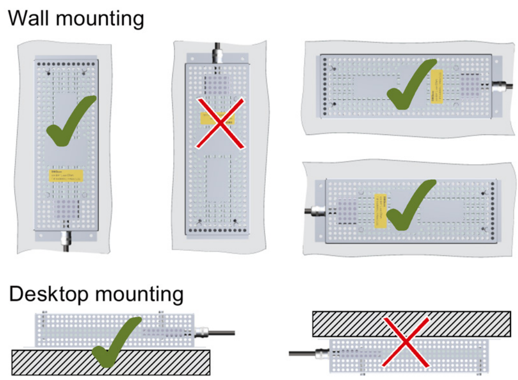
- Mount the resistor in such a way that it is not accessible and cannot be touched during operation.
- Allow sufficient distance from nearby materials to keep them at an acceptable temperature.
- Ensure that ventilation is provided.

Mounting orientations

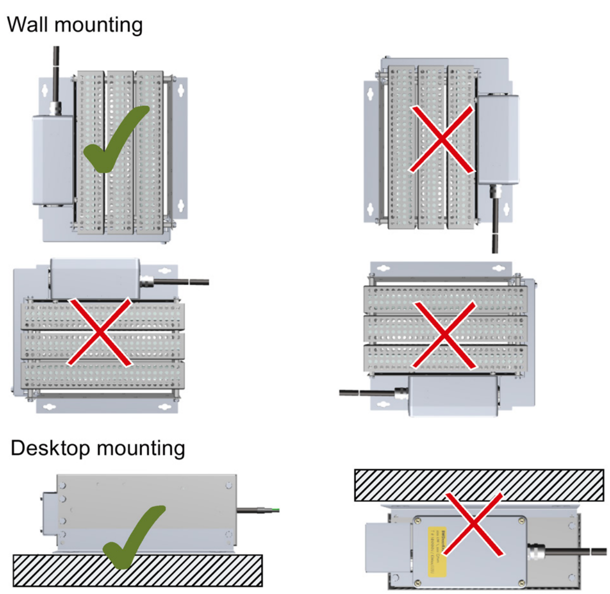
Mounting orientations: correct (✓); incorrect (✖)

- 6SL3501-1BE32-0AA0; 6SL3501-1BE32-4AA0;
  6SL3501-1BE32-0BA0; 6SL3501-1BE32-4BA0

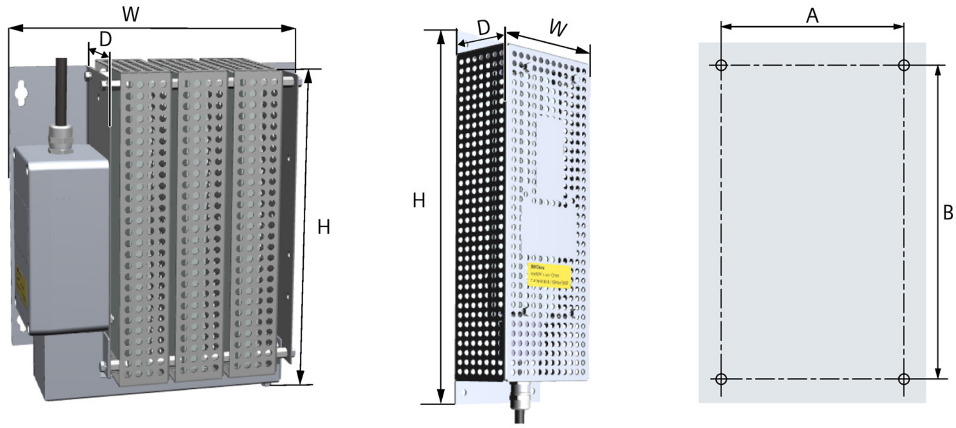
  Mount the braking resistor on a flat surface which has a minimum thickness of 2 mm and a minimum size of the braking resistor outline dimensions.



- 6SL3501-1BE34-8AA0; 6SL3501-1BE36-0BA0



Outline dimensions and drill pattern



Article number	Dimensions (mm/inch)					Weight (kg/lb.)
	H	W	D	A	B	
6SL3501-1BE32-0AA0	320 (12.6)	106 (4.2)	64 (2.5)	86 (3.4)	300 (11.8)	1.56 (3.43)
6SL3501-1BE32-4AA0						2.10 (4.62)
6SL3501-1BE34-8AA0	245 (9.6)	216 (8.5)	96.5 (3.8)	197 (7.8)	176 (6.9)	3.89 (8.56)
6SL3501-1BE32-0BA0	320 (12.6)	106 (4.2)	64 (2.5)	86 (3.4)	300 (11.8)	1.56 (3.43)
6SL3501-1BE32-4BA0						2.10 (4.62)
6SL3501-1BE36-0BA0	245 (9.6)	227 (8.9)	96.5 (3.8)	208 (8.2)	176 (6.9)	3.42 (7.52)

	Fastening	Tightening torque
Fixing to the mounting surface	4 x M4 screws, nuts, washers	2.5 Nm (22.1 lbf.in)

4.3.2 Mounting the SINAMICS G120 Smart Access

To mount the SINAMICS G120 Smart Access to the G115D converter, you must use the optional SAM interface kit (Page 31).

For detailed information on mounting the SINAMICS G120 Smart Access and the SAM interface kit, refer to SINAMICS G120 Smart Access Operating Instructions.

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Wiring 5

5.1 EMC installation guidelines

5.1.1 Connections and interference suppression

Set up reliable connections and make sure that all connections cannot be interrupted. Screwed connections on painted or anodized metal components must be made either by means of special contact washers, which penetrate the isolating surface and establish a metallically conductive contact, or by removing the isolating surface on the contact points.

Contactor coils, relays and solenoid valves must have interference suppressors to reduce high-frequency radiation when the contacts are opened (RC elements or varistors for AC current operated coils, and freewheeling diodes for DC current-operated coils). The interference suppressors must be connected directly on each coil.

5.1.2 Basic EMC rules

Measures to limit Electromagnetic Interference (EMI)

In the following list are the necessary measures that must be taken to ensure the correct installation of the converter within a system, which should minimize the effects of EMI.

Cables

- Keep all cable lengths to the minimum possible length; avoid excessive cable lengths.
- Route always signal and data cables, as well as their associated equipotential bonding cables, in parallel and with as short a distance as possible.
- Do not route signal and data cables parallel to the line supply cables.
- Signal and data cables should not cross the line supply cables; if crossing is necessary, they should cross at an angle of 90 °.
- Shield signal and data cables.
- Route particularly sensitive signal cables, such as setpoint and actual value cables, with optimum shield bonding at both ends and without any interruptions of the shield.
- Ground spare wires for signal and data cables at both ends.
- Route all power cables (line supply cables) separately from signal and data cables. The minimum distance should be approximately 25 cm.

Cable shields

- Use shielded cables with finely stranded braided shields. Foil shields are not suitable since they are much less effective.
- Connect shields to the grounded housings at both ends with excellent electrical conductivity and a large contact area.
- Bond the cable shields to the plug connectors of the converter.
- Do not interrupt cable shields by intermediate terminals.
- For power cables as well as signal and data cables, the cable shields should be connected by means of suitable EMC glands. The cable shields must be connected to the shield bonding options for cables and the unit housing respectively with excellent electrical conductivity and a large contact area.
- Use only metallic or metallized connector housings for shielded data cables.

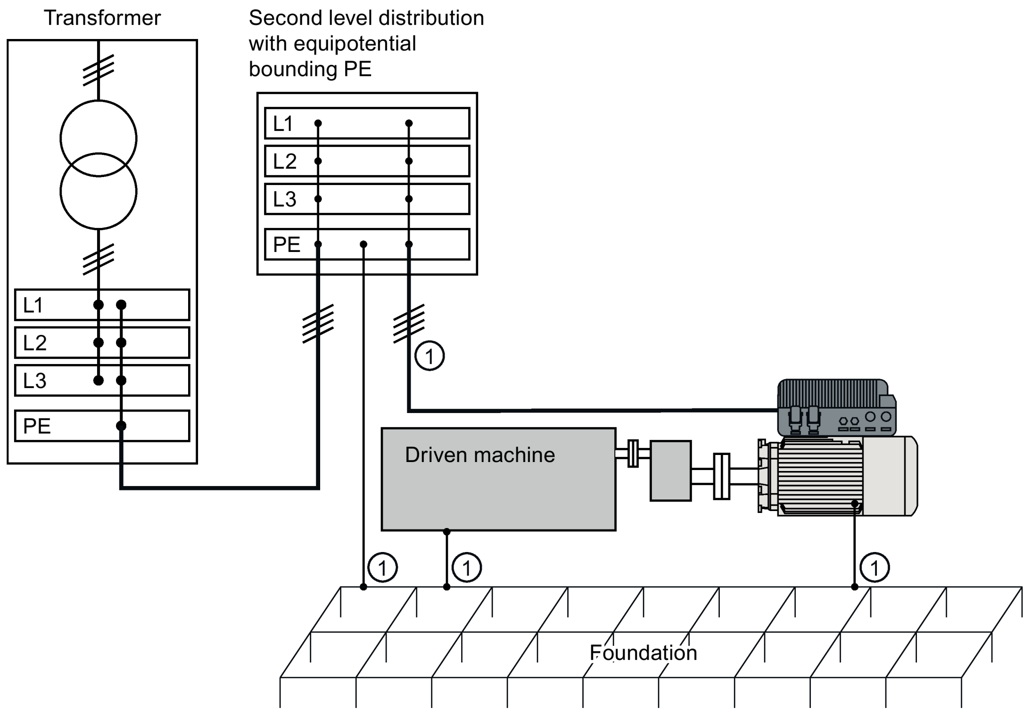
5.1.3 Equipotential bonding

Equipotential bonding within the drive system has to be established by connecting all electrical and mechanical drive components (transformer, motor and driven machine) to the grounding system. These connections are established by means of standard heavy-power PE cables, which do not need to have any special high-frequency properties.

In addition to these connections, the converter (as the source of the high-frequency interference) and all other components in each drive system (motor and driven machine) must be interconnected with respect to a high-frequency point of view. For this purpose cables with good high-frequency properties must be used.

Grounding and high-frequency equipotential bonding measures

The following figure illustrates all grounding and high-frequency equipotential bonding measures.



① Conventional grounding system without special high-frequency properties

The ground connections ① represent the conventional grounding system for the drive components. They are made with standard, heavy-power PE conductors without special high-frequency properties and ensure low frequency equipotential bonding as well as protection against injury.

The line supply cable of the converter can be unshielded. The converter has to be grounded by this cable.

The converter enclosure provides high-frequency equipotential bonding between the converter and the motor.

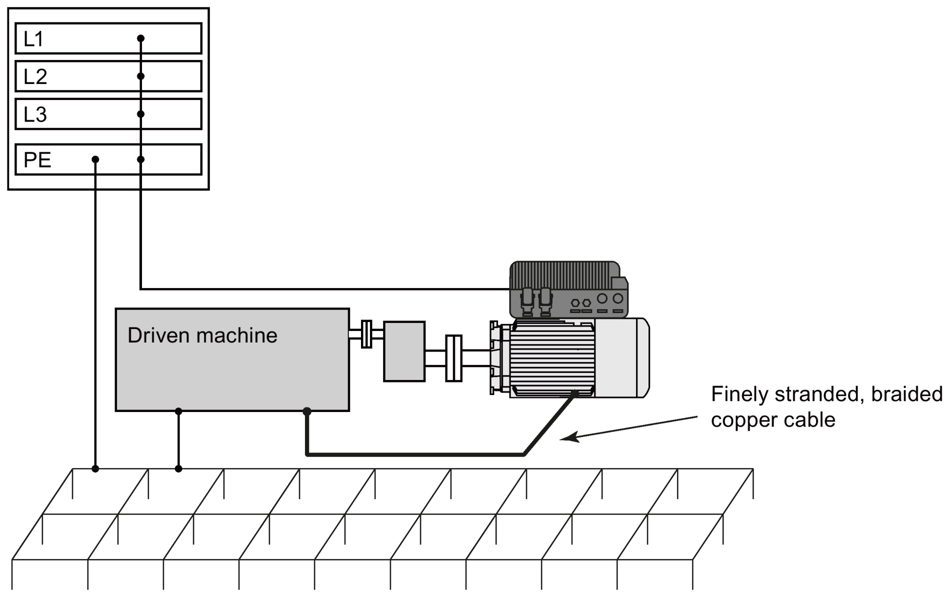
The connection provides solid bonding for high-frequency currents between the metal body of the converter and the unpainted metal mounting frame. This connection should be made with short, finely stranded, braided copper wires.

Additional measures

Finely stranded, braided copper cables have to be routed in parallel with the cable shields in the following cases:

- Old installations with already existing unscreened cables
- Cables with poor high-frequency properties
- Installations with bad grounding systems

The connections in the following figure provide a solid, high-frequency bonding between the driven machine and the converter.



Further information

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

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

5.2 Permissible line supplies

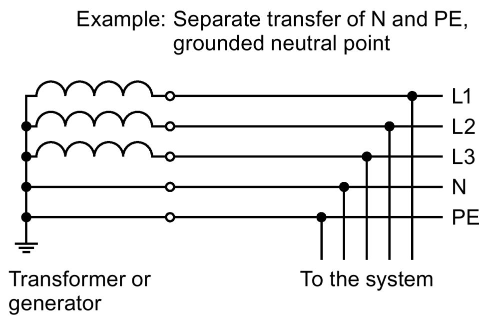
Note

Fault protection in case of insulation failure for the motor circuit

The electronic overcurrent trip of the converter complies with the requirements laid down in IEC 60364-4-41:2005/AMD1:2017 Section 411 and Appendix D 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.

5.2.1 TN line system



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

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

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

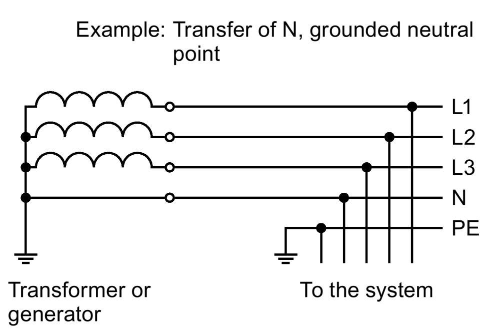
G115D converters can only be operated in a line system with grounded neutral point and are not suitable for corner-grounded networks.

Converter operated on a TN system

Converter	Line supply with grounded neutral	
Frame size	A	B
Integrated line filter C2	✓	✓

✓ Operation permissible

5.2.2 TT line system



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

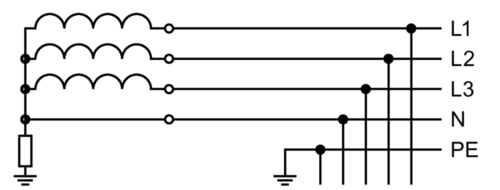
There are TT supplies where the neutral conductor N is either transferred – or not.

Converter operated on a TT system

Converter	Line supply with grounded neutral	
Frame size	A	B
Integrated line filter C2	✓	✓

✓ Operation permissible

5.2.3 IT line system



In an IT 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.

Converter operated on an IT system

Converter	Line supply with grounded neutral	
Frame size	A	B
Integrated line filter C2	✓ 1)	✓ 1)

✓ 1) Operation permissible once the functional grounding screw(s) has been removed

If the functional grounding screw has been removed, the converter no longer fulfills the requirements of class C2.

If you wish to use the converter in an IT line system, you must disconnect the capacitor with earth by removing the functional grounding connections from the converter.

Removing functional grounding connections from the converter

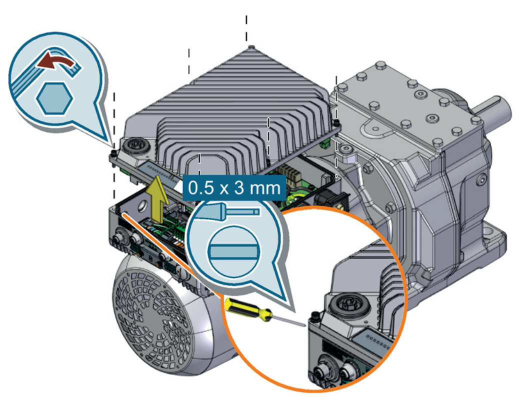
Precondition

Switch off the converter power supply before removing the functional grounding.

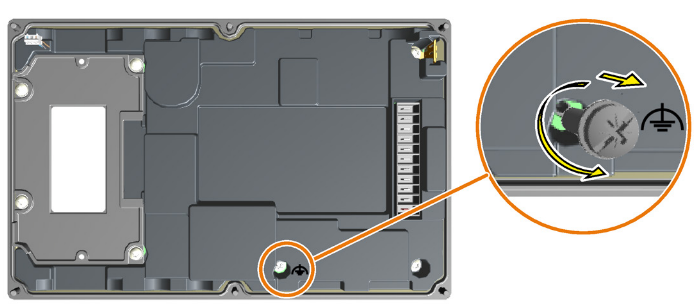
⚠ WARNING
Electric shock as a result of a residual charge in power components After the power supply has been switched off, it takes up to five minutes until the capacitors in the converter have discharged so that the residual charge is at a non-hazardous level. Therefore, touching the converter immediately after powering off can result in electric shock due to residual charge in the power components. • Check the voltage at the converter connections before you remove the functional grounding.

Procedure

1. Release the retaining screws (6 x M4) for the Electronic Module by using a 3 mm allen key, and then remove the module.



2. Remove the functional grounding screw marked with the ⏚ symbol from the back side of the Electronic Module.



3. Remove the grounding screw and the grounding cable from the Wiring Module.
4. Re-attach the Electronic Module with a tightening torque of 2.5 Nm (22.1 lbf.in).

You have removed the functional grounding from the converter.
❒

5.3 Requirements for the protective conductor

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

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

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

WARNING

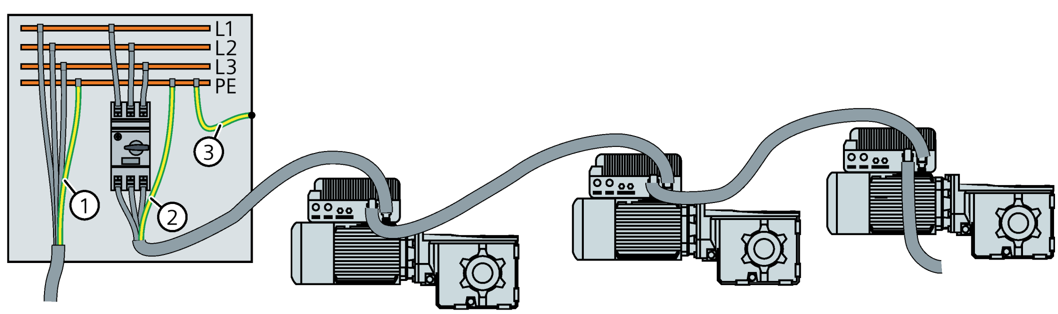
Electric shock due to interrupted protective conductor

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

- Comply with the requirements for the protective conductor.

Dimensioning the protective conductor

The figure below shows the protective conductors of the converter.



① Protective conductor for mains supply cables
② Protective conductor for converter line supply cables
③ Protective conductor between PE and the control cabinet

The minimum cross-section of the protective conductor ① ... ③ depends on the cross-section of the mains supply cable:

- Mains supply cable ≤ 16 mm^2

  ⇒ Minimum cross-section of the protective conductor = cross-section of the mains supply 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 control cabinets or enclosed machine housings are considered to be adequately protected against mechanical damage.)
  - As a conductor of a multi-conductor cable, the protective conductor has a cross-section ≥ 2.5 mm² Cu.
  - For an individual conductor, the protective conductor has a cross-section ≥ 10 mm² Cu.
  - The protective conductor consists of 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 ≥ 2.5 mm² Cu.

5.4 Requirements for branch circuit protection

Requirements for UL-compliant installation

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

5.5 Operation with residual current protective device (RCD)

WARNING

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

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

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

Protection and monitoring equipment

To provide protection against short-circuit, use the recommended overcurrent protective devices (fuses, circuit breakers etc.).

Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/ps/27867)

If the earth fault loop impedance of the line supply at the infeed point is too high to ensure that the overcurrent protective device disconnects within the stipulated time in the case of insulation failure (ground fault, fault to frame), then you must use additional residual current protective devices RCD, type B.

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

- The neutral point of the line supply is grounded.
- A dedicated RCD is used for each converter.
- Use a universal current-sensitive residual current protective device (RCD, RCM, ELCB or RCCB), type B, for example, Siemens SIQUENCE RCCB. Connect the RCCB in series with the overcurrent protective devices.
- Rated residual current is 300 mA.

5.6 Forming DC link capacitors

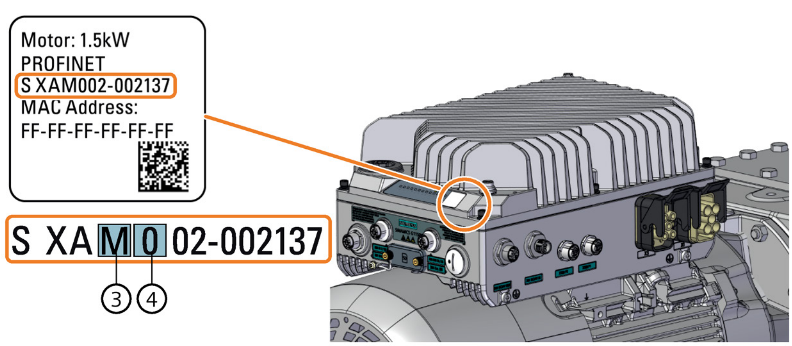
Introduction

You have to reform the DC link capacitors if the converter/Electronic Module has been stored for more than one year. Non-formed DC link capacitors can damage the converter in operation.

Precondition

The converter/Electronic Module has not yet been used, and according to the production date it was made over a year ago.

The production date is coded in the 3rd and 4th digit of the serial number. You may find the serial number easily on the service information label at the front of the Electronic Module.



Production year and month

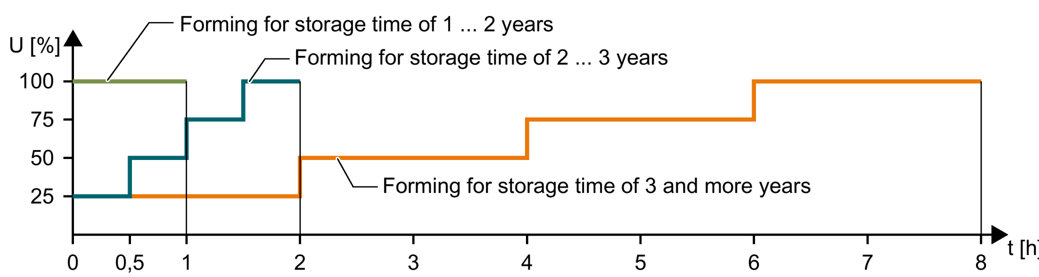
- Example: Serial number S XA**M0**02-002137 → Production date October 2020

Digit ③	Production year		Digit ④	Production month
M	2020		1 ... 9	January ... September
N	2021		0	October
P	2022		N	November
R	2023		D	December
...	...			

Function description

Procedure

You form the DC link capacitors by supplying the converter with a line voltage of ≤ 100% of the rated voltage for a defined time.

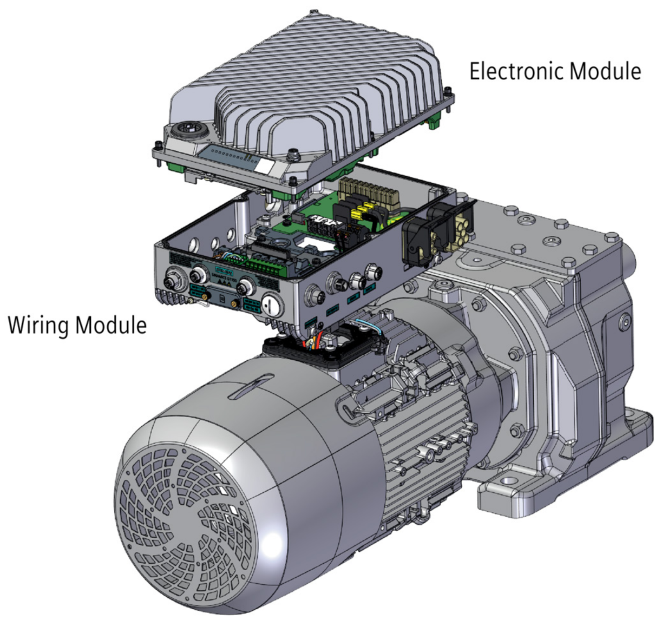


5.7 Overview of the converter interfaces

5.7.1 Overview

Overview

A G115D converter consists of an Electronic Module and a Wiring Module.

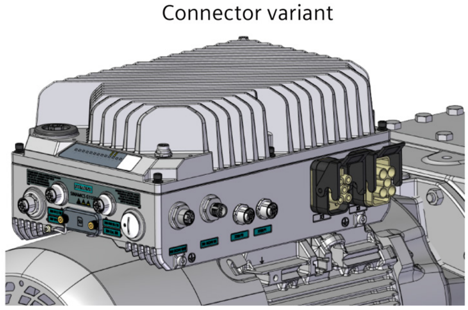


The Electronic Module is available in PROFINET variant, AS-i variant, and I/O Control (without fieldbus communication) variant. The Wiring Module is available in glanded variant and connector variant.

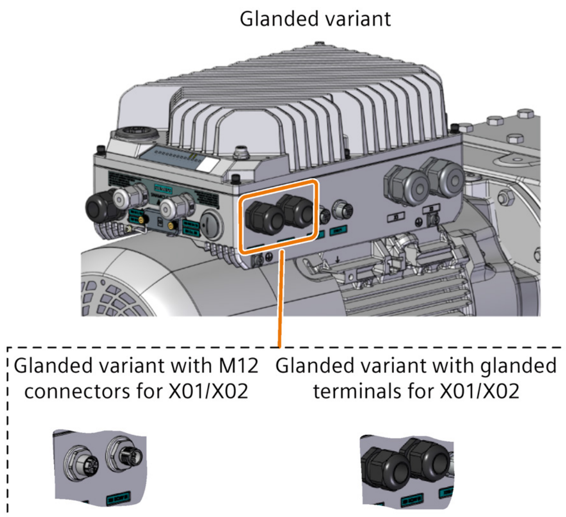
Depending on the variant ordered, the converter is equipped with plug-in sockets and/or blanking caps (for wiring with cable glands).

For the connector variant, the converter is all wired up internally when delivered and all that is required is the external wiring of the system.

Connector variant



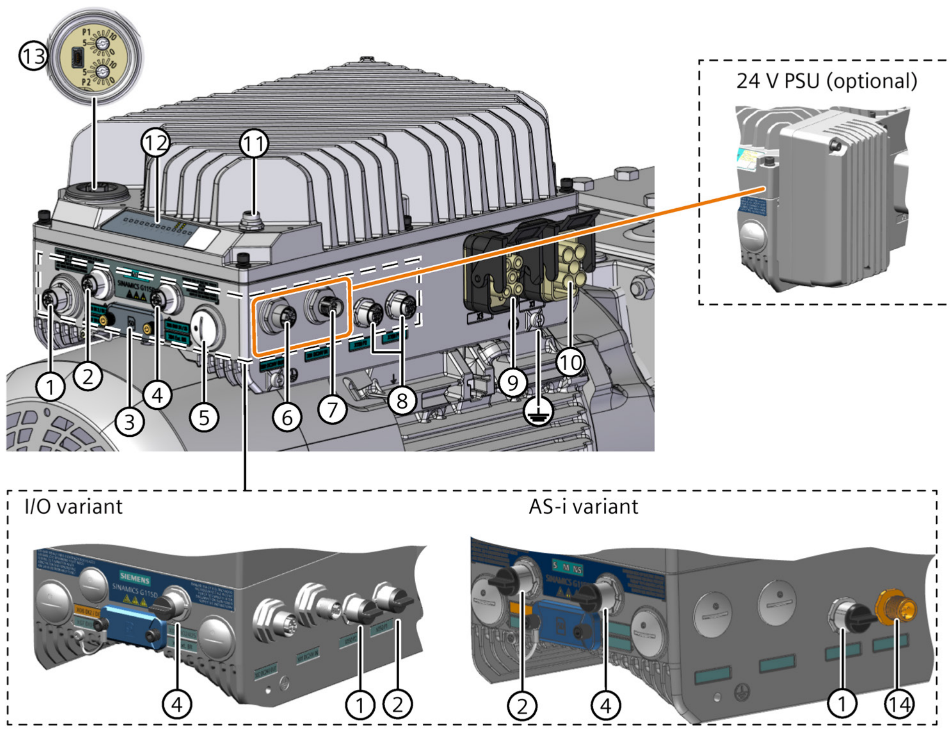
For the glanded variant, make sure you wire the terminals and route the cables inside the Wiring Module and fix with the cable glands.



Note that the converters of glanded variant provide no cable glands but blanking caps at delivery for all glanded interfaces.

5.7.2 Connection interfaces of the connector variant

The figure below shows an example of PROFINET variant of the motor-mounted converter with plug-in sockets:



①	Digital inputs DI 0 and DI 1 - X07	⑧	PROFINET communication - X150 P1 and P2 (for PROFINET variant only)
②	Digital inputs DI 2 and DI 3 - X08	⑨	Line supply interface (OUT) - X3
③	Memory card interface	⑩	Line supply interface (IN) - X1
④	Bidirectional digital inputs/outputs DIO 24 and DIO 25 - X05	⑪	Fan unit connector (reserved)
⑤	External braking resistor interface - X4	⑫	Status LED
⑥	24 V DC power supply interface (OUT) - X02 1)	⑬	Commissioning interface, including a mini-USB interface and two electromechanical potentiometers P1/P2
⑦	24 V DC power supply interface (IN) - X01 1)	⑭	AS-i communication and auxiliary power - X03 (for AS-i variant only)
⏚	Protective earth on the converter housing		

1) Not available on the AS-I variant

Note

The electromechanical potentiometers on the converter do not provide protection against unauthorized access. You must take appropriate measures to protect the converter against unauthorized operation or changes to the settings.

5.7.3 Terminal layout of the glanded variant

If you use the glanded variant of the converter, you must wire all the necessary terminals inside the Wiring Module.

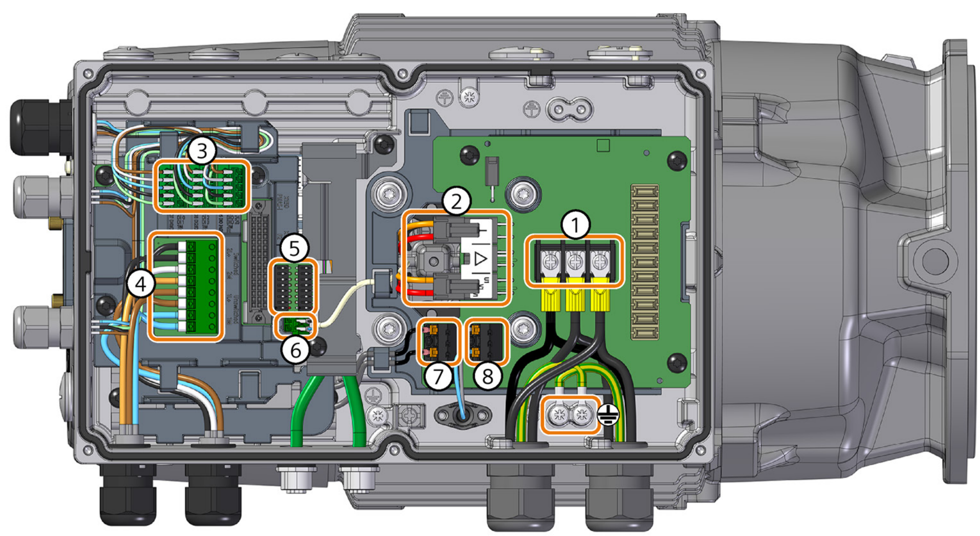
NOTICE
Device damage due to alteration to the factory connections
For the motor-mounted converter, the motor terminals inside the Wiring Module are already wired up in the factory. Any alteration to the factory connections can result in device malfunctions or damage. • Do not alter the motor connections of the motor-mounted converter unless otherwise explicitly instructed.

The figure below gives an overview of the terminals on the motor-mounted converter.

Note that the converters of glanded variant provide no cable glands but blanking caps at delivery for all glanded interfaces.

Applicable glanded installation kits are available as optional components and can be ordered with article numbers. For more information, refer to the following chapter:

Glanded installation kit (Page 29)



① Line supply terminals - L1, L2, L3
② Motor power terminals - U, V, W
③ Digital inputs/outputs terminals - DI0~DI3, DIO24, DIO25
④ Switched/unswitched 24 V power supply terminals - 2L+, 2M / 1L+, 1M
⏚ Protective earth
⑤ DIP switches - DIP1, DIP2
⑥ Motor temperature sensor terminals - T+, T-
⑦ Braking resistor terminals - DCP, PB
⑧ 180 V DC EM brake terminals - EM+, EM-

5.8 Cables and connectors

Note

NFPA compatibility

These devices are intended only for installation on industrial machines in accordance with the "Electrical Standard for Industrial Machinery" (NFPA79). Due to the nature of these devices they may not be suitable for installation accordance with the "National Electrical Code" (NFPA70).

Note

Mains supply impedance

To ensure trouble free operation we recommend the mains supply impedance is less than 4% (RSC > 25).

Cable, connectors and tools specifications

The detailed specifications for the cables, connectors and tools required to manufacture the necessary cables for the SINAMICS G115D are listed in the following documents and can be accessed using the relevant link:

Supplementary products (cables, connectors and accessories) (https://support.industry.siemens.com/cs/ww/en/view/65355810)

The connections that are detailed in this section relate to the physical connections that exist on the converter. Information for the preparation and construction of the individual connectors have separate detailed instructions delivered with the ordered parts, directly from the manufacturers.

For IEC-compliant applications, use the cable with the temperature rating specified in the following table.

For UL and cUL-compliant applications, use only the copper wires with the permissible temperature of 75 °C.

<table>
<tr><th rowspan="3">Cable</th><th rowspan="3">Converter variant</th><th colspan="4">Cable temperature rating</th></tr>
<tr><th colspan="2">IEC-compliant</th><th colspan="2">UL-compliant</th></tr>
<tr><th>No daisy chain</th><th>Daisy chain</th><th>No daisy chain</th><th>Daisy chain</th></tr>
<tr><td rowspan="2">Line cable</td><td>Glanded variant</td><td rowspan="2">75 °C</td><td>105 °C</td><td colspan="2" rowspan="2">75 °C</td></tr>
<tr><td>Connector variant</td><td>75 °C</td></tr>
<tr><td rowspan="2">24 V cable</td><td>Glanded variant</td><td rowspan="2">75 °C</td><td>105 °C</td><td colspan="2" rowspan="2">75 °C</td></tr>
<tr><td>Connector variant</td><td>75 °C [1)]</td></tr>
</table>

1) When the surrounding temperature exceeds 40 °C, cables with the temperature rating of 90 °C are required.

Further information

For information about the QUICKON connectors required for the corresponding G115D converter variant, see Section "Connectors (Page 29)".

5.8.1 Maximum permissible cable length

Maximum length for control cables

Cable type	Shield	Max. length
Digital input/output	Unshielded/shielded	30 m (98 ft.)
Encoder	Shielded, coverage ≥ 85%	30 m (98 ft.)

Maximum length for communication cables

Communications protocol	Transfer rate or cable type	Max. length
PROFINET	CAT5e network cable	100 m (328 ft.)
AS-i	Maximum length per segment	100 m (328 ft.)

The maximum length of any one segment on the AS-i network is normally 100 m; however, there are a number of devices that allow the overall length of AS-i network to be extended. For more information, see the FAQ at the following link: AS-i FAQ (https://support.industry.siemens.com/cs/ww/en/view/21189154)

5.8.2 Cable cross-sections and cable lugs

Line supply terminals (L1/L2/L3/PE)

Connector variant

Frame size	Terminal	Cross-section for stranded conductor
FSA	L1/L2/L3/PE	4 × 1.5 mm^2 to 4 mm^2 (AWG 14 to AWG 12)
FSB		4 × 2.5 mm^2 to 4 mm^2 (AWG 13 to AWG 12)

Glanded variant

Frame size	Terminal		Cable lug	Cross-section for stranded conductor	Screw tightening torque
FSA	L1/L2/L3	Screw-type	Fork-type	4 × 1.5 mm^2 to 4 mm^2 (AWG 14 to AWG 12)	1.75 Nm (15.5 lbf.in)
	PE		Ring-type		
FSB	L1/L2/L3		Fork-type	4 × 2.5 mm^2 to 4 mm^2 (AWG 13 to AWG 12)	
	PE		Ring-type		

For more information on cable cross-sections at line supply daisy chain application, see the following chapter: Connecting to the line supply using daisy chain (Page 61).

24 V DC power supply terminals (2L+/2M/1L+/1M)

Connector variant

Frame size	Cross-section for stranded conductor
FSA/FSB	4 × 0.75 mm^2 to 2.5 mm^2 (AWG 19 to AWG 13)

Glanded variant

Frame size	Terminal type	Cable lug	Cross-section for stranded conductor	Crimping length
FSA/FSB	Spring-type	Pin type	4 × 0.75 mm^2 to 2.5 mm^2 (AWG 19 to AWG 13)	10 mm

For more information on cable cross-sections at 24 V power supply daisy chain application, see the following chapter: Connecting to the 24 V power supply using daisy chain (Page 65).

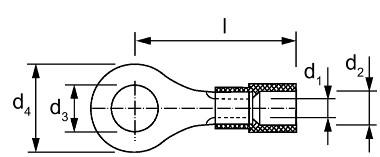
Digital input and output terminals

Frame size	Terminal type	Cable lug	Cross-section for stranded conductor	Crimping length
FSA/FSB	Spring-type	Pin type	5 × 0.25 mm^2 to 0.34 mm^2 (AWG 24 to AWG 22)	8 mm

Cable lugs

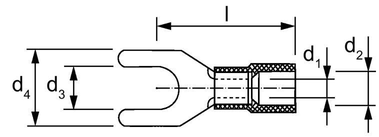
Use cable lugs with insulated end sleeves for cable connections. The maximum dimensions of the cable lugs are listed in the table below. These cable lugs are not to exceed these dimensions; otherwise, the mechanical fastening and adherence to the voltage distances are not guaranteed.

Ring type cable lug



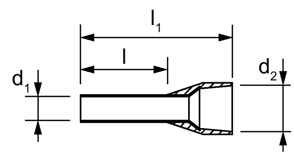
Screw/bolt	Cable cross-section (mm^2)	d_1 (mm)	d_2 (mm)	d_3 (mm)	d_4 (mm)	l (mm)
M4	0.5 to 1.5	1.7	4.1	4.3	8	17.0
M4	1.5 to 2.5	2.3	4.5	4.3	8.5	17.8
M4	4 to 6	3.4	6.5	4.3	9.5	20.8

Fork type cable lug



Screw/bolt	Cable cross-section (mm^2)	d_1 (mm)	d_2 (mm)	d_3 (mm)	d_4 (mm)	l (mm)
M3.5	1.5 to 2.5	2.3	4.5	3.7	5.8	16.3
M3.5	4 to 6	3.4	6.5	3.7	7.2	20
M4	4 to 6	3.4	6.5	4.3	8.5	20

Pin type cable lug



Cable cross-section (mm^2)	d_1 (mm)	d_2 (mm)	l_1 (mm)	Crimping length l (mm)
0.75	1.3	2.8	16	10
			18	12
1	1.5	3	16.5	10
			18.5	12
1.5	1.8	3.4	18.5	12
2.5	2.3	4.2	17	10
			19	12
4	2.9	4.7	19.5	12

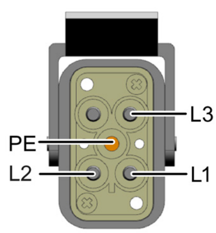
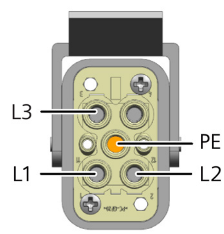
5.9 Connecting the line supply

5.9.1 Interface description - X1/X3

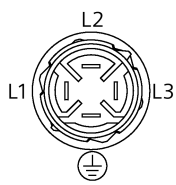
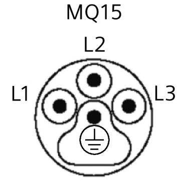
Connector variant

One of the three types of connectors (Q4/2, QUICKON, or MQ15) is provided depending on the variant that has been ordered. For the line connection in a daisy chain, only Q4/2 connectors are provided in pair when delivered.

Q4/2 connectors (daisy-chain connections supported)

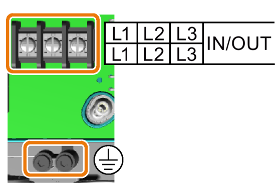
X1 - line supply (IN), 4-pin, plug	X3 - line supply (OUT), 4-pin, socket	Signal	Description
		L1	Line phase L1
		L2	Line phase L2
		L3	Line phase L3
		PE	Protective earth

QUICKON/MQ15 connector* (daisy-chain connections not supported)

X1 - line supply (IN), 4-pin, plug		Signal	Description
QUICKON 	MQ15 	L1	Line phase L1
		L2	Line phase L2
		L3	Line phase L3
		⏚	Protective earth

* Not suitable for UL applications

Glanded variant

X1/X3 - line supply terminals (screw-type)	Signal	Description
	L1	Line phase L1
	L2	Line phase L2
	L3	Line phase L3
	PE	Protective earth
Screw tightening torque: 1.75 Nm/15.5 lbf.in	Cable gland size: M25 * 1.5	

Further information

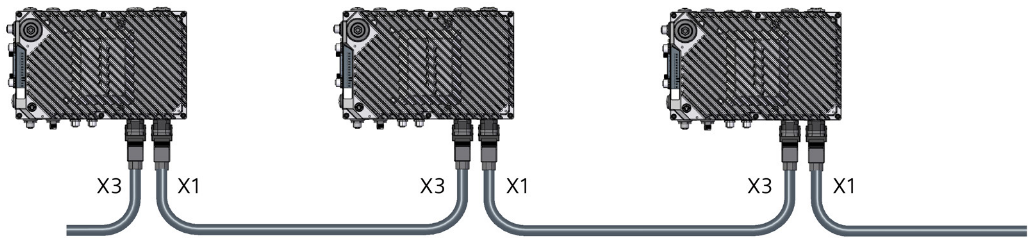
Cables and connectors (Page 56)

Glanded installation kit (Page 29)

5.9.2 Connecting to the line supply using daisy chain

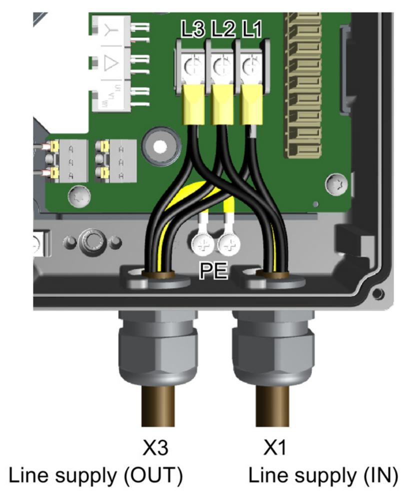
The SINAMICS G115D system has been designed to allow a converter to provide the mains power for a number of converters in a daisy chain.

The figure below exemplifies the methodology for daisy-chaining multiple converters:

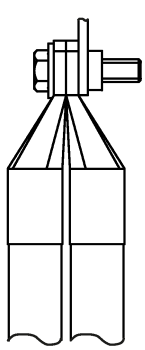


Wiring the line supply terminals for the glanded variant

The figure below shows examples of wiring the line supply terminals for the daisy-chain connection for a glanded variant of converter:



Make sure that you connect two cable lugs per terminal as recommended below to ensure reliable electrical connectivity:



Maximum current limit for daisy-chain connection

The maximum permissible number of daisy-chained converters depends on the maximum current limit for daisy-chain connection. The table below gives the maximum current limits dependent upon the cable cross-sections and surrounding air temperature:

IEC-compliant cable	UL-compliant cable	
	Connector variant	Glanded variant
23 A @ 4 mm², 40 °C 16 A @ 4 mm², 55 °C	16 A @ 12 AWG, 40 °C 11 A @ 12 AWG, 55 °C	16 A @ 12 AWG, 40 °C 13 A @ 12 AWG, 45 °C 12 A @ 12 AWG, 48 °C

Further information on protective devices

For both connector and glanded variants, the input for the daisy chained converters can be protected by group fusing.

For more information about the permissible types of the group fusing, see the SINAMICS G115D Product Information of Protective Devices:

Protective devices (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

Further information

If you don't use daisy chain connection, cover the unused connectors with the optional connector cover kit to maintain the IP rating of the system.

Connector cover kit (Page 30)

5.10 Connecting the motor

The G115D motor-mounted converter is connected to the motor internally upon delivery. You do not need to connect the converter to the motor.

5.11 Connecting the 24 V power supply

WARNING

Electric shock due to 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 (maximum 60 V DC briefly) for all connections and terminals of the electronics modules.

NOTICE

24 V power supply connection not available on AS-i variant

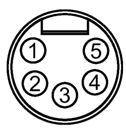
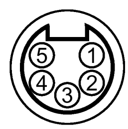
The AS-i variant receives the 24 V DC power through the AS-i interface X03; therefore, it does not require additional connection to the 24 V DC power supply.

5.11.1 Interface description - X01/X02

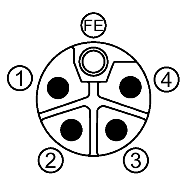
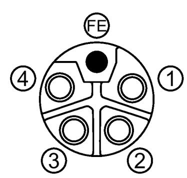
Connector variant

One of the two types of connectors (7/8" and M12 L-coding) is provided depending on the variant that has been ordered.

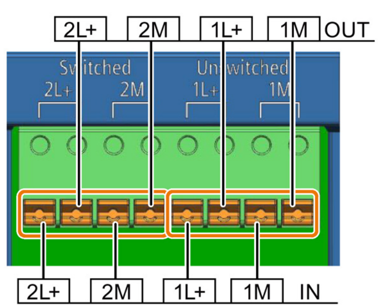
7/8" connector

X01 - 24 V power supply (IN), 5-pin, plug	X02 - 24 V power supply (OUT), 5-pin, socket	Pin	Signal	Description
		1	2M	Switched 0 V
		2	1M	Unswitched 0 V
		3	FE	Not connected
		4	1L+	Unswitched 24 V
		5	2L+	Switched 24 V

M12 L-coding connector

X01 - 24 V power supply (IN), 5-pin, plug	X02 - 24 V power supply (OUT), 5-pin, socket	Pin	Signal	Description
		1	1L+	Unswitched 24 V
		2	2M	Switched 0 V
		3	1M	Unswitched 0 V
		4	2L+	Switched 24 V
		-	FE	Functional earth

Glanded variant

X01/X02 - 24 V power supply terminals	Signal	Description
	2L+	Switched 24 V
	2M	Switched 0 V
	1L+	Unswitched 24 V
	1M	Unswitched 0 V
	Cable gland size: M20 * 1.5	

Switched/unswitched 24 V power supply

The unswitched (also known as "non-switched") 24 V power supply (1L+) is required for the drive to function.

- Use a power supply with PELV (Protective Extra Low Voltage).
- The 0 V of the power supply must be connected with low resistance to the PE of the system.

The switched 24 V (2L+) supplies the two bidirectional digital inputs/outputs DIO 24 and DIO 25. Switching off the 24 V power supply voltage brings all of the actuators connected to the digital outputs into the no-voltage state.

If you don't need the switching of 2L+ power supply, you can connect the conductors 2M (switched 0 V) to 1M (unswitched 0 V) and 2L+ (switched 24 V) to 1L+ (unswitched 24 V) at interface X01, so that both the switched and the unswitched 24 V come from the same supply.

24 V DC power supply unit

The integrated 24 V DC power supply unit (PSU) is optionally available to generate 24 V DC power supply from the line supply. It supplies 24 V DC power to one converter only and does not support daisy-chain connections.

For converters integrated with both the repair switch and the 24 V PSU, the 24 V DC power supply to the converter is maintained when you switch off the 400 V AC supply via the repair switch.

Requirements for applications in USA and Canada

Use a NEC Class 2 or a limited voltage/limited current power supply for variants with 7/8" connector; use a limited voltage power supply for all other variants.

Integrated AS-i 24 V DC supply

For converters with the AS-i interface and the integrated 24 V DC power supply should note that the integrated 24 V DC power supply powers the auxiliary 24 V DC. Therefore, the black AS-i cable is not needed in these circumstances.

Further information

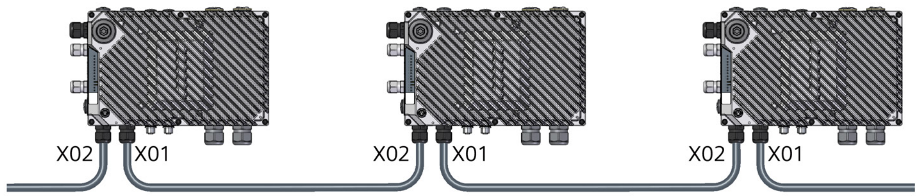
Cables and connectors (Page 56)

Glanded installation kit (Page 29)

5.11.2 Connecting to the 24 V power supply using daisy chain

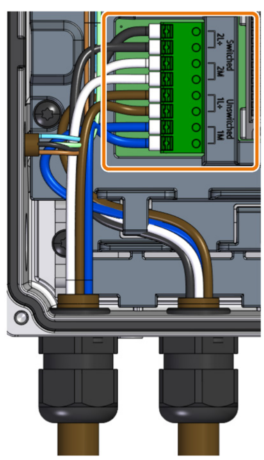
The SINAMICS G115D system has been designed to allow a converter to provide the 24 V DC power for a number of converters in a daisy chain.

The figure below exemplifies the methodology for daisy-chaining multiple converters:



Wiring the 24 V power supply terminals for the glanded variant

The figure shows an example of wiring the 24 V power supply terminals for the daisy-chain connection for the glanded variant of the converter:



Maximum current limit for daisy-chain connection

The maximum permissible number of daisy-chained converters depends on the maximum current limit for daisy-chain connection. The table below gives the maximum current limits dependent upon the cable cross-sections and surrounding air temperature:

IEC-compliant cable		UL-compliant cable	
Connector variant [1)]	Glanded variant	Connector variant [1)]	Glanded variant
12 A + 12 A @ 2.5 mm², 40 °C		12 A + 12 A @ 13 AWG, 40 °C	8 A + 8 A @ 13 AWG, 40 °C
12 A + 12 A @ 2.5 mm², 55 °C		8 A + 8 A @ 13 AWG, 55 °C	8 A + 8 A @ 13 AWG, 45 °C
			6 A + 6 A @ 13 AWG, 48 °C

1) The values in the table above are valid when connecting with M12 L-coding connectors. If 7/8" connectors are used, the maximum current limit is 8 A + 8 A at 40 °C and 6 A + 6 A at 55 °C.

Further information

If you don't use daisy chain connection, cover the unused connectors with the optional connector cover kit to maintain the IP rating of the system.

Connector cover kit (Page 30)

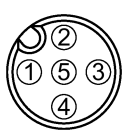
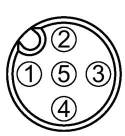
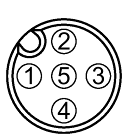
5.12 Connecting the digital inputs and outputs

5.12.1 Interface description - X07/X08/X05

The G115D converter has four digital inputs (DI 0 to DI 3) and two bidirectional digital inputs/outputs (DIO 24 and DIO 25). Digital inputs DI 0 and DI 1 can be used to connect an HTL encoder (track A/B). Digital inputs DI 2 and DI 3 can be used for the safety functions. The bidirectional DI/DO can be parameterized as digital inputs or digital outputs with parameter p0728.

Connector variant

M12 A-coding connector, 5-pin, socket

Digital inputs (X07, X08) and bidirectional digital inputs/outputs (X05)			
X07	**Pin**	**Signal**	**Description**
	1	1L+	Unswitched 24 V
	2	DI1	Digital input 1
	3	1M	Unswitched 0 V
	4	DI0	Digital input 0
	5	FE	Functional earth
X08	**Pin**	**Signal**	**Description**
	1	1L+	Unswitched 24 V
	2	DI3	Digital input 3
	3	1M	Unswitched 0 V
	4	DI2	Digital input 2
	5	FE	Functional earth
X05	**Pin**	**Signal**	**Description**
	1	2L+	Switched 24 V
	2	DIO25	Bidirectional digital output/input 25
	3	2M	Switched 0 V
	4	DIO24	Bidirectional digital output/input 24
	5	FE	Functional earth

Glanded variant

Digital inputs (X07, X08) and bidirectional digital inputs/outputs (X05)		Signal	Description
	**X07**	1L+	Unswitched 24 V
		DI0	Digital input 0
		DI1	Digital input 1
		1M	Unswitched 0 V
		FE	Functional earth
	X08	1L+	Unswitched 24 V
		DI2	Digital input 2
		DI3	Digital input 3
		1M	Unswitched 0 V
		FE	Functional earth
	X05	2L+	Switched 24 V
		DIO24	Bidirectional digital output/input 24
		DIO25	Bidirectional digital output/input 25
		2M	Switched 0 V
		FE	Functional earth
Cable gland size: M16 * 1.5; Tightening torque: 10 Nm/88.5 lbf.in			

Note

Malfunction caused by incorrect switching states as the result of diagnostic flows in 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.

5.12.2 Factory interface setting

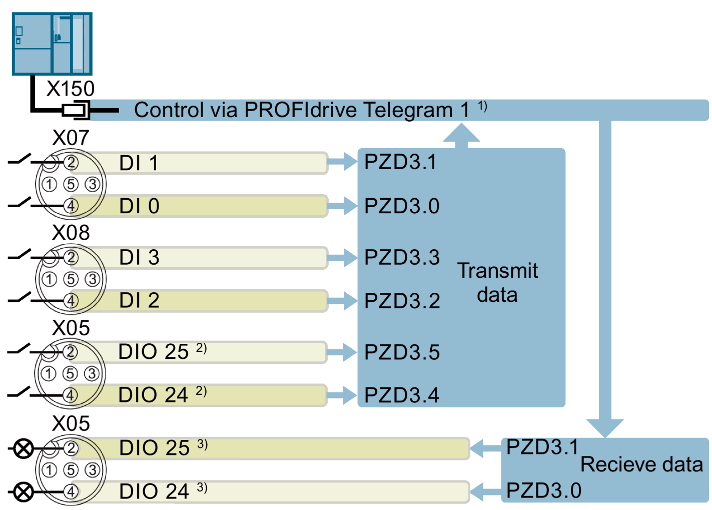
To ensure that the factory setting of the interfaces can be used, you must wire your drive as shown in the following examples.

See below for default macros for different communication variants of the G115D:

G115D communication variant	Default macro
PROFINET	Macro 67
AS-i	Macro 30
I/O	Macro 65

Macros for SINAMICS G115D PROFINET variant

Macro 67 - 4-DI decentral conveyor with fieldbus (default for the PROFINET variant)



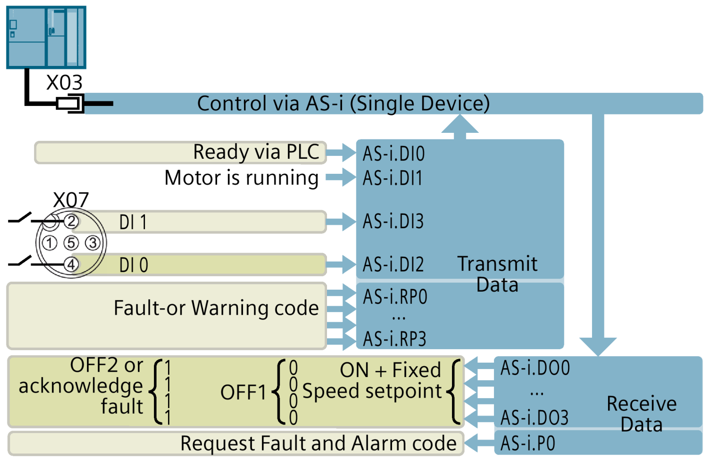
1) Telegram 1 is extended to provide extra PZD bits (PZD3.x) for signal interconnections in the converter. For more information about the extended telegram 1, refer to Section "Drive control via PROFINET (Page 126)".

2) Parameterized as digital inputs via p0728.

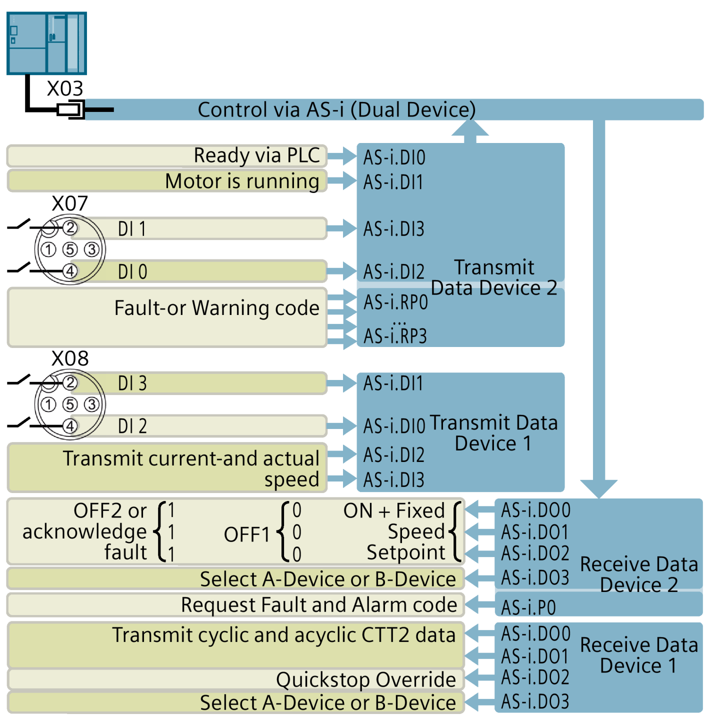
3) Parameterized as digital outputs via p0728.

Macros for SINAMICS G115D AS-i variant

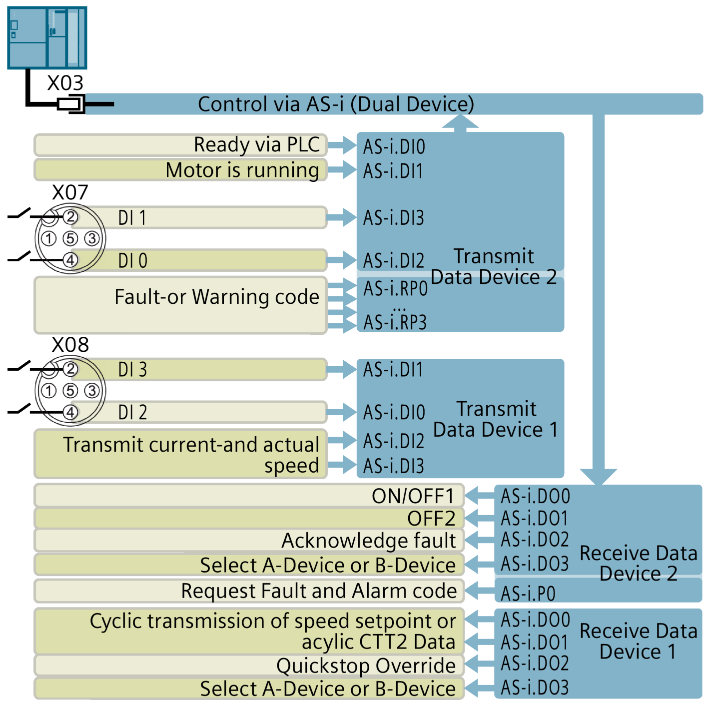
Macro 30 - AS-i Single Device with fixed setpoint (default for the AS-i variant)



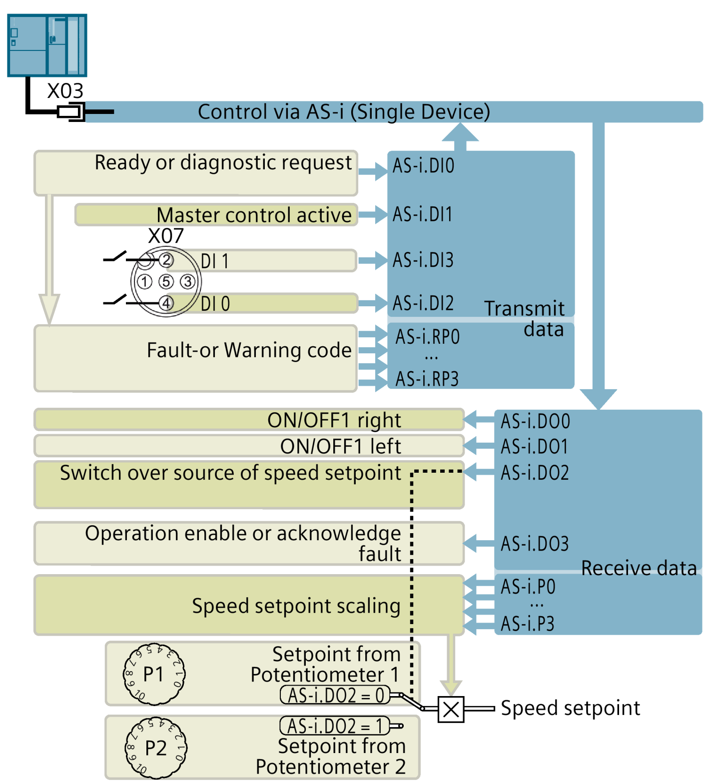
Macro 31 - AS-i Dual Device with fixed setpoint



Macro 34 - AS-i Dual Device with fieldbus setpoint

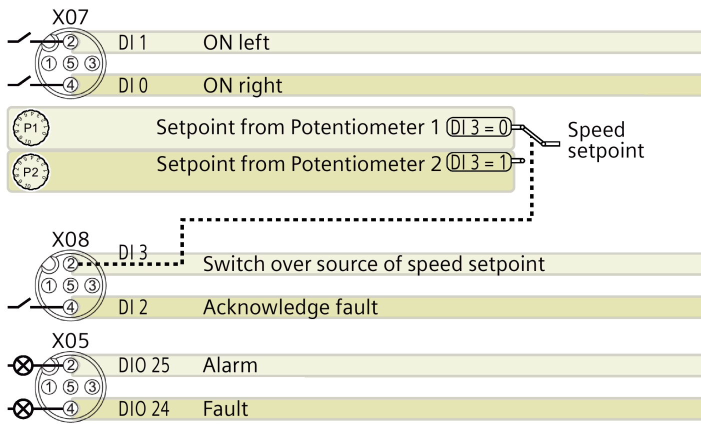


Macro 66 - AS-i Single Device with setpoint from Potentiometer 1 or Potentiometer 2

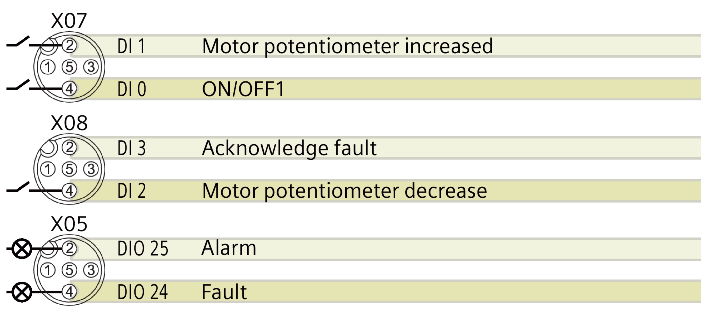


Macros for SINAMICS G115D I/O variant

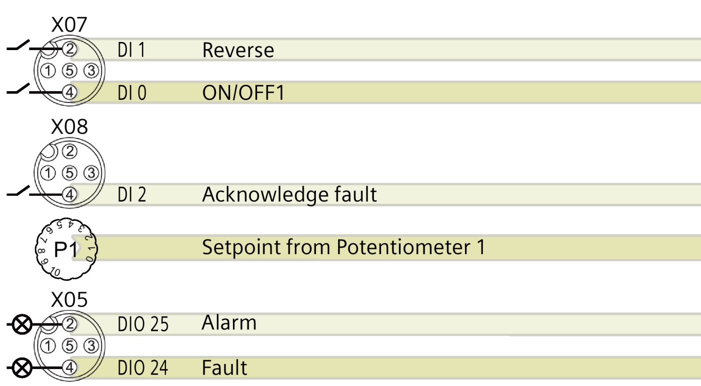
Macro 65 - Conveyor with setpoint from Potentiometer 1 or Potentiometer 2 (default for the I/O variant)



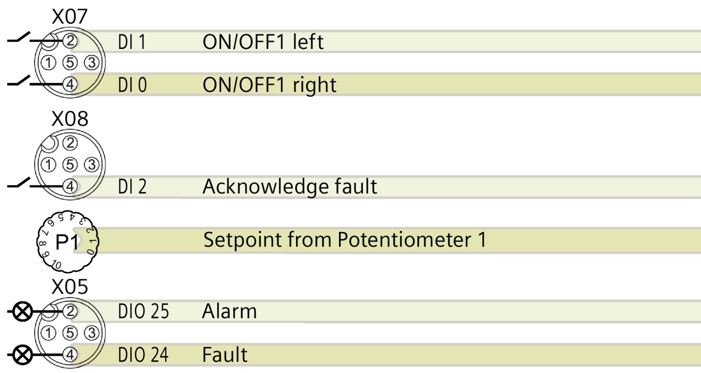
Macro 9 - Motorized potentiometer (MOP)



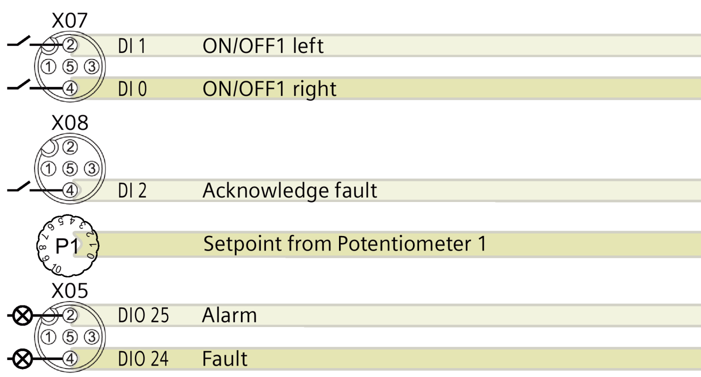
Macro 60 - Two-wire control with method 1



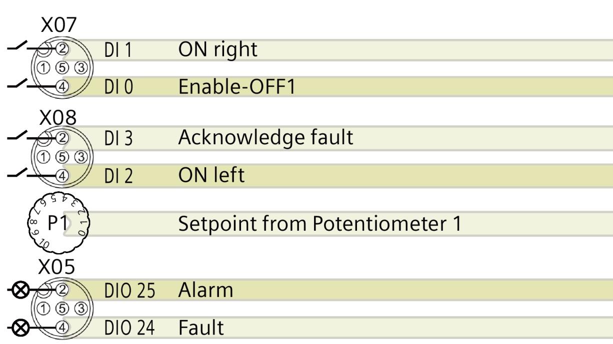
Macro 61 - Two-wire control with method 2



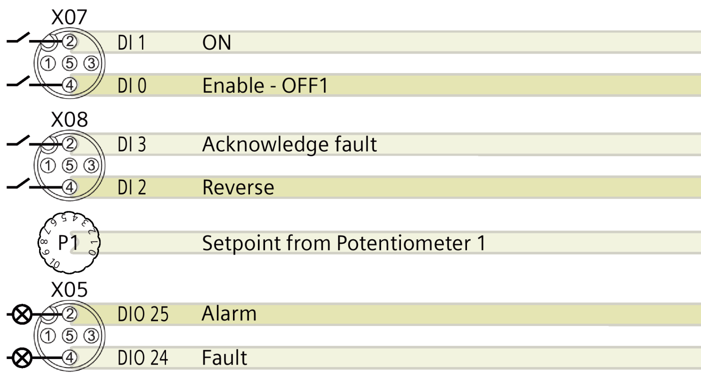
Macro 62 - Two-wire control with method 3



Macro 63 - Three-wire control with method 1



Macro 64 - Three-wire control with method 2



Further information

You can adjust the default interface settings to suit your requirements.

Adapt the default settings of the inputs and outputs (Page 117)

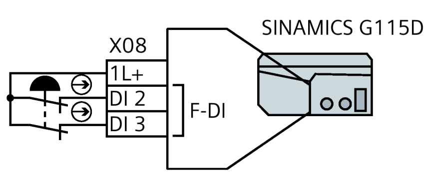
5.12.3 Fail-safe digital input

To enable a safety function via the terminal strip of the converter, you need a fail-safe digital input. The digital inputs DI 2 and DI 3 can be used for the safety functions.

In the factory setting of the converter, the fail-safe digital input is not assigned to the integrated safety functions. Only when commissioning do you define as to whether, for example, you use digital inputs for the standard functions, or you create a fail-safe digital input by combining them.

Wiring examples

An example for wiring the fail-safe digital input corresponding to PL d according to EN 13849-1 and SIL 2 according to IEC 61508 is given below:



Further information

Safe Torque Off (STO) safety function (Page 215)

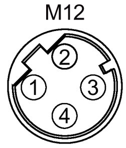
Additional configurations of the safety functions are described in the "Safety Integrated" Function Manual.

Overview of the manuals (Page 404)

5.13 Connecting to PROFINET and Ethernet

5.13.1 Interface description - X150 P1/P2

M12 D-coding connector

X150 P1/P2 - PROFINET, 4-pin, socket			
M12 	**Pin**	**Signal**	**Description**
	1	TXP	Transmit data +
	2	RXP	Receive data +
	3	TXN	Transmit data -
	4	RXN	Receive data -

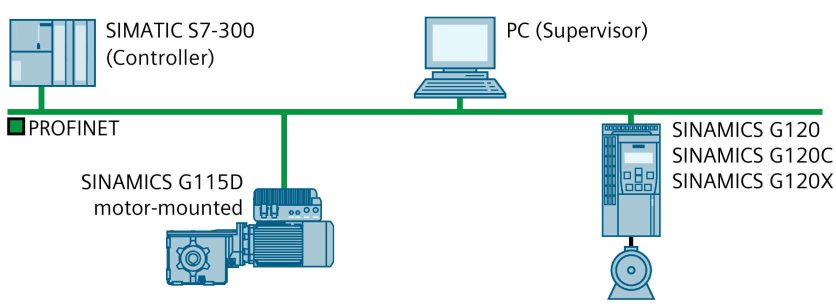
Further information

Cables and connectors (Page 56)

5.13.2 Communication via PROFINET IO and Ethernet

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

The converter in PROFINET IO operation

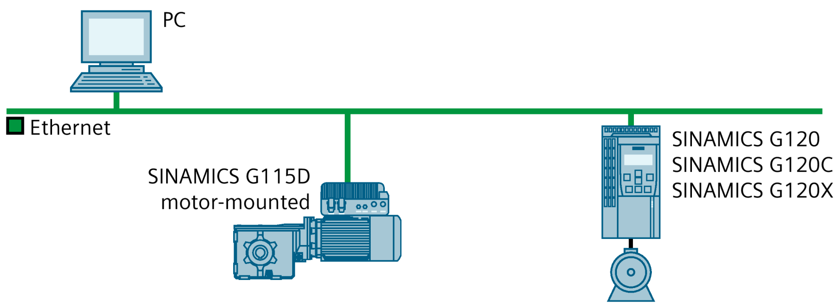


The converter supports the following functions:

- RT
- IRT: The converter 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
- Diagnostic alarms in accordance with the error classes specified in the PROFIdrive profile

- Device replacement without removable data storage medium: the replaced converter obtains the device name from the IO controller – not from its memory card or programming device
- Shared Device for converters that support PROFIsafe

The converter as Ethernet node



Further information on PROFINET

Further information on PROFINET can be found on the Internet:

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

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

Overview of the manuals (Page 404)

5.13.3 Protocols used

The converter supports the protocols listed in the following tables. The address parameters, the relevant communication layer as well as the communication role and the communication direction are specified for each protocol.

You require this information to set the appropriate safety measures to protect the automation system, e.g. in the firewall.

As the security measures are limited to Ethernet and PROFINET networks, no PROFIBUS protocols are listed in the table.

Table 5- 1 PROFINET protocols

Protocol	Port number	Layer (2) Link layer (4) Transport layer	Function/description
DCP: Discovery and configuration protocol	Not relevant	(2) Ethernet II and IEEE 802.1Q and Ethertype 0x8892 (PROFINET)	**Accessible stations, PROFINET Discovery and configuration** DCP is used by PROFINET to determine PROFINET devices and to make basic settings. DCP uses the special multicast MAC address: xx-xx-xx-01-0E-CF, xx-xx-xx = Organizationally Unique Identifier
LLDP: Link Layer Discovery Protocol	Not relevant	(2) Ethernet II and IEEE 802.1Q and Ethertype 0x88CC (PROFINET)	**PROFINET Link Layer Discovery protocol** LLDP is used by PROFINET to determine and manage neighborhood relationships between PROFINET devices. LLDP uses the special multicast MAC address: 01-80-C2-00-00-0E
MRP: Media Redundancy Protocol	Not relevant	(2) Ethernet II and IEEE 802.1Q and Ethertype 0x88E3 (PROFINET)	**PROFINET medium redundancy** MRP enables the control of redundant routes through a ring topology. MRP uses the special multicast MAC address: xx-xx-xx-01-15-4E, xx-xx-xx = Organizationally Unique Identifier
PTCP Precision Transparent Clock Protocol	Not relevant	(2) Ethernet II and IEEE 802.1Q and Ethertype 0x8892 (PROFINET)	**PROFINET send clock and time synchronization, based on IEEE 1588** PTC is used to implement send clock synchronization and time synchronization between RJ45 ports, which are required for IRT operation. PTCP uses the special multicast MAC address: xx-xx-xx-01-0E-CF, xx-xx-xx = Organizationally Unique Identifier
PROFINET IO data	Not relevant	(2) Ethernet II and IEEE 802.1Q and Ethertype 0x8892 (PROFINET)	**PROFINET Cyclic IO data transfer** The PROFINET IO telegrams are used to transfer IO data cyclically between the PROFINET IO controller and IO devices via Ethernet.
PROFINET Context Manager	34964	(4) UDP	**PROFINET connection less RPC** The PROFINET context manager provides an endpoint mapper in order to establish an application relationship (PROFINET AR).

Table 5- 2 EtherNet/IP protocols

Protocol	Port number	Layer (2) Link layer (4) Transport layer	Function/description
Implicit messaging	2222	(4) UDP	Used for exchanging I/O data. This is inactive when delivered. Is activated when selecting EtherNet/IP.
Explicit messaging	44818	(4) TCP (4) UDP	Used for parameter access (writing, reading). This is inactive when delivered. Is activated when selecting EtherNet/IP.

Table 5- 3 Connection-oriented communication protocols

Protocol	Port number	Layer (2) Link layer (4) Transport layer	Function/description
ISO on TCP (according to RFC 1006)	102	(4) TCP	**ISO-on-TCP protocol** ISO on TCP (according to RFC 1006) is used for the message-oriented data exchange to a remote CPU, WinAC or devices of other suppliers. Communication with ES, HMI, etc. is activated in the factory setting, and is always required.
SNMP Simple Network Management Protocol	161	(4) UDP	**Simple network management protocol** SNMP enables network management data to be read out and set (SNMP managed objects) by the SNMP manager. It is activated in the factory setting, and is always required
Reserved	49152 ... 65535	(4) TCP (4) UDP	Dynamic port area that is used for the active connection endpoint if the application does not specify the local port.

5.13.4 Connecting the converter to PROFINET

Procedure

1. Integrate the converter in the bus system (e.g. ring topology) of the control using PROFINET cables and PROFINET sockets X150 P1/P2.

   Cables and connectors (Page 56)

   The maximum permitted cable length from the previous station and to the next one is 100 m.
2. Externally supply the converter with 24 V DC.

You have now connected the converter to the control system via PROFINET.
❒

5.13.5 What do you have to set for communication via PROFINET

Configuring PROFINET communication in the I/O controller

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

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

Installing GSDML (Page 79)

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. Startdrive.

The converter saves the device name in its EEPROM. If an optional memory card is inserted, the converter saves the device name additionally on the 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 converter:

- You specify the IP address via an engineering software tool, e.g. Startdrive.
- The IO Controller assigns an IP address to the converter.

The converter saves the IP address in its EEPROM. If an optional memory card is inserted, the converter saves the IP address additionally on the memory card.

Telegram

Set the same telegram in the converter 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 PROFINET (Page 126)

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)

5.13.6 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 converter.
     Set p0804 = 12.
     The converter 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.
❒

5.13.7 Connecting the converter to Ethernet/IP

Overview

To connect the converter to a control system via Ethernet, proceed as follows:

Procedure

1. Connect the converter to the control system via an Ethernet cable.
2. Create an object for data exchange.
   You have the following options:
   – Load the EDS file into your controller if you want to use the ODVA profile.
     You can find the EDS file on the Internet:
     EDS (https://support.industry.siemens.com/cs/ww/en/view/78026217)
   – If your controller does not accept the EDS file, or if you wish to use the SINAMICS profile, you must create a generic module in your controller:
     Creating generic I/O module (Page 156)

You have connected the converter to the control system via Ethernet/IP.
❒

Example

You can find an example showing how to connect a converter to the control system via Ethernet/IP on the Internet:

Application example (https://support.industry.siemens.com/cs/ww/en/view/82843076)

Further information

You can find information on routing and shielding Ethernet cables on the Internet:

Ethernet/IP (https://www.odva.org/wp-content/uploads/2020/05/PUB00035R0_Infrastructure_Guide.pdf)

5.13.8 What do you need for communication via Ethernet/IP?

Check the communication settings using the following questions. If you answer "Yes" to the questions, you have correctly set the communication settings and can control the converter via the fieldbus.

- Is the converter correctly connected to the Ethernet/IP?
- Is the EDS file installed in your control system?
- Have the bus interface and IP address been correctly set?
- Have the signals that the converter and the control system exchange been correctly interconnected?

5.14 Connecting to AS-i

5.14.1 General information

General information

The converter operates based on the extended AS-i specification V3.0.

The signaling is made as Manchester-coded current pulses superimposed on the 28 V supply. Since the power supply is used for communications, it must be decoupled with inductors in order for the receiver to be able to decode the transmitted messages.

The yellow cable is the communication cable and provides the power to the converter and its digital inputs. The black cable is the auxiliary power supply cable and provides power to the digital outputs and the low voltage components of the converter including the fan. If the converter has a 24 V PSU, the 24 V PSU provides the auxiliary 24 V DC, and the black cable is not needed in this case.

The converter supports Single Device and Dual Device modes.

In Single Device mode, the converter has an address in the AS-i network over which four bits are transferred. In Dual Device mode, each converter has two AS-i addresses over each of which four bits are transferred.

In Single Device mode, communication is realized in accordance with profile 7.F.E. In Dual Device mode, communication is realized in accordance with profiles 7.A.5 and 7.A.E.

Interface settings for commissioning

To configure the communication of the converter via AS-i, the following possibilities are available for commissioning the converter:

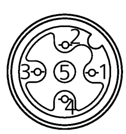
p0015=	Designation	Meaning
30	Macro 30 - AS-i Single Device with fixed setpoint	Single Device mode with specification of a fixed frequency via the control
31	Macro 31 - AS-i Dual Device with fixed setpoint	Dual Device mode with specification of a fixed frequency via the control
66	Macro 66 - AS-i Single Device with setpoint from Potentiometer 1 or Potentiometer 2	Single Device mode with setpoint from Potentiometer 1 or Potentiometer 2
34	Macro 34 - AS-i Dual Device with fieldbus setpoint	Dual Device mode with "ON/OFF1", "OFF2", speed setpoint via control

For details about the interface settings, refer to the following chapter:

Factory interface setting (Page 68)

5.14.2 Interface description - X03

M12 A-coding connector

X03 - AS-i, 5-pin, plug			
	Pin	**Signal**	**Description**
	1	AS-i +	AS-i positive
	2	AUX -	Auxiliary 0 V
	3	AS-i -	AS-i negative
	4	AUX +	Auxiliary 24 V
	5	FE	Not connected

Requirements for applications in USA and Canada

Use a NEC Class 2 or a limited voltage/limited current power supply as an external 24 V DC voltage source.

Further information

A number of converters can be connected via the same AS-i cable to the 24 V power supply with a total current of up to 8 A. Further connection information can be found in the AS-Interface system manual.

Overview of the manuals (Page 404)

5.14.3 Setting the address

As factory setting, all AS-i devices have address 0. Devices with address 0 are not included in the communication.

The addresses must be unique, although they can be mixed as required.

You have the following options when making the address assignment:

- Automatic addressing via the AS-i master
- Addressing via the addressing device
- Addressing via parameters

Before you set the address, you must specify whether the converter is integrated as Single Device or Dual Device in the AS-i network.

- p2013 = 0: Single Device (factory setting)
- p2013 = 2: Dual Device

If you select the Single Device macro (Macro 30 or 66) or the Dual Device macro (Macro 31 or 34) during the commissioning, the AS-i mode p2013 is automatically assigned to the appropriate value.

Note

Changes made to p2012 and p2013

Changes made to the p2012 and p2013 parameters take effect immediately after the change.

If you work with a commissioning tool, you must back up the changes so they are not lost when the system is switched off and on again.

Automatic addressing via the AS-i master

Single Device

For automatic addressing, the address is specified by the AS-i master. For a Single Device, the master checks which device has address 0 and assigns it the next free address. This address is also written to parameter p2012. If more than one device has address 0, an automatic addressing is not possible.

Dual Device

For automatic addressing, the address is specified by the AS-i master. If both devices have address 0, the second device is hidden and the control assigns a valid address for device 1.

Device 2 then becomes visible with address 0 and can be addressed.

Automatic addressing is not always possible for older AS-i masters. In this case, use the manual addressing and set the address from an addressing device, via Startdrive.

Further information is contained in the AS-Interface system manual, Section "Setting the AS-i address"

Overview of the manuals (Page 404)

Addressing via the addressing device (e.g. 3RK1904-2AB02)

Addressing via the addressing device is made offline.

Further information is contained in the AS-Interface system manual, Section "Setting the AS-i address"

Overview of the manuals (Page 404)

Addressing via parameters

The address assignment is made with the p2012[0] and p2012[1] parameters.

If you assign the address via a commissioning tool, you must back up the settings so that they are not lost if the power fails.

- Address range for Single Device converter, profile 7.F.E
  - p2012[1]: 0 ... 31, range for the A address, 0A ... 31A
- Address range for Dual Device converter, profile 7.A.5 or 7.A.E
  - p2012[0]: 0 ... 31, 33 ... 63 for device 1:
  - p2012[1]: 0 ... 31, 33 ... 63 for device 2:

  with
  - 0 ... 31 range for the A address, 0A ... 31A
  - 33 ... 63 range for B address, 1B ... 31B

5.14.4 Using the AS-i Programmer

Setting the device address with the AS-i Address Programmer

The converter contains two logical AS-i devices. Either device can be assigned an address in the range 1A...31A or 1B...31B. The addresses can be allocated to the devices sequentially, for example, 3A and 4A, 10B and 11B or they can occupy the same number using extended addressing, for example, 20A and 20B. If necessary they can have completely different unassociated addresses, for example, 14A and 16B.

The decision on how to allocate these addresses must also take into account the addressing used in the PLC program by either adherence to the memory map of the AS-i master or the way in which the inputs and outputs can be allocated by the PLC hardware configuration.

The default address of both devices is 0.

Setting the AS-i address of Device 1

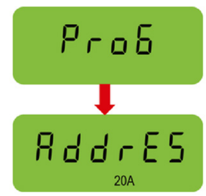
1. Plug the AS-i Programmer into the addressing socket (interface X03) of the converter.
2. Turn the dial on the Programmer to the **ADDR** position. The display will indicate that this mode has been selected.

3. Press the ↵ button; the screen will display the text, **SEt 0** with a small flashing **0** to the left of the display.

4. Press the ▲ button until you reach the required number.
   By pressing both the ▲ and ▼ simultaneously, you can toggle between A and B identifiers of the address.
5. Press the ↵ button to confirm the selected address.

   ProG is momentarily displayed, followed by **AddrES**.

   The number allocated to device 1 is now shown at the bottom of the display.



Setting the AS-i address of Device 2

1. Press the ↵ button; the display shows the text **SEArcH** followed by **uSE 0**.

   A small **0** is displayed to the left of the display and the number of the first device that has already been allocated to device 1 is shown at the bottom of the display.

2. Press the ↵ button to select this number.

   SEt 0 appears and the small **0** in the left of the display starts flashing.

3. Press the ▲ button until you reach the required number.
   By pressing both the ▲ and ▼ simultaneously, you can toggle between A and B identifiers of the address.
4. Press the ↵ button to accept this number.

   ProG is displayed briefly.

   Both of the numbers allocated to the devices are now displayed in the lower part of the screen.

Changing existing addresses of the AS-i devices

If the allocated addresses used two different numbers, for example, 10A and 11A, then if one of the device addresses is reset to 0 the other device is not affected.

If the allocated addresses use the same number, for example, 20A and 20B, then if one device address is reset to 0, then both device numbers will be reset to 0.

Modifying an existing address of a single device within the converter will not affect the address of the other device.

To change an existing address of a device, the following procedure should be performed:

1. Plug the AS-i Programmer into the addressing socket (interface X03) of the converter.
2. Turn the dial on the Programmer to the **ADDR** position. The display will indicate that this mode has been selected.

3. Press the button; the screen will display **uSE** and the number of the lower addressed device.
   The existing device addresses are shown at the bottom of the display.

4. Press the and buttons to select the device address number to be changed.
5. Press the button; the display now shows **SEt**.
   The selected number will begin to flash.

6. Press the and buttons to select the new device address number.

7. Press the button to confirm the new address.
   ProG is displayed briefly followed by confirmation of the address change.

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

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5.15 Connecting to SINAMICS G115D I/O variant

The SINAMICS G115D I/O variant uses I/O terminals to realize converter control functions. For more information on connecting the I/O terminals, refer to Section "Connecting the digital inputs and outputs".

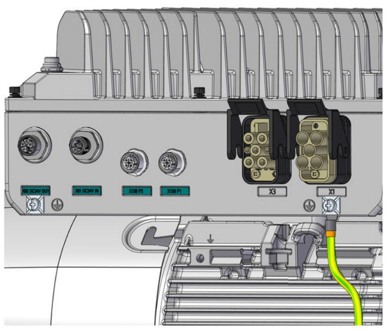
Connecting the digital inputs and outputs (Page 66)

5.16 Grounding the converter housing

To ensure that the converter is properly grounded and protected, you **MUST** connect an earthing cable to the converter housing.

- Connect the PE terminal on the converter housing to an appropriate grounding point of the installation.
- Use a short wire connection.
- Clean the connection to the steel construction from paint or dirt.
- Use a UL-approved ring-type cable lug to terminate the earthing cable to ensure a good physical connection which is resistant to accidental disconnection.

Wiring example of motor-mounted converter



Note: For the G115D motor-mounted converter, use the PE terminal which is close to the motor drive end (DE) to ground the converter housing.

Minimum cable cross-section: 4 mm^2 (AWG 10)

PE terminal tightening torque: 1.5 Nm (13.3 lbf.in)

5.17 Connecting the external braking resistor

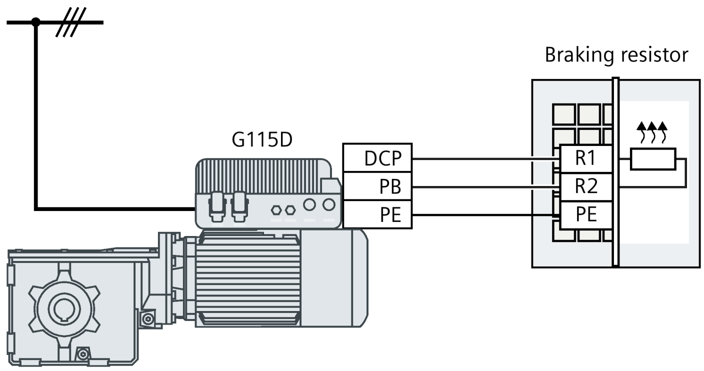
⚠WARNING

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

After the power supply has been switched off, it takes up to 5 minutes until the capacitors in the converter have discharged so that the residual charge is at a non-hazardous level. Therefore, touching the converter immediately after powering off can result in electric shock due to residual charge in the power components.

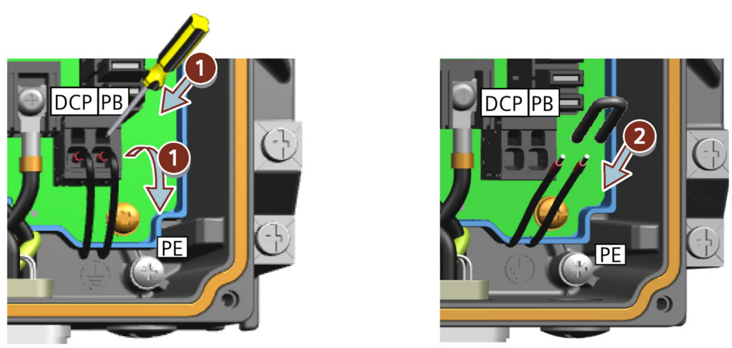
- Check the voltage at the converter connections before you connect the external braking resistor.

Connection overview

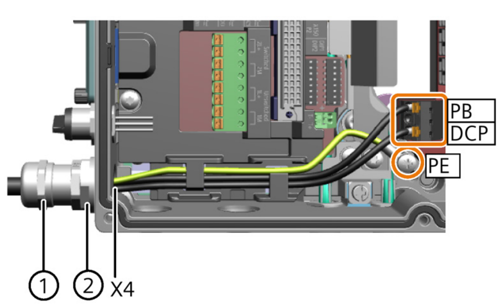


Procedure

1. Switch off all power supplies (line supply and external 24 V power supply) to the converter.
2. Wait 5 minutes to allow the converter to discharge and check that no voltage is present at the converter connections.
3. Release the retaining screws (6 x M4) on the Electronic Module by using a 3 mm allen key, and remove the module.
4. Remove the internal braking resistor connection from the terminal block DCP/PB in the Wiring Module, and insulate the cable conductors with the heat-shrinkable tube.



5. Remove the blanking cap at interface X4 and install the M16 cable gland. Firstly install the M16 reducer ② at interface X4, and then install the M16 cable gland ① on the M16 reducer.



6. Remove the insulation from the end of the braking resistor cable to expose the braided cable shield. Turn up the cable shield. Pass the cable through the cable gland and make the

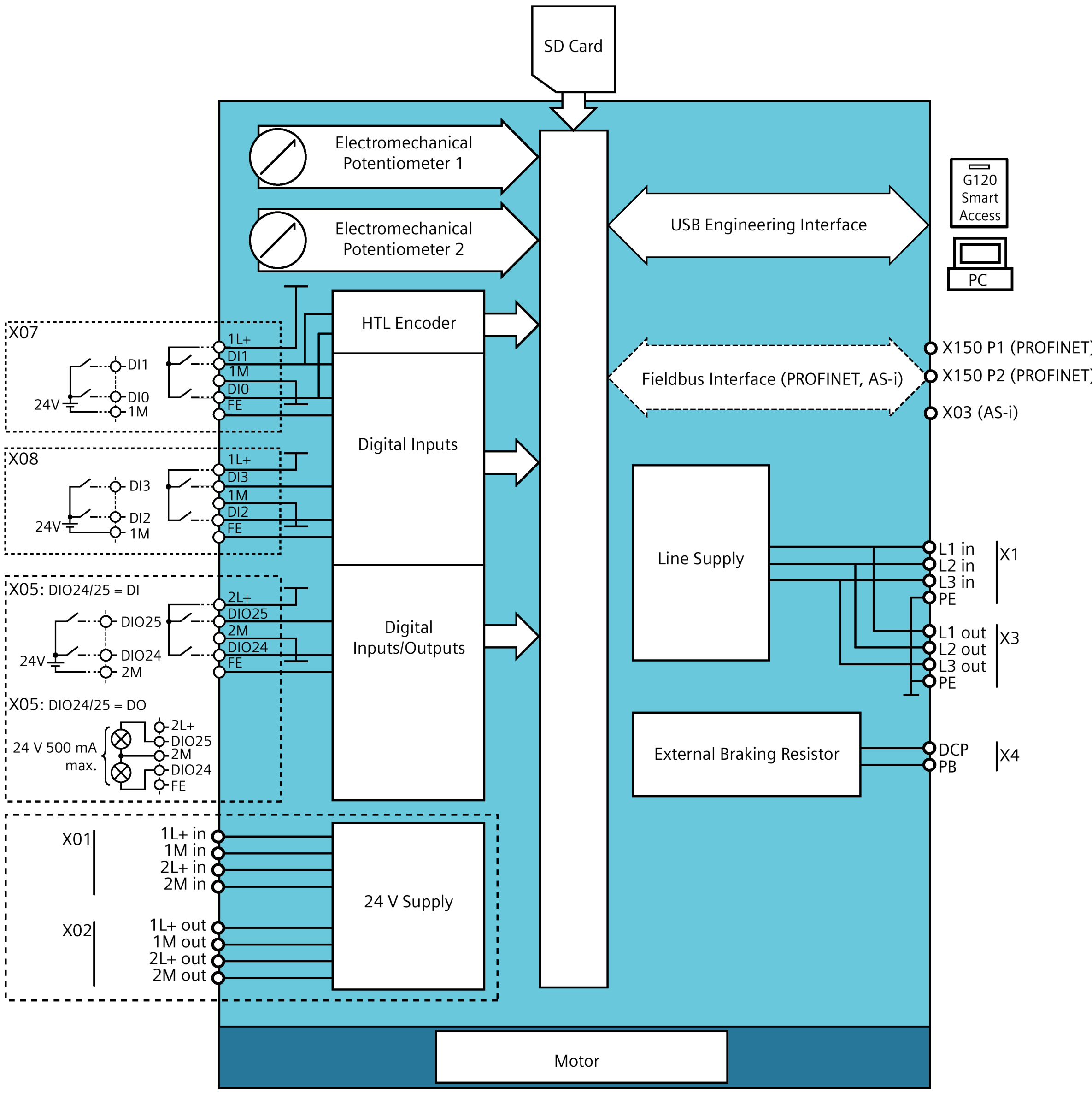
exposed braided cable shield in close contact with the inner surface of the cable gland. Make sure that the cable shield is connected to the shield bonding options for cables and the unit housing respectively with excellent electrical conductivity and a large contact area.

7. Connect the external braking resistor cable to the terminal block DCP/PB and the PE terminal.
8. Re-attach the Electronic Module with a tightening torque of 2.5 Nm (22.1 lbf.in).

❒

5.18 Connection examples

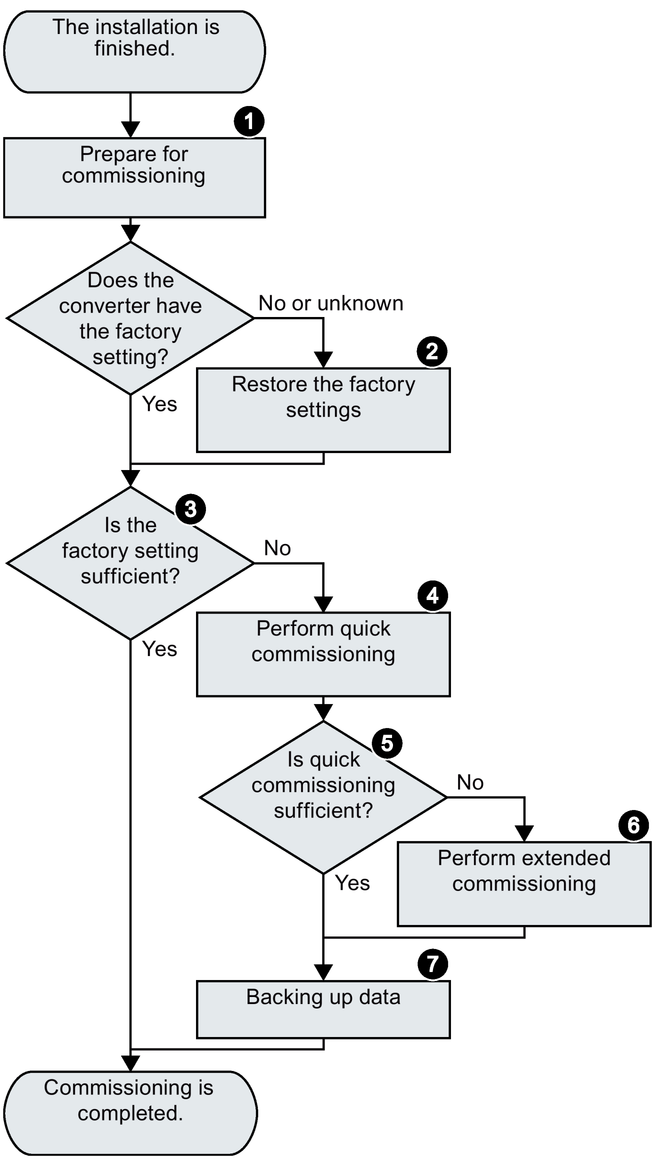
Connection example for G115D motor-mounted converter



Commissioning 6

6.1 Commissioning guidelines

Overview



1. Define the requirements to be met by the drive for your application.

   Preparing for commissioning (Page 94)

2. Restore the factory settings of the converter if necessary.

   Restoring the factory settings (Page 110)

3. Check if the factory setting of the converter is sufficient for your application.

   Factory settings (Page 94)

4. Perform quick commissioning of the drive in one of the following ways:
   – Quick commissioning with DIP switches (Page 98)
   – Quick commissioning with a PC (Startdrive) (Page 101)
   – Quick commissioning with the SINAMICS G120 Smart Access (Page 108)
5. Check if additional converter functions are required for the application.

   Advanced commissioning (Page 113)

6. If necessary, adapt the drive.

   Advanced commissioning (Page 113)

7. Save your settings and perform data backup.
   – Saving the settings in the converter (RAM → EEPROM) (Page 109)
   – Data backup and series commissioning (Page 327)

6.2 Compliance with the General Data Protection Regulation

Description

Siemens complies with the principles of the **General Data Protection Regulation (EU),** in particular the principle of data minimization (privacy by design). For this SINAMICS product, this means:

- **User management and access control (UMAC)**

  The product processes or stores the following personal data:

  - Login data for user management and access control:

    User name, group, password, role, rights.

  The data for user management and access control is stored in the converter and optionally on a memory card.

- **Support data (optional)**

  For optimal support in service cases, the end user or machine manufacturer (OEM) can optionally store contact data (header, email address, telephone number, homepage) in the converter.

  If this data is created, the author must give thought to data protection consent for this optional data. Siemens takes no responsibility for this data.

  This support contact data can be read and is freely accessible in, for example, the user interface as well as in the diagnostics report. This data is not encrypted.

This data is used for user management and access control (UMAC) and for the support function. The storage of this data is appropriate and limited to what is necessary, as it is essential to identify the authorized operators and service contact.

The personal data is also available as part of the backup system to ensure fast recovery of use cases.

The above-mentioned personal data cannot be stored anonymously or pseudonymized, as it serves the purpose of identifying the operating personnel. The anonymization or pseudonymization, e.g. of the login data, must be performed using suitable login names and contact data by the plant/machine operator.

Our product does not provide any functions for automatically deleting personal data. Individual UMAC data can be deleted manually by authorized personnel as soon as this is deemed recommended/required.

6.3 Commissioning tools

PC tool - Startdrive

Startdrive is a PC tool that is used to commission, troubleshoot and control the drive, as well as to back up and transfer the drive settings. You can connect the PC with the converter via a USB cable or via the PROFINET fieldbus. The maximum permissible length of the USB cable is 3 m.

For the PROFINET variant, the supported Startdrive version is 16.4 or later.

For the AS-i and I/O variants, the supported Startdrive version is 16.5 or later.

System requirements and download

Internet: Startdrive download
(https://support.industry.siemens.com/cs/ww/en/view/109771710)

Note

Commissioning and/or diagnostic failure resulting from unsafe mobile device or PC

Using unsafe mobile devices or PC to commission and/or diagnose the converter through commissioning tools can cause system failure or unsafe operating status in your system.

- Maintain the mobile device or PC for commissioning and diagnostics according to the security guidelines, for example, by deploying the patches for the operating system, activating firewalls, or using a virus scanner.

SINAMICS G120 Smart Access

The SINAMICS G120 Smart Access is a Web server module and an engineering tool that provides wireless connection to a PC, a tablet, or a smartphone. It has been designed for quick setup, parameterization and diagnostics of the supported SINAMICS G120 converter or SINAMICS G115D converter. The SINAMICS G120 Smart Access is only for commissioning and thus cannot be used with the converter permanently.

Operating instructions of the SINAMICS G120 Smart Access:

Overview of the manuals (Page 404)

6.4 Preparing for commissioning

6.4.1 Factory settings

Motor

For the SINAMICS G115D motor-mounted converter, the following converter settings have been set in the factory to the delivery condition to match the provided 2KJ8 geared motor.

Parameter	Description	Delivery condition
p1300[0...n]	Open-loop/closed-loop control operating mode	20: Speed control (encoderless)
p0300[0...n]	Motor type selection	The value is automatically preassigned to "181" or "602" dependent upon the selected SINAMICS G115D motor-mounted converter. 181: 2KJ8 asynchronous motor 602: 2KJ8 synchronous reluctance motor
p0301[0...n]	Motor code number selection	The value is automatically preassigned dependent upon the selected SINAMICS G115D motor-mounted converter.
p0541[0...n]	Load gearbox code number	
p0551[0...n]	Brake code number	
p0601[0...n]	Motor temperature sensor type	
p1215	Motor holding brake configuration	The value is automatically preassigned to "0" or "1" dependent upon the selected SINAMICS G115D motor-mounted converter. 0: No motor holding brake available 1: Motor holding brake according to sequence control

For more information about restoring settings to the delivery condition on the SINAMICS G115D motor-mounted converter, refer to the following section:

Restoring the factory settings/delivery condition (without safety functions) (Page 111)

Converter interfaces

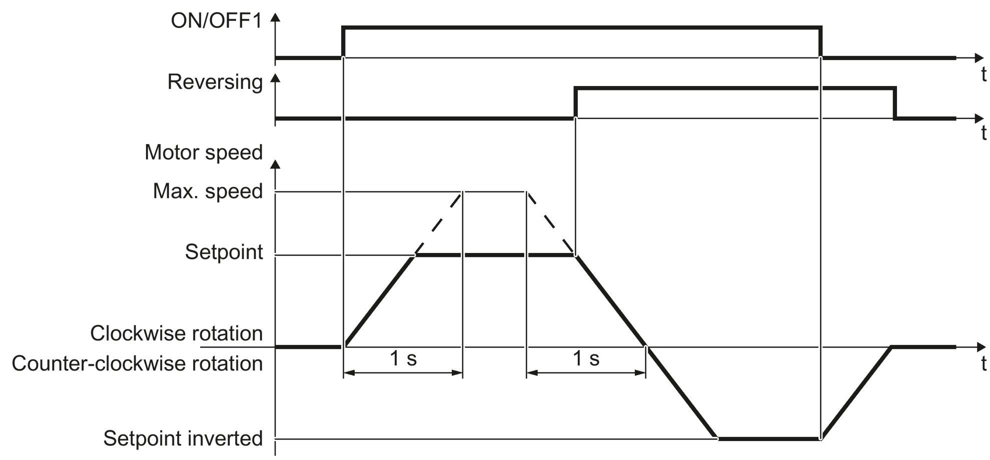
The inputs and outputs and the fieldbus interface of the converter have specific functions when set to the factory settings.

Factory interface setting (Page 68)

Switching the motor on and off

The converter is set in the factory as follows:

- For a converter with PROFINET or AS-i communication, the motor is switched on and off via the fieldbus.
- After the ON command, the motor accelerates with a ramp-up time of 1 s (referred to the maximum speed) to its speed setpoint.
- After the OFF1 command, the motor brakes down to standstill with 1 s ramp-down time.
- The motor direction of rotation reverses with the reversing command.

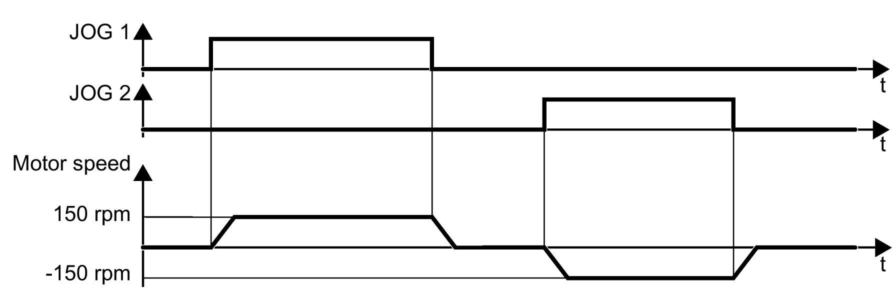


The ramp-up and ramp-down times define the maximum motor acceleration when the speed setpoint changes. The ramp-up and ramp-down times are derived from the time between motor standstill and the maximum speed, or between the maximum speed and motor standstill.

Traversing the motor in JOG mode

You can use a commissioning tool (e.g., Startdrive or SINAMICS G120 Smart Access) to operate the motor in JOG mode.

When a control command is received, the motor rotates at ±150 rpm. The same ramp-up and ramp-down times as described above apply.



6.4.2 Collecting motor data

For a G115D motor-mounted converter with Innomotics geared motor, you do not need to input specific motor data since all necessary motor data is pre-configured in the factory.

6.4.3 Selecting V/f control or speed control

For reluctance motors and permanent magnet synchronous motors, sensorless vector control (SLVC) is mandatory (p1300 = 20).

For asynchronous motors (2KJ8 asynchronous motors excluded), there are two different open-loop control or closed-loop control techniques:

- V/f control (calculation of the motor voltage using a characteristic curve)
- Closed-loop speed control (i.e. field-oriented control or vector control)

For 2KJ8 asynchronous motors, sensorless vector control (SLVC) is recommended (p1300 = 20).

Criteria for selecting either V/f control or speed control

In many applications, V/f control suffices to change the speed of asynchronous motors. Examples of typical applications for V/f control include:

- Horizontal conveyors
- Pumps
- Fans
- Compressors

When compared to V/f control, vector control offers the following advantages:

- The speed is more stable for motor load changes.
- Shorter accelerating times when the setpoint changes.
- Acceleration and braking are possible with an adjustable maximum torque.
- Improved protection of the motor and the driven machine as a result of the adjustable torque limiting.
- Torque control is only possible with vector control.

Examples of typical applications in which speed control is used:

- Hoisting gear and vertical conveyors
- Winders
- Extruders

It is not permissible to use speed control in the following cases:

- If the motor is too small in comparison to the converter (the rated motor power must not be less than one quarter of the rated converter power).
- When you operate several motors on one converter.
- When the maximum motor (4-pole) speed exceeds the following values:

	Converter pulse frequency	
	4 kHz	**4 kHz and higher**
Maximum motor speed	4980 rpm	7200 rpm

6.4.4 Calculating maximum speed for permanent magnet synchronous motors

CAUTION

Damage to the converter due to generator-driven motor

If the load machine drives the permanent magnet synchronous motor unintentionally, the permanent magnet synchronous motor charges the DC link of the converter. An impermissibly high DC link voltage can destroy the DC link capacitors of the converter.

- Ensure that the motor speed always remains below the calculated maximum speed even when the converter is disconnected from the power supply, e.g. via the brake on the load machine.

Calculate the maximum speed:

$$n_{max} = n_{rated} \cdot \sqrt{\frac{3}{2}} \cdot \frac{U_{DC\,max} \cdot I_{rated}}{P_{rated}}$$

n_{rated} Rated motor speed

$U_{DC\,max}$ Maximum permissible DC link voltage in converter:
$V_{DC\,max}$ = 820 V for mains voltage 380 V ... 480 V 3 AC

I_{rated} Rated motor current

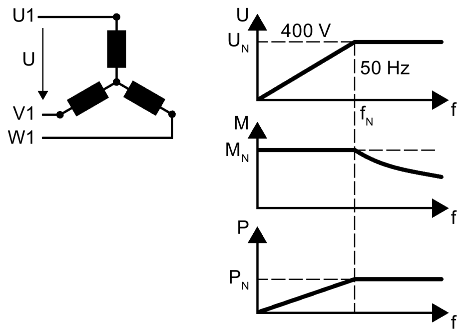
P_{rated} Rated motor power

6.4.5 Operating the motor in a star or delta connection

Standard asynchronous motors up to a rated power of approximately 3 kW are normally connected in a star/delta connection (Y/Δ) at 400 V/230 V. The connection type is stated on the product label.

Function description

Operating the motor in a star connection

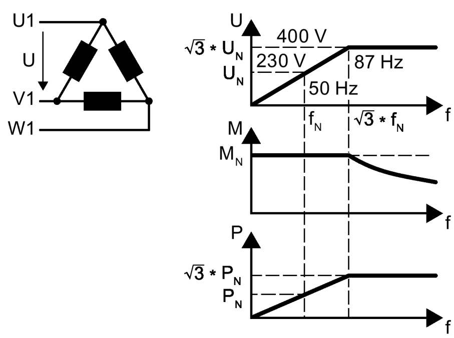


In a star connection, the motor can provide its rated torque M_N in the range 0 ... rated frequency f_N.

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

The motor goes into field weakening above the rated frequency. In field weakening, the available motor torque decreases 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 ... 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 converter must supply approximately 1.73x current. Select a converter based on its rated current - and not its rated power.
- The motor temperature increases more significantly than when operated with f ≤ 50 Hz.
- The motor must have windings that are approved for a voltage > rated voltage U_N.
- As the fan impeller rotates faster, the motor has a higher noise level than operation with f ≤ 50 Hz.

6.5 Quick commissioning

6.5.1 Quick commissioning with DIP switches

Overview

The G115D converters have been designed to allow quick commissioning to be performed using two sets of DIP switches. The DIP switches are located on the Wiring Module. To access the DIP switches, you must first remove the Electronic Module.

Accessing the DIP switches

WARNING

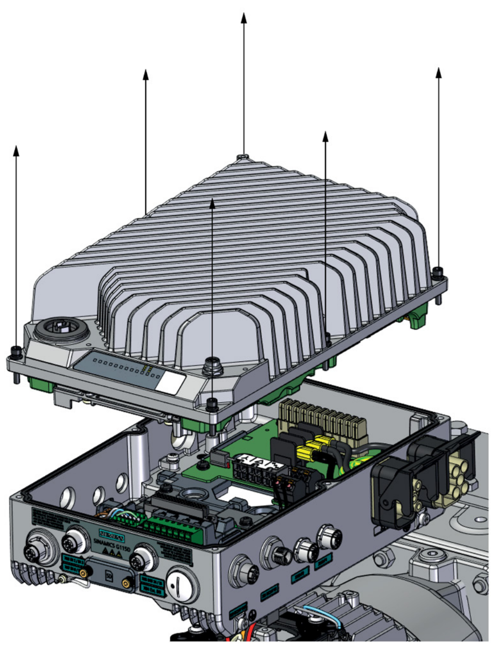
Electric shock caused by dangerous voltages and currents in the active converter

When power is applied to the converter, even when it is not active, dangerous levels of voltage and current are present in the system.

Before attempting the removal of any components of the system, the following steps should be taken to ensure that the system is completely safe:

1. Disconnect all mains power supplies (line supply and external 24 V power supply) to the system.
2. Wait five minutes to allow all the residual current and voltages to dissipate fully.
3. Check the voltage at the converter connections before removing any component.

Release the retaining screws (6 x M4) for the Electronic Module by using a 3 mm allen key, and then remove the module, as shown in the figure below:



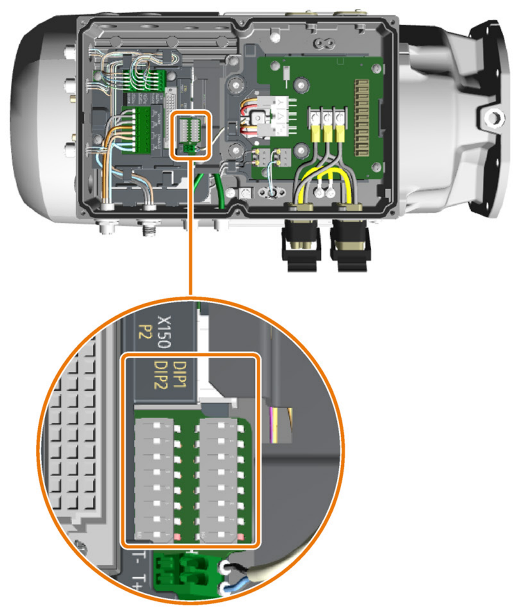
Note

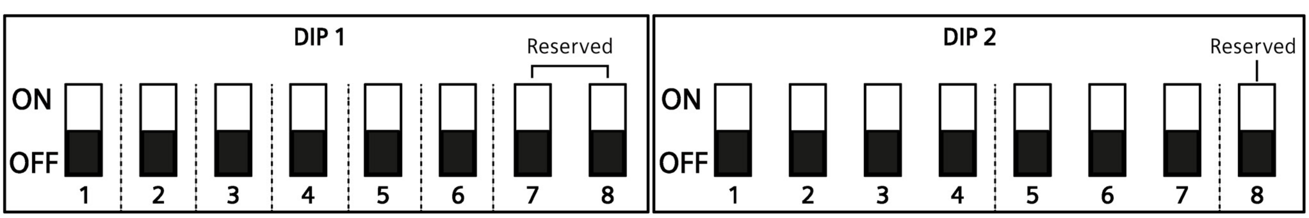
Reattach the screws with a tightening torque of 2.5 Nm (22.1 lbf.in).

Function description

You can use the DIP switches to perform basic commissioning and functional settings without using additional commissioning tools.

When the DIP switches are in the OFF position (by default), the value of the function is defined by the value of the according parameter(s) (see tables below). If the DIP switch is activated for a specific function, then the parameter(s) for that function cannot be modified by manually editing the parameter value.





Commissioning DIP switches 1.1 ... 1.6

DIP switch	Function	Value	
		ON position	OFF position
DIP 1.1	Motor temperature sensor type	Pt1000	p0601
DIP 1.2	Motor direction reversal	reversed	p1820
DIP 1.3	EM brake configuration	Brake according to sequence control	p1215
DIP 1.4	Pulse frequency	16 kHz	p1800
DIP 1.5	Motor type selection	Reluctance motor	p0300
DIP 1.6	87 Hz operation	87 Hz operation possible in a delta connection	p0133

Commissioning DIP switches 2.1 ... 2.4: ramp-up and ramp-down times

DIP switch				Value
DIP 2.1	DIP 2.2	DIP 2.3	DIP 2.4	
OFF	OFF	OFF	OFF	p1120, p1121, p1138, p1139
ON	OFF	OFF	OFF	0.1 s
OFF	ON	OFF	OFF	0.2 s
ON	ON	OFF	OFF	0.3 s
OFF	OFF	ON	OFF	0.5 s
ON	OFF	ON	OFF	0.7 s
OFF	ON	ON	OFF	1 s
ON	ON	ON	OFF	2 s
OFF	OFF	OFF	ON	3 s
ON	OFF	OFF	ON	5 s
OFF	ON	OFF	ON	7 s
ON	ON	OFF	ON	10 s
OFF	OFF	ON	ON	20 s
ON	OFF	ON	ON	30 s
OFF	ON	ON	ON	50 s
ON	ON	ON	ON	70 s

Commissioning DIP switches 2.5 ... 2.7: macro selection

DIP switch			Value for PROFINET variant	Value for AS-i variant	Value for I/O variant
DIP 2.5	DIP 2.6	DIP 2.7			
OFF	OFF	OFF	p0015 *	p0015 *	p0015 *
ON	OFF	OFF	-	Macro 31	Macro 9
OFF	ON	OFF	-	Macro 34	Macro 60
ON	ON	OFF	-	Macro 66	Macro 61
OFF	OFF	ON	-	-	Macro 62
ON	OFF	ON	-	-	Macro 63
OFF	ON	ON	-	-	Macro 64

* You must carry out quick commissioning in order to set parameter p0015.

6.5.2 Quick commissioning with a PC (Startdrive)

Overview

You can use a PC installed with Startdrive to perform quick commissioning via a USB or PROFINET interface. This chapter describes the commissioning via a USB interface.

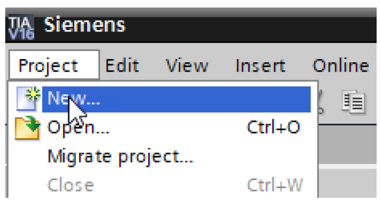
The screen forms that are shown in this manual show generally valid examples. The number of setting options available in screen forms depends on the particular converter type.

6.5.2.1 Creating a project

Procedure

1. Start the Startdrive commissioning software.
2. Switch to project view by clicking on the link at the bottom left of the window, as shown below:

3. In the menu, select the following command:



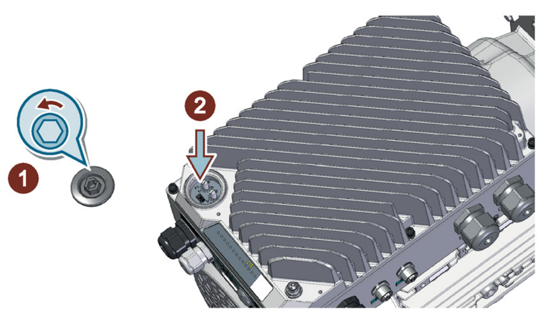
4. Specify a name of your choice for the project.

You have created a new project.
❐

6.5.2.2 Integrating the converter into the project

Procedure

1. Switch on the converter power supply.
2. Remove the commissioning cover (①) from the G115D converter by using an S12 hex nut driver and insert a USB cable (②) to establish the connection between your PC and the converter.

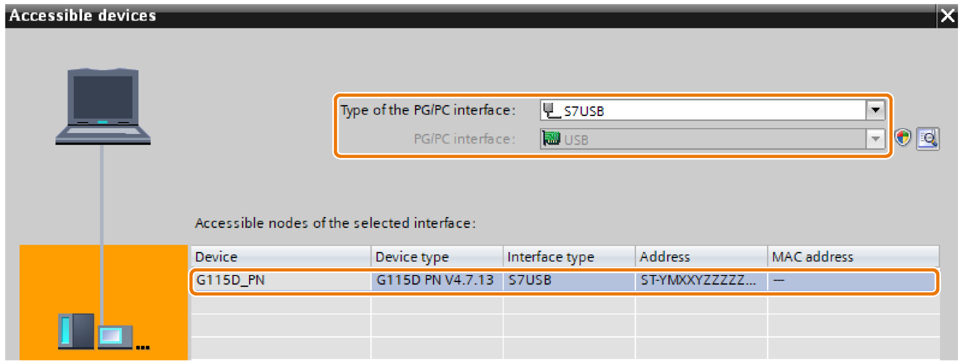


Note

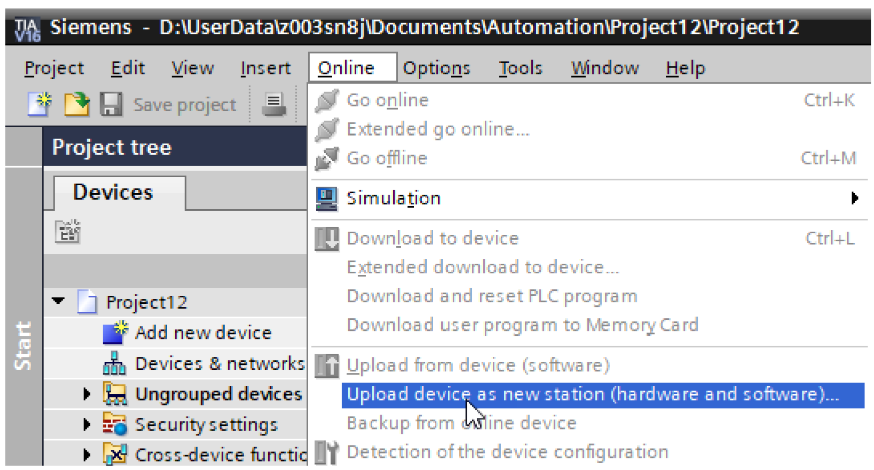
Reattach the commissioning cover with a tightening torque of 2.5 Nm (22.1 lbf.in).

3. The PC operating system installs the USB driver when you are connecting the converter and PC together for the first time.
4. Click on the button in the toolbar to open the window of accessible devices.

5. When the USB interface is appropriately set, then the screen form shows the devices that can be accessed.



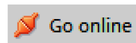
6. Select the desired device and click on the Show button.
7. Transfer the converter into the project using the following menu:



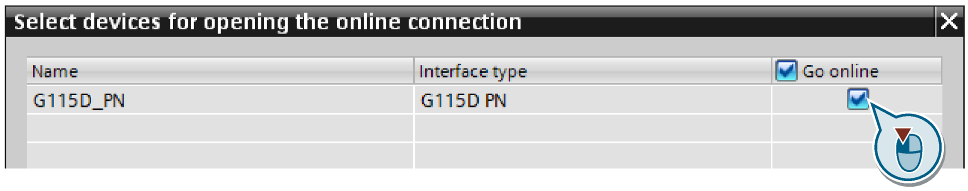
You have integrated a converter accessible via the USB interface into your project.
❒

6.5.2.3 Starting the Commissioning Wizard

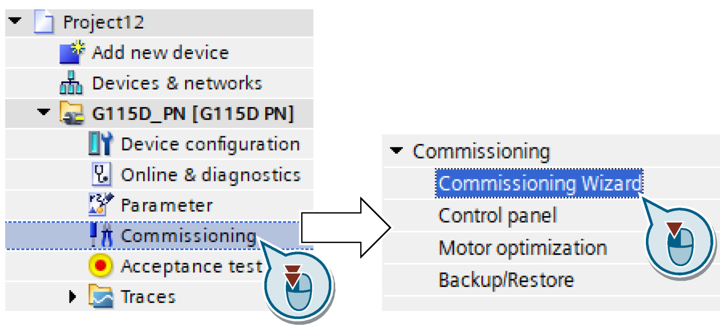
Procedure

1. Select your project and click on the 

button to establish the online connection.
2. In the following screen form, select the converter with which you wish to go online.



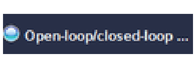
3. Once you are online, select the following command from the project tree:



You have started the Commissioning Wizard of the converter.
❒

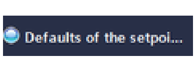
6.5.2.4 Carrying out quick commissioning

Procedure



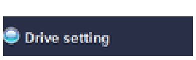
Select motor control mode.

Motor control (Page 264)

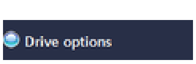


Select the I/O configuration to pre-assign the converter interfaces.

Factory interface setting (Page 68)



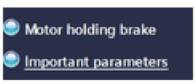
- Set the applicable motor standard and the converter supply voltage.
- Select the application for the drive:
  - [0] Load cycle with high overload: for applications requiring a high dynamic performance, e.g. conveyor systems.
  - [1] Load cycle with low overload: for applications that do not require a high dynamic performance, e.g. pumps or fans.
- Set the pulse frequency for the converter.



If an external braking resistor is installed, you must set the maximum permissible braking power of the braking resistor.

The geared motor with the G115D motor-mounted converter has been parameterized before factory delivery.

- Configure your motor in either of the following ways:
  - Enter the motor data according to the rating plate of your motor.
  - If you use a Siemens motor, select a motor based on its article number. In this case, the values of the selected motor are taken as default motor data.
- Set the motor connection (star/delta) and the 87 Hz characteristic.
- Select the temperature sensor for monitoring of the motor temperature.
- Select to reverse the output phase sequence or not.



Define whether the converter actuates a motor holding brake.

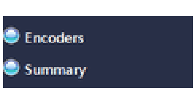
Set the most important parameters to suit your application.

- Select the technological application:
  - [0]: In all applications that do not fall under [3]
  - [3]: Applications involving pumps and fans with optimized efficiency. The setting only makes sense for steady-state operation with slow speed changes.
- Set the motor data identification:
  - [1]: Recommended setting for "speed control" control type. Measure the motor data at standstill and with the motor rotating. The converter switches off the motor after the motor data identification has been completed.
  - [2]: Measure the motor data at standstill. The converter switches off the motor after the motor data identification has been completed.

    Recommended setting for the following cases:

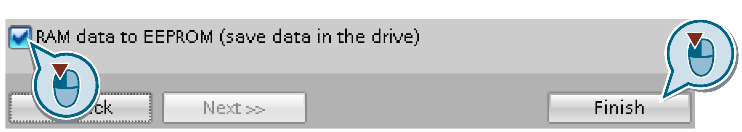
    ⇒ You have selected "Speed control" as control mode, however the motor cannot freely rotate, e.g. for mechanically limited traversing sections.

    ⇒ You have set "V/f control" as control mode.
  - [3]: Measure the motor data while the motor is rotating. The converter switches off the motor after the motor data identification has been completed.
- Calculate the motor parameters.



Enter the encoder data if you use an HTL encoder for the positioning function via PLC.

Set the check mark as follows to save your data in the converter and the memory card (if inserted) so that it is not lost if the power fails. Click on the Finish button.



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

6.5.2.5 Identifying motor data

Overview

Using the motor data identification, the converter measures the data of the stationary motor. In addition, based on the response of the rotating motor, the converter 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

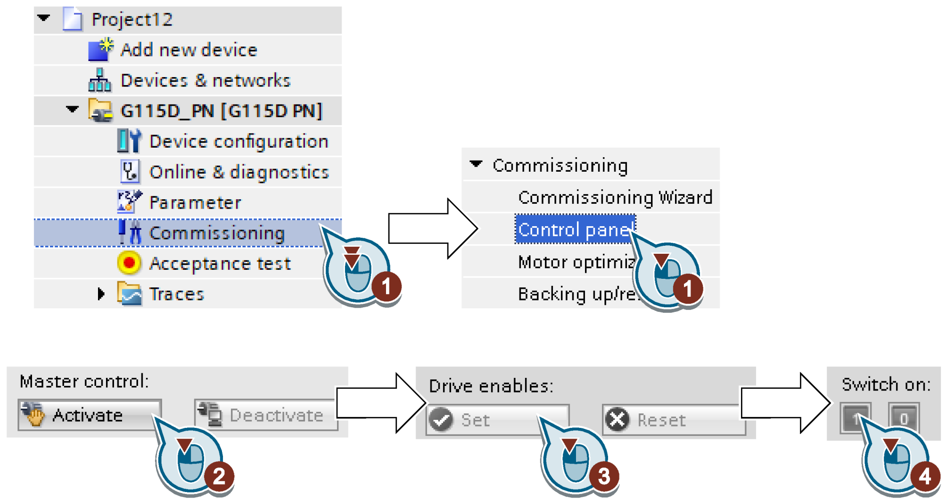
- You have selected a method of motor data identification during quick commissioning, e.g. measurement of the motor data while the motor is stationary.

  When quick commissioning is complete, the converter 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 converter 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 converter.
3. Set the drive to enable state.
4. Switch on the motor.

   The converter starts the motor data identification. This measurement can take several minutes.

   Depending on the setting, after motor data identification has been completed, the converter 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 converter (RAM → EEPROM) (Page 109).

You have completed the motor data identification.
❒

Self-optimization of the speed control

⚠ **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.

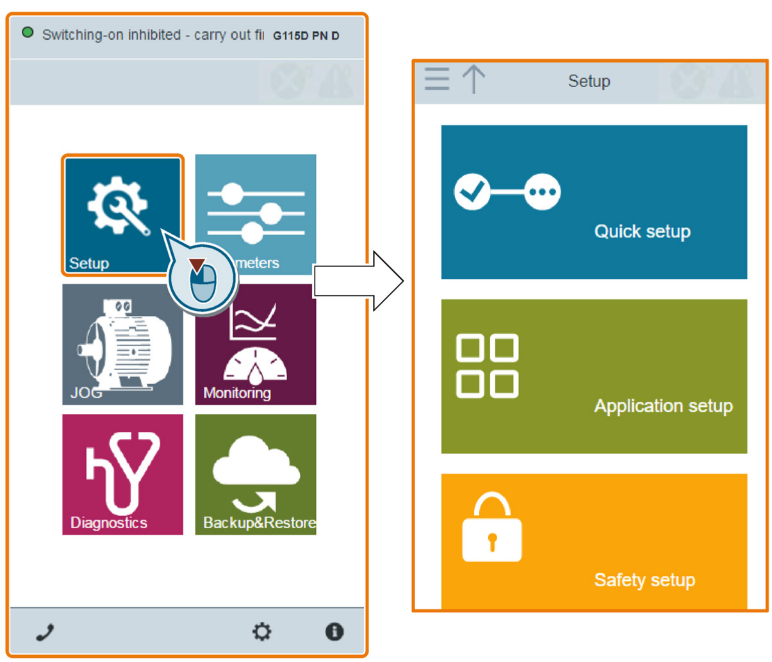
If you have not only selected motor data identification with the motor stationary, but also rotating measurement with self-optimization of the speed control, you must switch on the motor again as described above and wait for the optimization run to finish.

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

6.5.3 Quick commissioning with the SINAMICS G120 Smart Access

You can access the SINAMICS G120 Web pages from a PC or a mobile device that connects to the SINAMICS G120 Smart Access. The Web pages allow you to configure a comprehensive range of settings to meet the specific requirements of the G115D converters. You can perform the following three setups:

- Quick setup
- Application setup
- Safety setup



Further information

For more information on accessing the SINAMICS G120 Web pages and carrying out quick commissioning, see the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

6.5.4 Self-optimization of the speed control

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.

Recommendations

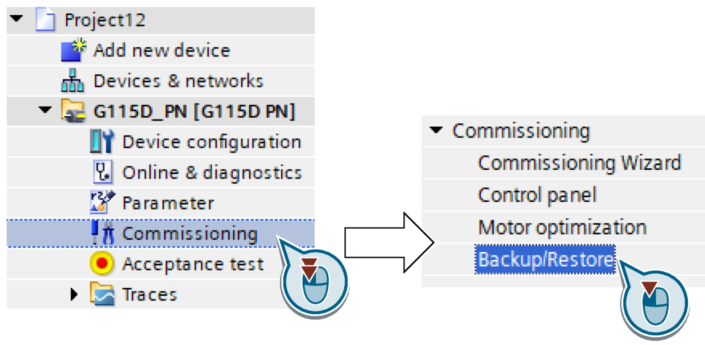
- Induction motors
  When commissioning induction machines, you are advised to proceed as follows:
  – Before connecting the load, a complete "rotating measurement" (p1900 = 3 or without encoder: p1960 = 1; with encoder: p1960 = 2) should be carried out. Since the induction machine is idling, you can expect highly accurate results for the saturation characteristic and the rated magnetizing current.
  – When the load is connected, speed controller tuning should be repeated because the total moment of inertia has changed. This is realized by selecting parameter p1960 (without encoder: p1960 = 3; with encoder: p1960 = 4). During the speed optimization, the saturation characteristic recording is automatically deactivated in parameter p1959.
- Permanent-magnet synchronous motors
  When permanent-magnet synchronous motors are commissioned, the speed controller should be tuned (p1900 = 3 or p1960 > 0) when the load is connected.

6.6 Saving the settings in the converter (RAM → EEPROM)

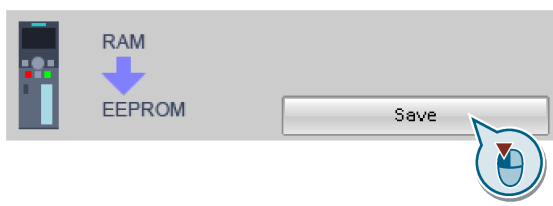
The parameter values are normally saved as volatile data in the RAM of the converter. After you finish the commissioning, you must save your settings to the converter's non-volatile memory (EEPROM) to prevent unexpected data loss. If an optional memory card is present, performing the save operations (RAM → EEPROM) automatically copies all settings to the memory card.

Procedure with Startdrive

1. Go online with the converter.
2. Select the command as follows from the project tree:



3. Click on the button in the dialog box as shown below:



You have saved your settings retentively in the EEPROM.
❒

Further information

For more information on saving the settings (RAM → EEPROM) on the SINAMICS G120 Smart Access, see Section "Parameters" in the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

6.7 Restoring the factory settings

When must you restore the factory settings?

Restore the converter to the factory settings in the following cases:

- You do not know the converter settings.
- The line voltage was interrupted during commissioning and you were not able to complete commissioning.

Restoring the factory settings when the safety functions are enabled

If you are using the integrated safety functions of the converter, e.g. "Safe Torque Off", you must reset the safety functions separately from the remaining converter settings.

The settings of the safety functions are protected by a password.

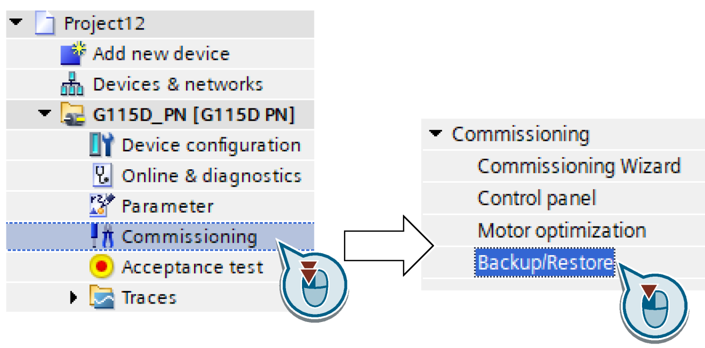
Settings that are not changed when restoring the factory setting

The communication settings and the settings of the motor standard (IEC/NEMA) are kept when restoring the factory setting.

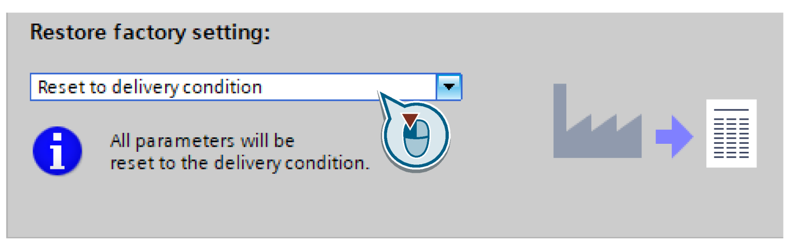
6.7.1 Restoring the factory settings/delivery condition (without safety functions)

Procedure with Startdrive

1. Go online with the converter.
2. Select the command as follows from the project tree:



3. Select the menu option as follows to restore to the delivery condition:



4. Click on the Start button.
5. Wait until the converter has been reset to the factory settings/delivery condition.

You have reset the converter to the factory settings/delivery condition.
❒

Further information

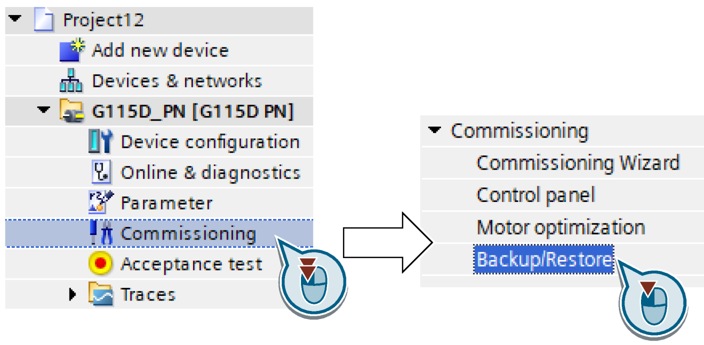
For more information on restoring on the SINAMICS G120 Smart Access, see Section "Backup and restore" in the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

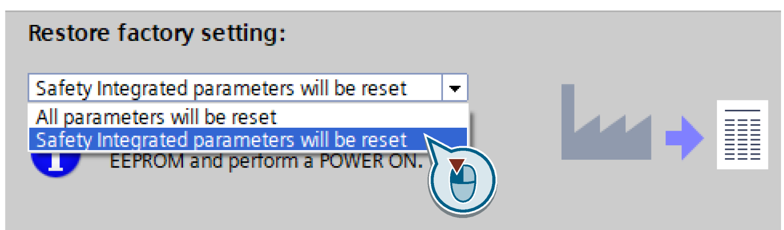
6.7.2 Resetting the safety functions to the factory settings

Procedure with Startdrive

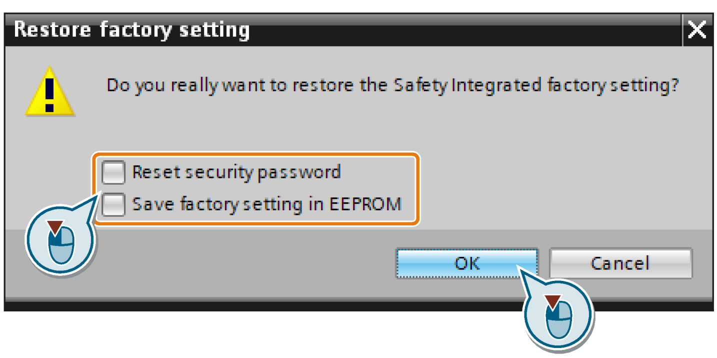
1. Go online with the converter.
2. Select the command as follows from the project tree:



3. Select the menu option as follows:



4. Click on the Start button.
5. Select the reset options as desired by setting the check marks in the following dialog box:

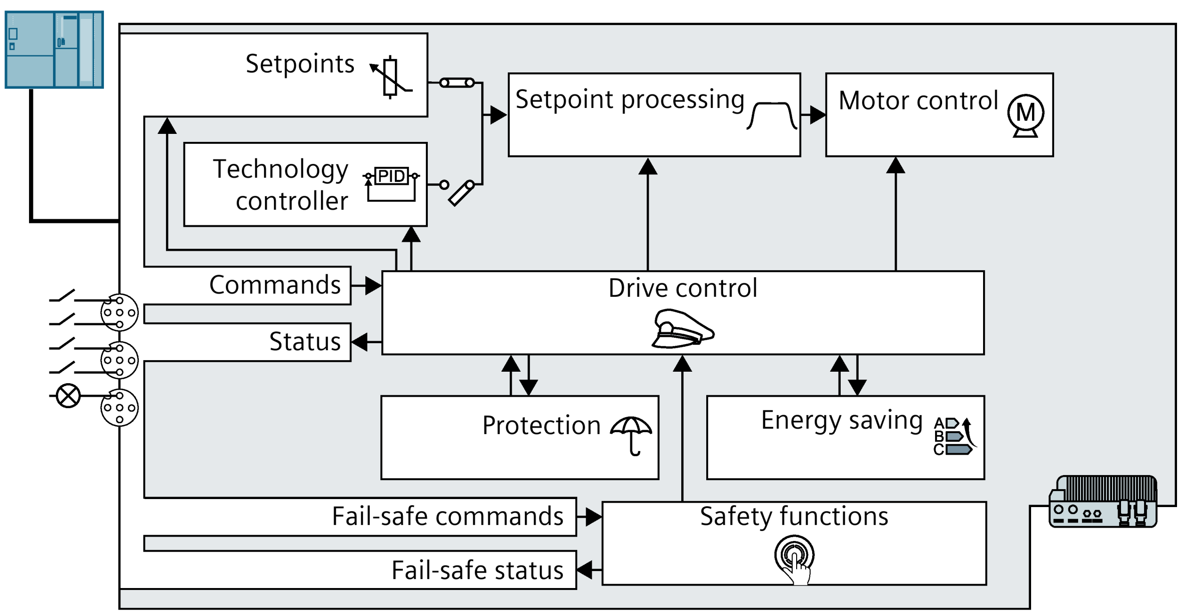


6. Enter the password for the safety functions and the resetting process starts.
7. Go offline with the converter after the reset finishes.
8. Switch off the converter power supply and wait until all LEDs on the converter are dark.
9. Switch on the converter power supply again.

You have restored the safety functions in the converter to the factory settings.
❒

7 Advanced commissioning

7.1 Overview of converter functions



Drive control

The converter receives its commands from the higher-level control via the terminal strip or the fieldbus interface of the converter. The drive control defines how the converter responds to the commands.

Sequence control when switching the motor on and off (Page 115)

Adapt the default settings of the inputs and outputs (Page 117)

Controlling clockwise and counter-clockwise rotation via digital inputs (Page 120)

Drive control via PROFINET (Page 126)

Drive control via Ethernet/IP (Page 141)

Drive control via AS-i (Page 158)

Drive control via I/O terminals (Page 66)

Jogging (Page 169)

Conveyor technology control functions (for G115D PROFINET and AS-i variants only) (Page 170)

The converter can switch between different settings of the drive control.

Switching over the drive control (command data set) (Page 204)

The converter can control a motor holding brake. The motor holding brake holds the motor in position when it is switched off.

Motor holding brake (Page 206)

The free function blocks permit configurable signal processing within the converter.

Free function block (Page 212)

You can select in which physical units the converter represents its associated values.

Selecting physical units (Page 212)

Safety functions

The safety functions fulfill increased requirements regarding the functional safety of the drive.

Safe Torque Off (STO) safety function (Page 215)

Safely Limited Speed (SLS) (Page 230)

Setpoints and setpoint processing

The setpoint normally defines the motor speed.

Setpoints (Page 237)

The setpoint processing uses a ramp-function generator to prevent speed steps occurring and to limit the speed to a permissible maximum value.

Setpoint processing (Page 247)

Technology controller

The technology controller controls process variables, e.g. pressure, temperature, level or flow. The motor control receives the setpoint either from the higher-level control or from the technology controller.

PID technology controller (Page 257)

Motor control

The motor control ensures that the motor follows the speed setpoint. You can choose between various control modes.

Motor control (Page 264)

The converter provides several methods to brake the motor electrically. During electrical braking, the motor develops a torque that reduces the speed to standstill.

Electrically braking the motor (Page 291)

Protection of the drive and the driven load

The protection functions prevent damage to the motor, converter and driven load.

Overcurrent protection (Page 296)

Converter protection using temperature monitoring (Page 297)

Motor temperature monitoring using a temperature sensor (Page 300)

Motor protection by calculating the temperature (Page 303)

Motor and converter protection by limiting the voltage (Page 305)

The monitoring of the driven load prevents impermissible operating modes, e.g. dry-running of a pump.

Monitoring the driven load (Page 306)

Energy saving

The converter can optimize the efficiency of the motor.

Efficiency optimization (Page 314)

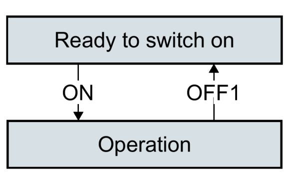
The converter calculates how much energy controlled converter operation saves when compared to mechanical flow control (e.g. throttle).

Calculating the energy saving for fluid flow machines (Page 317)

7.2 Sequence control when switching the motor on and off

Overview

The sequence control defines the rules for switching the motor on and off.



After switching the supply voltage on, the converter normally goes into the "ready to start" state. In this state, the converter waits for the command to switch on the motor.

The converter switches on the motor with the ON command. The converter changes to the "Operation" state.

After the OFF1 command, the converter brakes the motor down to standstill. The converter switches off the motor once standstill has been reached. The converter is again "ready to start".

Requirement

Functions

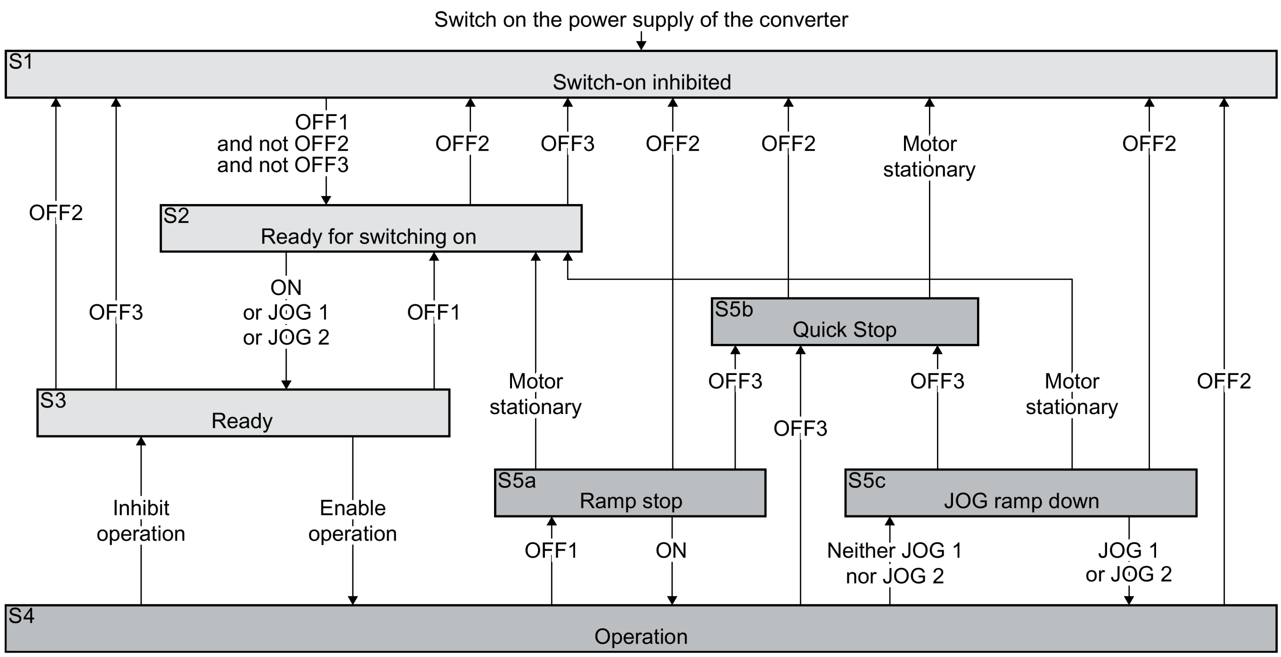
In order to be able to respond to external commands, you must set the command interface so that it fits your specific application.

Tools

To change the function settings, you can use a commissioning tool.

Commissioning tools (Page 92)

Function description



Converter states S1 ... S5c are defined in the PROFIdrive profile. The sequence control defines the transition from one state to another.

Converter 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 converter waits for a new ON command. The ON command is currently active. You must activate the ON command again in order that the converter exits the state.	S4	The motor is switched on.
S2	The converter waits for a new command to switch on the motor.	S5a, S5c	The motor is still switched on. The converter brakes the motor with the ramp-down time of the ramp-function generator.
S3	The converter waits for "Enable operation". The "Enable operation" command is always active in the converter factory setting.	S5b	The motor is still switched on. The converter brakes the motor with the OFF3 ramp-down time.

Commands for switching the motor on and off

ON JOG 1 JOG 2 Enable operation	The converter switches the motor on.
OFF1, OFF3	The converter brakes the motor. The converter 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 converter switches off the motor immediately without first braking it.

Further information

You will find additional information in function diagram 2610 of the List Manual.

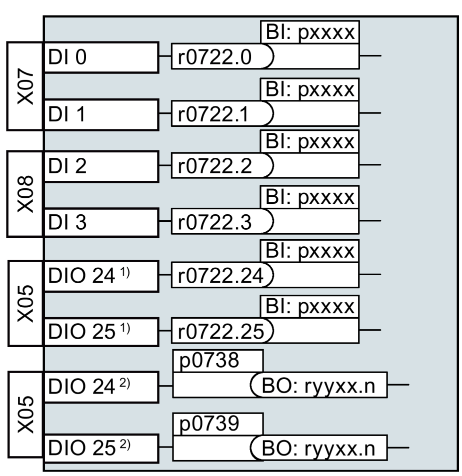
7.3 Adapt the default settings of the inputs and outputs

7.3.1 Overview

In the converter, the input and output signals are interconnected with specific converter 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 converter inputs and outputs using binectors and connectors.

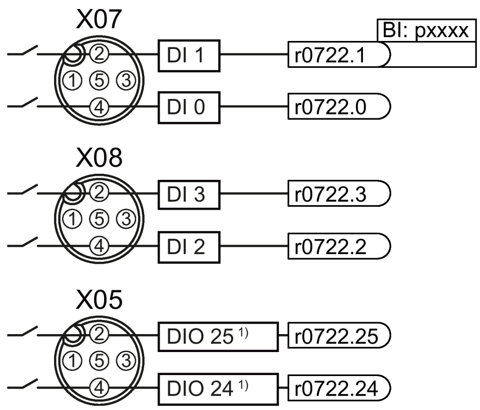


[1] If parameterized as digital inputs via p0728

[2] If parameterized as digital outputs via p0728

7.3.2 Digital Inputs

Changing the function of the digital inputs



[1)] Parameterized as digital inputs

Interconnect the status parameter of the digital input with a binector input of your choice.

Interconnecting signals in the converter (Page 397)

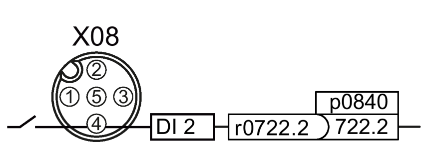
Binector inputs are marked with "BI" in the parameter list of the List Manual.

Binector inputs (BI) of the converter

BI	Significance	BI	Significance
p0810	Command data set selection CDS bit 0	p1036	Motorized potentiometer, setpoint, lower
p0840	ON/OFF1	p1055	Jog bit 0
p0844	OFF2	p1056	Jog bit 1
p0848	OFF3	p1113	Setpoint inversion
p0852	Enable operation	p1201	Flying restart enable signal source
p0855	Unconditionally release holding brake	p2103	1st acknowledge faults
p0856	Enable speed controller	p2106	External fault 1
p0858	Unconditionally close holding brake	p2112	External alarm 1
p1020	Fixed speed setpoint selection bit 0	p2200	Technology controller enable
p1021	Fixed speed setpoint selection bit 1	p3330	Two-wire/three-wire control, control command 1
p1022	Fixed speed setpoint selection bit 2	p3331	Two-wire/three-wire control, control command 2
p1023	Fixed speed setpoint selection bit 3	p3332	Two-wire/three-wire control, control command 3
p1035	Motorized potentiometer, setpoint, raise		

A complete list of the binector inputs is provided in the List Manual.

Example



In order to switch on the motor with digital input DI 2, you have to connect the status parameter of DI 2 to p0840: Set p0840 = 722.2.

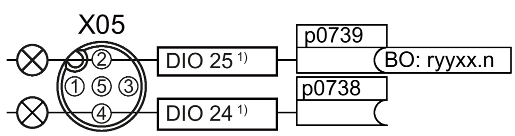
Advanced settings

You can debounce the digital input signal using parameter p0724.

For more information, see the parameter list and the function block diagram 2220 of the List Manual.

7.3.3 Digital outputs

Changing the function of the digital outputs



1) Parameterized as digital outputs

Interconnect the digital output with a binector output of your choice.

Interconnecting signals in the converter (Page 397)

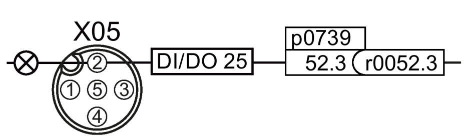
Binector outputs are marked with "BO" in the parameter list of the List Manual.

Binector outputs of the converter

0	Deactivating digital output	r0052.9	Process data control
r0052.0	Drive ready	r0052.10	f_actual >= p1082 (f_max)
r0052.1	Drive ready for operation	r0052.11	Alarm: Motor current/torque limit
r0052.2	Drive running	r0052.12	Brake active
r0052.3	Drive fault active	r0052.13	Motor overload
r0052.4	OFF2 active	r0052.14	Motor CW rotation
r0052.5	OFF3 active	r0052.15	Converter overload
r0052.6	Switching on inhibited active	r0053.0	DC braking active
r0052.7	Drive alarm active	r0053.2	f_actual > p1080 (f_min)
r0052.8	Setpoint/actual value discrepancy	r0053.6	f_actual ≥ setpoint (f_setpoint)

A complete list of the binector outputs is provided in the List Manual.

Example



In order to output the fault message over the digital output DI/DO 25, you have to connect the DI/DO 25 with the fault message: Set p0739 = 52.3.

Advanced settings

You can invert the signal of the digital output using parameter p0748.

For more information, see the parameter list and the function block diagram 2230 of the List Manual.

7.4 Controlling clockwise and counter-clockwise rotation via digital inputs

The converter offers different methods for controlling the motor using two or three commands.

Overview

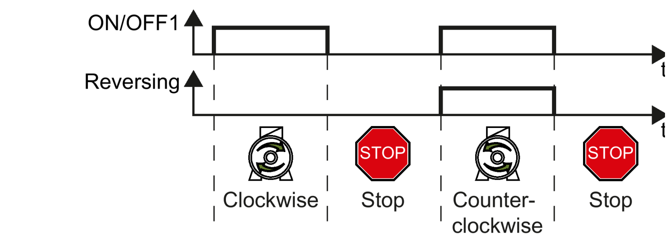
Two-wire control, method 1

ON/OFF1:

Switches the motor on or off

Reversing:

Reverses the motor direction of rotation



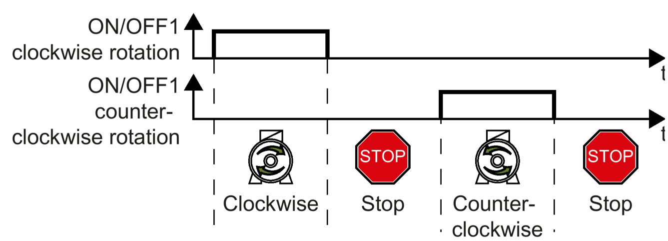
Two-wire control, method 2 - and two-wire control, method 3

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:

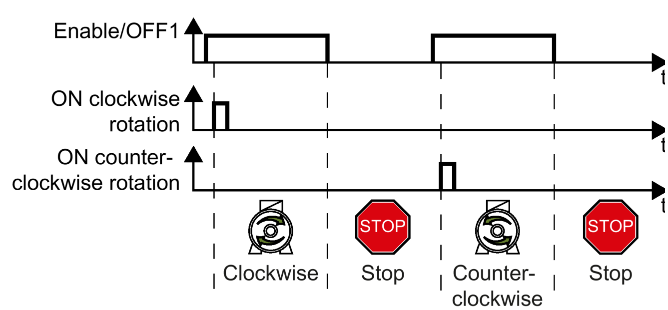
Enables the motor to be switched on or switched off

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:

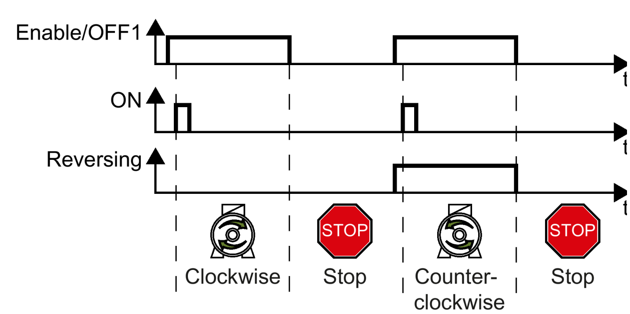
Enables the motor to be switched on or switched off

ON:

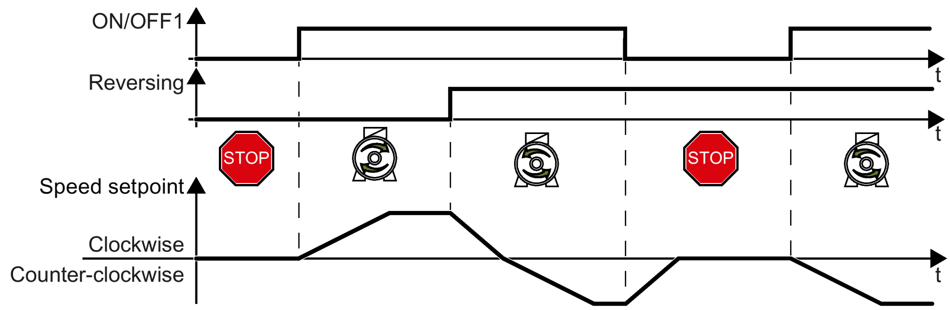
Switches on the motor

Reversing:

Reverses the motor direction of rotation



7.4.1 Two-wire control, method 1



Command "ON/OFF1" switches the motor on and off. The "Reversing" command inverts the motor direction of rotation.

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

Parameters

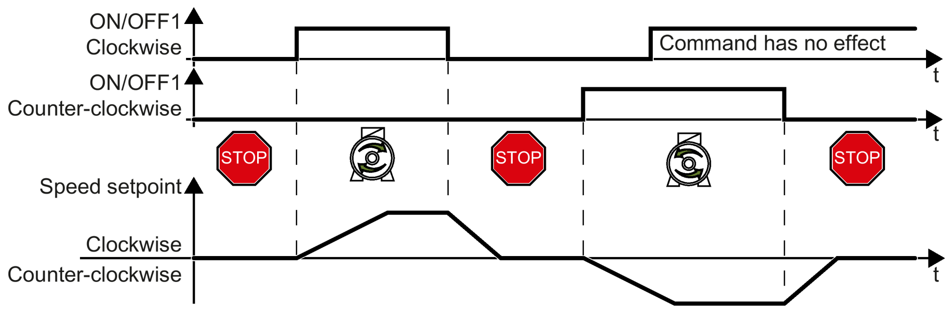
Select two-wire control, method 1

Parameter	Description
p0015 = 60	**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 DI 1: Reversing

Changing the assignment of the digital inputs

Parameter	Description
p0840[0...n] = 722.x	**BI: ON/OFF1** (ON/OFF1) Example: p0840 = 722.3 ⇒ DI 3: ON/OFF1
p1113[0...n] = 722.x	**BI: Setpoint inversion** (reversing)

7.4.2 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 converter only accepts a new command when the motor is at a standstill.

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".

Parameters

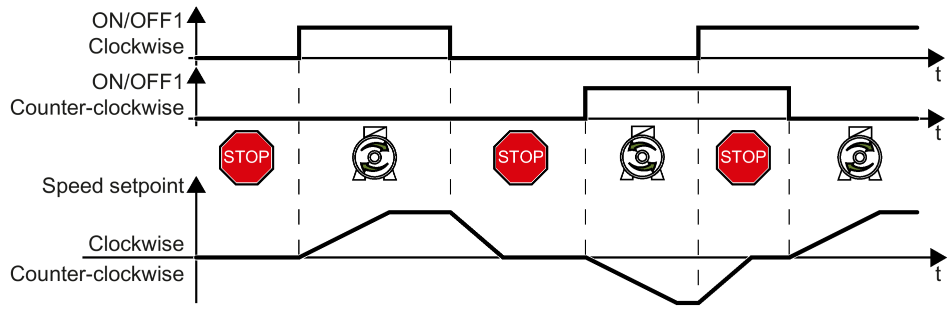
Select two-wire control, method 2

Parameter	Description
p0015 = 61	**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

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

7.4.3 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 converter accepts a new command at any time, independent of the motor speed.

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.

Parameters

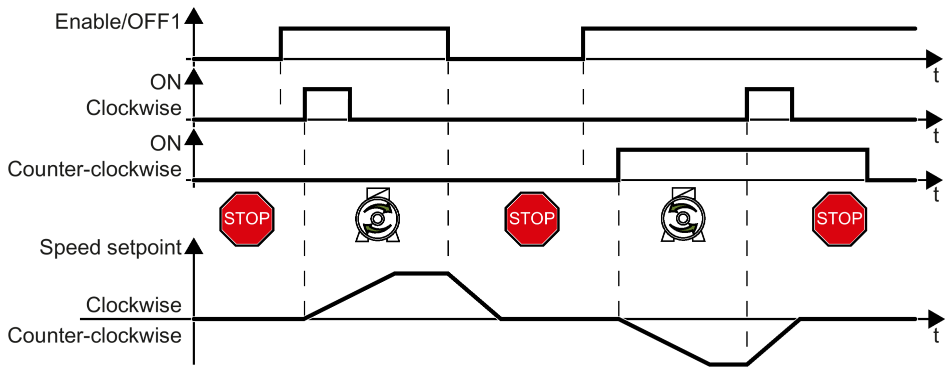
Select two-wire control, method 3

Parameter	Description
p0015 = 62	**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

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

7.4.4 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).

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.

Parameters

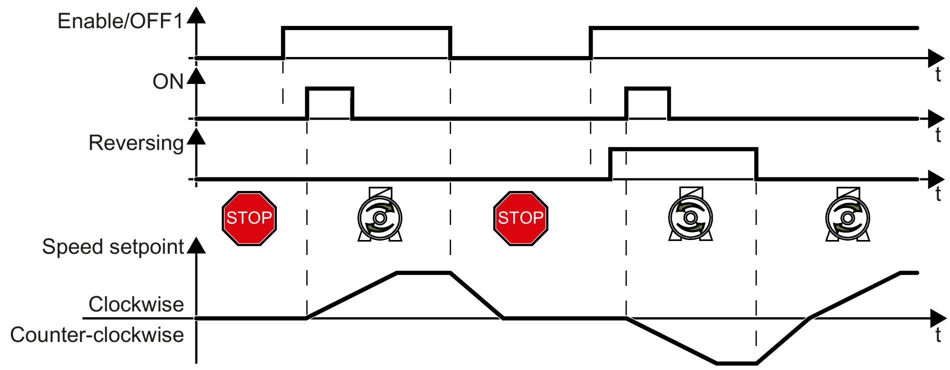
Select three-wire control, method 1

Parameter	Description
p0015 = 63	**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 counter-clockwise rotation DI 2: ON clockwise rotation

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

7.4.5 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).

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.

Parameters

Select three-wire control, method 2

Parameter	Description
p0015 = 64	**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 DI 2: Reversing

Changing the assignment of the digital inputs

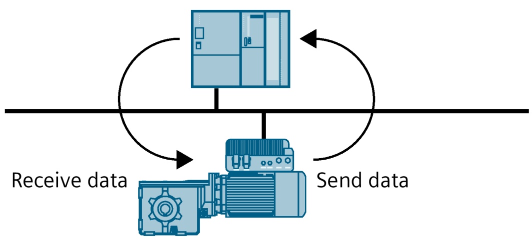
Parameter	Description
p3330[0 ... n] = 722.x	**BI: 2/3 wire control command 1** (enable/OFF1)
p3331[0 ... n] = 722.x	**BI: 2/3 wire control command 2** (ON) Example: p3331 = 722.0 ⇒ DI 0: ON command
p3332[0 ... n] = 722.x	**BI: 2/3 wire control command 3** (reversing)

7.5 Drive control via PROFINET

7.5.1 Receive data and send data

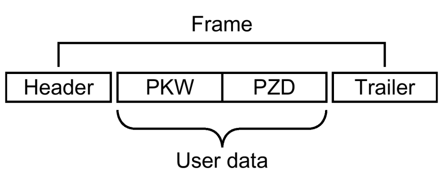
Cyclic data exchange

The converter receives cyclic data from the higher-level control and returns cyclic data to the control.



Converter and control system pack their data in telegrams.

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 converter via "PKW data".

    Not every telegram has a "PKW range".
  - PZD: The converter 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.

7.5.2 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

Receive user data

Send user data

16-bit speed setpoint

Telegram 3

PZD01	PZD02	PZD03	PZD04	PZD05	PZD06	PZD07	PZD08	PZD09
STW1	NSOLL_B		STW2	G1_ STW				
ZSW1	NIST_B		ZSW2	G1_ ZSW	G1_XIST1		G1_XIST2	

32-bit speed setpoint with 1 position encoder

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	Freely assignable			
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	Freely assignable			
PKW	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
STW1	Telegram length for the receive data										
ZSW1	Telegram length for the transmit data										

Unassigned interconnection and length

Explanation of the abbreviations

Abbreviation	Explanation	Abbreviation	Explanation
PZD	Process data	PKW	Parameter channel
STW	Control word	PIST_GLATT	Actual active power value, smoothed
ZSW	Status word	M_LIM	Torque limit
NSOLL_A	Speed setpoint 16 bit	FAULT_CODE	Fault code
NSOLL_B	Speed setpoint 32 bit	WARN_CODE	Alarm code
NIST_A	Speed actual value 16 bit	MELD_NAMUR	Message according to the VIK-NAMUR definition
NIST_B	Speed actual value 32 bit	G1_STW / G2_STW	Control word for encoder 1 or encoder 2
IAIST	Current actual value	G1_ZSW / G2_ZSW	Status word for encoder 1 or encoder 2
IAIST_GLATT	Current actual value, smoothed	G1_XIST1 / G2_XIST1	Position actual value 1 from encoder 1 or encoder 2
MIST_GLATT	Torque actual value, smoothed	G1_XIST2 / G2_XIST2	Position actual value 2 from encoder 1 or encoder 2

7.5.3 Control and status word 1

Control word 1 (STW1)

Bit	Significance		Explanation	Signal interconnection in the converter
	Telegram 20	All other telegrams		
0	0 = OFF1		The motor brakes with the ramp-down time p1121 of the ramp-function generator. The converter switches off the motor at standstill.	p0840[0] = r2090.0
	0 → 1 = ON		The converter goes into the "ready" state. If, in addition bit 3 = 1, then the converter 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 converter 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 converter 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 converter switches to the "switching on inhibited" state.	p2103[0] = r2090.7
8, 9	Reserved			
10	0 = No control via PLC		Converter ignores the process data from the fieldbus.	p0854[0] = r2090.10
	1 = Control via PLC		Control via fieldbus, converter accepts the process data from the fieldbus.	
11	1 = Direction reversal		Invert setpoint in the converter.	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 interconnection in the converter
	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 converter 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 converter 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 converter 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 converter actual value > 0	p2080[14] = r2197.3
	0 = Motor rotates counter-clockwise		Internal converter actual value < 0	
15	1 = CDS display	0 = Alarm, converter 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.

7.5.4 Control and status word 3

Control word 3 (STW3)

Bit	Meaning Telegram 350	Explanation	Signal interconnection in the converter [1)]
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 = technology controller enable	--	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	1 = torque control active 0 = speed control active	Changes over the control mode for vector control.	p1501[0] = r2093.12
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 converter sets all interconnections p1020, ... to "0". Exception: p2106 = 1.

Status word 3 (ZSW3)

Bit	Meaning	Description	Signal interconnection in the converter
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 ≧ p2170	Actual current ≥ current threshold value	
4	1 = |n_act | > p2155	Absolute actual speed > speed threshold value 2	
5	1 = |n_act | ≦ p2155	Absolute actual speed < speed threshold value 2	
6	1 = |n_act | ≧ r1119	Speed setpoint reached	
7	1 = DC link voltage ≦ p2172	Actual DC link voltage ≦ 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 ≦ 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		

7.5.5 Control and status word G115D

Control word G115D (STW_G115D)

Bit	Meaning	Description	Signal interconnection in the converter
0	1 = DO 24	Control via bidirectional DIO 24	p0738 = r2094.0
1	1 = DO 25	Control via bidirectional DIO 25	p0739 = r2094.1
2	1 = Stop/low speed sensor bypass	Activate or deactivate the stop/low speed sensor bypass for conveyor control	p3390 = r2094.2
6 ... 15	Not used		

Status word G115D (ZSW_G115D)

Bit	Meaning	Description	Signal interconnection in the converter
0	1 = DI 0	Status of the digital input 0	p2084[0] = r0722.0
1	1 = DI 1	Status of the digital input 1	p2084[1] = r0722.1
2	1 = DI 2	Status of the digital input 2	p2084[2] = r0722.2
3	1 = DI 3	Status of the digital input 3	p2084[3] = r0722.3
4	1 = DI 24	Status of the digital input 24	p2084[4] = r0722.24
5	1 = DI 25	Status of the digital input 25	p2084[5] = r0722.25
6	Not used		
7	Not used		
8	1 = Repair switch OFF	Repair switch is set to OFF and all power to the motor is terminated.	p2084[8] = r8559.12
9	1 = Remote control active	Remote control mode is activated via the LRC panel.	p2084[9] = r8559.2
10	1 = Manual mode active	Local control mode is activated via the LRC panel.	p2084[10] = r8559.3
11	1 = Sensor bypass activated	Stop/low speed sensor bypass is activated for the conveyor control.	p2084[11] = r8559.4
12	1 = Continuous motion activated	Continuous motion is activated via the LRC panel.	p2084[12] = r8559.5
13	1 = Jog left active	Motor Jogs to the left.	p2084[13] = r8559.6
14	1 = Jog right active	Motor Jogs to the right.	p2084[14] = r8559.7
15	Not used		

7.5.6 NAMUR message word

Fault word according to the VIK-NAMUR definition (MELD_NAMUR)

Bit	Significance	P no.
0	1 = converter signals a fault	p2051[5] = r3113
1	1 = line fault: phase failure or inadmissible voltage	
2	1 = DC link overvoltage	
3	1 = power unit fault, e.g. overcurrent or overtemperature	
4	1 = converter 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 converter communication	
11	1 = line fault	
15	1 = other fault	

7.5.7 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	SPM	PNU	Subindex	Page index	PWE 1	PWE 2

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 parameter channel word contain the request and response identifier AK.

Request ID, control → converter

AK	Description	Response ID	
		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.

Response ID, converter → 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	Converter cannot process the request. In the most significant word of the parameter channel, the converter 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).

Error numbers for response ID 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 converter)
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 → converter")
6B hex	**No change access for a controller that is enabled**. (The operating state of the converter prevents a parameter change)
86 hex	**Write access only for commissioning (p0010 = 15)** (operating state of the converter 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)
C9 hex	**Change request above the currently valid limit** (example: a parameter value is too large for the converter 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>
<tr><th></th><th>PWE 1</th><th colspan="2">PWE 2</th></tr>
<tr><td rowspan="4">Parameter value</td><td>Bit 15 ... 0</td><td>Bit 15 ... 8</td><td>Bit 7 ... 0</td></tr>
<tr><td>0</td><td>0</td><td>8-bit value</td></tr>
<tr><td>0</td><td colspan="2">16-bit value</td></tr>
<tr><td colspan="3">32-bit value</td></tr>
<tr><td rowspan="2">Connector</td><td>Bit 15 ... 0</td><td>Bit 15 ... 10</td><td>Bit 9 ... 0</td></tr>
<tr><td>Number of the connector</td><td>3F hex</td><td>The index or bit field number of the connector</td></tr>
</table>

Example

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	15 ... 10	9 ... 0
AK		Parameter number	Subindex	Page index	Parameter value	Drive object	Index
0 1 1 0	0	1 1 1 0 0 1 1 0 0 0 1	0 0 0 0 0 0 1 0	1 0 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 0	0 0 0 0 0 0 0 0 0 0

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	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 0 1 0 1 1 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 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 1 1 0 1 0

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** (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 - 63 = 3F hex)
- **PWE2, Bit 0 ... 9: = 2 hex** (Index of Parameter (DI 2 = 2))

<table>
<tr><td colspan="64">Parameter channel</td></tr>
<tr><td colspan="16">PKE, 1st word</td><td colspan="16">IND, 2nd word</td><td colspan="16">PWE1 - high, 3rd word</td><td colspan="16">PWE2 - low, 4th word</td></tr>
<tr><td colspan="4">15...12</td><td>11</td><td colspan="11">10 ... 0</td><td colspan="8">15 ... 8</td><td colspan="8">7 ... 0</td><td colspan="16">15 ... 0</td><td colspan="6">15 ... 10</td><td colspan="10">9 ... 0</td></tr>
<tr><td colspan="4">AK</td><td></td><td colspan="11">Parameter number</td><td colspan="8">Subindex</td><td colspan="8">Page index</td><td colspan="16">Parameter value</td><td colspan="6">Drive Object</td><td colspan="10">Index</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td><td>0</td></tr>
</table>

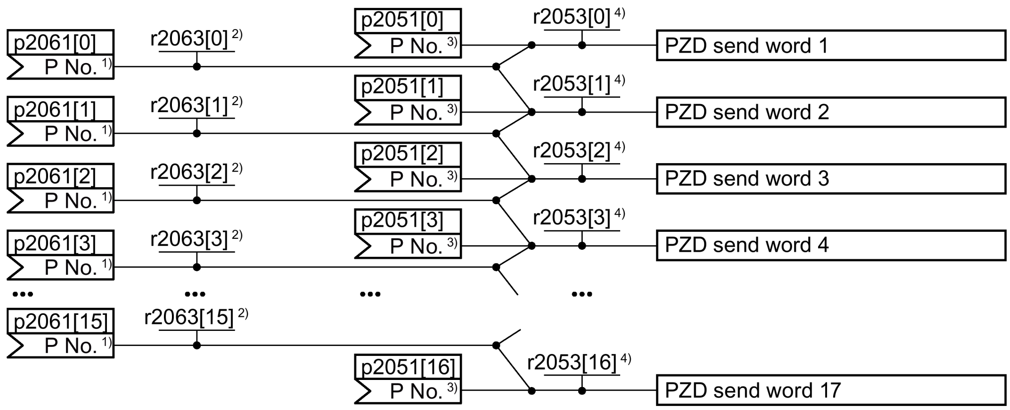
7.5.8 Expanding or freely interconnecting telegrams

Overview

When you have selected a telegram, the converter 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 converter, the telegram can be extended or even freely interconnected.

Function description

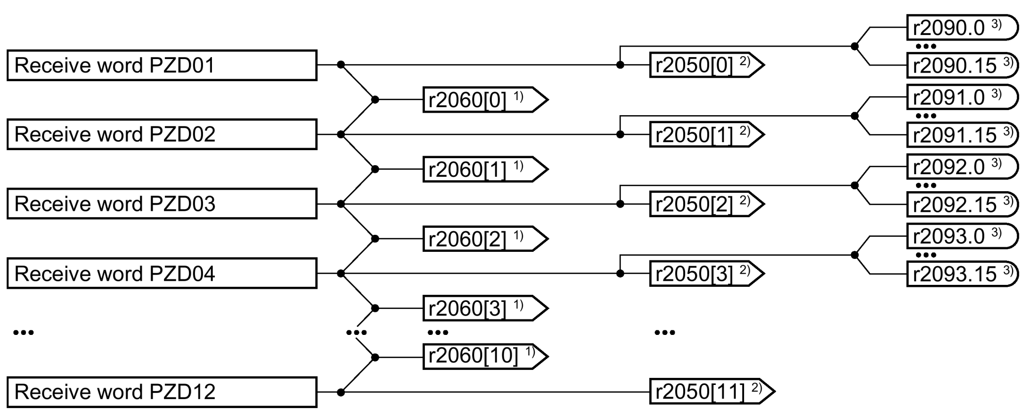
Interconnection of the send data



1) Send word parameter number, doubleword
2) Send word value, doubleword
3) Send word parameter number, word
4) Send word value, word

In the converter, 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 converter automatically interconnects parameters p2051 and p2061 with the appropriate signals.

Interconnection of the receive data



1) Receive word value, double word
2) Receive word value, word
3) Receive word value, bit by bit

The converter saves the receive data as follows:

- "Word" format in r2050
- "Double word" format in r2060
- Bit-by-bit in r2090 ...r2093)

Expanding the telegram

1. Set p0922 = 999.
2. Set parameter p2079 to the value of the corresponding telegram.
3. 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

1. Set p0922 = 999.
2. Set p2079 = 999.
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.
❒

Example

Expand telegram 1 to 6 send words and 6 receive words.

Procedure

1. p0922 = 999
2. p2079 = 1
3. p2051[2] = r2050[2]
4. ...
5. p2051[5] = r2050[5]
6. Check the telegram length for the received and sent words:
   - r2067[0] = 6
   - r2067[1] = 6

You have expanded telegram 1 to 6 send words and 6 receive words.
❒

7.5.9 Acyclically reading and writing converter parameters

Overview

The converter supports the writing and reading of parameters via acyclic communication:

- For PROFINET: Write or read requests via B02E hex and B02F hex

Further information about acyclic communication is provided in the Fieldbus Function Manual.

Overview of the manuals (Page 404)

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)

7.6 Drive control via Ethernet/IP

7.6.1 Configuring communication via Ethernet/IP

Overview

Ethernet/IP is real-time Ethernet, and is mainly used in automation technology.

Function description

To configure the converter's communication via Ethernet/IP, you must set the following parameters:

Procedure

1. p2030 = 10
2. The following parameters must match your Ethernet configuration:
   - p8921 = IP address
   - p8922 = default gateway
   - p8923 = subnet mask
   - p8920 = station name
3. p8925 = 2

4. Select the Ethernet/IP profile:

SINAMICS profile	**ODVA AC/DC drive profile**
p8980 = 0	p8980 = 1
Use p0922 to select the appropriate telegram. Telegrams (Page 127)	p0922 = 1: The converter communicates via telegram 1. Other telegrams are not possible. If necessary, however, you can extend the telegram 1. Expanding or freely interconnecting telegrams (Page 138)
	If necessary, set the following parameters: • p8981 • p8982 • p8983

5. Switch off the converter power supply.
6. Wait until all LEDs on the converter are dark.
7. Switch on the converter power supply again.

You have now configured the converter for communication via Ethernet/IP.
❒

Parameters

Parameter	**Description**	**Setting**
p2030	Fieldbus interface protocol selection	0: No protocol 7: PROFINET 10: Ethernet/IP The default setting is dependent upon the converter.
p8920	PN Name of Station	Sets the station name for the onboard PROFINET interface.
p8921	PN IP Address	Sets the IP address for the onboard PROFINET interface. Factory setting: 0
p8922	PN Default Gateway	Sets the default gateway for the onboard PROFINET interface. Factory setting: 0
p8923	PN Subnet Mask	Sets the subnet mask for the onboard PROFINET interface. Factory setting: 0
p8925	Activate PN interface configuration	Setting to activate the interface configuration 0: No function (factory setting) 2: Activate and save configuration 3: Delete configuration
r8931	PN IP Address actual	Displays the actual IP address.
r8932	PN Default Gateway actual	Displays the actual default gateway.
r8933	PN Subnet Mask actual	Displays the actual subnet mask.
p8980	Ethernet/IP profile	Sets the profile for Ethernet/IP. 0: SINAMICS 1: ODVA AC/DC

Parameter	Description	Setting
p8981	Ethernet/IP ODVA STOP mode	Sets the STOP mode for the Ethernet/IP ODVA profile (p8980 = 1). 0: OFF1 (factory setting) 1: OFF2
p8982	Ethernet/IP ODVA speed scaling	Sets the scaling for the speed for Ethernet/IP ODVA profile (p8980 = 1). 123: Scaling = 32 124: Scaling = 16 125: Scaling = 8 126: Scaling = 4 127: Scaling = 2 128: Scaling = 1 (factory setting) 129: Scaling = 0.5 130: Scaling = 0.25 131: Scaling = 0.125 132: Scaling = 0.0625 133: Scaling = 0.03125
p8983	Ethernet/IP ODVA torque scaling	Sets the scaling for the torque for Ethernet/IP ODVA profile (p8980 = 1). 123: Scaling = 32 124: Scaling = 16 125: Scaling = 8 126: Scaling = 4 127: Scaling = 2 128: Scaling = 1 (factory setting) 129: Scaling = 0.5 130: Scaling = 0.25 131: Scaling = 0.125 132: Scaling = 0.0625 133: Scaling = 0.03125

For more information about the parameters, refer to the List Manual.

Overview of the manuals (Page 404)

Further information

Ethernet/IP objects and assemblies of the converter:

Supported objects (Page 144)

7.6.2 Supported objects

Overview

Object class		Object name	Objects required	ODVA objects	SINAMICS objects
hex	dec				
1 hex	1	Identity object	x		
4 hex	4	Assembly Object	x		
6 hex	6	Connection Manager Object	x		
28 hex	40	Motor Data Object		x	
29 hex	41	Supervisor Object		x	
2A hex	42	Drive Object		x	
32C hex	812	Siemens Drive Object			x
32D hex	813	Siemens Motor Data Object			x
F5 hex	245	TCP/IP Interface Object 1)	x		
F6 hex	246	Ethernet Link Object 1)	x		
300 hex	768	Stack Diagnostic Object		x	x
302 hex	770	Adapter Diagnostic Object		x	x
303 hex	771	Explicit Messages Diagnostic Object		x	x
304 hex	772	Explicit Message Diagnostic List Object		x	x
401 hex	1025	Parameter object		x	x

1) These objects are part of the Ethernet/IP system management.

Identity Object, Instance Number: 1 hex

Supported services

Class
- Get Attribute all
- Get Attribute single

Instance
- Get Attribute all
- Get Attribute single
- Reset

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
1	get	UINT16	Vendor ID	1251
2	get	UINT16	Device Type - ODVA AC Drive - Siemens Drive	 02 hex 12 hex
3	get	UINT16	Product code	r0964[1]
4	get	UINT16	Revision	The versions should match the EDS file
5	get	UINT16	Status	See the following table
6	get	UINT32	Serial number	bits 0 ... 19: consecutive number; bits 20 ... 23: Production identifier bits 24 ... 27: Month of manufacture (0 = Jan, B = Dec) Bits 28 ... 31: Year of manufacture (0 = 2002)
7	get	Short String	Product name	Max. length 32 bytes

Explanation of No. 5 of the previous table

Byte	Bit	Name	Description
1	0	Owned	0: Converter is not assigned to any master 1: Converter is assigned to a master
	1		Reserved
	2	Configured	0: Ethernet/IP basic settings 1: Modified Ethernet/IP settings For G120, always = 1
	3		Reserved
	4 ... 7	Extended Device Status	0: Self-test or status not known 1: Firmware update active 2: At least one I/O connection with error 3: No I/O connections 4: Incorrect configuration in the ROM 5: Fatal fault 6: At least one I/O connection is active 7: All I/O connections in the quiescent state 8 ... 15: Reserved
2	8 ... 11		Not used
	12 ... 15		Reserved

Assembly Object, Instance Number: 4 hex

Supported services

Class
- Get Attribute single

Instance
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
3	set	Array of UINT8	Assembly	1 byte array Supported ODVA AC/DC assemblies (Page 155)

Connection Manager Object, Instance Number: 6 hex

Supported services

Class
- Get Attribute all
- Get Attribute single

Instance
- Forward open
- Forward close
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
1	get	UINT16	OpenReqs	Counters
2	get	UINT16	OpenFormat Rejects	Counters
3	get	UINT16	OpenResource Rejects	Counters
4	get	UINT16	OpenOther Rejects	Counters
5	get	UINT16	CloseReqs	Counters
6	get	UINT16	CloseFormat Rejects	Counters
7	get	UINT16	CloseOther Rejects	Counters
8	get	UINT16	ConnTimeouts	Counters Number of bus errors

Motor Data Object, Instance Number 28 hex

Supported services

Class
- Get Attribute single

Instance
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
3	get, set	USINT	Motor Type	p0300 motor type, see the following table
6	get, set	UINT16	Rated Current	p0305 rated motor current
7	get, set	UINT16	Rated Voltage	p0304 rated motor voltage
8	get, set	UINT32	Rated Power	p0307 rated motor power
9	get, set	UINT16	Rated Frequency	p0310 rated motor frequency
10	get, set	UINT16	Rated Temperature	p0605 motor temperature threshold
11	get, set	UINT16	Max Speed	p0322 maximum motor speed
12	get, set	UINT16	Pole Count	p0314 value of p0314*2
13	get	UINT32	Torque Constant	p0316 motor torque constant
14	get, set	UINT32	Inertia	p0341 motor moment of inertia
15	get, set	UINT16	Base Speed	p0311 motor rated speed

Value in p0300		Ethernet/IP motor data object,	
0	No motor	0	Non-standard motor
1	Asynchronous motor	7	Squirrel cage asynchronous motor
6	Reluctance motor	0	Non-standard motor
10	1LE1 asynchronous motor	7	Squirrel cage asynchronous motor
13	1LG6 asynchronous motor	7	Squirrel cage asynchronous motor
17	1LA7 asynchronous motor	7	Squirrel cage asynchronous motor
19	1LA9 asynchronous motor	7	Squirrel cage asynchronous motor
100	1LE1 asynchronous motor	7	Squirrel cage asynchronous motor
101	1PC1 asynchronous motor	0	Non-standard motor
181	2KJ8 asynchronous motor	0	Non-standard motor
600	1FP1 synchronous reluctance motor	0	Non-standard motor
602	2KJ8 synchronous reluctance motor	0	Non-standard motor
603	1FP3 synchronous reluctance motor OEM	0	Non-standard motor

Supervisor Object, Instance Number: 29 hex

Supported services

Class
- Get Attribute single

Instance
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
3	get, set	Bool	Run1	STW.0 operation, clockwise rotation
5	get, set	Bool	Net Control	Internal 0: Local 1: Network
6	get	UINT8	State	0: Vendor Specific 1: Startup 2: Not_Ready 3: Ready 4: Enabled 5: Stopping 6: Fault_Stop 7: Faulted
7	get	Bool	Running1	ZSW1:2 1: - (Enabled and Run1) or - (Stopping and Running1) or - (Fault_Stop and Running1) 0 = Other state
9	get	Bool	Ready	ZSW1:0 1: - Ready or - Enabled or - Stopping 0 = Other state
10	get	Bool	Fault	ZSW1:3 drive fault
11	get	Bool	Warning	ZSW1:7 alarm active
12	get, set	Bool	Fault reset	STW.7 acknowledge fault
13	get	UINT16	Fault Code	r945[0] error code
14	get	UINT16	Warning Code	r2122[0] alarm code
15	get	Bool	CtlFromNet	Display from Net Control 1: Control from network 0: Local control

Drive Object, Instance Number: 2A hex

Supported services

Class
- Get Attribute single

Instance
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
3	get	Bool	At reference	r2197.7 1: Speed setpoint - actual value deviation in tolerance t_off 0: Otherwise
4	get	Bool	Net_reference	Internal 0: Local 1: Network
6	get	UINT8	Drive_Mode	p1300 manufacturer-specific, see following table
7	get	INT	Speed Actual	Main actual value, see speed units
8	get, set	INT	Speed Ref	Main setpoint, see speed units
9	get	INT	Current Actual	r0027 absolute current actual value, smoothed
10	get	INT	Current limit	p0323 maximum motor current
15	get	INT	Power Actual	r0032 actual active power smoothed
16	get	INT	Output voltage	r0025 output voltage smoothed
17	get	INT	Output voltage	r0072 output voltage
18	get, set	UINT16	AccelTime	p1120 ramp-function generator ramp-up time
19	get, set	UINT16	DecelTime	p1121 ramp-function generator, ramp-down time
20	get, set	UINT16	Low Speed Lim	p1080 minimum speed
21	get, set	UINT16	High Speed Lim	p1082 maximum speed
22	get, set	SINT	Speed Scale	p8982 Ethernet/IP ODVA speed scaling
29	get	Bool	Ref From Net	Internal - display of Net_Reference 0: Local 1: Network

Value in p1300		Ethernet/IP motor data object	
0	V/f with linear characteristic	1	Open loop speed (frequency)
1	V/f with linear characteristic and FCC	0	Vendor-specific mode
2	V/f with parabolic characteristic		
4	V/f with linear characteristic and ECO		
7	V/f for parabolic characteristic and ECO		
20	Speed control (without encoder)	2	Closed-loop speed control

Siemens Drive Object, Instance Number: 32C hex

Supported services

Class
- Get Attribute single

Instance
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Type	Service	Name	Value/explanation
2	INT16	get, set	Commissioning state	p0010 commissioning parameter filter
3 ... 18	WORD	get	STW1	STW1 bit-by-bit access: Attr.3 = STW1.0 Attr.18 = STW1.15
19	WORD	get	Main setpoint	Main setpoint
20 ... 35	WORD	get	ZSW1	ZSW1 bit-by-bit access: Attr.20 = ZSW1.0 Attr.35 = ZSW1.15
36	WORD	get	Actual Frequency	Main actual value (actual frequency)
37	REAL	get, set	Ramp Up Time	p1120[0] ramp-function generator ramp-up time
38	REAL	get, set	Ramp Down Time	p1121[0] ramp-function generator ramp-down time
39	REAL	get, set	Current Limit	p0640[0] current limit
40	REAL	get, set	Frequency MAX Limit	p1082[0] maximum speed
41	REAL	get, set	Frequency MIN Limit	p1080[0] minimum speed
42	REAL	get, set	OFF3 Ramp Down Time	p1135[0] OFF3 ramp-down time
43	UINT32 / BOOL	get, set	PID Enable	p2200[0] technology controller enable
44	REAL	get, set	PID Filter Time Constant	p2265 technology controller actual value filter time constant
45	REAL	get, set	PID D Gain	p2274 technology controller differentiation time constant
46	REAL	get, set	PID P Gain	p2280 technology controller proportional gain
47	REAL	get, set	PID I Gain	p2285 technology controller integral time
48	REAL	get, set	PID Up Limit	p2291 technology controller maximum limiting
49	REAL	get, set	PID Down Limit	p2292 technology controller minimum limiting
50	REAL	get	Speed setpoint	r0020 speed setpoint
51	REAL	get	Output Frequency	r0024 output frequency
52	REAL	get	Output Voltage	r0025 output voltage
53	REAL	get	DC Link Voltage	r0026[0] DC link voltage
54	REAL	get	Actual Current	r0027 current actual value

No.	Type	Service	Name	Value/explanation
55	REAL	get	Actual Torque	r0031 torque actual value
56	REAL	get	Output power	r0032 actual active power value
57	REAL	get	Motor Temperature	r0035[0] motor temperature
58	REAL	get	Power Unit Temperature	r0037[0] power unit temperature
59	REAL	get	Energy kWh	r0039 energy display
60	UINT8	get	CDS Eff (Local Mode)	r0050 active command data set
61	WORD	get	Status Word 2	r0053 status word 2
62	WORD	get	Control Word 1	r0054 control word 1
63	REAL	get	Motor Speed (Encoder)	r0061 speed actual value
64	UINT32	get	Digital Inputs	r0722 digital inputs status
65	UINT32	get	Digital Outputs	r0747 digital outputs status
66	REAL	get	Analog Input 1	r0752[0] analog input 1
67	REAL	get	Analog Input 2	r0752[1] analog input 2
68	REAL	get	Analog Output 1	r0774[0] analog output 1
69	REAL	get	Analog Output 2	r0774[1] analog output 2
70	UINT16	get	Fault Code 1	r0947[0] fault number 1
71	UINT16	get	Fault Code 2	r0947[1] fault number 2
72	UINT16	get	Fault Code 3	r0947[2] fault number 3
73	UINT16	get	Fault Code 4	r0947[3] fault number 4
74	UINT16	get	Fault Code 5	r0947[4] fault number 5
75	UINT16	get	Fault Code 6	r0947[5] fault number 6
76	UINT16	get	Fault Code 7	r0947[6] fault number 7
77	UINT16	get	Fault Code 8	r0947[7] fault number 8
78	REAL	get	Pulse Frequency	r1801 pulse frequency
79	UINT16	get	Alarm Code 1	r2110[0] alarm number 1
80	UINT16	get	Alarm Code 2	r2110[1] alarm number 2
81	UINT16	get	Alarm Code 3	r2110[2] alarm number 3
82	UINT16	get	Alarm Code 4	r2110[3] alarm number 4
83	REAL	get	PID setpoint Output	r2260 technology controller setpoint after the ramp-function generator
84	REAL	get	PID Feedback	r2266 technology controller actual value after the filter
85	REAL	get	PID Output	r2294 technology controller output signal

Siemens Motor Data Object, Instance Number: 32D hex

Supported services

Class
- Get Attribute single

Instance
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
2	get, set	UINT16	Commissioning state	p0010
3	get	INT16	Motor Type	p0300
6	get, set	REAL	Rated Current	p0305
7	get, set	REAL	Rated Voltage	p0304
8	get, set	REAL	Rated Power	p0307
9	get, set	REAL	Rated Frequency	p0310
10	get, set	REAL	Rated Temperature	p0605
11	get, set	REAL	Max Speed	p0322
12	get, set	UINT16	Pole pair number	p0314
13	get	UINT32	Torque Constant	p0316
14	get, set	REAL	Inertia	p0341
15	get, set	REAL	Base Speed	p0311
19	get, set	REAL	Cos Phi	p0308

TCP/IP Interface Object, Instance Number: F5 hex

Supported services

Class
- Get Attribute all
- Get Attribute single

Instance
- Get Attribute all
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
1	get	UNIT32	Status	Fixed value: 1 hex 1: Configuration acknowledged, by DHCP or saved values
2	get	UNIT32	Configuration Capability	Fixed value: 94 hex 4 hex: DHCP supported, 10 hex: Configuration can be adjusted, 80 hex: ACD-capable
3	get, set	UNIT32	Configuration Control	1 hex: Saved values 3 hex: DHCP
4	get	UNIT16	Path Size (in WORDs)	Fixed value: 2 hex
		UNIT8	Path	20 hex, F6 hex, 24 hex, 05 hex, where 5 hex is the number of instances of F6 hex (four physical ports plus one internal port).
5	get, set	STRING	Interface Configuration	r61000 Name of Station
		UNIT32		r61001 IP address
6	get, set	UNIT16	Host Name	Host Name Length
		STRING		
10	get, set	UNIT8	Select ACD	local OM flash: 0: Disabled, 1: Enabled
11	get, set	UNIT8	Last Conflict Detected	local OM flash ACD Activity
		UNIT8		local OM flash Remote MAC
		UNIT8		local OM flash ARP PDU

Link Object, Instance Number: F6 hex

Supported services

Class
- Get Attribute all
- Get Attribute single

Instance
- Get Attribute all
- Get Attribute single
- Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Instance Attribute

No.	Service	Type	Name	Value/explanation
1	get	UINT32	Interface Speed	0: link down, 10: 10 Mbps, 100: 100 Mbps
2	get		Interface Flags	Bit 1: Link-Status Bit 2: Duplex Mode (0: halb duplex, 1 duplex Bit 3 ... 5: Automatic state identification Bit 6: Reset required Bit 7: Local hardware fault (0 = ok)
3	get	ARRAY	Physical Address	r8935 Ethernet MAC address
4	get_and_clear	Struct of	Interface Counters	Optional, required if the "Media Counters Attribute" is implemented.
		UINT32	In Octets	Received octets
		UINT32	In Ucast Packets	Received Unicast packets
		UINT32	In NUcast Packets	Received non-Unicast packets
		UINT32	In Discards	Incoming packets, not processed
		UINT32	In Errors	Incoming packets with errors
		UINT32	In Unknown Protos	Incoming packets with unknown protocol
		UINT32	Out Octets	Sent octets
		UINT32	Out Ucast Packets	Sent Unicast packets
		UINT32	Out NUcast packets	Sent non-Unicast packets
		UINT32	Out Discards	Outgoing packets, not processed
		UINT32	Out Errors	Outgoing packets, with errors
5	get_and_clear	Struct of	Media Counters	Media-specific counters
		UINT32	Alignment Errors	Structure received, which does not match the number of octets
		UINT32	FCS Errors	Structure received, which does not pass the FCS check
		UINT32	Single Collisions	Structure successfully transmitted, precisely one collision
		UINT32	Multiple Collisions	Structure successfully transmitted, several collisions
		UINT32	SQE Test Errors	Number of SQE errors
		UINT32	Deferred Transmissions	First transmission attempt delayed
		UINT32	Late Collisions	Number of collisions that occurred delayed by 512 bit timers to the request
		UINT32	Excessive Collisions	Transmission unsuccessful as a result of intensive collisions
		UINT32	MAC Transmit Errors	Transmission unsuccessful as a result of an internal MAC sublayer transmission error.
		UINT32	Carrier Sense Errors	Times that the carrier sense condition was lost or never asserted when attempting to transmit a frame
		UINT32	Frame Too Long	Structure too large
		UINT32	MAC Receive Errors	Transmission unsuccessful as a result of an internal MAC sublayer receive error.
6	get, set	Struct of	Interface Control	
		UINT16	Control Bits	
		UINT16	Forced Interface Speed	
10	get	String	Interface_Label	Interface-Label

Parameter Object, Instance Number: 401 hex

Supported services

Class	• Get Attribute all	Instance	• Get Attribute all • Set Attribute single

Class Attribute

No.	Service	Type	Name
1	get	UINT16	Revision
2	get	UINT16	Max Instance
3	get	UINT16	Num of Instances

Cyclic communication is established via parameter object 401.

Example: Read parameter 2050[10] (connector output to interconnect the PZD received from the fieldbus controller)

Get Attribute single function with the following values:

- Class = 401 hex
- Instance = 2050 = 802 hex corresponds to the parameter number
- Attribute = 10 = A hex corresponds to index 10

Example: Parameter 1520[0] writing (upper torque limit)

Set Attribute single function with the following values:

- Class = 401 hex
- Instance = 1520 = 5F0 hex corresponds to the parameter number
- Attribute = 0 = 0 hex corresponds to index 0
- Data = 500.0 (value)

7.6.3 Supported ODVA AC/DC assemblies

Overview

Number		required/ optional	Type	Name
hex	dec			
14 hex	20	Required	Sending	Basic Speed Control Output
46 hex	70	Required	Receiving	Basic Speed Control Input

Assembly Basic Speed Control, Instance Number: 20, type: Output

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0						Fault Reset		RUN Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							

Assembly Basic Speed Control, Instance Number: 70, type: Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0						Running Forward		Faulted
1								
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							

7.6.4 Creating generic I/O module

Overview

For certain controllers, or if you wish to use the SINAMICS profile, you cannot use the EDS file provided by Siemens. In these cases, you must create a generic I/O module in the control system for the cyclic communication.

Function description

Procedure

1. In your control, create a generic device with Ethernet/IP functionality.
2. In the control, enter the lengths for the process data for cyclic communication in the new device which you set in the converter, r2067[0] (input), r2067[1] (output), for example: Standard telegram 2/2 .
   4 ms is supported as the minimum value for RPI (Requested Packet Interval).
3. In the converter, set the same values for IP address, subnet mask, default gateway and name of the station as in the control.

   Configuring communication via Ethernet/IP (Page 141)

You have created a generic I/O module for cyclic communication with the converter.
❒

Further information

You can find a detailed description of how to create a generic I/O module on the Internet:

Application example (https://support.industry.siemens.com/cs/ww/en/view/82843076)

7.6.5 The converter as Ethernet node

Integrating a converter into an Ethernet network (assigning an IP address)

Procedure

1. Set p8924 (PN DHCP mode) = 2 or 3
   - p8924 = 2: The DHCP server assigns the IP address based on the MAC address of the converter.
   - p8924 = 3: The DHCP server assigns the IP address based on the device name of the converter.
2. Save the settings with p8925 = 2. The next time that the converter switches on, it retrieves the IP address, and you can address the converter as Ethernet node.

Note

Immediate switchover without restart

The switchover to DHCP is performed immediately and without a restart if the change is carried out with the Ethernet/IP command "Set Attribute Single" (class F5 hex, attribute 3). The following options are available:

- via an Ethernet/IP controller
- via an Ethernet/IP commissioning tool

You have now integrated the converter into Ethernet.

Displays

r8930: Device name of the converter

r8934: Operating mode, PN or DHCP

r8935: MAC address

Additional information

You can find information about parameters and messages (A08565) in the List Manual.

You can also integrate the converter into an Ethernet network by using Proneta or STEP 7.

7.7 Drive control via AS-i

7.7.1 Single Device mode

In Single Device mode, four bits are available for the communication between the AS-i master and the converter. The four bits are used to transfer process data. In parallel, the control can start a diagnostic request via AS-i.P0.

The following default interface settings are available; both work with profile 7.F.E.

- Macro 30: AS-i Single Device with fixed setpoint
- Macro 66: AS-i Single Device with setpoint from Potentiometer 1 or Potentiometer 2

Macro 30: AS-i Single Device with fixed setpoint

In standard addressing, the control specifies the speed setpoint via the motor control bits (AS-i.DO0 ... AS-i.DO3).

Control → Converter

- AS-i.DO0 → p1020 = 2093.0 Fixed speed bit 0
- AS-i.DO1 → p1021 = 2093.1 Fixed speed bit 1
- AS-i.DO2 → p1022 = 2093.2 Fixed speed bit 2
- AS-i.DO3 → p1023 = 2093.3 Fixed speed bit 3

Fixed speeds via the motor control bits (Page 163)

Converter → control

If the control specifies the speed setpoint, the converter replies:

- p2080[0] = 53.13 → AS-i.DI0 Operational enable for PLC
- p2080[1] = 899.11 → AS-i.DI1 Pulses enabled
- p2080[2] = 722.0 → AS-i.DI2 State DI0
- p2080[3] = 722.1 → AS-i.DI3 State DI1

If the control sends a diagnostic request via AS-i.P0, the converter replies with the currently pending fault or alarm messages.

Alarm and fault messages via RP0 ... RP3 from the converter to the AS-i master (Page 163)

Macro 66: AS-i Single Device with setpoint from Potentiometer 1 or Potentiometer 2

In Single Device mode with modified addressing the control specifies the following:

Control → Converter

- AS-i.DO0 → p3330.0 = 2093.0 ON clockwise / OFF 1
- AS-i.DO1 → p3331.0 = 2093.1 ON counter-clockwise / OFF 1
- AS-i.DO2 → p0810 = 2093.2 Switch speed setpoint between Potentiometer 1 and Potentiometer 2
- AS-i.DO3 → p2104 = 2093.3 Acknowledge errors with a positive edge
  p0852 = 2093.3 Operating enable, if p2093.3 = 1

Converter → control

The converter sends as response:

- p2080[0] = 899.0 → AS-i.DI0 Ready to switch on / diagnostic request
- p2080[1] = 807.0 → AS-i.DI1 Control priority
- p2080[2] = 722.0 → AS-i.DI2 State DI0
- p2080[3] = 722.1 → AS-i.DI3 State DI1

If the control sends a diagnostic request via AS-i DI0, the converter replies with the currently pending fault or alarm messages.

- AS-i DI0 = 1, pending alarm messages are replied.
- AS-i DI0 = 0, pending fault messages are replied.

Alarm and fault messages via RP0 ... RP3 from the converter to the AS-i master (Page 163)

Scaling factors for the speed

The scaling factor is specified via AS-i.P0 ... AS-i.P3.

This means, if the control specifies a scaling factor, it accepts simultaneously the sent value consisting of AS-i.P0 ... AS-i.P3 as new scaling factor.

- AS-i.P0 Scaling factor bit 0
- AS-i.P1 Scaling factor bit 1
- AS-i.P2 Scaling factor bit 2
- AS-i.P3 Scaling factor bit 3

Scaling of the speed setpoint via AS-i.P0 ... AS-i.P3 (Page 163)

Further information

For more information about the AS-i system, see the AS-Interface - Introduction and Basics Manual.

Overview of the manuals (Page 404)

7.7.2 Dual Device mode

In Dual Device mode, eight bits are available for the communication between the AS-i master and the converter. The eight bits are used to transfer process data. In parallel, the control can start a diagnostic request via AS-i.P0.

The following default interface settings are possible:

- Macro 31: AS-i Dual Device with fixed setpoint
- Macro 34: AS-i Dual Device with fieldbus setpoint

Macro 31: AS-i Dual Device with fixed setpoint

The control accesses the two devices of the converter each via four bits.

Via Device 2, in accordance with profile 7.A.E, the control specifies the speed setpoint via the motor control bits (AS-i.DO0 ... AS-i.DO2).

Via Device 1, the control sends data in cyclical or acyclical mode, in accordance with profile 7.A.5.

The control requires one bit per device in order to specify the device.

Macro 31, Device 2 with profile 7.A.E: Control → Converter

- AS-i.DO0 → p1020.0 = 2093.0 Fixed speed bit 0
- AS-i.DO1 → p1021.0 = 2093.1 Fixed speed bit 1
- AS-i.DO2 → p1022.0 = 2093.2 Fixed speed bit 2
- AS-i.DO3 → Select Device A or Device B, interconnected internally

Fixed speeds via the motor control bits and response in the converter (Page 163)

If the control specifies the speed setpoint, the converter replies:

Macro 31, Device 2 with profile 7.A.E: Converter → control

- p2080[0] = 53.13 PLC ready to switch on → AS-i.DI0
- p2080[1] = 899.11 Pulses enabled → AS-i.DI1
- p2080[2] = 722.0 State DI0 → AS-i.DI2
- p2080[3] = 722.1 State DI1 → AS-i.DI3

If the control sends a diagnostic request via AS-i.P0, the converter replies with the currently pending fault or alarm messages.

Alarm and fault messages via RP0 ... RP3 from the converter to the AS-i master (Page 163)

Macro 31, Device 1 with profile 7.A.5: Control → Converter

- AS-i.DO0 → Time signal for the CTT2 (Combined Transaction Type 2) transfer from the AS-i master
- AS-i.DO1 → Data bit for the CTT2 transfer, four bytes cyclically or acyclically via PIV (parameter channel). The reading and writing of parameters is possible via the PIV. Because data is transferred bit-by-bit, the read and write process is very slow.
- AS-i.DO2 → p3390 = 2093.4 Override quick stop
- AS-i.DO3 → Select Device A or Device B, interconnected internally

Macro 31, Device 1 with profile 7.A.5: Converter → control

- p2080[4] = 722.2 State DI2 → AS-i.DI0
- p2080[5] = 722.3 State DI3 → AS-i.DI1
- Serial data transfer CTT2, four bytes cyclically or acyclically via PIV. The reading and writing of parameters is possible via the PIV. Because data is transferred bit-by-bit, the read and write process is very slow. → AS-i.DI2
- Time signal for the CTT2 transfer to the AS-i master → AS-i.DI3

Cyclic and acyclic communication via CTT2 (Page 165)

Macro 34: AS-i Dual Device with fieldbus setpoint

The control accesses the two devices of the converter each via four bits.

Via Device 2, in accordance with profile 7.A.E, the control specifies the commands listed below (AS-i.DO0 ... AS-i.DO2).

Via Device 1, the control sends the command for quick stop and the data in cyclical or acyclical mode.

The control requires one bit per device in order to specify the device.

Macro 34, Device 2 with profile 7.A.E: Control → Converter

- AS-i.DO0 → ON / OFF 1
- AS-i.DO1 → OFF 2
- AS-i.DO2 → Acknowledge fault
- AS-i.DO3 → Select Device A or Device B, interconnected internally

If the control specifies the speed setpoint, the converter replies:

Macro 34, Device 2 with profile 7.A.E: Converter → control

- p2080[0] = 53.13 PLC ready to switch on → AS-i.DI0
- p2080[1] = 899.11 Pulses enabled → AS-i.DI1
- p2080[2] = 722.0 State DI0 → AS-i.DI2
- p2080[3] = 722.1 State DI1 → AS-i.DI3

If the control sends a diagnostic request via AS-i.P0, the converter replies with the currently pending fault or alarm messages.

Alarm and fault messages via RP0 ... RP3 from the converter to the AS-i master (Page 163)

Macro 34, Device 1 with profile 7.A.5: Control → Converter

- AS-i.DO0 → Time signal for the CTT2 transfer from the AS-i master
- AS-i.DO1 → Data bit for the CTT2 transfer, four bytes cyclically or acyclically via PIV. The reading and writing of parameters is possible via the PIV. Because data is transferred bit-by-bit, the read and write process is very slow.
- AS-i.DO2 → p3390 = 2093.4 Override quick stop
- AS-i.DO3 → Select Device A or Device B, interconnected internally

Macro 34, Device 1 with profile 7.A.5: Converter → control

- p2080[4] = 722.2 State DI2 → AS-i.DI0
- p2080[5] = 722.3 State DI3 → AS-i.DI1
- Serial data transfer CTT2, four bytes cyclically or acyclically via PIV. The reading and writing of parameters is possible via the PIV. Because data is transferred bit-by-bit, the read and write process is very slow. → AS-i.DI2
- Time signal for the CTT2 transfer to the AS-i master → AS-i.DI3

Cyclic and acyclic communication via CTT2 (Page 165)

Further information

For more information about the AS-i system, see the AS-Interface - Introduction and Basics Manual.

Overview of the manuals (Page 404)

7.7.3 Assignment tables

Fixed speeds - Single Device

Fixed speeds via the motor control bits

AS-i.DO3	AS-i.DO2	AS-i.DO1	AS-i.DO0	Response in the converter
0	0	0	0	OFF1
0	0	0	1	On + fixed speed 1 (factory setting: 1500 rpm)
0	0	1	0	On + fixed speed 2 (factory setting: -1500 rpm)
0	0	1	1	On + fixed speed 3 (factory setting: 300 rpm)
0	1	0	0	On + fixed speed 4 (factory setting: 450 rpm)
0	1	0	1	On + fixed speed 5 (factory setting: 600 rpm)
0	1	1	0	On + fixed speed 6 (factory setting: 750 rpm)
0	1	1	1	On + fixed speed 7 (factory setting: 900 rpm)
1	0	0	0	On + fixed speed 8 (factory setting: 1050 rpm)
1	0	0	1	On + fixed speed 9 (factory setting: 1200 rpm)
1	0	1	0	On + fixed speed 10 (factory setting: 1350 rpm)
1	0	1	1	On + fixed speed 11 (factory setting: 1500 rpm)
1	1	0	0	On + fixed speed 12 (factory setting: 1650 rpm)
1	1	0	1	On + fixed speed 13 (factory setting: 1800 rpm)
1	1	1	0	On + fixed speed 14 (factory setting: 1950 rpm)
1	1	1	1	Acknowledge fault or OFF2

Modified addressing - scaling factors

Scaling of the speed setpoint via AS-i.P0 ... AS-i.P3

AS-i.P3	AS-i.P2	AS-i.P1	AS-i.P0	Speed setpoint scaling factor
1	1	1	1	100%
1	1	1	0	90%
1	1	0	1	80%
1	1	0	0	70%
1	0	1	1	60%
1	0	1	0	50%
1	0	0	1	45%
1	0	0	0	40%
0	1	1	1	35%
0	1	1	0	30%
0	1	0	1	25%
0	1	0	0	20%
0	0	1	1	15%
0	0	1	0	10%
0	0	0	1	7%
0	0	0	0	5%

Fixed speeds - Dual Device

Fixed speeds via the motor control bits and response in the converter

AS-i.DO2	AS-i.DO1	AS-i.DO0	Response in the converter
0	0	0	OFF1
0	0	1	On + fixed speed 1 (factory setting: 1500 rpm)
0	1	0	On + fixed speed 2 (factory setting: -1500 rpm)
0	1	1	On + fixed speed 3 (factory setting: 300 rpm)
1	0	0	On + fixed speed 4 (factory setting: 450 rpm)
1	0	1	On + fixed speed 5 (factory setting: 600 rpm)
1	1	0	On + fixed speed 6 (factory setting: 750 rpm)
1	1	1	Acknowledge fault or OFF2

Alarm and fault messages

Alarm and fault messages via RP0 ... RP3 from the converter to the AS-i master

RP3	RP2	RP1	RP0	AS-i.P0 = 0 → alarm messages	AS-i.P0 = 1 → faults
0	0	0	0	No alarm	No fault
0	0	0	1	Not used	Overtemperature (F30004, F30012, F30013, F30024, F30025, F30036)
0	0	1	0	Not used	Not used
0	0	1	1	No load (A07929)	Not used
0	1	0	0	Overtemperature (A05000, A05004, A05006, A07012, A07015)	I^2t overload (F30005, F07936)
0	1	0	1	Overvoltage (A30502, A07400)	Equipment malfunction (F01000 to F01257)
0	1	1	0	Local/Remote keyswitch in "Off" (A03560)	Not used
0	1	1	1	Undervoltage (A30016, A07402)	Motor PTC sensor malfunction (F07011, F07016)
1	0	0	0	I^2t overload (A07805)	Overvoltage (F30002, F30011)
1	0	0	1	Not used	Not used
1	0	1	0	Local mode active (A03561)	Not used
1	0	1	1	Not used	Undervoltage (F30003, F07802)
1	1	0	0	Not used	Short-circuit at the output (F30001, F30017, F30021, F07801, F07807, F07900)
1	1	0	1	Motor phase loss (A30015 *)	Motor phase loss (F30015, F07902)
1	1	1	0	Not used	Safety fault (F016xx)
1	1	1	1	Other alarms	Other faults

* A30015 will be generated after the message type of F30015 is changed to "Alarm". For more information on changing the message type, see p2118 and p2119 in the List Manual.

7.7.4 Cyclic and acyclic communication via CTT2

Via CTT2 (Combined Transaction Type 2), both cyclical and acyclical communication is performed via AS-i. Because only one channel is available (AS-i.DO1 master → device or AS-i.DI3 device → master), a concurrent cyclical and acyclical data exchange is not possible.

The communication type (cyclical or acyclical) is always coded in the first byte in accordance with the following table.

CTT2 commands

Code (hex)	Explanation/meaning	Followed by
Cyclic communication		
Access to analog values via DS140 ... DS147. See CP 343–2 / CP 343–2 P AS–Interface master, Chapter 4 CP 343–2 / CP 343–2 P AS–Interface master (https://support.industry.siemens.com/cs/ww/en/view/5581657)		4 bytes: PWE1, PWE2
		4 bytes: PWE1, PWE2
Acyclic communication - standard		
10 hex	Read request: Master → device	2 bytes: Index, length
50 hex	Read request OK: Device → master	Index, data
90 hex	Read request failed: Device → master	1 byte: Standard error code (3 hex)
11 hex	Write request: Master → device	Index, length, data
51 hex	Write request OK: Device → master	
91 hex	Write request failed: Device → master	1 byte: Standard error code (3 hex)
Acyclic communication - manufacturer-specific		
12 hex	Read request: Master → device	Index, length
52 hex	Read request OK: Device → master	Data
92 hex	Read request failed: Device → master	Fault object
13 hex	Write request: Master → device	Index, length, data
53 hex	Write request OK: Device → master	
93 hex	Write request failed: Device → master	Fault object
1D hex	Exchange request: Master → device	Index, read length, write length, write data
5D hex	Exchange request OK: Device → master	PKE, index, n-2 data
9D hex	Exchange request faulty: Device → master	Fault object

If an acyclical request cannot be executed by the converter, it replies with one of the following error messages.

Error message	Meaning
0	No fault
1	Invalid index
2	Incorrect length
3	Request not implemented
4	Busy (the request could not be processed completely within the time window, retry later)
5	Last acyclical request was not confirmed
6	Invalid subindex
7	"Selective read request" command missing

7.7.4.1 Cyclic communication

Converter → master

The converter cyclically transfers the data from p2051[1] and p2051[2] in four bytes to the master. You can process these four bytes in the control as for analog data. Refer to the documentation for the AS-i master for detailed information about access to analog data.

If you selected Macro 31 or 34 during the commissioning, the two indexes are interconnected as follows:

- p2051[1] = 63: Smoothed actual speed value
- p2051[2] = 27: Absolute smoothed actual current value

The values for transfer are normalized in accordance with the PROFIdrive N2 data type. Using p2051[1] and p2051[2] you can interconnect any other or connector parameters and transfer to the control.

Master → Converter

The master transfers the data in the "Combined Transaction Type 2" (CTT2) to the converter and writes it to r2050[1] and r2050[2].

To process these values in the converter, you must appropriately interconnect r2050[1] and r2050[2] in the converter. This means, when the control sends the speed setpoint, you must interconnect parameter p1070 (source for the main setpoint) with r2050 as follows:
p1070[0] = 2050[1]

Note

Internal interconnection with Macro 34

If, when commissioning, you select Macro 34, then the main setpoint is internally interconnected with r2050[1].

Once a setpoint has been transferred completely, the setpoint present in the control will be transferred as next setpoint. Any setpoint changes made during the transfer are not considered.

7.7.4.2 Acyclic communication - standard

This type of acyclical communication supports the ID read request and the diagnostic read request. All other requests receive the "request not implemented" message response.

- ID request:
  - Master → device | 10 hex | 00 hex | nn hex |
  - Device → master | 50 hex | 00 hex | Manufacturer's ID | Product ID | BB hex |
- Diagnostic request:
  - Master → device | 10 hex | 01 hex | nn hex |
  - Device → master no error | 50 hex | 01 hex | 00 hex |
    Device → master general error | 50 hex | 01 hex | 99 hex |

The following response is issued for all other write or read requests:

- Read requests | 90 hex | 03 hex |
- Write requests | 91 hex | 03 hex |

7.7.4.3 Acyclic communication - manufacturer-specific

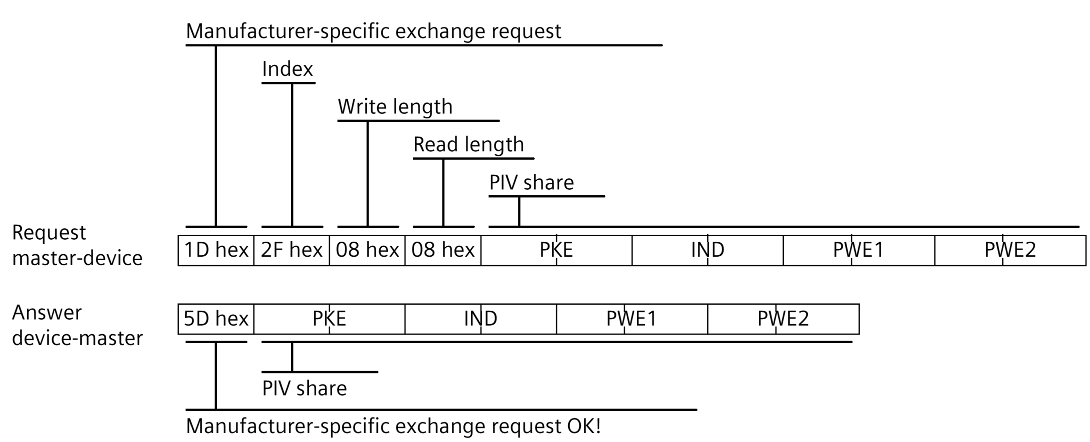
The manufacturer-specific acyclical communication is performed via data record 47 in PIV format. The PIV (parameter channel) format structure is identical with that for the USS parameter channel.

To reduce the transfer volume, there is not only the "normal" "data exchange" PIV mechanism, but also the "Read data" and "Write data" commands.

- Data exchange:
  - Control → converter request
  - Converter → control response
- Read data:
  The converter sends a read command, and the data of the last exchange request or write request is transferred from the converter to the control.
- Write data
  Write OK: → 53 hex.

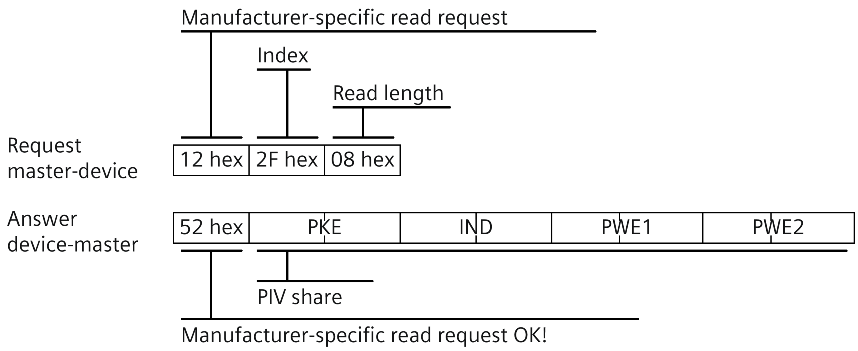
Because the PIV transfer protocol specifies the transfer direction independently, all parameters can be transferred as data exchange request/response. Requests for reading and writing data are included primarily to reduce the transferred data volume for the repeated reading or writing of parameters.

Data exchange

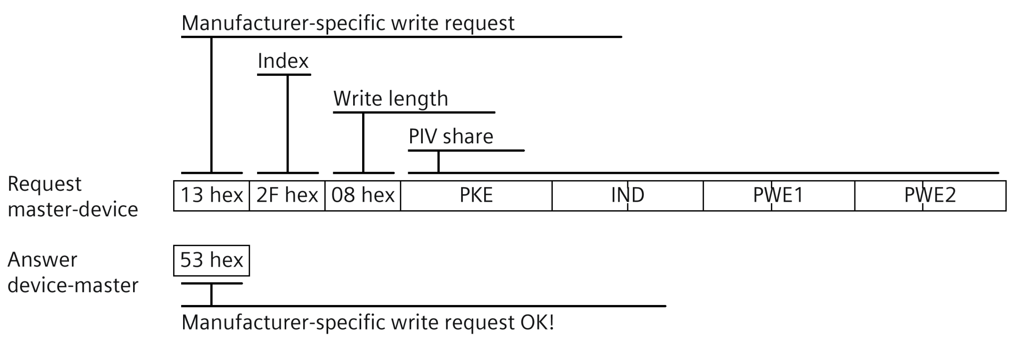


Reading data

The data for the last write or exchange request is read



Writing data



In the event of a fault, the converter sends the following telegram as response to the master:

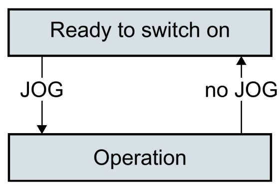
93 hex	00 hex	PWE1

Further information

For more information about the PIV format structure and the value for PWE in the USS parameter channel, see Section 5.3.4 "USS parameter channel" in the Fieldbus Function Manual.

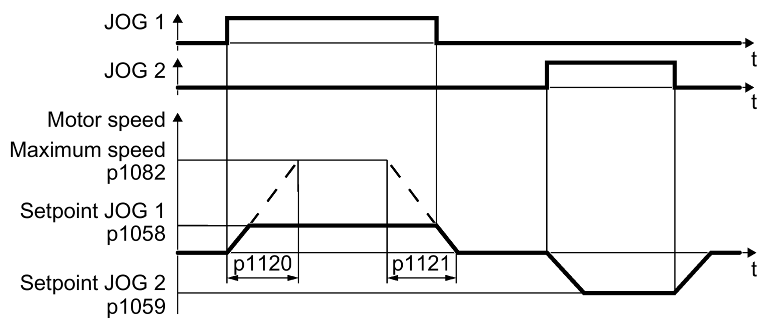
7.8 Jogging

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 converter is in the "Ready for switching on" state.



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.

In JOG mode, the same ramp-function generator is active as for the ON/OFF1 command.

Parameters

Parameter	Description	Setting
p1120[0...n]	Ramp-function generator, ramp-up time [s]	Sets the ramp-up time for the ramp-function generator. Factory setting: 1
p1121[0...n]	Ramp-function generator, ramp-down time [s]	Sets the ramp-down time for the ramp-function generator. Factory setting: 1
p1058[0...n]	Jog 1 speed setpoint [rpm]	Sets the speed for JOG 1. Factory setting: 150
p1059[0...n]	Jog 2 speed setpoint [rpm]	Sets the speed for JOG 2. Factory setting: -150
p1082[0...n]	Maximum speed [rpm]	Sets the highest speed. Factory setting: 1500

7.9 Conveyor technology control functions (for G115D PROFINET and AS-i variants only)

Overview

Conveyors are devices used for movement of materials, products and loads throughout a manufacturing or distribution facility. Conventionally, the conveyor technology control is implemented in the PLC controller. By transferring the functionality to the converter, the conveying process starts via the PLC while stops depending on the sensor(s) wired directly to the converter. In this case, the materials conveyed can always come to a standstill at the same point independent of the cycle time of the PLC controller.

The SINAMICS G115D PROFINET and AS-i variants (I/O variants not supported) offer flexible and efficient solutions for the conveyor technology requirements of various horizontal or inclined applications in such industrial sectors as intralogistics, automotive, and airport.

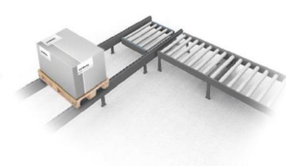
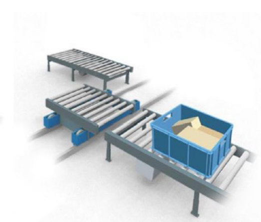
Note

To make sure that the conveyor control function works properly on the SINAMICS G115D AS-i variant, you must select Macro 31 or 34. For more information on the wiring arrangement, See Section "Factory interface setting (Page 68)".

Applications

- Roller, belt, or chain conveyors
- Turntables
- Corner turntable lifts
- Travelling trolleys



Commission tool

It is recommended that you commission the conveyor control function using the Startdrive PC tool or the SINAMICS G120 Smart Access.

Commissioning tools (Page 92)

Note

All screenshots in Chapter "Conveyor technology control functions" take the converter with PROFINET interface by using the Startdrive PC tool as examples. You can also commission the functions via the SINAMICS G120 Smart Access. For more information, see Section "Application setup" in the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

7.9.1 Conveyors

Conveyors move materials from one location to another. There are different types of conveyors (for example, roller conveyors, chain conveyors, or belt conveyors) available for use according to your particular applications.

7.9.1.1 Conveyor, one direction and one speed (p3393 = 1)

Overview

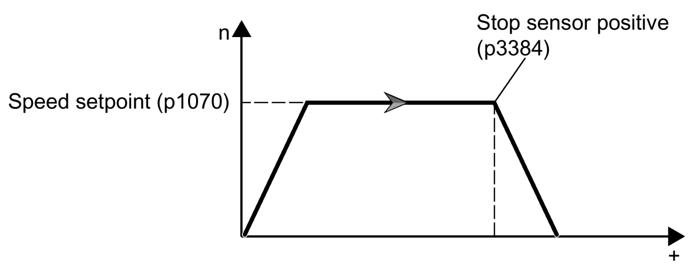
With p3393 (conveyor technology application) set to 1, the converter enables the load on a conveyor belt to move in one direction with a fixed speed. A sensor is required to signal the limit position for the motor to stop.

Precondition

You interconnect the signal of the sensor with the digital input of your choice.

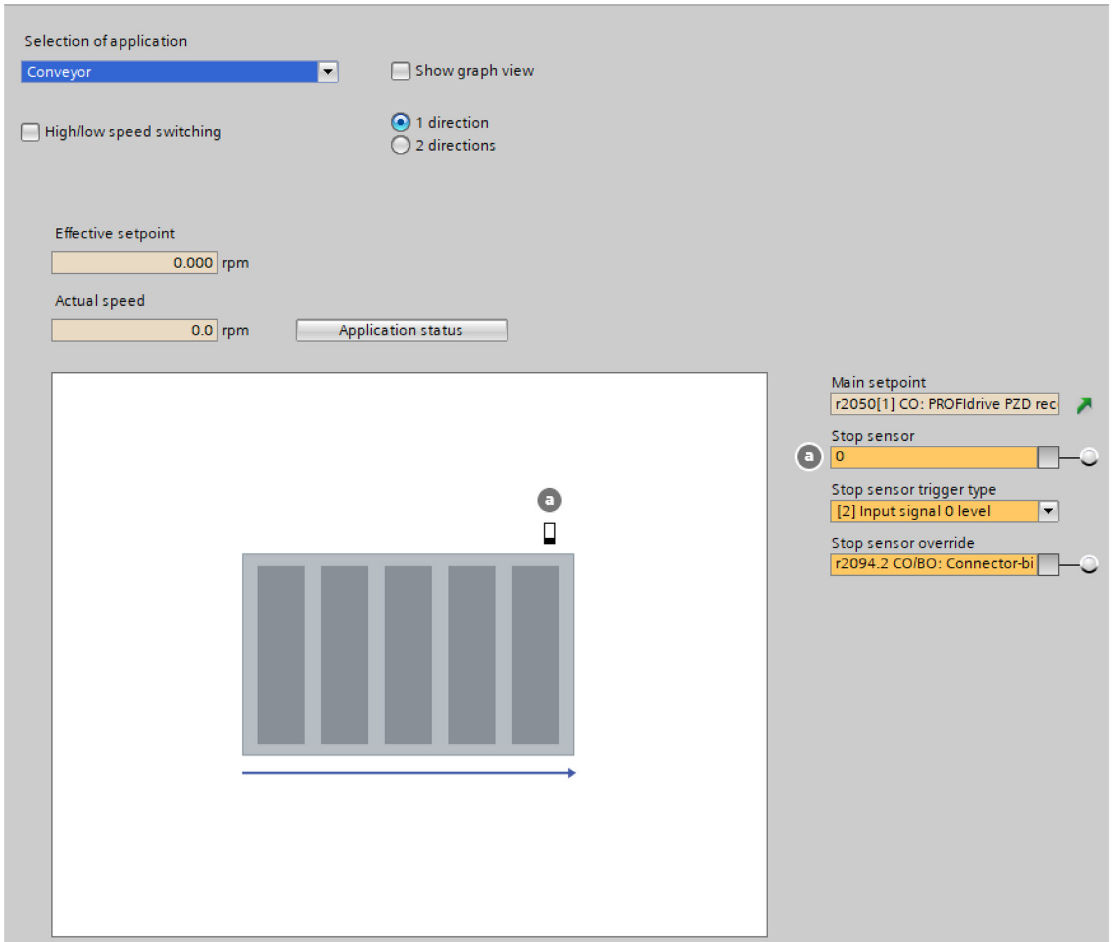
Function description

- With the ON command, the motor accelerates to its speed setpoint (p1070). The direction of the movement depends on the setpoint inversion (p1113):
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- The motor stops with OFF1 ramp when the stop sensor positive direction (p3384) is triggered (level/edge triggered depending on p3394).
- Setting the sensor bypass signal (p3390) to 1 overrides the stop sensor signal p3384.



Parameters

Conveyor technology control parameters (Page 203)



7.9.1.2 Conveyor, one direction and two speeds (p3393 = 2)

Overview

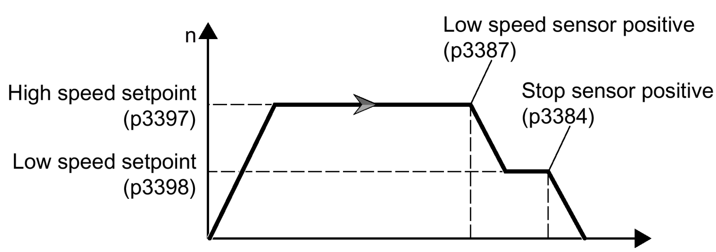
With p3393 (conveyor technology application) set to 2, the converter enables the load on a conveyor belt to move in one direction with variable speeds. Two sensors are required to signal the limit positions for the motor to stop or decelerate.

Precondition

You interconnect the signals of the sensors with the digital inputs of your choice.

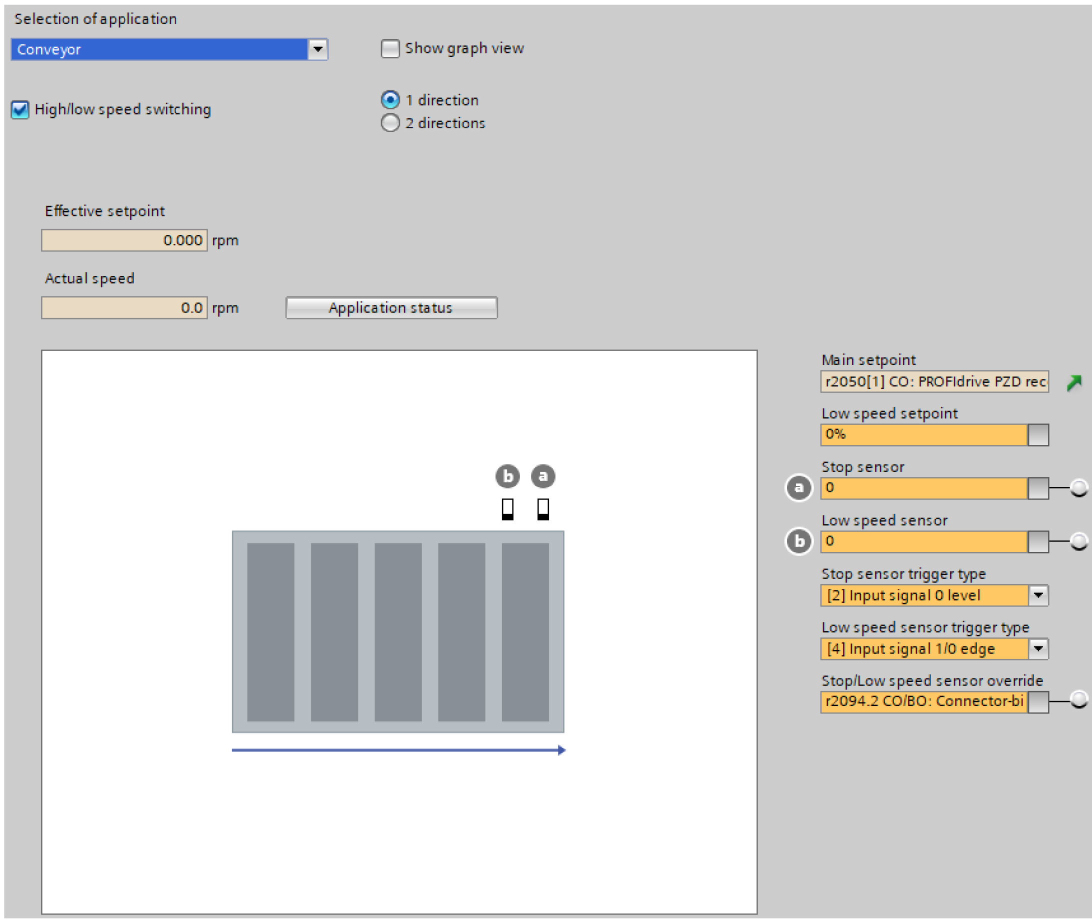
Function description

- With the ON command, the motor accelerates to the high speed setpoint (p3397). The direction of the movement depends on the setpoint inversion (p1113):
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- The motor decelerates with OFF1 ramp to the low speed setpoint (p3398) when the low speed sensor positive direction (p3387) is triggered (level/edge triggered depending on p3395).
- The motor stops with OFF1 ramp when the stop sensor positive direction (p3384) is triggered (level/edge triggered depending on p3394).
- Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384 and p3387.



Parameters

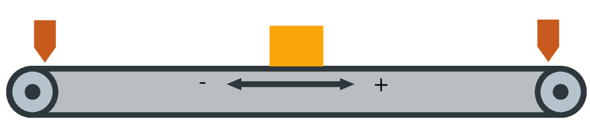
Conveyor technology control parameters (Page 203)



7.9.1.3 Conveyor, two directions and one speed (p3393 = 3)

Overview

With p3393 (conveyor technology application) set to 3, the converter enables the load on a conveyor belt to move in either positive or negative direction with a fixed speed. Two sensors are required to signal the limit positions for the motor to stop.

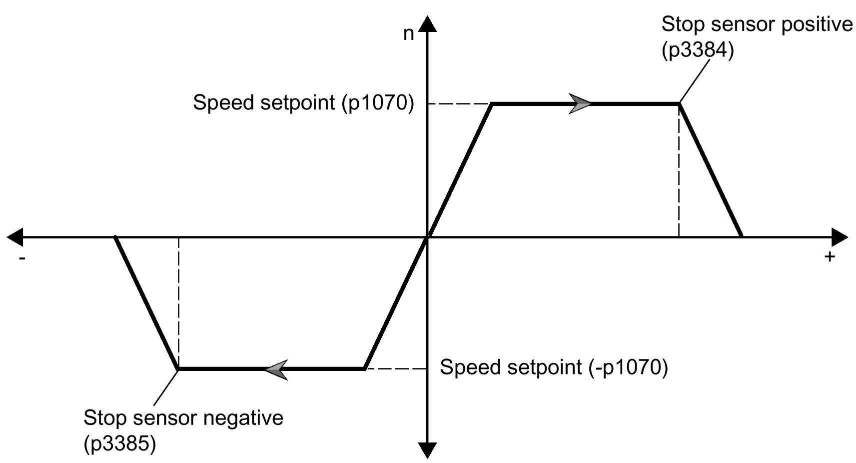


Precondition

You interconnect the signals of the sensors with the digital inputs of your choice.

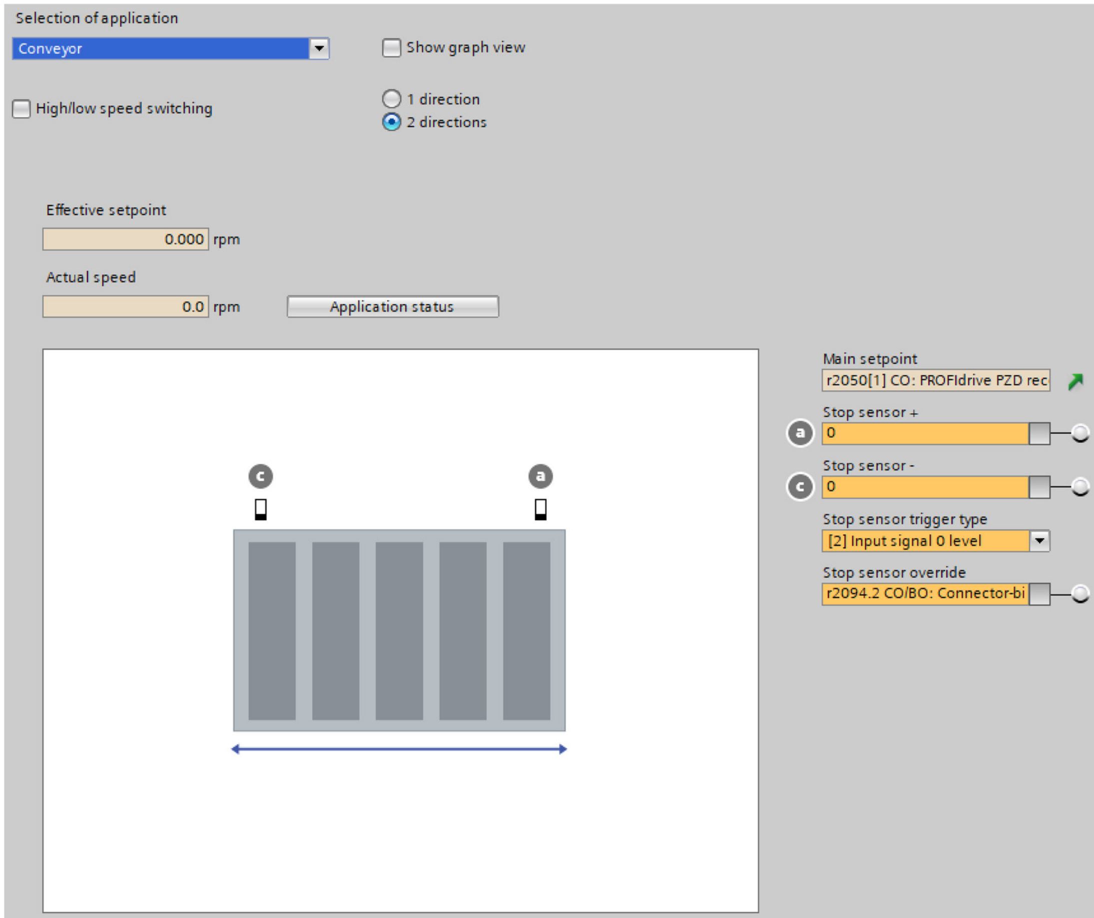
Function description

- With the ON command, the motor accelerates to its speed setpoint (p1070). The load can move in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the movement in positive direction, the following applies:
  - The motor stops with OFF1 ramp when the stop sensor positive direction (p3384) is triggered (level/edge triggered depending on p3394).
  - No motor reaction is triggered by the stop sensor negative direction signal (p3385).
- With the movement in negative direction, the following applies:
  - The motor stops with OFF1 ramp when the stop sensor negative direction (p3385) is triggered (level/edge triggered depending on p3394).
  - No motor reaction is triggered by the stop sensor positive direction signal (p3384).
- Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384 and p3385.



Parameters

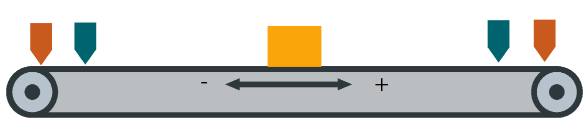
Conveyor technology control parameters (Page 203)



7.9.1.4 Conveyor, two directions and two speeds (p3393 = 4)

Overview

With p3393 (conveyor technology application) set to 4, the converter enables the load on a conveyor belt to move in either positive or negative direction with variable speeds. Four sensors are required to signal the limit positions for the motor to stop or decelerate.

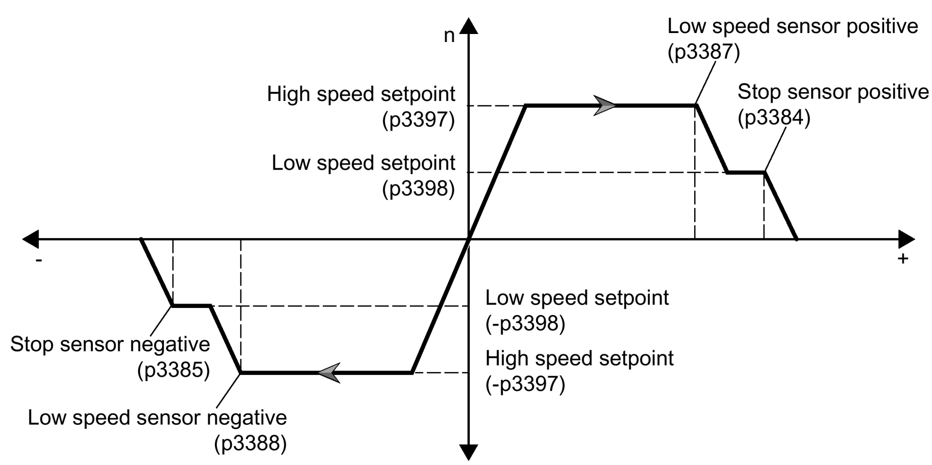


Precondition

You interconnect the signals of the sensors with the digital inputs of your choice.

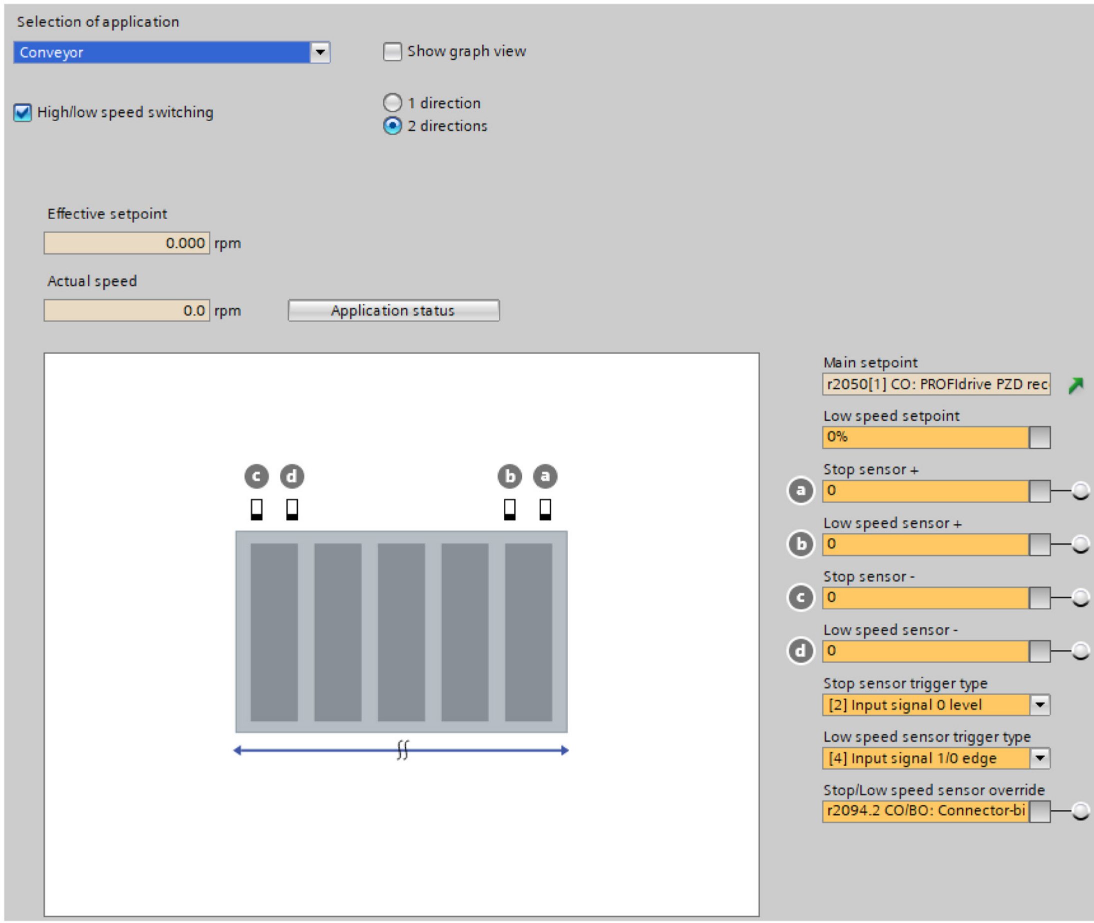
Function description

- With the ON command, the motor accelerates to the high speed setpoint (p3397). The load can move in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the movement in positive direction, the following applies:
  - The motor decelerates with OFF1 ramp to the low speed setpoint (p3398) when the low speed sensor positive direction (p3387) is triggered (level/edge triggered depending on p3395).
  - The motor stops with OFF1 ramp when the stop sensor positive direction (p3384) is triggered (level/edge triggered depending on p3394).
  - No motor reaction is triggered by the stop sensor negative direction (p3385) and low speed sensor negative direction (p3388) signals.
- With the movement in negative direction, the following applies:
  - The motor decelerates with OFF1 ramp to the low speed setpoint (p3398) when the low speed sensor negative direction (p3388) is triggered (level/edge triggered depending on p3395).
  - The motor stops with OFF1 ramp when the stop sensor negative direction (p3385) is triggered (level/edge triggered depending on p3394).
  - No motor reaction is triggered by the stop sensor positive direction (p3384) and low speed sensor positive direction (p3387) signals.
- Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384, p3385, p3387, and p3388.



Parameters

Conveyor technology control parameters (Page 203)



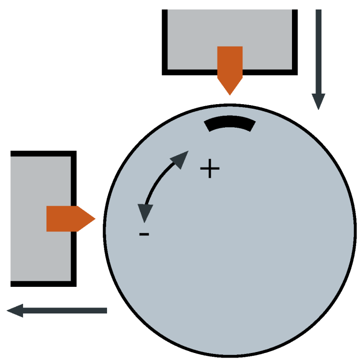
7.9.2 Turntables

A turntable in a conveyor system redirects the material at the crossing of two conveyor lines. The turntable rotates from one end position to the other in the direction depending on the setting of the end position shutdown (p3392) and the polarity of the speed setpoint.

7.9.2.1 Turntable, two positions and one speed (p3393 = 5)

Overview

With p3393 (conveyor technology application) set to 5, the converter enables a turntable in a conveyor system to rotate in either positive or negative direction with a fixed speed and stop at two dedicated positions. Two sensors are required to signal the limit positions for the motor to stop.



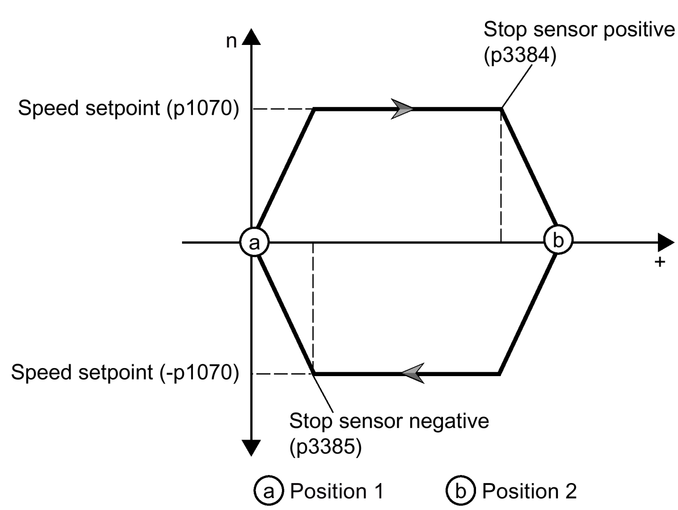
Precondition

- You interconnect the signals of the sensors with the digital inputs of your choice.
- Depending on the specific application and mechanical setup, you must set end position shutdown active (p3392) to 1, so as to limit the turntable movement between the dedicated positions.

Function description

- With the ON command, the motor accelerates to its speed setpoint (p1070). The turntable can rotate in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the end position shutdown deactivated (p3392 = 0), the following applies:
  - The motor stops with OFF1 ramp when either of the two stop sensors (p3384 and p3385) is triggered (level/edge triggered depending on p3394).
  - With the sensor evaluation type (p3394) set to 1 or 2 (level triggering), the motor starts again in either positive or negative direction when the level is canceled; with p3394 set to 3 or 4 (edge triggering), a new ON command must be initiated to start the motor again in either positive or negative direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384 and p3385.
- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it stops only when the stop sensor positive direction (p3384) is triggered.
  - If the motor runs in negative direction, it stops only when the stop sensor negative direction (p3385) is triggered.
  - A new ON command must be initiated to start the motor again and the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 does not override the stop sensor signals p3384 and p3385.

End position shutdown activated (p3392 = 1)

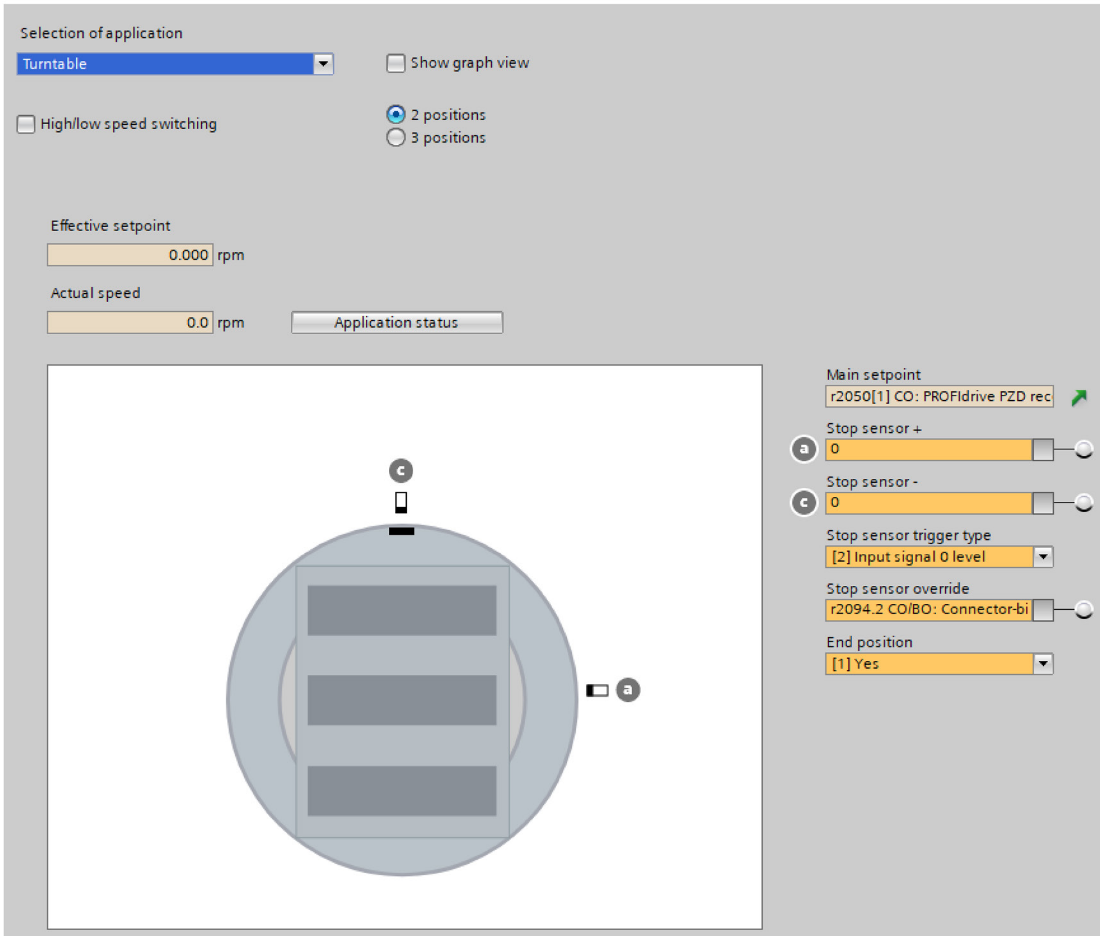


Note

With the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = 1 or 2) activated, once a stop sensor is triggered, the motor stops even if the level is canceled.

Parameters

Conveyor technology control parameters (Page 203)

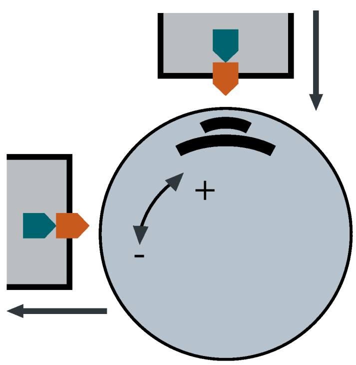


7.9.2.2 Turntable, two positions and two speeds (p3393 = 6)

Overview

With p3393 (conveyor technology application) set to 6, the converter enables a turntable in a conveyor system to rotate in either positive or negative direction with variable speeds and stop at two dedicated positions.

Four sensors are required to signal the limit positions for the motor to stop or decelerate. In the mechanical setup of the conveyor system, you must install the stop sensor and low speed sensor in a line. So do the stop and low speed cams. Besides, when setting up the cams, the low speed cam must be longer than the stop cam.



Precondition

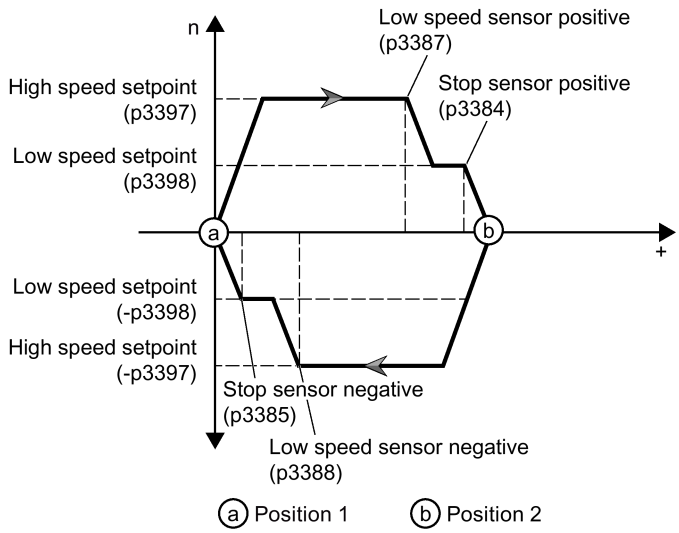
- You interconnect the signals of the sensors with the digital inputs of your choice.
- Depending on the specific application and mechanical setup, you must set end position shutdown active (p3392) to 1, so as to limit the turntable movement between the dedicated positions.

Function description

- With the ON command, the motor accelerates to the high speed setpoint (p3397). The turntable can rotate in either positive or negative direction depending on the setting of p1113:
  – p1113 = 0: positive direction
  – p1113 = 1: negative direction
- With the end position shutdown deactivated (p3392 = 0), the following applies:
  – The motor decelerates with OFF1 ramp to the low speed setpoint (p3398) when either of the two low speed sensors (p3387 and p3388) is triggered (level/edge triggered depending on p3395).
  – The motor stops with OFF1 ramp when either of the two stop sensors (p3384 and p3385) is triggered (level/edge triggered depending on p3394).
  – With the sensor evaluation type (p3394) set to 1 or 2 (level triggering), the motor starts again in either positive or negative direction when the level is canceled; with p3394 set to 3 or 4 (edge triggering), a new ON command must be initiated to start the motor again in either positive or negative direction.
  – Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384, p3385, p3387, and p3388.

- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it decelerates/stops only when the low speed sensor positive direction (p3387)/stop sensor positive direction (p3384) is triggered.
  - If the motor runs in negative direction, it decelerates/stops only when the low speed sensor negative direction (p3388)/stop sensor negative direction (p3385) is triggered.
  - A new ON command must be initiated to start the motor again and the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 does not override the sensor signals p3384, p3385, p3387, and p3388.

End position shutdown activated (p3392 = 1)

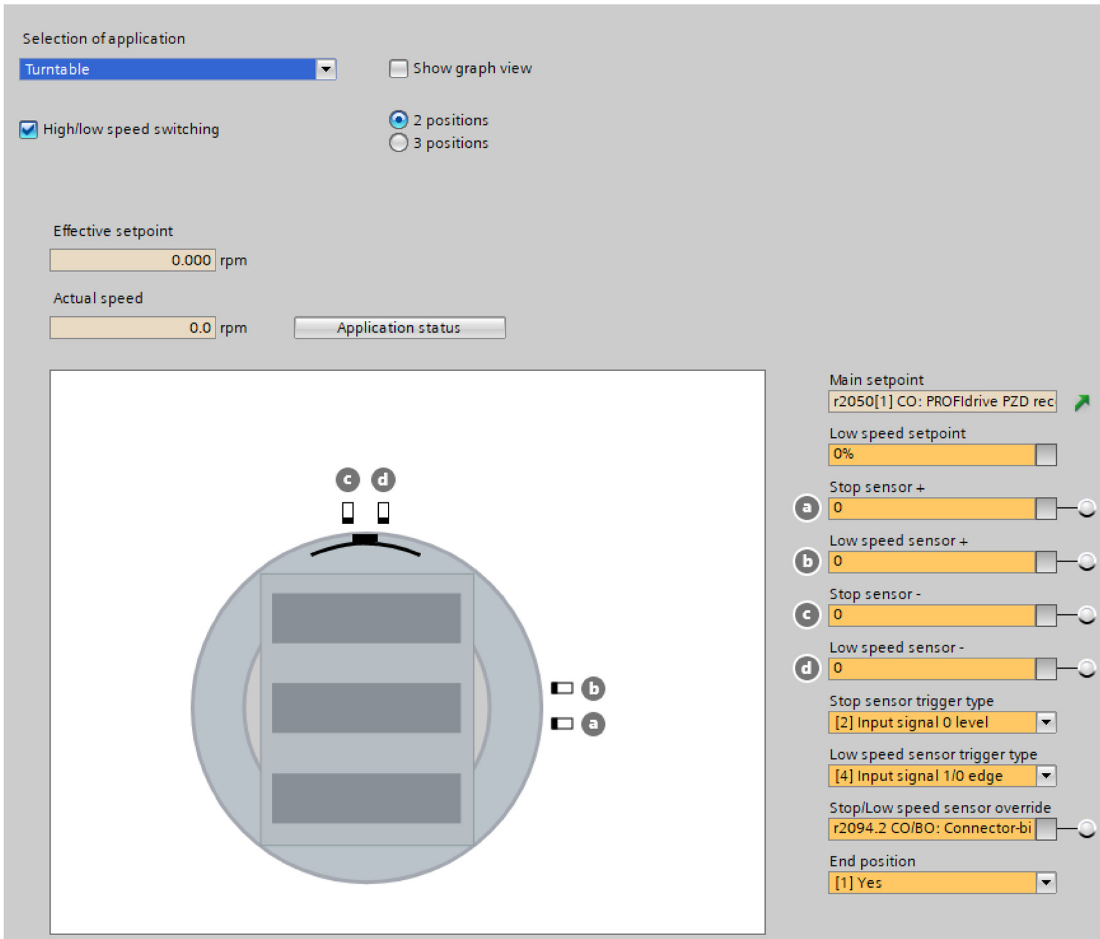


Note

With the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = p3395 = 1 or 2) activated, once a stop or low speed sensor is triggered, the motor stops or goes to low speed even if the level is canceled.

Parameters

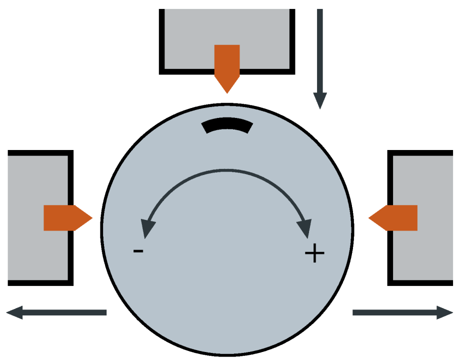
Conveyor technology control parameters (Page 203)



7.9.2.3 Turntable, three positions and one speed (p3393 = 7)

Overview

With p3393 (conveyor technology application) set to 7, the converter enables a turntable in a conveyor system to rotate in either positive or negative direction with a fixed speed and stop at three dedicated positions. Three sensors are required to signal the limit positions for the motor to stop.



Precondition

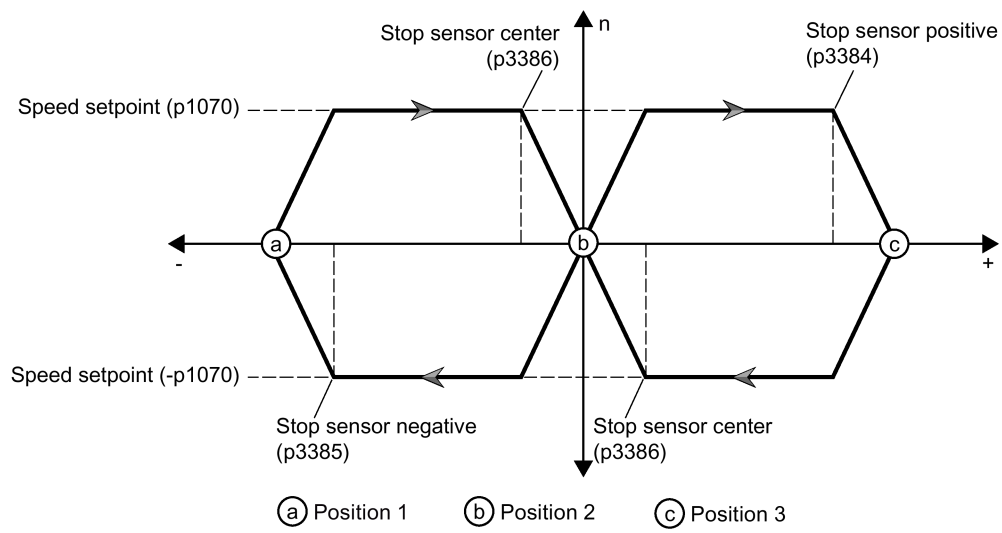
- You interconnect the signals of the sensors with the digital inputs of your choice.
- Depending on the specific application and mechanical setup, you must set end position shutdown active (p3392) to 1, so as to limit the turntable movement between the dedicated positions.

Function description

- With the ON command, the motor accelerates to its speed setpoint (p1070). The turntable can rotate in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the end position shutdown deactivated (p3392 = 0), the following applies:
  - The motor stops with OFF1 ramp when any of the three stop sensors (p3384, p3385, and p3386) is triggered (level/edge triggered depending on p3394).
  - With the sensor evaluation type (p3394) set to 1 or 2 (level triggering), the motor starts again in either positive or negative direction when the level is canceled; with p3394 set to 3 or 4 (edge triggering), a new ON command must be initiated to start the motor again in either positive or negative direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384, p3385, and p3386.

- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it stops only when the stop sensor center (p3386) or stop sensor positive direction (p3384) is triggered.
  - If the motor runs in negative direction, it stops only when the stop sensor center (p3386) or stop sensor negative direction (p3385) is triggered.
  - A new ON command must be initiated to start the motor again. If the motor stops upon triggering the stop sensor positive direction/negative direction, the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the stop sensor center signal p3386. In this case, the turntable can rotate directly from position 1 to position 3 and vice versa.

End position shutdown activated (p3392 = 1)



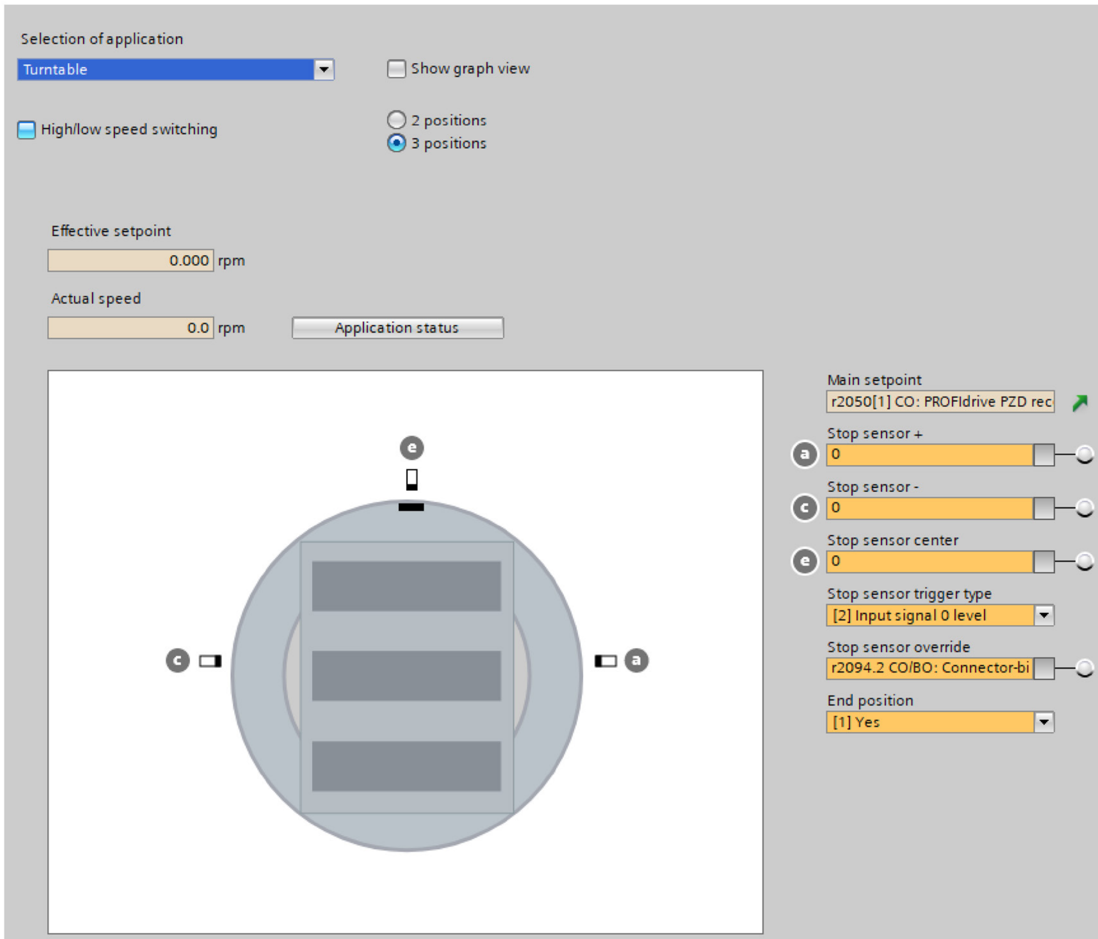
Note

The motor will have the following behavior with the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = 1 or 2) activated:

- Once a stop sensor at the positive or negative position is triggered, the motor stops even if the level is canceled.
- Once a stop sensor at the center position is triggered, the motor stops; if the level is cancelled, then the motor runs again.

Parameters

Conveyor technology control parameters (Page 203)

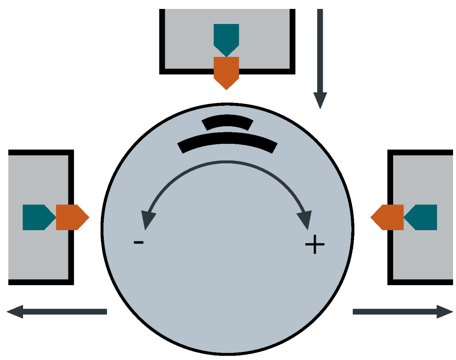


7.9.2.4 Turntable, three positions and two speeds (p3393 = 8)

Overview

With p3393 (conveyor technology application) set to 8, the converter enables a turntable in a conveyor system to rotate in either positive or negative direction with variable speeds and stop at three dedicated positions.

Six sensors are required to signal the limit positions for the motor to stop or decelerate. In the mechanical setup of the conveyor system, you must install the stop sensor and low speed sensor in a line. So do the stop and low speed cams. Besides, when setting up the cams, the low speed cam must be longer than the stop cam.



Precondition

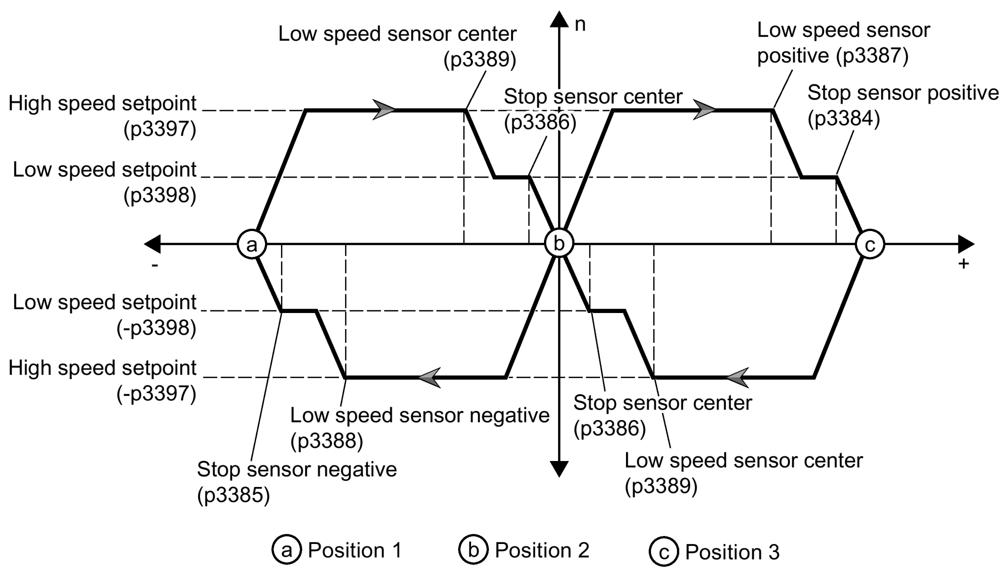
- You interconnect the signals of the sensors with the digital inputs of your choice.
- Depending on the specific application and mechanical setup, you must set end position shutdown active (p3392) to 1, so as to limit the turntable movement between the dedicated positions.

Function description

- With the ON command, the motor accelerates to the high speed setpoint (p3397). The turntable can rotate in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the end position shutdown deactivated (p3392 = 0), the following applies:
  - The motor decelerates with OFF1 ramp to the low speed setpoint (p3398) when any of the three low speed sensors (p3387, p3388, and p3389) is triggered (level/edge triggered depending on p3395).
  - The motor stops with OFF1 ramp when any of the three stop sensors (p3384, p3385, and p3386) is triggered (level/edge triggered depending on p3394).
  - With the sensor evaluation type (p3394) set to 1 or 2 (level triggering), the motor starts again in either positive or negative direction when the level is canceled; with p3394 set to 3 or 4 (edge triggering), a new ON command must be initiated to start the motor again in either positive or negative direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384, p3385, p3386, p3387, p3388, and p3389.

- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it decelerates/stops only when the low speed sensor positive direction or low speed sensor center (p3387 or p3389)/stop sensor positive direction or stop sensor center (p3384 or p3386) is triggered.
  - If the motor runs in negative direction, it decelerates/stops only when the low speed sensor negative direction or low speed sensor center (p3388 or p3389)/stop sensor negative direction or stop sensor center (p3385 or p3386) is triggered.
  - A new ON command must be initiated to start the motor again. If the motor stops upon triggering the stop sensor positive direction/negative direction, the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the stop sensor center and low speed sensor center signals p3386 and p3389. In this case, the turntable can rotate directly from position 1 to position 3 and vice versa.

End position shutdown activated (p3392 = 1)



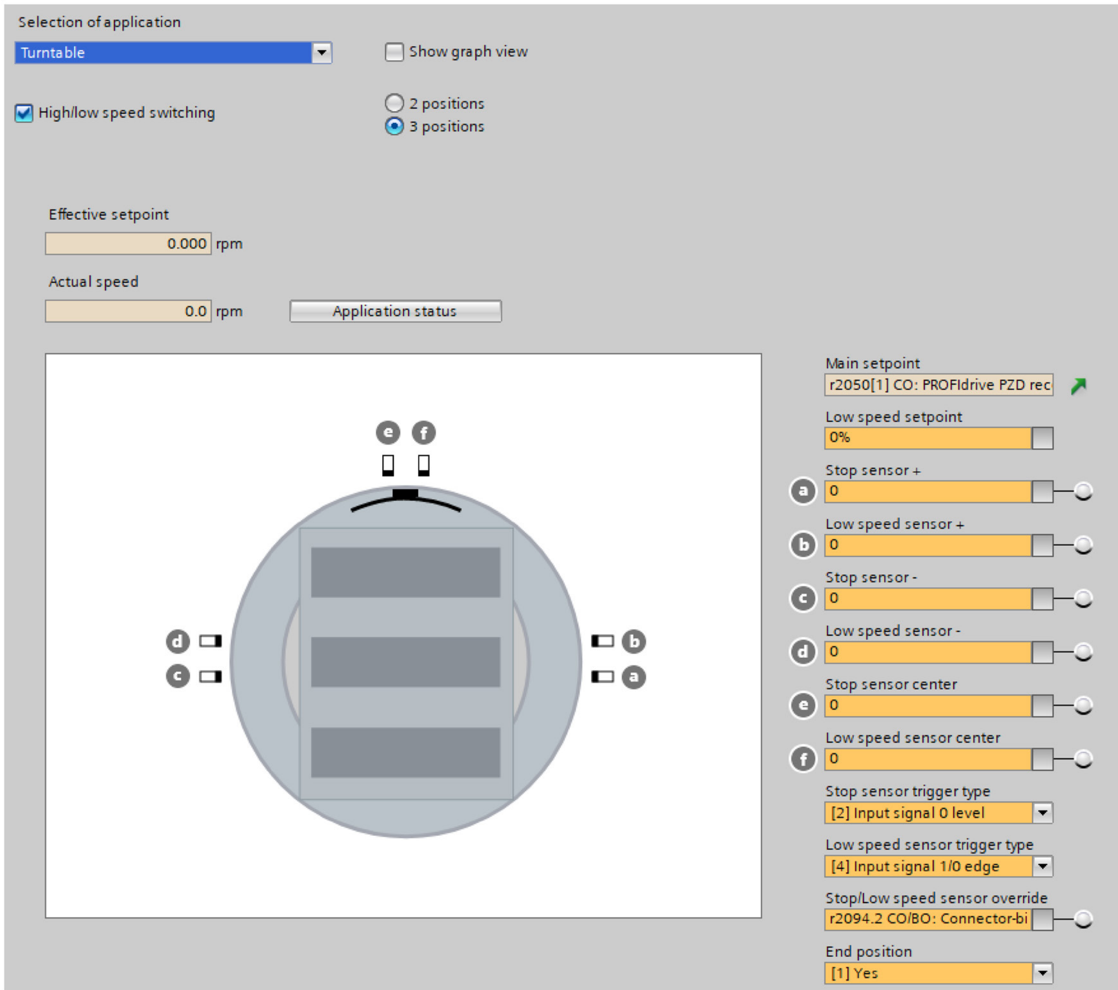
Note

The motor will have the following behavior with the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = p3395 = 1 or 2) activated:

- Once a stop or low speed sensor at the positive or negative position is triggered, the motor stops and goes to low speed even if the level is canceled.
- Once a stop or low speed sensor at the center position is triggered, the motor stops and goes to low speed; if the level is cancelled, then the motor runs again.

Parameters

Conveyor technology control parameters (Page 203)



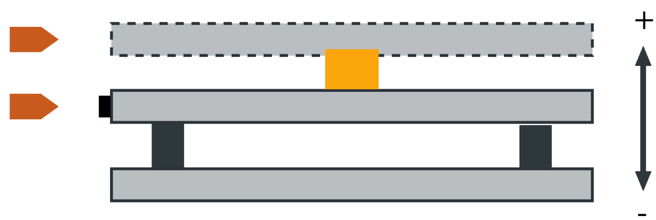
7.9.3 Corner turntable lifts

For transferring a load from one level to another, a corner turntable lift can be used to raise or lower the load.

7.9.3.1 Corner turntable lift, two positions and one speed (p3393 = 9)

Overview

With p3393 (conveyor technology application) set to 9, the converter enables a corner turntable lift in a conveyor system to move up and down with a fixed speed and stop at two dedicated positions. Two sensors are required to signal the limit positions for the motor to stop.



Precondition

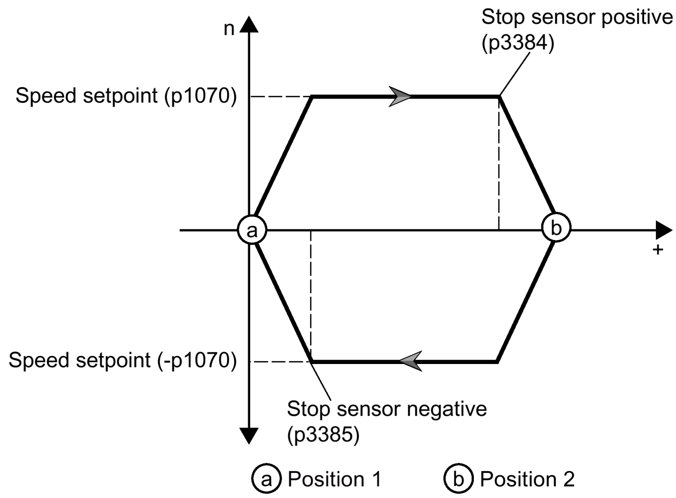
- You interconnect the signals of the sensors with the digital inputs of your choice.
- To make sure that the corner turntable lift moves between the higher position and the lower position, the end position shutdown must be activated with p3392 set to 1.

Function description

- With the ON command, the motor accelerates to its speed setpoint (p1070). The lift moves in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the end position shutdown deactivated (p3392 = 0), the following applies:
  - The motor stops with OFF1 ramp when either of the two stop sensors (p3384 and p3385) is triggered (level/edge triggered depending on p3394).
  - With the sensor evaluation type (p3394) set to 1 or 2 (level triggering), the motor starts again in either positive or negative direction when the level is canceled; with p3394 set to 3 or 4 (edge triggering), a new ON command must be initiated to start the motor again in either positive or negative direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384 and p3385.

- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it stops only when the stop sensor positive direction (p3384) is triggered.
  - If the motor runs in negative direction, it stops only when the stop sensor negative direction (p3385) is triggered.
  - A new ON command must be initiated to start the motor again and the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 does not override the stop sensor signals p3384 and p3385.

End position shutdown activated (p3392 = 1)

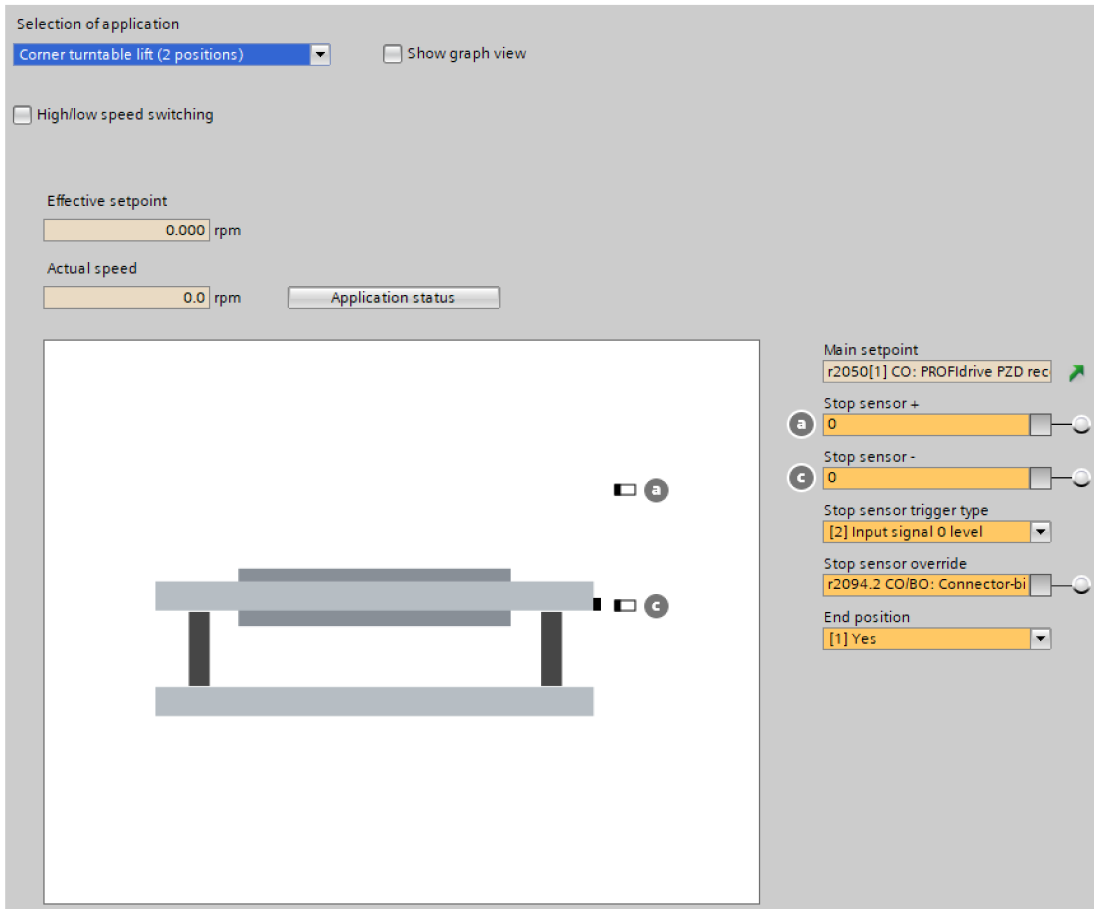


Note

With the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = 1 or 2) activated, once a stop sensor is triggered, the motor stops even if the level is canceled.

Parameters

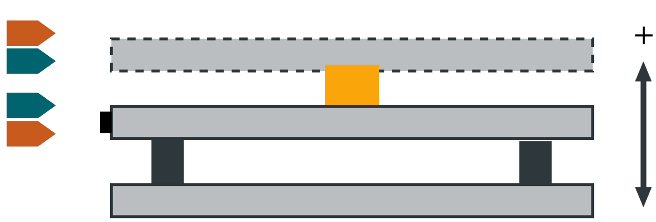
Conveyor technology control parameters (Page 203)



7.9.3.2 Corner turntable lift, two positions and two speeds (p3393 = 10)

Overview

With p3393 (conveyor technology application) set to 10, the converter enables a corner turntable lift in a conveyor system to move up and down with variable speeds and stop at two dedicated positions. Four sensors are required to signal the limit positions for the motor to stop or decelerate.



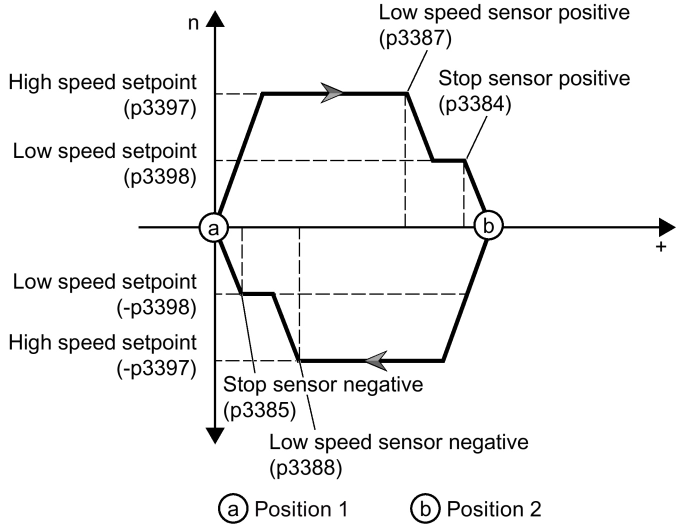
Precondition

- You interconnect the signals of the sensors with the digital inputs of your choice.
- To make sure that the corner turntable lift moves between the higher position and the lower position, the end position shutdown must be activated with p3392 set to 1.

Function description

- With the ON command, the motor accelerates to the high speed setpoint (p3397). The lift moves in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the end position shutdown deactivated (p3392 = 0), the following applies:
  - The motor decelerates with OFF1 ramp to the low speed setpoint (p3398) when either of the two low speed sensors (p3387 and p3388) is triggered (level/edge triggered depending on p3395).
  - The motor stops with OFF1 ramp when either of the two stop sensors (p3384 and p3385) is triggered (level/edge triggered depending on p3394).
  - With the sensor evaluation type (p3394) set to 1 or 2 (level triggering), the motor starts again in either positive or negative direction when the level is canceled; with p3394 set to 3 or 4 (edge triggering), a new ON command must be initiated to start the motor again in either positive or negative direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the sensor signals p3384, p3385, p3387, and p3388.
- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it decelerates/stops only when the low speed sensor positive direction (p3387)/stop sensor positive direction (p3384) is triggered.
  - If the motor runs in negative direction, it decelerates/stops only when the low speed sensor negative direction (p3388)/stop sensor negative direction (p3385) is triggered.
  - A new ON command must be initiated to start the motor again and the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 does not override the sensor signals p3384, p3385, p3387, and p3388.

End position shutdown activated (p3392 = 1)

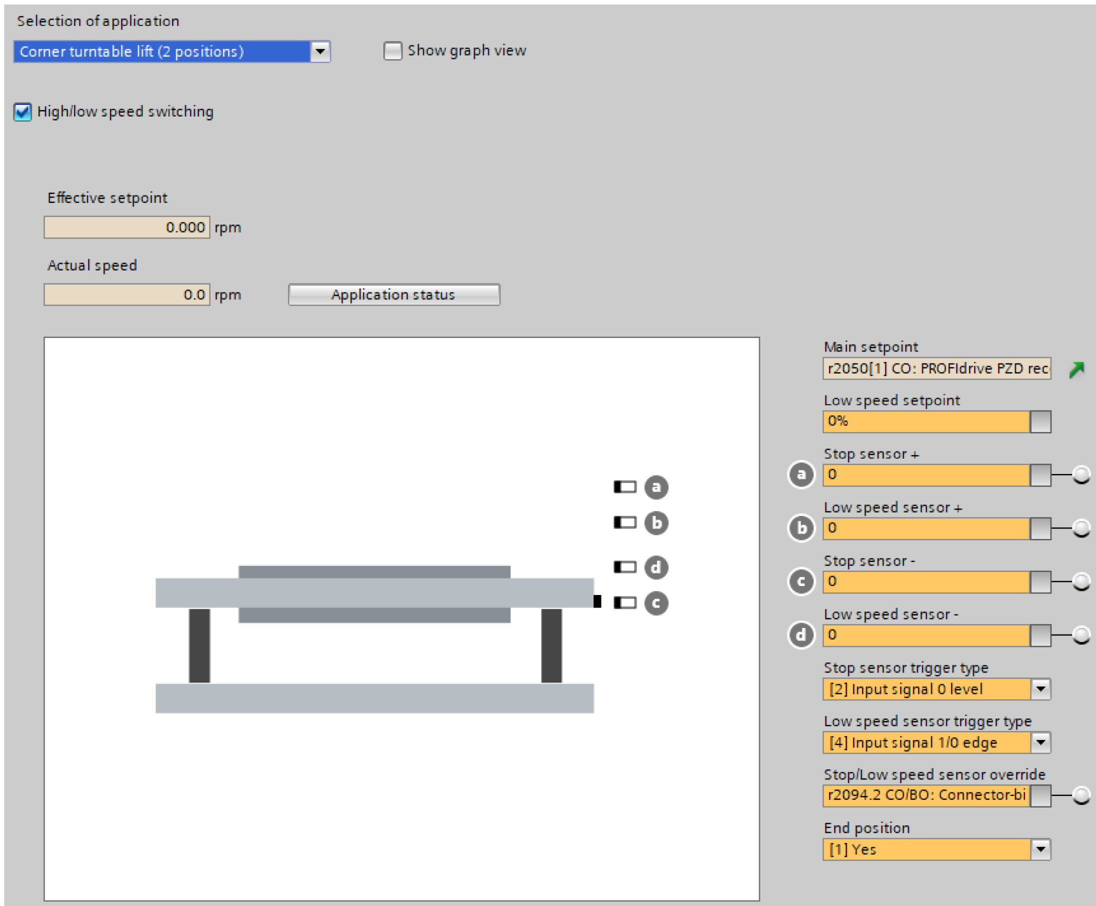


Note

With the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = p3395 = 1 or 2) activated, once a stop or low speed sensor is triggered, the motor stops or goes to low speed even if the level is canceled.

Parameters

Conveyor technology control parameters (Page 203)



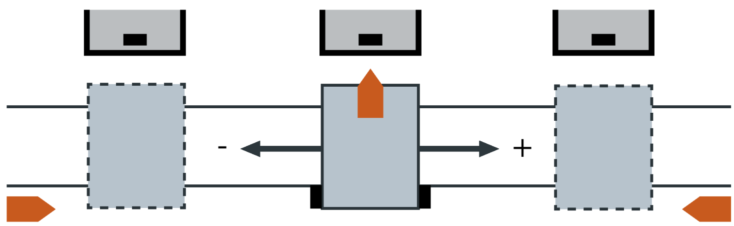
7.9.4 Travelling trolleys

Travelling trolleys travel along a fixed path with specific positions for loading and discharge.

7.9.4.1 Travelling trolley, one speed (p3393 = 11)

Overview

With p3393 (conveyor technology application) set to 11, the converter enables a travelling trolley to move in either positive or negative direction with a fixed speed and stop at dedicated positions. Three sensors are required to signal the limit positions for the motor to stop.

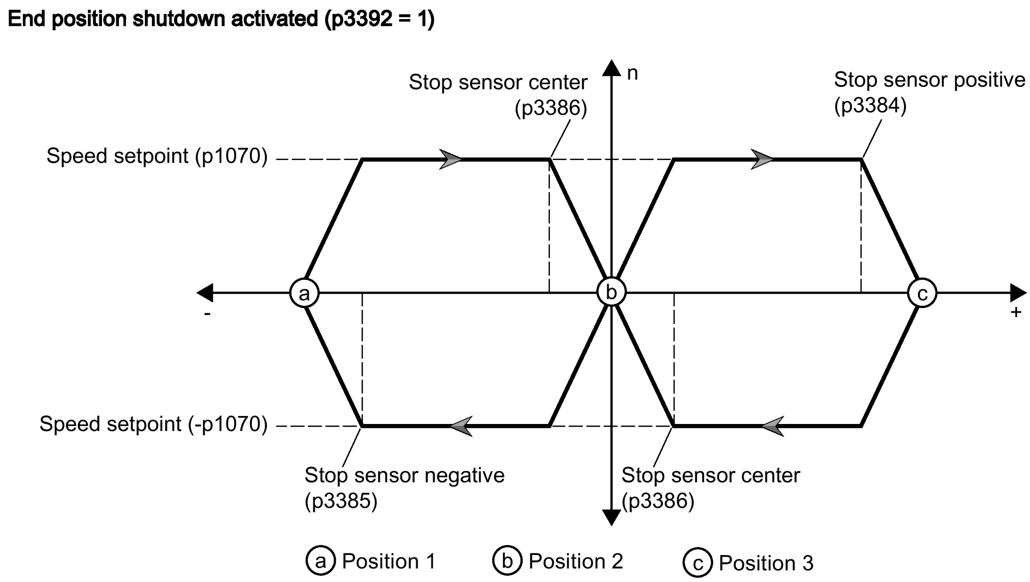


Precondition

- You interconnect the signals of the sensors with the digital inputs of your choice.
- The end position shutdown must be activated with p3392 set to 1 to avoid damage to the devices.
- The controlling PLC can activate/deactivate the sensor bypass signal (p3390) and define different positions among which the trolley can move.

Function description

- With the ON command, the motor accelerates to its speed setpoint (p1070). The trolley moves in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it stops only when the stop sensor center (p3386) or stop sensor positive direction (p3384) is triggered.
  - If the motor runs in negative direction, it stops only when the stop sensor center (p3386) or stop sensor negative direction (p3385) is triggered.
  - A new ON command must be initiated to start the motor again. If the motor stops upon triggering the stop sensor positive direction/negative direction, the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the stop sensor center signal p3386.



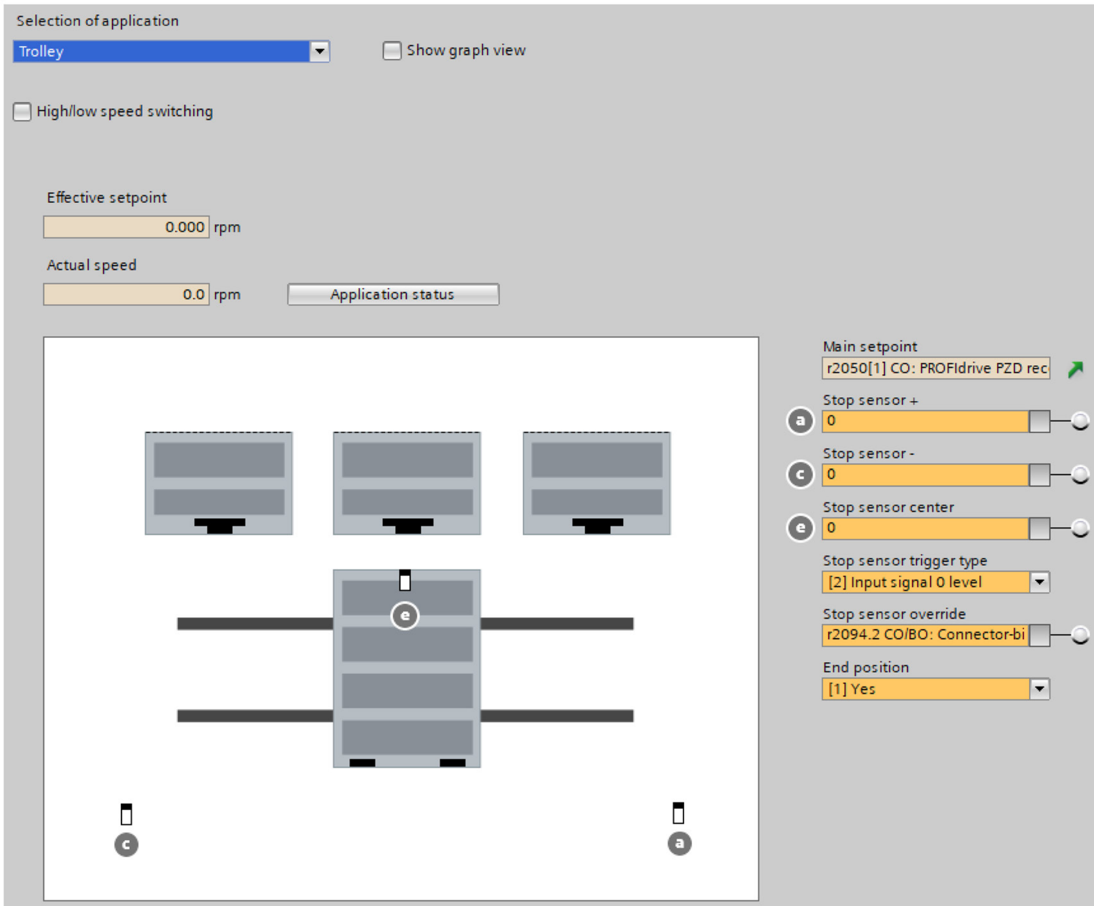
Note

The motor will have the following behavior with the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = 1 or 2) activated:

- Once a stop sensor at the positive or negative position is triggered, the motor stops even if the level is canceled.
- Once a stop sensor at the center position is triggered, the motor stops; if the level is cancelled, then the motor runs again.

Parameters

Conveyor technology control parameters (Page 203)

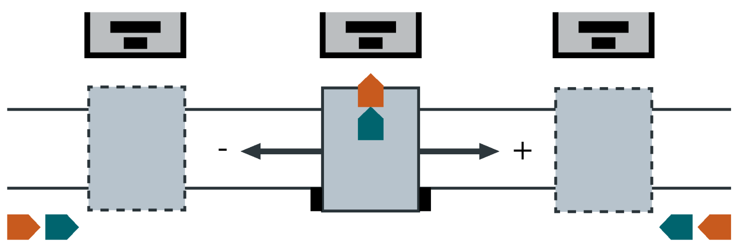


7.9.4.2 Travelling trolley, two speeds (p3393 = 12)

Overview

With p3393 (conveyor technology application) set to 12, the converter enables a travelling trolley to move in either positive or negative direction with variable speeds and stop at dedicated positions.

Six sensors are required to signal the limit positions for the motor to stop or decelerate. In the mechanical setup of the conveyor system, the stop sensor and low speed sensor on the travelling trolley must be installed in a line. So do the stop and low speed cams on the corresponding conveyor lines. Besides, when setting up the cams, the low speed cam must be longer than the stop cam.



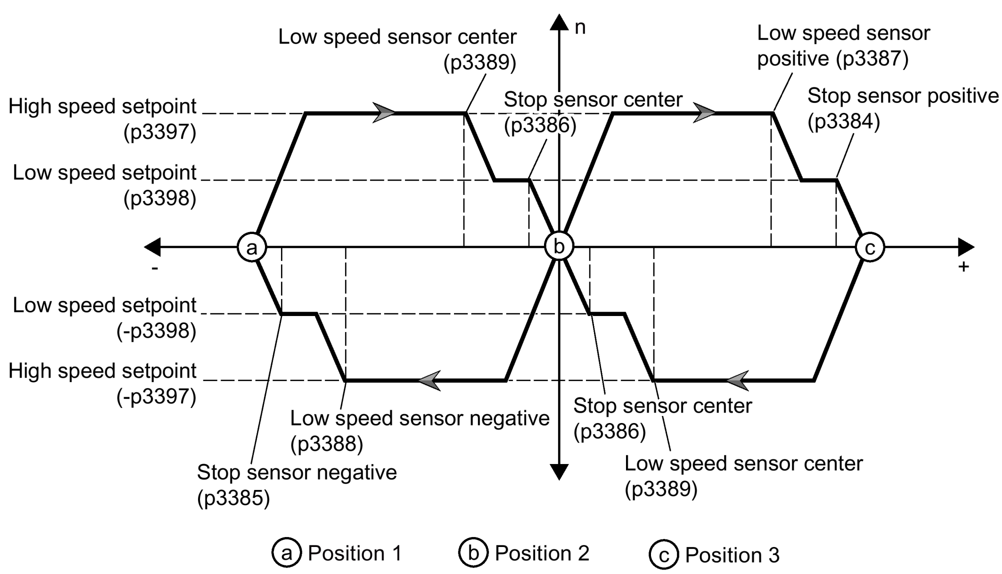
Precondition

- You interconnect the signals of the sensors with the digital inputs of your choice.
- The end position shutdown must be activated with p3392 set to 1 to avoid damage to the devices.
- The controlling PLC can activate/deactivate the sensor bypass signal (p3390) and define different positions among which the trolley can move.

Function description

- With the ON command, the motor accelerates to the high speed setpoint (p3397). The trolley moves in either positive or negative direction depending on the setting of p1113:
  - p1113 = 0: positive direction
  - p1113 = 1: negative direction
- With the end position shutdown activated (p3392 = 1), the following applies:
  - If the motor runs in positive direction, it decelerates/stops only when the low speed sensor positive direction or low speed sensor center (p3387 or p3389)/stop sensor positive direction or stop sensor center (p3384 or p3386) is triggered.
  - If the motor runs in negative direction, it decelerates/stops only when the low speed sensor negative direction or low speed sensor center (p3388 or p3389)/stop sensor negative direction or stop sensor center (p3385 or p3386) is triggered.
  - A new ON command must be initiated to start the motor again. If the motor stops upon triggering the stop sensor positive direction/negative direction, the new movement is only possible in the opposite direction.
  - Setting the sensor bypass signal (p3390) to 1 overrides the stop sensor center and low speed sensor center signals p3386 and p3389.

End position shutdown activated (p3392 = 1)



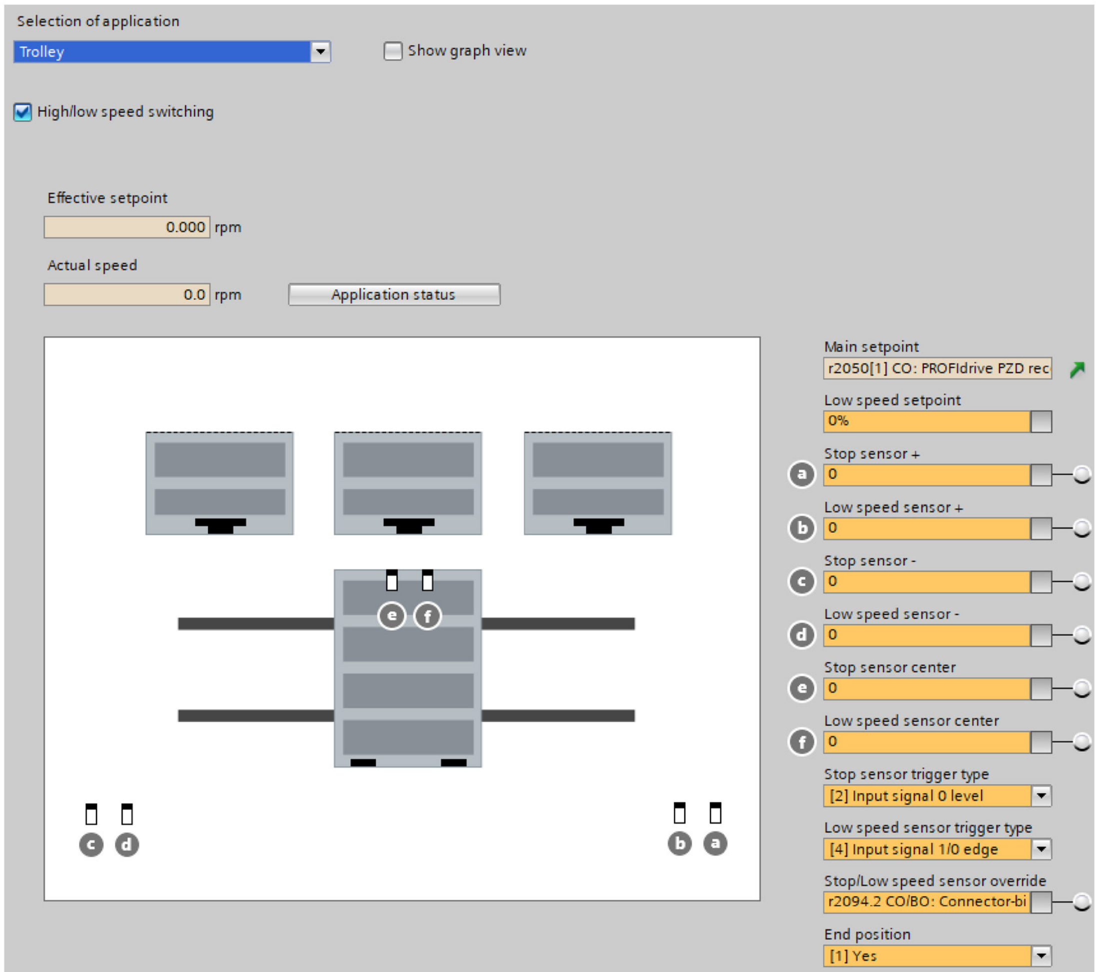
Note

The motor will have the following behavior with the end position shutdown (p3392 = 1) and level-triggered sensor signals (p3394 = p3395 = 1 or 2) activated:

- Once a stop or low speed sensor at the positive or negative position is triggered, the motor stops and goes to low speed even if the level is canceled.
- Once a stop or low speed sensor at the center position is triggered, the motor stops and goes to low speed; if the level is cancelled, then the motor runs again.

Parameters

Conveyor technology control parameters (Page 203)



7.9.5 Conveyor technology control parameters

Parameter	Description	Setting
r0722.0...25	CO/BO: Digital inputs status	Interconnect the signals of the sensors to the digital inputs as desired.
p1070[0...n]	CI: Main setpoint	Sets the signal source for the main setpoint.
p1071[0...n]	CI: Main setpoint scaling	Sets the signal source for scaling the main setpoint. Factory setting: 1
p1075[0...n]	CI: Supplementary setpoint	Sets the signal source for the supplementary setpoint. Note that the supplementary setpoint adds to both p3397 and p3398
p1076[0...n]	CI: Supplementary setpoint scaling	Sets the signal source for scaling the supplementary setpoint. Factory setting: 1
p1113[0...n]	BI: Setpoint inversion	Signal source for inverting the setpoint. 1 signal: Invert setpoint The factory setting depends on the converter fieldbus interface.
p3384	BI: Stop sensor positive direction signal source	Sets the signal source of the stop sensor for the positive direction. Factory setting: 0
p3385	BI: Stop sensor negative direction signal source	Sets the signal source of the stop sensor for the negative direction. Factory setting: 0
p3386	BI: Stop sensor center signal source	Sets the signal source of the stop sensor for the middle position. Factory setting: 0
p3387	BI: Low speed sensor positive direction signal source	Sets the signal source of the low speed sensor for the positive direction. Factory setting: 0
p3388	BI: Low speed sensor negative direction signal source	Sets the signal source of the low speed sensor for the negative direction. Factory setting: 0
p3389	BI: Low speed sensor center signal source	Sets the signal source of the low speed sensor for the middle position. Factory setting: 0
p3390	BI: Stop/low speed sensor bypass signal source	Sets the signal source for bypassing the stop and low speed sensors. 1 signal: The stop and low speed sensors are not taken into account. The factory setting depends on the converter fieldbus interface.
p3391	BI: Stop/low speed sensor bypass manual operation signal source	Sets the signal source for bypassing the stop and low speed sensors in the "manual operation" mode. Factory setting: 8559.4
p3392	End position shutdown activation	= 0: End position shutdown deactivated. Travel can be continued in both directions. = 1: End position shutdown activated (factory setting). Travel can only be continued in the opposite direction.
p3393	Conveyor technology application selection	Selects the conveyor technology application. Factory setting: 0

Parameter	Description	Setting
p3394	Stop sensor evaluation type	= 1: Input signal high level triggered = 2: Input signal low level triggered (factory setting) = 3: Input signal 0→1 edge triggered = 4: Input signal 1→0 edge triggered
p3395	Low speed sensor evaluation type	See p3394. Factory setting: 4
r3396.0...16	CO/BO: Conveyor technology application status	Displays the status of the conveyor technology application.
p3397	CI: Rapid traverse setpoint signal source	Sets the signal source of the high speed setpoint. The setpoint for the input is interconnected with the main setpoint p1070.
p3398	CI: Low speed setpoint signal source	Sets the signal source of the low speed setpoint. The connector input can be interconnected with a fixed setpoint (p1001 and following) or potentiometer (r0752). Factory setting: 0
r3399	CO: Setpoint active	Displays the active setpoint of the conveyor technology application.

For more information about the conveyor control function, refer to the parameter list and function diagrams 7040 to 7051 in the List Manual.

7.10 Switching over the drive control (command data set)

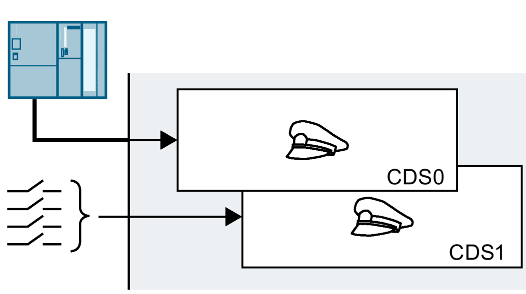
Overview

Several applications require the option of switching over the control authority to operate the converter.

Example: The motor is to be operable either from a central control via the fieldbus or via the local digital inputs of the converter.

Function description

Command data set (CDS)



This means that you can set the converter control in various ways and toggle between the settings. For instance, as described above, the converter can either be operated via a fieldbus or via its digital inputs.

The settings in the converter, 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.

Changing the number of command data sets

1. Set p0010 = 15.
2. The number of command data sets is configured with p0170.
3. Set p0010 = 0.

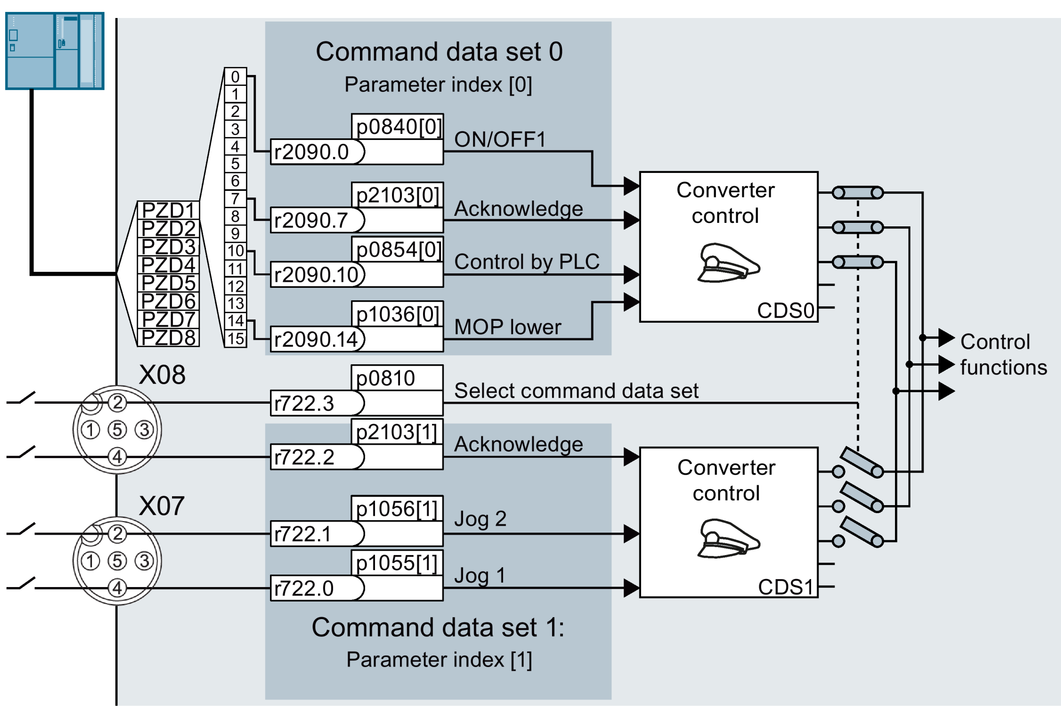
You have changed the number of command data sets.
❒

Copying command data sets

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 to start the copying.
4. The converter sets p0809[2] = 0 after the copying finishes.

You have copied the settings of a command data set into another command data set.
❒

Example



As in the example above, you obtain the interconnection if you configured the interfaces of the converter accordingly.

An overview of all the parameters that belong to the command data sets is provided in the List Manual.

Note

The converter requires approximately 4 ms to switch over the command data set.

Parameters

Parameter	Description	Setting
p0010	Drive commissioning parameter filter	Set p0010 = 15 to change the data set. Factory setting: 1
r0050.0...1	CO/BO: Command Data Set CDS effective	Displays the number of the currently active command data set
p0170	Number of command data sets (CDS)	p0170 = 2, 3 or 4 Factory setting: 2
p0809[0...2]	Copy command data set CDS	[0] Source command data set [1] Target command data set [2] 0→1: Starts the copy operation Factory setting: 0
p0810	BI: Command data set selection CDS bit 0	Sets the signal source to select CDS bit 0. Factory setting: dependent upon the converter
p0811	BI: Command data set selection CDS bit 1	Sets the signal source to select CDS bit 1. Factory setting: 0

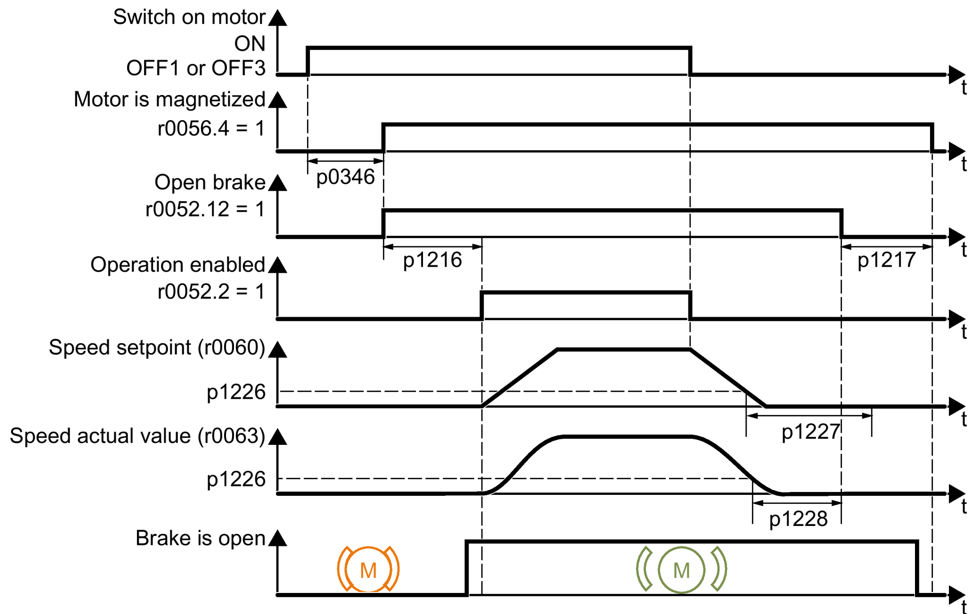
7.11 Motor holding brake

Overview

The motor holding brake holds the motor in position when it is switched off.

When the "Motor holding brake" function is correctly set, the motor remains switched on as long as the motor holding brake is open. The converter only switches the motor off when the motor holding brake is closed.

Function description



After the ON command

1. With the ON command, the converter switches the motor on.
2. At the end of the "motor excitation build-up time" (p0346), the converter issues the command to open the brake.
3. The converter keeps the motor at a standstill until the "motor holding brake opening time" p1216 has ended.

   The motor holding brake must be opened within time p1216.
4. The converter accelerates the motor to the speed setpoint.

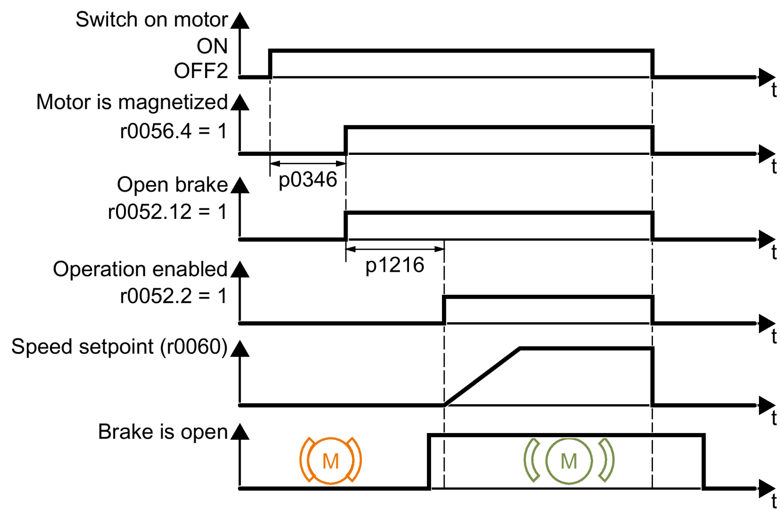
After the OFF1 or OFF3 command

1. The converter brakes the motor down to a standstill using the OFF1 or OFF3 command.
2. When braking, the converter compares the speed setpoint and the actual speed with the "standstill detection speed threshold" p1226:
   – Speed setpoint < p1226: the "standstill detection monitoring time" p1227 starts
   – Current speed < p1226: the "pulse cancellation deceleration time" p1228 starts
3. When the first of the two times (p1227 or p1228) has elapsed, the converter issues the command to close the brake.
4. After the "motor holding brake closing time" p1217, the converter switches off the motor.

   The motor holding brake must close within the time p1217.

After the OFF2 command

After the OFF2 command, the converter issues the signal to immediately close the motor holding brake, irrespective of the motor speed.



Commissioning a motor holding brake

Precondition

The motor holding brake is connected to the converter.

WARNING

Load can fall if the motor holding brake function is incorrectly set

For applications with a suspended load, such as cranes and elevators, there is a danger to life if the "Motor holding brake" function is not completely set or is incorrectly set.

- When commissioning the motor holding brake function, secure any suspended loads, e.g. by applying the following measures:
  - Lower the load down to the floor.
  - Secure the dangerous area so that nobody can inadvertently enter it.
- Set the motor holding brake function according to the following description.
- After commissioning, check that the motor holding brake and the motor control function reliably.

Procedure

1. Set p1215 = 1.

   The motor holding brake function is enabled.

2. Check the magnetizing time p0346.

   The magnetizing time must be greater than zero. The converter assigns the magnetizing time when it is being commissioned.

3. Find out the mechanical opening and closing times from the technical data of the motor holding brake.
   – Depending on the brake size, brake opening times lie between 25 ms and 500 ms.
   – Depending on the brake size, brake closing times lie between 15 ms and 300 ms.
4. Set the following parameters in the converter suitably for the mechanical opening and closing times of the motor holding brake:
   – p1216 ≥ mechanical opening time of the motor holding brake
   – p1217 > mechanical closing time of the motor holding brake
5. Switch on the motor.
6. Check the acceleration behavior of the drive immediately after the motor has been switched on:
   – If the motor holding brake opens too late, the converter will accelerate the motor suddenly against the closed motor holding brake.

     Set p1216 larger.
   – If the motor waits too long before accelerating after the motor holding brake has opened, reduce p1216.

     For applications involving a pulling load, e.g. lifting gear/crane, if p1216 is too long, then the load can briefly sag/sink after the motor holding brake is opened. If you reduce p1216, then the amount that the load sags/sinks is reduced.
7. If the load sags after switching on the motor, then you must increase the motor torque when opening the motor holding brake. Depending on the control mode, you must set different parameters:
   – V/f control (p1300 = 0 to 3):
     Increase p1310 in small steps.
     Increase p1351 in small steps.
   – Vector control (p1300 ≥ 20):
     Increase p1475 in small steps.
8. Switch off the motor.
9. Check the behavior of the drive immediately after the motor has been switched off:
   – If the motor holding brake closes too late, the load briefly sags before the motor holding brake closes.

     Set a larger value for p1217.
   – If the motor waits too long before switching off after the motor holding brake has closed, reduce p1217.

You have commissioned the motor holding brake function.
❒

Parameters

Basic settings

Parameter	Description	Setting
p1215	Enable motor holding brake	0: Motor holding brake locked (factory setting) 1: Motor holding brake just like the sequence control 2: Motor holding brake permanently open 3: Motor holding brake just like the sequential control, connected via BICO
p1216	Motor holding brake opening time [s]	p1216 > braking signal relay runtimes + brake release time Factory setting: 0.1
p1217	Motor holding brake closing time [s]	p1217 > braking signal relay runtimes + brake closing time Factory setting: 0.1
r0052.12	CO/BO: Status word 1: motor holding brake open	-

Advanced settings

Parameter	Description	Setting
p0346	Motor excitation build-up time [s]	During this time the asynchronous motor is magnetized. The converter calculates this parameter using p0340 = 1 or 3. Factory setting: 0
p0855	BI: Unconditionally release holding brake	Sets the signal source for the command "unconditionally open holding brake". Factory setting: 0
p0858	BI: Unconditionally close holding brake	Sets the signal source for the command "unconditionally close holding brake". Factory setting: 0
p1226	Threshold for zero speed detection [rpm]	When braking with OFF1 or OFF3, if the speed falls below this threshold, standstill is detected and the monitoring time p1227 or p1228 starts. Factory setting: 20
p1227	Zero speed detection monitoring time [s]	Sets the monitoring time for the standstill identification. Factory setting: 300
p1228	Pulse suppression delay time [s]	Sets the delay time for pulse suppression. Factory setting: 0.01
p1351	CO: Motor holding brake starting frequency [%]	Sets the frequency set value at the slip compensation output when starting with motor holding brake. With p1351 > 0, slip compensation is automatically switched on. Factory setting: 0
p1352	CI: Motor holding brake starting frequency signal source	Sets the signal source for the frequency set value at the slip compensation output when starting with motor holding brake. Factory setting: 1351
p1475	CI: Speed controller torque setting value for motor holding brake	Sets the signal source for the torque set value when starting with motor holding brake. Factory setting: 0

7.12 Encoder interface

Overview

The SINAMICS G115D converter has a simple HTL encoder interface where the A and B tracks of the HTL encoder are read into the converter via two digital inputs (DI0 and DI1).
The other encoder signals, inverted A and B tracks and zero signals, are not read in or evaluated.
As an alternative to the HTL encoder, one sensor can be connected as a pulse encoder or two sensors/signals as pulse/direction encoders.

An encoder or sensor connected to the SINAMICS G115D is not used for motor control.
The SINAMICS G115D converter is only a decentralized encoder interface for a higher-level controller (PLC).
This means that the encoder signal is acquired in the SINAMICS G115D and the counter value can be sent to the control system via Profinet with telegram 3 in order to realize positioning with a technology object.

When using an HTL encoder:

- An HTL encoder can be read in via DI0 and DI1 (A and B track only).
- 2-bit fine resolution
- Pulse multiplication (fourfold)

When using sensors (pulse / direction interface):

- One sensor (pulse) or two sensors / signals (pulse and direction) can be connected
- 2-bit fine resolution
- No pulse multiplication

Specifications

Maximum resolution: 2048 pulses/rotation
Maximum HTL frequency: 200 kHz
Maximum permitted cable length for the encoder: 30 m with shielding.

7.13 Free function block

Overview

The free function blocks permit configurable signal processing in the converter.

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 converter is limited. You can only use a function block once. The converter has 3 adders, for instance. If you have already configured three adders, then no other adders are available.

Further information

Further information about the application description for the free function blocks is provided on the Internet:

FAQ (https://support.industry.siemens.com/cs/ww/en/view/85168215)

7.14 Selecting physical units

7.14.1 Motor standard

Selection options and parameters involved

The converter represents the motor data corresponding to motor standard IEC or NEMA in different system units: SI units or US units.

It is only possible to change the motor standard during quick commissioning.

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 unit 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

7.14.2 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 [%]
- 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 ≙ p0505 = 2 and p0505 = 3 ≙ 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 ≙ p0505 = 3 and p0505 = 2 ≙ 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 → fixed speed = 80 % ≙ 1200 rpm
- Reference speed = 3000 rpm → fixed speed = 80 % ≙ 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.

7.14.3 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], [m^3/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.

7.14.4 Setting the system of units and technology unit

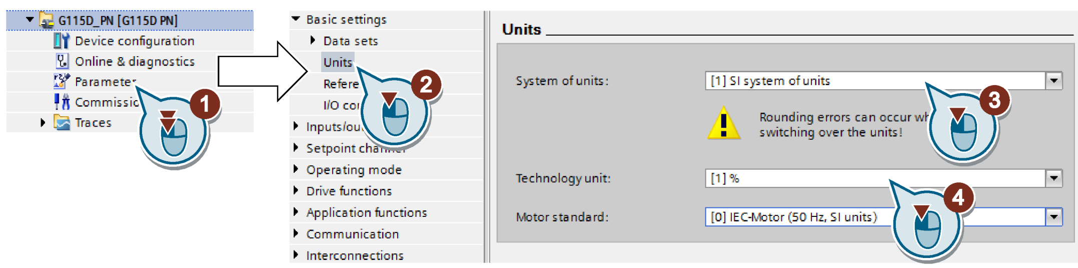
Setting using Startdrive

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 converter signals that offline, other units and process variables are set than in the converter itself.
7. Accept these settings in the converter.

You have selected the motor standard and system of units.
❒

7.15 Safe Torque Off (STO) safety function

The Operating Instructions describes how to commission the STO safety function as a basic function for control via a fail-safe digital input.

A description of all the safety function is provided in the "safety Integrated" Function Manual:

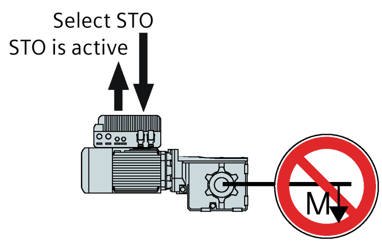
- The basic functions and extended functions
- Controlling safety functions via PROFIsafe

Overview of the manuals (Page 404)

7.15.1 Function description

A converter with active STO function prevents energy supply to the motor. The motor can no longer generate torque at the motor shaft.

Consequently, the STO function prevents the starting of an electrically-driven machine component.

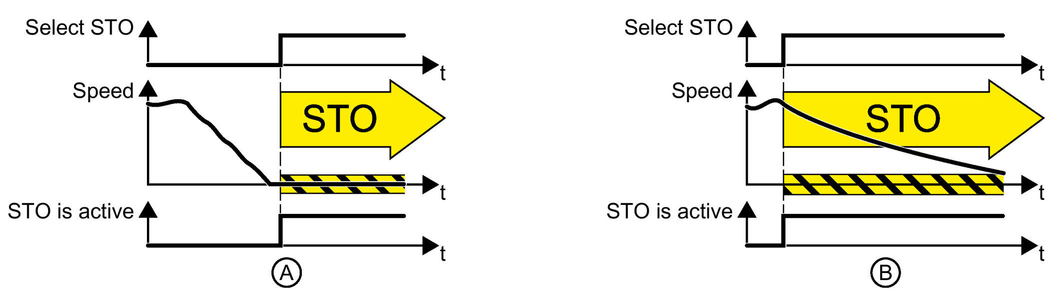


Principle of operation of STO

	Safe Torque Off (STO)	Standard converter functions linked with STO
1.	The converter recognizes the selection of STO via a safety-relevant input or via the PROFIsafe safe communication.	---
2.	The converter interrupts the energy supply to the motor.	If you use a motor holding brake, the converter closes the brake.
3.	The converter signals that "STO is active" via a safety-relevant output or via the PROFIsafe safe communication.	---

Functionality of STO when the motor is at standstill (A) and rotating (B)

If the motor is still rotating (B) when STO is selected, then it coasts down to standstill.



The STO safety function is standardized

The STO function is defined in IEC/EN 61800-5-2:

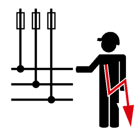
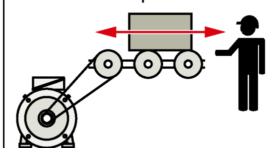
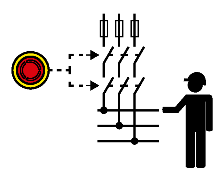
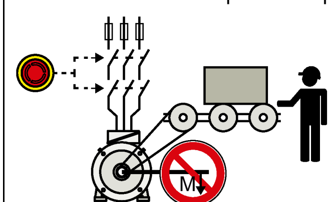
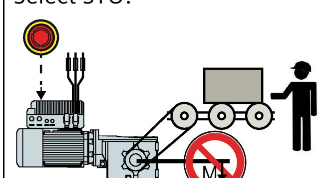
"[...] [The converter] does not supply any energy to the motor which can generate a torque (or for a linear motor, a force)."

⇒ The STO converter function is in conformance to IEC/EN 61800-5-2.

The distinction between Emergency Off and Emergency Stop

"Emergency Off" and "Emergency Stop" are commands that minimize different risks in the machine or plant.

The STO function is suitable for achieving an emergency stop but not an emergency off.

Risk:	Risk of electric shock: 	Risk of unexpected motion: 
Measure to minimize risk:	**Safe switch off** Switching off the electric power supply for the installation, either completely or partially.	**Safely stop and safely prevent restarting** Stopping or preventing the dangerous movement
Command:	**Emergency Off**	**Emergency Stop**
Classic solution:	Switch off the power supply: 	Switch off the drive power supply: 
Solution with the STO safety function integrated in the drive:	STO is not suitable for safely switching off an electric voltage.	Select STO:  It is permissible that you switch off the converter supply voltage as well. However, switching off the voltage is not required as a risk-reduction measurement.

Application examples for the STO function

The STO function is suitable for applications where the motor is already at a standstill or will come to a standstill in a short, safe period of time through friction. STO does not shorten the run-on of machine components with high inertia.

Examples	Possible solution
When the Emergency Stop button is pressed, a stationary motor should not unintentionally start.	• Wire the Emergency Stop button to a fail-safe input of the converter. • Select STO via the fail-safe input.
A central emergency stop button must prevent the unintentional acceleration of several motors that are at a standstill.	• Evaluate the Emergency Stop button in a central control. • Select STO via PROFIsafe.

Prerequisite for STO use

In order to use the STO safety function, the machine manufacturer should have already performed a risk assessment, e.g. in compliance with EN ISO 12100, "Safety of machinery – General principles for design – Risk assessment and risk reduction". The risk assessment must confirm that the converter is permitted for use in accordance with SIL 2 or PL d.

7.15.2 Commissioning STO

7.15.2.1 Commissioning tool

We recommend that you commission the safety functions using a commissioning tool (e.g. Startdrive or SINAMICS G120 Smart Access).

Commissioning tools (Page 92)

The following sections only introduce the commissioning process of Startdrive as examples. For more information on that of the SINAMICS G120 Smart Access, see the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

7.15.2.2 Safety function password

Overview

The password protects the settings of the safety function from being changed by unauthorized persons.

Function description

Do you have to assign a password?

You do not have to assign a password.

The machine manufacturer decides whether or not a password is required.

The probabilities of failure (PFH) and certification of the safety functions also apply without password.

What do I do if I lose the password?

You have forgotten the password, however, you would nevertheless like to change the setting of the safety functions.

Procedure

1. Create a new project for the converter using Startdrive.

   Leave all the factory setting in the project.
2. Load the project in the converter.

   After loading, the converter has the factory settings.
3. Recommission the converter.

You can obtain more information or learn about alternative procedures from Technical Support.

Parameters

Parameter	Description	Setting
p9761	SI password input	Enters the Safety Integrated password. 0: No password set (factory setting) 1 ... FFFF FFFF: Password is set
p9762	SI password new	Enters a new Safety Integrated password.
p9763	SI password acknowledgment	Acknowledges the new Safety Integrated password.

7.15.2.3 Configuring a safety function

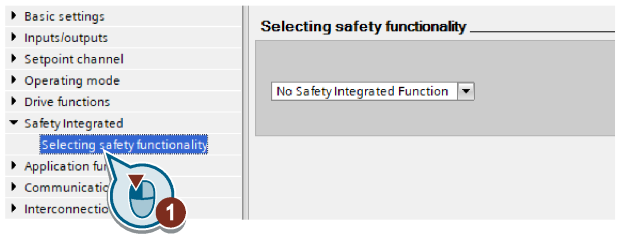
Overview

To ensure protection against unauthorized changes, it is recommended that you configure the safety function settings.

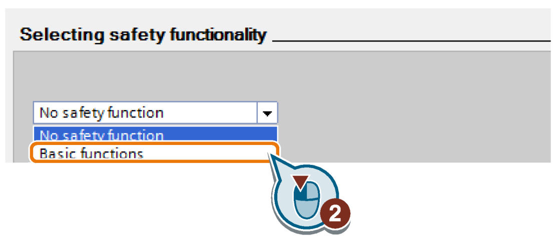
Function description

Procedure

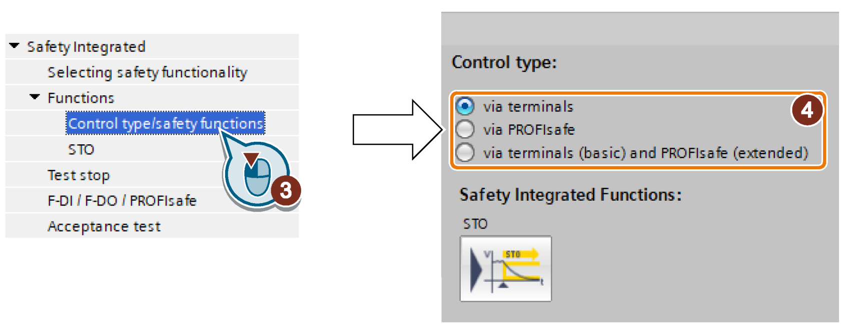
1. Select "Select safety functionality".



2. Select "Basic Functions".



3. Select "Control type/safety functions".



4. Select "Via terminals" as control type for the safety functions.

You have configured the safety functions.
❒

Additional configurations of the safety functions are described in the "Safety Integrated" Function Manual.

Overview of the manuals (Page 404)

7.15.2.4 Interconnecting the "STO active" signal

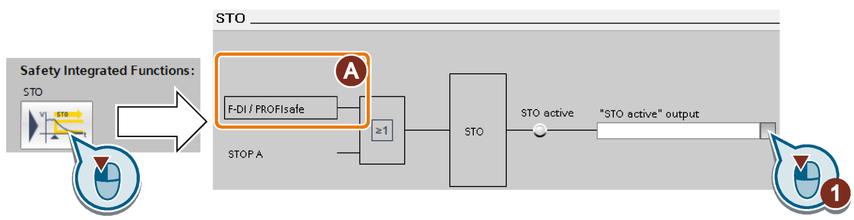
Overview

If you require the feedback signal "STO active" of the converter in your higher-level control system, then you must appropriately interconnect the signal.

Function description

Procedure

1. Select the button for the feedback signal.



The screen form varies depending on the interface selected.

(A) Control type

2. Select the signal that matches your particular application.

You have interconnected the "STO active" checkback signal.
❒

After STO has been selected, the converter signals "STO active" to the higher-level control.

Parameters

Parameter	Description	Setting
r9773.0...31	CO/BO: SI status (processor 1 + processor 2)	Display and BICO output for the Safety Integrated status on the drive (processor 1 + processor 2). Bit 0: STO is selected in the drive Bit 1: STO is active in the drive Bit 31: Test stop is required for STO

7.15.2.5 Setting the filter for fail-safe digital inputs

Overview

The following filters are available for the fail-safe digital inputs:

- A filter for the simultaneity monitoring
- A filter for suppressing short signals, e.g. test pulses.

Function description

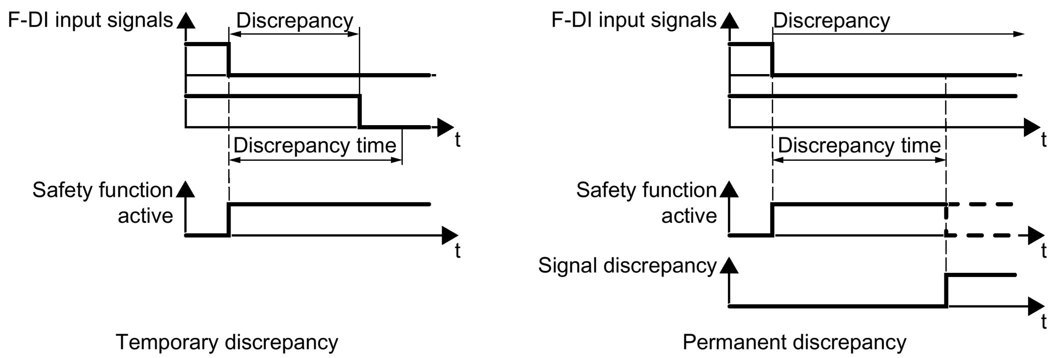
Discrepancy time for the simultaneity monitoring

The converter checks that the two input signals of the fail-safe digital input always have the same signal state (high or low).

With electromechanical sensors (e.g. emergency stop buttons or door switches), the two sensor contacts never switch at exactly the same time and are therefore temporarily inconsistent (discrepancy). A permanent discrepancy signifies a fault in the fail-safe digital input circuit, e.g. wire breakage.

When appropriately set, the converter tolerates brief discrepancies.

The discrepancy time does not extend the converter response time. The converter selects its safety function as soon as one of the two F-DI signals changes its state from high to low.

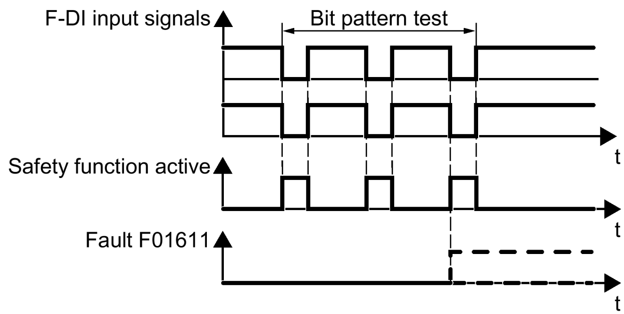


Filter for suppressing short signals

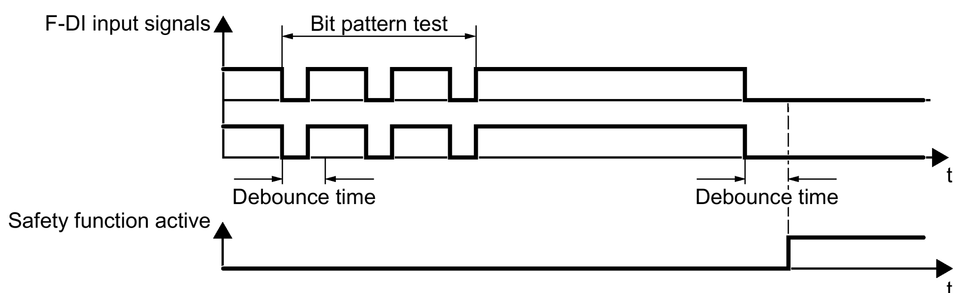
In the following cases, an immediate converter response to signal changes of the fail-safe digital inputs is not desirable:

- If a fail-safe digital input of the converter is interconnected with an electromechanical sensor, signal changes can occur due to contact bounce.
- In order to identify faults due to short-circuit or cross faults, several control modules test their fail-safe digital outputs with "bit pattern tests" (bright/dark test). If a fail-safe digital input of the converter is interconnected with a fail-safe digital output of an open-loop control module, then the converter responds with a bit pattern test.
  The typical duration of the signal change within a bit pattern test:
  - On test: 1 ms
  - Off test: 4 ms

If the fail-safe digital input responds to many signal changes within a certain time, then the converter responds with a fault.



A filter in the converter suppresses brief signals as a result of the bit pattern test or contact bounce.



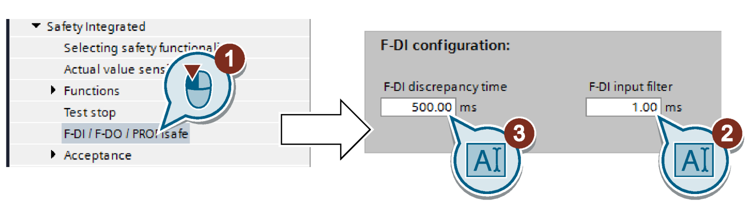
The filter extends the response time of the safety function by the debounce time.

Setting the filter for fail-safe digital inputs

Precondition

You are online with Startdrive.

Procedure



1. Navigate to the filter settings.
2. Set the debounce time for the F-DI input filter.
3. Set the discrepancy time for the simultaneity monitoring.

You have set the input filter and the simultaneity monitoring of the fail-safe digital input.
❒

Parameters

Parameter	Description	Setting
p9650	SI F-DI changeover discrepancy time (processor 1) [ms]	Tolerance time to change over the fail-safe digital input for the basic functions. Factory setting: 500 ms
p9651	SI STO debounce time (processor 1) [ms]	Debounce time of the fail-safe digital input for the basic functions. Factory setting: 1 ms

Further information

Debounce times for standard and safety functions

The debounce time p0724 for "standard" digital inputs has no influence on the fail-safe input signals. Conversely, the same applies: The F-DI debounce time does not affect the signals of the "standard" inputs.

If you use an input as a standard input, set the debounce time using parameter p0724.

If you use an input as a fail-safe input, set the debounce time as described above.

7.15.2.6 Setting the forced checking procedure (test stop)

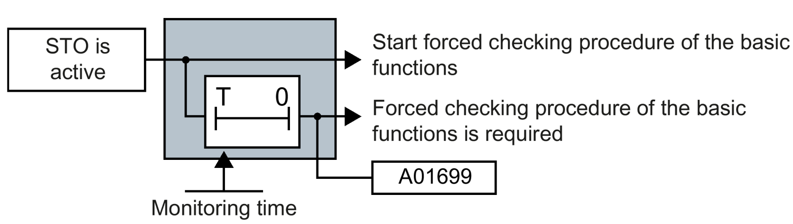
Overview

The forced checking procedure (test stop) of the basic functions is a converter self test. The converter checks its circuits to switch off the torque.

Function description

You start the forced checking procedure each time that the STO function is selected.

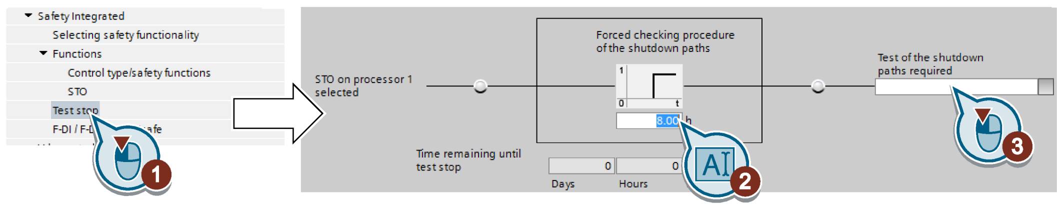
Using a timer block, the converter monitors as to whether the forced checking procedure is regularly performed.



Precondition

You are online with Startdrive.

Procedure



1. Select the screen form for setting the forced checking procedure.
2. Set the monitoring time to a value to match your application.

   Requirement: Forced checking procedure (test stop) must be performed at least once a year.
3. Using this signal, the converter signals that a forced checking procedure (test stop) is required.

   Interconnect this signal with a converter signal of your choice.

You have set the forced checking procedure (test stop) for the Basic Functions.
❒

Parameters

Parameter	Description	Setting
p9659	SI forced checking procedure timer [h]	Monitoring time for the forced dormant error detection. Factory setting: 8 h
r9660	SI forced checking procedure remaining time	Displays the remaining time until the forced dormant error detection and testing the safety switch-off signal paths.
r9773.0...31	CO/BO: SI status (processor 1 + processor 2)	Signals for the higher-level control system. Bit 31: Test stop is required for STO

7.15.2.7 Finalizing online commissioning

Overview

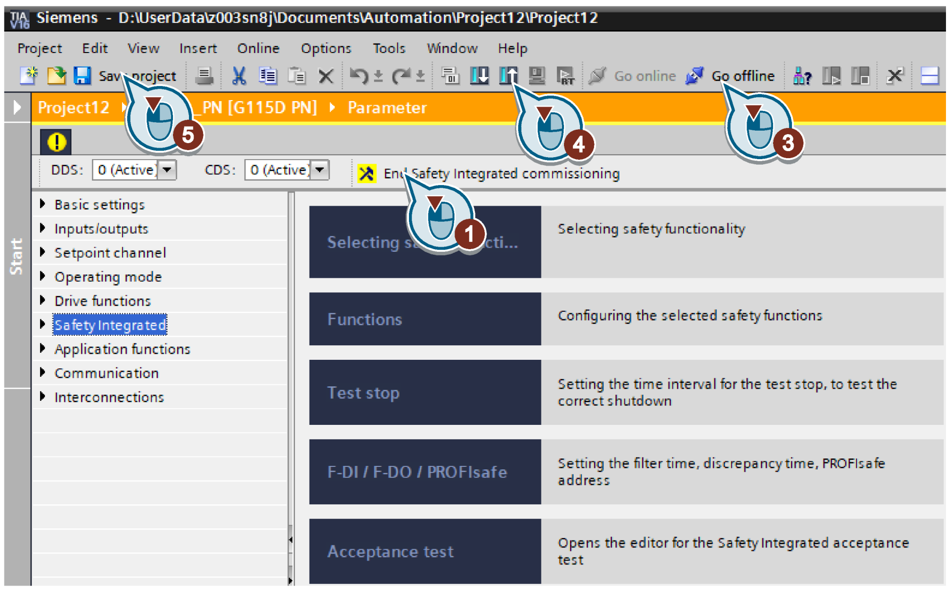
After you finish the configuration of the safety function, proceed through the following operations to activate the settings.

Precondition

You are online with Startdrive.

Function description

Procedure



1. Press the button to end the safety commissioning.
2. Confirm the prompt for saving your settings (copy RAM to ROM).
3. Disconnect the online connection.
4. Select the button to transfer settings from the converter to the PG/PC.
5. Save the project.
6. Switch off the converter power supply.
7. Wait until all LEDs on the converter go dark (no voltage condition).
8. Switch the converter power supply on again.

Your settings are now active.

❒

Parameters

Parameter	Description	Setting
p0010	Drive commissioning parameter filter	0: Ready
p0971	Save parameters	1: Save the drive object (copy from RAM to ROM) After the converter has saved the parameters in a non-volatile fashion, then p0971 = 0.
p9700	SI Motion copy function	Start the SI parameter copy function. Factory setting: 0
p9701	Acknowledge SI motion data change	Confirm SI Basic parameter change Factory setting: 0

7.15.2.8 Checking the interconnection of digital inputs

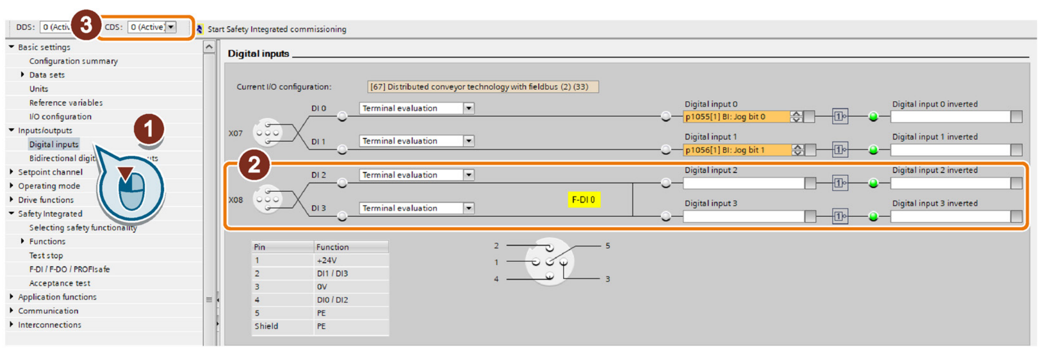
Overview

The simultaneous connection of digital inputs with a safety function and a "standard" function may lead to the drive behaving in unexpected ways.

If you control the safety functions in the converter via fail-safe digital inputs, then you must check as to whether the fail-safe digital inputs are in some instances interconnected with a "standard" function.

Function description

Procedure



1. Select the screen for the digital inputs.
2. Remove all interconnections of the digital inputs that you use as fail-safe digital input F-DI:
3. You must delete the digital input connections for all CDS if you use the switchover of the command data sets (CDS).

   You can find a description of the CDS switchover in the operating instructions.

You have ensured that the fail-safe digital inputs only control the safety functions in the converter.
❒

7.15.2.9 Acceptance - completion of commissioning

Overview

The machine manufacturer is responsible in ensuring that his plant or machine functions perfectly. As a consequence, after commissioning, the machine manufacturer must check those functions or have them checked by specialist personnel, which represent an increased risk of injury or material damage. This acceptance or validation is, for example, also specified in the European machinery directive and essentially comprises two parts:

- Checking the safety-relevant functions and machine parts.

  → **Acceptance test**.

- Generate an "Acceptance report" that describes the test results.

  → **Documentation**.

Supply information for the validation, e.g. the harmonized European standards EN ISO 13849-1 and EN ISO 13849-2.

Function description

Acceptance test of the machine or plant

The acceptance test checks whether the safety-relevant functions in the plant or machine function correctly. The documentation of the components used in the safety functions can also provide information about the necessary tests.

Testing the safety-related functions includes, e.g. the following:

- Are all safety equipment such as protective door monitoring devices, light barriers or emergency-off switches connected and ready for operation?
- Does the higher-level control respond as expected to the safety-relevant feedback signals of the converter?
- Do the converter settings match the configured safety-relevant function in the machine?

Acceptance test of the converter

The acceptance test of the converter is a part of the acceptance test of the entire machine or plant.

The acceptance test of the converter checks whether the integrated drive safety functions are set up correctly for the planned safety function of the machine.

Recommended acceptance test (Page 400)

Documentation of the converter

The following must be documented for the converter:

- The results of the acceptance test.
- The settings of the integrated drive safety functions.

The documentation must be signed.

Who may perform the acceptance test of the converter?

Personnel from the machine manufacturer, who, on account of their technical qualifications and knowledge of the safety functions, are in a position to perform the acceptance test in the correct manner are authorized to perform the acceptance testing of the converter.

Wizard for the acceptance test

The "Startdrive Advanced" commissioning tool (requires an appropriate license) includes a wizard for the acceptance test of the safety functions integrated in the drive.

"Startdrive Advanced" guides you through the acceptance test, generates the appropriate traces to analyze the machine response – and generates an acceptance report as Excel file.

Further information is provided on the Internet:

Startdrive, system requirements and download (https://support.industry.siemens.com/cs/ww/en/view/109771710) (Startdrive, system requirements and download)

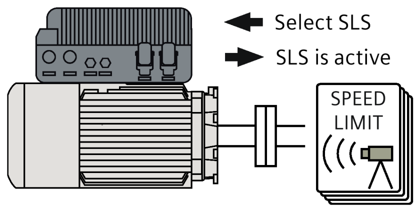
Reduced acceptance test after function expansions

A full acceptance test is necessary only after first commissioning. A reduced acceptance test is sufficient when safety functions are expanded.

Measure	Acceptance test	
	Acceptance test	Documentation
Functional expansion of the machine (additional drive).	Yes. Only check the safety functions of the new drive.	• Supplement machine overview • Supplement converter data • Add function table • Log the new checksums • Countersignature
Transfer of converter settings to other identical machines by means of series commissioning.	No. Only check the control of all of the safety functions.	• Add machine description • Check checksums • Check firmware versions

7.16 Safely Limited Speed (SLS)

Overview



The converter with active SLS function monitors the motor speed. When the monitoring limit is exceeded, the converter stops the motor as quickly as possible.

As a consequence, the SLS function allows an electrically driven machine component to be operated with a temporarily reduced speed or velocity that is not hazardous.

Requirement

The machine manufacturer has already performed a risk assessment, e.g. in compliance with EN ISO 12100, "Safety of machinery – General principles for design – Risk assessment and risk reduction". The risk assessment must confirm that it is permissible to use the SLS safety function.

Function description

Table 7- 1 An overview of the principle of operation of SLS, selected when the motor is rotating

	Safely Limited Speed (SLS)	Standard converter functions linked with SLS
1.	The converter identifies when SLS is selected via secure PROFIsafe communication.	---
2.	SLS allows a motor to reduce its possibly inadmissibly high speed within a defined time – or to reduce it along a defined braking ramp.	The converter limits the speed setpoint to values below the SLS monitoring. If the motor rotates faster than the SLS monitoring value, then the converter brakes the motor along the OFF3 ramp.
3.	The converter monitors the absolute actual speed against the set SLS monitoring. The converter signals "SLS is active" via PROFIsafe. If the motor speed exceeds the SLS monitoring, the converter responds with a "safe stop" and brakes the motor as quickly as possible.	The converter limits the speed setpoint to values below the SLS monitoring.

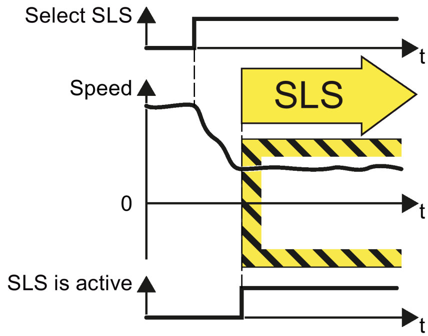


Figure 7-1 Principle of operation of SLS

The SLS safety function is standardized

The SLS function is defined in IEC/EN 61800-5-2:

"The SLS function prevents the motor from exceeding the defined speed limit."

⇒ The SLS converter function is in conformance with IEC/EN 61800-5-2.

Example

Examples	Possible solution
Setup mode: The machine operator must enter the dangerous area of a machine and manually introduce material into a machine part.	• Select SLS in the converter via PROFIsafe or use it always active. • The converter limits and monitors the speed of the machine part.
The maximum speed of a conveyor below should be safely limited for personnel protection.	

Further information

Expansion of the SLS function to include several SLS levels:

- The speed monitoring of the SLS function can be extended to include a maximum of 4 different SLS levels.
- The converter requires additional safety-related signals to select an SLS level and to signal back which SLS level is active.

It is only possible to select SLS levels via PROFIsafe.

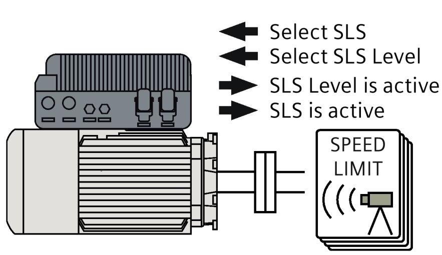


Figure 7-2 SLS level sign

The switchover from a higher SLS level 2 to a lower SLS level 1 is described below.

Table 7- 2 Switching over from SLS level 2 to SLS level 1

	Safely Limited Speed (SLS)	Standard converter functions linked with SLS
1.	The converter signals "SLS level 2 is active" via the safety-related PROFIsafe communication.	The converter limits the speed setpoint to values below SLS level 2.
2.	The converter recognizes the selection of SLS level 1 via secure PROFIsafe communication.	
3.	SLS allows a motor to reduce its possibly inadmissibly high speed within a defined time – or to reduce it along a defined braking ramp.	The converter limits the speed setpoint to values below SLS level 1. If the motor rotates faster than the SLS monitoring value, then the converter brakes the motor along the OFF3 ramp.
4.	The converter monitors the absolute actual speed against SLS level 1. The converter signals "SLS level 1 is active" via secure PROFIsafe communication.	The converter limits the speed setpoint to values below SLS level 1.

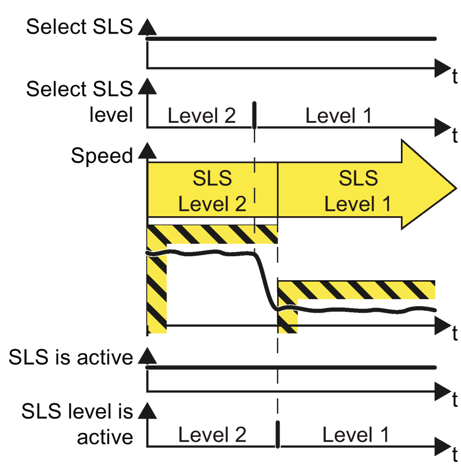


Figure 7-3 Switching over from SLS level 2 to SLS level 1

Table 7- 3 Application example for selecting SLS levels

Examples	Possible solution
Depending on the mass of the goods on a conveyor belt, the maximum permissible speed must no be exceeded.	• Select SLS and the corresponding SLS level in the converter via PROFIsafe.

Commissioning

Before proceeding with the commissioning of the SINAMICS G115D, it is important that you are fully conversant with the all the relevant information regarding Safety Integrated information contained within the Safety Integrated Function Manual. The Safety Integrated Function Manual can be downloaded at the following link:

Safety Integrated Function Manual (https://support.industry.siemens.com/cs/ww/en/view/109818119)

SINAMICS G115D PROFINET

1. Select "Selecting safety functionality".

   → Select "Extended Functions".

   → The "Actual value sensing" is added.

   The safe, encoderless actual value acquisition is used for the motion monitoring of the SLS function. The default settings available here can be used for most applications.
2. Select "Control type / safety functions.

   → Select "via PROFIsafe" as the control type for the safety functions.
3. Parameterization of the SLS function:

   The SLS speed limits are set here. A maximum of 4 limits are available.

   If you use more than one limit, then the step changeover must be programmed in the F program of the higher-level PLC. The stages are switched via PROFIsafe.

   With the setpoint limitation the converter limits the speed setpoint when SLS is selected.

   If this function is required, the signal interconnection must be set after upgrading from V4.7 SP13 to V4.7 SP14:

   – p9733[0] = p1051[0]

   – p9733[1] = p1052[0]

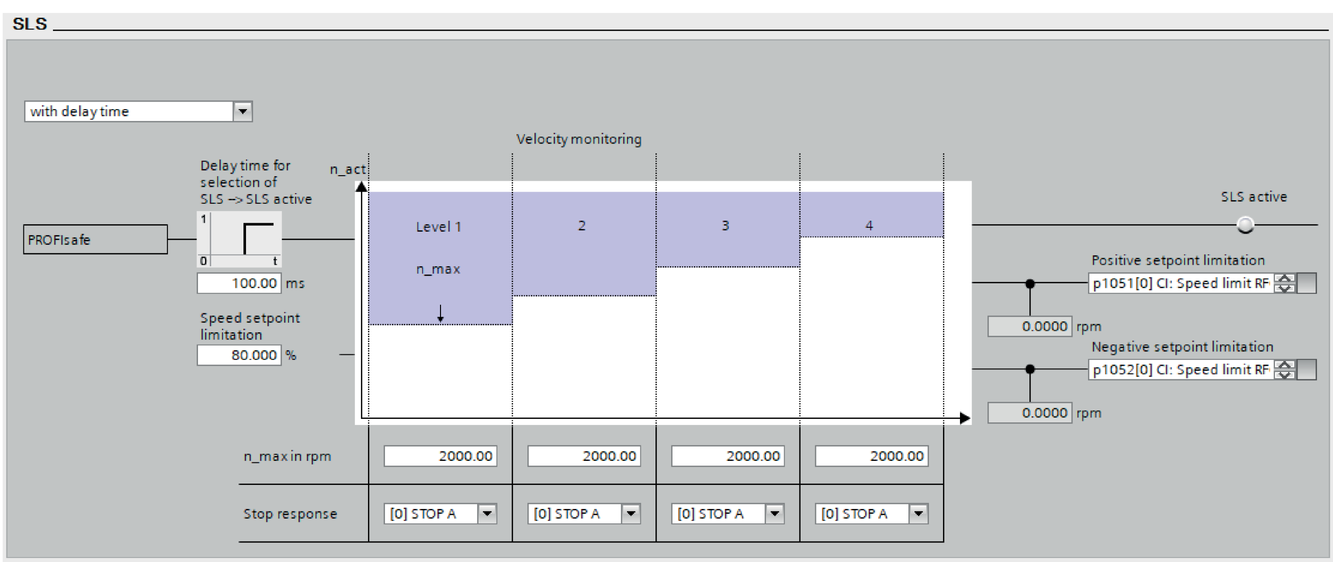


Figure 7-4 Setting the SLS limits

4. Select "Test stop"

   → Set the monitoring time to a value that matches your applications requirements.
5. Select "FDI / F-DO / PROFIsafe"

   → Select the Telegram configuration and set the Send and Receive data.
6. Finalize the commissioning.

SINAMICS G115D AS-i and SINAMICS G115D I/O Control

1. Select "Selecting safety functionality".

   → Select "Extended Functions".

   → The "Actual value sensing" is added.

   The safe, encoderless actual value acquisition is used for the motion monitoring of the SLS function. The default settings available can be used for most applications.

2. Select "Control type / safety functions".

   → Select "via terminals" as the control type for the safety functions.

   → The "F-DI assignment".

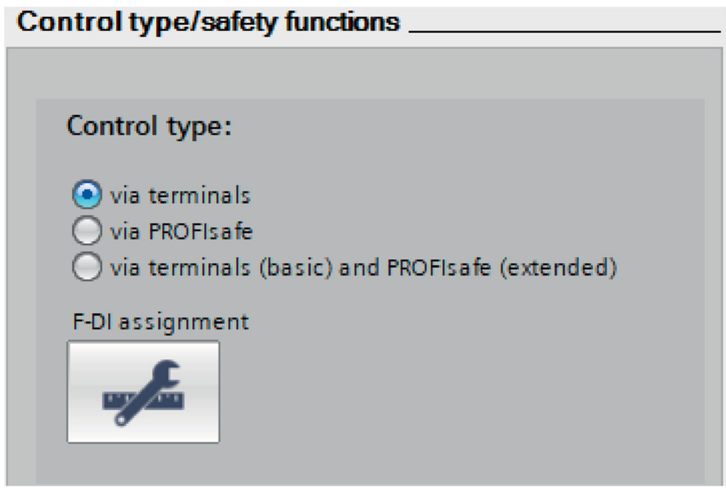


Figure 7-5 Select "via terminals" as the Control type

3. Select "F-DI assignment"

   If SLS should always be active, set the associated "Select F-DI" = "[0] statically active.

   The SLS limit violation must be acknowledged with a failsafe signal. The following options are available:

   – Acknowledge by switching the power supply voltage on and off.

   – Acknowledge via a failsafe digital input. In the case, please refer to Step 6.

Note

Switch on motor within 5s

Switch on the motor with the ON command within 5s after deselecting STO.

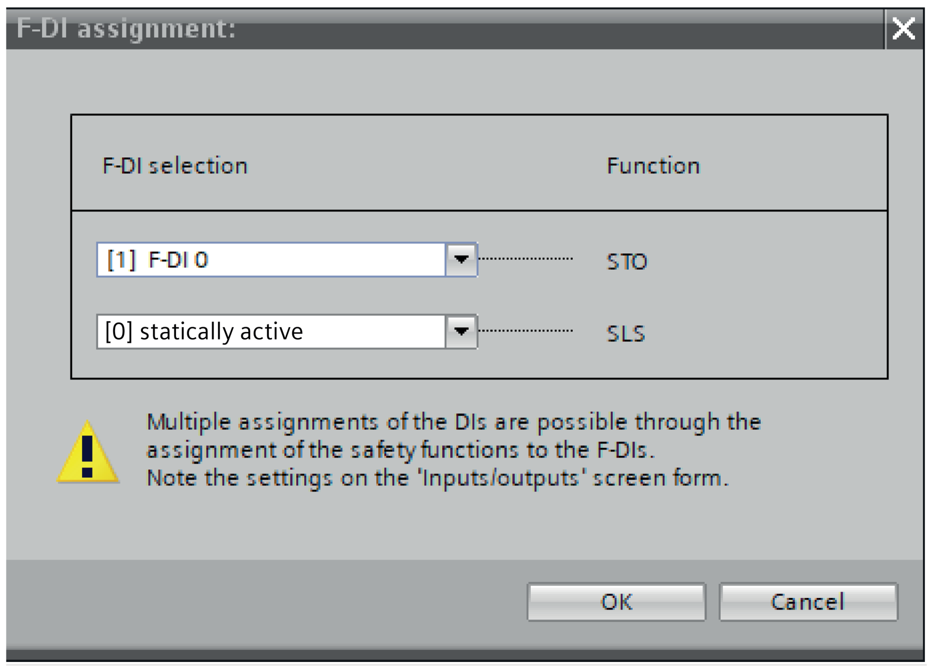


Figure 7-6 Selecting the "F-DI assignment"

   – Acknowledge by selecting and deselecting STO. In this case, the failsafe digital input F-DI0 is connected with STO. Thus STO can be used as an emergency stop and in parallel for the acknowledgement of the SLS errors.

4. Paramaterize the SLS function.

5. Set the SLS speed limit.

   With the setpoint limitation the converter limits the speed setpoint when SLS is selected.

   If this function is required, the signal interconnection must be set after upgrading from V4.7 SP13 to V4.7 SP14:

   – p9733[0] = p1051[0]
   – p9733[1] = p1052[0]

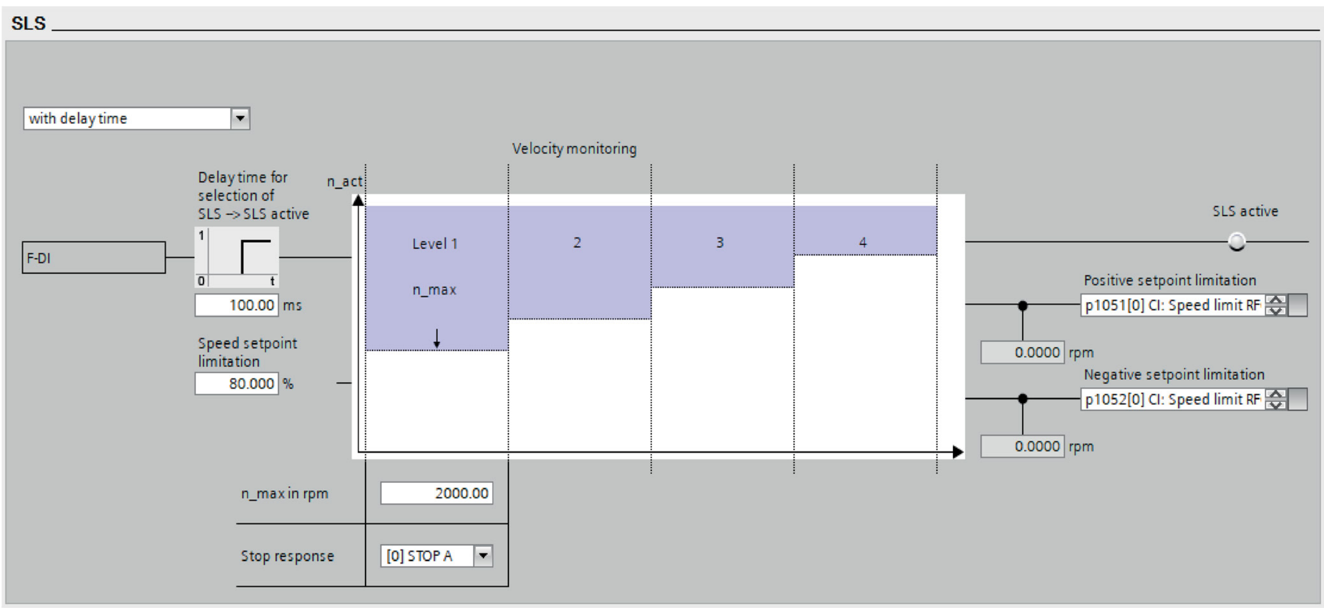


Figure 7-7 Setting the SLS limits

6. Select "Test stop".

   → Set the monitoring time to a value to match the application.

7. Select "F-DI / F-DO/ PROFIsafe"

   → Set the F-DI configuration.

   → Select F-DI if you want to acknowledge the safety alarms without using STO (see Step 3).

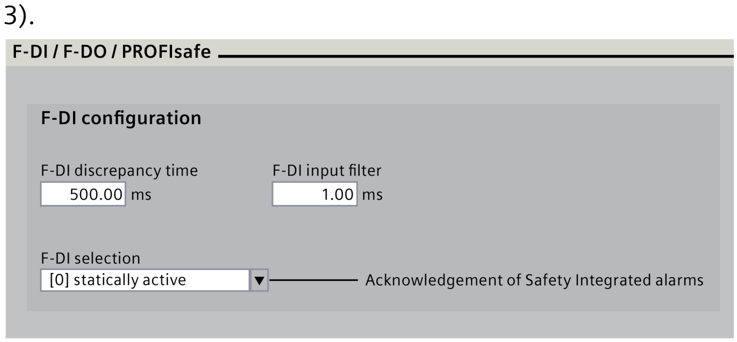


Figure 7-8 F-DI / F-DO/ PROFIsafe configuration

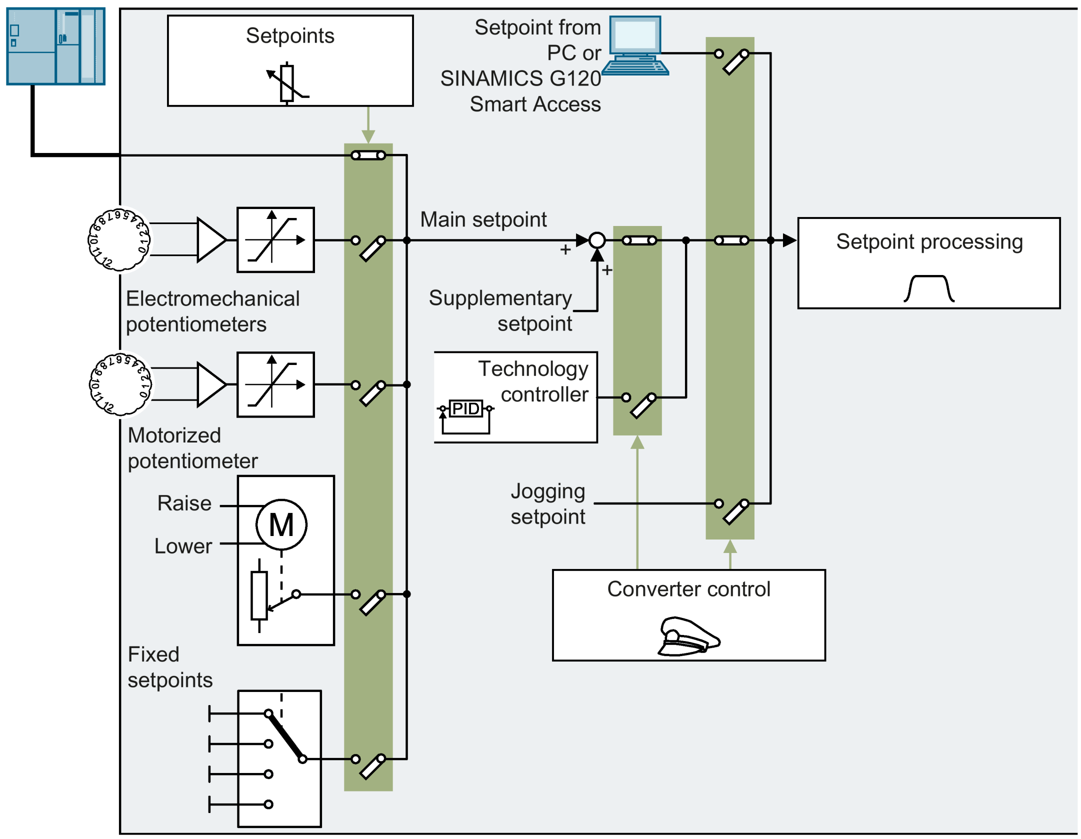
8. Finalize the commissioning.

For further details, please refer to the Safety Integrated Function Manual, available at the following link: Safety Integrated Function Manual (https://support.industry.siemens.com/cs/ww/en/view/109818119)

7.17 Setpoints

7.17.1 Overview

The converter receives its main setpoint from the setpoint source. The main setpoint generally specifies the motor speed.



You have the following options when selecting the source of the main setpoint:

- Converter fieldbus interface
- Electromechanical potentiometer
- Motorized potentiometer simulated in the converter
- Fixed setpoints saved in the converter

You have the same selection options when selecting the source of the supplementary setpoint.

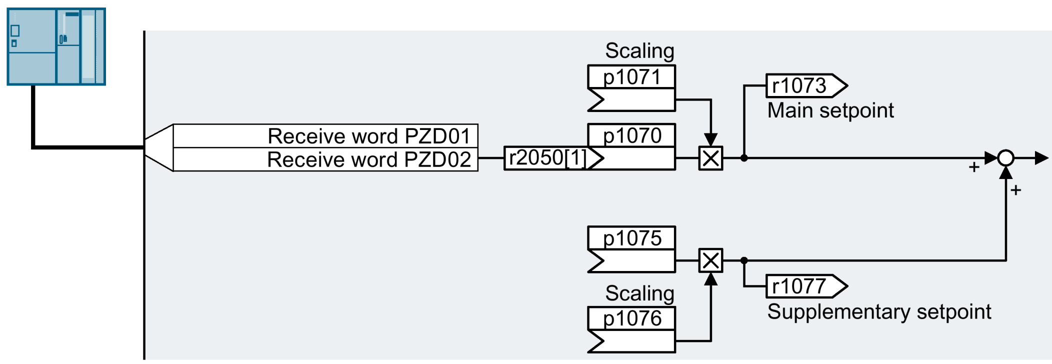
Under the following conditions, the converter switches from the main setpoint to other setpoints:

- When the technology controller is active and appropriately interconnected, its output specifies the motor speed.
- When jogging is active.
- When controlling from a Startdrive PC tool or the SINAMICS G120 Smart Access.

7.17.2 Specifying the setpoint via the fieldbus

Function description

In the quick commissioning, you define the preassignment for the converter 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.

Parameters

Parameter	Description	Setting
p1070[0...n]	CI: Main setpoint	Signal source for the main setpoint. The factory setting depends on the converter. Converter with PROFINET interface: [0] 2050[1] Converter without 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
r1077	CO: Supplementary setpoint effective	Displays the effective supplementary setpoint.
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

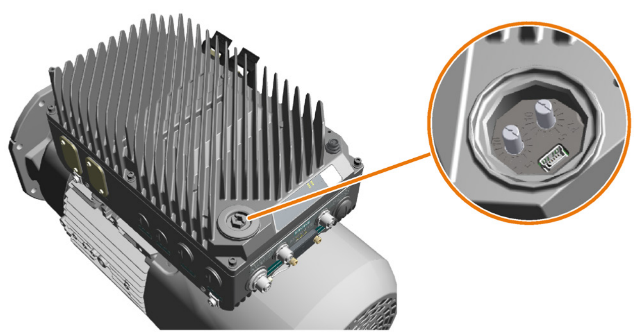
For further information refer to the function diagrams 2468, 9360 and 3030 of the List Manual.

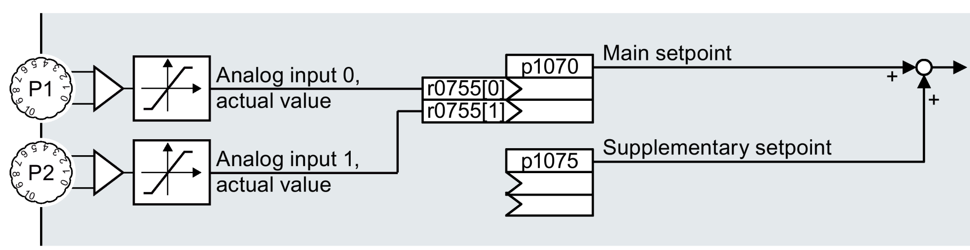
7.17.3 Electromechanical potentiometer

The converter has two electromechanical potentiometers.

The potentiometers are hardwired with the internal analog inputs 0 and 1.

For more information on using a tool to adjust the two electromechanical potentiometers, refer to the replacing procedure in Section "Replacing the Electronic Module (Page 368)".





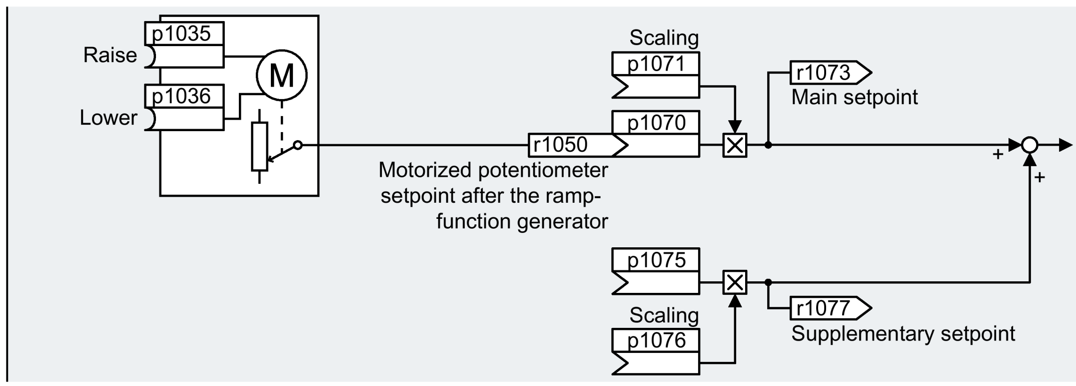
Setting the potentiometer as setpoint source

Parameter	Description
p1070[0] = 755[0] p1070[1] = 755[1]	**Main setpoint** Interconnect the main setpoint with the internal analog inputs 0 and 1.
p1075[0] = 755[0] p1075[1] = 755[1]	**Additional setpoint** Interconnect the additional setpoint with the internal analog inputs 0 and 1.

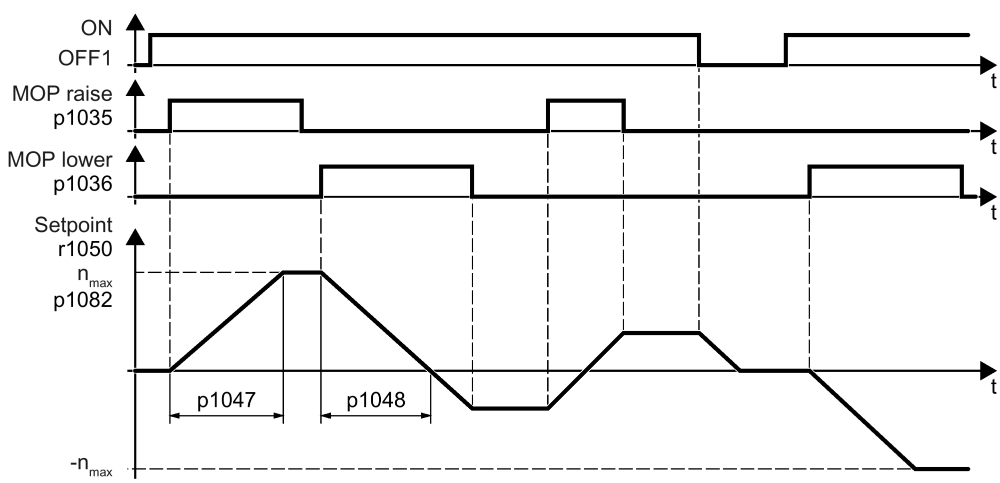
7.17.4 Motorized potentiometer as setpoint source

Overview

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.



Function description



Example

Setting with the motorized potentiometer as setpoint source:

Parameter	Description
p1070 = 1050	Interconnects the main setpoint with the motorized potentiometer output.

Parameters

Table 7- 4 Basic settings

Parameter	Description	Setting
p1035[0...n]	BI: Motorized potentiometer setpoint higher	Signal source to continuously increase the setpoint The factory setting depends on the converter. • With PROFINET interface: [0] 2090.13; [1] 0 • Without PROFINET interface: 0
p1036[0...n]	BI: Motorized potentiometer setpoint lower	Signal source to continuously decrease the setpoint The factory setting depends on the converter. • With PROFINET interface: [0] 2090.14; [1] 0 • Without 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	Motorized potentiometer, ramp-up time [s]	MOP ramp-up time Factory setting: 10 s
p1048	Motorized potentiometer, 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 converter. • With PROFINET interface: [0] 2050[1] • Without 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
r1077	CO: Supplementary setpoint effective [rpm]	Displays the effective supplementary setpoint. The value shown is the additional setpoint after scaling.

Table 7- 5 Advanced settings

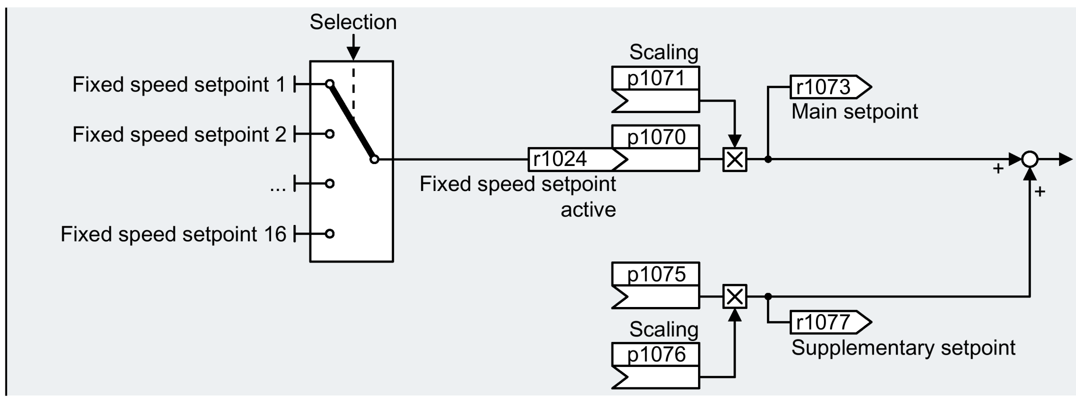
Number	Name	Factory setting
p1030[0...n]	Motorized potentiometer configuration	Configuration for the motorized potentiometer Factory setting: 00110 bin .00 Storage active = 0: After the motor has been switched on, the setpoint = p1040 = 1: After the motor has switched off, the converter saves the setpoint. After the motor has switched on, the setpoint = the stored value. .01 Automatic mode, ramp-function generator active (1-signal via BI: p1041) = 0: Ramp-up/ramp-down time = 0 = 1: With ramp-function generator In manual mode (p1041 = 0), the ramp-function generator is always active. .02 Initial rounding active 1: With initial rounding. Using the initial rounding function it is possible to enter very small setpoint changes. .03 Storage in NVRAM active 1: If bit 00 = 1, the setpoint is retained during a power failure. .04 Ramp-function generator always active 1: The converter also calculates the ramp-function generator when the motor is switched off.
p1037[0...n]	Motorized potentiometer, maximum speed [rpm]	The converter limits the motorized potentiometer output to p1037. Factory setting: 0 rpm After quick commissioning, the converter sets the parameter to the appropriate value.
p1038[0...n]	Motorized potentiometer, minimum speed [rpm]	The converter limits the motorized potentiometer output to p1038. Factory setting: 0 rpm After quick commissioning, the converter sets the parameter to the appropriate value.
p1043[0...n]	BI: Motorized potentiometer, accept setting value	Signal source for accepting the setting value. The motorized potentiometer accepts the setting value p1044 on signal change p1043 = 0 → 1. Factory setting: 0
p1044[0...n]	CI: Motorized potentiometer, setting value	Signal source for the setting value Factory setting: 0

Further information

For more information about the motorized potentiometer, refer to function diagram 3020 in the List Manual.

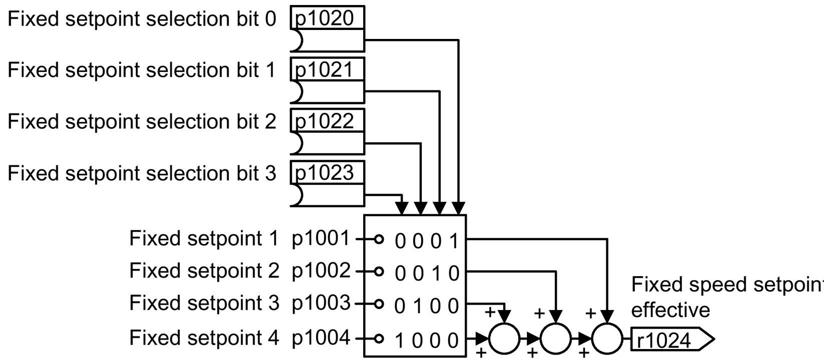
7.17.5 Fixed speed setpoint as setpoint source

Function description



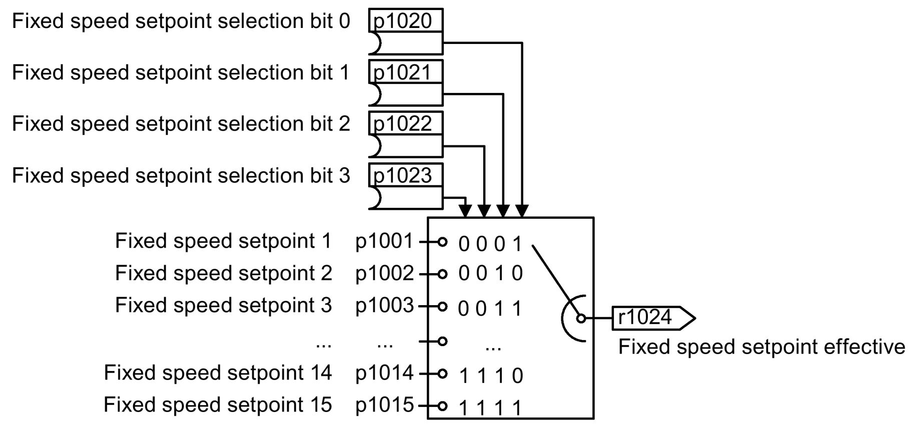
The converter makes a distinction between two methods when selecting the fixed speed setpoints:

Directly selecting a fixed speed setpoint



p1020	p1021	p1022	p1023	Resulting setpoint
0	0	0	0	0
1	0	0	0	p1001
0	1	0	0	p1002
1	1	0	0	p1001 + p1002
0	0	1	0	p1003
1	0	1	0	p1001 + p1003
0	1	1	0	p1002 + p1003
1	1	1	0	p1001 + p1002 + p1003
0	0	0	1	p1004
1	0	0	1	p1001 + p1004
0	1	0	1	p1002 + p1004
1	1	0	1	p1001 + p1002 + p1004
0	0	1	1	p1003 + p1004
1	0	1	1	p1001 + p1003 + p1004
0	1	1	1	p1002 + p1003 + p1004
1	1	1	1	p1001 + p1002 + p1003 + p1004

Selecting the fixed speed setpoint, binary



p1020	p1021	p1022	p1023	Resulting setpoint
0	0	0	0	0
1	0	0	0	p1001
0	1	0	0	p1002
1	1	0	0	p1003
0	0	1	0	p1004
1	0	1	0	p1005
0	1	1	0	p1006
1	1	1	0	p1007
0	0	0	1	p1008
1	0	0	1	p1009
0	1	0	1	p1010
1	1	0	1	p1011
0	0	1	1	p1012
1	0	1	1	p1013
0	1	1	1	p1014
1	1	1	1	p1015

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.

Settings for the application example

Parameter	Description
p1001[0] = 300.000	Fixed speed setpoint 1
p1002[0] = 2000.000	Fixed speed setpoint 2
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.

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

Parameters

Parameter	Description	Setting
p1001[0...n]	CO: Fixed speed setpoint 1 [rpm]	Fixed speed setpoint 1 Factory setting: 0 rpm
p1002[0...n]	CO: Fixed speed setpoint 2 [rpm]	Fixed speed setpoint 2 Factory setting: 0 rpm
...	...	...
p1015[0...n]	CO: Fixed speed setpoint 15 [rpm]	Fixed speed setpoint 15 Factory setting: 0 rpm
p1016	Fixed speed setpoint selection 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 is active.
r1025.0	Fixed speed setpoint status	Fixed speed setpoint status 1 signal: Fixed speed setpoint is selected.

Further information

Additional information about binary and direct selection can be found in function diagrams 3010 and 3011 in the List Manual.

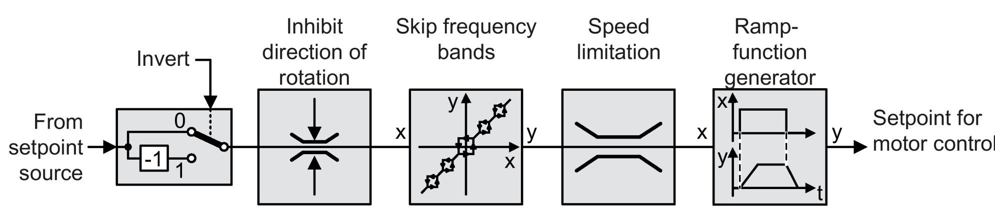
7.18 Setpoint processing

7.18.1 Overview

Overview

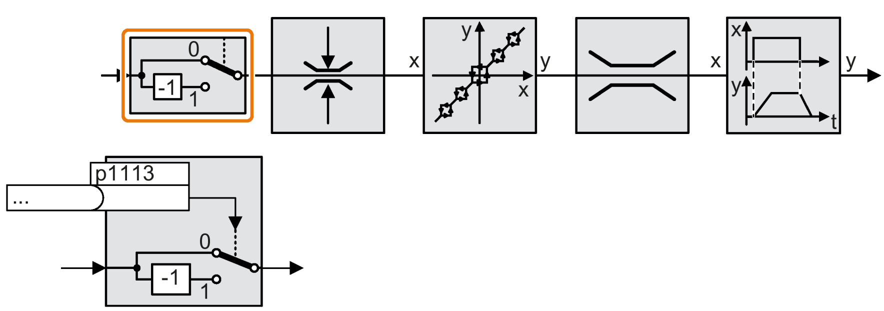
Setpoint processing influences the setpoint using the following functions:

- "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.



7.18.2 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 7- 6 Application examples showing how a setpoint is inverted

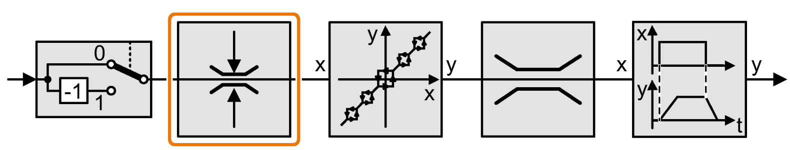
Parameter	Description
p1113 = 722.1	Digital input 1 = 0: Setpoint remains unchanged. Digital input 1 = 1: Converter inverts the setpoint.
p1113 = 2090.11	Inverts the setpoint via the fieldbus (control word 1, bit 11).

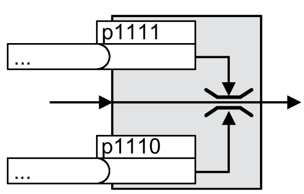
Parameters

Parameter	Description	Setting
p1113[0...n]	BI: Setpoint inversion	Sets the signal source to invert the setpoint. Factory setting: dependent upon the converter

7.18.3 Inhibit direction of rotation

Function description





In the factory setting of the converter, both motor directions of rotation are enabled.

Set the corresponding parameter to a value = 1 to permanently block directions of rotation.

Example

Table 7- 7 Application examples showing how a setpoint is inverted

Parameter	Description
p1110[0] = 1	Negative direction of rotation is permanently inhibited.
p1110[0] = 722.3	Digital input 3 = 0: Negative direction of rotation is enabled. Digital input 3 = 1: Negative direction of rotation is inhibited.

Parameters

Parameter	Description	Setting
p1110[0...n]	BI: Inhibit negative direction	Sets the signal source to disable the negative direction. Factory setting: 0
p1111[0...n]	BI: Inhibit positive direction	Sets the signal source to disable the positive direction. Factory setting: 0

7.18.4 Skip frequency bands and minimum speed

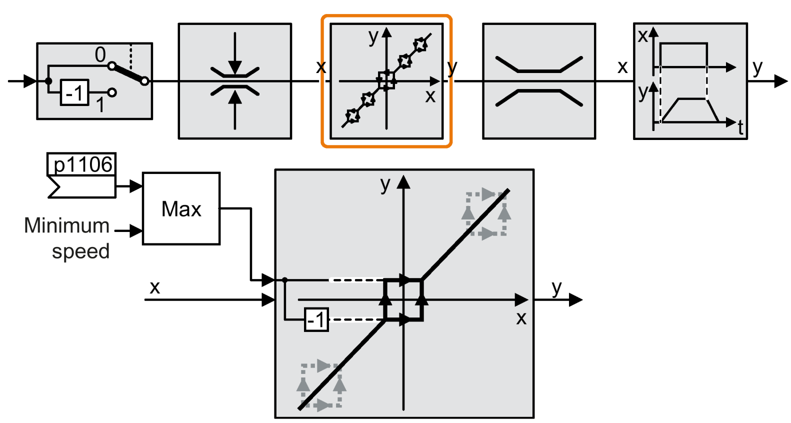
Overview

The converter has a minimum speed and four skip frequency bands:

- The minimum speed prevents continuous motor operation at speeds less than the minimum speed.
- Each skip frequency band prevents continuous motor operation within a specific speed range.

Function description

Minimum speed



Speeds where the absolute value is less than the minimum speed are only possible when the motor is accelerating or braking.

Skip frequency bands

Further information on the skip frequency bands is provided in function diagram 3050 of the List Manual.

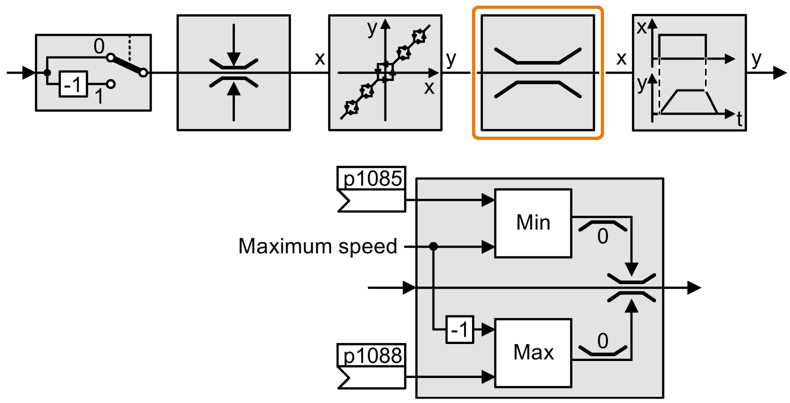
Parameters

Parameter	Description	Setting
p1051[0...n]	CI: Speed limit of ramp-function generator, positive direction of rotation	Sets the signal source for the speed limit of the positive direction on the ramp-function generator input. Factory setting: 1083
p1052[0...n]	CI: Speed limit of ramp-function generator, negative direction of rotation	Sets the signal source for the speed limit of the negative direction on the ramp-function generator input. Factory setting: 1086
p1080[0...n]	Minimum speed [rpm]	Sets the lowest possible motor speed. Factory setting: 0
p1083[0...n]	CO: Speed limit in positive direction of rotation [rpm]	Sets the maximum speed for the positive direction. Factory setting: 210000
r1084	CO: Speed limit positive active [rpm]	Display and connector output for the active positive speed limit.
p1085[0...n]	CI: Speed limit in positive direction of rotation	Sets the signal source for the speed limit of the positive direction. Factory setting: 1083
p1091[0...n] ... p1094[0...n]	Skip speed 1 ... 4 [rpm]	Sets skip speed 1 ... 4. Factory setting: 0
p1098[0...n]	CI: Skip speed scaling	Sets the signal source for scaling the skip speeds. Factory setting: 1
r1099.0	CO/BO: Skip frequency band of status word	Display and BICO output for the skip bands. .00 1 signal: r1170 within the skip band
p1106[0...n]	CI: Minimum speed signal source	Sets the signal source for lowest possible motor speed. Factory setting: 0
r1112	CO: Speed setpoint according to minimum limit [rpm]	Displays the speed setpoint after the minimum limiting.
r1114	CO: Setpoint after direction limiting [rpm]	Displays the speed/velocity setpoint after the changeover and limiting the direction.
r1119	CO: Ramp-function generator setpoint at the input [rpm]	Displays the setpoint at the input of the ramp-function generator.
r1170	CO: Speed controller setpoint sum [rpm]	Display and connector output for the speed setpoint after selecting the ramp-function generator.

Further information is provided in the parameter list of the List Manual.

7.18.5 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.

Parameters

Parameter	Description	Setting
p1082[0...n]	Maximum speed [rpm]	Sets the highest possible speed. Factory setting: 1500
p1083[0...n]	CO: Speed limit in positive direction of rotation [rpm]	Sets the maximum speed for the positive direction. Factory setting: 210000
p1085[0...n]	CI: Speed limit in positive direction of rotation	Sets the signal source for the speed limit of the positive direction. Factory setting: 1083
p1086[0...n]	CO: Speed limit in negative direction of rotation [rpm]	Sets the speed limit for the negative direction. Factory setting: -210000
p1088[0...n]	CI: Speed limit in negative direction of rotation	Sets the signal source for the speed/velocity limit of the negative direction. Factory setting: 1086

7.18.6 Ramp-function generator

Overview

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. In this case, the motor reduces the load on the mechanical system of the driven machine.

You can select between two different ramp-function generator types:

- Extended ramp-function generator

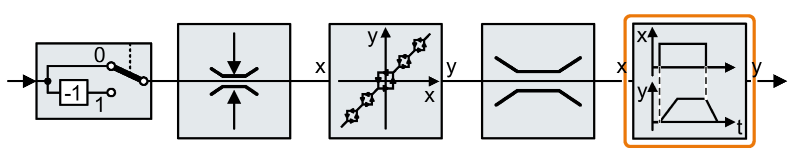
  The expanded ramp-function generator limits not only the acceleration but also the change in acceleration (jerk) by rounding the setpoint. In this case, the torque does not rise suddenly in the motor.

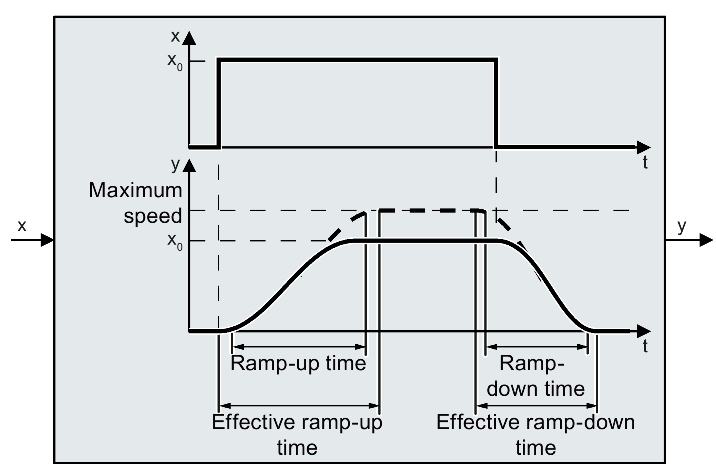
- Basic ramp-function generator

  The basic ramp-function generator limits the acceleration, however not the rate the acceleration changes (jerk).

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 optimal times depend on the application and can lie in the range from a few 100 ms to several minutes.



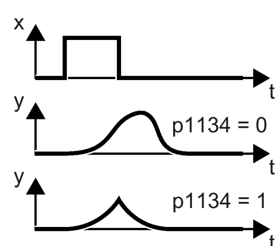


Initial and final rounding permit smooth, jerk-free acceleration and braking.

The ramp-up and ramp-down times of the motor are increased by the rounding times:

- Effective ramp-up time = p1120 + 0.5 × (p1130 + p1131).
- Effective ramp-down time = p1121 + 0.5 × (p1130 + p1131).

Parameters for setting the extended ramp-function generator

Parameter	Description	Setting
p1115	Ramp-function generator selection	Sets the ramp-function generator type. 0: Basic ramp-function generator 1: Extended ramp-function generator (factory setting)
p1120[0...n]	Ramp-function generator, ramp-up time [s]	The ramp-function generator ramps-up the speed setpoint from standstill (setpoint = 0) up to the maximum speed (p1082) in this time. Factory setting: 1
p1121[0...n]	Ramp-function generator, ramp-down time [s]	Sets the ramp-down time for the ramp-function generator. Factory setting: 1
p1130[0...n]	Ramp-function generator, initial rounding-off time [s]	Sets the initial rounding-off time for the extended ramp generator. The value applies to ramp-up and ramp-down. Factory setting: 0
p1131[0...n]	Ramp-function generator, final rounding-off time [s]	Sets the final rounding-off time for the extended ramp generator. Factory setting: 0
p1134[0...n]	Ramp-function generator, rounding-off type	Sets the smoothed response to the OFF1 command or the reduced setpoint for the extended ramp-function generator. 0: Continuous smoothing (factory setting) 1: Discontinuous smoothing 
p1135[0...n]	OFF3 ramp-down time [s]	Sets the ramp-down time from the maximum speed down to zero speed for the OFF3 command. Factory setting: 0
p1136[0...n]	OFF3 initial rounding-off time [s]	Sets the initial rounding-off time for OFF3 for the extended ramp generator. Factory setting: 0
p1137[0...n]	OFF3 final rounding-off time [s]	Sets the final rounding-off time for OFF3 for the extended ramp generator. Factory setting: 0

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.

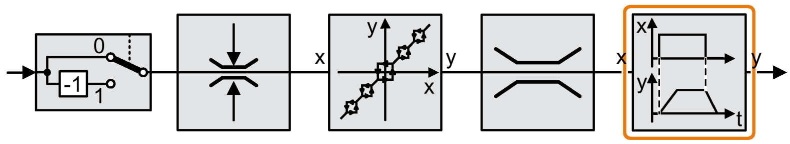
     An excessively short ramp-up time means that the motor will reach its current limiting when accelerating, and will temporarily not be able to follow the speed setpoint. In this case, the drive exceeds the set time.
   – If the motor accelerates too fast, then extend the ramp-up time.
   – Increase the initial rounding if the acceleration is jerky.

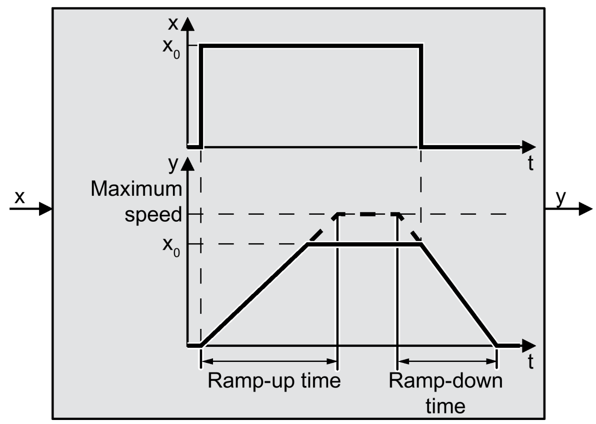
     In the case of a permanent magnet synchronous motor, initial rounding can prevent the motor from tilting during startup.
   – In most applications, it is sufficient when the final rounding is set to the same value as the initial rounding.
4. Switch off the motor.
5. Evaluate your drive response.
   – 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. For an excessively short ramp-down time, the converter either reaches the motor current, or the DC link voltage in the converter becomes too high.
   – Extend the ramp-down time if the motor is braked too quickly or the converter 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.
❒

Basic ramp-function generator





When compared to the extended ramp-function generator, the basic ramp-function generator has no rounding times.

Parameters for setting the basic ramp-function generator

Parameter	Description	Setting
p1082[0...n]	Maximum speed [rpm]	Sets the highest possible speed. Factory setting: 1500
p1115	Ramp-function generator selection	Sets the ramp-function generator type. 0: Basic ramp-function generator 1: Extended ramp-function generator (factory setting)
p1120[0...n]	Ramp-function generator, ramp-up time [s]	The ramp-function generator ramps-up the speed setpoint from standstill (setpoint = 0) up to the maximum speed (p1082) in this time. Factory setting: 1
p1121[0...n]	Ramp-function generator, ramp-down time [s]	Sets the ramp-down time for the ramp-function generator. Factory setting: 1
p1135	OFF3 ramp-down time [s]	Sets the ramp-down time from the maximum speed down to zero speed for the OFF3 command. Factory setting: 0

Changing the ramp-up and ramp-down times in operation

The ramping up and down time of the ramp-function generator can be changed during operation. The scaling value can come, e.g. from the fieldbus.

Preconditions

- You have commissioned the communication between the converter and the control system.
- Free telegram 999 has been set in the converter and in your higher-level control system.

  Expanding or freely interconnecting telegrams (Page 138)
- The control sends the scaling value to the converter in PZD 3.

Procedure

1. Set p1138 = 2050[2].

   This means that you have interconnected the scaling factor for the ramp-up time with PZD receive word 3.
2. Set p1139 = 2050[2].

   This means that you have interconnected the scaling factor for the ramp-down time with PZD receive word 3.

The converter receives the value for scaling the ramp-up and ramp-down times via PZD receive word 3.
❒

Parameters for setting the scaling

Parameter	Description	Setting
p1138[0...n]	CI: Ramp-function generator ramp-up time scaling	Sets the signal source for scaling the ramp-up time of the ramp-function generator. Factory setting: 1
p1139[0...n]	CI: Ramp-function generator ramp-down time scaling	Sets the signal source for scaling the ramp-down time of the ramp-function generator. Factory setting: 1
r2050[0...11]	CO: PROFIdrive PZD receive word	Connector output to interconnect PZD (setpoints) with word format received from the fieldbus controller.

7.19 PID technology controller

Overview

The technology controller controls process variables, e.g. pressure, temperature, level or flow.

Precondition

Additional functions

The V/f control or the vector control has been set.

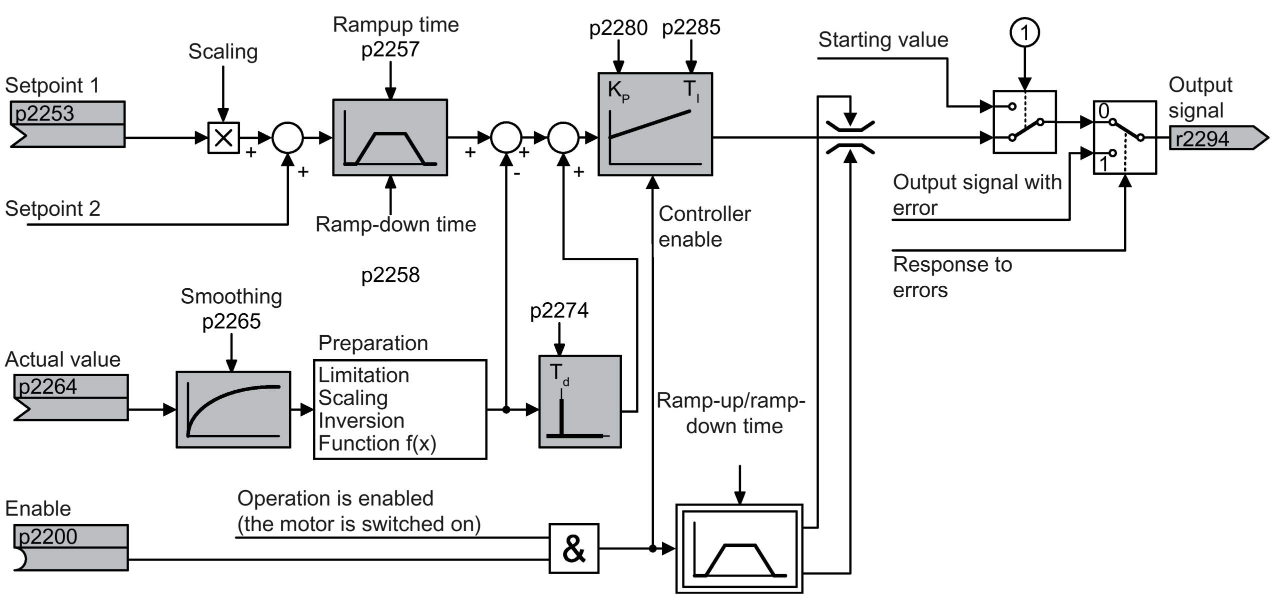
Tools

To change the function settings, you can use a PC tool, for example.

Function description

Function diagram

The technology controller is implemented as a PID controller (controller with proportional, integral, and differential action).



① The converter 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.

Basic settings

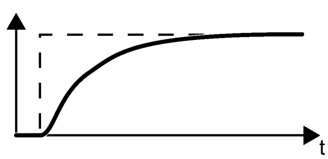
The settings required as a minimum are marked in gray in the function diagram:

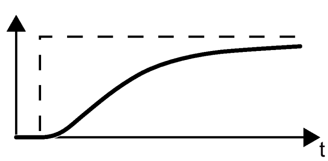
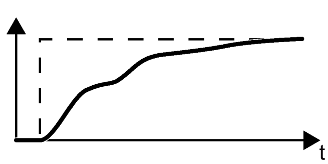
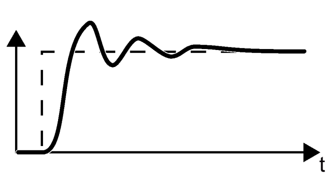
- Interconnect setpoint and actual values with signals of your choice
- Set ramp-function generator and controller parameters K_P, T_I and T_d.

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.
   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.

	Optimum controller response for applications that do not permit any overshoot. The actual value approaches the setpoint without any significant overshoot.
	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.

	The actual value only slowly approaches the setpoint. • Increase the proportional component K_P (p2280) and reduce the integration time T_I (p2285).
	The actual value only slowly approaches the setpoint with slight oscillation. • Increase the proportional component K_P (p2280) and reduce the rate time T_d (p2274)
	The actual value quickly approaches the setpoint, but overshoots too much. • 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 ± 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.

Parameters

Basic settings

Parameter	Description	Setting
r0046.0...31	CO/BO: Missing enable signals	Display and BICO output for missing enable signals that are preventing the closed-loop drive control from being commissioned.
r0052.0...15	CO/BO: Status word 1	Display and connector output for status word 1.
r0056.0...15	CO/BO: Status word, closed-loop control	Display and BICO output for the status word of the closed-loop control.
r1084	CO: Speed limit positive active [rpm]	Display and connector output for the active positive and negative speed limit.
r1087	CO: Speed limit negative active [rpm]	
p2200[0...n]	BI: Technology controller enable	Sets the signal source to switch in/switch out the technology controller. 1 signal: Technology controller is enabled. Factory setting: 0
p2252	Technology controller configuration	Sets the configuration of the technology controller. Factory setting: 0000 0000 bin
p2253[0...n]	CI: Technology controller setpoint 1	Sets the signal source for the setpoint 1 and setpoint 2 of the technology controller. Factory setting: 0
p2254[0...n]	CI: Technology controller setpoint 2	
p2255	Technology controller setpoint 1 scaling [%]	Sets the scaling for the setpoint 1 and setpoint 2 of the technology controller. Factory setting: 100
p2256	Technology controller setpoint 2 scaling [%]	
p2257	Technology controller ramp-up time [s]	Sets the ramp-up and ramp-down time of the technology controller. Factory setting: 1
p2258	Technology controller ramp-down time [s]	
r2260	CO: Technology controller setpoint after ramp-function generator [%]	Displays the setpoint after the ramp-function generator of the technology controller.
p2261	Technology controller setpoint filter time constant [s]	Sets the time constant for the setpoint filter (PT1) of the technology controller. Factory setting: 0
r2262	CO: Technology controller setpoint after filter [%]	Display and connector output for the smoothed setpoint after the setpoint filter (PT1) of the technology controller.

Parameter	Description	Setting
p2263	Technology controller type	Sets the type of technology controller. 0: D component in the actual value signal (factory setting) 1: D component in system deviation
r2273	CO: Technology controller system deviation [%]	Displays the system deviation between the setpoint and actual value of the technology controller.
p2274	Technology controller differentiation time constant [s]	Sets the time constant for the differentiation (D component) of the technology controller. Factory setting: 0
p2280	Technology controller proportional gain	Sets the proportional gain (P component) of the technology controller. Factory setting: 1
p2285	Technology controller integral time [s]	Sets the integral time (I component, integrating time constant) of the technology controller. Factory setting: 30
p2286[0...n]	BI: Hold technology controller integrator	Sets the signal source to hold the integrator for the technology controller. Factory setting: 56.13
p2289[0...n]	CI: Technology controller precontrol signal	Sets the signal source for the precontrol signal of the technology controller. Factory setting: 0
p2306	Technology controller system deviation inversion	Setting to invert the system deviation of the technology controller. 0: No inversion (factory setting) 1: Inversion
p2339	Technology controller threshold value for I proportion stop at skip speed [%]	Sets the threshold value for the system deviation of the technology controller, which controls holding the controller integral component in the range of the skip speeds of the ramp-function generator. Factory setting: 2
r2344	CO: Technology controller last speed setpoint (smoothed) [%]	Displays the smoothed speed setpoint of the technology controller prior to switching to operation with fault response (see p2345).
p2345	Technology controller fault response	Sets the response of the technology controller to the occurrence of fault F07426 (technology controller actual value limited). 0: Function inhibited (factory setting) 1: On fault: Changeover to r2344 (or p2302) 2: On fault: Changeover to p2215
r2349.0...13	CO/BO: Technology controller status word	Display and BICO output for the status word of the technology controller.

Limiting the output of the technology controller

Number	Name	Factory setting
p2290[0...n]	BI: Technology controller limitation enable	Sets the signal source to enable the technology controller output. The technology controller output is enabled with a 1 signal. Factory setting: 1
p2291	CO: Technology controller maximum limiting [%]	Sets the maximum limit of the technology controller. Factory setting: 100
p2292	CO: Technology controller minimum limiting [%]	Sets the minimum limit of the technology controller. Factory setting: 0
p2293	Technology controller ramp-up/ramp-down time [s]	Sets the ramping time for the output signal of the technology controller. Factory setting: 1
r2294	CO: Technology controller output signal [%]	Display and connector output for the output signal of the technology controller.
p2295	CO: Technology controller output scaling [%]	Sets the scaling for the output signal of the technology controller. Factory setting: 100
p2296[0...n]	CI: Technology controller output scaling	Sets the signal source for the scaling value of the technology controller. Factory setting: 2295
p2297[0...n]	CI: Technology controller maximum limiting signal source	Sets the signal source for the maximum limiting of the technology controller. Factory setting: 1084
p2298[0...n]	CI: Technology controller minimum limiting signal source	Sets the signal source for the minimum limiting of the technology controller. Factory setting: 1087
p2299[0...n]	CI: Technology controller limitation offset	Sets the signal source for the offset of the output limiting of the technology controller. Factory setting: 0
p2302	Technology controller output signal start value [%]	Sets the start value for the output of the technology controller. Factory setting: 0

Adapting the actual value of the technology controller

Parameter	Description	Setting
p2264[0...n]	CI: Technology controller actual value	Sets the signal source for the actual value of the technology controller. Factory setting: 0
p2265	Technology controller actual value filter time constant [s]	Sets the time constant for the actual value filter (PT1) of the technology controller. Factory setting: 0
p2266	CO: Technology controller actual value after filter [%]	Display and connector output for the smoothed actual value after the filter (PT1) of the technology controller.
p2267	Technology controller upper limit actual value [%]	Sets the upper limit for the actual value signal of the technology controller. Factory setting: 100
p2268	Technology controller lower limit actual value [%]	Sets the lower limit for the actual value signal of the technology controller. Factory setting: -100
p2269	Technology controller gain actual value [%]	Sets the scaling factor for the actual value of the technology controller. Factory setting: 100
p2270	Technology controller actual value function	Setting to use an arithmetic function for the actual value signal of the technology controller. 0: Output (y) = input (x) (factory setting) 1: Root function (root from x) 2: Square function (x * x) 3: Cube function (x * x * x)
p2271	Technology controller actual value inversion	Setting to invert the actual value signal of the technology controller. 0: No inversion (Factory setting) 1: Inversion actual value signal
r2272	CO: Technology controller actual value scaled [%]	Display and connector output for the scaled actual value signal of the technology controller.

PID technology controller, fixed values (binary selection)

Parameter	Description	Setting
p2201[0...n] ... p2215[0...n]	CO: Technology controller fixed value 1 ... 15 [%]	Sets the value for fixed value 1 ... 15 of the technology controller. Factory setting: 10, 20, 30 ... 150
p2216[0...n]	Technology controller fixed value selection method	Sets the method to select the fixed setpoints: 1: Direct selection (factory setting) 2: Binary selection
r2224	CO: Technology controller fixed value active [%]	Display and connector output for the selected and active fixed value of the technology controller.
r2225.0	CO/BO: Technology controller fixed value selection status word [%]	Display and BICO output for the status word of the fixed value selection of the technology controller.
r2229	Technology controller number actual	Displays the number of the selected fixed setpoint of the technology controller.

PID technology controller, fixed values (direct selection)

Parameter	Description	Setting
p2216[0...n]	Technology controller fixed value selection method	Sets the method to select the fixed setpoints: 1: Direct selection (factory setting) 2: Binary selection
p2220[0...n] ... p2223[0...n]	BI: Technology controller fixed value selection bit 0 ... 3	Sets the signal source to select a fixed value of the technology controller. Factory setting: 0
r2224	CO: Technology controller fixed value active [%]	Display and connector output for the selected and active fixed value of the technology controller.
r2225.0	CO/BO: Technology controller fixed value selection status word [%]	Display and BICO output for the status word of the fixed value selection of the technology controller.
r2229	Technology controller number actual	Displays the number of the selected fixed setpoint of the technology controller.

PID technology controller, motorized potentiometer

Parameter	Description	Setting
r2231	Technology controller motorized potentiometer setpoint memory [%]	Displays the setpoint memory for the motorized potentiometer of the technology controller.
p2235[0...n]	BI: Technology controller motorized potentiometer, setpoint, raise	Sets the signal source to continually increase the setpoint for the motorized potentiometer of the technology controller. Factory setting: 0
p2236[0...n]	BI: Technology controller motorized potentiometer, setpoint, lower	Sets the signal source to continually reduce the setpoint for the motorized potentiometer of the technology controller. Factory setting: 0
p2237[0...n]	Technology controller motorized potentiometer maximum value [%]	Sets the maximum value for the motorized potentiometer of the technology controller. Factory setting: 100
p2238[0...n]	Technology controller motorized potentiometer minimum value [%]	Sets the minimum value for the motorized potentiometer of the technology controller. Factory setting: -100
p2240[0...n]	Technology controller motorized potentiometer start value [%]	Sets the starting value for the motorized potentiometer of the technology controller. Factory setting: 0
r2245	CO: Technology controller motorized potentiometer, setpoint before RFG [%]	Displays the effective setpoint in front of the internal motorized potentiometer ramp-function generator of the technology controller.
p2247[0...n]	Technology controller motorized potentiometer ramp-up time [s]	Sets the ramp-up time and ramp-down time for the internal ramp-function generator for the motorized potentiometer of the technology controller. Factory setting: 10
p2248[0...n]	Technology controller motorized potentiometer ramp-down time [s]	
r2250	CO: Technology controller motorized potentiometer, setpoint after RFG [%]	Displays the effective setpoint after the internal ramp-function generator for the motorized potentiometer of the technology controller.

Further information

For additional information refer to the function diagrams 7950 ... 7958 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 (https://support.industry.siemens.com/cs/ww/en/view/92556266)

7.20 Motor control

Overview

The converter has two alternative methods to ensure the motor speed follows the configured speed setpoint:

- V/f control
- Vector control

7.20.1 Setting the saturation characteristic of the permanent magnet synchronous motor (third-party motor)

Overview

The motor control of the converter requires the simulation of the saturation characteristic "Quadrature axis flux over quadrature axis current" of the permanent magnet synchronous motor.

The saturation characteristics of Siemens motors are stored in the converter.

For non-Siemens motors, you need to set the saturation characteristic using the motor data sheet, for example.

Precondition

Quick commissioning has been completed.

The saturation characteristic for a third-party motor is available.

Procedure

1. Determine the following values using the motor data sheet:
   - Set the current value of the saturation characteristic iq[0] ... iq[4].
   - Determine the flux values psiq[0] ... psiq[4] associated with the current values.

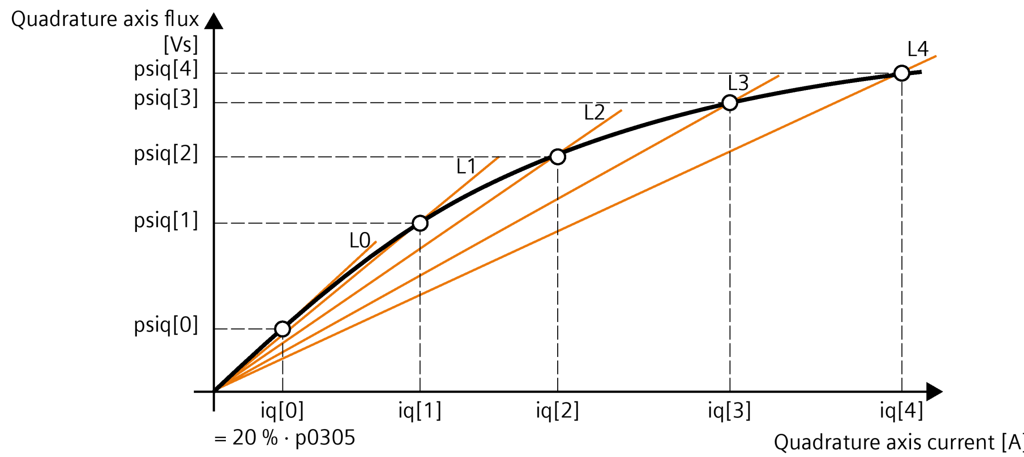


Figure 7-9 Saturation characteristic of the permanent magnet synchronous motor

   If the saturation characteristic of the third-party motor is not available, leave parameters p356 and p362 ... p369 in their factory settings.

   Commissioning usually leads to a satisfactory control behavior only with a correctly set saturation characteristic.

2. Set p0356 = psiq[0] / (20 % · p0305)
3. Set the following parameters:
   - p0362 = psiq[1] / (p0356 · p0305) · 100 %
   - p0363 = psiq[2] / (p0356 · p0305) · 100 %
   - p0364 = psiq[3] / (p0356 · p0305) · 100 %
   - p0365 = psiq[4] / (p0356 · p0305) · 100 %
   - p0366 = iq[1] / p0305 · 100 %
   - p0367 = iq[2] / p0305 · 100 %
   - p0368 = iq[3] / p0305 · 100 %
   - p0369 = iq[4] / p0305 · 100 %

   Alternatively, you can calculate parameters p0362 ... p0365 based on inductances L1 ... L4:
   - p0362 = L1 / p0356 · p0366
   - p0363 = L2 / p0356 · p0367
   - p0364 = L3 / p0356 · p0368
   - p0365 = L4 / p0356 · p0369

Result

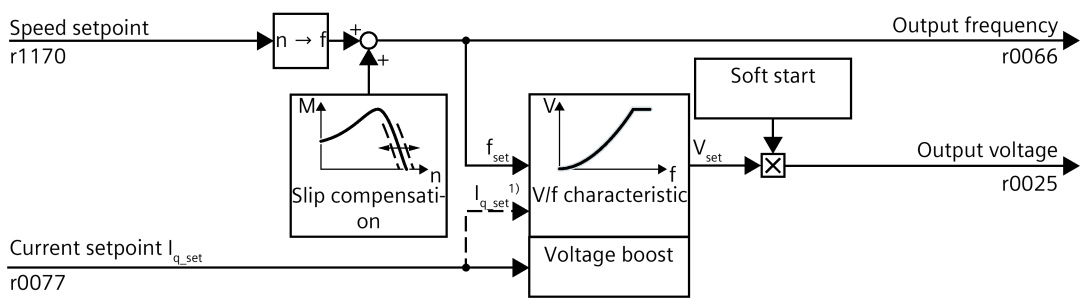
The parameters for emulating the saturation characteristic are defined in the converter in ascending order:

- 20 % < p0362 < p0363 < p0364 < p0365
- 20 % < p0366 < p0367 < p0368 < p0369

The converter extrapolates the characteristic curve linearly for currents iq > iq[4].

7.20.2 V/f control

Overview



1) In the V/f control variant, "flux current control (FCC)," the converter controls the motor current (starting current) at low speeds

The V/f control is a speed feedforward control with the following properties:

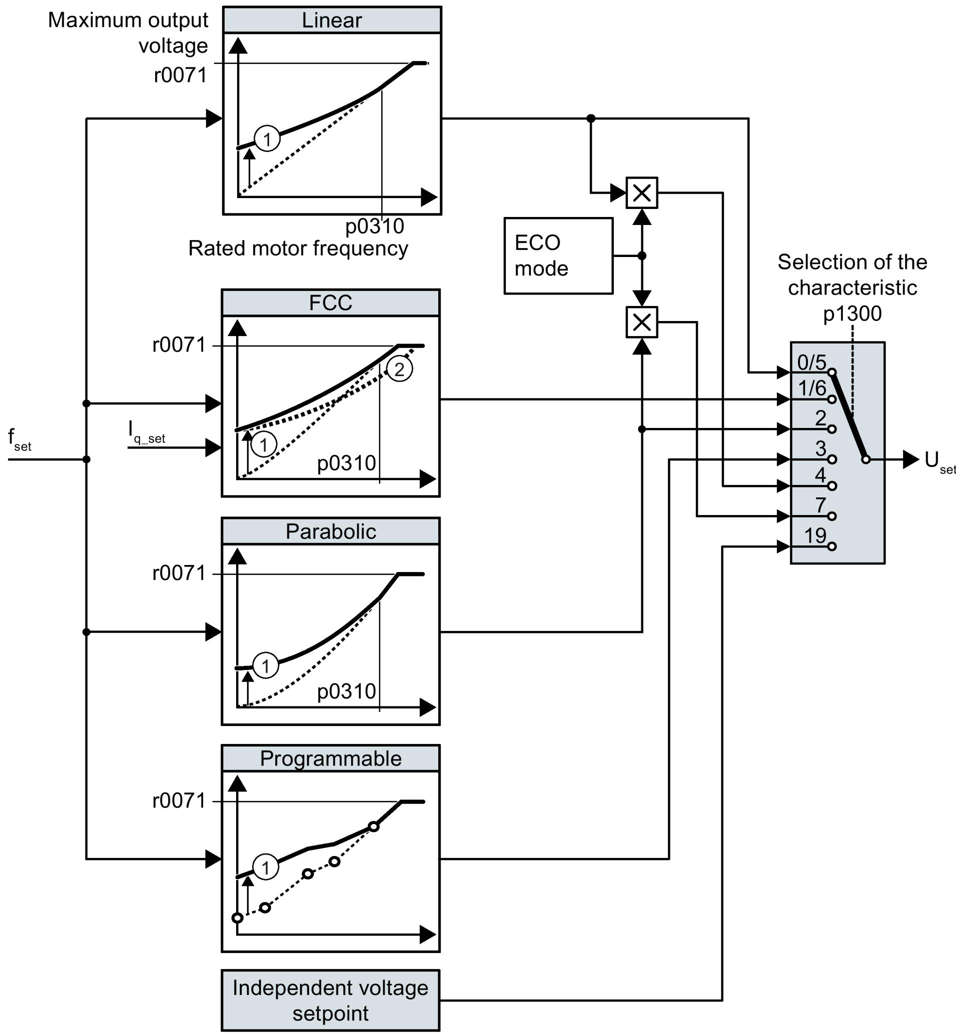
- The converter sets the output voltage on the basis of the V/f characteristic.
- The output frequency is essentially calculated from the speed setpoint and the number of pole pairs of the motor.
- The slip compensation corrects the output frequency depending on the load and thus increases the speed accuracy.
- The omission of a control loop means that the V/f control is stable in all cases.
- In applications with higher speed accuracy requirements, a load-dependent voltage boost can be selected (flux current control, FCC)

For operation of the motor with V/f control, you must set at least the following subfunctions appropriate for your application:

- V/f characteristic
- Voltage boost

7.20.2.1 Characteristics of V/f control

The converter has different V/f characteristics.



① The voltage boost of the characteristic optimizes the speed control at low speeds

② With the flux current control (FCC), the converter compensates for the voltage drop in the stator resistor of the motor

The converter increases its output voltage to the maximum possible output voltage. The maximum possible output voltage of the converter depends on the line voltage.

When the maximum output voltage is reached, the converter only increases the output frequency. At this point, the motor enters the field weakening range: At constant torque, the slip decreases quadratically as the speed increases.

The value of the output voltage at the rated motor frequency also depends on the following variables:

- Ratio between the converter 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 379)

7.20.2.2 Selecting the V/f characteristic

Table 7- 8 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	p1300 = 0
		The converter 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 quick commissioning.	Linear with Flux Current Control (FCC)	p1300 = 1
The required torque increases with the speed	Centrifugal pumps, radial fans, axial fans	Lower losses in the motor and converter than for a linear characteristic.	Parabolic	p1300 = 2

Table 7- 9 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	If the speed setpoint is reached, and remains unchanged for 5 seconds, then the converter reduces its output voltage. As a consequence, the ECO mode saves energy with respect to the parabolic characteristic.	ECO mode	p1300 = 4 or p1300 = 7
The converter must maintain the motor speed constant for the longest possible time.	Drives in the textile sector	When reaching the maximum current limit, the converter only reduces the output voltage, but not the frequency.	Precise frequency characteristic	p1300 = 5 or p1300 = 6
Freely adjustable V/f characteristic	-	-	Adjustable characteristic	p1300 = 3
V/f characteristic with independent voltage setpoint	-	The interrelationship between the frequency and voltage is not calculated in the converter, but is specified by the user.	Independent voltage setpoint	p1300 = 19

Additional information on V/f characteristics can be found in the parameter list and in the function diagrams of the List Manual.

7.20.2.3 Optimizing motor starting

Overview

After selection of the V/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 V/f characteristic at low speeds.

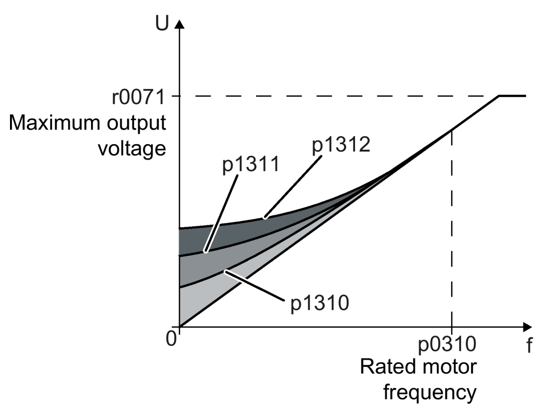
Precondition

The ramp-up time of the ramp-function generator is, depending on the motor rated power, 1 s (< 1 kW) ... 10 s (> 10 kW).

Function description

Setting the voltage boost for V/f control

The converter boosts the voltage corresponding to the starting currents p1310 ... p1312.



Increase parameter values p1310 ... p1312 in steps of ≤ 5%. Excessively high values in p1310 ... p1312 can cause the motor to overheat and stop (trip) the converter 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.
❒

Parameters

Parameter	Description	Setting
r0071	Maximum output voltage [V]	Displays the maximum output voltage.
p0310[0...n]	Rated motor frequency [Hz]	Sets the rated motor frequency. Factory setting: 0
p1310[0...n]	Starting current (voltage boost) permanent [%]	Defines the voltage boost as a [%] referred to the rated motor current (p0305). Factory setting: 50
p1311[0...n]	Starting current (voltage boost) when accelerating [%]	p1311 only results in a voltage boost when accelerating and generates a supplementary torque to accelerate the load. Factory setting: 0
p1312[0...n]	Starting current (voltage boost) when starting [%]	Setting for an additional voltage boost when powering-up, however, only for the first acceleration phase. Factory setting: 0

Further information

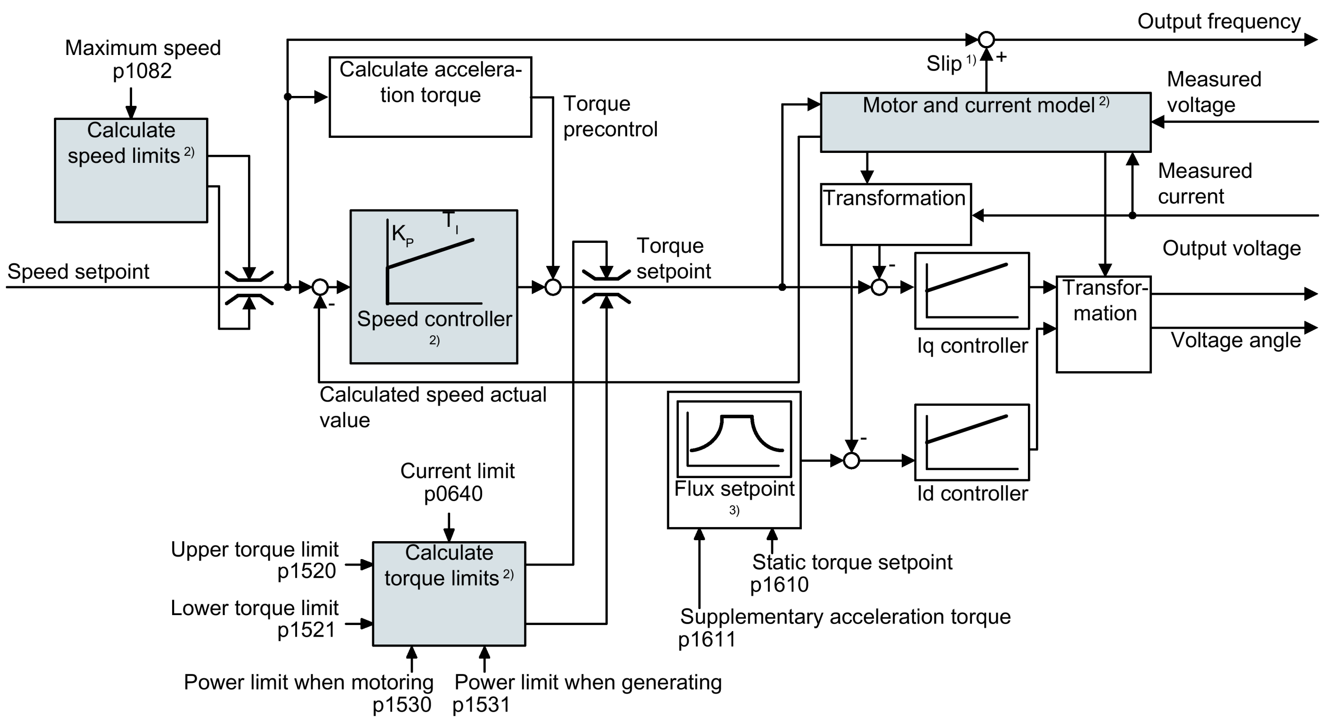
For further information refer to the parameter list and the function diagrams 6301 and 6310 of the List Manual.

7.20.3 Sensorless vector control with speed controller

7.20.3.1 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 asynchronous motors

2) Settings that are required

Using the motor model, the converter 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 converter 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.

Settings that are required

Restart quick commissioning and select the vector control in quick commissioning.

Quick commissioning (Page 98)

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 converter 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.

WARNING

The load falls due to incorrect closed-loop control settings

For encoderless vector control, the converter calculates the actual speed based on an electric motor model. In applications with pulling loads - e.g. hoisting gear, lifting tables or vertical conveyors - an incorrectly set motor model or other incorrect settings can mean that the load falls. A falling load can result in death or serious injury.

- Correctly set the motor data during the quick commissioning.
- Carry out the motor data identification.
- Correctly set the "Motor holding brake" function.

  Motor holding brake (Page 206)
- For pulling loads, carefully comply with the recommended settings for vector control.

  Advanced settings (Page 275)

Further information

For further information refer to the function diagrams 6040, 6050, and 6060 of the List Manual.

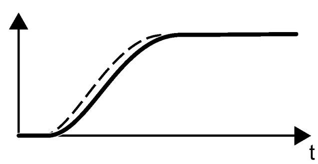
7.20.3.2 Optimizing the closed-loop speed controller

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 converter 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:

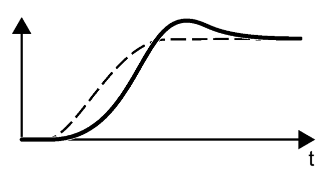


The speed setpoint (broken line) increases with the set ramp-up time and rounding.

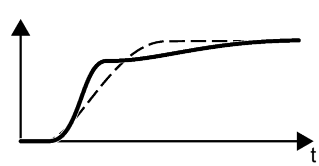
The speed actual value follows the setpoint without any overshoot.

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

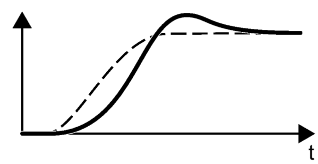
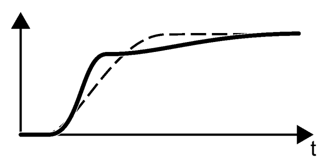
Requirements

- Torque precontrol is active: p1496 = 100%.
- The load moment of inertia is constant and independent of the speed.
- The converter 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).

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):

	Initially, the speed actual value follows the speed setpoint with some delay, and then overshoots the speed setpoint. • Increase p0342
	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. • Reduce p0342

7. Switch off the motor.
8. Set p0340 = 4. The converter 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 speed 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.

Parameters

Encoderless speed control

Parameter	Description	Setting
p0342[0...n]	Ratio between the total and motor moment of inertia	Sets the ratio of moment of inertia load + motor to moment of inertia of motor without load. Factory setting: 1
p1452[0...n]	Speed controller actual speed value smoothing time (encoderless) [ms]	Sets the smoothing time for the actual speed of the speed controller for encoderless closed-loop speed control. Factory setting: 10
p1470[0...n]	Speed controller encoderless operation P gain	Sets the P gain for encoderless operation for the speed controller. Factory setting: 0.3
p1472[0...n]	Speed controller encoderless operation integral time [ms]	Set the integral time for encoderless operation for the speed controller. Factory setting: 20
p1496[0...n]	Acceleration precontrol scaling [%]	Sets the scaling for the acceleration precontrol of the speed/velocity controller. Factory setting: 0

7.20.3.3 Advanced settings

K_P and T_I adaptation

K_p and T_I adaptation suppress speed control oscillations that may occur. The "rotating measurement" of the motor data identification optimizes the speed controller. If you have performed the rotating measurement, then the K_p- and T_n adaptation has been set.

You can find additional information in the List Manual:

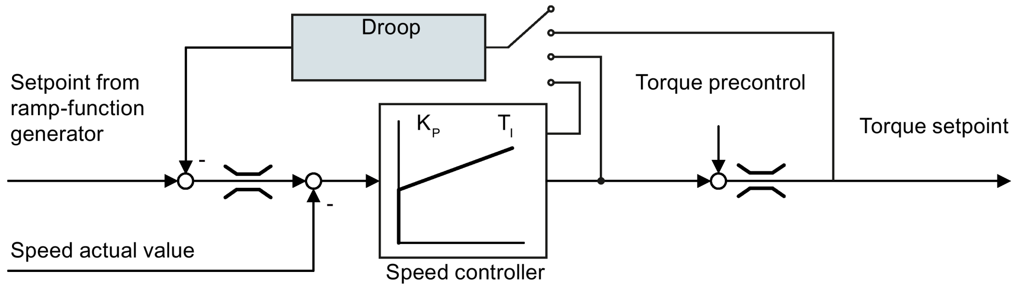
- Vector control with speed controller: Function diagram 6050

Droop

For mechanically coupled drives, there is the risk that the drives oppose one another: Small deviations in the speed setpoint or actual value of the coupled drives can mean that the drives are operated with significantly different torques.

The droop function ensures even torque distribution between several mechanically coupled drives.

The droop function reduces the speed setpoint as a function of the torque setpoint.



When droop is active, the ramp-function generators of all of the coupled drives must be set to have identical ramp-up and ramp-down times as well as rounding-off.

Parameter	Description	Setting
r1482	CO: Speed controller I torque output [Nm]	Display and connector output for the torque setpoint at the output of the I speed controller.
p1488[0...n]	Droop input source	Sets the source for droop feedback. 0: Droop feedback not connected (factory setting) 1: Droop from the torque setpoint 2: Droop from the speed control output 3: Droop from the integral output, speed controller
p1489[0...n]	Droop feedback scaling	Sets the scaling for the droop feedback A value of 0.05 means: At the rated motor torque, the converter reduces the speed by 5% of the rated motor speed. Factory setting: 0.05
r1490	CO: Droop feedback speed reduction [rpm]	Displays the output signal of the droop calculation.
p1492[0...n]	BI: Droop feedback enable	Enables the droop to be applied to the speed/velocity setpoint. Factory setting: 0

You can find additional information in the List Manual, function block diagram 6030.

Special settings for a pulling load

For a pulling load, e.g. a hoisting gear, a permanent force is exerted on the motor, even when the motor is stationary.

If you use encoderless vector control with a pulling load, the following settings are required:

- Set the following parameters:

Parameter	Description	Setting
p1750[0...n]	Motor model configuration	Sets the configuration for the motor model. Bit 07 = 1: Use speed switchover limits that are less sensitive to external effects.
p1610[0...n]	Static torque setpoint (encoderless) [%]	Sets the static torque setpoint for sensorless vector control in the low speed range. Set a value which is higher than the maximum load torque that occurs. Factory setting: 50

- When opening the motor holding brake, enter a speed setpoint > 0.

  For speed setpoint = 0, and with the motor holding brake open, the load drops because the asynchronous motor rotates with the slip frequency as a result of the pulling load.
- Set the ramp-up and ramp-down times ≤ 10 s in the ramp-function generator.

7.20.3.4 Optimizing the operation of the permanent magnet synchronous motor

Overview

An unfavorable parameter setting can lead to malfunctions or unwanted behavior of the motor during operation of the permanent magnet synchronous motor.

Description

Problem	Possible cause	Solution
The converter reports the F07807 fault (fault current, overcurrent or ground fault) during the standstill measurement of the motor identification or during the pole position identification.	The value of the rated motor voltage is too high.	1. Check the motor wiring and insulation resistance. 2. Start quick commissioning. 3. Reduce the rated motor voltage p0304 by 5 V ... 10 V. 4. Restart the standstill measurement of the motor identification or the pole position identification. 5. If the converter reports the F07807 fault again, go back to step 2.
The motor current increases significantly when operating at low speeds continually, despite no mechanical problems being present.	You are operating the motor continuously at a speed < p1755 or < 15 % of the rated speed.	Set p1080 > p1755.
The converter signals one of the following faults: • F07967 • F07969	The motor has significant pole saliency.	Change the PolID technique: p1980 = 4 or p1980 =10.
	The current is too high during pole position identification.	Decrease the value of p329 incrementally by 10 %.
The motor stalls or starts with difficulty.	The converter does not generate enough starting torque	Increase the value of p1610 or/and p1611 incrementally by 10 %. Let the motor cool down before each start attempt.
	Motor is oversaturated.	Decrease p1610 and p1611 incrementally by 10 %. Increase ramp-up time p1120. Increase initial rounding time p1130.
The motor speed tends to oscillate.	The transition from open loop to closed loop phase during acceleration is not stable.	Increase p1755 incrementally by approx. 10 % until the motor accelerates smoothly and stably.
	The speed controller gain is too high.	Optimize the speed controller.
Motor overspeed	The speed overshoots after the motor accelerates.	Increase ramp-up time p1120 or final rounding time p1131. Optimize the speed controller.

Parameters

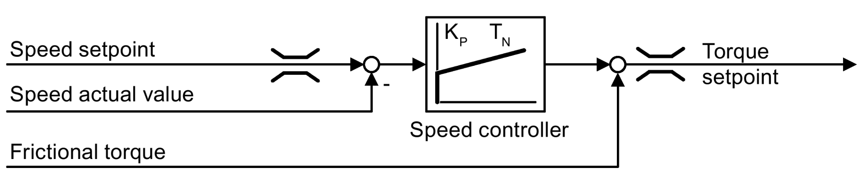
Number	Name	Factory setting
p0304[M]	Rated motor voltage	0 V
p0305[M]	Rated motor current	0 A
p0307[M]	Rated motor power	0 kW
p0310[M]	Rated motor frequency	0 Hz
p0311[M]	Rated motor speed	0 rpm
p0314[M]	Motor pole pair number	0
p0316[M]	Motor torque constant	0 Nm/A
p0329[M]	Motor pole position identification current	0 A
p1080[D]	Minimum speed	0 rpm
p1120[C]	Ramp-function generator ramp-up time	Dependent on rated power
p1131[C]	Ramp-function generator final rounding time	0 s
p1610[D]	Torque setpoint static (sensorless)	50 %
p1611[D]	Additional acceleration torque (sensorless)	30 %
p1755[D]	Motor model changeover speed sensorless operation	210000 rpm
p1980	PolID technique	4

7.20.3.5 Friction characteristic

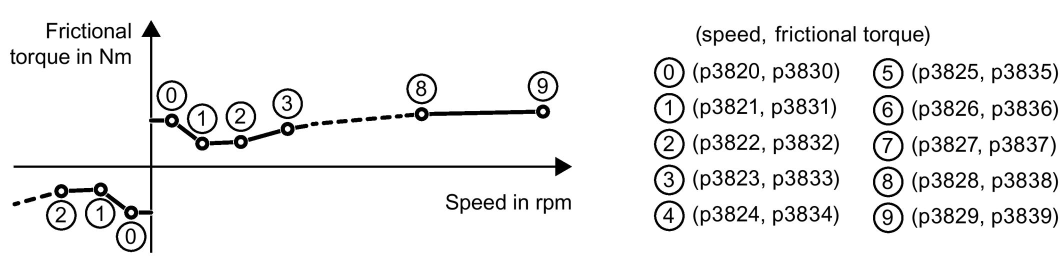
Function

In many applications, e.g. applications with geared motors or belt conveyors, the friction torque of the load is not negligible.

The converter provides the possibility of precontrolling the torque setpoint, bypassing the speed controller with the friction torque. The precontrol reduces overshooting of the speed after speed changes.



The converter calculates the current friction torque from a friction characteristic with 10 intermediate points.



The intermediate points of the friction characteristic are defined for positive speeds. In the negative direction of rotation, the converter uses the intermediate points with a negative sign.

Recording a friction characteristic

After quick commissioning, the converter sets the speeds of the intermediate points to values suitable for the rated speed of the motor. The friction torque of all intermediate points is still equal to zero. On request, the converter records the friction characteristic: The converter accelerates the motor step by step up to the rated speed, measures the friction torque and writes the friction torque into the intermediate points of the friction characteristic.

Precondition

The motor is permitted to accelerate up to the rated speed without endangering persons or property.

Procedure

1. Set p3845 = 1: The converter accelerates the motor successively in both directions of rotation and averages the measurement results of the positive and negative directions.
2. Switch on the motor (ON/OFF1 = 1).
3. The converter accelerates the motor.

   During measurement, the converter signals the alarm A07961.

   When the converter has determined all the intermediate points of the friction characteristic without fault code F07963, the converter stops the motor.

You have recorded the friction characteristic.
❒

Adding friction characteristic for the torque setpoint

If you enable the friction characteristic (p3842 = 1), the converter adds the output of the friction characteristic r3841 to the torque setpoint.

Parameters

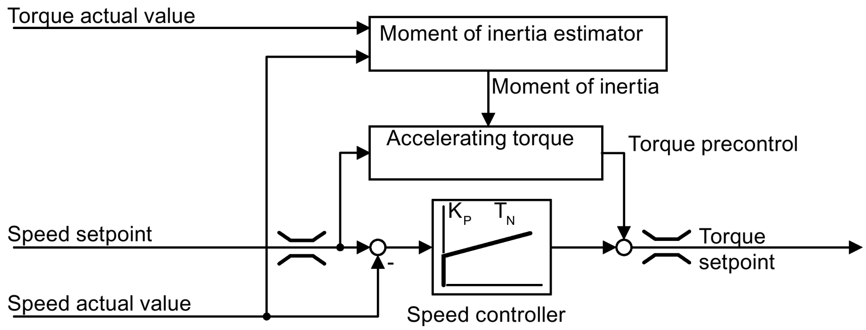
Parameter	Description	Setting
p3820[0...n] ... p3839[0...n]	Intermediate points of the friction characteristic [rpm; Nm]	The friction characteristic is defined by 10 value pairs.
r3840.0...8	CO/BO: Friction characteristic status word	Display and BICO output for the status word of the friction characteristic. .00 1 signal: Friction characteristic OK .01 1 signal: Determination of the friction characteristic is active .02 1 signal: Determination of the friction characteristic is complete .03 1 signal: Determination of the friction characteristic has been aborted .08 1 signal: Friction characteristic positive direction
r3841	CO: Friction characteristic output [Nm]	Display and connector output for the torque of the friction characteristic dependent on the speed.
p3842	Friction characteristic activation	Setting to activate and deactivate the friction characteristic. 0: Friction characteristic deactivated (factory setting) 1: Friction characteristic activated
p3845	Friction characteristic record activation	Setting for the friction characteristic record. 0: Friction characteristic plot deactivated (factory setting) 1: Friction characteristic plot activated, both directions 2: Friction characteristic plot activated, positive direction 3: Friction characteristic plot activated, negative direction
p3846[0...n]	Friction characteristic record ramp-up/ramp-down time [s]	Sets the ramp-up/ramp-down time of the ramp-up/ramp-down function generator to automatically record the friction characteristic. Factory setting: 10
p3847[0...n]	Friction characteristic record warm-up time [s]	Sets the warm-up time. At the start of automatic plotting, the converter accelerates the motor up to the speed = p3829 and keeps the speed constant for this time. Factory setting: 0

Further information on this topic is provided in the List Manual.

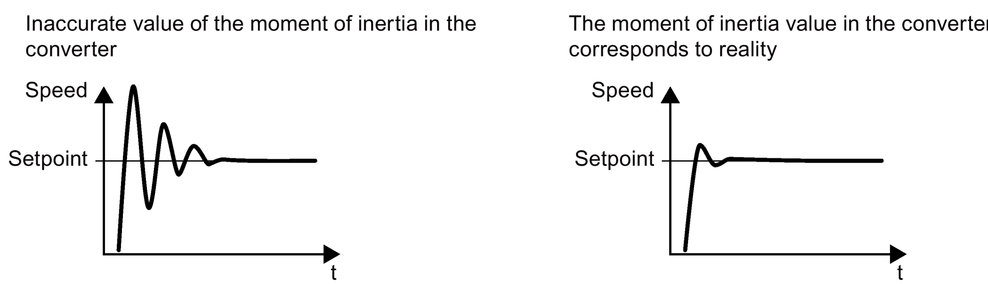
7.20.3.6 Moment of inertia estimator

Background

From the load moment of inertia and the speed setpoint change, the converter calculates the accelerating torque required for the motor. Via the speed controller precontrol, the accelerating torque specifies the main percentage of the torque setpoint. The speed controller corrects inaccuracies in the precontrol (feed-forward control).

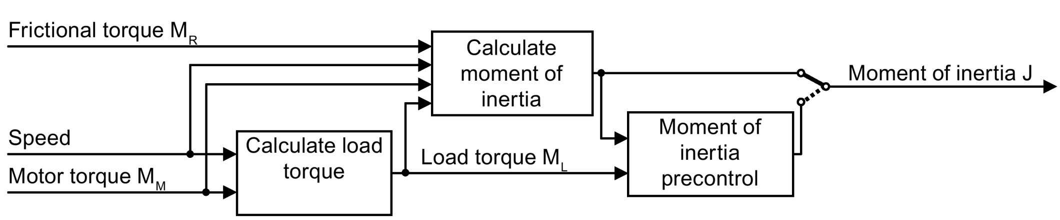


The more precise the value of the moment of inertia in the converter, the lower the overshoot after speed changes.



Function

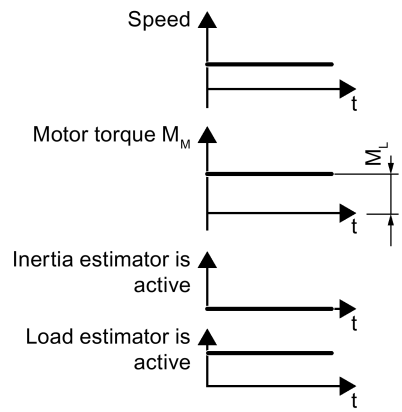
From the actual speed, the actual motor torque and the frictional torque of the load, the converter calculates the total moment of inertia of the load and motor.



When using the moment of inertia estimator, we recommend that you also activate the friction characteristic.

Friction characteristic (Page 279)

How does the converter calculate the load torque?

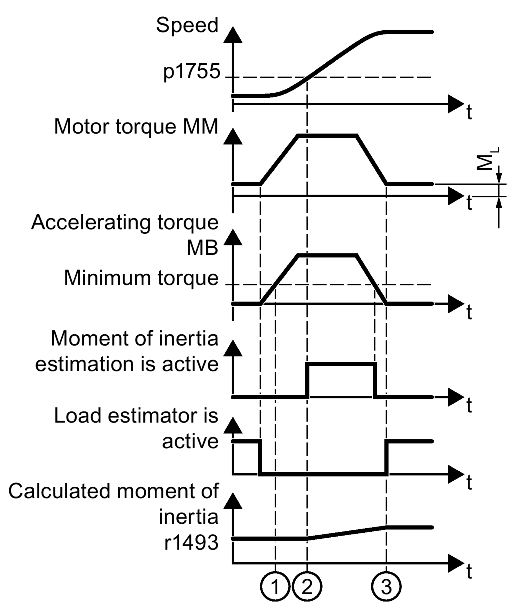


At low speeds, the converter calculates the load torque M_L from the actual motor torque.

The calculation takes place under the following conditions:

- Speed ≥ p1226
- Acceleration setpoint < 8 $1/s^2$ (≙ speed change 480 rpm per s)
- Acceleration × moment of inertia (r1493) < 0.9 × p1560

How does the converter calculate the moment of inertia?



For higher speed changes, the converter initially calculates the accelerating torque M_B as difference between the motor torque M_M, load torque M_L and frictional torque M_R:

$M_B = M_M - M_L - M_R$

Moment of inertia J of the motor and load is obtained from the accelerating torque M_B and angular acceleration α (α = rate at which the speed changes):

$J = M_B / \alpha$

If all of the following conditions are met, the converter calculates the moment of inertia:

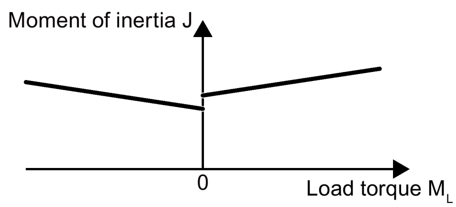
- ① The rated accelerating torque M_B must satisfy the following two conditions:
  - The sign of M_B is the same as the direction of the actual acceleration
  - M_B > p1560 × rated motor torque (r0333)
- ② speed > p1755
- The converter has calculated the load torque in at least one direction of rotation.
- Acceleration setpoint > 8 $1/s^2$ (≙ speed change 480 rpm per s)

③ The converter calculates the load torque again after acceleration.

Moment of inertia precontrol

In applications where the motor predominantly operates with a constant speed, the converter can only infrequently calculate the moment of inertia using the function described above. Moment of inertia precontrol is available for situations such as these. The moment of inertia precontrol assumes that there is an approximately linear relationship between the moment of inertia and the load torque.

Example: For a horizontal conveyor, in a first approximation, the moment of inertia depends on the load.



The relationship between load torque and torque is saved in the converter as linear characteristic.

- In a positive direction of rotation:

  Moment of inertia J = p5312 × load torque M_L + p5313
- In a negative direction of rotation:

  Moment of inertia J = p5314 × load torque M_L + p5315

You have the following options to determine the characteristic:

- You already know the characteristic from other measurements. In this case, you must set the parameters to known values when commissioning the system.
- The converter iteratively determines the characteristic by performing measurements while the motor is operational.

Activating the moment of inertia estimator

The moment of inertia estimator is deactivated in the factory setting. p1400.18 = 0, p1400.20 = 0, p1400.22 = 0.

If you performed the rotating measurement for the motor identification during quick commissioning, we recommend leaving the moment of inertia estimator deactivated.

Preconditions

- You have selected encoderless vector control.
- The load torque must be constant whilst the motor accelerates or brakes.

  Typical of a constant load torque are conveyor applications and centrifuges, for example.

  Fan applications, for example, are not permitted.
- The speed setpoint is free from superimposed unwanted signals.
- The motor and load are connected to each other in a force-locked way.

  Drives with slip between the motor shaft and load are not permitted, e.g. as a result of loose or worn belts.

If the conditions are not met, you must not activate the moment of inertia estimator.

Procedure

1. Set p1400.18 = 1
2. Check: p1496 ≠ 0
3. Activate the acceleration model of the speed controller pre-control: p1400.20 = 1.

You have activated the moment of inertia estimator.
❒

The most important settings

Parameter	Description	Setting
r0333[0...n]	Rated motor torque [Nm]	Displays the rated motor torque.
p0341[0...n]	Motor moment of inertia [kgm^2]	Sets the motor moment of inertia (without load). Note: The converter sets the parameter when selecting a listed motor. The parameter is then write-protected. Factory setting: 0
p0342[0...n]	Ratio between the total and motor moment of inertia	Sets the ratio of moment of inertia load + motor to moment of inertia of motor without load. Factory setting: 1
p1400[0...n]	Speed control configuration	Sets the configuration for the closed-loop speed control. .18 1 signal: Moment of inertia estimator active .20 1 signal: Acceleration model on .22 1 signal: Moment of inertia estimator retain value when motor switched off .24 1 signal: Shortened moment of inertia estimation is active. p1400.24 = 1 reduces the duration of the moment of inertia estimation. Disadvantage: If the accelerating torque is not constant while calculating the moment of inertia, the calculation of the moment of inertia using p1400.24 = 1 is less precise.

Parameter	Description	Setting
r1407.0...27	CO/BO: Status word speed controller	Display and BICO output for the status word of the speed controller. .24 1 signal: Moment of inertia estimator is active .25 1 signal: Load estimator is active .26 1 signal: Moment of inertia estimator is engaged .27 1 signal: Shortened moment of inertia estimation is active.
r1493	CO: Moment of inertia total, scaled [kgm^2]	Display and connector output for the parameterized total moment of inertia. r1493 = (p0341 × p0342) × p1496
p1496[0...n]	Acceleration precontrol scaling [%]	Sets the scaling for the acceleration precontrol of the speed/velocity controller. According to rotating measurement of the motor data identification is p1496 = 100%. Factory setting: 0
p1502[0...n]	BI: Freeze moment of inertia estimator	Sets the signal source to freeze the estimated moment of inertia. 0 signal: Moment of inertia estimator is active 1 signal: Determined moment of inertia is frozen If the load torque changes when accelerating the motor, set this signal to 0. Factory setting: 0
p1755[0...n]	Motor model changeover speed encoderless operation [rpm]	Defines the switchover between open-loop and closed-loop controlled operation of the encoderless vector control. When selecting the closed-loop speed control, the converter sets p1755 = 13.3% × rated speed. Factory setting: 210000.00

Advanced settings

Parameter	Description	Setting	
p1226[0...n]	Threshold for zero speed detection [rpm]	Sets the speed threshold for the standstill identification. The moment of inertia estimator only measures the load torque for speeds ≥ p1226. p1226 also defines from which speed the converter switches-off the motor for OFF1 and OFF3. Factory setting: 20	
p1560[0...n]	Moment of inertia estimator accelerating torque threshold value [%]	Sets the threshold for the accelerating torque for the moment of inertia estimator. Factory setting: 10	
p1561[0...n]	Change time for moment of inertia for moment of inertia estimator [ms]	Sets the change time for the moment of inertia for the moment of inertia estimator. Factory setting: 500	The lower that p1561 or p1562 is, the shorter the moment of inertia estimator

Parameter	Description	Setting
p1562[0...n]	Change time for the load torque for moment of inertia estimator [ms]	Sets the change time for the load torque for the moment of inertia estimator. Factory setting: 10 measurements. The larger p1561 or p1562 is, the more accurate the results provided by the moment of inertia estimator.
p1563[0...n]	Moment of inertia estimator load torque positive direction of rotation [Nm]	Display and connector output for the monitored load torque in the positive direction of rotation. Factory setting: 0
p1564[0...n]	Moment of inertia estimator load torque negative direction of rotation [Nm]	Display and connector output for the monitored load torque in the negative direction of rotation. Factory setting: 0
p5310[0...n]	Moment of inertia precontrol configuration	Configuration of the moment of inertia precontrol when the moment of inertia estimator is active. .00 1 signal: Activates calculation of the characteristic (p5312 ... p5315) .01 1 signal: Activates moment of inertia precontrol • p5310.00 = 0, p5310.01 = 0 Deactivating moment of inertia precontrol • p5310.00 = 1, p5310.01 = 0 Adapting the moment of inertia precontrol • p5310.00 = 0, p5310.01 = 1 Activating the moment of inertia precontrol. The characteristic of the moment of inertia precontrol remains unchanged. • p5310.00 = 1, p5310.01 = 1 Activating the moment of inertia precontrol. The converter adapts the characteristic in parallel. Factory setting: 0000 bin
r5311[0...n]	Moment of inertia precontrol status word	Displays the status word for the moment of inertia precontrol. .00 1 signal: New measuring points for the characteristic of the moment of inertia precontrol are available .01 1 signal: New parameters are been calculated .02 1 signal: Moment of inertia precontrol active .03 1 signal: The characteristic in the positive direction of rotation has been calculated and is ready .04 1 signal: The characteristic in the negative direction of rotation has been calculated and is ready .05 1 signal: The converter writes actual results to the parameter

Parameter	Description	Setting	
p5312[0...n]	Moment of inertia precontrol linear positive [1/s²]	Sets the linear coefficients for moment of inertia precontrol in the positive direction when the moment of inertia estimator is active. Factory setting: 0	In a positive direction of rotation: Moment of inertia = p5312 × load torque + p5313
p5313[0...n]	Moment of inertia precontrol constant positive [kgm²]	Sets of the constant coefficients for moment of inertia precontrol in the positive direction when the moment of inertia estimator is active. Factory setting: 0	
p5314[0...n]	Moment of inertia precontrol linear negative [1/s²]	Sets the linear coefficients for moment of inertia precontrol in the negative direction when the moment of inertia estimator is active. Factory setting: 0	In a negative direction of rotation: Moment of inertia = p5314 × load torque + p5315
p5315[0...n]	Moment of inertia precontrol constant negative [kgm²]	Sets the constant coefficients for moment of inertia precontrol in the negative direction when the moment of inertia estimator is active. Factory setting: 0	

7.20.3.7 Pole position identification

Overview

The converter must know the pole position of the rotor in the motor in order to be able to control the torque and speed of a synchronous motor.

For encoderless motors, the converter determines the pole position of the motor via a measurement.

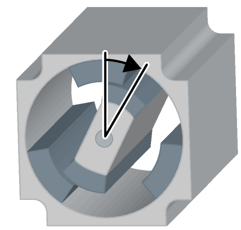
Precondition

The motor remains at a standstill.

Function description

The pole position of a synchronous motor is the deviation between the magnetic axis in the rotor and the magnetic axis in the stator.

The image below shows you the pole position of a synchronous motor in a simplified cross-section.



For permanent magnet synchronous motors, the following methods are possible for pole position identification:

- p1980 = 1: The most reliable and fastest, but also the loudest method

  During quick commissioning the converter sets p1980 = 1.
- p1980 = 4: Comparatively quiet method in two steps
- p1980 = 10: Comparatively slow method. This method is only possible if the motor can rotate freely during pole position identification.

If you are using a Siemens motor, then the converter automatically selects the appropriate technique to determine the pole position.

Each time the motor is switched on (ON/OFF1 command), the converter identifies the pole position.

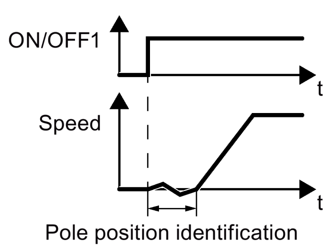


Figure 7-10 Pole position identification after switching on the motor

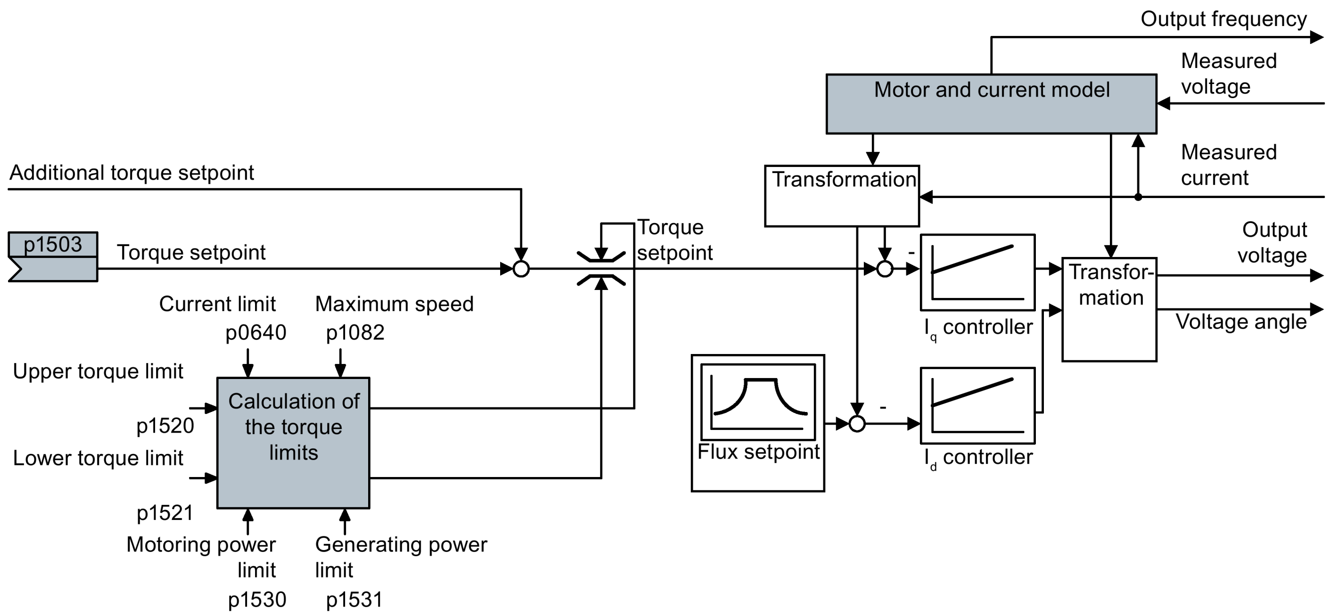
As a result of the pole position identification, the motor responds to an ON command with a delay of up to 1 second. The motor shaft can rotate slightly during the pole position identification.

Parameters

Parameters	Description	Factory setting
p1980	**PolID technique**	4
r1992	CO/BO: PolID diagnostics	-
p1998[D]	PolID circle center point	0.0 [A]

7.20.4 Torque control

Torque control is part of the vector control and normally receives its setpoint from the speed controller output. By deactivating the speed controller and directly entering the torque setpoint, the closed-loop speed control becomes closed-loop torque control. The converter then no longer controls the motor speed, but the torque that the motor generates.



Typical applications for torque control

The torque control is used in applications where the motor speed is specified by the connected driven load. Examples of such applications include:

- Load distribution between master and devices:
  The master is speed controlled, the device is torque controlled.
- Winding machines

The most important settings

Prerequisites for the correct functioning of the torque control:

- You have set the motor data correctly during the quick commissioning

  Quick commissioning (Page 98)
- You have performed a motor data identification on the cold motor

Parameter	Description	Setting
p1300[0...n]	Open-loop/closed-loop control operating mode	Sets the open and closed-loop control mode of a drive. 0: V/f control with linear characteristic (factory setting) 22: Torque control without speed encoder
p0300[0...n] ... p0360[0...n]	Motor data	Motor data is transferred from the motor rating plate during quick commissioning and calculated with the motor data identification.
p1511[0...n]	CI: Supplementary torque 1	Sets the signal source for supplementary torque 1. Factory setting: 0
p1520[0...n]	CO: Torque limit upper [Nm]	Sets the fixed upper torque limit. Factory setting: 0
p1521[0...n]	CO: Torque limit lower [Nm]	Sets the fixed lower torque limit. Factory setting: 0
p1530[0...n]	Motoring power limit [kW]	Sets the power limit when motoring. Factory setting: 0
p1531[0...n]	Regenerative power limit [kW]	Sets the regenerative power limit. Factory setting: -0.01

Additional information about this function is provided in the parameter list and in function diagrams 6030 onwards in the List Manual.

7.21 Electrically braking the motor

A differentiation is made between mechanically braking and electrically braking a motor:

- Mechanical brakes are generally motor holding brakes that are closed when the motor is at a standstill. Mechanical operating brakes, that are closed while the motor is rotating are subject to a high wear and are therefore often only used as an emergency brake.
  If your motor is equipped with a motor holding brake, then you should use the converter functions to control this motor holding brake, see Section Motor holding brake (Page 206).
- The motor is electrically braked by the converter. An electrical braking is completely wear-free. Generally, a motor is switched off at standstill in order to save energy and so that the motor temperature is not unnecessarily increased.

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 converter.

7.21.1 DC braking

DC braking is used for applications where the motor must be actively stopped; however, neither converter energy recovery nor a braking resistor is required for this function. DC braking is not possible with a permanent magnet synchronous motor.

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

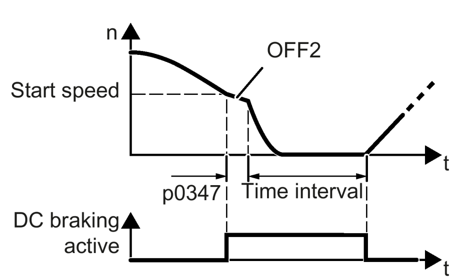
NOTICE
Motor overheating as a result of DC braking
The motor will overheat if you use DC braking too frequently or use it for too long. This may damage the motor. • Monitor the motor temperature. • Allow the motor to adequately cool down between braking operations. • If necessary, select another motor braking method.

With DC braking, the converter 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 asynchronous motors.

4 different events initiate DC braking:

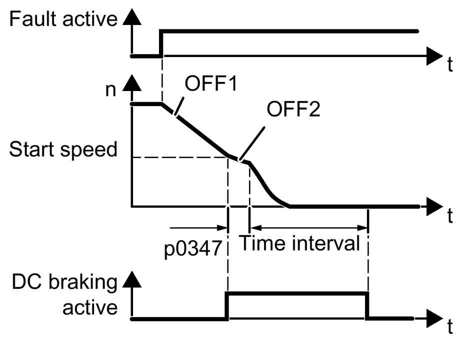
DC braking when falling below a starting speed



Requirement:
p1230 = 1 and p1231 = 14
Function:

1. The motor speed has fallen below the starting speed.
2. The converter activates the DC braking as soon as the motor speed falls below the starting speed.

DC braking when a fault occurs



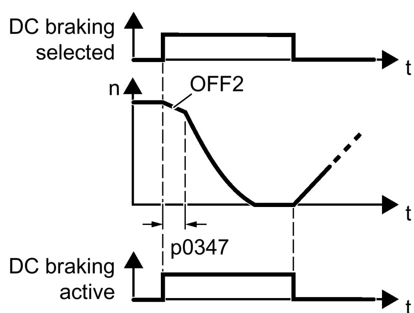
Requirement:

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:

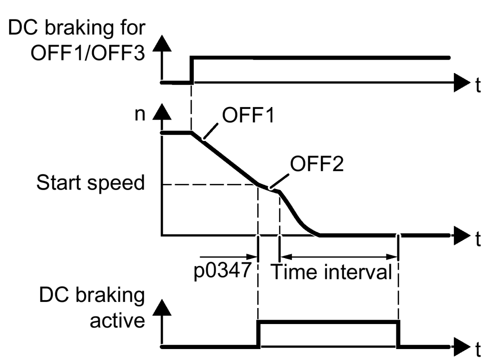
p1231 = 4 and p1230 = control command, e.g. p1230 = 722.3 (control command via DI 3)

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 converter 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.

Parameters

Settings for DC braking

Parameter	Description	Setting
p0347[0...n]	Motor de-excitation time [s]	Sets the de-magnetizing time (for asynchronous motors) after the converter pulses have been canceled (calculated after quick commissioning). The converter can trip due to an overcurrent during DC braking if the de-excitation time is too short. Factory setting: 0
p1230[0...n]	BI: DC braking activation	Sets the signal source to activate DC braking. 1 signal: DC braking activated. 0 signal: DC braking deactivated. Factory setting: 0
p1231[0...n]	Configuring DC braking	Sets to activate DC braking. 0: No DC braking (factory setting) 4: DC braking 5: DC braking for OFF1/OFF3 14: DC braking below starting speed
p1232[0...n]	DC braking, braking current [A]	Sets the braking current for DC braking. Factory setting: 0
p1233[0...n]	DC braking duration [s]	Sets the DC braking time (as fault response). Factory setting: 1
p1234[0...n]	Speed at the start of DC braking [rpm]	Sets the starting speed for DC braking. Factory setting: 210000
r1239[8...13]	CO/BO: DC braking status word	Status word of the DC braking. .08: DC braking active .10: DC braking ready .11: DC braking selected .12: DC braking selection internally locked .13: DC braking for OFF1/OFF3

Configuring DC braking as a response to faults

Parameter	Description	Setting
p2100[0...19]	Changing the fault reaction, fault number	Enter the fault number for which DC braking should be activated, e.g. p2100[3] = 7860 (external fault 1). Factory setting: 0
p2101[0...19]	Changing the fault reaction, reaction	Assign the fault response: p2101[3] = 6 (internal armature short-circuit / DC braking). The fault is assigned as an index of p2100. Assign the same index of p2100 or p2101 to the fault and fault response. The converter'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. Factory setting: 0

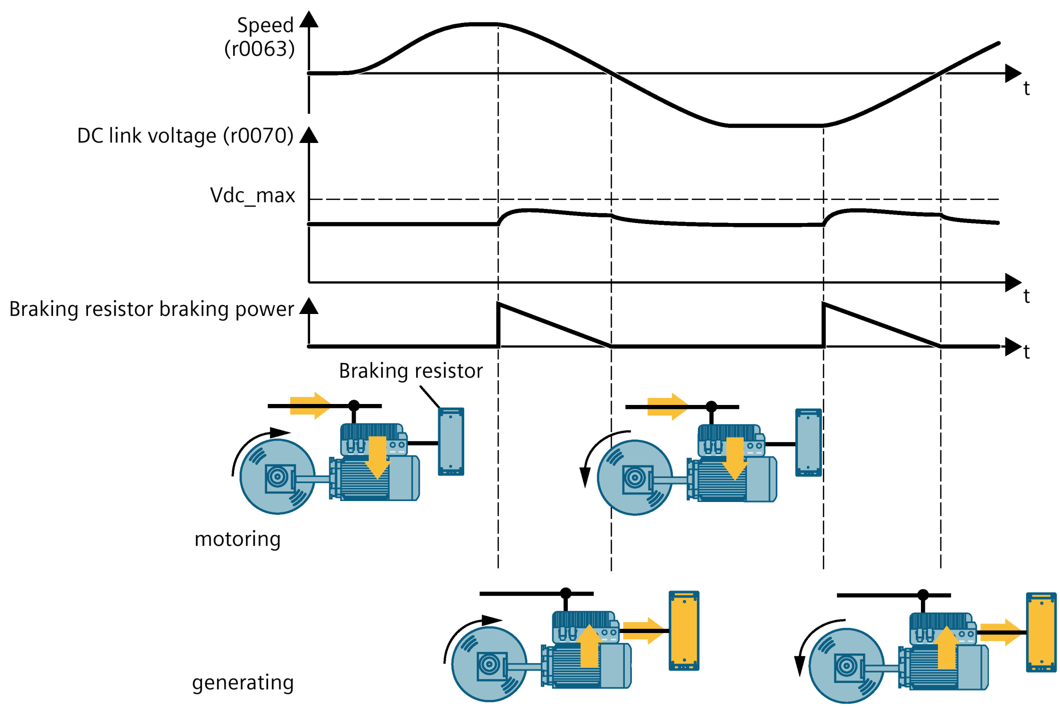
7.21.2 Dynamic braking

Typical applications for dynamic braking require continuous braking and acceleration operations or frequent changes of the motor direction of rotation:

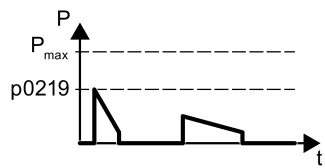
- Horizontal conveyors
- Vertical and inclined conveyors
- Hoisting gear

Principle of operation

The DC link voltage increases as soon as the motor supplies regenerative power to the converter when braking. Depending on the DC link voltage, the converter outputs the regenerative power to the integrated or optional braking resistor. The braking resistor converts the regenerative power into heat, therefore preventing DC link voltages > Vdc_max.



Setting the dynamic braking

Parameter	Description	Setting
p0219	Braking power of the braking resistor [kW]	For p0219 > 0, the converter deactivates the VDC_max controller. For vector control, p0219 defines the regenerative power limit p1531.  Using p0219, you define the maximum braking power that the braking resistor must absorb. For an excessively low braking power, the converter extends the motor ramp-down time. Factory setting: dependent upon the nominal power of the drive
p0212.8	Power unit configuration	If necessary, reduce the activation threshold for the braking resistor.
p0210	Unit supply voltage [V]	Sets the drive supply voltage. Factory setting: 400

An application 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/ww/en/view/103156155)

7.22 Overcurrent protection

Overview

The V/f control prevents too high a motor current by influencing the output frequency and the motor voltage (I_max controller).

Requirement

You have selected V/f control.

The application must allow the motor torque to decrease at a lower speed.

Function description

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 motor load is so high during steady-state operation that the motor current reaches the current limit, then the I_max controller reduces the speed and the motor voltage until the motor current returns to the permissible range again.

If the motor current reaches the current limit during deceleration, the I_max controller extends the deceleration operation.

Parameters

The factory setting for proportional gain and the integral time of the I_max controller ensures faultless operation in the vast majority of cases.

The factory setting of the I_max controller must only be changed in the following exceptional cases:

- Speed or torque of the motor tend to cause vibrations upon reaching the current limit.
- The converter goes into the fault state with an overcurrent message.

Parameter	Description	Setting
r0056.0 ... 15	CO/BO: Status word, closed-loop control	Display and BICO output for the status word of the closed-loop control.
p0305[0...n]	Rated motor current [A]	Sets the rated motor current. Factory setting: 0
p0640[0...n]	Current limit [A]	Sets the current limit.
p1340[0...n]	I_max frequency controller proportional gain	Sets the proportional gain of the I_max frequency controller. Factory setting: 0
p1341[D]	I_max frequency controller integral time [s]	Sets the integral time for the I_max frequency controller. Factory setting: 0.3
r1343	CO: I_max controller frequency output [rpm]	Displays the effective frequency limit.

You will find more information about this function in function diagram 6300 and in the parameter list.

7.23 Converter protection using temperature monitoring

Overview

The converter 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 converter monitors its temperature using the following monitoring types:

- I^2t monitoring (alarm A07805, fault F30005)
- Measuring the chip temperature of the converter (alarm A05006, fault F30024)
- Measuring the heat sink temperature of the converter (alarm A05000, fault F30004)

Function description

Overload response for p0290 = 0

The converter responds depending on the control mode that has been set:

- In vector control, the converter reduces the output current.
- In V/f control, the converter reduces the speed.

Once the overload condition has been removed, the converter re-enables the output current or speed.

If the measure cannot prevent a converter thermal overload, then the converter switches off the motor with fault F30024.

Overload response for p0290 = 1

The converter immediately switches off the motor with fault F30024.

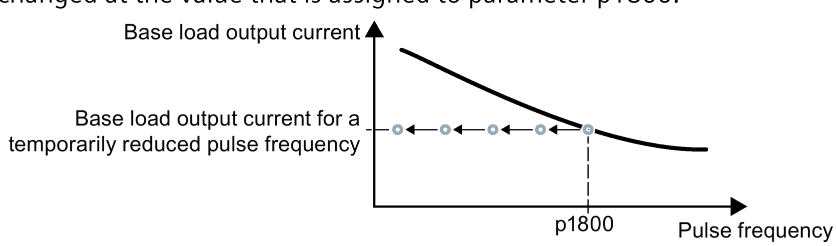
Overload response for p0290 = 2

We recommend this setting for drives with square-law torque characteristic, e.g. fans.

The converter responds in 2 stages:

1. If you operate the converter with increased pulse frequency setpoint p1800, then the converter 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 parameter p1800.

   Once the overload condition has been removed, the converter 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 converter reduces its output current.
   - In V/f control, the converter reduces the speed.

   Once the overload condition has been removed, the converter re-enables the output current or speed.

If both measures cannot prevent a power unit thermal overload, then the converter switches off the motor with fault F30024.

Overload response for p0290 = 3

If you operate the converter with increased pulse frequency, then the converter 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 converter 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 converter switches off the motor with fault F30024.

Overload response for p0290 = 12

The converter responds in 2 stages:

1. If you operate the converter with increased pulse frequency setpoint p1800, then the converter 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 converter 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 converter thermal overload cannot be prevented, then stage 2 follows:
   - In vector control, the converter reduces the output current.
   - In V/f control, the converter reduces the speed.

   Once the overload condition has been removed, the converter re-enables the output current or speed.

If both measures cannot prevent a power unit thermal overload, then the converter switches off the motor with fault F30024.

Overload response for p0290 = 13

We recommend this setting for drives with a high starting torque.

If you operate the converter with increased pulse frequency, then the converter 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 converter 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 converter switches off the motor with fault F30024.

Parameters

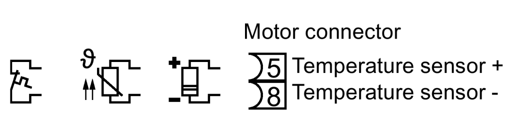
Parameter	Description	Setting
r0036	CO: Power unit overload I^2t [%]	Displays the power unit overload determined using the I^2t calculation. The I^2t monitoring calculates the converter utilization based on a current reference value defined in the factory. • Actual current > reference value: r0036 becomes higher. • Actual current < reference value: r0036 becomes lower or remains = 0.
r0037[0...19]	Power unit temperatures [°C]	Display and connector output for the temperature in the power unit.
p0290	Power unit overload response	Sets the response to a thermal overload condition of the power unit. The details are described above. Factory setting: 13
p0292[0...1]	Power unit temperature alarm threshold [°C]	Sets the alarm threshold for power unit overtemperature. The value is set as a difference to the tripping (shutdown) temperature. Factory setting: [0] Overtemperature heat sink: 5 [1] Temperature rise power semiconductor (chip): 15
p0294	Power unit alarm for I^2t overload [%]	Sets the alarm threshold for the I^2t power unit overload. Factory setting: 95

7.24 Motor temperature monitoring using a temperature sensor

You can use one of the following sensors to protect the motor against overtemperature:

- Temperature switch (e. g. bi-metal switch)
- PTC sensor
- KTY 84 sensor
- Pt1000 sensor

Connect the motor's temperature sensor through the motor output cable on the converter. For more information about motor interface, see Terminal layout of the glanded variant (Page 55).



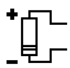
KTY84 sensor

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 converter cannot detect a motor overtemperature condition.

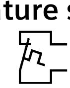
- Connect the KTY sensor with the correct polarity.



Using a KTY sensor, the converter monitors the motor temperature and the sensor itself for wire-break or short-circuit:

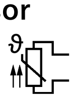
- Temperature monitoring:
  The converter uses a KTY sensor to evaluate the motor temperature in the range from -48° C ... +248° C.
  Use the p0604 or p0605 parameter to set the temperature for the alarm and fault threshold.
  - Overtemperature alarm (A07910):
    - motor temperature > p0604 and p0610 = 0
  - Overtemperature fault (F07011):
    The converter responds with a fault in the following cases:
    - motor temperature > p0605
    - motor temperature > p0604 and p0610 ≠ 0
- Sensor monitoring (A07015 or F07016):
  - Wire-break:
    The converter interprets a resistance > 2120 Ω as a wire-break and outputs the alarm A07015. After 100 milliseconds, the converter changes to the fault state with F07016.
  - Short-circuit:
    The converter interprets a resistance < 50 Ω as a short-circuit and outputs the alarm A07015. After 100 milliseconds, the converter changes to the fault state with F07016.

Temperature switch



The converter interprets a resistance ≥ 100 Ω as being an opened temperature switch and responds according to the setting for p0610.

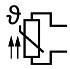
PTC sensor



The converter interprets a resistance > 1650 Ω as being an overtemperature and responds according to the setting for p0610.

The converter interprets a resistance < 20 Ω as being a short-circuit and responds with alarm A07015. If the alarm is present for longer than 100 milliseconds, the converter shuts down with fault F07016.

Pt1000 sensor



Using a Pt1000 sensor, the converter monitors the motor temperature and the sensor itself for wire breakage and/or short-circuit:

- Temperature monitoring:
  Using a Pt1000 sensor, the converter evaluates the motor temperature in the range from -48 °C ... +248 °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 converter responds with a fault in the following cases:
    - motor temperature > p0605
    - motor temperature > p0604 and p0610 ≠ 0
- Sensor monitoring (A07015 or F07016):
  - Wire-break:
    The converter interprets a resistance > 2120 Ω as a wire-break and outputs the alarm A07015. After 100 milliseconds, the converter changes to the fault state with F07016.
  - Short-circuit:
    The converter interprets a resistance < 603 Ω as a short-circuit and outputs the alarm A07015. After 100 milliseconds, the converter changes to the fault state with F07016.

Setting parameters for the temperature monitoring

Parameter	Description	Setting
p0335[0...n]	Motor-cooling method	Sets the motor cooling system used. 0: Natural cooling - with fan on the motor shaft (factory setting) 1: Forced ventilation - with a separately driven fan 2: Liquid cooling 128: No fan
p0601[0...n]	Motor temperature sensor type	Sets the sensor type for the motor temperature monitoring. 0: No sensor (factory setting) 1: PTC 2: KTY84 4: Temperature switch 6: Pt1000
p0604[0...n]	Mot_temp_mod 2/KTY alarm threshold [°C]	Sets the alarm threshold for monitoring the motor temperature of motor temperature model 2 or KTY/Pt1000. Factory setting: 130
p0605[0...n]	Mot_temp_mod 1/2/sensor threshold and temperature value [°C]	Sets the threshold and temperature value to monitor the motor temperature. Factory setting: 145

Parameter	Description	Setting
p0610[0...n]	Motor overtemperature response	Sets the system response when the motor temperature reaches the alarm threshold. 0: A07012, not reducing the current limit. 1: A07012 and F07011, reducing the current limit. 2: A07012 and F07011, not reducing the current limit. 12: A07012 and F07011, not reducing the current limit. (factory setting) Note: After setting p0610 = 12 and switching off the supply voltage, the converter 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.
p0640[0...n]	Current limit [A]	Sets the current limit. Factory setting: 0

Additional information on the motor temperature monitoring can be found in function diagram 8016 of the List Manual.

7.25 Motor protection by calculating the temperature

Overview

The converter calculates the motor temperature based on a thermal motor model.

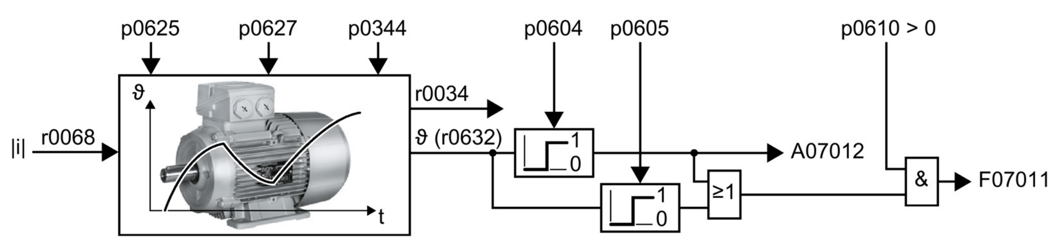
The thermal motor model responds far faster to temperature increases than a temperature sensor.

If the thermal motor model is used together with a temperature sensor, e.g. a Pt1000, then the converter corrects the model according to the measured temperature.

Function description

Thermal motor model 2 for asynchronous motors

The thermal motor model 2 for asynchronous 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.



Note

No thermal motor model for permanent magnet synchronous motor

Protect the permanent magnet synchronous motor against overtemperature by evaluating a temperature sensor of the motor in the converter.

Parameters

<table>
<tr><th>Parameter</th><th>Description</th><th colspan="2">Setting</th></tr>
<tr><td>r0034</td><td>CO: Thermal motor load [%]</td><td colspan="2">Display and connector output for the motor utilization from motor temperature model 1 (I^2t).</td></tr>
<tr><td>r0068[0...1]</td><td>CO: Absolute actual current value [A]</td><td colspan="2">Displays actual absolute current.
[0] Unsmoothed
[1] Smoothed with p0045</td></tr>
<tr><td>p0344[0...n]</td><td>Motor weight (for thermal motor model) [kg]</td><td>Sets the motor weight.
Factory setting: 0 kg</td><td rowspan="6">After selecting an asynchronous motor (p0300) or a listed asynchronous motor (p0301) during the commissioning, the converter sets the parameters to values appropriate for the motor.
The parameters are write-protected for listed motors (p0301 ≥ 0).</td></tr>
<tr><td>p0604[0...n]</td><td>Mot_temp_mod 2/KTY alarm threshold [°C]</td><td>Sets the alarm threshold for monitoring the motor temperature of motor temperature model 2 or KTY/Pt1000.
Factory setting: 130</td></tr>
<tr><td>p0605[0...n]</td><td>Mot_temp_mod 1/2/sensor threshold and temperature value [°C]</td><td>Sets the threshold and temperature value to monitor the motor temperature.
Factory setting: 145</td></tr>
<tr><td>p0612[0...n]</td><td>Motor temperature model activation</td><td>Activates the motor temperature model.
.01
1 signal: Activate motor temperature model 2 for asynchronous motors
.09
1 signal: Activate motor temperature model 2 expansions</td></tr>
<tr><td>p0627[0...n]</td><td>Motor overtemperature, stator winding [K]</td><td>Defines the rated overtemperature of the stator winding referred to the ambient temperature.
Factory setting: 80</td></tr>
<tr><td>p0610[0...n]</td><td>Motor overtemperature response</td><td colspan="2">Sets the system response when the motor temperature reaches the alarm threshold.
0: A07012, not reducing the current limit.
1: A07012 and F07011, reducing the current limit.
2: A07012 and F07011, not reducing the current limit.
12: A07012 and F07011, not reducing the current limit. (factory setting)
Note: After setting p0610 = 12 and switching off the supply voltage, the converter 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.</td></tr>
<tr><td>p0625[0...n]</td><td>Motor ambient temperature during commissioning [°C]</td><td colspan="2">Defines the ambient temperature of the motor for calculating the motor temperature model.
Factory setting: 20</td></tr>
<tr><td>r0632[0...n]</td><td>Mot_temp_mod stator winding temperature [°C]</td><td colspan="2">Displays the stator winding temperature of the motor temperature model.</td></tr>
<tr><td>p0640[0...n]</td><td>Current limit [A]</td><td colspan="2">Sets the current limit.
Factory setting: 0</td></tr>
</table>

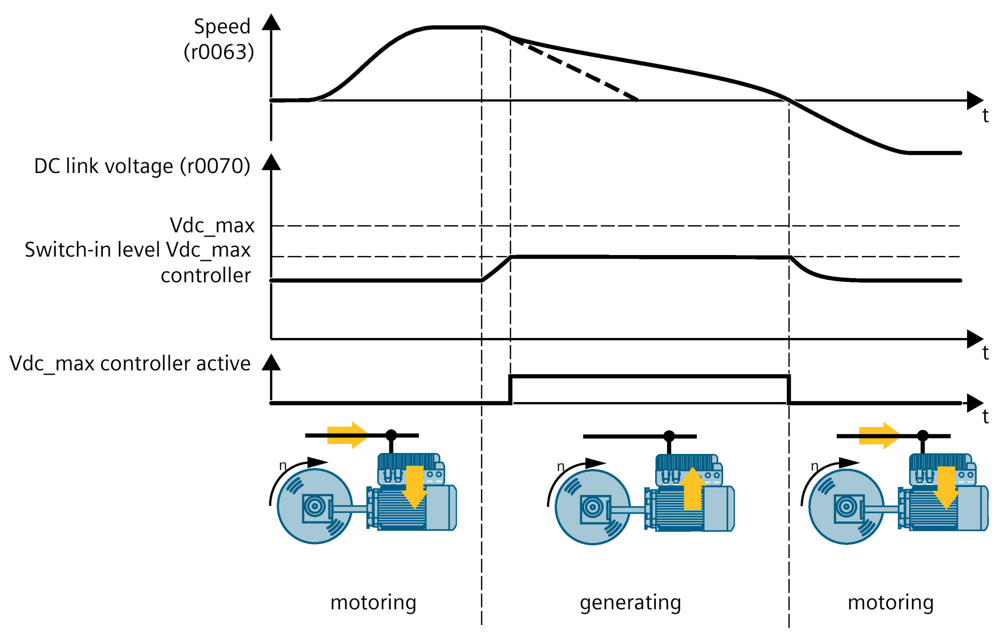
7.26 Motor and converter protection by limiting the voltage

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 converter. If the converter cannot output the electrical energy supplied by the motor, e.g. to a braking resistor, then the converter stores the energy in its DC link capacitance. As a consequence, the DC link voltage Vdc in the converter is higher.

An excessively high DC link voltage damages the converter and also the motor. As a consequence, the converter monitors its DC link voltage - and when necessary switches off the motor and outputs fault "DC link overvoltage".

Protecting the motor and converter against overvoltage



The Vdc_max control extends the motor ramp-down time when braking. The motor then only feeds so much energy into the converter to cover the losses in the converter. The DC link voltage remains in the permissible range.

The Vdc_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 291)

Parameters for Vdc_max control

The parameters differ depending on the motor control mode.

Parameter for V/f control	Parameter for vector control	Description	Setting
p1280 = 1	p1240 = 1	VDC controller configuration	0: VDC controller is disabled (factory setting) 1: VDC controller is enabled
r1282	r1242	Vdc_max control switch-on level [V]	DC-link voltage value above which the Vdc_max control is activated.
p1283	p1243	Vdc_max control dynamic factor [%]	Scaling closed-loop control parameters p1290, p1291 and p1292. Factory setting: 100
p1294	p1254	Vdc_max control automatic ON level sensing	0: Automatic detection disabled 1: Automatic detection enabled Factory setting: dependent upon the converter
p0210	p0210	Unit supply voltage [V]	If p1254 or p1294 = 0, the converter 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).

Overview of the manuals (Page 404)

7.27 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 converter 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.

7.27.1 No-load monitoring

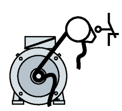
An insufficient motor current indicates that the motor cable is disconnected.

If the motor current for the time p2180 lies below the current level p2179, the converter signals the alarm A07929.

Parameters

Parameter	Description	Setting
r0068[0...1]	CO: Absolute actual current value [A]	Displays actual absolute current. [0] Unsmoothed [1] Smoothed with p0045
p2179[0...n]	Output load detection current limit [A]	Sets the current limit for output load identification. Factory setting: 0
p2180[0...n]	Output load detection delay time [ms]	Sets the delay time for the message "output load not available" (r2197.11 = 1). Factory setting: 2000
r2197.11	CO/BO: Status word monitoring functions 1	Display and BICO output for the first status word of the monitoring functions. Bit 11: Output load not available

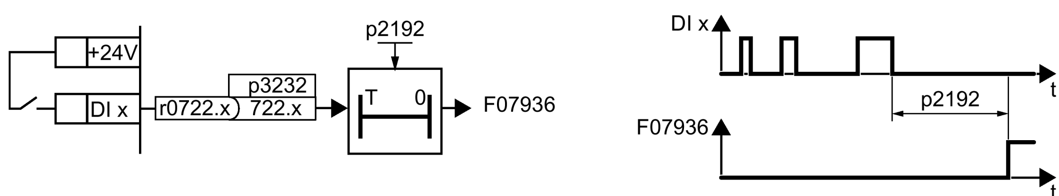
7.27.2 Rotation monitoring



The converter monitors the speed or velocity of a machine component via an electromechanical 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 converter checks whether the encoder consistently supplies a 24 V signal during motor operation. If the encoder signal fails for time p2192, the converter signals fault F07936.



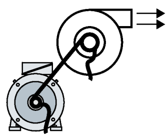
Parameters

Parameter	Description	Setting
r0722.0...25	CO/BO: CU digital inputs status	Displays the status of the digital inputs.
p2192[0...n]	Load monitoring delay time [s]	Sets the delay time to evaluate the load monitoring. Factory setting: 10
p2193[0...n]	Load monitoring configuration	Sets the load monitoring configuration: 0: Monitoring switched off 1: Monitoring torque and load drop (factory setting) 2: Monitoring speed and load drop 3: Load failure monitoring
p3232[0...n]	BI: Load monitoring, failure detection	Sets the signal source for detecting a failure. Factory setting: 1

For more information, see the List Manual (the parameter list and function diagram 8013).

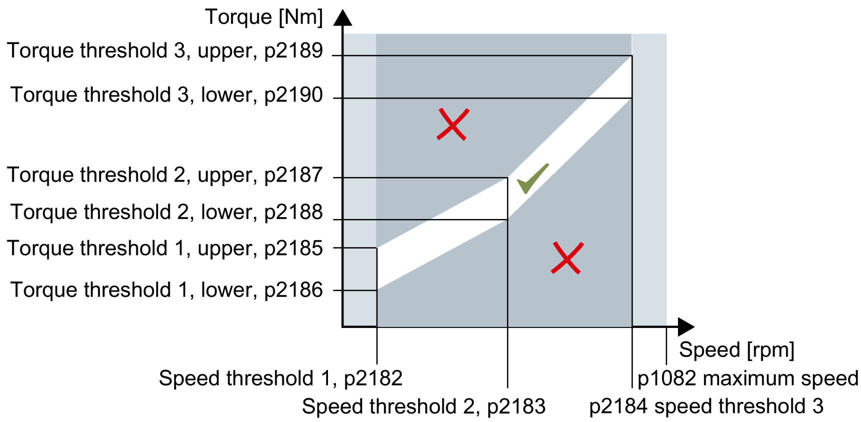
7.27.3 Torque monitoring

Function description



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 converter 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 converter reacts as specified in p2181.

The monitoring is not active below speed threshold 1 and above speed threshold 3.

Setting monitoring

1. Operate the drive at three different speeds in succession.
2. Set the speed thresholds p2182 ... p2184 to the respective values.
3. Set the torque thresholds for each speed.

   The converter displays the current torque in r0031.
4. Set p2193 = 1.

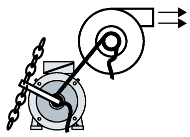
You have now set monitoring.
❒

Parameters

Parameters	Description	Setting	
r0031	Torque actual value, smoothed [Nm]	Displays the smoothed torque actual value.	
p2181[0...n]	Load monitoring response	Sets the response when evaluating the load monitoring. 0: Load monitoring disabled (factory setting) 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[0...n]	Load monitoring speed threshold 1 [rpm]	Sets the speed/torque envelope curve for load monitoring.	Factory setting: 150
p2183[0...n]	Load monitoring speed threshold 2 [rpm]		Factory setting: 900
p2184[0...n]	Load monitoring speed threshold 3 [rpm]		Factory setting: 1500
p2185[0...n]	Load monitoring torque threshold 1, upper [Nm]		Factory setting: 10000000
p2186[0...n]	Load monitoring torque threshold 1, lower [Nm]		Factory setting: 0
p2187[0...n]	Load monitoring torque threshold 2, upper [Nm]		Factory setting: 10000000
p2188[0...n]	Load monitoring torque threshold 2, lower [Nm]		Factory setting: 0
p2189[0...n]	Load monitoring torque threshold 3, upper [Nm]		Factory setting: 10000000
p2190[0...n]	Load monitoring torque threshold 3, lower [Nm]		Factory setting: 0
p2191[0...n]	Load monitoring torque threshold, no load [Nm]	Sets the torque threshold to identify dry running operation for pumps or belt breakage for fans. Factory setting: 0	
p2192[0...n]	Load monitoring delay time [s]	Sets the delay time to evaluate the load monitoring. Factory setting: 10	
p2193[0...n]	Load monitoring configuration	Sets the load monitoring configuration: 0: Monitoring switched off 1: Monitoring torque and load drop (factory setting) 2: Monitoring speed and load drop 3: Load failure monitoring	

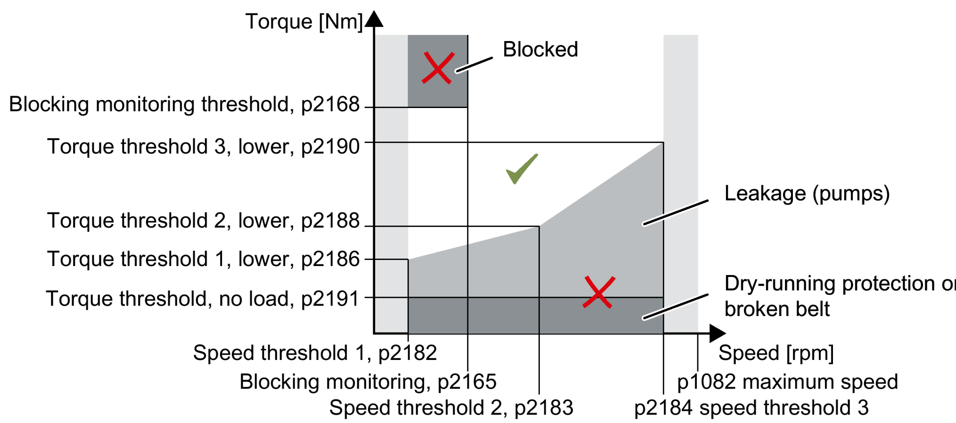
7.27.4 Blocking protection, leakage protection and dry-running protection

Overview



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.

Function description



If the torque and speed lie in the impermissible range longer than time p2192, the converter reacts as specified in p2181.

For applications with pumps, the converter detects the following states of the driven load:

- Blocked
- Leakage
- Dry running

For applications with fans or compressors, the converter detects the following states of the driven load:

- Blocked
- Torn belt

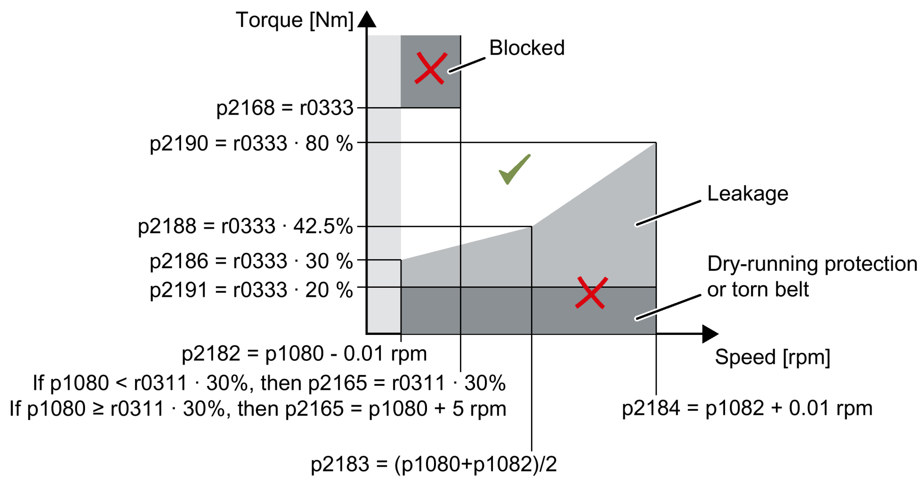
The monitoring is not active below speed threshold 1 and above speed threshold 3.

When using the control mode "V/f control" (p1300 < 10), the "Blocking protection" function becomes active when the current limit is reached.

No-load monitoring (Page 306)

Setting pump monitoring

1. Set p2193 = 4.
2. The converter sets the monitoring as shown.



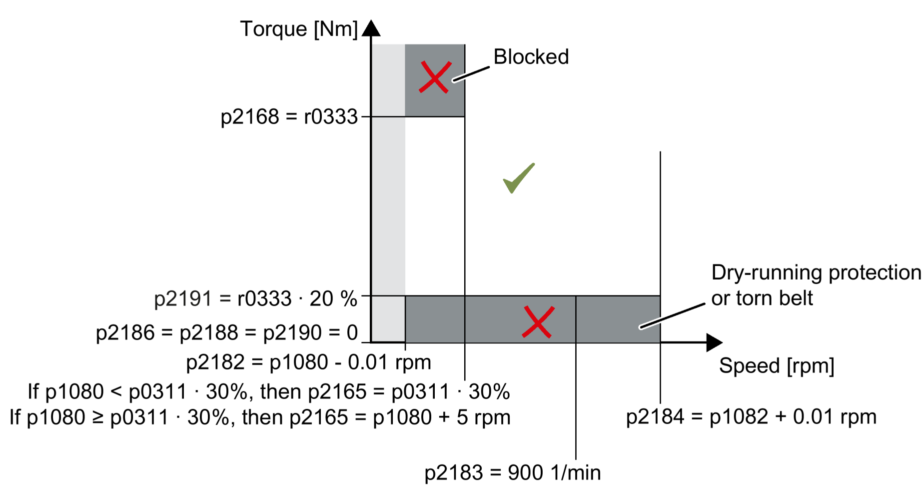
3. The converter sets monitoring response p2181 = 7
4. If necessary, adjust the speed thresholds p2182 ... p2184.
5. If necessary, adjust the torque threshold for each speed.

   The converter displays the current torque in r0031.

You have now set monitoring.
❒

Setting fan and compressor monitoring

1. Set p2193 = 5.
2. The converter sets the monitoring as shown.



3. The converter sets monitoring response p2181 = 7

4. If necessary, adjust the speed thresholds p2182 ... p2184.
5. Set the torque threshold for each speed.

   The converter displays the current torque in r0031.

You have now set monitoring.
❒

Parameters

Parameters	Description	Setting
r0031	Torque actual value, smoothed [Nm]	Displays the smoothed torque actual value.
p0311[0...n]	Rated motor speed [rpm]	Sets the rated motor speed. Factory setting: 0
r0333[0...n]	Rated motor torque [Nm]	Displays the rated motor torque.
p1080[0...n]	Minimum speed [rpm]	Sets the lowest possible motor speed. Factory setting: 0
p1082[0...n]	Maximum speed [rpm]	Sets the highest possible speed. Factory setting: 1500
p1300[0...n]	Open-loop/closed-loop control operating mode	Sets the open and closed-loop control mode. 0: V/f control with linear characteristic (factory setting) 1: V/f control with linear characteristic and FCC 2: V/f control with parabolic characteristic 3: V/f control with parameterizable characteristic 4: V/f control with linear characteristic and ECO 5: V/f control for drives requiring a precise frequency (e.g. textiles) 6: V/f control for drives requiring a precise frequency and FCC 7: V/f control for a parabolic characteristic and ECO 19: V/f control with independent voltage setpoint 20: Speed control (encoderless) 22: Torque control (encoderless)
p2165[0...n]	Load monitoring blocking monitoring threshold, upper [rpm]	Sets the upper speed threshold of the stall monitoring of the pump or fan. Factory setting: 0
p2168[0...n]	Load monitoring blocking monitoring torque threshold [Nm]	Sets the torque threshold of the stall monitoring of the pump or fan. Factory setting: 10000000
p2181[0...n]	Load monitoring response	Sets the response when evaluating the load monitoring. 0: Load monitoring disabled (factory setting) 7: Pump/fan load monitoring as alarm (A07891, A07892, A07893) 8: Pump/fan load monitoring as fault (F07894, F07895, F07896)

Parameters	Description	Setting	
p2182[0...n]	Load monitoring speed threshold 1 [rpm]	Sets the speed/torque envelope curve for load monitoring.	• When using the control mode "V/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) Factory setting: 150
p2183[0...n]	Load monitoring speed threshold 2 [rpm]		Factory setting: 900
p2184[0...n]	Load monitoring speed threshold 3 [rpm]		Factory setting: 1500
p2186[0...n]	Load monitoring torque threshold 1, lower [Nm]		Factory setting: 0
p2188[0...n]	Load monitoring torque threshold 2, lower [Nm]		Factory setting: 0
p2190[0...n]	Load monitoring torque threshold 3, lower [Nm]		Factory setting: 0
p2191[0...n]	Load monitoring torque threshold, no load [Nm]	Sets the torque threshold to identify dry running operation for pumps or belt breakage for fans. Factory setting: 0	
p2192[0...n]	Load monitoring delay time [s]	Sets the delay time to evaluate the load monitoring. Factory setting: 10	
p2193[0...n]	Load monitoring configuration	Sets the load monitoring configuration: 1: Monitoring torque and load drop (factory setting) 4: Monitoring pump and load failure 5: Monitoring fan and load failure	

Further information

If you deselect monitoring with p2193 < 4, the converter then resets the load monitoring parameters to factory settings.

7.28 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.

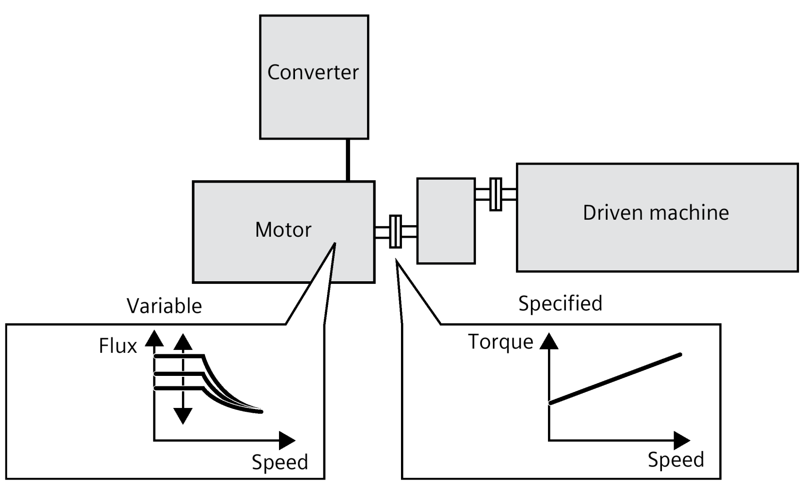
The disadvantage is only relevant when the motor must satisfy high requirements relating to the dynamic performance. Even when efficiency optimization is active, the converter closed-loop motor control prevents the motor from stalling.

Precondition

Efficiency optimization functions under the following preconditions:

- Operation with an asynchronous motor
- Vector control is set in the converter.

Function description



The three variables that the converter can directly set, which define efficiency of an asynchronous motor, are speed, torque and flux.

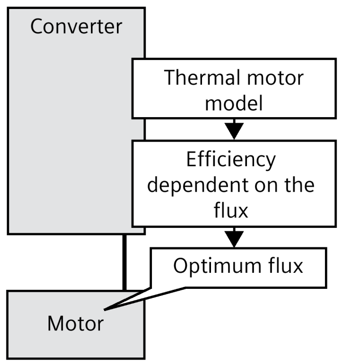
However, in all applications, speed and torque are specified by the driven machine. As a consequence, the remaining variable for the efficiency optimization is the flux.

The converter has two different methods of optimizing the efficiency.

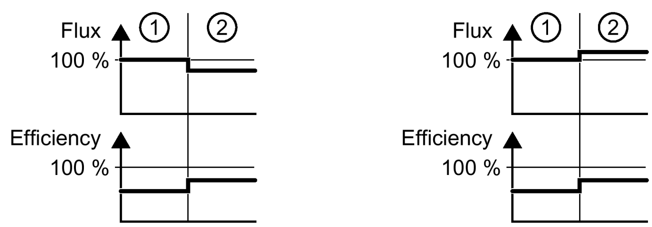
Efficiency optimization, method 2

Generally, energy efficiency optimization method 2 achieves a better efficiency than method 1.

We recommend that you set method 2.



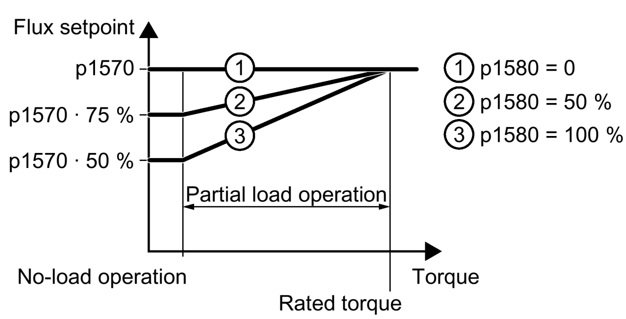
Based on its thermal motor model, the converter continually determines - for the actual operating point of the motor - the interdependency between efficiency and flux. The converter then sets the flux to achieve the optimum efficiency.



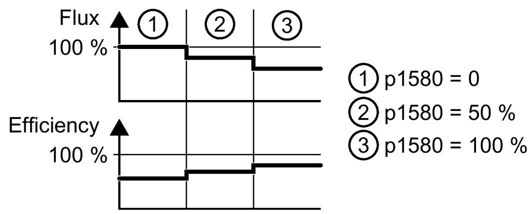
① Efficiency optimization is not active
② Efficiency optimization is active

Depending on the motor operating point, the converter either decreases or increases the flux in partial load operation of the motor.

Efficiency optimization, method 1



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 converter reduces the flux setpoint linearly with the torque.



The reduced flux in the motor partial load range results in higher efficiency.

Parameters

The converter calculates the parameters for the thermal motor model based on the motor data that has been set – and the motor data identification.

Efficiency optimization, method 2

Parameter	Description	Setting
p1401.14	Flux control configuration	1 signal: Efficiency optimization 2 active Factory setting: 0000 0000 0000 0110 bin
p1570[0...n]	CO: Flux setpoint [%]	Sets the flux setpoint referred to rated motor flux. Factory setting: 100
p3315[0...n]	Efficiency optimization 2 minimum flux limit value [%]	Sets the minimal limit value for the calculated optimum flux. Factory setting: 50
p3316[0...n]	Efficiency optimization 2 maximum flux limit value [%]	Sets the maximum limit value for the calculated optimum flux. Factory setting: 110

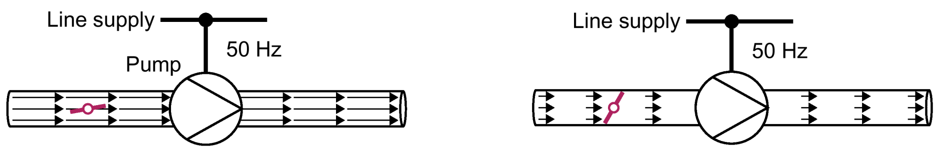
Efficiency optimization, method 1

Parameter	Description	Setting
p1570[0...n]	CO: Flux setpoint [%]	Sets the flux setpoint referred to rated motor flux. Factory setting: 100
p1580[0...n]	Efficiency optimization [%]	0 %: Efficiency optimization is deactivated. 100 %: In no-load operation, the converter reduces the flux setpoint to 50% of the rated motor flux. The factory setting depends on the converter.

7.29 Calculating the energy saving for fluid flow machines

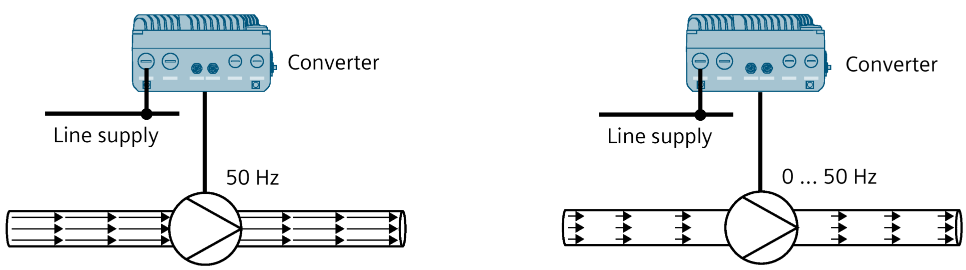
Overview

Fluid flow machines, which mechanically control the flow rate using valves or throttle flaps, operate with a constant speed corresponding to the line frequency.

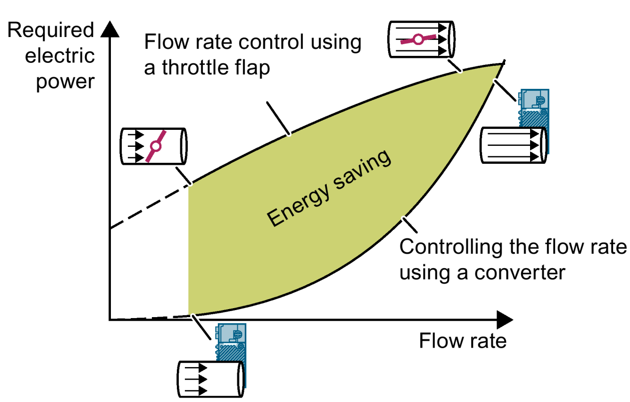


The lower the flow rate, the poorer the efficiency of the fluid flow machine (pump). The fluid flow machine (pump) has the poorest efficiency when the throttle or valve is completely closed. Further, undesirable effects can occur, for example the formation of vapor bubbles in liquids (cavitation) or the temperature of the medium being pumped can increase.

The converter controls the flow rate by appropriately varying the speed of the fluid flow machine. By controlling the flow rate, the fluid flow machine operates at the optimum efficiency for each flow rate. This situation means that in the partial load range less electric power is required than when controlling the flow rate using valves and throttles.



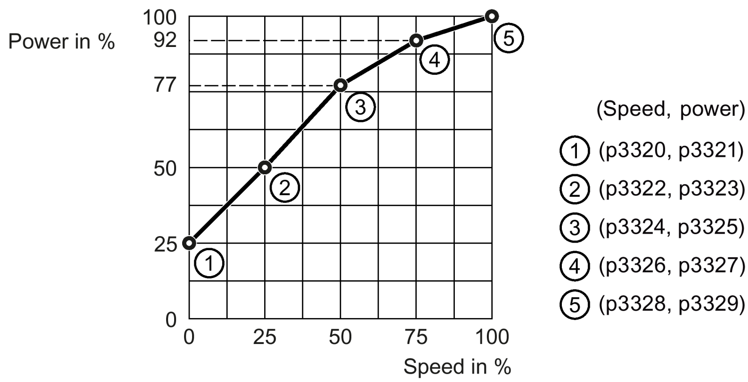
Function description



The converter 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.

Flow characteristic



To set the characteristic, you require the following data from the machine manufacturer for each speed interpolation point:

- The flow rate of the fluid-flow machine associated with the 5 selected converter speeds
- At constant speed, the power drawn which is associated with the 5 flow rates corresponds to the line frequency and mechanical throttling of the flow rate.

Parameters

Parameter	Description	Setting
r0039[0...2]	CO: Energy display [kWh]	[0] Energy consumption since the last reset. [1] Energy drawn since the last reset. [2] Energy fed back since the last reset. r0039 serves as reference signal of r0042.
p0040	Reset energy consumption display	Setting p0040 = 1 to reset the display in r0039 and r0041. Factory setting: 0
r0041	Energy saved [kWh]	Displays the saved energy referred to 100 operating hours. For an operating time of below 100 hours, the display is interpolated up to 100 hours.
r0042[0...2]	CO: Process energy display [Wh]	[0] Energy consumption since the last reset. [1] Energy drawn since the last reset. [2] Energy fed back since the last reset. For display as process variable. Enable with p0043.
p0043	BI: Energy consumption display enabled	Sets the signal source (BI: p0043 = 1 signal) to enable/reset the process energy display in r0042. Factory setting: 0
p3320[0...n]	Fluid flow machine power, point 1 [%]	Specifies the power (P) of point 1 as a [%]. Factory setting: 25
p3321[0...n]	Fluid flow machine speed, point 1 [%]	Specifies the speed (n) of point 1 as a [%]. Factory setting: 0
p3322[0...n]	Fluid flow machine power, point 2 [%]	Specifies the power (P) of point 2 as a [%]. Factory setting: 50

Parameter	Description	Setting
p3323[0...n]	Fluid flow machine speed, point 2 [%]	Specifies the speed (n) of point 2 as a [%]. Factory setting: 25
p3324[0...n]	Fluid flow machine power, point 3 [%]	Specifies the power (P) of point 3 as a [%]. Factory setting: 77
p3325[0...n]	Fluid flow machine speed, point 3 [%]	Specifies the speed (n) of point 3 as a [%]. Factory setting: 50
p3326[0...n]	Fluid flow machine power, point 4 [%]	Specifies the power (P) of point 4 as a [%]. Factory setting: 92
p3327[0...n]	Fluid flow machine speed, point 4 [%]	Specifies the speed (n) of point 4 as a [%]. Factory setting: 75
p3328[0...n]	Fluid flow machine power, point 5 [%]	Specifies the power (P) of point 5 as a [%]. Factory setting: 100
p3329[0...n]	Fluid flow machine speed, point 5 [%]	Specifies the speed (n) of point 5 as a [%]. Factory setting: 100

7.30 Switchover between different settings

Overview

There are applications that require different converter settings.

Example:

Different motors are operated on one converter. The converter must operate with the motor data of the particular motor and the appropriate ramp-function generator.

Function description

Drive data sets (DDS)

Some converter functions can be set differently, and there can be a switch between the different settings.

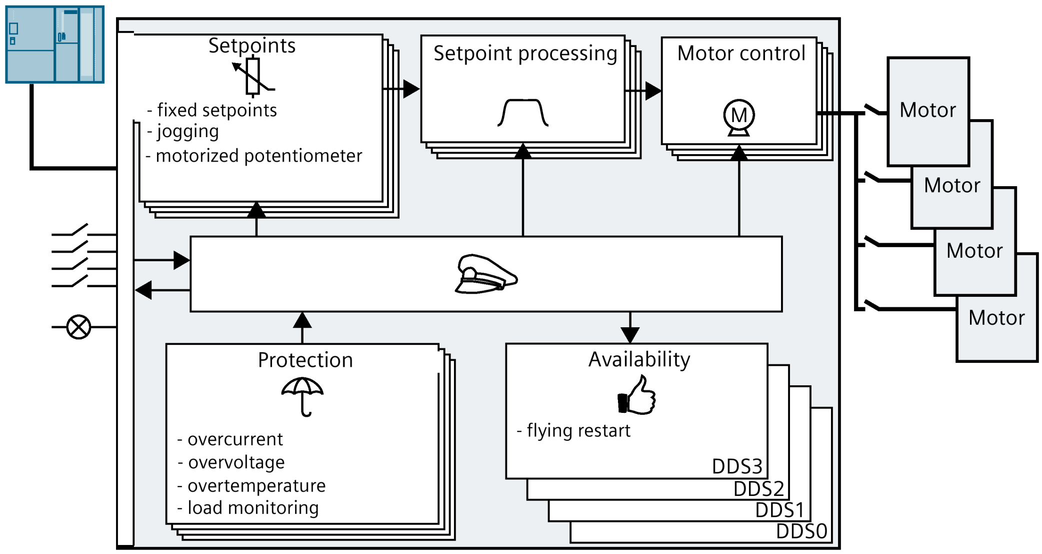
Note

You can only switch over the motor data of the drive data sets in the "ready for operation" state with the motor switched off. The switchover time is approx. 50 ms.

If you do not switch over the motor data together with the drive data sets (i.e. same motor number in p0826), then the drive data sets can also be switched over in operation.

The associated parameters are indexed (index 0, 1, 2, or 3). One of the four indexes is selected with control commands, and thereby one of the four saved settings.

The settings in the converter with the same index are called the drive data set.



Selecting the number of drive data sets

Parameter p0180 defines the number of drive data sets (1 ... 4).

Parameter	Description
p0010 = 0	Drive commissioning: Ready
p0010 = 15	Drive commissioning: Data sets
p0180	Drive data set (DDS) number

Copying the drive data sets

Parameter	Description
p0819[0]	Source drive data set
p0819[1]	Target drive data set
p0819[2] = 1	Starts the copy operation

Parameters

Parameter	Description	Setting
p0010	Drive commissioning parameter filter	Sets the parameter filter to commission a drive. 0: Ready 1: Quick commissioning (factory setting) 15: Data sets
r0051.0...1	CO/BO: Drive data set DDS effective	Displays the effective Drive Data Set (DDS).
p0180	Number of Drive data set (DDS)	p0180 = 1, 2, 3 or 4 Factory setting: 1
p0819[0...2]	Copy drive data set DDS	[0] Source Drive Data Set [1] Target Drive Data Set [2] 0→1: Starts the copy operation Factory setting: 0

Parameter	Description	Setting
p0820[0...n]	BI: Drive data set DDS selection, bit 0	Sets the signal source to select DDS, bit 0. Factory setting: 0
p0821[0...n]	BI: Drive data set DDS selection, bit 1	Sets the signal source to select DDS, bit 1. Factory setting: 0
p0826[0...n]	Motor changeover, motor number	Sets the freely assignable motor number for the drive data set changeover. Factory setting: 0

7.31 Activating licensed functions

7.31.1 Licensing

Purchasing a memory card with license

Procedure

1. Order a memory card - with or without firmware – with the license that you require.
2. Switch off the converter power supply.
3. Insert the card into the converter.
4. Switch on the power supply for the converter.

You have activated the licensed function.
❒

Purchasing a license and loading to a memory card

Requirement

You have a memory card without a license.

Memory cards (Page 327)

Procedure

1. Order the license for the function that you require.
2. You receive the "Certificate of License", it contains:
   - the software order number
   - the license number
   - the delivery note number
3. Create the license key using the "WEB License Manager".

   Creating or displaying the license key (Page 322)

4. Insert the card into the converter.
5. Write the license key to the card using Startdrive.

   Writing the license key to the card (Page 324)
6. Switch off the converter power supply.
7. Switch on the converter power supply again.

You have activated the licensed function.

❒

7.31.2 Creating or displaying the license key

Overview

The WEB License Manager has the following functions:

- Generate the license key for a new license
- Display the licenses on a card

WEB License Manager on the Internet:

WEB License Manager (http://www.siemens.com/automation/license)

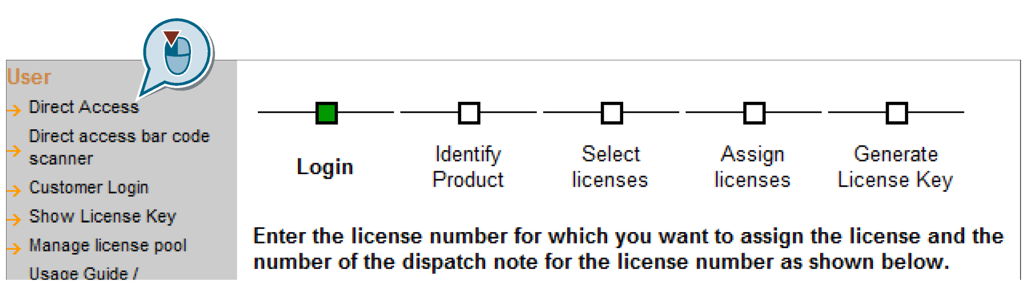
Creating the license key using "WEB License Manager"

Requirements

- You know the license number and the delivery note number from the Certificate of License.
- You know the serial number of your memory card.

Procedure

1. Open the WEB License Manager.
2. Click "Direct access" in the WEB License Manager in the navigation bar.



3. Enter the license number and delivery note number from your Certificate of License.
4. Click "Next".

5. Progress display: "Identify product".

   Enter the serial number of the memory card.
6. Select for "Product".
7. Click "Next".
   If licenses are already assigned to your software, they are displayed here.
8. Click "Next".
9. Progress display: "Select licenses".

   The WEB License Manager displays the licenses that you can assign. Select the checkbox for assignment.
10. Click "Next".
11. Progress display: "Assign licenses".

    The WEB License Manager displays a summary of the licenses selected for assignment.
12. Click "Assign".
13. Confirm the following confirmation prompt with OK.
14. Progress display: "Generate license key".

    The licenses are permanently assigned to the specified memory card. The license key is displayed.

    - License Key in SIN++SINAMICS G120+N3093102760044+;incl_key.Alm abspeichern.
    - License Key in keys.txt abspeichern
    - License Report als PDF abspeichern
15. Save the license key on your PC.

You have created a license key.
❒

Displaying and requesting the license key using the "WEB License Manager"

With this function, the WEB License Manager displays which converter functions are assigned to which card with which license keys.

Requirement

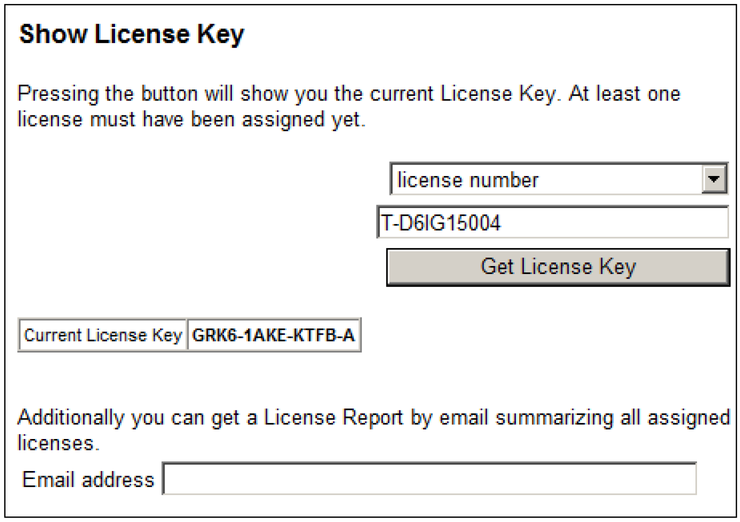
One of the following requirements must be satisfied:

- You know the serial number of the memory card
- You know the license number of the converter function

Procedure

1. Open the WEB License Manager.
2. Select "Show license key"
3. In the drop-down list, make the entry based on the license key you wish to display or request.

4. Complete the fields below appropriately.
5. Click the "Display license key" button.



6. Enter your e-mail address and click "Request license report".
7. You receive the license report as a PDF. In addition to the actual license key, it includes the serial number of the memory card and all of the licenses assigned to this memory card.

You have displayed and requested the license key.
❒

A new license is not required if you upgrade/downgrade to older or newer software versions. For this reason, do not delete the license key from the memory card (..\KEYS\SINAMICS\KEYS.txt), if you want to switch over to another software version.

7.31.3 Writing the license key to the card

Overview

You write the license key to the memory card by writing the individual positions – in an ascending order – into the bits of parameter p9920, and then subsequently activate the key using p9921.

The procedure for Startdrive, based on the fictitious "E1MQ-4BEA" license key, is described below.

Note

If you subsequently purchase an additional license, then you will require a new license key. You must overwrite the old license key. The new license key can have more than 9 positions.

You must set p9920[0] = 0 in order to reset the license key.

Activating the license key with Startdrive

Procedure

1. Go online and switch over to the parameter view.
2. In the parameter view, go to parameter p9920
3. Enter the license key (example: "E1MQ-4BEA") - always use uppercase letters:
   – p9920[0] = E
   – p9920[1] = 1
   – ...
   – p9920[7] = E
   – p9920[8] = A
4. Set p9921 = 1.
   After activation, the converter sets p9921 = 0.

You have activated the license key using Startdrive.
❒

Data backup and series commissioning 8

Saving settings outside the converter

After commissioning, your settings are saved in the converter so that they are protected against power failure.

We recommend that you additionally back up the settings on a storage medium outside the converter. Without backup, your settings could be lost if the converter develops a defect.

The following storage media are available for your settings:

- Memory card
- PG/PC
- SINAMICS G120 Smart Access

Carrying out series commissioning

Series commissioning is the commissioning of several identical converters.

Precondition

The converter to which the settings are transferred has the same article number and the same or a later firmware version as the source converter.

Overview of the procedure

1. Commission the first converter.
2. Back up the settings of the first converter to an external storage medium.
3. Transfer the settings from the first converter to an additional converter via the data storage medium.

8.1 Transferring settings using a memory card

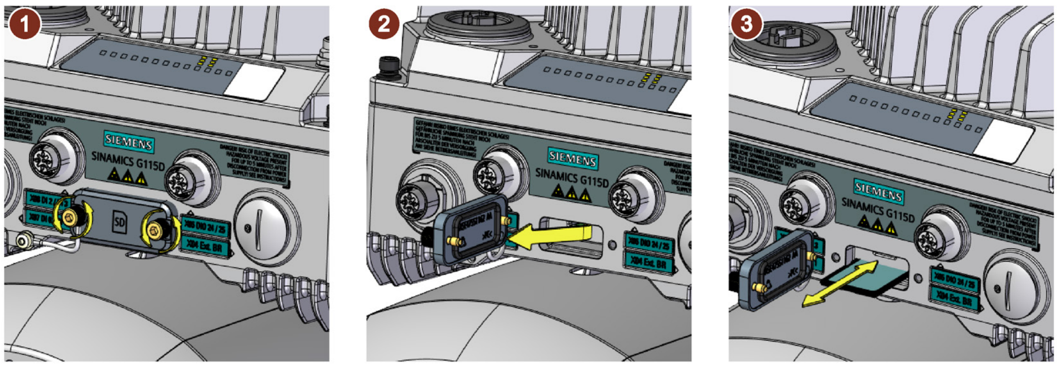
8.1.1 Memory cards

Recommended memory cards

Scope of delivery	Article number
Memory card without firmware	6SL3054-4AG00-2AA0
Memory card with firmware V4.7 SP13	6SL3054-7TG00-2BA0
Memory card with firmware V4.7 SP14	6SL3054-7TH00-2BA0

Inserting a memory card

You may find the memory card slot on the G115D Wiring Module. See the following images for the detailed location:



Fixings: 2 × M3 screws
Tightening torque: 0.8 Nm (7.1 lbf.in)

Note

For more information about performing a converter firmware upgrade and downgrade by using a memory card, see the following chapter:

Firmware upgrade and downgrade (Page 370)

Further information

Using memory cards from other manufacturers

If you do not use a recommended SD memory card, you must format it as follows:

- 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:

- Know-how protection is only possible with one of the recommended Siemens memory cards.
- Under certain circumstances, memory cards from other manufacturers do not support writing or reading data from/to the converter.

8.1.2 Converter → Memory card

We recommend that you insert a memory card before switching on the converter power supply for the first time. The converter then automatically ensures that the actual parameter settings are saved both in the converter as well as on the card.

You can transfer parameter settings from the converter to the memory card by the following methods:

- Automatic transfer
- Transfer with Startdrive
- Transfer with SINAMICS G120 Smart Access

Automatic transfer

Precondition

The converter power supply has been switched off.

Procedure

1. Insert an empty memory card into the memory card slot.

Note

Accidental firmware update

If the memory card contains a converter firmware, the converter may perform a firmware update after the supply voltage has been switched on.

Firmware upgrade and downgrade (Page 370)

Note

Accidental overwrite of the converter settings

When the supply voltage is switched on, the converter 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 converter.

- Use an empty memory card for the first automatic back-up of your settings.

---

2. Switch on the converter power supply.

After the converter power supply has been switched on, it copies all modified parameters to the memory card.

❒

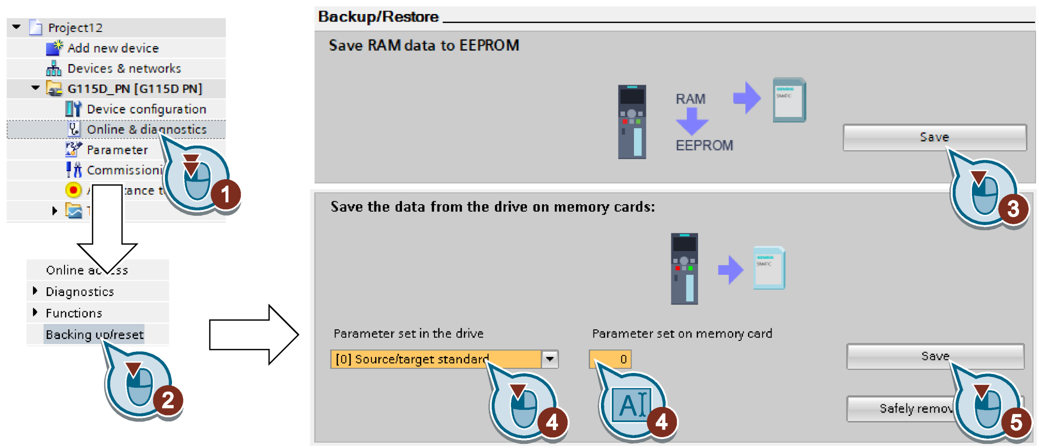
Transferring using Startdrive

Precondition

- A memory card is inserted in the converter.
- Connection between the PG/PC and converter has been properly established via a USB cable or the fieldbus.
- You have installed the Startdrive commissioning tool on your PG/PC.

Procedure

1. Go online.
2. Proceed as follows to transfer converter settings to the memory card.



3. Wait until Startdrive reports that data backup has been completed.

You have backed up the converter settings to the memory card.
❒

Transferring using SINAMICS G120 Smart Access

You can use the SINAMICS G120 Smart Access to transfer settings. For more information on the transferring process, see Section "Backup and restore" in the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

8.1.3 Memory card → converter

You can transfer parameter settings from a memory card to the converter by the following methods:

- Automatic transfer
- Transfer with Startdrive
- Transfer with SINAMICS G120 Smart Access

Automatic transfer

Precondition

The converter power supply has been switched off.

Procedure

1. Insert the memory card into the memory card slot.
2. Switch on the converter power supply.

If there is valid parameter data on the memory card, the converter accepts the data from the memory card.

❒

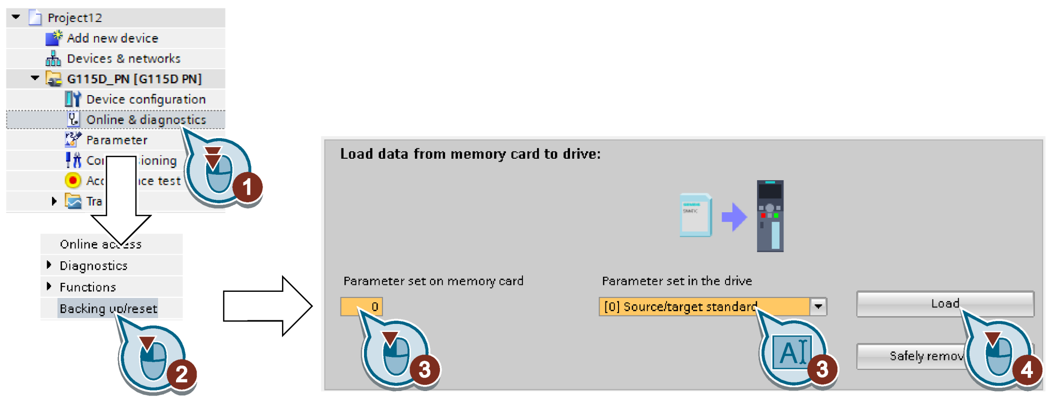
Transferring using Startdrive

Precondition

- A memory card is inserted in the converter.
- Connection between the PG/PC and converter has been properly established via a USB cable or the fieldbus.
- You have installed the Startdrive commissioning tool on your PG/PC.

Procedure

1. Go online.
2. Proceed as follows to transfer parameter settings from the memory card to the converter.



3. Wait until Startdrive has signaled that the data transfer has been completed.

Note

After the transferring process has completed, safely remove the memory card.

You have transferred your settings from a memory card to the converter.
❒

Your settings on the converter become effective after the next time you switch on its power supply.

Transferring using SINAMICS G120 Smart Access

You can use the SINAMICS G120 Smart Access to transfer settings. For more information on the transferring process, see Section "Backup and restore" in the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

8.1.4 Activating message for a memory card that is not inserted

Function

The converter identifies whether a memory card is not inserted, and signals this state. The message is deactivated in the converter 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.
❒

Parameters

Parameter	Description	Setting
p2118[0 ... 19]	Change message type, message number	Selects faults or alarms for which the message type should be changed. Factory setting: 0
p2119[0 ... 19]	Change message type	Sets the message type for the selected fault or alarm. 1: Fault (factory setting) 2: Alarm 3: No message
r9401	Safely remove memory card status	Displays the status of the memory card. Bit 00: Memory card inserted Bit 01: Memory card activated Bit 02: Siemens memory card Bit 03: Memory card used as USB data storage medium from the PC

8.2 Transferring settings using a PG/PC

8.2.1 Converter → PG/PC

You can transfer parameter settings from the converter to a PG/PC by the following method:

- Transfer with Startdrive
- Transfer with SINAMICS G120 Smart Access

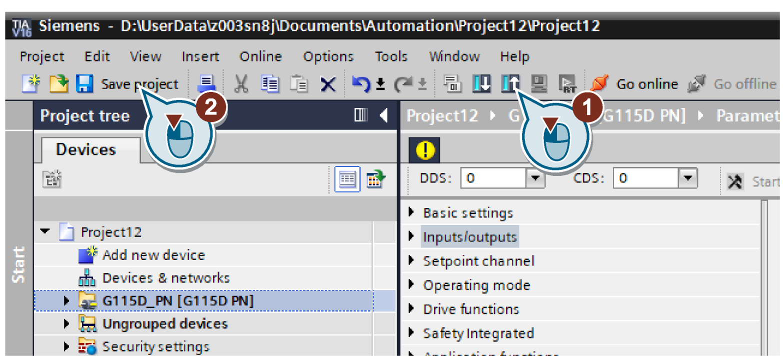
Transferring using Startdrive

Precondition

- Connection between the PG/PC and converter has been properly established via a USB cable or the fieldbus.
- You have installed the Startdrive commissioning tool on your PG/PC.

Converter → PC/PG

1. Make sure that the converter is offline with Startdrive.
2. Proceed as follows to transfer settings from the converter to the PG/PC:



3. Wait until Startdrive prompts that the transfer procedure is complete.

You have transferred the settings from the converter to the PG/PC with Startdrive.
❒

Transferring using SINAMICS G120 Smart Access

You can use the SINAMICS G120 Smart Access to transfer settings. For more information on the transferring process, see Section "Backup and restore" in the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

8.2.2 PG/PC → converter

You can transfer parameter settings from a PG/PC to the converter by the following method:

- Transfer with Startdrive
- Transfer with SINAMICS G120 Smart Access

Transferring using Startdrive

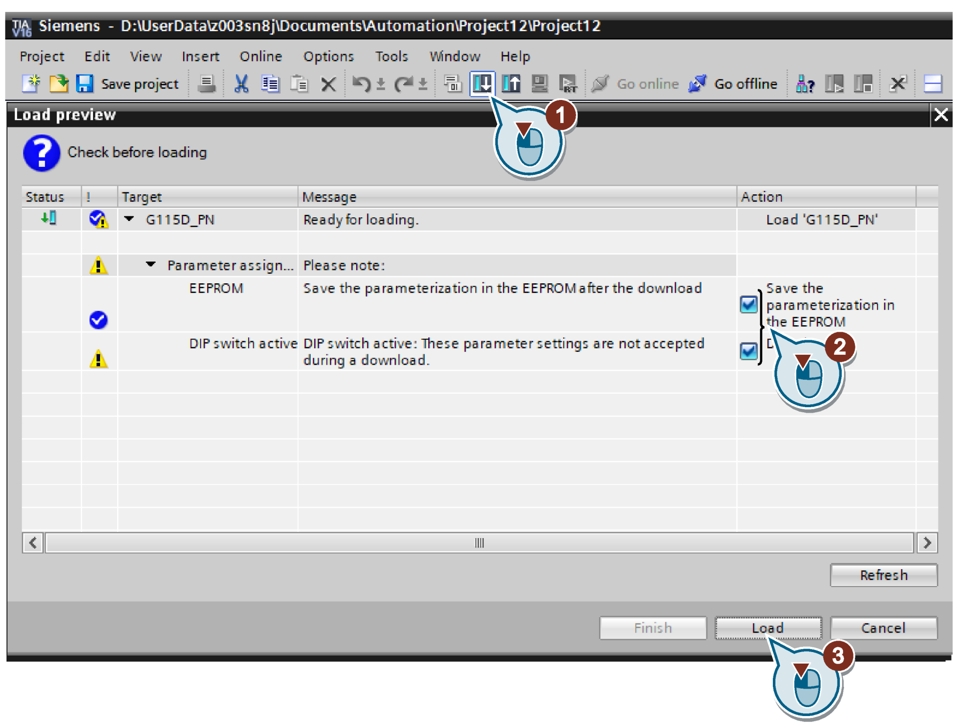
Precondition

- Connection between the PG/PC and converter has been properly established via a USB cable or the fieldbus.
- You have installed the Startdrive commissioning tool on your PG/PC.

The procedure depends on whether you also transfer settings of safety functions or not.

Procedure with Startdrive without enabled safety functions

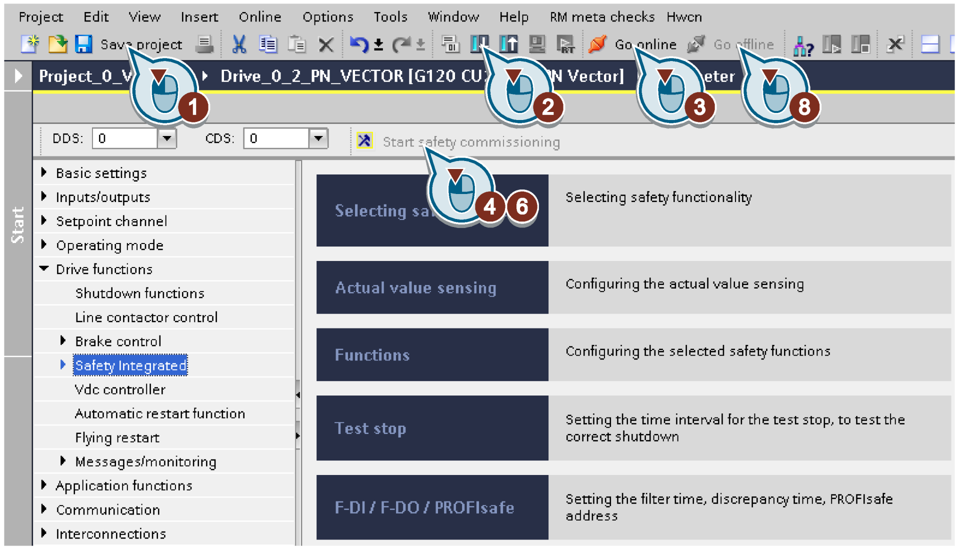
1. Go online.
2. Proceed as follows to transfer settings from the PG/PC to the converter:



3. Wait until Startdrive prompts that the transfer procedure is complete.
4. Go offline.

You have transferred the settings from the PG/PC to the converter with Startdrive.
❒

Procedure with Startdrive when the safety functions are enabled



1. Save the project.
2. Select the button to transfer settings from the PG/PC to the converter.
3. Connect Startdrive online with the drive.
4. Press the button to start the safety commissioning.
5. Enter the password for the safety functions.

   If the password is the factory default, you are prompted to change the password.
   If you try to set a password that is not permissible, the old password will not be changed.
6. Press the button to end the safety commissioning.
7. Confirm the prompt for saving your settings (copy RAM to ROM).
8. Disconnect the online connection.
9. Switch off the converter power supply.
10. Wait until all LEDs on the converter go dark (no voltage condition).
11. Switch on the converter power supply again.

You have transferred the settings from the PG/PC to the converter with Startdrive and have activated the safety functions.
❒

Transferring using SINAMICS G120 Smart Access

You can use the SINAMICS G120 Smart Access to transfer settings. For more information on the transferring process, see Section "Backup and restore" in the SINAMICS G120 Smart Access Operating Instructions.

Overview of the manuals (Page 404)

8.3 Other ways to back up settings

In addition to the default setting, the converter 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)

8.4 Write protection

The write protection prevents unauthorized changing of the converter settings. If you are working with Startdrive, write protection is only effective online. The offline project is not write-protected.

Write protection is applicable for all user interfaces:

- Startdrive PC tool
- Parameter changes via fieldbus
- SINAMICS G120 Smart Access

No password is required for write protection.

Function description

Activate and deactivate write protection

Parameter	Description	Setting
r7760	Write protection/know-how protection status	Displays the status for the write protection and know-how protection. Bit 00: Write protection active
p7761	Write protection	Setting for activating/deactivating the write protection for adjustable parameters. 0: Deactivate write protection 1: Activate write protection Factory setting: 0

Exceptions to write protection

Parameters that can be changed with active write protection

Parameter	Description	Setting
p0003	Access level	Sets the access level to read and write parameters.
p0010	Drive commissioning parameter filter	Sets the parameter filter to commission a drive.
p0124[0...n]	CU detection using LED	Identification of the Control Unit using an LED.
p0970	Reset drive parameters	The parameter is used to initiate the reset of the drive parameters.
p0971	Save parameters	Setting to save parameters in the non-volatile memory.
p0972	Drive unit reset	Sets the required procedure to execute a hardware reset for the drive unit.
p2111	Alarm counter	Number of alarms that have occurred after the last reset.
p3950	Service parameter	For service personnel only.
p3981	Acknowledge drive object faults	Setting to acknowledge all active faults of a drive object.
p3985	Master control mode selection	Sets the mode to change over the master control / LOCAL mode.
p7761	Write protection	Setting for activating/deactivating the write protection for adjustable parameters.
p8805	Identification and Maintenance 4 Configuration	Sets the configuration for the content of identification and maintenance 4 (I&M 4, p8809).
p8806[0...53]	Identification and Maintenance 1	Parameters for the PROFINET data set "Identification and Maintenance 1" (I&M 1).
p8807[0...15]	Identification and Maintenance 2	Parameters for the PROFINET data set "Identification and Maintenance 2" (I&M 2).
p8808[0...53]	Identification and Maintenance 3	Parameters for the PROFINET data set "Identification and Maintenance 3" (I&M 3).
p8809[0...53]	Identification and Maintenance 4	Parameters for the PROFINET data set "Identification and Maintenance 4" (I&M 4).
p9400	Safely remove memory card	Setting and display when memory card is "removed safely".
p9484	BICO interconnections search signal source	Sets the signal source (BO/CO parameter, BICO coded) to search in the signal sinks.

For more information about those parameters, see the List Manual.

8.5 Know-how protection

Overview

Know-how protection prevents unauthorized reading of the converter settings.

To protect your converter settings against unauthorized copying, in addition to know-how protection, you can also activate copy protection.

Precondition

Know-how protection is applicable for the following user interfaces:

- Startdrive PC tool
- Parameter changes via fieldbus

Know-how protection requires a password.

<table>
<tr><th>Combination of know-how protection and copy protection</th><th colspan="2">Is a memory card necessary?</th></tr>
<tr><td>Know-how protection without copy protection</td><td colspan="2">The converter can be operated with or without memory card.</td></tr>
<tr><td>Know-how protection with basic copy protection</td><td rowspan="2"></td><td rowspan="2">The converter can only be operated with a Siemens memory card.
Memory cards (Page 327)</td></tr>
<tr><td>Know-how protection with extended copy protection</td></tr>
</table>

Function description

The active know-how protection provides the following:

- With just a few exceptions, the values of all adjustable parameters p ... are invisible.
  - 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".
- The values of monitoring parameters r ... remain visible.
- Adjustable parameters cannot be changed using Startdrive.
- Locked functions:
  - Downloading converter settings using 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 converter via Startdrive
  - Uploading adjustable parameters that can be changed or read when know-how protection is active.
  - Displaying acceptance documents for safety functions

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 converter settings to other converters using a memory card or Startdrive.

Know-how protection with basic copy protection

After replacing a converter, to be able to operate the new converter with the settings of the replaced converter without knowing the password, the memory card must be inserted in the new converter.

Know-how protection with extended copy protection

It is not possible to insert and use the memory card in another converter without knowing the password.

Commissioning know-how protection

1. Check as to whether you must extend the exception list.

   List of exceptions (Page 339)

2. Activate the know-how protection.

   Know-how protection (Page 340)

8.5.1 Extending the exception list for know-how protection

In the factory setting, the exception list p7764[0...n] 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[0...29] from the exception list, it is no longer possible to enter or change the password for know-how protection.

You must reset the converter to the factory settings in order to be able to gain access to the converter adjustable parameters. When restoring the factory settings, you lose what you have configured in the converter, and you must recommission the converter.

Parameters

Parameter	Description	Setting
p7763	KHP OEM exception list number of indices for p7764	Sets the number of parameters for the OEM exception list (p7764[0...n]). Factory setting: 1
p7764[0...n]	KHP OEM exception list	Sets parameters that should be excluded from know-how protection. Factory setting [0] 7766, [1 ...499] 0
p7766[0...29]	KHP password input	Sets the password for know-how protection.

8.5.2 Activating and deactivating know-how protection

Activating know-how protection

Preconditions

- The converter 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.

Function description

Activating know-how protection

1. Enter a password of your choice in p7767.

   Each index of p7767 corresponds with a character in the ASCII format.
2. Complete entry of the password with p7767[29] = 0.
3. Enter the same password in p7768 as that for p7767.
4. Complete entry of the password with p7768[29] = 0.

The know-how protection for the converter is activated.
❐

Deactivating know-how protection

1. Enter the password for the know-how protection in p7766.

   Each index of p7766 corresponds with a character in the ASCII format.
2. Complete entry of the password with p7766[29] = 0.

The know-how protection for the converter is deactivated.
❒

Parameters

Parameter	Description	Setting
r7758[0...19]	KHP Control Unit serial number	Displays the actual serial number of the Control Unit.
p7759[0...19]	KHP Control Unit reference serial number	Sets the reference serial number for the Control Unit.
r7760	Write protection/know-how protection status	Bit 01: Know-how protection active Bit 02: Know-how protection temporarily unlocked Bit 03: Know-how protection cannot be deactivated Bit 04: Extended copy protection active Bit 05: Basic copy protection active Bit 06: Trace and measurement functions for diagnostic purposes active
p7765	KHP configuration	Configures whether the parameters and DCC data encrypted on the memory card should be protected before using on other memory cards or Control Units. Bit 00: Extended copy protection - linked to the memory card and CU Bit 01: Basic copy protection - linked to the memory card Bit 02: Permit trace and measuring functions for diagnostic purposes
p7766[0...29]	KHP password input	Sets the password for know-how protection.
p7767[0...29]	KHP password new	Sets the new password for know-how protection.
p7768[0...29]	KHP password confirmation	Confirms the new password for know-how protection.
p7769[0...20]	KHP memory card reference serial number	Sets the reference serial number for the memory card.
r7843[0...20]	Memory card serial number	Displays the actual serial number of the memory card.

Further information

Preventing data reconstruction from the memory card

As soon as know-how protection has been activated, the converter 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.

Alarms, faults and system messages 9

The converter has the following diagnostic types:

- LED

  The LEDs of the converter immediately inform you about the most important converter states.
- Alarms and faults

  Every alarm and every fault has a unique number.

  The converter signals alarms and faults via the following interfaces:
  - Fieldbus
  - Terminal strip with the appropriate setting
  - SINAMICS G120 Smart Access
  - Startdrive
- Identification & maintenance data (I&M)

  If requested, the converter sends data to the higher-level control via PROFINET:
  - Converter-specific data
  - Plant-specific data

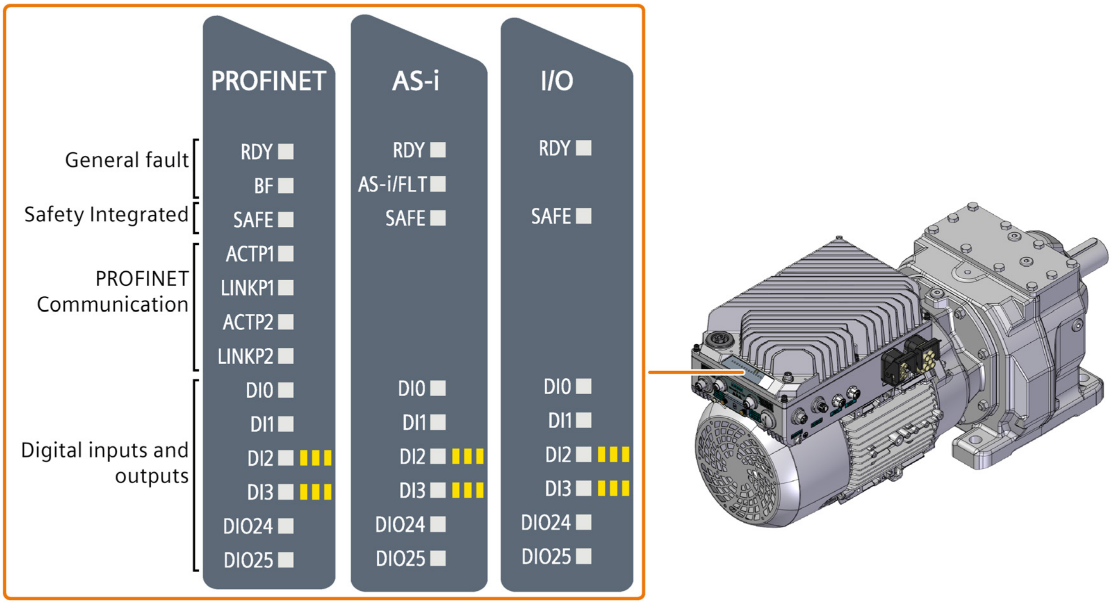
9.1 Status LED overview

LED status indicators

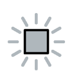
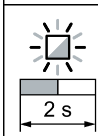
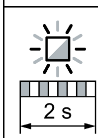
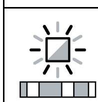
A G115D converter has a number of LEDs which are designed to indicate the operational state of the converter. The LEDs are used to indicate the following states:

- General fault conditions
- Communication status
- Safety-Integrated status
- Input and output status

For different communication variants, the number of LEDs may vary. The following figure illustrates the location of the various LEDs on the converter:

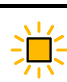
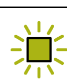


Explanation of symbols for the following tables

	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.

Basic states

RDY	Explanation
	Temporary state after the supply voltage is switched on
	The converter is free of faults

RDY	Explanation
	Commissioning or reset to factory settings
	A fault is active, or firmware update failed
	Licensing is not sufficient. Activating licensed functions (Page 321)
	Firmware update is active
	Converter waits until the power supply is switched off and switched on again after a firmware update

PROFINET fieldbus

BF	Explanation	
	Data exchange between the converter and control system is active	
	The fieldbus is improperly configured	
	RDY	In conjunction with a synchronously flashing LED RDY: Converter 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	

Integrated safety functions

SAFE	Explanation
	One or more safety functions are enabled, but not active
	One or more safety functions are active and error-free
	The converter has detected a safety function fault and initiated a stop response

PROFINET fieldbus

ACT	LNK	Explanation
		Communication via PROFINET is error-free. Converter and open-loop control exchange actual data
		The converter is establishing communication with a higher-level control or a PG/PC with Startdrive installed
		A physical connection has been set up
		Communication via PROFINET is not active

Digital inputs and digital inputs/outputs

DI & DI/O	Explanation
	The associated digital input or digital input/output has the "high" state
	The associated digital input or digital input/output has the "low" state

AS-i fieldbus

<table>
<tr><th>AS-i / FLT</th><th colspan="2">Explanation</th></tr>
<tr><td></td><td colspan="2">System OK</td></tr>
<tr><td></td><td colspan="2">AS-i master not connected or firmware update failed</td></tr>
<tr><td rowspan="2"></td><td colspan="2">The fieldbus is improperly configured</td></tr>
<tr><td>RDY</td><td>In conjunction with a synchronously flashing LED RDY:
Converter waits until the power supply is switched off and switched on again after a firmware update</td></tr>
<tr><td rowspan="2"></td><td colspan="2">No communications between processors within the converter</td></tr>
<tr><td>RDY</td><td>In conjunction with an asynchronously flashing LED RDY:
Incorrect memory card</td></tr>
<tr><td></td><td colspan="2">Device address 0</td></tr>
<tr><td></td><td colspan="2">Converter trip</td></tr>
<tr><td></td><td colspan="2">Firmware update is active</td></tr>
</table>

9.2 System runtime

By evaluating the system runtime of the converter, you can decide whether you must replace components subject to wear such as fans, motors and gear units.

Principle of operation

The converter starts the system runtime as soon as the converter is supplied with power. The system runtime stops when the converter 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), the converter sets the value of r2114[0] to 0 and increases the value of r2114[1] by 1.

Using system runtime, you can track the chronological sequence of faults and alarms over time. When a corresponding message is triggered, the converter transfers the parameter values r2114 to the corresponding parameters of the alarm or fault buffer.

Parameter	Description	Setting
r2114[0...1]	Total system runtime	Displays the total system runtime for the drive unit. **Index:** [0]: Milliseconds [1]: Days

You cannot reset the system runtime.

9.3 Identification & maintenance data (I&M)

I&M data

The converter supports the following identification and maintenance (I&M) data.

I&M data	Format	Explanation	Associated parameters	Example for the content
I&M0	u8[54] PROFINET	Converter-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 converter transfers its I&M data to a higher-level control or to a PC/PG with installed Startdrive.

I&M0

Designation	Format	Example for the content	Valid for PROFINET
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	✓

9.4 Alarms, alarm buffer, and alarm history

Overview

An alarm generally indicates that the converter may no longer be able to maintain the operation of the motor in future.

The extended diagnostics have an alarm buffer and an alarm history, in which the converter stores the most recent alarms.

Function description

Alarms have the following properties:

- Incoming alarms have no direct influence on the converter.
- Alarms disappear 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 in Startdrive
  - Display in the SINAMICS G120 Smart Access

The alarm code or alarm value describes the cause of the alarm.

Alarm buffer

Alarm code	Alarm value		Alarm time received			Alarm time removed	
	I32	float	Days	ms		Days	ms
r2122[0]	r2124[0]	r2134[0]	r2145[0]	r2123[0]	old	r2146[0]	r2125[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]	new	[7]	[7]

The converter 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

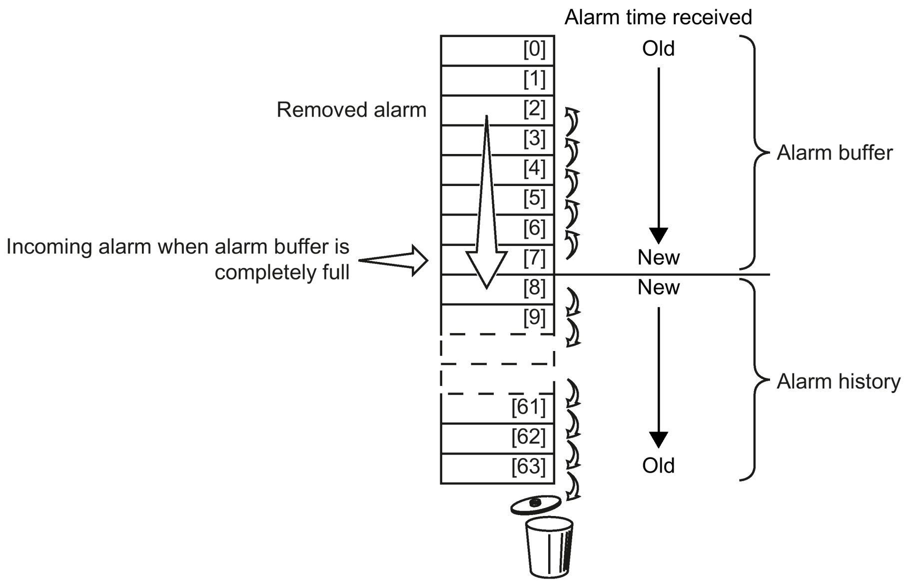
The converter takes its internal time calculation to save the alarm times.

System runtime (Page 347)

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 converter overwrites the values with Index [7].

Alarm history



If the alarm buffer is completely filled and an additional alarm occurs, the converter 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 converter shifts the alarms already stored in the alarm history "down" by one or more positions.

   If the alarm history is completely full, the converter will delete the oldest alarms.

2. The converter 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 converter 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 converter 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

Parameters of the alarm buffer and the alarm history

Parameter	Description	Setting
p2111	Alarm counter	Number of alarms that have occurred after the last reset. When setting p2111 = 0, the following is initiated: • All of the alarms that have been removed from the alarm buffer [0...7] are transferred into the alarm history [8...63]. • The alarm buffer [0...7] is deleted. Factory setting: 0
r2122[0 ... 63]	Alarm code	Displays the numbers of the alarms that have occurred.
r2123[0 ... 63]	Alarm time received in milliseconds	Displays the time in milliseconds when the alarm occurred.
r2124[0 ... 63]	Alarm value	Displays additional information about the alarm.
r2125[0 ... 63]	Alarm time removed in milliseconds	Displays the time in milliseconds when the alarm was removed.
r2132	CO: Actual alarm code	Displays the code of the alarm that last occurred.
r2134[0 ... 63]	Alarm value for float values	Displays additional information about the alarm that occurred for float values.
r2145[0 ... 63]	Alarm time received in days	Displays the time in days when the alarm occurred.
r2146[0 ... 63]	Alarm time removed in days	Displays the time in days when the alarm was removed.

Extended settings for alarms

Parameter	Description	Setting
You can change up to 20 different alarms into faults or suppress alarms:		
p2118[0 ... 19]	Changing message type, message number	Selects faults or alarms for which the message type should be changed. Factory setting: 0
p2119[0 ... 19]	Changing message type, type	Sets the message type for the selected fault or alarm. 1: Fault 2: Alarm 3: No message Factory setting: 1

For more information about this function, see function diagram 8075 and parameter description in the List Manual.

9.5 Faults, fault buffer and fault history

Overview

A fault generally indicates that the converter can no longer maintain the operation of the motor.

The extended diagnostics have a fault buffer and a fault history, in which the converter stores the most recent faults.

Function description

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 converter via the LED RDY
  - Display in Startdrive
  - Display in the SINAMICS G120 Smart Access

The fault code and fault value describe the cause of the fault.

Fault buffer

Fault code	Fault value		Fault time received			Fault time removed	
	I32	float	Days	ms		Days	ms
r0945[0]	r0949[0]	r2133[0]	r2130[0]	r0948[0]	Old	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]	New	[7]	[7]

The converter saves incoming faults in the fault buffer. A fault includes a fault code, a fault value, and two fault times:

- Fault code: r0945
- 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 converter takes its internal time calculation to save the fault times.

System runtime (Page 347)

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 converter overwrites the values with Index [7].

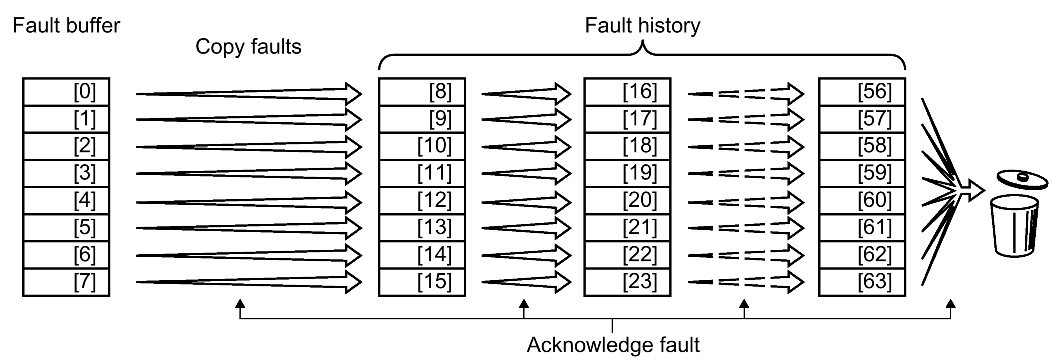
Acknowledging a fault

To acknowledge a fault, you have the following options:

- PROFIdrive control word 1, bit 7 (r2090.7)
- Acknowledging via a digital input
- Acknowledging via a commissioning tool
- Switch off the converter power supply and switch on again

Faults detected during the converter-internal monitoring of hardware and firmware can be acknowledged only by switching the supply voltage off and on again. The list of fault codes and alarm codes includes the note on the limitations on the acknowledgment for the corresponding fault codes in the List manual.

Fault history



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 converter shifts the values previously saved in the fault history by eight indexes.

   The converter deletes the faults that were saved in the indexes [56 ... 63] before the acknowledgment.
2. The converter copies the contents of the fault buffer to the memory locations [8 ... 15] in the fault history.
3. The converter 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 converter writes the time of acknowledgment 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 = 0.

Parameters

Parameters of the fault buffer and the fault history

Parameter	Description	Setting
r0945[0 ... 63]	Fault code	Displays the numbers of the faults that have occurred.
r0948[0 ... 63]	Fault time received in milliseconds	Displays the system runtime in milliseconds when the fault occurred.
r0949[0 ... 63]	Fault value	Displays additional information about the fault that occurred (as integer number).
p0952	Fault cases counter	Number of fault cases that have occurred since the last acknowledgment. With p0952 = 0, you delete the fault buffer and the fault history. Factory setting: 0
r2109[0 ... 63]	Fault time removed in milliseconds	Displays the system runtime in milliseconds when the fault was removed.
r2130[0 ... 63]	Fault time received in days	Displays the system runtime in days when the fault occurred.
r2131	Actual fault code	Displays the code of the oldest active fault.
r2133[0 ... 63]	Fault value for float values	Displays additional information about the fault that occurred for float values.
r2136[0 ... 63]	Fault time removed in days	Displays the system runtime in days when the fault was removed.

Extended settings for faults

Parameter	Description	Setting
You can change up to 20 different faults into alarms, suppress faults, modify the fault response, or modify the acknowledgment mode:		
p2100[0 ... 19]	Changing fault response, fault number	Selects the faults for which the fault response should be changed. Factory setting: 0
p2101[0 ... 19]	Changing the fault reaction, reaction	Sets the fault reaction for the selected fault. 0: NONE 1: OFF1 2: OFF2 3: OFF3 5: STOP2 6: Internal armature short-circuit / DC braking Factory setting: 0
p2118[0 ... 19]	Changing message type, message number	Selects faults or alarms for which the message type should be changed. Factory setting: 0
p2119[0 ... 19]	Changing message type, type	Sets the message type for the selected fault or alarm. 1: Fault 2: Alarm 3: No message Factory setting: 1

Parameter	Description	Setting
p2126[0 ... 19]	Changing the acknowledgment mode, fault number	Selects the faults for which the acknowledge mode is to be changed. Factory setting: 0
p2127[0 ... 19]	Changing the acknowledgment mode	Sets the acknowledgment type for the selected fault: 1: Acknowledgment only using POWER ON 2: Immediate acknowledgment after removing the fault cause Factory setting: 1

For more information about this function, see function diagram 8075 and parameter description in the List Manual.

9.6 List of alarms and faults

Overview

A message comprises a letter followed by the relevant number.

The letters have the following meaning:

A	Alarm code **. . . .**
F	Fault code **. . . .**

The expressions have the following meaning:

CU/Power Module/power unit	All refer to an Electronic Module. For example, replacing a CU, Power Module, or power unit means replacing an Electronic Module.

Important alarms and faults

Number	Cause	Remedy
F01000	Software fault in CU	Replace CU.
F01001	Floating Point Exception	Switch CU off and on again.
F01015	Software fault in CU	Upgrade firmware or contact technical support.
F01018	Power-up aborted more than once	1. Switch the module off and on again. 2. After this fault has been output, the module is booted with the factory settings. 3. Recommission the converter.
A01028	Configuration error	Explanation: Parameterization on the memory card has been created with a different type of module (article number, MLFB) Check the module parameters and recommission if necessary.
F01033	Unit switchover: 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).

Number	Cause	Remedy
F01034	Unit switchover: 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	Save parameters (p0971). Switch CU off and on again.
F01044	Loading of memory data card defective	Replace memory card or CU.
A01101	Memory card not available	Insert a memory card or disable the warning A01101. Activating message for a memory card that is not inserted (Page 332)
F01105	CU: Insufficient memory	Reduce number of data records.
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	Replace CU.
F01512	An attempt has been made to establish an conversion factor for scaling which is not present	Create scaling or check transfer value.
A01590	Motor maintenance interval lapsed	Carry out maintenance and reset the maintenance interval (p0651).
F01662	CU hardware fault	Switch CU off and on again, upgrade firmware, or contact technical support.
A01910 F01910	Setpoint timeout	The alarm is generated when p2040 ≠ 0 ms and one of the following causes is present: • The bus connection is interrupted • Communications error (CRC, parity bit, logical error) • An excessively low value for the fieldbus monitoring time (p2040)
F03505	Analog input, wire break	Check the connection to the signal source for interrupts. Check the level of the signal supplied. The input current measured by the analog input can be read out in r0752.
A03560	Local/Remote keyswitch in the "Off" position	Set the keyswitch to another position (e.g. "Local" or "Remote"). Note: Active faults are acknowledged if the keyswitch is turned from the "Off" position to "Local" or "Remote".
A03561	A03561(0): Local drive control	The Local/Remote keyswitch is set to "Local" and the drive is controlled locally. If required, set the keyswitch to "Remote" and control it remotely.
	A03561(1): Remote drive control (e.g. via Startdrive) failed because the Local/Remote keyswitch is set to "Local"	• Set the keyswitch to "Remote" position for remote control • Deactivate remote control for local control Note: Active faults are acknowledged if the keyswitch is turned from the "Off" position to "Local" or "Remote".
A05000 A05001 A05002 A05004 A05006	Power Module overtemperature	Check the following: - 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 parameterized	Check the parameterized 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.

Number	Cause	Remedy
A07012	I2t Motor Module overtemperature	Check and if necessary reduce the motor load. Check the motor's ambient temperature. Check 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 temperature sensor fault (p0607 = 0).
F07086 F07088	Unit switchover: Parameter limit violation	Check the adapted parameter values and if required correct.
F07320	Automatic restart aborted	Increase the number of restart attempts (p1211). The actual 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 search current (p1202), check motor connection.
A07352	Stop sensor not plausible	• Check the BICO interconnections for the stop sensors. • Check the sensors.
A07353	DC quantity control deactivated	Optimize the DC quantity controller (Kp, Tn, bandwidth, PT2 filter).
A07400	V_{DC_max} controller active	If it is not desirable that the controller intervenes: • Increase the ramp-down times. • Deactivate the V_{DC_max} controller (p1240 = 0 for vector control, p1280 = 0 for V/f control).
A07409	V/f control, current limiting controller active	The alarm automatically disappears after one of the following measures: • Increase the current limit (p0640). • Reduce the load. • Slow down the up ramp for the setpoint speed.
F07426	Technology controller actual value limited	• Adapt the limits to the signal level (p2267, p2268). • Check the actual value scaling (p2264).
F07801	Motor overcurrent	Check current limits (p0640). Vector control: Check current controller (p1715, p1717). V/f control: Check the current limiting controller (p1340 ... p1346). Increase acceleration ramp (p1120) or reduce load. Check motor and motor cables for short circuit and ground fault. Check motor for star-delta connection and rating plate parameterization. Check power unit / motor combination. Select flying restart function (p1200) if switched to rotating motor.

Number	Cause	Remedy
A07805	Power unit overload I2t	• Reduce the continuous load. • Adapt the load cycle. • Check the assignment of rated currents of the motor and power unit.
F07807	Short circuit detected	• Check the converter 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	The signal for "external alarm 1" has been triggered. Parameters p2112, p2116 and p2117 determine the signal sources for the external alarm 1... 3. Remedy: Remove the causes of these alarms.
F07860 F07861 F07862	External fault 1 ... 3	Remove the external causes for this fault.
F07900	Motor blocked	Check that the motor can run freely. Check the torque limits (r1538 and r1539). Check the parameters of the "Motor blocked" message (p2175, p2177).
F07901	Motor overspeed	Activate precontrol of the speed limiting controller (p1401 bit 7 = 1). Increase hysteresis for overspeed signal p2162.
F07902	Motor stalled	Check whether the motor data has been parameterized correctly and perform motor identification. Check the current limits (p0640, r0067, r0289). If the current limits are too low, the drive cannot be magnetized. Check whether motor cables are disconnected during operation.
A07903	Motor speed deviation	Increase p2163 and/or p2166. Increase the torque, current and power limits.
A07910	Motor overtemperature	Check the motor load. Check the motor's ambient temperature. Check the KTY84 or Pt1000 sensor. Check the overtemperatures of the thermal model (p0626 ... p0628).
A07920	Torque/speed too low	The torque deviates from the torque/speed envelope curve. • Check the connection between the motor and the load. • Adapt the parameterization corresponding to the load.
A07921	Torque/speed too high	
A07922	Torque/speed out of tolerance	
F07923	Torque/speed too low	• Check the connection between the motor and the load. • Adapt the parameterization corresponding to the load.
F07924	Torque/speed too high	
A07927	DC braking active	Not required
A07980	Rotary measurement activated	Not required
A07981	No enabling for rotary measurement	Acknowledge pending faults. Establish missing enables (see r00002, r0046).
A07991	Motor data identification activated	Switch on the motor and identify the motor data.
F08501	Setpoint timeout	• Check the PROFINET connection. • Set the controller to RUN mode. • If the error occurs repeatedly, check the set monitoring time p2044.
F08502	Monitoring time sign-of-life expired	• Check the PROFINET connection.
A08511	Receive configuration data not valid	• Check the PROFINET configuration

Number	Cause	Remedy
A08526	No cyclic connection	• Activate the controller with cyclic operation. • Check the parameters "Name of Station" and "IP of Station" (r61000, r61001).
A08565	Consistency error affecting adjustable parameters	Check the following: • 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.
F13100	Know-how protection: Copy protection error	The know-how protection and the copy protection for the memory card are active. An error occurred during checking of the memory card. • Insert a suitable memory card and switch the converter 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: • 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 • Power cable connections • Power cables for short-circuit or ground fault • Power cable length • Line phases If this doesn't help: • 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	Converter overtemperature	Check whether the converter 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 converter overload	Check the rated currents of the motor and Power Module. Reduce current limit p0640. When operating with V/f characteristic: Reduce p1341.
F30011	Line phase failure	Check the converter's input fuses. Check the line cables.

Number	Cause	Remedy
F30015	Motor cable phase failure	Check the motor cables. Increase the ramp-up or ramp-down time (p1120).
F30021	Ground fault	• 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).
F30022	Power Module: Monitoring U_{CE}	Check or replace the Power Module.
F30027	Time monitoring for DC link pre-charging	Check the supply voltage at the input terminals. Check the line voltage setting (p0210).
F30035	Overtemperature, intake air	• 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	See F30035 and, in addition: • Check the motor load. • Check the line phases
F30052	Incorrect Power Module data	Replace Power Module or upgrade CU firmware.
A30502	DC link overvoltage	Check the unit supply voltage (p0210).
F30662	CU hardware fault	Switch CU off and on again, upgrade firmware, or contact technical support.
F30664	CU power up aborted	Switch CU off and on again, upgrade firmware, or contact technical support.
F30850	Software fault in Power Module	Replace Power Module or contact technical support.
A30920	Temperature sensor fault	Check that the sensor is connected correctly.

For details, please refer to the List Manual.

Corrective maintenance 10

10.1 Spare parts compatibility

Continuous development within the scope of product maintenance

Drive 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. Take this fact into consideration in special installation situations (e.g. allow sufficient reserve regarding the cable length).

WARNING

Fire or electric shock due to defective components

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

- Have the converter and the overcurrent protection device checked and replaced (if damaged) by a specialist.

Repair

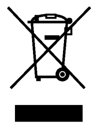
WARNING

Fire or electric shock due to improper repair

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

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

Recycling and disposal



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

10.2 Replacing the converter

10.2.1 Overview

For the G115D motor-mounted converter, you can replace either the Electronic Module or the complete drive (geared motor + G115D motor-mounted converter).

In most cases, you only need to replace the Electronic Module instead of the complete drive. For more information, see Chapter "Replacing the Electronic Module (Page 368)".

10.2.2 Replacing the converter hardware

You may only replace a converter with a new one under the preconditions given later in this chapter. After the replacement, you must transfer the settings of the replaced converter to the new converter.

Precondition

The following two prerequisites apply for replacing the converter:

- The new converter's firmware version is equal to or later than the replaced converter.
- The new converter must have the same frame size and the same or higher power rating as those of the replaced converter.

⚠ WARNING

Unexpected machine motion caused by incorrect converter type

Replacing converters of different types can result in incomplete or incorrect/inappropriate converter 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 not permitted according to the above requirement, you must recommission the drive after replacing the converter.

WARNING

Unexpected machine motion caused by inappropriate/incorrect converter settings

Missing or incorrect converter settings can lead to unexpected operating states or machine movements, e.g. a non-functioning EMERGENCY STOP or an incorrect direction of rotation. As a consequence, machine components or devices can become damaged or death or injury may result.

- If possible, back up the settings of the converter to be replaced by uploading them to an external storage medium, e.g. a memory card.
- Transfer the settings of the converter to be replaced by downloading them to the new converter.
- If you do not have a backup of the converter settings, commission the new converter as completely new converter.
- Check that the new converter works properly.

Procedure

1. Switch off all power supplies (line supply and external 24 V power supply) to the converter.

   WARNING

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

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

   - Check the voltage at the converter connections, before removing the connection cables.

2. Remove the connecting cables of the converter.
3. Remove the defective converter and install the new converter.
4. Adjust the electromechanical potentiometers to make sure the scaling is set as same as the replaced converter.

   Electromechanical potentiometer (Page 239)

5. Connect all of the cables to the converter.
6. Switch on all power supplies (line supply and external 24 V power supply) to the converter.

   Set the new converter to suit the application:

   – If the settings of the replaced converter are backed up on an external storage medium, transfer the settings to the new converter.

     Memory card → converter (Page 330)

     PG/PC → converter (Page 334)

   – If there is no data backup of the replaced converter, recommission the converter.

     Commissioning (Page 91)

7. For converters with safety functions enabled, perform a reduced acceptance test.

   Reduced acceptance test after component replacement and firmware change (Page 378)

You have successfully replaced the converter.

❒

10.2.3 Replacing a converter with active know-how protection

10.2.3.1 Replacing a converter with know-how protection without copy protection

In the case of know-how protection without copy protection, the converter settings can be transferred to another converter using a memory card.

Converter → Memory card (Page 328)

Memory card → converter (Page 330)

10.2.3.2 Replacing a converter with know-how protection with copy protection

The know-how protection with copy protection prevents the duplication of the converter settings.

If the converter settings can neither be copied nor forwarded, a recommissioning is required after converter replacement.

To avoid the recommissioning, there are two options for replacing the converter.

Precondition

- The end customer must use a Siemens memory card
- The machine manufacturer must have an identical prototype machine that it uses as sample

Procedure

Option 1: The machine manufacturer only knows the serial number of the new converter

1. The end customer provides the machine manufacturer with the following information:
   - For which machine must the converter be replaced?
   - What is the serial number (r7758) of the new converter?
2. The machine manufacturer performs the following steps online on the prototype machine:
   - Deactivating know-how protection

     Activating and deactivating know-how protection (Page 340)
   - Enter the serial number of the new converter 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 340)
   - 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 of the converter.
4. When powering up, the converter checks the serial numbers of the card and when there is a match, the converter goes into the "ready to start" state.

   If the numbers do not match, then the converter signals fault F13100 (no valid memory card).

You have transferred the converter settings to the new converter.
❒

Option 2: The machine manufacturer knows the serial number of the new converter 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 converter be replaced?
   - What is the serial number (r7758) of the new converter?
   - 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 340)
   - Enter the serial number of the new converter 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.

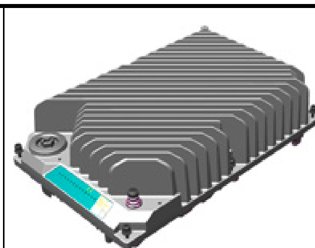
     Activating and deactivating know-how protection (Page 340)
   - Write the configuration with p0971 = 1 to the memory card.
   - Copy the encrypted project from the card to the associated PC.
   - Send the encrypted project to the end customer, e.g. via e-mail.
3. The end customer copies the project to the Siemens memory card that belongs to the machine, inserts it in the converter and switches on the power supply of the converter.
4. When powering up, the converter checks the serial numbers of the card and when there is a match, the converter goes into the "ready to start" state.

   If the numbers do not match, then the converter signals fault F13100 (no valid memory card).

You have transferred the converter settings to the new converter.
❒

10.3 Replacing the spare parts

10.3.1 Spare parts overview

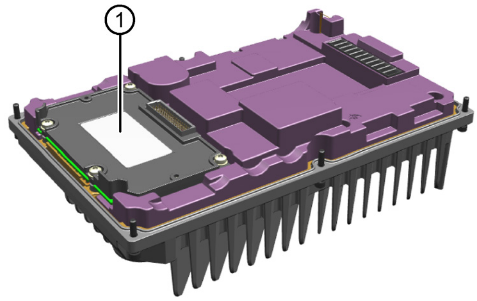
Spare parts		Frame size	Article number
Electronic Module		FSA/FSB	6SL3500-0XE5.-..A0
Spare part kit for G115D motor-mounted converter, consisting of 1 set of SD card cover, 1 set of commissioning cover, 1 set of main gaskets [1], 1 set of blanking caps and head screws		FSA/FSB	6SL3500-0XK50-0AA0
[1] The two main gaskets are for the Wiring Modules of FSA and FSB respectively.			

Electronic module

Ordering data

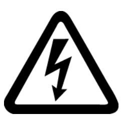
Frame size	Rated power	Article number					
FSA	0.37 kW	6SL3500-0XE5	0	-	3	❑	A0
	0.55 kW	6SL3500-0XE5	0	-	5	❑	A0
	0.75 kW	6SL3500-0XE5	0	-	7	❑	A0
	1.1 kW	6SL3500-0XE5	1	-	1	❑	A0
	1.5 kW	6SL3500-0XE5	1	-	5	❑	A0
FSB	2.2 kW	6SL3500-0XE5	2	-	2	❑	A0
	3 kW	6SL3500-0XE5	3	-	0	❑	A0
	4 kW	6SL3500-0XE5	4	-	0	❑	A0
AS-Interface						A	A0
I/O control						B	A0
PROFINET, EtherNet/IP						F	A0

You can find the article number from the label on the back side of the Electronic Module.



① Article number

10.3.2 Replacing the Electronic Module



WARNING

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

After the power supply has been switched off, it takes up to 5 minutes until the capacitors in the converter have discharged so that the residual charge is at a non-hazardous level. Therefore, touching the converter immediately after powering off can result in electric shock due to residual charge in the power components.

- Check the voltage at the converter connections before you replace the Electronic Module.

Precondition

- You have backed up the settings of the converter on an external storage medium.

  Memory card → converter (Page 330)

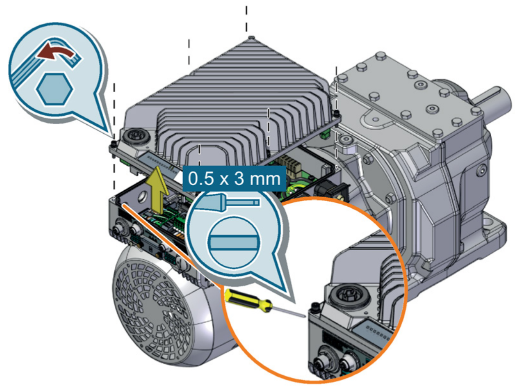
  Transferring settings using a PG/PC (Page 333)
- The new Electronic Module must have the same frame size and the same or higher power rating as those of the Electronic Module that is necessary for replacement.

Procedure

1. Switch off all power supplies (line supply and external 24 V power supply) to the converter.
2. Wait 5 minutes to allow the converter to discharge and check that no voltage is present at the converter connections.

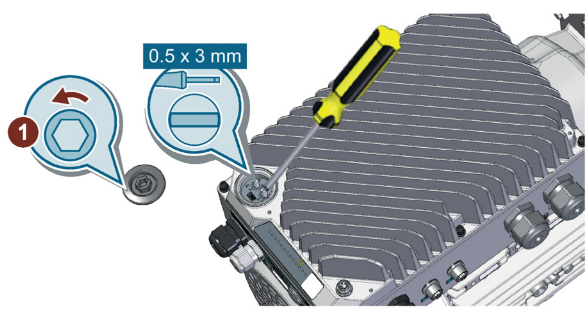
3. Release the retaining screws (6 x M4) for the Electronic Module by using a 3 mm allen key, and then remove the module.

   Note: If you cannot easily remove the Electronic Module, use a flat-bit screwdriver to lift one corner and remove the module.



4. Install the new Electronic Module and tighten it with a tightening torque of 2.5 Nm (22.1 lbf.in).

5. Remove the commissioning cover by using an S12 hex nut driver ①. Use a flat-bit screwdriver ② to adjust the value settings on the two electromechanical potentiometers to be identical with the settings for the Electronic Module that was replaced. Reattach the commissioning cover with a tightening torque of 2.5 Nm (22.1 lbf.in)



6. Switch on all power supplies (line supply and external 24 V power supply) to the converter.
7. Transfer the backed-up converter settings from the external storage medium to the converter with the new Electronic Module installed.

   Converter → PG/PC (Page 333)

   PG/PC → converter (Page 334)

Note

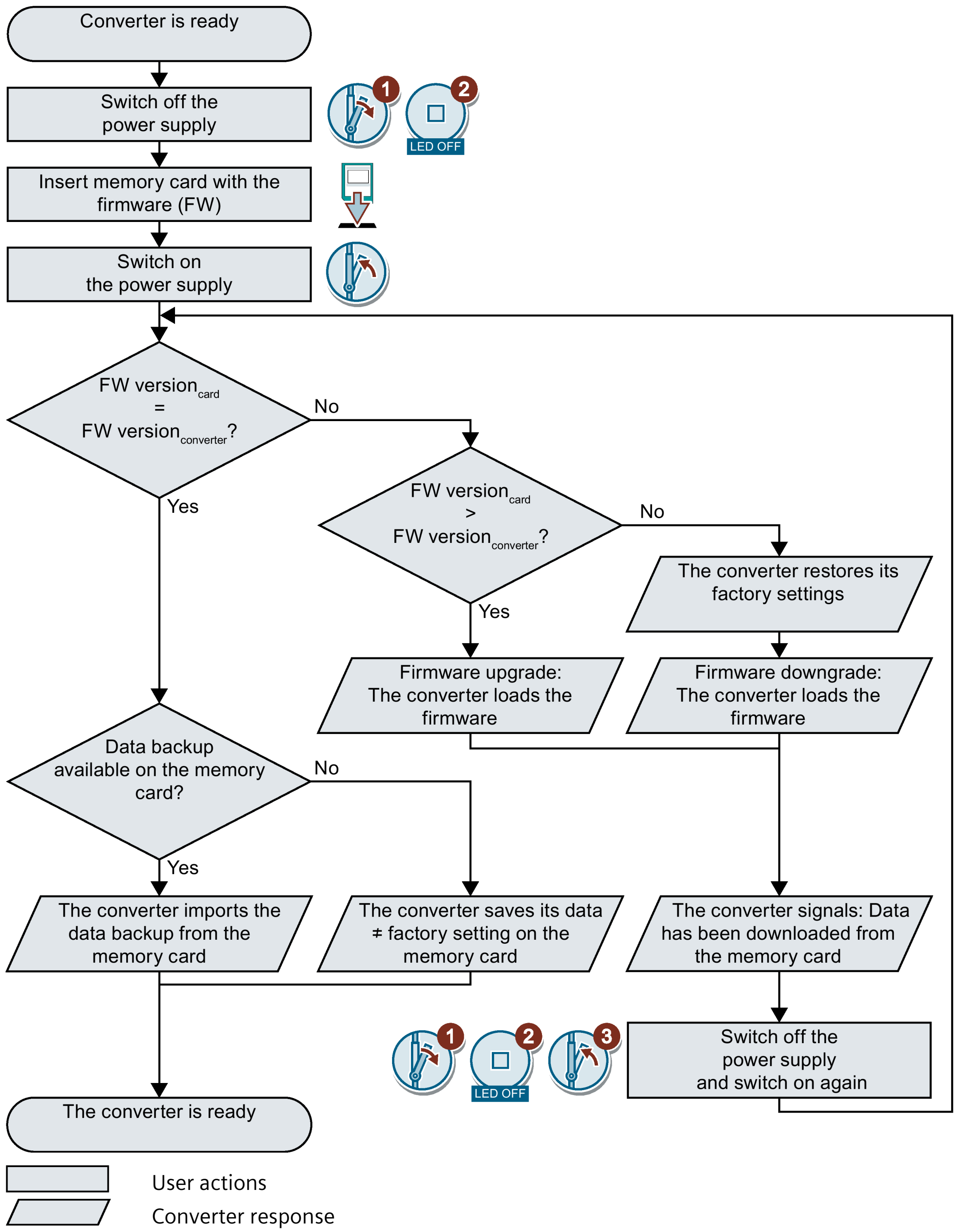
If you had not done data backup on an external storage medium before, recommission the converter. For more information, see the following chapter:

Commissioning (Page 91)

10.4 Firmware upgrade and downgrade

NOTICE
Damage to converter due to interruption of firmware upgrade or downgrade The converter can be damaged if the power supply is interrupted during firmware upgrade or downgrade. • Ensure that the power supply is stable before starting the firmware upgrade or downgrade.

Overview


Converter is ready
Switch off the power supply
LED OFF
Insert memory card with the firmware (FW)
Switch on the power supply
FW version card = FW version converter ?
No
Yes
FW version card > FW version converter ?
No
Yes
The converter restores its factory settings
Firmware upgrade: The converter loads the firmware
Firmware downgrade: The converter loads the firmware
Data backup available on the memory card?
No
Yes
The converter imports the data backup from the memory card
The converter saves its data ≠ factory setting on the memory card
The converter signals: Data has been downloaded from the memory card
LED OFF
Switch off the power supply and switch on again
The converter is ready
User actions
Converter response

10.4.1 Preparing the memory card

Overview

You can load the converter firmware from the Internet to a memory card.

Precondition

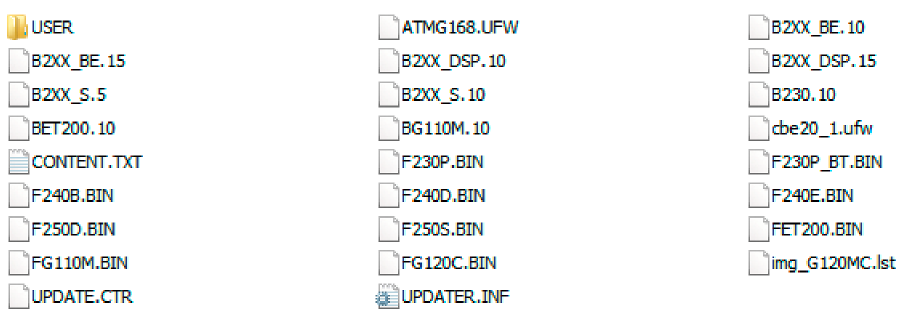
You have the appropriate memory card.

Memory cards (Page 327)

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.



   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 converter creates a new "USER" directory.

You have prepared the memory card for the firmware upgrade or downgrade.
❒

10.4.2 Upgrading the firmware

Overview

When upgrading the firmware, you replace the converter firmware with a newer version.

Precondition

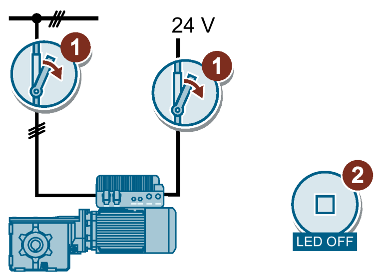
- Converter and memory card have different firmware versions.
- You have the memory card with the firmware for that particular converter.

Function description

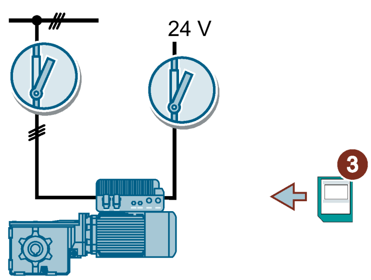
The following procedure applies to the G115D motor-mounted converter.

Procedure

1. Switch off the line voltage to the converter and (if installed) the external 24 V power supply or the voltage for the digital outputs of the converter.
2. Wait until all LEDs on the converter are dark.



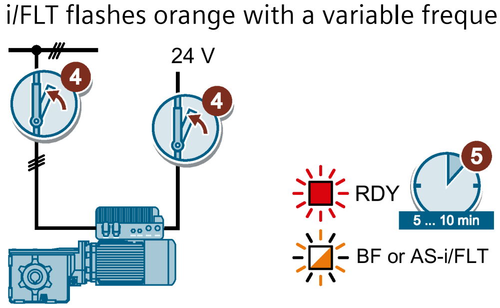
3. Insert the memory card with the matching firmware into the converter slot until it latches into place.



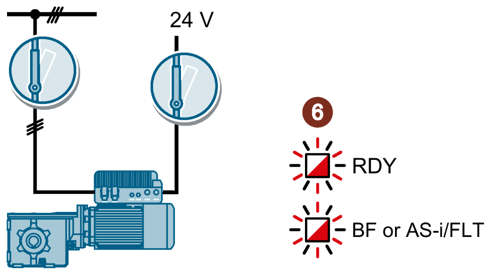
4. Switch on the power supply of the converter again.
5. The converter transfers the firmware from the memory card into its memory.

   The transfer takes approximately 5 to 10 minutes.

   While data is being transferred, the LED RDY on the converter stays red. The LED BF or AS-i/FLT flashes orange with a variable frequency.



6. At the end of the transfer, the LED RDY and BF (or AS-i/FLT) slowly flash red (0.5 Hz).

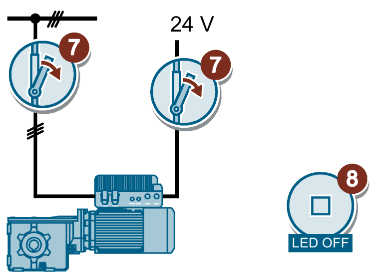


Power supply failure during transfer

The converter firmware will be incomplete if the power supply fails during the transfer.

– Start again with step 1 of the instructions.

7. Switch off the power supply of the converter.
8. Wait until all LEDs on the converter are dark.



9. Remove the memory card from the converter.

Note: You can also leave the memory card in the converter. The converter will behave differently depending on whether the memory card contains a data backup:

– If the memory card contains a data backup of the converter settings:

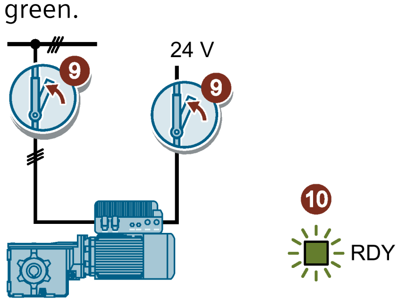
⇒ The converter will take the settings from the memory card in step 10.

– If the memory card does not have a data backup of the converter settings:

⇒ The converter will write its settings to the memory card in step 10.

10. Switch on the power supply of the converter again.

If the firmware upgrade was successful, after several seconds the converter LED RDY turns green.



You have upgraded the converter firmware to a newer version.
❒

10.4.3 Downgrading the firmware

Introduction

When downgrading the firmware, you replace the converter firmware with an older version.

Only update the firmware to an older level if, after replacing a converter, you require the same firmware in all converters.

Precondition

- Converter and memory card have different firmware versions.
- You have the memory card with the firmware for that particular converter.
- You have backed up the converter settings on the memory card or in a PC, or on the SINAMICS G120 Smart Access.

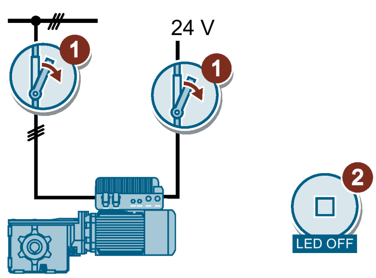
  Data backup and series commissioning (Page 327)

Function description

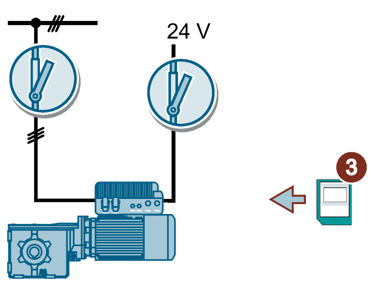
The following procedure applies to the G115D motor-mounted converter.

Procedure

1. Switch off the line voltage to the converter and (if installed) the external 24 V power supply or the voltage for the digital outputs of the converter.
2. Wait until all LEDs on the converter are dark.



3. Insert the memory card with the matching firmware into the converter slot until it latches into place.

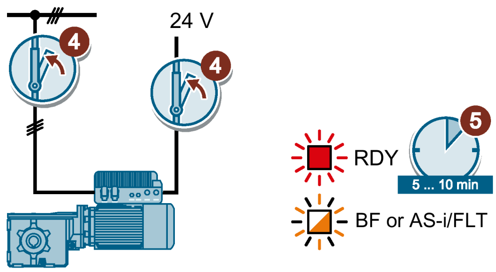


4. Switch on the power supply of the converter again.

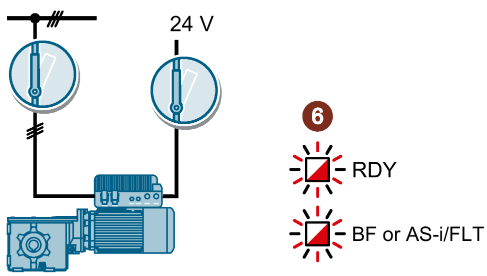
5. The converter transfers the firmware from the memory card into its memory.

   The transfer takes approximately 5 to 10 minutes.

   While data is being transferred, the LED RDY on the converter stays red. The BF or AS-i/FLT LED flashes orange with a variable frequency.



6. At the end of the transfer, the LED RDY and BF (or AS-i/FLT) slowly flash red (0.5 Hz).

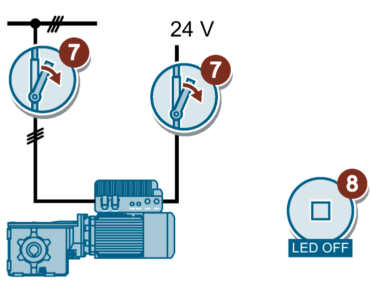


   Power supply failure during transfer

   The converter firmware will be incomplete if the power supply fails during the transfer.

   – Start again with step 1 of the instructions.

7. Switch off the power supply of the converter.
8. Wait until all LEDs on the converter are dark.



9. Remove the memory card from the converter.

   Note: You can also leave the memory card in the converter. The converter will behave differently depending on whether the memory card contains a data backup:

   – If the memory card contains a data backup of the converter settings:

     ⇒ The converter will take the settings from the memory card in step 10.

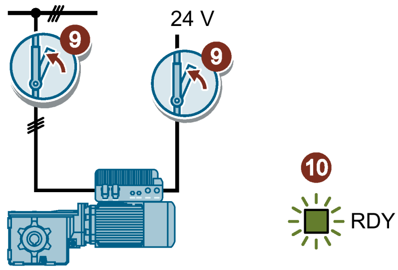
   – If the memory card does not have a data backup of the converter settings:

     ⇒ The converter will reset to factory settings and write the settings to the memory card in step 10.

10. Switch on the converter power supply again.

    If the firmware downgrade was successful, after several seconds the converter LED RDY turns green.

    The converter is reset to factory settings after firmware downgrade.



11. Transfer the settings from your data backup to the converter.

    Memory card → converter (Page 330)

    PG/PC → converter (Page 334)

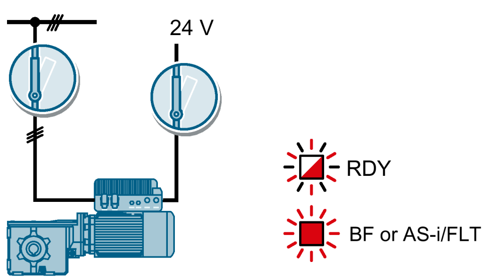
You have downgraded the converter firmware to an older version and transferred the settings to the converter.

❒

10.4.4 Correcting an unsuccessful firmware upgrade or downgrade

Precondition

The converter signals an unsuccessful firmware upgrade or downgrade with a quickly flashing LED RDY and a lit-up LED BF (or AS-i FLT).



Correcting a failed upgrade or downgrade

You can check the following to correct an unsuccessful firmware upgrade or downgrade:

- Have you inserted the card properly?
- Does the card contain the correct firmware?

Repeat the firmware upgrade or downgrade procedure.

10.5 Reduced acceptance test after component replacement and firmware change

After a component has been replaced or the firmware updated, a reduced acceptance test of the safety functions must be performed.

<table>
<tr><th rowspan="2">Measure</th><th colspan="2">Reduced acceptance test</th></tr>
<tr><th>Acceptance test</th><th>Documentation</th></tr>
<tr><td>Replacing the converter with an identical type</td><td rowspan="3">Not required.
Only check the direction of rotation of the motor.</td><td>• Supplement the converter data
• Log the new checksums
• Countersignature
• Supplement the hardware version in the converter data.</td></tr>
<tr><td>Replacing the motor with an identical pole pair number</td><td rowspan="2">No change.</td></tr>
<tr><td>Replace the gearbox with an identical ratio</td></tr>
<tr><td>Replacing safety-related I/O devices (e.g. Emergency Stop switch).</td><td>Not required.
Only check the control of the safety functions affected by the components that have been replaced.</td><td>No change.</td></tr>
<tr><td>Converter firmware upgrade.</td><td>Not required.</td><td>• Supplement firmware version in the converter data
• Log the new checksums
• Countersignature.</td></tr>
</table>

Technical data 11

11.1 General converter technical data

Electrical data

Property	Explanation
Line voltage	• For systems according to IEC: – 3 AC 380 V (-10 %) ... 480 V (+10 %) • For systems according to UL: – 3 AC 380Y/220 V ... 480Y/277 V The actual permissible line voltage depends upon the installation altitude.
Line supply configurations	TN, TT, IT[1)] Not for corner-grounded network. Permissible line supplies (Page 44)
Line frequency	50 Hz/60 Hz (±10%)
Output frequency	0 Hz ... 550 Hz in V/f 0 Hz ... 240 Hz in SLVC (default)
Converter efficiency	96% ... 98%
Power factor λ	0.73 ... 0.90
cos φ	0.98 ... 0.99
Line impedance	Uk<4% (RSC>25)
Inrush current	Less than 2 × rated input current. The converter can withstand 100000 power cycles with an interval of 120 s.
Overvoltage category	III, according to IEC 61800-5-1
Maximum short-circuit current (SCCR or Icc)	When using fuses: 65 kA rms You can find the data for further overcurrent protection devices on the Internet: Branch protection and short-circuit strength according to UL and IEC (https://support.industry.siemens.com/cs/ww/en/ps/27867)
Minimum short-circuit current	5 kA rms
Earth fault current	The converter can be operated with a type B 300 mA RCD.
Electromechanical (EM) brake	• 180 V DC – Rated current: 0.8 A – Disconnection on the DC side permits "fast" braking

1) For IT system, only permissible when the functional grounding in the converter has been removed.

Safety Integrated

Property	Explanation
Safety function	STO and SLS
	STO and SLS fulfil the requirements of the following standards: • SIL 2 according to IEC61508, part 1 to 3 (2010) • PL d according to IEC61800-5-2 (2016) • Category 3 according to ISO13849 part 1 (2015) The function STO corresponds to stop category 0 according to IEC60204 (2005). STO is always prioritized higher than SLS.
	Response Time The response times for the Safety Integrated functions can be found under: Safety Integrated response times (https://support.industry.siemens.com/cs/gb/en/view/109782490)
	Probability of failures The PFH values can be found under: PFH values (https://support.industry.siemens.com/cs/ww/en/view/76254308)

Environmental conditions

Property		Explanation
Surrounding temperature	Storage & transport	-25 °C to +50 °C
	Operation	-30 °C to +55 °C 1) Torque derating as a function of the surrounding temperature (Page 388)
Vibration during operation Shock during operation		Duty class 3M3 according to EN 60721-3-3 Duty class 3M3 according to EN 60721-3-3 Mounting the converter (Page 34)
Pollution degree		Suitable for pollution degree 2 environment according to EN 61800-5-1
Relative humidity		< 95% (non-condensation, no icing, no salt spray)
Installation altitude		Up to 1000 m above sea level without derating Above 1000 m (up to 4000 m) with derating Torque derating as a function of the installation altitude (Page 387)
Cooling method		Active cooling with the motor fan
Cooling air		Clean and dry air
Degree of protection 2)		IP65/IP66, indoor and outdoor use, has to be protected from direct weather conditions according to EN IEC 60721-3-3 Indoor use only according to UL type 4X Siemens recommends that you use the cables and connectors given in the linked chapter below to satisfy the suitable rating of the UL enclosed type. Cables and connectors (Page 56)
Weight		The weight is stated on the rating plate.

1) For UL-compliant applications, the maximum surrounding temperature for a glanded variant with daisy chain is 48 °C.

2) For the specific degree of protection of your converter, refer to the rating plate on your component.

11.2 Technical data of inputs and outputs

<table>
<tr><th>Property</th><th colspan="2">Explanation</th></tr>
<tr><td>Fieldbus interface</td><td colspan="2">PROFINET
AS-i</td></tr>
<tr><td rowspan="3">Operating voltage</td><td>• PROFINET variant:</td><td>24 V DC ± 15%</td></tr>
<tr><td>• I/O Control variant:</td><td>24 V DC ± 15%</td></tr>
<tr><td>• AS-i variant [1]:</td><td>26.5 V to 31.6 V, 24 V DC ± 15%</td></tr>
<tr><td>24 V power supply</td><td colspan="2">There are three options regarding the 24 V supply:
• The converter (I/O Control variant or PROFINET variant) obtains its 24 V power supply via terminals or via the M12 L-coding connector or 7/8" connector with 24 V DC ± 15%
• The converter (AS-i variant) obtains its 24 V power supply via X03 (M12 A-coding, two poles with AS-i power supply, two poles with 24 V DC ± 15%)
• The converter generates its 24 V power supply from the line voltage via the optional 24 V power supply unit.</td></tr>
<tr><td>Setpoint resolution</td><td colspan="2">0.01 Hz</td></tr>
<tr><td>Digital inputs</td><td>4 (DI 0 to DI 3)</td><td>• Programmable digital inputs
• PNP, SIMATIC-compatible
• Unswitched logic supply
• Input voltage: High > 11 V, Low < 5 V
• Maximum input voltage: 30 V
• Maximum input current: 15 mA</td></tr>
<tr><td>Configurable DI/DO</td><td>2 (DIO 24 & DIO 25)</td><td>• Can be configured as digital inputs or outputs
• When used as digital inputs:
– Switched logic supply
– Same specification as DI 0 to DI 3
• When used as digital output:
– PNP
– Switched logic supply
– 24 V DC/0 A to 0.5A (resistive load)
– Continuous current rating: max. 500 mA for two DOs in total
– Updating time of all digital outputs: 2 ms</td></tr>
<tr><td rowspan="4">Motor temperature sensor</td><td>PTC</td><td>• Short-circuit monitoring < 20 Ω
• Overtemperature 1650 Ω</td></tr>
<tr><td>Pt1000</td><td>• Measurement range: -48 °C to 248 °C
• Short-circuit monitoring < 603 Ω
• Wire-break > 2120 Ω</td></tr>
<tr><td>KTY84</td><td>• Measurement range: -48 °C to 248 °C
• Short-circuit monitoring < 50 Ω
• Wire-break > 2120 Ω</td></tr>
<tr><td>Temperature switch</td><td>• Opened temperature switch ≥ 100 Ω</td></tr>
</table>

Property	Explanation	
Fail-safe digital input	1 (DI 2 and DI 3)	• If you enable a safety function, then the fail-safe digital input comprises the two digital inputs DI 2 and DI 3. • The fail-safe digital inputs are in accordance with EN 61131-2: – Input voltage: High > 11 V, Low < 5 V – Maximum input current: 15 mA – Maximum input voltage: 30 V • Response time: – When the debounce time p9651 > 0: Typical 5 ms + p9651, worst case 15 ms + p9651 – When debounce time = 0: Typical 6 ms, worst case 16 ms
PROFIsafe		Yes (for PROFINET version only)
USB interface	Mini-USB	
Memory card (optional)	Slot for SD memory cards Memory cards (Page 327)	

1) For the AS-i variant, the converter is on the one hand powered by the specific AS-i power supply through the yellow cable; the supply voltage range is 26.5 V DC to 31.6 V DC. The auxiliary 24 V power supply (DC 24V +/- 15%) provided via the black cable must also be used for the correct operation of the converter.

11.3 Technical data dependent upon the power

Frame size	Rated power (kW)	Input current (A)	Power loss (W)
FSA	0.37	1.08	20.22
	0.55	1.47	24.43
	0.75	1.79	28.52
	1.1	2.43	37.47
	1.5	3.18	49.02
FSB	2.2	4.65	64.35
	3	6.23	85.89
	4	8.16	114.53

Typical current consumption on 24 V DC power supply

G115D motor-mounted converter	Typical current consumption from the 24 V power supply, unswitched [1) 3)]		Typical current consumption from the AS-i cable [2) 3)]	
	PROFINET variant	I/O variant	AS-i variant	
			Yellow cable	Black cable
FSA/FSB	290 mA	250 mA	90 mA	200 mA

1) The typical current consumption does not include the consumption of connected sensors at DI 0 to DI 3 from the unswitched 24 V power supply and the consumption of connected sensors/actors at DIO 24/DIO 25 from the switched 24 V power supply.

2) The typical current consumption does not include the consumption of connected sensors at DI 0 to DI 3 from the yellow cable and the consumption of connected sensors/actors at DIO 24/DIO 25 from the black cable.

3) The current consumption for digital inputs DI 0 ~ DI 3 is max. 200 mA in total. The current consumption for digital inputs DI 24 and DI 25 (when DIO 24/DIO 25 is configured as DI) is max. 200 mA in total, and the current consumption for digital outputs DO 24 and DO 25 (when DIO 24/DIO 25 is configured as DO) is max. 500 mA in total.

Standby currents

G115D motor-mounted converter		Standby current (mA) Mains power supply without optional 24 V DC power supply					
Frame size	Rated power	380 V, 50 Hz	380 V, 60 Hz	400 V, 50 Hz	400 V, 60 Hz	480 V, 50 Hz	480 V, 60 Hz
FSA	0.37 kW to 1.5 kW	32	39	34	41	41	49
FSB	2.2 kW to 4 kW	69	83	73	87	87	104

G115D motor-mounted converter		Standby current (mA) Mains power supply with optional 24 V DC power supply					
Frame size	Rated power	380 V, 50 Hz	380 V, 60 Hz	400 V, 50 Hz	400 V, 60 Hz	480 V, 50 Hz	480 V, 60 Hz
FSA	0.37 kW to 1.5 kW	64	71	62	69	59	67
FSB	2.2 kW to 4 kW	101	115	101	115	105	122

11.4 Technical data of braking resistors

Requirements for the minimum resistance of braking resistors

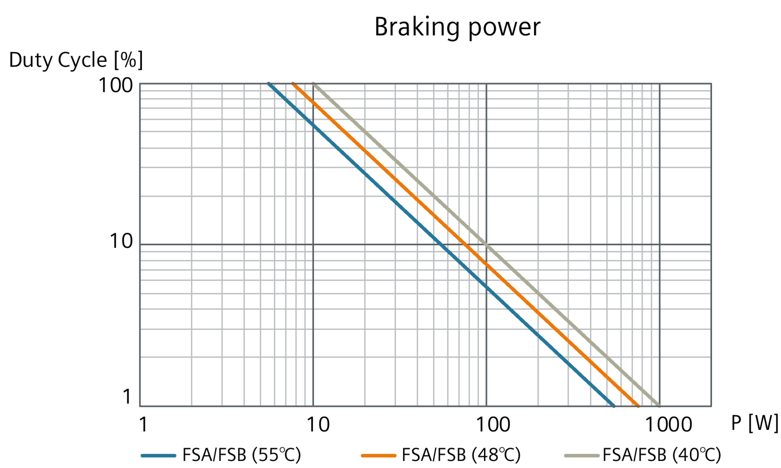
For each frame size, the minimum resistance of braking resistors is required as follows:

Frame size	Rated power	Minimum resistance of braking resistors
FSA	0.37 kW to 1.5 kW	200 Ω
FSB	2.2 kW to 4 kW	80 Ω

Technical data of integrated braking resistor

G115D motor-mounted converter		Integrated braking resistor		
Frame size	Rated power	Resistance	Continuous braking power	Peak braking power [1)]
FSA	0.37 kW to 1.5 kW	350 Ω	10 W	100 W
FSB	2.2 kW to 4 kW	175 Ω	10 W	100 W

1) Peak braking power at 10% cycle time of a 120s cycle. For the peak braking power at different duty cycles, refer to the following diagram.

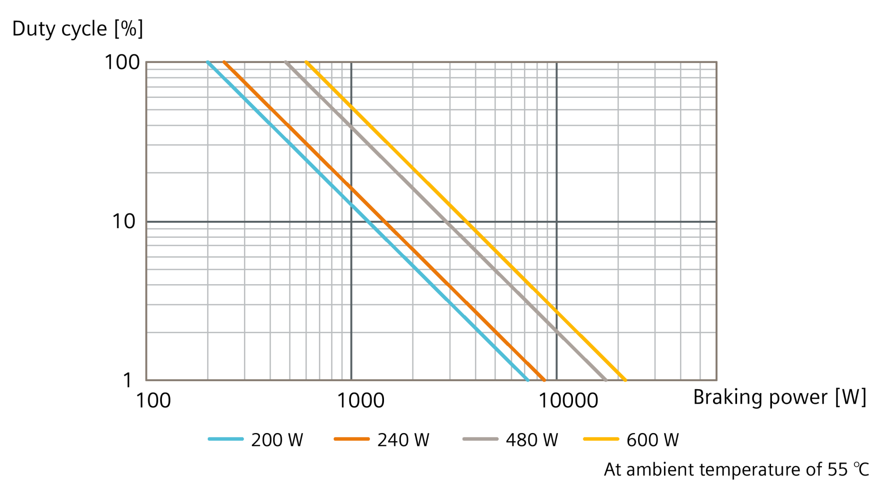


Technical data of external braking resistor

The external braking resistors are not included in the scope of delivery of the G115D converter. The following optional external braking resistors are available.

G115D motor-mounted converter		External braking resistor					
Frame size	**Rated power**	**Resistance (+/-10%)**	**Continuous braking power**	**Peak braking power [1)]**	**Article number**	**Vibration and shock during operation**	**Surrounding temperature**
FSA	0.37 kW to 1.5 kW	210 Ω	200 W	1200 W	6SL3501-1BE32-0AA0	Class 3M2, test according to EN 60721-3-3	-30 °C to +55 °C
		240 Ω	240 W	1440 W	6SL3501-1BE32-4AA0		
		480 Ω	480 W	2880 W	6SL3501-1BE34-8AA0		
FSB	2.2 kW to 4 kW	160 Ω	200 W	1200 W	6SL3501-1BE32-0BA0		
		150 Ω	240 W	1440 W	6SL3501-1BE32-4BA0		
		150 Ω	600 W	3600 W	6SL3501-1BE36-0BA0		

1) Peak braking power at 10% cycle time of a 120s cycle. For the peak braking power at different duty cycles, refer to the following diagram.



11.5 Load cycles and overload capabilities

Overload capability is the property of the converter to temporarily supply a current that is higher than the rated current to accelerate a load.

Definitions

Base load

Constant load between the accelerating phases of the converter

HO base load input current

Permissible input current for a "High Overload" load cycle

HO base load output current

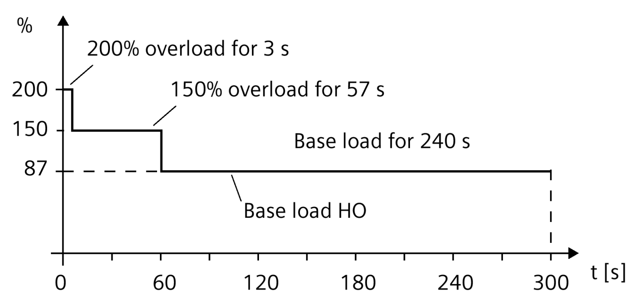
Permissible output current for a "High Overload" load cycle

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 High Overload.

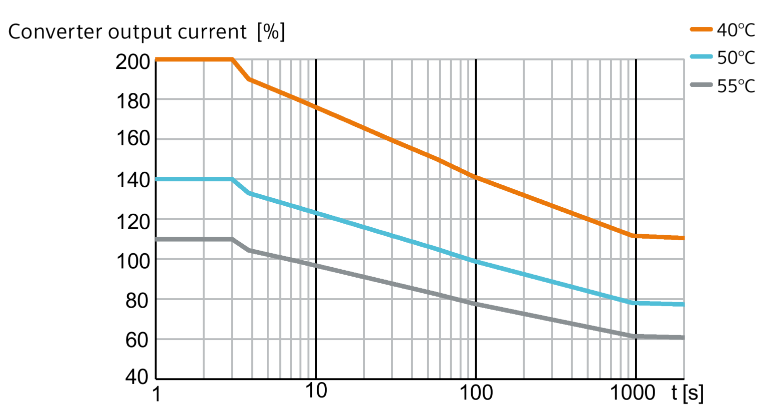
Permissible converter overload



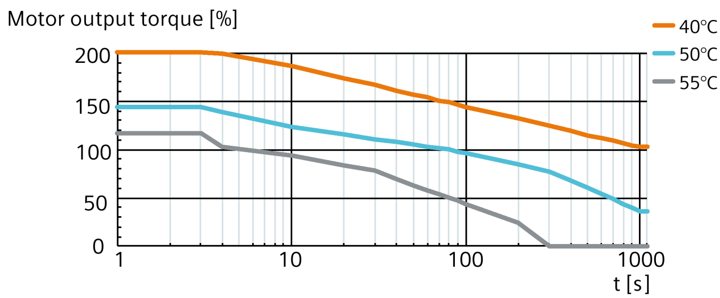
Note

- The rated ambient temperature for the above load cycles is 40 °C.
- You can set the parameter p0292[0] to a range of 5 °C to 25 °C based on the application.

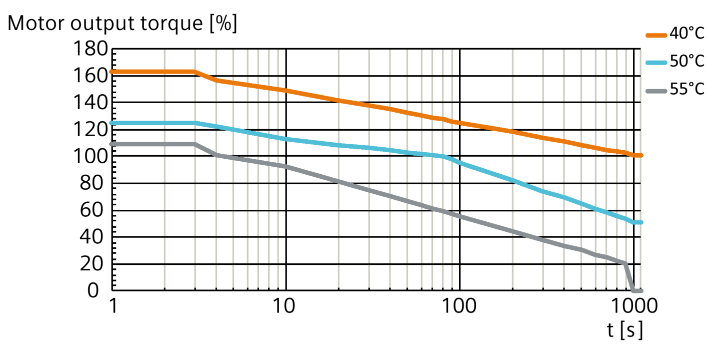
Permissible converter output current



Permissible motor output torque (2KJ8 asynchronous motor)



Permissible motor output torque (2KJ8 synchronous reluctance motor)

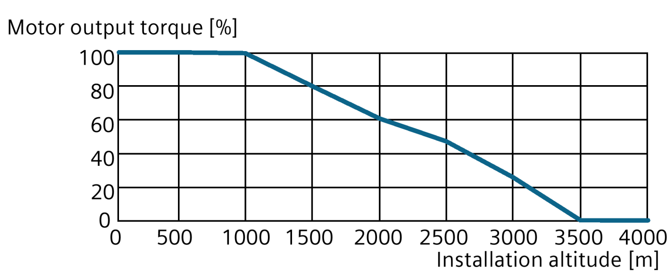


11.6 Derating data

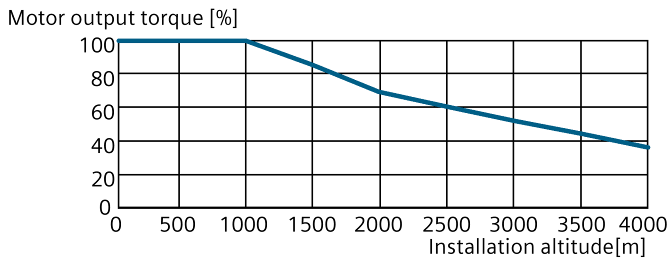
11.6.1 Torque derating as a function of the installation altitude

The permissible motor output torque is reduced above an installation altitude of 1000 m.

Torque derating of 2KJ8 asynchronous motor



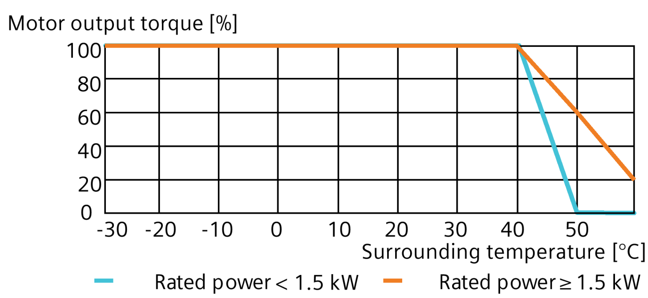
Torque derating of 2KJ8 synchronous reluctance motor



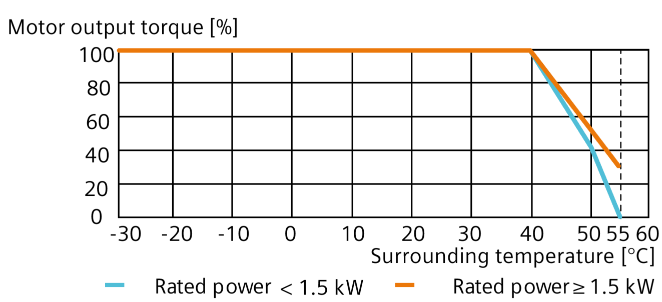
11.6.2 Torque derating as a function of the surrounding temperature

The permissible motor output torque is reduced when the surrounding air temperature is above 40 ℃.

Torque derating of 2KJ8 asynchronous motor



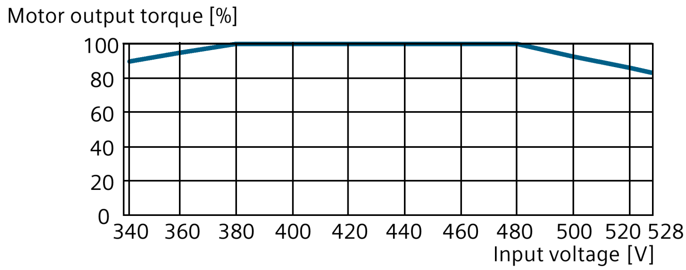
Torque derating of 2KJ8 synchronous reluctance motor



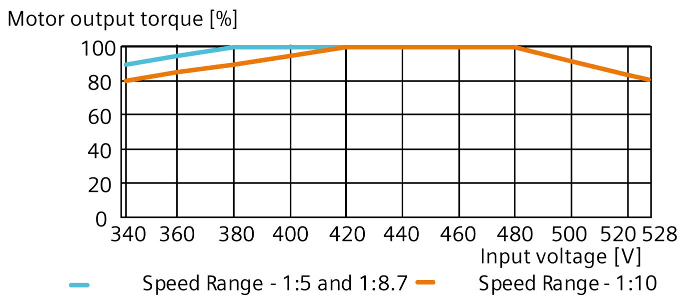
11.6.3 Torque derating as a function of the line voltage

The 2KJ8 asynchronous motor (across all speed ranges) and the 2KJ8 synchronous reluctance motor (with speed range 1:5 or 1:8.7) operate at 100% rated output torque at a line voltage from 380 V to 480 V. The 2KJ8 synchronous reluctance motor with speed range 1:10 operates at 100% rated output torque at a line voltage from 420 V to 480 V. The output torque should be reduced when the line voltage falls outside the range.

Torque derating of 2KJ8 asynchronous motor



Torque derating of 2KJ8 synchronous reluctance motor

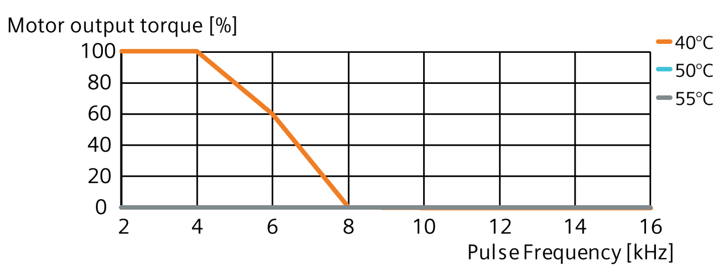


11.6.4 Torque derating as a function of the pulse frequency

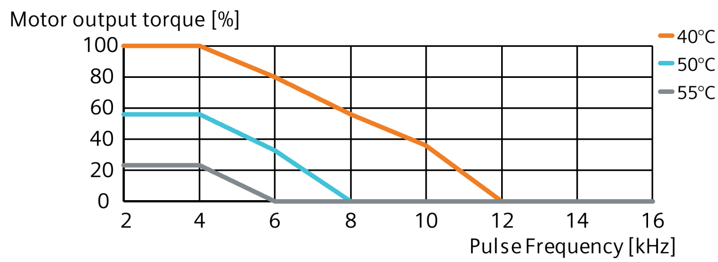
The permissible motor output torque is reduced when the converter is operated at a pulse frequency above 4 kHz and/or at an ambient temperature above 40°C.

The pulse frequency reduces automatically based on the heatsink temperature.

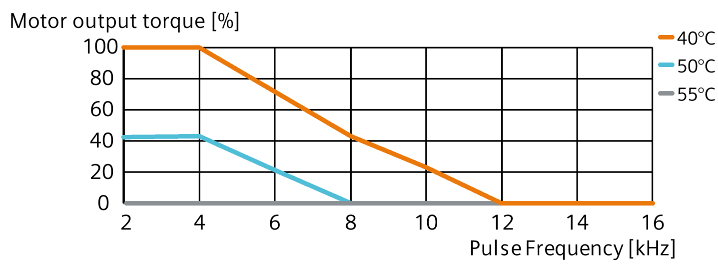
Torque derating of 2KJ8 asynchronous motor (motor rated power < 1.5 kW)



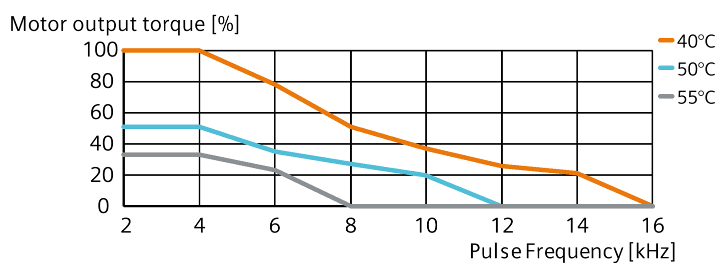
Torque derating of 2KJ8 asynchronous motor (motor rated power ≥ 1.5 kW)



Torque derating of 2KJ8 synchronous reluctance motor (motor rated power < 1.5 kW)



Torque derating of 2KJ8 synchronous reluctance motor (motor rated power ≥ 1.5 kW)

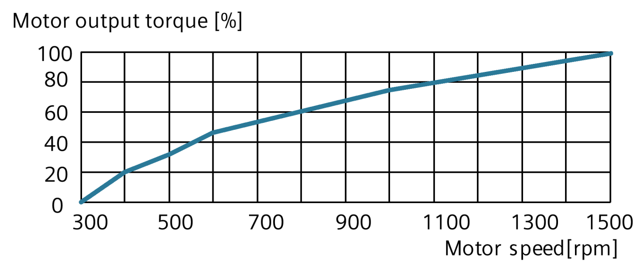


11.6.5 Torque derating as a function of the motor speed

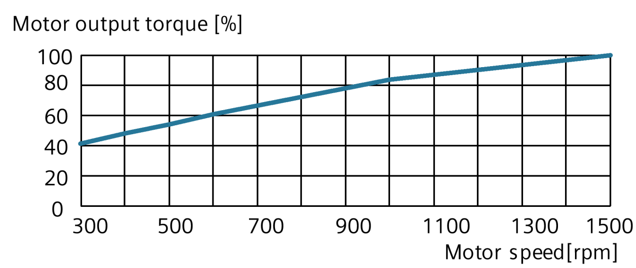
Derating of motor output torque as a function of motor speed (with daisy chain)

With daisy chain connection, the motor output torque should be reduced when the motor speed is below 1500 rpm.

Torque derating of 2KJ8 asynchronous motor



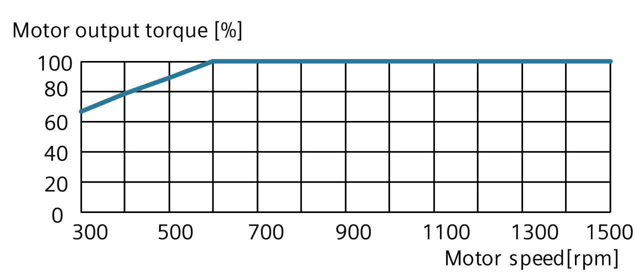
Torque derating of 2KJ8 synchronous reluctance motor



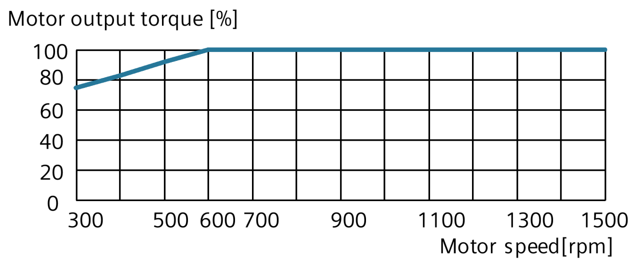
Derating of motor output torque as a function of motor speed (without daisy chain)

For motors with speed range 1:5 or 1:8.7, if the converter is not connected via daisy chain, the motor torque should be reduced when the motor speed is below 600 rpm. For motors with speed range 1:10 and without daisy chain connection, the motor can be operated at its rated torque until 300 rpm.

Torque derating of 2KJ8 asynchronous motor



Torque derating of 2KJ8 synchronous reluctance motor



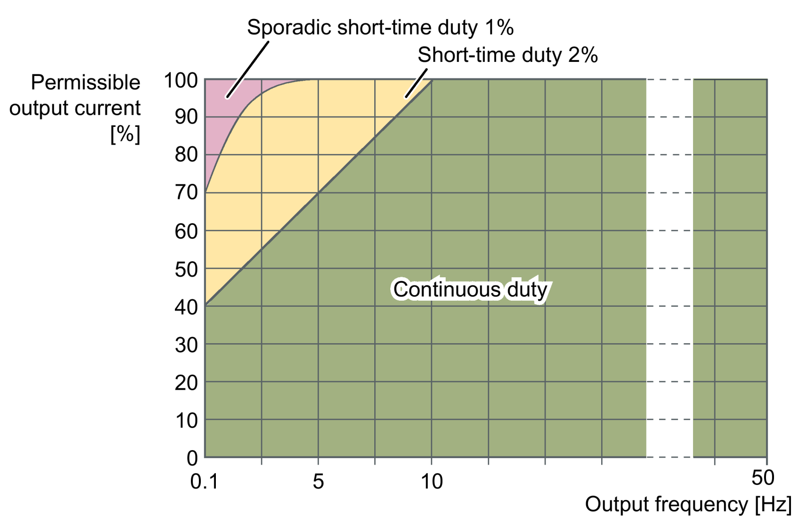
Note

For a 4 kW G115D motor-mounted converter without daisy chain, the derating curve is the same as that with daisy chain.

11.7 Low frequency operation

The converter can only be operated with reduced output current at low output frequencies.

NOTICE
Reduced converter service life as a result of overheating
Loading the converter with a high output current and at the same time with a low output frequency can cause the current-conducting components in the converter to overheat. Excessively high temperatures can damage the converter or reduce the converter service life. • Never operate the converter continuously with an output frequency = 0 Hz. • Only operate the converter in the permissible operating range.



- Continuous operation (green area in the figure)

  Operating state that is permissible for the complete operating time.
- Short-time operation (yellow area in the figure)

  Operating state that is permissible for less than 2% of the total operating time.
- Sporadic short-time operation (red area in the figure)

  Operating state that is permissible in very short and seldom operating conditions for less than 1% of the total operating time.

11.8 Data regarding the power loss in partial load operation

Note

According to Article 2, (3) a), the SINAMICS G115D motor-mounted converter is a motor-integrated converter and therefore no efficiency requirements apply. According to Article 2, (2) b), the geared motor for the SINAMICS G115D motor-mounted converter is a motor with an integrated variable speed drive and therefore no efficiency requirements apply.

11.9 Electromagnetic compatibility of the converter

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

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

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

The driven machine is not part of the drive system.

Note

PDS as component of machines or systems

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

Overview of environments and categories

Environments

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

- **First environment**

  Residential buildings or locations at which the PDS is directly connected to a public low-voltage supply without intermediate transformer.

- **Second environment**

  An environment that includes all other establishments which are not connected directly to a public low-voltage line supply.

Categories

- **Category C1**

  Power Drive System (PDS) of rated voltage less than 1000 V intended for use in the first (residential) environment.

- **Category C2**

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

- **Category C3**

  Power Drive System (PDS) of rated voltage less than 1000 V intended for use in the second (industrial) environment and not intended for use within the first (residential) environment.

Second environment - category C2

Conducted and radiated interference emissions

The converters meet the limit values of IEC 61800-3 Category C2 with regard to conducted and radiated interference emissions under the following conditions:

- EMC compliant installation and configuration by qualified technician
- Operation on TN or TT line supply with grounded neutral point
- Shielded external braking resistor cable with low capacitance
- Pulse frequency ≤ factory setting
- Converters with integrated C2 line filter

Note

The SINAMICS G115D converter is designed for operation in the second environment (industrial area) and may not be used in the first environment (residential area) unless the appropriate noise suppression measures have been adopted.

Note

A power drive system consisting of multiple units connected together in daisy-chain may require further measures to meet EMC requirements.

Harmonic currents

Frame size	Typical Harmonic current (% of rated input current) at U_K 1 %							
	5th	7th	11th	13th	17th	19th	23rd	25th
FSA	15.65	11.65	7.18	6.19	4.50	4.30	3.12	3.53
FSB	16.79	12.36	7.52	6.75	4.79	4.56	3.30	3.65

Note

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

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

11.10 Protecting persons from electromagnetic fields

Overview

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

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

Precondition

1. The laws for protection from electromagnetic fields in force in individual EU member states can go beyond the minimum requirements of the EMF Directive 2013/35/EU and always take precedence.
2. The ICNIRP 2010 limits for the workplace are the basis for the assessment.
3. The 26th BImSchV (German Federal Emission Protection Regulation) defines 100 μT (RMS) for the assessment of active implants. According to Directive 2013/35/EU, 500 μT (RMS) at 50 Hz is applicable here.

4. Compliance with the limit values was assessed for the following frequencies:
   – Line frequency 47 Hz to 63 Hz
   – Pulse frequency, for example 4/8/16 kHz and multiples thereof, assessed up to a maximum of 100 kHz
5. The routing of power cables has a significant impact on the electromagnetic fields that occur. Install and operate the components inside metallic cabinets in compliance with the documentation and use shielded motor cables.

   EMC installation guidelines (Page 41)

Description

The following information regarding electromagnetic fields relates solely to converters supplied by Siemens.

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

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

	Individuals without active implants	**Individuals with active implants**
Minimum distances to the converter	Forearm length (approx. 35 cm)	Must be separately assessed depending on the active implant.

Appendix

A

A.1 Interconnecting signals in the converter

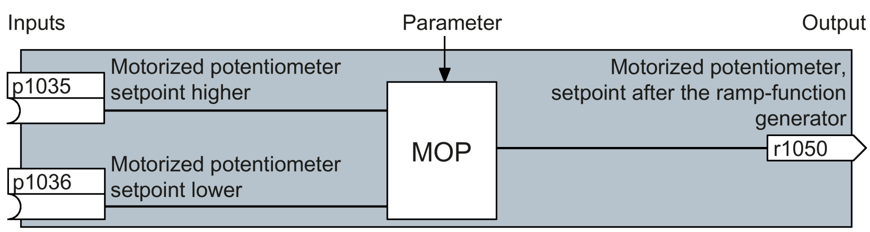
A.1.1 Fundamentals

The following functions are implemented in the converter:

- 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.

Example of a block: Motorized potentiometer (MOP)

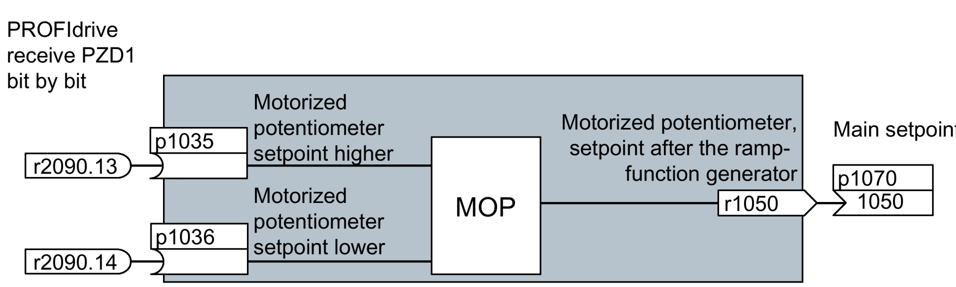


Most of the blocks can be adapted to specific applications using parameters.

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.

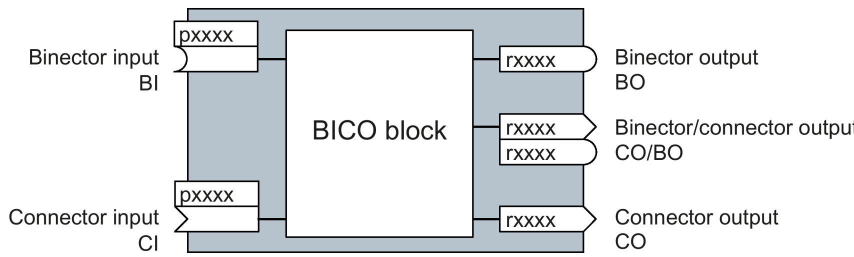
Example: Signal interconnection of two blocks for digital input 0



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)



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 converter?

If you change the signal interconnection in the converter, you can adapt the converter 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.

Where can you find additional information?

- All the binectors and connectors are located in the parameter list in the List Manual.
- The function diagrams in the List Manual provide a complete overview of the factory setting for the signal interconnections and the setting options.

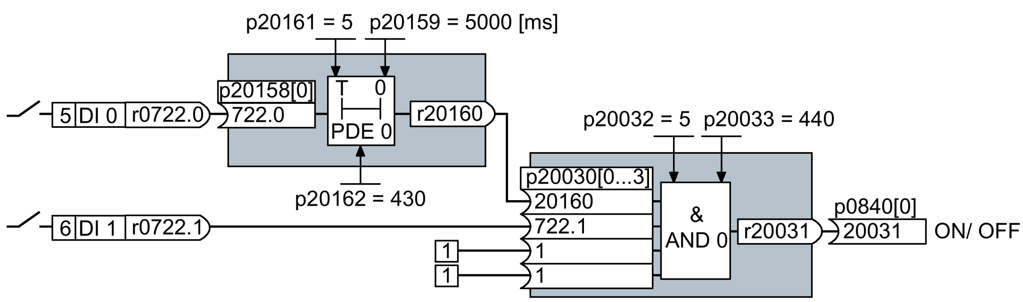
A.1.2 Application example

Shift the control logic into the converter

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).



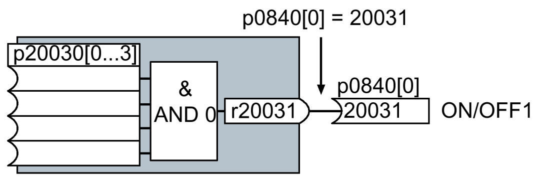
The signal of digital input 0 (DI 0) is fed through a time block (PDE 0) and is interconnected with the input of a logic block (AND 0). The signal of digital input 1 (DI 1) is interconnected to the second input of the logic block. The logic block output issues the ON/OFF1 command to switch on the motor.

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
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 converter. Parameter r20031 is the output of the AND block. To interconnect ON/OFF1 with the output of the AND block, set p0840 = 20031.



A.2 Acceptance tests for the safety functions

A.2.1 Recommended acceptance test

Note

The "Startdrive Advanced" commissioning tool (requires an appropriate license) includes a wizard for the acceptance test of the safety functions integrated in the drive. For more information, see Chapter "Acceptance - completion of commissioning (Page 228)".

The following descriptions for the acceptance test are recommendations that illustrate the principle of acceptance. You may deviate from these recommendations if you check the following once you have completed commissioning:

- Correct assignment of the interfaces of each converter with the safety function:
  - Fail-safe inputs
  - PROFIsafe address
- Correct setting of the STO safety function.

Note

Perform the acceptance test with the maximum possible velocity and acceleration in order to test the expected maximum braking distances and braking times.

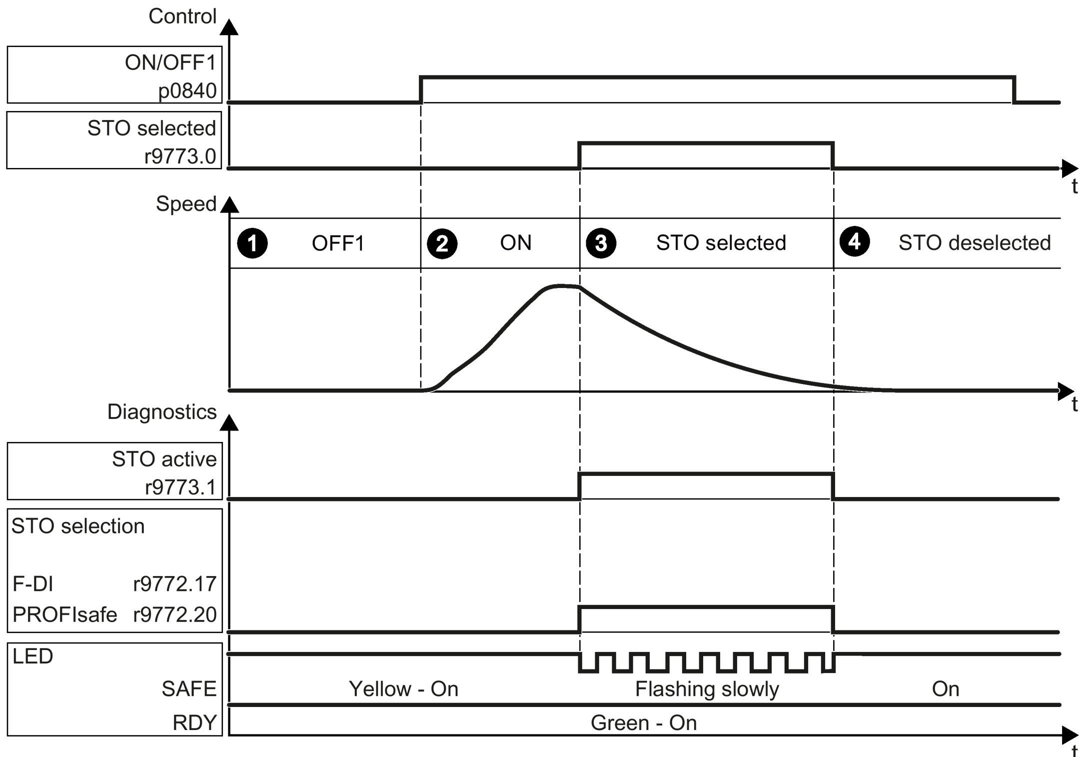
Note

Non-critical alarms

The following alarms are issued following each system ramp-up and are not critical for acceptance:

- A01697
- A01796

A.2.2 Acceptance test STO (basic functions)



Procedure

To perform an acceptance test of the STO function as part of the basic functions, proceed as follows:

				Status
1.	**The converter is ready**			
	• The converter signals neither faults nor alarms of the safety functions (r0945[0...7], r2122[0...7]).			
	• STO is not active (r9773.1 = 0).			
2.	**Switch on motor**			
	2.1.	Enter a speed setpoint ≠ 0.		
	2.2.	Switch on the motor (ON command).		
	2.3.	Check that the correct motor is running.		
3.	**Select STO**			
	3.1.	Select STO while the motor is running. *Test each configured activation, e.g. via digital inputs and PROFIsafe.*		
	3.2.	Check the following:		
		When controlled via PROFIsafe	When controlled via fail-safe digital inputs (F-DI)	

				Status
		• The converter signals the following: "STO selection via PROFIsafe" (r9772.20 = 1)	• The converter signals the following: "STO Selection via terminal" (r9772.17 = 1)	
		• If a mechanical brake is not available, the motor coasts down. A mechanical brake brakes the motor and holds it to ensure that it remains at standstill.		
		• The converter signals neither faults nor alarms of the safety functions (r0945[0...7], r2122[0...7]).		
		• The converter signals the following: "STO is selected" (r9773.0 = 1). "STO is active" (r9773.1 = 1).		
4.	**Deselect STO**			
	4.1.	Deselect STO.		
	4.2.	Check the following:		
		• STO is not active (r9773.1 = 0).		
		• The converter signals neither faults nor alarms of the safety functions (r0945[0...7], r2122[0...7]).		

You have performed the acceptance test of the STO function.
❒

A.2.3 Machine documentation

Machine or plant description

Designation	
Type	
Serial number	
Manufacturer	
End customer	
Overview diagram of the machine and/or system:	

Converter data

The converter data include the hardware version of the safety-relevant converter.

Labeling the drive	Article number and hardware version of the converter

Function table

The active safety functions depending on the operating mode and safety equipment are shown in the function table.

Operating mode	Safety equipment	Drive	Selected safety function	Checked

Table A- 1 Example of a function table

Operating mode	Safety equipment	Drive	Selected safety function	Checked
Automatic	*Protective door closed*	*Conveyor belt*	---	---
	Protective door open	*Conveyor belt*	*STO*	
	Emergency Stop button pressed	*Conveyor belt*	*STO*	

Acceptance test reports

File name of the acceptance reports	

Data backup

Data	Storage medium			Holding area
	Archiving type	Designation	Date	
Acceptance test reports				
PLC program				
Circuit diagrams				

Countersignatures

Commissioning engineer

The commissioning engineer confirms that the tests and checks listed above have been correctly executed.

Date	Name	Company/dept.	Signature
...	...	...	...

Machine manufacturer

The machine OEM confirms the correctness of the settings documented above.

Date	Name	Company/dept.	Signature
...	...	...	...

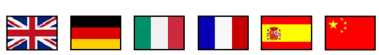
A.3 Manuals and technical support

A.3.1 Overview of the manuals

Manuals with additional information that can be downloaded:

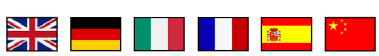
- Operating Instructions (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Installing, commissioning and maintaining the drive. Advanced commissioning (this manual)

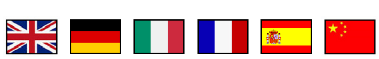
- Compact Operating Instructions for G115D Motor Mounted (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Installing and commissioning the drive

- Compact Operating Instructions for G115D Wall Mounted (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Installing and commissioning the converter

- Compact Installation Instructions for G115D Electronic Module (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Replacing the Electronic Module

- Compact Installation Instructions for G115D External Braking Resistor (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Installing and commissioning the external braking resistor

- SINAMICS G120 Smart Access Operating Instructions (https://support.industry.siemens.com/cs/ww/en/view/109758122)
  Operating the converter from a PC, tablet or smartphone

- Compact Installation Instructions for SAM interface kit (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Installing the SAM interface kit

- "Safety Integrated" Function Manual (https://support.industry.siemens.com/cs/ww/en/view/109477367)

  Commissioning and optimizing safety functions

- "Fieldbus" Function Manual (https://support.industry.siemens.com/cs/ww/en/view/109477369)

  Configuring fieldbuses

- List Manual (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Parameter list, alarms and faults, graphic function diagrams

- Protective devices (https://support.industry.siemens.com/cs/ww/en/ps/27867/man)

  Overcurrent protection devices of the G115D converter

- AS-Interface System Manual (https://support.industry.siemens.com/cs/ww/en/view/26250840)
- AS-Interface - Introduction and Basics Manual (https://support.industry.siemens.com/cs/gb/en/view/1171856)

A.3.2 Configuring support

Catalog

Ordering data and technical information for the converter.

Catalogs for download or online catalog (Industry Mall):

SINAMICS G115D (www.siemens.com/sinamics-g115d)

EMC (electromagnetic compatibility) technical overview

Standards and guidelines, EMC-compliant control cabinet design

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

EMC Guidelines configuration manual

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

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

A.3.3 Product support

Overview

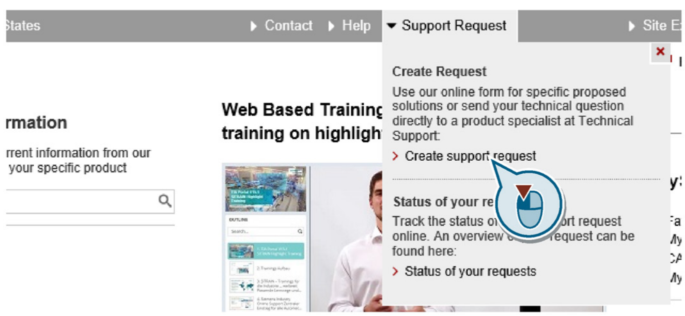
You can find additional information about the product on the Internet:

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

This URL provides the following:

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

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



Get more information

SINAMICS:
www.siemens.com/sinamics

Industry Mall:
www.siemens.com/industrymall

Industry Online Support:
www.siemens.com/online-support