SINAMICS G120

Inverters with the Control Units
CU230P-2 HVAC
CU230P-2 DP
CU230P-2 PN
CU230P-2 CAN
CU230P-2 BT - exclusively for Siemens IC BT

Operating Instructions · 01 2013

SINAMICS

Answers for industry.

SIEMENS

SIEMENS

SINAMICS

SINAMICS G120
Converters with Control Units
CU230P-2 HVAC
CU230P-2 DP
CU230P-2 PN
CU230P-2 CAN
CU230P-2 BT

Operating Instructions

Edition 01/2013, Firmware V4.6

Original instructions
01/2013, FW V4.6

A5E02430659B AF

Legal information

Warning notice system

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

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

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

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

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

Change history

Important changes with respect to the Manual, Edition 03/2012

New Power Modules	In Chapter
• Power Module PM230 FSD … FSF in IP20 degree of protection • Power Module PM230 FSD … FSF in push through design	Installing Power Module (Page 38)

New functions in firmware V4.6	In Chapter
Skip frequency band for analog inputs	Analog inputs (Page 88)
Firmware update of the Control Unit	Upgrading the firmware (Page 346) Firmware downgrade (Page 348)
EtherNet/IP	Communication via EtherNet/IP (Page 128)

An overview of all new and modified functions in Firmware V4.6 can be found in section Firmware version 4.6 (Page 401).

Revised descriptions	In Chapter
Summary of the general safety notes has been supplemented	Safety notes (Page 15)
EMC-compliant installation	Connecting inverters in compliance with EMC (Page 59)
Rounding times of the ramp-function generator have been supplemented	Ramp-function generator (Page 238)
Function expansions in CANopen	Communication over CANopen (Page 180)
PROFIenergy functionality of the inverter has been supplemented	PROFIenergy profile for PROFINET (Page 125)
"Essential service mode" inverter function has been revised	(Page 292)
"Energy-saving display" inverter function has been supplemented	Energy-saving display (Page 264)

Table of contents

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

9

Safety notes

<div style="text-align: right; font-size: 2em;">1</div>

Use for the intended purpose

The frequency converter described in this manual is a device for controlling an asynchronous low-voltage motor. The converter is designed for installation in electrical installations or machines.

It has been approved for industrial and commercial use on industrial networks. Its use in public line supplies requires a different configuration and/or additional measures.

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

⚠ **DANGER**

Danger to life when live parts are touched

Touching live parts can result in death or severe injury.

Note the following:

- Only work on electrical equipment if you are qualified to do so.
- When carrying out any work, always comply with the country-specific safety rules.

Follow the six steps to ensure safety:

1. Prepare for shutdown and inform team members who will be affected by the procedure.
2. Switch off the machine so that it is in a no-voltage state:
   – Switch off the machine.
   – Wait until the discharge time specified on the warning labels has elapsed.
   – Check that it really is in a no-voltage condition, from phase conductor to phase conductor and phase conductor to protective conductor.
   – Check that all auxiliary circuits are also in a no-voltage state.
   – Ensure that the motor cannot move.
3. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.
5. Lock out all energy sources to prevent reclosing.
6. Make sure that the machine is completely locked out ... and that you have the right machine!

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

⚠ WARNING
Danger to life when live parts are touched on damaged devices
Hazardous voltages can be present at the housing or exposed components on damaged devices.
• Ensure compliance with the limit values specified in the technical specifications during transport, storage and operation.
• Do not use any damaged devices.
• The components must be protected against conductive contamination (e.g. by installing them in a cabinet with degree of protection IP54B to EN 60529). Assuming that conductive contamination at the installation site can definitely be excluded, a lower degree of cabinet protection may be permitted.

⚠ WARNING
Danger to life due to unexpected movement of machines when using mobile wireless devices or mobile phones
Using mobile radios or mobile phones with a transmit power > 1 W closer than approx. 2 m to the frequency converter may cause the devices to malfunction, affecting the functional safety of machines and, therefore, putting people at risk or causing material damage.
• Switch off mobile radios and mobile telephones when you are close to the converter.

NOTICE
Damage due to electric fields or electrostatic discharge
Electric fields or electrostatic discharge can result in malfunctions as a result of damaged individual components, integrated circuits, modules or devices.
• Package, store, transport and send the electronic components, modules or devices only in the original product packaging or in other suitable materials, e.g. conductive foam rubber or aluminum foil.

• Only touch components, modules and devices if you are grounded by means of one of the following measures:
  – Wearing an ESD armband or
  – 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, for example).

⚠️ **CAUTION**

Risk of burns due to touching hot surfaces

During operation and for a short time after the frequency converter shuts down, the surface of the device can reach a high temperature. Touching the surface of the converter can cause burns.

- Do not touch the device during operation.
- After shutting down the converter, wait for the device to cool down before touching it.

Residual risks of power drive systems

The control and drive components of a drive system are approved for industrial and commercial use in industrial line supplies. Their use in public line supplies requires a different configuration and/or additional measures.

These components may only be operated in closed housings or in higher-level control cabinets with protective covers that are closed, and when all of the protective devices are used.

These components may only be handled by qualified and trained technical personnel who are knowledgeable and observe all of the safety instructions on the components and in the associated technical user documentation.

When assessing the machine's risk in accordance with the respective local regulations (e.g., EC Machinery Directive), the machine manufacturer 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 components during commissioning, operation, maintenance, and repairs caused by, for example:

   – Hardware defects and/or software errors in the sensors, controllers, actuators, and connection technology

   – Response times of the controller and drive

   – Operating and/or ambient conditions outside of the specification

   – Condensation / conductive contamination

   – Parameterization, programming, cabling, and installation errors

   – Use of radio devices / cellular phones in the immediate vicinity of the controller

   – External influences / damage

2. In the event of a fault, exceptionally high temperatures, including an open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter, e.g.:

   – Component malfunctions

   – Software errors

   – Operating and/or ambient conditions outside of the specification

   – External influences / damage

   Inverters of the Open Type / IP20 degree of protection must be installed in a metal control cabinet (or protected by another equivalent measure) such that the contact with fire inside and outside the inverter is not possible.

3. Hazardous shock voltages caused by, for example:

   – Component malfunctions

   – Influence of electrostatic charging

   – Induction of voltages in moving motors

   – Operating and/or ambient conditions outside of 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.

Note

The components must be protected against conductive contamination (e.g. by installing them in a control cabinet with degree of protection IP54 according to IEC 60529 or NEMA 12).

Assuming that conductive contamination at the installation site can definitely be excluded, a lower degree of cabinet protection may be permitted.

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

Introduction

<div style="text-align: right; font-size: 2em;">2</div>

2.1 About this manual

Who requires the operating instructions and what for?

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

What is described in the operating instructions?

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

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

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

What is the meaning of the symbols in the manual?

An operating instruction starts here.

This concludes the operating instruction.

The following text applies to the Basic Operator Panel BOP-2.
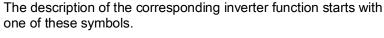
The following text applies if you are using a PC with STARTER.

Examples for the symbols of the inverter functions.

The description of the corresponding inverter function starts with one of these symbols.

See also: Overview of the inverter functions (Page 217).

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

19
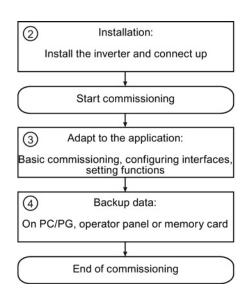
2.2 Guide through this manual

In this manual, you will find background information on your inverter, as well as a full description of the commissioning procedure:

① Inverter components:

Sizes, types, accessories

① Here you will find information about the hardware of your inverter and the commissioning tools:

- Identifying the converter (Page 21)

② Installation:

Install the inverter and connect up

Start commissioning

③ Adapt to the application:

Basic commissioning, configuring interfaces, setting functions

④ Backup data:

On PC/PG, operator panel or memory card

End of commissioning

② • Overview of the inverter installation (Page 35)

All information relating to the commissioning of your inverter is located in the following chapters:

③ • Basic commissioning (Page 73)
- Adapting the terminal strip (Page 85)
- Configuring the fieldbus (Page 97)
- Setting functions (Page 217)

④ • Backing up data and series commissioning (Page 319)

⑤ Maintenance and diagnostics:

Replacement of components, displays, alarms, faults

⑤ Information regarding the maintenance and diagnostics of your inverter is located in the following chapters:

- Corrective maintenance (Page 341)
- Alarms, faults and system messages (Page 353)

⑥ Technical data

⑥ The most important technical data for your inverter is located in this chapter:

- Technical data (Page 371)

⑦ Appendix

Fundamentals, application examples, additional sources of information

⑦ The appendix contains some background information and explanatory examples:

- Appendix (Page 401)

Description

3
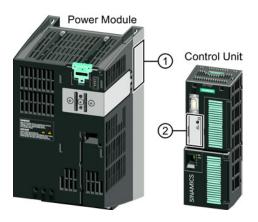
All power data refer to rated values or to power for operation with low overload (LO).

3.1 Identifying the converter

Main components of the converter

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

- The Control Unit controls and monitors the Power Module and the connected motor.
- The Power Modules are available for motors with a power range of between 0.37 kW and 250 kW.

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

- Designation: e.g. Power Module 240
- Technical data: Voltage, current and power
- Order number: e.g. 6SL3224-0BE13-7UA0
- Version: e.g. A02

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

- Designation: e.g. Control Unit CU240E-2 DP-F
- Order number: e.g. 6SL3244-0BB13-1PA0
- Version: e.g. A02 (Hardware)

Additional inverter components

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

- Line filter (Page 27)
- Line reactor (Page 28)
- Output reactor (Page 29)
- Sine-wave filter (Page 30)
- Braking resistor (Page 32)

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

21

3.2 Control Units

The CU230P 2 Control Units have integrated technology functions for pumps, fans and compressor applications. The I/O interfaces, the fieldbus interface and the specific software functions optimally support these applications. The integration of technological functions is a significant differentiating feature to the other Control Units of the SINAMICS G120 drive family.

CU230P-2-specific functions

- Essential service mode
- Multi-zone controller
- Cascade control
- Energy-saving mode
- Bypass

CU230P-2 Control Units are available in the following versions

Designation	CU230P-2 HVAC	CU230P-2 DP	CU230P-2 PN	CU230P-2 CAN	CU230P-2 BT[1]	
Order number	6SL3243-0BB30-1HA3	6SL3243-0BB30-1PA3	6SL3243-0BB30-1FA0	6SL3243-0BB30-1CA3	6SL3243-6BB30-1HA2	
Fieldbus	RS485 • USS, • Modbus RTU • BACnet MS/TP • P1	PROFIBUS DP	PROFINET IO	CANopen	RS485 • USS, • Modbus RTU • BACnet MS/TP • P1	
Digital inputs	6					
Analog inputs	4					
Digital outputs	3					
Analog outputs	2					

1) Exclusive version for Siemens IC BT

Shield connection kit for the Control Unit

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

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

Table 3- 1   Order numbers

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

3.3 Power Module

Which Power Module can I use with the Control Unit?

You can operate the CU230P-2 Control Unit with the following Power Modules:

- PM230 IP20, IP55 and push-through system
- PM240
- PM240-2 IP20 and push-through system
- PM250
- PM260

3.3.1 Power Modules in degree of protection IP20 and with push-through system

Figure 3-1   Power Modules with degree of protection IP20 FSA … FSGX

Figure 3-2   Power Modules with the push-through system FSA … FSC

PM230, 3 AC 400 V - Pump and fan applications

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

Range of order numbers:

- IP20:   6SL3210-1NE…
- Push through   6SL3211-1NE…

Frame size	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
Power range (kW), IP20	0,37 … 3	4 … 7,5	11 … 18,5	22 … 37	45 … 55	75 … 90	---
Power range (kW), PT	3	7,5	18,5	---	---	---	---

PM240, 3 AC 400 V - Standard areas of application

The PM240 Power Module is available without a filter or with an integrated class A line filter with degree of protection IP20. The PM240 allows dynamic braking via an external braking resistor.

Order number range: 6SL3224-0BE… and 6SL3224-0XE…

Frame size	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
Power range (kW)	0.37 … 1.5	2.2 … 4	7.5 … 15	18.5 … 30	37 … 45	55 … 132	160 … 250

PM240-2, 3 AC 400 V - standard areas of application, 2nd generation

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

Range of order numbers:

- IP20:   6SL3210-1PE…
- Push-through   6SL3211-1PE…

Frame size	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
Power range (kW), IP20	0.55 … 3	--	--	--	--	--	--
Power range (kW), PT	2.2 … 3	--	--	--	--	--	--

PM250, 3 AC 400 V - Application areas with line regeneration

The PM250 Power Module is available without a filter or with an integrated class A line filter with degree of protection IP20. The PM250 permits dynamic braking with energy feedback into the line supply.

Order number range, IP20:   6SL3225-0BE …

Frame size	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
Power range (kW)	---	---	7,5 … 15	18,5 … 30	37 … 45	55 … 90	---

PM260, 3 AC 690 V - Application areas with line regeneration

The PM260 Power Module is available without a filter or with an integrated class A line filter with degree of protection IP20. A sine-wave filter is fitted to the motor. The PM260 permits dynamic braking with energy feedback into the line supply.
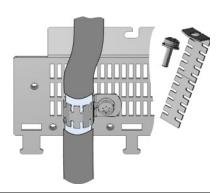
Order number range, IP20:   6SL3225-0BH…

Frame size	FSA	FSB	FSC	FSD	FSE	FSF	FSGX
Power range (kW)	---	---	---	11 … 18.5	---	30 … 55	---

3.3.1.1 Accessories for installation and shielding

Shield connection kit

The shield connection kit offers optimum shield support and strain relief for line and motor cables. It comprises a shield plate with serrated strips with screws.

Note

For Power Modules PM230 and PM240-2, the shield connection kit is included in the scope of delivery.

For the PM240, PM250 and PM260 Power Modules, the shield connection kit is an optional component.
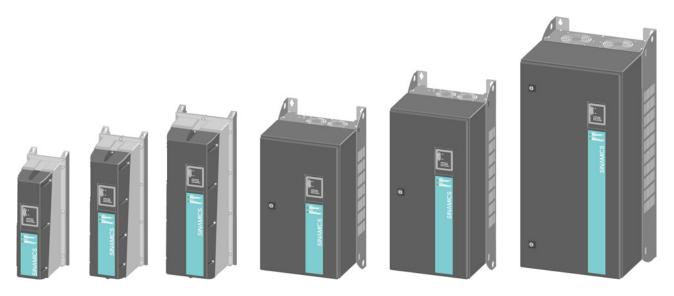
Adapter for rail mounting for PM240, PM250 and PM260, frame sizes FSA and FSB

You can use the adapter for rail mounting to mount the Power Module onto two mounting rails with a center-to-center distance of 100 mm.

Order numbers for shield connection kit and DIN rail mounting adapter

Frame size	Shield connection kit for Power Modules		Adapter for mounting on DIN rails
	PM240, PM250	PM260	
FSA	6SL3262-1AA00-0BA0	-	6SL3262-1BA00-0BA0
FSB	6SL3262-1AB00-0DA0	-	6SL3262-1BB00-0BA0
FSC	6SL3262-1AC00-0DA0	-	-
FSD	6SL3262-1AD00-0DA0	6SL3262-1FD00-0CA0	-
FSE	6SL3262-1AD00-0DA0	-	-
FSF	6SL3262-1AF00-0DA0	6SL3262-1FF00-0CA0	-

3.3.2 Power Module in IP55 degree of protection / UL Type 12

PM230, 3 AC 400 V, degree of protection IP55 / UL Type 12

Frame size		FSA	FSB	FSC	FSD	FSE	FSF
Power range (kW)	Filter Class A	0,37 … 3	4 … 7,5	11 … 18,5	22 … 30	37 … 45	55 … 90
	Filter Class B	0,37 … 3	4 … 7,5	11 … 15	18,5 … 30	37 … 45	55 … 90

The Power Module PM230 IP55/UL Type 12 is suitable for installation close to the motor.

Range of order numbers: 6SL3223-0DE…

3.4 System components for the Power Modules

3.4.1 Line filter

With a line filter, the inverter can achieve a higher radio interference class. For inverters with integrated line filter, an external filter is not required.

Examples:

Footprint line filter for Power Module PM240 FSA

Line filter for Power Module PM240 FSGX

External line filters for PM240

Table 3- 2   Class A according to EN 55011: 2009

PM240, order number 6SL3224-…		Power	Line filter, class A
FSA	…0BE13-7UA0, …0BE15-5UA0, …0BE17-5UA0, …0BE21-1UA0, …0BE21-5UA0	0.37 kW … 1.5 kW	6SE6400-2FA00-6AD0
FSF	…0BE38-8UA0, …0BE41-1UA0	110 kW … 132 kW	6SL3203-0BE32-5AA0
FSGX	…0XE41-3UA0, …0XE41-6UA0	160 kW … 200 kW	6SL3000-0BE34-4AA0
	…0XE42-0UA0	250 kW	6SL3000-0BE36-0AA0

Table 3- 3   Class B according to EN 55011: 2009

PM240, order number 6SL3224-…		Power	Line filter, class B
FSA	…0BE13-7UA0, …0BE15-5UA0, …0BE17-5UA0, …0BE21-1UA0, …0BE21-5UA0	0.37 kW … 1.5 kW	6SE6400-2FB00-6AD0
FSB	…0BE22-2AA0, …0BE23-0AA0, …0BE24-0AA0	2.2 kW … 4.0 kW	6SL3203-0BE21-6SA0
FSC	…0BE25-5UA0, …0BE27-5UA0, …0BE31-1UA0	7.5 kW … 15.0 kW	6SL3203-0BD23-8SA0

External line filters for PM250

Table 3- 4   Class B according to EN 55011: 2009

PM250, order number 6SL3225-…		Power	Line filter, class B
FSC	…0BE25-5AA0, …0BE27-5AA0, …0BE31-1AA0	7.5 kW … 15.0 kW	6SL3203-0BD23-8SA0

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

27

3.4.2 Line reactor

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

NOTICE
Damage to inverter as a result of a missing line reactor
The following cases are possible, depending on the inverter type and the line conditions:
• You must install a line reactor, if the Power Module is subsequently listed, and the relative short-circuit voltage of the line is below 1%
• You can install a line reactor, if the Power Module is subsequently listed, and you do not know the relative short-circuit voltage of the line
• It is not permissible that you install a line reactor, if the Power Module is not subsequently listed.

Line reactors for PM240

PM240, order number 6SL3224-…		Power	Line reactor
FSA	…0BE13-7UA0, …0BE15-5UA0	0.37 kW … 0.55 kW	6SE6400-3CC00-2AD3
	…0BE17-5UA0, …0BE21-1UA0	0.75 kW … 1.1 kW	6SE6400-3CC00-4AD3
	…0BE21-5UA0	1.5 kW	6SE6400-3CC00-6AD3
FSB	…0BE22-2□A0, …0BE23-0□A0	2.2 kW … 3.0 kW	6SL3203-0CD21-0AA0
	…0BE24-0□A0	4.0 kW	6SL3203-0CD21-4AA0
FSC	…0BE25-5□A0, …0BE27-5□A0	7.5 kW … 11.0 kW	6SL3203-0CD22-2AA0
	…0BE31-1□A0	15.0 kW	6SL3203-0CD23-5AA0
FSD	…0BE31-5□A0, …0BE31-8□A0	18.5 kW … 22 kW	6SL3203-0CJ24-5AA0
	…0BE32-2□A0	30 kW	6SL3203-0CD25-3AA0
FSE	…0BE33-0□A0, …0BE33-7□A0	37 kW … 45 kW	6SL3203-0CJ28-6AA0
FSF	…0BE34-5□A0, …0BE35-5□A0	55 kW … 75 kW	6SE6400-3CC11-2FD0
	…0BE37-5□A0	90 kW	6SE6400-3CC11-7FD0
	…0BE38-8UA0	110 kW	6SL3000-0CE32-3AA0
	…0BE41-1UA0	132 kW	6SL3000-0CE32-8AA0
FSGX	…0XE41-3UA0	160 kW	6SL3000-0CE33-3AA0
	…0XE41-6UA0, …0XE42-0UA0	200 kW … 250 kW	6SL3000-0CE35-1AA0

Line reactors for PM240-2

Order number6SL321□-…		Power	Line reactor
FSA	…1PE11-8□L0, …1PE12-3□L0, …1PE13-2□L0, …1PE14-3□L0	0.55 kW … 1.5 kW	6SL3203-0CE13-2AA0
	…1PE16-1□L0, …1PE18-0□L0	2.2 kW … 3.0 kW	6SL3203-0CE21-0AA0

3.4.3 Output reactor

Output reactors for the PM240 Power Module and the PM250 Power Module

Output reactors reduce the voltage stress on the motor windings. Further, they reduce the inverter load as a result of capacitive recharging currents in the cables.
For motor cables longer than 50 m, shielded or 100 m unshielded, an output reactor is required.

Examples:

Footprint output reactors for Power Modules PM240 FSA and FSB

Output reactor for Power Module PM240 FSGX

The output reactors are designed for pulse frequencies of 4 kHz.

Table 3- 5   Output reactors for PM240 Power Module

PM240, order number 6SL3224-…		Power	Output reactor
FSA	…0BE13-7UA0, …0BE15-5UA0, …0BE17-5UA0, …0BE21-1UA0, …0BE21-5UA0	0.37 kW … 1.5 kW	6SE6400-3TC00-4AD2
FSB	…0BE22-2☐A0, …0BE23-0☐A0, …0BE24-0☐A0	2.2 kW … 4.0 kW	6SL3202-0AE21-0CA0
FSC	…0BE25-5☐A0, …0BE27-5☐A0, …0BE31-1☐A0	7.5 kW … 15.0 kW	6SL3202-0AJ23-2CA0
FSD	…0BE31-5☐A0	18.5 kW	6SE6400-3TC05-4DD0
	…0BE31-8☐A0	22 kW	6SE6400-3TC03-8DD0
	…0BE32-2☐A0	30 kW	6SE6400-3TC05-4DD0
FSE	…0BE33-0☐A0	37 kW	6SE6400-3TC08-0ED0
	…0BE33-7☐A0	45 kW	6SE6400-3TC07-5ED0
FSF	…0BE34-5☐A0	55 kW	6SE6400-3TC14-5FD0
	…0BE35-5☐A0	75 kW	6SE6400-3TC15-4FD0
	…0BE37-5☐A0	90 kW	6SE6400-3TC14-5FD0
	…0BE38-8UA0	110 kW	6SL3000-2BE32-1AA0
	…0BE41-1UA0	132 kW	6SL3000-2BE32-6AA0
FSGX	…0XE41-3UA0	160 kW	6SL3000-2BE33-2AA0
	…0XE41-6UA0	200 kW	6SL3000-2BE33-8AA0
	…0XE42-0UA0	250 kW	6SL3000-2BE35-0AA0

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

29

Table 3- 6   Output reactors for PM250 Power Module

PM250, order number 6SL3225-…		Power	Output reactor
FSC	…0BE25-5☐A0, …0BE27-5☐A0, …0BE31-1☐A0	7.5 kW … 15.0 kW	6SL3202-0AJ23-2CA0
FSD	…0BE31-5☐A0	18.5 kW	6SE6400-3TC05-4DD0
	…0BE31-8☐A0	22 kW	6SE6400-3TC03-8DD0
	…0BE32-2☐A0	30 kW	6SE6400-3TC05-4DD0
FSE	…0BE33-0☐A0	37 kW	6SE6400-3TC08-0ED0
	…0BE33-7☐A0	45 kW	6SE6400-3TC07-5ED0
FSF	…0BE34-5☐A0	55 kW	6SE6400-3TC14-5FD0
	…0BE35-5☐A0	75 kW	6SE6400-3TC15-4FD0
	…0BE37-5☐A0	90 kW	6SE6400-3TC14-5FD0

3.4.4 Sine-wave filter

The sine-wave filter at the inverter outputs almost sinusoidal voltages to the motor, so that you can use standard motors without special cables. The maximum permissible length of motor feeder cables is increased to 300 m.

Example: Sine-wave filter for inverter with frame size FSF

The following applies when using a sine-wave filter:

- Operation is only permissible with pulse frequencies from 4 kHz to 8 kHz.
  From 110 kW power rating of the Power Modules (according to the rating plate) only 4 kHz is permissible.

- The inverter power is reduced by 5%.

- The maximum output frequency of the inverter is 150 Hz at 380 V to 480 V.

- Operation and commissioning may only be performed with the motor connected, as the sine-wave filter is not no-load proof.

- An output reactor is superfluous.

Table 3- 7   Sine-wave filter for PM240 Power Module

PM240, order number 6SL3224-…		Power	Sine-wave filter
FSA	…0BE13-7UA0, …0BE15-5UA0, …0BE17-5UA0	0.37 kW … 0.75 kW	6SL3202-0AE20-3SA0
	…0BE21-1UA0, …0BE21-5UA0	1.1 kW … 1.5 kW	6SL3202-0AE20-6SA0
FSB	…0BE22-2□A0, …0BE23-0□A0	2.2 kW … 3.0 kW	6SL3202-0AE21-1SA0
	…0BE24-0□A0	4.0 kW	6SL3202-0AE21-4SA0
FSC	…0BE25-5□A0	7.5 kW	6SL3202-0AE22-0SA0
	…0BE27-5□A0, …0BE31-1□A0	11.0 kW … 15.0 kW	6SL3202-0AE23-3SA0
FSD	…0BE31-5□A0, …0BE31-8□A0	18.5 kW … 22 kW	6SL3202-0AE24-6SA0
	…0BE32-2□A0	30 kW	6SL3202-0AE26-2SA0
FSE	…0BE33-0□A0, …0BE33-7□A0	37 kW … 45 kW	6SL3202-0AE28-8SA0
FSF	…0BE34-5□A0, …0BE35-5□A0	55 kW … 75 kW	6SL3202-0AE31-5SA0
	…0BE37-5□A0	90 kW	6SL3202-0AE31-8SA0
	…0BE38-8UA0, …0BE41-1UA0	110 kW … 132 kW	6SL3000-2CE32-3AA0
FSGX	…0XE41-3UA0	160 kW	6SL3000-2CE32-8AA0
	…0XE41-6UA0	200 kW	6SL3000-2CE33-3AA0
	…0XE42-0UA0	250 kW	6SL3000-2CE34-1AA0

Table 3- 8   Sine-wave filter for PM250 Power Module

PM250, order number 6SL3225-…		Power	Sine-wave filter
FSC	…0BE25-5□A0	7.5 kW	6SL3202-0AE22-0SA0
	…0BE27-5□ A0, …0BE31-1□A0	11.0 kW … 15.0 kW	6SL3202-0AE23-3SA0
FSD	…0BE31-5□A0, …0BE31-8□A0	18.5 kW … 22 kW	6SL3202-0AE24-6SA0
	…0BE32-2□A0	30 kW	6SL3202-0AE26-2SA0
FSE	…0BE33-0□A0, …0BE33-7□A0	37 kW … 45 kW	6SL3202-0AE28-8SA0
FSF	…0BE34-5□A0, …0BE35-5□A0	55 kW … 75 kW	6SL3202-0AE31-5SA0
	…0BE37-5□A0	90 kW	6SL3202-0AE31-8SA0

3.4.5 Braking resistor

The braking resistor allows loads with a high moment of inertia to be quickly braked.

The Power Module controls the braking resistor via its integrated braking module.

Braking resistors for PM240

For frame size FSGX there is an optional pluggable braking module (order number 6SL3300-1AE32-5AA0).

Order number 6SL3224-…		Power	Braking resistor
FSA	…0BE13-7UA0, …0BE15-5UA0	0.37 kW … 0.55 kW	6SE6400-4BD11-0AA0
	…0BE17-5UA0, …0BE21-1UA0	0.75 kW … 1.1 kW	
	…0BE21-5UA0	1.5 kW	
FSB	…0BE22-2□A0, …0BE23-0□A0	2.2 kW … 3.0 kW	6SL3201-0BE12-0AA0
	…0BE24-0□A0	4.0 kW	
FSC	…0BE25-5□A0, …0BE27-5□A0	7.5 kW … 11.0 kW	6SE6400-4BD16-5CA0
	…0BE31-1□A0	15.0 kW	
FSD	…0BE31-5□A0, …0BE31-8□A0	18.5 kW … 22 kW	6SE6400-4BD21-2DA0
	…0BE32-2□A0	30 kW	
FSE	…0BE33-0□A0, …0BE33-7□A0	37 kW … 45 kW	6SE6400-4BD22-2EA1
FSF	…0BE34-5□A0, …0BE35-5□A0	55 kW … 75 kW	6SE6400-4BD24-0FA0
	…0BE37-5□A0	90 kW	
	…0BE38-8UA0	110 kW	6SE6400-4BD26-0FA0
	…0BE41-1UA0	132 kW	
FSGX	…0XE41-3UA0	160 kW	6SL3000-1BE31-3AA0
	…0XE41-6UA0, …0XE42-0UA0	200 kW … 250 kW	6SL3000-1BE32-5AA0

Braking resistors for PM240-2

Order number 6SL321□-…		Power	Braking resistor
FSA	…1PE11-8□L0, …1PE12-3□L0, …1PE13-2□L0, …1PE14-3□L0	0.55 kW … 1.5 kW	6SL3201-0BE14-3AA0
	…1PE16-1□L0, …1PE18-0□L0	2.2 kW … 3.0 kW	6SL3201-0BE21-0AA0

3.5 Tools to commission the converter

Accessories for commissioning and data backup

Operator Panels for commissioning, diagnostics and controlling inverters		Order number
	BOP-2 (Basic Operator Panel) - for snapping onto the frequency inverter • Copying of drive parameters • Two-line display • Guided basic commissioning	6SL3255-0AA00-4CA1
	IOP (Intelligent Operator Panel) - for snapping onto the frequency inverter • Copying of drive parameters • Plain text display • Menu-based operation and application wizards	6SL3255-0AA00-4JA0
	Door mounting kit for IOP/BOP-2 • For installation of theBOP-2 or IOP in a control cabinet door. • Degree of protection with IOP: IP54 or UL Type 12 • Degree of protection with BOP-2: IP55	6SL3256-0AP00-0JA0

	For mobile use of the IOP: IOP handheld with IOP housing, power supply unit and rechargeable batteries as well as RS232 connecting cable If you are using your own connecting cable, carefully note the maximum permissible length of 5 m.	6SL3255-0AA00-4HA0

PC tools for commissioning, diagnostics and controlling the converter	
PC Connection Kit Includes a STARTER DVD and USB port.	6SL3255-0AA00-2CA0

	STARTER Commissioning tool (PC software) connection to the converter via USB port, PROFIBUS or PROFINET Downloading: STARTER (http://support.automation.siemens.com/WW/view/en/10804985/133200)	STARTER on the DVD: 6SL3072-0AA00-0AG0
	Drive ES Basic As an option to STEP 7 with routing function via network limits for PROFIBUS and PROFINET	6SW1700-5JA00-5AA0
Memory cards: to save and transfer the converter settings		
	MMC card	6SL3254-0AM00-0AA0
	SD card	6ES7954-8LB00-0AA0

34

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

Installing

4

4.1 Overview of the inverter installation

Installing the inverter

Precondition

Before installation, please check:

- Are the required inverter components available?
  - Power Module
  - Control Unit
  - Accessories, e.g. line reactor or braking resistor
- Do you have the necessary tools and small parts/components required to install the inverter?

Procedure

To install the inverter, proceed as follows:

1. Install the accessories (reactors, filter or braking resistor) for the Power Module:
   - Observe the installation instructions that are supplied with the accessories.
   - If you are using more than one base-mounted component, then you must observe a specific sequence when installing.

   See also Installing reactors, filters and braking resistors (Page 36).
2. Install the Power Module.
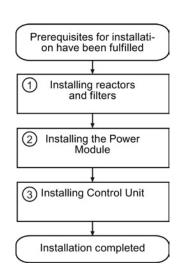
   See also Installing Power Module (Page 38).

   You can find information about your Power Module in the corresponding Hardware Installation Manual (http://support.automation.siemens.com/WW/view/en/30563173/133300).
3. Install the Control Unit.

   See also Installing Control Unit (Page 49).

You have installed all of the inverter components, and you can now commission the inverter.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

35

4.2 Installing reactors, filters and braking resistors

Installing reactors, filters and braking resistors

The installation of reactors, filters and braking resistors is described in the documentation provided. See also Section: Additional information on the inverter (Page 435).

Installing base components

Reactors, filters and braking resistors are available as base components for the PM240 and PM250 Power Modules, frame sizes FSA, FSB and FSC. You can also install base components next to Power Modules.

Inverter			Base component 1			Base component 2			
FSA	FSB	FSC	Line filter	Line reactor	Sine-wave filter	Line reactor	Output reactor	Sine-wave filter	Braking resistor
X			X			X			
X			X				X		
X			X					X	
X			X						X
X				X			X		
X				X				X	
X				X					X
	X		X			X			
	X		X				X		
	X		X						X
	X				X				
	X			X			X		
	X			X					X
		X	X			X			
		X	X				X		
		X		X			X		
		X			X				
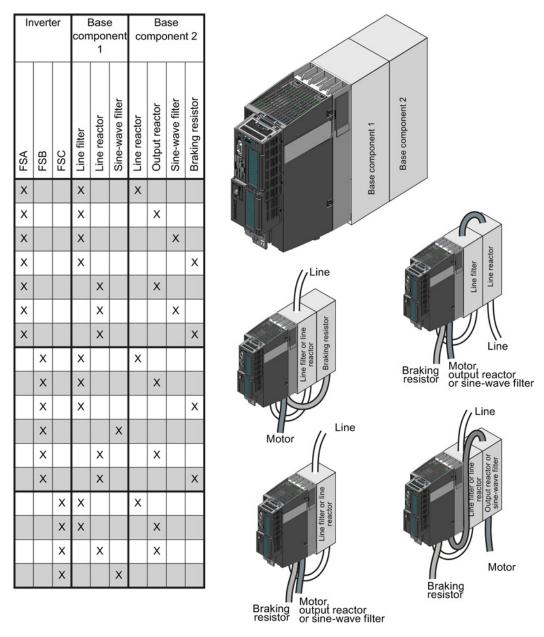
Figure 4-1　Permissible combination of base components

Electrical connections of the line reactor and line filter

- Line connection via terminals
- Inverter connection via a prefabricated cable

Electrical connections of the output reactor and sine-wave filter

- Inverter connection via a prefabricated cable
- Motor connection via terminals

4.3 Installing Power Module
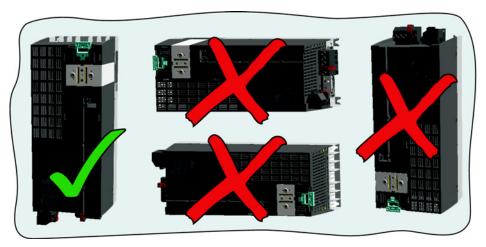
⚠ WARNING
Danger of fire spreading due to inadequate housing
Fire and smoke development can cause severe personal injury or material damage.
• Install devices without a protective housing in a metal control cabinet (or protect the device by another equivalent measure) in such a way that contact with fire inside and outside the device is prevented.

Installing Power Modules with degree of protection IP20

- Mount the Power Module vertically on a mounting plate in a control cabinet.
  For frame sizes FSA and FSB, an adapter is available for mounting on DIN rails.

- When installing, observe the minimum clearances to other components in the control cabinet.
  These minimum clearances are necessary to ensure adequate cooling of the inverter.

- Do not cover the ventilation openings of the inverter.

Installing additional components

Depending on the application, the following additional components, for example, may be required (also refer to Section Description (Page 21)):

- Line reactors

- Filter

- Braking resistors

- Brake Relay

Information about mounting these components is also provided in the relevant instructions that are provided with each component.

4.3.1 Dimensions, hole drilling templates, minimum clearances, tightening torques and IP55

Dimensions and drilling patterns for the PM230 Power Modules, IP55
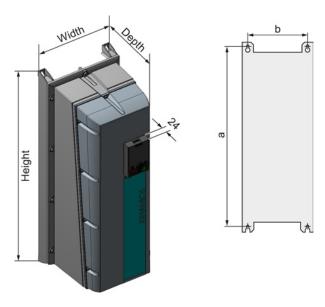
Table 4- 1   Dimensions and distances for the PM230 Power Modules, IP55
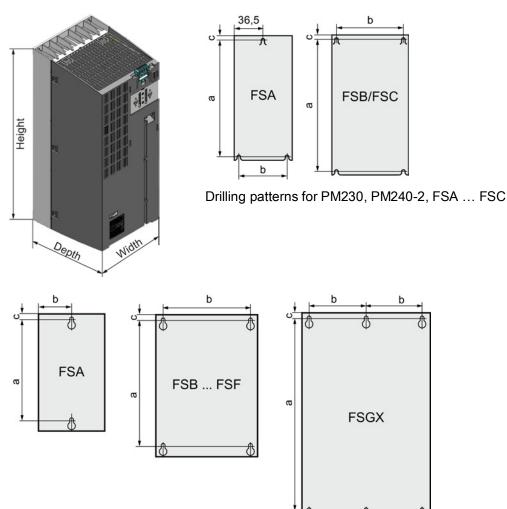
Frame size	Dimensions (mm)					Clearances (mm)		
	Height	Width	Depth	a	b	top	bottom	lateral
FSA	460	154	238	445	132	100	100	0
FSB	540	180	238	524	158	100	100	0
FSC	620	230	238	604	208	125	125	0
FSD	640	320	238	600	285	300	300	0
FSE	751	320	238	710	285	300	300	0
FSF	915	410	238	870	370	300	300	0
Fixing:	FSA/FSB: screws M4, 2.5 Nm, FSC: screws M5, 2.5 Nm,				FSD/FSE/FSF: screws M8, 13 Nm			

4.3.2 Dimensions, hole drilling templates, minimum clearances, tightening torques IP20 and push-through design

Note

The total depth of the converter increases – with the exception of frame sizes FSGX (160 kW ... 250 kW) – by 58 mm as a result of the Control Unit – and an additional 12 mm or 27 mm respectively, if you use a BOP or IOP.

Dimensions and drilling patterns for Power Modules PM230, PM240, PM250, PM260 - protection type IP20

Drilling patterns for PM230, PM240-2, FSA … FSC

Drilling patterns for PM230 FSD … FSF and for PM240, PM250 and PM260

40

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

Table 4- 2   Dimensions and clearances for PM230 and PM240-2 - degree of protection IP20, frame sizes FSA … FSC

Frame size	Dimensions (mm)						Clearances (mm)		
	Height[1]	Width	Depth	a	b	c	Top	Bottom	Lateral
FSA	196	73	165	186	62,3	6	80	100	0[2]
FSB	292	100	165	281	80	6	80	100	0[2]
FSC	355	140	165	343	120	6	80	100	0[2]
Fixing:	FSA/FSB: M4 screws, 2.5 Nm				FSC: M5 screws, 2.5 Nm				

[1]   With shield connection kit: FSA: + 80 mm; FSB: + 78 mm; FSC: + 77 mm

[2]   For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

Table 4- 3   Dimensions and clearances for PM240 and PM250 - degree of protection IP20, frame sizes FSA … FSC

Frame size	Dimensions (mm)						Clearances (mm)		
	Height[1]	Width	Depth	a	b	c	Top	Bottom	Lateral
FSA	173	73	145	160	36,5	--	100	100	30[2]
FSB	270	153	165	258	133	--	100	100	40[2]
FSC	355	140	165	343	120	6	80	100	50[2]
Fixing:	FSA/FSB: M4 screws, 2.5 Nm				FSC: M5 screws, 2.5 Nm				

[1]   With shield connection kit: FSA: +84 mm; FSB: +85 mm; FSC: +89 mm

[2]   At ambient temperatures in operation up to 40 °C without any lateral clearance. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

Table 4- 4   Dimensions and clearances for PM230, PM240, PM250 and PM260 - IP20 degree of protection, frame sizes FSD … FSGX

Frame size	Dimensions (mm)						Clearances (mm)		
	Height[1]	Width	Depth	a	b	c	Top	Bottom	Lateral
FSD without filter	419	275	204	325	235	11	300	300	0[2]
FSD with filter	512	275	204	419	235	11	300	300	0[2]
FSE without filter	499	275	204	405	235	11	300	300	0[2]
FSE with filter	635	275	204	541	235	11	300	300	0[2]
FSF without filter	634	350	316	598	300	11	350	350	0[2]
FSF with filter	934	350	316	899	300	11	350	350	0[2]
FSGX	1533	326	547	1506	125	14,5	250	150	50
Fixing:	FSD/FSE: M6 screws, 6 Nm				FSF/FSGX: M8 screws, 13 Nm				

[1]   With shield connection kit: FSD, FSE, FSF: +123 mm

[2]   For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

4.3.3 Dimension drawings PT

Dimensions and drilling patterns for PM230 and PM240 Power Modules with push through technology
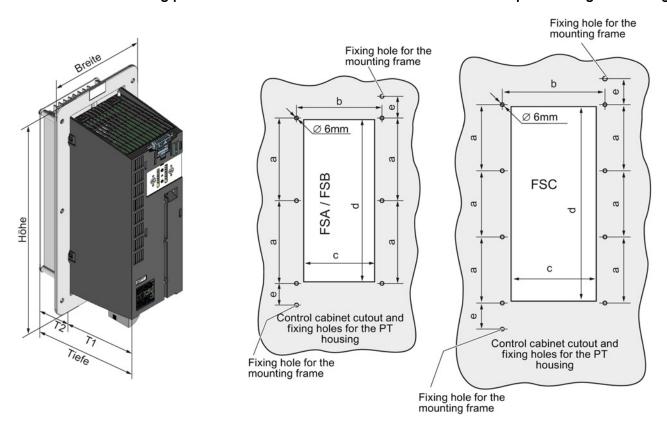
Table 4- 5   Dimensions and clearances for PM230 and PM240-2 in push through technology, frame sizes FSA … FSC

Frame size	Dimensions (mm)										Clearances (mm)		
	Height[1]	Width	Depth	T1	T2	a	b	c	d	e	Top	Bottom	Lateral
FSA	238	125,9	171	117,7	53,1	103	106	88	198	27	80	100	0[2]
FSB	345	153,9	171	117,7	53,1	147,5	134	116	304	34,5	80	100	0[2]
FSC	410,5	200	171	117,7	53,1	123	174	156	365	30,5	80	100	0[2]
Fixing:	FSA/FSB/FSC: M5 screws, 3 Nm												

[1]   With shield connection kit: FSA: +84 mm; FSB: +85 mm; FSC: +89 mm

[2]   The Power Modules can be mounted side by side. For tolerance reasons, we recommend a lateral clearance of approx. 1 mm.

4.3.4   Connecting the line supply, motor and converter components
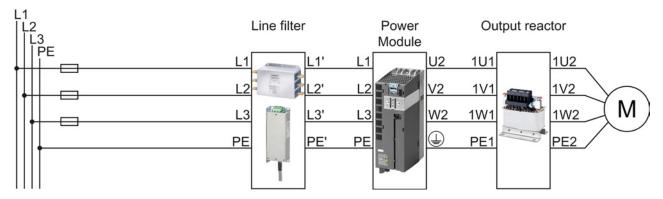
Figure 4-2   Connecting the PM230 IP20 and push-through Power Module

The line filter of Power Module PM230 fulfills Class A. For higher EMC requirements, you need an external Class B line filter.
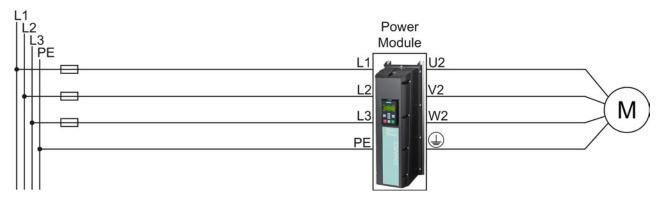
Figure 4-3   Connecting the PM230 IP55 Power Module

Either a Class A or a Class B filter is integrated in the Power Module PM230 IP55.
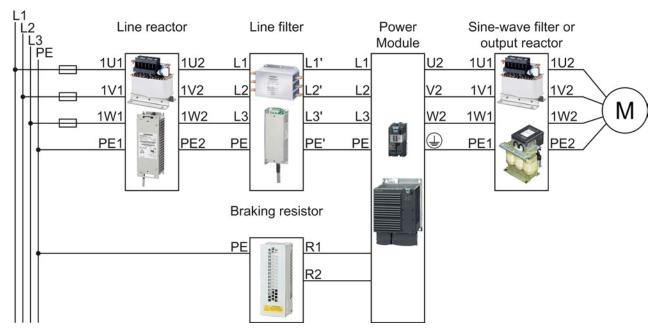
Figure 4-4   Connecting the PM240, PM240-2 IP20 and push-through Power Module

PM240 and PM240-2 Power Modules are available with and without integrated Class A line filters. For higher EMC requirements you need an external Class B line filter.
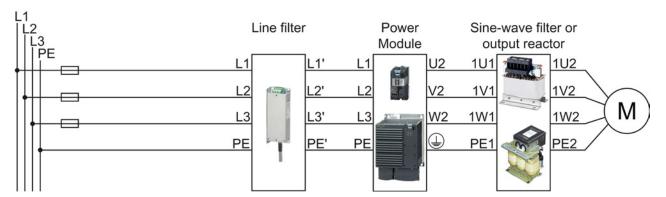
Figure 4-5   Connecting the PM250 Power Module

PM250 Power Modules are available with and without integrated Class A line filters. For higher EMC requirements you need an external Class B line filter.
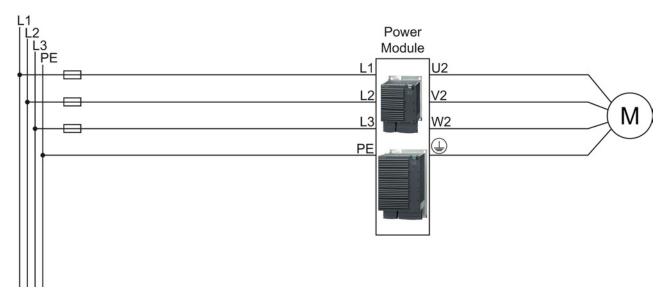
Figure 4-6   Connecting the PM260 Power Module

PM260 Power Modules are available with and without integrated Class A line filters. For higher EMC requirements you need an external Class B line filter.
The converter is designed for the following power distribution systems as defined in EN 60950.

Table 4- 6   Power distribution systems for the converter

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

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

45

⚠ WARNING
Danger of death caused by high leakage currents when the external protective conductor is interrupted
The inverter conducts high leakage currents > 3.5 mA via the protective conductor. When the protective conductor is interrupted, touching live components can result in electric shock, which can lead to death or serious injuries.

• Connect a protective conductor, which satisfies at least one of the following conditions, to the inverter:
  – The protective conductor is routed so that it is protected against mechanical damage.
    Cables routed in control cabinets or enclosed machine enclosures are considered to be adequately protected.
  – The protective conductor routed as an individual conductor has a cross-section of ≥ 10 mm² Cu.
  – In a multi-core cable the protective conductor has a cross-section of ≥ 2.5 mm² Cu.
  – Two parallel protective conductors with the same cross-section are installed.
  – The protective conductor corresponds to the local regulations for equipment with increased leakage current.

⚠ DANGER
((Electric shock through contact with the motor connections))
As soon as the converter is connected to the line supply, the motor connections of the converter may carry dangerous voltages. When the motor is connected to the converter, there is danger to life through contact with the motor terminals if the terminal box is open.
• Close the terminal box of the motor before connecting the converter to the line supply.

NOTICE
Damage to the converter through inappropriate supply system
Operating the converter with integrated or external line filter on an ungrounded supply system will destroy the line filter.
• Therefore, always connect the converter with an integrated or external line filter only to supply systems with grounded star point (TN system).

⚠ WARNING

Fire hazard for the motor due to overload of the insulation

There is a greater load on the motor insulation due to a ground fault in an IT system. A possible result is the failure of the insulation with a risk for personnel through smoke development and fire.

• Use a monitoring device that signals an insulation fault.

• Correct the fault as quickly as possible so the motor insulation is not overloaded.

NOTICE

Damage to the converter through fault in IT system

A ground fault on the motor cable during operation can result in a shutdown of the converter due to overcurrent. Under unfavorable conditions, the overcurrent may damage the converter.

• Use an output reactor in the IT system.

Connecting the line supply cable to the converter

Procedure

To connect the converter to the supply system, proceed as follows:

1. If available, open the terminal covers of the converter.

2. Connect the line supply to terminals U1/L1, V1/L2, and W1/L3.

3. Connect the protective conductor of the line supply to terminal PE of the converter.

4. If available, close the terminal covers of the converter.

You have connected the line supply cable to the converter.

Connecting the motor cable to the converter

Procedure

To connect the motor cable to the converter, proceed as follows:

1. If available, open the terminal covers of the converter.

2. Connect the motor to terminals U2, V2, and W2.
Carefully observe the regulations for EMC-compliant wiring:
EMC-compliant connection of the converter (Page 59)

3. Connect the protective conductor of the motor to the ⏚ terminal of the converter.

4. If available, close the terminal covers of the converter.

You have therefore connected the motor line to the converter.

Connect motor line to motor

Connect the motor in either the star or delta connection according to your particular application. Additional information on this is provided in the Section Star-delta motor connection and application examples (Page 402).

Permissible cable lengths

The permissible cables and cable lengths are specified in the Hardware Installation Manual of the Power Module or in Catalog D31.

Note

- Please observe the data on the rating plate (type plate) and the associated circuit diagrams.
- Use shielded control cables.
- Observe the EMC notes provided by the manufacturer of the converter

---

4.4   Installing Control Unit

Installing the Control Unit on an IP20 Power Module

Procedure
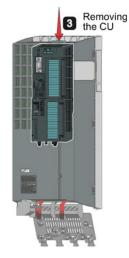
Proceed as follows to connect Power Modules and Control Units:

1. Locate the rear of the Control Unit in the matching recesses of the Power Module.

2. Press the Control Unit onto the Power Module until you hear the latching mechanism engage.
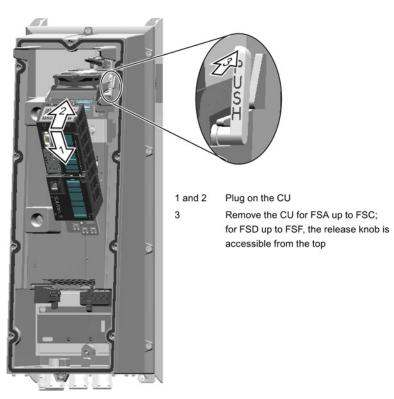
The Power Module and the Control Unit are now connected with one another.

If you want to remove the Control Unit, press the release button ③ and withdraw the Control Unit from the Power Module.
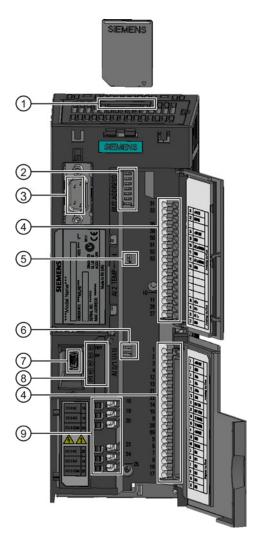
Installing the Control Unit on an IP55 Power Module

1 and 2	Plug on the CU
3	Remove the CU for FSA up to FSC; for FSD up to FSF, the release knob is accessible from the top

4.4.1   Interfaces, connectors, switches, control terminals, LEDs on the CU

Interfaces at the front of the Control Unit

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

① Memory card slot

② Selecting the fieldbus address:

- PROFIBUS
- USS
- Modbus RTU
- CanOpen

| Bit 6 (64) ■ |
| Bit 5 (32) ■ |
| Bit 4 (16) ■ |
| Bit 3 (8) ■ |
| Bit 2 (4) ■ |
| Bit 1 (2) ■ |
| Bit 0 (1) ■ |
| On   Off |

③ Connection to the Operator Panel

④ Terminal strips

⑤ Switch for AI2 (current/temperature)

⑥ Switch for AI0 and AI1 (U/I)

- I   0/4 mA … 20 mA
- U -10/0 V … 10 V

⑦ USB interface for connection to a PC

⑧ Status LED

RDY
BF

LNK1 (PROFINET)
LNK2 (PROFINET)

⑨ Terminal strips for the digital outputs
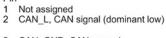
Interfaces on the lower side of the Control Unit

X150 P1 / X150 P2	X126 (connector)	X126 (socket)	X128
Pin	**Pin**	**Pin**	**Pin**
1 Shield, ground connection	1 Not assigned	1 RX+, receive data +	1 0 V, reference potential
2 Not assigned	2 CAN_L, CAN signal (dominant low)	2 RX-, receive data -	2 RS485P, receive and transmit (+)
3 RxD/TxD-P, receive and transmit (B/B')	3 CAN_GND, CAN ground	3 TX+. Transmit data +	3 RS485N, receive and transmit (-)
4 CNTR-P, control signal	4 Not assigned	4 Not assigned	4 Cable shield
5 DGND, reference potential for data (C/C')	5 (CAN _SHLD), optional shield	5 Not assigned	5 Not connected
6 VP, supply voltage	6 (GND), optional ground	6 TX-, transmit data -	
7 Not assigned	7 CAN_H, CAN signal (dominant high)	7 Not assigned	
8 RxD/TxD-N, receive and transmit (A/A')	8 Not assigned	8 Not assigned	
9 Not assigned	9 Not assigned		

PROFINET:	X150 P1, X150 P2
RS485:	X128
CANopen:	x126, connector
PROFIBUS:	x126, socket
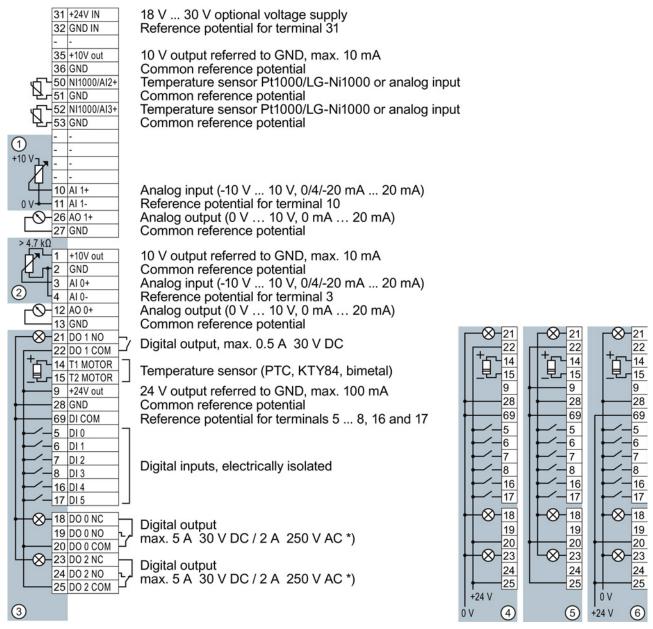
① Switch for bus terminating resistor

OFF   ON

4.4.2 Terminal strips of the CU

31	+24V IN	18 V ... 30 V optional voltage supply
32	GND IN	Reference potential for terminal 31
-	-	
35	+10V out	10 V output referred to GND, max. 10 mA
36	GND	Common reference potential
50	NI1000/AI2+	Temperature sensor Pt1000/LG-Ni1000 or analog input
51	GND	Common reference potential
52	NI1000/AI3+	Temperature sensor Pt1000/LG-Ni1000 or analog input
53	GND	Common reference potential
-	-	
-	-	
-	-	
-	-	
10	AI 1+	Analog input (-10 V ... 10 V, 0/4/-20 mA ... 20 mA)
11	AI 1-	Reference potential for terminal 10
26	AO 1+	Analog output (0 V … 10 V, 0 mA … 20 mA)
27	GND	Common reference potential
1	+10V out	10 V output referred to GND, max. 10 mA
2	GND	Common reference potential
3	AI 0+	Analog input (-10 V ... 10 V, 0/4/-20 mA ... 20 mA)
4	AI 0-	Reference potential for terminal 3
12	AO 0+	Analog output (0 V … 10 V, 0 mA … 20 mA)
13	GND	Common reference potential
21	DO 1 NO	Digital output, max. 0.5 A 30 V DC
22	DO 1 COM	
14	T1 MOTOR	Temperature sensor (PTC, KTY84, bimetal)
15	T2 MOTOR	
9	+24V out	24 V output referred to GND, max. 100 mA
28	GND	Common reference potential
69	DI COM	Reference potential for terminals 5 ... 8, 16 and 17
5	DI 0	
6	DI 1	
7	DI 2	
8	DI 3	Digital inputs, electrically isolated
16	DI 4	
17	DI 5	
18	DO 0 NC	Digital output
19	DO 0 NO	max. 5 A 30 V DC / 2 A 250 V AC *)
20	DO 0 COM	
23	DO 2 NC	Digital output
24	DO 2 NO	max. 5 A 30 V DC / 2 A 250 V AC *)
25	DO 2 COM	

① +10 V / 0 V > 4.7 kΩ

②

③

④ +24 V / 0 V

⑤

⑥ 0 V / +24 V

*) The following applies to systems complying with UL: A maximum of 3 A 30 V DC or 2 A 250 V AC may be connected via terminals 18 / 20 (DO 0 NC) and 23 / 25 (DO 2 NC).

① The analog input is supplied from an external 10 V voltage.

② The analog input is supplied from the internal 10 V voltage.

③ Wiring when using the internal power supplies. Connecting a current sourcing contact.

④ Wiring when using external power supplies. Connecting a current sourcing contact.

⑤ Wiring when using the internal power supplies. Connecting a current sinking contact.

⑥ Wiring when using external power supplies. Connecting a current sinking contact.

Note

When a current sinking contact is connected, a ground fault at the digital input can lead to unintentional setting of the input.

4.4.3   Finding a suitable setting for the interfaces

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

When you put the frequency inverter into operation, you can change the function of each of its inputs and outputs and the setting of the fieldbus interface.

To make the setting process easier, the inverter has various predefined assignments (macros).

Only the inputs and outputs whose functions change by selecting a specific assignment, are shown on the following pages.

Procedure

To select one of the inverter's pre-assigned settings, proceed as follows:

1. Think about which of the input and output functions you are using in the application.

2. Find the I/O configuration (macro) that best suits your application.

3. Note the macro number of the corresponding default setting.

    You must set this macro number when putting the frequency inverter into operation.

You have found the appropriate inverter pre-assignment.

Macro 7: Switch over between fieldbus and jogging via DI 3 Factory setting for inverters with PROFIBUS or PROFINET interface		Macro 9: Motorized potentiometer (MOP)
PROFIdrive telegram 1 5 DI 0 --- 6 DI 1 --- 7 DI 2 Acknowledge 8 DI 3 LOW 16 DI 4 --- 17 DI 5 --- 3 AI 0 --- 4 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 Jog 1 6 DI 1 Jog 2 7 DI 2 Acknowledge 8 DI 3 HIGH 16 DI 4 --- 17 DI 5 --- 3 AI 0 --- 4 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 ON/OFF1 6 DI 1 MOP raise 7 DI 2 MOP lower 8 DI 3 Acknowledge 16 DI 4 --- 17 DI 5 --- 3 AI 0 --- 4 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V

Macro 12: Two-wire control with method 1 Factory setting for inverters with CU230P-2 HVAC and CU230P-2 CAN Control Units	Macro 14: Switch over between fieldbus and motorized potentiometer (MOP) via DI 3	
5 DI 0 ON/OFF1 6 DI 1 Reversing 7 DI 2 Acknowledge 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I☐U -10 V ... 10 V 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	PROFIdrive telegram 1 5 DI 0 --- 6 DI 1 External fault 7 DI 2 Acknowledge 8 DI 3 LOW 16 DI 4 --- 17 DI 5 --- 3 AI 0 --- 4 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 ON/OFF1 6 DI 1 External fault 7 DI 2 Acknowledge 8 DI 3 HIGH 16 DI 4 MOP raise 17 DI 5 MOP lower 3 AI 0 --- 4 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V

Macro 15: Switch over between analog setpoint and motorized potentiometer (MOP) via DI 3		Macro 17: Two-wire control with method 2 Macro 18: Two-wire control with method 3
5 DI 0 ON/OFF1 6 DI 1 External fault 7 DI 2 Acknowledge 8 DI 3 LOW 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I☐U -10 V ... 10 V 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 ON/OFF1 6 DI 1 External fault 7 DI 2 Acknowledge 8 DI 3 HIGH 16 DI 4 MOP raise 17 DI 5 MOP lower 3 AI 0 --- 4 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 ON/OFF1 right 6 DI 1 ON/OFF1 left 7 DI 2 Acknowledge 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I☐U -10 V ... 10 V 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V

Macro 19: Three-wire control with method 1	Macro 20: Three-wire control with method 2	Macro 21: Fieldbus USS Macro 22: Fieldbus CANopen
5 DI 0 Enable/OFF1 6 DI 1 ON right 7 DI 2 ON left 8 DI 3 Acknowledge 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I◻■U -10 V ... 10 V 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 Enable/OFF1 6 DI 1 ON 7 DI 2 Reversing 8 DI 3 Acknowledge 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I◻■U -10 V ... 10 V 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	USS setting: 38400 baud, 2 PZD, PKW variable CANopen setting: 20 kBaud 5 DI 0 --- 6 DI 1 --- 7 DI 2 Acknowledge 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 --- 4 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V

Macro 101: Universal applications Control Units CU230P-2	Macro 103: Pump pressure control Control Units CU230P-2	Macro 104: ESM stairwell pressure control Control Units CU230P-2
5 DI 0 ON/OFF1 6 DI 1 External error 7 DI 2 Activate ESM 8 DI 3 Fixed speed 1 16 DI 4 Fixed speed 2 17 DI 5 Fixed speed 3 3 AI 0 Setpoint 4 I◻■U -10 V ... 10 V 52 AI 3 --- 53 18 DO 0 Fault 19 20 21 DO 1 Activate 22 converter 2 23 DO 2 Operation 24 25 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 ON/OFF1 6 DI 1 --- 7 DI 2 --- 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I◻■U -10 V ... 10 V 52 AI 3 --- 53 18 DO 0 Fault 19 20 21 DO 1 --- 22 23 DO 2 Operation 24 25 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 Activate ESM 6 DI 1 --- 7 DI 2 --- 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I◻■U -10 V ... 10 V 52 AI 3 --- 53 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 23 DO 2 Operation 24 25 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V

Macro 105: Fan pressure control + ESM with fixed setpoint	Macro 106: Cooling tower with active sensor + hibernation	Macro 107: Cooling tower with LG-Ni1000 sensor + hibernation
Control Units CU230P-2	**Control Units CU230P-2**	**Control Units CU230P-2**
5 DI 0 ON/OFF1 6 DI 1 Activate ESM 7 DI 2 --- 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I ▫ U -10 V ... 10 V 52 AI 3 --- 53 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 23 DO 2 Operation 24 25 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 ON/OFF1 6 DI 1 --- 7 DI 2 --- 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 Setpoint 4 I ▫ U -10 V ... 10 V 52 AI 3 --- 53 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 23 DO 2 Operation 24 25 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V	5 DI 0 ON/OFF1 6 DI 1 --- 7 DI 2 --- 8 DI 3 --- 16 DI 4 --- 17 DI 5 --- 3 AI 0 --- 4 52 AI 3 Setpoint 53 18 DO 0 Fault 19 20 21 DO 1 Alarm 22 23 DO 2 Operation 24 25 12 AO 0 Speed 13 0 V ... 10 V 26 AO 1 Current 27 0 V ... 10 V

4.4.4 Wiring terminal strips

⚠WARNING
Danger to life as a result of hazardous voltages when connecting an unsuitable power supply
Death or serious injury can result when live parts are touched in the event of a fault.
• For all connections and terminals of the electronic boards, only use power supplies that provide PELV (Protective Extra Low Voltage) or SELV (Safety Extra Low Voltage) output voltages.

⚠DANGER
Risk of electric shock from touching live parts
If the insulation is damaged on the lines that are connected to the terminals DO 0 and DO 2, parts of the Control Unit may still be connected to the power supply. When connecting 230 V on terminals DO 0 and DO 2 there is the risk of an electric shock.
• Close the power supplies of 230 V only via lines with double insulation on the relay outputs DO 0 and DO 2 on the control unit.

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

NOTICE
Damage to the inverter when using long signal cables
Using long cables at the inverter's digital inputs and 24 V power supply can lead to overvoltage during switching operations. Overvoltage can damage the inverter.
• If you use cables of more than 30 m at the digital inputs and 24 V power supply, connect an overvoltage protection element between the terminal and the associated reference potential. We recommend using the Weidmüller overvoltage protection terminal with designation MCZ OVP TAZ DIODE 24VDC.

Prerequisites

- Use suitable cables:

  – Solid or flexible cables.

  – Suitable cable cross-section: 0.5 mm² (21 AWG) to 1.5 mm² (16 AWG).

    When completely connecting up the unit, we recommend cables with a cross-section of 1 mm² (18 AWG).

- Do not use wire end ferrules.

- You have found an appropriate pre-assignment for the terminal strips, which you can now use to wire the inverter.

  See also Section: Finding a suitable setting for the interfaces (Page 53).

- You have the appropriate tools:

  – Small screwdriver to open the spring-loaded terminals

  – Tool for stripping the cables

Procedure

To wire the inverter's terminal strip, proceed as follows:

1. Remove the last 10 mm (approx.) of the cable insulation.

2. Using the screwdriver, press on the orange operator control of the spring-loaded terminal hard enough to open the terminal.

3. Insert the cable into the terminal as far as it will go and remove the screwdriver.

4. Ensure that the cable is securely connected by pulling on it lightly.

5. Wire all the required terminals on the strip in this way.

6. Route the signal cables in such a way that you can completely close the front doors after wiring the terminal strip.

7. If you use shielded cables, then you must connect the shield to the mounting plate of the control cabinet or with the shield support of the inverter through a good electrical connection and a large surface area.
   See also: EMC installation guideline
   (http://support.automation.siemens.com/WW/view/en/60612658)

8. Use a cable grip.

You have now wired the inverter's terminal strips.

4.5 Connecting inverters in compliance with EMC

4.5.1 EMC-compliant connection of the converter

EMC-compliant installation of the inverter and motor are required in order to ensure disturbance-free operation of the drive.

Install and operate inverters with IP20 degree of protection in a closed control cabinet.

Inverters with degree of protection IP55 are suitable for installation outside a control cabinet.

An overview of control cabinet installation and cabling can be found in the following section. For further details, refer to the installation instructions of the Power Module.

The EMC-compliant connection of the inverter itself is described in the following sections.

4.5.2 Avoid electromagnetic interference (EMI)

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

Control cabinet design

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

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

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

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

59

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

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

Connect the interference suppression elements directly at the coil.

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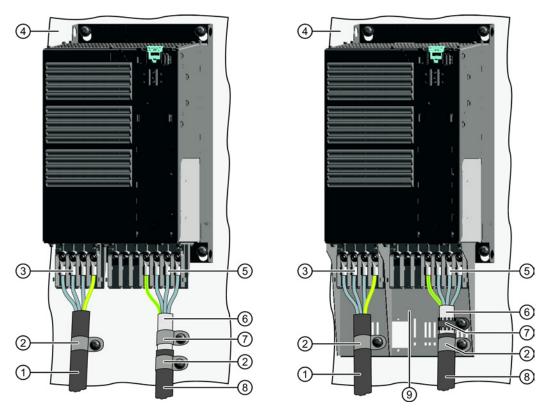
- Rout all inverter power cables (line supply cables, cables between the braking chopper and the associated braking resistance as well as the motor cables) separately from signal and data cables. Keep the minimum clearance to 25 cm. If the cables can not be separated use metal partitions with a good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

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

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

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

EMC-compliant wiring for Power Module with degree of protection IP20

The terminal cover is not shown in the diagram, so that it is easier to see how the cable is connected.

① Line connection cable (unshielded) for Power Modules with integrated line filter.

  If you use an external line filter, you will need a shielded cable between the line filter and the Power Module.

② Strain relief

③ Line supply connection

④ Metal mounting plate (unpainted and with a good electrical conductivity)

⑤ Motor connection

⑥ Cable shield

⑦ Cable clamps for establishing the connection between the shield and the mounting plate through a large surface area

⑧ Motor connection cable (shielded)

⑨ Shield plate (option). Use the shield plate for EMC-compliant installation of the PM240-2 and PM230 power Modules (FSA … FSC); connect the shield of the control cable at the shield plate of the CU as well as at the shield plate of the Power Module.

Figure 4-7   EMC-compliant wiring of a Power Module frame size E as example
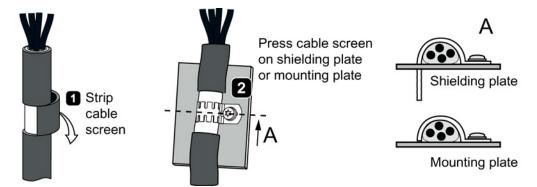
Figure 4-8   Shield connection - detail

Shielding with shield plate:	Shield connection kits are available for all Power Module frame sizes (you will find more information in Catalog D11.1). The cable shields must be connected to the shield plate through the greatest possible surface area using shield clamps.
Shielding without shield plate:	EMC-compliant shielding can also be implemented without using a shield plate. In this case, you must ensure that the cable shields are connected to the ground potential through the largest possible surface area.
Braking resistor connection:	• Connect the braking resistor using a shielded cable. • Connect the shield to the mounting plate or to the shield plate. • To do this, use a cable clamp to establish an electrically conductive connection through a large surface area.

EMC-compliant wiring of Power Modules in degree of protection IP55 / UL type 12

The following diagram shows the EMC-compliant installation of Power Modules with degree of protection IP55 / UL type 12.
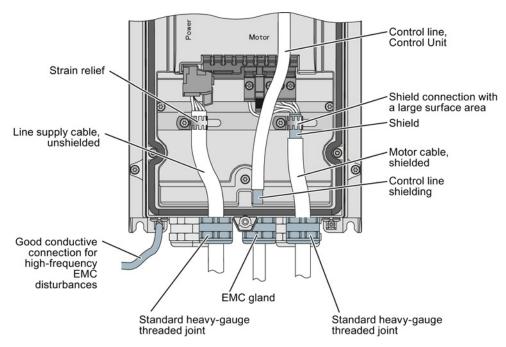
Figure 4-9   EMC-compliant connection of the Power Module PM230, degree of protection IP55 / UL Type 12

Note

You must use a shielded cable if you use the control terminals of the Control Unit. Connect the control screen to the gland plate via an EMC screw.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

63

Commissioning

5

5.1 Commissioning guidelines

Procedure

Proceed as follows to commission the inverter:
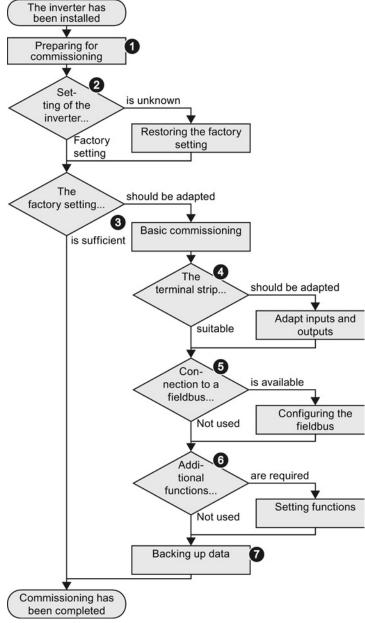
1. Define the requirements of your application placed on the drive.
   → (Page 66) .

2. Reset the inverter when required to the factory setting.
   → (Page 72) .

3. Check whether the factory setting of the inverter is appropriate for your application.

   If not, start with the basic commissioning.
   → (Page 73).

4. Check whether you need to adapt the functions of the terminal strip that you specify in the basic commissioning.
   → (Page 85).

5. If necessary, adapt the communications interface in the inverter.
   → (Page 97) .

6. If necessary, set further functions in the inverter.
   → (Page 217) .

7. Save your settings.
   → (Page 319) .

☐   You have commissioned the inverter.

5.2   Preparing for commissioning

Overview

Before starting commissioning, you must answer the following questions:

- What data does my converter have?

  → Identifying the converter (Page 21).

- What is the data for the connected motor?

  → Preparing for commissioning (Page 66).

- Which interfaces of the converter are active?

  → Wiring examples for the factory settings (Page 68).

- Via which converter interfaces does the higher-level controller operate the drive?

- How is my converter set?

  → Factory setting of the converter control (Page 70).

- What technological requirements must the drive fulfill?

  → V/f control or vector control (speed/torque)? (Page 71).

  → Defining additional requirements for the application (Page 72).

Which motor is connected to the inverter?

If you are using the STARTER commissioning tool and a Siemens motor, you only need the motor order number. Otherwise, note down the data on the motor rating plate.

In which region of the world is the motor used?

- Europe IEC: 50 Hz [kW]
- North America NEMA: 60 Hz [hp] or 60 Hz [kW]

How is the motor connected?

Pay attention to the connection of the motor (star connection [Y] or delta connection [Δ]). Note the appropriate motor data for connecting.

What is the operating temperature of the motor?

For commissioning you need the motor environmental temperature if it varies from 20° C.
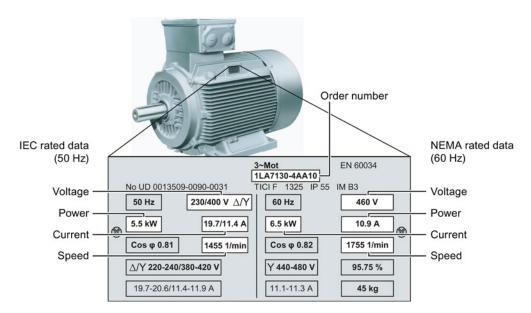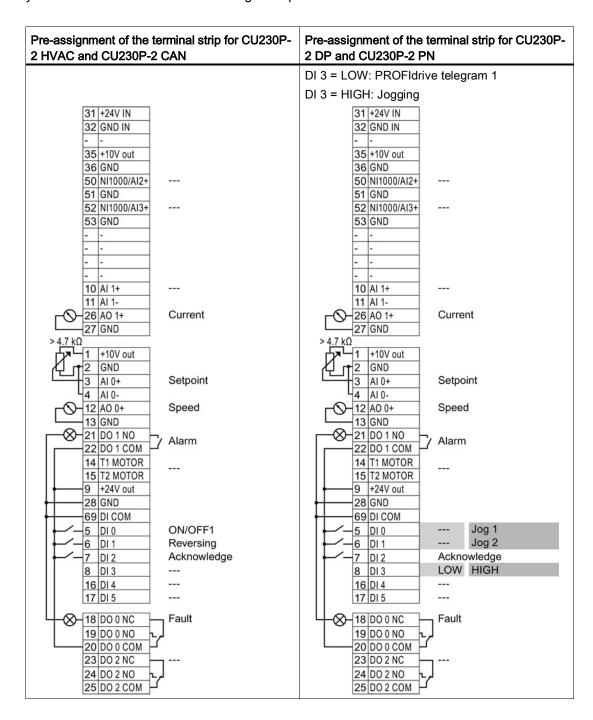
Figure 5-1   Motor data of the rating plate

5.2.1 Wiring examples for the factory settings

If you wish to use the factory setting of your inverter, then you must wire the terminal strip of your inverter as shown in the following examples.

Pre-assignment of the terminal strip for CU230P-2 HVAC and CU230P-2 CAN	Pre-assignment of the terminal strip for CU230P-2 DP and CU230P-2 PN
	DI 3 = LOW: PROFIdrive telegram 1 DI 3 = HIGH: Jogging

5.2.2 Does the motor match the converter?

The converter is preset on a motor at the factory as shown in the figure below.
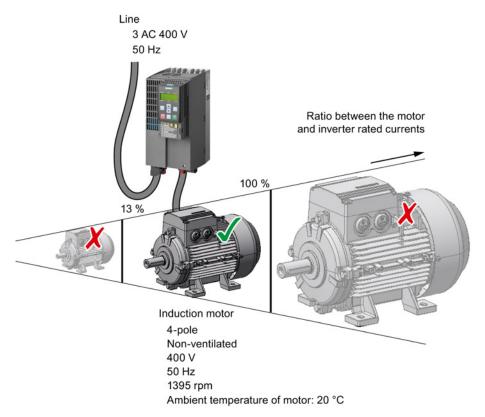
Figure 5-2   Motor data factory settings

The rated current of the motor must be in the range 13% to 100% of the rated converter current.

Example: With a converter with the rated current 10.2 A, you may operate induction motors whose rated currents are in the range 1.3 A to 10.2 A.

5.2.3 Factory setting of the converter control

Switching the motor on and off

The converters are set in the factory so that after it has been switched on, the motor accelerates up to its speed setpoint (referred to 1500 rpm) in 10 seconds. After it has been switched off, the motor brakes with a ramp-down time that is also 10 seconds.
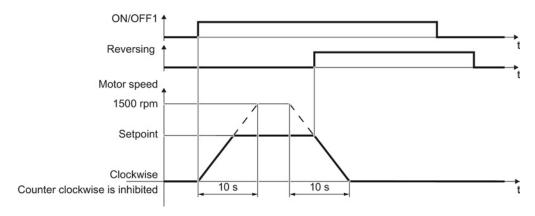
Figure 5-3   Switching on, switching off and reversing the motor in the factory setting

Switch on and switch off the motor in the jog mode

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

For a control command at the respective digital input, the motor rotates with ±150 rpm. The ramp-up and ramp-down times are also 10 seconds, referred to 1500 rpm.
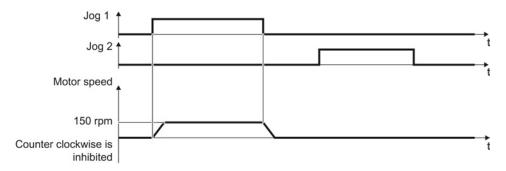
Figure 5-4   Jogging the motor in the factory setting

5.2.4 V/f control or vector control (speed/torque)?

For induction motors, 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 (also: field-oriented control or vector control)

Criteria for selecting either V/f control or vector control

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

- Pumps
- Fans
- Compressors
- Horizontal conveyors

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.
- Full torque is possible at standstill.

Examples of typical applications in which speed control is used:

- Hoisting gear and vertical conveyors
- Winders
- Extruders

It is not permissible to use vector 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
- If a power contactor is used between the converter and motor, and is opened while the motor is powered up
- When the maximum motor speed exceeds the following values:

Converter pulse frequency	2 kHz			4 kHz and higher		
Pole number of the motor	2-pole	4-pole	6-pole	2-pole	4-pole	6-pole
Maximum motor speed [rpm]	9960	4980	3320	14400	7200	4800

5.2.5 Defining additional requirements for the application

What speed limits should be set? (Minimum and maximum speed)

- Minimum speed - factory setting 0 [rpm]
  The minimum speed is the lowest speed of the motor independent of the speed setpoint.
  A minimum speed is, for example, useful for fans or pumps.

- Maximum speed - factory setting 1500 [rpm]
  The converter limits the motor speed to this value.

What motor ramp-up time and ramp-down time are needed for the application?

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

- Ramp-up time - factory setting 10 s

- Ramp-down time - factory setting 10 s

5.3 Restoring the factory setting

There are cases where something goes wrong when commissioning a drive system e.g.:

- The line voltage was interrupted during commissioning and you were not able to complete commissioning.

- You got confused during the commissioning and you can no longer understand the individual settings that you made.

- You do not know whether the inverter was already operational.

In cases such as these, reset the inverter to the factory settings.

Restoring the inverter to the factory setting

Procedure

Proceed as follows to restore the inverter settings to the factory settings:

1. Go online 2. Click the ⬩⬩⬩ key.	1. In the "Options" menu, select the "DRVRESET" entry 2. Confirm the reset using the OK key

You have restored the inverter factory settings.

5.4 Basic commissioning

5.4.1 Basic commissioning with the BOP-2 operator panel

Installing the BOP-2 Basic Operator Panel

Procedure

Proceed as follows to install the BOP-2 operator panel:

1. Locate the lower edge of the BOP-2 housing into the matching recess of the inverter housing.
2. Press the BOP-2 onto the inverter until you hear the latching mechanism engage.

The BOP-2 operator panel is ready for operation when you connect the inverter to the power supply.

Setting the basic commissioning data

Basic commissioning is the first step of the commissioning procedure. The BOP-2 operator panel guides you through the basic commissioning process and prompts you to enter the most important data for your inverter.

Prerequisite

You have inserted the BOP-2 operator panel on the inverter and connected the inverter to a power supply.

The Operator Panel has powered up and displays setpoints and actual values.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

73
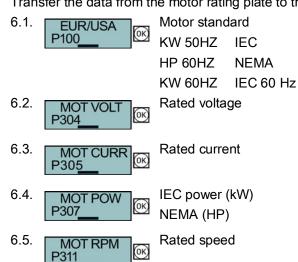
Procedure
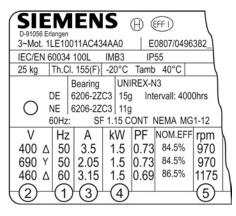
To enter the data for basic commissioning, proceed as follows:

1. ESC — Press the ESC key.

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

3. SETUP [OK] — In the "SETUP" menu, press the OK key to start basic commissioning.

4. RESET [OK] — If you wish to restore all of the parameters to the factory setting before the basic commissioning:

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

   4.2. Press the OK key.

5. CTRL MOD P1300 [OK] — Select the motor control mode. The most important control modes are:

   VF LIN — V/f control with a linear characteristic for basic applications, e.g. horizontal conveyors.

   VF QUAD — V/f control with a square-law characteristic for basic pump and fan applications.

   SPD N EN — We recommend that you use the closed-loop speed control.

   The control modes are described in the operating instructions of your inverter.

6. Transfer the data from the motor rating plate to the inverter:

   6.1. EUR/USA P100 [OK] — Motor standard

   KW 50HZ   IEC

   HP 60HZ   NEMA

   KW 60HZ   IEC 60 Hz

   6.2. MOT VOLT P304 [OK] — Rated voltage

   6.3. MOT CURR P305 [OK] — Rated current

   6.4. MOT POW P307 [OK] — IEC power (kW)
   NEMA (HP)

   6.5. MOT RPM P311 [OK] — Rated speed

SIEMENS Ⓗ ⒺFF I

D-91056 Erlangen

3~Mot. 1LE10011AC434AA0 | E0807/0496382

IEC/EN 60034 100L | IMB3 | IP55

25 kg | Th.Cl. 155(F) | -20°C Tamb 40°C

	Bearing	UNIREX-N3	
DE	6206-2ZC3	15g	Intervall: 4000hrs
NE	6206-2ZC3	11g	

60Hz: SF 1.15 CONT NEMA MG1-12

V	Hz	A	kW	PF	NOM.EFF	rpm
400 Δ	50	3.5	1.5	0.73	84.5%	970
690 Y	50	2.05	1.5	0.73	84.5%	970
460 Δ	60	3.15	1.5	0.69	86.5%	1175
②	① ③		④			⑤

7.	MOT ID P1900 [OK]	Motor data identification Select the method which the inverter uses to measure the data of the connected motor:

OFF	No measurement of motor data.
STIL ROT	Recommended setting: Measure the motor data at standstill and with the motor rotating.
STILL	Measure the motor data at standstill. Select this setting if one of the following cases is applicable: • You have selected the control mode "SPD N EN". However, the motor cannot rotate freely – for example, if the traversing range is mechanically limited. • You have selected V/f control as a control mode, e.g. "VF LIN" or "VF QUAD".
ROT	Measuring the motor data while it is rotating.
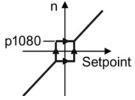
8.	MAc PAr P15 [OK]	Select the configuration for the interfaces of the inverter that is suitable for your application. You can find possible configurations in Section: Finding a suitable setting for the interfaces (Page 53)

coN 2 SP	Macro 1	Std ASPS	Macro 13
coN SAFE	Macro 2	Proc FB	Macro 14
coN 4 SP	Macro 3	Proc	Macro 15
coN Fb	Macro 4	2-wire 1	Macro 17
coN Fb S	Macro 5	2-wire 2	Macro 18
Fb SAFE	Macro 6	3-wire 1	Macro 19
Fb cdS	Macro 7	3-wire 2	Macro 20
MoP SAFE	Macro 8	USS	Macro 21
Std MoP	Macro 9	CAN	Macro 22
Std ASP	Macro 12		

9.	MIN RPM P1080 [OK]	Set the minimum speed of the motor.
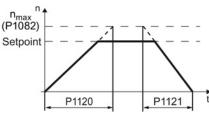
10.	RAMP UP P1120 [OK]	Set the ramp-up time of the motor.
11.	RAMP DWN P1121 [OK]	Set the ramp-down time of the motor.

12.	FINISH [OK]	Complete the basic commissioning: 12.1. Switch over the display using an arrow key: nO → YES 12.2. Press the OK key.

You have entered all of the data that is necessary for the basic commissioning of your converter.

Identifying the motor data and optimizing the closed-loop control

Following basic commissioning, the inverter generally has to measure other motor data and optimize its current and speed controllers.

To start motor data identification, you must switch on the motor. It does not matter whether you use the terminal strip, fieldbus, or operator panel to enter the ON command.

⚠**WARNING**

Risk of injury or material damage as a result of machine motion when switching on the motor
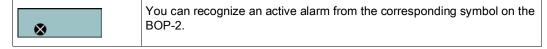
Switching on the motor for motor identification purposes may result in hazardous machine motion.

Secure dangerous machine parts before starting motor data identification:

- Before switching on check that no parts are loose on the machine or can be spun out.
- 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 hanging loads to the floor.

Preconditions

- In the basic commissioning, you have selected the motor identification (MOT ID). In this case, after the basic commissioning has been completed, the inverter issues the alarm A07991.

⊗	You can recognize an active alarm from the corresponding symbol on the BOP-2.

- The motor is cooled down to the ambient temperature.

  If the motor is too hot, the motor data identification will provide incorrect values and the closed-loop speed control can become unstable.

Procedure

To initiate motor data identification and optimization of the motor control, proceed as follows:

1.	[HAND/AUTO] ⇒ ✋	Press the HAND/AUTO key. The BOP-2 displays the HAND symbol.
2.	[I]	Switch on the motor.
3.		Wait until the inverter switches off the motor after completion of the motor data identification. The measurement takes several seconds.
4.	EXTRAS [OK] RAM-ROM [OK]	Save the measurements so that they are protected against power failure.
		If you have also selected a rotating measurement in addition to the motor data identification, then the inverter again issues the alarm A07991.
5.	[I]	Switch the motor on again in order to optimize the speed control.
6.		Wait until the inverter switches off the motor after completion of the optimization. The optimization can take up to one minute.
7.	[HAND/AUTO]	Switch the inverter control from HAND to AUTO.
8.	EXTRAS [OK] RAM-ROM [OK]	Save the measurements so that they are protected against power failure.

You have now completed motor data identification and the closed-loop speed control has been optimized.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

77

5.4.2   Basic commissioning with STARTER

STARTER and STARTER screen forms

STARTER is a PC-based tool to commission Siemens inverters. The graphic user interface of STARTER supports you when commissioning your inverter. Most inverter functions are combined in screen forms in STARTER.

The STARTER screen forms that are shown in this manual show general examples. You may therefore find that a screen contains more or fewer setting options than are shown in these instructions. A commissioning step may also be shown using an inverter other than the one you are using.

Overview: Commission the inverter in the online mode

We recommend that you commission the inverter using STARTER in the online mode. STARTER offers two options of going online with an inverter:

- Via the USB interface
- Via PROFIBUS or PROFINET

Precondition

You require the following to commission the inverter using STARTER:

- A pre-installed drive (motor and inverter)
- A computer with Windows XP or Windows 7, on which STARTER V4.3 or higher is installed.

  You can find updates for STARTER in the Internet under: Update or download path for STARTER (http://support.automation.siemens.com/WW/view/en/10804985/133100)

Procedure

Proceed as follows to carry out the basic commissioning of the inverter online using STARTER:

1. Adapt the inverter and PC interfaces:

    – Go online via USB:Adapting the USB interface (Page 79)

    – Go online via PROFINET:

      Adapting the PROFINET interface (Page 80)

      Configure the communication between inverter and PC: Configuring PROFINET communication in STEP 7 (Page 420).

2. Create a STARTER project (Page 81).

3. Go online and commission the inverter using the wizards (Page 81).

This means that you have completed the basic commissioning.

5.4.2.1   Adapting interfaces

Adapting the USB interface

Procedure
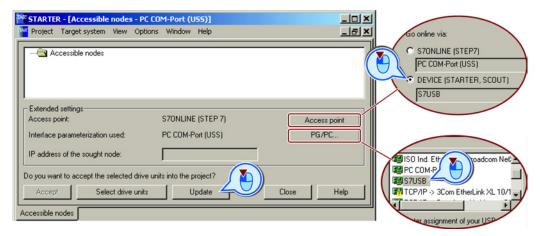
Proceed as follows to set the USB interface:

1. Switch on the converter power supply and connect the converter to the PC via USB.

2. The USB drivers are installed if you are connecting the converter and PC together for the first time. Windows 7 automatically installs the drivers without you having to take any action. For older Windows versions, acknowledge the corresponding screen forms with OK.

3. Start the STARTER commissioning software.

4. If you are using STARTER for the first time, you must check the USB interface setting. To do this, click in STARTER on 🔲 ("Accessible nodes").

   If the interface is appropriately set, then the "Accessible nodes" screen form lists the converters, which are connected via the USB interface. In this case, go to Point 7.

   If incorrectly set, then the "No additional nodes found" message is displayed.

5. Acknowledge this message, and set the "Access point" to "DEVICE (STARTER, Scout)" and the "PG/PC interface" to "S7USB".

6. Then click on "Update". The connected converters are now displayed in "Accessible nodes".

7. Close this screen form without selecting the converter(s) that has/have been found.

8. Create your STARTER project (Page 81).

You have set the USB interface.

Adapting the PROFINET interface

If you commission the inverter with STARTER via PROFINET, then you must correctly address your PC and allocate STARTER the interface via which it goes online with the inverter.

Procedure

To address the inverter, proceed as follows:
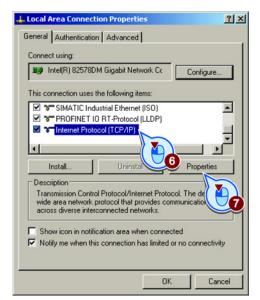
1. Establish the bus connection.
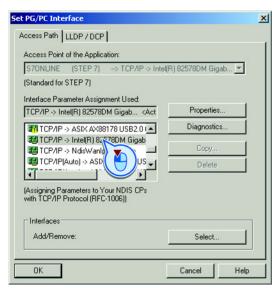
   See Section Communication via PROFINET (Page 98))

2. From the control panel, assign the IP address and the subnet mask address to your computer:

3. Go to "Start/Settings/Control Panel".

4. Select "Network Connections".

5. Right-click to open the properties window of the LAN connection.

6. In this window, select "Internet Protocol (TCP/IP)".

7. Select "Properties".

8. Set 192.168.0.100 as the IP address of the supervisor and 255.255.255.0 as subnet mask.

   In the company network it is possible that the IP address and the subnet mask have different values. You can obtain these values from your network administrator.

9. Open the SIMATIC Manager.

10. Assign the TCP/IP interface to "Intel(R) PRO/100 VE Network Connection" via "Tools/PG/PC interface".

You have allocated your computer the IP address and the address of the subnet mask, and defined the PC interface via which STARTER goes online with the inverter.

5.4.2.2 Generating a STARTER project
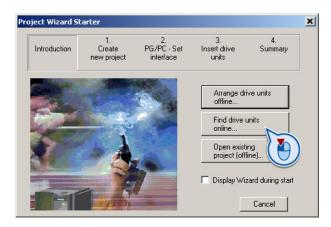
Creating a STARTER project using project wizards

Procedure

To create a project with the STARTER project Wizards, proceed as follows:

1. Using "Project / New with wizard" create a new project.
2. To start the wizard, click on "Search online for drive units ...".
3. Follow the instructions of the Wizard, and set everything that you require for your particular project.

You have created your STARTER project.

5.4.2.3 Go online and start wizard for basic commissioning

Procedure
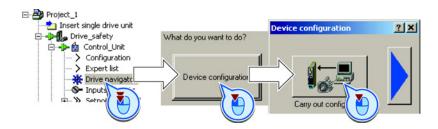
Proceed as follows to start the basic commissioning online with the converter:

1. Select your project and go online: 🖥.
2. Select the device or the devices with which you wish to go online.
3. Download the hardware configuration found online in your project (PG or PC). STARTER shows you which converter it is accessing online and which offline:
   ② The converter is online
   ③ The converter is offline
4. When you are online, double-click on "Control Unit".
5. Start the wizard for basic commissioning.

You are online and have started basic commissioning.

5.4.2.4   Carry-out basic commissioning

Procedure

Proceed as follows to carry out basic commissioning:

1.	☑ Control structure	Select the control mode. See also Section: U/f control or speed control? (Page 241)
2.	☑ Defaults of the setpoin	Select the default setting of the converter interfaces. See also Section: Finding a suitable setting for the interfaces (Page 53).
3.	☑ Drive setting	Select the application for the converter: Low overload for applications that only require a low dynamic performance, e.g. pumps or fans. High overload for applications requiring a high dynamic performance, e.g. conveyor systems.
4.	☑ Motor	Select your motor.
5.	☑ Motor data	Enter the motor data according to the rating plate of your motor. If you have selected a motor based on its order number, the data has already been entered.
6.	☑ Drive functions	If you have set the "Speed control" control mode, then we recommend setting "[1] Identify motor data at standstill and with motor rotating".

With this setting, the converter optimizes its speed controller.

If one of the following cases is applicable, select the setting "[2] Identify motor data at standstill":
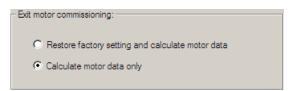
- You have selected "Speed control" as control mode, however the motor cannot freely rotate, e.g. for mechanically limited traversing sections.

- You have set "V/f control" as control mode.
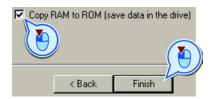
7. ☑ Important parameters — Set the most important parameters to suit your application.
8. ☑ Calculation of the moto — We recommend the setting "Calculate motor data only".

9. Set the check mark for "RAM to ROM (save data in the drive)" in order to save your data in the inverter so that it is not lost when the power fails.

Exit basic commissioning.

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

5.4.2.5 Identifying motor data

Preconditions

- In the basic commissioning, you have selected the motor identification (MOT ID). In this case, after the basic commissioning has been completed, the converter issues the alarm A07991.

- The motor has cooled down to the ambient temperature.

  If the motor is too hot, the motor data identification will provide incorrect values and the closed-loop speed control will become unstable.

⚠ **DANGER**

Risk of injury or material damage as a result of machine movements when switching on the motor

Switching on the motor for identification purposes may result in hazardous machine movements.

Secure dangerous machine parts before starting motor data identification:

- Before switching on, check that no parts are loose on the machine or can be spun out.
- 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 hanging/suspended loads to the floor.
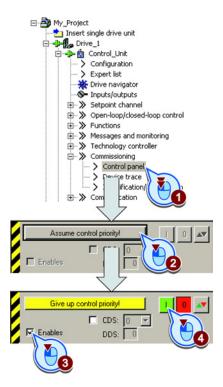
Procedure

To initiate motor data identification and optimization of the motor control, proceed as follows:

1. Open by double-clicking on the control panel in STARTER.
2. Assume master control for the converter.
3. Set the "Enable signals"
4. Switch on the motor.

   The converter starts the motor data identification. This measurement can take several minutes. After the measurement, the converter switches off the motor.
5. Relinquish the master control after the motor data identification.
6. Click the Save (RAM to ROM) button.

You have now completed motor data identification and optimization.

Self-optimization of the closed-loop control

If you have also selected a rotating measurement with self-optimization of the speed control in addition to the motor data identification, then you must switch on the motor again as described above and wait for the optimization run to be completed.

Adapting the terminal strip

6

6.1 Overview

This chapter describes how you adapt the function of individual inputs and outputs of the inverter.

If you adapt the function of an input or output, you overwrite the settings made during the basic commissioning.

See also the following chapter:
● Basic commissioning (Page 73)
● Finding a suitable setting for the interfaces (Page 53)
● Interconnecting signals in the converter (Page 413)

5	DI 0	r0722.0
6	DI 1	r0722.1
7	DI 2	r0722.2
8	DI 3	r0722.3
16	DI 4	r0722.4
17	DI 5	r0722.5

BI: pxxxx

p0730
BO: ryyxx.n

18	DO 0 NC
19	DO 0 NO
20	DO 0 COM

p0731

| 21 | DO 1 NO |
| 22 | DO 1 COM |

p0732

23	DO 2 NC
24	DO 2 NO
25	DO 2 COM

| 3 | AI 0+ |
| 4 | AI 0- |

I U   r0755[0]   CI: pyyyy

| 10 | AI 1+ |
| 11 | AI 1- |

I U   r0755[1]

| 50 | AI 2+ |
| 51 | GND |

I TEMP   r0755[2]

| 52 | AI 3+ |
| 53 | GND |

TEMP   r0755[3]

| 12 | AO 0+ |
| 13 | GND |

p0771[0]   CO: rxxyy

| 26 | AO 1+ |
| 27 | GND |

p0771[1]
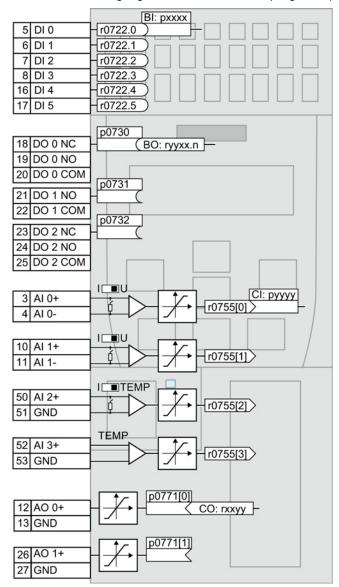
Figure 6-1   Internal interconnection of the inputs and outputs

6.2 Digital inputs

To change the function of a digital input, you must interconnect the status parameter of the digital input with a binector input of your choice.

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

Table 6- 1   Binector inputs (BI) of the inverter (selection)

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	1. 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/three-wire control, control command 1
p1022	Fixed speed setpoint selection bit 2	p3331	Two/three-wire control, control command 2
p1023	Fixed speed setpoint selection bit 3	p3332	Two/three-wire control, control command 3
p1035	Motorized potentiometer, setpoint, raise		

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

Changing the function of a digital input
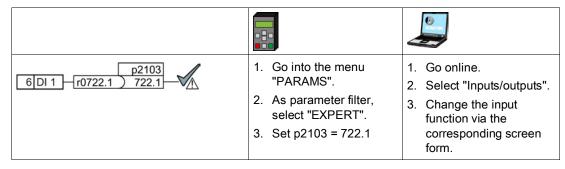
Example
You want to acknowledge inverter fault messages using digital input DI 1.

Procedure
Proceed as follows to acknowledge faults using digital input DI 1:

	1. Go into the menu "PARAMS". 2. As parameter filter, select "EXPERT". 3. Set p2103 = 722.1	1. Go online. 2. Select "Inputs/outputs". 3. Change the input function via the corresponding screen form.

You have interconnected digital input DI 1 with the command to acknowledge faults.
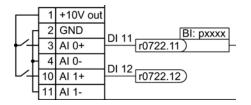
Advanced settings

You can debounce the digital input signal using parameter p0724.

For more information, please see the parameter list and the function block diagrams 2220 f of the List Manual.
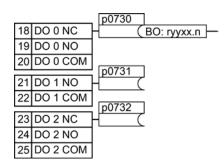
Analog inputs as digital inputs

When required, you can use the analog inputs as additional digital inputs.

If you use an analog input as digital input, interconnect the status parameter of the digital input with a binector input of your choice.

6.3   Digital outputs

To change the function of a digital output, you must interconnect the parameter of the digital output with a binector output of your choice.

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

Table 6- 2   Binector outputs (BO) of the inverter (selection)

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	Inverter overload
r0052.6	Closing lockout 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)

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

Changing the function of a digital output
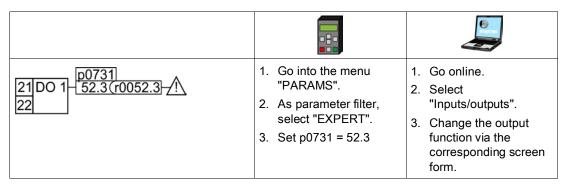
Example

You want to output inverter fault messages using digital output DO 1.

Procedure

Proceed as follows to interconnect digital output DO 1 with the fault message:

21 DO 1 — p0731 / 52.3 (r0052.3) — ⚠ 22	1. Go into the menu "PARAMS". 2. As parameter filter, select "EXPERT". 3. Set p0731 = 52.3	1. Go online. 2. Select "Inputs/outputs". 3. Change the output function via the corresponding screen form.
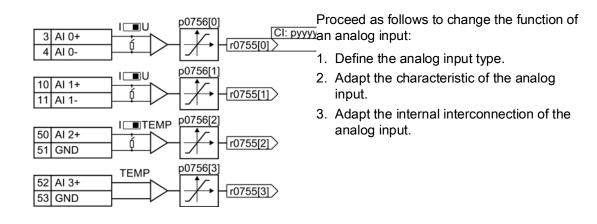
You have interconnected digital output DO 1 with the fault message.

Advanced settings

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

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

6.4 Analog inputs

Proceed as follows to change the function of an analog input:

1. Define the analog input type.
2. Adapt the characteristic of the analog input.
3. Adapt the internal interconnection of the analog input.

Define the analog input type

Procedure

Proceed as follows to define the analog input type:

1. Set p0756 to the appropriate value.

AI 0	Unipolar voltage input Unipolar voltage input monitored: Unipolar current input Unipolar current input monitored Bipolar voltage input (factory setting)	0 V … +10 V +2 V … +10 V 0 mA … +20 mA +4 mA … +20 mA -10 V … +10 V	p0756[0] =	0 1 2 3 4
AI 1	Unipolar voltage input Unipolar voltage input monitored: Unipolar current input Unipolar current input monitored Bipolar voltage input (factory setting)	0 V … +10 V +2 V … +10 V 0 mA … +20 mA +4 mA … +20 mA -10 V … +10 V	p0756[1] =	0 1 2 3 4
AI 2	Unipolar current input (factory setting) Unipolar current input monitored Temperature sensor LG-Ni1000 Temperature sensor Pt1000 No sensor connected	0 mA … +20 mA +4 mA … +20 mA	p0756[2] =	2 3 6 7 8
AI 3	Temperature sensor LG-Ni1000 Temperature sensor Pt1000 No sensor connected (factory setting)		p0756[3] =	6 7 8
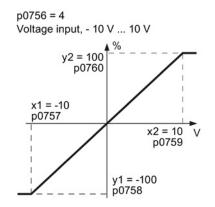
2. Set the switch associated with the analog input. You can find the switch on the Control Unit behind the front doors.

• the DIP switch for AI0 and AI1 (current / voltage) on the Control Unit behind the lower front door.	
• The DIP switch for AI2 (temperature / current) on the Control Unit behind the upper front door.	

You have now defined the analog input type.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

89

Characteristics of the analog input

If you change the analog input type using p0756, then the inverter automatically selects the appropriate scaling of the analog input. The linear scaling characteristic is defined using two points (p0757, p0758) and (p0759, p0760). Parameters p0757 … p0760 are assigned to an analog input via their index, e.g. parameters p0757[0] … p0760[0] belong to analog input 0.
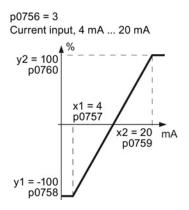
Figure 6-2   Examples for scaling characteristics

Parameter	Description
p0757	x-coordinate of 1st characteristic point [V or mA]
p0758	y coordinate of the 1st characteristic point [% of p200x] p200x are the parameters of the reference variables, e.g. p2000 is the reference speed
p0759	x-coordinate of 2nd characteristic point [V or mA]
p0760	y-coordinate of 2nd characteristic point [% of p200x]
p0761	Wire breakage monitoring response threshold

Adapting the characteristic of the analog input

You must define your own characteristic if none of the default types match your particular application.

Example

The inverter should convert a 6 mA … 12 mA signal into the value range -100 % … 100 % via analog input 0. The wire break monitoring of the inverter should respond when 6 mA is fallen below.

Procedure

Proceed as follows to adapt the characteristic to match the example:

90

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

1. Set p0756[0] = 3

   You have defined analog input 0 as current input with wire break monitoring.

   After the change p0756 = 3, the inverter sets the scaling characteristic to the following values (see the example above for the scaling characteristic):

   p0757[0] = 4,0; p0758[0] = 0,0; p0759[0] = 20; p0760[0] = 100

2. Set DIP switch for AI 0 to current input ("I"):

3. Adapt the characteristic:

p0757[0] = 6.0	Analog inputs, characteristic (x_1, y_1)	
p0758[0] = -100.0	6 mA corresponds to -100 %	
p0759[0] = 12.0	Analog inputs, characteristic (x_2, y_2)	
p0760[0] = 100.0	12 mA corresponds to 100 %	

You have adapted the characteristic of the analog input to match the example.

Internal interconnection of the analog input

You define the analog input function by interconnecting a connector input of your choice with parameter p0755 . Parameter p0755 is assigned to the particular analog input via its index, e.g. parameter p0755[0] is assigned to analog input 0.

Table 6- 3   Connector inputs (CI) of the inverter (selection)

CI	Significance	CI	Significance
p1070	Main setpoint	p1522	Torque limit, upper
p1075	Supplementary setpoint	p2253	Technology controller setpoint 1
p1503	Torque setpoint	p2264	Technology controller actual value
p1511	Supplementary torque 1		

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

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

91

Adapting the internal interconnection of the analog input

Example
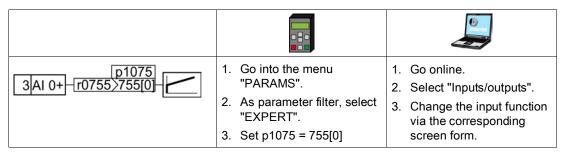
The inverter should receive the additional setpoint via analog input AI 0.

Procedure

Proceed as follows to interconnect the analog input with the additional setpoint:

3 AI 0+ — r0755 755[0] — p1075	1. Go into the menu "PARAMS". 2. As parameter filter, select "EXPERT". 3. Set p1075 = 755[0]	1. Go online. 2. Select "Inputs/outputs". 3. Change the input function via the corresponding screen form.

You have interconnected the analog input with the additional setpoint.

Advanced settings

Signal smoothing

When required, you can smooth the signal, which you read-in via an analog input, using parameter p0753.

For more information, see the parameter list and in the function block diagrams 9566 ff of the List Manual.

Skip frequency band

Interferences in the cable can corrupt small signals of a few millivolts. To be able to enter a setpoint of exactly 0 V via an analog input, you must specify a skip frequency band.
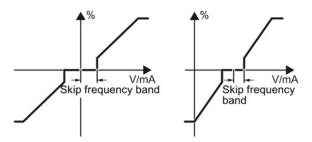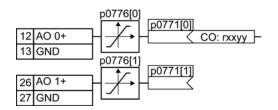
Figure 6-3   Skip frequency band of the analog input

p0764[0]	**Skip frequency band of the analog input AI 0** (factory setting: 0)
p0764[1]	**Skip frequency band of the analog input AI 1** (factory setting: 0)

6.5 Analog outputs

Proceed as follows to change the function of an analog output:

1. Define the analog output type.
2. Set the characteristic of the analog output.
3. Adapt the internal interconnection of the analog output.

Defining the analog output type

Procedure

Proceed as follows to define the analog output type:

Set parameter p0776 to the appropriate value:
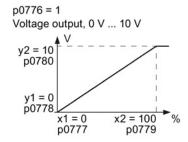
AO 0	Current output (factory setting)	0 mA … +20 mA	p0776[0] =	0
	Voltage output	0 V … +10 V		1
	Current output	+4 mA … +20 mA		2
AO 1	Current output (factory setting)	0 mA … +20 mA	p0776[1] =	0
	Voltage output	0 V … +10 V		1
	Current output	+4 mA … +20 mA		2

You have now defined the analog output type.

Characteristics of the analog output

If you change the analog output type, then the inverter automatically selects the appropriate scaling of the analog output. The linear scaling characteristic is defined using two points (p0777, p0778) and (p0779, p0780).

Figure 6-4   Examples for scaling characteristics

Parameters p0777 … p0780 are assigned to an analog output via their index, e.g. parameters p0777[0] … p0770[0] belong to analog output 0.

Table 6- 4   Parameters for the scaling characteristic

Parameter	Description
p0777	**X coordinate of the 1st characteristic point [% of p200x]** p200x are the parameters of the reference variables, e.g. p2000 is the reference speed.
p0778	**Y coordinate of the 1st characteristic point [V or mA]**
p0779	**X coordinate of the 2nd characteristic point [% of p200x]**
p0780	**Y coordinate of the 2nd characteristic point [V or mA]**

Setting the characteristic of the analog output

You must define your own characteristic if none of the default types match your particular application.

Example:

The inverter should convert a signal in the value range -100% … 100% into a 6 mA … 12 mA output signal via analog output 0.

Procedure
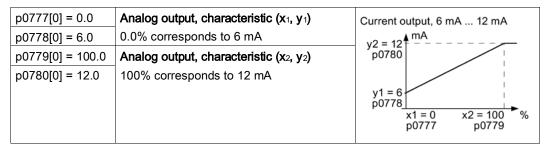
Proceed as follows to adapt the characteristic to match the example:

1. Set p0776[0] = 2.

   You have defined analog output 0 as current output.

   After changing p0776 = 2, the inverter sets the scaling characteristic parameters to the following values:

   p0777[0] = 0.0; p0778[0] = 4.0; p0779[0] = 100.0; p0780[0] = 20.0

2. Adapt the characteristic:

p0777[0] = 0.0	Analog output, characteristic (x_1, y_1)	
p0778[0] = 6.0	0.0% corresponds to 6 mA	
p0779[0] = 100.0	Analog output, characteristic (x_2, y_2)	
p0780[0] = 12.0	100% corresponds to 12 mA	

You have adapted the characteristic of the analog output to match the example.

Internal interconnection of the analog output

You define the analog output function by interconnecting parameter p0771 with a connector output of your choice. Parameter p0771 is assigned to the particular analog input via its index, e.g. parameter p0771[0] is assigned to analog output 0.

Table 6- 5   Connector outputs (CO) of the inverter (selection)

CO	Significance	CO	Significance
r0021	Actual frequency	r0026	Actual DC-link voltage
r0024	Output actual frequency	r0027	Output current
r0025	Output actual frequency		

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

For more information, please see the parameter list and the function block diagrams 9572 f of the List Manual.

Adapting the internal interconnection of the analog output

Example

You wish to output the inverter output current via analog output 0.

Procedure

Proceed as follows to interconnect analog output 0 with the signal for the output current:

12 AO 0+ — p0771 27 <r0027 — |i|	1. Go into the menu "PARAMS". 2. As parameter filter, select "EXPERT". 3. Set p0771 = 27	1. Go online. 2. Select "Inputs/outputs". 3. Change the output function via the corresponding screen form.

You have interconnected analog output 0 with the signal for the output current.

Advanced settings

You can manipulate the signal that you output via an analog output, as follows:

● Absolute-value generation of the signal (p0775)

● Signal inversion (p0782)

Additional information is provided in the parameter list of the List Manual.

Configuring the fieldbus

7

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

Fieldbus	Profile	Control Unit	Interface
PROFIBUS DP (Page 102)	• PROFIdrive	**CU230P-2 DP**	Sub D socket
PROFINET (Page 98)	• PROFIenergy	**CU230P-2 PN**	2 RJ45 connectors
EtherNet/IP (Page 128)	• OVDA AC/DC Drive • SINAMICS		
USS (Page 142)	-	**CU230P-2 HVAC**	RS485 connector
Modbus RTU (Page 153)	-		
BACnet MS/TP (Page 163)	-		
P1 (Page 175)	-		
CANopen (Page 180)	-	**CU230P-2 CAN**	SUB-D connector

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

97

7.1 Communication via PROFINET

The Control Unit provides the following functions

• IRT without isochronous mode	
• MRP	Media redundancy, not bumpless with 200 ms Precondition: Ring topology
• MRPD	Media redundancy, bumpless Precondition: IRT and the ring topology created in the control
• Diagnostic alarms	According to error classes specified in the PROFIdrive profile. See Activating diagnostics via the control (Page 101).
• Device replacement without removable data storage medium	Precondition: Topology created in the control
• Shared Device	Only for Control Units with fail-safe functions (see Safety Function Manual)

The Control Units have two RJ45 sockets, which you can use to implement a line topology. You can implement all topologies by using switches.

Additional information on PROFINET in the Internet

General information about PROFINET can be found at Industrial Communication (http://www.automation.siemens.com/mcms/automation/en/industrial-communications/profinet/Pages/Default.aspx).

The configuration of the functions is described in the PROFINET system description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

7.1.1 What do you need for communication via PROFINET?

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

Questions	Answer/description	Example
Is the converter correctly connected to the PROFINET?	See: Connect the converter to PROFINET (Page 99)	
Do the IP address and device name in the converter and controller match?	See Configuring communication to the control (Page 100)	See Configuring the controller and converter in HW Config (Page 420)
Is the same telegram set in the converter as in the higher-level controller?	Set the telegram in the converter, see: Select telegram (Page 100)	See: Configuring the controller and converter in HW Config (Page 420)
Are the signals that the converter and the controller exchange via PROFINET correctly interconnected?	PROFIdrive-compliant interconnection in the converter, see: PROFIdrive profile for PROFIBUS and PROFINET (Page 106)	See: STEP 7 program examples (Page 426)

7.1.2 Connect the converter to PROFINET

Connecting up

Connect the inverter (IO device) and your PG/PC (IO supervisor) via PROFINET cables with the control. The maximum permissible cable length is 100 m.

See also Section: Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).
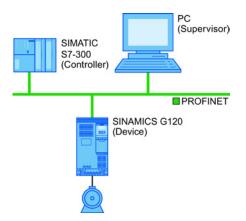
Figure 7-1   Example: PROFINET in a line topology

Recommended PROFINET connectors and pin assignment

We recommend the following connector with order number: 6GK1901-1BB10-2Ax0 for connecting the PROFINET cable.

Instructions for assembling the SIMATIC NET Industrial Ethernet FastConnect RF45 Plug 180 can be found on the Internet under product information " "Assembly instructions for SIMATIC NET Industrial Ethernet FastConnect RJ45 Plug (http://support.automation.siemens.com/WW/view/en/37217116/133300)".

Laying and shielding the PROFINET cable

Information can be found on the Internet: PROFIBUS user organization installation guidelines (http://www.profibus.com/downloads/installation-guide/).

7.1.3 Configuring communication to the control

Loading GSDML

In order to establish communication between the inverter and control system via PROFINET, you need the device file of the inverter "GSDML" for your control. You can then configure the communication.

Procedure

Proceed as follows to load the GSDML of the inverter:

Load the GSDML of the inverter into the PROFINET-Controller, i.e. into your control system. You can load the GSDML of your inverter in two ways:

- You can find the GSDML of the SINAMICS inverter on the Internet (http://support.automation.siemens.com/WW/view/en/22339653/133100).

- The GSDML is saved in the inverter. If you insert the memory card in the inverter and set p0804 = 12 , the GSDML will be written to the /SIEMENS/SINAMICS/DATA/CFG folder on the memory card as a compressed file (PNGSD.ZIP).

  Unpack the GSDML before you use the device file.

You have loaded the GSDML of the inverter.

7.1.4 Select telegram

The following telegrams are available:

Parameter	Description	
p0015	**Macro drive unit** Configure the interface in basic commissioning, and select a telegram.	
p0922	**PROFIdrive Telegram selection** Set the send and receive telegram, also see Cyclic communication (Page 106)	
	1:	Standard telegram 1, PZD-2/2 (factory setting)
	20:	Standard telegram 20, PZD-2/6
	350:	SIEMENS telegram 350, PZD-4/4
	352	SIEMENS telegram 352, PZD-6/6
	353:	SIEMENS telegram 353, PZD-2/2, PKW-4/4
	354:	SIEMENS telegram 354, PZD-6/6, PKW-4/4
	999:	Extend telegrams and change signal interconnection (Page 113)

Precondition

In the basic commissioning, you have selected a setting with fieldbus.

See also Section: Basic commissioning (Page 73).

Procedure

Proceed as follows to set a specific telegram in the inverter:

Using STARTER or an operator panel, set parameter p0922 to the appropriate value.

You have set a specific telegram in the inverter.

7.1.5 Activating diagnostics via the control

The converter provides the functionality to transmit fault and alarm messages (diagnostic messages) to the higher-level control according to the PROFIdrive error classes.

The functionality must be selected in the higher-level control (see example of STEP 7 (Page 424)) and activated by powering up.

7.2   Communication via PROFIBUS

7.2.1   What do you need for communication via PROFIBUS?

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

Questions	Description	Examples
Is the inverter correctly connected to the PROFIBUS?	See Section: Connect the frequency inverter to PROFIBUS (Page 102).	---
Have you configured the communication between the inverter and the higher-level controller?	See Section: Configuring communication to the control (Page 103)	See also Section: Configuring PROFIBUS communication in STEP 7 (Page 417).
Do the addresses in the inverter and the higher-level controller match?	See Section: Setting the address (Page 104).	
Is the same telegram set in the higher-level controller and in the inverter?	Adapt the telegram in the inverter. See Section: Select telegram (Page 105).	
Are the signals that the inverter and the controller exchange via PROFIBUS correctly interconnected?	Adapt the interconnection of the signals in the controller to the inverter. For the PROFIdrive-compliant interconnection in the inverter, see also Section: PROFIdrive profile for PROFIBUS and PROFINET (Page 106).	See also Section: STEP 7 program examples (Page 426).

7.2.2   Connect the frequency inverter to PROFIBUS

Permissible cable lengths, routing and shielding the PROFIBUS cable

For a data transfer rate of 1 Mbit/s, the maximum permissible cable length is 100 m.

You will find additional information on this topic in the Internet:

- Product support
  (http://www.automation.siemens.com/net/html_76/support/printkatalog.htm)

- PROFIBUS user organization installation guidelines
  (http://www.profibus.com/downloads/installation-guide/)

Recommended PROFIBUS connectors

We recommend connectors with the following order numbers for connecting the PROFIBUS cable:

- 6GK1500-0FC00
- 6GK1500-0EA02

Pin assignment at the inverter

For the pin assignment at the inverter refer to Section Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

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

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

In the case of short interruptions of the 24 V voltage supply, the inverter may report a fault without communications with the controller being interrupted.

7.2.3 Configuring communication to the control

To configure communication between the inverter and control system, you generally require the description file GSD of the inverter.

When STEP 7 and STARTER are installed, you do not need GSD.

Procedure

Proceed as follows to configure communication to the control system using GSD:

1. Obtain the GSD file of the inverter.
   You have two options:

   – You can find the GSD of the SINAMICS inverter on the Internet
     (http://support.automation.siemens.com/WW/view/en/22339653/133100).

   – The GSD is saved in the inverter. If you insert the memory card in the inverter and set p0804 = 12 , the inverter writes the GSD to the /SIEMENS/SINAMICS/DATA/CFG folder on the memory card.

2. Import the GSD into the configuring tool of your control system.

3. Configure the communication between the control and the inverter in your control.

   See also Section: Configuring PROFIBUS communication in STEP 7 (Page 417).

You have configured the communication to the control system.

7.2.4 Setting the address
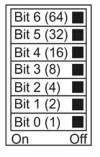
You set the PROFIBUS address of the inverter using the address switch on the Control Unit, using parameter p0918 or in STARTER.
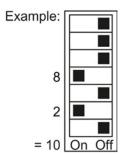
Using parameter p0918 (factory setting: 126) or using STARTER, you can only set the address, if all address switches are set to "OFF" (0) or "ON" (1).

If you have specified a valid address using the address switches, this address will always be the one that takes effect and parameter p0918 cannot be changed.

Valid address range: 1 … 125

The positions of the address switches are described in Section: Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

Bit 6 (64) ■	Example:
Bit 5 (32) ■	■
Bit 4 (16) ■	■
Bit 3 (8) ■	8 ■
Bit 2 (4) ■	■
Bit 1 (2) ■	2 ■
Bit 0 (1) ■	■
On Off	= 10 On Off

Procedure

To change the bus address, proceed as follows:

1. Set the address using one of the subsequently listed options:

   – using the address switches

   – with an operator panel using p0918

   – in STARTER using screen form "Control Unit/Communication/Fieldbus", or using the expert list with p0918

2. Switch on the inverter power supply and, if being used, the 24 V supply for the Control Unit.

3. Switch on the voltages again after all LEDs at the inverter have gone dark.

This means that you have changed the bus address.

7.2.5   Select telegram

The following telegrams are available:

Parameter	Description	
p0015	**Macro drive unit** Configure the interface in basic commissioning, and select a telegram.	
p0922	**PROFIdrive Telegram selection** Set the send and receive telegram, also see Cyclic communication (Page 106)	
	1:	Standard telegram 1, PZD-2/2 (factory setting)
	20:	Standard telegram 20, PZD-2/6
	350:	SIEMENS telegram 350, PZD-4/4
	352:	SIEMENS telegram 352, PZD-6/6
	353:	SIEMENS telegram 353, PZD-2/2, PKW-4/4
	354:	SIEMENS telegram 354, PZD-6/6, PKW-4/4
	999:	Extend telegrams and change signal interconnection (Page 113)

Precondition

In the basic commissioning, you have selected a setting with fieldbus.

See also Section: Basic commissioning (Page 73).

Procedure

Proceed as follows to set a specific telegram in the inverter:

Using STARTER or an operator panel, set parameter p0922 to the appropriate value.

You have set a specific telegram in the inverter.

7.3 PROFIdrive profile for PROFIBUS and PROFINET

7.3.1 Cyclic communication

The send and receive telegrams of the inverter for the cyclic communication are structured as follows:
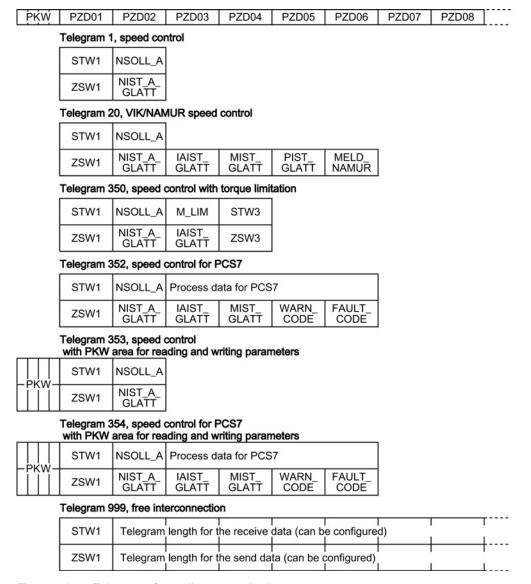
Figure 7-2   Telegrams for cyclic communication

Table 7- 1   Explanation of the abbreviations

Abbreviation	Explanation	Abbreviation	Explanation
STW1	Control word 1	MIST_GLATT	Current torque
ZSW1	Status word 1	PIST_GLATT	Current active power
STW3	Control word 3	M_LIM	Torque limit value
ZSW3	Status word 3	FAULT_CODE	Fault number
NSOLL_A	Speed setpoint	WARN_CODE	Alarm number
NIST_A_GLATT	Smoothed actual speed value	MELD_NAMUR	Fault word according to VIK-NAMUR definition
IAIST_GLATT	Smoothed actual current value		

Interconnection of the process data
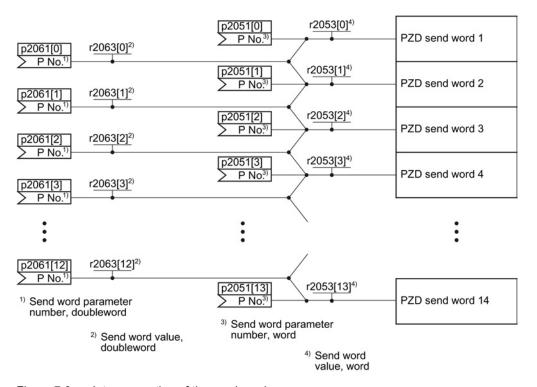
Figure 7-3   Interconnection of the send words

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

107
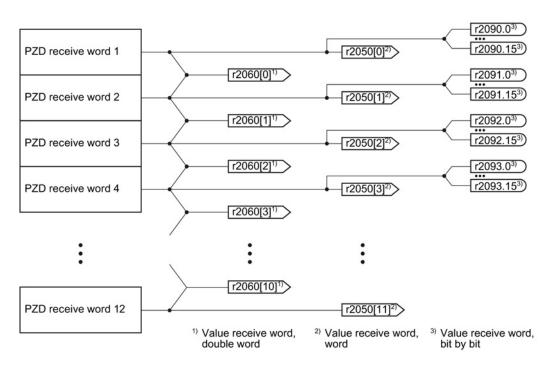
Figure 7-4   Interconnection of the receive words

The telegrams use - with the exception of telegram 999 (free interconnection) - the word-by-word transfer of send and receive data (r2050/p2051).

If you require an individual telegram for your application (e.g. for transferring double words), you can adjust one of the predefined telegrams via parameters p0922 and p2079. For details, please refer to the List Manual, function diagrams 2420 and 2472.

7.3.1.1   Control and status word 1

The control and status words fulfill the specifications of PROFIdrive profile version 4.1 for the "closed-loop speed controlled" mode.

Control word 1 (STW1)

Control word 1 (bits 0 … 10 in accordance with PROFIdrive profile and VIK/NAMUR, bits 11 … 15 specific to the inverter).

Bit	Significance		Explanation	Signal interconnection in the inverter
	Telegram 20	All other telegrams		
0	0 = OFF1		The motor brakes with the ramp-down time p1121 of the ramp-function generator. The inverter switches off the motor at standstill.	p0840[0] = r2090.0
	0 → 1 = ON		The inverter goes into the "ready" state. If, in addition bit 3 = 1, then the inverter switches on the motor.	
1	0 = OFF2		Switch off the motor immediately, the motor then coasts down to a standstill.	p0844[0] = r2090.1

Bit	Significance		Explanation	Signal interconnection in the inverter
	Telegram 20	All other telegrams		
	1 = No OFF2		The motor can be switched on (ON command).	
2	0 = Quick stop (OFF3)		Quick stop: The motor brakes with the OFF3 ramp-down time p1135 down to standstill.	p0848[0] = r2090.2
	1 = No quick stop (OFF3)		The motor can be switched on (ON command).	
3	0 = Inhibit operation		Immediately switch-off motor (cancel pulses).	p0852[0] = r2090.3
	1 = Enable operation		Switch-on motor (pulses can be enabled).	
4	0 = Disable RFG		The inverter immediately sets its ramp-function generator output to 0.	p1140[0] = r2090.4
	1 = Do not disable RFG		The ramp-function generator can be enabled.	
5	0 = Stop RFG		The output of the ramp-function generator stops at the actual value.	p1141[0] = r2090.5
	1 = Enable RFG		The output of the ramp-function generator follows the setpoint.	
6	0 = Inhibit setpoint		The inverter brakes the motor with the ramp-down time p1121 of the ramp-function generator.	p1142[0] = r2090.6
	1 = Enable setpoint		Motor accelerates with the ramp-up time p1120 to the setpoint.	
7	0 → 1 = Acknowledge faults		Acknowledge fault. If the ON command is still active, the inverter switches to"closing lockout" state.	p2103[0] = r2090.7
8, 9	Reserved			
10	0 = No control via PLC		Inverter ignores the process data from the fieldbus.	p0854[0] = r2090.10
	1 = Control via PLC		Control via fieldbus, inverter accepts the process data from the fieldbus.	
11	---[1]	0 = Direction reversal	Invert setpoint in the inverter.	p1113[0] = r2090.11
12	Not used			
13	---[1]	1 = MOP up	Increase the setpoint saved in the motorized potentiometer.	p1035[0] = r2090.13
14	---[1]	1 = MOP down	Reduce the setpoint saved in the motorized potentiometer.	p1036[0] = r2090.14
15	CDS bit 0	Reserved	Changes over between settings for different operation interfaces (command data sets).	p0810 = r2090.15

[1]   If you change over from another telegram to telegram 20, then the assignment of the previous telegram is kept.

Status word 1 (ZSW1)

Status word 1 (bits 0 … 10 in accordance with PROFIdrive profile and VIK/NAMUR, bits 11 … 15 specific to the inverter).

Bit	Significance		Comments	Signal interconnection in the inverter
	Telegram 20	All other telegrams		
0	1 = Ready to start		Power supply switched on; electronics initialized; pulses locked.	p2080[0] = r0899.0
1	1 = Ready		Motor is switched on (ON/OFF1 = 1), no fault is active. With the command "Enable operation" (STW1.3), the inverter switches on the motor.	p2080[1] = r0899.1
2	1 = Operation enabled		Motor follows setpoint. See control word 1, bit 3.	p2080[2] = r0899.2
3	1 = Fault active		The inverter has a fault. Acknowledge fault using STW1.7.	p2080[3] = r2139.3
4	1 = OFF2 inactive		Coast down to standstill is not active.	p2080[4] = r0899.4
5	1 = OFF3 inactive		Quick stop is not active.	p2080[5] = r0899.5
6	1 = Closing lockout active		It is only possible to switch on the motor after an OFF1 followed by ON.	p2080[6] = r0899.6
7	1 = Alarm active		Motor remains switched on; no acknowledgement is necessary.	p2080[7] = r2139.7
8	1 = Speed deviation within the tolerance range		Setpoint / actual value deviation within the tolerance range.	p2080[8] = r2197.7
9	1 = Master control requested		The automation system is requested to accept the inverter control.	p2080[9] = r0899.9
10	1 = Comparison speed reached or exceeded		Speed is greater than or equal to the corresponding maximum speed.	p2080[10] = r2199.1
11	0 = I, M or P limit reached		Comparison value for current, torque or power has been reached or exceeded.	p2080[11] = r1407.7
12	---[1]	1 = Holding brake open	Signal to open and close a motor holding brake.	p2080[12] = r0899.12
13	0 = Alarm, motor overtemperature		--	p2080[13] = r2135.14
14	1 = Motor rotates clockwise		Internal inverter actual value > 0	p2080[14] = r2197.3
	0 = Motor rotates counterclockwise		Internal inverter actual value < 0	
15	1 = CDS display	0 = Alarm, inverter thermal overload		p2080[15] = r0836.0 / r2135.15

[1] If you change over from another telegram to telegram 20, then the assignment of the previous telegram is kept.

7.3.1.2   Control and status word 3

The control and status words fulfill the specifications of PROFIdrive profile version 4.1 for the "closed-loop speed controlled" mode.

Control word 3 (STW3)

Control word 3 has the following default assignment. You can change the signal interconnection.

Bit	Value	Significance Telegram 350	Explanation	Signal interconnection in the inverter [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	DC braking enable	--	p1230[0] = r2093.9
10	–	Not used		
11	1	1 = Enable droop	Enable or inhibit speed controller droop.	p1492[0] = r2093.11
12	1	Torque control active	Changes over the control mode for vector control.	p1501[0] = r2093.12
	0	Closed-loop speed control active		
13	1	No external fault	--	p2106[0] = r2093.13
	0	External fault is active (F07860)		
14	–	Not used		
15	1	CDS bit 1	Changes over between settings for different operation interfaces (command data sets).	p0811[0] = r2093.15

[1]   If you switch from telegram 350 to a different one, then the inverter sets all interconnections p1020, … to "0". Exception: p2106 = 1.

Status word 3 (ZSW3)

Status word 3 has the following standard assignment.

Bit	Value	Significance	Description	Signal interconnection in the inverter
0	1	DC braking active	--	p2051[3] = r0053
1	1	|n_act| > p1226	Absolute current speed > stationary state detection	
2	1	|n_act| > p1080	Absolute actual speed > minimum speed	
3	1	i_act ≧ 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	Ramping completed	Ramp-function generator is not active.	
10	1	Technology controller output at lower limit	Technology controller output ≦ p2292	
11	1	Technology controller output at upper limit	Technology controller output > p2291	
12		Not used		
13		Not used		
14		Not used		
15		Not used		

7.3.1.3 Extend telegrams and change signal interconnection

When you have selected a telegram, the inverter interconnects the corresponding signals with the fieldbus interface. Generally, these interconnections are protected so that they cannot be changed. With the appropriate inverter settings, these interconnections can be changed.

Extend telegram

Every telegram can be extended, by "attaching" additional signals.

Procedure

Proceed as follows to extend a telegram:

1. Using STARTER or an operator panel, set parameter p0922 = 999.

2. Set parameter p2079 to the appropriate 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.

Parameter	Description	
p0922	**PROFIdrive telegram selection**	
	999:	Free telegram (message frame) configuration
p2079	**PROFIdrive PZD telegram selection extended**	
	1:	Standard telegram 1, PZD-2/2
	20:	Standard telegram 20, PZD-2/6
	350:	SIEMENS telegram 350, PZD-4/4
	352:	SIEMENS telegram 352, PZD-6/6
	353:	SIEMENS telegram 353, PZD-2/2, PKW-4/4
	354:	SIEMENS telegram 354, PZD-6/6, PKW-4/4
r2050[0…11]	**PROFIdrive PZD receive word** Connector output to interconnect the PZD (setpoints) in the word format received from the PROFIdrive controller.	
p2051[0…11]	**PROFIdrive PZD send word** Selection of the PZD (actual values) in the word format to be sent to the PROFIdrive controller.	

Selection of the PZD (actual values) in the word format to be sent to the PROFIdrive controller. For further information refer to the function block diagrams 2468 and 2470 of the List Manual.

Freely selecting the signal interconnection of the telegram

The signals in the telegram can be freely interconnected.

Procedure

Proceed as follows to change the signal interconnection of a telegram:

1. Using STARTER or an operator panel, set parameter p0922 = 999.

2. Using STARTER or an operator panel, set parameter 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.

Parameter	Description	
p0922	**PROFIdrive telegram selection**	
	999:	Free telegram (message frame) configuration
p2079	**PROFIdrive PZD telegram selection extended**	
	999:	Free telegram (message frame) configuration
r2050[0…11]	**PROFIdrive PZD receive word** Connector output to interconnect the PZD (setpoints) in the word format received from the PROFIdrive controller.	
p2051[0…11]	**PROFIdrive PZD send word** Selection of the PZD (actual values) in the word format to be sent to the PROFIdrive controller.	

For further information refer to the function block diagrams 2468 and 2470 of the List Manual.

7.3.1.4 Data structure of the parameter channel

Structure of the parameter channel

The parameter channel consists of four words. 1. and 2nd word transfer the parameter number and index as well as the type of job (read or write) The 3rd and 4th word contains the parameter contents. 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 word)	
15 ... 12 / 11	10 ... 0	15 ... 8	7 ... 0	15 ... 0	15 ... 0
AK / S P M	PNU	Subindex	Page index	PWE 1	PWE 2

You can find examples of telegrams at the end of this section.

Request and response IDs

Bits 12 to 15 of the first word of the parameter channel contain the request and response identifier. The possible identifiers and further explanations can be found in the following tables.

Overview of the request identifiers controller → inverter

Request identifier	Description	Response identifier	
		positive	negative
0	No request	0	7 / 8
1	Request parameter value	1 / 2	7 / 8
2	Change parameter value (word)	1	7 / 8
3	Change parameter value (double word)	2	7 / 8
4	Request descriptive element [1]	3	7 / 8
6[2]	Request parameter value (field) [1]	4 / 5	7 / 8
7[2]	Change parameter value (field, word) [1]	4	7 / 8
8[2]	Change parameter value (field, double word) [1]	5	7 / 8
9	Request number of field elements	6	7 / 8

[1]   The required element of the parameter is specified in IND (2nd word).

[2]   The following request IDs are identical: 1 ≡ 6, 2 ≡ 7 3 ≡ 8.
       We recommend that you use identifiers 6, 7, and 8.

Overview of the response identifiers inverter → controller

The response identifier depends on the request identifier.

Response identifier	Description
0	No response
1	Transfer parameter value (word)
2	Transfer parameter value (double word)
3	Transfer descriptive element [1]
4	Transfer parameter value (field, word) [2]
5	Transfer parameter value (field, double word) [2]
6	Transfer number of field elements
7	Inverter cannot process the request (with error number)
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).

Overview of the error numbers in response identifier 7 (inverter cannot process the request)

For response identifier 7, the inverter sends one of the following error numbers in the highest word of the parameter channel to the controller.

No.	Description
00 hex	**Illegal parameter number** (access to a parameter that does not exist)
01 hex	**Parameter value cannot be changed** (change request for a parameter value that cannot be changed)
02 hex	**Lower or upper value limit exceeded** (change request with a value outside the value limits)
03 hex	**Incorrect subindex** (access to a subindex that does not exist.)
04 hex	**No array** (access with a subindex to non-indexed parameters)
05 hex	**Incorrect data type** (change request with a value that does not match the data type of the parameter)
06 hex	**Setting not permitted, only resetting** (change request with a value not equal to 0 without permission)
07 hex	**Descriptive element cannot be changed** (change request to a descriptive element error value that cannot be changed)
0B hex	**No master control** (change request but with no master control, see also p0927.)
0C hex	**Keyword missing**
11 hex	**Request cannot be executed due to the operating state** (access is not possible for temporary reasons that are not specified)
14 hex	**Inadmissible value** (change request with a value that is within the limits but which is illegal for other permanent reasons, i.e. a parameter with defined individual values)
65 hex	**Parameter number is currently deactivated** (depending on the mode of the inverter)
66 hex	**Channel width is insufficient** (communication channel is too small for response)
68 hex	**Illegal parameter value** (parameter can only assume certain values)
6A hex	**Request not included / task is not supported** (the valid request identifications can be found in table "Request identifications controller → inverter")
6B hex	**No change access for a controller that is enabled**. (operating status of the inverter prevents a parameter change)
86 hex	**Write access only for commissioning (p0010 = 15)** (operating status of the inverter prevents a parameter change)
87 hex	**Know-how protection active, access locked**
C8 hex	**Change request below the currently valid limit** (change request to a value that lies within the "absolute" limits, but is however below the currently valid lower limit)
C9 hex	**Change request above the currently valid limit** (example: a parameter value is too large for the inverter power)
CC hex	**Change request not permitted** (change is not permitted as the access code is not available)

Offset and page index of the parameter numbers

Parameter numbers < 2000   PNU = parameter number.
Write the parameter number into the PNU (PKE bit 10 ... 0).

Parameter numbers ≥ 2000   PNU = parameter number - offset.
Write the parameter number minus the offset into the PNU
(PKE bit 10 … 0).
Write the offset in the page index (IND bit 7 … 0).

Parameter number	Offset	Page index								
		Hex	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0000 … 1999	0	0 hex	0	0	0	0	0	0	0	0
2000 … 3999	2000	80 hex	1	0	0	0	0	0	0	0
6000 … 7999	6000	90 hex	1	0	0	1	0	0	0	0
8000 … 9999	8000	20 hex	0	0	1	0	0	0	0	0
10000 … 11999	10000	A0 hex	1	0	1	0	0	0	0	0
20000 … 21999	20000	50 hex	0	1	0	1	0	0	0	0
30000 … 31999	30000	F0 hex	1	1	1	1	0	0	0	0
60000 … 61999	60000	74 hex	0	1	1	1	0	1	0	0

Indexed parameters

For indexed parameters, you must write the index as hex value into the subindex (IND
bit 15 … 8).

Parameter contents

Parameter contents can be parameter values or connector parameters. For interconnecting
connector parameters please see section: Interconnecting signals in the converter
(Page 413).

Enter the parameter value, right-justified, as follows in the 4th word of the parameter
channel:

- 8-bit values: 4. Word, bit 0 … 7,
  bits 8 … 15 of the 4th word and the 3rd word are zero.

- 16-bit values: 4. Word, bits 0 … 15,
  The 3rd word is zero.

- 32-bit values: 3. and 4th word

Enter a connector parameter as follows:

- Number of the connector parameter: 3. Word

- Drive object of the connector parameter: 4. Word, bits 10 … 15

- The index or bit field number of the
  connector parameter: 4. Word, bits 0 … 9

Telegram examples

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 the parameter)

- **IND, bit 0 ... 7 (page index): = 90 hex** (offset 6000 ≙ 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

Figure 7-5   Telegram for a read request from p7841[2]

Write request: Change restart mode (p1210)

The restart mode is inhibited in the factory setting (p1210 = 0). In order to activate the automatic restart with "acknowledge all faults and restart for an ON command", p1210 must be set to 26:

- **PKE, bit 12 ... 15 (AK): = 7** (change parameter value (field, word))

- **PKE, bit 0 ... 10 (PNU): = 4BA hex** (1210 = 4BA hex, no offset, as 1210 < 1999)

- **IND, bit 8 ... 15 (subindex): = 0 hex** (parameter is not indexed)

- **IND, bit 0 ... 7 (page index): = 0 hex** (offset 0 corresponds to 0 hex)

- **PWE1, bit 0 ... 15: = 0 hex**

- **PWE2, bit 0 ... 15: = 1A hex** (26 = 1A hex)

Parameter channel						
PKE, 1st word		IND, 2nd word		PWE1 - high, 3rd word	PWE2 - low, 4th word
15 ... 12	11	10 ... 0	15 ... 8	7 ... 0	15 ... 0	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

Figure 7-6   Telegram, to activate the automatic restart with p1210 = 26

Write request: Assign digital input 2 with the function ON/OFF1 (p0840[1] = 722.2)

In order to link digital input 2 with OFF1/ON, you must assign parameter p0840[1] (source, ON/OFF1) the value 722.2 (DI 2). To do this, you must fill the telegram of the parameter channel as follows:

- **PKE, bit 12 … 15 (AK): = 7 hex** (change, parameter value (field, word))

- **PKE, bit 0 … 10 (PNU): = 348 hex** (840 = 348 hex, no offset, as 840 < 1999)

- **IND bit 8 … 15 (subindex): = 1 hex** (CDS1 = index1)

- **IND, bit 0 … 7 (page index): = 0 hex** (offset 0 ≙ 0 hex)

- **PWE1, bit 0 … 15**: = **2D2 hex** (722 = 2D2 hex)

- **PWE2, bit 10 … 15: = 3f hex** (drive object - for SINAMICS G120, always 63 = 3f hex)

- **PWE2, bit 0 … 9: = 2 hex** (index of parameter (DI 2 = 2))

Parameter channel							
PKE, 1st word		IND, 2nd word		PWE1 - high, 3rd word	PWE2 - low, 4th word		
15 ... 12	11 10 ... 0	15 ... 8	7 ... 0	15 ... 0	15 ... 10	9 ... 0	
AK	Parameter number	Subindex	Page index	Parameter value	Drive Object	Index	
0 1 1 1	0 0 0 1 1 0 1 0 0 1 0 0 0	0 0 0 0 0 0 0 1	0 0 0 0 0 0 0 0	0 0 0 0 0 0 1 0 1 1 0 1 0 0 1 0	1 1 1 1 1 1	0 0 0 0 0 0 0 0 1 0	

Figure 7-7   Telegram, to assign DI 2 with ON/OFF1

Other application examples

See also: Reading and writing parameters via PROFIBUS (http://support.automation.siemens.com/WW/view/en/8894584).

7.3.1.5   Slave-to-slave communication

"Direct data exchange" is sometimes called "slave-to-slave communication" or "data exchange broadcast". Here, slaves exchange data without any direct involvement of the master.

Example: An inverter uses the actual speed value of another inverter as its speed setpoint.

Definitions

- **Publisher:** Slave, which sends data for direct data exchange.

- **Subscriber:** Slave, which receives the data for direct data exchange from the publisher.

- **Links and access points** define the data that is used for direct data exchange.

Restrictions

- Direct data exchange in the current firmware version is only possible for inverters with PROFIBUS communication.

- A maximum of 12 PZDs are permissible for each drive.

- To a publisher, a maximum of 4 links are possible.

Procedure

To configure direct data exchange, proceed as follows:

1. In the control, define:

   – Which inverters operate as publisher (sender) or subscriber (receiver)?

   – Which data or data areas do you use for direct data exchange?

2. In the inverter, define:

   How does the subscriber process the data transferred using direct data exchange?

You have configured direct data exchange.

See also Section: Configuring slave-to-slave communication in STEP 7 (Page 433).

7.3.2 Acyclic communication

You can communicate with the inverter both cyclically and acyclically via PROFIBUS and PROFINET.

The inverter supports the following types of acyclic communication:

● Reading and writing parameters via "data set 47" (up to 240 bytes per write or read request)

● Reading-out profile-specific parameters

● Data exchange with a SIMATIC panel (Human Machine Interface)

You can find a STEP 7 program example for acyclic data transfer in Section STEP 7 program example for acyclic communication (Page 429).

Reading parameter values

Table 7- 2   Request to read parameters

Data block	Byte n	Bytes n + 1	n
Header	Reference *01 hex ... FF hex*	**01 hex**: Read request	0
	01 hex	**Number of parameters (m)** *01 hex ... 27 hex*	2
Address, parameter 1	Attribute *10 hex:* Parameter value *20 hex:* Parameter description	**Number of indexes** *00 hex ... EA hex* (for parameters without index: 00 hex)	4
	Parameter number *0001 hex ... FFFF hex*		6
	Number of the 1st index *0000 hex ... FFFF hex* (for parameters without index: 0000 hex)		8
	…		…
Address, parameter 2	…		…
…	…		…
Address, parameter m	…		…

Table 7- 3   Inverter response to a read request

Data block	Byte n	Bytes n + 1	n
Header	**Reference** (identical to a read request)	**01 hex**: Inverter has executed the read request. **81 hex**: Inverter was not able to completely execute the read request.	0
	01 hex	**Number of parameters (m)** (identical to the read request)	2
Values, parameter 1	**Format** 02 hex: Integer8 03 hex: Integer16 04 hex: Integer32 05 hex: Unsigned8 06 hex: Unsigned16 07 hex: Unsigned32 08 hex: FloatingPoint 10 hex OctetString 13 hex TimeDifference 41 hex: Byte 42 hex: Word 43 hex: Double word 44 hex: Error	**Number of index values** or - for a negative response - **number of error values**	4
	Value of the 1st index or - for a negative response - **error value 1** You can find the error values in a table at the end of this section.		6
	…		…
Values, parameter 2	…		
…	…		
Values, parameter m	…		

Changing parameter values

Table 7- 4   Request to change parameters

Data block	Byte n	Bytes n + 1	n
Header	**Reference** *01 hex ... FF hex*	**02 hex**: Change request	0
	01 hex	**Number of parameters (m)** *01 hex ... 27 hex*	2
Address, parameter 1	**10 hex**: Parameter value	**Number of indexes** *00 hex ... EA hex* (00 hex and 01 hex have the same significance)	4
	Parameter number *0001 hex ... FFFF hex*		6
	Number of the 1st index *0001 hex ... FFFF hex*		8
	…		…
Address, parameter 2	…		
…	…		…
Address, parameter m	…		

Data block	Byte n	Bytes n + 1	n
Values, parameter 1	**Format** *02 hex:* Integer 8 *03 hex:* Integer 16 *04 hex:* Integer 32 *05 hex:* Unsigned 8 *06 hex:* Unsigned 16 *07 hex:* Unsigned 32 *08 hex:* Floating Point *10 hex* Octet String *13 hex* Time Difference *41 hex:* Byte *42 hex:* Word *43 hex:* Double word	**Number of index values** *00 hex ... EA hex*	
	Value of the 1st index		
	…		
Values, parameter 2	…		
…	…		
Values, parameter m	…		

Table 7- 5   Response, if the inverter has executed the change request

Data block	Byte n	Bytes n + 1	n
Header	**Reference** (identical to a change request)	**02 hex**	0
	01 hex	**Number of parameters** (identical to a change request)	2

Table 7- 6   Response if the inverter was not able to completely execute the change request

Data block	Byte n	Bytes n + 1	n
Header	**Reference** (identical to a change request)	**82 hex**	0
	01 hex	**Number of parameters** (identical to a change request)	2
Values, parameter 1	**Format** 40 hex: Zero (change request for this data block executed) 44 hex: Error (change request for this data block not executed)	**Number of error values** 00 hex or 02 hex	4
	Only for "Error" - **error value 1** You can find the error values in the table at the end of this section.		6
	Only for "Error" - **error value 2** Error value 2 is either zero, or it contains the number of the first index where the error occurred.		8
Values, parameter 2	...		
...	…		…
Values, parameter m	...		

Table 7- 7   Error value in the parameter response

Error value 1	Significance
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 parameter index 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 that cannot be changed)
09 hex	**Description data not available** (access to a description that does not exist, parameter value is available)
0B hex	**No master control** (change request but with no master control)
0F hex	**Text array does not exist** (although the parameter value is available, the request is made to a text array that does not exist)
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)
15 hex	**Response too long** (the length of the actual response exceeds the maximum transfer length)
16 hex	**Illegal parameter address** *(illegal or unsupported value for attribute, number of elements, parameter number, subindex or a combination of these)*
17 hex	**Illegal format** (change request for an illegal or unsupported format)
18 hex	**Number of values not consistent** *(number of values of the parameter data to not match the number of elements in the parameter address)*
19 hex	**Drive object does not exist** (access to a drive object that does not exist)
6B hex	**No change access for a controller that is enabled**.
6C hex	**Unknown unit**.
6E hex	**Change request is only possible when the motor is being commissioned (p0010 = 3)**.
6F hex	**Change request is only possible when the power unit is being commissioned (p0010 = 2)**.
70 hex	**Change request is only possible for quick commissioning (basic commissioning) (p0010 = 1)**.
71 hex	**Change request is only possible if the inverter is ready (p0010 = 0)**.
72 hex	**Change request is only possible for a parameter reset (restore to factory setting) (p0010 = 30)**.
73 hex	**Change request possible only during commissioning of the safety functions (p0010 = 95)**.
74 hex	**Change request is only possible when a technological application/unit is being commissioned (p0010 = 5)**.
75 hex	**Change request is only possible in a commissioning state (p0010 ≠ 0)**.
76 hex	**Change request is not possible for internal reasons (p0010 = 29)**.
77 hex	**Change request is not possible at download**.
81 hex	**Change request is not possible at download**.
82 hex	**Transfer of the control authority (master) is inhibited by BI: p0806**.
83 hex	**Desired interconnection is not possible** (the connector output does not supply a float value although the connector input requires a float value)
84 hex	**Inverter does not accept a change request** (inverter is busy with internal calculations. See parameter r3996 in the inverter List Manual. See also Section: Manuals for your inverter (Page 435))
85 hex	**No access methods defined**.

Error value 1	Significance
86 hex	**Write access only during commissioning of the data records (p0010 = 15)** (operating status of the inverter prevents a parameter change.)
87 hex	**Know-how protection active, access locked**
C8 hex	**Change request below the currently valid limit** (change request to a value that lies within the "absolute" limits, but is however below the currently valid lower limit)
C9 hex	**Change request above the currently valid limit** (example: a parameter value is too large for the inverter power)
CC hex	**Change request not permitted** (change is not permitted as the access code is not available)

Other application examples

See also: Reading and writing parameters acyclically (http://support.automation.siemens.com/WW/view/en/29157692).

7.4 PROFIenergy profile for PROFINET

7.4.1 PROFIenergy

The non-proprietary PROFIenergy profile provides the following functions:

- switches off plant or plant sections in non-operational periods
- monitors the energy flow
- signals the plant or system state

PROFIenergy functions of the inverter

The higher-level control transfers commands to the inverter acyclically. The following commands and queries are available for the control:

Control commands

- Start_Pause
  Signal for the start and duration of a pause
- End_Pause
  Signal for the return into the productive state

Status queries

- PEM_Status
  Actual device status: Energy-saving mode or productive state
- Query_Measurement
  Energy usage

Basic settings in the inverter

Parameter p5611 defines the responses to the PROFIenergy command "Start_Pause".

Enabling PROFIenergy	p5611.0 = 0	Yes	
	p5611.0 = 1		No
For "Start_Pause", the drive initiates OFF1	p5611.1= 0		No
	p5611.1= 1	Yes	
Transition into the energy-saving mode from S4	p5611.2 = 0		No
	p5611.2 = 1	Yes	

Table 7- 8   Dependency on the settings of p5611.0 … p5611.2

Bit 0	Bit 1	Bit 2	
0	0	0	Energy-saving mode enabled. • Display in r5613 • no additional "automatic" responses. • Set the responses to PROFIenergy commands on the inverter side.
1	0/1	0/1	Energy-saving mode not enabled. No response to PROFIenergy commands from the control

0	1	0	Energy-saving mode enabled with the following responses:
			
			• Display in r5613
			
			• OFF1 is set if the "Start_Pause" command is received from the control.
			   – The command is immediately effective in the inverter states "switching on inhibited" (S1) or "ready to start" (S2).
			   – In the "operation" state (S4), OFF1 only becomes effective if the inverter has been brought into the "switching on inhibited" (S1) or "ready to start" (S2) state as a result of other commands, either from the control or inverter side.
			• The inverter cannot be switched on as long as the "Start_Pause" command is present.
			The OFF1 command is withdrawn with "End_Pause".

0	1	1	Energy-saving mode enabled with the following responses: • Display in r5613 • OFF1 is set if the "Start_Pause" command is received from the control. The command is immediately effective in the inverter states "switching on inhibited" (S1), "ready to start" (S2), "ready" (S3) and operation (S4). • With the "End_Pause" command, the pulses are re-enabled and the motor starts, if one of the states "ready" (S3) or "operation" (S4) is present.

Additional settings and displays

Settings

- Minimum pause time: p5602
  is the time that the machine requires to change into the energy-saving mode and back into the production mode.

- Maximum pause time: p5606

- Signal source to set the inverter into state S1 (switching on inhibited): p5614
  (e.g. p5614 = 722.0, means that you bring the inverter into the "switching-on inhibited" state via DI0).

- Reset the energy usage display to 0: p0040

Displaying

Display value	in the inverter	in the PROFIenergy profile
Power output at the motor shaft	r0032 in kW	ID 34 in W
Power factor	r0038	ID166
Balance from the energy drawn and fed back	r0039[1], in kWh	ID 200 in Wh
Interconnectable display of the PROFIenergy state	r5613	---
Energy saved - with respect to the adjustable characteristic (p3320 … p3329)	r0041	---

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

127

7.5 Communication via EtherNet/IP

Via EtherNet/IP you can enter commands and setpoints, read-out status information and actual values, change parameter values and reset faults.

Process data (setpoints, actual values, etc.) are transferred in EtherNet/IP using assemblies. In addition to the assemblies, there are objects that you can use to set the communication. The objects and assemblies supported by the inverter are described in Section Supported objects (Page 131)

7.5.1 Connect converter to Ethernet/IP

The Control Units have two RJ45 sockets for connection to the control system, which you can use to implement a line topology. You can implement all topologies by using switches.

We recommend the following connector with order number: 6GK1901-1BB10-2Ax0 for connecting an EtherNet cable.

Instructions for assembling the SIMATIC NET Industrial Ethernet FastConnect RF45 Plug 180 can be found on the Internet under product information " "Assembly instructions for SIMATIC NET Industrial Ethernet FastConnect RJ45 Plug (http://support.automation.siemens.com/WW/view/en/37217116/133300)".

Procedure

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

1. Connect the inverter to the control system via an Ethernet cable.

2. Either
   create a generic I/O module (Page 140) in your control system for cyclic data exchange between the control system and the inverter
   or
   load the EDS file of the ODVA into the control system. You can find the file in the internet at:
   (http://www.odva.org/Home/CIPPRODUCTCOMPLIANCE/DeclarationsofConformity/EtherNetIPDOCs/tabid/159/lng/en-US/Default.aspx) .

You have connected the inverter to the control system via EtherNet/IP.

See also Section: Interfaces, connectors, switches, control terminals and LEDs on the CU (Page 50).

Routing and shielding the Ethernet cable

Information can be found on the Internet: EtherNet/IP guidelines (http://www.odva.org/Home/ODVATECHNOLOGIES/EtherNetIP/EtherNetIPLibrary/tabid/76/lng/en-US/Default.aspx).

Commissioning the inverter in an EtherNet/IP network

To commission the inverter, using STARTER you must access the inverter via the USB interface. To do this, connect the computer to the inverter via the USB interface. See also Basic commissioning with STARTER (Page 78).

7.5.2 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 inverter via the fieldbus.

- Is the inverter correctly connected to the EtherNet/IP?
- Is the EDS file (Page 128) installed in your control system?
- Have the bus interface and IP address been correctly set?
- Have the signals that the inverter and the control system exchange been correctly interconnected?

7.5.3 Communication settings for Ethernet/IP

General communication settings

In order to be able to communicate with a higher-level control system via EtherNet/IP, you must set parameter p2030 = 10.

Further, you must set the following data:

● IP address	in p8921	currently valid value in r8931
● Subnet mask	in p8923	currently valid value in r8933
● Default gateway	in p8922	currently valid value in r8932
● Name of station	in p8920	currently valid value in r8930

These parameters apply if p2030 = 10 is set, for EtherNet/IP, even if the parameter name indicates PROFINET.

Modified addresses only become effective if you switch-off the inverter and switch it on again; this includes any external 24 V supply that is being used.

Additional settings for communication via EtherNet/IP

Setting the communication profile

The inverter has two communication profiles

- p8980 = 0: SINAMICS profile (factory setting)
  A drive profile defined by Siemens for EtherNet/IP based on PROFIdrive

- p8980 = 1: ODVA AC/DC drive profile
  A drive profile defined by the ODVA organization

Telegram selection

You select the telegram using p0922.

You can select any of the listed telegrams if you are working with the SINAMICS profile.

If you use the AC/DC profile of the ODVA, select the standard telegram, p0922 = 1. You cannot work with the EDS file if you wish to use the assemblies described in Section Supported objects (Page 131). In this case, you must integrate the inverter into your control system.

Setting the bus monitoring time

You set the bus monitoring using parameter p8840 in the inverter.

If you set this parameter to 0, the inverter continues to operate even if the bus develops a fault condition. If you set a time ≠ 0, then the inverter switches off with F08501 "Setpoint timeout" if the control system does not issue any signals within this time.

7.5.4 Additional settings if you are working with the AC/DC profile

If you change the following settings in the inverter by accessing the appropriate parameters, you must switch-off the inverter and switched it on again in order that these changes become effective. The changes become immediately effective when making the changes via the control system with objects 90 hex or 91 hex.

Setting the off response for the motor

You set the standard off response for the inverter using parameter p8981:
- p8981 = 0: OFF1 (factory setting), also corresponds to the setting in the SINAMICS profile

- p8981 = 1: OFF2

You can find details on OFF1 and OFF2 in section Switching the motor on and off (Page 219)

Setting the speed and torque scaling

You scale the speed and torque display using parameter p8982 or p8983. Setting range: 2^5 to 2^{-5}.

Displaying the maximum process data that can be transferred (PZD)
- r2067[0] maximum interconnected PZD length - receiving
- p2067[1] maximum interconnected PZD length - sending

7.5.5 Supported objects

EtherNet/IP objects supported by the G120

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	30	Motor Data Object		x	
29 hex	31	Supervisor Object		x	
2A hex	42	Drive Object		x	
32C hex	44	Siemens Drive Object			x
32D hex	45	Siemens Motor Data Object			x
90 hex	144	Parameter object			x
91 hex	145	Parameter object free access (DS47)			x
F5 hex	245	TCP/IP Interface object [1]	x		
F6 hex	246	Ethernet Link object 1)	x		
401 hex … 43E hex	1025 … 1086	Parameter object			x

1) these objects are part of the EtherNet/IP system management.

ODVA AC/DC assembly

Number		required/ optional	Type	Name
hex	dec			
14 hex	20	Required	Sending	Basic Speed Control Output
15 hex	21	Optional	Sending	Extended Speed Control Output
16 hex	22	Optional	Sending	Speed and Torque Control Output
17 hex	23	Optional	Sending	Extended Speed and Torque Control Output
18 hex	24	Optional	Sending	Process Control Output
19 hex	25	Optional	Sending	Extended Process Control Output
46 hex	70	Required	Receiving	Basic Speed Control Input
47 hex	71	Optional	Receiving	Extended Speed Control Input
48 hex	72	Optional	Receiving	Speed and Torque Control Input
49 hex	73	Optional	Receiving	Extended Speed and Torque Control Input
4A hex	74	Optional	Receiving	Process Control Input
4B hex	75	Optional	Receiving	Extended Process 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)							

Assembly Basic Speed Control with parameter assembly, Instance Number: 120, 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)							
4	Data Out 1 Value (Low Byte)							
5	Data Out 1 Value (High Byte)							
6	Data Out 2 Value (Low Byte)							
7	Data Out 2 Value (High Byte)							
8	Data Out 3 Value (Low Byte)							
9	Data Out 3 Value (High Byte)							
10	Data Out 4 Value (Low Byte)							
11	Data Out 4 Value (High Byte)							
12	Data Out 5 Value (Low Byte)							
13	Data Out 5 Value (High Byte)							
14	Data Out 6 Value (Low Byte)							
15	Data Out 6 Value (High Byte)							
16	Data Out 7 Value (Low Byte)							
17	Data Out 7 Value (High Byte)							
18	Data Out 8 Value (Low Byte)							
19	Data Out 8 Value (High Byte)							
20	Data Out 9 Value (Low Byte)							
21	Data Out 9 Value (High Byte)							
22	Data Out 10 Value (Low Byte)							
23	Data Out 10 Value (High Byte)							

Assembly Basic Speed Control with parameter assembly, Instance Number: 170, 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)							
4	Data In 1 Value (Low Byte)							
5	Data In 1 Value (High Byte)							
6	Data In 2 Value (Low Byte)							
7	Data In 2 Value (High Byte)							
8	Data In 3 Value (Low Byte)							
9	Data In 3 Value (High Byte)							
10	Data In 4 Value (Low Byte)							
11	Data In 4 Value (High Byte)							
12	Data In 5 Value (Low Byte)							
13	Data In 5 Value (High Byte)							
14	Data In 6 Value (Low Byte)							
15	Data In 6 Value (High Byte)							
16	Data In 7 Value (Low Byte)							
17	Data In 7 Value (High Byte)							
18	Data In 8 Value (Low Byte)							
19	Data In 8 Value (High Byte)							
20	Data In 9 Value (Low Byte)							
21	Data In 9 Value (High Byte)							
22	Data In 10 Value (Low Byte)							
23	Data In 10 Value (High Byte)							

Assembly Extended Speed Control, Instance Number: 21, type: Output

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

Assembly Extended Speed Control, Instance Number: 71, type: Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	At Reference	Ref From Net	Crtl From Net	Ready	Running Reverse	Running Forward	Warning	Faulted
1	Drive State							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							

Assembly Extended Speed Control with parameter assembly, Instance Number: 121, type: Output

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		NetRef	Net CtrL			Fault Reset	RUN Reverse	RUN Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	Data Out 1 Value (Low Byte)							
5	Data Out 1 Value (High Byte)							
6	Data Out 2 Value (Low Byte)							
7	Data Out 2 Value (High Byte)							
8	Data Out 3 Value (Low Byte)							
9	Data Out 3 Value (High Byte)							
10	Data Out 4 Value (Low Byte)							
11	Data Out 4 Value (High Byte)							
12	Data Out 5 Value (Low Byte)							
13	Data Out 5 Value (High Byte)							
14	Data Out 6 Value (Low Byte)							
15	Data Out 6 Value (High Byte)							
16	Data Out 7 Value (Low Byte)							
17	Data Out 7 Value (High Byte)							
18	Data Out 8 Value (Low Byte)							
19	Data Out 8 Value (High Byte)							
20	Data Out 9 Value (Low Byte)							
21	Data Out 9 Value (High Byte)							
22	Data Out 10 Value (Low Byte)							
23	Data Out 10 Value (High Byte)							

Assembly Extended Speed Control with parameter assembly, Instance Number: 171, type: Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	At Reference	Ref From Net	Ref From Net	Ready	Running Reverse	Running Forward	Warning	Faulted
1	Drive State							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Data In 1 Value (Low Byte)							
5	Data In 1 Value (High Byte)							
6	Data In 2 Value (Low Byte)							
7	Data In 2 Value (High Byte)							
8	Data In 3 Value (Low Byte)							
9	Data In 3 Value (High Byte)							
10	Data In 4 Value (Low Byte)							
11	Data In 4 Value (High Byte)							
12	Data In 5 Value (Low Byte)							
13	Data In 5 Value (High Byte)							
14	Data In 6 Value (Low Byte)							
15	Data In 6 Value (High Byte)							
16	Data In 7 Value (Low Byte)							
17	Data In 7 Value (High Byte)							
18	Data In 8 Value (Low Byte)							
19	Data In 8 Value (High Byte)							
20	Data In 9 Value (Low Byte)							
21	Data In 9 Value (High Byte)							
22	Data In 10 Value (Low Byte)							
23	Data In 10 Value (High Byte)							

Assembly Basic Speed and Torque Control , Instance Number: 22, 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								
	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	Torque Reference (High Byte)							
5	Torque Reference (High Byte)							

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

135

Assembly Basic Speed and Torque Control , Instance Number: 72, type: Input

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

Assembly Basic Speed and Torque Control with parameter assembly , Instance Number: 122, 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)							
4	Torque Reference (High Byte)							
5	Torque Reference (High Byte)							
6	Data Out 1 Value (Low Byte)							
7	Data Out 1 Value (High Byte)							
8	Data Out 2 Value (Low Byte)							
9	Data Out 2 Value (High Byte)							
10	Data Out 3 Value (Low Byte)							
11	Data Out 3 Value (High Byte)							
12	Data Out 4 Value (Low Byte)							
13	Data Out 4 Value (High Byte)							
14	Data Out 5 Value (Low Byte)							
15	Data Out 5 Value (High Byte)							
16	Data Out 6 Value (Low Byte)							
17	Data Out 6 Value (High Byte)							
18	Data Out 7 Value (Low Byte)							
19	Data Out 7 Value (High Byte)							
20	Data Out 8 Value (Low Byte)							
21	Data Out 8 Value (High Byte)							
22	Data Out 9 Value (Low Byte)							
23	Data Out 9 Value (High Byte)							
24	Data Out 10 Value (Low Byte)							
25	Data Out 10 Value (High Byte)							

Assembly Basic Speed and Torque Control with parameter assembly , Instance Number: 172, type: Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
						Running Forward		Faulted
1								
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Torque Actual (High Byte)							
5	Torque Actual (High Byte)							
6	Data In 1 Value (Low Byte)							
7	Data In 1 Value (High Byte)							
8	Data In 2 Value (Low Byte)							
9	Data In 2 Value (High Byte)							
10	Data In 3 Value (Low Byte)							
11	Data In 3 Value (High Byte)							
12	Data In 4 Value (Low Byte)							
13	Data In 4 Value (High Byte)							
14	Data In 5 Value (Low Byte)							
15	Data In 5 Value (High Byte)							
16	Data In 6 Value (Low Byte)							
17	Data In 6 Value (High Byte)							
18	Data In 7 Value (Low Byte)							
19	Data In 7 Value (High Byte)							
20	Data In 8 Value (Low Byte)							
	Data In 8 Value (High Byte)							
22	Data In 9 Value (Low Byte)							
23	Data In 9 Value (High Byte)							
24	Data In 10 Value (Low Byte)							
25	Data In 10 Value (High Byte)							

Extended Speed and Torque Control, Instance Number: 23, type: Output

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

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

137

Extended Speed and Torque Control, Instance Number: 73, type: Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	At Reference	Ref From Net	Crtl From Net	Ready	Running Reverse	Running Forward	Warning	Faulted
1	Drive State							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Torque Actual (High Byte)							
5	Torque Actual (High Byte)							

Basic Speed and Torque Control with parameter assembly, Instance Number: 123, type: Output

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0		NetRef	Net CtrL			Fault Reset	RUN Reverse	RUN Forward
1								
2	Speed Reference (Low Byte)							
3	Speed Reference (High Byte)							
4	Torque Reference (High Byte)							
5	Torque Reference (High Byte)							
6	Data Out 1 Value (Low Byte)							
7	Data Out 1 Value (High Byte)							
8	Data Out 2 Value (Low Byte)							
9	Data Out 2 Value (High Byte)							
10	Data Out 3 Value (Low Byte)							
11	Data Out 3 Value (High Byte)							
12	Data Out 4 Value (Low Byte)							
13	Data Out 4 Value (High Byte)							
14	Data Out 5 Value (Low Byte)							
15	Data Out 5 Value (High Byte)							
16	Data Out 6 Value (Low Byte)							
17	Data Out 6 Value (High Byte)							
18	Data Out 7 Value (Low Byte)							
19	Data Out 7 Value (High Byte)							
20	Data Out 8 Value (Low Byte)							
21	Data Out 8 Value (High Byte)							
22	Data Out 9 Value (Low Byte)							
23	Data Out 9 Value (High Byte)							
24	Data Out 10 Value (Low Byte)							
25	Data Out 10 Value (High Byte)							

Basic Speed and Torque Control with parameter assembly, Instance Number: 173, type: Input

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	At Reference	Ref From Net	Crtl From Net	Ready	Running Reverse	Running Forward	Warning	Faulted
1	Drive State							
2	Speed Actual (Low Byte)							
3	Speed Actual (High Byte)							
4	Torque Actual (High Byte)							
5	Torque Actual (High Byte)							
6	Data In 1 Value (Low Byte)							
7	Data In 1 Value (High Byte)							
8	Data In 2 Value (Low Byte)							
9	Data In 2 Value (High Byte)							
10	Data In 3 Value (Low Byte)							
11	Data In 3 Value (High Byte)							
12	Data In 4 Value (Low Byte)							
13	Data In 4 Value (High Byte)							
14	Data In 5 Value (Low Byte)							
15	Data In 5 Value (High Byte)							
16	Data In 6 Value (Low Byte)							
17	Data In 6 Value (High Byte)							
18	Data In 7 Value (Low Byte)							
19	Data In 7 Value (High Byte)							
20	Data In 8 Value (Low Byte)							
21	Data In 8 Value (High Byte)							
22	Data In 9 Value (Low Byte)							
23	Data In 9 Value (High Byte)							
24	Data In 10 Value (Low Byte)							
25	Data In 10 Value (High Byte)							

7.5.6 Create generic I/O module

For certain control systems, you cannot use the EDS file provided by the ODVA. In these cases, you must create a generic I/O module in the control system for the cyclic communication.

Procedure

Proceed as follows to create a generic I/O module:

1. In your control system, via "New module" create a new "I/O module", "Generic" type.

2. In the control system, enter the lengths for the process data for cyclic communication, which you have selected in STARTER, r2067[0] (input), r2067[1] (output), for example: Standard telegram 2/2.

3. In STARTER, set the same values for IP address, Subnet Mask, Default Gateway and the Name of Station as in the control system (see Communication settings for Ethernet/IP (Page 129))

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

7.6 Communication via RS485

7.6.1 Integrating inverters into a bus system via the RS485 interface

Connecting to a network via RS485

Connect the inverter to your fieldbus via the RS485 interface. Position and assignment of the RS485 interface can be found in Section Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50). This connector has short-circuit proof, isolated pins.
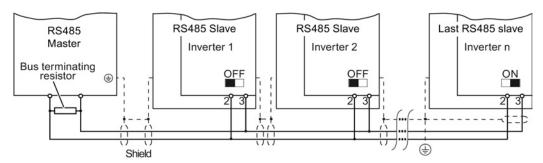
Figure 7-8   Communication network via RS485

You must switch-in the bus-terminating resistor for the first and last nodes. The position of the bus-terminating resistor can be found in Section Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

Note

During bus operation the first and last bus subscriber must be constantly supplied with power as otherwise the communication with the other subscribers is broken.

With the exception of the first or last slave, when required you can remove slaves from the bus. To do this, withdraw the bus connector. When doing this, communication to the other nodes (stations) is not interrupted.

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

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

In the case of short interruptions of the 24 V voltage supply, the inverter may report a fault without communications with the controller being interrupted.

7.6.2 Communication via USS

The USS protocol is a serial-data connection between one master and one or more slaves. A master is, for example:

- A programmable logic controller (e.g. SIMATIC S7-200)
- A PC

The inverter is always a slave.

A maximum of 31 slaves is possible.

The maximum cable length is 100 m.

Information about how to connect the inverter to the USS fieldbus is provided in Section Integrating inverters into a bus system via the RS485 interface (Page 141).

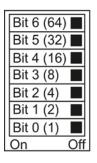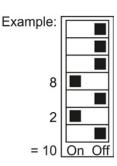### 7.6.2.1 Basic settings for communication

Setting the address

You set the bus address of the inverter using the address switches on the Control Unit, using parameter p2021 or in STARTER.

Valid address range: 1 … 30

If you have specified a valid address using the address switches, this address will always be the one that takes effect, and parameter p2021 (factory setting: 0) will not be able to be changed.

The positions of the address switches are described in Section: Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

Procedure

To change the bus address, proceed as follows:

1. Set the address using one of the subsequently listed options:
   - using the address switches
   - with an operator panel using p2021
   - in STARTER using screen form "Control Unit/Communication/Fieldbus", or using the expert list with p2021

2. Switch on the inverter power supply and, if being used, the 24 V supply for the Control Unit.

3. Switch on the voltages again after all LEDs at the inverter have gone dark.

This means that you have changed the bus address.

Additional settings

Parameter	Description			
p0015 = 21	**Macro drive device** Select the I/O configuration			
p2020	**Setting the baud rate**			
	Value	Baud rate	Value	Baud rate
	4	2400	9	57600
	5	4800	10	76800
	6	9600	11	93750
	7	19200	12	115200
	8	38400	13	187500
p2022	**Fieldbus interface USS PZD number** Sets the number of 16-bit words in the PZD part of the USS telegram Setting range: 0… 8 (0 … 8 words)			
p2023	**Fieldbus interface USS PIV number** Sets the number of 16-bit words in the PIV part of the USS telegram Setting range: • 0, 3, 4: 0, 3 or 4 words • 127: variable length			
p2040	**Fieldbus interface monitoring time [ms]** Sets the monitoring time to monitor the process data received via the fieldbus. If no process data is received within this time, an appropriate message is output			

7.6.2.2   Telegram structure

Overview

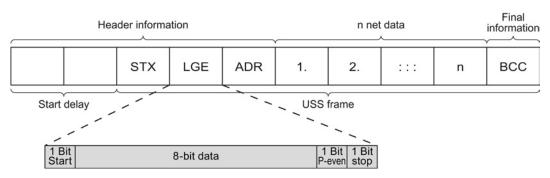A USS telegram comprises a series of elements with a defined sequence. Each element contains 11 bits.

Figure 7-9   Structure of a USS telegram

Telegram part	Description
Start delay / response delay	There is always a start and/or response delay between two telegrams (see alsoTime-out and other errors (Page 151))
STX	An ASCII character (02 hex) indicates the beginning of the message.
LGE	The telegram length "LGE" is calculated as follows: LGE = user data (n bytes) + ADR (1 byte) + BCC (1 byte)
ADR	 • Bit 7 = 0: Normal data exchange. Bit 7 =1, to transfer telegrams that require a net data structure different from the device profile. • Bit 6 = 0: Normal data exchange. Bit 6 = 1: Testing the bus connection: The converter returns the telegram unchanged to the master. • Bit 5 = 0: Normal data exchange. (Bit 5 = 1: Not supported in the converter.) • Bits 0 ... 4: Address of the converter.
Net data	See section User data range of the USS telegram (Page 144).
BCC	Checksum (exclusive or) across all telegram bytes – with the exception of BCC.

7.6.2.3 User data range of the USS telegram

The user data area consists of the following elements:

- Parameter channel (PIV) for writing and reading parameter values
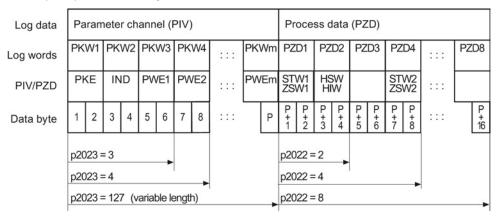- Process data (PZD) for controlling the drive.

Figure 7-10   USS telegram - user data structure

Parameter channel

In parameter p2023 you specify the parameter channel length.

Parameter channel with fixed and variable length

- p2023 = 0
  With this setting, no parameter values are transferred.

- p2023 = 3
  You can select this setting if you only want to read or write 16-bit data or alarm signals.

- p2023 = 4:
  If you want to read or write 32-bit values (for example indexed parameters or bit parameters, e.g. r0722.2), then this setting is required. In this case, the send or receive telegram always contains four words, even if only three would be required. The values are enter right-justified in the 4th word.

- p2023 = 127:
  If you set p2023 = 27 (variable length), the send and response telegrams are as long as the task actually requires.

Process data

Parameter p2022 defines the length for the process data. You can transfer up to eight process data items in one telegram (p2022 = 0 … 8). For p2022 = 0, no process data is transferred.

7.6.2.4 USS parameter channel (PIV)

Structure of the parameter channel

Depending on the setting in p2023, the parameter channel has a fixed length of three or four words, or a variable length, depending on the length of the data to be transferred.

1. and 2nd word contain the parameter number and index as well as the type of job (read or write). The other words of the parameter channel contain parameter contents. The parameter contents can be 8-bit values, 16-bit values (such as baud rate) or 32-bit values (e.g. CO parameters). The parameter contents are entered right justified in the word with the highest number. Words that are not required are assigned 0.

Bit 11 in the 1st word is reserved and is always assigned 0.

The diagram shows a parameter channel that is four words long.

Parameter channel					
PKE, 1st word		IND (2nd word)		PWE (3rd and 4th word)	
15 … 12 | 11	10 … 0	15 … 8	7 … 0	15 … 0	15 … 0
AK | S P M	PNU	Page index	Subindex	PWE 1, high word	PWE 2, low word

You can find examples of telegrams at the end of this section.

Request and response IDs

Bits 12 to 15 of the first word of the parameter channel contain the request and response identifier. The possible identifiers and further explanations can be found in the following tables.

Overview of the request identifiers controller → inverter

Request identifier	Description	Response identifier	
		positive	negative
0	No request	0	7 / 8
1	Request parameter value	1 / 2	7 / 8
2	Change parameter value (word)	1	7 / 8
3	Change parameter value (double word)	2	7 / 8
4	Request descriptive element [1]	3	7 / 8
6[2]	Request parameter value (field) [1]	4 / 5	7 / 8
7[2]	Change parameter value (field, word) [1]	4	7 / 8
8[2]	Change parameter value (field, double word) [1]	5	7 / 8
9	Request number of field elements	6	7 / 8

[1] The required element of the parameter is specified in IND (2nd word).

[2] The following request IDs are identical: 1 ≡ 6, 2 ≡ 7 3 ≡ 8.
We recommend that you use identifiers 6, 7, and 8.

Overview of the response identifiers inverter → controller

The response identifier depends on the request identifier.

Response identifier	Description
0	No response
1	Transfer parameter value (word)
2	Transfer parameter value (double word)
3	Transfer descriptive element [1]
4	Transfer parameter value (field, word) [2]
5	Transfer parameter value (field, double word) [2]
6	Transfer number of field elements
7	Inverter cannot process the request (with error number)
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).

Overview of the error numbers in response identifier 7 (inverter cannot process the request)

For response identifier 7, the inverter sends one of the following error numbers in the highest word of the parameter channel to the controller.

No.	Description
00 hex	**Illegal parameter number** (access to a parameter that does not exist)
01 hex	**Parameter value cannot be changed** (change request for a parameter value that cannot be changed)
02 hex	**Lower or upper value limit exceeded** (change request with a value outside the value limits)
03 hex	**Incorrect subindex** (access to a subindex that does not exist.)
04 hex	**No array** (access with a subindex to non-indexed parameters)
05 hex	**Incorrect data type** (change request with a value that does not match the data type of the parameter)
06 hex	**Setting not permitted, only resetting** (change request with a value not equal to 0 without permission)
07 hex	**Descriptive element cannot be changed** (change request to a descriptive element error value that cannot be changed)
0B hex	**No master control** (change request but with no master control, see also p0927.)
0C hex	**Keyword missing**
11 hex	**Request cannot be executed due to the operating state** (access is not possible for temporary reasons that are not specified)
14 hex	**Inadmissible value** (change request with a value that is within the limits but which is illegal for other permanent reasons, i.e. a parameter with defined individual values)
65 hex	**Parameter number is currently deactivated** (depending on the mode of the inverter)
66 hex	**Channel width is insufficient** (communication channel is too small for response)
68 hex	**Illegal parameter value** (parameter can only assume certain values)
6A hex	**Request not included / task is not supported** (the valid request identifications can be found in table "Request identifications controller → inverter")
6B hex	**No change access for a controller that is enabled**. (operating status of the inverter prevents a parameter change)
86 hex	**Write access only for commissioning (p0010 = 15)** (operating status of the inverter prevents a parameter change)
87 hex	**Know-how protection active, access locked**
C8 hex	**Change request below the currently valid limit** (change request to a value that lies within the "absolute" limits, but is however below the currently valid lower limit)
C9 hex	**Change request above the currently valid limit** (example: a parameter value is too large for the inverter power)
CC hex	**Change request not permitted** (change is not permitted as the access code is not available)

Parameter number

Parameter numbers < 2000	PNU = parameter number. Write the parameter number into the PNU (PKE bit 10 ... 0).
Parameter numbers ≥ 2000	PNU = parameter number - offset. Write the parameter number minus the offset into the PNU (PKE bit 10 … 0). Write the offset in the page index (IND bit 15 … 8).

Table 7- 9   Offset and page index of the parameter numbers

Parameter number	Offset	Page index								
		Hex	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
0000 … 1999	0	0 hex	0	0	0	0	0	0	0	0
2000 … 3999	2000	80 hex	1	0	0	0	0	0	0	0
6000 … 7999	6000	90 hex	1	0	0	1	0	0	0	0
8000 … 9999	8000	20 hex	0	0	1	0	0	0	0	0
10000 … 11999	10000	A0 hex	1	0	1	0	0	0	0	0
20000 … 21999	20000	50 hex	0	1	0	1	0	0	0	0
30000 … 31999	30000	F0 hex	1	1	1	1	0	0	0	0
60000 … 61999	60000	74 hex	0	1	1	1	0	1	0	0

Indexed parameters

For indexed parameters, you must write the index as hex value into the subindex (IND bit 7 … 0).

Parameter contents

Parameter contents can be parameter values or connector parameters. You require two words for connector parameters. For interconnecting connector parameters please see Section Interconnecting signals in the converter (Page 413).

Enter the parameter value in the parameter channel right-justified as follows:

- 8-bit values: Low word, bit 0 ... 7,
  bits 8 … 15 are zero.
- 16-bit values: Low word, bits 0 … 15,
- 32-bit values: Low word and high word

Enter a connector parameter right-justified as follows:

- Number of the connector parameter: High word
- Drive object of the connector parameter: Low word, bits 10 … 15
- The index or bit field number of the connector parameter: Low word, bits 0 … 9

Telegram examples, length of the parameter channel = 4

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 (page index): = 90 hex** (offset 6000 ≙ 90 hex)

- **IND, bit 0 … 7 (subindex): = 2** (Index of the parameter)

- 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	Page index	Subindex	Parameter value	Drive Object	Index
0 1 1 0	0	1 1 1 0 0 1 1 0 0 0 1	1 0 0 1 0 0 0 0	0 0 0 0 0 0 1 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0

Figure 7-11   Telegram for a read request from p7841[2]

Write request: Changing the automatic restart mode (p1210)

Parameter p1210 defines the automatic restart mode:

- **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 (page index): = 0 hex** (offset 0 corresponds to 0 hex)

- **IND, bit 0 … 7 (subindex): = 0 hex** (parameter is not indexed)

- **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	Page index	Subindex	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

Figure 7-12   Telegram, to activate the automatic restart with p1210 = 26

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

149

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 fill the telegram of the parameter channel as follows:

- **PKE, bit 12 … 15 (AK): = 7 hex** (change, parameter value (field, word))

- **PKE, bit 0 … 10 (PNU): = 348 hex** (840 = 348 hex, no offset, as 840 < 1999)

- **IND, bit 8 … 15 (page index): = 0 hex** (offset 0 ≙ 0 hex)

- **IND bit 0 … 7 (subindex): = 1 hex** (command data set, CDS1 = index1)

- **PWE1, bit 0 … 15: = 2D2 hex** (722 = 2D2 hex)

- **PWE2, bit 10 … 15: = 3f hex** (drive object - for SINAMICS G120, always 63 = 3f hex)

- **PWE2, bit 0 … 9: = 2 hex** (index or bit number of the parameter: DI 2 = r0722.2)

Parameter channel							
PKE, 1st word		IND, 2nd word		PWE1 - high, 3rd word	PWE2 - low, 4th word		
15 … 12 | 11	10 … 0	15 … 8	7 … 0	15 … 0	15 … 10	9 … 0	
AK	Parameter number	Page index	Subindex	Parameter value	Drive Object	Index	
0 1 1 1 | 0 | 0 1 1 0 1 0 0 1 0 0 0	0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 1	0 0 0 0 0 0 1 0 1 1 0 1 0 0 1 0	1 1 1 1 1 1	0 0 0 0 0 0 0 0 1 0			

Figure 7-13   Telegram, to assign DI 2 with ON/OFF1

7.6.2.5   USS process data channel (PZD)

Description

The process data channel (PZD) contains the following data depending on the transmission direction:

- Control words and setpoints for the slave

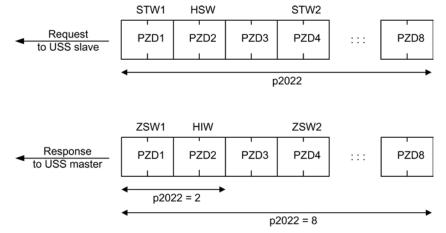- Status words and actual values for the master.

Figure 7-14   Process data channel

The first two words are:

- Control 1 (STW1) and main setpoint (HSW)

- Status word 1 (ZSW1) and main actual value (HIW)

If p2022 is greater than or equal to 4, then the converter receives the additional control word (STW2).

You define the sources of the PZD using parameter p2051.

For further information, please refer to the List Manual.

7.6.2.6 Time-out and other errors

You require the telegram runtimes in order to set the telegram monitoring. The character runtime is the basis of the telegram runtime:

Table 7- 10   Character runtime

Baud rate in bit/s	Transmission time per bit	Character run time (= 11 bits)
9600	104.170 µs	1.146 ms
19200	52.084 µs	0.573 ms
38400	26.042 µs	0.286 ms
115200	5.340 µs	0.059 ms

The telegram runtime is longer than just purely adding all of the character runtimes (=residual runtime). You must also take into consideration the character delay time between the individual characters of the telegram.
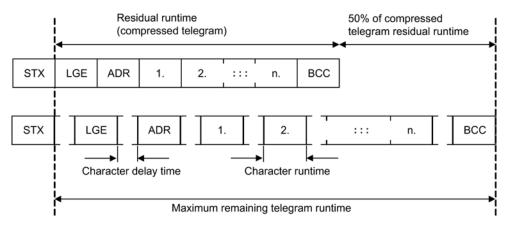

Figure 7-15   Telegram runtime as the sum of the residual runtime and character delay times

The total telegram runtime is always less than 150% of the pure residual runtime.

Before each request telegram, the master must maintain the start delay. The start delay must be > 2 × character runtime.

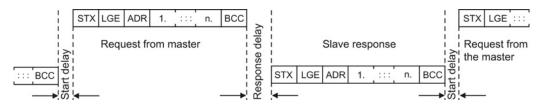The slave only responds after the response delay has expired.

Figure 7-16   Start delay and response delay

The duration of the start delay must at least be as long as the time for two characters and depends on the baud rate.

Table 7- 11   Duration of the start delay

Baud rate in bit/s	Transmission time per character (= 11 bits)	Min. start delay
9600	1.146 ms	> 2.291 ms
19200	0.573 ms	> 1.146 ms
38400	0.286 ms	> 0.573 ms
57600	0.191 ms	> 0.382 ms
115200	0.059 ms	> 0.117 ms

Note: The character delay time must be shorter than the start delay.

Telegram monitoring of the master

With your USS master, we recommend that the following times are monitored:

- Response delay: Response time of the slave to a request from the master

   The response delay must be < 20 ms, but longer than the start delay

- Telegram runtime: Transmission time of the response telegram sent from the slave

Telegram monitoring of the converter

The converter monitors the time between two requests of the master. Parameter p2040 defines the permissible time in ms. If a time p2040 ≠ 0 is exceeded, then the converter interprets this as telegram failure and responds with fault F01910.

150% of the residual runtime is the guide value for the setting of p2040, i.e. the telegram runtime without taking into account the character delay times.

For communication via USS, the converter checks bit 10 of the received control word 1. If the bit is not set when the motor is switched on ("Operation"), the converter responds with fault F07220.

7.6.3 Communication over Modbus RTU

Overview of communication using Modbus

The Modbus protocol is a communication protocol with linear topology based on a master/slave architecture.

Modbus offers three transmission modes:

- **Modbus ASCII**
  Data in ASCII code. The data throughput is lower compared to RTU.

- **Modbus RTU (RTU: Remote Terminal Unit)**
  Data in binary format. The data throughput is greater than in ASCII code.

- **Modbus TCP**
  Data as TCP/IP packets. TCP port 502 is reserved for Modbus TCP. Modbus TCP is currently undergoing definition as a standard (IEC PAS 62030 (pre-standard)).

The Control Unit supports Modbus RTU as a slave with even parity.

1 Bit Start	8 bits of data	1 Bit P-even	1 Bit stop

Communication settings

- Communication using Modbus RTU takes place over the RS485 interface with a maximum of 247 slaves.

- The maximum cable length is 100 m.

- Two 100 kΩ resistors are provided to polarize the receive and send cables.

Note

It is not permitted to change over the units

The "Unit changeover (Page 258)" function is not permissible with this bus system!
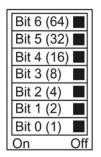

7.6.3.1 Basic settings for communication

You set the bus address of the inverter using the address switches on the Control Unit, using parameter p2021 or in STARTER.
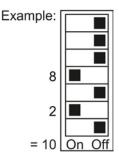
Using parameter p2021 (factory setting: 1) or using STARTER, you can only set the address, if all address switches are set to "OFF" (0).

Valid address range: 1 … 247

If you have specified a valid address using the address switches, this address will always be the one that takes effect, and parameter p2021 (factory setting: 1) will not be able to be changed.

The positions of the address switches are described in Section: Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

	Example:		
Bit 6 (64) ■			■
Bit 5 (32) ■			■
Bit 4 (16) ■			■
Bit 3 (8) ■	8	■	
Bit 2 (4) ■			■
Bit 1 (2) ■	2	■	
Bit 0 (1) ■			■
On Off	= 10	On	Off

Procedure

To change the bus address, proceed as follows:

1. Set the address using one of the subsequently listed options:

    – using the address switches

    – with an operator panel using p2021

    – in STARTER using screen form "Control Unit/Communication/Fieldbus", or using the expert list with p2021

2. Switch on the inverter power supply and, if being used, the 24 V supply for the Control Unit.

3. Switch on the voltages again after all LEDs at the inverter have gone dark.

This means that you have changed the bus address.

Additional settings

Parameter	Description
p0015 = 21	**Macro drive unit** Selecting the I/O configuration
p2030 = 2	**Fieldbus protocol selection** 2: Modbus
p2020	**Fieldbus baud rate** Factory setting = 19200 bit/s
p2024	**Modbus timing** (see Section "Baud rates and mapping tables (Page 156)") • **Index 0: Maximum slave telegram processing time:** The time after which the slave must have sent a response to the master. • **Index 1: Character delay time:** Character delay time: Maximum permissible delay time between the individual characters in the Modbus frame (Modbus standard processing time for 1.5 bytes). • **Index2: Inter-telegram delay:** Maximum permissible delay time between Modbus telegrams (Modbus standard processing time for 3.5 bytes).
p2029	**Fieldbus fault statistics** Displays receive faults on the fieldbus interface
p2040	**Process data monitoring time** Determines the time after which an alarm is generated if no process data is transferred **Note:** You must adapt the time depending on the number of slaves and the baud rate is set on the bus (factory setting = 100 ms).

7.6.3.2 Modbus RTU telegram

Description

For Modbus, there is precisely one master and up to 247 slaves. The master always starts the communication. The slaves can only transfer data at the request of the master. Slave-to-slave communication is not possible. The Control Unit always operates as slave.

The following figure shows the structure of a Modbus RTU telegram.
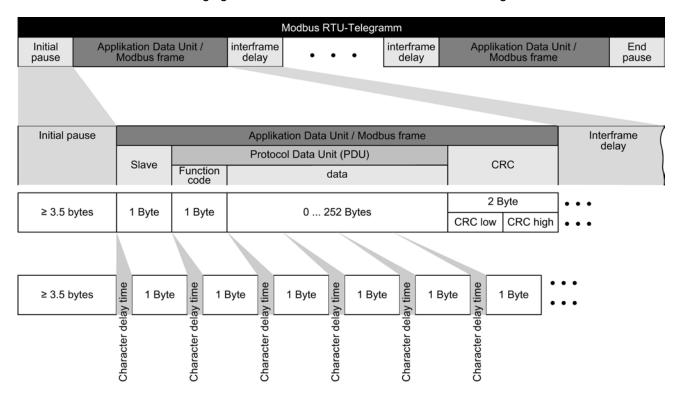
Figure 7-17   Modbus with delay times

The data area of the telegram is structured according to the mapping tables.

7.6.3.3 Baud rates and mapping tables

Permissible baud rates and telegram delay

The Modbus RTU telegram requires pauses for the following cases:

- Start detection
- Between the individual frames
- End detection

Minimum duration: Processing time for 3.5 bytes (can be set via p2024[2]).

A character delay time is also permitted between the individual bytes of a frame. Maximum duration: Processing time for 1.5 bytes (can be set via p2024[1]).

Table 7- 12   Baud rates, transmission times, and delays

Baud rate in bit/s (p2020)	Transmission time per character (11 bits)	Minimum pause between two telegrams (p2024[2])	Maximum pause between two bytes (p2024[1])
4800	2.292 ms	≥ 8.021 ms	≤ 3.438 ms
9600	1.146 ms	≥ 4.010 ms	≤ 1.719 ms
19200 (factory setting)	0.573 ms	≥ 1.75 ms	≤ 0.859 ms
38400	0.286 ms	≥ 1.75 ms	≤ 0.75 ms
57600	0.191 ms	≥ 1.75 ms	≤ 0.556 ms
76800	0.143 ms	≥ 1.75 ms	≤ 0.417 ms
93750	0.117 ms	≥ 1.75 ms	≤ 0.341 ms
115200	0.095 ms	≥ 1.75 ms	≤ 0.278 ms
187500	0.059 ms	≥ 1.75 ms	≤ 0.171 ms

Note

The factory setting for p2024[1] and p2024[2] is 0. The converter specifies the associated values depending on the protocol selection (p2030) or the baud rate.

Modbus register and Control Unit parameters

The Modbus protocol contains register or bit numbers for addressing memory. You must assign the appropriate control words, status words and parameters to these registers in the slave.

The converter supports the following addressing ranges:

Addressing range	Remark
40001 … 40065	Compatible with Micromaster MM436
40100 … 40522	

The valid holding register addressing range extends from 40001 to 40522. Access to other holding registers generates the fault "Exception Code".

The registers 40100 to 40111 are described as process data.

Note

R"; "W"; "R/W" in the column Modbus access stands for read (with FC03); write (with FC06); read/write.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

157

Table 7- 13   Assigning the Modbus register to the parameters of the Control Unit

Modbus Reg. No.	Description	Modbus access	Unit	Scaling factor	On/Off text or value range		Data / parameter
Process data							
Control data							
40100	Control word	R/W	--	1			Process data 1
40101	Main setpoint	R/W	--	1			Process data 2
Status data							
40110	Status word	R	--	1			Process data 1
40111	Main actual value	R	--	1			Process data 2
Parameter data							
Digital outputs							
40200	DO 0	R/W	--	1	HIGH	LOW	p0730, r747.0, p748.0
40201	DO 1	R/W	--	1	HIGH	LOW	p0731, r747.1, p748.1
40202	DO 2	R/W	--	1	HIGH	LOW	p0732, r747.2, p748.2
Analog outputs							
40220	AO 0	R	%	100	-100.0 … 100.0		r0774.0
40221	AO 1	R	%	100	-100.0 … 100.0		r0774.1
Digital inputs							
40240	DI 0	R	--	1	HIGH	LOW	r0722.0
40241	DI 1	R	--	1	HIGH	LOW	r0722.1
40242	DI 2	R	--	1	HIGH	LOW	r0722.2
40243	DI 3	R	--	1	HIGH	LOW	r0722.3
40244	DI 4	R	--	1	HIGH	LOW	r0722.4
40245	DI 5	R	--	1	HIGH	LOW	r0722.5
Analog inputs							
40260	AI 0	R	%	100	-300.0 … 300.0		r0755 [0]
40261	AI 1	R	%	100	-300.0 … 300.0		r0755 [1]
40262	AI 2	R	%	100	-300.0 … 300.0		r0755 [2]
40263	AI 3	R	%	100	-300.0 … 300.0		r0755 [3]
Converter identification							
40300	Powerstack number	R	--	1	0 … 32767		r0200
40301	Converter firmware	R	--	0.0001	0.00 … 327.67		r0018
Converter data							
40320	Rated power of the power unit	R	kW	100	0 … 327.67		r0206
40321	Current limit	R/W	%	10	10.0 … 400.0		p0640
40322	Ramp-up time	R/W	s	100	0.00 … 650.0		p1120
40323	Ramp-down time	R/W	s	100	0.00 … 650.0		p1121
40324	Reference speed	R/W	RPM	1	6.000 … 32767		p2000

Modbus Reg. No.	Description	Modbus access	Unit	Scaling factor	On/Off text or value range		Data / parameter
Converter diagnostics							
40340	Speed setpoint	R	RPM	1	-16250 … 16250		r0020
40341	Actual speed value	R	RPM	1	-16250 … 16250		r0022
40342	Output frequency	R	Hz	100	- 327.68 … 327.67		r0024
40343	Output voltage	R	V	1	0 … 32767		r0025
40344	DC-link voltage	R	V	1	0 … 32767		r0026
40345	Actual current value	R	A	100	0 … 163.83		r0027
40346	Actual torque value	R	Nm	100	- 325.00 … 325.00		r0031
40347	Actual active power	R	kW	100	0 … 327.67		r0032
40348	Energy consumption	R	kWh	1	0 … 32767		r0039
40349	Control priority	R	--	1	HAND	AUTO	r0807
Fault diagnostics							
40400	Failure number, index 0	R	--	1	0 … 32767		r0947 [0]
40401	Failure number, index 1	R	--	1	0 … 32767		r0947 [1]
40402	Failure number, index 2	R	--	1	0 … 32767		r0947 [2]
40403	Failure number, index 2	R	--	1	0 … 32767		r0947 [3]
40404	Failure number, index 3	R	--	1	0 … 32767		r0947 [4]
40405	Failure number, index 4	R	--	1	0 … 32767		r0947 [5]
40406	Failure number, index 5	R	--	1	0 … 32767		r0947 [6]
40407	Failure number, index 6	R	--	1	0 … 32767		r0947 [7]
40408	Alarm number	R	--	1	0 …32767		r2110 [0]
40499	PRM ERROR code	R	--	1	0 …99		--
Technology controller							
40500	Technology controller enable	R/W	--	1	0 … 1		p2200, r2349.0
40501	Technology controller MOP	R/W	%	100	-200.0 … 200.0		p2240
Technology controller adjustment							
40510	Time constant for actual-value filters of the technology controller	R/W	--	100	0.00 … 60.0		p2265
40511	Scaling factor for actual value of the technology controller	R/W	%	100	0.00 … 500.00		p2269
40512	Proportional amplification of the technology controller	R/W	--	1000	0.000 … 65.000		p2280
40513	Integral time of the technology controller	R/W	s	1	0 … 60		p2285
40514	Time constant D-component of the technology controller	R/W	--	1	0 … 60		p2274
40515	Max. limit of technology controller	R/W	%	100	-200.0 … 200.0		p2291
40516	Min. limit technology controller	R/W	%	100	-200.0 … 200.0		p2292
PID diagnostics							
40520	Effective setpoint acc. to internal technology controller MOP ramp-function generator	R	%	100	-100.0 … 100.0		r2250
40521	Actual value of technology controller after filter	R	%	100	-100.0 … 100.0		r2266
40522	Output signal technology controller	R	%	100	-100.0 … 100.0		r2294

7.6.3.4 Write and read access via FC 03 and FC 06

Function codes used

For data exchange between the master and slave, predefined function codes are used for communication via Modbus.

The Control Unit uses the Modbus function code 03, FC 03 (read holding registers) for reading, and the Modbus function code 06, FC 06 (preset single register) for writing.

Structure of a read request via Modbus function code 03 (FC 03)

Any valid register address is permitted as the start address.

The controller can access more than one register via FC 03 with a request. The number of addressed registers is contained in bytes 4 and 5 of the read request.

Table 7- 14   Invalid read requests

Read request	Converter response
Invalid register address	Exception code 02 (invalid data address)
Read a write-only register	Telegram in which all values are set to 0.
Read a reserved register	
Controller addresses more than 125 registers	Exception code 03 (invalid data value)
The start address and the number of registers of an address are located outside of a defined register block	Exception code 02 (invalid data address)

Table 7- 15   Structure of a read request for slave number 17

Example		
	Byte	Description
11 h	0	Slave address
03 h	1	Function code
00 h	2	Register start address "High" (register 40110)
6D h	3	Register start address "Low"
00 h	4	Number of registers "High" (2 registers: 40110; 40111)
02 h	5	Number of registers "Low"
xx h	6	CRC "Low"
xx h	7	CRC "High"

The response returns the corresponding data set:

Table 7- 16   Slave response to the read request

Example		
	Byte	**Description**
11 h	0	Slave address
03 h	1	Function code
04 h	2	Number of bytes (4 bytes are returned)
11 h	3	Data of first register "High"
22 h	4	Data of first register "Low"
33 h	5	Data of second register "High"
44 h	6	Data of second register "Low"
xx h	7	CRC "Low"
xx h	8	CRC "High"

Structure of a write request via Modbus function code 06 (FC 06)

Start address is the holding register address.

Using FC 06, precisely one register can always be addressed with one request. The value to be written to the addressed register is contained in bytes 4 and 5 of the write request.

Table 7- 17   Write request and response of the converter

Write request	Converter response
Incorrect address (a holding register address does not exist)	Exception code 02
Write to a "read-only" register	Modbus error telegram (exception code 04 - device failure)
Write to a reserved register	

If an incorrect address is entered (a holding register address does not exist), exception code 02 (invalid data address) is returned. An attempt to write to a "read-only" register or a reserved register is replied to with a Modbus error telegram (exception code 4 - device failure). In this instance, the detailed internal error code that occurred on the last parameter access via the holding registers can be read out via holding register 40499.

Table 7- 18   Structure of a write request for slave number 17

Example		
	Byte	**Description**
11 h	0	Slave address
06 h	1	Function code
00 h	2	Register start address "High" (write register 40100)
63 h	3	Register start address "Low"
55 h	4	Register data "High"
66 h	5	Register data "Low"
xx h	6	CRC "Low"
xx h	7	CRC "High"

The response returns the register address (bytes 2 and 3) and the value (bytes 4 and 5) that was written by the higher-level controller to the register.

Table 7- 19   Slave response to the write request

Example		
	Byte	**Description**
11 h	0	Slave address
06 h	1	Function code
00 h	2	Register start address "High"
63 h	3	Register start address "Low"
55 h	4	Register data "High"
66 h	5	Register data "Low"
xx h	6	CRC "Low"
xx h	7	CRC "High"

7.6.3.5   Communication procedure

Procedure for communication in a normal case

Normally, the master sends a telegram to a slave (address range 1 ... 247). The slave sends a response telegram to the master. This response telegram mirrors the function code; the slave enters its own address in the telegram and so the slave identifies itself with the master.

The slave only processes orders and telegrams which are directly addressed to it.

Communication errors

If the slave detects a communication error on receipt (parity, CRC), it does not send a response to the master (this can lead to "setpoint timeout").

Logical error

If the slave detects a logical error within a request, it responds to the master with an "exception response". In this case, the slave sets the highest bit in the function code to 1 in the response. If, for example, it receives an unsupported function code from the master, the slave responds with an "exception response" with code 01 (illegal function code).

Table 7- 20   Overview of exception codes

Exception code	Modbus name	Remark
01	Illegal function code	An unknown (unsupported) function code was sent to the slave.
02	Illegal Data Address	An invalid address was requested.
03	Illegal data value	An invalid data value was detected.
04	Server failure	Slave has terminated during processing.

Maximum processing time, p2024[0]

The slave-response time is the time in which the Modbus master expects a response to a request. Set the same slave-response time (p2024 [0] in the inverter) in the master and slave.

Process data monitoring time (setpoint timeout), p2040

The alarm "Setpoint timeout" (F1910) is issued by the Modbus if p2040 is set to a value > 0 ms and no process data is requested within this time period.

The alarm "Setpoint timeout" only applies for access to process data (40100, 40101, 40110, 40111). The alarm "Setpoint timeout" is not generated for parameter data (40200 … 40522).

Note

Adjust the time (factory setting = 100 ms) depending on the number of slaves and the baud rate set on the bus.

7.6.4   Communication via BACnet MS/TP

BACnet properties

In BACnet, components and systems are considered to be black boxes which contain a number of objects. BACnet objects only stipulate the behavior outside the device, BACnet sets no internal functions.

A range of object types and their instances represent one component.

Each BACnet device has precisely one BACnet device object. An NSAP (Network Service Access Point - comprising network number and MAC address; MAC: **M**edium **A**ccess **C**ontrol) uniquely identifies a BACnet device. This address is BACnet-specific and must not be confused with the Ethernet MAC address.

Data exchange with the client

The inverter receives control commands and setpoints via service instructions from the control and transmits its status back to the control. The inverter can also send telegrams automatically itself, respectively execute services, e.g. I-Am.

Communication settings

- The Control Unit supports BACnet via RS485 (BACnet MS/TP),
- Communication supports Unicode, coded with the character set UTF-8
- The maximum cable length is 1200 m (3281 ft).

Note

It is not permitted to change over the units

The "Unit changeover (Page 258)" function is not permissible with this bus system!

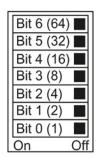## 7.6.4.1 Basic settings for communication

Setting the address

You set the MAC address of the inverter using the address switches on the Control Unit, using parameter p2021 or in STARTER.

Valid address range: 0 … 127.

For address 0, the inverter responds to a broadcast.

If you have specified a valid address ≠ 0 using the address switches, this address will always be the one that takes effect and parameter p2021 cannot be changed.

The positions of the address switches are described in Section: Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

Bit 6 (64) ■	E:
Bit 5 (32) ■	
Bit 4 (16) ■	
Bit 3 (8) ■	
Bit 2 (4) ■	
Bit 1 (2) ■	
Bit 0 (1) ■	
On	Off

Procedure

To change the bus address, proceed as follows:

1. Set the address using one of the subsequently listed options:

    – using the address switches

    – with an operator panel using p2021

    – in STARTER using screen form "Control Unit/Communication/Fieldbus", or using the expert list with p2021

2. Switch on the inverter power supply and, if being used, the 24 V supply for the Control Unit.

3. Switch on the voltages again after all LEDs at the inverter have gone dark.

This means that you have changed the bus address.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

165

Additional settings

P no.	Parameter name
p0015 = 21	**Macro drive unit** Selecting the I/O configuration (USS fieldbus)
p0791[0 … 1]	**Fieldbus analog outputs** Parameter to interconnect the analog outputs for control via the fieldbus
p2030 = 5	**Fieldbus telegram selection** 5: BACnet
p2020	**Baud rate** 6: 9600 (factory setting) 7: 19200 8: 38400 10: 76800
p2024[0 … 2]	**Processing times** p2024 [0]: 0 ms … 10000 ms, maximum processing time (APDU timeout), factory setting = 1000 ms, p2024 [1 … 2]: No significance for BACnet
p2025[0 … 3]	**BACnet communication parameter** • p2025 [0]: 0 … 4194303, Device object instance number, Factory setting = 1 • p2025 [1]: 1 … 10, Maximum Info Frames, factory setting = 1 • p2025 [2]: 0 … 99, Number of APDU Retries (repeated attempts after fault telegrams), factory setting = 3 • p2025 [3]: 1 … 127, maximum Master address, factory setting = 127
p2026[0 … 74]	**Setting of the COV_Increment** (COV = Change of values) 0 … 4194303.000, factory setting = 1 COV_Increment: Changing the value of the "present value" of an object instance for which the server transfers an UnConfirmedCOV_Notification or ConfirmedCOV_Notification. You can use these parameters to set for which inverter value changes an UnConfirmedCOV_Notification or ConfirmedCOV_Notification result is sent. The factory setting 1 means that the inverter sends an UnConfirmedCOV_Notification or ConfirmedCOV_Notification if the considered value e.g. for a range of 0 … 10 V, if the absolute value changes by ≥ 1. This requires an active SubscribeCOV_Service to send the relevant object instance. You can also set the COV_Increment via the object property "COV_Increment" of the relevant analog input, analog output or analog value.
p2027	**BACnet language selection** German/English - only becomes effective after power off/on
p2040	**Fieldbus monitoring time** 0 ms … 1999999 ms, factory setting = 100 ms. The more slaves that are connected in the network, the longer the fieldbus monitoring time must be. If process data is not transferred within one cycle of the fieldbus monitoring time, then the inverter shuts down with fault F01910. p2040 = 0 ⇒ bus monitoring deactivated.

7.6.4.2 Supported services and objects

BIBBs used by the inverter

The BIBBs are a collection of one or several BACnet services. The BACnet services are subdivided into A and B devices. An A device operates as client and B device as server.

The inverter is a server and therefore operates as B device, as "BACnet Application Specific Controller" (B-ASC).

The CU230P-2 HVAC uses the BIBBs listed below.

Overview of the BIBB used by CU230P-2 HVAC and associated services

Short designation	BIBB	Service
DS-RP-B	Data Sharing-ReadProperty-B	ReadProperty
DS-RPM-B	Data Sharing-ReadMultipleProperty-B	ReadPropertyMultiple
DS-WP-B	Data Sharing-WriteProperty-B	WriteProperty
DM-DDB-B	Device Management-Dynamic Device Binding-B	• Who-Is • I-Am
DM-DOB-B	Device Management-Dynamic Object Binding-B	• Who-Has • I-Have
DM-DCC-B	Device Management-DeviceCommunicationControl-B	DeviceCommunicationControl
DS-COV-B	Data Sharing-COV-B	• SubscribeCOV, • ConfirmedCOVNotification, • UnConfirmedCOVNotification

The inverter can simultaneously process up to 32 SubscribeCOV services. These can all refer to the same object instances - or different object instances.

SubscribeCOV monitors the property changes of the following objects:

- Analog Input (AIxx),
- Analog Output (AOxx),
- Analog Value (AVxx),
- Binary Value (BVxx) and
- Multi-state Input (MSIxx)

Note

SubscribeCOV services are not retentive; i.e. the master must re-initiate the SubscribedCOV services when restarting the CU.

Code numbers of the object types supported in BACnet

Object type	Code number for BACnet object type		Object type	Code number for BACnet object type
Device object	8		Analog Input Object	0
Binary Input Object	3		Analog Output Object	1
Binary Output Object	4		Analog Value Object	2
Binary Value Object	5		Multi-State Input Object	13

Object properties of the "Device" object type

• Object_Identifier	• Application_Software_Version	• APDU_Timeout
• Object_Name	• Protocol_Version	• Number_Of_APDU_Retries
• Object_Type	• Protocol_Revision	• Max Master
• System_Status	• Protocol_Services_Supported	• Max Info Frames
• Vendor_Name	• Protocol_Object_Types_Supported	• Device Address Binding
• Vendor_Identifier	• Object_List	• Database Revision
• Model_Name	• Max_APDU_Length_Accepted [1]	
• Firmware_Revision	• Segmentation_Supported [2]	

[1] Length = 480, [2] not supported

Object properties of other object types

Object property	Object type						
	Binary Input	Binary Output	Binary Value	Analog Input	Analog Output	Analog Value	Multi-State Input
Object_Identifier	X	X	X	X	X	X	X
Object_Name	X	X	X	X	X	X	X
Object_Type	X	X	X	X	X	X	X
Present_Value	X	X	X	X	X	X	X
Description	X	X	X	X	X	X	X
Status_Flags	X	X	X	X	X	X	X
Event_State	X	X	X	X	X	X	X
Out_Of_Service	X	X	X	X	X	X	X
Units				X	X	X	
Priority_Array		X	X*		X	X*	
Relinquish_Default		X	X*		X*	X	
Polarity	X	X					
Active_Text	X	X	X				
Inactive_Text	X	X	X				
COV_Increment				X	X	X	
State_Text							X
Number_of_States							X

* for command values only (access type C)

Note

Access types are available in the following versions

- C: Executable
- R: Readable
- W: Writable

Binary Input Objects

Instance ID	Object name	Description	Possible values	Text active / text inactive	Access type	Parameter
BI0	DI0 ACT	State of DI 0	ON/OFF	ON/OFF	R	r0722.0
BI1	DI1 ACT	State of DI 1	ON/OFF	ON/OFF	R	r0722.1
BI2	DI2 ACT	State of DI 2	ON/OFF	ON/OFF	R	r0722.2
BI3	DI3 ACT	State of DI 3	ON/OFF	ON/OFF	R	r0722.3
BI4	DI4 ACT	State of DI 4	ON/OFF	ON/OFF	R	r0722.4
BI5	DI5 ACT	State of DI 5	ON/OFF	ON/OFF	R	r0722.5
BI7	DI7 ACT	State of AI 1 - used as DI	ON/OFF	ON/OFF	R	r0722.11
BI8	DI8 ACT	State of AI 2 - used as DI	ON/OFF	ON/OFF	R	r0722.12
BI10	DO0 ACT	State of DO 0 (relay 1)	ON/OFF	ON/OFF	R	read r747.0
BI11	DO1 ACT	State of DO 1 (relay 2)	ON/OFF	ON/OFF	R	read r747.1
BI12	DO2 ACT	State of DO2 (relay 3)	ON/OFF	ON/OFF	R	read r747.2

Binary Output Objects

Instance ID	Object name	Description	Possible values	Text active / text inactive	Access type	Parameter
BO0	DO0 CMD	Controls DO 0 (relay 1)	ON/OFF	ON/OFF	C	p0730
BO1	DO1 CMD	Controls DO 1 (relay 2)	ON/OFF	ON/OFF	C	p0731
BO2	DO2 CMD	Controls DO 2 (relay 3)	ON/OFF	ON/OFF	C	p0732

Binary value Objects

Instance ID	Object name	Description	Possible values	Text active	Text inactive	Access type	Parameter
BV0	RUN / STOP ACT	Inverter status regardless of command source	RUN / STOP	STOP	RUN	R	r0052.2
BV1	FWD / REV	Direction of rotation regardless of command source	REV / FWD	FWD	REV	R	r0052.14

Instance ID	Object name	Description	Possible values	Text active	Text inactive	Access type	Parameter
BV2	FAULT ACT	Inverter fault	FAULT / OK	FAULT	OK	R	r0052.3
BV3	WARN ACT	Inverter warning	WARN / OK	WARN	OK	R	r0052.7
BV4	MANUAL / AUTO ACT	Indicates the source of the manual/auto inverter control	AUTO / MANUAL	AUTO	LOCAL	R	r0052.9
BV7	CTL OVERRIDE ACT	ACT displays the inverter's control unit from the BACnet override control unit via BV93. Note that the operator panel's "Manual" operating mode has a higher priority than the BACnet override control.	ON/OFF	0	1	R	r2032[10]
BV8	AT SET-POINT	Setpoint reached	YES / NO	YES	NO	R	r0052.8
BV9	AT MAX FREQ	Maximum speed reached	YES / NO	YES	NO	R	r0052.10
BV10	DRIVE READY	Inverter ready	YES / NO	YES	NO	R	r0052.1
BV15	RUN COM ACT	ACT indicates the status of the ON command, regardless of the source	YES / NO	0	1	R	r2032[0]
BV16	HIB MOD ACT	ACT means that the inverter is operating in energy-saving mode.	ON/OFF	0	1	R	r2399[1]
BV17	ESM MOD	ACT means that the inverter is operating in the essential service mode	ON/OFF	0	1	R	r3889[0]
BV20	RUN / STOP CMD	ON command for the inverter (when controlling via BACnet)	RUN / STOP	0	1	C	r0054.0
BV21	FWD / REV CMD	Reverse direction of rotation (when controlling via BACnet)	REV / FWD	0	1	C	r0054.11
BV22	FAULT RESET	Acknowledge fault (when controlling via BACnet)	RESET / NO	0	1	C	r0054.7
BV24	CDS	Local / Remote	Local / Remote	YES	NO	C	r0054.15
BV26	RUN ENA CMD	Enable inverter operation		ENABLED	DISABLED	C	r0054.3
BV27	OFF2	OFF2 status	RUN / STOP	0	1	C	r0054.1
BV28	OFF3	OFF3 status Note: BV28 sets the r0054.4, r0054.5, and r0054.6 bits	RUN / STOP	0	1	C	r0054.2
BV50	ENABLE PID	Enable technology controller	ENABLED / DISABLED	ENABLED	DISABLED	C	p2200
BV51	ENABLE PID 0	Enable technology 0 controller	ENABLED / DISABLED	ENABLED	DISABLED	C	p11000
BV52	ENABLE PID 1	Enable technology 1 controller	ENABLED / DISABLED	ENABLED	DISABLED	C	p11100
BV53	ENABLE PID 2	Enable technology 2 controller	ENABLED / DISABLED	ENABLED	DISABLED	C	p11200

Instance ID	Object name	Description	Possible values	Text active	Text inactive	Access type	Parameter
BV90	LOCAL LOCK	Use MANUAL (operator panel) to lock inverter control		LOCK	UNLOCK	C	p0806
BV93	CTL OVERRIDE CMD	Inverter control using BACnet override control	ON/OFF	0	1	C	r0054.10

Analog Input Objects

Instance ID	Object name	Description	Unit	Range	Access type	Parameter
AI0	ANALOG INPUT 0	AI0 input signal	V/mA	inverter-dependent	R	r0752[0]
AI1	ANALOG INPUT 1	AI1 input signal	V/mA	inverter-dependent	R	r0752[1]
AI2	ANALOG INPUT 2	AI2 input signal	V/mA	inverter-dependent	R	r0752[2]
AI3	ANALOG INPUT 3	AI3 input signal	V/mA	inverter-dependent	R	r0752[3]
AI10	ANALOG INPUT 0 SCALED	Scaled AI 0 input signal	%	inverter-dependent	R	r0755[0]
AI11	ANALOG INPUT 1 SCALED	Scaled AI 1 input signal	%	inverter-dependent	R	r0755[1]
AI12	ANALOG INPUT 2 SCALED	Scaled AI 2 input signal	%	inverter-dependent	R	r0755[2]
AI13	ANALOG INPUT 3 SCALED	Scaled AI 3 input signal	%	inverter-dependent	R	r0755[3]

Analog Output Objects

Instance ID	Object name	Description	Unit	Range	Access type	Parameter
AO0	ANALOG OUTPUT 0	AI0 value	%	inverter-dependent	C	p0791.0
AO1	ANALOG OUTPUT 1	AI1 value	%	inverter-dependent	C	p0791.1

Analog Value Objects

Instance ID	Object name	Description	Unit	Range	Access type	Parameter
AV0	OUTPUT FREQ_Hz	Output frequency (Hz)	Hz	inverter-dependent	R	r0024
AV1	OUTPUT FREQ_PCT	Output frequency (%)	%	inverter-dependent	R	HIW
AV2	OUTPUT SPEED	Motor speed	RPM	inverter-dependent	R	r0022
AV3	DC BUS VOLT	DC link voltage.	V	inverter-dependent	R	r0026
AV4	OUTPUT VOLT	Output voltage	V	inverter-dependent	R	r0025
AV5	CURRENT	Motor current	A	inverter-dependent	R	r0027
AV6	TORQUE	Motor torque	Nm	inverter-dependent	R	r0031

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

171

Instance ID	Object name	Description	Unit	Range	Access type	Parameter
AV7	POWER	Motor power	kW	inverter-dependent	R	r0032
AV8	DRIVE TEMP	Heat sink temperature	°C	inverter-dependent	R	r0037
AV9	MOTOR TEMP	Measured or calculated motor temperature	°C	inverter-dependent	R	r0035
AV10	KWH (NR)	Cumulative inverter energy consumption (cannot be reset!)	kWh	inverter-dependent	R	r0039
AV12	INV RUN TIME (R)	Motor's operating hours (is reset by entering "0")	h	0 … 4294967295	W	p0650
AV13	INV Model	Code number of Power Module	---	inverter-dependent	R	r0200
AV14	INV FW VER	Firmware version	---	inverter-dependent	R	r0018
AV15	INV POWER	Rated power of the inverter	kW	inverter-dependent	R	r0206
AV16	RPM STPT 1	Reference speed of the inverter	RPM	6.0 … 210000	W	p2000
AV17	FREQ STPT PCT	Setpoint 1 (when controlling via BACnet)	%	-199.99 … 199.99	C	HSW
AV18	ACT FAULT	Number of the fault due to be dealt with	---	inverter-dependent	R	r0947[0]
AV19	PREV FAULT 1	Number of the last fault	---	inverter-dependent	R	r0947[1]
AV20	PREV FAULT 2	Number of the fault before last	---	inverter-dependent	R	r0947[2]
AV21	PREV FAULT 3	Number of the fault third from last	---	inverter-dependent	R	r0947[3]
AV22	PREV FAULT 4	Number of the fault fourth from last	---	inverter-dependent	R	r0947[4]
AV25	Select Setpoint Source	Command to select the setpoint source	---	0 … 32767	W	p1000
AV28	AO1 ACT	Signal from AO 1	mA	inverter-dependent	R	r0774.0
AV29	AO2 ACT	Signal from AO 1	mA	inverter-dependent	R	r0774.1
AV30	MIN SPEED	Minimum speed	RPM	0.000 – 19500.000	W	p1080
AV31	MAX FREQ	Maximum speed	RPM	0.000 … 210000.000	W	p1082
AV32	ACCEL TIME	Ramp-up time	s	0.00 … 999999.0	W	p1120
AV33	DECEL TIME	Ramp-down time	s	0.00 … 999999.0	W	p1121
AV34	CUR LIM	Current limit	A	inverter-dependent	R	p0640
AV39	ACT WARN	Indication of pending alarm	---	inverter-dependent	R	r2110[0]
AV40	PREV WARN 1	Display of the last alarm	---	inverter-dependent	R	r2110[1]
AV41	PREV WARN 2	Display of the last but one alarm	---	inverter-dependent	R	r2110[2]
AV5000	RAMP UP TIME	Technology controller ramp-up time	s	0 … 650	W	p2257
AV5001	RAMP DOWN TIME	Technology controller ramp-down time	s	0 … 650	W	p2258
AV5002	FILTER TIME	Technology controller actual value filter time constant	s	0 … 60	W	p2265
AV5003	DIFF TIME	Technology controller differentiation time constant	s	0 … 60	W	p2274

Instance ID	Object name	Description	Unit	Range	Access type	Parameter
AV5004	PROP GAIN	Technology controller proportional gain	s	0 … 1000	W	p2280
AV5005	INTEG TIME	Technology controller integral time	s	0 … 1000	W	p2285
AV5006	OUTPUT MAX	Technology controller maximum limiting	%	- 200 … 200	W	p2291
AV5007	OUTPUT MIN	Technology controller minimum limiting	%	- 200 … 200	W	p2292
AV5100	RAMP UP TIME 0	Technology controller 0 ramp-up time	s	0 … 650	W	p11057
AV5101	RAMP DOWN TIME 0	Technology controller 0 ramp-down time	s	0 … 650	W	p11058
AV5102	FILTER TIME 0	Technology controller 0 actual value filter time constant	s	0 … 60	W	p11065
AV5103	DIFF TIME 0	Technology controller 0 differentiation time constant	s	0 … 60	W	p11074
AV5104	PROP GAIN 0	Technology controller 0 proportional gain	s	0 … 1000	W	p11080
AV5105	INTEG TIME 0	Technology controller 0 integral time	s	0 … 1000	W	p11085
AV5106	OUTPUT MAX 0	Technology controller 0 maximum limiting	%	- 200 … 200	W	p11091
AV5107	OUTPUT MIN	Technology controller 0 minimum limiting	%	- 200 … 200	W	p11092
AV5200	RAMP UP TIME 1	Technology controller 1 ramp-up time	s	0 … 650	W	p11157
AV5201	RAMP DOWN TIME 1	Technology controller 1 ramp-down time	s	0 … 650	W	p11158
AV5202	FILTER TIME 1	Technology controller 1 actual value filter time constant	s	0 … 60	W	p11165
AV5203	DIFF TIME 1	Technology controller 1 differentiation time constant	s	0 … 60	W	p11174
AV5204	PROP GAIN 1	Technology controller 1 proportional gain	s	0 … 1000	W	p11180
AV5205	INTEG TIME 1	Technology controller integral time	s	0 … 1000	W	p11185
AV5206	OUTPUT MAX 1	Technology controller 1 maximum limiting	%	- 200 … 200	W	p11191
AV5207	OUTPUT MIN 1	Technology controller 1 minimum limiting	%	- 200 … 200	W	p11192
AV5300	RAMP UP TIME 2	Technology controller 2 ramp-up time	s	0 … 650	W	p112257
AV5301	RAMP DOWN TIME 2	Technology controller 2 ramp-down time	s	0 … 650	W	p11258
AV5302	FILTER TIME 2	Technology controller 2 actual value filter time constant	s	0 … 60	W	p11265

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

173

Instance ID	Object name	Description	Unit	Range	Access type	Parameter
AV5303	DIFF TIME 2	Technology controller 2 differentiation time constant	s	0 … 60	W	p11274
AV5304	PROP GAIN 2	Technology controller 2 proportional gain	s	0 … 1000	W	p11280
AV5305	INTEG TIME 2	Technology controller 2 integral time	s	0 … 1000	W	p11285
AV5306	OUTPUT MAX 2	Technology controller 2 maximum limiting	%	- 200 … 200	W	p11291
AV5307	OUTPUT MIN 2	Technology controller 2 minimum limiting	%	- 200 … 200	W	p11292

Multi-State Input Objects

Instance ID	Object name	Description	Possible values	Access type	Parameter
MSI0	FAULT_1	Fault number 1	See list manual "List of faults and alarms"	R	r0947[0]
MSI1	FAULT_2	Fault number 2		R	r0947[1]
MSI2	FAULT_3	Fault number 3		R	r0947[2]
MSI3	FAULT_4	Fault number 4		R	r0947[3]
MSI4	FAULT_5	Fault number 5		R	r0947[4]
MSI5	FAULT_6	Fault number 6		R	r0947[5]
MSI6	FAULT_7	Fault number 7		R	r0947[6]
MSI7	FAULT_8	Fault number 8		R	r0947[7]
MSI8	WARNING_1	Warning number 1		R	r2110[0]
MS9	WARNING_2	Warning number 2		R	r2110[1]
MSI10	WARNING_3	Warning number 3		R	r2110[2]
MSI11	WARNING_4	Warning number 4		R	r2110[3]
MSI12	WARNING_5	Warning number 5		R	r2110[4]
MSI13	WARNING_6	Warning number 6		R	r2110[5]
MSI14	WARNING_7	Warning number 7		R	r2110[6]
MSI15	WARNING_8	Warning number 8		R	r2110[7]

7.6.5   Communication via P1

P1 is an asynchronous master-slave communication between what is known as a Field Cabinet (master) and the FLN devices (slaves). FLN stands for "Floor level network".

The master individually addresses the various slaves. A slave responds only if the master addresses it. Communication between the slaves is not possible.

A Field Cabinet can have several FLN ports. You can connect up to 32 FLN devices to each FLN port (slaves).

Settings in the controller

In the Field Cabinet, for each slave you must install what is known as a "Logical controller (LCTR) point". In addition, in the Field Cabinet you must define the "Point numbers" for communication.

An overview of the "Point Numbers" is provided on the following pages.
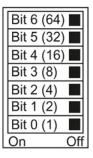
Setting the address
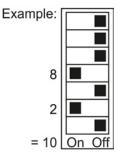
You set the bus address of the inverter using the address switches on the Control Unit, using parameter p2021 or in STARTER.

Valid address range: 1 … 99

If you have specified a valid address using the address switches, this address will always be the one that takes effect, and parameter p2021 (factory setting: 99) will not be able to be changed.

The positions of the address switches are described in Section: Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

Bit 6 (64) ■	Example:
Bit 5 (32) ■	
Bit 4 (16) ■	
Bit 3 (8) ■	8
Bit 2 (4) ■	
Bit 1 (2) ■	2
Bit 0 (1) ■	
On Off	= 10 On Off

Procedure

To change the bus address, proceed as follows:

1. Set the address using one of the subsequently listed options:

    – using the address switches

    – with an operator panel using p2021

    – in STARTER using screen form "Control Unit/Communication/Fieldbus", or using the expert list with p2021

2. Switch on the inverter power supply and, if being used, the 24 V supply for the Control Unit.

3. Switch on the voltages again after all LEDs at the inverter have gone dark.

This means that you have changed the bus address.

Settings in the inverter

After you have completed the basic commissioning, you must set the following P1-specific parameters in the inverter:

Parameter	Description
p2030 = 8	**Communication protocol for P1.** With this setting, the inverter sets parameters p2020 and p2021 as follows: • p2020 = 5: Baud rate 4800 bit/s, alternative setting option for P1: p2020 = 6 (9600 bits/s) • p2021 = 1 … **99:** Slave address (factory setting = 99).
p0840 = 2090.0	Wire **ON/OFF1** to control word 1 bit 0
p0852 = 2090.3	Wire the signal for "**Enable operation**" to control word 1 bit 3
p1070 = 2050.1	Connect the signal for the **main setpoint** to the communication interface
p2103.0 = 2090.7	Connect the first signal source for **acknowledgment** to the communication interface
p2051.0 = 52.0	Send status word via the communication interface
p2051.1 = 63.0	Send speed actual value via the communication interface
p0971 = 1	Permanently save the settings in the inverter

Note

Address 99 (to all)

No matter their address, all FLN devices answer telegrams with address 99.

Overview

The subsequently listed "Point Numbers" for communication are defined using P1 in the converter. The values listed in the tables refer to SI units.

Point No.	Descriptor	Default/factory	Units	Slope	Inter-cept	Subpt. Type	IO Type	On Text	Off Text / Range	CU Param / Word Type
1	CTLR ADDRESS	99	--	1	0	2	LAO_255		0 ... 255	p2021
2	APPLICATION	2767	--	1	0	2	LAO_32k		0 ... 32767	p8998[0]
3	FREQ OUTPUT	0	HZ	0.04	-650	1*	LAI_32k		-650 ... 650	r0024
5	SPEED	0	RPM	1	-16250	1*	LAI_32k		-16250 ... 16250	r0022
6	CURRENT	0	A	0.05	0	1*	LAI_32k		0 ... 1638.4	r0027
7	TORQUE	0	NM	0.2	-3250	1*	LAI_32k		-3250 ... 3250	r0031
8	ACTUAL PWR	0	KW	0.01	0	1	LAI_32k		0 ... 327.67	r0032
9	TOTAL KWH	0	KWH	1	0	1	LAI_32k		0 ... 32767	r0039
13	DC BUS VOLTS	0	V	1	0		LAI_32k		0 ... 32767	r0026
14	REFERENCE	0	HZ	0.04	-650		LAI_32k		-650 ... 650	r0020
16	RATED PWR	0	KW	0.01	0		LAI_32k		0 ... 327.67	r0206
17	OUTPUT VOLTS	0	V	1	0		LAI_32k		0 ... 32767	r0025
20	OVRD TIME	1	HRS	1	0	2	LAO_255		0 ... 255	p8998[1]
21	AR MAX FREQ	0	--	1	0	1	LDI	MAX	NO	ZSW:10
22	CMD FWD REV	0	--	1	0	1	LDO	REV	FWD	STW:11
23	FWD REV	0	--	1	0	1	LDI	FWD	REV	ZSW:14
24	CMD START	0	--	1	0	1	LDO	START	STOP	STW:0
25	STOP RUN	0	--	1	0	1	LDI	RUN	STOP	ZSW:2
26	CONTROL MODE	1	--	1	0	1	LDI	SERIAL	LOCAL	ZSW:9
28	READY TO RUN	0	--	1	0	1	LDI	READY	OFF	ZSW:1
29	DAY NIGHT	0	--	1	0	1	LDO	NIGHT	DAY	p8998[2]
30	CURRENT LMT	0.0	PCT	0.1	10.0	2	LAO_4k		0 ... 400	p0640
31	ACCEL TIME 1	10.00	SEC	0.02	0	2	LAO_32k		0 ... 650.00	p1120
32	DECEL TIME 1	10.00	SEC	0.02	0	2	LAO_32k		0 ... 650.00	p1121
34	HAND AUTO	0	--	1	0	2	LDI	HAND	AUTO	r0807.0

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

177

Point No.	Descriptor	Default/ factory	Units	Slope	Inter- cept	Subpt. Type	IO Type	On Text	Off Text	Range	CU Param / Word Type
35	RUN ENABLE	1	--	1	0	1	LDO	ENABLE	OFF		STW:3
36	ENABLED	0	--	1	0	1	LDI	ON	OFF		ZSW:0
40	DIGITAL OUT 1	0	--		0	2	LDO	ON	OFF		p0730 / r747.0
41	DIGITAL OUT 2	0	--	1	0	2	LDO	ON	OFF		p0731 / r747.1
42	DIGITAL OUT 3	0	--	1	0	2	LDO	ON	OFF		p0732 / r747.2
45	ANALOG IN 1	0	PCT	0.1	-300.0	1(*)	LAI_32k			-300 … 300	r0755[0]
46	ANALOG IN 2	0	PCT	0.1	-300.0	1(*)	LAI_32k			-300 … 300	r0755[1]
47	ANALOG OUT 1	0	PCT	0.1	-100.0	1	LAI_32k			-100 … 100	r0774[0]
48	ANALOG OUT 2	0	PCT	0.1	-100.0	1	LAI_32k			-100 … 100	r0774[1]
51	FREQ REF	0	PCT	0.006103515	0	1(*)	LAO_32k			0 … 100	HSW
52	FREQ ACTUAL	0	PCT	0.012207031	-100.0	1(*)	LAI_32k			-100.0 … 100.0	HIW
53	FREQ MAX	3000.00	HZ	0.02	1.00	1	LAO_32k			0.10 … 650.00	p2000 1/min à Hz
55	PID SP REF	0	PCT	0.024414063	-200.0	1	LAO_32k			-200.0 … 200.0	p2240
56	PID SP OUT	0	PCT	0.012207031	-100.0	1	LAI_32k			-100.0 … 100.0	r2250
57	PID UP LMT	100.0	PCT	0.024414063	-200.0	1	LAO_32k			-200.0 … 200.0	p2291
58	PID LO LMT	0	PCT	0.024414063	-200.0	1	LAO_32k			-200.0 … 200.0	p2292
59	PID OUTPUT	0	PCT	0.012207031	0	1	LAI_32k			-100.0 … 100.0	r2294
60	PI FEEDBACK	0	PCT	0.012207031	-100.0	1(*)	LAI_32k			-100.0 … 100.0	r2266
61	P GAIN	1.000	--	0.01	0	2	LAO_32k			0 … 100.00	p2280
62	I GAIN	0	SEC	0.002	0	2	LAO_32k			0 … 60.00	p2285
63	D GAIN	0	--	0.002	0	2	LAO_32k			0 … 60.00	p2274
64	ENABLE PID	0	--	1	0	2	LDO	ON	OFF		p2200
66	FEEDBK GAIN	100.0	PCT	0.02	0	2	LAO_32k			0 … 500.00	p2269
68	LOW PASS	0	--	0.01	0	2	LAO_32k			0 … 60.00	p2265
71	DIGITAL IN 0	0	--	1	0	1	LDI	ON	OFF		r0722.0

Point No.	Descriptor	Default/ factory	Units	Slope	Inter-cept	Subpt. Type	IO Type	On Text	Off Text Range	CU Param / Word Type
72	DIGITAL IN 1	0	--	1	0	1	LDI	ON	OFF	r0722.1
73	DIGITAL IN 2	0	--	1	0	1	LDI	ON	OFF	r0722.2
74	DIGITAL IN 3	0	--	1	0	1	LDI	ON	OFF	r0722.3
75	DIGITAL IN 4	0	--	1	0	1	LDI	ON	OFF	r0722.4
76	DIGITAL IN 5	0	--	1	0	1	LDI	ON	OFF	r0722.5
80	WDOG TIME	100	MS	10	0	2	LAO_8k	0 … 65530		p2040
83	INVERTER VER	Apr 50	--	0.01	0	2	LAI_32k	00.00 … 99.99		r0018
84	DRIVE MODEL	0	--	1	0	2	LAI_32k	0 … 32767		r0200
85	1st USER PARAMETER	0	--	1	0	2	LAO_32k	0 … 32767		p0013[0]
86	2nd USER PARAMETER	0	--	1	0	2	LAO_32k	0 … 32767		p0013[1]
87	3rd USER PARAMETER	0	--	1	0	2	LAO_32k	0 … 32767		p0013[2]
88	4th USER PARAMETER	0	--	1	0	2	LAO_32k	0 … 32767		p0013[3]
89	Finish of USER PARAMETER transfer	0	--	1	0	2	LDO	START	READY	p0016
90	ACTIVE FAULT	0	--	1	0	1*)	LAI_32k	0 … 32767		r0947[0]
91	1ST FAULT	0	--	1	0	1*)	LAI_32k	0 … 32767		r0947[1]
92	2ND FAULT	0	--	1	0	1*)	LAI_32k	0 … 32767		r0947[2]
93	3RD FAULT	0	--	1	0	1*)	LAI_32k	0 … 32767		r0947[3]
94	FAULT	0	--	1	0	1	LDI	FAULT	OK	ZSW:3
95	FAULT ACK	0	--	1	0	1	LDO	ON	OFF	STW:7
96	WARNING	0	--	1	0	1	LDI	WARN	OK	ZSW:7
97	ACTIVE WARNING	0	--	1	0	1*)	LAI_32k	0 … 32767		r2110[0]
98	RAM TO ROM	0	--	1	0	1	LDO	SAVE	DONE	p971/ p10=30
99	ERROR STATUS	0	--	1	0	1*)	LAI_255	0 … 255		r947[0]

1*): For reasons of compatibility, these type 1 subpoints can save COV area information.
Point Number 98 RAM TO ROM was implemented in order to be able to save these in a non-volatile fashion.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

179

7.7 Communication over CANopen

General information on CAN

You can find general information on CAN in the CAN Internet pages (http://www.can-cia.org); you can obtain an explanation of CAN terminology in the CANdictionary under CAN downloads (http://www.can-cia.org/index.php?id=6).

Integrating a converter in a CANopen network

To integrate a converter in a CANopen network, we recommend the EDS file on the Internet (http://support.automation.siemens.com/WW/view/en/48351511). This file is the description file of the SINAMICS G120 converter for CANopen networks. In this way, you can use the objects of the DSP 402 device profile.

7.7.1 CANopen functions of the converter

CANopen is a CAN-based communication protocol with linear topology that operates on the basis of communication objects (COB).

There are two ways you can setup the communication between the inverter and the controller:

- Via the Predefined connection set (Page 193)
- Via Free PDO mapping (Page 195)

Communication objects (COB)

The inverter operates with communication objects from the following profiles:

- CANopen communication profile CiA 301
- Device profile CiA 402 (Drives And Motion Control)
- Indicator profile DR 303-3

Specifically, these are:

- **NMT** Network management (NMT service) (Page 181)
  Network management objects for controlling CANopen communication and for monitoring the individual nodes on the basis of a master-slave relationship

- **SDO** SDO services (Page 184)
  Service data objects for reading and changing parameters

- **PDO** PDO and PDO services (Page 189)
  Process data objects to transfer process data; TPDO to send, RPDO to receive

- **SYNC**
  Synchronization objects

- **EMCY**
  Time stamp and fault messages

COB ID

A communication object contains the data to be transferred and a unique 11-bit COB ID. The COB ID also defines the priority for processing the communication objects. The communication object with the lowest COB ID always has the highest priority.

COB ID for individual communication objects

You will find the specifications for the COB IDs of the individual communication objects below:

- **COB ID$_{NMT}$ = 0**   Cannot be changed

- **COB ID$_{SYNC}$ = free**   Pre-assigned with 80 hex

- **COB ID$_{EMCY}$ = free**   80 hex + node ID = COB ID $_{EMCY}$

- **COB ID$_{TPDO}$ = free**   In the free PDO mapping *)

- **COB ID$_{RPDO}$ = free**   In the free PDO mapping *)

- **COB ID$_{TSDO}$ = 580 + node ID**

- **COB ID$_{RSDO}$ = 600 + node ID**

- **COB ID$_{Node Guarding/Heartbeat}$ = 700 + node ID**

*) In the "Predefined Connection Set", see SectionPredefined connection set (Page 193) .

7.7.1.1   Network management (NMT service)

Network management (NMT) is node-oriented and has a master-slave topology.

The NMT services can be used to initialize, start, monitor, reset, or stop nodes. Two data bytes follow each NMT service. All NMT services have the fixed COB ID = 0.

The SINAMICS converter is an NMT slave and can adopt the following states in CANopen:

- Initializing
  The converter initializes itself after power on. In the factory setting, the converter then enters the "Pre-Operational" state, which also corresponds to the CANopen standard. Using p8684, you can set that after the bus has booted, the converter does not go into the "Pre-Operational" state, but instead, into the "Stopped" or "Operational" state.

- Pre-Operational
  In this state, the node cannot process any process data (PDO). However, the controller can use SDO parameters to change or operate the converter, which means that you can also enter setpoints via SDO.

- Operational
  In this state, the node can process both SDO and PDO.

- Stopped
  In this state, the node cannot process either PDO or SDO. The "Stopped" state terminates one of the following commands:

  – Enter Pre-Operational

  – Start Remote Node

  – Reset Node

  – Reset Communication

The NMT recognizes the following transitional states:

- Start Remote Node:
  Command for switching from the "Pre-Operational" communication state to "Operational". The drive can only transmit and receive process data (PDO) in "Operational" state.

- Stop Remote Node:
  Command for switching from "Pre-Operational" or "Operational" to "Stopped". The node only processes NMT commands in the "Stopped" state.

- Enter Pre-Operational:
  Command for switching from "Operational" or "Stopped" to "Pre-Operational". In this state, the node cannot process any process data (PDO). However, the controller can use SDO parameters to change or operate the converter, which means that you can also enter setpoints via SDO.

- Reset Node:
  Command for switching from "Operational", "Pre-Operational" or "Stopped" to "Initialization". When the Reset Node command is issued, the converter resets all the objects (1000 hex - 9FFF hex) to the state that was present after "Power On".

- Reset Communication:
  Command for switching from "Operational", "Pre-Operational" or "Stopped" to "Initialization". When the Reset Communication command is issued, the converter resets all the communication objects (1000 hex - 1FFF hex) to the state that was present after "Power On".

182

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF
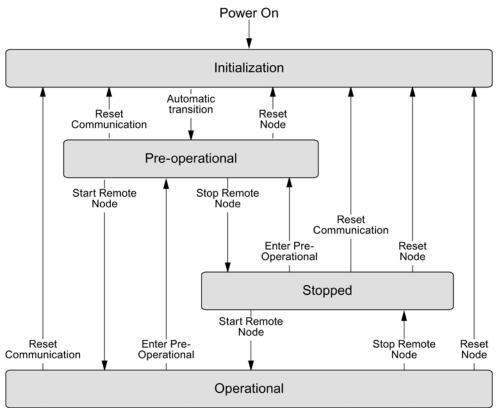
Figure 7-18   CANopen state diagram

Command specifier and Node_ID indicate the transition states and addressed nodes:

Overview of NMT commands

NMT master - request → NMT slave - message		
Command	**Byte 0 (command specifier, CS)**	**Byte 1**
Start	1 (01hex)	Node ID of the addressed node
Stop	2 (02hex)	Node ID of the addressed node
Enter Pre-Operational	128 (80hex)	Node ID of the addressed node
Reset Node	129 (81hex)	Node ID of the addressed node
Reset Communication	130 (82 hex)	Node ID of the addressed node

The NMT master can simultaneously direct a request to one or more slaves. The following is applicable:

● Requirement of a slave:
  The controller accesses the slave with its node ID (1 - 127).

● Requirement for all slaves:
  Node ID = 0

The current state of the node is displayed via p8685. It can also be changed directly using this parameter:

- p8685 = 0   Initializing (display only)
- p8685 = 4   Stopped
- p8685 = 5   Operational
- p8685 = 127   Pre-Operational (factory setting)
- p8685 = 128   Reset Node
- p8685 = 129   Reset Communication

You can also change the NMT state in STARTER via "Control_Unit / Communication / CAN" under the "Network-Management" tab.

7.7.1.2   SDO services

You can access the object directory of the connected drive unit using the SDO services. An SDO connection is a peer-to-peer coupling between an SDO client and a server.

The drive unit with its object directory is an SDO server.

The identifiers for the SDO channel of a drive unit are defined according to CANopen as follows.

Receiving:	Server ⇐ client:	COB ID = 600 hex + node ID
Transmitting:	Server ⇒ client:	COB ID = 580 hex + node ID

Properties

The SDOs have the following properties:

- An SDO connection exists only in the Pre-Operational and Operational states
- Transmission is confirmed
- Asynchronous transmission (matches the acyclical communication via PROFIBUS DB)
- Transmission of values > 4 bytes (normal transfer)
- Transmission of values ≤ 4 bytes (expedited transfer)
- All drive unit parameters can be addressed via SDO

Structure of the SDO protocols

The basic structure of the SDO protocols is shown below:

Byte 0	Byte 1 ... 2	Byte 3	Byte 4 ... 7
CS (Access mode)	Index (Object number)	Sub index (Parameter index)	
Header data			User data / cancellation code

Byte 0 (CS = command specifier) contains the access type of the protocol:

- 2F hex: Write 4 bytes
- 2B hex: Write 3 bytes
- 27 hex: Write 2 bytes
- 23 hex: Write 1 byte
- 40 hex: Read request
- 4F hex: Read 4 bytes

- 4B hex: Read 3 bytes
- 47 hex: Read 2 bytes
- 43 hex: Read 1 byte
- 60 hex: Write confirmation
- 80 hex: Error

7.7.1.3 Access to SINAMICS parameters via SDO

If you wish to change converter parameters in CANopen using the controller, use the SDO service.

You also configure RPDO and TPDO telegrams via SDO. You can find the objects that are available to do this in Section Object directories (Page 199).

Object numbers for SDO jobs

In CAN, access the converter parameters with the SDO service via manufacturer-specific objects in the range from 2000 hex to 470F hex of the CANopen object directory.

Because you cannot directly address all of the parameters using this area, you require for an SDO job always the parameter number itself and the offset dependent on the parameter number.

Selection of parameter range and the associated offset

Parameter range	Offset	Offset value
0 < parameter number < 10000	p8630[2] = 0	0
10000 ≤ parameter number < 20000	p8630[2] = 1	10000
20000 ≤ parameter number < 20000	p8630[2] = 2	20000
30000 ≤ parameter number < 20000	p8630[2] = 3	30000

Calculate object number for an SDO job

The object number for the SDO job is calculated as follows:
object number hex = (number of the converter parameter - offset value) hex + 2000 hex

Examples of object numbers

Parameter number	Number of the converter parameter - offset value		Object number
	Decimal	Hexadecimal	
• p0010:	10 dec	A hex	⇒ 200A hex
• p11000:	1000 dec	3E8 hex	⇒ 23E8 hex
• r20001:	1 dec	1 hex	⇒ 2001 hex
• p31020:	1020 dec	3FC hex	⇒ 23FC hex

Selection, index range

A CANopen object can contain a maximum of 255 indexes. For parameters with more than 255 indexes, you must create additional CANopen objects via p8630[1]. Overall, 1024 indexes are possible.

- P8630[1] = 0: 0 … 255
- P8630[1] = 1: 256 … 511
- P8630[1] = 2: 512 … 767
- P8630[1] = 3: 768 … 1023

Switch-on access to objects of the converter parameters

Access to objects of the converter parameters is activated via p8630[0], where:

- p8630[0] = 0: only access to CANopen objects (SDO, PDO, ...)
- p8630[0] = 1: access to virtual CANopen objects (converter parameters)
- p8630[0] = 2: not relevant for G120 converters

A selection of important manufacturer-specific objects is included in the EDS file.

7.7.1.4 Access PZD objects via SDO

Access to mapped PZD objects

When you access objects mapped via transmit or receive telegrams, you can access the process data without additional settings.
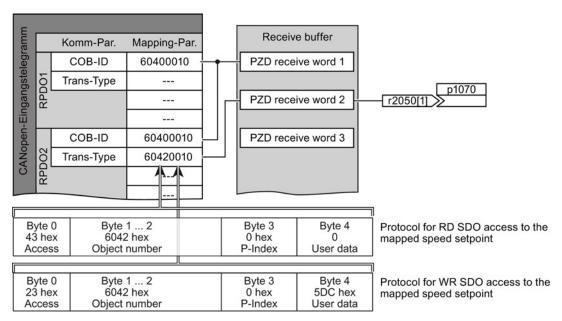
Figure 7-19   Access to the process data

Access to non-mapped PZD objects

When you access objects that are not interconnected via the receive or transmit telegram, you must also establish the interconnection with the corresponding CANopen parameters.

There follows an example for switching the control word with the CANopen parameters:

ON/OFF1	p840[0] = r8795.0
No coast down activated	p0844[0] = r8795.1
No fast stop activated	p0848[0] = r8795.2
Enable operation	p0852[0] = r8795.3
Enable ramp-function generator	p1140[0] = r8795.4
Continue ramp-function generator	p1141[0] = r8795.5
Enable speed setpoint	p1142[0] = r8795.6
Acknowledge fault	p2103[0] = r8795.7
Stop	p8791 = r8795.8

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

187

SDO abort codes

Abort code	Description
0503 0000 hex	Toggle bit not alternated Toggle bit has not changed
0504 0000 hex	SDO protocol timed out Timeout for the SDO protocol
0504 0001 hex	Client/server command specifier not valid or unknown Client/server command not valid or unknown
0504 0002 hex	Invalid block size (block mode only) Invalid block size
0504 0003 hex	Invalid sequence number (block mode only) Invalid sequence number
0504 0004 hex	CRC error (block mode only) CRC error
0504 0005 hex	Out of memory. Memory overflow
0601 0000 hex	Unsupported access to an object. Access to an object that is not supported
0601 0001 hex	Attempt to read a write only object. Attempt to read a "write-only object"
0601 0002 hex	Attempt to write a read only object. Attempt to write a "read-only object"
0602 0000 hex	Object does not exist in the object dictionary. Object does not exist in the object dictionary
0604 0041 hex	Object cannot be mapped to the PDO. Object cannot be linked with the PDO
0604 0042 hex	The number and length of the objects to be mapped would exceed PDO length. The number and length of the linked objects exceeds the PDO length
0604 0043 hex	General parameter incompatibility reason. Basic parameter incompatibility
0604 0047 hex	General internal incompatibility in the device. Basic incompatibility in the device
0606 0000 hex	Access failed due to an hardware error. Access failed due to a hardware fault
0607 0010 hex	Data type does not match, length of service parameter does not match. Data type and length of the service parameter do not match
0607 0012 hex	Data type does not match, length of service parameter too high. Data type is not correct, service parameter is too long
0607 0013 hex	Data type does not match, length of service parameter too low. Data type is not correct, service parameter is too short
0609 0011 hex	Subindex does not exist. Subindex does not exist
0609 0030 hex	Value range of parameter exceeded (only for write access). Value range of the parameter exceeded (only for write access)
0609 0031 hex	Value of parameter written too high. Subindex does not exist

Abort code	Description
0609 0032 hex	Value of parameter written too low. Value of written parameter too small
0609 0036 hex	Maximum value is less than minimum value. Maximum value is less than the minimum value
060A 0023 hex	Resource not available: SDO connection. Source does not exist: SDO connection
0800 0000 hex	General error. General error
0800 0020 hex	Data cannot be transferred or stored to the application. Data cannot be transferred or saved in the application
0800 0021 hex	Data cannot be transferred or stored to the application because of local control. Data cannot be transferred or saved because of the local controller
0800 0022 hex	Data cannot be transferred or stored to the application because of the current device state. Data cannot be transferred or saved because of the device condition
0800 0023 hex	Object dictionary dynamic generation failed or no object dictionary is present (e.g. object dictionary is generated from file and generation fails because of a file error). Dynamic creation of the object dictionary failed or no object dictionary exists (e.g. object directory was generated from a defective file)

7.7.1.5 PDO and PDO services

Process data objects (PDO)

CANopen transfers the process data using "Process Data Objects" (PDO). There are send PDOs (TDPO) and receive PDOs (RPDO). CAN controller and inverter each exchange eight TPDOs and RPDOs.

PDO communication parameters and PDO mapping parameters define a PDO.

Link the PDO with the elements of the object directory that contain the process data. You can use Free PDO mapping (Page 195) or the Predefined connection set (Page 193) to do this.

Parameter area for PDO	RPDO		TPDO	
	In the inverter	In CANopen	In the inverter	In CANopen
Communication parameters	p8700 … p8707	1400 hex … 1407 hex	p8720 … p8727	1800 hex … 1807 hex
Mapping parameters	p8710 … p8717	1600 hex … 1607 hex	p8730 … p8737	1A00 hex …1A07 hex

Structure of the PDO

A PDO consists of communication and mapping parameters. Examples for the structure of the TPDO and RPDO follow.

The values for communication parameters can be found in the tables in Section Object directories (Page 199)

Aufbau der RPDO am Beispiel des RPDO1

p8700[0] = COB-ID	p8700[1] = Trans-Type	p8710.0_xx_yy	p8710.1_xx_yy	p8710.2_xx_yy	p8710.3_xx_yy
Sub-Ind 01	Sub-Ind 02	Objekt 1	Objekt 2	Objekt 3	Objekt 4
Communication parameters		Mapping parameters			

TPDO structure based on the example of the TPDO1

p8720[0] = COB-ID	p8720[1] = Trans-Type	p8720[2] = Inhibit time	p8720[4] = Event timer	p8730.0_xx_yy	p8730.1_xx_yy	p8730.2_xx_yy	p8730.3_xx_yy
Sub-Ind 01	Sub-Ind 02	Sub-Ind 03	Sub-Ind 05	Objekt 1	Objekt 2	Objekt 3	Objekt 4
Communication parameters				Mapping parameters			

Mapping-parameters structure based on the example of the first mapped object

| | | | 0|0|1|0|

Length of the object (hex, two places), 10 for 16-bit values, 20 for 32-bit values
Sub-index (two places), always 00 for G120
OD index (four places), value of p8710.0 for RPDO, from p8730.0 for TPDO
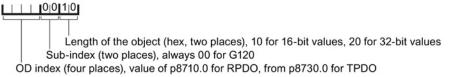
Figure 7-20   Structure of the RPDO and TPDO communication objects

COB ID

An overview of the COB IDs can be found in Section CANopen functions of the converter (Page 180). Section Predefined connection set (Page 193) explains how the COB IDs are calculated.

Transmission type

For process data objects, the following transmission types are available, which you set in index 1 of the communication parameter (p8700[1] … p8707[1] / p8720[1] … p8727[1]) in the inverter:

● Cyclic synchronous (value range: 1 … 240)
  – TPDO after each n-th SYNC
  – RPDO after each n-th SYNC
● Acyclic synchronous (value: 0)
  – TPDO when a SYNC is received and a process data has changed in the telegram.
  – Cyclic asynchronous (values: 254, 255 + event time)
  – TPDO when a process data has changed in the telegram.
  – Acyclic asynchronous (values: 254, 255)

– TPDO when a process data has changed in the telegram.

– The controller accepts the RPDO immediately.

Inhibit time

The inhibit time defines the minimum interval between two transmissions.

Synchronous data transmission

A periodic synchronization object (SYNC object) ensures that the devices on the CANopen bus remain synchronized during transmission.

Each PDO transferred as synchronization object must include a "transmission type" 1 ... n:

– Transmission type 1: PDO in each SYNC cycle

– Transmission type n: PDO in every n-th SYNC cycle

The following diagram shows the principle of synchronous and asynchronous transmission:
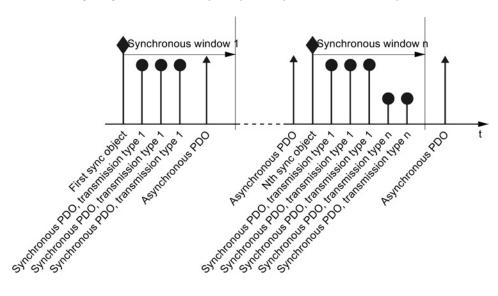
Figure 7-21   Principle of synchronous and asynchronous transmission

For synchronous TPDOs, the transmission mode also identifies the transmission rate as a factor of the SYNC object transmission intervals.

The CAN controller transfers data from synchronous RPDOs that it received after a SYNC signal only after the next SYNC signal to the inverter.

Note

The SYNC signal synchronizes only the communication on the CANopen bus and not functions in the inverter, e.g. the clock times of the speed control.

PDO services

The PDO services can be subdivided as follows:

– Write PDO

– Read PDO

– SYNC service

Write PDO

The "Write PDO" service is based on the "push" model. The PDO has exactly one producer. There can be no consumer, one consumer, or multiple consumers.

Via Write PDO, the producer of the PDO sends the data of the mapped application object to the individual consumer.

Read PDO

The "Read PDO" service is based on the "pull" model. The PDO has exactly one producer. There can be one consumer or multiple consumers.

Via Read PDO, the consumer of the PDO receives the data of the mapped application object from the producer.

SYNC service

The SYNC object is sent periodically from the SYNC producer. The SYNC signal represents the basic network cycle. The standard "Communication cycle time" parameter sets the time interval between two SYNC signals in the master.

In order to ensure CANopen accesses in real-time, the SYNC object has a high priority, which is defined using the COB ID. It can be changed via p8602 (factory setting = 80 hex). The service runs unconfirmed.
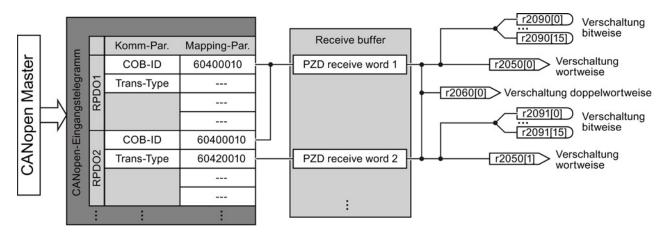
Note

Set the COB ID of the SYNC object to the same value for all nodes of a bus that should respond to the SYNC telegram from the master.

The COB ID of the SYNC object is defined in object 1005h (p8602).

7.7.1.6 Predefined connection set

If you integrate the converter using the factory setting in CANopen, the converter receives the control word and the speed setpoint from the controller. The converter returns the status word and the actual speed value to the controller. These are the settings stipulated in the Predefined Connection Set.

Structure of the mapping parameter using the control word in the predefined connections set as an example
RPDO1: Communication parameters
- p8700[0] = COB-ID
- p8700[1] = Transmission Type

Structure of the mapping parameter using the control word in the predefined connections set as an example

|6|0|4|0|0|0|1|0|

Length of the object (digits 7 ... 8 of p8710[0])
Sub-index (digits 5 ... 6 of p8710[0], for G120 always = 0)
OV index (digits 1 ... 4 of p8710[0])
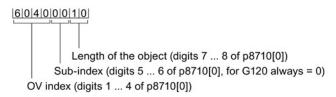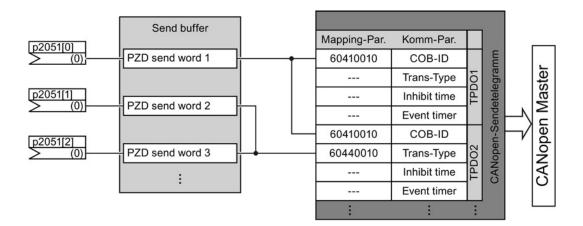
Figure 7-22   RPDO mapping with the Predefined Connection Set
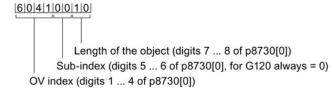
Figure 7-23   TPDO mapping with the Predefined Connection Set

Calculate the COB IDs using the following formula and enter the results in the p8700, p8701, p8720 and p8721 parameters.

COB ID for TPDO and RPDO in the Predefined Connection Set

- **COB ID**$_{TPDO}$ = 180 hex + node ID + ((TPDO no. - 1) * 100 hex)

    Example: For p8721[0] = COB-ID from TPDO 2, the following value results with the Node ID = C hex:

    180 hex + C hex + ((2 - 1)*100 hex) = 18C hex + 100 hex = 28C hex

- **COB ID**$_{RPDO}$ = 200 hex + node ID + ((RPDO no. - 1) * 100 hex)

    Example: For p8700[0] = COB-ID from RPDO 1, the following value results with the Node ID = C hex:

    200 hex + C hex + ((1 - 1) * 100 hex) = 20C hex + 0 hex = 20C hex

7.7.1.7 Free PDO mapping

Using the free PDO mapping, you configure and interconnect any process data as required as follows:

– as free objects, or

– as objects of drive profile CiA 402, corresponding to the requirements of your system for the PDO service

This requires that the inverter is set to a free PDO mapping (p8744 = 2) (factory setting).

Interconnecting process data via a free PDO mapping

Procedure

To interconnect process data, proceed as follows:

1. Define process data,
   examples:

   – Send actual current value (r0068) from the inverter to the controller (TPDO - Transmit Process Data Object)

   – Send additional speed setpoint from the controller to the inverter (RPDO - Receive Process Data Object) and write in p1075

2. Specify objects for transmission of the process data

   – TPDO1 for the actual current value

   – RPDO1 for additional speed setpoint

3. Set communication parameters for RPDO and TPDO

   – Define the communication parameters for RPDO, see RPDO communication parameters (Page 201)

   – Define the communication parameters for TPDO, see TPDO communication parameters (Page 204)

4. Select the OD index for the mapping parameters:

   – Mapping parameters for RPDO, see RPDO mapping parameters (Page 202)

   – Mapping parameters for TPDO, see TPDO mapping parameters (Page 206)

5. Write OV index into the SINAMICS mapping parameters

   – p8710 … p8717 for RPDO

   – p8730 … p8737 for TPDO

   – You will find the OD index in the free objects (Page 208) or in the objects of the CiA 402 drive profile (Page 199)
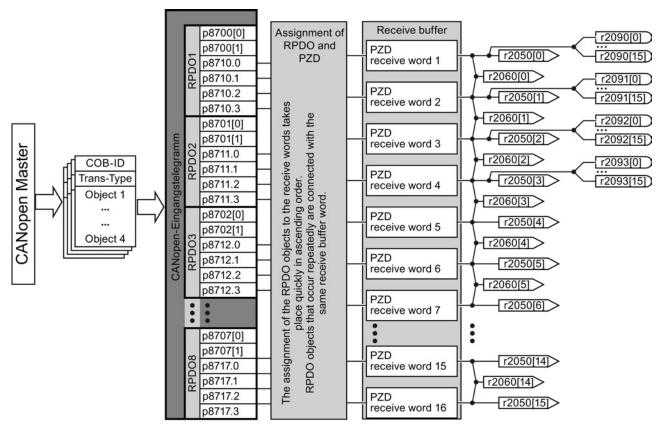
Note

Requirement for changing the OD indexes of the SINAMICS mapping parameters

To allow you to change the values of the mapping parameters, you must set the COB ID of the corresponding parameter to invalid. Add the value 80000000 hex to the COB ID. If you have changed the mapping parameter, you must reset the COB ID to the valid value.

You have interconnected the process data.

Free RPDO mapping - Overview
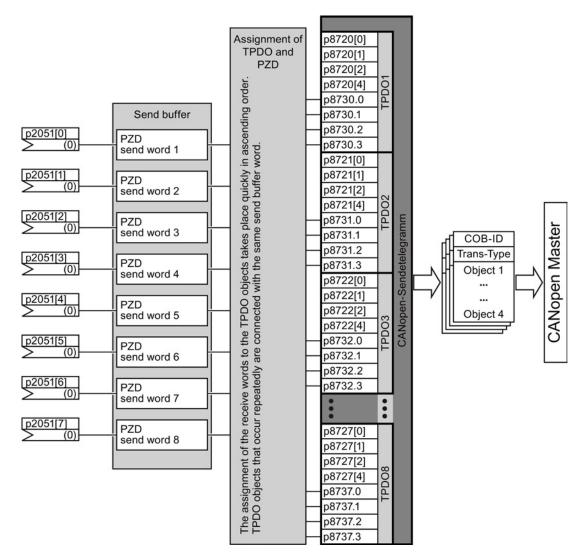
Interconnection possibilities: ► By bit with r2090 ... r2093
► By word with r2050[0 ... 15]
► By double word with r2060[0 ... 14]

Free TPDO mapping - Overview

7.7.1.8   Interconnect objects from the receive and transmit buffers

Procedure

Proceed as follows to configure the CANopen PDO:

1. Create a telegram:
   create PDO (parameterize the PDO Com. Parameter and PDO mapping parameters),
   see Predefined connection set (Page 193) and Free PDO mapping (Page 195)

2. Interconnect the parameters:
   Interconnect the parameters of the PZD buffer (p2050/p2060, p2051) corresponding to
   the mapping of point "Create telegram" using the mapping table r8750/r8760 or
   r8751/r8761. The mapping table indicates the position of a mapped CANopen object in
   the PZD buffer.

You have configured the CANopen PDO.

Interconnecting the receive buffer

The inverter writes the received data in the receive buffer:

- – PZD receive word 1 … PZD receive word 12 double word in r2060[0] … r2060[10].
- – PZD receive word 1 … PZD receive word 12 word in r2050[0] … r2050[11].
- – PZD 1 … PZD 4 bit-by-bit in r2090.0 … r2090.15 to r2093.0 … r2093.15

The position of the mapped objects in the receive buffer is displayed in:

- – r8760 for double word switching
- – r8750 for word switching

Examples

Object	Mapped receive objects	Receive word r2050	
Control word	r8750[0] = 6040 hex (PZD1)	Interconnect r2050[0] (PZD1) with control word [1]	p0840.0 = 2090.0 p0844.0 = 2090.1 p0844.0 = 2090.2 p0852.0 = 2090.3 p2130.0 = 2090.7
Torque limit	r8750[1] = 5800 hex (PZD2)	Link r2050[1] (PZD2) with torque limit:	p1522 = 2050[1]
Speed setpoint	r8750[2] = 6042 hex (PZD3)	Link r2050[2] (PZD3) with speed setpoint:	p1070 = 2050[2]

[1] see also p8790, "Automatic CAN control word interconnection"

Interconnecting the send buffer

The inverter sends the data from the send buffer as follows:

- – p2051[0] … p2051[13] in PZD 1 … PZD 14 (indication of the actual link in r2053[0 … 13])
- – p2061[0] … p2061[12] in PZD 1 … PZD 14 (indication of the actual link in r2063[0 … 12])

Examples

Object	Mapped send objects	Send word p2051	
Status word	r8751[0] = 6041 hex (PZD1)	Interconnect p2051[0] with PZD1	p2051[0] = r8784
Actual current value	r8751[1] = 5810 hex (PZD2)	Link PZD2 with actual current value	p2051[1] = r68[1]
Actual speed value	r8751[2] = 6044 hex (PZD3)	Link PZD3 with actual speed value	p2051[2] = r63[0]

7.7.1.9 CANopen operating modes

The converter works with the "Velocity Mode" CANopen operating mode. "Velocity Mode" is a simple velocity control with ramps and the objects intended for this purpose. It is preferably used for converters with V/f and I/f control.

7.7.2 Object directories

7.7.2.1 General objects from the CiA 301 communication profile

Overview

The following table lists the drive-independent communication objects. The "SINAMICS parameters" column shows the parameter numbers assigned in the converter.

Table 7- 21 Drive-independent communication objects

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	Transmission	Data type	Default values	Can be read/ written
1000		Device type	r8600	SDO	U32	–	r
1001		Error register	r8601	SDO	U8	–	r
1003	0...52 hex	Predefined error field	p8611[0...82]	SDO	U32	0	r/w
	0	Number of errors	p8611.0	SDO	U32	0	rw
	1	Number of module	p8611.1	SDO	U32	0	r
	2	Number of errors: module 1	p8611.2	SDO	U32	0	r
	3-A	Standard error field: module 1	p8611.3-p8611.10	SDO	U32	0	r
	B	Number of errors: module 2	p8611.11	SDO	U32	0	r
	C-13	Standard error field: module 2	p8611.12-p8611.19	SDO	U32	0	r
	14	Number of errors: module 3	p8611.20	SDO	U32	0	r
	15-1C	Standard error field: module 3	p8611.21-p8611.28	SDO	U32	0	r
	1D	Number of errors: module 4	p8611.29	SDO	U32	0	r
	1E-25	Standard error field: module 4	p8611.30-p8611.37	SDO	U32	0	r
	26	Number of errors: module 5	p8611.38	SDO	U32	0	r
	27-2E	Standard error field: module 5	p8611.39-p8611.46	SDO	U32	0	r
	2F	Number of errors: module 6	p8611.47	SDO	U32	0	r
	30-37	Standard error field: module 6	p8611.48-p8611.55	SDO	U32	0	r
	38	Number of errors: module 7	p8611.56	SDO	U32	0	r

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	Transmission	Data type	Default values	Can be read/ written
	39-40	Standard error field: module 7	p8611.57-p8611.64	SDO	U32	0	r
	41	Number of errors: module 8	p8611.65	SDO	U32	0	r
	42-49	Standard error field: module 8	p8611.66-p8611.73	SDO	U32	0	r
	4A	Number of Control Unit faults	p8611.74	SDO	U32	0	r
	4B-52	Field Control Unit standard error	p8611.75-p8611.82	SDO	U32	0	r
1005		SYNCH COB ID	p8602	SDO	U32	128	rw
1008		Manufacturer device name		SDO			
100A		Manufacturer software version	r0018	SDO	U32	–	r
100C		Guard time	p8604.0	SDO	U16	0	rw
100D		Lifetime factor	p8604.1	SDO	U16	0	rw
1010		Store parameters	p0977	SDO	U16	0	rw
	0	Largest subindex supported		SDO			
	1	Save all parameters	p0977	SDO	U16	0	rw
	2	Save communication parameters (0x1000-0x1fff)	p0977	SDO	U16	0	rw
	3	Save application-related parameters (0x6000-0x9fff)	p0977	SDO	U16	0	rw
1011		Restore default parameters	p0976	SDO	U16	0	rw
	0	Largest subindex supported		SDO			
	1	Restore all default parameters	p0976	SDO	U16	0	rw
	2	Restore communication default parameters (0x1000-0x1fff)	p0976	SDO	U16	0	rw
	3	Restore application default parameters (0x6000-0x9fff)	p0976	SDO	U16	0	rw
1014		COB ID emergency	p8603	SDO	U32	0	rw
1017		Producer heartbeat time	p8606	SDO	U16	0	rw
1018		Identy Object	r8607[0...3]		U32	–	r
	0	Number of entries		SDO			
	1	Vendor ID	r8607.0	SDO	U32	–	r
	2	Product code	r8607.1	SDO	U32	–	r
	3	Revision number	r8607.2	SDO	U32	–	r
	4	Serial number	r8607.3	SDO	U32	0	r
1027		Module list					
	0	Number of entries	r0102	SDO	U16	–	r
	1-8	Module ID	p0107[0...15]	SDO	I16	0	rw

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	Transmission	Data type	Default values	Can be read/ written
1029		Error behavior					
	0	Number of error classes		SDO			
	1	Communication Error	p8609.0	SDO	U32	1	rw
	2	Device profile or manufacturer-specific error	p8609.1	SDO	U32	1	rw
1200		1st server SDO parameter					
	0	Number of entries		SDO			
	1	COB ID client -> server (rx)	r8610.0	SDO	U32	–	r
	2	COB ID server -> client (tx)	r8610.1	SDO	U32	–	r

RPDO configuration objects

The following tables list the communication and mapping parameters together with the indexes for the individual RPDO configuration objects. The configuration objects are established via SDO. The "SINAMICS parameters" column shows the parameter numbers assigned in the converter.

Table 7- 22   RPDO configuration objects - communication parameters

OD Index (hex)	Subi ndex (hex)	Name of the object	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written to
1400		Receive PDO 1 communication parameter				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8700.0	U32	200 hex + node ID	r/w
	2	Transmission type	p8700.1	U8	FE hex	r/w
1401		Receive PDO 2 communication parameter				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8701.0	U32	300 hex + node ID	r/w
	2	Transmission type	p8701.1	U8	FE hex	r/w
1402		Receive PDO 3 communication parameter				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8702.0	U32	8000 06DF hex	r/w
	2	Transmission type	p8702.1	U8	FE hex	r/w
1403		Receive PDO 4 communication parameter				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8703.0	U32	8000 06DF hex	r/w
	2	Transmission type	p8703.1	U8	FE hex	r/w
1404		Receive PDO 5 communication parameter				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8704.0	U32	8000 06DF hex	r/w
	2	Transmission type	p8704.1	U8	FE hex	r/w

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

201

OD Index (hex)	Subindex (hex)	Name of the object	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written to
1405		**Receive PDO 6 communication parameter**				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8705.0	U32	8000 06DF hex	r/w
	2	Transmission type	p8705.1	U8	FE hex	r/w
1406		**Receive PDO 7 communication parameter**				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8706.0	U32	8000 06DF hex	r/w
	2	Transmission type	p8706.1	U8	FE hex	r/w
1407		**Receive PDO 8 communication parameter**				
	0	Largest subindex supported		U8	2	r
	1	COB ID used by PDO	p8707.0	U32	8000 06DF hex	r/w
	2	Transmission type	p8707.1	U8	FE hex	r/w

Table 7- 23   RPDO configuration objects - mapping parameters

OD index (hex)	Subindex (hex)	Name of the object	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written to
1600		**Receive PDO 1 mapping parameter**				
	0	Number of mapped application objects in PDO		U8	1	r
	1	PDO mapping for the first application object to be mapped	p8710.0	U32	6040 hex	r/w
	2	PDO mapping for the second application object to be mapped	p8710.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8710.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8710.3	U32	0	r/w
1601		**Receive PDO 2 mapping parameter**				
	0	Number of mapped application objects in PDO		U8	2	r
	1	PDO mapping for the first application object to be mapped	p8711.0	U32	6040 hex	r/w
	2	PDO mapping for the second application object to be mapped	p8711.1	U32	6042 hex	r/w
	3	PDO mapping for the third application object to be mapped	p8711.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8711.3	U32	0	r/w

OD index (hex)	Subi ndex (hex)	Name of the object	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written to
1602		Receive PDO 3 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8712.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8712.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8712.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8712.3	U32	0	r/w
1603		Receive PDO 4 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8713.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8713.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8713.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8713.3	U32	0	r/w
1604		Receive PDO 5 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8714.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8714.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8714.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8714.3	U32	0	r/w
1605		Receive PDO 6 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8715.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8715.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8715.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8715.3	U32	0	r/w

OD index (hex)	Subi ndex (hex)	Name of the object	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written to
1606		Receive PDO 7 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8716.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8716.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8716.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8716.3	U32	0	r/w
1607		Receive PDO 8 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8717.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8717.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8717.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8717.3	U32	0	r/w

TPDO configuration objects

The following tables list the communication and mapping parameters together with the indexes for the individual TPDO configuration objects. The configuration objects are established via SDO. The "SINAMICS parameters" column shows the parameter numbers assigned in the converter.

Table 7- 24   TPDO configuration objects - communication parameters

OD index (hex)	Subi ndex (hex)	Object name	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written
1800		Transmit PDO 1 communication parameter				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8720.0	U32	180 hex + node ID	r/w
	2	Transmission type	p8720.1	U8	FE hex	r/w
	3	Inhibit time	p8720.2	U16	0	r/w
	4	Reserved	p8720.3	U8	---	r/w
	5	Event timer	p8720.4	U16	0	r/w

OD index (hex)	Subi ndex (hex)	Object name	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written
1801		Transmit PDO 2 communication parameter				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8721.0	U32	280 hex + node ID	r/w
	2	Transmission type	p8721.1	U8	FE hex	r/w
	3	Inhibit time	p8721.2	U16	0	r/w
	4	Reserved	p8721.3	U8	---	r/w
	5	Event timer	p8721.4	U16	0	r/w
1802		Transmit PDO 3 communication parameter				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8722.0	U32	C000 06DF hex	r/w
	2	Transmission type	p8722.1	U8	FE hex	r/w
	3	Inhibit time	p8722.2	U16	0	r/w
	4	Reserved	p8722.3	U8	---	r/w
	5	Event timer	p8722.4	U16	0	r/w
1803		Transmit PDO 4 communication parameter				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8723.0	U32	C000 06DF hex	r/w
	2	Transmission type	p8723.1	U8	FE hex	r/w
	3	Inhibit time	p8723.2	U16	0	r/w
	4	Reserved	p8723.3	U8	---	r/w
	5	Event timer	p8723.4	U16	0	r/w
1804		Transmit PDO 5 communication parameter				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8724.0	U32	C000 06DF hex	r/w
	2	Transmission type	p8724.1	U8	FE hex	r/w
	3	Inhibit time	p8724.2	U16	0	r/w
	4	Reserved	p8724.3	U8	---	r/w
	5	Event timer	p8724.4	U16	0	r/w
1805		Transmit PDO 6 communication parameter				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8725.0	U32	C000 06DF hex	r/w
	2	Transmission type	p8725.1	U8	FE hex	r/w
	3	Inhibit time	p8725.2	U16	0	r/w
	4	Reserved	p8725.3	U8	---	r/w
	5	Event timer	p8725.4	U16	0	r/w

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written
1806		**Transmit PDO 7 communication parameter**				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8726.0	U32	C000 06DF hex	r/w
	2	Transmission type	p8726.1	U8	FE hex	r/w
	3	Inhibit time	p8726.2	U16	0	r/w
	4	Reserved	p8726.3	U8	---	r/w
	5	Event timer	p8726.4	U16	0	r/w
1807		**Transmit PDO 8 communication parameter**				
	0	Largest subindex supported		U8	5	r
	1	COB ID used by PDO	p8727.0	U32	C000 06DF hex	r/w
	2	Transmission type	p8727.1	U8	FE hex	r/w
	3	Inhibit time	p8727.2	U16	0	r/w
	4	Reserved	p8727.3	U8	---	r/w
	5	Event timer	p8727.4	U16	0	r/w

Table 7- 25   TPDO configuration objects - mapping parameters

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written
1A00		**Transmit PDO 1 mapping parameter**				
	0	Number of mapped application objects in PDO		U8	1	r/w
	1	PDO mapping for the first application object to be mapped	p8730.0	U32	6041 hex	r/w
	2	PDO mapping for the second application object to be mapped	p8730.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8730.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8730.3	U32	0	r/w
1A01		**Transmit PDO 2 mapping parameter**				
	0	Number of mapped application objects in PDO		U8	2	r/w
	1	PDO mapping for the first application object to be mapped	p8731.0	U32	6041 hex	r/w
	2	PDO mapping for the second application object to be mapped	p8731.1	U32	6044 hex	r/w
	3	PDO mapping for the third application object to be mapped	p8731.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8731.3	U32	0	r/w

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written
1A02		Transmit PDO 3 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r/w
	1	PDO mapping for the first application object to be mapped	p8732.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8732.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8732.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8732.3	U32	0	r/w
1A03		Transmit PDO 4 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r/w
	1	PDO mapping for the first application object to be mapped	p8733.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8733.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8733.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8733.3	U32	0	r/w
1A04		Transmit PDO 5 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8734.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8734.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8734.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8734.3	U32	0	r/w
1A05		Transmit PDO 6 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r/w
	1	PDO mapping for the first application object to be mapped	p8735.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8735.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8735.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8735.3	U32	0	r/w

OD index (hex)	Subind ex (hex)	Object name	SINAMICS parameters	Data type	Predefined connection set	Can be read/ written
1A06		Transmit PDO 7 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8736.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8736.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8736.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8736.3	U32	0	r/w
1A07		Transmit PDO 8 mapping parameter				
	0	Number of mapped application objects in PDO		U8	0	r
	1	PDO mapping for the first application object to be mapped	p8737.0	U32	0	r/w
	2	PDO mapping for the second application object to be mapped	p8737.1	U32	0	r/w
	3	PDO mapping for the third application object to be mapped	p8737.2	U32	0	r/w
	4	PDO mapping for the fourth application object to be mapped	p8737.3	U32	0	r/w

7.7.2.2   Free objects

You can interconnect any process data objects of the receive and transmit buffer using receive and transmit double words.

– Scaling the process data of the free objects:

– 16-bit (word): 4000 hex ≙ 100%

– 32-bit (doubleword) 4000000 hex ≙ 100%

– For temperature values: 16-bit (word): 4000 hex ≙ 100° C

– For temperature values: 32-bit (doubleword): 4000000 hex ≙ 100° C

The "SINAMICS parameters" column shows the parameter numbers assigned in the converter. The assignment applies to the case in which an object which is not mapped in any PDO is to be accessed via SDO.

OD index (hex)	Description	Data type per PZD	Default values	Can be read/ written	SINAMICS parameters
5800 … 580F	16 freely-interconnectable receive process data	I16	0	r/w	r8745[0 … 15]
5810 … 581F	16 freely-interconnectable transmit process data	I16	0	r	r8746[0 … 15]
5820 … 5827	8 freely-interconnectable receive process data	I32	0	r/w	r8747[0 … 7]
5828 … 582F	Reserved				
5830 … 5837	8 freely-interconnectable transmit process data	I32	0	r	r8748[0 … 7]
5828 … 582F	Reserved				

7.7.2.3 Objects from the CiA 402 drive profile

The following table lists the object directory with the index of the individual objects for the drives. The "SINAMICS parameters" column shows the parameter numbers assigned in the converter.

OD index (hex)	Subindex (hex)	Name of the object	SINAMICS parameters	Transmission	Data type	Default setting	Can be read/ written
Predefinitions							
67FF		Single device type		SDO	U32		r
Common entries in the object dictionary							
6007		Abort connection option code	p8641	SDO	I16	3	r/w
6502		Supported drive modes		SDO	I32		r
6504		Drive manufacturer		SDO	String	SIEMENS	r
Device control							
6040		Control word	r8795	PDO/SDO	U16	–	r/w
6041		Status word	r8784	PDO/SDO	U16	–	r
605D		Halt option code	p8791	PDO/SDO	I16	–	r/w
6060		Modes of operation	p1300	SDO	I8	–	r/w
6061		Modes of operation display	p1300	SDO	I8	–	r
Factor group							
6094		Velocity encoder factor		SDO	U8	-	r
	01	velocity encoder factor numerator	p8798[1]	SDO	U32	1	r/w
	02	velocity encoder factor denumerator	p8798[2]	SDO	U32	1	r/w
Profile Velocity Mode [3)]							
6063		Actual position value	r0482	SDO/PDO	I32	–	r
6069		Velocity sensor actual value	r0061	SDO/PDO	I32	–	r
606B		Velocity demand value	r1170	SDO/PDO	I32	–	r
606C		Velocity actual value Actual velocity	r0063	SDO/PDO	I32	–	r
6083		Profile acceleration	p1082/p1120	SDO	I32	–	r/w
6084		Profile deceleration	p1082/p1121	SDO	I32	0	r/w
6085		Quick stop deceleration	p1082/p1135	SDO	I32	0	r/w
6086		Motion profile type	p1115/p1134	SDO	I32	0	r/w
60FF		**Target** velocity Set velocity	p1155[0] [1)] p1072 [2)]	SDO/PDO	I32	0	r/w

OD index (hex)	Subindex (hex)	Name of the object	SINAMICS parameters	Transmission	Data type	Default setting	Can be read/ written
Profile Torque Mode [3]							
6071		Target torque torque setpoint	r8797	SDO/PDO	I16	–	r/w
6072		Max. torque	p1520	SDO	0	0	
6074		Torque demand value overall torque setpoint	r0079	SDO/PDO	I16	–	r
6077		Torque actual value	r0080	SDO/PDO	I16	–	r
Velocity mode							
6042		vl target velocity	r8792	SDO/PDO	I16	–	r/w
6043		vl velocity demand	r1170	SDO/PDO	I16	–	r
6044		vl velocity actual value	r0063	SDO/PDO	I16	–	r
6046	0	vl velocity min./max. amount		SDO	U8	–	r
	1	vl velocity min. amount	p1080	SDO	U32	–	r/w
	2	vl velocity max. amount	p1082	SDO	U32	–	r/w
6048	0	vl velocity acceleration		SDO	U8	–	r
	1	Delta speed	p1082	SDO	U32	–	r/w
	2	Delta time	p1120	SDO	U16	–	r/w

1) Without ramp-function generator

2) With ramp-function generator

3) The converter processes the objects of profile velocity mode and profile torque mode. But they cannot be set nor selected in converters.

7.7.3 Integrating the converter into CANopen

Commissioning

Precondition

- STARTER ≥ version 4.2, is installed on the computer used to commission the system.
- The inverter is connected to a CANopen master.
- The EDS (Electronic Data Sheet) (http://support.automation.siemens.com/WW/view/en/48351511)is installed on your CANopen master.
- In the basic commissioning you have set the inverter interfaces to the CANopen fieldbus.

  See also Finding a suitable setting for the interfaces (Page 53).

  This means that the following signals in the inverter are interconnected corresponding to the Predefined Connection Sets:
  – Speed setpoint and control word
  – Speed actual value and status word

Procedure

Proceed as follows to commission the CANopen interface:

1. Connecting inverter to CAN bus (Page 212)

2. Set the node ID, baud rate and the monitoring of the communication.
   Also see "Setting the node ID and baud rate (Page 212)" as well as "Setting the monitoring of the communication (Page 213)"

3. Interconnecting additional process data
   Set p8744 = 2. You can now interconnect additional process data.

   See also "Free PDO mapping (Page 195)"

4. Signal interconnection of the links created in free PDO mapping.

   See also Interconnect objects from the receive and transmit buffers (Page 197).

5. Exiting commissioning
   Select the "Operational" status in the "Network management" tab in the "Control Unit/Communication/CAN" STARTER screen form and exit the commissioning.

You have commissioned the CANopen interface.

More information about configuring the communication is provided in Sections Object directories (Page 199) and CANopen functions of the converter (Page 180).

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

211

7.7.3.1 Connecting inverter to CAN bus

Connect the converter to the fieldbus via the 9-pin SUB-D pin connector.

The connections of this pin connector are short-circuit proof and isolated. If the converter forms the first or last slave in the CANopen network, then you must switch-in the bus-terminating resistor.

For additional information on the SUB-D pin connector and on the bus-terminating resistor, please refer to Section Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

7.7.3.2 Setting the node ID and baud rate
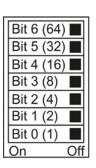
Setting the node ID
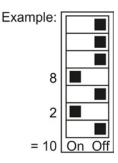
You set the node ID of the inverter using the address switches on the Control Unit, using parameter p8620 or in STARTER.

Valid address range: 1 … 127

If you have specified a valid node ID using the address switches, this node ID will always be the one that takes effect, and parameter p8620 (factory setting: 0) will not be able to be changed.

The positions of the address switches are described in Section: Interfaces, connectors, switches, control terminals, LEDs on the CU (Page 50).

Procedure

To change the bus address, proceed as follows:

1. Set the address using one of the subsequently listed options:

   – using the address switches

   – with an operator panel using p8620

   – in STARTER using screen form "Control Unit/Communication/Fieldbus", or using the expert list with p8620

2. Switch on the inverter power supply and, if being used, the 24 V supply for the Control Unit.

3. Switch on the voltages again after all LEDs at the inverter have gone dark.

This means that you have changed the bus address.

Setting the data transfer rate

You set the data transfer rate using parameter p8622 or in the STARTER "Control Unit/Communication/CAN" screen form under the "CAN interface" tab.

Setting range: 10 kbit/s … 1 Mbit/s. The maximum permissible cable length for1 Mbit/s is 40 m.

In order that a newly set or modified data transfer rate becomes effective, switch on the inverter power supply and, if being used, the 24 V supply for the Control Unit. Switch on the voltages again after all LEDs at the inverter have gone dark.

7.7.3.3 Setting the monitoring of the communication

To monitor the communication, use one of the following methods:

- Node guarding / life guarding

- Heartbeat

Node guarding / life guarding

Principle of operation

- Node guarding:
  Is always active if heartbeat is not activated (p8606 = 0). Node guarding means the master sends monitoring queries to the converter which then answers.

The converter does not monitor the communication. Set the responses to a bus failure in the master.

- Life guarding:
  is active if you use p8604.0 and p8604.1 to set a lifetime ≠ 0.
  Life Guarding means that the converter monitors the master's monitoring query and reports fault F8700 (A) with fault value 2, if a life guarding protocol (life guarding event) is not received within the lifetime. Set additional responses to a bus failure in the master.

Calculate value for lifetime

Life time = guard time in milliseconds (p8604.0) * life time factor (p8604.1)

Heartbeat

Principle of operation

The slave periodically sends heartbeat messages. Other slaves and the master can monitor this signal. In the master, set the responses for the case that the heartbeat does not come.

Setting value for heartbeat

Set in p8606 the cycle time for the heartbeat in milliseconds.

Converter behavior with a bus fault

With a bus fault, the CAN master goes to the "Bus OFF" status. In the converter set the response via the p8641 parameter. Factory setting: p8641 = 3 (AUS3). When you have resolved the bus fault, you can confirm the error as follows:

– via OFF/ON: this enables you to remove the Bus OFF state and start communication again.

– via the DI 2 or direct via p3981: the converter remains in the Bus OFF state. To start the communication again, set p8608 = 1.

⚠️**WARNING**

Stopping the motor after a bus error

If the converter does not enter into a fault for a bus fault (p8641 = 0), the motor cannot be stopped via the controller.

For this case, wire an additional OFF command via terminals.

To stop the motor from the controller, you must resolve the bus fault and restart the communication via p8608 = 1.

7.7.4 Free PDO mapping for example of the actual current value and torque limit

You integrate the actual current value and torque limit into the communication via the free PDO mapping.

The actual current value and the torque setpoint are transferred in TPDO1 and RPDO1, respectively. TPDO1 and RPDO1 have already been specified by the Predefined Connection Set.

Mapping the actual current value (r0068) with TPDO1

Procedure

Proceed as follows to accept the current actual value as send object in the communication:

1. Set the OV index for the actual current value:
   first free OV index from the send data from the "Free objects" 5810 table

2. Map the OV index for the actual current value with PZD2:

   – Set the COB-ID of TPDO1 to "invalid":
     p8720[0] = 800001B2 hex

   – Link the mapping parameter object 2 of TPDO1 (p8730.1) with the OV index for the actual current value:
     p8730.1 = 58100010 hex (5810 = OV index, 00 = fixed value, 10 ≙ 16 bit value)

   – Set the COB-ID of TPDO1 to "valid":
     p8720[0] = 400001B2 hex

   r8751 shows which object is matched to which PZD:
   PZD2 (r8751[1]) = 5810 (actual current value)

3. link the PZD send word 2 in the send word (p2051) with the actual current value:
   p2051[1] = r0086[0]

This means you have transferred the actual current value into the communication as the send object.

Mapping the torque limit (p1520) with RPDO1

Procedure
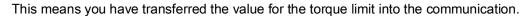
Proceed as follows to accept the torque limit value in the communication:

1. Set the OV index for the torque limit:
   first free OV index from the receive data from the "Free objects" 5800 table

2. Map the OV index for the torque limit with PZD2

   – Set the COB-ID of RPDO1 to "invalid":
   p8700[0] = 80000232 hex

   – Link the mapping parameter object 2 of RPDO1 (p8710.1) with the OV index for the torque limit:
   p8710.1 = 58000010 hex (5800 = OV index, 00 = fixed value, 10 ≙ 16 bit value)

   – Set the COB-ID of RPDO1 to "valid":
   p8700[0] = 40000232 hex

   r8750 shows which object is mapped to which PZD:
   PZD2 (r8750[1]) = 5800 (torque limit)

3. Link the PZD receive word 2 in the receive word (p2050) with the torque limit:
   p2050[1] = p1520[0]

This means you have transferred the value for the torque limit into the communication.

Setting functions

8

8.1 Overview of the inverter functions
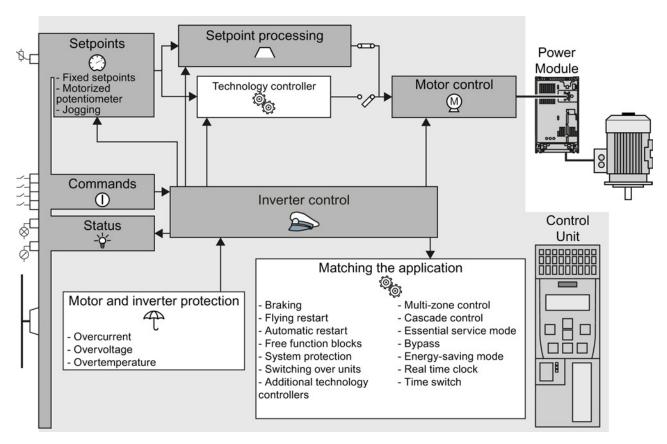
Figure 8-1   Overview of inverter functions

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

217

Functions relevant to all applications		Functions required in special applications only	
The functions that you require in each application are shown in a dark color in the function overview above. In the quick commissioning, the parameters of these functions are assigned an appropriate basic setting, so that in many cases the motor can be operated without having to assign any other parameters.		The functions whose parameters you only need to adapt when actually required are shown in white in the function overview above.	
	Inverter control is responsible for all of the other inverter functions. Among other things, it defines how the inverter responds to commands from the higher-level control system. Inverter control (Page 219)		The protection functions prevent damage to the motor, inverter and driven load, e.g. using temperature monitoring or torque monitoring. Protection functions (Page 251)
	The commands from the higher-level control are sent to the inverter via digital inputs or the fieldbus. Adapting the terminal strip (Page 85) Configuring the fieldbus (Page 97)		The status signals provide signals at the outputs of the Control Unit via the fieldbus, e.g. the actual motor speed or the inverter fault signal. Adapting the terminal strip (Page 85) Configuring the fieldbus (Page 97)
	You must define a setpoint , which defines the motor speed, for example. Setpoints (Page 230)		Functions suitable for the application permit, for example, a higher-level closed-loop pressure or temperature control using the technology controller. Further, the inverter provides solution options specifically for applications in the area of pumps, fans and climate control systems (HVAC). Application-specific functions (Page 258)
	The setpoint processing uses a ramp-function generator to prevent speed steps occurring and to limit the speed to a permissible maximum value. Setpoint calculation (Page 236)		
	The motor closed-loop control ensures that the motor follows the speed setpoint. You can select either closed-loop speed control or U/f control. Motor control (Page 241)		
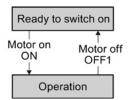
8.2 Inverter control

8.2.1 Switching the motor on and off

After switching on the supply voltage, the inverter normally goes into the "Ready to switch on" state. In this state, the inverter waits for the command to switch-on the motor:

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

- After the OFF1 command, the inverter brakes the motor with the ramp-down time of the ramp-function generator. The inverter switches off the motor once standstill has been reached. The inverter is again "ready to start".

Inverter states and commands for switching the motor on and off

In addition to the OFF1 command, there are other commands that are used to switch off the motor:

- OFF2 - the inverter immediately switches off the motor without first braking it.

- OFF3 - this command means "quick stop". After OFF3, the inverter brakes the motor with the OFF3 ramp-down time. After reaching standstill, the inverter switches off the motor.
  The command is frequently used for exceptional operating situations where it is necessary to brake the motor especially quickly. Collision protection is a typical application for this function.

The following diagram shows the internal sequence control of the inverter when switching the motor on and off.
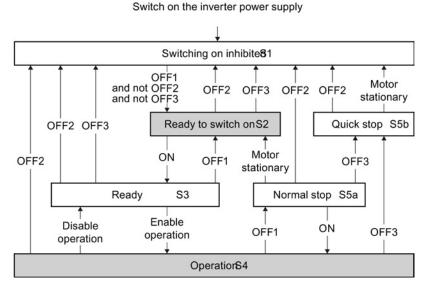
Figure 8-2   State overview of the inverter

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

219

Table 8- 1   Explanation of the inverter states

State	Explanation
Switching on inhibited (S1)	In this state, the inverter does not respond to the ON command. The inverter goes into this state under the following conditions: • ON was active when switching on the inverter. Exception: When the automatic start function is active, ON must be active after switching on the power supply. • OFF2 or OFF3 is selected.
Ready to switch on (S2)	This state is required to switch on the motor.
Ready (S3)	The inverter waits for the operating enable. If the inverter is controlled via a fieldbus, then you must set the operating enable in a control word bit. If the inverter is exclusively controlled via its digital inputs, then the operating enable signal is automatically set in the factory setting.
Operation (S4)	The motor is switched on.
Normal stop (S5a)	The motor was switched off with OFF1 and brakes with the ramp-down time of the ramp-function generator.
Fast stop (S5b)	The motor was switched off with OFF3 and brakes with the OFF3 ramp-down time.

Five different methods are available for controlling the motor via digital inputs.

Table 8- 2   Two-wire control and three-wire control

Behavior of the motor		Control commands	Typical application
	Clockwise rotation | Stop | Counter-clockwise rotation | Stop		
		Two-wire control, method 1 1. Switching the motor on and off (ON/OFF1). 2. Reverse the motor direction of rotation.	Local control in conveyor systems.
		Two-wire control, method 2 and two-wire control, method 3 1. Switch the motor on and off (ON/OFF1), clockwise rotation. 2. Switch the motor on and off (ON/OFF1), counter-clockwise rotation.	Traction drives with control via joystick
		Three-wire control, method 1 1. Enable signal for switching the motor on and off (OFF1). 2. Switch on the motor (ON), clockwise rotation. 3. Switch on the motor (ON), counter-clockwise rotation.	Traction drives with control via joystick
		Three-wire control, method 2 1. Enable signal for switching the motor on and off (OFF1). 2. Switch on motor (ON). 3. Reverse the motor direction of rotation.	-

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

221

8.2.2 Two-wire control: method 1

You switch the motor on and off using a control command (ON/OFF1). while the other control command reverses the motor direction of rotation.
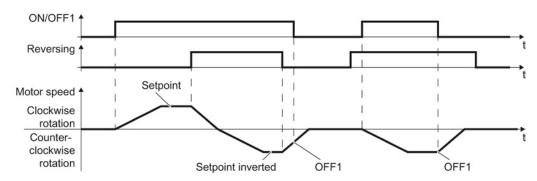
Figure 8-3   Two-wire control, method 1

Table 8- 3   Function table

ON/OFF1	Reversing	Function
0	0	OFF1: The motor stops.
0	1	OFF1: The motor stops.
1	0	ON: Clockwise motor rotation.
1	1	ON: Counter-clockwise motor rotation.

Parameter	Description		
p0015 = 12	**Macro drive unit** (factory setting for inverters without PROFIBUS interface)		
	Controlling the motor using the digital inputs of the inverter:	DI 0	DI 1
		ON/OFF1	Reversing
Advanced setting Interconnecting control commands with digital inputs of your choice (DI x).			
p0840[0 … n] = 722.x	**BI: ON/OFF1** (ON/OFF1)		
p1113[0 … n] = 722.x	**BI: Setpoint inversion** (reversing)		
Example			
p0840 = 722.3	DI 3: ON/OFF1 Also see section Digital inputs (Page 86).		

8.2.3 Two-wire control, method 2

You switch the motor on and off using a control command (ON/OFF1) and at the same time select clockwise motor rotation. You also use the other control command to switch the motor on and off, but in this case you select counter-clockwise rotation for the motor.

The inverter only accepts a new control command when the motor is at a standstill.
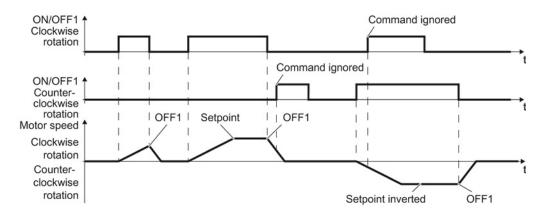
Figure 8-4 Two-wire control, method 2

Table 8- 4 Function table

ON/OFF1 clockwise rotation	ON/OFF1 counter-clockwise rotation	Function
0	0	OFF1: The motor stops.
1	0	ON: Clockwise motor rotation.
0	1	ON: Counter-clockwise motor rotation.
1	1	ON: The motor direction of rotation is based on the signal that assumes status "1" first.

Parameter	Description		
p0015 = 17	**Macro drive unit**		
	Controlling the motor using the digital inputs of the inverter:	DI 0	DI 1
		ON/OFF1 clockwise rotation	ON/OFF1 counter-clockwise rotation
Advanced setting Interconnecting control commands with digital inputs of your choice (DI x).			
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 Also see section Digital inputs (Page 86).		

8.2.4 Two-wire control, method 3

You switch the motor on and off using a control command (ON/OFF1) and at the same time select clockwise motor rotation. You also use the other control command to switch the motor on and off, but in this case you select counter-clockwise rotation for the motor.

Unlike method 2, the inverter will accept the control commands at any time, regardless of the motor speed.
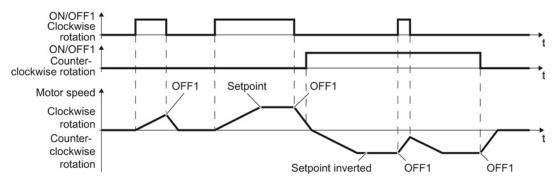
Figure 8-5   Two-wire control, method 3

Table 8- 5   Function table

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.

Parameter	Description		
p0015 = 18	**Macro drive unit**		
	Controlling the motor using the digital inputs of the inverter:	DI 0	DI 1
		ON/OFF1 clockwise rotation	ON/OFF1 counter-clockwise rotation
Advanced setting Interconnecting control commands with digital inputs of your choice (DI x).			
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[0 … n] = 722.2	DI 2: ON/OFF1 counter-clockwise rotation Also see section Digital inputs (Page 86).		

8.2.5 Three-wire control, method 1

With one control command, you enable the two other control commands. You switch the motor off by withdrawing the enable (OFF1).

You switch the motor's direction of rotation to clockwise rotation with the positive edge of the second control command. If the motor is still switched off, switch it on (ON).

You switch the motor's direction of rotation to counter-clockwise rotation with the positive edge of the third control command. If the motor is still switched off, switch it on (ON).
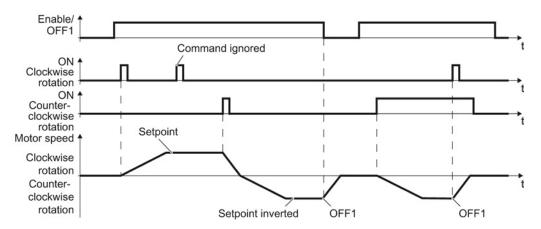
Figure 8-6   Three-wire control, method 1

Table 8- 6   Function table

Enable / OFF1	ON clockwise rotation	ON 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.

Parameter	Description			
p0015 = 19	**Macro drive unit**			
	Controlling the motor using the digital inputs of the inverter:	DI 0	DI 1	DI 2
		Enable / OFF1	ON clockwise rotation	ON clockwise rotation
Advanced setting Interconnecting control commands with digital inputs of your choice (DI x).				
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. Also see section Digital inputs (Page 86).			

8.2.6 Three-wire control, method 2

With one control command, you enable the two other control commands. You switch the motor off by withdrawing the enable (OFF1).

You switch on the motor with the positive edge of the second control command (ON).

The third control command defines the motor's direction of rotation (reversing).
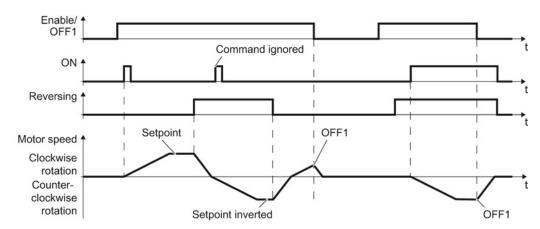
Figure 8-7   Three-wire control, method 2

Table 8- 7   Function table

Enable / OFF1	ON	Reversing	Function
0	0 or 1	0 or 1	OFF1: The motor stops.
1	0→1	0	ON: Clockwise motor rotation.
1	0→1	1	ON: Counter-clockwise motor rotation.

Parameter	Description		
p0015 = 20	**Macro drive unit**		
	Controlling the motor using the digital inputs of the inverter:	DI 0	DI 1	DI 2
		Enable / OFF1	ON	Reversing
Advanced setting Interconnecting control commands with digital inputs of your choice (DI x).			
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)		
p3332[0 … n] = 722.x	**BI: 2-3-WIRE Control Command 3** (reversing)		
Example			
p3331 = 722.0	DI 0: ON Also see section Digital inputs (Page 86).		

8.2.7 Running the motor in jog mode (JOG function)

The "Jog" function is typically used to slowly move a machine part, e.g. a conveyor belt.

With the "Jog" function, you switch the motor on and off using a digital input. When the motor is switched on, it accelerates to the jogging setpoint. There are two different setpoints available, e.g. for motor counter-clockwise rotation and clockwise rotation.

The same ramp-function generator acts on the setpoint as for the ON/OFF1 command.
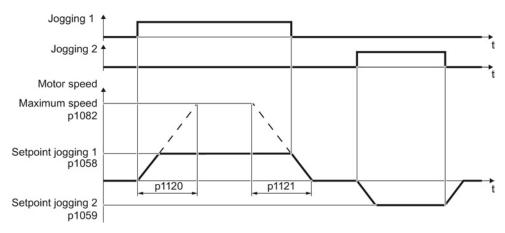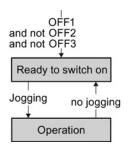
Figure 8-8   Behavior of the motor when "jogging"

The inverter must be ready to start before you issue the "Jog" control command. If the motor is already switched on, then the "Jog" command has no effect.

Setting jogging

Parameter	Description	
p1058	**Jogging 1 speed setpoint** (factory setting 150 rpm)	
p1059	**Jogging 2 speed setpoint** (factory setting -150 rpm)	
p1082	**Maximum speed** (factory setting 1500 rpm)	
p1110	**Inhibit negative direction**	
	=0: Negative direction of rotation is enabled	=1: Negative direction of rotation is inhibited
p1111	**Inhibit positive direction**	
	=0: Positive direction of rotation is enabled	=1: Positive direction of rotation is inhibited
p1113	**Setpoint inversion**	
	=0: Setpoint is not inverted	=1: Setpoint is inverted
p1120	**Ramp-function generator ramp-up time** (factory setting 10 s)	
p1121	**Ramp-function generator ramp-down time** (factory setting 10 s)	
p1055 = 722.0	**Jog bit 0:** Select jogging 1 via digital input 0	
p1056 = 722.1	**Jog bit 1:** Select jogging 2 via digital input 1	

8.2.8   Switching over the inverter control (command data set)

In several applications, the inverter must be able to be operated from different, higher-level control systems.

Example: Switchover from automatic to manual operation
You control the motor either from a central control system, via fieldbus or from a local control panel.

Command data set (CDS)

This means that you can set the inverter control in various ways and toggle between the settings. For instance, as described above, the inverter can either be operated via a fieldbus or via the terminal strip.

The settings in the inverter, which are associated with a certain control type of the inverter, are called command data set.
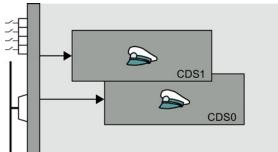
Figure 8-9   Different inverter control using several command data sets (CDS)

You select the command data set using parameter p0810. To do this, you must interconnect parameter p0810 with a control command of your choice, e.g. a digital input.
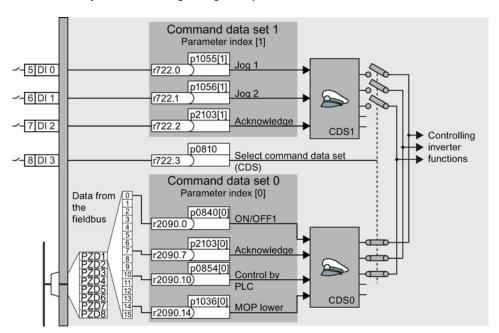
Figure 8-10   Example: Switching over the control via terminal strip to control via PROFIBUS or PROFINET

You obtain the interconnection as in the example above, if you configured the interfaces of the inverter with p0015 = 7 in the basic commissioning, also see Section Finding a suitable setting for the interfaces (Page 53).

An overview of all the parameters that belong to the command data sets is provided in the List Manual.

Note

It takes approximately 4 ms to toggle between command data sets.

Advanced settings

If you require more than two command data sets, then define the number of command data sets (2, 3 or 4) using parameter p0170.

Table 8- 8   Defining the number of command data sets

Parameter	Description
p0010 = 15	**Drive commissioning:** Data sets
p0170	**Number of command data sets** (factory setting 2) p0170 = 2, 3 or 4
p0010 = 0	**Drive commissioning:** Ready
r0050	**Displaying the number of the CDS that is currently active**

You require two bits to be able to make a clear selection for more than two command data sets.

Table 8- 9   Selecting a command data set

Parameter	Description
p0810	**Command data set selection CDS bit 0**
p0811	**Command data set selection CDS bit 1**
r0050	**Displaying the number of the CDS that is currently active**

A copy function is available making it easier to commission more than one command data set.

Table 8- 10   Parameters for copying the command data sets

Parameter	Description
p0809[0]	**Number of the command data set to be copied (source)**
p0809[1]	**Number of the command data set to which the data is to be copied (target)**
p0809[2] = 1	**Copying is started** Once copying has been completed, the converter sets p0809[2] to 0.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

229

8.3 Setpoints

The converter receives its main setpoint from the setpoint source. The main setpoint generally specifies the motor speed.
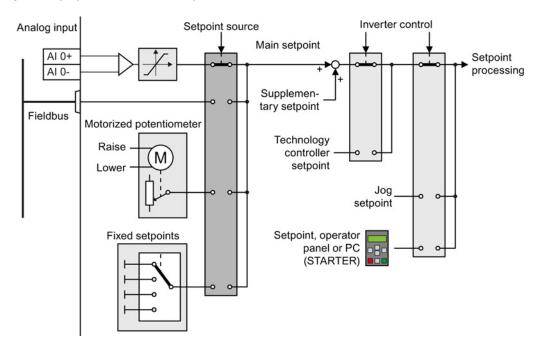
Figure 8-11   Setpoint sources for the converter

You have the following options when selecting the source of the main setpoint:

– Converter analog input.

– Converter fieldbus interface.

– 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, it's output specifies the motor speed.

– When jogging is active.

– When controlling from an operator panel or the STARTER PC tool.

In the basic commissioning, you have already selected a setpoint source. Refer also to Section: Finding a suitable setting for the interfaces (Page 53).

However, you can change this setting. On the following pages, you will find a more detailed description of the setpoint sources.

230

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

8.3.1 Analog input as setpoint source

Interconnecting an analog input

If you have selected a pre-assignment without a function of the analog input, then you must interconnect the parameter of the main setpoint with an analog input.
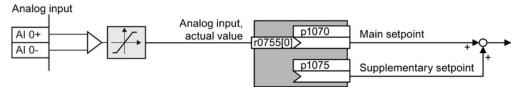
Figure 8-12   Example: Analog input 0 as setpoint source

Table 8- 11   Setting with analog input 0 as setpoint source

Parameter	Remark
p1070 = 755[0]	**Main setpoint** Interconnect the main setpoint with analog input 0
p1075 = 755[0]	**Additional setpoint** Interconnect the additional setpoint with analog input 0

You must adapt the analog input to the connected signal, e.g. ± 10 V or 4 … 20 mA. You will find additional information in the section: Analog inputs (Page 88).

8.3.2 Specifying the motor speed via the fieldbus

If you enter the setpoint via a fieldbus, you must connect the converter to a higher-level control. For additional information, see Section Configuring the fieldbus (Page 97).

Interconnecting the fieldbus with the main setpoint
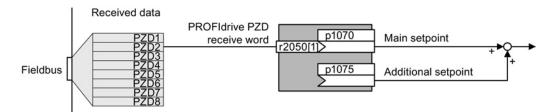
Figure 8-13   Fieldbus as setpoint source

Most standard telegrams receive the speed setpoint as a second process data PZD2.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

231

Table 8- 12   Setting the fieldbus as setpoint source

Parameter	Remark
p1070 = 2050[1]	**Main setpoint** Interconnect the main setpoint with process data PZD2 from the fieldbus.
p1075 = 2050[1]	**Additional setpoint** Interconnect the additional setpoint with process data PZD2 from the fieldbus.

8.3.3   Motorized potentiometer as setpoint source

The "Motorized potentiometer" function emulates an electromechanical potentiometer The output value of the motorized potentiometer can be continually set using the "up" and "down" control signals.

Interconnecting the motorized potentiometer (MOP) with the setpoint source
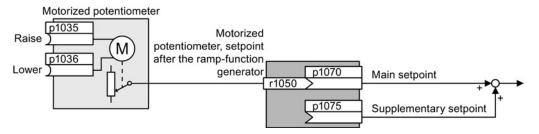
Figure 8-14   Motorized potentiometer as setpoint source

Table 8- 13   Basic setup of motorized potentiometer

Parameter	Description
p1047	**MOP ramp-up time** (factory setting 10 s)
p1048	**MOP ramp-down time** (factory setting 10 s)
p1040	**MOP start value** (factory setting 0 rpm) Defines the start value [rpm], which is effective when first switching on the motor.

Table 8- 14   Setting the MOP as setpoint source

Parameter	Remark
p1070 = 1050	**Main setpoint** Interconnecting the main setpoint with MOP.
p1035	**Motorized potentiometer, increase setpoint** (factory setting 0) Interconnect this signal, for example with a digital input of your choice: p1035 = 722.1 (digital input 1)
p1036	**Motorized potentiometer, decrease setpoint** (factory setting 0) Interconnect this signal, for example with a digital input of your choice.

232

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

Adapting the behavior of the motorized potentiometer
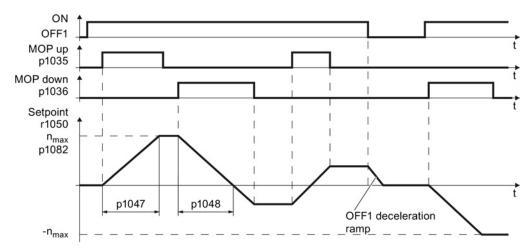
Figure 8-15   Function chart of motorized potentiometer

Table 8- 15   Extended setup of motorized potentiometer

Parameter	Description
p1030	**MOP configuration** (factory setting 00110 bin)
	Parameter value with four independently adjustable bits 00 … 03
	Bit 00: Save setpoint after switching off motor 0: After the motor is switched on, p1040 is specified as the setpoint 1: Setpoint is saved after the motor is switched off and set to the saved value once it is switched on
	Bit 01: Configure ramp-function generator in automatic mode (1-signal via BI: p1041) 0: Without ramp-function generator in the automatic mode (ramp-up/ramp-down time = 0) 1: With ramp-function generator in the automatic mode In manual mode (0-signal via BI: p1041) the ramp-function generator is always active
	Bit 02: Configure initial rounding 0: Without initial rounding 1: With initial rounding. Using the initial rounding function it is possible to enter very small setpoint changes
	Bit 03: Store setpoint in power-independent manner 0: No power-independent saving 1: Setpoint is saved in the event of a power failure (bit 00 = 1)
	Bit 04: Ramp-function generator always active 0: Setpoint is only calculated with enabled pulses 1: The setpoint is calculated independent of the pulse enable.
p1037	**MOP maximum speed** (factory setting 0 rpm) Automatically pre-assigned when commissioning
p1038	**MOP minimum speed** (factory setting 0 rpm) Automatically pre-assigned when commissioning
p1044	**MOP setting value** (factory setting 0) Signal source for the setting value.

For more information about the motorized potentiometer, refer to function diagram 3020 in the List Manual.

8.3.4 Fixed speed as setpoint source

In many applications after switching on the motor, all that is needed is to run the motor at a constant speed or to switch between different speeds.

Example: After it has been switched on, a conveyor belt only runs with two different velocities.

Interconnecting the fixed speeds with a main setpoint
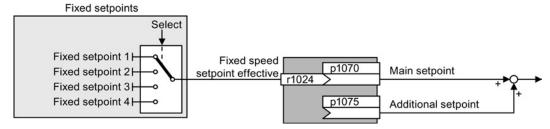
Figure 8-16   Fixed speeds as setpoint source

Table 8- 16   Setting the fixed speed as a setpoint source

Parameter	Remark
p1070 = 1024	**Main setpoint** Interconnecting the main setpoint with fixed speeds.
p1075 = 1024	**Additional setpoint** Interconnecting the additional setpoint with fixed speeds

Select direct or binary fixed setpoint

The inverter has up to 16 different fixed setpoints. The superior controller selects the appropriate fixed setpoints via digital inputs or the field bus.

The inverter distinguishes between two methods for selecting the fixed setpoints:

1. Direct selection:
   You set four different fixed setpoints. By adding one or more of the four fixed setpoints, up to 16 different resulting setpoints are obtained.
   Direct selection is the most suitable method for controlling the inverter via the digital inputs.

   Additional information about direct selection can be found in function diagram 3011 in the List Manual.

2. Binary selection:
   You set 16 different fixed setpoints. You precisely select one of these fixed setpoints by a combination of four selection bits.
   The binary selection is the suitable method of controlling the inverter via a field bus.
   Additional information about binary selection can be found in function diagram 3010 of the List Manual.
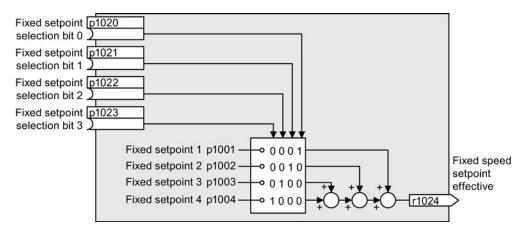
Figure 8-17   Simplified function diagram for directly selecting fixed setpoints

Example: Select two fixed setpoints directly

The motor is to operate at two different speeds as follows:

- The signal on digital input 0 switches the motor on and accelerates it to 300 rpm.

- The signal at digital input 1 accelerates the motor to 2000 rpm.

Table 8- 17   Settings for the example

Parameter	Description
p1001 = 300.000	**Fixed speed setpoint 1** in [rpm]
p1002 = 2000.000	**Fixed speed setpoint 2** in [rpm]
p0840 = 722.0	**ON/OFF1:** Switch on motor with digital input 0
p1070 = 1024	**Main setpoint:** Interconnect the main setpoint with the fixed speed setpoint.
p1020 = 722.0	**Fixed speed setpoint selection bit 0:** Interconnect fixed setpoint 1 with digital input 0 (DI 0).
p1021 = 722.1	**Fixed speed setpoint selection bit 1:** Interconnect fixed setpoint 2 with DI 1.
p1016 = 1	**Fixed speed setpoint mode:** Select direct selection of the fixed setpoints.

Table 8- 18   Resulting fixed setpoints for the example above

Fixed setpoint selected by	Resulting setpoint
DI 0 = LOW	Motor stops
DI 0 = HIGH and DI 1 = LOW	300 rpm
DI 0 = HIGH and DI 1 = HIGH	2300 rpm

8.4 Setpoint calculation

8.4.1 Overview of setpoint processing

The setpoint can be modified as follows using the setpoint processing:

– Invert setpoint to reverse the motor direction of rotation (reversing).

– Inhibit positive or negative direction of rotation, e.g. for conveyor belts, pumps or fans.

– Minimum speed to avoid standstill when the motor is switched on.

– Limit to a maximum speed to protect the motor and mechanical system.

– Ramp-function generator to accelerate and brake the motor with an optimum torque.
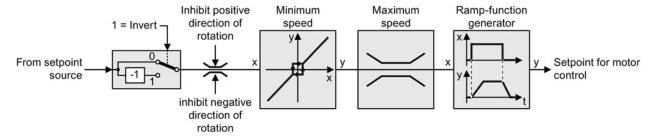
Figure 8-18   Setpoint processing in the inverter
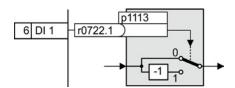
8.4.2 Invert setpoint

Procedure

Proceed as follows to invert the setpoint:

Interconnect parameter p1113 with a binary signal, e.g. digital input 1.

You have inverted the setpoint.

Table 8- 19   Examples of settings to invert the setpoint

Parameter	Remark
p1113 = 722.1	**Setpoint inversion** Digital input 1 = 0: Setpoint remains unchanged. Digital input 1 = 1: Inverter inverts the setpoint.
p1113 = 2090.11	Invert setpoint via control word 1, bit 11.

8.4.3 Inhibit direction of rotation
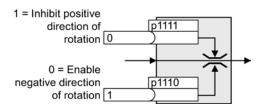
In the factory setting of the inverter, the negative direction of rotation of the motor is inhibited.

Procedure

Proceed as follows to permanently enable the negative direction of rotation:

Set parameter p1110 to a value = 0.

You have permanently enabled the negative direction of rotation.

Table 8- 20   Examples of settings to inhibit the direction of rotation

Parameter	Remark
p1110 = 1	**Inhibit negative direction** Negative direction is permanently inhibited.
p1110 = 722.3	**Inhibit negative direction** Digital input 3 = 0: Negative direction of rotation is enabled. Digital input 3 = 1: Negative direction of rotation is inhibited.

8.4.4 Minimum speed

Function

The converter prevents continuous motor operation at speeds < minimum speed.

Speeds, where the absolute value is less than the minimum speed, are only possible when accelerating or braking.
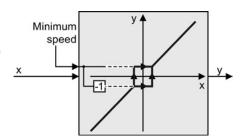
Table 8- 21   Setting the minimum speed

Parameter	Description
p1080	Minimum speed

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

237
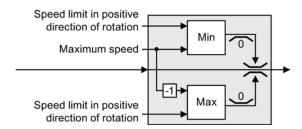
8.4.5   Maximum speed

Function

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.

The maximum speed also acts as a reference value for several other functions, e.g. the ramp-function generator.

If you must limit the speed depending on the direction of rotation, then you can define speed limits for each direction.

Table 8- 22   Parameters for minimum and maximum speed

Parameter	Description
p1082	**Maximum speed** (factory setting 1500 rpm)
p1083	**Speed limit, positive direction of rotation** (factory setting 210,000 rpm)
p1086	**Speed limit, negative direction of rotation** (factory setting -210,000 rpm)

8.4.6   Ramp-function generator

The ramp-function generator in the setpoint channel limits the rate that the speed setpoint changes. As a consequence the motor accelerates and brakes more softly, reducing the stress on the mechanical system of the driven machine.

The ramp-function generator is not active if the technology controller in the inverter specifies the speed setpoint.

Extended ramp-function generator

The ramp-up and ramp-down times of the extended ramp-function generator can be set independently of each other. The optimum times that you select depend on your particular application in question and can range from just a few 100 ms (e.g. for belt conveyor drives) to several minutes (e.g. for centrifuges).

Initial and final rounding permit smooth, jerk-free acceleration and braking.

The ramp-up and ramp-down times of the motor are increased by the rounding times:

- Effective ramp-up time = p1120 + 0.5 × (p1130 + p1131).
- Effective ramp-down time = p1121 + 0.5 × (p1130 + p1131).
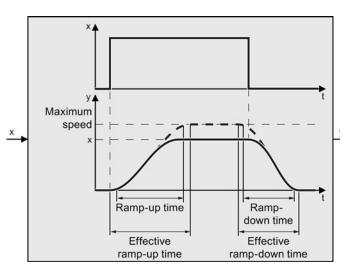
Table 8- 23   Additional parameters to set the extended ramp-function generator

Parameter	Description
p1115	**Ramp-function generator selection** (factory setting: 1) Select ramp-function generator: 0: Basic ramp-function generator 1: Extended ramp-function generator
p1120	**Ramp-function generator, ramp-up time** (factory setting 10 s) Accelerating time in seconds from zero speed up to the maximum speed p1082
p1121	**Ramp-function generator, ramp-down time** (factory setting 10 s) braking time in seconds from the maximum speed down to standstill
p1130	**Ramp-function generator initial rounding time** (factory setting: 0 s) Initial rounding for the extended ramp-function generator. The value applies for ramp up and ramp down.
p1131	**Ramp-function generator final rounding time** (factory setting: 0 s) Final rounding for the extended ramp-function generator. The value applies for ramp up and ramp down.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

239

Parameter	Description	
p1134	**Ramp-function rounding type** (factory setting: 0) 0: Continuous smoothing 1: Discontinuous smoothing	
p1135	**OFF3 ramp-down time** (factory setting 0 s) The quick stop (OFF3) has its own ramp-down time.	
p1136	**OFF3 initial rounding time** (factory setting: 0 s) Initial rounding for OFF3 for the extended ramp-function generator.	
p1137	**OFF3 final rounding time** (factory setting: 0 s) Final rounding for OFF3 for the extended ramp-function generator	

You can find more information in function diagram 3070 and in the parameter list of the List Manual.

Setting the extended ramp-function generator

Procedure

Proceed as follows to set the extended ramp-function generator:

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.
   - We recommend that you set the final rounding 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.

     An excessively short ramp-down time means that the motor will temporarily not be able to follow the speed setpoint. Depending on the Power Module being used, the reason for this is that either the motor current limit has been reached, or there is a risk of an excessively high inverter DC link voltage.

     In any case, the drive exceeds the set time.
   - If the motor decelerates too quickly, then extend the ramp-down time.
6. Repeat steps 1 … 5, until you are satisfied with your drive response.

You have set the extended ramp-function generator.

8.5 Motor control

Decision-making criteria for the control mode that is suitable for your application is provided in Section V/f control or vector control (speed/torque)? (Page 71)

8.5.1 V/f control

U/f control sets the voltage at the motor terminals on the basis of the specified speed setpoint.

The relationship between the speed setpoint and stator voltage is calculated using characteristic curves. The required output frequency is calculated on the basis of the speed setpoint and the number of pole pairs of the motor (f = n * number of pole pairs / 60, in particular: f_{max} = p1082 * number of pole pairs / 60).

The inverter provides the two most important characteristics (linear and square-law). User-defined characteristic curves are also supported.
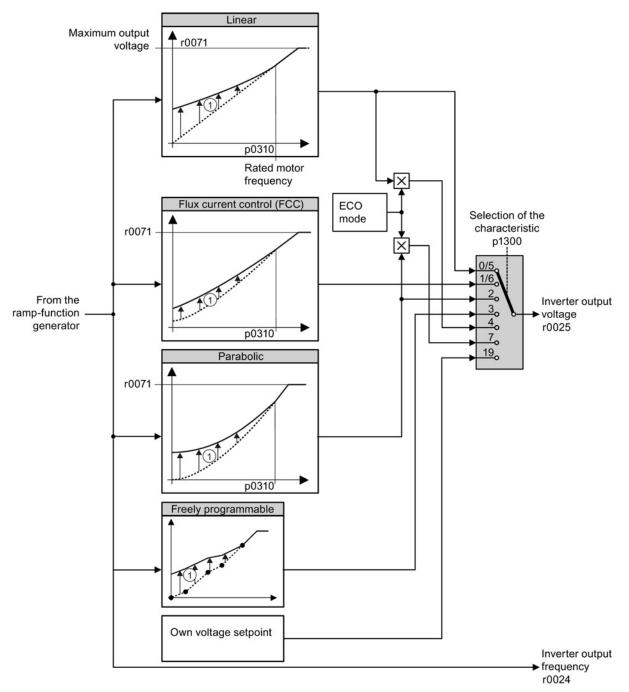
U/f control is not a high-precision method of controling the speed of the motor. The speed setpoint and the speed of the motor shaft are always slightly different. The deviation depends on the motor load.

If the connected motor is loaded with the rated torque, the motor speed is below the speed setpoint by the amount of the rated motor slip. If the load is driving the motor (i.e. the motor is operating as a generator), the motor speed is above the speed setpoint.

Parameter p1300 sets the characteristic curve.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

241

8.5.1.1 Characteristics of U/f control

The inverter has several U/f characteristics. Based on the characteristic, as the frequency increases, the inverter increases the voltage at the motor.

① The voltage boost of the characteristic improves motor behavior at low speeds. The voltage boost is effective for frequencies < rated frequency

Figure 8-19   U/f characteristics of the inverter

The inverter increases its output voltage – also above the motor rated speed up to the maximum output voltage. The higher the line voltage, the greater the maximum inverter output voltage.

If the inverter has reached its maximum output voltage, then it can only increase its output frequency. From this point onwards, the motor is operated in field weakening; this means that the available torque linearly decreases with increasing speed.

The value of the motor voltage at the rated motor frequency also depends on the following variables:

– Ratio between the inverter size and the motor size

– Line voltage

– Line impedance

– Actual motor torque

The maximum possible motor voltage as a function of the input voltage is provided in the technical data, also see Section Technical data (Page 371).

8.5.1.2 Selecting the U/f characteristic

Procedure

Proceed as follows to select a U/f characteristic:

1. Go into the menu "PARAMS". 2. As parameter filter, select "EXPERT". 3. Set p1300 to the appropriate value.	1. Go online. 2. Select the U/f characteristic curve in one of the screen forms "speed controller" or "U/f control".

You have selected a U/f characteristic.
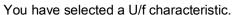
Table 8- 24   Linear and parabolic characteristics

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 inverter equalizes the voltage drops across the stator resistance. Recommended for motors less than 7.5 kW. Precondition: You have set the motor data according to the rating plate and have performed the motor identification after the basic commissioning.	Linear with Flux Current Control (FCC)	p1300 = 1
The required torque increases with the speed	Centrifugal pumps, radial fans, axial fans	Lower losses in the motor and inverter than for a linear characteristic.	Parabolic	p1300 = 2

Table 8- 25   Characteristics for special applications
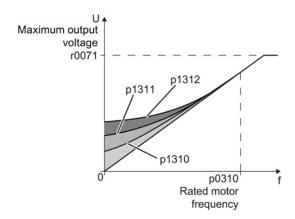
Requirement	Application examples	Remark	Characteristic	Parameter
Applications with a low dynamic response and constant speed	Centrifugal pumps, radial fans, axial fans	The ECO mode results in additional energy saving when compared to the parabolic characteristic. If the speed setpoint is reached and remains unchanged for 5 seconds, the inverter again reduces its output voltage.	ECO mode	p1300 = 4 or p1300 = 7
The inverter must keep the motor speed constant under all circumstances.	Drives in the textile sector	When the maximum current limit is reached, the inverter only reduces the stator voltage but not the speed.	Precise frequency characteristic	p1300 = 5 or p1300 = 6
Freely adjustable U/f characteristic	Operating the inverter with a synchronous motor	-	Adjustable characteristic	p1300 = 3
U/f characteristic with independent voltage setpoint	-	The interrelationship between the frequency and voltage is not calculated in the inverter, but is specified by the user.	Independent voltage setpoint	p1300 = 19

Additional information on U/f characteristics can be found in the parameter list and in the function diagrams 6300 ff of the List Manual.

8.5.1.3   Optimizing with a high break loose torque and brief overload

Setting the voltage boost for U/f control

The voltage boost acts on every U/f characteristic. The adjacent diagram shows the voltage boost using a linear characteristic as example.

Procedure

Proceed as follows to set the voltage boost:

Only increase the voltage boost in small steps. Excessively high values in p1310 ... p1312 can cause the motor to overheat and switch off (trip) the inverter due to overcurrent.

1. Power-up the motor with an average speed.

2. Reduce the speed to just a few revolutions per minute.

3. Check whether the motor rotates smoothly.

4. If the motor does not rotate smoothly, or even remains stationary, increase the voltage boost p1310 until you are satisfied with the motor behavior.

5. Accelerate the motor to the maximum speed with maximum load and check as to whether the motor follows the setpoint.

6. If, when accelerating, the motor stalls, increase the voltage boost p1311 until the motor accelerates to the maximum speed without any problems.

To achieve satisfactory motor behavior, you must increase the parameter p1312 only in applications with a significant breakaway torque.

You will find more information about this function in the parameter list and in function diagram 6300 of the List Manual.

You have set the voltage boost.

Parameter	Description
p1310	**Permanent voltage boost** (factory setting 50%)
	Compensates voltage drops as a result of long motor cables and the ohmic losses in the motor.
p1311	**Voltage boost when accelerating** (factory setting 0%)
	Provides additional torque when the motor accelerates.
p1312	**Voltage boost when starting** (factory setting 0%)
	Provides additional torque, however, only when the motor accelerates for the first time after it has been switched on ("break loose torque").

8.5.2 Closed-loop speed control

8.5.2.1 Properties of the sensorless vector control

Sensorless vector control

Using a motor model, the speed control calculates the load and the motor slip. As a result of this calculation, the inverter controls its output voltage and frequency so that the motor speed follows the setpoint, independent of the motor load.

Speed control is possible without directly measuring the motor speed and is therefore also called "sensorless vector control".
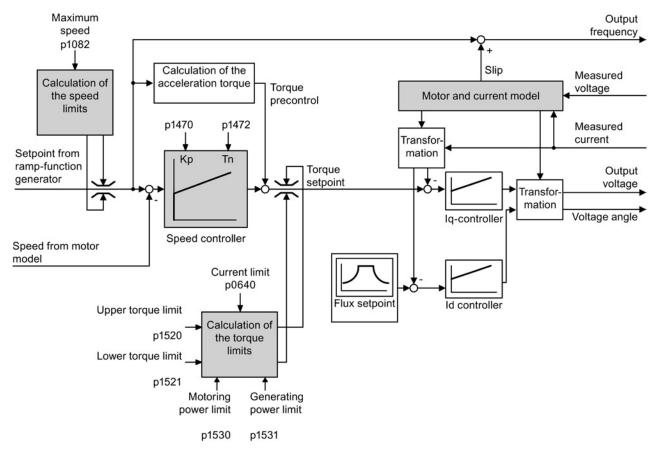
Figure 8-20   Simplified function diagram of sensorless vector control

8.5.2.2 Select motor control

Speed control is already preset

To achieve a good controller response, you must adapt the elements marked in gray in the figure in the overview diagram above. If you selected speed control as control mode in the basic commissioning, you will already have set the following:
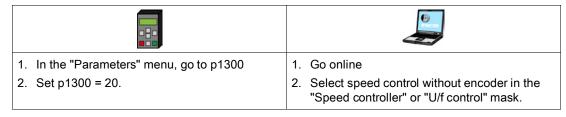
– The maximum speed for your application.

– The motor and current model: If the motor data in the inverter correspond to the motor data on the rating plate, then the motor and current model in the inverter are correct and the vector control can operate satisfactorily.

– The inverter calculates the torque limits matching the current limit that you have set for the basic commissioning.
Regardless of it, you can also set additional positive and negative torque limits or limit the power of the motor.

– The inverter has a preset speed controller with self-optimization (rotating measurement).
If you want to continue to optimize this setting, follow the instructions further down in this chapter.

Select encoderless vector control

Procedure

Proceed as follows to select encoderless vector control:

1. In the "Parameters" menu, go to p1300 2. Set p1300 = 20.	1. Go online 2. Select speed control without encoder in the "Speed controller" or "U/f control" mask.

You have selected encoderless vector control.

8.5.2.3 Re-optimize the speed controller

In the following cases you will need to manually optimize the speed controller:

– Your application does not permit self-optimization because the motor cannot rotate freely.

– You are dissatisfied with the result of the inverter self-optimization.

– The inverter interrupted the self-optimization with a fault.

Procedure

To manually optimize the speed controller, proceed as follows:
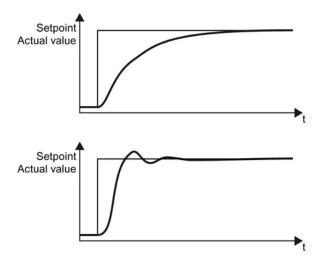
1. Set the ramp-up and ramp-down times of the ramp-function generator p1120 = 0 and p1121 = 0.	1. Go online, and in the "Ramp-function generator" screen form, set the times = 0 .
2. Set the pre-control of the speed controller p1496 = 0.	2. Go online, and in the "Speed controller" screen form, set the pre-control = 0 .
3. Enter a setpoint step and observe the associated actual value.	3. Enter a setpoint step and monitor the associated actual value, e.g. using the trace function in STARTER.
4. Optimize the speed controller by changing controller parameters K_P and T_N until the drive runs optimally (see the diagrams below). – K_P = p1470 – T_N = p1472	4. Go online and optimize the controller in the "Speed controller" screen form by changing the controller parameters K_P and T_N until the drive runs optimally (refer to the diagrams below).
5. Set the ramp-up and ramp-down times of the ramp-function generator p1120 and p1121 back to their original value.	5. Set the ramp-up and ramp-down times of the ramp-function generator back to their original value.
6. Set the pre-control of the speed controller p1496 = 100%.	6. Set the pre-control of the speed controller back to 100%.

You have optimized the speed controller.
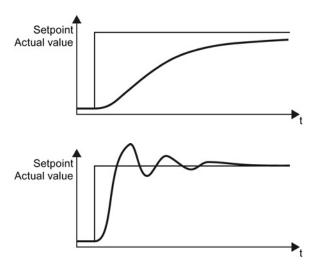
Optimum control response for applications that do not permit any overshoot.

The actual value approaches the setpoint, without any significant overshoot.

Optimum control response for fast correction and quick compensation of noise 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 and reduce the integration time T_N.

The actual value quickly approaches the setpoint, but overshoots too much

- Decrease the proportional component K_P and increase the integration time T_N.

8.5.2.4 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 inverter 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 slave drives:
  The master drive is speed controlled, the slave drive is torque controlled.

– Winding machines

Commissioning the torque control

The torque control only functions error-free if, during the basic commissioning, you correctly set the motor data and performed the motor data identification with the motor in the cold state.

You can find the basic commissioning in the following sections:

– Basic commissioning with the BOP-2 operator panel (Page 73)

– Basic commissioning with STARTER (Page 78)

Table 8- 26   The most important torque control parameters

Parameter	Description
p1300 = …	**Control mode:** 20: Vector control without speed encoder 22: Torque control without speed encoder
p0300 … p0360	**Motor data** is transferred from the rating plate during basic commissioning and calculated with the motor data identification
p1511 = …	**Additional torque**
p1520 = …	**Upper torque limit**
p1521 = …	**Lower torque limit**
p1530 = …	**Motoring power limit**
p1531 = …	**Regenerative power limit**

Additional information about this function is provided in the parameter list and in function diagrams 6030 onwards in the List Manual.

8.6 Protection functions

The frequency inverter offers protective functions against overtemperature and overcurrent for both the frequency inverter as well as the motor. Further, the frequency inverter protects itself against an excessively high DC link voltage when the motor is regenerating.

8.6.1 Inverter temperature monitoring

The inverter protects itself against overtemperature with different monitoring functions:

– I^2t monitoring (alarm A07805, fault F30005)
The I^2t monitoring measures the actual utilization on the basis of a current reference value. Parameter r0036 [%] displays the actual utilization as a %. As long as the actual current does not exceed the reference value, then the utilization in r0036 = 0.

– Monitoring the chip temperature of the power unit (alarm A05006 - fault F30024)
The inverter monitors the difference in temperature between the power chip (IGBT) and the heat sink. The measured values are in r0037[1] [°C].

– Heat sink monitoring (alarm A05000, fault F30004)
The inverter monitors the heat sink temperature of the Power Module. The values are in r0037[0] [°C].

Inverter response

The inverter temperature is essentially defined by the following effects:

– the ohmic losses of the output current

– the switching losses that occur when the motor is pulsed

Parameter p0290 defines how the inverter responds to an excessively high temperature.

Parameter	Description
p0290	**Power unit overload response** (factory setting for SINAMICS G120 inverters with Power Module PM260: 0; factory setting for all other inverters: 2) Setting the reaction to a thermal overload of the power unit: 0: Reduce output current (in vector control mode) or speed (in U/f mode) 1: No reduction, shutdown when overload threshold is reached (F30024) 2: Reduce pulse frequency and output current (in vector control mode) or pulse frequency and speed (in U/f mode) 3: Reduce pulse frequency
p0292	**Power unit temperature warning threshold** (factory setting Heat sink [0] 5° C, power semiconductor [1] 15° C) The value is set as a difference to the shutdown temperature.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

251

8.6.2 Motor temperature monitoring using a temperature sensor

Connecting the temperature sensor

You can use one of the following sensors to protect the motor against overtemperature:

– Temperature switch (e.g. bimetallic switch)

– PTC sensor

– KTY84 sensor

Connect the temperature sensor of the motor to terminals 14 and 15 of the inverter.
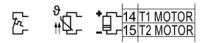
Figure 8-21   Connecting the motor temperature sensor at the inverter

Set response to excess motor temperature

If you use a temperature switch or PTC sensor, set the response to excess motor temperature via P0610 as follows:

– p0610 = 0

– Warning A07910,

– No shutdown

– p0610 = 1, p0610 = 2, p0610 = 12

– Warning A07910

– Shutdown with fault F07011

If you use a KTY84 sensor, set the temperature for the warning or fault threshold via p0604 or p0605.

– Monitoring via p0604: Response as per the setting in p0610

– Monitoring via p0605: Shutdown with fault as soon as the set threshold is exceeded.

For details, please refer to the List Manual.

Temperature switch

The inverter interprets a resistance ≥ 100 Ω as being an opened temperature switch and responds according to the setting for p0610.

PTC sensor

The inverter interprets a resistance > 1650 Ω as being an overtemperature and responds according to the setting for p0610.

The inverter 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 inverter shuts down with fault F07016.

KTY84 sensor

Use a KTY sensor to monitor the motor temperature and the sensor itself for wire-break or short-circuit.

NOTICE
Motor destruction through overheating
If a KTY sensor is connected with the incorrect polarity, the motor can be destroyed due to overheating, as the inverter cannot detect a motor overtemperature condition.
Connect the KTY sensor with the correct polarity.

- – Temperature monitoring:
  The inverter 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 inverter switches off with fault in the following cases:
  - motor temperature > p0605
  - motor temperature > p0604 and p0610 ≠ 0

- – Sensor monitoring (A07015 or F07016):

- – Wire-break:
  The inverter interprets a resistance > 2120 Ω as a wire-break and outputs the alarm A07015. After 100 milliseconds, the inverter changes to the fault state with F07016.

- – Short-circuit:
  The inverter interprets a resistance < 50 Ω as a short-circuit and outputs the alarm A07015. After 100 milliseconds, the inverter changes to the fault state with F07016.

Setting parameters for the temperature monitoring

Parameter	Description
p0335	**Specify the motor cooling** 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	**Motor-temperature sensor type** 0: No sensor (factory setting) 1: PTC (→ p0604) 2: KTY84 (→ p0604, p0605) 4: Temperature switch
p0604	**Motor temperature alarm threshold** (factory setting 130° C)
p0605	**Motor temperature fault threshold** (factory setting 145° C) Setting for KTY84 sensor. The parameter has no significance for a PTC sensor.
p0610	**Motor-overtemperature response** Determines the response when the motor temperature reaches the alarm threshold p0604. 0: Alarm (A07910), no fault. 1: Alarm (A07910); current limit is reduced and timer is started. Shutdown with fault (F07011). 2: Alarm (A07910); timer is started. Shutdown with fault (F07011). 12: As for 2 but the last shutdown temperature is used to calculate the motor temperature (factory setting).
p0640	**Current limit** (input in A)

Additional information on the motor temperature monitoring can be found in function diagram 8016 of the List Manual.

8.6.3 Protecting the motor by calculating the motor temperature

The temperature calculation is only possible in the vector control mode (p1300 ≥ 20) and functions by calculating a thermal motor model.

Table 8- 27   Parameters for temperature acquisition without using a temperature sensor

Parameter	Description
p0621= 1	**Motor-temperature acquisition after restart** 0: No temperature measurement (factory setting) 1: Temperature measurement after the motor is switched on for the first time 2: Temperature measurement each time that the motor is switched on
p0622	**Magnetization time of the motor for temperature measurement after starting** *(set automatically as the result of motor data identification)*
p0625 = 20	**Ambient motor temperature** Enter the ambient motor temperature in °C at the instant that the motor data is acquired (factory setting: **20° C**). The difference between the motor temperature and motor environment (p0625) must lie within a tolerance range of approx. ± 5° C.

8.6.4 Overcurrent protection

During vector control, the motor current remains within the torque limits set there.

During V/f control, the maximum current controller (I-max controller) protects the motor and converter against overload by limiting the output current.

I-max controller operation

If an overload situation occurs, the speed and stator voltage of the motor are reduced until the current is within the permissible range. If the motor is in regenerative mode, (i.e. it is being driven by the connected machine), the I-max controller increases the speed and stator voltage of the motor to reduce the current.

Note

The converter load is only reduced if the motor torque decreases at lower speeds (e.g. for fans).

In the regenerative mode, the current only decreases if the torque decreases at a higher speed.

Settings

You only have to change the factory settings of the I-max controller if the drive tends to oscillate when it reaches the current limit or it is shut down due to overcurrent.

Table 8- 28   I-max controller parameters

Parameter	Description
p0305	Rated motor current
p0640	Motor current limit
p1340	Proportional gain of the I-max controller for speed reduction
p1341	Integral time of the I-max controller for speed reduction
r0056.13	Status: I-max controller active
r1343	Speed output of the I-max controller Shows the amount to which the I-max controller reduces the speed.

For more information about this function, see function diagram 1690 in the List Manual.

8.6.5 Limiting the maximum DC link voltage

How does the motor generate overvoltage?

An induction motor operates as a generator if it is driven by the connected load. A generator converts mechanical power into electrical power. The electrical power flows back into the inverter and causes V_{DC} in the inverter to increase.

Above a critical DC-link voltage both the inverter and the motor will be damaged. Before harmful voltages occur, the inverter switches off the connected motor with the fault

"DC-link overvoltage".

Protecting the motor and inverter against overvoltage

To the extent the application permits, the Vdc_max control prevents the DC-link voltage from reaching critical levels. The Vdc_max control increases the ramp-down time of the motor during braking, so that the motor feeds back only as little power to the inverter as is covered by the losses in the inverter.

The Vdc_max control is not suitable for applications where the motor is continuously in the generator mode. This includes, for example, cranes or applications involving braking large moments of inertia. Further information on inverter braking methods can be found in Section Braking functions of the converter (Page 266).

There are two different groups of parameters for the Vdc_max control, depending on whether the motor is being operated with U/f control or vector control.

Table 8- 29   Parameters of the Vdc_max control

Parameter for V/f control	Parameter for vector control	Description
p1280 = 1	p1240 = 1	**Vdc_max control Vdc monitoring configuration** (factory setting: 1)1: Enable Vdc_max control
r1282	r1242	**Vdc_max control activation level** Shows the value of the DC link voltage above which the Vdc_max control is active
p1283	p1243	**Vdc_max control dynamic factor** (factory setting: 100 %) scaling of the control parameters p1290, p1291 and p1292
p1290	p1250	**Vdc_max control proportional gain** (factory setting: 1)
p1291	p1251	**Vdc_max control integral time** (factory setting p1291: 40 ms, factory setting p1251: 0 ms)
p1292	p1252	**Vdc_max control rate time** (factory setting p1292: 10 ms, factory setting p1252: 0 ms)

Parameter for V/f control	Parameter for vector control	Description
p1294	p1254	**Vdc_max control automatic sensing ON level** (factory setting p1294: 0, factory setting p1254: 1) Activates or deactivates automatic detection of the switch-on levels of the Vdc_max control. 0: Automatic detection disabled 1: Automatic detection enabled
p0210	p0210	**Unit supply voltage** If p1254 or p1294 = 0, the 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).

8.7 Application-specific functions

The inverter offers a series of functions that you can use depending on your particular application, e.g.:

- Switching over units
- Braking functions
- Automatic restart and flying restart
- Basic process control functions
- Logical and arithmetic functions using function blocks that can be freely interconnected
- Energy-saving display for pumps and fans
- Essential service mode
- Multi-zone controller
- Cascade control
- Bypass
- Energy-saving mode

Refer to the following sections for detailed descriptions.

8.7.1 Unit changeover

Description

With the unit changeover function, you can adapt the inverter to the line supply (50/60 Hz) and also select US units or SI units as base units.

Independent of this, you can define the units for process variables or change over to percentage values.

Specifically, you have the following options:

- Changing over the motor standard (Page 260) IEC/NEMA (adaptation to the line supply)
- Changing over the unit system (Page 261)
- Changing over process variables for the technology controller (Page 262)

Note

The motor standard, the unit system as well as the process variables can only be changed offline.

The procedure is described in Section Switching units with STARTER (Page 263).

258

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

Note

Restrictions for the unit changeover function

- The values on the rating plate of the inverter or motor cannot be displayed as percentage values.

- Using the unit changeover function a multiple times (for example, percent → physical unit 1 → physical unit 2 → percent) may lead to the original value being changed by one decimal place as a result of rounding errors.

- If the unit is changed over into percent and the reference value is then changed, the percentage values relate to the new reference value.
  Example:
  - For a reference speed of 1500 rpm, a fixed speed of 80% corresponds to a speed of 1200 rpm.
  - If the reference speed is changed to 3000 rpm, then the value of 80% is kept and now means 2400 rpm.

Reference variables for unit changeover

p2000   Reference frequency/speed

p2001   Reference voltage

p2002   Reference current

p2003   Reference torque

r2004   Reference power

p2005   Reference angle

p2007   Reference acceleration

8.7.1.1 Changing over the motor standard

You change over the motor standard using p0100. The following applies:

- – p0100 = 0: IEC motor (50 Hz, SI units)

- – p0100 = 1: NEMA motor (60 Hz, US units)

- – p0100 = 2: NEMA motor (60 Hz, SI units)

The parameters listed below are affected by the changeover.

Table 8- 30   Variables affected by changing over the motor standard

P no.	Designation	Unit for p0100 =		
		0*)	1	2
r0206	Power Module rated 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
r0334	Motor torque constant, actual	Nm/A	lbf ft/A	Nm/A
p0341	Motor moment of inertia	kgm^2	$lb\ ft^2$	kgm^2
p0344	Motor weight (for thermal motor type)	kg	Lb	kg
r1969	Speed_cont_opt moment of inertia determined	kgm^2	$lb\ ft^2$	kgm^2

*) Factory setting

8.7.1.2 Changing over the unit system

You change over the unit system using p0505. The following selection options are available:

– p0505 = 1: SI units (factory setting)

– p0505 = 2: SI units or % relative to SI units

– p0505 = 3: US units

– p0505 = 4: US units or % relative to US units

Note

Special features

The percentage values for p0505 = 2 and for p0505 = 4 are identical. For internal calculation and for the output of physical variables, it is, however, important whether the conversion is made to SI or US units.

In the case of variables for which changeover to % is not possible, 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.

Parameters affected by changeover

The parameters affected by changing over the unit system are grouped according to unit. An overview of the unit groups and the possible units can be found in the List Manual in the Section "Unit group and unit selection".

8.7.1.3   Changing over process variables for the technology controller

> **Note**
>
> We recommend that the units and reference values of the technology controller are coordinated and harmonized with one another during commissioning.
>
> Subsequent modification in the reference variable or the unit can result in incorrect calculations or displays.

Changing over process variables of the technology controller

You change over the process variables of the technology controller using p0595. For physical values, you define the reference variable in p0596.

The parameters affected by changing over units of the technology controller belong to unit group 9_1. For details, please refer to the section titled "Unit group and unit choice" in the List Manual.

Switching the process variables of the additional technology controller 0

The process variables of the additional technology controller 0 switch over via p11026. You define the reference variable for absolute units in p11027.

The parameters affected by the unit switchover of the additional technology controller 0 belong to units group 9_2. Details can be found in the Parameter Manual, under the section entitled "units group and unit selection".

Switching the process variables of the additional technology controller 1

The process variables of the additional technology controller 1 switch over via p11126. You define the reference variable for absolute units in p11127.

The parameters affected by the unit switchover of the additional technology controller 1 belong to units group 9_3. Details can be found in the Parameter Manual, under the section entitled "units group and unit selection".

Switching the process variables of the additional technology controller 2

The process variables of the additional technology controller 2 switch over via p11226. You define the reference variable for absolute units in p11227.

The parameters affected by the unit switchover of the additional technology controller 2 belong to units group 9_4. Details can be found in the Parameter Manual, under the section entitled "units group and unit selection".

8.7.1.4 Switching units with STARTER

Precondition

The inverter must be in the offline mode in order to change over the units.

STARTER shows whether you change settings online in the inverter or change offline in the PC (**Online mode** / **Offline mode**).

You switch over the mode using the adjacent buttons in the menu bar.

Go offline (disconnect)

Establish the online connection
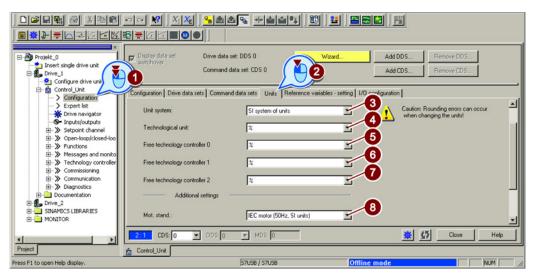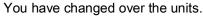
Procedure
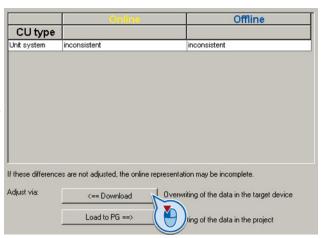
To change over the units, proceed as follows:

1. Select the configuration

2. Go to the "Units" tab in the configuration screen form to change over the units.

3. Changing over the system of units

4. Select process variables of the technology controller

5. Select process variables of the additional technology controller 0

6. Select process variables of the additional technology controller 1

7. Select process variables of the additional technology controller 2

8. Adapting to the line supply

You have changed over the units.

- Save your settings and go online.
  In this case, the converter detects that other units or process variables have been set offline than are actually in the converter; the converter displays this in the following screen form:
- Accept these settings in the converter.

8.7.2 Energy-saving display

Background

Conventionally-controlled fluid flow machines control the flow rate using valves or throttles. In so doing, the drive operates constantly at the rated speed. The efficiency of the system decreases if the flow rate is reduced using valves or throttles. The efficiency is the lowest when valves or throttles are ompletely closed. Further, undesirable effects can occur, e.g. the formation of vapor bubbles in liquids (cavitation) or the temperature rise of the medium being pumped increases.

The inverter controls the flow rate or the pressure by varying the speed of the fluid flow machine. As a consequence, over its complete operating range, a fluid-flow machine operates close to its maximum efficiency – and especially in partial load operation, uses less energy than for valve and throttle-based controls.

Function

The energy-saving display calculates the energy saved when operating fluid-flow machines, e.g. centrifugal pumps, fans, radial and axial compressors. The energy saving display compares inverter operation with direct on line operation and throttle control.

The inverter indicates the energy saved in parameter r0041 in kWh, referred to the last 100 operating hours.

For less than 100 operating hours, the inverter interpolates the energy saving to 100 operating hours.

The inverter calculates the energy-saving based on the operating characteristic that has been saved.

Table 8- 31   Operating characteristic set in the factory

	Point 1	Point 2	Point 3	Point 4	Point 5
Power	p3320 = 25 %	p3322 = 50 %	p3324 = 77 %	p3326 = 92 %	p3328 = 100 %
Speed	p3321 = 0 %	p3323 = 25 %	p3325 = 50 %	p3327 = 75 %	p3329 = 100 %

If you require a precise value for the energy saving, then you must adapt the operating characteristic set in the factory.

Additional parameters for the energy usage display:

r0039.0: Energy usage since the last reset

r0039.1: Energy drawn since the last reset

r0039.2: Energy fed back since the last reset

p0040: Parameter to reset parameters r0039 and r0041.

r0041: Displays the saved energy since the last reset, referred to the operating characteristic, defined by parameters p3320 …p3329.

Adapting the operating characteristic

Precondition

You require the following data to calculate the system-specific operating characteristic:

– Operating characteristics of the manufacturer

– for pumps: Delivery height and power as a function of the flow rate

– for fans: Total pressure increase and power as a function of the flow rate

– System characteristics for 5 different flow rates.

Procedure

Proceed as follows to adapt the operating characteristic:

1. For the 5 different flow rates, calculate the delivery height requirement, referred to a pump, which is directly connected to the line supply (n = 100 %).

   To do this, set the formula for the system characteristic the same as the formula for the operating characteristic of the delivery height.

   For a correspondingly lower delivery height, you only require a correspondingly low speed.

2. Enter the speeds into parameters p3321, p3323, p3325, p3327 and p3329.

3. Based on the flow rates and the associated operating characteristic of the manufacturer, calculate the power that the pump requires for the various flow rates when connected directly to the line supply.

4. Enter the values into parameters p3320, p3322, p3324, p3326 and p3328.

You have adapted the operating characteristic, and you now obtain a precise result for the energy saving.

8.7.3 Braking functions of the converter

8.7.3.1 Electrical braking methods

Regenerative power

If an induction motor electrically brakes the connected load and the mechanical power exceeds the electrical losses, then it operates as a generator. The motor converts mechanical power into electrical power. Examples of applications, in which regenerative operation briefly occurs, include:

– Grinding disk drives

– Fans

For certain drive applications, the motor can operate in the regenerative mode for longer periods of time, e.g.:

– Centrifuges

– Hoisting gear and cranes

– Conveyor belts with downward movement of load (vertical or inclined conveyors)

The inverter offers the following options to convert the regenerative power of the motor into heat or to feed it back into the line: This depends on the Power Module used:

– DC braking (Page 268)
For Power Modules **PM230, PM240, PM250** and **PM260**

– Compound braking (Page 271)
For Power Module **PM240**

– Dynamic braking (Page 272)
For Power Module **PM240**

– Braking with regenerative feedback to the line (Page 275)
for Power Modules **PM250** and **260**

A comparison with the main features of the individual braking functions is listed in the following paragraphs.

Main features of the braking functions

DC braking

The motor converts the regenerative power into heat.

- *Advantage:* The motor brakes without the inverter having to process the regenerative energy
- *Disadvantages:* Significant increase in the motor temperature; no defined braking characteristics; no constant braking torque; no braking torque at standstill; regenerative power is lost as heat; does not function when the line supply fails

Compound braking

A version of DC braking in which the motor is braked defined. All other properties are identical to DC braking.

Dynamic braking
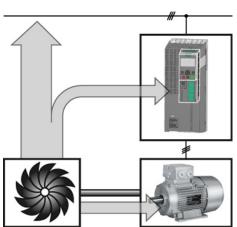
The inverter converts the regenerative power into heat using a braking resistor.

- *Advantages:* Defined braking characteristics; no additional motor temperature increase; constant braking torque; in principle, also functions when the power fails
- *Disadvantages:* Braking resistor required; regenerative power is dissipated as heat

Braking with regenerative feedback into the line supply

The converter feeds the regenerative power back into the line supply.

- *Advantages:* Constant braking torque; the regenerative power is not converted into heat, but is regenerated into the line supply; can be used in all applications; continuous regenerative operation is possible - e.g. when lowering a crane load
- *Disadvantage:* Does not function when power fails

Braking with regenerative feedback into the line supply

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

267

Braking method depending on the application

Application examples	Electrical braking methods	Power Modules that can be used
Pumps, fans, mixers, compressors, extruders	Not required	PM230, PM240, PM250, PM260
Grinding machines, conveyor belts	DC braking, compound braking	PM240
Centrifuges, vertical conveyors, hoisting gear, cranes, winders	Dynamic braking	PM240
	Braking with regenerative feedback into the line supply	PM250, PM260

8.7.3.2 DC braking

DC braking is used for applications without regenerative feedback into the line supply, where the motor can be more quickly braked by impressing a DC current than along a braking ramp.

Typical applications for DC braking include:

– Centrifuges

– Saws

– Grinding machines

– Conveyor belts

Function

NOTICE
Motor damage caused by overheating
The motor can overheat if it is braked for long periods of time or frequently using DC braking. This may damage the motor.
• Monitor the motor temperature.
• If the motor gets too hot during operation you must select another braking method or give the motor more time to cool down.
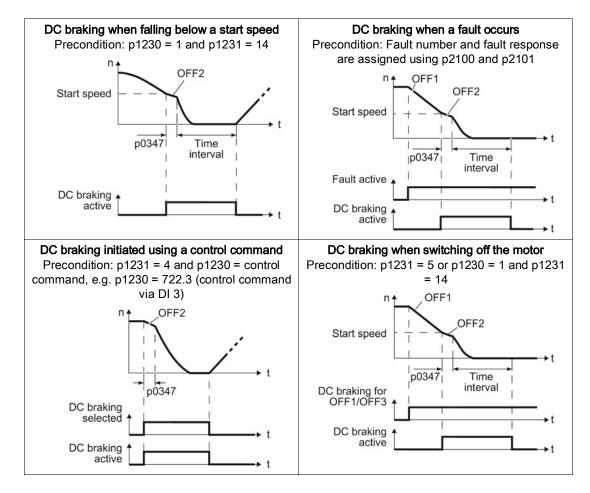
With DC braking, the inverter outputs an internal OFF2 command for the time that it takes to de-energize the motor p0347 - and then impresses the braking current for the duration of the DC braking.

The DC-braking function is possible only for induction motors.

DC braking when falling below a start speed	DC braking when a fault occurs
Precondition: p1230 = 1 and p1231 = 14	Precondition: Fault number and fault response are assigned using p2100 and p2101
DC braking initiated using a control command	**DC braking when switching off the motor**
Precondition: p1231 = 4 and p1230 = control command, e.g. p1230 = 722.3 (control command via DI 3)	Precondition: p1231 = 5 or p1230 = 1 and p1231 = 14

DC braking when falling below a starting speed

1. The motor speed has exceeded the starting speed.

2. The inverter activates the DC braking as soon as the motor speed falls below the starting speed.

DC braking when a fault occurs

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

1. The higher-level control issues the command for DC braking, e.g. using DI3: p1230 = 722.3.

2. DC braking starts.

If the higher-level control withdraws the command during DC braking, the inverter interrupts DC braking and the motor accelerates to its setpoint.

DC braking when the motor is switched off

1. The higher-level control switches off the motor (OFF1 or OFF3).

2. The motor brakes along the down ramp to the speed for the start of DC braking.

3. DC braking starts.

Settings for DC braking

Parameter	Description
p0347	**Motor de-excitation time** (calculated after the basic commissioning)
	The inverter can trip due to an overcurrent during DC braking if the de-excitation time is too short.
p1230	**DC braking activation** (factory setting: 0)
	Signal source to activate DC braking
	• 0 signal: Deactivated
	• 1 signal: Active
p1231	**Configuring DC braking** (factory setting: 0)
	0 No DC braking 4 General release for DC braking 5 DC braking for OFF1/OFF3 14 DC braking below the starting speed
p1232	**DC braking braking current** (factory setting 0 A)
p1233	**DC braking duration** (factory setting 1 s)
p1234	**DC braking start speed** (factory setting 210000 rpm)
r1239	**DC braking status word**
	.08 DC braking active .10 DC braking ready .11 DC braking selected .12 DC braking selection internally locked .13 DC braking for OFF1/OFF3

Table 8- 32   Configuring DC braking when faults occur

Parameter	Description
p2100	**Set fault number for fault response** (factory setting 0)
	Enter the fault number for which DC braking should be activated, e.g. p2100[3] = 7860 (external fault 1).
p2101 = 6	**Fault response setting** (factory setting 0)
	Assigning the fault response: p2101[3] = 6.
The fault is assigned an index of p2100. Assign the same index of p2100 or p2101 to the fault and fault response.	
The inverter's List Manual lists in the "Faults and alarms" list the possible fault responses for every fault. The "DCBRAKE" entry means that it is permissible to set DC braking as response for this particular fault.	

270

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

See also

Flying restart – switching on while the motor is running (Page 276)

8.7.3.3 Compound braking

Typical applications for compound braking include:

– Centrifuges

– Saws

– Grinding machines

– Horizontal conveyors

For these applications, the motor is normally operated with a constant speed, and is only braked down to standstill after longer periods of time.

Principle of operation
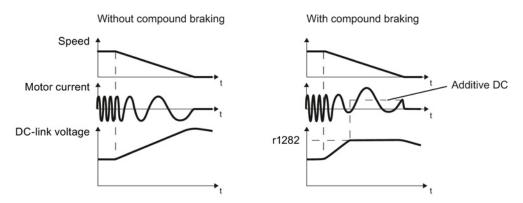
Figure 8-22   Motor brakes with and without active compound braking

Compound braking prevents the DC-link voltage increasing above a critical value. The inverter activates compound braking depending on the DC-link voltage. Above a DC-link voltage threshold (r1282), the inverter adds a DC current to the motor current. The DC current brakes the motor and prevents an excessive increase in the DC-link voltage.

Note

Compound braking is possible only with the U/f control.

Compound braking does not operate in the following cases:

- The "flying restart" function is active
- DC braking is active
- Vector control is selected

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

271

Setting and enabling compound braking

Parameter	Description
p3856	**Compound braking current (%)**
	With the compound braking current, the magnitude of the DC current is defined, which is additionally generated when stopping the motor for operation with U/f control to increase the braking effect.
	p3856 = 0 Compound braking locked
	p3856 = 1 … 250 Current level of the DC braking current as a % of the rated motor current (p0305)
	Recommendation: p3856 < 100% × (r0209 - r0331) / p0305 / 2
r3859.0	**Compound-braking status word**
	r3859.0 = 1: Compound braking is active

NOTICE
Motor damage from overheating with compound braking
The motor will overheat if braking lasts too long or the motor is braked too often. This may damage the motor.
Monitor the motor temperature. If the motor gets too hot during operation you must select another braking method or give the motor more time to cool down.

8.7.3.4 Dynamic braking

Typical applications for dynamic braking include:

– Horizontal conveyors

– Vertical and inclined conveyors

– Hoisting gear

For these applications, dynamic motor behavior with different speeds or continuous change of direction is required.

Principle of operation

⚠ CAUTION
Burns when touching a hot braking resistor
A braking resistor reaches high temperatures during operation. Touching the braking resistor may result in burns.
• Do not touch a braking resistor during operation.

The inverter controls the braking chopper depending on its DC-link voltage. The DC-link voltage increases as soon as the inverter absorbs the regenerative power when braking the motor. The braking chopper converts this power into heat in the braking resistor. This prevents the DC-link voltage from increasing above the limit value $U_{DC\ link,\ max}$.
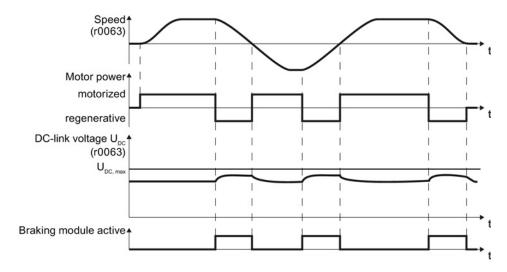
Figure 8-23   Simplified representation of dynamic braking with respect to time

Connecting a braking resistor

⚠ WARNING
Injuries from smoke gases when using an unsuitable braking resistor
An unsuitable braking resistor may result in a fire during operation. The following risks exist as a result: • Smoke gas development   • Expansion of the fire due to open flames   Remedy: • Only use the specified braking resistors.   • Maintain an appropriate distance from the other components around the braking resistor.   • Ensure adequate ventilation.

Procedure

To connect a braking resistor to the inverter, proceed as follows:

1. Connect the braking resistor to terminals R1 and R2 of the Power Module

2. Ground the braking resistor directly to the control cabinet's grounding bar. It is not permissible that the braking resistor is grounded via the PE terminals on the Power Module.

3. If you must observe the EMC guidelines, pay special attention to the shielding.

4. Evaluate the braking resistor's temperature monitoring (terminals T1 and T2) such that the inverter outputs a fault when the resistor has an overtemperature condition.
   You can do this in the following two ways:

   – Use a contactor to disconnect the inverter from the line as soon as the temperature monitoring responds.

   – Connect the contact of the temperature monitoring function of the braking resistor with a free digital input of your choice on the inverter.

      Define the function of this digital input as external fault, e.g. for a digital input DI 3: p2106 = 722.3.
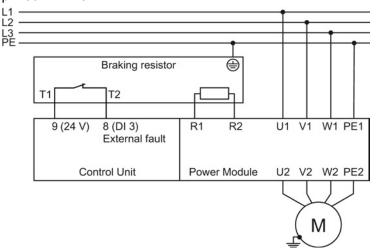
Figure 8-24   Braking resistor connection (as example: Temperature monitoring via digital input DI 3)

You have connected the braking resistor to the inverter.

You will find more information about the braking resistor in the installation instructions for Power Module PM240 (http://support.automation.siemens.com/WW/view/en/30563173/133300).

274

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

Procedure: Set dynamic braking

In order to optimally utilize the connected braking resistor, you must know the braking power that occurs in your particular application.

Table 8- 33   Parameter

Parameter	Description	
p0219	**Braking power of the braking resistor** (factory setting: 0 kW) Set the maximum braking power that the braking resistor must handle in your particular application.	
	Under certain circumstances, for low braking power ratings, the inverter extends the ramp-down time of the motor.	
	Example: In your particular application, the motor brakes every 10 seconds. In so doing, the braking resistor must handle a braking power of 1 kW for 2 s. Use a braking resistor with a continuous power rating of 1 kW × 2 s / 10 s = 0.2 kW and set the maximum braking power to: p0219 = 1 (kW).	
p0844	**No coast down/coast down (OFF2) signal source 1**	
	p0844 = 722.x	Monitor the overtemperature of the braking resistor with digital input x of the inverter.

8.7.3.5   Braking with regenerative feedback to the line

Typical applications for braking with energy recovery (regenerative feedback into the line supply):

– Centrifuges

– Unwinders

– Cranes and hoisting gear

For these applications, the motor must brake frequently or for longer periods of time.

Pre-requisite for regenerative braking is the Power Module PM250 or PM260.

The inverter can feed back up to 100% of its power into the line supply (referred to "High Overload" base load, see Section Technical data, Power Modules (Page 373)).

Setting the braking with regenerative feedback to the line

Parameter	Description
Limiting the regenerative feedback for U/f control (p1300 < 20)	
p0640	**Motor overload factor**
	Limiting the regenerative power is not directly possible with U/f control, but can be achieved indirectly by limiting the motor current.
	If the current exceeds this value for longer than 10 s, the inverter shuts down the motor with fault F07806.
Limiting feedback with vector control (p1300 ≥ 20)	
p1531	**Regenerative power limit**
	The maximum regenerative load is entered as negative value via p1531. (-0.01 … -100000.00 kW).
	Values higher than the rated value of the power unit (r0206) are not possible.

8.7.4 Automatic restart and flying restart

8.7.4.1 Flying restart – switching on while the motor is running

If you switch on the motor while it is still running, then it is highly likely that a fault will occur due to overcurrent (F07801). Examples of applications involving an unintentionally rotating motor directly before switching on:

– The motor rotates after a brief line interruption.

– A flow of air turns the fan impeller.

– A load with a high moment of inertia drives the motor.

After the ON command, the "flying restart" function initially synchronizes the inverter output frequency to the motor speed and then accelerates the motor up to the setpoint.
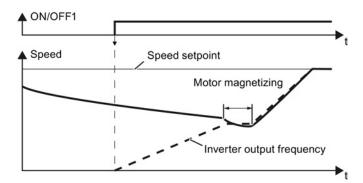
Figure 8-25   Principle of operation of the "flying restart" function

Setting "flying restart" function

If the inverter simultaneously drives several motors, then you must only use the "flying restart" function if the speed of all of the motors is always the same (group drive with a mechanical coupling).

Table 8- 34   Basic setting

Parameter	Description	
P1200	**Flying restart operating mode** (factory setting: 0)	
	0	Flying restart is locked
	1	Flying restart is enabled, look for the motor in both directions, start in direction of setpoint
	4	Flying restart is enabled, only search in direction of setpoint

Table 8- 35   Advanced settings

Parameter	Description
P1201	**Flying restart enable signal source** (factory setting: 1)
	Defines a control command, e.g. a digital input, through which the flying restart function is enabled.
P1202	**Flying restart search current** (Factory setting for Power Module PM230: 90%. Factory setting for PM240, PM250 and PM260: 100%)
	Defines the search current with respect to the magnetizing current (r0331), which flows in the motor during the flying restart.
P1203	**Flying restart search speed factor** (Factory setting for Power Module PM230: 150%. Factory setting for PM240, PM250 and PM260: 100%)
	The value influences the speed with which the output frequency is changed during the flying restart. A higher value results in a longer search time.
	If the inverter does not find the motor, reduce the search speed (increase p1203).

8.7.4.2 Automatic switch-on

The automatic restart includes two different functions:

– The inverter automatically acknowledges faults.

– After a fault occurs or after a power failure, the inverter automatically switches-on the motor again.

The inverter interprets the following events as power failure:

– The inverter signals fault F30003 (DC-link undervoltage), as the line supply voltage of the inverter has briefly failed.

– The inverter power supply has failed for a long enough time so that the inverter has been switched-off.

⚠ **WARNING**

Injuries from the automated machine restart

When the "automatic restart" function is active (p1210 > 1), the motor automatically starts after a power failure. The movements that the machine executes may result in serious injuries.

• Block the machine to prevent unintentional access.

• Before working on the machine switch the automatic restart mechanism off.

Commissioning the automatic restart

Procedure

Proceed as follows to commission the automatic restart:

1. If it is possible that the motor is still rotating for a longer period of time after a power failure or after a fault, then in addition, you must activate the "flying restart" function, see Flying restart – switching on while the motor is running (Page 276).

2. Using p1210, select the automatic restart mode that best suits your application.

Automatic restart mode (AR)				
No AR	Automatically acknow-ledge faults.	Automatically acknow-ledge faults, if ON/OFF1 = 1	Do not automatically acknowledge faults.	Automatically acknow-ledge faults.
	Do not automatically switch on motor	Automatically switch on motor.	Automatically switch on motor.	Automatically switch on motor.
		After power failure / After power failure and faults	After power failure / After power failure and faults	
p1210 = 0	p1210 = 1	p1210 = 4 / p1210 = 6	p1210 = 14 / p1210 = 16	p1210 = 26

Figure 8-26   Selecting the automatic restart mode

3. Set the parameters of the automatic restart function.
   The method of operation of the parameters is explained in the following diagram and in the table.

[1] The inverter automatically acknowledges faults under the following conditions:
   - p1210 = 1 or 26: Always.
   - p1210 = 4 or 6: If the command to switch-on the motor is available at a digital input or via the fieldbus (ON/OFF1 = 1).
   - p1210 = 14 or 16: Never.

[2] The inverter attempts to automatically switch-on the motor under the following conditions:
   - p1210 = 1: Never.
   - p1210 = 4, 6, 14, 16, or 26: If the command to switch-on the motor is available at a digital input or via the fieldbus (ON/OFF1 = 1).

[3] If no fault has occurred one second after flying restart and magnetizing (r0056.4 = 1), the start attempt was successful.

Figure 8-27   Time response of the automatic restart

You have commissioned the automatic restart function.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

279

Parameter for setting the automatic restart

Parameter	Explanation
p1210	**Automatic restart mode** (factory setting 0)
	0: Disable automatic restart. 1: Acknowledge all faults without restarting. 4: Restart after power failure without further restart attempts. 6: Restart after fault with further restart attempts. 14: Restart after power failure after manual acknowledgement. 16: Restart after fault after manual acknowledgement. 26: Acknowledgement of all faults and restart with ON/OFF1 = 1 command.
p1211	**Automatic restart start attempts** (factory setting 3)
	This parameter is only effective for the settings p1210 = 4, 6, 14, 16, 26.
	You define the maximum number of start attempts using p1211. After each successful acknowledgement, the inverter decrements its internal counter of start attempts by 1.
	For p1211 = n, up to n + 1 start attempts are made. Fault F07320 is output after n + 1 unsuccessful start attempts.
	The inverter sets the start attempt counter back again to the value of p1211, if one of the following conditions is fulfilled:
	• After a successful start attempt, the time in p1213[1] has expired. • After fault F07320, switch off the motor (OFF1) and acknowledge the fault. • You change the start value p1211 or the mode p1210.
p1212	**Automatic restart wait time start attempt** (factory setting 1.0 s)
	This parameter is only effective for the settings p1210 = 4, 6, 26.
	Examples for setting this parameter:
	1. After a power failure, a certain time must elapse before the motor can be switched-on, e.g. because other machine components are not immediately ready. In this case, set p1212 longer than the time, after which all of the fault causes have been removed.
	2. In operation, the inverter develops a fault condition. The lower you select p1212, then the sooner the inverter attempts to switch-on the motor again.
p1213[0]	**Automatic restart monitoring time for restart** (factory setting 60 s)
	This parameter is only effective for the settings p1210 = 4, 6, 14, 16, 26.
	With this monitoring function, you limit the time in which the inverter may attempt to automatically switch-on the motor again.
	The monitoring function starts when a fault is identified and ends with a successful start attempt. If the motor has not successfully started after the monitoring time has expired, fault F07320 is signaled.
	Set the monitoring time longer than the sum of the following times:
	+ p1212 + Time that the inverter requires to start the motor on the fly. + Motor magnetizing time (p0346) + 1 second
	You deactivate the monitoring function with p1213 = 0.

Parameter	Explanation
p1213[1]	**Automatic restart monitoring time** **to reset the fault counter** (factory setting 0 s)
	This parameter is only effective for the settings p1210 = 4, 6, 14, 16, 26.
	Using this monitoring time, you prevent that faults, which continually occur within a certain time period, are automatically acknowledged each time.
	The monitoring function starts with a successful start attempt and ends after the monitoring time has expired.
	If the inverter has made more than (p1211 + 1) successful start attempts within monitoring time p1213[1], the inverter cancels the automatic restart function and signals fault F07320. In order to switch on the motor again, you must acknowledge the fault and set ON/OFF1 = 1.

Additional information is provided in the parameter list of the List Manual.

Advanced settings

If you with to suppress the automatic restart function for certain faults, then you must enter the appropriate fault numbers in p1206[0 … 9].

Example: p1206[0] = 07331 ⇒ No restart for fault F07331.

Suppressing the automatic restart only functions for the setting p1210 = 6, 16 or 26.

⚠ WARNING
Personal injury and property damage
In the case of communication via the fieldbus interface, the motor restarts with the setting p1210 = 6 even if the communication link is interrupted. This means that the controller cannot stop the motor. To avoid this dangerous situation, you must enter the fault code of the communications fault in parameter p1206.
Example: A communication failure via PROFIBUS is signaled using fault code F01910. You should therefore set p1206[n] = 1910 (n = 0 … 9).

8.7.5 Technology controller

8.7.5.1 Overview

The technology controller controls process variables, e.g. pressure, temperature, level or flow.
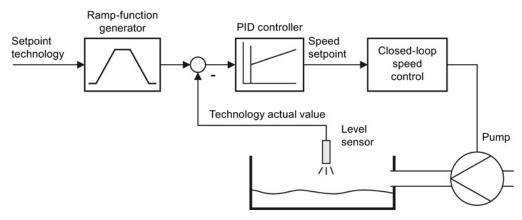
Figure 8-28   Example: technology controller as a level controller

8.7.5.2 Setting the controller

Simplified representation of the technology controller

The technology controller is implemented as PID controller (controller with proportional, integral and differential component) and so can be adapted very flexibly.
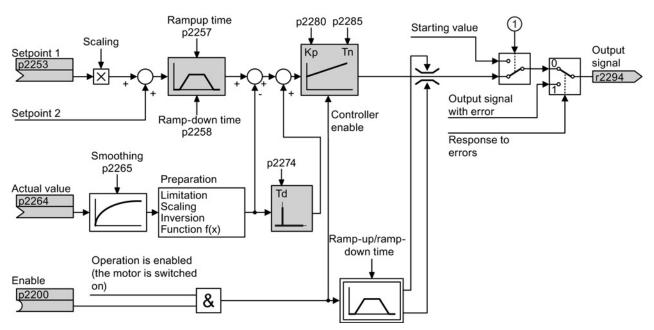
Figure 8-29   Simplified representation of the technology controller

Setting the technology controller

Parameter	Remark
p2200 = 1	Enable technology controller.
p1070 = 2294	Interconnect the main speed setpoint with the output of the technology controller.
p2253 = …	Define the setpoint for the technology controller. Example: p2253 = 2224: The converter interconnects the fixed setpoint p2201 with the setpoint of the technology controller. p2220 = 1: The fixed setpoint p2201 is selected.
p2264 = …	Define the actual value for the technology controller. Example: For p2264 = 755[0], analog input 0 is the source for the actual value.
p2257, p2258	Define the ramp-up and ramp-down times [s]
p2274	Differentiation time constant [s] The differentiation improves the rise time characteristics for very slow controlled variables, e.g. a temperature control. p2274 = 0: The differentiation is switched off.
p2280	Proportional gain K_P
p2285	Integral time T_N [s] Without an integral time, the controller cannot completely equalize deviations between the setpoint and actual value. p2285 = 0: The integral time is switched off.

Advanced settings

Parameter	Remark
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.	
p2297 = 2291	Interconnect the upper limit with p2291.
p2298 = 2292	Interconnect the lower limit with p2292.
p2291	Upper limit for the technology controller output e.g.: p2291 =100
p2292	Lower limit for the technology controller output e.g.: p2292 = 0
Manipulating the actual value of the technology controller	
p2267, p2268	Limit the actual value
p2269	Scale the actual value
p2271	Invert the actual value
p2270	Actual value

You can find additional information in function block diagram 7958 of the List Manual.

8.7.5.3 Optimizing the controller

Setting the technology controller from a practical perspective

Procedure
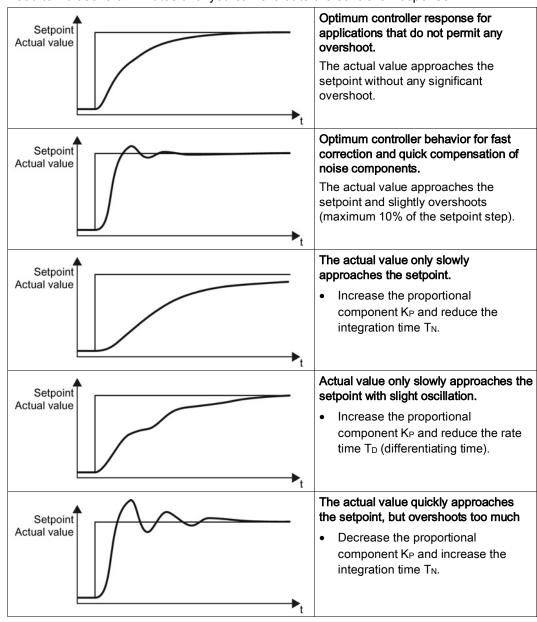
Proceed as follows to set the technology controller:

1. Temporarily set the ramp-up and ramp-down times of the ramp-function generator (p2257 and p2258) to zero.

2. Enter a setpoint step and monitor the associated actual value, e.g. with the trace function of STARTER.
   The slower the response of the process to be controlled, the longer you must monitor the controller response. Under certain circumstances (e.g. for a temperature control), you need to wait several minutes until you can evaluate the controller response.

Setpoint Actual value (graph)	**Optimum controller response for applications that do not permit any overshoot.** The actual value approaches the setpoint without any significant overshoot.
Setpoint Actual value (graph)	**Optimum controller behavior for fast correction and quick compensation of noise components.** The actual value approaches the setpoint and slightly overshoots (maximum 10% of the setpoint step).
Setpoint Actual value (graph)	**The actual value only slowly approaches the setpoint.** • Increase the proportional component K_P and reduce the integration time T_N.
Setpoint Actual value (graph)	**Actual value only slowly approaches the setpoint with slight oscillation.** • Increase the proportional component K_P and reduce the rate time T_D (differentiating time).
Setpoint Actual value (graph)	**The actual value quickly approaches the setpoint, but overshoots too much** • Decrease the proportional component K_P and increase the integration time T_N.

284

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

3. Set the ramp-up and ramp-down times of the ramp-function generator back to their original value.

☐ You have now set the technology controller.

Additional technology controllers

The inverter has additional technology controllers in the following parameter ranges:

- p11000 … p11099:   free technology controller 0
- p11100 … p11199:   free technology controller 1
- p11200 … p11299:   free technology controller 2

Refer to the parameter descriptions and in function diagram 7030 of the associated List Manual for additional details.

8.7.6   Monitor the load torque (system protection)

In many applications, it is advisable to monitor the motor torque:

- Applications where the load speed can be indirectly monitored by means of the load torque. For example, in fans and conveyor belts with too low a torque indicates that the drive belt is torn.

- Applications that are to be protected against overload or locking (e.g. extruders or mixers).

- Applications in which no-load operation of the motor represents an impermissible situation (e.g. pumps).

Load torque monitoring functions

The inverter monitors the motor torque in different ways:

- No-load monitoring
  The inverter generates a message if the motor torque is too low.

- Blocking protection
  The inverter generates a message if the motor speed cannot match the speed setpoint despite maximum torque.

- Stall protection:
  The inverter generates a message if the inverter control has lost the orientation of the motor.

- Speed-dependent torque monitoring
  The inverter measures the actual torque and compares it with a set speed/torque characteristic.
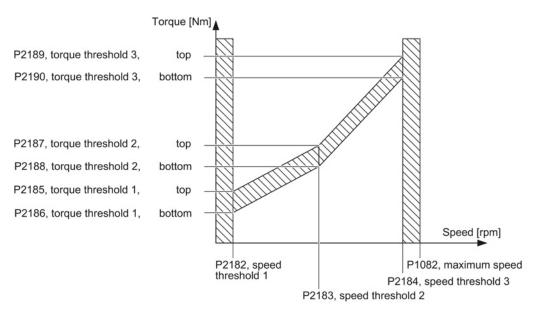
Figure 8-30   Parameters for the load torque monitoring

Table 8- 36   Parameterizing the monitoring functions

Parameter	Description
No-load monitoring	
p2179	**Current limit for no-load detection** If the inverter current is below this value, the message "no load" is output.
p2180	**Delay time for the "no load" message**
Blocking protection	
p2177	**Delay time for the "motor locked" message**
Stall protection	
p2178	**Delay time for the "motor stalled" message**
p1745	**Deviation of the setpoint from the actual value of the motor flux as of which the "motor stalled" message is generated** This parameter is only evaluated as part of encoderless vector control.
Speed-dependent torque monitoring	
p2181	**Load monitoring, response** Setting the response when evaluating the load monitoring. 0: Load monitoring disabled >0: Load monitoring enabled
p2182	**Load monitoring, speed threshold 1**
p2183	**Load monitoring, speed threshold 2**
p2184	**Load monitoring, speed threshold 3**
p2185	**Load monitoring, torque threshold 1, upper**
p2186	**Load monitoring, torque threshold 1, lower**
p2187	**Load monitoring, torque threshold 2, upper**
p2188	**Load monitoring, torque threshold 2, lower**
p2189	**Load monitoring, torque threshold 3, upper**

Parameter	Description
p2190	**Load monitoring torque threshold 3, lower**
p2192	**Load monitoring, delay time**
	Delay time for the message "Leave torque monitoring tolerance band"

For more information about these functions, see the List Manual (function diagram 8013 and the parameter list).

8.7.7 Monitor load failure via digital input

Using this function, the inverter monitors the load failure of the driven machine, e.g. for fans or conveyor belts.
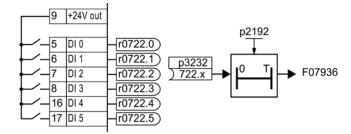
Figure 8-31   Load failure monitoring by means of a digital input

Table 8- 37   Setting load failure monitoring

Parameter	Description
p2193 = 1 … 3	**Load monitoring configuration** (factory setting: 1) 1: Torque and load failure monitoring 2: Speed and load failure monitoring 3: Load failure monitoring
p2192	**Load monitoring delay time** (factory setting 10 s) If, after the motor is switched on, the "LOW" signal is present on the associated digital input for longer than this time, a load failure is assumed (F07936)
p3232 = 722.x	**Load monitoring failure detection** (factory setting: 1) Interconnect the load monitoring with a digital input of your choice.

For more information, see the List Manual (the parameter list and function diagram 8013).

8.7.8 Real time clock (RTC)

The real time clock is the basis for time-dependent process controls, e.g.:

– To reduce the temperature of a heating control during the night

– Increase the pressure of a water supply at certain times during the day

Real time clock: Format and commissioning

The real time clock starts as soon as the Control Unit power supply is switched on for the first time. The real time clock comprises the clock time in a 24 hour format and the date in the "day, month, year" format.

After a Control Unit power supply interruption, the real time clock continues to run for approx. five days.

If you wish to use the real time clock, you must set the time and date once when commissioning. If you restore the inverter factory setting, the real time clock parameters are not reset.

Parameter	Real time clock (RTC)
p8400[0]	**RTC time**, hour (0 … 23)
p8400[1]	**RTC time**, minute (0 … 59)
p8400[2]	**RTC time**, second (0 … 59)
p8401[0]	**RTC date** , day (1 … 31)
p8401[1]	**RTC date** , month (1 … 12)
p8401[2]	**RTC date** , year (1 … 9999)
r8404	**RTC weekday** 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday 7: Sunday
p8405	**RTC activate/deactivate alarm A01098** Sets whether the real time clock issues an alarm if the time is not running in synchronism (e.g. after a longer power supply interruption). 0: Alarm A01098 deactivated 1: Alarm A01098 activated

288

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

Accept the real time clock in the alarm and fault buffer

Using the real time clock, you can track the sequence of alarms and faults over time. When an appropriate message occurs, the real time clock is converted into the UTC time format (Universal Time Coordinated):

Date, time $\Rightarrow$ 01.01.1970, 0:00 + d (days) + m (milliseconds)

The number "d" of the days and the number "m" of milliseconds is transferred into the alarm and fault times of the alarm or fault buffer, see Chapter Alarms, faults and system messages (Page 353).

Converting UTC into RTC

An RTC can again be calculated from the UTC.

Procedure

Proceed as follows to calculate a date and time from a fault or alarm time saved in the UTC format:

1. Calculate the number of seconds of UTC:
   Number of seconds = ms / 1000 + days × 86400

2. In the Internet, you will find programs to convert from UTC into RTC, e.g.:
   UTC to RTC (http://unixtime-converter.com/)

3. Enter the number of seconds in the corresponding screen and start the calculation.

   You have calculated the date and time of day.

Example:

Saved as alarm time in the alarm buffer:

r2123[0] = 2345 [ms]
r2145[0] = 14580 [days]

Number of seconds = 2345 / 1000 + 14580 × 86400 = 1259712002
Converting this number of seconds in RTC provides the date: 02.12.2009, 01:00:02.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

289

8.7.9 Time switch (DTC)

The "time switch" (DTC) function, along with the real time clock in the inverter, offers the option of controlling when signals are switched on and off.

Examples:

– Switching temperature control from day to night mode.

– Switching a process control from weekday to weekend.

Principle of operation of the time switch (DTC)

The inverter has three independently adjustable time switches. The time switch output can be interconnected with every binector input of your inverter, e.g. with a digital output or a technology controller's enable signal.
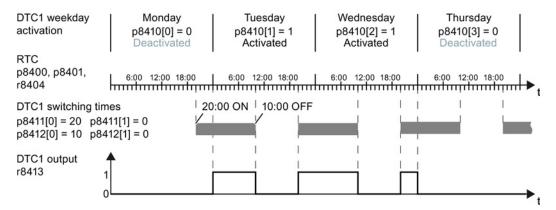
Figure 8-32   Time behavior of the time switch using example DTC1

Setting the time switch

– Enable parameterization of the DTC: p8409 = 0.
As long as DTC parameterization is enabled, the inverter keeps the output of all three DTC (r84x3, x = 1, 2, 3) at LOW.

– Set the activation of the weekdays; the switching on and off times.

– Enable the setting: p8409 = 1.
The inverter enables the DTC output once more.

Additional information is provided in the parameter list of the List Manual.

8.7.10   Record temperature via temperature-dependent resistances

Analog input AI 2

Via the DIP switch and parameter p0756.2, set the function of the analog input AI 2:

  – P0756.2 = 2 or 3 → options for setting as current input

  – P0756.2 = 6, 7 or 8 → options for setting as temperature sensor

Analog input AI 3

Analog input AI 3 is designed as a resistance input for a temperature sensor.

Setting options:

  – P0756.3 = 6, 7 or 8 → options for setting as temperature sensor

Permissible temperature sensors

The temperature-dependent resistances Pt1000 or LG-Ni1000 are permissible as temperature sensors. If you want to use the temperature signal as the actual value of the temperature controller, set p2264 = 756.2 or 756.3.

Connect the temperature sensor as follows:

  – AI 2 (terminals 50, 51)

  – AI 3 (terminals 52, 53)

Measuring ranges and alarm thresholds for LG-Ni1000

The measuring range of the LG-Ni1000 sensor extends from – 88 °C … 165 °C. For values outside this range, the converter outputs alarm A03520 "Temperature sensor fault". The fault type is displayed in r2124.

Measuring ranges and alarm thresholds for Pt1000

The measuring range of the Pt1000 sensor extends from – 88 °C … 240 °C. For values outside this range, the converter outputs alarm A03520 "Temperature sensor fault". The fault type is displayed in r2124.

Fault values for temperature sensing via AI 2

  – r2124 = 33:   Wire break or sensor not connected

  – r2124 = 34:   Short-circuit

Fault values for temperature sensing via AI 3

  – r2124 = 49:   Wire break or sensor not connected

  – r2124 = 50:   Short-circuit

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

291

Note

If you use a temperature sensor as the input for the technology controller, you have to modify the scaling of the analog input.

- Scaling example for LG-Ni1000:
  0 °C (p0757) = 0 % (p0758); 100 °C (p0759) = 100 % (p0760)
- Scaling example for Pt1000:
  0 °C (p0757) = 0 % (p0758); 100 °C (p0759) = 80 % (p0760)

Please refer to the parameter list for more details.

8.7.11 Essential service mode

In the Essential Service Mode (ESM), the motor must operate for as long as possible, for example in the case of a fire, to keep the evacuation routes open by extracting smoke.

Contrary to normal operation, when faults develop, the inverter does not shut down, but responds as follows

- Faults that do not immediately result in the destruction of the inverter or the motor:
  The inverter ignores these faults, and continues to operate in the "essential service mode"

- Faults/errors, which cannot be ignored, and demand a restart, for example software errors:
  The inverter automatically restarts and attempts to acknowledge the existing fault/error using this function.

- Faults, which also cannot be resolved after a restart:
  In this case, there is the option of activating the bypass function and to directly operate the motor from the line supply.

⚠ **WARNING**

Loss of warranty for an inverter operated in the essential service mode

If you activate the essential service mode, then all warranty claims are null and void with reference to the inverter.

The essential service mode is an exceptional state, and is not suitable for continuous operation.

Please note that the essential service mode can result in exceptionally high temperatures, including open fire, as well as emissions of light, noise, particles, gases, etc. can occur inside and outside the inverter.

The inverter logs the essential service mode, and the faults that occur while in essential service mode in a password-protected memory. This data is only accessible for the service and repair organization.

Special features of essential service mode

Priority

The essential service mode has priority over all other operating modes (e.g. hibernation or energy-saving mode).

Starting and ending the essential service mode

The essential service mode is started via a digital input, and remains active as long as the signal is available.

If the signal is withdrawn via the digital input, then the inverter reverts to normal operation and its behavior depends on the pending commands and setpoints.

Automatic restart in the essential service mode

In the essential service mode, the inverter operates with the "Restart after fault with additional start attempts" setting (p1210 = 6). We recommend that you set the automatic restart function, also for normal operation, to a value p1210 ≠ 0.

In the essential service mode, the inverter ignores the settings in p1206 (faults without automatic restart).

The inverter carries out the maximum number of restart attempts set in p1211 corresponding to the settings in p1212 and p1213. If these attempts are not successful, then the inverter goes into a fault condition with F07320.

Speed setpoint and direction of rotation in the essential service mode

The essential service mode has its own setpoint source (p3881), and if this source is lost, an alternative setpoint (p3882).

For the case that this is not possible to define the direction of rotation of the essential service mode setpoint when configuring the system, then the direction of rotation can be inverted using a digital input.

If the technology controller is active as setpoint source for the essential service mode setpoint, then the direction of rotation cannot be changed via the digital input.

Bypass and essential service mode

- – If, when activating the essential service mode, bypass operation is active, inverter operation is selected internally in order to ensure that the setpoint is entered via the source intended for the essential service mode.

- – If faults are still present after the number of start attempts parameterized in p1211, then the inverter goes into a fault condition with F07320. In this case, there is an option of switching over to bypass operation and then directly connecting the motor to the line supply.

Application example

To improve the air circulation in the stairwells, the ventilation control creates a slight underpressure in the building. With this control, a fire would mean that smoke gases enter into the stairwell. This would then mean that the stairway would be blocked as escape or evacuation route.

Using the essential service mode function, the ventilation switches over to the control of an overpressure. This prevents the propagation of smoke in the stairwell, thereby keeping the stairs free as an evacuation route.

Settings for the essential service mode

Procedure

Proceed as follows in order to be able to use the essential service mode:

1. **Interconnect a free digital input as source for the essential service mode.**
   Example DI3: Set p3880 = 722.3.
   Ensure that this digital input is not interconnected with other functions.

2. **Using p3881, set the setpoint source for the essential service mode**
   Option 1:

   – P3881 = 0: Last recognized setpoint (factory setting), or
   – p3881 = 1: Fixed setpoint 15, or
   – p3881 = 2: Analog setpoint, or
   – p3881 = 3: Fieldbus

   Option 2:

   – p3881 = 4: Technology controller
   – Using p3884, set the source for the essential service mode setpoint.
     If you cannot connect a setpoint in p3884, then the inverter takes technology setpoint 1 that has been connected (p2253).

3. **Using p3882, set the source for the alternative setpoint.**

   – P3882 = 0: Last recognized setpoint (factory setting)

   p3882 = 1: Fixed speed setpoint which is defined in p1015

   p3882 = 2: Maximum speed (value of p1082)

4. **Parameterize the source to select the direction of rotation for the essential service mode.**
   Option 1: Emergency setpoint using p3881 = 0, 1, 2, 3:
   Using p3883, invert the direction of rotation for the essential service mode. To do this, interconnect p3883 with a digital input, e.g. with digital input 4 (DI4): Set p3883 = 722.4
   The following applies:

   – p3883 = 0 → normal direction of rotation in the essential service mode,

   – p3883 = 1 → inverted direction of rotation in the essential service mode,

   Option 2: Essential service mode via technology controller (p3881 = 4)
   If you enter the setpoint for the essential service mode via the technology controller, then the direction of rotation of the essential service mode setpoint is always valid.

5. **Switchover to bypass operation - option**
   If the inverter is not in a position to acknowledge pending faults using the automatic restart, then it goes into a fault condition with fault F07320.

   In order to also be able to operate the motor in this case, you have the option of directly connecting the motor to the line supply using the bypass operation function.

   To do this, you must:

   – Start the script described in this FAQ
     http://support.automation.siemens.com/WW/view/de/66936543
     (http://support.automation.siemens.com/WW/view/en/66936543). This means that you enable the "Bypass in the essential service mode" function.

   – Ensure that the direction of rotation does not change when switching over to bypass operation.

   – Set that the bypass is activated via a signal (p1267 = 0).

   – Make other settings for "Switch over to bypass (Page 302)".

   This means that you have made the settings for the essential service mode.

Application example

An application example for the essential service mode can be found on the Internet at the following address: http://support.automation.siemens.com/WW/view/de/63969509
(http://support.automation.siemens.com/WW/view/en/63969509)

8.7.12 Multi-zone control

Multi-zone control is used to control quantities such as pressure or temperature via the technology setpoint deviation. The setpoints and actual values are fed in via the analog inputs as current (0 … 20 mA) or voltage (0 … 10 V) or as a percentage via temperature-dependent resistances (LG-Ni1000 / Pt1000, 0 °C = 0 %; 100 °C = 100 %).

Control variants for multi-zone control

There are three control variants for multi-zone control, which are selected via p31021:

– **One setpoint and one, two or three actual values**

The actual value for the control can be calculated as mean value, maximum value or minimum value by the converter. You can find all of the setting options in the parameter list in parameter p31022.

– Average value: The deviation from the setpoint of the average value of two or three actual values is controlled.

– Minimum value: The deviation from the setpoint of the smallest actual value is controlled.

– Maximum value: The deviation from the setpoint of the highest actual value is controlled.

– **Two setpoint/actual value pairs as maximum value control (cooling)**

The maximum value control compares two setpoints/actual value pairs and controls the actual value which has the largest deviation upwards from its associated setpoint. No control takes place if both actual values lie below their setpoints.

In order to avoid frequent changeover, the inverter only switches over if the deviation of the controlled setpoint-actual value pair is more than two percent lower than the deviation of the uncontrolled value pair.

– **Two setpoint/actual value pairs as minimum value control (heating)**

The minimum value control compares two setpoints/actual value pairs and controls the actual value, which has the highest deviation downwards from its associated setpoint. The control pauses if both actual values lie above their setpoints.

The control only switches over if the deviation of the controlled setpoint-actual value pair is more than two percent lower than the deviation of the uncontrolled value pair.

Switching from day to night mode

You can modify the setpoints for day and night mode individually. You have the following opportunities to switch from day to night mode:

– Signal via the digital input DI 4

– via p31025 with the aid of free components and the real time clock

---

Note

If you activate the multi-zone control, the converter switches its analog inputs as sources for the setpoint and current value of the technology controller (refer to table).

Table 8- 38   Parameters to set the multi-zone control:

Parameter	Description	
p2200 = …	**Technology controller enable**	
p2251	**Set technology controller as main setpoint**	
P31020 = …	**Multi-zone control interconnection** (factory setting = 0) A subsequent parameterization is performed by activating or deactivating the multi-zone control.	
	Subsequent connection for p31020 = 1 (activate multi-zone control)	Subsequent connection for p31020 = 0 (deactivate multi-zone control)
	p31023[0] = 0755.0 (AI0) p31023[2] = 0755.1 (AI1) p31026[0] = 0755.2 (AI2) p31026[1] = 0755.3 (AI3) p2253 = 31024 (setpoint output, technology controller) p2264 = 31027 (actual value output, technology controller)	p31023[0] = 0 p31023[2] = 0 p31026[0] = 0 p31026[1] = 0 p2253 = 0 p2264 = 0
P31021 = …	**Configuration of multi-zone control** • 0 = Setpoint 1 / several actual values (factory setting) • 1 = Two zones / maximum value setting • 2 = Two zones / minimum value setting	
p31022 = …	**Processing of actual values for multi-zone control** (only for p31021 = 0) Possible values: 0 … 11 (factory setting = 0)	
p31023[0 … 3] = …	**Setpoints for multi-zone control** Parameters for selecting the source for setpoints in multi-zone control (factory setting = 0)	
r31024 = …	**Multi-zone control setpoint output for technology controller** CO parameters	
p31025 = …	**Switching from day to night mode for multi-zone control** Parameters for selection of the source for switching between day and night operation by the multi-zone control (default setting = 0)	
p31026[0 … 2] = …	**Actual values for multi-zone control** Parameters for selecting the source for actual values of the multi-zone control (factory setting = 0)	
r31027 = …	**Multi-zone control actual value output for technology controller** CO parameters	

Note

If you de-activate the multi-zone control, the converter resets the switch on its analog inputs to the default setting.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

297

Example

In an open plan office, temperature sensors (Lg-Ni1000) are installed in three different places. The converter receives the measured values and temperature setpoint via its analog inputs. Temperature setpoints between 8 °C … 30 °C are permissible. Overnight the average temperature should be 16 °C.

Settings

p2200.0 = 1	Technology controller enable
p2251 = 0	Set technology controller as main setpoint
p2900.0 = 16	Temperature setpoint overnight as a fixed value in %.
p31020 = 1	Activate multi-zone control
p31021 = 0	Select multi-zone control with one setpoint and three actual values
p31022 = 7	Three actual values, one setpoint. The average value of the three actual values is used for the control.
p31023.0 = 755.0	Temperature setpoint via analog input 0
p0756.0 = 0	Select analog input type (voltage input 0 … 10 V)
p0757.0 = 0 / p0758.0 = 8	Set the lower value to 8 °C (0 V ≙ 8 °C)
p0759.0 = 10 / p0760.0 = 30	Set the upper value to 30 °C (10 V ≙ 30 °C)
p31023.1 = 2900.0	Supply p31023.1 with the value written in P2900 to reduce the temperature overnight
p31026.0 = 755.2	Temperature actual value 1 via analog input 2 as a %
p0756.2 = 6	Select analog input type (temperature sensor LG-Ni1000)
p0757.2 = 0 / p0758.2 = 0	Set lower value of the scaling characteristic
p0759.2 = 100 / p0760.2 = 100	Set upper value of the scaling characteristic
p31026.1 = 755.3	Temperature actual value 2 via analog input 3 as a %
p0756.3 = 6	Select analog input type (temperature sensor LG-Ni1000)
p0757.3 = 0 / p0758.3 = 0	Set lower value of the scaling characteristic
p0759.3 = 100 / p0760.3 = 100	Set upper value of the scaling characteristic
p31026.2 = 755.1	Temperature actual value 3 via temperature sensor with current output (0 mA … 20 mA) via analog input 1
p0756.1 = 2	Select analog input type (current input 0 … 20 mA)
p0757.1 = 0 / p0758.1 = 0	Set lower value of the scaling characteristic (0 mA ≙ 0 °C)
p0759.1 = 20 / p0760.1 = 100	Set upper value of the scaling characteristic (20 mA ≙ 100 %)
p31025 = 722.4	Changeover from day to night via digital input 4

You will find more information about this multi-zone control in the parameter list and in (function diagram 7972 of the List Manual).

8.7.13 Cascade control

Cascade control is suitable for applications that require simultaneous operation of up to four motors as a function of the load. Here, for example, significantly fluctuating pressures or flow rates are equalized.

Depending on the PID variance, the inverter's cascade control switches up to three other motors on or off via contactors or motor starters.

Note

Technology controller as main setpoint

For cascade control switch the main setpoint with the output of the technology controller (p2251 = 0, p2200 =1)

Operating principle

– **Switching-in external motors**

If the main drive is run at maximum speed and the deviation on the technology controller input continues to increase, the control also switches the external motors on the line. At the same time, the main drive is ramped down to the switch-on/switch-off speed (p2378) to keep the total output power as constant as possible. The technology controller is deactivated while ramping down to the switch-on/switch-off speed.

– **Shutting down external motors**

If the main drive is running at minimum speed and the deviation on the technology controller input continues to decrease, the control switches external motors M1 to M3 off the line. The main drive is simultaneously ramped-up to the switch-on/switch-off speed to keep the total output power as constant as possible.

To avoid frequent activation/deactivation of the uncontrolled motors, you must specify a time in p2377 which must have elapsed before the inverter can switch a further motor on or off. After the time set in p2377 has elapsed, a further motor will be activated immediately if the PID deviation is greater than the value set in p2376. If, after p2377 has elapsed, the PID deviation is smaller than p2376 but greater than 2373, the timer p2374 is started before the uncontrolled motor is activated.

The motors are deactivated in the same way.
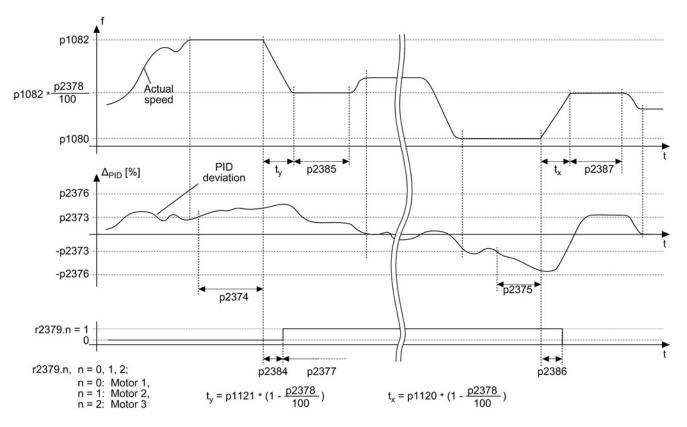
Figure 8-33   Conditions for activating/deactivating an uncontrolled motor

Controlling the activation and deactivation of motors

Use p2371 to determine the order of activation/deactivation for the individual external motors.

Table 8- 39   Order of activation for external motors depending on setting in p2371

p2371	Significance	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
0	Cascade control deactivated	---					
1	One motor can be activated	M1					
2	Two motors can be activated	M1	M1+M2				
3	Two motors can be activated	M1	M2	M1+M2			
4	Three motors can be activated	M1	M1+M2	M1+M2+M3			
5	Three motors can be activated	M1	M3	M1+M3	M1+M2+M3		
6	Three motors can be activated	M1	M2	M1+M2	M2+M3	M1+M2+M3	
7	Three motors can be activated	M1	M1+M2	M3	M1+M3	M1+M2+M3	
8	Three motors can be activated	M1	M2	M3	M1+M3	M2+M3	M1+M2+M3

Table 8- 40   Order of deactivation for external motors depending on setting in p2371

p2371	Activated motors	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
1	M1	M1					
2	M1+M2	M1+M2	M1				
3	M1+M2	M1+M2	M2	M1			
4	M1+M2+M3	M1+M2+M3	M1+M2	M1			
5	M1+M2+M3	M1+M2+M3	M3+M1	M3	M1		
6	M1+M2+M3	M1+M2+M3	M3+M2	M2+M1	M2	M1	
7	M1+M2+M3	M1+M2+M3	M3+M1	M3	M2+M1	M1	
8	M1+M2+M3	M1+M2+M3	M3+M2	M3+M1	M3	M2	M1

If you are using motors of the same power rating, you can use p2372 to define whether the motors are to be activated/de-activated following the setting specified in p2371 (p2372 = 0) or based on the operating hours (p2372 = 1, 2 ,3. Details see parameter list).

Parameters to set and activate the cascade control:

p0730 = r2379.0	**Signal source for digital output 0** Control external motor 1 via DO 0
p0731 = r2379.1	**Signal source for digital output 1** Control external motor 2 via DO 1
p0732 = r2379.2	**Signal source for digital output 2** Control external motor 3 via DO 2
p2200 = 1	**Technology controller release** Activate technology controller
p2251 = 0	**Technology controller mode** Technology controller as main speed setpoint
p2370	**Cascade control - enable** Signal source for staging on/off
p2371	**Cascade control- configuration** Activate staging and define switch-on sequence
p2372	**Cascade control - motor selection mode** Define automatic motor switch-on
p2373	**Cascade control - switch-in threshold** Define switch-on threshold
p2374	**Cascade control - switch-in delay** Define delay time
p2375	**Cascade control switch-off delay** Define delay time for de-staging
p2376	**Cascade control - overcontrol threshold** Define overcontrol threshold
p2377	**Cascade control - interlock time** Define interlock time
p2378	**Cascade control - switch-on/switch-off speed** Defining the speed for the main drive after switching-on/switching-off a motor

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

301

r2379	**Cascade control - status word**
p2380	**Cascade control - operating hours**
p2381	**Cascade control - maximum time for continuous mode**
p2382	**Cascade control - absolute operating time limit**
p2383	**Cascade control - switch-off sequence** Define switch-off sequence for an OFF command
p2384	**Cascade control - motor switch-on delay** Define motor switch-on delay
p2385	**Cascade control - switch-in speed hold time** Define speed hold time after switching-in of an external motor
p2386	**Cascade control - motor switch-off delay** Define motor switch-off delay
p2387	**Cascade control - switch-off speed hold time**Define speed hold time after switching-off of an external motor

For more information about the parameters, see the List Manual.

8.7.14 Bypass

The bypass function switches the motor from inverter operation to direct on line operation. The following options are possible:

– Bypass function when activating via a control signal (p1267.0 = 1)

– Bypass function is dependent on the speed (p1267.1 = 1)

The inverter controls two contactors via its digital outputs. The inverter analyses the feedback signals from the contactors via its digital inputs. If using direct connection logic (high level = ON), both contactors should be NO contacts.
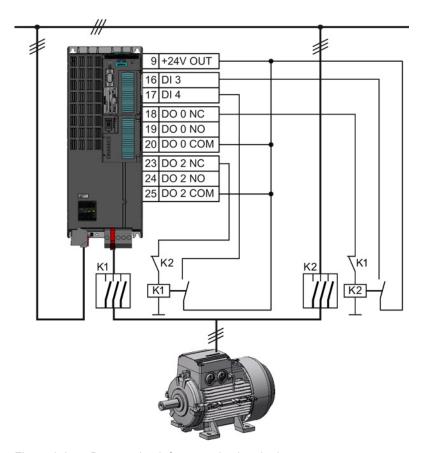
Figure 8-34   Bypass circuit for control using the inverter

Note

Flying restart must be activated for the bypass function (p1200 = 1 or 4).

Note

Bypass operation in the essential service mode

The special features for bypass operation in the essential service mode are described in Section Essential service mode (Page 292).

Changeover operation between line and inverter operation

When switching over to direct online operation, contactor K1 is opened after the inverter pulses have been inhibited. The system then waits for the de-energization time of the motor and then contactor K2 is closed so that the motor is connected directly to the line.

When the motor is switched to the line supply, an equalizing current flows that must be taken into account when the protective equipment is selected and dimensioned.
When changing over to inverter operation, initially contactor K2 must be opened and after the de-excitation time, contactor K1 is closed. The inverter then captures the rotating motor and the motor is operated on the inverter.

Bypass function when activating via a control signal (p1267.0 = 1)

The status of the bypass contactors is evaluated when the inverter is switched on. If the automatic restart function is active (p1210 = 4) and an ON command (r0054.0 = 1) as well as the bypass signal (p1266 = 1) are still present at power up, then after power up, the inverter goes into the "ready and bypass" state (r899.0 = 1 and r0046.25 = 1) and the motor continues to run directly connected to the line supply.
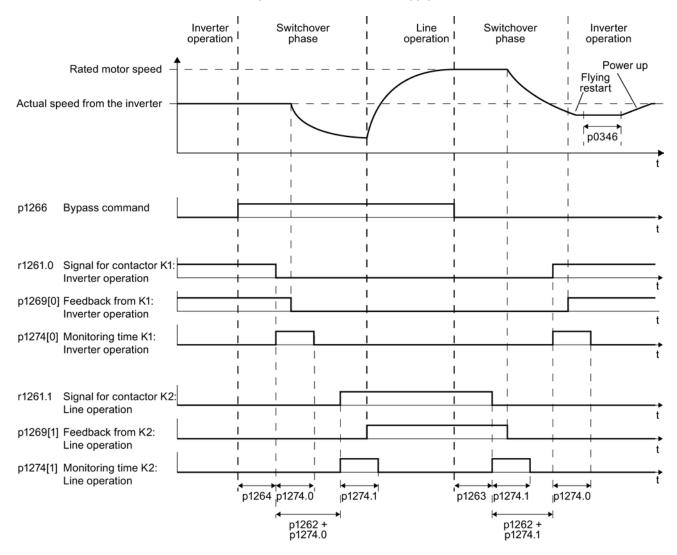
Figure 8-35   Bypass control independent of the speed via a control signal (p1267.0 = 1)

Bypass function is dependent on the speed (p1267.1 = 1)

With this function, changeover to line operation is realized corresponding to the following diagram, if the setpoint lies above the bypass threshold.

If the setpoint falls below the bypass threshold, the motor is captured by the inverter and operates in inverter operation.
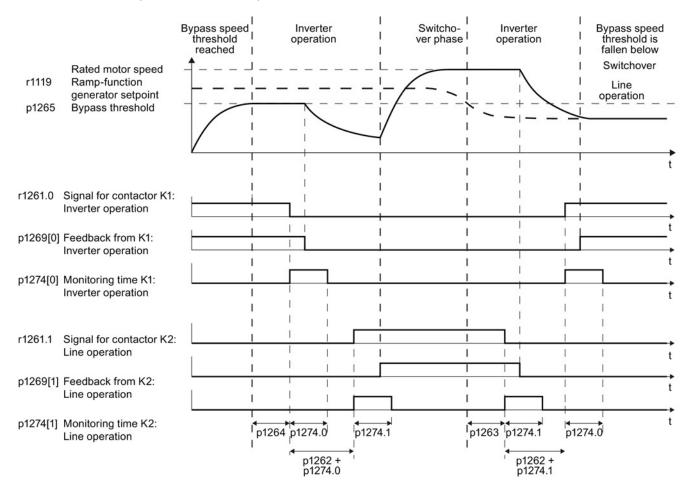
Figure 8-36   Switchover behavior from inverter to line operation dependent on the speed

General properties of the bypass function

  – The two motor contactors must be designed for switching under load.

  – Contactor K2 must be designed for switching an inductive load.

  – Contactors K1 and K2 must be mutually interlocked so that they cannot close at the same time.

Switch off motor in bypass operation

  – In bypass mode the motor no longer responds to the AUS1 command, but rather only to AUS2 and AUS3.

  – If you cut off power to the inverter in bypass mode, the bypass contactor opens and the motor coasts down. If you want to operate the motor even when the inverter is switched off, the signal for the bypass contactor must come from the superior controller.

Temperature monitoring and overload protection in bypass mode

  – If the motor is running in bypass mode, while the inverter is in the "ready and bypass" state (r899.0 = 1 and r0046.25 = 1), then the motor temperature monitoring via the temperature sensor is active.

  – Install the overload protection for the motor bypass operation.

Parameters for setting the bypass function

Parameter	Description
p1260	**Bypass configuration** Activating the bypass function
r1261	**Bypass control/status word** Control and feedback signals for the bypass function.
p1262	**Bypass dead time** Changeover time for contactors. This should be larger than the motor's de-magnetizing time!
p1263	**Debypass delay time** Delay time for switching back to inverter operation.
p1264	**Bypass delay time** Delay time for switching to bypass operation.
p1265	**Bypass speed threshold** Speed threshold for switching to bypass operation.
p1266	**Bypass control command** Signal source for switching to bypass operation.
p1267	**Bypass changeover source configuration** Switch to bypass operation using speed threshold or control signal.
p1269	**Bypass switch feedback** Signal source for contactor feedback for bypass mode.
p1274	**Bypass switch monitoring time** Monitoring time setting for bypass contactors.

For more details about parameters, please refer to the List Manual.

8.7.15 Energy-saving mode

The energy-saving mode is especially suitable for pumps and fans. Typical applications include pressure and temperature controls.

The energy-saving mode offers the advantages of energy saving, lowering mechanical wear and reduced noise.

Note

If a motorized potentiometer in the inverter delivers the setpoint in energy-saving mode, you have to set p1030.4 and p2230.4 = 1.

Function

In energy-saving mode the inverter switches the motor off if the device conditions permit this and back on again if required.

The energy-saving mode starts as soon as the motor speed drops below the energy-saving mode start speed. The inverter switches the motor off only after an adjustable amount of time has elapsed. If, during this time, the speed setpoint increases above the energy-saving mode start speed due to pressure or temperature changes, the energy-saving mode is exited and the inverter goes into normal operation.

In energy-saving mode the motor is switched off but the inverter continues to monitor the speed setpoint or technology controller variation.

– **For an external setpoint setting (without technology controller) the speed setpoint is monitored** and the motor is switched-on again as soon as the setpoint increases above the restart speed. The restart speed is calculated as follows: Restart speed = p1080 + p2390 + p2393.

In the factory setting, the positive speed setpoint is monitored, i.e. the motor is switched on as soon as the setpoint exceeds the restart speed.

If you also want to monitor the negative speed setpoint, you have to monitor the setpoint amount. This can be set using p1110 = 0.

Additional setting options are described in the List Manual, in function diagrams 3030 and 3040 as well as in the associated parameter descriptions.

– **When the setpoint setting is entered from the technology controller, the technology controller deviation (r2273) is monitored** and the motor is switched on if the deviation of the technology controller exceeds the energy-saving mode restart value (p2392).

In the factory setting, only the positive deviation of the technology controller is monitored, i.e. the motor is switched on as soon as the technology controller deviation is greater than the energy-saving mode restart value (p2392).

To switch the motor back on for negative technology controller deviation, the value of the deviation must be monitored.

Set p2298 = 2292 and set the minimum threshold in p2292.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

307

Note

Energy-saving mode after switching the inverter on

After switching the inverter on, a waiting period starts in the inverter. The waiting period is at most the following times:

- p1120 (ramp-up time)
- p2391 (energy-saving mode delay time)
- 20 s

If the motor does not reach the energy-saving mode start speed within this waiting period, the inverter activates energy-saving mode and switches the motor off.

Additional setting options are provided in the List Manual in function diagram 7958 and in the associated parameter descriptions.

If you want to prevent frequent activation and de-activation, before de-activation you still have to set a short speed boost. The boost is de-activated with p2394 = 0.

To avoid tank deposits, particularly where liquids are present, it is possible to exit the energy-saving mode after an adjustable time (p2396) has expired and switch to normal operation.

The settings required for the respective variant can be found in the following tables.

Activate energy-saving mode with setpoint setting using the internal technology controller

With this operating mode you have to set the technology controller as the setpoint source (p2200) and use the output of the technology controller as the main setpoint (p2251). The boost can be de-activated.
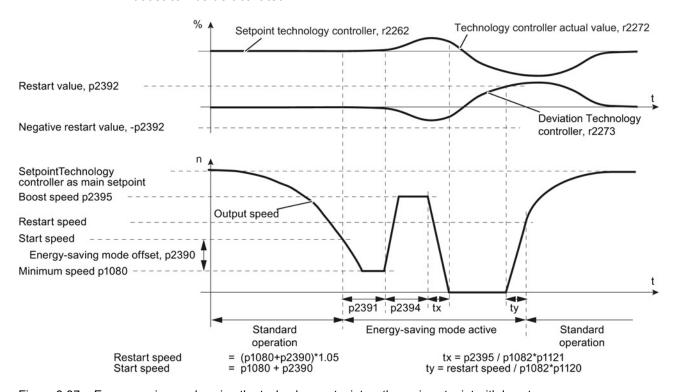
Figure 8-37   Energy-saving mode using the technology setpoint as the main setpoint with boost

Activate energy-saving mode with external setpoint setting

In this operating mode, the setpoint is specified by an external source (e.g. a temperature sensor); the technology setpoint can be used here as a supplementary setpoint.

$$\text{Restart speed} = p1080 + p2390 + p2393$$
$$\text{Start speed} = p1080 + p2390$$

$$tx = p2395 / p1082 * p1121$$
$$ty = \text{Hibernation restart speed} / p1082 * p1120$$
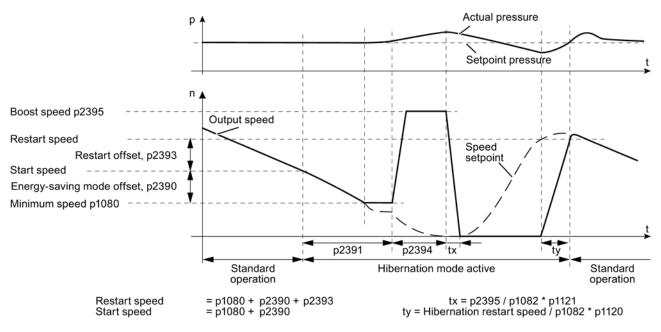
Figure 8-38   Energy-saving mode using an external setpoint with boost

$$\text{Restart speed} = p1080 + p2390 + p2393$$
$$\text{Start speed} = p1080 + p2390$$

$$tx = p1080 / p1082 * p1121$$
$$ty = \text{restart speed} / p1082 * p1120$$
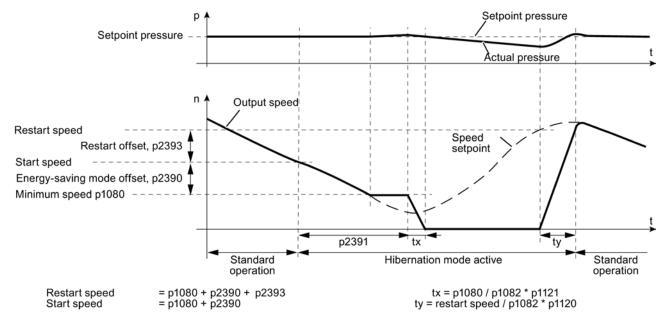
Figure 8-39   Energy-saving mode using an external setpoint without boost

Set energy-saving mode

Parameter	Description	Via tech. setpoint	Via external setpoint
p1080	**Minimum speed** 0 (factory setting) … 19500 rpm. Lower limit of the motor speed is independent of the speed setpoint.	x	x
p1110	**Block negative direction** Parameter to block the negative direction	-	x
p2200	**Technology controller enable** 0: Technology controller de-activated (factory setting), 1: Technology controller activated	x	-
p2251 = 1	**Technology controller mode** 0: Technology controller as main setpoint (factory setting), 1: Technology controller as supplementary setpoint	x	-
p2298	**Technology controller minimum limiting** Parameter for the minimum limiting of the technology controller	x	-
p2398	**Energy-saving operating mode** 0: Energy-saving mode inhibited (factory setting) 1: Energy-saving mode enabled	x	x
p2390	**Energy-saving mode start speed** 0 (factory setting) … 21000 rpm. As soon as this speed is fallen below, the energy-saving mode delay time starts and switches off the motor once it expires. The energy-saving mode start speed is calculated as follows: Start speed = p1080 + p2390 p1080 = minimum speed p2390 = energy-saving mode start speed.	x	x
p2391	**Energy-saving mode delay time** 0 ... 3599 s (factory setting 120). The energy-saving mode delay time starts as soon as the output frequency of the inverter drops below the energy-saving mode start speed p2390. If the output frequency increases above this threshold during the delay time, the energy-saving mode delay time is interrupted. Otherwise, the motor is switched off after the delay time has expired (if necessary, after a short boost).	x	x
p2392	**Energy-saving mode restart value (in %)** is required if the technology controller is used as the main setpoint. As soon as the technology controller deviation (r2273) exceeds the energy-saving mode restart value, the inverter switches to normal operation and the motor starts with a setpoint of 1.05 * (p1080 + p2390). As soon as this value is reached, the motor continues to operate with the setpoint of the technology controller (r2260).	x	-
p2393	**Energy-saving mode restart speed (rpm),** required in the case of external setpoint setting. The motor starts as soon as the setpoint exceeds the restart speed. The restart speed is calculated as follows: Restart speed = p1080 + p2390 + p2393 p1080 = minimum speed p2390 = energy-saving mode start speed p2393 = energy-saving mode restart speed	-	x

Parameter	Description	Via tech. setpoint	Via external setpoint
p2394	**Energy-saving mode boost duration** 0 (factory setting) … 3599 s. Before the inverter switches over into the energy-saving mode, the motor is accelerated for the time set in p2394 according to the acceleration ramp, but not to more than the speed set in P2395.	x	x
p2395	**Energy-saving mode boost speed** 0 (factory setting) … 21000 rpm. Before the inverter switches over into the energy-saving mode, the motor is accelerated for the time set in p2394 according to the acceleration ramp, but not to more than the speed set in p2395. **Caution:** The boost may not result in any overpressure or overrun.	x	x
p2396	**Maximum energy-saving mode shutdown time** 0 (factory setting) … 863999 s. At the latest when this time expires, the inverter switches to normal operation and is accelerated up to the start speed (p1080 + p2390). If the inverter is switched to normal operation in advance, the shutdown time is reset to the value set in this parameter. With p2396 = 0, automatic changeover to normal operation after a certain time is de-activated.	x	x

Status of the energy-saving mode

Parameter	Description
r2273	**Display of the setpoint/actual value deviation of the technology controller**
r2397	**Actual energy-saving mode output speed** Actual boost speed before the pulses are inhibited or the actual start speed after restart.
r2399	**Energy-saving mode status word** 00 Energy-saving mode enabled (P2398 <> 0) 01 Energy-saving mode active 02 Energy-saving mode delay time active 03 Energy-saving mode boost active 04 Energy-saving mode motor switched off 05 Energy-saving mode motor switched off, cyclic restart active 06 Energy-saving mode motor restarts 07 Energy-saving mode supplies the total setpoint of the ramp-function generator 08 Energy-saving mode bypasses the ramp-function generator in the setpoint channel

8.7.16 Logical and arithmetic functions using function blocks

The free function blocks permit additional signal interconnections within the inverter. In order to use the free function blocks, you must interconnect the inputs and outputs of the function blocks with the appropriate signals.

Among others, the following free function blocks are available:

– Logic modules AND, OR, XOR, NOT

– Arithmetic blocks ADD, SUB, MUL, DIV, AVA (device for forming absolute values), NCM (numeric comparator), PLI (polyline)

– Time modules MFP (pulse generator), PCL (pulse shortening), PDE (ON delay), PDF (OFF delay), PST (pulse stretching)

– Memories RSR (RS flip-flop), DSR (D flip-flop)

– Switches NSW (numeric change-over switch) BSW (binary change-over switch)

– Controllers LIM (limiter), PT1 (smoothing element), INT (integrator), DIF (differentiating element)

– Limit value monitoring LVM

You will find an overview of all of the free function blocks and their parameters in the List Manual, in Chapter "Function diagrams" in Section "Free function blocks" (function diagrams 7210 ff).

Enabling free modules

None of the free function blocks in the inverter are used in the factory setting.

Procedure

Proceed as follows to activate the free blocks:

1. In the parameter list, select the function block from the function diagrams - there you will find all parameters that you require to interconnect the block.

2. Assign the block to a runtime group.

3. Define the run sequence within the runtime group - this is only required if you have assigned several blocks to the same runtime group

4. Interconnect the block's inputs and outputs with the corresponding signals on the inverter

You have activated the free blocks.

The runtime groups are calculated at different intervals (time slices). Refer to the following table to see which free function blocks can be assigned to which time slices.

Table 8- 41   Runtime groups and possible assignments of the free function blocks

Free function blocks	Runtime groups 1 … 6 with associated time slices					
	1	2	3	4	5	6
	8 ms	16 ms	32 ms	64 ms	128 ms	256 ms
Logic modules AND, OR, XOR, NOT	✓	✓	✓	✓	✓	✓
Arithmetic blocks ADD, SUB, MUL, DIV, AVA, NCM, PLI	-	-	-	-	✓	✓
Time modules MFP, PCL, PDE, PDF, PST	-	-	-	-	✓	✓
Memories RSR, DSR	✓	✓	✓	✓	✓	✓
Switches NSW	-	-	-	-	✓	✓
Switches BSW	✓	✓	✓	✓	✓	✓
Controllers LIM, PT1, INT, DIF	-	-	-	-	✓	✓
Limit value monitoring LVM	-	-	-	-	✓	✓

✓: The block can be assigned to the runtime group

  -: The block cannot be assigned to this runtime group

Normalizing analog signals

If you interconnect a physical quantity, e.g. speed or voltage to the input of a free function block, then the signal is automatically scaled to a value of 1. The analog output signals of the free function blocks are also available as scaled quantities (0 ≙ 0%, 1≙ 100%).

As soon as you have interconnected the scaled output signal of a free function block to functions that require physical input quantities, then the inverter converts the signal into the physical quantity. An example of this is the signal source for the upper torque limit (p1522).

The quantities with their associated scaling parameters are listed in the following:

- Speeds   p2000   Reference speed   (≙100 %)
- Voltage values   p2001   Reference voltage   (≙100 %)
- Current values   p2002   Reference current   (≙100 %)
- Torque values   p2003   Reference torque   (≙100 %)
- Power values   p2004   Reference power   (≙100 %)
- Angle   p2005   Reference angle   (≙100 %)
- Acceleration   p2007   Reference acceleration   (≙100 %)
- Temperature   100° C ≙ 100%

Scaling examples

– Speed:
Reference speed p2000 = 3000 rpm, actual speed 2100 rpm. As a consequence, the following applies to the scaled input quantity: 2100 / 3000 = 0,7.

– Temperature:
Reference quantity is 100° C. For an actual temperature of 120° C, the input value is obtained from 120° C / 100° C = 1.2.

Note

Enter limits within the function blocks as scaled values. Calculation of the normalized value: Scaled limit value = physical limit value / value of the reference parameter.

The assignment to reference parameters is provided in the parameter list in the individual parameter descriptions.

Example: Logic combination of two digital inputs

You want to switch on the motor via digital input 0 and also via digital input 1.

Procedure

Proceed as follows to logically interconnect two digital inputs:

1. Activate a free OR block by assigning it to a runtime group, and define the run sequence.

2. Interconnect the status signals of the two digital inputs DI 0 and DI 1 with the two inputs of the OR block.

3. Finally, interconnect the OR block output with the internal ON command (p0840).

You have logically interconnected two digital inputs.

Parameter	Description
p20048 = 1	**Assignment of block OR 0 to runtime group 1** (factory setting 9999) The block OR 0 is calculated in the time slice with 8 ms
p20049 = 60	Definition of run sequence within runtime group 1 (factory setting 60) Within one runtime group, the block with the smallest value is calculated first.
p20046[0] = 722.0	**Interconnection of first OR 0 input (factory setting 0)** The first OR 0 input is linked to digital input 0 (r0722.0)
p20046[1] = 722.1	**Interconnection of second OR 0 input (factory setting 0)** The second OR 0 input is linked to digital input 1 (r0722.1)
p0840 = 20047	**Interconnection of OR 0 output (factory setting 0)** The OR 0 output (r20047) is connected with the motor's ON command

Example: AND operation

An example of an AND logic operation, explained in detail, including the use of a time block is provided in the Interconnecting signals in the converter (Page 413)chapter.

You can find additional information in the following manuals:

–   Function Manual "Free Function Blocks"
    (http://support.automation.siemens.com/WW/view/en/35125827)

–   Function Manual "Description of the Standard DCC Blocks"
    (http://support.automation.siemens.com/WW/view/en/29193002)

8.8 Switchover between different settings

There are applications that require different inverter settings.

Example:

You connect different motors to one inverter. Depending on the particular motor, the inverter must operate with the associated motor data and the appropriate ramp-function generator.

Drive data sets (DDS)

Your can set several inverter functions differently and then switch over between the different settings.

The associated parameters are indexed (index 0, 1, 2 or 3). Using control commands select one of the four indexes and therefore one of the four saved settings.

The settings in the inverter with the same index are called the drive data set.
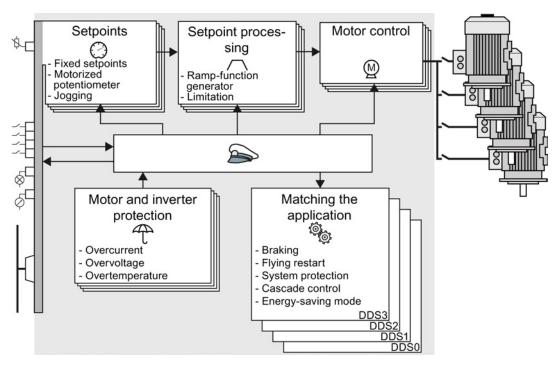
Figure 8-40   Switching over between different settings using drive data sets (DDS)

Using parameter p0180 you can define the number of drive data sets (1 ... 4).

Table 8- 42   Selecting the number of **drive data sets**

Parameter	Description
p0010 = 15	**Drive commissioning:** Data sets
p0180	**Drive data sets (DDS) number**(factory setting: 1)
p0010 = 0	**Drive commissioning:** Ready

316

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

Table 8- 43   Parameters for switching the drive data sets:

Parameter	Description
p0820	**Drive data set selection DDS bit 0**
p0821	**Drive data set selection DDS bit 1**
p0826	**Motor changeover, motor number**
	Each drive data set is assigned a motor number:
	p0826[0] = motor number for drive data set 0.
	…
	p0826[3] = motor number for drive data set 3.
	If you operate the same motor with different drive data sets, then you must enter the same motor number in every index of parameter p0826. In this particular case, you can also switch over between the different drive data sets in operation.
	If you operate different motors on one inverter, then the motors must be numbered in parameter p0826. In this case, you may only switch over the drive data sets in the "ready for operation" state with the motor switched-off. The switchover time is approx. 50 ms.
r0051	**Displaying the number of the DDS that is currently effective**

For an overview of all the parameters that belong to the drive data sets and can be switched, see the List Manual.

Table 8- 44   Parameters for copying the drive data sets

Parameter	Description
p0819[0]	**Source drive data set**
p0819[1]	**Target drive data set**
p0819[2] = 1	**Start copy operation**

For more information, see the List Manual (the parameter list and function diagram 8565).

Backing up data and series commissioning

<div style="text-align: right; font-size: 3em;">9</div>

External data backup

After commissioning, your settings are saved in the inverter so that they are protected against power failure.

We recommend that you additionally back up the settings on a storage medium outside the inverter. Without backup, your settings could be lost if the inverter developed a defect (see also Replace Control Unit (Page 342)).

The following storage media are available for your settings:

- Memory card
- PG/PC
- Operator panel

NOTICE

Data backup using operator panels with USB connection with the PG/PC is not possible

If the inverter is connected to a PG/PC via a USB cable, you can save any data on the MMC via the operator panels.

To allow you to save data on the MMC using an operator panel, you must release the USB connection between PG/PC and inverter.

Carrying out series commissioning

Series commissioning is the commissioning of several identical drives.

Procedure

You must proceed as follows to carry out series commissioning:

1. Commission the first inverter.
2. Back up the settings of the first inverter to an external storage medium.
3. Transfer the settings of the first inverter to another inverter via the storage medium.

Note

The control unit to which the settings are transferred must have the same order number and the same or a higher firmware version as the source control unit.

You have carried out series commissioning.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

319

9.1 Backing up and transferring settings using a memory card

What memory cards do we recommend?

We recommend that you use one of the memory cards with the following order numbers:

– MMC (order number 6SL3254-0AM00-0AA0)

– SD (order number 6ES7954-8LB01-0AA0)

Using memory cards from other manufacturers

If you use other SD or MMC memory cards, then you must format the memory card as follows:

– MMC: Format FAT 16

– Insert the card into your PC's card reader.

– Command to format the card:
format x: /fs:fat (x: Drive code of the memory card on your PC)

– SD: Format FAT 32

– Insert the card into your PC's card reader.

– Command to format the card:
format x: /fs:fat32 (x: Drive code of the memory card on your PC.)

Note

Limited function with memory cards from other manufacturers

Under certain circumstances, third-party memory cards do not support all functions (e.g. download). You use these cards at your own risk.

9.1.1 Saving setting on memory card

We recommend that you insert the memory card before switching on the inverter. The inverter always also backs up its settings on an inserted card.

If you wish to backup the inverter settings on a memory card, you have two options:

Automatically backing up

Precondition

The inverter power supply has been switched off.

Procedure

Proceed as follows to automatically backup your settings:

1. Insert an empty memory card into the inverter.
2. Then switch-on the inverter power supply.

After it has been switched on, the frequency inverter copies its settings to the memory card.

Note

If the memory card is not empty, then the inverter accepts the data from the memory card. This deletes the old setting in the inverter.

Only use empty memory cards for automatic data backup.

Manually backing up

Precondition

- The inverter power supply has been switched on.
- Insert a memory card into the inverter.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

321

Procedure using STARTER
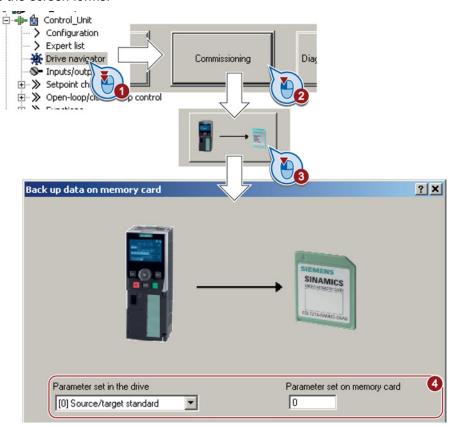
Proceed as follows to manually back up your settings on a memory card:

1. Go online with STARTER, and in your drive, select the "Drive Navigator".

2. Select the "Commissioning" button.

3. Select the button to transfer the settings to the memory card.

4. Select the settings as shown in the diagram and start the data backup.

5. Close the screen forms.

You have manually backed up the settings on the memory card.

Procedure with the BOP-2

Proceed as follows to manually back up your settings on a memory card:

1. Plug a BOP-2 onto the inverter.
2. Go to the menu level "EXTRAS".
3. In the menu, select "EXTRAS" - "TO CRD".

You have manually backed up the settings on the memory card.

9.1.2 Transferring the setting from the memory card

Automatically transferring
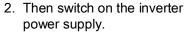
Precondition

The inverter power supply has been switched off.

Procedure

Proceed as follows to automatically transfer your settings:

1. Insert the memory card into the inverter.
2. Then switch on the inverter power supply.

If there is valid parameter data on the memory card, then the inverter accepts the data from the memory card.

Manually transferring

Precondition

- The inverter power supply has been switched on.
- Insert a memory card into the inverter.

Procedure using STARTER
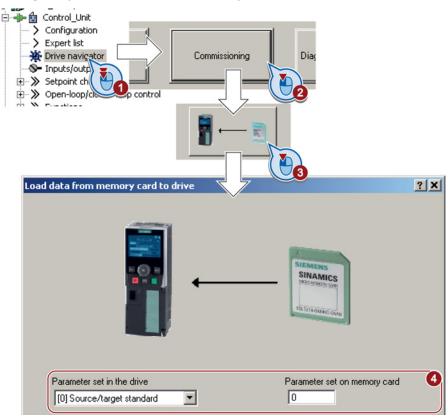
Proceed as follows to manually transfer your settings from a memory card:

1. Go online with STARTER, and in your drive, select the "Drive Navigator".

2. Select the "Commissioning" button.

3. Select the button to transfer the data from the memory card to the inverter.

4. Select the settings as shown in the diagram and start the data backup.

5. Close the screen forms.

6. Go offline with STARTER.

7. Switch off the inverter power supply.

8. Wait until all LED on the inverter go dark. Now switch on the inverter power supply again. Your settings only become effective after this power-on reset.

You have manually transferred the settings from the memory card.

Procedure with the BOP-2
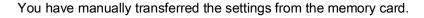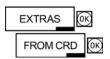
Proceed as follows to manually transfer your settings from a memory card:

1. Plug a BOP-2 onto the inverter.
2. Go to the menu level "EXTRAS".
3. Start data transfer in the menu "EXTRAS" - "FROM CRD".
4. Switch off the inverter power supply.
5. Wait until all LED on the inverter go dark.
6. Now switch on the inverter power supply again. Your settings only become effective after this power-on reset.

You have manually transferred the settings from the memory card.

9.1.3 Safely remove the memory card

NOTICE
Destruction of files on the memory card when the memory card is removed
If you remove the memory card when the converter is switched on without implementing the "safe removal" function you may destroy the file system on the memory card. The memory card will then no longer function. Only remove the memory card using the "safe removal" function.
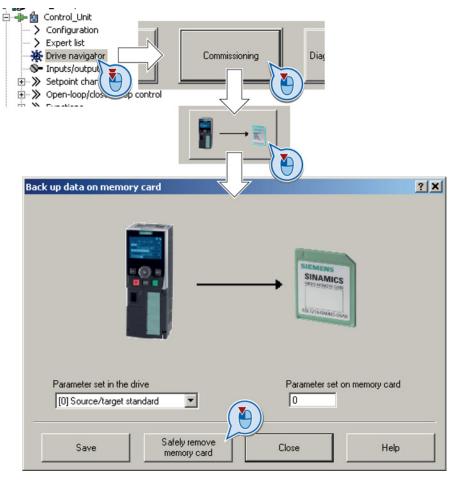
Procedure using STARTER

To safely remove the memory card, proceed as follows:

1. In the Drive Navigatorselect the following screen form:

2. Click on the button to safely remove the memory card.

3. You may remove the memory card from the inverter after the appropriate message has been output.

You have now safely removed the memory card.
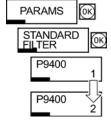
Procedure with the BOP-2

To safely remove the memory card, proceed as follows:

1. Go to parameter p9400. If a memory card is correctly inserted, then p9400 = 1.
2. Set p9400 = 2 The BOP-2 displays "BUSY" for several seconds and then jumps to either p9400 = 3 or p9400 = 100.
3. For Bei p9400 = 3 you may remove the memory card.
4. For p9400 = 100, you may not remove the memory card at the moment.
   In this case, try again by setting p9400 = 2.

You have now safely removed the memory card.

9.2 Backing up and transferring settings using STARTER

Precondition

With the supply voltage switched on, you can transfer the inverter settings from the inverter to a PG/PC, or the data from a PG/PC to the inverter.

This requires you to have installed the STARTER commissioning tool on your PG/PC.

You will find additional information about STARTER in Section Tools to commission the converter (Page 33).

Inverter → PC/PG

Procedure

To back up the settings, proceed as follows:

1. Go online with STARTER : 🔲.

2. Select the button "Download project to PG": 🔼.

3. To save the data in the PG, select the button: 💾.

4. Go offline with STARTER : 🔲.

You have backed up the settings.

PC/PG → inverter

Procedure

To transfer the settings, proceed as follows:

1. Go online with STARTER : 🔲.

2. Select the button "Download project to target system": 🔽.

3. To save the data in the inverter, select the "Copy RAM to ROM" button: 🔲.

4. Go offline with STARTER : 🔲.

You have transferred the settings.

9.3 Saving settings and transferring them using an operator panel

Precondition

When the power supply is switched on, you can transfer the settings of the inverter to the BOP-2 or, vice versa, transfer the data from the BOP-2 to the inverter.

Inverter → BOP-2

Procedure

To back up the settings, proceed as follows:

Start data transfer in the menu "EXTRAS" - "TO BOP".

You have backed up the settings.

BOP-2 → inverter

Procedure

To transfer the settings, proceed as follows:

1. Start data transfer in the menu "EXTRAS" - "FROM BOP".
2. Switch off the inverter power supply.
3. Wait until all LED on the inverter go dark. Now switch on the inverter power supply again. Your settings only become effective after this power-on reset.

You have transferred the settings.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

329

9.4 Other ways to back up settings

Description

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.

You will find additional information on the Internet at: Memory options (http://support.automation.siemens.com/WW/view/en/43512514).

Table 9- 1   Backing up settings in the converter

Parameter	Description
p0970	**Reset drive parameters** Load backed-up setting (number 10, 11 or 12). The load overwrites the current setting.
p0971	**Save parameters** Back up the setting (10, 11 or 12).

Table 9- 2   Backing up additional settings on the memory card

Parameter	Description
p0802	**Data transfer with memory card as source/target** (factory setting 0) Default setting: p802 = 0 Further settings: p802 = 1 … 99
p0803	**Data transfer with device memory as source/target** (factory setting 0) Default setting: p803 = 0 Further settings: p803 = 10, 11 or 12

Table 9- 3   Operation on the BOP-2

	Description
EXTRAS [OK] TO CRD [OK]	The converter writes its setting 0, 10, 11 or 12 to the memory card in accordance with p0802. The file on the memory card is assigned the number according to p0802.
EXTRAS [OK] FROM CRD [OK]	The converter loads the setting with the number according to p0802 from the memory card and thus overwrites its setting 0, 10, 11 or 12.

9.5 Write and know-how protection

The inverter offers the option to protect configured settings from being changed or copied.

Write protection and know-how protection are available for this purpose.

Write protection - overview

Write protection is primarily used to prevent inverter settings from being inadvertently changed. No password is required for write protection, your settings remain unencrypted.

The following functions are excluded from the write protection:

- Activating/deactivating write protection (p7761)

- Changing the access level (p0003)

- Saving parameters (p0971)

- Safely removing the memory card (p9400)

- Access to service parameters (p3950) - only for service personnel, a password is required

- Restoring the factory setting

- Upload

- Acknowledging alarms and faults

- Switching over to the control panel

- Trace

- Function generator

- Measuring functions

- Reading out diagnostic buffer

The individual parameters that are excluded from the write protection, can be found in the List Manual in Chapter "Parameters for write protection and protection of know-how".

Know-how protection - overview

The know-how protection is used, for example, so that machine manufacturers can encrypt their configuration know-how and protect it against changes or copying.

The know-how protection is available in the following versions:

- **Know-how protection without copy protection** (possible with or without memory card)

- **Know-how protection with copy protection** (possible only with Siemens memory card)

A password is required for the know-how protection.

In case of active know-how protection, the STARTER dialog screens are locked. The expert list in STARTER shows only display parameters.

Actions that are also possible during active know-how protection

– Restoring factory settings

– Acknowledging messages

– Displaying messages

– Displaying the alarm history

– Reading out diagnostic buffer

– Switching to the control panel (complete control panel functionality: Fetch master control, all buttons and setting parameters)

– Upload (only parameters, which are accessible even though know-how protection is active)

Actions that are not possible during active know-how protection

– Download

– Export/import

– Trace

– Function generator

– Measuring functions

– Automatic controller setting

– Stationary/rotating measurement

– Deleting the alarm history

The individual parameters that are excluded from the know-how protection can be found in the List Manual in Chapter "Parameters for write protection and protection of know-how".

9.5.1 Write protection

Set write protection

Precondition

In order that you can set write protection, your inverter must be connected online with STARTER.

Activate and deactivate write protection

Procedure

Proceed as follows to activate or deactivate the write protection:

1. Select the inverter in your STARTER project with the left mouse button.
2. Open the shortcut menu with a right click.
3. Activate write protection.

   Deactivation is executed in analog.

   To make this setting permanent, you need to select "Copy RAM to ROM" [icon]. Otherwise, your settings will be lost when the inverter is switched off.

You have activated or deactivated write protection.

Points to note about restoring the factory settings

If you select "Reset to factory settings" using the [icon] button when write protection is active, the following confirmation prompt opens.

The confirmation prompt is not issued, if you select another way to restore the factory setting, e.g. using the expert list.

Note

Points to note regarding CAN, BACnet and MODBUS

Using these bus systems, parameter factory settings can be changed despite active write protection. So that write protection is also active when accessing via these fieldbuses, you must additionally set p7762 to 1.

This setting is only possible via the expert list.

9.5.2 Know-how protection

When the inverter is operated with know-how protection, please take note of the following information:

Note

Support provided by technical support for active know-how protection

In the case of active know-how protection, support by the technical support is only possible with the consent of the machine manufacturer.

Know-how protection can only be activated online.

If you have created a project offline on your computer, you must download it to the inverter and go online. Only then can you activate the know-how protection.

You cannot activate know-how protection in the project on the computer.

Know-how protection with copy protection is only possible with a Siemens memory card.

For "know-how protection with copy protection", a Siemens memory card must be plugged in!

If you try to activate the "know-how protection with copy protection" without a memory card, or with a different memory card, the message "Know-how protection for the drive unit could not be activated" is displayed.

Password check for know-how protection and Windows language settings

Please note that if the Windows language settings are changed, after activating know-how protection, faults can occur when subsequently checking the password. Therefore, only use characters from the ASCII character set for your password.

Commissioning the inverter with know-how protection

Procedure

Proceed as follows to commission an inverter with know-how protection:

1. Commission the inverter.

2. Create the exception list (Page 337).

3. Activate the know-how protection (Page 335).

4. Save the settings in the inverter by copying RAM to ROM with ▣ or via p0971 = 1.

5. Save the project with ▣ on the PG/PC. Also back up any other project-related data (machine type, password, etc.) that may be required for the support of the end customer.

You have commissioned the inverter with know-how protection.

9.5.2.1 Settings for the know-how protection

Activating know-how protection

Procedure

Proceed as follows to activate know-how protection:

1. Select the inverter in the STARTER project, and then select "Know-how protection drive unit/activate ..." in the shortcut menu (see also Write protection (Page 333)).

2. Enter your password, and confirm with OK.

   The password must consist of at least one character and can be no longer than 30 characters. All characters are permissible.

3. In this screen form "Copy RAM to ROM" has been selected in the factory. This will ensure that your settings are permanently stored.

   If "Copy RAM to ROM" is not selected, then your know-how protection settings are only saved in the volatile memory, and will no longer be available the next time the system is switched on.

You have activated know-how protection.

Backing up settings on the memory card

When the know-how protection is activated, you can save the settings via p0971 on the memory card.

To do this, set p0971 = 1. The data is encrypted before being written to the memory card. After saving, p0971 is reset to 0.

Deactivate know-how protection, delete password

Procedure

Proceed as follows to deactivate know-how protection:

1. Select the inverter in the STARTER project, and right-click to open the dialog box "Know-how protection drive unit/deactivate …".
2. There, select the desired option.
3. Enter the password and exit the screen form with OK.

You have deactivated know-how protection.

Note

Permanently or temporarily deactivating know-how protection

Temporarily deactivating know-how protection means that know-how protection is active again after switching off and switching on. Permanently deactivating means that know-how protection is no longer active after switching off and switching on again.

Deactivating know-how protection temporarily

To temporarily deactivate the know-how protection means that you can change the settings in the inverter until you switch the inverter off and on again, or until you reactivate the know-how protection.

Finally deactivating know-how protection (delete password)

Finally deactivating the know-how protection means that you delete the password

– Immediately and finally, if you select "Copy RAM to ROM"

– Until the next OFF/ON if you do not select "Copy RAM to ROM"

Changing the password

Select the inverter in the STARTER project and open the dialog box via the shortcut menu "know-how protection drive unit/change password … ".

9.5.2.2 Creating an exception list for the know-how protection

Using the exception list, you as a machine manufacturer may make individual adjustable parameters accessible to end customers although know-how protection is active. You may define the exception list via parameters p7763 and p7764 in the expert list. Specify the number of parameters for the selection list in p7763. Assign the individual indexes to the parameter numbers of the selection list in p7764.

Procedure

Proceed as follows to change the number of parameters for the selection list:

1. Save the inverter settings via an upload () on the PC/PG and go offline ()

2. In the project on the PC, set p7763 to the desired value.

3. Save the project.

4. Go online and load the project into the inverter ().

5. Now make the additional settings in p7764.

You have modified the number of parameters for the selection list.

Factory setting for the exception list:

– p7763 = 1 (selection list contains precisely one parameter)

– p7764[0] = 7766 (parameter number for entering the password)

Note

Block access to the inverter as a result of incomplete exception lists

If you remove p7766 from the exception list, you can no longer enter a password and therefore no longer de-activate know-how protection.

In this case to access the inverter again, you have to reset the inverter to the factory settings.

9.5.2.3 Replacing devices with active know-how protection

Replacing devices during know-how protection without copy protection

For know-how protection without copy protection, the converter settings can be transferred to another converter using a memory card.

See also:

- – Saving setting on memory card (Page 321)

- – Transferring the setting from the memory card (Page 323)

Replacing devices for know-how protection with copy protection

The know-how protection with copy protection prevents the inverter settings from being copied and passed on. This function is predominantly used by machine manufacturers.

If know-how protection with copy protection is active, the inverter cannot be replaced as described in "Replace Control Unit (Page 342)".

However, to allow the inverter to be replaced, you must use a Siemens memory card, and the machine manufacturer must have an identical machine that he uses as sample.

There are two options for replacing the device:

Option 1: The machine manufacturer only knows the serial number of the new inverter

- – The end customer provides the machine manufacturer with the following information:

- – For which machine must the inverter be replaced?

- – What is the serial number (r7758) of the new inverter?

- – The machine manufacturer goes online on the sample machine.

- – deactivates the know-how protection, see Settings for the know-how protection (Page 335)

- – enters the serial number of the new inverter in p7759

- – enters the serial number of the inserted memory card as reference serial number in p7769

- – activates the know-how protection with copy protection ("Copy RAM to ROM" must be activated!), see Settings for the know-how protection (Page 335)

- – writes the configuration with p0971 = 1 to the memory card

- – sends the memory card to the end customer

- – The end customer inserts the memory card and switches on the inverter.

When powering up, the inverter checks the serial numbers of the card and when there is a match, the inverter goes into the "ready to start" state.

If the numbers do not match, then the inverter signals fault F13100 (no valid memory card).

Option 2: The machine manufacturer knows the serial number of the new inverter and the serial number of the MMC

    – The end customer provides the machine manufacturer with the following information:

    – For which machine must the inverter be replaced?

    – What is the serial number (r7758) of the new inverter?

    – What is the serial number of the memory card?

    – The machine manufacturer goes online on the sample machine.

    – deactivates the know-how protection, see Settings for the know-how protection (Page 335)

    – enters the serial number of the new inverter in p7759

    – enters the serial number of the customer's memory card as reference serial number in p7769

    – activates the know-how protection with copy protection ("Copy RAM to ROM" must be activated!), see Settings for the know-how protection (Page 335)

    – writes the configuration with p0971 = 1 to the memory card

    – copies the encrypted project from the card to his PC

    – for example, sends it by e-mail to the end customer

    – The end customer copies the project to the Siemens memory card that belongs to the machine, inserts it in the inverter and switches on the inverter.

When powering up, the inverter checks the serial numbers of the card and when there is a match, the inverter goes into the "ready to start" state.

If the numbers do not match, then the inverter signals fault F13100 (no valid memory card).

Corrective maintenance

10

10.1 Overview of replacing converter components

Permissible replacement of components

In the event of a long-term function fault, you must replace the Power Module or Control Unit. The inverter's Power Module and Control Unit can be replaced independently of each other.

Replacing the Power Module		Replacing the Control Unit	
Replacement: • Same type • Same power rating	Replacement: • Same type • *Higher* power rating	Replacement: • Same type • Same firmware version	Replacement: • Same type • *higher* firmware version (e.g. replace FW V4.2 by FW V4.3)
	Power Module and motor must be adapted to one another (ratio of motor and Power Module rated power > 1/8)	After replacing the Control Unit, you must restore the inverter's settings.	

⚠ WARNING
Physical injury or material damage as a result of unexpected drive behavior
Replacing inverters of different types can result in an unpredictable drive response.
• In all cases that are not permitted according to the table above, recommission the drive after replacing an inverter.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

341

Device replacement without removable storage medium - only for communication via PROFINET

If you have created a topology in your control, you can use environment detection to replace a defective inverter with a new device of the same type and with the same software release. Recommissioning is not required in this case.

You can either load the inverter settings into the inverter using the memory card or – if you are using a SIMATIC S7 controller with DriveES – using DriveES.

Details of the device replacement without removable storage medium can be found in the Profinet system description (http://support.automation.siemens.com/WW/view/en/19292127).

10.2 Replace Control Unit

⚠ DANGER
Risk of electric shock from touching live parts
230 V AC may be in place on terminals DO 0 and DO 2 of the control unit's relay output independently of the voltage status of the power module. Touching the contacts may result in an electrical shock.
Protective measures before exchanging the control unit:
1. Switch the contacts off-circuit.
2. Secure the power supply against being unintentionally switched on again.
3. Check that the cabinet is de-energized.

Replacing a Control Unit with data backup on a memory card

Procedure

Proceed as follows to exchange the Control Unit:

1. Disconnect the line voltage to the Power Module and (if installed) the external 24 V supply or the voltage for the digital outputs of the Control Unit.

2. Remove the signal cables from the Control Unit.

3. Remove the defective Control Unit.

4. Mount the new Control Unit onto the Power Module. The new Control Unit must have the same order number and the same or a higher firmware version as the Control Unit that was replaced.

5. Remove the memory card from the old Control Unit and insert it in the new Control Unit.

6. Reconnect the signal cables of the Control Unit.

7. Connect up the line voltage again.

8. The inverter loads the settings from the memory card.

9. After loading, check whether the inverter outputs Alarm A01028.

   – Alarm A01028:

     The settings that have been loaded are not compatible with the inverter.

     Clear the alarm with p0971 = 1, and recommission the drive.

   – No alarm A01028:

     The inverter accepts the settings that have been loaded.

You have successfully replaced the Control Unit.

Replacing a Control Unit with data backup in the PC

Procedure

Proceed as follows to exchange the Control Unit:

1. Disconnect the line voltage to the Power Module and (if installed) the external 24 V supply or the voltage for the digital outputs of the Control Unit.

2. Remove the signal cables of the Control Unit.

3. Remove the defective Control Unit.

4. Mount the new Control Unit onto the Power Module.

5. Reconnect the signal cables of the Control Unit.

6. Connect up the line voltage again.

7. Open the project that matches the drive in STARTER.

8. Go online and transfer the settings from the PC into the inverter by pressing the 🔽 button.
   The inverter signals faults after the download. Ignore these faults, as they will be automatically acknowledged by the following steps.

9. Save your settings (copy RAM to ROM).

You have successfully replaced the Control Unit.

10.3 Replacing the Control Unit without data backup
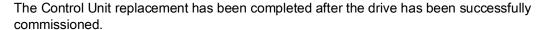
If you do not backup the settings, then you must recommission the drive after replacing the Control Unit.

Procedure

To replace the Control Unit without backed-up settings, proceed as follows:

1. Disconnect the line voltage to the Power Module and (if installed) the external 24 V supply or the voltage for the digital outputs of the Control Unit.

2. Remove the signal cables of the Control Unit.

3. Remove the defective Control Unit.

4. Mount the new Control Unit on the Power Module.

5. Reconnect the signal cables of the Control Unit.

6. Connect up the line voltage again.

7. Recommission the drive.

The Control Unit replacement has been completed after the drive has been successfully commissioned.

10.4   Replacing a Power Module

Procedure

Proceed as follows to exchange a Power Module:

1. Switch off the supply voltage to the Power Module.
   You do not have to switch off an external 24 V power supply for the Control Unit if one is being used.

⚠ DANGER
Risk of electric shock from touching inverter connections
After the power supply has been switched off, it takes up to 5 min. until the capacitors in the inverter have discharged so that the remaining voltage is non-hazardous.
Check the voltage at the inverter connections, before removing the connection cables.

2. Remove the connecting cables of the Power Module.

3. Remove the Control Unit from the Power Module.

4. Replace the old Power Module with the new Power Module.

5. Mount the Control Unit onto the new Power Module.

6. Connect up the new Power Module using the connecting cables.

NOTICE
Material damage when interchanging the motor connecting cables
The direction in which the motor rotates switches if you exchange the two phases of the motor line.
Connect the three phases of the motor lines in the right order.
After exchanging the power module check the direction in which the motor rotates.

7. Switch on the line supply and, if being used, the 24 V supply of the Control Unit.

You have successfully replaced the Power Module.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

345

10.5   Upgrading the firmware

When upgrading the firmware, you replace the inverter firmware by a later version. Only update the firmware to a later version if you require the expanded functional scope of the newer version.

Precondition

– The firmware version of your inverter is at least V4.5.

– You have the memory card with the firmware that matches the inverter.

Procedure
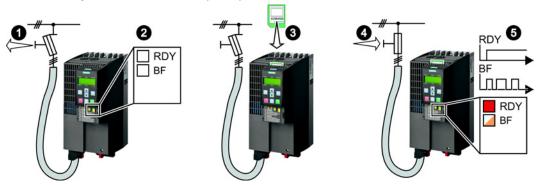
Proceed as follows to upgrade the inverter firmware to a later version:

1. Switch off the inverter power supply.

2. Wait until all LEDs on the inverter are dark.

3. Insert the card with the matching firmware into the inverter slot until it latches into place.

4. Switch on the inverter power supply.

5. The inverter transfers the firmware from the memory card into its memory.

   The transfer takes approximately 5 … 10 minutes.

   While data is being transferred, the LED RDY on the inverter stays red. The LED BF flashes orange with a variable frequency.

6. At the end of the transfer, the LED RDY and BF slowly flash red (0.5 Hz).

Note

Corrupted firmware if the power supply fails during the transfer

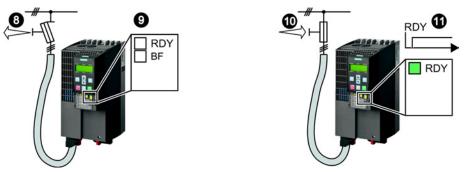The inverter firmware can be corrupted if the power supply fails during the transfer.

• Do not switch off the inverter power supply as long as data is being transferred.

346

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

7. Remove the card with the firmware from the inverter.

8. Switch off the inverter power supply.

9. Wait until all LEDs on the inverter are dark.

10. Switch on the inverter power supply.

11. If the firmware upgrade was successful, after several seconds the inverter LED RDY turns green.

You have successfully updated the firmware to a more recent version. When upgrading, your settings in the inverter are kept.

10.6   Firmware downgrade

When downgrading the firmware, you replace the inverter firmware by an older version. Only downgrade the firmware to an older version if, after replacing an inverter, you require the same firmware in all of your inverters.

Precondition

– The firmware version of your inverter is at least V4.6.

– You have the memory card with the firmware that matches the inverter.

– You have backed up your settings on the memory card, in an operator panel or in a PC.

Procedure

Proceed as follows to downgrade the inverter firmware to an older version:

1. Switch off the inverter power supply.

2. Wait until all LEDs on the inverter are dark.

3. Insert the card with the matching firmware into the inverter slot until it latches into place.

4. Switch on the inverter power supply.

5. The inverter transfers the firmware from the memory card into its memory.

   The transfer takes approximately 5 … 10 minutes.

   While data is being transferred, the LED RDY on the inverter stays red. The LED BF flashes orange with a variable frequency.

6. At the end of the transfer, the LED RDY and BF slowly flash red (0.5 Hz).

Note

Corrupted firmware if the power supply fails during the transfer

The inverter firmware can be corrupted if the power supply fails during the transfer.

• Do not switch off the inverter power supply as long as data is being transferred.

348

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

7. Remove the card with the firmware from the inverter.

8. Switch off the inverter power supply.

9. Wait until all LEDs on the inverter are dark.

10. Switch on the inverter power supply.

11. If the firmware downgrade was successful, after several seconds the inverter LED RDY turns green.

After the firmware has been downgraded, the inverter has been reset to the factory settings.

12. Transfer your settings from your data backup to the inverter.
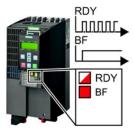
See also Section: Backing up data and series commissioning (Page 319).

You have downgraded the firmware of the inverter to an older version and have transferred the backed up settings into the inverter.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

349

10.7 Correcting an unsuccessful firmware upgrade or downgrade

How does the inverter signal an unsuccessful upgrade or downgrade?

The inverter signals an unsuccessful firmware upgrade or downgrade by a quickly flashing LED RDY and the lit LED BF.

Correcting an unsuccessful upgrade or downgrade

You can check the following to correct an unsuccessful firmware upgrade or downgrade:

– Does the firmware version of your inverter fulfill the preconditions?

– For an upgrade, as a minimum V4.5.

– For a downgrade, as a minimum V4.6.

– Have you correctly inserted the card?

– Does the card contain the correct firmware?

– Repeat the appropriate procedure.

10.8 If the converter no longer responds

If the inverter no longer responds

For example, when loading an incorrect file from the memory card, the inverter can go into a state where it can no longer respond to commands from the operator panel or from a higher-level control system. In this case, you must reset the inverter to its factory setting and recommission it. This inverter state is manifested in two different ways:

Case 1

– The motor is switched off.

– You cannot communicate with the inverter, either via the operator panel or other interfaces.

– The LEDs flicker and after 3 minutes the inverter has still not powered up.

Procedure

Proceed as follows to restore the inverter factory settings:

1. Remove the memory card if one is inserted in the inverter.

2. Switch off the inverter power supply.

3. Wait until all LEDs on the inverter go dark. Then switch on the inverter power supply again.

4. Repeat steps 2 and 3 as often as required until the inverter outputs fault F01018:

5. Set p0971 = 1.

6. Switch off the inverter power supply.

7. Wait until all LEDs on the inverter go dark. Then switch on the inverter power supply again.

   The inverter now powers up with the factory settings.

8. Recommission the inverter.

You have restored the inverter factory settings.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

351

Case 2

– The motor is switched off.

– You cannot communicate with the inverter, either via the operator panel or other interfaces.

– The LEDs flash and are dark - this process is continually repeated.

Procedure

Proceed as follows to restore the inverter factory settings:

1. Remove the memory card if one is inserted in the inverter.

2. Switch off the inverter power supply.

3. Wait until all LEDs on the inverter go dark. Then switch on the inverter power supply again.

4. Wait until the LEDs flash orange.

5. Repeat steps 2 and 3 as often as required until the inverter outputs fault F01018.

6. Now set p0971 = 1.

7. Switch off the inverter power supply.

8. Wait until all LEDs on the inverter go dark. Then switch on the inverter power supply again.

   The inverter now powers up with the factory settings.

9. Recommission the inverter.

You have restored the inverter factory settings.

Alarms, faults and system messages 11

The inverter has the following diagnostic types:

- LED

The LED at the front of the inverter immediately informs you about the most important inverter states right at the inverter.

- Alarms and faults

The inverter signals alarms and faults via

- the fieldbus

- the terminal strip with the appropriate setting

- a connected operator panel, or

- STARTER

Alarms and faults have a unique number.

11.1 Operating states indicated on LEDs

The LED RDY (Ready) is temporarily orange after the power supply voltage is switched-on. As soon as the color of the LED RDY changes to either red or green, the LEDs signal the inverter state.

Signal states of the LED

In addition to the signal states "on" and "off" there are two different flashing frequencies:
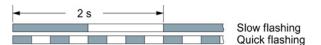
Table 11- 1   Inverter diagnostics

LED		Explanation
RDY	BF	
GREEN - on	---	There is presently no fault
GREEN - slow	---	Commissioning or reset to factory settings
GREEN - fast	---	Inverter writes data to the memory card
RED - slow	---	Inverter waits until the power supply is switched off and switched on again after a firmware update
RED - fast	---	There is presently a fault
RED - fast	RED - fast	Incorrect memory card or unsuccessful firmware update

Table 11- 2   Inverter diagnostics

LNK LED	Explanation
GREEN - on	The communication via PROFINET is in order.
GREEN - slow	Device naming is active.
Off	No communication via PROFINET.

Table 11- 3   Communication diagnostics via RS485

LED BF	Explanation
On	Receive process data
RED - slow	Bus active - no process data
RED - fast	No bus activity
YELLOW - variable frequency	Firmware update in progress

Table 11- 4   Communication diagnostics via PROFIBUS DP

LED BF	Explanation
off	Cyclic data exchange (or PROFIBUS not used, p2030 = 0)
RED - slow	Bus fault - configuration fault
RED - fast	Bus fault - no data exchange - baud rate search - no connection
YELLOW - variable frequency	Firmware update in progress

LED BF display for CANopen

In addition to the signal states "on" and "off" there are three different flashing frequencies:
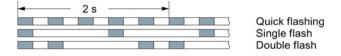
Table 11- 5   Communication diagnostics via CANopen

BF LED	Explanation
GREEN - on	Bus state "Operational"
GREEN - fast	Bus state "Pre-Operational"
GREEN - single flash	Bus state "Stopped"
RED - on	No bus
RED - single flash	Alarm - limit reached
RED - double flash	Error event in control (Error Control Event)
YELLOW - variable frequency	Firmware update in progress

11.2 System runtime

By evaluating the system runtime of the inverter, you can decide when you should replace components subject to wear in time before they fail - such as fans, motors and gear units.

Principle of operation

The system runtime is started as soon as the Control Unit power supply is switched-on. The system runtime stops when the Control Unit is switched off.

The system runtime comprises r2114[0] (milliseconds) and r2114[1] (days):

System runtime = r2114[1] × days + r2114[0] × milliseconds

If r2114[0] has reached a value of 86,400,000 ms (24 hours), r2114[0] is set to the value 0 and the value of r2114[1] is increased by 1.

Parameter	Description
r2114[0]	System runtime (ms)
r2114[1]	System runtime (days)

You cannot reset the system runtime.

11.3 Alarms

Alarms have the following properties:

- They do not have a direct effect in the converter and disappear once the cause has been removed
- They do not need have to be acknowledged
- They are signaled as follows
- Status display via bit 7 in status word 1 (r0052)
- At the Operator Panel with a Axxxxx
- Via STARTER, if you click on TAB ◢ at the bottom left of the STARTER screen

In order to pinpoint the cause of an alarm, there is a unique alarm code and also a value for each alarm.

Alarm buffer

For each incoming alarm, the converter saves the alarm, alarm value and the time that the alarm was received.

	Alarm code	Alarm value		Alarm time received		Alarm time removed	
1. Alarm	r2122[0]	r2124[0]	r2134[0]	r2145[0]	r2123[0]	r2146[0]	r2125[0]
		I32	Float	Days	ms	Days	ms

Figure 11-1   Saving the first alarm in the alarm buffer

r2124 and r2134 contain the alarm value - important for diagnostics - as "fixed point" or "floating point" number.

The alarm times are displayed in r2145 and r2146 (in complete days) as well as in r2123 and r2125 (in milliseconds referred to the day of the alarm).
The converter uses an internal time calculation to save the alarm times. More information on the internal time calculation can be found in Chapter Real time clock (RTC) (Page 288).

As soon as the alarm has been removed, the converter writes the associated instant in time into parameters r2125 and r2146. The alarm remains in the alarm buffer even if the alarm has been removed.

If an additional alarm is received, then this is also saved. The first alarm is still saved. The alarms that have occurred are counted in p2111.

	Alarm code	Alarm value		Alarm time received		Alarm time removed	
1. Alarm	r2122[0]	r2124[0]	r2134[0]	r2145[0]	r2123[0]	r2146[0]	r2125[0]
2. Alarm	[1]	[1]	[1]	[1]	[1]	[1]	[1]

Figure 11-2   Saving the second alarm in the alarm buffer

The alarm buffer can contain up to eight alarms. If an additional alarm is received after the eighth alarm - and none of the last eight alarms have been removed - then the next to last alarm is overwritten.

	Alarm code	Alarm value		Alarm time received		Alarm time removed	
1. Alarm	r2122[0]	r2124[0]	r2134[0]	r2145[0]	r2123[0]	r2146[0]	r2125[0]
2. Alarm	[1]	[1]	[1]	[1]	[1]	[1]	[1]
3. Alarm	[2]	[2]	[2]	[2]	[2]	[2]	[2]
4. Alarm	[3]	[3]	[3]	[3]	[3]	[3]	[3]
5. Alarm	[4]	[4]	[4]	[4]	[4]	[4]	[4]
6. Alarm	[5]	[5]	[5]	[5]	[5]	[5]	[5]
7. Alarm	[6]	[6]	[6]	[6]	[6]	[6]	[6]
Last alarm	[7]	[7]	[7]	[7]	[7]	[7]	[7]

Figure 11-3   Complete alarm buffer

Emptying the alarm buffer: Alarm history

The alarm history traces up to 56 alarms.

The alarm history only takes alarms that have been removed from the alarm buffer. If the alarm buffer is completely filled - and an additional alarm occurs - then the converter shifts all alarms that have been removed from the alarm buffer into the alarm history. In the alarm history, alarms are also sorted according to the "alarm time received", however, when compared to the alarm buffer, in the inverse sequence:

– The youngest alarm is in index 8

– The second youngest alarm is in index 9

– etc.
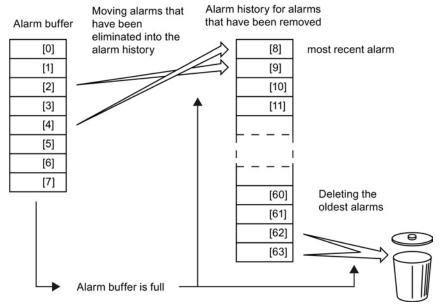
Figure 11-4   Shifting alarms that have been removed into the alarm history

Any alarms that have not been removed remain in the alarm buffer. The converter sorts the alarms and closes gaps between the alarms.

If the alarm history is filled up to index 63, each time a new alarm is accepted in the alarm history, the oldest alarm is deleted.

Parameters of the alarm buffer and the alarm history

Parameter	Description
r2122	**Alarm code**
	Displays the numbers of alarms that have occurred
r2123	**Alarm time received in milliseconds**
	Displays the time in milliseconds when the alarm occurred
r2124	**Alarm value**
	Displays additional information about the alarm
r2125	**Alarm time removed in milliseconds**
	Displays the time in milliseconds when the alarm was removed
p2111	**Alarm counter**
	Number of alarms that have occurred after the last reset When setting p2111 = 0, all of the alarms that have been removed from the alarm buffer [0...7] are transferred into the alarm history [8...63]
r2145	**Alarm time received in days**
	Displays the time in days when the alarm occurred
r2132	**Actual alarm code**
	Displays the code of the alarm that last occurred
r2134	**Alarm value for float values**
	Displays additional information about the alarm that occurred for float values
r2146	**Alarm time removed in days**
	Displays the time in days when the alarm was removed

Extended settings for alarms

Parameter	Description
You can change up to 20 different alarms into a fault or suppress alarms:	
p2118	**Setting the message number for the message type**
	Selection of the alarms for which the message type should be changed
p2119	**Setting the message type**
	Setting the message type for the selected alarm 1: Fault 2: Alarm 3: No message

You will find details in function diagram 8075 and in the parameter description of the List Manual.

11.4 Faults

A fault displays a severe fault during operation of the inverter.

The inverter signals a fault as follows:

- – At the operator panel with Fxxxxx
- – On the inverter using the red LED RDY
- – In bit 3 of status word 1 (r0052)
- – Via STARTER

To delete a message, you must remedy the cause of the fault and acknowledge the fault.

Every fault has a clear fault code and also a fault value. You need this information to determine the cause of the fault.

Fault buffer of actual values

The inverter saves the time, fault code and fault value for every fault it receives.

	Fault code	Fault value		Fault time received		Fault time removed	
1st fault	r0945[0]	r0949[0]	r2133[0]	r2130[0]	r0948[0]	r2136[0]	r2109[0]
		I32	Float	Days	ms	Days	ms

Figure 11-5   Saving the first fault in the fault buffer

r0949 and r2133 contain the fault value - important for diagnostics - as "fixed point" or "floating point" number.

The "fault time received" is in parameter r2130 (in complete days) as well as in parameter r0948 (in milliseconds referred to the day of the fault). The "fault time removed" is written into parameters r2109 and r2136 when the fault has been acknowledged.
The inverter uses its internal time calculation to save the fault times. More information on the internal time calculation can be found in Chapter Real time clock (RTC) (Page 288).

If an additional fault occurs before the first fault has been acknowledged, then this is also saved. The first alarm remains saved. The fault cases that have occurred are counted in p0952. A fault case can contain one or several faults.

	Fault code	Fault value		Fault time received		Fault time removed	
1st fault	r0945[0]	r0949[0]	r2133[0]	r2130[0]	r0948[0]	r2136[0]	r2109[0]
2nd fault	[1]	[1]	[1]	[1]	[1]	[1]	[1]

Figure 11-6   Saving the second fault in the fault buffer

The fault buffer can accept up to eight actual faults. The next to last fault is overwritten if an additional fault occurs after the eighth fault.

	Fault code	Fault value		Fault time received		Fault time removed	
1st fault	r0945[0]	r0949[0]	r2133[0]	r2130[0]	r0948[0]	r2136[0]	r2109[0]
2nd fault	[1]	[1]	[1]	[1]	[1]	[1]	[1]
3rd fault	[2]	[2]	[2]	[2]	[2]	[2]	[2]
4th fault	[3]	[3]	[3]	[3]	[3]	[3]	[3]
5th fault	[4]	[4]	[4]	[4]	[4]	[4]	[4]
6th fault	[5]	[5]	[5]	[5]	[5]	[5]	[5]
7th fault	[6]	[6]	[6]	[6]	[6]	[6]	[6]
Last fault	[7]	[7]	[7]	[7]	[7]	[7]	[7]

Figure 11-7   Complete fault buffer

Acknowledgement

In most cases, you have the following options to acknowledge a fault:

– Switch-off the inverter power supply and switch-on again.

– Press the acknowledgement button on the operator panel

– Acknowledgement signal at digital input 2

– Acknowledgement signal in bit 7 of control word 1 (r0054) for Control Units with fieldbus interface

Faults detected during the inverter-internal monitoring of hardware and firmware can be acknowledged only with switch-on and switch-off. The list of faults of the List Manual contains the note on this limited acknowledgement possibility.

Emptying the fault buffer: Fault history

The fault history can contain up to 56 faults.

The acknowledgement has no effect as long as none of the fault causes of the fault buffer have been removed. If at least one of the faults in the fault buffer has been removed (the cause of the fault has been removed) and you acknowledge the faults, then the following happens:

1. The inverter accepts all faults from the fault buffer in the first eight memory locations of the fault history (indexes 8 ... 15).

2. The inverter deletes the faults that have been removed from the fault buffer.

3. The inverter writes the time of acknowledgement of the faults that have been removed into parameters r2136 and r2109 (fault time removed).
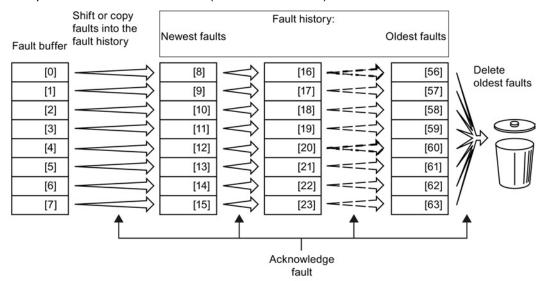
Figure 11-8   Fault history after acknowledging the faults

After acknowledgement, the faults that have not been removed are located in the fault buffer as well as in the fault history. For these faults, the "fault time coming" remains unchanged and the "fault time removed" remains empty.

If less than eight faults were shifted or copied into the fault history, the memory locations with the higher indexes remain empty.

The inverter shifts the values previously saved in the fault history each by eight indexes. Faults, which were saved in indexes 56 … 63 before the acknowledgement, are deleted.

Deleting the fault history

If you wish to delete all faults from the fault history, set parameter p0952 to zero.

Parameters of the fault buffer and the fault history

Parameter	Description
r0945	**Fault code**
	Displays the numbers of faults that have occurred
r0948	**Fault time received in milliseconds**
	Displays the time in milliseconds when the fault occurred
r0949	**Fault value**
	Displays additional information about the fault
p0952	**Fault cases, counter**
	Number of fault cases that have occurred since the last acknowledgement The fault buffer is deleted with p0952 = 0.
r2109	**Fault time removed in milliseconds**
	Displays the time in milliseconds when the fault occurred
r2130	**Fault time received in days**
	Displays the time in days when the fault occurred
r2131	**Actual fault code**
	Displays the code of the oldest fault that is still active
r2133	**Fault value for float values**
	Displays additional information about the fault that occurred for float values
r2136	**Fault time removed in days**
	Displays the time in days when the fault was removed

The motor cannot be switched-on

If the motor cannot be switched-on, then check the following:

– Is a fault present?
  If there is, then remove the fault cause and acknowledge the fault.

– Is p0010 = 0?
  If not, the inverter is e.g. still in a commissioning state.

– Is the inverter reporting the "ready to start" status (r0052.0 = 1)?

– Is the inverter missing enabling (r0046)?

– How does the inverter receive its setpoint and commands (p0015)?

Extended settings for faults

Parameter	Description
	You can change the fault response of the motor for up to 20 different fault codes:
p2100	**Setting the fault number for fault response**
	Selection of the faults for which the fault response applies
p2101	**Setting, fault response**
	Setting the fault response for the selected fault
	You can change the acknowledgement type for up to 20 different fault codes:
p2126	**Setting the fault number for the acknowledgement mode**
	Selection of the faults for which the acknowledgement type should be changed
p2127	**Setting, acknowledgement mode**
	Setting the acknowledgement type for the selected fault 1: Can only be acknowledged using POWER ON 2: IMMEDIATE acknowledgement after removing the fault cause
	You can change up to 20 different faults into an alarm or suppress faults:
p2118	**Setting the message number for the message type**
	Selection of the message for which the message type should be changed
p2119	**Setting the message type**
	Setting the message type for the selected fault 1: Fault 2: Alarm 3: No message

You will find details in function diagram 8075 and in the parameter description of the List Manual.

11.5 List of alarms and faults

Axxxxx Alarm

Fyyyyy: Fault

Table 11- 6   Faults, which can only be acknowledged by switching the converter off and on again (power on reset)

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	After this fault is output, the converter powers up with the factory settings. Remedy: Back up factory setting with p0971=1. Switch CU off and on again. Recommission the converter.
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.
F01105	CU: Insufficient memory	Reduce number of data records.
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.
F01662	CU hardware fault	Switch CU off and on again, upgrade firmware, or contact technical support.
F30022	Power Module: Monitoring U_{CE}	Check or replace the Power Module.
F30052	Incorrect Power Module data	Replace Power Module or upgrade CU firmware.
F30053	Error in FPGA data	Replace the Power Module.
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.

Table 11- 7   The most important alarms and faults

Number	Cause	Remedy
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 inverter.
A01028	Configuration error	Explanation: Parameterization on the memory card has been created with a different type of module (order number, MLFB) Check the module parameters and recommission if necessary.
F01033	Switching over units: Reference parameter value invalid	Set the value of the reference parameter not equal to 0.0 (p0304, p0305, p0310, p0596, p2000, p2001, p2002, p2003, r2004).
F01034	Switching over units: Calculation of the parameter values after reference value change unsuccessful	Select the value of the reference parameter so that the parameters involved can be calculated in the per unit notation (p0304, p0305, p0310, p0596, p2000, p2001, p2002, p2003, r2004).
A01053	System overload measured	The maximum computing power of the control unit was exceeded. The following measures reduce the load on the control unit: • Use only one data record (CDS and DDS) • Only use the safety features of the basic functions • De-activate the technology controller • Use the simple ramp-function generator rather than the extended ramp-function generator • Do not use any free function components • Reduce the sampling time of the free function blocks
F01054	System limit exceeded	
F01122	Frequency at the probe input too high	Reduce the frequency of the pulses at the probe input.
A01590	Motor maintenance interval lapsed	Carry out maintenance and reset the maintenance interval (p0651).
A01900	PROFIBUS: Configuration telegram faulty	Explanation: A PROFIBUS master is attempting to establish a connection with a faulty configuration telegram. Check the bus configuration on the master and slave side.
A01910 F01910	Setpoint timeout	The alarm is generated when p2040 ≠ 0 ms and one of the following causes is present: • The bus connection is interrupted • The Modbus master is switched off • Communications error (CRC, parity bit, logical error) • An excessively low value for the fieldbus monitoring time (p2040)
A01920	PROFIBUS: Cyclic connection interrupt	Explanation: The cyclic connection to PROFIBUS master is interrupted. Establish the PROFIBUS connection and activate the PROFIBUS master with cyclic operation.
F03505	Analog input, wire break	Check the wiring for interruptions. Check the level of the injected signal. The input current measured by the analog input can be read out in r0752.
A03520	Temperature sensor fault	Check that the sensor is connected correctly.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

365

Number	Cause	Remedy
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 set	Check the set supply voltage and if required change (p0210). Check the line voltage.
F07011	Motor overtemperature	Reduce the motor load. Check ambient temperature. Check the wiring and connection of the sensor.
A07012	I2t Motor 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 motor temperature sensor fault evaluation (p0607 = 0).
F07086 F07088	Switching over units: Parameter limit violation	Check the adapted parameter values and if required correct.
F07320	Automatic restart aborted	Increase the number of restart attempts (p1211). The 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.
A07400	DC link voltage maximum controller active	**Vector control or U/f control:** If it is not desirable that the controller intervenes: • Increase the ramp-down times. • Deactivate the Vdc_max control (p1240 = 0 for vector control, p1280 = 0 for U/f control). **Servo control:** No measures required; the alarm disappears automatically if the upper threshold is significantly fallen below. Possible measures: • Use a Braking Module or regenerative feedback unit, increase the ramp-down times (p1121, p1135), deactivate the Vdc_max controller (p1240 = 0).

Number	Cause	Remedy
A07409	U/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). U/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 the motor regarding the star/delta connection and rating plate parameterization. Check power unit / motor combination. Select flying restart function (p1200) if switched to rotating motor.
A07805	Drive: Power unit overload I2t	• Reduce the continuous load. • Adapt the load cycle. • Check the assignment of rated currents of the motor and power unit.
F07806	Regenerative power limit exceeded	Increase deceleration ramp. Reduce driving load. Use power unit with higher energy recovery capability. For vector control, the regenerative power limit in p1531 can be reduced until the fault is no longer activated.
F07807	Short circuit detected	• Check the inverter connection on the motor side for any phase-phase short-circuit. • Rule out that line and motor cables have been interchanged.
A07850 A07851 A07852	External alarm 1 … 3	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 the precontrol for the speed limiting controller (p1401 bit 7 = 1). Increase hysteresis for overspeed signal p2162.
F07902	Motor stalled	Check whether the motor data has been set correctly and perform a 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.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

367

Number	Cause	Remedy
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 sensor. Check the overtemperatures of the thermal model (p0626 ... p0628).
A07920	Torque/speed too low	The torque deviates from the torque/speed envelope curve.
A07921	Torque/speed too high	• Check the connection between the motor and the load.
A07922	Torque/speed out of tolerance	• Adapt the parameterization corresponding to the load.
F07923	Torque/speed too low	• Check the connection between the motor and the load.
F07924	Torque/speed too high	• Adapt the parameterization corresponding to the load.
A07927	DC braking active	Not required
A07980	Rotary measurement activated	Not required
A07981	No enabling for rotary measurement	Acknowledge pending faults. Establish missing enables (see r00002, r0046).
A07991	Motor identification activated	Switch on the motor and identify the motor data.
F08501	Setpoint timeout	• Check the PROFINET connection. • Set the controller into the RUN mode. • If the fault occurs repeatedly, check the monitoring time set p2044.
F08502	Monitoring time, sign-of-life expired	• Check the PROFINET connection.
F08510	Send configuration data not valid	• Check the PROFINET configuration
A08511	Receive configuration data not valid	
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.
F08700	Communications error	A CAN communications error has occurred. Check the following: • Bus cable • Baud rate (p8622) • Bit timing (p8623) • Master Start the CAN controller manually with p8608 = 1 after the cause of the fault has been resolved!

Number	Cause	Remedy
F13100	Know-how protection: Copy protection error	The know-how protection and the copy protection for the memory card are active. An error occurred when checking the memory card. • Insert a suitable memory card and switch the inverter supply voltage temporarily off and then on again (POWER ON). • Deactivate the copy protection (p7765).
F13101	Know-how protection: Copy protection cannot be activated	Insert a valid memory card.
F30001	Overcurrent	Check the following: • Motor data, if required, carry out commissioning • Motor connection method (Y / Δ) • U/f operation: Assignment of rated currents of motor and Power Module • Line quality • Make sure that the line commutating reactor is connected properly • Power cable connections • Power cables for short-circuit or ground fault • Power cable length • Line phases If this doesn't help: • U/f operation: Increase the acceleration ramp • Reduce the load • Replace the power unit
F30002	DC-link voltage overvoltage	Increase the ramp-down time (p1121). Set the rounding times (p1130, p1136). Activate the DC link voltage controller (p1240, p1280). Check the line voltage (p0210). Check the line phases.
F30003	DC-link voltage undervoltage	Check the line voltage (p0210).
F30004	Inverter overtemperature	Check whether the inverter fan is running. Check whether the ambient temperature is in the permissible range. Check whether the motor is overloaded. Reduce the pulse frequency.
F30005	I2t inverter overload	Check the rated currents of the motor and Power Module. Reduce current limit p0640. When operating with U/f characteristic: Reduce p1341.
F30011	Line phase failure	Check the inverter's input fuses. Check the motor feeder cables.
F30015	Motor cable phase failure	Check the motor cables. Increase the ramp-up or ramp-down time (p1120).

Number	Cause	Remedy
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).
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
A30049	Internal fan defective	Check the internal fan and if required replace.
F30059	Internal fan defective	Check the internal fan and if required replace.
A30502	DC link overvoltage	• Check the unit supply voltage (p0210). • Check the dimensioning of the line reactor.
A30920	Temperature sensor fault	Check that the sensor is connected correctly.
A50001	PROFINET configuration error	A PROFINET controller is attempting to establish a connection with an incorrect configuration telegram. Check to see whether "Shared Device" is activated (p8929 = 2).
A50010	PROFINET name of station invalid	Correct name of station (p8920) and activate (p8925 = 2).
A50020	PROFINET: Second controller missing	"Shared Device" is activated (p8929 = 2). However, only the connection to a PROFINET controller is available.
For further information, please refer to the List Manual.		

For further information, please refer to the List Manual.

Technical data

12

12.1   Technical data for CU230P-2

Feature	Data / explanation	
Order numbers	6SL3243-0BB30-1CA3	With CANopen interface
	6SL3243-0BB30-1HA3	With RS485 interface for the following protocols: • USS • Modbus RTU • BACnet MS/TP
	6SL3243-0BB30-1PA3	With PROFIBUS interface.
	6SL3243-0BB30-1FA0	With PROFINET interface.
Operating voltage	• Supply from the Power Module • or externally via terminals 31 and 32 with 24 VDC, a maximum of 200 VA Use a power supply with PELV (Protective Extra Low Voltage according to EN 61800-5-1): The 0 V of the power supply must be connected with low resistance to the PE of the system. Example: SITOP Power power supply unit 5 A.	
Current consumption	max 0.5 A the current consumption can be higher if the Control Unit supplies external components.	
Power loss	5.0 W	
Output voltages	+24 V out (terminal 9),18 V … 28.8 V, max. 100 mA	
	+10 V out (terminals 1 and 35), 9.5 V … 10.5 V, max. 10 mA	
Setpoint resolution	0.01 Hz	
Digital inputs	6 (DI 0 … DI 5)	• Low < 5V, high > 11V • Electrically isolated • 30 V maximum input voltage • 5.5 mA current consumption • SIMATIC-compatible • PNP/NPN switchable • 10 ms response time for debounce time p0724 = 0.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

371

Feature	Data / explanation	

Analog inputs	4 (AI 0 … AI 3)	• Differential inputs
		• 12 bit resolution
		• 13 ms response time
		• AI2 and AI3 can be switched:
		  – 0 V … 10 V, 0 mA … 20 mA or -10 V … +10 V
		  – Temperature sensor Pt1000/LG-Ni1000
		• If AI 0 and AI 1 are configured as supplementary digital inputs: Low < 1.6 V, high > 4.0 V,
		13 ms ± 1 ms response time for a debounce time p0724 = 0.

Digital outputs /relay outputs	3 (DO 0 … DO 2)	• DO 0, DO 2: 30 V DC 5 A / 250 V AC, 2 A [1] • DO 1: 30 VDC 0.5A • Update time: 2ms
Analog outputs	2 (AO 0 … AO 1)	• 0 V … 10 V or 0 mA … 20 mA • Reference potential: "GND" • 16 bit resolution • 4 ms update time
Motor temperature sensor	PTC	• Short-circuit monitoring < 20Ω • Overtemperature 1650Ω
	KTY84	• Short-circuit monitoring < 50 Ω • Wire breakage: > 2120Ω
	Temperature switch with isolated contact	
USB interface	Mini-B	
Dimensions (WxHxD)	73mm × 199mm × 50mm	Depth when mounting on the Power Module
Memory card (optional)	MMC	Recommendation: 6SL3254-0AM00-0AA0
	SD	Recommendation: 6SL3254-0AM00-0AA0 SDHC cards are not possible (SD High Capacity).
Weight	0.61kg	
Operating temperature	0°C … 60°C	For operation without inserted operator panel.
	0°C … 50°C	For operation with inserted operator panel.
	Observe any possible restrictions regarding the operating temperature as a result of the Power Module.	
Storage temperature	- 40°C … 70°C	
Relative humidity	< 95 %	Condensation is not permissible.

1) The following applies to systems complying with UL: A maximum of 3 A 30 V DC or 2 A 250 V AC may be connected via terminals 18 / 20 (DO 0 NC) and 23 / 25 (DO 2 NC).

Note

Losses of voltage from external 24 V power supply if the 400 V supply is switched off

The converter responds to losses of voltage from the external 24 V supply (≤ 95 % and ≤ 3 ms) with error F30074 without however interrupting the fieldbus communication.

You can confirm the error via DI2 (default setting).

12.2 Technical data, Power Modules

Permissible converter overload

There are two different power data specifications for the Power Modules: "**Low Overload**" (LO) and "**High Overload**" (HO), depending on the expected load.
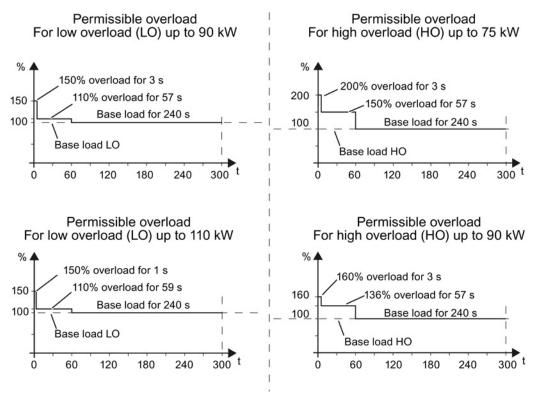
Figure 12-1   Duty cycles, "High Overload" and "Low Overload"

Note

The base load (100% power or current) of "Low Overload" is greater than the base load of "High Overload".

We recommend the "SIZER" engineering software to select the inverter based on duty cycles. See Manuals for your inverter (Page 435).

Definitions

- **LO input current**   100 % of the permissible input current for a load cycle according to Low Overload (LO base load input current).

- **LO output current**   100 % of the permissible output current for a load cycle according to Low Overload (LO base load output current).

- **LO power**   Power of the inverter for LO output current.

- **HO input current**   100 % of the permissible input current for a load cycle according to High Overload (HO base load input current).

- **HO output current**   100 % of the permissible output current for a load cycle according to High Overload (HO base load output current).

- **HO power**   Power of the inverter for HO output current.

If the power data comprise rated values without any further specifications they always refer to an overload capability corresponding to Low Overload.

12.2.1　Technical data, PM230 IP20

12.2.1.1　General data, PM230 - IP20

Feature	Version		
Line voltage	380 V ... 480 V 3-ph. AC ± 10%		
Output voltage	0 V 3-ph. AC … input voltage x 0.95 (max.)		
Input frequency	50 Hz … 60 Hz, ± 3 Hz		
Output frequency	0 … 650 Hz, depending on the control mode		
Power factor λ	0.9		
Line impedance	Uk ≤ 1%, no line reactor permitted		
Starting current	Less than the input current		
Pulse frequency (factory setting)	4 kHz The pulse frequency can be increased in 2 kHz steps up to 16 kHz (up to 8 kHz for 55 kW and 75 kW). An increase in the pulse frequency results in a lower output current.		
Electromagnetic compatibility	Devices with filters in compliance with EN 61800-3: 2004 are suitable for Category C2 environments. For details, see the Hardware Installation Manual, Appendix A2.		
Braking methods	DC braking		
Degree of protection	IP20 built-in units PT devices	IP20 when mounted in a control cabinet IP54 on the control cabinet wall	
Operating temperature	LO without power reduction: HO without power reduction: LO/HO with power reduction:	0° C …+40° C 0° C …+50° C to 60° C	For details, see the Hardware Installation Manual.
Storage temperature	-40 °C … +70 °C		
Relative humidity	< 95% - condensation not permissible		
Contamination	Protected according to pollution degree 2 to EN 61800-5-1: 2007		
Environmental requirements	Protected against damaging chemical substances according to environmental class 3C2 to EN 60721-3-3; 1995		
Shock and vibration	• Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1: 1997 • Transport in the transport packaging according to Class 2M3 to EN 60721-3-2: 1997 • Vibration during operation according to Class 3M2 to EN 60721-3-3: 1995		
Installation altitude	without power reduction: with power reduction:	up to 1000 m above sea level up to 4000 m above sea level	For details, see the Hardware Installation Manual
Permissible short-circuit current	Frame size D ... F: 65 kA [1]		
Overvoltage category	Supply circuits: Non-supply circuits:	Overvoltage category III Overvoltage category II	
Standards	UL [1),2)], CE, C-tick The drive only satisfies the UL requirements when UL-certified fuses are used.		

[1]　If fuse-protected with a listed Class J or 3NE1 fuse, rated voltage 600 VAC with the rated current of the specific converter.

[2]　UL available soon for frame sizes D … F

12.2.1.2 Power-dependent data, PM230, IP20

Note

For the PM230 Power Modules, IP20, the low overload values (LO) are identical to the rated values.

Table 12- 1   PM230, IP20, Frame Sizes A, 3 AC 380 V … 480 V

| Order No. - without filter | 6SL3210… | …1NE11-3UL0 | …1NE11-7UL0 | …1NE12-2UL0 |
Order No. - with filter	6SL3210…	…1NE11-3AL0	…1NE11-7AL0	…1NE12-2AL0
LO power		0.37 kW	0.55 kW	0.75 kW
LO input current		1.3 A	1.8 A	2.3 A
LO output current		1.3 A	1.7 A	2.2 A
HO power		0.25 kW	0.37 kW	0.55 kW
HO input current		0.9 A	1.3 A	1.8 A
HO output current		0.9 A	1.3 A	1.7 A
Fuse according to IEC		3NE1 813-0	3NE1 813-0	3NE1 813-0
Fuse according to UL		AJT2 / 3NE1 813-0	AJT4 / 3NE1 813-0	AJT4 / 3NE1 813-0
Power loss		0.04 kW	0.04 kW	0.05 kW
Required cooling air flow		1.5 l/s	1.5 l/s	4.5 l/s
Cross section of line and motor cables		1 … 2.5 mm^2 18 … 14 AWG	1 … 2.5 mm^2 18 … 14 AWG	1 … 2.5 mm^2 18 … 14 AWG
Tightening torque for line and motor cables		0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight, unfiltered		1.4 kg	1.4 kg	1.4 kg
Weight, filtered		1.6 kg	1.6 kg	1.6 kg

Table 12- 2   PM230, IP20, Frame Sizes A, 3 AC 380 V … 480 V

| Order No. - without filter | 6SL3210… | …1NE13-1UL0 | …1NE14-1UL0 | …-1NE15-8UL0 |
Order No. - with filter	6SL3210…	…1NE13-1AL0	…1NE14-1AL0	…-1NE15-8AL0
LO power		1.1 kW	1.5 kW	2.2 kW
LO input current		3.2 A	4.2 A	6.1 A
LO output current		3.1 A	4.1 A	5.9 A
HO power		0.75 kW	1.1 kW	1.5 kW
HO input current		2.3 A	3.2 A	4.2 A
HO output current		2.2 A	3.1 A	4.1 A
Fuse according to IEC		3NE1 813-0	3NE1 813-0	3NE1 813-0
Fuse according to UL		AJT6 / 3NE1 813-0	AJT6 / 3NE1 813-0	AJT10 / 3NE1 813-0
Power loss		0.06 kW	0.07 kW	0.08 kW
Required cooling air flow		4.5 l/s	4.5 l/s	4.5 l/s
Cross section of line and motor cables		1 … 2.5 mm^2 18 … 14 AWG	1 … 2.5 mm^2 18 … 14 AWG	1.5 … 2.5 mm^2 16 … 14 AWG
Tightening torque for line and motor cables		0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight, unfiltered		1.4 kg	1.4 kg	1.4 kg
Weight, filtered		1.6 kg	1.6 kg	1.6 kg

Table 12- 3   PM230, IP20, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - without filter	6SL3210…	…1NE17-7UL0
Order No. - with filter	6SL3210…	…1NE17-7AL0
LO power LO input current LO output current		3 kW 8.0 A 7.7 A
HO power HO input current HO output current		2.2 kW 6.1 A 5.9 A
Fuse according to IEC Fuse according to UL		3NE1 813-0 AJT10 / 3NE1 813-0
Power loss		0.11 kW
Required cooling air flow		4.5 l/s
Cross section of line and motor cables		1.5 … 2.5 mm^2 16 … 14 AWG
Tightening torque for line and motor cables		0.5 Nm / 4 lbf in
Weight, unfiltered Weight, filtered		1.4 kg 1.6 kg

Table 12- 4   PM230, PT, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - without filter	6SL3211…	…1NE17-7UL0
Order No. - with filter	6SL3211…	…1NE17-7AL0
LO power LO input current LO output current		3 kW 8.0 A 7.7 A
HO power HO input current HO output current		2.2 kW 6.1 A 5.9 A
Fuse according to IEC Fuse according to UL		3NE1 813-0 AJT10 / 3NE1 813-0
Power loss		0.11 kW
Required cooling air flow		4.5 l/s
Cross section of line and motor cables		1.5 … 2.5 mm^2 16 … 14 AWG
Tightening torque for line and motor cables		0.5 Nm / 4 lbf in
Weight, unfiltered Weight, filtered		1.7 kg 1.9 kg

Table 12- 5   PM230, IP20, Frame Sizes B, 3 AC 380 V … 480 V

Order No. - without filter	6SL3210…	…1NE21-0UL0	…1NE21-3UL0	…1NE21-8UL0
Order No. - with filter	6SL3210…	…1NE21-0AL0	…1NE21-3AL0	…1NE21-8AL0
LO power		4 kW	5.5 kW	7.5 kW
LO input current		10.5 A	13.6 A	18.6 A
LO output current		10.2 A	13.2 A	18 A
HO power		3 kW	4 kW	5.5 kW
HO input current		8.0 A	10.5 A	13.6 A
HO output current		7.7 A	10.2 A	13.2 A
Fuse according to IEC		3NE1 813-0	3NE1 814-0	3NE1 815-0
Fuse according to UL		AJT15 / 3NE1 813-0	AJT20 / 3NE1 814-0	AJT25 / 3NE1 815-0
Power loss		0.12 kW	0.15 kW	0.22 kW
Required cooling air flow		9.2 l/s	9.2 l/s	9.2 l/s
Cross section of line and motor cables		1.5 … 6 mm^2 16 … 10 AWG	1.5 … 6 mm^2 16 … 10 AWG	1.5 … 6 mm^2 16 … 10 AWG
Tightening torque for line and motor cables		0.6 Nm / 5 lbf in	0.6 Nm / 5 lbf in	0.6 Nm / 5 lbf in
Weight, unfiltered		2.8 kg	2.8 kg	2.8 kg
Weight, filtered		3 kg	3 kg	3 kg

Table 12- 6   PM230, PT, Frame Sizes B, 3 AC 380 V … 480 V

Order No. - without filter	6SL3211…	…1NE21-8UL0
Order No. - with filter	6SL3211…	…1NE21-8AL0
LO power		7.5 kW
LO input current		18.6 A
LO output current		18 A
HO power		5.5 kW
HO input current		13.6 A
HO output current		13.2 A
Fuse according to IEC		3NE1 815-0
Fuse according to UL		AJT25 / 3NE1 815-0
Power loss		0.22 kW
Required cooling air flow		9.2 l/s
Cross section of line and motor cables		1.5 … 6 mm^2 16 … 10 AWG
Tightening torque for line and motor cables		0.6 Nm / 5 lbf in
Weight, unfiltered		3.4 kg
Weight, filtered		3.6 kg

Table 12- 7   PM230, IP20, Frame Sizes C, 3 AC 380 V … 480 V

Order No. - without filter	6SL3210…	…1NE22-6UL0	…1NE23-2UL0	…1NE23-8UL0
Order No. - with filter	6SL3210…	…1NE22-6AL0	…1NE23-2AL0	…1NE23-8AL0
LO power		11 kW	15 kW	18.5 kW
LO input current		26.9 A	33.1 A	39.2 A
LO output current		26 A	32 A	38 A
HO power		7.5 kW	11 kW	15 kW
HO input current		18.6 A	26.9 A	33.1 A
HO output current		18 A	26 A	32 A
Fuse according to IEC		3NE1 803-0	3NE1 817-0	3NE1 817-0
Fuse according to UL		AJT35 / 3NE1 803-0	AJT45 / 3NE1 817-0	AJT50 / 3NE1 817-0
Power loss		0.3 kW	0.35 kW	0.45 kW
Required cooling air flow		18.5 l/s	18.5 l/s	18.5 l/s
Cross section of line and motor cables		6 …16 mm^2 10 … 6 AWG	6 …16 mm^2 10 … 6 AWG	6 …16 mm^2 10 … 6 AWG
Tightening torque for line and motor cables		1.3 Nm / 12 lbf in	1.3 Nm / 12 lbf in	1.3 Nm / 12 lbf in
Weight, unfiltered		4.5 kg	4.5 kg	4.5 kg
Weight, filtered		5.1 kg	5.1 kg	5.1 kg

Table 12- 8   PM230, PT, Frame Sizes C, 3 AC 380 V … 480 V

Order No. - without filter	6SL3211…	…1NE23-8UL0
Order No. - with filter	6SL3211…	…1NE23-8AL0
LO power		18.5 kW
LO input current		39.2 A
LO output current		38 A
HO power		15 kW
HO input current		33.1 A
HO output current		32 A
Fuse according to IEC		3NE1 817-0
Fuse according to UL		AJT50 / 3NE1 817-0
Power loss		0.45 kW
Required cooling air flow		18.5 l/s
Cross section of line and motor cables		6 …16 mm^2 10 … 6 AWG
Tightening torque for line and motor cables		1.3 Nm / 12 lbf in
Weight, unfiltered		5.4 kg
Weight, filtered		6 kg

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

379

Table 12- 9   PM230, IP20, Frame Sizes D, 3 AC 380 V … 480 V

Order No. - without filter	6SL3210…	…1NE24-5UL0	…1NE26-0UL0
Order No. - with filter	6SL3210…	…1NE24-5AL0	…1NE26-0AL0
LO power		22 kW	30 kW
LO input current		42 A	56 A
LO output current		45 A	60 A
HO power		18.5 kW	22 kW
HO input current		36 A	42 A
HO output current		38 A	45 A
Fuse according to IEC		3NE1818-0	3NE1820-0
Fuse according to UL		3NE1818-0	3NE1820-0
Power loss		0.52 kW	0.68 kW
Required cooling air flow		80 l/s	80 l/s
Cross section of line and motor cables		16 … 35 mm^2 5 … 2 AWG	16 … 35 mm^2 5 … 2 AWG
Tightening torque for line and motor cables		6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight, unfiltered		11 kg	11 kg
Weight, filtered		14 kg	14 kg

Table 12- 10 PM230, IP20, Frame Sizes E, 3 AC 380 V … 480 V

Order No. - without filter	6SL3210…	…1NE27-5UL0	…1NE28-8UL0
Order No. - with filter	6SL3210…	…1NE27-5AL0	…1NE28-8AL0
LO power		37 kW	45 kW
LO input current		70 A	84 A
LO output current		75 A	90 A
HO power		30 kW	37 kW
HO input current		56 A	70 A
HO output current		60 A	75 A
Fuse according to IEC		3NE1021-0	3NE1022-0
Fuse according to UL		3NE1021-0	3NE1022-0
Power loss		0.99 kW	1.2 kW
Required cooling air flow		80 l/s	80 l/s
Cross section of line and motor cables		25 … 50 mm^2 3 … 1-1/0 AWG	25 … 50 mm^2 3 … 1-1/0 AWG
Tightening torque for line and motor cables		6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight, unfiltered		15 kg	15 kg
Weight, filtered		22 kg	22 kg

Table 12- 11 PM230, IP20, Frame Sizes F, 3 AC 380 V … 480 V

Order No. - without filter Order No. - with filter	6SL3210… 6SL3210…	…1NE31-1UL0 …1NE31-1AL0	…1NE31-5UL0 …1NE31-5AL0
LO power LO input current LO output current		55 kW 102 A 110 A	75 kW 135 A 145 A
HO power HO input current HO output current		45 kW 84 A 90 A	55 kW 102 A 110 A
Fuse according to IEC Fuse according to UL		3NE1224-0 3NE1224-0	3NE1225-0 3NE1225-0
Power loss		1.4 kW	1.9 kW
Required cooling air flow		150 l/s	150 l/s
Cross section of line and motor cables		35 … 120 mm² 2 … 4/0 AWG	35 … 120 mm² 2 … 4/0 AWG
Tightening torque for line and motor cables		13 Nm / 115 lbf in	13 Nm / 115 lbf in
Weight, unfiltered Weight, filtered		33 kg 48 kg	33 kg 48 kg

12.2.2   Technical data, PM230 - IP55

12.2.2.1   General data, PM230, IP55

Feature	Version
Line voltage	380°V°...°480°V 3-ph.°AC ±°10%
Output voltage	0 V 3-ph. AC … input voltage x 0.95 (max.)
Input frequency	50 Hz … 60 Hz, ± 3 Hz
Output frequency	0 … 650 Hz, depending on the control mode
Power factor λ	0.9
Line impedance	Uk ≤ 1%, no line reactor permitted
Starting current	Less than the input current
Pulse frequency (factory setting)	4 kHz The pulse frequency can be increased in 2 kHz steps up to 16 kHz (up to 8 kHz for 75kW and 90kW). An increase in the pulse frequency results in a lower output current.
Electromagnetic compatibility	The devices comply with EN 61800-3: 2004 suitable for Category C1 and C2 environments. For details, see the Hardware Installation Manual, Appendix A2
Braking methods	DC braking
Degree of protection	FSA … FSC IP55 / UL Type 12 FSD … FSF IP55 / UL Type 12 in preparation Note: For the end cover plate, you must use the relevant bolting plates for the cable glands and the corresponding cable glands and seals to achieve the degree of protection UP55 (UL type 12). Degree of protection IP54 / UL Type 12 is reached if an IOP is inserted.
Operating temperature	without power reduction: 0°C … +40°C with power reduction: to 60°C For details, see the Hardware Installation Manual
Storage temperature	-40 °C … +70 °C
Relative humidity	< 95% - condensation not permissible
Contamination	Protected from contact with dangerous parts, dust, spray water and water jets
Environmental requirements	Protected against damaging chemical substances according to environmental class 3C2 to EN 60721-3-3; 1995
Shock and vibration	• Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1: 1997 • Transport in the transport packaging according to Class 2M3 to EN 60721-3-2: 1997 • Vibration during operation according to Class 3M2 to EN 60721-3-3: 1995
Installation altitude	without power reduction: up to 1000 m above sea level with power reduction: up to 4000 m above sea level For details, see the Hardware Installation Manual
Permissible short-circuit current	Frame size A ... C: 40kA [1] Frame sizes D ... F: 65 kA [1]
Standards	UL [2], CE, C-tick The drive only satisfies the UL requirements when UL-certified fuses are used.

[1] If fuse-protected with a listed Class J fuse, rated voltage 600 VAC with the rated current of the specific converter.
[2] UL available soon for frame sizes D … F

12.2.2.2   Power dependent data, PM230, IP55

Table 12- 12 PM230, IP55, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Filtered, Class A	6SL3223-…	…0DE13-7AA0	…0DE15-5AA0	…0DE17-5AA0
Order No. - Filtered, Class B	6SL3223-…	…0DE13-7BA0	…0DE15-5BA0	…0DE17-5BA0
Rated / LO power		0.37 kW	0.55 kW	0.75 kW
Rated / LO input current		1.3 A	1.8 A	2.3 A
Rated / LO Output current		1.3 A	1.7 A	2.2 A
HO power		0.25 kW	0.37 kW	0.55 kW
HO input current		0.9 A	1.3 A	1.8 A
HO output current		0.9 A	1.3 A	1.7 A
Fuse according to IEC		3NA3803	3NA3803	3NA3803
Fuse according to UL		10 A, class J	10 A, class J	10 A, class J
Power losses		0.06 kW	0.06 kW	0.06 kW
Required cooling air flow		7 l/s	7 l/s	7 l/s
Cross section of line and motor cable		1 … 2.5 mm²	1 … 2.5 mm²	1 … 2.5 mm²
		18 … 14 AWG	18 … 14 AWG	18 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4.4 lbf in	0.5 Nm / 4.4 lbf in	0.5 Nm / 4.4 lbf in
Weight		4.3 kg	4.3 kg	4.3 kg

Table 12- 13 PM230, IP55, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Filtered, Class A	6SL3223-…	…0DE21-1AA0	…0DE21-5AA0	…0DE22-2AA0
Order No. - Filtered, Class B	6SL3223-…	…0DE21-1BA0	…0DE21-5BA0	…0DE22-2BA0
Rated / LO power		1.1 kW	1.5 kW	2.2 kW
Rated / LO input current		3.2 A	4.2 A	6.1 A
Rated / LO Output current		3.1 A	4.1 A	5.9 A
HO power		0.75 kW	1.1 kW	1.5 kW
HO input current		2.3 A	3.2 A	4.2 A
HO output current		2.2 A	3.1 A	4.1 A
Fuse according to IEC		3NA3803	3NA3803	3NA3803
Fuse according to UL		10 A, class J	10 A, class J	10 A, class J
Power losses		0.07 kW	0.08 kW	0.1 kW
Required cooling air flow		7 l/s	7 l/s	7 l/s
Cross section of line and motor cable		1 … 2.5 mm²	1 … 2.5 mm²	1 … 2.5 mm²
		18 … 14 AWG	18 … 14 AWG	18 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4.4 lbf in	0.5 Nm / 4.4 lbf in	0.5 Nm / 4.4 lbf in
Weight		4.3 kg	4.3 kg	4.3 kg

Table 12- 14 PM230, IP55, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Filtered, Class A	6SL3223-…	…0DE23-0AA0
Order No. - Filtered, Class B	6SL3223-…	…0DE23-0BA0
Rated / Low Overlaod values		
Rated / LO power		3 kW
Rated / LO input current		8,0 A
Rated / LO Output current		7,7 A
High Overload values		
HO power		2,2 kW
HO input current		6,1 A
HO output current		5,9 A
Fuse according to IEC		3NA3803
Fuse according to UL		10 A, class J
Power losses		0.12 kW
Required cooling air flow		7 l/s
Cross section of line and motor cable		1 … 2.5 mm^2 18 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4.4 lbf in
Weight		4.3 kg

Table 12- 15 PM230, IP55, Frame Sizes B, 3 AC 380 V … 480 V

Order No. - Filtered, Class A	6SL3223-…	…0DE24-0AA0	…0DE25-5AA0	…0DE27-5AA0
Order No. - Filtered, Class B	6SL3223-…	…0DE24-0BA0	…0DE25-5BA0	…0DE27-5BA0
Rated / LO power		4 kW	5.5 kW	7.5 kW
Rated / LO input current		10.5 A	13.6 A	18.6 A
Rated / LO Output current		10.2 A	13.2 A	18 A
HO power		3 kW	4 kW	5.5 kW
HO input current		8.0 A	10.5 A	13.6 A
HO output current		7.7 A	10.2 A	13.2 A
Fuse according to IEC		3NA3805	3NA3807	3NA3810
Fuse according to UL		16 A, class J	25 A, class J	35 A, class J
Power losses		0.14 kW	0.18 kW	0.24 kW
Required cooling air flow		9 l/s	9 l/s	9 l/s
Cross section of line and motor cable		2.5 … 6 mm^2 14 … 10 AWG	4 … 6 mm^2 12 … 10 AWG	4 … 6 mm^2 12 … 10 AWG
Tightening torque for line and motor cable		0.5 Nm / 4.4 lbf in	0.5 Nm / 4.4 lbf in	0.5 Nm / 4.4 lbf in
Weight		6.3 kg	6.3 kg	6.3 kg

Table 12- 16 PM230, IP55, Frame Sizes C, 3 AC 380 V … 480 V

Order No. - Filtered, Class A	6SL3223-…	…0DE31-1AA0	…0DE31-5AA0	…0DE31-8AA0
Order No. - Filtered, Class B	6SL3223-…	…0DE31-1BA0	…0DE31-5BA0	-
Rated / Low Overlaod values				
Rated / LO power		11 kW	15 kW	18.5 kW
Rated / LO input current		26,9 A	33,1 A	39,2 A
Rated / LO Output current		26 A	32 A	38 A
High Overload values				
HO power		7,5 kW	11 kW	15 kW
HO input current		18,6 A	26,9 A	33,1 A
HO output current		18 A	26 A	32 A
Fuse according to IEC		3NA3814	3NA3820	3NA3820
Fuse according to UL		40 A, class J	50 A, class J	50 A, class J
Power losses		0.32 kW	0.39 kW	0.46 kW
Required cooling air flow		20 l/s	20 l/s	20 l/s
Cross section of line and motor cable		6 … 16 mm²	10 … 16 mm²	10 … 16 mm²
		10 … 5 AWG	7 … 5 AWG	7 … 5 AWG
Tightening torque for line and motor cable		1.5 Nm / 13 lbf in	1.5 Nm / 13 lbf in	1.5 Nm / 13 lbf in
Weight		9,5 kg	9,5 kg	9,5 kg

Table 12- 17 PM230, IP55, Frame Sizes D, 3 AC 380 V … 480 V

Order No. - Filtered, Class A	6SL3223-…	-	…0DE32-2AA0	…0DE33-0AA0
Order No. - Filtered, Class B	6SL3223-…	…0DE31-8BA0	…0DE32-2BA0	…0DE33-0BA0
Rated / LO power		18.5 kW	22 kW	30 kW
Rated / LO input current		39.2 A	42 A	56 A
Rated / LO Output current		38 A	45 A	60 A
HO power		15 kW	18.5 kW	22 kW
HO input current		33.1 A	36 A	42 A
HO output current		32 A	38 A	45 A
Fuse according to IEC		3NA3820	3NA3822	3NA3824
Fuse according to UL		50 A, class J	63 A, class J	80 A, class J
Power losses		0.46 kW	0.52 kW	0.68 kW
Required cooling air flow		20 l/s	39 l/s	39 l/s
Cross section of line and motor cable		10 … 35 mm²	16 … 35 mm²	16 … 35 mm²
		7 … 2 AWG	5 … 2 AWG	5 … 2 AWG
Tightening torque for line and motor cable		6 Nm / 53 lbf in	6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight		30.2 kg	30.2 kg	30.2 kg

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

385

Table 12- 18   PM230, IP55, Frame Sizes E, 3 AC 380 V … 480 V

Order No. - Filtered, Class A Order No. - Filtered, Class B	6SL3223-… 6SL3223-…	…0DE33-7AA0 …0DE33-7BA0	…0DE34-5AA0 …0DE34-5BA0
Rated / LO power Rated / LO input current Rated / LO Output current		37 kW 70 A 75 A	45 kW 84 A 90 A
HO power HO input current HO output current		30 kW 56 A 60 A	37 kW 70 A 75 A
Fuse according to IEC Fuse according to UL		3NA3830 100 A, class J	3NA3832 125 A, class J
Power losses		0.99 kW	1.2 kW
Required cooling air flow		39 l/s	39 l/s
Cross section of line and motor cable		25 … 50 mm^2 3 … 1 AWG	25 … 50 mm^2 3 … 1 AWG
Tightening torque for line and motor cable		6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight		35.8 kg	35.8 kg

Table 12- 19   PM230, IP55, Frame Sizes F, 3 AC 380 V … 480 V

Order No. - Filtered, Class A Order No. - Filtered, Class B	6SL3223-… 6SL3223-…	…0DE35-5AA0 …0DE35-5BA0	…0DE37-5AA0 …0DE37-5BA0	…0DE38-8AA0 …0DE38-8BA0
Rated / LO power Rated / LO input current Rated / LO Output current		55 kW 102 A 110 A	75 kW 135 A 145 A	90 kW 166 A 178 A
HO power HO input current HO output current		45 kW 84 A 90 A	55 kW 102 A 110 A	75 kW 135 A 145 A
Fuse according to IEC Fuse according to UL		3NA3836 160 A, class J	3NA3140 200 A, class J	3NA3144 250 A, class J
Power losses		1.4 kW	1.9 kW	2.3 kW
Required cooling air flow		117 l/s	117 l/s	117 l/s
Cross section of line and motor cable		35 … 120 mm^2 2 … 4/0 AWG	35 … 120 mm^2 2 … 4/0 AWG	35 … 120 mm^2 2 … 4/0 AWG
Tightening torque for line and motor cable		13 Nm / 115 lbf in	13 Nm / 115 lbf in	13 Nm / 115 lbf in
Weight		70.0 kg	70.0 kg	70.0 kg

12.2.3 Technical data, PM240

12.2.3.1 General data, PM240

Feature	Version			
Line voltage	380 V ... 480 V 3-ph. AC ± 10%			
Output voltage	0 V 3-ph. AC … input voltage x 0.95 (max.)			
Input frequency	50 Hz … 60 Hz, ± 3 Hz			
Output frequency	0 … 650 Hz, depending on the control mode			
Power factor λ	0,7 ... 0,85			
Starting current	Less than the input current			
Pulse frequency (factory setting)	4 kHz for 0.37 kW ... 90 kW 2 kHz for 110 kW ... 250 kW The pulse frequency can be increased in 2 kHz steps. An increase in the pulse frequency results in a lower output current.			
Electromagnetic compatibility	The devices in compliance with EN 61800-3: 2004 are suitable for Category C1 and C2 environments. For details, see the Hardware Installation Manual, Appendix A2			
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper			
Degree of protection	IP20 chassis units			
Operating temperature	LO without derating: HO without derating: HO without derating: LO/HO with derating:	all power ratings 0.37 ... 110 kW 132 … 200 kW all power ratings	0° C … +40° C 0° C … +50° C 0° C … +40° C up to 60° C	For details, see the Hardware Installation Manual.
Storage temperature	-40° C … +70° C			
Dirt and contamination	Protected according to pollution degree 2 to EN 61800-5-1: 2007			
Relative humidity	< 95% - condensation not permissible			
Environmental requirements	Protected against damaging chemical substances according to environmental class 3C2 to EN 60721-3-3; 1995			
Shock and vibration	• Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1: 1997 • Transport in the transport packaging according to Class 2M3 to EN 60721-3-2: 1997 • Vibration during operation according to Class 3M2 to EN 60721-3-3: 1995			
Installation altitude	without derating: with derating:	0.37 kW ... 132 kW 160 kW ... 250 kW all power ratings	up to 1000 m above sea level up to 2000 m above sea level up to 4000 m above sea level	For details, see the Hardware Installation Manual
Standards	UL, cUL, CE, C-tick, SEMI F47 The drive only satisfies the UL requirements when UL-certified fuses are used.			

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

387

12.2.3.2 Power-dependent data, PM240

Note

The given input currents are valid for operation without a line reactor for a line voltage of 400 V with Vk = 1 % referred to the rated power of the inverter. If a line reactor is used, the specified values are reduced by a few percent.

Table 12- 20 PM240, IP20, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Unfiltered 6SL3224-…	…0BE13-7UA0	…0BE15-5UA0	…0BE17-5UA0
Rated / LO power	0.37 kW	0.55 kW	0.75 kW
Rated / LO input current	1.6 A	2.0 A	2.5 A
Rated / LO Output current	1.3 A	1.7 A	2.2 A
HO power	0.37 kW	0.55 kW	0.75 kW
HO input current	1.6 A	2.0 A	2.5 A
HO output current	1.3 A	1.7 A	2.2 A
Fuse	10 A, class J	10 A, class J	10 A, class J
Power losses	0.097 kW	0.099 kW	0.102 kW
Required cooling air flow	4.8 l/s	4.8 l/s	4.8 l/s
Cross section of line and motor cable	1 … 2.5 mm² 18 … 14 AWG	1 … 2.5 mm² 18 … 14 AWG	1 … 2.5 mm² 18 … 14 AWG
Tightening torque for line and motor cable	0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight	1.2 kg	1.2 kg	1.2 kg

Table 12- 21 PM240, IP20, Frame Sizes A, 3 AC 380 V … 480 V

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

Table 12- 22 PM240, IP20, Frame Sizes B, 3 AC 380 V … 480 V

| Order No. - Unfiltered 6SL3224-… | …0BE22-2UA0 | …0BE23-0UA0 | …0BE24-0UA0 |
Order No. - Filtered 6SL3224-…	…0BE22-2AA0	…0BE23-0AA0	…0BE24-0AA0
Rated / LO power	2.2 kW	3 kW	4 kW
Rated / LO input current	7.6 A	10.2 A	13.4 A
Rated / LO Output current	5.9 A	7.7 A	10.2 A
HO power	2.2 kW	3 KW	4 kW
HO input current	7.6 A	10.2 A	13.4 A
HO output current	5.9 A	7.7 A	10.2 A
Fuse	16 A, Class J	16 A, Class J	20 A, Class J
Power losses	0.139 kW	0.158 kW	0.183 kW
Required cooling air flow	24 l/s	24 l/s	24 l/s
Cross section of line and motor cable	1.5 … 6 mm^2 16 … 10 AWG	1.5 … 6 mm^2 16 … 10 AWG	1.5 … 6 mm^2 16 … 10 AWG
Tightening torque for line and motor cable	1.5 Nm / 13 lbf in	1.5 Nm / 13 lbf in	1.5 Nm / 13 lbf in
Weight	4.3 kg	4.3 kg	4.3 kg

Table 12- 23 PM240, IP20, Frame Sizes C, 3 AC 380 V … 480 V

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

Table 12- 24 PM240, IP20, Frame Sizes D, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0BE31-5UA0	…0BE31-8UA0	…0BE32-2UA0
Order No. - Filtered	6SL3224-…	…0BE31-5AA0	…0BE31-8AA0	…0BE32-2AA0
Rated / LO power		18.5 kW	22 kW	30 kW
Rated / LO input current		46 A	53 A	72 A
Rated / LO Output current		38 A	45 A	60 A
HO power		15 kW	18.5 kW	22 kW
HO input current		40 A	46 A	56 A
HO output current		32 A	38 A	45 A
Fuse according to IEC		3NA3820	3NA3822	3NA3824
Fuse according to UL		50 A, Class J	63 A, Class J	80 A, Class J
Power losses		0.44 kW	0.55 kW	0.72 kW
		0.42 kW	0.52 kW	0.69 kW
Required cooling air flow		22 l/s	22 l/s	39 l/s
Cross section of line and motor cable		10 … 35 mm^2	10 … 35 mm^2	16 … 35 mm^2
		7 … 2 AWG	7 … 2 AWG	5 … 2 AWG
Tightening torque for line and motor cable		6 Nm / 53 lbf in	6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight, unfiltered		13 kg	13 kg	13 kg
Weight, filtered		16 kg	16 kg	16 kg

Table 12- 25 PM240, IP20, Frame Sizes E, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0BE33-0UA0	…0BE33-7UA0
Order No. - Filtered	6SL3224-…	…0BE33-0AA0	…0BE33-7AA0
Rated / LO power		37 kW	45 kW
Rated / LO input current		88 A	105 A
Rated / LO Output current		75 A	90 A
HO power		30 kW	37 kW
HO input current		73 A	90 A
HO output current		60 A	75 A
Fuse according to IEC		3NA3830	3NA3832
Fuse according to UL		100 A, Class J	125 A, Class J
Power losses, unfiltered		0.99 kW	1.2 kW
Power losses, filtered		1.04 kW	1.2 kW
Required cooling air flow		22 l/s	39 l/s
Cross section of line and motor cable		25 … 35 mm^2	25 … 35 mm^2
		3 … 2 AWG	3 … 2 AWG
Tightening torque for line and motor cable		6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight, unfiltered		16 kg	16 kg
Weight, filtered		23 kg	23 kg

Table 12- 26 PM240, IP20, Frame Sizes F, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0BE34-5UA0	…0BE35-5UA0	…0BE37-5UA0
Order No. - Filtered	6SL3224-…	…0BE34-5AA0	…0BE35-5AA0	…0BE37-5AA0
Rated / LO power		55 kW	75 kW	90 kW
Rated / LO input current		129 A	168 A	204 A
Rated / LO Output current		110 A A	145 A	178 A
HO power		45 kW	55 kW	75 kW
HO input current		108 A	132 A	169 A
HO output current		90 A	110 A	145 A
Fuse according to IEC		3NA3832	3NA3140	3NA3144
Fuse according to UL		160 A, Class J	200 A, Class J	250 A, Class J
Power losses, unfiltered		1.4 kW	1.9 kW	2.3 kW
Power losses, filtered		1.5 kW	2.0 kW	2.4 kW
Required cooling air flow		94 l/s	94 l/s	117 l/s
Cross section of line and motor cable		35 … 120 mm² 2 … 4/0 AWG	70 … 120 mm² 2/0 … 4/0 AWG	95 … 120 mm² 3/0 … 4/0 AWG
Tightening torque for line and motor cable		13 Nm / 115 lbf in	13 Nm / 115 lbf in	13 Nm / 115 lbf in
Weight, unfiltered		36 kg	36 kg	36 kg
Weight, filtered		52 kg	52 kg	52 kg

Table 12- 27 PM240, IP20, Frame Sizes F, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0BE38-8UA0	…0BE41-1UA0
Rated / LO power		110 kW	132 kW
Rated / LO input current		234 A	284 A
Rated / LO Output current		205 A	250 A
HO power		90 kW	110 kW
HO input current		205 A	235 A
HO output current		178 A	205 A
Fuse according to IEC		---	---
Fuse according to UL		250 A, Class J	315 A, Class J
Power losses		2.4 kW	2.5 kW
Required cooling air flow		117 l/s	117 l/s
Cross section of line and motor cable		95 … 120 mm² 3/0 … 4/0 AWG	95 … 120 mm² 3/0 … 4/0 AWG
Tightening torque for line and motor cable		13 Nm / 115 lbf in	13 Nm / 115 lbf in
Weight,		39 kg	39 kg

Table 12- 28 PM240 Frame Sizes GX, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3224-…	…0XE41-3UA0	…0XE41-6UA0	…0XE42-0UA0
Rated / Low Overlaod values				
Rated / LO power		160 kW	200 kW	240 kW
Rated / LO input current		297 A	354 A	442 A
Rated / LO Output current		302 A	370 A	477 A
High Overload values				
HO power		132 kW	160 kW	200 kW
HO input current		245 A	297 A	354 A
HO output current		250 A	302 A	370 A
Fuse according to IEC		3NA3254	3NA3260	3NA3372
Fuse according to UL		355 A, Class J	400 A, Class J	630 A, Class J
Power losses,		3.9 kW	4.4 kW	5.5 kW
Required cooling air flow		360 l/s	360 l/s	360 l/s
Cross section of line and motor cable		95 … 2 x 240 mm^2 3/0 … 2 x 600 AWG	120 ... 2 x 240 mm^2 4/0 … 2 x 600 AWG	185 ... 2 x 240 mm^2 6/0 … 2 x 600 AWG
Tightening torque for line and motor cable		14 Nm / 120 lbf in	14 Nm / 120 lbf in	14 Nm / 120 lbf in
Weight,		176 kg	176 kg	176 kg

12.2.4 Technical data, PM240-2

12.2.4.1 General data, PM240-2

Feature	Version		
Line voltage	380 V ... 480 V 3-ph. AC ± 10%		
Output voltage	0 V 3-ph. AC … input voltage x 0.95 (max.)		
Input frequency	50 … 60 Hz, ± 3 Hz		
Output frequency	0 … 650 Hz, depending on the control mode		
Power factor λ	0.7 without line reactor; 0.85 with line reactor		
Line impedance	Uk ≥ 1%, a line reactor is required for lower values		
Starting current	Less than the input current		
Pulse frequency (factory setting)	4 kHz The pulse frequency can be increased in 2 kHz steps. An increase in the pulse frequency results in a lower output current.		
Electromagnetic compatibility	Devices with filters in compliance with EN 61800-3: 2004 are suitable for Category C2 environments. For details, see the Hardware Installation Manual, Appendix A2.		
Braking methods	DC braking, compound braking, dynamic braking with integrated braking chopper		
Degree of protection	IP20 built-in units PT devices	IP20 when mounted in a control cabinet IP54 on the control cabinet wall	
Operating temperature	LO without derating: HO without derating: LO/HO with derating:	0° C … +40° C 0° C … +50° C to 60° C	For details, see the Hardware Installation Manual.
Storage temperature	-40° C … +70° C (-40° F … 158° F)		
Relative humidity	< 95% - condensation not permissible		
Dirt and contamination	Protected according to pollution degree 2 to EN 61800-5-1: 2007		
Environmental requirements	Protected against damaging chemical substances according to environmental class 3C2 to EN 60721-3-3; 1995		
Shock and vibration	• Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1: 1997 • Transport in the transport packaging according to Class 2M3 to EN 60721-3-2: 1997 • Vibration during operation according to Class 3M2 to EN 60721-3-3: 1995		
Installation altitude	without derating: with derating:	up to 1000 m above sea level up to 4000 m above sea level	For details, see the Hardware Installation Manual
Standards	UL, cUL, CE, C-tick, SEMI F47 The drive only satisfies the UL requirements when UL-certified fuses are used.		

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

393

12.2.4.2 Power-dependent data PM240-2

Table 12- 29 PM240-2, IP20, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3210…	…1PE11-8UL0	…1PE12-3UL0	…1PE13-2UL0
Order No. - Filtered	6SL3210…	…1PE11-8AL0	…1PE12-3AL0	…1PE13-2AL0
LO power		0.55 kW	0.75 kW	1.1 kW
LO input current		2.3 A	2.9 A	4.1 A
LO output current		1.7 A	2.2 A	3.1 A
HO power		0.37 kW	0.55 kW	0.75 kW
HO input current		2 A	2.6 A	3.3 A
HO output current		1.3 A	1.7 A	2.2 A
Fuse according to IEC		3NA3 801 (6 A)	3NA3 801 (6 A)	3NA3 801 (6 A)
Fuse according to UL		10 A class J	10 A class J	10 A class J
Power losses, unfiltered		0.04 kW	0.04 kW	0.04 kW
Power losses, filtered		0.04 kW	0.04 kW	0.04 kW
Required cooling air flow		5 l/s	5 l/s	5 l/s
Cross section of line and motor cable		1 … 2.5 mm^2	1 … 2.5 mm^2	1 … 2.5 mm^2
		18 … 14 AWG	18 … 14 AWG	18 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight, unfiltered		1.4 kg	1.4 kg	1.4 kg
Weight, filtered		1.5 kg	1.5 kg	1.5 kg

Table 12- 30 PM240-2, IP20, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Unfiltered	6SL3210…	…1PE14-3UL0	…1PE16-1UL0	…1PE18-0UL0
Order No. - Filtered	6SL3210…	…1PE14-3AL0	…1PE16-1AL0	---
LO power		1.5 kW	2.2 kW	3 kW
LO input current		5.5 A	7.7 A	10.1 A
LO output current		4.1 A	5.9 A	7.7 A
HO power		1.1 kW	1.5 kW	2.2 kW
HO input current		4.7 A	6.1 A	8.8 A
HO output current		3.1 A	4.1 A	5.9 A
Fuse according to IEC		3NA3 803 (10 A)	3NA3 803 (10 A)	3NA3 805 (16 A)
Fuse according to UL		10 A class J	10 A class J	15 A class J
Power losses, unfiltered		0.07 kW	0.1 kW	0.12 kW
Power losses, filtered		0.07 kW	0.1 kW	0.12 kW
Required cooling air flow		5 l/s	5 l/s	5 l/s
Cross section of line and motor cable		1 … 2.5 mm^2	1.5 … 2.5 mm^2	1.5 … 2.5 mm^2
		18 … 14 AWG	16 … 14 AWG	16 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight, unfiltered		1.4 kg	1.4 kg	1.4 kg
Weight, filtered		1.5 kg	1.5 kg	---

Table 12- 31 PM240-2, PT, Frame Sizes A, 3 AC 380 V … 480 V

Order No. - Unfiltered Order No. - Filtered	6SL3211… 6SL3211…	--- …1PE16-1AL0	…1PE18-0UL0 __
LO power LO input current LO Output current		2.2 kW 7.7 A 5.9 A	3 kW 10.1 A 7.7 A
HO power HO input current HO output current		1.5 kW 6.1 A 4.1 A	2.2 kW 8.8 A 5.9 A
Fuse according to IEC Fuse according to UL		3NA3 803 (10 A) 10 A class J	3NA3 805 (16 A) 15 A class J
Power losses, unfiltered Power losses, filtered		0.1 kW [1] 0.1 kW [1]	0.12 kW [2] 0.12 kW [2]
Required cooling air flow		7 l/s	7 l/s
Cross section of line and motor cable		1.5 … 2.5 mm^2 16 … 14 AWG	1.5 … 2.5 mm^2 16 … 14 AWG
Tightening torque for line and motor cable		0.5 Nm / 4 lbf in	0.5 Nm / 4 lbf in
Weight, unfiltered Weight, filtered		--- 1.8 kg	1.7 kg ---

1) 0.08 kW via heat sink;
2) 0.1 kW via heat sink

12.2.5 Technical data, PM250

12.2.5.1 General data, PM250

Feature	Version		
Line voltage	380 V ... 480 V 3-ph. AC ± 10%		
Output voltage	0 V 3-ph. AC … input voltage x 0.87 (max.)		
Input frequency	47 Hz … 63 Hz		
Power factor λ	0.9		
Starting current	Less than the input current		
Pulse frequency (factory setting)	4 kHz The pulse frequency can be increased up to 16 kHz in 2 kHz steps. An increase in the pulse frequency results in a lower output current.		
Electromagnetic compatibility	The devices in compliance with EN 61800-3: 2004 are suitable for Category C1 and C2 environments. For details, see the Hardware Installation Manual, Appendix A2		
Braking methods	DC braking, energy recovery (up to 100% of the output power)		
Degree of protection	IP20 chassis units		
Operating temperature	LO without derating: HO without derating: LO/HO with derating:	0° C … +40° C 0° C … +50° C to 60° C	For details, see the Hardware Installation Manual.
Storage temperature	-40° C … +70° C		
Relative humidity	< 95% - condensation not permissible		
Dirt and contamination	Protected according to pollution degree 2 to EN 61800-5-1: 2007		
Environmental requirements	Protected against damaging chemical substances according to environmental class 3C2 to EN 60721-3-3; 1995		
Shock and vibration	• Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1: 1997 • Transport in the transport packaging according to Class 2M3 to EN 60721-3-2: 1997 • Vibration during operation according to Class 3M2 to EN 60721-3-3: 1995		
Installation altitude	without derating: with derating:	up to 1000 m above sea level up to 4000 m above sea level	For details, see the Hardware Installation Manual
Standards	UL, CE, CE, SEMI F47 The drive only satisfies the UL requirements when UL-certified fuses are used.		

12.2.5.2 Power-dependent data, PM250

Table 12- 32 PM250, IP20, Frame Sizes C, 3 AC 380 V … 480 V

Order No. - Filtered 6SL3225-…	0BE25-5AA0	0BE27-5AA0	0BE31-1AA0
Rated / LO power	7.5 kW	11 kW	15 kW
Rated / LO input current	18 A	25 A	32 A
Rated / LO Output current	18 A	25 A	32 A
HO power	5. 5 kW	7.5 kW	11 kW
HO input current	13.2 A	19 A	26 A
HO output current	13.2 A	19 A	26 A
Fuse	20 A, Class J	32 A, Class J	35 A, Class J
Power losses	0.24 kW	0.30 kW	0.31 kW
Required cooling air flow	38 l/s	38 l/s	38 l/s
Cross section of line and motor cable	2.5 … 10 mm^2 14 … 8 AWG	4.0 … 10 mm^2 12 … 8 AWG	4.0 … 10 mm^2 12 … 8 AWG
Tightening torque for line and motor cable	2.3 Nm / 20 lbf in	2.3 Nm / 20 lbf in	2.3 Nm / 20 lbf in
Weight	7.5 kg	7.5 kg	7.5 kg

Table 12- 33 PM250, IP20, Frame Sizes D, 3 AC 380 V … 480 V

Order No. - Filtered 6SL3225-…	0BE31-5AA0	0BE31-8AA0	0BE32-2AA0
Rated / LO power	18.5 kW	22 kW	30 kW
Rated / LO input current	36 A	42 A	56 A
Rated / LO Output current	38 A	45 A	60 A
HO power	15 kW	18.5 kW	22 kW
HO input current	30 A	36 A	42 A
HO output current	32 A	38 A	45 A
Fuse according to IEC	3NA3820	3NA3822	3NA3824
Fuse according to UL	50 A, Class J	63 A, Class J	80 A, Class J
Power losses	0.44 kW	0.55 kW	0.72 kW
Required cooling air flow	22 l/s	22 l/s	39 l/s
Cross section of line and motor cable	10 … 35 mm^2 7 … 2 AWG	10 … 35 mm^2 7 … 2 AWG	16 … 35 mm^2 6 … 2 AWG
Tightening torque for line and motor cable	6 Nm / 53 lbf in	6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight	15 kg	15 kg	16 kg

Table 12- 34   PM250, IP20, Frame Sizes E, 3 AC 380 V … 480 V

Order No. - Filtered 6SL3225-…	0BE33-0AA0	0BE33-7AA0
Rated / LO power Rated / LO input current Rated / LO Output current	37 kW 70 A 75 A	45 kW 84 A 90 A
HO power HO input current HO output current	30 kW 56 A 60 A	37 kW 70 A 75 A
Fuse according to IEC Fuse according to UL	3NA3830 100 A, Class J	3NA3832 125 A, Class J
Power losses	1.04 kW	1.2 kW
Required cooling air flow	22 l/s	39 l/s
Cross section of line and motor cable	25 … 35 mm^2 3 … 2 AWG	25 … 35 mm^2 3 … 2 AWG
Tightening torque for line and motor cable	6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight	21 kg	21 kg

Table 12- 35   PM250, IP20, Frame Sizes F, 3 AC 380 V … 480 V

Order No. - Filtered 6SL3225-…	0BE34-5AA0	0BE35-5AA0	0BE37-5AA0
Rated / LO power Rated / LO input current Rated / LO Output current	55 kW 102 A 110 A	75 kW 135 A 145 A	90 kW 166 A 178 A
HO power HO input current HO output current	45 kW 84 A 90 A	55 kW 102 A 110 A	75 kW 135 A 145 A
Fuse according to IEC Fuse according to UL	3NA3836 160 A, Class J	3NA3140 200 A, Class J	3NA3144 250 A, Class J
Power losses	1.5 kW	2.0 kW	2.4 kW
Required cooling air flow	94 l/s	94 l/s	117 l/s
Cross section of line and motor cable	35 … 120 mm^2 2 … 4/0 AWG	35 … 120 mm^2 2 … 4/0 AWG	35 … 120 mm^2 2 … 4/0 AWG
Tightening torque for line and motor cable	13 Nm / 115 lbf in	13 Nm / 115 lbf in	13 Nm / 115 lbf in
Weight	51 kg	51 kg	51 kg

12.2.6 Technical data, PM260

12.2.6.1 General data, PM260

Feature	Version		
Line voltage	660 V ... 690 V 3-ph. AC ± 10%		
	The power units can also be operated with a minimum voltage of 500 V –10 %. In this case, the power is linearly reduced.		
Input frequency	50 Hz … 60 Hz, ± 3 Hz		
Power factor λ	0.9		
Starting current	Less than the input current		
Pulse frequency	16 kHz		
Electromagnetic compatibility	The devices in compliance with EN 61800-3: 2004 are suitable for Category C1 and C2 environments. For details, see the Hardware Installation Manual, Appendix A2		
Braking methods	DC braking, energy recovery (up to 100% of the output power)		
Degree of protection	IP20 chassis units		
Operating temperature	LO without derating: HO without derating: LO/HO with derating:	0° C … +40° C 0° C … +50° C to 60° C	For details, see the Hardware Installation Manual.
Storage temperature	-40° C … +70° C (-40° F … 158° F)		
Relative humidity	< 95% - condensation not permissible		
Dirt and contamination	Protected according to pollution degree 2 to EN 61800-5-1: 2007		
Environmental requirements	Protected against damaging chemical substances according to environmental class 3C2 to EN 60721-3-3; 1995		
Shock and vibration	• Long-term storage in the transport packaging according to Class 1M2 to EN 60721-3-1: 1997 • Transport in the transport packaging according to Class 2M3 to EN 60721-3-2: 1997 • Vibration during operation according to Class 3M2 to EN 60721-3-3: 1995		
Installation altitude	without derating: with derating:	up to 1000 m above sea level up to 4000 m above sea level	For details, see the Hardware Installation Manual
Standards	CE, C-TICK		

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

399

12.2.6.2 Power-dependent data, PM260

Table 12- 36 PM260, IP20, Frame Sizes D - 3 AC 660 V … 690 V

Order No. - Unfiltered	6SL3225-…	0BH27-5UA1	0BH31-1UA1	0BH31-5UA1
Order No. - Filtered	6SL3225-…	0BH27-5AA1	0BH31-1AA1	0BH31-5AA1
Rated / LO power		11 kW	15 kW	18.5 kW
Rated / LO input current		13 A	18 A	22 A
Rated / LO Output current		14 A	19 A	23 A
HO power		7.5 kW	11 kW	15 kW
HO input current		10 A	13 A	18 A
HO output current		10 A	14 A	19 A
Fuse		20 A	20 A	32 A
Power losses, unfiltered				
Power losses, filtered				
Required cooling air flow		22 l/s	22 l/s	39 l/s
Cross section of line and motor cable		2,5 … 16 mm²	4 … 16 mm²	6 … 16 mm²
		14 … 6 AWG	12 … 6 AWG	10 … 6 AWG
Tightening torque for line and motor cable		1,5 Nm / 53 lbf in	1,5 Nm / 53 lbf in	1,5 Nm / 53 lbf in
Weight, unfiltered		22 kg	22 kg	22 kg
Weight, filtered		23 kg	23 kg	23 kg
Noise pressure		< 64 dB(A)	< 64 dB(A)	< 64 dB(A)

Table 12- 37 PM260, IP20, Frame Sizes F - 3 AC 660 V … 690 V

Order No. - Unfiltered	6SL3225-…	0BH32-2UA1	0BH33-0UA1	0BH33-7UA1
Order No. - Filtered	6SL3225-…	0BH32-2AA1	0BH33-0AA1	0BH33-7AA1
Rated / LO power		30 kW	37 kW	55 kW
Rated / LO input current		34 A	41 A	60 A
Rated / LO Output current		35 A	42 A	62 A
HO power		22 kW	30 kW	37 kW
HO input current		26 A	34 A	41 A
HO output current		26 A	35 A	42 A
Fuse		50 A	50 A	80 A
Power losses, unfiltered				
Power losses, filtered				
Required cooling air flow		94 l/s	94 l/s	117 l/s
Cross section of line and motor cable		10 … 35 mm²	16 … 35 mm²	25 … 35 mm²
		8 … 2 AWG	6 … 2 AWG	4 … 2 AWG
Tightening torque for line and motor cable		6 Nm / 53 lbf in	6 Nm / 53 lbf in	6 Nm / 53 lbf in
Weight, unfiltered		56 kg	56 kg	56 kg
Weight, filtered		58 kg	58 kg	58 kg
Noise pressure		< 70 dB(A)	< 70 dB(A)	< 70 dB(A)

Appendix

A.1 Firmware version 4.6

Table A- 1 New functions and function changes in Firmware 4.6

	Function	SINAMICS							
			G120					G120D	
		G120C	CU230P-2	CU240B-2	CU240E-2	CU250S-2 Vektor	CU250S-2 Servo	CU240D-2	CU250D-2
1	Support for the new Power Modules • PM240-2 IP20 FSB … FSC • PM240-2 in through-hole technology FSB ... FSC	-	✓	✓	✓	✓	✓	-	-
2	Support for the new Power Modules • PM230 in through-hole technology FSD ... FSF	-	✓	✓	✓	✓	-	-	-
3	Motor data preassignment for the 1LA/1LE motors via code number • During basic commissioning with the operator panel, set the motor data using a code number	✓	✓	✓	✓	✓	✓	✓	✓
4	Extension to communication via CANopen • CAN velocity, ProfilTorque, SDO channel for each axis, system test with CodeSys, suppression of ErrorPassiv alarm	✓	✓	-	-	✓	✓	-	-
5	Extension to communication via BACnet • Multistate value objects for alarms, commandable AO objects, objects for configuring the PID controller	-	✓	-	-	-	-	-	-
6	Communication via Ethernet/IP	✓	✓	-	✓	✓	✓	✓	✓
7	Skip frequency band for analog input • A symmetrical skip frequency band can be set for each analog input around the 0 V range.	✓	✓	✓	✓	✓	✓	✓	-
8	Changing the control of the motor holding brake	✓	-	✓	✓	✓	✓	✓	-
9	Safety function SBC (Safe Brake Control) • Secure control of a motor holding brake when using the "Safe Brake Module" option	-	-	-	-	✓	✓	-	-
10	Safety function SS1 (Safe Stop 1) without speed monitoring	-	-	-	-	✓	✓	-	-
11	Straightforward selection of standard motors • Selection of 1LA... and 1LE... motors with an operator panel using a list containing code numbers	✓	✓	✓	✓	✓	✓	✓	✓
12	Firmware update via memory card	✓	✓	✓	✓	✓	✓	✓	✓
13	Safety info channel • BICO source r9734.0...14 for the status bits of the extended safety functions	-	-	-	✓	✓	✓	✓	✓
14	Diagnostic alarms for PROFIBUS	✓	✓	✓	✓	✓	✓	✓	✓

A.2 Star-delta motor connection and application examples

Depending on your application, you can operate the motor in the star or delta connection (Y/Δ).

Examples for operating the converter and motor on a 400 V line supply

Assumption: The motor rating plate states 230/400 V Δ/Y.

Case 1: A motor is normally operated between standstill and its rated speed (i.e. a speed corresponding to the line frequency). In this case, you need to connect the motor in Y. Operating the motor above its rated speed is only possible in field weakening, i.e. the motor torque available is reduced above the rated speed.

Case 2: If you want to operate the motor with the "87 Hz characteristic", you need to connect the motor in Δ.
With the 87 Hz characteristic, the motor's power output increases. The 87 Hz characteristic is mainly used with geared motors.
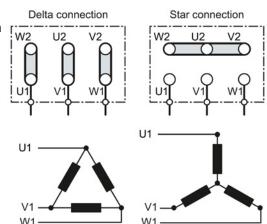
Before you connect the motor, ensure that the motor has the appropriate connection for your application:

Motor is connected in the star or delta configuration

With SIEMENS motors, you will see a diagram of both connection methods on the inside of the cover of the terminal box:

- Star connection (Y)
- Delta connection (Δ)

A.3 Parameter

Parameters are the interface between the firmware of the converter and the commissioning tool, e.g. an Operator Panel.

Adjustable parameters

Adjustable parameters are the "adjusting screws" with which you adapt the converter to its particular application. If you change the value of an adjustable parameter, then the converter behavior also changes.

Adjustable parameters are shown with a "p" as prefix, e.g. p1082 is the parameter for the maximum motor speed.

Display parameters

Display parameters allow internal measured quantities of the converter and the motor to be read.

The Operator Panel and STARTER represent display parameters with an "r" prefix, for example, r0027 is the parameter for the converter output current.

Parameters that in many cases help

Table A- 2   How to switch to commissioning mode or restore the factory setting

Parameter	Description
p0010	**Commissioning parameters** 0: Ready (factory setting) 1: Carry out basic commissioning 3: Carry out motor commissioning 5: Technological applications and units 15: Define number of data sets 30: Factory setting - initiate restore factory settings

Table A- 3   How to determine the firmware version of the Control Unit

Parameter	Description
R0018	**Firmware version is displayed**

Table A- 4   How to select the command and setpoint sources for the inverter

Parameter	Description
p0015	Additional information is available in Section Finding a suitable setting for the interfaces (Page 53).

Table A- 5   How to set the ramp-up and ramp-down

Parameter	Description
p1080	**Minimum speed** 0.00 [rpm] factory setting
p1082	**Maximum speed** 1500.000 [rpm] factory setting
p1120	**Ramp-up time** 10.00 [s]
p1121	**Ramp-down time** 10.00 [s]

Table A- 6   This is how you set the closed-loop type

Parameter	Description
P1300	0: U/f control with linear characteristic 1: U/f control with linear characteristic and FCC 2: U/f control with parabolic characteristic 3: U/f control with adjustable characteristic 4: U/f control with linear characteristic and ECO 5: U/f control for drives requiring a precise frequency (textile area) 6: U/f control for drives requiring a precise frequency and FCC 7: U/f control with parabolic characteristic and ECO 19: U/f control with independent voltage setpoint 20: Speed control (without encoder) 22: Torque control (without encoder)

Table A- 7   This is how you optimize the starting behavior of the U/f control for a high break loose torque and overload

Parameter	Description
p1310	**Voltage boost to compensate ohmic losses** The voltage boost is active from standstill up to the rated speed. It is at its highest at speed 0 and continually decreases as the speed increases. Value of the voltage boost at speed 0 in V: 1.732 × rated motor current (p0305) × stator resistance (r0395) × p1310 / 100%
p1311	**Voltage boost when accelerating** The voltage boost is effective from standstill up to the rated speed. It is independent of the speed and has a value in V of: 1.732 × rated motor current (p0305) × stator resistance (p0350) × p1311 / 100%
p1312	**Voltage boost when starting** Setting to additionally boost the voltage when starting, however only when accelerating for the first time.

A.4 Handling the BOP 2 operator panel
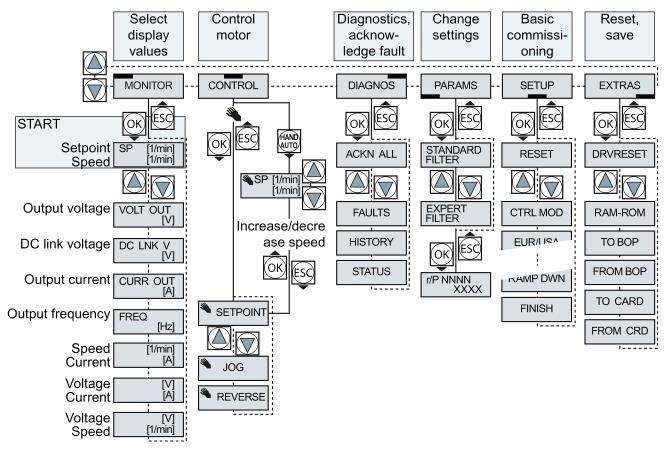
Figure A-1   Menu of the BOP-2
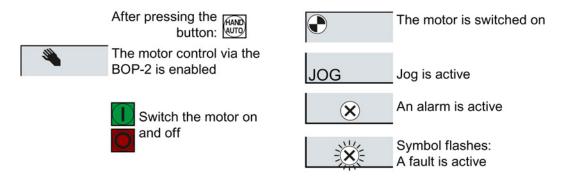
Figure A-2   Other keys and symbols of the BOP-2

A.4.1 Changing settings using BOP-2

Changing settings using BOP-2
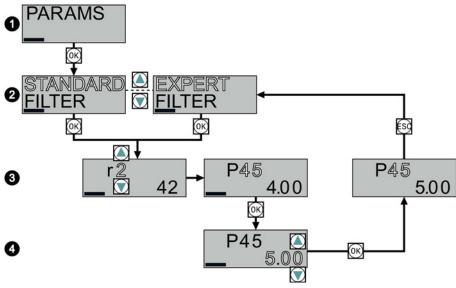
You can modify the settings of your converter by changing the values of the its parameters. The converter only permits changes to "write" parameters. Write parameters begin with a "P", e.g. P45.

The value of a read-only parameter cannot be changed. Read-only parameters begin with an "r", for example: r2.

Procedure

To change write parameters using the BOP-2, proceed as follows:

1. Select the menu to display and change parameters.
   Press the OK key.

2. Select the parameter filter using the arrow keys.
   Press the OK key.

   – STANDARD: The inverter only displays the most important parameters.

   – EXPERT: The inverter displays all of the parameters.

3. Select the required number of a write parameter using the arrow keys.
   Press the OK key.

4. Select the value of the write parameter using the arrow keys.
   Accept the value with the OK key.

You have now changed a write parameter using the BOP-2.

The converter saves all the changes made using the BOP-2 so that they are protected against power failure.

A.4.2 Changing indexed parameters

Changing indexed parameters
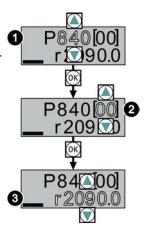
For indexed parameters, several parameter values are assigned to a parameter number. Each of the parameter values has its own index.

Procedure

To change an indexed parameter, proceed as follows:

1. Select the parameter number.
2. Press the OK button and set the parameter index.
3. Press the OK button and set the parameter value for the selected index.

You have now changed an indexed parameter.

A.4.3 Directly entering the parameter number and value

Directly select the parameter number

The BOP-2 offers the possibility of setting the parameter number digit by digit.

Prerequisite
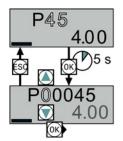
The parameter number is flashing in the BOP-2 display.

Procedure

To select the parameter number directly, proceed as follows:

1. Press the OK button for longer than five seconds.
2. Change the parameter number digit-by-digit.
   If you press the OK button then the BOP-2 jumps to the next digit.
3. If you have entered all of the digits of the parameter number, press the OK button.

You have now entered the parameter number directly.

Entering the parameter value directly

The BOP-2 offers the option of setting the parameter value digit by digit.

Prerequisite
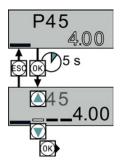
The parameter value flashes in the BOP-2 display.

Procedure

To select the parameter value directly, proceed as follows:

1. Press the OK button for longer than five seconds.
2. Change the parameter value digit-by-digit.
   If you press the OK button then the BOP-2 jumps to the next digit.
3. If you have entered all of the digits of the parameter value, press the OK button.
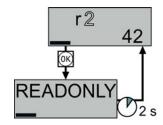
You have now entered the parameter value directly.
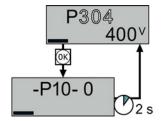
A.4.4   A parameter cannot be changed

When must you not change a parameter?
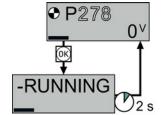
The converter indicates why it currently does not permit a parameter to be changed:

You have attempted to change a read-only parameter.	You must change to basic commissioning to set this parameter.	You must turn the motor off to set this parameter.

The operating state in which you can change a parameter is provided in the List Manual for each parameter.

A.5 Handling STARTER
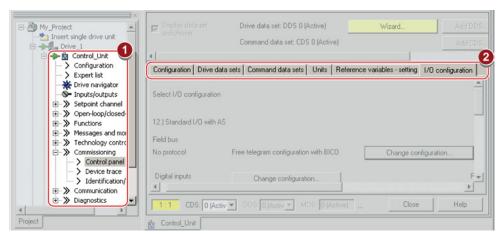
A.5.1 Change settings

After the basic commissioning, you can adapt the inverter to your application as described in the Commissioning guidelines (Page 65).

STARTER offers two options:

- – Change the settings using the appropriate screen forms - **our recommendation**.
  ① Navigation bar: For each inverter function, select the corresponding screen form.
  ② tabs: Switch between screen forms.
  If you change the settings using screen forms you do not need to know the parameter numbers.

- – You change the settings using the parameters in the expert list.
  If you wish to change the settings using the expert list, you need to know the corresponding parameter number and its significance.

Saving settings so that they are not lost when the power fails

The inverter initially only saves changes temporarily. You must do the following so that the inverter saves your settings securely in the event of a power failure.

Procedure

Proceed as follows to save your settings in the inverter so that they are not lost when the power fails:

1. Mark the appropriate drive in the project navigator.

2. Click the Save (RAM to ROM) button.

You have saved your settings securely in the inverter in case of a power failure.

Go offline

You can now exit the online connection after the data backup (RAM to ROM) with 🖳 "Disconnect from target system".

A.5.2 Optimize the drive using the trace function

Description

The trace function is used for inverter diagnostics and helps to optimize the behavior of the drive. Start the function in the navigation bar using "... Control_Unit/Commissioning/Device trace".

In two settings that are independent of one another, using ▣ you can interconnect eight signals each. Each signal that you interconnect is active as standard

You can start a measurement as often as required; the results are temporarily stored (until you exit STARTER) under the "Measurements" tab, together with the date and time. When terminating STARTER or under the "Measurements" tab, you can save the measurement results in the *.trc format.

If you require more than two settings for your measurements, you can either save the individual traces in the project or export them in the *.clg format – and if necessary, load or import.

Recording

Recording is performed in a CU-dependent basic clock cycle. The maximum recording duration depends on the number of recorded signals and the trace clock cycle.

You can extend the recording duration by increasing the trace clock cycle by multiplying with an integer factor and then accepting the displayed maximum duration with ◀. Alternatively, you can also specify the measurement period and then calculate the trace clock cycle of STARTER using ▲.

Recording individual bits for bit parameters

You can record individual bits of a parameter (e.g. r0722) by allocating the relevant bit using "bit track" (🗹).

Mathematical function

Using the mathematical function ( )) you can define a curve, for example the difference between the speed setpoint and the actual speed value.

Note

If you use the "record individual bits" or "mathematical functions" option, then this is displayed under signal No. 9.

Trigger

You can create your own start condition (trigger) for the trace. With the factory setting (default setting) the trace starts as soon as you press the ► button (Start Trace). Using the button ⬇, you can define another trigger to start the measurement.

Using pretrigger, set the time for the recording before the trigger is set. As a consequence, the trigger condition traces itself.
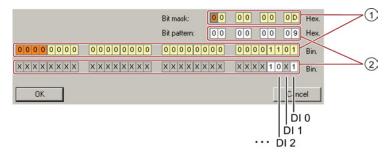
Example of a bit pattern as trigger:

You must define the pattern and value of a bit parameter for the trigger. To do so, proceed as follows:

Using ⬇, select "Trigger to variable - bit pattern"

Using ⬚, select the bit parameter

Using bin... , open the screen form in which you set the bits and their values for the start condition

① Select the bits for the trace trigger, upper row hex format, lower row binary format
② Define the bits for the trace trigger, upper row hex format, lower row binary format

Figure A-3   Bit pattern

In the example, the trace starts if DI0 and DI3 are high and DI2 is low. The state of the other digital inputs is not relevant for the start of the trace.

Further, you can either set an alarm or fault as start condition.

Display options

In this area, you can set how the measurement results are displayed.

– Measurement repetition
This places the measurements that you wish to perform at different times above one other

– Arrange curves in tracks
This means that you define as to whether all measured values are to be displayed with a common zero line – or whether each measured value is displayed with its own zero line.

– Measuring cursor on
This allows you to analyze the measuring intervals in detail
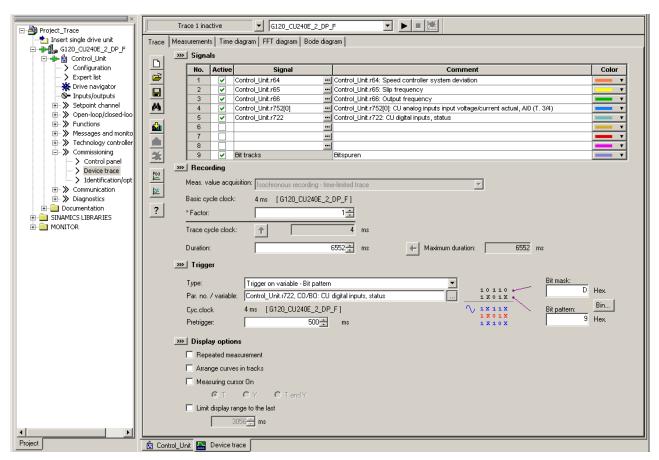
Figure A-4   Trace dialog box

A.6 Interconnecting signals in the converter

A.6.1 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.
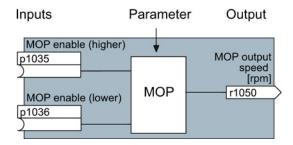
Figure A-5   Example of a block: Motorized potentiometer (MOP)

Most of the blocks can be adapted to specific applications using parameters.

You cannot change the signal interconnection within the block. However, the interconnection between blocks can be changed by interconnecting the inputs of a block with the appropriate outputs of another block.

The signal interconnection of the blocks is realized, contrary to electric circuitry, not using cables, but in the software.

Figure A-6   Example: Signal interconnection of two blocks for digital input 0

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

413

Binectors and connectors

Connectors and binectors are used to exchange signals between the individual blocks:

– Connectors are used to interconnect "analog" signals. (e.g. MOP output speed)

– Binectors are used to interconnect "digital" signals. (e.g. 'Enable MOP up' command)
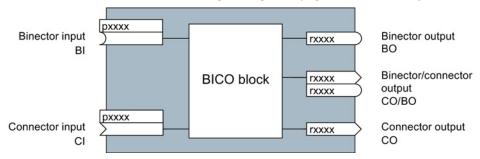
Figure A-7   Symbols for binector and connector inputs and outputs

Binector/connector outputs (CO/BO) are parameters that combine more than one binector output in a single word (e.g. r0052 CO/BO: status word 1). Each bit in the word represents a digital (binary) signal. This summary reduces the number of parameters and simplifies parameter assignment.

Binector or connector outputs (CO, BO or CO/BO) can be used more than once.

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.

How much care is required when you change the signal interconnection?

Always take care when establishing internal signal interconnections. Note which changes you make as you go along since the process of analyzing them later can be quite difficult.

The STARTER commissioning tool offers signals in plain text and simplifies their interconnection.

Where can you find additional information?

– This manual is sufficient for simple signal interconnections (e.g. assigning a different function to digital inputs).

– The parameter list in the List Manual is sufficient for more complex signal interconnections.

– You can also refer to the function diagrams in the List Manual for complex signal interconnections.

A.6.2   Example

Example: Moving a basic control logic into the inverter

A conveyor system is to be configured in such a way that it can only start when two signals are present simultaneously. These could be the following signals, for example:

– The oil pump is running (the required pressure level is not reached, however, until after 5 seconds)

– The protective door is closed

To implement this task, you must insert free function blocks between digital input 0 and the command to switch on the motor (ON/OFF1).
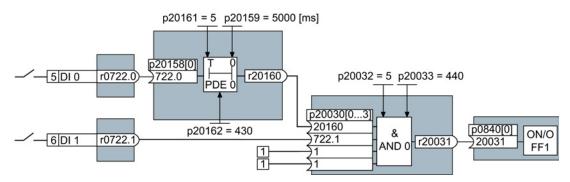
Figure A-8   Example: Signal interconnection for control logic

The signal of digital input 0 (DI 0) is fed through a time block (PDE 0) and is interconnected with the input of a logic block (AND 0). The signal of digital input 1 (DI 1) is interconnected to the second input of the logic block. The logic block output issues the ON/OFF1 command to switch-on the motor.

Setting the control logic

Parameter	Description
p20161 = 5	The time block is enabled by assigning to runtime group 5 (time slice of 128 ms)
p20162 = 430	Run sequence of the time block within runtime group 5 (processing before the AND logic block)
p20032 = 5	The AND logic block is enabled by assigning to runtime group 5 (time slice of 128 ms)
p20033 = 440	Run sequence of the AND logic block within runtime group 5 (processing after the time block)
p20159 = 5000.00	Setting the delay time [ms] of the time module: 5 seconds
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 input of the AND
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

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

415

Explanation of the example using the ON/OFF1 command

Parameter p0840[0] is the input of the "ON/OFF1" block of the inverter. Parameter r20031 is the output of the AND block. To interconnect ON/OFF1 with the output of the AND block, set p0840 = 20031.
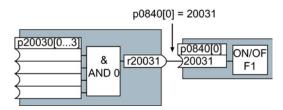
Figure A-9   Interconnecting blocks by setting p0840[0] = 20031

Principle for interconnecting blocks

Always interconnect the input (connector or binector input) with the signal source.

Note

For the basic commissioning, you determine the function of the interfaces for your converter via predefined settings (p0015).

If you subsequently select a different predefined setting for the function of the interfaces, then all interconnections that you changed will be lost.

A.7 Application examples

A.7.1 Configuring PROFIBUS communication in STEP 7

Using a suitable example, the following section provides information on how you configure the communication of an inverter to a higher-level SIMATIC control system.

To configure the communication between an inverter and a SIMATIC control system, you require the SIMATIC STEP 7 software tool with HW Config.

It is assumed that you are knowledgeable about working with SIMATIC control systems and that you have a sound understanding of the STEP 7 engineering tool.
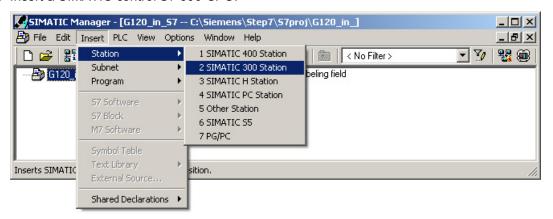
A.7.1.1 Creating a STEP 7 project and network

Procedure
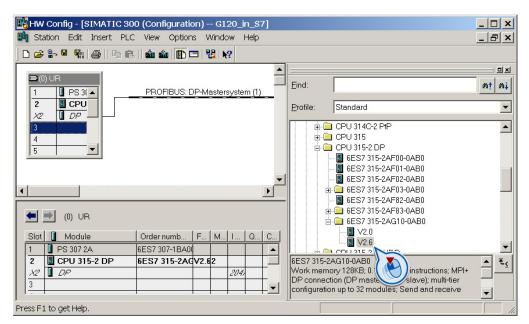
In order to create a STEP 7 project, proceed as follows:

1. Create a new STEP 7 project, e.g. "G120_in_S7".

2. Insert a SIMATIC control S7 300 CPU.

3. Select the SIMATIC 300 station in your project and open HW Config.

4. Insert an S7 300 mounting rail from the hardware catalog into your project with drag & drop.

5. Locate a power supply at slot 1 of the mounting rail and a CPU 315-2 DP control at slot 2.

   When inserting the control, HW Config opens the network setting.

6. Create a PROFIBUS DP network.

You have created a STEP 7 project with a SIMATIC control and a PROFIBUS network.

A.7.1.2   Inserting the inverter into the project

There are two ways to insert an inverter into the project:

– Using the inverter GSD

– Using the STEP 7 object manager

The more user-friendly option is only available when STARTER is installed (see Section Tools to commission the converter (Page 33)).

Using an example of a SINAMICS G120 with Control Unit CU240B-2 or CU240E-2, the procedure shows how you insert the inverter into the project using the GSD.

Precondition

You have installed the GSD of the inverter in your PC using HW Config (menu "Options - Install GSD files").
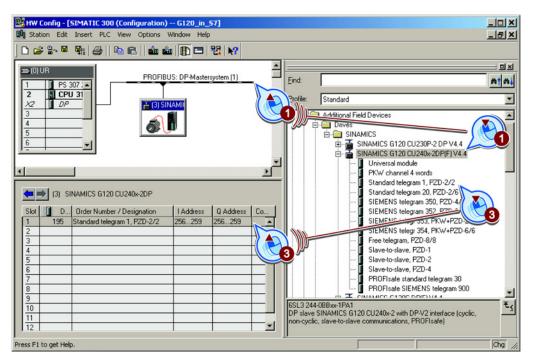
Procedure

In order to insert an inverter into your project, proceed as follows:

1. Insert the inverter by dragging and dropping it into the PROFIBUS network.

   You can find the inverter under "PROFIBUS DP - Other field devices" in the HW Config hardware catalog.

2. Enter the PROFIBUS address set at the inverter in HW Config.

3. Select the appropriate telegram and insert the telegram into slot 1 of the inverter by dragging and dropping.

   More information on the telegram types can be found in Chapter Cyclic communication (Page 106).

4. If you wish to assign several inverter slots with telegrams, then you must comply with the permitted sequence of slot assignments.

5. Save and compile the project.

6. Download the project data to the S7-CPU.

■ You have inserted your project into the inverter and loaded your configuration to the CPU.

Permitted sequence for the slot assignment

1. PROFIsafe telegram, if one is being used.
    Information on connecting the inverter via PROFIsafe can be found in the "Safety
    Integrated Function Manual".

2. PKW channel, if one is used.

3. Standard, SIEMENS or free telegram, if one is used.

4. Direct data exchange

If you do not use one or several of the telegrams 1, 2 or 3, configure your telegrams starting
with the 1st slot.

Cyclic communication to the inverter when using the universal module

A universal module with the following properties is not permitted:

– PZD length 4/4 words

– Consistency over the complete length

With these properties, the universal module has the same DP identifier (4AX) as the "PKW
channel 4 words". The higher-level control does not establish cyclic communication with the
inverter.

Workaround when using the universal module above:

– In the properties of the DP slave, change the PZD length to 8/8 bytes

– Change the consistency to "Unit".

A.7.2 Configuring PROFINET communication in STEP 7

Using a suitable example, the following section provides information on how you configure the communication of an inverter to a higher-level SIMATIC control system.

To configure the communication between an inverter and a SIMATIC control system, you require the SIMATIC STEP 7 software tool with HW Config.

It is assumed that you are knowledgeable about working with SIMATIC control systems and that you have a sound understanding of the STEP 7 engineering tool.

A.7.2.1 Configuring the controller and converter in HW Config

Using an example of a SINAMICS G120 with Control Unit CU240B-2 or CU240E-2, the procedure shows how you insert the inverter into the project.

Procedure
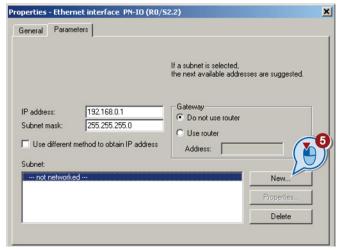
Proceed as follows to configure communications between the inverter and the control system via PROFINET:

1. Open HW Config in STEP 7 via "Insert/[Station]", and create the components in accordance with your hardware structure. The following example is limited to the components that are absolutely required.

2. Build your station with a rack and power supply unit.

3. Insert the CPU.

   HW Config opens a screen form with suggestions for the next free IP address and a subnet screen form.
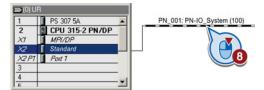
4. If you have configured a local area network, and are not working within a larger Ethernet network, use the proposed entries.

   Otherwise, ask your administrator about the IP addresses for the PROFINET participants and subnet mask. CPU and supervisor must have the same subnet screen form.
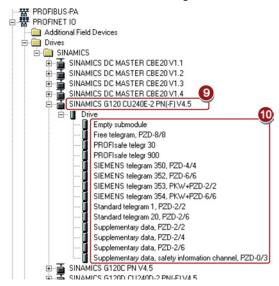
5. Use the "New" button to either create a new PROFINET subnet or select an existing one.

6. Assign a name for your PROFINET network.

7. Exit this screen form and the next one with OK.

8. Select your subnet.
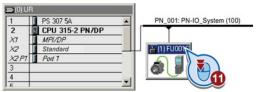
9. Using the hardware catalog, first insert the inverter using drag & drop.

10. Insert the communication telegram.

11. Open the properties window of the inverter and enter a unique and descriptive device name for the inverter.
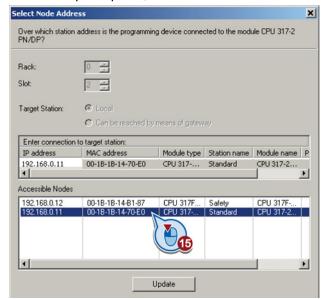
   Using the device name, the PROFINET controller assigns the IP address when starting up.

12. You will also find the proposed IP address in this screen form. If required, you can change the IP address via "Properties".

13. Save your hardware configuration with "Save and compile" ().

14. Load the configuration into the control unit via the button.

15. Enter the IP address of the controller.

   If you do not have the IP address readily available, you can display the participants that can be reached by clicking the "Display" button. Select the control from the list of accessible participants, and exit the screen form with OK.

16. If you have installed Drive ES Basic, open the STARTER by double-clicking the inverter symbol in the Hardware Manager and configure the inverter in the STARTER.

   In this case, STARTER automatically accepts the device name and IP address. The approach described in the following section is therefore superfluous.

17. If you are working with the GSDML, close HW Config now and create a reference for STARTER as described in the following section.

You have configured the communication between the inverter and the control unit using PROFINET .

A.7.2.2 Create a reference for STARTERS

If you have configured the inverter via GSDML, in STEP 7, you must create a reference of the inverter for STARTER, so that you can call up STARTER from STEP 7.
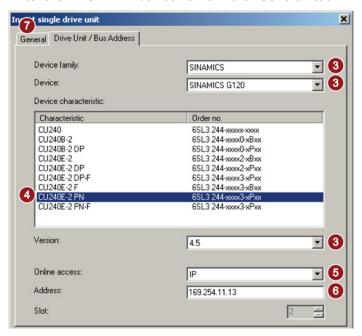
This procedure is described using the example of a SINAMICS G120 with Control Unit CU240B-2 or CU240E-2.

Procedure

Proceed as follows to create a reference of the inverter for STARTER:

1. Highlight the project in the SIMATIC manager

2. Open the "Insert single drive unit" screen form by right clicking on "Insert New Object/SINAMICS".

3. Under the "Drive device/address" tab, set the device family, device and the firmware version.

4. In the device version, select your inverter.

5. Set the online access.

6. Set the address.

7. Enter the PROFINET device name in the "General" tab.

8. Exit the screen form with OK.

9. The inverter is visible in your project.

In your project, you have created an inverter reference for STARTER. You can now call STARTER from your STEP 7 project.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

423
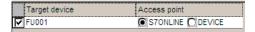
A.7.2.3 Call the STARTER and go online

Procedure

To call STARTER from STEP 7 and establish an online connection to the inverter, proceed as follows:

1. Highlight the inverter in the SIMATIC manager with the right mouse button.

2. Open the STARTER via "Open object".

3. Configure the inverter in STARTER and click on the Online button (🖥).

4. In the following window, select the inverter and then the S7ONLINE as access point.

Target device	Access point
☑ FU001	⦿ S7ONLINE ◯ DEVICE

5. Exit the screen form with OK.

You have called STARTER from STEP 7, and have established the online connection to the inverter.

A.7.2.4 Activate diagnostic messages via STEP 7

Procedure
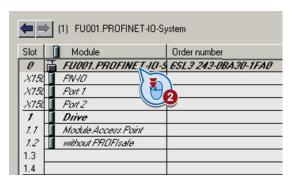
Proceed as follows to activate the diagnostic messages of the inverter:

1. In HW Config, select the inverter.
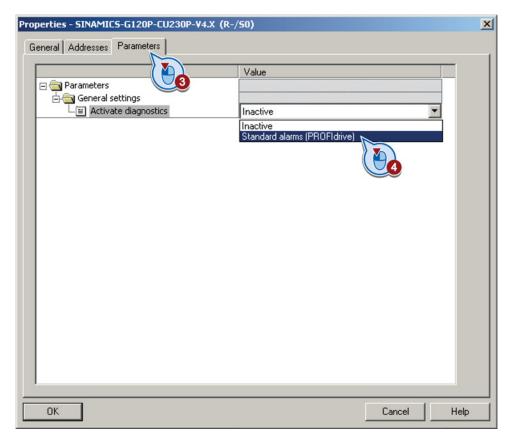
Figure A-10   Highlight inverter in HW Config

2. By double clicking on slot 0 in the station window, open the property window for the inverter's network settings.

3. Select the Parameters tab.

4. Activate the standard alarms.

You have activated the diagnosis messages.

With the next ramp-up of the controller, the diagnostic messages of the inverter are then transferred to the controller.

A.7.3   STEP 7 program examples

Data exchange via the fieldbus

Analog signals

The inverter always scales signals that are transferred via the fieldbus to a value of 4000 hex.

Table A- 8   Signal category and the associated scaling parameters

Signal category	4000 hex ≙ …	Signal category	4000 hex ≙ …
Speeds, frequencies	p2000	Power	p2004
Voltage	p2001	Angle	p2005
Current	p2002	Temperature	p2006
Torque	p2003	Acceleration	p2007

Control and status words

Control and status words consist of a high byte and a low byte. A SIMATIC control interprets words differently than the inverter: The higher and lower-order bytes are interchanged when they are transferred. See also the following program example.

A.7.3.1   STEP 7 program example for cyclic communication

Network 1:   Control word 1 and setpoint

Control word 1: 047E hex
Setpoint: 2500 hex

```
L    W#16#47E
T    MW    1
L    W#16#2500
T    MW    3
```

Network 2:   Acknowledge fault

```
U    E    0.6
=    M    2.7
```

Network 3:   Switch the motor on and off

```
U    E    0.0
=    M    2.0
```

Network 4:   Write process data

```
L    MW    1
T    PAW    256
L    MW    3
T    PAW    258
```

Network 4:   Read process data

Status word 1: MW 5
Actual value: MW 7

```
L    PEW    256
T    MW    5
L    PEW    258
T    MW    7
```

The controller and inverter communicate via standard telegram 1. The control specifies control word 1 (STW1) and the speed setpoint, while the inverter responds with status word 1 (ZSW1) and its actual speed.

In this example, inputs E0.0 and E0.6 are linked to the ON/OFF1 bit or to the "acknowledge fault" bit of STW 1.

Control word 1 contains the numerical value 047E hex. The bits of control word 1 are listed in the following table.

The hexadecimal numeric value 2500 specifies the setpoint frequency of the inverter. The maximum frequency is the hexadecimal value 4000 (also see STEP 7 program examples (Page 426)).
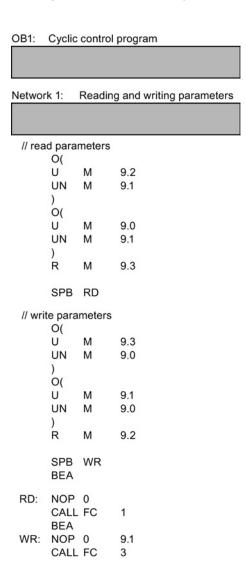
The controller cyclically writes the process data to logical address 256 of the inverter. The inverter also writes its process data to logical address 256. You define the address area in HW Config.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

427

Table A- 9   Assignment of the control bits in the inverter to the SIMATIC flags and inputs

HEX	BIN	Bit in STW1	Significance	Bit in MW1	Bit in MB1	Bit in MB2	Inputs
E	0	0	ON/OFF1	8		0	E0.0
	1	1	OFF2	9		1	
	1	2	OFF3	10		2	
	1	3	Operation enable	11		3	
7	1	4	Ramp-function generator enable	12		4	
	1	5	Start ramp-function generator	13		5	
	1	6	Setpoint enable	14		6	
	0	7	Acknowledge fault	15		7	E0.6
4	0	8	Jog 1	0	0		
	0	9	Jog 2	1	1		
	1	10	PLC control	2	2		
	0	11	Setpoint inversion	3	3		
0	0	12	Irrelevant	4	4		
	0	13	Motorized potentiometer ↑	5	5		
	0	14	Motorized potentiometer ↓	6	6		
	0	15	Data set changeover	7	7		

A.7.3.2 STEP 7 program example for acyclic communication

```
OB1:    Cyclic control program

Network 1:    Reading and writing parameters

    // read parameters
        O(
        U      M      9.2
        UN     M      9.1
        )
        O(
        U      M      9.0
        UN     M      9.1
        )
        R      M      9.3

        SPB    RD

    // write parameters
        O(
        U      M      9.3
        UN     M      9.0
        )
        O(
        U      M      9.1
        UN     M      9.0
        )
        R      M      9.2

        SPB    WR
        BEA

RD:     NOP    0
        CALL   FC     1
        BEA
WR:     NOP    0      9.1
        CALL   FC     3
```

M9.0   Starts reading parameters

M9.1   Starts writing parameters

M9.2   Displays the read process

M9.3   Displays the write process

The number of simultaneous requests for acyclic communication is limited. More detailed information can be found under http://support.automation.siemens.com/WW/view/de/15364459 (http://support.automation.siemens.com/WW/view/en/15364459).

FC1:   PAR_RD

Network 1:   Parameters for reading

```
        L    MB    40
        T    DB1.DBB   0
        L    B#16#01
        T    DB1.DBB   1
        T    DB1.DBB   2
        L    MB    62
        T    DB1.DBB   3
// -------------------------------------
        L    MW    50
        T    DB1.DBW   6
        L    MB    58
        T    DB1.DBB   5
        L    MW    63
        T    DB1.DBW   8
// -------------------------------------
        L    MW    52
        T    DB1.DBW   12
        L    MB    59
        T    DB1.DBB   11
        L    MW    65
        T    DB1.DBW   14
// -------------------------------------
        L    MW    54
        T    DB1.DBW   18
        L    MB    60
        T    DB1.DBB   17
        L    MW    67
        T    DB1.DBW   10
// -------------------------------------
        L    MW    56
        T    DB1.DBW   24
        L    MB    61
        T    DB1.DBB   23
        L    MW    69
        T    DB1.DBW   26
```

Network 2:   Read request, part 1

```
    CALL    SFC    58
        REQ        :=M9.0
        IOID       :=B#16#54
        LADDR      :=W#16#170
        RECNUM     :=B#16#2F
        RECORD     :=P#DB1.DBX0.0 BYTE 28
        RET_VAL    :=MW10
        BUSY       :=M8.1

    U    M    8.1
    R    M    9.0
    S    M    9.2
```

Network 3:   Read delay after a read request

```
    U     M    8.1
    UN    M    9.1
    L     S5T#1s
    SS    T    1
    U     M    8.3
    R     T    1
    U     T    1
    =     M    8.2
```

Network 4:   Read request, part 2

```
    CALL    SFC    59
        REQ        :=M8.2
        IOID       :=B#16#54
        LADDR      :=W#16#170
        RECNUM     :=B#16#2F
        RET_VAL    :=MW12
        BUSY       :=M8.3
        RECORD     :=P#DB2.DBX0.0 BYTE 36

    U    M    8.3
    R    M    8.2
```

Figure A-11   Reading parameters

Note

With PROFINET standard function blocks (SFB) instead of system functions (SFC)

With acyclic communication via PROFINET, you must replace the system functions with standard function blocks as follows:

- SFC 58 → SFB 53
- SFC 59 → SFB 52

Explanation of FC 1
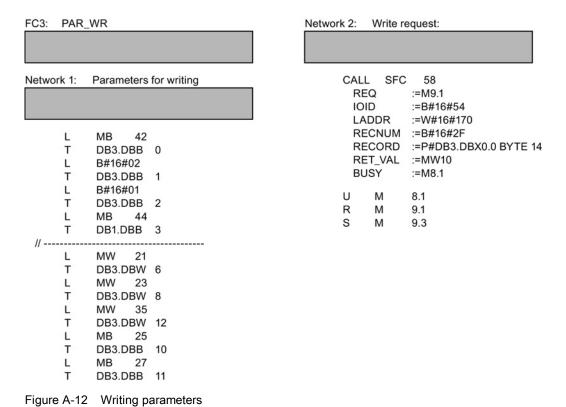
Table A- 10   Request to read parameters

Data block DB 1	Byte n	Bytes n + 1	n
Header	**Reference** *MB 40*	**01 hex**: Read request	0
	01 hex	**Number of parameters (m)** *MB 62*	2
Address, **parameter 1**	**Attribute** *10 hex: Parameter value*	**Number of indexes** *MB 58*	4
	Parameter number *MW 50*		6
	Number of the 1st index *MW 63*		8
Address, **parameter 2**	**Attribute** *10 hex: Parameter value*	**Number of indexes** *MB 59*	10
	Parameter number *MW 52*		12
	Number of the 1st index *MW 65*		14
Address, **parameter 3**	**Attribute** *10 hex: Parameter value*	**Number of indexes** *MB 60*	16
	Parameter number *MW 54*		18
	Number of the 1st index *MW 67*		20
Address, **parameter 4**	**Attribute** *10 hex: Parameter value*	**Number of indexes** *MB 61*	22
	Parameter number *MW 56*		24
	Number of the 1st index *MW 69*		26

SFC 58 copies the specifications for the parameters to be read from DB 1 and sends them to the inverter as a read request. No other read requests are permitted while this one is being processed.

After the read request and a waiting time of one second, the controller takes the parameter values from the inverter via SFC 59 and saves them in DB 2.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

431

```
FC3:    PAR_WR


Network 1:    Parameters for writing


        L     MB      42
        T     DB3.DBB   0
        L     B#16#02
        T     DB3.DBB   1
        L     B#16#01
        T     DB3.DBB   2
        L     MB      44
        T     DB1.DBB   3
    // -------------------------------------
        L     MW      21
        T     DB3.DBW   6
        L     MW      23
        T     DB3.DBW   8
        L     MW      35
        T     DB3.DBW   12
        L     MB      25
        T     DB3.DBB   10
        L     MB      27
        T     DB3.DBB   11
```

```
Network 2:    Write request:


    CALL    SFC    58
      REQ      :=M9.1
      IOID     :=B#16#54
      LADDR    :=W#16#170
      RECNUM   :=B#16#2F
      RECORD   :=P#DB3.DBX0.0 BYTE 14
      RET_VAL  :=MW10
      BUSY     :=M8.1

    U   M    8.1
    R   M    9.1
    S   M    9.3
```

Figure A-12   Writing parameters

Explanation of FC 3

Table A- 11   Request to change parameters

Data block DB 3	Byte n	Bytes n + 1	n
Header	Reference *MB 42*	**02 hex**: Change request	0
	01 hex	**Number of parameters** *MB 44*	2
Address, parameter 1	**10 hex**: Parameter value	**Number of indexes** *00 hex*	4
	Parameter number *MW 21*		6
	Number of the 1st index *MW 23*		8
Values, parameter 1	**Format** *MB 25*	**Number of index values** *MB 27*	10
	Value of the 1st index *MW35*		12

SFC 58 copies the specifications for the parameters to be written from DB 3 and sends them to the inverter. The inverter blocks other write jobs while this write job is running.

A.7.4 Configuring slave-to-slave communication in STEP 7

Two drives communicate via standard telegram 1 with the higher-level controller. In addition, drive 2 receives its speed setpoint directly from drive 1 (actual speed).
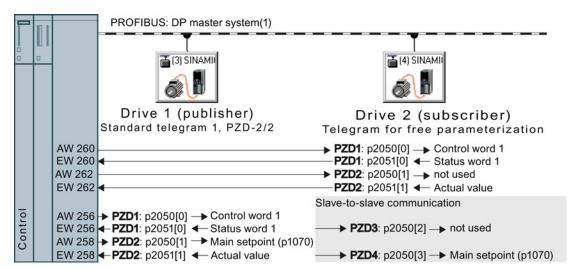
Figure A-13 Communication with the higher-level controller and between the drives with direct data exchange
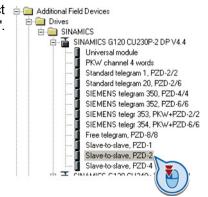
Setting direct data exchange in the control

Procedure

Proceed as follows to set direct data exchange in the control:

1. In HW Config in drive 2 (subscriber), insert a direct data exchange object, e.g. "Slave-to-slave, PZD2".
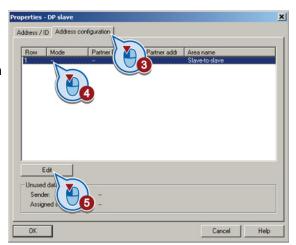
2. With a double-click, open the dialog box to make additional settings for the direct data exchange.

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

433

3.	Activate the tab "Address configuration".
4.	Select line 1.
5.	Open the dialog box in which you define the Publisher and the address area to be transferred.

6.	Select DX for direct data exchange
7.	Select the address of drive 1 (publisher).
8.	In the address field, select the start address specifying the data area to be received from drive 1. In the example, these are the status word 1 (PZD1) and the actual speed value with the start address 256.

9.	Close both screen forms with OK.

You have now defined the value range for direct data exchange.

In the direct data exchange, drive 2 receives the sent data and writes this into the next available words, in this case, PZD3 and PZD4.

Settings in drive 2 (subscriber)

Drive 2 is preset in such a way that it receives its setpoint from the higher-level controller. In order that drive 2 accepts the actual value sent from drive 1 as setpoint, you must set the following:

– In drive 2, set the PROFIdrive telegram selection to "Free telegram configuration" (p0922 = 999).

– In drive 2, set the source of the main setpoint to p1070 = 2050.3.

The inverter indicates the inverter addresses that are configured for direct data exchange in parameter r2077.

A.8 Additional information on the inverter

A.8.1 Manuals for your inverter

Table A- 12   Manuals for your converter

Depth of the information	Manual	Contents	Languages	Download or order number
++	**Getting Started Guide** for the SINAMICS G120 converter with the CU230P-2; CU240B-2 and CU240E-2 Control Units	Installing the converter and commissioning.	English, German, Italian, French, Spanish, Chinese	Download manuals (http://support.automation.siemens.com/WW/view/en/22339653/133300) **SINAMICS Manual Collection** Documentation on DVD, order number 6SL3097-4CA00-0YG0
+++	**Operating instructions**	(this manual)		
+++	**List Manual** for the SINAMICS G120 converter with the CU230P-2 Control Units	Graphic function block diagrams. List of all parameters, alarms and faults.	English, German, Chinese	
+	**Getting Started Guide** for the following SINAMICS G120 Power Modules: • PM240, PM250 and PM260 • PM240-2 • PM230	Installing the Power Module	English	
+	**Installation Instructions** for reactors, filters and braking resistors	Installing components		
+++	**Hardware Installation Manual** for the following SINAMICS G120 Power Modules: • PM230 IP20 • PM230 IP55 • PM240 • PM240-2 • PM250 • PM260	Installing power modules, reactors and filters. Maintaining power modules.	German, English	
+++	**Operating Instructions** for the following Operator Panels: • BOP-2 • IOP	Operating Operator Panels, door mounting kit for mounting of IOP.		

Table A- 13   Support when configuring and selecting the converter

Manual or tool	Contents	Available languages	Download or order number
Catalog D 31	Ordering data and technical information for the standard SINAMICS G converters	English, German, Italian, French, Spanish	Everything about SINAMICS G120 (www.siemens.en/sinamics-g120)
Online catalog (Industry Mall)	Ordering data and technical information for all SIEMENS products	English, German	
SIZER	The overall configuration tool for SINAMICS, MICROMASTER and DYNAVERT T drives, motor starters, as well as SINUMERIK, SIMOTION controls and SIMATIC Technology	English, German, Italian, French	You obtain SIZER on a DVD (Order number: 6SL3070-0AA00-0AG0) and in the Internet: Download SIZER (http://support.automation.siemens.com/WW/view/en/10804987/130000)
Configuration Manual	Selecting geared motors, motors, converters and braking resistor based on calculation examples	English, German	Configuration Manual (http://support.automation.siemens.com/WW/view/en/37728795)

If you have further questions

You can find additional information on the product and more in the Internet under: Product support (http://support.automation.siemens.com/WW/view/en/4000024).

In addition to our documentation, under this address we offer our complete knowledge base online: You can find the following information:

– Actual product information (Update), FAQ (frequently asked questions), downloads.

– The Newsletter contains the latest information on the products you use.

– The Knowledge Manager (Intelligent Search) helps you find the documents you need.

– Users and specialists from around the world share their experience and knowledge in the Forum.

– You can find your local representative for Automation & Drives via our contact database under "Contact & Partner".

– Information about local service, repair, spare parts and much more can be found under "Services".

A.9 Mistakes and improvements

If you come across any mistakes when reading this manual or if you have any suggestions for how it can be improved, then please send your suggestions to the following address or by E-mail:

Siemens AG
Drive Technologies
Motion Control Systems
Postfach 3180
91050 Erlangen, Germany

E-mail (mailto:documentation.standard.drives@siemens.com)

Index

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

439

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

441

Converters with Control Units CU230P-2 HVAC, CU230P-2 DP, CU230P-2 PN, CU230P-2 CAN, CU230P-2 BT
Operating Instructions, 01/2013, FW V4.6, A5E02430659B AF

443