SIEMENS

Commissioning Manual

SINAMICS

S120

CANopen interface

Edition 11/2017

www.siemens.com/drives

SIEMENS

SINAMICS

S120
CANopen interface

Commissioning Manual

Valid for:
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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

Disclaimer of Liability

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

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Preface

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

- General documentation/catalogs
- User documentation
- Manufacturer/service documentation

Additional information

You can find information on the following topics at the following address (https://support.industry.siemens.com/cs/de/en/view/108993276):

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following e-mail address (mailto:docu.motioncontrol@siemens.com).

Siemens MySupport/Documentation

At the following address (https://support.industry.siemens.com/My/ww/en/documentation), you can find information on how to create your own individual documentation based on Siemens' content, and adapt it for your own machine documentation.

Training

At the following address (http://www.siemens.com/sitrain), you can find information about SITRAIN (Siemens training on products, systems and solutions for automation and drives).

FAQs

You can find Frequently Asked Questions in the Service&Support pages under Product Support (https://support.industry.siemens.com/cs/de/en/ps/faq).

SINAMICS

You can find information about SINAMICS at the following address (http://www.siemens.com/sinamics).

Usage phases and their documents/tools (as an example)

Table 1 Usage phases and the available documents/tools

Usage phase	Document/tool
Orientation	SINAMICS S Sales Documentation
Planning/configuration	• SIZER Engineering Tool • Configuration Manuals, Motors
Deciding/ordering	SINAMICS S120 catalogs • SINAMICS S120 and SIMOTICS (Catalog D 21.4) • SINAMICS Converters for Single-Axis Drives and SIMOTICS Motors (Catalog D 31) • SINUMERIK 840 Equipment for Machine Tools (Catalog NC 62)
Installation/assembly	• SINAMICS S120 Manual for Control Units and Additional System Components • SINAMICS S120 Manual for Booksize Power Units • SINAMICS S120 Manual for Booksize Power Units C/D Type • SINAMICS S120 Manual for Chassis Power Units, Air-cooled • SINAMICS S120 Manual for Chassis Power Units, Liquid-cooled • SINAMICS S120 Manual for AC Drives • SINAMICS S120 Manual Combi • SINAMICS S120M Manual Distributed Drive Technology • SINAMICS HLA System Manual Hydraulic Drive
Commissioning	• STARTER Commissioning Tool • Startdrive commissioning tool • SINAMICS S120 Getting Started with STARTER • SINAMICS S120 Getting Started with Startdrive • SINAMICS S120 Commissioning Manual with STARTER • SINAMICS S120 Commissioning Manual with Startdrive • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual Drive Functions • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drive
Usage/operation	• SINAMICS S120 Commissioning Manual with STARTER • SINAMICS S120 Commissioning Manual with Startdrive • SINAMICS S120/S150 List Manual • SINAMICS HLA System Manual Hydraulic Drive
Maintenance/servicing	• SINAMICS S120 Commissioning Manual with STARTER • SINAMICS S120 Commissioning Manual with Startdrive • SINAMICS S120/S150 List Manual
References	• SINAMICS S120/S150 List Manual

Target group

This documentation is intended for machine manufacturers, commissioning engineers, and service personnel who use the SINAMICS drive system.

Benefits

This manual provides all of the information, procedures and operator actions required for the particular usage phase.

Standard scope

The scope of the functionality described in this document can differ from that of the drive system that is actually supplied.

- Other functions not described in this documentation might be able to be executed in the drive system. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or in the event of service.
- The documentation can also contain descriptions of functions that are not available in a particular product version of the drive system. The functionality of the supplied drive system should only be taken from the ordering documentation.
- Extensions or changes made by the machine manufacturer must be documented by the machine manufacturer.

For reasons of clarity, this documentation does not contain all of the detailed information on all of the product types, and cannot take into consideration every conceivable type of installation, operation and service/maintenance.

Technical Support

Country-specific telephone numbers for technical support are provided in the Internet at the following address (https://support.industry.siemens.com/sc/ww/en/sc/2090) in the "Contact" area.

Relevant directives and standards

You can obtain an up-to-date list of currently certified components on request from your local Siemens office. If you have any questions relating to certifications that have not yet been completed, please ask your Siemens contact person.

Certificates for download

The certificates can be downloaded from the Internet:

Certificates (https://support.industry.siemens.com/cs/ww/de/ps/13206/cert)

EC Declaration of Conformity

You can find the EC Declaration of Conformity for the relevant directives as well as the relevant certificates, prototype test certificates, manufacturers declarations and test certificates for functions relating to functional safety ("Safety Integrated") on the Internet at the following address (https://support.industry.siemens.com/cs/ww/en/ps/13231/cert).

The following directives and standards are relevant for SINAMICS S devices:

- **European Low Voltage Directive**

  SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2014/35/EU, insofar as they are covered by the application area of this directive.

- **European Machinery Directive**

  SINAMICS S devices fulfil the requirements stipulated in the Low-Voltage Directive 2006/42/EU, insofar as they are covered by the application area of this directive.

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

- **Directive 2011/65/EU**

  SINAMICS S devices comply with the requirements of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic devices (RoHS II).

- **European EMC Directive**

  SINAMICS S devices comply with the EMC Directive 2014/30/EU.

- **EMC requirements for South Korea**

  SINAMICS S devices with the KC marking on the type plate satisfy the EMC requirements for South Korea.

- **Eurasian conformity**

  SINAMICS S comply with the requirements of the Russia/Belarus/Kazakhstan customs union (EAC).

- **North American market**

  SINAMICS S devices provided with one of the test symbols displayed fulfill the requirements stipulated for the North American market as a component of drive applications.

  You can find the relevant certificates on the Internet pages of the certifier (http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html).

- **Specification for semiconductor process equipment voltage drop immunity**

  SINAMICS S devices meet the requirements of standard SEMI F47-0706.

- **Australia and New Zealand (RCM formerly C-Tick)**

  SINAMICS S devices showing the test symbols fulfill the EMC requirements for Australia and New Zealand.

- **Quality systems**

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

Not relevant standards

China Compulsory Certification

SINAMICS S devices do not fall in the area of validity of the China Compulsory Certification (CCC).

EMC limit values in South Korea

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device. This device is intended to be used in areas other than at home.

The EMC limit values to be observed for Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3 of category C2 or the limit value class A, Group 1 to KN11. By implementing appropriate additional measures, the limit values according to category C2 or limit value class A, Group 1, are observed. Further, additional measures may be required, such as using an additional radio interference suppression filter (EMC filter).
The measures for EMC-compliant design of the system are described in detail in this manual respectively in the EMC Installation Guideline Configuration Manual.
The final statement regarding compliance with the standard is given by the respective label attached to the individual unit.

Ensuring reliable operation

The manual describes a desired state which, if maintained, ensures the required level of operational reliability and compliance with EMC limit values.

Should there be any deviation from the requirements in the manual, appropriate actions (e.g. measurements) must be taken to check/prove that the required level of operational reliability and compliance with EMC limit values are ensured.

Spare parts

Spare parts are available on the Internet at the following address (https://www.automation.siemens.com/sow?sap-language=EN).

Product maintenance

The components are subject to continuous further development within the scope of product maintenance (improvements to robustness, discontinuations of components, etc).

These further developments are "spare parts-compatible" and do not change the article number.

In the scope of such spare parts-compatible further developments, connector/connection positions are sometimes changed slightly. This does not cause any problems with proper use of the components. Please take this fact into consideration in special installation situations (e.g. allow sufficient clearance for the cable length).

Use of third-party products

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

You can use equivalent products from other manufacturers.

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

Ground symbols

Table 2 Symbols

Symbol	Meaning
	Connection for protective conductor
	Ground (e.g. M 24 V)
	Connection for function potential bonding

Notation

The following notation and abbreviations are used in this documentation:

Notation for faults and alarms (examples):

- F12345 Fault 12345
- A67890 Alarm 67890
- C23456 Safety message

Notation for parameters (examples):

- p0918 Adjustable parameter 918
- r1024 Display parameter 1024
- p1070[1] Adjustable parameter 1070, index 1
- p2098[1].3 Adjustable parameter 2098, index 1 bit 3
- p0099[0...3] Adjustable parameter 99, indices 0 to 3
- r0945[2](3) Display parameter 945, index 2 of drive object 3
- p0795.4 Adjustable parameter 795, bit 4

Steps when commissioning a CANopen interface

Note

This "SINAMICS S120 Commissioning Manual CANopen" describes the steps involved when commissioning a CANopen interface in the SINAMICS drive line-up.

This Commissioning Manual supplements the description of "Initial commissioning servo control booksize format" to include a description of the initial commissioning procedure for the CANopen communication interface:

- SINAMICS S120 with the CBC10 communication module
- Detailed instructions on commissioning the entire SINAMICS drive line-up are available in the "SINAMICS S120 with STARTER" Commissioning Manual.

Table of contents

Fundamental safety instructions

1

1.1 General safety instructions

⚠WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

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

Generally, the following six steps apply when establishing safety:

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

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

⚠WARNING

Electric shock due to connection to an unsuitable power supply

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

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

⚠WARNING

Electric shock due to equipment damage

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

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

⚠WARNING

Electric shock due to unconnected cable shield

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

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

⚠WARNING

Electric shock if there is no ground connection

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

- Ground the device in compliance with the applicable regulations.

⚠WARNING

Arcing when a plug connection is opened during operation

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

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

⚠WARNING

Electric shock due to residual charges in power components

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

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

NOTICE

Property damage due to loose power connections

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

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

⚠WARNING

Spread of fire from built-in devices

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

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

⚠WARNING

Failure of pacemakers or implant malfunctions due to electromagnetic fields

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors. People with pacemakers or implants in the immediate vicinity of this equipment are at particular risk.

- If you have a heart pacemaker or implant, maintain a minimum distance of 2 m from electrical power equipment.

⚠WARNING

Unexpected movement of machines caused by radio devices or mobile phones

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

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

⚠WARNING

Motor fire in the event of insulation overload

There is higher stress on the motor insulation through a ground fault in an IT system. If the insulation fails, it is possible that death or severe injury can occur as a result of smoke 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.

⚠WARNING

Fire due to inadequate ventilation clearances

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

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

⚠WARNING

Unrecognized dangers due to missing or illegible warning labels

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

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

NOTICE

Device damage caused by incorrect voltage/insulation tests

Incorrect voltage/insulation tests can damage the device.

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

⚠WARNING

Unexpected movement of machines caused by inactive safety functions

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

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

Note

Important safety notices for Safety Integrated functions

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

⚠WARNING

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

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

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

1.2 Equipment damage due to electric fields or electrostatic discharge

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

NOTICE

Equipment damage due to electric fields or electrostatic discharge

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

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

1.3 Warranty and liability for application examples

The application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. The application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks. You are responsible for the proper operation of the described products. These application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

1.4 Industrial security

Note

Industrial security

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

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

The customer is responsible for preventing unauthorized access to its plants, systems, machines and networks. Systems, machines and components should only be connected to the enterprise network or the internet if and to the extent necessary and with appropriate security measures (e.g. use of firewalls and network segmentation) in place.

Additionally, Siemens' guidance on appropriate security measures should be taken into account. For more information about industrial security, please visit:

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

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

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

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

⚠WARNING

Unsafe operating states resulting from software manipulation

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

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.

1.5 Residual risks of power drive systems

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

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

5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network

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

Add infeed

2

2.1 Previous knowledge

To fully understand this Commissioning Manual, you must be familiar with CANopen terminology.

You must be familiar with the following standards:

SINAMICS with CANopen complies with the following standards:

- CiA 301 (Application Layer and Communication Profile)
- CiA 303-3 (Indicator Specification)
- CiA 306 (Electronic Data Sheet Specification for CANopen)
- CiA 402 (Device Profile for Drives and Motion Control)

2.2 CAN bus structure for SINAMICS

The following diagram shows the hardware and software layout when a CANopen interface is commissioned.

The diagram shows the following:

- How a master application of a CANopen user is connected to a SINAMICS drive line-up.
- The CAN bus interface of the CBC10 communication board.
- The associated CANopen slave software on the Control Unit and the meaning of the terms "send" and "receive", which are used for the transmit and receive message frames during commissioning.
- How a PC on which the STARTER commissioning tool has been installed can be connected via ETHERNET.

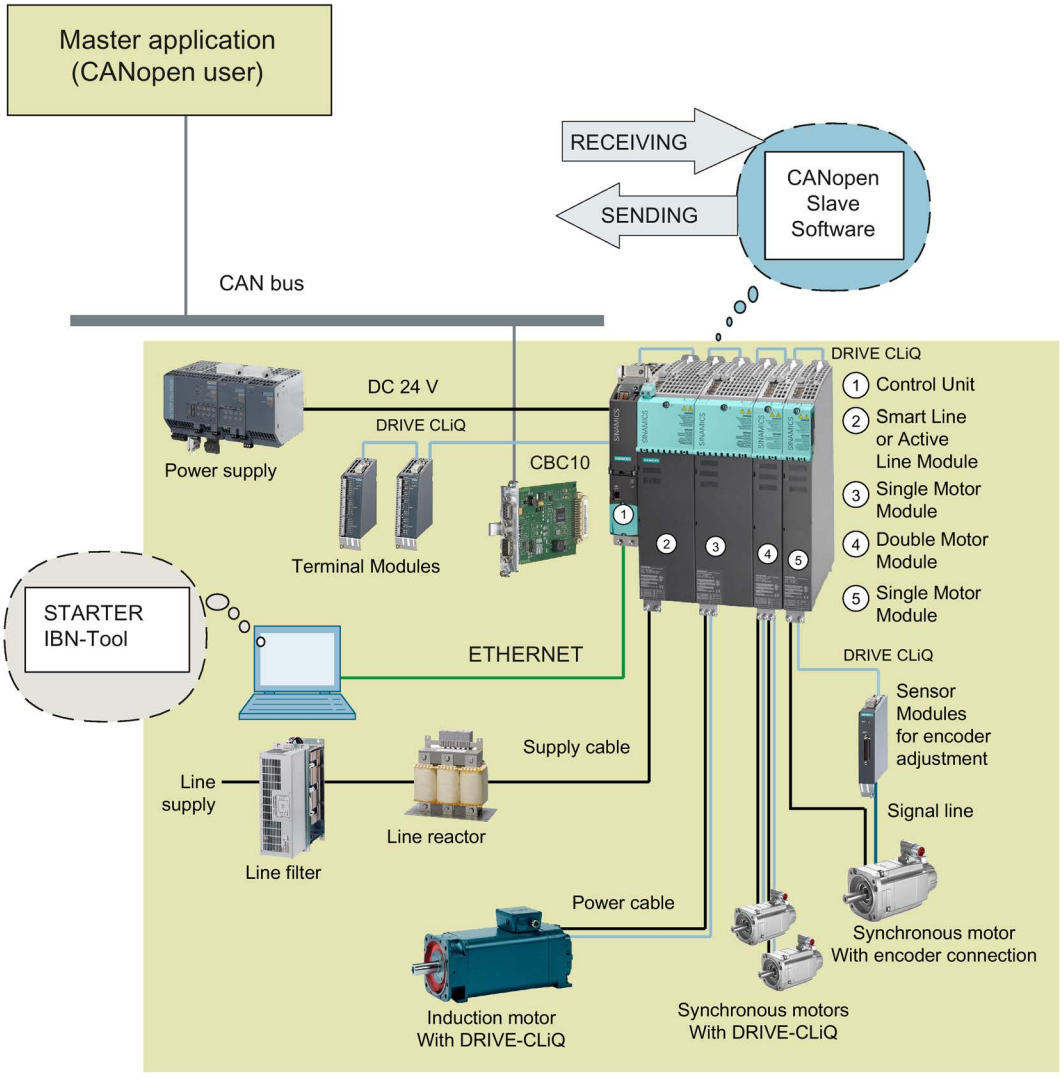


Figure 2-1 SINAMICS S120 drive line-up with CAN bus

2.3 CANopen functions that are supported

A SINAMICS drive is a CANopen slave. SINAMICS supports the following CANopen functions:

CANopen functions	Details	Detailed information
NMT (network management)	• Boot-up Service • Node Control Service – Start Remote Node – Stop Remote Node – Enter Pre-Operational – Reset Node – Reset Communication • Error Control Service – Life guarding – Heartbeat	Network management (Page 30) Bootup protocol (Page 31) NMT services - Node Control Services (Page 31) NMT services - Error Control Services (Page 33)
CANopen object directory	All of the obligatory CANopen objects are supported. These include data, parameters and functions.	CANopen object directory (Page 34)
SDO (Service Data Object)	SDO transmission is supported when accessing CANopen objects in the CANopen object directory.	SDO (Service Data Object) (Page 58)
PDO (Process Data Object)	The PDO transmission is supported with free PDO mapping for real-time-capable process data exchange.	PDO (Process Data Object) (Page 67)
SYNC (Synchronization Object)	A PDO can be configured so that it responds to the SYNC.	Data transmission types (Page 68)
EMCY (Emergency Object)	EMCY is supported for event-orientated signaling of device faults and errors.	Alarm object (Emergency Object) (Page 124)
CANopen operating modes	The following operating modes are supported: • Profile Velocity Mode • Profile Torque Mode • Velocity Mode • Homing mode • Profile Position Mode	Operating modes (Page 129)

2.4 Network management

Network management is node oriented and has a master-slave structure.

The NMT service can be used to initialize, start, monitor, reset and stop nodes. All NMT services have the COB-ID = 0.

The drive unit is an NMT slave.

2.4.1 Overview

The following screen shows an example of an CANopen node. The NMT services that are available for controlling the status transitions are listed in the table in Chapter "NMT services - Node Control Services (Page 31)".

The NMT services are described in detail in the CANopen "CiA 301 (Application Layer and Communication Profile)"

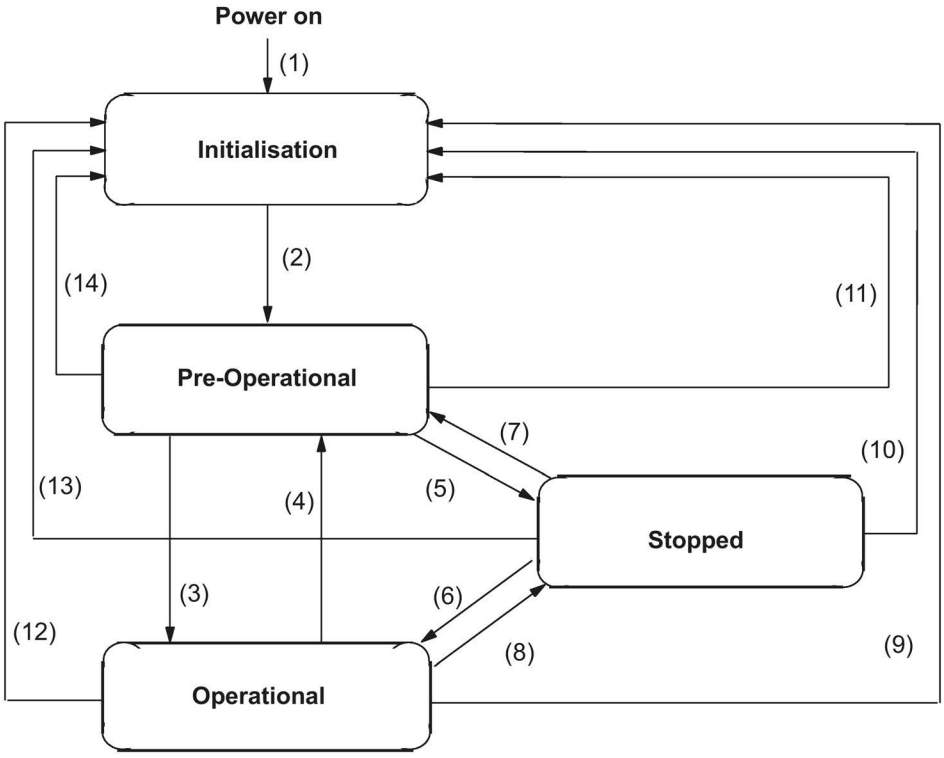


Figure 2-2 State diagram of a CANopen node

Note

The diagnostics LED -> green (CANopen RUN LED) indicates the status.

2.4.2 Bootup protocol

After the NMT slave has booted, this protocol signals that the NMT slave has taken on the state "Pre-Operational" after having been in the "Initialization" state.

Bootup protocol COB-ID = 700 hex + node ID

1 data byte with the value 0 is transmitted.

2.4.3 NMT state after power up

As an extension to the NMT services, automatic switching to the "Operational" state after POWER ON can also be achieved using parameter settings (see Fig. "State diagram of a CANopen node (Page 30)").

Using parameter p8684, the CANopen-NMT state is set, which is effective after booting or as result of the NMT service "Reset Node" or "Reset Communication".

Possible values:

- 4: Stopped
- 5: Operational
- 127: Pre-Operational (factory setting).

The NMT state "Pre-Operational" is selected in the factory setting, as this corresponds to the CANopen standard.

2.4.4 NMT services - Node Control Services

The following table lists the NMT services that are available for controlling the status transitions.

Table 2- 1 Transitions in the status diagram

Transitions	Services
(1)	After POWER ON, the Control Unit automatically switches to "Initialization".
(2)	After initialization, it switches to "Pre-Operational". (see also Chapter "Drive-dependent communication objects (Page 38)" or Chapter "Manufacturer-specific objects (Page 51)").
(3), (6)	Start_Remote_Node command
(4), (7)	Enter_Pre-Operational_State command
(5), (8)	Stop_Remote_Node command
(9), (10), (11)	Reset_Node command
(12), (13), (14)	Reset_Communication command

The NMT services have the following functions:

- Start Remote Node
  Command for switching from the "Pre-Operational" communication state to "Operational". The drive can only transmit and receive process data in the "Operational" state.
- Stop Remote Node:
  command for switching from "Pre-Operational" to "Stopped" or from "Operational" to "Stopped". The node can only process NMT commands in the "Stopped" state.
- Enter Pre-Operational:
  command for switching from "Operational" or "Stopped" to "Pre-Operational". In the "Pre-Operational" state, the node cannot process any PDO. It can, however, be parameterized or operated via SDOs, which means that setpoints can also be specified.
- Reset Node:
  command for switching from "Operational", "Pre-Operational", or "Stopped" to "Initialization". When the "Reset Node" command is issued, all the objects (1000 hex - 9FFF hex) are reset to their saved values.
- Reset Communication:
  command for switching from "Operational", "Pre-Operational", or "Stopped" to "Initialization". When the "Reset Communication" command is issued, all the communication objects (1000 hex - 1FFF hex) are reset to their saved values.

CANopen-NMT state

The CANopen NMT state can be displayed or the desired state set using the parameter p8685.

Possible values:

- 0: Initializing (display only)
- 4: Stopped
- 5: Operational
- 127: Pre-operational
- 128: Reset Node
- 129: Reset Communication

Note

Sending an incorrect NMT state

If the control sends an incorrect NMT state to the inverter, the inverter goes into the "Stopped" state.

2.4.5 NMT services - Error Control Services

Note

In the basic setting, both methods "Life Guarding" and "Heartbeat" are deactivated.

Node guarding protocol and heartbeat protocol cannot be used at the same time. As soon as the "heartbeat producer time" is not equal to zero, the heartbeat protocol is used automatically.

Life guarding

The NMT master Issues monitoring queries using the node guarding protocol. The slave's answer contains information about its state. If one of the NMT slaves addressed does not reply within a certain time window ("Node lifetime") – or the state of the NMT slave has changed – then the NMT master informs its master application.

The NMT slave supports "Life guarding" (NMT slave monitors the NMT master). For this purpose, the entries for "Guard time" and "Life time factor" are used from its object directory to write its "Node life time". The "Node lifetime" results from the "Node guard time" multiplied by the "Lifetime factor". The "Node lifetime" corresponds to p8604.

If the NMT slave is not addressed/monitored by the NMT master within its "Node lifetime", it informs its local application of this using a "Life guarding event". If the entries for "Guard time" and "Lifetime factor" in the slave's object directory are at "0" (default setting), then the NMT slave does not monitor the NMT master.

Monitoring of the NMT slave starts when the first "Remote transmit request" (RTR) is received from the NMT master via its COB ID. The activated and initiated "life guarding monitoring" is displayed via the PROFIdrive PZD state "Fieldbus oper" r8843.2.

In the case of a CAN communication error, e.g. too many message frame failures, SINAMICS issues fault F08700 with fault value 2 (for details see SINAMICS S120/150 List Manual). The fault is displayed in parameter r0949. The reaction of the drive to the fault is set with p8641.

The values for the "Node guard time" and the "Lifetime factor" are stored in the appropriate NMT slave's object directory.

Heartbeat

The SINAMICS drive only supports the "Heartbeat producer protocol".

A "Heartbeat producer" (CANopen device) issues heartbeat messages periodically. CANopen devices in the network recognize this heartbeat message. If a heartbeat cycle of the "Heartbeat producer" is missing, a Heartbeat Consumer can respond to this.

2.5 CANopen object directory

When the drive objects are initialized, the CANopen objects are initialized in the object directory for the SINAMICS drive line-up (CANopen slave software).

Object directory

The following diagram shows the distribution of CANopen objects involved in the communications (the values are hexadecimal values):

- Control Unit communication objects independent of the drive
- Drive-dependent communication objects
- Manufacturer-specific objects
- Drive-dependent objects of the drive profile "DSP 402"

CANopen supports a maximum of 8 drive objects.

A maximum of 8 logical CANopen device modules are supported. One CANopen device module corresponds to one drive object of the "MOTION CONTROL” category. The r8743 parameter "CAN assignment of device module/drive object" shows the assignment of these SINAMICS drive objects to the CANopen device modules via the SINAMICS drive object number. As such, the index number corresponds to the CANopen device module number.

Notes:

- The CANopen device module number cannot be selected via online PDO mapping. Assignment of CANopen device modules to the SINAMICS drive objects is performed during commissioning or run-up and cannot be changed online.
- The CANopen device modules must be configured in ascending order without any gaps from 0 to 7. Incomplete configuration of the CANopen device modules is not permitted. During download, it results in refusal of writing the PDO communication or PDO mapping parameters and PDO configuration warnings.

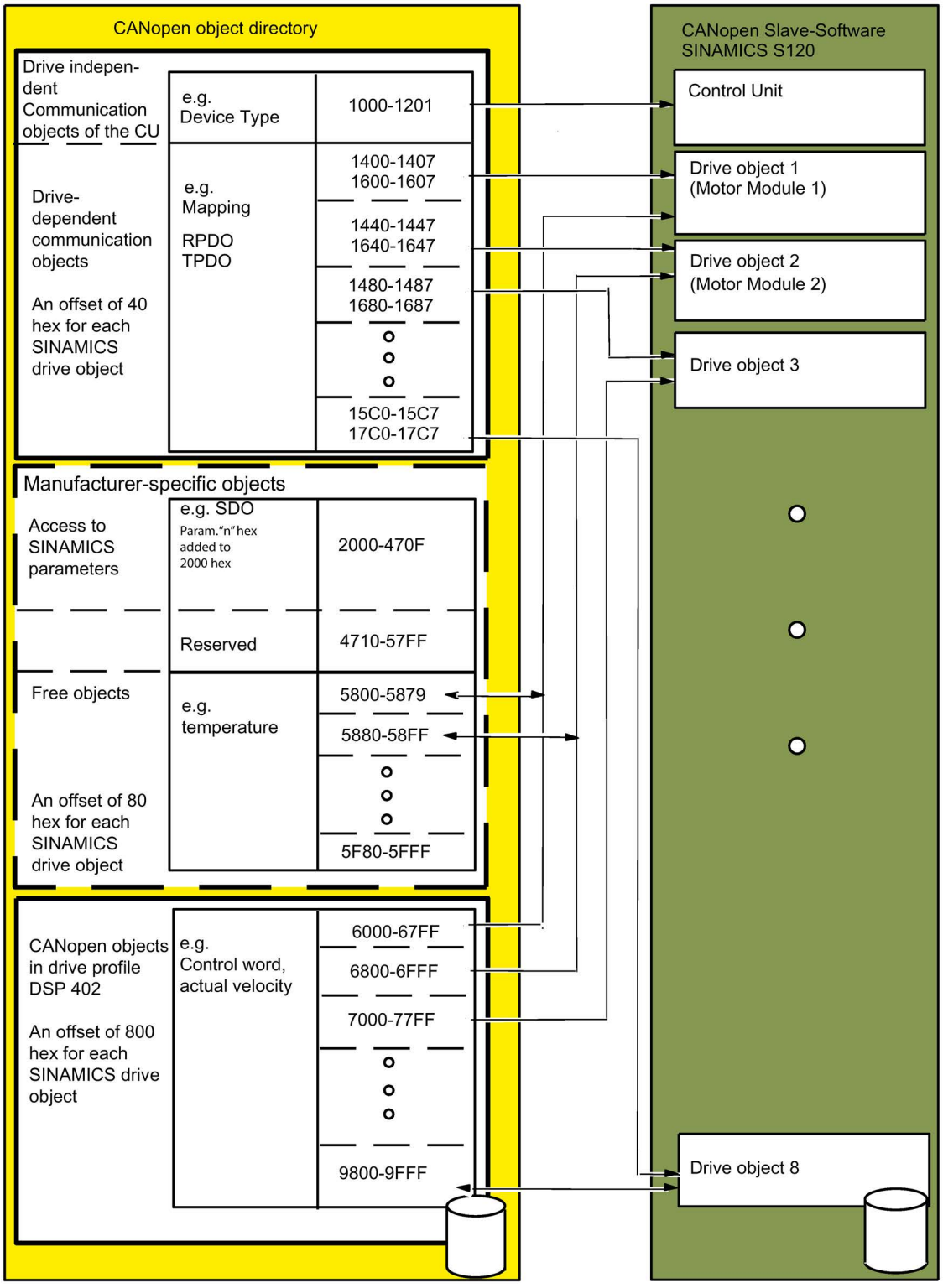


Figure 2-3 CANopen object directory

2.5.1 Control Unit communication objects independent of the drive

The following table lists the object directory with the index of the individual drive-independent Control Unit communication objects. The column "SINAMICS parameter" shows the parameter numbers that are assigned to the communication objects for SINAMICS.

Table 2- 2 Control Unit communication objects independent of the drive

OD index (hex)	Sub index (hex)	Object name	SINAMICS parameters	PDO Mapping	Data type	Default values	SDO access
1000		Device type	r8600	No	Unsigned32	–	ro
1001		Error register	r8601	No	Unsigned8	–	ro
1003	0...52	Predefined error field	p8611[0...82]	No	Unsigned32	0	ro/rw
	0	Number of errors	p8611.0	No	Unsigned32	0	rw
	1	Number of module	p8611.1	No	Unsigned32	0	ro
	2	Number of errors module 1	p8611.2	No	Unsigned32	0	ro
	3-A	Standard error field 1. Module	p8611.3-p8611.10	No	Unsigned32	0	ro
	B	Number of errors module 2	p8611.11	No	Unsigned32	0	ro
	C-13	Standard error field 2. Module	p8611.12-p8611.19	No	Unsigned32	0	ro
	14	Number of errors module 3	p8611.20	No	Unsigned32	0	ro
	15-1C	Standard error field 3. Module	p8611.21-p8611.28	No	Unsigned32	0	ro
	1D	Number of errors module 4	p8611.29	No	Unsigned32	0	ro
	1E-25	Standard error field 4. Module	p8611.30-p8611.37	No	Unsigned32	0	ro
	26	Number of errors module 5	p8611.38	No	Unsigned32	0	ro
	27-2E	Standard error field 5. Module	p8611.39-p8611.46	No	Unsigned32	0	ro
	2F	Number of errors module 6	p8611.47	No	Unsigned32	0	ro
	30-37	Standard error field 6. Module	p8611.48-p8611.55	No	Unsigned32	0	ro
	38	Number of errors module 7	p8611.56	No	Unsigned32	0	ro
	39-40	Standard error field 7. Module	p8611.57-p8611.64	No	Unsigned32	0	ro
	41	Number of errors module 8	p8611.65	No	Unsigned32	0	ro
	42-49	Standard error field 8. Module	p8611.66-p8611.73	No	Unsigned32	0	ro

OD index (hex)	Sub index (hex)	Object name	SINAMICS parameters	PDO Mapping	Data type	Default values	SDO access
	4A	Number of errors Control Unit	p8611.74	No	Unsigned32	0	ro
	4B-52	Standard Control Unit Error Field	p8611.75-p8611.82	No	Unsigned32	0	ro
1005		SYNCH COB ID	p8602	No	Unsigned32	128	rw
1008		Manufacturer device name	–	No	–	–	–
100A		Manufacturer software version	r0018	No	Unsigned32	–	ro
100C		Guard time	p8604.0	No	Unsigned16	0	rw
100D		Lifetime factor	p8604.1	No	Unsigned16	0	rw
1010		Store parameters	p0977	No	Unsigned16	0	rw
	0	Largest subindex supported	–	No	–	–	–
	1	Save all parameters	p0977	No	Unsigned16	0	rw
	2	Save communication parameters (0x1000-0x1fff)	p0977	No	Unsigned16	0	rw
	3	Save application-related parameters (0x6000-0x9fff)	p0977	No	Unsigned16	0	rw
1011		Restore default parameters	p0976	No	Unsigned16	0	rw
	0	Largest subindex supported	–	No	–		
	1	Restore all default parameters	p0976	No	Unsigned16	0	rw
	2	Restore communication default parameters (0x1000-0x1fff)	p0976	No	Unsigned16	0	rw
	3	Restore application default parameters (0x6000-0x9fff)	p0976	No	Unsigned16	0	rw
1014		COB ID emergency	p8603	No	Unsigned32	0	rw
1017		Producer heartbeat time	p8606	No	Unsigned16	0	rw
1018		Identy Object	r8607[0...3]	–	Unsigned32	–	ro
	0	Number of entries	–	No	–	–	–
	1	Vendor ID	r8607.0	No	Unsigned32	–	ro
	2	Product code	r8607.1	No	Unsigned32	–	ro
	3	Revision number	r8607.2	No	Unsigned32	–	ro
	4	Serial number	r8607.3	No	Unsigned32	0	ro

OD index (hex)	Sub index (hex)	Object name	SINAMICS parameters	PDO Mapping	Data type	Default values	SDO access
1027		Module list	–	–	–	–	–
	0	Number of entries	r0102	No	Unsigned16	–	ro
	1-8	Module ID	p0107[0...15]	No	Integer16	0	rw
1029		Error behavior	–	–	–	–	–
	0	No. of error classes	–	No	–	–	–
	1	Communication Error	p8609.0	No	Unsigned32	1	rw
	2	Device profile or manufacturer-specific error	p8609.1	No	Unsigned32	1	rw
1200		1st server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	–
	1	COB ID client -> server (rx)	r8610.0	No	Unsigned32	–	ro
	2	COB ID server -> client (tx)	r8610.1	No	Unsigned32	–	ro
1201		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw

2.5.2 Drive-dependent communication objects

Eight PDOs per drive can be parameterized for transmitting and receiving.

Each PDO contains:

- Communication parameters
- Mapping parameters (max. 8 bytes/4 words/64 bits).

Rule

In the following tables, as example, the 1st PDO is highlighted in **bold** to indicate that the communication and mapping parameters for one PDO are associated with one another.

The "predefined connection set" column contains the predefined values for the "predefined connection set".

2.5.2.1 Communication objects receive PDO

The following table lists the object directory with the index of the individual drive-dependent communication objects for the receive PDO of the first drive object:

Table 2- 3 Drive-dependent communication objects for receive PDO

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
1400		**Receive PDO 1 communication parameter**	–	–	–	–	–
	0	**Largest subindex supported**	–	**No**	**Unsigned8**	**2**	**ro**
	1	**COB ID used by PDO**	**p8700.0**	**No**	**Unsigned32**	**200 hex + node ID**	**rw**
	2	**Transmission type**	**p8700.1**	**No**	**Unsigned8**	**FE hex**	**rw**
1401		Receive PDO 2 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	2	ro
	1	COB ID used by PDO	p8701.0	No	Unsigned32	300 hex + node ID	rw
	2	Transmission type	p8701.1	No	Unsigned8	FE hex	rw
1402		Receive PDO 3 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	2	ro
	1	COB ID used by PDO	p8702.0	No	Unsigned32	400 hex + node ID	rw
	2	Transmission type	p8702.1	No	Unsigned8	FE hex	rw
1403		Receive PDO 4 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	2	ro
	1	COB ID used by PDO	p8703.0	No	Unsigned32	500 hex + node ID	rw
	2	Transmission type	p8703.1	No	Unsigned8	FE hex	rw
1404		Receive PDO 5 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	2	ro
	1	COB ID used by PDO	p8704.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8704.1	No	Unsigned8	FE hex	rw

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
1405		Receive PDO 6 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	2	ro
	1	COB ID used by PDO	p8705.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8705.1	No	Unsigned8	FE hex	rw
1406		Receive PDO 7 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	2	ro
	1	COB ID used by PDO	p8706.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8706.1	No	Unsigned8	FE hex	rw
1407		Receive PDO 8 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	2	ro
	1	COB ID used by PDO	p8707.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8707.1	No	Unsigned8	FE hex	rw
1600		**Receive PDO 1 mapping parameter**	–	–	–	–	–
	0	**Number of mapped application objects in PDO**	–	**No**	**Unsigned8**	**1**	**ro**
	1	**PDO mapping for the first application object to be mapped**	**p8710.0**	**No**	**Unsigned32**	**6040 hex**	**rw**
	2	**PDO mapping for the second application object to be mapped**	**p8710.1**	**No**	**Unsigned32**	**0**	**rw**
	3	**PDO mapping for the third application object to be mapped**	**p8710.2**	**No**	**Unsigned32**	**0**	**rw**
	4	**PDO mapping for the fourth application object to be mapped**	**p8710.3**	**No**	**Unsigned32**	**0**	**rw**

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
1601		Receive PDO 2 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	2	ro
	1	PDO mapping for the first application object to be mapped	p8711.0	No	Unsigned32	6040 hex	rw
	2	PDO mapping for the second application object to be mapped	p8711.1	No	Unsigned32	60FF hex	rw
	3	PDO mapping for the third application object to be mapped	p8711.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8711.3	No	Unsigned32	0	rw
1602		Receive PDO 3 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	2	ro
	1	PDO mapping for the first application object to be mapped	p8712.0	No	Unsigned32	6040 hex	rw
	2	PDO mapping for the second application object to be mapped	p8712.1	No	Unsigned32	6071 hex	rw
	3	PDO mapping for the third application object to be mapped	p8712.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8712.3	No	Unsigned32	0	rw
1603		Receive PDO 4 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	3	ro
	1	PDO mapping for the first application object to be mapped	p8713.0	No	Unsigned32	6040 hex	rw

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
	2	PDO mapping for the second application object to be mapped	p8713.1	No	Unsigned32	60FF hex	rw
	3	PDO mapping for the third application object to be mapped	p8713.2	No	Unsigned32	6071 hex	rw
	4	PDO mapping for the fourth application object to be mapped	p8713.3	No	Unsigned32	0	rw
1604		Receive PDO 5 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8714.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8714.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8714.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8714.3	No	Unsigned32	0	rw
1605		Receive PDO 6 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8715.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8715.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8715.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8715.3	No	Unsigned32	0	rw

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
1606		Receive PDO 7 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8716.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8716.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8716.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8716.3	No	Unsigned32	0	rw
1607		Receive PDO 8 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8717.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8717.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8717.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8717.3	No	Unsigned32	0	rw

Note

The object index range for each additional drive can be determined using r8743. The parameter value corresponds to the drive object ID. The parameter index corresponds to the factor with which the offset 40 hex must be multiplied and added to the basis object. For instance, the drive starts with offset factor 1 from 1640 hex.

2.5.2.2 Communication objects send PDO

The following table lists the object directory with the index of the individual drive-dependent communication objects for the transmit PDO of the first drive object:

Table 2- 4 Drive-dependent communication objects for transmit PDO

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
1800		Transmit PDO 1 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	5	ro
	1	COB ID used by PDO	p8720.0	No	Unsigned32	180 hex + node ID	rw
	2	Transmission type	p8720.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8720.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8720.3	No	Unsigned8	3	rw
	5	Event timer	p8720.4	No	Unsigned16	0	rw
1801		Transmit PDO 2 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	5	ro
	1	COB ID used by PDO	p8721.0	No	Unsigned32	280 hex + node ID	rw
	2	Transmission type	p8721.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8721.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8721.3	No	Unsigned8	0	rw
	5	Event timer	p8721.4	No	Unsigned16	0	rw
1802		Transmit PDO 3 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	5	–
	1	COB ID used by PDO	p8722.0	No	Unsigned32	380 hex + node ID	rw
	2	Transmission type	p8722.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8722.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8722.3	No	Unsigned8	0	rw
	5	Event timer	p8722.4	No	Unsigned16	0	rw
1803		Transmit PDO 4 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	5	ro

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
	1	COB ID used by PDO	p8723.0	No	Unsigned32	480 hex + node ID	rw
	2	Transmission type	p8723.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8723.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8723.3	No	Unsigned8	0	rw
	5	Event timer	p8723.4	No	Unsigned16	0	rw
1804		Transmit PDO 5 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	5	ro
	1	COB ID used by PDO	p8724.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8724.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8724.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8724.3	No	Unsigned8	0	rw
	5	Event timer	p8724.4	No	Unsigned16	0	rw
1805		Transmit PDO 6 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	5	ro
	1	COB ID used by PDO	p8725.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8725.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8725.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8725.3	No	Unsigned8	0	rw
	5	Event timer	p8725.4	No	Unsigned16	0	rw
1806		Transmit PDO 7 communication parameter	–	–	–	–	–
	0	Largest subindex supported	–	No	Unsigned8	5	ro
	1	COB ID used by PDO	p8726.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8726.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8726.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8726.3	No	Unsigned8	0	rw
	5	Event timer	p8726.4	No	Unsigned16	0	rw
1807		Transmit PDO 8 communication parameter	–	–	–	–	–

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
	0	Largest subindex supported	–	No	Unsigned8	5	ro
	1	COB ID used by PDO	p8727.0	No	Unsigned32	C000 06E0 hex	rw
	2	Transmission type	p8727.1	No	Unsigned8	FE hex	rw
	3	Inhibit time	p8727.2	No	Unsigned16	0	rw
	4	Compatibility entry	p8727.3	No	Unsigned8	0	rw
	5	Event timer	p8727.4	No	Unsigned16	0	rw
1A00		**Transmit PDO 1 mapping parameter**	–	–	–	–	–
	0	**Number of mapped application objects in PDO**	–	**No**	**Unsigned8**	**1**	**ro**
	1	**PDO mapping for the first application object to be mapped**	**p8730.0**	**No**	**Unsigned32**	**6041 hex**	**rw**
	2	**PDO mapping for the second application object to be mapped**	**p8730.1**	**No**	**Unsigned32**	**0**	**rw**
	3	**PDO mapping for the third application object to be mapped**	**p8730.2**	**No**	**Unsigned32**	**0**	**rw**
	4	**PDO mapping for the fourth application object to be mapped**	**p8730.3**	**No**	**Unsigned32**	**0**	**rw**
1A01		Transmit PDO 2 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	2	ro
	1	PDO mapping for the first application object to be mapped	p8731.0	No	Unsigned32	6041 hex	rw
	2	PDO mapping for the second application object to be mapped	p8731.1	No	Unsigned32	606C hex	rw

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
	3	PDO mapping for the third application object to be mapped	p8731.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8731.3	No	Unsigned32	0	rw
1A02		Transmit PDO 3 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	2	ro
	1	PDO mapping for the first application object to be mapped	p8732.0	No	Unsigned32	6041 hex	rw
	2	PDO mapping for the second application object to be mapped	p8732.1	No	Unsigned32	6077 hex	rw
	3	PDO mapping for the third application object to be mapped	p8732.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8732.3	No	Unsigned32	0	rw
1A03		Transmit PDO 4 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	2	ro
	1	PDO mapping for the first application object to be mapped	p8733.0	No	Unsigned32	6041 hex	rw
	2	PDO mapping for the second application object to be mapped	p8733.1	No	Unsigned32	6063 hex	rw
	3	PDO mapping for the third application object to be mapped	p8733.2	No	Unsigned32	0	rw

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
	4	PDO mapping for the fourth application object to be mapped	p8733.3	No	Unsigned32	0	rw
1A04		Transmit PDO 5 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8742.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8742.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8742.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8742.3	No	Unsigned32	0	rw
1A05		Transmit PDO 6 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8752.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8752.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8752.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8752.3	No	Unsigned32	0	rw

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Predefined connection set	SDO access
1A06		Transmit PDO 7 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8752.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8752.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8752.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8752.3	No	Unsigned32	0	rw
1A07		Transmit PDO 8 mapping parameter	–	–	–	–	–
	0	Number of mapped application objects in PDO	–	No	Unsigned8	0	ro
	1	PDO mapping for the first application object to be mapped	p8752.0	No	Unsigned32	0	rw
	2	PDO mapping for the second application object to be mapped	p8752.1	No	Unsigned32	0	rw
	3	PDO mapping for the third application object to be mapped	p8752.2	No	Unsigned32	0	rw
	4	PDO mapping for the fourth application object to be mapped	p8752.3	No	Unsigned32	0	rw

Note

The object index range for each additional drive can be determined using r8743. The parameter value corresponds to the drive object ID. The parameter index corresponds to the factor with which the offset 40 hex must be multiplied and added to the basis object. For instance, the drive starts with offset factor 1 from 1840 hex.

2.5.2.3 Other communication objects

The following table lists the object directory with the index of all other communication objects dependent on the drive:

Table 2- 5 Other communication objects

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Default values:	SDO access
1202		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw
1203		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw
1204		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw
1205		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw

OD index (hex)	Subin-dex (hex)	Object name	SINAMICS parameters	PDO map-ping	Data type	Default val-ues:	SDO access
1206		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw
1207		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw
1208		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw
1209		Drive object server SDO parameter	–	–	–	–	–
	0	Number of entries	–	No	–	–	ro
	1	COB ID client -> server (rx)	p8612.0	No	Unsigned32	0x80000000	rw
	2	COB ID server -> client (tx)	p8612.1	No	Unsigned32	0x80000000	rw

2.5.3 Manufacturer-specific objects

There is an area for manufacture-specific objects in the CANopen object directory.

Manufacturer-specific objects are defined as:

- Objects to access SINAMICS parameters
- Free objects to send/receive process data

This manufacturer-specific range starts in the object directory from address "2000 hex" and ends at "5FFF hex".

2.5.3.1 Objects to access SINAMICS parameters

Data values of SINAMICS parameters can be accessed using the objects in the range from "2000 hex" to "470F hex" of the object directory via the default SDO server (see Chapter “SDO server (Page 64)”).

Example

The following diagram shows the distribution of objects in the object directory.

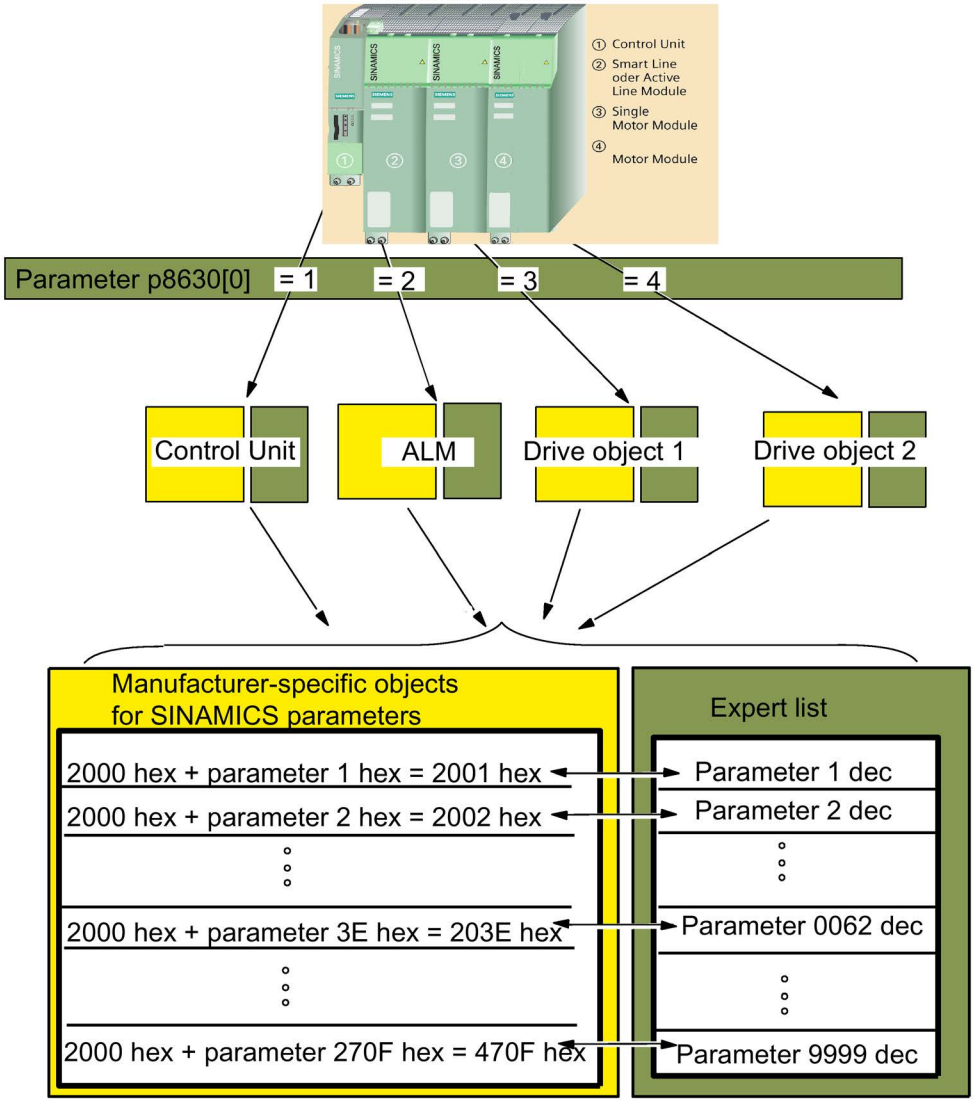


Figure 2-4 Manufacturer-specific objects

Parameter p8630[0…2]

Using parameter p8630 indices 0 to 2, you can define the way drive objects are accessed in SINAMICS. The following access methods are available:

- The drive object is selected in p8630[0]
  - 0: Virtual objects cannot be accessed
  - 1: Control Unit
  - 2…65535: Drive object
- Subindex range in p8630[1]
  - 0: 0…255
  - 1: 256…511
  - 2: 512…767
  - 3: 768…1023
- Parameter range in p8630[2]
  - 0: 0…9999
  - 1: 10000…19999
  - 2: 20000…29999
  - 3: 30000…39999
  - 4: 40000…49999
  - 5: 50000…59999

General procedure

All SINAMICS parameters in the range "2000 hex" to "470F hex"can be addressed via SDO access.

This functions as follows:

- All SINAMICS parameters can be addressed using the objects "2000 hex" to "470F hex".
- The SDO access is based on internally converting manufacturer-specific objects into parameters. "2000 hex" is added to the parameter number converted to a hexadecimal value.

  This number is the object number in the SDO request required to access the SINAMICS parameter.
- Since the parameter range of a SINAMICS drive object occupies the entire object space of the parameter access in the manufacturer-specific range, the drive object that is to be accessed is selected in parameter p8630[0] (in SINAMICS).

- A SINAMICS parameter can be an r or p parameter. The manufacturer-specific objects contain the data values for these parameters.
- Depending on the switch position of parameter p8630[0], the data values for the modules can be read or written.

  If, for example, parameter r0062 of the setpoint velocity is to be read out from drive object 1, then:

  – The switch must be set to "3" in parameter p8630[0] (see previous diagram),

  – The parameter number r0062 is converted to a hexadecimal value and "2000 hex" is added. With this hexadecimal number "203E hex", which corresponds to the object number, the parameter r0062 can be accessed via an SDO request.

2.5.3.2 Free objects

In the object directory (OD), you have the option to use free objects for process data (PZD) in the range from "5800 hex" to "5FFF hex" (also refer to section “CANopen object directory (Page 34)”).

For each drive object, the following objects – that can be freely interconnected – are available in the object directory:

OD index (hex)	Description	SINAMICS parameters	PDO mapping	Data type per PZD	Default values	SDO access
5800 to 580F	16 freely-interconnectable receive process data	r8745[x]	Yes	Integer16	0	rw
5810 to 581F	16 freely-interconnectable transmit process data	r8746[x]	Yes	Integer16	0	ro
5820 to 5827	8 freely-interconnectable receive process data	r8747[x]	Yes	Integer32	0	rw
5828 to 582F	Reserved	–	–	–	–	–
5830 to 5837	8 freely-interconnectable transmit process data	r8748[x]	Yes	Integer32	0	ro
5838 to 5879	Reserved	–	–	–	–	–

Note

The object index range for each additional drive can be determined using r8743. The parameter value corresponds to the drive object ID. The parameter index corresponds to the factor with which the offset 80 hex must be multiplied and added to the basis object. For instance, the drive starts with offset factor 1 from 5880 hex.

You can interconnect any process data objects using receive/transmit words/double words of the receive and transmit buffer.

Scaling the process data of the free objects for percentage values:

- 16 bit (word): 4000 hex corresponds to 100 %
- 32 bit (double word): 4000000 hex corresponds to 100 %

Scaling the process data of the free objects for unit-deficient values:

- 16-bit (word): 4000 hex corresponds to the value of the corresponding reference parameter p200x
- 32 bit (double word): 4000000 hex corresponds to the value of the corresponding reference parameter p200x

Example:

If the process data is a temperature value, the scaling of the free objects appears as follows:

- 16 bit (word): 4000 hex corresponds to p2006
- 32 bit (double word): 4000000 hex corresponds to p2006

2.5.4 CANopen objects of the drive profile DSP402

Overview

The following table lists the object directory with the index of the individual objects for the drives.

CANopen for SINAMICS S120 supports the following modes:

- Profile Velocity Mode
- Profile Torque Mode
- Velocity Mode

Table 2- 6 Objects in drive profile DSP402

OD index (hex)	Subin-dex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Default values	SDO ac-cess
Device control							
6007	–	Abort connection option code	p8641	No	Integer16	3	rw
6040	–	Control word	r8795	Yes	Unsigned16	–	rw
6041	–	Status word	r8784	Yes	Unsigned16	–	ro
605D	–	Stop option code	p8791	No	Integer16	–	rw
6060	–	Modes of operation	p1300	Yes	Integer8	–	rw
6061	–	Modes of operation display	r8762	Yes	Integer8	–	ro
6502	–	Supported drive modes	–	No	Unsigned32	–	ro
6504	–	Drive manufacturer	–	No	String	–	ro

OD index (hex)	Subindex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Default values	SDO access
67FF	–	Single device type	–	No	Unsigned32	–	ro
Factor group							
6094	00	Velocity encoder factor	–	No	Unsigned8	2	ro
	01	Velocity encoder factor numerator	p8798[0]	No	Unsigned32	1	rw
	02	Velocity encoder factor denumerator	p8798[1]	No	Unsigned32	1	rw
Profile Velocity Mode							
6063	–	Actual position value	r0482	Yes	Integer32	–	ro
6069	–	Velocity sensor actual value	r0061	Yes	Integer32	–	ro
606B	–	Velocity demand value	r1170	Yes	Integer32	–	ro
606C	–	Velocity actual value Actual velocity	r0063	Yes	Integer32	–	ro
6083	–	Profile acceleration	p1082/ p1120	No	Unsigned32	–	rw
6084	–	Profile deceleration	p1082/ p1121	No	Unsigned32	–	rw
6085	–	Quick stop deceleration	p1082/ p1135	No	Unsigned32	–	rw
6086	–	Motion profile type	p1115/ p1134	No	Integer16	0	rw
60FF	–	Target velocity Setpoint velocity	Without ramp-function generator -> p1155[0] With ramp-function generator -> p1070	Yes	Integer32	–	rw
Profile Torque Mode							
6071	–	Target torque Setpoint torque	r8797	Yes	Integer16	–	rw
6072	–	Max torque	p1520	No	0	0	0
6074	–	Torque demand value Setpoint torque total	r0079	Yes	Integer16	–	ro
6077	–	Torque actual value	r0080	Yes	Integer16	–	ro
Velocity Mode							
6042	–	vl target velocity	r8792	Yes	Integer16	–	rw
6043	–	vl velocity demand	r1170	Yes	Integer16	–	ro
6044	–	vl velocity actual value	r0063	Yes	Integer16	–	ro
6046	0	vl velocity min./max. amount	–	No	Unsigned8	–	ro
	1	vl velocity min. amount	p1080	No	Unsigned32	–	rw
	2	vl velocity max. amount	p1082	No	Unsigned32	–	rw

OD index (hex)	Subin-dex (hex)	Object name	SINAMICS parameters	PDO mapping	Data type	Default values	SDO ac-cess
6048	0	vl velocity acceleration	–	No	Unsigned8	–	ro
	1	Delta speed	p1082	No	Unsigned32	–	rw
	2	Delta time	p1120	No	Unsigned16	–	rw

Note

The object index range for each additional drive can be determined using r8743. The parameter value corresponds to the drive object ID. The parameter index corresponds to the factor with which the offset 800 hex must be multiplied and added to the basis object. For instance, the drive starts with offset factor 1 from 6807 hex.

2.6 SDO (Service Data Object)

2.6.1 General

SDO services allow you to access the object directory for the connected drive unit. An SDO connection is a peer-to-peer connection between an SDO client and a server.

The drive unit with its object directory is an SDO server (Page 64).

SDO services have the following properties:

- Confirmed transmission of objects
- The transmission procedure is always asynchronous
- Transmission of values greater than four bytes (normal transfer)
- Transmission of values with no more than four bytes (expedited transfer)
- Corresponds to the acyclic PROFIBUS parameter channel
- All drive unit variables can be addressed via SDO
- An SDO connection exists only in the "PREOPERATIONAL" and "OPERATIONAL" states

2.6.2 SDO server for each drive object

2.6.2.1 Mapping models

Several mapping models are supported:

- Multi-DO SINAMICS drive unit with one SDO server (default SDO server)
- Multi-DO SINAMICS drive unit with several EDS files and SDO servers

Multi-DO SINAMICS drive unit with one SDO server

With this mapping model, the multi-DO SINAMICS drive unit is mapped via modules with an SDO server (default SDO server). A modular EDS file, without manufacturer-specific CANopen objects, exists for every SINAMICS drive unit.

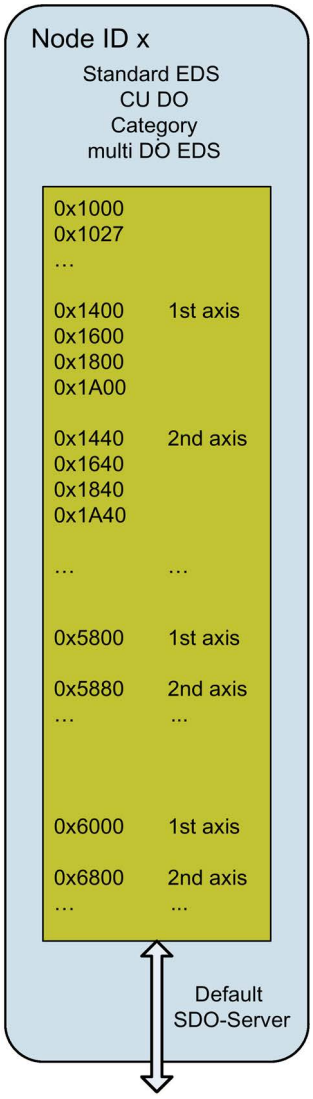


Figure 2-5 Modeling a multi-DO SINAMICS drive unit

Multi-DO SINAMICS drive unit with several EDS files and SDO servers

For this mapping model, the multi-DO SINAMICS drive unit is mapped from n+2 EDS files and n+2 SDO servers.

Components	Explanation
n+2 EDS files	1 standard EDS file for CU drive object 1 manufacturer-specific EDS file for the drive object of the Control Unit n manufacturer-specific EDS files for n axes, which support CANopen (with n = 1 … 8 axes)
n+2 SDO channels	1 default SDO server for CU-DO 1 manufacturer-specific SDO server for the drive object of the Control Unit n manufacturer-specific SDO servers for n axes (for each drive object, which CANopen supports, with n = 1 … 8 axes).

Each additional SDO server is responsible for a drive object. In particular, it is responsible for the manufacturer-specific objects of this drive object. The default SDO server has access to the standard EDS file.

This means that for each CANopen drive object (including the drive object of the Control Unit), there is an additional dedicated manufacturer-specific EDS file.

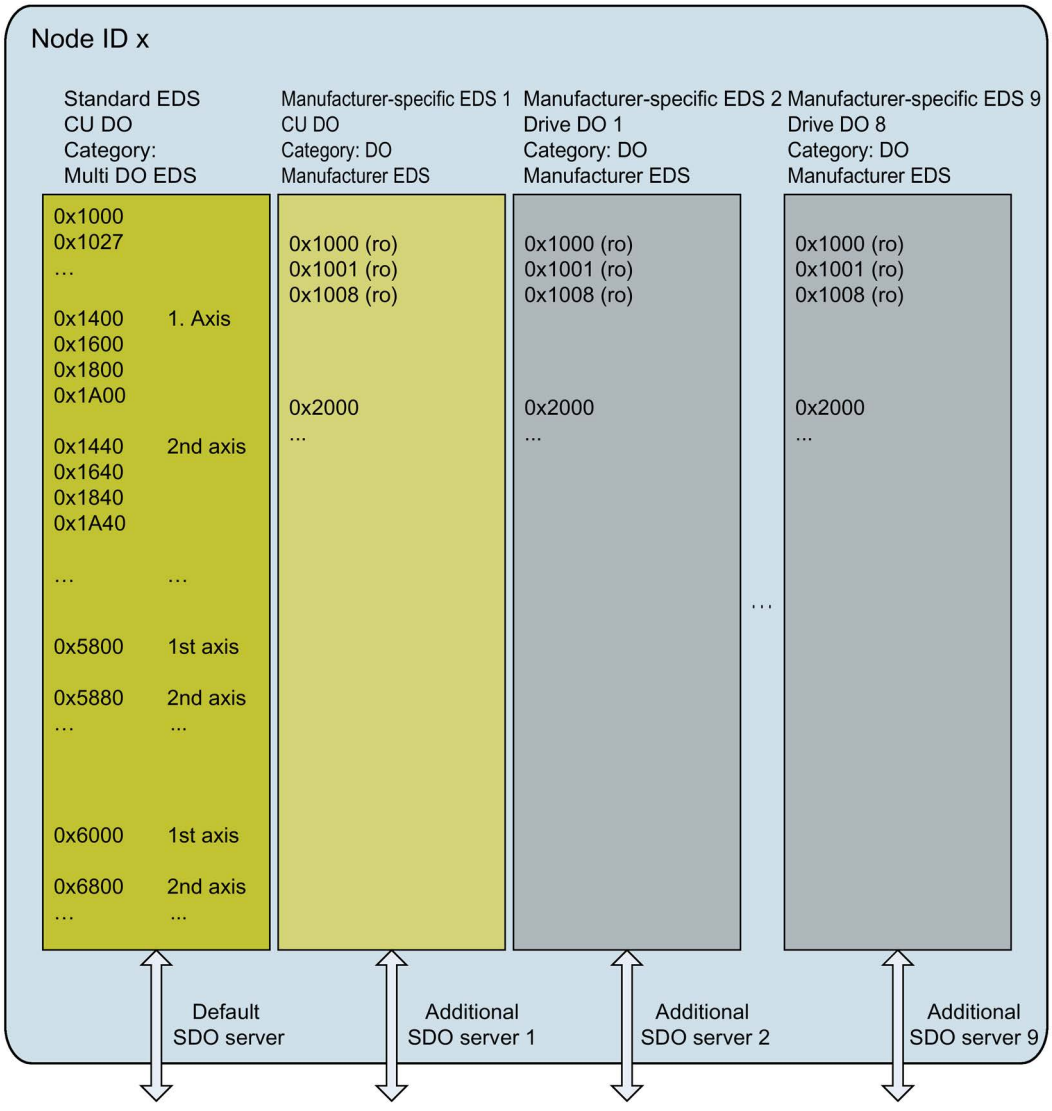


Figure 2-6 Modeling a multi-DO SINAMICS drive unit

2.6.2.2 EDS files

In addition to the standard EDS files (EDS = Electronic Data Sheet), there are also standardized CANopen objects (SDO server parameter), which were extended for the additional SDO server.

In addition, you can use the following EDS:

- A modular EDS file without manufacturer-specific objects
- EDS files of both categories (modular and manufacturer-specific)

There is then an EDS file for each SINAMICS drive unit and one for each SINAMICS drive object, which supports CANopen.

You can download EDS files from the following Internet address: Download EDS (http://support.automation.siemens.com/WW/view/de/48802094).

Overview of EDS Files

Name	G120P	G120C	G120S_SERVO	G120S_VECTOR	S110	S120	S150	G130	G150	GL150	GM150	SL150	SM120	MV	Category
SINAMICS_G120P.eds	X	–	–	–	–	–	–	–	–	–	–	–	–	–	Single DO EDS
SINAMICS_G120C.eds	–	X	–	–	–	–	–	–	–	–	–	–	–	–	Single DO EDS
SINAMICS_G120S_SERVO.eds	–	–	X	–	–	–	–	–	–	–	–	–	–	–	Single DO EDS
SINAMICS_G120S_VECTOR.eds	–	–	–	X	–	–	–	–	–	–	–	–	–	–	Single DO EDS
SINAMICS_MV.eds	–	–	–	–	–	–	–	–	–	–	–	–	–	X	Multi DO EDS
SINAMICS_S120.eds	–	–	–	–	–	X	–	–	–	–	–	–	–	–	Multi DO EDS
SINAMICS_S110.eds	–	–	–	–	X	–	–	–	–	–	–	–	–	–	Multi DO EDS
SINAMICS_S150.eds	–	–	–	–	–	–	X	–	–	–	–	–	–	–	Multi DO EDS
SINAMICS_SL150.eds	–	–	–	–	–	–	–	–	–	–	–	X	–	–	Multi DO EDS
SINAMICS_SM150.eds	–	–	–	–	–	–	–	–	–	–	–	–	X	–	Multi DO EDS
SINAMICS_G130.eds	–	–	–	–	–	–	–	X	–	–	–	–	–	–	Multi DO EDS
SINAMICS_G150.eds	–	–	–	–	–	–	–	–	X	–	–	–	–	–	Multi DO EDS
SINAMICS_GL150.eds	–	–	–	–	–	–	–	–	–	X	–	–	–	–	Multi DO EDS
SINAMICS_GM150.eds	–	–	–	–	–	–	–	–	–	–	X	–	–	–	Multi DO EDS
SINAMICS_S120_CU.eds	–	–	–	–	–	X	–	–	–	–	–	–	–	–	DO Manufacturer EDS
SINAMICS_S150_CU.eds	–	–	–	–	–	–	X	–	–	–	–	–	–	–	DO Manufacturer EDS
SINAMICS_G130_CU.eds	–	–	–	–	–	–	–	X	–	–	–	–	–	–	DO Manufacturer EDS
SINAMICS_G150_CU.eds	–	–	–	–	–	–	–	–	X	–	–	–	–	–	DO Manufacturer EDS
SINAMICS_MV_CU.eds	–	–	–	–	–	–	–	–	–	–	–	–	–	X	DO Manufacturer EDS
SINAMICS_SERVO.eds	–	–	–	–	–	X	–	–	–	–	–	–	–	–	DO Manufacturer EDS
SINAMICS_VECTOR.eds	–	–	–	–	–	X	X	X	X	–	–	–	–	–	DO Manufacturer EDS
SINAMICS_VECTORMV.eds	–	–	–	–	–	–	–	–	–	–	X	X	–	X	DO Manufacturer EDS
SINAMICS_A_INFM2C.eds	–	–	–	–	–	–	–	–	–	–	–	–	–	X	DO Manufacturer EDS

Figure 2-7 EDS files of the SINAMICS devices

Multi DO EDS

Device-specific EDS without manufacturer-specific objects.
File name: "SINAMICS_Gerätename.eds"

CANopen objects	Name
Objects from the communication profile - number range 0x1000 - 0x1FFF:	
0x1000	Device Type
0x1001	Error Register
0x1003	Pre-defined error field
0x1005	COB-ID SYNC message
0x1008	Manufacturer device name
0x100A	Manufacturer software version
0x100C	Guard time
0x100D	Life time factor
0x1010	Store parameters
0x1011	Restore default parameters
0x1014	COB-ID EMCY
0x1017	Producer heartbeat time
0x1018	Identity object
0x1027	Module list
0x1029	Error behavior object
0x1200	SDO server parameter Default SDO channel
0x1201	SDO server parameter CU DO channel
0x1200 + (n+1)	with n = 1 … 8 SDO server parameter Drive DO channels
0x1400 + (n-1) · 0x40 to 0x1407 + (n-1) · 0x40	with n = 1 … 8 axes RPDO communication parameter
0x1600 + (n-1) · 0x40 to 0x1607 + (n-1) · 0x40	with n = 1 … 8 axes RPDO mapping parameter
0x1800 + (n-1) · 0x40 to 0x1807 + (n-1) · 0x40	with n = 1 … 8 axes TPDO communication parameter
0x1A00 + (n-1) · 0x40 to 0x1A07 + (n-1) · 0x40	with n = 1 … 8 axes TPDO mapping parameter
Free process data objects in the manufacturer-specific number range of all n logical devices (n axes)	
0x5800 + (n-1) · 0x80 to 0x580F + (n-1) · 0x80	with n = 1 … 8 axes 16 Bit free receive PDOs
0x5810 + (n-1) · 0x80 to 0x581F + (n-1) · 0x80	with n = 1 … 8 axes 16 Bit free transmit PDOs
0x5820 + (n-1) · 0x80 to 0x5827 + (n-1) · 0x80	with n = 1 … 8 axes 32 Bit free receive PDOs
0x5830 + (n-1) · 0x80 to 0x5837 + (n-1) · 0x80	with n = 1 … 8 axes 32 Bit free transmit PDOs
Objects of the standard profile - number range of all n logical devices (n axes)	
0x6000 + (n-1) · 0x800 to 0x67FF + (n-1) · 0x800	with n = 1 … 8 axes

DO manufacturer EDS

Drive object-specific EDS with manufacturer-specific objects.
File name for CU DO: "SINAMICS_Gerätename_CU.eds"

File name for DO: "SINAMICS_DOClassID.eds"

CANopen objects	Name
Specified objects (mandatory) from the communication profile - number range 0x1000 to 0x1FFF:	
0x1000 (read only)	Device Type
0x1001 (read only)	Error Register
0x1018 (read only)	Identity Object
Manufacturer-specific objects in the number range 0x2000 to 0x57FF from the Table Manufacturer-specific CANopen object (Page 65). Conversion rule: Manufacturer-specific object index = SINAMICS parameter No. in hex + 0x2000	

2.6.2.3 SDO server

Default SDO server

The default SDO server is used to access the standardized objects, i.e. on the EDS file of category "Multi DO EDS".

By changing the default value of the p8630[0] ≥ 1, manufacturer-specific objects can still be accessed.

Server default SDO parameters:

0x1200.0 = 2
0x1200.1 = 0x600 + Node ID
0x1200.2 = 0x580 + Node ID

The server SDO parameters of the default SDO server are read-only, and mapped in SINAMICS parameter r8610.

Additional SDO server

The next SDO server after the default SDO server is used to access the manufacturer-specific objects of the CU drive object; i.e. to access the EDS file of the category "DO Manufacturer EDS".

Server SDO parameters of the drive object of the control unit:

0x1201.0 = 2
0x1201.1 = 0x601 + Node ID
0x1201.2 = 0x581 + Node ID

The object in the fixed area is in the EDS file.

The n additional SDO servers are used to access the manufacturer-specific objects of the CAN drive object with n = 1 … 8 axes, i.e. to access the EDS files of the category "DO Manufacturer EDS".

There is no SDO access to drive object categories that are not supported by CAN.

Server SDO parameters of the nth axis:

(0x1201 + n).0	= 2	with n = 1 … 8 axes
(0x1201 + n).1	= 0x601 + Node ID + n	with n = 1 … 8 axes
(0x1201 + n).2	= 0x581 + Node ID + n	with n = 1 … 8 axes

The objects in the modular area are located in the EDS file.

The additional SDO servers are used to improve the addressing, and not to facilitate parallel SDO access. Response times should be expected when accessing the parameter manager.

In the factory setting, all additional SDO servers are set to invalid using bit 31, and when required, must be manually activated.

The server SDO parameters of the additional SDO servers can be written to, and are mapped in SINAMICS parameter p8612.

The CAN identifiers of the additional SDO servers can be freely selected within the CANopen SDO number range 0x601 - 0x67F for receive SDO or 0x581 - 0x5FF for send SDO.

2.6.2.4 Objects of the manufacturer-specific EDS files

There are manufacture-specific CANopen objects for a series of SINAMICS parameters in the corresponding manufacture-specific EDS files:

Table 2- 7 Manufacturer-specific CANopen object

Parameter name	Parameter reference	CANopen object
Current limit	p0640	0x2280
Technology controller enable	p2200	0x2898
Technology controller actual value filter time constant	p2265	0x28D9
Technology controller differentiation time constant	p2274	0x28E2
Technology controller proportional gain	p2280	0x28E8
Technology controller maximum limiting	p2291	0x28F3
Technology controller minimum limiting	p2292	0x28F4
Output frequency	r0066	0x2042
Speed setpoint smoothed	r0020	0x2014
Output frequency smoothed	r0024	0x2018
Output voltage smoothed	r0025	0x2019
DC link voltage, smoothed	r0026	0x201A
Absolute actual current, smoothed	r0027	0x201B
Actual torque, smoothed	r0031	0x201F
Actual active power, smoothed	r0032	0x2020
Motor temperature	r0035	0x2023

Parameter name	Parameter reference	CANopen object
Power unit temperatures	r0037	0x2025
Energy display	r0039	0x2027
Command Data Set CDS effective	r0050	0x2032
Status word 2 (ZSW2) effective	r0053	0x2035
Control word 1 (STW1) effective	r0054	0x2036
CU digital inputs, status	r0722	0x22D2
CU, digital outputs status	r0747	0x22EB
CU analog inputs input voltage/current	r0752	0x22F0
CU analog outputs output voltage/current	r0774	0x2306
Fault number	r0947	0x23B3
Actual pulse frequency	r1801	0x2709
Alarm number	r2110	0x283E
Technology controller setpoint after ramp-function generator	r2260	0x28D4
Technology controller actual value after filter	r2266	0x28DA
Technology controller output signal	r2294	0x28F6
Technology controller ramp-up time	p2257	0x28D1
Technology controller ramp-down time	p2258	0x28D2
Technology controller integral action time	p2285	0x28ED

2.7 PDO (Process Data Object)

PDOs (Process Data Object) are used to transmit process data, which is used for real-time access to selected data. For certain variables, mappings to certain PDOs are preconfigured.

The PDOs are linked with entries in the object directory and represent the interface with the drive objects. Data type and mapping of the drive objects in a PDO are determined by the PDO mapping structure inside the object directory. The number of PDOs and the mapping of the drive objects in a PDO are transmitted to the unit during the unit configuration process.

This transmission is implemented at the corresponding entries in the object directory via SDO services.

PDOs are used in two different ways:

PDO type	Task	Protocol/model
Transmit PDO (TPDO)	Sending data	PDO Producer
Receive PDO (RPDO)	Receiving data	PDO Consumer

The PDO is characterized by PDO communication parameters and PDO mapping parameters. The structure of these parameter is listed in the following tables.

2.7.1 Parameter

Table 2- 8 PDO communication parameters 1400 hex ff, 1800 hex ff.

Subindex	Name	Data type
00 hex	Number of subindices	UNSIGNED8
01 hex	COB-ID of the PDO	UNSIGNED32
02 hex	Transmission type of the PDO	UNSIGNED8
03 hex[1)]	Inhibit time	UNSIGNED16
04 hex[1)]	Reserved	UNSIGNED8
05 hex[1)]	Event Timer	UNSIGNED16

[1)] only valid for 1800 hex ff

Table 2- 9 PDO mapping parameters 1600 hex ff, 1A00 hex ff.

Subindex	Name	Data type
00 hex	Number of mapped objects in the PDO	UNSIGNED8
01 hex	1st object to be mapped	UNSIGNED32
02 hex	2nd object to be mapped	UNSIGNED32
03 hex	3rd object to be mapped	UNSIGNED32
04 hex	4th object to be mapped	UNSIGNED32

The PDO communications parameter describes the communication options of the PDO. The PDO mapping parameter contains information on the content of the PDO.

It is necessary to define communication parameters and mapping parameters for each PDO.

A maximum of 8 RPDO and 8 TPDO can be configured per logical CANopen device module. The object index range for each additional drive can be determined using r8743. The parameter value corresponds to the drive object ID. The parameter index corresponds to the factor with which the offset 40 hex must be multiplied and added to the basis object. For instance, the drive starts with offset factor 1 from 1640 hex.

The indices of the corresponding entries in the object directory are calculated as follows:

- RPDO communication parameter index = 1400 hex + offset factor 40 hex
- RPDO mapping parameter index = 1600 hex + offset factor 40 hex
- TPDO communication parameter index = 1800 hex + offset factor 40 hex
- TPDO mapping parameter index = 1A00 hex + offset factor 40 hex

2.7.2 Data transmission types

The following PDO transmission types are available:

- Synchronous transmission
- Asynchronous transmission

In order that the communicating devices remain synchronized during transmission, a synchronization object (SYNC object) must be transmitted at periodic intervals.

The following diagram shows the principle of synchronous and asynchronous transmission:

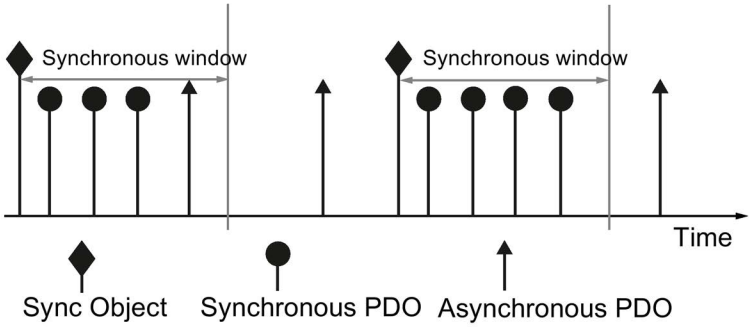


Figure 2-8 Principle of synchronous and asynchronous transmission

The type of transmission is characterized by a PDO's parameter for transmission type.

For synchronous TPDOs, the transmission type also identifies the transmission rate as a factor of the SYNC object "transmission intervals". Here, the transmission type "1" means that the message will be transmitted in every SYNC object cycle. The transmission type "n" means that the message will be transmitted in every nth SYNC object cycle.

Asynchronous TPDOs are transmitted without reference to the SYNC signal. Data from synchronous RPDOs, which are received after a SYNC signal, is not transmitted to the application until after the next SYNC signal.

The SYNC object is sent periodically from the SYNC producer. The SYNC signal represents the basic network cycle. The time interval between 2 SYNC signals is determined by the standard parameter "Communication cycle time".

In order to provide real-time access to the CAN bus, the SYNC object has a very high-priority identifier, the factory setting is 80 hex. The service runs unconfirmed. The SYNC object identifier can be changed to another value. Then all the CANopen slaves on the same bus should also be changed appropriately, so that communication remains possible. The identifier of the SYNC object has object index 1005 hex.

Note

The SYNC signal does not synchronize the applications in the SINAMICS drive, only the communication on the CANopen bus.

Data from asynchronous RPDO is passed on to the application directly.

2.7.3 Number of PDO that can be created

In a SINAMICS drive object a maximum of 8 receive and 8 send PDO can be defined.

For drive objects supported by CANopen, the total number of valid RPDO is limited to 25 as a result of the hardware.

For the drive object supported by CANopen, the total number of valid TPDO is defined by the following ratio:

$$\text{Total number of valid TPDOs} = \frac{\text{CAN sampling time (p8848)}}{\text{Smallest CAN processing time (r8739)}}$$

Alarm A08758 "CAN: Maximum number of valid PDO exceeded" is output when these limits are exceeded.

2.7.4 Send and receive message frames for process data

In the SINAMICS drive line-up, the STARTER commissioning tool offers two options for commissioning a CANopen interface:

- Using predefined telegrams ("Predefined Connection Set") and COB IDs.
- Using free PDO mapping (user-defined telegrams).

Note

Recommendation

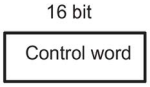
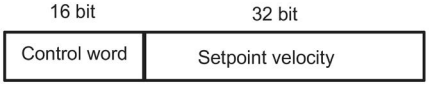
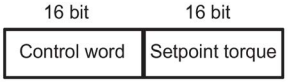
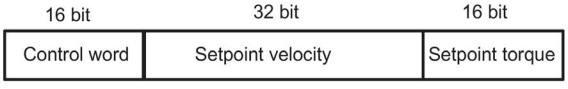
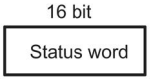
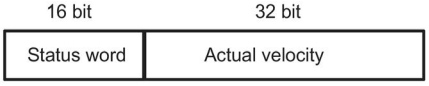
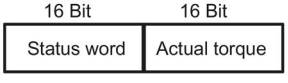
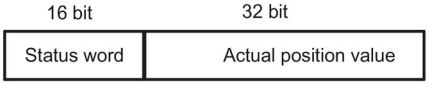
In the first step, activate the "Predefined Connection Set" and then update the preconfigured parameters in accordance with your application in the free PDO mapping.

For automatic commissioning, the "Predefined Connection Set" is already set.

Predefined telegrams for SINAMICS

The following process data objects are predefined and mapped in the "predefined connection set" in the receive and transmit telegrams for the corresponding drive objects. Each additional drive object begins with an offset of "800 hex".

Table 2- 10 Process data objects in the predefined connection set

Type	Process data	Telegram
Receive telegram	RPDO1	 6040 hex
	RPDO2	 6040 hex + 60FF hex
	RPDO3	 6040 hex + 6071 hex
	RPDO4	 6040 hex + 60FF hex + 6071 hex
Transmit tele-gram	TPDO1	 6041 hex
	TPDO2	 6041 hex + 606C hex
	TPDO3	 6041 hex + 6077 hex
	TPDO4	 6041 hex + 6063 hex

Note

For each drive object in the expert list, the process data objects for mapping the telegrams begin as follows:

- For receive telegrams starting from parameter p8710
- For transmit telegrams starting from parameter p8730

Users must create the corresponding BICO interconnections of the PZD interface.

Note

The object index range for each additional drive can be determined using r8743. The parameter value corresponds to the drive object ID. The parameter index corresponds to the factor with which the offset 800 hex must be multiplied and added to the basis object. For instance, the drive starts with offset factor 1 from 6840 hex.

2.7.5 PDO mapping

PDO mapping is used to map CAPopen standard objects (process data, e.g. setpoints or actual values) and "free objects" from the object directory for the PDO service as message frame.

The PDO message frame transmits the data values of these objects.

For this purpose, a maximum of 8 receive and 8 transmit PDOs are available for each drive object.

A CAN message frame can transmit up to 8 bytes of user data. The user decides which data is to be transmitted in a PDO.

Example

The following diagram uses an example to illustrate PDO mapping (values are hexadecimal (e.g. object size "20 hex" = 32 bits)):

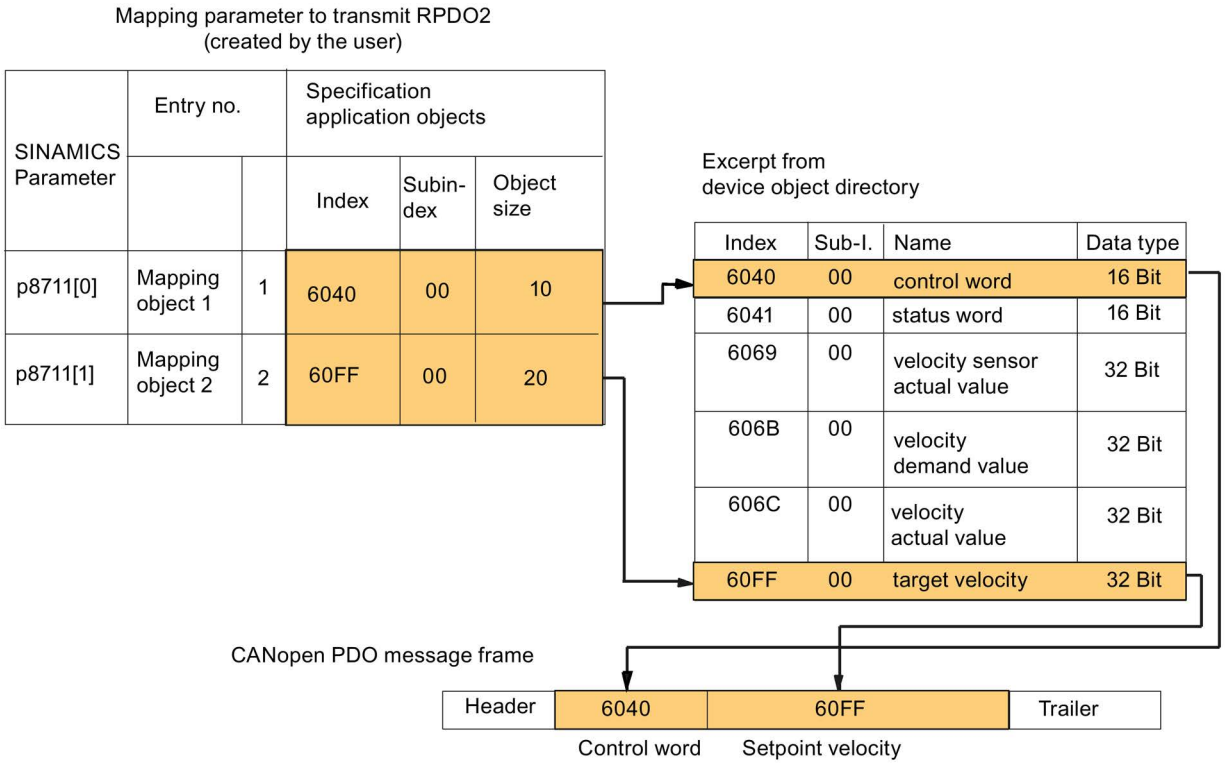


Figure 2-9 PDO mapping

2.7.6 RPDO monitoring

RPDO monitoring (Receive Process Data Object) for process data received via CAN bus is activated by writing the monitoring time (in ms) in p8699. Values that cannot be divided by the CANopen sampling time with an integer result are rounded up.

If no process data is received within this time, error F08702 is output. The monitoring time begins when the first RPDO of the topology has been received.

The activated and initiated RPDO monitoring is displayed via the PROFIdrive PZD state "Fieldbus oper" r8843.2.

p8848: CANopen sampling time

2.8 CANopen device state machine

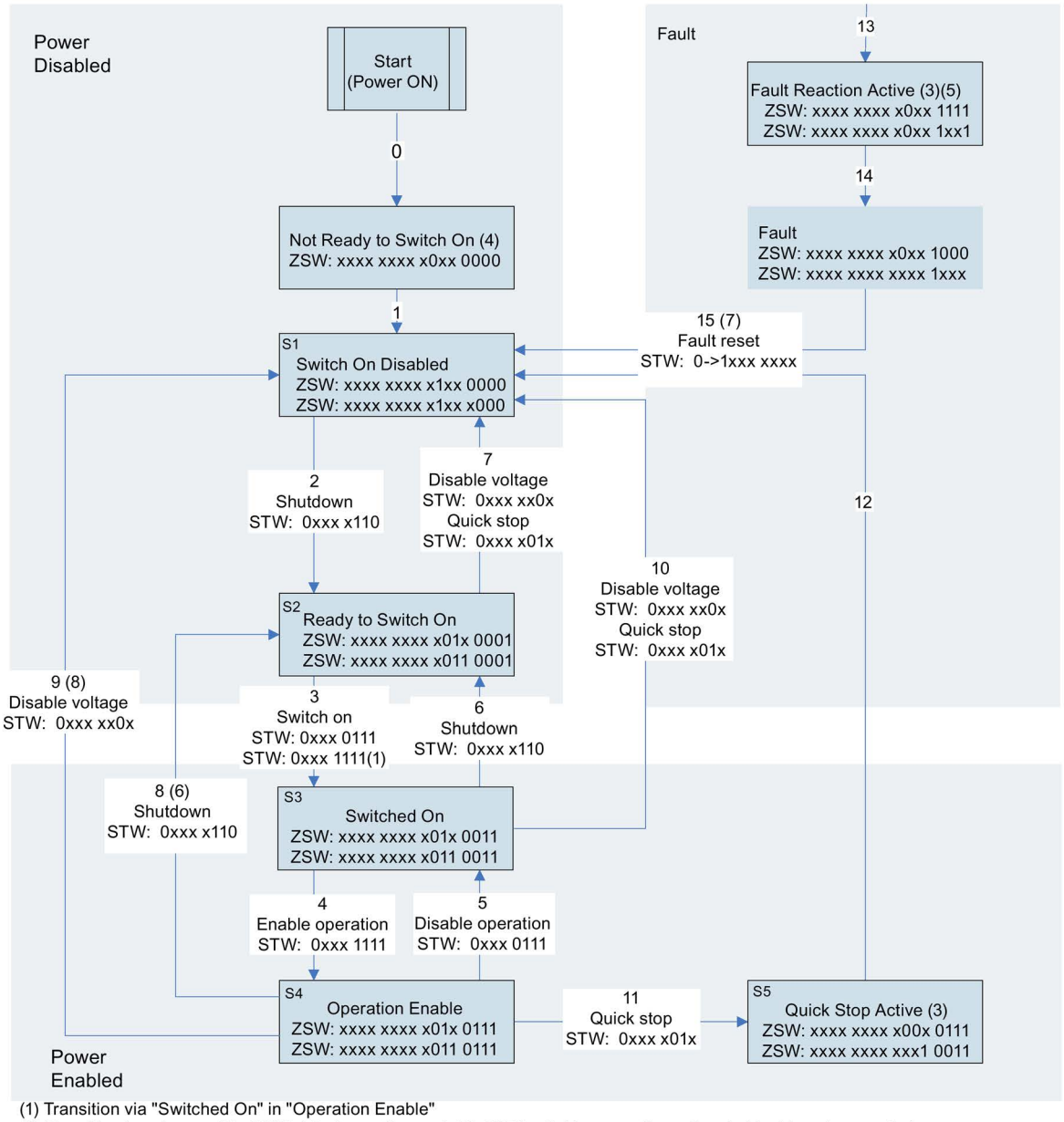
The CANopen device state machine describes the drive status and the possible drive device status transitions. Each individual status describes a particular internal or external behavior. Depending on the drive device status, only certain transition commands are accepted.

The drive device status is changed using a defined CANopen control word (6040 hex/r8795) – and/or corresponding to an internal event. The actual status can be read from the CANopen status word (6041 hex/r8784).

Table 2- 11 Status of the CANopen device machine

Status	Condition
Not Ready to Switch On	Low power is present at the drive. The drive is initialized. The drive function is deactivated.
Switch On Disabled	Drive initialization has been completed. The drive parameters may be changed. The drive function is deactivated. It is not permissible that a high voltage is connected to the drive.
Ready to Switch On	The drive parameters may be changed. The drive function is deactivated. It is permissible that a high voltage is connected to the drive.
Switched On	The drive parameters may be changed. The drive function is deactivated. A high voltage was connected to the drive. The current amplifier is ready.
Operation Enable	No faults were identified. The drive parameters may be changed. The drive-function is activated and the motor is supplied with current. This corresponds to normal drive operation.
Quick Stop Active	The quick stop function is executed. The drive parameters may be changed. The drive-function is activated and the motor is supplied with current.
Fault Reaction Active	A non-fatal fault has occurred at the drive. The quick stop function is executed. The drive parameters may be changed. The drive-function is activated and the motor is supplied with current.
Fault	The drive parameters may be changed. A fault has occurred at the drive.

States of the CANopen device state machine and their mapping on SINAMICS drives



(1) Transition via "Switched On" in "Operation Enable"
(2) Transition is only permitted if "Quick stop option code" 0x605A = 5. However, the optional object is not supported.
(3) The state is only recognized if PZD sampling time p8848 <= 2 ms, since the underlying SINAMICS sequence control is calculated in 2 ms.

(4) Internal state, not visible in CANopen ZTW, since no CANopen communication is possible at this time.
(5) The state will not run if a fault appears in "Switch On Disabled".
(6) Automatic switching via "Switched On" to "Ready to Switch On", only visible for CBC10 sampling time p8848 <= 2ms.
(7) Automatic switching via "Switch On Disabled" to "Ready to Switch On" with the command "Fault Reset" and "Shutdown", only visible for CBC10 sampling time p8848 <= 2 ms.
(8) Display of state xx03hex (for STW=0hex) or xx27hex (for STW=27hex) for one cycle, as the power unit displays the actual state, only visible for CBC10 sampling time p8848 <= 2ms.
Sx = PROFIdrive state numbers
ZSW = Status word according to CANopen (Object 6041)
ZSW = Status word for SINAMICS
STW = Control word (Object 6040)

2.9 Save parameters restore factory settings

Parameters can be saved and the factory settings restored using the following Control Unit communication objects.

- Parameter save -> communication object 1010 hex
- Restore factory settings -> communication object 1011 hex

Parameter save (object 1010 hex).

- Subindex 0: (1010.0):

  The number of subindices of this object are shown in this subindex.

- Subindex 1: (1010.1):

  By writing the ASCII character sequence "evas" - which corresponds to the hexadecimal value "65 76 61 73" - to this subindex, all of the drive parameters are saved in the non-volatile memory (memory card).

  This corresponds to writing a "1" to drive parameter p0977.

- Subindex 2: (1010.2)[1)]:

  By writing the ASCII character sequence "evas" - which corresponds to the hexadecimal value "65 76 61 73" - to this subindex, only the communication objects (objects of the number range 1000 hex to 1FFF hex) of the drive are saved in the non-volatile memory (memory card).

- Subindex 3: (1010.3)[1)]:

  By writing the ASCII character sequence "evas" - which corresponds to the hexadecimal value "65 76 61 73" - to this subindex, only the application objects (objects of the number range 6000 hex to 9FFF hex) of the drive are saved in the non-volatile memory (memory card).

[1)] A partial data save (subindex 2 or 3) is only possible if previously a complete data save was performed (subindex 1).

The parameters of the communication objects are saved in the CCxxxxxn.ACX files in the directory \USER\SINAMICS\DATA\ on the memory card.

The parameters of the application objects are saved in the CAxxxxxn.ACX files in the directory \USER\SINAMICS\DATA\ on the memory card.

"n" corresponds to the drive object ID to which the parameters belong.

When reading subindices 1...3, a value of 1 is obtained, this has the following significance: Device saves parameters using a write access of the object.

Restoring the factory setting of the parameters (object 1011 hex)

- Subindex 0: (1011.0):

  The number of subindices of this object are shown in this subindex.

- Subindex 1: (1011.1):

  By writing the ASCII character sequence "daol" - which corresponds to the hexadecimal value "64 61 6F 6C" - to this subindex, all of the drive parameters are reset to their original factory setting.

  This corresponds to writing a "1" to drive parameter p0976.

- Subindex 2: (1011.2):

  By writing the ASCII character sequence "daol" - which corresponds to the hexadecimal value "64 61 6F 6C" - to this subindex, only the communication objects (objects of the number group 1000 hex to 1FFF hex) of the drive are reset to their factory setting.

- Subindex 3: (1011.3):

  By writing the ASCII character sequence "daol" - which corresponds to the hexadecimal value "64 61 6F 6C" - to this subindex, only the application objects (objects of the number group 6000 hex to 9FFF hex) of the drive are reset to their factory setting.

When reading subindices 1 to 3, a value of "1" is obtained, this has the following significance: The device sets the parameters back to their factory setting via write access of the object.

Note

The factory setting values of the parameters are immediately effective after successfully writing to object 1011 hex. According to CANopen, it should only be effective after the NMT commands "Reset Node" or "Reset Communication" or after switching on/off.

2.10 CAN bus sampling time

The sampling time of the CBC10 can be set with the parameter p8848 "IF2 PZD sampling time".

In the factory setting, the sampling time is 4 ms. Asynchronous message frames can be received and sent within a period of 4 ms.

Cycle time

- For cyclic receive message frames, the cycle time, according to the Shannon sampling theorem, must be greater than twice the sampling time. If the cycle time is long enough, no receive message frame is lost and alarm A08751 is not output.

  Example: The SYNC cycle should be 3 ms. The setting in p8848 =1 ms. So the cycle time is larger than double the sampling time.

- For receive message frames, whose data does not change according to the Shannon sampling theorem faster than twice the sampling time, then the cycle time can be increased. Alarm A08751, which is output when the cycle time is increased, can be suppressed by changing over the message type to "No message" using parameters p2118, p2119.

Setting the CAN bus sampling time using p8848:

- Set the device commissioning parameter filter p0009 = 3 (drive basis configuration).
- Change and save parameter p8848.
- Set parameter p0009 = 0. The CU is automatically booted, and the parameter change p8848 becomes effective.

2.11 The number of drives supported by CAN

Depending on the requirements placed on the drives, up to 5 axes can be simultaneously controlled – with the factory set sampling times – via the CAN bus.

CAN CBC10 Communication Board

3

3.1 Connection

The CBC10 is used to connect drives of the SINAMICS S120 drive system to higher-level automation systems with a CAN bus.

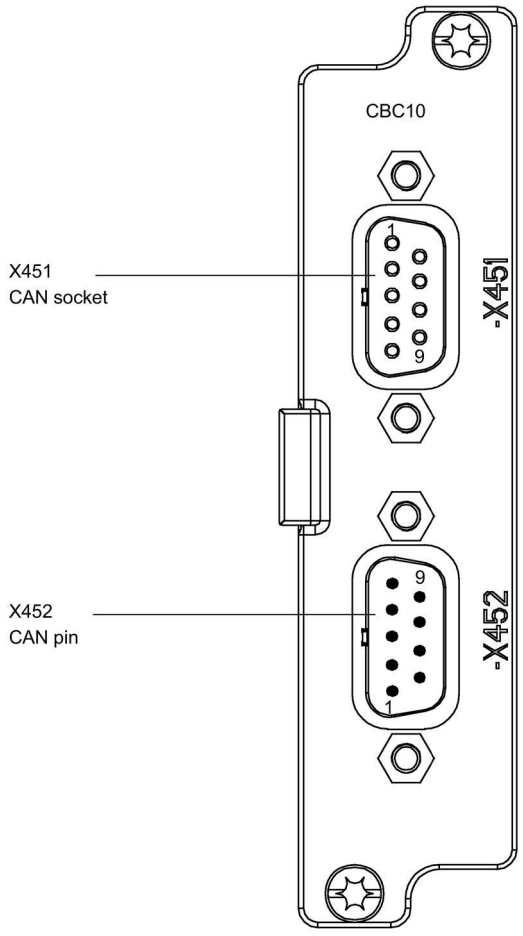


Figure 3-1 View of CBC10

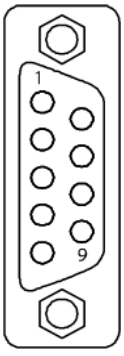
The CBC10 uses two 9-pin sub D connectors for the connection to the CAN bus system.

The connectors can be used as inputs or outputs. Unused pins are plated through.

The following baud rates are supported: 10, 20, 50, 125, 250, 500, 800 kBaud, and 1 Mbaud.

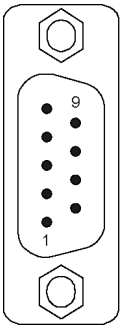
The X451 CAN bus interface has the following socket assignment.

Table 3- 1 CAN BUS interface X451

	Pin	Designation	Technical data
	1	Reserved	-
	2	CAN_L	CAN signal (dominant low)
	3	CAN_GND	CAN ground
	4	Reserved	-
	5	CAN_SHLD	Optional shield
	6	GND	CAN ground
	7	CAN_H	CAN signal
	8	Reserved	-
	9	Reserved	-
Type: 9-pin SUB D socket			

The X452 CAN bus interface has the following socket assignment.

Table 3- 2 CAN BUS interface X452

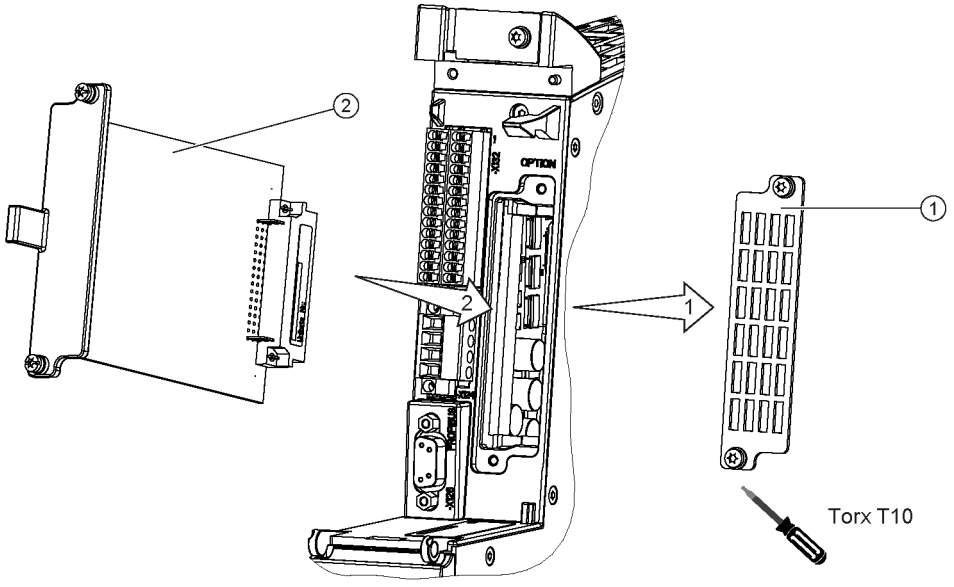
	Pin	Designation	Technical data
	1	Reserved	-
	2	CAN_L	CAN signal (dominant low)
	3	CAN_GND	CAN ground
	4	Reserved	-
	5	CAN_SHLD	Optional shield
	6	GND	CAN ground
	7	CAN_H	CAN signal
	8	Reserved	-
	9	Reserved	-
Type: 9-pin SUB-D pin (male)			

3.2 Mounting

Mounting and installation steps

The CBC10 is mounted in the option slot on Control Unit CU320-2 as follows (see diagram below):

1. Unscrew and remove the protective cover.
2. Insert the CBC10.
3. Fix the CBC10 in place with screws.



① Protective cover
② Option Board CBC10

Figure 3-2 Mounting a CBC10 based on CU320-2 DP example

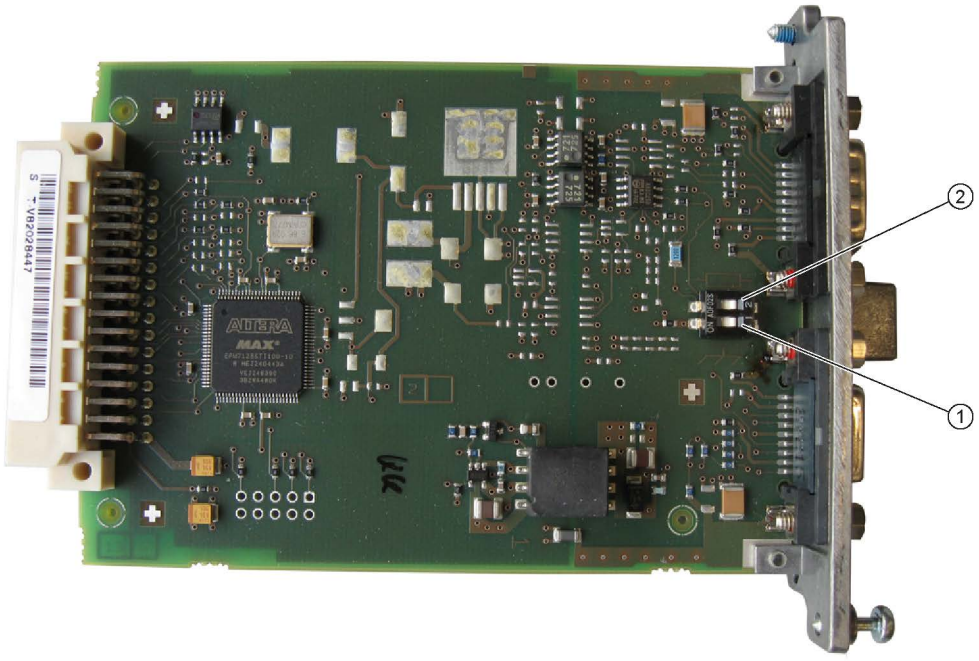
The following are required:

Screws	M3
Tools	Torx T10 screwdriver
Tightening torque	0.8 Nm

3.3 Hardware settings

To ensure that data can be transmitted reliably via the CAN bus, switches S1/S2 on the CBC10 must be set accordingly (see table below). Set the following:

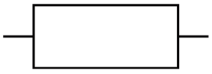
- Bus terminating resistor
- Operation with/without ground



① Switch 1
② Switch 2

Figure 3-3 2-pin SMD DIL switch 1 and 2 on the CBC10

Table 3- 3 2-pin SMD DIL switch

ID on the component	Switch	Function	Switch position		Default
	2	Bus terminating resistor 120 Ω	OFF	Inactive	OFF
			ON	Active	
	1	Operation with/without ground	OFF	Ground-free operation	OFF
			ON	Operation with ground	

Note

A bus terminating resistor must be located at the end of the bus line. When the CBC10 is the last participant (node) on the bus, then the best terminating resistor of the CBC10 can be used.

Grounding the CANopen Control Unit

When grounding the CAN cables, the S1 grounding switch connects the CAN ground with the 24 V ground potential of the system.

The optional shield (pin 5) and the connector housing are connected with the 24 V ground potential of the system.

Interconnection:

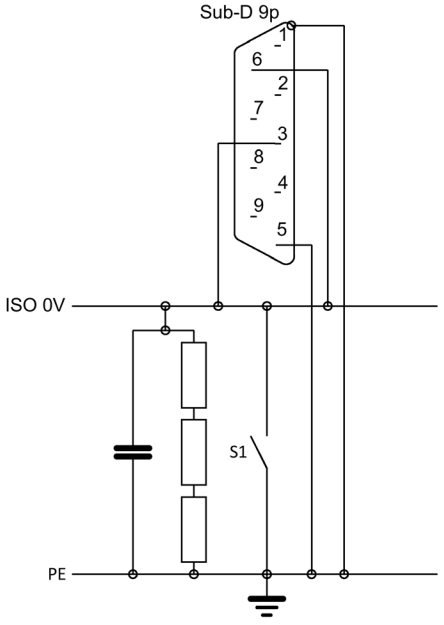


Figure 3-4 CAN grounding for the CBC10

Configuration

4

4.1 Overview

The following steps must be carried out when configuring the CANopen interface in the SINAMICS drive line-up:

1. Configuring the CANopen interface
2. Configuring the PDO message frames
3. Process data interconnection
4. SDO access, process data
5. PDO access to the infeed

4.2 Configuring the CANopen interface

4.2.1 Selecting the CBC10 option module

With STARTER, you have created a CANopen project OFFLINE. For CANopen, the drive object requires an option module.

Procedure

1. Double-click on "Configure drive unit" in the project navigator below the drive unit.

   The configuration Wizard is then started.

Figure 4-1 Selecting option module

2. Select the option module "CBC10 (CAN module)".

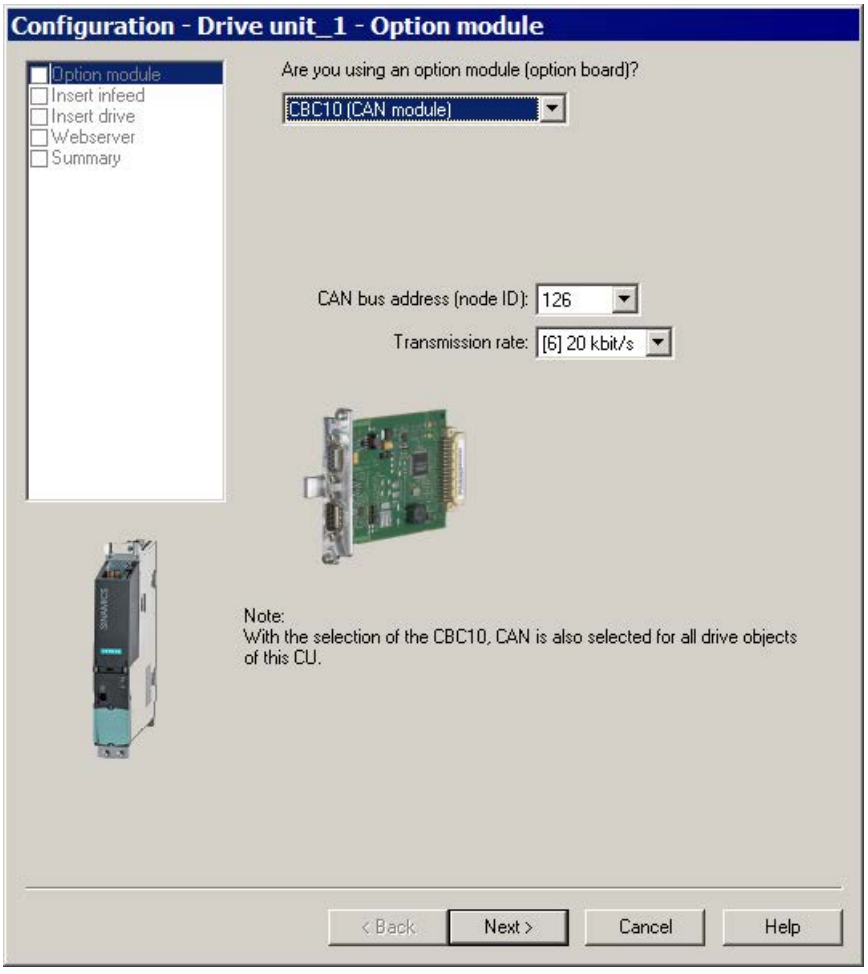


Figure 4-2 Selecting the CBC10

You can change the default setting of the CAN bus address and the data transmission rate at any time.

3. Click on "Next >".

4.2.2 Configuring the infeed

Presently, CANopen does not support the infeed. From the perspective of CANopen, it is not necessary to configure the infeed (see Chapter "PDO access to the infeed (Page 114)").

4.2.3 Configuring a drive

CANopen requires the "Extended setpoint channel" function module to access the following CANopen objects:

- 0x8046.1 "vl velocity min amount"
- 0x8048 "vl velocity acceleration delta time"
- 0x8083 "Profile acceleration"
- 0x8086 "Motion profile type"

This function module can be activated and configured in the setting range of the closed-loop control structure.

Procedure

1. In the configuration Wizard, click on "Next", until you come to the drive configuration.
2. For the drive properties, define the drive object name and the drive object type and then make the necessary detail settings.

3. Click on "Next >".

   You define the closed-loop control structure of the drive in the next setting area.

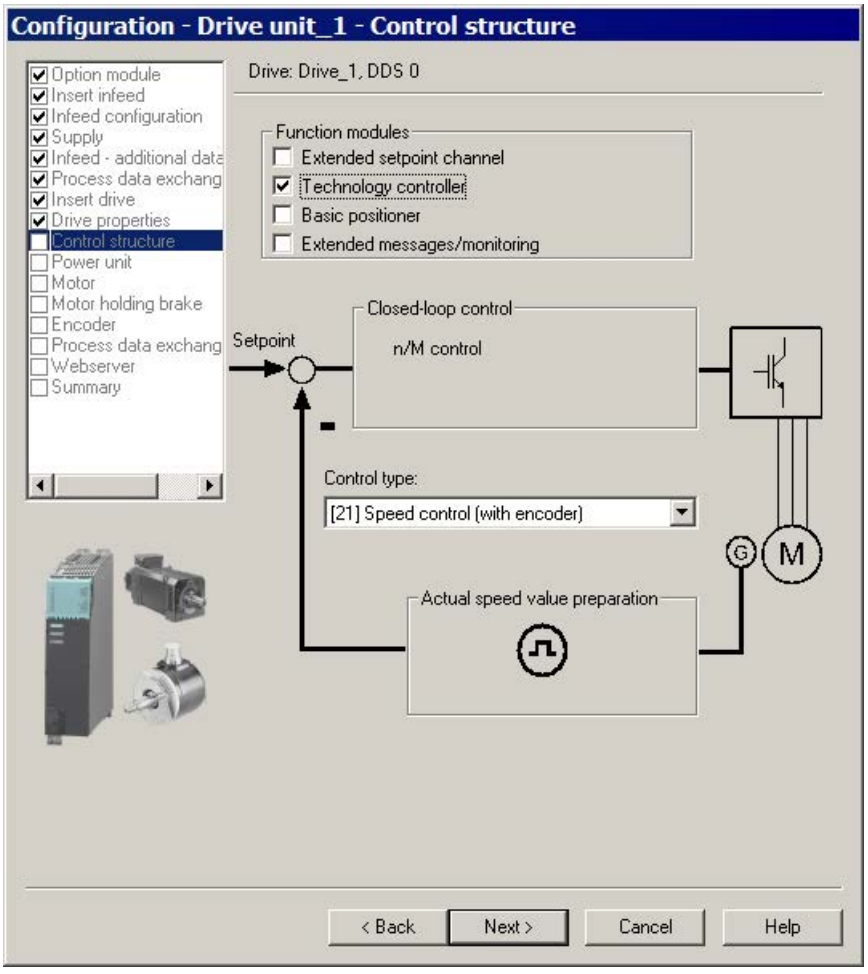


Figure 4-3 Configuring the closed-loop control structure

4. Activate the "Extended setpoint channel" function module.

   The control type is emulated in parameter p1300, and corresponds to the CANopen operating modes defined in Chapter Operating modes (Page 129).

5. Set the control type and click on "Next >".

   The following settings in the configuration wizard are independent of CANopen.

6. In the various setting areas, make the necessary settings and then click on "Next".

7. Then click on "Finish", therefore completing the settings in the configuration dialog.

4.2.4 Configuring CBC10

4.2.4.1 Parameterizing the transmission properties for Control Unit CU320-2

Precondition

You have configured the drive unit with the CBC10 in the STARTER commissioning tool.

Procedure

1. In the project navigator, double-click on each of the entries "Control_Unit" > "CAN Option Module" > "Configuration".

   Information about the CBC10 is displayed in the dialog shown below.

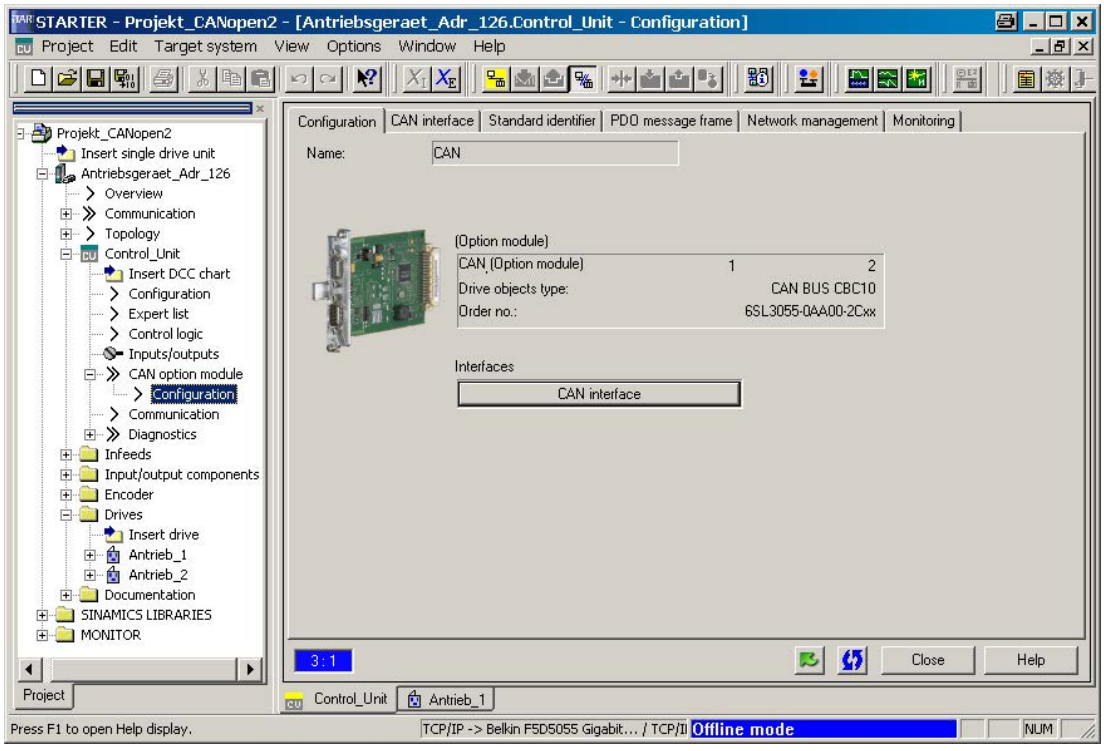


Figure 4-4 Configuration "CBC10"

2. For the CBC10, at the CU320-2 Control Unit, check and configure the following transmission properties:
   - Transmission rate
   - CAN bus address (node ID)
   - Number of PDO message frames (Page 96)
   - Node monitoring (Page 127) (heartbeat, life guarding)

4.2.4.2 Configuring the transmission rate and CAN bus address

Note

- Permissible CAN bus addresses are 1...127.
- Each change using the address switch p8620 or in the screen form is not effective until POWER ON.
- While the SINAMICS is being booted, the address switch is queried first in order to set the bus address. If this is set to 0, the address can be set using parameter p8620.
- If the address is set to a valid node address (1...127), this is copied to parameter p8620, where it is displayed.
- The value in p8620 or in the screen form is written with the STARTER download.

Setting via the "CAN interface" tab in STARTER

The transmission rate and the CAN bus address/node ID can be configured in the "CAN interface" tab.

1. Select the "CAN interface" tab.

   The factory setting for the transmission rate is 20 kbit/s.

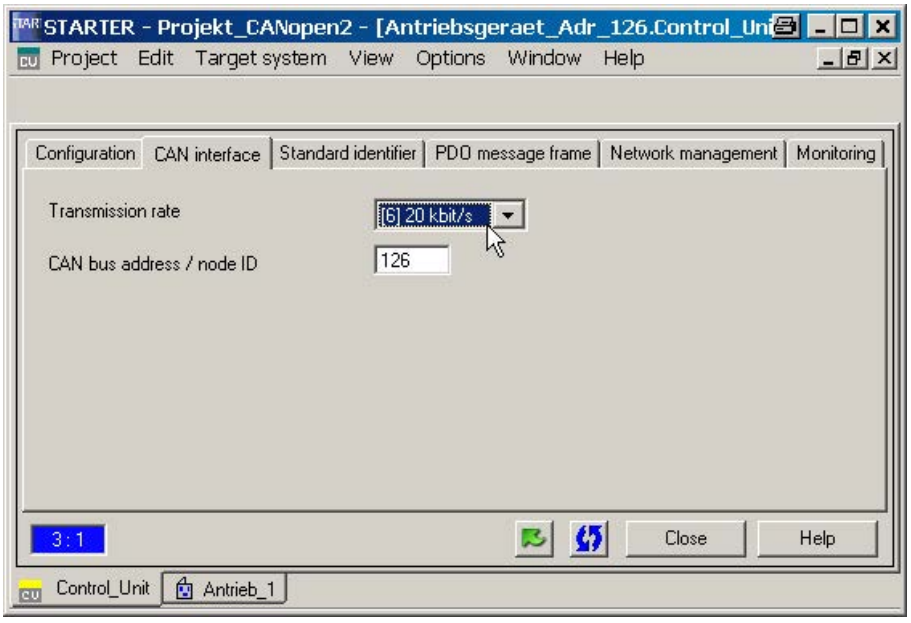


Figure 4-5 CAN interface

2. For commissioning, select another transmission rate (e.g. "1 Mbit/s").

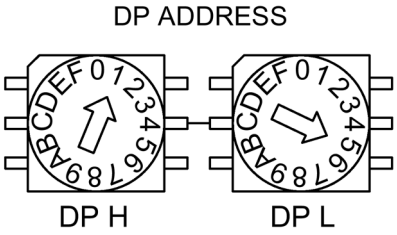
   You have 2 options for the CAN bus address/node ID:

   – In this dialog, you can set a value of 1...127, if the address switch on the Control Unit (labeled "DP address") is set to 0.
     This corresponds to parameter p8620.

   – Directly using the address switch on the Control Unit.
     Make the settings for "Bus address/node ID" (see "Setting via address switch...").

Setting using the address switch on the Control Unit

Setting the CAN bus address via the address switch on the Control Unit.



Example: 15 hex = 21 dec

Figure 4-6 Example: Bus address via the address switch on the Control Unit

4.3 Configuring the PDO message frames

PDO message frames are configured via the expert list using the communication parameters and mapping parameters.

The communication parameters and mapping parameters are essentially automatically predefined ("predefined connection set") for each drive object when the CANopen interface is commissioned for the first time.

You assign COB IDs for each drive object in the expert list starting from p8700 for receive message frames and from p8720 for transmit message frames.

For each drive object in the expert list, the mapping parameters of the message frames start from parameter p8710 for receive message frames and from parameter p8730 for transmit message frames.

The following screenshots show the predefined COB IDs and mapped process data objects for transmitting and receiving drive object 1 in the expert list in the STARTER commissioning tool.

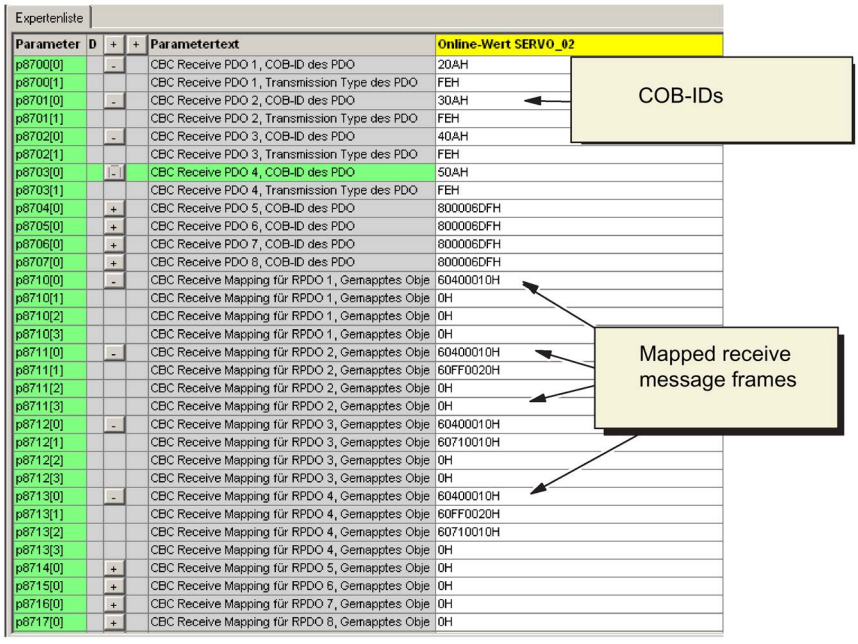


Figure 4-7 COB IDs and mapped process data objects for receive message frame drive object 1

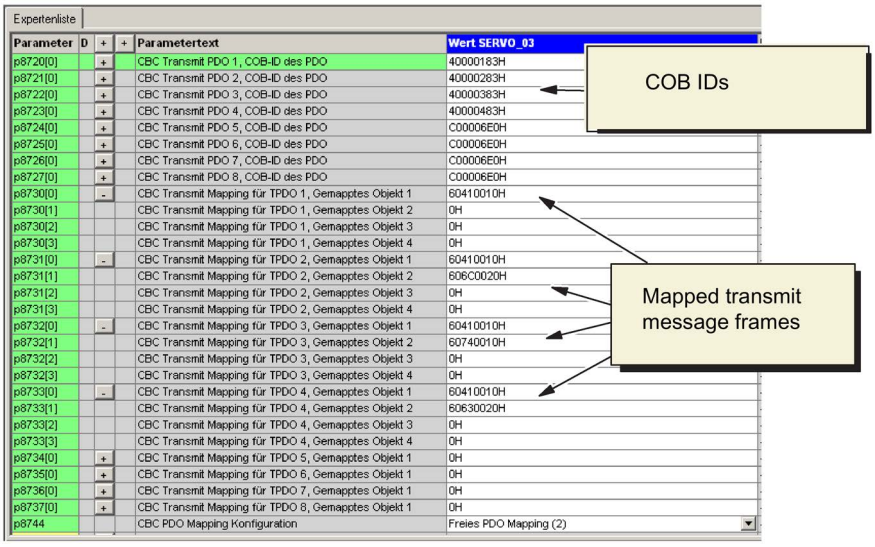


Figure 4-8 COB IDs and mapped process data objects for transmit message frame drive object 1

4.3.1 Assigning COB IDs and mapping parameters for free PDO mapping

You have the following options when making the assignment:

- COB IDs

  You can assign a COB as required in the following parameters:

  – Receive (RPDO) in parameters p8700 to p8707

  – Transmit (TPDO) in parameters p8720 to p8727

- Mapping parameters

  You can enter the process data objects for mapping the transmission message frames in the following parameters:

  – Receive message frames (RPDO) starting from parameter p8710

  – Transmit message frames (TPDO) starting from parameter p8730

If mapping parameters or COB ID are changed in the STARTER commissioning tool in the ONLINE mode, then the COB ID for the PDO in question must first be set to "invalid" in the communication parameters and, once the parameters have been changed, set back to "valid".

COB-ID, bit 31	= 0 ->	COB-ID valid
Bit 31	= 1 ->	COB-ID invalid

This procedure is not required in the OFFLINE mode.

Principle procedure in the ONLINE mode

1. Set the COB ID of the RPDO or TPDO in question to "invalid" (e.g.: p8700[0], COB ID of the PDO).
2. Enter the process data objects as mapping parameters into the relevant RPDO or TPDO (for e.g.: from p8710[0], mapped object).
3. Set the COB ID of the RPDO or TPDO in question to "valid".

Adapting mapping parameters

1. Choose the process data object to be mapped (e.g. RPDO1, control word = 6040 hex) from the "Objects of the drive profile DSP402" table (refer to the section "CANopen objects of the drive profile DSP402 (Page 55)").
2. Add a suitable offset for the SINAMICS drive object (e.g. starting from the drive with the offset factor 1 plus 800 hex).
   Refer to the column "Values from table "OD index (hex) (e.g. 6840 hex)"" in the parameterization table in the following section.
3. Convert the OD index (bits 31…16), subindex (bits 15…8) and object size (bits 7…0) into a hexadecimal value (32 bits).
   See the following table (e.g. 6840 0010 hex).
4. Enter this value in the STARTER commissioning tool in the corresponding mapping parameter.
   See the following table, column "Mapping parameters in STARTER" (e.g. p8710[0]).

Mapping RPDO1

When you choose the process data object for the control word from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameters p8710[0] to p8710[3] for RPDO1 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 1 Values for RPDO1

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter RPDO1
Control word	6840	00	10 hex (16 bit)	6840 0010	p8710[0]
No object	-	-	-	0	p8710[1...3]

Mapping RPDO2

When you choose the process data object for the control word and the setpoint velocity from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameters p8711[0...3] for RPDO2 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 2 Values for RPDO2

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter RPDO2
Control word	6840	00	10 hex (16 bit)	6840 0010	p8711[0]
Setpoint velocity	68FF	00	20 hex (32 bit)	68FF 0020	p8711[1]
No object	-	-	-	0	p8711[2...3]

Mapping RPDO3

When you choose the process data object for the control word and the setpoint torque from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameters p8712[0...3] for RPDO3 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 3 Values for RPDO3

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter RPDO3
Control word	6840	00	10 hex (16 bit)	6840 0010	p8712[0]
Setpoint torque	6871	00	10 hex (16 bit)	6871 0010	p8712[1]
No object	-	-	-	0	p8712[2...3]

Mapping RPDO4

When you choose the process data object for the control word, setpoint velocity and the setpoint torque from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameter p8713[0...3] for RPDO4 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 4 Values for RPDO4

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter RPDO4
Control word	6840	00	10 hex (16 bit)	6840 0010	p8713[0]
Setpoint velocity	68FF	00	20 hex (32 bit)	68FF 0020	p8713[1]
Setpoint torque	6871	00	10 hex (16 bit)	6871 0010	p8713[2]
No object	-	-	-	0	P8713[3]

Mapping TPDO1

When you choose the process data object for the CBC status word from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameter p8730[0...3] for TPDO1 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 5 Values for TPDO1

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter TPDO1
CBC status word	6841	00	10 hex (16 bit)	6841 0010	p8730[0]
No object	-	-	-	0	p8730[1...3]

Mapping TPDO2

When you choose the process data object for the CBC status word and the setpoint velocity from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameter p8731[0...3] for TPDO2 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 6 Values for TPDO2

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter TPDO2
CBC status word	6841	00	10 hex (16 bit)	6841 0010	p8731[0]
Actual velocity	686C	00	20 hex (32 bit)	686C 0020	p8731[1]
No object	-	-	-	0	p8731[2...3]

Mapping TPDO3

When you choose the process data object for the CBC status word and the actual torque from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameter p8732[0...3] for TPDO3 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 7 Values for TPDO3

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter TPDO3
CBC status word	6841	00	10 hex (16 bit)	6841 0010	p8732[0]
Actual torque	6874	00	10 hex (16 bit)	6874 0010	p8732[1]
No object	-	-	-	0	p8732[2...3]

Mapping TPDO4

When you choose the process data object for the CBC status word and the encoder position actual value from the "Objects of the drive profile DSP402" table, this yields the following values, which you enter in parameter p8733[0...3] for TPDO4 mapping (see the "Resulting hexadecimal value" column in the following table):

Table 4- 8 Values for TPDO4

Object name	Values from "Objects of the drive profile DSP402" table			Mapping parameters in STARTER	
	OD index (hex)	Subindex (hex)	Object size	Resulting hexadecimal value	Parameter TPDO4
CBC status word	6841	00	10 hex (16 bit)	6841 0010	p8733[0]
Actual position value	6863	00	20 hex (32 bit)	6863 0020	p8733[1]
No object	-	-	-	0	p8733[2...3]

4.4 Process data interconnection

After configuring the PDO message frames, the process data buffer must be interconnected using BICO.

1. Read out the image of the mapped process data objects to the PZD receive and PZD send words in the receive and send buffers.
2. Interconnect the source parameter of the PZD receive word at the receive buffer with the SINAMICS target parameters of the process data object (see Chapter “Interconnecting the receive buffer (Page 106)”).
3. Interconnect the SINAMICS source parameter of the process data object with the target parameter of the PZD send word at the send buffer (see Chapter “Interconnecting the transmit buffer (Page 108)”).

4.4.1 Reading out the image of mapped process data objects

Once you have parameterized PDO mapping, the device automatically recognizes how the individual process data objects have to be distributed to the PZD receive and PZD send words.

The image of the process data objects to the PZD receive and PZD send words for the receive and send buffers can only be read out.

Each drive object has a separate receive and send buffer for transferring message frames.

The expert list for each of the drive objects contains the images for the following parameters:

- 16-bit process data objects for
  - Receive, starting from parameter r8750[0]
  - Transmit, starting from parameter r8751[0]
- 32-bit process data objects for
  - Receive, starting from parameter r8760[0]
  - Transmit, starting from parameter r8761[0]

Examples

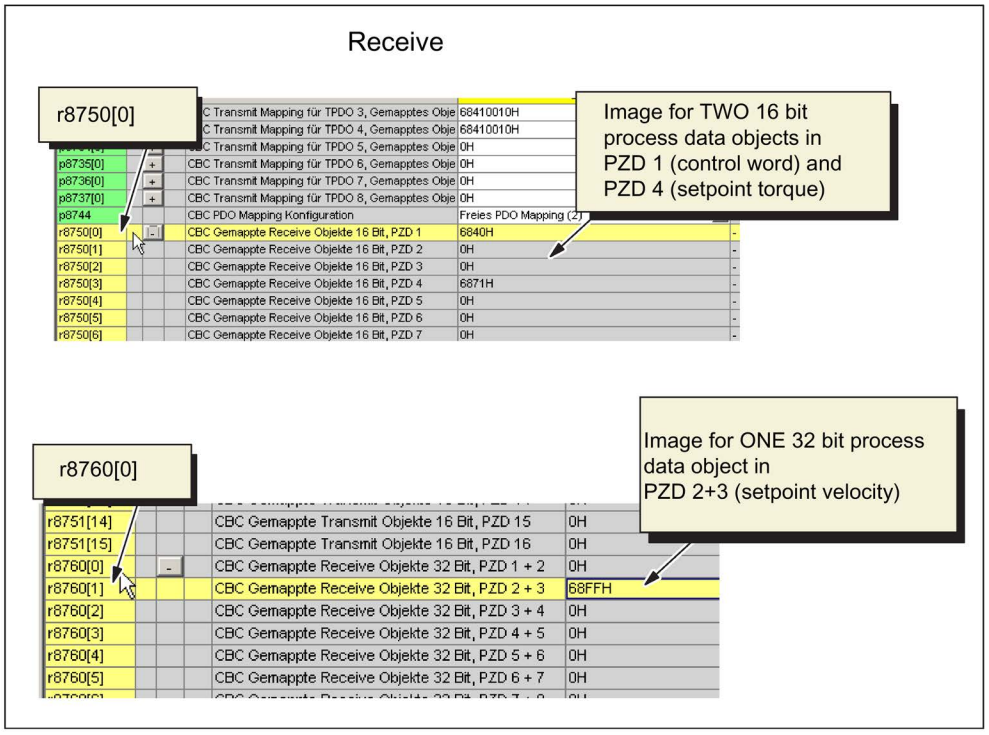


Figure 4-9 Image of process data objects in receive buffer

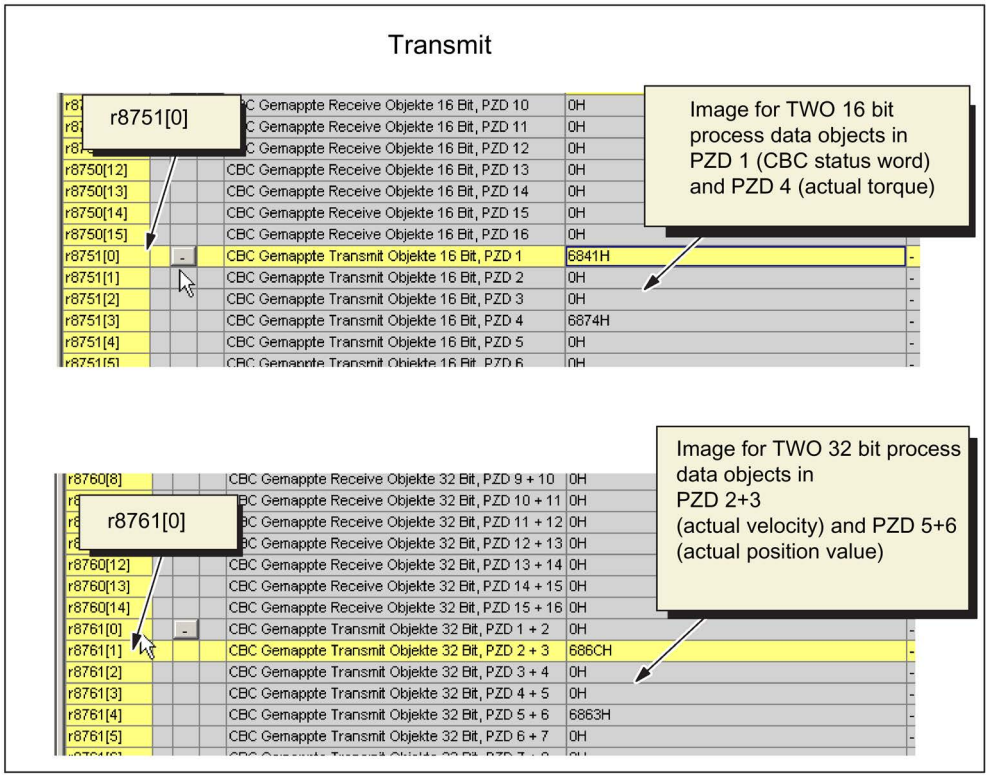


Figure 4-10 Image of process data objects in send buffer

4.4.2 Interconnecting process data for the PDO message frame

The following objects are interconnected with each other:

- SINAMICS source and/or target parameters for the process data objects
- The receive or send words in the receive/send buffer

The excerpts of function diagrams for the receive/send buffer, which are shown in the following sections, illustrate:

- How the process data objects in the receive and send buffers are distributed to the receive and send words.
- Which associated target and source parameters for the receive and send words have to be interconnected (highlighted in color).

4.4.2.1 Interconnecting the receive buffer

For instance, interconnect the following incoming process data for the RPDO message frames:

- Control word (PZD 1)
- Setpoint velocity (PZD 2+3)
- Set torque (PZD 4)

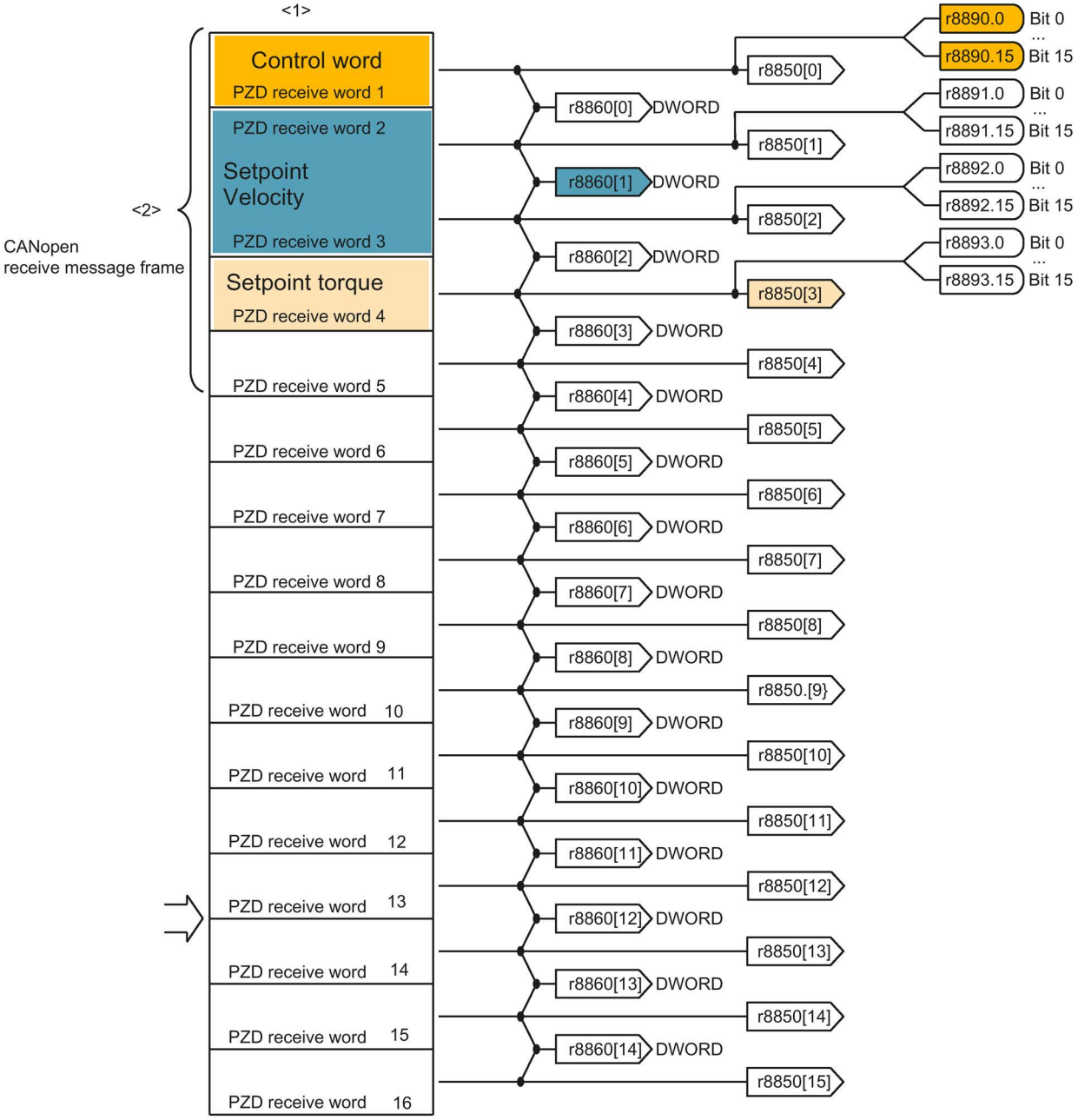


Figure 4-11 Excerpt of function diagram: receive buffer

Control word (PZD 1, 16 bit)

Set r8890 = 1 to interconnect the control word as SINAMICS target parameter.

Setpoint velocity (PZD 2+3, 32 bit)

The following table shows the parameters for the setpoint velocity, which has to be interconnected with the corresponding source.

Table 4- 9 Interconnect setpoint velocity

Target (sink)	Source PZD 2+3	Meaning
p1155[0]	r8860[1]	Speed setpoint 1

For the setpoint velocity, data type 32 bit, interconnect parameter p1155[0] with parameter r8860[1].

Setpoint torque (PZD 4, 16 bit)

For the setpoint torque, the target parameter p1513[0] must be interconnected with the source parameter r8850[3]:

Table 4- 10 Interconnect the setpoint torque

Target (sink)	Source PZD 4	Meaning
p1513[0]	r8850[3]	Additional torque

4.4.2.2 Interconnecting the transmit buffer

Interconnect the following process data in the send buffer for TPDO message frames:

- CBC status word (PZD 1)
- Actual velocity (PZD 2+3)
- Actual torque (PZD 4)

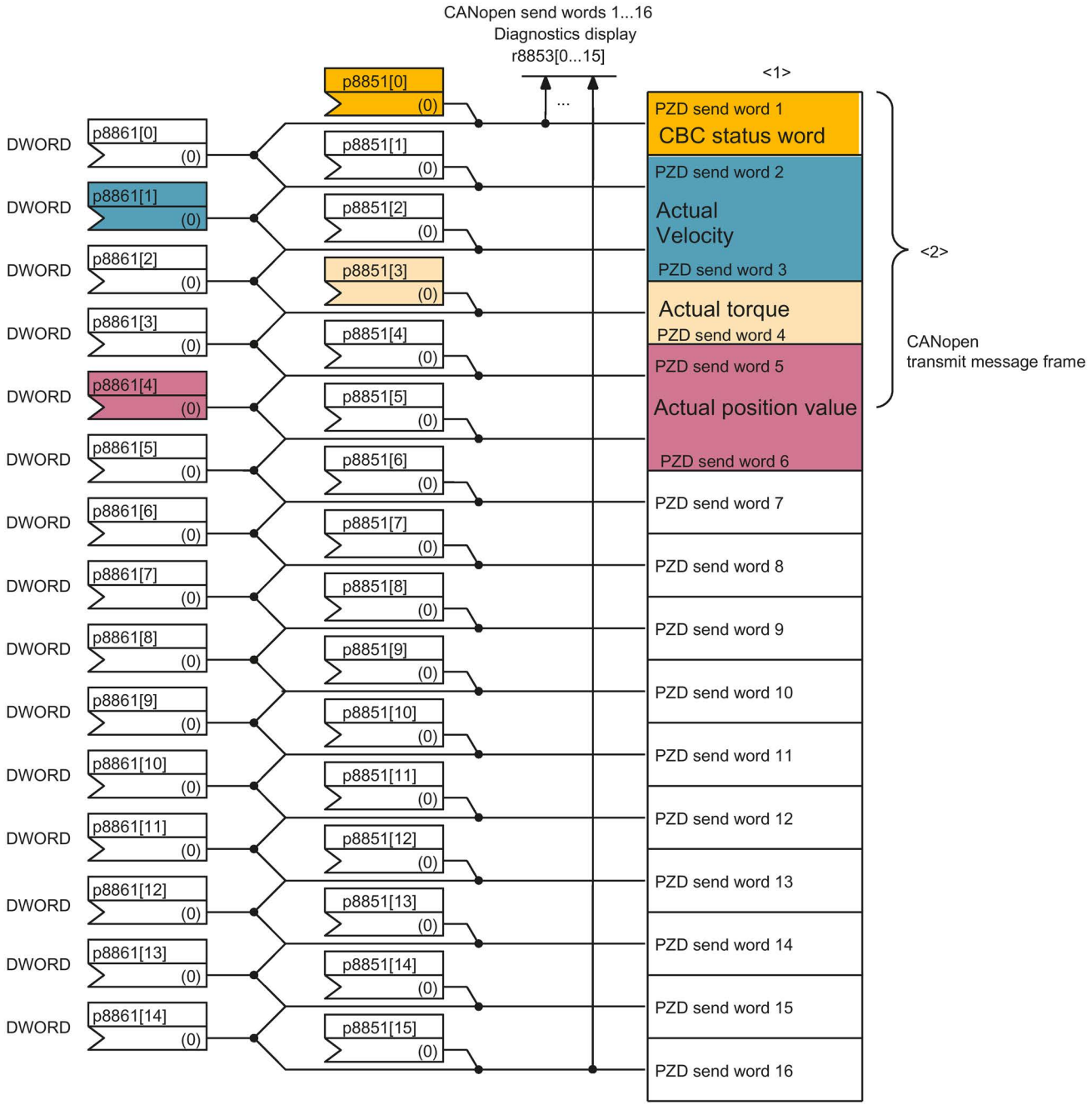


Figure 4-12 Excerpt of function diagram: send buffer

CBC status word (PZD 1, 16 bit)

For the CBC status word, the target parameter p8851[0] must be interconnected with the source parameter r8784:

Table 4- 11 Interconnecting the CBC status word

Target (sink) PZD 1	Source	Meaning
p8851[0]	r8784	CBC status word

Actual velocity (PZD 2+3, 32 bit)

The target parameter p8861[1] must be interconnected with the source parameter r0063 for the actual velocity:

Table 4- 12 Interconnect the actual velocity

Target (sink) PZD 2+3	Source	Meaning
p8861[1]	r0063	Speed actual value

Setpoint torque (PZD 4, 16 bit)

The target parameter p8851[3] must be interconnected with the source parameter r0079 for the actual torque:

Table 4- 13 Interconnect the setpoint torque

Target (sink) PZD 4	Source	Meaning
p8851[3]	r0079	Setpoint torque, total

Position actual value (PZD 5+6, 32 bit)

The target parameter p8861[4] must be interconnected with the source parameter r0482 for the position actual value:

Table 4- 14 Interconnect the actual position value

Target (sink) PZD 5+6	Source	Meaning
p8861[4]	r0482	Actual position value

4.5 SDO access, process data

4.5.1 Standardized CANopen PZD objects

Accessing standardized objects (number range 0x6000 - 0x67FF)

When commissioning, as user you have the responsibility for selecting the appropriate access type and the BICO interconnection.

PDO access

PDO access to mapped standardized CANopen-PZD objects is realized via the BICO interconnection of the corresponding PZD interface parameter.

SDO access

The SDO access depends on whether an object is mapped to a PDO:

- Object is mapped in a PDO

  SDO access acts consistently on the corresponding PZD interface parameters.
- SETPOINT object not mapped in the PDO

  SDO access acts on the corresponding SDO source parameters of the object.
- ACTUAL VALUE object not mapped in the PDO

  SDO access is realized directly at an actual value parameter.

See also “Table 2-6 Objects in drive profile DSP402 (Page 55)”.

The following diagrams clearly show the access operations to standardized CANopen PZD objects.

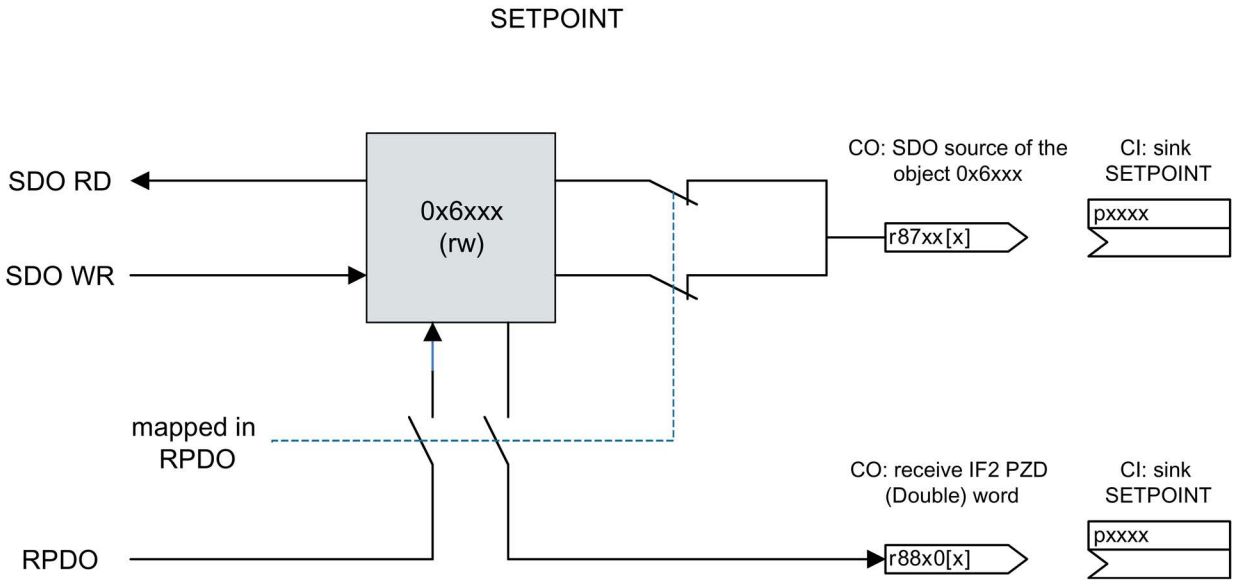


Figure 4-13 Access to standardized CANopen-PZD setpoint objects

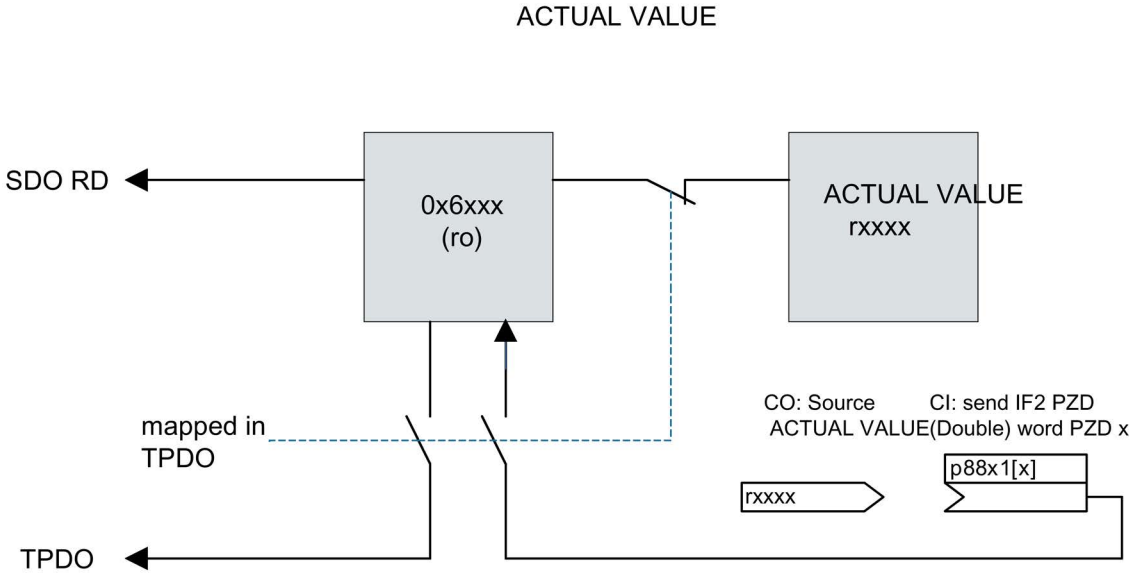


Figure 4-14 Access to standardized CANopen-PZD actual value objects

4.5.2 Free CANopen PZD objects

Access to free CANopen PZD objects (number range 0x5800 – 0x58xx)

When commissioning, as user you have the responsibility for selecting the appropriate access type and the BICO interconnection.

PDO access

PDO access to mapped free CANopen-PZD objects is realized via the BICO interconnection of the corresponding PZD interface parameter.

SDO access

The SDO access depends on whether an object is mapped to a PDO:

- Object is mapped in a PDO

  SDO access acts consistently on the corresponding PZD interface parameters

- SETPOINT object not mapped in the PDO

  The SDO access is realized via CO parameters that must be interconnected in the corresponding setpoint sinks.

  – r8745[0...15] CO: CAN free PZD receive objects 16 bit

  – r8747[0...7] CO: CAN free PZD receive objects 32 bit

- ACTUAL VALUE object not mapped in the PDO

  The SDO access is realized via CI parameters that must be interconnected in the corresponding actual value sources.

  – r8746[0...15] CI: CAN free PZD send objects 16 bit

  – r8748[0...7] CI: CAN free PZD send objects 32 bit

The following diagrams clearly show access operations to free PZD objects.

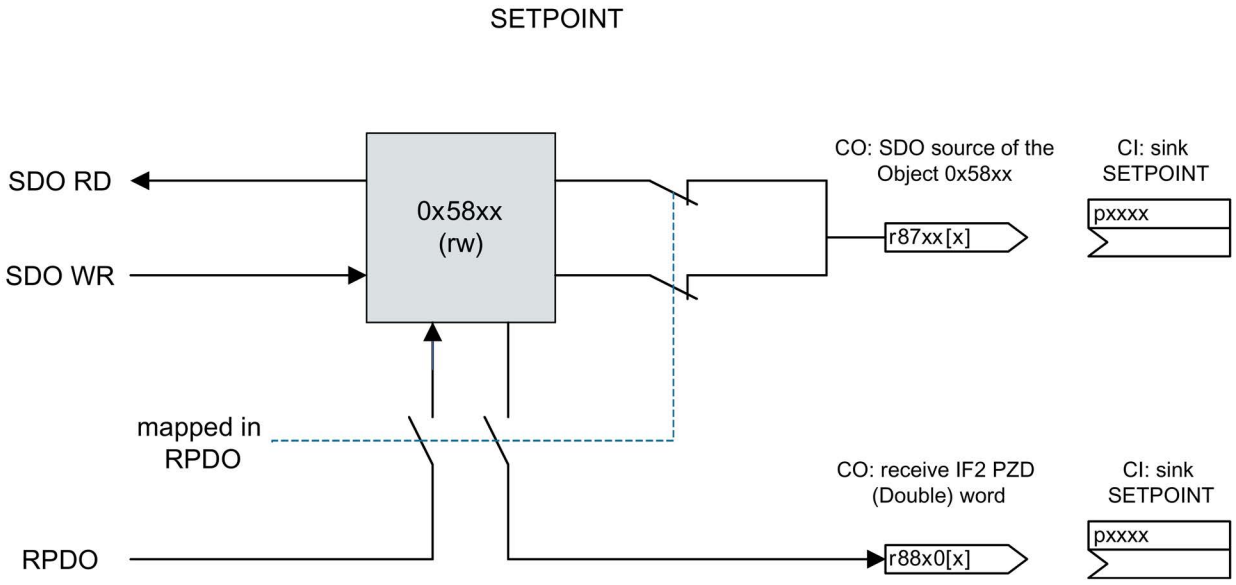


Figure 4-15 Access to free PZD setpoint objects

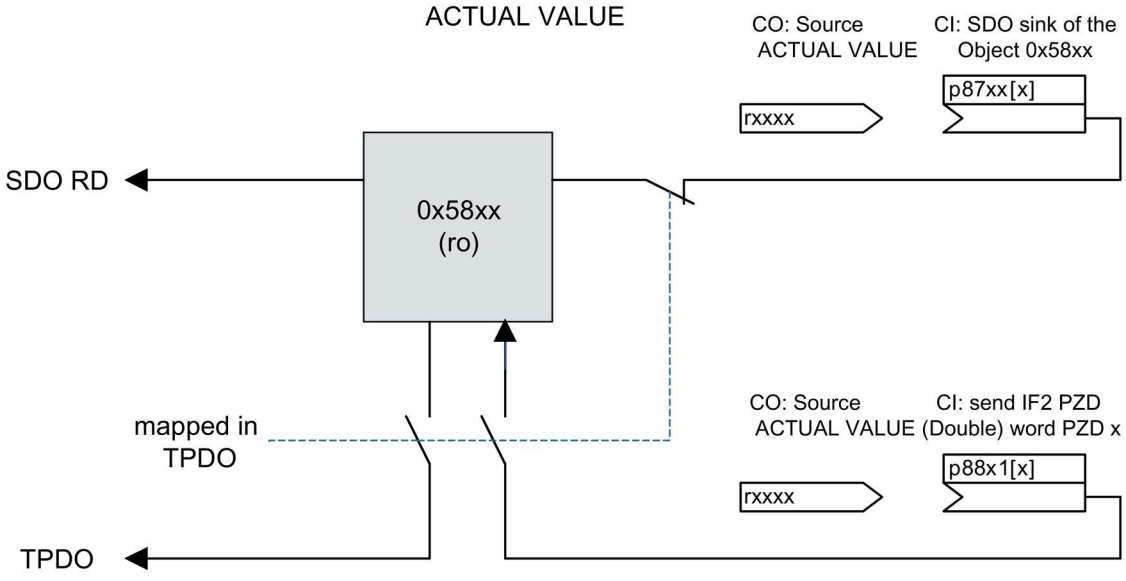


Figure 4-16 Access to free PZD actual value objects

4.6 PDO access to the infeed

Infeed drive objects (e.g. Active Line Modules) do not have their own PDO message frames with the present firmware.

However, an infeed unit can be realized using the PDO message frame of a Motor Module with the appropriate BICO interconnection.

Example:

The "ON/OFF (OFF1)" signal p0840 can be interconnected with a free bit of the CANopen control word of a Motor Module (e.g. r8890 bit 15).

Calculation/conversion setpoints/actual values 5

5.1 Speed setpoint input and evaluation of the speed actual value

The CANopen object "Target Velocity 0x60FF" or "Velocity actual value 0x606C" is accessed using PDO or SDO transfer.

By default, these CANopen objects are displayed in the unit "increments/second".

Note

The CANopen object index of a specific drive object is calculated as follows:

- 60FF hex + 800 hex · x (x: drive number 0 ... 7)
- 606C hex + 800 hex · x (x: drive number 0 ... 7)

The following parameters must be taken into account to enter the speed setpoint and evaluate the speed actual value:

- p8798 = CBC speed conversion factor

  The parameter corresponds to the CANopen object 6094 hex.

  The factor converts the required velocity units into the internal velocity units (rev/s).

  Factory setting of the velocity unit for CANopen:

  – with encoder -> increments/second

  – without encoder -> revolutions/minute

The internal velocity is calculated as follows:

Speed setpoint

$$n\_set\_intern\ [rev/s] = \frac{n\_set\_bus}{p0408 \cdot 2^{p0418}} \cdot \frac{p8798[0]}{p8798[1]}$$

- p0408 = pulse number
- p0418 = fine resolution

Speed setpoint with/without encoder

- With encoder

  The value to be sent to the bus is calculated as follows:

$$n\_set\_bus = n\_set\ [rpm] \cdot \frac{1}{60\ s} \cdot p0408 \cdot 2^{p0418} \cdot \frac{p8798[1]}{p8798[0]}$$

  If the target velocity should be, e.g.: 3000 rpm, then the following must be sent to the bus to SINAMICS, for an encoder with a pulse number 2048 and a fine resolution of 11:

$$C800000\ hex = \frac{3000\ [rpm]}{60\ s} \cdot 2048 \times 2^{11} \cdot \frac{1}{1}$$

- Without encoder

$$n\_set\_bus = n\_set\ [rpm] \cdot \frac{p8798[1]}{p8798[0]}$$

Process data interface

If the incoming speed setpoint is read in parameter r8860[x], this is formed from the following calculation:

$$r8860[x] = \frac{n\_set\_bus}{p0408 \cdot 2^{p0418}} \cdot 60\ s \cdot \frac{4000\ 0000\ hex}{p2000}$$

$$r8860[x] = n\_set\ [rpm] \cdot \frac{4000\ 0000\ hex}{p2000}$$

In order to see the process value specified via the bus referred to 4000 000 hex in r8860[x], then p2000 must be set to p0311.

Note

For an operating mode without encoder, an encoder can still be commissioned. Example: for encoderless closed-loop speed control (p1300 = 20) or encoderless closed-loop torque control (p1300 = 22). For these operating modes, the velocity is calculated using the formula "with encoder".

Speed actual value

Speed actual value with/without encoder

- With encoder

$$n\_act\ [rpm] = n\_act\_bus \quad 60\ s \cdot \frac{1}{p0408 \cdot 2^{p0418}} \cdot \frac{p8798[0]}{p8798[1]}$$

- Without encoder

$$n\_act\ [rpm] = n\_act\_bus \cdot \frac{p8798[0]}{p8798[1]}$$

Process data interface

If the incoming speed setpoint is read in parameter r8863[x], this is formed from the following calculation:

$$r8863[x] = \frac{n\_act\_bus}{p0408 \cdot 2^{p0418}} \cdot 60\ s \cdot \frac{4000\ 0000\ hex}{p2000}$$

$$r8863[x] = n\_act\ [rpm] \cdot \frac{4000\ 0000\ hex}{p2000}$$

In order to see the process value specified via the bus referred to 4000 000 hex in r8863[x], then p2000 must be set to p0311.

Note

For an operating mode without encoder, an encoder can still be commissioned. Example: for encoderless closed-loop speed control (p1300 = 20) or encoderless closed-loop torque control (p1300 = 22). For these operating modes, the velocity is calculated using the formula "with encoder".

5.2 Torque setpoint input and evaluation of the torque actual value

The CANopen object "Target Torque 0x6071" or "Torque actual value 0x6077" is accessed using PDO or SDO transfer.

The CANopen objects are displayed as default as per mille (1/1000).

Note

The CANopen object index of a specific drive object is calculated as follows:

6071 hex + 800 hex · x (x: drive number 0 ... 7)

6077 hex + 800 hex · x (x: drive number 0 ... 7)

The following parameters must be taken into account to enter the torque setpoint and evaluate the torque actual value:

- r0333 = rated motor torque

Torque setpoint

The value to be sent to the bus should be calculated as follows:

$$\text{m\_set\_bus [per mille]} = \frac{\text{m\_soll [Nm]}}{\text{r0333 [Nm]}} \cdot 1000$$

Process data interface

If the incoming torque setpoint is read in parameter r8850[x], this is formed from the following calculation:

Example:

$$\text{r8850[x]} = \frac{\text{m\_set\_bus [per mille]} \quad \text{r0333 [Nm]}}{1000} \cdot \frac{\text{4000 hex}}{\text{p2003 [Nm]}}$$

In order to see the process value specified via the bus referred to 4000 hex in r8850[x], then p2003 must be set to r0333.

Actual torque value

The torque actual value is calculated as follows:

$$\text{m\_act [Nm]} = \frac{\text{m\_act\_bus [per mille]}}{1000} \cdot \text{r0333 [Nm]}$$

Process data interface

If the outgoing torque actual value is read in parameter r8853[x], this is formed from the following calculation:

$$r8853[x] = \frac{m\_act\_bus\ [per\ mille] \quad r0333\ [Nm]}{1000} \cdot \frac{4000\ hex}{p2003\ [Nm]}$$

$$r8853[x] = \frac{m\_act\ [Nm] \quad 1000}{r0333\ [Nm]} \cdot \frac{4000\ hex}{p2003\ [Nm]}$$

In order to see the process value specified via the bus referred to 4000 hex in r8853[x], then p2003 must be set to r0333.

Diagnosis

6

CANopen supports a standardized system for detecting, describing, and signaling device states and/or device errors with the following equipment:

- “OPT” diagnostics LED (Page 122)
- Alarm object ("Emergency Object") (Page 124)
- Drive unit internal error list (“predefined error field”) (Page 125)
- Error register (Page 126)

6.1 Diagnostics LED "OPT"

The following diagnostics LED "OPT" on the Control Unit CU320-2 indicates the status of the CANopen node at the device.

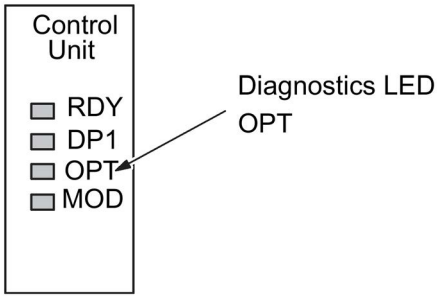


Figure 6-1 Overview of the LEDs on the Control Unit

The diagnostics LED "OPT" on the Control Unit, which displays both the module and communication status, provides users with all the required information about the current status of the CBC10.

General procedure

The different flashing frequencies indicate the following:

- Diagnostics LED OPT -> red
  Is there a fault?
- Diagnostics LED OPT -> green
  In which state is the node in the communication state machine?

OPT diagnostics LED

Table 6- 1 Diagnostics LED OPT -> red (CANopen error LED)

ERROR LED flashing frequency	Status	Meaning
Off	No error	Ready to run
Single flash	Warning limit reached	At least one of the CAN controller error counters has reached the "Error Passive" alarm threshold (too many incorrect telegrams).
Double flash	Error Control Event	A Life Guard event has occurred.
On	Bus off	The CAN controller is "Bus off".

Table 6- 2 Diagnostics LED -> green (CANopen RUN LED)

RUN LED flashing frequency	Status	Meaning
Single flash	Stopped	The node is in the "STOPPED" state. Only one NMT communication is possible.
Blinking	PRE-OPERATIONAL	The node is in the "PRE-OPERATIONAL" state. No PDO communication is possible.
On	OPERATIONAL	The node is in the "OPERATIONAL" state.

Flashing frequency of LEDS

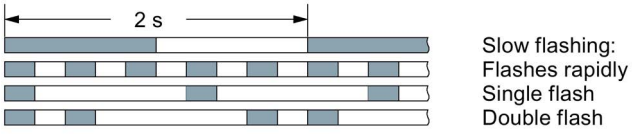


Figure 6-2 LED statuses

6.2 Alarm object (Emergency Object)

Error statuses for each drive unit are signaled via the high-priority 8-byte emergency object (error message).

You can find the relevant parameters here:

- In the object directory index 1014 hex (COB ID EMCY) and 1015 hex (inhibit time EMCY)
- For SINAMICS in parameter p8603 of the Control Unit.

When an error occurs, an error telegram (emergency telegram) is sent to the identifier set in object "1014 hex".

Every error is assigned an error code in CANopen, with the error codes being further subdivided into, for example, current errors, voltage errors, etc.

Emergency telegram

When an error occurs, the CANopen drive unit automatically transmits an emergency telegram asynchronously. The emergency telegram is structured as follows:

Table 6- 3 Structure of the emergency telegram

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CANopen Error code		CANopen Error Register	SINAMICS fault number		Drive object number	Reserved	Reserved

The CANopen error code is in bytes 0 and 1 (refer to the section "Drive-unit-internal error list ("predefined error field") (Page 125)").

The codings for the CANopen error register are located in byte 2 (refer to the section "Drive-unit-internal error list ("predefined error field") (Page 125)").

Byte 5 contains the number of the drive object from which the error originated.

Alarms that do not result in a shutdown are indicated only by the alarm bit or fault bit in the status word and do not trigger an emergency telegram. Faults trigger an emergency telegram and cause the drives to be shut down. The fault telegram can be suppressed by setting bit 31 in object 1014 hex.

6.3 Drive-unit-internal error list ("predefined error field")

The drive unit internal error list ("predefined error field") can be read via the following objects:

- Object directory index 1003 hex
- SINAMICS parameter p8611 of the Control Unit

Fault list

This list contains the individual, unacknowledged faults and pending alarms in the CANopen alarm number range F08700 to F08799 diagnosed in a drive unit. The faults (errors) are listed in the order in which they occur, along with an error code and additional, device-specific information. As soon as a fault is acknowledged or an alarm is resolved, they are deleted from the drive device internal error list.

All drive objects in the selected Control Unit are acknowledged by writing the subindex 0, as well as for object directory index 1003 hex and for the parameter p8611 with value 0.

The following table describes the CANopen error code that is evaluated with SINAMICS (in the emergency telegram, byte 0/1).

Table 6- 4 CANopen Errorcode

CANopen Errorcode	Meaning	Triggered by SINAMICS
0000 hex	No error present	Successful acknowledgement of all faults or all the alarms are cleared in the display.
1000 hex	CAN Error 1	All other SINAMICS faults
1001 hex	CAN Error 2	All other CANopen alarms in the alarm number range F08700 up to F08799
8110 hex	CAN overflow, message lost	CBC: Telegram loss (A(N)08751) [alarm]
8120 hex	CAN Error Passive	CBC: Error number for Error Passive exceeded (A08752) [alarm]
8130 hex	CAN Life Guard Error	CBC: Communications error, alarm value 2 F08700(A) [fault/alarm]

Note

For other SINAMICS alarms, an emergency telegram is not sent.

6.4 Error register

The 1-byte error register can be read via the following objects:

- Object directory index 1001 hex
- SINAMICS parameter r8601 of the Control Unit

Error register

The register displays any drive unit errors that have occurred and their type.

The following table describes the CANopen error register that is evaluated with SINAMICS (in the emergency message frame, bytes 1 and 2).

Table 6- 5 Error register

Error Register	Meaning	Triggered by SINAMICS
Bit 0	generic error	Set for every alarm that CAN identifies.
Bit 4	communication error	For CAN communication alarms set, i.e. for alarms in the number range F08700 to F08799.
Bit 7	manufacturer error	Set for all SINAMICS errors outside the CAN communication alarm number range.

6.5 Response in the case of an error

In the case of an error in the CAN communication, e.g. too many message frame failures, fault F(A)08700(2) is signaled (for details see the SINAMICS S120/S150 List Manual). The fault is displayed in parameter r0949. The reaction of the drive to the fault is set with p8641. The reaction of the CAN node is set with p8608 or P8609.

Parameter	Setting	Values	Index
p8608	Behavior of the CAN node with reference to BUS error.	• 0: Deactivated (factory setting) • 1: Starting the CAN controller	• [0] = Manual controller start function • [1] = Activation of automatic controller start function The parameter is automatically reset to 0 following the start.
p8609	Behavior of the CAN node with reference to the communications error or equipment fault.	• 0: Pre-operational • 1: No change (factory setting) • 2: Stopped	Corresponds to CANopen object 1029 hex. • [0] = Behavior for communication errors • [1] = Behavior for device faults
p8641	Drive behavior if a CAN communication error occurs.	• 0: No response • 1: OFF1 • 2: OFF2 • 3: OFF3 (factory setting)	-

Example: Setting in the event of a bus fault

1. In the inverter, set the general response to the bus fault using parameter p8641.

   In order for a reaction to be detected, the p8641 = 0 setting must not be selected.

   With a bus fault, the CAN master goes to the "Bus OFF" status.
2. Rectify the bus fault.
3. Then re-establish communication. The following two options are available for this:
   - Switch off the power supply voltage of the inverter and switch on again. This means that you withdraw the bus state and restart communication.
   - You acknowledge the bus fault via DI 2 or directly via p3981 and re-establish communication via p8608[0] or p8608[1].

⚠WARNING

Uncontrollable motor due to bus fault

If you are working with parameter setting p8641 = 0 (no response for bus error), then for a bus error, you cannot stop the motor via the control system. An unstoppable motor may result in death or serious injury.

- For this case, wire an additional OFF command via terminals.

Operating modes

7

CANopen supports velocity and torque-referred operating modes – and with deviations to the CANopen standard, also position-referred operating modes:

- Velocity Mode (velocity-related)
  Simple velocity control with ramps and the relevant objects (e.g. frequency converters or current converters)
- Profile Velocity Mode (velocity-related)
  Velocity control, closed-loop speed control and the relevant objects.
- Profile Torque Mode (torque-related)
  Torque control and the relevant objects
- Homing Mode (position-referred (Page 134))
  Using various techniques, it determines a home position (reference position)
- Profile Position Mode (position-referred (Page 134))
  Positioning operating mode, where velocity, position and acceleration values can be set

Overview of CANopen objects and operating modes

Operating modes	Preferred Access via Objects of CANopen Operating mode	0x6060 – Operating mode	0x6061 – Displaying Operating mode	0x6502 – Supported Operating mode	P1300 – Open-loop control/ closed-loop contro Operating mode
Velocity Mode	Velocity Mode	2	2	Bit 1	0
Manufacturer-specific Operation Mode 1	Velocity Mode	-1	-1	Bit 16	1
Manufacturer-specific Operation Mode 2	Velocity Mode	-2	-2	Bit 17	2
Manufacturer-specific Operation Mode 3	Velocity Mode	-3	-3	Bit 18	3
Manufacturer-specific Operation Mode 4	Velocity Mode	-4	-4	Bit 19	4
Manufacturer-specific Operation Mode 5	Velocity Mode	-5	-5	Bit 20	5
Manufacturer-specific Operation Mode 6	Velocity Mode	-6	-6	Bit 21	6
Manufacturer-specific Operation Mode 7	Velocity Mode	-7	-7	Bit 22	7
Manufacturer-specific Operation Mode 8	Velocity Mode	-15	-15	Bit 23	15
Manufacturer-specific Operation Mode 9	Manual specific Operation Mode	-18	-18	Bit 22	18
Manufacturer-specific Operation Mode 10	Velocity Mode	-19	-19	Bit 25	19
Manufacturer-specific Operation Mode 11	Profile Velocity Mode	-20	-20	Bit 26	20
Profile Velocity Mode	Profile Velocity Mode	3	3	Bit 2	21
Manufacturer-specific Operation Mode 12	Profile Torque Mode	-22	-22	Bit 27	22
Profile Torque Mode	Profile Torque Mode	4	4	Bit 3	23
No mode change/ no mode assigned	–	0	0	–	–

Figure 7-1 CANopen objects and operating modes

CANopen object 0x6502

The CANopen object "0x6502 Supported drive modes" indicates which CANopen operating modes can be selected in the corresponding drive units and in the existing commissioning state via the object "0x6060", via SDO and/or via PDO access.

CANopen object 0x6060

By writing the CANopen object "0x6060 Modes of operation", the required operating mode can be selected.

The object always displays the requested mode, even if this is not effective, because it is not supported for example from the drive object.

Also writing via SDO is always successful, if a value is written within its data type.

If an operating mode cannot be selected, for example, because it is not supported, then the old operating mode remains effective.

By reading the object "0x6061" the controller itself must check as to whether the requested operating mode was able to be successfully selected, and is therefore effective.

Access via RPDO

The object can be mapped, and therefore transferred via PDO unconfirmed. Presently, for SINAMICS, this process data access within the scope of the CAN sampling time only makes sense for switching between speed and torque control; this is because only these operating modes are supported by CANopen, and for SINAMICS, can presently be switched over in operation.

All switchover operations of the known operating modes, lead to the SINAMICS parameter channel that runs in the background.

If the object is mapped in an RPDO, then also an SDO access consistently acts on the corresponding PZD interface parameters and no longer on p1300. The diagram below should clearly illustrate this.

All switchover operations of other operating modes, lead to the SINAMICS parameter channel that runs in the background. It does not make sense to create a PDO access for this purpose. If the object is mapped in an RPDO, then also an SDO access consistently acts on the corresponding PZD interface parameters and no longer on p1300. The diagram below should clearly illustrate this.

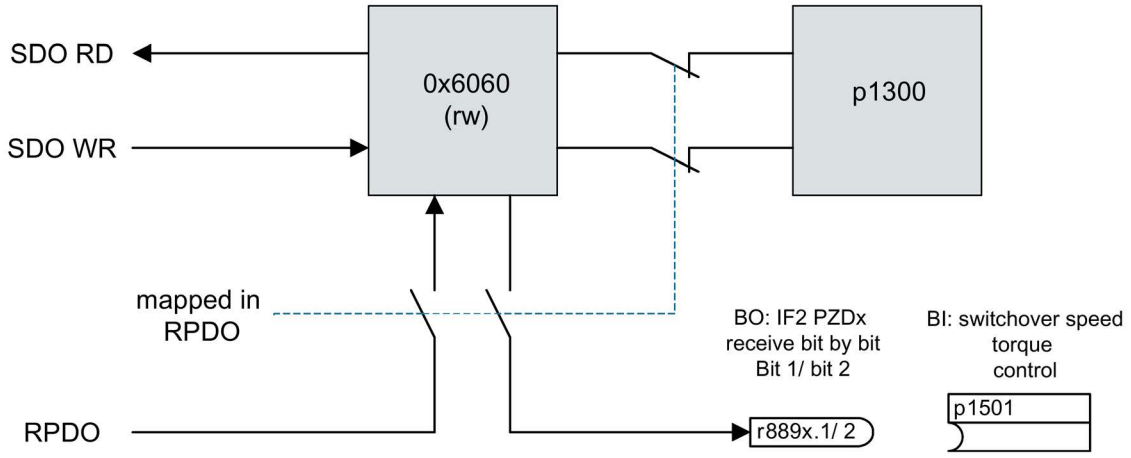


Figure 7-2 Accessing operating modes

As user, you are responsible when commissioning for selecting the appropriate access type.

Access via SDO

For an SDO access, a value is written to the object 0x6060 in parameter p1300. You can take the corresponding value from the Figure CANopen objects and operating modes (Page 130).

CANopen object 0x6061

The CANopen object "0x6061 modes of operation display" indicates the currently active operating mode.

The object can be mapped, and therefore transferred via PDO unconfirmed.

If the object is mapped in a TPDO, then an SDO access consistently acts on the corresponding PZD interface parameters. When commissioning, the CO parameter "r8762 CAN operating mode display" can be interconnected in the corresponding sink of the PZD interface IF2.

The value of parameter r8762 is formed as follows:

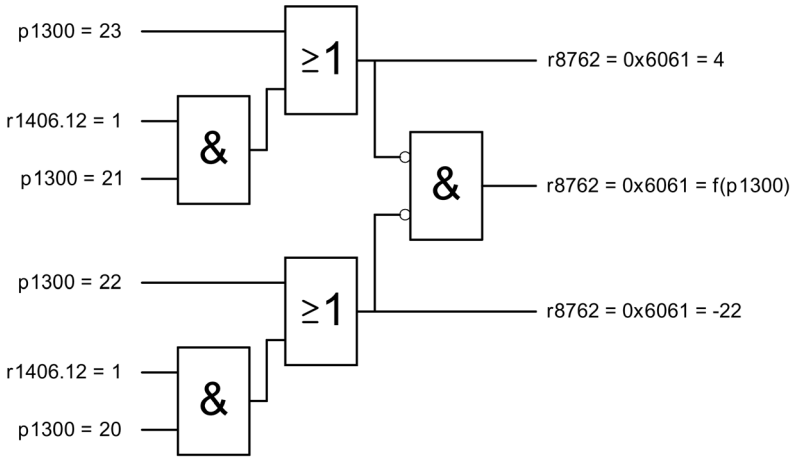


Figure 7-3 Operating mode display

If the transmission mode of the corresponding TPDO is configured to be asynchronous, when the operating mode has been successfully changed, it is immediately sent, therefore informing the control that the operating mode has been successfully changed.

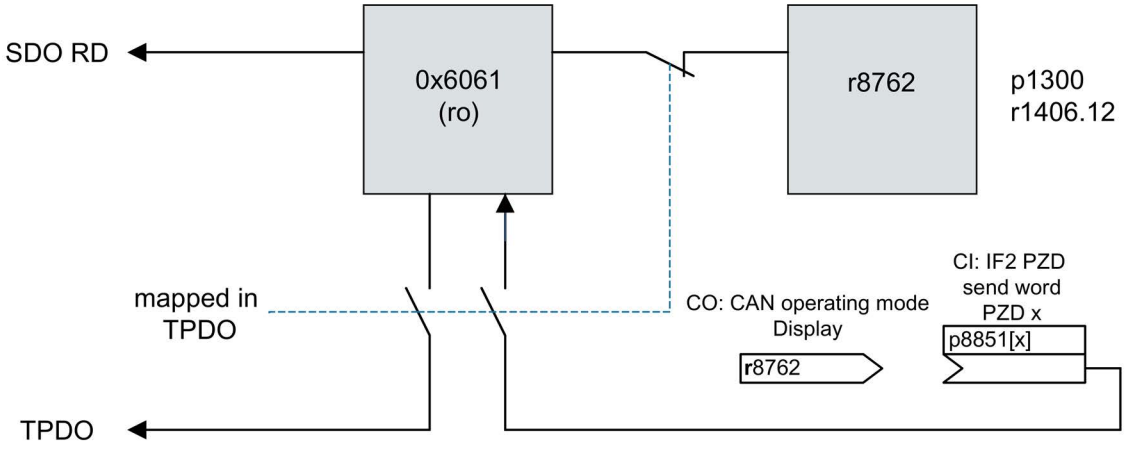


Figure 7-4 Accessing the operating mode display

7.1 Position-referred operating modes

In addition to torque and velocity-referred operating modes, with deviations to the CANopen standard, also the position-referred operating modes "Homing Mode" and "Profile Position Mode" can be used. The deviations to the standard are listed below:

Deviations for the Homing Mode

- It is only possible to activate the Homing Mode by activating the "Basic positioner" function module in SINAMICS (p0108.4 = 1). Presently, selection using the standardized CANopen objects (6060 hex or 6061 hex) is not possible.
- Although the following standardized CANopen objects are obligatory for the Homing Mode, they are presently not supported:
  - 6098 hex "Homing method"
  - 6099 hex "Homing speeds"

  However, these CANopen objects can be implemented using free objects (Page 54).
- Bits 4 and 8 of the CANopen control word are not supported according to the standard.
- Bits 12 and 13 of the CANopen status word are not supported according to the standard.

Deviation for the Profile Position Mode

- It is only possible to activate the Profile Position Mode by activating the "Basic positioner" function module in SINAMICS (p0108.4 = 1). Presently, selection using the standardized CANopen objects (6060 hex or 6061 hex) is not possible.
- Although the following standardized CANopen objects are obligatory for the Profile Position Mode, they are presently not supported:
  - 607A hex "Target position"
  - 6081 hex "Profile velocity"

  However, these CANopen objects can be implemented using free objects (Page 54).
- Bits 4, 5, 6, 8 and 9 of the CANopen control word are not supported according to the standard.
- Bits 12 and 13 of the CANopen status word are not supported according to the standard.

Appendix

A

A.1 List of abbreviations

Note

The following list of abbreviations includes all abbreviations and their meanings used in the entire SINAMICS family of drives.

Abbreviation	Source of abbreviation	Meaning
A		
A…	Alarm	Warning
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short-Circuit	Armature short-circuit
ASCII	American Standard Code for Information Interchange	American coding standard for the exchange of information
AS-i	AS-Interface (Actuator Sensor Interface)	AS-Interface (open bus system in automation technology)
ASM	Asynchronmotor	Induction motor
AVS	Active Vibration Suppression	Active load vibration damping
B		
BB	Betriebsbedingung	Operation condition
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	BG Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic operator panel

C		
C	Capacitance	Capacitance
C…	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication Board CAN
CBE	Communication Board Ethernet	PROFINET communication module (Ethernet)
CD	Compact Disc	Compact disc
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computerized Numerical Control	Computer-supported numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB-ID	CAN Object-Identification	CAN Object Identification
CoL	Certificate of License	Certificate of License
COM	Common contact of a change-over relay	Center contact of a change-over contact
COMM	Commissioning	Startup
CP	Communication Processor	Communications processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC	Control Unit DC
D		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	Direct current
DCB	Drive Control Block	Drive Control Block
DCBRK	DC Brake	DC braking
DCC	Drive Control Chart	Drive Control Chart
DCN	Direct Current Negative	Direct current negative
DCP	Direct Current Positive	Direct current positive
DDC	Dynamic Drive Control	Dynamic Drive Control
DDS	Drive Data Set	Drive Data Set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output, bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DMM	Double Motor Module	Double Motor Module
DO	Digital Output	Digital output
DO	Drive Object	Drive object
DP	Decentralized Peripherals	Distributed I/O

DPRAM	Dual Ported Random Access Memory	Dual-Port Random Access Memory
DQ	DRIVE-CLiQ	DRIVE-CLiQ
DRAM	Dynamic Random Access Memory	Dynamic Random Access Memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
DSM	Doppelsubmodul	Double submodule
DTC	Digital Time Clock	Timer
E		
EASC	External Armature Short-Circuit	External armature short-circuit
EDS	Encoder Data Set	Encoder data set
EEPROM	Electrically Erasable Programmable Read-Only Memory	Electrically Erasable Programmable Read-Only Memory
EGB	Elektrostatisch gefährdete Baugruppen	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Residual current operated circuit breaker
ELP	Earth Leakage Protection	Ground-fault monitoring
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromotive Force	Electromotive force
EMK	Elektromotorische Kraft	Electromotive force
EMV	Elektromagnetische Verträglichkeit	Electromagnetic compatibility
EN	Europäische Norm	European standard
EnDat	Encoder-Data-Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering system
ESB	Ersatzschaltbild	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESM	Essential Service Mode	Essential service mode
ESR	Extended Stop and Retract	Extended stop and retract
F		
F…	Fault	Fault
FAQ	Frequently Asked Questions	Frequently Asked Questions
FBLOCKS	Free Blocks	Free function blocks
FCC	Function Control Chart	Function control chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEPROM	Flash-EPROM	Non-volatile write and read memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Funktionsplan	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array

FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte
GC	Global Control	Global control telegram (broadcast telegram)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as M)
GSD	Gerätestammdatei	Generic Station Description: Describes the features of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate supply voltage
GUID	Globally Unique Identifier	Globally Unique Identifier
H		
HF	High frequency	High frequency
HFD	Hochfrequenzdrossel	Radio frequency reactor
HLA	Hydraulic Linear Actuator	Hydraulic linear actuator
HLG	Hochlaufgeber	Ramp-function generator
HM	Hydraulic Module	Hydraulic Module
HMI	Human Machine Interface	Human Machine Interface
HTL	High-Threshold Logic	Logic with high interference threshold
HW	Hardware	Hardware
I		
i. V.	In Vorbereitung	Under development: This property is currently not available
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short-Circuit	Internal armature short-circuit
IBN	Inbetriebnahme	Startup
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse suppression
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terre	Non-grounded three-phase line supply
IVP	Internal Voltage Protection	Internal voltage protection
J		
JOG	Jogging	Jogging
K		
KDV	Kreuzweiser Datenvergleich	Data cross-check
KHP	Know-how protection	Know-how protection

KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY84	-	Temperature sensor
L		
L	-	Symbol for inductance
LED	Light Emitting Diode	Light emitting diode
LIN	Linearmotor	Linear motor
LR	Lageregler	Position controller
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line-Side Switch	Line-side switch
LU	Length Unit	Length unit
LWL	Lichtwellenleiter	Fiber-optic cable
M		
M	-	Symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDI	Manual Data Input	Manual data input
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-readable product code
MM	Motor Module	Motor Module
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (class 1) and slave
MSR	Motorstromrichter	Motor-side converter
MT	Messtaster	Probe
N		
N. C.	Not Connected	Not connected
N…	No Report	No report or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regel-technik in der chemischen Industrie	Standardization association for measurement and control in chemical industries
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization association in USA (United States of America)
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact
NSR	Netzstromrichter	Line-side converter

NTP	Network Time Protocol	Standard for synchronization of the time of day
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
O		
OA	Open Architecture	Software component which provides additional functions for the SINAMICS drive system
OAIF	Open Architecture Interface	Version of the SINAMICS firmware as of which the OA application can be used
OASP	Open Architecture Support Package	Expands the STARTER commissioning tool by the corresponding OA application
OC	Operating Condition	Operation condition
OCC	One Cable Connection	One-cable technology
OEM	Original Equipment Manufacturer	Original equipment manufacturer
OLP	Optical Link Plug	Bus connector for fiber-optic cable
OMI	Option Module Interface	Option Module Interface
P		
p…	-	Adjustable parameters
P1	Processor 1	CPU 1
P2	Processor 2	CPU 2
PB	PROFIBUS	PROFIBUS
PcCtrl	PC Control	Master control
PD	PROFIdrive	PROFIdrive
PDC	Precision Drive Control	Precision Drive Control
PDS	Power unit Data Set	Power unit data set
PDS	Power Drive System	Drive system
PE	Protective Earth	Protective ground
PELV	Protective Extra Low Voltage	Safety extra-low voltage
PFH	Probability of dangerous failure per hour	Probability of dangerous failure per hour
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional integral
PID	Proportional Integral Differential	Proportional integral differential
PLC	Programmable Logical Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PM	Power Module	Power Module
PMSM	Permanent-magnet synchronous motor	Permanent-magnet synchronous motor
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point to Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PT1000	-	Temperature sensor
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point To Point	Point-to-point

PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
Q		
R		
r…	-	Display parameters (read-only)
RAM	Random Access Memory	Memory for reading and writing
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current device
RCM	Residual Current Monitor	Residual current monitor
REL	Reluctance motor textile	Reluctance motor textile
RESM	Reluctance synchronous motor	Synchronous reluctance motor
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RLM	Renewable Line Module	Renewable Line Module
RO	Read Only	Read only
ROM	Read-Only Memory	Read-only memory
RPDO	Receive Process Data Object	Receive Process Data Object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known as EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known as EIA485)
RTC	Real Time Clock	Real-time clock
RZA	Raumzeigerapproximation	Space-vector approximation
S		
S1	-	Continuous operation
S3	-	Intermittent duty
SAM	Safe Acceleration Monitor	Safe acceleration monitoring
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	Safe Brake Ramp	Safe brake ramp monitoring
SBT	Safe Brake Test	Safe brake test
SCA	Safe Cam	Safe cam
SCC	Safety Control Channel	Safety Control Channel
SCSE	Single Channel Safety Encoder	Single-channel safety encoder
SD Card	SecureDigital Card	Secure digital memory card
SDC	Standard Drive Control	Standard Drive Control
SDI	Safe Direction	Safe motion direction
SE	Sicherer Software-Endschalter	Safe software limit switch
SESM	Separately-excited synchronous motor	Separately excited synchronous motor

SG	Sicher reduzierte Geschwindigkeit	Safely limited speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe stop
SI	Safety Integrated	Safety Integrated
SIC	Safety Info Channel	Safety Info Channel
SIL	Safety Integrity Level	Safety Integrity Level
SITOP	-	Siemens power supply system
SLA	Safely-Limited Acceleration	Safety limited acceleration
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely Limited Position
SLS	Safely-Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Sensorless vector control
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SMI	SINAMICS Sensor Module Integrated	SINAMICS Sensor Module Integrated
SMM	Single Motor Module	Single Motor Module
SN	Sicherer Software-Nocken	Safe software cam
SOS	Safe Operating Stop	Safe operating stop
SP	Service Pack	Service pack
SP	Safe Position	Safe position
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial peripheral interface
SPS	Speicherprogrammierbare Steuerung	Programmable logic controller
SS1	Safe Stop 1	Safe Stop 1 (time-monitored, ramp-monitored)
SS1E	Safe Stop 1 External	Safe Stop 1 with external stop
SS2	Safe Stop 2	Safe Stop 2
SS2E	Safe Stop 2 External	Safe Stop 2 with external stop
SSI	Synchronous Serial Interface	Synchronous serial interface
SSL	Secure Sockets Layer	Encryption protocol for secure data transfer (new TLS)
SSM	Safe Speed Monitor	Safe feedback from speed monitor
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word
T		
TB	Terminal Board	Terminal Board
TEC	Technology Extension	Software component which is installed as an additional technology package and which expands the functionality of SINAMICS (previously OA application)
TIA	Totally Integrated Automation	Totally Integrated Automation

TLS	Transport Layer Security	Encryption protocol for secure data transfer (previously SSL)
TM	Terminal Module	Terminal Module
TN	Terre Neutre	Grounded three-phase line supply
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit Process Data Object
TSN	Time-Sensitive Networking	Time-Sensitive Networking
TT	Terre Terre	Grounded three-phase line supply
TTL	Transistor-Transistor-Logic	Transistor-transistor logic
Tv	-	Rate time
U		
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
USV	Unterbrechungsfreie Stromversorgung	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
V		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Verband Deutscher Elektrotechniker [Association of German Electrical Engineers]
VDI	Verein Deutscher Ingenieure	Verein Deutscher Ingenieure [Association of German Engineers]
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak to peak	Volt peak to peak
VSM	Voltage Sensing Module	Voltage Sensing Module
W		
WEA	Wiedereinschaltautomatik	Automatic restart
WZM	Werkzeugmaschine	Machine tool
X		
XML	Extensible Markup Language	Extensible markup language (standard language for Web publishing and document management)
Y		
Z		
ZK	Zwischenkreis	DC link
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

A.2 Documentation overview

General documentation/catalogs			
SINAMICS	G110	D 11	- Converter built-in units 0.12 kW up to 3 kW
	G120	D 31	- SINAMICS Converters for Single-Axis Drives and SIMOTICS Motors
	G130, G150	D 11	- Converter built-in units - Converter cabinet units
	S120, S150	D 21	- SINAMICS S120 built-in units in the chassis format and Cabinet Modules - SINAMICS S150 Converter Cabinet Units
	S120	D 21.4	- SINAMICS S120 and SIMOTICS
Manufacturer/service documentation			
SINAMICS	G110		- Getting Started - Operating instructions - List Manuals
	G120		- Getting Started - Operating instructions - Hardware Installation Manuals - Function Manual Safety Integrated - List Manuals
	G130		- Operating instructions - List Manual
	G150		- Operating instructions - List Manual
	GM150, SM120/SM150, GL150, SL150		- Operating instructions - List Manuals
	S110		- Manual - Getting Started - Function Manual - List Manual
	S120		- Getting Started with STARTER - Commissioning Manual with STARTER - Getting Started with Startdrive - Commissioning Manual with Startdrive - Commissioning Manual CANopen - Function Manual Drive Functions - Function Manual Safety Integrated - Function Manual DCC - List Manual - Manual Control Unit and supplementary system components - Manual Power Unit Booksize - Manual Power Unit Booksize C/D Type - Manual Power Unit Chassis air-cooled - Manual Power Unit Chassis liquid-cooled - Combi Manual - Manual Cabinet Modules - Manual AC Drive - SINAMICS S120M Manual Distributed Drive Technology - SINAMICS HLA System Manual Hydraulic Drive
	S150		- Operating instructions - List Manual
Motors			- Configuration Manuals, Motors
General			- Configuration Manual, EMC Guidelines

A.3 CANopen glossary

When using a CANopen profile via the CAN bus, you will encounter the following common terms and abbreviations:

CAL (CAN Application Layer)

Communication layer above the CAN bus designed for CAN bus applications in open communication systems. It comprises NMT, DBT, LMT, and CMS elements. Since CAL is very extensive and highly flexible, a subset of CAL functions for automation applications has been defined with the CANopen communication profile CiA DS 301.

CAN (controller area network)

A serial bus system (also known as CAN bus) that was originally designed for use in vehicles but is now also used in automation technology. CANopen (see below) extends the CAN bus protocols to include additional layers.

CAN controller

An electronic module whose hardware processes the CAN bus protocols.

CAN identifier

With the assignment of CAN identifiers to CAN messages (CANopen: PDO, SDO), the relative priority of the CAN messages to one another is specified.

CANopen

A CiA-defined communication model based on the CAN bus and CAL. To make it easier to use devices produced by different manufacturers on a bus, a subset of CAL functions for automation applications has been defined with the CANopen communication profile CiA DS 301. Other profiles are also defined for certain device types (e.g. drives).

CiA (CAN in Automation international users and manufacturers group)

Association of manufacturers and users of devices with a CAN interface.

CMS (CAN message specification)

A part of the CAL that defines different mechanisms for transferring data.

COB (communication object)

On the CAN bus, data is transferred in packages known as communication objects (COB) or CAN message).

Devices connected to the CAN bus can transmit and receive COB.

COB-ID (COB identifier)

Each COB can be uniquely identified by means of an identifier, which is part of the COB. CAN specification 2.0A supports up to 2048 COB, which are identified by means of 11-bit identifiers. In this Commissioning Manual, COB IDs are always specified as hexadecimal values.

A list of COB identifiers, which contains all the COB that can be accessed via CAN, is available in the object directory for the relevant drive unit.

DRIVECOM

Association of drive manufacturers that has developed standards for networking drives (profiles). DRIVECOM profile 22 for positioning drives, which is implemented in the servo amplifier, was used by CiA as a basis for developing CANopen drive profile CiA DSP 402.

EDS (Electronic Data Sheet)

Electronic data sheet

EMCY (Emergency)

SINAMICS features an emergency object to inform other nodes on the CANopen bus of internal device faults or CAN bus faults. It is assigned a high priority and provides important information about the status of the drive unit.

NMT (network management)

A part of CAL used for initialization, configuration, and troubleshooting purposes.

Node ID (node identification)

Uniquely identifies a device in the CANopen network. For this reason, all the devices must have a unique node ID (bus address). The default distribution (standard setting) of the COB IDs is derived from the node ID. In this Commissioning Manual, node IDs are always specified as hexadecimal values.

OD (object directory)

A "database" – or object directory – containing all the objects supported by a drive is defined for each drive unit. The object directory contains:

- Type, description, and serial number of the device
- Name, format, description + index for each object
- Lists of PDO, SDO
- Which data is assigned to the PDO?
- When are PDO transmitted? (SYNC, change in object, etc.)
- The time at which emergency messages are transmitted
- ...

All the drive unit variables are accessed via objects. The SDO and PDO communication services access the object directory of the drive unit.

PDO (process data object)

Used for accessing selected data rapidly and in real time. For certain variables, mappings to certain PDOs are preconfigured.

The SDO is used to access all the other variables.

Profile

In the case of communication with bus systems, profiles are documents used for device standardization purposes, whereby communication functions (in a communication profile), device functions (in a device profile), or drive functions (in a drive profile) are described from the point of view of the communication interface.

RPDO (receive PDO)

PDO is received by the device (contains the final position, for example).

SDO (service data object)

The SDO provides access to all variables in a CANopen device (in the case of drives: drive and CANopen variables).

The SDO is generally used for configuration purposes. PDO provide fast, real-time access to selected variables.

SYNC (synchronization)

SYNC is a special message frame that synchronizes the CAN devices with each other. This message frame has a very high priority.

TPDO (transmit PDO)

PDO transmitted by the drive (contains the actual position value, for example).

Variable

All the drive and CANopen functions can be accessed via variables.

Variables can be accessed via SDO or PDO.

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More information

Siemens:
www.siemens.com

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

IndustryMall:
www.siemens.com/industrymall

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Scan the QR-Code for product information