Commissioning Manual 04/2006 Edition

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SINAMICS S120

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SINAMICS S120

Commissioning Manual

Valid for

Drive	*Firmware release*
SINAMICS S120	2.4

04.2006 Edition

Safety information

This Manual contains information which you should carefully observe to ensure your own personal safety and the prevention of material damage. Notices which are relevant to your own personal safety are highlighted by a safety alert symbol; notices which are relevant only to equipment and property damage have no safety alert symbol. These notices shown below are graded according to the level of danger:

Danger

Indicates that death or serious injury **will** result if proper precautions are not taken.

Warning

Indicates that death or serious injury **may** result if proper precautions are not taken.

Caution

With a safety alert symbol, indicates that minor personal injury **may** result if proper precautions are not taken.

Caution

Without a safety alert symbol, indicates that property damage may result if proper precautions are not taken.

Notice

Indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one level of danger exists, the warning notice for the highest level of danger is used. A warning notice accompanied by a safety alert symbol indicating a risk of bodily injury can also indicate a risk of property damage.

Qualified Personnel

The associated device/system may only be set up and operated using this documentation. Only **qualified personnel** should be allowed to commission and operate the device/system. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct usage

Please note the following:

Warning

The equipment may only be used for single purpose applications explicitly described in the catalog and in the technical description and it may only be used along with third-party devices and components recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

Trademarks

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Automation & Drives
Motion Control Systems
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GERMANY

Preface

SINAMICS Documentation

The SINAMICS documentation is sub-divided into 2 areas:

- General documentation/catalogs
- Manufacturer/Service Documentation

A current overview of the documentation in the available languages is provided in the Internet:

http://www.siemens.com/motioncontrol

Follow menu items “Support” –> “Technical documentation” –> “Overview of publications”.

The Internet version of DOConCD (DOConWEB) is available in the Internet:

http://www.automation.siemens.com/doconweb

Information on the range of training courses and FAQs (Frequently Asked Questions) are available in the Internet:

http://www.siemens.com/motioncontrol

Follow the menu item “Support”.

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

Table V-1 Usage phases and the available documents/tools

Usage phase	Document/tool
Exploratory	SINAMICS S Sales Documentation
Planning/configuration	SIZER configuration tool Configuration Manuals, Motors
Decision/ordering	SINAMICS S Catalogs
Installation/assembly	SINAMICS S120 Equipment Manual • SINAMICS S120 Equipment Manual for Control Units and Supplementary System Components • SINAMICS S120 Equipment Manual Power Modules Booksize • SINAMICS S120 Equipment Manual Power Modules Chassis • SINAMICS S120 Equipment Manual AC DRIVE

Table V-1 Usage phases and the available documents/tools, continued

Usage phase	Document/tool
Commissioning	• STARTER parameterization and commissioning tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual • SINAMICS S List Manual
Usage/operation	• SINAMICS S120 Commissioning Manual • SINAMICS S List Manual • SINAMICS S150 Operating Manual
Maintenance/servicing	• SINAMICS S120 Commissioning Manual • SINAMICS S List Manual • SINAMICS S150 Operating Manual

Target group

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

Benefits

The Commissioning Manual describes all the procedures and operational instructions required for commissioning and servicing SINAMICS S120.

The Commissioning Manual has the following structure:
Chapter 1 System overview
Chapter 2 Preparations for commissioning
Chapter 3 Commissioning
Chapter 4 PROFIdrive
Chapter 5 PROFIBUS
Chapter 6 PROFINET
Chapter 7 SINAMICS Safety Integrated
Chapter 8 Diagnostics
Chapter 9 Basics of the drive system

Advice for beginners:
First read Chapters 1 and 9 and then read the relevant chapters.

In addition to the Commissioning Manual, you need the List Manual and the Function Manual.

Finding your way around

The following guides are provided to help you locate information in this manual:

1. List of contents
2. List of Abbreviations
3. References
4. Index

Standard scope

The scope of the functionality described in this document can differ from the scope of the functionality 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 servicing.
- Functions can be described in the documentation 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. This documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

Technical support

If you have any questions, please get in touch with our Hotline:

European and African time zones

A&D Technical Support
Tel.: +49 (0) 180 5050 - 222
Fax: +49 (0) 180 5050 - 223

Internet: http://www.siemens.com/automation/support-request
E-Mail: adsupport@siemens.com

Asian and Australian time zones

A&D Technical Support
Tel: +89 1064 719 990
Fax: +86 1064 747 474

Internet: http://www.siemens.com/automation/support-request
E-Mail: adsupport@siemens.com

American time zones

A&D Technical Support
Tel: +1 423 262 2522
Fax: +1 423 262 2289

Internet: http://www.siemens.com/automation/support-request
E-Mail: adsupport@siemens.com

Note

Country telephone numbers for technical support are provided under the following Internet address:

http://www.siemens.com/automation/service&support

Questions about the Manual

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following fax number or E-Mail address:

Fax: +49 (0) 9131 / 98 - 63315
E-Mail: motioncontrol.docu@siemens.com
Fax form: See reply sheet at the end of this Manual

Internet address for SINAMICS

http://www.siemens.com/sinamics

EC declaration of conformity

The EC Declaration of Conformity for the EMC Directive can be obtained from:

- Internet

  http://www.ad.siemens.de/csinfo

  Product/Order No.: 15257461
- Branch offices

  At the responsible branch office of the A&D MC Business Division of Siemens AG.

Notation

The following notation and abbreviations are used in this documentation:

Notation for parameters (examples):

- p0918 Adjustable parameter 918
- r1024 Visualization 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) Visualization parameter 945, index 2 of drive object 3
- p0795.4 Adjustable parameter 795, bit 4

Notation for faults and alarms (examples):

- F12345 Fault 12345
- A67890 Alarm 67890

General notation:

- The sign “≙” means “is equal to”

ESDS notices

Caution

Electro**S**tatic **D**ischarge **S**ensitive Devices (ESDS) are individual components, integrated circuits, or modules that can be damaged by electrostatic fields or discharges.

Regulations for handling ESDS components:

- When handling electronic components, you must ensure that the person carrying out the work, the work place, and packaging are properly grounded.
- Personnel in ESDS areas with conductive flooring may only handle electronic components if:
  - They are grounded with an ESDS wrist band
  - They are wearing ESDS shoes or ESDS shoe grounding straps
- Electronic boards should only be touched if absolutely necessary. They must only be handled on the front panel or, in the case of printed circuit boards, at the edge.
- Electronic boards must not come into contact with plastics or items of clothing containing synthetic fibers.
- Boards must only be placed on conductive surfaces (work surfaces with ESDS surface, conductive ESDS foam, ESDS packing bag, ESDS transport container).
- Electronic modules must be kept at a distance from data display equipment, monitors, and televisions (minimum distance from screen: >10 cm).
- Measurements must only be taken on boards when:
  - The measuring device is grounded (with a protective conductor, for example).
  - The measuring head has been temporarily discharged before measurements are taken on a floating measuring device (e.g. touching a bare metal controller housing).

Safety information

Danger

- Commissioning must not start until you have ensured that the machine in which the components described here are to be installed complies with Directive 98/37/EC.
- SINAMICS devices and AC motors must only be commissioned by suitably qualified personnel.
- The personnel must take into account the information provided in the technical customer documentation for the product, and be familiar with and observe the specified danger and warning notices.
- When electrical equipment and motors are operated, the associated electrical circuits are at hazardous voltage levels.
- When the machine or system is operated, hazardous axis movements can occur.
- All of the work carried-out on the electrical machine or system must be carried-out with it in a no-voltage condition.
- SINAMICS devices with AC motors must only be connected to the power supply via an AC-DC residual-current-operated device with selective switching once verification has been provided that the SINAMICS device is compatible with the residual-current-operated device in accordance with EN 50178, Subsection 5.2.11.2.

Warning

- The successful and safe operation of these devices and motors depends on correct transport, proper storage and installation, as well as careful operation and maintenance.
- The specifications in the catalogs and offers also apply to special variants of the devices and motors.
- In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and system-specific regulations and requirements must be taken into account.
- Only protective extra-low voltages (PELVs) that comply with EN60204-1 must be connected to all connections and terminals between 0 and 48 V.

Caution

- The surface temperature of the motors can reach over +80 °C.
- For this reason, temperature-sensitive parts (lines or electronic components, for example) must not be placed on or attached to the motor.
- When attaching the connecting cables, you must ensure that:
  - They are not damaged
  - They are not under tension
  - They cannot come into contact with rotating parts**.**

Caution

- As part of routine tests, SINAMICS devices with AC motors undergo a voltage test in accordance with EN 50178. Before the voltage test is performed on the electrical equipment of industrial machines to EN 60204-1, Section 19.4, all connectors of SINAMICS equipment must be disconnected/unplugged to prevent the equipment from being damaged.
- Motors must be connected in accordance with the circuit diagram provided, otherwise they can be destroyed.

Note

- When operated in dry operating areas, SINAMICS equipment with AC motors conforms to low-voltage Directive 73/23/EEC.

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Contents

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Notes

System Overview

1

1.1 Applications

SINAMICS is the new range of drives from Siemens designed for mechanical and plant engineering applications. SINAMICS offers solutions for all drive tasks:

- Simple pump and fan applications in the process industry
- Complex individual drives in centrifuges, presses, extruders, elevators, as well as conveyor and transport systems
- Drive line-ups in textile, plastic film, and paper machines, as well as in rolling mill plants
- Highly dynamic servo drives for machine tools, as well as packaging and printing machines

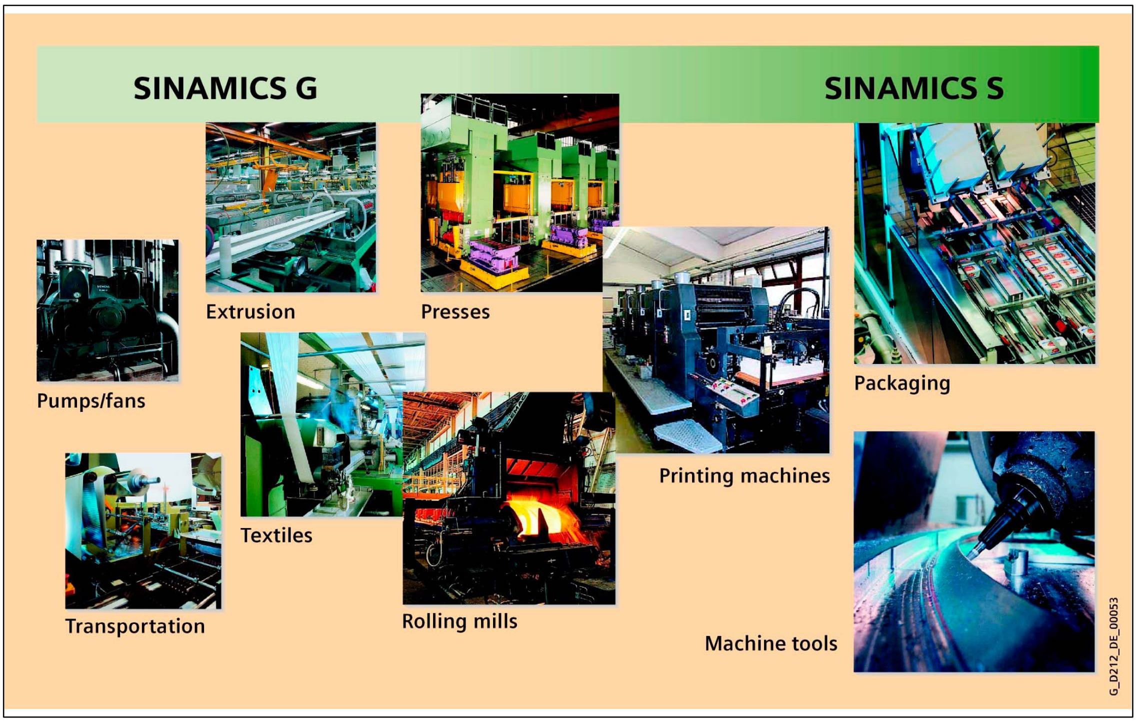

Fig. 1-1 SINAMICS applications

1.2 Versions

Depending on the application, the SINAMICS range offers the ideal version for any drive task.

- SINAMICS G is designed for standard applications with induction motors. These applications have less stringent requirements regarding the dynamics and accuracy of the motor speed.
- SINAMICS S handles complex drive tasks with synchronous/induction motors and fulfills stringent requirements regarding
  - Dynamics and accuracy,
  - Integration of extensive technological functions in the drive control system.

1.3 Platform concept and Totally Integrated Automation

All SINAMICS versions are based on a platform concept. Joint hardware and software components, as well as standardized tools for design, configuration, and commissioning tasks ensure high-level integration across all components. SINAMICS handles a wide variety of drive tasks with no system gaps. The different SINAMICS versions can be easily combined with each other.

SINAMICS is part of the Siemens “Totally Integrated Automation” concept. Integrated SINAMICS systems covering configuration, data storage, and communication at automation level ensure low-maintenance solutions with SIMATIC, SIMOTION, and SINUMERIK.

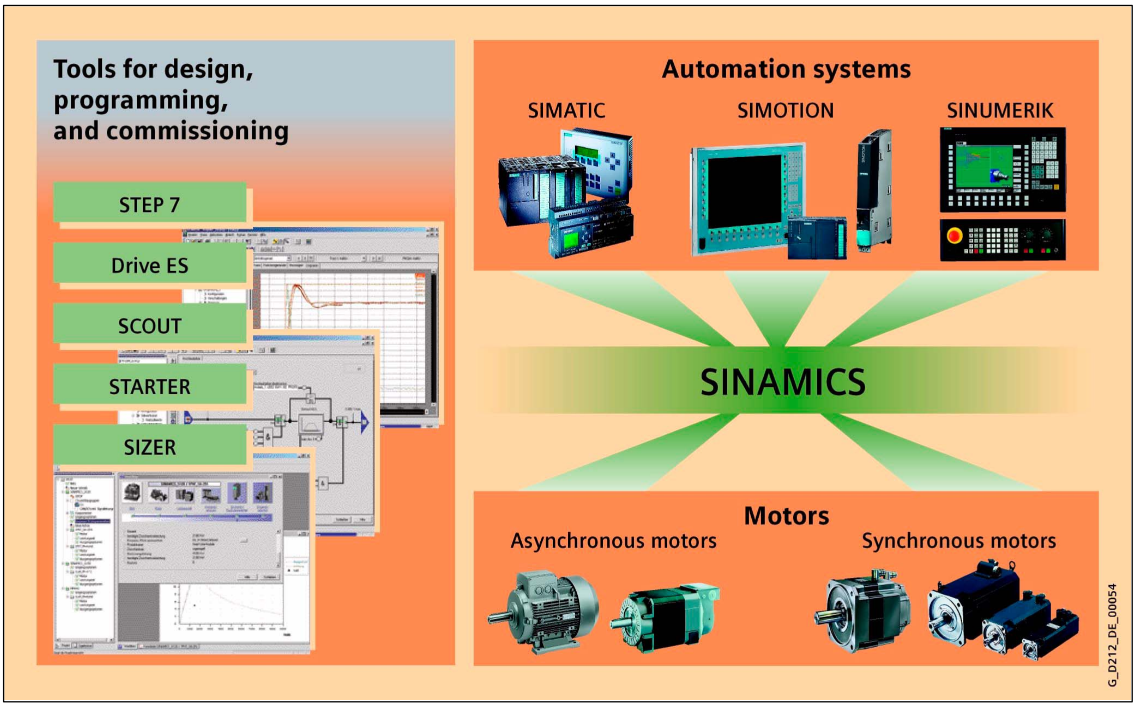

Fig. 1-2 SINAMICS as part of the Siemens modular automation concept

1.4 Overview

Modular system for complex drive tasks

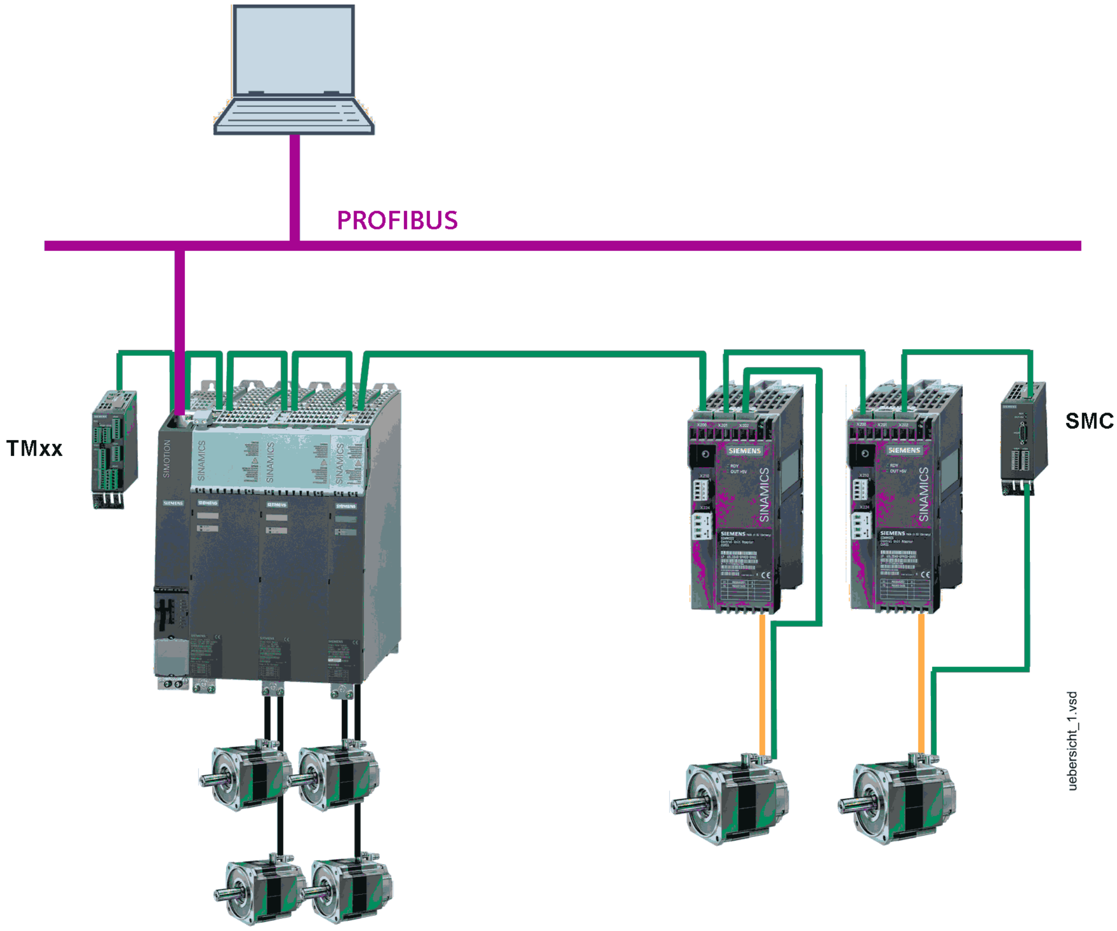

Fig. 1-3 Configuration with multi-axis and single-axis drives

SINAMICS S120 solves complex drive tasks for a wide range of industrial applications and is, therefore, designed as a modular system. Users can choose from many different harmonized components and functions to create a solution that best meets their requirements. SIZER, a high-performance configuration tool, makes it easier to choose and determine the optimum drive configuration. SINAMICS S120 is enhanced by a wide range of motors. Whether synchronous or induction, all motor types are supported by SINAMICS S120.

SINAMICS S120 AC Drive

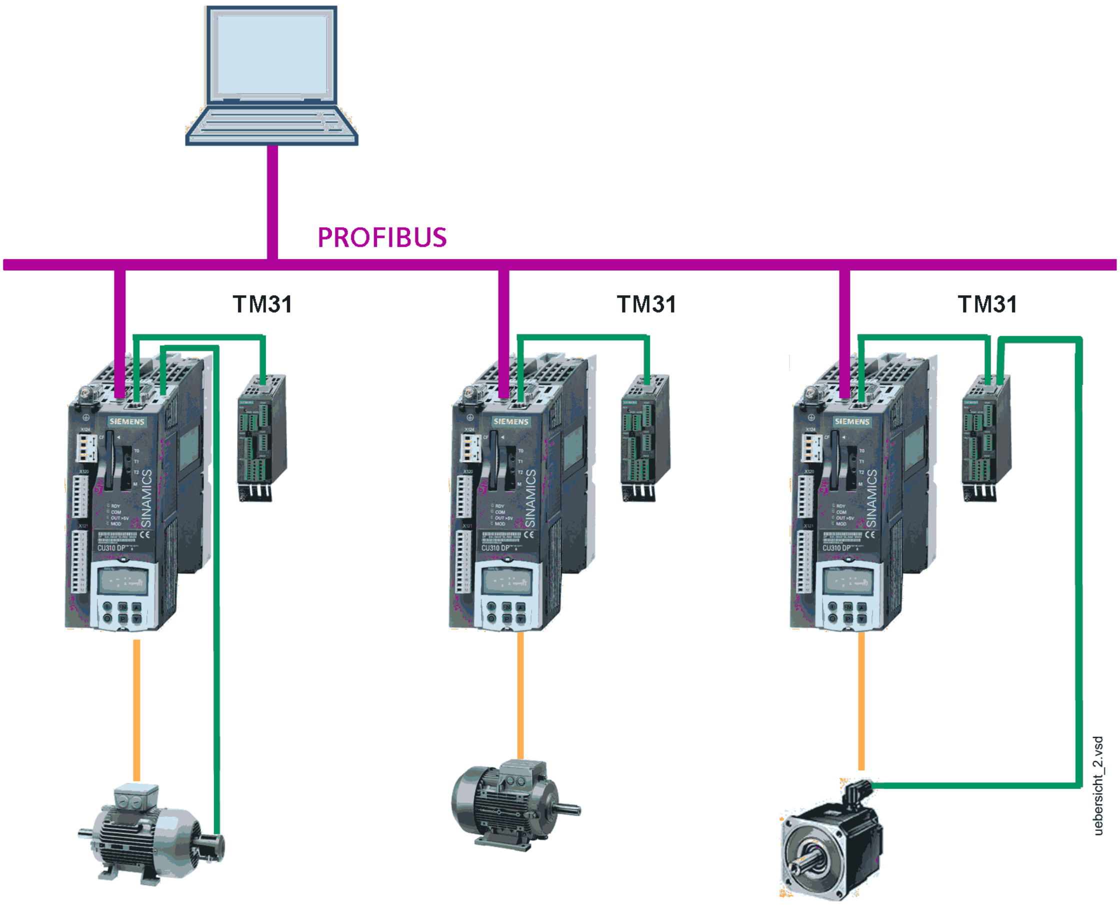

Fig. 1-4 Overview, AC Drive

SINAMICS S120 AC Drive is a modular drive system for individual axes and addresses sophisticated drive tasks for an extremely wide range of industrial applications.

Applications include:

- Machine concepts with a central drive (e.g. presses, printing, packaging)
- Modular machine concepts where the machine modules broken down to single axes
- Single-motor drives that when compared to standard drives have a high accuracy, stability and smooth running requirements in machinery and industrial plant construction
- Single-motor drives for transport applications (conveying, raising, lowering)
- Drives without regenerative feedback into the line supply (wire-drawing, extruding)
- Drive groups with high requirements placed on the availability (when the infeed fails, this may not cause all of the axes to fail)

The combination of a power unit (Power Module) and a Control Unit (CU) or a Control Unit Adapter form a single-motor drive in a compact design for machinery and plant construction.

The high-performance SIZER engineering tool makes it easier to select and determine the optimum drive configuration. The drive can be simply commissioned a user-friendly fashion using the STARTER commissioning tool.

SINAMICS S120 AC Drive is supplemented by a wide range of motors. Whether synchronous or induction, whether rotary or linear motors, all motor types are supported by SINAMICS S120 AC Drive.

Particularly suitable for multi-axis applications

Coordinated drives that carry out drive tasks together are used in many mechanical and plant engineering applications, examples include traversing gear in gantry cranes, stretching systems in the textile industry, or paper machines and rolling mills. Drives with coupled DC links are required for such applications in order to permit cost-saving energy exchange between braking and driving axes. SINAMICS S120 includes line infeeds and inverter modules over a wide power range. Their design allows side-by-side installation thus permitting space-saving multi-axis drive configurations.

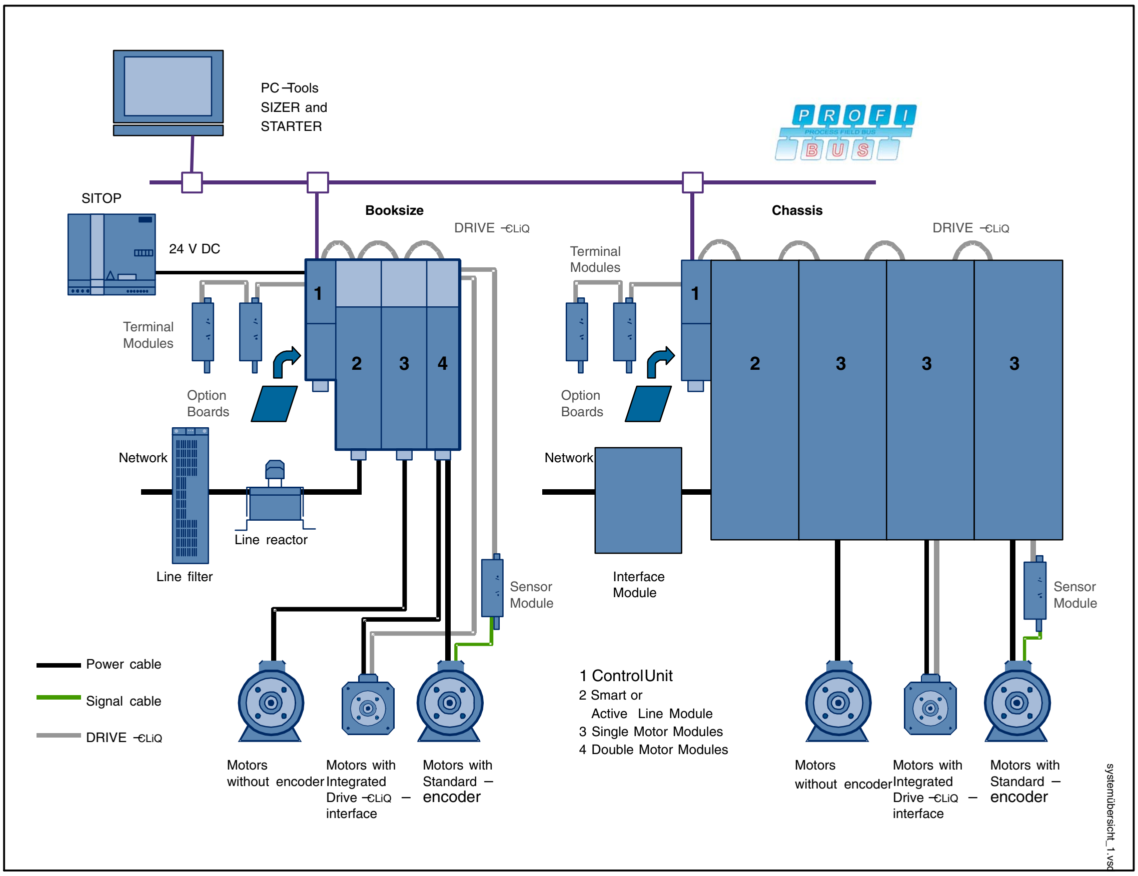

Fig. 1-5 SINAMICS S120 system overview

New system architecture with a central Control Unit

Electronically coordinated individual drives work together to perform your drive tasks. Higher-level controllers operate the drives to achieve the required coordinated movement. This requires cyclic data exchange between the controller and all the drives. This exchange always had to take place via a field bus, which required a great deal of time and effort for installation and configuration. SINAMICS S120 takes a different approach. A central Control Unit controls the drive for all connected axes and also establishes the technological links between the drives and axes. Since all the required data is stored in the central Control Unit, it does not need to be transferred. Inter-axis connections can be established within a module and easily configured in the STARTER commissioning tool using a mouse.
The SINAMICS S120 Control Unit can handle simple technological tasks itself. For complex technological tasks, the user-programmable modules in the SIMOTION D product spectrum are used instead.

DRIVE-CLiQ – a digital interface between all components

All SINAMICS S120 components, including the compact asynchronous motors and encoders, are interconnected via a common serial interface called DRIVE-CLiQ. All of the cables and connectors have a standard design that reduces the number of different parts and inventory costs.
Converter modules (Sensor Modules) are available for motors without an integrated DRIVE-CLiQ interface; these converter modules convert all conventional encoder signals to DRIVE-CLiQ.

Electronic type plate in all components
All SINAMICS S120 components have an electronic type plate, which contains all the relevant data about that particular component. In the compact asynchronous motors with a DRIVE-CLiQ interface, this data includes the parameters of the electric equivalent circuit diagram and the built-in motor encoder. The Control Unit records this data automatically via DRIVE-CLiQ so that it does not need to be entered during commissioning or if the equipment is replaced.

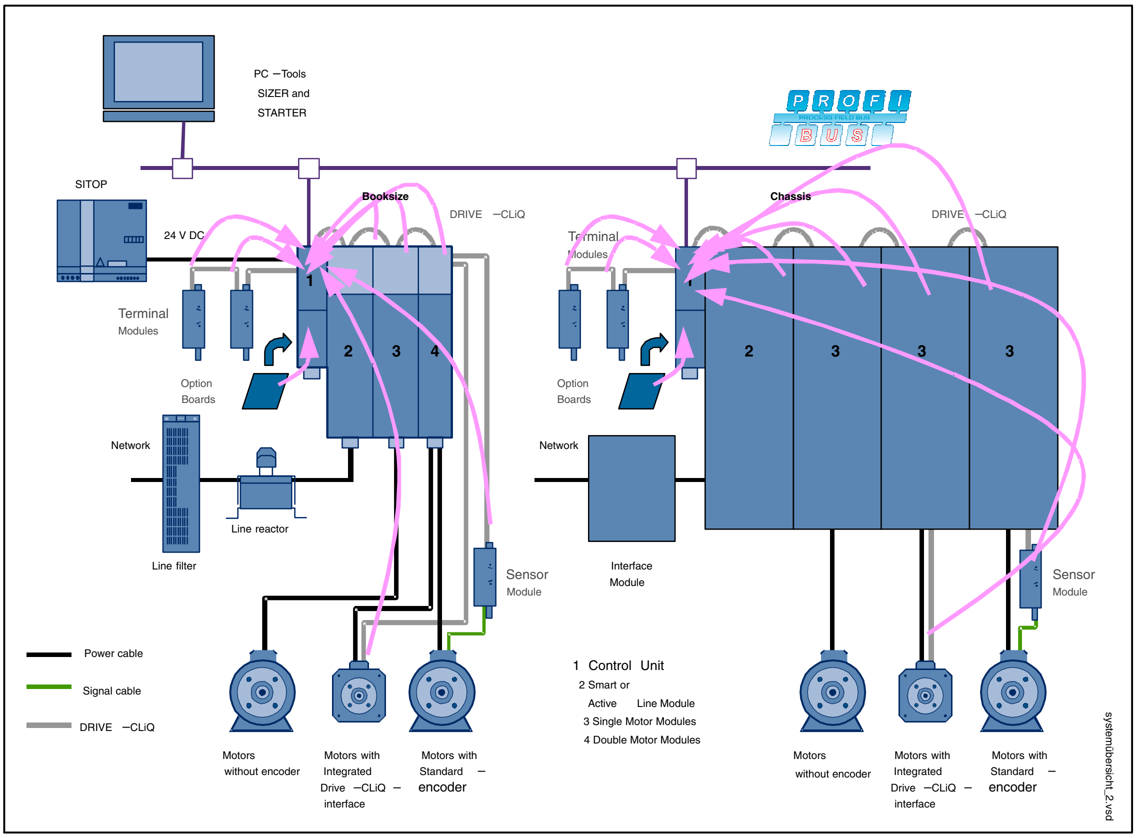

Fig. 1-6 Detection of the electronic rating plate via DRIVE-CLiQ on SINAMICS S120

In addition to the technical data, the type plate includes logistical data (manufacturer ID, order number, and globally unique ID). Since this data can be called up electronically on site or remotely, all the components used in a machine can always be individually identified, which helps simplify servicing.

SIMATIC S7-H system

SINAMICS can be connected to a fault-tolerant SIMATIC S7-H system via the so-called Y link. In this case, the SINAMICS at the PROFIBUS outlet of the Y link must be configured as DPV0 standard slave via the GSD file.
It is not possible to configure SINAMICS with the Drive ES interface at a Y link. This means that using STARTER, from a central engineering PC in the central control room, it is not possible to access SINAMICS via routed S7 connections through the H station. To engineer SINAMICS at the PROFIBUS outlet of the Y link, STARTER must be connected.

1.5 SINAMICS S120 components

Fig. 1-7 SINAMICS S120 component overview

1.6 Servo versus vector

Table 1-1 Servo versus vector

	Servo	Vector
Typical applications	Drives with highly dynamic motion control. Angular-locked synchronism with isochronous PROFIdrive. For use in production machine tools and clocked production machines.	Speed and torque-controlled drives with high speed and torque accuracy especially for operation without an encoder (sensorless operation).
Maximum number of drives that can be controlled by one Control Unit	1 Active Line Module + 6 Motor Modules (for current controller sampling rate 125 µs / speed controller 125 µs) 1 Active Line Module + 2 Motor Modules (for current controller sampling rate 62.5 µs / speed controller 62.5 µs)	1 Active Line Module + 2 Motor Modules (current controller scanning frequency 250 µs/speed controller 1 ms) 1 Active Line Module + 4 Motor Modules (for the current controller sampling time 400 µs/500 µs/speed controller 1.6 ms/2ms) 1 Active Line Module + 8 Motor Modules (current controller scanning frequency 500 µs/speed controller 4 ms)
Dynamic response	High	Medium
Sampling time current controller/ speed controller/ pulse frequency	**Booksize:** 125 µs/125 µs/≥ 4 kHz (factory setting, 4 kHz) **Chassis (sizes Fx and Gx):** 250 µs/250 µs/≥ 2 kHz (factory setting, 2 kHz) 125 µs/125 µs /≥ 4 kHz	**Booksize:** 250 µs/1000 µs/≥ 2 kHz (factory setting, 4 kHz) 400 µs/1600 µs/≥ 1.25 kHz (factory setting, 2.5 kHz) **Blocksize:** 250 µs/1000 µs/≥ 2 kHz (factory setting, 4 kHz) 500 µs/2000 µs/≥ 2 kHz (factory setting, 4 kHz) **Chassis:** ≤ 250 kW: 250 µs/1000 µs/ ≥ 2 kHz > 250 kW: 400 µs/1600 µs / ≥ 1.25 kHz 690 V: 400 µs/1600 µs / ≥ 1.25 kHz

Table 1-1 Servo versus vector, continued

	Servo	Vector
Connectable motors	Synchronous servomotors Induction motors	Induction motors Synchronous motors (incl. torque motors) Reluctance motors (only for V/f control) Separately-excited synchronous motors (only for closed-loop control with encoder) **Note:** No synchronous motors of types 1FT6, 1FK6, and 1FK7
Position interface via PROFIdrive for higher-level motion control	Yes	Yes
Sensorless speed control	Yes (as of 10% of rated motor speed)	Yes (as of standstill or 2% rated motor speed)
Motor identification (third-party motors)	Yes	Yes
Speed controller optimization	Yes	No, only parameter pre-assignment
V/f Control	Diagnosis mode	Yes (different characteristics)
Speed control (without encoder)	No	Yes (controlled at low speeds)
Field-weakening range for induction motors	≤ 16 * Threshold speed for field weakening (with encoder) ≤ 5 * Threshold speed for field weakening (without encoder)	≤ 5 * Rated motor speed
Maximum output frequency with closed-loop control	1300 Hz with 62.5 μs/8 kHz 650 Hz with 125 μs/4 kHz 300 Hz with 250 μs/2kHz	300 Hz with 250 μs/4 kHz or with 400 μs/5 kHz 240 Hz with 500 μs/4 kHz
Note: The derating characteristic in the Equipment Manuals must be carefully observed! Max. output frequency when using dv/dt and sinusoidal filters 150 Hz!		
Response during operation at thermal limit of motor	Reduction of current setpoint or shutdown	Reduction of pulse frequency and/or current setpoint or shutdown (not with parallel connection/sinusoidal filter)

Table 1-1 Servo versus vector, continued

	Servo	Vector
Speed setpoint channel (ramp-function generator)	Optional (reduces the number of drives from 6 to 5 Motor Modules with a sampling time for current controller of 125 µs/speed controller 125 µs)	Standard
Parallel connection of Power Modules	No	**Booksize:** No **Chassis:** Yes

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Preparations for Commissioning 2

Before you start commissioning (see Chapter 3), you will need to make the preparations described in this chapter:

- Requirements for commissioning
- PROFIBUS/PROFINET components
- Rules for wiring with DRIVE-CLiQ

2.1 Requirements for commissioning

The following are the basic requirements for commissioning a SINAMICS S drive system:

- STARTER Commissioning Tool
- PROFIBUS or PROFINET interface
- Wired drive line-up (see Equipment Manual)

  The following diagram shows a basic sample configuration with booksize and chassis components.

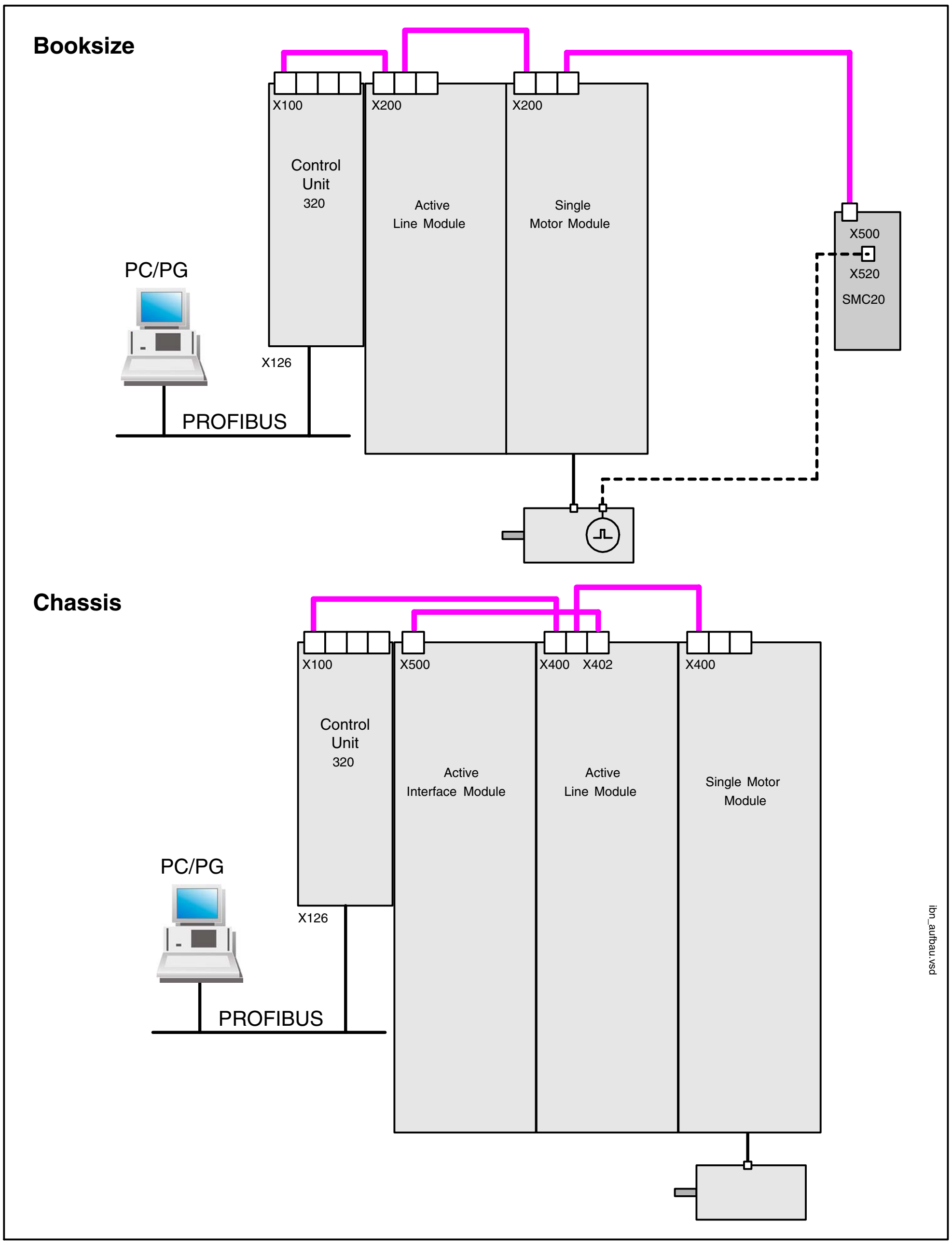


Fig. 2-1 Component configuration (example)

Checklist for commissioning booksize power sections

The following checklist must be carefully observed. Read the safety information in the Equipment Manuals before starting work.

Table 2-1 Checklist for commissioning (booksize)

Check	O. K. ✓
The ambient conditions must be permissible. See Equipment Manuals. The components must be firmly attached to the fixing points provided. The cooling air can flow unobstructed.	
The ventilation clearances for the components must be observed.	
The CompactFlash Card must be inserted in the Control Unit.	
All necessary components of the configured drive line-up are installed and available.	
The DRIVE-CLiQ topology rules must be observed. For information about DRIVE-CLiQ wiring, see 2.4.	
The line-side and motor-side power cables must be dimensioned and routed in accordance with the ambient and routing conditions. The maximum permissible cable lengths between the converter and the motor must be observed depending on the type of cables used. The cables must be properly connected with the correct torque to the component terminals. The cables for the motor and low-voltage switchgear must also be connected with the required torques.	
Has all wiring work been successfully completed?	
Are all connectors correctly plugged in and screwed in place?	
Have all the screws been tightened to the specified torque?	
Have all the covers for the DC link been closed and latched into place?	
Are the shield connections installed correctly?	

Checklist for commissioning chassis power sections

The following checklist must be carefully observed. Read the safety information in the Equipment Manuals before starting work.

Table 2-2 Checklist for commissioning (chassis)

Activity	O. K.
The ambient conditions must be permissible. See Equipment Manuals. The components must be properly installed in the cabinet units. The air flow for the modules, which undergo forced cooling, must be ensured. The ventilation clearances must be ensured. The air flow specified in the technical specifications must be ensured. An air short-circuit must not be allowed to form between the chassis air inlet and outlet on account of the installation.	
The ventilation clearances for the components must be observed.	
The CompactFlash Card must be inserted in the Control Unit.	
All necessary components of the configured drive line-up are installed and available.	
The DRIVE-CLiQ topology rules must be observed. For information about DRIVE-CLiQ wiring, see 2.4.	
The line-side and motor-side power cables must be dimensioned and routed in accordance with the ambient and routing conditions. The maximum permissible cable lengths between the converter and the motor must be observed depending on the type of cables used. The ground for the motor should be directly connected to the ground for the Motor Module (short distance). The cables must be properly connected with the correct torque to the component terminals. The cables for the motor and low-voltage switchgear must also be connected with the required torques.	
The busbar/wiring for the DC connection between the infeed and the Motor Modules must be checked with regard to the load and installation conditions. When more than one motor is used, the total current of the DC connection must be observed.	
The cables between the low-voltage switchgear and the power section must be protected with line fuses for conductor protection (VDE 636, Part 10). Combined fuses are recommended for conductor and semi-conductor protection (VDE 636, Part 40/EN 60269-4). For information about the relevant fuses, see the catalog.	
Ensure that measures are taken to relieve strain on the cables.	

Table 2-2 Checklist for commissioning (chassis), continued

Activity	O. K.
When EMC-shielded cables are used, screwed glands that connect the shield to ground with the greatest possible surface area must be provided on the motor terminal box. The cable shields must be connected as close to the conductor terminal connections as possible to ensure a low-impedance connection with cabinet ground.	
The cable shields must be properly applied and the cabinet properly grounded at the appropriate points.	
The connection voltage for the fans in the chassis units must be adapted accordingly to the supply voltages by making the appropriate settings on the fan transformers.	
The connection bracket for the interference-suppression capacitor must be removed from the infeeds for operation with an ungrounded supply.	
The type plate can be used to ascertain the date of manufacture. If the period from the date of manufacture to initial commissioning or the downtime of the power components is less than two years, the DC link capacitors do not have to be reformed. If the downtime period is longer than two years, they must be reformed in accordance with the description in the “Maintenance and Servicing” chapter in the Equipment Manual.	
With an external auxiliary supply, the cables must be connected in accordance with the Equipment Manual.	
Drive operation by higher-level controller/control room. The control cables must be connected in accordance with the required interface configuration and the shield applied. Taking into account electrical interference and the distance from power cables, the digital and analog signals must be routed with separate cables.	

2.2 PROFIBUS components

We recommend the following components for communication via PROFIBUS:

1. Communication modules if PC/PG interface via the **PROFIBUS interface**
   - CP5511 (PROFIBUS interface via PCMCIA card)

     Configuration: PCMCIA type 2 card + adapter with 9-pin SUB-D socket for connection to PROFIBUS.

     Order No.: 6GK1551-1AA00
   - CP5512 (PROFIBUS connection via CARDBUS)

     Configuration: PCMCIA type 2 card + adapter with 9-pin SUB-D socket for connection to PROFIBUS.

     For MS Windows 2000/XP Professional and PCMCIA 32 only

     Order No.: 6GK1551-2AA00
   - CP5611 (PROFIBUS interface via short PCI card)

     Configuration: Short PCI card with 9-pin SUB-D socket for connection to PROFIBUS.

     Order No.: 6GK1561-1AA00
   - CP5613 (PROFIBUS interface via short PCI card)

     Configuration: Short PCI card with 9-pin SUB-D socket for connection to PROFIBUS, diagnostic LEDs, PROFIBUS controller ASPC2 StepE

     Order No.: 6GK1561-3AA00
   - USB adapter (PROFIBUS connection via USB)

     Configuration: Adapter with USB connection to PC/PG and 9-pin SUB-D socket for connection to PROFIBUS

     For MS Windows 2000/XP Professional only and max. 1.5 Mbaud

     Order No.: 6ES7972-0CB20-0XA0
2. **Connecting cables**
   - Between: CP 5xxx <—> PROFIBUS

     Order No.: 6ES7901-4BD00-0XA0

Cable lengths

Table 2-3 Permissible PROFIBUS cable lengths

Baud rate [bit/s]	Max. cable length [m]
9.6 k to 187.5 k	1000
500 k	400
1.5 M	200
3 to 12 M	100

2.3 PROFINET components

We recommend the following components for communication via PROFINET:

1. Communication modules if PC/PG interface via the **PROFINET interface**

Note

A standard Ethernet interface can be used for pure commissioning with STARTER.

The CBE20 supports all Ethernet cables (crossover cable and 1:1 cable).

---

2. **Recommended connecting cable**
   – Industrial Ethernet FC TP Standard Cable GP 2 x 2 (up to max. 100 m)

     Standard bus cable with rigid conductors and a special design for fast installation

     Order No.: 6XV1840-2AH10

   – Industrial Ethernet FC TP Flexible Cable GP 2 x 2 (up to max. 85 m)

     Order No.: 6XV1870-2B

   – Industrial Ethernet FC Trailing Cable GP 2x2 (up to max. 85 m)

     Order No.: 6XV1870-2D

   – Industrial Ethernet FC Trailing Cable 2x2 (up to max. 85 m)

     Order No.: 6XV1840-3AH10

   – Industrial Ethernet FC Marine Cable 2x2 (up to max. 85 m)

     Order No.: 6XV1840-4AH10

3. **Recommended connectors**
   – Industrial Ethernet FC RJ45 Plug 145 for CU320 with CBE20

     Order No.: 6GK1901-1BB30-0Ax0

   – Industrial Ethernet FC RJ45 Plug 180 for CU310 PN (available from approx. July 2006)

     Order No.: 6GK1901-1BB10-2Ax0

2.4 Rules for wiring with DRIVE-CLiQ

The following rules apply for wiring components with DRIVE-CLiQ. The rules are sub-divided into **DRIVE-CLiQ rules** that must be unconditionally complied with and **recommended rules**, which if they are complied with, do not require any subsequent changes in the topology generated in STARTER offline.
If the real topology does not correspond with the topology that STARTER sets-up offline – then the offline topology must be adapted before the download (also see Subsection 2.4.6).

2.4.1 General rules

DRIVE-CLiQ rules

- A maximum of 16 nodes can be connected to a DRIVE-CLiQ line on the Control Unit.
- Up to 8 nodes can be connected in a row. A row is always seen from the perspective of the Control Unit.

Note

One Double Motor Module corresponds to two DRIVE-CLiQ nodes.

- Ring wiring is not permitted.
- Components must not be double-wired.

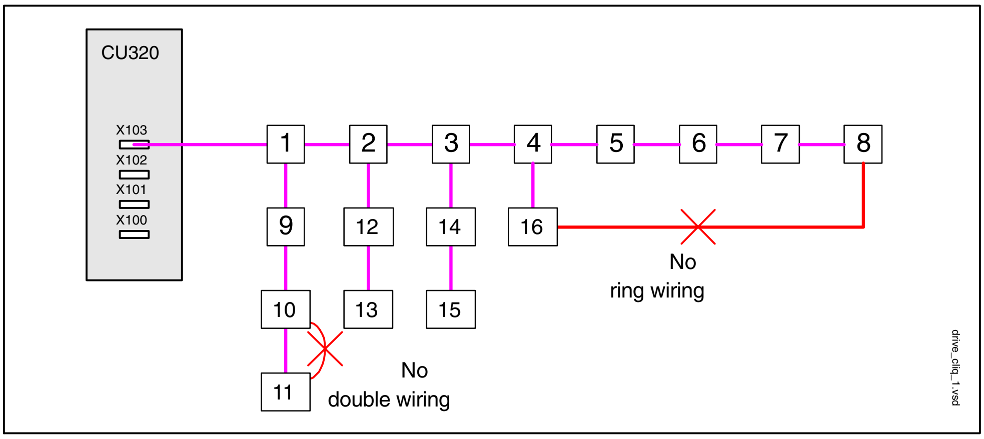


Fig. 2-2 Example: DRIVE-CLiQ line on a CU320 X103

Note

You can call up the “Topology” screen in STARTER to change and/or check the DRIVE-CLiQ topology for each drive unit.

Recommended rules

- The DRIVE-CLiQ cable from the Control Unit must be connected to X200 on the first booksize power section or X400 on the first chassis power section.
- The DRIVE-CLiQ connections between the power sections must each be connected from interface X201 to X200/from X401 to X400 on the follow-on component.

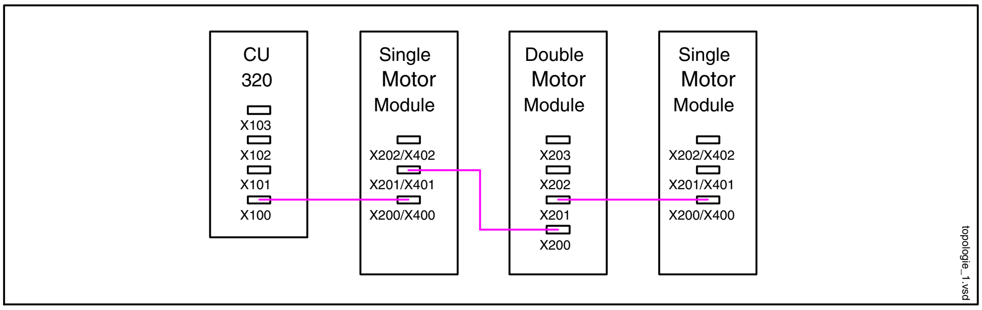


Fig. 2-3 Example: DRIVE-CLiQ line

- The motor encoder must be connected to the associated Motor Module.

Table 2-4 Motor encoder connection

Component	Motor encoder connection
Single Motor Module Booksize	X202
Double Motor Module (booksize)	• Motor connection X1: Encoder at X202 • Motor connection X2: Encoder at X203
Single Motor Module Chassis	X402

Note

If an additional encoder is connected to a Motor Module, it is automatically assigned to this drive as encoder 2.

- The Voltage Sensing Module (VSM module) must, for chassis components, be connected to the associated Active Line Module and is installed there in the Active Interface Module Chassis.

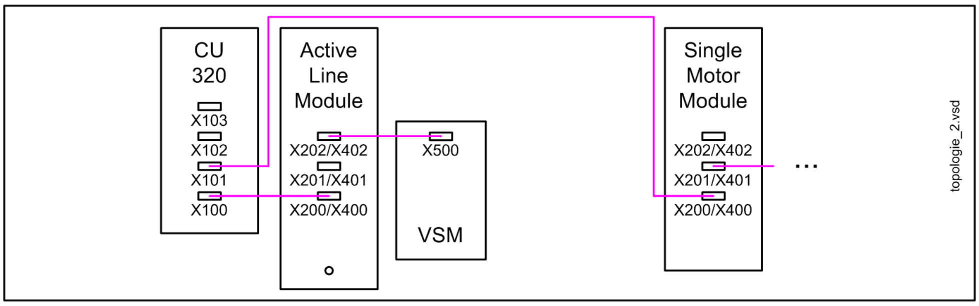


Fig. 2-4 Example of a topology with VSM for Booksize and Chassis components

Table 2-5 VSM connection

Component	VSM connection
Active Line Module Booksize	X202
Active Line Module (chassis)	X402
Notice! All of the stations (nodes) on the DRIVE-CLiQ line must have the same sampling time in p0115[0]. Otherwise, the VSM must be connected to a separate DQ interface of the Control Unit.	

2.4.2 Rules for different firmware releases

Rules for FW2.1

- Only one Active Line Module can be connected to a Control Unit.
- The default sampling times must not be changed.
- A Double Motor Module must not be operated as a single drive.
- Mixed operation (servo and vector) is not permitted.
- A maximum of 9 Sensor Modules can be connected.
- A maximum of 8 Terminal Modules can be connected.
- The Active Line Module and the Motor Modules must be connected to separate DRIVE-CLiQ lines.

Table 2-6 Maximum number of drives that can be controlled by a Control Unit 320

	Servo	Vector
Number of components	1 Active Line Module + 6 Motor Modules	1 Active Line Module + 2 Motor Modules (scanning frequency of current controller: 250 µs/speed controller: 1000 µs)
Note: In addition, the “Safe standstill” function can be activated and a TM31 connected.		

Rules for FW2.2

- Only one Active Line Module can be connected to a Control Unit.
- The default sampling times must not be changed.
- A Double Motor Module must not be operated as a single drive.
- Mixed operation (servo with vector V/f) is possible.
- A maximum of 9 Sensor Modules can be connected.
- A maximum of 8 Terminal Modules can be connected.
- The Active Line Module (booksize) and Motor Modules (booksize)
  - can be connected to one DRIVE-CLiQ line in **servo** mode.
  - must be connected to separate DRIVE-CLiQ lines in **vector** mode.
- During mixed operation (servo and vector V/f), separate DRIVE-CLiQ lines must be used.
- The Active Line Module (chassis) and the Motor Modules (chassis) must be connected to separate DRIVE-CLiQ lines.
- Motor Modules (chassis) with different pulse frequencies must be connected to separate DRIVE-CLiQ lines.

Table 2-7 Maximum number of drives that can be controlled by a Control Unit 320

<table>
<tr><th></th><th>Servo</th><th>Vector V/f (=vector without speed control function module)</th><th>Vector</th></tr>
<tr><td rowspan="2">Number of components</td><td>1 Active Line Module +
6 Motor Modules</td><td>1 Active Line Module +
4 Motor Modules
(current controller sampling time 250 µs)
1 Active Line Module +
6 Motor Modules
(current controller sampling time 400 µs)</td><td rowspan="2">1 Active Line Module +
2 Motor Modules
(current controller sampling time 250 µs/speed controller 1000 µs)
1 Active Line Module +
4 Motor Modules
(current controller sampling time 400 µs/speed controller 1600 µs)</td></tr>
<tr><td colspan="2">Servo and vector V/f:
1 Active Line Module + 5 Motor Modules
(servo: Current controller 125 µs/speed controller 125 µs
vector V/f:
current controller sampling time 250 µs for maximum 2 V/f drives
current controller sampling time 400 µs for more than 2 V/f drives)</td></tr>
<tr><td colspan="4">Notes on the maximum number of drives that can be controlled by a CU320:
• In addition, the “Safe standstill” function can be activated and a TM31 connected.
• No function modules must be activated.</td></tr>
</table>

Rules for FW2.3

- Only one Active Line Module (or if connected in parallel, several) can be connected to a Control Unit.
- The default sampling times must not be changed.
- Mixed operation (servo with vector V/f) is possible.
- A maximum of 9 Sensor Modules can be connected.
- A maximum of 8 Terminal Modules can be connected.
- The Active Line Module (booksize) and Motor Modules (booksize)
  - can be connected to one DRIVE-CLiQ line in **servo** mode.
  - must be connected to separate DRIVE-CLiQ lines in **vector** mode.
- During mixed operation (servo and vector V/f), separate DRIVE-CLiQ lines must be used (mixed operation is not permissible on Double Motor Modules).
- The Active Line Module (chassis) and the Motor Modules (chassis) must be connected to separate DRIVE-CLiQ lines.
- Motor Modules (chassis) with different pulse frequencies must be connected to separate DRIVE-CLiQ lines.

Table 2-8 Maximum number of drives that can be controlled by a Control Unit 320

<table>
<tr><th></th><th>Servo</th><th>Vector V/f (=vector without speed control function module)</th><th>Vector</th></tr>
<tr><td rowspan="2">Number of components</td><td>1 Active Line Module +
6 Motor Modules</td><td>1 Active Line Module +
4 Motor Modules[1]
(sampling time of current controller: 250 µs/speed controller: 1000 µs)
1 Active Line Module +
6 Motor Modules[1]
(sampling time of current controller: 400 µs/speed controller: 1600 µs)
1 Active Line Module +
10 Motor Modules[1]
(sampling time of current controller: 500 µs/speed controller: 4000 µs)</td><td rowspan="2">1 Active Line Module +
2 Motor Modules
(current controller sampling time 250 µs/speed controller 1000 µs)
1 Active Line Module +
4 Motor Modules
(current controller sampling time 400 µs/speed controller 1 600 µs)</td></tr>
<tr><td colspan="2">Servo and vector V/f:
1 Active Line Module + 5 Motor Modules
(servo: Current controller 125 µs/speed controller 125 µs
vector V/f:
current controller sampling time 250 µs for maximum 2 V/f drives
current controller sampling time 400 µs for more than 2 V/f drives)</td></tr>
<tr><td colspan="4">Notes on the maximum number of drives that can be controlled by a CU320:
In addition, the “Safe standstill” function can be activated and a TM31 connected.
No function modules must be activated.</td></tr>
</table>

Rules for FW2.4

- Only one Line Module (or if connected in parallel, several) can be connected to a Control Unit.
- The Voltage Sensing Module (VSM) must be connected to a dedicated DRIVE-CLiQ port of the Control Unit.
- The default sampling times may be changed.
- Mixed operation (servo with vector V/f) is possible.
- A maximum of 9 encoders can be connected.
- A maximum of 8 Terminal Modules can be connected.
- The Active Line Module (booksize) and Motor Modules (booksize)
  - can be connected to one DRIVE-CLiQ line in **servo** mode.
  - must be connected to separate DRIVE-CLiQ lines in **vector** mode.
- During mixed operation (servo and vector V/f), separate DRIVE-CLiQ lines must be used (mixed operation is not permissible on Double Motor Modules).
- The Active Line Module (chassis) and the Motor Modules (chassis) must be connected to separate DRIVE-CLiQ lines.
- Motor Modules (chassis) with different pulse frequencies must be connected to separate DRIVE-CLiQ lines.
- If possible, the CUA31 should be connected at the end of the line.
- For vector control, more than 4 nodes (devices) may only be connected at **one** DQ line of the Control Unit.

Table 2-9 Maximum number of drives that can be controlled by a Control Unit 320

<table>
<tr><th></th><th>Servo</th><th>Vector V/f (=vector without speed control function module and without encoder)</th><th>Vector</th></tr>
<tr><td rowspan="2">Number of components</td><td>1 Active Line Module + 6 Motor Modules 1)</td><td>1 Active Line Module + 4 Motor Modules 1) (sampling time of current controller: 250 µs/speed controller: 1000 µs)
1 Active Line Module + 6 Motor Modules 1) (sampling time of current controller: 400 µs/speed controller: 1600 µs)
1 Active Line Module + 8 Motor Modules 1) (sampling time of current controller: 500 µs/speed controller: 4000 µs)</td><td rowspan="2">1 Active Line Module + 2 Motor Modules 1) (sampling time of current controller: 250 µs/speed controller: 1000 µs)
1 Active Line Module + 4 Motor Modules 1) (sampling time of current controller: 400 µs/speed controller: 1 600 µs)</td></tr>
<tr><td colspan="2">Servo and vector V/f:
1 Active Line Module + 5 Motor Modules 1)
(servo: Current controller 125 µs/speed controller 125 µs
vector V/f:
current controller sampling time 250 µs/speed controller 1000 µs for more than 2 V/f drives
current controller sampling time 400 µs/speed controller 1600 µs for more than 2 V/f drives)</td></tr>
<tr><td colspan="4">Notes on the maximum number of drives that can be controlled by a CU320:
In addition, the “Safe standstill” function can be activated and 1 TM31 connected.
No function modules must be activated.</td></tr>
</table>

1) If a CUA31 is connected as the first module to the Control Unit, then the maximum number is decreased by one.

2.4.3 Sample wiring for vector drives

Drive line-up comprising three Motor Modules (chassis) with identical pulse frequencies or vector (booksize)

Motor Modules (chassis) with identical pulse frequencies or vector (booksize) can be connected to a DRIVE-CLiQ interface on the Control Unit.

In the following diagram, three Motor Modules are connected to interface X101.

Note

This topology does not match the topology created offline by STARTER and must be changed (see 2.4.6.)

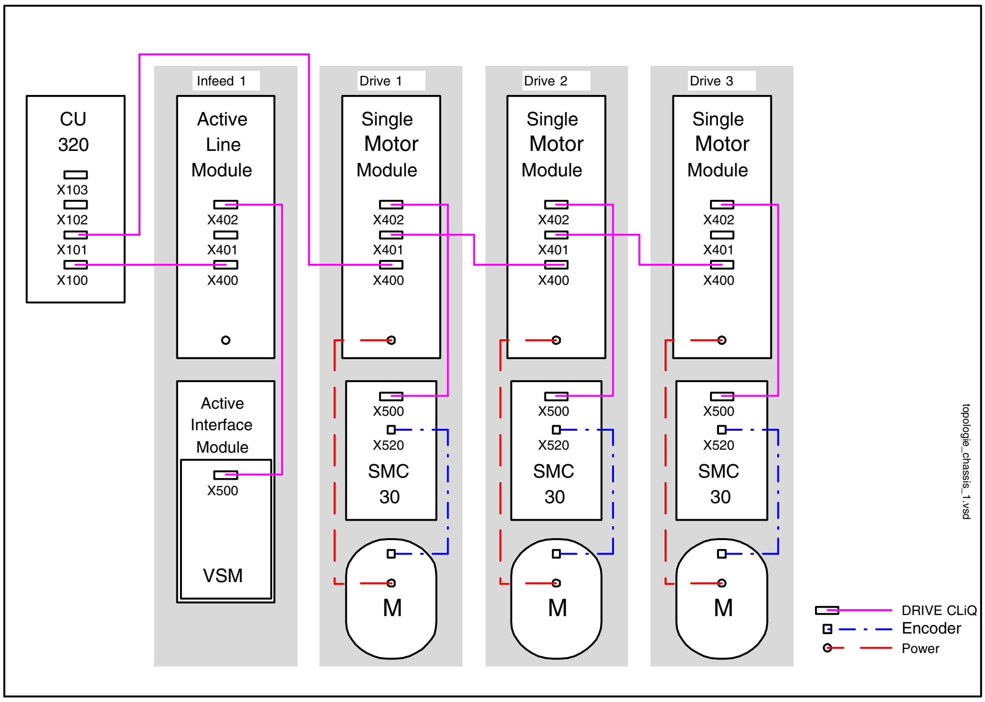


Fig. 2-5 Drive line-up (chassis) with identical pulse frequencies

Drive line-up comprising four Motor Modules (chassis) with different pulse frequencies

Motor Modules with different pulse frequencies must be connected to different DRIVE-CLiQ interfaces on the Control Unit.

In the following diagram, two Motor Modules (400 V, power $\leq$ 250 kW; pulse frequency 2 kHz) are connected to interface X101 and two Motor Modules (400 V, power > 250 kW, pulse frequency 1.25 kHz) connected to interface X102.

Note

This topology does not match the topology created offline by STARTER and must be changed (see 2.4.6.)

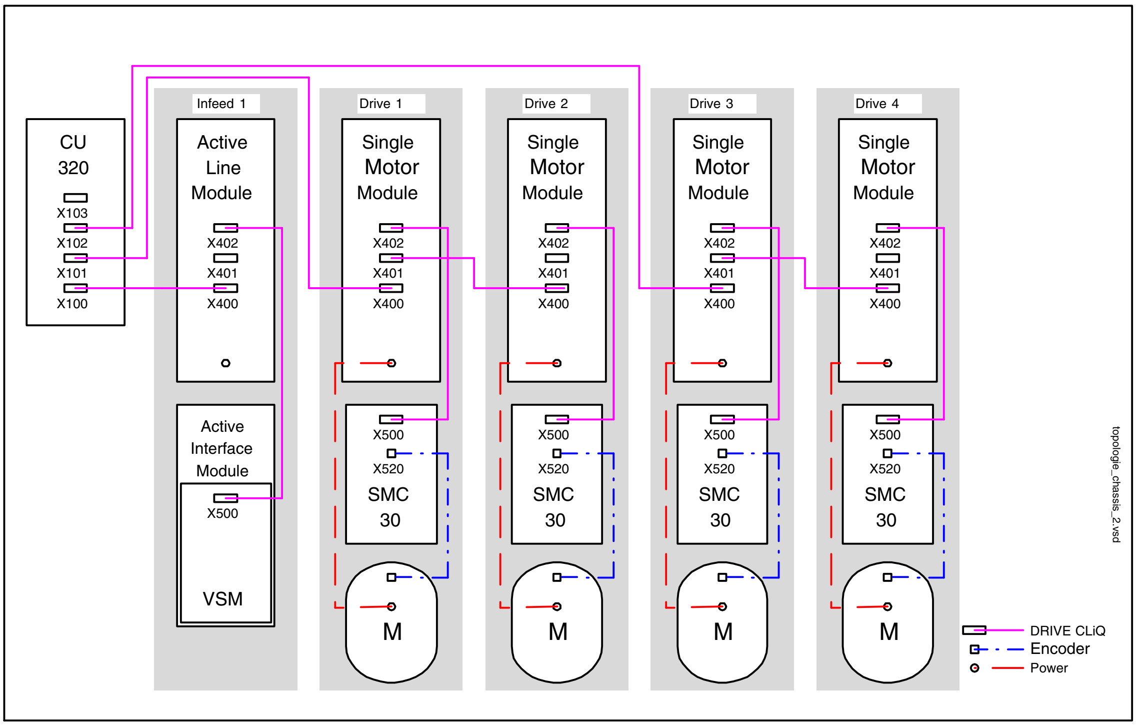


Fig. 2-6 Drive line-up (chassis) with different pulse frequencies

2.4.4 Sample wiring of Vector drives connected in parallel

Drive line-up with two parallel-connected Line Modules and Motor Modules (chassis) of the same type

Parallel-connected Line Modules (chassis) and Motor Modules (chassis) of the same type can be connected to a DRIVE-CLiQ interface of the Control Unit.

In the following diagram, two Active Line Modules and two Motor Modules are connected to the X100 and X101 interface.

For further information on parallel connection, refer to the Function Manual.

Note

This topology does not match the topology created offline by STARTER and must be changed (see 2.4.6.)

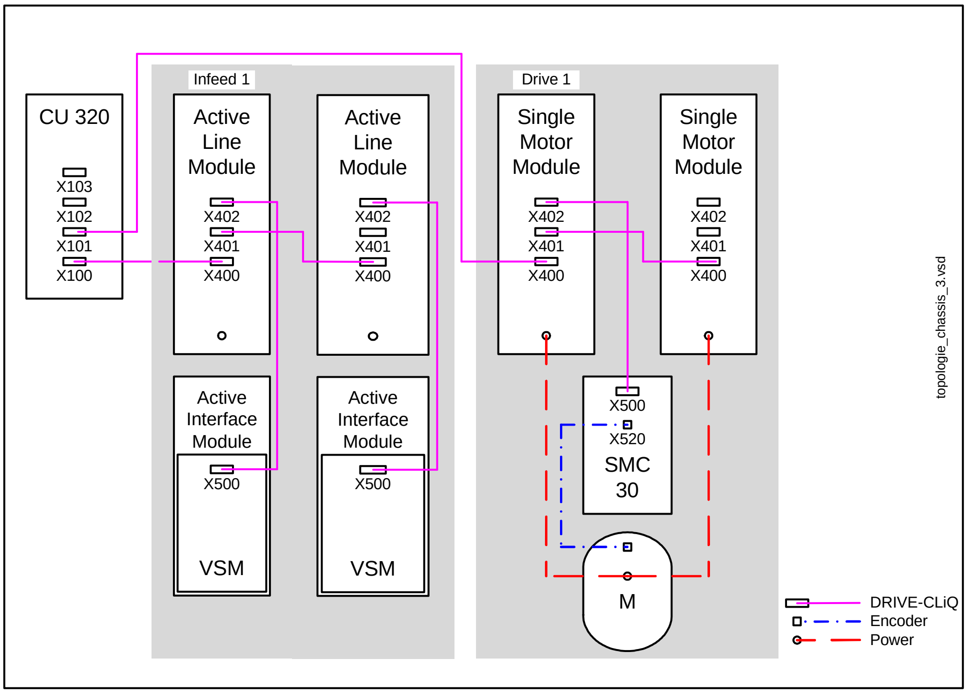


Fig. 2-7 Drive line-up with parallel-connected power units (chassis)

2.4.5 Wiring example for Power Modules

Blocksize

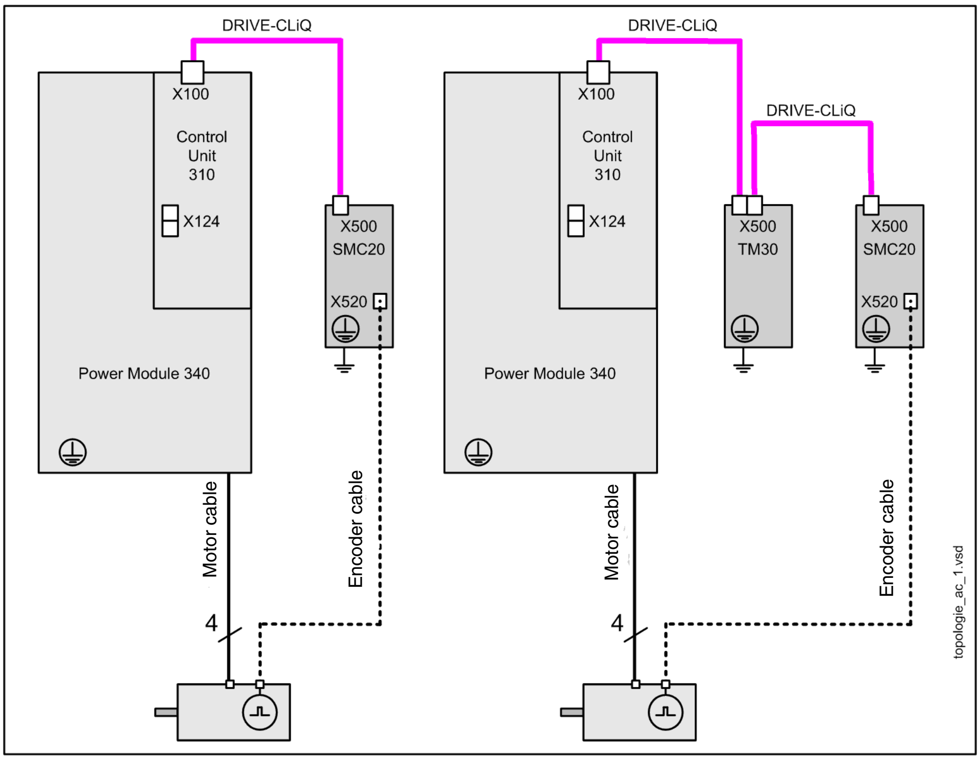


Fig. 2-8 Wiring example for Power Modules Blocksize

Chassis

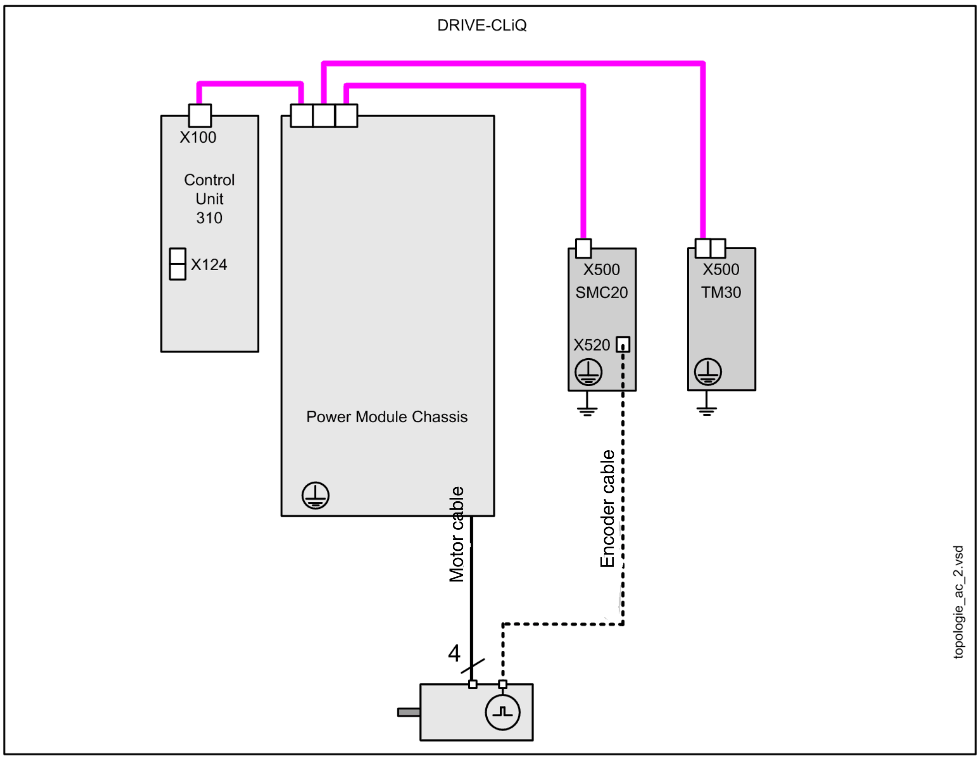
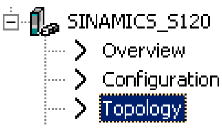
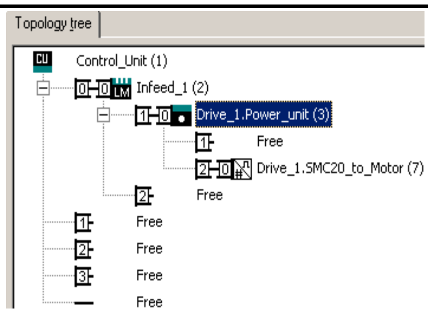
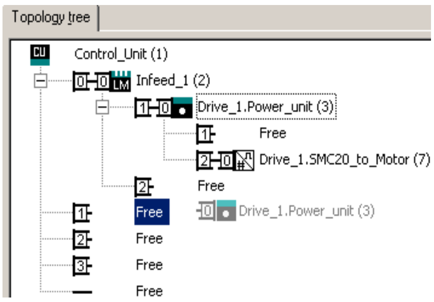
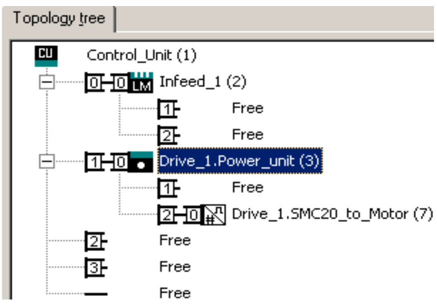


Fig. 2-9 Wiring example for Power Modules Chassis

2.4.6 Changing the offline topology in STARTER

The device topology can be changed in STARTER by moving the components in the topology tree.

Table 2-10 Example: changing the DRIVE–CLiQ topology

<table>
<tr><th></th><th>Topology tree view</th><th>Comments</th></tr>
<tr><td rowspan="3">
</td><td>
</td><td>Select the DRIVE–CLiQ component.</td></tr>
<tr><td>
</td><td>Keeping the mouse button depressed, drag the component to the required DRIVE–CLiQ interface and release the mouse button.</td></tr>
<tr><td>
</td><td>You have changed the topology in STARTER.</td></tr>
</table>

2.5 Powering-up/powering-down the drive system

Powering-up the infeed

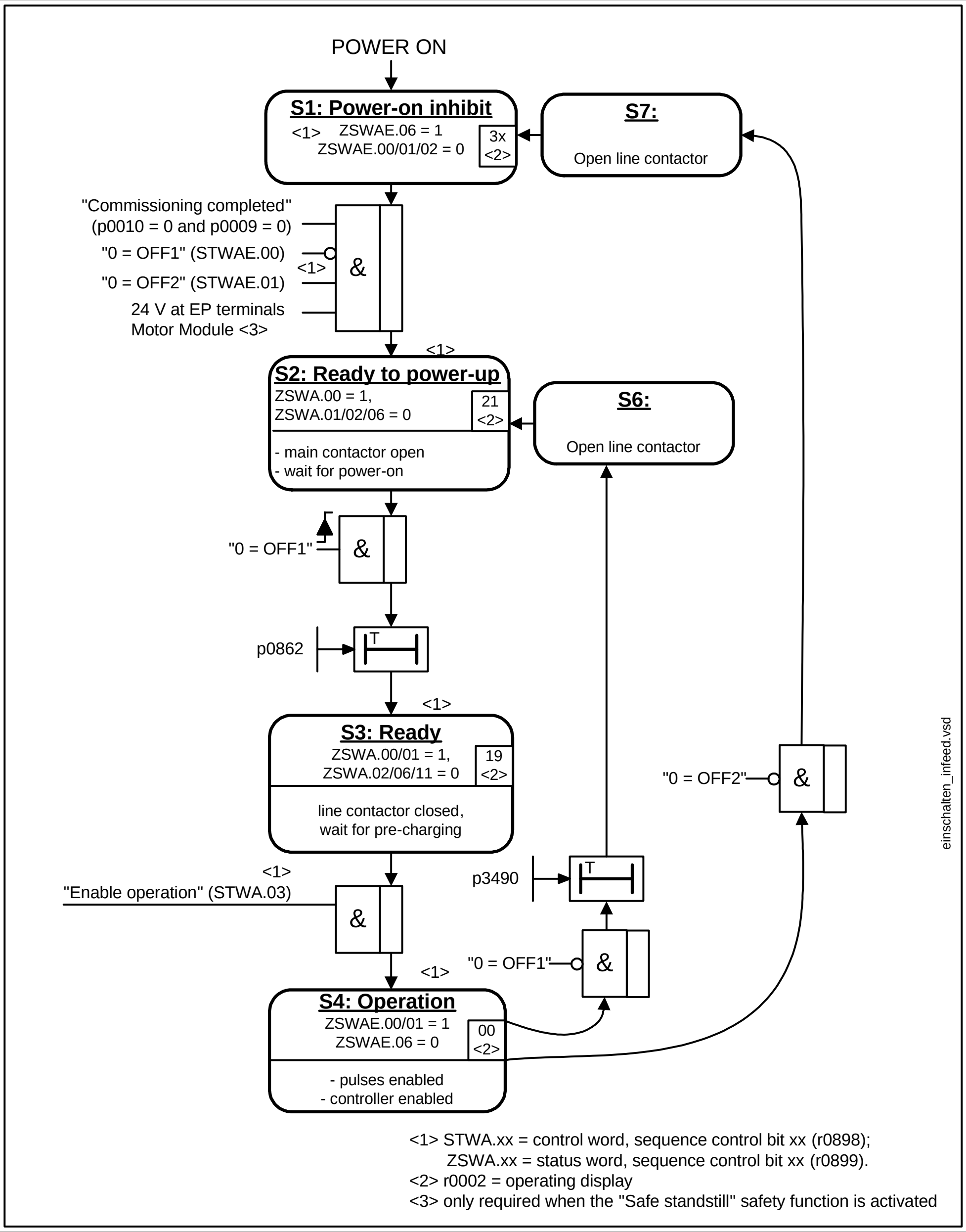


Fig. 2-10 Powering-up the infeed

Powering-up the drive

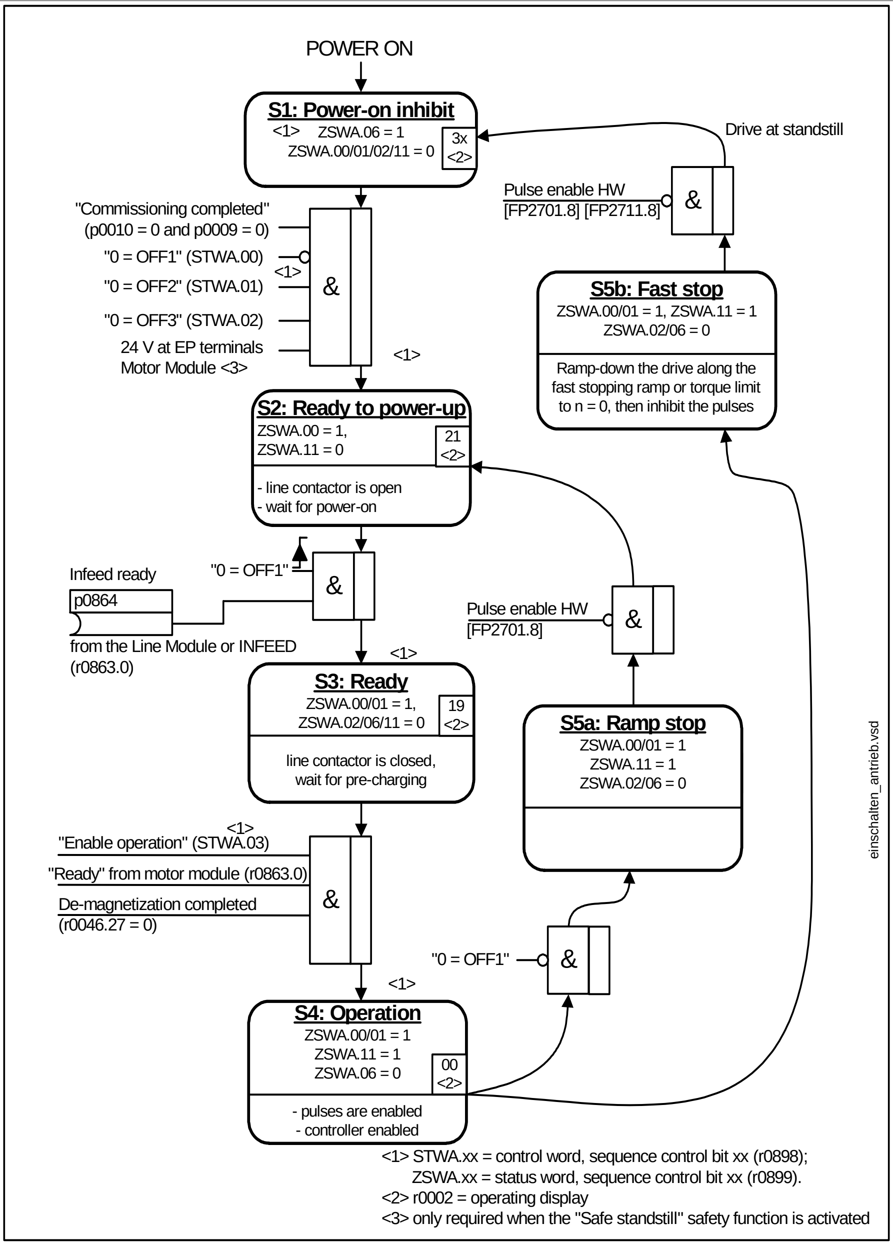


Fig. 2-11 Powering-up the drive

Off responses

- OFF1
  - n_set = 0 is input immediately to brake the drive along the deceleration ramp (p1121).
  - When zero speed is detected, the motor holding brake (if parameterized) is closed (p1215). The pulses are suppressed when the brake application time (p1217) expires. Zero speed is detected if the actual speed drops below the threshold in p1226 or if the monitoring time (p1227) started when speed setpoint <= speed threshold (p1226) has expired.
- OFF2
  - Instantaneous pulse suppression, the drive “coasts” to a standstill.
  - The motor holding brake (if parameterized) is closed immediately.
  - Power-on inhibit is activated.
- OFF3
  - n_set=0 is input immediately to brake the drive along the OFF3 deceleration ramp (p1135).
  - When zero speed is detected, the motor holding brake (if parameterized) is closed. The pulses are suppressed when the brake application time (p1217) expires. Zero speed is detected if the actual speed drops below the threshold in p1226 or if the monitoring time (p1227) started when speed setpoint <= speed threshold (p1226) has expired.
  - Power-on inhibit is activated.

Control and status messages

Table 2-11 Power-on/power-off control

Signal name	Internal control word	Binector Input	PROFIBUS Telegram 2 ... 106
0 = OFF1	STWA.00 STWAE.00	p0840 ON/OFF1	STW1.0
0 = OFF2	STWA.01 STWAE.01	p0844 1. OFF2 p0845 2. OFF2	STW1.1
0 = OFF3	STWA.02	p0848 1. OFF3 P0849 2. OFF3	STW1.2
Enable operation	STWA.03 STWAE.03	p0852 Enable operation	STW1.3

Table 2-12 Switch-in/switch-out status signal

Signal name	Internal status word	Parameters	PROFIBUS telegram 2 ... 106
Ready to power-up	ZSWA.00 ZSWAE.00	r0899.0	ZSW1.0
Ready to operate	ZSWA.01 ZSWAE.01	r0899.1	ZSW1.1
Operation enabled	ZSWA.02 ZSWAE.02	r0899.2	ZSW1.2
Power-up inhibit	ZSWA.06 ZSWAE.06	r0899.6	ZSW1.6
Pulses enabled	ZSWA.11	r0899.11	ZSW1.11

Function diagram overview (see List Manual)

- 2610 Sequence control – control unit
- 2634 Missing enable signals, line contactor control
- 8732 Active infeed – control unit
- 8832 Smart infeed – control unit
- 8932 Active infeed – processor

■

Notes

Commissioning 3

3.1 Sequence of operations during commissioning

Once the basic requirements have been met (see Chapter 2), you may proceed as follows to commission the drive:

Table 3-1 Commissioning sequence

Step	Execution of	Section
1	Create project with STARTER.	3.4
2	Configure the drive unit in STARTER.	3.5.4, 3.6.4, 3.7.4
3	Save the project in STARTER.	3.5.4, 3.6.4, 3.7.4
4	Go online with the target device in STARTER.	3.2.2, 3.2.3
5	Load the project to the target device.	3.5.4, 3.6.4, 3.7.4
6	The motor starts rotating.	3.5.4, 3.6.4, 3.7.4

3.1.1 Safety information

Danger

A hazardous voltage will be present in all components for a further 5 minutes after the system has been shutdown.

Please follow the instructions on the component!

Caution

For safety reasons, Safety Integrated must be commissioned using STARTER in online mode.

Reason:

STARTER should only be used to store the safety parameters of a project monitoring channel. As a result, downloading a project with active Safety Integrated results in safety problems.

Note

The design guidelines and safety information in the Equipment Manuals must be carefully observed (refer to the documentation SINAMICS S120, Equipment Manual).

Residual risk

A risk assessment enables the machine manufacturer to determine the residual risk for his machine with respect to the drive units. The following residual risks are known:

- Unexpected drive movement from standstill:

  Caused, for example, by installation/operational errors or by a malfunction in the higher-level controller, drive controller, encoder evaluator, or the encoder.

  This residual risk can be significantly reduced by means of the “Safe standstill” function (see Chapter 7, Safety Integrated).

- Unexpected change in speed/velocity during operation:

  Caused, for example, by a malfunction in the higher-level controller, drive controller, or encoder.

3.2 STARTER Commissioning Tool

Brief description

STARTER is used for commissioning drive units in the MICROMASTER and SINAMICS product ranges.

STARTER can be used for the following:

- Commissioning
- Testing
- Diagnostics

System requirements

The system requirements for STARTER can be found in the "read me" file in the STARTER installation directory.

3.2.1 Important STARTER functions

Description

STARTER supports the following tools for managing the project:

- Copy RAM to ROM
- Download to target device
- Load to PG/PC
- Restoring the factory settings
- Commissioning Wizard
- Displaying toolbars

Copy RAM to ROM

You can use this function to save volatile Control Unit data to the non-volatile CompactFlash card. This ensures that the data is still available after the 24 V Control Unit supply has been switched off.

This function can be activated as follows:

- Tools –> Setting –> Download –> Activating "Copy RAM to ROM"
  This means that for each "Download to target system" or "Download to target device" data is transferred into the non-volatile memory.
- Right-click Drive unit –> Target device –> Copy RAM to ROM
- Drive unit grayed out –> "Copy RAM to ROM" button

Download to target device

You can use this function to load the current STARTER project to the Control Unit. The data is loaded to the working memory of the Control Unit. A reset is then triggered.

This function can be activated as follows:

- Right-click Drive unit –> Target device –> Download to target device
- Drive unit grayed out –> “Download to target device” button
- Online/offline comparison screen form –> Button “Load to PG/PC”
- Project to all drives simultaneously:
  “Load project to target system” button, menu project –> Load to target system

Load to PG/PC

You can use this function to load the current Control Unit project to STARTER.

This function can be activated as follows:

- Right-click Drive unit –> Target device –> Load to PG/PC
- Drive unit grayed out –> “Load to PG” button
- Online/offline comparison screen form –> Button “Load to PG”

Restoring the factory settings

You can use this function to set all the parameters in the working memory of the Control Unit to the factory settings. To ensure that the data on the CompactFlash card is also reset to the factory settings, choose the “Copy RAM to ROM” function.

This function can be activated as follows:

- Right-click Drive unit –> Target device –> Restore factory setting
- Drive unit grayed out –> “Restore factory setting” button

For more information about STARTER, see Getting Started.

Displaying toolbars

The toolbars can be activated by choosing View –> Toolbars (checkmark).

3.2.2 Activating online operation: STARTER via PROFIBUS

Description

The following options are available for online operation via PROFIBUS:

- Online operation via PROFIBUS

STARTER via PROFIBUS (example with 2 CU320 and one CU310DP)

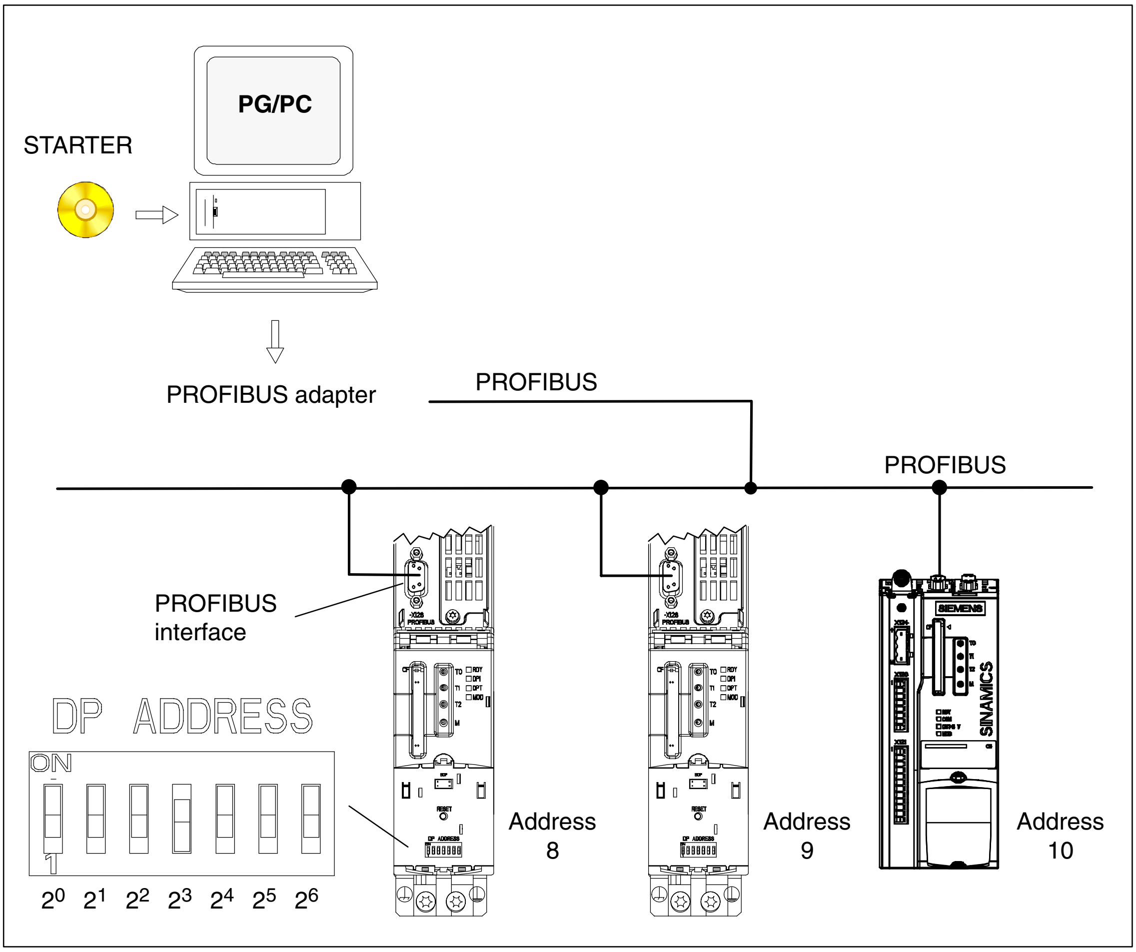


Fig. 3-1 STARTER via PROFIBUS (example with 2 CU320 and one CU310DP)

Settings in STARTER for direct online connection via PROFIBUS

The following settings are required in STARTER for communication via PROFIBUS:

- Tools – Set PG/PC interface...

  Add/remove interfaces
- Tools – Set PG/PC interface... – Properties

  Activate/deactivate “PG/PC is only master on bus”

Note

- Baud rate

  Switching STARTER to a working PROFIBUS:

  STARTER automatically detects the baud rate used by SINAMICS for the PROFIBUS.

  Switching the STARTER for commissioning:

  The Control Unit automatically detects the baud rate set in STARTER.
- PROFIBUS addresses

  The PROFIBUS addresses for the individual drive units must be specified in the project and must match the address settings on the devices.

3.2.3 Activating online operation: STARTER via PROFINET IO

Description

The following options are available for online operation via PROFINET IO:

- Online operation via IP

Prerequisites

- STARTER with version ≥ 4.0
- Registration tool PST Primary Setup Tool Version ≥ 3.0

  The Primary Setup Tool is provided on the STARTER CD or can be downloaded at now charge from the Internet under the following link:

  http:/support.automation.siemens.com/WW/view/de/19440762
- Firmware release ≥ 2.4
- CBE20 (not for CU310 PN, available from approx. July 2006)

  When CBE20 is inserted, cyclic communications via PROFIBUS are no longer possible.

STARTER via PROFINET IO (example)

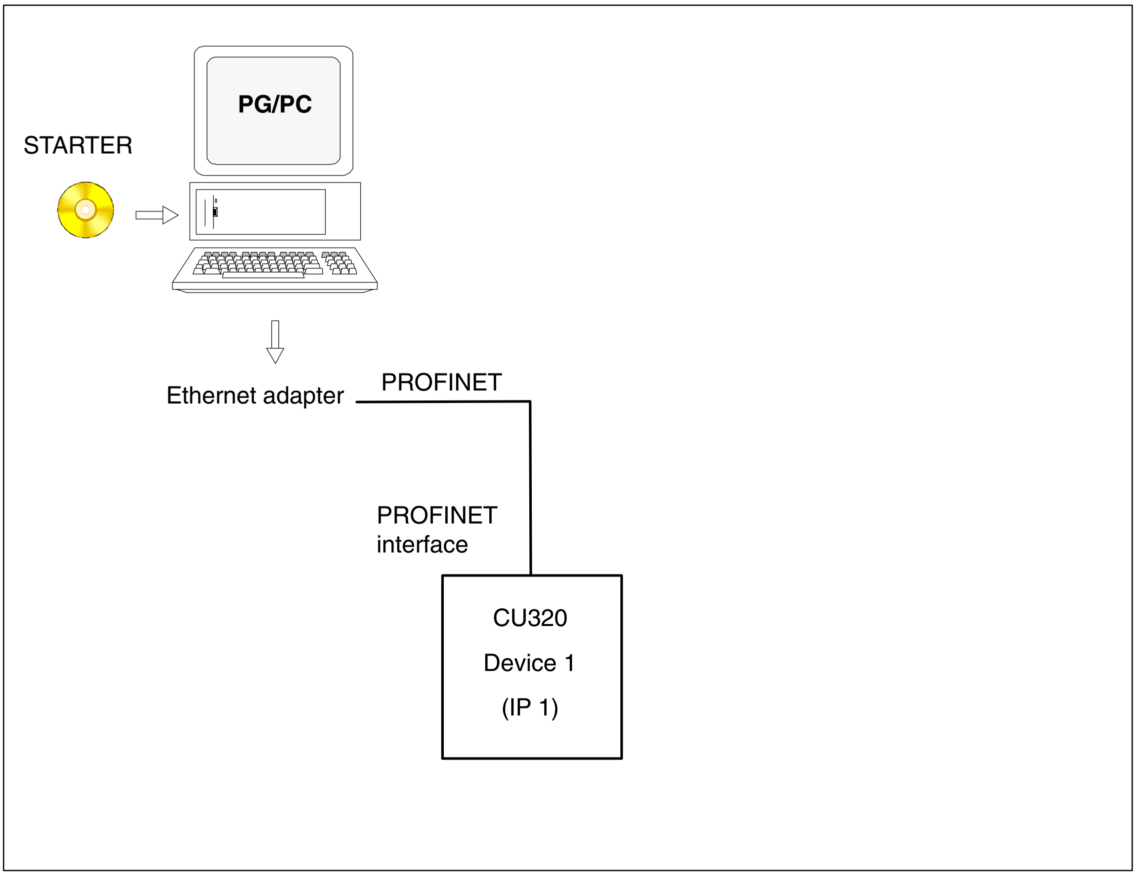


Fig. 3-2 STARTER via PROFINET (example)

Procedure, establishing online operation with PROFINET

1. Set the IP address in Windows XP

   The PC/PG is referred here to a fixed, free IP address.
2. Settings in STARTER
3. Assigning the IP address and the name via PST (registering the node (device))

   The PROFINET interface must be “registered” so that STARTER can establish communications.
4. Select online operation in STARTER.

Set the IP address in Windows XP

On the Desktop, right mouse click on “Network environment” -> Properties -> double click on the network card -> Properties -> “Select Internet Protocol (TCP/IP)” -> Properties -> enter the freely assignable addresses

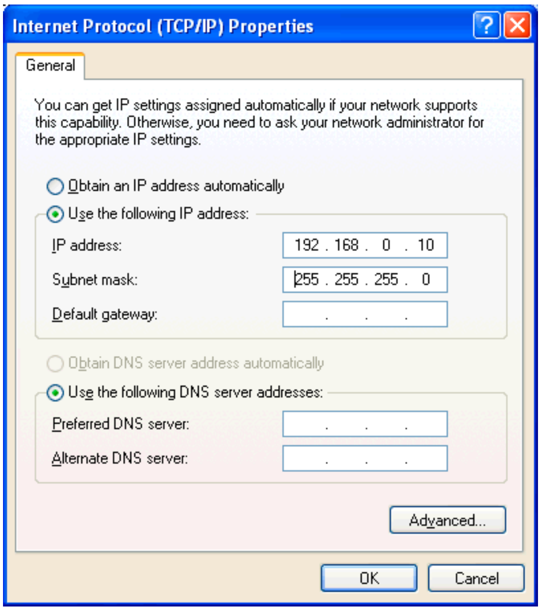


Fig. 3-3 Properties of the Internet Protocol (TCP/IP)

Settings in STARTER

The following settings are required in STARTER for communication via PROFINET:

- Tools – Set PG/PC interface...

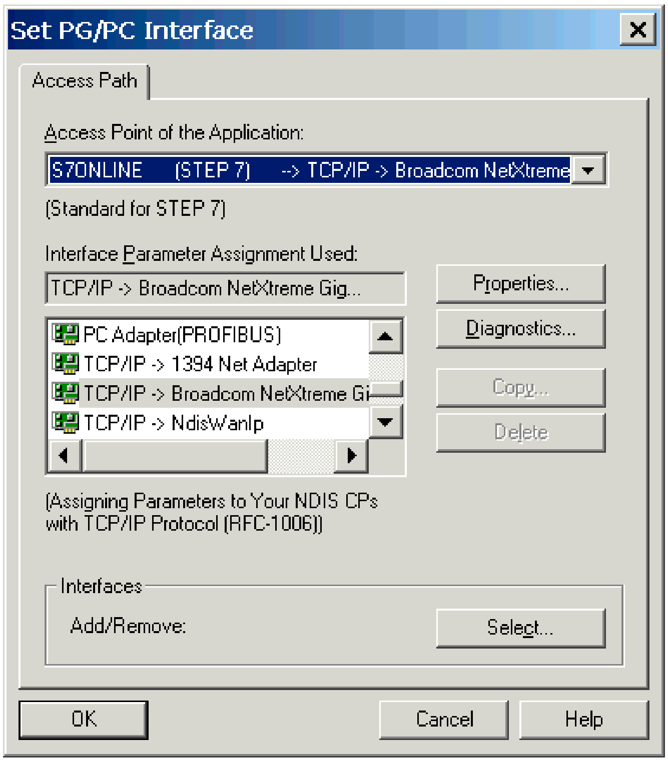


Fig. 3-4 Set the PG/PC interface

- Right-click the drive unit -> Target device -> Online access -> Module address

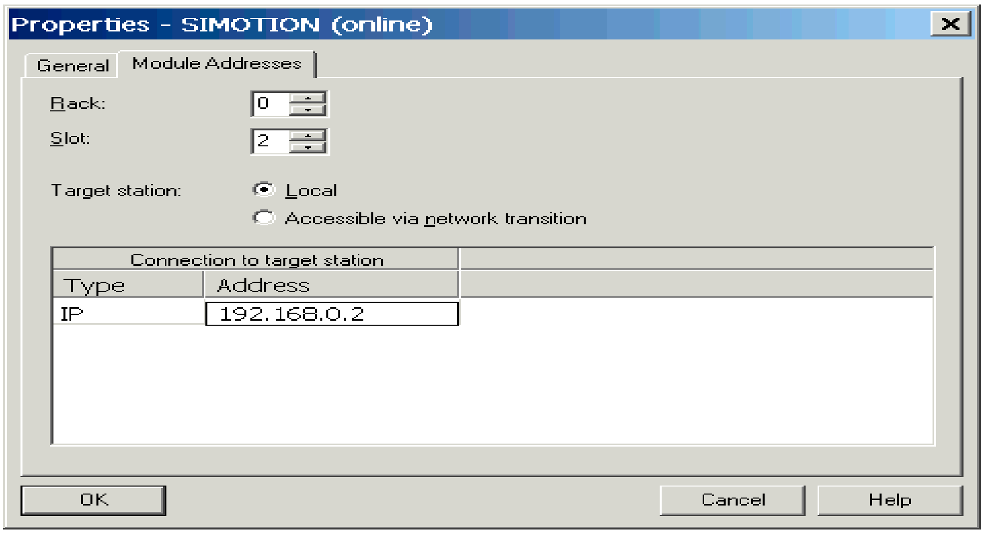


Fig. 3-5 Setting online access

Assigning the IP address and the name via the registration tool PST

Using the registration tool PST (Primary Setup Tool), the PROFINET interface (e.g. CBE20/CU310 PN) can be assigned an IP address and a name.

- Connect the direct Ethernet cable from the PG/PC to the PROFINET interface.
- Power-up the Control Unit.
- Start the Primary Setup Tools (is located on the STARTER-CD)
- Settings –> Network card –> Selecting the network card
- Network –> Search (or F5)
- Select the PROFINET device –> Module –> Assign name –> Enter station name –> OK
- Module –> Download
- Network –> Search (or F5)
- Select the "Ind. Ethernet interface" branch under the PROFINET device –> Assign an IP address –> Enter an IP address (e.g. 192.168.0.2) –> Enter a sub-network mask (e.g. 255.255.255.0)

  The sub-network masks must coincide when using STARTER. For more information about addresses, see 6.1.3.
- Module –> Download

Note

For the Control Unit the IP address and the device name are saved on the Compact-Flash card in a non-volatile fashion.

3.3 Basic Operator Panel 20 (BOP20)

Brief description

The Basic Operator Panel 20 (BOP20) is a basic operator panel with six keys and a display unit with background lighting. The BOP20 can be plugged onto the SINAMICS Control Unit (e.g. CU310, CU320) and operated. Operation is only possible from FW 2.4.

The following functions are possible using BOP20

- Entering parameters
- Display of operating modes, parameters, alarms and faults
- Powering-up/powering-down while commissioning

3.3.1 Important functions via BOP20

Description

Using the BOP20, the following functions can be executed via parameters that support you when handling projects:

- Restoring the factory settings
- Copy RAM to ROM
- Identification via LED
- Acknowledge error

For more information on BOP20, refer to Subsection 9.13.2.

Restoring the factory settings

The factory setting of the complete device can be established in the drive object CU.

- p0009 = 30
- p0976 = 1

Copy RAM to ROM

In the drive object CU you can initiate that all parameters are saved in the non-volatile memory (CompactFlash card):

- Press the P key for 3 seconds or
- p0009 = 0
- p0977 = 1

Notice

This parameter is not accepted if an identification routine has been selected at a drive (e.g. motor identification routine).

Identification via LED

The main components of a drive object (e.g. Motor Module) can be identified using the index of p0124. The ready LED of the module starts to flash. The index corresponds to the index in p0107; the drive object type can be identified using this parameter.

On the drive objects the components can be additionally identified using the following parameters:

- p0124 Power unit identification via LED
- p0144 Voltage Sensing Module identification via LED
- p0144 Sensor Module identification via LED

Acknowledge error

All of the faults can be acknowledged – whose cause has been removed – by pressing the Fn key.

3.4 Creating a project in STARTER

3.4.1 Creating a project offline

To create the project offline, you need the PROFIBUS address, the device type (e.g. SINAMICS S120) and the device version (e.g. FW 2.2).

Table 3-2 Sequence for creating a project in STARTER (example)

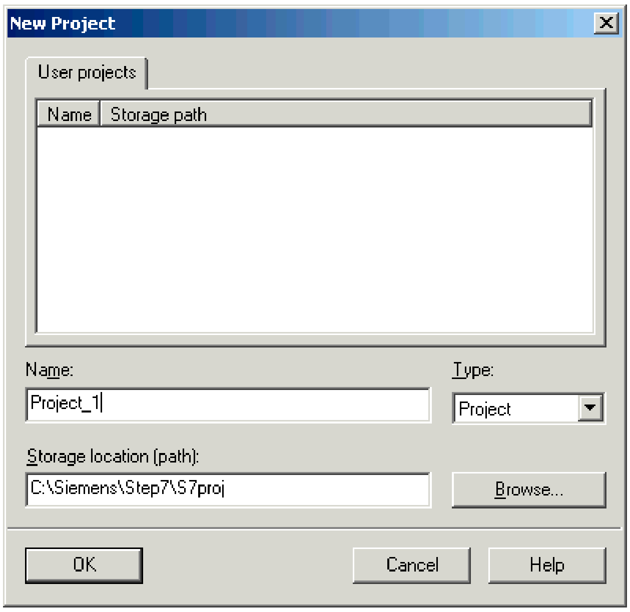
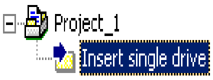
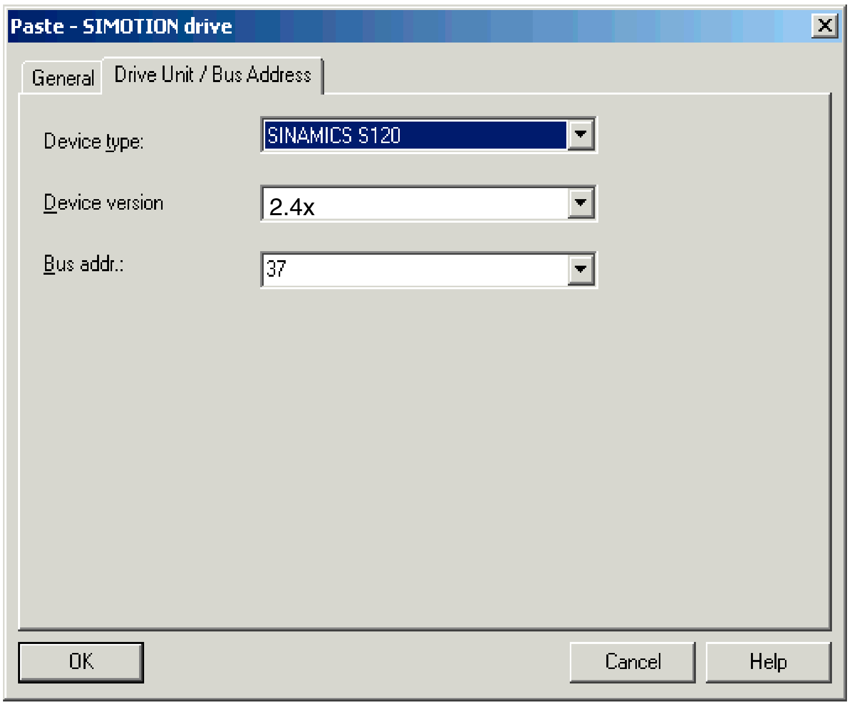
What to do?	How to do it?	Remark
1. **Create a new project**	Operator action: Menu: "Project"—> New ... User projects: Projects already in the target directory Name: Project_1 (can be freely selected) Type: Project Storage location (path): Default (can be set as req.)	The project is created offline and loaded to the target system when configuration is complete.
		

Table 3-2 Sequence for creating a project in STARTER (example), continued

<table>
<tr><th>What to do?</th><th>How to do it?</th><th>Remark</th></tr>
<tr><td>2. Add individual drive</td><td>Operator action:
—> Double-click on “Add individual drive”
Device type: SINAMICS S120 (choose one)
Device version: 2.4x (can be selected)
Address type: PROFIBUS/USS/PPI (can be selected)
Bus address: 37 (can be selected)</td><td>Information about the bus address:
When commissioning the system for the first time the PROFIBUS address of the Control Unit must be set here.
The address is set via the address switch on the Control Unit (or via p0918 if the address switch = “all ON” or “all OFF” (factory setting = 126)).</td></tr>
<tr><td>
</td><td colspan="2">
</td></tr>
<tr><td>3. Configuring the drive unit</td><td colspan="2">Once you have created the project, you have to configure the drive unit.
The following sections provide some examples.</td></tr>
</table>

3.4.2 Searching for a drive unit online

To search for a drive unit online, the drive unit and the PG/PC must be connected via PROFIBUS.

Table 3-3 Search sequence in STARTER (example)

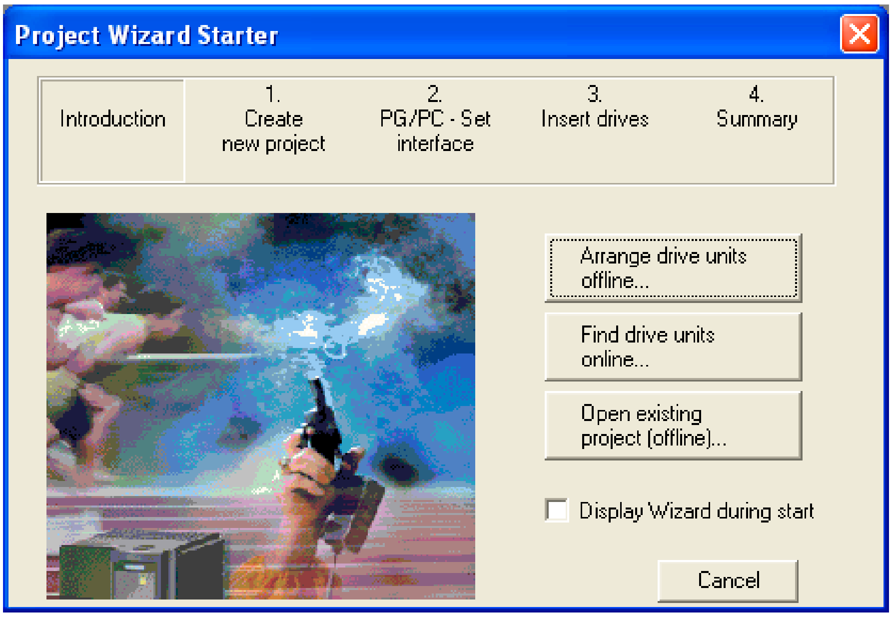
What to do?	How to do it?	Remark
1. **Create a new project**	Operator action: Menu: “Project”—> New with Wizard Click “Find drive unit online”.	
		

Table 3-3 Search sequence in STARTER (example), continued

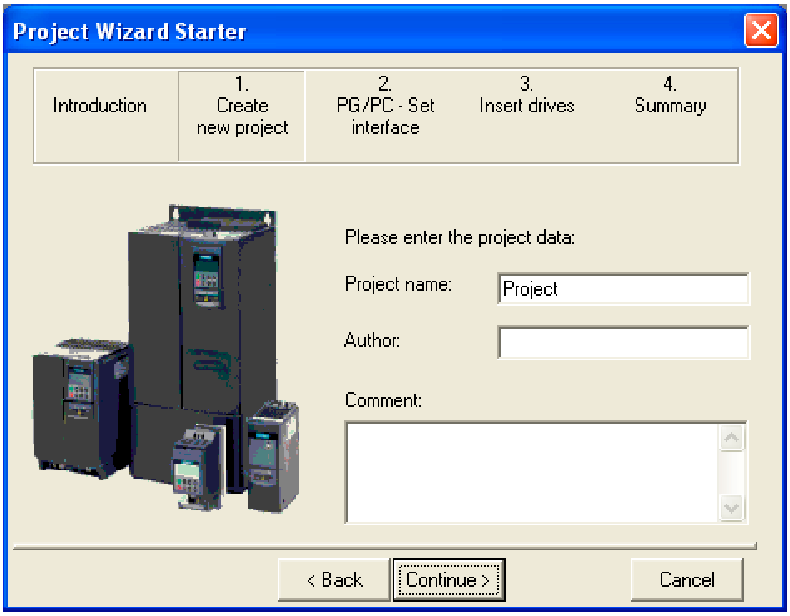
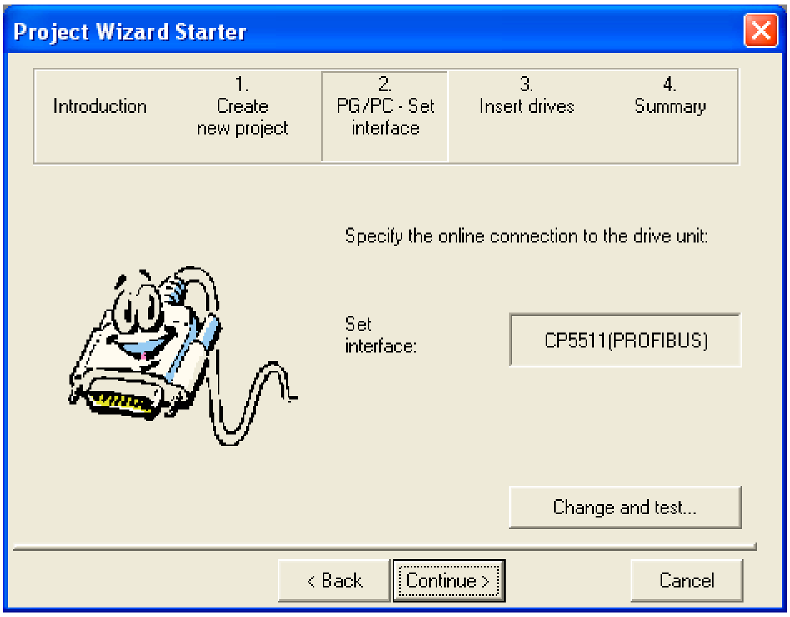
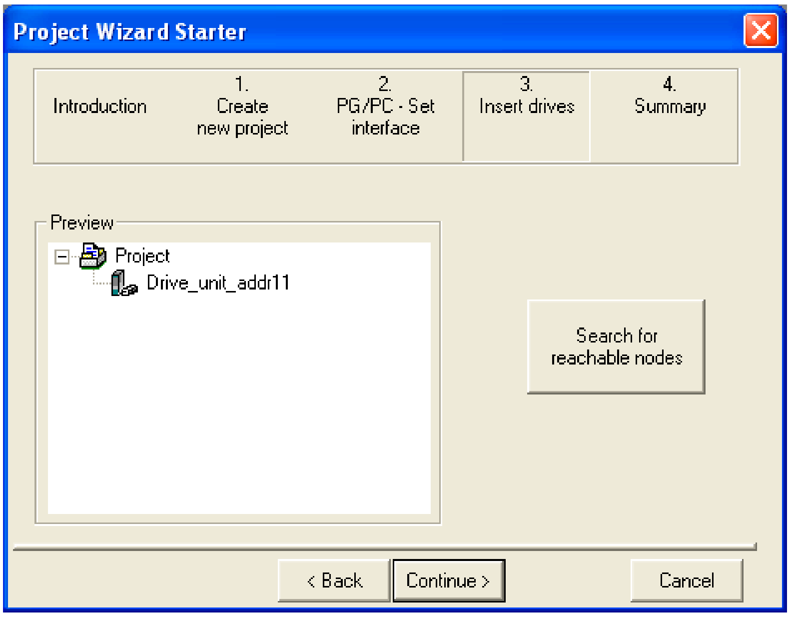
<table>
<tr><th>What to do?</th><th>How to do it?</th><th>Remark</th></tr>
<tr><td rowspan="2">1.1. Enter project data</td><td>Project name: Project_1 (can be freely selected)
Author: Choose any name
Comment: Enter any</td><td></td></tr>
<tr><td colspan="2">
</td></tr>
<tr><td rowspan="2">2. Set up the PG/PC interface</td><td colspan="2">Here, you can set up the PG/PC interface by clicking “Change and test”.</td></tr>
<tr><td colspan="2">
</td></tr>
</table>

Table 3-3 Search sequence in STARTER (example), continued

What to do?	How to do it?	Remark
3. **Add drive unit**	Here, you can search for nodes that can be accessed.	
		
4. **Summary**	You have now created the project. —> Click “Complete”.	
		
5. **Configuring the drive unit**	Once you have created the project, you have to configure the drive unit. The following sections provide some examples.	

3.5 Initial commissioning using servo (booksize) as an example

The commissioning example described in this section shows all the necessary configuration and parameter settings and testing routines. Commissioning is carried out using the STARTER commissioning tool.

Requirements for commissioning

1. The commissioning requirements have been met.

   —> see Chapter 2
2. The checklist for commissioning has been completed and all items are O.K.

   —> see Chapter 2
3. STARTER is installed and ready to run.

   —> see the "read me" file on the STARTER installation CD.
4. The electronics power supply (24 V DC) is switched on.

3.5.1 Task

1. Commission a drive system with the following components:

Table 3-4 Component overview

Designation	Component	Order No.
Closed-loop control and infeed		
Control Unit 1	Control Unit 320	6SL3040-0MA00-0AAx
Active Line Module 1	Active Line Module 16 kW	6SL3130-7TE21-6AAx
Line filter package 16 kW	Line filter and line reactor	6SL3000-0FE21-6AAx
Drive 1		
Motor Module 1	Single Motor Module 9 A	6SL3120-1TE21-0AAx
Sensor Module 1.1	SMC20	6SL3055-0AA00-5BAx
Motor 1	Synchronous motor	1FK7061-7AF7x-xxxx
Motor encoder 1	Incremental encoder sin/cos C/D 1Vpp 2048 p/r	1FK7xxx-xxxxx-xAxx
Sensor Module 1.2	SMC20	6SL3055-0AA00-5BAx
External encoder	Incremental encoder sin/cos 1Vpp 4096 p/r	–
Drive 2		
Motor Module 2	Single Motor Module 18 A	6SL3120-1TE21-8AAx
Motor 2	Induction motor	1PH7103-xNGxx-xLxx
Sensor Module 2	SMC20	6SL3055-0AA00-5BAx
Motor encoder 2	Incremental encoder sin/cos 1Vpp 2048 p/r	1PH7xxx-xMxxx-xxxx

2. The enable signals for the infeed and the two drives must be transmitted via PROFIBUS.
   - Telegram for the Active Line Module

     Telegram 370 Infeed, 1 word
   - Telegram for drive 1

     Standard telegram 4: Speed control, 2 position encoder
   - Enable signals for drive 2

     Standard telegram 3: Speed control, 1 position encoder

Note

For more information on the telegram types, see “Communication via PROFIBUS” or refer to the SINAMICS S120 List Manual.

3.5.2 Component wiring (example)

The following diagram shows a possible component configuration and wiring option. The DRIVE-CLiQ wiring is highlighted in **bold**.

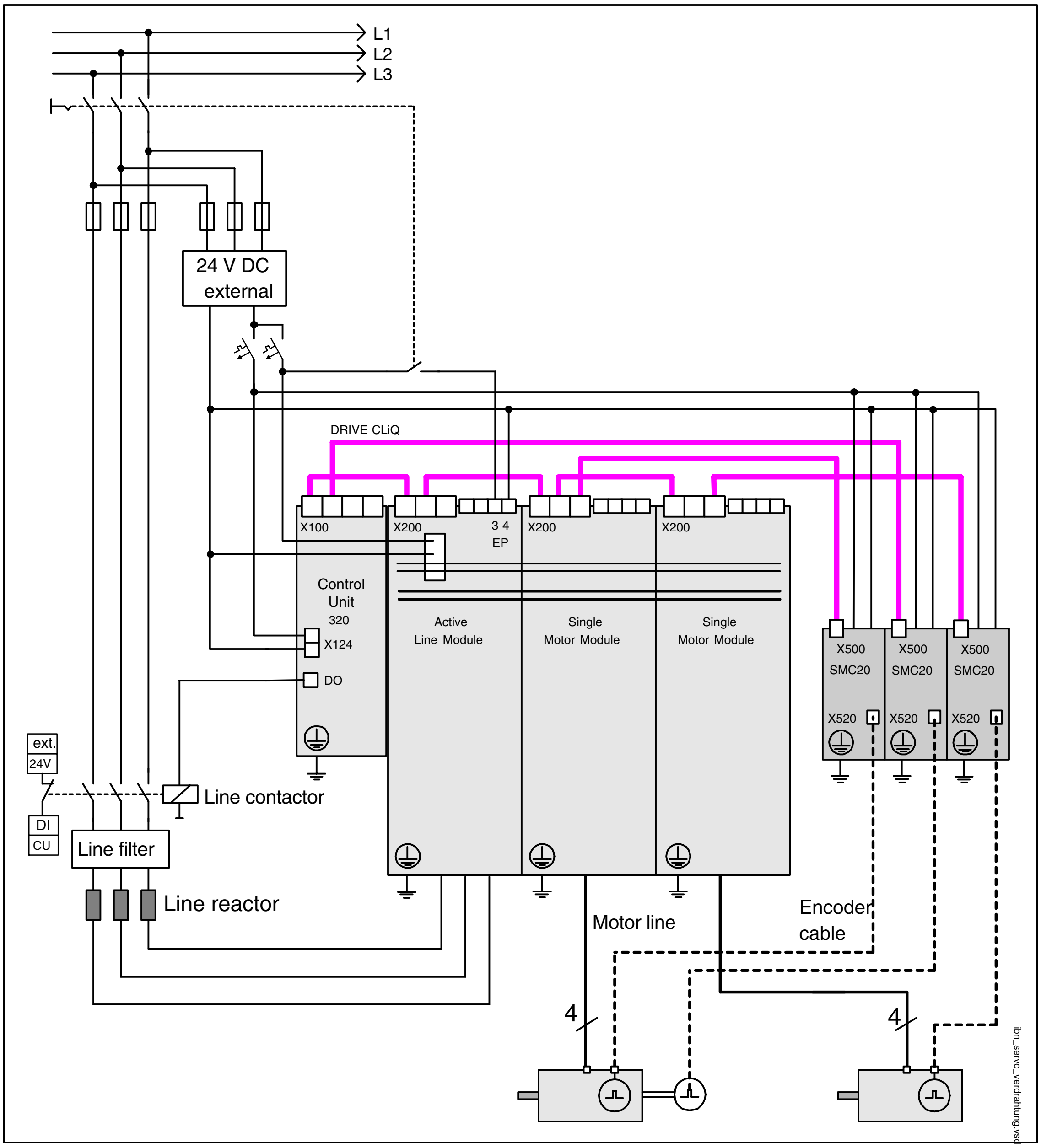


Fig. 3-6 Component wiring (example)

For more information on the wiring and connecting-up the encoder system, see the Equipment Manual.

3.5.3 Signal flow for commissioning example

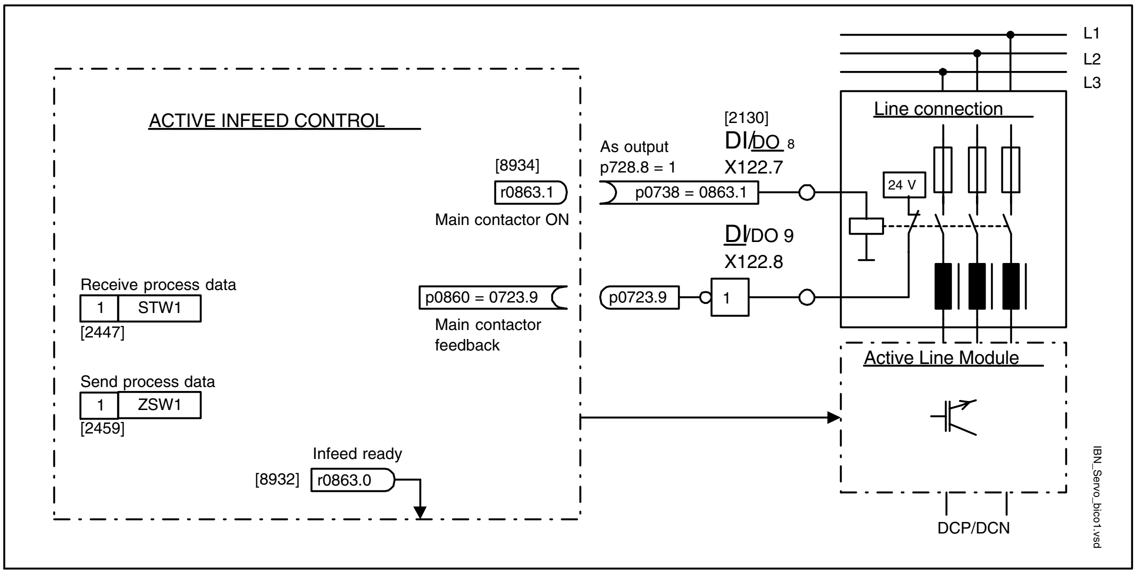


Fig. 3-7 Signal flow for initial commissioning example (servo; part 1)

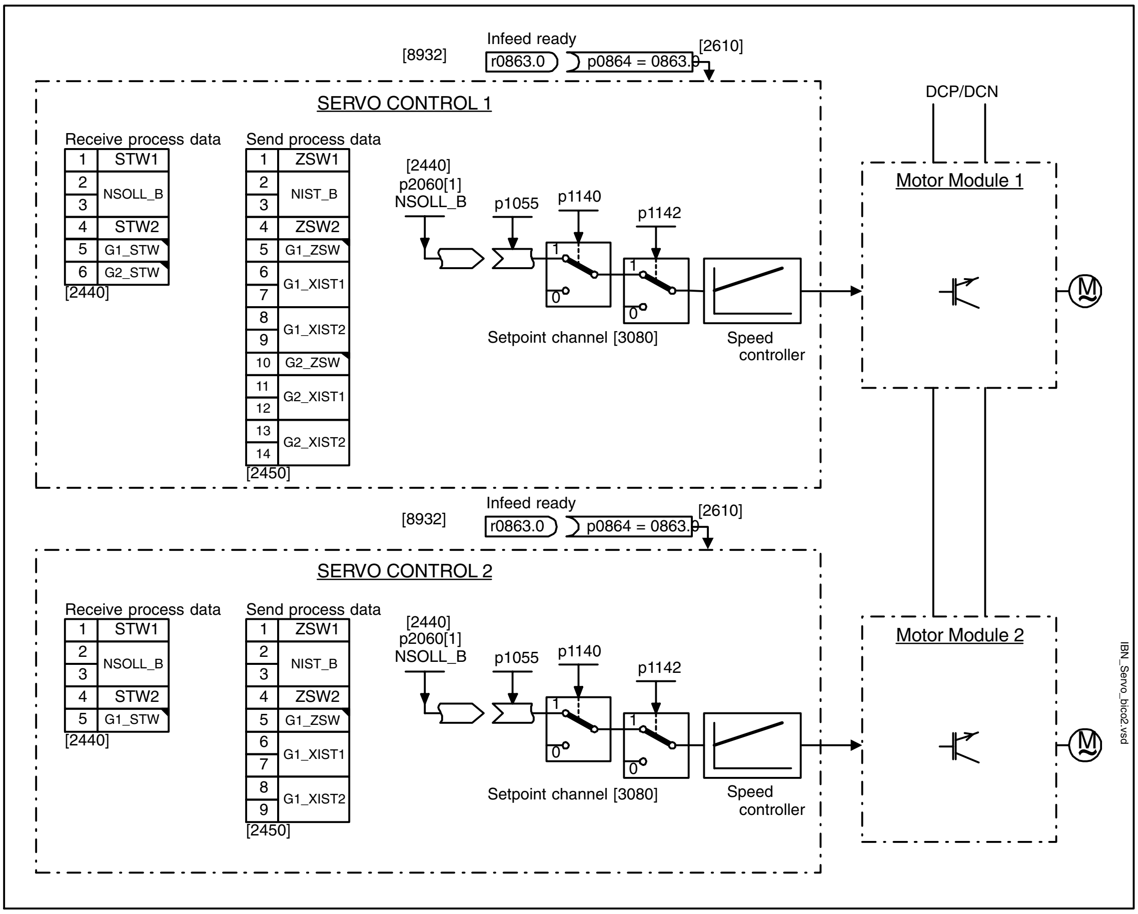


Fig. 3-8 Signal flow for initial commissioning example (servo; part 2)

3.5.4 Commissioning with STARTER (example)

The table below describes the steps for commissioning the example with STARTER.

Table 3-5 Commissioning sequence with STARTER (example)

What to do?	How to do it?	Remark
1. **Automatic configuration**	Operator action: —> “Project” —> “Connect to target system” —> Double-click “Automatic configuration”. —> Follow the instructions provided in the Wizard.	–
2. **Configure the supply**	The supply must be configured. Name of supply —> Double-click “Configuration” —> Click “Configure DDS”	–
2.1. Supply Wizard	The Wizard displays the data determined automatically from the electronic type plate. You can now set the line/DC link identification. You have to enter the device connection voltage and rated line frequency. “Line filter available” must be active. PROFIBUS telegram type 370 must be installed. This completes the configuration for the supply.	If the line environment or DC link components are changed, line/DC link identification should be repeated.
3. **Configure drives**	The drives must be configured individually. —> “Drives” —> Drive name —> Double-click “Configuration” —> Click “Configure DDS”.	–
3.1. Control structure	You can activate the function modules. You can select the control type.	–
3.2. Power unit	The Wizard displays the data determined automatically from the electronic type plate.	–
Caution If the infeed is controlled from another Control Unit, then the ready signal of the infeed r0863.0 must be connected to parameter p0864 “infeed ready” of the drive through a digital input/output. If this is not taken into account this can damage the infeed.		
3.3. Motor	You can enter the name of the motor (e.g. equipment ID). Select standard motor from list: Yes Select the motor type (see type plate).	You can select a standard motor from the list of motors or you can enter the motor data yourself. You can then select the motor type.

Table 3-5 Commissioning sequence with STARTER (example), continued

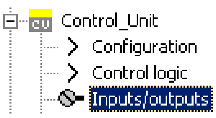
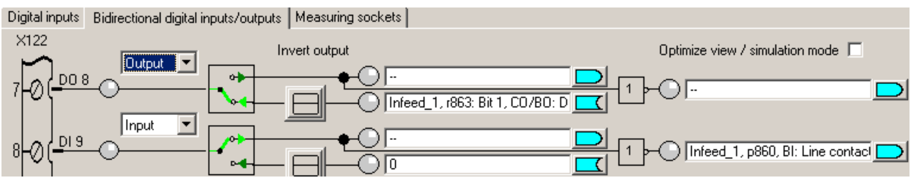
What to do?	How to do it?	Remark
3.4. Motor brakes	Here, you can configure the brake and activate the “Extended brake control” function module.	For more information, see the Function Manual.
3.5. Motor data	You can enter the motor data on the type plate here. Induction motors (rotary): If known, mechanical data for the motor and drive line can be entered. Synchronous motors (rotary, permanent-magnet) If known, the data for a PE spindle can be entered.	If you do not enter any mechanical data, it is estimated on the basis of the data on the type plate. The equivalent circuit diagram data is also estimated on the basis of the data on the type plate or determined by means of automatic motor data identification.
3.6. Encoder	Motor encoder (encoder 1): Choose standard encoder from list: Yes Choose “2048, 1Vpp, A/B C/D R”. External encoder (encoder 2): Rotary: Yes Measuring system: “incremental sinusoidal/cosinusoidal” Resolution: “4096” Zero marker: “No zero marker”	If you are using an encoder that is not in the list, you can also enter the data.
3.7. Process data exchange	PROFIBUS telegram type 4 (drive 1) and 3 (drive 2) must be selected.	–
3.8. Drive functions	Here, after entering the motor data the technological application can be selected.	Your choice of application influences the calculation for the open-loop/closed-loop control parameters.
3.9. Summary	The drive data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.	–
4. **Line contactor** 	Line contactor p0728.8 = 1 Set DI/DO as output p0738 = 863.1 Line contactor on p0860 = 723.9 Line contactor feedback 	The line contactor must be controlled by the infeed_1 drive object. See function diagram [8934] In the Function —> Line contactor control screen, you can check that the interconnection is correct.

Table 3-5 Commissioning sequence with STARTER (example), continued

What to do?	How to do it?	Remark
5. **Save the parameters on the device.**	• Connect with target system (go online) • Target system –> Download to target device • Target system –> Copy RAM to ROM (save the data on the CF card)	Position cursor on drive unit (SINAMICS S120) and right-click.
6. **The motor starts rotating.**	The drives can be started via the control panel in STARTER. • This can be done once the pulses have been enabled for the infeed and line/DC link identification has been activated. The infeed then switches to operational mode.	For more information about the control panel, see Getting Started. The control panel supplies the control word 1 (STW1) and speed setpoint 1 (NSOLL). For more information about line/DC link identification, see the Function Manual.

STARTER diagnosis options

Under "Component" –> Diagnosis –> Control/status words

- Control / status words
- Status parameters
- Missing enable signals

3.6 Initial commissioning using vector (booksize) as an example

The commissioning example described in this section shows all the necessary configuration and parameter settings and testing routines. Commissioning is carried out using the STARTER commissioning tool.

Requirements for commissioning

1. The commissioning requirements have been met.

   —> see Chapter 2
2. The checklist for commissioning has been completed and all items are O.K.

   —> see Chapter 2
3. STARTER is installed and ready to run.

   —> see the “read me” file on the STARTER installation CD.
4. The electronics power supply (24 V DC) is switched on.

3.6.1 Task

1. Commission a drive system with the following components:

Table 3-6 Component overview

Designation	Component	Order No.
Closed-loop control and infeed		
Control Unit	Control Unit 320	6SL3040-0MA00-0AAx
Smart Line Module	Smart Line Module 10 kW	6SL3130-6AE21-0AAx
Line filter package 10 kW	Line filter and line reactor	6SL3130-0GE21-0AAx
Drive 1		
Motor Module	Single Motor Module 5 A	6SL3120-1TE15-0AAx
Motor	Induction motor	1LA
Drive 2		
Motor Module	Single Motor Module 5 A	6SL3120-1TE15-0AAx
Motor	Induction motor	1LA

2. The enable signals for the infeed and drive are to be transmitted via terminals.

3.6.2 Component wiring (example)

The following diagram shows a possible component configuration and wiring option. The DRIVE-CLiQ wiring is highlighted in **bold**.

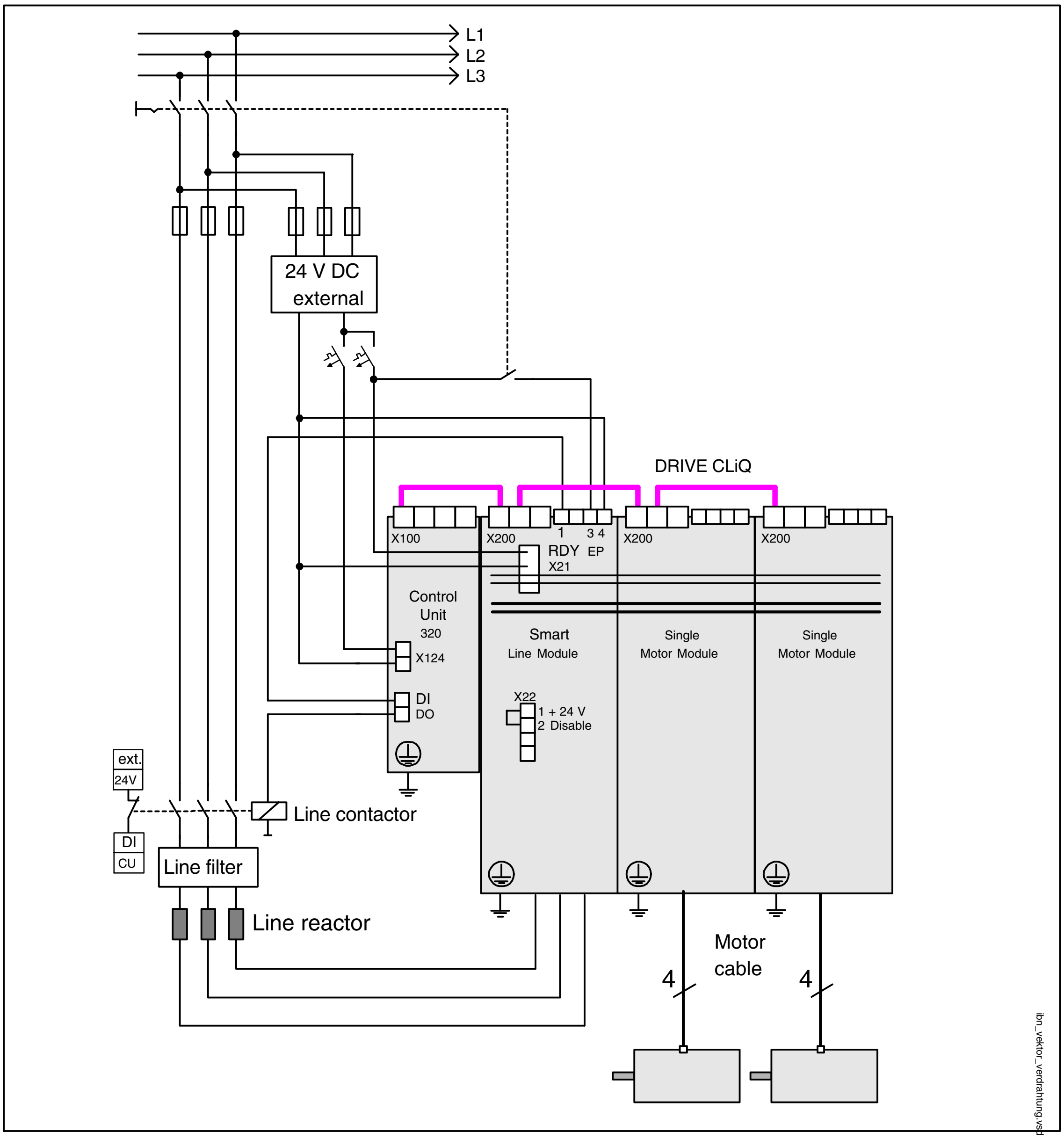


Fig. 3-9 Component wiring (example)

For more information on the wiring and connecting-up the encoder system, see the Equipment Manual.

3.6.3 Signal flow for commissioning example

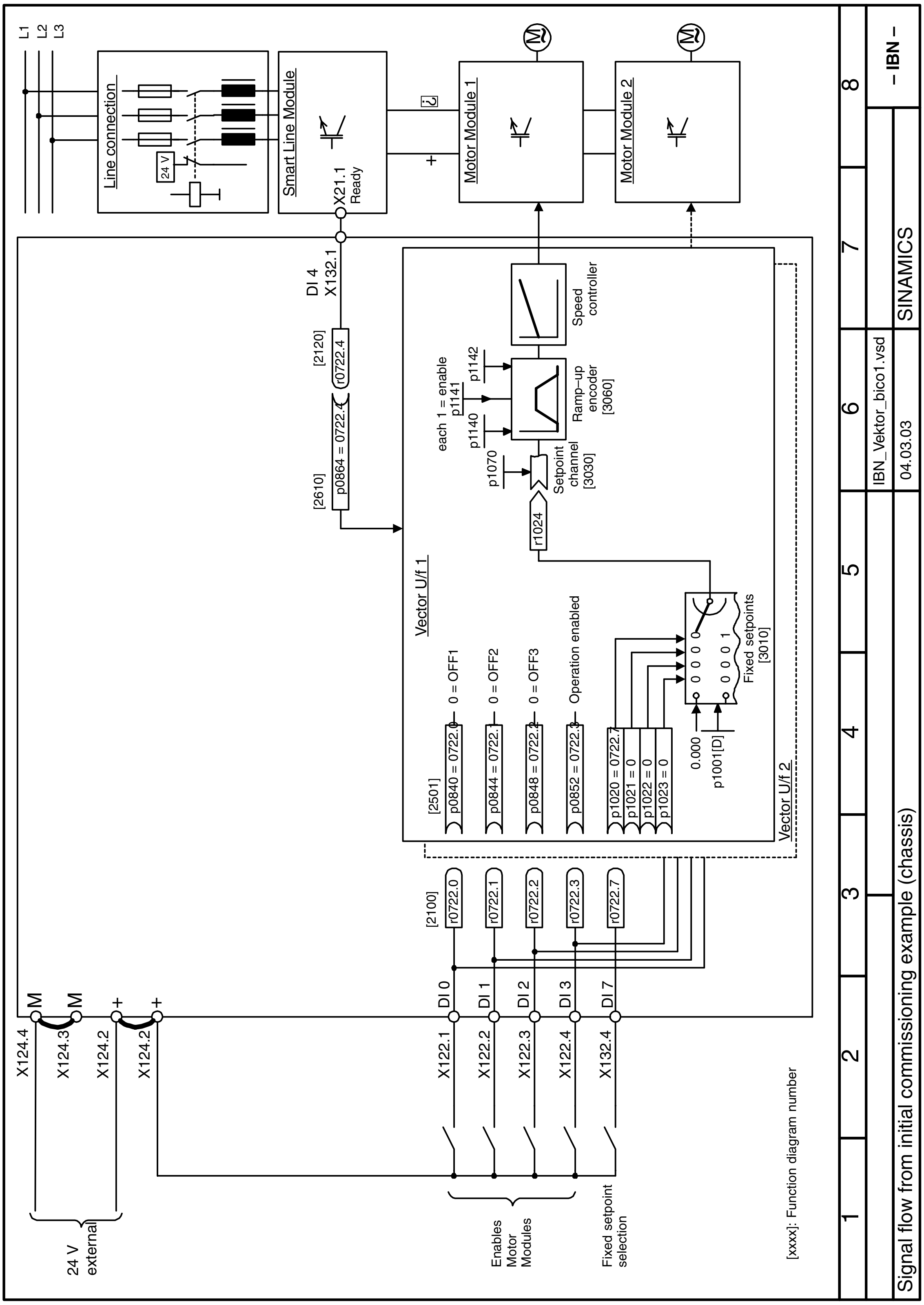


Fig. 3-10 Signal flow for initial commissioning example (booksize; vector)

3.6.4 Commissioning with STARTER (example)

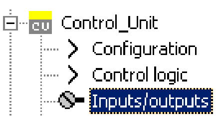
The table below describes the steps for commissioning the example with STARTER.

Table 3-7 Commissioning sequence with STARTER (example)

What to do?	How to do it?	Remark
1. **Automatic configuration**	Operator action: —> “Project” —> “Connect to target system” —> Double-click “Automatic configuration”. —> Follow the instructions provided in the Wizard.	
2. **Configure drives**	The drives must be configured individually. —> “Drives” —> Drive name —> Double-click “Configuration” —> Click “Configure DDS”.	
2.1. Control structure	You can activate the function modules. You can select the control type.	
2.2. Power unit	The Wizard displays the data determined automatically from the electronic type plate.	**Caution** If a sinusoidal filter is connected, it must be activated here to prevent it from being destroyed.
2.3. BiCo power section	Supply in operation Control Unit: r0722.4 (digital input 4)	
Caution If the infeed is controlled from another Control Unit, then the ready signal of the infeed must be connected to parameter p0864 “infeed ready” of the drive through a digital input/output. If this is not taken into account this can damage the infeed.		
2.4. Drive setting	You can select the motor standard (IEC/NEMA) and power section application (duty cycles).	
2.5. Motor	You can enter the name of the motor (e.g. equipment ID). Enter motor data: Yes Select motor type “1LAx”.	You can select a standard motor from the list of motors or you can enter the motor data yourself. You can then select the motor type.
2.6. Motor data	You can enter the motor data on the type plate here. If known, mechanical data for the motor and drive line can be entered. Equivalent circuit diagram data: No	If you do not enter any mechanical data, it is estimated on the basis of the data on the type plate. The equivalent circuit diagram data is also estimated on the basis of the data on the type plate or determined by means of automatic motor data identification.

Table 3-7 Commissioning sequence with STARTER (example), continued

What to do?	How to do it?	Remark
2.7. Motor brake	Here, you can configure the brake and activate the “Extended brake control” function module.	For more information, see the Function Manual.
2.8. Encoder	The encoder must be deselected in this example.	If you are using an encoder that is not in the list, you can also enter the data.
2.9. Drive functions	You can choose the application and motor identification here. Motor identification: “1”	Your choice of application influences the calculation for the open-loop/closed-loop control parameters. When the pulses are enabled, a one-off identification run is carried out. Current flows through the motor which means that it can align itself by up to a quarter of a revolution. Once the measurement is complete, optimization with rotating motor is carried out the next time the pulses are enabled.
2.10. Key parameters	You must enter key parameters in accordance with the relevant application. Note, for example, the general mechanical conditions for the drive line.	
2.11. Summary	The drive data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.	
3. **Enable signals and BICO interconnections**	The enable signals for the infeed and the two drives must be transmitted via the digital input on Control Unit 320.	
3.1. Line contactor	• Line contactor p0728.8 = 1 Set DI/DO as output p0738 = 863.1 Activate line contactor p0860 = 723.9 Line contactor feedback	The line contactor must be controlled by the infeed_1 drive object. The inputs/outputs are located on the Control Unit. See function diagram [8934]



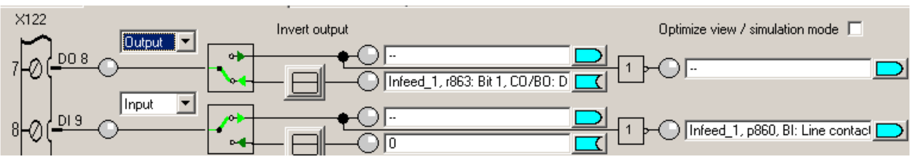


Table 3-7 Commissioning sequence with STARTER (example), continued

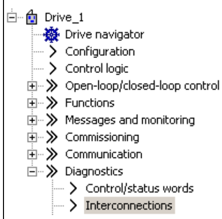
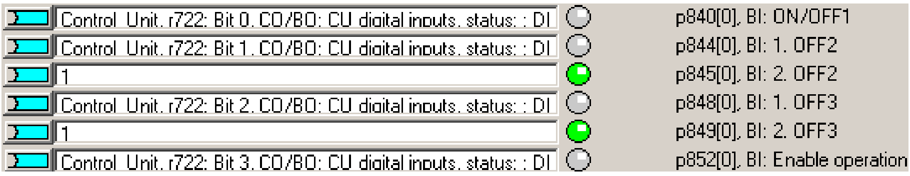
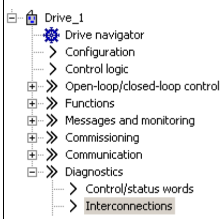
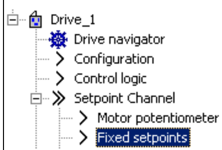
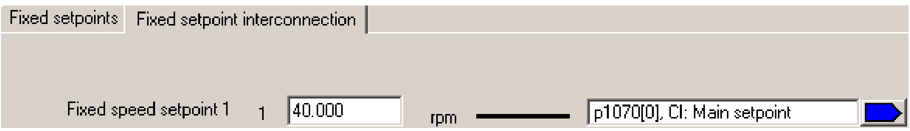
What to do?	How to do it?	Remark
3.2. Enable Motor Module	• Enable signals for the Motor Module (drive_1) p0840 = 722.0 ON/OFF1 p0844 = 722.1 1st OFF2 p0845 = 1 2nd OFF2 p0848 = 722.2 1st OFF3 p0849 = 1 2nd OFF3 p0852 = 722.3 Enable operation	See function diagram [2501]
		
3.3. Ramp-function generator	Ramp-function generator p1140 = 1 Enable ramp-fct generator p1141 = 1 Start ramp-function generator p1142 = 1 Enable speed setpoint	See function diagram [3060]
		
3.4. Setpoint	Specify setpoint p1001 = 40 Fixed speed setpoint 1	See function diagram [3010]
		

Table 3-7 Commissioning sequence with STARTER (example), continued

What to do?	How to do it?	Remark
4. **Save the parameters on the device.**	• Connect with target system (go online) • Target device –> Download to target device • Target device –> Copy RAM to ROM	Position cursor on drive unit (SINAMICS S120) and right-click.
5. **The motor starts rotating.**	The drives can be started via the control panel in STARTER. • This can be done once the pulses have been enabled for the infeed and line/DC link identification has been activated. The infeed then switches to operational mode. • Once the pulses are enabled, a one-off motor data identification run (if activated) is carried out. • When the pulses are enabled again, optimization with a rotating motor (if activated) is carried out.	For more information about the control panel, see Getting Started. During motor identification, a current flows through the motor, which means that it can align itself by up to a quarter of a revolution. For more information about line/DC link identification and motor identification, see the Function Manual.

STARTER diagnosis options

Under "Component" –> Diagnosis –> Control/status words

- Control / status words
- Status parameters
- Missing enable signals

3.7 Initial commissioning using vector (chassis) as an example

The commissioning example described in this section shows all the necessary configuration and parameter settings and testing routines. Commissioning is carried out using the STARTER commissioning tool.

Requirements for commissioning

1. The commissioning requirements have been met.

   —> see Section 2.1
2. The checklist for commissioning has been completed and all items are O.K.

   —> see Section 2.2
3. STARTER is installed and ready to run.

   —> see the “read me” file on the STARTER installation CD.
4. The electronics power supply (24 V DC) is switched on.

3.7.1 Task

1. Commission a drive system with the following components:

Table 3-8 Component overview

Designation	Component	Order No.
Closed-loop control and infeed		
Control Unit	Control Unit 320	6SL3040-0MA00-0AAx
Active Line Module	Active Line Module 380 kW/400 V	6SL3330–7TE36–1AAx
Active Interface Module	Active Interface Module	6SL3300–7TE38–4AAx
Drive 1		
Motor Module	Motor Module 380 A	6SL3320–1TE33–8AAx
Motor	Induction motor – without brake – with encoder	Type: 1LA8 rated voltage = 400 V rated current = 345 A rated power = 200 kW rated power factor = 0.86 rated frequency = 50.00 Hz rated speed = 989 rpm cooling type = non-ventilated HTL encoder, 1024 p/r, A/B, R
Drive 2		
Motor Module	Motor Module 380 A	6SL3320–1TE33–8AAx
Motor	Induction motor – without brake – with encoder	Type: 1LA8 rated voltage = 400 V rated current = 345 A rated power = 200 kW rated power factor = 0.86 rated frequency = 50.00 Hz rated speed = 989 rpm cooling type = non-ventilated HTL encoder, 1024 p/r, A/B, R

2. The enable signals for the infeed and drive are to be transmitted via terminals.

3.7.2 Component wiring (example)

The following diagram shows a possible component configuration and wiring option. The DRIVE-CLiQ wiring is highlighted in **bold**.

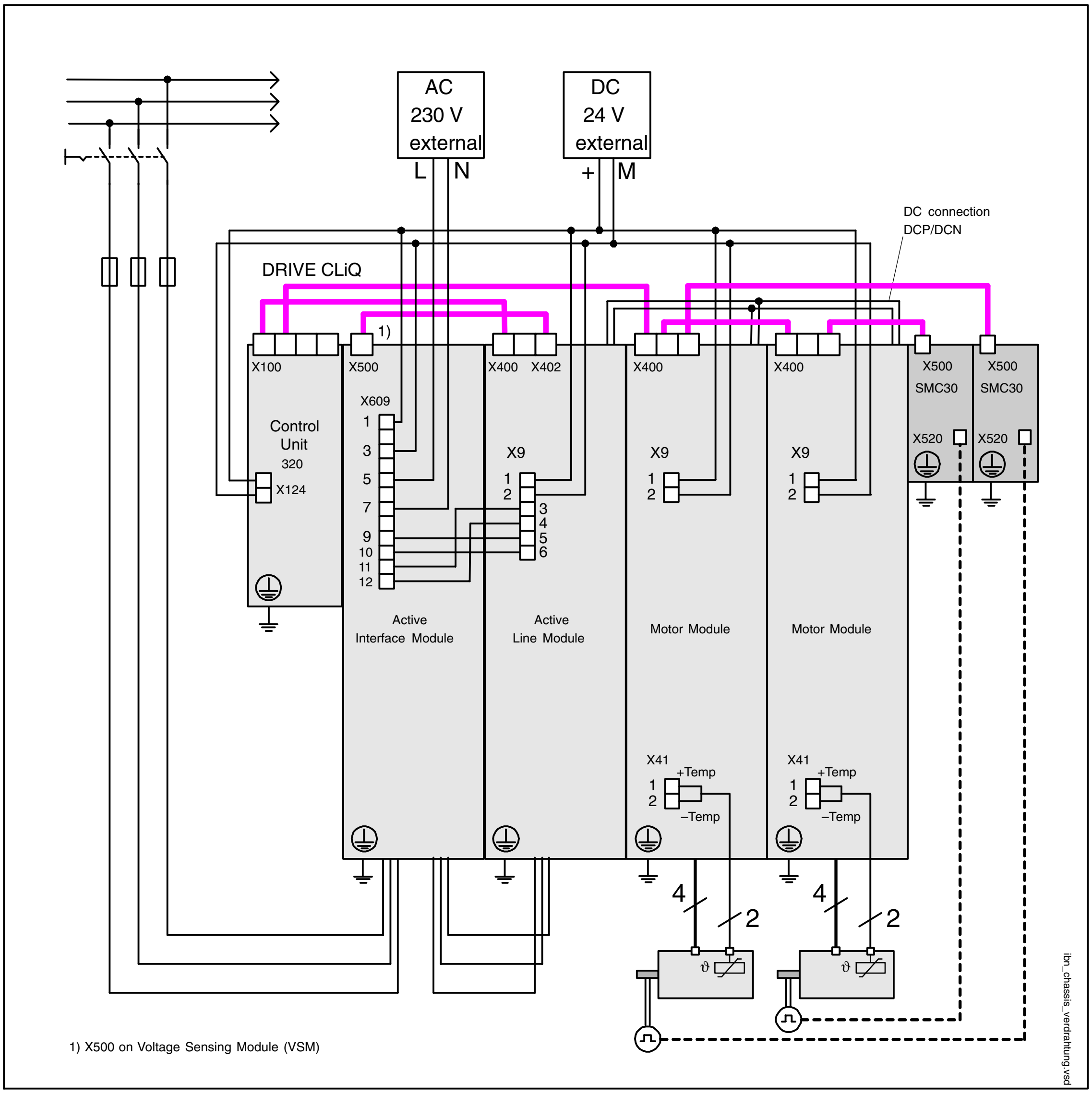


Fig. 3-11 Component wiring (example)

For more information on the wiring and connecting-up the encoder system, see the Equipment Manual.

3.7.3 Signal flow for commissioning example

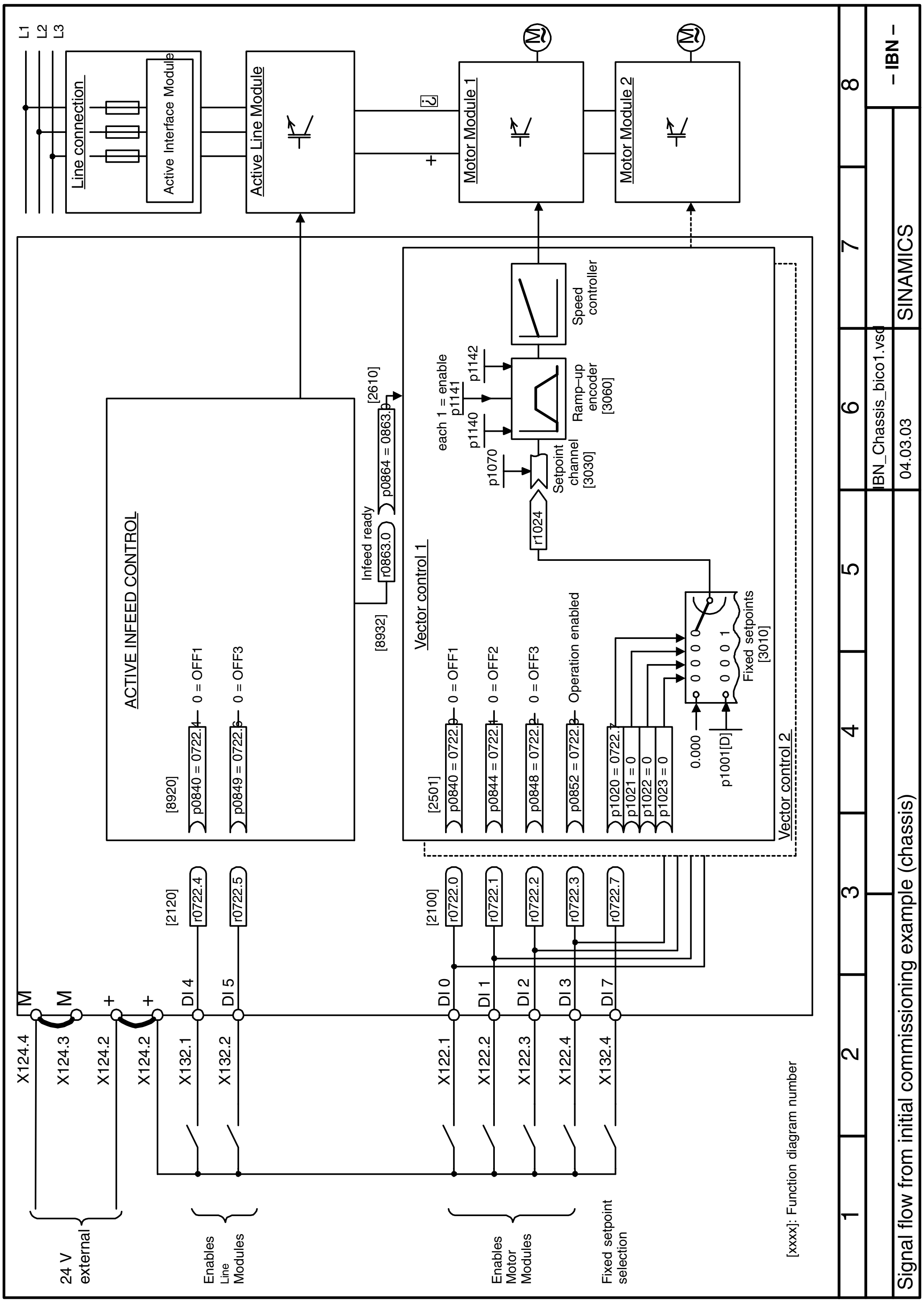


Fig. 3-12 Signal flow from initial commissioning example (chassis)

3.7.4 Commissioning with STARTER (example)

The table below describes the steps for commissioning the example with STARTER.

Table 3-9 Commissioning sequence with STARTER (example)

<table>
<tr><th>What to do?</th><th>How to do it?</th><th>Remark</th></tr>
<tr><td>1. Automatic configuration</td><td>Operator action:
—> “Project” —> “Connect to target system”
—> Double-click “Automatic configuration”.
—> Follow the instructions provided in the Wizard.
STARTER then automatically switches to offline mode.</td><td>The DRIVE-CLiQ topology is determined and the electronic type plates are read. The data is then transferred to STARTER.
The next steps are carried out offline.</td></tr>
<tr><td>2. Configure the supply</td><td>The supply must be configured.
Name of supply —> Double-click “Configuration” —> Click “Configure DDS”</td><td></td></tr>
<tr><td>2.1. Supply Wizard</td><td>The Wizard displays the data determined automatically from the electronic type plate.
You can now set the line/DC link identification.
You have to enter the device connection voltage and rated line frequency.
This completes the configuration for the supply.</td><td>If the line environment or DC link components are changed, line/DC link identification should be repeated.</td></tr>
<tr><td>3. Configure drives</td><td>The drives must be configured individually.
—> “Drives” —> Drive name —> Double-click “Configuration” —> Click “Configure DDS”.</td><td></td></tr>
<tr><td>3.1. Control structure</td><td>You can activate the function modules.
You can select the control type.</td><td></td></tr>
<tr><td>3.2. Power unit</td><td>The Wizard displays the data determined automatically from the electronic type plate.</td><td>Caution
If a sinusoidal filter is connected, it must be activated here to prevent it from being destroyed.</td></tr>
<tr><td colspan="3">Caution
If the infeed is controlled from another Control Unit, then the ready signal of the infeed r0863.0 must be connected to parameter p0864 “infeed ready” of the drive through a digital input/output. If this is not taken into account this can damage the infeed.</td></tr>
<tr><td>3.3. Drive setting</td><td>You can select the motor standard (IEC/NEMA) and power section application (duty cycles).</td><td></td></tr>
</table>

Table 3-9 Commissioning sequence with STARTER (example), continued

What to do?	How to do it?	Remark
3.4. Motor	You can enter the name of the motor (e.g. equipment ID). Enter motor data: Yes Select motor type "1LA8".	You can select a standard motor from the list of motors or you can enter the motor data yourself. You can then select the motor type.
3.5. Motor data	You can enter the motor data on the type plate here. If known, mechanical data for the motor and drive line can be entered. Equivalent circuit diagram data: No	If you do not enter any mechanical data, it is estimated on the basis of the data on the type plate. The equivalent circuit diagram data is also estimated on the basis of the data on the type plate or determined by means of automatic motor data identification.
3.6. Motor brake	Here, you can configure the brake and activate the "Extended brake control" function module.	For more information, see the Function Manual.
3.7. Encoder	Choose standard encoder from list: Yes Choose "1024 HTL A/B R to X521/X531".	If you are using an encoder that is not in the list, you can also enter the data.
3.8. Drive functions	You can choose the application and motor identification here. Motor identification: "1"	Your choice of application influences the calculation for the open-loop/closed-loop control parameters. When the pulses are enabled, a one-off identification run is carried out. Current flows through the motor which means that it can align itself by up to a quarter of a revolution. Once the measurement is complete, optimization with rotating motor is carried out the next time the pulses are enabled.
3.9. Key parameters	You must enter key parameters in accordance with the relevant application. Note, for example, the general mechanical conditions for the drive line.	
3.10.Summary	The drive data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.	

Table 3-9 Commissioning sequence with STARTER (example), continued

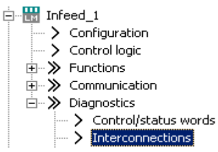
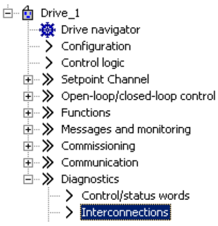
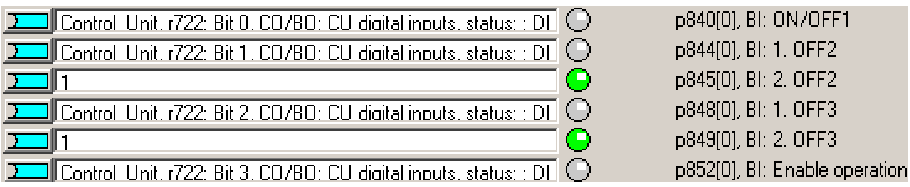
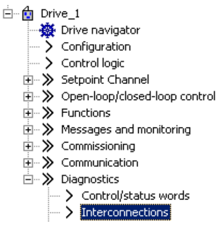
What to do?	How to do it?	Remark
4. **Enable signals and BICO interconnections**	The enable signals for the infeed and the two drives must be transmitted via the digital input on Control Unit 320.	Note: If an Active Line Module is installed, the same signal source must not be used to enable both the infeed and the drive. See also: Fig. 3-12
4.1. Active Line Module	• Enable signals for the Active Line Module p0840 = 722.4 ON/OFF1 p0844 = 722.5 OFF2 p0852 = 722.6 Enable operation	See function diagram [8920]
		
4.2. Enable Motor Module	• Enable signals for the Motor Module (drive_1) p0840 = 722.0 ON/OFF1 p0844 = 722.1 1st OFF2 p0845 = 1 2nd OFF2 p0848 = 722.2 1st OFF3 p0849 = 1 2nd OFF3 p0852 = 722.3 Enable operation p0864 = 863.0 Infeed operation	See function diagram [2501]
		
4.3. Ramp-function generator	Ramp-function generator p1140 = 1 Enable ramp-fct generator p1141 = 1 Start ramp-function generator p1142 = 1 Enable speed setpoint	See function diagram [3060]
		

Table 3-9 Commissioning sequence with STARTER (example), continued

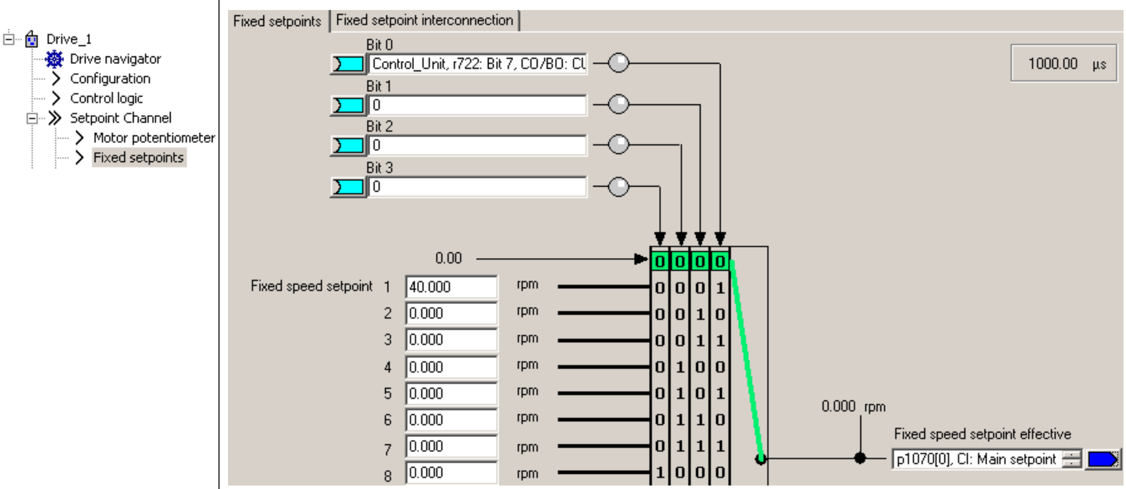
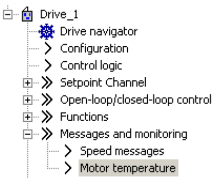
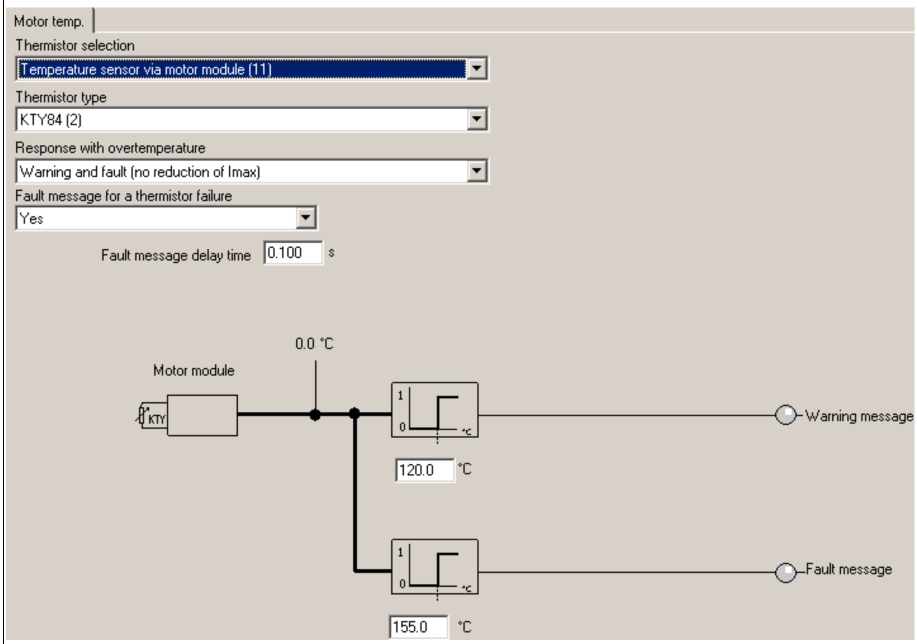
<table>
<tr><th>What to do?</th><th>How to do it?</th><th>Remark</th></tr>
<tr><td>4.4. Setpoint</td><td>Specify setpoint
p1001 = 40 Fixed speed setpoint 1
p1020 = r0722 Fixed speed setpoint selection
r1024 = p1070 Fixed setpoint effective</td><td>A setpoint of 0 or 40 is defaulted via digital input 7. This setpoint is then applied to the main setpoint p1070.
See function diagram [3010]</td></tr>
<tr><td colspan="3">
</td></tr>
<tr><td>4.5. Motor temperature</td><td>Thermistor selection: via Motor Module (11)
Temperature sensor type: KTY84 (2)
Response to overtemperature: Alarm and fault (no reduction of Imax)
Fault message for thermistor failure: ON
Delay time: 0.100 s
Alarm threshold: 120.0 °C
Fault threshold: 155,.0 °C</td><td></td></tr>
</table>

Table 3-9 Commissioning sequence with STARTER (example), continued

What to do?	How to do it?	Remark
		
5. **Save the parameters on the device.**	• Connect with target system (go online) • Target device –> Download to target device • Target device –> Copy RAM to ROM	Position cursor on drive unit (SINAMICS S120) and right-click.
6. **The motor starts rotating.**	The drives can be started via the control panel in STARTER. • This can be done once the pulses have been enabled for the infeed and line/DC link identification has been activated. The infeed then switches to operational mode. • When the pulses are enabled, a one-off motor data identification run (if activated) is carried out. • When the pulses are enabled again, optimization with a rotating motor (if activated) is carried out.	For more information about the control panel, see Getting Started. During motor identification, a current flows through the motor, which means that it can align itself by up to a quarter of a revolution. For more information about line/DC link identification and motor identification, see the Function Manual.

Parameter overview for diagnosis (see List Manual)

r0002 Infeed/drive operating display

r0046 Missing enable signals (see Diagnostics chapter for further information)

3.8 Commissioning for the first time using as an example Vector AC DRIVE with BOP20

The commissioning example described in this chapter shows all the necessary configuration and parameter settings. Commissioning is performed using the BOP20.

Requirements for commissioning

1. The commissioning requirements have been met.

   —> see Section 2.1

2. The checklist for commissioning has been completed and all items are O.K.

   —> see Section 2.1

3.8.1 Task

1. Commission a drive unit (operating mode vector, closed-loop speed control) with the following components:

Table 3-10 Component overview

Designation	Component	Order No.
Closed-loop control		
Control Unit	Control Unit 310 DP	6SL3040-0LA00-0AAx
Operator Panel	Basic Operator Panel BOP20	6SL3055-0AA00-4BAx
Infeed and drive		
Power Module	Power Module 340	6SL3210-xxxxx-xxxx
Motor	Induction motor (without DRIVE-CLiQ interface)	1LA5

2. Commissioning is performed using the BOP20.
3. The function keys of the Basic Operator Panel BOP20 should be parameterized so that the ON/OFF signal and the speed setpoints are entered using these keys.

3.8.2 Component wiring (example)

The following diagram shows a possible component configuration and wiring option. The DRIVE-CLiQ wiring is highlighted in **bold**.

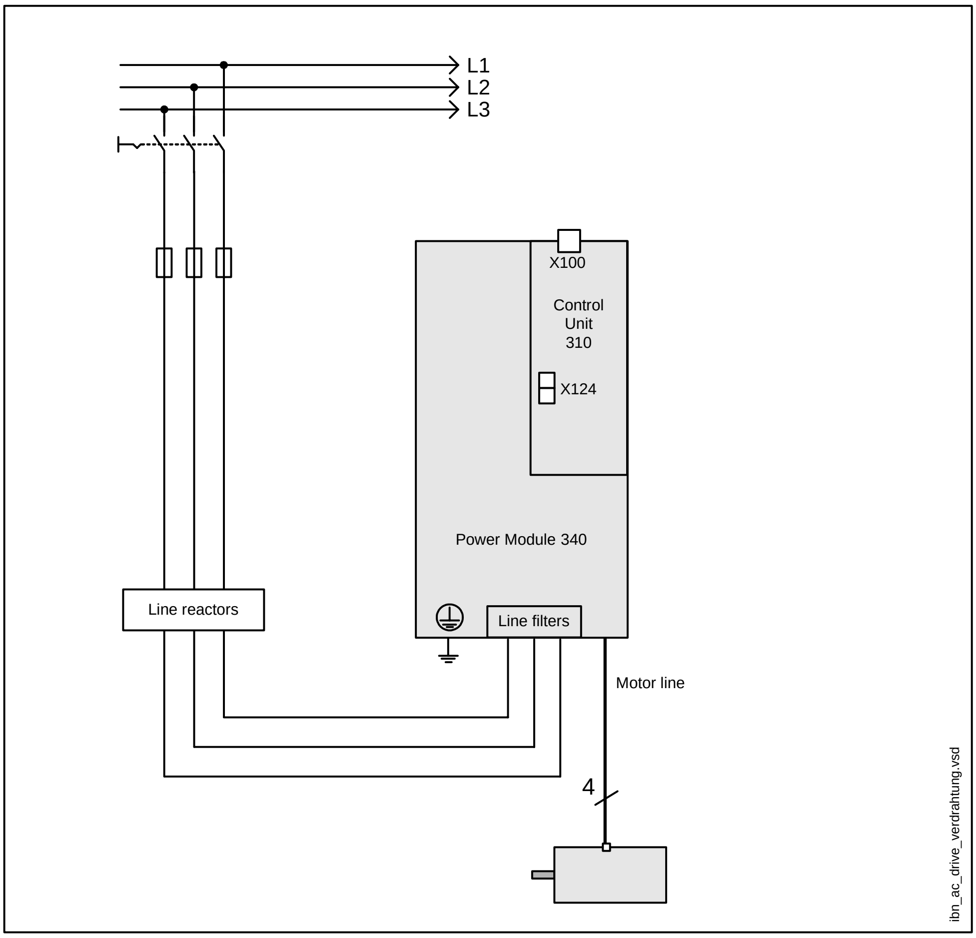


Fig. 3-13 Component wiring (example)

For more information on wiring, see the Equipment Manual.

3.8.3 Quick commissioning using the BOP (example)

Table 3-11 Quick commissioning for a motor without a DRIVE-CLiQ interface

Outlet	Description	Factory setting
Note: Before commissioning for the first time, the drive must be in the factory setting. Procedure, see Subsection 3.3.1		
p0009 = 1 ↓	**Device commissioning parameter filter *** 0 Ready 1 Device configuration 30 Parameter reset	1
p0097 = 2 ↓	**Select drive object type *** 0 No selection 1 Drive object type SERVO 2 Drive object type VECTOR	0
p0009 = 0 ↓	**Device commissioning parameter filter *** 0 Ready 1 Device configuration 30 Parameter reset	1
DO = 2 ↓	**Select drive object (DO) 2 (= VECTOR)** 1 CU 2 VECTOR To select a drive object (DO), simultaneously press the Fn key and an arrow key. The selected project is displayed at the top left.	1
p0010 = 1 ↓	**Drive, commissioning parameter filter *** 0 Ready 1 Quick commissioning 30 Parameter reset	1

* These parameters offer more setting possibilities than specified here. For additional setting possibilities, see the List Manual
[CDS] Parameter depends on the Command Data Sets (CDS). Data set 0 is preset.
[DDS] Parameter depends on the Drive Data Sets (DDS). Data set 0 is preset.
[MDS] Parameter depends on the Motor Data Sets (MDS). Data set 0 is preset.
BI Binector Input
BO Bector Output
CI Connector Input
CO Connector Output

Table 3-11 Quick commissioning for a motor without a DRIVE-CLiQ interface, continued

Outlet	Description	Factory setting
p0100 = …	**IEC/NEMA mot stds** 0 IEC motor (SI units, e.g. kW) Pre-assignment: Rated motor frequency (p0310): 50 Hz Enter the power factor cos φ (p0308) 1 NEMA motor (US units, e.g. hp) Pre-assignment: Rated motor frequency (p0310): 60 Hz Enter the efficiency (p0309) **Note** If p0100 is changed, all of the rated motor parameters are reset.	0
p0300[0] = 15	**Motor type selection [MDS]*** 0 No motor selected Commissioning cannot be exited. Standard motors: 1 Induction motor (rotating) 2 Synchronous motor (rotating, permanent-magnet) 5 Synchronous motor (rotary, separately-excited) 1x 1LAx standard induction motor (x = 1, 5, 6, 7, 8) 12 1LE2 standard induction motor (NEMA) You must individually enter rated motor data (see type plate) in parameter p0304 and onwards. SIEMENS catalog motors: 10x 1PHx induction motor (x = 2, 4, 7) 13x 1PMx induction motor (x = 4, 6) 2xx Synchronous motors The list motors are contained in a motor code list (see Attachment A). The motors are selected by entering the motor type (p0300) and the motor code number (p0301). The parameter for the rated motor data (p0304 and onwards) are appropriately pre-assigned.	0

* These parameters offer more setting possibilities than specified here. For additional setting possibilities, see the List Manual
[CDS] Parameter depends on the Command Data Sets (CDS). Data set 0 is preset.
[DDS] Parameter depends on the Drive Data Sets (DDS). Data set 0 is preset.
[MDS] Parameter depends on the Motor Data Sets (MDS). Data set 0 is preset.
BI Binector Input
BO Bector Output
CI Connector Input
CO Connector Output

Table 3-11 Quick commissioning for a motor without a DRIVE-CLiQ interface, continued

Outlet	Description	Factory setting
p0304[0] = … … ↓	**Rated motor data [MDS]** Only for p0300 < 100 (third-party motor) Enter the rated motor data according to the type plate, e.g. p0304[0 Rated motor voltage [MDS] p0305[0] Rated motor current [MDS] p0307[0] Rated motor power [MDS] p0308[0] Rated motor power factor [MDS] (only for p0100 = 0) p0309[0] Rated motor efficiency [MDS] (only for p0100 = 1) p0310[0] Rated motor frequency [MDS] p0311[0] Rated motor speed [MDS] p0335[0] Motor cooling type [MDS] * 0: Natural cooling 1: Forced cooling 2 Water cooling	–
p1900 = 1 ↓	**Motor data identification and rotating measurement*** 0 Inhibited 1 Motor data identification for rotating motor 2 Motor data identification at standstill Alarms A07991 and A7980 are displayed	2
Danger During the motor identification routine, the drive can cause the motor to move. When commissioning, EMERGENCY STOP functions must be functioning. To protect the machines and personnel, the relevant safety regulations must be carefully observed.		

* These parameters offer more setting possibilities than specified here. For additional setting possibilities, see the List Manual
[CDS] Parameter depends on the Command Data Sets (CDS). Data set 0 is preset.
[DDS] Parameter depends on the Drive Data Sets (DDS). Data set 0 is preset.
[MDS] Parameter depends on the Motor Data Sets (MDS). Data set 0 is preset.
BI Binector Input
BO Bector Output
CI Connector Input
CO Connector Output

Table 3-11 Quick commissioning for a motor without a DRIVE-CLiQ interface, continued

Outlet	Description	Factory setting
p3900 = 3	**Completion of quick commissioning *** 0 No quick commissioning 1 Quick parameterization after parameter reset: Reset all parameters to the factory setting (with the exception of the quick commissioning parameter) Restore the PROFIBUS telegram (p0922) and the BICO interconnections (p0700, p1000, p1500) Motor calculation corresponding to p0340 = 1 2 Quick parameterization (only) for BICO and motor parameters Restore the PROFIBUS telegram (p0922) and the BICO interconnections (p0700, p1000, p1500) Motor calculation corresponding to p0340 = 1 3 Quick parameterization (only) for motor parameters Only motor calculation corresponding to p0340 = 1 When the calculations have been completed, p3900 and p0010 are automatically set to 0. Parameters of a selected SIEMENS catalog motor (p0301) are not overwritten.	0
p0840[0] = r0019.0(DO 1)	**BI: ON/OFF1 [CDS]** Sets the signal source for STW1.0 (ON/OFF1) Interconnecting to r0019.0 of the drive object Control Unit (DO 1) Effect: Signal ON/OFF1 from the BOP Binector interconnections with the BOP20, see Subsection 9.13.2	0
p1035[0] = r0019.13 (DO 1)	**BI: Motorized potentiometer, raise setpoint [CDS]** Sets the signal source to increase the setpoint for the motorized potentiometer Interconnecting to r0019.13 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer raise setpoint from BOP Binector interconnections with the BOP20, see Subsection 9.13.2	0
p1036[0] = r0019.14 (DO 1)	**BI: Motorized potentiometer, lower setpoint [CDS]** Sets the signal source to reduce the setpoint for the motorized potentiometer Interconnecting to r0019.14 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer lower setpoint from BOP Binector interconnections with the BOP20, see Subsection 9.13.2	0

* These parameters offer more setting possibilities than specified here. For additional setting possibilities, see the List Manual
[CDS] Parameter depends on the Command Data Sets (CDS). Data set 0 is preset.
[DDS] Parameter depends on the Drive Data Sets (DDS). Data set 0 is preset.
[MDS] Parameter depends on the Motor Data Sets (MDS). Data set 0 is preset.
BI Binector Input
BO Bector Output
CI Connector Input
CO Connector Output

Table 3-11 Quick commissioning for a motor without a DRIVE-CLiQ interface, continued

Outlet	Description	Factory setting
p1070[0] = r1050 (DO 63) ↓	**CI: Main setpoint [CDS]** Sets the signal source for speed setpoint 1 of the speed controller Interconnecting to r1050 on its own drive object (DO 63) Effect: Motorized potentiometer supplies the speed setpoint Binector interconnections with the BOP20, see Subsection 9.13.2	0
p0006 = 0 ↓	**BOP operating display mode*** 0 Operation –> r0021, otherwise r0020 <–> r0021 1 Operation –> r0021, otherwise r0020 2 Operation –> p0005, otherwise p0005 <–> r0020 3 Operation –> r0002, otherwise r0002 <–> r0020 4 p0005	4
Save all parameters	Press the P key for 3s	

* These parameters offer more setting possibilities than specified here. For additional setting possibilities, see the List Manual
[CDS] Parameter depends on the Command Data Sets (CDS). Data set 0 is preset.
[DDS] Parameter depends on the Drive Data Sets (DDS). Data set 0 is preset.
[MDS] Parameter depends on the Motor Data Sets (MDS). Data set 0 is preset.
BI Binector Input
BO Bector Output
CI Connector Input
CO Connector Output

3.9 Commissioning for the first time using as an example Servo AC DRIVE with BOP20

The commissioning example described in this chapter shows all the necessary configuration and parameter settings. Commissioning is performed using the BOP20.

Requirements for commissioning

1. The commissioning requirements have been met.

   —> see Section 2.1
2. The checklist for commissioning has been completed and all items are O.K.

   —> see Section 2.1

3.9.1 Task

1. Commission a drive unit (operating mode servo, closed-loop speed control) with the following components:

Table 3-12 Component overview

Designation	Component	Order No.
Closed-loop control		
Control Unit	Control Unit 310 DP	6SL3040-0LA00-0AAx
Operator Panel	Basic Operator Panel 20 (BOP20)	6SL3055-0AA00-4BAx
Infeed and drive		
Power Module	Power Module 340	6SL3210-xxxx-xxxx
Motor	Synchronous motor with DRIVE-CLiQ interface	1FK7061-7AF7x-xAxx
Motor encoder via DRIVE-CLiQ	Incremental encoder sin/cos C/D 1Vpp 2048 p/r	1FK7xxx-xxxxx-x**A**xx

2. Commissioning is performed using the BOP20.
3. The function keys of the Basic Operator Panel (BOP) should be parameterized so that the ON/OFF signal and the speed setpoints are entered using these keys.

3.9.2 Component wiring (example)

The following diagram shows a possible component configuration and wiring option. The DRIVE-CLiQ wiring is highlighted in **bold**.

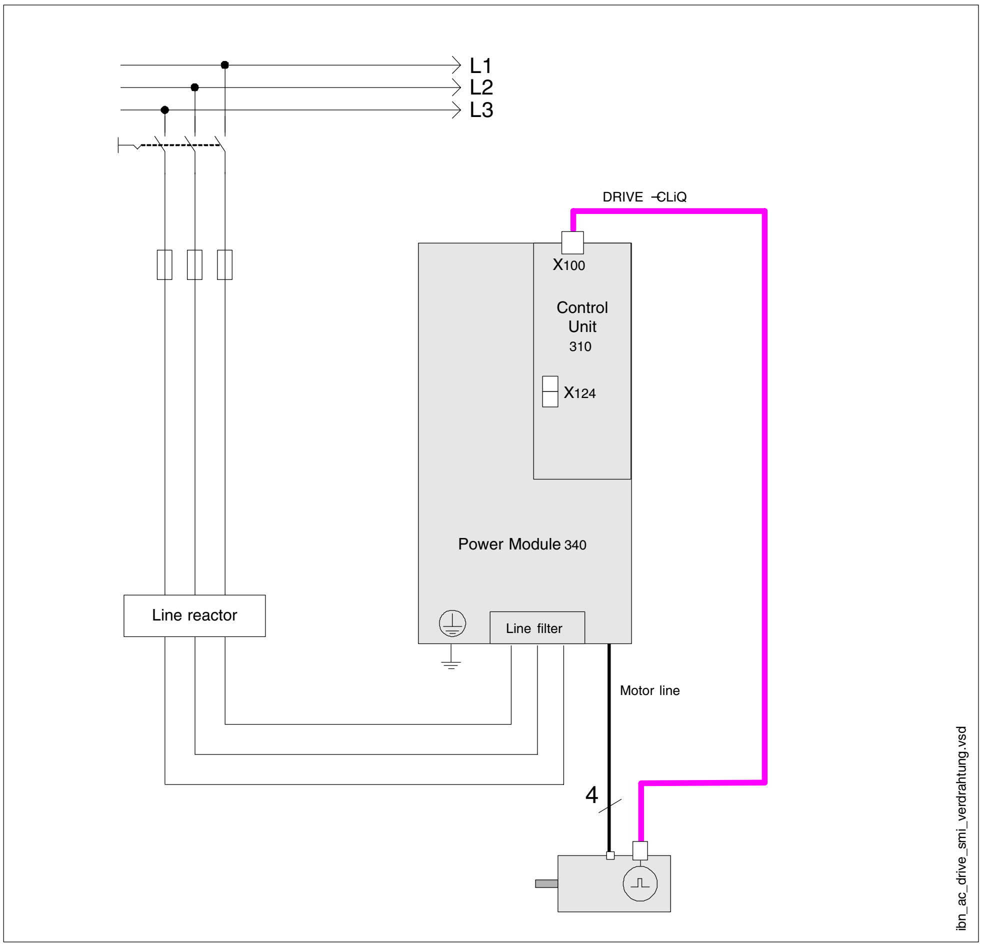


Fig. 3-14 Component wiring with integrated sensor module (example)

For more information on the wiring and connecting-up the encoder system, see the Equipment Manual.

3.9.3 Quick commissioning using the BOP (example)

Table 3-13 Quick commissioning for a motor with a DRIVE-CLiQ interface

Outlet	Description	Factory setting
Note: Before commissioning for the first time, the drive must be in the factory setting. Procedure, see Subsection 3.3.1		
p0009 = 1 ↓	**Device commissioning parameter filter *** 0 Ready 1 Device configuration 30 Parameter reset	1
p0097 = 1 ↓	**Select drive object type *** 0 No selection 1 Drive object type SERVO 2 Drive object type VECTOR	0
p0009 = 2 ↓	**Device commissioning parameter filter *** 0 Ready 1 Device configuration 2 Define drive type / drive options 30 Parameter reset	1
p0108[1] = H0104 ↓	**Drive object, function module *** Bit 2 Speed/torque control Bit 8 Expanded setpoint channel	0000
p0009 = 0 ↓	**Device commissioning parameter filter *** 0 Ready 1 Device configuration 30 Parameter reset	1
DO = 2 ↓	**Select drive object (DO) 2 (= SERVO)** 1 CU 2 SERVO To select a drive object (DO), simultaneously press the Fn key and an arrow key. The selected project is displayed at the top left.	1

* These parameters offer more setting possibilities than specified here. For additional setting possibilities, see the List Manual
[CDS] Parameter depends on the Command Data Sets (CDS). Data set 0 is preset.
[DDS] Parameter depends on the Drive Data Sets (DDS). Data set 0 is preset.
BI Binector Input
BO Bector Output
CI Connector Input
CO Connector Output

Table 3-13 Quick commissioning for a motor with a DRIVE-CLiQ interface, continued

Outlet	Description	Factory setting
p0840[0] = r0019.0(DO 1)	**BI: ON/OFF1 [CDS]** Sets the signal source for STW1.0 (ON/OFF1) Interconnecting to r0019.0 of the drive object Control Unit (DO 1) Effect: Signal ON/OFF1 from the BOP Binector interconnections with the BOP20, see Subsection 9.13.2	0
p1035[0] = r0019.13 (DO 1)	**BI: Motorized potentiometer, raise setpoint [CDS]** Sets the signal source to increase the setpoint for the motorized potentiometer Interconnecting to r0019.13 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer raise setpoint from BOP Binector interconnections with the BOP20, see Subsection 9.13.2	0
p1036[0] = r0019.14 (DO 1)	**BI: Motorized potentiometer, lower setpoint [CDS]** Sets the signal source to reduce the setpoint for the motorized potentiometer Interconnecting to r0019.14 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer lower setpoint from BOP Binector interconnections with the BOP20, see Subsection 9.13.2	0
p1070[0] = r1050 (DO 63)	**CI: Main setpoint [CDS]** Sets the signal source for speed setpoint 1 of the speed controller Interconnecting to r1050 on its own drive object (DO 63) Effect: Motorized potentiometer supplies the speed setpoint Binector interconnections with the BOP20, see Subsection 9.13.2	0
p0006 = 0	**BOP operating display mode*** 0 Operation –> r0021, otherwise r0020 <–> r0021 1 Operation –> r0021, otherwise r0020 2 Operation –> p0005, otherwise p0005 <–> r0020 3 Operation –> r0002, otherwise r0002 <–> r0020 4 p0005	4
Save all parameters	Press the P key for 3s	

* These parameters offer more setting possibilities than specified here. For additional setting possibilities, see the List Manual

[CDS] Parameter depends on the Command Data Sets (CDS). Data set 0 is preset.

[DDS] Parameter depends on the Drive Data Sets (DDS). Data set 0 is preset.

BI Binector Input

BO Bector Output

CI Connector Input

CO Connector Output

3.10 Commissioning linear motors (servo)

3.10.1 General information on commissioning linear motors

Before commissioning motors, the following questions must be answered:

- Are all of the prerequisites for commissioning checked and were the points in the checklist for commissioning checked (refer to Chapter 2)?

Detailed information on linear motors, encoders and power connection, configuring and mounting are provided in:

/PJLM/ Configuration Manual for Linear Motors 1FN1, 1FN3

Terminology for rotary and linear drives

Table 3-14 Comparison

Terminology for rotary drives	Terminology for linear drives
Speed	Velocity
Torque	Force
Stator	Primary section
Rotor	Secondary section
Rotor	Secondary section
Direction of rotation	Direction
Pulse number	Grid spacing
Rotate	Run

Checks in the no-current state

The following checks can be made:

1. Linear motor
   - Which linear motor is being used?

     1FN _ _ _ _ – _ _ _ _ _ _ – _ _ _ _
   - Is the motor already mounted and ready to be powered up?
   - If a cooling circuit is being used, is it functional?
2. Mechanical system
   - Is the axis easy to move over the complete traversing range?
   - Does the air gap between the primary and secondary section and the mounting dimensions correspond to the motor manufacturer's data?

– Hanging (suspended) axis:
  If wait equalizing is used for the axis is this functioning?
– Brake:
  If a brake is being used, is it correctly controlled (see Function Manual)?
– Traversing range limiting:
  Are the mechanical end stops available and tightly bolted to both ends of the traversing path?
– Are the moving feeder cables correctly routed in a cable drag assembly?

3. Measuring system
   – Which measuring system is being used?

     _ _ _ _ _ _ _ _ _ _ _ _

     Absolute or incremental abs ☐ incr ☐

     Grid spacing _ _ _ _ _ _ _ _ _ _ µm

     Zero marks (number and position) _ _ _ _ _ _ _ _ _ _ _ _
   – Where is the positive drive direction?
     Where is the positive counting direction of the measuring system?

     Invert (p0410)? yes ☐ no ☐
4. Wiring
   – Power Module (connect UVW, phase sequence, clockwise rotating field)
   – Protective conductor connected?
   – Screen connected?
   – Temperature monitoring circuits:
     Are the cables connected to the terminal block of the screen connecting plate?

     —> Temperature sensor (Temp-F):
     The temperature sensor (Temp-F) can be used to measure the mean absolute winding temperature.

     —> Overtemperature switch (Temp-S)
     The over temperature shutdown circuit (Temp-S) allows each individual motor phase winding to be digitally monitored for an overtemperature condition.

Danger

The circuits of Temp-F and Temp-S neither have “protective separation” between each other nor to the power circuits in accordance with VDE 0160/EN 50178.

Thus, they may not be used as SELV/PELV circuits, or connected with these.

See also the /PJLM/ Configuration Manual for Linear Motors 1FN1, 1FN3

– Temperature sensor evaluation

5. Encoder system connection
   Is the encoder system connected correctly to SINAMICS?

3.10.2 Commissioning: Linear motor with one primary section

Commissioning with STARTER

Danger

Linear drives can achieve significantly higher rates of acceleration and velocities than conventional drives.

The traversing range must always be kept clear in order to avoid any potential danger for man or machine.

Commissioning the motor with STARTER

1. Selecting the motor type

   You can select a standard motor from the list of motors or you can enter the motor data yourself if third-party motors are used.
   The number of parallel primary sections (p0306) must be entered.

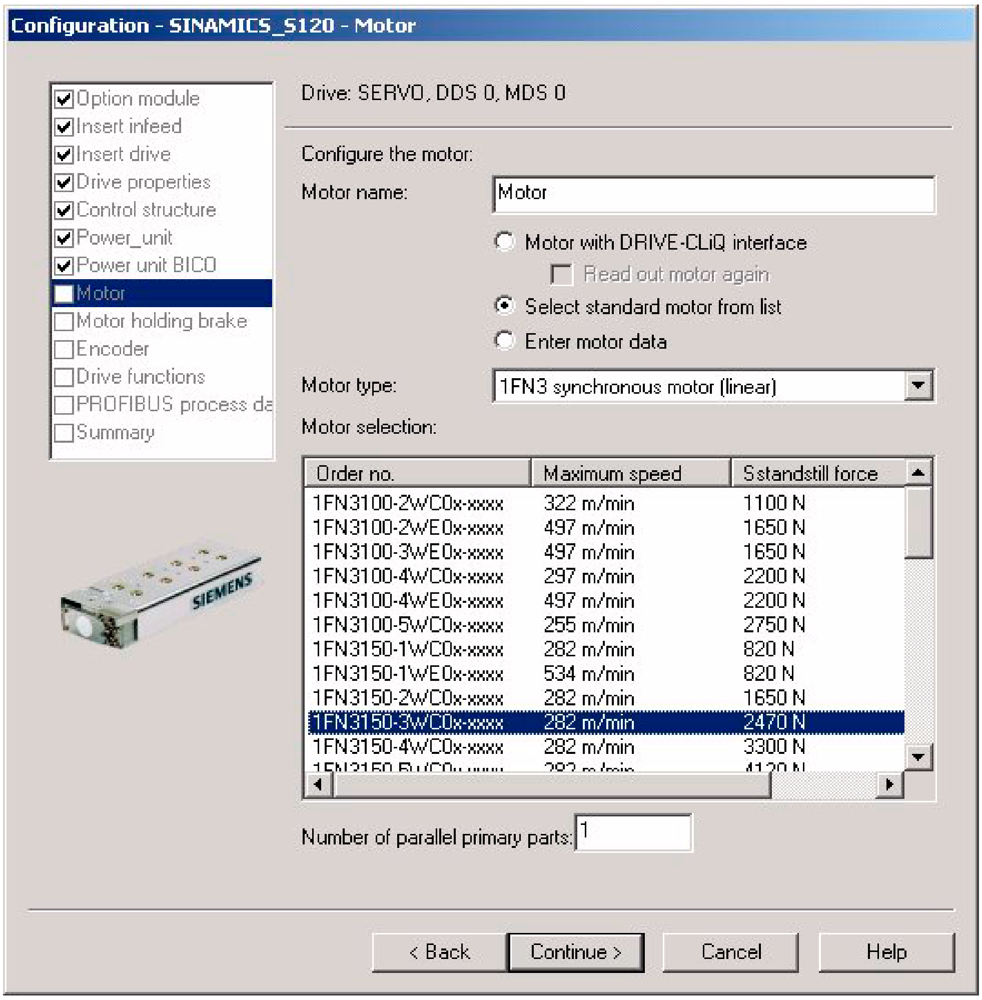


Fig. 3-15 Motor screen in STARTER

2. Enter motor data

   The following motor data can be entered for third-party motors.

Table 3-15 Motor data

Parameters	Description	Remark
p0305	Rated motor current	–
p0311	Motor rated velocity	–
p0315	Motor pole pair width	
p0316	Motor force constant	–
p0322	Motor velocity, maximum	–
p0323	Maximum motor current	–
p0338	Motor limit current	–
p0341	Motor weight	–
p0350	Motor stator resistance, cold	–
p0356	Motor stator leakage inductance	–

Table 3-16 Optional motor data, synchronous motor (linear)

Parameters	Description	Remark
p0312	Rated motor force	–
p0317	Motor voltage constant	–
p0318	Motor stall current	–
p0319	Motor stall force	–
p0320	Rated motor magnetization current	–
p0326	Stall torque correction factor	–
p0329	Pole position identification current	–
p0348	Speed at start of field weakening	–
p0353	Motor series inductance	–
p0391	Current controller adaptation, lower starting point	–
p0392	Current controller adaptation, upper starting point	–
p0393	Current controller adaptation, P gain, scaling upper	–

3. User-defined encoder data

   With linear motors, the encoder is configured in the "User-defined encoder data" screen.

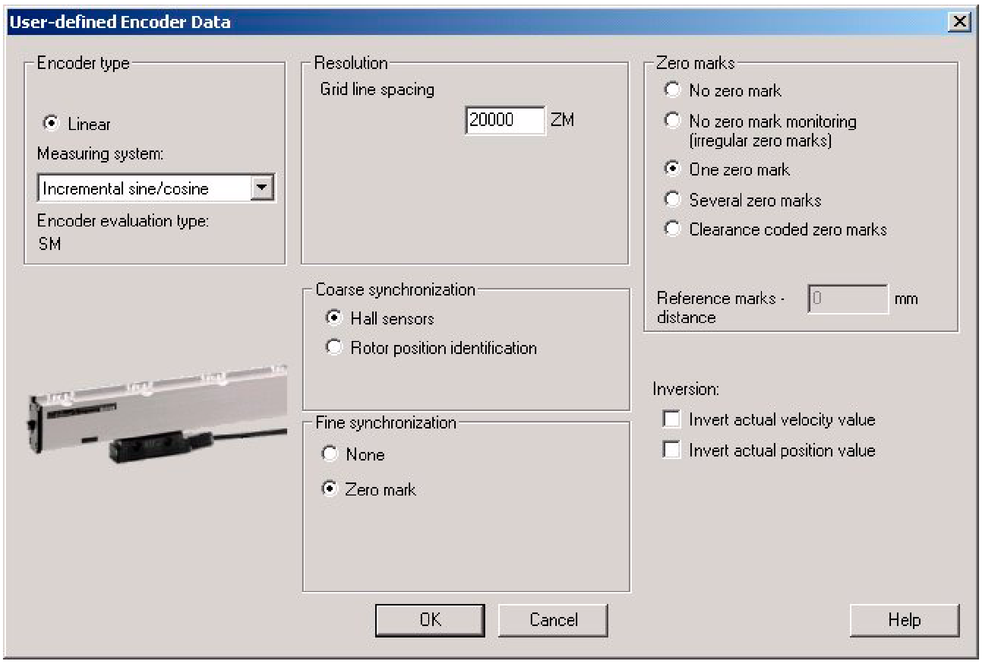


Fig. 3-16 Encoder data screen in STARTER

Warning

When linear motors are configured for the first time, the commutation angle offset (p0431) must be adjusted. Refer to the functional description for further information on the commutation angle offset and pole position identification (servo).

3.10.3 Commissioning: Linear motors with several similar primary sections

General information

If it is certain that the EMF of more than one motor has the same relative phase position to one another, the connecting cables can be connected in parallel and operated from one drive.

Linear motors, which are connected in parallel, are commissioned, based on the commissioning of a single linear motor. The number of parallel-connected primary sections is entered in the “Motor” screen (p0306) when the drive is configured in STARTER.

First, only one linear motor (motor 1) is connected to the drive, and is commissioned as individual motor (1FNx ...). The angular commutation offset is automatically determined and noted.

Instead of motor 1, the other motors are connected and commissioned as individual motors. Also here, the angular commutation offset is automatically determined and noted.

If the difference between the commutation angle offset of motor 1 and the other motors is less than 10 degrees (electrical), all the motors can be connected to the drive in parallel and commissioned as a parallel configuration of n linear motors (e.g. 2 • 1FN1xxx).

Note

Only identical linear motors (the same forces, winding types, secondary section types and air gap) may be connected in parallel. (Order number of the primary sections to be connected in parallel must be identical up to the winding sense and/or primary section length.)

If linear motors in an axis are connected in parallel, the position of the primary sections with respect to one another and to the secondary sections must exhibit a specific grid, in order to achieve a matching electrical phase position.

For more information see: /PJLM/ Configuration Manual for Linear Motors 1FN1, 1FN3

Temperature sensor and electrical wiring

The temperature sensors can be evaluated, for example, as follows:

- Temperature sensor
  - Motor 1: Evaluated via the drive
  - Motor n: not connected
    (short-circuited and connected to the PE)
- Temperature switch
  - Motor 1 to n: Evaluation via a PLC

See also: /PJLM/ Configuration Manual for Linear Motors 1FN1, 1FN3

Warning

When connecting-up the temperature monitoring circuits, carefully observe the specifications relating to protective separation DIN EN 50178.

See also: /PJLM/ Configuration Manual for Linear Motors 1FN1, 1FN3

3.10.4 Thermal motor protection

Description

Two independent monitoring circuits are available for the 1FN1, 1FN3 primary sections for thermal motor protection.

The absolute, average winding temperature can be measured using the temperature sensor (Temp-F) comprising a temperature sensor (KTY 84).

The overtemperature shutdown circuit (Temp-S) allows each individual motor phase winding to be digitally monitored for an overtemperature condition.

The two independent temperature circuits Temp-F and Temp-S can be used for motor protection, either individually or together. At least one Temp_S must be used for the motor overtemperature protection.

The circuit and connection system for Temp-F and Temp-S are described in detail in: /PJLM/ Configuration Manual for Linear Motors 1FN1, 1FN3

Danger

The circuits of Temp-F and Temp-S neither have “protective separation” between each other nor to the power circuits in accordance with VDE 0160/EN 50178.

Danger

Temp-S must be connected for thermal motor protection; it is not permissible not to connect Temp-S!

Temp-F can be optionally connected to a measuring device for commissioning and testing.

For regular operation, the Temp-F connections should be short-circuited and connected to PE.

Note

The temperature sensor (Temp-F) only evaluates the winding temperature of one phase in the primary section. The phases in the synchronous motor are, however, loaded to different degrees with the result that, in the worst case, the phases that are not measured have higher temperatures.

Note

With protective separation, you must not connect Temp-F to a Sensor Module of the SINAMICS drive system without using a suitable protective device.

When handling and connecting Temp-F, it must be assumed that when the drive is powered up, there are hazardous voltages at the terminals on the motor side and at the Temp-F connecting cable. This means that the drive must always be disconnected so that it is ensured that it really is in a no-voltage condition.

Note

EWith protective separation, you must not connect Temp-S to the PLC or to the Sensor Module of the SINAMICS drive system without using a 3RN1013-1BW10 thermistor motor protective device.

When handling and connecting Temp-F, it must be assumed, that when the drive is powered up, there are hazardous voltages at the terminals on the motor side and at the Temp-F connecting cable – this means that the drive must always be disconnected so that it is ensured that it really is in a no-voltage condition.

Evaluating the temperature sensors

See also: /PJLM/ Configuration Manual for Linear Motors 1FN1, 1FN3

3.10.5 Measuring system

Determining the control sense

The control sense of an axis is correct if the positive direction of the drive (= clockwise rotating field U, V, W) coincides with the positive counting direction of the measuring system.

Note

The data to determine the drive direction is only valid for Siemens motors (1FNx motors).

If the positive direction of the drive and positive counting direction of the measuring system **do not match**, the actual speed value (P0410.0) must be inverted when the drive is commissioned.

The control sense can also be checked by first parameterizing the drive, and then manually moving it, with the enable signals inhibited (switched out).
If the axis is shifted in the positive direction, then the velocity actual value count direction must also be positive.

Determining the drive direction

The direction of the drive is positive if the primary section moves relative to the secondary section in the opposite direction to the cable outlet direction.

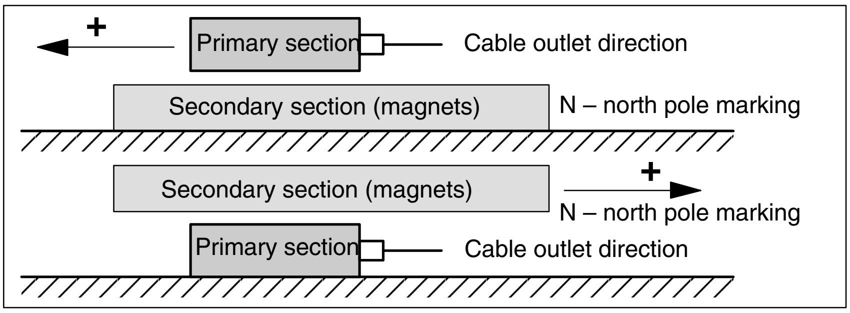


Fig. 3-17 Determining the positive direction of the drive

Determining the counting direction of the measuring system

The counting direction is determined depending on the measuring system.

- Measuring systems from Heidenhain

Note

The counting direction of the measuring system is positive, if the distance between the sensor head and rating plate increases.

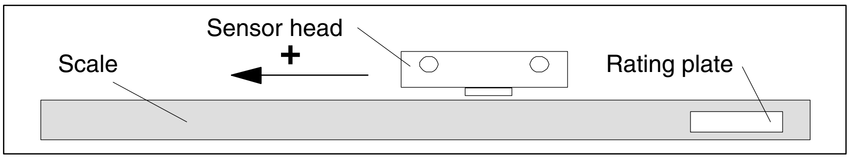


Fig. 3-18 Determining the counting direction for measuring systems from the Heidenhain Company

- Measuring systems from Renishaw (e.g. RGH22B)

As the reference mark for the Renishaw RGH22B has a direction-dependent position, with control cables BID and DIR, the encoder must be parameterized, so that the reference mark is only output in one direction.
The direction (positive/negative) depends on the geometrical arrangement at the machine and the reference point approach direction.

Table 3-17 Overview, signals

Signal	Cable color	12-pin circular connector	Connected to	
			+5 V	0 V
BID	Black	Pin 9	Reference marks in both directions	Reference marks in one direction
DIR	Orange	Pin 7	Positive directions	Negative direction
+5 V	Brown	Pin 12		
0 V	White	Pin 10		

The counting direction of the measuring system is positive if the sensor head moves relative to the gold band in the cable outlet direction.

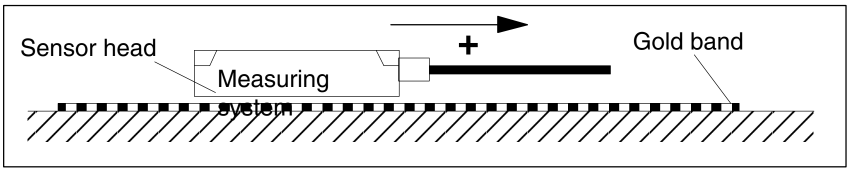


Fig. 3-19 Determining the counting direction for measuring systems from Renishaw

Note

If the sensor head is mechanically connected to the primary section, the cable outlet direction must be different. Otherwise, invert the actual value.

3.10.6 Checking the linear motor by making measurements

Why make measurements?

If the linear motor was commissioned according to the relevant instructions, and unexplained fault/error messages still occur, then all of the signals must be checked using an oscilloscope.

Checking the phase sequence U-V-W

For primary sections connected in parallel, the EMF_U from motor 1 must be in phase with the EMF_U from motor 2. The same is true for EMF_V and EMF_W.
It is absolutely necessary that this is checked by making the appropriate measurements.

Making the necessary measurements:

- Disconnect the drive line-up from the power supply.
- Important: Wait until the DC link has been discharged!
- Disconnect the power cables from the drive.
  Disconnect any primary components connected in parallel.
- Form an artificial neutral point using 1 kOhm resistors.

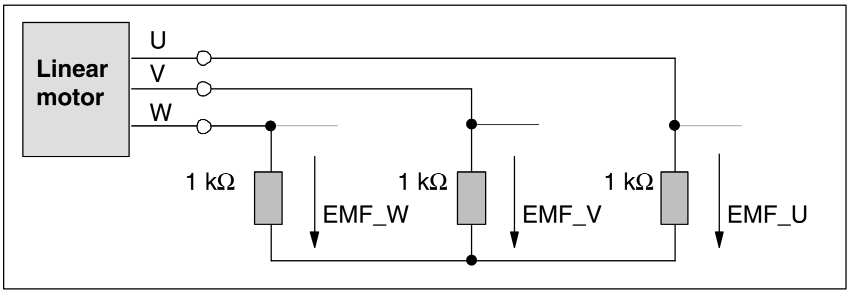


Fig. 3-20 Configuration for making the measurements

For a positive traversing direction, the phase sequence must be U-V-W.
The direction of the drive is positive if the primary section moves relative to the secondary section in the opposite direction to the cable outlet direction.

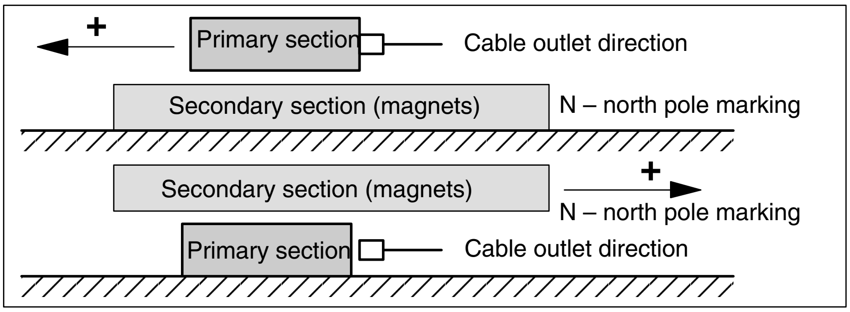


Fig. 3-21 The positive direction of the drive (clockwise rotating field)

Determining the commutation angle using an oscilloscope

Once the oscilloscope has been connected, the drive must first pass the zero mark so that fine synchronization can be carried out.

The angular, commutation offset can be determined by measuring the EMF and normalized electrical pole position via an analog output.

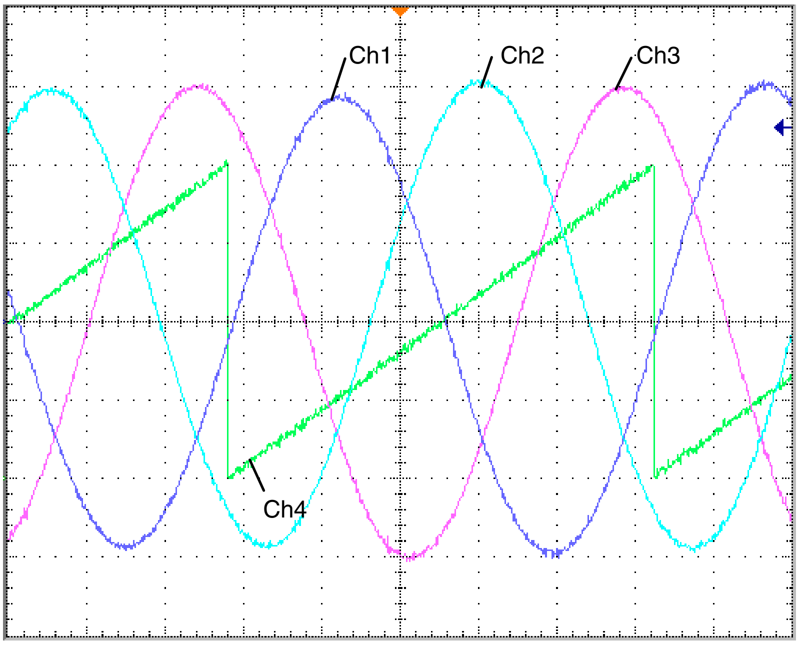


Fig. 3-22 Oscillogram

Definition of channels (Ch1 ... Ch4):

- Ch1 EMF phase U to neutral point
- Ch2: EMF phase V to neutral point
- Ch3: EMF phase W to neutral point
- Ch4: Normalized electrical rotor angular displacement via analog output

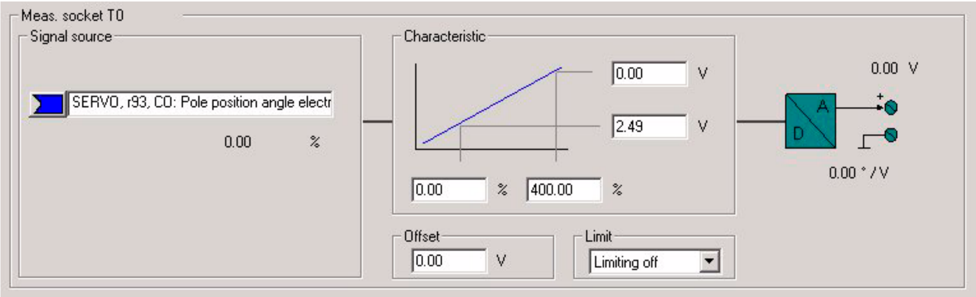


Fig. 3-23 Example of setting for measuring socket T0 on the CU320

When the drive is synchronized, the difference between the EMF/phase U and the electrical rotor position is a maximum of 10°.

If the difference is greater, the commutation angle offset must be adjusted.

■

4 Communications according to PROFIdrive

4.1 General information about PROFIdrive

4.1.1 General information about PROFIdrive for SINAMICS

General information

PROFIdrive V4 is the PROFIBUS and PROFANED profile for drive technology with a wide range of applications in production and process automation.
PROFIdrive is independent of the bus system being used (PROFIBUS, PROFINET).

Note

PROFIdrive for drive technology is standardized and described in the following document:

References: /P5/ PROFIdrive Profile Drive Technology

Controller, Supervisor and Drive Unit

- Features of the Controller, Supervisor and Drive Unit

Table 4-1 Features of the Controller, Supervisor and Drive Unit

Characteristics	Controller, Supervisor	Drive Unit
As bus node	Active	Passive
Send messages	Permitted without external request	Only possible on request by master
Receive messages	Possible with no restrictions	Only receive and acknowledge permitted

- Controller (PROFIBUS: Master Class 1, PROFINET IO: IO Controller)

  This is typically a higher-level control in which the automation program runs.

  Example: SIMATIC S7 and SIMOTION
- Supervisor (PROFIBUS: Master Class 2, PROFINET IO: IO Supervisor)

  Devices for configuration, commissioning, operator control and monitoring during bus operation. Devices that only non-cyclically exchange data with Drive Units and Controllers.

  Examples: Programming devices, human machine interfaces
- Drive Unit (PROFIBUS: Slave, PROFINET IO: IO Device)

  The SINAMICS drive unit is with reference to PROFIdrive, a Drive Unit.

4.2 Cyclic communication

Cyclic communication is used to exchange time-critical process data.

4.2.1 Telegrams and process data

General information

The selection of a telegram via p0922 determines, on the drive unit side (Control Unit) which process data is transferred.

From the perspective of the drive unit, the received process data comprises the receive words and the process data to be sent the send words.

The receive and send words comprise the following elements:

- Receive words: Control words or setpoints
- Send words: Status words or actual values

What kinds of telegram are used?

1. Standard telegrams

   The standard telegrams are structured in accordance with the PROFIdrive Profile. The internal process data links are set up automatically in accordance with the telegram number setting.

   The following standard telegrams can be set via p0922:

   – 1 Speed control, 2 words

   – 2 Speed control, 4 words

   – 3 Speed control, 1 position encoder

   – 4 Speed control, 2 position encoders

   – 5 DSC, 1 position encoder

   – 6 DSC, 2 position encoders

   – 7 Basic positioner

   – 20 Speed control, VIK-NAMUR

2. Manufacturer-specific telegrams

   The manufacturer-specific telegrams are structured in accordance with internal company specifications. The internal process data links are set up automatically in accordance with the telegram number setting.

   The following vendor-specific telegrams can be set via p0922:

   – 102 Speed control with torque reduction, 1 position encoder
   – 103 Speed control with torque reduction, 2 position encoders
   – 105 DSC with torque reduction, 1 position encoder
   – 106 DSC with torque reduction, 2 position encoders
   – 110 Basic positioner
   – 116 DSC with torque reduction, 2 position encoders
   – 352 Speed control, PCS7
   – 370 Telegram for the infeed
   – 390 Telegram for Control Unit (drive object 1, DO1), Digital inputs/outputs
   – 391 Telegram for Control Unit (drive object 1, DO1), Digital inputs/outputs and 2 probes
   – 392 Telegram for Control Unit (drive object 1, DO1), Digital inputs/outputs and 6 probes

3. Free telegrams (p0922 = 999)

   The send and receive telegrams can be configured as required by using BICO technology to interconnect the send and receive process data.

Table 4-2 Receive and send process data

	SERVO, VECTOR	**CU_S**	**A_INF, B_INF, S_INF, CU_S, TB30, TM31, TM15DI/DO**
Receive process data			
DWORD connector output	r2060[0 ... 14]	–	
WORD connector output	r2050[0 ... 15]	r2050[0 ... 4]	
Binector output	r2090.0 ... 15 r2091.0 ... 15 r2092.0 ... 15 r2093.0 ... 15	r2090.0 ... 15 r2091.0 ... 15	
Free binector-connector converter	p2080[0 ... 15], p2081[0 ... 15], p2082[0 ... 15], p2083[0 ... 15] / r2089[0 ... 3]		
Send process data			
DWORD connector input	p2061[0 ... 14]	–	

Table 4-2 Receive and send process data, continued

	SERVO, VECTOR	**CU_S**	**A_INF, B_INF, S_INF, CU_S, TB30, TM31, TM15DI/DO**
WORD connector input	p2051[0 ... 18]	p2051[0 ... 6]	p2051[0 ... 4]
Free connector-binector converter	p2099[0 ... 1] / r2094.0 ... 15, r2095.0 ... 15		

Telegram interconnections

When you change p0922 = 999 (factory setting) to p0922 $\neq$ 999, the telegrams are interconnected and blocked automatically.

Note

Telegrams 20, 352 are the exceptions. Here, PZD06 in the transmit telegram and PZD03 to PZD06 in the receive telegram can be interconnected as required.

When you change p0922 $\neq$ 999 to p0922 = 999, the previous telegram interconnection is retained and can be changed.

When you change p0922 = 999 and p2079 $\neq$ 999, the telegram interconnection parameterized via p2079 is carried out automatically and blocked. The telegram can be extended, however.

These are both easy methods of interconnecting free telegrams as required on the basis of existing telegrams.

The telegram structure

p0978 can be re-sorted and a zero inserted in order to identify those drive objects that participate in the PZD exchange and to define their sequence in the PZD exchange. Drive objects that are listed after the first zero, are excluded from the process data exchange.

For p0978, in addition, the value 255 can be inserted a multiple number of times. P0978[n] = 255 emulates a visible, empty drive object for the PROFIBUS master without process data actually being exchanged. This enables cyclic communication of a PROFIBUS master with the same configuration with drive units with a different number of drive objects.

Note

- The following must apply to ensure conformity with the PROFIdrive profile:
  - Interconnect PZD receive word 1 as control word 1 (STW1)
  - Interconnect PZD send word 1 as status word 1 (ZSW1)
    Use WORD format for PZD1.
- One PZD = one word.
  Only one of the interconnection parameters (p2051 or p2061) can have the value $\neq$ 0 for a PZD word.
- Physical word and double word values are inserted in the telegram as referenced variables.
  p200x apply as reference variables (telegram contents = 4000 hex or 4000 0000 hex in the case of double words if the input variable has the value p200x).

Structure of the telegrams

Tele-gram	Appl. class	Function in the drive	PZD 01	PZD 02	PZD 03	PZD 04	PZD 05	PZD 06	PZD 07	PZD 08	PZD 09	PZD 10	PZD 11	PZD 12	PZD 13	PZD 14	PZD 15	PZD 16	PZD 17	PZD 18	PZD 19
1	1	Speed control, 2 words	STW1	NSOLL_A	← Receive telegram from PROFIdrive																
			ZSW1	NIST_A	→ Send telegram to PROFIdrive																
2	1	Speed control, 4 words	STW1	NSOLL_B		STW2															
			ZSW1	NIST_B		ZSW2															
3	1, 4	Speed control, 1 position encoder	STW1	NSOLL_B		STW2	G1_STW														
			ZSW1	NIST_B		ZSW2	G1_ZSW	G1_XIST1		G1_XIST2											
4	1, 4	Speed control, 2 position encoder	STW1	NSOLL_B		STW2	G1_STW	G2_STW													
			ZSW1	NIST_B		ZSW2	G1_ZSW	G1_XIST1		G1_XIST2		G2_ZSW	G2_XIST1		G2_XIST2						
5	4 DSC	DSC, 1 position encoder	STW1	NSOLL_B		STW2	G1_STW	XERR		KPC											
			ZSW1	NIST_B		ZSW2	G1_ZSW	G1_XIST1		G1_XIST2											
6	4 DSC	DSC, 2 position encoder	STW1	NSOLL_B		STW2	G1_STW	G2_STW	XERR		KPC										
			ZSW1	NIST_B		ZSW2	G1_ZSW	G1_XIST1		G1_XIST2		G2_ZSW	G2_XIST1		G2_XIST2						
7	3	Basic positioner	STW1	SATZANW																	
			ZSW1	AKTSATZ																	
20	1	Speed control, VIK-NAMUR	STW1	NSOLL_A																	
			ZSW1	NIST_A_GLATT	IAIST_GLATT	MIST_GLATT	PIST_GLATT	<2>													
102	1, 4	Speed control with torque reduction, 1 position encoder	STW1	NSOLL_B		STW2	MOMRED	G1_STW													
			ZSW1	NIST_B		ZSW2	MELDW	G1_ZSW	G1_XIST1		G1_XIST2										
103	1, 4	Speed control with torque reduction, 2 position encoders	STW1	NSOLL_B		STW2	MOMRED	G1_STW	G2_STW												
			ZSW1	NIST_B		ZSW2	MELDW	G1_ZSW	G1_XIST1		G1_XIST2		G2_ZSW	G2_XIST1		G2_XIST2					
105	4 DSC	DSC with torque reduction, 1 position encoders	STW1	NSOLL_B		STW2	MOMRED	G1_STW	XERR		KPC										
			ZSW1	NIST_B		ZSW2	MELDW	G1_ZSW	G1_XIST1		G1_XIST2										
106	4 DSC	DSC with torque reduction, 2 position encoders	STW1	NSOLL_B		STW2	MOMRED	G1_STW	G2_STW	XERR		KPC									
			ZSW1	NIST_B		ZSW2	MELDW	G1_ZSW	G1_XIST1		G1_XIST2		G2_ZSW	G2_XIST1		G2_XIST2					
110	3	Basic positioner	STW1	SATZANW	PosSTW	STW2	Over	MDIPos		MDIVel		MDIAcc	MDIDec	MDIMode							
			ZSW1	AKTSATZ	PosZSW	ZSW2	MELDW	XistP										GL = SMOOTH			
116	4 DSC	DSC with torque reduction, 2 position encoders	STW1	NSOLL_B		STW2	MOMRED	G1_STW	G2_STW	XERR		KPC									
			ZSW1	NIST_B		ZSW2	MELDW	G1_ZSW	G1_XIST1		G1_XIST2		G2_ZSW	G2_XIST1		G2_XIST2		AIST_GL	MSOLL_GL	PIST_GL	ITIST_GL
352	1	Speed control, PCS7	STW1	NSOLL_A	<3>	<3>	<3>	<3>													
			ZSW1	NIST_A_GLATT	IAIST_GLATT	MIST_GLATT	WARN_CODE	FAULT_CODE													
370	-	Infeed, 1 word	E_STW1																		
			E_ZSW1																		
390	-	CU (DO1), digital inputs/outputs	CU_STW	A_DIGITAL																	
			CU_ZSW	E_DIGITAL																	
391	-	CU (DO1), digital inputs/outputs and 2 probes	CU_STW	A_DIGITAL	MT_STW																
			CU_ZSW	E_DIGITAL	MT_ZSW	MT1_ZS_F	MT1_ZS_S	MT2_ZS_F	MT2_ZS_S												
392	-	CU (DO1), digital inputs/outputs and 6 probes	CU_STW	A_DIGITAL	MT_STW																
			CU_ZSW	E_DIGITAL	MT_ZSW	MT1_ZS_F	MT1_ZS_S	MT2_ZS_F	MT2_ZS_S	MT3_ZS_F	MT3_ZS_S	MT4_ZS_F	MT4_ZS_S	MT5_ZS_F	MT5_ZS_S	MT6_ZS_F	MT6_ZS_S				
999	-	Free interconnection via BICO	STW1<1>	The receive telegram length can be selected as required via the central PROFIdrive configuration in the Supervisor																	
			ZSW1<1>	The send telegram length can be selected as required via the central PROFIdrive configuration in the Supervisor																	

▭ = Position encoder signal

<1> To comply with the PROFIdrive profile, PZD1 must be used as control word 1 (STW1) or status word 1 (ZSW1).
If STW1 according to the PROFIdrive profile is not transferred with PZD1, then p2037 should be set to 2.
<2> Freely interconnectable (default: MELD_NAMUR).
<3> Freely interconnectable.

Fig. 4-1 Structure of the telegrams

Depending on the drive object, only certain telegrams can be used:

Table 4-3 Telegrams that can be activated as a function of the drive object

Drive object	Telegrams (p0922)
A_INF	370, 999
B_INF	370, 999
S_INF	370, 999
SERVO	2, 3, 4, 5, 6, 102, 103, 105, 106, 116, 999
SERVO (EPOS)	7, 110, 999
SERVO (extension, setpoint channel)	1, 2, 3, 4, 5, 6, 102, 103, 105, 106, 116, 999
VECTOR	1, 2, 3, 4, 20, 352, 999
VECTOR (EPOS)	7, 110, 999
TM15DI/DO	No telegram default defined
TM31	No telegram default defined
TM41	3, 999
TB30	No telegram default defined
CU_S	390, 391, 392, 999

Depending on the drive object, the following maximum number of process data items can be transmitted for user-defined telegram structures:

Drive object Max. number of PZD for sending/receiving

- A_INF 5
- A_INF 5
- S_INF 5
- SERVO Send 19, receive 16
- VECTOR 32
- TM15DI/DO 5
- TM31 5
- TM41 Send 19, receive 16
- TB30 5
- CU Send 7, receive 5

Interface mode

Interface mode is used for adjusting the assignment of the control and status words in line with other drive systems and standardized interfaces.

The mode can be set as follows:

Value	Interface mode
• p2038 = 0	SINAMICS (factory setting)
• p2038 = 1	SIMODRIVE 611 universal
• p2038 = 2	VIK-NAMUR

Procedure:

1. Set p0922 $\neq$ 999
2. Set p2038 = set required interface mode

When you set a telegram in the range between 100 and 199, interface mode is set by default (p2038 = 1) and cannot be changed.

Interface mode defines the setting of the standard telegram 20 (p2038 = 2). The assignment cannot be modified.

When a telegram defined by the interface mode (e.g. p0922 = 102) is changed to a different telegram (e.g. p0922 = 3), the setting in p2038 is retained.

Function diagram overview (see List Manual)

- 2410 PROFIBUS address, diagnostics
- ...
- 2483 Send telegram, free interconnection via BICO (p0922 = 999)

4.2.2 Monitoring: telegram failure

Description

After a telegram failure and a monitoring time has elapsed (t_An), bit r2043.0 is set to “1” and alarm A01920 is output. Binector output r2043.0 can, e.g. be used for a fast stop.
Fault F01910 is output after a delay time p2044 has expired. Fault F01910 triggers fault response OFF2 (pulse inhibit) for the supply and fault response OFF3 (emergency stop) for SERVO/VECTOR. If no OFF response is to be triggered, the fault response can be reparameterized accordingly.
Fault F01910 can be immediately acknowledged. The drive can then be operated even without PROFIdrive.

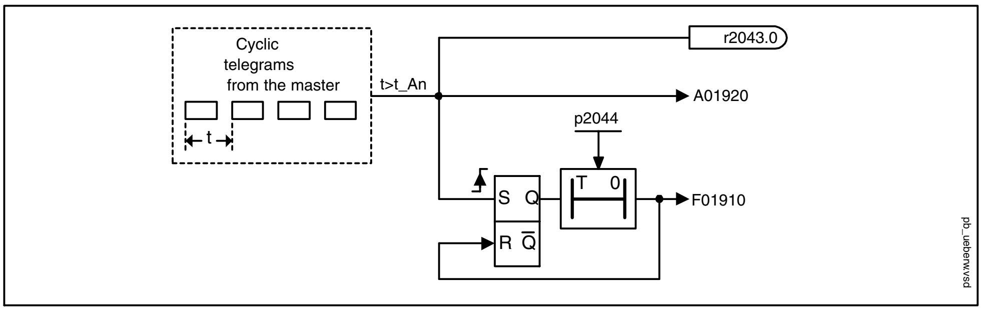


Fig. 4-2 Monitoring: telegram failure

Example: emergency stop with telegram failure

Assumption:

A drive unit with an Active Line Module and a Single Motor Module.

VECTOR mode is activated.

After the ramp-down time has elapsed (p1135), the drive is at a standstill.

Settings:

- A_INF p2044 = 2
- VECTOR p2044 = 0

Sequence:

After a telegram failure (t > t_An), binector output r2043.0 of drive object CU switches to “1”. At the same time, alarm A01920 is output for the A_INF drive objects and alarm A01920 and fault F01910 are output for VECTOR. When F01910 is output, an OFF3 is triggered for the drive. After a delay time (p2044) of two seconds has elapsed, fault F01910 is output on the infeed and triggers OFF2.

4.2.3 Description of control words and setpoints

Note

This chapter describes the assignment and meaning of the process data in SINAMICS interface mode (p2038 = 0).

The reference parameter is also specified for the relevant process data. The process data is generally normalized in accordance with parameters p2000 to r2004.

The following normalization applies:
A temperature of 100 °C corresponds to 100% or 0 °C corresponds to 0%
An electrical angle of 90° also corresponds to 100% or 0° corresponds to 0%.
For additional information, refer to Section 9.4.

Overview of control words and setpoints

Table 4-4 Overview of control words and setpoints

Abbrevia–tion	Name	Signal number	Data type 1)	Interconnection parameter
STW1	Control word 1	1	U16	(bit serial)[2)]
STW2	Control word 2	3	U16	(bit serial)[2)]
NSOLL_A	Speed setpoint A (16-bit)	5	I16	p1070
NSOLL_B	Speed setpoint B (32-bit)	7	I32	p1155 p1430(DSC)
G1_STW	Encoder 1 control word	9	U16	p0480[0]
G2_STW	Encoder 2 control word	13	U16	p0480[1]
G3_STW	Encoder 3 control word	17	U16	p0480[2]
A_DIGITAL	Digital outputs	22	U16	(bit serial)
XERR	Position deviation	25	I32	p1190
KPC	Position controller gain factor	26	I32	p1191
MOMRED	Torque reduction	101	I16	p1542
MT_STW	Control word for probe	130	U16	p0682
SATZANW	Pos block selection	201	U16	(bit serial)
PosSTW	Pos control word	203	U16	(bit serial)
Over	Pos velocity override	205	I16	p2646
MDIPos	Pos MDI position	221	I32	p2642
MDIVel	Pos MDI velocity	223	I32	p2643
MDIAcc	Pos MDI acceleration override	225	I16	p2644
MDIDec	Pos MDI deceleration override	227	I16	p2645
MDIMode	Pos MDI mode	229	U16	p2654

Table 4-4 Overview of control words and setpoints, continued

Abbrevia–tion	Name	Signal number	Data type 1)	Interconnection parameter
E_STW1	Control word for INFEED	320	U16	(bit serial)2)
CU_STW	Control word for Control Unit (CU)	500	U16	(bit serial)

1) Data type to PROFIdrive Profile V4:
I16 = Integer16, I32 = Integer32, U16 = Unsigned16, U32 = Unsigned32
2) Bitwise interconnection: refer to the following pages

STW1 (control word 1)

See function diagram [2442]

Table 4-5 Description of STW1 (control word 1)

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Comments</th><th>BICO</th></tr>
<tr><td rowspan="3">0</td><td rowspan="2">ON/OFF1</td><td>0/1</td><td>ON
Pulse enable possible</td><td rowspan="2">BI: p0840</td></tr>
<tr><td>0</td><td>OFF1
Braking with the ramp-function generator, then pulse cancellation and power-on inhibit.</td></tr>
<tr></tr>
<tr><td rowspan="3">1</td><td rowspan="2">OFF2</td><td>1</td><td>No OFF2
Enable possible</td><td rowspan="2">BI: p0844</td></tr>
<tr><td>0</td><td>OFF2
Immediate pulse cancellation and power-on inhibit</td></tr>
<tr><td colspan="4">Note:
Control signal OFF2 is generated by ANDing BI: p0844 and BI: p0845.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="2">OFF3</td><td>1</td><td>No OFF3
Enable possible</td><td rowspan="2">BI: p0848</td></tr>
<tr><td>0</td><td>Fast stop (OFF3)
Braking along the OFF3 ramp p1135, then pulse cancellation and power-on inhibit.</td></tr>
<tr><td colspan="4">Note:
Control signal OFF3 is generated by ANDing BI: p0848 and BI: p0849.</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Enable operation</td><td>1</td><td>Enable operation
Pulse enable possible</td><td rowspan="2">BI: p0852</td></tr>
<tr><td>0</td><td>Inhibit operation
Cancel the pulses</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Enable ramp generator</td><td>1</td><td>Operating condition
Ramp-function generator enable possible</td><td rowspan="2">BI: p1140</td></tr>
<tr><td>0</td><td>Inhibit ramp-function generator
Set ramp-function generator output to zero</td></tr>
<tr><td rowspan="3">5</td><td rowspan="2">Start ramp-function generator</td><td>1</td><td>Start ramp-function generator</td><td rowspan="2">BI: p1141</td></tr>
<tr><td>0</td><td>Freeze ramp-function generator</td></tr>
<tr><td colspan="4">Note:
The ramp-function generator cannot be frozen via p1141 in jog mode (r0046.31 = 1).</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Enable speed setpoint</td><td>1</td><td>Enable setpoint</td><td rowspan="2">BI: p1142</td></tr>
<tr><td>0</td><td>Inhibit setpoint
Set ramp-function generator input to zero</td></tr>
<tr><td rowspan="3">7</td><td rowspan="2">Acknowledge fault</td><td>0/1</td><td>Acknowledge fault</td><td rowspan="2">BI: p2103</td></tr>
<tr><td>0</td><td>No effect</td></tr>
<tr><td colspan="4">Note:
Acknowledgement is realized with a 0/1 edge via BI: p2103 or BI: p2104 or BI: p2105.</td></tr>
</table>

Table 4-5 Description of STW1 (control word 1), continued

Bit	Meaning	Comments		BICO
8	Reserved	–	–	–
9	Reserved	–	–	–
10	Master ctrl by PLC	1	Master ctrl by PLC This signal must be set so that the process data transferred via PROFIdrive is accepted and becomes effective.	BI: p0854
		0	PLC has no master control Process data transferred via PROFIdrive is rejected – i.e. it is assumed to be zero.	
	Note: This bit should only be set to “1” after a feedback signal was received via PROFIdrive using ZSW1.9 = “1”.			
11	Direction reversal	1	Direction reversal	BI: p1113
		0	No direction reversal	
12	Reserved			
13	Motorized potentiometer, setpoint, raise	1	Motorized potentiometer, setpoint, raise	BI: p1035
		0	Motorized potentiometer setpoint raise not selected	
14	Motorized potentiometer, lower setpoint	1	Motorized potentiometer, lower setpoint	BI: p1036
		0	Motorized potentiometer setpoint lower not selected	
	Note: If motorized potentiometer setpoint raise and lower are 0 or 1 simultaneously, the current setpoint is frozen.			
15	Reserved	–	–	–

STW1 (control word 1), positioning mode, p0108.4 = 1

See function diagram [2475]

Table 4-6 Description STW1 (control word 1), positioning mode

Bit	Meaning	Comments		BICO
0	ON/OFF1	0/1	ON Pulse enable possible	BI: p0840
		0	OFF1 Braking with the ramp-function generator, then pulse cancellation and power-on inhibit.	
1	OFF2	1	No OFF2 Enable possible	BI: p0844
		0	OFF2 Immediate pulse cancellation and power-on inhibit	
	Note: Control signal OFF2 is generated by ANDing BI: p0844 and BI: p0845.			
2	OFF3	1	No OFF3 Enable possible	BI: p0848
		0	Fast stop (OFF3) Braking along the OFF3 ramp p1135, then pulse cancellation and power-on inhibit.	
	Note: Control signal OFF3 is generated by ANDing BI: p0848 and BI: p0849.			
3	Enable operation	1	Enable operation Pulse enable possible	BI: p0852
		0	Inhibit operation Cancel the pulses	
4	Reject traversing task	1	Do not reject traversing task	BI: p1140
		0	Reject traversing task	
5	Intermediate stop	1	No intermediate stop	BI: p2640
		0	Intermediate stop	
6	Activate traversing task	0/1	Enable setpoint	BI: p2631, p2650
		0	No effect	
	Note: In addition, the interconnection p2649 = 0 is made.			
7	Acknowledge fault	0/1	Acknowledge fault	BI: p2103
		0	No effect	
8	Jog 1	1	Jogging 1 ON Also refer to the List Manual, function diagram 3610	BI: p2589
		0	No effect	

Table 4-6 Description STW1 (control word 1), positioning mode, continued

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Comments</th><th>BICO</th></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Jog 2</td><td>1</td><td>Jogging 2 ON
Also refer to the List Manual, function diagram 3610</td><td rowspan="2">BI: p2590</td></tr>
<tr><td>0</td><td>No effect</td></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Master ctrl by PLC</td><td>1</td><td>Master ctrl by PLC
This signal must be set so that the process data transferred via PROFIdrive is accepted and becomes effective.</td><td rowspan="2">BI: p0854</td></tr>
<tr><td>0</td><td>PLC has no master control
Process data transferred via PROFIdrive is rejected – i.e. it is assumed to be zero.</td></tr>
<tr><td colspan="4">Note:
This bit should only be set to “1” after a feedback signal was received via PROFIdrive using ZSW1.9 = “1”.</td></tr>
<tr><td rowspan="2">11</td><td rowspan="2">Start referencing</td><td>1</td><td>Start referencing</td><td rowspan="2">BI: p2595</td></tr>
<tr><td>0</td><td>Stop referencing</td></tr>
<tr><td>12</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>13</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>14</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>15</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
</table>

STW2 (control word 2)

See function diagram [2444]

Table 4-7 Description STW2 (control word 2)

Bit	Meaning	Comments		BICO
0	Drive data set selection DDS bit 0	–	Drive data set selection (5-bit counter) For more information about data sets, see 9.2.	BI: p0820[0]
1	Drive data set selection DDS bit 1	–		BI: p0821[0]
2	Drive data set selection DDS bit 2	–		BI: p0822[0]
3	Drive data set selection DDS bit 3	–		BI: p0823[0]
4	Drive data set selection DDS bit 4	–		BI: p0824[0]
5...6	Reserved			
7	Parking axis	1	Request parking axis (handshake with ZSW2 bit 7)	BI: p0897
		0	No request	
8	Travel to fixed stop	1	Select “Travel to fixed stop” The signal must be set before the fixed stop is reached.	BI: p1545
		1/0	Deselect “Travel to fixed stop”. The edge is necessary in order to move away from the fixed stop, i.e. upon direction reversal.	
9 10	Reserved	–	–	–
11	Motor changeover/selection	0/1	Motor switchover complete	BI: p0828[0]
		0	No effect	
12	Master sign-of-life bit 0	–	User data integrity (4-bit counter)	CI: p2045
13	Master sign-of-life bit 1	–		
14	Master sign-of-life bit 2	–		
15	Master sign-of-life bit 3	–		

E_STW1 (control word for INFEED)

See function diagram [8920]

Table 4-8 Description E_STW1 (control word for INFEED)

Bit	Meaning	Comments		BICO
0	ON/OFF1	0/1	ON Pulse enable possible	BI: p0840
		0	OFF1 Reduce DC link voltage via ramp (p3566), then pulse inhibit/line contactor open	
1	OFF2	1	No OFF2 Enable possible	BI: p0844
		0	OFF2 Immediate pulse cancellation and power-on inhibit	
	Note: Control signal OFF2 is generated by ANDing BI: p0844 and BI: p0845.			
2	Reserved	–	–	–
3	Enable operation	1	Enable operation Pulse enable is present	BI: p0852
		0	Inhibit operation Pulse inhibit is present	
4	Reserved	–	–	–
5	Inhibit motor operation	1	Inhibit motor operation Motoring operation as step-up converter is inhibited.	BI: p3532
		0	Enable motoring operation Motoring operation as step-up converter is enabled.	
	Note: When “Inhibit motoring operation” is present, power can still be taken from the DC link. The DC link voltage is then no longer controlled. The voltage level is the same as the rectified value of the current line voltage.			
6	Inhibit regenerating	1	Inhibit regenerating Regenerative operation is inhibited.	BI: p3533
		0	Enable regenerative operation Regenerative operation is enabled.	
	Note: If regenerative operation is inhibited and power is fed to the DC link (e.g. by braking the motor), the DC link voltage increases (F30002).			
7	Acknowledge error	0/1	Acknowledge error	BI: p2103
	Note: Acknowledgement is realized with a 0/1 edge via BI: p2103 or BI: p2104 or BI: p2105.			

Table 4-8 Description E_STW1 (control word for INFEED), continued

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Comments</th><th>BICO</th></tr>
<tr><td>8
9</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Master ctrl by PLC</td><td>1</td><td>Master ctrl by PLC
This signal must be set so that the process data transferred via PROFIdrive is accepted and becomes effective.</td><td rowspan="2">BI: p0854</td></tr>
<tr><td>0</td><td>PLC has no master control
Process data transferred via PROFIdrive is rejected – i.e. it is assumed to be zero.</td></tr>
<tr><td colspan="4">Note:
This bit should only be set to “1” after a feedback signal was received via PROFIdrive using ZSW1.9 = “1”.</td></tr>
<tr><td>11
12
13
14
15</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
</table>

SATZANW (positioning mode, p0108.4 = 1)

See function diagram [2476]

Table 4-9 Description SATZANW (positioning mode, p0108.4 = 1)

Bit	Meaning	Comments		BICO
0	1 = block selection, bit 0 (2^0)	Block selection Traversing block 0 to 63		BI: p2625
1	1 = block selection, bit 1 (2^1)			BI: p2626
2	1 = block selection, bit 2 (2^2)			BI: p2627
3	1 = block selection, bit 3 (2^3)			BI: p2628
4	1 = block selection, bit 4 (2^4)			BI: p2629
5	1 = block selection, bit 5 (2^5)			BI: p2630
6 ... 14	Reserved	–	–	–
15	Activate MDI	1	Activate MDI	p2647
		0	De-activate MDI	
Note: See also: Function Manual, Chapter Basic Positioner				

PosSTW (positioning mode, p0108.4 = 1)

See function diagram [2477]

Table 4-10 Description PosSTW (positioning mode, p0108.4 = 1)

Bit	Meaning	Comments		BICO
0	Tracking mode	1	Activate tracking mode	BI: 2655
		0	Tracking mode de-activated	
1	Set reference point	1	Set reference point	BI: 2696
		0	Do not set reference point	
2	Reference cam	1	Reference cam active	BI: 2612
		0	Reference cam not active	
3 4	Reserved	–	–	–
5	Jogging, incremental	1	Jogging incremental active	BI: 2591
		0	Jogging velocity active	
6 ... 15	Reserved	–	–	–
Note: See also: Function Manual, Chapter Basic Positioner				

NSOLL_A (speed setpoint A (16 bit))

- Speed setpoint with a 16-bit resolution with sign bit.
- Bit 15 determines the sign of the setpoint:
  - Bit = 0 —> positive setpoint
  - Bit = 1 —> negative setpoint
- The speed is normalized via p2000.

  NSOLL_A = 4000 hex or 16384 dec ≙ speed in p2000

NSOLL_B (speed setpoint B (32 bit))

- Speed setpoint with a 32-bit resolution with sign bit.
- Bit 31 determines the sign of the setpoint:
  - Bit = 0 —> positive setpoint
  - Bit = 1 —> negative setpoint
- The speed is normalized via p2000.

  NSOLL_B = 4000 0000 hex or 1 073 741 824 dec ≙ speed in p2000

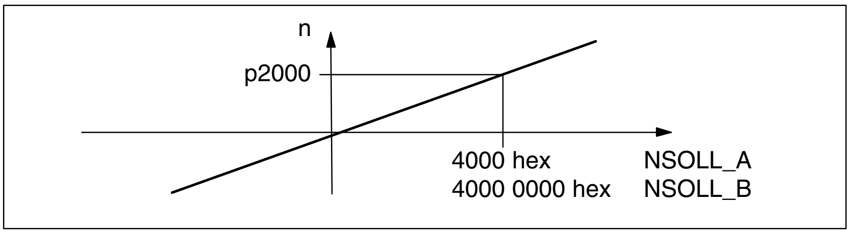


Fig. 4-3 Normalization of speed

Gn_STW (encoder n control word)

This process data belongs to the encoder interface and is described in Subsection 4.2.5.

XERR (position deviation)

The position deviation for dynamic servo control (DSC) is transmitted via this setpoint.

The format of XERR is identical to the format of G1_XIST1 (see Subsection 4.2.5).

KPC (position controller gain factor)

In dynamic servo control (DSC), the position controller gain factor is transmitted via this setpoint.

Transmission format: KPC is transmitted in the unit 0.001 1/s

Value range: 0 to 4000.0

Special case: When KPC = 0, the “DSC” function is deactivated.

Example:

A2C2A hex ≙ 666666 dec ≙ KPC = 666.666 1/s ≙ KPC = 40 1000/min

MDIPos (pos MDI position)

This process data specifies the position for MDI blocks.
Normalization: 1 corresponds to 1 LU

MDIVel (pos MDI velocity)

This process data specifies the velocity for MDI blocks.
Normalization: 1 corresponds to 1000 LU/min

MDIAcc (pos MDI acceleration)

This process data specifies the acceleration for MDI blocks.
Normalization: 4000 hex (16384 dec) corresponds to 100 %
Internally, the value is limited to 0.1 ... 100 %

MDIDec (pos MDI deceleration override)

This process data specifies the percentage value for the deceleration override for MDI blocks.
Normalization: 4000 hex (16384 dec) corresponds to 100 %
Internally, the value is limited to 0.1 ... 100 %

MDIMode (pos MDI mode)

This process data specifies the mode for MDI blocks.

Prerequisite: p2654 > 0
MDIMode = xx0x hex –> Absolute
MDIMode = xx1x hex –> Relative
MDIMode = xx2x hex –> Abs_pos (only for modulo correction)
MDIMode = xx3x hex –> Abs_neg (only for modulo correction)

Over (pos velocity override)

This process data specifies the percentage value for the velocity override.
Normalization: 4000 hex (16384 dec) corresponds to 100 %.
Value range: 0 ... 7FFF hex
Values outside this range are interpreted as 0 %.

MOMRED (torque reduction)

This setpoint can be used to reduce the torque limit currently active on the drive.

When you use manufacturer-specific PROFIdrive telegrams with the MOMRED control word, the signal flow is automatically interconnected up to the point where the torque limit is scaled.

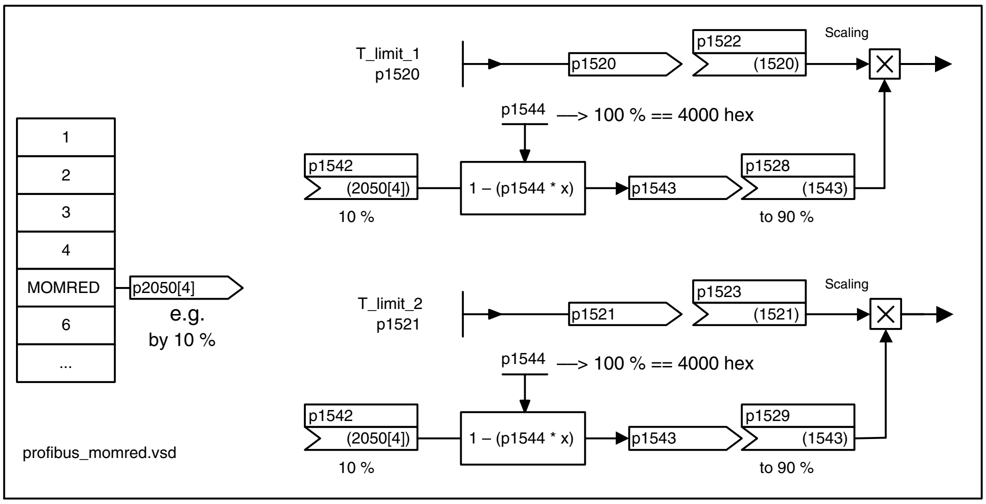


Fig. 4-4 MOMRED setpoint

MOMRED specifies the percentage by which the torque limit is to be reduced. This value is converted internally to the amount by which the torque is to be reduced and normalized via p1544.

MT_STW
CU_STW
A_DIGITAL

This process data is part of the central process data and is described in Subsection 4.2.6.

4.2.4 Description of status words and actual values

Note

This chapter describes the assignment and meaning of the process data in SINAMICS interface mode (p2038 = 0).

The reference parameter is also specified for the relevant process data. The process data is generally normalized in accordance with parameters p2000 to r2004.

Further, the following normalization applies:
A temperature of 100 °C corresponds to 100%
An electrical angle of 90° also corresponds to 100%.
For additional information, refer to Section 9.4.

Overview of status words and actual values

Table 4-11 Overview of status words and actual values

Abbreviation	Name	Signal number	Data type 1)	Remark
ZSW1	Status word 1	2	U16	r2089[0] (bit serial)2)
ZSW2	Status word 2	4	U16	r2089[1] (bit serial)2)
NIST_A	Speed setpoint A (16 bit)	6	I16	r0063 (servo) r0063[0] (vector)
NIST_B	Speed setpoint B (32 bit)	8	I32	r0063 (servo) r0063[0] (vector)
G1_ZSW	Encoder 1 status word	10	U16	r0481[0]
G1_XIST1	Encoder 1 actual position 1	11	U32	r0482[0]
G1_XIST2	Encoder 1 actual position 2	12	U32	r0483[0]
G2_ZSW	Encoder 2 status word	14	U16	r0481[1]
G2_XIST1	Encoder 2 actual position 1	15	U32	r0482[1]
G2_XIST2	Encoder 2 actual position 2	16	U32	r0483[1]
G3_ZSW	Encoder 3 status word	18	U16	r0481[2]
G3_XIST1	Encoder 3 actual position 1	19	U32	r0482[2]
G3_XIST2	Encoder 3 actual position 2	20	U32	r0483[2]
E_DIGITAL	Digital inputs	21	U16	r2089[2]
IAIST_GLATT	Absolute actual current smoothed	51	I16	r0068[1]
ITIST_GLATT	Current actual value, torque-generating	52	I16	r0078[1]
MIST_GLATT	Actual torque smoothed	53	I16	r0080[1]
PIST_GLATT	Power factor, smoothed	54	I16	r0082[1]
NIST_A_GLATT	Actual speed smoothed	57	U16	r0063[1]
MELD_ NAMUR	VIK-NAMUR message bit bar	58	U16	r3113

Table 4-11 Overview of status words and actual values, continued

Abbreviation	Name	Signal number	Data type 1)	Remark
MELDW	Message word	102	U16	r2089[2] (bit serial)2)
MSOLL_GLATT	Total speed setpoint	120	I16	r00079[1]
AIST_GLATT	Torque utilization	121	I16	r0081
MT_ZSW	Status word for probe	131	U16	r0688
MT1_ZS_F	Probe 1 measuring time, falling edge	132	U16	r0687[0]
MT1_ZS_S	Probe 1 measuring time, rising edge	133	U16	r0686[0]
MT2_ZS_F	Probe 1 measuring time, falling edge	134	U16	r0687[1]
MT2_ZS_S	Probe 2 measuring time, rising edge	135	U16	r0686[1]
AKTSATZ	Pos selected block	202	U16	r2670
PosZSW	Pos status word	204	U16	r2683
XistP	Pos position actual value	206	U16	r2521
FAULT_CODE	Fault code	301	U16	r2131
WARN_CODE	Alarm code	303	U16	r2132
E_ZSW1	Status word for INFEED	321	U16	r899, r2139 (bit serial)2)
CU_ZSW	Control word for Control Unit (CU)	501	U16	r2089[1]

1) Data type to PROFIdrive Profile V4:
I16 = Integer16, I32 = Integer32, U16 = Unsigned16, U32 = Unsigned32
2) Bitwise interconnection: Refer to the following pages, r2089 via binector-connector converter

ZSW1 (status word 1)

See function diagram [2452]

Table 4-12 Description of ZSW1 (status word 1)

Bit	Meaning	Comments		BICO
0	Ready to power-up	1	Ready to power-up Power supply on, electronics initialized, line contactor released if necessary, pulses inhibited.	BO: r0899.0
		0	Not ready to power-up	
1	Ready to operate	1	Ready to operate Voltage at Line Module (i.e. line contactor closed (if used)), field being built up.	BO: r0899.1
		0	Not ready Cause: No ON command has been issued.	

Table 4-12 Description of ZSW1 (status word 1), continued

Bit	Meaning	Comments		BICO
2	Operation enabled	1	Operation enabled Enable electronics and pulses, then ramp up to active setpoint.	BO: r0899.2
		0	Operation inhibited	
3	Fault active	1	Fault active The drive is faulty and is, therefore, out of service. The drive switches to Power-on inhibit once the fault has been acknowledged and the cause has been remedied. The active faults are stored in the fault buffer.	BO: r2193.3
		0	No fault present There is no active fault in the fault buffer.	
4	Coasting active (OFF2)	1	No OFF2 active	BO: r0899.4
		0	Coasting active (OFF2) An OFF2 command is present.	
5	Fast stop active (OFF3)	1	No OFF3 active	BO: r0899.5
		0	Fast stop active (OFF3) An OFF3 command is present.	
6	Power-up inhibit	1	Power-up inhibit A restart is only possible through OFF1 followed by ON.	BO: r0899.6
		0	No power-up inhibit Power-up is possible.	
7	Alarm present	1	Alarm present The drive is operational again. No acknowledgement necessary. The active alarms are stored in the alarm buffer.	BO: r2139.7
		0	No alarm present No active alarm is present in the alarm buffer.	
8	Speed setpoint– actual value deviation within the tolerance bandwidth	1	Setpoint/actual value monitoring within tolerance bandwidth Actual value within tolerance band; dynamic overshoot or shortfall permitted for $t < t_{max}$, e.g. $n = n_{setp} \pm$ $f = f_{setp} \pm$, etc., t_{max} is parameterizable	BO: r2197.7
		0	Setpoint/actual value monitoring not within tolerance band	

Table 4-12 Description of ZSW1 (status word 1), continued

Bit	Meaning	Comments		BICO
9	Control requested	1	Control from the PLC The programmable logic controller is requested to assume control. Condition for applications with isochronous mode: drive synchronized with PLC system.	BO: r0899.9
		0	Local operation Control only possible on device	
10	f or n comparison value reached or exceeded	1	f or n comparison value reached or exceeded	BO: r2199.1
		0	f or n comparison value not reached	
	Note: The message is parameterized as follows: p2141 Threshold value p2142 Hysteresis			
11	I, M or P limit reached or exceeded	1	I, M or P limit not reached	BO: r1407.7 (inverted)
		0	I, M or P limit reached or exceeded	
12	Holding brake open	1	Holding brake open	BO: r0899.12
		0	Holding brake closed	
13	No motor overtemperature alarm	1	Motor overtemperature alarm not active	BO: r2135.14 (inverted)
		0	Motor overtemperature alarm active	
14	n_act >= 0	1	Actual speed value > = 0	BO: r2197.3
		0	Actual speed value < 0	
15	Alarm, drive converter thermal overload	1	No alarm present	BO: r2135.15 (inverted)
		0	Alarm, drive converter thermal overload The alarm for the overtemperature of the drive converter is present.	

ZSW1 (status word 1), positioning mode, p0108.4 = 1

See function diagram [2479]

Table 4-13 Description, ZSW1 (status word 1, positioning mode)

Bit	Meaning	Comments		BICO
0	Ready to power-up	1	Ready to power-up Power supply on, electronics initialized, line contactor released if necessary, pulses inhibited.	BO: r0899.0
		0	Not ready to power-up	

Table 4-13 Description, ZSW1 (status word 1, positioning mode), continued

Bit	Meaning	Comments		BICO
1	Ready to operate	1	Ready to operate Voltage at Line Module (i.e. line contactor closed (if used)), field being built up.	BO: r0899.1
		0	Not ready Cause: No ON command has been issued.	
2	Operation enabled	1	Operation enabled Enable electronics and pulses, then ramp up to active setpoint.	BO: r0899.2
		0	Operation inhibited	
3	Fault active	1	Fault active The drive is faulty and is, therefore, out of service. The drive switches to Power-on inhibit once the fault has been acknowledged and the cause has been remedied. The active faults are stored in the fault buffer.	BO: r2193.3
		0	No fault present There is no active fault in the fault buffer.	
4	Coasting active (OFF2)	1	No OFF2 active	BO: r0899.4
		0	Coasting active (OFF2) An OFF2 command is present.	
5	Fast stop active (OFF3)	1	No OFF3 active	BO: r0899.5
		0	Fast stop active (OFF3) An OFF3 command is present.	
6	Power-up inhibit	1	Power-up inhibit A restart is only possible through OFF1 followed by ON.	BO: r0899.6
		0	No power-up inhibit Power-up is possible.	
7	Alarm present	1	Alarm present The drive is operational again. No acknowledgement necessary. The active alarms are stored in the alarm buffer.	BO: r2139.7
		0	No alarm present No active alarm is present in the alarm buffer.	
8	Following error within the tolerance range	1	Setpoint/actual value monitoring within tolerance bandwidth Actual value within a tolerance bandwidth; The tolerance bandwidth can be parameterized.	BO: r2684.8
		0	Setpoint/actual value monitoring not within tolerance band	

Table 4-13 Description, ZSW1 (status word 1, positioning mode), continued

Bit	Meaning	Comments		BICO
9	Control requested	1	Control from the PLC The programmable logic controller is requested to assume control. Condition for applications with isochronous mode: drive synchronized with PLC system.	BO: r0899.9
		0	Local operation Control only possible on device	
10	Target position reached	1	Target position is reached	BO: r2684.10
		0	Target position not reached	
11	Reference point set	1	Reference point is set	BO: r2684.11
		0	Reference point is not set	
12	Acknowledgement, traversing block activated	0/1	Acknowledgement, traversing block	BO: r2684.12
		0	No effect	
13	Drive at standstill	1	Drive at standstill	BO: r2199.0
		0	Drive not stationary	
14 15	Reserved	–	–	–

ZSW2 (status word 2)

See function diagram [2454]

Table 4-14 Description of ZSW2 (status word 2)

Bit	Meaning	Comments		BICO
0	DDS eff., bit 0	–	Drive data set effective (5-bit counter) For more information about data sets, see 9.2.	BO: r0051.0
1	DDS eff., bit 1	–		BO: r0051.1
2	DDS eff., bit 2	–		BO: r0051.2
3	DDS eff., bit 3	–		BO: r0051.3
4	DDS eff., bit 4	–		BO: r0051.4
5...6	Reserved	–	–	–
7	Parking axis	1	Axis parking active	BO: r0896.0
		0	Axis parking not active	
8	Travel to fixed stop	1	Travel to fixed stop	BO: r1406.8
		0	No travel to fixed stop	
9 10	Reserved	–	–	–
11	Data set changeover	1	Data record changeover active	BO: r0835.0
		0	No data set changeover active	
12	Slave sign-of-life bit 0	–	User data integrity (4-bit counter)	Implicitly inter-connected
13	Slave sign-of-life bit 1	–		
14	Slave sign-of-life bit 2	–		
15	Slave sign-of-life bit 3	–		

NIST_A (actual speed value A (16-bit))

- Actual speed value with 16-bit resolution.
- The speed actual value is normalized in the same way as the setpoint (see NSOLL_A).

NIST_B (speed actual value B (32-bit))

- Actual speed value with 32-bit resolution.
- The speed actual value is normalized in the same way as the setpoint (see NSOLL_B).

Gn_ZSW (encoder n status word)
Gn_XIST1 (encoder n position actual value 1)
Gn_XIST2 (encoder n position actual value 2)

This process data belongs to the encoder interface and is described in Subsection 4.2.5.

ITIST_GLATT

The actual current value smoothed with p0045 is displayed.

MELDW (message word)

See function diagram [2456]

Table 4-15 Description of MELDW (message word)

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Comments</th><th>BICO</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Ramp-up/ramp-down completed/ramp-function generator active</td><td>1</td><td>Ramp-up/ramp-down completed
The ramp-up procedure is completed once the speed setpoint has been changed.</td><td rowspan="4">BO:
r2199.5</td></tr>
<tr><td>1/0</td><td>Ramp-up starts
The start of the ramp-up procedure is detected as follows:
• The speed setpoint changes
and
• The defined tolerance bandwidth (p2164) is exited.</td></tr>
<tr><td>0</td><td>Ramp-function generator active
The ramp-up procedure is still active once the speed setpoint has been changed.</td></tr>
<tr><td>0/1</td><td>Ramp-up procedure completed
The ramp-up procedure is complete when:
• The speed setpoint is constant
and
• The actual speed value is within the tolerance bandwidth and has reached the speed setpoint
and
• The waiting time (p2166) has elapsed.</td></tr>
</table>

Table 4-15 Description of MELDW (message word), continued

Bit	Meaning	Comments		BICO
1	Torque utilization < p2194	1	Torque utilization < p2194 The current torque utilization is less than the set torque utilization threshold (p2194). or Ramp-up is not yet complete.	BO: r2199.11
		0	Torque utilization > p2194 The current torque utilization is greater than the set torque utilization threshold (p2194).	
	Application: This message indicates that the motor is overloaded and appropriate measures need to be taken to rectify the situation (e.g. stop the motor or reduce the load).			
2	$\lvert n\_act \rvert$ < p2161	1	$\lvert n\_act \rvert$ < p2161 The actual speed value is less than the set threshold value (p2161).	BO: r2199.0
		0	$\lvert n\_act \rvert$ ≥ p2161 The actual speed value is greater than or the same as the set threshold value (p2161).	
	Note: The message is parameterized as follows: p2161 Threshold value p2150 Hysteresis **Application:** To protect the mechanics, the gear stages are not switched mechanically until the speed is less than the set threshold value.			
3	$\lvert n\_act \rvert$ ≤ p2155	1	$\lvert n\_act \rvert$ ≤ p2155 The actual speed value is less than or the same as the set threshold value (p2155).	BO: r2197.1
		0	$\lvert n\_act \rvert$ > p2155 The actual speed value is greater than the set threshold value (p2155).	
	Note: The message is parameterized as follows: p2155 Threshold value p2140 Hysteresis **Application:** Speed monitoring			
4	Reserved	1	–	–
		0	–	

Table 4-15 Description of MELDW (message word), continued

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Comments</th><th>BICO</th></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Reserved</td><td>1</td><td>–</td><td rowspan="2">–</td></tr>
<tr><td>0</td><td>–</td></tr>
<tr><td rowspan="3">6</td><td rowspan="2">No motor overtemperature alarm</td><td>1</td><td>No motor overtemperature alarm
The temperature of the motor is within the permissible range.</td><td rowspan="2">BO:
r2135.14
(inverted)</td></tr>
<tr><td>0</td><td>Alarm, motor overtemperature
The temperature of the motor is greater than the set motor temperature threshold (p0604).</td></tr>
<tr><td colspan="4">Note:
• When the motor temperature threshold is exceeded, only an alarm is output initially to warn you of this. The alarm is canceled automatically when the temperature no longer exceeds the alarm threshold.
• If the overtemperature is present for longer than the value set via p0606, a fault is output to warn you of this.
• Motor temperature monitoring can be switched-out via p0600 = 0.
Application:
The user can respond to this message by reducing the load, thereby preventing the motor from shutting down with the “Motor temperature exceeded” fault after the set time has elapsed.</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">No thermal overload in power section alarm</td><td>1</td><td>No thermal overload in power section alarm
The temperature of the heat sink in the power section is within the permissible range.</td><td rowspan="2">BO:
r2135.15
(inverted)</td></tr>
<tr><td>0</td><td>Thermal overload in power section alarm
The temperature of the heat sink in the power section is outside the permissible range.
If the overtemperature remains, the drive switches itself off after approx. 20 s.</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Speed setp – act val deviation in tolerance t_on</td><td>1</td><td>The absolute value of the speed setpoint – actual value deviation is within the tolerance p2163: The signal is switched-in with a delay specified in p2167.</td><td rowspan="2">BO:
r2199.4</td></tr>
<tr><td>0</td><td>The actual speed setpoint/actual deviation is outside the tolerance.</td></tr>
<tr><td rowspan="2">9
...
12</td><td rowspan="2">Reserved</td><td>1</td><td>–</td><td rowspan="2">–</td></tr>
<tr><td>0</td><td>–</td></tr>
<tr><td rowspan="3">13</td><td rowspan="2">Pulses enabled</td><td>1</td><td>Pulses enabled
The pulses for activating the motor are enabled.</td><td rowspan="2">BO:
r0899.11</td></tr>
<tr><td>0</td><td>Pulses inhibited</td></tr>
<tr><td colspan="4">Application:
Armature short-circuit protection must only be switched on when the pulses are inhibited.
This signal can be evaluated as one of many conditions when armature short-circuit protection is activated.</td></tr>
</table>

Table 4-15 Description of MELDW (message word), continued

Bit	Meaning	Comments		BICO
14 15	Reserved	1	–	–
		0	–	

MSOLL_GLATT

The torque setpoint smoothed with p0045 is displayed.

AIST_GLATT

The torque utilization smoothed with p0045 is displayed.

E_DIGITAL
MT_STW
MT_n_ZS_F/MT_n_ZS_S
CU_ZSW

This process data is part of the central process data and is described in Subsection 4.2.6.

IAIST_GLATT

The actual current value smoothed with p0045 is displayed.

MIST_GLATT

The actual torque value smoothed with p0045 is displayed.

PIST_GLATT

The power factor smoothed with p0045 is displayed.

MELD_NAMUR

Display of the NAMUR message bit bar

WARN_CODE

Display of the alarm code (see function diagram 8066)

FAULT_CODE

Display of the alarm code (see function diagram 8060)

E_ZSW1 (status word for INFEED)

See function diagram [8926]

Table 4-16 Description of E_ZSW1 (status word for E_INF)

Bit	Meaning	Comments		BICO
0	Ready to power-up	1	Ready to power-up	BO: r0899.0
		0	Not ready to power-up	
1	Ready to operate	1	Ready to operate DC link pre-charged, pulses inhibited	BO: r0899.1
		0	Not ready	
2	Operation enabled	1	Operation enabled Vdc = Vdc_setp	BO: r0899.2
		0	Operation inhibited	
3	Fault active	1	Fault active	BO: r2139.3
		0	No fault	
4	No OFF2 active	1	No OFF2 active	BO: r0899.4
		0	OFF2 active	
5	Reserved	–	–	–
6	Power-up inhibit	1	Power-up inhibit Fault active	BO: r0899.6
		0	No power-up inhibit	
7	Alarm present	1	Alarm present	BO: r2139.7
		0	No alarm	
8	Reserved	–	–	–
9	Control requested	1	Control from the PLC The programmable logic controller is requested to assume control. Condition for applications with isochronous mode: drive synchronized with PLC system.	BO: r0899.9
		0	Local operation Control only possible on device	
10	Reserved	–	–	–
11	Bypass energized	1	Bypass energized Pre-charging is complete and the bypass relay for the pre-charging resistors is energized.	BO: r0899.11
		0	Bypass not energized Pre-charging not yet complete	
12	Line contactor activated	1	Line contactor activated	BO: r0899.12
		0	Line contactor not energized	

Table 4-16 Description of E_ZSW1 (status word for E_INF), continued

Bit	Meaning	Comments		BICO
13 14 15	Reserved	–	–	–

PosZSW

See function diagram [3645]

Table 4-17 Description PosZSW (status word positioning operation)

Bit	Meaning	Comments		BICO
0	Tracking mode active	1	Tracking mode active	BO: r2683.0
		0	Tracking mode not active	
1	Velocity limiting active	1	Active	BO: r2683.1
		0	Not active	
2	Setpoint static	1	Setpoint static	BO: r2683.2
		0	Setpoint not static	
3	Reserved	–	–	–
4	Axis moves forwards	1	Axis moves forwards	BO: r2683.4
		0	Axis stationary or moving backwards	
5	Axis moving backwards	1	Axis moving backwards	BO: r2683.5
		0	Axis stationary or moving forwards	
6	Minus software limit switch actuated	1	Minus SW limit switch actuated	BO: r2683.6
		0	Minus SW limit switch not actuated	
7	Plus software limit switch actuated	1	Plus SW limit switch actuated	BO: r2683.7
		0	Plus SW limit switch not actuated	
8	Position actual value <= cam switching position 1	1	Position actual value <= cam switching position 1	BO: r2683.8
		0	Cam switching position 1 passed	
9	Position actual value <= cam switching position 2	1	Position actual value <= cam switching position 2	BO: r2683.9
		0	Cam switching position 2 passed	
10	Direct output 1 via the traversing block	1	Direct output 1 active	BO: r2683.10
		0	Direct output 1 not active	
11	Direct output 2 via the traversing block	1	Direct output 1 active	BO: r2683.11
		0	Direct output 1 not active	
12 ... 15	Reserved	–	–	–

AktSatz

See function diagram [3650]

Table 4-18 Description AktSatz (active traversing block/MDI active)

Bit	Meaning	Comments		BICO
0	Active traversing block, bit 0	–	Active traversing block (6-bit counter)	BO: r2670.0
1	Active traversing block, bit 1	–		BO: r2670.1
2	Active traversing block, bit 2	–		BO: r2670.2
3	Active traversing block, bit 3	–		BO: r2670.3
4	Active traversing block, bit 4	–		BO: r2670.4
4	Active traversing block, bit 5	–		BO: r2670.5
5..14	Reserved	–	–	–
15	MDI active	1	MDI active	BO: r2670.15
		0	MDI not active	

XistP

Displays the position actual value
Normalization: 1 corresponds to 1 LU

4.2.5 Control and status words for encoders

Description

The process data for the encoders is available in various telegrams. For example, telegram 3 is provided for speed control with 1 position encoder and transmits the process data of encoder 1.

The following process data is available for the encoders:

- Gn_STW Encoder n control word (n = 1, 2, 3)
- Gn_ZSW Encoder n status word
- Gn_XIST1 Encoder n position actual value 1
- Gn_XIST2 Encoder n position actual value 2

Note

Encoder 1: Motor encoder

Encoder 2: Direct measuring system

Encoder 3: Additional measuring system
Encoder 3 can be connected via p2079 and extension of the standard telegrams.

Example of encoder interface

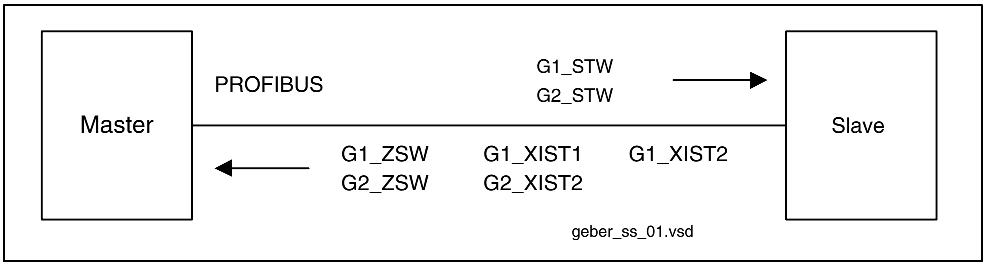


Fig. 4-5 Example for encoder interface (encoder –1: two actual values, encoder –2: one actual value)

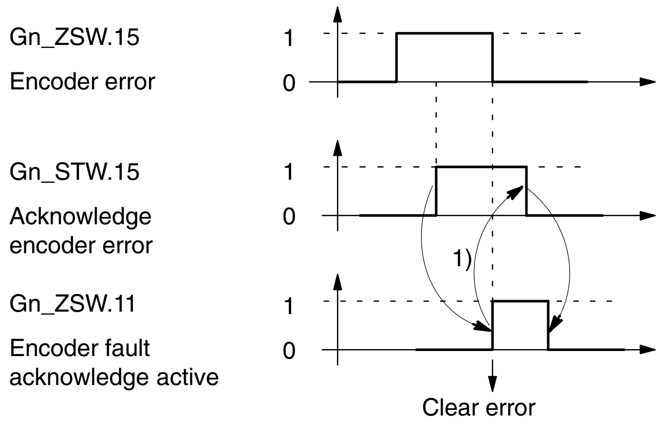
Encoder n control word (Gn_STW, n = 1, 2, 3)

The encoder control word controls the encoder functions.

Table 4-19 Description of the individual signals in Gn_STW

<table>
<tr><th>Bit</th><th colspan="2">Name</th><th colspan="2">Signal state: description</th></tr>
<tr><td>0</td><td rowspan="8">Find reference mark
or
flying measurement</td><td rowspan="4">Functions</td><td colspan="2" rowspan="4">If bit 7 = 0, then find reference mark request applies:
Bit Meaning
0 Function 1 Reference marker 1
1 Function 2 Reference marker 2
2 Function 3 Reference marker 3
3 Function 4 Reference marker 4
If bit 7 = 1, then flying measurement request applies:
Bit Meaning
0 Function 1 Measuring input 1 rising edge
1 Function 2 Measuring input 1 falling edge
2 Function 3 Measuring input 2 rising edge
3 Function 4 Measuring input 2 falling edge
Note:
• Bit x = 1 Request function
Bit x = 0 Request no function
• The following applies if more than 1 function is activated:
The values for all functions cannot be read until each activated function has terminated and this has been confirmed in the corresponding status bit (ZSW.0/.1/.2/.3 “0” signal again).
• Find reference mark
It is possible to search for a reference marker.
• Equivalent zero mark
• Flying measurement
The positive and negative edge can be activated simultaneously.</td></tr>
<tr><td>1</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="3">Command</td><td colspan="2" rowspan="3">Bit 6, 5, 4 Meaning
000 –
001 Activate function x
010 Read value x
011 Abort function x
(x: function selected via bits 0 – 4)</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Mode</td><td>1</td><td>Measurement on-the-fly (fine resolution via p0418)</td></tr>
<tr><td>0</td><td>Find reference marker (fine resolution via p0418)</td></tr>
<tr><td>8
...
12</td><td colspan="2">Reserved</td><td colspan="2">–</td></tr>
</table>

Table 4-19 Description of the individual signals in Gn_STW, continued

Bit	Name	Signal state: description	
13	Request cyclic absolute value	1	Request cyclic transmission of the absolute position actual value in Gn_XIST2. Used for (e.g.): • Additional measuring system monitoring • Synchronization during ramp-up
		0	No request
14	Parking encoder	1	Request parking encoder (handshake with Gn_ZSW bit 14)
		0	No request
15	Acknowledge encoder error	0/1	Request to reset encoder errors  1) Signal must be reset by user
		0	No request

Example 1: Find reference mark

Assumptions for the example:

- Distance-coded reference mark
- Two reference markers (function 1/function 2)
- Position control with encoder 1

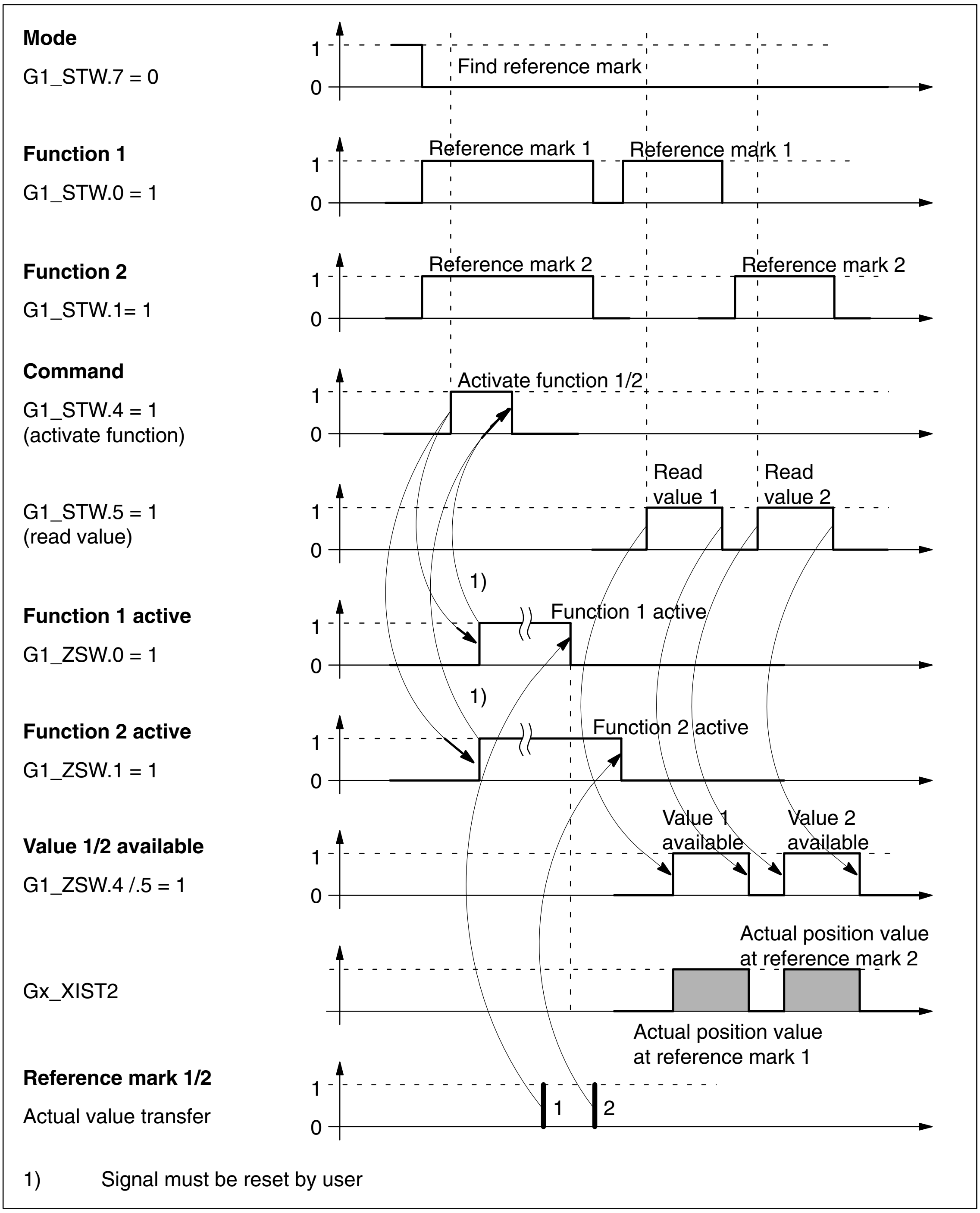


Fig. 4-6 Flowchart for “find reference mark”

Example 2: Measurement on-the-fly

Assumptions for the example:

- Measuring probe with rising edge (function 1)
- Position control with encoder 1

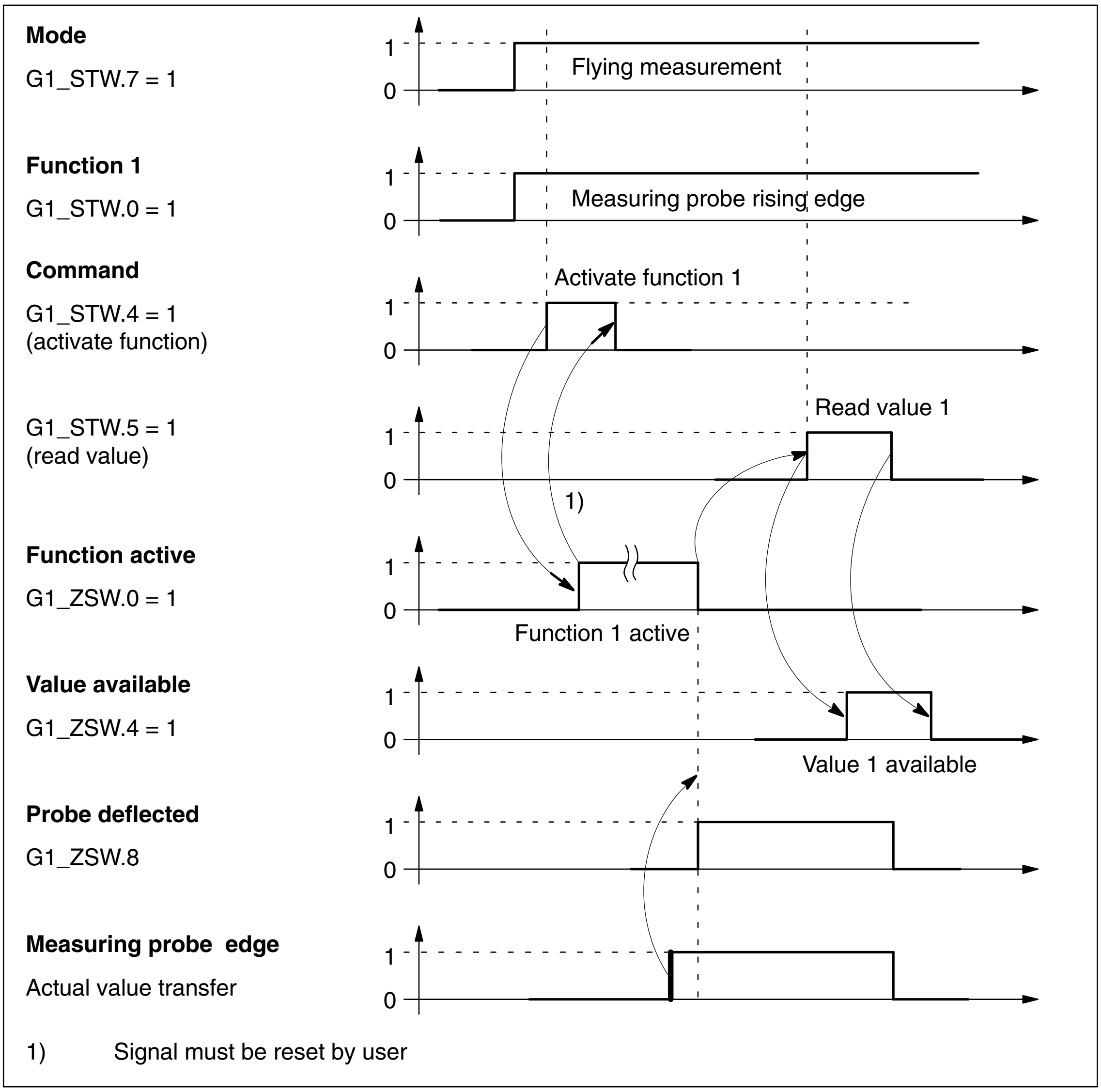


Fig. 4-7 Function chart for “measurement on-the-fly”

Encoder 2 control word (G2_STW)

- see G1_STW (Table 4-19)

Encoder 3 control word (G3_STW)

- see G1_STW (Table 4-19)

Encoder n status word (Gn_ZSW, n = 1, 2, 3)

The encoder status word is used to display states, errors and acknowledgements.

Table 4-20 Description of the individual signals in Gn_ZSW

Bit	Name		Signal state: description
0 1 2 3	Find reference mark or Flying measurement	**Status: Function 1 – 4 active**	Valid for find reference marker and measurement on-the-fly Bit Meaning 0 Function 1 Reference mark 1, Measuring probe 1 rising edge 1 Function 2 Reference mark 2, Measuring probe 1 falling edge 2 Function 3 Reference mark 3, Measuring probe 2 rising edge 3 Function 4 Reference mark 4, Measuring probe 2 falling edge **Note:** • Bit x = 1 Function active Bit x = 0 Function inactive

4
5
6
7
	Find reference mark or Flying measurement	**Status: Value 1 – 4 available**	Valid for find reference marker and measurement on-the-fly
			Bit Meaning
			4 Value 1 Reference mark 1, Measuring probe 1 rising edge
			5 Value 2 Measuring probe 1 falling edge
			6 Value 3 Measuring probe 2 falling edge
			7 Value 4 Measuring probe 2 falling edge
			Note:
			• Bit x = 1 Value available
			  Bit x = 0 Value not available
			• Only one value can be fetched at a time.
			  Reason: There is only one common status word Gn_XIST2 to read the values.
			• The probe must be configured to a “high-speed input” DI/DO on the Control Unit.

8	Find reference mark or Flying measurement	Probe 1 deflected	1 Probe deflected (high signal) 0 Probe not deflected (low signal)

Table 4-20 Description of the individual signals in Gn_ZSW, continued

Bit	Name	Signal state: description	
9	Probe 2 deflected	1	Probe deflected (high signal)
		0	Probe not deflected (low signal)
10	Reserved		–
11	Encoder fault acknowledge active	1	Encoder fault acknowledge active **Note:** see STW.15 (acknowledge encoder error)
		0	No acknowledgement active
12	Reserved		–
13	Transmit cyclic absolute value	1	Acknowledgement for Gn_STW.13 (request cyclic absolute value) **Note:** Cyclic transmission of the absolute value can be interrupted by a function with higher priority. —> see Fig. 4-9 —> See Gn_XIST2
		0	No acknowledgement
14	Parking encoder	1	Parking encoder active (i.e. parking encoder switched off)
		0	No active parking encoder
15	Encoder error	1	Error from encoder or actual-value sensing is active. **Note:** The error code is in Gn_XIST2
		0	No error is active.

Encoder 1 actual position value 1 (G1_XIST1)

- Resolution: encoder lines • 2^n

  n: fine resolution, no. of bits for internal multiplication

  The fine resolution is specified via p0418.
- Used to transmit the cyclic actual position value to the master.
- The transmitted value is a relative, free-running actual value.
- Any overflows must be evaluated by the master controller.

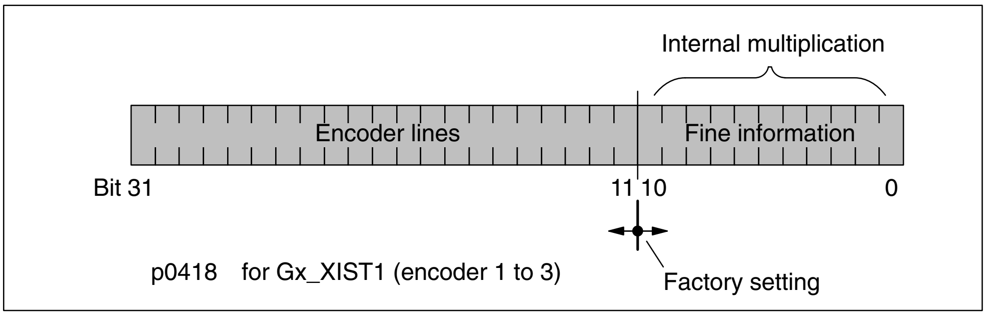


Fig. 4-8 Subdivision and settings for Gx_XIST1

- Encoder lines of incremental encoder
  - For encoders with sin/cos 1Vpp:

    Encoder lines = no. of sinusoidal signal periods
- After power-up: Gx_XIST1 = 0
- An overflow in Gx_XIST1 must be viewed by the master controller.
- There is no modulo interpretation of Gx_XIST1 in the drive.

Encoder 1 actual position value 2 (G1_XIST2)

Different values are entered in Gx_XIST2 depending on the function (see Fig. 4-9).

- Priorities for Gx_XIST2

  The following priorities should be considered for values in Gx_XIST2:

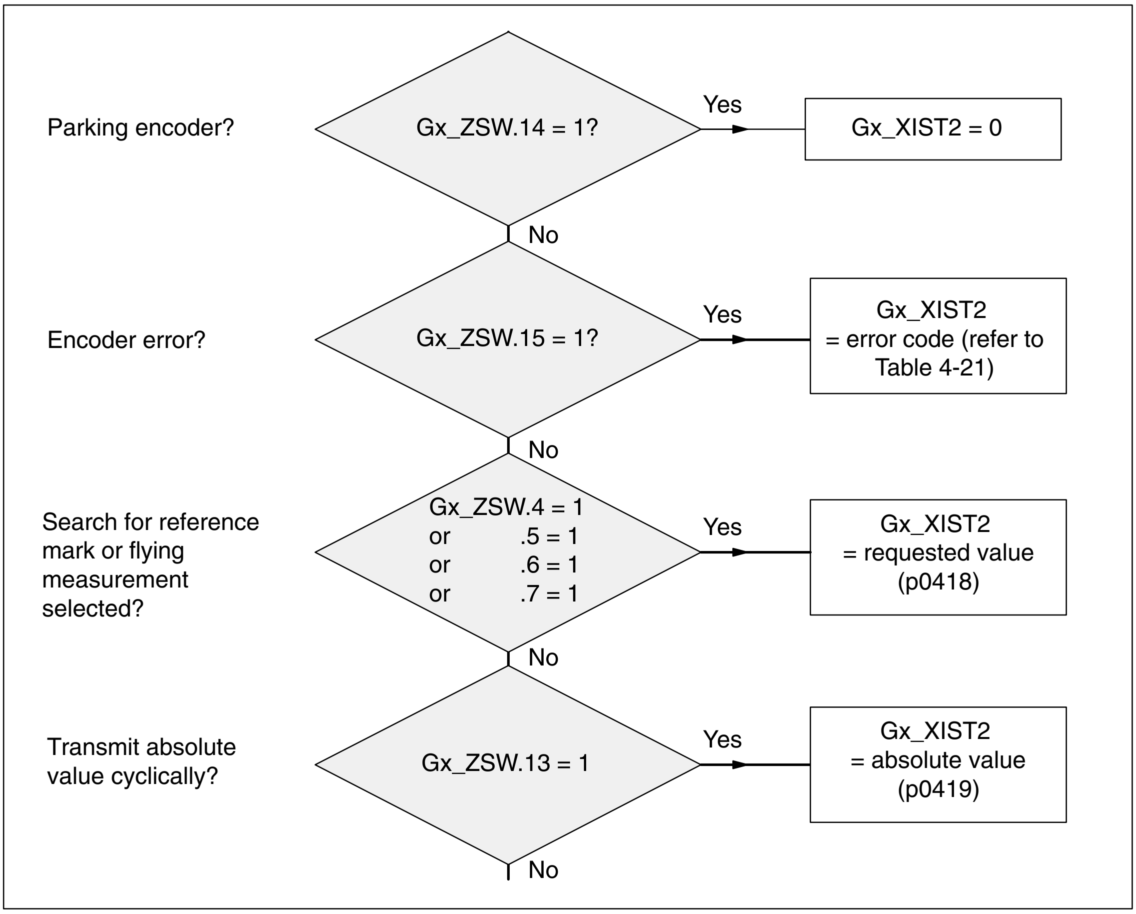


Fig. 4-9 Priorities for functions and Gx_XIST2

- Resolution: encoder lines • 2^n

  n: fine resolution, no. of bits for internal multiplication

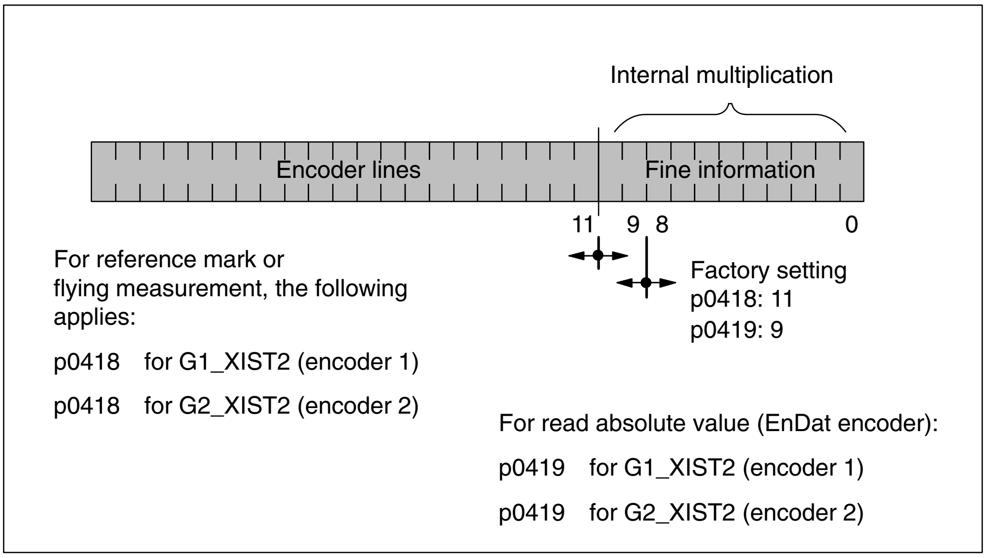


Fig. 4-10 Subdivision and settings for Gx_XIST2

- Encoder lines of incremental encoder
  - For encoders with sin/cos 1Vpp:

    Encoder lines = no. of sinusoidal signal periods

Error code in Gn_XIST2

Table 4-21 Error code in Gn_XIST2

n_XIST2	Meaning	Possible causes/description
1	Encoder error	One or more existing encoder faults. Detailed information in accordance with drive messages.
2	Zero marker monitoring	–
3	Abort parking sensor	• Parking drive object already selected
4	Abort find reference marker	• A fault exists (Gn_ZSW.15 = 1) • Encoder has no zero marker (reference marker) • Reference marker 2, 3 or 4 is requested • Switchover to “Measurement on-the-fly” during search for reference marker • Command “Read value x” set during search for reference marker • Inconsistent position measured value with distance-coded reference markers
5	Abort get reference value	• More than four values requested • No value requested • Requested value not available

Table 4-21 Error code in Gn_XIST2, continued

n_XIST2	Meaning	Possible causes/description
6	Abort, flying measurement	• No probe configured p0488, p0489 • Switchover to “Find reference marker” during measurement on-the-fly • Command “Read value x” set during measurement on-the-fly
7	Abort get measured value	• More than one value requested • No value requested • Requested value not available • Parking encoder active • Parking drive object active
8	Abort absolute value transmission on	• Absolute encoder not available • Alarm bit absolute value protocol set
3841	Function not supported	–

Encoder 2 status word (G2_ZSW)

- See G1_ZSW (Table 4-20)

Encoder 2 actual position value 1 (G2_XIST1)

- See G1_XIST1

Encoder 2 actual position value 2 (G2_XIST2)

- See G1_XIST2

Encoder 3 status word (G3_ZSW)

- See G1_ZSW (Table 4-20)

Encoder 3 actual position value 1 (G3_XIST1)

- See G1_XIST1

Encoder 3 actual position value 2 (G3_XIST2)

- See G1_XIST2

Function diagram overview (see List Manual)

- 4720 Encoder interface, receive signals, encoders n
- 4730 Encoder interface, send signals, encoders n
- 4735 Find reference marker with equivalent zero mark, encoders n
- 4740 Measuring probe evaluation, measured value memory, encoders n

Parameter overview (see List Manual)

Adjustable parameter drive, CU_S parameter is marked

- p0418[0...15] Fine resolution Gx_XIST1
- p0419[0...15] Fine resolution Gx_XIST2
- p0480[0...2] CI: Signal source for encoder control word Gn_STW
- p0488[0...2] Measuring probe 1 input terminal
- p0489[0...2] Measuring probe 2 input terminal
- p0490 Invert measuring probe (CU_S)

Visualization parameters drive

- r0481[0...2] CO: Encoder status word Gn_ZSW
- r0482[0...2] CO: Encoder position actual value Gn_XIST1
- r0483[0...2] CO: Encoder position actual value Gn_XIST2
- r0487[0...2] CO: Diagnostic encoder control word Gn_STW

4.2.6 Central control and status words

Description

The central process data exists for different telegrams. For example, telegram 391 is used for transferring measuring times and digital inputs/outputs.

The following central process data is available:

Receive signals:

- CU_STW Control Unit control word
- A_DIGITAL Digital outputs
- MT_STW Probe control word

Transmit signals:

- CU_ZSW Control Unit status word
- E_DIGITAL Digital inputs
- MT_ZSW Probe status word
- MTn_ZS_F Probe n measuring time, falling edge (n = 1, 2)
- MTn_ZS_S Probe n measuring time, rising edge (n = 1, 2)

CU_STW (control word for Control Unit, CU)

See function diagram [2448]

Table 4-22 Description CU_STW (control word for Control Unit)

Bit	Meaning	Comments		BICO
0	Synchronizations flag	–	This signal is used to synchronize the joint system time between the master and slave.	BI: p0681
1...6	Reserved	–	–	–
7	Acknowledging faults	0/1	Acknowledging faults	BI: p2103
8...11	Reserved	–	–	–
12	Master sign-of-life bit 0	–	Master sign of life	CI: p2045
13	Master sign-of-life bit 1	–		
14	Master sign-of-life bit 2	–		
15	Master sign-of-life bit 3	–		

A_DIGITAL (digital outputs)

This process data can be used to control the Control Unit outputs. See function diagram [2449].

Table 4-23 Description A_DIGITAL (digital outputs)

Bit	Meaning	Comments		BICO
0	Digital input/output 8 (DI/DO 8)	–	DI/DO 8 on the Control Unit must be parameterized as an output (p0728.8 = 1).	BI: p0738
1	Digital input/output 9 (DI/DO 9)	–	DI/DO 9 on the Control Unit must be parameterized as an output (p0728.9 = 1).	BI: p0739
2	Digital input/output 10 (DI/DO 10)	–	DI/DO 10 on the Control Unit must be parameterized as an output (p0728.10 = 1).	BI: p0740
3	Digital input/output 11 (DI/DO 11)	–	DI/DO 11 on the Control Unit must be parameterized as an output (p0728.11 = 1).	BI: p0741
4	Digital input/output 12 (DI/DO 12)	–	DI/DO 12 on the Control Unit must be parameterized as an output (p0728.12 = 1).	BI: p0742
5	Digital input/output 13 (DI/DO 13)	–	DI/DO 13 on the Control Unit must be parameterized as an output (p0728.13 = 1).	BI: p0743
6	Digital input/output 14 (DI/DO 14)	–	DI/DO 14 on the Control Unit must be parameterized as an output (p0728.14 = 1).	BI: p0744
7	Digital input/output 15 (DI/DO 15)	–	DI/DO 15 on the Control Unit must be parameterized as an output (p0728.15 = 1).	BI: p0745
8...15	Reserved	–	–	–

Note:

The bidirectional digital inputs/outputs (DI/DO) can be connected as either an input or an output (see also transmit signal E_DIGITAL).

MT_STW

Control word for the “central probe” function. Display via r0685.

Table 4-24 Description MT_STW (control word for Control Unit)

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Comments</th><th>BICO</th></tr>
<tr><td>0</td><td>Falling edge probe 1</td><td>–</td><td rowspan="6">Activation of measuring time determination with the next falling edge
For telegram 392, in addition, probes 3 and 6</td><td rowspan="15">CI: p0682</td></tr>
<tr><td>1</td><td>Falling edge probe 2</td><td>–</td></tr>
<tr><td>2</td><td>Falling edge probe 3</td><td>–</td></tr>
<tr><td>3</td><td>Falling edge probe 4</td><td>–</td></tr>
<tr><td>4</td><td>Falling edge probe 5</td><td>–</td></tr>
<tr><td>5</td><td>Falling edge probe 6</td><td>–</td></tr>
<tr><td>6...7</td><td>Reserved</td><td>–</td><td>–</td></tr>
<tr><td>8</td><td>Rising edge probe 1</td><td>–</td><td rowspan="6">Activation of measuring time determination with the next rising edge
For telegram 392, in addition, probes 3 and 6</td></tr>
<tr><td>9</td><td>Rising edge probe 2</td><td>–</td></tr>
<tr><td>10</td><td>Rising edge probe 3</td><td>–</td></tr>
<tr><td>11</td><td>Rising edge probe 4</td><td>–</td></tr>
<tr><td>12</td><td>Rising edge probe 5</td><td>–</td></tr>
<tr><td>13</td><td>Rising edge probe 6</td><td>–</td></tr>
<tr><td>14...15</td><td>Reserved</td><td>–</td><td>–</td></tr>
</table>

CU_ZSW (status word for Control Unit, CU)

See function diagram [2458]

Table 4-25 Description CU_ZSW (status word for Control Unit)

<table>
<tr><th>Bit</th><th>Meaning</th><th colspan="2">Comments</th><th>BICO</th></tr>
<tr><td>0...2</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Fault active</td><td>1</td><td>Fault active</td><td rowspan="2">BO: r2139.3</td></tr>
<tr><td>0</td><td>No fault present</td></tr>
<tr><td>4...6</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Alarm present</td><td>1</td><td>Alarm present</td><td rowspan="2">BO: 2139.7</td></tr>
<tr><td>0</td><td>No alarm present</td></tr>
<tr><td>8</td><td>SYNC</td><td>–</td><td>–</td><td>BO: r0899.8</td></tr>
<tr><td>9...11</td><td>Reserved</td><td>–</td><td>–</td><td>–</td></tr>
</table>

Table 4-25 Description CU_ZSW (status word for Control Unit), continued

Bit	Meaning	Comments		BICO
12	Slave sign-of-life bit 0	–	Slave sign of life	Implicitly interconnected
13	Slave sign-of-life bit 1	–		
14	Slave sign-of-life bit 2	–		
15	Slave sign-of-life bit 3	–		

E_DIGITAL (digital inputs)

See function diagram [2459]

Table 4-26 Description E_DIGITAL (digital inputs)

Bit	Meaning	Comments		BICO
0	Digital input/output 8 (DI/DO = 8)	–	DI/DO 8 on the Control Unit must be parameterized as an input (p0728.8 = 0).	BO: p0722.8
1	Digital input/output 9 (DI/DO = 9)	–	DI/DO 9 on the Control Unit must be parameterized as an input (p0728.9 = 0).	BO: p0722.9
2	Digital input/output 10 (DI/DO = 10)	–	DI/DO 10 on the Control Unit must be parameterized as an input (p0728.10 = 0).	BO: p0722.10
3	Digital input/output 11 (DI/DO = 11)	–	DI/DO 11 on the Control Unit must be parameterized as an input (p0728.11 = 0).	BO: p0722.11
4	Digital input/output 12 (DI/DO = 12)	–	DI/DO 12 on the Control Unit must be parameterized as an input (p0728.12 = 0).	BO: p0722.12
5	Digital input/output 13 (DI/DO = 13)	–	DI/DO 13 on the Control Unit must be parameterized as an input (p0728.13 = 0).	BO: p0722.13
6	Digital input/output 14 (DI/DO = 14)	–	DI/DO 14 on the Control Unit must be parameterized as an input (p0728.14 = 0).	BO: p0722.14
7	Digital input/output 15 (DI/DO = 15)	–	DI/DO 15 on the Control Unit must be parameterized as an input (p0728.15 = 0).	BO: p0722.15
8	Digital input 0 (DI 0)	–	Digital input DI 0 on the Control Unit	BO: r0722.0
9	Digital input 1 (DI 1)	–	Digital input DI 1 on the Control Unit	BO: r0722.1
10	Digital input 2 (DI 2)	–	Digital input DI 2 on the Control Unit	BO: r0722.2
11	Digital input 3 (DI 3)	–	Digital input DI 3 on the Control Unit	BO: r0722.3
12	Digital input 4 (DI 4)	–	Digital input DI 4 on the Control Unit	BO: r0722.4
13	Digital input 5 (DI 5)	–	Digital input DI 5 on the Control Unit	BO: r0722.5
14	Digital input 6 (DI 6)	–	Digital input DI 6 on the Control Unit	BO: r0722.6
15	Digital input 7 (DI 7)	–	Digital input DI 7 on the Control Unit	BO: r0722.7
Note: The bidirectional digital inputs/outputs (DI/DO) can be connected as either an input or an output (see also receive signal A_DIGITAL).				

MT_ZSW

Status word for the "central probe" function.

Table 4-27 Description MT_ZSW (status word for the central probe function)

Bit	Meaning	Comments		BICO
0	Digital input probe 1	–	Display of the digital inputs For telegram 392, in addition, probes 3 and 6	CO: r0688
1	Digital input probe 2	–		
2	Digital input probe 3	–		
3	Digital input probe 4	–		
4	Digital input probe 5	–		
5	Digital input probe 6	–		
6...7	Reserved	–	–	
8	Sub-sampling probe 1	–	Not yet carried out. For telegram 392, in addition, probes 3 and 6	
9	Sub-sampling probe 2	–		
8	Sub-sampling probe 3	–		
9	Sub-sampling probe 4	–		
8	Sub-sampling probe 5	–		
9	Sub-sampling probe 6	–		
10...15	Reserved	–	–	

MTn_ZS_F and MTn_ZS_S

Displays the determined measuring time
The measuring time is specified as a 16-bit value with a resolution of 0.25 μs.

Features of the central probe

- The time stamps from probes in more than one drive can be transferred simultaneously in a single telegram.
- The time in the controller and drive unit is synchronized via the CU_STW and the CU_ZSW.
  Note: The controller must support time synchronization!
- A higher-level controller can then use the time stamp to determine the actual position value of more than one drive.
- The system outputs a message if the measuring time determination function in the probe is already in use (see also p0488, p0489, and p0580).

Example: central probe

Assumptions for the example:

- Determination of the time stamp MT1_ZS_S by evaluating the rising edge of probe 1
- Determination of the time stamp MT2_ZS_S and MT2_ZS_F by evaluating the rising and falling edge of probe 2
- Probe 1 on DI/DO9 of the Control Unit (p0680[0] = 1)
- Probe 2 on DI/DO10 of the Control Unit (p0680[1] = 2)
- Manufacturer-specific telegram p0922 = 391 is set

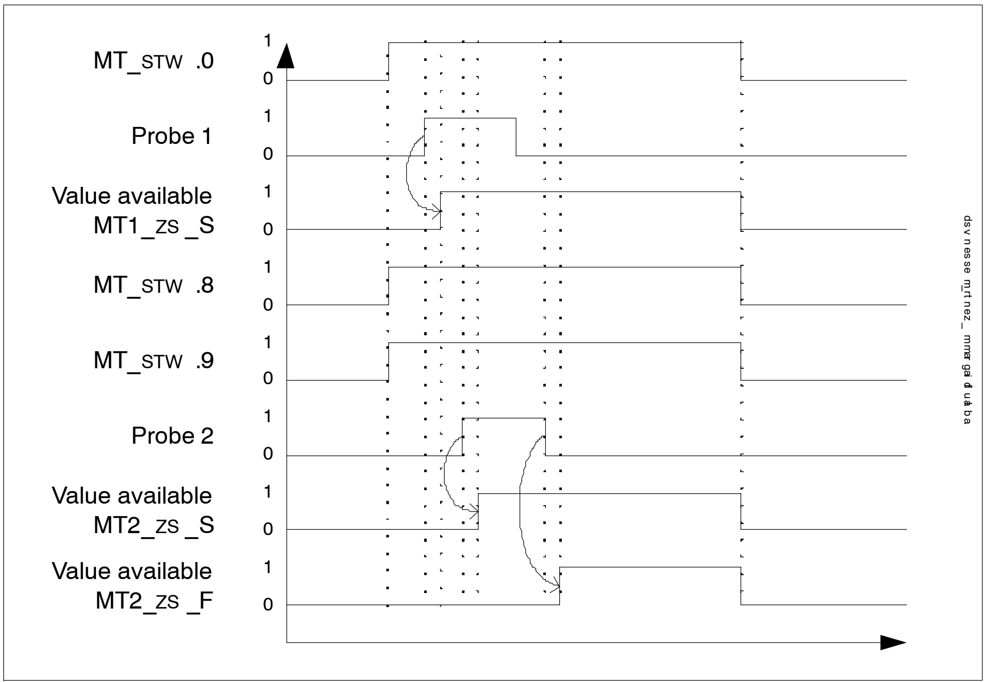


Fig. 4-11   Function chart for central probe example

4.3 Acyclic communication

4.3.1 General information about acyclic communication

Description

With acyclic communication, as opposed to cyclic communication, data transfer takes place only when an explicit request is made (e.g. in order to read and write parameters).

The DPV1 services (read data set/write data set) are available for acyclic communication.

Note

Please refer to the following documentation for a detailed description of acyclic communication via DPV1:

References: /P5/ PROFIdrive Profile Drive Technology

The following options are available for reading and writing parameters:

- S7 protocol

  This protocol uses the STARTER commissioning tool, for example, in online mode via PROFIBUS.
- PROFIdrive parameter channel (DPV1) with data set 47

  The DPV1 services are available for master class 1 and class 2.

Properties of the DPV1 parameter channel

- One 16-bit address each for parameter number and subindex.
- Concurrent access by several PROFIBUS masters (master class 2, e.g. commissioning tool).
- Transfer of different parameters in one access (multiple parameter request).
- Transfer of complete arrays or part of an array possible.
- Only one parameter request is processed at a time (no pipelining).
- A parameter request/response must fit into a data set (max. 240 bytes).
- The task or response header are user data.

4.3.2 Requests and responses according to DPV1

Structure of parameter request and parameter response

	Parameter request			Offset
	Request header	**Request reference**	**Task ID**	0
		Axis	**No. of parameters**	2
	1. parameter address	**Attribute**	**No. of elements**	4
		Parameter number		6
		Subindex		8
	...			
	nth parameter address	**Attribute**	**No. of elements**	
		Parameter number		
		Subindex		
Values for write access only	1. parameter value(s)	**Format**	**No. of values**	
		Values		
		...		
	...			
	nth parameter value(s)	**Format**	**No. of values**	
		Values		
		...		

	Parameter response			Offset
	Response header	**Request reference mirrored**	**Response ID**	0
		Axis mirrored	**No. of parameters**	2
Values for read access only Error values for negative response only	1. parameter value(s)	**Format**	**No. of values**	4
		Values or error values		6
		...		
	...			
	nth parameter value(s)	**Format**	**No. of values**	
		Values or error values		
		...		

Description of fields in DPV1 parameter request and response

Table 4-28 Description of fields

Field	Data type	Values	Remark
Request reference	Unsigned8	0x01 ... 0xFF	
	Unique identification of the request/response pair for the master. The master changes the request reference with each new request. The slave mirrors the request reference in its response.		
Task ID	Unsigned8	0x01 0x02	Read request Write request
	Specifies the type of request. In the case of a write request, the changes are made in a volatile memory (RAM). A save operation is needed in order to transfer the data to the non-volatile memory (p0971, p0977).		
Response ID	Unsigned8	0x01 0x02 0x81 0x82	Read request (+) Write request (+) Read request (–) Write request (–)
	Mirrors the request identifier and specifies whether request execution was positive or negative. Negative means: Cannot execute part or all of request. The error values are transferred instead of the values for each subresponse.		
Drive object number	Unsigned8	0x00 ... 0xFF	Number
	Setting for the drive object number with a drive unit with more than one drive object. Different drive objects with separate parameter number ranges can be accessed over the same DPV1 connection.		
No. of parameters	Unsigned8	0x01 ... 0x27	No. 1 ... 39 Limited by DPV1 telegram length
	Defines the number of adjoining areas for the parameter address and/or parameter value for multi-parameter requests. The number of parameters = 1 for single requests.		
Attribute	Unsigned8	0x10 0x20 0x30	Value Description Text (not implemented)
	Type of parameter element accessed.		
No. of elements	Unsigned8	0x00 0x01 ... 0x75	Special function No. 1 ... 117 Limited by DPV1 telegram length
	Number of array elements accessed.		
Parameter number	Unsigned16	0x0001 ... 0xFFFF	No. 1 ... 65535
	Addresses the parameter to be accessed.		

Table 4-28 Description of fields, continued

Field	Data type	Values	Remark
Subindex	Unsigned16	0x0000 ... 0xFFFF	No. 0 ... 65535
	Addresses the first array element of the parameter to be accessed.		
Format	Unsigned8	0x02	Data type Integer8
		0x03	Data type Integer16
		0x04	Data type Integer32
		0x05	Data type Unsigned8
		0x06	Data type Unsigned16
		0x07	Data type Unsigned32
		0x08	Data type FloatingPoint
		Other values	See PROFIdrive Profile V3.1
		0x40	Zero (without values as a positive subresponse to a write request)
		0x41	Byte
		0x42	Word
		0x43	Double word
		0x44	Error
	The format and number specify the adjoining space containing values in the telegram. Data types in conformity with PROFIdrive Profile shall be preferred for write access. Bytes, words and double words are also possible as a substitute.		
No. of values	Unsigned8	0x00 ... 0xEA	No. 0 ... 234 Limited by DPV1 telegram length
	Specifies the number of subsequent values.		
Error values	Unsigned16	0x0000 ... 0x00FF	Meaning of the error values —> see table 4-29
	The error values in the event of a negative response. If the values make up an odd number of bytes, a zero byte is appended. This ensures the integrity of the word structure of the telegram.		
Values	Unsigned16	0x0000 ... 0x00FF	
	The values of the parameter for read or write access. If the values make up an odd number of bytes, a zero byte is appended. This ensures the integrity of the word structure of the telegram.		

Error values in DPV1 parameter responses

Table 4-29 Error values in DPV1 parameter responses

Fault value	Meaning	Remark	Supplementary information
0x00	Illegal parameter number	Access to a parameter which does not exist.	–
0x01	Parameter value cannot be changed	Modification access to a parameter value which cannot be changed.	Subindex
0x02	Lower or upper value limit exceeded	Modification access with value outside value limits.	Subindex
0x03	Invalid subindex	Access to a subindex which does not exist.	Subindex
0x04	No array	Access with subindex to an unindexed parameter.	–
0x05	Wrong data type	Modification access with a value which does not match the data type of the parameter.	–
0x06	Illegal set operation (only reset allowed)	Modification access with a value not equal to 0 in a case where this is not allowed.	Subindex
0x07	Description element cannot be changed	Modification access to a description element which cannot be changed.	Subindex
0x09	No description data	Access to a description which does not exist (the parameter value exists).	–
0x0B	No operating priority	Modification access with no operating priority.	–
0x0F	No text array exists	Access to a text array which does not exist (the parameter value exists).	–
0x11	Request cannot be executed due to operating status	Access is not possible temporarily for unspecified reasons.	–
0x14	Illegal value	Modification access with a value which is within the limits but which is illegal for other permanent reasons (parameter with defined individual values).	Subindex
0x15	Response too long	The length of the present response exceeds the maximum transfer length.	–
0x16	Illegal parameter address	Illegal or unsupported value for attribute, number of elements, parameter number, subindex or a combination of these.	–
0x17	Illegal format	Write request: illegal or unsupported parameter data format	–
0x18	No. of values inconsistent	Write request: a mismatch exists between the number of values in the parameter data and the number of elements in the parameter address.	–
0x19	Drive object does not exist	You have attempted to access a drive object that does not exist.	–

Table 4-29 Error values in DPV1 parameter responses, continued

Fault value	Meaning	Remark	Supplementary information
0x65	Presently deactivated.	You have tried to access a parameter that, although available, is currently inactive (e.g. n control set and access to parameter from V/f control).	–
0x6B	Parameter %s [%s]: no write access for the enabled controller	–	–
0x6C	Parameter %s [%s]: unit unknown	–	–
0x6D	Parameter %s [%s]: write access only in the commissioning state, encoder (p0010 = 4).	–	–
0x6E	Parameter %s [%s]: write access only in the commissioning state, motor (p0010 = 3).	–	–
0x6F	Parameter %s [%s]: write access only in the commissioning state, Power Module (p0010 = 2).	–	–
0x70	Parameter %s [%s]: write access only in fast commissioning state (p0010 = 1).	–	–
0x71	Parameter %s [%s]: write access only in the ready state (p0010 = 0).	–	–
0x72	Parameter %s [%s]: write access only in the commissioning state, parameter reset (p0010 = 30).	–	–
0x73	Parameter %s [%s]: write access only in the commissioning state, Safety (p0010 = 95).	–	–
0x74	Parameter %s [%s]: write access only in the commissioning state, technological application/units (p0010 = 5).	–	–
0x75	Parameter %s [%s]: write access only in the commissioning state (p0010 not equal to 0).	–	–
0x76	Parameter %s [%s]: write access only in the commissioning state, download (p0010 = 29).	–	–
0x77	Parameter %s [%s] may not be written in download.	–	–
0x78	Parameter %s [%s]: write access only in the commissioning state, drive configuration (device: p0009 = 3).	–	–

Table 4-29 Error values in DPV1 parameter responses, continued

Fault value	Meaning	Remark	Supplementary information
0x79	Parameter %s [%s]: write access only in the commissioning state, definition of the drive type (device: p0009 = 2).	–	–
0x7A	Parameter %s [%s]: write access only in the commissioning state, data set basis configuration (device: p0009 = 4).	–	–
0x7B	Parameter %s [%s]: write access only in the commissioning state, device configuration (device: p0009 = 1).	–	–
0x7C	Parameter %s [%s]: write access only in the commissioning state, device download (device: p0009 = 29).	–	–
0x7D	Parameter %s [%s]: write access only in the commissioning state, device parameter reset (device: p0009 = 30).	–	–
0x7E	Parameter %s [%s]: write access only in the commissioning state, device ready (device: p0009 = 0).	–	–
0x7F	Parameter %s [%s]: write access only in the commissioning state, device (device: p0009 not equal to 0).	–	–
0x81	Parameter %s [%s] may not be written in download.	–	–
0x82	Transfer of the control authority (master) is inhibited by BI: p0806.	–	–
0x83	Parameter %s [%s]: requested BICO interconnection not possible	BICO output does not supply float values. The BICO input, however, requires a float value.	–
0x84	Parameter %s [%s]: parameter change inhibited (refer to p0300, p0400, p0922)	–	–
0x85	Parameter %s [%s]: access method not defined.	–	–
0xC8	Below the valid values.	Modification request for a value that, although within “absolute” limits, is below the currently valid lower limit.	–
0xC9	Above the valid values.	Modification request for a value that, although within “absolute” limits, is above the currently valid upper limit (e.g. governed by the current converter rating).	–

Table 4-29 Error values in DPV1 parameter responses, continued

Fault value	Meaning	Remark	Supplementary information
0xCC	Write access not permitted.	Write access is not permitted because an access key is not available.	–

4.3.3 Determining the drive object numbers

Further information about the drive system (e.g. drive object numbers) can be determined as follows using parameters p0101, r0102, and p0107/r0107:

1. The value of parameter r0102 (“Number of drive objects”) for drive object/axis 1 is read via a read request.

   Drive object 1 is the Control Unit (CU), which is a minimum requirement for each drive system.

2. Depending on the result of the initial read request, further read requests for drive object 1 are used to read the indices for parameter p0101 (“Drive object numbers”), as specified by parameter r0102.

   Example:

   If the number of drive objects is “5”, the values for indices 0 to 4 for parameter p0101 are read. Of course, the relevant indexes can also be read at once.

Note

The first two points provide you with the following information:

- The number of drive objects in the drive system
- The numbers of the existing drive objects

---

3. Following this, parameter r0107/p0107 (“Drive object type”) is read for each drive object/axis (indicated by the drive object number).

   Depending on the drive object, parameter 107 can be either an adjustable or visualization parameter.

   The value in parameter r0107/p0107 indicates the drive object type. The coding for the drive object type is specified in the parameter list.

4. From here, refer to the parameter list for each drive object.

4.3.4 Example 1: read parameters

Prerequisites

1. The PROFIBUS master has been commissioned and is fully operational.
2. PROFIBUS communication between master and slave is operational.
3. The master can read and write data sets in conformance with PROFIBUS DPV1.

Task description

Following the occurrence of at least one fault (ZSW1.3 = "1") on drive 2 (also drive object number 2), the active fault codes must be read from the fault buffer r0945[0] ... r0945[7].

The request is to be handled using a request and response data block.

Basic procedure

1. Create a request to read the parameters.
2. Invoke the request.
3. Evaluate the response.

Execution of

1. Create the request.

<table>
<tr><td colspan="3">Parameter request</td><td>Offset</td></tr>
<tr><td rowspan="2">Request header</td><td>Request reference = 25 hex</td><td>Request ID = 01 hex</td><td>0 + 1</td></tr>
<tr><td>Axis = 02 hex</td><td>No. of parameters = 01 hex</td><td>2 + 3</td></tr>
<tr><td rowspan="3">Parameter address</td><td>Attribute = 10 hex</td><td>No. of elements = 08 hex</td><td>4 + 5</td></tr>
<tr><td colspan="2">Parameter no. = 945 dec</td><td>6</td></tr>
<tr><td colspan="2">Subindex = 0 dec</td><td>8</td></tr>
</table>

Information about the parameter request:

- Request reference:

  The value is selected at random from the valid value range. The request reference establishes the relationship between request and response.

- Request ID:

  01 hex —> This identifier is required for a read request.

- Axis:

  02 hex —> Drive 2, fault buffer with drive and device-specific faults
- No. of parameters:

  01 hex —> One parameter is read.
- Attribute:

  10 hex —> The parameter values are read.
- No. of elements:

  08 hex —> The current fault incident with 8 faults is to be read.
- Parameter number:

  945 dec —> p0945 (fault code) is read.
- Subindex:

  0 dec —> Read access starts at index 0.

2. Invoke the parameter request.

   If ZSW1.3 = “1” —> Initiate parameter request.
3. Evaluate the parameter response.

Parameter response			Offset
Response header	Request reference mirrored = 25 hex	Response ID = 01 hex	0 + 1
	Axis mirrored = 02 hex	No. of parameters = 01 hex	2 + 3
Parameter value	Format = 06 hex	No. of values = 08 hex	4 + 5
	1. value = 1355 dec		6
	2. value = 0 dec		8
	...		...
	8. value = 0 dec		20

Information about the parameter response:

- Request reference mirrored:

  This response belongs to the request with request reference 25.
- Response ID:

  01 hex —> Read request positive, values stored as of 1st value
- Axis mirrored, no. of parameters:

  The values correspond to the values from the request.
- Format:

  06 hex —> Parameter values are in Unsigned16 format.

- No. of values:

  08 hex —> 8 parameter values are available.

- 1. value ... 8th value

  A fault is only entered in value 1 of the fault buffer for drive 2.

4.3.5 Example 2: write parameters (multi-parameter request)

Prerequisites

1. The PROFIBUS master has been commissioned and is fully operational.
2. PROFIBUS communication between master and slave is operational.
3. The master can read and write data sets in conformance with PROFIBUS DPV1.

   Special requirements for this example:
4. Control type: VECTOR

Task description

Jog 1 and 2 are to be set up for drive 2 (also drive object number 2) via the input terminals of the Control Unit. A parameter request is to be used to write the corresponding parameters as follows:

- BI: p1055 = r0722.4 Jog bit 0
- BI: p1056 = r0722.5 Jog bit 1
- p1058 = 300 rpm Jog 1 speed setpoint
- p1059 = 600 rpm Jog 2 speed setpoint

The request is to be handled using a request and response data block.

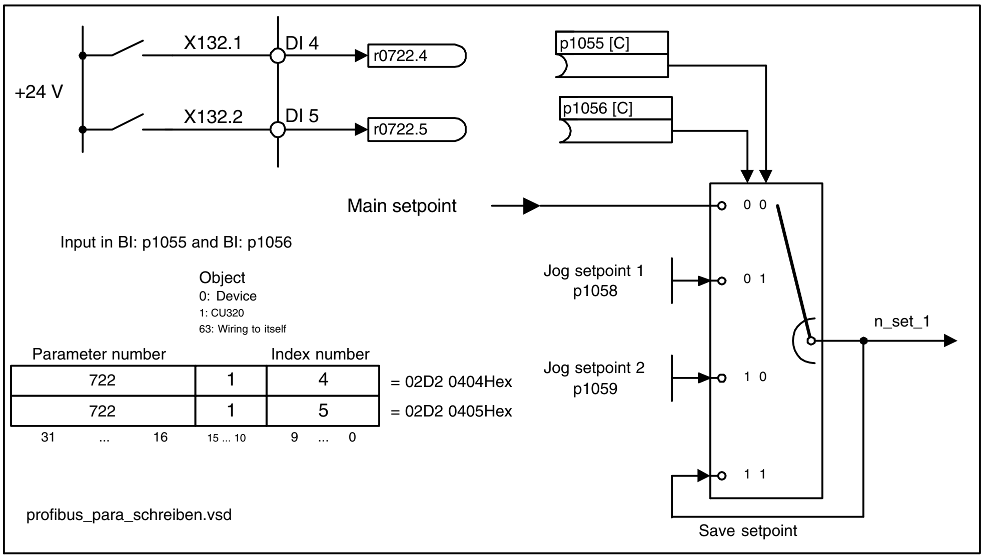


Fig. 4-12 Task description for multi-parameter request (example)

Basic procedure

1. Create a request to write the parameters.
2. Invoke the request.
3. Evaluate the response.

Execution of

1. Create the request.

Parameter request			Offset
Request header	Request reference = 40 hex	Request ID = 02 hex	0 + 1
	Axis = 02 hex	No. of parameters = 04 hex	2 + 3
1. parameter address	Attribute = 10 hex	No. of elements = 01 hex	4 + 5
	Parameter no. = 1055 dec		6
	Subindex = 0 dec		8
2. parameter address	Attribute = 10 hex	No. of elements = 01 hex	10 + 11
	Parameter no. = 1056 dec		12
	Subindex = 0 dec		14
3. parameter address	Attribute = 10 hex	No. of elements = 01 hex	16 + 17
	Parameter no. = 1058 dec		18
	Subindex = 0 dec		20
4. parameter address	Attribute = 10 hex	No. of elements = 01 hex	22 + 23
	Parameter no. = 1059 dec		24
	Subindex = 0 dec		26
1. parameter value(s)	Format = 07 hex	No. of values = 01 hex	28 + 29
	Value = 02D2 hex		30
	Value = 0404 hex		32
2. parameter value(s)	Format = 07 hex	No. of values = 01 hex	34 + 35
	Value = 02D2 hex		36
	Value = 0405 hex		38
3. parameter value(s)	Format = 08 hex	No. of values = 01 hex	40 + 41
	Value = 4396 hex		42
	Value = 0000 hex		44
4. parameter value(s)	Format = 08 hex	No. of values = 01 hex	46 + 47
	Value = 4416 hex		48
	Value = 0000 hex		50

Information about the parameter request:

- Request reference:

  The value is selected at random from the valid value range. The request reference establishes the relationship between request and response.

- Request ID:

  02 hex —> This identifier is required for a write request.

- Axis:

  02 hex —> The parameters are written to drive 2.

- No. of parameters

  04 hex —> The multi-parameter request comprises 4 individual parameter requests.

1. parameter address ... 4th parameter address

- Attribute:

  10 hex —> The parameter values are to be written.

- No. of elements

  01 hex —> 1 array element is written.

- Parameter number

  Specifies the number of the parameter to be written (p1055, p1056, p1058, p1059).

- Subindex:

  0 dec —> ID for the first array element.

1. parameter value ... 4th parameter value

- Format:

  07 hex —> Unsigned32 data type

  08 hex —> FloatingPoint data type

- No. of values:

  01 hex —> A value is written to each parameter in the specified format.

- Value:

  BICO input parameter: enter signal source (see Fig. 4-12)

  Adjustable parameter: enter value

2. Invoke the parameter request.

3. Evaluate the parameter response.

Parameter response			Offset
Response header	Request reference mirrored = 40 hex	Response ID = 02 hex	0
	Axis mirrored = 02 hex	No. of parameters = 04 hex	2

Information about the parameter response:

- Request reference mirrored:

  This response belongs to the request with request reference 40.
- Response ID:

  02 hex —> Write request positive
- Axis mirrored:

  02 hex —> The value matches the value from the request.
- No. of parameters:

  04 hex —> The value matches the value from the request.

■

Communication via PROFIBUS 5

5.1 General information about PROFIBUS

5.1.1 General information about PROFIBUS for SINAMICS

General information

PROFIBUS is an open international field bus standard for a wide range of production and process automation applications.

The following standards ensure open, multi-vendor systems:

- International standard EN 50170
- International standard IEC 61158

PROFIBUS is optimized for high-speed, time-critical data communication at field level.

Note

PROFIBUS for drive technology is standardized and described in the following document:

References: /P5/ PROFIdrive Profile Drive Technology

Caution

Before synchronizing to the isochronous PROFIBUS, all of the pulses of the drive objects must be inhibited – also for those drives that are not controlled via PROFIBUS.

Caution

If the CAN connector is mistakenly plugged into the PROFIBUS connector, this can destroy the CAN master.

Master and slave

- Master and slave properties

Table 5-1 Master and slave properties

Properties	Master	Slave
As bus node	Active	Passive
Send messages	Permitted without external request	Only possible on request by master
Receive messages	Possible with no restrictions	Only receive and acknowledge permitted

- Master

  Masters are categorized into the following classes:

  – Master class 1 (DPMC1):

    Central automation stations that exchange data with the slaves in cyclic and acyclic mode. Communication between the masters is also possible.

    Examples: SIMATIC S7, SIMOTION

  – Master class 2 (DPMC2):

    Devices for configuration, commissioning, operator control and monitoring during bus operation. Devices that only exchange data with the slaves in acyclic mode.

    Examples: Programming devices, human machine interfaces

- Slaves

  With respect to PROFIBUS, the SINAMICS drive unit is a slave.

Bus access method

PROFIBUS uses the token passing method, i.e. the active stations (masters) are arranged in a logical ring in which the authorization to send is received within a defined time frame.

Within this time frame, the master with authorization to send can communicate with other masters or handle communication with the assigned slaves in a master/slave procedure.

PROFIBUS telegram for cyclic data transmission and acyclic services

For each drive unit with cyclic process data exchange, there is one telegram to send and receive all process data. A separate telegram is sent in order to perform all the acyclic services (read/write parameters) under a single Profibus address. The acyclic data is transmitted with a lower priority after cyclic data transmission.

The overall length of the telegram increases with the number of drive objects that are involved in exchanging process data.

Sequence of drive objects in the telegram

On the drive side, the sequence of drive objects in the telegram is displayed via a list in p0978[0...15] where it can also be changed.

You can use the STARTER commissioning tool to display the sequence of drive objects for a commissioned drive system in online mode by choosing —> “Drive unit” —> “Configuration”.

When you create the configuration on the master side (e.g. HWConfig), the process-data-capable drive objects for the application are added to the telegram in this sequence.

The following drive objects can exchange process data:

Drive object

- Active Infeed (A_INF)
- Basic Infeed (B_INF)
- Smart Infeed (S_INF)
- SERVO
- VECTOR
- Terminal Module 15 (TM15DI/DO)
- Terminal Module 31 (TM31)
- Terminal Module 41 (TM41)
- Terminal Board 30 (TB30)
- Control Unit (CU_S)

Note

The sequence of drive objects in the configuration must be the same as that in the drive system.

The structure of the telegram depends on the drive objects taken into account during configuration. Configurations that do not take into account all of the drive objects in the drive system are permitted.

Example:

Assumption: The hardware set-up is as described in Subsection 5.1.2.

The following configurations, for example, are possible:

—> Configuration with SERVO, SERVO, SERVO

—> Configuration with A_INF, SERVO, SERVO, SERVO, TB30

—> and others

5.1.2 Example: telegram structure for cyclic data transmission

Task

The drive system comprises the following drive objects:

- Control Unit (CU_S)
- Active Infeed (A_INF)
- SERVO 1 (comprises a Single Motor Module and other components)
- SERVO 2 (comprises a Double Motor Module terminal X1 and other components)
- SERVO 3 (comprises a Double Motor Module terminal X2 and other components)
- Terminal Board 30 (TB30)

The process data is to be exchanged between the drive objects and the higher-level automation system.

- Telegrams to be used:
  - Telegram 370 for Active Infeed
  - Standard telegram 6 for servo
  - User defined for Terminal Board 30

Component and telegram structure

The predefined component structure results in the telegram structure shown in the following diagram.

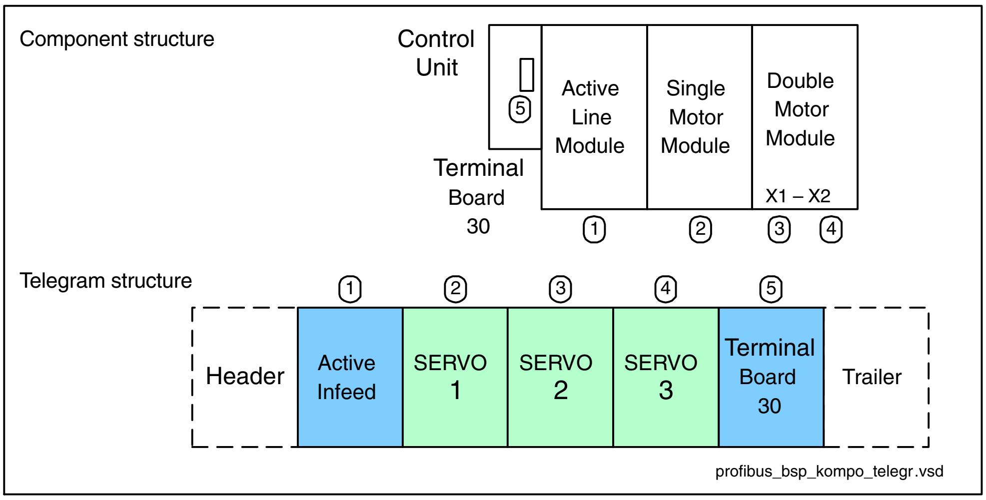


Fig. 5-1 Component and telegram structure

You can check and change the sequence of the telegrams via p0978[0...15].

Configuration settings (e.g. HWConfig for SIMATIC S7)

The components are mapped to objects for configuration.

Due to the telegram structure shown in Fig. 5-1, the objects in the “DP slave properties” overview must be configured as follows:

- Active Infeed (A_INF): Telegram 370
- SERVO 1: Standard telegram 6
- SERVO 2: Standard telegram 6
- SERVO 3: Standard telegram 6
- Terminal Board 30 (TB30): User defined

DP slave properties: overview

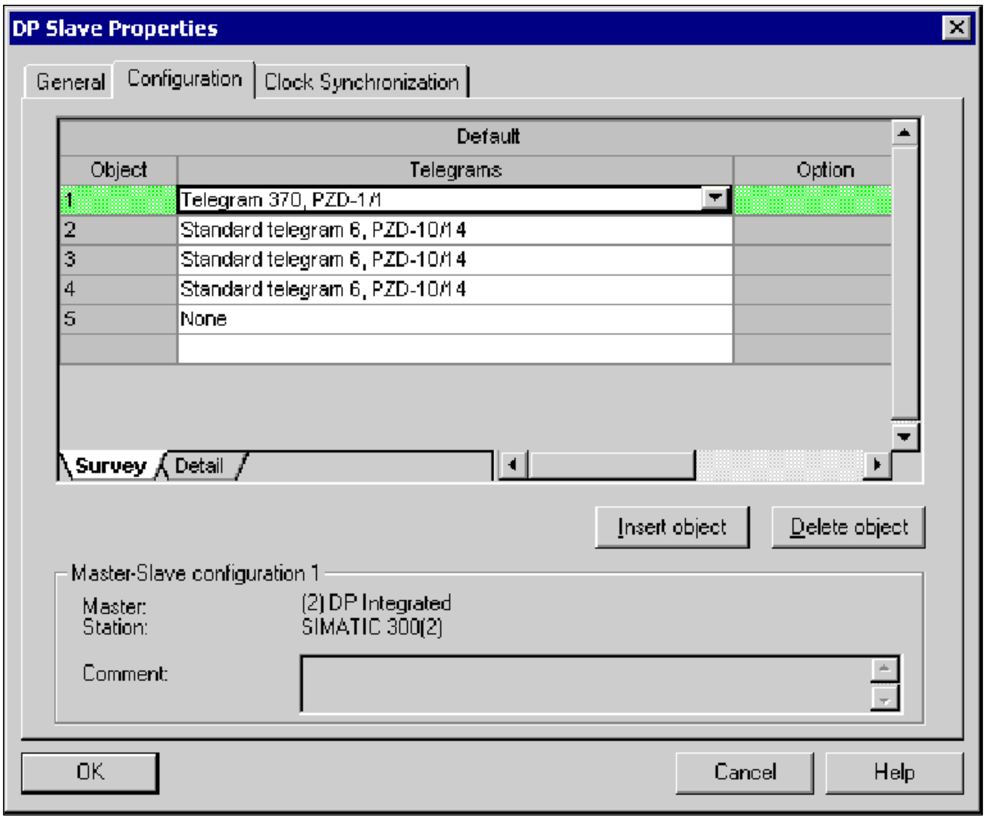


Fig. 5-2 Slave properties – overview

When you click "Details", the properties of the configured telegram structure are displayed (e.g. I/O addresses, axis separator).

DP slave properties: details

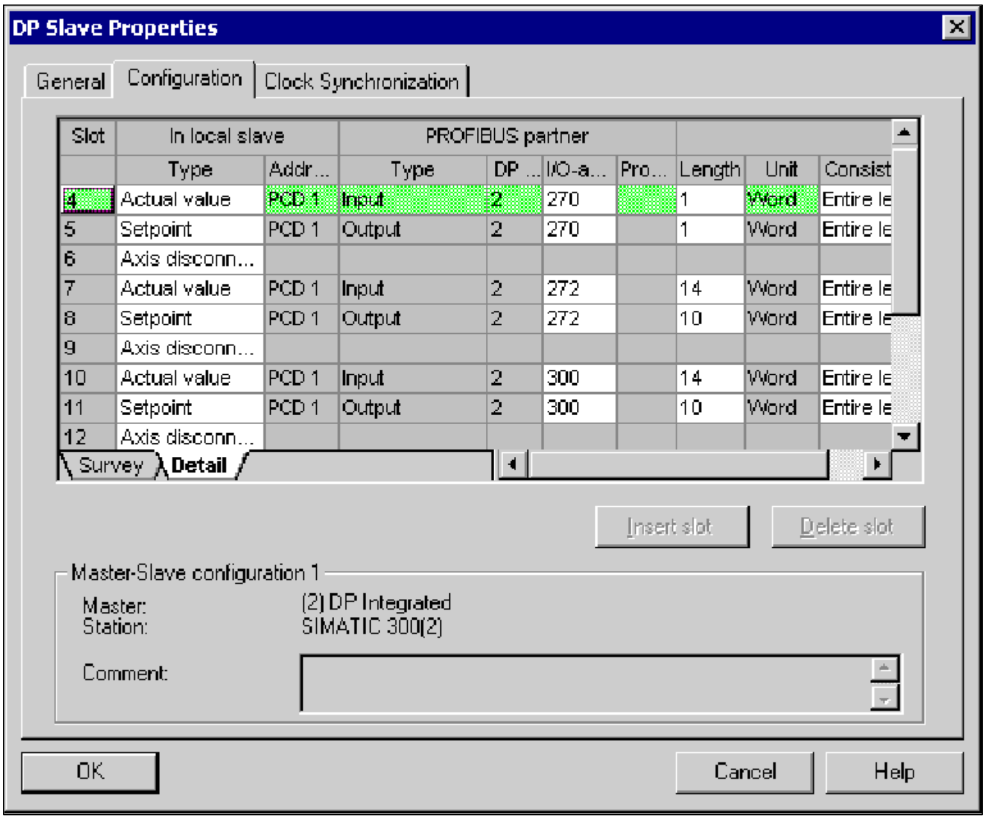


Fig. 5-3 Slave properties – details

The axis separator separates the objects in the telegram as follows:

- Slot 4 and 5: Object 1 --> Active Infeed (A_INF)
- Slot 7 and 8: Object 2 --> SERVO 1
- Slot 10 and 11: Object 3 --> SERVO 2

  etc.

5.2 Commissioning PROFIBUS

5.2.1 General information about commissioning

Interfaces and diagnostic LED

A PROFIBUS interface with LEDs and address switches is available as standard on the Control Unit.

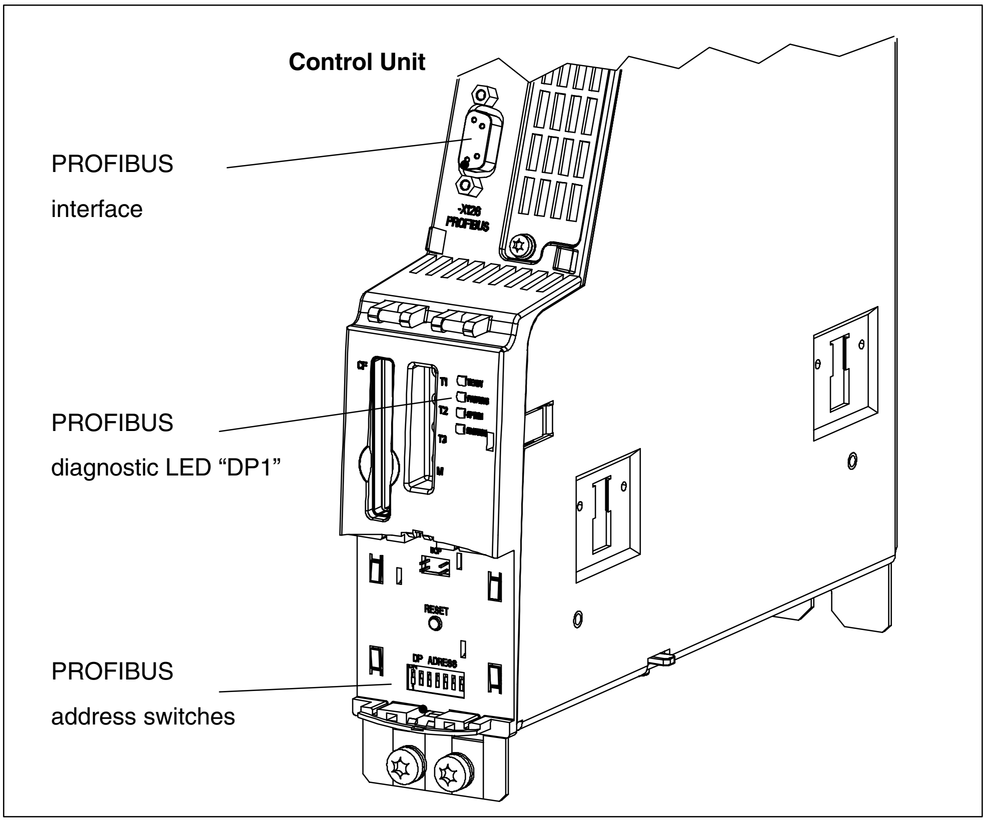


Fig. 5-4 Interfaces and diagnostic LED

- PROFIBUS interface

  The PROFIBUS interface is described in the following documentation:

  References: /GH1/ SINAMICS S120 Equipment Manual Control Units and supplementary system components

- PROFIBUS diagnostic LED

  For a description of the diagnostics LED —> refer to Subsection 8.1.1.

Note

A teleservice adapter can be connected to the PROFIBUS interface (X126) for remote diagnosis purposes.

Setting the PROFIBUS address

Two methods are available for setting the PROFIBUS address:

1. Via the PROFIBUS address switches on the Control Unit
   – In this case, p0918 is read-only and simply displays the set address.
   – A change is not effective until POWER ON.
2. Via p0918
   – You can only use this method when all the PROFIBUS address switches from S1 to S7 are set to ON or OFF.
   – Address changes made via parameters must be saved in a non-volatile memory using the “Copy from RAM to ROM” function.
   – A change is not effective until POWER ON.

Example:

Setting the PROFIBUS address using the PROFIBUS address switches on the Control Unit.

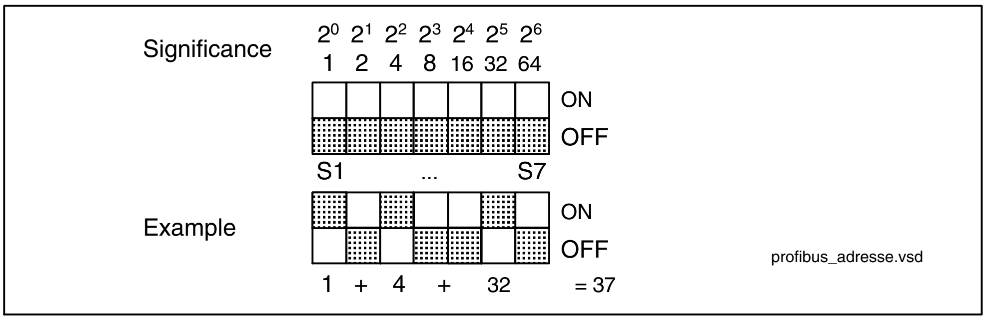


Fig. 5-5 Example: setting the PROFIBUS address using the PROFIBUS address switch on the Control Unit

Note

The factory settings are “ON” or “OFF” for all switches. With these two settings, the PROFIBUS address is set by parameterization.

Parameter p0918 is unique to the Control Unit (see Control Unit). The factory setting is 126.

Address 126 is used for commissioning. Permitted PROFIBUS addresses are 1 ... 126.

If several CUs are connected to one Profibus line, the address settings must differ from the factory settings. Note that each address can only be assigned once on a Profibus line. This can be achieved using the address switch or by setting parameter p0918 accordingly. The setting can be made by connecting the 24 V supply step by step and resetting p0918, for example.

The address setting on the switch is displayed in r2057.

Each change made to the bus address is not effective until POWER ON.

Device master file

A device master file provides a full and clear description of the features of a PROFIBUS slave. The device master files are ASCII files with an accurately defined format.

The following device master files (GSD files) for SINAMICS S120 are available:

- si0280e5.gs**e** English
- si0280e5.gs**f** French
- si0280e5.gs**g** German
- si0280e5.gs**i** Italian
- si0280e5.gs**s** Spanish

  The GSD files are in accordance with the GSD guidelines (revision 4) and allow you to configure the isochronous mode via a GSD.
  A minimum of STEP7 from V5.1 SP3 onwards is required for use in the SIMATIC environment.

The GSD files can be found at the following locations:

- On the Internet: http://www4.ad.siemens.de/WW/view/de/113204
- On the CD supplied with the STARTER commissioning tool
  Order No. 6SL3072-0AA00-0AGx
- On the CompactFlash card in directory
  \\SIEMENS\SINAMICS\DATA\CFG\

Commissioning for VIK-NAMUR

To be able to operate a SINAMICS drive as a VIK-NAMUR drive, standard telegram 20 must be set and the VIK-NAMUR identification number activated via p2042 =1. In this case, only the NAMUR GSD can be used.

Device identification

An identification parameter for individual slaves facilitates diagnosis and provides an overview of the nodes on the PROFIBUS.

The information for each slave is stored in the following CU-specific parameter:

r0964[0...6] Device identification

Bus terminating resistor and shielding

Reliable data transmission via PROFIBUS depends, amongst other things, on the setting for the bus terminating resistors and the shielding for the PROFIBUS cables.

- Bus terminating resistor

  The bus terminating resistors in the PROFIBUS plugs must be set as follows:

  - First and last nodes in the line switch on terminating resistor
  - Other nodes in the line: switch out terminating resistor

- Shielding for the PROFIBUS cables

  The cable shield in the plug must be connected at both ends with the greatest possible surface area.

References: /GH1/ SINAMICS S120 Equipment Manual Control Units and supplementary system components

5.2.2 Commissioning procedure

Preconditions and assumptions for commissioning

PROFIBUS slave

- The PROFIBUS address to be set for the application is known.
- The telegram type for each drive object is known by the application.

PROFIBUS master

- The communication properties of the SINAMICS S120 slave must be available in the master (GSD file or drive ES slave OM).

Commissioning steps (example with SIMATIC S7)

1. Set the PROFIBUS address on the slave.

   Refer to Subsection 5.2.1
2. Set the telegram type on the slave.

   Refer to Subsection 4.2.1
3. Perform the following steps in HWConfig:
   - Connect the drive to PROFIBUS and assign an address.
   - Set the telegram type.

     The same telegram type as on the slave must be set for every drive object exchanging process data via PROFIBUS.

     The setting “without PZD” can be defined on a node or object (e.g. infeed controlled via terminals).
4. The I/O addresses must be assigned in accordance with the user program.

5.2.3 Diagnosis options

Diagnosis via parameters (see List Manual)

- r2050 CO: PROFIBUS PZD receive word
- r2053 PROFIBUS diagnostics PZD send word
- r2054 PROFIBUS status (CU_S)
- r2055 PROFIBUS diagnostics standard (CU_S)
- r2060 CO: PROFIBUS PZD receive double word
- r2063 PROFIBUS diagnostics PZD send double word
- r2064 PROFIBUS diagnostics isochronous mode (CU_S)
- r2065 PROFIBUS diagnostics master sign-of-life
- r2075 PROFIBUS diagnostics telegram offset PZD receive
- r2076 PROFIBUS diagnostics telegram offset PZD send
- r2090 BO: PROFIBUS PZD1 receive bit-serial

Diagnostics via LED DP1 (refer to Section 8.1)

The following diagnostic screen forms are available in STARTER.

5.2.4 SIMATIC HMI addressing

You can use a SIMATIC HMI as a PROFIBUS master (master class 2) to access SINAMICS directly. With respect to SIMATIC HMI, SINAMICS behaves like a SIMATIC S7. For accessing drive parameters, the following simple rule applies:

- Parameter number = data block number
- Parameter sub-index = bit 0 – 9 of data block offset
- Drive object number = bit 10 –15 of data block offset

Pro Tool and WinCC flexible

The SIMATIC HMI can be configured flexibly with “Pro Tool” or “WinCC flexible”.

The following special drive settings must be taken into account when carrying out configuration with Pro Tool or WinCC flexible.

Controllers: Protocol always “SIMATIC S7 – 300/400”

Table 5-2 Further parameters

Field	Value
Network parameter profile	DP
Network parameter baud rate	Any

Table 5-2 Further parameters, continued

Field	Value
Communication partner address	PROFIBUS address of the drive unit
Communication partner slot/subrack	Don't care, 0

Table 5-3 Tags: "General" tab

Field	Value
Name	Any
Controller	Any
Type	Depending on the addressed parameter value, e.g.: INT: for integer 16 DINT: for integer 32 WORD: for unsigned 16 REAL: for float
Area	DB
DB (data block number)	Parameter number 1 ... 65535
DBB, DBW, DBD (data block offset)	Drive object No. and sub-index bits 15 – 10: Drive object Nos. 0 ... 63 bits 9 – 0: Sub-index 0 ... 1023 or expressed differently: DBW = 1024 * drive object No. + sub-index
Length	Not activated
Acquisition cycle	Any
No. of elements	1
Decimal places	Any

Note

- You can operate a SIMATIC HMI together with a drive unit independently of an existing control.
  A basic "point-to-point" connection can only be established between two nodes (devices).
- The "variable" HMI functions can be used for drive units. Other functions cannot be used (e.g. "messages" or "recipes").
- Individual parameter values can be accessed. Entire arrays, descriptions, or texts cannot be accessed.

5.2.5 Monitoring: telegram failure

Description

After a telegram failure and a monitoring time has elapsed (t_An), bit r2043.0 is set to “1” and alarm A01920 is output. Binector output r2043.0 can, e.g. be used for a fast stop.
Fault F01910 is output after a delay time p2044 has expired. Fault F01910 triggers fault response OFF2 (pulse inhibit) for the supply and fault response OFF3 (emergency stop) for SERVO/VECTOR. If no OFF response is to be triggered, the fault response can be reparameterized accordingly.
Fault F01910 can be immediately acknowledged. The drive can then be operated even without PROFIBUS.

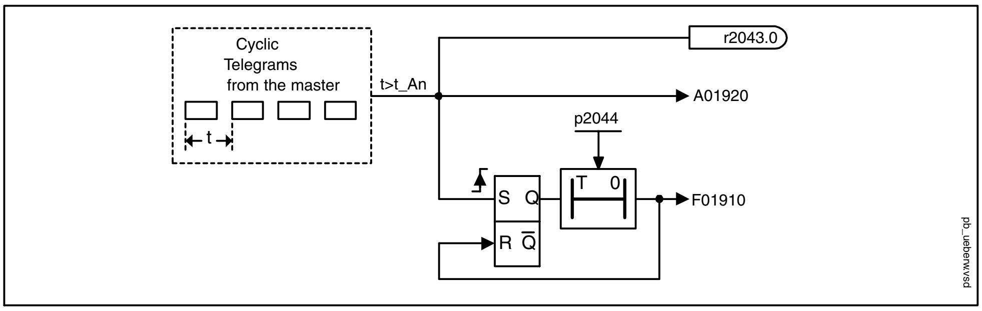


Fig. 5-6 Monitoring: telegram failure

Example: emergency stop with telegram failure

Assumption:

A drive unit with an Active Line Module and a Single Motor Module.

VECTOR mode is activated.

After the ramp-down time has elapsed (p1135), the drive is at a standstill.

Settings:

- A_INF p2044 = 2
- VECTOR p2044 = 0

Sequence:

After a telegram failure (t > t_An), binector output r2043.0 of drive object CU switches to “1”. At the same time, alarm A01920 is output for the A_INF drive objects and alarm A01920 and fault F01910 are output for VECTOR. When F01910 is output, an OFF3 is triggered for the drive. After a delay time (p2044) of two seconds has elapsed, fault F01910 is output on the infeed and triggers OFF2.

5.3 Motion Control with PROFIBUS

Description

The “Motion control with PROFIBUS” function can be used to implement an isochronous drive link between a master and one or more slaves via the PROFIBUS fieldbus.

Note

The isochronous drive link is defined in the following documentation:

References: /P5/ PROFIdrive Profile Drive Technology

Properties

- No additional parameters have to be entered in addition to the bus configuration in order to activate this function. All that is necessary is to initialize the master and slave for the function.
- The master-side default setting is made via the hardware configuration (e.g. HWConfig with SIMATIC S7). The slave-side default setting is made via the parameterization telegram when the bus is ramping up.
- Fixed sampling times are used for all data communication.
- The Global Control (GC) clock information is transmitted before the beginning of each cycle.
- The length of the clock cycle depends on the bus configuration: When the clock cycle is selected, the bus configuration tool (e.g. HWConfig) supports:
  - Large number of drives per slave/drive unit –> long cycle
  - Large number of slaves/drive units –> long cycle
- A sign-of-life counter is used to monitor user data transfer and clock pulse failures.

Overview of closed-loop control

- Sensing of the actual position value on the slave can be performed using:
  - An indirect measuring system (motor encoder)
  - An additional direct measuring system
- The encoder interface must be configured in the process data.
- The control loop is closed via the PROFIBUS.
- The position controller is located on the master.
- The current and speed control systems and actual value sensing (encoder interface) are located on the slave.
- The position controller clock cycle is transmitted across the field bus to the slaves.
- The slaves synchronize their speed and/or current controller cycle with the position controller cycle on the master.
- The speed setpoint is specified by the master.

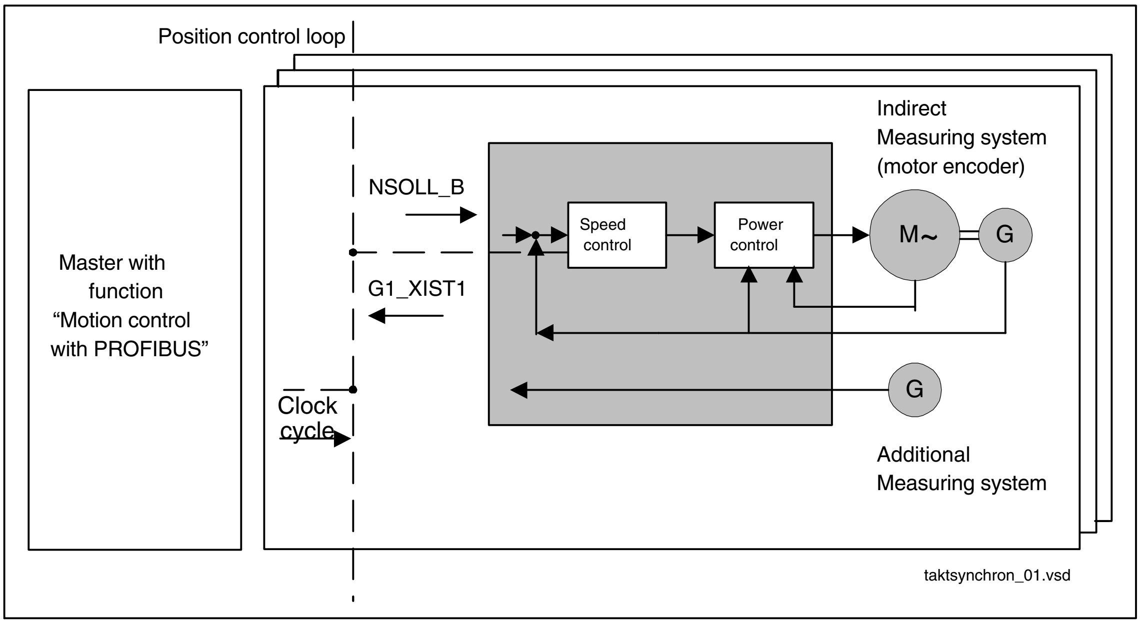


Fig. 5-7 Overview of "Motion control with PROFIBUS" (example: master and 3 slaves)

Structure of the data cycle

The data cycle comprises the following elements:

1. Global control message frame
2. Cyclic part
   – Setpoints and actual values.
3. Acyclic part
   – Parameters and diagnostic data.
4. Reserved part
   – Forwarding the token (T_{TH}).
   – For searching for a new node in the drive line-up (GAP).
   – Waiting time until next cycle.

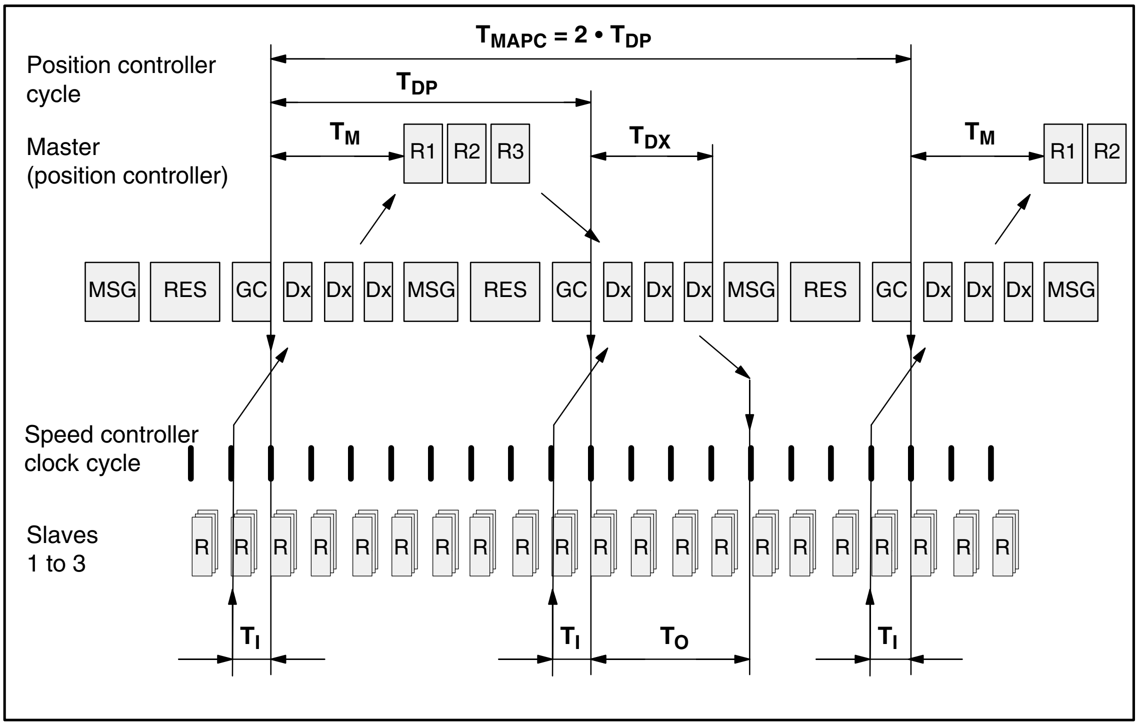


Fig. 5-8 Example: Optimized cycle with $T_{MAPC} = 2 \bullet T_{DP}$

Sequence of data transfer to closed-loop control system

1. Position actual value G1_XIST1 is read into the telegram image at time T_I before the start of each cycle and transferred to the master in the next cycle.
2. Closed-loop control on the master starts at time T_M after each position controller cycle and uses the current actual values read previously from the slaves.
3. In the next cycle, the master transmits the calculated setpoints to the telegram image of the slaves. The speed setpoint command NSOLL_B is issued to the closed-loop control system at time T_O after the beginning of the cycle.

Designations and descriptions for Motion Control

Table 5-4 Time settings and meanings

Name	Value[1)]	Limit value	Description
T_{BASE_DP}	5DC hex ≙ 1500 dec	–	Time base for T_{DP} Calculation: T_{BASE_DP} = 1500 • T_{Bit} = 125 µs T_{Bit} = 1/12 µs at 12 Mbaud
T_{DP}	8	$T_{DP} \geq T_{DP\_MIN}$ T_{DP_MIN} = 8	Cycle time T_{DP} = integer multiple • T_{BASE_DP} Calculation: T_{DP} = 8 • T_{BASE_DP} = 1 ms Minimum DP cycle time Calculation: T_{DP_MIN} = 8 • T_{BASE_DP} = 1 ms
T_{MAPC}	1	n • T_{DP} n = 1 – 14	Master application cycle time This is the time frame in which the master application generates new setpoints (e.g. in the position controller cycle). Calculation: T_{MAPC} = 1 • T_{DP} = 1 ms
T_{SAPC}			Slave application cycle time
T_{BASE_IO}	5DC hex ≙ 1500 dec	–	Time base for T_I, T_O Calculation: T_{BASE_IO} = 1500 • T_{Bit} = 125 µs T_{Bit} = 1/12 µs at 12 Mbaud
T_I	2	$T_{I\_MIN} \leq T_I < T_{DP}$ T_{I_MIN} = 1	Time of actual-value sensing This is the time at which the actual position value is captured before the start of each cycle. T_I = integer multiple of T_{BASE_IO} Calculation: T_I = 2 • 125 µs = 250 µs For T_I = 0: T_I = T_{DP} Minimum T_I Calculation: T_{I_MIN} = 1 • T_{BASE_IO} = 125 µs

Table 5-4 Time settings and meanings, continued

Name	Value[1)]	Limit value	Description
T_O	4	$T_{DX} + T_{O\_MIN} \leq T_O \leq T_{DP}$ $T_{O\_MIN} = 1$	Time of setpoint transfer This is the time at which the transferred setpoints (speed setpoint) are accepted by the closed-loop control system after the start of the cycle. T_O = integer multiple of T_{BASE_IO} Calculation: $T_O = 4 \bullet 125\ \mu s = 500\ \mu s$ For $T_O = 0$: $T_O \doteq T_{DP}$ Minimum time interval between T_O and T_{DX} $T_{O\_MIN} = 1 \bullet T_{BASE\_IO} = 125\ \mu s$
T_{DX}	E10 hex ≙ 3600 dec	$T_{DX} < T_{DP}$	Data exchange time This is the time required within one cycle for transferring process data to all available slaves. T_{DX} = integer multiple of T_{Bit} $T_{Bit} = 1/12\ \mu s$ at 12 Mbaud Calculation: $T_{DX} = 3600 \bullet T_{BIT} = 300\ \mu s$
T_{PLL_W}	0	–	PLL window (half the width of the GC synchronization window) The following applies to the setting: • Small window —> minimization of synchronization fluctuations on the drive • Large window —> higher tolerance of GC fluctuations Calculation: (assumption: T_{PLL_W} = A hex ≙ 10 dec) $T_{PLL\_W} = 10 \bullet T_{BIT} = 0.833\ \mu s$ $T_{Bit} = 1/12\ \mu s$ at 12 Mbaud
T_{PLL_D}	0	–	PLL dead time The PLL dead time can be used to compensate for different data transfer times to the slaves (e.g. due to repeaters). The slaves with faster transfer times are delayed with a corresponding PLL dead time. Calculation: $T_{PLL\_D} = 0 \bullet T_{BIT} = 0\ \mu s$ $T_{Bit} = 1/12\ \mu s$ at 12 Mbaud
GC			Global Control Telegram (broadcast telegram)
T_{TH}			Token hold time This time is calculated by the engineering system.
Dx			Data_Exchange This service is used to implement user data exchange between master and slave 1 – n.
MSG			Acyclic service After cyclic transmission, the master checks whether the token hold time has already expired. If not, another acyclic DPV1 service is transmitted.

Table 5-4 Time settings and meanings, continued

Name	Value[1)]	Limit value	Description
RES			Reserve: “Active pause” until the isochronous cycle has expired
R			Processing time for speed or position controller
T_M			Master time This is the time from the start of the position controller cycle to the start of master closed-loop control.
GAP			Attempt to open connection with new node. This attempt takes place every xth cycle.
T_J			T_J returns the duration of the cycle jitter. The cycle jitter is the delay of the GC telegram.

1) The values correspond to device master file si0280e5.gs_

Setting criteria for times

- Cycle (T_{DP})
  - T_{DP} must be set to the same value for all bus nodes.
  - $T_{DP} > T_{DX}$ and $T_{DP} \geqq T_O$

    T_{DP} is thus large enough to enable communication with all bus nodes.

Notice

After T_{DP} has been changed on the PROFIBUS master, the drive system must be switched on (POWER ON).

- T_I and T_O
  - Setting the times in T_I and T_O as small as possible reduces the dead time in the position control loop.
  - $T_O > T_{DX} + T_{Omin}$
- Various tools (e.g. HWConfig in SIMATIC S7) are available for making settings and carrying out optimization measures. Note the following:
  - Configuring reserves allows the following:

    Class 2 masters can be connected

    Non-cyclic communication

Minimum times for reserves

Table 5-5 Minimum times for reserves

Data	Time required [μs]
Basic load	300
Per slave	20
Per byte of user data	1.5
One additional class 2 master	500

User data integrity

User data integrity is verified in both transfer directions (master <—> slave) by a sign-of-life (4-bit counter).

The sign-of-life counters are incremented from 1 to 15 and then start again at 1.

- Master sign-of-life
  - STW2.12 ... STW2.15 are used for the master sign-of-life.
  - The master sign-of-life counter is incremented on each master application cycle (T_{MAPC}).
  - The number of sign-of-life errors tolerated can be set via p0925.
  - p0925 = 65535 deactivates sign-of-life monitoring on the slave.
  - Monitoring

    The master sign-of-life is monitored on the slave and any sign-of-life errors are evaluated accordingly.

    The maximum number of tolerated master sign-of-life errors with no history can be set via p0925.

    If the number of tolerated sign-of-life errors set in p0925 is exceeded, the response is as follows:

    —> A corresponding message is output.

    —> The value zero is output as the slave sign-of-life.

    —> Synchronization with the master sign-of-life is started.
- Slave sign-of-life
  - ZSW2.12 ... ZSW2.15 are used for the slave sign-of-life.
  - The slave sign-of-life counter is incremented in each DP cycle (T_{DP}).

5.4 Slave-to-slave communications

5.4.1 General information

Description

For PROFIBUS-DP, the master addresses all of the slaves one after the other in a DP cycle. In this case, the master transfers its output data (setpoints) to the particular slave and receives as response the input data (actual values). Fast, distributed data transfer between drives (slaves) is possible using the “slave-to-slave communications” function without involving the master.

The following terms are used for the functions described here:

- Slave-to-slave communications
- Data Exchange Broadcast (DXB.req)
- Slave-to-slave communications (is used in the following)

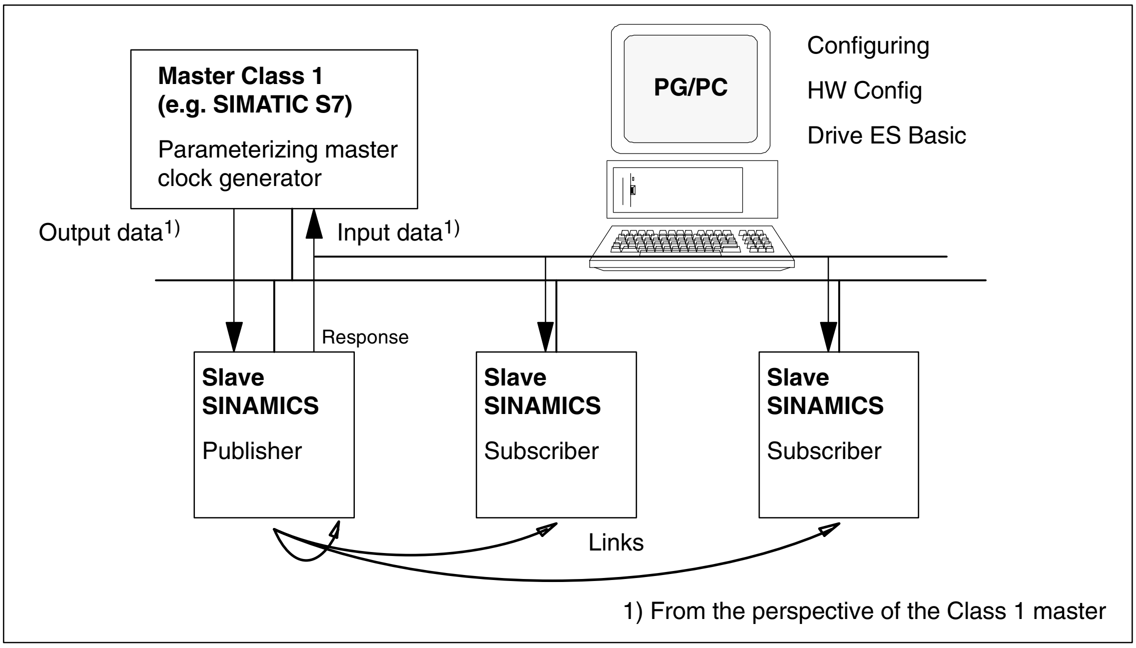


Fig. 5-9 Slave-to-slave communications with the publisher-subscriber model

Publisher

For the function “slave-to-slave communications” at least one slave must assume the role of the Publisher.
The Master addresses the Publisher when transferring output data with a modified layer 2 function code (DXB.req). The publisher then sends its input data to the master with a broadcast telegram to all bus nodes.

Subscriber

The subscribers evaluate the broadcast telegrams, sent from the publishers, and use the data which has been received as setpoints. The setpoints are used, in addition to the setpoints received from the master, corresponding to the configured telegram structure (p0922).

Links and taps

The links configured in the subscriber (connection to publisher) contain the following information:

- From which publishers may input data be received?
- Which input data is there?
- A which location should the input data be used as setpoints?

Several taps are possible within a link. Several input data or input data areas, which are not associated with one another, can be used as setpoint via a tap.

Links are possible to the device itself. This means, e.g. for a Double Motor Module, data can be transferred from drive A to B. This internal link corresponds, as far as the timing is concerned, to a link via PROFIBUS.

Prerequisites and limitations

The following limitations should be observed for the “slave-to-slave” communications function:

- Drive ES Basic V5.3 SP3
- Firmware release $\geq$ 2.4
- Number of process data, max. per drive
- Number of links to Publishers
- Number of taps per link

Applications

For example, the following applications can be implemented using the “slave-to-slave communications” function:

- Axis couplings (this is practical for isochronous mode)
  - Angular-locked synchronism where the position reference value or position actual value is entered
  - Torque setpoint coupling (master/slave operation)

    Master drive, closed-loop speed controlled <–> Slave drive, open-loop torque controlled
- Specifying binector connections from another slave

5.4.2 Setpoint assignment in the subscriber

Setpoints

The following statements can be made about the setpoint:

- Number of setpoint

  When bus communications is being established, the master signals the slave the number of setpoints (process data) to be transferred using the configuring telegram (ChkCfg).
- Contents of the setpoints

  The structure and contents of the data for the “SINAMICS slave” using the local process data configuring (p0922).
- Operation as “standard” slave

  The drive (slave) only receives its setpoints and output data from the master.
- Operation as subscriber

  When operating a slave subscriber, some of the setpoints are entered from one or several publishers instead of from the master.
  The assignment is communicated to the slave when establishing the bus connection via the parameterizing and configuring telegram.

Example, setpoint assignment

The slave in Fig. receives its process data as follows:

- STW1 and STW2 from the master
- NSOLL_B and MOMRED as tap from a publisher

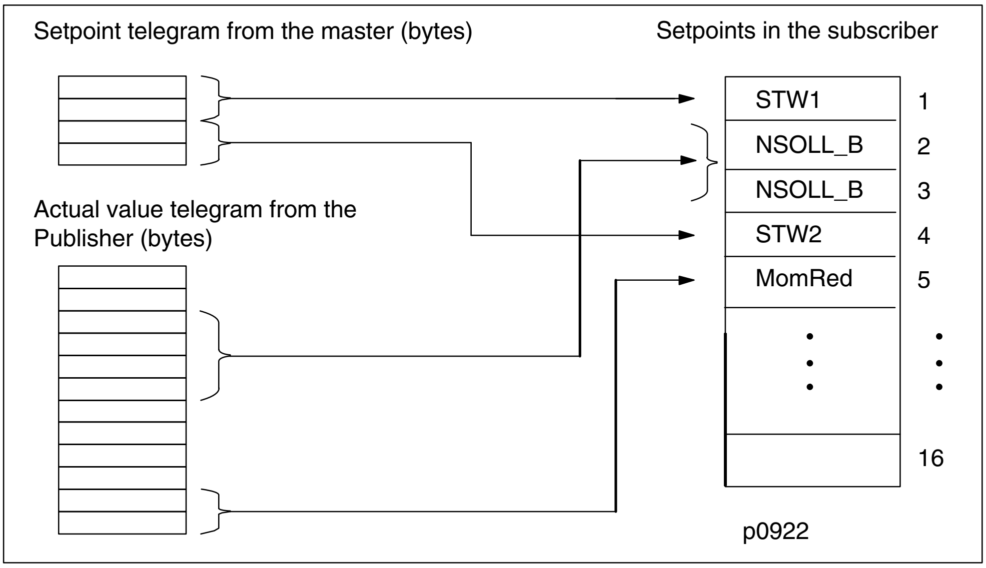


Fig. 5-10 Example, setpoint assignment

5.4.3 Activating/parameterizing slave-to-slave communications

The “slave-to-slave communications” function must be activated both in the publishers as well as in the subscribers, whereby only the subscriber is to be configured. The Publisher is automatically activated by the bus system when booting.

Activation in the Publisher

The master is communicated via the link configuration with the Subscribers which slaves are to be addressed as Publisher with a modified layer 2 function code (DXB request).
As a result, the Publisher not only sends its input data to the master, but also to all bus nodes as broadcast telegram.

These settings are automatically made by the S7 software.

Activation in the Subscriber

The slave, which is to be used as Subscriber, requires a filter table. The slave must know which setpoints are received from the master and which are received from a publisher.

STEP7 automatically generates the filter table.

The filter table contains the following information:

- Address of the publisher
- Length of the process data
- Position (offset) of the input data
- Amount of data
- Target of the data

Parameterizing telegram (SetPrm)

The filter table is transferred, as dedicated block from the master to the slave with the parameterizing telegram when bus communications are established.

Configuring telegram (ChkCfg)

Using the configuration telegram, a slave knows how may setpoints are to be received from the master and how many actual values are to be sent to the master.

For slave-to-slave communications, a special space ID is required for each tap. The PROFIBUS configuration tool (e.g. HW Config) generates this ID and then transferred with the ChkCfg in the drives that operate as Subscribers.

Block header	Block-Len[1)]	12 – 244
	Command	0xE2
	Slot	0x00
	Specifier	0x00
Filter table Header	Version identifier	0xE2
	Number of links	0 – 3
	Offset Link1	
	...	
	Offset Link n	
Link1	Publisher DP address	
	Publisher input length	
Tap1	Offs. in the publ. data	
	Targ. offs. in the subscr.	
	Length of the data acc.	
Tap2	...	
Link2	Publisher DP address	
	...	

1) Specified in bytes
2) Calculated from the version ID

Fig. 5-11 Filter block in the parameterizing telegram (SetPrm)

5.4.4 Commissioning with STARTER

Description

The slave-to-slave communications is configured via HW Config and e.g. only represents an extension of an existing telegram. STARTER is presently already supporting the extension of a telegram (e.g. p0922 = 999). The diagnostic capability of slave-to-slave communication relationships using screen forms (via parameters (r2074, r2075 for the receive direction and r2076 for the send direction)) is possible in STARTER.

■

Notes

6 Communications via PROFINET IO

6.1 General information about PROFINET IO

6.1.1 General information about PROFINET IO for SINAMICS

General information

PROFINET IO is an open Industrial Ethernet standard for a wide range of production and process automation applications. PROFINET IO based on Industrial Ethernet and uses TCP/IP and IT standards.

The following standards ensure open, multi-vendor systems:

- International standard IEC 61158

PROFINET IO is optimized for high-speed, time-critical data communication at field level.

PROFINET

Within the framework of Totally Integrated Automation (TIA), PROFINET represents a consequent enhancement of:

- PROFIBUS DP, the established fieldbus and
- Industrial Ethernet, the communication bus for the cell level.

Experience gained from both systems was and is being integrated into PROFINET. PROFINET as an Ethernet-based automation standard from PROFIBUS International (PROFIBUS User Organisation) defines a vendor-independent communication and engineering model.

When a CBE20 is inserted, SINAMICS S120 becomes an IO device in the sense of PROFINET. With SINAMICS S120 and CBE20, communications can either be established via PROFINET IO with IRT or via PROFINET IO with RT. It is not possible to combine both types (the mutually exclude one another).

Note

PROFINET for drive technology is standardized and described in the following document:

Referenced: /P5/ PROFIdrive Profile Drive Technology
// PROFINET System Description,
Order No. 6ES7398-8FA10-8AA0, 6ES7151-1AA10-8AA0

6.1.2 Real time (RT) and isochronous real time communications (IRT)

Real time communications

Industrial communication in which supervisors take part in communication involves run times during communication that are too long for production automation. When communicating time-critical IO user data, PROFINET therefore uses its own real time channel, rather than TCP/IP.

Definition: Real Time (RT) and determinism

Real time means that a system processes external events in a defined time.
A deterministic system means that it responds in a predictable fashion (deterministic).

In industrial networks, both of these requirements are important. PROFINET meets these requirements. PROFINET is implemented as a deterministic real time network as follows:

- Transmission of time-critical data takes place at guaranteed time intervals. To achieve this, PROFINET provides an optimized communication channel for real time communication: Real Time (RT).
- An exact prediction of the time at which the data transfer takes place is possible.
- Problem-free communication using other standard protocols is guaranteed within the same network.

Definition: Isochronous real time communication (IRT)

Isochronous real time Ethernet: Real time properties of PROFINET IO where IRT telegrams are transmitted deterministically via planned communication paths in a defined sequence to achieve the best possible synchronism and performance. This is also known as time-scheduled communications whereby knowledge about the network structure is utilized. IRT requires special network components supporting a planned data transmission.

When this transmission method is implemented in ERTEC-ASICs (Enhanced Real Time Ethernet Controller), cycle times of min. 500 µs and jitter accuracy of less than 1 µs are achieved.

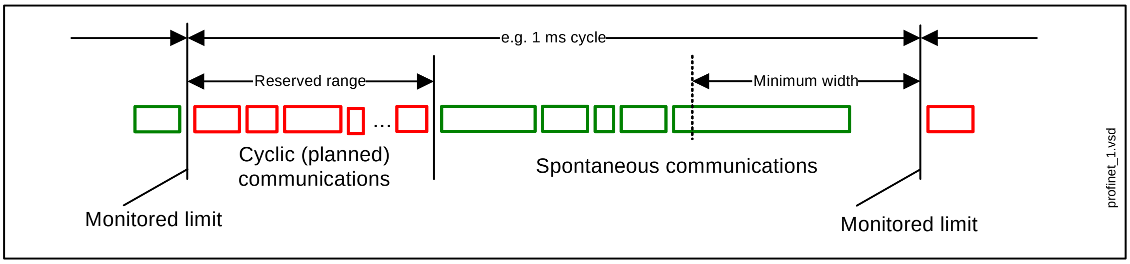


Fig. 6-1 Broadband distribution/reservation, PROFINET IO IRT

Note

When operating S7-300 stations with SINAMICS drives, presently only communications via PROFINET IO with RT are possible. For SIMOTION with SINAMICS drives, communications via PROFINET IO with IRT are possible.

6.1.3 Addresses

Definition: MAC address

Each PROFINET device is assigned a worldwide unique device identifier in the factory. This 6-byte long device identifier is the MAC address. The MAC address is divided up as follows:

- 3 bytes manufacturer's ID and
- 3 bytes device identifier (consecutive number).

As a rule the MAC is located visibly on the front of the device
e.g.: 08–00–06–6B–80–C0

IP address

To allow a PROFINET device to be addressed as a node on Industrial Ethernet, this device also requires an IP address that is unique within the network. The IP address is made up of 4 decimal numbers with a range of values from 0 through 255. The decimal numbers are separated by a period. The IP address is made up of

- The address of the (sub-) network and
- The address of the node (generally called the host or network node).

IP address assignment

The TCP/IP protocol is a prerequisite for establishing a connection and parameterization. This is the reason that an IP address is required.

The IP addresses of IO devices can be assigned by the IO controller and always have the same sub-network mask as the IO controller. The can be consecutively assigned from the IP address of the IO controller. The IP address can be changed manually, if necessary – and is saved in a volatile fashion.

If the IP address is to be saved in a non-volatile fashion, then the Primary Setup Tool (PST) must be used to assign an address (see Subsection 3.2.3).
This function can also be carried-out with HW Config from STEP 7 – here, the function is called “Edit Ethernet Node”.

Note

If the network is part of an existing Ethernet company network, obtain the information from your network administrator (IP address, sub-network mask and a router that is possibly being used).

Device name

When it is shipped, an IO device does not have a device name. An IO device can only be addressed by an IO controller, for example, for the transfer of project engineering data (including the IP address) during startup or for user data exchange in cyclic operation, after it has been assigned a device name with the IO supervisor.

Notice

The device name must be saved in a non-volatile fashion either using the Primary Setup Tool (PST) or using HW Config from STEP 7.

Replacing Control Unit CU320 (IO-Device)

If the IP address and the device name are saved in a **non-volatile fashion**, then this data is transferred using the memory card (CF card) of the Control Unit.

If an IO device must be completely replaced due to a device or submodule defect, the Control Unit automatically assigns parameters and configures the new device or submodule. Following this, cyclic exchange of user data is restarted. The CF card allows module exchange without an IO supervisor when a fault occurs in a PROFINET device.

Definition: Sub-network mask

The bits set in the sub-network mask defines the part of the IP address that contains the address of the (sub-) network. The following generally applies:

- The network address is obtained by an AND operation on the IP address and sub-network mask
- The node address is obtained by an AND NOT operation on the IP address and sub-network mask.

Example of the sub-network mask

Sub-network mask: 255.255.0.0 (decimal) = 11111111.11111111.00000000.00000000 (binary) IP address: 140.80.0.2 significance: The first 2 bytes of the IP address decide the sub-network – in other words 140.80. The last two bytes address the node – in other words 0.2.

Default router

A default router is used when data have to be forwarded via TCP/IP to a partner located outside the sub-network. In the STEP 7 properties dialog box Properties Ethernet Interface > Parameters > Gateway, the default router is called Router. STEP 7 assigns the local IP address to the default router.

6.2 Hardware configuration

6.2.1 Configuring SINAMICS drives with PROFINET

Communication Board Ethernet CBE20

The CBE20 option board is inserted in the option slot of the CU320. CB20 has 4 ports via which the PROFINET sub-network can be connected.

References

A description of the CBE20 and how these can be used in the drive is provided in the Equipment Manual for the Control Unit and supplementary system components.

Step 7 routing with CBE20

CBE20 does not support Step7 routing between PROFIBUS and PROFINET IO.

Connecting the supervisor

There are various ways of going online with STARTER that are shown as an example in the following diagram.

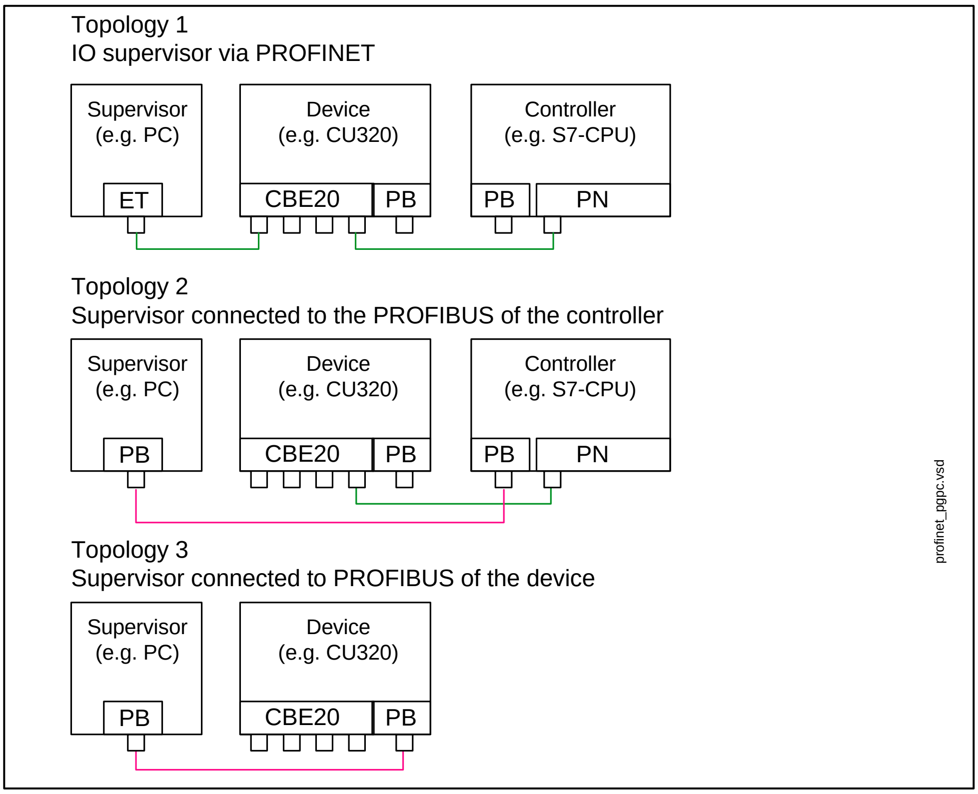


Fig. 6-2 Connecting the supervisor

Notice

SINAMICS does not support routing from PROFIBUS to PROFINET and vice versa.

6.3 Data exchange

6.3.1 Overview

Properties

The Communication Board CBE20 supports operation of:

- IRT – isochronous real time Ethernet
- RT – real time Ethernet
- Standard Ethernet services (TCP/IP, LLDP, UDP and DCP)

PROFIdrive telegram for cyclic data transmission and non-cyclic services

Telegrams to send and receive process data are available for each drive object of a drive unit with cyclic process data exchange. In additional to cyclic data transfer, non-cyclic services can be used in order to parameterize and configure the drive. The supervisor or controller can use these non-cyclic services.
The total length of the Ethernet frame increases with the number of drive objects of a drive unit.

Sequence of drive objects in the data transfer

The sequence of drive objects is displayed via a list in p0978[0...15] where it can also be changed.

Note

The sequence of drive objects in HW Config must be the same as that in the drive (p0978).

Notice

A ring-type topology is not permissible.

6.3.2 RT communications with GSDML v1.0

Prerequisite

For example, a CPU 315 or a CPU 317 is configured with a PROFINET sub-network, and a drive inserted via the GSD file **SINAMICS S120 CBE20 Pilot RT**.

Now, drives and drive objects (DOs) are to be parameterized. For this version of the drive, the telegrams must be inserted step-by-step. To start, a **Parameter Access Point** must be inserted, then a telegram and then again another **Parameter Access Point** - and so on.

Note

The sequence of the telegram structure must match the sequence of the drive objects in the configuration screen of the drive in STARTER.

Procedure

1. Select the inserted drive in the hardware catalog.
2. Drag the Parameter Access Point entry to slot 1 in the station window of the drive.
3. For the first drive object (DO), drag the appropriate telegram for cyclic data transfer to the next slot of the station window.
4. Points 2 and 3 must be repeated for every drive object that exchanges cyclic data.
5. The project must be saved and compiled once all of the drive objects have been inserted.

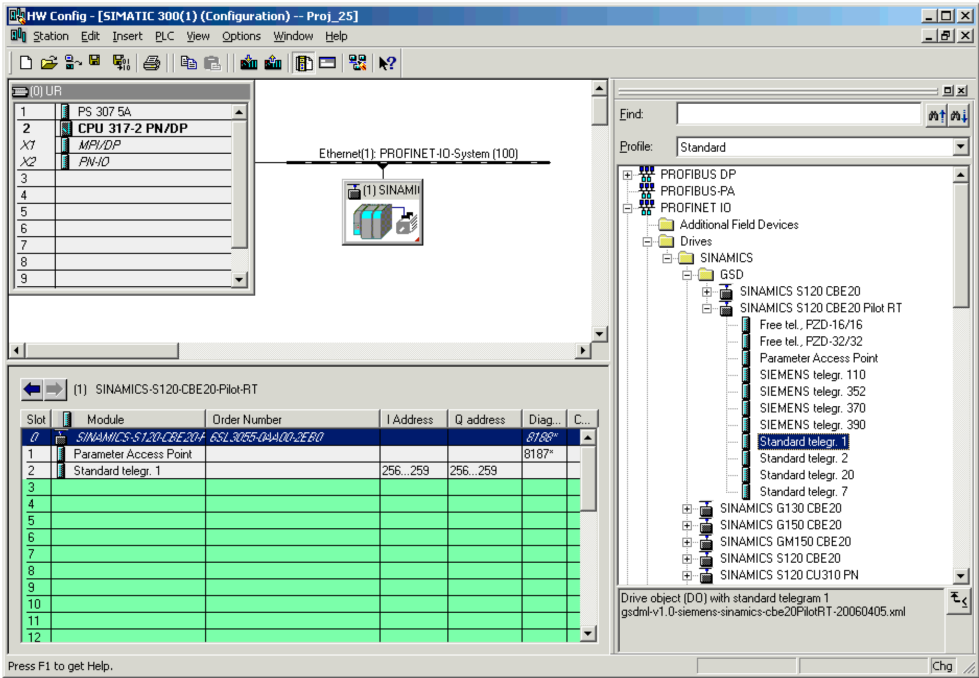


Fig. 6-3 Configured project in HW Config

6. Assigning the device name.

   “Assign IP address via IO Controller” means that the configured IP address is assigned in a volatile fashion when the IO controller and IO device boot. The configured device name must match the device name of the IO device.

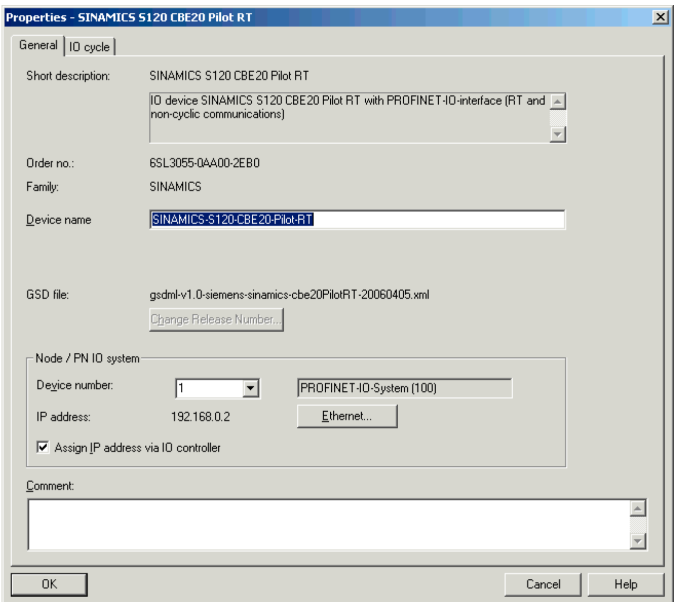


Fig. 6-4 Properties of the IO device

7. The configuration in HW Config has now been completed.

6.3.3 RT– / IRT communications with GSDML v2.0

Prerequisite

For example, a CPU319 with a PROFINET IO is configured with RT sub-network and a drive is inserted via the GSD file **SINAMICS S120 CBE20.**

If IRT communications are to be established using GSDML V2.0, then this is only possible using a SIMOTION controller. The procedure in HW Config is identical with the difference that instead of a SIMATIC–CPU, e.g. a SIMOTION D is used.

Now, drives and drive objects (DOs) are to be parameterized. For this version of the GSDML file, the telegrams can be inserted one after the other.

Note

The sequence of the telegram structure must match the sequence of the drive objects in the configuration screen of the drive in STARTER.

Procedure

1. Select the inserted drive in the hardware catalog.
2. For the first drive object (DO), drag the appropriate telegram for cyclic data transfer to the next slot of the station window. A **Parameter Access Point** is automatically inserted.
3. Point 2 should be repeated for every drive object where cyclic data is exchanged.
4. The project must be saved and compiled once all of the drive objects have been inserted.

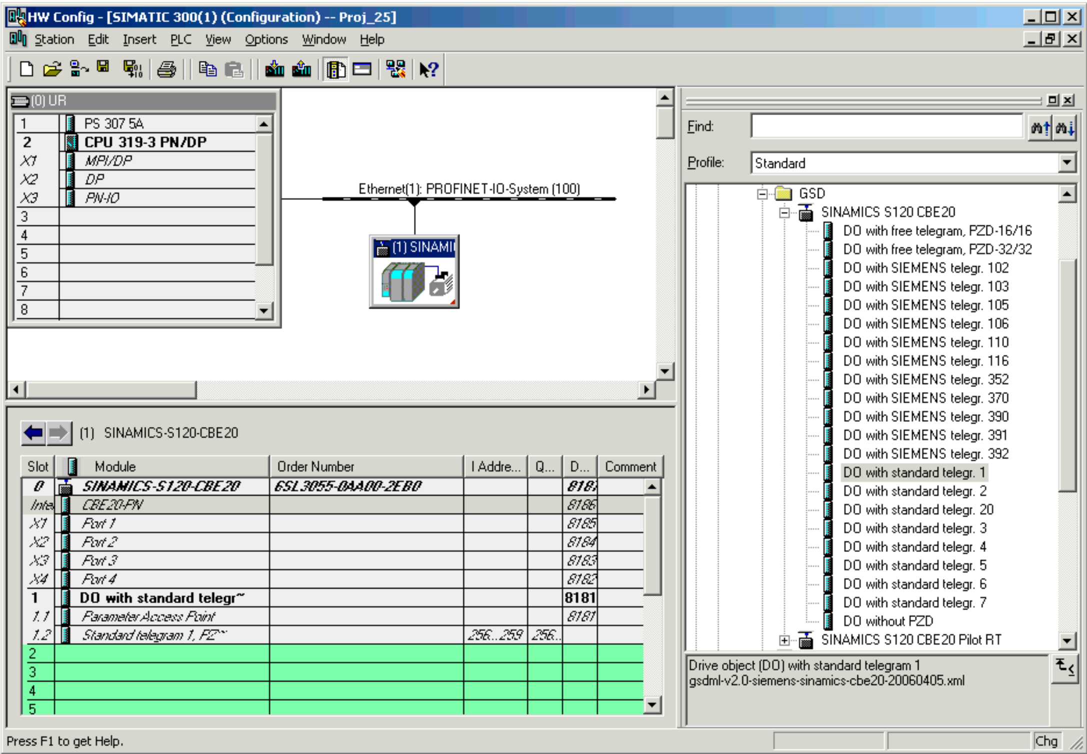


Fig. 6-5 Configure DOs in HW Config

5. Double click on the drive unit. The dialog box for the properties of the IO device is displayed.

   "Assign IP address via IO Controller" means that the configured IP address is assigned in a volatile fashion when the IO controller and IO device boot. The configured device name must match the device name of the IO device.

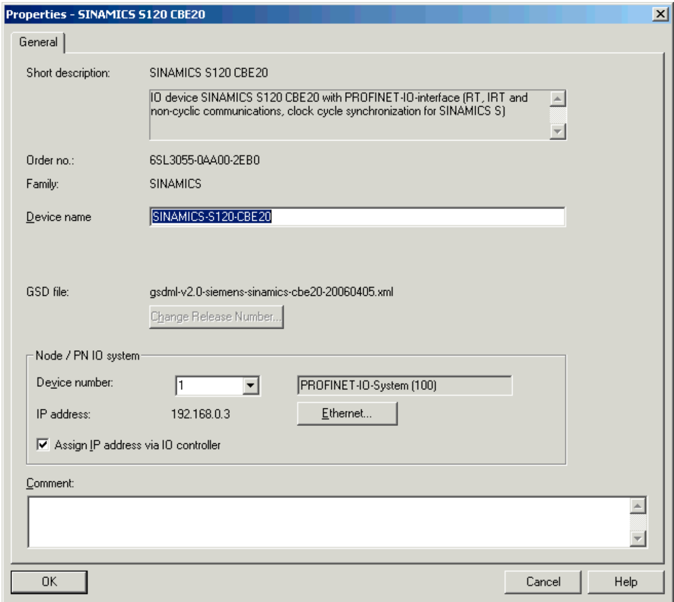


Fig. 6-6 Properties of the IO device

6. The configuration in HW Config has now been completed.

6.3.4 RT- / IRT communications with Device OM

Introduction

If a full version of STEP7 V5.4 is installed on the engineering station (PC), then with the STARTER setup, the Device OM is installed.

SIMOTION SCOUT also includes the Device OM. A full version of STEP 7 is required. Unless, SCOUT standalone is installed – in this case, an OEM version of STEP 7 is supplied, which allows SIMOTION projects to be handled.

SCOUT includes STARTER which can be used to commission drives. This means that also SINAMICS drives with SIMATIC CPU and PROFINET can be configured Device OM allows drive objects to be configured in a user-friendly fashion - these automatically include routing information.

Note

The GSD files of the drives should still be used for older FW releases of SIMATIC controls (e.g. CPU317 PN/DP < V2.4).

SIMATIC CPU with SINAMICS drives and PROFINET IO with RT

In our example, we will describe the Device OM in conjunction with the CPU319 and PROFINET IO with RT. If PROFINET IO with IRT is to be configured using Device OM, then this is only possible when using a SIMOTION controller. The procedure in HW Config is identical with the difference that instead of a SIMATIC-CPU, e.g. a SIMOTION D is used.

Please contact SIEMENS Product Service for a list of SIMATIC S7 modules that work with Device OM.

1. In the hardware catalog, open the folder **PROFINET IO –> Drives –> SINAMICS –> appropriate drive**.

   The available SINAMICS Device OM drive objects are listed. If GSD files are already installed, then in addition, a GSD directory is displayed.
2. Select the appropriate drive object (DO) and drag to the appropriate slot of the station window. The slot for the CPU is now shown in green.
3. Drag the drive object to this slot. The **SINAMICS properties** dialog box is displayed.
4. Keep firmware 2.4 and acknowledge with **OK**.

5. Double click on the drive unit. The dialog box for the properties of the IO device is displayed.

   “Assign IP address via IO Controller” means that the configured IP address is assigned in a volatile fashion when the IO controller and IO device boot. The configured device name must match the device name of the IO device.

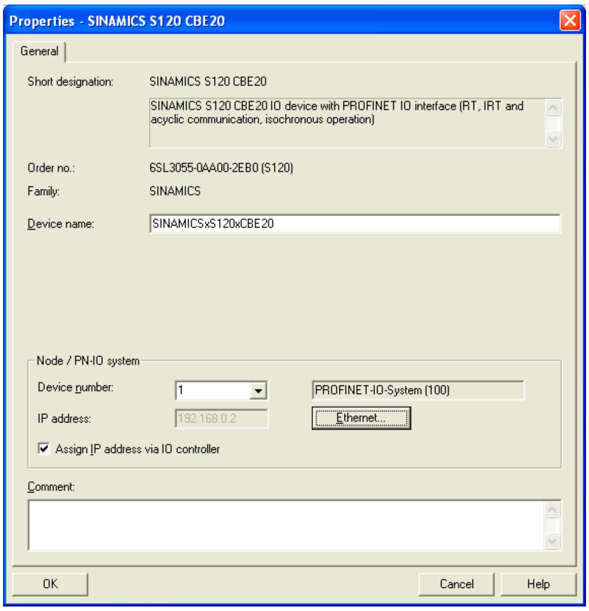


Fig. 6-7 Properties of the IO device

6. The drive object is inserted with telegram 1 provided as standard. This telegram setting can be changed.
7. Double-click on the telegram entry

   The **Telegram_x** properties dialog box opens.

8. Selects telegram for the drive object

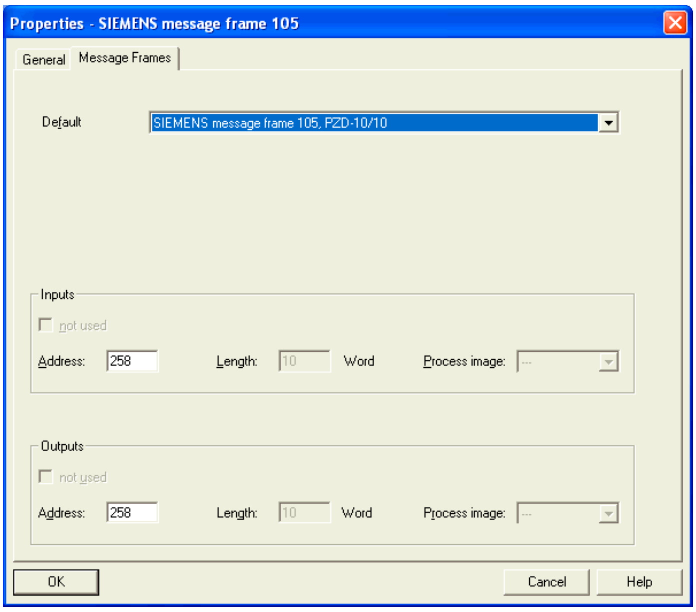


Fig. 6-8 Properties of the IO device

9. For each drive, insert an additional drive object an configure the appropriate telegram.

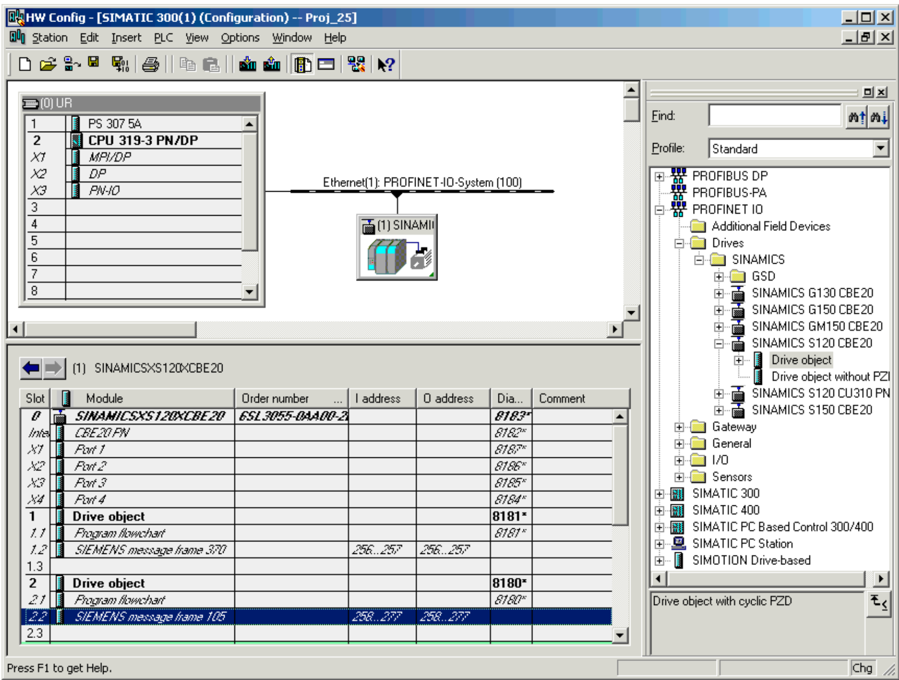


Fig. 6-9 CPU 319 with drive

10. The configuration in HW Config has now been completed.

Note

Drive objects without PZD do not transfer process data and are used e.g. to transfer parameters.

SIMOTION CPU with SINAMICS drives and PROFINET IO with IRT

Contrary to SIMATIC CPU, with SIMOTION CPU (SIMOTION D and SIMOTION P350), communications can be established to SINAMICS drives via PROFINET IO with IRT.

Requirements

For PROFINET IO, SIMOTION 4.0 and STEP 7 V5.4 must be installed on the PG/PC. For SIMOTION D, the Communication Board CBE30 is required; for SIMOTION P350 an MCI-PN Board.

PROFINET IO with IRT

For PROFINET IO with IRT, in addition to the settings for SIMATIC CPU319, additional settings must be made – e.g. the sync domain, the update times and the topology.

Configuring SIMOTION CPU with PROFINET IO is described in the Commissioning Manuals for SIMOTION D4xx and SIMOTION P350.

Procedure

1. Configuring the sync domain

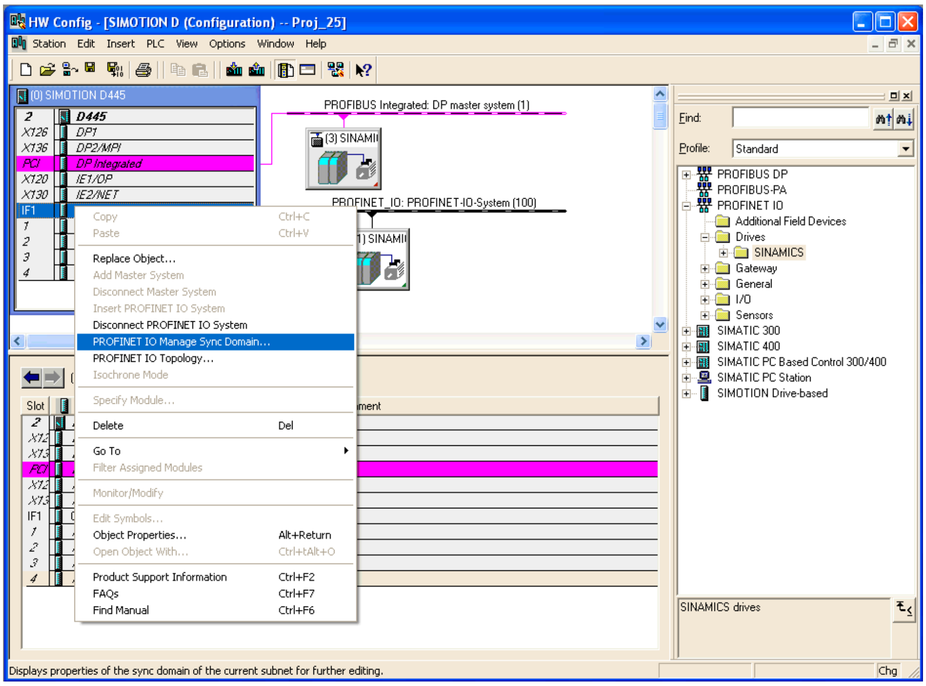


Fig. 6-10 Example, SIMOTION D sync domain

2. Define the properties of the devices.

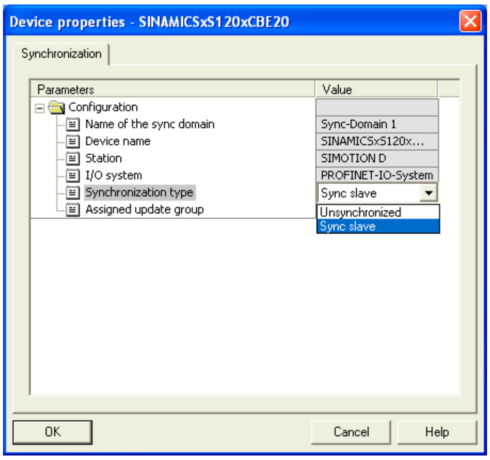


Fig. 6-11 Example, properties of a device

3. The send clock cycle and the update group can be defined under the tab Update Group.
   The transfer times for input and output data can be defined (Ti / To).

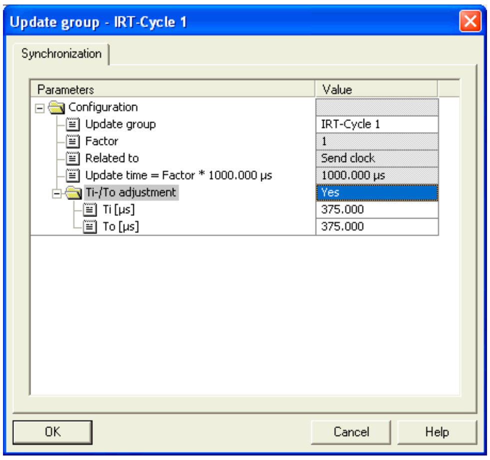


Fig. 6-12 Example, Ti- / To adjustment

4. PROFINET IO topology: Port interconnection

   You select a port in the lefthand sub-window and with a double-click the partner port is assigned in the righthand sub-window.

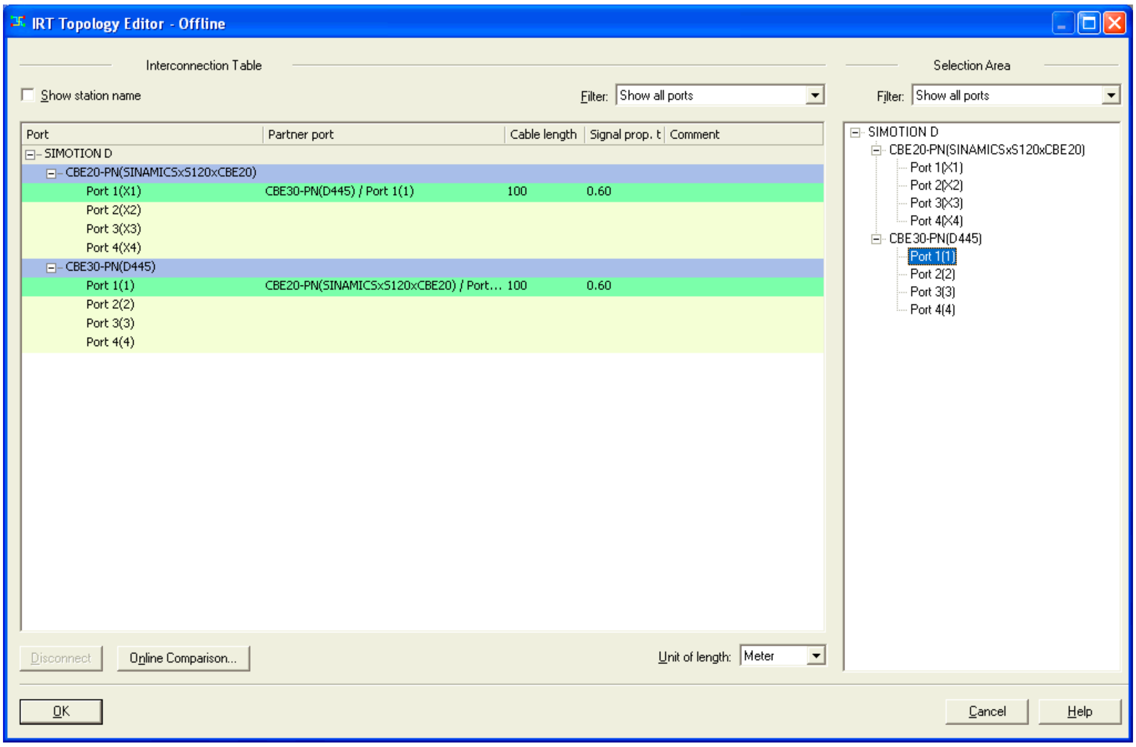


Fig. 6-13 Example, IRT topology

5. The configuration in HW Config has now been completed.

■

Notes

SINAMICS Safety Integrated 7

7.1 General information about SINAMICS Safety Integrated

7.1.1 Explanations, standards, and terminology

Safety Integrated

The “Safety Integrated” functions, which have been prototype tested, provide highly-effective application-oriented protection for personnel and machinery.

This innovate safety technology offers the following benefits:

- Increased safety
- More economic operation
- Greater flexibility
- Higher level of plant availability

The following Safety Integrated (SI) functions are available:

- Safe standstill (SH)

  “Safe standstill (SH)” is a function that helps prevent the drive from restarting unexpectedly (to EN 60204–1, Section 5.4).
- Safe Stop 1 (SS1)

  Safe Stop 1 is based on the “Safe standstill“ function. This means that stopping according to EN 60204–1 of stop Category 1 can be implemented.
- Safe Brake Control (SBC)

  Chassis components do not support the SBC function.
  For this function, Power Modules Blocksize require, in addition, a Safe Brake Relay.

Note

These functions are integrated in the drive; this means that a higher-level controller is not required.

Standards and directives

Various standards and guidelines for safety technology must be observed.

Guidelines are binding for both the manufacturer and operator of machines.

Standards generally reflect the state of the art and act as a basis for implementing safety concepts. Unlike guidelines, however, they are not binding.

Below is a list of standards and guidelines for safety technology.

- EC 98/37/EG machinery directive

  This guideline defines basic protection measures for safety technology
- EN 292–1

  Basic terminology and general principles for design
- EN 954–1

  Safety-related parts of control systems
- EN 1050

  Risk assessment
- IEC 61508

  Functional reliability of electrical and electronic systems

  This standard defines “safety integrity levels” (SIL), which not only describe a certain degree of integrity with regard to safety-oriented software but also defined, quantitative error probability ranges with regard to the hardware.

Note

In conjunction with certified components, the safety functions of the SINAMICS S120 drive system fulfill the following requirements:

- Category 3 to EN 954–1.
- Safety integrity level 2 (SIL 2) to IEC 61508.

A list of certified components is available on request from your local Siemens office.

Notice

The “automatic restart” function may not be used together with the safety functions SH/SBC and SS1. The reason for this is that IEC60204 Part 1 (1998) in Subsection 9.2.5.4.2 does not permit this.
(Just de-selecting a safety shutdown function may not cause the machine to restart)

Expectations

The monitoring functions in each monitoring channel work on the principle that a defined status must prevail before each action is carried out and a specific acknowledgement made after each action.

If these expectations of a monitoring channel are not fulfilled, the drive coasts to a standstill (two channel) and an appropriate message is output.

Shutdown paths

Two independent shutdown paths are available. All shutdown paths are low active thereby ensuring that the system is always switched to a safe status if a component fails or in the event of cable breakage.

If an error is discovered in the shutdown paths, the “Safe standstill” function is activated and a system restart inhibited.

Two-channel monitoring structure

All the main hardware and software functions for Safety Integrated are implemented in two independent monitoring channels (e.g. shutdown paths, data management, data comparison).

The two drive monitoring channels are implemented using the following components:

- Control Unit
- The Motor Module/Power Module belonging to a drive.

Forced checking procedure or test for shutdown paths

Forced checking procedure for the shutdown paths is used for detecting errors in the software/hardware of the two monitoring channels as quickly as possible and is carried out automatically when the “Safe standstill” function is activated/deactivated.

To fulfill the requirements of EN 954–1 regarding timely error detection, the two shutdown paths must be tested at least once within a defined time to ensure that they are functioning properly. For this purpose, forced checking procedure must be triggered manually by the user or automatically.

A timer ensures that forced checking procedure is carried out as quickly as possible.

- p9659 SI timer for the forced checking procedure

Forced checking procedure of the shutdown paths must be carried out at least once during the time set in this parameter.

Once this time has elapsed, an alarm is output and remains present until the forced checking procedure is carried out.

The timer returns to the set value each time the “Safe standstill” function is deactivated.

When the appropriate safety devices are implemented (e.g. protective doors), it can be assumed that running machinery will not pose any risk to personnel. For this reason, only an alarm is output to inform the user that a forced checking procedure is due and request that this be carried out at the next available opportunity. This alarm does not affect machine operation.

The user must set the time interval for carrying out forced checking procedure to between 0.00 and 9000.00 hours depending on the application (factory setting: 8.00 hours).

When to carry out the forced checking procedure:

- When the drives are at a standstill after the system has been switched on.
- When the protective door is opened.
- At defined intervals (e.g. every 8 hours).
- In automatic mode (time and event dependent).

Safety-related input signals (SGE)

Safety-relevant input signals act as an interface with the process. These digital signals are transmitted to the system (two channel) and are used for selecting/deselecting safety functions.

Example: Selecting/deselecting “Safe standstill” (SH)

Notice

The detection time of the input signals must be less than 1 ms.

Crosswise data comparison

A cyclic crosswise comparison of the safety-relevant data in the two monitoring channels is carried out.

In the event of inconsistencies, the following occurs:

1. Fault F01611 or F30611 (STOP F) is output and the time in p9658 or p9858 triggered.
2. Once the time has elapsed, a further fault (F01600 or F30600 (STOP A)) is output and the safe pulse disable activated.

The fault response is transferred to the other monitoring channel so that two-channel standstill can be carried out.

Monitoring clock cycle

The safety-relevant drive functions are executed cyclically in the monitoring clock cycle.

The safety monitoring clock cycle lasts a minimum of 4 ms. Increasing the basic DRIVE-CLiQ sampling time (p0110) also increases the safety monitoring clock cycle.

Parameter overview (see List Manual)

- r9780 SI monitoring clock cycle (Control Unit)
- r9880 SI monitoring clock cycle (Motor Module)

7.1.2 Parameter, checksum, version, password

Properties of Safety Integrated parameters

The following applies to Safety Integrated parameters:

- They are kept separate for each monitoring channel.
- They are password-protected against accidental or unauthorized changes.
- During ramp-up, a checksum (cyclic redundancy check: CRC) is generated and checked via the safety parameters, which have undergone a checksum check.
- Data management
  - Safety parameters for Control Unit

    These parameters are stored on the non-volatile CompactFlash card.
  - Safety parameters for Motor Module

    These parameters are stored on the non-volatile CompactFlash card in a different format.
- Factory settings for safety parameters

  You can only reset the safety parameters to the factory setting on a drive-specific basis using p0970 or p3900 when the safety functions are not enabled (p9601 = p9801 = 0).

  All the factory settings can be restored (p0976 = 1 and p0009 = 1 on the Control Unit) even when the safety functions are enabled (p9601 = p9801 = 1).

Checking the checksum

For each monitoring channel, the safety parameters include one parameter for the actual checksum for the safety parameters that have undergone a checksum check.

During commissioning, the actual checksum must be transferred to the corresponding parameter for the specified checksum.

- r9798 SI actual checksum SI parameters (Control Unit)
- p9799 SI reference checksum SI parameters (Control Unit)
- r9898 SI actual checksum SI parameters (Motor Module)
- p9899 SI reference checksum SI parameters (Motor Module)

During each ramp-up procedure, the actual checksum is calculated via the safety parameters and then compared with the specified checksum.

If the actual and specified checksums are different, fault F01650 or F30650 is output and an acceptance test requested.

Safety Integrated versions

The safety software has a separate version ID for the Control Unit and Motor Module.

- r9770[0...2] SI Version, safety functions integrated in the drive (Control Unit)
- r9870[0...2] SI Version (Motor Module)

Password

The safety password protects the safety parameters against unauthorized write access.

In commissioning mode for Safety Integrated (p0010 = 95), you cannot change safety parameters until you have entered the valid safety password in p9761.

- When Safety Integrated is commissioned for the first time, the following applies:
  - Safety password = 0
  - Default setting for p9761 = 0

  This means:

  The safety password does not need to be set during initial commissioning.
- Change password
  - p0010 = 95 commissioning mode (see Section 7.5)
  - p9761 = Enter “old safety password”.
  - p9762 = Enter “new password”.
  - p9763 = Confirm “new password”.
  - The new and confirmed safety password is valid immediately.

If you need to change safety parameters but you do not know the safety password, proceed as follows:

1. Set the entire drive unit (Control Unit with all connected drives/components) to the factory setting (see 3.2.1).
2. Recommission the drive unit and drives.
3. Recommission Safety Integrated.

Parameter overview (see List Manual)

- p9761 SI password input
- p9762 SI password new
- p9763 SI password acknowledgement

7.2 Safe standstill (SH)

General description

In conjunction with a machine function or in the event of an error, the “Safe standstill (SH)” function is used to safely disconnect the torque-generating motor power supply.

When the function is selected, the drive unit is in a “safe status”. The power-on disable function prevents the drive unit from being restarted.

The pulse cancellation integrated in the Motor Modules / Power Modules is a basis for this function.

Features of “safe standstill”

- This function is integrated in the drive; this means that a higher-level controller is not required.
- The function is drive specific, that is, it must be commissioned individually on a drive-by-drive basis.
- Enable of the function using parameters required
- The terminals for the “safe standstill” function can be grouped together.
  Not for the Control Unit CU310.
- When the “safe standstill” function is selected:
  - The motor cannot be started accidentally.
  - The pulse disable safely disconnects the torque-generating motor power supply.
  - The power unit and motor are not electrically isolated.

Caution

Appropriate measures must be taken to ensure that the motor does not move once the motor power supply has been disconnected (“coast down”) (e.g. enable the “Safe brake control” function with a vertical axis).

Caution

If two power transistors in the power unit (one in the upper and one in the lower bridge) fail at the same time, this can cause a momentary movement.

The maximum movement can be:

Synchronous rotary motors: max. movement = 180° / number of pole pairs

Synchronous linear motors: max. movement = pole width

- The status of the “Safe standstill” function is displayed via the appropriate parameters.

Overview of the safety function terminals for SINAMICS S120

The different power unit formats of SINAMICS S120 have different terminal designations for the inputs of the safety functions. These are shown in the following table.

Table 7-1 Inputs for safety functions

	1. Shutdown path (p9620)	**2. Shutdown path**
Control unit CU320	X122.1....4 / X132.1...4 (on the CU320) Digital inputs 0 to 7	(see Motor Modules / Power Modules)
Single Motor Module Booksize	(see CU320)	X21.3 and X21.4 (on the Motor Module)
Single Motor Module Chassis	(see CU320)	X41.1 and X41.2 (on the CIB)
Double Motor Module Booksize	(see CU320)	X21.3 and X21.4 (motor connection X1)/ X22.3 and X22.4 (motor connection X2) (on the Motor Module)
Power Module Blocksize with CUA31	(see CU320)	X210.3 and X210.4 (on the CUA31)
Power Module Blocksize with CU310	X121.1...4 (on the CU310) Digital inputs 0 to 3	X120.7 and X120.8 (on the CU310)
Power Module Chassis with CU310	X121.1...4 (on the CU310) Digital inputs 0 to 3	X41.1 and X41.2 (on the CIB)
For further information about the terminals, refer to the Equipment Manuals		

Terminals for "Safe standstill"

The function "safe standstill" is separately selected/de-selected for each drive using two terminals.

- 1. Shutdown path (CU310/CU320)

  The required input terminal for "Safe standstill (SH)" is selected via the BICO interconnection (BI: p9620).

- 2. Shutdown path (Motor Module/Power Module/CUA31)

  The input terminal for "Safe standstill (SH)" is terminal "EP" ("Enable pulses").

Both terminals must be operated simultaneously, otherwise a fault will be issued.

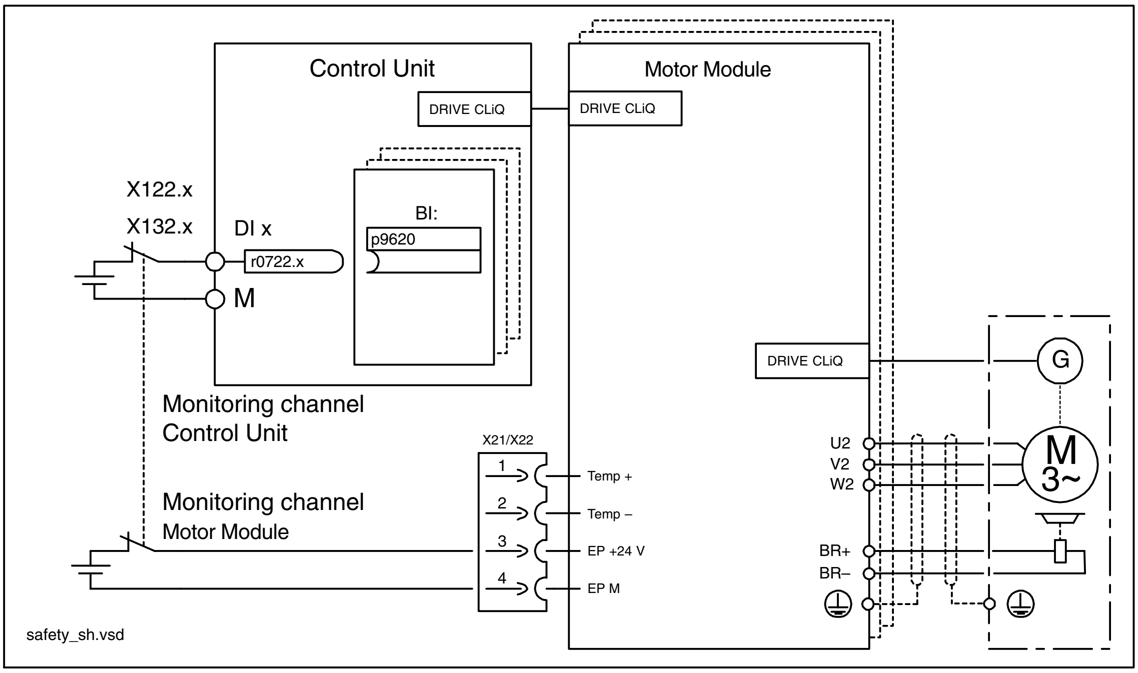


Fig. 7-1 Terminals for "safe standstill", example for Motor Modules Booksize and CU320

Grouping drives (not for CU310)

To ensure that the function works for more than one drive, the terminals for the corresponding drives must be grouped together as follows:

- 1. Shutdown path (CU320)

  By connecting the binector input to the joint input terminal on the drives in one group.

- 2. Shutdown path (Motor Module/CUA31)

  By appropriately connecting-up the terminals for the individual Motor Modules/Power Modules belonging to the group with CUA31.

Note

The grouping must be identical in both monitoring channels.

If a fault in a drive results in a "Safe standstill (SH)", this does not automatically mean that the other drives in the same group also switch to "Safe standstill (SH)".

The assignment is checked during the test for the shutdown paths, whereby the operator selects "Safe standstill" for each group. The check is drive specific.

Example: terminal grouping for "Safe standstill (SH)"

It must be possible to select/deselect "Safe standstill" separately for group 1 (drive 1 and 2) and group 2 (drive 3 and 4).

In addition, the same grouping for "Safe standstill" must be assigned on both the Control Unit and the Motor Modules.

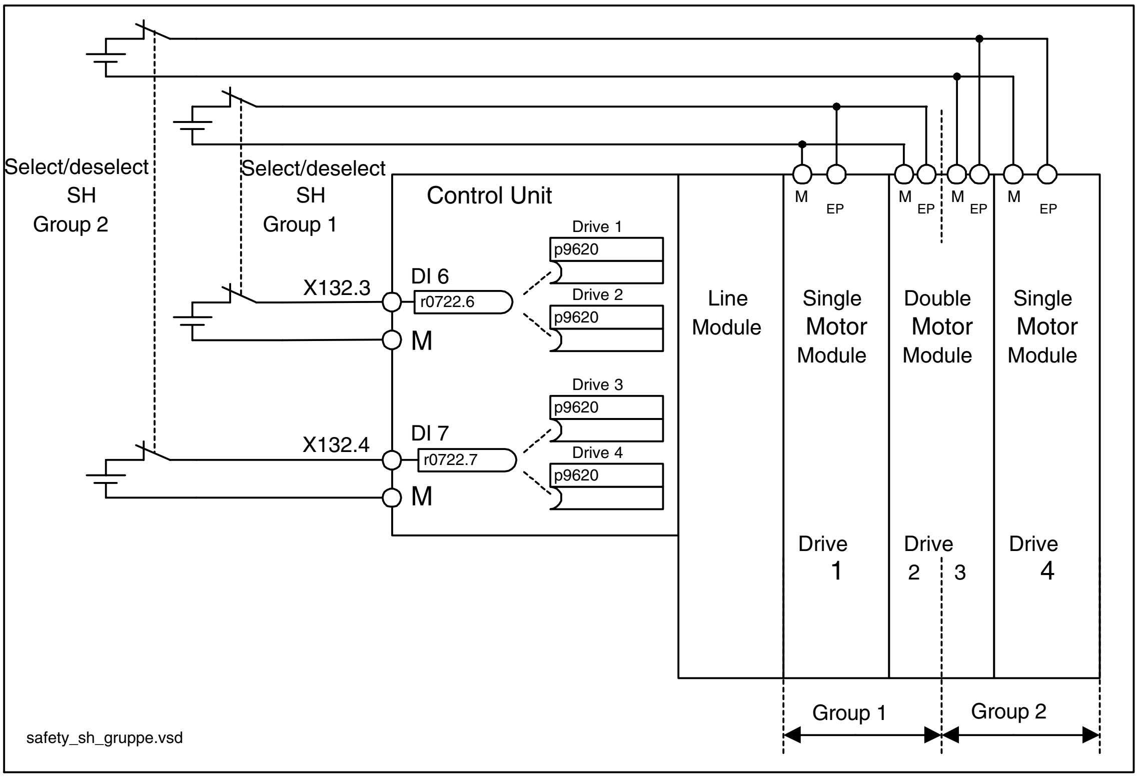


Fig. 7-2 Example: Grouping terminals with Motor Modules Booksize and CU320

Enabling the "Safe standstill (SH)" function

The "Safe standstill" function is enabled via the following parameters:

- p9601.0 SH via terminals (Control Unit)
- p9801.0 SH via terminals (Motor Module/Power Module/CUA31/CU310)

Selecting/deselecting "Safe standstill"

The "Safe standstill" function must be selected/deselected "simultaneously" in both monitoring channels using the input terminals and act only on the associated drive.

1 signal: Deselect function

0 signal: Select function

"Simultaneously" means:

The changeover must be complete in both monitoring channels within the parameterized tolerance time.

- p9650 SI tolerance time SGE changeover (Control Unit)
- p9850 SI tolerance time SGE changeover (Motor Module)

If the "Safe standstill" function is not selected/deselected within the tolerance time, this is detected by the crosswise data comparison and fault F01611 or F30611 (STOP F) is output. In this case, the pulses have already been canceled as a result of the selection of "safe standstill" on one channel.

The following occurs when "Safe standstill" is selected:

- Each monitoring channel triggers the safe pulse disable via its shutdown path.
- A motor holding brake is applied (if connected and configured).

The following occurs when "Safe standstill" is deselected:

- Each monitoring channel cancels the safe pulse disable via its shutdown path.
- The safety prompt "Apply motor holding brake" is canceled.
- Any STOP F or STOP A commands are canceled (see r9772/r9872).

Note

If "Safe standstill" is de-selected through one channel within the time in p9650/p9850, the pulses are cancelled but a signal is not output.

If you want a message to be displayed in this case, however, you have to reconfigure N01620/N30620 via p2118 and p2119 as an alarm or fault (refer to Subsection 8.3.3).

Restart once the “Safe standstill” function has been selected

1. Deselect the function in each monitoring channel via the input terminals.
2. Issue drive enable signals.
3. Cancel the power-on inhibit and switch the drive back on.
   – 1/0 edge at input signal “ON/OFF1” (cancel power-on inhibit)
   – 0/1 edge at input signal “ON/OFF1” (switch on drive)
4. Run the drives again.

Status with “Safe standstill”

The status of the “Safe standstill (SH)” function is indicated via the following parameters:

Parameter overview (see List Manual)

- r9772 CO/BO: SI status (Control Unit)
- r9872 CO/BO: SI status list (Motor Module)
- r9773 CO/BO: SI status (Control Unit + Motor Module)
- r9774 CO/BO: SI status (safe standstill group)

As an alternative, the status of the functions can be displayed using the configurable messages N01620 and N30620 (configured using p2118 and p2119).

Response time for “Safe standstill” function

The following values can be specified for the response times when the function is selected/deselected via input terminals:

- Typical response time

  2 x Safety monitoring clock cycle CU (r9780) + input/output time sampling time (p0799)
- Max. response time when error is present

  4 x Safety monitoring clock cycle CU (r9780) + input/output time sampling time (p0799)

Examples, Booksize:

Assumption:
Safety monitoring clock cycle time CU (r9780) = 4 ms and
inputs/outputs sampling time (r0799) = 4 ms

t_{R_typ} = 2 x r9780 (4 ms) + r0799 (4 ms) = 12 ms

t_{R_max} = 4 x r9780 (4 ms) + r0799 (4 ms) = 20 ms

Parameter overview (see List Manual)

- p0799 CU inputs/outputs sampling times
- r9780 SI monitoring clock cycle (Control Unit)
- r9880 SI monitoring clock cycle (Motor Module)

7.3 Safe Stop 1 (SS1)

General description

Safe Stop 1 is based on the function “Safe standstill” which means that stopping according to EN 60204–1, stop Category 1 can be implemented. After selecting “Safe Stop 1” with the OFF3 ramp (p1135), the drive brakes and safely cancels the pulses after the delay time in p9652/p9852.

Functional features of “Safe Stop 1”

- SS1 is activated by p9652 and p9852 (delay time) not equal to “0”
- This function is only available in conjunction with “Safe standstill”.
- When SS1 is selected, the drive is braked along the OFF3 ramp (p1135) and SH/SBC are automatically initiated after the delay time expires (p9652/p9852).

  After the function has been activated the delay time runs – even if the function is de-selected during this time. In this case, after the delay time has expired, the SH/SBC function is selected and then again de-selected immediately.
- The selection is realized through two channels – however braking along the OFF3 ramp, only through one channel.

Commissioning

The function is activated by entering the delay time in p9652 and p9852.

Requirements

The “Safe standstill” function must be enabled.

In order that the drive can brake down to a standstill even when selected through one channel, the time in p9652/p9852 must be shorter than the sum of the parameters for the crosswise data comparison (p9650/p9850 and p9658/p9858).

The time in p9652/9852 must be dimensioned so that after selection, the drive brakes down to a standstill.

Status for "Safe Stop 1"

The status of the "Safe Stop 1" function is displayed using the following parameters:

- r9772 CO/BO: SI status (Control Unit)
- r9773 CO/BO: SI status (Control Unit + Motor Module)
- r9774 CO/BO: SI status (safe standstill group)
- r9872 CO/BO: SI status list (Motor Module)

Alternatively, the status of the functions can be displayed using the configurable messages N01621 and N30621 (configured using p2118 and p2119).

Overview of important parameters (refer to the List Manual)

- Refer to the "Safe standstill" function
- p1135 OFF3 ramp-down time
- p9652 SI Safe Stop 1 delay time (Control Unit)
- p9852 SI Safe Stop 1 delay time (Motor Module)

7.4 Safe brake control (SBC)

Description

Safe brake control is used to activate holding brakes that function according to the standby current principle (e.g. motor holding brake).

The command for releasing or applying the brake is transmitted to the Motor Module/Power Module via DRIVE-CLiQ. The Motor Module/Safe Brake Relay then carries out the action and activates the outputs for the brake.

Brake activation via the brake connection on the Motor Module/Safe Brake Relay is carried out using a safe, two-channel method.

Note

Chassis components do not support this function.

Note

In order that Power Modules Blocksize can use this function, a Safe Brake Relay must be used (for additional information, see the Equipment Manual).
For the automatic configuration of the Power Module, the Safe Brake Relay is detected and the motor holding brake type pre-assigned (p1278 = 0).

Warning

"Safe brake control" does not detect faults in the brake itself (e.g. brake winding short-circuit, worn brakes, and so on).

If a cable breaks, this is only recognized by the "safe brake control" function when the status changes (e.g. when the brake is applied/released).

Features of “Safe brake control (SBC)”

- When “Safe standstill” is selected or when safety monitors are triggered, “SBC” is triggered by means of safe pulse disable.
- Unlike conventional brake control, “SBC” is triggered via p1215 with two channels.
- “SBC” is triggered independently of the brake control mode set in p1215. “SBC” is not recommended, however, when 1215 = 0 or 3.
- Enable of the function using parameters required
- Each time “Safe standstill” is selected, the holding brake is applied immediately with forced checking procedure.

Enabling the “Safe brake control (SBC)” function

The “Safe brake control” function is enabled via the following parameters:

- p9602 SI enable safe brake control (Control Unit)
- p9802 SI enable safe brake control (Motor Module)

The “Safe brake control” function is not activated until at least one safety monitoring function is enabled (i.e. p9601 = p9801 $\neq$ 0).

Two-channel brake control

The brake is controlled from the Control Unit. Two signal paths are available for applying the brake.

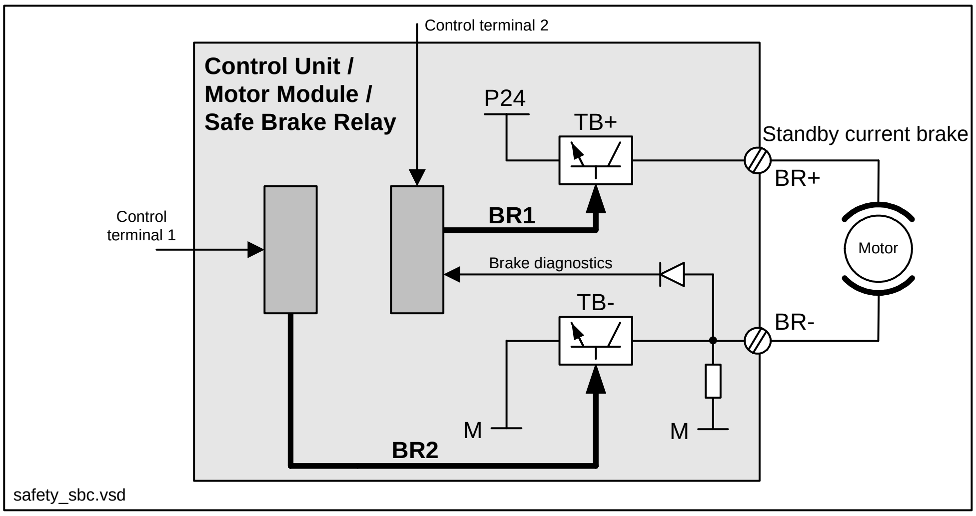


Fig. 7-3 Two-channel brake control, Booksize

The Motor Module carries out a check to ensure that the “Safe brake control” function is working properly and ensures that if the Control Unit fails or is faulty, the brake current is interrupted and the brake applied.

The brake diagnosis can only reliably detect a malfunction in either of the switches (TB+, TB-) when the status changes (when the brake is released or applied).

If the Motor Module or Control Unit detects a fault, the brake current is switched off and the safe status is reached.

Response time for “Safe brake control” function

The following values can be specified for the response times when the function is selected/deselected via input terminals:

- Typical response time

  4 x Safety monitoring clock cycle CU (r9780) + input/output time sampling time (p0799)
- Max. response time when error is present

  8 x Safety monitoring clock cycle CU (r9780) + input/output time sampling time (p0799)

Examples:

Assumption:
Safety monitoring clock cycle time CU (r9780) = 4 ms and
inputs/outputs sampling time (r0799) = 4 ms

t_{R_typ} = 4 x r9780 (4 ms) + r0799 (4 ms) = 20 ms

t_{R_max} = 8 x r9780 (4 ms) + r0799 (4 ms) = 36 ms

Parameter overview (see List Manual)

- p0799 CU inputs/outputs sampling times
- r9780 SI monitoring clock cycle (Control Unit)
- r9880 SI monitoring clock cycle (Motor Module)

7.5 Commissioning the “SH”, “SBC” and “SS1” functions

7.5.1 General information about commissioning safety functions

Commissioning notes

Notice

For safety reasons, safety functions cannot be commissioned offline with the STARTER commissioning tool (or SCOUT).

Note

- The “SH”, “SBC” and “SS1” functions are drive specific, that is, the functions must be commissioned individually for each drive.
- To support the “SH” and “SBC” functions, the following (minimum) safety versions are required:

  Control Unit: V02.01.01 (r9770[0...2])

  Motor Modules: V02.01.01 (r9870[0...2])
- To support the “SS1” functions, the following (minimum) safety version is required:

  Control Unit: V02.04.01 (r9770[0...2])

  Motor Modules: V02.04.01 (r9870[0...2])
- If the version in the Motor Module is incompatible, the Control Unit responds as follows during the switchover to safety commissioning mode (p0010 = 95):
  – Fault F01655 (SI CU: Align the monitoring functions) is output. The fault triggers stop response OFF2.

    The fault cannot be acknowledged until safety commissioning mode (p0010 ≠ 95) is exited.
  – The Control Unit triggers a safe pulse disable via its own safety shutdown path.
  – If parameterized (p1215), the motor holding brake is applied.
  – The safety functions cannot be enabled (p9601/p9801 and p9602/p9802).

Prerequisites for commissioning the safety functions

1. Commissioning of the drives must be complete.
2. Non-safe pulse disable must be present.

   e.g. via OFF1 = “0” or OFF2 = “0”

   If the motor holding brake is connected and parameterized, the holding brake is applied.
3. The terminals for “Safe standstill” must be wired.
   – Control Unit: Digital input DI 0 ... DI 7 or DI 0 ... 3
   – Motor Modules: Terminal “EP”
4. For operation with SBC, the following applies:

   A motor with motor holding brake must be connected to the appropriate terminal of the Motor Module.

Standard commissioning of the safety functions

1. A project that has been commissioned and uploaded to STARTER can be transferred to another drive unit without losing the safety parameterization.
2. If the source and target devices have different software versions, it may be necessary to adjust the setpoint checksums (p9799, p9899). This is indicated by the faults F01650 (fault value: 1000) and F30650 (fault value: 1000).
3. Once the project has been downloaded to the target device, a short acceptance must be carried out (see table 7-10). This is indicated by fault F01650 (fault value: 2004).

Notice

Once a project has been downloaded, it must be stored on the non-volatile CompactFlash card (copy from RAM to ROM).

Replacing Motor Modules with a more up-to-date FW release

1. After a Motor Module fails, a more receive firmware release can be installed on the new Motor Module.
2. If the old and new devices have different software versions, it may be necessary to adjust the reference checksums (p9899) (see Table 7-2). This is indicated by F30650 (fault value: 1000).

Table 7-2 Adapting the reference checksum (p9899)

No.	Parameters	Description/comments
1	p0010 = 95	Safety Integrated: set commissioning mode
2	p9761 = “Value”	Set the safety password
3	p9899 = “r9898”	Adapt the reference checksum on the Motor Module
4	p0010 = Value not equal to 95	Safety Integrated: exit commissioning mode
5	POWER ON	Carry-out a POWER ON

Adapt the reference checksum with the safety screens of STARTER:

Change settings –> Enter password –> Activate settings

After the settings have been activated, the checksums are automatically adapted.

7.5.2 Procedure for commissioning “SH”, “SBC” and “SS1”

To commission the “SH”, “SBC” and “SS1” functions, carry-out the following steps:

Table 7-3 Commissioning the “SH”, “SBC” and “SS1” functions

No.	Parameters	Description/comments
1	p0010 = 95	**Safety Integrated: set commissioning mode** • The following alarms and faults are output: – A01698 (SI CU: commissioning mode active) During initial commissioning only: – F01650 (SI CU: acceptance test required) with fault value = 130 (no safety parameters exist for the Motor Module). – F30650 (SI MM: acceptance test required) with fault value = 130 (no safety parameters exist for the Motor Module). For information on the acceptance test and certificate, see Step 14. • The pulses are reliably disabled and monitored by the Control Unit and Motor Module. • The safety sign-of-life is monitored by the Control Unit and Motor Module. • The function for exchanging stop responses between the Control Unit and Motor Module is active. • An existing and parameterized motor holding brake has already been applied. • In this mode, fault F01650 or F30650 with fault value = 2003 is output after a safety parameter is changed for the first time. This behavior applies for the entire duration of safety commissioning, that is, the “Safe standstill” function cannot be selected/deselected while safety commissioning mode is active because this would constantly force safe pulse disable.
2	p9761 = “Value”	**Set the safety password** When Safety Integrated is commissioned for the first time, the following applies: • Safety password = 0 • Default setting for p9761 = 0 This means that the safety password does not need to be set during initial commissioning.
3		**Enable the “Safe standstill” function**
	p9601.0	SH via Control Unit terminals
	p9801.0	SH via Motor Module terminals
		• The parameters are not changed until safety commissioning mode has been exited (i.e. when p0010 ≠ 95 is set). • Both parameters are contained in the crosswise data comparison and must, therefore, be identical.

Table 7-3 Commissioning the "SH", "SBC" and "SS1" functions, continued

No.	Parameters	Description/comments
4	 p9602 = 1 p9802 = 1	**Enable the "Safe brake control" function** Enable "SBC" on the Control Unit Enable "SBC" on the Motor Module • The parameters are not changed until safety commissioning mode has been exited (i.e. when p0010 ≠ 95 is set). • Both parameters are contained in the crosswise data comparison and must, therefore, be identical. • The "Safe brake control" function is not activated until at least one safety monitoring function is enabled (i.e. p9601 = p9801 ≠ 0).
5	 p9652 > 0 p9852 > 0	**Enable "Safe Stop 1" function** Enable "SS1" on the Control Unit Enable "SS1" on the Motor Module • The parameters are not changed until safety commissioning mode has been exited (i.e. when p0010 ≠ 95 is set). • Both parameters are contained in the crosswise data comparison and must, therefore, be identical. • The "Safe Stop 1" function is only activated if at least one safety monitoring function is enabled (i.e. p9601 = p9801 ≠ 0).
6	 p9620 = "Value" Terminal "EP"	**Set terminals for "Safe standstill"** Set the signal source for "Safe standstill" on the Control Unit. Wire terminal "EP" (enable pulses) on the Motor Module. • Control Unit monitoring channel: By appropriately interconnecting BI: p9620 for the individual drives, the following is possible: – Select/deselect "Safe standstill" – Group the terminals for "Safe standstill" • Motor Module monitoring channel: By wiring the "EP" terminal accordingly on the individual Motor Modules, the following is possible: – Select/deselect "Safe standstill" – Group the terminals for "Safe standstill" **Note:** The "Safe standstill" terminals must be grouped identically in both monitoring channels.

Table 7-3 Commissioning the “SH”, “SBC” and “SS1” functions, continued

No.	Parameters	Description/comments
7	 p9650 = “Value” p9850 = “Value”	**Set the tolerance time for the SGE changeover** Tolerance time for the SGE changeover on the Control Unit Tolerance time for the SGE changeover on the Motor Module • The parameters are not changed until safety commissioning mode has been exited (i.e. when p0010 ≠ 95 is set). • Due to the different runtimes in the two monitoring channels, an SGE changeover (e.g. selection/deselection of SH) does not take immediate effect. After an SGE switchover, dynamic data is not subject to a crosswise data comparison during this tolerance time. • Both parameters are contained in the crosswise data comparison and must, therefore, be identical. A difference of one safety monitoring clock cycle is tolerated for the values.
8	 p9658 = “Value” p9858 = “Value”	**Set transition period from STOP F to STOP A** Transition period from STOP F to STOP A on the Control Unit Transition period from STOP F to STOP A on the Motor Module • The parameters are not changed until safety commissioning mode has been exited (i.e. when p0010 ≠ 95 is set). • STOP F is the stop response that is initiated when the crosswise data comparison is violated as a result of fault F01611 or F30611 (SI: defect in a monitoring channel). STOP F normally triggers “No stop response”. • After the parameterized time has expired, STOP A (immediate safety pulse cancellation) is triggered by the fault F01600 or F30600 (SI: STOP A initiated). The default setting for p9658 and p9858 is 0 (i.e. STOP F immediately results in STOP A). • Both parameters are contained in the crosswise data comparison and must, therefore, be identical. A difference of one safety monitoring clock cycle is tolerated for the values.
9	p9659 = “Value”	**Time for carrying out forced checking procedure and testing the safety shutdown paths** • After this time has expired, the user is requested to test the shutdown paths as a result of alarm A01699 (SI CU: Necessary to test the shutdown paths) (i.e. select/de-select SH). • The commissioning engineer can change the time required for carrying out the forced checking procedure and testing the safety shutdown paths.

Table 7-3 Commissioning the “SH”, “SBC” and “SS1” functions, continued

No.	Parameters	Description/comments
10	 p9799 = “r9798” p9899 = “r9898”	**Adjust specified checksums** Specified checksum on the Control Unit Specified checksum on the Motor Module The current checksums for the Safety parameters that have undergone a checksum check are displayed as follows: • Actual checksum on the Control Unit: r9798 • Actual checksum on the Motor Module: r9898 By setting the actual checksum in the parameter for the specified checksum, the commissioning engineer confirms the Safety parameters in each monitoring channel. This procedure is performed automatically when STARTER and the commissioning Wizard for SINAMICS Safety Integrated are used.
11	 p9762 = “Value” p9763 = “Value”	**Set the new Safety password** Enter a new password Confirm the new password • The new password is not valid until it has been entered in p9762 and confirmed in p9763. • As of now, you must enter the new password in p9761 so that you can change Safety parameters. • Changing the Safety password does not mean that you have to change the checksums in p9799 and p9899.
12	p0010 = Value not equal to 95	**Safety Integrated: exit commissioning mode** • If at least one Safety monitoring function is enabled (p9601 = p9801 $\neq$ 0), the checksums are checked: If the target checksum on the Control Unit has not been correctly adapted, then fault F01650 (SI CU: Acceptance test required) is output with fault code 2000 and it is not possible to exit the safety commissioning mode. If the target checksum on Motor Modules has not been correctly adapted, then fault F01650 (SI CU: Acceptance test required) is output with fault code 2001 and it is not possible to exit the safety commissioning mode. • If a safety monitoring function has not been enabled (p9601 = p9801 = 0), safety commissioning mode is exited without the checksums being checked. When safety commissioning mode is exited, the following is carried out: • All the drive parameters are stored on the non-volatile CompactFlash card. • The safety parameters on the motor module are loaded by the control unit and stored on the non-volatile CompactFlash card. • The new safety parameters are active on the Control Unit and Motor Module.
13	POWER ON	**Carry-out a POWER ON** After commissioning, a POWER ON reset must be carried out.

Table 7-3 Commissioning the “SH”, “SBC” and “SS1” functions, continued

No.	Parameters	Description/comments
14	–	**Carry out acceptance test and create test certificate** Once safety commissioning is complete, the commissioning engineer must carry out an acceptance test for the enabled safety monitoring functions. The results of the acceptance test must be documented in an acceptance certificate (see Section 7.8).

7.5.3 Safety faults

Stop response

When Safety Integrated faults occur, the following stop responses can be triggered:

Table 7-4 Safety Integrated stop responses

<table>
<tr><th>Stop response</th><th>Action</th><th>Effect</th><th>Triggered when...</th></tr>
<tr><td>STOP A
Cannot be acknowledged</td><td rowspan="2">Trigger safe pulse disable via the shutdown path for the relevant monitoring channel.
For operation with SBC: Close motor holding brake.</td><td rowspan="2">The motor coasts to a standstill or is braked by the holding brake.</td><td>For all non-acknowledgeable Safety faults with pulse disable.</td></tr>
<tr><td>STOP A</td><td>For all acknowledgeable safety faults with pulse disable.
As a follow-up reaction of STOP F.</td></tr>
<tr><td></td><td colspan="3">STOP A is identical to stop Category 0 to EN 60204–1.
With STOP A, the motor is switched directly to zero torque via the “Safe standstill (SH)” function.
A motor at standstill cannot be started again accidentally.
A moving motor coasts to standstill. This can be prevented by using external braking mechanisms (e.g. armature short-circuiting, holding or operational brake).
When STOP A is present, “Safe standstill (SH)” is effective.</td></tr>
<tr><td>STOP F</td><td>Transition to STOP A.</td><td>None. 1)</td><td>If an error occurs in the crosswise data comparison.</td></tr>
<tr><td></td><td colspan="3">STOP F is permanently assigned to the crosswise data comparison (CDC). In this way, errors are detected in the monitoring channels.
After STOP F, STOP A is triggered.
When STOP A is present, “Safe standstill (SH)” is effective.</td></tr>
</table>

1) If STOP F is output by the crosswise data comparison of the two input signals when the “Safe standstill” function is selected, this means that the pulses have already been canceled when “Safe standstill” was selected on one channel.

Warning

With a vertical axis or pulling load, there is a risk of uncontrolled axis movements when STOP A/F is triggered. This can be prevented by using “Safe brake control (SBC)” and a holding brake with sufficient retention force (non-safe).

Acknowledging the safety faults

Safety Integrated faults must be acknowledged as follows:

1. Remove the cause of the fault.
2. Deselect “Safe standstill (SH)”.
3. Acknowledge the fault.

If safety commissioning mode is exited when the safety functions are switched off (p0010 = value not equal to 95 when p9601 = p9801 = 0), all the safety faults can be acknowledged.

Once safety commissioning mode has been reset (p0010 = 95), all the faults that were previously present reappear.

Notice

The safety faults can also be acknowledged (as with all other faults) by switching the drive unit off and then on again (Power On).

If this action has not eliminated the fault cause, the fault is displayed again immediately after power up.

Description of faults and alarms

Note

The faults and alarms for SINAMICS Safety Integrated are described in the following documentation:

/LH1/ SINAMICS S List Manual – Section 3.2

7.6 Overview of parameters and function diagrams

Parameter overview (see List Manual)

Table 7-5 Safety Integrated parameters

No. Control Unit (CU)	No. Motor Module (MM)	Name	Can be changed in
p9601	p9801	SI enable safety functions	Safety Integrated commissioning (p0010 = 95)
p9602	p9802	SI enable safe brake control	
p9620	–	SI signal source for safe standstill	
p9650	p9850	SI SGE changeover, tolerance time (Motor Module)	
p9652	p9852	SI Safe Stop 1 delay time	
p9658	p9858	SI transition time STOP F to STOP A	
p9659	–	SI timer for the forced checking procedure	
p9761	–	SI password input	In every operating mode
p9762	–	SI password new	Safety Integrated commissioning (p0010 = 95)
p9763	–	SI password acknowledgment	
r9770[0...2]	r9870[0...2]	SI version safety function integrated in the drive	–
r9771	r9871	SI shared functions	–
r9772	r9872	SI CO/BO: Status	–
r9773	–	SI CO/BO: Status (Control Unit + Motor Module)	–
r9774	–	SI CO/BO: Status (group safe standstill)	–
r9780	r9880	SI monitoring clock cycle	–
r9794	r9894	SI crosswise comparison list	–
r9795	r9895	SI diagnostics for STOP F	–
r9798	r9898	SI actual checksum SI parameters	–
p9799	p9899	SI target checksum SI parameters	Safety Integrated commissioning (p0010 = 95)

Description of the parameters

Note

The SINAMICS Safety Integrated parameters are described in the following documentation:

/LH1/ SINAMICS S List Manual – Section 1.2

Function diagram overview (see List Manual)

- 2800 Safety parameter manager
- 2802 Monitoring functions and faults/alarms
- 2804 Status words
- 2810 Safe standstill (SH)
- 2814 Safe brake control (SBC)

7.7 Application examples

7.7.1 Safe standstill with locked protective door (emergency stop shutdown)

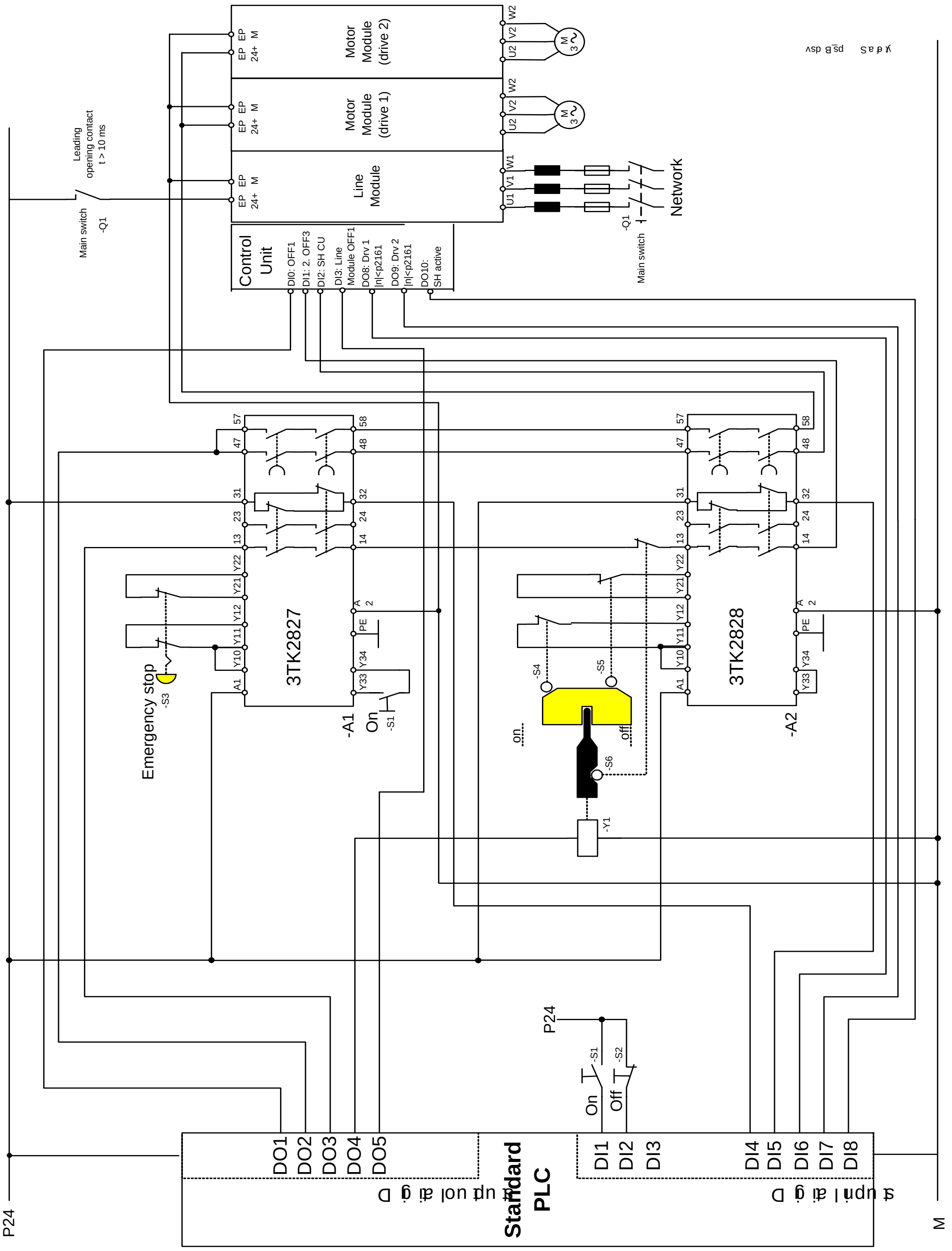


Fig. 7-4 Application example

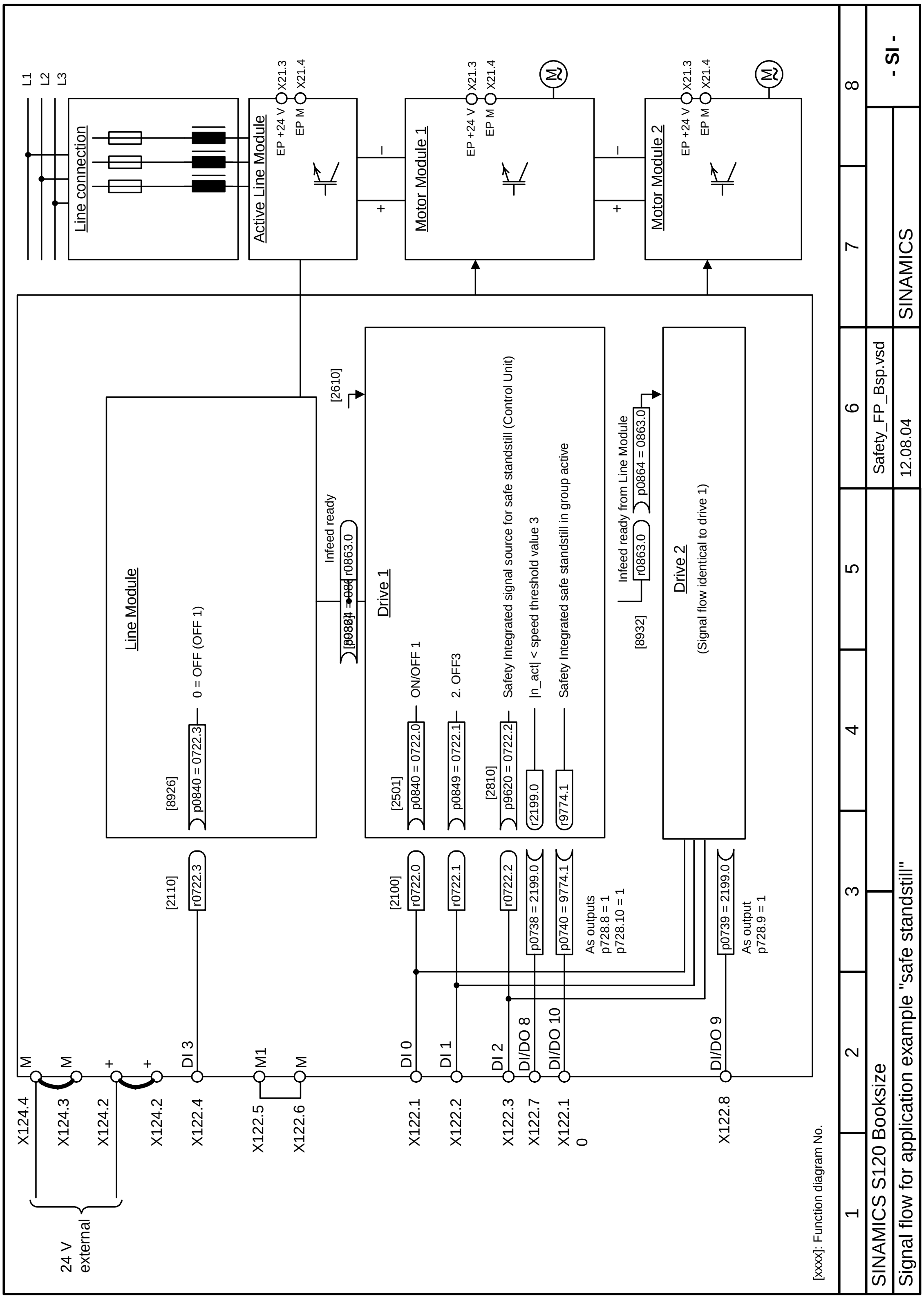


Fig. 7-5 Signal flow: application example for Safety Integrated safe standstill

Notice

This example illustrates implementation options. The solution required for the machine must be suitable for the machine function, which means that parameters and control commands are defined individually.

Notice

The fault responses and output functions (e.g. inversion or simulation) must not be changed or activated with respect to the factory setting.

Function description

With two SIGUARD safety combinations for emergency stop and the protective door, as well as a standard PLC, the system can be configured according to EN 954-1, category 3, and EN1037. The drives are brought to a standstill in accordance with stop category 1 to EN 60204–1.

- The “Safe standstill” safety function, which is integrated in the drive, complies with category 3 to EN 954–1 and SIL 2 to IEC 61508. The non-safe message “Safe standstill active” is sufficient.
- Safety combinations for emergency stop and protective door monitoring comply with category 4 (instantaneous enable circuits) or category 3 (delayed enable circuits).
- The electric circuits for emergency stop and protective door monitoring are monitored for cross-circuits on two channels.
- Switches S4, S5, and S6 are positively-opening position switches corresponding to EN 1088.
- Being a higher-level circuit with contacts, the “Safe standstill” function also works if the PLC malfunctions or fails.
- I/O communication via the digital interface between the drive and PLC can also be replaced by non-safe standard communication (e.g. PROFIBUS).

Note

In order to implement the Emergency Stop function (stopping in an emergency – emergency stop) it is not absolutely necessary to electrically isolate the drive converter from the line supply using electromechanical switching devices according to EN 60204–1 (1998) and IEC60204–1 (2005). When work is carried-out on the motor or drive converter, the voltage must be disconnected via a main circuit-breaker (that can be locked-out). Other Standards – e.g. NFPA79-2002/US – specify additional requirements regarding the EMERGENCY STOP function. For the EMERGENCY SWITCHING-OFF function (switching-off in an emergency) according to EN60204-1 (1998) and IEC60204-1 (2005), the supply voltage to the equipment must be disconnected through an electromechanical switching device. The risk analysis to be carried-out by the machinery construction OEM must determine which emergency functions (emergency operations) are actually required for a specific application.

Behavior for Emergency Stop

An emergency stop is triggered by the S3 button ("Emergency stop"). The drive is brought to a standstill in accordance with stop category 1 of EN 60204–1.

- Via the instantaneous enable contacts of the safety combination A1, at terminal X122.2 (DI 1: 2. OFF3) of the drive, a 0 signal is entered and the drives are immediately braked along the speed ramp (p1135) and the pulses are cancelled.
- The safe delayed enable contacts for safety combination A1 open once the set delay time has elapsed. This activates the "Safe standstill" function of the drives via two channels via terminal X122.3 (DI 2) on the Control Unit and terminals X21.3 (EP +24 V) and X21.4 (EP M) on the Motor Module. When all the grouped drives have activated "Safe standstill", this is signaled back via terminal X122.10 (DO 10: SH group active).
- The confirmation from the safety combination and the drive is monitored in the PLC to ensure that it is plausible.

Behavior when the protective door is opened

To issue a request to open the protective door, press the S2 button (“OFF”). The drive is brought to a standstill in accordance with stop category 1 of EN 60204–1.

- When the PLC output DO3 is reset, at terminal X122.2 (DI 1: 2. OFF3) of the drive, a 0 signal is entered and the drives are immediately braked along the speed ramp (p1135) and the pulses are cancelled.
- When the drives have reached a standstill (DO 8 and DO 9: |n|<p2161), the “safe standstill” function for the drive is activated via two channels by resetting the PLC output DO 2. The status is fed back to the PLC (DI 8) via terminal X122.10 (DO 10: SH active).
- When the PLC detects that the “Safe standstill” function has been selected (PLC DI 8 “SH active”), the interlock for the protective door is released when coil Y1 is energized (PLC output DO 4). By opening the protective doors, the protective door safety circuit is interrupted, safety combination A2 opens its safety circuits.

Note

The position of the protective door interlock is monitored by S6! If the PLC malfunctions and causes the interlock for the protective door to open before the drives reach speed = 0, signal 0 is specified by means of S6 at terminal X122.2 (DI 1: 2. OFF3) of the Control Unit via the BICO interconnection with the drives. The drives are immediately braked via the speed ramp (p1135) and the pulses canceled. When the protective door is opened, the “Safe standstill” function is selected. It must be ensured that movements that will result in danger are brought to a halt beforehand.

Switching on the drives

The drives can be started when the protective door is shut and emergency off button S3 is released. The Line Module must be switched on via PLC output DO5 by means of an edge from “0” to “1”.

- Once you have pressed button S1 (“ON”), safety combination A1 switches to “ready for operation”. When PLC output DO 4 is reset, the coil of tumbler Y1 is no longer energized and the protective door is locked. Safety combination A2 is also ready for operation.
- When PLC outputs DO 2 and DO 3 are set simultaneously, the “Safe standstill” safety function is deselected via two channels via terminal X122.3 on the Control Unit and terminals X21.3 (EP +24 V) and X21.4 (EP M) on the Motor Modules. The fast stop function is also deselected at terminal X122.2 (DI 1: 2. OFF3).
- A rising edge of the PLC output DO1 can bring the drives back into the run status via terminal X122.1 (DI 0: OFF1).

7.8 Acceptance test and certificate

7.8.1 General information about acceptance

Acceptance test

The machine manufacturer must carry out an acceptance test for the activated Safety Integrated functions (SI functions) on the machine.

During the acceptance test, all the limit values entered for the enabled SI functions must be exceeded to check and verify that the functions are working properly.

Notice

The acceptance test must only be carried out after the safety functions have been commissioned and POWER ON reset.

Authorized persons, acceptance certificate

Each SI function must be tested and the results documented and signed in the acceptance certificate by an authorized person. The acceptance certificate must be stored in the machine logbook.

Authorized in this sense refers to a person who has the necessary technical training and knowledge of the safety functions and is authorized by the machine manufacturer to carry out the test.

Note

- Please read the commissioning notes and descriptions in Sections 7.1 to 7.6 in this Commissioning Manual.
- If any parameters are altered by SI functions, the acceptance test must be carried out again and documented in the acceptance certificate.
- Template for the acceptance certificate
  A printed form is available in this chapter of the Commissioning Manual as an example/suggestion.

Scope of a complete acceptance test

Documentation (see Subsection 7.8.2)

Machine documentation (including the SI functions)

1. Machine description and overview diagram (see Tables 7-6 and 7-7)
2. SI functions for each drive (see Table 7-8)
3. Description of safety equipment (see Table 7-9)

Functional test (see Subsection 7.8.3)

Check the individual SI functions used

4. “Safe standstill” function, part 1 (see Table 7-10)
5. “Safe standstill” function, part 2 (see Table 7-11)
6. “Safe Stop 1” function (refer to Table 7-12)
7. “Safe brake control” function (see Table 7-13)

Completion of certificate (see Subsection 7.8.4)

Record the commissioning procedure and provide countersignatures.

8. Check the Safety parameters
9. Record the checksums
10. Verify the data backups
11. Countersignatures

Appendix

Measurement records for functional test parts 1 and 2.

- Alarm logs
- Trace recordings

7.8.2 Documentation

Table 7-6 Machine description and overview diagram

Designation	
Type	
Serial number	
Manufacturer	
End customer	
Electrical axes	
Other axes	
Spindles	
Overview diagram of machine	

Table 7-7 Values from relevant machine data

Parameters Control Unit		FW version	–
		r0018 =	–
Parameters Motor Modules	Drive number	FW version	SI version
		–	r9770 =
		r0128 =	r9870 =
		r0128 =	r9870 =
		r0128 =	r9870 =
		r0128 =	r9870 =
		r0128 =	r9870 =
		r0128 =	r9870 =
	Drive number	SI monitoring clock cycle Control Unit	SI monitoring clock cycle Motor Module
Parameters Motor Modules		r9780 =	r9880 =
		r9780 =	r9880 =
		r9780 =	r9880 =
		r9780 =	r9880 =
		r9780 =	r9880 =
		r9780 =	r9880 =

Table 7-8 SI functions for each drive

Drive number	SI function

Table 7-9 Description of safety equipment

Examples: Wiring of SH terminals (protective door, emergency OFF), grouping of SH terminals, holding brake for vertical axis, etc.

7.8.3 Functional test

The functional test must carried out individually for each drive (as far as the machine allows).

Carrying out the test

Initial commissioning	
Serial commissioning	
	Please tick

"Safe standstill" (SH) function, part 1

This test comprises the following steps:

Table 7-10 "Safe standstill" (SH) function, part 1

No.	Description	Status
1.	Initial state	
	• Drive in "Ready" status (p0010 = 0)	
	• Enable SH function (p9601.0 = 1, p9801.0 = 1)	
	• No safety faults and alarms (r0945, r2122, r2132)	
	• r9772.0 = r9772.1 = 0 (SH deselected and inactive – CU)	
	• r9872.0 = r9872.1 = 0 (SH deselected and inactive – MM)	
	• r9773.0 = r9773.1 = 0 (SH deselected and inactive – drive)	
	• For terminal grouping for "Safe standstill": r9774.0 = r9774.1 = 0 (SH deselected and inactive – group)	
2.	Run the drive	
3.	Ensure that the correct drive is running	
4.	Select SH when you issue the run command	
5.	Check the following:	
	• The drive coasts to a standstill or is braked and stopped by the mechanical brake (if available and configured (p1215, p9602, p9802)).	
	• No safety faults and alarms (r0945, r2122, r2132)	
	• r9772.0 = r9772.1 = 1 (SH selected and active – CU)	
	• r9872.0 = r9872.1 = 1 (SH selected and active – MM)	
	• r9773.0 = r9773.1 = 1 (SH selected and active – drive)	
	• For terminal grouping for "Safe standstill": r9774.0 = r9774.1 = 1 (SH selected and active – group)	
6.	Deselect SH	

Table 7-10 “Safe standstill” (SH) function, part 1, continued

No.	Description	Status
7.	Check the following:	
	• No safety faults and alarms (r0945, r2122, r2132)	
	• r9772.0 = r9772.1 = 0 (SH deselected and inactive – CU)	
	• r9872.0 = r9872.1 = 0 (SH deselected and inactive – MM)	
	• r9773.0 = r9773.1 = 0 (SH deselected and inactive – drive)	
	• For terminal grouping for “Safe standstill”: r9774.0 = r9774.1 = 0 (SH deselected and inactive – group)	
	• r0046.0 = 1 (drive in “Power-on inhibit” state)	
8.	Acknowledge “Power-on inhibit” and run the drive	
9.	Ensure that the correct drive is running	
	The following is tested: • Correct DRIVE-CLiQ wiring between Control Unit and Motor Modules • Correct drive no. – Motor Module – motor assignment • The hardware is functioning properly • The shutdown paths are wired correctly • Correct SH terminal assignment on the Control Unit • Correct SH grouping (if available) • The SH function is parameterized correctly • Routine for the forced checking procedure of the shutdown paths	

“Safe standstill” (SH) function, part 2

This test comprises the following steps:

Table 7-11 “Safe standstill” (SH) function, part 2

No.	Description	Status
1.	Initial state	
	• A channel for selecting SH is permanently connected to HIGH level (here as example: SH wiring, Motor Module)	
	• Drive in “Ready” status (p0010 = 0)	
	• Enable SH function (p9601.0 = 1, p9801.0 = 1)	
	• No safety faults and alarms (r0945, r2122, r2132)	
	• r9772.0 = r9772.1 = 0 (SH deselected and inactive – CU)	
	• r9872.0 = r9872.1 = 0 (SH deselected and inactive – MM)	
	• r9773.0 = r9773.1 = 0 (SH deselected and inactive – drive)	
2.	Run the drive	
3.	Ensure that the correct drive is running	

Table 7-11 “Safe standstill” (SH) function, part 2, continued

No.	Description	Status
4.	Select SH when you issue the run command	
5.	Check the following:	
	• The drive coasts to a standstill or is braked and stopped by the mechanical brake (if available and configured (p1215, p9602, p9802)).	
	• The following Safety faults are output (r0945, r0949, r2122, r2132): – F01611, fault value = 2000 – F01600, fault value = 9999 – F30611, fault value = 2000 – F30600, fault value = 9999	
	• r9772.0 = r9772.1 = 1 (SH selected and active – CU)	
	• r9872.0 = 0, r9872.1 = 1 (SH deselected but active – MM)	
	• r9773.0 = 0, r9773.1 = 1 (SH deselected but active – drive)	
	The following is tested: • The shutdown paths are wired correctly • Crosswise comparison of SH terminals • Routine for the forced checking procedure of the shutdown paths	

"Safe Stop 1" function (SS1)

This test comprises the following steps:

Table 7-12 "Safe Stop 1" (SS1) function

No.	Description	Status
1.	Initial state	
	• Drive in "Ready" status (p0010 = 0)	
	• Enable SH function (p9601.0 = 1, p9801.0 = 1)	
	• Enable SS1 function (p9652 > 0, p9852 > 0)	
	• No safety faults or alarms (r0945, r2122)	
	• r9772.0 = r9772.1 = 0 (SH deselected and inactive – CU)	
	• r9872.0 = r9872.1 = 0 (SH deselected and inactive – MM)	
	• r9773.0 = r9773.1 = 0 (SH deselected and inactive – drive)	
	• r9772.2 = r9872.2 = 0 (SS1 not requested – CU and MM)	
2.	Run the drive	
3.	Ensure that the correct drive is running	
4.	Select SS1 when the run command is issued	
5.	Check the following:	
	• The drive is braked along the OFF3 ramp (p1135)	
	• SH is initiated after the SS1 delay time expires (p9652, p9852)	
	• No safety faults or alarms (r0945, r2122)	
	• r9772.0 = r9772.1 = 1 (SH selected and active – CU)	
	• r9872.0 = r9872.1 = 1 (SH selected and active – MM)	
	• r9773.0 = r9773.1 = 1 (SH selected and active – drive)	
6.	Deselect SH	
7.	Check the following:	
	• No safety faults or alarms (r0945, r2122)	
	• r9772.0 = r9772.1 = 0 (SH deselected and inactive – CU)	
	• r9872.0 = r9872.1 = 0 (SH deselected and inactive – MM)	
	• r9773.0 = r9773.1 = 0 (SH deselected and inactive – drive)	
	• r0046.0 = 1 (drive in "Power-on inhibit" state)	
8.	Acknowledge "Power-on inhibit" and run the drive	
9.	Ensure that the correct drive is running	
	The following is tested: • Correct parameterization of the SS1 function	

“Safe brake control” (SBC) function

This test comprises the following steps:

Table 7-13 “Safe brake control” (SBC) function

No.	Description	Status
1.	Initial state	
	• Drive in “Ready” status (p0010 = 0)	
	• Enable SH function (p9601.0 = 1, p9801.0 = 1)	
	• Enable SBC function (p9602 = 1, p9802 = 1)	
	• Vertical axis: Brake as in sequential control (p1215 = 1) • No vertical axis: Brake always released (p1215 = 2)	
	• Vertical axis: Mechanical brake is applied • No vertical axis: Mechanical brake is released	
	• No safety faults or alarms (r0945, r2122)	
	• r9772.0 = r9772.1 = 0 (SH deselected and inactive – CU)	
	• r9872.0 = r9872.1 = 0 (SH deselected and inactive – MM)	
	• r9773.0 = r9773.1 = 0 (SH deselected and inactive – drive)	
	• r9772.4 = r9872.4 = 0 (SBC not requested – CU and MM)	
2.	Run drive (applied brake is released)	
3.	Ensure that the correct drive is running	
4.	Select SH when you issue the run command	
5.	Check the following:	
	• Drive is braked and stopped by the mechanical brake.	
	• No safety faults or alarms (r0945, r2122)	
	• r9772.0 = r9772.1 = 1 (SH selected and active – CU)	
	• r9872.0 = r9872.1 = 1 (SH selected and active – MM)	
	• r9773.0 = r9773.1 = 1 (SH selected and active – drive)	
	• r9772.4 = r9872.4 = 1 (SBC requested – CU and MM)	
6.	Deselect SH	

Table 7-13 “Safe brake control” (SBC) function, continued

No.	Description	Status
7.	Check the following:	
	• Vertical axis: Mechanical brake remains applied • No vertical axis: Mechanical brake is released	
	• No safety faults or alarms (r0945, r2122)	
	• r9772.0 = r9772.1 = 0 (SH deselected and inactive – CU)	
	• r9872.0 = r9872.1 = 0 (SH deselected and inactive – MM)	
	• r9773.0 = r9773.1 = 0 (SH deselected and inactive – drive)	
	• r9772.4 = r9872.4 = 0 (SBC not requested – CU and MM)	
	• r0046.0 = 1 (drive in “Power-on inhibit” state)	
8.	Acknowledge “Power-on inhibit” and run the drive (Vertical axis: mechanical brake is released)	
9.	Ensure that the correct drive is running	
	The following is tested: • The brake is connected properly • The hardware is functioning properly • The SBC is parameterized correctly • Routine for the forced checking procedure of the brake control	

7.8.4 Completion of certificate

SI parameters

	Specified values checked?	
	Yes	No
Control Unit		
Motor Module		

Checksums

Axis/spindle		Checksum (8 hex)	
Name	Drive number	Control Unit (p9798)	Motor Module (p9898)

Data backup

	Storage medium			Storage location
	Type	Designation	Date	
Parameters				
PLC program				
Circuit diagrams				

Countersignatures

Commissioning engineer

This confirms that the tests and checks have been carried out properly.

Date	Name	Company/dept.	Signature

Machine manufacturer

This confirms that the parameters recorded above are correct.

Date	Name	Company/dept.	Signature

■

8 Diagnosis

This chapter describes the following diagnostic features of the SINAMICS S120 drive system:

- Diagnostics using LEDs
- Diagnostics using STARTER
- Fault and alarm messages

8.1 Diagnostics using LEDs

8.1.1 LEDs while the Control Unit is booting

The individual statuses during the booting procedure are indicated by means of the LEDs on the Control Unit (CU310, CU310).

- The duration of the individual statuses varies.
- If an error occurs, the booting procedure is terminated and the cause is indicated accordingly via the LEDs.
- Once the unit has been successfully booted, all the LEDs are switched off briefly.
- Once the unit has been booted, the LEDs are driven via the loaded software.

  Refer to the description of the LEDs after booting (see Chapter 8.1.2 and 8.1.3).

Table 8-1 Control Unit 320 – description of the LEDs during booting

<table>
<tr><th rowspan="2">LED</th><th colspan="2">Load software 1</th><th colspan="5">Load software 2</th><th colspan="2">Firmware</th></tr>
<tr><th>Reset</th><th>Error</th><th>Loaded</th><th>Running</th><th>Error file</th><th>Error crc</th><th>FW Loaded</th><th>Initializing</th><th>Running</th></tr>
<tr><td>RDY</td><td>Red</td><td>Red 2 Hz</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td><td rowspan="4">See table 8-2</td></tr>
<tr><td>DP1/ COM</td><td>Red</td><td>Red</td><td>Red</td><td>Orange</td><td>Red 2 Hz</td><td>Red 0.5 Hz</td><td>Off</td><td>Off</td></tr>
<tr><td>OPT/ OUT> 5 V</td><td>Red</td><td>Red</td><td>Red</td><td>Red</td><td>Red</td><td>Red</td><td>Red</td><td>Off</td></tr>
<tr><td>MOD</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td><td>Off</td></tr>
<tr><td colspan="2"></td><td colspan="8">Possible causes:
Error (Load software 1):
• CompactFlash Card not installed.
• Load software 2 has not been installed on the CompactFlash card or is defective.
Error file:
• Software on the CompactFlash card is incomplete or defective.
Error crc:
• CRC invalid.
Remedy:
Plug the appropriate CompactFlash card with the correct software and parameters into the unit.</td></tr>
</table>

8.1.2 LEDs after the Control Unit CU320 has booted

Table 8-2 Control Unit 320 – description of the LEDs after booting

LED	Color	State	Description, cause	Remedy
RDY (READY)	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	The module is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
		Flashing 2 Hz	Writing to CompactFlash card.	–
	Red	Steady light	At least one fault is present in this module.	Remedy and acknowledge fault
		Flashing 0.5 Hz	Boot error	Check whether CompactFlash card is plugged in correctly Replace CompactFlash card Replace Control Unit Carry-out a POWER ON
	Green/ Red	Flashing 0.5 Hz	Control Unit 320 is ready. No software licenses.	Obtain licenses
	Orange	Steady light	DRIVE-CLiQ communication is being established.	–
		Flashing 0.5 Hz	Unable to load firmware to RAM.	Check whether CompactFlash card is plugged in correctly Replace CompactFlash card Replace Control Unit Carry-out a POWER ON
		Flashing 2 Hz	Firmware CRC error.	Check whether CompactFlash card is plugged in correctly Replace CompactFlash card Replace Control Unit Carry-out a POWER ON

Table 8-2 Control Unit 320 – description of the LEDs after booting, continued

LED	Color	State	Description, cause	Remedy
DP1 PROFIdrive cyclic operation	–	Off	Cyclic communication has not (yet) taken place. Note: PROFIdrive is ready for communication when the Control Unit is ready (see LED RDY).	–
	Green	Steady light	Cyclic communication is taking place.	–
		Flashing 0.5 Hz	Full cyclic communication is not yet taking place. Possible causes: • The controller is not transmitting setpoints. • During isochronous operation, no global control (GC) or a faulty global control (GC) is transferred by the Controller.	–
	Red	Steady light	Cyclic communication has been interrupted.	Remedy fault
OPT (OPTION)	–	Off	Electronics power supply is missing or outside permissible tolerance range. Module is not ready. Option board not installed or no associated drive object has been created.	–
	Green	Steady light	Option board is ready.	–
		Flashing 0.5 Hz	Depends on the option board used.	–
	Red	Steady light	At least one fault is present in this module. Option board not ready (e.g. after power-on).	Remedy and acknowledge fault
MOD	–	Off	Reserved	–

8.1.3 LEDs after the Control Unit CU310 has booted

Table 8-3 Control Unit 310 – description of the LEDs after booting

LED	Color	State	Description, cause	Remedy
RDY (READY)	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	The module is ready for operation and cyclic DRIVE–CLiQ communication is taking place.	–
		Flashing 2 Hz	Writing to CompactFlash card.	–
	Red	Steady light	At least one fault is present in this module.	Remedy and acknowledge fault
		Flashing 0.5 Hz	Boot error	Check whether CompactFlash card is plugged in correctly Replace CompactFlash card Replace Control Unit Carry-out a POWER ON
	Green/ Red	Flashing 0.5 Hz	Control Unit 310 is ready. No software licenses.	Obtain licenses
	Orange	Steady light	DRIVE-CLiQ communication is being established.	–
		Flashing 0.5 Hz	Unable to load firmware to RAM.	Check whether CompactFlash card is plugged in correctly Replace CompactFlash card Replace Control Unit Carry-out a POWER ON
		Flashing 2 Hz	Firmware CRC error.	Check whether CompactFlash card is plugged in correctly Replace CompactFlash card Replace Control Unit Carry-out a POWER ON

Table 8-3 Control Unit 310 – description of the LEDs after booting, continued

LED	Color	State	Description, cause	Remedy
COM PROFIdrive cyclic operation	–	Off	Cyclic communication has not (yet) taken place. Note: PROFIdrive is ready for communication when the Control Unit is ready (see LED RDY).	–
	Green	Steady light	Cyclic communication is taking place.	–
		Flashing 0.5 Hz	Full cyclic communication is not yet taking place. Possible causes: • The controller is not transmitting setpoints. • During isochronous operation, no global control (GC) or a faulty global control (GC) is transferred by the Controller.	–
	Red	Steady light	Cyclic communication has been interrupted.	Remedy fault
OUT >5 V	–	Off	Electronics power supply is missing or outside permissible tolerance range. Power supply ≤ 5 V	–
	Orange	Steady light	Electronics power supply for measuring system available. Power supply >5 V. **Notice** You must ensure that the connected encoder can be operated with a 24 V supply. If an encoder that is designed for a 5 V supply is operated with a 24 V supply, this can destroy the encoder electronics.	–
MOD	–	Off	Reserved	–

8.1.4 Active Line Module

Table 8-4 Active Line Module – description of LEDs

State		Description, cause	Remedy
Ready (H200)	**DC link (H201)**		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/ Red	–	Firmware is being downloaded.	–
Green/ Orange or Red/ Orange	–	Component recognition via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

Warning

Hazard DC link voltages may be present at any time regardless of the status of the “DC link” LED.
The warning information on the components must be carefully observed!

8.1.5 Basic Line Module

Table 8-5 Basic Line Module – description of the LEDs

State		Description, cause	Remedy
Ready (H200)	**DC link (H201)**		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/ Red	–	Firmware is being downloaded.	–
Green/ Orange or Red/ Orange	–	Component recognition via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

Warning

Hazard DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

8.1.6 Smart Line Module 5 kW and 10 kW

Table 8-6 Smart Line Module 5 kW and 10 kW – description of LEDs

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	Component is ready to operate.	–
	Yellow	Steady light	Precharging not yet complete Bypass relay has dropped-out EP terminals are not supplied with 24 V DC	–
	Red	Steady light	Overtemperature Overcurrent trip	Diagnose the fault (via output terminals) and acknowledge (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Steady light	DC link voltage within permissible tolerance range.	–
	Red	Steady light	DC link voltage outside permissible tolerance range. Supply failure.	Check supply voltage

8.1.7 Smart Line Module 16 kW and 36 kW

Table 8-7 Smart Line Module 16 kW and 36 kW – description of LEDs

State		Description, cause	Remedy
Ready (H200)	**DC link (H201)**		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/ Red	–	Firmware is being downloaded.	–
Green/ Orange or Red/ Orange	–	Component recognition via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

Warning

Hazard DC link voltages may be present at any time regardless of the status of the “DC link” LED.
The warning information on the components must be carefully observed!

8.1.8 Single Motor Module / Double Motor Module / Power Module

Table 8-8 Motor Module / Power Module – description of LEDs

State		Description, cause	Remedy
Ready (H200)	**DC link (H201)**		
Off	Off	Electronics power supply is missing or outside permissible tolerance range.	–
Green	Off	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is present.	–
	Red	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place. The DC link voltage is too high.	Check supply voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/ Red	–	Firmware is being downloaded.	–
Green/ Orange or Red/ Orange	–	Component recognition via LED is activated (p0124). **Note:** Both options depend on the LED status when component recognition is activated via p0124 = 1.	–

Warning

Hazard DC link voltages may be present at any time regardless of the status of the "DC link" LED.
The warning information on the components must be carefully observed!

8.1.9 Braking Module Booksize

Table 8-9 Braking Module Booksize – description of the LEDs

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronics power supply is missing or outside permissible tolerance range. Component deactivated via terminal.	–
	Green	Steady light	Component is ready to operate.	–
	Red	Steady light	Overtemperature. Overcurrent switch off. I^2t monitoring activated. Ground fault/short-circuit. Note: In the event of an overtemperature, the fault cannot be acknowledged until a cooling time has elapsed.	Diagnose the fault (via output terminals) and acknowledge (via input terminal)
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range. Component not active.	–
	Green	Flashing	Component active (DC link discharge via braking resistor in progress).	–

8.1.10 Control Supply Module

Table 8-10 Control Supply Module – description of LEDs

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	Component is ready to operate.	–
DC LINK	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Orange	Steady light	DC link voltage within permissible tolerance range.	–
	Red	Steady light	DC link voltage outside permissible tolerance range.	–

8.1.11 Sensor Module Cabinet 10/20 (SMC10/SMC20)

Table 8-11 Sensor Module cabinet 10/20 – description of LEDs

LED	Color	State	Description, cause	Remedy
RDY READY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Steady light	DRIVE-CLiQ communication is being established.	–
	Red	Steady light	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/ Red	Flashing	Firmware is being downloaded.	–
	Green/ Orange or Red/ Orange	Flashing	Component recognition via LED is activated (p0144). **Note:** Both options depend on the LED status when component recognition is activated via p0144 = 1.	–

8.1.12 Sensor Module Cabinet 30 (SMC30)

Table 8-12 Sensor Module cabinet 30 – description of LEDs

LED	Color	State	Description, cause	Remedy
RDY READY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Steady light	DRIVE-CLiQ communication is being established.	–
	Red	Steady light	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/ Red	Flashing	Firmware is being downloaded.	–
	Green/ Orange or Red/ Orange	Flashing	Component recognition via LED is activated (p0144). **Note:** Both options depend on the LED status when component recognition is activated via p0144 = 1.	–
OUT >5 V	–	Off	Electronics power supply is missing or outside permissible tolerance range. Power supply $\leq$5 V.	–
	Orange	Steady light	Electronics power supply for measuring system available. Power supply > 5 V. **Notice** You must ensure that the connected encoder can be operated with a 24 V supply. If an encoder that is designed for a 5 V supply is operated with a 24 V supply, this can destroy the encoder electronics.	–

8.1.13 Terminal Module 15 (TM15)

Table 8-13 Terminal Module 15 – description of LEDs

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Steady light	DRIVE-CLiQ communication is being established.	–
	Red	Steady light	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/ Red	Flashing	Firmware is being downloaded.	–
	Green/ Orange or Red/ Orange	Flashing	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when module recognition is activated via p0154 = 1.	–

8.1.14 Terminal Module 31 (TM31)

Table 8-14 Terminal Module 31 – description of LEDs

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Steady light	DRIVE-CLiQ communication is being established.	–
	Red	Steady light	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/ Red	Flashing	Firmware is being downloaded.	–
	Green/ Orange or Red/ Orange	Flashing	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when module recognition is activated via p0154 = 1.	–

8.1.15 Terminal Module 41 (TM41)

Table 8-15 Terminal Module 41 – description of LEDs

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Steady light	DRIVE-CLiQ communication is being established.	–
	Red	Steady light	At least one fault is present in this component. **Note:** LED is driven irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/ Red	Flashing	Firmware is being downloaded.	–
	Green/ Orange or Red/ Orange	Flashing	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when module recognition is activated via p0154 = 1.	–
Z pulses	–	Off	Zero mark found, wait for zero mark output OR component powered-down	–
	Red	Steady light	Zero mark not enabled or zero mark search	–
	Green	Steady light	Stopped at zero mark	–
		Flashing	Zero mark is output at each virtual revolution	–

8.1.16 Communication Board Ethernet 20 (CBE20)

Table 8-16 CBE20 – description of the LEDs

LED	Color	State	Description, cause	Remedy
Link port	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Steady light	A different device is connected to port x and a physical connection exists.	–
Activity port	–	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Yellow	Steady light	Component active (DC link discharge via braking resistor in progress).	–
Fault	–	Off	If the Link Port LED is green: The CBE20 is operating normally, data is being exchanged with the configured IO Controller.	–
	Red	Flashing	• The response monitoring time has expired. • Communications is interrupted. • The IP address is incorrect. • Incorrect or no configuration. • Incorrect parameter settings. • Incorrect or missing device name. • IO Controller not connected/switched off, although an Ethernet connection has been established. • Other CBE20 errors	–
		Steady light	CBE20 bus error • No physical connection to a subnet/switch • Incorrect transmission rate • Full duplex transmission is not activated	–
Sync	–	Off	If the Link Port LED is green: Control Unit task system is not synchronized with the IRT clock. An internal substitute clock is generated.	–
	Green	Flashing	The Control Unit task system has synchronized with the IRT clock cycle and data is being exchanged.	–
		Steady light	Task system and MC-PLL have synchronized with the IRT clock.	–

Table 8-16 CBE20 – description of the LEDs, continued

LED	Color	State	Description, cause	Remedy
OPT on the Control Unit	–	OFF	Electronics power supply is missing or outside permissible tolerance range. Communication Board either defective or not inserted.	–
	Green	Steady light	Communication Board is ready and cyclic communications is taking place.	–
		Flashing 0.5 Hz	The Communication Board is ready, but cyclic communications is not running. Possible causes: • There is at least one fault/error • Communications is presently being established	–
	Red	Steady light	Cyclic communications via PROFINET have still not been established. However, non-cyclic communications are possible. SINAMICS waits for a parameterizing/configuring telegram	–
		Flashing 0.5 Hz	The firmware download into the CBE20 has been completed with an error. Possible causes: • CBE20 is defective • The CF card of the Control Unit is defective In this state CBE20 cannot be used.	–
		Flashing 2.5 Hz	There is a communications error between the Control Unit and the CBE20. Possible causes: • Board was withdrawn after booting. • The board is defective	Correctly insert the board, if required, replace.
	Orange	Flashing 2.5 Hz	Firmware is being downloaded.	–

8.2 Diagnostics using STARTER

Description

The diagnostic functions support commissioning and service personnel during commissioning, troubleshooting, diagnostics and service activities.

General information

Prerequisite: STARTER is online.

The following diagnostic functions are available in STARTER:

- Specifying signals with the ramp-function generator

  See Subsection 8.2.1
- Signal recording with the trace function

  See Subsection 8.2.2
- Analyzing the control response with the measuring function

  See Subsection 8.2.3
- Outputting voltage signals for external measuring devices via measuring sockets

  See Subsection 8.2.4

8.2.1 Function generator

Description

The ramp-function generator can be used, for example, for the following tasks:

- To measure and optimize control loops.
- To compare the dynamic response of coupled drives.
- To specify a simple traversing profile without a traversing program.

The ramp-function generator can be used to generate different signal shapes.

In the connector output operating mode, the output signal can be injected into the control loop via the BICO interconnection.

In servo operation and depending on the mode set, this setpoint can also be injected into the control structure as a current setpoint, disturbing torque, or speed setpoint, for example. The impact of superimposed control loops is automatically suppressed.

Parameterizing and operating the ramp-function generator

The ramp-function generator is parameterized and operated via the parameterization and commissioning tool STARTER.

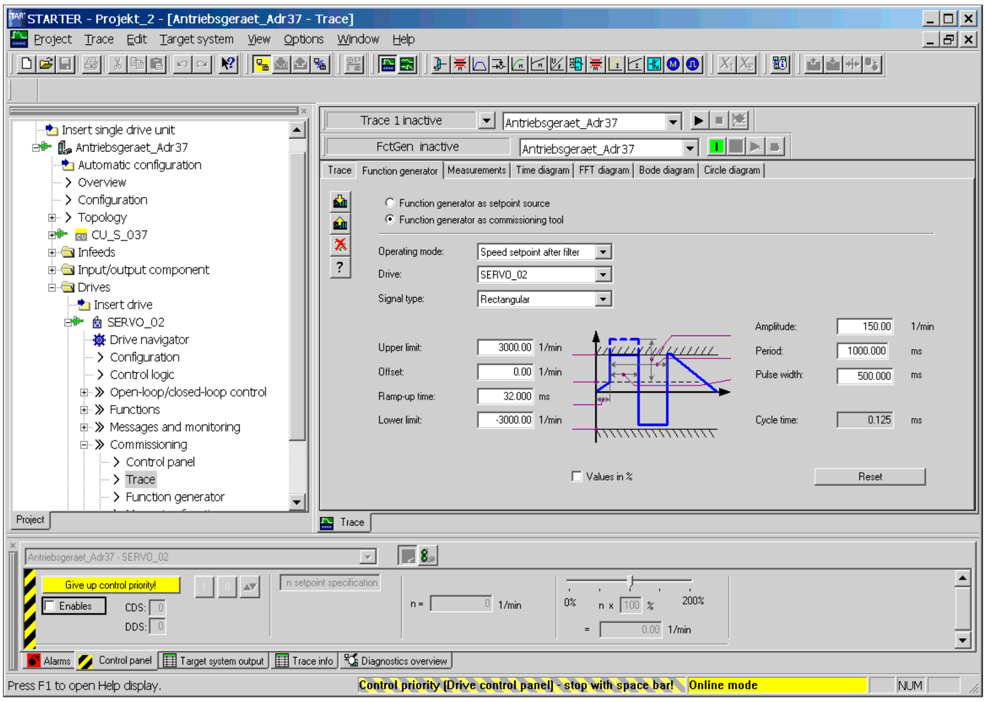


Fig. 8-1 “Ramp-function generator” initial screen

Note

Please refer to the online help for more information about parameterizing and using the measuring sockets.

Properties

- Concurrent injection to several drives possible.
- The following parameterizable signal shapes can be set:
  - Square-wave
  - Staircase
  - Triangular
  - PRBS (pseudo random binary signal, white noise)
  - Sinusoidal
- An offset is possible for each signal. The ramp-up to the offset is parameterizable. Signal generation begins after the ramp-up to the offset.
- Restriction of the output signal to the minimum and maximum value settable.
- Operating modes of the ramp-function generator for servo and vector
  - Connector output
- Operating modes of the ramp-function generator (servo only)
  - Current setpoint downstream of filter (current setpoint filter)
  - Disturbing torque (downstream of current setpoint filter)
  - Speed setpoint downstream of filter (speed setpoint filter)
  - Current setpoint upstream of filter (current setpoint filter)
  - Speed setpoint upstream of filter (speed setpoint filter)

Injection points of the ramp-function generator

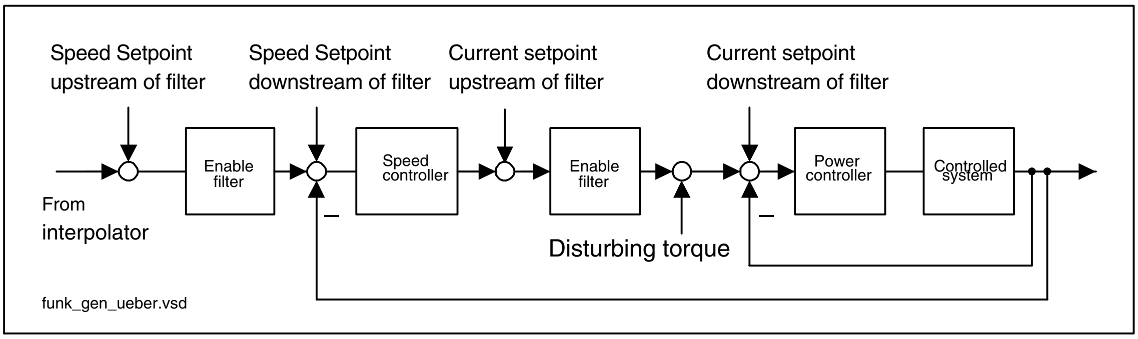


Fig. 8-2 Injection points of the ramp-function generator

Further signal shapes

Further signal shapes can be parameterized.

Example:

The “triangular” signal shape can be parameterized with “upper limitation” to produce a triangle with no peak.

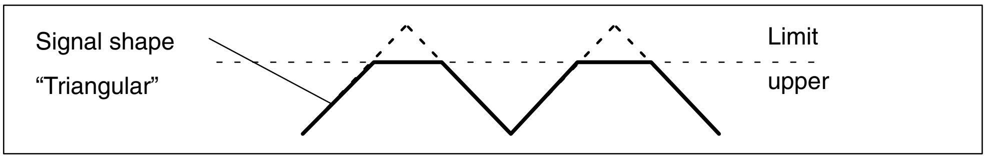


Fig. 8-3 “Triangular” signal without peak

Starting/stopping the ramp-function generator

Caution

With the corresponding ramp-function generator parameter settings (e.g. offset), the motor can “drift” and travel to its end stop.

The movement of the drive is not monitored while the ramp-function generator is active.

To start the ramp-function generator:

1. Meet the conditions for starting the ramp-function generator
   – Activate the control board
     Drives –> Drive_x –> Commissioning –> Control board
   – Switch on the drive
     Control board –> Issue enable signals –> Switch on
2. Select the operating mode
   e.g. speed setpoint downstream of filter
3. Select the drive (as control board)
4. Set the signal shape
   e.g. square-wave
5. Load the settings to the target system (“Download parameters” pushbutton)
6. Start the ramp-function generator (“Start FctGen” pushbutton)

To stop the measuring function:

“Stop FctGen” pushbutton

Parameterization

The “function generator” parameter screen is selected via the following icon in the toolbar of the STARTER commissioning tool:

Fig. 8-4 STARTER icon for “trace function/ramp-function generator”

8.2.2 Trace function

Description

The trace function can be used to record measured values over a defined period depending on trigger conditions.

Parameterizing and using the trace function

The trace function is parameterized and operated via the parameterization and commissioning tool STARTER.

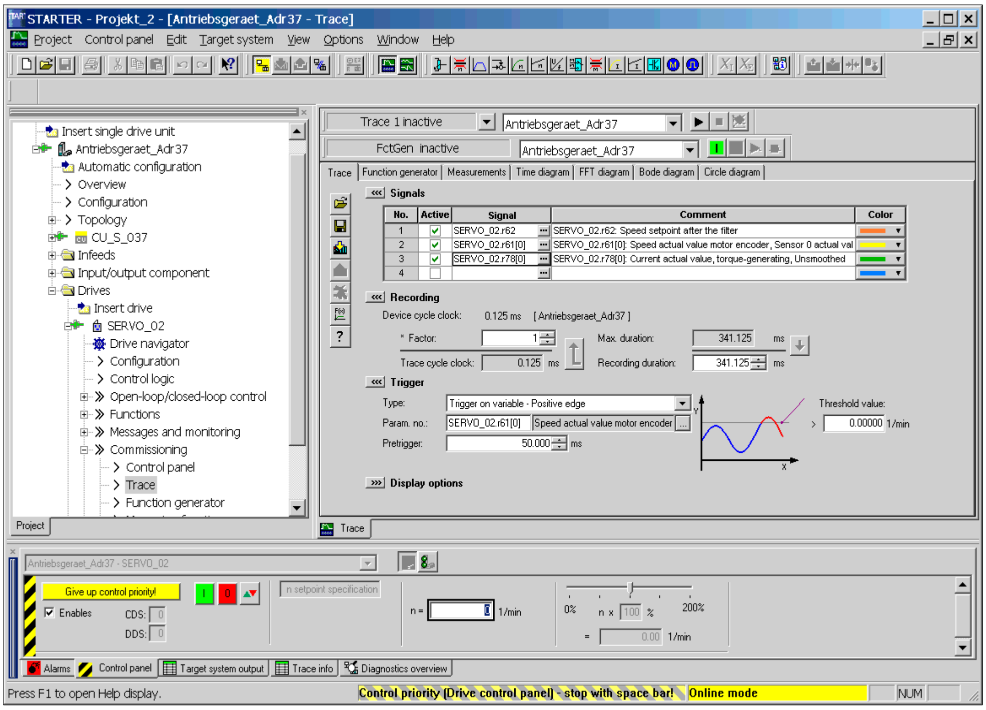


Fig. 8-5 “Trace function” initial screen

Note

Please refer to the online help for more information about parameterizing and using the measuring sockets.

Properties

- Four recording channels per recorder
- Two independent trace recorders per Control Unit
- Triggering
  - Without triggering (recording immediately after start)
  - Triggering on signal with edge or on level
  - Trigger delay and pretrigger possible
- STARTER parameterization and commissioning tool
  - Automatic or adjustable scaling of display axes
  - Signal measurement via cursor
- Settable trace cycle: integers of the base sample time

  (See also: Section 9.8)

Parameterization

The “trace function” parameter screen is selected via the following icon in the toolbar of the STARTER commissioning tool.

Fig. 8-6 STARTER icon for “trace function/ramp-function generator”

8.2.3 Measuring function (Servo)

Description

The measuring function is used for optimizing the drive controller. By parameterizing the measuring function, the impact of superimposed control loops can be suppressed selectively and the dynamic response of the individual drives analyzed. The ramp-function generator and trace function are linked for this purpose. The control loop is supplied with the ramp-function generator signal at a given point (e.g. speed setpoint) and recorded by the trace function at another (e.g. speed actual value). The trace function is parameterized automatically when the measuring function is parameterized. Specific predefined operating modes for the trace function are used for this purpose.

Parameterizing and using the measuring function

The measuring function is parameterized and operated via the parameterization and commissioning tool STARTER.

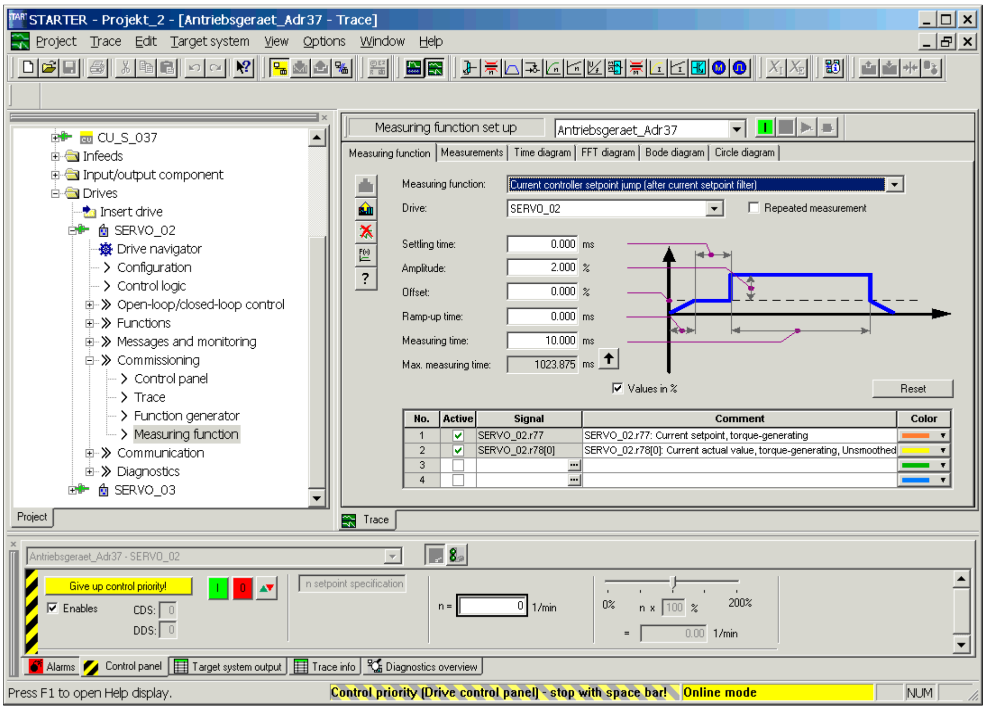


Fig. 8-7 “Measuring function” initial screen

Note

Please refer to the online help for more information about parameterizing and using the measuring sockets.

Properties

- Measuring functions
  - Current controller setpoint change (downstream of the current setpoint filter)
  - Current controller reference frequency response (downstream of the current setpoint filter)
  - Speed controller setpoint change (downstream of the speed setpoint filter)
  - Speed controller disturbance step change (fault downstream of the current setpoint filter)
  - Speed controller reference frequency response (downstream of the speed setpoint filter)
  - Speed controller reference frequency response (upstream of the speed setpoint filter)
  - Speed controller interference frequency response (fault downstream of the current setpoint filter)
  - Speed controller path (excitation downstream of current setpoint filter)

Starting/stopping the measuring function

Caution

With the corresponding measuring function parameter settings (e.g. offset), the motor can “drift” and travel to its end stop.

The movement of the drive is not monitored while the measuring function is active.

To start the measuring function:

1. Meet the conditions for starting the measuring function
   – Activate the control board
     Drives –> Drive_x –> Commissioning –> Control board
   – Switch on the drive
     Control board –> Issue enable signals –> Switch on
2. Select the drive (as control board)
3. Set the measuring function
   e.g. current controller setpoint change
4. Load the settings to the target system (“Download parameters” pushbutton)
5. Start the measuring function (“Start Measuring Function” pushbutton)

To stop the measuring function:

“Stop Measuring Function” pushbutton

Parameterization

The “measuring function” parameter screen is selected via the following icon in the toolbar of the STARTER commissioning tool:

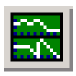


Fig. 8-8 STARTER icon for “measuring function”

8.2.4 Measuring sockets

Description

The measuring sockets are used to output analog signals. Any interconnectable signal can be output to any measuring socket on the Control Unit.

Caution

The measuring sockets should be used for commissioning and servicing purposes only.

The measurements may only be carried out by properly trained specialist personnel.

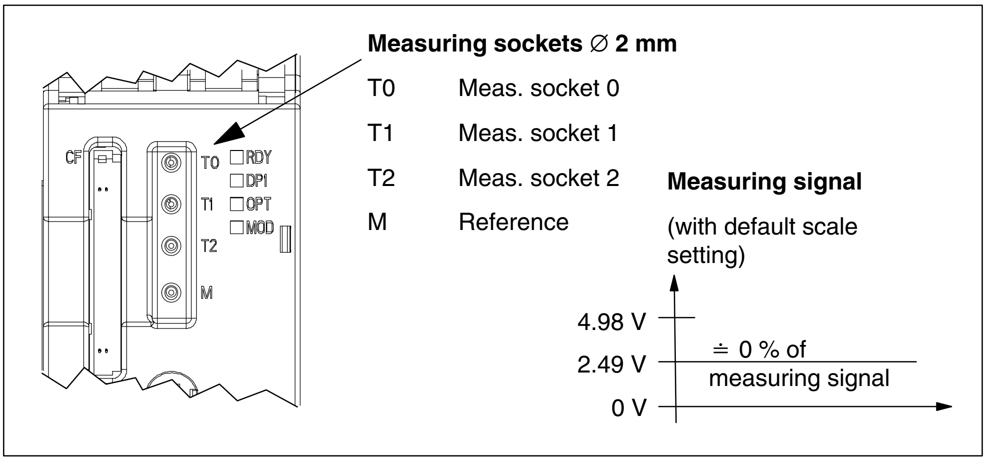


Fig. 8-9 Arrangement of the measuring sockets on the Control Unit CU310/CU320

Parameterizing and using the measuring sockets

The measuring sockets are parameterized and used via the parameterization and commissioning tool STARTER (see Section 3.2).

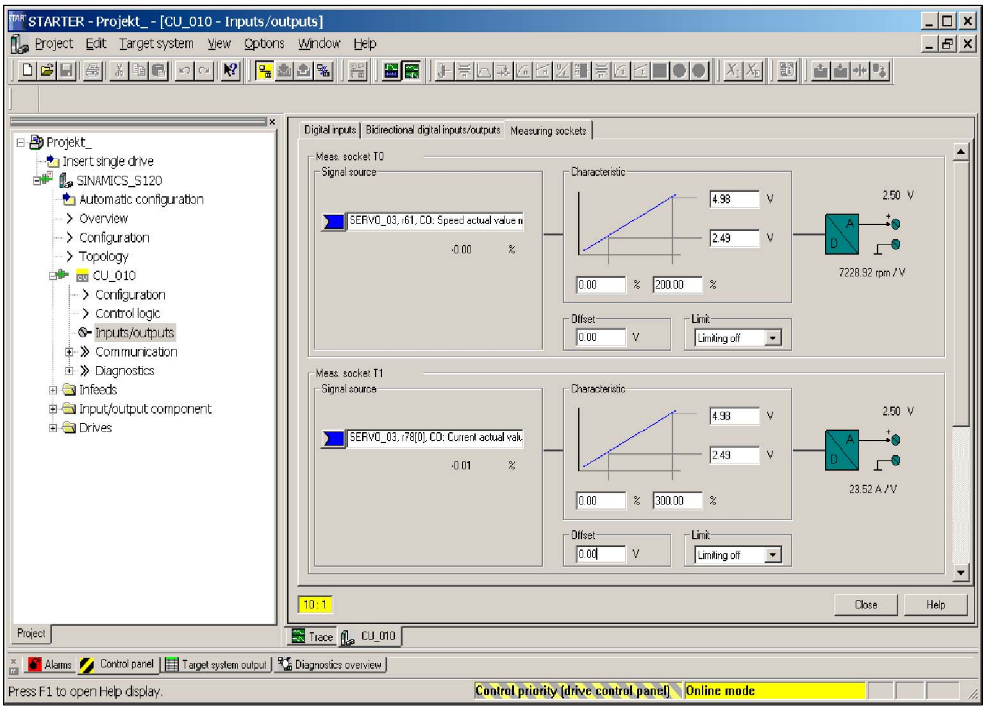


Fig. 8-10 “Measuring sockets” initial screen

Note

Please refer to the online help for more information about parameterizing and using the measuring sockets.

Properties

- Resolution: 8 bit
- Voltage range: 0 V to +4.98 V
- Measuring cycle: dependant on the measuring signal (e.g. speed actual value in speed controller clock cycle, 125 μs)
- Short-circuit-proof
- Parameterizable scaling
- Adjustable offset
- Adjustable limitation

Signal chart for measuring sockets

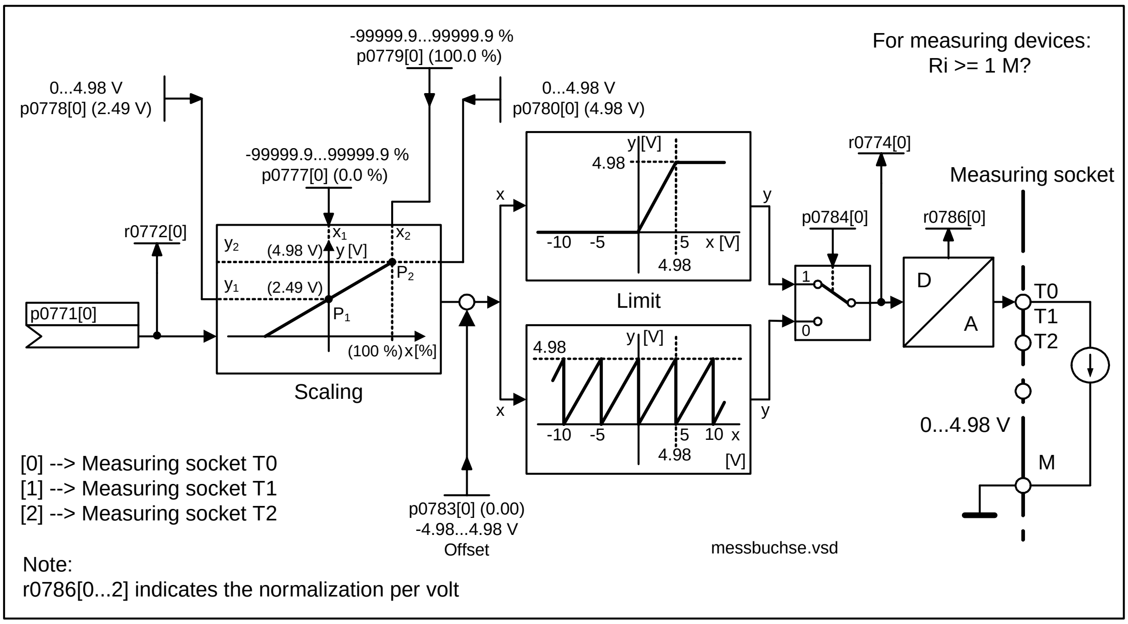


Fig. 8-11 Signal chart for measuring sockets

Which signal can be output via measuring sockets?

The signal to be output via a measuring socket is specified by parameterizing the connector input p0771[0...2].

Important measuring signals (examples):

r0060	CO: Speed setpoint before speed setpoint filter
r0063	CO: Actual speed value
r0069[0...2]	CO: Phase current, actual value
r0075	CO: Field-generating current setpoint
r0076	CO: Field-generating actual current
r0077	CO: Torque-generating current setpoint
r0078	CO: Torque-generating actual current

Scaling

Scaling specifies how the measuring signal is processed. A straight line with 2 points must be defined for this purpose.

Example:

x1/y1 = 0.0 %/2.49 V   x2/y2 = 100.0 %/4.98 V (default setting)

—>   0.0 % is mapped onto 2.49 V

—>   100.0 % is mapped onto 4.98 V

—>   –100.0 % is mapped onto 0.00 V

Offset

The offset is applied additively to the signal to be output. The signal to be output can thus be displayed within the measuring range.

Limit

- Limitation on

  If signals are output outside the permissible measuring range, the signal is limited to 4.98 V or to 0V.
- Limitation off

  The output of signals outside the permissible measuring range causes a signal overflow. In the event of an overflow, the signal jumps from 0 V to 4.98 V or from 4.98 to 0 V.

Example of a measurement

Assumption:

The actual speed (r0063) is to be output for a drive via measuring socket T1.

How do you do it?

1. Connect and set the measuring device.
2. Interconnect the signal (e.g. STARTER).

   Interconnect the connector input (CI) belonging to the measuring socket with the desired connector output (CO).

   CI: p0771[1] = CO: r0063
3. Parameterize the signal characteristic (scaling, offset, limitation).

Note

r0786[1] indicates the normalization per volt.

A change in the output voltage by 1 volt corresponds to the value in this parameter. The units are determined by the interconnected test signal.

Example:

r0786 = 1500.0 and the measuring signal is r0063 (CO: Speed actual value).

A change of 1 volt at the output of the measuring socket corresponds to 1500.0 rpm.

Parameter overview (see List Manual)

Variable parameters

- p0771[0...2] CI: Measuring sockets signal source
- p0777[0...2] Measuring socket characteristic value x1
- P0778[0...2] Measuring socket characteristic value y1
- p0779[0...2] Measuring socket characteristic value x2
- p0780[0...2] Measuring socket characteristic value y2
- p0783[0...2] Measuring sockets offset
- p0784[0...2] Measuring socket limit on/off

Visualization parameters

- r0772[0...2] Measuring sockets output signal
- r0774[0...2] Measuring sockets output voltage
- r0786[0...2] Measuring socket normalization per volt

Function diagram overview (see List Manual)

- 8134 Measuring sockets

8.3 Fault and alarm messages

8.3.1 General information about faults and alarms

Description

The errors and states detected by the individual components of the drive system are indicated by messages.

The messages are categorized into faults and alarms.

Note

The individual faults and alarms are described in detail in:

References: /LH1/ SINAMICS S List Manual

Properties of faults and alarms

- Faults
  - Are identified by Fxxxxx.
  - Can lead to a fault reaction.
  - Must be acknowledged once the cause has been remedied.
  - Status via Control Unit and LED RDY.
  - Status via PROFIBUS status signal ZSW1.3 (fault active).
  - Entry in the fault buffer (see Subsection 8.3.2).
- Alarms (identification A56789)
  - Are identified by Axxxxx.
  - Have no further effect on the drive.
  - The alarms are automatically reset once the cause has been remedied. No acknowledgement is required.
  - Status via PROFIBUS status signal ZSW1.7 (alarm active).
  - Entry in the alarm buffer (see Subsection 8.3.2).
- General properties of faults and alarms
  - Can be configured (e.g. change fault to alarm, fault reaction).
  - Triggering on selected messages possible.
  - Initiation of messages possible via an external signal.

Acknowledging faults

The list of faults and alarms specifies how each fault is acknowledged after the cause has been remedied.

1. Acknowledgement of faults by “POWER ON”
   – Switch the drive on/off (POWER ON)
   – Press the RESET button on the Control Unit
2. Acknowledgement of faults by “IMMEDIATE”
   – Via PROFIBUS control signal

     STW1.7 (reset fault memory): 0/1 edge

     Set STW1.0 (ON/OFF1) = “0” and “1”
   – Via external input signal

     Binector input and interconnection with digital input

     p2103 = “Requested signal source”

     p2104 = “Requested signal source”

     p2105 = “Requested signal source”

     Across all of the drive objects (DO) of a Control Unit

     p2102 = “Requested signal source”
3. Acknowledge faults with “PULSE INHIBIT”
   – The fault can only be acknowledged with a pulse inhibit (r0899.11 = 0).
   – The same possibilities are available for acknowledging as described under acknowledge IMMEDIATELY.

Note

The drive cannot resume operation until all active faults have been acknowledged.

8.3.2 Buffer for faults and alarms

Note

A fault and alarm buffer is provided for each drive.

The drive and device-specific messages are entered in this buffer.

The contents of the fault buffer are saved to non-volatile storage when the Control Unit 320 (CU320) is powered down, i.e. the fault buffer history is still available when the unit is powered up again.

Notice

The entry in the fault/alarm buffer is made after a delay. For this reason, the fault/alarm buffer should not be read until a change in the buffer is also recognized (r0944, r2121) after “Fault active”/“Alarm active” is output.

Fault buffer

Faults which occur are entered in the fault buffer as follows:

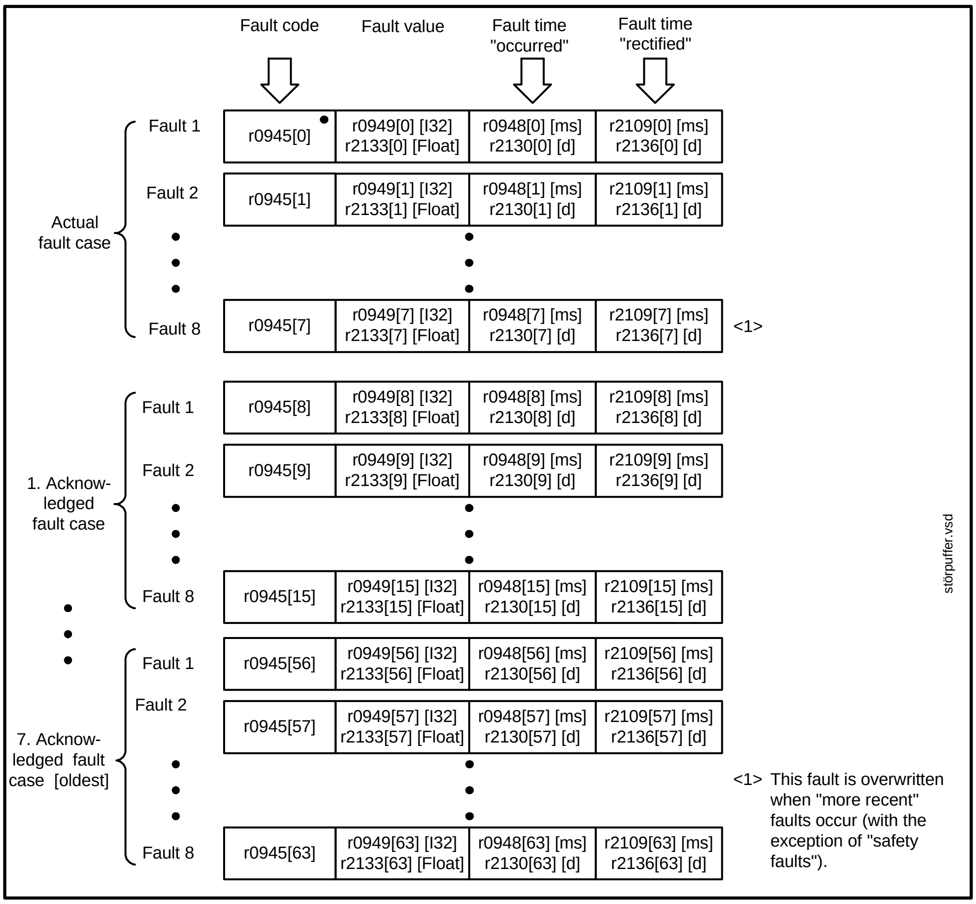


Fig. 8-12 Structure of fault buffer

Properties of the fault buffer:

- A new fault incident encompasses one or more faults and is entered in “Current fault incident”.
- The entries are arranged in the buffer according to the time at which they occurred.
- If a new fault incident occurs, the fault buffer is reorganized. The history is recorded in “Acknowledged fault incident” 1 to 7.
- If the cause of at least one fault in “Current fault incident” is remedied and acknowledged, the fault buffer is reorganized. The faults that have not been remedied remain in “Current fault incident”.
- If “Current fault incident” contains eight faults and a new fault occurs, the fault in the parameters in index 7 is overwritten by the new fault.
- r0944 is incremented each time the fault buffer changes.

- A fault value (r0949) can be output for a fault. The fault value is used to diagnose the fault more accurately; please refer to the fault description for details of the meaning.

Clearing the fault buffer:

- The fault buffer is reset as follows: p0952 = 0

Alarm buffer, alarm history

The alarm buffer comprises the alarm code, the alarm value and the alarm time (received, resolved). The alarm history occupies the last indices ([8...63]) of the parameter.

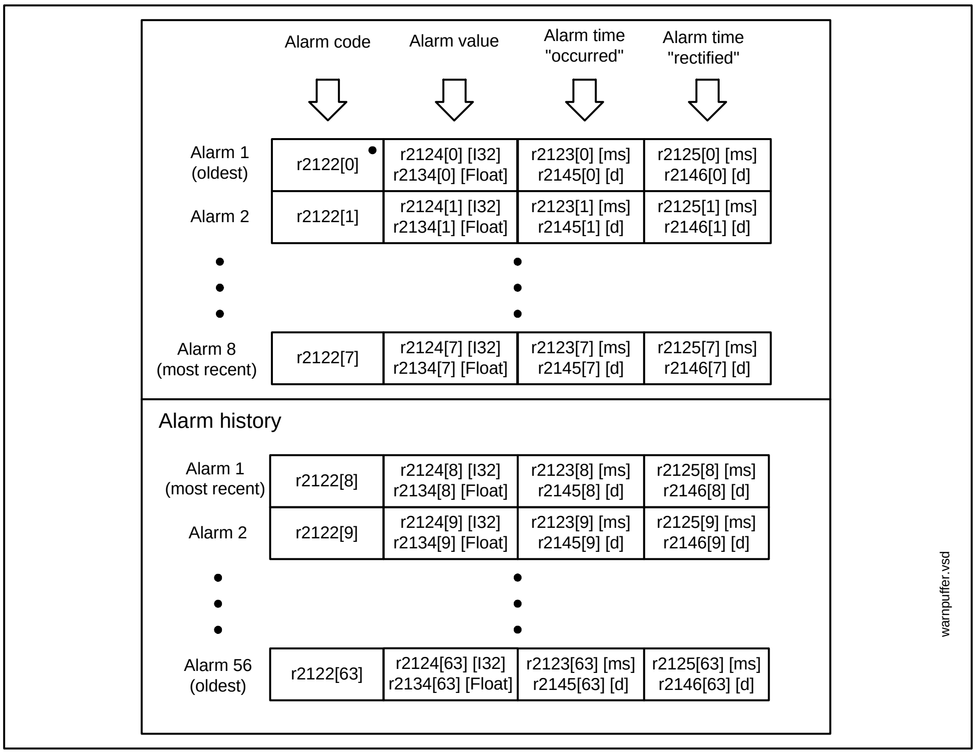


Fig. 8-13 Structure of alarm buffer

Alarms that occur are entered in the alarm buffer as follows:

A maximum of 64 alarms are displayed in the alarm buffer:

Index 0 .. 6 The **first** 7 alarms are displayed

Index 7 The **last** alarm is displayed

A maximum of 56 alarms are displayed in the alarm history:

Index 8 The **latest** alarm is displayed

Index 9 .. 56 The **first** 55 alarms are displayed

Properties of the alarm buffer/alarm history:

- The arrangement in the alarm buffer is made after the time that they occurred from 7 to 0. In the alarm history, this is from 8 to 56.
- If 8 alarms have been entered into the alarm buffer, and a new alarm is received, then the alarms that have been resolved are transferred into the alarm history.
- r2121 is incremented each time the alarm buffer changes.
- An alarm value (r2124) can be output for an alarm. The alarm value is used to diagnose the alarm more accurately; please refer to the alarm description for details of the meaning.

Deleting the alarm buffer, index [0...7]:

- The alarm buffer index [0...7] is reset as follows: p2111 = 0

8.3.3 Configuring messages (faults and alarms)

The properties of the faults and alarms in the drive system are permanently defined.

The following can be configured for some of the messages within a permanently defined framework for the drive system:

- Change message type (example)

Select message	Set message type	
p2118[5] = 1001	p2119[5]	= 1: fault (F)
		= 2: alarm (A, alarm)
		= 3: no message (N, no report)

- Change fault reaction (example)

Select message	Set fault reaction	
p2100[3] = 1002	p2101[3]	= 0: none
		= 1: OFF1
		= 2: OFF2
		= 3: OFF3
		= 4: STOP1 (being developed)
		= 5: STOP2
		= 6: DCBRAKE (being developed)
		= 7: ENCODER (p0491)

- Change acknowledgement (example)

Select message	Set acknowledgement	
p2126[4] = 1003	p2127[4]	= 1: POWER ON
		= 2: IMMEDIATELY
		= 3: PULSE INHIBIT

Note

- If BICO interconnections exist between drive objects, all interconnected objects must be configured.

  Example:
  The TM31 has BICO interconnections with drive 1 and 2 and F35207 is to be reconfigured as an alarm.

  —> p2118[n] = 35207 and p2119[n] = 2

  —> This must be set for TM31, drive 1 and drive 2.

Note

Only those messages which are listed in the indexed parameters can be changed as desired. All other message settings retain their factory settings or are reset to the factory settings.

Examples:

- In the case of messages listed via p2128[0...19], the message type can be changed. The factory setting is set for all other messages.
- The fault response of fault F12345 has been changed via p2100[n]. The factory settings are to be reinstated.

  —> p2100[n] = 0

Triggering on messages (example)

Select message	Trigger signal
p2128[0] = 1001	BO: r2129.0
or	
p2128[1] = 1002	BO: r2129.1

Note

The value from CO: r2129 can be used as group trigger.

CO: r2129 = 0	None of the selected message occurred.
CO: r2129 > 0	Group trigger. At least 1 selected message has occurred. The individual binector outputs BO: r2129 should be investigated.

External triggering of messages

If the appropriate binector input is interconnected with an input signal, fault 1, 2 or 3 or alarm 1, 2 or 3 can be triggered via an external input signal.

Once an external fault (1 to 3) has been triggered on the Control Unit drive object, this fault is also present on all associated drive objects. If one of these external faults is triggered on a different drive object, it is only present on that particular drive object.

BI: p2106	—> External fault 1	—> F07860(A)
BI: p2107	—> External fault 2	—> F07861(A)
BI: p2108	—> External fault 3	—> F07862(A)
BI: p2112	—> External fault 1	—> A07850(F)
BI: p2116	—> External fault 2	—> A07851(F)
BI: p2117	—> External fault 3	—> A07852(F)

Note

An external fault or alarm is triggered by a 1/0 signal.

An external fault and alarm do not usually mean that an internal drive message has been generated. The cause of an external fault and warning should, therefore, be remedied outside the drive.

8.3.4 Parameters and function diagrams for faults and alarms

Parameter overview (see List Manual)

- r0944 Counter for fault buffer changes

  ...
- p0952 Fault counter
- p2100[0...19] Sets the fault number for fault response

  ...
- r2139 Status word faults/alarms

Function diagram overview (see List Manual)

- 1710 Overview diagram – Monitoring functions, faults, alarms
- 8060 Faults and alarms – Fault buffer
- 8065 Faults and alarms – Alarm buffer
- 8070 Faults and alarms – Fault/alarm trigger word r2129
- 8075 Faults and alarms – Fault/alarm configuration

■

Basic Information about the Drive System 9

9.1 Parameters

Parameter types

The following adjustable and visualization parameters are available:

- Adjustable parameters (read/write)

  These parameters have a direct impact on the behavior of a function.

  Example: Ramp-up and ramp-down time of a ramp-function generator

- Monitoring parameters (read only)

  These parameters are used to display internal variables.

  Example: Current motor current

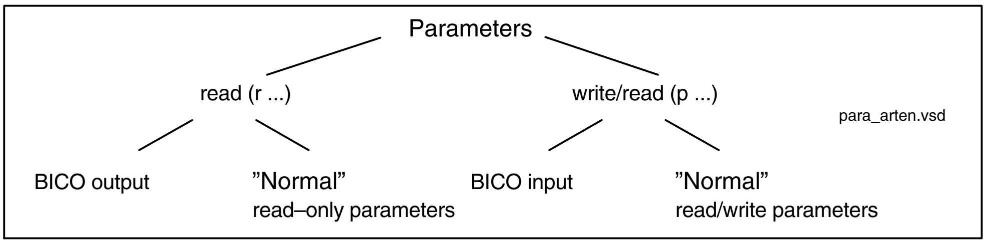


Fig. 9-1 Parameter types

All these drive parameters can be read and changed via PROFIBUS using the mechanisms defined in the PROFIdrive profile.

Parameter categories

The parameters for the individual drive objects (see 9.2) are categorized according to data sets as follows (see 9.2):

- Data-set-independent parameters

  These parameters exist only once per drive object.

- Data-set-dependent parameters

  These parameters can exist several times for each drive object and can be addressed via the parameter index for reading and writing. A distinction is made between various types of data set:

  – CDS: Command Data Set (see Section 9.2)

    By parameterizing several command data sets and switching between them, the drive can be operated with different pre-configured signal sources.

  – DDS: Drive Data Set

    The drive data set contains the parameters for switching between different drive control configurations.

  The CDS and DDS can be switched over during normal operation. Further types of data set also exist, however these can only be activated indirectly by means of a DDS switchover.

- EDS Encoder Data Set
- MDS Motor Data Set

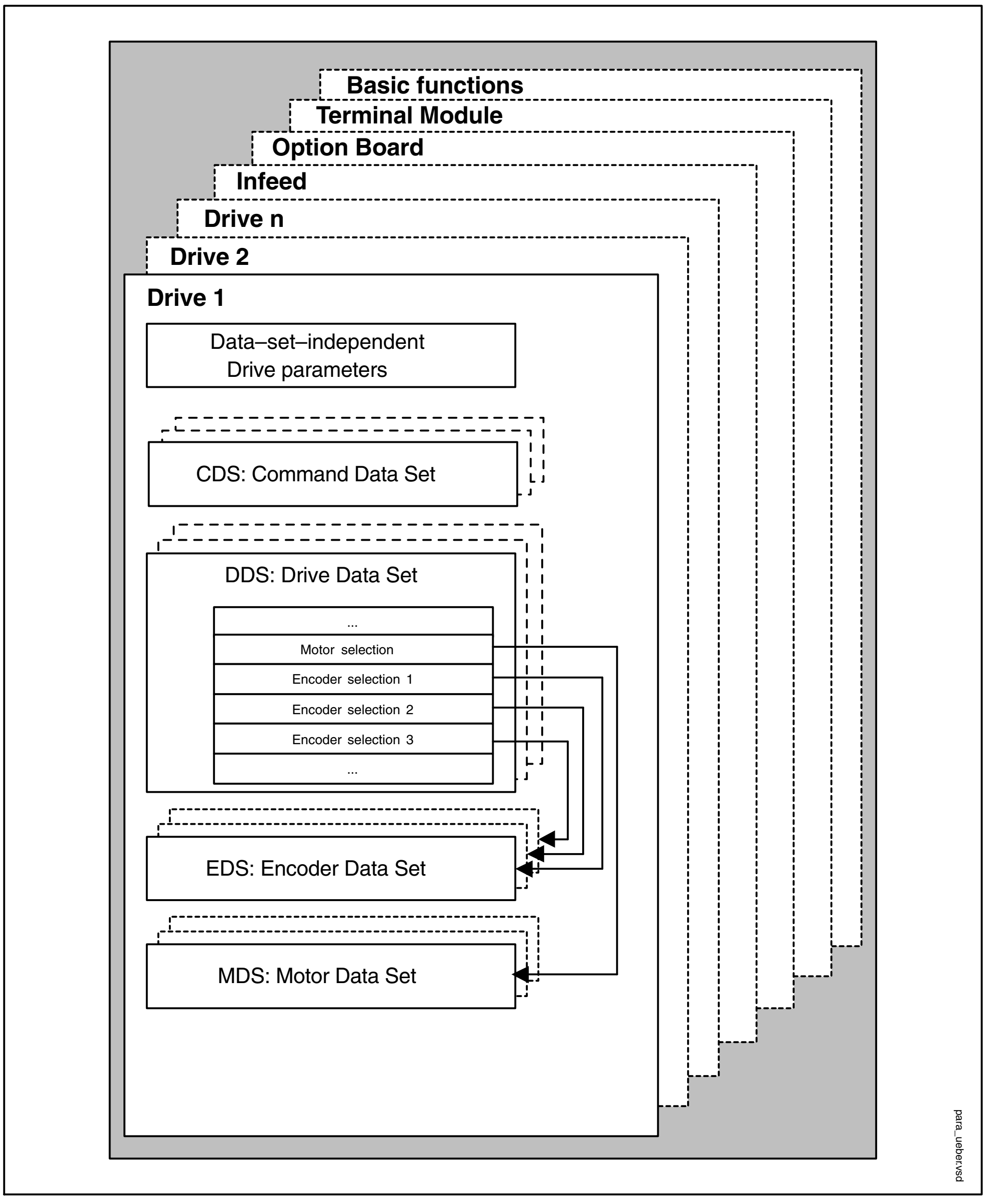


Fig. 9-2 Parameter categories

Saving parameters in a non-volatile memory

The modified parameter values are stored in the volatile RAM. When the drive system is switched off, this data is lost.

The data has to be saved as follows in a non-volatile memory so that it is available the next time the drive is switched on.

- Save parameters – device and all drives

  p0977 = 1 Is automatically reset to 0

- Saving parameters with STARTER

  See the “Copy from RAM to ROM” function.

Resetting parameters

The parameters can be reset to the factory setting as follows:

- Reset parameters – current drive object

  p0970 = 1 Is automatically reset to 0

- Reset parameters – all parameters of drive object “Control Unit”

  p0009 = 30 Parameter reset

  p0976 = 1 Is automatically reset to 0

Access level

The parameters are sub-divided into access levels. The List Manual specifies in which access level the parameter is displayed and can be changed. The required access level 0 to 4 can be set in p0003.

Table 9-1 Access levels

Access level	Remark
0 User-defined	Parameter from the user-defined list (p0013).
1 Standard	Parameters for the simplest operator functions (e.g. p1120 = ramp-function generator ramp-up time).
2 Extended	Parameters to handle the basic functions of the device.
3 Expert	Expert knowledge is already required for this parameter (e.g. knowledge about BICO parameterization).
4 Service	The password for parameters with access level 4 (service), please contact your local Siemens office. It must be entered into p3950.
5 Macro	The parameter can only be changed via a macro.

Note

Parameter p0003 is CU-specific (belongs to Control Unit).

9.2 Data sets

CDS: Command Data Set (CDS)

The BICO parameters (binector and connector inputs) are grouped together in a command data set. These parameters are used to interconnect the signal sources of a drive (see Section 9.4).

By parameterizing several command data sets and switching between them, the drive can be operated with different pre-configured signal sources.

A command data set contains the following (examples):

- Binector inputs for control commands (digital signals)
  - ON/OFF, enable signals (p0844, etc.)
  - Jog (p1055, etc.)
- Connector inputs for setpoints (analog signals)
  - Voltage setpoint for V/f control (p1330)
  - Torque limits and scaling factors (p1522, p1523, p1528, p1529)

A drive object, depending on the type, can manage up to 4 drive data sets. The number of drive data sets is configured with p0170.

The following parameters are available for selecting command data sets and for displaying currently selected command data sets – e.g. in the vector mode, the following parameters are available:

Binector inputs p0810 to p0811 are used to select a command data set. They represent the number of the command data set (0 to 3) in binary format (where p0811 is the most significant bit).

- p0810 BI: Command data set selection CDS bit 0
- p0811 BI: Command data set selection CDS bit 1

If a command data set, which does not exist, is selected, the current data set remains active. The selected data set is displayed using parameter (r0836).

Example: Switching between command data set 0 and 1

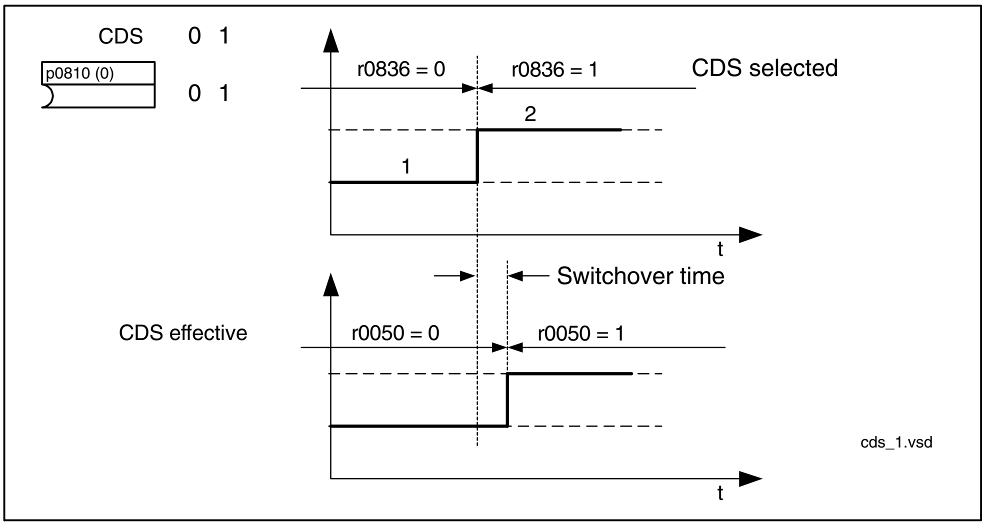


Fig. 9-3 Switching the command data set (example)

DDS: Drive Data Set

A drive data set contains various adjustable parameters that are relevant with respect to open and closed-loop drive control:

- Numbers of the assigned motor and encoder data sets:
  - p0186: assigned motor data set (MDS)
  - p0187 to p0189: up to 3 assigned encoder data sets (EDS)
- Various control parameters, e.g.:
  - Fixed speed setpoints (p1001 to p1015)
  - Speed limits min./max. (p1080, p1082)
  - Characteristic data of ramp-function generator (p1120 ff)
  - Characteristic data of controller (p1240 ff)
  - ...

The parameters that are grouped together in the drive data set are identified in the SINAMICS parameter list by “Data Set DDS” and are assigned an index [0..n].

It is possible to parameterize several drive data sets. You can switch easily between different drive configurations (control type, motor, encoder) by selecting the corresponding drive data set.

One drive object can manage up to 32 drive data sets. The number of drive data sets is configured with p0180.

Binector inputs p0820 to p0824 are used to select a drive data set. They represent the number of the drive data set (0 to 31) in binary format (where p0824 is the most significant bit).

- p0820 BI: Drive data set selection DDS bit 0
- p0821 BI: Drive data set selection DDS bit 1
- p0822 BI: Drive data set selection DDS bit 2
- p0823 BI: Drive data set selection DDS bit 3
- p0824 BI: Drive data set selection DDS bit 4

Supplementary conditions and recommendations

- Recommendation for the number of drive data sets for a drive

  The number of drive data sets for a drive should correspond to the options for switchover. The following must therefore apply:

  p0180 (DDS) $\geq$ max (p0120 (PDS), p0130 (MDS))
- Max. number of DDS for one drive object = 32 DDS

EDS: Encoder Data Set

An encoder data set contains various adjustable parameters describing the connected encoder for the purpose of configuring the drive (refer to Table 9-2).

- Adjustable parameters, e.g.:
  – Encoder interface component number (p0141)
  – Encoder component number (p0142)
  – Encoder type selection (p0400)

The parameters that are grouped together in the encoder data set are identified in the SINAMICS parameter list by “Data Set EDS” and are assigned an index [0..n].

A separate encoder data set is required for each encoder controlled by the Control Unit. Up to 3 encoder data sets are assigned to a drive data set via parameters p0187, p0188, and p0189.

An encoder data set can only be changed using a DDS changeover.

Each encoder may only be assigned to one drive and within a drive must – in each drive data set – either always be encoder 1, always encoder 2 or always encoder 3.

One power unit from which several motors are operated, alternating, would be a typical application for the EDS changeover. A contactor circuit is used to changeover between these motors. Each of the motors can be equipped with an encoder or be operated without an encoder (sensorless). Every encoder must be connected to its own SMx (also refer to the Chapter Motor changeover in the Function Manual).

If encoder 1 (p0187) is changed over via DDS, then an MDS must also be changed over.

One drive object can manage up to 16 encoder data sets. The number of encoder data sets configured is specified in p0140.

When a drive data set is selected, the assigned encoder data sets are selected automatically.

MDS: Motor Data Set

An encoder data set contains various adjustable parameters describing the connected encoder for the purpose of configuring the drive (refer to Table 9-2). It also contains certain visualization parameters with calculated data.

- Adjustable parameters, e.g.:
  - Motor component number (p0131)
  - Motor type selection (p0300)
  - Rated motor data (p0304 ff)
  - ...
- Visualization parameters, e.g.:
  - Calculated rated data (p0330 ff)
  - ...

The parameters that are grouped together in the motor data set are identified in the SINAMICS parameter list by “Data Set MDS” and are assigned an index [0..n].

A separate motor data set is required for each motor that is controlled by the Control Unit via a Motor Module. The motor data set is assigned to a drive data set via parameter p0186.

A motor data set can only be changed using a DDS changeover.
The motor data set changeover is, e.g. used for:

- Changing over between different motors
- Changing-over between different windings in a motor (e.g. star-delta changeover)
- Motor data adaptation

If several motors are operated alternately on a Motor Module, a matching number of drive data sets must be created. For further information about motor change-over, see the “Motor switchover” section in the Function Manual.
One drive object can manage up to 16 motor data sets. The number of motor data sets in p0130 may not exceed the number of drive data sets in p0180.

For the 611U interface mode (p2038 = 1), the drive data sets are divided into groups of eight (1–8; 8–16;...). Within a group, the assignment to the motor data set must be set the same:
p0186[0] = p0186[1] = ... = p0186[7]
p0186[8] = p0186[9] = ... = p0186[15]
p0186[16] = p0186[17] = ... = p0186[23]
p0186[24] = p0186[25] = ... = p0186[31]
If this rule is not compiled with alarm A07514 is output.

If you need a precise representation of the data set structure of the 611U, 32 drive data sets and 4 motor data sets must be configured.

Example of a data set assignment

Table 9-2 Example, data set assignment

DDS	Motor (p0186)	Encoder 1 (p0187)	Encoder 2 (p0188)	Encoder 3 (p0189)
DDS 0	MDS 0	EDS 0	EDS 1	EDS 2
DDS 1	MDS 0	EDS 0	EDS 3	–
DDS 2	MDS 0	EDS 0	EDS 4	EDS 5
DDS 3	MDS 1	EDS 6	–	–

Copying a command data set

Set parameter p0809 as follows:

1. p0809[0] = number of the command data set to be copied (source)
2. p0809[1] = number of the command data to which the data is to be copied (target)
3. p0809[2] = 1

Start copying.

Copying is finished when p0809[2] = 0.

Note

In STARTER, you can copy the command data sets (Drive –> Configuration –> “Command data sets” tab page).
The displayed command data set can be selected in the associated STARTER screen forms.

Copying a drive data set

Set parameter p0819 as follows:

1. p0819[0] = Number of the drive data set to be copied (source)
2. p0819[1] = Number of the drive data set to which the data is to be copied (target)
3. p0819[2] = 1

Start copying.

Copying is finished when p0819[2] = 0.

Note

The drive data sets can be copied in STARTER (Drive –> Configuration –> “Drive data sets” tab page).
The displayed drive data set can be selected in the associated STARTER screen forms.

Copying the motor data set

Set parameter p0139 as follows:

1. p0139[0] = Number of the motor data set that is to be copied (source)
2. p0139[1] = Number of the motor data set which should be copied into (target)
3. p0139[2] = 1

Start copying.

Copying has been completed, if p0139[2] = 0.

Note

In STARTER, you can set the drive data sets via the drive configuration.

Function diagram overview (see List Manual)

- 8560 Command data sets (CDS)
- 8565 Drive data set (DDS)
- 8570 Encoder data set (EDS)
- 8575 Motor data sets (MDS)

Parameter overview (see List Manual)

Variable parameters

- p0120 Power module data set (PDS) number
- p0130 Motor data set (MDS) number
- p0139 Copy motor data set (MDS)
- p0140 Encoder data set (EDS) number
- p0170 Command data set (CDS) number
- p0180 Drive data sets (DDS) number
- p0809 Copy command data set CDS
- p0810 BI: Command data set selection CDS bit 0
- p0811 BI: Command data set selection CDS bit 1
- p0812 BI: Command data set selection CDS bit 2
- p0813 BI: Command data set selection CDS bit 3
- p0819[0...2] Copy drive data set DDS
- p0820 BI: Drive data set selection DDS bit 0
- p0821 BI: Drive data set selection DDS bit 1
- p0822 BI: Drive data set selection DDS bit 2
- p0823 BI: Drive data set selection DDS bit 3
- p0824 BI: Drive data set selection DDS bit 4

9.3 Drive objects

A drive object is a self-contained software function with its own parameters and, if necessary, its own faults and alarms. Drive objects can be provided as standard (e.g. I/O evaluation), or you can add single (e.g. terminal board) or multiple objects (e.g. drive control).

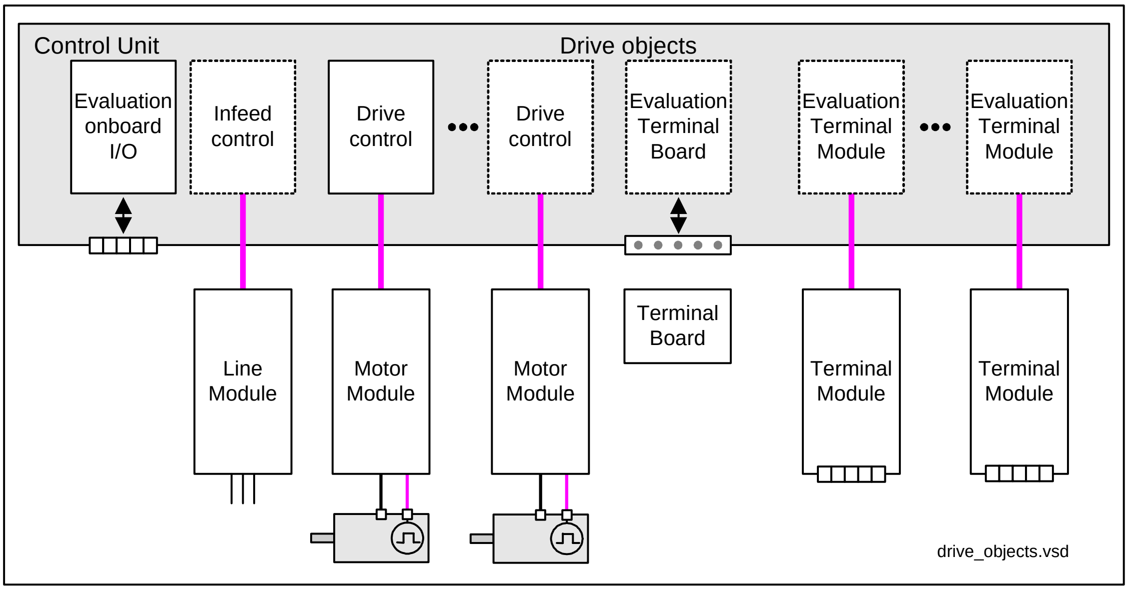


Fig. 9-4 Drive objects

Overview of drive objects

- Drive control

  Drive control handles closed-loop control of the motor. At least 1 Motor Module and at least 1 motor and up to 3 sensors are assigned to the drive control.

  Various types of drive control can be configured (e.g. servo control, vector control, etc.).

  Several drive controls can be configured, depending on the performance of the Control Unit and the demands made on the drive control system.

- Control Unit, inputs/outputs

  The I/Os on the Control Unit are evaluated within a drive object. High-speed inputs for probes are processed here in addition to bidirectional digital I/Os.

- Properties of a drive object
  - Separate parameter space
  - Separate window in STARTER
  - Separate fault/alarm system (for VECTOR, SERVO, INFEED)
  - Separate PROFIBUS telegram for process data (for VECTOR, SERVO, INFEED)
- Supply: Line Module infeed control with DRIVE-CLiQ interface

  If an Active Line Module with a DRIVE-CLiQ interface is used for the infeed in a drive system, open-loop/closed-loop control is implemented on the Control Unit within a corresponding drive object.
- Supply: Line Module infeed control with DRIVE-CLiQ interface

  If a Line Module without a DRIVE-CLiQ interface is used for the infeed in a drive system, the Control Unit must handle activation and evaluation of the corresponding signals (RESET, READY).
- Option board evaluation

  A further drive object handles evaluation of an installed option board. The specific method of operation depends on the type of option board installed.
- Terminal Module evaluation

  A separate drive object handles evaluation of the respective optional Terminal Modules.

Configuring drive objects

When you commission the system for the first time using the STARTER tool, you will use configuration parameters to set up the software-based “drive objects” which are processed on the Control Unit. Various drive objects can be created within a Control Unit.

The drive objects are configurable function blocks and are used to execute specific drive functions.

If you need to configure additional drive objects or delete existing ones after initial commissioning, the drive system must be switched to configuration mode.

The parameters of a drive object cannot be accessed until the drive object has been configured and you have switched from configuration mode to parameterization mode.

Note

Each installed drive object (Drive Objects) is allocated a unique number range from 0 to 63 for internal identification during initial commissioning.

Parameter overview (see List Manual)

Variable parameters

- p0101 Drive object numbers
- p0107 Drive object type
- p0108 Drive object configuration

Visualization parameters

- r0102 Number of drive objects

9.4 BICO technology: interconnection of signals

Description

Every drive contains a large number of interconnectable input and output variables and internal control variables.

BICO technology (Binector Connector Technology) allows the drive to be adapted to a wide variety of conditions.

Digital and analog signals, which can be connected freely by means of BICO parameters, are identified by the prefix BI, BO, CI or CO in their parameter name. These parameters are identified accordingly in the parameter list or in the function diagrams.

Note

The STARTER parameterization and commissioning tool is recommended when using BICO technology.

Binectors, BI: binector input, BO: binector output

A binector is a digital (binary) signal without a unit which can assume the value 0 or 1.

Binectors are subdivided into binector inputs (signal sink) and binector outputs (signal source).

Table 9-3 Binectors

Abbreviation and symbol	Name	Description
BI	Binector Input Binector Input (signal sink)	Can be interconnected to a binector output as source. The number of the binector output must be entered as a parameter value.
BO	Binector output Binector output (signal source)	Can be used as a source for a binector input.

Connectors, CI: connector input, CO: connector output

A connector is a digital signal, e.g. in the 32-bit format. It can be used to emulate words (16 bit), double words (32 bit) or analog signals. Connectors are subdivided into connector inputs (signal sink) and connector outputs (signal source).

The options for interconnecting connectors are restricted to ensure that performance is not adversely affected.

Table 9-4 Connectors

Abbreviation and symbol	Name	Description
CI	Connector Input Connector Input (signal sink)	Can be interconnected to a connector output as source. The number of the connector output must be entered as a parameter value.
CO	Connector output Connector Output (signal source)	Can be used as a source for a connector input.

Interconnecting signals using BICO technology

To interconnect two signals, a BICO input parameter (signal sink) must be assigned to the desired BICO output parameter (signal source).

The following information is required in order to connect a binector/connector input to a binector/connector output:

- Binectors: Parameter number, bit number and drive object ID
- Connectors with no index: Parameter number and drive object ID
- Connectors with index: Parameter number, index, and drive object ID

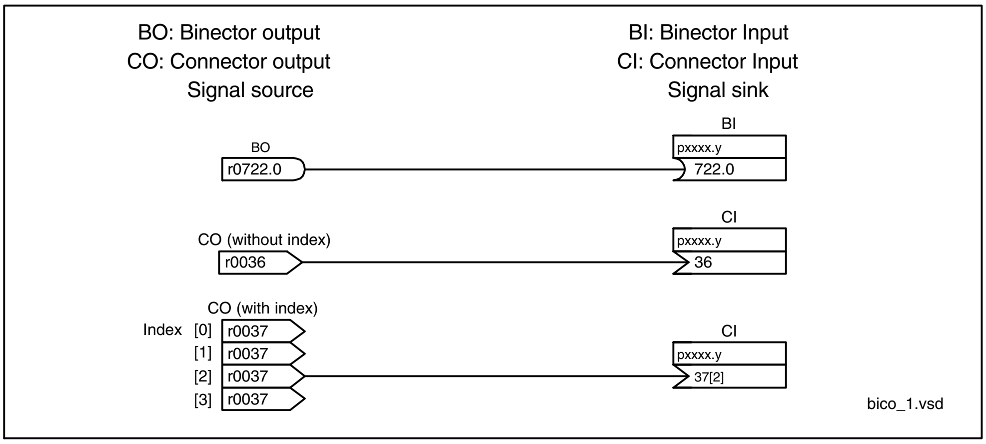


Fig. 9-5 Interconnecting signals using BICO technology

Note

A signal source (BO) can be connected to any number of signal sinks (BI).

A signal sink (BI) can only ever be connected to one signal source (BO).

The BICO parameter interconnection can be implemented in different command data sets (CDS). The different interconnections are activated by switching data sets. Interconnections across drive objects are also possible.

Internal encoding of the binector/connector output parameters

The internal codes are needed, for example, in order to write BICO input parameters via PROFIBUS.

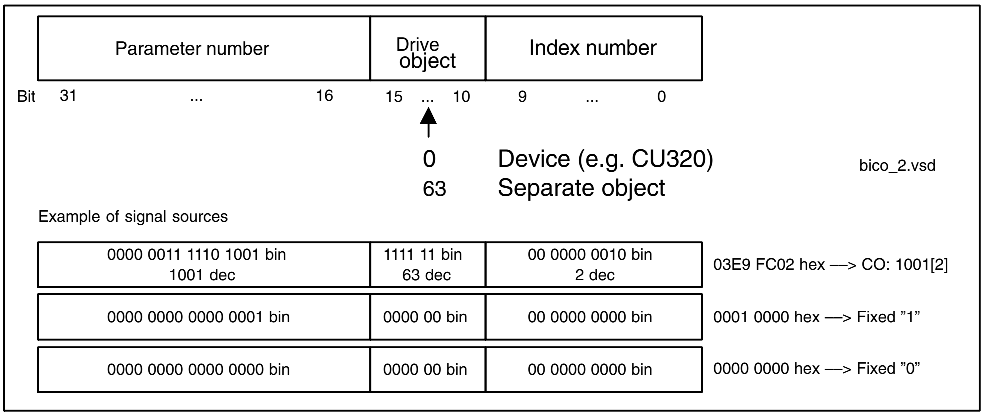


Fig. 9-6 Internal encoding of the binector/connector output parameters

Example 1: interconnecting digital signals

Suppose you want to operate a drive via terminals DI 0 and DI 1 on the Control Unit using jog 1 and jog 2.

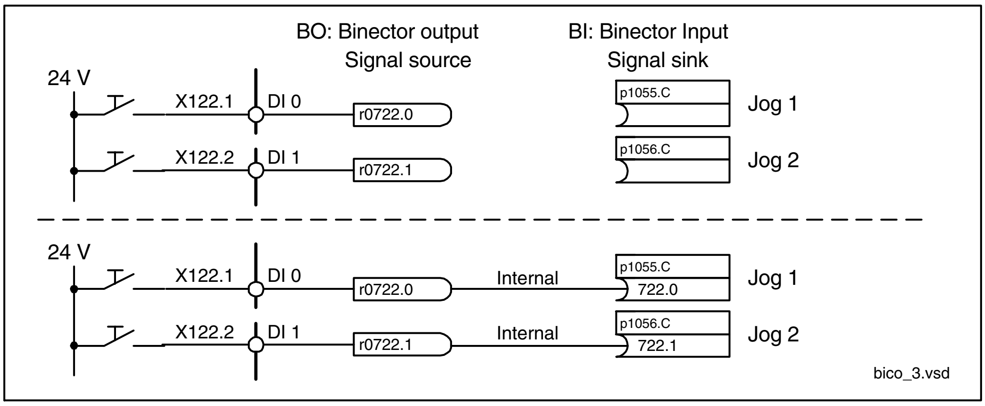


Fig. 9-7 Interconnection of digital signals (example)

Example 2: connection of OC/OFF3 to several drives

The OFF3 signal is to be connected to two drives via terminal DI 2 on the Control Unit.

Each drive has a binector input 1. OFF3 and 2. OFF3. The two signals are processed via an AND gate to STW1.2 (OFF3).

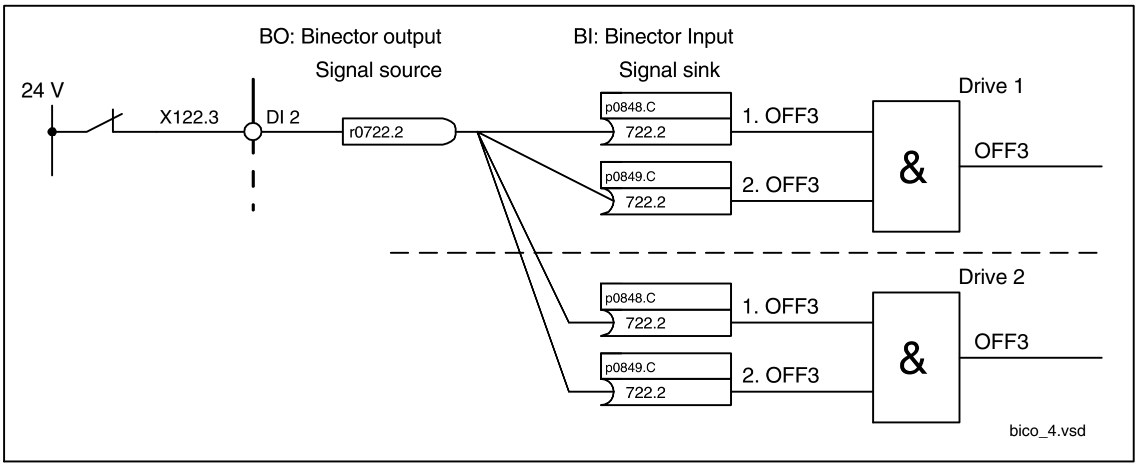


Fig. 9-8 Connection of OFF3 to several drives (example)

BICO interconnections to other drives

The following parameters are available for BICO interconnections to other drives:

- r9490 Number of BICO interconnections to other drives
- r9491[0...15] BI/CI of BICO interconnections to other drives
- r9492[0...15] BO/CO of BICO interconnections to other drives
- p9493[0...15] Reset BICO interconnections to other drives

Copying drives

When a drive is copied, the interconnection is copied with it.

Binector-connector converters and connector-binector converters

Binector-connector converter

- Several digital signals are converted to a 32-bit integer double word or to a 16-bit integer word.
- p2080[0...15] BI: PROFIBUS PZD send bit-serial

Connector-binector converter

- A 32-bit integer double word or a 16-bit integer word is converted to individual digital signals.
- p2099[0...1] CI: PROFIBUS PZD selection receive bit-serial

Fixed values for interconnection using BICO technology

The following connector outputs are available for interconnecting any fixed value settings:

- p2900[0...n] CO: Fixed value_%_1
- p2901[0...n] CO: Fixed value_%_2
- p2930[0...n] CO: Fixed Value_M_1

Example:

These parameters can be used to interconnect the scaling factor for the main setpoint or to interconnect an additional torque.

Signals for the analog outputs

Table 9-5 List of signals for analog outputs

Signal	Parameters	Unit	Scaling (100% = ...)
Speed setpoint before the setpoint filter	r0060	rpm	p2000
Speed actual value motor encoder	r0061	rpm	p2000
Actual speed value	r0063	rpm	p2000
Drive output frequency	r0066	Hz	Reference frequency
Absolute current actual value	r0068	Aeff	p2002
Actual DC link voltage value	r0070	V	p2001
Total torque setpoint	r0079	Nm	p2003
Actual active power	r0082	kW	r2004
Control deviation	r0064	rpm	p2000
Control factor	r0074	%	Reference modulation depth
Current setpoint, torque-generating	r0077	A	p2002
Current actual value, torque-generating	r0078	A	p2002
Flux setpoint	r0083	%	Reference flux
Actual flux	r0084	%	Reference flux
Speed controller PI torque output	r1480	Nm	p2003
Speed controller I torque output	r1482	Nm	p2003

Scaling for vector object

Table 9-6 Scaling for vector object

Size	Scaling parameter	Default at initial commissioning
Reference speed	100 % = p2000	p2000 = Maximum speed (p1082)
Reference voltage	100 % = p2001	p2001 = 1000 V
Reference current	100 % = p2002	p2002 = Current limit (p0640)
Reference torque	100 % = p2003	p2003 = 2 * rated motor torque (p0333)
Reference power	100 % = r2004	r2004 = p2003 * p2000 * 2π / 60
Reference frequency	100 % = p2000/60	–
Reference modulation depth	100 % = Maximum output voltage without overload	–
Reference flux	100 % = Rated motor flux	–
Reference temperature	100 % = 100°C	–
Reference electrical angle	100 % = 90°	–

Scaling for servo object

Table 9-7 Scaling for servo object

Size	Scaling parameter	Default at initial commissioning
Reference speed	100 % = p2000	Induction motor p2000 = Maximum motor speed (p0322) Synchronous motor p2000 = Rated motor speed (p0311)
Reference voltage	100 % = p2001	p2001 = 1000 V
Reference current	100 % = p2002	p2002 = Motor limit current (p0338); when p0338 = “0”, 2 * rated motor current (p0305)
Reference torque	100 % = p2003	p2003 = p0338 * p0334; when “0”, 2 * rated motor torque (p0333)
Reference power	100 % = r2004	r2004 = p2003 * p2000 * π / 30
Reference frequency	100 % = p2000/60	–
Reference modulation depth	100 % = Maximum output voltage without overload	–
Reference flux	100 % = Rated motor flux	–
Reference temperature	100 % = 100°C	–
Reference electrical angle	100 % = 90°	–

Scaling for object A_Inf

Table 9-8 Scaling for object A_Inf

Size	Scaling parameter	Default at initial commissioning
Reference frequency	100 % = p2000	p2000 = p0211
Reference voltage	100 % = p2001	p2001 = r0206/r0207
Reference current	100 % = p2002	p2002 = p0207
Reference power	100 % = r2004	r2004 = p0206
Reference modulation depth	100 % = Maximum output voltage without overload	–
Reference temperature	100 % = 100°C	–
Reference electrical angle	100 % = 90°	–

Scaling for object B_Inf

Table 9-9 Scaling for object B_Inf

Size	Scaling parameter	Default at initial commissioning
Reference frequency	100 % = p2000	p2000 = 50
Reference voltage	100 % = p2001	p2001 = r0206/r0207
Reference current	100 % = p2002	p2002 = p0207
Reference power	100 % = r2004	r2004 = p0206
Reference temperature	100 % = 100°C	–
Reference electrical angle	100 % = 90°	–

9.5 Function modules

Description

A function module is a functional expansion of a drive object that can be activated during commissioning.
Examples of function modules:

- Technology controller
- Setpoint channel for SERVO drive object
- Parallel connection of Motor Modules or Line Modules
- Extended brake control
- Linear motors

A function module generally has separate parameters and, in some cases, separate faults and warnings too. These parameters and messages are only displayed when the function module is active. An active function module also generally requires additional processing time, which must be taken into account during configuration.

Commissioning with STARTER

In the commissioning screen forms of STARTER, you can either directly or indirectly activate the function modules (e.g. technology controller direct, linear motor indirect by selecting a linear motor).

Commissioning via parameter (only with BOP20)

The function modules can be activated/de-activated using parameter p0108 of the Control Unit (CU). The indices of parameters r0107, p0108 and p0124 represent the different drive object types; these are displayed in r0107 (CU) after the device has been configured. The READY LED of the main component of the drive object (e.g. Motor Module, TM31) can be made to flash using parameter p0124 (CU).

Overview of important parameters (refer to the List Manual)

- r0107 Drive object type
- p0108 Drive objects, function module
- p0124 Identifying the main components using LEDs

9.6 DRIVE-CLiQ topology

Introduction

The term topology is used in SINAMICS to refer to a wiring harness with DRIVE-CLiQ cables. A unique component number is allocated to each component during the start-up phase.

DRIVE-CLiQ (DRIVE Component Link with IQ) is a communication system for connecting the various components in SINAMICS (e.g. Control Unit, Line Module, Motor Modules, motors, and encoders).

DRIVE-CLiQ supports the following properties:

- Automatic detection of components by the Control Unit
- Standard interfaces to all components
- Standardized diagnostics down to component level
- Standardized service down to component level

Electronic type plate

The electronic type plate contains the following data:

- Component type (e.g. SMC20)
- Order number (e.g. 6SL3055-0AA0-5BA0)
- Manufacturer (e.g. SIEMENS)
- Hardware version (e.g. A)
- Serial number (e.g. “T-PD3005049)
- Technical specifications (e.g. rated current)

Actual topology

The actual topology is the actual DRIVE-CLiQ wiring harness.

When the drive system components are started up, the actual topology is detected automatically via DRIVE-CLiQ.

Target topology

The target topology is stored on the CompactFlash card on the Control Unit and is compared with the actual topology when the Control Unit is started up.

The target topology can be specified in two ways and saved on the CompactFlash card:

- Via STARTER
  by creating the configuration and loading it onto the drive
- Via quick commissioning (automatic configuration)

  The actual topology is read and the target topology written to the CompactFlash card.

Comparison of topologies at Power On

Comparing the topologies prevents a component from being controlled/evaluated incorrectly (e.g. drive 1 and 2).

When the drive system is started, the Control Unit compares the detected actual topology and the electronic type plates with the target topology stored on the CompactFlash card.

You can specify how the electronic type plates are compared for all the components of a Control Unit via p9906. The type of comparison can be changed subsequently for each individual component. You can use p9908 for this or the right mouse button in the topology view in the STARTER tool. All data on the electronic type plate is compared by default.

The following data in the target and actual topologies is compared depending on the settings made in p9906/9908:

- p9906/9908 = 0: component type, order number, manufacturer, serial number
- p9906/9908 = 1: component type, order number
- p9906/9908 = 2: component type
- p9906/9908 = 3: component class (e.g. Sensor Module or Motor Module)

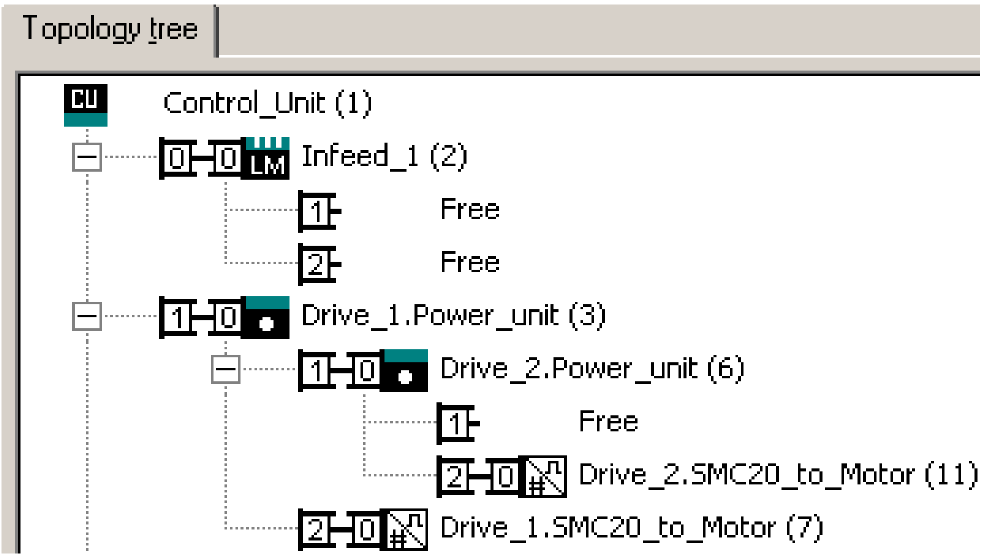


Fig. 9-9 Topology view in the STARTER tool

Notice

The Control Unit and the Option Board are not monitored. The system automatically accepts new components and does not output a message.

9.6.1 Permissible combinations of Line Modules and Motor Modules

With the exception of the Line Module, all components on a DRIVE-CLiQ line must have the same sampling time.

The following table shows the permissible sampling times of other nodes on a DRIVE-CLiQ line for a Line Module. Default settings of the sampling times, see Subsection 9.8.2.

Table 9-10 Permissible sampling times on a DRIVE-CLiQ line

Line Module	Motor Module
250 µs	125 µs (booksize servo only) and 250 µs
375 µs	375 µs
400 µs	400 µs

9.7 Examples of replacing components

Note

To ensure that the entire functionality of a firmware version can be used, it is recommended that all the components in a drive line-up have the same firmware version.

Description

If the type of comparison is set to the highest setting, the following examples apply.

A distinction is made between the following scenarios:

- Components with identical order number
  - Topology comparison component replacement active (p9909 = 1)
  - Topology comparison component replacement inactive (p9909 = 0)
- Component with a different order number

For p9909 = 1, the serial number and the hardware version of the new replaced component is automatically transferred from the actual topology into the target topology and then saved in a non-volatile fashion.

For the components that have been replaced, the electronic type plate must match as far as the following data is concerned:

- Component type (e.g. “SMC20”)
- Order No. (e.g. “6SL3055-0AA0-5BA0”)

For p9909 = 0, serial numbers and hardware versions are not automatically transferred. In this case, when the data in the electronic type plate match, then the transfer is realized using p9904 = 1.

Example: topology comparison component replacement active (p9909 = 1)

Prerequisite:

- The replaced component has an identical order number
- The target topology of the Control Unit must not contain the serial number of the new component that has replaced the old component.
- Topology comparison component replacement active (p9909 = 1)

Components that are not contained in the target topology of the Control Unit and have identical order numbers are automatically transferred to the target topology and saved in a non-volatile memory.

Note

Components must be replaced before POWER ON in order that the changes in the target topology are automatically saved in a non-volatile fashion.

Example, replacing a defective component with an identical Order No. (p9909 = 0)

Prerequisite:

- The replaced component has an identical order number
- Topology comparison component replacement inactive (p9909 = 0)

Table 9-11 Example: Replacing a Motor Module

Action	Response	Remark
• Switch off the power supply • Replace the defective component and connect the new one • Switch on the power supply	Alarm A01425	
• Set p9905 to “1”	• Alarm disappears • The serial number is copied to the target topology	The serial number is stored in the RAM of the Control Unit and has to be copied to the non-volatile memory with p0971 or p0977.
The component has been successfully replaced		

Example of replacing a component with a different order number

Prerequisite:

- The replaced component has a different order number

Table 9-12 Example of replacing a component with a different order number

Action	Response	Remark
• Switch off the power supply • Replace the defective component and connect the new one • Switch on the power supply	Alarm A01420	
• Load the project from the Control Unit to the STARTER (PG) • Configure the replacement drive and select the current component • Load the project to the Control Unit (target system)	• Alarm disappears	The new order number is stored in the RAM of the Control Unit and has to be copied to the non-volatile memory with p0971 or p0977.
The component has been successfully replaced		

Example, replacing a Motor Module/Power Module with a different power rating

Prerequisite:

- The replaced power unit has a different power rating
- Vector: Power rating of the Motor Module/Power Module not greater than 4 * motor current

Table 9-13 Example, replacing a power unit with a different power rating

Action	Response	Remark
• Switch off the power supply • Replace the defective component and connect the new one • Switch on the power supply	Alarm A01420	
• Drive Object CU: – p0009 = 1 – p9906 = 2 – p0009 = 0 – p0977 = 1	• Device configuration • Component comparison • Completing the configuration • Data backup	
• Drive Object component: – p0201 = r0200 – p0010 = 0 – p0971 = 1	• Use the code number • Completing commissioning • Data backup	The new order number is stored in the RAM of the Control Unit and has to be copied to the non-volatile memory with p0971 or p0977.
The component has been successfully replaced		

9.8 System sampling times

9.8.1 Description

The software functions installed in the system are executed cyclically at different sampling times (p0115, p0799, p4099).

The sampling times of the functions are automatically pre-assigned when configuring the drive unit.

The settings are based on the selected mode (vector/servo), the number of connected components, and the functions activated.

The sampling times can be adjusted using parameter p0112 (sampling times, presetting p0115), p0113 (pulse frequency, minimum selection) or directly using p0115.

For p0092 = 1, the sampling times are pre-assigned so that isochronous operation together with a control is possible. If isochronous operation is not possible due to incorrect sampling time settings, then an appropriate message is output (A01223, A01224). Before the automatic configuration, parameter p0092 must be set to “1” in order that the sampling times are appropriately pre-set.

9.8.2 Setting the sampling times

Introduction

The rules in Subsection 9.8.3 must be carefully observed when setting the sampling times.

Setting the sampling times via p0112

The sampling times for:

- Current controller (p0115[0])
- Speed controller (p0115[1])
- Flux controller (p0115[2])
- Setpoint channel (p0115[3])
- Position controller (p0115[4]) being prepared
- Positioner (p0115[5]) being prepared
- Technology controller (p0115[6])

are set by selecting the appropriate values in p0115[0...6] for the closed-loop control configuration and are copied to p0115 depending on the performance levels required. The performance levels range from xLow to xHigh.

The sampling times are shown in the following table.

Table 9-14 For Active Infeed, the sampling time is set using p0112 (p0112 = 1 not for p0092 = 1)

p0112	p0115[0]	p0115[1]	p0115[2]	p0115[3]	p0115[4]	p0115[5]	p0115[6]
1: xLow	400	–	–	1600	–	–	–
2: Low	250	–	–	2000	–	–	–
3: Standard	125	–	–	2000	–	–	–
4: High	125	–	–	1000	–	–	–
5: xHigh	125	–	–	500	–	–	–

Table 9-15 For Smart Infeed, the sampling time is set using p0112 (p0112 = 1 not for p0092 = 1)

p0112	p0115[0]	p0115[1]	p0115[2]	p0115[3]	p0115[4]	p0115[5]	p0115[6]
1: xLow	400	–	–	1600	–	–	–
2: Low	250	–	–	2000	–	–	–
3: Standard	250	–	–	2000	–	–	–
4: High	250	–	–	1000	–	–	–
5: xHigh	–	–	–	–	–	–	–

Table 9-16 For the Basic Infeed, the sampling time is set via p0112

p0112	p0115[0]	p0115[1]	p0115[2]	p0115[3]	p0115[4]	p0115[5]	p0115[6]
1: xLow	2000	–	–	2000	–	–	–
2: Low	2000	–	–	2000	–	–	–
3: Standard	2000	–	–	2000	–	–	–
4: High	–	–	–	–	–	–	–
5: xHigh	–	–	–	–	–	–	–

Table 9-17 For Servo, the sampling time is set via p0112

p0112	p0115[0]	p0115[1]	p0115[2]	p0115[3]	p0115[4]	p0115[5]	p0115[6]
1: xLow	250	250	250	4000	2000	8000	4000
2: Low	125	250	250	4000	2000	8000	4000
3: Standard	125	125	125	4000	1000	4000	4000
4: High	62.5	62.5	62.5	1000	1000	2000	1000
5: xHigh	–	–	–	–	–	–	–

Table 9-18 For Vector, the sampling time is set using p0112 (p0112 = 1 not for p0092 = 1 and not for PM340)

p0112	p0115[0]	p0115[1]	p0115[2]	p0115[3]	p0115[4]	p0115[5]	p0115[6]
1: xLow	400	1600	1600	3200	3200	3200	3200
2: Low	250	1000	2000	1000	2000	4000	4000
3: Standard	250	1000	1000	1000	2000	4000	4000
4: High	250	500	1000	500	1000	2000	2000
5: xHigh	250	250	1000	250	1000	2000	1000

Setting the pulse frequency via p0113 when STARTER is in the online mode

The minimum pulse frequency can be entered in p0113. The parameter can only be changed for p0112 = 0 (expert). The current controller sampling time (p0115[0]) is set to the inverse value of twice the minimum pulse frequency. The current controller sampling time (p0115[0]) calculated from the pulse frequency is set in the 1.25 μs time grid.

Servo:
For p0113 = 2.0 kHz, p0115[0] is set to 250 μs; for p0113 = 4.0 kHz, p0115[0] is set to 125 μs.

Vector:
For p0113 = 1.0 kHz, p0115[0] is set to 500 μs; for p0113 = 2.0 kHz, p0115[0] is set to 250 μs.

The effective pulse frequency (p1800) is, depending on p0113 when existing commissioning (p0009 = p0010 = 0) appropriately pre-assigned and can be subsequently modified.

Setting the sampling times using p0115

If sampling times are required, which cannot be set using p0112 > 1, then the sampling times can be directly set using p0115; to do this, p0112 must be set to 0 (expert).

If p0115 is changed online, then the values of higher indices are automatically adapted.

We do not recommend that p0115 is changed when STARTER is in the offline mode. The reason for this is that if the parameterization is incorrect, then the project download is interrupted.

9.8.3 Rules when setting the sampling times

The following rules apply when setting the sampling times:

1. The current controller sampling times of the drive objects (DOs) and the sampling time of the inputs/outputs of the Control Unit, TM and TB modules must be a multiple integer of 1.25 μs.
2. The sampling times (p0115[0] and p4099) of all of the components, which are connected to a DQS, must be integer multiples of one another.
   If, at a DO, the current controller sampling time must be changed into another time grid that does not match the other DOs at the DQS, then the following possibilities are available:
   – Change over the DO to another, separate DQS
   – Also change the current controller sampling time and the sampling time of the inputs/outputs of the DOs not involved so that they again fit into the time grid.
3. The sampling times of the inputs/outputs (4099[0..2]) of a TB30 must be an integer multiple of the current controller sampling time (p0115[0]) of a drive object connected to a DRIVE-CLiQ group.

   – Sampling time of the inputs/outputs p4099[0..2]: for TB30

4. For Active Line Modules (ALM) Booksize format, only a current controller sampling time of 125.0 µs or 250.0 µs can be set.
5. For Chassis format ALMs, only a current controller sampling time of 250.0 µs or 400.0 µs / 375.0 µs (375 µs for p0092 = 1) can be set.
6. For Basic Line Modules (BLM), only a current controller sampling time of 2000 µs can be set.
7. For Chassis format Motor Modules, a minimum current controller sampling time of 250 µs can be set (250 µs ≤ p115[0] ≤ 500 µs).
8. For Blocksize format Motor Modules (PM340), a current controller sampling time 62.5 µs, 125.0 µs, 250.0 µs and 500.0 µs can be set (only pulse frequencies in a 2 kHz time grid are permitted).
9. If a Chassis unit is connected, at a DQS, the minimum current controller sampling time is 250 µs.
   Example:
   When both Chassis and Booksize units are connected to a DQS
10. For servo drives, a current controller sampling time of between 62.5 µs and 250.0 µs can be set (62.5 µs ≤ p115[0] ≤ 250.0 µs).
11. For vector drives, a current controller sampling time of between 250.0 µs and 500.0 µs can be set (250.0 µs ≤ p115[0] ≤ 500.0 µs).
12. For servo drives with a current controller sampling time of p0115[0] = 62.5 µs, the following applies:
    – Only possible for Booksize formats
    – Cannot be combined with a Line Module connected to a DQS

    Maximum number of components/devices:

    – 2 servo with p0115[0] = 62.5 µs + Line Module (connected to another DQS)
    – At a DQS, can be combined with a servo with p0115[0] = 125.0 µs.
      However, nothing changes relating to the components/devices that can be connected
13. Synchronous Profibus operation (set p0092 to 1):
    – Servo, vector and vector-V/f control objects must have the same current controller sampling time.
      Exception: It is possible mix 125.0 µs with 62.5 µs.
    – The current controller sampling time must, in addition, be a a multiple integer of 125.0 µs or also equal to 62.5 µs.
14. For vector and vector-V/f control drive types, and when using a sinusoidal filter (p0230 > 0), it is only permissible to change the current controller sampling time of the DO involved in multiple integer steps of the default value.
15. The following applies when using a Voltage Sensing Module (VSM):

    All current controller sampling times at the DQS must be the same.
16. For 3 vector drives (speed control: r0108.2 = 1) a minimum current controller sampling time of 375.0 µs) can be set (375.0 µs ≤ p115[0] ≤ 500 µs).

This rule is also applicable for a parallel circuit configuration (3 or 4 Motor Modules connected in parallel)

17. For 4 vector drives (speed control: r0108.2 = 1) a minimum current controller sampling time of 400.0 µs) can be set
(400.0 µs ≤ p115[0] ≤ 500 µs).

18. When servo is operated together with vector-V/f, a maximum of 5 DOs is possible (ALM, TB and TM additionally possible):
Examples:
   – 1 servo + 4 vector-V/f (vector-V/f: 400 µs ≤ p115[0] ≤ 500 µs)
   – 2 servo + 3 vector-V/f (vector-V/f: 400 µs ≤ p115[0] ≤ 500 µs)
   – 3 servo + 2 vector-V/f (vector-V/f: 250 µs ≤ p115[0] ≤ 500 µs)
   – 4 servo + 1 vector-V/f (vector-V/f: 250 µs ≤ p115[0] ≤ 500 µs)

19. A maximum of two DRIVE-CLiQ lines are possible in the unit where the lowest sampling times are not integer multiples of one another.

Example 1:
At CU-X100: ALM with 250 µs
At CU-X101: 1 drive object vector with 455 µs (p113=1.098kHz)
This setting is permissible.
Additional DQS must have the lowest sampling time, that is either 250 µs or 455 µs.

9.8.4 Default settings for the sampling times

When commissioning for the first time, the current controller sampling times (p0115[0]) are automatically pre-set with these default values as follows:

Table 9-19 Default settings

Type	Number	p0112	p0115[0]	p1800
Active Infeed and Smart Infeed				
Booksize	1	2 (Low)	250 µs	8 kHz
Chassis 400 V / ≤ 300 kW 690 V / ≤ 330 kW	1	2 (Low)	250 µs	8 kHz
Chassis 400 V / > 300 kW 690 V / > 330 kW	1	0 (Expert) 1 (xLow)	375 µs (p0092 = 1) 400 µs (p0092 = 0)	2.666 kHz 2.5 kHz
Basic Infeed				
Chassis	1	3 (Standard)	2000 µs	0.5 kHz

Table 9-19 Default settings, continued

Type	Number	p0112	p0115[0]	p1800
Servo				
Booksize	1 to 6	3 (Std.)	125 µs	4 kHz
Chassis	1 to 6	1 (xLow)	250 µs	2 kHz
Blocksize	1 to 5	3 (Standard)	125 µs	4 kHz
Vector				
Booksize	1 to 2 **only** n_ctrl 1 to 4 **only** V/f 1 to 2 n_ctrl and V/f **mixed**	3 (Standard)	250 µs	4 kHz
Chassis 400 V / ≤ 250 kW				2 kHz
Booksize	3 **only** n_ctrl 5 to 6 **only** V/f 3 n_ctrl and V/f **mixed**	0 (Expert) 1 (xLow)	375 µs (p0092 = 1) 400 µs (p0092 = 0)	2.666 kHz 2.5 kHz
Chassis 400 V / ≤ 250 kW			375 µs (p0092 = 1) 400 µs (p0092 = 0)	1.333 kHz 1.25 kHz
Chassis > 250 kW 690 V	1 to 3 **only** n_ctrl 1 to 6 **only** V/f 1 to 3 n_ctrl and V/f **mixed**	0 (Expert) 1 (xLow)	375 µs (p0092 = 1) 400 µs (p0092 = 0)	1,333 kHz 1.25 kHz
Booksize	4 **only** n_ctrl 4 n_ctrl and V/f **mixed**	0 (Expert) 1 (xLow)	500 µs (p0092 = 1) 400 µs (p0092 = 0)	4 kHz 2.5 kHz
Chassis		0 (Expert) 1 (xLow)	500 µs (p0092 = 1) 400 µs (p0092 = 0)	2 kHz 1.25 kHz
Booksize	> 6 **only** V/f	0 (Expert)	500 µs	4 kHz
Chassis				2 kHz
Blocksize	1 to 2 **only** n_ctrl 1 to 4 **only** V/f	3 (Standard)	250 µs	4 kHz
Blocksize	> 2 n_ctrl (min. 1) > 4 **only** V/f	0 (Expert)	500 µs	4 kHz
Caution If a Power Module Blocksize is connected to a Control Unit, then the sampling times of all vector drives are set according to the rules for Power Modules Blocksize (only 250 µs or 500 µs possible).				

9.8.5 Examples when changing sampling times / pulse frequencies

Example, changing the current controller sampling time from 62.5 μs with p0112

Prerequisites:

- Maximum 2 drives, Booksize format
- Servo motor control type

Procedure:

1. p0009 = 3 (not for offline operation)
2. Change into the first servo drive object
3. p0112 = 4
4. Change into the second servo drive object and repeat step 3.
5. p0009 = 0 (not for offline operation)
6. When STARTER is in the offline mode. Download into the drive.
7. Save the parameter changes in a non-volatile fashion using the function “Copy RAM to ROM” (also see Subsection 3.2.1 and 3.3.1).
8. We recommend that the controller settings are re-calculated (p0340 = 4).

Example, changing the pulse frequency with p0113

Prerequisites:

- STARTER is in the online mode

Assumption:

- A TB30 has been installed
- Servo motor control type

Procedure:

1. p0009 = 3 (not for offline operation)
2. Change into the first servo drive object
3. p0112 = 0
4. Enter the required pulse frequency in p0113.
   If this is not in compliance with rule 1 in Subsection 9.8.3, an alarm is output and a suitable pulse frequency is recommended in p0114. This can be entered into p0113 taking into account all of the rules in Subsection 9.8.3.
5. Change into the second servo drive object and repeat steps 3. and 4.
6. Change into the drive object TB30
7. Set the sampling times p4099[0..2] to a multiple of the current controller sampling time of a servo drive.
8. p0009 = 0
   Note: The pulse frequency in p1800 is automatically adapted.
9. Save the parameter changes in a non-volatile fashion using the function “Copy RAM to ROM” (also see Subsection 3.2.1 and 3.3.1).
10. We recommend that the controller settings are re-calculated (p0340 = 4).

9.8.6 Parameter overview (see List Manual)

- p0009 Device commissioning, parameter filter
- p0092 Isochronous PROFIBUS operation, pre-assignment/check
- p0097 Selects the drive object type
- r0110 [0..2] DRIVE-CLiQ basis sampling times
- r0111 DRIVE-CLiQ basis sampling time selection
- p0112 Sampling times pre-setting p0115
- p0113 Selects the minimum pulse frequency
- r0114 Recommended minimum pulse frequency
- p0115[0..6] Sampling times for internal control loops
- r0116 Recommended drive sampling time
- p0118 Current controller computation deadtime
- p0799 CU inputs/outputs sampling time
- p1800 Pulse frequency
- p4099 Inputs/outputs sampling time
- r9780 SI monitoring clock cycle (Control Unit)
- r9880 SI monitoring clock cycle (Motor Module)

9.9 Inputs/outputs

9.9.1 Overview of inputs/outputs

The following digital/analog inputs/outputs are available:

Table 9-20 Overview of inputs/outputs

Component	Digital			Analog	
	Inputs	Inputs/ outputs bidirectional	Outputs	Inputs	Outputs
CU310	4 1)	4 3)	–	–	–
CU320	8 1)	8 2)	–	–	–
TB30	4	–	4	2	2
TM15	–	24	–	–	–
TM31	8	4	–	2	2
	Relay outputs: 2 Temperature sensor input: 1				
TM41	4	4	–	1	–
	Incremental encoder emulation: 1 (also refer to: Function Manual)				

1) Adjustable: floating or non-floating
2) 6 of these are "high-speed inputs"
3) 3 of these are "high-speed inputs"

Note

For detailed information about the hardware properties of I/Os, please refer to:

References: /GH1/ SINAMICS S120 Equipment Manual: Control Units

For detailed information about the structural relationships between all I/Os of a component and their parameters, please refer to the function diagrams in:

References: /LH1/ SINAMICS S List Manual

9.9.2 Digital inputs/outputs

Digital inputs

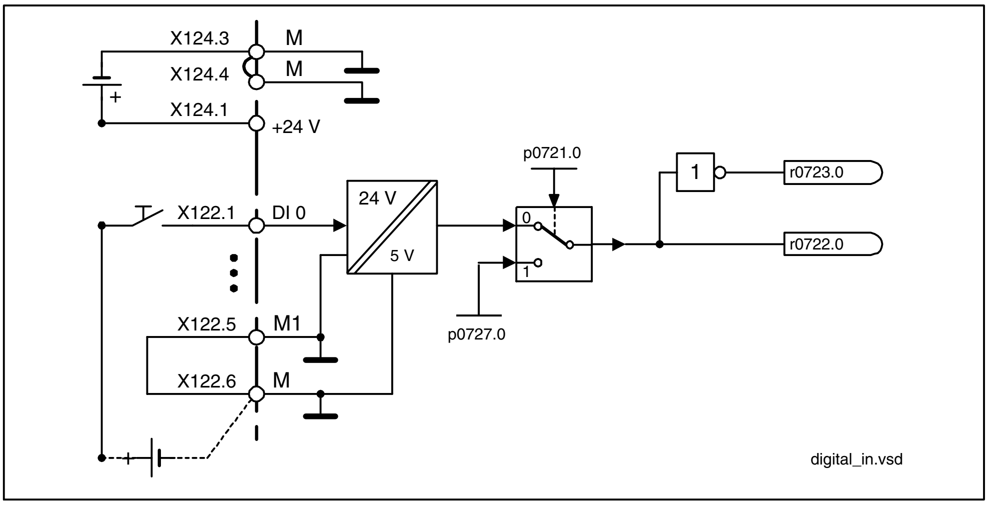


Fig. 9-10 Digital inputs signal processing using DI 0 of CU320 as an example

Properties

- The digital inputs are "high active".
- An open input is interpreted as "low".
- Fixed debouncing setting

  Delay time = 1 to 2 current controller cycles (p0115[0])
- Availability of the input signal for further interconnection
  - inverted and not inverted as a binector output
  - as a connector output
- Simulation mode settable and parameterizable.
- CU 320: Isolation block by block, set by jumper.
  - Jumper open floating

    The digital inputs function only if a reference ground is connected.
  - Jumper closed non-floating

    The reference potential of the digital inputs is the ground of the Control Unit.
- Sampling time for digital inputs/outputs adjustable on CU320 (p0799)

Function diagram overview for digital inputs/outputs (see List Manual)

- 2020 Digital inputs, electrically isolated (DI 0 ... DI 3)
- 2120 Digital inputs, electrically isolated (DI 0 ... DI 3)
- 2121 Digital inputs, electrically isolated (DI 4 ... DI 7)
- 9100 Digital inputs, electrically isolated (DI 0 ... DI 3)
- 9400 Digital inputs/outputs, bidirectional (DI 0 ... DI 7)
- 9401 Digital inputs/outputs, bidirectional (DI 8 ... DI 15)
- 9402 Digital inputs/outputs, bidirectional (DI 16 ... DI 23)
- 9550 Digital inputs, electrically isolated (DI 0 ... DI 3)
- 9552 Digital inputs, electrically isolated (DI 4 ... DI 7)
- 9660 Digital inputs, electrically isolated (DI 0 ... DI 3)

Digital outputs

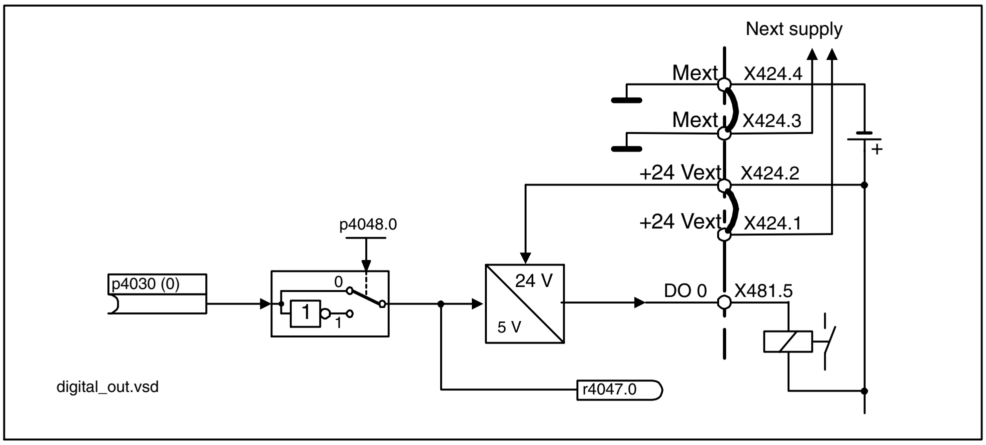


Fig. 9-11 Digital outputs: signal processing using DO 0 of TB30 as an example

Properties

- Separate power supply for the digital outputs.
- Source of output signal can be selected by parameter.
- Signal can be inverted by parameter.
- Status of output signal can be displayed.
  - as a binector output
  - as a connector output

Note

Before the digital outputs can function, their own electronics power supply must be connected.

Function diagram overview (see List Manual)

- 9102 Electrically isolated digital outputs (DO 0 to DO 3)
- 9556 Digital relay outputs, electrically isolated (DO 0 and DO 1)

Bidirectional digital inputs/outputs

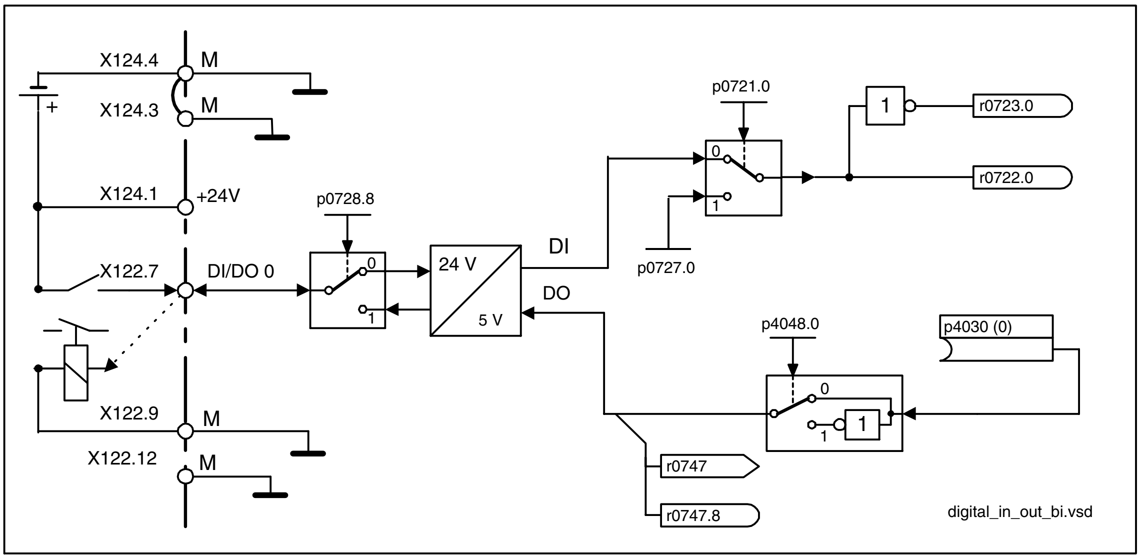


Fig. 9-12 Bidirectional inputs/outputs signal: processing using DI/DO 0 of CU320 as an example

Properties

- Can be parameterized as digital input or output.
- When set as digital input:
  - Six “high-speed inputs” on Control Unit 320

    If these inputs are used, for example, for the “flying measurement” function, they act as “high-speed inputs” with virtually no time delay when the actual value is saved.
  - The properties of the “pure” digital outputs apply.
- When set as digital output:
  - The properties of the “pure” digital outputs apply.

Function diagram overview (see List Manual)

- 2030 Bidirectional digital inputs/outputs (DI/DO 8 ... DI/DO 9)
- 2031 Bidirectional digital inputs/outputs (DI/DO 10 ... DI/DO 11)
- 2130 Bidirectional digital inputs/outputs (DI/DO 8 and DI/DO 9)
- 2131 Bidirectional digital inputs/outputs (DI/DO 10 and DI/DO 11)
- 2132 Bidirectional digital inputs/outputs (DI/DO 12 and DI/DO 13)
- 2133 Bidirectional digital inputs/outputs (DI/DO 14 and DI/DO 15)
- 9400 Bidirectional digital inputs/outputs (DI/DO 0 ... DI/DO 7)
- 9401 Bidirectional digital inputs/outputs (DI/DO 8 ... DI/DO 15)
- 9402 Bidirectional digital inputs/outputs (DI/DO 16 ... DI/DO 23)
- 9560 Bidirectional digital inputs/outputs (DI/DO 8 and DI/DO 9)
- 9562 Bidirectional digital inputs/outputs (DI/DO 10 and DI/DO 11)
- 9661 Bidirectional digital inputs/outputs (DI/DO 0 and DI/DO 1)
- 9662 Bidirectional digital inputs/outputs (DI/DO 2 and DI/DO 3)

9.9.3 Analog inputs

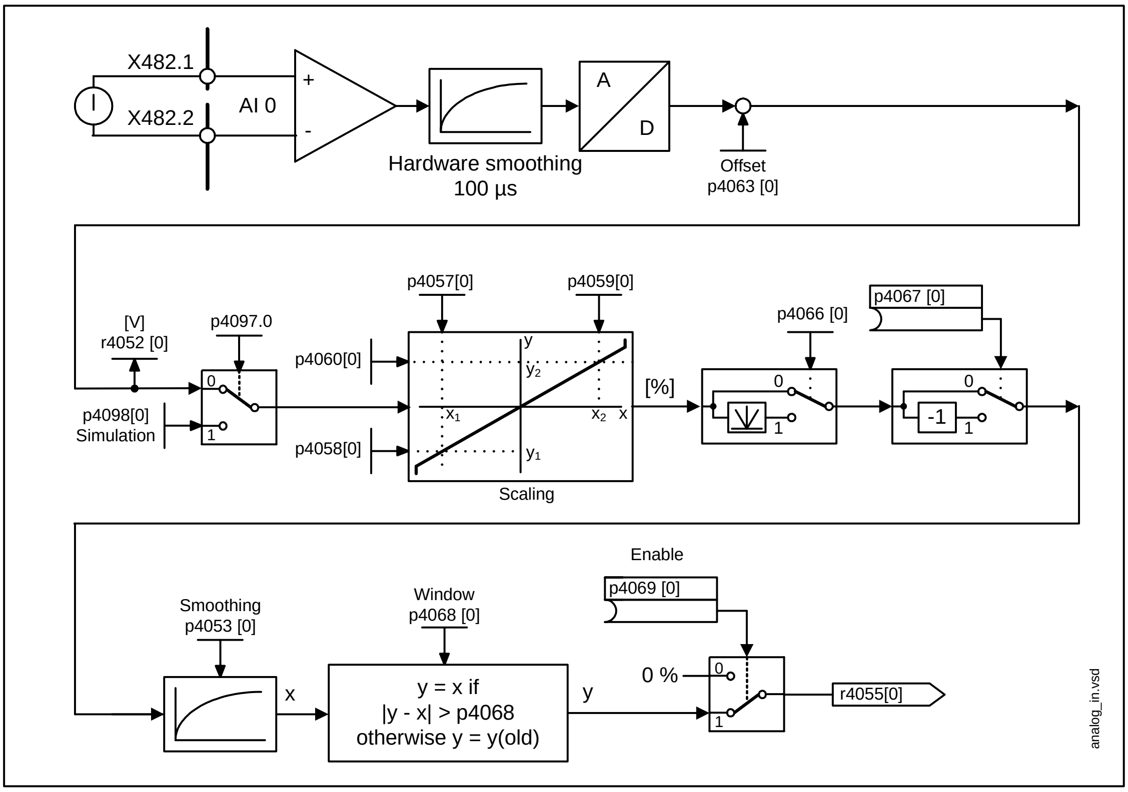


Fig. 9-13 Analog inputs: Signal processing using AI0 of the TB30

Properties

- Hardware input filter set permanently
- Simulation mode parameterizable
- Adjustable offset
- Signal can be inverted via binector input
- Adjustable absolute-value generation
- Noise suppression (p4068)
- Enabling of inputs via binector input
- Output signal available via connector output
- Scaling
- Smoothing

Notice

Parameters p4057 to p4060 of the scaling do not limit the voltage values/current values (for TM31, the input can be used as current input).

Function diagram overview (see List Manual)

- 9104 Analog inputs (AI 0 and AI 1)
- 9566 Analog input 0 (AI 0)
- 9568 Analog input 1 (AI 1)
- 9663 Analog input (AI 0)

9.9.4 Analog outputs

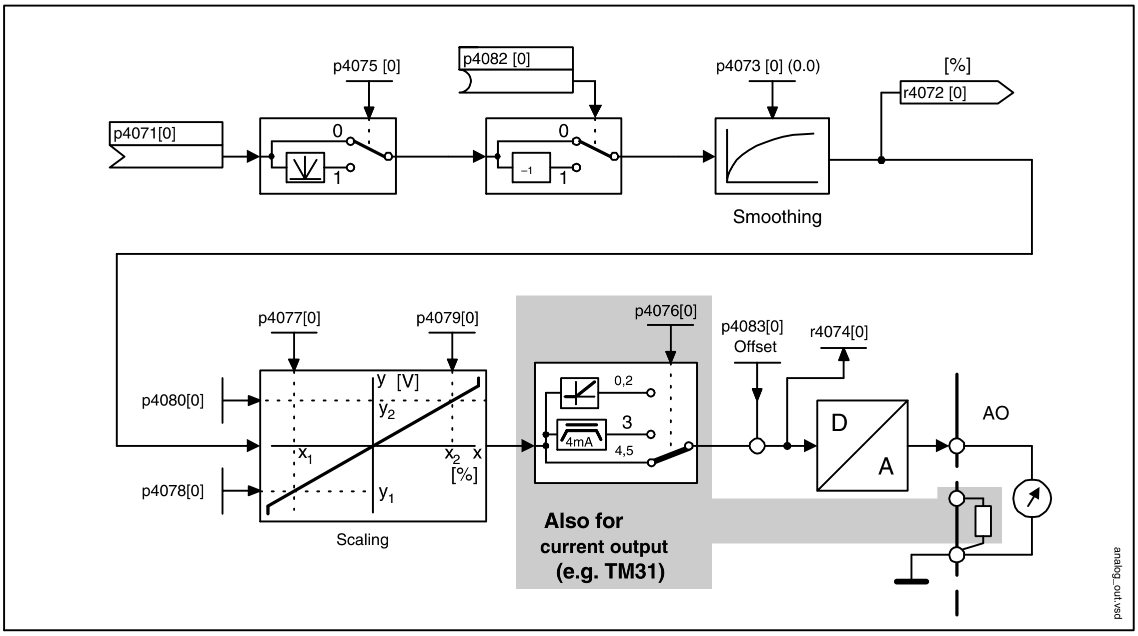


Fig. 9-14 Analog outputs: Signal processing using AO 0 of TB30/TM31 as an example

Properties

- Adjustable absolute-value generation
- Inversion via binector input
- Adjustable smoothing
- Adjustable transfer characteristic
- Output signal can be displayed via visualization parameter

Notice

Parameters p4077 to p4080 of the scaling do not limit the voltage values/current values (for TM31, the input can be used as current input).

Function diagram overview (see List Manual)

- 9106 Analog outputs (AO 0 and AO 1)
- 9572 Analog outputs (AO 0 and AO 1)

9.10 Monitoring and protective functions

9.10.1 Protecting power components

Description

SINAMICS power sections offer comprehensive functions for protecting power components.

Table 9-21 General protection for power sections

Protection against:	Protective measures	Responses
Overcurrent[1)]	Monitoring with two thresholds: • First threshold exceeded • Second threshold exceeded	 A30031, A30032, A30033 Current limiting of a phase has responded. The pulsing in the phase involved is inhibited for one pulse period. If it is too frequently exceeded F30017 –> OFF2 F30001 “Overcurrent” –> OFF2
Overvoltage[1)]	Comparison between the DC link voltage and the hardware shutdown threshold	F30002 “Overvoltage” –> OFF2
Undervoltage[1)]	Comparison between the DC link voltage and the hardware shutdown threshold	F30003 “Undervoltage” –> OFF2
Short-circuit[1)]	• Second threshold for monitoring for overcurrent • Uce monitoring of IGBT modules (chassis only)	F30001 “Overcurrent” –> OFF2 F30022 “Uce monitoring” –> OFF2 (chassis only)
Ground fault	Monitoring the sum of all phase currents	After threshold in p0287 is exceeded: F30021 “power unit: ground fault” —> OFF2 Note: The sum of all phase currents is displayed in r0069[6]. For operation, the value in p0287[1] must be greater than the sum of the phase currents when the insulation is intact.
Line phase failure detection[1)]		F30011 “Line phase-failure in main circuit” –> OFF2

[1)] The monitoring thresholds are permanently defined in the converter and cannot be changed.

9.10.2 Thermal monitoring and overload responses

Description

The priority of thermal power section monitoring is to identify critical situations. If alarm thresholds are exceeded, the user can set parameterizable response options that enable continued operation (e.g. with reduced power) and immediate shutdown is prevented. The parameterization options, however, only enable intervention below the shutdown thresholds, which cannot be changed by the user.

The following thermal monitoring options are available:

- I^2t monitoring – A07805 – F30005
  The I^2t monitoring is used to protect components that have a high thermal time constant compared with semi-conductors. An overload with regard to I^2t is present when the converter load r0036 is greater than 100% (load in % in relation to rated operation).
- Heatsink temperature – A05000 – F30004
  Monitoring of the heat-sink temperature (r0037) of the power semi-conductor (IGBT).
- Chip temperature – A05001 – F30025
  Significant temperature differences can occur between the barrier layer of the IGBT and the heatsink. These differences are taken into account and monitored by the chip temperature (r0037).

If an overload occurs with respect to any of these three monitoring functions, an alarm is first output. The alarm threshold p0294 (I^2t monitoring) can be parameterized relative to the shutdown (trip) values.

Example

The alarm threshold to monitor the chip temperature is set, in the factory to 15 Kelvin (K); for the heatsink temperature monitoring and the air intake, 5 K are set. This means that 15 K or 5 K below the shutdown (trip) threshold the alarm "Overtemperature, overload" is output.

The parameterized responses are induced via p0290 simultaneously when the alarm is output. Possible responses include:

- Reduction in pulse frequency (p0290 = 2, 3)
  This is a highly effective method of reducing losses in the power section, since switching losses account for a high proportion of overall losses. In many applications, a temporary reduction in the pulse frequency can be tolerated to allow the process to continue.
  Disadvantage:
  As a result of the pulse frequency reduction, the current ripple is increased which can mean that the torque ripple is increased at the motor shaft (for low moments of inertia) and also an increased noise level. Reducing the pulse frequency does not affect the dynamic response of the current control circuit, since the sampling time for the current control circuit remains constant.
- Reducing the output frequency (p0290 = 0, 2)
  This variant is recommended when you do not need to reduce the pulse frequency or the pulse frequency has already been set to the lowest level. Further, the load should also have a characteristic similar to the fan, that is, a quadratic torque characteristic with falling speed. Reducing the output frequency has the effect of significantly reducing the converter output current which, in turn, reduces losses in the power section.
- No reduction (p0290 = 1)
  You should choose this option if it is neither possible to reduce the pulse frequency nor reduce the output current. After the warning threshold has been exceeded, the drive converter does not change its operating point so that the drive can continue to operate until the shutdown values are reached. Once it reaches its shutdown threshold, the converter switches itself off and the "Overtemperature, overload" fault is output. However, the time up to shutdown is not defined and depends on the magnitude of the overload. Only the alarm threshold can be changed in order to therefore obtain an earlier alarm, and if necessary to externally intervene in the drive process (e.g. reduce the load, reduce the ambient temperature).

Function diagram for thermal monitoring and overload responses

- 8014 Thermal monitor power section

Overview of key parameters

- r0036 Power Module overload
- r0037 Power Module temperatures
- p0290 Power Module overload response
- p0294 Power Module alarm with I^2t overload

9.10.3 Block protection

Description

The error message “Motor blocked” is only triggered if the speed of the drive is below the variable speed threshold set in p2175. For closed-loop vector control, the condition must be fulfilled that the speed controller is at its limit, for V/f control, the current limit must have been reached.
After the power-on delay p2177 has expired, the message “Motor locked” is output together with fault F7900.

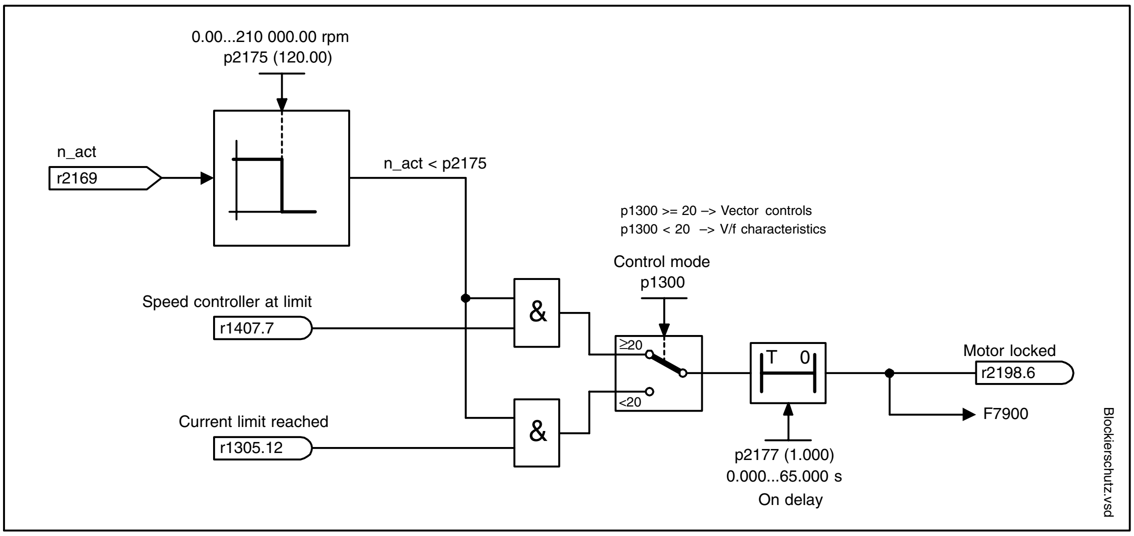


Fig. 9-15 Block protection

Function diagram for block protection

- 8012 Torque messages, motor blocked/stalled

Parameters for block protection

- p2175 Motor blocked speed threshold
- p2177 Motor blocked delay time

9.10.4 Stall protection (only for vector control)

Description

If, for closed-loop speed control with encoder, the speed threshold set in p1744 for stall detection is exceeded, then r1408.11 (speed adaptation, speed deviation) is set.

If, in the low speed range (less than p1755 * p1756), the fault threshold value, set in p1745 is exceeded, then r1408.12 is set (motor stalled).

If one of the two signals is set, then after the delay time in p2178, fault F7902 (motor stalled) is output.

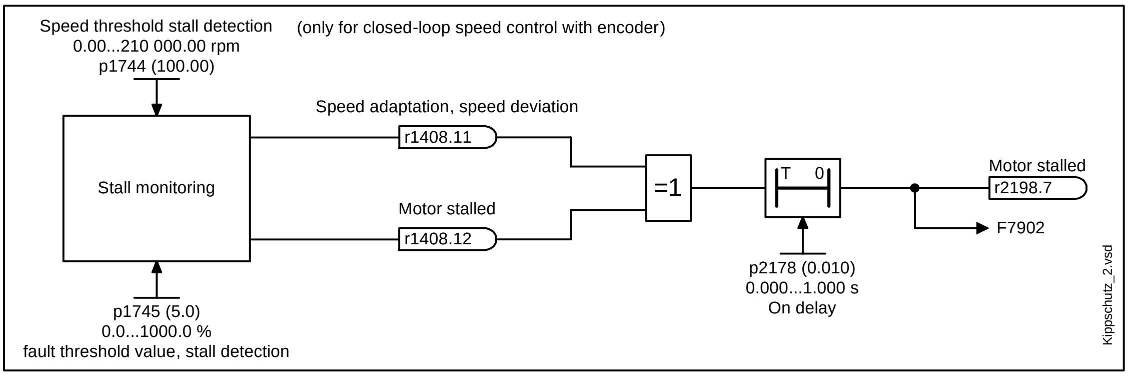


Fig. 9-16 Stall protection

Function diagram for stall protection

- 6730 Closed-loop control
- 8012 Torque messages, motor blocked/stalled

Parameters for stall protection

- r1408 CO/BO: Closed-loop control status word 3
- p1744 Motor model speed threshold stall detection
- p1745 Motor model fault threshold value stall detection
- p1755 Motor model changeover speed sensorless operation
- p1756 Motor model changeover speed hysteresis
- p2178 Motor stalled delay time

9.10.5 Thermal motor protection

Description

The priority of thermal motor protection is to identify critical situations. If alarm thresholds are exceeded, the user can set parameterizable response options (p0610) that enable continued operation (e.g. with reduced power) and to avoid immediate shutdown.

- Protection is also effective even without using a temperature sensor (p4100 = 0).
  The temperatures of different motor components (stators, core, rotors) can be determined indirectly using a temperature model.
- Connecting temperature sensors allows the motor temperature to be determined directly. In this way, accurate start temperatures are available immediately when the motor is switched on again or after a power failure.

Temperature measurement via KTY

The device is connected to terminals X522:7 (anode) and X522:8 (cathode) at the customer terminal block (TM31) in the diode conducting direction. The measured temperature value is limited to a range of –48 °C ... +248 °C and is available for additional evaluation.

- Set the KTY temperature sensor type: p0601 = 2
- Activate motor temperature measurement via the external sensor: p0600 = 10
- When the alarm threshold is reached (set via p0604; factory setting 120 °C), alarm A7910 is initiated.

  Parameter p0610 can be used to set how the drive responds to the alarm triggered:

  – 0: No response, only alarm, no reduction of I_max

  – 1: Alarm with reduction of I_max and fault (F7011)

  – 2: Alarm and fault (F7011), no reduction of I_max
- When the fault threshold is reached (set via p0605), fault F7011 is triggered in conjunction with the setting in p0610.

Temperature measurement via PTC

The device is connected, for example, to terminal X522:7/8 on the terminal block (TM31). The threshold for switching to an alarm or fault is 1650 Ω. If the threshold is exceeded, the system switches internally from an artificially-generated temperature value of –50 °C to +250 °C and makes it available for further evaluation.

- Set the KTY temperature sensor type: p0601 = 1
- Activate motor temperature measurement via the external sensor: p0600 = 10
- Alarm A7910 is triggered once the PTC responds.
- Fault F7011 is triggered once the waiting time defined in p0606 has elapsed.

Sensor monitoring for cable breakage/short-circuit

If the temperature of the motor temperature monitor is outside the range –50 °C ... +250 °C, the sensor cable is broken or the sensor cable is short-circuited and alarm A07915 “Alarm temperature sensor fault” is output. Fault F07016 (“Fault: temperature sensor fault“) is triggered once the waiting time defined in p0607 has elapsed.

Fault F07016 can be suppressed by p0607 = 0. If an induction motor is connected, the drive continues operating with the data calculated in the thermal motor model.

If the system detects that the motor temperature sensor set in p0600 is not connected, alarm A07820 “Temperature sensor not connected” is output.

Function diagrams for thermal motor protection

- 8016 Thermal monitor motor
- 9576 Temperature evaluation KTY/PTC
- 9577 Sensor monitoring KTY/PTC

Parameters for thermal motor protection

- p0600 Motor temperature sensor for monitoring
- p0601 Motor temperature sensor type
- p0604 Motor overtemperature alarm threshold
- p0605 Motor overtemperature fault threshold
- p0606 Motor over temperature timer
- p0607 Temperature sensor fault timer
- p0610 Response to motor overtemperature condition

9.11 Updating the firmware

The SW release must be updated if extended functions are made available in a more recent version and these functions are to be used.
The software of the SINAMICS drive system is available, distributed throughout the system. Software (this is also known as firmware (FW)) is installed on each individual DRIVE-CLiQ component and the Control Unit.
When booting, the Control Unit takes its software automatically from the CF card and therefore does not have to be separately upgraded. In this case, it is sufficient to replace the CF card by a new one with a later software release.
If a DRIVE-CLiQ component is to be updated then it must be explicitly selected by making the appropriate operator action. The software is saved in a non-volatile fashion in the DRIVE-CLiQ component. The software of the DRIVE-CLiQ components is also on the CF card; however, only when upgrading the CF card is it copied to the DRIVE-CLiQ components.

Note

The versions of the DRIVE-CLiQ components and that of the Control Unit can differ. An overview of the versions is provided on the CF card in the file “content.txt”.

Note

The firmware on the DRIVE-CLiQ components may have a more recent version than the Control Unit, but may not be older.

An overview of the versions is provided on the CF card in the file “content.txt”. The DQ components must have, as a minimum, this firmware version.

9.11.1 Upgrading firmware and the project in STARTER

To ensure that the project functions, you need a CompactFlash card containing the new firmware and a current version of STARTER.

Upgrade the project

1. Is the project in STARTER? Yes: continue with 3.
2. Upload project with STARTER
   – Connect with target system (go online)
   – Downloading the project into the PG
3. Install the latest firmware version for the project
   – In the project navigator, right-click the drive unit –> Target device –> Device version
   – e.g. select version "SINAMICS S120 V2.3x" –> Change version

Update the firmware and load the new project to the target device.

1. Insert CompactFlash Card with the new firmware version
   – Disconnect the Control Unit from the power supply –>
   – Insert the CF card with the new firmware version –>
   – Power-up the Control Unit again.
2. Go online and download the project to the target device –> Copy from RAM to ROM
3. Upgrading the firmware for the DRIVE-CLiQ components
   – In the project navigator under the drive unit –> Configuration –> Version overview
   – Firmware update
   – Select all –> Copy from RAM to ROM
4. Reset the drive unit using a POWER ON (Control Unit and all DRIVE-CLiQ components). The new firmware release is only effective in the DRIVE-CLiQ components now and is also displayed in the version overview.

9.12 Licensing

Description

To use the SINAMICS S120 drive system and the activated options, you need to assign the corresponding licenses to the hardware. When doing so, you receive a license key, which electronically links the relevant option with the hardware.

The license key is an electronic license stamp that indicates that one or more software licenses are owned.

Actual customer verification of the license for the software that is subject to license is called a certificate of license.

Note

Refer to the order documentation (e.g. catalogs) for information on basic functions and functions subject to license.

An insufficient license is indicated via the following alarm and LED on the Control Unit:

- A13000 License not sufficient
- READY LED Flashes green/red at 0.5 Hz

Notice

The drive can only be operated with an insufficient license during commissioning and servicing.

The drive requires a sufficient license in order for it to operate normally.

Information regarding the Performance 1 option (this is not valid for Control Unit CU310)

The option Performance 1 (Order No.: 6SL3074-0AA01-0AA0) is required from a computation time utilization greater than 50 %. The remaining computation time is displayed in parameter r9976[2]. As of a CPU runtime utilization greater than 50%, alarm A13000 is output and the READY LED on the Control Unit flashes green/red at 0.5 Hz.

Properties of the license key

- Assigned to a specific CompactFlash card.
- Is stored on the non-volatile CompactFlash card.
- Is not transferrable.
- Can be acquired using the “WEB License Manager” from a license database.

Generating a license key via the “WEB License Manager”

The following information is required:

- Serial number of the CompactFlash card (on CF card)
- License number, delivery note number, and the license (on the Certificate of License)

1. Call up the “WEB License Manager”.

   http://www.siemens.com/automation/license
2. Choose “Direct access”.
3. Enter the license number and delivery note number of the license.

   —> Click “Next”.
4. Enter the serial number of the CompactFlash card.
5. Select the product (“SINAMICS S CU320”).

   —> Click “Next”.
6. Choose “Available license numbers”.

   —> Click “Next”.
7. Check the assignment.

   —> Click “Assignment”.
8. When you are sure that the license has been correctly assigned, click “OK”.
9. The license key is displayed and can be entered.

Entering the license key

Example of a license key:

E1MQ-4BEA = 69 49 77 81 45 52 66 69 65 dec (ASCII characters)

Procedure for entering a license key (see example):

1. p9920[0] = 69 1st character

   ...
2. p9920[8] = 65 9th character
3. p9920[9] = 0 No character

   ...
4. p9920[19] = 0 No character

Note

When changing p9920[x] to the value 0, all of the following indices are also set to 0.

After the license key has been entered, it has to be activated as follows:

5. p9921 = 1 Licensing, activate license key

   The parameter is automatically reset to 0.

In the table below, you can enter the characters in the license key and the associated decimal numbers.

Table 9-22 License key table

Letter/number												
Decimal												

ASCII code

Table 9-23 Excerpt of ASCII code

Letter/number	Decimal	Letter/number	Decimal
–	45	I	73
0	48	J	74
1	49	K	75
2	50	L	76
3	51	M	77
4	52	N	78
5	53	O	79
6	54	P	80
7	55	Q	81
8	56	R	82
9	57	S	83
A	65	T	84
B	66	U	85
C	67	V	86
D	68	W	87
E	69	X	88
F	70	Y	89
G	71	Z	90
H	72	Blanks	32

Parameter overview (see List Manual)

- p9920 Licensing, enter license key
- p9921 Licensing, activate license key
- p9950
- p9976[0...2] Remaining computation time

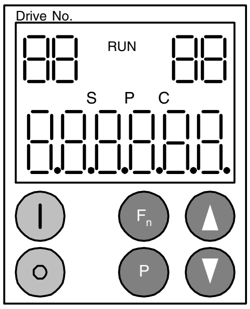
9.13 Parameterizing using the BOP 20 (Basic Operator Panel 20)

9.13.1 General information on the BOP

With the BOP20, drives can be powered-up and powered-down during the commissioning phase and parameters can be displayed and modified. Faults can be diagnosed as well as acknowledged.

The BOP20 is snapped onto the Control Unit; to do this the dummy cover must be removed (for additional information on mounting, please refer to the Equipment Manual).

Overview of displays and keys



bop_uebersicht.vsd

Fig. 9-17 Overview of displays and keys

Information on the displays

Table 9-24 Displays

Display	Meaning
Top left 2-digit	The active drive object of the BOP is displayed here. The displays and key operations always refer to this drive object.
RUN	Is lit if at least one drive in the drive line-up is in the RUN (operation) state. RUN is also displayed using bit r0899.2 of the particular drive.
Top right 2-digit	The following is displayed in this field: • More than 6 digits: Characters that are present but cannot be seen (e.g. “r2” —> 2 characters to the right are invisible, “L1” —> 1 character to the left is invisible) • Faults: Selects/displays other drives with faults • Designation of BICO inputs (bi, ci) • Designation of BICO outputs (bo, co) • Source object of a BICO interconnection to a drive object different than the active one.
S	Is (bright) if at least one parameter was changed and the value was not transferred into the non-volatile memory.

Table 9-24 Displays, continued

Display	Meaning
P	Is lit (bright) if, for a parameter, the value only becomes effective after pressing the P key.
C	Is light (bright) if at least one parameter was changed and the calculation for consistent data management has still not been initiated.
Below, 6 digit	Displays, e.g. parameters, indices, faults and alarms.

Information on the keys

Table 9-25 Keys

Key	Name	Meaning
I	ON	Powering-up the drives for which the command “ON/OFF1” should come from the BOP. Binector output r0019.0 is set using this key.
O	OFF	Powering-down the drives for which the commands “ON/OFF1”, “OFF2” or “OFF3” should come from the BOP. The binector outputs r0019.0, .1 and .2 are simultaneously reset when this key is pressed. After the key has been released, binector outputs r0019.1 and .2 are again set to a “1” signal.
		Note: The effectiveness of these keys can be defined by appropriately parameterizing the BICO (e.g. using these keys it is possible to simultaneously control all of the existing drives).
Fn	Functions	The significance of these keys depends on the actual display. Note: The effectiveness of this key to acknowledge faults can be defined by appropriately parameterizing the BICO.
P	Parameters	The significance of these keys depends on the actual display. If this key is pressed for 3 s, the “Copy RAM to ROM” function is executed. The “S” displayed on the BOP disappears.
▲	Raise	The keys are dependent on the actual display and are used to either raise or lower values.
▼	Lower	

BOP20 functions

Table 9-26 Functions

Name	Description
Backlighting	The backlighting can be set using p0007 so that if there is no operator action, then it switches itself out after the selected time.
Changeover active drive	From the BOP perspective the active drive is defined using p0008 or using the keys “Fn” and “Arrow up”.
Units	The units are not displayed on the BOP.
Access level	The access level for the BOP is defined using p0003. The higher the access level, the more parameters can be selected using the BOP.
Parameter filter	Using the parameter filter in p0004, the available parameters can be filtered corresponding to their particular function.
Selecting the operating display	Actual values and setpoints are displayed on the operating display. The operating display can be set using p0006.
User parameter list	Using the user parameter list in p0013, parameters can be selected for access.
Withdrawing under voltage	The BOP can be withdrawn and inserted under voltage. • The ON and OFF keys have a function When withdrawing, the drives are stopped. After inserting, the drives must be powered-up again. • ON and OFF keys have no function Withdrawing and inserting has no effect on the drives.
Actuating keys	The following applies to the “P” and “Fn” keys: • When used in a combination with another key, “P” or “Fn” must be pressed first and then the other key.

Parameters for BOP

All drive objects

- p0005 BOP operating display selection
- p0006 BOP operating display mode
- p0013 BOP user-defined list
- p0971 Drive object, save parameters

Drive object, Control Unit

- r0000 BOP operating display
- p0003 BOP access level
- p0004 BOP display filter
- p0007 BOP background lighting
- p0008 BOP drive object selection
- p0009 Device commissioning, parameter filter
- p0011 BOP password input (p0013)
- p0012 BOP password confirmation (p0013)
- r0019 CO/BO: Control word, BOP
- p0977 Save all parameters

Other drive objects (e.g. SERVO, VEKTOR, INFEED, TM41 etc.)

- p0010 Commissioning parameter filter

9.13.2 Displays and using the BOP20

Features

- Operating display
- Changing the active drive object
- Displaying/changing parameters
- Displaying/acknowledging faults and alarms
- Controlling the drive using the BOP20

Operating display

The operating display for each drive object can be set using p0005 and p0006. Using the operating display, you can change into the parameter display or to another drive object. The following functions are possible:

- Changing the active drive object
  - Press key “Fn” and “Arrow up” –> the drive object number at the top left flashes
  - Select the required drive object using the arrow keys
  - Acknowledge using the “P” key
- Parameter display
  - Press the “P” key
  - The required parameters can be selected using the arrow keys
  - Press the “Fn” key –> parameter r0000 is displayed
  - Press the “P” key –> changes back to the operating display

Parameter display

The parameters are selected in the BOP20 using the number. The parameter display is reached from the operating display by pressing the “P” key. Parameters can be searched for using the arrow keys. The parameter value is displayed by pressing the “P” key again. You can toggle between the drive objects by simultaneously pressing the keys “Fn” and the arrow keys. You can toggle between r0000 and the parameter that was last displayed by pressing the “Fn” key in the parameter display.

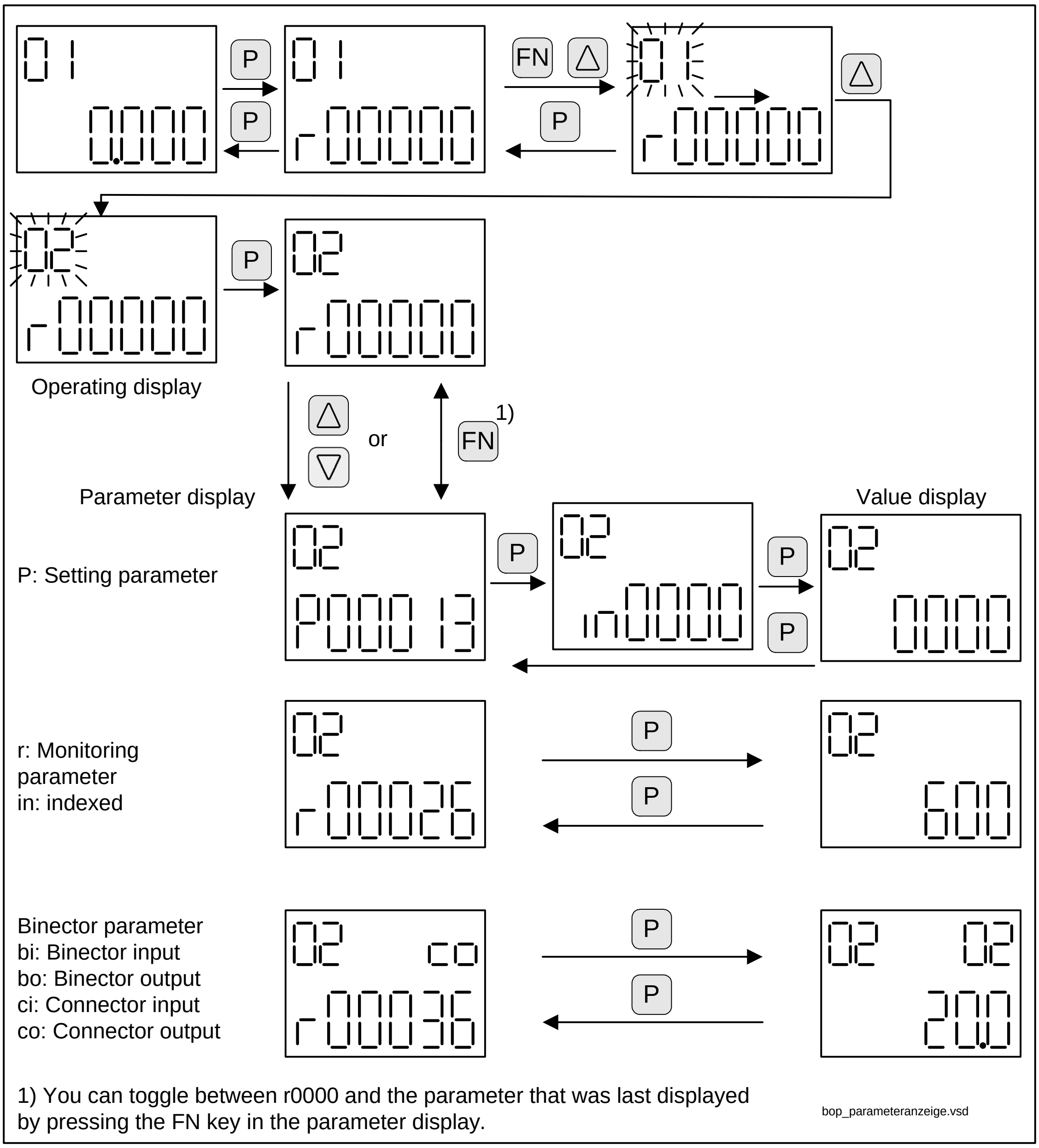


Fig. 9-18 Parameter display

Value display

Using the “P” you can change from the parameter display to the value display. In the value display, the values of the setting parameters can be increased and decreased using the arrow. The cursor can be selected using the Fn key.

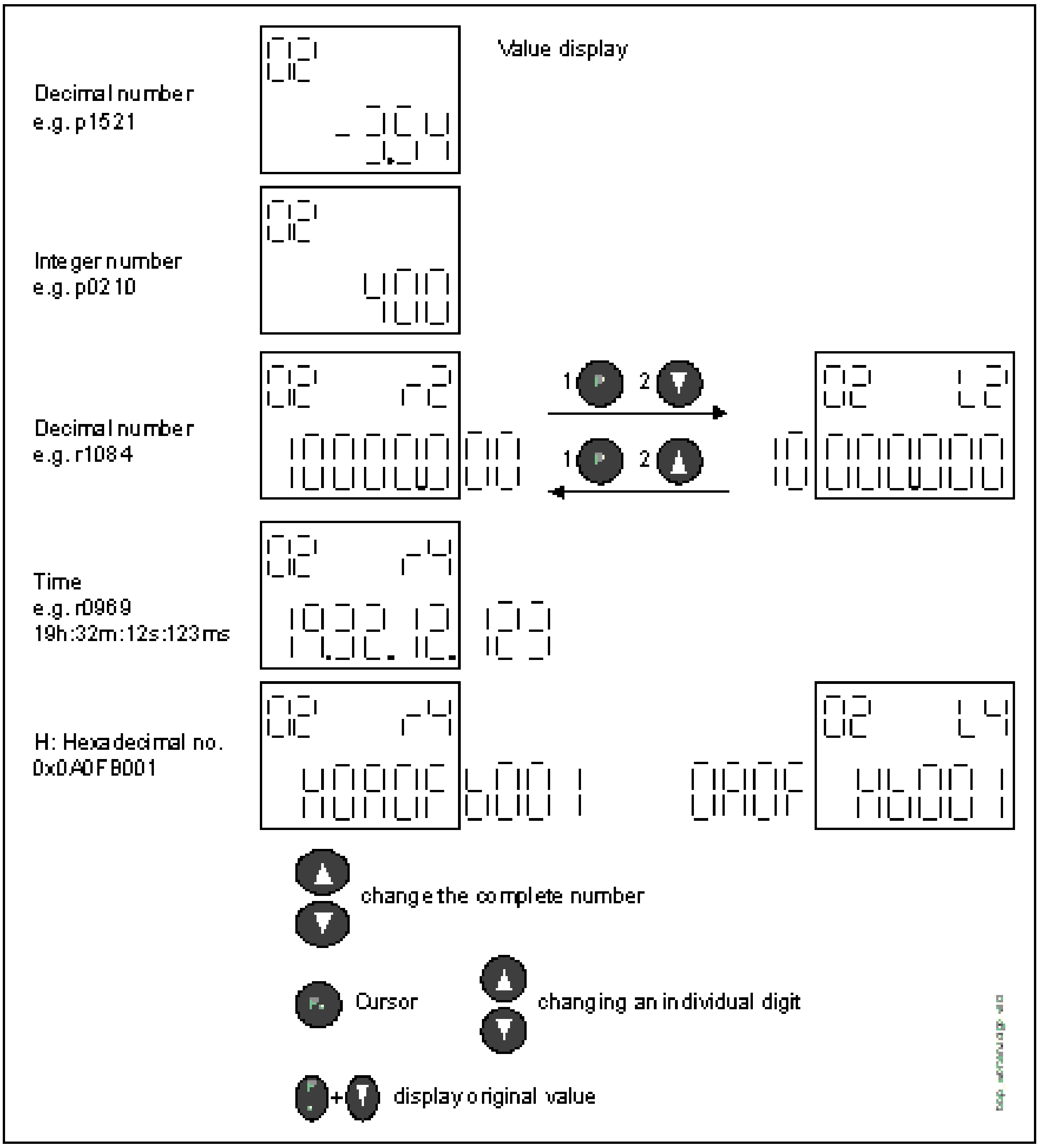


Fig. 9-19 Value display

Example: Changing a parameter

Prerequisite: The appropriate access level is set (for this particular example, p0003 = 3).

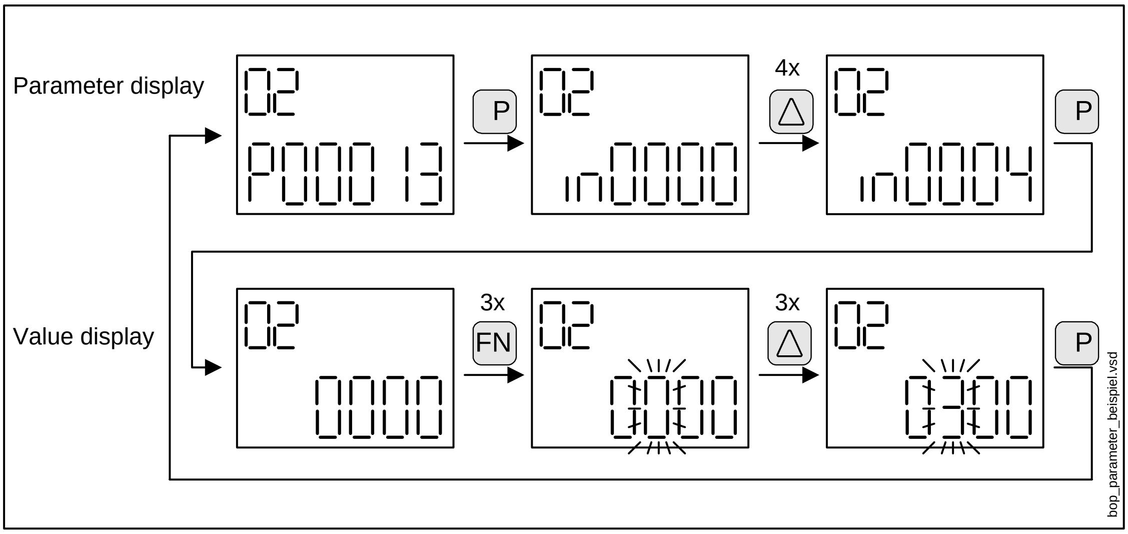


Fig. 9-20 Example: Changing p0013[4] from 0 to 300

Example: Changing binector and connector input parameters

For the binector input p0840[0] (OFF1) of drive object 2 binector output r0019.0 of the Control Unit (drive object 1) is interconnected.

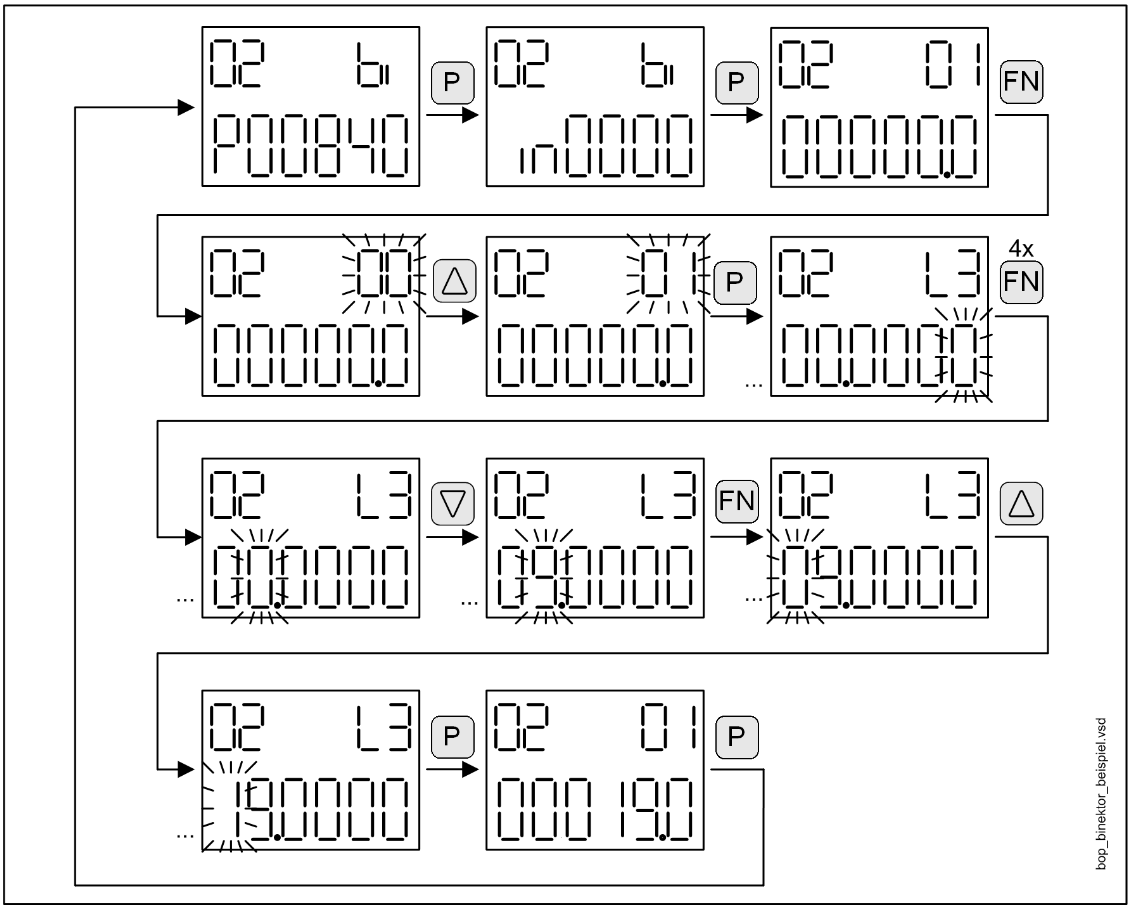


Fig. 9-21 Example: Changing indexed binector parameters

9.13.3 Fault and alarm displays

Displaying faults

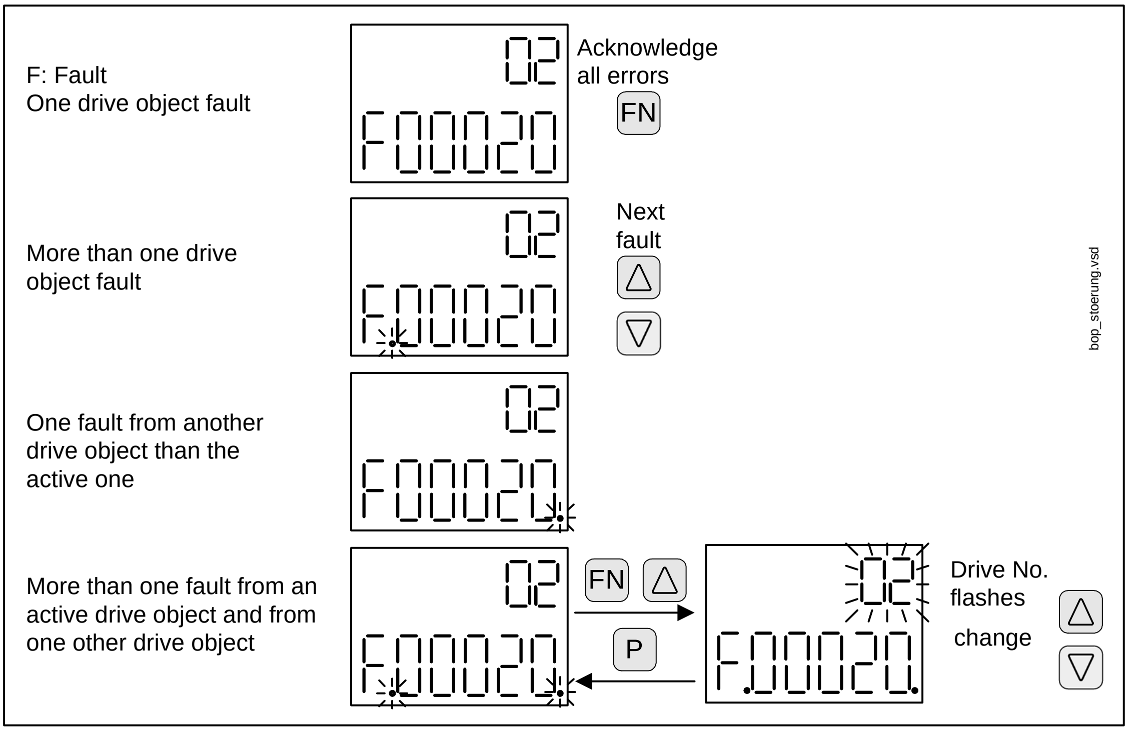


Fig. 9-22 Faults

Displaying alarms

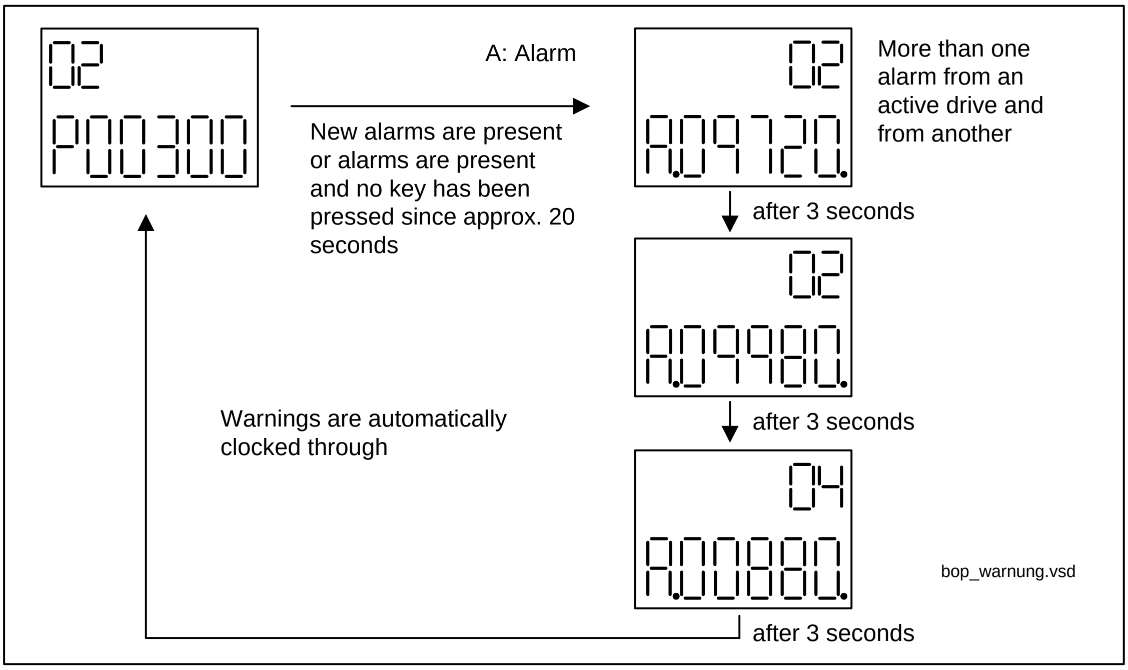


Fig. 9-23 Alarms

9.13.4 Controlling the drive using the BOP20

Description

When commissioning the drive, it can be controlled via the BOP20. A control word is available on the Control Unit drive object (r0019) that can be interconnected with the appropriate binector inputs e.g. of the drive or the infeed.

The interconnections do not function if a standard PROFIdrive telegram was selected as its interconnection cannot be disconnected.

Table 9-27 BOP20 control word

Bit (r0019)	Name	Example, interconnection parameters
0	ON/OFF (OFF1)	p0840
1	No coast down/coast down (OFF2)	p0844
2	No fast stop/fast stop (OFF3)	p0848
Note: For simple commissioning, only bit 0 should be interconnected. When interconnecting bits 0 ... 2, then the system is powered-down according to the following priority: OFF2, OFF3, OFF1.		
7	Acknowledge fault (0 –> 1)	p2102
13	Motorized potentiometer, raise	p1035
14	Motorized potentiometer, lower	p1036

■

Motor/Encoder Code Lists

A

A.1 Induction motors

Order number	Motor type	Motor code
1PH7228-xxFxx-xxxx	107	10741
1PL6186-xxFxx-xxxx	107	10799
1PH7186-xxFxx-xxxx	107	10740
1PH7226-xxFxx-xxxx	107	10739
DMR160.80.6RIF	1	19901
1PH4103-4NF2x-xxxx	104	10401
1PH4105-4NF2x-xxxx	104	10403
1PH4107-4NF2x-xxxx	104	10405
1PH4133-4NF2x-xxxx	104	10407
1PH4135-4NF2x-xxxx	104	10409
1PH4137-4NF2x-xxxx	104	10411
1PH4138-4NF2x-xxxx	104	10413
1PH4163-4NF2x-xxxx	104	10416
1PH4167-4NF2x-xxxx	104	10418
1PH4168-4NF2x-xxxx	104	10420
1PH2093-6WF4x-xxxx	102	10202
1PH2095-6WF4x-xxxx	102	10203
1PH2113-6WF4x-xxxx	102	10205
1PH2115-6WF4x-xxxx	102	10206
1PH2117-6WF4x-xxxx	102	10207
1PH2118-6WF4x-xxxx	102	10208
1PH2092-4WG4x-xxxx	102	10201
1PH2096-4WG4x-xxxx	102	10204
1PH2123-4WF4x-xxxx	102	10209
1PH2127-4WF4x-xxxx	102	10210
1PH2128-4WF4x-xxxx	102	10211
1PH2143-4WF4x-xxxx	102	10212
1PH2147-4WF4x-xxxx	102	10213
1PH2182-6WC4x-xxxx	102	10214
1PH2184-6WP4x-xxxx	102	10215
1PH2186-6WB4x-xxxx	102	10216
1PH2188-6WB4x-xxxx	102	10217
1PH2254-6WB4x-xxxx	102	10218
1PH2256-6WB4x-xxxx	102	10219
2SP1253-8xAxx-0xxx	191	19102
2SP1253-8xAxx-0xxx	191	19101
2SP1255-8xAxx-0xxx	191	19103
2SP1255-8xAxx-0xxx	191	19104
1PH7131-xxFxx-xxxx	107	10709
1PH7133-xxDxx-xxxx	107	10710
1PH7133-xxGxx-xxxx	107	10712
1PH7137-xxDxx-xxxx	107	10714
1PH7137-xxGxx-xxxx	107	10716
1PH7163-xxDxx-xxxx	107	10718
1PH7163-xxFxx-xxxx	107	10719

1PH7167-xxFxx-xxxx	107	10723
1PH7184-xxExx-xxxx	107	10727
1PH7186-xxExx-xxxx	107	10730
1PH7224-xxFxx-xxxx	107	10732
1PH7224-xxCxx-xxxx	107	10731
1PH7184-xxTxx-xxxx	107	10726
1PH7186-xxTxx-xxxx	107	10729
1PH7101-xxFxx-xxxx	107	10701
1PH7103-xxGxx-xxxx	107	10704
1PH7105-xxFxx-xxxx	107	10705
1PH7107-xxFxx-xxxx	107	10707
1PH7103-xxDxx-xxxx	107	10702
1PH7103-xxFxx-xxxx	107	10703
1PH7107-xxDxx-xxxx	107	10706
1PH7107-xxGxx-xxxx	107	10708
1PH7133-xxFxx-xxxx	107	10711
1PH7135-xxFxx-xxxx	107	10713
1PH7137-xxFxx-xxxx	107	10715
1PH7163-xxBxx-xxxx	107	10717
1PH7163-xxGxx-xxxx	107	10720
1PH7167-xxBxx-xxxx	107	10721
1PH7167-xxDxx-xxxx	107	10722
1PH7167-xxGxx-xxxx	107	10724
1PH7184-xxDxx-xxxx	107	10735
1PH7184-xxFxx-xxxx	107	10736
1PH7184-xxLxx-xxxx	107	10737
1PH7186-xxDxx-xxxx	107	10734
1PH7101-xxFxx-xLxx	107	12701
1PH7103-xxDxx-xLxx	107	12702
1PH7103-xxFxx-xLxx	107	12703
1PH7103-xxGxx-xLxx	107	12704
1PH7105-xxFxx-xLxx	107	12705
1PH7107-xxDxx-xLxx	107	12706
1PH7107-xxFxx-xLxx	107	12707
1PH7107-xxGxx-xLxx	107	12708
1PH7131-xxFxx-xLxx	107	12709
1PH7133-xxDxx-xLxx	107	12710
1PH7133-xxFxx-xLxx	107	12711
1PH7133-xxGxx-xLxx	107	12712
1PH7135-xxFxx-xLxx	107	12713
1PH7137-xxDxx-xLxx	107	12714
1PH7137-xxFxx-xLxx	107	12715
1PH7137-xxGxx-xLxx	107	12716
1PH7163-xxBxx-xLxx	107	12717
1PH7163-xxDxx-xLxx	107	12718
1PH7163-xxFxx-xLxx	107	12719
1PH7163-xxGxx-xLxx	107	12720
1PH7167-xxBxx-xLxx	107	12721
1PH7167-xxDxx-xLxx	107	12722

1PH7167-xxFxx-xLxx	107	12723
1PH7167-xxGxx-xLxx	107	12724
1PH7224-xxDxx-xxxx	107	10738
1PM4101-xxF8x-xxxx	134	14401
1PM4101-xxF8x-xxxx	134	14402
1PM4105-xxF8x-xxxx	134	14403
1PM4105-xxF8x-xxxx	134	14404
1PM4133-xxF8x-xxxx	134	14405
1PM4133-xxF8x-xxxx	134	14406
1PM4137-xxF8x-xxxx	134	14407
1PM4137-xxF8x-xxxx	134	14408
1PM6101-xxF8x-xxxx	136	14601
1PM6101-xxF8x-xxxx	136	14602
1PM6105-xxF8x-xxxx	136	14603
1PM6105-xxF8x-xxxx	136	14604
1PM6133-xxF8x-xxxx	136	14605
1PM6133-xxF8x-xxxx	136	14606
1PM6137-xxF8x-xxxx	136	14607
1PM6137-xxF8x-xxxx	136	14608
1PM6138-xxF8x-xxxx	136	14609
1PM6138-xxF8x-xxxx	136	14610
1PM4133-xxW2x-xxxx	134	13405
1PM4137-xxW2x-xxxx	134	13407
1PM4101-xxW2x-xxxx	134	13401
1PM4105-xxW2x-xxxx	134	13403

A.2 Synchronous motors

Order number	Motor type	Motor code
1FT6102-xAB7x-xxxx	206	20636
1FT6105-xAB7x-xxxx	206	20640
1FT6108-xAB7x-xxxx	206	20643
1FT6132-xAB7x-xxxx	206	20646
1FT6134-xAB7x-xxxx	206	20649
1FT6136-xAB7x-xxxx	206	20651
1FT6061-xAC7x-xxxx	206	20609
1FT6062-xAC7x-xxxx	206	20613
1FT6064-xAC7x-xxxx	206	20617
1FT6081-xAC7x-xxxx	206	20621
1FT6082-xAC7x-xxxx	206	20625
1FT6084-xAC7x-xxxx	206	20629
1FT6086-xAC7x-xxxx	206	20633
1FT6102-xAC7x-xxxx	206	20637
1FT6105-xAC7x-xxxx	206	20641
1FT6108-xAC7x-xxxx	206	20644
1FT6132-xAC7x-xxxx	206	20647
1FT6134-xAC7x-xxxx	206	20650
1FT6136-xAC7x-xxxx	206	20652
1FT6041-xAF7x-xxxx	206	20605
1FT6044-xAF7x-xxxx	206	20607
1FT6061-xAF7x-xxxx	206	20610
1FT6062-xAF7x-xxxx	206	20614
1FT6064-xAF7x-xxxx	206	20618
1FT6081-xAF7x-xxxx	206	20622
1FT6082-xAF7x-xxxx	206	20626
1FT6084-xAF7x-xxxx	206	20630
1FT6086-xAF7x-xxxx	206	20634
1FT6102-xAF7x-xxxx	206	20638
1FT6105-xAF7x-xxxx	206	20642
1FT6108-xAF7x-xxxx	206	20645
1FT6132-xAF7x-xxxx	206	20648
1FT6061-xAH7x-xxxx	206	20611
1FT6062-xAH7x-xxxx	206	20615
1FT6064-xAH7x-xxxx	206	20619
1FT6081-xAH7x-xxxx	206	20623
1FT6082-xAH7x-xxxx	206	20627
1FT6084-xAH7x-xxxx	206	20631
1FT6086-xAH7x-xxxx	206	20635
1FT6102-xAH7x-xxxx	206	20639
1FT6021-6AK7x-xxxx	206	20601
1FT6024-6AK7x-xxxx	206	20602
1FT6031-xAK7x-xxxx	206	20603
1FT6034-xAK7x-xxxx	206	20604
1FT6041-xAK7x-xxxx	206	20606

1FT6044-xAK7x-xxxx	206	20608
1FT6061-xAK7x-xxxx	206	20612
1FT6062-xAK7x-xxxx	206	20616
1FT6064-xAK7x-xxxx	206	20620
1FT6081-xAK7x-xxxx	206	20624
1FT6082-xAK7x-xxxx	206	20628
1FT6084-xAK7x-xxxx	206	20632
1FT6105-xSB7x-xxxx	206	21607
1FT6108-xSB7x-xxxx	206	21611
1FT6132-xSB7x-xxxx	206	21614
1FT6134-xSB7x-xxxx	206	21617
1FT6136-xSB7x-xxxx	206	21620
1FT6163-xSB7x-xxxx	206	21623
1FT6168-xSB7x-xxxx	206	21625
1FT6105-xSC7x-xxxx	206	21608
1FT6108-xSC7x-xxxx	206	21612
1FT6132-xSC7x-xxxx	206	21615
1FT6134-xSC7x-xxxx	206	21618
1FT6136-xSC7x-xxxx	206	21621
1FT6163-xSD7x-xxxx	206	21624
1FT6084-xSF7x-xxxx	206	21601
1FT6086-xSF7x-xxxx	206	21604
1FT6105-xSF7x-xxxx	206	21609
1FT6108-xSF7x-xxxx	206	21613
1FT6132-xSF7x-xxxx	206	21616
1FT6134-xSF7x-xxxx	206	21619
1FT6136-xSF7x-xxxx	206	21622
1FT6084-xSH7x-xxxx	206	21602
1FT6086-xSH7x-xxxx	206	21605
1FT6105-xSH7x-xxxx	206	21610
1FT6084-xSK7x-xxxx	206	21603
1FT6086-xSK7x-xxxx	206	21606
1FT6108-xWB7x-xxxx	206	22615
1FT6132-xWB7x-xxxx	206	22618
1FT6134-xWB7x-xxxx	206	22620
1FT6136-xWB7x-xxxx	206	22622
1FT6138-xWB7x-xxxx	206	22624
1FT6163-xWB7x-xxxx	206	22626
1FT6168-xWB7x-xxxx	206	22628
1FT6105-xWC7x-xxxx	206	22613
1FT6108-xWC7x-xxxx	206	22616
1FT6132-xWD7x-xxxx	206	22619
1FT6134-xWD7x-xxxx	206	22621
1FT6136-xWD7x-xxxx	206	22623
1FT6138-xWD7x-xxxx	206	22625
1FT6163-xWD7x-xxxx	206	22627
1FT6062-xWF7x-xxxx	206	22601
1FT6064-xWF7x-xxxx	206	22604
1FT6084-xWF7x-xxxx	206	22607

1FT6086-xWF7x-xxxx	206	22610
1FT6105-xWF7x-xxxx	206	22614
1FT6108-xWF7x-xxxx	206	22617
1FT6062-xWH7x-xxxx	206	22602
1FT6064-xWH7x-xxxx	206	22605
1FT6084-xWH7x-xxxx	206	22608
1FT6086-xWH7x-xxxx	206	22611
1FT6062-xWK7x-xxxx	206	22603
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1FT6084-xWK7x-xxxx	206	22609
1FT6086-xWK7x-xxxx	206	22612
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1FS6134-xAB7x-xxxx	276	27611
1FS6074-xAC7x-xxxx	276	27601
1FS6096-xAC7x-xxxx	276	27605
1FS6115-xAC7x-xxxx	276	27609
1FS6134-xAC7x-xxxx	276	27612
1FS6074-xAF7x-xxxx	276	27602
1FS6096-xAF7x-xxxx	276	27606
1FS6115-xAF7x-xxxx	276	27610
1FS6134-xAF7x-xxxx	276	27613
1FS6074-xAH7x-xxxx	276	27603
1FS6096-xAH7x-xxxx	276	27607
1FS6074-xAK7x-xxxx	276	27604
1FK7086-7AA7x-xxxx	237	23737
1FK7105-5AC7x-xxxx	237	23728
1FK7032-5AF2x-xxxx	237	23727
1FK7033-7AF2x-xxxx	237	23741
1FK7034-5AF2x-xxxx	237	23740
1FK7043-7AF2x-xxxx	237	23743
1FK7042-5AF7x-xxxx	237	23703
1FK7042-5AF2x-xxxx	237	23735
1FK6042-6AF7x-xxxx	236	23604
1FK6044-7AF7x-xxxx	236	23607
1FK7044-7AF7x-xxxx	237	23707
1FK6060-6AF7x-xxxx	236	23609
1FK7060-5AF7x-xxxx	237	23709
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1FK7063-5AF7x-xxxx	237	23713
1FK7064-7AF7x-xxxx	237	23715
1FK6064-7AF7x-xxxx	236	23613
1FK6080-6AF7x-xxxx	236	23615
1FK7080-5AF7x-xxxx	237	23717
1FK7082-7AF7x-xxxx	237	23719
1FK6082-7AF7x-xxxx	236	23616
1FK6083-6AF7x-xxxx	236	23617
1FK7083-5AF7x-xxxx	237	23720

1FK7085-7AF7x-xxxx	237	23722
1FK6085-7AF7x-xxxx	236	23618
1FK7086-7AF7x-xxxx	237	23731
1FK7100-5AF7x-xxxx	237	23723
1FK6100-8AF7x-xxxx	236	23619
1FK7101-5AF7x-xxxx	237	23724
1FK6101-8AF7x-xxxx	236	23620
1FK7103-5AF7x-xxxx	237	23725
1FK6103-8AF7x-xxxx	236	23621
1FK7105-5AF7x-xxxx	237	23729
1FK6043-7AH7x-xxxx	236	23605
1FK7043-7AH7x-xxxx	237	23705
1FK7044-7AH7x-xxxx	237	23708
1FK6044-7AH7x-xxxx	236	23608
1FK7060-5AH7x-xxxx	237	23710
1FK6061-7AH7x-xxxx	236	23611
1FK7061-7AH7x-xxxx	237	23712
1FK7063-5AH7x-xxxx	237	23714
1FK6064-7AH7x-xxxx	236	23614
1FK7064-7AH7x-xxxx	237	23716
1FK7080-5AH7x-xxxx	237	23718
1FK7083-5AH7x-xxxx	237	23721
1FK7022-5AK2x-xxxx	237	23733
1FK7022-5AK7x-xxxx	237	23726
1FK6032-6AK7x-xxxx	236	23601
1FK7032-5AK7x-xxxx	237	23727
1FK6033-7AK7x-xxxx	236	23602
1FK7033-7AK7x-xxxx	237	23701
1FK7034-5AK7x-xxxx	237	23732
1FK7040-5AK7x-xxxx	237	23702
1FK6040-6AK7x-xxxx	236	23603
1FK7042-5AK7x-xxxx	237	23704
1FK6043-7AK7x-xxxx	236	23606
1FK7043-7AK7x-xxxx	237	23706
1FK7086-7SF7x-xxxx	237	23730
1FK7088-7WK7x-xxxx	237	23736
1FE1052-6LK00-xxxx	261	26114
1FE1084-6LN00-xxxx	261	26162
1FE1093-7LN00-xxxx	261	26189
1FE1064-6LQ00-xxxx	261	26127
1FE1054-6LR00-xxxx	261	26120
1FE1116-6LS01-xxxx	261	26224
1FE1095-6LT01-xxxx	261	26195
1FE1116-6LT01-xxxx	261	26225
1FE1055-6LU00-xxxx	261	26123
1FE1113-6LU01-xxxx	261	26214
1FE1114-6LU11-xxxx	261	26215
1FE1061-6LW00-xxxx	261	26125
1FE1094-4LW01-xxxx	261	26190

1FE1112-6LW01-xxxx	261	26213
1FE1055-6LX00-xxxx	261	26124
1FE9114-6WE30-xxxx	300	30001
1FE1093-4WF01-xxxx	261	26177
1FE1072-4WH11-xxxx	261	26129
1FE1093-4WH11-xxxx	261	26178
1FE1051-6WK10-xxxx	261	26106
1FE1052-4WK11-xxxx	261	26111
1FE1052-6WK10-xxxx	261	26115
1FE1093-4WK01-xxxx	261	26179
1FE1094-4WK11-xxxx	261	26191
1FE1096-4WK10-xxxx	261	26196
1FE1051-4WL11-xxxx	261	26103
1FE1051-4WL51-xxxx	261	26104
1FE1072-4WL11-xxxx	261	26130
1FE1094-4WL11-xxxx	261	26192
1FE1074-4WM11-xxxx	261	26139
1FE1093-4WM11-xxxx	261	26180
1FE1051-4WN11-xxxx	261	26105
1FE1051-6WN20-xxxx	261	26109
1FE1051-6WN00-xxxx	261	26107
1FE1051-6WN30-xxxx	261	26110
1FE1051-6WN10-xxxx	261	26108
1FE1052-4WN11-xxxx	261	26112
1FE1052-4WN51-xxxx	261	26113
1FE1052-6WN00-xxxx	261	26116
1FE1053-4WN11-xxxx	261	26119
1FE1052-6WN10-xxxx	261	26117
1FE1064-6WN11-xxxx	261	26128
1FE1072-4WN01-xxxx	261	26131
1FE1072-4WN31-xxxx	261	26133
1FE1072-4WN11-xxxx	261	26132
1FE1073-4WN01-xxxx	261	26134
1FE1073-4WN11-xxxx	261	26135
1FE1074-4WN11-xxxx	261	26140
1FE1074-4WN51-xxxx	261	26141
1FE1082-4WN01-xxxx	261	26142
1FE1082-4WN51-xxxx	261	26144
1FE1082-4WN11-xxxx	261	26143
1FE1083-4WN01-xxxx	261	26153
1FE1083-4WN11-xxxx	261	26154
1FE1084-4WN11-xxxx	261	26155
1FE1084-4WN31-xxxx	261	26156
1FE1085-4WN11-xxxx	261	26166
1FE1084-6WN11-xxxx	261	26163
1FE1091-6WN30-xxxx	261	26170
1FE1091-6WN10-xxxx	261	26169
1FE1092-6WN00-xxxx	261	26173
1FE1093-4WN01-xxxx	261	26181

1FE1092-6WN30-xxxx	261	26175
1FE1092-6WN10-xxxx	261	26174
1FE1093-4WN10-xxxx	261	26182
1FE1093-4WN11-xxxx	261	26183
1FE1093-6WN10-xxxx	261	26184
1FE1095-4WN11-xxxx	261	26194
1FE1096-4WN11-xxxx	261	26197
1FE1103-4WN01-xxxx	261	26245
1FE1103-4WN31-xxxx	261	26199
1FE1103-4WN11-xxxx	261	26198
1FE1104-4WN11-xxxx	261	26205
1FE1105-4WN01-xxxx	261	26206
1FE1105-4WN11-xxxx	261	26207
1FE1106-4WN11-xxxx	261	26210
1FE1124-4WN11-xxxx	261	26229
1FE1125-4WN11-xxxx	261	26230
1FE1126-4WN11-xxxx	261	26232
1FE1145-8WN11-xxxx	261	26235
1FE1147-8WN11-xxxx	261	26238
1FE1082-4WP11-xxxx	261	26145
1FE1082-6WP10-xxxx	261	26148
1FE1084-4WP11-xxxx	261	26157
1FE1125-4WP11-xxxx	261	26231
1FE1126-4WP11-xxxx	261	26233
1FE1054-6WQ10-xxxx	261	26122
1FE1082-6WQ11-xxxx	261	26149
1FE1084-4WQ51-xxxx	261	26159
1FE1084-4WQ11-xxxx	261	26158
1FE1085-4WQ11-xxxx	261	26167
1FE1103-4WQ01-xxxx	261	26200
1FE1103-4WQ11-xxxx	261	26201
1FE1105-4WQ01-xxxx	261	26208
1FE1105-4WQ11-xxxx	261	26209
1FE1126-4WQ11-xxxx	261	26234
1FE1147-8WQ11-xxxx	261	26239
1FE1147-8WQ31-xxxx	261	26240
1FE1073-4WR01-xxxx	261	26136
1FE1082-4WR31-xxxx	261	26147
1FE1082-4WR11-xxxx	261	26146
1FE1084-6WR11-xxxx	261	26164
1FE1092-6WR11-xxxx	261	26176
1FE1114-6WR31-xxxx	261	26217
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1FE1116-6WR11-xxxx	261	26226
1FE1082-6WS10-xxxx	261	26150
1FE1082-6WS30-xxxx	261	26151
1FE1091-6WS10-xxxx	261	26171
1FE1094-4WS11-xxxx	261	26193
1FE1093-6WS30-xxxx	261	26186

1FE1093-6WS10-xxxx	261	26185
1FE1106-4WS11-xxxx	261	26211
1FE1145-8WS11-xxxx	261	26237
1FE1147-8WS11-xxxx	261	26241
1FE1073-4WT31-xxxx	261	26138
1FE1073-4WT11-xxxx	261	26137
1FE1084-4WT51-xxxx	261	26161
1FE1084-4WT11-xxxx	261	26160
1FE1085-4WT11-xxxx	261	26168
1FE1103-4WT01-xxxx	261	26202
1FE1103-4WT11-xxxx	261	26203
1FE1114-6WT10-xxxx	261	26218
1FE1114-6WT11-xxxx	261	26219
1FE1114-6WT51-xxxx	261	26221
1FE1114-6WT31-xxxx	261	26220
1FE1116-6WT11-xxxx	261	26227
1FE1144-8WT10-xxxx	261	26244
1FE1094-4WU11-xxxx	261	26243
1FE1103-4WU01-xxxx	261	26204
1FE1061-6WV10	261	26284
1FE1092-4WV11-xxxx	261	26172
1FE1093-6WV31-xxxx	261	26188
1FE1093-6WV11-xxxx	261	26187
1FE1082-6WW11-xxxx	261	26152
1FE1114-6WW11-xxxx	261	26222
1FE1114-6WW31-xxxx	261	26223
1FE1116-6WW11-xxxx	261	26242
1FE1084-6WX11-xxxx	261	26165
1FE1052-6WY10-xxxx	261	26118
1FE1061-6WY10-xxxx	261	26126
1FE1106-4WY11-xxxx	261	26212
1FE1116-6WY11-xxxx	261	26228
1FW3201-1xE7x-xxxx	283	28316
1FW3202-1xE7x-xxxx	283	28319
1FW3203-1xE7x-xxxx	283	28322
1FW3204-1xE7x-xxxx	283	28325
1FW3206-1xE7x-xxxx	283	28328
1FW3208-1xE7x-xxxx	283	28331
1FW3281-1xE7x-xxxx	283	28334
1FW3283-1xE7x-xxxx	283	28336
1FW3285-1xE7x-xxxx	283	28338
1FW3288-1xE7x-xxxx	283	28340
1FW3402-1xE7x-xxxx	283	28342
1FW3281-1xG7x-xxxx	283	28335
1FW3283-1xG7x-xxxx	283	28337
1FW3285-1xG7x-xxxx	283	28339
1FW3288-1xG7x-xxxx	283	28341
1FW3150-1xH7x-xxxx	283	28301
1FW3152-1xH7x-xxxx	283	28304

1FW3154-1xH7x-xxxx	283	28307
1FW3155-1xH7x-xxxx	283	28310
1FW3156-1xH7x-xxxx	283	28313
1FW3201-1xH7x-xxxx	283	28317
1FW3202-1xH7x-xxxx	283	28320
1FW3203-1xH7x-xxxx	283	28323
1FW3204-1xH7x-xxxx	283	28326
1FW3206-1xH7x-xxxx	283	28329
1FW3208-1xH7x-xxxx	283	28332
1FW3150-1xL7x-xxxx	283	28302
1FW3152-1xL7x-xxxx	283	28305
1FW3154-1xL7x-xxxx	283	28308
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1FW3156-1xL7x-xxxx	283	28314
1FW3201-1xL7x-xxxx	283	28318
1FW3202-1xL7x-xxxx	283	28321
1FW3203-1xL7x-xxxx	283	28324
1FW3204-1xL7x-xxxx	283	28327
1FW3206-1xL7x-xxxx	283	28330
1FW3208-1xL7x-xxxx	283	28333
1FW3150-1xP7x-xxxx	283	28303
1FW3152-1xP7x-xxxx	283	28306
1FW3154-1xP7x-xxxx	283	28309
1FW3155-1xP7x-xxxx	283	28312
1FW3156-1xP7x-xxxx	283	28315
1FW6090-0xx05-0Kxx	286	28602
1FW6090-0xx05-0Fxx	286	28601
1FW6090-0xx07-1Jxx	286	28604
1FW6090-0xx07-0Kxx	286	28603
1FW6090-0xx10-1Jxx	286	28606
1FW6090-0xx10-0Kxx	286	28605
1FW6090-0xx15-2Jxx	286	28608
1FW6090-0xx15-1Jxx	286	28607
1FW6130-0xx05-1Jxx	286	28621
1FW6130-0xx05-0Kxx	286	28620
1FW6130-0xx07-0Kxx	286	28622
1FW6130-0xx07-1Jxx	286	28623
1FW6130-0xx10-2Jxx	286	28625
1FW6130-0xx10-1Jxx	286	28624
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1FW6160-0xx05-2Jxx	286	28629
1FW6160-0xx07-2Jxx	286	28631
1FW6160-0xx07-1Jxx	286	28630
1FW6160-0xx10-1Jxx	286	28632
1FW6160-0xx10-2Jxx	286	28633
1FW6160-0xx15-2Jxx	286	28634
1FW6160-0xx15-5Gxx	286	28635
1FW6190-0xx05-2Jxx	286	28637

1FW6190-0xx05-1Jxx	286	28636
1FW6190-0xx07-2Jxx	286	28639
1FW6190-0xx07-1Jxx	286	28638
1FW6190-0xx10-2Jxx	286	28641
1FW6190-0xx10-1Jxx	286	28640
1FW6190-0xx15-5Gxx	286	28610
1FW6190-0xx15-2Jxx	286	28609
1FW6230-0xx05-1Jxx	286	28611
1FW6230-0xx05-2Jxx	286	28612
1FW6230-0xx07-1Jxxx	286	28613
1FW6230-0xx07-2Jxx	286	28614
1FW6230-0xx10-5Gxx	286	28616
1FW6230-0xx10-2Jxx	286	28615
1FW6230-0xx15-5Gxx	286	28618
1FW6230-0xx15-4Cxx	286	28617
1FW6290-0xx15-7Axx	286	28619
2SP1202-1HAxx-xxxx	291	29101
2SP1204-1HAxx-xxxx	291	29103
2SP1202-1HBxx-xxxx	291	29102
2SP1204-1HBxx-xxxx	291	29104
2SP1253-1xAxx-xxxx	291	29105
2SP1255-1xAxx-xxxx	291	29107
2SP1253-1xBxx-xxxx	291	29106
2SP1255-1xBxx-xxxx	291	29108

A.3 Linear motors

Order number	Motor type	Motor code
1FN1124-5xC7x-xxxx	401	40101
1FN1184-5xC7x-xxxx	401	40102
1FN1122-5xC7x-xxxx	401	40103
1FN1126-5xC7x-xxxx	401	40104
1FN1186-5xC7x-xxxx	401	40105
1FN1244-5xC7x-xxxx	401	40106
1FN1246-5xC7x-xxxx	401	40107
1FN1122-5xF7x-xxxx	401	40121
1FN1126-5xF7x-xxxx	401	40122
1FN1124-5xF7x-xxxx	401	40123
1FN1184-5xF7x-xxxx	401	40124
1FN1186-5xF7x-xxxx	401	40125
1FN1244-5xF7x-xxxx	401	40126
1FN1246-5xF7x-xxxx	401	40127
1FN1072-3xF7x-xxxx	401	40131
1FN1076-3xF7x-xxxx	401	40132
1FN3050-2WC0x-xxxx	403	40349
1FN3100-2WC0x-xxxx	403	40302
1FN3100-2WE0x-xxxx	403	40303
1FN3100-3WE0x-xxxx	403	40304
1FN3100-4WC0x-xxxx	403	40305
1FN3100-4WE0x-xxxx	403	40306
1FN3100-5WC0x-xxxx	403	40307
1FN3150-1WC0x-xxxx	403	40308
1FN3150-1WE0x-xxxx	403	40309
1FN3150-2WC0x-xxxx	403	40310
1FN3150-3WC0x-xxxx	403	40311
1FN3150-4WC0x-xxxx	403	40312
1FN3150-5WC0x-xxxx	403	40313
1FN3300-2WB0x-xxxx	403	40314
1FN3300-2WC0x-xxxx	403	40315
1FN3300-2WG0x-xxxx	403	40316
1FN3300-3WC0x-xxxx	403	40317
1FN3300-3WG0x-xxxx	403	40318
1FN3300-4WB0x-xxxx	403	40319
1FN3300-4WC0x-xxxx	403	40320
1FN3450-2WC0x-xxxx	403	40321
1FN3450-2WE0x-xxxx	403	40322
1FN3450-3WB0x-xxxx	403	40323
1FN3450-3WB5x-xxxx	403	40324
1FN3450-3WC0x-xxxx	403	40325
1FN3450-3WE0x-xxxx	403	40326
1FN3450-4WB0x-xxxx	403	40327
1FN3450-4WB5x-xxxx	403	40328
1FN3450-4WC0x-xxxx	403	40329

1FN3450-4WE0x-xxxx	403	40330
1FN3600-3WB0x-xxxx	403	40331
1FN3600-3WC0x-xxxx	403	40332
1FN3600-4WB0x-xxxx	403	40333
1FN3600-4WB5x-xxxx	403	40334
1FN3600-4WC0x-xxxx	403	40335
1FN3900-2WB0x-xxxx	403	40336
1FN3900-2WC0x-xxxx	403	40337

A.4 Encoder code lists

1FK6 encoders

Order number:	Encoder code	
1FK6xxx-xxxxx-xAxx	I2001	
1FK6xxx-xxxxx-xExx	2051	
1FK6xxx-xxxxx-xGxx	2052	
1FK6xxx-xxxxx-xHxx	I2053	
1FK6xxx-xxxxx-xJxx	2054	
1FK6xxx-xxxxx-xSxx	4p (2-speed)	1002
	6p (3-speed	1003
	8p (4-speed)	1004

The pole number of the resolver corresponds to the motor pole number, refer to the Catalog data.

1FK6xxx-xxxxx-xTxx	I1001	

1FK7 encoders

1FK7xxx-xxxxx-xAxx	2001	
1FK7xxx-xxxxx-xExx	I2051	
1FK7xxx-xxxxx-xGxx	2052	
1FK7xxx-xxxxx-xHxx	I2053	
1FK7xxx-xxxxx-xJxx	2054	
1FK7xxx-xxxxx-xSxx	4p (2-speed)	1002
	6p (3-speed)	1003
	8p (4-speed)	1004

The pole number of the resolver corresponds to the motor pole number, refer to the Catalog data.

1FK7xxx-xxxxx-xTxx	1001	

1FS6 encoders

1FS6xxx-xxxxx-xAxx	2001
1FS6xxx-xxxxx-xExx	2051

1FT6 encoders

1FT6xxx-xxxxx-xAxx	2001	
1FT6xxx-xxxxx-xExx	2051	
1FT6xxx-xxxxx-xHxx	2053	
1FT6xxx-4xxxx-xSxx	4p (2-speed)	1002
1FT6xxx-6xxxx-xSxx	6p (3-speed)	1003
1FT6xxx-8xxxx-xSxx	8p (4-speed)	1004
1FT6xxx-xxxxx-xTxx	1001	

1FW3 encoders

1FW3xxx-xAxxx-xxxx	2001
1FW3xxx-xExxx-xxxx	2051
1FW3xxx-xGxxx-xxxx	2052
1FW3xxx-xSxxx-xxxx	1003

1PH4 encoders

1PH4xxx-xNxxx-xxxx	2002

1PH7 encoders

1PH7xxx-xExxx-xxxx	2051
1PH7xxx-xHxxx-xxxx	3002
1PH7xxx-xJxxx-xxxx	3003
1PH7xxx-xMxxx-xxxx	2001
1PH7xxx-xNxxx-xxxx	2002
1PH7xxx-xRxxx-xxxx	1001

1PM4 encoders

1PM4xxx-xGxxx-xxxx	2002
1PM4xxx-xLxxx-xxxx	2003

1PM6 encoders

1PM6xxx-xGxxx-xxxx	2002
1PM6xxx-xLxxx-xxxx	2003

2SP1X encoders

2SP1xxx-xHxxx-xxxx	2003

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Notes

B Availability of HW Components

Table B-1 HW components available from **03.2006**

No.	HW components	Order No.	Version	Revisions	Availa-ble from
1	SMC30	6SL3055–0AA00–5CA1		with SSI support	03.2006
2	DMC20	6SL3055–0AA00–6AA0		new	03.2006
3	TM41	6SL3055–0AA00–3PA0		new	03.2006
4	SME120/ SME125	6SL3055–0AA00–5JA0 6SL3055–0AA00–5KA0		new	03.2006
5	BOP20	6SL3055–0AA00–4BA0		new	03.2006

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Notes

C List of Abbreviations

Abbreviation	German	English
A		
A...	Warnung	Alarm
AC	Wechselstrom	Alternating Current
ADC	Analog-Digital-Konverter	Analog Digital Converter
AI	Analogeingang	Analog Input
ALM	Active Line Module	Active Line Module
AO	Analogausgang	Analog Output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
ASC	Ankerkurzschluss	Armature Short-Circuit
ASCII	Amerikanische Code-Norm für den Informationsaustausch	American Standard Code for Information Interchange
ASM	Asynchronmotor	Induction motor
B		
BB	Betriebsbedingung	Operating Condition
BERO	Firmenname für einen Näherungsschalter	Trade name for a type of proximity switch
BI	Binektoreingang	Binector Input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	Berufsgenossenschaftliches Institut für Arbeitssicherheit (German Institute for Occupational Safety)
BICO	Binektor-Konnektor-Technologie	Binector Connector Technology
BLM	Basic Line Module	Basic Line Module
BOP	Basic Operator Panel	Basic Operator Panel
C		
C	Kapazität	Capacitance
C...	Safety-Meldung	Safety message
CAN	Serielles Bussystem	Controller Area Network
CBC	Kommunikationsbaugruppe CAN	Communication Board CAN
CD	Compact Disc	Compact Disc
CDS	Befehlsdatensatz	Command Data Set
CI	Konnektoreingang	Connector Input

Abbreviation	German	English
CNC	Computerunterstützte numerische Steuerung	Computer Numerical Control
CO	Konnektorausgang	Connector Output
CO/BO	Konnektor-/Binektorausgang	Connector Output/Binector Output
COB-ID	CAN Object-Identification	CAN Object-Identification
COM	Mittelkontakt eines Wechselkontaktes	Common contact of a change-over relay
CP	Kommunikationsprozessor	Communications Processor
CPU	Zentralbaugruppe	Central Processing Unit
CRC	Checksummenprüfung	Cyclic Redundancy Check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
D		
DAC	Digital-Analog-Konverter	Digital Analog Converter
DC	Gleichstrom	Direct Current
DCN	Gleichstrom negativ	Direct Current Negative
DCP	Gleichstrom positiv	Direct Current Positive
DDS	Antriebsdatensatz	Drive Data Set
DI	Digitaleingang	Digital Input
DI/DO	Digitaleingang/-ausgang bidirektional	Bidirectional Digital Input/Output
DMC	DRIVE-CLiQ Module Cabinet (Hub)	DRIVE-CLiQ Module Cabinet (Hub)
DO	Digitalausgang	Digital Output
DO	Antriebsobjekt	Drive Object
DPRAM	Speicher mit beidseitigem Zugriff	Dual-Port Random Access Memory
DRAM	Dynamischer Speicher	Dynamic Random Access Memory
DRIVE CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
E		
EDS	Geberdatensatz	Encoder Data Set
EGB	Elektrostatisch gefährdete Baugruppen	Electrostatic Sensitive Devices (ESD)
ELP	Erdschlussüberwachung	Earth Leakage Protection
EMK	Elektromagnetische Kraft	Electromagnetic Force (EMF)
EMV	Elektromagnetische Verträglichkeit	Electromagnetic Compatibility (EMC)
EN	Europäische Norm	European Standard
EnDat	Geber-Schnittstelle	Encoder-Data-Interface
EP	Impulsfreigabe	Enable Pulses
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering System
ESB	Ersatzschaltbild	Equivalent circuit diagram

Abbreviation	German	English
ESR	Erweitertes Stillsetzen und Rückziehen	Extended Stop and Retract
F		
F...	Störung	Fault
FAQ	Häufig gestellte Fragen	Frequently Asked Questions
FCC	Function Control Chart	Function Control Chart
FCC	Flussstromregelung	Flux Current Control
FEM	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPROM	Schreib- und Lesespeicher nichtflüchtig	Flash-EPROM
FG	Funktionsgenerator	Function Generator
FI	Fehlerstrom-Schutzschalter	Residual-Current Circuit-Breaker (RCCB)
FP	Funktionsplan	Function diagram
FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte
GC	Global-Control-Telegramm (Broadcast-Telegramm)	Global Control telegram (broadcast telegram)
GSD	Gerätestammdatei: beschreibt die Merkmale eines PROFIBUS-Slaves	Device master file: describes the features of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate Supply Voltage
H		
HF	Hochfrequenz	High Frequency
HFD	Hochfrequenzdrossel	High frequency reactor
HLG	Hochlaufgeber	Ramp-Function Generator
HMI	Mensch-Maschine-Schnittstelle	Human Machine Interface
HTL	Logik mit hoher Störschwelle	High-Threshold Logic
HW	Hardware	Hardware
I		
i. V.	In Vorbereitung: diese Eigenschaft steht zur Zeit nicht zur Verfügung	In preparation: this feature is currently not available
IBN	Inbetriebnahme	Commissioning
I/O	Eingang/Ausgang	Input/Output
ID	Identifizierung	Identifier
IEC	Internationale Norm in der Elektrotechnik	International Electrotechnical Commission
IGBT	Bipolartransistor mit isolierter Steuerelektrode	Insulated Gate Bipolar Transistor
IL	Impulslöschung	Pulse suppression
IT	Drehstromversorgungsnetz ungeerdet	Insulated three-phase supply network
IVP	Interner Spannungsschutz	Internal Voltage Protection

Abbreviation	German	English
J		
JOG	Tippen	Jogging
K		
KDV	Kreuzweiser Datenvergleich	Data cross-checking
KIP	Kinetische Pufferung	Kinetic buffering
Kp	Proportionalverstärkung	Proportional gain
KTY	Spezieller Temperatursensor	Special temperature sensor
L		
L	Induktivität	Inductance
LED	Leuchtdiode	Light Emitting Diode
LIN	Linearmotor	Linear motor
LR	Lageregler	Position controller
LSB	Niederstwertiges Bit	Least Significant Bit
LSS	Netzschalter	Line Side Switch
LU	Längeneinheit	Length Unit
M		
M	Masse	Reference potential, zero potential
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motordatensatz	Motor Data Set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-readable product designation
MMC	Mensch Maschine Kommunikation	Man Machine Communication
MSB	Höchstwertiges Bit	Most Significant Bit
MSCY_C1	Zyklische Kommunikation zwischen Master (Klasse 1) und Slave	Master Slave Cycle Class 1
MT	Messtaster	Measuring probe
N		
N. C.	Nicht angeschlossen	Not Connected
N...	Keine Meldung oder Interne Meldung	No Report
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for instrumentation and control in the chemical industry
NC	Öffner	Normally Closed contact
NC	Numerische Steuerung	Numerical Control
NEMA	Normengremium in USA (United States of America)	National Electrical Manufacturers Association
NM	Nullmarke	Zero Mark
NO	Schließer	Normally Open contact

Abbreviation	German	English
O		
OA	Open Architecture	Open Architecture
OEM	Original Equipment Manufacturer	Original Equipment Manufacturer
OLP	Busstecker für Lichtleiter	Optical Link Plug
OMI	Option Module Interface	Option Module Interface
P		
p...	Einstellparameter	Adjustable parameter
PcCtrl	Steuerungshoheit	Master Control
PDS	Leistungsteildatensatz	Power unit Data Set
PE	Schutzerde	Protective Earth
PELV	Schutzkleinspannung	Protective Extra Low Voltage
PEM	Permanenterregter Synchronmotor	Permanent-magnet synchronous motor
PG	Programmiergerät	Programming device
PI	Proportional Integral	Proportional Integral
PID	Proportional Integral Differential	Proportional Integral Differential
PLC	Speicherprogrammierbare Steuerung (SPS)	Programmable Logic Controller
PLL	Baustein zur Synchronisierung	Phase Locked Loop
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organisation
PPI	Punkt zu Punkt Schnittstelle	Point to Point Interface
PRBS	Weißes Rauschen	Pseudo Random Binary Signal
PROFIBUS	Serieller Datenbus	Process Field Bus
PS	Stromversorgung	Power Supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positiver Temperaturkoeffizient	Positive Temperature Coefficient
PTP	Punkt zu Punkt	Point To Point
PWM	Pulsweitenmodulation	Pulse Width Modulation
PZD	PROFIBUS Prozessdaten	PROFIBUS process data
Q		
R		
r...	Beobachtungsparameter (nur lesbar)	Display parameter (read only)
RAM	Speicher zum Lesen und Schreiben	Random Access Memory
RCCB	Fehlerstrom-Schutzschalter	Residual Current Circuit Breaker
RCD	Fehlerstrom-Schutzschalter	Residual Current Device
RJ45	Norm. Beschreibt eine 8-polige Steckverbindung mit Twisted-Pair Ethernet.	Standard. Describes an 8-pole plug connector with twisted pair Ethernet.
RKA	Rückkühlanlage	Cooling system

Abbreviation	German	English
RO	Nur lesbar	Read Only
RPDO	Receive Process Data Object	Receive Process Data Object
RS232	Serielle Schnittstelle	Serial Interface
RS485	Norm. Beschreibt die Physik einer digitalen seriellen Schnittstelle.	Standard. Describes the physical characteristics of a digital serial interface.
RTC	Echtzeituhr	Real Time Clock
S		
S1	Dauerbetrieb	Continuous operation
S3	Aussetzbetrieb	Periodic duty
SBC	Sichere Bremsenansteuerung	Safe Brake Control
SBH	Sicherer Betriebshalt	Safe Operational Stop
SBR	Sichere Bremsrampe	Safe Braking Ramp
SBT	Sicherer Bremsentest	Safe Brake Test
SCA	Sichere Nocke	Safe Cam
SDI	Sichere Richtung	Safe Direction
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	Safety-relevant output
SGE	Sicherheitsgerichteter Eingang	Safety-relevant output
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Sicherheitsintegritätsgrad	Safety Integrity Level
SLI	Sicheres Schrittmaß	Safely Limited Increment
SLM	Smart Line Module	Smart Line Module
SLP	Sichere Endlage	Safely Limited Position
SLS	Sicher reduzierte Geschwindigkeit	Safely Limited Speed
SLVC	Geberlose Vektorregelung	Sensorless Vector Control
SM	Sensor Module	Sensor Module
SMC	Sensor Module Cabinet	Sensor Module Cabinet
SME	Sensor Module External	Sensor Module External
SN	Sicherer Software-Nocken	Safe software cam
SOS	Sicherer Betriebshalt	Safe Operational Stop
SPC	Sollwertkanal	Setpoint Channel
SPS	Speicherprogrammierbare Steuerung	Programmable Logic Controller (PLC)
SS1	Safe Stop 1	Safe Stop 1
SS2	Safe Stop 2	Safe Stop 2
SSI	Synchron Serielle Schnittstelle	Synchronous Serial Interface
SSM	Sichere Geschwindigkeitsanzeige n < nx	Safe Speed Monitoring n < nx

Abbreviation	German	English
SSR	Sichere Bremsrampe	Safe Stop Ramp
STO	Sicherer Halt	Safe Torque Off
STW	PROFIBUS Steuerwort	PROFIBUS control word
T		
TB	Terminal Board	Terminal Board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal Module
TN	Drehstromversorgungsnetz geerdet	Grounded three-phase supply network
Tn	Nachstellzeit	Integral time
TPDO	Transmit Process Data Object	Transmit Process Data Object
TT	Drehstromversorgungsnetz geerdet	Grounded three-phase supply network
TTL	Transistor-Transistor-Logik	Transistor-Transistor-Logic
U		
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
USV	Unterbrechungsfreie Stromversorgung	Uninterruptible Power Supply (UPS)
V		
VC	Vektorregelung	Vector Control
Vdc	Zwischenkreisspannung	DC link voltage
VdcN	Teilzwischenkreisspannung negativ	Partial DC link voltage negative
VdcP	Teilzwischenkreisspannung positiv	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Association of German Electrical Engineers
VDI	Verein Deutscher Ingenieure	Association of German Engineers
Vpp	Volt Spitze zu Spitze	Volt peak to peak
VSM	Voltage Sensing Module	Voltage Sensing Module
W		
WEA	Wiedereinschaltautomatik	Automatic restart
WZM	Werkzeugmaschine	Machine tool
X		
XML	Erweiterbare Auszeichnungssprache (Standardsprache für Web-Publishing und Dokumentenmanagement)	Extensible Markup Language
Y		
Z		
ZK	Zwischenkreis	DC Link
ZSW	PROFIBUS Zustandswort	PROFIBUS status word

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Notes

References

D

SINAMICS Documentation

Catalogs

/D11.1/ **SINAMICS G110 Converter Chassis Units 0,12 kW to 3 kW**
Order No.: E86060-K5511-A111-A2-7600 10/2005 Edition

/D11/ **SINAMICS G130 Drive Converter Chassis Units,**
SINAMICS G150 Drive Converter Cabinet Units
Order No.: E86060-K5511-A101-A3-7600 12/2005 Edition

/D21.1/ **SINAMICS S120 Chassis Units**
Order No.: E86060-K5521-A111-A2-7600 06/2005 Edition

/D21.3/ **SINAMICS S150 Converter Cabinet Units**
Order No.: E86060-K5521-A131-A1-7600 05/2004 Edition

Related catalogs

/ST70/ **SIMATIC Components for Totally Integrated Automation, Catalog ST70**
Ordering information
Order No.: E86060-K4670-A111-A9-7600 10/2004 Edition

/PM10/ **SIMOTION Motion Control System, Catalog PM10**
Ordering information
Order No.: E86060-K4910-A101-A5-7600 07/2005 Edition

/NC61/ **SINUMERIK & SINAMICS**
Automation Systems for Machine Tools
Ordering information
Order No.: E86060–K4461–A101–A1 09/2005 Edition

Interactive catalogs

/CA01/ **Automation and Drives' Offline Mall**
CD-ROM
Order No.: E86060-D4001-A100-C4-7600 10/2005 Edition

/Mall/ **A&D Mall, Catalog and Online Ordering System**
http://www.siemens.com/automation/mall

Electronic documentation

/CD2/ **SINAMICS**
The SINAMICS System
Order No.: 6SL3097-2CA00-0YG3 05/2006 Edition

User Documentation

Note

Ring binders in a matching design can be ordered to file the SINAMICS documents.
Order No.: E20001–Y60–M112–X–7400

/BA1/ **SINAMICS G150**
Operating Instructions
Order No.: Available on request 03/2006 Edition

/BA2/ **SINAMICS G130**
Operating Instructions
Order No.: Available on request 03/2006 Edition

/BA3/ **SINAMICS S150**
Operating Instructions
Order No.: Available on request 03/2006 Edition

/GH1/ **SINAMICS S120**
Equipment Manual for Control Units and Additional System Components
Order No.: 6SL3097-2AH00-0BP3 03/2006 Edition

/GH2/ **SINAMICS S120**
Equipment Manual for Booksize Power Sections
Order No.: 6SL3097-2AC00-0BP3 03/2006 Edition

/GH3/ **SINAMICS S120**
Equipment Manual for Chassis Power Sections
Order No.: 6SL3097-2AE00-0BP1 03/2006 Edition

/GH4/ **SINAMICS S120**
Equipment Manual for Booksize Cold Plate
Order No.: 6SL3097-2AJ00-0BP3 03/2006 Edition

/GH5/ **SINAMICS S120**
Equipment Manual Cabinet Modules
Order No.: On request 03.2006 Edition

/GH6/ **SINAMICS S120**
Equipment Manual AC DRIVE
Order No.: 6SL3097–2AL00–0BP0 03.2006 Edition

/GS1/ **SINAMICS S120**
Getting Started
Order No.: 6SL3097-2AG00-0BP2 03/2006 Edition

/IH1/ **SINAMICS S120**
Installation and Start-Up Manual
Order No.: 6SL3097-2AF00-0BP5 04/2006 Edition

/FH1/ **SINAMICS S120**
Function Manual
Order No.: 6SL3097-2AB00-0BP2 03/2006 Edition

/IH2/ **SINAMICS S120**
Installation and Start-up Manual for CANopen
Order No.: 6SL3097-2AA00-0BP2 03/2006 Edition

/LH1/ **SINAMICS S**
List Manual
Order No.: 6SL3097-2AP00-0BP4 03/2006 Edition

Further supplementary documentation

1 **Drive ES Basic V5.1**
Function Description
Engineering system for drives from the SIEMENS A&D product range
Order No.: 6SW1700-0JA00-0BA0 08/2001 Edition

2 **SIMOTION Engineering System**
Handling
Order No.: 6AU1900-1AB31-0BA0 12/2004 Edition

/PJAL/ **SIMODRIVE, SIMOVERT MASTERDRIVES, SINAMICS**
General Part for Synchronous Motors
Planning Guide
Order No.: 6SN1197-0AD07-0BP2 12/2004 Edition

/PFK7S/ **SIMODRIVE Synchronous Motors 1FK7**
Planning Guide
Order No.: 6SN1197-0AD16-0BP0 12/2004 Edition

/PFT6S/ **SIMODRIVE Synchronous Motors 1FT6**
Planning Guide
Order No.: 6SN1197-0AD12-0BP0 12/2004 Edition

/PFK7/ **SIMODRIVE and SIMOVERT MASTERDRIVES Synchronous Motors 1FK7**
Planning Guide
Order No.: 6SN1197-0AD06-0BP2 07/2005 Edition

/PFT6/ **SIMODRIVE and SIMOVERT MASTERDRIVES Synchronous Motors 1FT6**
Planning Guide
Order No.: 6SN1197-0AD02-0BP1 07/2005 Edition

PROFIBUS documentation

/P1/ **PROFIBUS-DP/DPV1 IEC 61158**
Basics, Tips and Tricks for Users
Hüthig; Manfred Popp, 2nd Edition
ISBN 3-7785-2781-9

/P2/ **PROFIBUS-DP, Getting Started**
PROFIBUS Nutzerorganisation e.V.; Manfred Popp
Order No.: 4.071

/P3/ **Decentralization with PROFIBUS-DP**
Architecture and Fundamentals, Configuration and Use of PROFIBUS-DP with SIMATIC S7
SIEMENS; Publics MCD Verlag; Josef Weigmann, Gerhard Kilian
Order No.: A19100-L531-B714-7600
ISBN 3-89578-074-X

/P4/ **Manual for PROFIBUS Networks, SIEMENS**
Order No.: 6GK1970-5CA20-0BA0

/P5/ **PROFIBUS Profile PROFIdrive Profile Drive Technology**
PROFIBUS User Organization e. V.
Haid-und-Neu-Straße 7, 76131 Karlsruhe
Order No.: 3.172 Version 3.1 November 2002

/IKPI/ **SIMATIC NET, Industrial Communication and Field Devices**
Catalog
Order No.: E86060-K6710-A101-B4-7600 2005 Edition

/PDP/ **PROFIBUS Installation Guidelines**
Installation Guideline for PROFIBUS-FMS/DP
Installation and wiring recommendation for RS 485 Transmission
Order No.: 2.112 Version 1.0

Documentation for Safety Equipment

Note

For more information about technical documentation for Safety Integrated, visit the following address:

http://www.siemens.com/safety

The following list contains some of the safety–related documentation available.

/LVP/ **Low-Voltage Switchgear**
Catalog
Order No.: E86060-K1002-P101-A5-7600 2005 Edition

/LV10/ **Industrial Switchgear**
Catalog
Order No.: E86060-K1002-A101-A4-7600 2004 Edition

/LV20/ **BERO – Sensors for Automation Applications**
Catalog
Order No.: E86060-K1803-A101-A3-7600 2004 Edition

/LV30/ **Products and Systems for Energy Distribution**
Catalog
Order No.: E86060-K1801-A101-A4-7600 2004 Edition

/MRL/ **Directive 98/37/EG of the European Parliament and Council**
Machine directive
Bundesanzeiger-Verlags GmbH June 22, 1998 Edition

/SIAH/ **Safety Integrated**
Application manual
Order No.: 6ZB5000-0AA01-0BA0 4th edition

/SICD/ **Safety Integrated**
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Suggestions

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For publication/manual:

SINAMICS S120

Manufacturer/Service Documentation

Commissioning Manual

Order no.: 6SL3 097-2AF00-0BP5
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General Documentation/Catalogs

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SINAMICS G130 G150
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Converter Cabinet Units

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