SINAMICS S120

Commissioning Manual · 01/2013

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S120
Commissioning Manual

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Applies to:
Firmware version 4.6

(IH1), 01/2013
6SL3097-4AF00-0BP3

Legal information

Warning notice system

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

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

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

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

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

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Disclaimer of Liability

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

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Ⓟ 01/2013 Technical data subject to change

Preface

SINAMICS documentation

The SINAMICS documentation is organized in the following categories:

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

More information

The following link provides information on the topics:

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and browse through manuals/information)
  http://www.siemens.com/motioncontrol/docu

Please send any questions about the technical documentation (e.g. suggestions for improvement, corrections) to the following e-mail address:
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My Documentation Manager

Under the following link there is information on how to create your own individual documentation based on Siemens' content, and adapt it for your own machine documentation:
http://www.siemens.com/mdm

Training

Under the following link there is information on SITRAIN - training from Siemens for products, systems and automation engineering solutions:
http://www.siemens.com/sitrain

FAQs

You can find Frequently Asked Questions in the Service&Support pages under **Product Support**:
http://support.automation.siemens.com

SINAMICS

You can find information on SINAMICS under:
http://www.siemens.com/sinamics

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

Table 1 Usage phases and the available documents/tools

Usage phase	Document/tool
Orientation	SINAMICS S Sales Documentation
Planning/configuration	• SIZER engineering tool • Configuration Manuals, Motors
Deciding/ordering	SINAMICS S120 catalogs • SIMOTION, SINAMICS S120 and Motors for Production Machines (Catalog PM 21) • SINAMICS and motors for single-axis drives (catalog D 31) • SINUMERIK & SINAMICS Equipment for Machine Tools (Catalog NC 61) • SINUMERIK 840D sl Type 1B Equipment for Machine Tools (Catalog NC 62)
Installation/assembly	• SINAMICS S120 Equipment Manual for Control Units and Additional System Components • SINAMICS S120 Equipment Manual for Booksize Power Units • SINAMICS S120 Equipment Manual for Chassis Power Units • SINAMICS S120 Equipment Manual for AC Drives • SINAMICS S120M Equipment Manual Distributed Drive Technology
Commissioning	• STARTER commissioning tool • SINAMICS S120 Getting Started • SINAMICS S120 Commissioning Manual • SINAMICS S120 CANopen Commissioning Manual • SINAMICS S120 Function Manual • SINAMICS S120 Safety Integrated Function Manual • SINAMICS S120/S150 List Manual
Usage/operation	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
Maintenance/servicing	• SINAMICS S120 Commissioning Manual • SINAMICS S120/S150 List Manual
References	• SINAMICS S120/S150 List Manual

Target group

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

Benefits

This Manual describes all the information, procedures and operational instructions required for commissioning and servicing SINAMICS S120.

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.

- It may be possible for other functions not described in this documentation 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 that are not available in a particular product version of the drive system may be described in the documentation. 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

Country-specific telephone numbers for technical support are provided in the Internet under Contact:

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

EC Declaration of Conformity

The EC Declaration of Conformity for the EMC Directive can be found on the Internet at:

http://support.automation.siemens.com

There – as a search term – enter the number 15257461 or contact your local Siemens office.

The EC Declaration of Conformity for the Low Voltage Directive can be found on the Internet at:

http://support.automation.siemens.com

There – as a search term – enter the number 22383669.

Note

When operated in dry areas, SINAMICS S units conform to Low-Voltage Directive 2006/95/EC.

Note

SINAMICS S units fulfill EMC Directive 2004/108/EC in the configuration specified in the associated EC Declaration of Conformity for EMC and when the EMC installation guideline provided in the Configuration Manual with Order No. 6FC5297-0AD30-0□P□ is implemented.

Note

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

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

EMC limit values in South Korea

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device. This device is intended to be used in areas other than at home.

The EMC limit values to be complied with for South Korea correspond to the limit values of the EMC product standard for variable-speed electric drives EN 61800-3, Category C2 or limit value class A, Group 1 according to EN 55011. By applying suitable supplementary measures, the limit values according to Category C2 or according to limit value class A, Group 1, are maintained. Further, additional measures may be required, for instance, using an additional radio interference suppression filter (EMC filter).
The measures for EMC-compliant design of the system are described in detail in this manual respectively in the Configuration Manual EMC Installation Guideline.
Please note that the final statement regarding compliance with the standard is given by the respective label attached to the individual unit.

Spare parts

Spare parts are available on the Internet at:
http://support.automation.siemens.com/WW/view/de/16612315

Test certificates

The Safety Integrated functions of SINAMICS components are generally certified by independent institutes. An up-to-date list of already certified components is available on request from your local Siemens office. If you have any questions relating to certifications that have not yet been completed, please ask your Siemens contact.

Explanation of symbols

Symbol	Meaning
	Protective earth (PE)
	Ground (e.g. M 24 V)
	Functional ground Equipotential bonding

Notation

The following notation and abbreviations are used in this documentation:

Notation for faults and alarms (examples):

- F12345 Fault 12345
- A67890 Alarm 67890

Notation for parameters (examples):

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

ESD Notes

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

NOTICE

Damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can result in malfunctions as a result of damaged individual components, integrated circuits, modules or devices.

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

Safety notices

DANGER

Danger of death when live parts are touched

Touching live parts can result in death or severe injury.

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

Generally, six steps apply when establishing safety:

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

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

DANGER

Risk of electric shock, hazardous axis movements

- Commissioning is absolutely prohibited until it has been completely ensured that the machine, in which the components described here are to be installed, is in full compliance with the provisions of the EC Machinery Directive.
- SINAMICS devices and AC motors may 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 electrical circuits automatically conduct a dangerous voltage.
- Dangerous mechanical movements are possible during system operations.
- All the work carried out on the electrical machine or system must be carried out with it in a no-voltage condition.
- SINAMICS devices with three-phase motors must only be connected to the power supply via a universal current-sensitive residual current operated device with selective switching once it has been verified that the SINAMICS device is compatible with the residual current operated device in accordance with IEC 61800-5-1.

WARNING

Improper handling of the devices

- The successful and safe operation of this equipment and motors is dependent on professional transport, storage, installation and mounting as well as careful operations , service and maintenance.
- Information and data from the catalogs and quotations also apply to special versions of the equipment and motors.
- In addition to the danger and warning information provided in the technical customer documentation, the applicable national, local, and plant-specific regulations and requirements must be taken into account.
- Only protective extra-low voltages (PELV) that comply with EN60204-1 may be connected to all connections and terminals between 0 and 48 V.
- The motors can have surface temperatures of over +100 °C.
- This is why temperature-sensitive components, e.g. cables or electronic components must not be in contact with or attached to the motor.
- When attaching the connecting cables, you must ensure that
  - they are not damaged
  - they are not stressed
  - they cannot come into contact with any rotating parts

WARNING

Hazardous axis movements for safety functions that have not been parameterized

The Safe Torque Off (STO) safety function (Safety Integrated basic functions or extended functions) **must** be parameterized in order to use the pulse inhibit terminals at the Motor Modules, booksize, booksize compact, chassis and Cabinet Modules and at the Power Modules, chassis and blocksize formats.

The procedure to do this is described in both function manuals (SINAMICS S120 Function Manual Drive Functions and SINAMICS S120 Function Manual Safety Integrated).

NOTICE

Material damage as a result of incorrect voltage tests

- As part of routine tests, SINAMICS devices with three-phase motors are subject to a voltage test in accordance with EN 61800-5-1. Before the voltage test is performed on the electrical equipment of industrial machines to EN 60204-1, Section 18.4, all connectors of SINAMICS devices must be disconnected/withdrawn to prevent the equipment from being damaged.
- Motors should be connected up according to the circuit diagram provided otherwise they may be destroyed.

Note

Low-voltage directive

When operated in dry areas, SINAMICS devices with three-phase motors conform to Low-Voltage Directive 2006/95/EC.

Contents

1 Preparation for commissioning

Before commissioning observe the conditions described in this chapter.

- The preconditions for commissioning must be fulfilled (in the next chapter).
- The relevant checklist must have been worked through.
- The bus components required for communication must be wired up.
- DRIVE-CLiQ wiring rules must be complied with.
- The ON-OFF responses of the drive.

1.1 Requirements for commissioning

The following are necessary for commissioning a SINAMICS S drive system:

- A programming device (PG/PC)
- STARTER commissioning tool
- A communication interface, e.g. PROFIBUS, PROFINET, Ethernet
- Completely wired-up drive line-up (see the SINAMICS S120 Manual)

The following diagram shows a configuration example with booksize and chassis components, as well as with PROFIBUS and PROFINET communication:

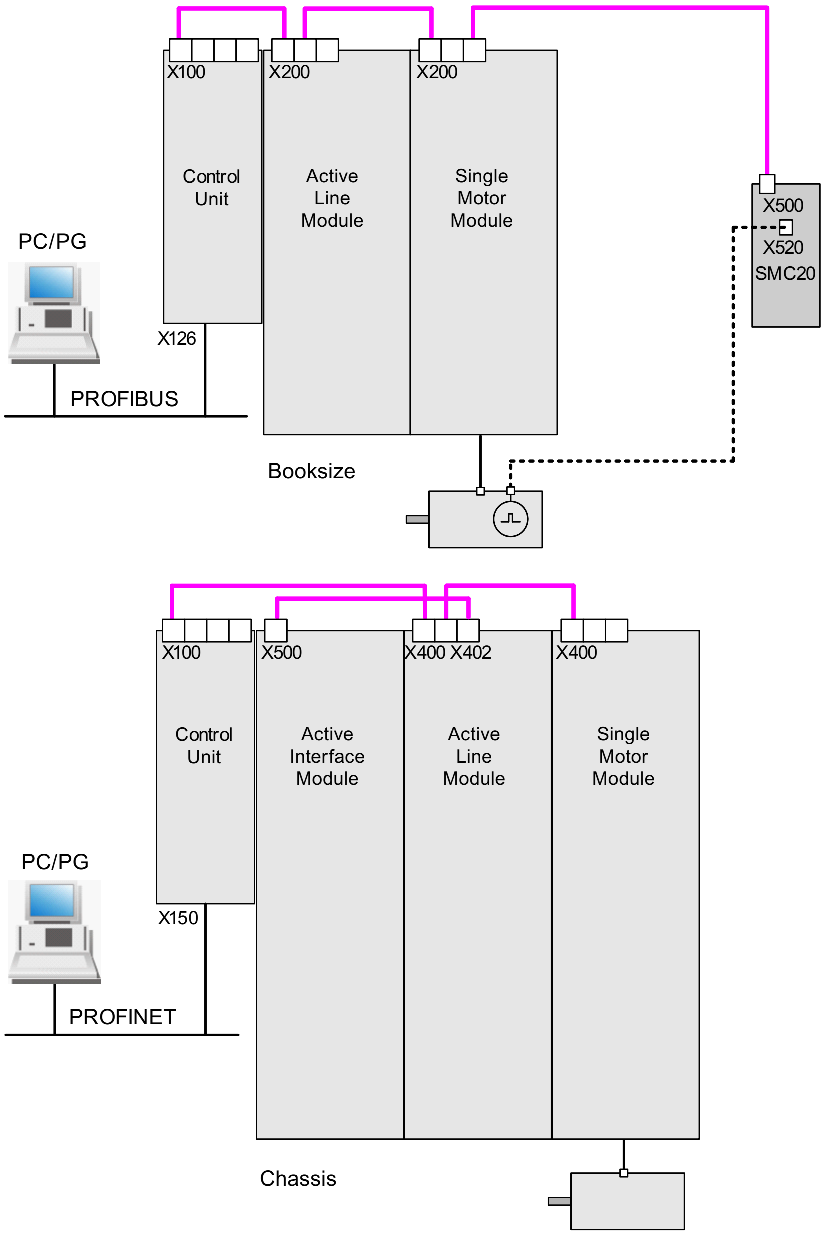


Figure 1-1 Component configuration (example)

1.2 Check lists to commission SINAMICS S

Checklist (1) for commissioning booksize power units

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

Table 1- 1 Checklist for commissioning (booksize)

Check	OK
Are the environmental conditions in the permissible range?	
Is the component firmly attached to the fixing points provided?	
Is the specified air flow for cooling the devices ensured?	
Have the ventilation clearances for the components been observed?	
Is the memory card correctly inserted in the Control Unit?	
Are all of the necessary components of the configured drive line-up available, installed and connected?	
Do the temperature monitoring circuits fulfill the specifications of protective separation?	
Have the DRIVE-CLiQ topology rules been observed?	
Have the line-side and motor-side power cables been dimensioned and routed in accordance with the environmental and routing conditions?	
Have the maximum permissible cable lengths between the frequency converter and the motor (depending on the type of cables used) been observed?	
Have the power cables been properly connected to the component terminals with the specified torque?	
Have all of the remaining screws been tightened to the specified torque?	
Has all wiring work been successfully completed?	
Are all connectors correctly plugged in and screwed in place?	
Have all the covers for the DC link been closed and latched into place?	
Have the shield supports been correctly connected through a large surface area?	

Checklist (2) for commissioning chassis power units

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

Table 1- 2 Checklist for commissioning (chassis)

Activity	OK
Are the environmental conditions in the permissible range?	
Are the components correctly installed in the cabinets?	
Is the specified air flow for cooling the devices ensured?	
Is an air short-circuit between the air inlet and outlet for the chassis components prevented by the installation arrangements?	
Have the ventilation clearances for the components been observed?	
Is the memory card correctly inserted in the Control Unit?	
Are all of the necessary components of the configured drive line-up available, installed and connected?	
Do the temperature monitoring circuits fulfill the specifications of protective separation?	
Have the DRIVE-CLiQ topology rules been observed?	
Have the line-side and motor-side power cables been dimensioned and routed in accordance with the environmental and routing conditions?	
Have the maximum permissible cable lengths between the frequency converter and the motor (depending on the type of cables used) been observed?	
Is the ground for the motors directly connected to the ground for the Motor Modules (shortest distance)?	
Are the motors connected with shielded power cables?	
Are the power cable shields connected as closely as possible to the terminal box across a wide area?	
Have the power cables been properly connected to the component terminals with the specified torque?	
Have all of the remaining screws been tightened to the specified torque?	
Has the total power of the DC busbar been dimensioned sufficiently?	
Has the busbar/wiring for the DC connection between the infeed and the Motor Modules been dimensioned sufficiently with regard to the load and installation conditions?	
Are the cables between the low-voltage switchgear and the power unit protected with line fuses? Line protection(1) should be taken into account.	
Have measures been taken to relieve strain on the cables?	
For external auxiliary infeed: Have the cables for the auxiliary infeed been connected according to the Equipment Manual?	
Have the control cables been connected in accordance with the required interface configuration and the shield applied?	
Have the digital and analog signals been routed with separate cables?	
Has the distance from power cables been observed?	
Has the cabinet been properly grounded at the points provided?	
Has the connection voltage for the fans in the chassis components been adapted accordingly to the supply voltages?	

Activity	OK
For operation on non-grounded supply systems: Has the connection bracket for the interference suppression at the Infeed Module or the Power Module been removed?	
Is the period from the date of manufacture to initial commissioning or the downtime of the power components less than two years(2)?	
Is the drive operated from a higher-level controller/control room?	

(1) Combined fuses are recommended for conductor and semi-conductor protection (VDE 636, Part 10 and Part 40 / EN 60269-4). For information about the relevant fuses, see the catalog.

(2)If the downtime period is longer than two years, the DC link capacitors must be reformed (see the "Maintenance and Servicing" chapter in the Equipment Manual). The cabinet rating plate can be used to ascertain the date of manufacture.

Checklist (3) for commissioning blocksize Power Modules

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

Table 1- 3 Check list for commissioning blocksize

Check	OK
Are the environmental conditions in the permissible range?	
Is the component firmly attached to the fixing points provided?	
Is the specified air flow for cooling the devices ensured?	
Have the ventilation clearances for the components been observed?	
Is the memory card correctly inserted in the Control Unit?	
Are all of the necessary components of the configured drive line-up available, installed and connected?	
Do the temperature monitoring circuits fulfill the specifications of protective separation?	
Have the line-side and motor-side power cables been dimensioned and routed in accordance with the environmental and routing conditions?	
Have the maximum permissible cable lengths between the frequency converter and the motor (depending on the type of cables used) been observed?	
Have the power cables been properly connected to the component terminals with the specified torque?	
Have all of the remaining screws been tightened to the specified torque?	
Has all wiring work been successfully completed?	
Are all connectors correctly plugged in and screwed in place?	
Have the shield supports been correctly connected through a large surface area?	

1.3 PROFIBUS components

For communication via PROFIBUS, the following components are necessary.

- A communication module for PG/PC connection via the PROFIBUS interface.
  - PROFIBUS connection to a PG/PC via USB port (USB V2.0).
    Structure: USB port (USB V2.0) + adapter with 9-pin SUB-D socket connector to connect to PROFIBUS.
    Used with driver SIMATIC Net PC Software Edition 2008 + SP2
    Order No.: 6GK1571-1AA00

Connecting cable

Connecting cable between PROFIBUS adapter and programming device/PC, such as

- CP 5xxx cable, Order No.: 6ES7901-4BD00-0XA0
- MPI cable (SIMATIC S7), Order No.: 6ES7901-0BF00-0AA0

Cable lengths

Table 1- 4 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

1.4 PROFINET components

For communication via PROFINET, the following components are necessary:

- A communication module for programming device/PC connection via the PROFINET interface.

Note

Cables that can be used for commissioning

For commissioning using the STARTER commissioning tool, the onboard Ethernet interface of the Control Unit can be used with a crossover cable from CAT5 and higher.

The PROFINET module CBE20 supports all standard Ethernet cables and crossover cables from CAT5/5e and higher.

- Connecting cable
  Connecting cable between PROFINET adapter and programming device/PC, such as
  - 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 2 x 2 (up to max. 85 m)

    Order No.: 6XV1870-2D
  - Industrial Ethernet FC Trailing Cable 2 x 2 (up to max. 85 m)

    Order No.: 6XV1840-3AH10
  - Industrial Ethernet FC Marine Cable 2 x 2 (up to max. 85 m)

    Order No.: 6XV1840-4AH10
- Connector
  Connector between the PROFINET adapter and the PG/PC, for example
  - Industrial Ethernet FC RJ45 Plug 145 for Control Unit

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

1.5 Rules for wiring with DRIVE-CLiQ

Rules apply for wiring components with DRIVE-CLiQ. A distinction is made between binding DRIVE-CLiQ rules, which must be unconditionally observed and recommended rules, which should then be maintained so that the topology, generated offline in the STARTER commissioning tool, no longer has to be changed.

The maximum number of DRIVE-CLiQ components and the possible wiring type depend on the following factors:

- The binding DRIVE-CLiQ wiring rules
- The number and type of activated drives and functions on the Control Unit in question
- The computing power of the Control Unit in question
- The set processing and communication cycles

Below you will find the binding wiring rules and some other recommendations as well as a few sample topologies for DRIVE-CLiQ wiring.

The components used in these examples can be removed, replaced with others or supplemented. If components are replaced by another type or additional components are added, then the SIZER configuring tool should be used to check this topology.

If the actual topology does not match the topology created offline using the STARTER commissioning tool, the offline topology must be changed accordingly before it is downloaded.

1.5.1 DRIVE-CLiQ diagnostics

DRIVE-CLiQ diagnostics

Using the DRIVE-CLiQ diagnostics, you can check the connections and cables of DRIVE-CLiQ connections. For data transfer errors, to localize the faulted connection, the error counter in the PHY blocks involved can be evaluated.

In addition to the error counter showing all errors, detailed diagnostics can be carried out for the individual connections. For selected connections, the number of errors is determined for a time interval that can be specified and made traceable using a parameter. As a result of the interconnectability, you can record when data transfer errors occur and correlate them with other events in the drive.

Overview of important parameters

- r9936[0...199] DRIVE-CLiQ diagnostics, error counter connection
- p9937 DRIVE-CLiQ diagnostics configuration
- p9938 DRIVE-CLiQ detailed diagnostics configuration
- p9939 DRIVE-CLiQ detailed diagnostics time interval
- p9942 DRIVE-CLiQ detailed diagnostics individual connection selection
- r9943 DRIVE-CLiQ detailed diagnostics individual connection error counter

Detailed information on the parameters for DRIVE-CLiQ diagnostics is provided in the SINAMICS S120/S150 List Manual.

1.5.2 Binding DRIVE-CLiQ rules

The wiring rules below apply to standard cycle times (servo control 125 µs, vector control 250 µs). For cycle times that are shorter than the corresponding standard cycle times, additional restrictions apply due to the computing power of the Control Unit (configured using the SIZER engineering tool).

Note

A Double Motor Module, one DMC20, one DME20, one TM54F and one CUA32 each correspond to two DRIVE-CLiQ participants. This also applies to Double Motor Modules, at which just one drive is configured.

The following generally binding DRIVE-CLiQ rules must be observed to ensure safe operation of the drive.

- A maximum of 14 DRIVE-CLiQ nodes can be connected to one DRIVE-CLiQ line at a Control Unit, e.g. 12 U/f axes + 1 Infeed Module + 1 additional module. In the example below, the DRIVE-CLiQ line includes drive objects 1 to 14.
- A maximum of 8 Motor Modules may be connected to one Control Unit. For multi-axis modules, each axis counts individually (1 Double Motor Module = 2 Motor Modules). Exception: For U/f control it is permissible to connect a maximum of 12 Motor Modules.
- With vector U/f control, it is only permissible to connect more than 4 participants to one DRIVE-CLiQ line of the Control Unit.
- Ring wiring of components is not permitted.

- Double wiring of components is not permitted.

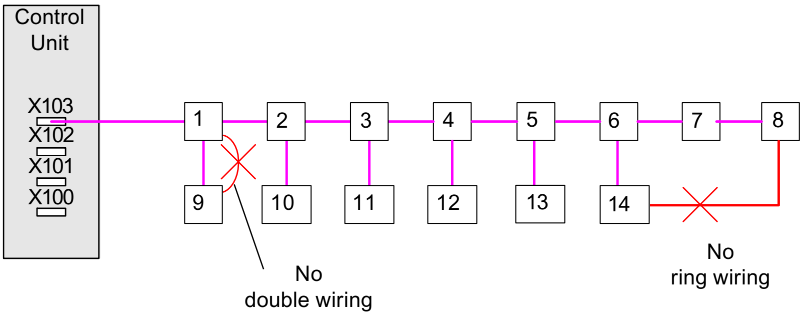


Figure 1-2 Example: DRIVE-CLiQ line connected to the X103 DRIVE-CLiQ connection of a Control Unit

- DRIVE-CLiQ components of unknown type within a topology are functionally not supported. The DRIVE-CLiQ signals are looped through.
  The following criteria denote the unknown type:
  - Characteristics of the component are not available.
  - A deputy drive object is not defined.
  - An assignment of the component to a known drive object (DO) is not defined.
- In a DRIVE-CLiQ topology with a CU link and DRIVE-CLiQ connections, precisely one Control Unit is permissible as a CU Link master/DRIVE-CLiQ master.
- If a CU link connection is detected, the DRIVE-CLiQ basic clock cycle 0 (r0110[0]) is set to 125 µs and assigned to this DRIVE-CLiQ socket.
- The following applies for booksize format:
  - In the servo control, vector control and U/f control operating modes, only one Line Module may be connected to the Control Unit.
  - It is permissible that one Line Module and Motor Modules are connected together to one DRIVE-CLiQ line in servo control.
  - One Line Module and Motor Modules must be connected to separate DRIVE-CLiQ lines in vector control.
  - For booksize format, a parallel connection of Line Modules or Motor Modules is not possible.
- The following applies for chassis format:
  - Line Modules (Active Line, Basic Line, Smart Line) and Motor Modules must be connected to separate DRIVE-CLiQ lines.

- Parallel operation of power units in chassis format:
  - A parallel connection of Infeed Modules as well as Motor Modules is only permitted for vector control or for V/f control.
  - A maximum of 4 Infeed Modules are permissible within a parallel connection.
  - A maximum of 4 Motor Modules are permissible within a parallel connection.
  - Precisely one parallel connection of Motor Modules is permitted. For a parallel connection, precisely one drive object is created in the topology.
- For a parallel connection of Motor Modules, only one motor with integrated DRIVE-CLiQ interface (SINAMICS Sensor Module Integrated) is permitted for each Motor Module.
- Switchover between different motors is not permitted for a parallel connection.
- Mixed operation of Infeed Modules or Motor Modules:
  - The operation of Infeed Modules or Motor Modules with different performance values is not permitted within a parallel connection.
  - For Line Modules in chassis format, two parallel connections are permissible for mixed operation of Smart Line Modules and Basic Line Modules.
  - The following combinations of Line Modules are not permissible:
Active Line Module (ALM) with Basic Line Module (BLM)
Active Line Module (ALM) with Smart Line Module (SLM)
- Mixed operation of formats:
  - Combining small power units (400V; >250kW) and large power units (500 - 690V) to a DriveCLiQ line results in current derating as a result of the pulse frequency adaptation. Chassis Motor Modules and booksize Motor Modules must therefore be connected to separate DRIVE-CLiQ lines.
- Mixed operation of control types:
  - Mixed operation of servo control and vector control is not permissible.
  - Mixed operation of servo control and U/f control is permissible.
  - Mixed operation of vector control and U/f control is permissible.
- Mixed operation of control cycles:
The following combinations are permissible:
  - Servo control with 62.5 µs and servo control with 125 µs
  - Servo control with 125 µs and servo control with 250 µs
  - Vector control with 250 µs and vector control with 500 µs
- Operation with Voltage Sensing Module (VSM):
  - If the function module for line infeed is activated, then a second or third Voltage Sensing Module (VSM) can be connected to a Line Module.
  - The VSM must be connected to a free DRIVE-CLiQ socket of the associated Line Modules or Motor Modules (to support automatic assignment of the VSM).

- At a drive object "SERVO" or "VECTOR", up to three encoder data sets can be created for each drive data set. The maximum number of encoder data sets depends on the quantity structure and the current controller clock cycle:
  - For a quantity structure of 6 axes in servo control with a controller cycle of 125 μs and one Line Module, it is permissible to connect a maximum of 12 encoders.
  - For 5 axes in servo control with a current controller cycle of 125 μs, a maximum of 15 encoders can be connected.
- A maximum of 24 drive objects (DOs) can be connected.
- At the CU320-2 Control Unit, a maximum of 16 Terminal Modules can be connected. Note: If a TM15 Base, TM31, TM54F or a TM41 is connected, it is necessary to reduce the number of connected standard axes.
- At the CU310-2 Control unit a maximum of 8 Terminal Modules, type TM15 Base and TM31 can be connected.
- At the CU310-2 Control Unit, a maximum of 3 Terminal Modules, type TM15, TM17 or TM41 can be connected.
- Cycle times with TM31
  A maximum of 3 Terminal Modules 31 (TM31) can be connected for a 2 ms time slice.
- The communication basic clock cycles (p0115[0] and p4099) of all components that are connected to a DRIVE-CLiQ line must be divisible by one another with an integer result.
  - The smallest communication basic clock cycle is 125 μs.
  - The exception are a maximum of 3 servo-controlled axes with 62.5 μs communication basic clock cycle or a servo-controlled axis with 31.25 μs communication basic clock cycle.
- For current controller clock cycles T_i < 125 μs, the Motor Modules – also with the same controller clock cycle – must be symmetrically connected to two DRIVE-CLiQ ports.
- The fastest sampling time of a drive object in the servo control mode is obtained as follows:
  - T_i = 31.25 μs: Exactly 1 drive object in servo control (only CU320-2)
  - T_i = 62.5 μs: Max. 3 drive objects in servo control with CU320-2
    Exactly 1 drive object in servo control with CU310-2
  - T_i = 125 μs: Max. 6 drive objects in servo control
- The fastest sampling time of a drive object in vector control mode is obtained as follows:
  - T_i = 250 μs: Max. 3 drive objects in vector control
  - T_i = 400 μs: Max. 5 drive objects in vector control
  - T_i = 500 μs: Max. 6 drive objects in vector control
- The fastest sampling time of a drive object in vector U/f vector control mode is given as:
  - T_i = 500 μs: Max. 12 drive objects in U/f control mode

- The maximum number of DRIVE-CLiQ nodes on a DRIVE-CLiQ line of the Control Unit 320-2 depends on the basic clock cycle of the DRIVE-CLiQ line:
  - For a current controller cycle of 31.25 µs, a maximum of 3 DRIVE-CLiQ nodes are permissible
  - For a current controller cycle of 62.5 µs, a maximum of 5 DRIVE-CLiQ nodes are permissible
  - For a current controller cycle of 125 µs, a maximum of 14 DRIVE-CLiQ nodes are permissible
  - For a current controller cycle of 250 µs, a maximum of 20 DRIVE-CLiQ nodes are permissible
  - For a current controller cycle of 500 µs, a maximum of 30 DRIVE-CLiQ nodes are permissible
- The maximum number of DRIVE-CLiQ nodes on a DRIVE-CLiQ line of the Control Unit 310-2 depends on the basic clock cycle of the DRIVE-CLiQ line:
  - From a current controller cycle of 125 µs, a maximum of 8 DRIVE-CLiQ nodes are permissible
- Examples, CU320-2 with 62.5 µs sampling time:
  - Topology 1: 1 x ALM (250 µs) + 2 x servo (62.5 µs) + 2 x servo (125 µs) + 3 x TM15 + TM54F + 4 x Safety Integrated Extended Functions with encoder SI Motion monitoring clock cycle (p9500) = 12 ms + SI Motion actual value sensing clock cycle (p9511) = 4 ms + 4 x dir. measuring systems
  - Topology 2: 1 x ALM (250 µs) + 2 x servo (62.5 µs) + 2 x U/f (500 µs) + 3 x TM15 Base 2 ms +2 x Safety Integrated Extended Functions with encoder SI Motion monitoring clock cycle (p9500) = 12 ms + SI Motion actual value sensing clock cycle (p9511) = 4 ms + 2 x Safety Integrated Extended Functions sensorless + 2 x dir. measuring systems
  - Topology 3: 1 x servo (62.5 µs) + 4 x U/f is not possible in connection with Safety Integrated.
- Example, CU320-2 with 31.25 µs sampling time:
  - Topology 1: 1 ALM (250 µs) on a line, 1 x servo (31.25 µs) on a line, 3 Terminal Modules on a line and in series
  - Topology 2: 1 ALM (250 µs) on a line, 1 x servo (31.25 µs) on a line, 1 direct measuring system on a line
- If the current controller sampling time T_i at one drive object has to be changed in a sampling time that does not match the other drive objects in the DRIVE-CLiQ line, the following solutions are available:
  - Insert the modified drive object into a separate DRIVE-CLiQ line.
  - Modify the current controller sampling times and/or the sampling times of the inputs/outputs of the other drive objects in the same way, so that they match the modified sampling time again.

- Only components that have the same sampling time may be connected to DRIVE-CLiQ connections with a sampling time of T_i = 31.25 µs.
  The following components are permissible:
  - Sensor Modules
  - High-frequency damping modules (HF damping modules)
  - Active Line Modules Booksize in the line of the HF filter module
  - Smart Line Modules Booksize in the line of the HF filter module
  - Additional DRIVE-CLiQ lines must be used for additional components:
    Additional Motor Modules in servo control, in vector control, in U/f control or Terminal Modules.
- Connection of the following components is not permissible for a sampling time of T_i = 31.25 µs:
  - Additional Motor Modules in servo control
  - Additional Motor Modules in U/f control
  - When using a 310-2 Control Unit
- Rules for using a TM54F:
  - A TM54F must be connected directly to a Control Unit via DRIVE-CLiQ.
  - Only one TM54F Terminal Module can be assigned to each Control Unit.
  - Additional DRIVE-CLiQ nodes can be operated at the TM54F, such as Sensor Modules and Terminal Modules (excluding an additional TM54F). It is not permissible that Motor Modules and Line Modules are connected to a TM54F.
  - In the case of a CU310-2 Control Unit, it is not possible to connect the TM54F to the DRIVE-CLiQ line of a Power Module. The TM54F can only be connected to the sole DRIVE-CLiQ X100 socket of the Control Unit.
- A maximum of 4 Motor Modules with Safety Extended Functions may be operated on one DRIVE-CLiQ line (only for T_I = 125 µs). Additional DRIVE-CLiQ components may not be connected to this DRIVE-CLiQ line.
- If an axis has only one encoder, and if Safety functions are activated for this axis, then this encoder may be connected to the Motor Module or to the Hub Module DMC20 only.
- The following applies to the DRIVE-CLiQ connection of CX/NX components to a Control Unit:

  The connection to the Control Unit is obtained from the PROFIBUS address of the CX/NX (10 → X100, 11 → X101, 12 → X102, 13 → X103, 14 → X104, 15 → X105).
- It is not permissible to combine SIMOTION Master Control Units and SINUMERIK Slave Control Units.
- It is not permissible to combine SINUMERIK Master Control Units and SIMOTION Slave Control Units.

For the CU310-2 Control Unit the following applies:

- The CU310-2 is a 1-axis control module that is plugged on to a PM340 Power Module
- The connection to Power Modules in the chassis format is established via the DRIVE-CLiQ connection X100.
- The minimum current controller clock cycle that can be selected both for plug-on operation as well as via the DRIVE-CLiQ connection X100, is 62.5 μs.
- A current controller clock cycle of 31.25 μs is not possible.

1.5.3 Recommended DRIVE-CLiQ rules

To enable the function "Automatic configuration" to assign the encoders to the drives, the recommended rules below must also be observed:

- The following applies to all DRIVE-CLiQ components with the exception of the Control Unit: The DRIVE-CLiQ sockets Xx00 are DRIVE-CLiQ inputs, the other DRIVE-CLiQ sockets are outputs.
- A single Line Module should be connected directly to the X100 DRIVE-CLiQ socket of the Control Unit.
  - Several Line Modules should be connected in a line.
  - If the X100 DRIVE-CLiQ socket is not available, the next higher DRIVE-CLiQ socket should be used.
- For a current controller cycle of 31.25 μs, a filter module should be directly connected to a DRIVE-CLiQ socket of the Control Unit.
- For the chassis format, Motor Modules with a current controller cycle of 250 μs should be connected to DRIVE-CLiQ socket X101 of the Control Unit. If required, they should be connected in a line.
  - If the DRIVE-CLiQ socket X101 is not available, the next higher DRIVE-CLiQ socket should be used for these Motor Modules.
- For the chassis format, Motor Modules with a current controller cycle of 400 μs should be connected to DRIVE-CLiQ socket X102 of the Control Unit. If required, they should be connected in a line.
  - If the DRIVE-CLiQ socket X102 is not available, the next higher DRIVE-CLiQ socket should be used for these Motor Modules.
- Motor Modules in the chassis format with different pulse frequencies (frame sizes FX, GX, HX, JX) should be connected to separate DRIVE-CLiQ lines.
- Line Modules and Motor Modules in the chassis format should be connected to separate DRIVE-CLiQ lines.
- Peripheral components (e.g. Terminal Module, TM) should be connected to DRIVE-CLiQ socket X103 of the Control Unit in a line.
  - If the DRIVE-CLiQ socket X103 is not available, any free DRIVE-CLiQ socket can be selected for the peripheral components.

- In the servo control mode, Motor Modules in the booksize format should be connected to DRIVE-CLiQ socket X100 on the Control Unit in the line.
  – If the DRIVE-CLiQ socket X100 is not available, the next higher DRIVE-CLiQ socket should be used for these Motor Modules.
- The motor encoders for the first drive of a Double Motor Module should be connected to the associated DRIVE-CLiQ socket X202.
- The motor encoders for the second drive of a Double Motor Module should be connected to the associated DRIVE-CLiQ socket X203.
- The motor encoder should be connected to the associated Motor Module:
  Connecting the motor encoder via DRIVE-CLiQ:
  – Single Motor Module Booksize to terminal X202
  – Double Motor Module Booksize motor X1 to terminal X202 and motor X2 to terminal X203
  – Single Motor Module Chassis to terminal X402
  – Power Module Blocksize with CUA31: Encoder to terminal X202
  – Power Module blocksize with CU310-2: Encoder to terminal X100 or via TM31 to X501
  – Power Module Chassis to terminal X402

Note

Automatically assigning an additional encoder

If an additional encoder is connected to a Motor Module, it is assigned to this drive as encoder 2 in the automatic configuration.

- DRIVE-CLiQ sockets should, as far as possible, be symmetrically wired.
  Example: Do not connect 8 DRIVE-CLiQ nodes in series at one DRIVE-CLiQ socket of the CU - but instead, connect 2 nodes at each of the 4 DRIVE-CLiQ sockets.
- The DRIVE-CLiQ cable from the Control Unit should be connected to DRIVE-CLiQ socket X200 on the first booksize power unit or X400 on the first chassis power unit.
- The DRIVE-CLiQ connections between the power units should each be connected from the DRIVE-CLiQ sockets X201 to X200 and/or X401 to X400 on the follow-on component.

- A Power Module with the CUA31 should be connected to the end of the DRIVE-CLiQ line.

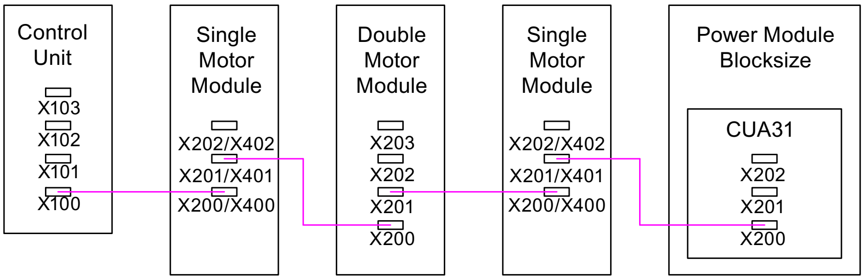


Figure 1-3 Example: DRIVE-CLiQ line

- Only one final node should be connected to free DRIVE-CLiQ sockets of components within a DRIVE-CLiQ line (e.g. Motor Modules wired in series), for example, one Sensor Module or one Terminal Module, without routing to additional components.
- If possible, Terminal Modules and Sensor Modules of direct measuring systems should not be connected to the DRIVE-CLiQ line of Motor Modules, but rather, to free DRIVE-CLiQ sockets of the Control Unit.
  Note: This restriction does not apply to star-type connections.
- The TM54F should not be operated on the same DRIVE-CLiQ line as Motor Modules.
- The Terminal Modules TM15, TM17 and TM41 have faster sample cycles than the TM31 and TM54F. For this reason, the two Terminal Module groups should be connected to separate DRIVE-CLiQ lines.
- For mixed operation of the servo control and vector U/f control operating modes, separate DRIVE-CLiQ lines should be used for the Motor Modules.
  – A combination of operating modes is not possible on a Double Motor Module.
- The Voltage Sensing Module (VSM) should be connected to the DRIVE-CLiQ socket X202 (booksize format) or X402 (chassis format) of the Line Module.
  – If the X202/X402 DRIVE-CLiQ sockets are not available, a free DRIVE-CLiQ socket of the Line Module should be used.

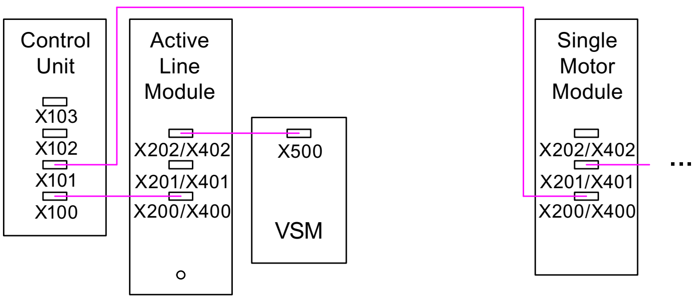


Figure 1-4 Example of a topology with VSM for booksize and chassis components

1.5.4 Notes on the number of controllable drives

The number and type of controlled axes and the additionally activated functions can be scaled by configuring the firmware. Especially for demanding configurations, drives with high dynamics or a large number of axes with additional utilization of special functions for example, a check using the SIZER engineering tool is recommended. The SIZER engineering tool calculates the feasibility of the project.

The maximum possible functionality depends on the performance of the Control Unit used and the components configured.

1.5.4.1 System sampling times and number of controllable drives

This chapter lists the number of axes that can be operated with a Control Unit. The number of axes depends on the cycle times and the control mode. The other available remaining computation times are available for options (e.g. DCC).

Cycle times for servo control

This following table lists the number of axes that can be operated with a Control Unit in the servo control mode. The number of axes is also dependent on the cycle times of the controller:

Table 1- 5 Sampling time setting for servo control

Cycle times [µs]		Number		Motor / dir. measuring systems	TM[1)]/TB
Current controller	Speed controller	Axes	Infeed		
125	125	6	1 [250 µs]	6 / 6	3 [2000 µs]
62,5	62,5	3	1 [250 µs]	3 / 3	3 [2000 µs]
31,25[2)]	31,25[2)]	1	1 [250 µs]	1 / 1	3 [2000 µs]

[1)] Valid for TM31 or TM15IO; for TM54F, TM41, TM15, TM17, TM120, TM150 - restrictions are possible dependent on the set sampling time.

[2)] At the 31.25 µs cycle level you can additionally setup the following objects:

- Sensor Module External (SME) and the SMC20 supported with the current firmware and hardware. These can be identified by the final digit of the order number ... 3.
- No additional axis can be operated at this cycle level.

The following combinations are permissible for current controller cycle mixed operation:

- Servo control with 125 µs and servo control with 250 µs (max. 2 clock cycle levels can be mixed)
- Servo control with 62.5 µs and servo control with 125 µs (max. 2 clock cycle levels can be mixed)

Note the following: 1 axis with 31.25 µs corresponds to

- 2 servo control axes with 62.5 µs
- 4 servo control axes with 125 µs
- 8 U/f control axes with 500 µs

Cycle times for vector control

This following table lists the number of axes that can be operated with a Control Unit in the vector control mode. The number of axes is also dependent on the cycle times of the controller:

Table 1- 6 Sampling time setting for vector control

Cycle times [µs]		Number		Motor / dir. measuring systems	TM[1)]/TB
Current controller	Speed controller	Axes	Infeed[2)]		
500 µs	2000 µs	6	1 [250 µs]	6 / 6	3 [2000 µs]
400[3)] µs	1600 µs	5	1 [250 µs]	5 / 5	3 [2000 µs]
250 µs	1000 µs	3	1 [250 µs]	3 / 3	3 [2000 µs]

[1)] Valid for TM31 or TM15IO; for TM54F, TM41, TM15, TM17, TM120, TM150 - restrictions are possible dependent on the set sampling time.

[2)] For power units in chassis format, the infeed cycle depends on the power rating of the module and can be 400 µs, 375 µs or 250 µs.

[3)] This setting results in lower remaining computation times.

In closed-loop vector control, current controller cycles can be mixed with 250 µs and 500 µs.

Note

Restriction for the chassis format

If edge modulation and wobbling are activated simultaneously with p1802 ≥ 7 and p1810.2 = 1 respectively, the quantity structure for vector control is halved. Then a maximum of 3 axes at a current control cycle of 500 µs, 2 axes at 400 µs or 1 axis at 250 µs are permissible.

Cycle times for U/f control

This following table lists the number of axes that can be operated with a Control Unit in the U/f control mode. The number of axes is dependent on the current controller clock cycle:

Table 1- 7 Sampling time setting for U/f control

Cycle times [µs]		Number		Motor / dir. measuring systems	TM/TB
Current controller	Speed controller	Drives /	Infeed		
500	2000	12	1 [250 µs]	- / -	3 [2000 µs]

Mixed operation of servo control and U/f open-loop control

In mixed operation with servo control and U/f control, one axis in servo control at 125 µs uses exactly as much computing performance as two axes in U/f control at 500 µs. In conjunction with servo control, a maximum of 11 axes are permitted (1 servo control plus 10 vector control U/f).

Table 1- 8 Number of axes for mixed servo control operation

Number of axes in servo control				Number of axes in U/f control	
6	125 µs	3	62.5 µs	0	
5	125 µs			2	500 µs
4	125 µs	2	62.5 µs	4	500 µs
3	125 µs			6	500 µs
2	125 µs	1	62.5 µs	8	500 µs
1	125 µs			10	500 µs
0		0		12	500 µs

Mixed operation of vector control and U/f open-loop control

In mixed operation with vector control and U/f control, one axis in vector control at 250 µs uses exactly as much computing performance as two axes in U/f control at 500 µs. In conjunction with vector control, a maximum of 11 axes are permitted (1 vector control plus 10 U/f control).

Table 1- 9 Number of axes for mixed vector control operation

Number of axes in vector control				Number of axes in U/f control	
6	500 µs	3	250 µs	0	
5	500 µs			2	500 µs
4	500 µs	2	250 µs	4	500 µs
3	500 µs			6	500 µs
2	500 µs	1	250 µs	8	500 µs
1	500 µs			10	500 µs
0		0		12	500 µs

Cycle times of the CU310-2 in the servo control mode

Table 1- 10 Sampling time setting for servo control

Cycle times [µs]		Number		Via DQ[2]	Snapped-on	TM[1]/TB
Current controller	Speed controller	Axes	Infeed	Motor Module	Power Module	
125	125	1	-	-	1	3 [2000 µs]
62,5	62,5	1	-	-	1	3 [2000 µs]

[1] Valid for TM15, TM17 or TM41; for TM54F, TM31, TM120, TM150 - restrictions are possible dependent on the set sampling time.

[2] DQ = DRIVE-CLiQ

If the 310-2 Control Unit is snapped on to a PM340 Power Module, a minimum current controller clock cycle of 62.5 µs is possible.

Using DCC

The available remaining computation time can be used for DCC. In this case, the following supplementary conditions apply:

- For a 2 ms time slice, a max. of 75 DCC blocks can be configured for each servo control axis with 125 µs that can be omitted/eliminated (≙ 2 U/f axes with 500 µs).
- 50 DCC blocks for 2 ms time slice correspond to 1.5 U/f axes with 500 µs.

Detailed information about handling and using DCC standard blocks is provided in the "SINAMICS/SIMOTION Editor description DCC" manual.

Using EPOS

The following table lists the number of axes that can be operated with a SINAMICS S120 when using a basic positioning system (EPOS). The number of axes is dependent on the current controller clock cycle.

Table 1- 11 Sampling times when using EPOS

Cycle times [µs]		Cycle times [ms]		Number	
Current controller	Speed controller	Position controller	Positioner	Axes	Infeed
250	250	2	8	6	1 [250 µs]
250	250	1	4	5	1 [250 µs]
125	125	1	4	4	1 [250 µs]

The CPU processing time required for the function module EPOS (with 1 ms position controller/4 ms positioner) corresponds to the same CPU processing time of 0.5 U/f axes with 500 µs.

Using CUA31/CUA32

Information on using the Control Unit Adapter CUA31 or CUA32:

- CUA31/32 is the first component in the CUA31/32 topology: 5 axes
- CUA31/32 is **not** the first component in the CUA31/32 topology: 6 axes
- For a current controller cycle of 62.5 μs, only 1 axis is possible with one CUA31/32.

1.5.4.2 Optimizing DRIVE-CLiQ

Symmetrical distribution for the controller clock cycles 62.5 μs and 31.25 μs

For optimum computation times of the Control Unit, the axes must be distributed across the DRIVE-CLiQ connections as follows:

- DRIVE-CLiQ socket X100: Infeed, axes 2, 4, 6, ...
- DRIVE-CLiQ socket X101: Axes 1, 3, 5, ...

The advantage of this arrangement is that the Control Unit always receives 2 measured values simultaneously.

1.5.4.3 Default settings for the sampling times

When commissioning for the first time, the current controller sampling times (p0115[0]) are automatically pre-set with factory setting values:

Table 1- 12 Factory settings

Construction type	Number	p0112	p0115[0]	p1800
Active Infeed				
Booksize	1	2 (Low)	250 μs	-
Chassis 400 V / ≤ 300 kW 690 V / ≤ 330 kW	 1 1	 2 (Low) 2 (Low)	 250 μs 250 μs	 - -
Chassis 400 V / > 300 kW 690 V / > 330 kW	 1 1	 0 (Expert) 1 (xLow)	 375 μs (p0092 = 1) 400 μs (p0092 = 0)	 - -
Smart Infeed				
Booksize	1	2 (Low)	250 μs	-
Chassis 400 V / ≤ 355 kW 690 V / ≤ 450 kW	 1 1	 2 (Low) 2 (Low)	 250 μs 250 μs	 - -
Chassis 400 V / > 355 kW 690 V / > 450 kW	 1 1	 0 (Expert) 1 (xLow)	 375 μs (p0092 = 1) 400 μs (p0092 = 0)	 - -
Basic Infeed				
Booksize	1	4 (High)	250 μs	-
Chassis	1	2 (Low)	2000 μs	-

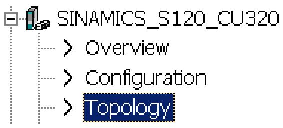
Construction type	Number	p0112	p0115[0]	p1800
SERVO				
Booksize	1 to 6	3 (Standard)	125 µs	4 kHz
Chassis	1 to 6	1 (xLow)	250 µs	2 kHz
Blocksize	1 to 5	3 (Standard)	125 µs	4 kHz
VECTOR				
Booksize	1 to 3 only n_ctrl 1 to 6 only U/f	3 (Standard)	250 µs	4 kHz
Chassis 400 V / ≤ 250 kW				2 kHz
Booksize	4 to 12	0 (Expert)	500 µs	4 kHz
Chassis 400 V / ≤ 250 kW				2 kHz
Chassis > 250 kW 690 V	1 to 4 only n_ctrl 1 to 5 only U/f 1 to 6 only n_ctrl	0 (Expert) 1 (xLow) 0 (Expert)	375 µs (p0092 = 1) 400 µs (p0092 = 0) 500 µs (p0092 = 1)	1.333 kHz 1.25 kHz 2 kHz

Note

If a Power Module in blocksize format is connected to a Control Unit, the sampling times of all vector drives are set according to the rules for Power Modules in blocksize format (only 250 µs or 500 µs possible).

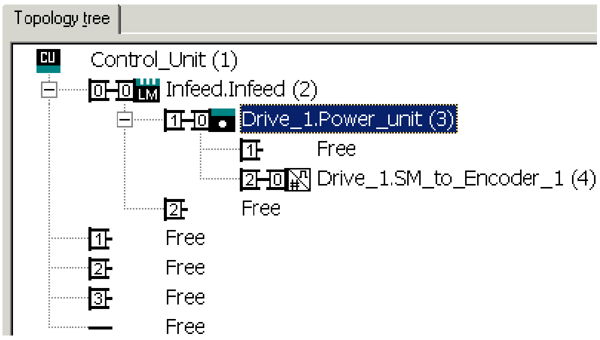
1.5.5 Changing the offline topology in the STARTER commissioning tool

The device topology can be changed in the STARTER commissioning tool by shifting the components in the topology tree.

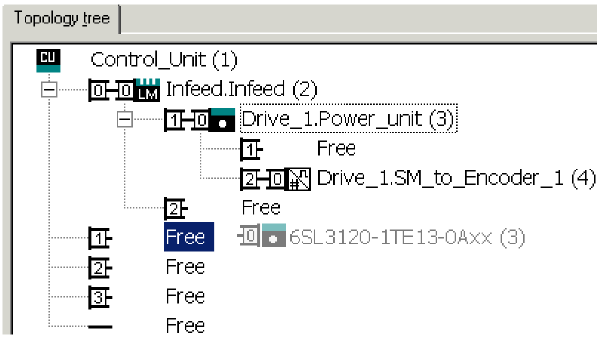


Example: Changing the DRIVE-CLiQ topology

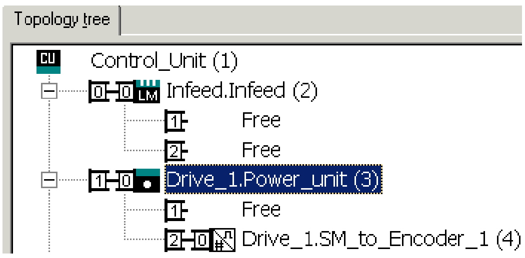
1. Select the DRIVE-CLiQ component.



2. While holding down the mouse button, drag the component to the required DRIVE-CLiQ interface and release the mouse button.



You have changed the topology in the STARTER commissioning tool.



1.5.6 Modular machine concept: Offline correction of the reference topology

The topology is based on a modular machine concept. The machine concept is created offline in the STARTER commissioning tool in the maximum version as reference topology.

The maximum version is the maximum expansion of a particular machine type. In the maximum version, all the machine components that can be used are pre-configured in the reference topology.

Deactivating components / handling non-existent components

In a lower expansion stage of the machine, you must mark drive objects and encoders that are not used in the STARTER topology. To do this, for the corresponding drive objects and encoder, set parameter p0105 or p0145 = 2 (deactivate component and does not exist). Components set to the value "2" in a project generated offline must never be inserted in the actual topology at all.

If a component fails, the sub-topology can also be used to allow a machine to continue to operate until the spare part is available. In this case, however, no BICO source must be interconnected from this drive object to other drive objects.

Example of a sub-topology

The starting point is a machine created offline in the STARTER commissioning tool. "Drive 1" was not implemented for this machine.

1. You can remove drive object "Drive 1" "offline" from the reference topology using p0105 = 2.
2. Change over the DRIVE-CLiQ cable from the Control Unit directly to "Drive 2".
3. Transfer the project with "Download to drive unit".

4. Then execute a "Copy RAM to ROM".

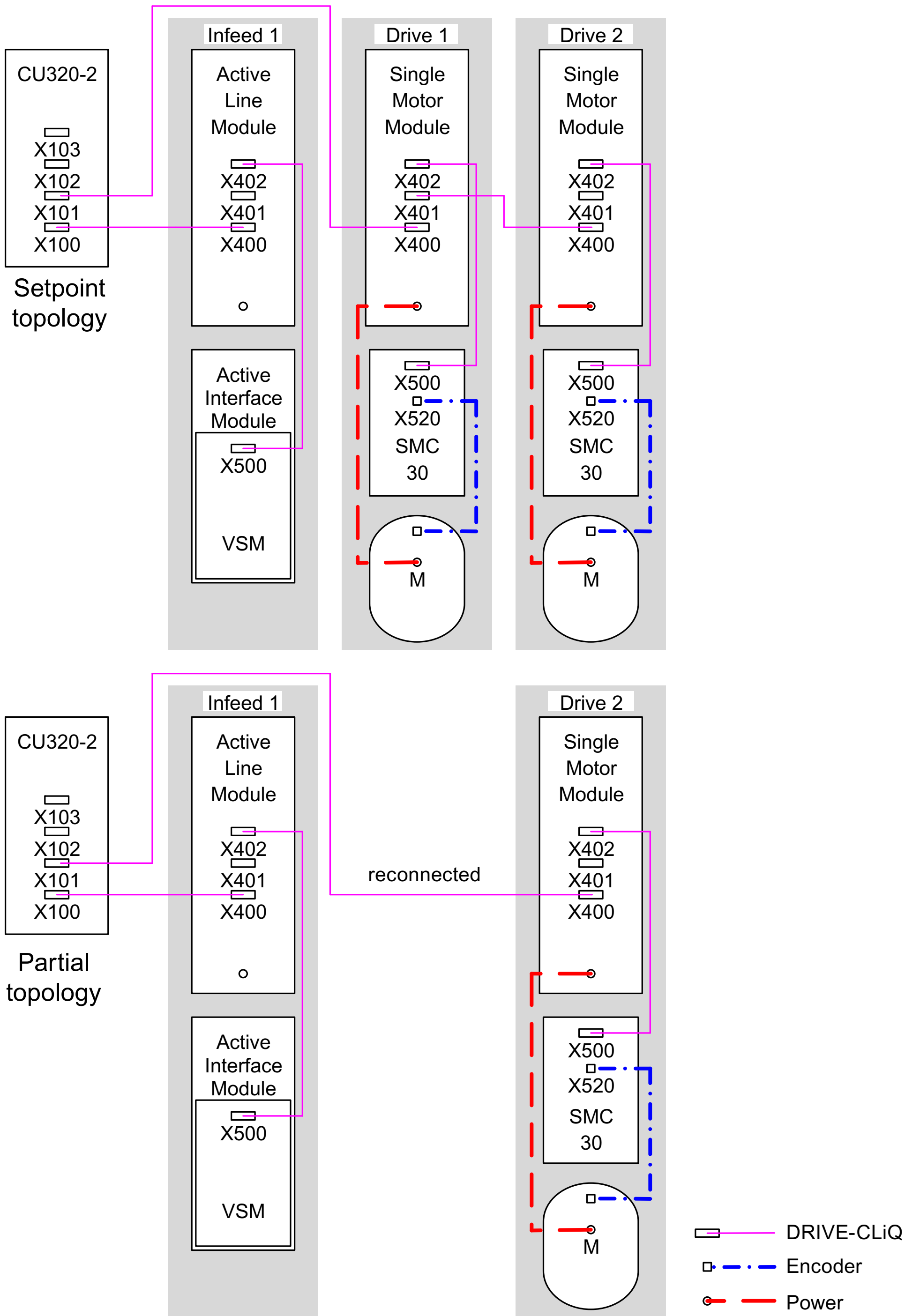


Figure 1-5 Example of a sub-topology

CAUTION

Incorrect SI status

If a drive in a Safety Integrated drive line-up is deactivated using p0105, then r9774 is not correctly output because the signals of the deactivated drive are no longer updated.

Therefore, withdraw the associated drive from the group before deactivating it.
See also: SINAMICS S120 Safety Integrated Function Manual

Activating/deactivating components

Drive objects can be activated/deactivated using parameter p0105 and encoders with p0145[0...n] in the Expert list in the same way. If a component is not required at certain times, then for the component, change parameter p0105 or p0145 from "1" to "0". The deactivated components remain inserted, however, they are deactivated. Errors are not displayed from deactivated components.

Overview of important parameters (see SINAMICS S120/S150 List Manual)

- p0105 Activating/deactivating drive object
- r0106 Drive object active/inactive
- p0125 Activate/deactivate power unit component
- r0126 Power unit components active/inactive
- p0145[0...n] Enable/disable sensor interface
- r0146 Sensor interface active/inactive
- p9495 BICO behavior to de-activated drive objects
- p9496 BICO behavior when activating drive objects
- r9498[0...29] BICO BI/CI parameters to de-activated drive objects
- r9499[0...29] BICO BO/CO parameters to de-activated drive objects
- r9774.0...31 CO/BO: SI Status (group STO)

1.5.7 Topology example: Drives in vector control

Example 1

A drive line-up with three Motor Modules in chassis format with identical pulse frequencies or three Motor Modules in booksize format in vector control mode.

The Motor Modules chassis format with identical pulse frequencies or the Motor Modules booksize format in vector control mode can be connected to one DRIVE-CLiQ interface on the Control Unit.

In the following diagram, three Motor Modules are connected to the DRIVE-CLiQ socket X101.

Note

The offline topology automatically generated in the STARTER commissioning tool must be manually modified, if this topology was wired.

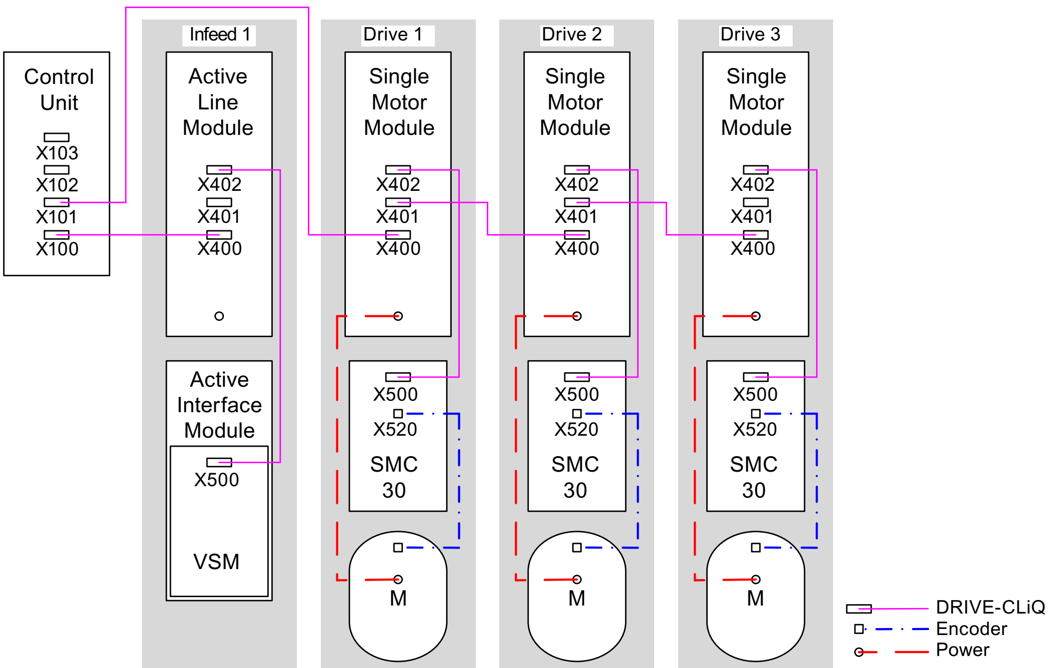


Figure 1-6 Drive line-up (chassis) with identical pulse frequencies

Drive line-up comprising four Motor Modules in the chassis format with different pulse frequencies

It is advantageous to connect Motor Modules with different pulse frequencies to different DRIVE-CLiQ sockets of the Control Unit. They may also be connected at the same DRIVE-CLiQ line.

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

Note

The offline topology automatically generated in the STARTER commissioning tool must be manually modified, if this topology was wired.

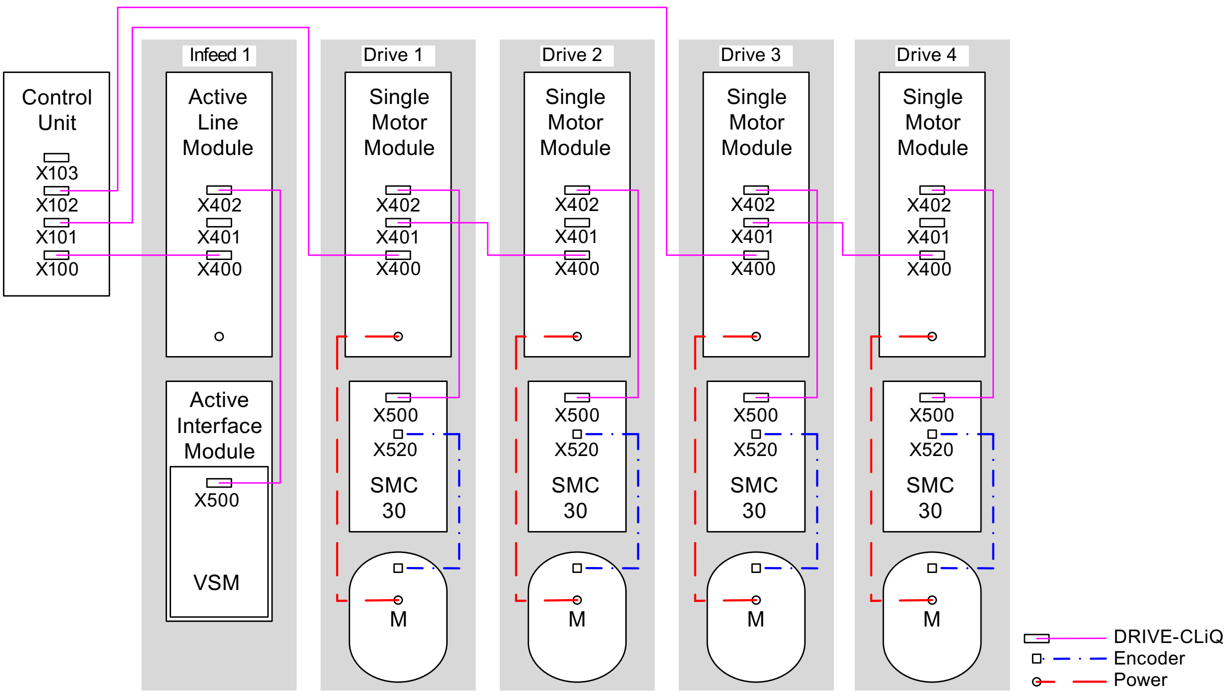


Figure 1-7 Drive line-up in chassis format with different pulse frequencies

1.5.8 Topology example: Parallel Motor Modules in vector control

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

Parallel-connected Line Modules in the chassis format and Motor Modules in the chassis format of the same type can be connected to a DRIVE-CLiQ socket of the Control Unit.

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

You can find additional notes in the chapter "Parallel connection of power units" in the SINAMICS S120 Function Manual.

Note

The offline topology automatically generated in the STARTER commissioning tool must be manually modified, if this topology was wired.

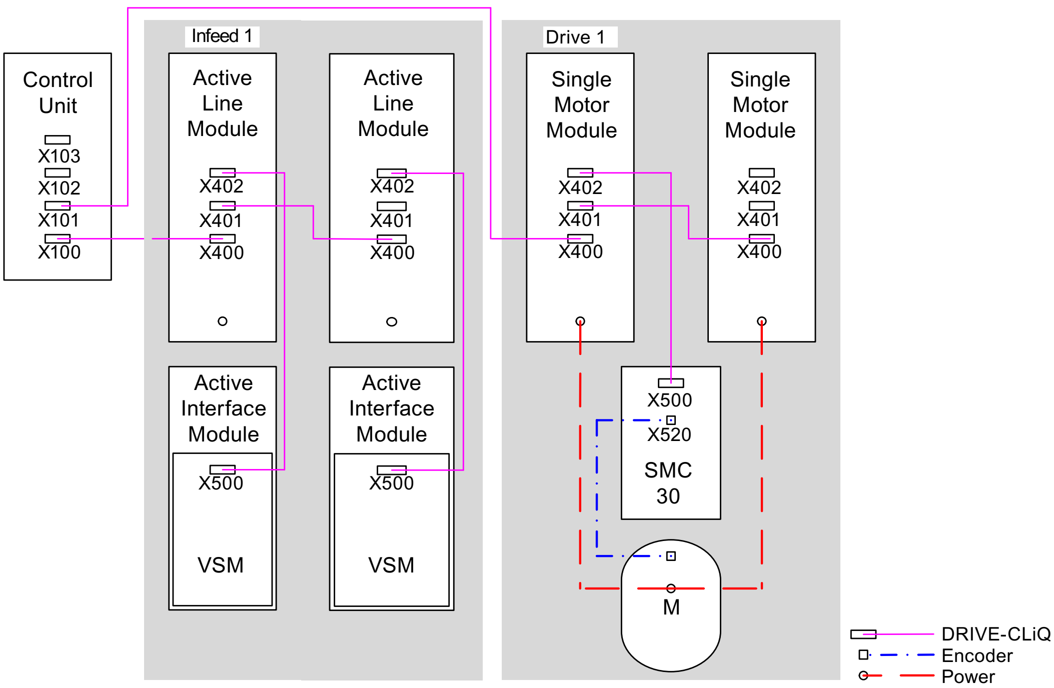


Figure 1-8 Drive line-up with parallel-connected power units in the chassis format

1.5.9 Topology example: Drives in U/f control (vector control)

The following diagram shows the maximum number of controllable vector V/f drives with additional components. The sampling times of individual system components are:

- Active Line Module: p0115[0] = 250 µs
- Motor Modules: p0115[0] = 500 µs
- Terminal Module/Terminal Board p4099 = 2 ms

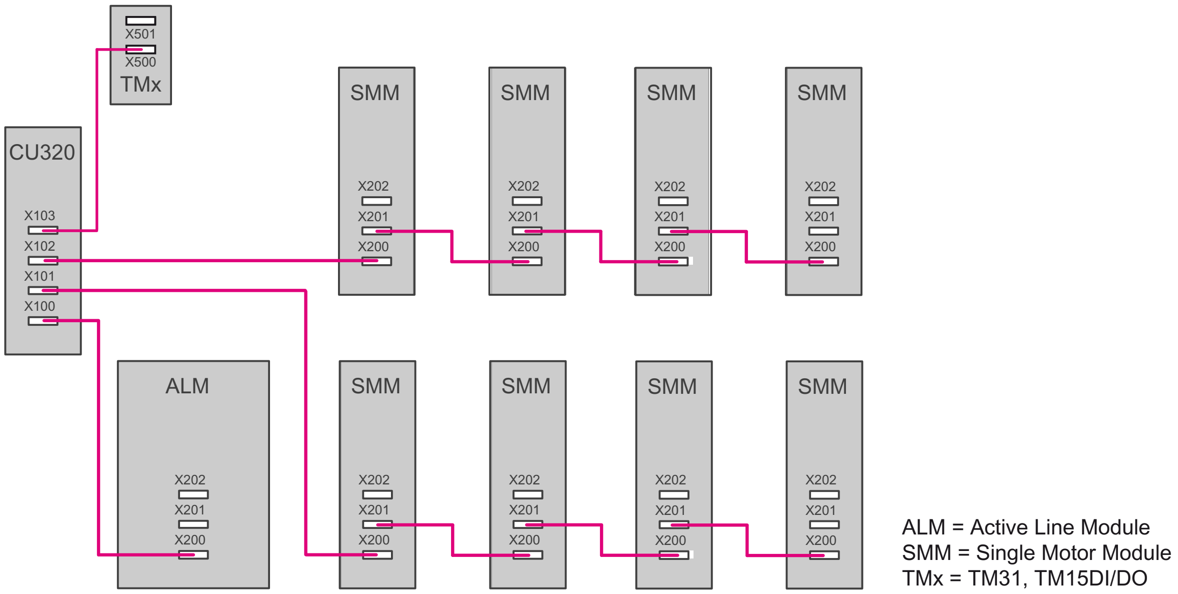


Figure 1-9 Topology example of a vector drive line-up in U/f control

1.5.10 Topology example: Drives in servo control

The following diagram shows the maximum number of controllable SERVO drives and extra components. The sampling times of individual system components are:

- Active Line Module: p0115[0] = 250 µs
- Motor Modules: p0115[0] = 125 µs
- Terminal Module/Terminal Board p4099 = 1 ms

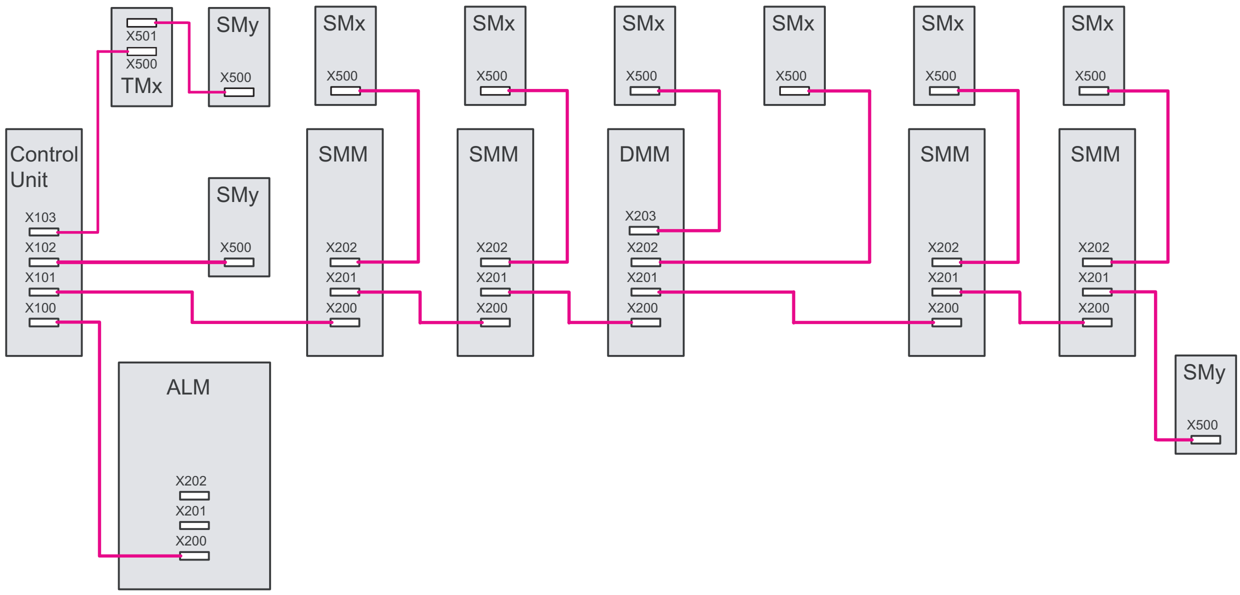


Figure 1-10 Topology example of a SERVO drive line-up

Legend for topology example:
ALM = Active Line Module
SMM = Single Motor Module
DMM = Double Motor Module
SMx = Motor encoder
SMy = Direct measuring system
TMx = TM31, TM15DI/DO, TB30

1.5.11 Topology example: Power Modules

Blocksize

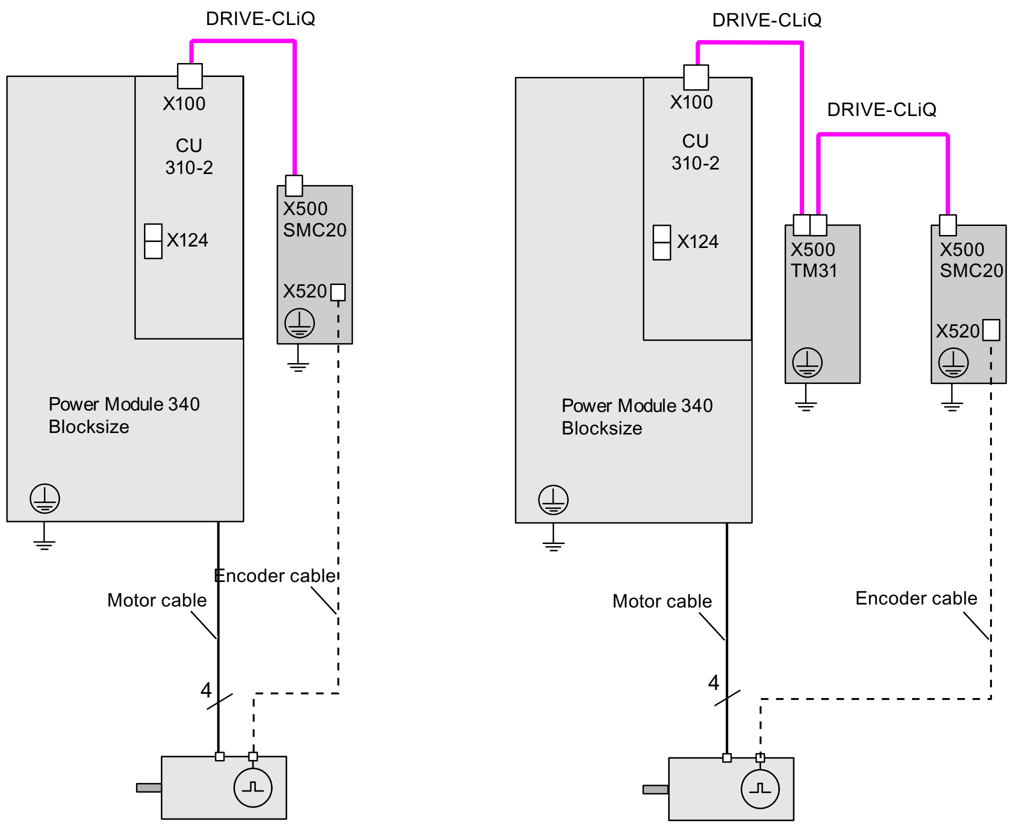


Figure 1-11 Drive line-ups with Power Modules blocksize

Chassis

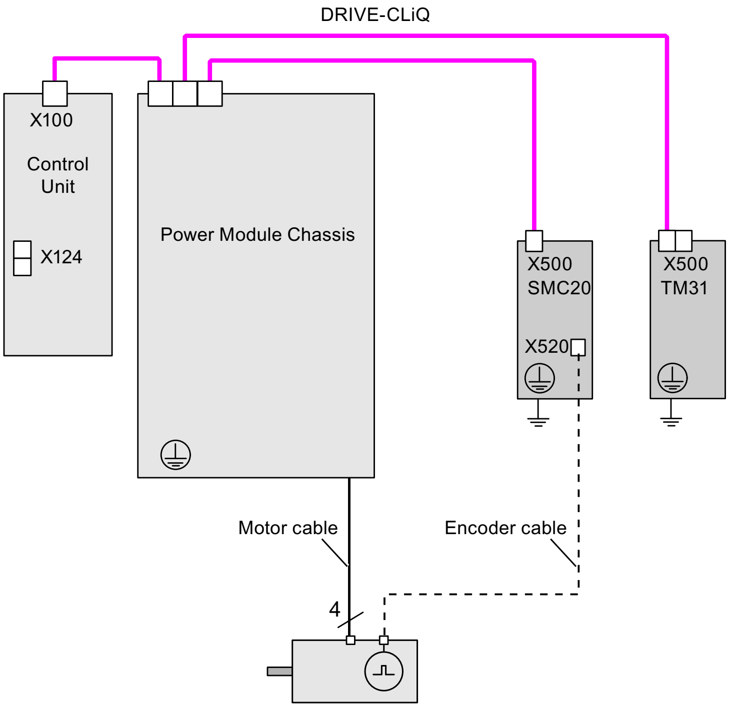
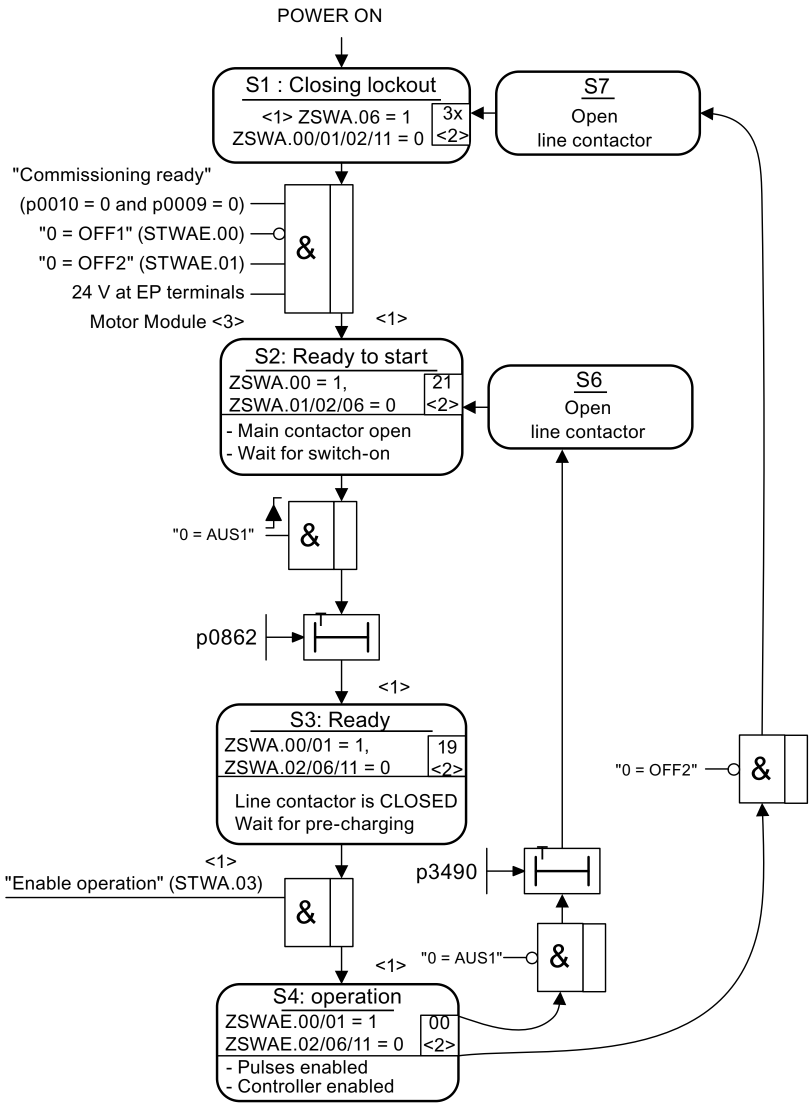


Figure 1-12 Drive line-up of a Power Module chassis

1.6 Powering-up/powering-down the drive system

Powering up the infeed



<1> STWA.xx = control word sequence control bit xx (r0898);
ZSWA.xx = status word sequence control bit xx (r0899).
<2> r0002 = operating display
<3> only required, if "Safe Torque Off (STO)" safety function is activated

Figure 1-13 Powering up the infeed

Powering up the drive

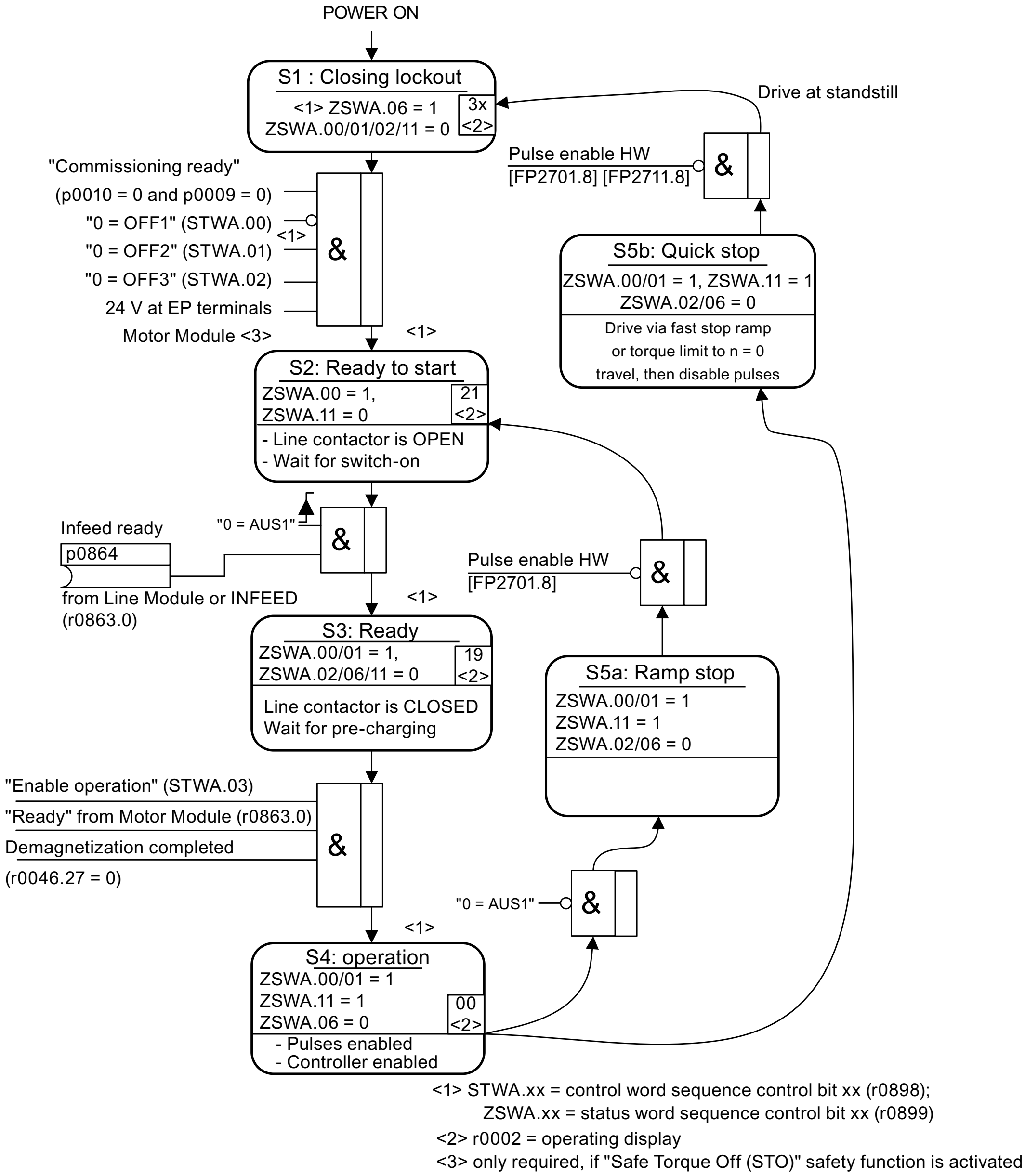


Figure 1-14 Powering up the drive

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 (p1226) or if the monitoring time (p1227) started when the 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.
  - Switching on inhibited 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 (p1226) or if the monitoring time (p1227) started when the speed setpoint ≤ speed threshold (p1226) has expired.
  - Switching on inhibited is activated.

Control and status messages

Table 1- 13 Power-on/power-off control

Signal name	Internal control word	Binector input	PROFIdrive/Siemens telegram 1 ... 352
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 1- 14 Switch-in/switch-out status signal

Signal name	Internal status word	Parameter	PROFIdrive/Siemens telegram 1 ... 352
Ready for switching on	ZSWA.00 ZSWAE.00	r0899.0	ZSW1.0
Ready for operation	ZSWA.01 ZSWAE.01	r0899.1	ZSW1.1
Operation enabled	ZSWA.02 ZSWAE.02	r0899.2	ZSW1.2
Pulse inhibit	ZSWA.06 ZSWAE.06	r0899.6	ZSW1.6
Pulses enabled	ZSWA.11	r0899.11	ZSW2.10 [1)]

[1)] only available in Interface Mode p2038 = 0

Function diagrams (see SINAMICS S120/S150 List Manual)

- 2610 Sequence control - control unit
- 2634 Sequence control - missing enable signals, line contactor control, logic operation
- 8732 Basic Infeed - control unit
- 8832 Smart Infeed - control unit
- 8932 Active Infeed - control unit

Commissioning 2

2.1 Procedure when commissioning

The following steps are required when commissioning a drive:

1. Create project with STARTER.
2. Configure the drive unit in STARTER.
3. Save the project in STARTER.
4. Establish online operation with the target device in STARTER.
5. Load project to target device.
6. The result: the motor turns.

Note

Save motor and encoder data in the non-volatile memory

If motors with integrated DRIVE-CLiQ interface are used, when the Sensor Module is replaced at the motor, all motor and encoder data should be saved in a non-volatile manner by setting parameter p4692 = 1.

⚠ DANGER

Dangerous voltage after switch-off

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

Therefore, please note the information on the component!

Note

Acceptance test required

A project with Safety Integrated can be created offline. However, for commissioning an acceptance test must be performed, which is only possible online.

Note

Updating units only after the project upload

In the STARTER commissioning tool, after the changeover of the axis type via p9302/p9502 and subsequent POWER ON, the units that depend on the axis type are only updated after a project upload.

Note

The installation guidelines and safety instructions in the manuals must be carefully taken into consideration (see SINAMICS S120 Manual Control Units and
Supplementary System Components and SINAMICS S120 Manual, Booksize Power Units).

WARNING

Inadvertent acceleration of individual drives

If several Motor Modules are supplied from a non-regenerative infeed unit (e.g. a Basic Line Module), or for power failure or overload (for SLM/ALM), the Vdc_max control may only be activated for a Motor Module whose drive should have a high moment of inertia.
For the other Motor Modules this function must be disabled or monitoring must be set.
If the Vdc_max control is active for several Motor Modules, then for an unfavorable parameterization, the controllers can mutually influence one another negatively. The drives can become unstable, individual drives can unintentionally accelerate.

- Activating the Vdc_max control:
  - Vector control: p1240 = 1 (factory setting)
  - Servo control: p1240 = 1
  - U/f control: p1280 = 1 (factory setting)
- Inhibiting the Vdc_max control:
  - Vector control: p1240 = 0
  - Servo control: p1240 = 0 (factory setting)
  - U/f control: p1280 = 0
- Activating the Vdc_max monitoring function
  - Vector control: p1240 = 4 or 6
  - Servo control: p1240 = 4 or 6
  - U/f control: p1280 = 4 or 6

2.2 STARTER commissioning tool

The STARTER commissioning tool is used to parameterize and commission drive units from the SINAMICS product family.

The STARTER commissioning tool can be used for the following:

- Commissioning
- Testing (via the control panel)
- Drive optimization
- Diagnostics
- Setting up and activating the safety functions

System prerequisites

You can find the system requirements for the STARTER commissioning tool in the "readme" file in the STARTER installation directory.

2.2.1 General information on STARTER

2.2.1.1 Calling STARTER

Calling the STARTER application

1. Click on the STARTER symbol  of your user interface.

   Or

2. Call the menu command "Start > SIMATIC > STEP 7 > STARTER" in your Windows Start menu.

2.2.1.2 Description of the user interface

You can use the STARTER commissioning tool to create the project. The different areas of the user interface are used for different configuration tasks (refer to diagram below):

- Project navigator: this area displays the elements and objects that can be added to your project.
- Working area: in this area you perform the tasks to create the project:
  - When you are configuring the drive, this area contains the Wizards that help you configure the drive objects.
  - When you configure, for example, the parameters for the speed setpoint filter.
  - When you call up the expert list, the system displays a list of all the parameters that you can view or change.
- Detail view: This area provides detailed information on faults and alarms, for example.

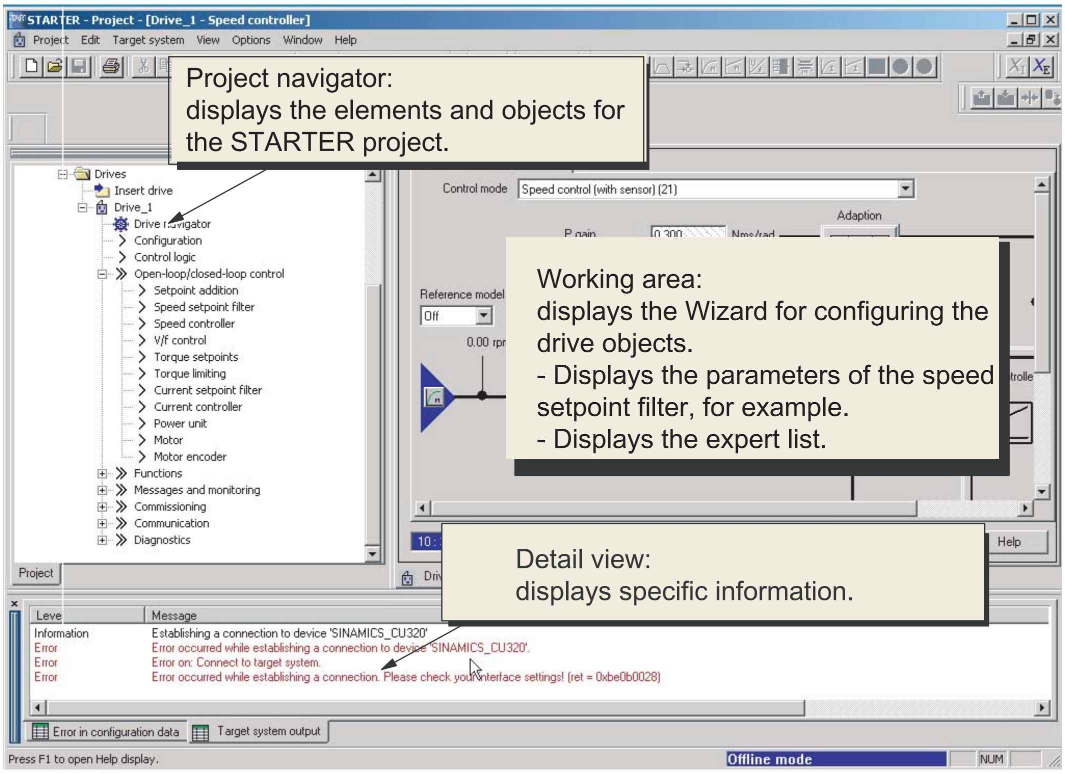


Figure 2-1 The different areas of the STARTER user interface

2.2.2 Important functions in the STARTER commissioning tool

The STARTER commissioning tool offers the following functions to support the project handling:

- Restoring the factory settings
- Various operating wizards
- Configuring and parameterizing drives
- A virtual control panel to rotate the motors
- Run trace functions for drive controller optimization
- Create and copy data records
- Load the project from the programming device to the target device
- Copy volatile data from the RAM to a ROM
- Load the project from the target device to the programming device
- Create and activate safety functions
- Activate write protection
- Activate know-how protection

The programming device is called "PG/PC" in the subsequent text. The Control Unit of the SINAMICS drive system is called the "Target device".

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 memory card is also reset to the factory settings, choose the "Copy from RAM to ROM" function. This function can only be activated in the online mode. You activate the function by:

1. Call the shortcut menu "Drive unit > Target device > Restore factory settings".

   In the following prompt window you can select as to whether you also wish to save the factory setting in the ROM.
2. Click on "OK" to acknowledge.

Operating support using wizards

Wizards are integrated in STARTER for various functions to support operation.

Create data records (offline) and copy

Drive and command data sets (DDS and CDS) can be added in the drive's configuration screen. Click on the appropriate buttons to do this. Before data sets are copied, all the wiring needed for both data sets should be completed.

For more information about data sets, refer to Chapter "Basics of the drive system" in the SINAMICS S120 Function Manual Drive Functions.

Load project to target device.

You can use this function to load the actual project from the programming device into the Control Unit. A consistency check is first made for the project. If inconsistencies are detected, corresponding messages are output. You must resolve the inconsistencies before loading. If the data are consistent, then they will be transferred into the work memory of the Control Unit. In order to execute this function in the online mode, the following operator actions are alternatively available:

1. Select the drive unit and call the menu "Project > Load to target system".

   or

2. Select the drive unit and call the shortcut menu "Target device > Load to target device".

   or

3. Select the drive unit and call the menu "Target system > Load > Load CPU/drive unit to target device...".

   or

4. If the drive unit has a gray background, click on the symbol  "Load CPU/drive unit to target device...".

Retentively saving data

You can use this function to save volatile Control Unit data to the non-volatile memory (memory card). After backing up, the data are also kept if the 24 V Control Unit supply has been switched off. In order to execute this function in the online mode, the following operator actions are alternatively available:

1. Select the drive unit and call the menu "Target system > Copy RAM to ROM".

   or

2. Select the drive unit and call the shortcut menu "Target device > Copy RAM to ROM".

   or

3. If the drive unit has a gray background, click on the symbol  "Copy RAM to ROM".

   or

4. if, after every download into the target device, data is also to be automatically transferred into the non-volatile memory, call the menu "Tools > Settings...".
5. Click the "Download" tab and activate the option "After loading, copy RAM to ROM". Click "OK" to confirm this setting.

Load the project to the PG/PC

You can use this function to load the current Control Unit project to STARTER. This function can only be activated in the online mode. In order to execute this function in the online mode, the following operator actions are alternatively available:

1. Select the drive unit and call the shortcut menu "Target device > Load CPU/drive unit into PG/PC...".

   or

2. Select the drive unit and call the menu "Target system > Load > Load CPU/drive unit to PG...".

   or

3. If the drive unit has a gray background, click on the symbol  "Load CPU/drive unit to PG/PC...".

Create and activate safety functions

To set up, activate and operate the Safety Integrated functions, various screen forms are available in the STARTER commissioning tool wizards. You can access the Safety Integrated Functions online and offline in the project tree.

1. In the project tree, open the following structure: "Drive unit xy > Drives > Drive xy > Functions > Safety Integrated".
2. Double-click the function entry "Safety Integrated".

Note

Additional information about how to use Safety Integrated Functions is provided in the SINAMICS S120 Function Manual Safety Integrated.

Activate write protection

Write protection prevents settings from being inadvertently changed. No password is required for write protection. This function can only be activated in the online mode.

1. Select the required drive unit in the project navigator of your STARTER project.
2. Call the shortcut menu "Write protection drive unit > Activate".

   Write protection is now activated. In the expert list you can recognize that write protection is active by the fact that the entry fields of all adjustable parameters are shown with gray shading.

   In order to permanently transfer your setting, after changing write protection, you must carry out the "RAM to ROM" data save operation.

Activate know-how protection

The "Know-how protection function (KHP)" prevents e.g. strictly confidential company know-how for configuration and parameter assignment from being read. The know-how protection requires a password. The password must comprise at least 1 and a maximum of 30 characters.

1. Select the required drive unit in the project navigator of your STARTER project.

2. Call the shortcut menu "Know-how protection drive unit > Activate".

   The "Activate know-how protection for drive unit" dialog box opens.

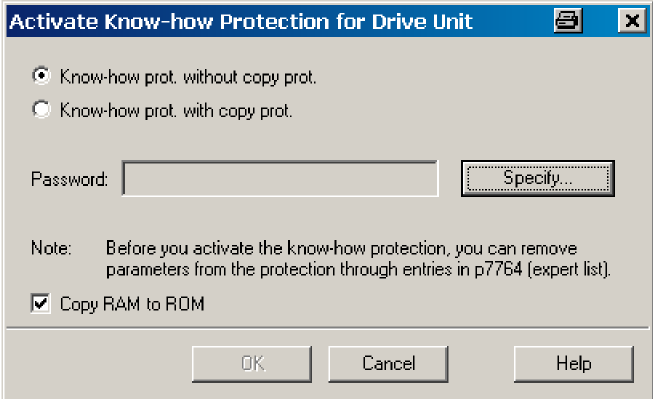


Figure 2-2 Activating know-how protection

3. If you want to activate the copy protection in addition to know-how protection, then click on the "Know-how protection with copy protection" option.
4. Click on "Assign".

   The "Know-how protection for the drive unit - assign password" dialog box opens.

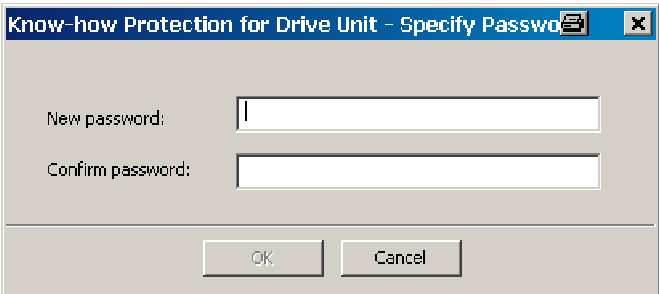


Figure 2-3 Setting the know-how protection password

5. In the "New password" field, enter the password (1 to 30 characters) once. Pay attention to upper and lower case.
6. Re-enter your password in the "Confirm password" box and click "OK" to confirm the entry.

   The dialog box is closed and the password is shown in encrypted form in the "Activate know-how protection for drive unit" dialog box.

   The "Copy RAM to ROM" option is automatically active and ensures that the know-how protection is permanently stored in the Control Unit. If you want to only temporarily activate know-how protection, you can deactivate this option.
7. Click "OK" to confirm the settings you made.

   Know-how protection is now activated. The text "Know-how protected" is in all protected parameters of the expert list instead of the content.

Note

A detailed description of the know-how protection functions is provided in the chapter "Basics of the drive system" in the SINAMICS S120 Function Manual Drive Functions.

2.2.3 Activating online operation: STARTER via PROFIBUS

The programming device (PG/PC), on which the STARTER commissioning tool is activated, is connected to PROFIBUS using a PROFIBUS adapter.

STARTER via PROFIBUS (example with 2 CU320-2 DP)

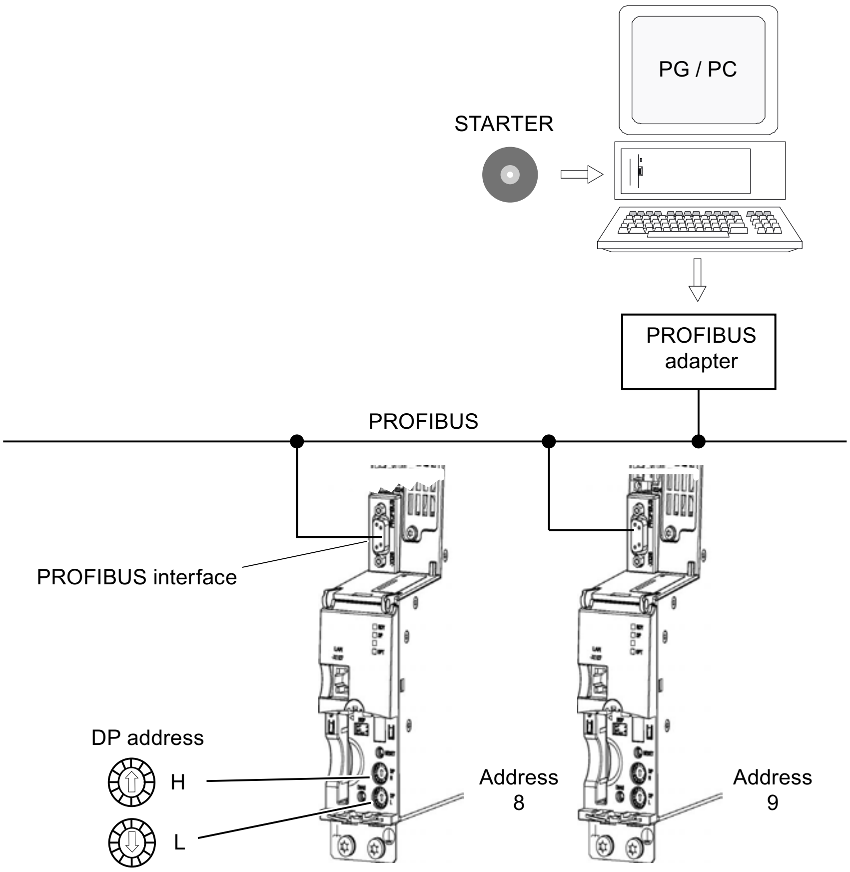


Figure 2-4 Connecting the programming device to the target device via PROFIBUS

Making the STARTER settings for PROFIBUS

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

1. Call the menu "Tools > Set PG/PC interface ...".
2. If the interface has still not been installed, click on the "Select" button.
3. In the selection list on the left-hand side, select the module that you want to use as the interface.
4. Click the "Install" button.

   The selected module is then listed in the "Installed" list.

5. Click on "Close".
6. Call the menu "Tools > Set PG/PC interface ..." and click on the "Properties" button.
7. Activate or deactivate the option "PG/PC is the only master on the bus".

Note

PROFIBUS setting

- Baud rate
  - Connect STARTER to an operational PROFIBUS:
    The STARTER commissioning tool automatically detects the baud rate used by SINAMICS for PROFIBUS, and this is then used.
  - Connect STARTER for commissioning:
    The Control Unit automatically detects the baud rate set in the STARTER commissioning tool, and this is then used.
- 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.

2.2.4 Activating online operation: STARTER via Ethernet

The Control Unit can be commissioned with the programming device (PG/PC) via the integrated Ethernet Interface. This interface is provided for commissioning purposes only and cannot be used to control the drive in operation. Routing with a possibly inserted CBE20 expansion card is not possible.

Precondition

- STARTER from version 4.1.5 or higher
- Control Unit CU320-2 DP from version "C" and higher or CU320-2 PN

STARTER via Ethernet (example)

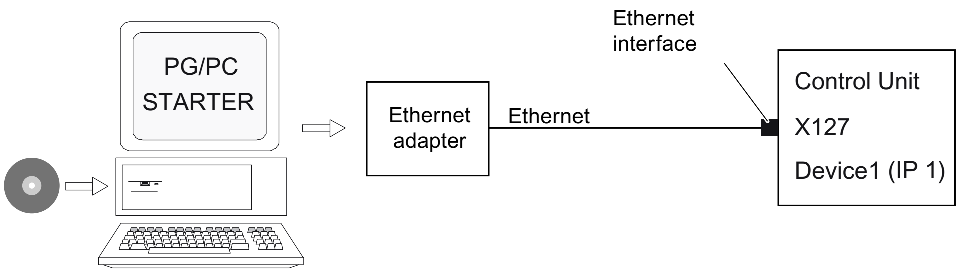


Figure 2-5 Connecting the programming device to the target device via Ethernet (example)

Install online operation via Ethernet

1. Install the Ethernet interface in the programming device according to the manufacturer's instructions.
2. Set the IP address of the Ethernet interface in Windows XP:
   - Assign the programming device a free IP address (e.g. 169.254.11.1).
   - In the delivery condition, the IP address of the internal Ethernet interface X127 of the Control Unit is 169.254.11.22.
3. Set the access point of the STARTER commissioning tool.
4. Using the STARTER commissioning tool, specify a name for the Control Unit interface.

Setting the IP address in Windows XP

1. On the desktop, click on the symbol "Network Environment" and click the right mouse button to open the "Properties" shortcut menu.
2. Double-click the appropriate network card and then click "Properties".
3. Select the Internet Protocol (TCP/IP) and click the "Properties" button.
4. Then enter IPs for the "IP address" and the "Subnet mask".

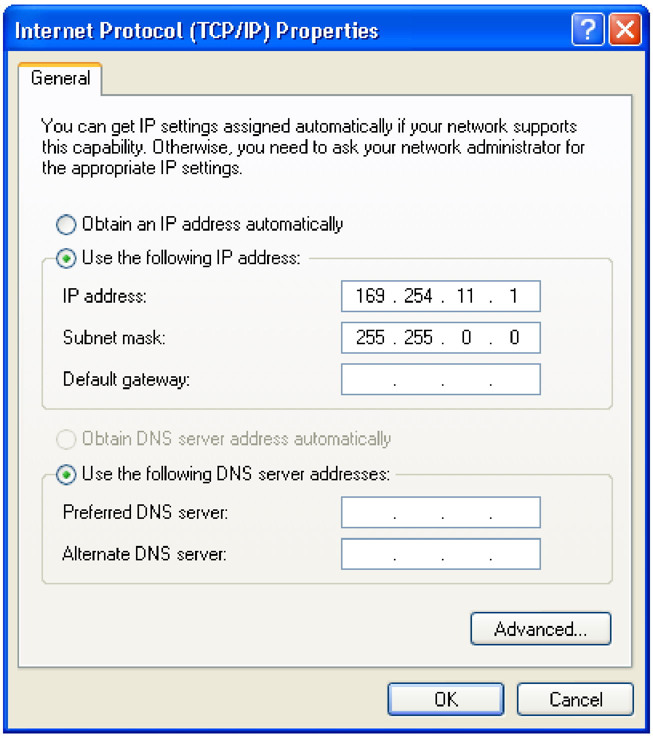


Figure 2-6 Setting the IP address from the PG/PC

Making settings in the STARTER commissioning tool

In the STARTER commissioning tool, set the communication via Ethernet as follows (in our example, we are using the Ethernet interface "Belkin F5D 5055"):

1. Call the menu "Tools > Set PG/PC interface ...".
2. Select the "Access point of the application", and therefore the interface parameter assignment (in the example we use the access point "S7ONLINE (STEP 7)" and the interface parameterization "TCP/IP(Auto)->Belkin F5D 5055").

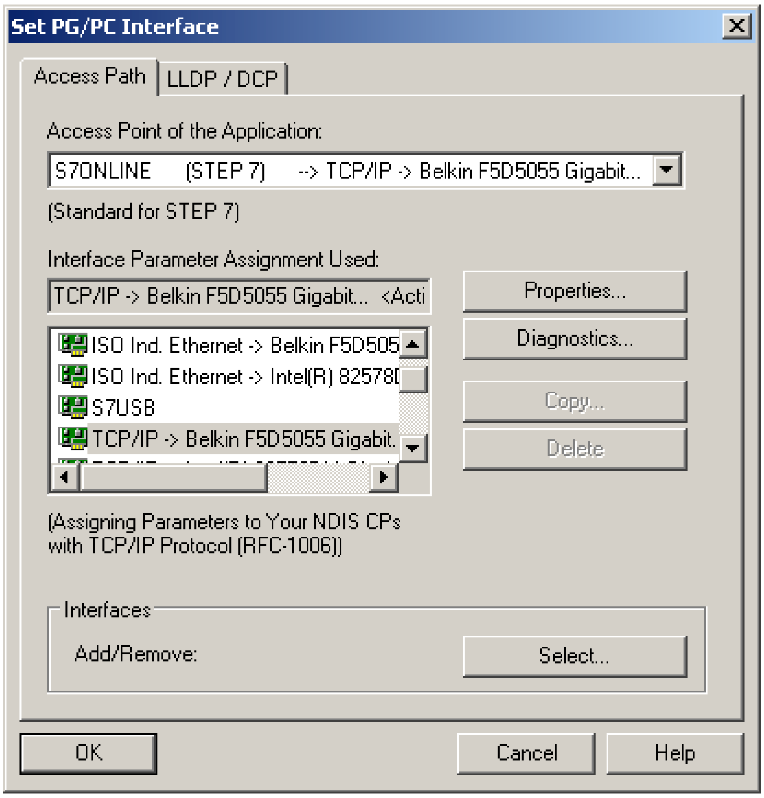


Figure 2-7 Selecting the Ethernet interface at the programming device

If the desired interface does not yet exist in the selection list, you can create this.

3. Click on button "Select".

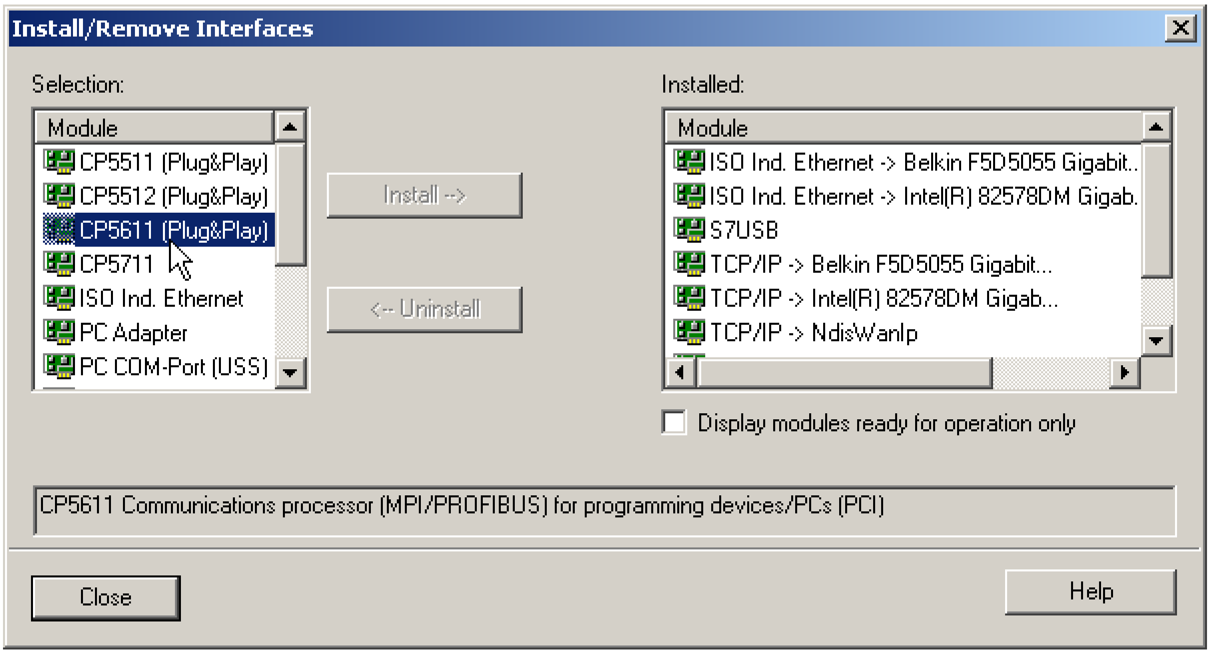


Figure 2-8 Setting the interface

4. In the selection list on the left-hand side, select the module that you want to use as the interface.
5. Click the "Install" button.

   The selected module is then listed in the "Installed" list.
6. Click on "Close".

   You can then check the IP address of the integrated Ethernet interface as follows:

7. Select the drive unit and call the shortcut menu "Target device > Online access ...".
8. Then click on the "Module addresses" tab.

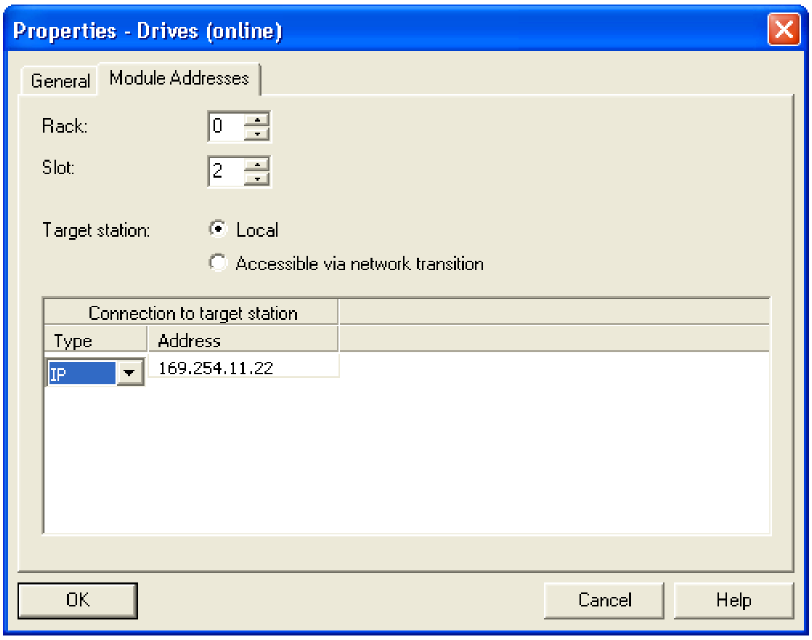


Figure 2-9 Setting the online access

Assigning the IP address and name

Note

When assigning names to IO devices (e.g. a Control Unit) in Ethernet (SINAMICS components), then ST conventions (Structured Text) must be complied with. The names must be unique within Ethernet. "-" and "." are not permitted in the name of an IO device.

Note

The IP address and device name for the Control Unit are stored on the memory card (non-volatile).

Assigning the IP address using the "Accessible nodes" function

Use the STARTER commissioning tool to assign an IP address and a name for the Ethernet interface.

1. Connect the Control Unit to the programming device.
2. Switch on the Control Unit.
3. Open STARTER.
4. Load your project or create a new project.
5. Call the menu "Project > Accessible nodes" or click on the symbol  "Accessible nodes" to search for available nodes in the Ethernet.

   The SINAMICS drive unit is identified and displayed as bus participant Drive unit_1 with IP address 169.254.11.22.
6. Select the bus node entry and select the shortcut menu "Edit Ethernet node...".
7. In the dialog "Edit Ethernet nodes", enter the device name for the Ethernet interface.
   – Click "Assign name".
   – If no entry is in the subnet mask, enter 255.255.0.0 in the subnet mask for the IP configuration.
   – Then click the "Assign IP configuration" button.
   – Close the Information window "The parameters were transferred successfully".
   – Click on the "Close" button.
8. Click on the "View/Refresh (F5)" button to display the IP address and the value "NameOfStation" = "The assigned name" in the entry for the bus node.

   Note

   If these two pieces of information are not be displayed in the entry for the bus node, close the "Accessible nodes" dialog and search for nodes that can be accessed again.

9. If the Ethernet interface is displayed as bus node, select the entry and click on the "Accept" button.

   The SINAMICS drive is displayed as new drive object in the project tree. You can now configure the new drive unit.
10. Click on the button "Connect to selected target devices" and call the menu "Target system > Load to target device", to load the project to the Control Unit memory card.

The IP address and device name are stored on the memory card of the Control Unit in a non-volatile fashion.

Parameterizing the interface in the expert list

1. Assign the "Name of Station" using parameter p8900
2. Assign the "IP Address of Station" using parameter p8901 (factory setting 169.254.11.22)
3. Assign the "Default Gateway of Station" using parameter p8902 (factory setting 0.0.0.0)
4. Assign the "Subnet Mask of Station" using parameter p8903 (factory setting 255.255.0.0)
5. Activate the configuration with p8905 = 1
6. Activate the configuration and save with p8905 = 2

2.2.5 Activating online operation: STARTER via PROFINET IO

Online operation with PROFINET IO is implemented using TCP/IP.

Preconditions

- STARTER from version 4.1.5 or higher
- Control Unit CU320-2 PN
- Communication Board CBE 20 in the Control Unit

STARTER via PROFINET IO (example)

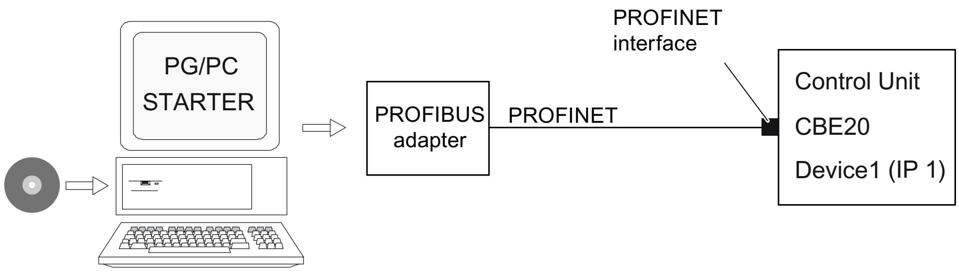


Figure 2-10 Connecting the programming device to the target device via PROFINET (example)

Sequence: Establishing the online mode with PROFINET

1. Setting the IP address in Windows XP

   Assign the programming device (PG/PC) a fixed, free IP address. In our example, we selected 169.254.11.1, based on the factory setting of the integrated Ethernet interface X127 (169.254.11.22). Set the subnet mask to 255.255.0.0.
2. Settings in the STARTER commissioning tool
3. Select online operation in the STARTER commissioning tool.

Setting the IP address in Windows XP

1. On the desktop, click on the symbol "Network Environment" and click the right mouse button to open the "Properties" shortcut menu.
2. Double-click the appropriate network card and then click "Properties".
3. Select the Internet Protocol (TCP/IP) and click the "Properties" button.
4. Then enter IPs for the "IP address" and the "Subnet mask".

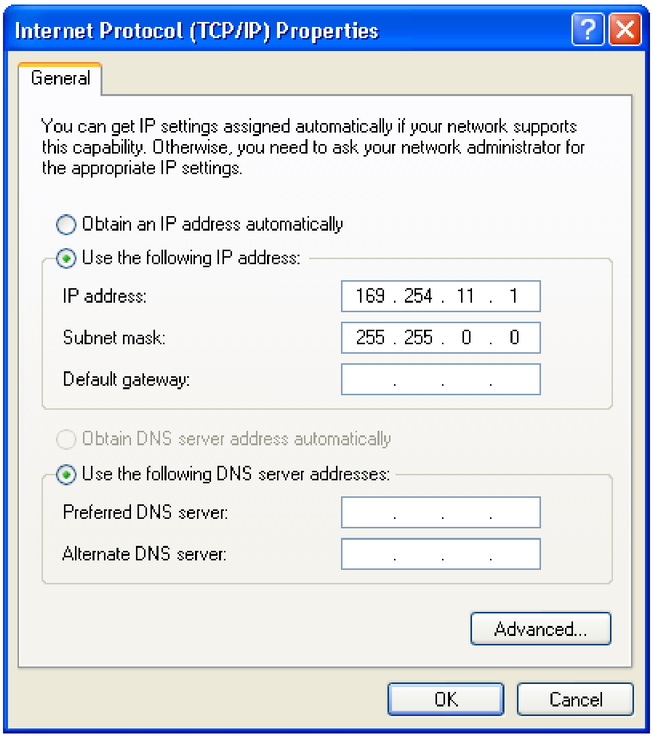


Figure 2-11 Internet Protocol (TCP/IP) properties

Setting the interface in the STARTER commissioning tool

In the STARTER commissioning tool, you set communication via PROFINET as follows:

1. Call the menu "Tools > Set PG/PC interface ...".

2. Select the "Access point of the application", and therefore the interface parameter assignment (in the example we use the access point "S7ONLINE (STEP7)" and the interface parameterization "TCP/IP(Auto)->Belkin F5D 5055").

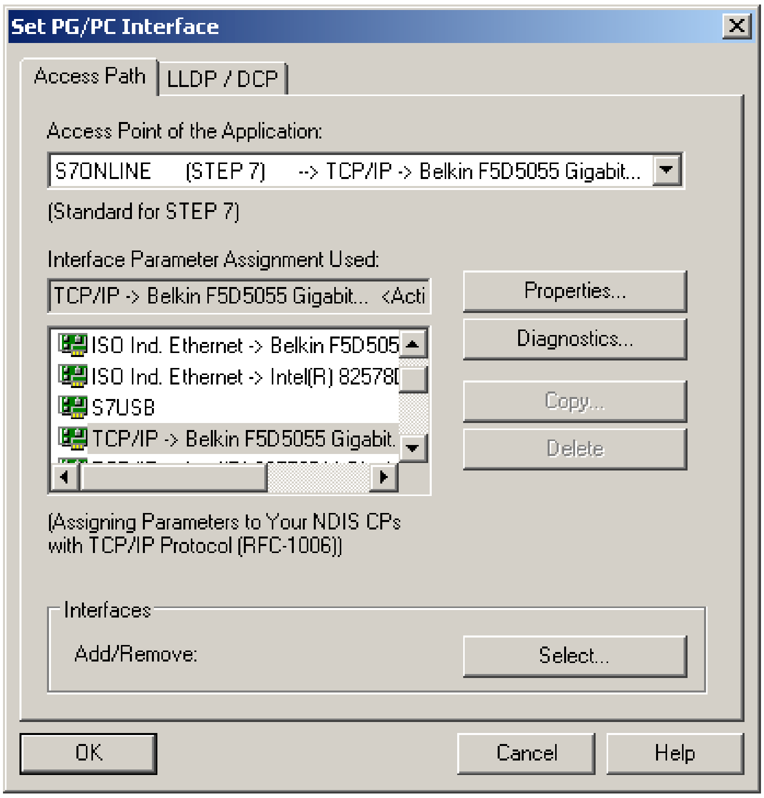


Figure 2-12 Setting the PG/PC Interface

If the desired interface does not yet exist in the selection list, you can create this.

3. Click on button "Select".

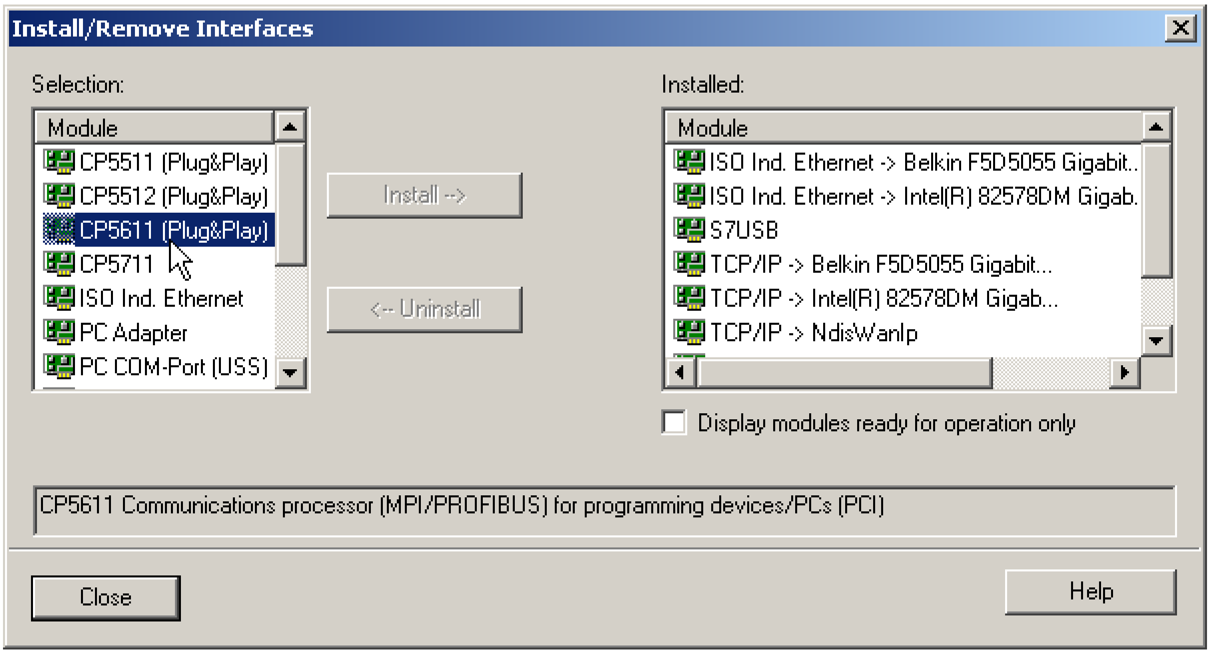


Figure 2-13 Setting the interface

4. In the selection list on the left-hand side, select the module that you want to use as the interface.
5. Click the "Install" button.

   The selected module is then listed in the "Installed" list.
6. Click on "Close".

You can then check the IP address of the integrated Ethernet interface as follows:

7. Select the drive unit and call the shortcut menu "Target device > Online access ...".
8. Then click on the "Module addresses" tab.

   The IP address that you set must be located under "Connect to target station".

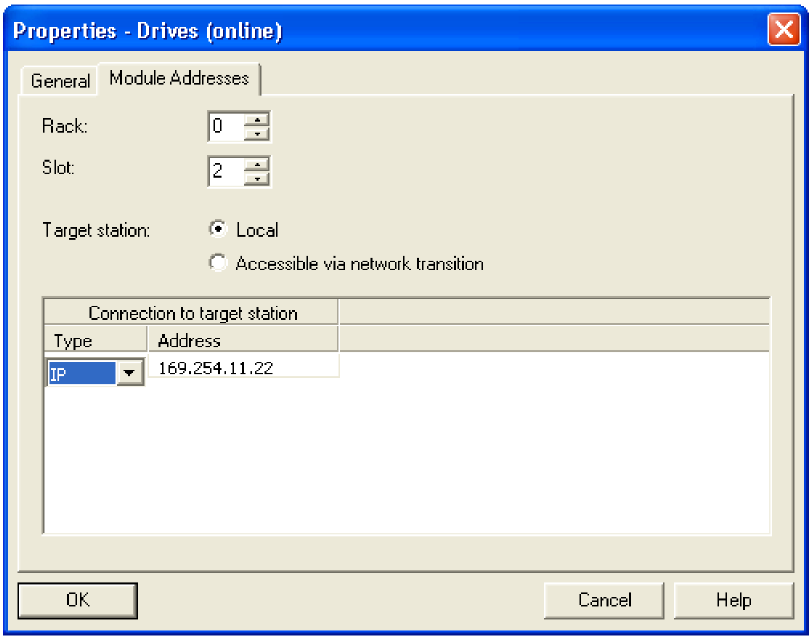


Figure 2-14 Setting online access

Assigning an IP address and a name to the drive unit

With the STARTER commissioning tool, you can assign an IP address and a name to the PROFINET interface (e.g. CBE20) of the drive unit. The following steps are required:

1. Connect the programming device via a Crosslink-Ethernet cable with the CBE20, inserted in the CU320-2.
2. Switch on the Control Unit.
3. Open the STARTER commissioning tool.

4. Call the menu "Project > Accessible nodes" or click on the symbol "Accessible nodes".
   – The search is performed for available nodes connected to PROFINET.
   – The Control Unit is identified and displayed under "Accessible nodes" as the bus node with the IP address 0.0.0.0, without any type information.

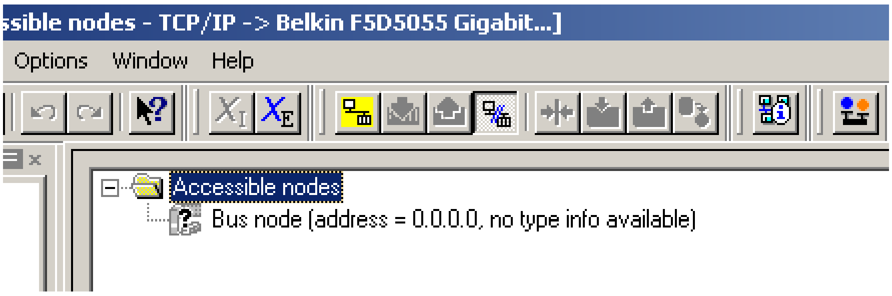


Figure 2-15 Bus nodes found

5. Right click on the bus node entry to open the shortcut menu "Edit Ethernet node ...".
   – In the selection window that opens "Edit Ethernet node" you will also see the MAC address.
6. Under "Set IP configuration", enter the IP address that you selected (e.g. 169.254.11.33) and the subnet mask (e.g. 255.255.0.0).
7. Click on the "Set IP Configuration" button.
   – The data transfer is confirmed.
8. Click on the "Update" button.
   – The bus node is identified as drive unit.
   – The address and the type are specified.

   In the "Edit Ethernet node" selection window you can also assign a device name to the drive unit that has been detected.
9. In the "Device name" field, enter the name that you have selected.

Note

ST (Structured Text) conventions must be satisfied for the name assignment of IO devices in PROFINET (SINAMICS components). The names must be unique within PROFINET.
The characters "-" and "." are not permitted in the name of an IO device.

---

10. Then click on the "Assign Name" button.
    – The data transfer is confirmed.
11. Click on the "Update" button.
    – The bus node is detected as drive unit and is consecutively numbered.
    – The address, device name and the type are specified.
12. Close the "Edit Ethernet node" window.
13. Activate the option button in front of the detected drive unit and click the "Accept" button.

    The SINAMICS drive with CBE20 is transferred as a drive object into the project tree. You can now continue to configure the drive object.
14. Click on the button "Connect to target system" and then call the menu "Target system > Load > To target device", to load the project to the Control Unit memory card.

    The IP address and device name for the Control Unit are stored on the memory card (non-volatile).

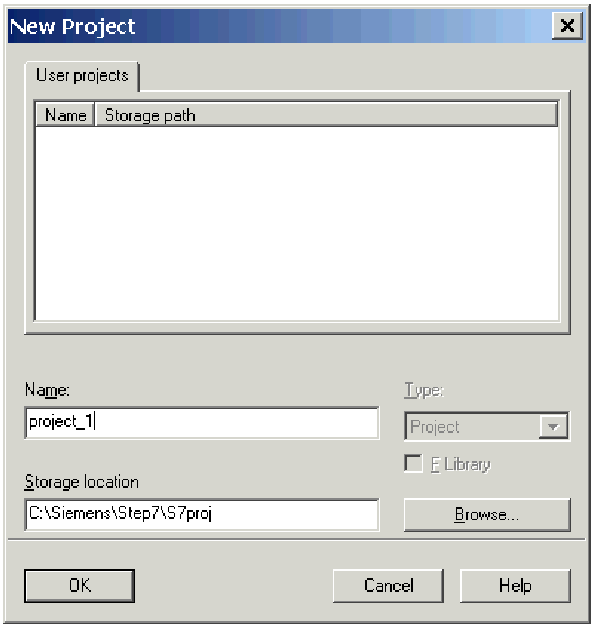
2.3 Creating a project in the STARTER commissioning tool

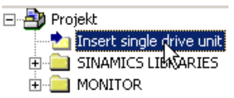
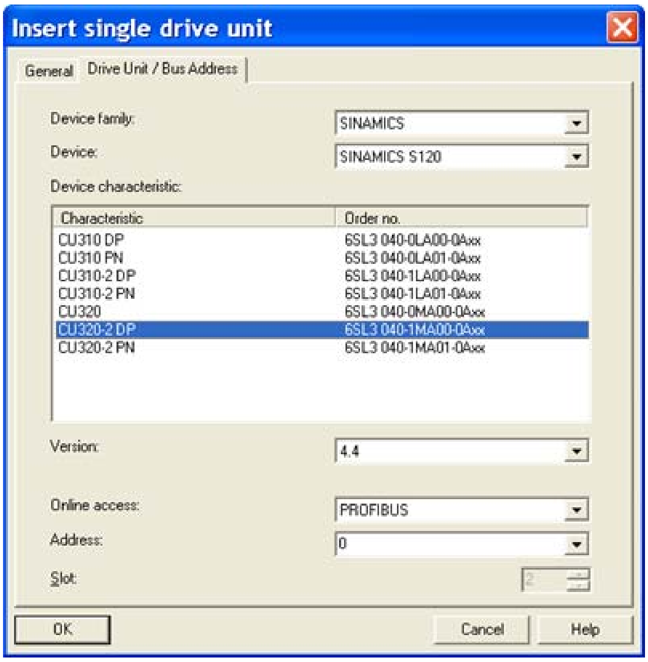
2.3.1 Creating a project offline

PROFIBUS

To create a project offline, you need the PROFIBUS address, the device type and the device version, e.g. firmware version 4.5 or higher.

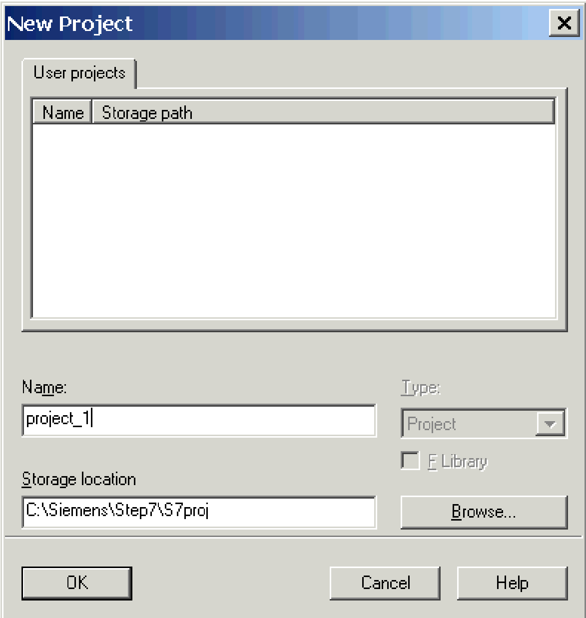
Table 2- 1 Example of a sequence for creating a project in the STARTER commissioning tool

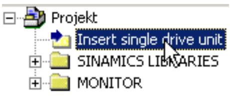
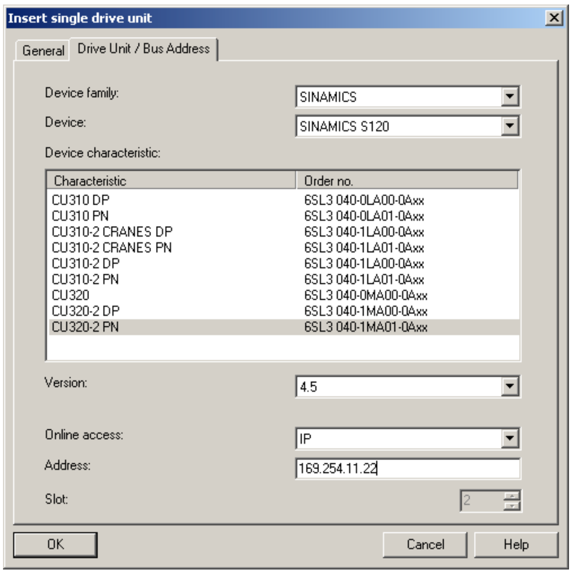
	What?	How?	Comment
1.	Create a new project	1. Call the menu "Project > New ...". The following default settings are displayed: – User projects: Projects already in the target directory – Name: Project_1 (can be freely selected) – Type: Project – Storage location (path): Default (can be set as required) 2. If necessary, correct "Name" and "Storage location".  	The project is created offline and loaded to the target system when configuration is complete.

	What?	How?	Comment
2.	Add individual drive 	1. Double-click in the project tree on "Insert single drive unit". The following settings are pre-assigned: – Device type: CU320-2 DP – Device version: 4.5 or higher – Address type: PROFIBUS/USS/PPI – Bus address: 7 2. If necessary, correct these settings. 	Information about the bus address: The PROFIBUS address of the Control Unit must be set for initial commissioning. Using the rotary coding switches on the Control Unit, the address can be set to a value between 1 and 126 and read via p0918. If the coding switches are at "0" (factory setting), the value can be alternatively set between 1 and 126 using p0918.
3.	Configure the drive unit	Once you have created the project, you have to configure the drive unit. Some examples are provided in the following Chapters.	

PROFINET

To create a project offline, you need the PROFINET address, the device type and the device version, e.g. firmware version 4.5 or higher.

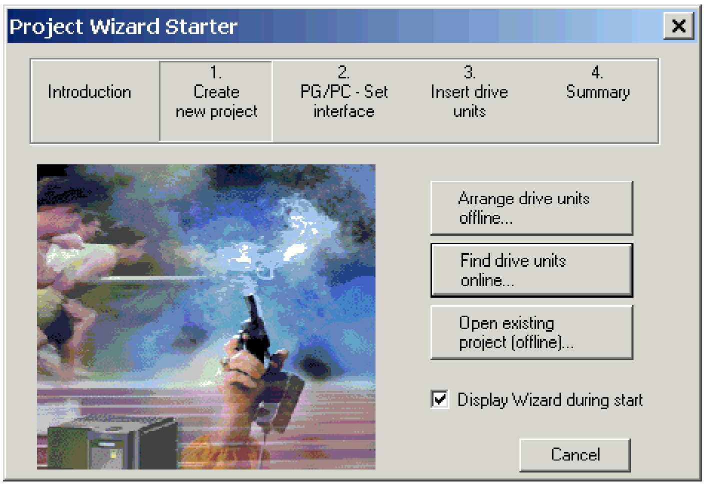
	What?	How?	Comment
1	Create a new project	1. Call the menu "Project > New ...". The following default settings are displayed: – User projects: Projects already in the target directory – Name: Project_1 (can be freely selected) – Type: Project – Storage location (path): Default (can be set as required) 2. If necessary, correct "Name" and "Storage location". 	The project is created offline and loaded to the target system when configuration is complete.

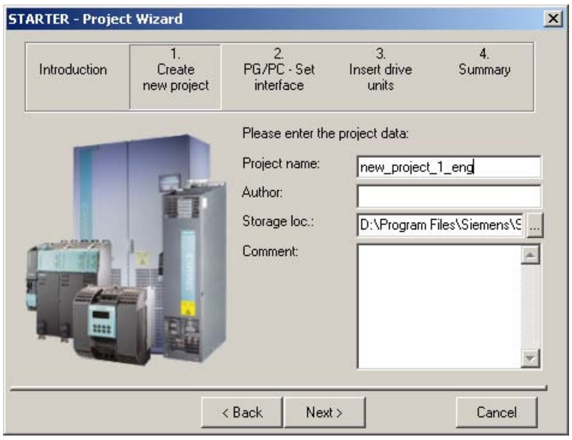
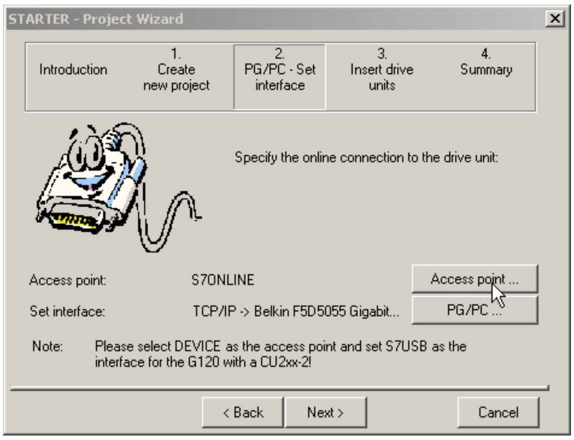
	What?	How?	Comment
2.	Add individual drive 	1. Double-click in the project tree on "Insert single drive unit". The following settings are pre-assigned: – Device type: CU320-2 PN – Version: 4.5 or higher – Online access: IP – Address: 169.254.11.22 2. If necessary, correct these settings. 	Information about the bus address: The PROFINET address of the Control Unit must not be set for initial commissioning. When delivered, the TCP/IP address of the Control Unit is set to 169.254.11.22. The address can be correspondingly changed to meet individual requirements.
3	Configure the drive unit	Once you have created the project, you have to configure the drive unit. Some examples are provided in the following Chapters.	

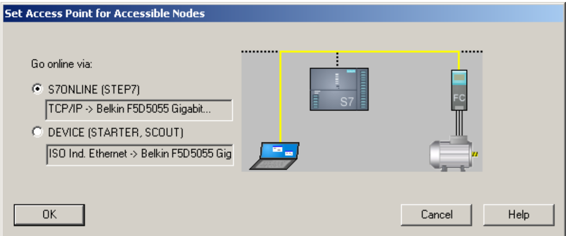
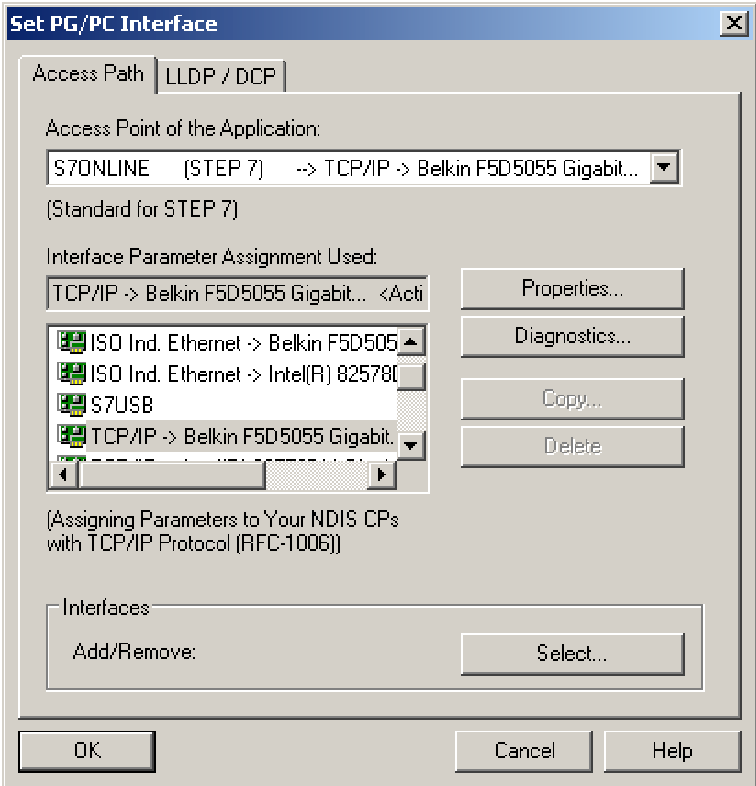
2.3.2 Creating a project online

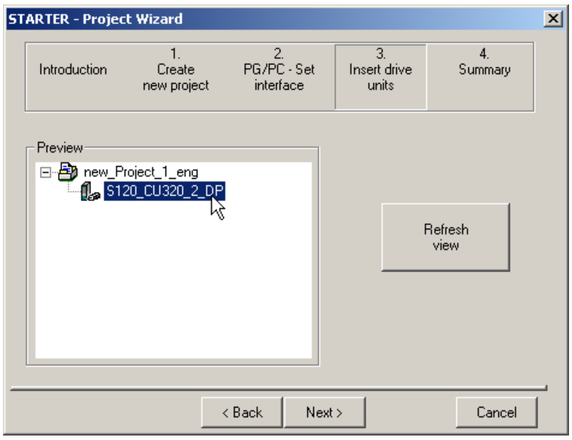
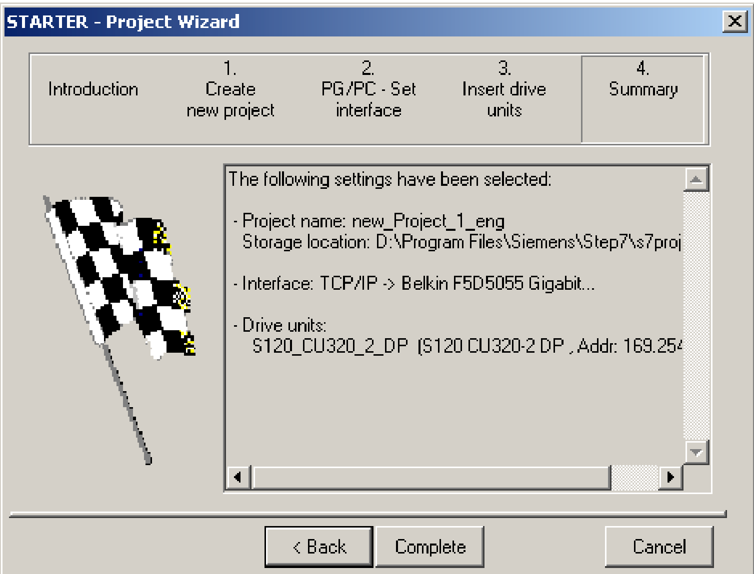
In order to search online for bus nodes via PROFIBUS or PROFINET, the drive unit must be connected with the programming device (PG/PC) via PROFIBUS or PROFINET.

Table 2- 2 Example of search sequence with the STARTER commissioning tool

	What?	How?
1.	Create a new project	1. Call the menu "Project > New with wizard". 2. Click on "Find drive units online". 

	What?	How?
1.1	Enter the project data.	1. Enter the following project data: – Project name: Project_1, can be freely selected – Author: Any – Storage location: Any – Comment: Any 2. If necessary, correct the corresponding project data. 
2	Set up the PG/PC interface	The PG/PC interface can be setup in this window. 

	What?	How?
2.1	Selecting the access point	The target device can be accessed using STARTER or via STEP 7. 1. For step 2, click on "Access point". 2. Select the access point for the accessible nodes. 
2.2	Selecting the PG/PC interface	In this window, the interface can be selected, set and tested. 1. For step 2, click on "PG/PC". 2. Select the "Access point of the application" and therefore also the interface parameter assignment. If the desired interface does not yet exist in the selection list, you can create additional interfaces using the "Select" button. 

	What?	How?
3.	Insert drives	The nodes are shown here in the preview. Use the button "Refresh view" to update the preview. 
4.	Summary	You have now created the project. 1. Click on "Finish". 
5.	Configure the drive unit	Once you have created the project, you have to configure the drive unit. Some examples are provided in the following Chapters.

2.4 Commissioning the servo control booksize format for the first time

An example provided in this chapter explains all the configuration and parameter settings, as well as tests that are required for initial commissioning. Commissioning is carried out using the STARTER commissioning tool.

Preconditions for commissioning

- The commissioning preconditions (Page 18) have been met.
- The commissioning checklists (Page 20) (Tables 1-1 and 1-2) have been completed and the points fulfilled.
- The STARTER commissioning tool is installed and activated.
  - see the "Readme" file on the STARTER installation DVD
- The drive system has been wired according to the specifications.
- The communication between the PG/PC and drive system has been prepared.
- The power supply of the Control Unit (24 V DC) has been switched on.

2.4.1 Task

Commissioning a drive unit with the following components:

Table 2- 3 Component overview

Designation	Component	Order number
Closed-loop control and infeed		
Control Unit 1	Control Unit 320-2 DP	6SL3040-1MA00-0AA1
Active Line Module	Active Line Module 16 kW	6SL3130-7TE21-6AAx
Line filter	Active Interface Module	6SL3100-0BE21-6AB0
Drive 1		
Single motor module 1	Single Motor Module 9 A	6SL3120-1TE21-0AAx
Sensor Module 1.0	SMC20	6SL3055-0AA00-5BAx
Motor 1	Synchronous motor	1FK7061–7AF7x–xxxx
Motor encoder 1	Incremental encoder sin/cos C/D 1 Vpp 2048 p/r	1FK7xxx–xxxxx–xAxx
Sensor Module 1.1	SMC20	6SL3055-0AA00-5BAx
External encoder	Incremental encoder sin/cos 1 Vpp 4096 p/r	-
Drive 2		
Single Motor Module 2.0	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 1 Vpp 2048 p/r	1PH7xxx–xMxxx–xxxx

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 encoders
- Enable signals for drive 2
  Standard telegram 3: Speed control, 1 position encoder

Note

For more information about telegram types, see SINAMICS S120 Function Manual Drive Functions or SINAMICS S120/S150 List Manual.

2.4.2 Component wiring (example)

The following diagram shows the structure of the components and the appropriate wiring. The DRIVE-CLiQ wiring is highlighted in bold.

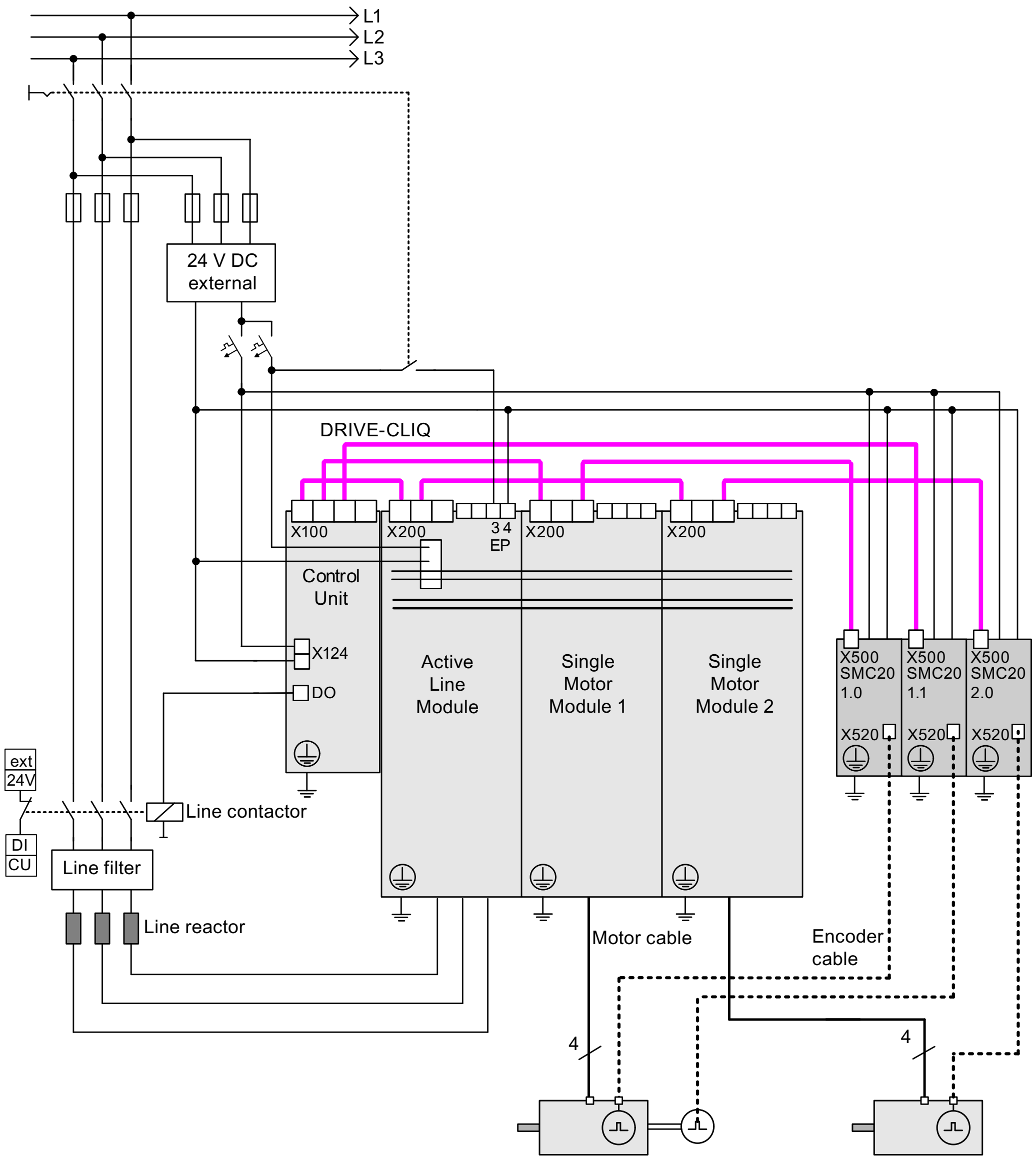


Figure 2-16 Component wiring (example)

Additional information on wiring and connecting the encoder system is provided in the Manual.

2.4.3 Signal flow of the commissioning example

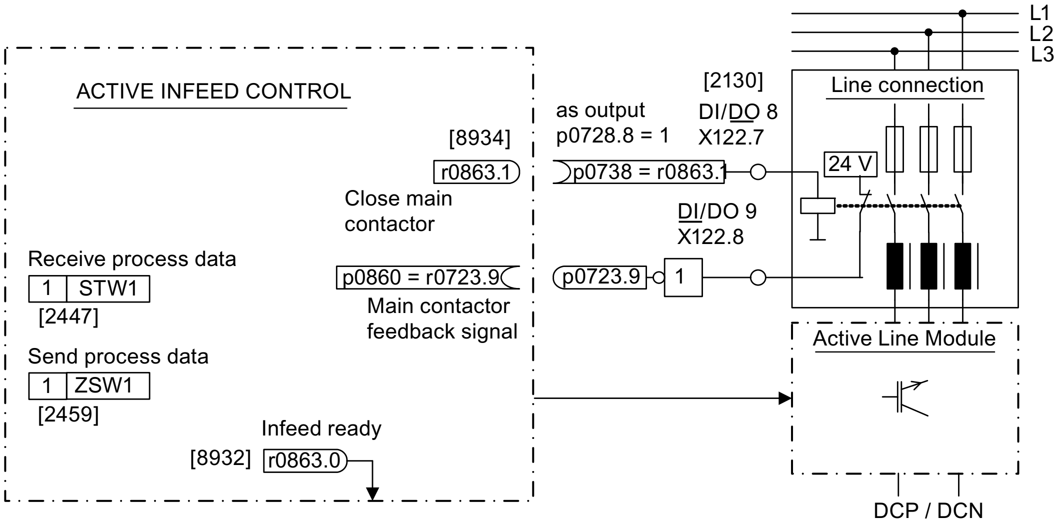


Figure 2-17 Signal flow of the commissioning example - servo control, Part 1

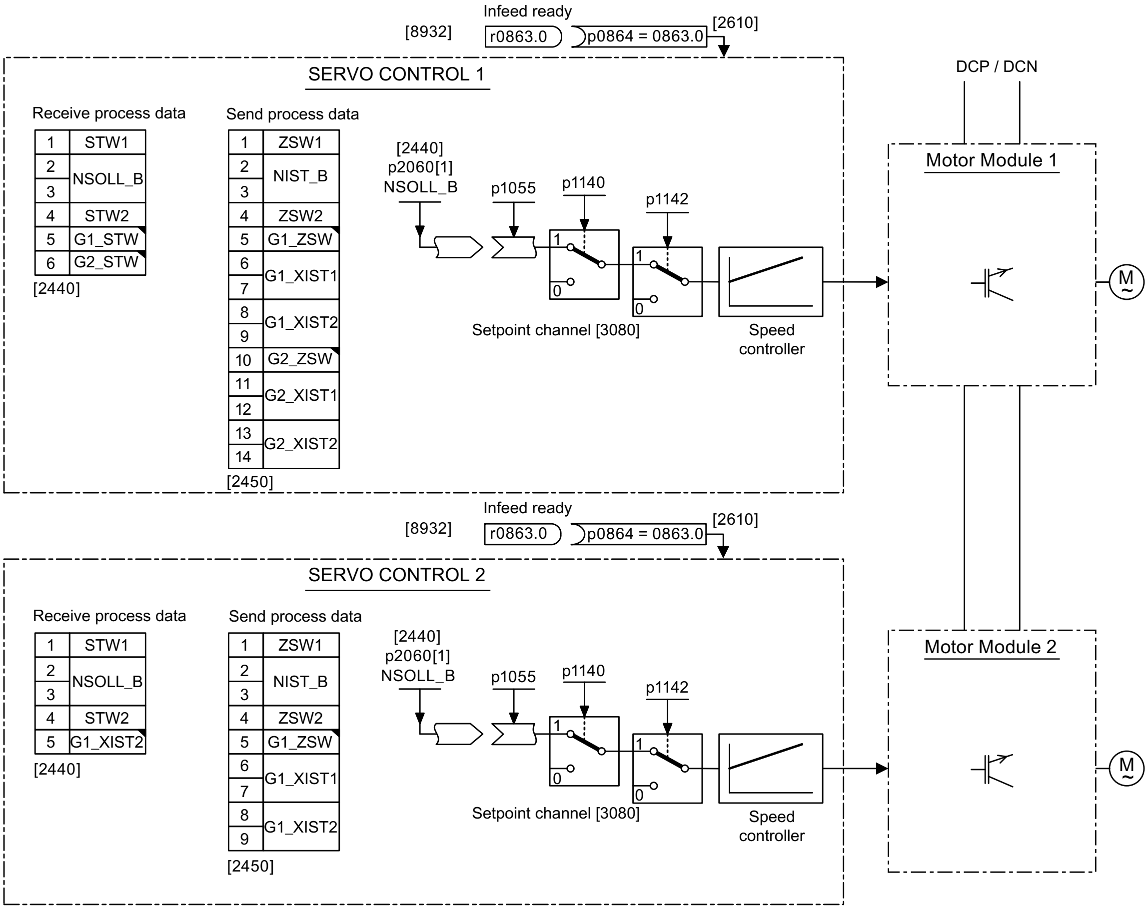


Figure 2-18 Signal flow of the commissioning example - servo control, Part 2

2.4.4 Commissioning with STARTER (example)

The table below describes the steps for commissioning a drive using the STARTER commissioning tool.

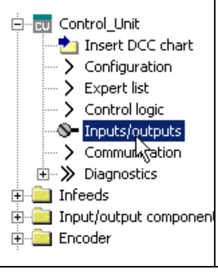
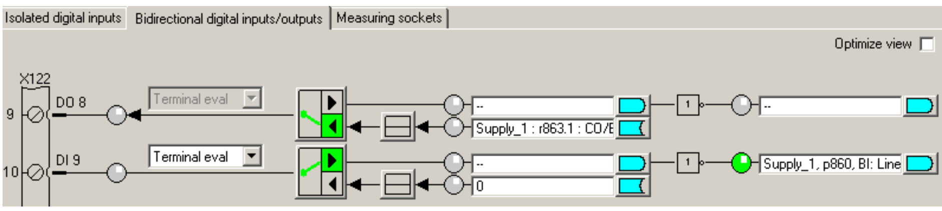
Table 2- 4 Sequence for commissioning with of the STARTER commissioning tool (example)

	What?	How?	Comment
1.	Creating a new project	1. Call the menu "Project > New...". 2. Assign a new name in the "New project" dialog. 3. Click "OK".	-
2.	Automatic configuration	1. Call the menu "Project > Connect to selected target devices". As there is still no device available in the project, the STARTER commissioning tool offers the option of searching for accessible nodes. 2. Click on "Yes". 3. Activate the drive unit reached by clicking on the check box. 4. Click on "Apply". The drive project is transferred into the project view. 5. Call the menu again "Project" > "Connect to selected target devices". You are now connected online with the drive unit. . 6. Double-click on "Automatic configuration". Click on "Configure". 7. During automatic commissioning, the wizard will offer you the option of selecting the drive object type. As default assignment, select all of the "SERVO" components. 8. Click on "Create". 9. After the automatic configuration has been completed, you have the option of going OFFLINE or remaining ONLINE. Select "Go OFFLINE".	-
3.	Configure the infeed	1. Double-click in the project tree on "Infeeds" 2. Double-click on the infeed that has been created 3. Click on the yellow button "Wizard..." 4. To check the automatic settings and to enter additional data, such as equipment codes etc. continue with Point 3.2.	-
Note: When the factory setting is p7826 = 1, the firmware is automatically updated to the status on the memory card when a configured DRIVE-CLiQ component is first booted. This may take several minutes and is indicated by the READY-LED on the corresponding components flashing green/red and the Control Unit flashing orange (0.5 Hz). Once all updates have been completed, the READY-LED on the Control Unit flashes orange at 2 Hz and the corresponding READY-LED on the components flashes green/red at 2 Hz. For the firmware to be activated, a POWER ON must be carried out for the components.			
For infeed units connected to the drive unit, which during the automatic configuration do not communicate with the Control Unit via DRIVE-CLiQ, you must manually configure and transfer into the drive topology. These devices can only be inserted in the offline mode.			

	What?	How?	Comment
3.1	Inserting an infeed unit	If there is no DRIVE-CLiQ connection to the Control Unit, then you must manually enter the data of the infeed unit using the wizard. 1. Double-click in the project tree on "Infeeds". 2. Double-click on "Insert infeeds". 3. Enter a name for the infeed unit. 4. Select the type. 5. Click "OK".	If the line environment or DC link components are changed, line/DC link identification should be repeated.
3.2	Infeed	1. Assign a component name. 2. Select the line voltage range. 3. Select the cooling type. 4. Select the baud rate. 5. The available components are now in the selection list. 6. Select the required infeed from the list. 7. Click on "Continue >".	-
3.3	Infeed - additional data	1. Activate the line/DC link identification when switching-on for the first time. 2. Accept the device supply voltage from the previous window. The rated line frequency is determined automatically. 3. Make sure that the option "Line filter available" is activated. 4. For an infeed in the "booksize" format, select a line filter. You can select one from several versions. 5. If applicable, enter the number of parallel infeeds. 6. Where relevant, select a Voltage Sensing Module. 7. Where relevant, select an external Braking Module. 8. Where relevant, select master/slave operation for several infeeds. 9. Click on "Continue >".	-
3.4	Process data exchange (infeed)	One of three telegrams can be selected for communication: 370, 371 and 999. 1. Select the required telegram (e.g. 370). 2. Click on "Continue >".	-
3.6	Configuration, summary	Configuration of the infeed unit has been completed. A summary is displayed. 1. Click on "Complete".	The infeed unit data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.
Caution If the infeed is controlled by a Control Unit other than that used for the Motor Module, then the "Ready" signal for the infeed r0863.0 must be interconnected with drive parameter p0864 "Infeed ready" via a digital input/output. If this is not taken into account, the infeed may be damaged.			

<table>
<tr><th></th><th>What?</th><th>How?</th><th>Comment</th></tr>
<tr><td>4.</td><td>Configuration of the drives</td><td>You must individually configure the drives in the offline mode. The wizard displays the data determined automatically from the electronic type plate.</td><td>-</td></tr>
<tr><td colspan="4">For drives connected to the drive unit, which during the automatic configuration do not communicate with the Control Unit via DRIVE-CLiQ, you must manually configure and transfer into the drive topology. These devices can only be inserted in the offline mode. In this case, continue commissioning with step 4.1.
If the drives have already been created by the automatic configuration, under the drive, click on "Configuration" > "Configure DDS... ". Then continue from 4.2. Settings of the power unit data and for motors with DRIVE-CLiQ interface also the motor data, are already pre-assigned based on the electronic rating plate/type plate.</td></tr>
<tr><td>4.1</td><td>Inserting drives</td><td>1. Double-click in the project tree on "Drives".
2. Double-click on the entry "Insert drives".
3. Enter a name for the drive.
4. For the drive object, select "SERVO".
5. Click "OK".</td><td>-</td></tr>
<tr><td>4.2</td><td>Control structure</td><td>1. Select function modules.
2. Select the required control mode.
3. Click on "Continue >".</td><td>-</td></tr>
<tr><td>4.3</td><td>Power unit</td><td>1. Enter a name for the component.
2. Select the DC supply voltage.
3. Select the cooling type.
4. Select the type.
The available components are now in the selection list.
5. Select the required power unit from the list.
6. Click on "Continue >".</td><td>-</td></tr>
<tr><td>4.4</td><td>Configuration, power unit BICO interconnection</td><td>If an infeed without DRIVE-CLiQ connection is used, a message is displayed stating that the operating signal must be connected.
1. In the following dialog "Infeed in operation", set parameter p0864 to the binector output of the digital input to which the operating feedback signal of the infeed is interconnected.
2. Click on "Continue >".</td><td>-</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Configuring the motor</td><td>1. Enter a name for the motor (e.g. equipment code).
2. If your motor has its own DRIVE-CLiQ interface, select the item.
3. Click on "Continue >" and proceed with step 5.2.
When commissioning, the motor data is automatically transferred to the Control Unit.</td><td rowspan="2">You can select a standard motor from the list of motors or manually enter the motor data. You can then select the motor type.</td></tr>
<tr><td>1. If you use a standard motor select the item, "Select standard motor from list".
2. Select the standard motor type from the "Motor type" list.
3. Then, select your motor.
4. Click on "Continue >".
Depending on the particular motor type, motor properties are additionally queried; then the continue with Point 5.2.</td></tr>
</table>

	What?	How?	Comment
		1. If your motor is not in the default list, select "Enter motor data". 2. Click on your motor type in the "Motor type" list. 3. Click on "Continue >".	
5.1	Configuring the motor data	1. Enter your motor data according to the data sheet.	If you have no mechanical data, then the data are estimated based on the rating plate data. The equivalent circuit diagram data is also estimated on the basis of the data on the rating plate or determined by means of automatic motor data identification.
		1. Alternatively, after entering the motor data, carry out a motor identification when commissioning for the first time.	
		Alternatively, for some motor types you can use motor data from the motor list. 1. To do so, click on the template. 2. Follow the instructions of the wizard and click on "Continue >". 3. If known, enter the mechanical/electrical data of the motor and the drive train or the data of a PE spindle. 4. For this drive, select whether you require a calculation of the motor/controller data.	
5.2	Configuring a motor holding brake	1. If you are not using a motor holding brake, click on "Continue >" Or 2. If you are using a motor holding brake, select this in the dialog box and then subsequently configure it. 3. Click on "Continue >".	Additional information: see SINAMICS S120 Function Manual Drive Functions.
5.3	Configuring an encoder	You can connect up to 3 encoders. 1. If you are using DRIVE-CLiQ encoders, select the appropriate item. 2. Click on "Continue >". The encoder is automatically identified and configured.	If you are using an encoder that is not in the list, you can also manually enter the data. By clicking on details, you can view the data of the encoder selected from the the encoder list.
		1. Alternatively, you can use a standard encoder. Select this encoder from the list. 2. Click on "Continue >".	
		Alternatively, you can use your own encoder. 1. Select "Enter data". 2. Click on "Encoder data". 3. Select the measuring system. 4. Enter the required data and click on "OK". 5. Click on "Continue >".	

	What?	How?	Comment
5.4	Entering encoder data	1. Enter the encoder data into the input screen form and click on "OK". 2. If a standard motor was selected in step 5, continue with step 5.6.	Enter additional encoders in the same way as described above.
5.5	Drive functions	1. If a standard motor was not selected, select the technological application here. 2. When required, activate the motor identification function.	Your choice of application influences the calculation for the open-loop/closed-loop control parameters.
5.6	Configuring process data exchange	1. For communication, select the PROFIdrive telegram from several telegrams.	-
5.7	Configuration, summary	The configuration of the drive train has been completed. A summary is displayed. 1. Click on "Complete".	The drive data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.
5.8	Configuring drive functions	1. In the project tree click on Drives\Drive xy\Configuration. 2. Click on the "Function modules/technology packages" button. Under the "Function modules" tab, you can activate single or multiple function modules. 3. Click "OK".	-
5.9	Summary	The drive data can be copied to the clipboard for system documentation purposes and then pasted into a word processing program, for example.	-
Note The reference parameters and limit values can be protected from being automatically overwritten in the STARTER commissioning tool by p0340 = 1: Drive -> Configuration-> "Reference parameters / blocked list" tab.			
6	Enable signals and BICO interconnections	The enable signals for the infeed and the two drives must be realized via the digital inputs on the Control Unit.	-
6.1	Line contactor	1. Make the following settings for the line contactor: – p0728.8 = 1, sets DI/DO as output – p0738 = 0863.1 line contactor on – p0860 = 0723.9 line contactor, feedback signal	The line contactor should be controlled from the drive object (DO) Infeed_1. See function diagram [8834] In the "Function > Line contactor control" screen form, you can check that the interconnection is correct.
			

	What?	How?	Comment
7.	Save the parameters on the device	1. Call the menu "Project" > "Connect to selected target devices" (online mode). 2. Call the menu "Target system > Load > Load CPU/drive unit to target device...".	Left-click on the drive unit (SINAMICS S120).
		1. Select the drive unit in the project tree. 2. Call the menu "Target system > Copy RAM to ROM". (save the data on the memory card)	
8.	The motor starts to run.	The drives can be started via the control panel in the STARTER commissioning tool. The control panel can be found in the project navigator under "Drive unit > Drives > Commissioning > Control panel".	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 SINAMICS S120 Function Manual Drive Functions.

Diagnostic functions in the STARTER commissioning tool

Under Component > Diagnostics > Control/status words

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

2.5 Commissioning U/f vector control booksize format for the first time

An example provided in this chapter explains all the configuration and parameter settings, as well as tests that are required for initial commissioning. Commissioning is carried out using the STARTER commissioning tool.

Preconditions for commissioning

- The commissioning preconditions (Page 18) have been met.
- The commissioning checklists (Page 20) (Tables 1-1 and 1-2) have been completed and the points fulfilled.
- The STARTER commissioning tool is installed and activated.
  - see the "Readme" file on the STARTER installation DVD
- The drive system has been wired according to the specifications.
- The communication between the PG/PC and drive system has been prepared.
- The power supply of the Control Unit (24 V DC) has been switched on.

2.5.1 Task

A drive in the "booksize" format with "U/f vector control" control mode with the following components is to be commissioned for the first time:

Table 2- 5 Component overview

Designation	Component	Order number
Closed-loop control and infeed		
Control Unit	Control Unit 320-2 DP	6SL3040-1MA00-0AA1
Smart Line Module	Smart Line Module 16 kW	6SL3130-6TE21-6Axx
Line filter package 16 kW	Line filter and line reactor	6SL3100-0BE21-6AB0
Drive 1		
Motor Module	Single Motor Module 9 A	6SL3120-1TE21-0Axx
Motor	Induction motor	1PH8083-1xF2x-xxxx
Drive 2		
Motor Module	Single Motor Module 9 A	6SL3120-1TE21-0Axx
Motor	Induction motor	1PH8083-1xF2x-xxxx

The enable signals for the infeed and the drive should be realized via terminals.

2.5.2 Component wiring (example)

The following diagram shows the structure of the components and the appropriate wiring. The DRIVE-CLiQ wiring is highlighted in bold.

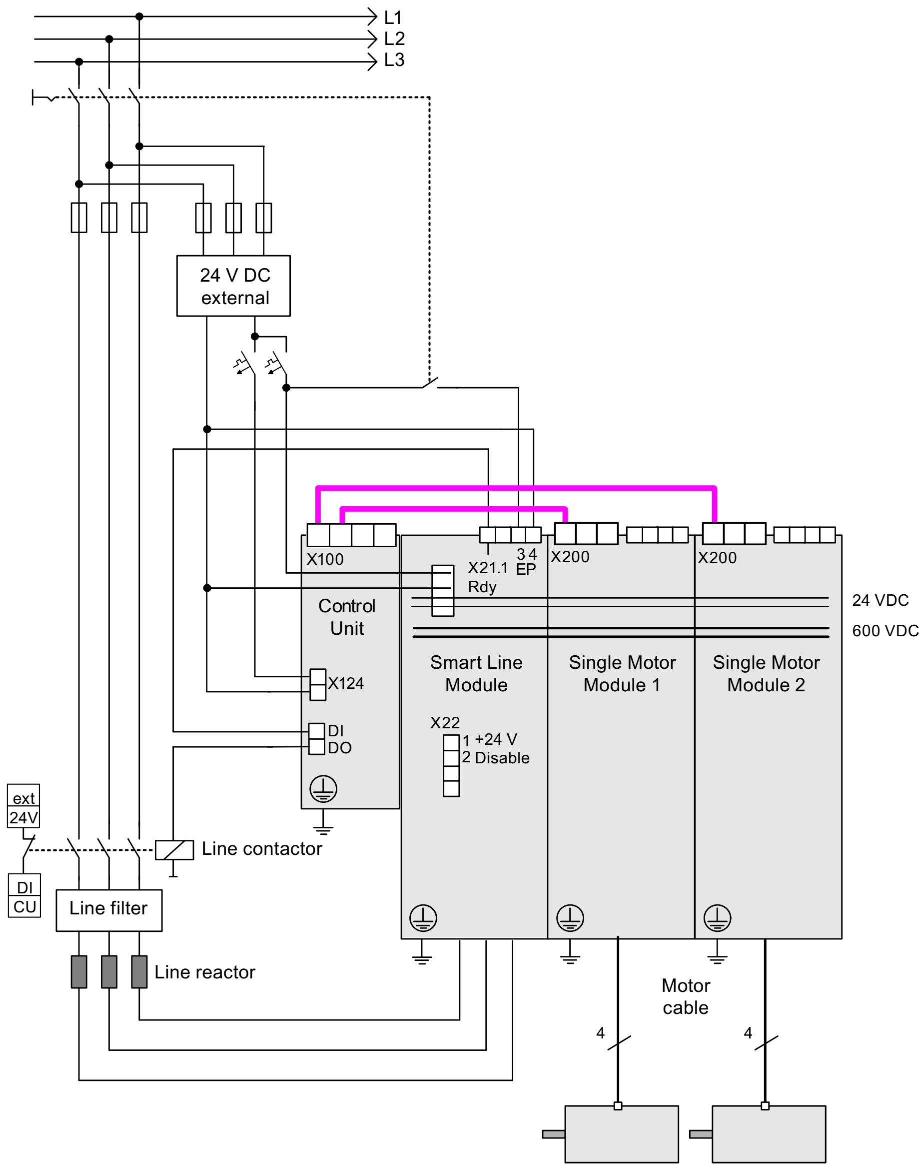


Figure 2-19 Component wiring (example)

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

2.5.3 Signal flow of the commissioning example

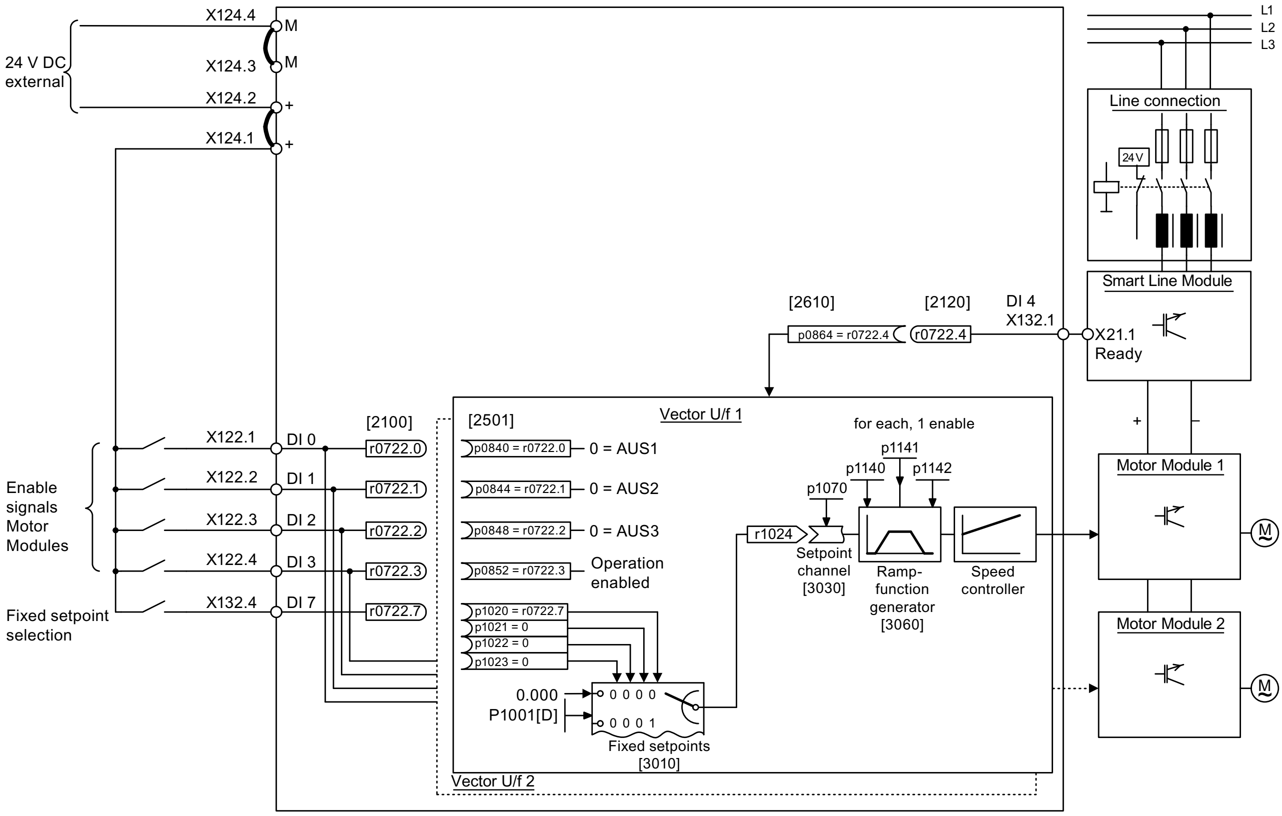


Figure 2-20 Signal flow diagram of the example vector U/f control mode in the booksize format

2.5.4 Commissioning with STARTER (example)

The table below describes the steps for commissioning the example using the STARTER commissioning tool.

Table 2- 6 Commissioning sequence (example)

	What?	How?	Comment
1.	Creating a new project	1. Call the menu "Project > New...". 2. Assign a new name in the "New project" dialog. 3. Click "OK".	-
2.	Automatic configuration	1. Call the menu "Project > Connect to selected target devices". As there is still no device available in the project, STARTER offers the option of searching for accessible nodes. 2. Click on "Yes". 3. Activate the drive unit reached by clicking on the check box. 4. Click on "Apply". The drive unit is transferred into the project window. 5. Call the menu again "Project" > "Connect to selected target devices". You are now connected online with the drive unit. 6. Double-click on "Automatic configuration". Click on "Configure". 7. During automatic commissioning, the wizard will offer you the option of selecting the drive object type. As default assignment, select all of the "Vector" components. 8. Click on "Create". 9. After the automatic configuration has been completed, you have the option of going OFFLINE or remaining ONLINE. Select "Go OFFLINE".	-
3.	Configure the infeed	1. Double-click in the project tree on "Infeeds". 2. Double-click on the infeed that has been created. 3. Click on the yellow button "Wizard...". 4. To check the automatic settings and to enter additional data, such as equipment codes etc. continue with Point 3.2.	-

Note:

When the factory setting is p7826 = 1, the firmware is automatically updated to the status on the memory card when a configured DRIVE-CLiQ component is first booted. This may take several minutes and is indicated by the READY-LED on the corresponding components flashing green/red and the Control Unit flashing orange (0.5 Hz). Once all updates have been completed, the READY-LED on the Control Unit flashes orange at 2 Hz and the corresponding READY-LED on the components flashes green/red at 2 Hz. For the firmware to be activated, a POWER ON must be carried out for the components.

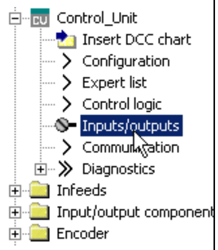
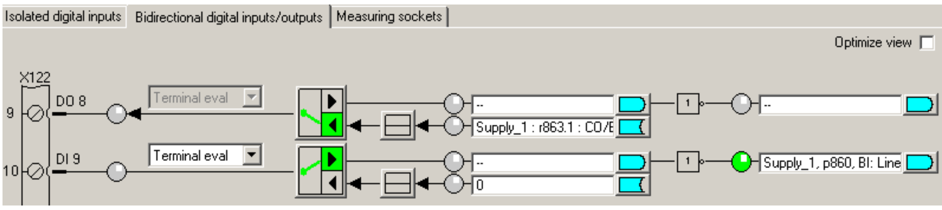
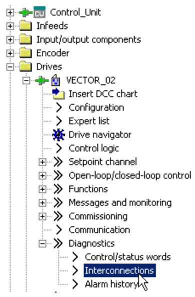
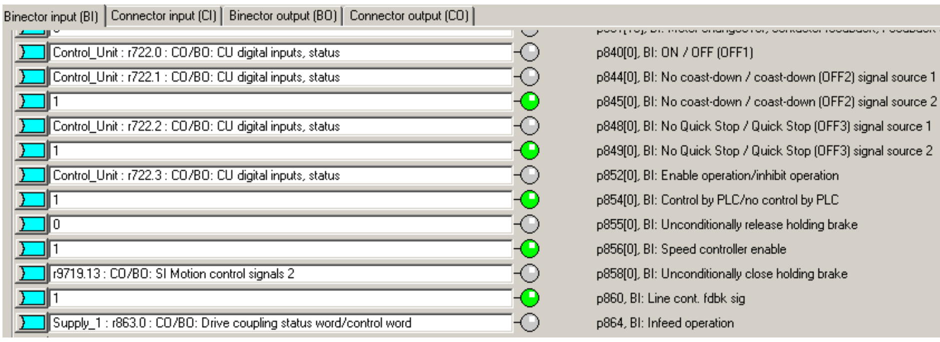
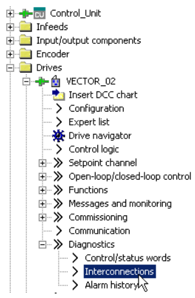
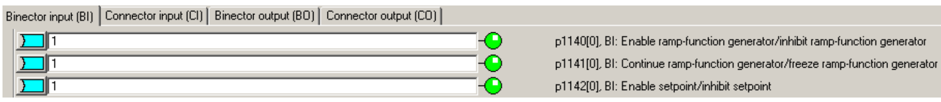
For infeed units connected to the drive unit, which during the automatic configuration do not communicate with the Control Unit via DRIVE-CLiQ, you must manually configure and transfer into the drive topology. These devices can only be inserted in the offline mode.

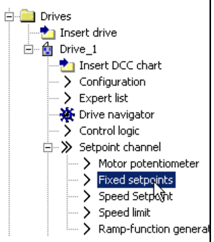
	What?	How?	Comment
3.1	Inserting an infeed unit	If there is no DRIVE-CLiQ connection to the Control Unit, then you must manually enter the data of the infeed unit using the wizard. 1. Double-click in the project tree on "Infeeds". 2. Double-click on "Insert infeed". 3. Enter a name for the infeed unit. 4. Select the type. 5. Click "OK".	If the line environment or DC link components are changed, line/DC link identification should be repeated.
3.2	Infeed	1. Assign a component name. 2. Select the line voltage range. 3. Select the cooling type. 4. Select the type. The available components are now in the selection list. 5. Select the required infeed from the list. 6. Click on "Continue >".	-
3.3	Infeed - additional data	1. Activate the line/DC link identification when switching-on for the first time. 2. Accept the device supply voltage from the previous window. The rated line frequency is determined automatically. 3. If applicable, enter the number of parallel infeeds. 4. Where relevant, select a Voltage Sensing Module. 5. Where relevant, select an external Braking Module. 6. Click on "Continue >".	-
3.4	Process data exchange (infeed)	One of three telegrams can be selected for communication: 370, 371 and 999. 1. Select the required telegram. 2. Click on "Continue >".	-
3.5	Configuration, summary	Configuration of the infeed unit completed. A summary is displayed. 1. Click on "Complete".	The infeed unit data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.
Notice 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, the infeed may be damaged.			
4.	Configuration of the drives	You must individually configure the drives in the offline mode. The wizard displays the data determined automatically from the electronic type plate.	-

<table>
<tr><th></th><th>What?</th><th>How?</th><th>Comment</th></tr>
<tr><td colspan="4">For drives connected to the drive unit, which during the automatic configuration do not communicate with the Control Unit via DRIVE-CLiQ, you must manually configure and transfer into the drive topology. These devices can only be inserted in the offline mode. In this case, continue commissioning with step 4.1.
If the drives have already been created by the automatic configuration, under the drive, click on "Configuration" > "Configure DDS... ". Then continue from 4.2. Settings of the power unit data and for motors with DRIVE-CLiQ interface also the motor data, are already pre-assigned based on the electronic rating plate/type plate.</td></tr>
<tr><td>4.1</td><td>Inserting drives</td><td>1. Double-click in the project tree on "Drives".
2. Double-click on the entry "Insert drives".
3. Enter a name for the drive.
4. For the drive object, select "VECTOR".
5. Click "OK".</td><td>-</td></tr>
<tr><td>4.2</td><td>Control structure</td><td>1. Select function modules.
2. Switch the closed-control to "U/f control".
3. Select the required control mode.
4. Click on "Continue >".</td><td>-</td></tr>
<tr><td>4.3</td><td>Power unit</td><td>1. Enter a name for the component.
2. Select the DC supply voltage.
3. Select the cooling type.
4. Select the type.
The available components are now in the selection list.
5. Select the required power unit.
6. Click on "Continue >".</td><td>-</td></tr>
<tr><td>4.4</td><td>Configuration, power unit BICO interconnection</td><td>If an infeed without DRIVE-CLiQ connection is used, a message is displayed stating that the operating signal must be connected.
1. In the following dialog "Infeed in operation", set parameter p0864 to the binector output of the digital input to which the operating feedback signal of the infeed is interconnected.
2. Click on "Continue >".</td><td>-</td></tr>
<tr><td>4.5</td><td>Configuring additional data</td><td>In this window, you can additionally select the following
• Various output filters
• A Voltage Sensing Module
• A parallel connection</td><td>With this dialog window, the configuration of the Motor Module has been completed.</td></tr>
<tr><td colspan="4">Notice
If a sine-wave filter is connected, then it must be activated here as otherwise it could be destroyed!</td></tr>
<tr><td>5</td><td>Drive setting</td><td>You can select the motor standard (IEC/NEMA) and power unit application (duty cycles).</td><td>-</td></tr>
</table>

	What?	How?	Comment
5.1	Configuring the motor	1. Enter a name for the motor (e.g. equipment code). 2. If your motor has its own DRIVE-CLiQ interface, select the item. 3. Click on "Continue >". When commissioning, the motor data is automatically transferred to the Control Unit.	You can select a standard motor from the list of motors or manually enter the motor data. You can then select the motor type.
		1. If you use a standard motor select the item, "Select standard motor from list". 2. Select the standard motor type from the "Motor type" list. 3. Then, select your motor. 4. Click on "Continue >".	
		1. If your motor is not in the default list, select "Enter motor data". 2. Click on your motor type in the "Motor type" list. 3. Click on "Continue >".	
5.2	Configuring the motor data	1. Enter your motor data according to the data sheet.	If you have no mechanical data, then the data are estimated based on the rating plate data. The equivalent circuit diagram data is also estimated on the basis of the data on the rating plate or determined by means of automatic motor data identification.
		1. Alternatively, after entering the motor data, carry out a motor identification when commissioning for the first time.	
		Alternatively, for some motor types you can use motor data from the motor list. 1. To do so, click on the template. 2. Follow the wizard by clicking on "Next >". 3. If known, you can enter the mechanical/electrical data of the motor and the drive train or the data of a PE spindle. 4. If necessary, select a complete calculation of the motor/controller data without equivalent circuit diagram data. 5. For this example, select the simple drive.	
5.3	Configuring a motor holding brake	1. If you are not using a motor holding brake, click on "Continue >". Or 2. If you are using a motor holding brake, you can select and configure the brake in this window. 3. Click on "Continue >".	For additional information, see SINAMICS S120 Function Manual Drive Functions.
5.4	Configuring an encoder	You can connect up to 3 encoders. 1. If you are using a DRIVE-CLiQ encoder, then select the appropriate item. 2. Click on "Next >". The encoder is automatically identified and configured.	When using an encoder that is not in the list, after point 4.8, you can also enter the data manually. By clicking on details, you can view the data of the encoder selected from the the encoder list.
		1. Alternatively, you can use a standard encoder. Select the encoder from the list. 2. Click on "Continue >".	

	What?	How?	Comment
		Alternatively, you can use your own encoder. 1. Select enter data. 2. Click on encoder data. 3. Select the measuring system. 4. Enter the required data and click on "OK". 5. Click on "Continue >".	
5.5	Entering encoder data	1. Enter the encoder data into the input screen form and click on "OK".	Enter additional encoders in the same way as described above.
5.6	Configuring drive functions	You can select certain technological applications and the type of motor identification.	Your choice of application influences the calculation for the open-loop/closed-loop control parameters.
5.7	Configuring process data exchange	1. For communication, select the PROFIdrive telegram from several telegrams.	-
5.8	Important parameters	In this window, you can specify important parameters as limit values. When doing this, observe the general mechanical conditions for the drive train.	-
5.9	Configuration, summary	The configuration of the drive train has been completed. A summary is displayed. 1. Click on "Complete".	The drive data can be copied to the clipboard for system documentation purposes and then added to a text program, for example.
Note The reference parameters and limit values can be protected from being automatically overwritten in the STARTER commissioning tool by setting p0340 = 1. In the STARTER commissioning tool, you will find this under Drive > Configuration > Blocked list tab.			
6.	Enable signals and BICO interconnections	The enable signals for the infeed and the two drives must be realized via the digital inputs on the Control Unit. 1. In the project tree, click on "Drive unit \ Control Unit \ Inputs/outputs". 2. Select "Bidirectional digital inputs/outputs".	-
6.1	Line contactor	1. Make the following settings for the line contactor: – p0728.8 = 1, sets DI/DO as output – p0738 = 0863.1 control (energize) line contactor – p0860 = 0723.9 line contactor, feedback signal	The line contactor must be controlled by the infeed_1 drive object (DO). See function diagram [8834] In the "Function > Line contactor control" screen form, you can check that the interconnection is correct.

	What?	How?	Comment
			
6.2	Enable Motor Module	• Enable signals for the Motor Module (drive_1) p0840 = 722.0 ON/OFF1 p0844 = 722.1 1. OFF2 p0845 = 1 2. OFF2 p0848 = 722.2 1. OFF3 p0849 = 1 2. OFF3 p0852 = 722.3 Enable operation	See function diagram [2501]
			
6.3	Ramp-function generator	• Ramp-function generator p1140 = 1 Ramp-function generator enable p1141 = 1 Ramp-function generator start p1142 = 1 Enable setpoint	See function diagram [3060]
			
6.4	Setpoint	• Specify setpoint p1001 = 40 Fixed setpoint 1	See function diagram [3010]

	What?	How?	Comment
			
7	Save the parameters on the device	1. Select the drive unit in the project tree. 2. Call the "Connect target device" shortcut menu. 3. Call the "Target device > Load to target device" shortcut menu. The option "After loading, copy RAM to ROM" is active. Click on "Yes" to confirm backup. or 4. Call the shortcut menu "Target device > Copy RAM to ROM".	Position cursor on drive unit (SINAMICS S120) and right-click.
8	The motor starts to run.	The drives can be started via the control panel in the STARTER commissioning tool. • Line/DC link identification will be carried out once the pulses for the infeed have been enabled and line/DC link identification has been activated. The infeed then switches into the "Operation" state. • 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 is carried out, if this is activated.	For more information about the control panel, see Getting Started. During motor data 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/motor data identification, see the SINAMICS S120 Function Manual Drive Functions.

Diagnostic functions in the STARTER commissioning tool

Under Component > Diagnostics > Control/status words

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

2.6 Commissioning the vector control chassis format for the first time

An example provided in this chapter explains all the configuration and parameter settings, as well as tests that are required for initial commissioning. Commissioning is carried out using the STARTER commissioning tool.

Preconditions for commissioning

- The commissioning preconditions (Page 18) have been met.
- The commissioning checklists (Page 20) (Tables 1-1 and 1-2) have been completed and the points fulfilled.
- The STARTER commissioning tool is installed and activated.
  – see the "Readme" file on the STARTER installation DVD
- The drive system has been wired according to the specifications.
- The communication between the PG/PC and drive system has been prepared.
- The power supply of the Control Unit (24 V DC) has been switched on.

2.6.1 Task

A drive in the "chassis" format in vector control with the following components is to be commissioned for the first time:

Table 2- 7 Component overview

Designation	Component	Order number
Closed-loop control and infeed		
Control Unit	Control Unit 320-2 PN	6SL3040-1MA01-0AA1
Active Line Module	Active Line Module 380 kW / 400 V	6SL3330–7TE36–1AAx
Active Interface Module	Active Interface Module	6SL3300–7TE38–4Ax0
Drive 1		
Motor Module	Motor Module 380 A	6SL3320–1TE33–8AAx
Motor	Induction motor • Without brake • With encoder	Type: 1PL6226-xxFxx-xxxx Rated voltage = 400 V Rated current = 350 A Rated power = 200 kW Rated frequency = 59.10 Hz Rated speed = 1750 rpm Cooling type = non-ventilated HTL encoder, 1024 p/r, A/B, R

Designation	Component	Order number
Drive 2		
Motor Module	Motor Module 380 A	6SL3320–1TE33–8AAx
Motor	Induction motor • Without brake • With encoder	Type: 1PL6226-xxFxx-xxxx Rated voltage = 400 V Rated current = 350 A Rated power = 200 kW Rated frequency = 59.10 Hz Rated speed = 1750 rpm Cooling type = non-ventilated HTL encoder, 1024 p/r, A/B, R

The enable signals for the infeed and the drive should be realized via terminals.

2.6.2 Component wiring (example)

The following diagram shows the structure of the components and the appropriate wiring. The DRIVE-CLiQ wiring is highlighted in bold.

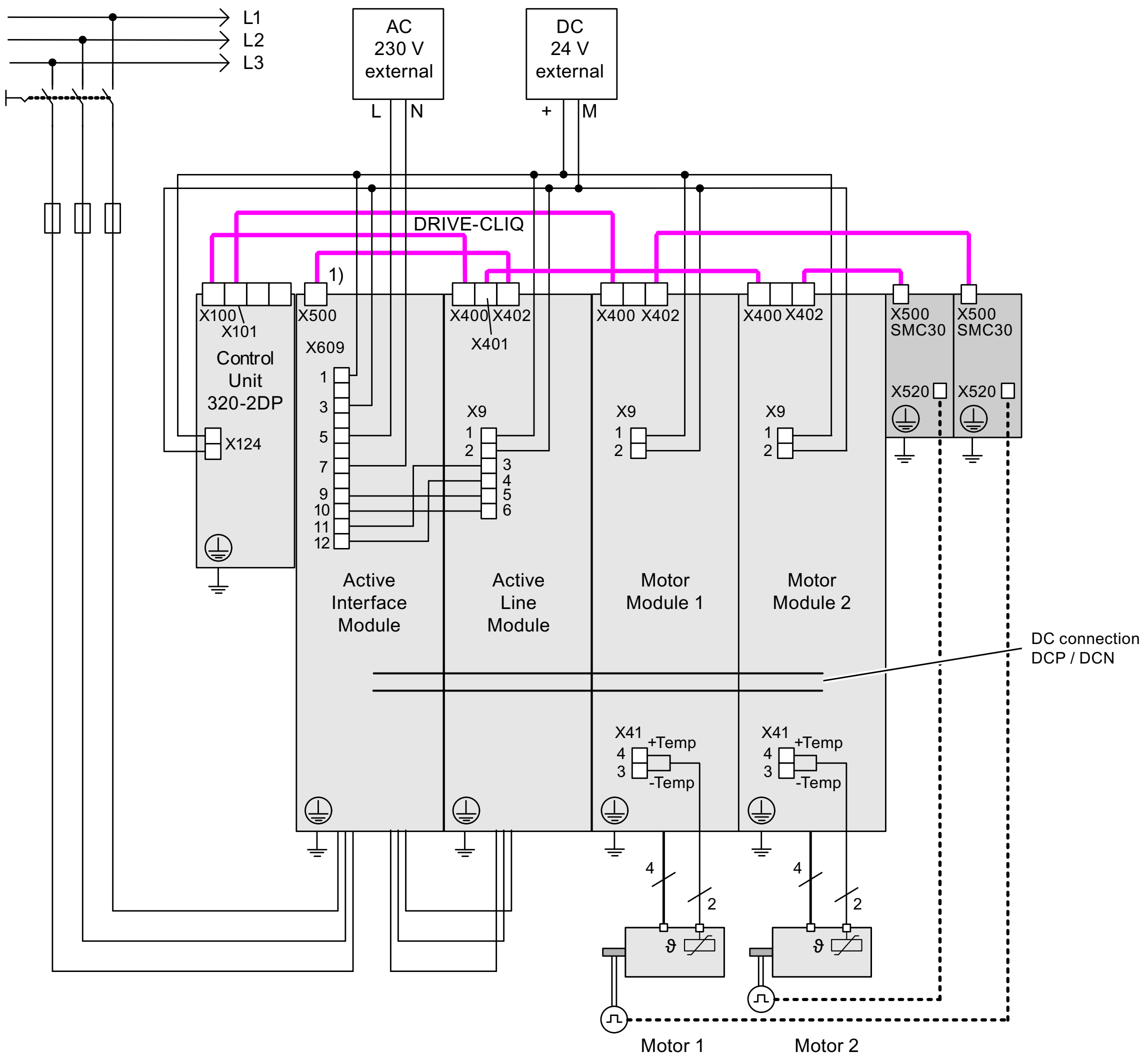


Figure 2-21 Component wiring (example)

1) X500 at the Voltage Sensing Module

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

2.6.3 Signal flow of the commissioning example

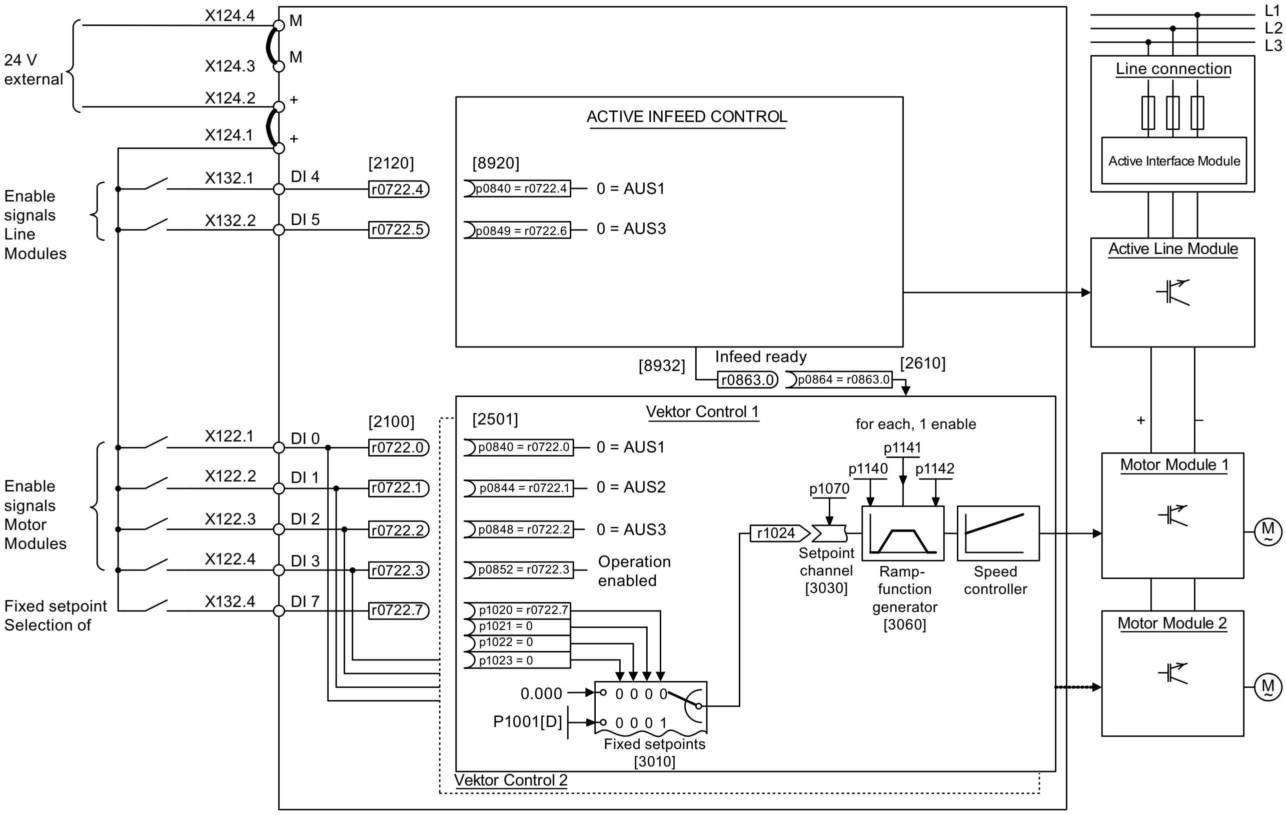


Figure 2-22 Signal flow of the commissioning example chassis

2.6.4 Commissioning with STARTER (example)

The table below describes the steps for commissioning a drive using the STARTER commissioning tool.

Table 2- 8 Commissioning sequence (example)

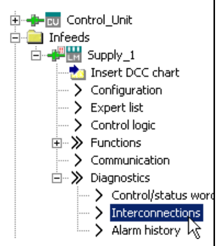
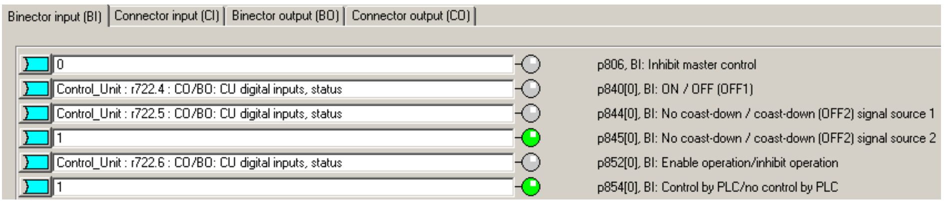
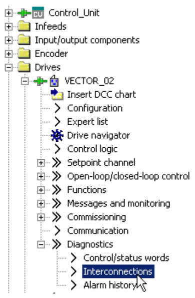
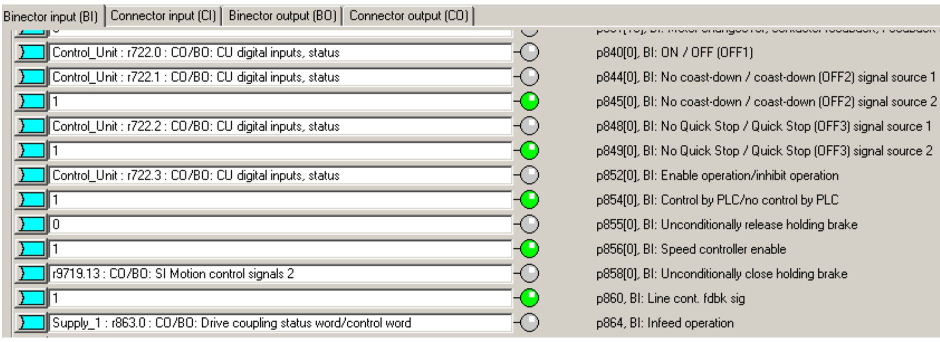
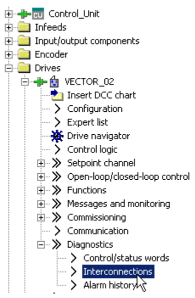
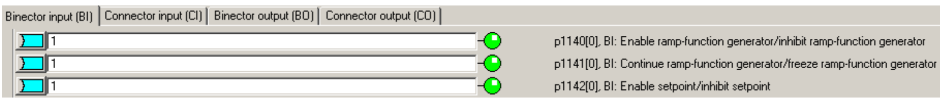
	What?	How?	Comment
1.	Creating a new project	1. Call the menu "Project > New...". 2. Assign a new name in the "New project" dialog. 3. Click "OK".	-
2.	Automatic configuration	1. Call the menu "Project > Connect to selected target devices". As there is still no device available in the project, STARTER offers the option of searching for accessible nodes. 2. Click on "Yes". 3. Activate the drive unit reached by clicking on the check box. 4. Click on "Apply". The drive unit is transferred into the project window. 5. Call the menu again "Project" > "Connect to selected target devices". You are now connected online with the drive unit. 6. Double-click on "Automatic configuration". Click on "Configure". 7. During automatic commissioning, the wizard will offer you the option of selecting the drive object type. As default assignment, select all of the "Vector" components. 8. Click on "Create". 9. After the automatic configuration has been completed, you have the option of going OFFLINE or remaining ONLINE. Select "Go OFFLINE".	-
3.	Configure the infeed	1. Double-click in the project tree on "Infeeds". 2. Double-click on the infeed that has been created. 3. Click on the yellow button "Wizard...". 4. To check the automatic settings and to enter additional data, such as equipment codes etc. continue with Point 3.2.	-
Note: When the factory setting is p7826 = 1, the firmware is automatically updated to the status on the memory card when a configured DRIVE-CLiQ component is first booted. This may take a few minutes and is indicated by the READY-LED on the corresponding components flashing green/red and the LED on the Control Unit flashing orange (0.5 Hz). Once all updates have been completed, the READY-LED on the Control Unit flashes orange at 2 Hz and the corresponding READY-LED on the components flashes green/red at 2 Hz. For the firmware to be activated, a POWER ON must be carried out for the components.			
For infeed units connected to the drive unit, which during the automatic configuration do not communicate with the Control Unit via DRIVE-CLiQ, you must manually configure and transfer into the drive topology. These devices can only be inserted in the offline mode.			

	What?	How?	Comment
3.1	Inserting an infeed unit	If there is no DRIVE-CLiQ connection to the Control Unit, then you must manually enter the data of the infeed unit using the wizard. 1. Double-click in the project tree on "Infeeds". 2. Double-click on "Insert infeed". 3. Enter a name for the infeed unit. 4. Select the type. 5. Click "OK".	If the line environment or DC link components are changed, line/DC link identification should be repeated.
3.2	Infeed	1. Assign a component name. 2. Select the line voltage range. 3. Select the cooling type. 4. Select the type. The available components are now in the selection list. 5. Select the required infeed from the list. 6. Click on "Continue >".	-
3.3	Infeed - additional data	1. Activate the line/DC link identification when switching-on for the first time. 2. Accept the device supply voltage from the previous window. The rated line frequency is determined automatically. 3. Make sure that the option "Line filter available" is activated. 4. If applicable, enter the number of parallel infeeds. 5. Where relevant, select an external Braking Module. 6. Where relevant, select master/slave operation for several infeeds. 7. Click on "Continue >".	-
3.4	Process data exchange (infeed)	One of three telegrams can be selected for communication: 370, 371 and 999. 1. Select the required telegram. 2. Click on "Continue >".	-
3.5	Configuration, summary	Configuration of the infeed unit completed. A summary is displayed. 1. Click on "Complete".	The infeed unit data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.
Caution If the infeed is controlled by a Control Unit other than that used for the Motor Module, then the "Ready" signal for the infeed r0863.0 must be connected with drive parameter p0864 "Infeed ready" via a digital input/output. If this is not taken into account, the infeed may be damaged.			
4.	Configuration of the drives	You must individually configure the drives in the offline mode. The wizard displays the data determined automatically from the electronic type plate.	-

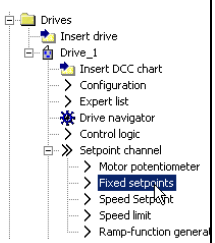
	What?	How?	Comment
For drives connected to the drive unit, which during the automatic configuration do not communicate with the Control Unit via DRIVE-CLiQ, you must manually configure and transfer into the drive topology. These devices can only be inserted in the offline mode. In this case, continue commissioning with step 4.1. If the drives have already been created by the automatic configuration, under the drive, click on "Configuration" > "Configure DDS... ". Then continue from 4.2. Settings of the power unit data and for motors with DRIVE-CLiQ interface also the motor data, are already pre-assigned based on the electronic rating plate/type plate.			
4.1	Inserting drives	1. Double-click in the project tree on "Drives". 2. Double-click on the entry "Insert drives". 3. Enter a name for the drive. 4. Select "Vector" as drive object type. 5. Click "OK".	-
4.2	Control structure	1. Where relevant, select function modules. 2. Select the control "n-/M control + U/f control, I/f control". 3. Select the control mode "[21] speed control (with encoder)". 4. Click on "Continue >".	-
4.3	Power unit	1. Enter a name for the component. 2. Select the DC supply voltage. 3. Select the cooling type. 4. Select the baud rate. 5. Select the required power unit from the list. 6. Click on "Continue >".	-
4.4	Configuration, power unit BICO interconnection	If an infeed without DRIVE-CLiQ connection is used, a message is displayed stating that the operating signal must be connected. 1. In the following dialog "Infeed in operation", set parameter p0864 to the binector output of the digital input to which the operating feedback signal of the infeed is interconnected. 2. Click on "Continue >".	-
4.5	Additional power unit data	In this window, you can additionally select the following • Various output filters • A Voltage Sensing Module • A parallel connection	With this dialog window, the configuration of the Motor Module has been completed.
Caution If a sine-wave filter is connected, then you must activate it here as otherwise it could be destroyed!			
5	Configuration, drive setting	You can select the motor standard (IEC/NEMA) and power unit application (duty cycles).	The motor data are selected and entered.

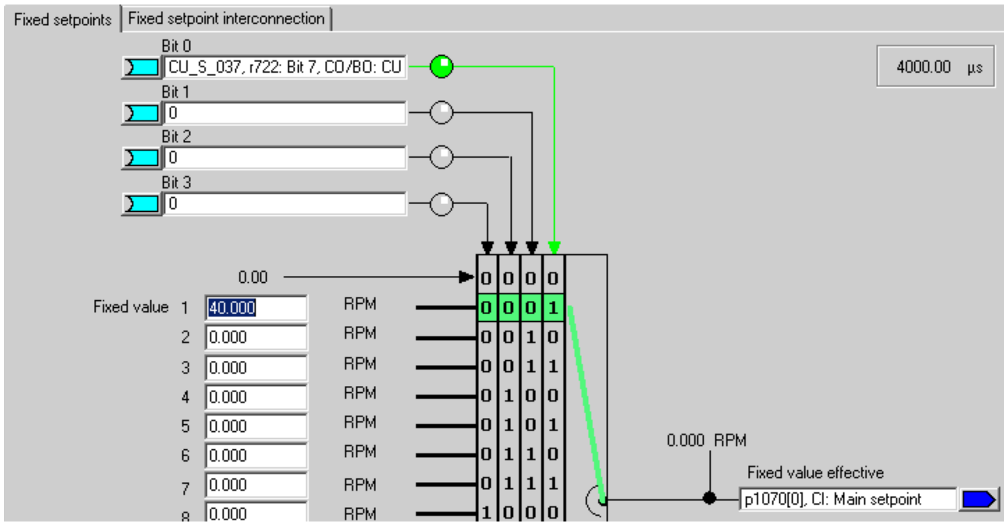
	What?	How?	Comment
5.1	Configuring the motor	1. Enter a name for the motor (e.g. equipment code). 2. If your motor has its own DRIVE-CLiQ interface, select the item. 3. Click on "Continue >". When commissioning, the motor data is automatically transferred to the Control Unit. 1. If you use a standard motor select the item, "Select standard motor from list". 2. Select the standard motor type from the "Motor type" list. 3. Then, select your motor. 4. Click on "Continue >". 1. If your motor is not in the default list, select "Enter motor data". 2. Click on your motor type in the "Motor type" list. 3. Click on "Continue >".	You can select a standard motor from the list of motors or manually enter the motor data. You can then select the motor type.
5.2	Configuring the motor data	1. Enter your motor data according to the data sheet. 1. Alternatively, after entering the motor data, carry out a motor identification when commissioning for the first time. Alternatively, for some motor types you can use motor data from the motor list. 1. To do so, click on the template. 2. Follow the wizard by clicking on "Next >". 3. If known, you can enter the mechanical data of the motor and the drive train or the data of a PE spindle. 4. If necessary, select a complete calculation of the motor/controller data without equivalent circuit diagram data. 5. For this example, select the simple drive.	If you have no mechanical data, then the data are estimated based on the rating plate data. The equivalent circuit diagram data is also estimated on the basis of the data on the rating plate or determined by means of automatic motor data identification.
5.3	Configuring a motor brake	1. If you are not using a motor holding brake, click on "Continue >". 2. If you are using a motor holding brake, you can select and configure the brake in this window. 3. Click on "Continue >".	For more information, see SINAMICS S120 Function Manual Drive Functions.
5.4	Configuring an encoder	You can connect up to 3 encoders. 1. If you are using a DRIVE-CLiQ encoder, then select the appropriate item. 2. Click on "Next >". The encoder is automatically identified and configured. 1. Alternatively, you can use a standard encoder. Select the encoder from the list. 2. Click on "Continue >".	If you are using an encoder that is not in the list, you can also manually enter the data. By clicking on details, you can view the data of the encoder selected from the the encoder list.

<table>
<tr><th></th><th>What?</th><th>How?</th><th>Comment</th></tr>
<tr><td></td><td></td><td>Alternatively, you can use your own encoder.
1. Select enter data.
2. Click on encoder data.
3. Select the measuring system.
4. Enter the required data and click on "OK".
5. Click on "Continue >".</td><td></td></tr>
<tr><td>5.5</td><td>Entering encoder data</td><td>1. Enter the encoder data into the input screen form.
2. Click "OK".</td><td>Enter additional encoders in the same way as described above.</td></tr>
<tr><td>5.6</td><td>Configuring drive functions</td><td>You can select certain technological applications and the type of motor identification.</td><td>Your choice of application influences the calculation for the open-loop/closed-loop control parameters.</td></tr>
<tr><td>5.7</td><td>Configuring process data exchange</td><td>For communication, you can select the PROFIdrive telegram from various telegrams.
1. For the example, select "[999] Free telegram configuration with BICO".
2. Click on "Continue >".</td><td>-</td></tr>
<tr><td>5.8</td><td>Important parameters</td><td>In this window, you can specify important parameters as limit values.
When doing this, observe the general mechanical conditions for the drive train.</td><td>-</td></tr>
<tr><td>5.9</td><td>Summary</td><td>The configuration of the drive train has been completed. A summary is displayed.
1. Click on "Complete".</td><td>The drive data can be copied to the clipboard for plant documentation purposes and then added to a text program, for example.</td></tr>
<tr><td colspan="4">Note
The reference parameters and limit values can be protected from being automatically overwritten in the STARTER commissioning tool by setting p0340 = 1. You can find this function in the STARTER commissioning tool under Drive > Configuration > Blocked list tab.</td></tr>
<tr><td>6.</td><td>Enable signals and BICO interconnections</td><td>The enable signals for the infeed and the two drives must be realized via the digital inputs on the Control Unit.</td><td>Note:
If an Active Line Module is used, to enable the infeed unit, a signal source other that that used for the Motor Module must be used.</td></tr>
<tr><td>6.1</td><td>Active Line Module</td><td>• Enable signals for the Active Line Module:
p0840 = 722.4 ON/OFF1
p0844 = 722.5 OFF2
p0852 = 722.6 Enable operation</td><td>See function diagram [8920]</td></tr>
</table>

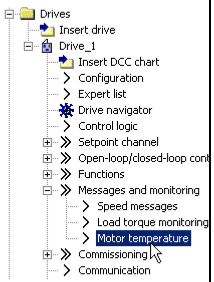
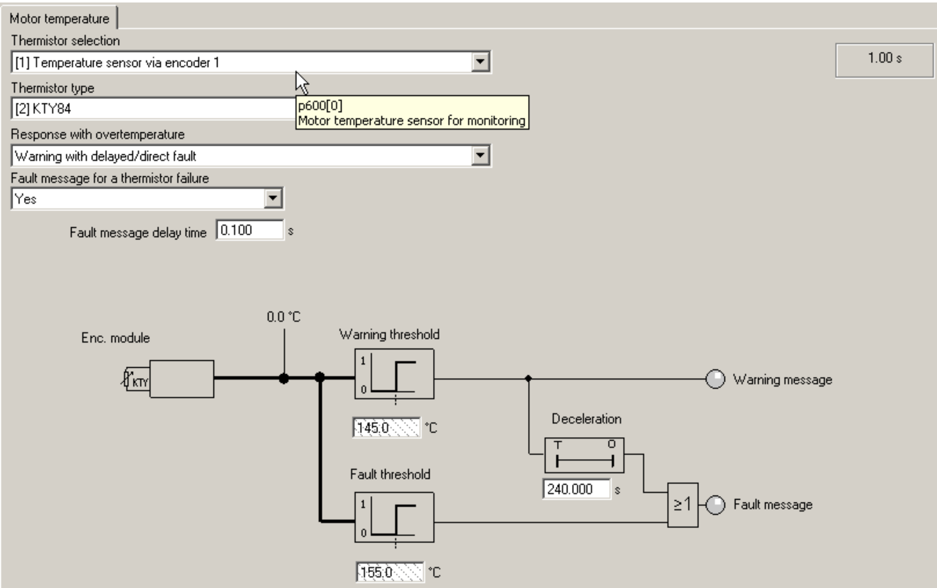
<table>
<tr><th></th><th>What?</th><th>How?</th><th>Comment</th></tr>
<tr><td></td><td>
</td><td colspan="2">
</td></tr>
<tr><td>6.2</td><td>Enable Motor Module</td><td>• Enable signals for the Motor Module (drive_1):
p0840 = 722.0 ON/OFF1
p0844 = 722.1 1. OFF2
p0845 = 1 2. OFF2
p0848 = 722.2 1. OFF3
p0849 = 1 2. OFF3
p0852 = 722.3 Enable operation
p0864 = 863.0 Infeed operation</td><td>See function diagram [2501]</td></tr>
<tr><td></td><td>
</td><td colspan="2">
</td></tr>
<tr><td>6.3</td><td>Ramp-function generator configuration</td><td>• Ramp-function generator
p1140 = 1 Ramp-function generator enable
p1141 = 1 Ramp-function generator start
p1142 = 1 Enable setpoint</td><td>See function diagram [3060]</td></tr>
<tr><td></td><td>
</td><td colspan="2">
</td></tr>
</table>

	What?	How?	Comment
6.4	Setpoint configuration	• Specify setpoint: p1001 = 0 Fixed setpoint 1 p1002 = 40 Fixed setpoint 2 p1020 = r0722 Fixed speed setpoint selection r1024 = p1070 Fixed setpoint active	A setpoint of 0 (0 signal) or 40 (1 signal) is defaulted via digital input 7. This setpoint is then applied to the main setpoint p1070. See function diagram [3010]





7.	Load parameters to device	1. Select the drive unit in the project tree. 2. Call the "Connect target device" shortcut menu. 3. Then call "Target device" > "Load to target device" shortcut menu.	Position cursor on drive unit and right-click.
8.	Configuration, motor temperature	For the setting, p0340 must be 0. If p0340 >< 0, then the temperature sensor selection is locked. 1. Make the following settings: – the way in which the motor temperature is received – the temperature sensor type – for overtemperature, the response to alarm and fault (no reduction of I_{max}). – the alarm message when a sensor fails – the delay time to 0.100 s – the warning threshold to 120.0 C – the fault threshold to 155.0 °C	

<table>
<tr><th></th><th>What?</th><th>How?</th><th>Comment</th></tr>
<tr><td></td><td>
</td><td colspan="2">
</td></tr>
<tr><td>9.</td><td>Save the parameters on the device</td><td>1. Select the drive unit in the project tree.
2. Call the "Connect target device" shortcut menu.
3. Call the "Target device > Load to target device" shortcut menu.
The option "After loading, copy RAM to ROM" is active.
Click on "Yes" to confirm backup.
or
4. Call the shortcut menu "Target device > Copy RAM to ROM".</td><td>Position cursor on drive unit (SINAMICS S120) and right-click.</td></tr>
<tr><td>10</td><td>The motor starts to run.</td><td>The drives can be started via the control panel in the STARTER commissioning tool.
• Line/DC link identification will be carried out once the pulses for the infeed have been enabled and line/DC link identification has been activated. The infeed then switches into the "Operation" state.
• 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.</td><td>For more information about the control panel, see Getting Started.
During motor data 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/motor data identification, see the SINAMICS S120 Function Manual Drive Functions.</td></tr>
</table>

Important diagnostic parameters (see the SINAMICS S120/S150 List Manual)

- r0002 Infeed/drive operating display
- r0046 Missing enable signals, for more information, see Chapter, "Diagnostics"

2.7 First commissioning vector control AC drive blocksize format

An example provided in this chapter explains all the configuration and parameter settings, as well as tests that are required for initial commissioning. Commissioning is carried out using the STARTER commissioning tool.

Preconditions for commissioning

- The commissioning preconditions (Page 18) have been met.
- The commissioning checklists (Page 20) (Tables 1-1 and 1-2) have been completed and the points fulfilled.
- The STARTER commissioning tool is installed and activated.
  – see the "Readme" file on the STARTER installation DVD
- The drive system has been wired according to the specifications.
- The communication between the PG/PC and drive system has been prepared.
- The power supply of the Control Unit (24 V DC) has been switched on.

2.7.1 Task

A drive unit is to be commissioned (vector control, closed-loop speed control), without DRIVE-CLiQ and without speed encoder with the following components:

Designation	Component	Order number
Closed-loop control		
Control Unit	Control Unit 310-2 DP	6SL3040-1LA00-0AA0
Operator Panel	Basic Operator Panel BOP20	6SL3055-0AA00-4BAx
Infeed and drive		
Power Module	Power Module 340	6SL3210-1SB14-xxxx
Motor	Induction motor (without DRIVE-CLiQ interface)	1LA7

Commissioning is performed using the BOP20.

The function keys on the BOP20 must be parameterized so that the ON/OFF signal and speed settings can be defined via these keys.

2.7.2 Component wiring (example)

The following diagram shows the structure of the components and the appropriate wiring.

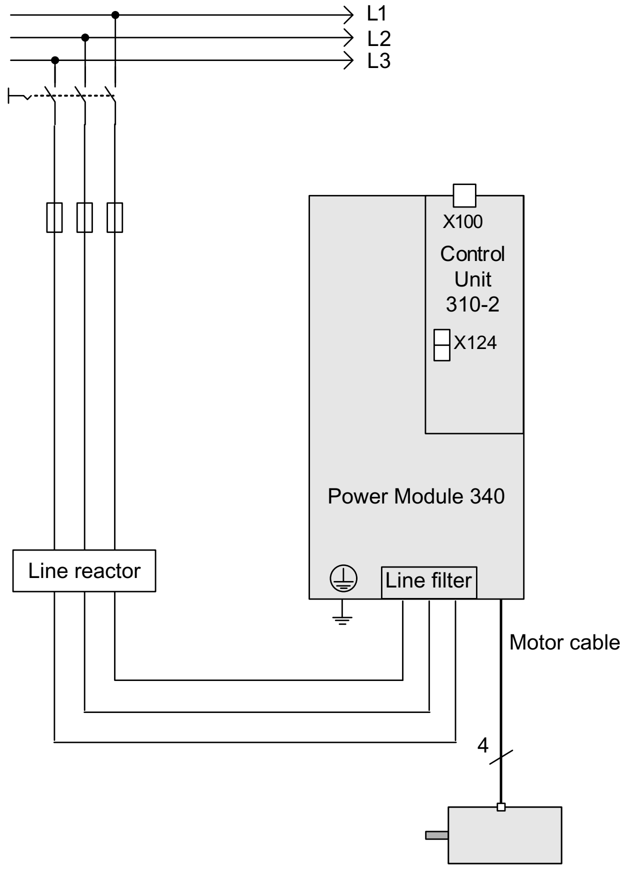


Figure 2-23 Component wiring (example)

For more information on wiring, see the Equipment Manual.

2.7.3 Quick commissioning using the BOP (example)

> ⚠ **WARNING**
>
> **Danger due to hazardous axis movements**
>
> During motor data identification, the drive may cause the motor to move.
>
> The EMERGENCY OFF functions must be fully operational during commissioning. To protect the machines and personnel, the relevant safety regulations must be observed.

Table 2- 9 Quick commissioning for a VECTOR drive without a DRIVE-CLiQ interface

	Procedure	Description		Factory setting
Restore the drive to the factory setting:				
1.	p0009 = 30	**Device commissioning parameter filter ***		1
		0	Ready	
		1	Device configuration	
		30	Parameter reset	
2.	p0976 = 1	**Reset and load all parameters**		0
		0	Not active	
		1	Start restoring all parameters to their factory settings	
After approx. 15 sec. wait time, the BOP display = 35 and the RDY-LED is green. p0009 is automatically set to 1, p0976 to 0. **Note:** As soon as the RDY-LED is green again, the factory setting has been completed and commissioning can start.				
3.	p0009 = 1	**Device commissioning parameter filter ***		1
		0	Ready	
		1	Device configuration	
		30	Parameter reset	
4.	p0097 = 2	**Select drive object type ***		0
		0	No selection	
		1	Drive object type SERVO	
		2	Drive object type VECTOR	
5.	p0009 = 0	**Device commissioning parameter filter ***		1
		0	Ready	
		1	Device configuration	
Note: Wait approx. 10 sec. The basic configuration is saved once the RDY lights green. In order to transfer this state into the ROM, press the "p" button until the display flashes. When the flashing stops, the RDY changes from orange to green and the transfer has been completed. Alarm A07991 indicates that the motor data identification function has been activated at drive "DO 2". The drive parameters are entered:				
6.	DO = 2	**Select drive object (DO) = 2 (= VECTOR)**		1
		1	Expert list of the CU	
		2	Expert list of the drive	
		To select a drive object (DO), simultaneously press the "Fn" key and the arrow ↑ key. The selected drive object is displayed at the top left.		
7.	p0010 = 1	**Drive, commissioning parameter filter ***		1
		0	Ready	
		1	Quick commissioning	

	Procedure	Description	Factory setting
8.	p0100 = 0	**IEC/NEMA motor standard**	0
		0: IEC motor (SI units, e.g. kW) Preset: Rated motor frequency (p0310): 50 Hz Specification of the power factor cos φ (p0308)	
		1: NEMA motor (US units, e.g. hp) Preset: Rated motor frequency (p0310): 60 Hz Specification of the efficiency (p0309)	
		Note: When p0100 is changed, all the rated motor parameters are reset.	
9.	p030X[0] = ...	**Rated motor data [MDS]** Only when p0300 < 100 (third-party motor) Enter the rated motor data in accordance with the rating plate, e.g.	-
		p0304[0]: Rated motor voltage [MDS]	
		p0305[0]: Rated motor current [MDS]	
		p0307[0]: Rated motor output [MDS]	
		p0308[0]: Rated motor power factor [MDS] (only when p0100 = 0)	
		p0309[0]: Rated motor efficiency [MDS] (only when 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	
10.	p1900 = 2	**Motor data identification and rotating measurement***	2
		0: Inhibited	
		1: Motor data identification for rotating motor	
		2: Motor data identification for a stationary motor	
		Message A07991 is displayed, motor data identification was activated.	
11.	p0010 = 0	**Drive, commissioning parameter filter ***	1
		0: Ready	
		1: Quick commissioning	
RDY is lit red, fault F07085 signals that a control parameter has been changed.			
Parameter p0840[0] can only be changed with access level p0003 = 3.			
12.	p0840[0] = r0019.0(DO 1)	**BI: ON/OFF1 [CDS]** Sets the signal source for STW1.0 (ON/OFF1) Interconnection with r0019.000 of the drive object Control Unit (DO 1) Effect: Signal ON/OFF1 from the BOP	0
13.	p1035[0] = r0019.0013 (DO 1)	**BI: Motor potentiometer setpoint higher [CDS]** Sets the signal source to increase the setpoint for the motorized potentiometer Interconnection with r0019.013 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer setpoint higher from BOP	0

	Procedure	Description	Factory setting
14.	p1036[0] = r0019.0014 (DO 1)	**BI: Motor potentiometer setpoint lower [CDS]** Sets the signal source to reduce the setpoint for the motorized potentiometer Interconnection with r0019.014 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer lower setpoint from BOP	0
15.	p1070[0] = r1050 (DO 63)	**CI: Main setpoint [CDS]** Sets the signal source for speed setpoint 1 of the speed controller. Interconnection with r1050.000 to the separate drive object (DO 63) Effect: Motorized potentiometer supplies the speed setpoint	0
16.	"FN", then press "P". The display indicates 41, press "O", the display jumps to 31.		
17.	Start the motor data identification with "I". The drive switches off again after approx. 5 sec., the display goes back to 41.		
18.	After pressing "O", 31 is displayed again. The drive is now ready. The drive is switched on by pressing "I", the motor accelerates by pressing the "↑" key.		
19.	Save all parameters	Press the P key for approx. 5 sec until the display flashes.	
* These parameters offer more setting options than the ones described here. For further setting options see SINAMICS S120/S150 List Manual [CDS] Parameter depends on command data sets (CDS). Data set 0 is preset. [DDS] Parameter depends on drive data sets (DDS). Data set 0 is preset. [MDS] Parameter depends on motor data sets (MDS). Data set 0 is preset. BI binector input BO binector output CI connector input CO connector output			

2.8 First commissioning servo control AC drive blocksize format

An example provided in this chapter explains all the configuration and parameter settings, as well as tests that are required for initial commissioning. Commissioning is carried out using the STARTER commissioning tool.

Preconditions for commissioning

- The commissioning preconditions (Page 18) have been met.
- The commissioning checklists (Page 20) (Tables 1-1 and 1-2) have been completed and the points fulfilled.
- The STARTER commissioning tool is installed and activated.
  – see the "Readme" file on the STARTER installation DVD
- The drive system has been wired according to the specifications.
- The communication between the PG/PC and drive system has been prepared.
- The power supply of the Control Unit (24 V DC) has been switched on.

2.8.1 Task

A drive unit is to be commissioned (servo control, closed-loop speed control) with the following components:

Designation	Component	Order number
Closed-loop control		
Control Unit	Control Unit 310-2 DP	6SL3040-1LA00-0AA0
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 1 Vpp 2048 p/r	1FK7xxx–xxxxx–xAxx

Commissioning is performed using the BOP20.

The Basic Operator Panel (BOP) should be parameterized so that the ON/OFF signal and the speed setpoints are entered using the function keys.

2.8.2 Component wiring (example)

The following diagram shows the structure of the components and the appropriate wiring.

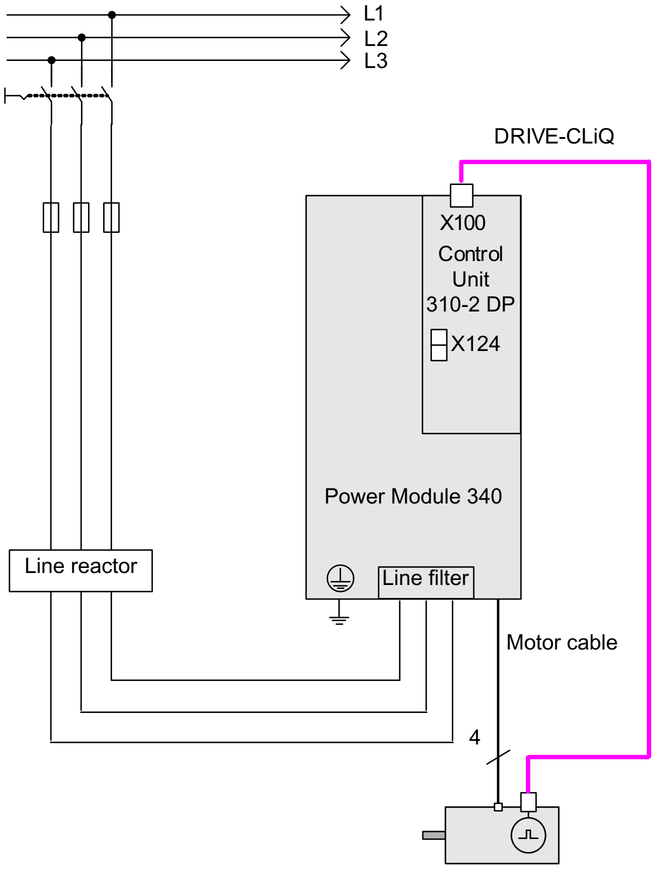


Figure 2-24 Component wiring with integrated Sensor Module (example)

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

2.8.3 Quick commissioning using the BOP (example)

Table 2- 10 Quick commissioning for a servo drive with a DRIVE-CLiQ interface

	Procedure	Description		Factory setting
Note: Before commissioning for the first time, in the drive mode DO = 1, the drive is restored to the factory setting.				
1.	p0009 = 30	**Device commissioning parameter filter**		1
		0	Ready	
		1	Device configuration	
		30	Parameter reset	
2.	p0976 = 1	**Reset and load all parameters**		0
		0	Not active	
		1	Start restoring all parameters to their factory settings	
Note: As soon as the RDY-LED is green again, the factory setting has been established and commissioning can start.				
3.	p0003 = 3	**Access levels**		1
		1	Standard	
		2	Extended	
		3	Expert	
4.	p0009 = 1	**Device commissioning parameter filter ***		1
		0	Ready	
		1	Device configuration	
		30	Parameter reset	
5.	p0097 = 1	**Select drive object type ***		0
		0	No selection	
		1	Drive object type SERVO	
		2	Drive object type VECTOR	
6.	p0009 = 0	**Device commissioning parameter filter ***		1
		0	Ready	
		1	Device configuration	
		30	Parameter reset	
Note: For the firmware to be activated, a POWER ON must be carried out for the components. The extended setpoint channel must be opened for motorized potentiometer simulation with p0108[1] = H0104				
7.	p0009 = 2	**Device commissioning parameter filter ***		1
		0	Ready	
		1	Device configuration	
		2	Defining the drive type / drive options	
		30	Parameter reset	
8.	p0108[1] = H0104		**Drive object, function module ***	H0000
		Bit 2	Closed-loop speed/torque control	
		Bit 8	Extended setpoint channel	

	Procedure	Description		Factory setting
9.	p0009 = 0	**Device commissioning parameter filter ***		1
		0	Ready	
		1	Device configuration	
		30	Parameter reset	
Note: Wait until the RDY-LED changes from orange to green. To save the setting in the ROM, press about 5 seconds on the "P" key until the BOP display flashes, then wait until flashing has stopped. The drive is now prepared.				
10.	DO = 2	**Select drive object (DO) 2 (= SERVO)**		1
		1	Expert list of the CU	
		2	Expert list of the SERVO drive	
		To select a drive object (DO), simultaneously press the Fn key and the "Arrow up" key. The selected drive object is displayed at the top left.		
11.	p0840[0] = r0019.0(DO 1)	**BI: ON/OFF1 [CDS]** Sets the signal source for STW1.0 (ON/OFF1) Interconnection with r0019.0 of the drive object Control Unit (DO 1) Effect: Signal ON/OFF1 from the BOP		0
12.	p1035[0] = r0019.0013 (DO 1)	**BI: Motor potentiometer setpoint higher [CDS]** Sets the signal source to increase the setpoint for the motorized potentiometer Interconnection with r0019.13 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer setpoint higher from BOP		0
13.	p1036[0] = r0019.0014 (DO 1)	**BI: Motor potentiometer setpoint lower [CDS]** Sets the signal source to reduce the setpoint for the motorized potentiometer Interconnection with r0019.14 of the drive object Control Unit (DO 1) Effect: Signal, motorized potentiometer lower setpoint from BOP		0
14.	p1037 = 6.000	Max. speed, setpoint potentiometer		0.000
15.	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		1024
16.	p0006 = 0	**BOP operating display mode***		4
		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	
"FN", then press "P", the display in DO = 2 displays 31.				

	Procedure	Description	Factory setting
17.	Save all parameters	Press the "P" key for approx. 5 sec, 41 is displayed. After pressing the "O" key, the display jumps to 31 - and the drive is now ready. 10 is displayed in DO = 1.	
* These parameters offer more setting options than the ones described here. For further setting options see SINAMICS S120/S150 List Manual [CDS] Parameter depends on command data sets (CDS). Data set 0 is preset. [DDS] Parameter depends on drive data sets (DDS). Data set 0 is preset. BI binector input BO binector output CI connector input CO connector output			

2.9 Commissioning of power units connected in parallel

During commissioning, power units connected in parallel are treated like a power unit on the line or motor side. With parallel connection, the parameter display for the actual values changes only slightly. Suitable "total values" are derived from the individual values of the power units.

Only power units in the "chassis" format are released for a parallel connection:

- Infeeds
- Motor Modules for vector control

When commissioning the power units for the first time, activate the parallel connection via the wizards in the STARTER commissioning tool. Select the parallel connection when selecting the power unit (infeed and/or Motor Module) according to the following diagrams as option:

Parallel connection of infeeds in the STARTER commissioning tool

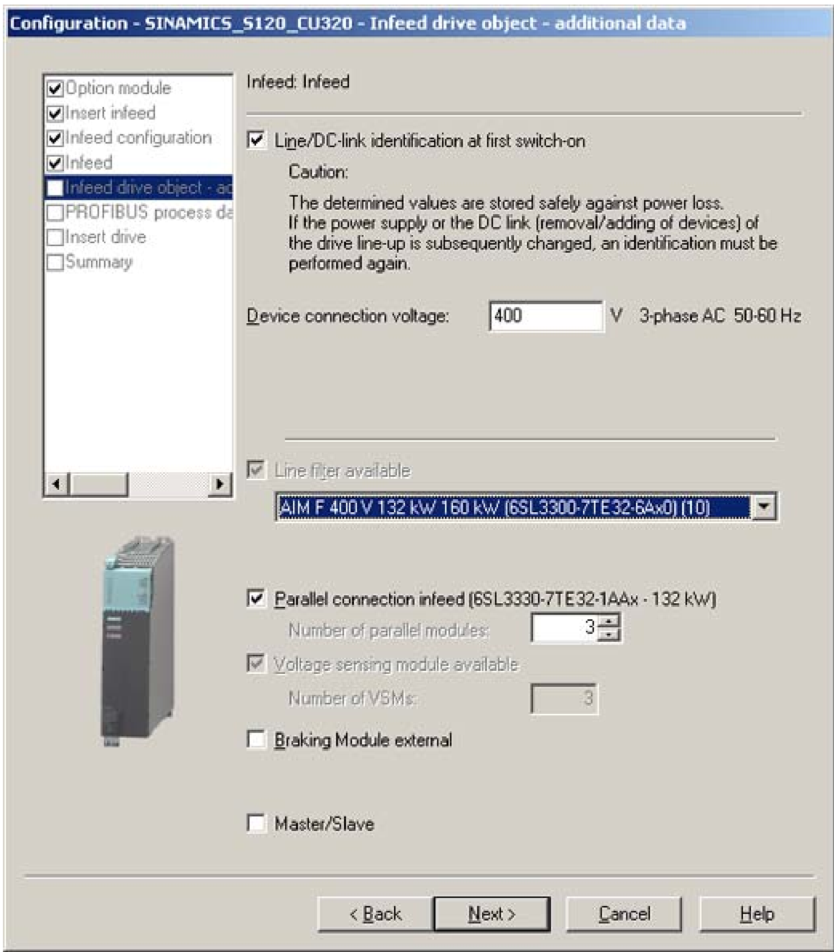


Figure 2-25 Example of parallel connection of 3 Active Line Modules (chassis type)

You need to specify the number of infeeds to be connected in parallel in the appropriate field (maximum 4 infeeds are permitted).

Active Line Modules can also be used in the master/slave mode. The master/slave function can be selected as option in this window (for further information, refer to the Chapter "Master/slave function for infeeds" in the SINAMICS S120 Function Manual Drive Functions).

The line filter is offered as an option, depending on the infeed. An Active Interface Module (AIM) with integrated line filter is required to operate an "Active Line Module" (ALM). We recommend external line filters to operate the "Basic Line Module" (BLM) and "Smart Line Module" (SLM) Line Modules.

Parallel connection of Motor Modules in the STARTER commissioning tool

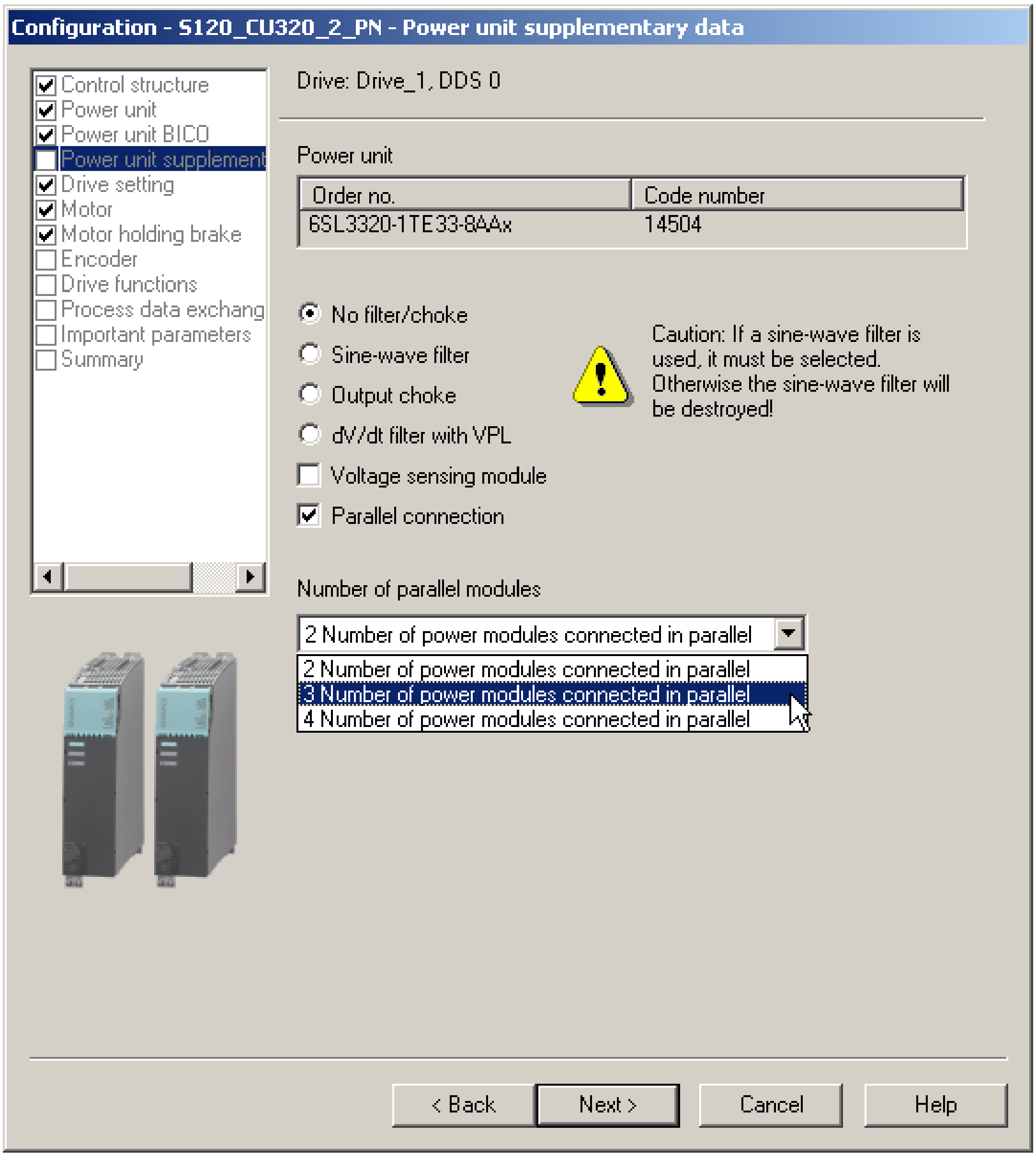


Figure 2-26 Example of a parallel connection of 3 Motor Modules (chassis format, in vector control)

Select the number of Motor Modules connected in parallel in the drop-down list, "Number of parallel modules" (max. 4 Motor Modules).

Note

For the parallel connection, operation is released for a maximum of 8 power units (max. 4 Motor Modules and max. 4 Line Modules).

Configuration of parallel connections using parameters

From the perspective of the higher-level control system, the parallel connection of infeeds behaves exactly the same as when controlling a single infeed, whose power is the same as the total power of the individual infeeds connected in parallel.

PROFIdrive telegrams allow the power units to be individually activated and their status queried using parameter services from a higher-level controller. Infeeds may also be activated using the appropriate control and status words. These are documented in the chapter "Communication according to PROFIdrive" in the SINAMICS S120 Drive Functions Function Manual.

Power units should only be activated and deactivated in the event of a fault, for example, after replacing a failed power unit. This approach is unsuitable for variable power control, because the Control Unit recalculates the drive line-up control parameters after every change. Optimal, highly dynamic control behavior of the drive line-up can only be ensured by recalculation.

The power units can be monitored and parameterized individually:

- Using p0125, you activate or deactivate a power unit from the topology (select using the topology number).
- With p0895, you specifically activate or deactivate power units via an interconnected digital input (BI).
- The number of currently active power units in a parallel connection is displayed in r7000.
- After a fault or replacement, parameter p7001 allows you to specifically deactivate or activate connected power units.

Alarm messages (e.g. as a result of overtemperature) can still be sent in this state. Individual power units cannot be disabled for motors with separate winding systems (p7003 = 1).
p7001 is reset automatically if a power unit is deactivated with p0125 or p0895.

- You can use parameter r7002 to query whether the pulses in a power unit are inhibited or enabled.
- The circulating currents of U, V, W at the power units are displayed in parameters r7050, r7051 and r7052.
- Overload states and various temperature states in the power units can be displayed in parameters from r7200 up to r7219.

Parallel connection is indicated with a "P" in front of the value shown on the parameter value display.

Other parameters relevant for the operation and parameterization of power units can be taken from the SINAMICS S120/S150 List Manual from parameter r7002 or from p0125 onwards.

Parallel connection with one or two Control Units

If an infeed is deactivated, the pre-charging must be able to charge the remaining infeeds in the DC link. For example, the charging time is doubled, if only one of the two infeeds connected in parallel is activated. Configure the infeeds in such a way that one of the parallel infeeds or, for redundant interconnection (2 Control Units), one subsystem is able to pre-charge the whole DC link.

The connected capacitance should not be too large. However, pre-charging double an infeed's rated capacitance (one of two infeeds previously out of operation) will work with no problems.

Pre-charging contactor monitoring

To monitor the pre-charging contactors (for infeed failure), you must insert the auxiliary terminal blocks on the pre-charging contactors.

The following diagram shows the basic concept of interconnection:

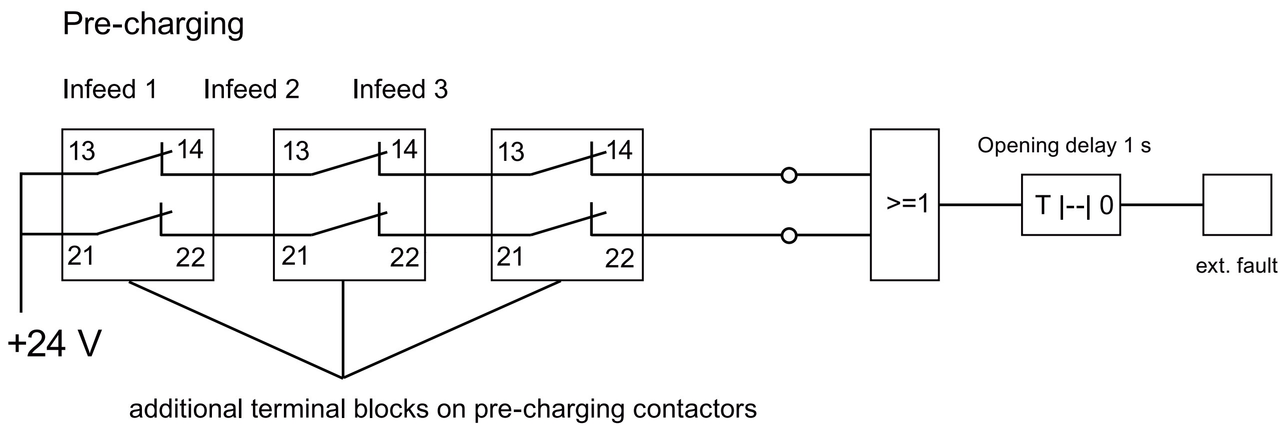


Figure 2-27 Pre-charging contactor monitoring

The contactor states can be monitored using the logic blocks "free blocks" in the SINAMICS drive. If one of the contactors does not pick up, an external fault message is generated.

Operating state of power units connected in parallel

Fault messages and alarms from A05000 or F05000 onwards indicate faults in a power unit.

Power unit faults are stored in the fault buffer in the appropriate Control Unit and can be read as a fault value using parameter r0949 (interpreted decimally). This fault value corresponds to the drive object number in the drive line-up topology. The number of the fault occurring is stored in parameter r0945.

The power unit's operating state (infeed or Motor Module) is displayed at both front LEDs on the corresponding Control Interface Module (CIM).

The power unit for a specific drive can be identified using parameter p0124. During p0124[0...n] = 1, the LED READY on the power unit concerned flashes green/orange or red/orange at 2 Hz. For parallel connections the parameter index is assigned to one power unit in each case.

Configuration of power units connected in parallel

Information on the hardware configuration and wiring the power units is provided in the SINAMICS S120 Manual Chassis Power Units.

You can find information on configuration in "SINAMICS Configuration Manual G130, G150, S120 Chassis, S120 Cabinet Modules, S150". The installation of power units within a control cabinet with Line Connection Modules is also described in this manual.

2.10 Learn devices

Description

Using a software update, the "learning devices" function amends an existing STARTER (from version V4.2) with information about later drive firmware versions.

The update is implemented with a SINAMICS Support Package (SSP) from STARTER version 4.2. Here, equipment descriptions have been added to the STARTER commissioning tool, without having to reinstall the tool or change the code and without the drive being physically available.

A SINAMICS Support Package must be installed if SINAMICS versions are to be supported by the STARTER commissioning tool that are not included in STARTER version 4.2. You can download SINAMICS Support Packages on the Internet from the eSupport and Product Support pages.
The existence of new SSPs in Product Support will be announced when a new SINAMICS version is released for delivery.

SSP (SINAMICS Support Package)

An SSP contains only description files of the devices and drive objects. By installing an SSP, new drive objects and devices can be added to an existing STARTER installation, without changing its program code.
After installation, all the functions of the new SINAMICS version can be configured with the expert list. All screens and wizards are also available for all the functions compatible with the previous version.

SSP content:

- New drive objects
- New device versions
- New and changed parameters in the expert list
- New and changed faults, alarms and messages
- New and changed sequence parameterizations
- Expansions of the component catalog (new motors, encoders, DRIVE-CLiQ components)
- Expansion of the configuration catalog (SD)
- Changed online help files (parameter help, function diagrams)

Installation

All SSPs released for a STARTER version may be installed in any order.

The installed SINAMICS Support Packages are displayed in the Info dialog box of STARTER.

If a new STARTER version has been created and delivered, this STARTER contains all SSPs released up until the present time, or is compatible with them.

Compatible SSPs can also be installed a multiple number of times if repairs are necessary, without functional changes.

The STARTER commissioning tool should not be running during SSP installation. The installation program should be started and run through. Only after the installation has been finished and STARTER has been called up again, can you now configure the newly installed SINAMICS versions offline and operate them online (via "Accessible nodes" for example).

2.11 Selection and configuration of encoders

Encoder selection

For a SINAMICS drive system, there are three possibilities of selecting the encoder using the STARTER commissioning tool:

- Evaluating the motor and encoder data via a DRIVE-CLiQ interface.

  The encoder is automatically identified by setting parameter p0400 = 10000 or 10100, i.e. all of the motor and encoder data required for the configuration are read out of the encoder. For p0400 = 10100, the identification time is not limited.
- Select a standard encoder from a list (also possible via the motor order number for encoder 1/motor encoder). Every encoder type on the list has a code number, that can also be assigned using parameter p0400 (encoder type selection).
- Manually entering user-defined encoder data. In this case, the encoder can be configured using the encoder-specific input screens in the STARTER commissioning tool.

The encoders can also be configured on their own using parameters (parameters p0400 to p0499).

Table 2- 11 Assigning encoder type, encoder code and evaluation modules for standard encoders

Encoder type		Encoder code	Encoder evaluation procedure	Evaluation module
DRIVE-CLiQ encoder	Absolute rotary value	202 242 204 244	Abs.,singleturn 20 bit abs.,singleturn 24 Bit abs.,multiturn 12 bit, singleturn 20 bit) abs.,multiturn 12 bit, singleturn 24 bit)	-
Resolver	Incremental rotary	1001 1002 1003 1004	Resolver 1-speed Resolver 2-speed Resolver 3-speed Resolver 4-speed	SMC10, SMI10
Encoder with sin/cos 1Vpp	Incremental encoder rotary	2001 2002 2003 2005 2010	2048, 1 Vpp, A/B C/D R 2048, 1 Vpp, A/B R 256, 1 Vpp, A/B R 512, 1 Vpp, A/B R 18000, 1 Vpp, A/B R distance-coded	SMC20, SMI20, SME20, SME120
EnDat encoder	Absolute value rotary	2051 2052 2053 2054 2055	2048, 1 Vpp, A/B, EnDat, multiturn 4096 32, 1 Vpp, A/B, EnDat, multiturn 4096 512, 1 Vpp, A/B, EnDat, multiturn 4096 16, 1 Vpp, A/B, EnDat, multiturn 4096 2048, 1 Vpp, A/B, EnDat, singleturn	SMC20, SMC40, SMI20, SME25
SSI encoder with sin/cos 1Vpp	Absolute value rotary	2081 2082 2083 2084	2048, 1 Vpp, A/B, SSI, singleturn 2048, 1 Vpp, A/B, SSI, multiturn 4096 2048, 1 Vpp, A/B, SSI, singleturn, error bit 2048, 1 Vpp, A/B, SSI, multiturn 4096, error bit	SMC20, SMI20, SME25, SME125
Linear encoder	Incremental linear	2110 2111 2112 2151	4000 nm, 1 Vpp, A/B R distance-coded 20000 nm, 1 Vpp, A/B R distance-coded 40000 nm, 1 Vpp, A/B R distance-coded 16000 nm, 1 Vpp, A/B, EnDat, resolution 100 nm	SMC20, SMI20, SME20

Encoder type		Encoder code	Encoder evaluation procedure	Evaluation module
	Absolute value linear	2151	16000 nm, 1 Vpp, A/B, EnDat, resolution 100 nm	SMC20, SMI20, SME25
HTL/TTL encoders	Incremental square wave rotary	3001 3002 3003 3005 3006 3007 3008 3009 3011 3020	1024 HTL A/B R 1024 TTL A/B R 2048 HTL A/B R 1024 HTL A/B 1024 TTL A/B 2048 HTL A/B 2048 TTL A/B 1024 HTL A/B unipolar 2048 HTL A/B unipolar 2048 TTL A/B R, with Sense	SMC30
SSI encoder absolute	Absolute value rotary	3081 3082	SSI, singleturn, 24 V SSI, multiturn 4096, 24 V Not for motor control, only as a direct measurement system	SMC20, SMI20, SME25, SME125
SSI encoder absolute HTL	Absolute value rotary	3090	4096, HTL, A/B, SSI, singleturn	SMC30
Linear encoder	Incremental linear	3109	2000 nm, TTL, A/B R distance-coded	SMC20, SMI20, SME20
SIMAG H2	Incremental encoder rotary	2002 2003 2004 2005 2006 2007 2008	2048, 1 Vpp, A/B R 256, 1 Vpp, A/B R 400, 1 Vpp, A/B R 512, 1 Vpp, A/B R 192, 1 Vpp, A/B R 480, 1 Vpp, A/B R 800, 1 Vpp, A/B R	SMC20, SMI20, SME20

Note

The SMC40 can only be completely configured, if an associated EnDat 2.2 encoder is connected. Without a connected encoder, it is not possible to integrate the SMC40 into the topology.

Configuring an encoder

You can configure the encoders using an input screen in the STARTER commissioning tool. You have three configuration options:

Configuration for encoders with DRIVE-CLiQ interface

1. Activate the "Encoder with DRIVE-CLiQ interface" option button with a mouse click.

   Then the encoder with DRIVE-CLiQ interface is automatically identified in the encoder configuration screen.

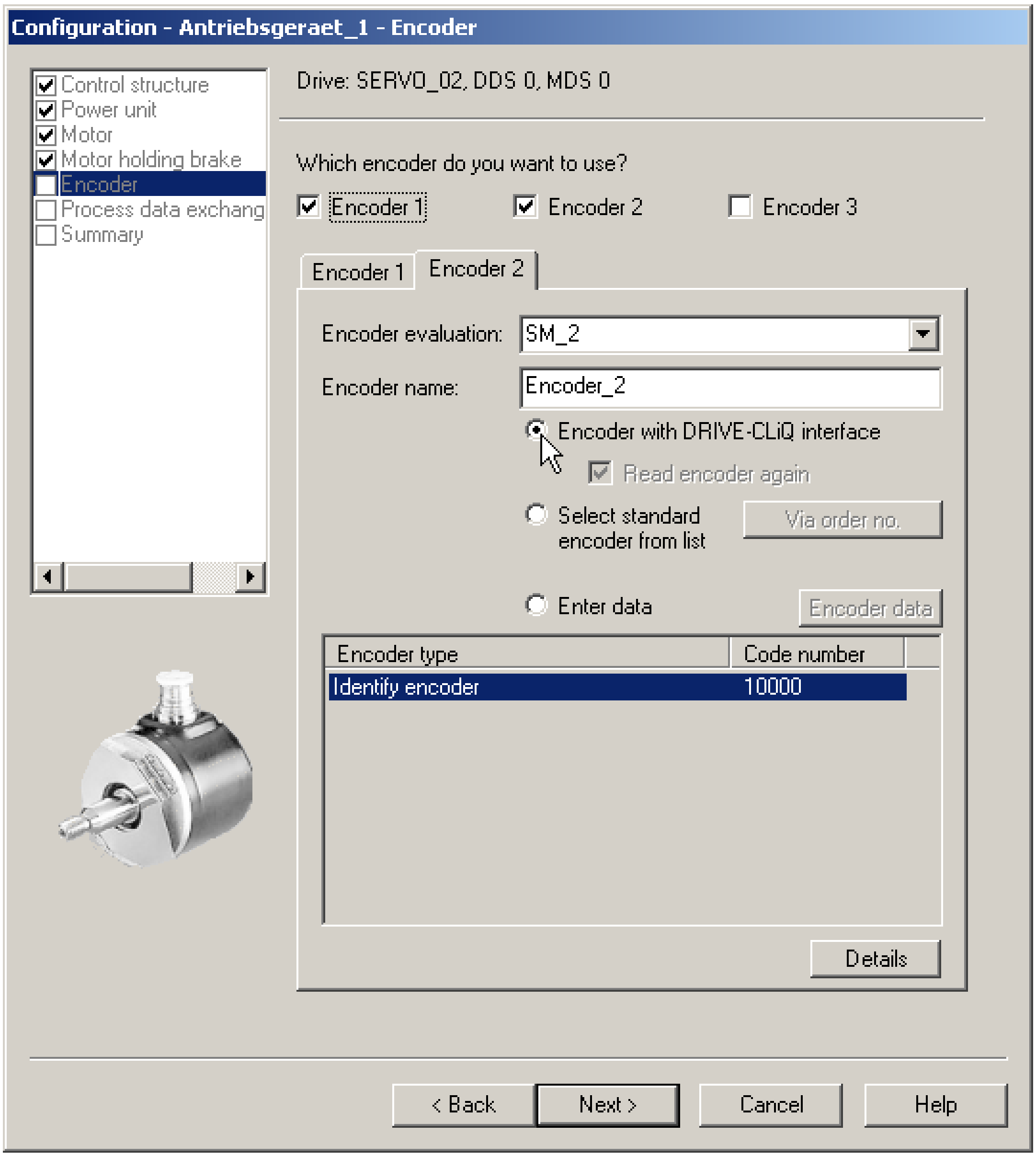


Figure 2-28 Identifying DRIVE-CLiQ encoders

Configuration of standard encoders

1. Select the "Select standard encoder from list" option field.

   The encoder 1 / motor encoder can also be selected and configured at the same time using the motor order number.

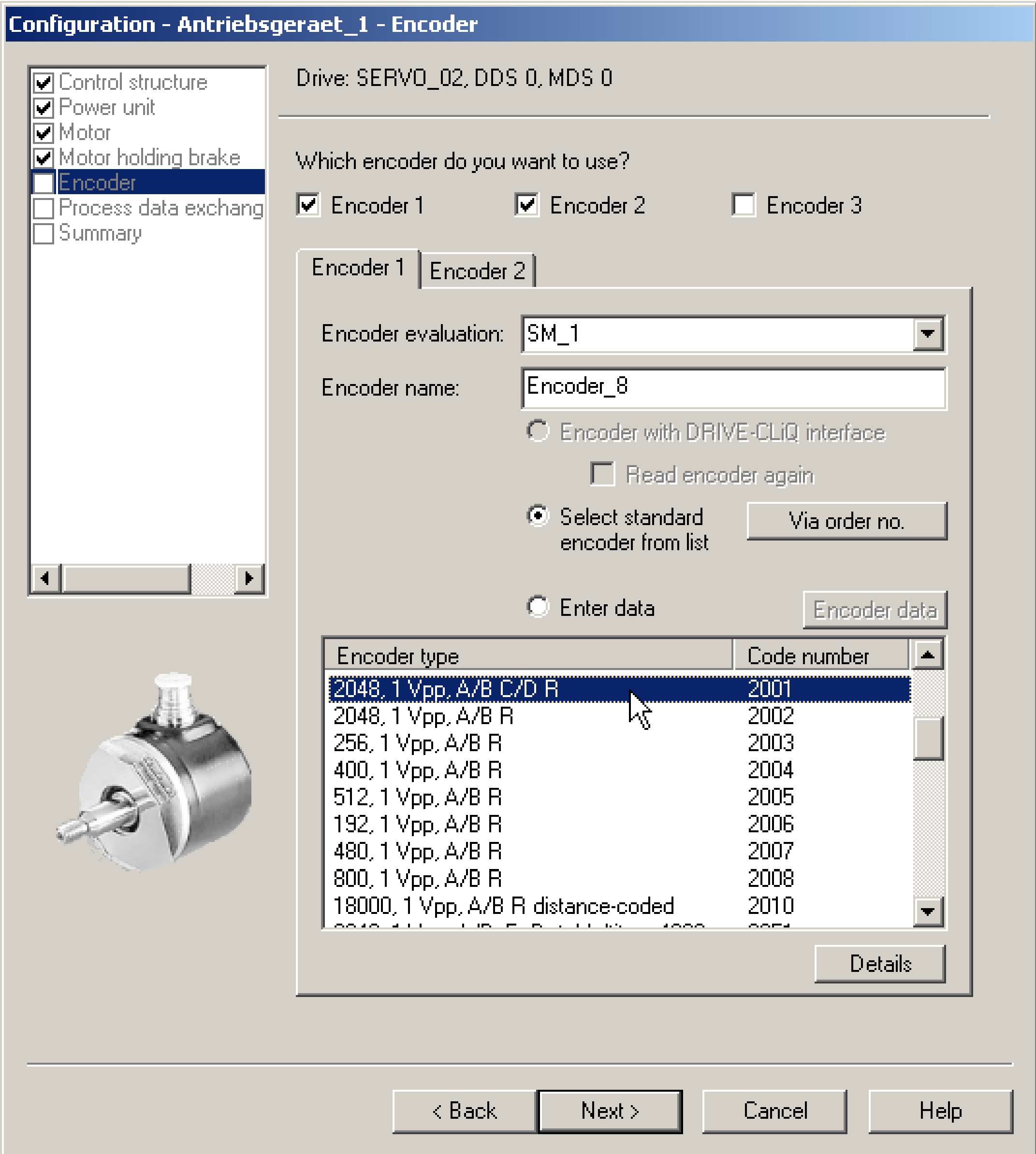


Figure 2-29 Standard encoder option

When configuring the drive you can select the standard encoders offered by Siemens from a list under "encoder". When the encoder type is chosen, all necessary parameterizations are simultaneously and automatically transferred into the encoder configuration. The standard encoder type and the corresponding evaluation modules are shown in the above table.

Configuration using manually determined user data

1. To manually enter user-defined encoder data, use the mouse to activate the option button "Enter data".

   In this case, the encoder can be configured using the encoder-specific input screens in the STARTER commissioning tool.

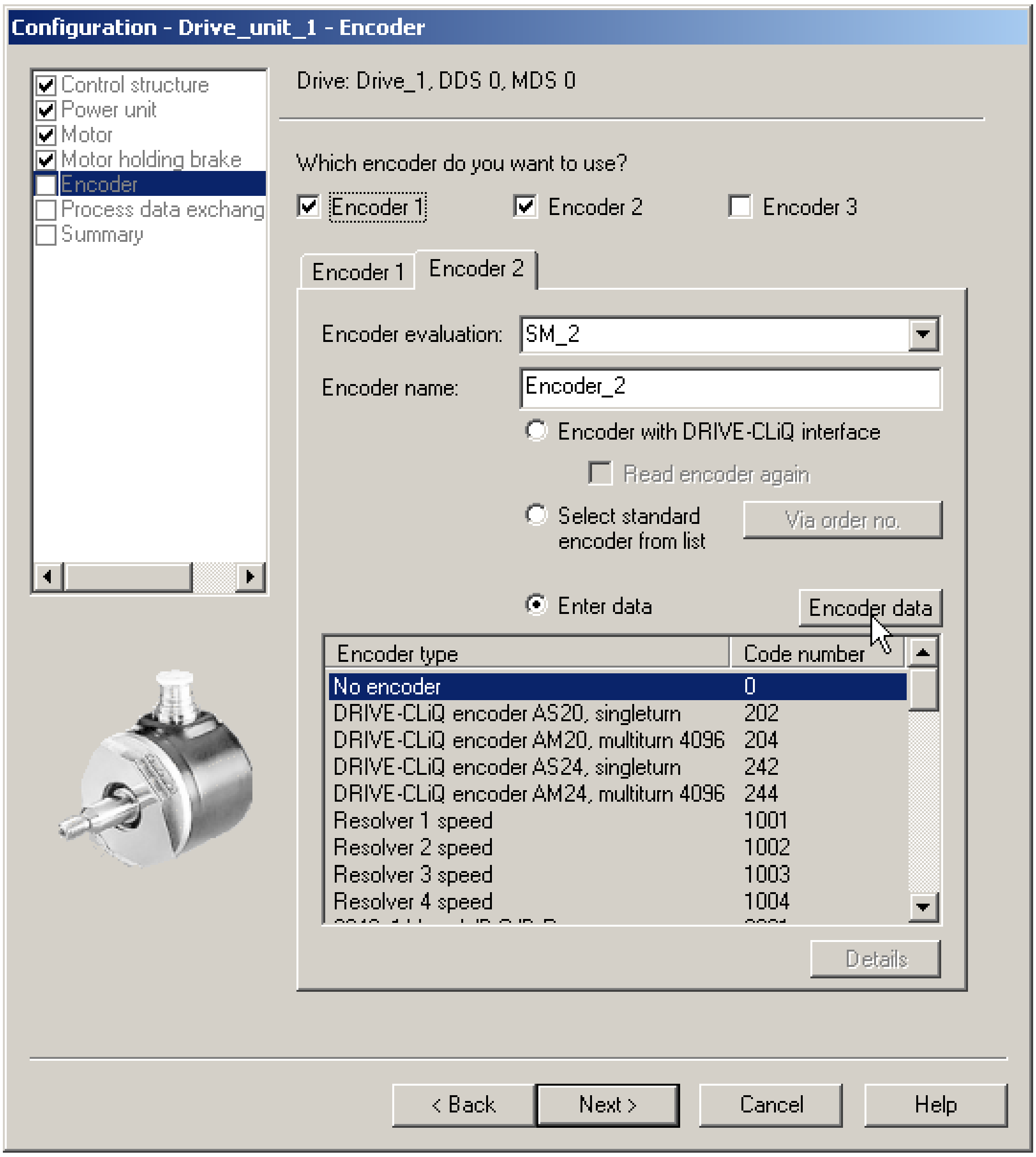


Figure 2-30 User-defined encoder option

2. Click on the "Encoder data" button.

   The following window opens for encoder data:

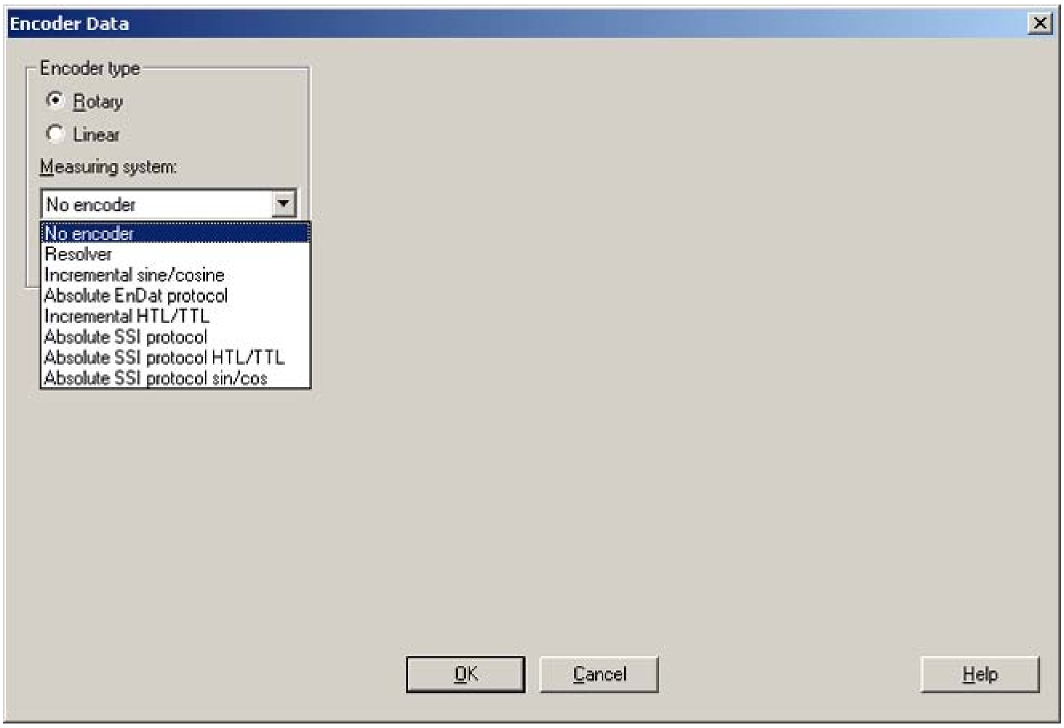


Figure 2-31 Rotary encoder types

   In this window, you can select between "rotary" and "linear" encoders.

3. Select the encoder type by clicking on the appropriate option button.

   For encoder type "rotary", you can select the following encoders:

   – Resolver
   – Incremental encoder with sin/cos signal
   – Absolute encoder with EnDat protocol
   – Incremental encoder with HTL/TTL signal
   – Absolute encoder with SSI protocol
   – Absolute encoder with SSI protocol and HTL/TTL signal
   – Absolute encoder with SSI protocol and sin/cos signal

The drop-down list for the "rotary" encoder type lists the following encoders:

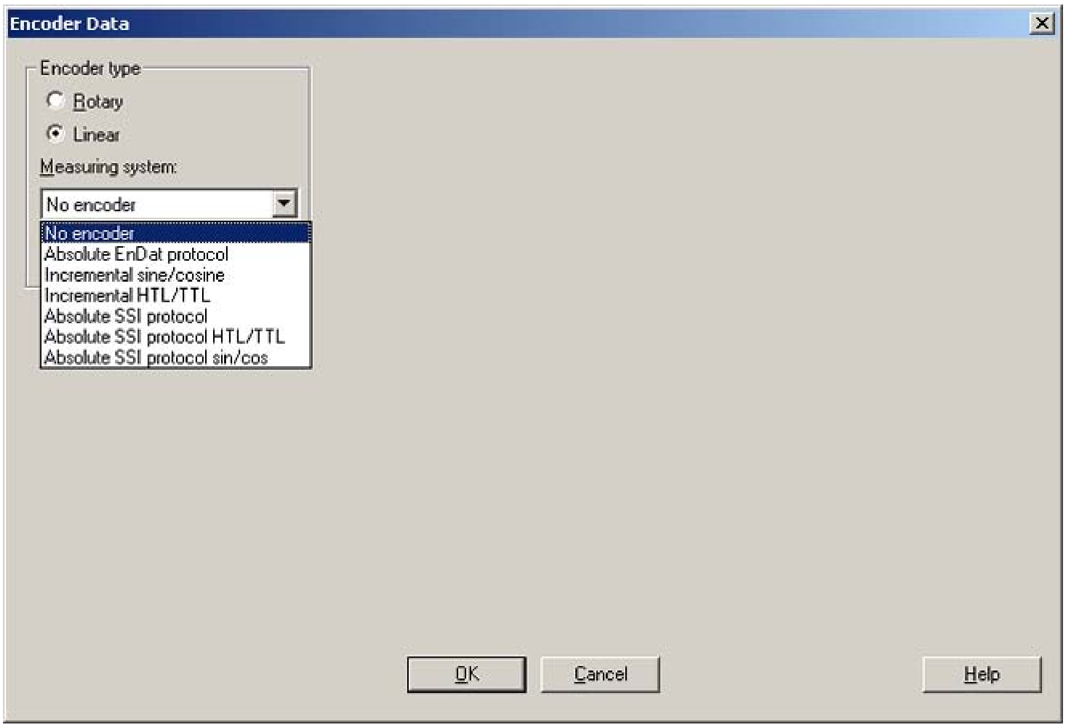


Figure 2-32 Linear encoder types

The following encoders can be configured for "linear" encoder type:

– Absolute encoder with EnDat protocol
– Incremental encoder with sin/cos signal
– Incremental encoder with HTL/TTL signal
– Absolute encoder with SSI protocol
– Absolute encoder with SSI protocol and HTL/TTL signal
– Absolute encoder with SSI protocol and sin/cos signal

4. Select the required encoder from the drop-down list.

The encoder-specific input screens for rotary and linear encoders are self-explanatory and therefore not explicitly explained here.

The following describes commissioning and replacing an encoder using the DRIVE-CLiQ encoder as an example.

Encoders with a DRIVE-CLiQ interface

Encoder evaluation units with DRIVE-CLiQ interface are available in the following versions:

- Sensor Module Cabinet-Mounted (SMCx) for rail mounting
- Sensor Module External (SMEx) to be incorporated in the feeder cable
- Sensor Module Integrated (SMI), mounted on the motor
- DRIVE-CLiQ Module Integrated (DQI) integrated in the motor

A temperature sensor at the DRIVE-CLiQ encoder to detect the motor temperature is connected in the factory.

Support with STARTER version

The STARTER commissioning tool supports encoders with DRIVE-CLiQ interface. Additional order numbers (MLFBs) are available for the corresponding DRIVE-CLiQ motors in the encoder overview.

The motor order number is used for an SMI or DQI motor.

When configuring a motor with DRIVE-CLiQ interface, a distinction is not made between SMI motors and DQI motors.

If you replace a motor with encoder and external DRIVE-CLiQ interface by an SMI motor or DQI motor, then you must appropriately reparameterize the SMI/DQI motor.

The functional behavior differs for the following encoder changes:

- If the encoders differ due to the measurement principle and the resolution.
- If the encoders are used in applications where the evaluation requires a zero mark (for example for referencing purposes). The encoder with integrated DRIVE-CLiQ interface does not supply a separate zero mark, as it involves an absolute encoder. So in these applications (and/or in the superimposed controls) the changed behavior must be selected.
- If an encoder is to be used on an axis with SINAMICS Safety Integrated Extended Functions or SINUMERIK Safety Integrated, because a lower position accuracy (SOS Safe Operating Stop) and a lower maximum velocity (SLS Safely Limited Speed) is obtained as a result of the lower resolution of the redundant position value (POS2).

A new commissioning test and, if necessary, new configuration must be carried out for activated SINAMICS Safety Integrated Extended Functions or SINUMERIK Safety Integrated.

Commissioning encoders with DRIVE-CLiQ interface

For DRIVE-CLiQ encoders, the properties of a rotary absolute encoder are identified with the following parameters of the Control Unit:

p0404[0..n]	Encoder configuration active
p0408[0..n]	Rotary encoder pulse No.
p0421[0..n]	Absolute encoder rotary multi-turn resolution
p0423[0..n]	Absolute encoder rotary single-turn resolution

This data is pre-assigned according to the preset codes in p0400 (encoder type selection) from the encoder lists. Parameters p0404, p0408, p0421 and p0423 are checked by the Control Unit when booting.

Alternatively, this data can be read out of the encoder with the setting p0400 = 10000 or p0400 = 10100. If the encoder data read out matches a known encoder type, this code is entered in p0400 using the Control Unit. In the other case, general codes are entered, e.g.: P0400 = 10050 (encoder with EnDat interface 2.1 identified), p0400 = 10058 (digital encoder (absolute) identified) or p0400 = 10059 (digital encoder (incremental) identified).

A DRIVE-CLiQ encoder is identified by the parameter p0404.10 = 1.

For DRIVE-CLiQ encoders, encoder codes are defined respectively for parameter p0400 (see SINAMICS S120/S150 List Manual and above table).
If the Control Unit identifies a DRIVE-CLiQ encoder type for which no code is stored, during identification it enters the code p0400 = 10051 (DRIVE-CLiQ encoder identified).

The data is also automatically identified if a DRIVE-CLiQ encoder is found during automatic commissioning. During identification, the Control Unit reads out the values for p0404, p0421 and p0423 from the DRIVE-CLiQ encoder. The Control Unit uses this data to determine the contents of p0400. The newly defined codes are not stored in the DRIVE-CLiQ encoder.

Replacing a SINAMICS Sensor Module Integrated

If a defect occurs in a SINAMICS Sensor Module Integrated (SMI) or in a DRIVE-CLiQ Sensor Integrated (DQI), contact your local Siemens office for a repair.

2.12 Notes on commissioning linear motors

2.12.1 General information on commissioning linear motors

Before commissioning motors, the following questions must be answered:

- Are the preconditions for commissioning (Page 18) fulfilled?
- Have the commissioning checklists (Page 20) been completed and are all of the points fulfilled?

Detailed information on linear motors, encoders and power connection, configuring and mounting can be found in the Configuration Manual of the 1FN1, 1FN3 or 1FN6 linear motors.

Terminology for rotary and linear drives

Table 2- 12 Terminology

Rotary	Linear
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:

- Linear motor
  - What linear motor is used?
    1FN _ _ _ _ – _ _ _ _ _ – _ _ _ _
  - Is the motor already mounted and ready to be powered up?
  - If a cooling circuit is being used, is it functional?
- 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?
  - Suspended axis:
    If weight equalization is being used for the axis, is this functioning?
  - Brake:
    If a brake is being used, is it correctly controlled (see the SINAMICS S120 Function Manual Drive Functions)?
  - 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?
- 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

- Wiring
  - Power unit (connect UVW, phase sequence, clockwise rotating field)
  - Protective conductor connected?
  - Shield connected?
  - Temperature monitoring circuits:
    Are the cables connected to the terminal block of the shield connecting plate?
    Temperature sensor (Temp-F):
    With the temperature sensor (Temp-F), the average absolute winding temperature can be measured.
    Overtemperature switch (Temp-S):
    The overtemperature trip circuit (Temp-S) enables each individual motor phase winding to be digitally monitored for an overtemperature condition.

> ⚠ WARNING
>
> **Risk of electric shock if there is no electrical isolation**
>
> The circuits of Temp-F and Temp-S neither have "protective separation" between each other nor to the power circuits in accordance with IEC 61800-5-1.
>
> These specifications are not fulfilled when the temperature monitoring circuits are connected via the SMC20 Sensor Module. The temperature monitoring circuits must be connected via the Sensor Module SME12x so that the specifications of the EN 61800-5-1 are fulfilled.
>
> Also refer to the Configuration Manuals for 1FN1, 1FN3 or 1FN6 linear motors.

  - Temperature sensor evaluation
  - Temperature monitoring with SME12x, (description of the temperature monitoring circuits see - connection to the SME12x in the Configuration Manual 1FN1, 1FN3 or 1FN6 in chapter "Thermal motor protection", description for connection to the SME12x, see chapter "Connection of the temperature monitoring circuits)
  - Encoder system connection
    Is the encoder system connected correctly to SINAMICS?

2.12.2 Commissioning: Linear motor with one primary section

⚠ WARNING

Hazardous motion for linear motors

Linear motors 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 a motor using the STARTER commissioning tool

The required motor can be selected from a motor list. Alternatively, data for third-party motors can be manually entered. When doing this, the number of parallel primary sections (p0306) must be entered.

1. Use the mouse to activate the "Select standard motor from list" option. Select a motor type, and then a standard motor from the "Motor selection" list.

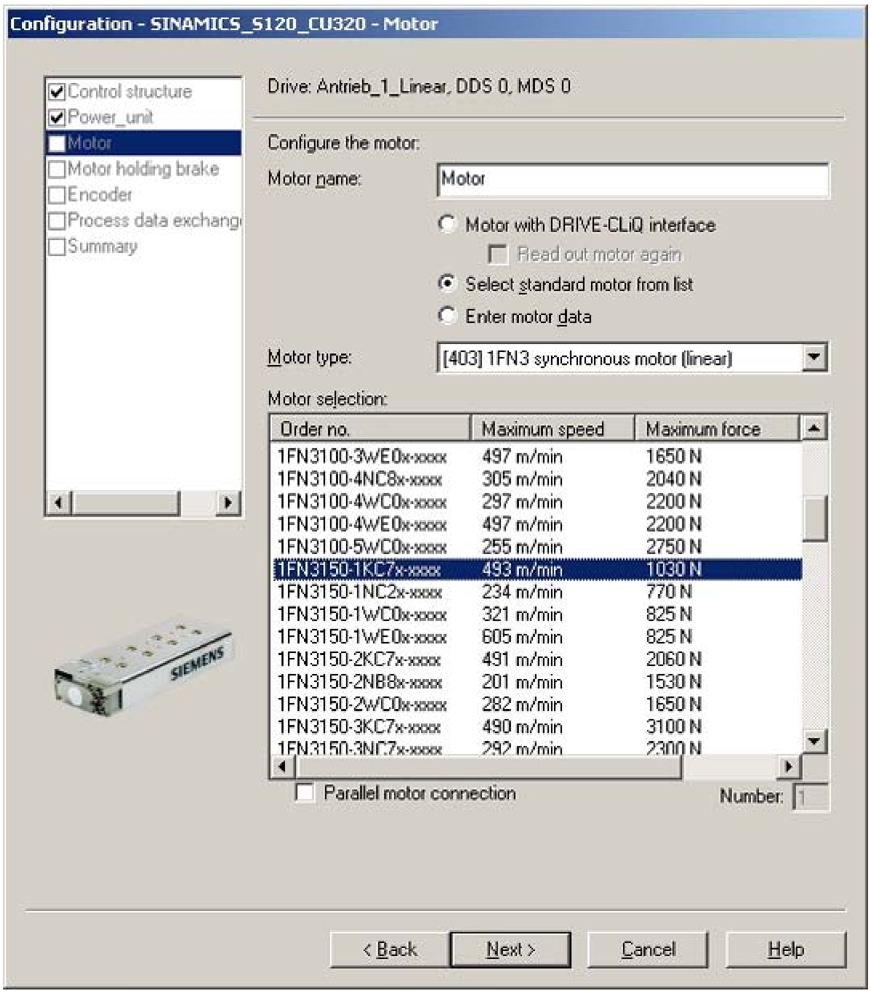


Figure 2-33 STARTER screen, linear motor selection 1FN3

OR

2. Use the mouse to activate the "Enter motor data" option. Select a motor type and click on "Next". Then manually enter the data of a third-party motor.

The following motor data must be entered for third-party motors:

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

Optionally, further motor data (linear synchronous motor) can be entered for third-party motors:

Parameter	Description
p0312	Rated motor force
p0317	Motor voltage constant
p0318	Motor stall current
p0319	Motor stall force
p0320	Rated motor magnetizing current
p0325	Motor pole position identification current 1st phase
p0326	Motor stall torque correction factor
p0329	Motor pole position identification current
p0348	Speed at start of field weakening
p0352	Cable resistance cold
p0353	Motor series inductance
p0391	Current controller adaptation, starting point KP adapted
p0392	Current controller adaptation, starting point KP adapted
p0393	Current controller adaptation P gain adaptation

3. Enter user-defined encoder data via the dialog box with the same name.
   With linear motors, the encoder is configured in the "User-defined encoder data" screen.

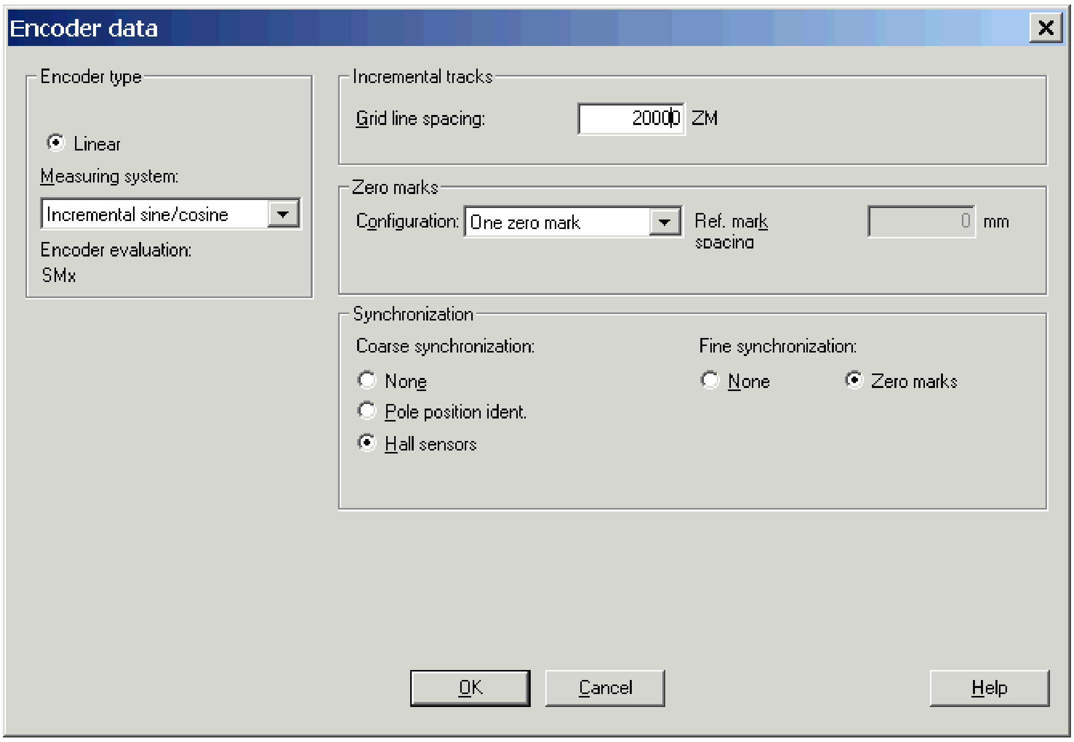


Figure 2-34 Encoder data screen in STARTER

WARNING
Hazardous motion for linear motors When linear motors are configured for the first time, the commutation angle offset (p0431) must be adjusted. For more information about the commutation angle offset and pole position identification, see the Chapter "Servo control" SINAMICS S120 Function Manual Drive Functions.

2.12.3 Commissioning: Linear motor with several identical primary sections

If you are sure that the EMF of several linear motors has the same relative phase position to one another, then these linear motors can be connected in parallel using the connecting cables and operated from one Motor Module.

Linear motors connected in parallel are commissioned based on the commissioning of a single linear motor. To activate the parallel connection of linear motors, in the window "Configuration - SINAMICS_S120_CU320 - 2nd motor" set a check mark for "Parallel motor connection".

The number of linear motors connected in parallel is entered in the "Motor" screen form (p0306) when the drive is configured in the STARTER commissioning tool.

The linear motors are connected individually in sequence to the drive, and are commissioned as a single motor (1FNx ...). The angular commutation offset is automatically determined and noted for each motor. Finally, the measured angular commutation offset of the motors are compared with each other.

If the difference between the angular commutation offset is less than 5 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 • 1FN3xxx).

Permitted parallel connection

Only linear motors that fulfill the following preconditions may be connected in parallel:

- Identical primary section size
- Identical winding type
- Identical air gap

Note

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 additional information, refer to the Configuration Manual of the 1FN1, 1FN3 or 1FN6 linear motors.

Temperature sensors and electrical wiring

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

- Temperature sensor
  - Motor 1: Connection via SME12x and evaluation via the drive control
  - Motor n: not connected
    (short-circuited and connected to the PE)
- Temperature switch
  - Motor 1 to n: Evaluation via the drive control

See also: Configuration Manual for Linear Motors 1FN3 or 1FN6

> ⚠ **WARNING**
>
> **Risk of electric shock**
>
> When connecting-up the temperature monitoring circuits, carefully observe the requirements regarding protective separation in accordance with EN 61800-5-1.
>
> For additional information, refer to the Configuration Manual of the 1FN1, 1FN3 or 1FN6 linear motors.

2.12.4 Thermal motor protection

Temperature monitoring circuits Temp-F and Temp-S

The motors are supplied with two temperature monitoring circuits: Temp - F and Temp - S. Temp-F is to monitor and evaluate the temperature characteristic in the motor being used. Temp-S is used to activate the motor protection in the event of overheating in the motor windings.

Both temperature monitoring circuits are independent of each other. The evaluation is realized via the Control Unit. The temperature sensors are connected to the drive system or to the Motor Module using Sensor Modules from the SME12x series.

Temp-F (KTY 84 Sensor)

The temperature monitoring circuit Temp-F consists of a KTY 84 temperature sensor located at the coils. Under certain circumstances – for example when the individual phases have different current levels – this can mean that the maximum temperature of the three phase windings is not Detective. Therefore, it is not permissible for motor protection to solely evaluate the Temp-F temperature monitoring circuit. Temp-F is used to monitor the temperature - and if necessary to output an alarm indicating that the drive is being shutdown because the Temp-S temperature monitoring circuit has responded.

Temp-S (PTC element)

The temperature shutdown circuit comprises PTC thermistor temperature sensors (PTC elements). There is a PTC thermistor temperature sensor for monitoring the motor winding in each of the three phase-windings (U, V and W). This ensures overload protection, even if the current in the individual phases of a primary section is not the same - or if several primary sections have different load levels. The PTC elements are connected in series.

The circuit and connection system for Temp-F and Temp-S are described in detail in the Configuration Manual; linear motors 1FN3 or 1FN6.

The SME12x (**S**ensor **M**odule **E**xternal) is a device with connectors enabling the connection of various sensors of a direct drive (WMS, Hall sensors, temperature sensors). The output of the SME12x is connected to SINAMICS drive systems via DRIVE-CLiQ. The requirements regarding protective separation in accordance with EN 61800-5-1 are fulfilled by the electrical isolation between the voltage circuits for power and sensors. The SME12x therefore fulfills the following functions:

- All signal cables can be connected close to the motor.
- Temperature sensors can be fully evaluated:
  - Thermal motor protection through evaluation of Temp-S
  - Display of the temperature curve via evaluation of Temp-F

There are two variants of SME12x:

- SME120 for incremental position measurement systems
- SME125 for absolute position measurement systems

You will find further information on the SME12x in the SINAMICS S120 Manual, Control Units and Additional System Components, in the chapter "Encoder system connection".

> ⚠ **WARNING**
>
> **Risk of electric shock if there is no electrical isolation**
>
> The circuits of Temp-F and Temp-S neither have "protective separation" between each other nor to the power circuits in accordance with IEC 61800-5-1.
>
> These specifications are not fulfilled when the temperature monitoring circuits are connected via the SMC20 Sensor Module. The temperature monitoring circuits must be connected via the Sensor Module SME12x so that the specifications of the EN 61800-5-1 are fulfilled.
>
> Also refer to the Configuration Manuals for 1FN1, 1FN3 or 1FN6 linear motors.

NOTICE
Material damage caused by overtemperature
For thermal motor protection you must connect Temp-S. It is impermissible to not connect Temp-S!
You can optionally connect Temp-F to a measuring instrument for commissioning or test purposes.
In normal operation, short-circuit the Temp-F connections and connect to PE.

Note

The Temp-F temperature sensor only evaluates the winding temperature of one phase in the primary section. However, the phases in the synchronous motor have different loads. Higher temperatures can occur in the phases that are not measured.

⚠ WARNING
Risk of electric shock
Without using a suitable protective module (e.g. TM120), for safe electrical separation it is not permissible to connect Temp-F to a Sensor Module of the SINAMICS drive system.
The drive must always be switched into a no-voltage condition. When handling and connecting Temp-F, when the drive is switched-on, hazardous voltages can be present at the terminals on the motor side and at the Temp-F connecting cable.

⚠ WARNING
Risk of electric shock
If a 3RN1013-1BW10 thermistor motor protection device or a suitable protective module is not used, then for safe electrical separation it is not permissible to connect Temp-S to a PLC or to a Sensor Module of the SINAMICS drive system.
The drive must always be switched into a no-voltage condition. When handling and connecting Temp-S, when the drive is switched-on, hazardous voltages can be present at the terminals on the motor side and at the Temp-S connecting cable.

Temperature evaluation unit with safe electrical separation

Terminal Module 120 is a temperature evaluation unit with DRIVE-CLiQ interface for installation in a control cabinet. The TM120 has 4 measuring channels with safe electrical separation to connect KTY or PTC temperature sensors. A TM120 can also be used with Sensor Modules for encoder evaluation (SMCxx, SMIxx and SMExx) if safe electrical separation of the temperature sensors is necessary.

Evaluating the temperature sensors

For additional information, refer to the Configuration Manual of the 1FN1, 1FN3 or 1FN6 linear motors.

2.12.5 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 in the "Encoder configuration - details" screen form when the drive is being 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 pushed in the positive direction, the actual speed value must also count in the positive direction.

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.

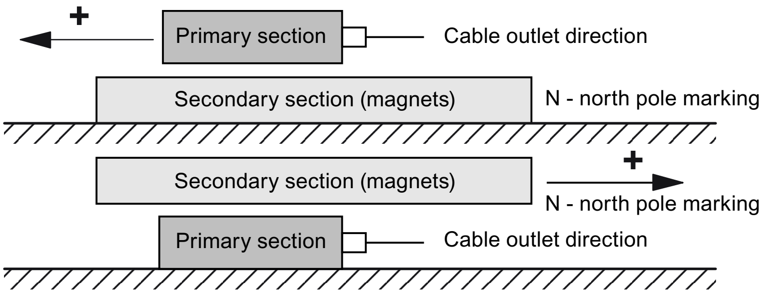


Figure 2-35 Determining the positive direction of the drive

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.

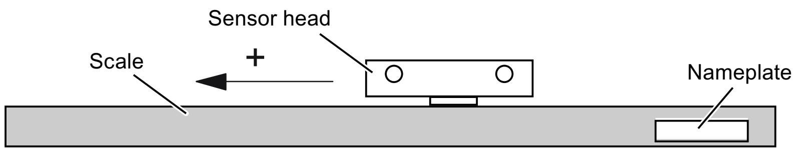


Figure 2-36 Determining the counting direction for measuring systems from the Heidenhain Company

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 2- 13 Overview of signals

Signal	Cable color	Round connector 12-pin	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.

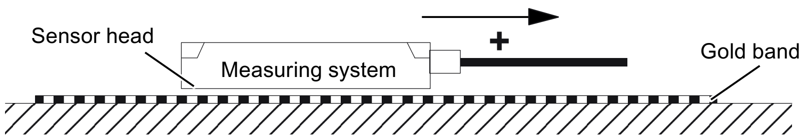


Figure 2-37 Determining the counting direction for measuring systems from Renishaw

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Note

Cable outlet direction different to the counting direction

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

2.12.6 Checking the linear motor by taking measurements

Why make measurements?

If the linear motor was commissioned according to the relevant instructions, and unexplained fault messages still occur, then all of the EMF 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.

Taking the necessary measurements

- Disconnect the drive line-up from the power supply.
- Notice: 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.

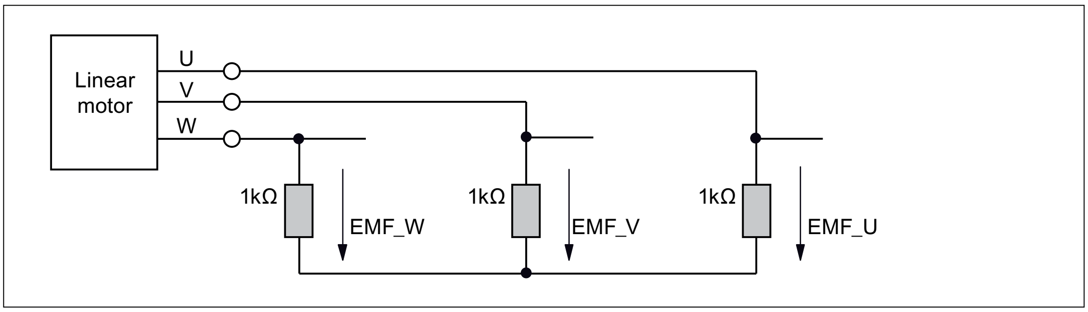


Figure 2-38 Configuration for taking the measurements

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.

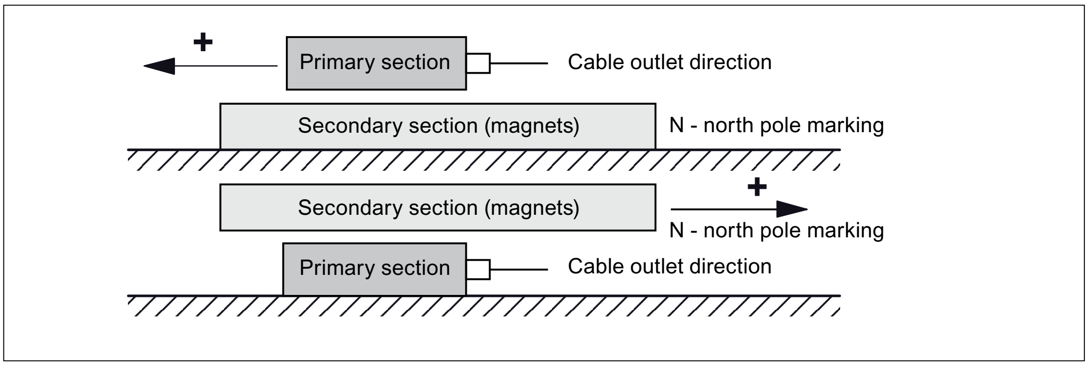


Figure 2-39 The positive direction of the drive (clockwise rotating field)

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.

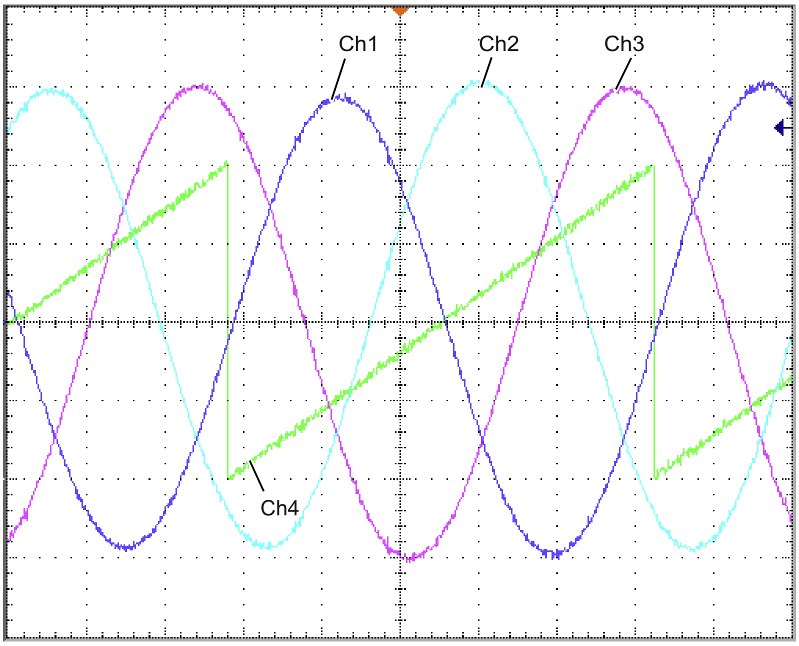


Figure 2-40 Oscillogram

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 angular pole position via analog output

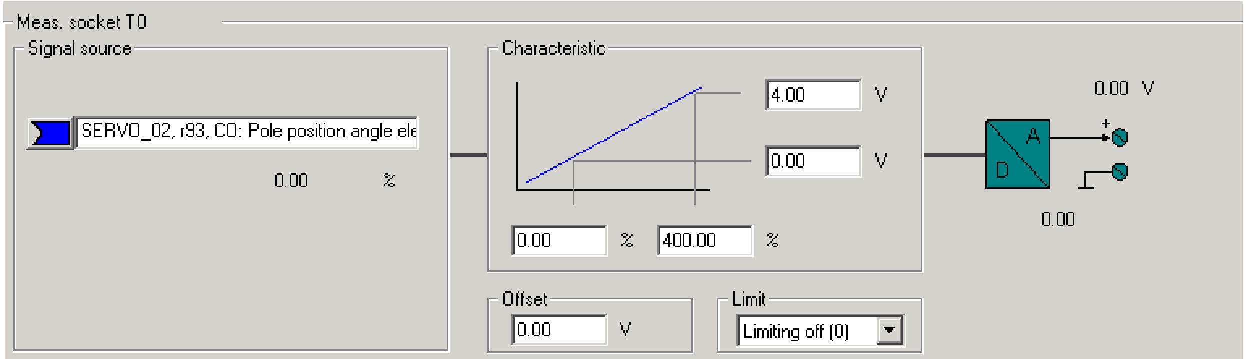


Figure 2-41 Setting of the measuring socket T0 on CU320

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.

2.13 Commissioning SIMOTICS 1FW6 built-in torque motors

2.13.1 Safety instructions for commissioning

⚠DANGER

There is danger of death, serious bodily injury and/or property damage when untrained personnel is allowed to handle direct drives and/or their components.

Only personnel who are familiar with and who observe the safety guidelines are allowed to handle direct drives and their components.

Installation, commissioning, operation and maintenance may only be performed by qualified, trained and instructed personnel. The personnel must be thoroughly familiar with the content of this guide.

All work must be performed by at least two persons.

⚠DANGER

Risk of death, serious personal injury, and/or material damage if a machine is commissioned that does not fulfill the recognized safety requirements.

Plants and machines with converter-fed low-voltage three-phase motors must fulfill the protection requirements of the EMC Directive 2004/108/EC. The company building the plant or system is responsible for ensuring that installation is carried out in an EMC-compliant manner. The signal and power cables must be shielded. Refer to the EMC installation guideline (order designation 6FC5297-□AD30-0AP□) issued by the converter manufacturer.

⚠DANGER

Unexpected movements of the motor may result in a risk of death, serious personal, and/or material damage.

Danger from rotating rotor. Never carry out work in the vicinity of rotating parts when the machine is switched on.

Keep persons away from rotating parts and areas where there is a danger of crushing.

Ensure that the rotors can rotate without hindrance.

Check the commutation setting before switching on the machine. Note also the commissioning instructions issued for the drive system.

Limit the motor currents.

Set low values for speed limiting.

Monitor limit positions.

⚠ WARNING
The surface temperature of the motors may be more than 100 °C (212 °F). Risk of burns
Make sure that the cooling system (if available) is working properly.
Do not touch the motor during/directly after use.
Attach the "Hot Surface Do Not Touch" (DW-026) warning sign close to the source of danger where it can be easily seen!
Temperature-sensitive parts (electric cables, electronic components) may not be placed on hot surfaces.

⚠ DANGER
Electrical shock hazard!
A voltage is induced when the rotor rotates. The motor power connections must be properly connected or insulated before the rotor turns!

⚠ DANGER
The temperature monitoring circuits pose a risk of electric shock!
The circuits of Temp-S and Temp-F do not meet the electrical separation requirements for power circuits according to DIN EN 61800-5-1 (previously protective electrical separation according to DIN EN 50178).
Directly connecting temperature monitoring circuits Temp-S and Temp-F via the encoder connector of the Sensor Module SMC20 (X520 pin 13 and pin 15) does not fulfill the requirements of electrical isolation, and is therefore not permitted.
Use, for example, the SME12x or TM120 to connect the Temp-S and Temp-F temperature monitoring circuits.

⚠ WARNING
When a torque motor is being operated, the rotor must not exceed a temperature of 120°C otherwise the permanent magnet may become demagnetized.
This must be ensured during initial commissioning by carrying out the appropriate checks.
Special attention should be paid here to non-uniform current loads during standstill or operation with short, cyclic rotation because this can generate extremely high, localized temperatures.

NOTICE
The motor may overheat without temperature protection and be destroyed.
Check whether the temperature protection is effective before (!) switching on the DC link voltage for the first time!

2.13.2 Checklists for commissioning

Checklists for commissioning 1FW6 built-in torque motors

Please thoroughly familiarize yourself with the safety instructions and observe the checklists below before starting any work.

Table 2- 14 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, correctly installed and connected?	
Are the manufacturer's documentation for the system components (e.g. drive system, encoder, cooling system, brake) and the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors" available?	
Are the following current SINAMICS documents available? • SINAMICS S120 Commissioning Manual • SINAMICS S120 Getting Started • SINAMICS S120 Function Manual Drive Functions • SINAMICS S120/S150 List Manual	
Was the Chapter "Checklists for commissioning SINAMICS S" taken into account?	
Is the motor type to be commissioned known? (e.g. 1FW6 _ _ _ – _ _ _ _ _ – _ _ _ _)	
As a minimum, is the following data for the motor known, if it involves a "third-party motor"? ("third-party motor" is every motor that is not saved as standard in the Siemens commissioning software.) • Rated motor current • Rated motor speed • Motor pole pair number • Motor torque constant • Maximum motor speed • Maximum motor current • Motor limit current • Motor moment of inertia • Motor stator resistance, cold • Motor stator leakage inductance	
Are the environmental conditions in the permissible range?	

Table 2- 15 Checklist (2) - checking the mechanical system

Check	OK
Has the motor been correctly installed according to the motor manufacturer's specifications and is it ready to be switched on?	
Were the transport locks removed according to the installation chapter of the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors"?	
Can the axis freely rotate over the complete rotational range?	
Have all the screws been tightened to the specified torque?	
Are the stator and rotor centered with respect to one another corresponding to the motor manufacturer's specifications?	
If there is a motor holding brake, does this function correctly?	
Has the encoder been correctly mounted and adjusted according to the manufacturer's specifications? Important information on the encoders can also be found in the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors".	
Has a cooling system, required for liquid-cooled motors, been connected according to the manufacturer's specifications and is it functioning correctly?	
Does the cooling medium comply with the requirements listed in the Chapter "Cooling media" in the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors"?	
Were the cooling circuits flushed before been filled with the cooling medium?	
Is it ensured that the permissible pressure in the cooling circuit is not exceeded (here, refer to "Technical features" in the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors")?	
Are moving cables correctly routed in a tow chain?	
Have the power cables been properly connected to the component terminals with the specified torque?	
Have measures been taken to relieve strain on the cables?	

Table 2- 16 Checklist (3) - checking the electrical system

Check	OK
Has all wiring work been successfully completed?	
Is the protective conductor correctly connected?	
Is the motor ground directly connected to the Power Module ground (short distance in order to avoid high leakage currents)?	
Are all connectors correctly plugged in and screwed in place?	
Are the motors connected with shielded power cables?	
Are the power cable shields connected as closely as possible to the terminal box across a wide area?	
Are all cable shields connected to the respective housing through a large surface area?	
Have the control cables been connected in accordance with the required interface configuration and the shield applied?	
Have the motor power cables been correctly connected to the power module with the phase sequence UVW (clockwise rotating field)?	
Do the temperature monitoring circuits fulfill the specifications of protective separation? Additional important information on temperature monitoring circuits Temp-S and Temp-F can be found in the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors".	
Before commissioning and before switching on the DC link voltage for the first time, have you checked the temperature monitoring circuits to ensure that they correctly trip/shut down?	
Is the encoder correctly connected?	
Are the digital and analog signals routed using separate cables?	
Has the distance from power cables been observed?	
Have the line-side and motor-side power cables been dimensioned and routed in accordance with the environmental and routing conditions?	
Have the maximum permissible cable lengths between the frequency converter and the motor (depending on the type of cables used) been observed?	

2.13.3 General information for setting the commutation

You can use the following two pole position identification techniques for all frame sizes of SIMOTICS T-1FW6 built-in torque motors:

- The motion-based technique
- The saturation-based technique (1st harmonic)

Note

Fine synchronization is recommended for precise commutation

Use either a measuring system with a zero mark that can be evaluated or an absolute measuring system.

Motion-based technique

This technique can also be used during commissioning when the commutation angle offset is initially determined or when it is checked in conjunction with an absolute measuring system (e.g. RCN 85xx from Heidenhain).

The procedure can be applied for vertical and horizontal axes whose load cannot be reduced in an uncontrolled manner when the machine is disconnected from the power supply. In this case, the axes must be able to be freely moved and not be braked. (static friction < 10% of the rated motor torque).

In the worst-case scenario, the rotor can move in the range of ± 5 degrees when this technique is used.

> ⚠ WARNING
>
> **For inclined and horizontal axes, the load may be reduced in an uncontrolled manner if the center of gravity is outside the rotary axes when the system is disconnected from the power supply. At certain times the axes angle cannot be monitored.**
>
> Carefully take this into account when you use the motion-based technique.

Saturation-based technique

This technique does not require the rotor to move, which means that it can also be used for axes that are locked (e.g. using a brake). Axes that are not locked can rotate, however. Depending on the actual mechanical design, this technique can result in a higher noise level when the axes is powered up during the identification routine.

2.13.4 Parameterizing a motor and encoder

Note

Parameterizing with STARTER

The following descriptions and screenshots were created using the STARTER commissioning tool.

The parameterization is shown with the help of screen forms and the expert list of the STARTER commissioning tool.

Configuring data for a standard motor

You must individually configure the drives.

1. Double-click in the project navigator on "Drives" > "Drive name" > "Configuration" > "Configure DDS" one after the other.

2. Select the standard motor to be commissioned from the list.

   The associated motor data are stored and must not be entered manually.

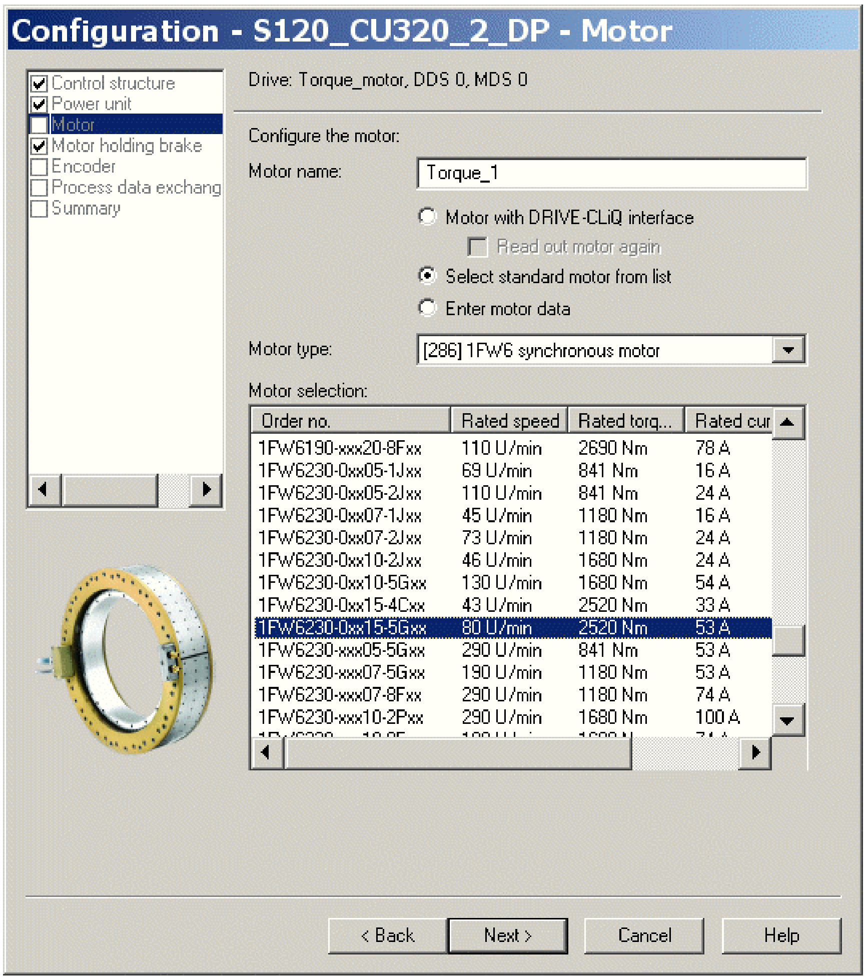


Figure 2-42 Screen to configure a motor - selecting a standard motor

Configuring data for a third-party motor

1FW6 built-in torque motors are not included in the list if they are customer-specific special motors or new developments.

1. Please take the motor data from the attached motor data sheet and make the following settings:

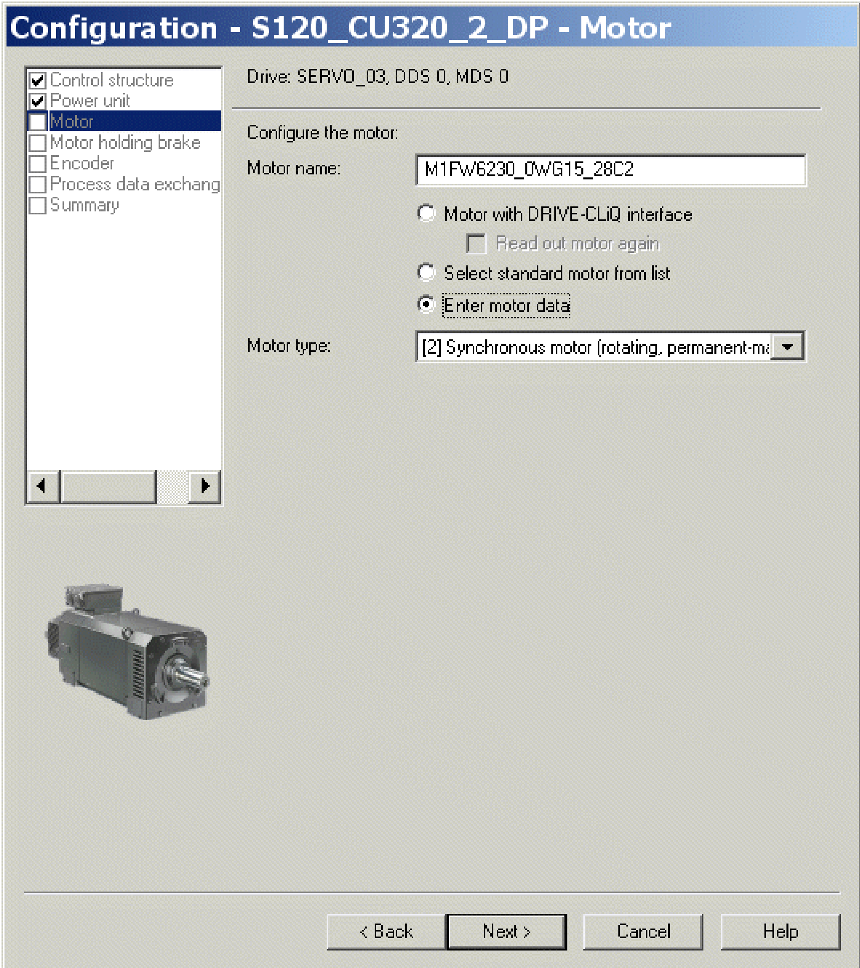


Figure 2-43 Screen to configure the motor – setting for a third-party motor

2. Enter the following data for a rotating permanent-magnet synchronous motor:

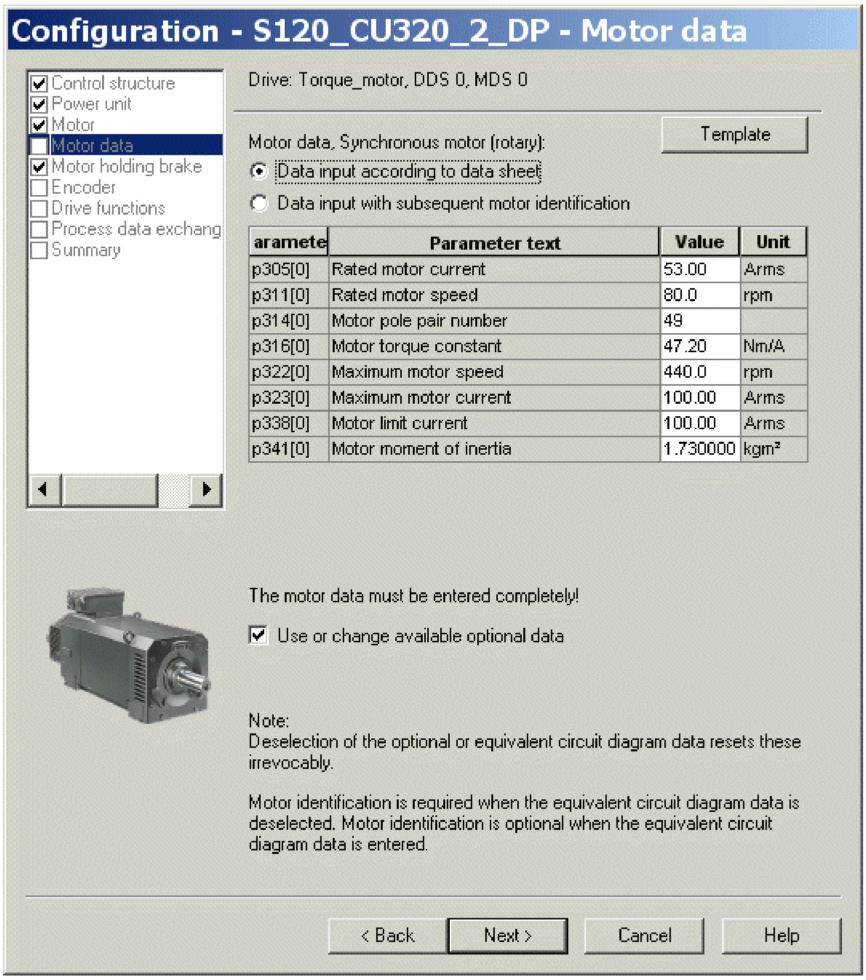


Figure 2-44 Example of motor data that have been entered

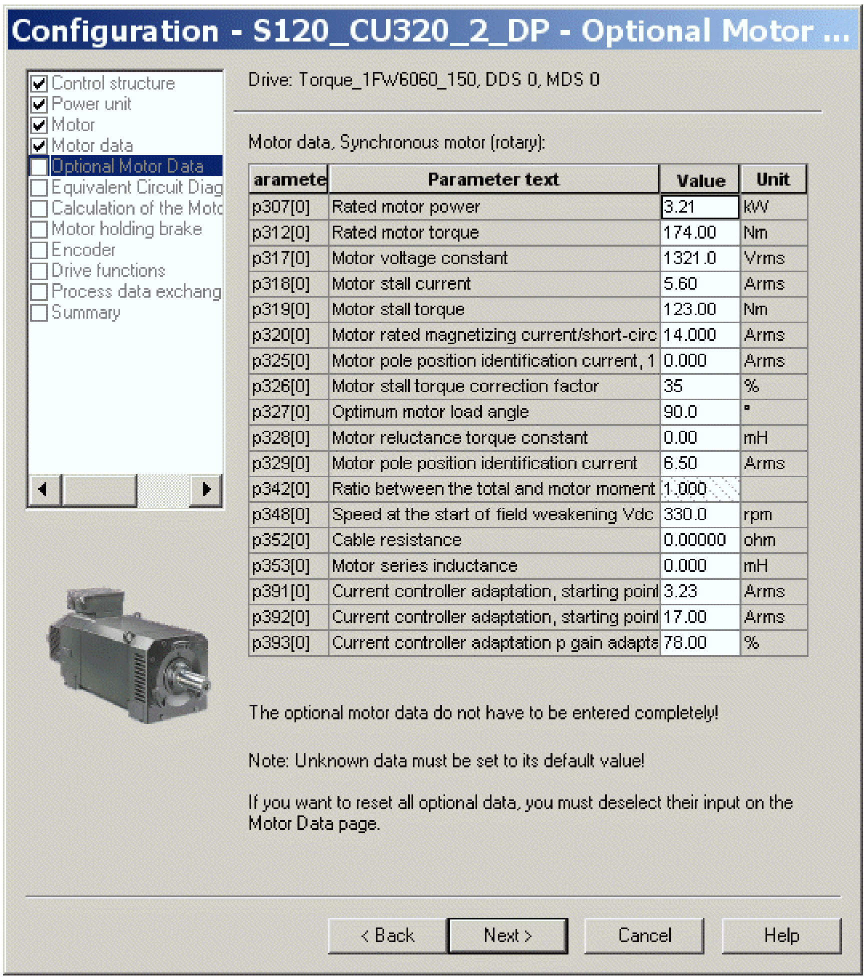


Figure 2-45 Example of optional motor data that have been entered

Entering equivalent circuit diagram data

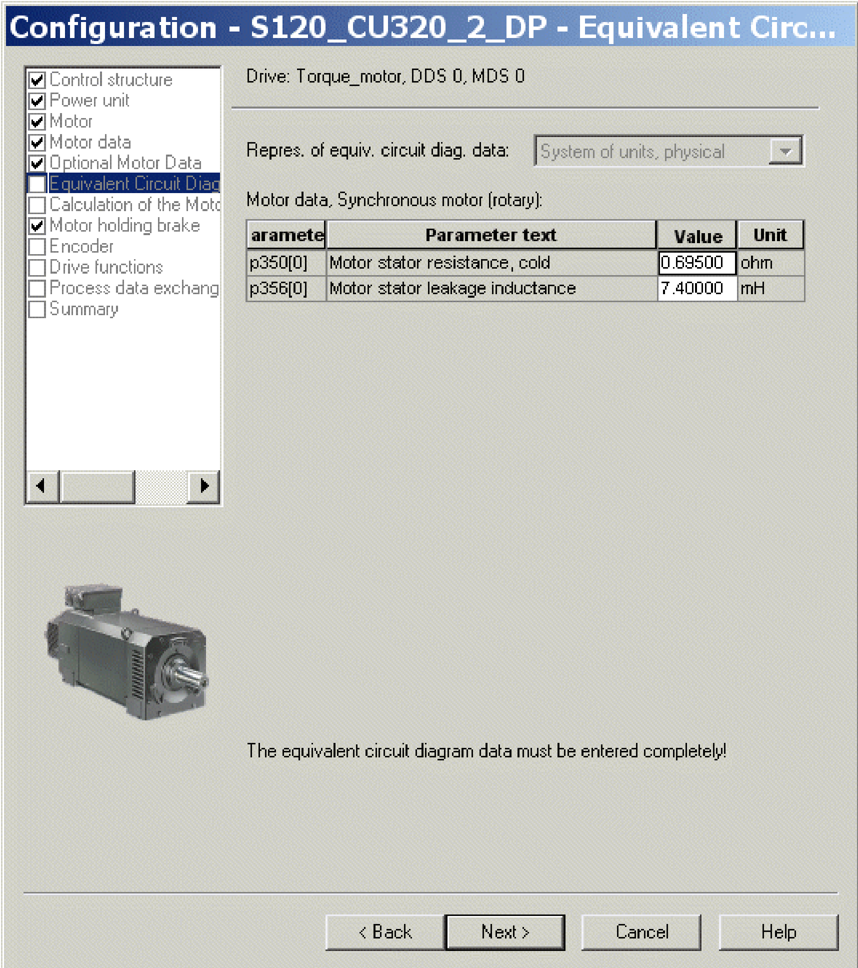


Figure 2-46 Example of equivalent circuit diagram data that have been entered

Calculating controller data

After selecting the motor and entering the motor data, completely calculate the controller data.

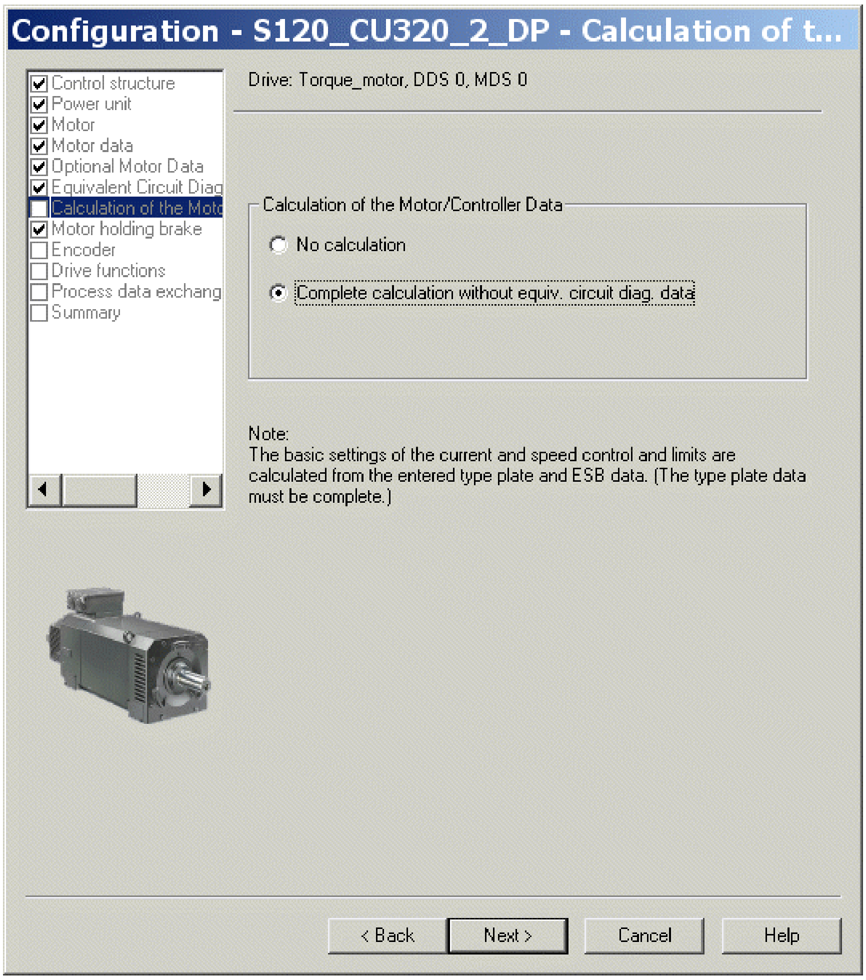


Figure 2-47 Screen form for calculating the motor/controller data

Configuring the motor holding brake

If a motor holding brake is being used, configure it in the following window.

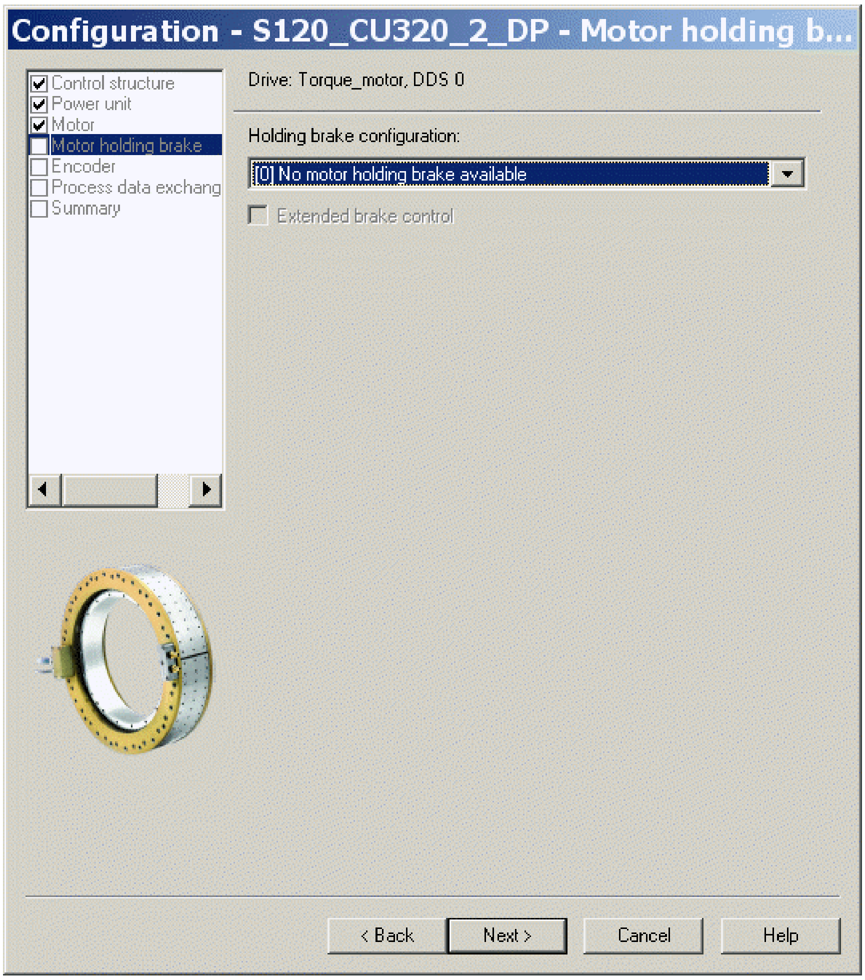


Figure 2-48 Screen form for configuring a motor holding brake

Encoder data

1. Note the data of the encoder manufacturer and the information in Chapter "Selecting and configuring encoders (Page 140)" in this manual.

2. Configure the encoder data for the torque motor using the "Encoder data" screen form. To do this, in the dialog click on the "Encoder data" button.

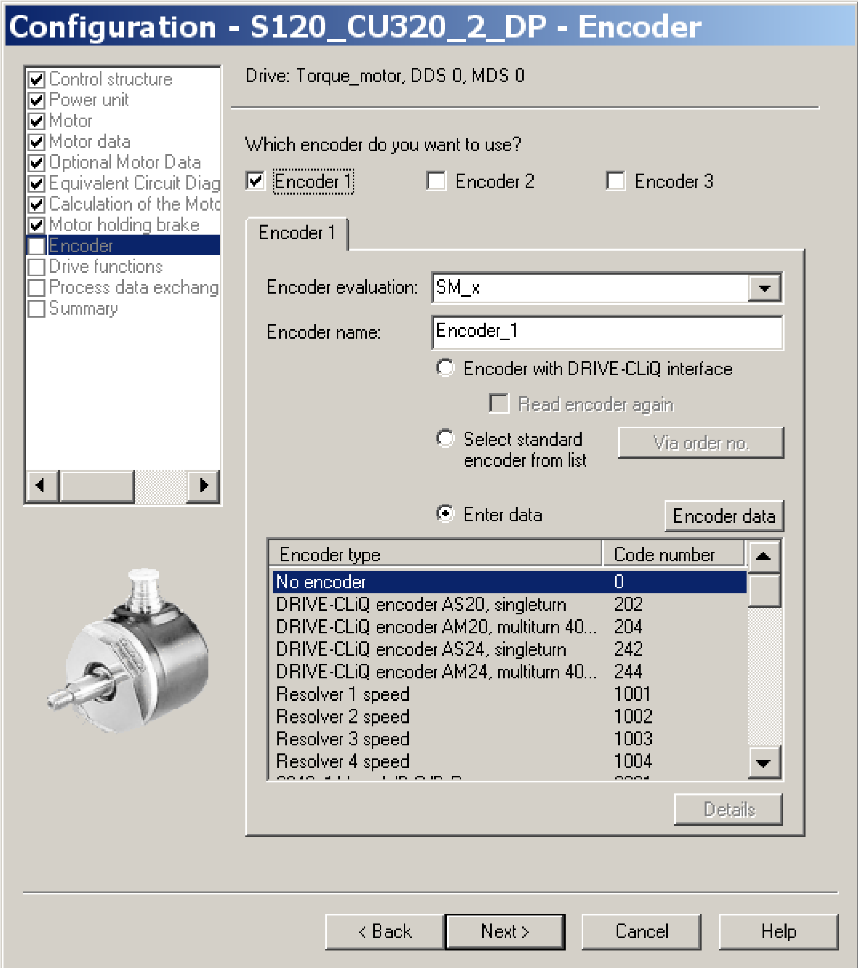


Figure 2-49 Screen form to configure an encoder

Incremental measuring system

Example of an incremental sine/cosine encoder with 18,000 pulses per revolution with one zero mark per revolution:

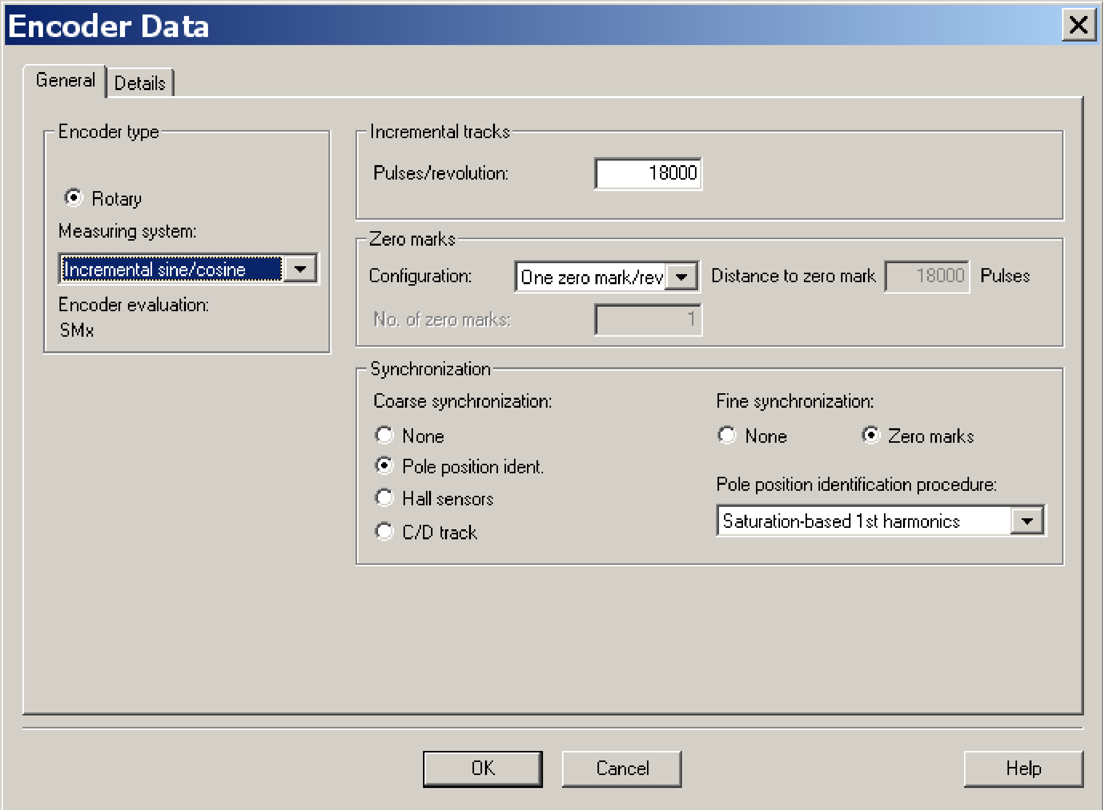


Figure 2-50 Screen form for entering the encoder data

Note

Pole position identification is required for SIMOTICS T-1FW6 built-in torque motors with incremental measuring systems.

The following techniques are possible to do this:

- The motion-based technique
- The saturation-based technique (1st harmonic)

For incremental measuring systems, generally fine synchronization is performed at the zero mark. When commissioning the system for the first time, the angular commutation offset (p0431) must be pre-assigned, see Chapter "Determining the angular commutation offset (Page 193)".

For third-party motors, a pole position identification routine to determine the angular commutation offset cannot be entered.

Absolute measuring system

The encoder is detected by the Control Unit as long as it is a DRIVE-CLiQ encoder. For other encoders, the following data must be entered via the configuration screen form after pressing the "Encoder data" button (example of an absolute encoder with Endat protocol, order code EnDat 01 or 02 with incremental signals to transfer the absolute values from the encoder to the Control Unit e.g. RCN 85xx Heidenhain):

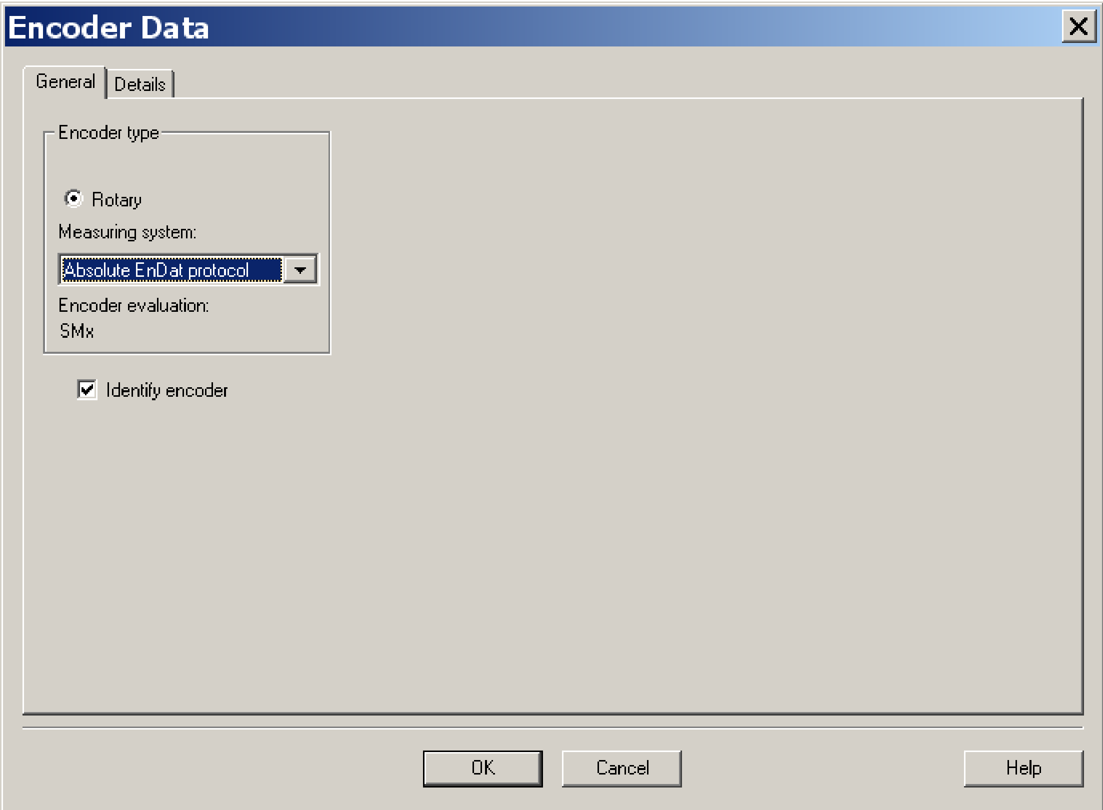


Figure 2-51 Screen form to configure an absolute encoder with EnDat protocol

1. If necessary, use "Encoder data" and "Details" to invert the speed and position actual value. This allows the control sense to be changed.

2. To do this, first click on the "Encoder data" button in the screen form used for the encoder configuration.

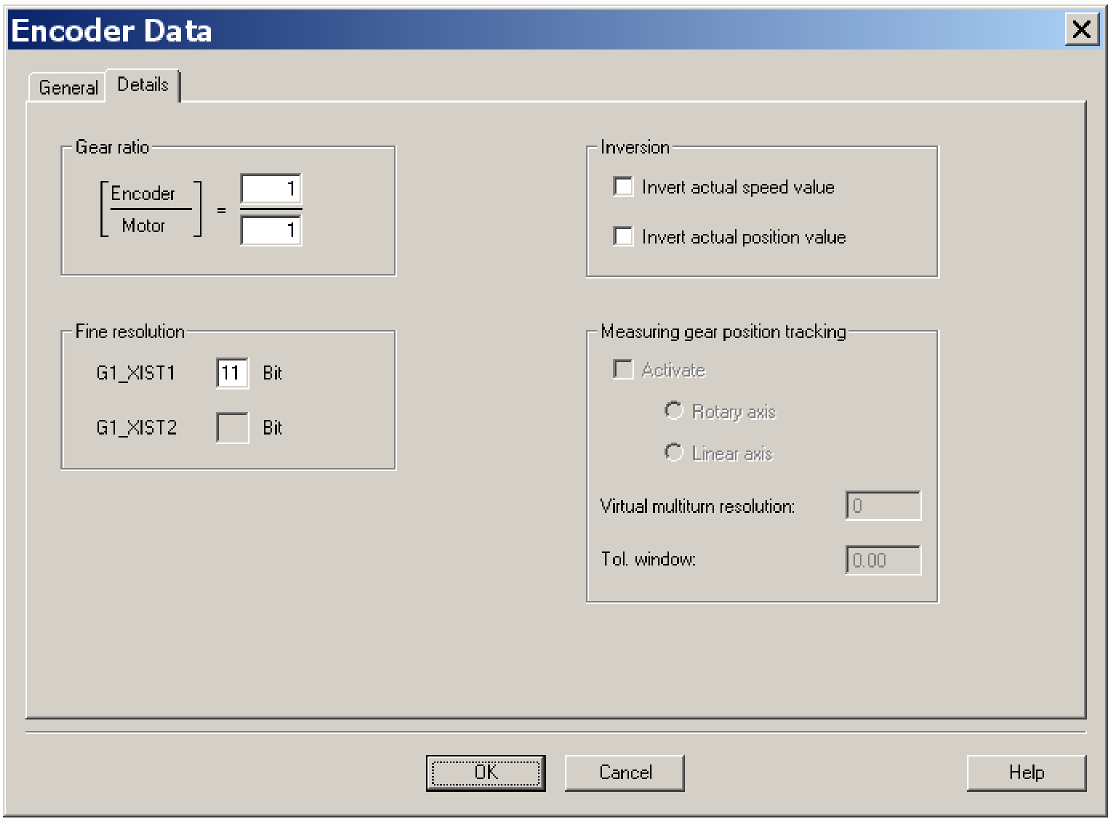


Figure 2-52 Screen form for entering additional encoder data

Definition of 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.

The data used to determine the drive direction is only valid for 1FWx motors from Siemens.

If the positive direction of the drive and positive counting direction of the measuring system do not match, then you must invert the actual speed value in the "Encoder configuration - details" screen form when the drive is being commissioned (p0410.0 or p0410.1).

Determining the drive direction

The direction of the drive is positive, if when viewing the DE flange, the rotor is rotating clockwise.

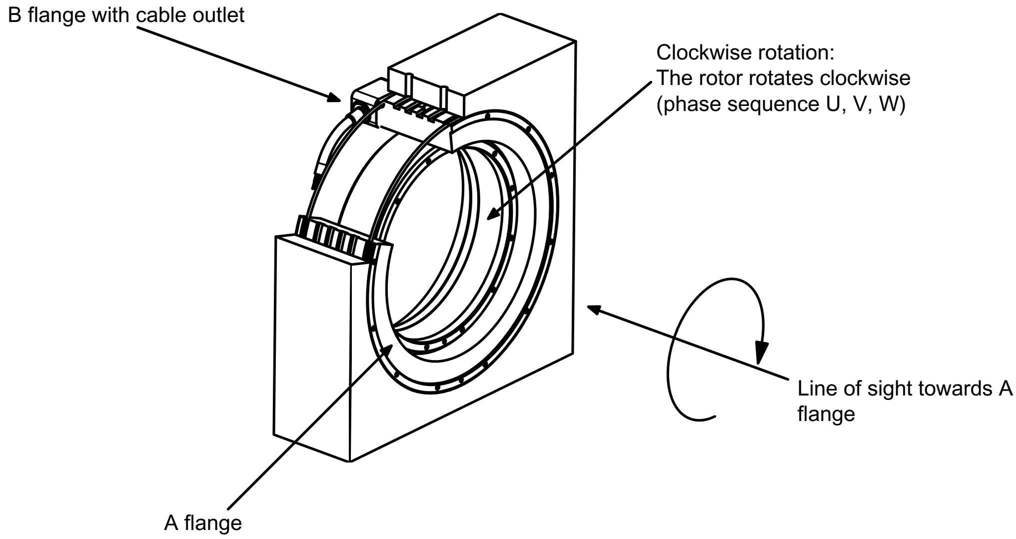


Figure 2-53 Determining the positive direction of the drive

Determining the counting direction of the measuring system

The counting direction depends on the measuring system and the mounting position. The counting direction of the measuring system must match the direction of rotation of the motor. If necessary, you must adapt the counting direction by making the appropriate parameter assignment. Please refer to the manufacturer's documentation for the measuring system. If necessary, you must invert the counting direction as described in Figure 2-52 Screen form for entering additional encoder data (Page 184).

Note

Checking the measuring system counting direction

The measuring system counting direction can also be checked, by first parameterizing the drive, and then manually rotating it with the enable signals inhibited.

If the axis is rotated in the positive direction, the actual speed value must also count in the positive direction.

See also

Parameterizing a motor and encoder (Page 173)

Completing parameterization

SIMOTICS T-1FW6 built-in torque motors are feed drives (maximum current limiting).

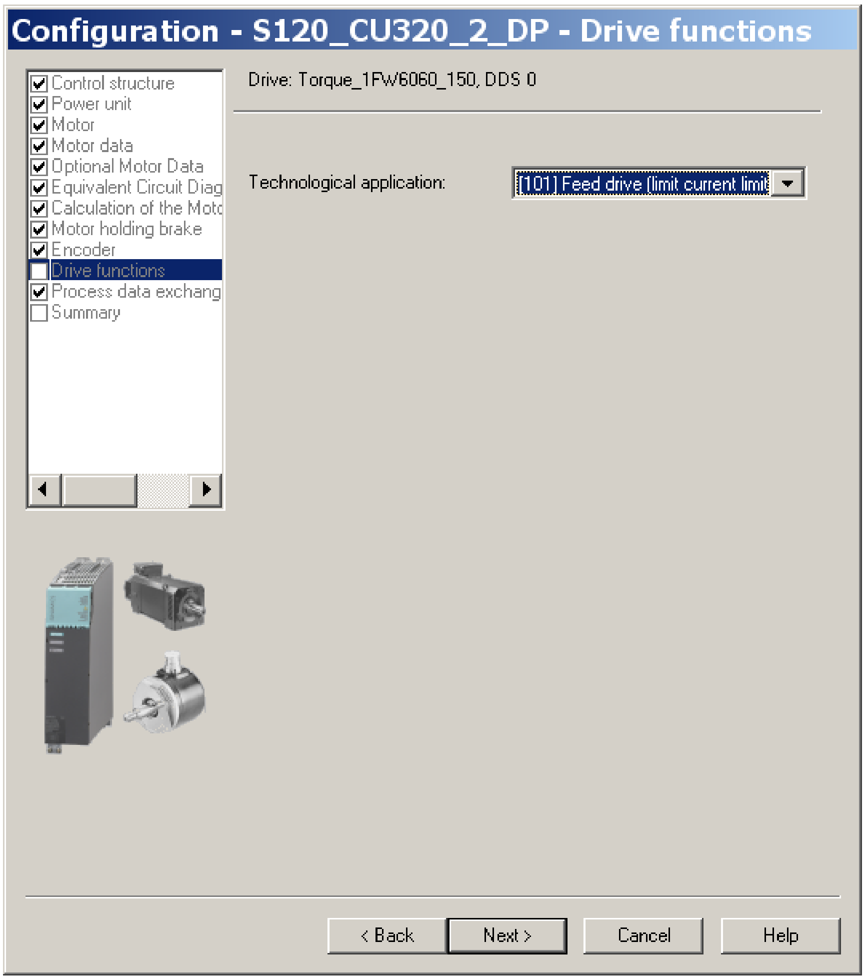


Figure 2-54 Screen form to select the application

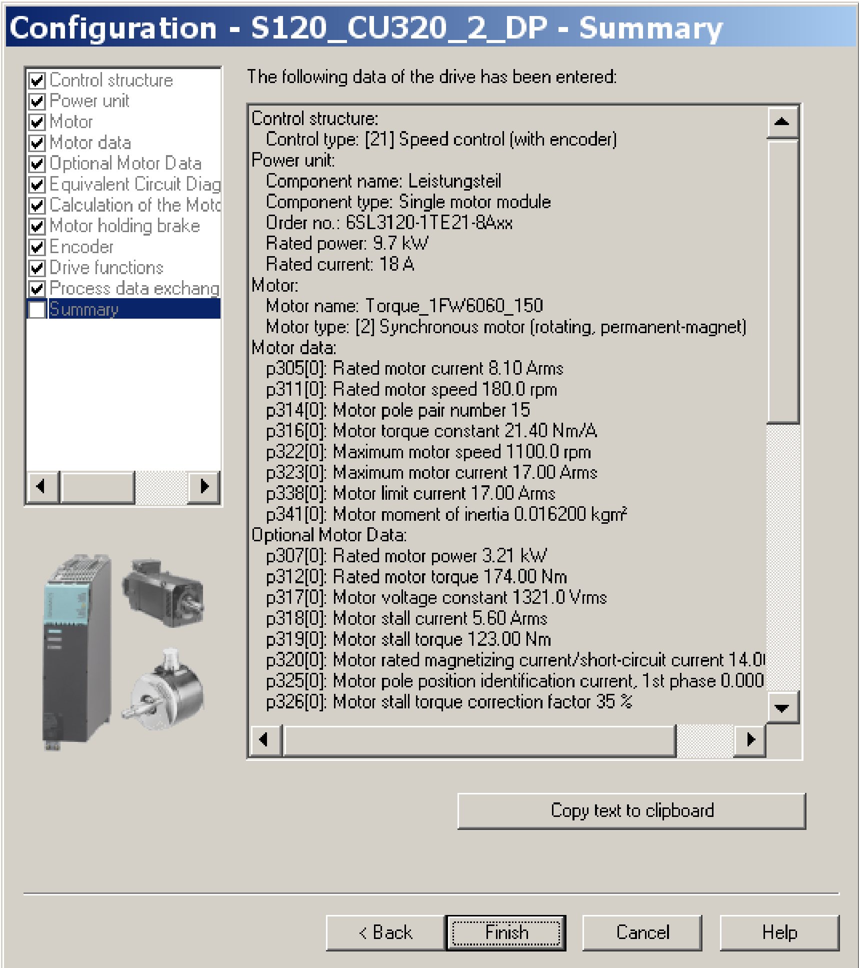


Figure 2-55 Summary of the configuration

The created offline project must now be loaded into the drive. In STARTER, go online with the target device.

If an absolute measuring system with EnDat protocol was selected, then after establishing an online connection, the encoder serial number is loaded and the corresponding encoder parameters are set.

2.13.5 Parameterizing and testing the temperature sensors

Sensor Module External SME12x

The connection of the SME modules is described in the Chapter, "System integration" in the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors". Information on the Sensor Module External SME12x can be found in the "SINAMICS S120 Equipment Manual for Control Units and Additional System Components" in the Chapter "Sensor Module External 120 (SME120)" and in the Chapter "Sensor Module External 125 (SME125)".

The parameterization of the temperature sensors is explained in detail in Chapter "Temperature sensors for SINAMICS components (Page 213)".

A parameterizing example for a torque motor with a KTY 84 and two PTC sensors, connected to a Sensor Module External SME12x is subsequently provided.

Use the parameter list to parameterize the drive.

Table 2- 17 Parameterization in the drive:

Parameter	Input
p0600	Motor temperature sensor for monitoring 1: Temperature sensor via encoder 1
p0601	Motor temperature sensor, sensor type 10: Evaluation via several temperature channels SME12x
p0604	Motor temperature alarm threshold Sets the alarm threshold for monitoring the motor temperature For motors from the motor list (p0301), this parameter is automatically pre-assigned (120 °C).
p0605	Motor temperature fault threshold Sets the fault threshold for monitoring the motor temperature For motors from the motor list (p0301), this parameter is automatically pre-assigned (155 °C).
p0606	Motor temperature timer 0 to 2s Setting the timer for the alarm threshold for the motor temperature monitoring, when alarm with timer was selected in parameter p4600...4603. This timer is started when the temperature alarm threshold (p0604) is exceeded. If the timer has expired, and in the meantime the temperature alarm threshold has not been fallen below, then fault F07011 is output.
p4600...p4603	Motor temperature sensor 1...4 sensor type Sets the temperature sensor type for the motor temperature monitoring. Channels 2 - 4 are used for the Sensor Module External SME12x. Channel 1 remains free. The following values are possible for torque motors: 0: No sensor 10: PTC fault 12: PTC alarm & timer 20: KTY 84

If you make a selection with timer, you must pre-assign parameter p0606 with the corresponding timer of a maximum of 2 s.

Example: Standard SIMOTICS T-1FW6 built-in torque motors

p4600	0: No sensor
p4601	20: KTY 84
p4602	10: PTC fault (PTC 130 °C)
p4603	10: PTC fault (PTC 150 °C)

If you are not using a standard motor, then you must parameterize parameters p0600...p0606 (see above). Select parameters p4600...p4603 to match the sensor types or temperature channels of the Sensor Module External SME12x.

Checking the temperature sensors for the Sensor Module External SME12x

In the online mode, you can read out the temperatures of the sensors at the channels of the Sensor Module External SME12x using parameter r4620[0…3] using the STARTER commissioning tool.

The maximum motor temperature can also be read in r0035. This parameter indicates the highest value from parameters r4620[0…3].

For a parameterized PTC sensor type, irrespective of the actual temperature in r4620 - 200 °C is always displayed.

If a negative value in the range from – 40 °C to – 80 °C is displayed in parameter r0035 or r4620[1], then the KTY connection has been interchanged with that of the PTC.

Checking the PTC sensor type

You can simulate a sensor responding to an overtemperature condition (high ohmic state) by disconnecting the connections. You can disconnect the connections for the temperature sensors by removing the Sensor Module External SME12x (connector, interface X200).

If the sensor type is parameterized as PTC fault, then fault "F07011 drive: Motor overtemperature" is immediately displayed independent of the setting of p0604 - p0606. If the sensor type is parameterized as PTC alarm with timer, after the time parameterized in p0606, fault F7011 is generated.

Checking the KTY sensor type

When you withdraw the connector of interface X200, and have therefore disconnected the KTY connection, after the time parameterized in p0607 has expired, fault "F07016 drive: Motor temperature sensor fault" is displayed in the alarm window of the STARTER commissioning tool.

Check the wiring of the temperature sensors, by checking the resistance values at connector interface X200. The wiring is OK for the following resistance values:

KTY 84 at 20 °C, approx. 570 Ω

PTC at 20 °C, 120 Ω – 240 Ω

The assignment of connector interface X200 can be found in the "SINAMICS S120 Manual Control Units and Additional System Components".

Terminal Module TM120

Terminal Module TM120 is a DRIVE-CLiQ component for temperature evaluation with safe isolation, see also "SINAMICS S120 Manual for Control Units and Additional System Components" in the Chapter "Supplementary system components".

TM120 is an autonomous input/output component. You can freely assign the temperature channels to any Motor Module.

You can assign every channel to the following sensor types:

- PTC
- KTY 84
- Bimetallic NC contact

Note

Standard topology

The standard topology is:

Motor Module - Terminal Module TM120 - Sensor Module Cabinet SMC20

Parameterization

For a standard configuration with correct pre-assignment of the temperature channels, the Terminal Module TM120 must be located between the Sensor Module SMC20 and the Motor Module (DRIVE-CLiQ port X202).

If this is not the case, you must parameterize all of the required temperature channels in both the Motor Module and Terminal Module TM120.

You must always carefully check the temperature shutdown circuits (e.g. by disconnecting the sensors) before commissioning the motor for the first time.

Use the expert list to parameterize the drive.

Table 2- 18 Parameterization in the drive:

Parameter	Input
p0600	Motor temperature sensor for monitoring 20: Temperature sensor via BICO interconnection p0608
p0601	Motor temperature sensor, sensor type 11: Evaluation via several temperature channels BICO
p0606	Motor temperature timer 0 to 2s Sets the timer for the alarm threshold for the motor temperature monitoring, if alarm with timer was selected in p4610...4613. This timer is started when the temperature alarm threshold (p0604) is exceeded. If the timer expires before the temperature falls below the alarm threshold, then fault F07011 is output.
p0608	[0...3] CI: Motor temperature, signal source 2 Sets the signal source 2 for the evaluation of the motor temperature via a BICO interconnection, e.g. [0]: Motor temperature channel 1 TM120 . r4105[0] [1]: Motor temperature channel 2 TM120 . r4105[1] [2]: Motor temperature channel 3 TM120 . r4105[2] [3]: Motor temperature channel 4 TM120 . r4105[3]
p4610...p4613	Motor temperature sensor 1...4 sensor type Sets the temperature sensor type for the motor temperature monitoring. The following values are possible for torque motors: 0: No sensor 10: PTC fault 12: PTC alarm & timer 20: KTY84 30: Bimetallic NC contact fault 32: Bimetallic NC contact alarm & timer

If you make a selection with timer, you must pre-assign parameter p0606 with the corresponding timer of a maximum of 2 s.

Table 2- 19 Parameterization in Terminal Module TM120

Parameter	Input
p4100[0...3]	TM120 temperature evaluation, sensor type Sets the temperature evaluation of Terminal Module TM120. This means that the temperature sensor type is selected and the evaluation is activated. The following values are possible: 0: Evaluation deactivated 1: PTC thermistor 2: KTY84 4: Bimetallic NC contact

Check the temperature sensors in the same way as described for Sensor Module External SME12x. Test each individual temperature channel by withdrawing the connection.

PTC connection via thermistor motor protection device 3RN1013-1GW10

You can evaluate the PTC sensors via a thermistor motor protection device 3RN1013-1GW10. The normally closed contact must be connected to the temperature input at the Motor Module (terminals X21.1 X21.2).

For a parallel connection of several motors, a thermistor motor protection device 3RN1013-1GW10 must be used for each motor. The NC contacts must be connected in series.

Table 2- 20 Parameterization in the drive:

Parameter	Input
p0600	Motor temperature sensor for monitoring 11: Temperature sensor via Motor Module / Control Unit terminals
p0601	Motor temperature sensor, sensor type 4: Bimetallic NC contact alarm & timer (only for temperature evaluation via the Motor Module)
p0604	Motor temperature alarm threshold Sets the alarm threshold for monitoring the motor temperature. Pre-assignment,120 °C
p0605	Motor temperature fault threshold Sets the fault threshold for monitoring the motor temperature. Pre-assignment,155 °C
p0606	Motor overtemperature timer Maximum 0.1 s; for the bimetallic switch, you must select a timer of 0.1 s to ensure that the motor is reliably shutdown. If the timer has expired, then fault F07011 is output.

Testing temperature sensors for interconnection via the thermistor motor protection device

To test the PTC connection, remove at least one contact. F07011 is displayed after the time set in p0606 has expired (in this case, 0.1 s).

2.13.6 Determining the angular commutation offset

⚠ CAUTION
When the system is commissioned for the first time before adjusting the angular commutation offset, it is possible that the drive could be completely incorrectly commutated. Current is fed into the motor at the incorrect time for an incorrectly commutated motor. As a consequence, it can make unintentional movements, for example it can rotate at a high speed in the incorrect direction.
As a consequence, for safety reasons you must limit the current to 20% of the maximum motor current using parameter p0640.

You can determine the pole position, required for synchronous motors, for the SIMOTICS T-1FW6 built-in torque motors using a software-based automatic pole position identification technique.

The following two techniques are suitable for all frame sizes of SIMOTICS T-1FW6 built-in torque motors:

- The motion-based technique p1980 = 10
- The saturation-based technique (1st harmonic) p1980 = 1

Also refer to the information in Chapter General information for setting the commutation (Page 172).

Parameter entries / commutation setting

Incremental measuring system

Set the drive enable signals (OFF3, OFF2, OFF1). This results in coarse synchronization. A successful coarse synchronization is indicated by the parameter r1992.9. Then select the automatic determination of the angular commutation offset using p1990 = 1. Alarm A07971 is output while the angular commutation offset is being determined. You must then move the drive over the zero mark. When the zero mark is passed, the angular commutation offset is entered into p0431. p1990 is automatically set to 0 after the angular commutation offset has been determined. Alarm A07965 is displayed as a prompt to save the change in a non-volatile fashion.

Absolute measuring system

Set p1990 = 1 before activating the enable signals. By activating the enable signals, the angular commutation offset is entered into p0431 and p1990 is automatically set to 0. Alarm A07965 is displayed as a prompt to save the change in a non-volatile fashion.

2.13.6.1 Checking the angular commutation offset

⚠ WARNING
Danger as a result of an incorrectly commutated drive
An incorrectly commutated drive can result in loss of torque, increased temperature rise and uncontrolled motion of the drive.
Therefore, to complete commissioning, it is imperative that you check the angular commutation offset according to the following description!

Coarse synchronization means that the pole position identification has been carried out, but the drive has not yet been moved over the zero mark. After the drive has been moved over the zero mark, the drive is finely synchronized. Fine synchronization is omitted when an absolute measuring system is being used.

Checking the pole position identification

You can check the pole position identification with p1983 in the finely-synchronized state.

Position the drive at different points in an electrical period (pole pitch) and set parameter p1983 = 1. This means that a pole position identification is performed again and the deviation determined is displayed in parameter p1984.

After completion of the pole position identification, parameter p1983 is set to 0 again. The angular difference read out of parameter p1984 must lie in the interval [- 10°...+10°]. If the average value of the measured angular differences is greater than + 10°, then the average value must be added to the angular commutation offset entered in p0431 (see Figure 2-66 Tolerance envelope for the pole position angle (Page 204)).

If the average value of the measured angular difference is less than - 10°, then the average value must be subtracted from the angular commutation offset entered in p0431. For a change to parameter p0431, p0010 must be set to 4.

You must again perform coarse and fine synchronization. The fine synchronization is not applicable for an absolute measuring system.

See also

Checking the angular commutation offset by making a measurement (Page 195)

2.13.6.2 Checking the angular commutation offset by making a measurement

⚠ DANGER
Risk of electric shock when working on the DC link!
After opening the line switch, hazardous DC link voltages can always be present.
Observe the warning information on the component!
Check the voltage using a voltmeter (CAT III) between the motor terminals U - V; V - W; U - W (DC voltage measuring range up to at least 600 V).

Checking the EMF voltages

If you have commissioned the built-in torque motor according to the appropriate instructions, and in spite of this, unexpected messages are output, then initially you must check the individual EMF voltages of the built-in torque motor. To do this, the following techniques are described:

- Technique, "Recording the phase voltage and pole position angle using an oscilloscope"
- Technique, "Tracing the phase voltage and pole position angle" using the trace function of the STARTER commissioning tool

Technique, "Recording the phase voltage and pole position angle using an oscilloscope"

1. Switch the drive line-up into a no-current condition.
2. After the DC link has completely discharged, disconnect the motor cables from the converter.
   If motors are connected in parallel, then disconnect them.
3. Form an artificial neutral point using 1 kΩ resistors (for a parallel connection, for each motor).

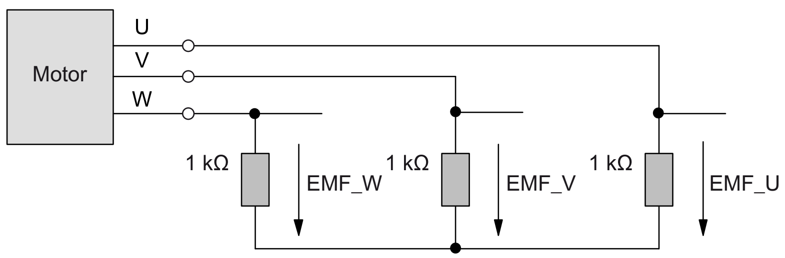


Figure 2-56 Arrangement for checking using measurements

4. Turn the rotor with the most constant speed possible in the clockwise direction. The rotor is turning in a clockwise direction if, when viewing the DE flange, it rotates clockwise (see also the Configuration Manual "SIMOTICS T-1FW6" built-in torque motors, Chapter "Technical features").

Checking the phase sequence, EMF phase U - EMF phase V - EMF phase W

For a positive direction of rotation of the drive, the phase sequence must be EMF phase U - EMF phase V - EMF phase W

Checking the phase position, EMF phase U - EMF phase V - EMF phase W

In the following diagram, the phase shift of the individual voltages with respect to each other is 120°.

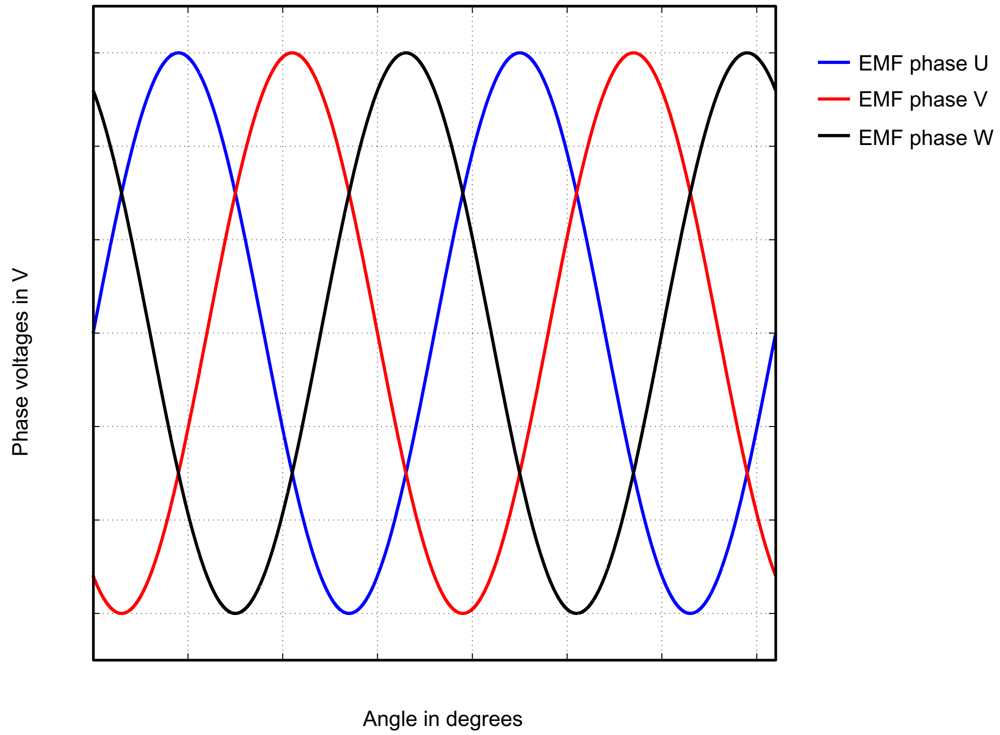


Figure 2-57 Phase sequence, EMF phase U - EMF phase V - EMF phase W

Checking the phase position, EMF phase U - EMF phase V - EMF phase W for parallel motors

The phase positions of the individual motors with respect to each other must match:

- EMF phase U motor 1 with EMF phase U motor 2
- EMF phase V motor 1 with EMF phase V motor 2
- EMF phase W motor 1 with EMF phase W motor 2

The deviation within a particular phase position may be a maximum of 10°.

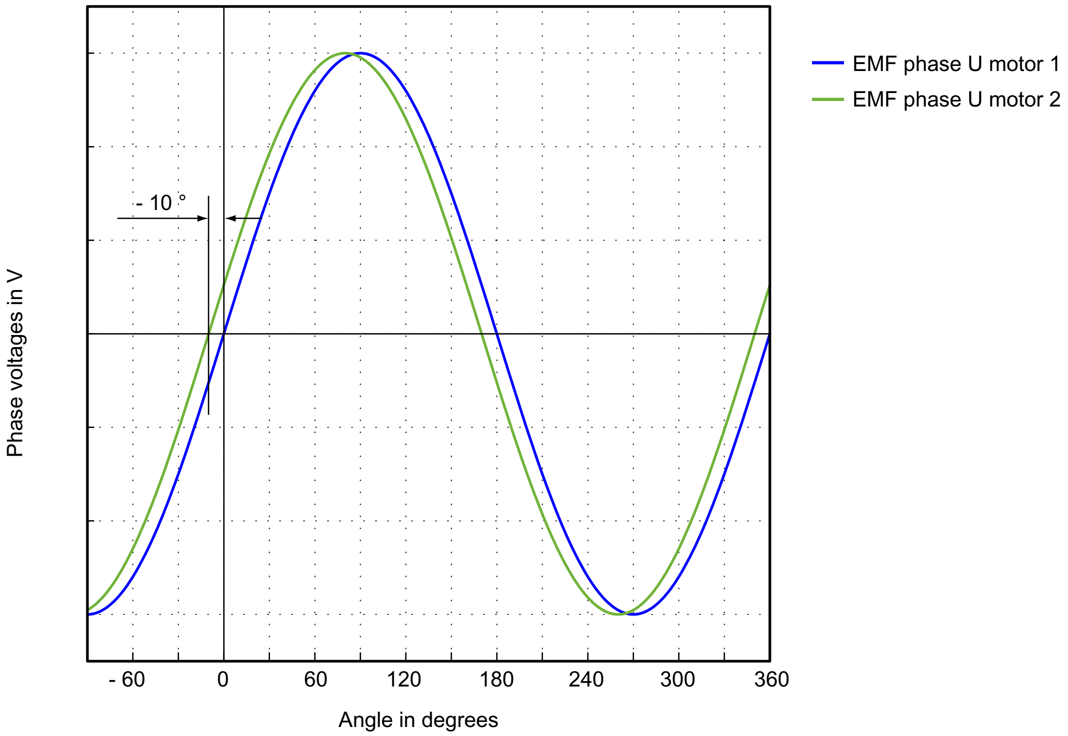


Figure 2-58 Phase U motor 1 may not lag behind EMF phase U motor 2 by more than 10 °

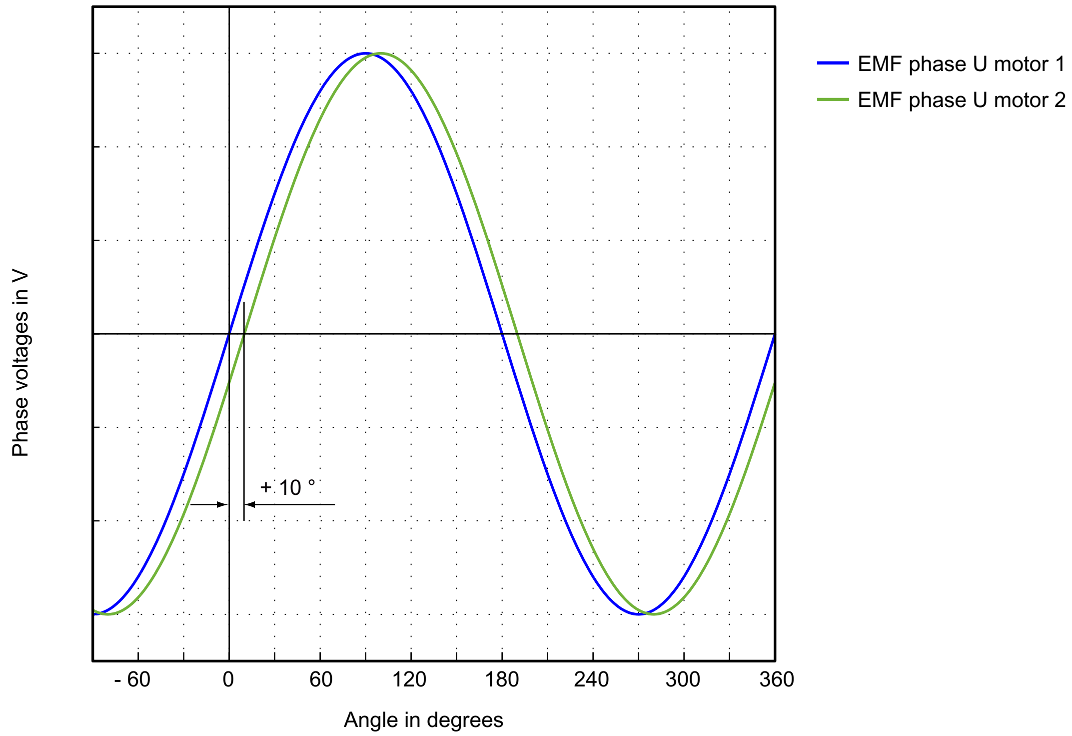


Figure 2-59 EMF phase U motor 1 may not lead EMF phase U motor 2 by more than 10 °

Determining the angular commutation offset using a measurement.

In the event of a fault and for a parallel connection, you must check the angular commutation offset as follows.

The drive with an incremental measuring system must be finely synchronized. This means that if required, you must connect the motor and set the controller enable so that coarse synchronization can be performed. Then move the drive over the zero mark. As described under the technique "Recording the phase voltage and pole position angle using an oscilloscope " you must bring the drive into a no-current condition. Please note that for this technique, it is not permissible that the control voltage for the Control Unit is shut down; however the infeed must be disconnected from the line supply

⚠ DANGER
Risk of electric shock when working on the DC link! After opening the line switch, hazardous DC link voltages can always be present. Observe the warning information on the component! Check the voltage using a voltmeter (CAT III) between the motor terminals U - V; V - W; U - W (DC voltage measuring range up to at least 600 V).

You can determine the angular commutation offset by measuring the EMF and the normalized electrical pole position angle via the analog output. The normalized electrical pole position angle allows you to parameterize the test socket connections T0 to T2 and retrieve the signals.

Definition of channels (Ch1 ... Ch4):

- Ch1: EMF phase U with respect to the neutral point
- Ch2: EMF phase V with respect to the neutral point
- Ch3: EMF phase W with respect to the neutral point
- Ch4: Normalized electrical angular pole position via analog output

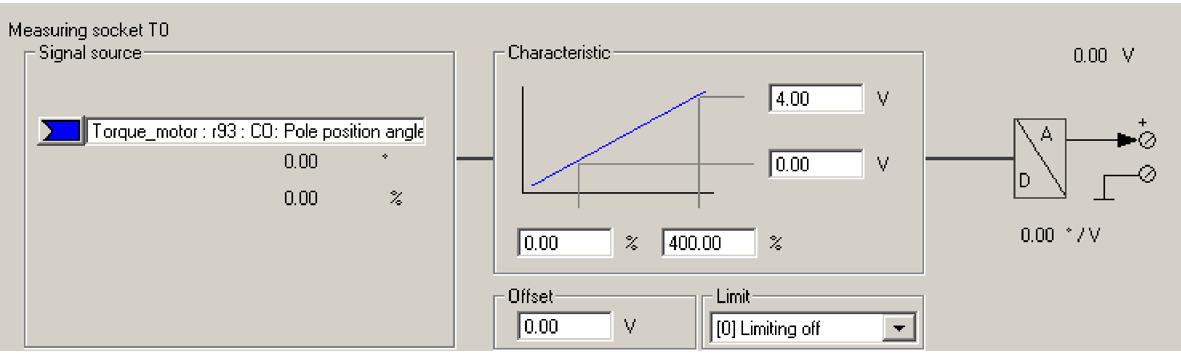


Figure 2-60 Setting measuring socket T0 on CU320

The status of the coarse and fine synchronization can be read out online via parameter r1992: r1992.8 (fine synchronization carried out) and r1992.9 (coarse synchronization carried out).

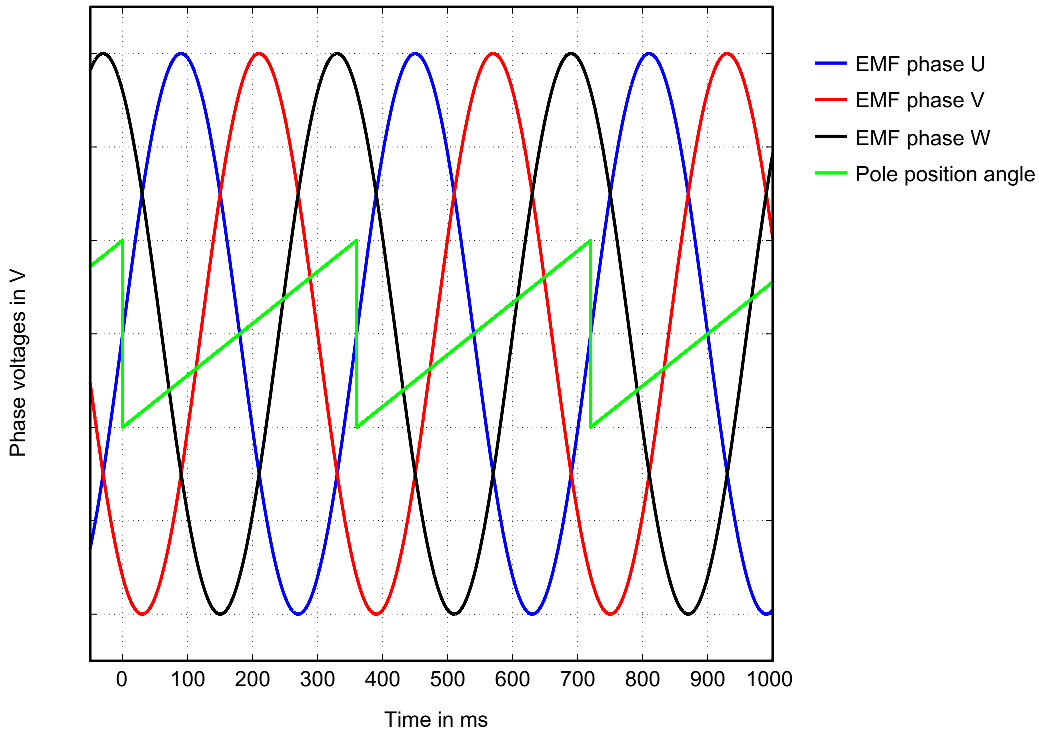


Figure 2-61 Ideal characteristic of EMF voltages and the pole position angle of an optimally commutated drive

Technique, "Recording the phase voltage and pole position angle" using the trace function of the STARTER commissioning tool

An oscilloscope is not used for this technique. You do not need to disconnect the motor. However, this technique is less accurate, as the motor voltages are not directly measured, but calculated from the transistor turn-on duration. This technique is not permitted for parallel motors, see Chapter "Special case parallel connection (Page 206)".

You must set the following parameters:

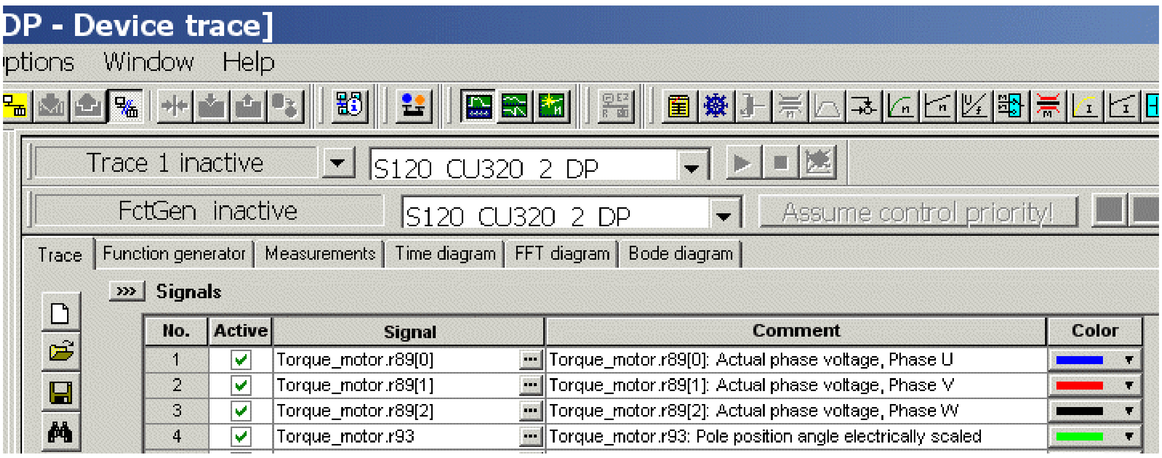


Figure 2-62 Assignment of trace channels to check the angular commutation offset

The drive is operated in the open-loop torque controlled mode. The following parameterization is required:

1. Set p1501 = 1, to switch over the speed/torque control.
2. Set p0640 = 0 to limit the motor current to 0.
3. Set p1545 = 1, to activate the travel to fixed stop.
4. The motor must be in closed-loop control and rotated externally.

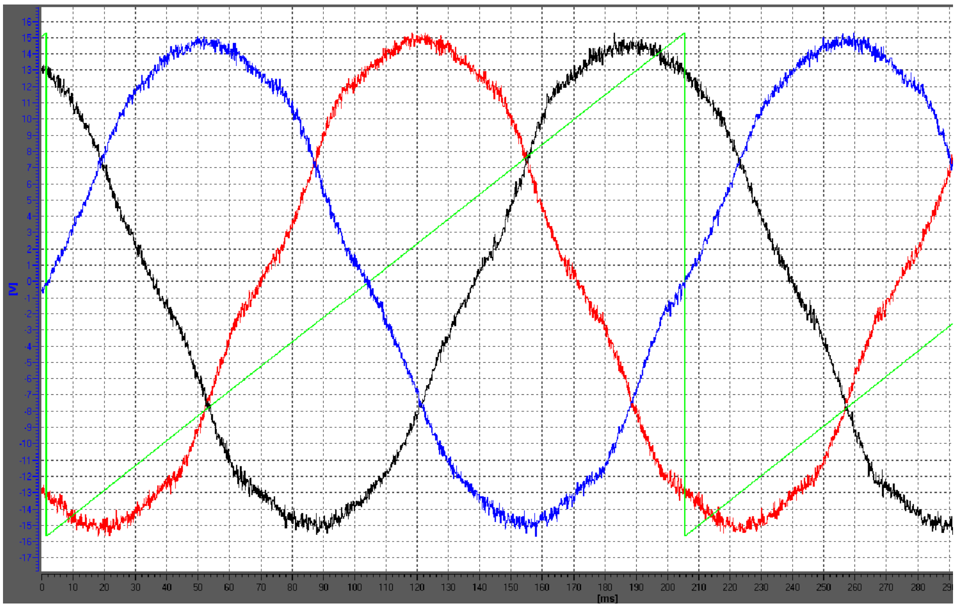


Figure 2-63 Example of an optimally commutated drive (recorded using the trace function of the STARTER commissioning tool, refer to the previous diagram for the color assignment)

Evaluation of the results (applies to both measuring techniques)

For a positive drive direction (definition, refer to the diagram "Determining the positive direction of the drive (Page 185)", the sawtooth must increase monotonously between 0° and 360°, refer to the diagram "Ideal characteristic of the EMF voltages and the pole position angle for an optimally commutated drive (Page 200)."

If the curve is falling monotonously, and the phase sequence is EMF phase U - EMF phase V - EMF phase W, then you must change the control sense of the drive if necessary via p0410 bit 0 "Invert speed actual value". If the position controller is being used, then you must also check p0410 bit 1 "Invert position actual value".

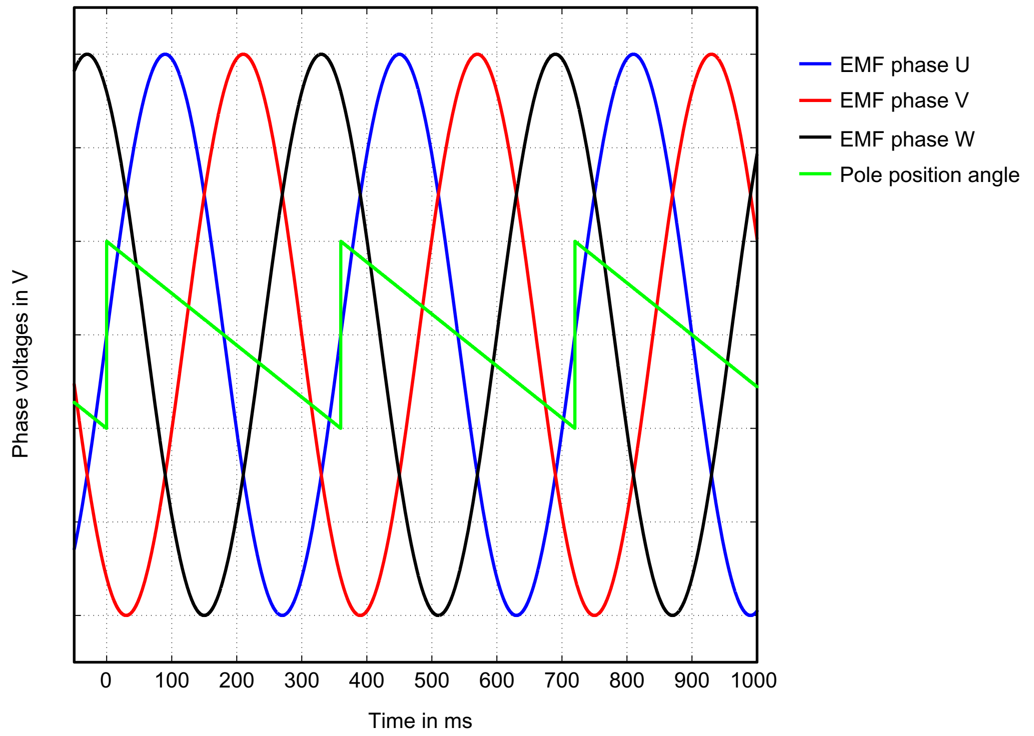


Figure 2-64 EMF for incorrect speed actual value inversion

If the curve is monotonously decreasing, and the phase sequence is EMF phase U – EMF phase W – EMF phase V (i.e. if the phase sequence of V and W is interchanged), then according to the diagram "Determining the positive direction of the drive" in Chapter "Parameterizing a motor and encoder", the drive direction is negative (i.e. when viewing the DE flange the axis is rotating counterclockwise).

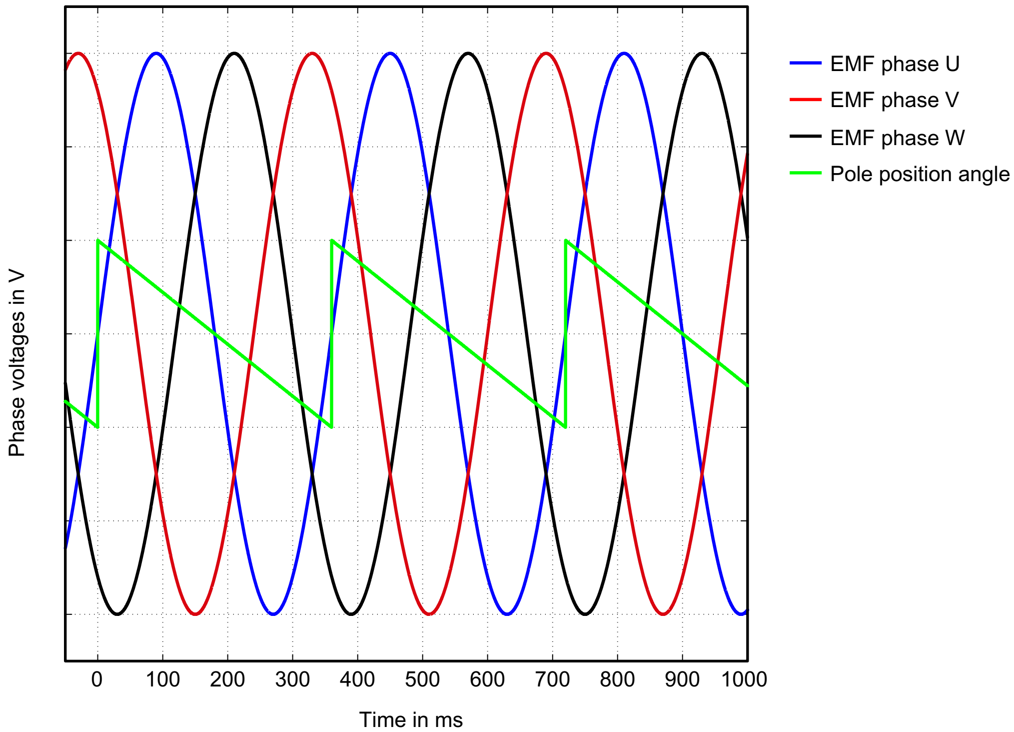


Figure 2-65 EMF for counterclockwise direction of rotation

Displaying the commutation angle tolerance

For a finely synchronized drive, the difference between EMF phase U and the normalized, electrical pole position angle may be maximum of 10°. This means that the zero points of the falling edge of the sawtooth and EMF phase U may differ by a maximum of 10° electrical. For motors connected in parallel, this maximum deviation for the EMF, phase U is valid for each motor connected in parallel.

If the difference is greater, then you must adapt the angular commutation offset. If, when passing the zero mark, fault message "F31130 (N, A) encoder 1: Zero mark and position error from the coarse synchronization" is output, then the deviation of the commutation is greater than 60° electrical. You must check the commutation angle again using the techniques described.

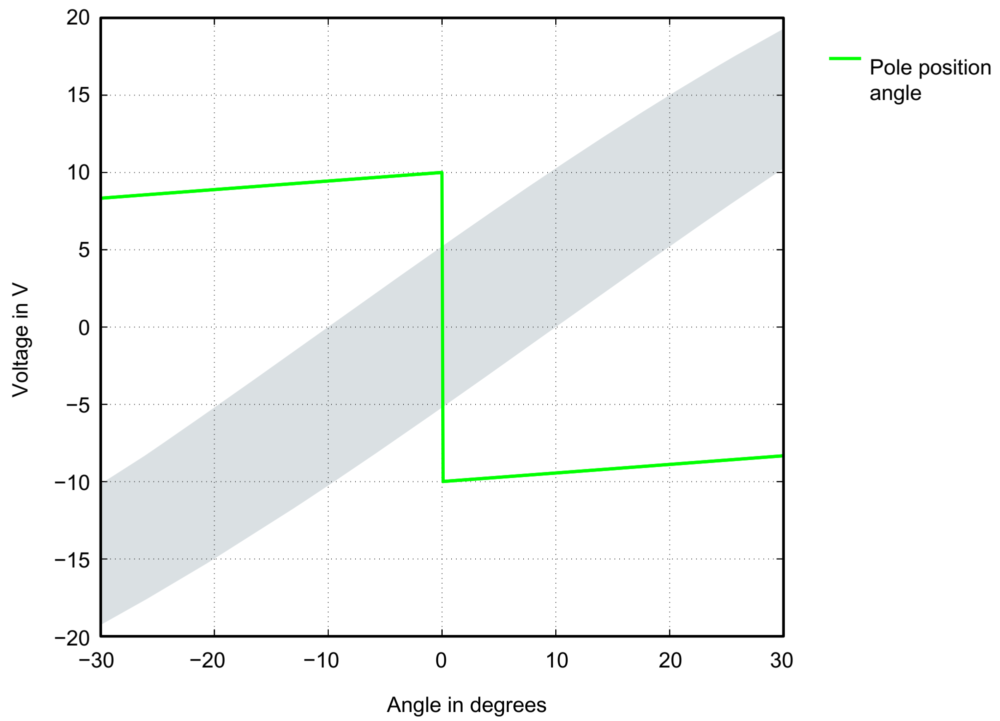


Figure 2-66 Tolerance envelope for the pole position angle

Commutation angle outside the tolerance

Example: The falling edge of the sawtooth voltage (pole position angle) leads the zero crossing of EMF phase U by approx. 18° electrical.

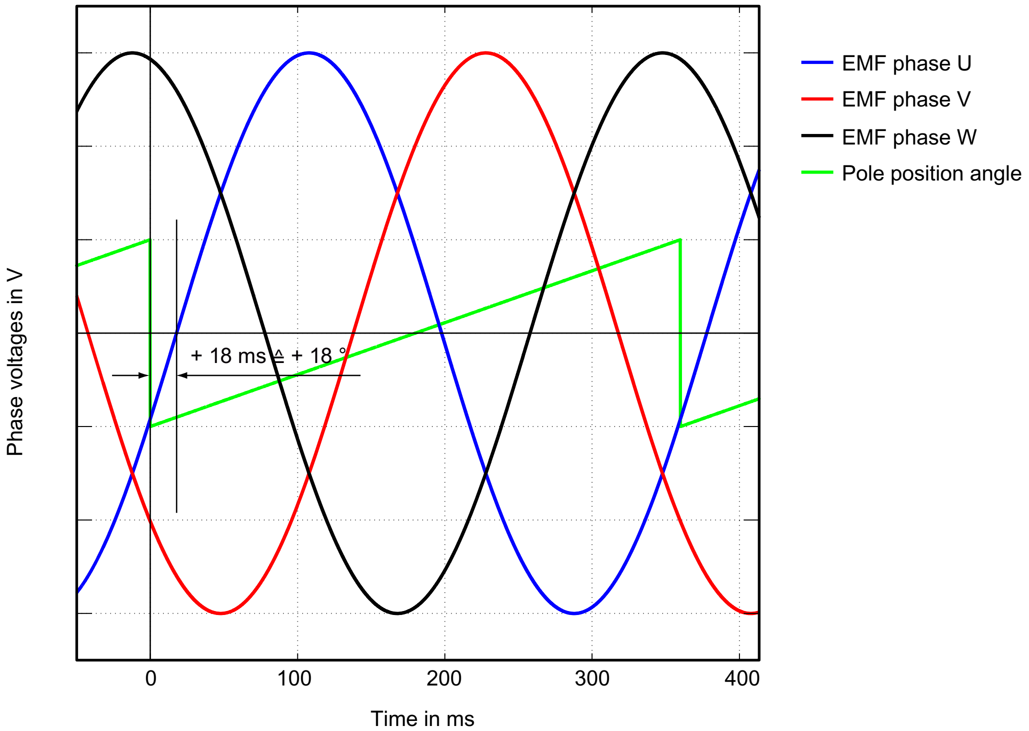


Figure 2-67 Example of an incorrectly commutated drive

Adapt the incorrect commutation shown in the diagram above according to the Chapter "Checking the angular competition offset (Page 194)".

p0431 = p0431 - 18

See also

Parameterizing a motor and encoder (Page 173)

Checking the angular commutation offset by making a measurement (Page 195)

2.13.7 Special case of a parallel connection

Note

Parallel connection

Only torque motors that are the same size and have the same current requirements (same winding design) can be connected in parallel. The order designations (MLFB) of the motors must only differ with regard to the position "component (position of the interfaces)".

For more information and connection diagrams, refer to the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors in Chapter "Coupled motors".

The following requirements must be met in order to operate several torque motors in parallel on a SINAMICS Motor Module:

- The motors must be arranged according to the data in the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors".
- The direction of rotation of parallel motors must match the data in the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors". For a Janus arrangement, when connecting the stoker, phases V and W must be interchanged so that the stoker has the same direction of rotation as the master, also refer to the Configuration Manual "SIMOTICS T-1FW6 built-in torque motors" Chapter "Power and signal connection for parallel operation".
- Ensure the position of the EMF voltages of the parallel motors as described under Chapter "Checking the angular commutation offset by taking measurements (Page 195)"; it is imperative that you check these carefully. Maintain the maximum deviation of the phase angle between the EMF voltages of the motors according to Chapter "Check angular commutation offset by taking measurements". You may only connect the motors to the converter after the deviation of the commutation angle for all of the motors to be connected in parallel lies within the limit value.
- Before commissioning and switching-on the DC voltage for the first time, note that the temperature monitoring circuits must be carefully checked to ensure that they correctly trip.

Then commission the system using the STARTER commissioning tool according to Chapter "Parameterizing a motor and encoder (Page 173)". The parallel connection for the SIMOTICS T-1FW6 built-in torque motors selected from the motor list can only be parameterized in the expert list of the drive.

After completing the configuration, in the STARTER commissioning tool, open the expert list of the drive and assign parameter p0306 = N, where N is the number of motors to be operated in parallel. The number of motors set must correspond to the number of motors that are actually connected in parallel.

After changing p0306, you must unconditionally adapt the control parameters using automatic calculation with p0340 = 1, see also help for parameter p0306 in the STARTER commissioning tool.

If p0306 is changed during quick commissioning (p0010 = 1), then the maximum current p0640 is appropriately pre-assigned. This is not the case in the motor commissioning (p0010 = 3)!

The motor data displayed in the STARTER commissioning tool is only valid for one motor and is only internally interpolated up to N motors connected in parallel.

2.13.8 Optimization of the closed-loop control

When running through the drive configuration, in the step "Calculating the motor/controller data", drive-specific controller parameters are calculated, see the diagram "Screen form to calculate motor/controller data (Page 179)" However, to be able to use the optimal performance of the machine, a subsequent optimization of the controller parameters is required. Higher positioning/machining accuracy can be achieved and cycle times can be reduced by means of optimized settings.

Controller optimization may only be performed by experienced specialists.

In the control, for optimizing the controller, there is the possibility of measuring frequency responses or recording setpoint steps. Especially the frequency response measurement allows machine-specific natural frequencies that restrict the bandwidth of the closed-loop control to be taken into account, .

You can ask your local Siemens office regarding optimization of the closed-loop control as a service.

See also

Parameterizing a motor and encoder (Page 173)

2.14 Notes on commissioning SSI encoders

Using error bits

The number and position of error bits may vary for SSI encoders. In the event of faults, error codes may even sometimes be transferred within the position information.

It is therefore essential that you assess all the error bits present (see "Parameterization" and "Limitations" in this chapter) as otherwise an error code may be interpreted as position information if faults are present.

Hardware requirements

- SMC20 Sensor Module Cabinet-Mounted
- SME25 Sensor Module External
- SMC30 Sensor Module Cabinet-Mounted
- CU320-2 Control Unit

Types of encoder that can be connected

Table 2- 21 Overview of encoder types that can be connected depending on the SIEMENS evaluation module

Encoder evaluation using the module	Incremental tracks	Absolute position	Voltage supply for encoder	SSI baud rate	Remarks
SMC20	sin/cos, 1 Vpp	SSI not cyclic [1]	5 V	100 kBaud	-
SME25	sin/cos, 1 Vpp	SSI not cyclic [1]	5 V	100 kBaud	SME25 is only suited to direct measuring systems
SMC30	Square or no incremental tracks	SSI not cyclic [1), 3] SSI, cyclic [2]	5 V or 24 V	100- 250 kBaud	-

[1] "not cyclic" means that the absolute position is only read when initializing the Sensor Module, after which the position is only calculated by the incremental tracks.

[2] "cyclic" means that the absolute position is read permanently (usually in the PROFIBUS or position controller cycle) and the position (X_IST1) formed from this.

[3] the SSI protocol is cyclically read-out for the plausibility checks

Note

Only encoders that support a transfer rate of 100 kHz and that have a high level in idle state may be used.

The monoflop time should be parameterized such that it is greater than or equal to the specified monoflop time of the encoder. This must lie in the range between 15 – 30 µs.

The level during the monoflop time must be low.

Ramp-up time of the encoder

In order to ensure that the correct sensor data is received, the encoder evaluation module checks whether the connected encoder is activated and ready for operation:

- After the power supply is switched on at the encoder, no signals are evaluated for a waiting period of 800 ms.
- After the waiting period has expired, test signals are applied to the clock cable and the response of the data line observed. As long as the encoder is not ready, the encoder holds the data line permanently in the idle state (as a rule, "high").
  It is expected that the encoder has reached its ready state by this time.
- If the encoder has not signaled that it is in the ready state after approx. 10 seconds, the encoder evaluation module signals a timeout error.

The waiting period starts again when:

- The 5 V power supply is applied to the encoder.
- Switchover to 24 V power supply after completed ramp-up of the encoder evaluation in accordance with the parameterized voltage level.

Note

The activation routine is started each time that the encoder is inserted. The activation routine has been completed with the ready message to the evaluation module.

Note

An external 24 V encoder supply is permitted.

Parameterization

Predefined encoders

Various predefined SSI encoders are available for commissioning. These can be selected in the commissioning windows of the STARTER commissioning tool.

User-defined encoders

If there are no predefined entries for the encoder used, user-defined encoder data can be entered via windows using the commissioning wizard.

Special settings

- Error bits (special case, several error bits)

  If an SSI encoder has several error bits, the evaluation is activated in the list of experts as follows using parameter p0434[x]:

  Value = dcba
  ba: Position of error bit in protocol (0 ... 63)
  c: Level (0: Low level 1: High level)
  d: Status of evaluation (0: Off, 1: On with 1 error bit, 2: On with 2 error bits ... 9: On with 9 error bits)

  For several error bits, the following applies:

  – The position specified under ba and the additional bits are assigned in ascending order.
  – The level set under c is applicable for all error bits.

  Example:

  p0434 = 1013
  --> the evaluation is activated, and the error bit is at position 13 with low level.

  p0434 = 1113
  --> the evaluation is activated, and the error bit is at position 13 with high level.

  p0434 = 2124
  --> the evaluation is activated, and the 2 error bits are at a high level from position 24.

- Fine resolution p0418 and p0419

  In order to make full use of the entire traversing range of the absolute encoder, the position information, including fine resolution, must not exceed 32 bits.

  Example:

  An SSI encoder without incremental tracks is used. The encoder has a singleturn resolution of 16 bits and a multiturn resolution of 14 bits. The absolute position resolution is therefore 30 bits.

  Consequently, only a fine resolution of 2 bits can be set. Parameters p0418[x] and p0419[x] in the list of experts should therefore be set to the value 2.

Diagnostics

Example 1

An SSI encoder without incremental tracks is used. The encoder has a singleturn resolution of 16 bits and a multiturn resolution of 14 bits. The fine resolution p0418[x] and p0419[x] is set to the value 2. In parameter r0482[x] (X_IST1), the product is formed from "pulses per revolution" and fine resolution p0418[x]. If using SSI encoders without incremental tracks, the number of pulses and singleturn resolution are identical. In our example, the actual position value X_IST1 (r0482[x]) must therefore have changed by the following value after one encoder revolution:

Single turn resolution * fine resolution = $2^{16} * 2^{2}$ = 262144

Example 2

An SSI encoder with incremental tracks is used. In this case, incorrect SSI protocol settings can be seen, e.g. by the fact that once the system has been switched on a different absolute position is indicated from that before it was last deactivated.

The absolute position X_IST2 (r0483[x]) must be considered by way of a check. Following PROFIdrive, however, just one value is displayed in this parameter if bit 13 (request absolute value in cycles) is set to the value 1 in the encoder control word p0480[x].

This bit can be set, e.g. with the aid of the binector-connector converter.

Once switched on, the SSI encoder is now turned a few revolutions. Once switched off and on again, the absolute position of X_IST2 (r0483[x]) must indicate an unchanged value. Only minor deviations may occur in the fine resolution area.

2.15 Notes on the commissioning of a 2-pole resolver as absolute encoder

Description

You can use 2-pole (1 pole pair) resolvers as singleturn absolute encoders. The absolute encoder position actual value is provided in Gn_XIST2 (r0483[x]).

Actual position value format

The factory setting for the fine resolution of Gn_XIST1 differs from the fine resolution in Gn_XIST2 (p0418 = 11, p0419 = 9). This may cause a slight displacement of the encoder position after switching the drive unit off/on.

Therefore, when using a 2-pole resolver as an absolute encoder, we recommend that the fine resolution for Gn_XIST1 (p0418) is set the same as the fine resolution for Gn_XIST2 (p0419), e.g. p0418 = p0419 =11.

2-pole resolvers are automatically entered in the PROFIdrive profile (r0979) as singleturn absolute encoders.

Position tracking

You can also activate position tracking for a 2-pole resolver. Please note, however, that the resolver may not be moved more than half an encoder revolution (pole width) when switched off. The activation and configuration of the position tracking is described in the chapter "Position tracking".

EPOS - absolute encoder adjustment

If the 2-pole resolver is used as an absolute encoder for basic positioning (EPOS), the absolute encoder adjustment must be performed:

- In the STARTER commissioning tool (Basic positioner → Referencing) or
- In the Expert list.

To do this, set reference point coordinate p2599 to the value corresponding to the mechanical system and request the adjustment with p2507 = 2.

You will then need to back up the data from RAM to ROM.

2.16 Temperature sensors for SINAMICS components

> **DANGER**
>
> **Risk of electric shock**
>
> Only temperature sensors that meet the electrical separation specifications laid out in EN 61800-5-1 may be connected to terminals "+Temp" and "-Temp". If safe electrical separation cannot be guaranteed (e.g. for linear motors or third-party motors), a Sensor Module External SME120, SME125 or the Terminal Module TM120 must be used. If these instructions are not complied with, there is a risk of electric shock!

The following table provides an overview of the SINAMICS drive system components available with temperature sensor connections.

Table 2- 22 Temperature sensor connections for SINAMICS components

Module	Interface	Pin	Signal name	Technical specifications
SMC10/SMC20	X520 (sub D)	13 25	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC
SMC30	X520 (sub D) Temperature channel 2	1 8	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC / bimetallic switch with NC contact
	X531 (terminal) temperature channel 1	3 4	- Temp +Temp	Temperature sensor KTY84-1C130 / PTC / bimetallic switch with NC contact
CU310-2 DP CU310-2 PN	X23 (sub D)	1 8	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC
	X120 (terminal)	1 2	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC
CUA31	X210 (terminal)	1 2	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC
CUA32	X210 (terminal) Temperature channel 2	1 2	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC / bimetallic switch with NC contact
	X220 (sub D) Temperature channel 1	1 8	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC / bimetallic switch with NC contact
TM31	X522 (terminal)	7 8	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC
TM120	X524 (terminal)	1 2	- Temp +Temp	Temperature sensor connection KTY84-1C130 / PTC/bimetallic switch with NC contact for linear motor applications, here the motor temperature sensor connect KTY84-1C130
		3 4	- Temp +Temp	
		5 6	- Temp +Temp	
		7 8	- Temp +Temp	

Module	Interface	Pin	Signal name	Technical specifications
TM150	X531	1 2 3 4	+Temp - Temp +Temp - Temp	KTY84-1C130/PTC/bimetallic NC contact/-PT100/PT1000 Information on interconnecting the temperature channels can be found below.
	X532	1 2 3 4	+Temp - Temp +Temp - Temp	
	X533	1 2 3 4	+Temp - Temp +Temp - Temp	
	X534	1 2 3 4	+Temp - Temp +Temp - Temp	
	X535	1 2 3 4	+Temp - Temp +Temp - Temp	
	X536	1 2 3 4	+Temp - Temp +Temp - Temp	
SME20	Measuring system interface	7 9	- Temp +Temp	Temperature sensor KTY84-1C130 / PTC connection cable with order number 6FX8002-2CA88- xxxx necessary [1)]
SME120/SME125	X200 (connector) Temperature channel 2	1 2	- Temp +Temp	Temperature sensor KTY84-1C130 / PTC / bimetallic switch with NC contact
	X200 (connector) Temperature channel 3	3 4	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC / bimetallic switch with NC contact
	X200 (connector) Temperature channel 4	5 6	+Temp - Temp	Temperature sensor KTY84-1C130 / PTC / bimetallic switch with NC contact
Active Line Module	Booksize X21 (terminal)	1 2	+Temp - Temp	Active Line Module temperature sensor Temperature switch type: bimetallic switch with NC contact
	Chassis X41 (terminal)	4 3	+Temp - Temp	
Smart Line Module	Booksize X21 (terminal)	1 2	+Temp - Temp	Active Line Module temperature sensor Temperature switch type: bimetallic switch with NC contact
	Chassis X41 (terminal)	4 3	+Temp - Temp	
Basic Line Module	Booksize X21 (terminal)	1 2	+Temp - Temp	Basic Line Module temperature sensor temperature switch type: bimetallic switch with NC contact
	Chassis X41 (terminal)	4 3	+Temp - Temp	

Module	Interface	Pin	Signal name	Technical specifications
Motor Module	Booksize X21/X22 (terminal)	1 2	+Temp - Temp	Temperature sensor KTY84–1C130 / PTC Bimetallic switch with NC contact: Alarm and timer (only for temperature evaluation via MM) PT100 temperature sensor
	The following applies to chassis: X41 (terminal)	4 3	+Temp - Temp	

[1)] Cable for connection to direct measurement systems: Order number 6FXx002-2CB54-xxxx

Commissioning information

The index [0..n] used in the following identifies either the motor data set or the encoder data set.

SMC10/SMC20

You can use the STARTER screen (\signals and monitoring \ motor temperature) to parameterize the motor temperature evaluation via SUB-D socket X520.

SMC30 (from Order No. 6SL3055-0AA00-5CA2)

In addition to temperature evaluation via terminal X531 (temperature channel 1), this module also has temperature evaluation at SUB-D socket X520 (temperature channel 2).

At the default setting (p0600 = 1 "Temperature via encoder 1" and p0601 = 2 "KTY") the temperature is evaluated via the first temperature channel. The temperature sensor is connected to terminal X531 on the SMC30. The temperature is shown via r0035.

The parameterization of the motor temperature evaluation via the sub D socket X520 must be performed in the expert list as follows:

- p0600[0..n]: Selection of the encoder (1, 2 or 3) to which the SMC30, that is used for the temperature evaluation, is assigned (n = motor data set).
- p0601[0..n] = 10 (evaluation via several temperature channels), n = motor data set.
- p4601[0..n]: Select the temperature sensor type for temperature channel 2 (depends on encoder data set n, not motor data set).

Note

With several encoders, the index [n] of the relevant encoder / encoder data set, via which the temperature evaluation is performed, must be used.

The temperature is displayed in parameter r4620[1] (temperature channel 2). For multiple temperature channels (use of temperature channels 1 and 2 on SMC30), parameter r0035 shows the maximum temperature.

Example:

A KTY temperature sensor is connected at the sub D socket X520 on the SMC30 of Encoder 1.

This is parameterized via:

- p0600[0..n] = 1 / p0601[0..n] = 10 / p4601[0..n] = 20

Both temperature channels (X520 and X531) can be used at the same time. In addition to the above parameterization, the sensor type of the temperature sensor connected at terminal X531 must be entered in p4600[0..n]. The maximum value is then generated for the motor temperature and displayed in r0035.

Note

With several encoders, the index [n] of the relevant encoder / encoder data set, via which the temperature evaluation is performed, must be used.

CU310-2 DP/CU310-2 PN

The Control Unit 310-2 has an integrated SMC30 encoder interface. This encoder interface is accessed via the 15-pin Sub-D-contact X23 and is evaluated as temperature channel 1.

There are three options available to evaluate the temperature:

Option	The following parameter settings must be made:
Temperature channel 1 via the SMC30 encoder interface X23.	• p0600[0..n] = 1: Selects the encoder (1, 2 or 3), which is assigned to encoder interface X23 and via which the temperature is evaluated (n = motor data set). • p0601[0..n] = 1 or 2: Selection of the temperature sensor type, n = motor data set • r0035: Display of the temperature value.
Temperature channel 1 via terminal X120, for example, if an encoder is being used.	• p0600[0..n] = 11: Activation from temperature channel 1 via terminal X120 • p0601[0..n] = 1 or 2: Selection of the temperature sensor type, n = motor data set • r0035: Display of the temperature value.
Two temperature channels via X23 and X120. Encoder interface X23 is assigned to temperature channel 1 and terminal X120 is assigned to temperature channel 2.	• p0600[0..n] = 1: Selects the encoder (1, 2 or 3), which is assigned to encoder interface X23 and via which the temperature is evaluated (n = motor data set). • p0601[0..n] = 10: Evaluation via several temperature channels • p4600[0..n]: Selection of the temperature sensor type from temperature channel 1, n = encoder data set • p4601[0..n]: Selection of the temperature sensor type from temperature channel 2, n = encoder data set • r4620[0...3]: Reading the temperature values. – Index n = 0 temperature channel 1 – Index n = 1 temperature channel 2 • r0035: Display of the higher temperature value of temperature channels 1 and 2.

CUA31

The parameterization of the temperature evaluation via terminal X210 can be performed using the STARTER screen (messages and monitoring > motor temperature). "Temperature sensor via Motor Module (11)" should be selected in the "Temperature sensor selection" field. The temperature of the sensor is displayed in r0035.

CUA32

The parameterization of the temperature evaluation via terminal X210 or sub D socket X220 is performed using two temperature channels.

p0600 = 11: Temperature sensor via Motor Module

For the SINAMICS S120 AC Drive (AC/AC) and if Control Unit Adapter CUA31/CUA32 is used, the temperature sensor connection is on the adapter (X210).

TM31

A Terminal Module 31 (TM31) is used when additional digital and analog inputs/outputs required. The sensor type used is set via p4100 and the temperature signal interconnected via r4105.

TM120

If the temperature sensors in the installed motors do not have protective separation, then you require a Terminal Module 120 (TM120). Up to 4 different temperature sensors can be connected to the TM120. The TM120 senses the temperature values, evaluates them, and sends them via DRIVE-CLiQ to the Control Unit. The temperature actual values measured using KTY84 are evaluated in the range from -140 °C ... +188.6 °C. Temperature actual values outside this range are not taken into account. The fault and alarm thresholds (p4102) of the temperature values can be set from -48 °C up to 251°C.

Settings for the measurement:

- With p0600 = 20 or 21, the motor temperature sensing is activated using an external sensor.
- With p0601 = 11, the evaluation is set over several temperature channels.
- In p0604, the motor temperature alarm threshold is set.
- In p0605, the motor temperature fault threshold is set.
- With p0608 and p0609, the temperature channels are assigned to the signal sources for the motor temperatures.
  - With p4100[0...3] = 1, temperature sensor type PTC is set to the corresponding channel 1 to 4 and the evaluation activated.
  - With p4100[0...3] = 2, temperature sensor type KTY84 is set to the corresponding channel 1 to 4 and the evaluation activated.
  - With p4100[0...3] = 4, the temperature sensor type bimetal NC contact is set and the evaluation activated.
- The actual resistance value of the particular temperature sensor is displayed in parameter r4101[0...3].
- The temperature actual value of the temperature evaluation is displayed in parameter r4105[0...3]. If no sensor has been selected, or if the temperature actual value is invalid, then the value -300 °C is in parameter r4105[0...3].
- With p4610[0...n] to p4613[0...n], the temperature sensors are assigned to the motor and the response defined.

TM150

The Terminal Module 150 (TM150) has 6x 4-pole terminals for temperature sensors. Temperature sensors can be connected in a 2, 3 or 4-wire system. Up to 12 input channels can be evaluated if two 2-wire sensors are connected to the 4 poles at the input terminal strips. Twelve (12) input channels can be evaluated in the factory setting. The temperature channels of a TM150 can be subdivided into 3 groups and evaluated together.

When using 2-wire sensors, to increase the measuring accuracy, the cable resistance can be measured and saved. To do this, short-circuit the sensor cable as close as possible to the sensor. The procedure is described in the SINAMICS S120/150 List Manual under p4109[0...11]. The measured cable resistance is then taken into account when evaluating the temperature. The cable resistance value is saved in p4110[0...11].

The TM150 can acquire the signals from KTY84, PTC, bimetallic NC contact, PT100 and PT1000 temperature sensors and evaluate them. The fault and alarm thresholds of the temperature values can be set from -99 °C to 251°C. The temperature sensors are connected at terminal strip X531 to X536 according to the table above. For further information on the configuration and the connections, refer to the function diagrams 9625, 9626 and 9627 in the SINAMICS S120/S150 List Manual.

- p4100[0...11] sets the sensor type for the respective temperature channel.

Value of p4100[0...11]	Temperature sensor	Temperature display range r4105[0...11]
0	Evaluation disabled	-
1	PTC thermistor	-50°C or +250°C
2	KTY84	-99°C to +250°C
4	Bimetallic NC contact	-50°C or +250°C
5	PT100	-99°C to +250°C
6	PT1000	-99°C to +250°C

- r4105[0...11] indicates the actual value of the temperature channel.

  For switching temperature sensors, such as PTC and bimetallic NC contact, two limit values are displayed symbolically:

  – r4105[0...11] = -50°C: The actual temperature value is below the rated response temperature.

  – r4105[0...11] = +250°C: The actual temperature value is above the rated response temperature.

Note

For PTC and bimetal NC contact the following applies

What is shown in r4105[0...11] does not correspond to the actual temperature value.

- With p4108[0...5] = 0, you evaluate a sensor in a 2-wire system at a 4-wire connection at terminals 1 and 2. Terminals 3 and 4 remain open.

- With p4108[0...5] = 2, you evaluate a sensor in a 3-wire system at a 4-wire connection at terminals 3 and 4. The measuring cable is connected to terminal 1. You must short-circuit terminals 2 and 4.
- With p4108[0...5] = 3, you evaluate a sensor in a 4-wire system at a 4-wire connection at terminals 3 and 4. The measuring cable is connected to terminals 1 and 2.

You can find additional information in function diagram 9626 in the SINAMICS S120/S150 List Manual and in the SINAMICS S120 Function Manual Drive Functions in Chapter "Thermal motor protection".

SME20

The evaluation of KTY or PTC temperature sensors can be parameterized using the STARTER screen (Messages and monitoring > Motor temperature):

- Temperature sensor selection (≙ p0600[0..n]): Selection of the source to which the SME module is assigned (temperature sensor via encoder (1, 2 or 3), temperature sensor via BICO interconnections or temperature sensor via Motor Module)
- Temperature sensor type (≙ p0601[0..n]): Sets the sensor type for motor temperature monitoring.

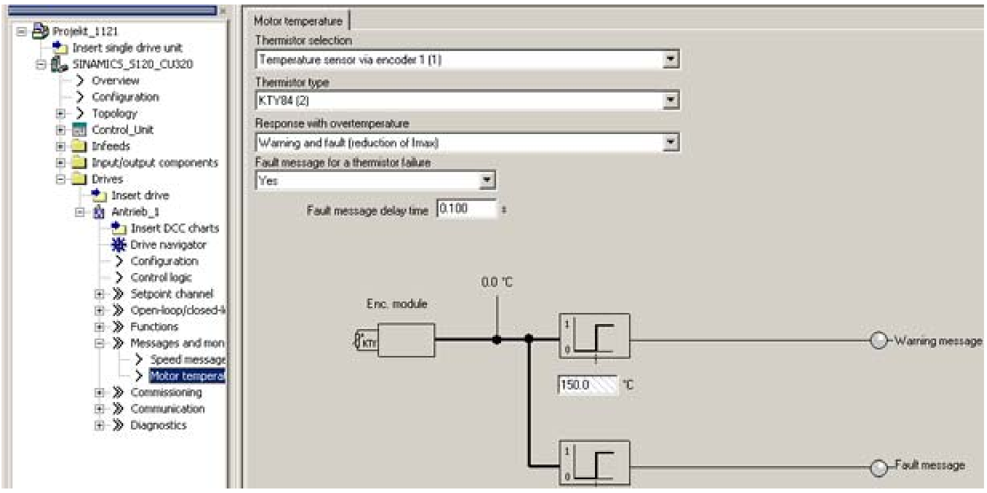


Figure 2-68 Selection of temperature sensor for SME20 modules

SME120/SME125

For modules with several temperature sensor connections (SME Modules), the temperature sensor is selected depending on encoder data set n via parameters p4601[0..n]..p4603[0..n]. A maximum of three motor temperature sensors can be evaluated simultaneously via terminal X200.

The parameterization of the motor temperature evaluation via terminal X200 must be performed in the expert list as follows:

- p0600[0..n]: Selection of the encoder (1, 2 or 3) to which the SME Module, that is used for the temperature evaluation, is assigned (n = motor data set).
- p0601[0..n] = 10 (evaluation via several temperature channels), n = motor data set.

- p4601[0..n]-p4603[0..n]: Select the temperature sensor type of temperature channels 2-4, depending on encoder data set n.
  Only temperature channels 2-4 are available at terminal X200.
- Parameter r4620[0...3] Motor temperatures SME
  is used to display the current temperatures in the motor, measured via an SME120 or SME125. The indices mean:
  [1] = SME temperature channel 2 / motor temperature sensor 2
  [2] = SME temperature channel 3 / motor temperature sensor 3
  [3] = SME temperature channel 4 / motor temperature sensor 4

Diagnostic parameters r0458[0...2] Sensor Module properties

Index [0...2]: Encoder 1...encoder 3

Parameter r0458 allows the following properties to be queried at the temperature sensor modules:

Bit	Feature
02	Temperature sensor connection present
03	Connection for PTC for motors with DRIVE-CLiQ also present
04	Module temperature available
08	Evaluation set up across several temperature channels

Selection of several temperature channels p4601 ... p4603 is only possible, for example, when parameter p0601 = 10 is set. This can be checked using the entry r0458.8 = 1.

You can find further information on parameter r0458 in: SINAMICS S 120/S150 List Manual.

Active Line Module, Basic Line Module, Smart Line Module, Motor Module (chassis)

Parameter p0601 "Motor temperature sensor type" enables the setting for the sensor type for the temperature measurement at input X21 (booksize) or X41 (chassis). The measured value is displayed in r0035.

Faults and alarms

F07011 drive: Motor overtemperature

KTY sensor:
The motor temperature has exceeded the fault threshold (p0605) or the timer stage (p0606) after the alarm threshold was exceeded (p0604) has expired.
This results in the reaction parameterized in p0610.

PTC sensor + bimetallic switch:
The response threshold of 1650 Ohm was exceeded and the timer stage (p0606) has expired.
This results in the reaction parameterized in p0610.

If an SME Module is used (p0601 = 10), parameter r949 displays the number of the sensor channel that has triggered the message.

A07015 drive: Motor temperature sensor alarm

An error was detected when evaluating the temperature sensor set in p0600 and p0601.

When the fault occurs, the time in p0607 is started. If the fault is still present after this time has expired, fault F07016 is output – however, not until at least 50 ms after alarm A07015.

If an SME Module is used (p0601 = 10), parameter r2124 displays the number of the sensor channel that has triggered the message.

F07016 drive: Motor temperature sensor fault

An error was detected when evaluating the temperature sensor set in p0600 and p0601.

If alarm A07015 is present, the time in p0607 is started. If the fault is still present after this time has expired, fault F07016 is output – however, not until at least 50 ms after alarm A07015.

If an SME Module is used (p0601 = 10), parameter r949 displays the number of the sensor channel that has triggered the message.

Function diagrams (see SINAMICS S120/S150 List Manual)

- 8016 Signals and monitoring functions - thermal monitoring motor

Overview of important parameters (see SINAMICS S120/S150 List Manual)

- r0035 CO: Motor temperature
- r0458[0...2] Sensor Module properties
- p0600[0..n] Motor temperature sensor for monitoring
- p0601[0..n] Motor temperature sensor type
- p0601 Motor temperature sensor type
- p0603 CI: Motor temperature signal source
- p0604[0...n] Mot_temp_mod 2/KTY alarm threshold
- p0605[0...n] Mot_temp_mod 1/2 threshold
- p0606[0...n] Mot_temp_mod 2/KTY timer
- p0607[0...n] Temperature sensor fault timer
- p0610[0...n] Motor overtemperature response
- p4100[0...3] TM120 temperature evaluation, sensor type
- p4100 TM31 temperature evaluation, sensor type
- p4102[0...7] TM150 fault threshold/alarm threshold
- r4105[0...3] CO:TM120 temperature evaluation actual value
- r4105 CO:TM31 temperature evaluation actual value
- p4600[0...n] Motor temperature sensor 1 sensor type
- p4601[0...n] Motor temperature sensor 2 sensor type
- p4602[0...n] Motor temperature sensor 3 sensor type
- p4603[0...n] Motor temperature sensor 4 sensor type
- r4620[0...3] Motor temperature measured

2.17 Basic Operator Panel 20 (BOP20)

Short description

The Basic Operator Panel 20 (BOP20) is a basic operator panel with six keys and a two-line display unit with background lighting. The BOP20 can be plugged onto the SINAMICS Control Unit and operated.

The BOP20 supports the following functions:

- Input and changing parameters
- Display of operating modes, parameters and alarms
- Display and acknowledgement of faults
- Powering-up/powering-down while commissioning
- Simulation of a motorized potentiometer

2.17.1 Operation with BOP20 (Basic Operator Panel 20)

2.17.1.1 General information about the BOP20

The BOP20 can be used to switch on and switch off drives during the commissioning phase as well as to display and modify parameters. Faults can be diagnosed as well as acknowledged.

The BOP20 is snapped onto the Control Unit. To do this, the blanking cover must be removed (for additional information on mounting, please refer to the SINAMICS S120 Manual Control Units and Supplementary System Components).

Displays and keys

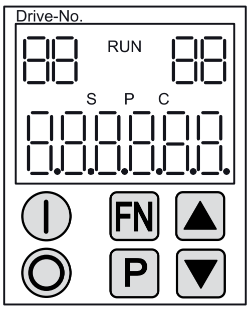


Figure 2-69 Overview of displays and keys

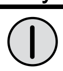
Information on the displays

Table 2- 23 LED

Display	Meaning
top left 2 positions	The active drive object of the BOP is displayed here. The displays and key operations always refer to this drive object.
RUN	Lit if at least one drive in the drive line-up is in the RUN state (in operation). RUN is also displayed via bit r0899.2 of the drive.
top right 2 positions	The following is displayed in this field: • More than 6 digits: Characters that are still present but are invisible (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.
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 2- 24 Keys

Key	Name	Meaning
	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.
	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).
	Functions	The significance of this key depends on the actual display. Note: The effectiveness of this key to acknowledge faults can be defined using the appropriate BiCo parameterization.

Key	Name	Meaning
P	Parameter	The significance of this key 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 significance of these keys is dependent on the actual display and is used to increase or decrease values.
▼	Lower	

BOP20 functions

Table 2- 25 Functions

Name	Description
Backlighting	The backlighting can be set using p0007 in such a way that it switches itself off automatically after the set time if no actions are carried out.
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.
Unplug while voltage is present	The BOP can be withdrawn and inserted under voltage. • The ON key and OFF key have a function. When withdrawing, the drives are stopped. After inserting, the drives must be switched on again. • The ON key and OFF key 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.

Overview of important parameters (see SINAMICS S120/S150 List Manual)

All drive objects

- p0005 BOP status display selection
- p0006 BOP status display mode
- p0013 BOP user-defined list
- p0971 Save drive object parameters

Drive object, Control Unit

- r0002 Control Unit status display
- p0003 BOP access level
- p0004 BOP display filter
- p0007 BOP backlighting
- p0008 BOP drive object after powering up
- 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, VECTOR, X_INF, TM41 etc.)

- p0010 Commissioning parameter filter

2.17.1.2 Displays and using the BOP20

Features

- Status indicator
- Changing the active drive object
- Displaying/changing parameters
- Displaying/acknowledging faults and alarms
- Controlling the drive using the BOP20

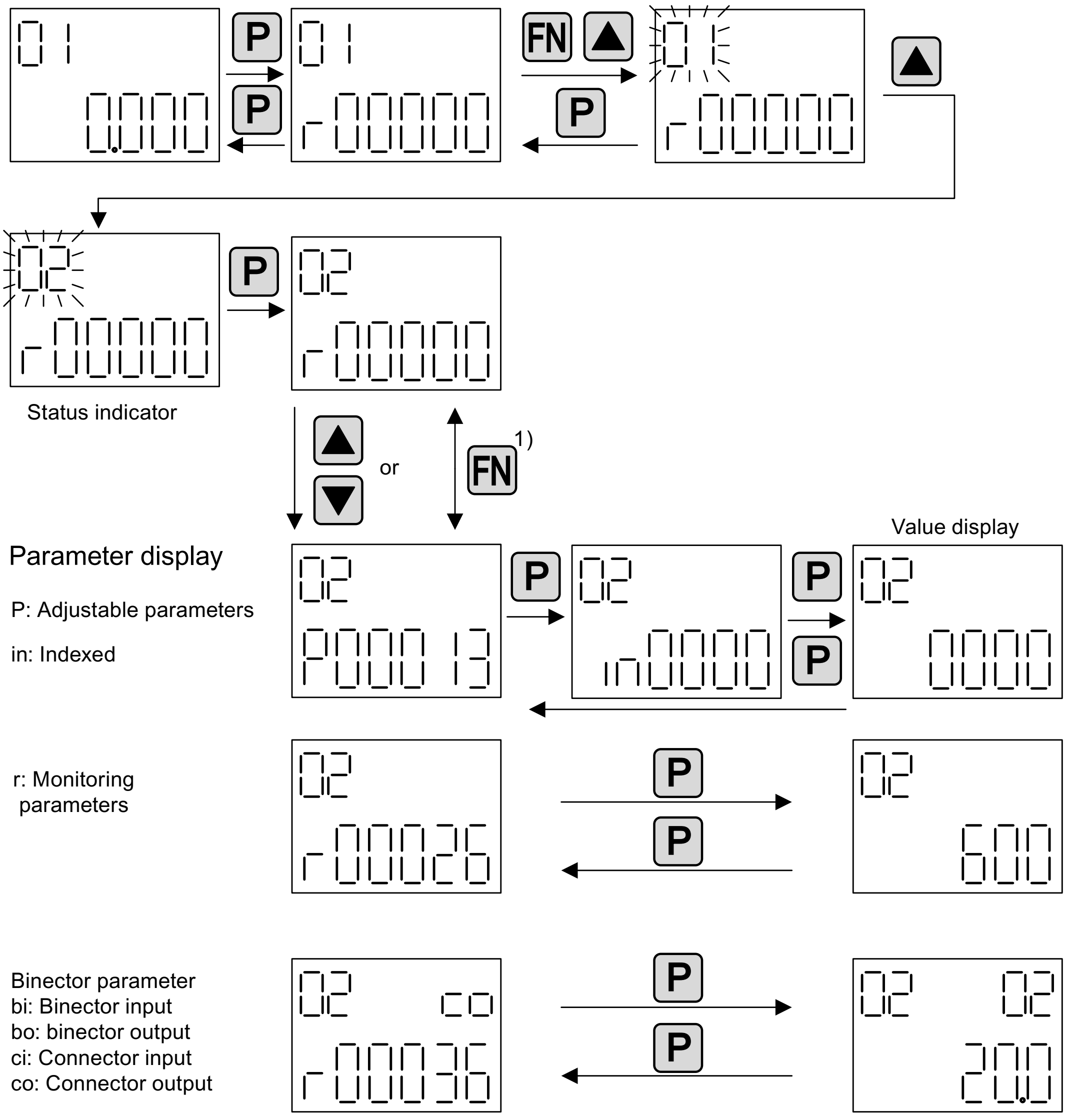
Status indicator

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 -> "r00000" 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 "FN" key and an arrow key. You can toggle between "r00000" and the parameter that was last displayed by pressing the "FN" key in the parameter display.



1) You can switch between "r00000" and the parameter that was last displayed by pressing the FN key in the parameter display.

Figure 2-70 Parameter display

Value display

To switch from the parameter display to the value display, press the "P" key. In the value display, the values of the adjustable parameters can be increased and decreased using the arrow. The cursor can be selected using the "FN" key.

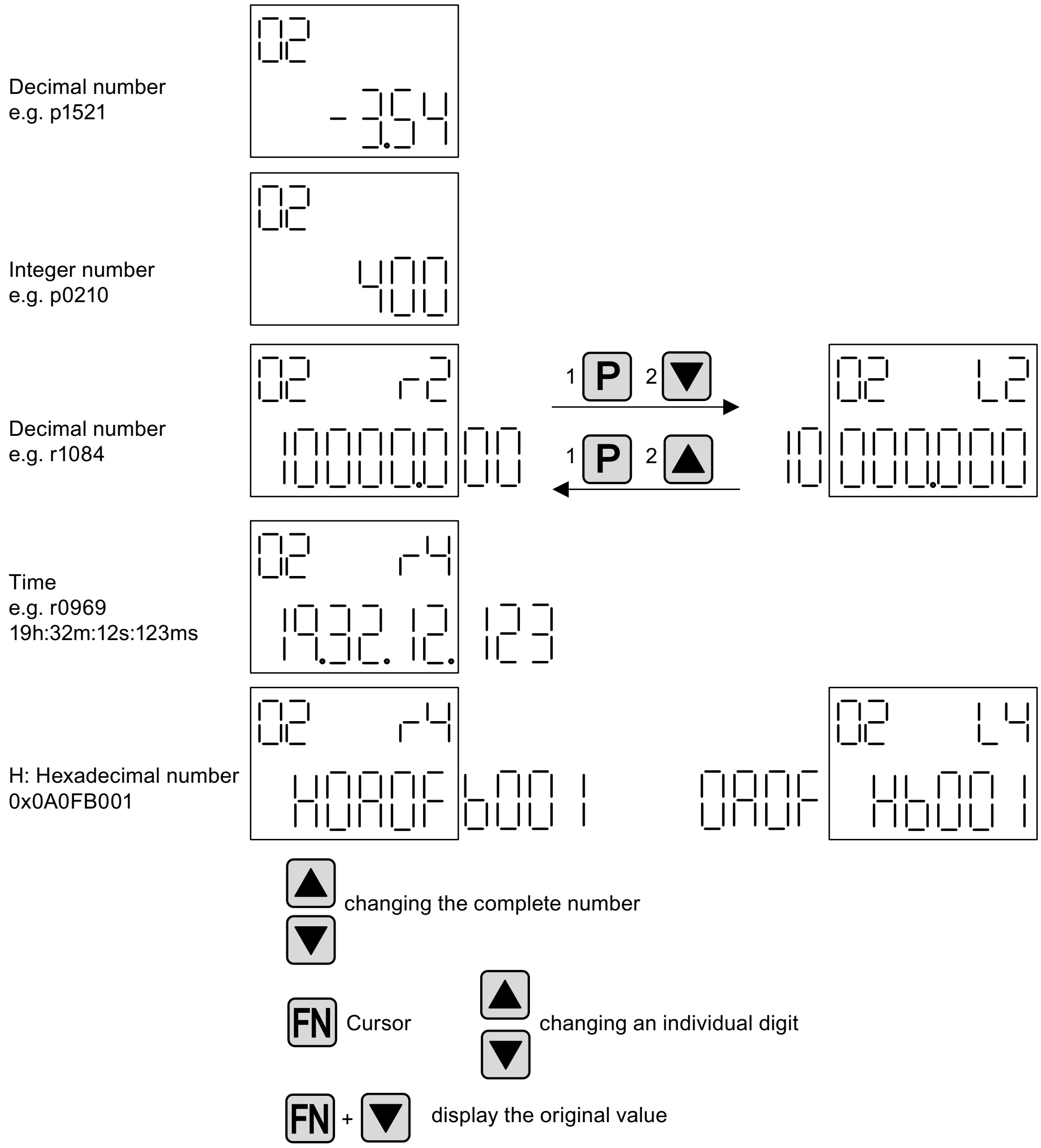


Figure 2-71 Value display

Example: Changing a parameter

Precondition: The appropriate access level is set (for this particular example, p0003 = 3).

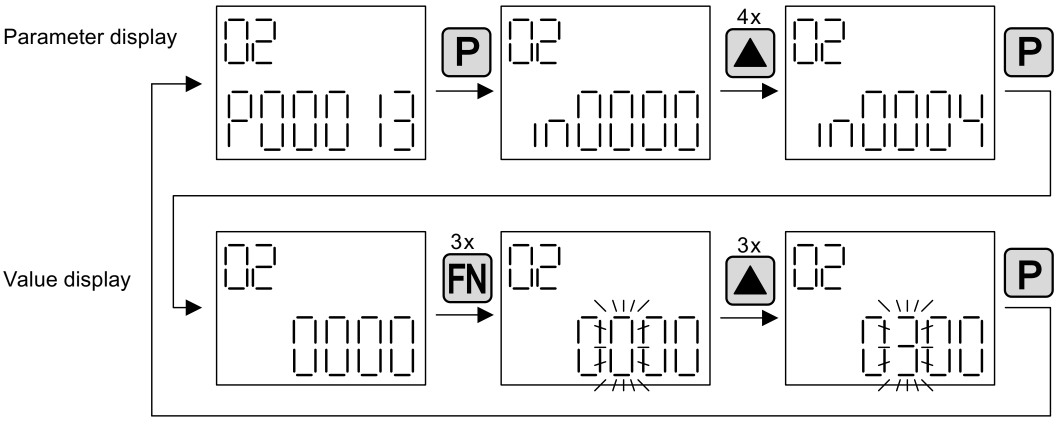


Figure 2-72 Example: Changing p0013[4] from 0 to 300

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.

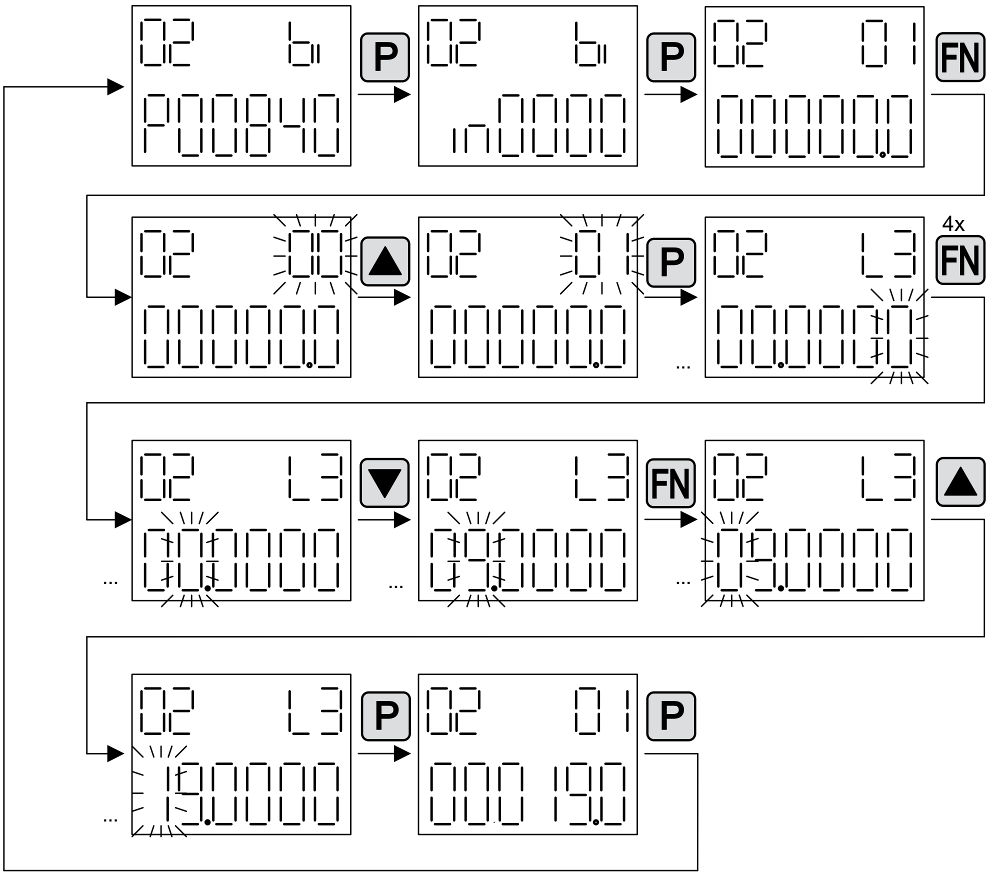


Figure 2-73 Example: Changing indexed binector parameters

2.17.1.3 Fault and alarm displays

Displaying faults

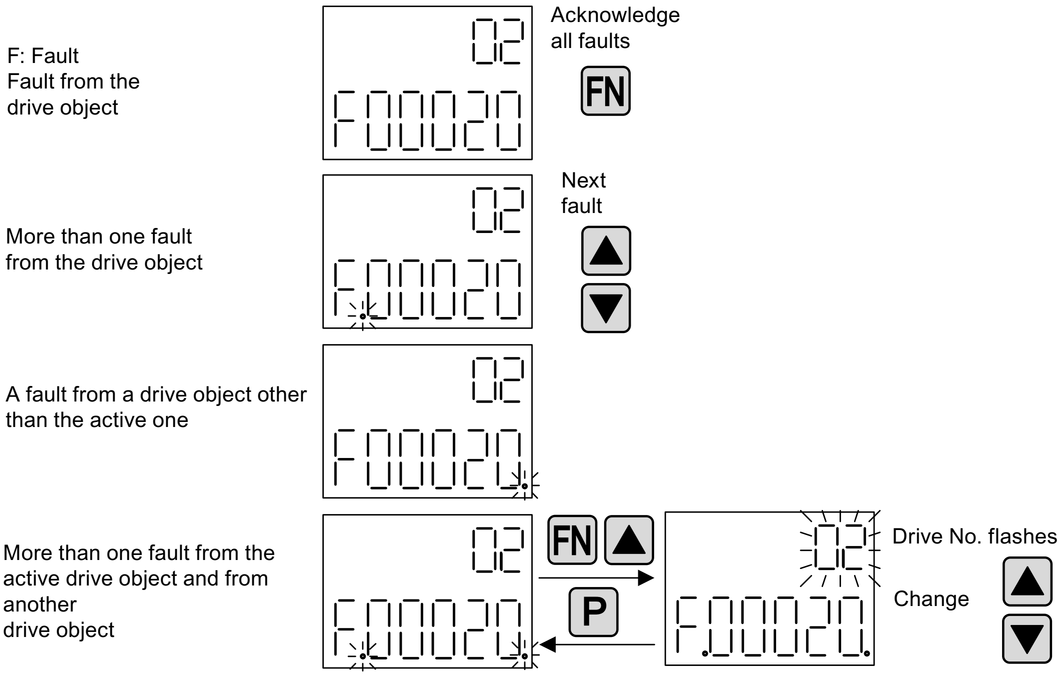


Figure 2-74 Faults

Displaying alarms

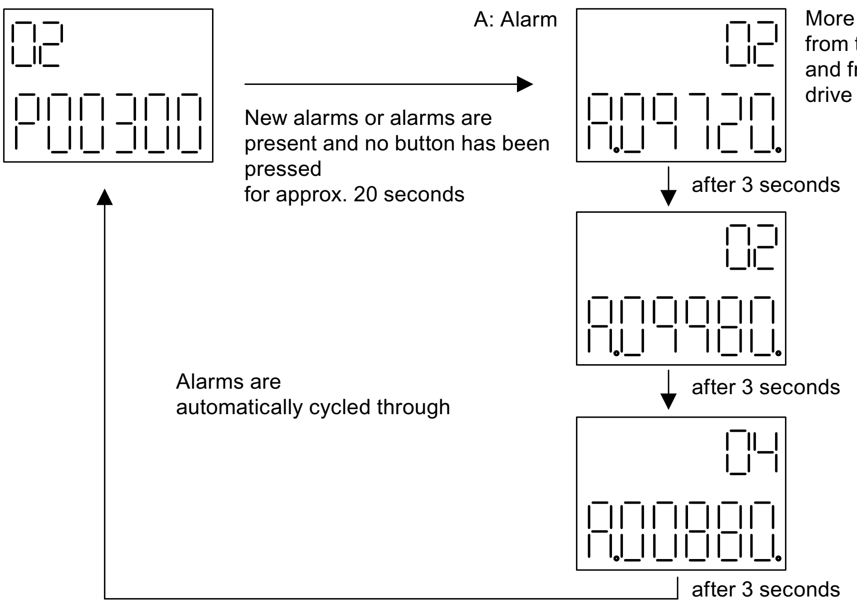


Figure 2-75 Alarms

2.17.1.4 Controlling the drive using the BOP20

When commissioning the drive, it can be controlled via the BOP20. A control word is available on the Control Unit drive object (r0019) for this purpose, which can be interconnected with the appropriate binector inputs of e.g. the drive.

The interconnections do not function if a standard PROFIdrive telegram was selected as its interconnection cannot be disconnected.

Table 2- 26 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
7	Acknowledge fault (0 -> 1)	p2102
13	Motorized potentiometer, raise	p1035
14	Motorized potentiometer, lower	p1036

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.

2.17.2 Important functions via BOP20

Description

The BOP20 can be used to execute the following functions (via parameters) that help you handle your project:

- Restoring the factory settings
- Copy RAM to ROM
- Identification via LED
- Acknowledging faults

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

You can initiate the saving of all parameters to the non-volatile memory (memory card) in the drive object CU:

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

Note

This parameter is not accepted if an identification run (e.g. motor data identification) has been selected on a drive.

Identification via LED

The main component of a drive object (e.g. Motor Module) can be identified using the index of p0124. The "Ready" LED on the component starts to flash. The index matches the index in p0107. The drive object type can be identified via this parameter.

On the drive objects, the components can also be identified via the following parameters:

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

Acknowledging faults

To acknowledge all the faults that have been rectified, press the Fn key.

Diagnostics 3

This chapter describes the following diagnostic features of the SINAMICS S drive system:

- Diagnostics via LEDs
- Diagnostics via STARTER
- Diagnostic buffer
- Diagnostics of uncommissioned axes
- Fault and alarm messages
- Encoder troubleshooting

3.1 Diagnostics via LEDs

3.1.1 Control Units

3.1.1.1 Description of the LED states of a CU320-2

The various states of the Control Units CU320-2 DP and CU320-2 PN during power-up and during operation are displayed using LEDs on the Control Unit. The duration of the individual statuses varies.

Table 3- 1 LEDs

LED	Function
RDY	Ready
DP/PN	PROFIdrive cyclic operation via PROFIBUS (DP) or PROFINET (PN)
OPT	OPTION

- If an error occurs, the booting procedure is terminated and the cause is indicated accordingly via the LEDs.
- Once the unit has successfully booted up, all the LEDs are switched off briefly.
- Once the unit has booted up, the LEDs are controlled via the loaded software.

Control Unit 320-2 DP while powering up

Table 3- 2 Load software

LED			State	Comment
RDY	DP	OPT		
Red	Orange	Orange	Reset	Hardware reset RDY LED lights up red, all other LEDs light up orange
Red	Red	Off	BIOS loaded	–
Red flashing light 2 Hz	Red	Off	BIOS error	• Error occurred while loading the BIOS
Red flashing light 2 Hz	Red Flashing light 2 Hz	Off	File error	• Memory card not inserted or faulty • Software on memory card not present or corrupted
Red	Orange flashing light	Off	FW loading	RDY LED lights up red, PN LED flashes orange without fixed frequency
Red	Off	Off	FW loaded	–
Off	Red	Off	FW checked (no CRC error)	–
Red flashing light 0.5 Hz	Red flashing light 0.5 Hz	Off	FW checked (CRC error)	• CRC invalid

Table 3- 3 Firmware

LED			State	Comment
RDY	DP	OPT		
Orange	Off	Off	Initializing	–
Alternating			Running	See the table below

Control Unit 320-2 DP in operation

Table 3- 4 Control Unit CU320-2 DP – Description of the LEDs after booting

LED	Color	State	Description, cause	Remedy
RDY (READY)	–	OFF	Electronic power supply is missing or outside permissible tolerance range.	Check power supply
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
		Flashing light 0.5 Hz	Commissioning/reset	–
		Flashing light 2 Hz	Writing to the memory card	–
	Red	Flashing light 2 Hz	General errors	Check parameterization / configuration data
	Red/ green	Flashing light 0.5 Hz	Control Unit is ready for operation. However, there are no software licenses.	Obtain licenses
	Orange	Flashing light 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components	–
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update complete. Wait for POWER ON for the components in question.	Turn POWER ON for the components in question
	Green/ orange or red/ orange	Flashing light 2 Hz	Component detection via LED is activated (p0124[0]). Note: Both options depend on the LED status when component recognition is activated via p0124[0] = 1.	–
DP 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	Continuous light	Cyclic communication is taking place.	–
		Flashing light 0.5 Hz	Full cyclic communication has not yet taken place. Possible causes: • The controller is not transferring any setpoints. • During isochronous operation, no global control (GC) or a faulty global control (GC) is transferred by the controller.	–
	Red	Flashing light 0.5 Hz	PROFIBUS master is sending wrong parameterization/configuration data	Adapt configuration between master/controller and CU
		Flashing light 2 Hz	Cyclic bus communication has been interrupted or could not be established	Remedy fault

LED	Color	State	Description, cause	Remedy
OPT (OPTION)	–	Off	Electronic power supply is missing or outside permissible tolerance range. Component is not ready. Option board not installed or no associated drive object has been created.	Check power supply and/or component
	Green	Continuous light	Option board is ready.	–
		Flashing light 0.5 Hz	Depends on the option board used.	–
	Red	Flashing light 2 Hz	This component has at least one fault. The Option Board is not ready (e.g. after switching on).	Remedy and acknowledge fault
RDY and DP	Red	Flashing light 2 Hz	Bus error - communication has been interrupted	Remedy fault
RDY and OPT	Orange	Flashing light 0.5 Hz	Firmware update in progress for connected Option Board CBE20	–

Control Unit 320-2 PN while powering up

Table 3- 5 Load software

LED			Status	Comment
RDY	PN	OPT		
Red	Orange	Orange	Reset	Hardware reset RDY LED lights up red, all other LEDs light up orange
Red	Red	Off	BIOS loaded	–
Red flashing light 2 Hz	Red	Off	BIOS error	• Error occurred while loading the BIOS
Red flashing light 2 Hz	Red flashing light 2 Hz	Off	File error	• Memory card not inserted or faulty • Software on memory card not present or corrupted
Red	Orange flashing light	Off	FW loading	RDY LED lights up red, PN LED flashes orange without fixed frequency
Red	Off	Off	FW loaded	–
Off	Red	Off	FW checked (no CRC error)	–
Red flashing light 0.5 Hz	Red flashing light 0.5 Hz	Off	FW checked (CRC error)	• CRC invalid

Table 3- 6 Firmware

LED			Status	Comment
RDY	PN	OPT		
Orange	Off	Off	Initializing	–
Alternating			Running	See the table below

Control Unit 320-2 PN in operation

Table 3- 7 Control Unit CU320-2 PN – Description of the LEDs after booting

LED	Color	Status	Description, cause	Remedy
RDY (READY)	–	OFF	Electronics power supply is missing or outside the permissible tolerance range.	Check power supply
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
		Flashing light 0.5 Hz	Commissioning/reset	–
		Flashing light 2 Hz	Writing to the memory card	–
	Red	Flashing light 2 Hz	General error	Check parameterization / configuration
	Red/ green	Flashing light 0.5 Hz	Control Unit is ready for operation. However, there are no software licenses.	Obtain licenses
	Orange	Flashing light 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components	–
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update complete. Wait for POWER ON for the components in question.	Turn POWER ON for the components in question
	Green/ orange or red/ orange	Flashing light 2 Hz	Component detection via LED is activated (p0124[0]). **Note**: Both options depend on the LED status when component recognition is activated via p0124[0] = 1.	–
PN 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	Continuous light	Cyclic communication is taking place.	–

LED	Color	Status	Description, cause	Remedy
		Flashing light 0.5 Hz	Full cyclic communication has not yet taken place. Possible causes: • The controller is not transferring any setpoints. • During isochronous operation, no global control (GC) or a faulty global control (GC) is transferred by the controller. • "Shared Device" is selected (p8929=2) and only one controller connected.	–
	Red	Flashing light 0.5 Hz	Bus error, incorrect parameter assignment/configuration	Adapt configuration between controller and devices
		Flashing light 2 Hz	Cyclic bus communication has been interrupted or could not be established	Remove fault
OPT (OPTION)	–	Off	Electronics power supply is missing or outside the permissible tolerance range. Component is not ready. Option board not installed or no associated drive object has been created.	Check power supply and/or component
	Green	Continuous light	Option board is ready.	–
		Flashing light 0.5 Hz	Depends on the option board used.	–
	Red	Flashing light 2 Hz	This component has at least one fault. The Option Board is not ready (e.g. after switching on).	Remove the fault and acknowledge
RDY and DP	Red	Flashing light 2 Hz	Bus error - communication has been interrupted	Remove fault
RDY and OPT	Orange	Flashing light 0.5 Hz	Firmware update in progress for connected Option Board CBE20	–

3.1.1.2 Description of the LED states of a CU310-2

There are four LEDs on the front panel of the CU310-2 DP housing.

Table 3- 8 LEDs

RDY	Ready
COM	Option Board
OUT > 5V	Encoder current supply > 5 V (TTL/HTL)
MOD	Operating mode (reserved)

The various LEDs are switched on and off as the control unit is powered up (depending on the phase the system is currently running through). When switched on, the color of the LEDs shows the status of the corresponding power-up phase.

In the event of a fault, power up will be ended in the corresponding phase. The LEDs that are switched on retain their colors so that the fault can be determined on the basis of the combination of the color LEDs that are lit and unlit.

All the LEDs go out briefly if the CU310-2 DP has powered up without error. The system is ready for operation when the LED "RDY" is permanently green.

All the LEDs are controlled by the software loaded during operation.

Control Unit 310-2 DP while powering up

Table 3- 9 Load software

LED				State	Comment
RDY	COM	OUT > 5V	MOD		
Orange	Orange	Orange	Orange	POWER ON	All LEDs light up for approx. 1 s
Red	Red	Off	Off	Hardware reset	After pressing the RESET button the LEDs light up for approx. 1 s
Red	Red	Off	Off	BIOS loaded	-
Red Flashing light 2 Hz	Red	Off	Off	BIOS error	Error occurred while loading the BIOS
Red Flashing light 2 Hz	Red Flashing light 2 Hz	Off	Off	File error	Memory card not inserted or faulty
					Software on memory card not present or corrupted

Table 3- 10 Firmware

LED				State	Comment
RDY	COM	OUT > 5V	MOD		
Red	Orange	Off	Off	Firmware loading	COM-LED flashing without specific flashing frequency
Red	Off	Off	Off	Firmware loaded	-
Off	Red	Off	Off	Firmware check (no CRC error)	-
Red Flashing light 0.5 Hz	Red Flashing light 0.5 Hz	Off	Off	Firmware check (CRC error)	CRC is incorrect
Orange	Off	Off	Off	Firmware initialization	-

Control Unit 310-2 DP in operation

Table 3- 11 Description of the LEDs during operation of the CU310-2 DP

LED	Color	State	Description / cause	Remedy
RDY (READY)	-	Off	Electronic power supply is missing or outside permissible tolerance range.	Check the power supply
	Green	Continuous light	The unit is ready for operation. Cyclic DRIVE-CLiQ communication is in progress.	-
		Flashing light 0.5 Hz	Commissioning/reset	-
		Flashing light 2 Hz	Writing to the memory card.	-
	Red	Flashing light 2 Hz	General errors	Check parameter assignment/configuration
	Red/green	Flashing light 0.5 Hz	The control unit is ready for operation, but there are no software licenses.	Install the missing licenses.
	Orange	Flashing light 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components.	-
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update completed. Waiting for POWER ON of the corresponding components.	Switch on the component.
	Green/ orange or red/orange	Flashing light 2 Hz	Detection of the component via LED is activated (p0124[0]). **Note:** Both options depend on the LED status when module recognition is activated via p0124[0] = 1.	-

LED	Color	State	Description / cause	Remedy
COM	-	Off	Cyclic communication is not (yet) running. **Note:** The PROFIdrive is ready for communication when the Control Unit is ready for operation (see LED: RDY).	-
	Green	Continuous light	Cyclic communication is taking place.	-
		Flashing light 0.5 Hz	Cyclic communication is not fully established yet. **Possible causes:** - The controller is not transmitting any setpoints. - In isochronous mode, the controller is not sending a GC (Global Control) or is sending a defective GC.	-
	Red	Flashing light 0.5 Hz	The PROFIBUS master is sending a faulty parameter assignment or the configuration file is corrupted.	Modify the configuration between master/controller and control unit.
		Flashing light 2 Hz	Cyclic bus communication has been interrupted or could not be established.	Rectify the fault in bus communication.
MOD	-	Off	-	-
OUT > 5 V	-	Off	-	-
	Orange	Continuous light	The voltage of the electronics power supply for the measuring system is 24 V. 1)	

1) Make sure that the encoder connected is designed for a 24 V supply. Connecting a 5 V encoder to a 24 V supply can result in destruction of the encoder electronics.

Control Unit 310-2 PN while powering up

Table 3- 12 Load software

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Orange	Orange	Orange	Orange	POWER ON	All LEDs light up for approx. 1 s
Red	Red	Off	Off	Hardware reset	After pressing the RESET button the LEDs light up for approx. 1 s
Red	Red	Off	Off	BIOS loaded	-
Red Flashing light 2 Hz	Red	Off	Off	BIOS error	Error occurred while loading the BIOS
Red Flashing light 2 Hz	Red Flashing light 2 Hz	Off	Off	File error	Memory card not inserted or faulty
					Software on memory card not present or corrupted

Table 3- 13 Firmware

LED				State	Comment
RDY	COM	OUT>5V	MOD		
Red	Orange	Off	Off	Firmware loading	COM-LED flashing without specific flashing frequency
Red	Off	Off	Off	Firmware loaded	-
Off	Red	Off	Off	Firmware check (no CRC error)	-
Red Flashing light 0.5 Hz	Red Flashing light 0.5 Hz	Off	Off	Firmware check (CRC error)	CRC is incorrect
Orange	Off	Off	Off	Firmware initialization	-

Control Unit 310-2 PN in operation

Table 3- 14 Description of the LEDs during operation of the CU310-2 PN

LED	Color	State	Description / cause	Remedy
RDY (READY)	-	Off	Electronic power supply is missing or outside permissible tolerance range.	Check the power supply
	Green	Continuous light	The unit is ready for operation. Cyclic DRIVE-CLiQ communication is in progress.	-
		Flashing light 0.5 Hz	Commissioning/reset	-
		Flashing light 2 Hz	Writing to the memory card.	-
	Red	Flashing light 2 Hz	General errors	Check parameter assignment/configuration
	Red/green	Flashing light 0.5 Hz	The control unit is ready for operation, but there are no software licenses.	Install the missing licenses.
	Orange	Flashing light 0.5 Hz	Updating the firmware of the DRIVE-CLiQ components.	-
		Flashing light 2 Hz	DRIVE-CLiQ component firmware update completed. Waiting for POWER ON of the corresponding components.	Switch on the component.
	Green/ orange or red/orange	Flashing light 2 Hz	Component detection via LED is activated (p0124[0]). **Note:** Both options depend on the LED status when component recognition is activated via p0124[0] = 1.	-

LED	Color	State	Description / cause	Remedy
COM	-	Off	Cyclic communication has not (yet) taken place. **Note:** PROFIdrive is ready for communication when the Control Unit is ready (see LED: RDY).	-
	Green	Continuous light	Cyclic communication is taking place.	-
		Flashing light 0.5 Hz	Full cyclic communication is not yet taking place. **Possible causes:** • The controller is not transferring any setpoints. • During isochronous operation, no GC (Global Control) or a faulty GC is transferred by the controller.	-
	Red	Flashing light 0.5 Hz	The PROFIBUS master is sending a faulty parameter assignment or the configuration file is corrupted.	Modify the configuration between master/controller and control unit.
		Flashing light 2 Hz	Cyclic bus communication has been interrupted or could not be established.	Rectify the fault in bus communication.
MOD	-	Off	-	-
OUT > 5 V	-	Off	-	-
	Orange	Continuous light	The voltage of the electronics power supply for the measuring system is 24 V. [1]	

[1] Make sure that the encoder connected is designed for a 24 V supply. Connecting a 5 V encoder to a 24 V supply can result in destruction of the encoder electronics.

3.1.2 Power units

3.1.2.1 Active Line Module booksize

Table 3- 15 Meaning of the LEDs on the Active Line Module

State		Description, cause	Remedy
Ready	DC link		
Off	Off	Electronic 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 the line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green / red flashing light 0.5 Hz	–	Firmware is being downloaded.	–
Green / red flashing light 2 Hz	–	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green / orange or Red / orange	–	Component detection via LED is activated (p0124). Note: Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.
Note the warning information on the component!

3.1.2.2 Basic Line Module booksize

Table 3- 16 Meaning of the LEDs on the Basic Line Module

State		Description, cause	Remedy
Ready	**DC link**		
Off	Off	Electronic 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 the line voltage.
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault.
Green / red flashing light 0.5 Hz	–	Firmware is being downloaded.	–
Green / red flashing light 2 Hz	–	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green / orange or Red / orange flashing light	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.
Note the warning information on the component!

3.1.2.3 Smart Line Modules booksize 5 kW and 10 kW

Table 3- 17 Meaning of the LEDs at the Smart Line Modules 5 kW and 10 kW

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronic power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
	Yellow	Continuous light	Pre-charging not completed. Bypass relay dropped out EP terminals not supplied with 24 VDC.	–
	Red	Continuous light	Overtemperature Overcurrent	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	Electronic power supply is missing or outside permissible tolerance range.	–
	Yellow	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range. Line supply fault.	Check the line voltage.

⚠ WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.
Note the warning information on the component!

3.1.2.4 Smart Line Modules booksize 16 kW to 55 kW

Table 3- 18 Meaning of the LEDs at the Smart Line Modules ≥ 16 kW

State		Description, cause	Remedy
Ready	DC link		
Off	Off	Electronic 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 the line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green / red flashing light 0.5 Hz	–	Firmware is being downloaded.	–
Green / red flashing light 2 Hz	–	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green / orange or Red / orange flashing light	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

⚠ WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.
Note the warning information on the component!

3.1.2.5 Single Motor Module / Double Motor Module / Power Module

Table 3- 19 Meaning of the LEDs on the Motor Module

State		Description, cause	Remedy
Ready	DC link		
Off	Off	Electronic 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 the line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green / red flashing light 0.5 Hz	–	Firmware is being downloaded.	–
Green / red flashing light 2 Hz	–	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green / orange or Red / orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

> ⚠ **WARNING**
>
> **Risk of electric shock as a result of the high DC link voltage**
>
> Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.
> Note the warning information on the component!

3.1.2.6 Braking Modules booksize format

Table 3- 20 Meaning of the LEDs on the Braking Module booksize

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronic power supply is missing or outside permissible tolerance range. Component deactivated via terminal.	–
	Green	Continuous light	Component is ready to operate.	–
	Red	Continuous light	Enable signal missing (input terminal) Overtemperature Overcurrent trip I^2t monitoring responded Ground fault/short circuit **Note:** In the event of an overtemperature, the error cannot be acknowledged until after a cooling down time.	Diagnose fault (via output terminals) and acknowledge it (via input terminal)
DC LINK	–	Off	There is no DC link voltage or the electronic power supply is missing or outside permissible tolerance range. Component not active.	–
	Green	Flashing light	Component active (DC link discharge via braking resistor in progress).	–

3.1.2.7 Smart Line Module booksize compact format

Table 3- 21 Meaning of the LEDs on the Smart Line Module booksize compact

State		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronic power supply is missing or outside permissible tolerance range.	–
Green	–	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 the line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	–	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/ orange or red/orange	–	Identifying whether the component is activated using the LED (p0124) **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the LED "DC LINK".
Note the warning information on the component!

3.1.2.8 Motor Module booksize compact format

Table 3- 22 Meaning of the LEDs on the Motor Module booksize compact

State		Description, cause	Remedy
RDY	DC LINK		
Off	Off	Electronic power supply is missing or outside permissible tolerance range.	–
Green	–	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 the line voltage
Orange	Orange	DRIVE-CLiQ communication is being established.	–
Red	–	At least one fault is present in this component. **Note:** LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
Green/red (0.5 Hz)	–	Firmware is being downloaded.	–
Green/red (2 Hz)	–	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
Green/ orange or red/orange	–	Component detection via LED is activated (p0124). **Note:** Both options depend on the LED status when module recognition is activated via p0124 = 1.	–

> ⚠ **WARNING**
>
> **Risk of electric shock as a result of the high DC link voltage**
>
> Hazardous DC link voltages may be present at any time regardless of the state of the LED "DC LINK".
> Note the warning information on the component!

3.1.2.9 Control Interface Module in the Active Line Module chassis format

Table 3- 23 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Active Line Module

LED, state		Description
Ready	DC link	
Off	Off	The electronic power supply is missing or lies outside the 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.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	---	At least one fault is present in this component. Note: LED is activated irrespective of any reconfiguring of the corresponding messages.
Green / red flashing light 0.5 Hz	---	Firmware is being downloaded.
Green / red flashing light 2 Hz	---	Firmware download is complete. Wait for POWER ON.
Green / orange or red / orange flashing light 2 Hz	---	Component detection using LED is activated (p0124). Note: Both options depend on the LED state when module recognition is activated via p0124 = 1.

Table 3- 24 Meaning of the LED "POWER OK" on the Control Interface Module in the Active Line Module

LED	Color	State	Description
POWER OK	Green	Off	DC link voltage < 100 V and voltage at -X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.

Observe the warning information on the component!

3.1.2.10 Control Interface Module in the Basic Line Module chassis format

Table 3- 25 Meaning of the LEDs "Ready" and "DC Link" on the Control Interface Module in the Basic Line Module

LED, state		Description
Ready	DC link	
Off	Off	The electronic power supply is missing or lies outside the 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.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	---	At least one fault is present in this component. Note: LED is activated irrespective of any reconfiguring of the corresponding messages.
Green / red flashing light 0.5 Hz	---	Firmware is being downloaded.
Green / red flashing light 2 Hz	---	Firmware download is complete. Wait for POWER ON.
Green / orange or red / orange flashing light 2 Hz	---	Component detection using LED is activated (p0124). Note: Both options depend on the LED state when module recognition is activated via p0124 = 1.

Table 3- 26 Meaning of the LED "POWER OK" on the Control Interface Module in the Basic Line Module

LED	Color	State	Description
POWER OK	Green	Off	DC link voltage < 100 V and voltage at -X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

⚠ WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.

Observe the warning information on the component!

3.1.2.11 Control Interface Module in the Smart Line Module chassis format

Table 3- 27 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Smart Line Module

LED, state		Description
READY	DC LINK	
Off	Off	The electronic power supply is missing or lies outside the 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.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	---	At least one fault is present in this component. Note: LED is activated irrespective of any reconfiguring of the corresponding messages.
Flashing light 0.5 Hz: Green / red	---	Firmware is being downloaded.
Flashing light 2 Hz: Green / red	---	Firmware download is complete. Wait for POWER ON.
Flashing light 2 Hz: Green / orange or red / orange	---	Component detection using LED is activated (p0124). Note: Both options depend on the LED state when module recognition is activated via p0124 = 1.

Table 3- 28 Meaning of the LED "POWER OK" on the Control Interface Module in the Smart Line Module

LED	Color	State	Description
POWER OK	Green	Off	DC link voltage < 100 V and voltage at -X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

⚠ WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC LINK" LED.

Observe the warning information on the component!

3.1.2.12 Control Interface Module in the Motor Module chassis format

Table 3- 29 Meaning of the LEDs "Ready" and "DC Link" on the Control Interface Module in the Motor Module

LED, state		Description
Ready	DC link	
Off	Off	The electronic power supply is missing or lies outside the 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.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	---	At least one fault is present in this component. Note: LED is activated irrespective of any reconfiguring of the corresponding messages.
Green / red flashing light 0.5 Hz	---	Firmware is being downloaded.
Green / red flashing light 2 Hz	---	Firmware download is complete. Wait for POWER ON.
Green / orange or red / orange flashing light 2 Hz	---	Component detection using LED is activated (p0124). **Note**: Both options depend on the LED status when module recognition is activated via p0124 = 1.

Table 3- 30 Meaning of the LED "POWER OK" on the Control Interface Module in the Motor Module

LED	Color	State	Description
POWER OK	Green	Off	DC link voltage < 100 V and voltage at -X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

⚠ WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC link" LED.

Observe the warning information on the component!

3.1.2.13 Control Interface Module in the Power Module chassis format

Table 3- 31 Meaning of the LEDs "READY" and "DC LINK" on the Control Interface Module in the Power Module

LED, state		Description
READY	**DC LINK**	
Off	Off	The electronic power supply is missing or lies outside the 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.
Orange	Orange	DRIVE-CLiQ communication is being established.
Red	---	At least one fault is present in this component. **Note**: LED is controlled irrespective of the corresponding messages being reconfigured.
Flashing light 0.5 Hz: Green / red	---	Firmware is being downloaded.
Flashing light 2 Hz: Green / red	---	Firmware download is complete. Wait for POWER ON.
Flashing light 2 Hz: Green / orange or red / orange	---	Component detection using LED is activated (p0124). **Note**: Both options depend on the LED status when module recognition is activated via p0124 = 1.

Table 3- 32 Meaning of the LED "POWER OK" on the Control Interface Module in the Power Module

LED	Color	State	Description
POWER OK	Green	Off	DC link voltage < 100 V and voltage at -X9:1/2 less than 12 V.
		On	The component is ready for operation.
		Flashing light	There is a fault. If the LED continues to flash after you have performed a POWER ON, please contact your Siemens service center.

WARNING

Risk of electric shock as a result of the high DC link voltage

Hazardous DC link voltages may be present at any time regardless of the state of the "DC LINK" LED.

Observe the warning information on the component!

3.1.3 Additional modules

3.1.3.1 Control Supply Module

Table 3- 33 Control Supply Module – description of the LEDs

LED	Color	State	Description, cause	Remedy
READY	–	off	Electronic power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	Component is ready to operate.	–
DC LINK	–	off	Electronic power supply is missing or outside permissible tolerance range.	–
	Orange	Continuous light	DC link voltage within permissible tolerance range.	–
	Red	Continuous light	DC link voltage outside permissible tolerance range.	–

3.1.3.2 Sensor Module Cabinet SMC10 / SMC20

Table 3- 34 Sensor Module Cabinet 10/20 (SMC10/SMC20) – description of the LEDs

LED	Color	State	Description, cause	Remedy
RDY READY	–	off	Electronic power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	At least one fault is present in this component. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON
	Green/ orange or Red/orange	Flashing light	Component recognition via LED is activated (p0144). Note: Both options depend on the LED status when module recognition is activated via p0144 = 1.	–

3.1.3.3 Sensor Module Cabinet SMC30

Table 3- 35 Meaning of LEDs on the Sensor Module Cabinet SMC30

LED	Color	State	Description, cause	Remedy
RDY READY	–	Off	Electronic power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
	Green/red	Flashing light 2 Hz	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
	Green/ orange or Red/orange	Flashing light	Component recognition via LED is activated (p0144). Note: Both options depend on the LED status when module recognition is activated via p0144 = 1.	–
OUT > 5 V	–	Off	Electronic power supply is missing or outside permissible tolerance range. Power supply ≤ 5 V.	–
	Orange	Continuous light	Electronics power supply for encoder system available. Power supply > 5 V. Notice Make sure that the connected encoder can be operated with a 24 V power 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.	–

3.1.3.4 Sensor Module Cabinet SMC40

Table 3- 36 Meaning of the LEDs on the Sensor Module Cabinet-Mounted SMC40

LED	Color	Status	Description, cause	Remedy
RDY READY	–	Off	Electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	At least one fault is present in this component. **Note:** LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/red	Flashing light 2 Hz	Firmware download is complete. Waiting for POWER ON.	Carry out a POWER ON
	Green/ orange or Red/ orange	Flashing light	Component recognition via LED is activated (p0144). **Note:** Both options depend on the LED status when module recognition is activated via p0144 = 1.	–

Each channel has a multifunction LED.

3.1.3.5 Communication Board CBC10 for CANopen

Table 3- 37 Meaning of the LEDs on the Communication Board CAN CBC10

LED	Color	State	Description, cause	Remedy
OPT on the Control Unit	–	Off	Electronic power supply is missing or outside permissible tolerance range. Communication Board either defective or not inserted.	–
	Green	LED ON	OPERATIONAL	–
		LED Blinking	PREOPERATIONAL No PDO communication possible	–
		LED Single flash	STOPPED Only NMT communication possible	–
	Red	LED ON	BUS OFF	Check baud rate Check cabling
		LED Single flash	ERROR PASSIVE MODE The error counter for "error passive" has reached the value 127. After the SINAMICS drive system was booted no further active CAN component was on the bus.	Check baud rate Check cabling
		LED Double flash	Error Control Event, a Guard Event has occurred	Check connection to CANopen master

3.1.3.6 Communication Board Ethernet CBE20

Meaning of the LEDs on the CBE20 Communication Board Ethernet

Table 3- 38 Meaning of the LEDs at ports 1 to 4 of the X1400 interface

LED	Color	State	Description
Link port	–	Off	Electronics power supply is missing or outside permissible tolerance range (link missing or defective).
	Green	Continuous 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 (no activity).
	Yellow	Flashing light	Data is being received or sent at port x.

Table 3- 39 Meaning of the Sync and Fault LEDs on the CBE20

LED	Color	State	Description
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 interval has elapsed. • 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
		Continuous 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 light	Control Unit task system has synchronized with the IRT clock and data is being exchanged.
		Continuous light	Task system and MC-PLL have synchronized with the IRT clock.

Table 3- 40 Meaning of the OPT LED on the Control Unit

LED	Color	State	Description, cause	Remedy
OPT	–	OFF	Electronic power supply is missing or outside permissible tolerance range. Communication Board either defective or not inserted.	–
	Green	Continuous light	Communication Board is ready and cyclic communication is taking place.	–
		Flashing light 0.5 Hz	The Communication Board is ready, but cyclic communications is not running. Possible causes: • At least one fault is present. • Communication is being established.	–
	Red	Continuous light	Cyclic communication via PROFINET has not yet been established. However, non-cyclic communications are possible. SINAMICS waits for a parameterizing/configuring telegram	–
		Flashing light 0.5 Hz	The firmware update into the CBE20 has been completed with an error. Possible causes: • The CBE20 is defective. • The memory card for the Control Unit is defective. In this state CBE20 cannot be used.	–
		Flashing light 2 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 light 0.5 Hz	Firmware is being updated.	–

3.1.3.7 Voltage Sensing Module VSM10

Table 3- 41 Meanings of the LEDs on the Voltage Sensing Module VSM10

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronic power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON
	Green/ orange or Red/ orange	Flashing light	Component recognition via LED is activated (p0144). Note: Both options depend on the LED status when module recognition is activated via p0144 = 1.	–

3.1.3.8 DRIVE-CLiQ Hub Module DMC20

Table 3- 42 Description of the LEDs on the DRIVE-CLiQ Hub Module DMC20

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronic power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. Note: LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON

LED	Color	State	Description, cause	Remedy
	Green/ orange or Red/ orange	Flashing light	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when module recognition is activated via p0154 = 1.	–

3.1.4 Terminal Module

3.1.4.1 Terminal Module TM15

Table 3- 43 Meanings of the LEDs on the Terminal Module TM15

LED	Color	Status	Description, cause	Remedy
READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
	Green/red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON
	Green/ orange or Red/ orange	Flashing light	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when component recognition is activated via p0154 = 1.	–

3.1.4.2 Terminal Module TM31

Table 3- 44 Meanings of the LEDs on the Terminal Module TM31

LED	Color	Status	Description, cause	Remedy
READY	-	OFF	Electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
	Green/red	0.5 Hz flashing light	Firmware is being downloaded.	–
		2 Hz flashing light	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON
	Green/ orange or Red/ orange	Flashing light	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when component recognition is activated via p0154 = 1.	–

3.1.4.3 Terminal Module TM120

Table 3- 45 Meaning of the LEDs on the Terminal Module TM120

LED	Color	Status	Description, cause	Remedy
READY	-	Off	Electronics power supply is missing or outside permissible tolerance range.	Check power supply
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	-
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	-
	Red	Continuous light	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
	Green/ Red	Flashing light 0.5 Hz	Firmware is being downloaded.	-
		Flashing light 2 Hz	Firmware download is complete. Wait for POWER ON	Carry out a POWER ON
	Green/ orange or red/ orange	Flashing light 2 Hz	Detection of the components via LED is activated (p0154). **Note:** Both options depend on the LED status when module recognition is activated via p0154 = 1.	-

3.1.4.4 Terminal Module TM150

Table 3- 46 Meaning of the LEDs at the Terminal Module TM150

LED	Color	State	Description, cause	Remedy
READY	–	Off	Electronic power supply is missing or outside permissible tolerance range.	Check power supply
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	This component has at least one fault. **Note:** LED is controlled irrespective of the corresponding messages being reconfigured.	Remedy and acknowledge fault
	Green/ Red	Flashing light 0.5 Hz	Firmware is being downloaded.	–
		Flashing light 2 Hz	Firmware has been downloaded. Wait for POWER ON.	Carry out a POWER ON
	Green/ orange or red/ orange	Flashing light 2 Hz	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when module recognition is activated via p0154 = 1.	–

3.1.4.5 Terminal Module TM41

Table 3- 47 Meaning of the LEDs on the Terminal Module TM41

LED	Color	Status	Description, cause	Remedy
READY	-	Off	Electronics power supply is missing or outside the permissible tolerance range.	–
	Green	Continuous light	The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.	–
	Orange	Continuous light	DRIVE-CLiQ communication is being established.	–
	Red	Continuous light	At least one fault is present in this component. **Note:** The LED is activated regardless of whether the corresponding messages have been reconfigured.	Remedy and acknowledge fault
	Green/red	0.5 Hz flashing light	Firmware is being downloaded.	–
		2 Hz flashing light	Firmware download is complete. Wait for POWER ON.	Carry out a POWER ON
	Green/ orange or Red/ orange	Flashing light	Component recognition via LED is activated (p0154). **Note:** Both options depend on the LED status when component recognition is activated via p0154 = 1.	–

LED	Color	Status	Description, cause	Remedy
Z pulses	–	Off	Zero mark found; wait for zero marker output; OR component switched off.	–
	Red	Continuous light	Zero mark not enabled or zero mark search.	–
	Green	Continuous light	Stopped at zero mark.	–
		Flashing light	Zero mark is output at each virtual revolution.	–

3.1.4.6 Terminal Module TM54F

Table 3- 48 Meaning of the LEDs on the Terminal Module TM54F

<table>
<tr><th>LED</th><th colspan="2">Color</th><th>Status</th><th>Description, cause</th><th>Remedy</th></tr>
<tr><td rowspan="8">READY</td><td colspan="2">-</td><td>Off</td><td>Electronics power supply is missing or outside the permissible tolerance range.</td><td>–</td></tr>
<tr><td colspan="2">Green</td><td>Continuous light</td><td>The component is ready for operation and cyclic DRIVE-CLiQ communication is taking place.</td><td>–</td></tr>
<tr><td colspan="2">Orange</td><td>Continuous light</td><td>DRIVE-CLiQ communication is being established.</td><td>–</td></tr>
<tr><td colspan="2">Red</td><td>Continuous light</td><td>At least one fault is present in this component.
Note:
The LED is activated irrespective of whether the corresponding messages have been reconfigured.</td><td>Remedy and acknowledge fault</td></tr>
<tr><td colspan="2" rowspan="2">Green/red</td><td>0.5 Hz flashing light</td><td>Firmware is being downloaded.</td><td>–</td></tr>
<tr><td>2 Hz flashing light</td><td>Firmware download is complete. Wait for POWER ON</td><td>Carry out a POWER ON</td></tr>
<tr><td colspan="2">Green/orange
or
Red/orange</td><td>Flashing light</td><td>Component recognition via LED is activated (p0154).
Note:
Both options depend on the LED status when component recognition is activated via p0154 = 1.</td><td>–</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td rowspan="2">L1+, L2+,</td><td colspan="2">–</td><td>ON</td><td>The controllable sensor power supply is functioning fault-free.</td><td>–</td></tr>
<tr><td colspan="2">Red</td><td>Continuous light</td><td>There is a fault in the controllable sensor power supply.</td><td>–</td></tr>
<tr><td rowspan="2">L3+</td><td colspan="2">–</td><td>ON</td><td>Sensor power supply is functioning fault-free.</td><td></td></tr>
<tr><td colspan="2">Red</td><td>Continuous light</td><td>There is a fault in the sensor power supply.</td><td></td></tr>
<tr><td colspan="6">Fail-safe inputs / double inputs</td></tr>
<tr><td rowspan="5">F_DI z
(input x,
(x+1)+,
(x+1)-)</td><td>LED</td><td>LED</td><td></td><td></td><td>–</td></tr>
<tr><td>x</td><td>x+1</td><td></td><td>NC contact / NC contact [1)]: (z = 0..9, x = 0, 2, ..18)</td><td></td></tr>
<tr><td>–</td><td>Red</td><td>Continuous light</td><td>Different signal states at input x and x+1</td><td></td></tr>
<tr><td>–</td><td>–</td><td>–</td><td>No signal at input x and no signal at input x+1</td><td></td></tr>
<tr><td colspan="3"></td><td>NC contact / NO contact[1)]: (z = 0..9, x = 0, 2, ..18)</td><td></td></tr>
</table>

LED	Color		Status	Description, cause	Remedy
	–	Red	Continuous light	Same signal states at input x and x+1	
	–	–	–	No signal at input x and no signal at input x+1	
	LED	**LED**			
	x	x+1		**NC contact / NC contact**[1]**: (z = 0..9, x = 0, 2, ..18)**	
	Green	Green	Continuous light	One signal at input x and one signal at input x+1	
				NC contact / NO contact[1]**: (z = 0..9, x = 0, 2, ..18)**	
	Green	Green	Continuous light	One signal at input x and no signal at input x+1	–
[1] Inputs x+1 (DI 1+, 3+, .. 19+) can be set individually via parameter p10040 (TM54F). p10040 (TM54F) = 0: Input x+1 is an NC contact. p10040 (TM54F) = 1: Input x+1 is NO contact. Factory setting: p10040 (TM54F) = 0 for all inputs x+1.					
Single digital inputs, not fail-safe					
DI x	–		Off	No signal at digital input x (x = 20..23)	–
	Green		Continuous light	Signal at digital input x	–
Fail-safe digital outputs with associated readback channel					
F_DO y (0+..3+, 0-..3-)	Green		Continuous light	Output y (y=0 .. 3) carries a signal	–
Readback input DI 2y for output F_DO y (y = 0..3) at test stop. The status of the LEDs also depends on the type of external circuit.					
DI 2y	–		Off	One of the two output lines y+ or y- or both lines of output y carry a signal	–
	Green		Continuous light	Both output lines y+ and y- carry no signal	–

3.2 Diagnostics via STARTER

The diagnostic functions support commissioning and service personnel during commissioning, troubleshooting, diagnostics and service activities.

Precondition

- Online operation of the STARTER commissioning tool.

Diagnostic functions

The following diagnostic functions are available in the STARTER commissioning tool:

- Specifying signals with the ramp-function generator
- Signal recording with the trace function
- Analyzing the control response with the measuring function
- Outputting voltage signals for external measuring devices via test sockets

3.2.1 Function generator

The function generator is part of the STARTER commissioning tool.

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 (r4818), the output signal can be injected into the control loop via the BICO interconnection.

For vector control, corresponding to the selected operating mode, this setpoint can also be fed into the control structure as, for example, a current setpoint, disturbing torque, or current setpoint. The impact of superimposed control loops is automatically suppressed.

Properties

- Operating modes of the ramp-function generator for SERVO and VECTOR drive types:
  - Connector output
- Operating modes of the function generator for a SERVO drive:
  - Speed setpoint downstream of filter (speed setpoint filter)
  - Speed setpoint upstream of filter (speed setpoint filter)
  - Disturbing torque (downstream of current setpoint filter)
  - Current setpoint downstream of filter (current setpoint filter)
  - Current setpoint upstream of filter (current setpoint filter)
- Connecting to each drive of the topology is possible.
- The following parameterizable signal shapes can be set:
  - Square-wave
  - Staircase
  - Triangular
  - Sinusoidal
  - PRBS (pseudo random binary signal, white noise)
- 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.

Injection points of the function generator

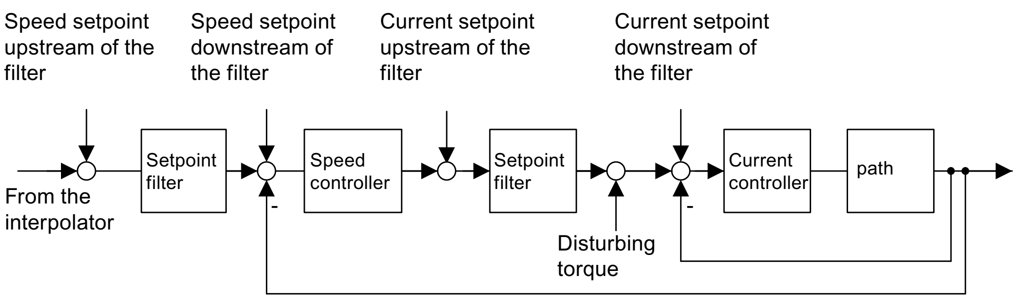


Figure 3-1 Injection points of the ramp-function generator

Further signal shapes

Additional signal waveforms can be generated.

Example:

The "triangular" signal form can be parameterized with "upper limitation" to produce a triangle with no peak.

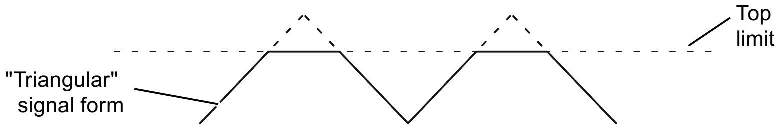


Figure 3-2 "Triangular" signal without peak

Parameterizing and operating the ramp-function generator

You operate and parameterize the function generator using the STARTER commissioning tool.

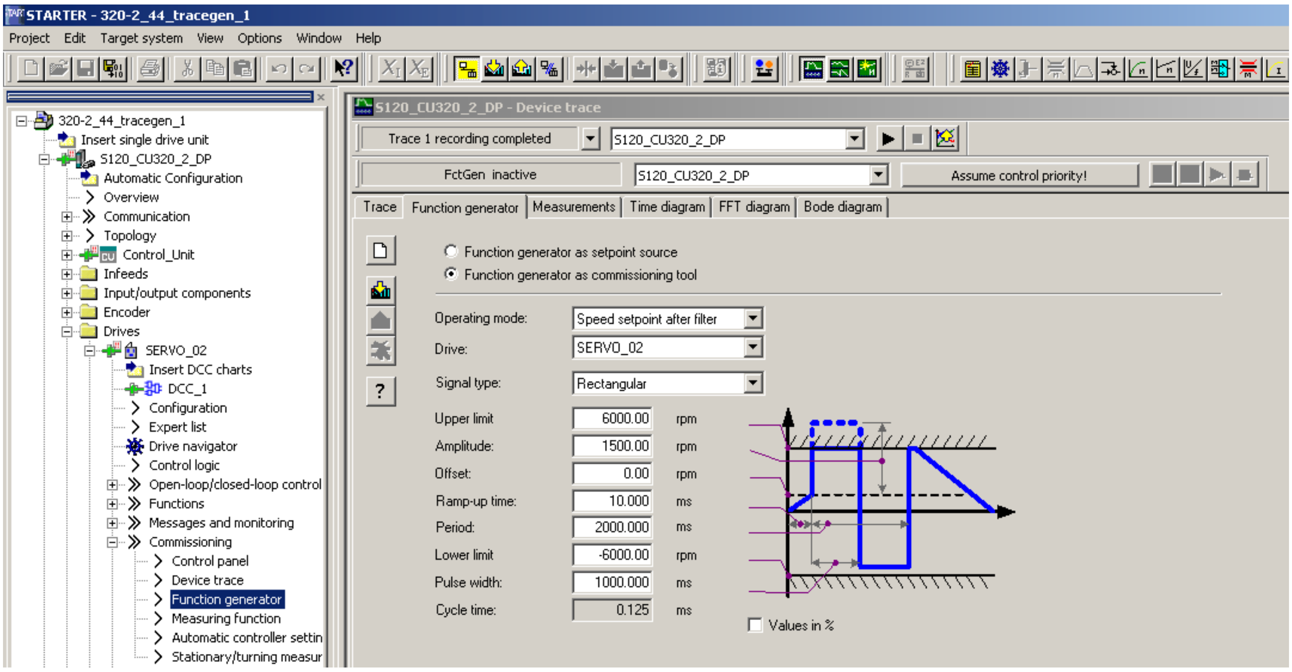


Figure 3-3 Function generator

Note

Please refer to the online help for more information about parameterizing and operation.

Starting/stopping the ramp-function generator

⚠ WARNING
Danger due to hazardous axis movement
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.

Start function generator:

1. Load the function generator.
   - Click on the symbol .

     or
   - In the project navigator, double-click on "Drives" > "Drive_xy" > "Commissioning" > "Function generator".
2. Select "Function generator as a commissioning tool".
3. Select an operating mode e.g. "Speed setpoint after filter".
4. Select a drive, for instance "SERVO_02".
5. Set a signal shape, for example, "Squarewave".
6. Click the "Assume control priority!" button.
7. For "Sign of life monitoring" click on the "Accept" button.
   (the control priority button then changes to yellow).
8. Click on the symbol I "Drive on".
9. Start the function generator by clicking on the triangle next to the red zero ("Start FctGen" button).
10. Carefully read the "Caution" note and confirm with "Yes".

    The drive starts and executes the selected trace function.

    Trace recordings are now possible.

Stopping the function generator:

1. Click on the "Stop FctGen" button.

   Or
2. Click on the symbol 0 "Drive off" in order to stop the drive.

Parameterization

The "Function generator" parameter screen is selected with the symbol in the toolbar of the STARTER commissioning tool.

3.2.2 Trace function

3.2.2.1 Single trace

You can use the trace function to record measured values over a defined period, depending on trigger conditions. Alternatively, the measured values can also be recorded using immediate recording.

In the STARTER commissioning tool you can parameterize the trace function by using the "Trace" parameterizing screen form.

Calling the "Trace" parameterizing screen form

1. In the STARTER commissioning tool, click on the symbol  (device trace-function generator).

   The "Trace" parameterizing screen form is then displayed. Example:

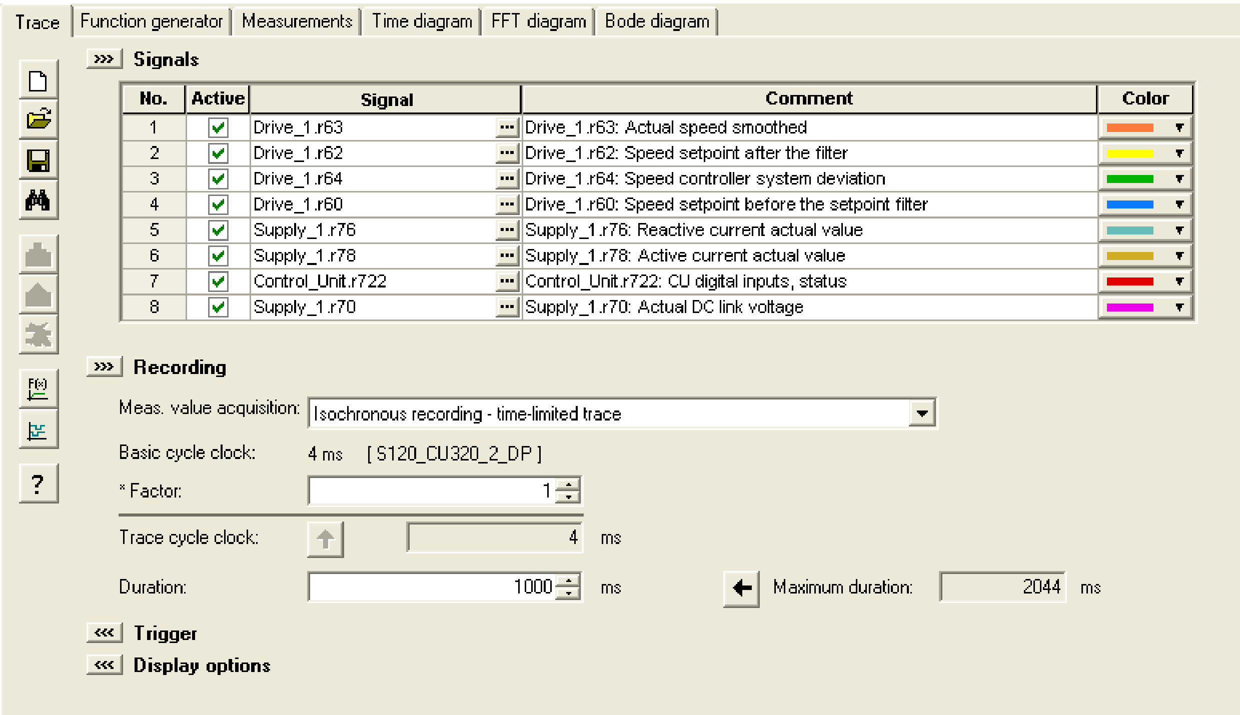


Figure 3-4 Trace function

Parameterizing and using the trace function

Note

Detailed information on how to parameterize and operate the trace function is available in the STARTER online help in Chapter "Trace, measuring functions and automatic controller setting".

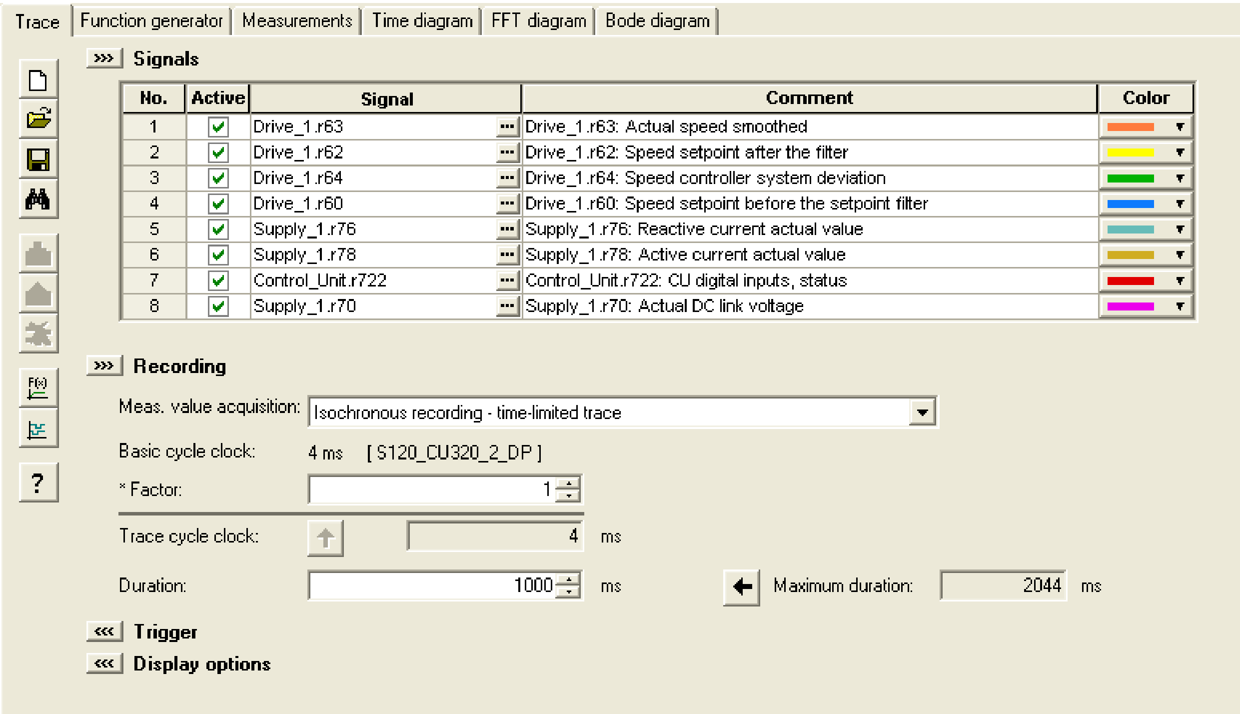


Figure 3-5 Trace function

The unit cycle time display flashes 3 times at around 1 Hz when the time slice is changed from < 4 ms to ≥ 4 ms (see description under "Properties"). The display also flashes in the inverse direction from ≥ 4 ms to < 4 ms.

Properties

- Two independent traces per Control Unit
- Up to 8 recording channels for each trace
  When more than 4 channels per single trace are used, the trace's device clock cycle is switched automatically from 0.125 ms (0.250 ms for vector control) to 4 ms. As a consequence, the performance of the SINAMICS S120 is not influenced too strongly by the trace function.
- Single trace:
  Device clock cycles of the SINAMICS S120 trace
  Up to 4 channels: 0.125 ms (servo control)/0.250 ms (vector control)
  ≥ 5 channels: 4 ms (servo control/vector control)
  The specified trace cycles can be increased.
- Endless trace:
  The parameter data are written to the memory until it is full. Additional parameter data are then lost.
  A ring buffer can be selected in order to avoid this. When the ring buffer is activated, then the STARTER commissioning tool automatically starts again from the beginning to write to the trace memory after the last trace parameter was saved.
  Device cycle of the SINAMICS S120 trace for an endless trace:
  – Up to 4 channels: 2 ms (servo control/vector control)
  – ≥ 5 channels: 4 ms (servo control/vector control)
    The specified trace cycles can be increased.
    If the 4 ms time slice is not available, then the next higher time slice is selected.
- Triggering
  – Without triggering (recording immediately after start)
  – Triggering on signal with edge or on level
- STARTER commissioning tool
  – Automatic or adjustable scaling of display axes
  – Signal measurement via cursor
- Adjustable trace cycle: Integer multiples of the basic sampling time

3.2.2.2 Multiple trace

A multiple trace consists of individual, completed consecutive traces. Using multiple tracing on a card, it is possible to cyclically record (a specific number) traces with the same trace configuration (number of channels, sample depth, recording cycle,..), and to save these traces persistently on the drive memory card.

The functions "endless trace", "individual trace" and "multiple-trace" cannot be used at the same time. With a correspondingly incorrect configuration, alarm "A02097" is output. However, a multiple trace with a cycle of 1 is nothing more than a single trace with saved measurement results.

NOTICE
Shorter service life of memory cards as a result of multiple traces
The service life of the cards can be shortened by the multiple traces because the memory media is subject to wear as a result of the write access operations from a technical point of view.

Note

The performance of the complete system can be negatively influenced by a continuous multiple trace.

Precondition

A multiple trace is only possible if the memory card is plugged in and not blocked. In this case, alarm "A02098 MTrace: cannot be saved" is output with alarm value "1".

Performing a multiple trace

Activating a multiple trace

Note

The multiple trace can be activated or set separately for each trace recorder.

The multiple trace and the number of cycles is defined by means of parameter p4840. The multiple trace is deactivated with the setting p4840 = 0.

The multiple trace is activated using the parameter setting p4840 ≥ 1.

Sequence of multiple trace

1. A multiple trace is started just like a conventional single trace using parameter p4700.
2. The multiple trace component saves the measurement result after the trigger condition has occurred and the trace data have been completely recorded.
3. The single trace that has actually been completed is now automatically restarted from the multiple trace component. In this case, the same trace configuration (trigger condition, recording cycle, etc.) is used as before. The trace buffer of the previous single trace is emptied in the process.
4. All additional cycles are automatically executed in the same way. The currently running cycle is displayed in parameter r4841 – including its subsequent deadtime (starting with 1).

Trace status

The status of the particular single trace can be read via parameter r4705. You cannot stop a multiple trace and then continue it. A multiple trace can only be canceled and restarted.

Time assignment

An individual trace can be assigned with respect to time using two parameters. The two parameters show the time at which the trigger condition was fulfilled:

- r4797 shows the trigger instant for trace recorder 0
- r4798 shows the trigger instant for trace recorder 1

3.2.2.3 Startup trace

A start up trace basically consists of a conventional single trace with all of its configuration options (number of channels, sampling depth, recording cycle, etc.). With the appropriate configuration, a startup trace is automatically active after a drive restarts.

Configure startup trace

1. Set the required trace configuration (e.g.: p4710, p4711, …).
2. Activate the startup trace using the parameter setting p4703[bit 0] = 1.

   After the drive restarts, a new trace is immediately started (without any additional user action).

3.2.2.4 Overview of important alarms and parameters

Overview of important alarms and faults (see SINAMICS S120/S150 List Manual)

- A02097 MTrace: multiple trace cannot be activated
- A02098 MTrace: cannot be saved

Overview of important parameters (see SINAMICS S120/S150 List Manual)

Startup trace

- p4703 Trace options

Multiple trace

- r4797 Trace 0 trigger instant
- r4798 Trace 1 trigger instant
- p4840 MTrace, setting the number of cycles
- r4841 MTrace, actual cycle display

3.2.3 Measuring function

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 STARTER commissioning tool.

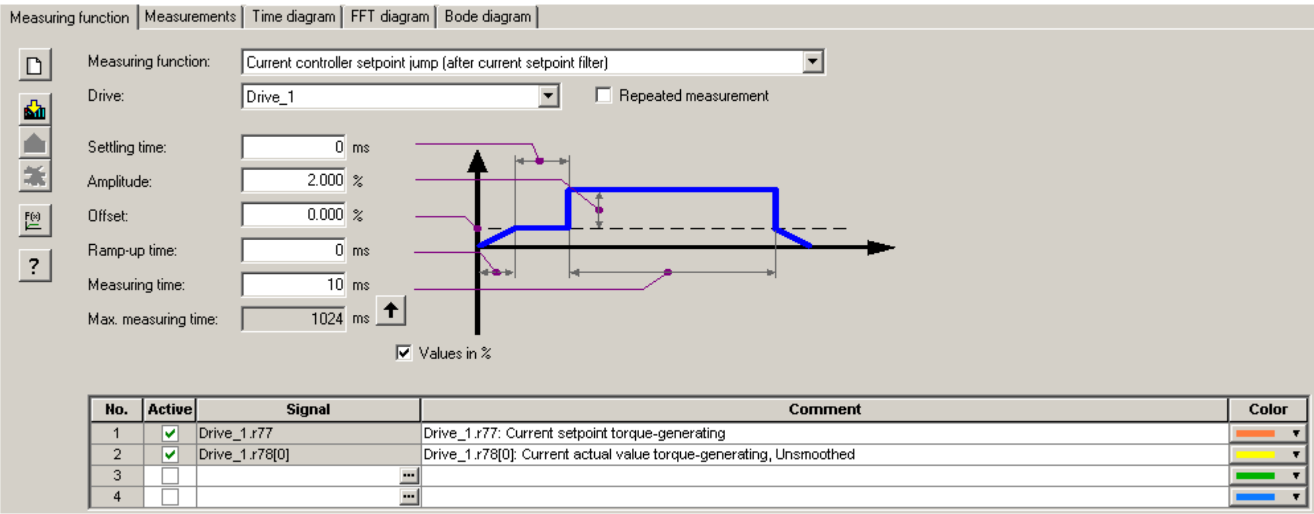


Figure 3-6 "Measuring function" initial screen

Note

Please refer to the online help for more information about parameterizing and operation.

Measuring functions

- Speed controller reference frequency response (downstream of the speed setpoint filter)
- Speed controller path (excitation downstream of current setpoint filter)
- Speed controller interference frequency response (fault downstream of the current setpoint filter)
- Speed controller reference frequency response (upstream of the speed setpoint filter)
- Speed controller setpoint change (downstream of the speed setpoint filter)
- Speed controller disturbance step change (fault downstream of the current setpoint filter)
- Current controller reference frequency response (downstream of the current setpoint filter)
- Current controller setpoint change (downstream of the current setpoint filter)

Starting/stopping the measuring function

> ⚠ WARNING
>
> **Danger due to hazardous axis movement**
>
> 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. Set the preconditions for starting the measuring function.
2. Select the drive in the project tree.
3. In the project tree, double-click on "Drive" > "Commissioning" > "Measuring function".
4. Set the required measuring function.
5. Then download the settings to the target device by clicking on the symbol  "Download parameterization".
6. Start the function generator ("Start measuring function" button).

To stop the measuring function:

The measuring function runs for a limited time and then automatically stops.

1. If you wish to immediately stop, click on the button "Stop measuring function".

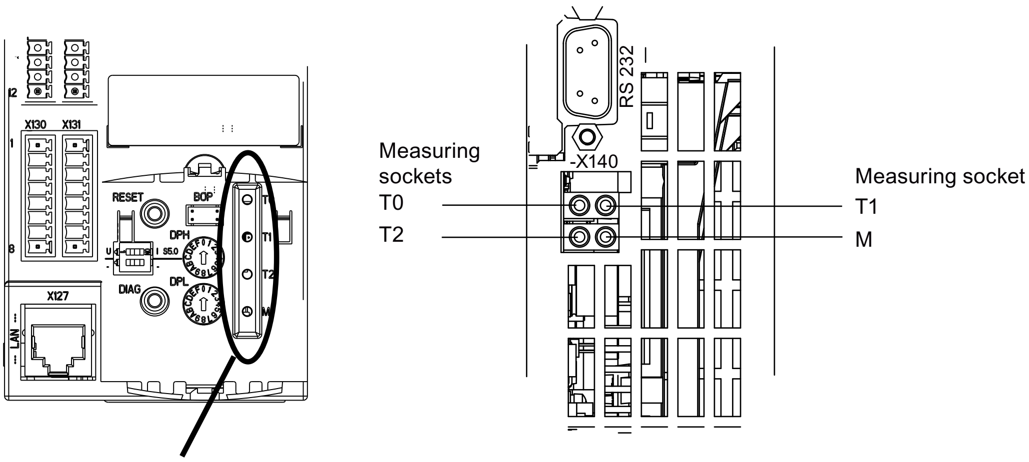
Parameterization

The "Measurement function" parameterizing screen form is selected via the following symbol  in the toolbar of the STARTER commissioning tool.

3.2.4 Measuring sockets

The three measuring sockets are used to output analog signals. Any interconnectable analog signal can be output at each measuring socket on the Control Unit.

NOTICE
Incorrect use of measuring sockets
The measuring sockets should be used for commissioning and servicing purposes only.
The measurements may only be carried out by properly trained specialist personnel.



Front view View from below

Figure 3-7 CU310-2 DP/PN measuring sockets, CU320-2 DP/PN measuring sockets

Parameterizing and using the measuring sockets

The measuring sockets are parameterized and operated via the STARTER commissioning tool. You can access the operating window for the measuring sockets in the project window under "Control Unit" > "Inputs/outputs". In the inputs/outputs window, click on the "Test sockets" tab.

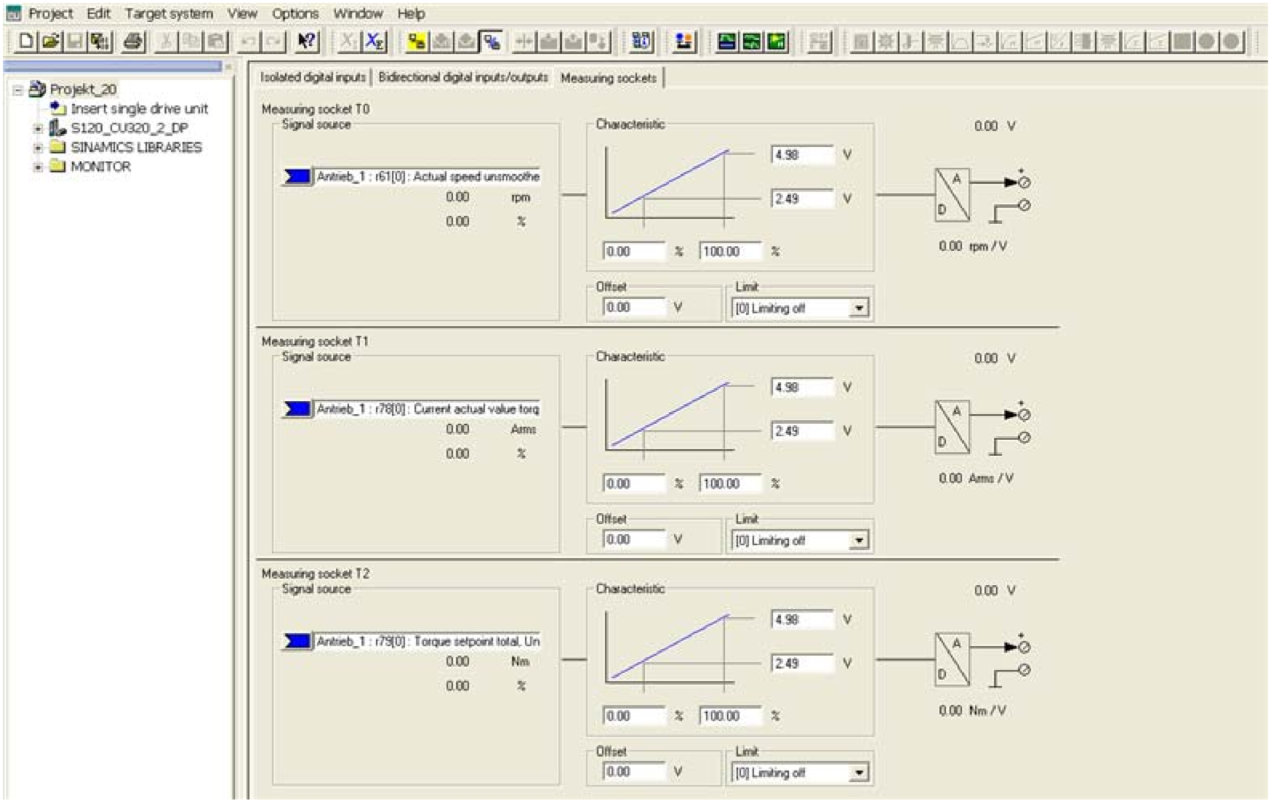


Figure 3-8 "Measuring sockets" initial screen

Note

You can find additional information on parameterizing and operating in the online help.

Properties

- Resolution: 8-bit
- Voltage range: 0 V to +4.98 V
- Measuring cycle: Depends on the measuring signal
  (e.g. actual speed value in speed controller cycle 125 μs)
- Short-circuit-proof
- Parameterizable scaling
- Adjustable offset
- Adjustable limitation

Signal chart for measuring sockets

The signal characteristic for measuring sockets is shown in function diagram 8134 (see SINAMICS S120/S150 List Manual).

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 currents 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.

Limitation

- 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 measured value output via a measuring socket

The actual speed (r0063) is to be output for a drive via measuring socket T1.

The following settings should be made:

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).

Function diagrams (see SINAMICS S120/S150 List Manual)

- 8134 Diagnostics - measuring sockets

Overview of important parameters (see SINAMICS S120/S150 List Manual)

Adjustable parameters

- p0771[0...2] CI: Measuring sockets signal source
- p0777[0...2] Measuring sockets characteristic value x1
- p0778[0...2] Measuring sockets characteristic value y1
- p0779[0...2] Measuring sockets characteristic value x2
- p0780[0...2] Measuring sockets characteristic value y2
- p0783[0...2] Measuring sockets offset
- p0784[0...2] Measuring sockets limit on/off

Display parameters

- r0772[0...2] Measuring sockets signal to be output
- r0774[0...2] Measuring sockets output voltage
- r0786[0...2] Measuring sockets normalization per volt

3.3 Diagnostic buffer

A diagnostic buffer mechanism has already been implemented in the SIMATIC S7 environment. It can record important operational events in the automation system as a kind of log book (restriction: The availability of the diagnostics buffer mechanism is also dependent on the hardware release of the Control Unit).

The diagnostic buffer is in the non-volatile memory, so data written to it can be read out for subsequent analysis of a malfunction (including pre-history).

The essential events recorded in the buffer are:

- Faults
- Important changes to the boot status (end status) and partial booting of DOs
- Commissioning procedures
- State change of PROFIBUS/PROFINET communication
- Exceptions

The entries in the diagnostic buffer can be called up via the drive unit properties (symbol in project navigator --> right mouse-click) under the menu option "Target device" > "Device diagnostics".

Note

STEP 7 full version

Device diagnostics in the STARTER commissioning tool is only displayed when you have installed the full version of STEP7.

Events recorded by the diagnostic buffer

The following list shows the entries defined for SINAMICS drive units. Additional information is marked with <>.

Faults

An entry is defined for each possible DO number. The fault code and fault value are entered in the additional information.

Example:
Fault DO 5: Fault code 1005 fault value 0x30012
Alarms are not saved in the diagnostic buffer. Propagated faults (faults which are signaled to all DOs) are only stored in the diagnostic buffer once.

Booting procedures and booting status changes

In principle, only start and completion are recorded for booting procedures. Booting status (see r3988) are only recorded when an end status arises that can only be exited by user action (r3988 = 1, 10, 200, 250, 325, 370, 800). Booting statuses and booting status changes are:

- POWER ON
- Error in booting (r3988 = 1)
- Fatal error in booting (r3988 = 10)
- Waiting for first commissioning (r3988 = 200)
- Topology error in booting (r3988 = 250)
- Waiting for entry of drive type (r3988 = 325)
- Waiting until p0009 = 0 is set (r3988 = 370)
- Boot status r3988 = <state at which 670 or 680> reached
- Booting finished, cyclic operation
- Reason for new boot < 0 = Internal reason; 1 = Warm start; 2 = Booting from saved data; 3 = Booting after download>
- Drive reset via p0972 = <Mode>
- Partial booting DO started <DO number>
- Partial booting DO <DO number> finished

Commissioning procedures

- Device commissioning: New status p0009 = <new value p0009>
- Commissioning DO <DO number>: New status p0010 = <new value p0010>
- Ram2Rom DO <0 for all DOs> started
- Ram2Rom DO <0 for all DOs> completed
- Project download started
- DO <DO_Number> deactivated
- DO <DO_Number> reactivated
- Component <Component number> deactivated
- Component <Component number> reactivated
- Power Off/ Power On required after firmware update (DO <DO number>
  Component < Component number >)
- DO <DO-No> deactivated and not available
- Component <component number> deactivated and not available

Communication (PROFIBUS, PROFINET, ...)

- PZD <IF1 or IF2> cyclic data exchange started
- PZD <IF1 or IF2> cyclic data exchange completed
- Changeover to UTC time for operating hours count status <Days> <Milliseconds>
- Time correction (correct) by <correction value> seconds

Exceptions

Exceptions can be taken from the crash diagnostics already available in the new boot run. The exceptions are always entered into the diagnostic buffer first, even before the entry "POWER ON".

- Data Abort Exception Address: <Content Program Counter>
- Floating Point Exception Address: <Content Program Counter>
- Prefetch Abort Exception Address: <Content Program Counter>
- Exception type <Type coding> Info: <Info depends on type>

Treatment of the time stamp

After successful time synchronization (in cyclic operation), the UTC time is used as a time stamp. Up until this time (POWER ON and switching to UTC time) the operating hours counter is used for all entries. The UTC time is entered for following entries.

3.4 Diagnostics of uncommissioned axes

To be able to identify uncommissioned drive objects of the classes "Infeeds", "Motor Module", "SERVO" and "VECTOR", there is an operating display in parameter r0002.

- r0002 "Infeed operating display" = 35: Carry out the first start-up
- r0002 "Drive operating display" = 35: Carry out the first start-up

The parameter r0002 "drive operating display" = 35 is then displayed if p3998[D]=0 is in any data set. Parameter p3998 specifies whether the first commissioning of the drive is still to be carried out (0 = yes, 2 = no).

Parameter p3998 is set to the value 2 when the calculation of the motor and control parameters for all data sets has been completed without errors (see r3925 bit0 = 1) and the encoder selection p0400 is not at 10100 (encoder identification).

The limitation that all drive data sets (DDS) must be commissioned in order to exit commissioning is ensured by checking the parameters involved (see also F07080 in the SINAMICS S120/S150 List Manual).

Infeed module

An infeed (Active Line Modules, Basic Line Modules or Smart Line Modules with DRIVE-CLiQ) is considered commissioned when the line voltage and line frequency have been parameterized with appropriate values. A basic setting of 50 Hz or 60 Hz is expected for the line frequency.

The line voltage p0210 may need to be adjusted to the existing power supply.

To exit the state r0002 "Infeed operating display" = 35, set parameter p3900 "completion of quick commissioning" to the value 3, after any necessary adjustment to the line voltage.

For a 400 V unit, for example, the voltage p0210 is always initialized with 400 V. Although it is possible to switch on when connected to all line supplies from 380 V - 480V, operation is not always optimal and/or alarm messages are displayed (see SINAMICS S120/S150 List Manual).
If the unit is not connected to a 400V line supply, then the rated voltage p0210 should be adjusted. This can also be done after the first time the unit is switched on, by setting p0010 = 1.

Motor Module

A drive is considered to have been commissioned when in every drive data set (DDS) the motor and encoder data sets have been assigned valid data:

- Motor data sets (MDS):
  p0131, p0300, p0301 etc. (see SINAMICS S120/S150 List Manual)
- Encoder data sets (EDS):
  p0141, p0142, p0400 etc. (see SINAMICS S120/S150 List Manual)

After parameterizing the motor and encoder data via quick commissioning
(p0010 = 1 ->0) use p3900 "completion of quick commissioning" > 0 to exit.

If commissioning should not be run using quick commissioning, the motor data should be entered via p0010 = 3 (p0340[0...n] "Automatic calculation of motor/control parameters" =1) after entering the rating plate data, and after that the encoder data entered via p0010 = 4.

If the above conditions are not met, in r0002 of the drive concerned the value r0002 = 35: "Carry out first commissioning" is shown.

It is not taken into account whether at switch on (pulse enable) required BICO sources are already parameterized, or are still at the value 0. Example:

- p0840 "BI: ON/OFF1" or
- p0864 "BI: Infeed operation"

If, after commissioning all DDSs, parameter p0010 is set once more to a value greater than 0, in r0002 the value r0002 = 46: "Switching on inhibited - exit the commissioning mode (p0009, p0010)" will be displayed.

The drive has been commissioned, however the pulses cannot be enabled.

Note on p0010 = 1 (quick commissioning):
Quick commissioning with p3900 > 0 (when p0010 = 1) works for all DDSs, where motor and encoder data have been entered.

This means that if quick commissioning is carried out a second or third time (or more), previously calculated and possibly user-adjusted data will be overwritten or recalculated.

For this reason we recommend carrying out any subsequent commissioning of a certain DDS (e.g. changing the motor), specifically using p0010 = 3 and p0010 = 4 instead of p0010 = 1.

Example

The image below shows a diagram of the diagnostic performance of uncommissioned infeeds and drives. A configuration with one power unit (DO2) and respectively two DDSs, MDSs and EDSs has been assumed. DO1 represents the CU.

The unit has already been commissioned.

The number of data sets and the components assigned to the DO2 have already been entered and the data set allocated.

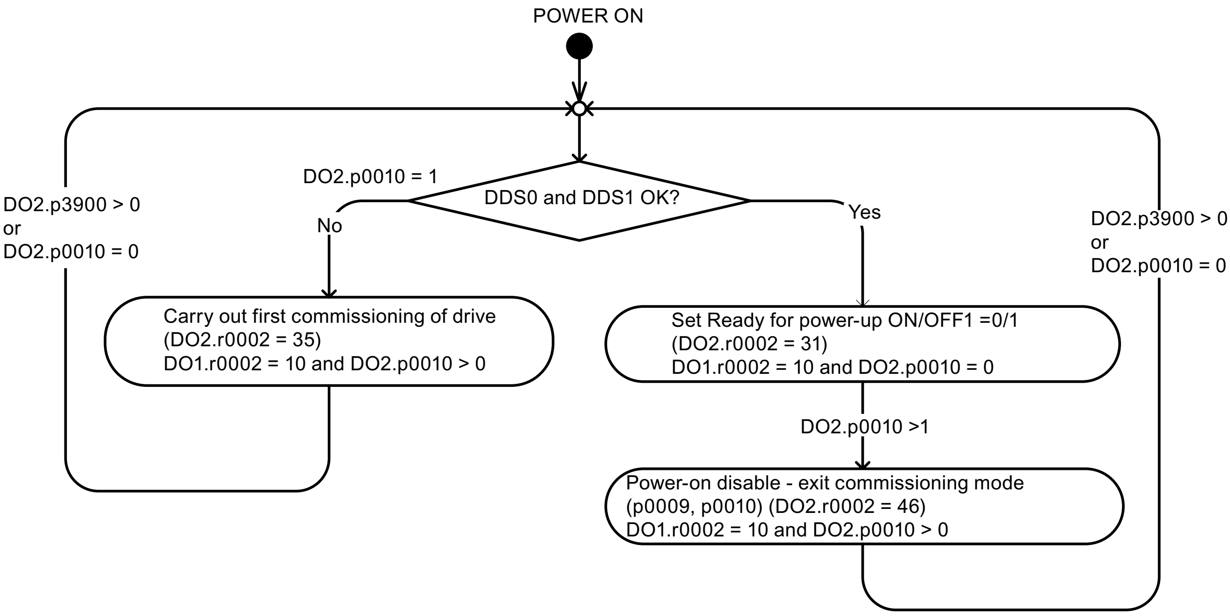


Figure 3-9 Diagnostics of uncommissioned axes

3.5 Fault and alarm messages

3.5.1 General information about faults and alarms

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 Chapter "Faults and alarms" in the SINAMICS S120/S150 List Manual. Function diagrams for the fault buffer, alarm buffer, fault trigger and fault configuration are also contained in the Section "Function diagrams" - "Faults and alarms".

Properties of faults and alarms

- Faults (code F01234)
  - 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.
- Alarms (code 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.
- 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.
  - Contains the component number for identifying the SINAMICS component involved
  - Contains diagnostic information on the message involved

Acknowledging faults

The list of faults and alarms specifies how each fault is acknowledged after the cause has been remedied.

- Acknowledgement of faults by "POWER ON"
  - Switch the drive on/off (POWER ON)
  - Press the RESET button on the Control Unit
- 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"
- 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 can only resume operation after all active faults have been acknowledged.

3.5.2 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 these buffers.

The contents of the fault buffer are saved to non-volatile memory when the Control Unit is powered down, i.e. the fault buffer history is still available when the unit is powered up again.

Note

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:

		Fault code	Fault value	Fault time "received"	Fault time "resolved"	Drive object fault triggering	Component number Fault	Diagnosis attributes Fault
Current incident	Fault 1	r0945[0]	r0949[0] [I32] r2133[0] [Float]	r0948[0] [ms] r2130[0] [d]	r2109[0] [ms] r2136[0] [d]	r3115[0]	r3120[0]	r3122[0]
	Fault 2	r0945[1]	r0949[1] [I32] r2133[1] [Float]	r0948[1] [ms] r2130[1] [d]	r2109[1] [ms] r2136[1] [d]	r3115[7]	r3120[7]	r3122[7]
	• • •		• • •					
	Fault 8	r0945[7]	r0949[7] [I32] r2133[7] [Float]	r0948[7] [ms] r2130[7] [d]	r2109[7] [ms] r2136[7] [d]	r3115[7] <1>	r3120[7]<1>	r3122[7]<1>
1st acknow-ledged incident	Fault 1	r0945[8]	r0949[8] [I32] r2133[8] [Float]	r0948[8] [ms] r2130[8] [d]	r2109[8] [ms] r2136[8] [d]	r3115[8]	r3120[8]	r3122[8]
	Fault 2	r0945[9]	r0949[9] [I32] r2133[9] [Float]	r0948[9] [ms] r2130[9] [d]	r2109[9] [ms] r2136[9] [d]	r3115[9]	r3120[9]	r3122[9]
	• • •		• • •					
	Fault 8	r0945[15]	r0949[15] [I32] r2133[15] [Float]	r0948[15] [ms] r2130[15] [d]	r2109[15] [ms] r2136[15] [d]	r3115[15]	r3120[15]	r3122[15]
• • •								
7th acknow-ledged incident [oldest]	Fault 1	r0945[56]	r0949[56] [I32] r2133[56] [Float]	r0948[56] [ms] r2130[56] [d]	r2109[56] [ms] r2136[56] [d]	r3115[56]	r3120[56]	r3122[56]
	Fault 2	r0945[57]	r0949[57] [I32] r2133[57] [Float]	r0948[57] [ms] r2130[57] [d]	r2109[57] [ms] r2136[57] [d]	r3115[57]	r3120[57]	r3122[57]
	• • •		• • •					
	Fault 8	r0945[63]	r0949[63] [I32] r2133[63] [Float]	r0948[63] [ms] r2130[63] [d]	r2109[63] [ms] r2136[63] [d]	r3115[63]	r3120[63]	r3122[63]

<1> This fault is overwritten by "more recent" faults (except "Safety faults").

Figure 3-10 Structure of the 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. 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.

Clear fault buffer

- Delete fault buffer for all drive objects:
  p2147 = 1 --> p2147 = 0 is automatically set after execution.
- Delete fault buffer for a specific drive object:
  p0952 = 0 --> The parameter belongs to the specified drive object.

The fault buffer contents are automatically deleted for the following events:

- Restore factory setting (p0009 = 30 and p0976 = 1).
- Download with modified structure (e.g. number of drive objects changed).
- Power-up after other parameter values have been loaded (e.g. p0976 = 10).
- Upgrade firmware to later version.

Alarm buffer, alarm history

An alarm in 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.

	Alarm code	Alarm value	Alarm time "received"	Alarm time "resolved"	Component number Warning	Diagnosis attributes Warning
Alarm 1 (oldest)	r2122[0]	r2124 [0] [I32] r2134[0] [Float]	r2123[0] [ms] r2145[0] [d]	r2125[0] [ms] r2146[0] [d]	r3121[0]	r3123[0]
Alarm 2	r2122[1]	r2124 [1] [I32] r2134[1] [Float]	r2123[1] [ms] r2145[1] [d]	r2125[1] [ms] r2146[1] [d]	r3121[1]	r3123[1]
• • •		• • •				
Alarm 8 (most recent)	r2122[7]	r2124 [7] [I32] r2134[7] [Float]	r2123[7] [ms] r2145[7] [d]	r2125[7] [ms] r2146[7] [d]	r3121[7]	r3123[7]

Alarm history

Alarm 1 (most recent)	r2122[8]	r2124 [8] [I32] r2134[8] [Float]	r2123[8] [ms] r2145[8] [d]	r2125[8] [ms] r2146[8] [d]	r3121[8]	r3123[8]
Alarm 2	r2122[9]	r2124 [9] [I32] r2134[9] [Float]	r2123[9] [ms] r2145[9] [d]	r2125[9] [ms] r2146[9] [d]	r3121[9]	r3123[9]
• • •		• • •				
Alarm 56 (oldest)	r2122[63]	r2124 [63] [I32] r2134[63] [Float]	r2123[63] [ms] r2145[63] [d]	r2125[63] [ms] r2146[63] [d]	r3121[10]	r3123[10]

Figure 3-11 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 most recent alarm is displayed.

A maximum of 56 alarms are displayed in the alarm history:

- Index 8: The most recent alarm is displayed.
- Index 9 .. 63: 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 63.
- 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

3.5.3 Configuring messages

The properties of the faults and alarms in the drive system are permanently defined.

For several messages, in a specific scope defined by the drive system, the properties can be changed as follows:

Change message type (example)

Select message	Set message type	
p2118[5] = 1001	p2119[5]	= 1: Fault (F)
		= 2: Alarm (A)
		= 3: No message (N)

Change fault reaction (example)

Select message	Set fault response	
p2100[3] = 1002	p2101[3]	= 0: None
		= 1: OFF1
		= 2: OFF2
		= 3: OFF3
		= 4: STOP1 (available soon)
		= 5: STOP2
		= 6: IASC/DC brake Internal armature short-circuit braking or DC brake
		= 7: ENCODER (p0491)

Change acknowledgement (example)

Select message	Set acknowledgement	
p2126[4] = 1003	p2127[4]	= 1: POWER ON
		= 2: IMMEDIATELY
		= 3: PULSE INHIBIT

19 message types per drive object can be changed.

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
- These settings are required for 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 should be restored (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 No selected message has been output.

CO: r2129 > 0 Group trigger.
At least one selected message has been output.
The individual binector outputs BO: r2129 should be investigated.

External triggering 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 alarm 1	—> A07850(F)
BI: p2116	—> External alarm 2	—> A07851(F)
BI: p2117	—> External alarm 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.

3.5.4 Overview of important function diagrams and parameters

Overview of important function diagrams (see SINAMICS S120/S150 List Manual)

- 1750 Overviews – monitoring functions, faults, alarms
- 8060 Diagnostics - fault buffer
- 8065 Diagnostics - alarm buffer
- 8070 Diagnostics - fault/alarm trigger word (r2129)
- 8075 Diagnostics - fault/alarm configuration
- 8134 Diagnostics - measuring sockets

Overview of important parameters (see SINAMICS S120/S150 List Manual)

- r0944 CO: Counter for fault buffer changes
- p0952 Fault cases, counter
- p2100[0...19] Setting the fault number for fault response
- r2139.0...12 CO/BO: Status word, faults/alarms 1
- r3120[0...63] Component number fault
- r3121[0...63] Component number alarm
- r3122[0...63] Diagnostic attribute fault
- r3123[0...63] Diagnostic attribute alarm

3.5.5 Propagation of faults

Forwarding faults to the Control Unit

When faults are triggered on the "Control Unit" drive object, it is always assumed that central functions of the drive are affected. For this reason, these faults are also forwarded to all other drive objects (propagation). The fault responses act on the Control Unit drive object and all other drive objects. This behavior also applies to the faults that are set in a DCC chart on the Control Unit with the aid of the DCC block.

A fault propagated from the Control Unit must be acknowledged at all drive objects to which this fault was transferred. In this way, this fault on the Control Unit is automatically acknowledged. Alternatively, the faults of the drive objects can also be acknowledged on the Control Unit.

Alarms are not propagated from the Control Unit, i.e. transferred to other drive objects.

Example

Drive object faults are only transferred to the drives; i.e. a fault on a TB30 stops the drive. However, a drive fault does not stop the TB30.

Forwarding of faults due to BICO interconnections

If two or more drive objects are connected via BICO interconnections, faults of drive objects of type Control Unit, TB30, DMC20, DME20, all Terminal Modules or ENCODER DO are transferred to drive objects with closed-loop control functions, e.g. infeed units or Motor Modules. There is no forwarding of faults within these two groups of drive object types.

This behavior also applies to the faults set in a DCC chart on the above drive object types with the aid of DCC STM.

3.5.6 Alarm classes

Fault and alarm classes

There are differentiated alarm messages in the cyclic telegrams between the former alarm classes "Alarm" and "Fault".

The alarm classes have been extended to give 3 additional levels of alarm between the "pure" alarm and the fault.

The function permits higher-level control (SIMATIC, SIMOTION, SINUMERIK, etc.) to have different control reactions to alarm messages from the drive.

The new statuses act as alarms for the drive, therefore there is NO immediate reaction from the drive (like for the former level "alarm").

Information on alarm classes are described in status word ZSW2 at bit positions bit 5 - 6 (for SINAMICS) or bit 11-12 (SIMODRIVE 611) (see also "ZSW2" in Chapter "Cyclic communication" for PROFIdrive communication in the SINAMICS S120 Function Manual Drive Functions).

ZSW2: Valid for SINAMICS Interface Mode p2038=0 (function diagram 2454)

Bit 5 - 6 Alarm classes alarms

= 0: Alarm (former alarm level)

= 1: Alarm class A alarms

= 2: Alarm class B alarms

= 3: Alarm class C alarms

ZSW2: Valid for SIMODRIVE 611 Interface Mode p2038=1 (function diagram 2453)

Bit 11 - 12 Alarm classes alarms

= 0: Alarm (former alarm level)

= 1: Alarm class A alarms

= 2: Alarm class B alarms

= 3: Alarm class C alarms

These attributes for differentiating the alarms are implicitly assigned to the appropriate alarm numbers. The reaction to the existing alarm classes in the alarm is defined by the user program in the higher-level control.

Explanations of the alarm classes

- Alarm class A: Drive operation currently not limited
  - e.g. alarm when measurement systems inactive
  - no limitation on current movement
  - Prevent possible switching to the defective measuring system
- Alarm class B: Time-limited operation
  - e.g. prewarning temperature: without further action the drive may need to be switched off
  - After a timer stage -> additional fault
  - after exceeding a switch-off threshold -> additional fault
- Alarm class C: Functionally limited operation
  - e.g. reduced voltage/current/torque/speed limits (i2t)
  - e.g. continue with reduced accuracy / resolution
  - e.g. continue without encoder

3.6 Troubleshooting for encoders

If an encoder fault is present, it can be acknowledged separately according to encoder channels in a PROFIdrive telegram via the encoder interface (Gn_STW.15) or the drive interface of the appropriate drive object.

Configuration example: 2-encoder system

- Encoder G1 motor measurement system
- Encoder G2 direct measurement system

Case considered: All encoders signal encoder faults.

- The errors are entered in the encoder interface - and from there into the encoder channel n of the PROFIDRIVE telegram. Bit15 of the encoder status word (Gn_ZSW.15 = 1).
- The faults are transferred to the drive object.
- Motor measuring system faults set the drive object to fault (ZSW1 bit3), the faults are additionally signaled via the drive interface. An entry is made in fault buffer p0945. The parameterized fault reaction is initiated internally.
- Direct measuring system faults are converted by the assigned drive object into the "Alarm" message type and signaled via the drive interface (ZSW1 bit7). An entry is made in alarm buffer r2122.
  No drive reactions are initiated.

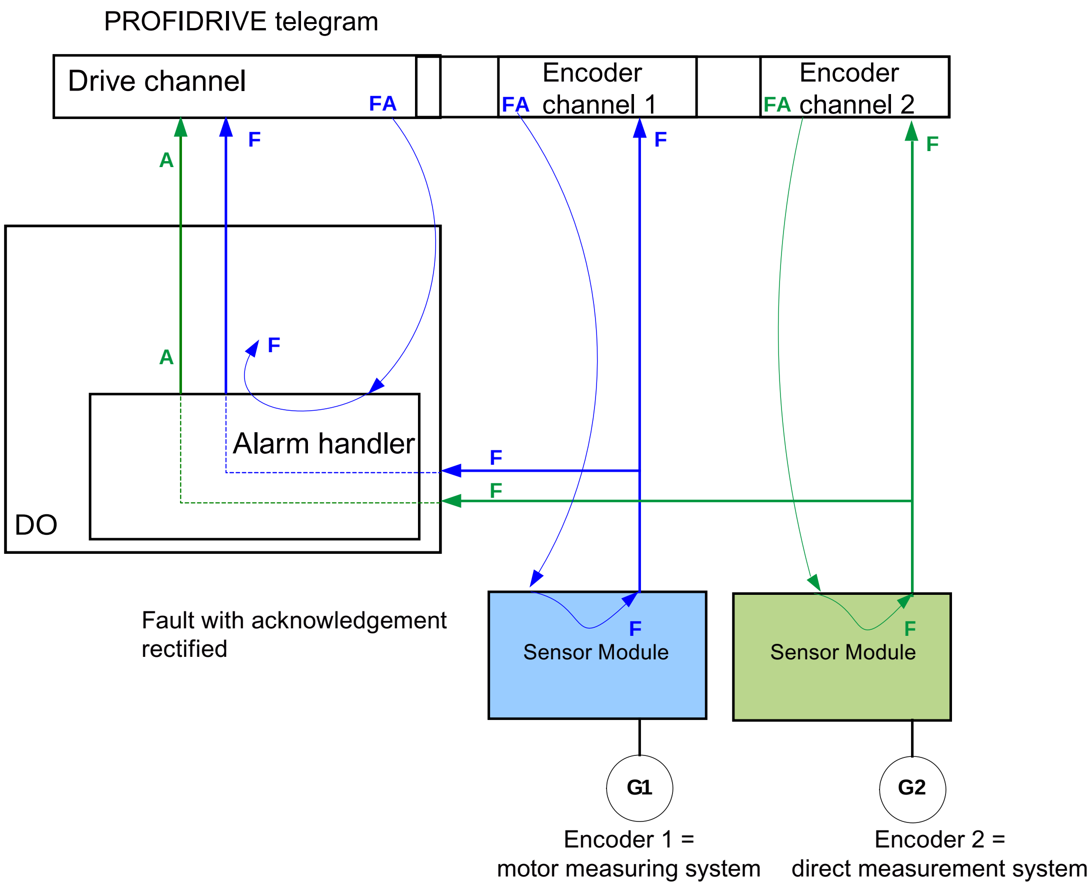


Figure 3-12 Encoder fault handling

Alarm A:
The alarm is canceled immediately, if the encoder fault was able to be acknowledged.
Faults F:
The fault remains active at the drive object until it is acknowledged via the cyclic interface.

Cyclic acknowledgment

Acknowledgment using the encoder interface (Gn_STW.15)

The following responses are possible:

- The encoder is set to fault-free if a fault is no longer active. The fault bit in the encoder interface is acknowledged. The evaluation modules indicate RDY LED = green after acknowledgment.
  This behavior is valid for all encoders connected to the encoder interface, irrespective of the measurement system type (motor or direct).
- If the fault is still present, or if other faults are present, the acknowledgment is not successful – and the highest priority fault (can be the same or another fault entry) is transferred via the encoder interface.
  The RDY LED on the evaluation modules is continuously red.
  This behavior is valid for all encoders connected via the encoder interface, irrespective of the measuring system type (motor or direct).
- The drive object is not detected via the encoder interface. Faults set in the drive object remain, the drive does not even start with the encoder which in the meantime is fault-free. The drive object must also be acknowledged via the drive interface (fault memory RESET).

Acknowledgment using the drive interface (STW1.7 (cyclic) or p3981(acyclic))

The following responses are possible:

- If no more errors are present, the encoder is set to fault free and the fault bit in the drive interface is acknowledged. The evaluation modules indicate RDY LED = green. Acknowledgment takes place on all encoders that are logically assigned to the drive.
- If the fault is still present, or other faults are present, then the acknowledgment is not successful; the next, highest priority fault is transferred via the drive interface and also via the encoder interface involved.
- The RDY LED on the evaluation modules is continuously red.
- The encoder interfaces of the assigned encoders are NOT reset by acknowledgement at the drive interface; the set faults remain.
- The encoder interfaces must also be acknowledged via the corresponding encoder control word Gn_STW.15.

Appendix A

A.1 Availability of hardware components

Table A- 1 Hardware components available as of 03.2006

No.	HW component	Order number	Version	Revisions
1	AC Drive (CU320, PM340)	refer to the Catalog		new
2	SMC30	6SL3055-0AA00-5CA1		with SSI support
3	DMC20	6SL3055-0AA00-6AAx		new
4	TM41	6SL3055-0AA00-3PAx		new
5	SME120 SME125	6SL3055-0AA00-5JAx 6SL3055-0AA00-5KAx		new
6	BOP20	6SL3055-0AA00-4BAx		new
7	CUA31	6SL3040-0PA00-0AAx		new

Table A- 2 Hardware components available as of 08.2007

No.	HW component	Order number	Version	Revisions
1	TM54F	6SL3055-0AA00-3BAx		new
2	Active Interface Module (booksize)	6SL3100-0BExx-xABx		new
3	Basic Line Module (booksize)	6SL3130-1TExx-0AAx		new
4	DRIVE-CLiQ encoder	6FX2001-5xDxx-0AAx		new
5	CUA31 Suitable for Safety Extended Functions via PROFIsafe and TM54	6SL3040-0PA00-0AA1		new
6	CUA32	6SL3040-0PA01-0AAx		new
7	SMC30 (30 mm wide)	6SL3055-0AA00-5CA2		new

Table A- 3 Hardware components available as of 10.2008

No.	HW component	Order number	Version	Revisions
1	TM31	6SL3055-0AA00-3AA1		new
2	TM41	6SL3055-0AA00-3PA1		new
3	DME20	6SL3055-0AA00-6ABx		new
4	SMC20 (30 mm wide)	6SL3055-0AA00-5BA2		new
5	Active Interface Module booksize 16 kW	6SL3100-0BE21-6ABx		new
6	Active Interface Module booksize 36 kW	6SL3100-0BE23-6ABx		new
7	Smart Line Modules booksize compact	6SL3430-6TE21-6AAx		new
8	Motor Modules booksize compact	6SL3420-1TE13-0AAx 6SL3420-1TE15-0AAx 6SL3420-1TE21-0AAx 6SL3420-1TE21-8AAx 6SL3420-2TE11-0AAx 6SL3420-2TE13-0AAx 6SL3420-2TE15-0AAx		new
9	Power Modules blocksize liquid cooled	6SL3215-1SE23-0AAx 6SL3215-1SE26-0AAx 6SL3215-1SE27-5UAx 6SL3215-1SE31-0UAx 6SL3215-1SE31-1UAx 6SL3215-1SE31-8UAx		new
10	Reinforced DC link busbars for 50 mm components	6SL3162-2DB00-0AAx		new
11	Reinforced DC link busbars for 100 mm components	6SL3162-2DD00-0AAx		new

Table A- 4 Hardware components available as of 11.2009

No.	HW component	Order number	Version	Revisions
1	Control Unit 320-2DP	6SL3040-1MA00-0AA1	4.3	new
2	TM120	6SL3055-0AA00-3KA0	4.3	new
3	SMC10 (30 mm wide)	6SL3055-0AA00-5AA3	4.3	new

Table A- 5 Hardware components available as of 01.2011

No.	HW component	Order number	Version	Revisions
1	Control Unit 320-2PN	6SL3040-1MA01-0AA1	4.4	new
2	Braking Module Booksize Compact	6SL3100-1AE23-5AA0	4.4	new
3	SLM 55kW Booksize	6TE25-5AAx	4.4	new
4	TM120 evaluation of up to four motor temperature sensors	6SL3055-0AA00-3KAx	4.4	new

Table A- 6 Hardware components available as of 04.2011

No.	HW component	Order number	Version	Revisions
1	S120 Combi 3 axes Power Module	6SL3111-3VE21-6FA0 6SL3111-3VE21-6EA0 6SL3111-3VE22-0HA0	4.4	new
2	S120 Combi 4 axes Power Module	6SL3111-4VE21-6FA0 6SL3111-4VE21-6EA0 6SL3111-4VE22-0HA0	4.4	new
3	S120 Combi Single Motor Module	6SL3420-1TE13-0AA0 6SL3420-1TE15-0AA0 6SL3420-1TE21-0AA0 6SL3420-1TE21-8AA0	4.4	new
4	S120 Combi Double Motor Module	6SL3420-2TE11-7AA0 6SL3420-2TE13-0AA0 6SL3420-2TE15-0AA0	4.4	new
5	Braking Module Booksize	6SL3100-1AE31-0AB0	4.4	new

Table A- 7 Hardware components available from 01.2012

No.	HW component	Order number	Version	Revisions
1	TM150 evaluation of up to 12 temperature sensors	6SL3055- 0AA0-3LA0	4.5	new
2	CU310-2 PN	6SL3040-1LA00-0AA0	4.5	new
3	CU310-2 DP	6SL3040-1LA01-0AA0	4.5	new

Table A- 8 Hardware components available as of the 4th quarter 2012

No.	HW component	Order number	Version	Revisions
1	Adapter Module 600	6SL3555-2BC10-0AA0	4.5	new
2	SINAMICS S120M	6SL3532-6DF71-0Rxx 6SL3540-6DF71-0Rxx 6SL3542-6DF71-0Rxx 6SL3562-6DF71-0Rxx 6SL3563-6DF71-0Rxx	4.5	new

Table A- 9 Hardware components available as of 01.2013

No.	HW component	Order number	Version	Revisions
1	300% overload, Booksize up to 18 A	6SL312x-xxxxx-xxx4 for Motor Modules with 50 mm and: 3 A, 5 A, 9 A, 18 A, 2x3 A, 2x5 A, 2x9 A	4.6	new

A.2 Availability of SW functions

Table A- 10 New functions, firmware 4.3

No.	SW function	SERVO	VECTOR	HW component
1	The 1FN6 motor series is supported	x	-	-
-2	DRIVE-CLiQ motors with star-delta changeover are supported	x	-	-
3	Referencing with several zero marks per revolution via the encoder interface	x	-	-
4	Permanent-magnet synchronous motors can be controlled down to zero speed without having to use an encoder	-	x	-
5	"SINAMICS Link" : Direct communication between several SINAMICS S120	x	x	-
6	Safety Integrated: • Control of the Basic Functions via PROFIsafe • SLS without encoder for induction motors • SBR without encoder for induction motors • Own threshold value parameters for SBR: Up until now, SSM used parameter p9546	x	x	-
7	Drive object encoder: An encoder can now be directly read in via the encoder drive object and can then be evaluated by SIMOTION using the TO external encoder.	-	x	-
8	Support of new components • CU320-2 • TM120	x	x	-
9	GSDML file expanded for Profisafe	x	x	-
10	USS protocol at interface X140	x	x	-
11	U/f diagnostics (p1317) permitted as regular operating mode	x	-	-
12	Setpoint-based utilization display, instead of the previous actual value-based utilization display	x	x	-
13	A performance license is now required from the 4th axis (for servo/vector) or from the 7th U/f axis, instead of from a utilization of 50 % and higher - which was the case up until now.	x	x	-
14	Tolerant encoder monitoring, 2nd part: • Monitoring, tolerance band, pulse number • Switchable edge evaluation for squarewave encoders • Setting the zero speed measuring time for pulse encoder signal evaluation • Changeover measuring technique, actual value sensing for squarewave encoder • "LED check" encoder monitoring	x	x	-

Table A- 11 New functions, firmware 4.4

No.	SW function	SERVO	VECTOR	HW component
1	Safety Integrated functions • SDI (Safe Direction) for induction motors (with and without encoder), for synchronous motors with encoder • Supplementary condition for Safety without encoder (for induction motors): Only possible with devices in booksize and blocksize format. Not for devices in chassis format	x	x	-
2	Communication • PROFINET address can be written via parameter (e.g. when completely generating the project offline) • Shared device for SINAMICS S PROFINET modules: CU320-2 PN, CU310-2 PN	x	x	-
3	Emergency retraction (ESR = Extended Stop and Retract)	x	x	-
4	TM41: Rounding for pulse encoder emulation (gear ratio; also resolver as encoder)	x	x	-
5	Further pulse frequencies for servo control and isochronous operation (3.2 / 5.33 / 6.4 kHz)	x	-	-
6	Chassis format: Current controller in 125 µs for servo control for higher speeds (up to approx. 700 Hz output frequency)	x	-	-
7	Propagation of faults	x	x	-

Table A- 12 New functions, firmware 4.5

No.	SW function	SERVO	VECTOR	HW component
1	Support of new components CU310-2	x	x	Refer to Appendix A1
2	Support of new components, TM150	x	x	-
3	Support of new components S120M	x	-	-
4	Support for high-frequency spindles with pulse frequencies up to 32 kHz (a current controller cycle of 31.25 µs)	x	-	-
5	PROFINET: Support of the PROFIenergy profile	x	x	-
6	PROFINET: Improved usability for Shared Device	x	x	-
7	PROFINET: Smallest selectable send cycle 250 µs	x	x	-
8	PROFINET: Bumpless media redundancy with CU310-2 PN, CU320-2 PN and CU320-2 with CBE20	x	x	-
9	Ethernet/IP communication extension via CBE20	x	x	-
10	SINAMICS Link: Smallest adjustable send clock 0.5 ms	x	x	-
11	Parameterization of SINAMICS Link connections without POWER ON	x	x	-
12	Write protection	x	x	-
13	Know-how protection	x	x	-
14	PEM encoderless up to n = 0 rpm	x	x	-
15	Decoupling of the pulse frequency from the current controller cycle only valid for power units in the chassis format	-	x	-

No.	SW function	SERVO	VECTOR	HW component
16	Expansion of the number of process data words for infeeds up to 10 words for the send and receive directions	x	x	-
Safety Integrated functions				
17	CU310-2 safety functionality via terminals and PROFIsafe	x	x	-
18	Permanent activation of the speed limit and the safe direction of rotation without PROFIsafe or TM54F	x	x	-
19	Safely Limited Position (SLP)	x	x	-
20	Transfer of the safely limited position via PROFIsafe	x	x	-
21	Variably adjustable SLS limit	x	x	-
22	New PROFIsafe telegrams 31, 901, 902	x	x	-

Table A- 13 New functions, firmware 4.6

No.	SW function	SERVO	VECTOR	HW component
1	Integrated web server for SINAMICS Project and firmware download via Ethernet on the memory card Protection against power failure while updating via the Web server	x	x	-
2	Replacing a part with know-how protection Encrypted loading into the file system	x	x	-
3	Parameterizable bandstop filters for Active Infeed control, chassis format	x	x	-
4	Current setpoint filter	x	-	-
5	Shortened rotating measurement	-	x	-
6	Redundant data backup on the memory card	x	x	-
7	Multiple trace	x	x	-
8	Brake control adaptation	x	x	-
9	Fast flying restart	-	x	-
10	Diagnostic alarms for PROFIBUS	x	x	-
11	DCC SINAMICS: Support of DCB libraries generated from the SINAMICS DCB Studio	x	x	-
12	SMC40 (EnDat 2.2)	x	x	-
13	CANopen expansions	x	x	-
Safety Integrated functions				
14	Safety Integrated Extended Functions with 2 TTL/HTL encoders	x	x	-
15	Safety: Safe Brake Test	x	x	-
16	Safety Info Channel	x	x	-

A.3 List of abbreviations

Note:

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

Abbreviation	Source of abbreviation	Meaning
A		
A...	Alarm	Alarm
AC	Alternating Current	Alternating current
ADC	Analog Digital Converter	Analog digital converter
AI	Analog Input	Analog input
AIM	Active Interface Module	Active Interface Module
ALM	Active Line Module	Active Line Module
AO	Analog Output	Analog output
AOP	Advanced Operator Panel	Advanced Operator Panel
APC	Advanced Positioning Control	Advanced Positioning Control
AR	Automatic Restart	Automatic restart
ASC	Armature Short Circuit	Armature short circuit
ASCII	American Standard Code for Information Interchange	American standard code for information interchange
ASM	Asynchronmotor	Induction motor
B		
BERO	-	Contactless proximity switch
BI	Binector Input	Binector input
BIA	Berufsgenossenschaftliches Institut für Arbeitssicherheit	Germany's Institute for Occupational Safety and Health
BICO	Binector Connector Technology	Binector connector technology
BLM	Basic Line Module	Basic Line Module
BO	Binector Output	Binector output
BOP	Basic Operator Panel	Basic Operator Panel

Abbreviation	Source of abbreviation	Meaning
C		
C	Capacitance	Capacitance
C...	-	Safety message
CAN	Controller Area Network	Serial bus system
CBC	Communication Board CAN	Communication board CAN
CD	Compact Disc	Compact Disc
CDC	Crosswise data comparison	Crosswise data comparison
CDS	Command Data Set	Command data set
CF Card	CompactFlash Card	CompactFlash Card
CI	Connector Input	Connector input
CLC	Clearance Control	Clearance control
CNC	Computer Numerical Control	Computer numerical control
CO	Connector Output	Connector output
CO/BO	Connector Output/Binector Output	Connector/binector output
COB ID	CAN Object Identification	CAN Object identification
COM	Common contact of a changeover relay	Center contact of a changeover contact
COMM	Commissioning	Commissioning
CP	Communication Processor	Communication processor
CPU	Central Processing Unit	Central processing unit
CRC	Cyclic Redundancy Check	Cyclic redundancy check
CSM	Control Supply Module	Control Supply Module
CU	Control Unit	Control Unit
CUA	Control Unit Adapter	Control Unit Adapter
CUD	Control Unit DC MASTER	Control Unit DC MASTER
D		
DAC	Digital Analog Converter	Digital analog converter
DC	Direct Current	DC current
DC link	DC link	DC link
DCB	Drive Control Block	Drive Control Block
DCC	Drive Control Chart	Drive Control Chart
DCC	Data Cross Check	Crosswise data comparison
DCN	Direct Current Negative	DC current negative
DCP	Direct Current Positive	DC current positive
DDS	Drive Data Set	Drive data set
DI	Digital Input	Digital input
DI/DO	Digital Input/Digital Output	Digital input/output bidirectional
DMC	DRIVE-CLiQ Hub Module Cabinet	DRIVE-CLiQ Hub Module Cabinet
DME	DRIVE-CLiQ Hub Module External	DRIVE-CLiQ Hub Module External
DO	Digital Output	Digital output
DO	Drive Object	Drive object

Abbreviation	Source of abbreviation	Meaning
DP	Decentralized Peripherals	Distributed IOs
DPRAM	Dual Ported Random Access Memory	Memory with dual access ports
DRAM	Dynamic Random Access Memory	Dynamic memory
DRIVE-CLiQ	Drive Component Link with IQ	Drive Component Link with IQ
DSC	Dynamic Servo Control	Dynamic Servo Control
E		
EASC	External Armature Short Circuit	External armature short circuit
EDS	Encoder Data Set	Encoder data set
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ELCB	Earth Leakage Circuit Breaker	Earth leakage circuit breaker
ELP	Earth Leakage Protection	Earth leakage protection
EMC	Electromagnetic Compatibility	Electromagnetic compatibility
EMF	Electromagnetic Force	Electromagnetic force
EMC	Electromagnetic compatibility	Electromagnetic compatibility
EN	European standard	European standard
EnDat	Encoder Data Interface	Encoder interface
EP	Enable Pulses	Pulse enable
EPOS	Einfachpositionierer	Basic positioner
ES	Engineering System	Engineering System
ESB	Equivalent circuit diagram	Equivalent circuit diagram
ESD	Electrostatic Sensitive Devices	Electrostatic sensitive devices
ESR	Extended Stop and Retract	Extended stop and retract
F		
F...	Fault	Fault
FAQs	Frequently Asked Questions	Frequently asked questions
FBL	Free Blocks	Free function blocks
FCC	Function Control Chart	Function Control Chart
FCC	Flux Current Control	Flux current control
FD	Function Diagram	Function diagram
F-DI	Failsafe Digital Input	Fail-safe digital input
F-DO	Failsafe Digital Output	Fail-safe digital output
FEM	Fremderregter Synchronmotor	Separately excited synchronous motor
FEPROM	Flash EPROM	Non volatile read and write memory
FG	Function Generator	Function generator
FI	-	Fault current
FOC	Fiber-Optic Cable	Fiber-optic cable
FP	Function diagram	Function diagram
FPGA	Field Programmable Gate Array	Field Programmable Gate Array

Abbreviation	Source of abbreviation	Meaning
FW	Firmware	Firmware
G		
GB	Gigabyte	Gigabyte
GC	Global Control	Global Control Telegram (Broadcast Telegramm)
GND	Ground	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as G)
GSD	Generic Station Description	Generic station description: Describes the characteristics of a PROFIBUS slave
GSV	Gate Supply Voltage	Gate Supply Voltage
GUID	Globally Unique Identifier	Globally unique identifier
H		
HF	High Frequency	High frequency
HFD	Hochfrequenzdrossel	High-frequency reactor
HMI	Human Machine Interface	Human machine interface
HTL	High-Threshold Logic	Logic with a high fault threshold
HW	Hardware	Hardware
I		
I/O	Input/Output	Input/output
I2C	Inter-Integrated Circuit	Internal serial data bus
IASC	Internal Armature Short Circuit	Internal armature short circuit
IBN	Inbetriebnahme	Commissioning
ID	Identifier	Identification
IE	Industrial Ethernet	Industrial Ethernet
IEC	International Electrotechnical Commission	International Electrotechnical Commission
IF	Interface	Interface
IGBT	Insulated Gate Bipolar Transistor	Insulated gate bipolar transistor
IGCT	Integrated Gate-Controlled Thyristor	Semiconductor power switch with integrated control electrode
IL	Impulslöschung	Pulse cancelation
IP	Internet Protocol	Internet Protocol
IPO	Interpolator	Interpolator
IT	Isolé Terré	Non-grounded three-phase power supply
IVP	Internal Voltage Protection	Internal voltage protection
J		
JOG	Jogging	Jogging

Abbreviation	Source of abbreviation	Meaning
K		
KIP	Kinetische Pufferung	Kinetic buffering
Kp	-	Proportional gain
KTY	-	Special temperature sensor
L		
L	-	Formula symbol for inductance
LED	Light Emitting Diode	Light Emitting Diode
LIN	Linear motor	Linear motor
LSB	Least Significant Bit	Least significant bit
LSC	Line-Side Converter	Line-side converter
LSS	Line Side Switch	Line side switch
LU	Length Unit	Length unit
M		
M	-	Formula symbol for torque
M	Masse	Reference potential for all signal and operating voltages, usually defined as 0 V (also referred to as GND)
MB	Megabyte	Megabyte
MCC	Motion Control Chart	Motion Control Chart
MDS	Motor Data Set	Motor data set
MLFB	Maschinenlesbare Fabrikatebezeichnung	Machine-Readable Product Code
MMC	Man-Machine Communication	Man-machine communication
MMC	Micro Memory Card	Micro memory card
MSB	Most Significant Bit	Most significant bit
MSC	Motor-Side Converter	Motor-side converter
MSCY_C1	Master Slave Cycle Class 1	Cyclic communication between master (Class 1) and slave
MSR	Motorstromrichter	Motor-side converter
MT	Machine Tool	Machine tool
N		
N. C.	Not Connected	Not connected
N...	No Report	No message or internal message
NAMUR	Normenarbeitsgemeinschaft für Mess- und Regeltechnik in der chemischen Industrie	Standardization association for measurement and control in the chemical industry
NC	Normally Closed (contact)	NC contact
NC	Numerical Control	Numerical control
NEMA	National Electrical Manufacturers Association	Standardization body in the US
NM	Nullmarke	Zero mark
NO	Normally Open (contact)	NO contact

Abbreviation	Source of abbreviation	Meaning
NSR	Netzstromrichter	Line-side converter
NVRAM	Non-Volatile Random Access Memory	Non-volatile read/write memory
O		
OA	Open Architecture	Open Architecture
OC	Operating Condition	Operating condition
OEM	Original Equipment Manufacturer	Original Equipment Manufacturer
OLP	Optical Link Plug	Fiber-optic bus connector
OMI	Option Module Interface	Option module interface
P		
p...	-	Adjustable parameters
PB	PROFIBUS	PROFIBUS
PC	Position Controller	Position Controller
PcCtrl	PC Control	Control for master
PD	PROFIdrive	PROFIdrive
PDS	Power unit Data Set	Power unit data set
PE	Protective Earth	Protective earth
PELV	Protective Extra Low Voltage	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	Programmable Logic Controller	Programmable logic controller
PLL	Phase-Locked Loop	Phase-locked loop
PN	PROFINET	PROFINET
PNO	PROFIBUS Nutzerorganisation	PROFIBUS user organization
PPI	Point-to-Point Interface	Point-to-point interface
PRBS	Pseudo Random Binary Signal	White noise
PROFIBUS	Process Field Bus	Serial data bus
PS	Power Supply	Power supply
PSA	Power Stack Adapter	Power Stack Adapter
PTC	Positive Temperature Coefficient	Positive temperature coefficient
PTP	Point-To-Point	Point-to-Point
PWM	Pulse Width Modulation	Pulse width modulation
PZD	Prozessdaten	Process data
R		
r...	-	Display parameters (read-only)
RAM	Random Access Memory	Read/write memory
RCCB	Residual Current Circuit Breaker	Residual current operated circuit breaker
RCD	Residual Current Device	Residual current operated circuit breaker
RCM	Residual Current Monitor	Residual current monitor

Abbreviation	Source of abbreviation	Meaning
RFG	Ramp-Function Generator	Ramp-function generator
RJ45	Registered Jack 45	Term for an 8-pin socket system for data transmission with shielded or non-shielded multi-wire copper cables
RKA	Rückkühlanlage	Cooling unit
RO	Read Only	Read only
RPDO	Receive Process Data Object	Receive process data object
RS232	Recommended Standard 232	Interface standard for cable-connected serial data transmission between a sender and receiver (also known under EIA232)
RS485	Recommended Standard 485	Interface standard for a cable-connected differential, parallel, and/or serial bus system (data transmission between a number of senders and receivers, also known under EIA485)
RTC	Real Time Clock	Real time clock
RZA	Raumzeigerapproximation	Space vector approximation
S		
S1	-	Uninterrupted duty
S3	-	Intermittent duty
SBC	Safe Brake Control	Safe brake control
SBH	Sicherer Betriebshalt	Safe operating stop
SBR	-	Safe acceleration monitoring
SCA	Safe Cam	Safe cam
SD Card	SecureDigital Card	Secure digital memory card
SE	Sicherer Software-Endschalter	Safe software limit switch
SG	Sicher reduzierte Geschwindigkeit	Safely reduced speed
SGA	Sicherheitsgerichteter Ausgang	Safety-related output
SGE	Sicherheitsgerichteter Eingang	Safety-related input
SH	Sicherer Halt	Safe standstill
SI	Safety Integrated	Safety Integrated
SIL	Safety Integrity Level	Safety Integrity Level
SLM	Smart Line Module	Smart Line Module
SLP	Safely-Limited Position	Safely-limited position
SLS	Safely Limited Speed	Safely limited speed
SLVC	Sensorless Vector Control	Vector control without encoder
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	Safe Operating Stop	Safe operating stop

Abbreviation	Source of abbreviation	Meaning
SP	Service Pack	Service pack
SPC	Setpoint Channel	Setpoint channel
SPI	Serial Peripheral Interface	Serial interface for connecting peripherals
SS1	Safe Stop 1	Safe stop 1 (monitored for time and ramping up)
SS2	Safe Stop 2	Safe stop 2
SSI	Synchronous Serial Interface	Synchronous serial interface
SSM	Safe Speed Monitor	Safe feedback for speed monitoring (n < nx)
SSP	SINAMICS Support Package	SINAMICS support package
STO	Safe Torque Off	Safe torque off
STW	Steuerwort	Control word
T		
TB	Terminal Board	Terminal Board
TIA	Totally Integrated Automation	Totally Integrated Automation
TM	Terminal Module	Terminal module
TN	Terre Neutre	Grounded three-phase supply network
Tn	-	Integral time
TPDO	Transmit Process Data Object	Transmit process data object
TT	Terre Terre	Grounded three-phase supply network
TTL	Transistor-Transistor Logic	Transistor-transistor logic
Tv	-	Rate time
U		
u.d.	under development	Under development: This feature is not cur- rently available
UL	Underwriters Laboratories Inc.	Underwriters Laboratories Inc.
UPS	Uninterruptible Power Supply	Uninterruptible power supply
UTC	Universal Time Coordinated	Universal time coordinated
V		
VC	Vector Control	Vector control
Vdc	-	DC link voltage
VdcN	-	Partial DC link voltage negative
VdcP	-	Partial DC link voltage positive
VDE	Verband Deutscher Elektrotechniker	Association of German electrical engineers
VDI	Verein Deutscher Ingenieure	Association of German Engineers
VPM	Voltage Protection Module	Voltage Protection Module
Vpp	Volt peak-to-peak	Volt peak-to-peak
VSM	Voltage Sensing Module	Voltage Sensing Module

Abbreviation	Source of abbreviation	Meaning
X		
XML	Extensible Markup Language	Standard language for Web publishing and document management
Z		
ZM	Zero Mark	Zero mark
ZSW	Zustandswort	Status word

SINAMICS documentation overview

General documentation / catalogs

SINAMICS G110	SINAMICS G130, G150	SIMOTION SINAMICS S120	SINAMICS S120, S150
D11.1 Converter chassis units 0.12 kW to 3 kW	D11 Converter chassis units Converter cabinet units	PM21 SIMOTION, SINAMICS S120 and Motors for Production Machines	D21.3 SINAMICS S120 Chassis Format Units and Cabinet Modules SINAMICS S150 Converter cabinet units

Manufacturer / service documentation

SINAMICS G110	SINAMICS G120, G120C	SINAMICS G130	SINAMICS G150	SINAMICS GM150, SM120 / SM150, GL150, SL150
Getting Started Operating Instructions List Manual	Getting Started Operating Instructions Hardware Installation Manual Function Manual Safety Integrated List Manual	Operating Instructions List Manual	Operating Instructions List Manual	Operating Instructions List Manual

Manufacturer / service documentation

SINAMICS S110	SINAMICS S120	SINAMICS S120	SINAMICS S150
Equipment Manual Getting Started Function Manual List Manual	Getting Started Commissioning Manual Commissioning Manual for CANopen Function Manual for Drive Functions Function Manual for Safety Integrated Function Manual DCC List Manual	Equipment Manual for Control Units and Supplementary Components Equipment Manual for Booksize Power Units Equipment Manual for Chassis Power Units Equipment Manual for Chassis Liquid Cooled Power Units Manual for Cabinet Modules Manual for AC Drives	Operating Instructions List Manual

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