SIEMENS

SINUMERIK 840Di sl

Manual

Valid for

Control
SINUMERIK 840Di sl/840DiE sl

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SINUMERIK® documentation

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The status of each edition is shown by the code in the ”Remarks” column.

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We have checked the contents of this manual for agreement with the hardware and software described. Nevertheless, differences might exist and therefore we cannot guarantee that they are completely identical. The data in this document is regularly checked and the necessary corrections are included in the following editions. Suggestions for improvement are also welcome.

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PREFACE

SINUMERIK documentation

The SINUMERIK documentation is subdivided into 3 parts:

- General Documentation
- User Documentation
- Manufacturer/Service Documentation

An overview of publications, which is updated monthly and also provides information about the language versions available, can be found on the Internet at:

http://www.siemens.com/motioncontrol

Follow menu items – ”Support” –> ”Technical Documentation” –> ”Overview of Documentation”.

The Internet version of DOConCD (DOConWEB) is available at:

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Information about training courses and FAQs (Frequently Asked Questions) can be found in internet under:

http://www.siemens.com/motioncontrol and there under the menu item ”Support”

Target group

This documentation is intended for manufacturers/end users of machine tools and production machines who use SINUMERIK 840Di sl and SINAMICS S120.

Standard scope

This documentation only describes the functionality of the standard version. Additions or revisions made by the machine manufacturer are documented by the machine manufacturer.

Other functions not described in this documentation might be executable in the control. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

For the sake of simplicity, this documentation does not contain all detailed information about all types of the product and cannot cover every conceivable case of installation, operation, or maintenance.

Technical support

If you have any technical questions, please contact our hotline:

	Europe/Africa	Asia/Australia	America
Phone	+49 180 / 5050 – 222	+86 1064 719 990	+1 423 262 2522
Fax	+49 180 / 5050 – 223	+86 1064 747 474	+1 423 262 2289
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SINUMERIK 840Di sl

Search: SINUMERIK 840Di sl

Link box

The Link Box on the SINUMERIK 840Di sl page gives you direct access to all important information about the product.

Aims

This manual provides detailed information required for the configuration and commissioning of a SINUMERIK 840Di sl system.

This manual describes the control system design and the interfaces of the individual components. The commissioning procedure with SINUMERIK 840Di sl (NCK, PLC and drives) is also described.

For detailed information about individual functions, function assignment and performance data of individual components, please refer to the appropriate document for the subject concerned (e.g. manuals, function descriptions etc.).

Separate documents are available for user–oriented activities. These include, for example, generating part programs and handling controls.

Separate information is also available for operations that the machine tool manufacturer must carry–out. These include, for example, configuring/engineering, installation and programming the PLC.

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Notes on how to use this manual

The following help functions are available with this description of functions:

- Overall table of contents
- Appendix with abbreviations and references, glossary
- Index

If you require information about a certain term, please look in the Appendix for the specific Chapter Index for the particular term. Both the chapter number and the page number are listed where you will find this particular information.

Safety notes

This manual contains information which you should observe in order to ensure your own personal safety, as well to avoid material damage. Notices referring to your personal safety are highlighted in the manual by a safety alert symbol; notices referring to property damage only have no safety alert symbol. Depending on the hazard level, warnings are indicated in a descending order as follows:

If multiple levels of hazards can occur, the warning is always displayed with the highest possible level. If a warning with a warning triangle is to indicate physical injury, the same warning may also contain information about damage to property.

Danger and warning strategy

The following danger and warning signs are used in this document. Explanation of symbols used:



Danger

This symbol indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.



Warning

This symbol indicates that death, severe personal injury or substantial property damage **may** result if proper precautions are not taken.



Caution

This warning (with the triangular symbol) means that minor physical injury or damage to property **can** occur if the appropriate precautions are not taken.

Caution

This warning (without the warning triangle) means that material damage **may** result if proper precautions are not taken.

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Notice

This warning means that an undesirable result **can** occur if the information is ignored.

Further notes

Explanation of symbols

Note

The symbol always appears in this documentation where further, explanatory information is provided.



Machine Manufacturer

This pictorial symbol always appears in this document to indicate that the machine manufacturer can affect or modify the function described. Never ignore information provided by the machine manufacturer!

Danger notices

The following notices are intended firstly for your personal safety and secondly to prevent damage occurring to the products described or any connected devices and machines.



Warning

Operating electrical equipment has parts and components that are at hazardous voltage levels.

Actions by an **unqualified** device/system operator or failure to observe the warning notices may result in serious physical injury or material damage. Only suitably **qualified personnel**, trained in assembling, installing, commissioning or operating the product should work on this device/system.

Should it be necessary to test or take measurements on live equipment, then the specifications and procedures defined in Accident Prevention Regulation VBG 4.0 must be adhered to, in particular § 8 ”Permissible deviations when working on live components”. Suitable electric tools should be used.

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Warning

- Repairs to devices that have been supplied by our company must only be carried out by **SIEMENS Customer Service** or by repair centers **authorized by SIEMENS**. When replacing parts or components, only use those parts that are included in the spare parts list.
- Before opening the device, always disconnect the power supply.
- EMERGENCY STOP devices complying with EN 60204 IEC 204 (VDE 0113) must remain effective in all automation equipment modes. Resetting the EMERGENCY STOP device must not cause an uncontrolled or undefined restart.
- Anywhere in the automation equipment where faults might cause major material damage or even physical injury, in other words, where faults could be dangerous, additional external precautions must be taken, or facilities must be provided, that guarantee or enforce a safe operational state, even when there is a fault (e.g. using an independent limit value switch, mechanical interlocks etc.)



Caution

- Connecting cables and signal cables should be installed so that inductive and capacitive interference does not in any way impair the automation functions.

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ESD Notes

Electrostatically **S**ensitive **D**evices

Important

Handling of modules containing devices sensitive to electrostatic discharge:

- When handling electrostatically sensitive devices, make sure that operator, workplace and packing material are properly grounded.
- Generally, electronic modules must not be touched unless work has to be carried out on them. When handling PC boards make absolutely sure that you do not touch component pins or printed conductors.
- Touch components only if
  - you are permanently grounded by means of an antistatic chain,
  - you are wearing ESD boots or ESD boots with grounding strips in conjunction with ESD flooring.
- Modules may be placed only on electrically conductive surfaces (table with ESD top, conductive ESD foam plastic, ESD packing bags, ESD transport containers).
- Keep modules away from visual display units, monitors or TV sets (minimum distance from screen > 10 cm).
- Do not bring ESD–sensitive modules into contact with chargeable and highly–insulating materials, such as plastic sheets, insulating table tops or clothing made of synthetic materials.
- Measurements on modules are allowed only if
  - the measuring instrument is properly earthed (e.g. equipment grounding conductor), or
  - before measuring with a potential–free measuring instrument, the probe is briefly discharged (e.g. touch the unpainted metal parts of the control housing).

Qualified personnel

Setup and operation of the device/equipment/system in question must only be performed using this documentation. Only **qualified personnel** should be allowed to commission and operate the device/system. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Proper use

Please note the following:

Warning

The equipment may only be used for single purpose applications explicitly described in the catalog and in the technical description and it may only be used along with third–party devices and components recommended by Siemens. To ensure trouble–free and safe operation of the product, it must be transported, stored and installed as intended and maintained and operated with care.

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1 General Information on the SINUMERIK 840Di sl

1.1 Overview of SINUMERIK 840Di sl

With the SINUMERIK 840Di sl, Siemens can provide a complete PC-integrated control that controls the drive units and I/Os through the standard fieldbus PROFIBUS DP with Motion Control functionality and therefore permits a distributed design of the overall system. It therefore constitutes the basis for PC-based automation solutions and is generally designed especially for applications with the following requirements:

- Distributed automation solutions in the fields of PLC I/Os and drives.
- Fully PC-integrated control, owing to increased integratability in the target or current automation environment.

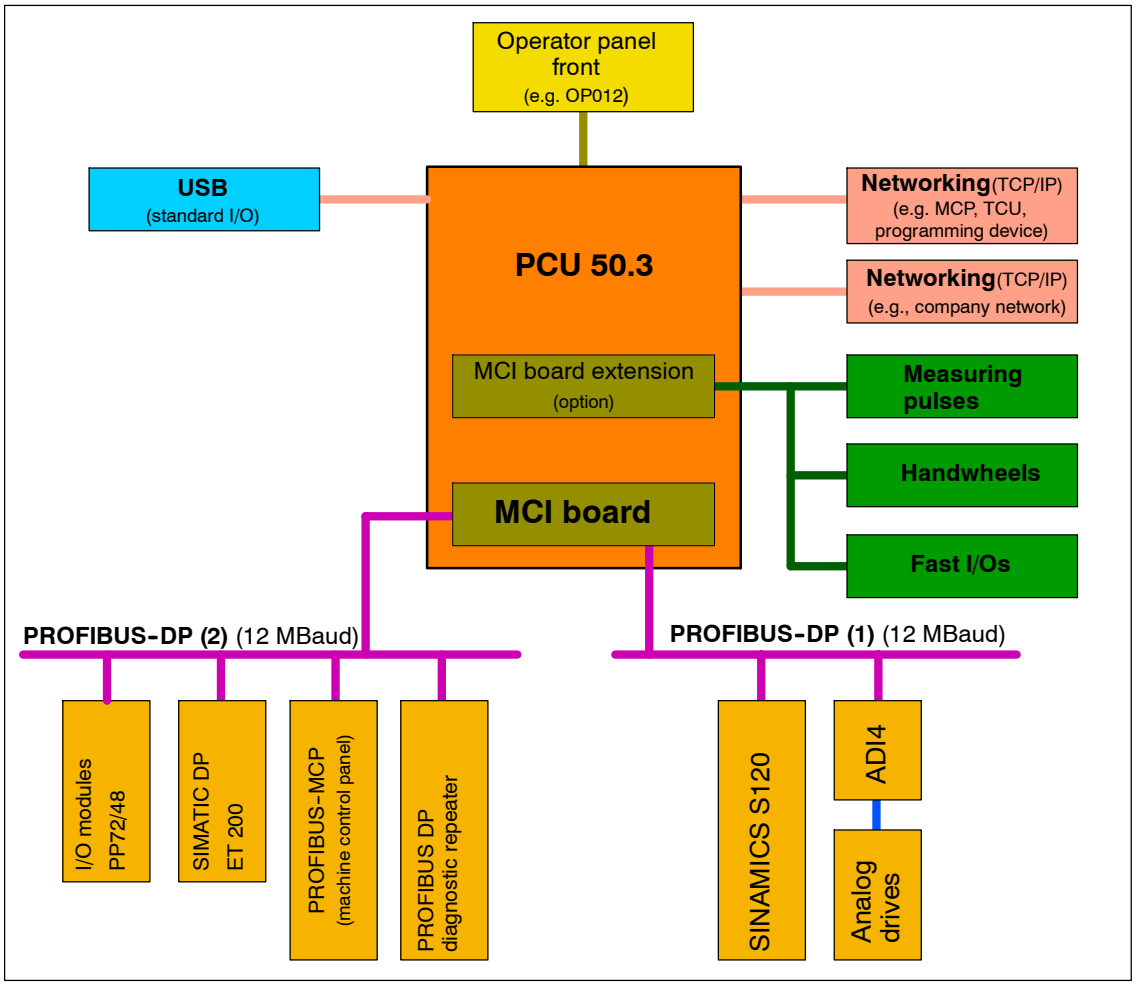


Fig. 1-1 System overview of SINUMERIK 840Di sl

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1.1.1 System components

This manual refers to the following system components:

System components	Version
SINUMERIK 840Di sl system software	SW 1.4
SINUMERIK Industrial PC	PCU 50.3–C: 1.5 GHz, 512 MB DRAM PCU 50.3–P: 2.0 GHz, 1024 MB DRAM
PC operating system	Windows XP ProEmbSys
MCI board	MCI2 board for 840Di sl

Notice

It is not possible to combine the named system components with older versions.

1.1.2 System software packages and quantity frameworks

System software packages

The following system software packages are available for SINUMERIK 840Di sl:

- 6 axes system software
- 20 axes system software

Quantity framework

The system software packages are each designed for the following quantities:

	6 axes		20 axes	
	Basic configuration	Maximum	Basic configuration	Maximum
Axes	3	6	5	20
Channels	1	2	1	10
Mode groups	1	2	1	10
Channels per mode group	1	2	1	10
Basic configuration:	Default number of available components			
Maximum:	Maximum possible number of components with additional options			

1.1.3 Hardware components

The hardware basis for the SINUMERIK 840Di sl is an industrial PC further referred to as **PCU** (PC–Unit) from Siemens A&D, in conjunction with the **MCI board** (Motion Control–Interface).

PCU

The SINUMERIK 840Di sl is available with the following PCU 50.3 versions, each with 24 V power supply:

- PCU 50.3–C: 1.5 GHz, 512 MB SDRAM
- PCU 50.3–P: 2.0 GHz, 1024 MB SDRAM

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PCU interfaces

The PCU 50.3 features interfaces to connect the SINUMERIK operator panel fronts (OP 0xx) as well as standard PC interfaces for connecting, e.g., monitor, keyboard, mouse, and Ethernet connection.

PCU slot

The PCU 50.3 has the following slots:

– 1 x PCI (length: max. 175 mm, occupied with option MCI board extension and MCI board extension slot variant)
– 1 x PCI (length: max. 265 mm, occupied by the MCI board)

MCI2 board

The MCI2 board, further referred to as the MCI board is a short PCI plug–in card with integrated SIMATIC S7 compatible CPU:

- PLC317–2 DP

as a routing–capable DP Master. The MCI board has the following external interfaces:

– PROFIBUS DP with Motion Control Functionality (Master)
– MPI (Multi–Point Interface)/PROFIBUS–DP (Master/Slave)
– MCI board extension (option)

PROFIBUS DP interface X101

This interface (X101) can be used to connect drives, distributed ext. I/Os, machine control panels, programming units, etc. via PROFIBUS DP with motion control capability (clocked and isochronous data exchange between the DP master and DP slaves) to the SINUMERIK 840Di sl. Both the PLC and the NC have direct access to this PROFIBUS interface.

PROFIBUS DP X102 interface

Unlike the PROFIBUS DP interface (X101), interface (X102) can only be accessed via the PLC. As a result, no drives and no NC I/Os can be operated via this interface.

The interface (X102) can also be operated as an MPI interface.

MCI board extension slot variation (option)

A maximum of four fast digital I/Os, two sensing probes and two handwheels each can be connected using the optional MCI board extension slot variant. Either differential or TTL handwheels can be operated.

The module is inserted into a slot in the PCU and is connected to the MCI board via a ribbon cable.

Digital drives

SINUMERIK 840Di sl is available with the components from the new SINAMICS range of drives offering the following characteristics:

– **SINAMICS S120**

The drive components from the SIMODRIVE range of drives offering the following characteristics can also be used:

– **SIMODRIVE 611 universal** and **universal E**
with option module **MotionControl with PROFIBUS DP**

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– **SIMODRIVE POSMO CD/CA**
– **SIMODRIVE POSMO SI distributed servo drive**
– **SIMODRIVE POSMO A** (not suitable for interpolatory procedures)

Note

SINAMICS S120 and SIMODRIVE drives cannot be operated in parallel on a SINUMERIK 840Di sl.

Analog drives

To operate drives with an analog setpoint interface via PROFIBUS, the following interface module is available:

– **ADI4 (Analog Drives Interface for 4 Axes).**

I/Os

For use as distributed I/Os, the module range **SIMATIC DP ET 200** (for connection conditions, see SIMATIC documentation) and the **I/O module PP 72/48** are available.

Operator panel front

You can select one of the operator panel fronts from the SINUMERIK range (**OP 010, OP 010C, OP 010S, OP 012, OP 012T, OP 015, OP 015A, TP 015A**) as an operator component.

TCU

A TCU (Thin Client Unit) permits distributed connection of an operator panel to the PCU. The TCU and PCU communicate via the Ethernet.

1.1.4 Software components

The SINUMERIK 840Di sl is based on the following software components:

Windows XP

SINUMERIK 840Di sl runs on the Windows XP ProEmbSys operating system with Service Pack 2.

Windows XP is the platform on which all applications, such as the individual user interfaces of the HMI modular system and the commissioning tools run.

As is generally known, Windows XP does not have full real–time capability. We call this soft real time. So SIEMENS has developed a procedure that allows operation of NC system software in hard real time without making it necessary to modify Windows XP (see Subsection 1.1.5, Page 1-26).

NC system software

The NC system software mostly has the same functionality as the SINUMERIK 840D. It comprises both simple Motion Control processes (positioning and linear interpolation) and complex automation tasks of the type found on machining centers, handling and mounting, machine tools, and machine tool–related applications.

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NCK

The NCK (Numerik Control Kernel) is part of the NC system software that realizes the real–time capability of the SINUMERIK 840Di sl.

The NCK is characterized by the following features:

- The NCK is automatically started when Windows powers up.
- The NCK runs cyclically in the background.
- The current status of the NCK is displayed on the SINUMERIK 840Di sl standard user interface 840Di start–up:
  Menu command **Window > Diagnostics > NC/PLC**
- The NCK is automatically ended when you exit Windows XP.
- When the NCK is ended, it writes the remanent SRAM data from NCK and PLC to the hard disk of the PCU as a backup copy.

PLC system software

The PLC system software, like the NC system software, largely has the same functionality as the SINUMERIK 840D.

SinuCom NC

SinuCom NC is a Windows–based tool for commissioning the SINUMERIK 840Di sl NC offering the possibilities for the:

- interactive parameterization of the NC
- option management and license management
- management of series startup files.

840Di start–up

The Windows–based user interface 840Di start–up (see Section 1.5, Page 1-38) offers basic operation functionality to allow the operator to become familiar with the SINUMERIK 840Di sl.

840Di start–up is part of the scope of supply of a SINUMERIK 840Di sl and is already installed on the hard disk of the PCU.

Optional HMI components

The following components of the SINUMERIK HMI modular system can be used optionally:

- **SINUMERIK HMI Advanced**
  HMI Advanced is the SINUMERIK standard user interface intended especially for machine tools.
- **SIMATIC Protool/Pro** and **Protool/Pro option SINUMERIK**
  SIMATIC Protool/Pro and Protool/Pro Option SINUMERIK are configuring packages for creating technology–specific user interfaces.

  The ProTool/Pro runtime system is required to run a configured user interface.
- **SINUMERIK HMI Programming Package**
  The HMI Programming Package can be used to integrate OEM high–level language applications using standardized interfaces (COM/OPC). The OEM obtains as much flexibility as possible for developing user interfaces using standard development tools (such as Visual C++).

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The HMI Programming Package basically contains interface descriptions and corresponding example applications. Detailed information on the OPC interface can be called from the Internet at the address of OPC Foundation (http://www.opcfoundation.org.).

Note

For a detailed list of the installed software components or the ones required to prepare for installation, please refer to Section 1.2, Page 1-33.

1.1.5 Real–time properties

Windows XP is not an operating system designed for hard real–time requirements. Hard real–time requirements mean the operating system will respond to an external event within a defined time frame of a few μseconds.

The NC system software is therefore integrated into Windows XP as a ”Kernel mode driver”. This means it has its own integrated real–time system that runs concurrently with Windows XP to ensure the conditions for real–time processing are met.

Real–time violations

Real–time violations occur when unsuitable PC components block interrupt processing for too long, stopping the NC system software from being activated at the specified time.

Inappropriate PC components are drivers or hardware extensions that have an adverse effect on the real–time behavior due to overly long interrupt disable times or PCI bus disables in PCI bus mastering.

With real–time violations exceeding 200 μs, we cannot guarantee that the NC system software will operate correctly. The system will respond appropriately for the magnitude of the real–time violation:

- Display of an error message
- Alarm with axis stop from the NC
- Alarm and drive–independent axis stop.

The real–time response can be monitored in the NCK latency displays in the system diagnostics of the 840Di Start–up (see Subsection 1.5, Page 1-38) or the NC/PLC diagnostics of HMI Advanced (see Subsection 11.11, Page 11-406).

Screen resolution and depth of color

The following points must be taken into account for screen resolution and depth of color settings on the PCU.

- Screen resolution
  The standard screen resolution setting depends on the optimized value that was set for the operator panel. This value was defined for technical reasons and should be adhered to.

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- Color depth
  The default color depth setting is 65536 colors. Higher values can, in certain circumstances, increase the CPU time used by Windows XP and occasionally also by the real–time operating system.

Testing or switching over

If it is necessary to test the screen resolution or switch to a different resolution and/or color depth, the NCK must be terminated first. Otherwise a malfunction may occur in the real–time response.

Notice

Screen savers that modify the screen resolution when activated must not be used in conjunction with SINUMERIK 840Di sl.

Terminating the NCK

The NCK is integrated in Windows XP as a ”SINUMERIK–NC” service.
This service must be started and stopped manually in the service dialog box.

Windows Start menu: **Start > Programs > Administrative Tools > Services > ”SINUMERIK–NC”**



Warning

The NCK must be stopped before testing/switching the screen resolution and/or color depth on the PCU and started again explicitly after testing/switching using the Windows XP service ”SINUMERIK–NC”. Otherwise a malfunction may occur in the real–time response.

1.1.6 System integrity

To offer high quality and wide functionality of the entire system, SINUMERIK 840Di sl comes completely configured and ready to operate.

For this purpose, the system components used are subject to a certification procedure with Siemens as the system manufacturer. This is to certify and document compliance with real–time capability of the whole configuration.

If PC components (hardware or software) are modified or expanded by a third party, compliance with product features cannot be guaranteed. These are the sole responsibility of the OEMs or the user who has made the modifications.

The effect of the changes to the system software can be read on the user interface of the ”840Di Startup” or ”HMI Advanced” commissioning tool (see Section 11.11.1, Page 11-406). It graphically displays whether the installed hardware or software violates the real–time conditions.

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1.1.7 Failure safety

Fatal exception error (blue screen)

If Windows XP detects a fatal exception error during the operation of the NC system software, the following steps are taken:

- Windows XP stops.
- An error message appears on screen.
- NC and PLC continues to operate normally.
- The NC signals the fatal exception error detected to the PLC via the ”PC OS fault” interface signal.

Depending on the current machining situation, the PLC user program can either continue or step machining.

After completion of machining, the PLC user program can request a shutdown of the PC by sending the ”PC shutdown” interface signal.

The ”PC shutdown” interface signal causes the following actions:

– Retentive NC and PLC data are stored

– NC and PLC are closed down

– The Windows XP ”Blue Screen” is displayed

– (Optional) The PCU reboots
The behavior of Windows XP in the event of a fatal exception error (Blue Screen) can be configured via the Control Panel: Windows Start menu: **Start > Settings > Control Panel > System**

Note

For a brief description of the ”PC OS fault” and ”PC shutdown” interface signals, please refer to Subsection 18.1.1, Page 18-499.

Notice

The ”PC shutdown” interface signal must be reset in the organization block OB100 (cold restart) of the PLC.

Power failure

A power failure lasting more than 5 ms is detected by the POWER FAIL functionality of the SINUMERIK 840Di sl as a fault scenario and the following actions are initiated:

– The background lighting of the operator panel display is switched off

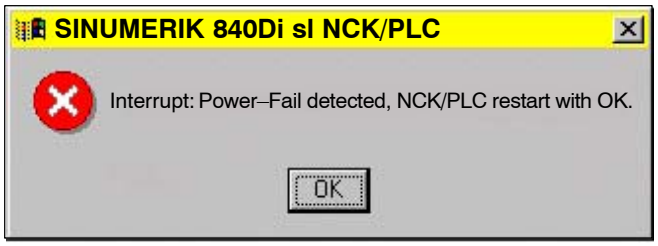
– NC and PLC are closed down properly

– The NC and PLC user data are saved in the SRAM of the MCI board.

The battery–backed user data are available again immediately the next time the SINUMERIK 840Di sl is booted. The SINUMERIK 840Di sl is therefore ready to use again immediately, without data loss.

If the power supply recovers before final PCU shutdown, the following message box is displayed:

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Notice

1. **Supply voltage**
   A supply voltage of the PCU of at least 24 V is required to ensure consistency of the NC and PLC user data.

   References /BH/ Operator Components, Manual
   Chapter: PCU 50.3
2. **UPS system**
   The internal power backup time after a power failure is not long enough for Windows NT to shut down correctly. To remedy this, we recommend using an uninterruptible power system (see Subsection 1.1.9, Page 1-31).
3. **Replacing the MCI board or PCU battery**
   When Windows XP is shut down correctly, the current NCK and PLC user data are saved to the SRAM of the MCI board and to the PCU's hard disk. If the MCI board or PCU battery is replaced after a power failure, this will result in a data loss of the battery–backed user data on the SRAM of the MCI board. How to proceed further: see Subsection 5.3.3, Page 5-112.

Temperature monitor

The SINUMERIK 840Di sl monitors three different temperatures for their respective thresholds:

1. Housing temperature
2. CPU module temperature
3. CPU temperature

Error response

- Interrupt: "2110 NCK temperature alarm"
- Logbook entry: "Alarm: Critical temperature"

Cause of errors/error handling

One of the 3 monitored temperatures has reached or exceeded its threshold value. A temperature change of at least 3°C below the threshold is required for the alarm to reset.

If the temperature alarm occurs, the user and/or the machine manufacturer (PLC user program) must decide whether to interrupt machining and end and shut down the SINUMERIK 840Di sl.

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1.1.8 Deactivation

Windows XP

To ensure safe operation of the SINUMERIK 840Di sl, Windows XP must be shut down correctly before the PCU is switched off.

Note

Windows XP is shut down correctly as follows.

- Windows XP start bar: **Start > Shutdown**
- PLC interface signal: ”PC shutdown”, see Subsection 18.1.1, Page 18-499

Failure to shut down Windows XP correctly can damage the Windows XP installation and prevent the SINUMERIK 840Di sl from operating.

NC and PLC

On correct shutdown of Windows XP the following occurs:

- The SINUMERIK 840Di sl components NC and PLC are terminated correctly
- The NC and PLC user data in the SRAM of the MCI board and on the hard disk of the PCU are backed up.

If the PCU is switched off without first correctly shutting down Windows XP, the SINUMERIK 840Di sl’s POWER FAIL functionality:

- ends the NC and PLC correctly;
- saves the NC and PLC user data in the SRAM of the MCI board.

The NC and PLC user data cannot be backed up on the hard disk of the PCU.

Notice

If you switch off the PCU without first having correctly shut down Windows XP, please observe the following:

1. **Supply voltage**
   A supply voltage of the PCU of at least 24 V is required to ensure consistency of the NC and PLC user data.

   References /BH/ Operator Components, Manual
   Chapter: PCU 50.3
2. **UPS system**
   The internal power backup time after switch–off is not long enough for Windows NT to shut down correctly. To remedy this, we recommend using an uninterruptible power system (see Subsection 1.1.9, Page 1-31).
3. **Replacing the MCI board or PCU battery**
   When Windows XP is shut down correctly, the current NCK and PLC user data are saved to the SRAM of the MCI board and to the PCU’s hard disk. If the MCI board or the PCU battery is replaced after the abnormal shutdown of Windows XP, this will result in loss of the battery–backed user data on the SRAM of the MCI board. How to proceed further: see Subsection 5.3.3, Page 5-112.

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1.1.9 UPS system

Physical SRAM

The PCU features POWER FAIL detection that, in conjunction with the NC system software, ensures that the user data are backed up in the SRAM of the MCI board on a PCU power failure or power–off without Windows XP first having been shut down correctly.

The internal power backup time is not long enough for Windows XP to shut down correctly.

This can be avoided by using a UPS, e.g. SITOP POWER DC UPS MODULE 15 (see Section 2.10, Page 2-76). The UPS also backs up the power supply of the PCU for a settable duration or until a set battery voltage limit has been reached.

This gives the user time to correctly shut down Windows XP manually, or permits automatic shutdown via a status signal from the UPS to the PLC, which then passes the ”PC shutdown” interface signal to the NC.

Connection options

The above UPS has the following connection options to signal the current status to the SINUMERIK 840Di sl:

Table 1-1 Connection options of the UPS system

Terminal	Signal to	Comment
1) UPS –> PCU: USB connection	Windows XP	The UPS functionality is configured: see Configuration below. Advantage: also works when the PLC user program is not active. Disadvantage: does not work in the event of serious exceptions from Windows XP (BlueScreen)
2) Signal terminals via free interconnection –> S7 I/O inputs	PLC	The UPS functionality is configured using the PLC user program. Advantage: also works in the event of a fatal exception error of Windows XP (BlueScreen) Disadvantage: PLC user program must be active
3) Signal terminals via free interconnection –> MCI board extension inputs	NC	The UPS functionality is configured using menu: Settings in HMI Advanced (see Subsection 11.11.2, Page 11-410). Advantage: also works in the event of a fatal exception error of Windows XP (BlueScreen) and when the PLC user program is not active. Requirement: MCI board extension (option)
Note re 3) For information on the boot response of the SINUMERIK 840Di sl with pending shutdown signal, see Subsection 5.3.8, Page 5-116.		

Notice

One of the following connection variants must be used for full back–up protection:

- Variant 1: Connection **1)** and **2)**
- Variant 2: Connection **3)**

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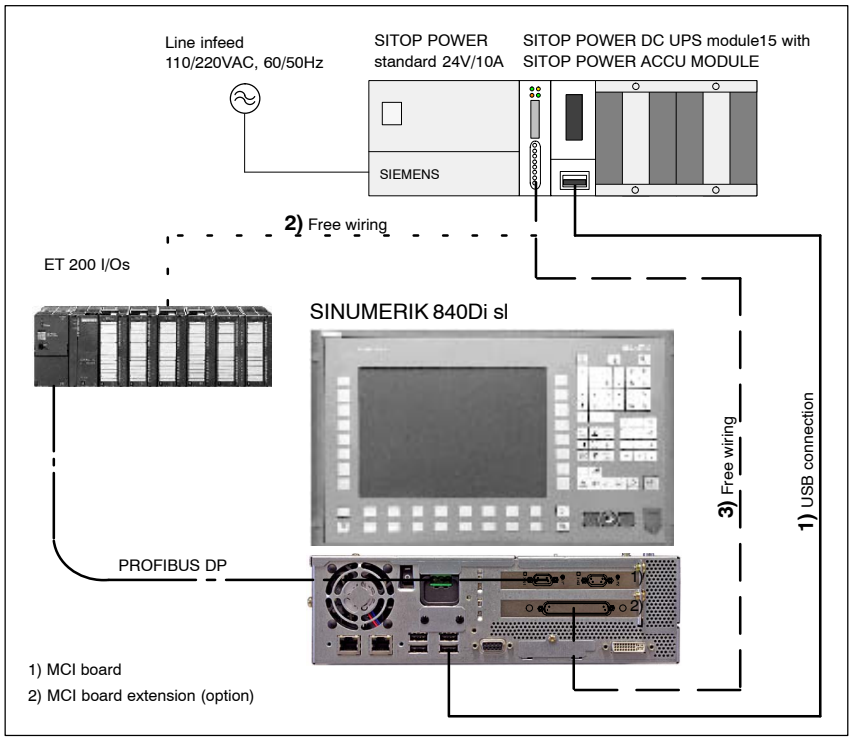


Fig. 1-2 Possible connections: UPS

Configuration

The UPS functionality can be configured in two ways:

- When using SITOP POWER DC UPS MODULE 15 (see Subsection 2.10, Page 2-76) with a special software tool.

  Download: **http://www.siemens.de/sitop > Further topics: Download Software DC UPS 15 A**

- With Windows XP standard tools.

  Start bar: **Start > Settings > Control Panel > Power Options > tab card: UPS**

Notice

If the SINUMERIK user interface HMI Advanced (option) is installed on the PCU, the following application must be executed with the UPS software: F:\mmc2**hmiexit.exe** to end HMI Advanced before the PCU is shut down.

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1.2 Overview of software components

The software components listed below are part of the SINUMERIK 840Di sl system software. The first time the PCU is booted, all the software components required to operate the SINUMERIK 840Di sl are automatically installed. Other software components including engineering tools or SIMATIC S7 add–on software are also available for installation on the PCU or an external computer.

Note

See Section 5.4.7, Page 5-121 for information on how to determine the installation path of the SINUMERIK 840Di sl system software (CD path).

Before installing a software component, please read the information (*.txt, *.rtf, *.wri) for each application.

Basic software

The basic software essentially comprises the following components:

- **840Di sl basic software** *(installed)*
  - NCK–specific real–time drivers
  - 840Di start–up
- **PLC system software** *(installed)*
- **NCK system software** *(installed)*
- **PCU basic software** *(installed)*
  - Windows XP Pro with SP2, English version
  - Internet Explorer 6, English version
  - HMI Explorer
  - MPI driver
  - Norton Ghost™
  - Norton GhostWalker™
  - ServiceCenter under Windows PE
  - PCU–specific drivers
  - TCU Support
- **HMI basic software** *(installed)*
  - HMI–specific display and communications drivers

Engineering Tools

The Engineering Tools include applications for the commissioning of the SINUMERIK 840Di sl NC and SIMODRIVE drives:

- **SinuCom NC** *(installed)*
  Commissioning tool for SINUMERIK 840Di sl NC
- **SIMODRIVE 611 universal tool box**
  Contents:
  - PLC Parameterization Toolbox
    Various files for assigning parameters to an S7 configuration with SIMODRIVE drives (611U, POSMO SI, CD, CA) and PROFIdrive communication (see readme.txt)
    (example files: <CD path>\611utb\toolbox\<version>\<file>)

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- SimoCom U
  Commissioning tool for SIMODRIVE 611 universal/E and SIMODRIVE POSMO SI, CD/CA drives
  (installed and for installation: <CD path>\611utb\SimoComU\Setup.exe)
- SIMODRIVE 611 universal drive firmware
  (firmware file: <CD path>\611utb\Sys611U\<version>\611u.ufw)
- SIMODRIVE 611 universal option module: ”Motion Control with PROFIBUS DP” firmware
  (firmware file: <CD path>\611utb\dpc31\<version>\v1sl.ufw)
- SIMODRIVE POSMO SI, CD/CA drive firmware
  (firmware file: <CD path>\611utb\SysPosmo\<version>\posmo.ufw)

Note

SINAMICS drives
The commissioning tool: STARTER is not included in the SINUMERIK 840Di scope of supply. The STARTER must be purchased separately.

References:
Catalog: NC 61 > SINAMICS S120 Drive System

SIMATIC S7 add–on software

The SIMATIC S7 add–on software contains sample programs and applications:

- **PLC Toolbox**
  The PLC Toolbox contains the following components:
  - PLC basic program
  - SINUMERIK Add–On for STEP 7
    e.g. SlaveOM for SINUMERIK 840Di sl, GSD file for PROFIBUS MCP
  - NC variable selector
  - PLC Symbol generator

  (installation software: <CD path>\installs\add_on\plc_tb\setup.exe)
- **GSD file** for **I/O modules PP72/48**
  Device master file with the required information in ASCII format required for integration of the I/O module PP72/48 into a SIMATIC project as DP slave.
  (DMF file: <CD path>\support\siem80a2.gsd)
- **PLC application example**
  Sample application of a SIMATIC S7 project for SINUMERIK 840Di sl with PROFIBUS machine control panel MCP 483 or MCP 310.
  (ZIP file: <CD path>\support\840dismp\840disl_smpl.zip)
  (archive file: <CD path>\support\840dismp\840disl_smpl.arc)

Note

The PLC Toolbox should be installed on the PG/PC on which the SIMATIC STEP 7 is already installed.

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1.3 Notes on commissioning

This SINUMERIK 840Di sl Manual describes the basic commissioning of the following components:

- SINUMERIK 840Di sl NC and PLC
- SINAMICS S120 drives
- Ethernet communication
- PROFIBUS DP and DP components

Notice

We recommend performing commissioning of the SINUMERIK 840Di sl according to the sequence in which the chapters of this manual are laid out.

Software

To commissioning the SINUMERIK 840Di sl, the following software is required (part of a SINUMERIK 840Di sl):

- NCK commissioning:
  - **840Di start–up**
  - **SinuCom NC**
- PLC commissioning, including MPI and PROFIBUS communication:
  - **SlaveOM** for SIMODRIVE drives
  - **PLC basic program**
- SIMODRIVE drive commissioning
  - **SimoCom U**

Additional software

To commissioning the SINUMERIK 840Di sl, the following software is needed (**not** part of a SINUMERIK 840Di sl):

- PLC commissioning, including MPI and PROFIBUS DP communication:
  - **SIMATIC Manager STEP 7**: as from Version 5.3, Service Pack 2
  - **SlaveOM** for SINAMICS drives (part of STARTER)
- SINAMICS drive commissioning
  - **STARTER**

Additional hardware

The following hardware components are required for commissioning:

- a programming device with MPI/PROFIBUS interface, e.g., PG740:
  - Creation of the SIMATIC S7 project for commissioning of the PLC, as well as the MPI and PROFIBUS communication

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  - Installation of additional software on the PCU
    To install software on the PCU see Chapter 17, Page 17-477.
- Communications link: PG/PC with NC, PLC and drives
  - Ethernet cable
  - MPI/PROFIBUS cable

Note

No programming device is required in the following cases:

- SIMATIC Manager STEP7 is installed on the SINUMERIK 840Di sl PCU
- A PG/PC is used to install additional software
  To install software on the PCU, see Section 17, Page 16-467.

Documentation

The following documentation is required for commissioning:

- /BH/ Operator Components Manual
  - Operator panel fronts
  - PCU 50.3
  - Machine control panels
  - Operator panel, handheld terminal HT8

Depending on the NC and PLC functions used, the relevant Descriptions of Functions:

- /FB/ Description of Functions – Basic Functions
- /FB/ Description of Functions – Extended Functions
- /FB/ Description of Functions – Special Functions
- /LIS/ Lists
  - Overview of the functions
  - Machine, Setting Data and Variables
  - Interface Signals and PLC Blocks.
- /DA/ Diagnostics Guide, Contents:
  - Alarms

Drive commissioning:

- SINAMICS
  - SINAMICS S120 Commissioning Manual
- SIMODRIVE
  - /FBU/SIMODRIVE 611 universal and universal E
    Closed–Loop Control Components for Speed Control and Positioning
  - /POS3/SIMODRIVE SI and CD/CA
    Distributed Servo Drive Systems

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1.4 Standard/export version

Export license requirement

Because certain control functions require an export license in accordance with the German Export List, the SINUMERIK 840Di sl is available in two versions.

The **standard** version **SINUMERIK 840Di sl** can contain the **full** scope of functions of the control but this does mean that it requires export approval with regard to its **type**.

In the **export** version **SINUMERIK 840DiE sl**, e.g. the following options are not available:

- Interpolation with more than 4 axes
- Machining package 5 axes
- Helical interpolation 2D + n (n greater than 2)
- OEM package

The following restrictions apply to options that can be used:

- Sag compensation: limited to traversing a maximum distance of 10 mm.

Note

A complete overview of options not available on the **export** version are listed in: Catalog NC 61

The corresponding option bits can be set but they have no effect (alarm output if functions programmed). The export version requires no export license with respect to its **type**.

(This does not mean that there is not export license requirement with respect to the **intended use**. This is a separate matter and may apply in addition.)

The characteristics of the control are defined by the system software which is available in two versions (standard and export). This means that the export license requirement of the system software (for details see delivery note or invoice) is passed on to the control system on which it is installed.

It is important to be aware of this in the case of updates/upgrades of the system software because this might affect the export license requirement.

Identification of the control

In addition to the information provided on the delivery note and invoice, the hardware components supplied with the system software are also clearly identified by adhesive labels as standard or export versions.

Note

The adhesive labels supplied additionally in the packaging are intended to identify the control after commissioning and must be pasted into the control log book. In the case of license orders, a corresponding number of labels is provided, which must also be pasted into the log book.

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When the control has booted, the export version can be identified by the additional character 'E' on the Service screen of the NCU version.

- HMI Advanced (option): Diagnosis operating area > Service displays > Version > Version NCU

Identification of control variants in this way is important for service personnel and can also be helpful as evidence on export, especially when using the embargo–exempt certificates provided for the export version.

1.5 840Di start–up

The user interface 840Di start–up included in the scope of supply of the SINUMERIK 840Di sl is intended as an initial introduction to SINUMERIK 840Di sl functionality.

Overview of the functions

The user interface comprises the following functions:

- Display of main screens
- Display of alarms and messages
- Management of part programs
- ASCII editor
- NC, PLC, and PROFIBUS diagnoses
- Logbook

Menu bar

The menu bar comprises the following menu commands:

- File
- Edit
- Window
- Display

Context–sensitive menu functions

The functions that can be called using the menu commands **File** and **Edit** are context–sensitive, i.e. only those functions are offered that are possible in the context of the currently active window.

Example:

- The part program management window is selected. The menu command **Edit** provides the following functions:
  - Copy
  - Paste
  - Paste ...
  - Load
  - Unload
- The window for display of the axis actual values is selected. The menu command **Edit** provides no further functions.

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1.5.1 Menu command: Window

The menu command **Window** provides the following functions:

Menu command	Functionality
Window	
Main screen	
General data	Display of: - Channel status - Program status
Axis actual values	Display of: - Axis names - Axis positions in the selected coordinate system - Distance-to-go - Feedrate - Override Switchover of the position display between: - MCS - WCS
Current block display	Display of: - Part programs and up to 3 blocks
Program control	Selection of: - Machine function SBL1 - SBL2 after each block - PRogram Test
G functions/H functions	Display of: - Current G functions - Current H functions
Program pointer	Display of: - Program name of the selected part program - Number of passes P - Block number - Program levels: Main program and 3 subroutine levels
Alarm	Display of current alarms and messages
Alarm log	Display of all alarms and messages in chronological order

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Menu command	Functionality
Part programs	• Management of part programs Menu command **File** - New ... - Open - Delete - Exit Menu command **Edit** - Copy - Paste - Load - Unload - Select • Editing part programs: - Menu command **File > Open** - **Double-click** the file with the left mouse button
Editor	Editing files Start the editor with: - Menu command **File > Open** - **Double-click** the file with the left mouse button Menu command **File** - Open - Close - Cut - Exit Menu command **Edit** - Copy - Paste - Load - Unload - Select
Diagnostics	
PROFIBUS	
Bus	Display of bus configuration: - Baud rate - Cycle time - Synchr. portion (T_{DX}) Display of status: - Configuration - Bus status
Slaves	Display of: - Slave no. (DP address) - Assignment - Active on the bus - Synchr. with NC - Number of slots - Details

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Menu command	Functionality
NC/PLC	• NC - Display of NC status - ”NC Reset” - ”Clear NC memory” • PLC - Display of PLC status - ”RUN-P” - ”RUN” - ”STOP” - ”MRES” • Latency display - Current value - Maximum value - Number of violations - Oscilloscope
Logbook	Display of SINUMERIK 840Di sl system messages

■

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Space for your notes

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Hardware Descriptions

2

2.1 Overview of hardware components

SINUMERIK 840Di sl: Hardware

A SINUMERIK 840Di sl can only be ordered as a complete system (PCU and MCI board).

- **SINUMERIK 840Di sl**
  PCU 50.3–**C** 1.5 GHz/512 MB and MCI2 board,
  40 GB hard disk and Windows XP ProEmbSys
  24 V power supply
  Order number: 6FC5 220–0AA31–2AA0
- **SINUMERIK 840Di sl**
  PCU 50.3–**P** 2.0 GHz/1024 MB and MCI2 board,
  40 GB hard disk and Windows XP ProEmbSys
  24 V power supply
  Order number: 6FC5 220–0AA33–2AA0

Spare parts

The following hardware components are available as spare parts:

- **MCI2 board** for SINUMERIK 840Di sl
  Spare parts order number: 6FC5 222–0AA02–2AA0
- Hard disk
  for PCU 50.3 with mounting plate and damping elements
  Spare parts order number: 6FC5 247–0AF08–4AA0

Optional components

The following hardware components are optional and can be ordered separately:

MCI board extension

- SINUMERIK 840Di sl **MCI board extension slot variant**
  Order number: 6FC5 222–0AA00–0AA1

Operation and display

- SINUMERIK operator panel fronts
  - **OP 010**
    Order number: 6FC5 203–0AF00–0AA1
  - **OP 010C**
    Order number: 6FC5 203–0AF01–0AA0
  - **OP 010S**
    Order number: 6FC5 203–0AF04–0AA0
  - **OP 012**
    Order number: 6FC5 203–0AF02–0AA1
  - **OP 012T**
    Order number: 6FC5203–0AF06–1AA0
  - **TP 012**
    Order number: 6FC5203–0AF07–0AA0

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- **OP 015**
  Order number: 6FC5 203-0AF03-0AA0
- **TP 015A**
  Order number: 6FC5203-0AF08-0AA0

- Components for distributed connection of SINUMERIK operator panel fronts
  - **TCU (Thin Client Unit)**
    Order number: 6FC5 312-0DA00-0AA0

External storage media

- **USB disk drive 3.5"** incl.1m connecting cable
  Order number: 6FC5 235-0AA05-1AA2

Power supply of the PCU

- **SITOP POWER standard 24V/10A**
  Order number: 6EP1 334-1SH01

Uninterruptible power supply (UPS)

- **SITOP POWER DC UPS module 15**
  Order number: 6EP1 931-2EC31
- **SITOP POWER ACCU MODULE 24VDC/10A/3.2AH**
  Order number: 6EP1 935-6MD11

PROFIBUS DP modules

S7 I/O modules

- **SIMATIC ET 200 (**distributed I/O system)
  for detailed order information see:

  References: /ST7/ SIMATIC S7 programmable logic controllers
  Catalog ST 70
- **I/O module PP72/48**
  Order number: 6FC5 611-0CA01-0AA0

Interface modules

- **ADI4** (Analog Drive Interface for 4 Axes)
  Order number: 6FC5 211-0BA01-0AA2

SINAMICS drives

- **SINAMICS S120**

For detailed order information on the SINAMICS S120, please refer to:

References: /BU/ SINAMICS
SINAMICS S120
Servo Control Drive System
Catalog D21.2

Drives: SIMODRIVE

- **SIMODRIVE 611 universal**
  with optional module **MotionControl with PROFIBUS DP**
- **SIMODRIVE 611 universal E**
  with option module **MotionControl with PROFIBUS DP**
- **SIMODRIVE POSMO CD/CA**

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- **SIMODRIVE POSMO SI distributed servo drive**
- **SIMODRIVE POSMO A**

For detailed ordering information on various drives, see:

References: /BU/ SINUMERIK & SIMODRIVE
Ordering Information
Catalog NC 60

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2.2 MCI2 board for 840Di sl

2.2.1 Module

The MC12 board for 840Di sl is a short 32–bit PCI plug&play card. The MCI2 board referred to below simply as MCI board (Motion Control Interface) provides the following interfaces:

- PROFIBUS DP with Motion Control Functionality (X101)
- MPI (Multi–Point Interface) or PROFIBUS DP without Motion Control Functionality (X102) (alternative)
- MCI board extension (slot variation: Section 2.3, Page 2-53)

The MCI board also provides the following functionality:

- PLC: Compatible with SIMATIC S7 CPU 317–2 DP
- Static memory (SRAM) for storing retentive NCK and PLC–specific user data.

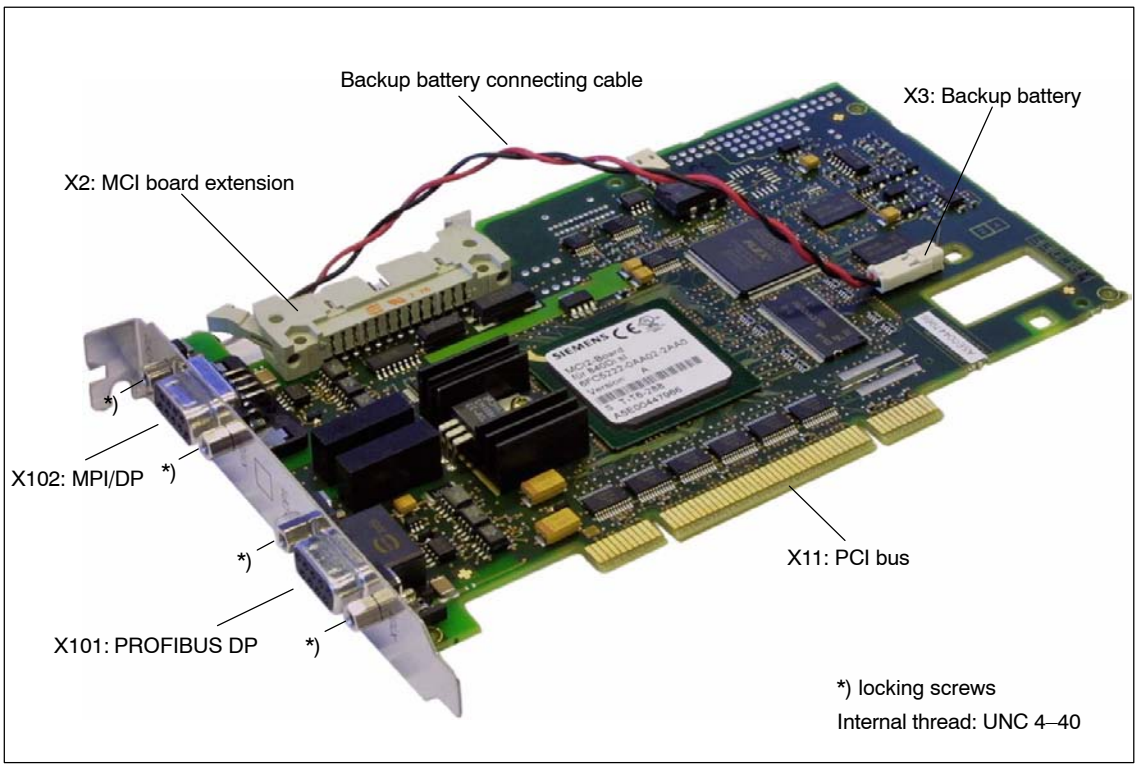


Fig. 2-1 Module: MCI2 board for 840Di sl

Order number: MCI2 board

Designation	Order No. (MLFB)
MCI2 board for 840Di sl (as spare part)	6FC5 222–0AA02–2AA0

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Order no.:
Bus connector

Designation	Order No. (MLFB)
Bus connector RS–485 for PROFIBUS DP and MPI	
180° cable outlet	6GK1 500–0EA02
35° cable outlet, without PG connection socket	6ES7 972–0BA40–0XA0
35° cable outlet, with PG connection socket	6ES7 972–0BB40–0XA0
90° cable outlet, without PG connection socket	6ES7 972–0BA11–0XA0
90° cable outlet, with PG connection socket	6ES7 972–0BB11–0XA0

2.2.2 Interface description

Interface overview

Interfaces of the MCI board module

Table 2-1 Interface overview: MCI board

Interface	Designation	Type
PROFIBUS DP	X101	Socket
MPI/DP	X102	Socket
MCI board extension	X2	Plug connector
Buffer voltage	X3	Plug connector
PCI bus	X11	Direct connector
LED 1	DP1	LEDs
LED 2	DP2	LEDs

PROFIBUS DP interface (X101)

Interface description PROFIBUS DP interface (X101):

- Connection: 9–pin SUB–D socket connector
- Pin assignment

Table 2-2 Pin assignment: PROFIBUS DP interface (X101)

Pin	Designation	Type[1)]	Function
1	Not assigned	–	–
2	Not assigned	–	–
3	RS–DP	B	RS 485 differential signals
4	RTS	O	Request to Send
5	GNDext	VO	External ground [2)]
6	P5ext	VO	Ext. 5V power supply [2)]
7	Not assigned	–	–
8	XRS DP	B	RS 485 differential signals
9	Not assigned	–	–

1) VO Voltage Output
O Output
B Bidirectional
2) Pin 5 and 6 can only be used to supply the bus termination resistances

- Connecting cable: See Section 3.3.2, Page 3-103

MPI/DP interface (X102)

Interface description MPI/DP interface (X102):

- Connection: 9–pin SUB–D socket connector
- Pin assignment

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Table 2-3 Pin assignment: MPI interface (X102)

Pin	Designation	Type[1)]	Function
1	Not assigned	–	–
2	Not assigned	–	–
3	RS–MPI/DP	B	RS 485 differential signals
4	RTS	O	Request to Send
5	GNDext	VO	External ground [2)]
6	P5ext	VO	Ext. 5V power supply [2)]
7	Not assigned	–	–
8	XRS–MPI/DP	B	RS 485 differential signals
9	Not assigned	–	–

1) VO Voltage Output
O Output
B Bidirectional
2) Pin 5 and 6 can only be used to supply the bus termination resistances

- Connecting cable: See Section 3.3.2, Page 3-103

Notice

The PROFIBUS DP (X101) and MPI/DP bus (X102) interfaces are isolated both from one another and from the PCU.

Backup voltage connection (X3)

Interface description of the backup voltage connection (X3):

- Connection: 2–pin plug connector
- Pin assignment

Table 2-4 Pin assignment: Backup voltage connection (X3)

Pin	Designation	Type[1)]	Function
1	BATT–	VI	Backup voltage minus
2	BATT+	VI	Backup voltage plus

1) VI Voltage input

Diagnostic LEDs (DP1/DP2)

The diagnostics LEDs ”DP 1” und ”DP 2” are only used to display the internal status of the MCI board. A diagnosis with regard to the PROFIBUS DP communication of the interfaces is not possible via the LEDs.

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2.2.3 Module replacement

License key

If the MCI board is to be inserted as a replacement (either only the MCI board or together with the PCU), you will need a new license key.

Consult the central hotline. You will need the:

- HW series number of the old MCI board
- HW series number of the new MCI board

The HW series number of the MCI board is to be found on the rating plate of the module (see Fig. 2-2).

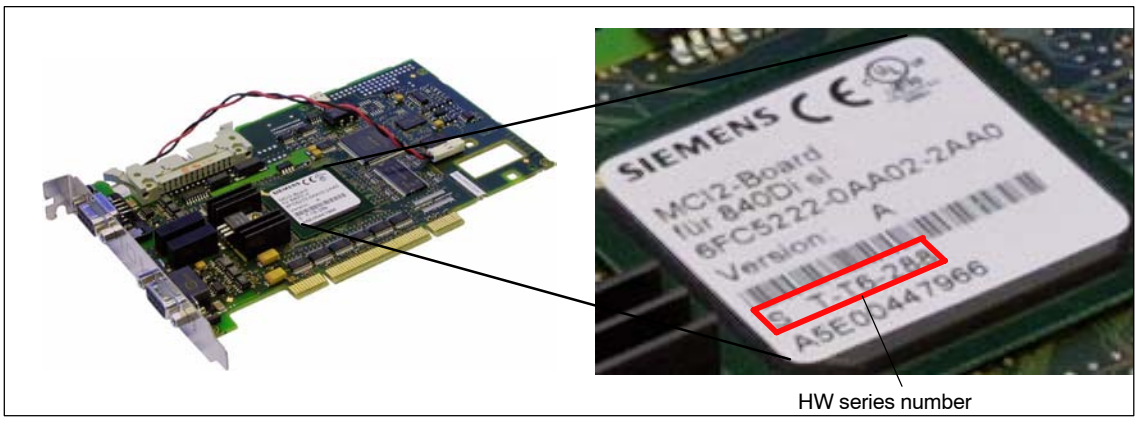


Fig. 2-2 MCI2 board: HW series number

For instructions on how to enter the license key, see Subsection 5.7, Page 5-127.

Note

If the MCI board is to be inserted as a replacement (either only the MCI board or together with the PCU), you will need a new license key.

Warning

Operating electrical equipment has parts and components that are at hazardous voltage levels.

Failure to properly maintain the equipment can result in death, serious bodily injury or substantial material damage.

When servicing these devices, you should therefore observe all notices provided in this section and attached to the product itself.

- This device may only be serviced by appropriately qualified personnel.
- Before starting any maintenance and service work, disconnect the device from power supply.
- Use authorized spare parts only.
- Strictly observe the prescribed maintenance intervals, as well as the instructions for repair and replacement.

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Notice

The module contains electrostatically sensitive devices.

Electrostatically discharge your own body before touching the module. The simplest way of doing this is to touch an electrically conductive grounded object (e.g. a bare metal part of a cabinet or a power receptacle ground conductor).

Execution

To change the module, proceed as follows:

1. Check that there is a suitable series startup file (NCK and PLC) available before removing the module.

   For information on how to create a series startup file, please refer to Chapter 15, Page 15-459.

2. Shut down the SINUMERIK 840Di sl and Windows XP correctly.
   Use one of the following methods to do this:
   - Windows XP taskbar: Start > Shut Down
   - Interface signal: ”PC shutdown”, see Section 18.1.1, Page 18-499
3. Disconnect your PC from power supply.
4. Remove the screws from the cover of the housing (Fig. 2-3) and open the housing of your PC, observing the relevant safety regulations.

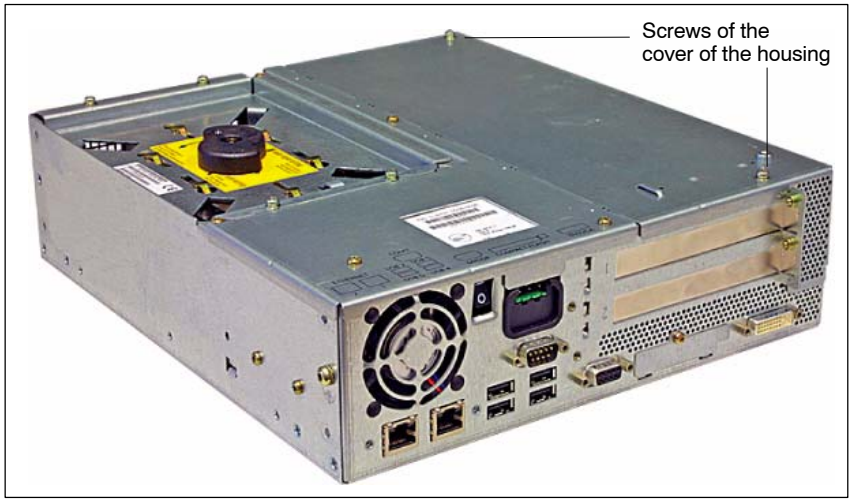


Fig. 2-3 Cover of the housing of the PCU 50.3

5. Optional:
   Remove interconnecting cable to the MCI board extension module, interface X2.
6. Remove the fastening screw (Fig. 2-4) and remove the module holding–down device.

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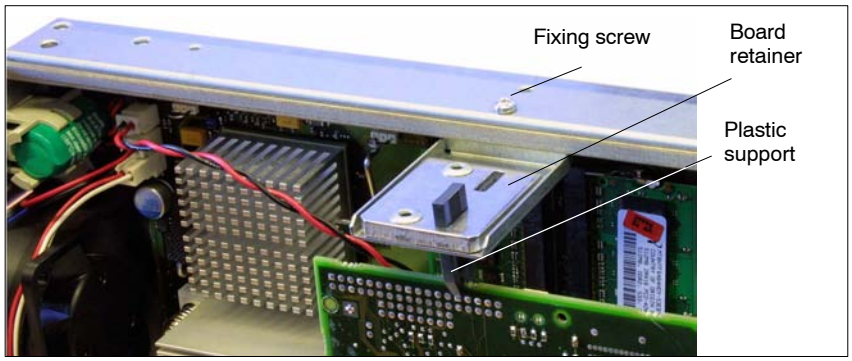


Fig. 2-4 Mounting of the module

7. Remove the cable connection X3 (backup battery) from the module.

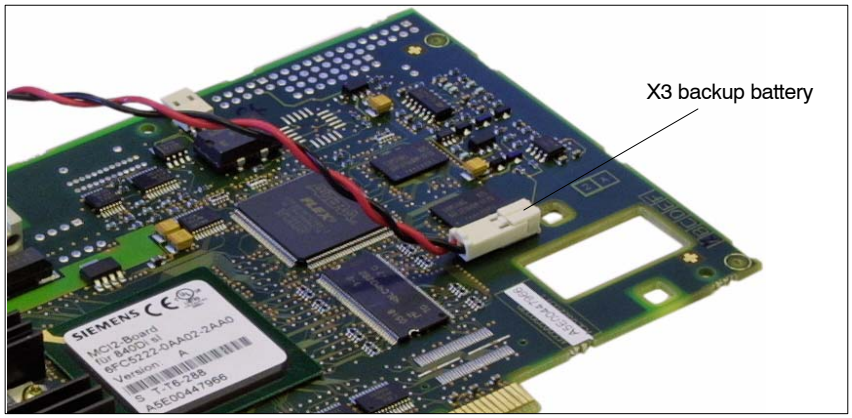


Fig. 2-5 Backup battery connector

8. Loosen the fastening screw on the cover plate of the module and remove the module while observing ESD measures.
9. Insert the new module into the appropriate slot on the mother board and fasten it using the fastening screw on the cover plate.
10. Insert the cable connection X3 (backup battery) into the module.
11. Mount the board retainer.
12. Optional:
    Insert the connecting cable to the MCI board extension module, interface X2.
13. Close the housing of your PC and fasten the screws from the cover of the housing (Fig. 2-3).
14. Connect your PC to power supply again and start it.

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2.2.4 Technical data

Safety		
Degree of protection	IP 00	
Safety class	I, acc. to VDE 0106 P1: 1982 (IEC 536)	
Safety regulations	EN61131–1	
Approvals	CE, UL, CSA	
Power consumption 5 V		
Typically	3.75 W	
Maximum	5 W	
Mechanical data		
Dimensions	PCI card, short	
Weight	140 g	
Ambient environmental conditions		
Heat dissipation	Open circuit ventilation	
Temperature limits	**Operation**	**Storage/transport**
– MCI board alone	–	–40 ... 70 °C
– MCI board in PCU 50.3	5 ... 55 °C	–20 ... 60 °C
Tested to	DIN IEC 68–2–1, DIN IEC 68–2–2 (DIN EN 60068–2–2), DIN IEC 68–2–14	
Limits for relative humidity	5 ... .80 %	5 ... .95 %
Tested to	DIN IEC 68–2–30	
	Per minute	**Per hour**
Temperature change	Max. 1 K	Max. 10 K
Condensation	Not permissible	
Quality assurance	to ISO 9001	
Vibrational load during operation		
Category	3M4	
Frequency range	10 ... 58 Hz/58... 200 Hz	
Const. excursion/acceleration	0.075 mm/1 g	
Tested to – module in PCU 50.3	DIN EN 60068–2–6	
Shock load during operation		
Acceleration	50 m/s^2	
Duration of nominal shock	30 ms	
Tested to – module in PCU 50.3	DIN EN 60068–2–6	

Notice

The specified safety regulations, certifications, degree of protection and safety class only apply if the module is plugged into a SINUMERIK PCU 50.3.

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2.3 MCI board extension slot variant

2.3.1 Module

The MCI board extension slot variant provides the following functions as an optional expansion board of the MCI board:

- 4 binary inputs (isolated)
- 4 binary outputs (isolated)
- 2 measuring inputs (isolated)
- 2 handwheels (non–isolated).

Either differential or TTL handwheels (switch S1) can be operated on the module.

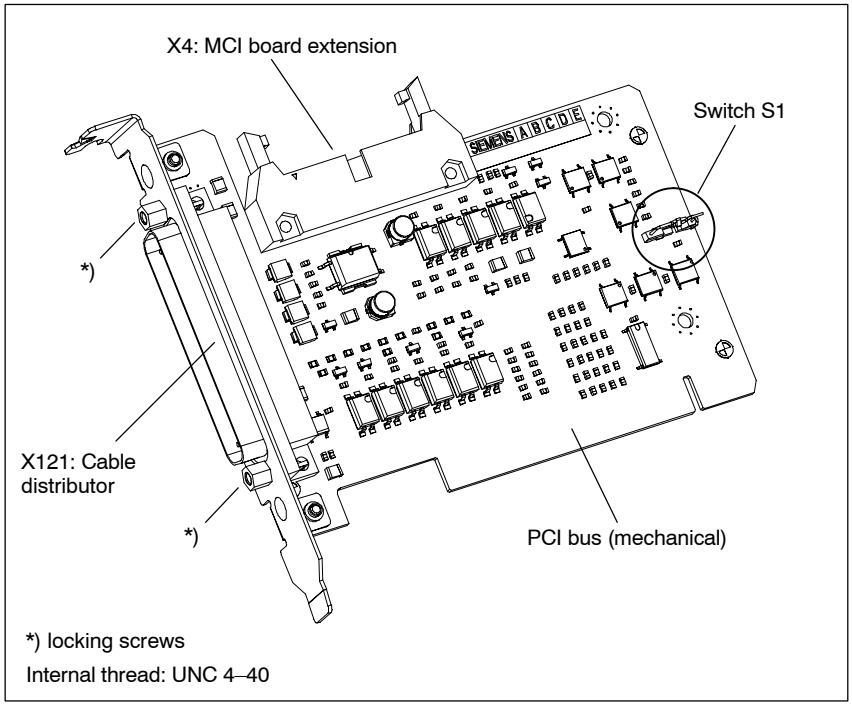


Fig. 2-6 MCI board extension slot variation

Order number:

Designation	Order No. (MLFB)
MCI board extension slot variation (option)	6FC5 222–0AA00–0AA1

Caution

Connection or **disconnection of the cable distributor** to or from interface X121 on the module is only allowed when the equipment is **de–energized**.

Before you plug in or remove the cable connector, switch off the PCU (shut down Windows XP correctly!). Otherwise, short circuits might occur on the module. This could destroy the module.

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Switch S1

With switch S1 you can select the type of handwheel that is to be operated on the module:

- Differential handwheels:
  Switch S1 closed (on delivery)
- TTL handwheels:
  switch S1 open

Differential or TTL handwheels can only be operated alternately.

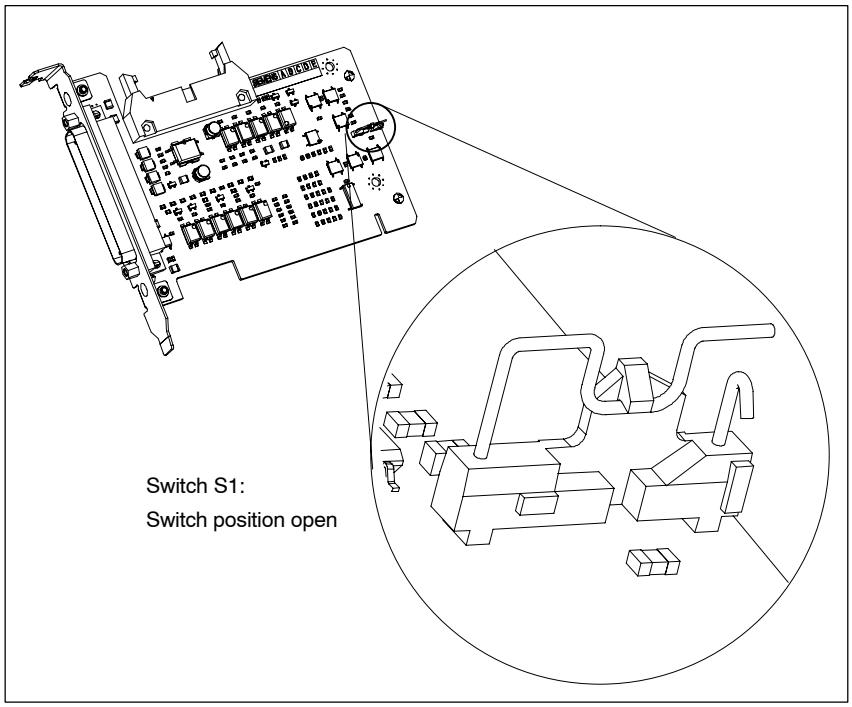


Fig. 2-7 Switch S1 switch position open (TTL handwheels)

Notice

You **select** between differential and TTL handwheels on the module using switch S1 **before installing** the module.

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2.3.2 Installation instructions

The connecting cable with the MCI board is part of the scope of supply and is already plugged into the MCI board extension slot variation.

Installing the module

To install the module, proceed in the sequence described below.



Warning

Operating electrical equipment has parts and components that are at hazardous voltage levels.

Failure to properly maintain the equipment can result in death, serious bodily injury or substantial material damage.

When servicing these devices, you should therefore observe all notices provided in this section and attached to the product itself.

- This device may only be serviced by appropriately qualified personnel.
- Before starting any maintenance and service work, disconnect the device from power supply.
- Use authorized spare parts only.
- Strictly observe the prescribed maintenance intervals, as well as the instructions for repair and replacement.



Notice

The module contains electrostatically sensitive devices.

Electrostatically discharge your own body before touching the module. The simplest way of doing this is to touch an electrically conductive grounded object (e.g. a bare metal part of a cabinet or a power receptacle ground conductor).

1. Shut down the SINUMERIK 840Di sl and Windows XP correctly.
   Use one of the following methods to do this:
   - Windows XP taskbar: Start > Shut Down
   - Interface signal: ”PC shutdown”, see Section 18.1.1, Page 18-499
2. Disconnect your PC from power supply.
3. Remove the screws from the cover of the housing (Fig. 2-8) and open the housing of your PC, observing the relevant safety regulations.

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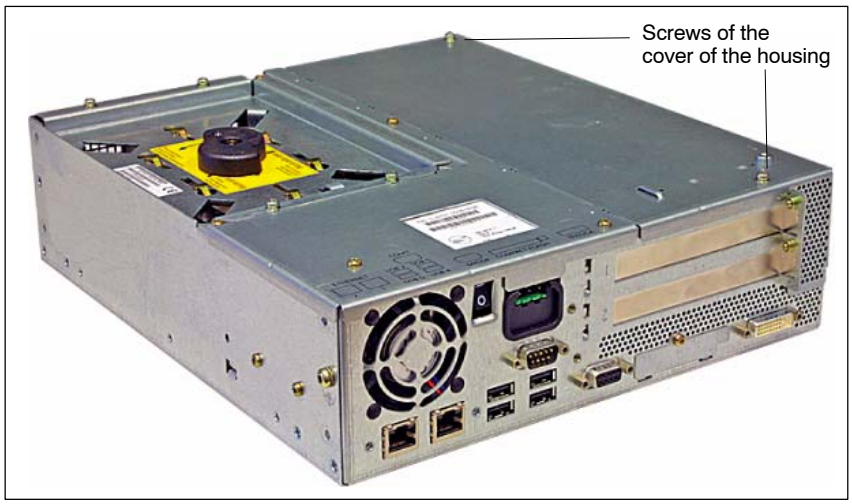


Fig. 2-8 Cover of the housing of the PCU 50.3

4. Remove the fastening screw of the module holding–down device (Fig. 2-9) of the MCI board and remove the module holding–down device.

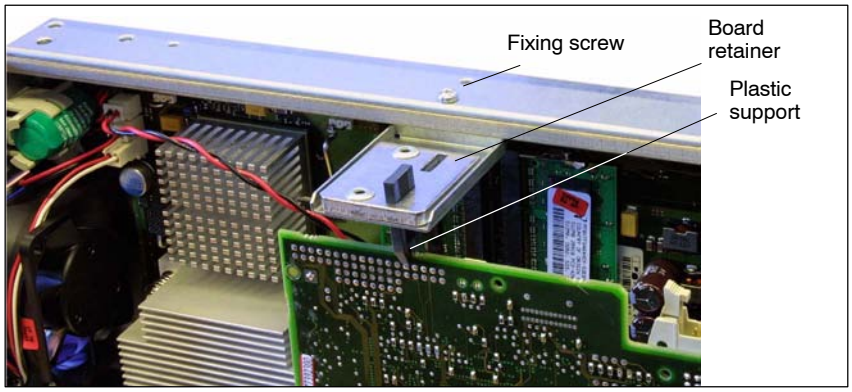


Fig. 2-9 Mounting of the module

5. Remove the blanking plate of the free PCI slot.
6. Insert the module carefully but firmly into the PCI slot and tighten the connector plate of the module.
7. Plug the connector of the connecting cable into the MCI board. Make sure that the latches of the connectors have securely engaged on both modules:
   – MCI board: Interface X2
   – MCI board extension: Interface X4
8. Mount the module holding–down device again.
9. Close the housing and fix it again with the two housing screws.

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2.3.3 Interface description

Interface overview

Interfaces of the MCI board extension slot variant

Table 2-5 Interfaces of the MCI board extension slot variation

interface	Designation	Type
Cable distributor	X121	Connector
MCI board extension	X4	Plug connector

Cable distributor (X121)

Interface description of the cable distributor interface (X121):

- Connector: 37–pinSub D connector
  (see cable distributor Section 2.4, Page2-61)
- Pin assignment:

Table 2-6 Pin assignment: Interface X121

Pin	Designation	Type[1)]	Function
1	M24EXT	VI/VO	24 V ground, 24 V output ground
2	M24EXT	VI/VO	24 V ground, 24 V output ground
3	DOUT_CON(1)	O	2nd output 24 V
4	DOUT_CON(0)	O	1st output 24 V
5	DIN_CON(3)	I	4th input 24 V
6	DIN_CON(2)	I	3rd output 24 V
7	DIN_CON(1)	I	2nd input 24 V
8	DIN_CON(0)	I	1st input 24 V
9	MEPU0_S	I	1st probe input (signal: 24 V)
10	MEPU0_C	I	1st probe input (reference: 0 V)
11	MPG1_XA	I	Input 2nd handwheel, track A inverted
12	P5	VO	Optional 5 V handwheel power supply
13	P5	VO	Optional 5 V handwheel power supply
14	MPG1_XB	I	Input 2nd handwheel, track B inverted
15	MPG0_XA	I	Input 1st handwheel, track A inverted
16	P5	VO	Optional 5 V handwheel power supply
17	P5	VO	Optional 5 V handwheel power supply
18	MPG0_XB	I	Input 1st handwheel, track B inverted
19	Not assigned	–	–
20	P24EXT	VI	24 V output load power supply
21	P24EXT	VI	24 V output load power supply
22	DOUT_CON(3)	O	4th output 24 V
23	DOUT_CON(2)	O	3rd output 24 V
24	MEXT	VO	24 V input ground
25	MEXT	VO	24 V input ground
26	MEXT	VO	24 V input ground
27	MEXT	VO	24 V input ground
28	MEPU1_S	I	2nd probe input (signal)
29	MEPU1_C	I	2nd probe input (0 V)
30	MPG1_A	I	Input 2nd handwheel, track A
31	M	VO	Handwheel PS ground, TTL handwh. ground

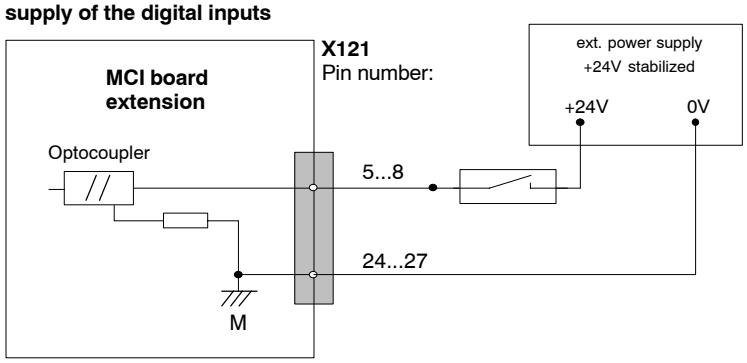
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Table 2-6 Pin assignment: Interface X121

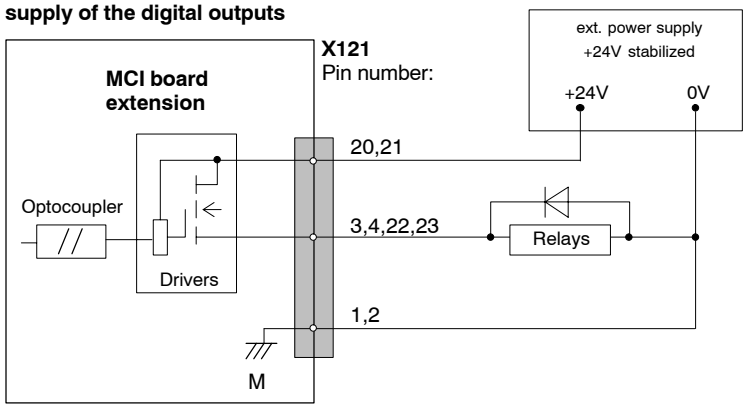
Pin	Designation	Type[1)]	Function
32	M	VO	Handwheel PS ground, TTL handwh. ground
33	MPG1_B	I	Input 2nd handwheel, track B
34	MPG0_A	I	Input 1st handwheel, track A
35	M	VO	Handwheel PS ground, TTL handwh. ground
36	M	VO	Handwheel PS ground, TTL handwh. ground
37	MPG0_B	I	Input 1st handwheel, track B

1) VI/VO Voltage Input/Voltage Output
VI Voltage Input
VO Voltage Input
I Input
O Output

Power supply of the digital inputs



Power supply of the digital outputs



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Digital inputs

Electrical data of the digital input interface:

- Isolated from the board electronics
- Common ground (MEXT)

Digital outputs

Electrical data of the digital output interface:

- Isolated from the board electronics
- Common ground and with regard to the external power supply (M24EXT)
- Rated current: 500 mA

Differential handwheels

Electrical data of the differential handwheel interface:

- Connected to the board electronics
- Signals used:
  - MPGx_A
  - MPGx_B
  - MPGx_XA
  - MPGx_XB

TTL handwheels

Electrical data of the TTL handwheel interface:

- Connected to the board electronics
- Signals used:
  - MPGx_A
  - MPGx_B
  - M

Notice

The optional power supply of the handwheels (P5) is electronically protected with 2A. The maximum continuous load is 1 A. Per handwheel 500 mA.

Probe

Electrical data of the probe interface:

- Isolated both from one another and from all other voltage areas (board electronics, digital inputs/outputs and handwheels)
- Signal delay active edge: 10 us
- Signal delay inactive edge: 100 us

Note

The maximum cable length is 25 m for all functions.

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2.3.4 Technical data

Table 2-7 Technical data for MCI board extension, slot version

Safety		
Degree of protection	IP 20	
Safety class	Safety class I, in accordance with VDE 0106 P1: 1982 (IEC 536)	
Safety regulations	EN61131–1	
Approvals	CE, UL, CSA	
Electrical data		
	Maximum	Typical
Power consumption without I/Os	500 mW	350 mW
Power consumption with I/Os	2.1 W	850 mW
	both handwheels	per handwheel
Max. current–carrying capacity of the 5 V power supply	1A	500mA
Mechanical data		
Dimensions	Short PCI card	
Weight	110g	
Ambient environmental conditions		
Heat dissipation	Open circuit ventilation	
	Operation	**Storage/transport**
Temperature limits	5 ... 55°C	–40 ... 70°C
Tested to	DIN IEC 68–2–1, DIN IEC 68–2–2 (DIN EN 60068–2–2), DIN IEC 68–2–14	
Limits for relative humidity	5 ... .80%	5 ... .95%
Tested to	DIN IEC 68–2–30	
	Per minute	**Per hour**
Temperature change	Max. 1K	Max. 10K
Condensation	Not permissible	
Quality assurance	to ISO 9001	
Vibrational load during operation		
Category	3M4	
Frequency range	10 ... 58 Hz/58... 200 Hz	
Const. excursion/acceleration	0.075 mm/1 g	
Tested to – module in PCU 50.3	DIN EN 60068–2–6	
Shock load during operation		
Acceleration	50m/s^2	
Duration of nominal shock	30 ms	
Tested to – module in PCU 50.3	DIN EN 60068–2–6	

Notice

The specified safety regulations, certifications, degree of protection and safety class only apply if the module is plugged into a SINUMERIK PCU 50.3.

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2.4 Cable distributor

Order number

Designation	Order No. (MLFB)
Cable distributor	6FX2 006–1BA02

Cable connection

The cable distributor consists of a connector jacket for a 37–pin Sub–D connector with enlarged interior. The cable distributor is used to split the I/O electronic handwheel extension interface (X121) to a maximum of 7 single cables. These must be connected in the order shown in Table 2-9, Page 2-63.

To supply the digital outputs, an external 24 V supply is possible at the cable distributor.

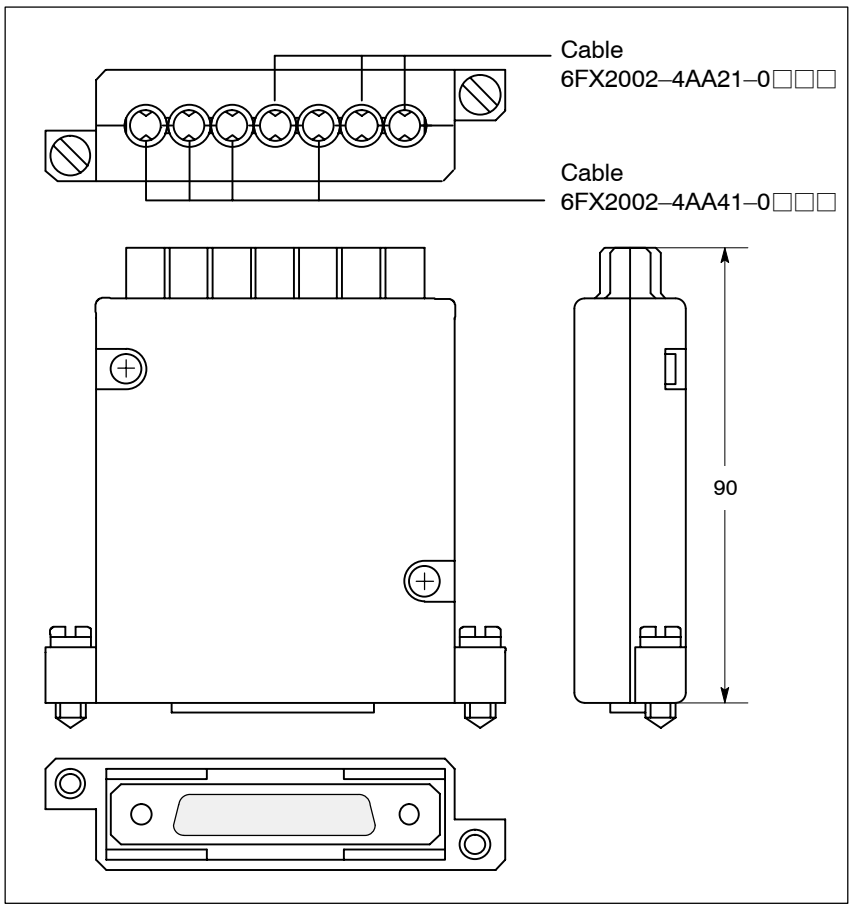


Fig. 2-10 Cable distributor

Insert the appropriate individual cable in the opened cable distributor at the associated connector X1 to X10. Place the cable in the appropriate cable guide.

Make sure that the shield jackets that became free have a large conductive connection to the metallic contact areas of the cable distributor. See Fig. 2-11, Page 2-62. Locate the upper terminal bar in such a way that its ”teeth” are facing the ”teeth” of the lower terminal bar and then retain the upper housing section.

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This will reliably press the cable shields between the contact areas of the contact springs and contact them safely. The shield potential is reliably routed to the housing of the PCU using the contact springs of the cable distributor on the front panel of the PCU.

Location of interfaces

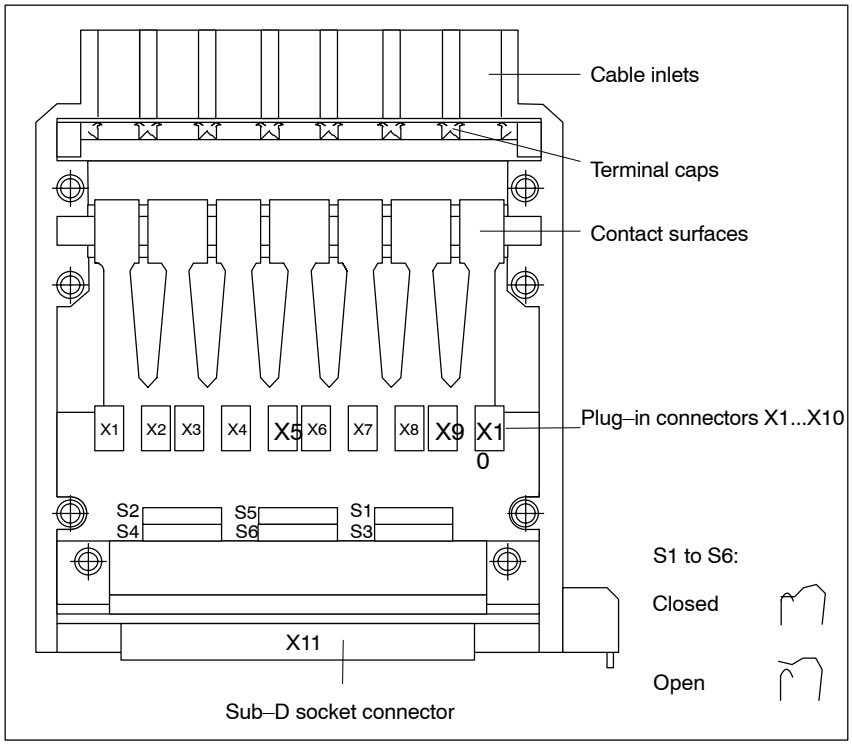


Fig. 2-11 Position of the interfaces of the cable distributor

DIP FIX switches

The DIP FIX switches in the cable distributor must be set as follows:

Table 2-8 Setting the DIP–FIX switches in the cable distributor

Switch	S1	S2	S3	S4	S5	S6
Open	x	x	x	x		
Closed					x	x

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Connector assignments

Table 2-9 Connector assignments

Connector No.	Cable No.	I/O
X1	1 (top)	1st handwheel
X2		
X3	2	2nd handwheel
X4		
X5	3	2nd probe
X6	4	4 binary inputs
X7		
X8	5	4 binary outputs
X9	6	Supply for 4 binary outputs
X10	7 (bottom)	1st probe

Notice

When assembling the cable distributor, make absolutely sure that the supplied washer is installed correctly and the coding pins are installed.

Mounting

The cable distributor is fastened using the two supplied adapter plates at the X121 cable distributor interface of the MCI board extension module using screws.

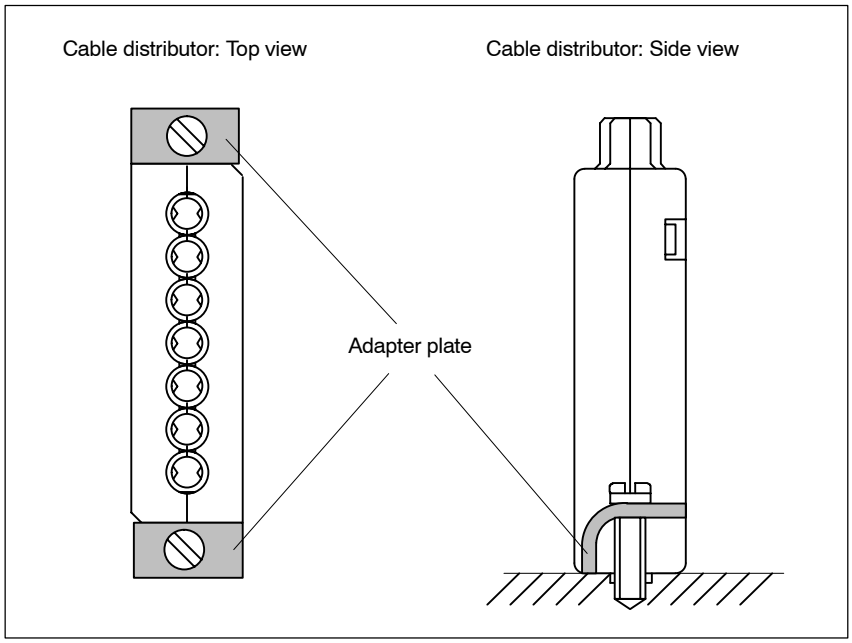


Fig. 2-12 Mounting the cable distributor

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Connection assignment

Connector designation: **X1...X10**
Connector type: DU–BOX plug connectors

Table 2-10 Connector pin assignment of the cable distributor

Pin no. 37–pin connector	Signal name	DU BOX connector no./pin	Cable No.	Cable order No. 6FX2002–4AA....	Core color	I/Os	Terminal
– 9 – 10	– MEPUS 0 – MEPUC 0	X10/2 X10/1 X10/4 X10/3	7	41–0□□□	rd or br bk shield	1st probe 1st probe	Signal +24 V Reference 0 V
1 20 2 21	M24EXT P24EXT M24EXT P24EXT	X9/2 X9/1 X9/4 X9/3	6	41–0□□□	rd or br bk shield	Parameterization of the 4 binary outputs/of the MPI connector	Ground 24 V Ground 24 V
3 22 4 23	OUTPUT 1 OUTPUT 3 OUTPUT 0 OUTPUT 2	X8/2 X8/1 X8/4 X8/3	5	41–0□□□	rd or br bk shield	4 binary outputs	2nd output 4th output 1st output 3rd output
5 24 6 25 7 26 8 27	INPUT 3 MEXT INPUT 2 MEXT INPUT 1 MEXT INPUT 0 MEXT	X7/2 X7/1 X7/4 X7/3 X6/2 X6/1 X6/4 X6/3	4	21–0□□□	rd or br bk gn ye vio bl shield	4 binary inputs	4th input ground 3rd input ground 2nd input ground 1st input ground
– 28 – 29	– MEPUS 1 – MEPUC 1	X5/2 X5/1 X5/4 X5/3	3	41–0□□□	rd or br bk shield	2nd probe 2nd probe	Signal +24 V Reference 0 V
11 30 12 31 13 32 14 33	MPG1 XA MPG1 A MPG1 5V MPG1 0V MPG1 5V MPG1 0V MPG1 XB MPG1 B	X4/2 X4/1 X4/4 X4/3 X3/2 X3/1 X3/4 X3/3	2	21–0□□□	rd or br bk gn ye vio bl shield	2nd handwheel 6FC9320–5DB	XA A 5 V 0 V 5 V 0 V XB B
15 34 16 35 17 36 18 37	MPG0 XA MPG0 A MPG0 5V MPG0 0V MPG0 5V MPG0 0V MPG0 XB MPG0 B	X2/2 X2/1 X2/4 X2/3 X1/2 X1/1 X1/4 X1/3	1	21–0□□□	rd or br bk gn ye vio bl shield	1st handwheel 6FC9320–5DB	XA A 5 V 0 V 5 V 0 V XB B

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Signal names

MPG0, 1 5 V	Supply voltage 1st/2nd handwheel 5 V
MPG0, 1 0 V	Supply voltage 1st/2nd handwheel 0 V
MPG0, 1 A, XA	1st/2nd differential handwheel input A, XA
MPG0, 1 B, XB	1st/2nd differential handwheel input B, XB
MEPUS 0, 1	1st/2nd meas. pulse signal
MEPUC 0, 1	1st/2nd meas. pulse common (reference ground)
INPUT [0...3]	1st to 4th binary NC input
MEXT	Ext. ground (reference ground for binary NC inputs)
OUTPUT [0...3]	1st to 4th binary NC output
M24EXT	External 24 V supply (–) for binary NC outputs
P24EXT	External 24 V supply (+) for binary NC outputs

Notice

The maximum current carrying capacity of the handwheel interface is 1 A for both handwheels. 500 mA per handwheel.

Color Depth

rd	Red
or	Orange
bn	Brown
bk	Black
gn	Green
ye	Yellow
vt	Violet
bu	Blue

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2.5 SINUMERIK Industrial PC

2.5.1 SINUMERIK PCU 50.3

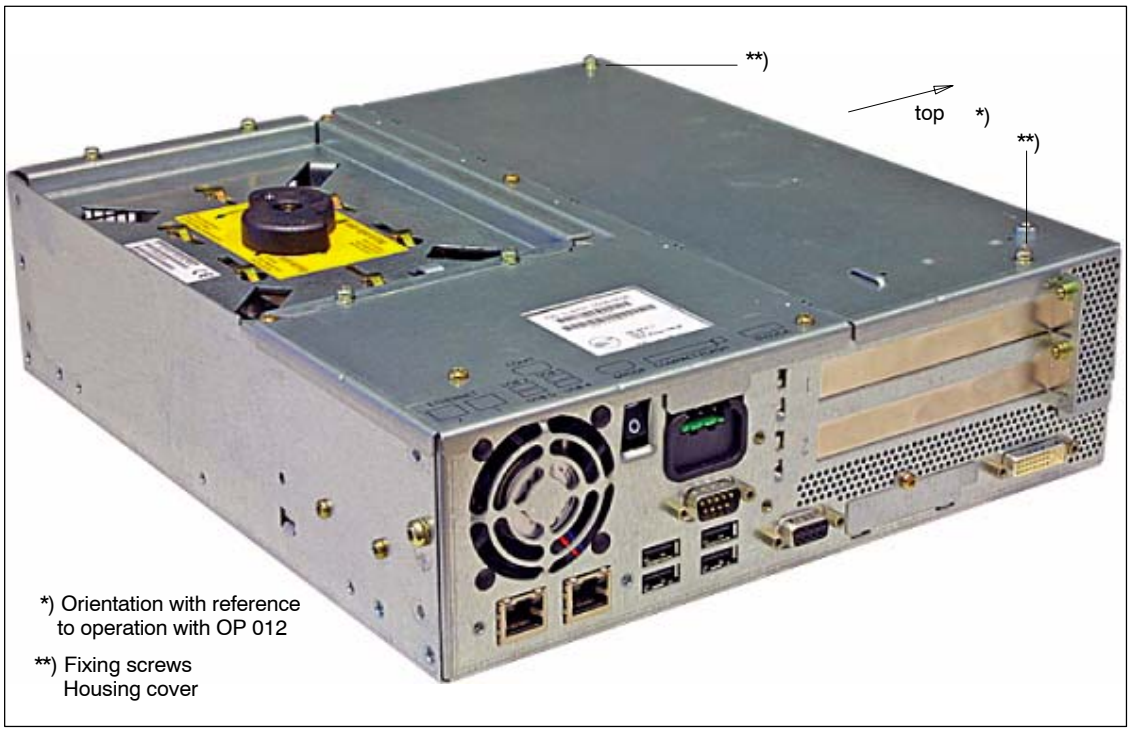


Fig. 2-13 PCU 50.3: Perspective view with installed hard disk drive

Order number

PCU as spare part with MCI board:

Designation	Order No. (MLFB)
with Windows XP ProEmbSys and MCI board:	
PCU 50.3–C/1.5 GHz, 512 MB SDRAM	6FC5 220–0AA31–2AA0
PCU 50.3–P/2.0 GHz, 1024 MB SDRAM	6FC5 220–0AA33–2AA0

Features

The SINUMERIK industrial PC "PCU 50.3" provides, together with the MCI board, the basis for the SINUMERIK 840Di sl. The PCU 50.3 has the following important features:

- Versions:
  - Celeron M, 1.5 GHz, 512 MB SDRAM
  - Pentium M, 2.0 GHz, 1024 MB SDRAM
- Hard disk min. 40 GB (replaceable)
- Operating system Windows XP ProEmbSys with Service Pack 2
- Robust design (continuous operation, high noise immunity)
- Compact dimensions for space–saving installation
- Easy installation with four screws on the rear of the operator panel front

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- Mounting position and location to a large degree variable
- Screen resolution 640 x 480, up to max. 1600 x 1200
- Power Supply: 24 V DC
- Interfaces to peripheral devices:
  - 1 x PROFIBUS DP (max. 12 Mbaud)
  - 1 x DVI–I interface for external monitor
  - 2 x Ethernet connections 10/100 Mbaud
  - 1 x CF card shaft (covered)
  - 4 x high–speed USB ports (USB 2.0)
- Interfaces to operator panel front:
  - LVDS panel interface (channel 1 and optional channel 2)
  - I/O USB panel interface
  - Additional high–speed USB port (USB 2.0)
- No. of slots
  - 1 x PCI (length: max. 265 mm, occupied by the MCI board)
  - 1 x PCI (length: max. 175 mm, occupied with option MCI board extension slot variant)

Options

The following options are offered:

- Memory expansion up to max. 2048 MB
- External floppy disk drive

Mounting bracket

Mounting brackets are required to mount the PCU directly behind the operator panel front:

- Mounting bracket MLFB: 6FC5 248–0AF20–2AA0

Spare part installation

When installing spare parts please note the following:

- When replacing the PCU, remove the mounting brackets (MLFB 6FC5 248–0AF20–2AA0) from the defective PCU and attach to the replacement part.

References

For the complete documentation on the PCU 50.3, please refer to:

References: /BH/ Operator Components Manual
Component PCU 50.3

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Technical data

Table 2-11 Technical data for PCU 50.3 with MCI board

Safety			
Safety class	I per IEC 60536		
Degree of protection to EN 60529	IP20		
Approvals	CE		
Electrical data			
Input voltage	24 VDC		
Max. power consumption	1 x PCI slot (length: min. 140 mm) 1 x PCI slot (length: max. 288 mm)		
3.3 V 5 V 12 V –12 V	2 A 2 A 0.3 A 0.05 A		
Power consumption	PCU	PCI slot 1)	
	max. 190 W	15 W	
Main power outage buffering time	min. 20 ms		
Mechanical data			
Dimensions (mm)	Width 297	Height 267	Depth 81.7
Weight	Approx. 7.2 kg		
Mechanical ambient conditions (with OP 012)	**Operation**	**Transport** (in packaging)	
Vibration stressing	10 – 58 Hz: 0.075 mm 58 – 200 Hz: 9.8 m/s^2 DIN IEC 60068–2–6	5 – 9 Hz: 6.2 mm 9 – 500 Hz: 19.6 m/s^2 DIN IEC 60068–2–6	
Shock stressing	50 m/s^2, 30 ms, 18 shocks DIN IEC60068–2–27	250 m/s^2, 6 ms, 18 shocks DIN IEC60068–2–29	
Noise	< 55 dB(A) to DIN 45635–1		
Ambient environmental conditions			
Heat dissipation	Open circuit ventilation		
Condensation, spraying water and icing	Not permissible		
Air inlet	Without caustic gases, dusts and oils		
	Operation	Storage/transport (in transport packaging)	
Applicable standards	DIN IEC 60068–2–1	DIN IEC 60068–2–2/–2–14	
Climate class	3K5	1K3/2K4	
Temperature limits	9 W 2): 5 ... 55 °C 14 W 2): 5 ... 50 °C 24 W 2): 5 ... 45 °C	–20 ... 60 °C	
Temperature change	Max. 10 K/h	Max. 18 K/h	
Limits for relative humidity	10 ... to 80 % at 25° C	5 ... to 95% at 25° C	
Permissible change in the relative air humidity	max. 0.1% /min		

1) All of the slots must not exceed this total output

2) Max. power of additional extensions e.g.,: MCI board extension, PC card, USB interface; the MCI board is already plugged in

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2.6 SINUMERIK operator panel fronts

SINUMERIK operator panel fronts can be connected to the PCU either centrally, i.e. directly via LVDS or USB interfaces, or decentrally with TCU (Thin Client Unit) via Ethernet.

In the following section, the OP 012 operator front is described as an example in detail.

2.6.1 Operator panel front OP 012

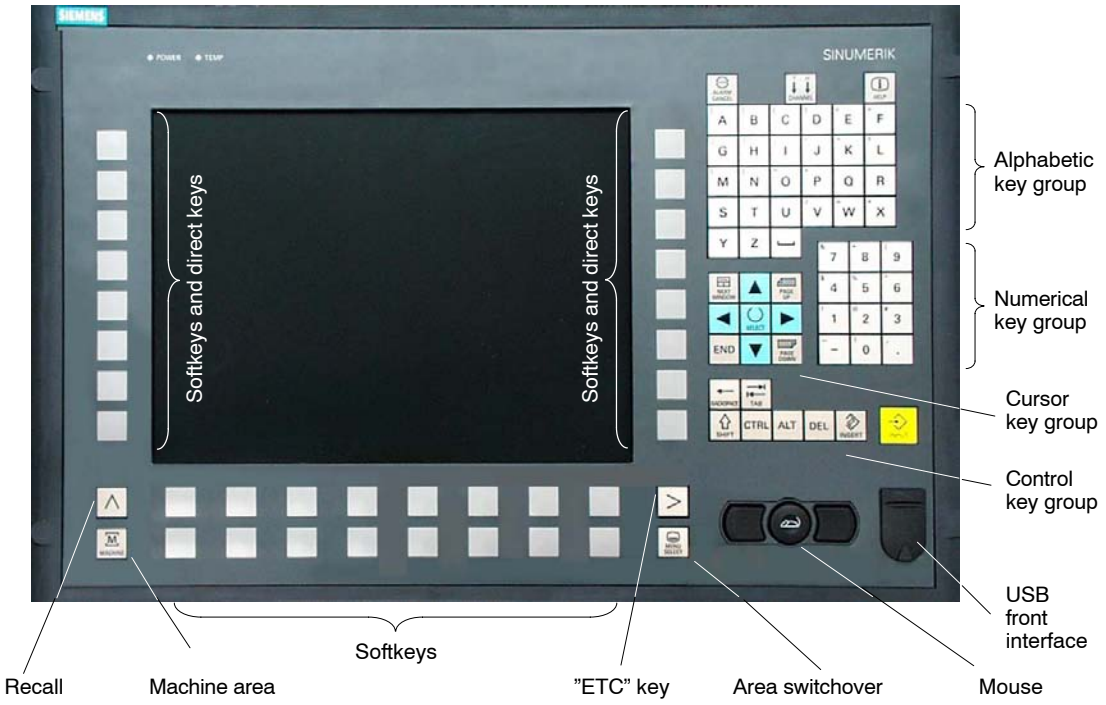


Fig. 2-14 View of OP 012 operator panel front

Order number

Designation	Order No. (MLFB)
SINUMERIK OP 012	6FC5 203–0AF02–0AA1

Features

The OP 012 operator front provides the following features:

- 12.1" TFT flat screen (color); resolution 800 x 600 pixels
- Membrane keyboard with alpha, numeric, cursor and control keypad
- Softkeys/direct keys:
  - 2 x 8 horizontal rows of keys with softkey function
  - 2 x 8 vertical key rows with softkey and direct key functions

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  - Direct keys connectable using PP031−MC or directly to the I/Os
- Shift key for switchover to the second key level (not for switching over the letters, since uppercase letters only)
- Integrated mouse
- Status LEDs for power supply and overtemperature
- USB interface at front
- Degree of protection IP65
- Can be combined with PCU or TCU
- External floppy disk drive can be connected

References

For detailed documentation about the operator panel front OP 012 please see:

References: /BH/ Operator Components Manual
Operator panel front OP 012

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2.7 TCU (Thin Client Unit)

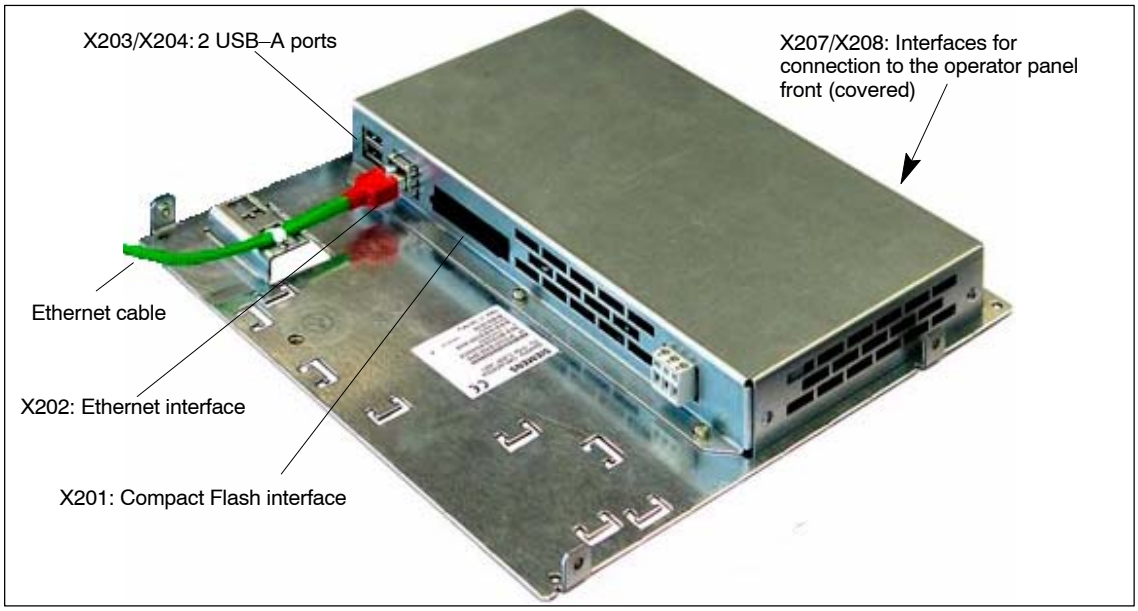


Fig. 2-15 TCU with Ethernet cable plugged in

Order number

Designation	Order No. (MLFB)
TCU (Thin Client Unit)	6FC5312–0DA00–0AA1

Features

A TCU permits the distributed connection of SINUMERIK OP/TP operator panel fronts and the SINUMERIK PCU. The features include the following:

- Communication with the PCU is performed via Industrial Ethernet (10/100 Mbaud) in a separate sub–network with DHCP server (on the PCU).
- Permits large distances between the PCU and operator panel front (maximum possible distance between two network nodes/access points: approx. 100 m).
- Graphics resolutions: 640x480 to 1024x768 pixels; depth of color: 16 bits
- Interfaces:
  - 1 x Ethernet 10/100 Mbaud
  - 1 x Compact Flash
  - 2 x USB 1.1 for connection of mouse and keyboard
  - Interfaces for operator panel front:
    LVDS interface for SINUMERIK OP,
    USB interface for SINUMERIK OP (internal)

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References

Comprehensive documentation about the configuration and commissioning of the TCU are to be found in:

Structure	**References**:	/BH/	Operator Components Manual Distributed configuration with TCU
Commissioning	**References**:	/IAM/	HMI Commissioning Manual TCU Commissioning (IM5)

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2.8 Floppy disk drives

2.8.1 Floppy disk drive 3.5” (USB)

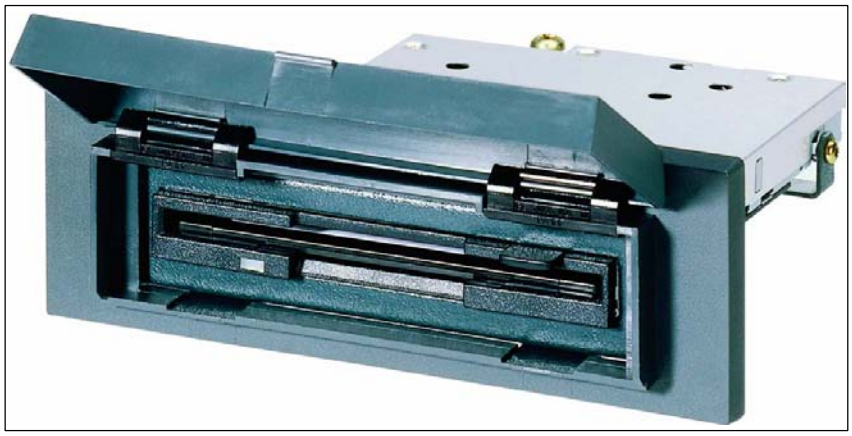


Fig. 2-16 External 3.5” floppy disk drive with USB interface

Order number

Designation	Order No. (MLFB)
3.5” disk drive with USB interface incl. 1 m USB connecting cable	6FC5 235–0AA05–1AA2
Cover (spare part)	6FC5 247 – 0AA20 – 0AA0

Features

The disk drive is used to read in and save data from/to 3.5” disks with a maximum capacity of 1.44 MB. The disk drive has the following features:

- USB interface: Version 1.1
- Can be inserted into customized operator panel fronts
- Bootable
- Input voltage 5.25 V DC
- Power consumption, max. 2.5 W
- Degree of protection to DIN EN 60529 IP 54 (front)
IP 00 (rear)

References

For a complete description of the 3.5” floppy disk drive (USB), please refer to:

References: /BH/ Operator Components Manual
3.5” disk drive (USB)

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2.9 Power supply

2.9.1 SITOP POWER standard 24V/10A



Fig. 2-17 View: SITOP POWER standard 24V/10A

Order number

Designation	Order No. (MLFB)
SITOP POWER standard 24V/10A	6EP1 334–1SH01

Features

The SITOP POWER Standard 24V/10A power supply mode provides the following features:

- Input voltage nominal value 120/230 V AC
- Input voltage range 93 ... 132 V/187 ... 264 V
- Power failure back–up time > 20 ms
- Line frequency nominal value 50/60 Hz
- Line frequency range 47 ... 63 Hz
- Input current nominal value 3.5/1.7 A
- Inrush current (25 °C) 55 A
- Output voltage nominal value 24 V DC
- Output voltage tolerance ± 3 %
- Efficiency > 87 %

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- Output current nominal value 10 A
- Electron. short–circuit protection with automatic restart
- Galvanic isolation (SELV acc. to EN 60950)
- Class of protection (IEC 536; VDE 1006 T1) class I
- Degree of protection (VDE 0470, IEC 529) IP 20
- Radio interference level (EN 55011) class A

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2.10 Uninterruptible power supply (UPS)

2.10.1 SITOP POWER DC UPS MODULE 15



Fig. 2-18 View: SITOP POWER, DC–UPS MODULE 15

Order number

Designation	Order No. (MLFB)
SITOP POWER DC UPS module 15 (USB interface)	6EP1 931–2EC42

Features

The SITOP POWER DC UPS module 15 provides the following features:

- Compact design (HxWxD: 125 mm x 50 mm x 125 mm)
- Nominal input voltage 24 V DC
- Nominal output voltage 24 V DC
- Nominal output current 15 A DC
- High efficiency approx. 96 %
- Class of protection (IEC 536; VDE 1006 T1) Class III
- Degree of protection (VDE 0470, IEC 529) IP 20
- Setting options
  - Connection threshold
  - Charging current
  - End–of–charge voltage
  - Operating state ON/OFF
  - Backup time
  - Interruption of output voltage
- Protection and monitoring functions
  - Reverse voltage protection
  - Overcurrent and short–circuit protection

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  - Exhaustive discharge protection
  - Accu test
- Signaling of current status via LED
  - Normal operation
  - >85 % full charge
  - Battery standby supply
  - Buffer standby not available (alarm)
- Additional output of all signals via a PC–capable interface:
  - Type ....–2EC31: Serial Interface
  - Type ....–2EC41: USB interface

USB interface

The USB interface corresponds to specification 2.0. Communication is however only performed at ”full speed” corr. to 12 Mbaud. A commercial type four–core shielded USB cable with a maximum cable length of 3 m can be used.

Table 2-12 Signal assignment of USB connector

Pin	Signal	Designation
1	VBUS	Power supply
2	D–	Transmitted data
3	D+	Transmitted data
4	GRD	Ground

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2.10.2 SITOP POWER ACCU MODULE 24 V DC/10 A/3.2 AH



Fig. 2-19 View: SITOP POWER lead–acid battery module

Order number

Designation	Order No. (MLFB)
SITOP POWER ACCUMODULE 24 V DC/10 A/3.2 AH	6EP1 935–6MD11

Features

The SITOP POWER LEAD–ACID MODULE 24 V DC/10 A/3.2 AH features the following:

- It has two maintenance–free, closed lead–acid batteries from the same lot, which are installed in a holder and connected in series.
- Complete with battery retainer and terminals
- Low self–discharge rate of approx. 3 % per month (at +20 °C)
- Short circuit protection (battery fuse 15 A/32 V)
- Class of protection (IEC 536; VDE 1006 T1) Class III
- Degree of protection (EN 60 529; VDE 0470 T1) IP 00

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2.11 I/O module PP72/48

2.11.1 Module

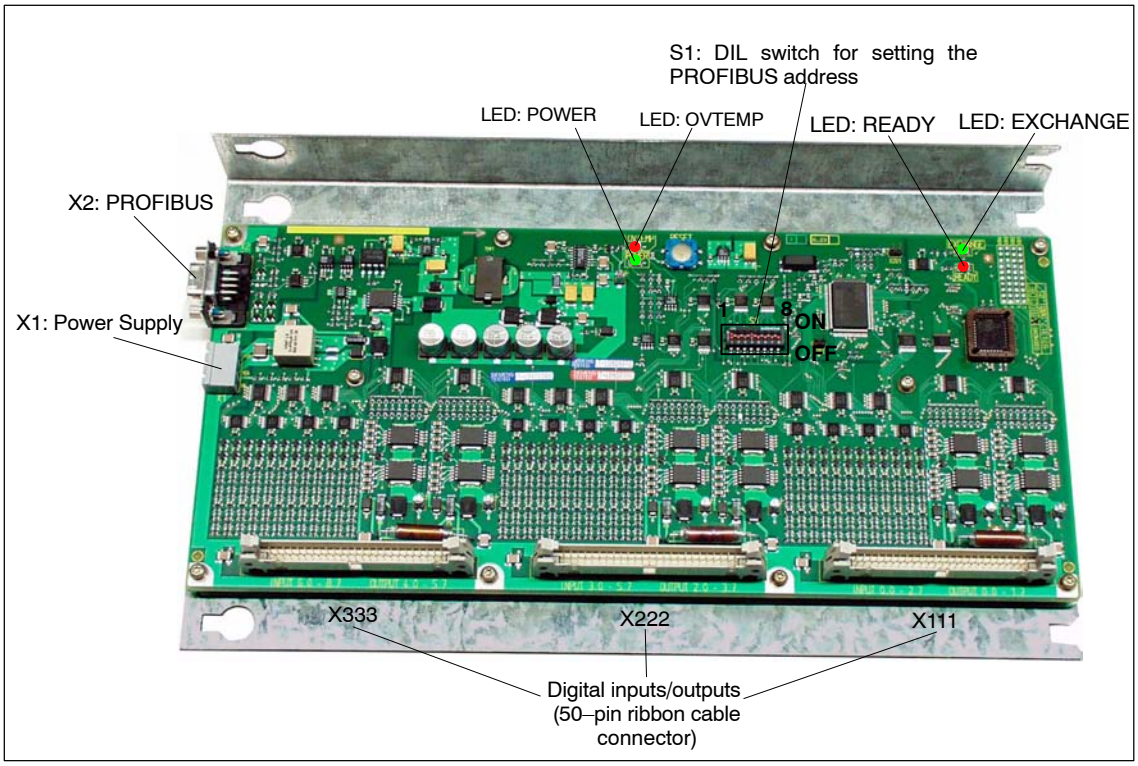


Fig. 2-20 I/O module PP72/48

Order number

Designation	Order No. (MLFB)
I/O module PP72/48	6FC5 611–0CA01–0AA0

Features

I/O module PP72/48 is a simple module (without a separate housing) for connecting digital input/outputs as part of an automation system based on PROFIBUS DP.

The module has the following important features:

- PROFIBUS DP connection (max. 12 MBaud)
- 72 digital inputs and 48 digital outputs
- Onboard status display by means of 4 diagnostic LEDs

To power the module and the digital outputs, an external power supply source (+24 V DC) is required.

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2.11.2 Interface description

Interface overview

Interfaces of I/O module PP72/48

Table 2-13 Interfaces of I/O module PP72/48

Interface	Designation	Type
Power supply connection	X1	Screw–terminal block
PROFIBUS DP	X2	Socket
PROFIBUS DP address	S1	DIL switch
Digital input/outputs 1	X111	Ribbon cable connector
Digital input/outputs 2	X222	Ribbon cable connector
Digital input/outputs 3	X333	Ribbon cable connector

External power supply (X1)

Interface description of the external power supply (X1):

- Screw–terminal block MSTBVA 2,5/3–G–5,08, Phoenix
- Pin assignment

Table 2-14 Pin assignment: Ext. power supply (X1)

Pin	Designation	Type 1)	Function
1	P24	VI	External power supply of the module (+24 V)
2	M24	VI	Reference for external supply
3	PI	VI	Protective conductor of the external supply
1) VI Voltage input			

- Connecting cable
  The required connecting cables must be provided by the user:
  – Wire, conductor cross section: 1.0 – 1.5 mm^2 (AWG17 – AWG16)
- Power supply
  For data concerning the power supply, see Subsection 2.11.3, Page 2-87.

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PROFIBUS DP (X2)

Interface description of the PROFIBUS DP interface (X2):

- Connection: 9–pin SUB–D socket connector
- Pin assignment

Table 2-15 Pin assignment: PROFIBUS DP (X2)

Pin	Designation	Type 1)	Function
1	–	–	–
2	–	–	–
3	RxD/TxD–P	B	Receive/transmit data P (B line)
4	RTS	O	Request to Send
5	DGND	VO	Data reference potential (M5V)
6	VP	VO	Supply voltage plus (P5V)
7	–	–	–
8	RxD/TxD–N	B	Receive/transmit data N (A line)
9	–	–	–

1) VO Voltage Output
O Output
B Bidirectional

- Connector
  - 6ES7972–0BA40–0XA0; cable outlet 35^0, without PC socket connector
  - 6ES7972–0BB40–0XA0; cable outlet 35^0, with PC socket connector
  - 6ES7972–0BA11–0XA0; cable outlet 90^0, without PG socket connector
  - 6ES7972–0BB11–0XA0; cable outlet 90^0, with PG socket connector
- Cable
  - 6XV1830–0EH10; by the meter, non–trailable
  - 6XV1830–3BH10; by the meter, trailable
- Additional technical specifications

  Maximum possible data rate: 12 Mbits/s

PROFIBUS address (S1)

The PROFIBUS address of the ADI4 can be set in the range 1 to 127 using switch S1.

Table 2-16 Meaning of switch S1

Switch	Significance
1	PROFIBUS address: $2^0 = 1$
2	PROFIBUS address: $2^1 = 2$
3	PROFIBUS address: $2^2 = 4$
4	PROFIBUS address: $2^3 = 8$
5	PROFIBUS address: $2^4 = 16$
6	PROFIBUS address: $2^5 = 32$
7	PROFIBUS address: $2^6 = 64$
8	Not used

Notice

A newly set PROFIBUS address will only come into effect after power OFF/ON.

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Digital inputs/outputs (X111/X222/X333)

Interface description of the digital input/output interfaces (X111/X222/X333):

- Connector: 50–pin ribbon cable connector
- Pin assignment on each connector.

Table 2-17 Pin assignment (X111/X222/X333)

Pin	Signal designation	Type 1)	Pin	Signal designation	Type 1)
1	M	VO	26	Input 2.7	I
2	P24OUT	VO	27	–	–
3	Input 0.0	I	28	–	–
4	Input 0.1	I	29	–	–
5	Input 0.2	I	30	–	–
6	Input 0.3	I	31	Output 0.0	O
7	Input 0.4	I	32	Output 0.1	O
8	Input 0.5	I	33	Output 0.2	O
9	Input 0.6	I	34	Output 0.3	O
10	Input 0.7	I	35	Output 0.4	O
11	Input 1.0	I	36	Output 0.5	O
12	Input 1.1	I	37	Output 0.6	O
13	Input 1.2	I	38	Output 0.7	O
14	Input 1.3	I	39	Output 1.0	O
15	Input 1.4	I	40	Output 1.1	O
16	Input 1.5	I	41	Output 1.2	O
17	Input 1.6	I	42	Output 1.3	O
18	Input 1.7	I	43	Output 1.4	O
19	Input 2.0	I	44	Output 1.5	O
20	Input 2.1	I	45	Output 1.6	O
21	Input 2.2	I	46	Output 1.7	O
22	Input 2.3	I	47	DOCOMx	VI
23	Input 2.4	I	48	DOCOMx	VI
24	Input 2.5	I	49	DOCOMx	VI
25	Input 2.6	I	50	DOCOMx	VI

1) VI Voltage Input
VO Voltage Output
I Signal Input
O Signal Output
x with x = 1,2,3

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Digital inputs

- Terminal assignment for the digital inputs

  The following figure shows an example of the terminal assignment for the digital inputs on connector X111. Connectors X222 and X333 are assigned analogously.

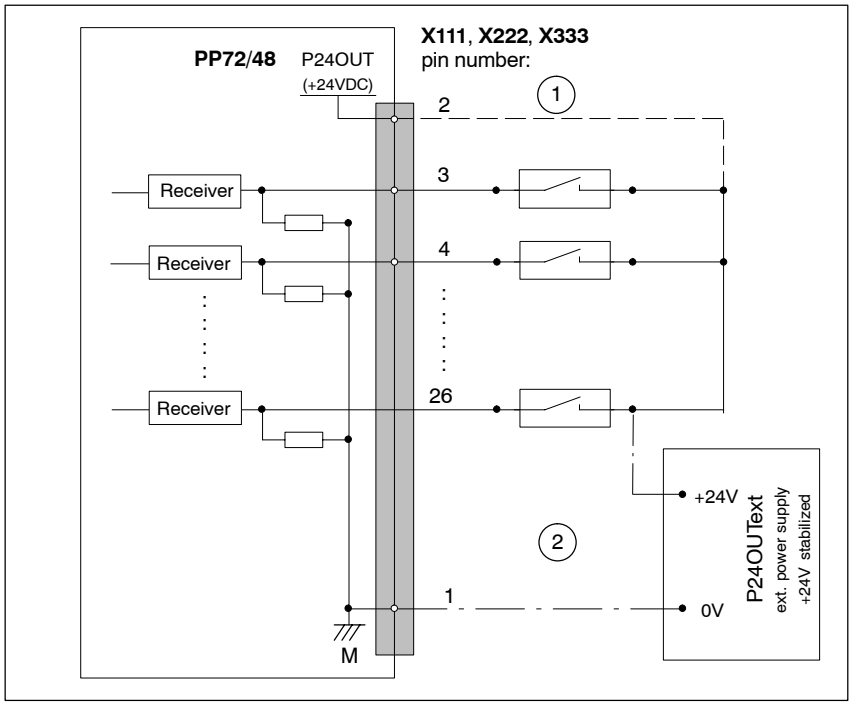


Fig. 2-21 Terminal assignment for the digital inputs

(1) If you are using the internal power supply P24OUT

(2) If you are using an external power supply $P24OUT_{ext}$

- Internal power supply (P24OUT)
  The internal power supply for the digital inputs (X111, X222, X333: Pin 2) is derived from the general power supply of module X1, pin 2 (P24). Specification: See Section 2.11.3, Page 2-87

Caution

A max. current of I_{out} = 0.5 A on X111, X222, X333: Pin 2 must not be exceeded. An exceeding of the maximum current might destroy the module.

- External power supply ($P24OUT_{ext}$)
  If an external power supply is used for the digital inputs, its reference ground must be connected with X111, X222, X333: Pin 1 (M).

  X111, X222, X333: Pin 2 (P24OUT) then remains open.

  For specification of the external power supply, see Subsection 2.11.3, Page 2-87.

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- Connecting cable: The required connecting cables (ribbon cables) must be provided by the user.·
- Electrical specification of the digital inputs:

Table 2-18 Electrical specification of the digital inputs:

Digital inputs	Min.	Typical	Max. 5 A	Nominal
Voltage at high signal level ($U_{H)}$	15V	1)	30V	24V
Input current I_{IN} at V_H	2mA	–	15mA	–
Voltage at low signal level ($U_{L)}$	–30V	–	+5V	0V
Signal delay time T_{PHL} 2)	0.5 ms	–	3 ms	–

- Supply voltage of the digital inputs
  1) typical output voltage: $V_{CC} – I_{OUT} * R_{ON}$
  V_{CC}: actual operating voltage (P24OUT) at X111, X222, X333: Pin 2
  max. output current I_{OUT}: 500 mA per pin
  max. short–circuit current: 4 A (max. 100 µs, V_{CC}= 24 V)
  internal resistance R_{ON}: 0.4 Ω
- 2)
  Moreover, the PROFIBUS communication time and the application cycle time must be taken into account.
- Polarity reversal causes neither high level nor destruction of the inputs.

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Digital outputs

- Terminal assignment for the digital outputs

  The following figure shows an example of the terminal assignment for the digital outputs on connector X111. Connectors X222 and X333 are assigned analogously.

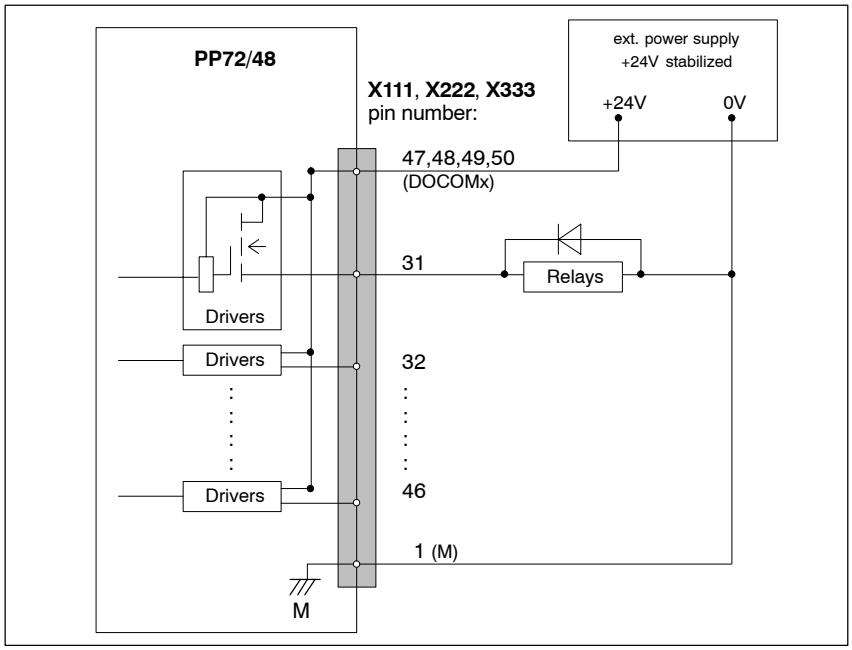


Fig. 2-22 Terminal assignment for the digital outputs

- Connecting cable: The required connecting cables (ribbon cables) must be provided by the user.
- Supply voltage:
  To power the digital outputs, an external 24 V DC power supply source must be connected to DOCOMx (X111, X222, X333: Pin 47, 48, 49, 50).

  The reference ground of the external power supply source must be connected to X111, X222, X333: Pin 1 (M).

  For further data, see Subsection 2.11.3, Page 2-87.

Caution

At the user end, it must be ensured that the maximum current drawn per DOCOMx Pin (X111, X222, X333: Pins 47, 48, 49, 50) does not exceed 1 A. The power supply (+24 V DC) for the digital outputs must therefore be connected **to all 4 pins** (X111, X222, X333: Pin **47**, **48**, **49**, **50**) for each DOCOMx.

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- Electrical specification of the digital outputs:

Table 2-19 Electrical specification of the digital outputs

Digital outputs	Min.	Typical	Max. 5 A	Nominal
Voltage at high signal level ($U_{H)}$	V_{CC} – 3 V	1)	V_{CC}	24V
Output current I_{OUT}	–	–	250mA	–
Voltage at low signal level ($U_{L)}$	–	–	–	Output open
Leakage current at low level	–	50µA	400µA	–
Signal delay time T_{PHL} 2)	–	0.5 ms	–	–
Maximum switching frequency 2)				
Resistive load	100Hz	–	–	–
Inductive load	2Hz	–	–	–
Lamp	11Hz	–	–	–

- 1)
  $U_{H_typical} = V_{CC} - I_{OUT} * R_{ON}$
  V_{CC}: actual operating voltage
  I_{OUT}: maximum output current (see above)
  maximum short–circuit current: 4A (max. 100µs, V_{CC}= 24V)
  R_{ON}: internal resistance = 0.4Ω
- 2)
  Moreover, the PROFIBUS communication time and the application cycle time must be taken into account.
- Incorrect connection causes neither high level nor destruction of the outputs.

- General electrical properties
  - No electrical isolation
  - Current limitation to maximum 500 mA
  - Protection against: short–circuit, overtemperature, and loss of ground
  - Automatic disconnection in case of undervoltage

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LED: Status display The module has 3 LEDs through which the module status is displayed.

Table 2-20 LED: Status display

Designation	Color	Description
POWER	Green	Power supply
OVTEMP	Red	Overtemperature indication
EXCHANGE	Green	Cycl. data exchange with DP master in progress
READY	Red	Ready for cycl. data exchange with DP master

2.11.3 Power supply

Module The supply voltage (24 V DC) of the I/O module PP72/48 is connected to the screw terminal block X1. See Subsection 2.11.2, Page 2-80.

Digital outputs To power the digital outputs (+24 V DC), an external power supply source is required. The power supply is connected through terminals X111, X222, X333, pins 47, 48, 49, 50 (DOCOMx).

Digital inputs If the internal power supply from X111, X222, X333, Pin 2 (P24OUT) is not used to power the digital inputs, it can be replaced by an external power supply source (+24 V DC) as an option.

The reference ground of the power supply source must be connected with X111, X222, X333, Pin 1 (GND). X111, X222, X333, Pin 2 (P24OUT) then remains open.

Specification of the power supply voltages (+24 V DC) The external power supply voltages must be generated as functional extra–low voltages with safe electrical isolation (according to IEC 204–1, Section 6.4, PELV) and must be grounded centrally by the user.

The reference ground of the terminals X111, X222, X333, pin 1 (GND) must be connected to a common grounding point with the reference ground of the power supply of the I/O module PP27/48.

Caution

The external power supply voltages must be generated as function extra–low voltages with safe electrical isolation (IEC 204–1, Section 6.4, PELV) and must be grounded centrally by the user.

Moreover, the external power supply voltages for the I/O modules PP72/48, the digital outputs, and optionally the digital inputs must meet the specifications according to Table 2-21.

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Table 2-21 Specification of the power supply voltage P24OUT,

Voltage	
Minimum	20.4 V
Nominal	24 V
Maximum	28.8 V
Minimum (dynamic)	18.5 V
Maximum (dynamic)	30.2 V
Non–cyclic overvoltage	
Max. (absolute, transient)	35 V
Max. duration	500 ms
Min. recovery time	50 s
Max. events per h	10
Voltage failure for min. power supply voltage	
Max. duration 1)	50 ms
Min. recovery time	1 s
Max. events per h	10
Power consumption	
Maximum	approx. 40 W

On the module side the power supplies must be protected against:

- Polarity reversal
- Short–circuit (elec. current limitation of the outputs)
- Overload (fuse protection).

2.11.4 Grounding

The module must be installed according to EN 60204.

If a large–area, permanent metallic connection with the central ground point through the rear panel is not possible, the mounting plate must be connected to the grounding by means of a line (cross section >10 mm^2).



Caution

A protective conductor must be connected.

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2.11.5 Dimension drawing

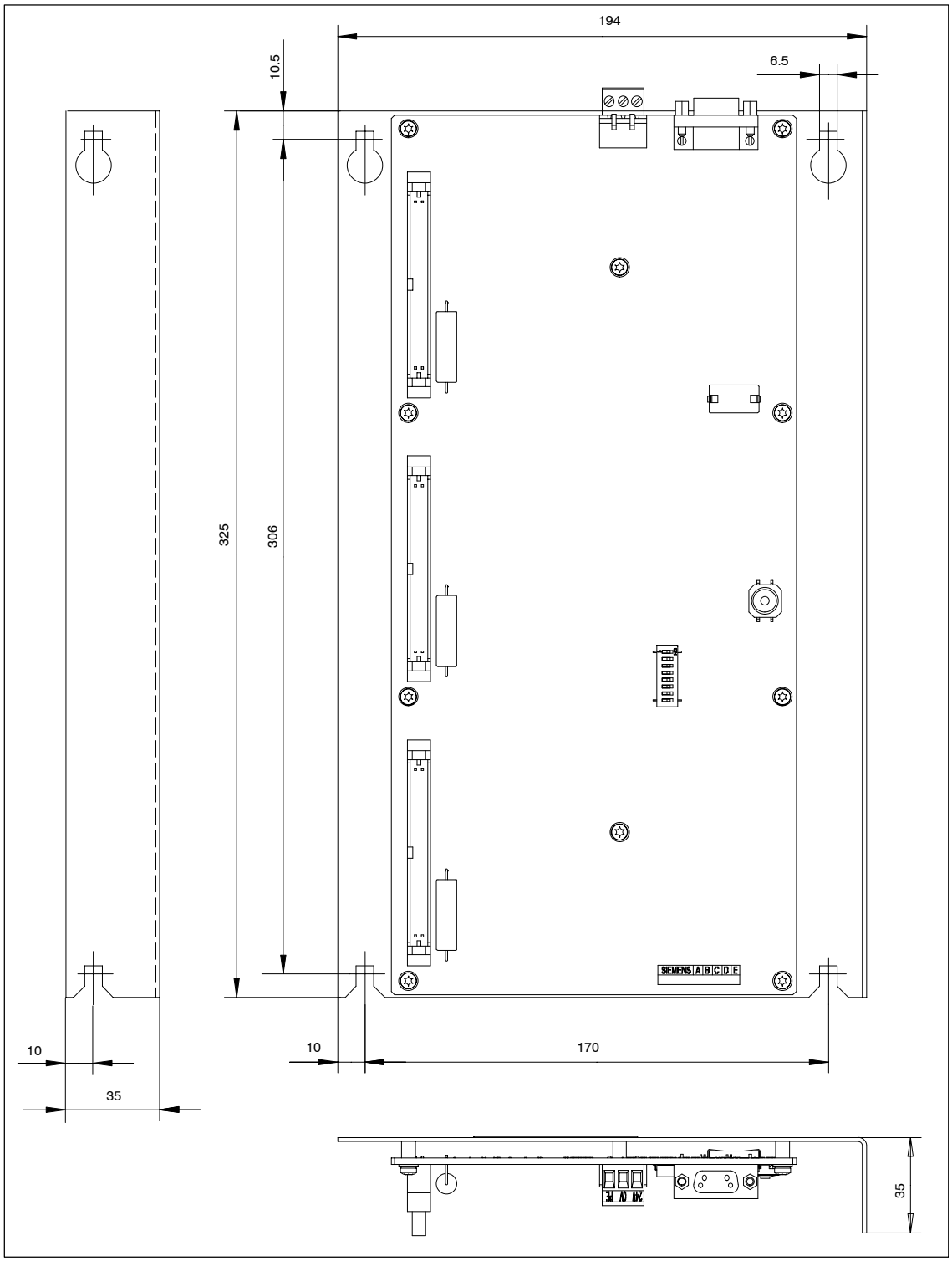


Fig. 2-23 Dimension drawing: I/O module PP72/48

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2.11.6 Technical data

Technical data of I/O module PP72/48

Safety		
Degree of protection	IP 00	
Safety class	Safety class I, in accordance with VDE 0106 P1: 1982 (IEC 536); Protection against ingress of foreign bodies and water in accordance with IEC 529	
Approvals	UL/CSA, CE	
Power consumption		
At nominal load	11W	
Mechanical data		
Dimensions WxHxD [mm]	194 x 325 x 35	
Weight	Approx. 0.3 kg without mounting plate	Approx. 1.2 kg with mounting plate
Ambient environmental conditions		
Heat dissipation	Open circuit ventilation	
	Operation	**Storage/transport**
Temperature limits	0 ... 50°C	–20 ... 55°C/–40 ... 70 °C
Limits for relative humidity	5 ... 95 % without condensation	5 ... 95 % without condensation
Condensation	Not permissible	
Atmospheric pressure	700 ... 1060 hPa	700 ... 1060 hPa
Transportation altitude	–	–1000 ... 3000 m
Shock stress during transportation		
Free fall in transport packaging	≤ 1000 mm	

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2.12 ADI4 (Analog Drive Interface for 4 Axes)

2.12.1 Module

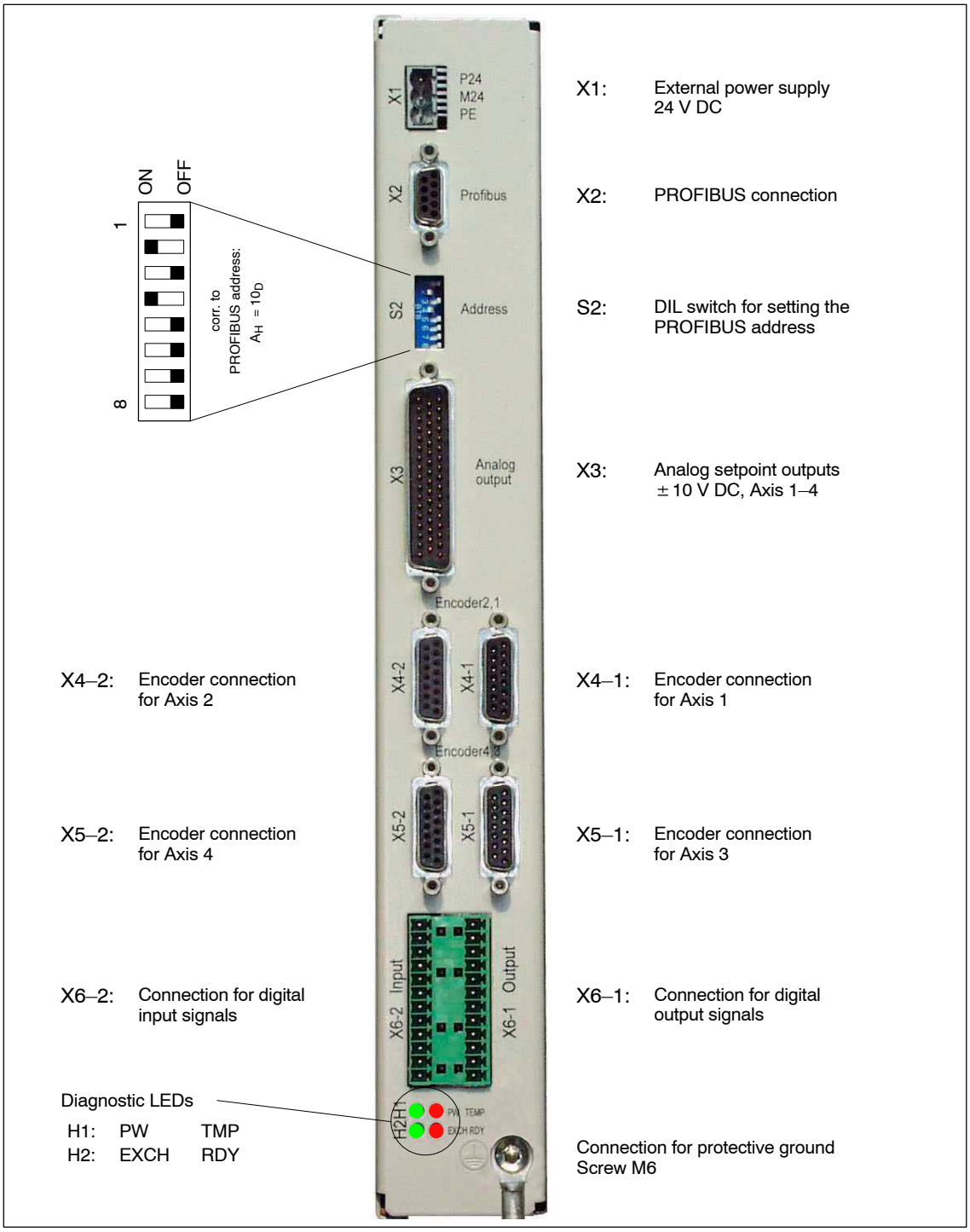


Fig. 2-24 Connection overview for ADI4

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Order number

Designation	Order No. (MLFB)
ADI4	6FC5 211–0BA01–0AA2

Features

The interface module ADI4 is suitable for operating up to 4 drives with an analog setpoint interface on the PROFIBUS DP.

The module has the following essential features:

- PROFIBUS DP connection (max 12 Mbits/s)
- 4 servo interfaces each with one:
  - Input: TTL/SSI encoder for incremental and absolute measuring systems
  - Outlet: ±10 V analog
- General and drive–specific digital input/output signals
- Onboard status display by means of 4 diagnostic LEDs

To power the module and the digital outputs, an external power supply source (+24 V DC) is required.

Notice

Please observe the following framework conditions for operating the ADI4 DP slave:

- An ADI4 DP slave can only be operated on an **equidistant** PROFIBUS DP (see Subsection 8.8, Page 8-222).
- An ADI4 DP slave is **not** a DP standard slave certified as compliant with the PROFIDrive profile, e.g. the ADI4 DP slave does not support acyclic communication.

References

For detailed documentation about the operator panel front OP 012 please see:

References: /ADI4/ Analog drive port for 4 axes

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2.13 Diagnostic repeater for PROFIBUS DP

2.13.1 Module



Fig. 2-25 View: Diagnostic repeater for PROFIBUS DP

Order number

Designation	Order No. (MLFB)
Diagnostic repeater for PROFIBUS DP	6ES7 972–0AB01–0XA0

Features

The diagnostics repeater with online line diagnostics for PROFIBUS DP offers the following main features:

- Module–specific features:
  - PROFIBUS DP standard slave (DP–V1)
  - Data transmission speed: 9.6 kBaud to 12 MBaud
  - Maximum depth of cascading: 9
  - Redundant operation: no
- Automatic detection of fault type and fault location
- Distance given in line diagonistics:
  - Resolution: 0.5 m
  - Accuracy: ± 1 m
- Repeater throughput time:
  - Baud rates ≥ 1.5 Mbaud: 2.5 T_{BIT} + 153 ns; (12MBaud: T_{BIT} = 83.3 ns)
  - Jitter: 1T = 1/48 MHz = 20.83 ns
- Monitoring function of isosynchronous PROFIBUS
  - DP bus cycle (T_{DP}): min. 1 ms, max. 32 ms
  - Tolerance range T_{DP} monitoring: ± 2 µs
  - Tolerance range T_{DX} monitoring: ± 10 µs
- Supply voltage: Rated voltage 24 V DC (20.4 to 28.8 V)

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- Permissible ambient conditions:
  - Operating temperature 0 °C to +60 °C
  - Transport/storage temperature –40 °C to +70 °C
  - Relative humidity max. 95 % at 25 °C
- Mechanical design:
  - Dimensions (B X H X T) 80 x 125 x 67.5
  - Weight 300 g
- Degree of protection: IP20

References

A full description of the diagnostic repeater for PROFIBUS DP is to be found in:

References:

Manual
SIMATIC diagnostic repeater for PROFIBUS DP

Drawing number: A5E00352937–01, 10/2004 Edition

Order number (MLFB): 6ES7972–0AB00–8AA0

■

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3 Design

3.1 System overview

3.1.1 Operator panels and touch panels

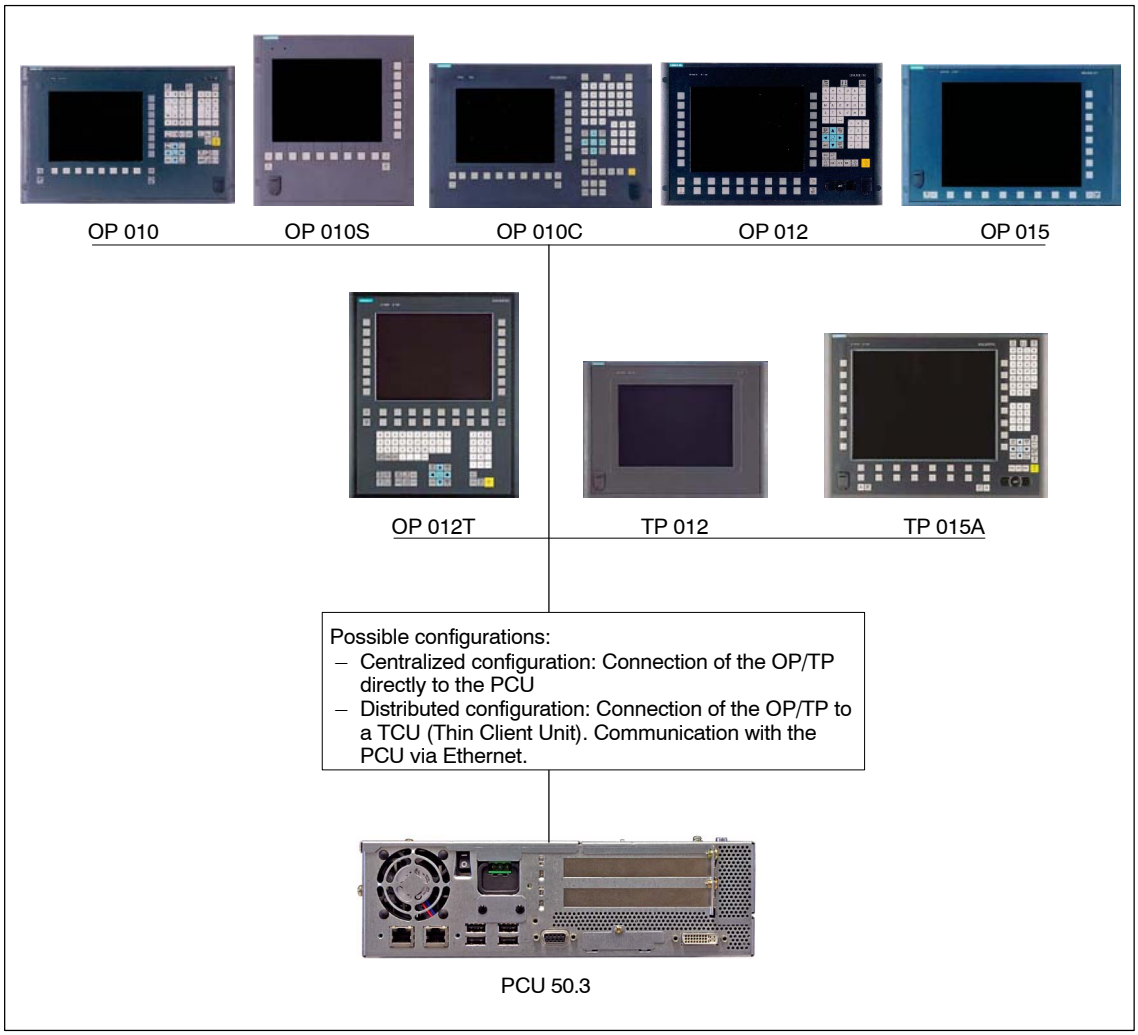


Fig. 3-1 System overview of SINUMERIK 840Di sl Operator panels and touch panels

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3.1.2 PROFIBUS DP components

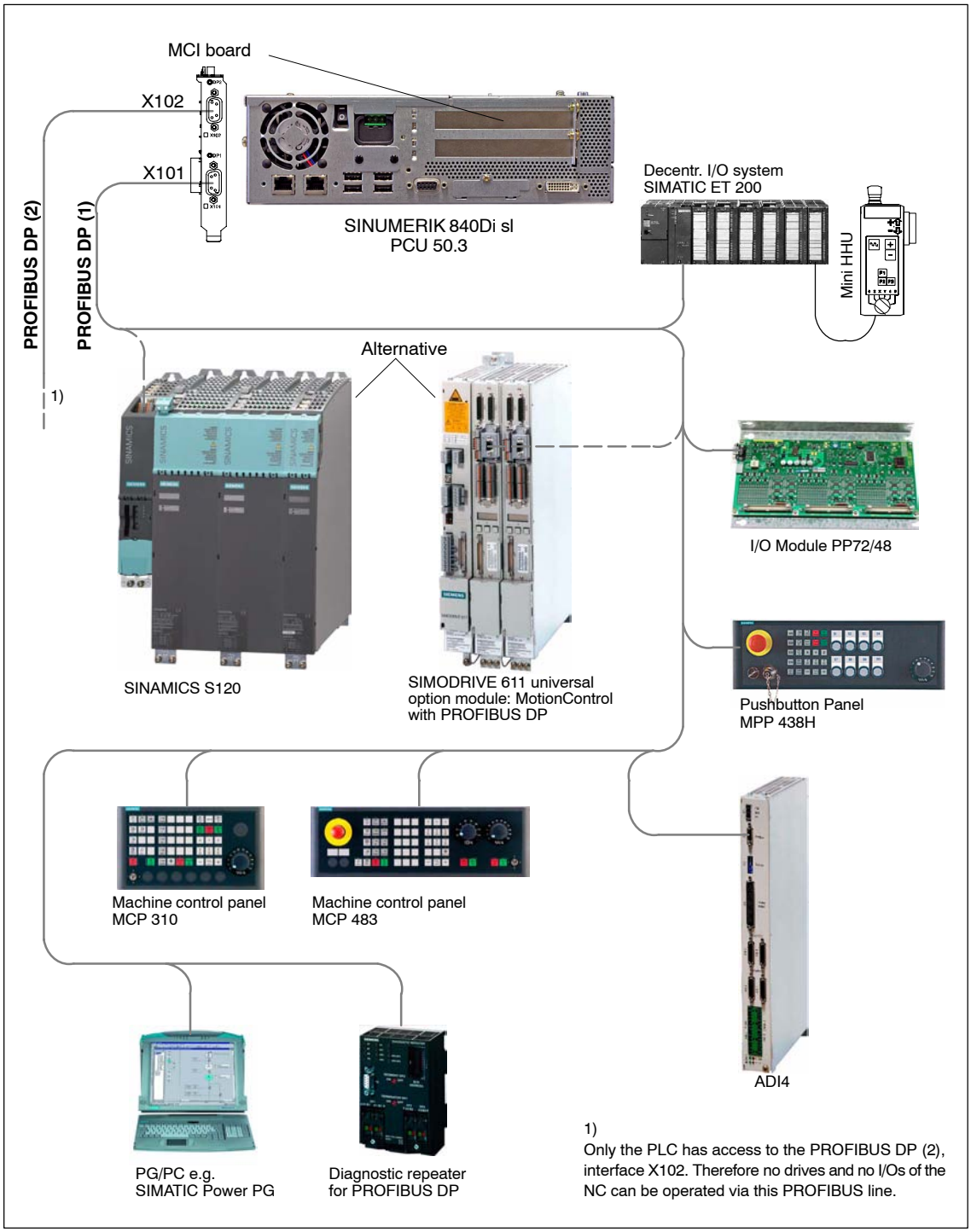


Fig. 3-2 System overview of SINUMERIK 840Di sl PROFIBUS DP (schematic)

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3.1.3 MPI components

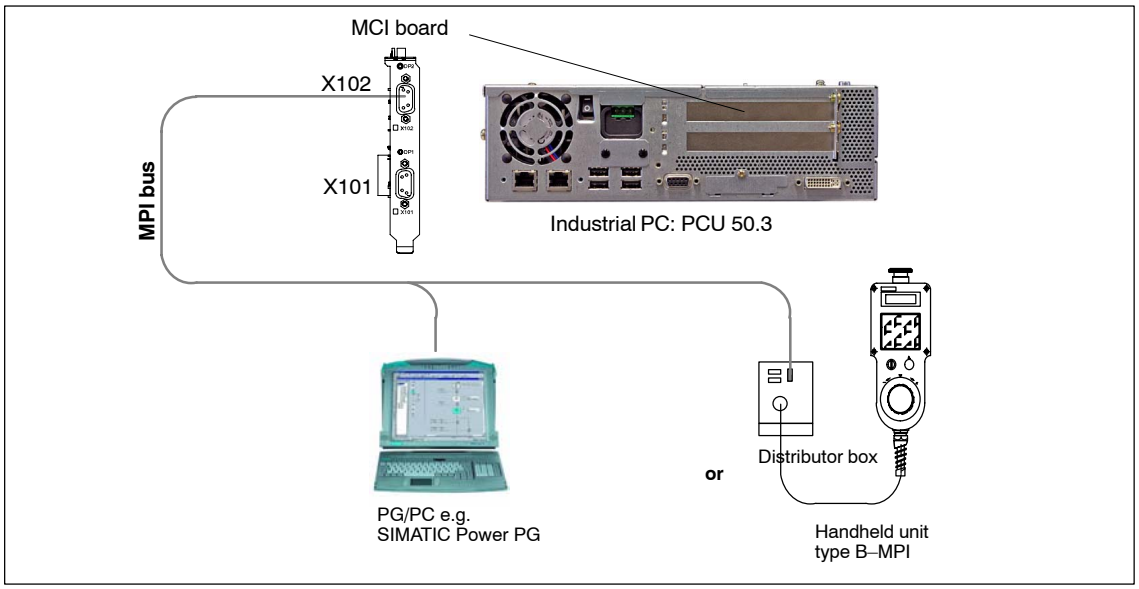


Fig. 3-3 System overview of SINUMERIK 840Di sl MPI (schematic)

3.1.4 PCU components

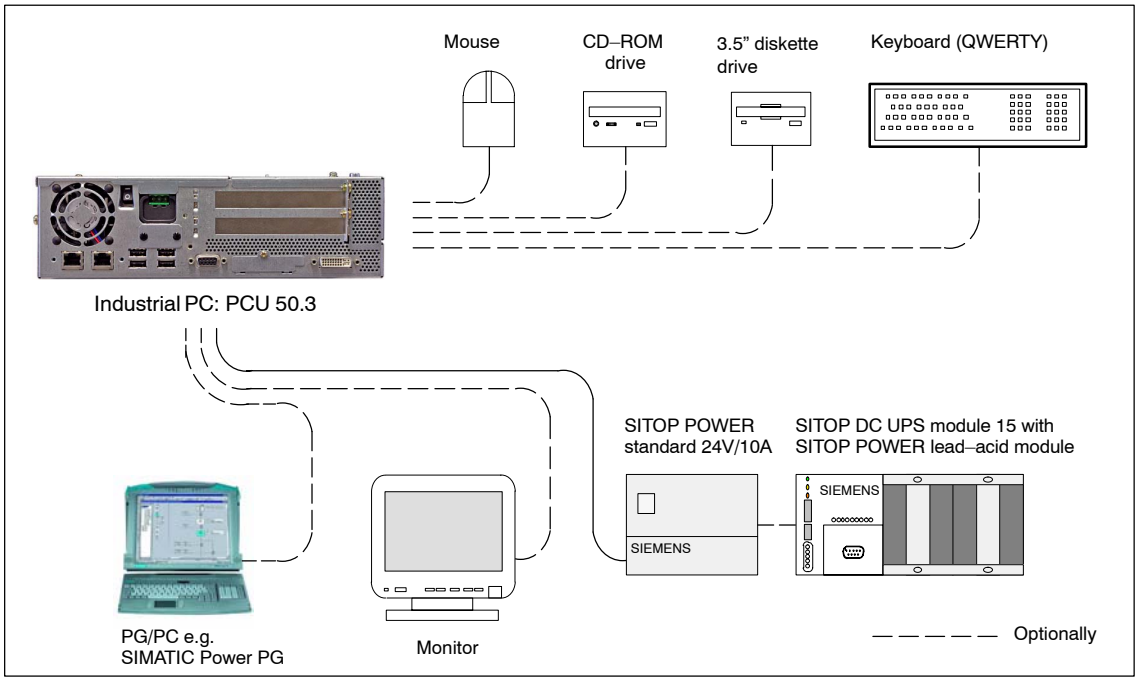


Fig. 3-4 System overview of SINUMERIK 840Di sl PCU components (as a diagram)

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3.2 Electrical design

3.2.1 MCI board and PROFIBUS DP

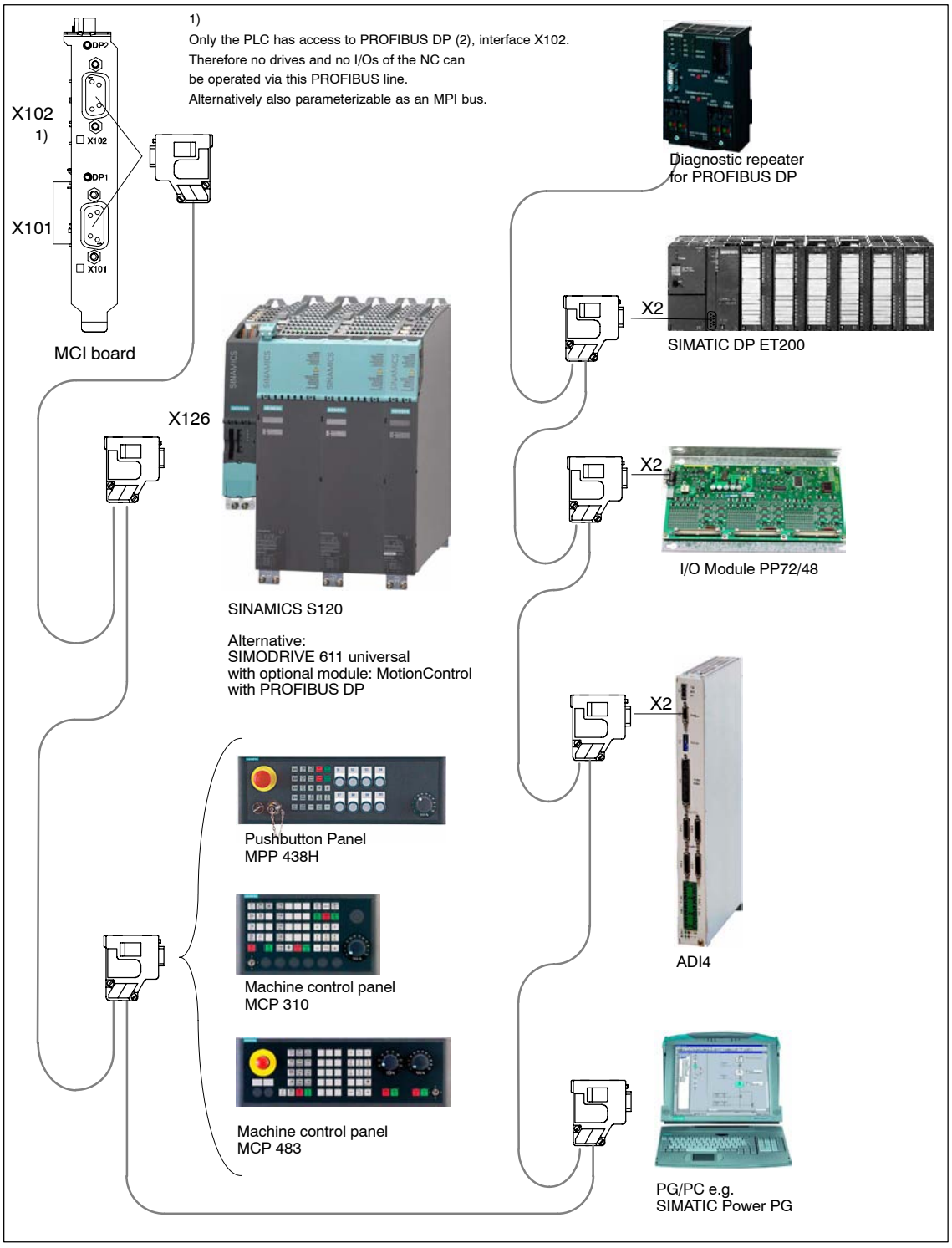


Fig. 3-5 SINUMERIK 840Di sl MCI board and PROFIBUS DP components

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Note

For details on general accessories, such cables, connectors and prefabricated cables, please refer to:

References: Catalog NC 61, MOTION–CONNECT

3.2.2 MCI board and MPI bus

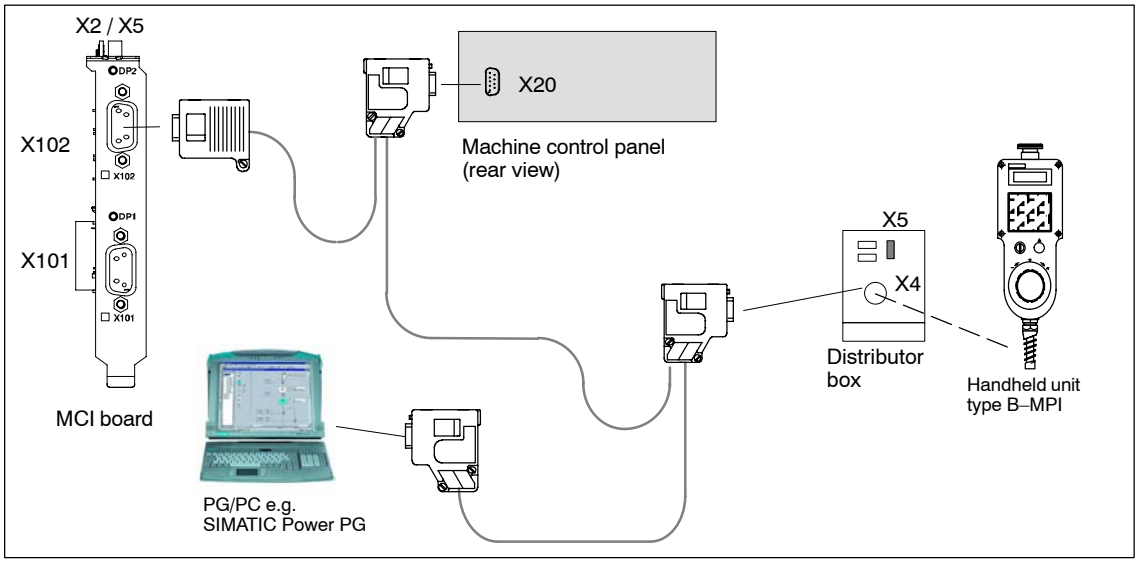


Fig. 3-6 SINUMERIK 840Di sl MCI board and MPI bus components

3.2.3 MCI board extension

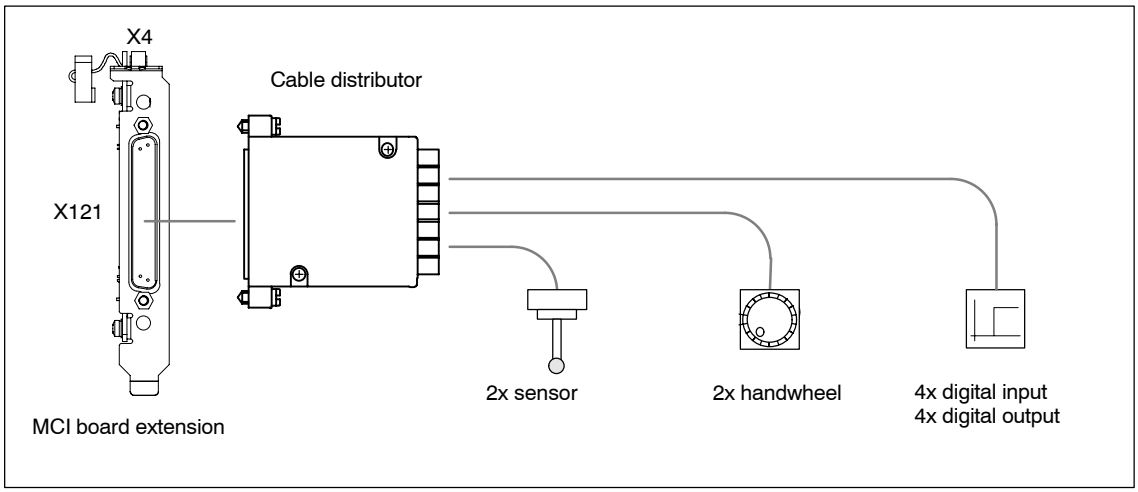


Fig. 3-7 SINUMERIK 840Di sl MCI board extension

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3.2.4 PCU 50.3

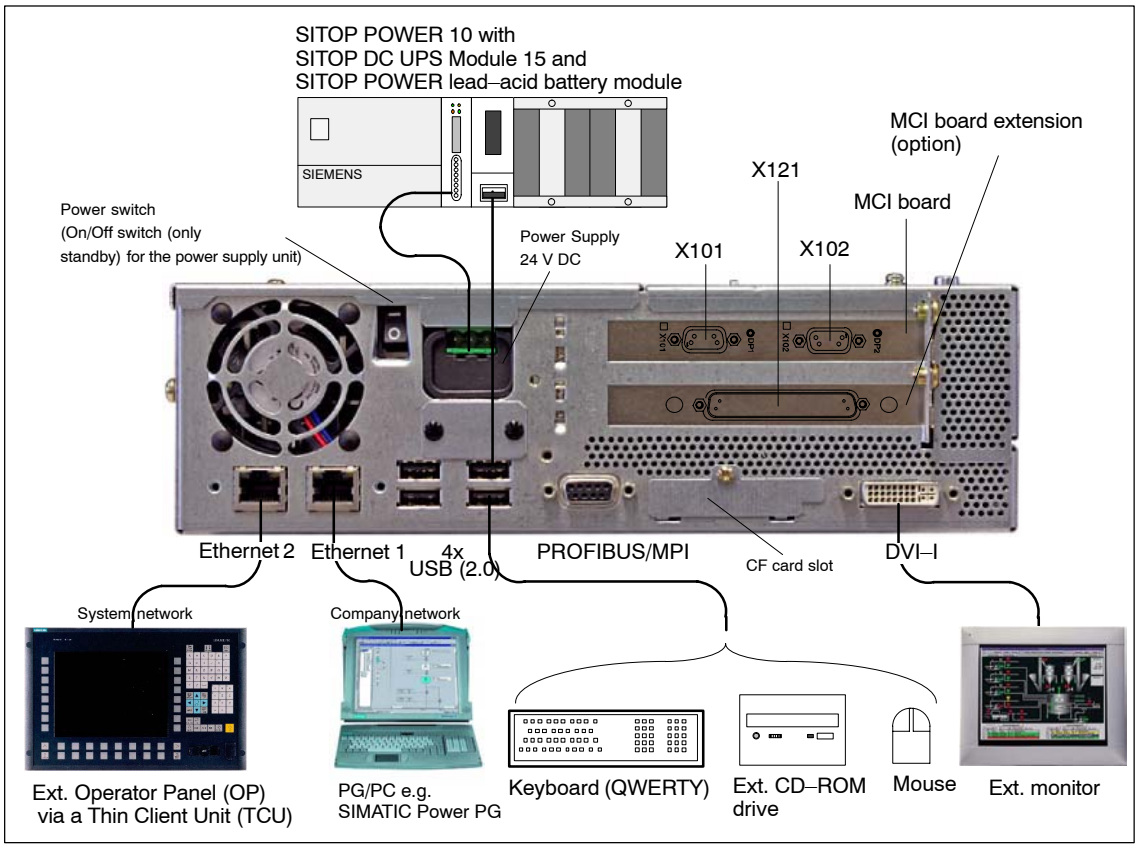


Fig. 3-8 SINUMERIK 840Di sl: PCU 50.3 (right housing)

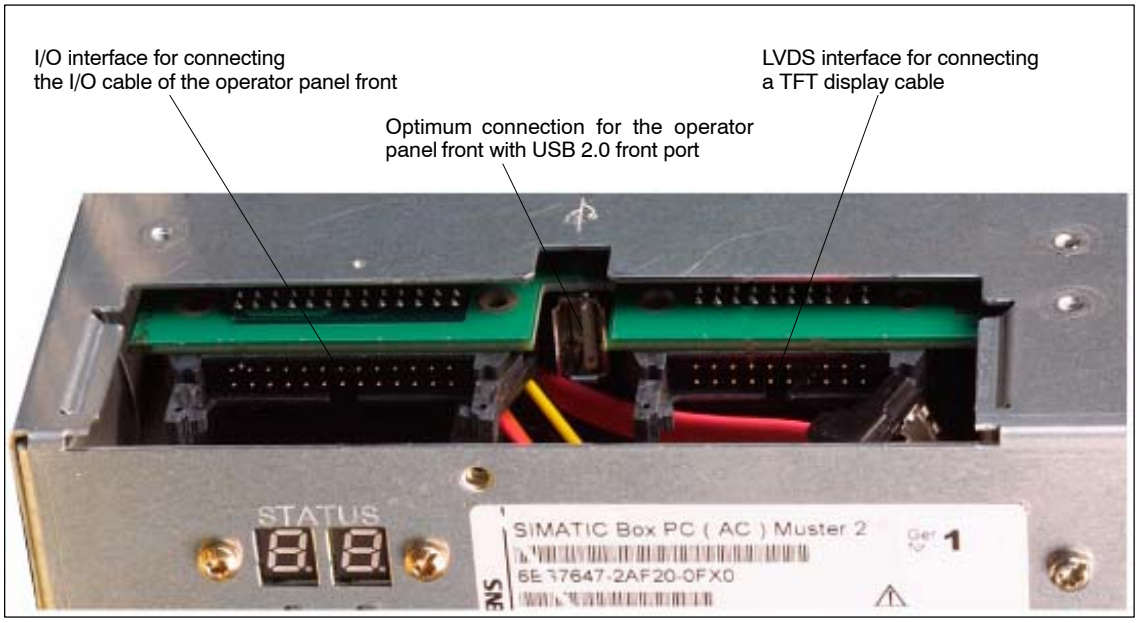


Fig. 3-9 SINUMERIK 840Di sl: PCU 50.3 (rear housing)

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3.3 Overview of connections

3.3.1 MCI board and MCI board extension

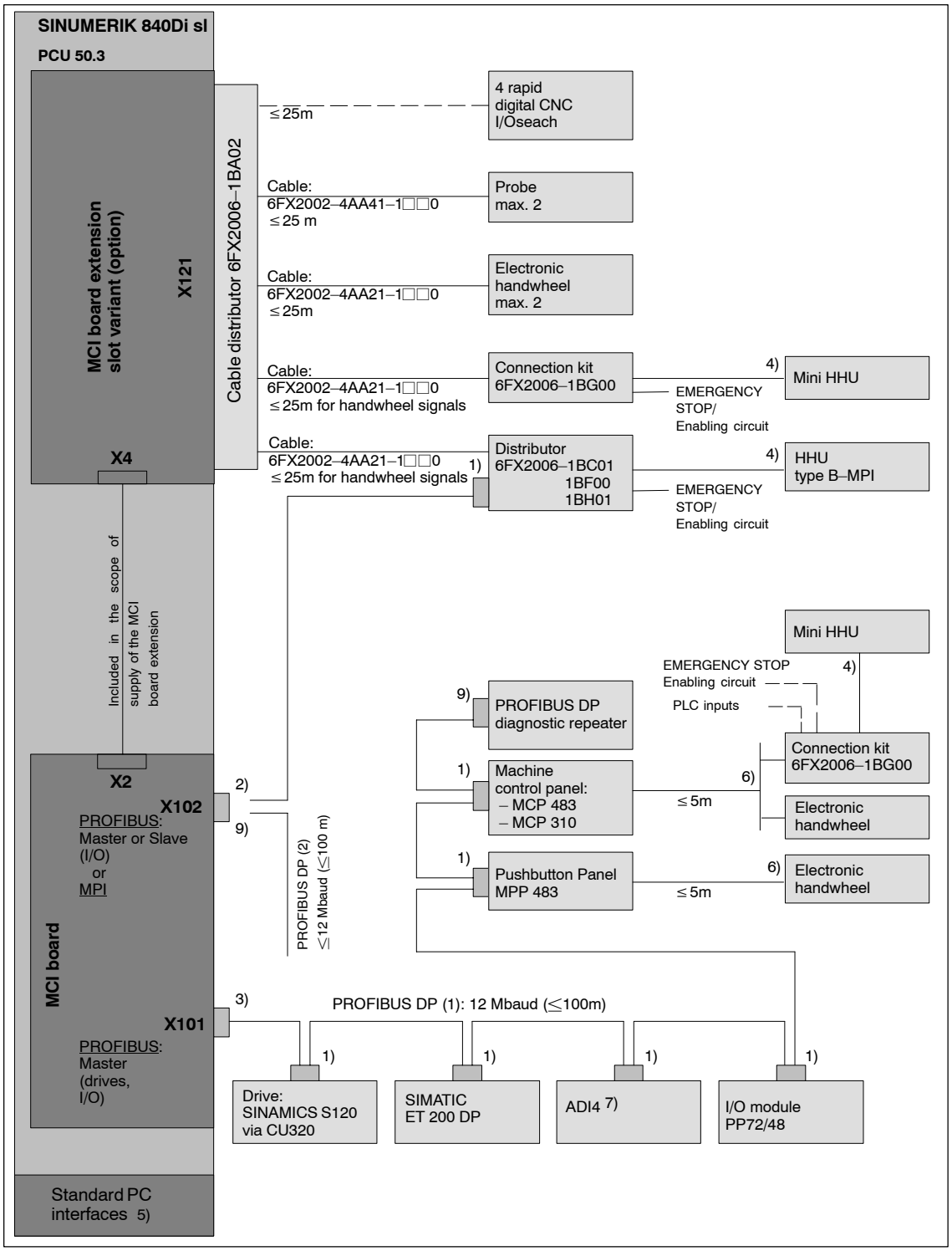


Fig. 3-10 Connection overview: MCI board and MCI board extension

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1) Connector:
6ES7972–0BA41–0XA0; cable outlet 35^0, without socket connector for programming device
6ES7972–0BB41–0XA0; cable outlet 35^0, with socket connector for programming device
6ES7972–0BA12–0XA0; cable outlet 90^0, without socket connector for programming device
6ES7972–0BB12–0XA0; cable outlet 90^0, with socket connector for programming device

Cable:
6XV1830–0EH10; by the meter, not trailable
6XV1830–3EH10; by the meter, trailable

2) Connector:
6GK1500–0EA02; cable outlet 180^0, without PG socket connector for programming device

Cable:
6XV1830–0EH10; by the meter, not trailable
6XV1830–3EH10; by the meter, trailable

3) Connector:
6ES7972–0BB41–0XA0; cable outlet 35^0, with socket connector for programming device
6ES7972–0BB12–0XA0; cable outlet 90^0, with socket connector for programming device

Cable:
6XV1830–0EH10; by the meter, not trailable
6XV1830–3EH10; by the meter, trailable

4) The cable is included in the scope of supply.

5) For an overview of the standard PC interfaces, see Fig. 3-8, Page 3-100 and Fig. 3-9, Page 3-100, as well as:

References: /BH/ Operator Components Manual
Component PCU 50.3

6) Cable: 6FX8002–2CP00–1A□0

7) For a detailed overview of the connection to the AD14 please refer to
References: /ADI4/ Analog drive interface for four axes
Connection overview

8) Connection via Fast Connect (insulation displacement method) see:
References: SIMATIC Manual: Diagnostic repeater for PROFIBUS DP

9) Can be assigned parameters either as an MPI or a PROFIBUS interface. Only the PLC has access to this PROFIBUS interface. No drives and no NCK I/Os can be operated via this PROFIBUS line.

Note

The length codes for preassembled cables 6FX□002–... can be found in:

References: Catalog NC 61, MOTION–CONNECT.

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3.3.2 PCU50

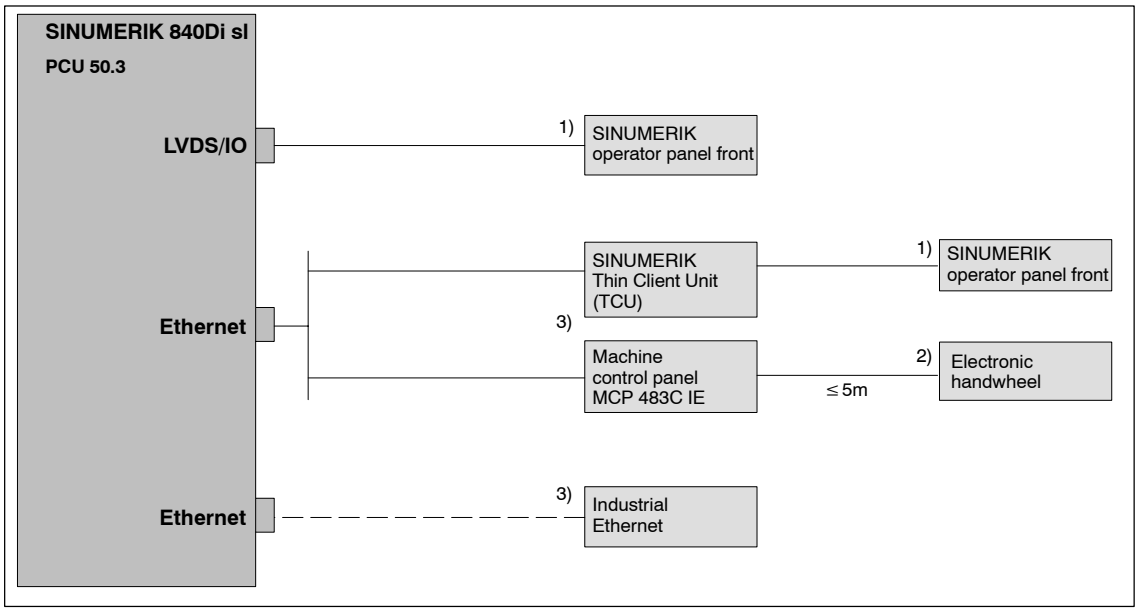


Fig. 3-11 Connection overview: PCU

1) The cable is included in the scope of supply.

2) Cable: 6FX8002–2CP00–1A□0

3) For information on Ethernet cables, please refer to **References**: Catalog NC 61, MOTION–CONNECT

■

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Space for your notes

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EMC and ESD Measures

4

4.1 Interference suppression measures

Shielded signal cables

To ensure safe, interference–free operation of the installation, it is essential to use the cables specified in the individual diagrams. Both ends of the shield must always be conductively connected to the equipment housing.

Exception:

- If non–Siemens devices are connected (printers, programming devices, etc.), you can also use standard shielding cables, which are connected at one end.

  These external devices may not be connected to the control during normal operation. However, if the system cannot be operated without them, then the cable shields must be connected at both ends. Furthermore, the external device must be connected to the control via an equipotential bonding lead.

Rules for routing cables

In order to achieve the best possible noise immunity of the complete system (control, power module, machine), the following EMC measures must be carefully observed:

- Signal cables and load cables must be routed at the greatest possible distance from one another.
- Only use SIEMENS signal cables for connecting to and from the NC or PLC.
- Signal cables may not be routed close to strong external magnetic fields (e.g. motors and transformers).
- Pulse–carrying HC/HV cables must always be laid completely separately from all other cables.
- If signal cables cannot be laid at a sufficient distance from other cables, then they must be installed in shielded cable ducts (metal).
- The distance (noise field) between the following leads should be as small as possible:
  - Signal cable and signal cable
  - Signal lead and associated equipotential bonding lead
  - Equipotential bonding lead and PE conductor (routed together).

! **Important**

For further notes on interference suppression measures and the connection of shielded cables, please refer to
References: /EMC/ EMC Directives.

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4.2 ESD measures



Notice

Handling of modules containing devices sensitive to electrostatic discharge:

- When handling electrostatically sensitive devices, make sure that operator, workplace and packing material are properly grounded.
- As a general principle, electronic modules should only be touched if this is absolutely unavoidable (owing to repair work, etc.). When you are handling PCBs, therefore, make sure that you never touch any submodule pins or conducting paths.
- Touch components only if
  - you are permanently grounded by means of an antistatic chain,
  - you are wearing ESD boots or ESD boots with grounding strips in conjunction with ESD flooring.
- Modules may be placed only on electrically conductive surfaces (table with ESD top, conductive ESD foam plastic, ESD packing bags, ESD transport containers).

  Notice
  Exceptions to this are modules with their own power source (e.g. battery). These may not be placed on conductive surfaces, as this might result in short circuits and thus destroy the component on the module.
- Keep modules away from visual display units, monitors or TV sets (minimum distance from screen > 10 cm).
- Do not bring ESD–sensitive modules into contact with chargeable and highly–insulating materials, such as plastic sheets, insulating table tops or clothing made of synthetic materials.
- Measurements on modules are allowed only if
  - the measuring instrument is grounded (e.g. via PE conductor) or
  - the measuring head on an isolated instrument is discharged briefly (e.g. by being brought into contact with bare metal part of control housing) before the measurement is taken.

■

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Power–On and Power–Up 5

5.1 Preparing for commissioning

5.1.1 Checklist

SINUMERIK 840Di sl

The following checklist will help you to commissioning the supplied components without undue problems and ensure high availability on your product:

- When handling the components, all ESD measures are observed.
- All screws are tightened with their prescribed torque.
- All connectors are plugged correctly and locked/screwed.
- All components are grounded and connected to shields.
- The load capacity of the central power supply is taken into account.

Drives

Additional points should be observed depending on the drive system used. For detailed information, please refer to:

- SINAMICS S120
  Commissioning Manual
  Section: Prerequisites for commissioning
- SIMODRIVE 611 universal
  /FBU/ Description of Functions SIMODRIVE 611 universal
  Section: General commissioning information

Limit values

All components are dimensioned for defined mechanical, climatic and electrical environmental conditions. No limit value may be exceeded, neither during operation, nor during transportation.

In particular, the following must be observed:

- Power supply conditions
- Pollution burden
- Function–impairing gases
- Ambient environmental conditions
- Storage/transport
- Shock stressing
- Vibration stressing
- Ambient temperature

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5.1.2 Recommended sequence for first commissioning

The individual steps for first commissioning are listed below in the recommended order.

1. The whole plant is mechanically and electrically connected and tested for errors acc. to the checklist (see above).
   - SINUMERIK 840Di sl
   - SINAMICS S120 or SIMODRIVE 611 universal inverter system
   - Motors
   - SIMATIC S7 I/O components
   - HMI user interfaces
2. The order numbers (MLFB) of the SIMODRIVE 611 universal drives and SIMATIC S7–I/O components should be available.
   When creating the SIMATIC S7 project, they are used to check whether the component chosen from the hardware catalog by ”HW Config” corresponds to the component used on the plant.
3. Configure the SINUMERIK 840Di sl completely on first booting
   (Section 5.2, Page 5-109)
4. Take the PLC default program supplied as the commissioning file for the PLC (basic PLC program, PLC user program and configuration) or create your own SIMATIC S7 project and load it into the PLC
   (Section 8, Page 8-175)
5. Prepare the drives on the PROFIBUS DP for communication:
   - SINAMICS S120 (Section 9, Page 9-241)
   - SIMODRIVE 611 universal (Section 10, Page 10-275)
6. Perform commissioning of the NC (channels, axes and spindles, etc. (Section 11.5, Page 11-310))
7. Set up the alarm texts (Section 12, Page 12-413)
8. Perform the commissioning of the drives:
   - SINAMICS S120 (Section 9, Page 9-241)
   - SIMODRIVE 611 universal (Section 10, Page 10-275)
9. Carry out a dry run for all axes and the spindle.
   (Section 18, Page 13-421)
10. Perform the optimization of the drives:
    - SINAMICS S120: STARTER
    - SIMODRIVE 611 universal: HMI Advanced (Section 14, Page 14-427) and/or SimoCom U
11. Carry out a user data backup (series startup file)
    (Section 15, Page 15-459)
12. Optional: Make a complete data backup (partition and/or hard disk image):

References

/IAM2/ CNC Commissioning Part 5
Section: IM8
4 Save and restore data

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5.2 First power–up

5.2.1 Basic commissioning of the system software

Objective of basic commissioning

After the basic commissioning described in the following two sections, the following conditions should apply:

- SINUMERIK 840Di sl NC and PLC are operated in cyclical operation
- If a machine control panel is connected, no alarms or messages should be pending.
- The displayed axes of the NC can be traversed by simulation.

Factory settings

The hard disk of the PCU is already partitioned upon delivery for operating the SINUMERIK 840Di sl. Additional software applications which have been been ordered, e.g. HMI Advanced, are ready for installation under:

- D:\Setup\Apps\<*Application1*> . . . <*Application n*>

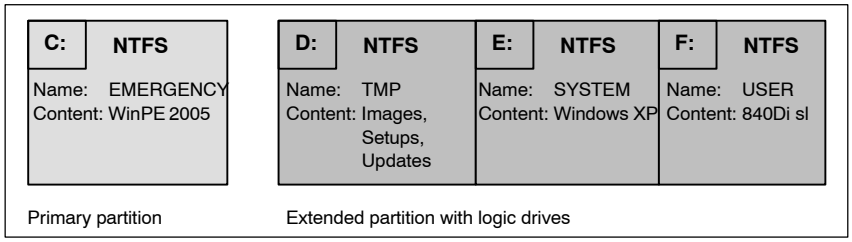
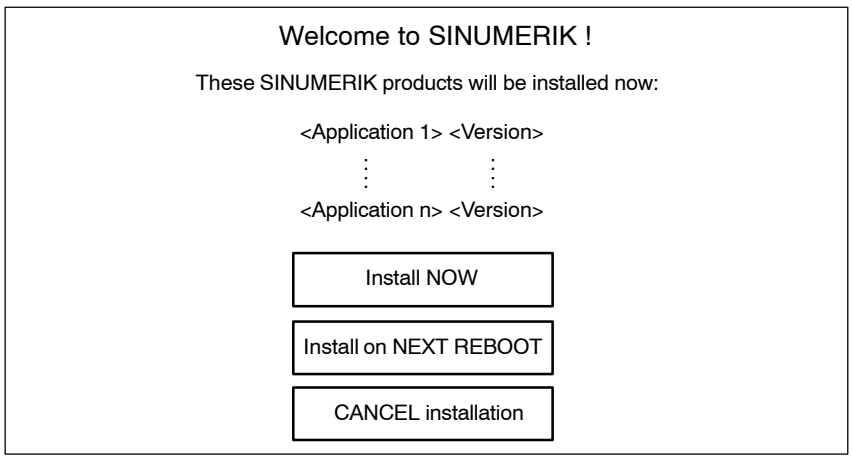


Fig. 5-1 Partitioning the hard disk

Installing the software

When the PCU is first booted, the following menu is displayed:



Menu commands:

- **Install NOW**

  All the applications displayed will be installed in the listed order. During the installation procedure follow the instructions that appear on the screen.

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Notice

You must not switch off the PCU during the entire installation procedure. Data loss!

- **Install on NEXT REBOOT**

  None of the listed applications are installed and you are taken to the Windows desktop. The installation menu is displayed again the next time the PCU is booted.

- **CANCEL installation**

  None of the listed applications are installed.

  Application:
  Subsequent installation of a hard drive image as part of a standard commissioning.

Notice

The current installation menu will **not be** displayed the next time the PCU is booted. The installation procedure which was cancelled with ”Cancel installing” **cannot** be repeated

Completion

When installation is complete rebooting automatically starts. Once the PCU has booted again, you can continue with the basic PLC commissioning (Section 5.2.2, Page 5-110).

5.2.2 Basic commissioning of the PLC

Once the Service Desktop is active the PLC series startup file supplied must be loaded into the PLC for basic commissioning. To do so, proceed as follows:

1. Start the ”SinuCom NC” commissioning tool from the Windows taskbar:
   Start > Programs > SinuCom NC > SinuCom NC
2. Use SinuCom NC to load the series startup file **PLC_SMP.ARC** into the PLC.

   Menu command: **File > Archive > Series commissioning archive > Read in**

   Dialog box: Reading–in an archive

   – Radio button: Data Storage

   – Button: ”NEXT”

   – Select file PLC_SMP.ARC in directory Archive

   – Button: ”FINISH”.

This executes the PLC basic commissioning. NC and PLC run in cyclic mode.

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5.3 Booting

5.3.1 SRAM handling

The user data of the NC (machine data, setting data, user variables, part programs, cycles, etc.), as well as the retentive data of the PLC are battery–backed in the static memory area (SRAM) of the MCI board.

With each ”NCK power ON RESET” (warm restart) or shutting down Windows XP correctly, the contents of the SRAM is saved to the hard disk of the PCU as an SRAM image. In this case, the SRAM image valid until then is also saved to the hard disk of the PCU as an SRAM backup.

In certain error or servicing instances, the SRAM image or backup can be accessed so that work can be continued immediately without recommissioning the SINUMERIK 840Di sl.

Table 5-1 SRAM handling

HW serial number MCI board	SRAM MCI board ”OK”	SRAM image (hard disk) ”OK”	SRAM backup (hard disk) ”OK”	Used user data/*remark*
Known	Yes	Not applicable	Not applicable	MCI/*Normal power–up*
Known	No	Yes	Not applicable	IMAGE/*no message box or alarms;* see Section 5.3.3; case 1
Known	No	No	Yes	BACKUP/*message box and alarm;* see Section 5.3.3; case 2
Known	No	No	No	Commissioning/*recommissioning required*
Unknown	Yes	Yes	Not applicable	MCI or IMAGE/*Request carried out;* see Chapter5.3.5
Unknown (SW update)	Yes	Not applicable	Not applicable	MCI/*MessageBox;* See Section 5.3.4
Unknown	Yes	No	Yes	MCI or BACKUP/*Request carried out; if BACKUP is selected, message box and alarm will occur;* see Section 5.3.3; case 2
Unknown	Yes	No	No	MCI/*MessageBox;* See Section 5.3.4
Unknown	No	Yes	Not applicable	IMAGE/*MessageBox;* see Section 5.3.3; case 1
Unknown	No	No	Yes	BACKUP/*message box and alarm;* see Section 5.3.3; case 2
Unknown	No	No	No	Commissioning/*recommissioning required*

HW serial number. MCI board

Known: The hardware serial no. of the MCI board matches the serial number last stored on the PCU.

Unknown: The hardware serial no. of the MCI board does **not** match the serial number last stored on the PCU.

Unknown: Provided that the SRAM of the MCI board is ”OK”, the system does not request which SRAM (MCI or IMAGE) is to be used when booted for the first time (SW update). The SRAM of the MCI board is always used.

SRAM image or SRAM backup (hard disk) ”OK”

Yes: The following criteria must be fulfilled:

1. NC and PLC–SW version of SRAM image or backup must match the installed software version.

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2. Windows XP must have been shut down correctly (the POWER FAIL mechanism of the SINUMERIK 840Di sl is also sufficient).
3. The checksum test using the SRAM image or backup must be successful.
4. The battery status at the time of saving the SRAM image must be OK.

Used user data

MCI:	The battery–backed user data in the SRAM of the MCI board are used.
IMAGE:	The battery–backed user data in the SRAM image on the hard disk of the PCU are used.
BACKUP:	The battery–backed user data in the SRAM backup on the hard disk of the PCU are used.
Commissioning:	The user data of the NC are deleted and default machine data loaded.

5.3.2 Start–up after battery replacement (PCU backup battery)

Correct shutdown

Before replacing the PCU backup battery, the SINUMERIK 840Di sl or Windows XP **must** be shut down **correctly**.

For shutting down, use one of the following options:

- Windows taskbar: Start > Shut Down
- Interface signal: ”PC shutdown”, see Section 18.1.1, Page 18-499

Inverting SRAM memory cells

If SRAM memory cells are inverted when changing the battery, this will be detected during power–up. The SRAM image will then be written back to the SRAM of the MCI board and the SINUMERIK 840Di sl is now immediately ready for operation.

Responses

None.

Notice

If Windows XP is not correctly shut down before changing the backup battery, an inversion of the SRAM memory cells during the battery change cannot reliably be detected.

The SINUMERIK 840Di sl must then be recommissioned.

5.3.3 Start–up after replacement of the MCI board

After the MCI board has been replaced, the subsequent procedure depends on the previous history. The following cases are distinguished:

1. An up–to–date SRAM image exists
2. An up–to–date SRAM image does not exist.

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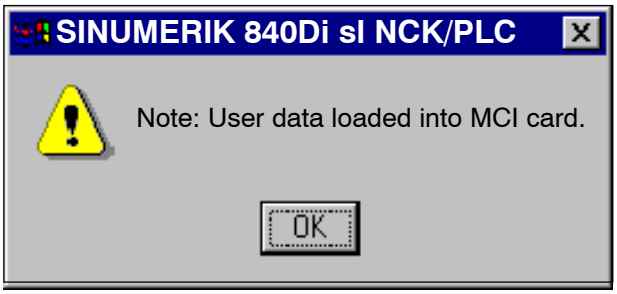
Case 1:
An up–to–date SRAM image exists

Before the MCI board has been changed, Windows XP could not be shut down correctly. An up–to–date SRAM image is thus provided.

During power–up, the MCI board is detected as a new one using the HW serial number. The SRAM image will then be written back to the SRAM of the MCI board. The SINUMERIK 840Di sl is thus ready again immediately.

Responses

A note will appear in a message box, which must be acknowledged with ”OK”:



Notice

1. If the MCI board is recognized as being faulty while the SINUMERIK 840Di sl is booting, the last SRAM image is retained when Windows XP is shut down. After the MCI board has been changed, proceed as described above.
2. If the MCI board is to be replaced as a result of a suspected or actual error (suspected error, sporadic errors, etc.), the SINUMERIK 840Di sl NC and PLC should be recommissioned, as possible data errors may otherwise be imported from the SRAM image.

Case 2:
An up–to–date SRAM image does <u>not</u> exist

A fault occurred with the MCI board during operation of the SINUMERIK 840Di sl. Windows XP has possibly been shut down correctly, but no SRAM image could be created.

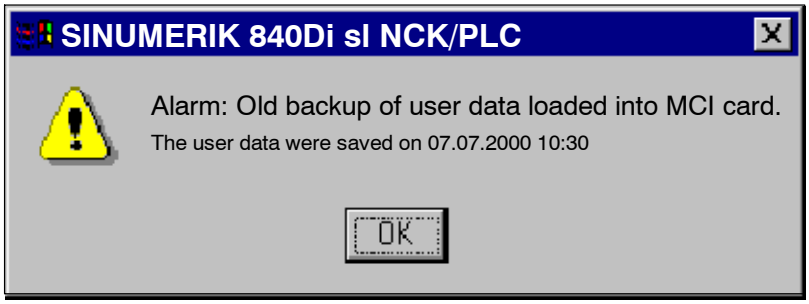
After replacement, based on the hardware serial number the MCI board will be identified as ”unknown”. Since no up–to–date SRAM image exists, the SRAM backup is written back into the SRAM of the MCI board. The SINUMERIK 840Di sl is now immediately ”operational”.

The user data, or operating state of the SINUMERIK 840Di sl must be checked to ascertain if operation can be continued. It might be necessary to recommission the SINUMERIK 840Di sl NC and PLC.

Responses

A note will appear in a message box, which must be acknowledged with ”OK”.

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An NC alarm is also generated, which is displayed on the respective SINUMERIK 840Di sl user interface (840Di start-up, HMI Advanced, etc.):

- Alarm: "4065 Battery-backed memory has been restored from the hard disk (possible data loss)"

To acknowledge the alarm you must first acknowledge the alarm itself with a special operation before executing the required NCK POWER ON Reset. See Section 11.11.1, Page 11-406et sqq.

5.3.4 Power up after reinstallation/update of the 840Di sl software

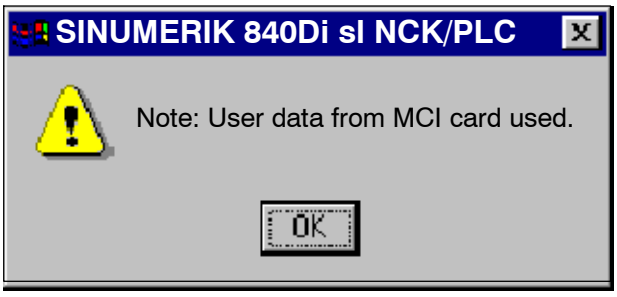
If the 840Di sl software is reinstalled on an operational SINUMERIK 840Di sl, the user data saved in the SRAM of the MCI board is retained.

To achieve this, it is essential that the current NC and PLC software version complies with the software version with which the battery-backed user data of the SRAM have been created.

The SINUMERIK 840Di sl is thus ready again immediately.

Responses

A note will appear in a message box, which must be acknowledged with "OK":



Notice

If the buffered user data is not going to be used again, the SINUMERIK 840Di sl must be recommissioned.

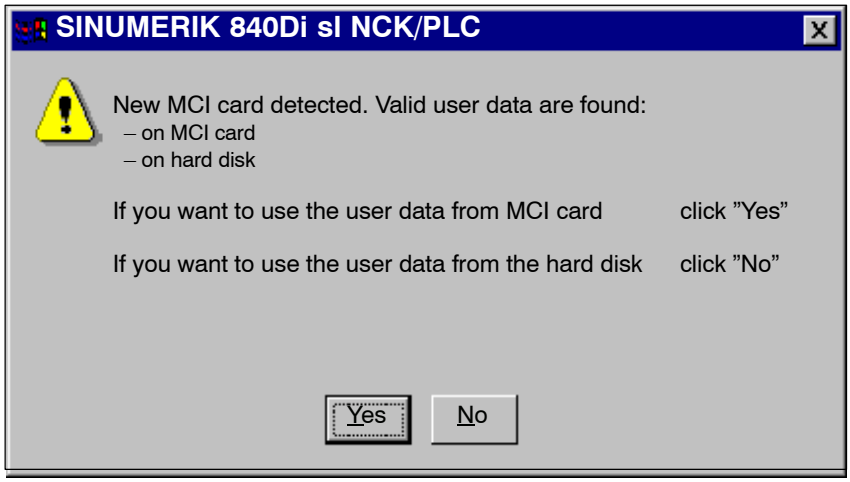
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5.3.5 Start–up after replacement of the PCU or the MCI board

If, during booting, it has been ascertained that both the SRAM image on the PCU hard disk and the MCI board SRAM have buffered valid, but divergent user data (both components were already in use in one SINUMERIK 840Di sl), no automatic selection can be made.

Responses

The following message box is displayed with which the user has to decide which user data have to be used further.



5.3.6 Start–up after importing a backup copy

If a backup copy (ghost image) of a previously booted SINUMERIK 840Di sl is loaded into the PCU again, the user data puffered in the SRAM of the MCI board will be used again.

The SINUMERIK 840Di sl is thus ready again immediately.

5.3.7 Start–up after power failure/Power Fail

Case 1: SRAM saved

Thanks to the Power Fail Detection integrated in the PCU, in the event of a power failure the SINUMERIK 840Di sl saves the user data in the SRAM of the MCI board. An SRAM image, however, cannot be created any more in this case.

When the power returns or with the next power–up, the data will be available again.

The SINUMERIK 840Di sl is thus ready again immediately.

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Notice

Saving of the user data in the SRAM of the MCI board in case of power failure is only guaranteed if the PCU is operated within its defined specifications.

References: /BH/ Operator Components, Manual
Section: Component PCU 50

Case 2: SRAM not saved

If the SINUMERIK 840Di sl was operated outside its defined specifications, it may not be possible to save the user data in the SRAM. Therefore, proceed as described in Section 5.3.3, Page 5-112 case 2.

5.3.8 Power–up with shutdown signal

If the SINUMERIK 840Di sl is operated with a UPS unit, the shutdown signal must be configured accordingly. See Section 11.11.2, Page 11-410. If a shutdown signal is pending, first the NC and PLC and then Windows XP are shut down correctly.

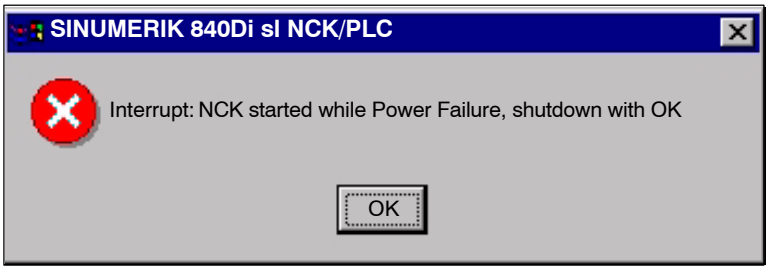
1st start–up

If power–up is executed with a pending shutdown signal Windows XP is immediately correctly shut down again.

From 2nd power–up

The system responds as follows if it is powered up a second time with pending shutdown signal:

- Windows XP is not immediately shut down correctly.
- NC and PLC are not started
- The following message box appears:



This system response ensures that an error in the protection circuit of the MCI board extension module or in the configuration of the shutdown signal does not result in an endless loop (power–up > shutdown signal > power–up > etc.).

As long as the message box has not been acknowledged the protective circuit of the MCI board extension module and the configuration of the shutdown signal (see Section 11.11.2, Page 11-410) can be checked and changed, if necessary.

If the shutdown signal has been acknowledged from the message box, the NC and PLC are started. Otherwise Windows XP is again shut down correctly.

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5.4 Service Desktop

The Service Desktop is intended for machine manufacturer/service personnel. Numerous SINUMERIK–specific applications are available on the Service Desktop in addition to the standard Windows functions.

5.4.1 Activation

Proceed as follows to enable the Service Desktop:

1. As soon as (1) is displayed under the version number on the bottom right of the start–up screen, press ”3”.



Fig. 5-2 Display during start–up of the SINUMERIK 840Di sl

2. Enter a password for protection levels 0 – 2:

Security class	Password	Area
0	Reserved	Siemens
1	SUNRISE (default)	Machine manufacturer
2	EVENING (default)	Commissioning/service

3. Click the ”Service Desktop” button in the displayed selection menu or press the ”Return” key.

5.4.2 SINUMERIK–specific applications

The following SINUMERIK–specific applications are available on the Service Desktop:

- Ghost Explorer
  The Ghost Explorer is used to display the content of Ghost images.

  References
  The Ghost tools documentation is located on the PCU hard drive under: E:\TOOLS

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- HMI Explorer
  The HMI Explorer is used to display the version and install or post-install the supplied SINUMERIK application. See Section 5.4.7, Page 5-121.
- Touchware
  Program for calibrating the touchscreen connected to the PCU directly.

  References
  /BHsl/ Operator Components Manual
  Section: Configure system
  Configure system network with 'Settings system network'
- Settings System Network
  Setting up the Ethernet connection of a TCU to the SINUMERIK 840Di sl.

  References
  /IAM2/ CNC Commissioning Part 5
  Section: Thin Client Configuration (IM5)
  Commissioning
  Calibration of the touchscreen
- HMI Analyzer
  Analysis tool for HMI Advanced in conjunction with PCU 50.3

  References
  /IAM/ CNC Commissioning Part 2
  Section: Commissioning HMI Advanced IM4
  Diagnosis and Service
  HMI Analyzer
- ServiceCenter
  Starts the ServiceCenter after the computer reboots under WinPE to create, restore and manage partition and hard disk images.

  References
  /IAM2/ CNC Commissioning HMI Advanced
  Section: IM8 PCU-Basesoftware 8.x
  Save and restore data
- Folder: SINUMERIK 840Di
  - SINUMERIK 840Di Start-up
    Simple SINUMERIK 840Di-specific user interface.
  - NT desktop/HMI desktop
    Autostart of the HMI application: OFF/ON
    See Section 5.4.3, Page 5-119.
  - Readme
    Notes and conditions concerning the installed SINUMERIK 840Di sl system software.

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- Folder: SINUMERIK 840Di > tools
  - HT8TCU
    Activation of the transfer of an HT8 machine control panel signal

    References
    /IAM2/ CNC Commissioning Part 5
    Section: Thin Client Configuration (IM5)
    Configure system network
    Configure HT 8 in the system network

  - Install/uninstall MCIS RCS Host
    Installation and uninstall program of the host for remote diagnostics of SINUMERIK systems with Windows–based HMI within the framework of the Motion Control Information System.

    References
    Catalog NC 61: Motion Control Information System (MCIS)
- Folder: SinuCom NC
  - CT Editor
    Tool for creating test templates
  - NC Connect Wizard
    Tool for establishing the communications link from SinuCom NC to SINUMERIK 840Di sl.
  - SinuCom NC

Note

When Windows starts up, the SINUMERIK 840Di sl NCK system software is automatically started in the background.

5.4.3 Setting the boot response for the Service Desktop

The NC or MHI desktop settings are used to determine if the NC–desktop (Windows desktop) is displayed after booting the SINUMERIK 840Di sl, or if the HMI user interface, e.g. HMI Advanced, is started immediately:

- NC desktop
  HMI application autostart: OFF
- HMI desktop
  HMI application autostart: ON

5.4.4 System information after ”Fatal exceptional error”

After a ”fatal exception error” (blue screen), system information is written to the following file:

- D:\Memory.dmp.

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5.4.5 Starting OEM programs

OEM directories

OEM programs can be executed before starting the SINUMERIK system software. These programs or their respective links must be stored in the following directories:

- C:\RunOEM\SeqOnce
  Programs stored here are started once and sequentially.
- C:\RunOEM\Seq
  Programs stored here are started on every power–up and sequentially.

Note

Sequential: The subsequent program will only be started when the previous program has been ended.

- C:\RunOEM\ParOnce
  Programs stored here are started once. They run in parallel with the HMI system software.
- C:\RunOEM\Par
  Programs stored here are initiated at every boot. They run in parallel with the HMI system software.

Order of execution

Directories and programs are processed in the following order:

- Directories
  1. C:\RunOEM\SeqOnce
  2. C:\RunOEM\Seq
  3. C:\RunOEM\ParOnce
  4. C:\RunOEM\Par
- Programs
  The programs within a subdirectory are started according to the chronological order in which they were placed in the subdirectory.

Data files

In addition to executable programs, you can also place data files in the subdirectories. They will be opened in the application with which their file type is associated.

Example:

- File type: ".txt" –> Notepad
- File type: ".htm"–> Internet Explorer

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5.4.6 User–specific HMI start–up images

User–specific start–up images can be displayed while the HMI is booting. The boot images must be stored in bitmap format (*.BMP) in a defined directory structure.

Directory structure

The directory structure must be created under ”F:\OEM\IB\DATA” according to the following schema:

- F:\OEM\IB\DATA\<*NCK type*>\<*screen resolution*>\<*file name*>.BMP

Parameters: *NCK type*

The different NCK types are displayed depending on the directory name.

The following values may be used as directory names for the SINUMERIK 840Di sl:

- **default**
  If a directory: default is created, the start–up image stored in this directory will always be displayed irrespective of the NCK type.
- **5000**
  Under directory: 5000 (ID for SINUMERIK 840Di sl) stored start–up images are only displayed by the HMI application together with a SINUMERIK 840Di sl.

Parameters: *Screen resolution*

The start–up images for the various screen resolutions must be stored in different directories. The directory name corresponds to the screen resolution:

- **640**
  start–up image for screen resolution: 640 x 480 [dpi]
- **800**
  start–up image for screen resolution: 800 x 600 [dpi]
- **1024**
  start–up image for screen resolution: 1024 x 768 [dpi]

Note

Directory: *Screen resolution* may only contain <u>one</u> file.

Parameters: *File name*

You can choose any file name.

5.4.7 HMI Explorer

The HMI Explorer is used to manage the Siemens A&D software components on the PCU. The following main functions are available:

- Version display
- Installation, de–installation, and re–installation
- Application–specific information (detailed information, history, available language versions, etc.)

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- Installation directory

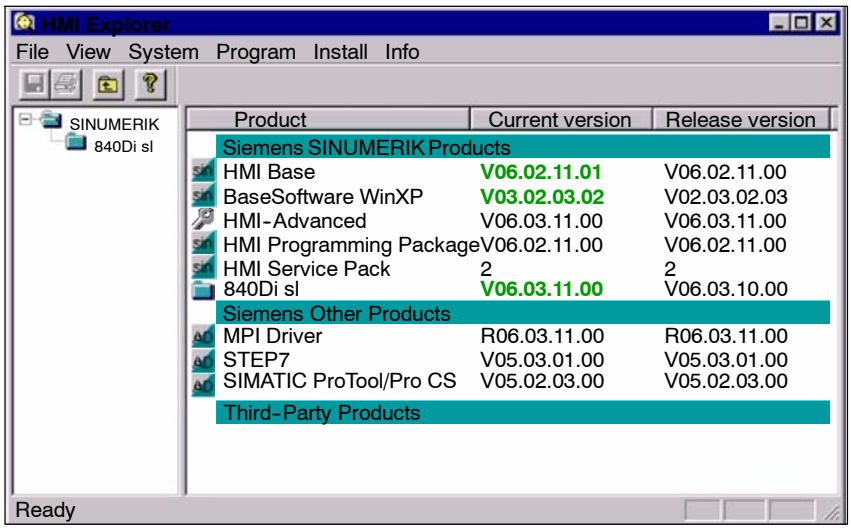


Fig. 5-3 HMI Explorer: Product/Version Display (Example)

Version display

The following versions are displayed for each software application:

- Current version
  Current version number
- Release version
  Version number with which the product was first installed.

Installation directory

The path of the installation directory of a software component is displayed in the Install dialog box: Menu command: **Install**

5.4.8 SW installation/update

The Service Desktop allows you to install or update software directly from an external computer using a specially configured network link. For a detailed description see Section 17, Page 16-467.

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5.5 ServiceCenter

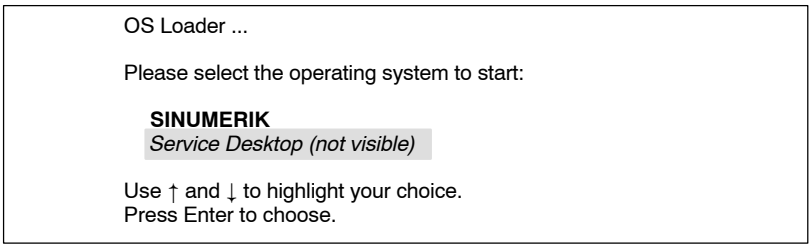
The ServiceCenter is used to create, restore and manage partition and hard disk images. With the SINUMERIK 840Di sl, the startup mode of NCK and PLC can also be specified via the ServiceCenter.

The ServiceCenter is intended for the machine manufacturer/service personnel.

5.5.1 Activation

Proceed as follows to enable the Service Desktop:

1. Restart the PCU, e.g. via Power Off/On.
2. While starting up the PCU, press the "↓" key (cursor down) in the selection screen for the operating system to be started. (The selection screen is displayed immediately after the booting of the PCU.)



3. Enter a password for protection levels 0 – 2:

Protection level	Password	Area
0	Reserved	Siemens
1	SUNRISE (default)	Manufacturer
2	EVENING (default)	Commissioning, service

4. Press the Enter key for immediate activation of the selection or wait until the selection is started automatically after the preset wait time has elapsed.

5.5.2 Setting NCK/PLC startup mode

In the SINUMERIK 840Di sl–specific part of the ServiceCenter, you can specify the mode that the NCK and PLC are to assume after start–up. The following options can be set:

- Start NCK and PLC
- Do not start NCK and PLC
- Start NCK and PLC in specified mode:

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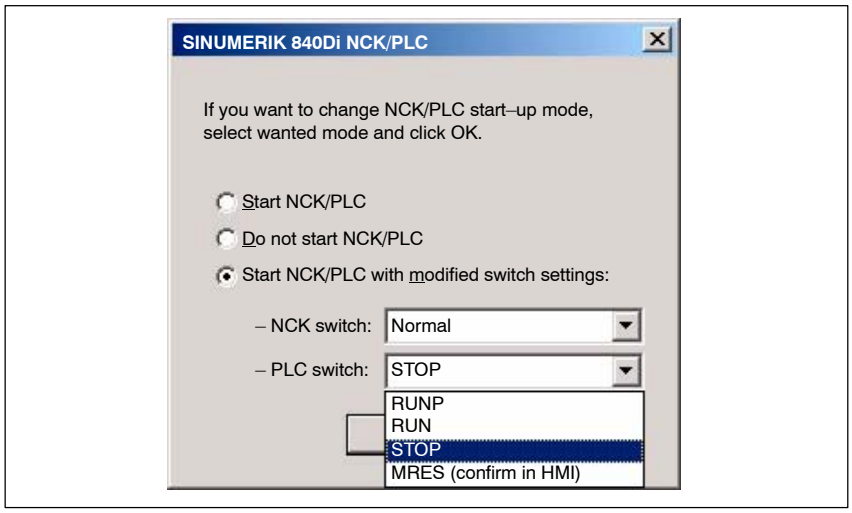


Fig. 5-4 HMI Explorer: Product/version display (example)

NCK modes

The following NCK modes can be set:

- Normal
- Load standard machine data
  After start–up, the NCK is in the reset mode. All machine and user data are deleted and standard machine data are loaded.

Note

You may have to consult your network administrator to obtain the above information or any other information required for your current network.

PLC modes

The following PLC modes can be set:

- RUNP
  In the ”RUNP” mode, changes can be made to the PLC user program without activation of the password.
- RUN
  Only read accesses are possible via a programming device (PG) in the ”RUNP” mode. It is not possible to make changes to the PLC user program until the password has been set.
- STOP
  Processing of the PLC user program has stopped and all PLC outputs are set to substitute values in the ”STOP” mode.
- MRES (confirm in HMI)
  The PLC is switched to STOP mode and then PLC general reset (default data) is performed. The following actions are performed by the PLC:

  1. The PLC disconnects all links.

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2. The user data are deleted (data and program blocks)
3. The system data blocks (SDB) are deleted.
4. Battery–backed data are copied back into the RAM area from the PLC after general reset.
5. The diagnostics buffer, the MPI parameters, the clock time, and the operating hours counter are not reset.

Note

After start–up in the specified mode, the PLC must be explicitly switched to the desired following mode, e.g. ”RUNP”. This can be performed via a programming device (PG) or via the HMI user interface (see Section 11.11, Page 11-406).

5.5.3 Backup/restore functions

The function contained in the standard part of the ServiceCenter for creating, restoring and managing partition and hard disk images are described in detail in:

References

/IAM2/ CNC Commissioning Manual Part 5
Section: PCU–Basesoftware (IM8)
Save and restore data

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5.6 Configuring the network link of PCU (LAN/WAN)

To perform service functions (software installation/update), the SINUMERIK 840Di sl requires an active connection to an external computer at least for the duration of the service task.

PTP link

The PTP link (peer–to–peer) to a single computer is described in Section 16.1, Page 16-467.

LAN/WAN link

The PCU basic software is preconfigured for an Ethernet network link with protocol: TCP/IP.

The settings for the local network links (Windows taskbar: Start > Settings > Network Connections >> Local Area Connections) regarding IP address and domain are assigned as follows:

Dialog box: Local Area Connections Properties

- Tab: General
  - IP address via DHCP
    Option: Obtain an IP address automatically
  - Automatic DNS server address
    Option: Obtain a DNS server address automatically
- Tab: Alternate Configuration
  - Automatic IP address as alternative configuration
    Option: Automatic private IP address

If changes have been made or a network link cannot be established, settings regarding:

- TCP/IP protocol
- IP address and subnet mask
- Computer name and domain/workgroup

must be made and/or checked.

Note

You may have to consult your network administrator to obtain the above information or any other information required for your current network.

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5.7 License management

5.7.1 License management with the Automation License Manager

License management with the Automation License Manager is described in a separate section: Section 17, Page 17-477.

5.7.2 License management with SinuCom NC

To use SINUMERIK 840Di sl system software and the enabled options, the corresponding software licenses must be assigned to the SINUMERIK 840Di sl hardware. During the assignment procedure, you will be given a license key for each piece of software (system software or options) which electronically links the respective software to the hardware.

You can also activate options without the license keys and use them for test purposes. The control will then cyclically display a reminder/alarm that a license has not yet been registered for the option.

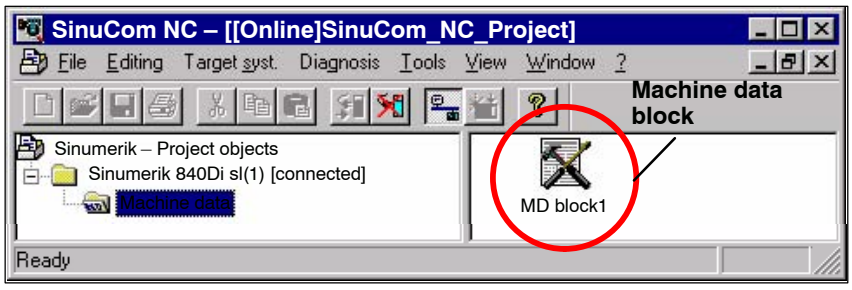
The procedure for ordering through to entering the license key of an option is as follows:

1. Order and purchase of the relevant license packages and/or single licenses: **Order catalog: NC 61**
2. Activate the options **SinuCom NC**
3. Obtain the license key for the required control: **Web License Manager** by Internet connection to the SINUMERIK 840Di sl or external PG/PC via http://www.siemens.com/automation/license
4. Enter the license key: **SinuCom NC**

New license key

To obtain and enter a new license key in the control system, proceed as follows:

1. Start SinuCom NC from the Windows taskbar: **Start > Programs > SinuCom NC > SinuCom NC**
2. Use SinuCom NC to go online control system.
3. Double–click on the machine data module to open:



4. Select the data area: ”Options”.

   Via the dialog box: ”Options”, you can:

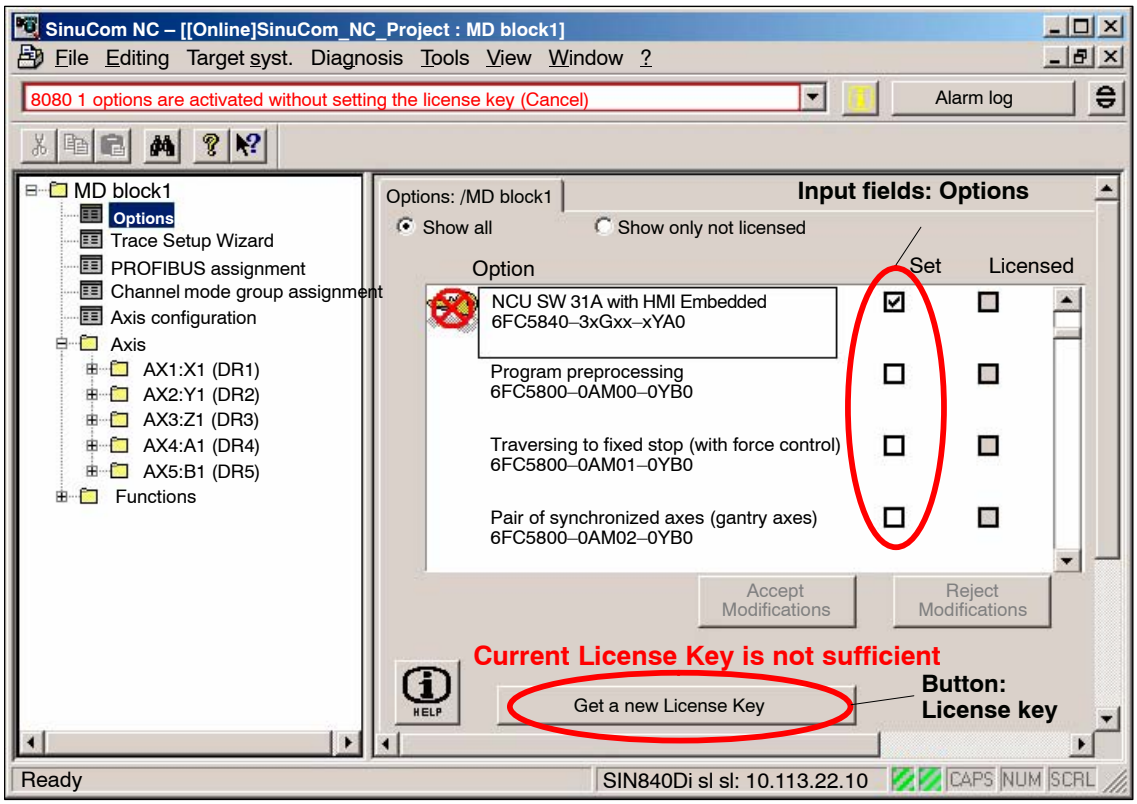
   – Enable/disable options

   or

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– Obtain new license keys (Web License Manager)
– Enter license keys in the control system

Click the ”Get a new license key” button and follow the instructions in the subsequent dialogs.



■

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PLC Commissioning

6

6.1 General

6.1.1 Compatibility

The PLC integrated on the MCI board of the SINUMERIK 840Di sl is compatible with the SIMATIC S7 PLC: AS317–2 DP.

6.1.2 Performance data

The PLC of the SINUMERIK 840Di sl has the following features:

Table 6-1 Performance data of the PLC

PLC317–2DP (6FC5 317–2AJ10–0AB0)		
Memory for PLC basic program and user program		768 KB
Data block memory		Max. 256 KB
Memory submodule		No
Bit memories		32768
Timers		512
Meters		512
Clock memories		8
Program and data blocks		
	OB	1, 10, 20–21, 32–35, 40, 55–57, 80, 82, 85–87, 100, 121–122
	FB	0–2048
	FC	0–2048
	DB	1–2048
Max. length of data block		32 KB
Max. block length FC, FB		64 KB
Inputs/outputs (addressing capacity) **Notice** The inputs/outputs above 4096 are reserved for integrated drives.		
	Digital/analog	4096/4096 bytes
	Incl. reserved area	8192/8192 bytes
	Process image	256/256 bytes
Inputs/outputs (addressing) Row 0 is integrated in the NC. Rows 1 to 3 are available for I/O devices		Through optional configuring of I/O devices

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Table 6-1 Performance data of the PLC

PLC317–2DP (6FC5 317–2AJ10–0AB0)		
	Digital	From I/O byte 0
	Analog	From PI/PO byte 272 only PROFIBUS
Processing time		
	Bit instructions (I/O)	<= 0.031 ms/kA
	Word instructions	0.1 ms/kA
PDIAG (Alarm S,SQ)		yes
PROFIBUS		Master/Slave
Number of PROFIBUS slaves (see note below)		Max. 125
PBC programmable block communication		yes
Consistent data to standard slave via SFC 14, 15		128

6.1.3 PLC program

The PLC program is constructed modularly. It comprises the two parts:

- **PLC basic program**
  The PLC basic program organizes the exchange of signals and data between the PLC user program and the NC, HMI, and machine control panel components.
  The PLC basic program is part of the PLC Toolbox supplied with SINUMERIK 840Di sl.
- **PLC user program**
  The PLC user program is the user–specific part of the PLC program by which the basic PLC program has been added to or extended.

References

For a complete description of the basic PLC program, its structure and all modules including their call parameters, please refer to:

References: /FB1/ Description of Functions, Basic Functions
Section: P3, Basic PLC Program

6.1.4 Installing the PLC basic program library

To be able to use the blocks of the basic PLC program (OBs, FBs, DBs, etc.) in a SIMATIC S7 project, the library must first be installed in the SIMATIC manager. Information that you need to install the PLC basic program (storage path of file: setup.exe and additional installation instructions) are included in file:

- <Installation path>\importantinfo.rtf

Notice

The library of the basic PLC program must be installed on the computer on which the SIMATIC manager for creating the S7 project is already installed.

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6.1.5 STEP 7 example projects

Included in the scope of supply for the SINUMERIK 840Di sl system software are two STEP 7 projects, on which the basic configuration of the SINUMERIK 840Di sl Station and an MCP (PROFIBUS/Ethernet) is displayed. The example projects can be used as a basis for your own projects.

Storage path

The example projects are on the SINUMERIK 840Di sl CD under:

- Example project with PROFIBUS MCP:
  <CD path>\support\840dismp\840Di_sl_DPMCP_smpl.zip
- Example project with Ethernet MCP:
  <CD path>\support\840dismp\840Di_sl_ETMCP_smpl.zip

Dearchive

Example programs must first be dearchived in the SIMATIC Manager before they can be used. SIMATIC Manager: **File > Dearchive...**

The example projects can be dearchived to the default target directory: "S7Proj".

Use

The example projects are listed in the SIMATIC Manager under user projects if the target directory: "S7Proj" is retained. SIMATIC Manager: **File > Open... > Dialog box: "Open project" > Tab: "User projects"**

- Example project with PROFIBUS MCP: 840Disl_DPMCP
  station
- Example project with Ethernet MCP: 840Disl_ETMCP

Loading into the PLC

The communication link from SIMATIC STEP 7 to the SINUMERIK 840Di sl PLC must be checked and established before loading an example project.

- External connection
  The PG/PC on which SIMATIC STEP 7 runs, can be connected to the SINUMERIK 840Di sl PLC via the MPI connection of the MCI board or via one of the Ethernet interfaces (Ethernet 1: company network or Ethernet 2: local network) of the PCU.
  - MPI connection
    The MPI interface of the MCI board is already configured in both example projects. Configuring the PG/PC interface is described in Section 6.2.3, Page 6-135.
  - Ethernet connection
    Configuring the PG/PC interface is described in Section 6.2.2, Page 6-135. Configuring the communications processor (CP 840D sl) of the SINUMERIK 840Di sl is described in Section 6.3.8, Page 6-145.
- Internal connection
  A local SIMATIC STEP 7 installed on the SINUMERIK 840Di sl is linked via the preset local "SOFTMC" communications link with the SINUMERIK 840Di sl PLC. Configuring the PG/PC interface is described in Section 6.2.4, Page 6-136.

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6.1.6 PLC user program

The organization blocks:

- OB100 (cold restart)
- OB1 (cyclic processing)
- OB40 (process alarm)

contain the entry points for the appropriate parts of the PLC user program.

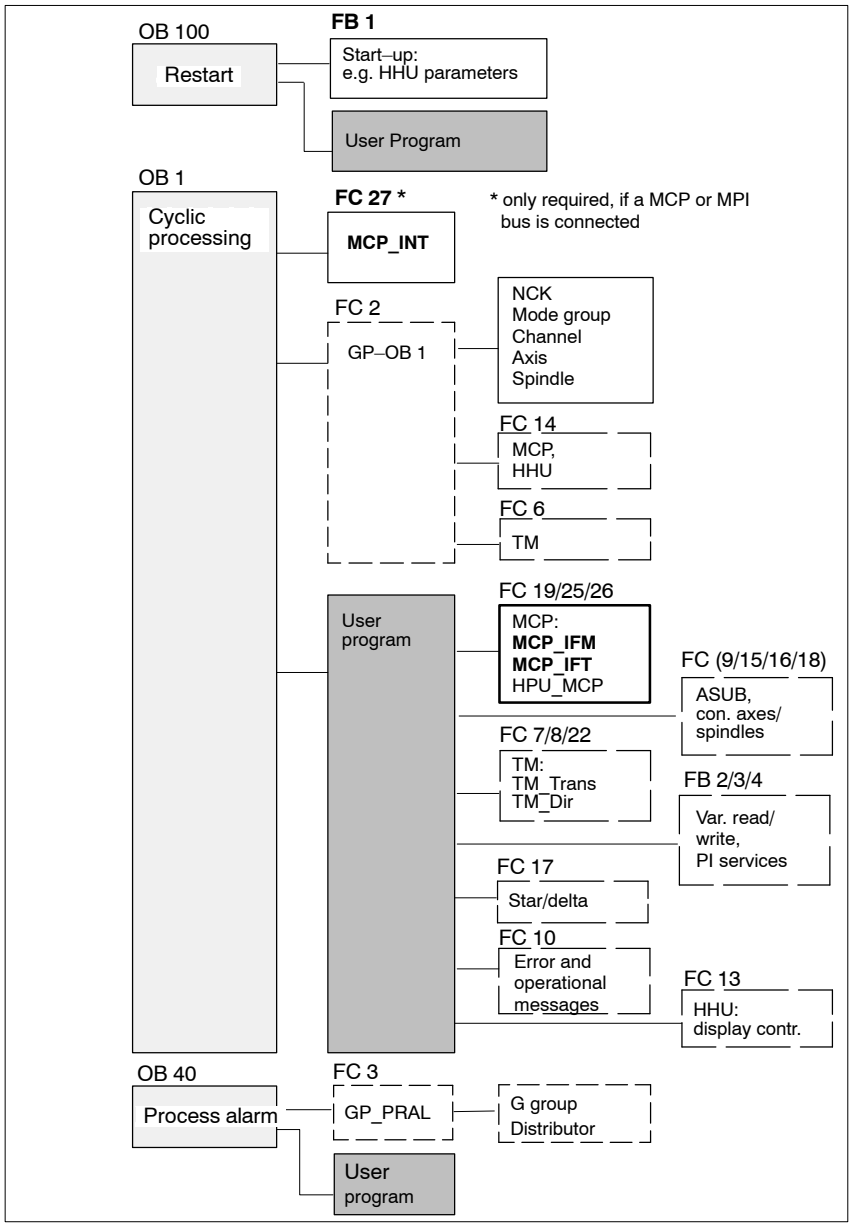


Fig. 6-1 Structure of the PLC program

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Processing modules

The individual blocks in the basic PLC program can be processed in the SIMATIC manager:

- Select the appropriate block, e.g. OB 100 in the folder **Blocks** of the corresponding **Module**
- Use the menu command **Edit > Open Object** to open the block or double–click the block with the left mouse button
- Edit the block using the LAD/STL/CSF editor
  Switch over the block display using the menu command **View > LAD** or **STL** or **CSF**

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6.2 Commissioning

The PLC commissioning can be performed by:

- Creating an S7 project and loading the configuration.
  For how to create an S7 project using the PLC basic program supplied with the SINUMIERK 840Di sl and basic parameter assignment for MPI and PROFIBUS communication please refer to Section 6.3, Page6-139.
- Loading an existing series startup file.
  For how to create and read in a series startup file please refer to Section 15, Page 15-459.

6.2.1 Basic requirements

SINUMERIK 840Di sl

The SINUMERIK 840Di sl must be successfully booted to commission the PLC:

- NCK in cyclic operation
- PLC in status: RUN

  Note
  The NCK and PLC status can be checked with:

  – User interface 840Di start–up
    See corresponding online help
  – Commissioning tool: SinuCom NC
    See relevant online help
  – User interface HMI–Advanced (optional)
    See Section 11.11, Page 11-406.

SIMATIC STEP 7

SIMATIC STEP 7 is required in the following version:

- SIMATIC STEP 7 as as Version 5.3, Service Pack 2

SIMATIC STEP 7 can either be installed directly on the SINUMERIK 840Di sl PCU or on an external computer (PG/PC).

Communications link

Depending on which computer is running SIMATIC STEP 7, there must be one of the following communications links between SIMATIC STEP 7 and the SINUMERIK 840Di sl PLC:

- External computer (PG/PC)
  – Ethernet
  – MPI/PROFIBUS
- PCU of the SINUMERIK 840Di sl
  – Local communications link (SOFTMC)

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6.2.2 External communications link: Ethernet

To load the configuration from an external computer (PG/PC) into the SINUMERIK 840Di sl PLC via an Ethernet connection, the following conditions must be met on the PG/PC:

- Ethernet communication is possible in principle or set up
- PG/PC interface is parameterized (see below)
- The PG/PC is connected to one of the Ethernet interfaces of the SINUMERIK 840Di sl PCU (Ethernet 1: company network or Ethernet 2: local network)

PG/PC interface

The PG/PC interface is parameterized in the **SIMATIC Manager** via menu item: **Options > Set PG/PC interface...**:

Dialog box

Dialog box: Set PG/PC interface
tab: Access path
Interface parameterization used: ***<Interface>***

OK

Notice

Do not select ISO interfaces as Ethernet interfaces from the list of interfaces, e.g. "ISO Ind. Ethernet –> Realtek RTL8139...".

Instead, use the appropriate TCP/IP interfaces, e.g. "TCP/IP –> Realtek RTL8139...".

6.2.3 External communications link: MPI/PROFIBUS

To load the configuration from an external computer (PG/PC) into the SINUMERIK 840Di sl PLC via an MPI connection, the following conditions must be met on the PG/PC:

- Communications module (alternative):
  - CP5611: MPI/PROFIBUS communications processor (PCI)
  - CP5511: MPI/PROFIBUS communications processor (PCMCIA)
- MPI/PROFIBUS driver is installed
- PG/PC interface is parameterized (see below)
- The MPI/PROFIBUS interface of the CP is linked to the MPI/PROFIBUS interface of the MCI board (X1).

PG/PC interface

The PG/PC interface is parameterized in the **SIMATIC Manager** via menu item: **Options > Set PG/PC interface...**:

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Dialog box

Dialog box: Set PG/PC interface
tab: Access path
Interface parameterization used: **CP5611(AUTO)** or **CP5511(AUTO)**

OK

Note

If the MPI/PROFIBUS interface of the MCI board (X1) is configured in the S7 project as a PROFIBUS interface, we recommend you set the PG/PC interface of the external computer to "CPxxxx(**AUTO**)".

The PLC continuously transmits the communication parameters in cyclic operation, so that the connected devices can adjust automatically.

The default setting of the MPI/PROFIBUS interface of the MCI board (X1) is MPI. The default setting takes effect after resetting the PLC.

6.2.4 Local communications link: SOFTMC

The configuration is loaded from a local SIMATIC 7 installed on the SINUMERIK 840Di sl to the PLC via the default local "SOFTMC" communications link.

PG/PC interface

The PG/PC interface can be parameterized in the **SIMATIC Manager** via menu item: **Options > Set PG/PC interface...**:

Dialog box

Dialog box: Set PG/PC interface
tab: Access path
Interface parameterization used: **SOFTMC**

OK

6.2.5 Check PLC status and communication interface

The PLC status and therefore also the communications link to the PLC can be checked from "HW Config" via menu item: **Target system > Status**.

- If the current operating status of the PLC is displayed, the communications link is operating correctly.
- If the current operating status of the PLC is not displayed, the communications link must be checked for correct parameterization. If no connection is established to the PLC despite correct parameterization, a general reset of the PLC is necessary.

PLC general reset

General reset of the PLC can be performed using 840Di Start–up or HMI Advanced (option):

- 840Di start–up

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- Start 840Di start-up: Windows XP taskbar: **Start > Programs > SINUMERIK 840Di > 840Di Start-up**
- Open the dialog box: Menu command **Window > Diagnosis > NC/PLC**.

- HMI Advanced (option).
  - Open the dialog box: **Operating area switchover > Commissioning > NC/PLC Diagnosis**

- Request general reset of PLC: **"PLC Delete Program"**.

After general reset the PLC is in RUN mode, i.e. the LED in the display is lit: "RUN" green.

6.2.6 First commissioning

On first commissioning of the PLC, a general reset of the PLC has to be performed after the SINUMERIK 840Di sl has been switched on and booted.

To obtain a defined initial state of the whole system (NC and PLC), the NC data should also be deleted.

- PLC general reset

  General reset puts the PLC in a defined initial state by deleting and initializing all system and user data.
- Delete NC data

  After a request to delete NC data, all user data are deleted and the system data are reinitialized on the next NC power-up, e.g. after NC Reset.

PLC general reset, deleting NC data

General reset of the PLC and deletion of NC data can be performed using 840Di Start-up or HMI Advanced.

- 840Di start-up
  - Start: WINDOWS XP taskbar: **Start > Programs > SINUMERIK 840Di > 840Di Start-up**
  - Open the dialog box: Menu command **Window > Diagnosis > NC/PLC**

- HMI Advanced
  - Open the dialog box: **Operating area switchover > Commissioning > NC/PLC Diagnosis**

Dialog box

Proceed as follows in the dialog boxes:

1. PLC general reset

   PLC group

   Button: **"PLC Delete Program"**

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Notice

After a general reset of the PLC, interface X102 (MPI/DP) of the MCI board is set to ”MPI” and the following MPI parameters are set:

– MPI address of the PLC = 2

– MPI data transmission rate = 187.5 kbaud

2. Delete NC data

   NC group
   button: **”NCK Default Data”**

3. Initiate NC Reset

   To start cyclic operation or NC/PLC communication, NC reset (button: ”NCK Reset”) must be triggered:

The subsequent SINUMERIK 840Di sl boot has been successfully completed if the following display appears in the dialog box:

- NC status:
  NC group
  6 NC in cyclic mode
- PLC status:
  PLC group
  LED **RUN** constantly lit

Note

Since no PLC program is executed after PLC general reset, the following alarms are displayed:

- Interrupt: ”120201 Communication failed”
- Interrupt: ”380040 PROFIBUS DP: Configuring error 3, parameter”
- Interrupt: ”2001 PLC not booted”

These alarms have no influence on how to continue.

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6.3 Creating a SIMATIC S7 project

This section describes the creation of an S7 project for basic commissioning of the PLC, the MPI and PROFIBUS communications, and the input/output data areas of the NC. To do this you will have to perform the following operations:

- Create a project
- Set up a station
- Parameterize MPI communications (optional)
- Parameterize PROFIBUS communications
- Parameterize the input/output data areas of the NC

Note

- The X102 interface: MPI/DP can either be used as an MPI or PROFIBUS interface.
- The MPI communication only has to be parameterized when the PLC is in the original state (state of the PLC after general reset) and no PLC archive is present that can be loaded via HMI Advanced.

MPI

For the parameterization of the MPI communication, the MPI addresses of the PLC and NC and the transmission rate must be set on the MPI bus (see Section 6.3.4, Page 6-142).

PROFIBUS DP

Maximum two PROFIBUS lines can be connected to a SINUMERIK 840Di sl:

- Interface X101: PROFIBUS DP

  In the case of the SINUMERIK 840Di sl, the position controller cycle of the NC is derived directly from the isochronous PROFIBUS cycle. Defined values must therefore always be entered for the following PROFIBUS parameters:

  - Mode: DP master
  - Isochronous PROFIBUS: Active
  - Isochronous time T_{DP} on PROFIBUS DP: Position control cycle

  Both the PLC and the NC have direct access to this PROFIBUS interface. PROFIBUS drives and NC–specific I/Os can only be connected via this interface.

- Interface X102: MPI/DP

  This PROFIBUS interface is only available to the PLC. Alternatively it can be operated in the mode: ”DP master” or ”DP slave”.

A full description of how to parameterize PROFIBUS communications is given in Section 8, Page 8-175.

Note

The instructions given in this section are essentially limited to the special characteristics of the SINUMERIK 840Di sl. For more details about working with SIMATIC STEP 7 please refer to the relevant SIMATIC documentation or Online Help.

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6.3.1 Creating a project

To create a new project select menu items **File > New** in the SIMATIC Manager.

Enter the following project data in the dialog box:

- Name (for example: SIN840Di sl)
- Storage location (path)
- Type

and confirm the dialog box with OK. The project window is now displayed showing an empty S7 project structure.

6.3.2 Inserting Station 300

Before you can insert the required hardware in the S7 project you must first insert a SIMATIC Station 300 in the project. To do that, select menu item: **Insert > Station > SIMATIC Station–300**.

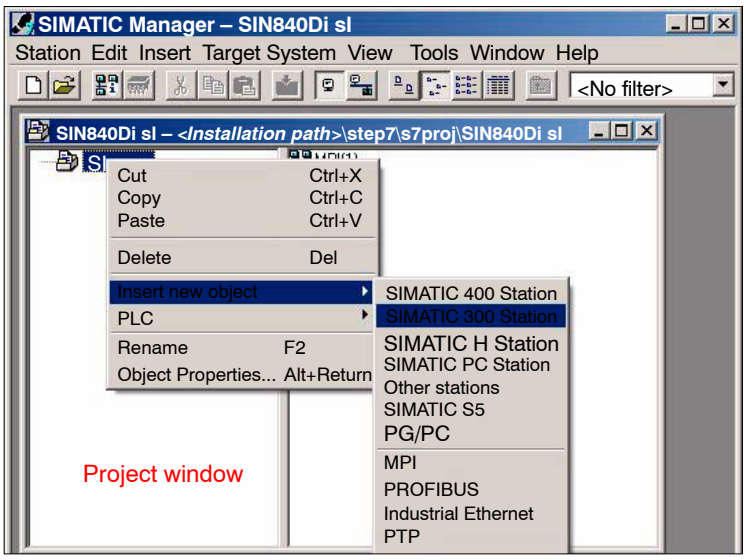


Fig. 6-2 Inserting the SIMATIC 300 station

Starting HW Config

Start ”HW Config” by opening the station and double–clicking the hardware icon.

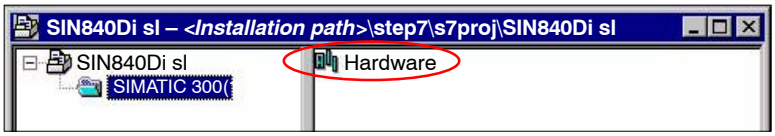


Fig. 6-3 Inserting the SIMATIC 300 station

We recommend giving the inserted SIMATIC Station 300 a meaningful name: e.g. *840Di sl*

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6.3.3 HW Config

The user interface of ”HW Config” mainly contains:

- Station window
  The station window is split. The upper part displays the structure of the station graphically, and the lower part provides a detailed view of the selected module.
- Hardware catalog
  If the hardware catalog is not displayed, open it using the menu command: **View > Catalog**.

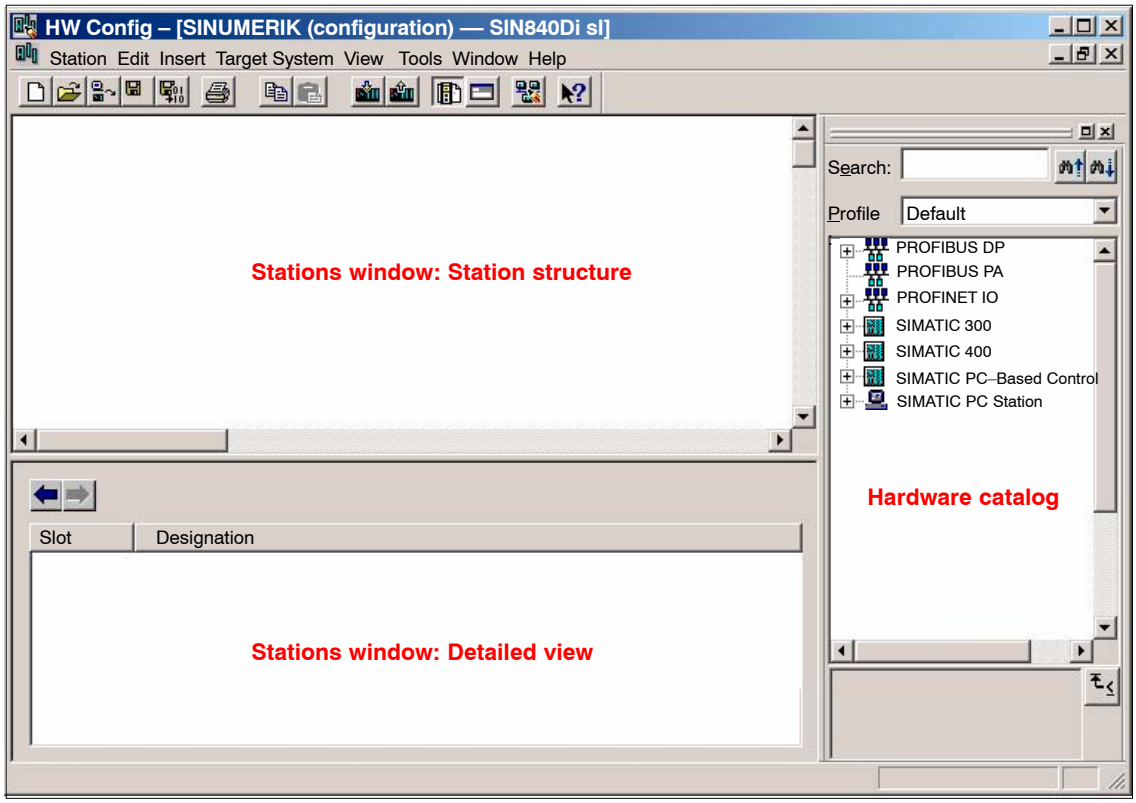


Fig. 6-4 HW Config: Names of the main areas

Note

To check whether a module selected from the hardware catalog complies with the module in the automation system, the following procedure is recommended:

1. Note the MLFB numbers of all modules used in the automation system.
2. Select the appropriate module from the hardware catalog and compare the order number (MLFB) displayed with the noted MLFB number. The MLFB numbers must be identical.

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6.3.4 Inserting the 840Di sl Rack

The 840Di sl Rack contains the already partially preconfigured components:

- SINUMERIK 840Di sl PLC
  Standard designation: PLC 317-2DP 2AJ10
- MPI/DP interface
  Standard designation: MPI/DP
- PROFIBUS DP interface
  Standard designation: DP
- SINUMERIK 840Di sl NC
  Standard designation: NCK 840D sl
- SINUMERIK CP for Industrial Ethernet TCP/IP
  Standard designation: CP 840D sl

Inserting the 840Di sl Rack

The 840Di sl Rack is located in the hardware catalog under:

Profile: **Standard**
SIMATIC 300 > SINUMERIK > 840Di sl > 840Di sl

Use the right mouse button to select the 840Di sl Rack and drag it to the Station window, while holding down the mouse button. When you release the mouse button, the 840Di sl Rack will be inserted in the S7 project.

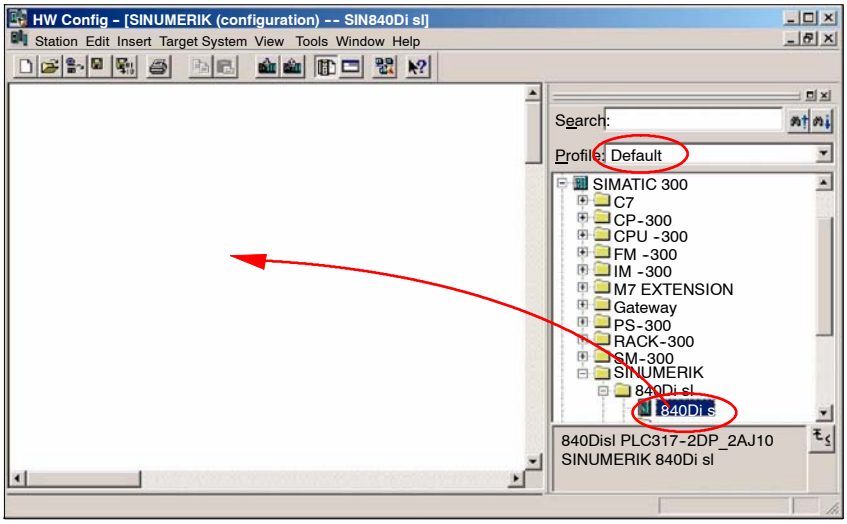


Fig. 6-5 HW Config: SINUMERIK 840Di sl Rack

Notice

Even if the MPI/DP interface (X102) is not used, at least the the MPI communication must be parameterized for this interface. See Section 6.3.7, Page 6-145.

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6.3.5 Parameterizing the PROFIBUS interface (X101)

When you have inserted the 840Di sl Rack, the dialog box for assigning parameters to the PROFIBUS interface (X101) opens automatically as for slot X2. Make the following settings in the Properties box:

- PROFIBUS address of DP master
  The default setting of the PROFIBUS address is 2. It is recommended to keep this setting.
- Subnet
- Equidistant DP cycle
- Equidistant time

Equidistant time

The SINUMERIK 840Di sl will accept the set **isochronous DP cycle** as the NC system clock cycle and position controller cycle.

Position controller cycle = NC system clock cycle = equidistant DP cycle

The time you can set for the equidistant DP cycle depends on:

1. The cyclic communication load by the drives and field devices on the PROFIBUS DP
2. The capacity utilization of the cyclic position controller level by the NC due to the number of position–controlled machine axes and active functions

Dialog box

Dialog box: Properties – PROFIBUS DP interface
Tab: Parameter
Address: **2**
Subnet:
Button: "New..."

Dialog box: Properties – New PROFIBUS Subnet
Tab: General
S7 subnet ID: <***Subnet ID***> (see below: Note)
Tab: Network settings
Transmission rate: **12 Mbits/s**
Profile: **DP**
Button: "Options..."

Dialog box: Options
Tab Equidistance
Activate equidistant bus cycle: ☑
Equidistant DP cycle: ***<Equidistance time>***
OK

OK

OK

Note

SIMODRIVE
We recommend making a note of the **S7 subnet ID**, since it will be needed later to assign parameters for the routing settings of the drive commissioning tool **SimoCom U**. See Section 10.1.6, Page 10-281.

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6.3.6 Parameterizing the PROFIBUS interface (X102) (optional)

When you have completed the "Properties – PROFIBUS DP Interface" dialog box (see previous Section 6.3.5, Page 6-143) the 840Di sl Rack is displayed in the Station window.

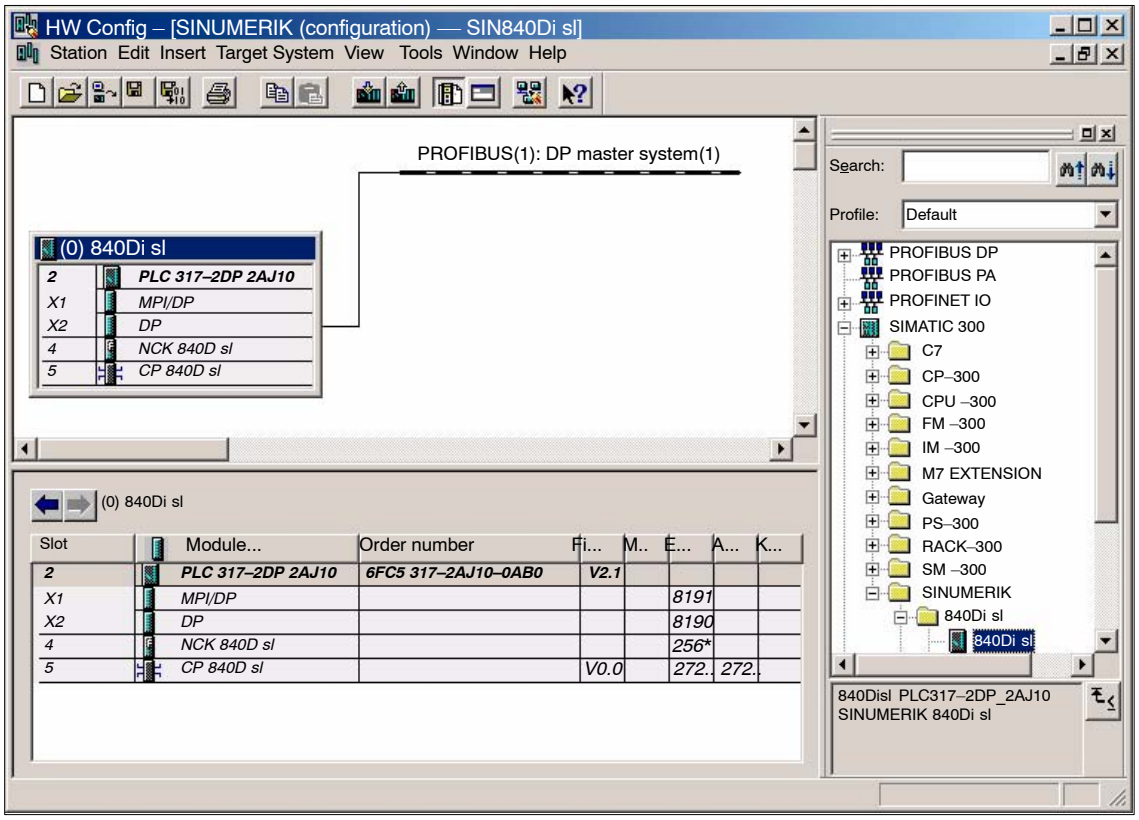


Fig. 6-6 HW Config: SINUMERIK 840Di sl Rack

To parameterize the PROFIBUS interface (X102) as for slot X1, set the following parameters:

- Interface type
- Transmission rate

Double–click module: *MPI/DP*, slot *X1* in the 840Di sl Rack, to open the MPI/DP Properties dialog box.

Dialog box

Dialog box: MPI/DP Properties
Tab: General
Name: <***Designation of 2nd DP interface***>
Group: Interface
Type: **PROFIBUS**
Button: "Properties..."

Dialog box: Properties – PROFIBUS MPI/DP Interface
Tab: Parameter
Address: <***Address***>
Button: "New..."

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Dialog box: Properties – New PROFIBUS Subnet
Tab: Network settings
Transmission rate: <***Trans.rate***>
Profile: **DP**
OK

Tab: Mode
Radio button: <***Mode***> ⦿
OK
OK

6.3.7 Parameterizing the MPI interface (X102) (optional)

When you have completed the "Properties – PROFIBUS DP Interface" dialog box (see previous Section 6.3.5, Page 6-143) the 840Di sl Rack is displayed in the Station window.

To parameterize the MPI interface you will have to make the following parameter settings:

- Interface type
- Transmission rate

Double–click module: *MPI/DP*, slot *X1* in the 840Di sl Rack, to open the MPI/DP Properties dialog box.

Dialog box

Dialog box: MPI/DP Properties
Tab: General
Group box: Interface
Type: **MPI**
Button: "Properties..."

Dialog box: Properties – MPI Interface MPI/DP
Tab: Parameter
Address: **2** (see note)
Subnet: **MPI(1)** **187.5 kbaud**

OK

OK

Notice

With SINUMERIK 840Di sl, the MPI address of the PLC must always be set to 2.

6.3.8 Parameterization of the communications processor (CP 840D sl) (Ethernet)

For the parameterization of the integrated communications processor: "CP 840D sl", the following parameters have to be set:

- IP address of the PCU
- Subnet mask of the PCU

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- PCU gateway type
- Subnet

Note

Determining the IP address and subnet mask of the PCU:
On the PCU: Windows XP taskbar: **Start > Run**, Command: *ipconfig*

Double–click module: *CP 840D sl*, Slot *5* in the 840Di sl Rack, Properties dialog box:

Dialog box

Dialog box: Properties CP 840D sl
Tab: General
Group box: Interface
Button: ”Properties...”

Dialog box: Properties – Ethernet interface CP 840D sl
Tab: Parameter
IP address: <***IP address of the PCU***> (1)
Subnet mask: <***Subnet mask of the PCU***> (2)
Group: Gateway

Option: No router ⦿ (3)
Group: Subnet
Button: ”New...” (4)

Dialog box: Properties – New subnet Ind. Ethernet
Name: <***Name***>
OK

OK

OK

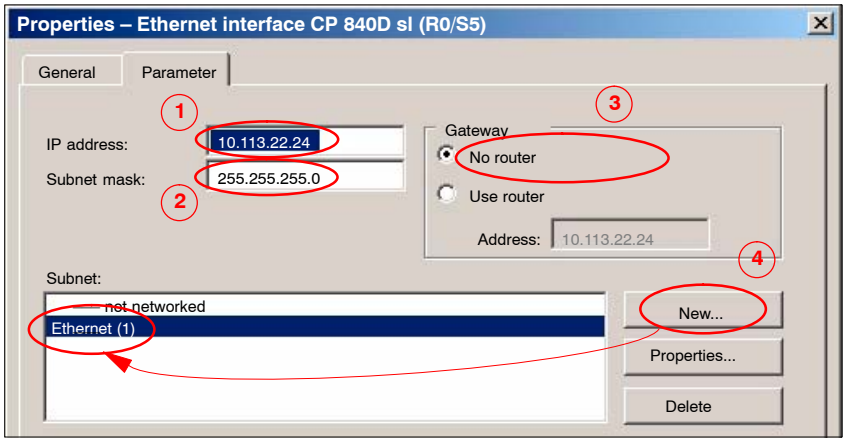


Fig. 6-7 Parameterize the properties of the CP 840D sl (excerpt)

Notice

The IP address and subnet mask in the figure above are only sample values!

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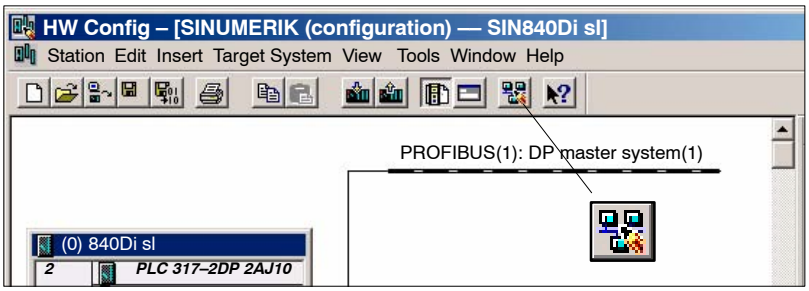
6.3.9 Networking PG/PC and PCU (Ethernet)

In order that external components connected via Ethernet, e.g. PG/PC with the SINAMICS drive commissioning tool STARTER or SIMATIC Step 7, can communicate with SINUMERIK 840Di sl and SIMATIC drive units, the PG/PC must be linked to the PCU in the S7 project.

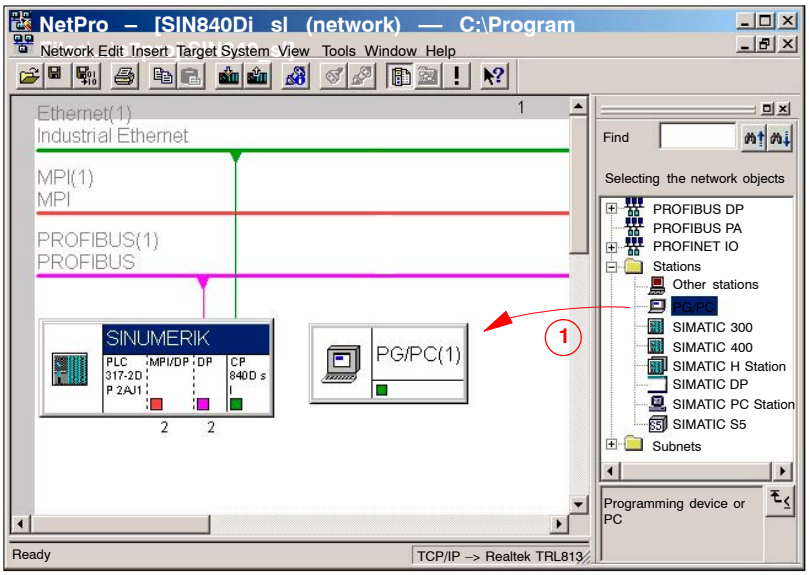
Execution

Perform the following actions for networking:

1. Start the NetPro configuration tool in HW Config.

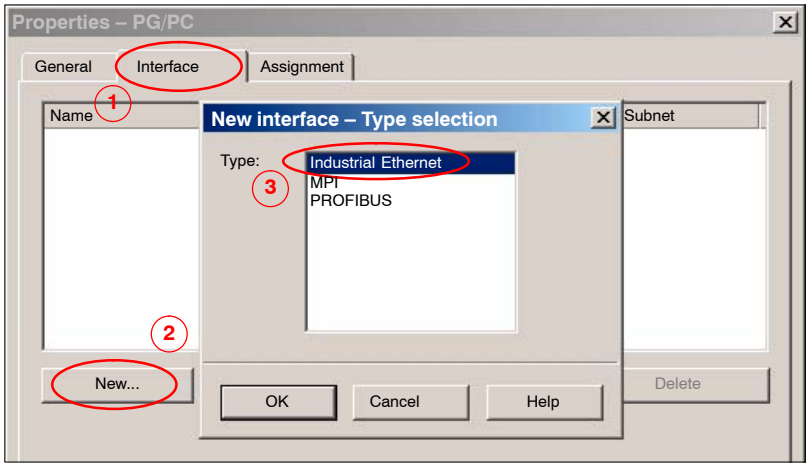


2. From the selection list of the network objects, open **Stations** and insert a PG/PC into the project (1).



3. Double–click the inserted station: PG/PC to open the Properties dialog box. Select the tab: Interface (1). Click the button: New... to open the dialog box for creating a new interface (2). Select the interface type: Industrial Ethernet (3) . Click OK to confirm the dialog.

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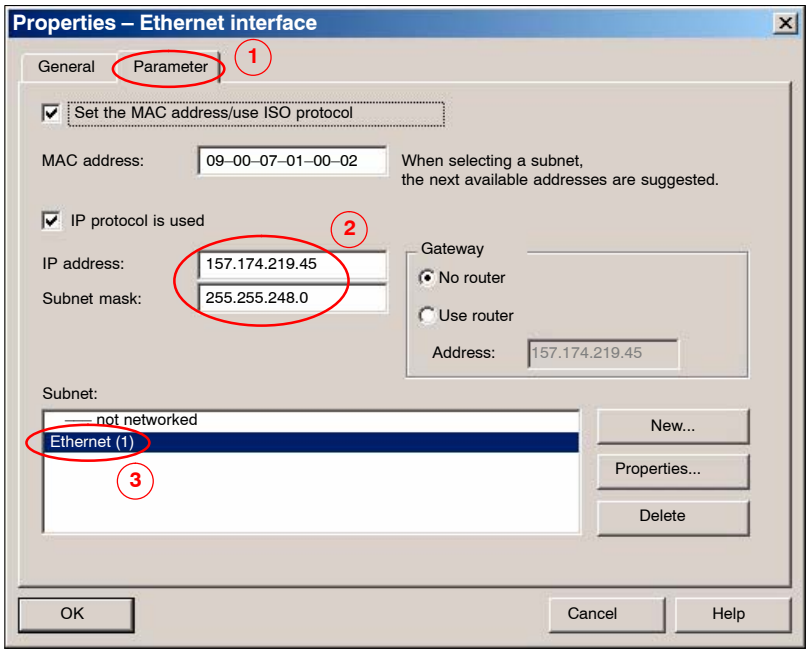


4. After confirming with OK, the properties dialog box of the Ethernet interface is displayed. Select the tab: Parameter (1) tab and enter the IP address and subnet mask of the PG/PC (2).

Note
Determining the IP address and subnet mask of the PG/PC:
On the PG/PC: Windows XP taskbar: **Start > Run**, Command: *ipconfig*

Select the Ethernet connection already parameterized in the previous Section 6.3.8, Page 6-145 as the subnet: "Ethernet (1)" (3)

Click OK to confirm the dialog.



Notice

The MAC address, IP address and subnet mask in the figure above are only sample values!

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5. The configured Ethernet interface must be assigned to an interface parameterization of the PG/PC. Select the tab: ”Assignment” (1).

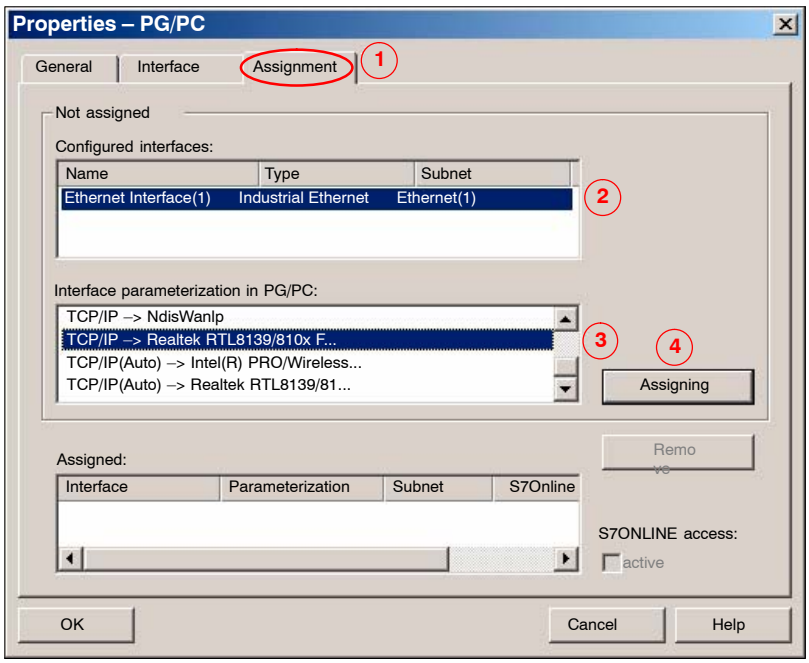
   Select from the list: ”Configured interfaces”, the interface configured above: ”Ethernet (1)” (2) and from the list: ”Interface parameterizations in the PG/PC”, the Ethernet interface via which the connection to the PCU is established. In the example: ”TCP/IP –> Realtek RTL8139...” (3).

Notice

From the list: ”Interface parameterizations in the PG/PC”, do not select ISO interfaces as Ethernet interfaces, e.g. ”ISO Ind. Ethernet –> Realtek RTL8139...”. Instead, use the appropriate TCP/IP interfaces, e.g. ”TCP/IP –> Realtek RTL8139...”.

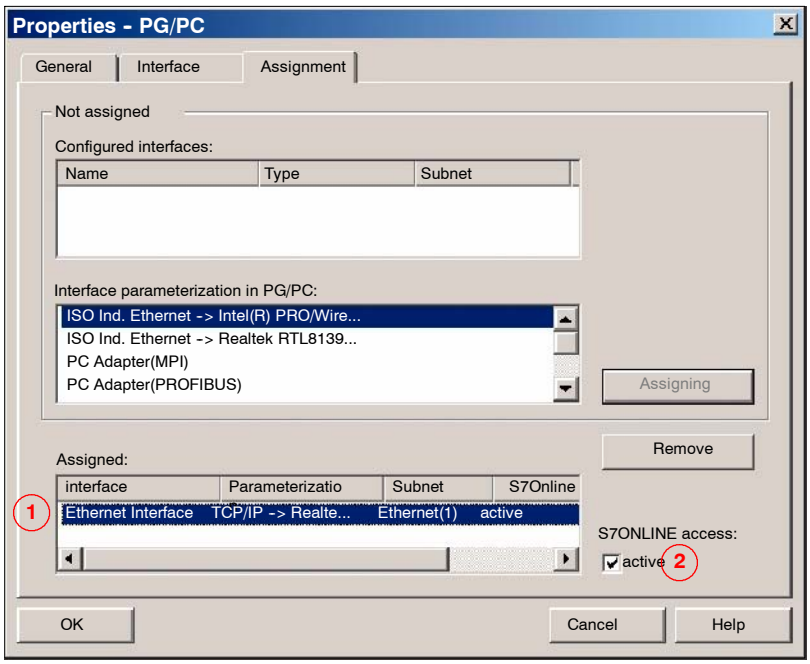
Assign the interface using the ”Assign” button (4).

Confirm the next dialog: ”Edit Object Properties” with OK.

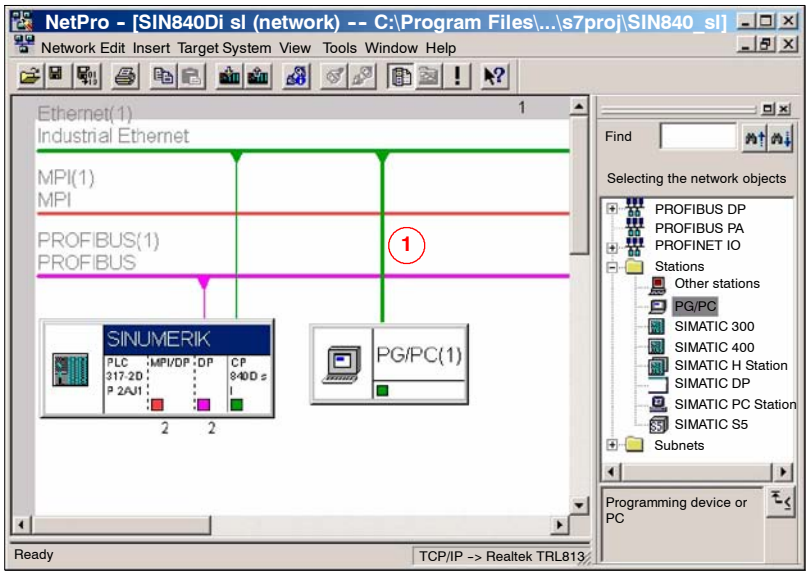


The list ”Assigned” now contains the Ethernet interface (1). If several interfaces are assigned, make sure that the interface to be used for communication, ”Ethernet (1)” in this case, is active. To do this, select the interface (Ethernet (1)) and activate the S7 online access for this interface (2). Click OK to confirm the dialog.

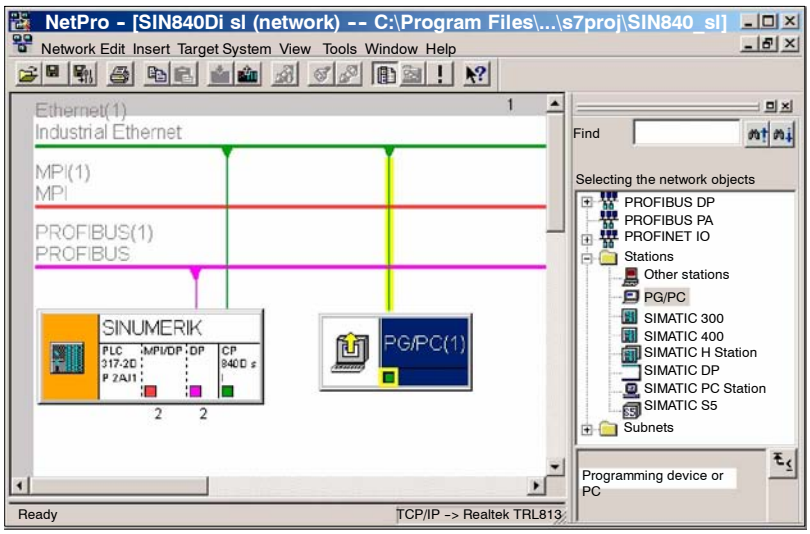
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6. The PG/PC networking with the Ethernet interface is displayed in the project view and identified by the highlighted connection (1).



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7. Then compile and save the project.
   NetPro can then be shut down.

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6.4 Creating a PLC program

6.4.1 PLC basic program

Opening the library

To insert the PLC basic program in the S7 project: *SIN840Di sl* you have created, open the library installed in Section 6.1.4, Page 6-130 with menu item: **Open > File**.

Select the library of the PLC basic program: for example, *gp8x0d65* and confirm the dialog box with OK.

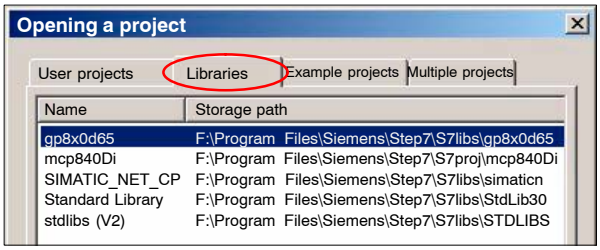


Fig. 6-8 Opening the library of the PLC basic program

Copying blocks

Copy all blocks of the PLC basic program from the library to the block directory of the PLC.

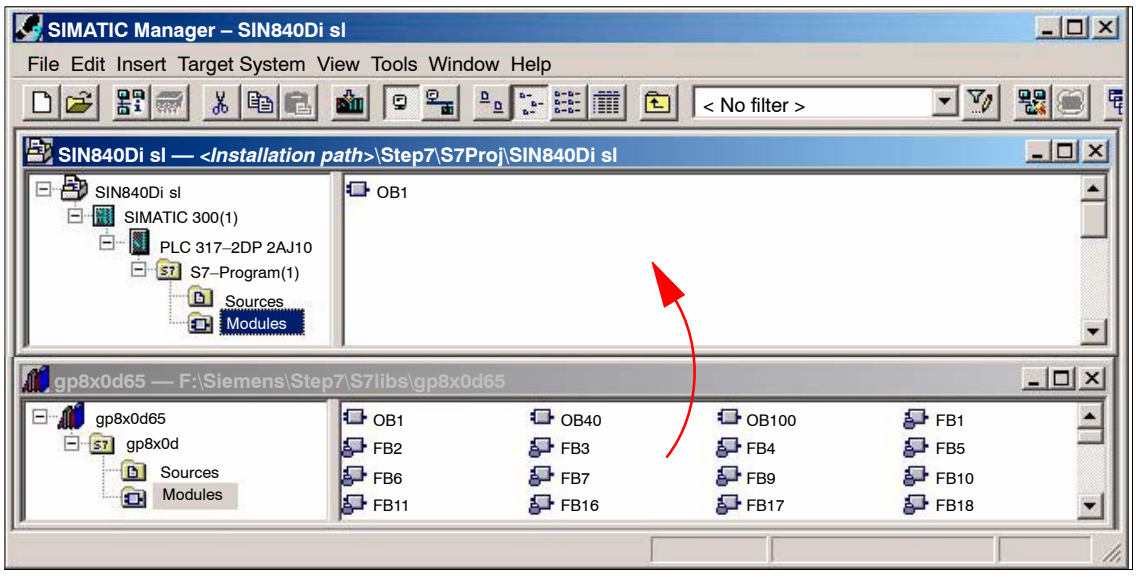


Fig. 6-9 Inserting blocks of the PLC basic program

Overwriting OB 1

Inserting blocks overwrites the existing organization block OB1. Confirm the query as to whether you want to overwrite the block with "Yes".

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6.4.2 PLC user program

The PLC user program according to its definition contains all functions required to process user–specific automation tasks. Tasks of the PLC user program include:

- Defining the conditions for a restart (warm restart) and PLC restart.
- Processing process data, for example, combining signals, reading in and evaluating analog values, defining signals for output and outputting analog values.
- Responding to alarms
- Processing faults in normal program execution

The basis of the PLC user program is the PLC basic program already included in the S7 project. Now expand and alter the PLC basic program to suit your automation task.

6.5 Creating a PROFIBUS configuration

Creation of a PROFIBUS configuration is described in a separate section. See Section 8, Page 8-175.

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6.6 Loading the configuration

6.6.1 Requirements

For loading the configuration into the PLC, the following prerequisites must be fulfilled:

- A communications link exists between STEP 7 and the PLC.
- The configuration to be loaded corresponds to the actual station configuration.
- SINUMERIK 840Di sl is active:
  - NC: Cyclic operation
  - PLC: RUN or STOP mode

6.6.2 Loading the configuration

Note

You are recommended to check consistency of the configuration before loading it.
HW Config: **Station > Check consistency**

Boundary condition

The following supplementary conditions regarding the system data blocks are observed when the configuration is loaded:

- SIMATIC Manager

  When loading the configuration via the SIMATIC manager all the system data blocks are loaded into the module.

- HW Config

  When loading the configuration via HW Config, only the system data blocks generated by HW Config during compilation of the configuration are loaded into the module.

  System data block SDB210 of the MPI configuration is therefore not additionally loaded.

First loading

As part of the MPI configuration, system data block SDB210 has also been loaded into the block directory of the PLC. Because of the supplementary conditions stated above, system data block SDB210 is only loaded into the PLC if it is loaded with the SIMATIC Manager.

When the configuration is loaded into the PLC for the first time, it must be loaded from the SIMATIC Manager.

Notice

When loading the configuration into the PLC, the system data block of MPI configuration SDB210 is only loaded with the SIMATIC Manager, not with HW Config.

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Loading in the module

To load the configuration into the PLC select the following menu item: **Target System > Load in Module**.

The dialog box for loading the configuration now displayed offers the following options:

- Set the PLC to the operating status STOP. See note below.
- Compress the memory if not enough contiguous free memory is available
- Reset PLC to operating status RUN

Note

When the PLC program is loaded in the RUN operating status, each block loaded becomes active immediately. This can result in inconsistencies when executing the active PLC program. You are therefore advised to place the PLC in the STOP state before loading the configuration.

NC Reset triggered

The STOP condition of the PLC which is taken by the PLC for a short time on loading is interpreted by the NC as a PLC failure with an appropriate alarm response.

Once the configuration has been loaded you must therefore initiate an ”NC Reset”, for example, via the ”840Di–Start–up” user interface. In ”840Di–Start–up” select menu item: **Window > Diagnostics > NC/PLC**:

Dialog box

Dialog box: NC/PLC Diagnosis
Group box NC
Button: **”NC Reset”**

6.6.3 Series startup file

The PLC user data can be backed up by creating a series–startup file or loading an existing series startup file using the following applications:

- **SinuCom NC** (part of the SINUMERIK 840Di sl installation)
- **HMI Advanced** (optional)

For detailed information about data back–up please refer to Section 15, Page 15-459 or:

References

SinuCom NC
Online Help

HMI Advanced
/BAD/ Operator’s Guide HMI Advanced
Section: Commissioning functions

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6.7 Testing the PLC program

6.7.1 Start–up behavior

Start–up of a SIMATIC–CPU module can be set for the following start–up modes:

- Restart
- Cold restart (warm restart)
- Cold restart

With a SINUMERIK 840Di sl, the start–up type of the PLC is permanently set to RESTART. It cannot be changed.

Start–up mode: RESTART

With **COLD RESTART** block ”OB100” is executed first. Then cyclic operation starts with call–up of block ”OB1”.

The following data are kept in the case of COLD RESTART:

- All data blocks and their contents
- Retentive timers, counters and flags

Retentive ranges

The ranges of the timers, counters and flags that are to be retentive must be set using the dialog box **Properties,** tab **Retention** of the PLC–CPU module.

Notice

The retention of the data areas can only be achieved with the backup supply (backup battery) active. If the battery backup is empty, the PLC will not restart.

The following operations are performed during a restart:

- UStack, BStack and non–retentive flags, timers and counters will be deleted
- The process output image (POI) will be deleted
- Process and diagnostics alarms will be canceled
- The system status list will be updated
- Parameterization objects of modules (from SD100 onwards) will be evaluated or defaults parameters will be output to all modules in single–processor mode
- OB100 (cold restart) is executed
- The process input image (PII) is read in
- The command output disable (COD) is canceled

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6.7.2 Cyclic operation

In cyclic operation, communication or exchange of data and signals is carried out between the PLC and the components NC, HMI (e.g. HMI Advanced) and MCP (machine control panel).

The execution of the PLC program is carried out such that – with regard to time – the basic PLC user program is executed prior to the PLC user program.

NC communication

Communication of the PLC with the NC is carried out using the NC/PLC interface. The interface is divided into the following areas:

- Mode groups
- Channels
- Axes/spindles
- General NC data

Data exchange through the NC/PLC interface is carried out in the basic PLC program at the beginning of ”OB1”. This ensures that the data for the PLC remain constant over the entire PLC cycle.

The current G functions of the NC channels are transferred to the PLC (provided function is activated) on the process alarm level (OB40).

Sign–of–life monitoring

A cyclic, mutual sign–of–life monitoring function is activated between PLC and NCK once power–up and the first OB1 cycle have been completed.

In case of failure of the PLC or in case of STOP of the PLC program execution, the following alarm is displayed:

- Interrupt: ”2000 sign–of–life monitoring for PLC”

6.7.3 Monitor/control using the SIMATIC Manager

The SIMATIC Manager provides extensive functionality for testing the PLC program or the module.

Monitoring and controlling the variable

The menu command **Target System > Monitor/Control Variable** is used to start the tool **”Monitor/control variable”**.

The following functions can be performed with ”Monitor/Control Variable”:

- **Monitoring variables**
  Displaying the current value of individual variables of the PLC user program or CPU module.
- **Controlling variables**
  Assigning values to variables of the PLC user program or CPU module.

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- **Enabling PA** and **activating control values**
  Assigning values to I/O outputs of the PLC user program or CPU module in the STOP state.
- **Forcing variables**
  Assigning values to variables of the PLC user program or CPU module that cannot be overwritten from the PLC user program.

Variable types

The values of the following variable types can be defined or displayed:

- Inputs, outputs, flags, timers, and counters
- Contents of data blocks
- I/Os

The variables that are to be displayed or controlled are grouped in variable tables.

You determine when and how often variables will be monitored or overwritten with values by defining trigger points and trigger conditions.

Additional test functions

The menu command **Target System > ...** provides the following additional test functions:

- Display accessible nodes
- CPU messages ...
- Display force values
- Diagnose hardware
- Module status ...
- Operating status ...

6.7.4 Monitor/control using HMI Advanced

PLC status display

The PLC status display of HMI Advanced is used to monitor and control:

- Inputs, outputs, flags, timers, and counters
- Contents of data blocks

The menu of the PLC status display is located at operation path: **Operating Area Switchover > Diagnosis > PLC Status**.

Input syntax

The following two tables show the input syntax of the fields: **Operand** and **Format** of the PLC status display.

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Table 6-2 Input field: **Operand**

Syntax	Significance
In.x	Input byte n, bit x
IBn	Input byte n
IWn	Input word n
IDn	Input double–word n
DBn.DBXm.x	Data block n, byte m, bit x
DBn.DBBm	Data block n, byte m
DBn.DBWm	Data block n, word m
DBn.DBDm	Data block n, double word m
On	Output n
Fn	Flag n
T n	Timer n
Z n	Counter n

Table 6-3 Input field: **Format**

Syntax	Significance
H	Hexadecimal
D	Decimal
B	Binary
G	Floating point (only in conjunction with double word)

Monitoring

After the variable to be displayed has been input in the field **Operand** using the syntax described above, the current value of the variable is displayed in the format you have set.

Controlling: Start

Use the softkey **Change** to switch over to **Control** mode. Now you can use the field **Value** to specify new values for the displayed variables. The entered value must be within the definition range of the set format.

Controlling: End

As long as **Control** mode is active, the entered values are not imported. Only when you quit the mode using the softkey **Accept**, the entered values are written to the variables and processed in the PLC program.

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6.8 Load configuration into PG (PLC -> STEP 7)

The configuration of a SINUMERIK 840Di sl PLC must be loaded onto an external computer (STEP 7 PG/PC) using an Ethernet connection.

Requirements

The following conditions must be fulfilled:

- The computer can communicate via Ethernet or an Ethernet connection has been established
- The PG/PC is connected to the Ethernet interface 1 (company network) of the SINUMERIK 840Di sl PCU. (See Section 7.1.1, Page 7-161)
- The IP address of the Ethernet interface 1 (company network) of the SINUMERIK 840Di sl PCU is known. (See Section 7.1.2, Page 7-161)

Implementation

Perform the following steps to load the configuration from the target system:

1. Start STEP 7 on the external computer (PG/PC).
2. Create a new STEP 7 project to which the configuration shall be loaded.
3. In STEP 7, select the following menu options for the project: **Target system > Load station into PG**

   Since the communication parameters have not yet been communicated to STEP 7, the node address selection dialog is displayed. Enter the following data:

Dialog

Dialog: “Select node address”

Rack:	**0**
Slot:	**2**
Target station:	**Local**
IP address:	<**IP addr. of PCU Ethernet interface 1**> Note Press the ”Return” key to confirm the entry of the IP address

OK

After entering all relevant data, press OK to confirm the dialog.

The configuration is now uploaded from the controller into the project.

■

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Ethernet Communication 7

7.1 General

7.1.1 Ethernet PCU connections 50.3

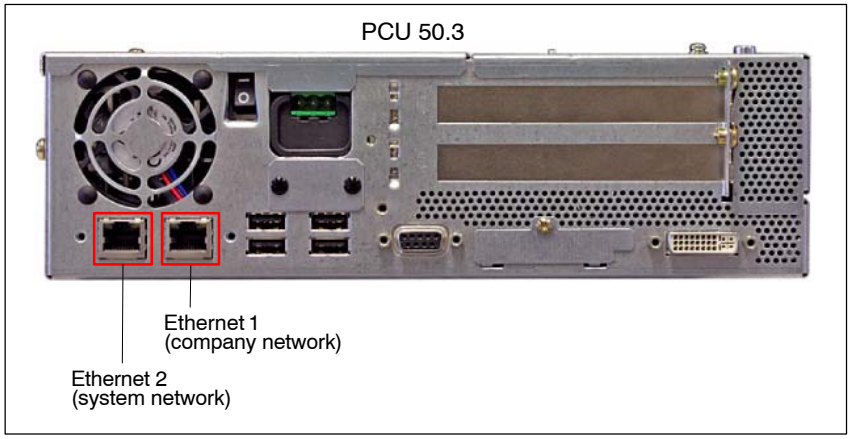


Fig. 7-1 Ethernet connections of the PCU 50.3

The PCU 50.3 has 2 Ethernet connections (10/100 MBaud):

- Ethernet 1 (company network)
- Ethernet 2 (system network)

Ethernet 1 The interface ”Ethernet 1” is preset as a SINUMERIK DHCP client for connecting to a company network or a PTP connection.

Ethernet 2 The interface ”Ethernet 2” is preset as a SINUMERIK DHCP server for connecting to a system network with IP address 192.168.214.241.

The Ethernet components described below, e.g. Machine control panel MCP 483 IE, are connected via this Ethernet interface.

7.1.2 Determining the PCU Ethernet communication parameters

Start a Windows console on the PCU to determine the Ethernet communication parameters of the PCU: Windows XP Start menu: **Start > Run: cmd**. On the console, enter the command **ipconfig**.

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7.1.3 Checking an Ethernet connection

If there is an Ethernet connection between a SINUMERIK 840Di sl PCU with a direct operator panel connection and another component, the connection can be checked as followed:

1. Start a Windows console on the PCU: Windows XP Start menu: **Start > Run: cmd**
2. On the console, enter the command ”ping” followed by the IP address of the component.

   Example: ping 192.168.214.192

   – Positive reply: ”Reply from 192.168.214.192: . . . .”

   – Negative reply: ”Request timed out . . . .”

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7.2 SINUMERIK 840Di sl commissioning tool: SinuCom NC

The SINUMERIK 840Di sl commissioning tool ”SinuCom NC” communicates with a SINUMERIK 840Di sl exclusively via an Ethernet connection independent of the installation location (externally or internally).

Start the SinuCom NC Connect Wizard from the Windows XP Start menu to parameterize the Ethernet connection: **Start > Programs > SinuCom > NC Connect Wizard**

Make the following settings in the NC Connect Wizard:

1. Control Mode: 840Di (any)
2. Port: RJ−45 (solutionline ONLY)
3. IP address:
   The IP address by which the SinuCom NC communicates with the SINUMERIK 840Di sl depends on where SinuCom NC is installed:
   - PG/PC (external connection)
     Enter the IP address of the PCU Ethernet interface used (Ethernet 1: company network or Ethernet 2: system network).

     To determine the IP address, see Section 7.1.2, Page 7-161.
   - SINUMERIK 840Di sl PCU (internal connection)
     Enter the IP address: 127.0.0.1 (local host).

7.3 SINAMICS drive commissioning tool: STARTER

The SINAMICS STARTER drive commissioning tool communicates with the SINAMCS S120 drives via PROFIBUS only.

If the STARTER is connected to the SINUMERIK 840Di sl via Ethernet link, within the framework of the S7 project for configuring the PLC the PG/PC on which the STARTER runs must be linked by means of SIMATIC STEP 7 ”Net-Pro” with the SINUMERIK 840Di sl. The SINUMERIK 840Di sl PLC then routes the STARTER on the PROFIBUS to the SINAMICS drives.

The networking is described in: Section 6.3.9, Page 6-147.

Note

The SINAMICS STARTER drive commissioning tool can currently only be operated on a SINUMERIK 840Di sl PCU if at least one of the two Ethernet interfaces is active. To do this, at least one component must be connected to the relevant Ethernet interface, e.g. an ”MCP 483C IE” machine control panel to Ethernet interface 2 (system network), and communicate with the SINUMERIK 840Di sl.

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7.4 External HMI Advanced

If the SINUMERIK HMI Advanced user interface is not installed on the SINUMERIK 840Di sl PCU, but on an external computer, e.g. PCU 50.3 with OP 012 (referred to as HMI PCU), there must be an Ethernet connection established between both computers.

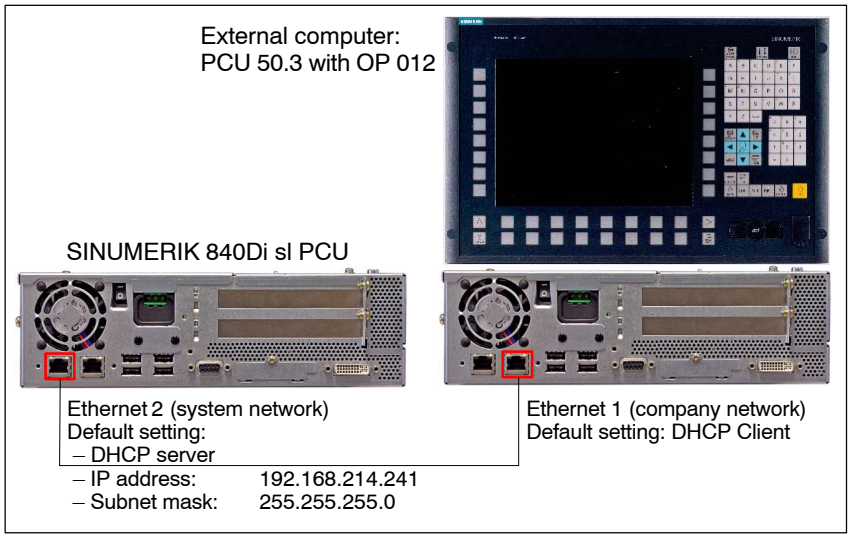


Fig. 7-2 Example of a possible Ethernet connection

Note

There are no restrictions in terms of Ethernet topology within the SINUMERIK 840Di sl PCU and HMI PCU.

Requirements

The following conditions must be fulfilled:

- There is an Ethernet connection between SINUMERIK 840Di sl PCU and HMI PCU and both computers communicate.
- The communication parameters of the SINUMERIK 840Di sl PCU Ethernet interface with which the HMI PCU is connected are known.

  To check an Ethernet connection, see Section 7.1.3, Page 7-162.

HMI configuration

The configuration of HMI Advanced, with respect to the Ethernet connection to the SINUMERIK 840Di sl, is performed as follows:

1. Start HMI Advanced.
2. Open the dialog for entering the IP address: **Operating area switchover > Installation > HMI > NCU connection> NCU address**
3. Enter the IP address of the interface by which the HMI communicates with the SINUMERIK 840Di sl.

   Example:
   Interface: Ethernet 2 (system network)
   IP address: 192.168.214.241 (default)

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7.5 MCP 483C IE



Fig. 7-3 MCP 483Front panel; Version T (turning machines)

7.5.1 Conditions for general commissioning

Hardware

The following hardware is required:

- Ethernet connecting cable

Software

The following software is required:

- PLC basic program
  The relevant modules of the basic PLC program are **FB 1** (MCP communication parameters), **FC 19** (interface parameter assignment version: milling) and **FC 25** (interface parameter assignment, version: turning).

  The library of the PLC basic program is part of the SINUMERIK 840Di sl. How to install the library is described in Section 6.4, Page 6-152.

- SIMATIC STEP 7
  SIMATIC STEP 7 is needed to customize the PLC basic and user programs to the requirements of the respective automation system. SIMATIC STEP7 can be installed directly on the PCU of the SINUMERIK 840Di sl. How to install additional software is described in Section 17, Page 17-477.

References

The following manuals are required for the commissioning of the MCP:

/FB1/ Description of Functions, Basic Functions P3, PLC Basic Program
Program structure and modules of the PLC basic program.

/FB2/ Description of Functions, Extended Functions H1 Jog with/without Handwheel
Commissioning of handwheels

/BHsl/ Operator Components Manual
Description of MCP (interfaces, electrical connection, etc.)

/Z/ Catalog NCZ
Connection Components: Cables, connectors, etc.

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Automation system

To commission the MCP the automation system must be completely electrically and mechanically connected with respect to NC, PLC and MCP.

The drives must be secured against accidental moving.

7.5.2 Parameterization of the MCP

Interfaces

Fig. 7-4 shows the interfaces on the rear of the module:

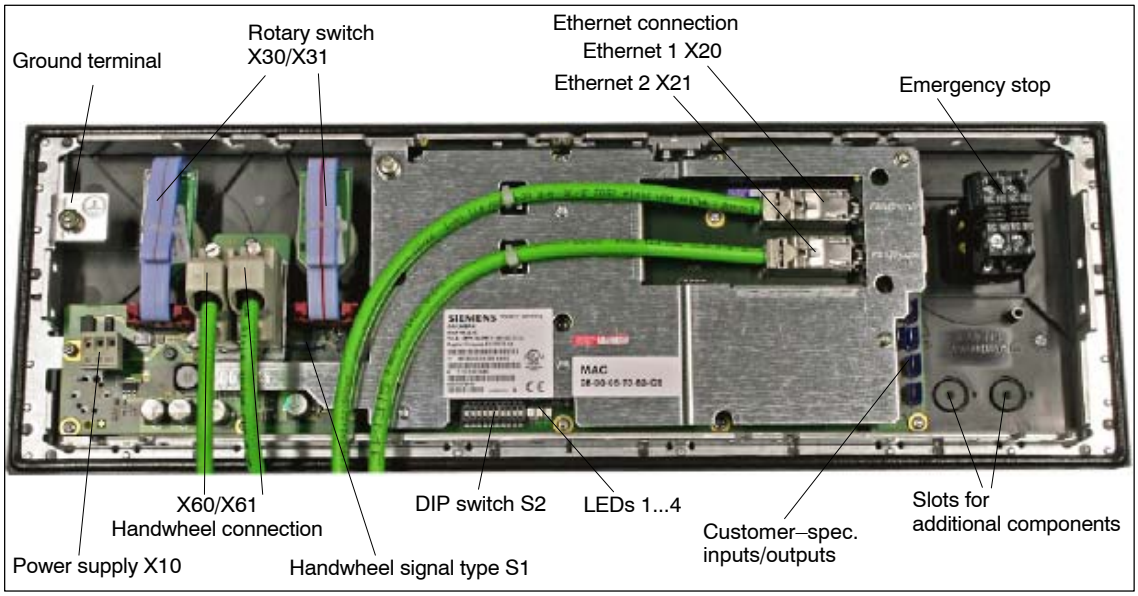


Fig. 7-4 Position of interfaces on rear side of machine control panel

For a detailed description of the electrical and mechanical design and of the machine control panel interfaces, please refer to:

References: /BHsl/ Operator Components Manual
Section: Machine control panel MCP 483C IE

Display of the software version

After the MCP has been electrically connected, all LEDs on the front side of the MCP flash until communication is established between MCP and PLC.

Simultaneously pressing the two keys ”Feed stop” and ”Feed enable” displays the version number of the current software using the LEDs now continuously illuminated.

Example: Software version: V 01.02.00

	1st digit ***1)***	**2nd digit** ***1)***	**3rd digit** ***1)***
Simultaneous pressing of the keys ”Feed enable” and ”Feed stop”	1	2	0
1) Display of the digit by means of continuously illuminated LEDs on the individual LED blocks according to Fig. 7-5			

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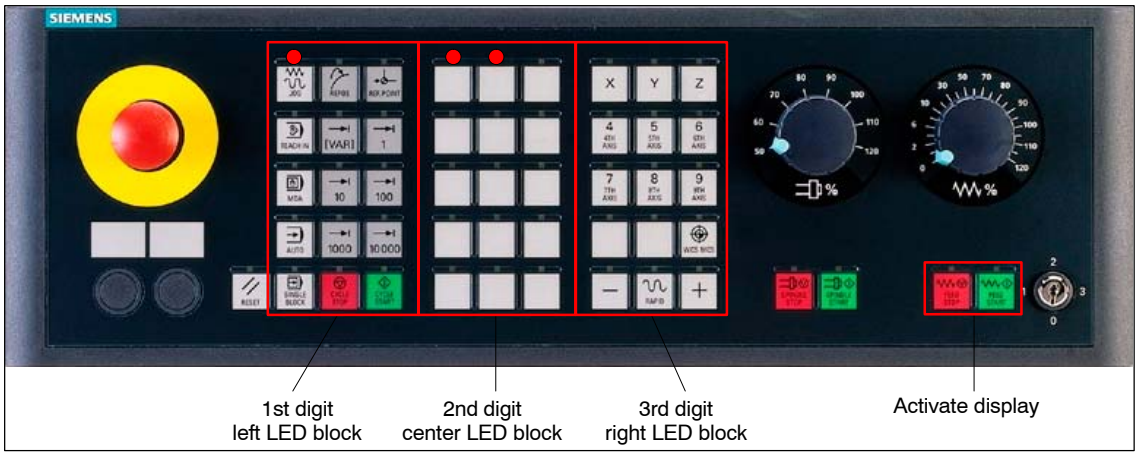


Fig. 7-5 Display of software version: 1 . 2 . 0

Display of the IP address

After the MCP has been electrically connected, all LEDs on the front side of the MCP flash until communication is established between MCP and PLC.

Simultaneously pressing the two keys ”Feed stop” and ”Feed enable” displays the version number of the current software using the LEDs now continuously illuminated.

If the ”Feed stop” and ”Feed enable” keys are pressed, one digit of the IP address is displayed with each press of the ”Spindle enable” key.

Example default IP address: 192.168.214.192

Pressing the ”Spindle enable” key n times	***1st digit 1)***	**2nd digit *1)***	**3rd digit *1)***	**Digit of the IP address**
1	1	9	2	1
2	1	6	8	2
3	2	1	4	3
4	1	9	2	4
1) Display of the digit by means of continuously illuminated LEDs on the individual LED blocks according to Fig. 7-6				

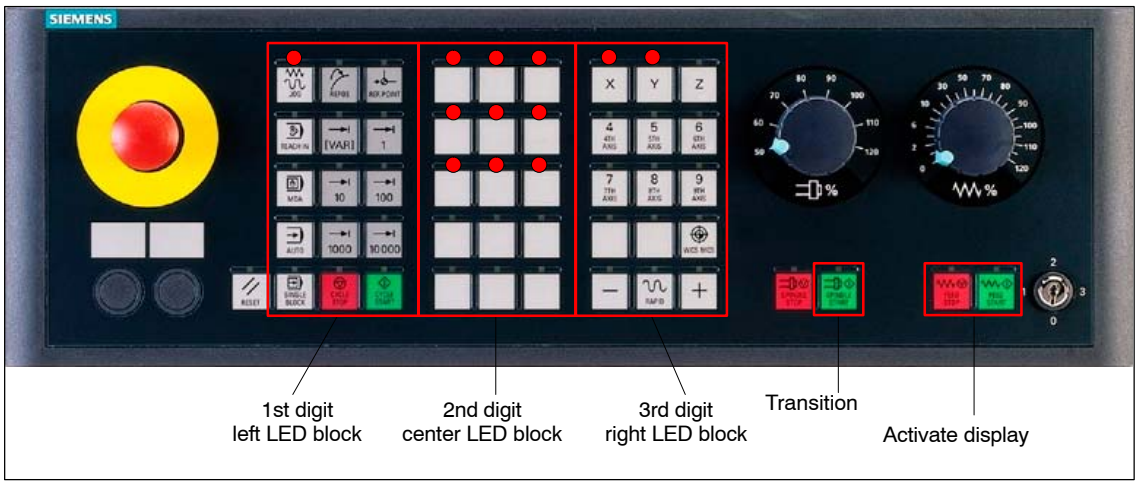


Fig. 7-6 Display of the 1st digit of the IP address: 192

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Switch S1

With switch S1 you can select the type of handwheel that is to be operated on the module:

- Differential handwheels
  switch S1 closed (on delivery)
- TTL handwheels
  switch S1 open

Switch S2

Switch S2 is used to set the address by which the MCP is addressed by the PLC user program.

Table 7-1 Switch S2: MCP address (1 – 8)

10	*9*	*8*	7	6	5	4	3	2	1	**Meaning/value**
off	off	–	–	–	–	–	–	–	–	Reserved
										MCP address
–	–	off	off	off	off	off	off	off	off	0
–	–	off	off	off	off	off	off	off	on	1
–	–	off	on	off	off	off	off	on	off	2
–	–	off	off	off	off	off	off	on	on	3
–	–	:	:	:	:	:	:	:	:	:
–	–	on	on	off	off	off	off	off	off	192 (on delivery)
–	–	:	:	:	:	:	:	:	:	:
–	–	on	on	on	on	on	on	on	off	254
–	–	on	on	on	on	on	on	on	on	255

7.5.3 MCP functions

The MCP offers the following functions:

- Standard
  The input/output data of the MCP 483C IE are compatible with the input/output data from the previous MCP, e.g. MCP 483 and MCP 310.
- Handwheel
  Up to 2 handwheels can be connected to the MCP. For each handwheel the current handwheel value is transferred as a 16–bit absolute value relative to the starting value. The starting value for the sensor counter in the handwheel is 0.
- Additional I/Os
  The additional I/Os include:
  - Customer keys (KT1 to KT9)
  - Customer key outputs (KT_OUT1 to KT_OUT6)
  - RESET output (R14_LED)
  - Rotary switch (X31)

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7.5.4 Linking to the basic PLC and user program

This section describes how to link DP slave: MCP 483

- to the PLC basic program for transferring standard I/O data to the VDI interface
- to the PLC user program (optional) to implement a user–specific response to a module failure

Notice

Processing of additional I/O data is the sole responsibility of the user (machine manufacturer) and is not supported by the PLC basic program.

PLC basic program

To transfer standard MCP 483C IE input/output data IE via the PLC basic program, the MCP address configured by means of the S2 switch on the module must be entered in the communication parameters of the FB 1 function block.

Function block FB 1

The communication parameters of the MCP are called MCPx... (x = 1 or 2) in function block FB 1. A maximum of 2 machine control panels are supported by the basic PLC program.

To synchronize several MCPs, the PLC program must be adapted accordingly. This is the user's (machine manufacturer's) responsibility.

To operate an MCP 483C IE on a SINUMERIK 840Di sl, the following parameters are relevant:

```
MCPNum:      INT       // Number of the MCPs

MCP1In:      POINTER   // Address of the input signals
MCP1Out:     POINTER   // Address of the output signals
MCP1BusAdr   Byte      // PROFIBUS address of the DP slave MCP
```

The MCP2... parameters are only needed if a 2nd MCP is used in addition to the 1st MCP:

```
MCP2In:      POINTER   // Address of the input signals
MCP2Out:     POINTER   // Address of the output signals
MCP2BusAdr   Byte      // PROFIBUS address of the DP slave MCP
```

Bus type via which the MCP is connected:

```
MCPBusTyp    Byte      // MPI       = 0
                       // PROFIBUS  = B#16#33
                       // Ethernet  = B#16#55
```

Notice

Parameters: MCPxStop and MCPxNotSend are of no significance.

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References
For a detailed description of the PLC basic program or of function block FB 1, please refer to:

/FB1/ Description of Functions, Basic Functions: PLC Basic Program P3
Section: FB 1: RUN_UP Basic program, startup section

VDI interface parameter assignment

The following function blocks are available to transfer the MCP signals to the VDI interface:

- FC 19: MCP_IFM, version M (milling)
- FC 24: MCP_IFM2, version M (milling)
- FC 25: MCP_IFT, version T (turning)

Notice

Function blocks FC 19, FC 24 and FC 25 are part of the PLC basic program. It is the user's (machine manufacturer's) responsibility to call the block correctly and/or assign the interface the appropriate parameters.

References
A detailed description of the function blocks for transferring machine control panel signals to the VDI interface can be found in:

/FB1/ Description of Functions, Basic Functions: P3, PLC Basic Program
Section: FC 19: MCP_IFM ...
Section: FC 24: MCP_IFM2 ...
Section: FC 25: MCP_IFT ...

Example

The following example shows the communication parameter settings for function block FB 1 for an MCP:

```
MCPNum        :=  1             // Number of MCPs
MCP1In        := P#E0.0         // Address: Input data
MCP1Out       := P#A0.0         // Address: Output data
MCP1StatRec   := P#A8190.0      // Configured diagnostic address
MCP1BusAdr    :=  192           // MCP address (switch S2)
MCP1Timeout   := S5T#700MS      // Default setting
MCPMPI        := FALSE          // No MPI bus
MCP1Stop      := FALSE          // Deactivation of the DP slave MCP
MCPSDB210     := FALSE          // No SDB210 for MCP
MCPCopyDB77   := FALSE          // No copying to DB77
MCPBusTyp     := B#16#55        // Ethernet
```

MCP failure

An MCP failure is detected by the PLC basic program immediately after restarting the PLC, even if no data have been exchanged between the MCP and PLC.

The monitoring function is activated as soon as all components have signaled "Ready" after powerup.

An alarm is displayed on the user interface if an MCP fails:

- 1st MCP alarm: "400260 Failure of machine control panel 1"
- 2nd MCP alarm: "400261 Failure of machine control panel 2"

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Note

An Ethernet MCP is connected via a PCU Ethernet interface. Since the Ethernet communication of the MCP with the SINUMERIK system software (PLC) is based on Windows components, the MCP monitoring time may be exceeded in the following cases:

1st cause: Windows XP identifies a fatal exception error (Blue Screen)
Possible measures: none

2nd cause: Impairment of Ethernet communication through unsuitable PC components.
Possible measures: Increase in MCP monitoring time (parameter: MCPxTimeout)

7.5.5 Input/output image

Arrangement: Keys and LEDs

A key and the LED positioned above it form a logical unit. The key and the LED have the same number.

- Key number xy corresponds to Sxy
- LED number xy corresponds to LEDxy

Fig. 8-20 shows the arrangement of keys and LEDs on the machine control panel. For the sake of clarity, the LED designations are not shown in full.

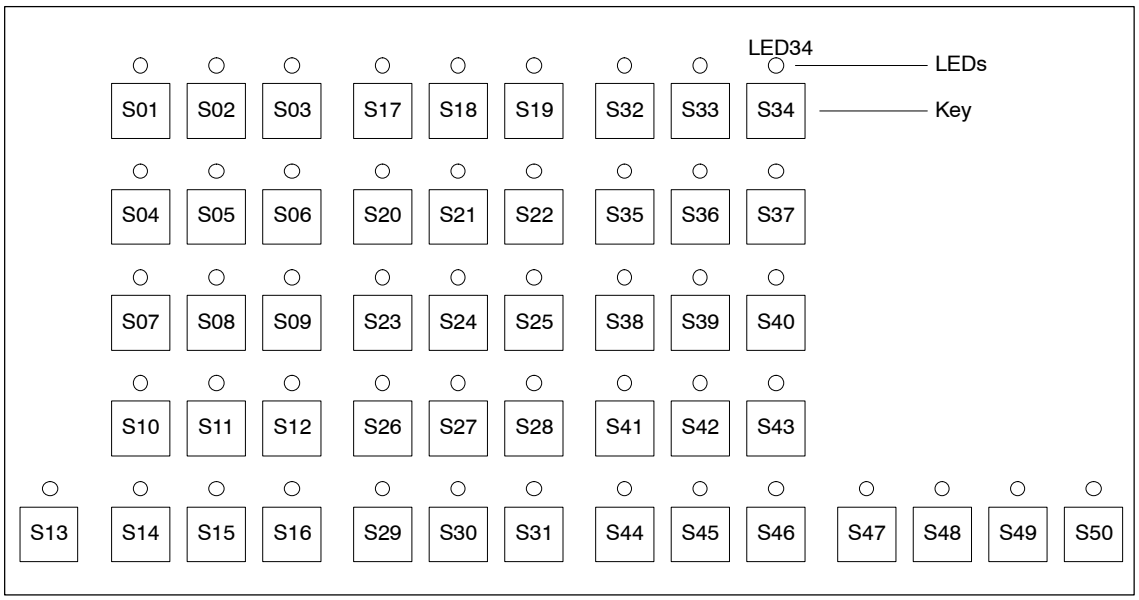


Fig. 7-7 Keyboard layout MCP 483C IE (front view)

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Input image

The following information is to be found in the table for each input bit:

- 1st line: Default designation
- 2nd line: Key number (Sxy) or feedrate override switch (X30/X31), key-switch (X50), optional customer keys (X52)

Table 7-2 Assignment of the key signals in the input image

Signals from machine control panel (keys)								
Byte	**Bit7**	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
EB n+0	*Spindle override*				Mode			
	Override Spindle8 X31.7	*Override Spindle4 X31.8*	*Override Spindle2 X31.9*	*Override Spindle4 X31.10*	JOG S01	TEACH S04	MDA S07	AUTO S10
EB n+1	Machine functions							
	REPOS S02	REF S03	var. INC S05	10000 INC S12	1000 INC S11	100 INC S09	10 INC S08	1 INC S06
EB n+2	*Key Pos. 0 X50.4*	*Key Pos. 2 X50.1*	Spindle Start S48	*****Spindle Stop S47	Feed Start S50	*****Feed Stop S49	NC Start S20	*****NC Stop S15
EB n+3	RESET S13	*Key Pos. 1 X50.6*	Single Block S14	*Feed override*				
				Override F.over.16 X30.6	*Override F.over.8 X30.7*	*Override F.over.4 X30.8*	*Override F.over.2 X30.9*	*Override F.over.1 X30.6*
EB n+4	Arrow keys			*Key Pos. 3 X50.3*	Axis selection			
	R15 S46	R13 S44	R14 S45		R1 S32	R4 S35	R7 S38	R10 S41
EB n+5	Axis selection			MKS/WKS			Axis selection	
	R2 S33	R3 S34	R5 S36	S43	R11 S42	R9 S40	R8 S39	R6 S37
EB n+6	Freely assignable customer keys							
	T9 S25	T10 S26	T11 S27	T12 S28	T13 S29	T14 S30	T15 S31	–
EB n+7	Freely assignable customer keys							
	T1 S17	T2 S18	T3 S19	T4 S20	T5 S21	T6 S22	T7 S23	T8 S24
EB n+8	–	–	–	–	–	–	–	–
EB n+9	–	–	–	–	–	–	–	–
EB n+10	–	–	–	–	–	–	–	–
EB n+11	–	–	–	–	–	–	–	–
EB n+12	–	–	–	Override spindle16	Override spindle8	Override spindle4	Override spindle2	Override spindle1

***** Inverse transferred signals
– Free signals

Note
Free signals are transferred from the MCP with 0.

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Output image The following information is contained in the table for each output bit:

- 1st line: Default designation
- 2nd line: LED number

Table 7-3 Assignment of the LED signals in the input image

Signals to machine control panel (LEDs)								
Byte	**Bit7**	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
AB n+0	Machine function				Mode			
	1000 INC LED11	100 INC LED09	10 INC LED08	1 INC LED06	JOG LED01	TEACH LED04	MDA LED07	AUTO LED10
AB n+1	Feed Start LED50	Feed Stop LED49	NC Start LED16	NC Stop LED15	Machine function			
					REPOS LED02	REF LED03	var. INC LED05	10000 INC LED12
AB n+2	Axis selection					Single Block LED14	Spindle Start LED48	Spindle Stop LED47
	R13 LED44	R1 LED32	R4 LED35	R7 LED38	R10 LED41			
AB n+3	Axis selection							
	R3 LED34	R5 LED36	R12 LED43	R11 LED42	R9 LED40	R8 LED39	R6 LED37	R15 LED46
AB n+4	Freely assignable customer keys							Axis selection
	T9 LED25	T10 LED26	T11 LED27	T12 LED28	T13 LED29	T14 LED30	T15 LED31	R2 LED33
AB n+5	Freely assignable customer keys							
	T1 LED17	T2 LED18	T3 LED19	T4 LED20	T5 LED21	T6 LED22	T7 LED23	T8 LED24
AB n+6	–	–	–	–	–	–	RESET LED13 (optional)	R14 LED45 (optional)
AB n+7	–	–	KT_OUT6	KT_OUT5	KT_OUT4	KT_OUT3	KT_OUT2	KT_OUT1

– Free signals

Note
We recommend setting free signals to 0 in the user program.

■

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Space for your notes

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PROFIBUS DP Communication

8

8.1 General

8.1.1 PROFIBUS DP interfaces of the MCI board

There are two PROFIBUS DP interfaces on the MCI board:

- Interface X101: PROFIBUS DP

  The NC only has direct access to this PROFIBUS interfaces. Therefore all PROFIBUS drives and NC–specific I/Os, e.g. MCPs with handwheels, must be connected via this interface.

  The NC also derives the position control cycle clock from the parameterized equidistant PROFIBUS cycle clock of this interface.

  The interface is operated exclusively in the ”DP master” mode.

- Interface X102: MPI/DP

  This PROFIBUS interface is only available to the PLC. Alternatively it can be operated in the mode: ”DP master” or ”DP slave”.

8.1.2 PROFIBUS DP with Motion Control option

PROFIBUS DP

PROFIBUS DP is an international, open fieldbus standard, which is specified in the European Fieldbus Standard EN 50170 Part 2. PROFIBUS DP is optimized for fast, data transmission at the field level for time–critical applications.

The components communicating via the PROFIBUS DP are categorized as either master or slave components.

1. Master (active node)
   Components operating on the bus as master determine the data exchange on the bus and are therefore also designated active nodes.

   Masters divide into two classes:

   - DP Master class 1 (DPMC1):
     These are central master systems that exchange data with the slaves in defined message cycles.
     Examples: SIMATIC S5, SIMATIC –, etc.

   - DP Master class 2 (DPMC2):
     These are devices for configuring, commissioning, operator control and monitoring in bus operations.
     Examples: Programming devices, operator control and monitoring devices

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2. Slaves (passive nodes)
   These devices may only receive messages, acknowledge them and transfer message to the master on its request.
   Examples: Drives, I/O modules

Motion Control extension

Communication between SINUMERIK 840Di sl (NC and PLC), as the master, and the slave components on PROFIBUS is based on PROFIBUS DP with the MotionControl extension.

The MotionControl extension is characterized by:

- Configurable isochronous DP cycle
- Cyclic synchronization of the DP slaves using GlobalControl message frames from the DP master
- Automatic maintenance of the internal clock by the DP slaves during a short communication failure between the DP master and DP slave

References: /PPA/ PROFIDrive Profile Drive Technology Version 3, Draft V1.4.2, 01. September 00

8.1.3 Message format for cyclic DP communication

Message frame structure

A PROFIBUS message generally adopts the following format for cyclic data transmission:

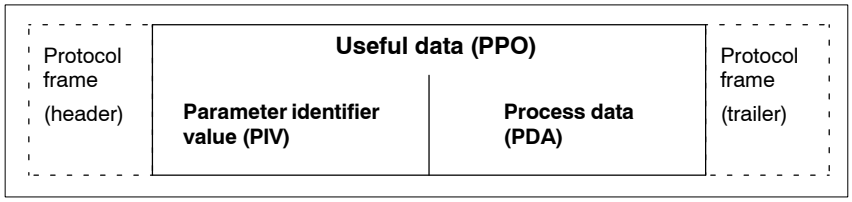


Fig. 8-1 Main message format for cyclic data transmission

Useful data structure

The useful data for cyclic communication are referred to as parameter process data objects (PPO). They are subdivided into two areas within the message frame:

- Parameter area (PIV, parameter identifier value)
  This part of the message frame is for reading and/or writing parameters and for reading out faults.
- Process data area (PDA, process data)
  In the case of a drive, for example, this area contains the control words, setpoints, or additional information and actual values.
  The following data are transmitted with the process data:
  - Control words and setpoints (requests: master —> drive) or
  - Status words and actual values (responses: drive —> master)

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8.1.4 Description of a DP cycle

Actual values

At time T_I, the current actual position values are read from all isochronous DP slave drives. In the next DP cycle, the actual values are transferred to the DP master in the time T_{DX}.

Position controller

The NC position controller is started at the time T_M, with $T_M > T_{DX}$, and computes the new speed setpoint for each axis on the basis of the position setpoint and the transferred actual position value.

Setpoints

At the start of the next DP cycle, the speed setpoints are transferred from the DP master to the DP slave drives in the time T_{DX}.

At time T_O, the speed setpoints are taken as new specified values for all drive controllers.

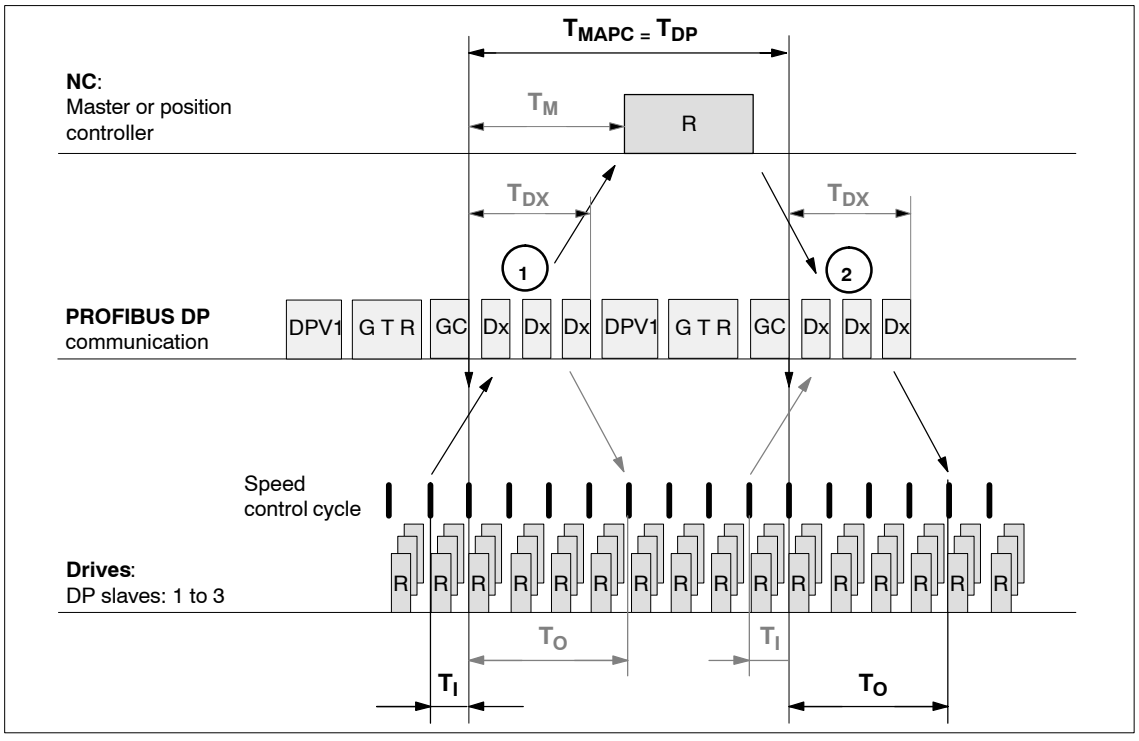


Fig. 8-2 Example: Optimized DP cycle with 3 DP 611U slaves

Key to Fig. 8-2:

T_{MAPC}	Master application cycle: NC position control cycle The following always applies for SINUMERIK 840Di sl: $T_{MAPC} = T_{DP}$
T_{DP}	DP cycle time: DP cycle time
T_{DX}	Data exchange time: Sum of transfer times of all DP slaves
T_M	Master time: Offset of the start time for NC position control

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T_I	Input time: Time of the actual value acquisition. The actual values are transferred to the DP master in the next DP cycle.
T_O	Output time: Time of the setpoint transfer. The setpoints were generated by the DP master application in the previous DP cycle.
GC	Global control message frame (broadcast message frame) for cyclic synchronization of the equidistance between the DP master and DP slaves
R	Speed or position controller computing time
Dx	Exchange of user data between DP master and DP slaves
DPV1	After cyclic communication, an acyclic service is sent, if the token holding time T_{TH} is not yet exceeded. T_{TH} is calculated by the configuring system.
G T R G: GAP T: TOKEN D: RES	 An attempt is made during GAP to accept new active stations. The token passing is either to itself or other masters. The reserve is used as an ”active pause” for the station to send the token to itself until the isochronous cycle is terminated.
(1)	The actual values for the current DP cycle/position control cycle are transferred from the DP slave drives to the NC position controller
(2)	The setpoints computed by the NC position controller are transferred to the DP slave drives

8.1.5 Networking rules

The following basic rules must be observed:

1. The bus line must be terminated at **both ends**. For this purpose, enable the terminator in the PROFIBUS DP connector of the first and of the last nodes and disable the remaining terminators.

Notice

Only two enabled terminating resistors are permitted per bus line.

---

2. **At least** 1 terminal must be supplied with **5 V**.
   This is done by connecting an PROFIBUS DP connector with the terminating resistor inserted to an energized device.
3. No tap lines may be routed on the PROFIBUS DP.
4. Every PROFIBUS DP node must **first** be connected and then activated. When disconnecting a node, **first** deactivate the connection and then remove the connector.
5. The **cable** of a PROFIBUS DP bus segment may be **max. 100 m**.

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Example: PROFIBUS DP network installation

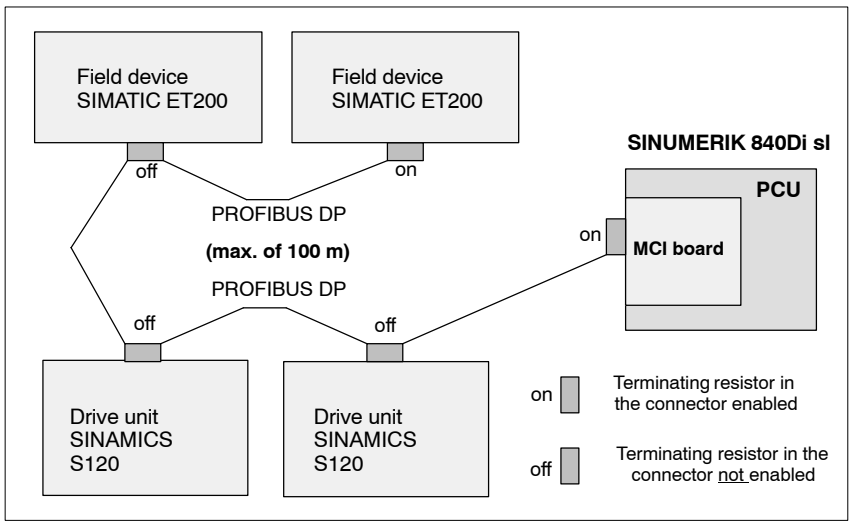


Fig. 8-3 Example of a PROFIBUS DP network installation

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8.2 Requirements

As a condition for creating a PROFIBUS configuration using the default configuration the following components are required:

- SIMATIC STEP 7
- 840Di sl Rack
  (a SIMATIC 300 station preconfigured for SINUMERIK 840Di sl. Part of the PLC basic program)
- SlaveOM
  (part of the scope of supply of a SINUMERIK 840Di sl: SIMATIC add–on software)

SIMATIC STEP 7

SIMATIC STEP 7 (option) is required in the following version or later:

- SIMATIC STEP 7 as of Version 5.3, Service Pack 2

SIMATIC STEP 7 can either be installed directly on the SINUMERIK 840Di sl PCU or on an external computer (PG/PC).

SINUMERIK 840Di sl

If SIMATIC STEP 7 is installed on the SINUMERIK 840Di sl, no additional MPI/PROFIBUS cable is required to load the S7 configuration in the PLC.

Windows applications executed on the SINUMERIK 840Di sl have direct access to the PLC through the internal MPI interface of the MCI board.

Installation of additional software on the SINUMERIK 840Di sl is described in detail in Section 17, Page 17-477.

External computer (PG/PC)

If SIMATIC STEP 7 is installed on an external computer (PG/PC), it must fulfill the following conditions:

- PG/PC interface is parameterized (see Section 6.2.2, Page 6-135)
- An MPI/PROFIBUS connection exists between the external computer (PG/PC) and the SINUMERIK 840Di sl.

840Di sl Rack

The 840Di sl Rack is a SIMATIC–300 station preconfigured for SINUMERIK 840Di sl. The following version is available in the hardware catalog of HW Config:

- **SINUMERIK 840Di sl with PLC 317–2DP 2AJ10**
  - Slot 2: SINUMERIK 840Di sl PLC
    Standard designation: PLC317–2DP 2AJ10
  - Slot X1: MPI/PROFIBUS interface (X102)
    Standard name: MPI/DP
  - Slot X2: PROFIBUS interface (X101)
    Standard name: DP
  - Slot 4: SINUMERIK 840Di sl NC
    Standard designation: NCK 840D sl
  - Slot 5: SINUMERIK CP for Industrial Ethernet TCP/IP
    Standard designation: CP 840D sl

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Installation

The 840Di sl Rack is part of the PLC Toolbox. When the PLC Toolbox is installed, it is automatically installed in SIMATIC STEP 7.

Note

The PLC basic program must be installed on the computer on which SIMATIC STEP 7 is installed. For installing the PLC basic program, please observe the appropriate notes in the file:

- <*Installation path*>**importantinfo.rtf**

Once the PLC basic program has been successfully installed the 840Di sl Rack can be accessed in the hardware catalog of SIMATIC STEP 7, "HW Config":

- "HW Config" hardware catalog:
  Profile: **Standard**
  SIMATIC 300 > SINUMERIK > 840Di sl > 840Di sl

SlaveOM

The SlaveOM (Slave Object Manager) for SINUMERIK 840Di sl permits dialog–based S7 configuration of the following PROFIBUS drives:

- SIMATIC S120
- SIMODRIVE 611 universal or universal E
- SIMODRIVE POSMO CD/CA
- SIMODRIVE POSMO SI distributed servo drive
- SIMODRIVE POSMO A
- ADI4 (Analog Drive Interface for 4 Axes)

Notice

If the SlaveOM is used in conjunction with other PLC CPUs, a consistency error is signaled when compiling the S7 configuration and no system data blocks are generated.

Installation

The SlaveOM is part of the PLC Toolbox. When the PLC Toolbox is installed, it is automatically installed in SIMATIC STEP 7. The DP slave drives specified above are available in the hardware catalog at the following location:

- HW Config: Hardware catalog:
  Profile: **Default**
  - **PROFIBUS DP > SINAMICS > SINAMICS S120**
  - **PROFIBUS DP > SIMODRIVE > SIMODRIVE 611 universal**
  - **SIMODRIVE POSMO CD**
  - **SIMODRIVE POSMO CA**
  - **SIMODRIVE POSMO SI**
  - **SIMODRIVE POSMO A**
  - **PROFIBUS DP > SINUMERIK > ADI4**

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Note

The PLC basic program must be installed on the computer on which SIMATIC STEP 7 is installed. For installing the PLC basic program, please observe the appropriate notes in the file:

- <*Installation path*>**importantinfo.rtf**

GSD file

All properties of a DP slave are stored in a DMF file (Device Master File) in ASCII format. STEP 7 requires one module–specific GSD file each for each DP slave so that the DP slave can be selected from the hardware catalog.

If a DP slave is not displayed in the hardware catalog of ”HW Config”, you must install a GSD file. To do that, use menu command **Tools > Install new GSD file**.

As soon as you have installed the GSD file the DP slave is available in the hardware catalog at the following location:

- ”HW Config” hardware catalog:
  Profile: **Standard**
  PROFIBUS DP > Further field units > <*DP slave*>

Notice

The GSD files must be installed on the computer on which SIMATIC STEP 7 is already installed.

To install a GSD file, please refer to the appropriate notes in the file:
<*Installation path*>**importantinfo.rtf**

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8.3 Creating a PROFIBUS configuration

8.3.1 Requirements

S7 project

The procedure described in this section for setting up the PROFIBUS configuration as well as the parameterization of various components (for example, SINAMIC drives, AD14), is based on an S7 project created using the description in Section 8.3, Page 8-183.

The following status of the S7 project is required:

- S7 project is has been set up (name: SIN840Di sl)
- Station 300 has been set up
- Interface (X102) MPI or PROFIBUS is parameterized
- Interface (X101) PROFIBUS is parameterized
- Input/output data areas of the NC are parameterized

Note

The instructions given in this section are essentially limited to the special characteristics of the SINUMERIK 840Di sl. For more details about working with SIMATIC STEP 7 please refer to the relevant SIMATIC documentation or online help.

Starting HW Config

Start "HW Config" by opening the station and double–clicking the hardware icon.



Fig. 8-4 Inserting the SIMATIC 300 station

In HW Config, now insert the required PROFIBUS modules from the hardware catalog into the S7 project.

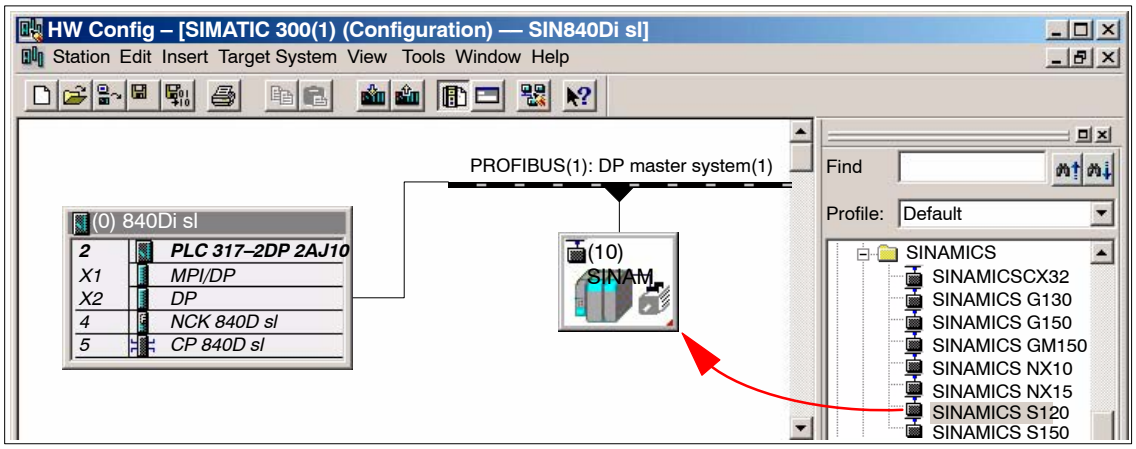


Fig. 8-5 HW Config: Inserting modules, e.g. SINAMICS S120

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8.3.2 Inserting DP slaves

In principle, both PROFIBUS interfaces have the same functionality. They merely differ in the way they can be accessed by the NC and the PLC:

- The NC only has access to the PROFIBUS interface (X101) corresponding to slot X2.
- The PLC has access to both PROFIBUS interfaces (X101 and X102) corresponding to slots X2 and X1.

Note

- PROFIBUS(1), interface (X101) corresponding to slot X2:
  As the drives are connected via this interface, the PROFIBUS can only be operated in mode "DP master".
- PROFIBUS(2), interface (X102) corresponding to slot X1:
  The interface can be operated in modes: "DP master" and "DP slave".
  Please refer to the relevant SIMATIC documentation for how to connect the PLC to the higher–level DP master as a DP slave.

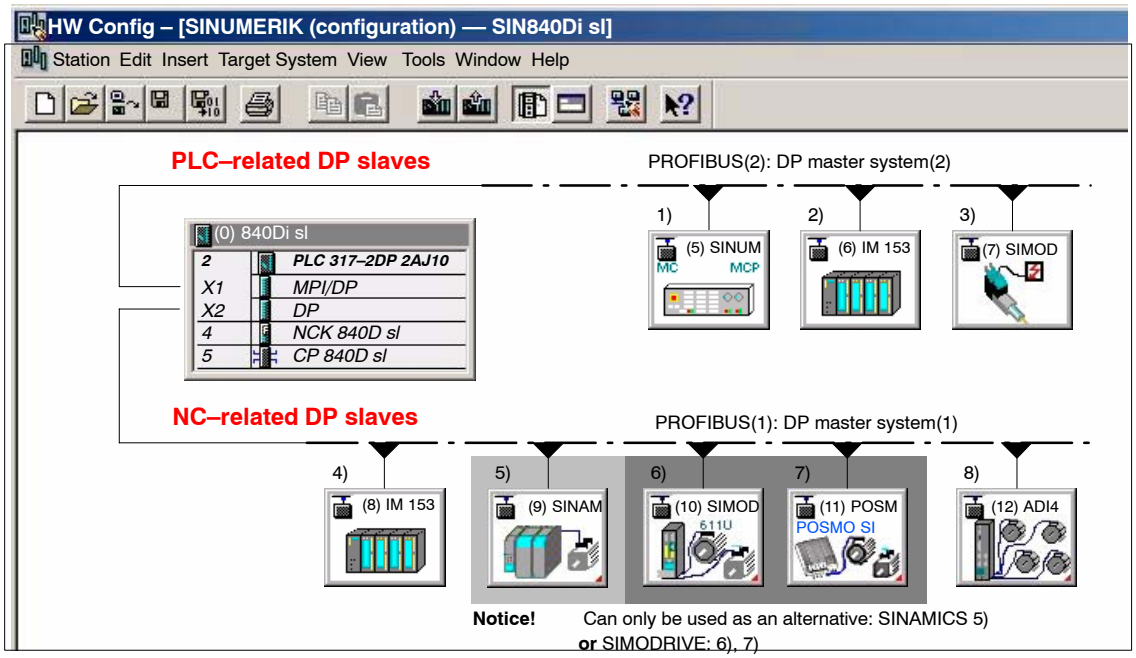


Fig. 8-6 Recommended distribution of DP slaves (schematic)

1)	Machine control panel: MCP 483, MCP310
2) and 4)	ET200... I/Os
3)	SIMODRIVE POSMO A
5)	SINAMICS S120
6)	SIMODRIVE 611 universal
7)	SIMODRIVE SI, CD/CA
8)	ADI4

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If you are using both PROFIBUS connections, we recommend the following distribution of DP slaves:

- PROFIBUS(1): Interface (X101) corresponding to slot X2
  - NC–specific I/Os
  - Drives
  - ADI4
- PROFIBUS(2): Interface (X102) corresponding to slot X1
  - PLC–specific I/Os
  - Machine control panel, e.g. MCP 483

8.3.3 Final parameterization of the isochronous DP slaves

Once you have included the DP slaves in the configuration and parameterized them individually, for concluding parameterization of the isochronous DP communication of the PROFIBUS(1): interface (X101) corresponding to slot X2, you must set the following parameters of the isochronous DP slaves in two separate stages:

Step1:

- Activation of the equidistant DP cycle
- Equidistance master cyclic component T_{DX}

Step2:

- Equidistant DP cycle T_{DP}
- Master application cycle T_{MAPC}
- Actual value acquisition T_I
- Setpoint acceptance T_O

An overview of the various times of a DP cycle is shown in Fig. 8-2, Page 8-177.

Note

The procedure for assigning the final parameters for isochronous DP communication is exemplified by one DP slave S120. Proceed in the same manner for other isochronous DP slaves, e.g., SIMODRIVE 611U, ADI4; etc.

Notice

If DP slave ADI4 interfaces are present in an S7 project on which final parameterization is to be performed, certain boundary conditions must be observed. See also:

References /ADI4/ Analog drive interface for four axes
Section: Parameterization
Parameterization of DP communication
Boundary conditions

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Activation of the isochronous DP cycle

If you double–click an S120 DP slave in the station window, the dialog box: ”DP Slave Properties” opens.

It is recommended that the isochronous DP cycle be enabled for all DP slaves S120 by enabling the isochronous DP cycle for the selected DP slave S120, and then performing an alignment.

During adjustment all the values displayed in dialog box:

- DP slave properties
  Tab card: Cycle synchronization

are transferred to all DP slaves of the same type in the configuration, here DP slave S120.

Dialog box: Start

Dialog box: DP slave properties
Tab card: Cycle clock synchronization
Radio button: ”Synchronize drive to isochronous DP cycle” ☑
Button: ”**Adjust**”

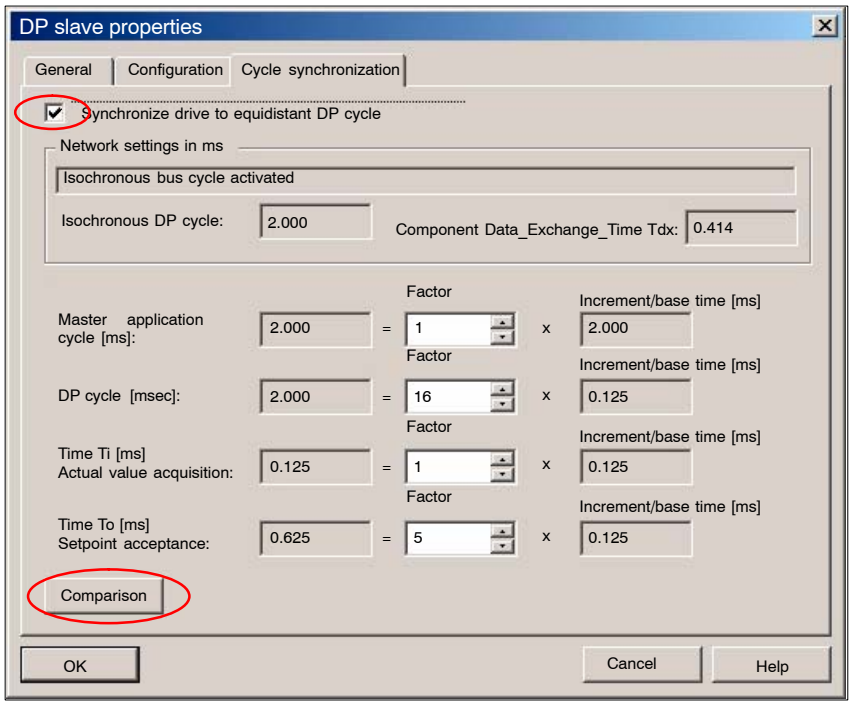


Fig. 8-7 Enabled isochronous DP cycle

Notice

If there are different types of isochronous DP slaves in a S7 project, e.g. different SINAMICS drives, ADI4, etc., the following steps:

1. Synchronize drive to equidistant DP cycle
2. Perform adjustment

must be performed for each type of DP slave first before you can continue to set the other parameters.

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Equid. master cycl. component T_{DX}

After synchronization to the isochronous DP cycle has been activated for all DP slaves, the timer requirement of the cyclic portion of DP communication must be calculated.

Calculation is performed by the DP master on activation of the isochronous bus cycle.

Dialog box: Continuation

Tab: General
Group box: Station/Master System
Button: "PROFIBUS..."
Dialog box: Properties – PROFIBUS interface SINAMICS ...
Tab: Parameter
Button: "Properties..."
Dialog box: Properties PROFIBUS
Tab card: Network settings
Button: "Options..."
Dialog box: Options ☐
Radio button: Activate isochronous bus cycle ☑

Isochronous DP cycle T_{DP}

When calculating the cyclic portion of the PROFIBUS communication, the time for the isochronous DP cycle is automatically changed to the time required as the minimum. This change must be undone by reentering the time intended for the isochronous DP cycle.

Dialog box: Continuation

Group box: Isochronous time in ms
Isochronous DP cycle: ***Equidistance time***
OK
OK
OK

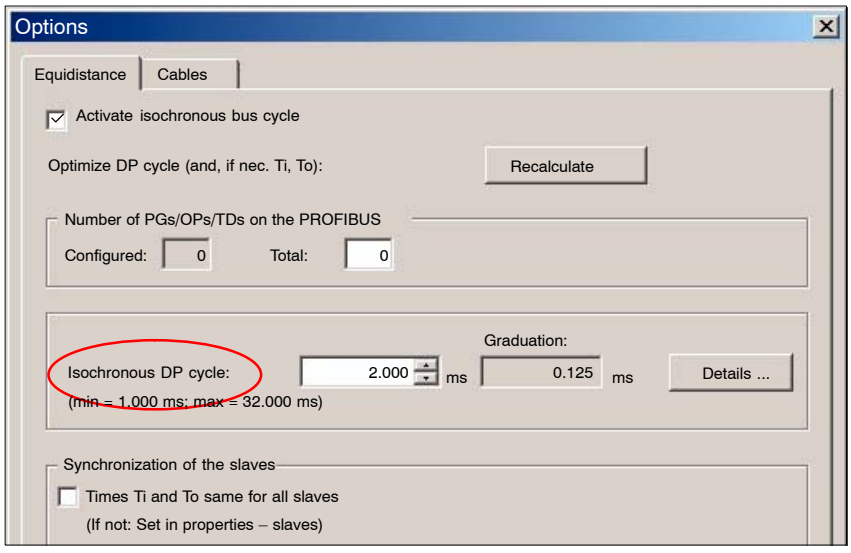


Fig. 8-8 Dialog box: Options (excerpt)

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Note

You are advised not to activate the option ”Times Ti and To same for all slaves” in the ”Synchronization of the slaves” group.

On tab card ”Clock synchronization” the following parameters are now set for each type of DP slave:

- Equidistant DP cycle T_{DP}
- Master application cycle T_{MAPC}
- Actual value acquisition Ti
- Setpoint transfer T_o

.

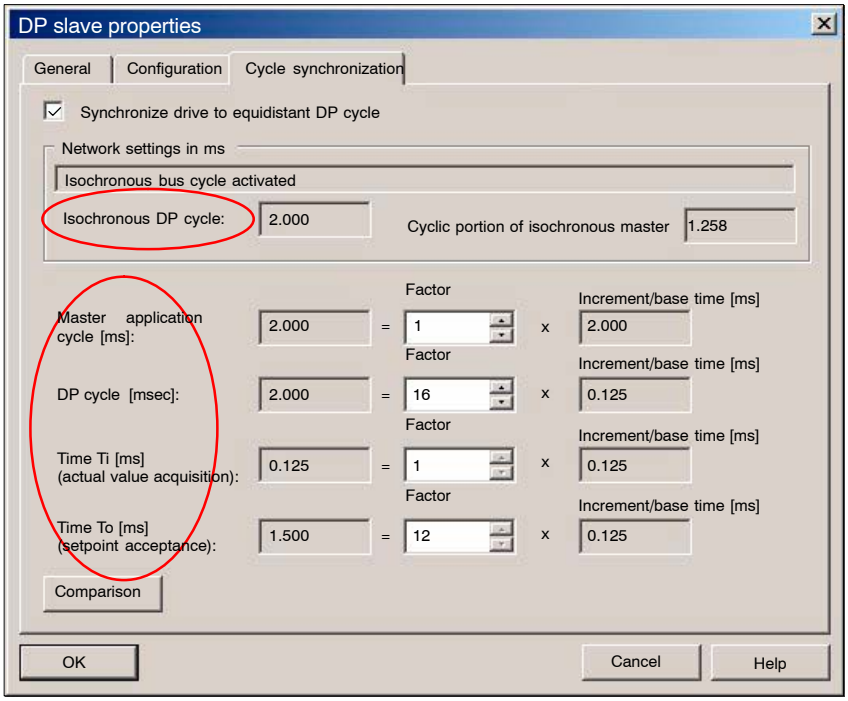


Fig. 8-9 Dialog box: DP slave properties

DP cycle T_{DP}

The ”DP cycle” of DP slave S120 must be set to the cycle time of the DP master displayed under >”Isochronous DP cycle” in group box ”Network settings in ms”.

Notice

For DP cycle time T_{DP} the following condition must be fulfilled:

DP cycle = isochron. DP cycle

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Master application cycle T_{MAPC}

Via parameter: Master Application Cycle T_{MAPC} defines the integer ration between the master application (NC position controller) and the isochronous DP cycle.

Using ratios other then 1:1, the dead times of the position controller can be reduced if NC hardware of the lower performance range is used.

Notice

On a DP slave S120 used with SINUMERIK 840Di sl, the ratio between the master application cycle T_{MAC} and DP cycle time T_{DP} must be 1:1.

Master application cycle = DP cycle

Dialog box: Continuation

Tab: Clock synchronization
Master application cycle [msec]:
Factor: **1**

Actual value acquisition Ti

Via parameter: Actual–value acquisition Ti defines the time at which the actual value (actual position value) can be read in from a DP slave S120.

Note

You are strongly recommended to use the same value for the time of actual value acquisition Ti for all DP slaves S120, in particular if the axes interpolate.

Notice

The following condition must be observed for the time of actual–value sensing T_I:

DP cycle >= actual value acquisition >= base time

Dialog box: Continuation

Tab: Clock synchronization
Actual value acquisition [ms]:
Factor: **Factor**

Setpoint acceptance To

Via parameter: Setpoint acceptance To defines the time when the speed setpoint of the NC position controller is accepted by a DP slave S120.

Note

You are strongly recommended to use the same value for the time of setpoint acceptance To for all DP slaves S120, in particular if the axes interpolate.

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Notice

The following condition must be observed for the time of setpoint acceptance T_O:

DP cycle >= setpoint accept. >= isochron. master cycl. component + base time

Dialog box: Continuation

Tab: Clock synchronization
Setpoint acceptance [ms]:
Factor: **Factor**

Adjustment

Activating button: Adjust transfers the values displayed in the ”Clock synchronization” tab to all other DP slaves S120 in the configuration.

This adjustment must be carried out at the end, and the dialog box must then be confirmed with OK.

Dialog box: End

Tab: Clock synchronization
Button: **”Adjust”**
OK

Notice

If there are different types of isochronous DP slaves in a S7 project, e.g. different SINAMICS drives, ADI4, etc., the following parameters:

- Equidistant DP cycle T_{DP}
- Master application cycle T_{MAPC}
- Actual value acquisition T_I
- Setpoint acceptance T_O

must be set for each DP slave type separately as described above, and then adjusted.

Adjustment only transfers the values displayed on tab card: ”Clock Synchronization” to the DP slave **of the same** type.

8.3.4 Generating system data blocks (SDB)

System data blocks (SDB) contain all the information required for PROFIBUS communication between the DP master and connected DP slaves. System data blocks are generated by compiling the current configuration with ”HW Config”.

Consistency check

Always check that the system data blocks are error–free before storing and compiling them. To do that select menu item: **Station > Check consistency**.

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If inconsistencies are detected in the configuration, an error dialog box is displayed and the error messages and help are displayed.

Save and compile

The menu command **Station > Save and Compile** saves the current configuration in S7 as object: ”Station” and is then compiled.

System data blocks

If the configuration is compiled without error the system data blocks are generated and stored in directory: ”Blocks” of the PLC.

In example project: ”SIN840Di sl” the system data blocks are located at:

- SIN840Di sl
  SIMATIC 300(1)
  PLC317-2DP 2AJ10
  STEP 7 Program(3)
  Blocks > **System data**

The current system data blocks can be displayed by double-clicking the icon: ”System data” in dialog box: ”System Data Blocks”.

Note

System data blocks cannot be edited individually. Only the configuration as a whole can be edited.

8.3.5 Loading a configuration into the PLC

Once you have successfully generated the system data blocks you can load the configuration into the PLC.

Loading of the configuration is described in detail as part of PLC commissioning in Section 6.6, Page 6-154.

8.3.6 PROFIBUS diagnosis

The following specific diagnostic displays are recommended for diagnosis of the PROFIBUS or DP slave status when checking the configuration or when errors occur:

- 840Di start-up
  menu bar: **Window > Diagnosis > PROFIBUS > Bus** or **Slaves**
- HMI Advanced
  Operating Area Switchover > Diagnosis > Service Displays > ”ETC” key > PROFIBUS Diagnosis

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8.4 SIMATIC I/O devices (ET200...)

The SIMATIC I/O devices of the series ET200, e.g. ET200M, are integrated into the S7 project as usual using HW Config and configured.

Note

To simplify parameterization of the isochronous communication on the PROFIBUS DP, you must first insert all the SIMATIC I/Os you require into the configuration **before** parameterization of the DP drives (e.g. DP slave 611U or ADI4).

Note

To check whether a module selected from the hardware catalog complies with the module in the automation system, the following procedure is recommended:

1. Note the MLFB numbers of all modules used in the automation system.
2. Select the appropriate module from the hardware catalog and compare the order number (MLFB) with the MLFB number of the module displayed in the hardware catalog. Both MLFB numbers must be the same.

8.5 DP slave: I/O Module PP72/48

8.5.1 GSD file

A PP72/48 I/O module is parameterized with a GSD file.

- The GSD file is part of the SINUMERIK 840Di sl software. See Section 1.2, Page 1-34: **SIMATIC add–on software**: **GSD file**for **I/O modules PP72/48**
- For installation of a GSD file, see Section 8.1.5, Page 8-182: **GSD files**.

Note

To make parameterization of isochronous communication with PROFIBUS DP easier, we recommend inserting all required DP slaves 611U into the configuration before setting the times for isochronous communication.

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8.5.2 Inserting a DP slave

To insert a DP slave PP72/48 into the configuration, open the hardware catalog using menu command **View > Catalog**.

The DP slave PP72/48 is to be found at:

- Profile: **Standard**
  PROFIBUS DP > Further field units > Drives > IO > PP input/ output module

Click with the left mouse button on the DP slave PP72/48 (PP input/output module) in the hardware catalog and drag it onto the DP master system in the station window, holding down the left mouse button.

The DP master system is displayed in the station window with the following symbol:



When you release the left mouse button, the DP slave PP72/48 is inserted into the configuration.

Note

Make sure that the cursor that appears as a crossed–out circle when dragging the DP slave is positioned exactly on the DP master system so that it can be inserted into the configuration.

8.5.3 Setting PROFIBUS parameters

As soon as you have inserted DP slave PP72/48 into the configuration, dialog box ”PROFIBUS properties interface PP input/output” is displayed.

The following PROFIBUS parameters must either be set or verified:

- PROFIBUS address
- Transmission rate
- Profile

Notice

The PROFIBUS address of DP slave PP72/48 set in the S7 project must match the PROFIBUS address set on the module using switch S1 (see Section 2.11, Page 2-79).

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration of DP slave PP72/48
   PROFIBUS address
2. I/O module PP72/48
   PROFIBUS address (switch S1)

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Dialog box

Dialog box: PROFIBUS properties Interface PP input/output
Tab card: Parameter
Address: **<PROFIBUS address>**
Button: ”Properties...”

Dialog box: Properties – PROFIBUS
Tab card: Network settings
Transmission rate: **12 Mbaud**
Profile: **DP**
OK

OK

8.5.4 Setting the I/O addresses

When the dialog box is closed DP slave PP72/48 is inserted into the DP master system and the detail view of DP slave PP72/48 is displayed in the station window. Select one of the modules listed under DP slave PP72/48 (PP input/output module) from the hardware catalog and insert it in slot 1 of the detail view.

The I/O addresses are assigned by ”HW Config” automatically and should be changed taking into account the following supplementary conditions:

- I/O address range of the NC
  For compatibility reasons and for future system expansions, the I/O addresses 256 – 271 should not be assigned.
- Selective access to inputs/outputs by the PLC
  The PLC cannot directly access individual inputs/outputs of I/O addresses >256. The input/output data must first be copied into internal flags of the PLC with the system functions SFC14 and 15.

For the reasons above, it is recommended to assign the I/O addresses to the range between 0 and 255.

The dialog box offers the following configurations to choose from:

1. I/O 6/9 O222 I212121
2. I/O 6/9 O411 I212121
3. I/O 6/9 O42 I41

For DP slave PP72/48, select the 1st configuration and click **OK** to confirm the dialog box.

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8.6 DP slave: MCP 310



Fig. 8-10 MCP 310 front panel

8.6.1 General conditions for commissioning

Hardware

The following hardware is required:

- PROFIBUS connecting cable
  No terminating resistor is integrated in the machine control panel.

Software

The following software is required:

- PLC basic program
  The relevant modules of the basic PLC program are **FB 1** (MCP communication parameters), **FC 19** (interface parameter assignment version: milling) and **FC 25** (interface parameter assignment, version: turning).

  The library of the PLC basic program is part of the SINUMERIK 840Di sl. How to install the library is described in Section 6.4, Page 6-152.
- SIMATIC STEP 7
  SIMATIC STEP 7 is needed to customize the PLC basic and user programs to the requirements of the respective automation system. SIMATIC STEP7 can be installed directly on the PCU of the SINUMERIK 840Di sl. How to install additional software is described in Section 17, Page 17-477.
- DP slave: MCP 310
  The DP slave: MCP 310 is part of the PLC Toolbox. When the PLC Toolbox is installed, it is automatically installed in SIMATIC STEP 7.

Note

The PLC basic program must be installed on the computer on which SIMATIC STEP 7 is installed. For installing the PLC basic program, please observe the appropriate notes in the file:

- *<Installation path>***importantinfo.rtf**

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References

The following manuals are required for the commissioning of the MCP:

/**FB1**/ **Description of Functions, Basic Functions P3, PLC Basic Program**
Program structure and modules of the PLC basic program.

/**FB2**/ **Description of Functions, Extended Functions H1 Jog with/without Handwheel**
Commissioning of handwheels

/**BH**/ **Operator Components Manual**
Description of MCP 310 (interfaces, electrical connection, etc.)

/**Z**/ **Catalog NCZ**
Connection Components: Cables, connectors, etc.

Automation system

To commission the MCP the automation system must be completely electrically and mechanically connected with respect to NC, PLC and MCP.

The drives must be secured against accidental moving.

8.6.2 Parameterization of the MCP

Interfaces

Fig. 8-11 below shows the interfaces on the rear of the module:

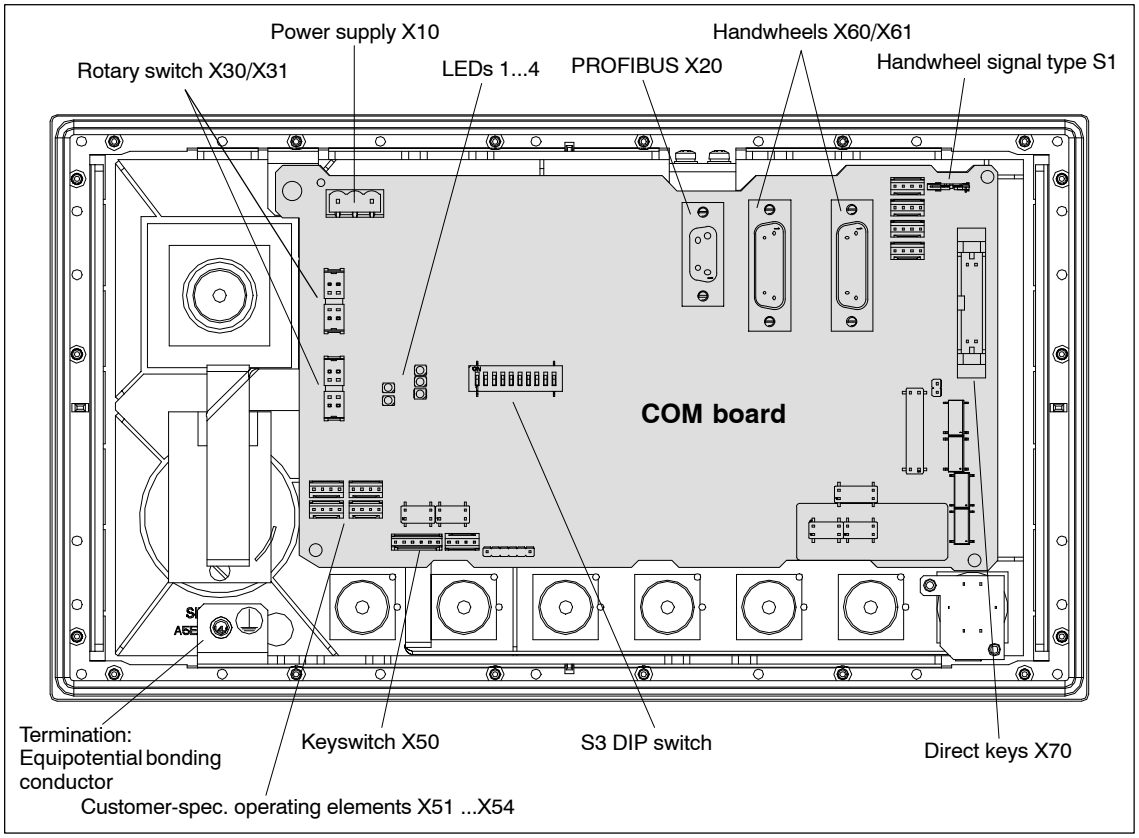


Fig. 8-11 Rear of the MCP 310 showing the control and display elements and the interfaces

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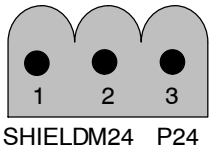


Fig. 8-12 Connection overview: Power supply X10

For a detailed description of the electrical and mechanical design and of the machine control panel interfaces, please refer to:

References: /BH/ Operator Components, Manual
Section: Machine control panel MCP 310

Display of the software version

After the MCP has been electrically connected, all LEDs on the front side of the MCP flash until communication is established between MCP and PLC.

Simultaneously pressing the two keys ”Feed stop” and ”Feed enable” (in the bottom right corner) displays the version number of the current software version using the LEDs now lighting continuously.

Version number = V ”Number of lit LEDs on the left LED block”**.**
”Number of lit LEDs on the center LED block”**.**
”Number of lit LEDs on the right LED block”

In the example (Fig. 8-18) version number: **V 01.02.00** is displayed.

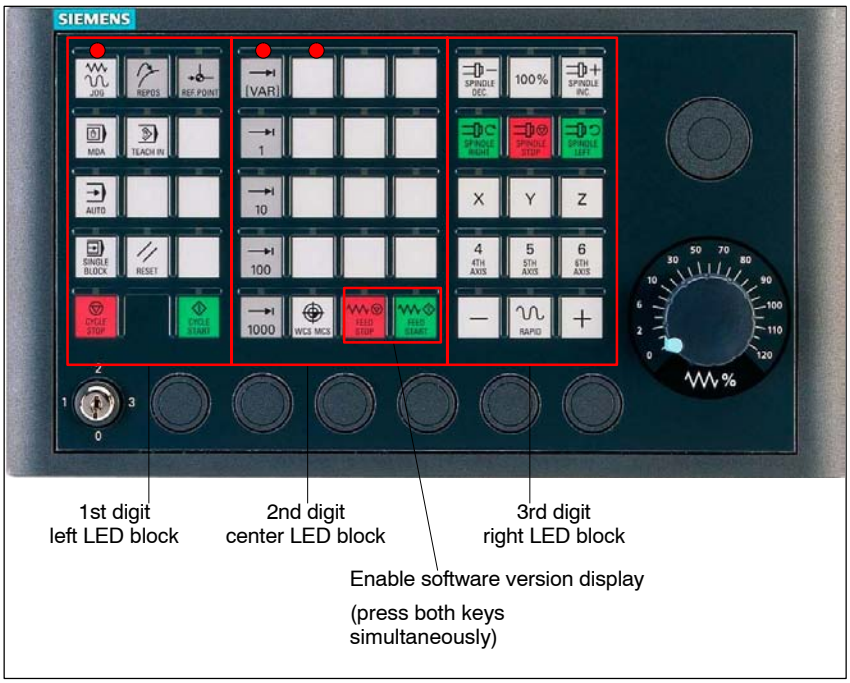


Fig. 8-13 MCP 310 front panel

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Switch S3

The PROFIBUS address and connection type are set with switch S3 on the rear of the MCP:

Table 8-1 Switch S3: PROFIBUS address (1 – 7)

10	*9*	*8*	7	6	5	4	3	2	1	Meaning/value
on	on	–	–	–	–	–	–	–	–	Connection type: PROFIBUS
–	–	off	–	–	–	–	–	–	–	Reserved
										PROFIBUS address
–	–	–	off	off	off	off	off	off	off	0
–	–	–	off	off	off	off	off	off	on	1
–	–	–	on	off	off	off	off	on	off	2
–	–	–	off	off	off	off	off	on	on	3
–	–	–	:	:	:	:	:	:	:	:
–	–	–	on	on	on	on	on	on	off	126
–	–	–	on	on	on	on	on	on	on	127
Switch settings 10 – 8 must be set according to the data in the table.										

Notice

In the state as delivered, the connection type is: MPI (10 – 9: off, off).

8.6.3 Functions of the machine control panel

The machine control panel offers the following functions:

- Default
- Hand wheel
- Additional I/Os

Default

The function transfers input/output data from the function keys and user–specific keys and outputs:

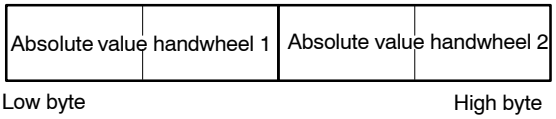
- Input data: 8 byte
- Output data: 8 byte

The input/output data for machine control panel MCP 310 is compatible with the input/output data from the previous machine control panel OP 032S.

Hand wheel

The function transfers the absolute values for the two handwheels that can be connected to the machine control panel:

- Input data: 2 x 2 bytes



For each handwheel the current handwheel value is transferred as a 16–bit absolute value relative to the starting value. The starting value for the sensor counter in the handwheel is 0.

The absolute values are transferred in big endian format.

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The data for both handwheels is always transferred. The absolute value for a handwheel that is not connected is always 0.

Notice

If the ”Handwheel” function is used, the machine control panel must be connected to PROFIBUS interface X101 of the MCI board. The handwheel is evaluated by the NC and the NC only has direct access to this PROFIBUS interface.

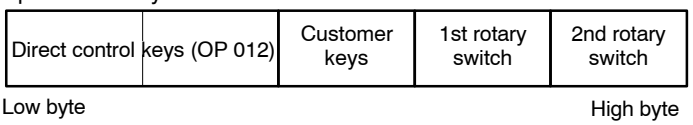
Additional I/Os

The function transfers the data for all non–standard inputs/outputs:

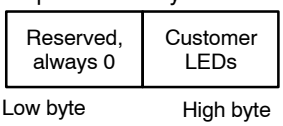
- Direct control keys
- Customer keys: 6 signals (bit 0 to bit 6)
- Rotary switch

with the following distribution:

- Input data: 5 byte



- Output data: 2 byte



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8.6.4 Configuring the DP slave: MCP 310

This section describes the configuration of a DP slave: MCP 310 by way of example of the configuration of a SIMATIC S7 project shown in Fig. 8-14.

The configuration comprises the following modules:

- SIMATIC Station 300 with SINUMERIK 810D/840D and PLC 317–2DP
- SINUMERIK MCP with module: standard, handwheel, extended

To configure DP slave: MCP 310 the following steps must be carried out in the S7 project:

1. Insert DP slave: MCP 310 in the configuration
   (see Fig. 8-14, Page 8-200: **1**)
2. Set the PROFIBUS address.
3. Insert the modules in DP slave: MCP 310 for the functions required.
   (see Fig. 8-14, Page 8-200: **2**)
4. Set the I/O addresses for the individual slots.

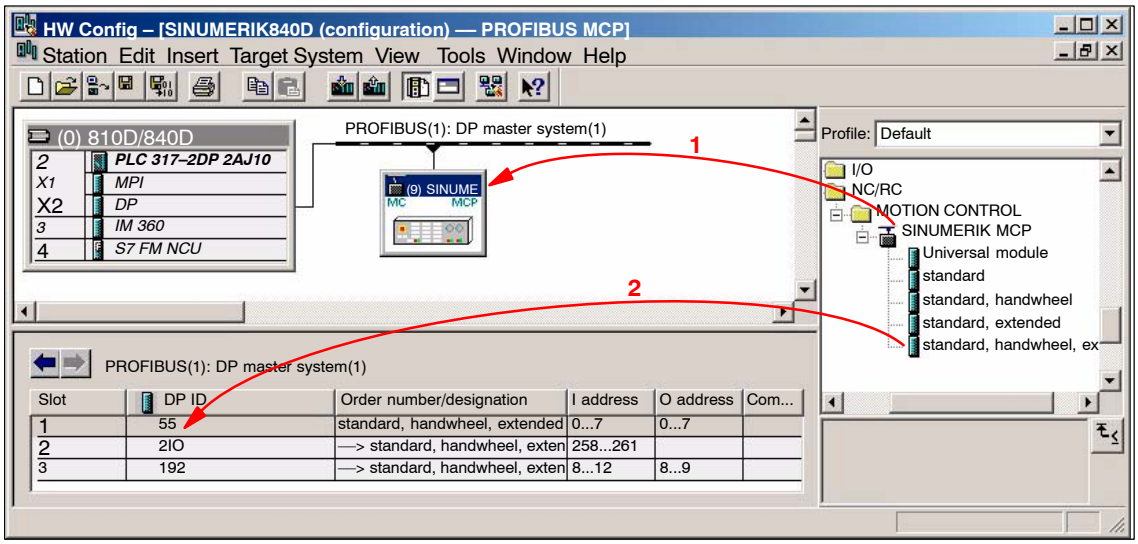


Fig. 8-14 Configuration with DP slave: MCP 310

Preconditions: S7 project

The following status of the S7 project into which DP–Slave: MCP 310 is to be inserted is assumed:

- You have created the S7 project
- You have set up a SIMATIC 300 station with PROFIBUS master–capable SINUMERIK controller

Inserting the DP slave

To insert a DP slave: MCP 310 into the configuration, open the hardware catalog with menu item **View > Catalog**.

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DP slave: MCP 310 is located under:

- Profile: **Standard**
  PROFIBUS DP > Other field devices > NC/RC > Motion Control > SINUMERIK MCP

Select the DP slave by left–clicking it in the hardware catalog: MCP 310 (SINUMERIK MCP) and drag it while holding down the mouse key onto the DP master system in the station window.

The DP master system is displayed in the station window with the following symbol:

When you release the left mouse key, DP slave: MCP is inserted in the configuration.

Note

As you drag the DP slave the cursor appears as a circle with a slash through it. When the cursor is positioned exactly over the DP master system, it changes to a plus sign, and the DP slave can be added to the configuration.

PROFIBUS parameters

When you have inserted DP slave: MCP 310 into the configuration, dialog ”Properties – PROFIBUS Interface SINUMERIK MCP” is displayed.

The following PROFIBUS parameters must either be set or verified:

- PROFIBUS address
- Transmission rate
- Profile

Dialog box

Dialog box: Properties – PROFIBUS Interface SINUMERIK MCP
Tab card: Parameter
Address: **<PROFIBUS address>**
Button: ”Properties...”

Dialog box: Properties – PROFIBUS
Tab card: Network settings
Transmission rate: **12 Mbaud**
Profile: **DP**
OK

OK

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Notice

The PROFIBUS address set in the S7 project for DP slave: MCP 310 must match the PROFIBUS address set on the module (DIP switch S3).

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration DP slave: MCP 310
   PROFIBUS address
2. Machine control panel MCP 310
   PROFIBUS address (DIP switch S3)

Adding a module

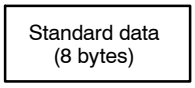
The active functions and hence the number of user data elements to be transferred are chosen by selecting the appropriate pre-configured module. The modules are listed in the hardware catalog under DP slave: MCP 310. The following modules are available:

- *Universal module* (not applicable)
- standard
- standard, handwheel
- standard, extended
- standard, handwheel, extended

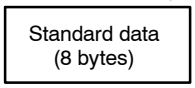
Module: standard

The module transfers the data for the ”Standard” function:

- Input data: 8 byte



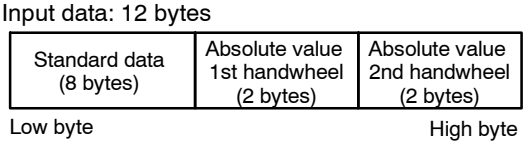
- Output data: 8 byte



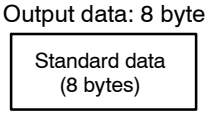
Module: standard, handwheel

The module transfers the data for the ”Standard” and ”Handwheel” functions:

- Input data: 12 bytes



- Output data: 8 byte

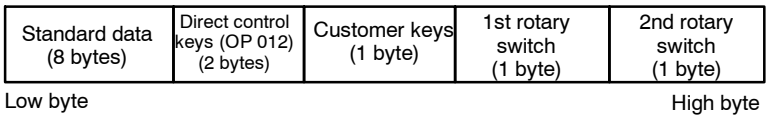


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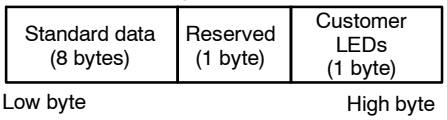
Module: standard, extended

The module transfers the data for the ”Standard” and ”Additional I/Os” functions:

- Input data: 13 byte



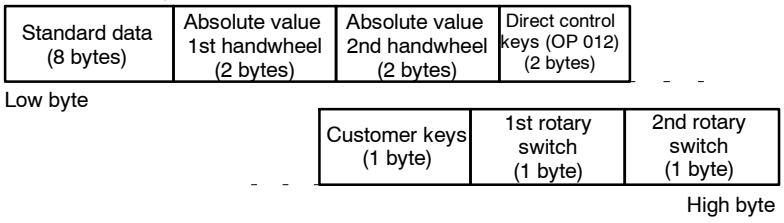
- Output data: 10 bytes



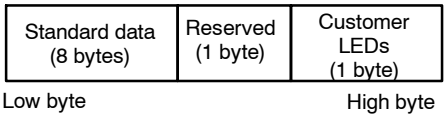
Module: standard, handwheel, extended

The module transfers the data for the ”Standard”, ”Handwheel” and ”Additional I/Os” functions:

- Input data: 17 byte



- Output data: 10 bytes



Setting the I/O addresses

When you insert a module in slot 1 of DP slave: MCP 310 the input/output addresses of STEP 7 are automatically assigned.

Double clicking with the left mouse button on a slot opens the ”Properties - DP slave” dialog box. The starting addresses for the I/O data for the slot can be set here.

8.6.5 Linking to the basic PLC and user program

This section describes how to link DP slave: MCP 310

- to the PLC basic program for transferring standard I/O data to the VDI interface
- to the PLC user program (optional) to implement a user-specific response to a module failure

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Notice

Processing of additional I/O data is the sole responsibility of the user (machine manufacturer) and is not supported by the PLC basic program.

PLC basic program

In order to transfer standard input/output data of DP slave: MCP 310 with the PLC basic program, the I/O address range in question must be entered in the communications parameters of function block FB1.

Function block FB1

The communications parameters of the MCP are called MCPx... (x = 1 or 2) in function block FB1. A maximum of 2 machine control panels are supported by the basic PLC program.

To synchronize several MCPs, the PLC program must be adapted accordingly. This is the user's (machine manufacturer's) responsibility.

To operate an MCP 310 as a DP slave on a SINUMERIK 840Di sl, the following parameters are relevant:

```
MCPNum:      INT       // Number of the MCPs

MCP1In:      POINTER   // Address of the input signals
MCP1Out:     POINTER   // Address of the output signals
MCP1BusAdr   Byte      // PROFIBUS address of the DP slave MCP
```

The MCP2... parameters are only needed if a 2nd MCP is used in addition to the 1st MCP:

```
MCP2In:      POINTER   // Address of the input signals
MCP2Out:     POINTER   // Address of the output signals
MCP2BusAdr   Byte      // PROFIBUS address of the DP slave MCP
```

Bus type via which the MCP is connected:

```
MCPBusTyp    Byte      // MPI       = 0
                       // PROFIBUS  = B#16#33
                       // Ethernet  = B#16#55
```

Notice

Parameters: MCPxStop and MCPxNotSend are of no significance.

References

For a detailed description of the PLC basic program or of function block FB 1, please refer to:

/FB1/ Description of Functions, Basic Functions: PLC Basic Program P3
Section: FB 1: RUN_UP Basic program, startup section

VDI interface parameter assignment

The following function blocks can be used to assign the VDI interface:

- FC 24: Machine control panel MCP 310, version M (milling)

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Notice

Function blocks FC 19, FC 24 and FC 25 are part of the PLC basic program. It is the user's (machine manufacturer's) responsibility to call the block correctly and/or assign the interface the appropriate parameters.

References
A detailed description of the function blocks for transferring machine control panel signals to the VDI interface can be found in:

/FB1/ Description of Functions, Basic Functions: P3, PLC Basic Program
Section: FC 19: MCP_IFM ...
Section: FC 24: MCP_IFM2 ...
Section: FC 25: MCP_IFT ...

Example

The following example shows the communication parameter settings for function block FB 1 for an MCP:

```
MCPNum          :=  1           // Number of MCPs
MCP1In          := P#E0.0       // Address: Input data
MCP1Out         := P#A0.0       // Address: Output data
MCP1StatRec     := P#A8190.0    // Configured diagnostic address
MCP1BusAdr      :=  5           // PROFIBUS address of the DP slave MCP
MCP1Timeout     := S5T#700MS    // Default setting
MCPMPI          := FALSE        // No MPI bus
MCP1Stop        := FALSE        // Deactivation of the DP slave MCP
MCPSDB210       := FALSE        // No SDB210 for MCP
MCPCopyDB77     := FALSE        // No copying to DB 77
MCPBusTyp       := B#16#33      // PROFIBUS
```

PLC user program

If an MCP is connected via PROFIBUS DP, the basic PLC program does not check for module failure.

In this case the MCP is monitored by a standard mechanism to monitor the active DP slave:

- PLC operating system
- PROFIBUS controller

If the failure of DP slave: MCP 310 is detected the PLC goes into the STOP status as default.

Customized response

to allow the user to intervene when a DP slave: MCP 310, the following organization blocks are inserted in the PLC user program:

- OB 82: Diagnostic alarm
- OB 86: Rack failure

Please refer to the corresponding SIMATIC literature for details of linking organization blocks and evaluating diagnostic data.

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Notice

In the event of the failure of a machine control panel connected via MPI, the following alarm is triggered by the PLC basic program:

- Alarm ”40026x machine control panel (x+1) failure”; with x = 0, 1

If the machine control panel is being operated as a DP slave, the user (machine manufacturer) is responsible for triggering a corresponding alarm.

8.6.6 Input/output image

Arrangement: Keys and LEDs

A key and the LED positioned above it form a logical unit. The key and the LED have the same number.

- Key: Sxy = Key number xy
- LED: LEDxy = LED number xy

Fig. 8-20 shows the arrangement of keys and LEDs on the machine control panel together with their internal designation. For the sake of clarity, the LED designations are not shown in full.

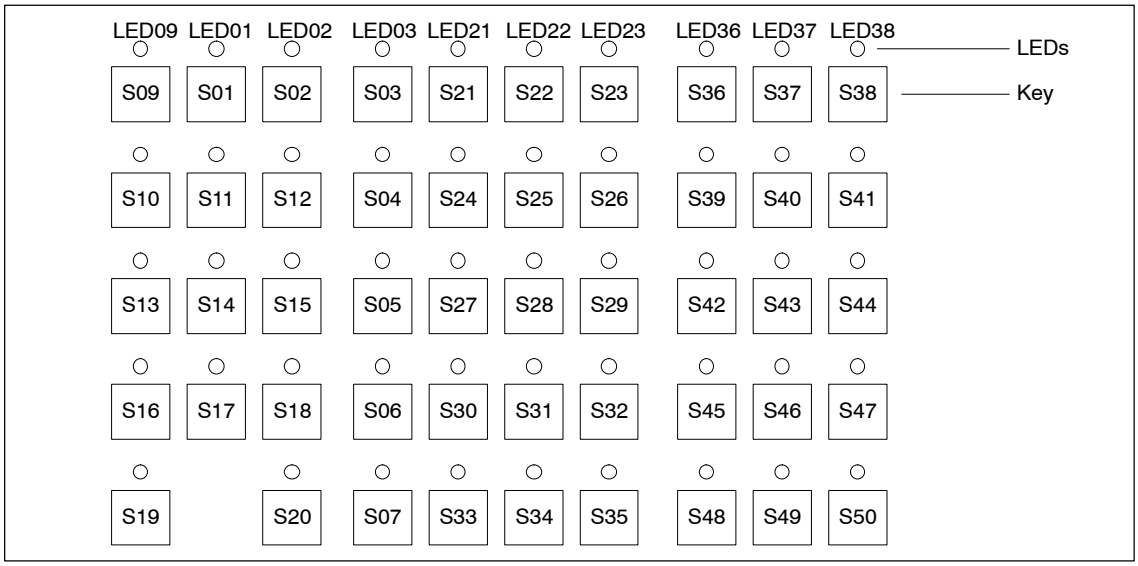


Fig. 8-15 Designation of keys and LEDs

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Input image Arrangement of key signals in the input image of DP slave: MCP 310:

Table 8-2 Input image

Signals from machine control panel (keys)								
Byte	**Bit7**	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
EB n+0	Spindle override				Mode			
	*NC stop S19	SP – S36	SP 100% S37	SP + S38	Single block S16	JOG S09	MDA S10	AUTO S13
EB n+1	Spindle				*Key Pos. 3* *X50.3*	Machine function		
	NC Start S20	SP right S39	*SP Stop S40	SP left S41		REF S02	REP S01	TEACH S11
EB n+2	Feedrate		Mach. fu.	*Key Pos. 0* *X50.4*	Machine function			
	Feed Start S35	*Feed Stop S34	INC VAR S03		INC1000 S07	INC100 S06	INC10 S05	INC1 S04
EB n+3	RESET S17	*Key Pos. 2* *X50.1*	*Key Pos. 1* *X50.6*	*Feed override*				
				*F.over.16 X30.6	*F.over.8 X30.7	*F.over.4 X30.8	*F.over.2 X30.9	*F.over.1 X30.10
EB n+4	Arrow keys			*Optional customer keys*				
	+ S50	– S48	Rapid traverse S49	*KT4* *X52.2*	*KT3* *X52.1*	*KT2* *X51.3*	*KT1* *X51.2*	*KT0* *X51.1*
EB n+5	Free K.	*Opt. K.*	Axis selection					
	T16 S18	*KT5* *X52.3*	6 S47	5 S46	4 S45	Z S44	Y S43	X S42
EB n+6	Freely assignable customer keys				WCS/MCS	Freely assignable customer keys		
	T9 S29	T10 S30	T11 S31	T12 S32	S33	T13 S12	T14 S14	T15 S15
EB n+7	Freely assignable customer keys							
	T1 S21	T2 S22	T3 S23	T4 S24	T5 S25	T6 S26	T7 S27	T8 S28

Signals marked with * are inverse signals.

The following information is to be found in the table for each input bit:

- 1st line: Default designation
- 2nd line: Key number (Sxy) or feedrate override switch (X30/X31), key-switch (X50), optional customer keys (X52)

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Output image Arrangement of LED signals in the output image of the DP slave: MCP 310:

Table 8-3 Output image

Signals to machine control panel (LEDs)								
Byte	**Bit7**	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
AB n+0	Spindle override				Mode			
	*NC Stop LED19	SP – LED36	SP 100% LED37	SP + LED38	Single block LED16	JOG LED09	MDA LED10	AUTO LED13
AB n+1	Spindle				Machine functions			
	NC Start LED20	SP right LED39	*SP Stop LED40	SP left LED41	Reset LED 17	REF LED02	REP LED01	TEACH LED11
AB n+2	Feedrate		Mach. fu.	*not used*	Machine functions			
	Start LED35	*Hold LED34	var. INC LED03		1000 INC LED07	100 INC LED06	10 INC LED05	1 INC LED04
AB n+3	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*
AB n+4	Arrow keys			Optional customer keys				
	+ LED50	– LED48	Rapid traverse LED49	KT4 24 V	KT3 24 V	KT2 24 V	KT1 24 V	KT0 24 V
AB n+5	Free K.	Opt.K.	Axis selection					
	T16 LED18	KT5 24 V	6 LED47	5 LED46	4 LED45	Z LED44	Y LED43	X LED42
AB n+6	Freely assignable customer keys				WCS/MCS LED33	Freely assignable customer keys		
	T9 LED29	T10 LED30	T11 LED31	T12 LED32		T13 LED12	T14 LED14	T15 LED15
AB n+7	Freely assignable customer keys							
	T1 LED21	T2 LED22	T3 LED23	T4 LED24	T5 LED25	T6 LED26	T7 LED27	T8 LED28

The following information is to be found in the table for each output bit:

- 1st line: Default designation
- 2nd line: LED number

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8.7 DP slave: MCP 483



Fig. 8-16 MCP 483Front panel; Version T (turning machines)

8.7.1 Conditions for general commissioning

Hardware

The following hardware is required:

- PROFIBUS connecting cable
  No terminating resistor is integrated in the machine control panel.

Software

The following software is required:

- PLC basic program
  The relevant modules of the basic PLC program are **FB 1** (MCP communication parameters), **FC 19** (interface parameter assignment version: milling) and **FC 25** (interface parameter assignment, version: turning).

  The library of the PLC basic program is part of the SINUMERIK 840Di sl. How to install the library is described in Section 6.4, Page 6-152.
- SIMATIC STEP 7
  SIMATIC STEP 7 is needed to customize the PLC basic and user programs to the requirements of the respective automation system. SIMATIC STEP7 can be installed directly on the PCU of the SINUMERIK 840Di sl. How to install additional software is described in Section 17, Page 17-477.
- DP slave: MCP 483
  The DP slave: MCP 483 is part of the PLC Toolbox. When the PLC Toolbox is installed, it is automatically installed in SIMATIC STEP 7.

References

The following manuals are required for the commissioning of the MCP:

/FB1/ Description of Functions, Basic Functions P3, PLC Basic Program
Program structure and modules of the PLC basic program.

/FB2/ Description of Functions, Extended Functions H1 Jog with/without Handwheel
Commissioning of handwheels

/BH/ Operator Components Manual
Description of MCP (interfaces, electrical connection, etc.)

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/**Z**/ **Catalog NCZ**
Connection Components: Cables, connectors, etc.

Automation system

To commission the MCP the automation system must be completely electrically and mechanically connected with respect to NC, PLC and MCP.

The drives must be secured against accidental moving.

8.7.2 Parameterization of the MCP

Interfaces

Fig. 8-17 below shows the interfaces on the rear of the module:

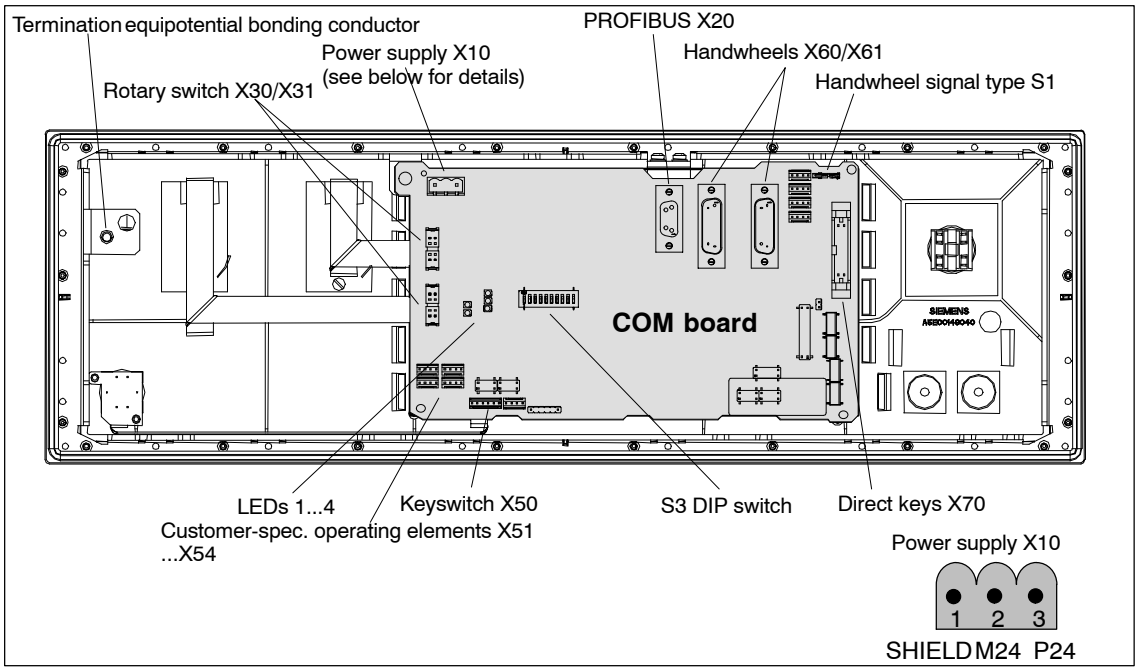


Fig. 8-17 Position of interfaces on rear side of machine control panel

For a detailed description of the electrical and mechanical design and of the machine control panel interfaces, please refer to:

References: /BH/ Operator Components, Manual
Section: Machine control panel MCP 483

Display of the software version

After the MCP has been electrically connected, all LEDs on the front side of the MCP flash until communication is established between MCP and PLC.

Simultaneously pressing the two keys ”Feed stop” and ”Feed enable” (in the bottom right corner) displays the version number of the current software version using the LEDs now lighting continuously.

Version number = V ”Number of lit LEDs on the left LED block”**.**
”Number of lit LEDs on the center LED block”**.**
”Number of lit LEDs on the right LED block”

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In the example (Fig. 8-18) version number: **V 01.02.00** is displayed.

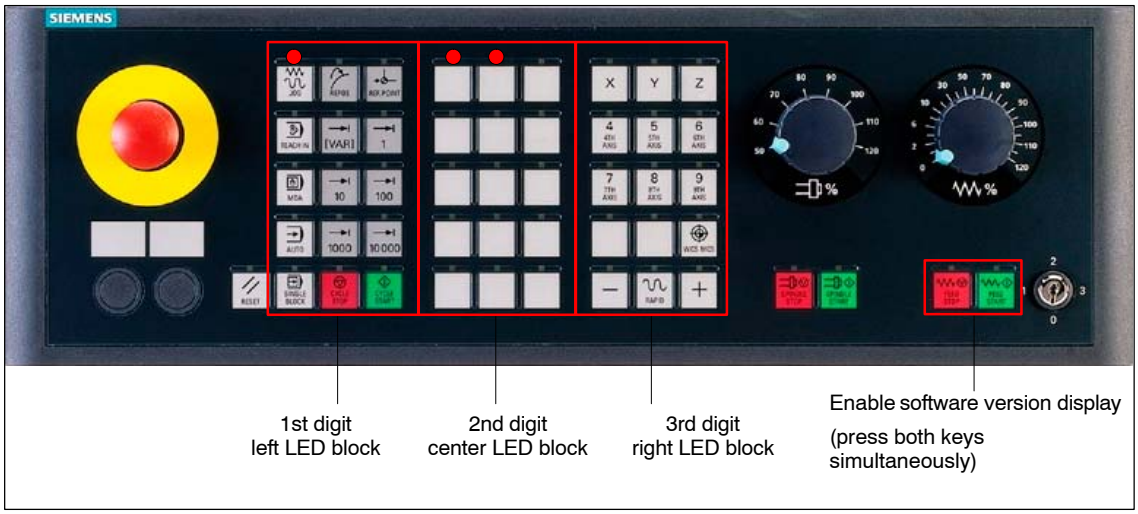


Fig. 8-18 MCP software version display

Switch S3

The PROFIBUS address and connection type are set with switch S3 on the rear of the MCP:

Table 8-4 Switch S3: PROFIBUS address (1 – 7)

10	***9***	***8***	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Meaning/value**
on	on	–	–	–	–	–	–	–	–	Connection type: PROFIBUS
–	–	off	–	–	–	–	–	–	–	Reserved
										PROFIBUS address
–	–	–	off	off	off	off	off	off	off	0
–	–	–	off	off	off	off	off	off	on	1
–	–	–	on	off	off	off	off	on	off	2
–	–	–	off	off	off	off	off	on	on	3
–	–	–	:	:	:	:	:	:	:	:
–	–	–	on	on	on	on	on	on	off	126
–	–	–	on	on	on	on	on	on	on	127
Switch settings 10 – 8 must be set according to the data in the table.										

Notice

In the state as delivered, the connection type is: MPI (10 – 9: off, off).

8.7.3 Functions of the machine control panel

The machine control panel offers the following functions:

- Default
- Hand wheel
- Additional I/Os

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Default

The function transfers input/output data from the function keys and user–specific keys and outputs:

- Input data: 8 byte
- Output data: 8 byte

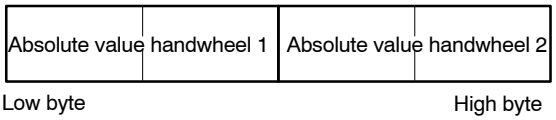
The input/output data for machine control panel MCP 483 is compatible with the input/output data from the previous machine control panel:

– Machine control panel (MCP), MPI
– 19” machine control panel

Hand wheel

The function transfers the absolute values for the two handwheels that can be connected to the machine control panel:

- Input data: 2 x 2 bytes



For each handwheel the current handwheel value is transferred as a 16–bit absolute value relative to the starting value. The starting value for the sensor counter in the handwheel is 0.

The absolute values are transferred in big endian format.

The data for both handwheels is always transferred. The absolute value for a handwheel that is not connected is always 0.

Notice

If the ”Handwheel” function is used, the machine control panel must be connected to PROFIBUS interface X101 of the MCI board. The handwheel is evaluated by the NC and the NC only has direct access to this PROFIBUS interface.

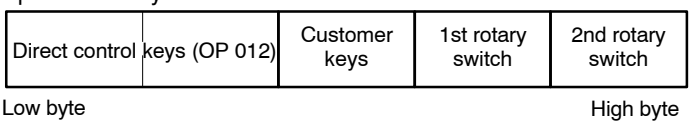
Additional I/Os

The function transfers the data for all non–standard inputs/outputs:

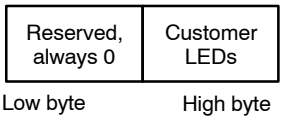
- Direct control keys
- Customer keys: 6 signals (bit 0 to bit 6)
- Rotary switch

with the following distribution:

- Input data: 5 byte



- Output data: 2 byte



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8.7.4 Configuring the DP slave: MCP 483

This section describes the configuration of a DP slave: MCP 483 by way of example of the configuration of a SIMATIC S7 project shown in Fig. 8-19.

The configuration comprises the following modules:

- SIMATIC Station 300 with SINUMERIK 810D/840D and PLC 317–2DP
- SINUMERIK MCP with module: standard, handwheel, extended

To configure DP slave: MCP 483 the following steps must be carried out in the S7 project:

1. Insert DP slave: MCP 1,226.82 cm the configuration
   (see Fig. 8-19, Page 8-213: **1**)
2. Set the PROFIBUS address.
3. Insert the modules in DP slave: MCP 483 for the functions required.
   (see Fig. 8-19, Page 8-213: **2**)
4. Set the I/O addresses for the individual slots.

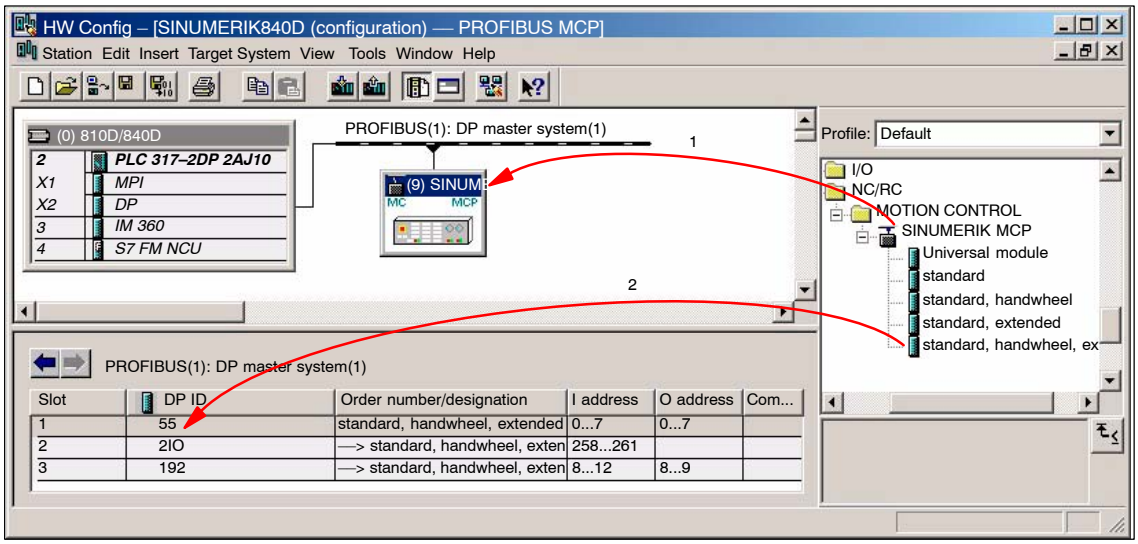


Fig. 8-19 Configuration with DP slave: MCP 483

Preconditions: S7 project

The following status of the S7 project into which DP–Slave: MCP 483 is to be inserted is assumed:

- You have created the S7 project
- You have set up a SIMATIC 300 station with PROFIBUS master–capable SINUMERIK controller

DP slave: MCP 483

To insert a DP slave: MCP 483 into the configuration, open the hardware catalog with menu item **View > Catalog**.

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DP slave: MCP 483 is located under:

- Profile: **Standard**
  PROFIBUS DP > Other field devices > NC/RC > Motion Control > SINUMERIK MCP

Select the DP slave by left–clicking it in the hardware catalog: MCP 483 (SINUMERIK MCP) and drag it while holding down the mouse key onto the DP master system in the station window.

The DP master system is displayed in the station window with the following symbol:

When you release the left mouse key, DP slave: MCP 483 is inserted in the configuration.

Note

As you drag the DP slave the cursor appears as a circle with a slash through it. When the cursor is positioned exactly over the DP master system, it changes to a plus sign, and the DP slave can be added to the configuration.

PROFIBUS parameters

When you have inserted DP slave: MCP 483 into the configuration, dialog "Properties – PROFIBUS Interface SINUMERIK MCP" is displayed.

The following PROFIBUS parameters must either be set or verified:

- PROFIBUS address
- Transmission rate
- Profile

Dialog box

Dialog box: Properties – PROFIBUS Interface SINUMERIK MCP
Tab card: Parameter
Address: **<PROFIBUS address>**
Button: "Properties..."

Dialog box: Properties – PROFIBUS
Tab card: Network settings
Transmission rate: **12 Mbaud**
Profile: **DP**
OK

OK

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Notice

The PROFIBUS address set in the S7 project for DP slave: MCP 483 must match the PROFIBUS address set on the module (DIP switch S3).

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration DP slave: MCP 483
   PROFIBUS address
2. Machine control panel MCP 483
   PROFIBUS address (DIP switch S3)

Adding a module

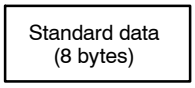
The active functions and hence the number of user data elements to be transferred are chosen by selecting the appropriate pre-configured module. The modules are listed in the hardware catalog under DP slave: MCP 483. The following modules are available:

- *Universal module* (not applicable)
- standard
- standard, handwheel
- standard, extended
- standard, handwheel, extended

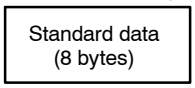
Module: standard

The module transfers the data for the ”Standard” function:

- Input data: 8 byte



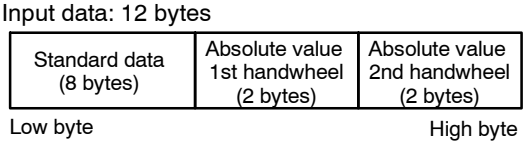
- Output data: 8 byte



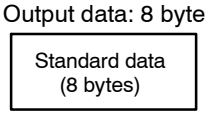
Module: standard, handwheel

The module transfers the data for the ”Standard” and ”Handwheel” functions:

- Input data: 12 bytes



- Output data: 8 byte

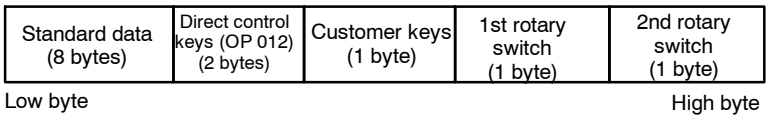


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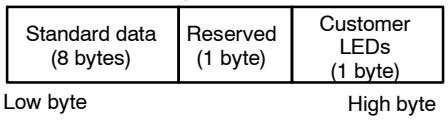
Module: standard, extended

The module transfers the data for the ”Standard” and ”Additional I/Os” functions:

- Input data: 13 byte



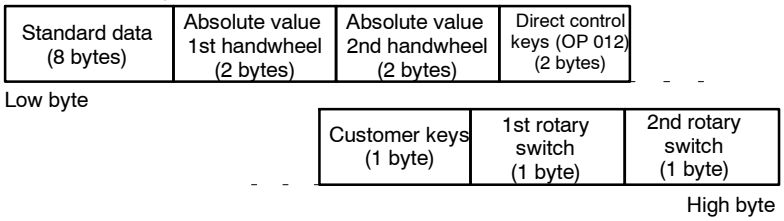
- Output data: 10 bytes



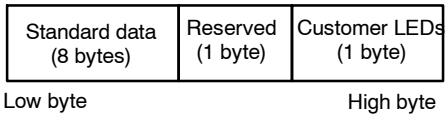
Module: standard, handwheel, extended

The module transfers the data for the ”Standard”, ”Handwheel” and ”Additional I/Os” functions:

- Input data: 17 byte



- Output data: 10 bytes



Setting the I/O addresses

When you insert a module in slot 1 of DP slave: MCP 483 the input/output addresses of STEP 7 are automatically assigned.

Double clicking with the left mouse button on a slot opens the ”Properties - DP slave” dialog box. The starting addresses for the I/O data for the slot can be set here.

8.7.5 Linking to the basic PLC and user program

This section describes how to link DP slave: MCP 483

- to the PLC basic program for transferring standard I/O data to the VDI interface
- to the PLC user program (optional) to implement a user-specific response to a module failure

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Notice

Processing of additional I/O data is the sole responsibility of the user (machine manufacturer) and is not supported by the PLC basic program.

PLC basic program

In order to transfer standard input/output data of DP slave: MCP 483 with the PLC basic program, the I/O address range in question must be entered in the communications parameters of function block FB1.

Function block FB1

The communications parameters of the MCP are called MCPx... (x = 1 or 2) in function block FB1. A maximum of 2 machine control panels are supported by the basic PLC program.

To synchronize several MCPs, the PLC program must be adapted accordingly. This is the user's (machine manufacturer's) responsibility.

To operate an MCP 483 as a DP slave on a SINUMERIK 840Di sl, the following parameters are relevant:

```
MCPNum:      INT       // Number of the MCPs

MCP1In:      POINTER   // Address of the input signals
MCP1Out:     POINTER   // Address of the output signals
MCP1BusAdr   Byte      // PROFIBUS address of the DP slave MCP
```

The MCP2... parameters are only needed if a 2nd MCP is used in addition to the 1st MCP:

```
MCP2In:      POINTER   // Address of the input signals
MCP2Out:     POINTER   // Address of the output signals
MCP2BusAdr   Byte      // PROFIBUS address of the DP slave MCP
```

Bus type via which the MCP is connected:

```
MCPBusTyp    Byte      // MPI       = 0
                       // PROFIBUS  = B#16#33
                       // Ethernet  = B#16#55
```

Notice

Parameters: MCPxStop and MCPxNotSend are of no significance.

References

For a detailed description of the PLC basic program or of function block FB 1, please refer to:

/FB1/ Description of Functions, Basic Functions: PLC Basic Program P3
Section: FB 1: RUN_UP Basic program, startup section

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VDI interface parameter assignment

The following function blocks can be used to assign the VDI interface:

- FC 19: Machine control panel MCP 483, version M (milling)
- FC 25: Machine control panel MCP 483, version T (turning)

Notice

Function blocks FC 19, FC 24 and FC 25 are part of the PLC basic program. It is the user's (machine manufacturer's) responsibility to call the block correctly and/or assign the interface the appropriate parameters.

References
A detailed description of the function blocks for transferring machine control panel signals to the VDI interface can be found in:

/FB1/ Description of Functions, Basic Functions: P3, PLC Basic Program
Section: FC 19: MCP_IFM ...
Section: FC 24: MCP_IFM2 ...
Section: FC 25: MCP_IFT ...

Example

The following example shows the communication parameter settings for function block FB 1 for an MCP:

```
MCPNum        := 1            // Number of MCPs
MCP1In        := P#E0.0       // Address: Input data
MCP1Out       := P#A0.0       // Address: Output data
MCP1StatRec   := P#A8190.0    // Configured diagnostic address
MCP1BusAdr    := 5            // PROFIBUS address of the DP slave MCP
MCP1Timeout   := S5T#700MS    // Default setting
MCPMPI        := FALSE        // No MPI bus
MCP1Stop      := FALSE        // Deactivation of the DP slave MCP
MCPSDB210     := FALSE        // No SDB210 for MCP
MCPCopyDB77   := FALSE        // No copying to DB77
MCPBusTyp     := B#16#33      // PROFIBUS
```

PLC user program

If an MCP is connected via PROFIBUS DP, the basic PLC program does not check for module failure.

In this case the MCP is monitored by a standard mechanism to monitor the active DP slave:

- PLC operating system
- PROFIBUS controller

If the failure of DP slave: MCP 483 is detected the PLC goes into the STOP status as default.

Customized response

to allow the user to intervene when a DP slave: MCP 483, the following organization blocks are inserted in the PLC user program:

- OB 82: Diagnostic alarm
- OB 86: Rack failure

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Please refer to the corresponding SIMATIC literature for details of linking organization blocks and evaluating diagnostic data.

Notice

In the event of the failure of a machine control panel connected via MPI, the following alarm is triggered by the PLC basic program:

- Alarm ”40026x machine control panel (x+1) failure”; with x = 0, 1

When connecting the machine control panel via PROFIBUS, the user (machine manufacturer) is responsible for triggering a corresponding alarm.

8.7.6 Input/output image

Arrangement: Keys and LEDs

A key and the LED positioned above it form a logical unit. The key and the LED have the same number.

- Key number xy corresponds to Sxy
- LED number xy corresponds to LEDxy

Fig. 8-20 shows the arrangement of keys and LEDs on the machine control panel. For the sake of clarity, the LED designations are not shown in full.

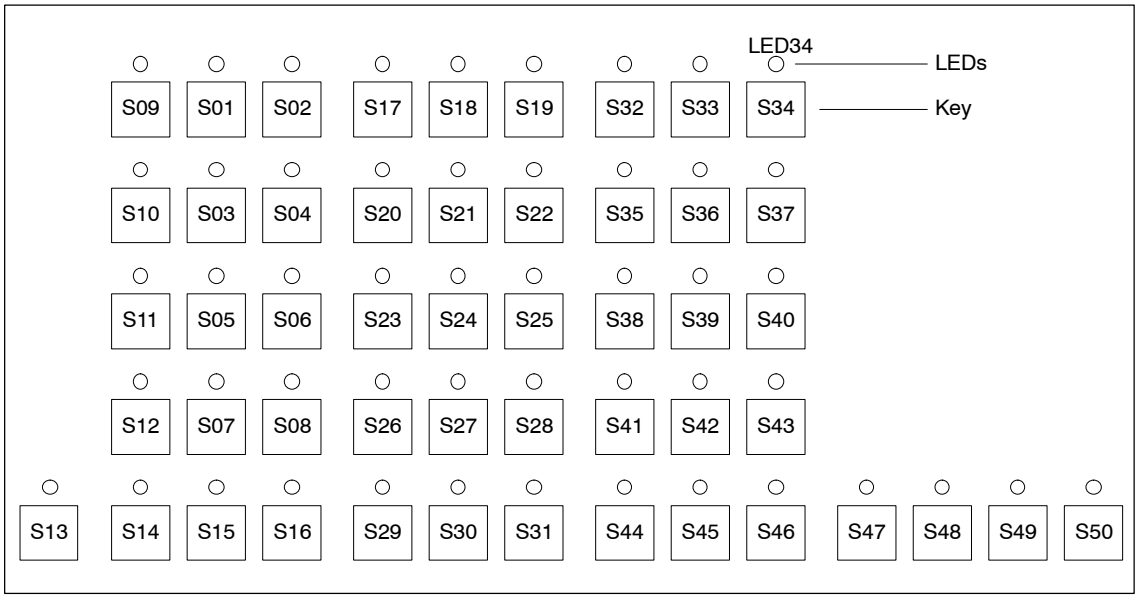


Fig. 8-20 MCP 483 keyboard layout (front view)

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Input image Arrangement of key signals in the input image of DP slave: MCP 483:

Table 8-5 Input image

Signals from machine control panel (keys)								
Byte	**Bit7**	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
EB n+0	*Spindle override*				Mode			
	***Override Spindle8 X31.7**	***Override Spindle4 X31.8**	***Override Spindle2 X31.9**	***Override Spindle4 X31.10**	JOG S09	TEACH S10	MDA S11	AUTO S12
EB n+1	Machine functions							
	REPOS S01	REF S02	var. INC S03	10000 INC S08	1000 INC S07	100 INC S06	10 INC S05	1 INC S04
EB n+2	*Key Pos. 0 X50.4*	*Key Pos. 2 X50.1*	Spindle Start S48	*Spindle Stop S47	Feed Start S50	*Feed Stop S49	NC Start S20	*NC Stop S15
EB n+3	RESET S13	*Key Pos. 1 X50.6*	Single Block S14	*Feed override				
				***Override F.over.16 X30.6**	***Override F.over.8 X30.7**	***Override F.over.4 X30.8**	***Override F.over.2 X30.9**	***Override F.over.1 X30.10**
EB n+4	Arrow keys			*Key Pos. 3 X50.3*	Axis selection			
	R15 S46	R13 S44	R14 S45		R1 S32	R4 S35	R7 S38	R10 S41
EB n+5	Axis selection							
	R2 S33	R3 S34	R5 S36	R12 S43	R11 S42	R9 S40	R8 S39	R6 S37
EB n+6	Freely assignable customer keys							
	F9 S25	F10 S26	F11 S27	F12 S28	F13 S29	F14 S30	F15 S31	*not used*
EB n+7	Freely assignable customer keys							
	F1 S17	F2 S18	F3 S19	F4 S20	F5 S21	F6 S22	F7 S23	F8 S24

Signals marked with ***** are inverse signals.

The following information is to be found in the table for each input bit:

- 1st line: Default designation
- 2nd line: Key number (Sxy) or feedrate override switch (X30/X31), key-switch (X50), optional customer keys (X52)

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Output image Arrangement of LED signals in the output image of the DP slave: MCP 483:

Table 8-6 Output image

Signals to machine control panel (LEDs)								
Byte	**Bit7**	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
AB n+0	Machine function				Mode			
	1000 INC LED07	100 INC LED06	10 INC LED05	1 INC LED04	JOG LED09	TEACH LED10	MDA LED11	AUTO LED12
AB n+1	Feed Start LED50	Feed Stop LED49	NC Start LED16	NC Stop LED15	Machine function			
					REPOS LED01	REF LED02	var. INC LED03	10000 INC LED08
AB n+2	Axis selection					Single Block LED14	Spindle Start LED48	Spindle Stop LED47
	R13 LED44	R1 LED32	R4 LED35	R7 LED38	R10 LED41			
AB n+3	Axis selection							
	R3 LED34	R5 LED36	R12 LED43	R11 LED42	R9 LED40	R8 LED39	R6 LED37	R15 LED46
AB n+4	Freely assignable customer keys							Axis selection
	F9 LED25	F10 LED26	F11 LED27	F12 LED28	F13 LED29	F14 LED30	F15 LED31	R2 LED33
AB n+5	Freely assignable customer keys							
	F1 LED17	F2 LED18	F3 LED19	F4 LED20	F5 LED21	F6 LED22	F7 LED23	F8 LED24
AB n+6	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*	RESET LED13 (optional)	R14 LED45 (optional)
AB n+7	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*	*not used*

The following information is to be found in the table for each output bit:

- 1st line: Default designation
- 2nd line: LED number

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8.8 DP slave: ADI4

Notice

The ADI4 DP slave can only be operated on an **isochronous** PROFIBUS DP.

8.8.1 Slave OM

Parameters for the configuration with regard to the ADI4 interface modules, called DP slave ADI4 here, are assigned with the SlaveOM for SINUMERIK 840Di sl. For how to install the slaveOM, see below: References.

Note

To simplify parameterization of the isochronous communication on the PROFIBUS DP, you must first insert all the DP slaves (drives, ADI4, I/O modules, etc.) you require into the configuration before parameterization of the DP drives, before you set the times for isochronous communication.

8.8.2 Inserting DP slave

To insert an ADI4 DP slave in the configuration, open the hardware catalog using the **View > Catalog** menu command.

The DP slave ADI4 is to be found at:

- Profile: **Default**

  PROFIBUS DP > SINUMERIK > ADI4

Select DP slave ADI4 by clicking it with the left mouse button and drag it to the DP master system in the Station window holding down the mouse button.

The DP master system is displayed in the station window with the following symbol: 

When you release the left mouse button, the DP slave ADI4 is inserted into the configuration.

Note

Make sure that the cursor, which appears as a crossed–out circle when dragging the DP slave, is positioned exactly on the DP master system so that the DP slave is inserted into the configuration.

References

For a complete description of the parameterization of an AD14 DP slave please refer to:

References: /ADI4/ Analog drive interface for four axes
Section: Parameterization

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8.9 DP slave: SINAMICSS120

The following SINAMICS drive system is available for SINUMERIK 840Di sl:

– SINAMICS S120 with CU320 on PROFIBUS DP

8.9.1 SlaveOM for SINAMICS

The SlaveOM for SINAMICS is required to configure SINAMICS S120 drives. The SlaveOM is automatically installed in SIMATIC STEP7, if the SINAMICS STARTER commissioning tool is installed on the same computer (PG/PC) as SIMATIC STEP7.

Note

- Configuration and SlaveOM for SINAMICS
  The SlaveOM for SINAMICS must be installed to configure SINAMICS S120 drives. To do this, install the SINAMICS STARTER commissioning tool on the same computer (PG/PC) as SIMATIC STEP7.
- Assigning parameters for isochronous communication
  To simplify the assignment of parameters for isochronous communication on the PROFIBUS DP, you must first insert all the DP slaves (drives, ADI4, I/O modules, etc.) you require into the configuration before assigning parameters on the DP drives, before you set the times for isochronous DP communication.

8.9.2 Inserting the DP slave

To insert a DP slave S120 into the configuration, open the hardware catalog using the menu command **View > Catalog**.

The DP slave S120 is to be found at:

- Profile: **Default**
  PROFIBUS DP > SINAMICS > SINAMICS S120

Select DP slave S120 by clicking it with the left mouse button and drag it to the DP master system in the station window while holding down the mouse button.

The DP master system is displayed in the station window with the following symbol: 

Releasing the mouse button inserts the DP slave S120 in the configuration.

Note

Make sure that the cursor, which appears as a crossed–out circle when dragging the DP slave, is positioned exactly on the DP master system so that the DP slave is inserted into the configuration.

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Expanded message frame configuration

The ”expanded message frame configuration” has been provided to transfer additional drive data to the NC in the cyclic PROFIBUS message frame in addition to the process data (PDA) for the selected standard message frame type (102 to 107).

The expanded message frame configuration is described in Section 18.2, Page 18-501.

8.9.3 Parameterizing DP slaves

The assignment of parameters to DP slave S120 is divided into 2 steps:

- Step 1
  In Step 1, DP slave S120–specific parameter settings are made for:
  - PROFIBUS address
  - Device version
  - PROFIBUS message frame
  - I/O addresses
  - Expanded message frame configuration

  Step 1 should first be carried out for **all** DP slaves S120 required for the configuration.
- Step 2
  Step 2 includes parameterization of isochronous DP communication. Step 2 can be carried out **finally**, for **any** DP slave S120.

  The settings made during the operational sequence above can be transferred to all of the remaining DP slaves S120 using the matching function of SlaveOM.

PROFIBUS address

Inserting a DP slave S120 into the configuration will open the dialog for assigning parameters for PROFIBUS DP properties.

The PROFIBUS address is automatically set to the next free PROFIBUS address.

The PROFIBUS address can generally be freely selected. It must, however, match the PROFIBUS address set in the drive Control Unit (parameter P0918).

Notice

The PROFIBUS address of DP slave S120, which is set using HW Config, must match the PROFIBUS address set in the drive:

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration of DP slave S120
   PROFIBUS address
2. SINAMICS S120, CU320
   Parameter P0918 (PROFIBUS node address)

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Dialog box

Dialog box: Properties – PROFIBUS interface SINAMICS
Tab: Parameter
Address: <**PROFIBUS address**>

OK

Device version

After this dialog has been confirmed using the button: ”OK”, the dialog box: ”SIMOTION drive properties” dialog opens enabling you to set the device version used in the drive.

Dialog box

Dialog box: Properties – SIMOTION drive
Tab: Drive unit/Bus address
Device version: <**Device version**>

PROFIBUS message frame

After this dialog has been confirmed using the button: ”OK”, the dialog box: ”DP Slave Properties” dialog opens.

Message frames and process data
Selecting a message frame defines the process data (PDA) exchanged between the DP master and the DP slave.

The following vendor–specific message frames are predefined for exchanging process data between a SINUMERIK 840Di sl (DP master) and a DP slave S120:

Table 8-7 Telegrams and process data

Drive object	Telegram	PDA_{set}	PDA_{act}	Description
Closed–loop drive control	102	6	10	Speed control with torque reduction, 1 position encoders
	103	7	15	Speed control with torque reduction, 2 position encoders
	105	10	10	DSC with torque reduction, 1 position encoder
	106	11	15	DSC with torque reduction, 2 position encoder
	116	11	19	DSC with torque reduction, 2 position encoder
Infeed	370	1	1	Message frame for the infeed
Control unit	390	2	2	Message frame for Control Unit (drive object 1, DO1), Digital inputs/outputs
	391	3	3	Message frame for Control Unit (drive object 1, DO1), Digital inputs/outputs and probe
”Free interconnection via BICO”	999	–	–	The send and receive message frames can be configured as required by using BICO technology to interconnect the send and receive process data.
PDA_{set}/PDA_{act} DSC	Number of process data words: Setpoints/Actual values Function: Dynamic Servo Control			

For a detailed description of message frames, please see:

References:
SINAMICS S120 Commissioning Manual,
Section: Communications via PROFIBUS DP

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Message frame structure

The configuration of the PROFIBUS message frame for a DP slave S120 must observe the following framework conditions:

- The process data of the axes or drive objects: ”Drives” must be available before the process data of all other drive objects (Control Unit, infeed, etc.).

Note

Currently, no message frames must be configured for the Control Unit and infeed of a drive unit. Error acknowledgement and release are performed in the STARTER by means of free message frame configuration with BICO.

- The structure of the process data for the PROFIBUS message frame configured in HW Config (object sequence and message frame type) must be identical to the structure configured in STARTER.

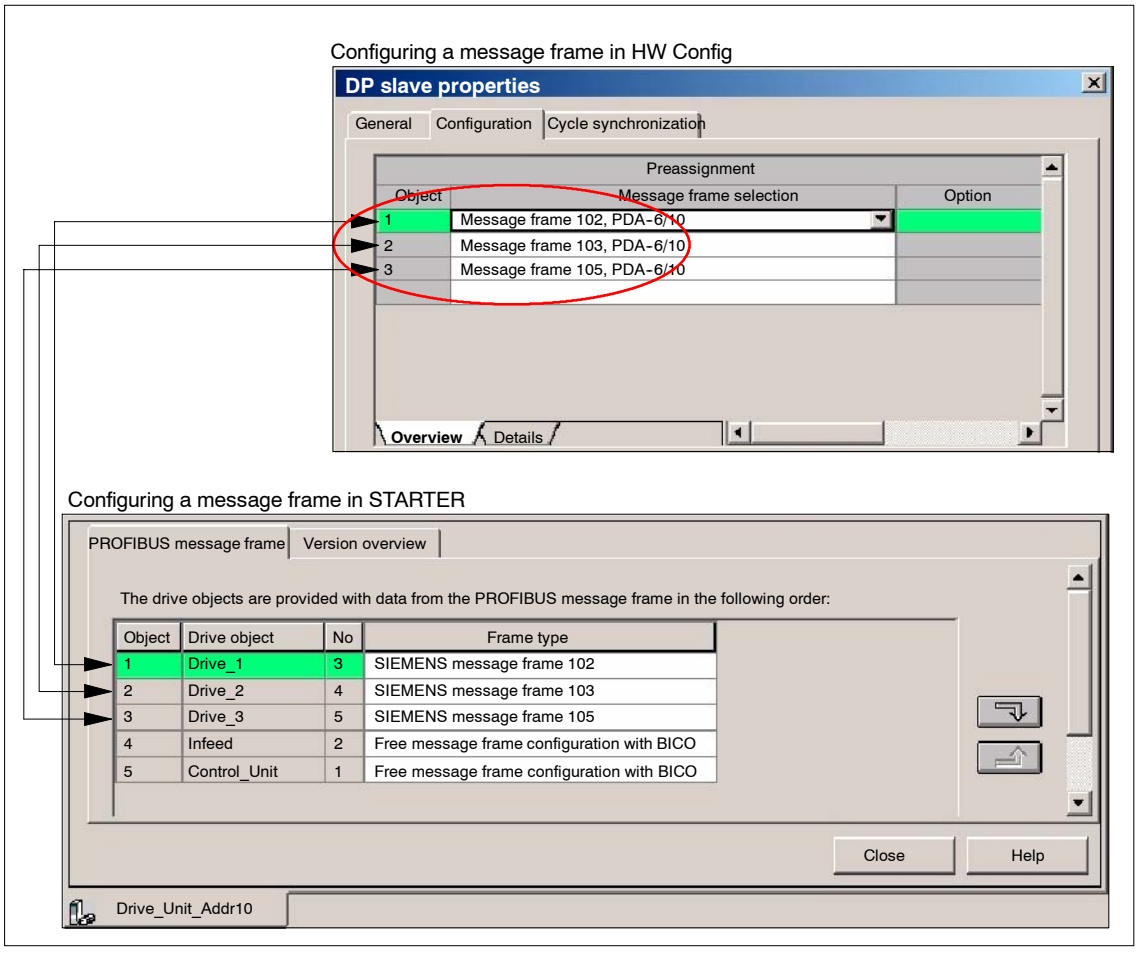


Fig. 8-21 Process data structure: HW Config and STARTER

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Dialog box

Dialog box: DP slave properties
Tab card: Configuration
Tab: Overview
Message frame selection: <**Telegram**>

OK

Notice

The PROFIBUS message frame of DP slave S120, which is parameterized using HW Config, must match the corresponding data parameterized in the NC and in the drive.

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration DP slave S120
   Drive object: "Drive control": Message frame
2. SINUMERIK 840Di sl NC
   MD13060 $MN_DRIVE_TELEGRAM_TYP[n]
3. SINAMICS S120
   Parameter p0922 (PROFIBUS PDA message frame selection) and STARTER: Drive unit> **Configuration**

I/O addresses

Communication between the NC and the drive object of a DP slave S120 in the SINUMERIK 840Di sl can only take place if the I/O addresses for the I/O data of a drive object are the same.

Notice

- The I/O addresses of the I/O data of a drive object must be the same, e.g., drive object: "Drive control":

  I/O address actual value = = I/O address setpoint

- The I/O address set by the HW Config for a drive object must match the I/O address set in the NC.

  There is **no automatic adjustment!**

  The following data must agree:

  - SIMATIC configuration DP slave S120
    Drive object: "Drive control": I/O address

    SINUMERIK 840Di sl NC
    MD13050 $MN_DRIVE_LOGIC_ADDRESS[n]

  - SIMATIC configuration DP slave S120
    Drive object: "Control Unit": I/O address

    SINUMERIK 840Di sl NC
    MD13120 $MN_CONTROL_UNIT_LOGIC_ADDRESS[n]

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Note

To prevent changes to the I/O addresses in the NC machine data, we recommend using the default machine data values when assigning I/O addresses:

- Drive objects: ”Drive control”:
  MD13050 $MN_DRIVE_LOGIC_ADDRESS[n], n = 0,1,...
  Default values: 4100 + n*40
- Drive objects: ”Control Unit”:
  MD13120 $MN_CONTROL_UNIT_LOGIC_ADDRESS[n], n = 0,1,...
  Default values: 6500 (1. CU), 0 (all other CUs)

Dialog box

Dialog box: DP slave properties
Tab card: Configuration
Tab: Details
Entry in table: PROFIBUS Partner, I/O address: <**I/O address**>

OK

After you have confirmed this dialog box using the button: ”OK”, the dialog box: ”DP slave properties” closes. Step 1 of parameterization of DP slave S120 is then complete.

Consistency

The default setting with regard to the consistency of the I/O data is **whole length**.

This setting results in:

- Direct accesses from the PLC user program (e.g. byte, word or double word) to this address range are not admitted by the PLC operating system.
- Accesses to this address range must be carried out using the system functions SFC 14 and SFC 15.
- The system functions SFC 14 and SFC 15 guarantee consistent reading/ writing of the data of an axis, e.g.:
  – Message frame type 102: 6 words for the set value or 10 words for the actual value
- Because DP slaves 611U can be assigned both to the NC and to the PLC, check system functions SFC 14 and SFC 15 when writing data to see whether the drive belongs to the writing component. If this is not the case, the data access is denied.

8.9.4 Dependencies of PROFIBUS DP communication

The overview example shows the interrelations or interdependencies when configuring the PROFIBUS DP communication between the components:

- NC
- DP master
- DP slave S120

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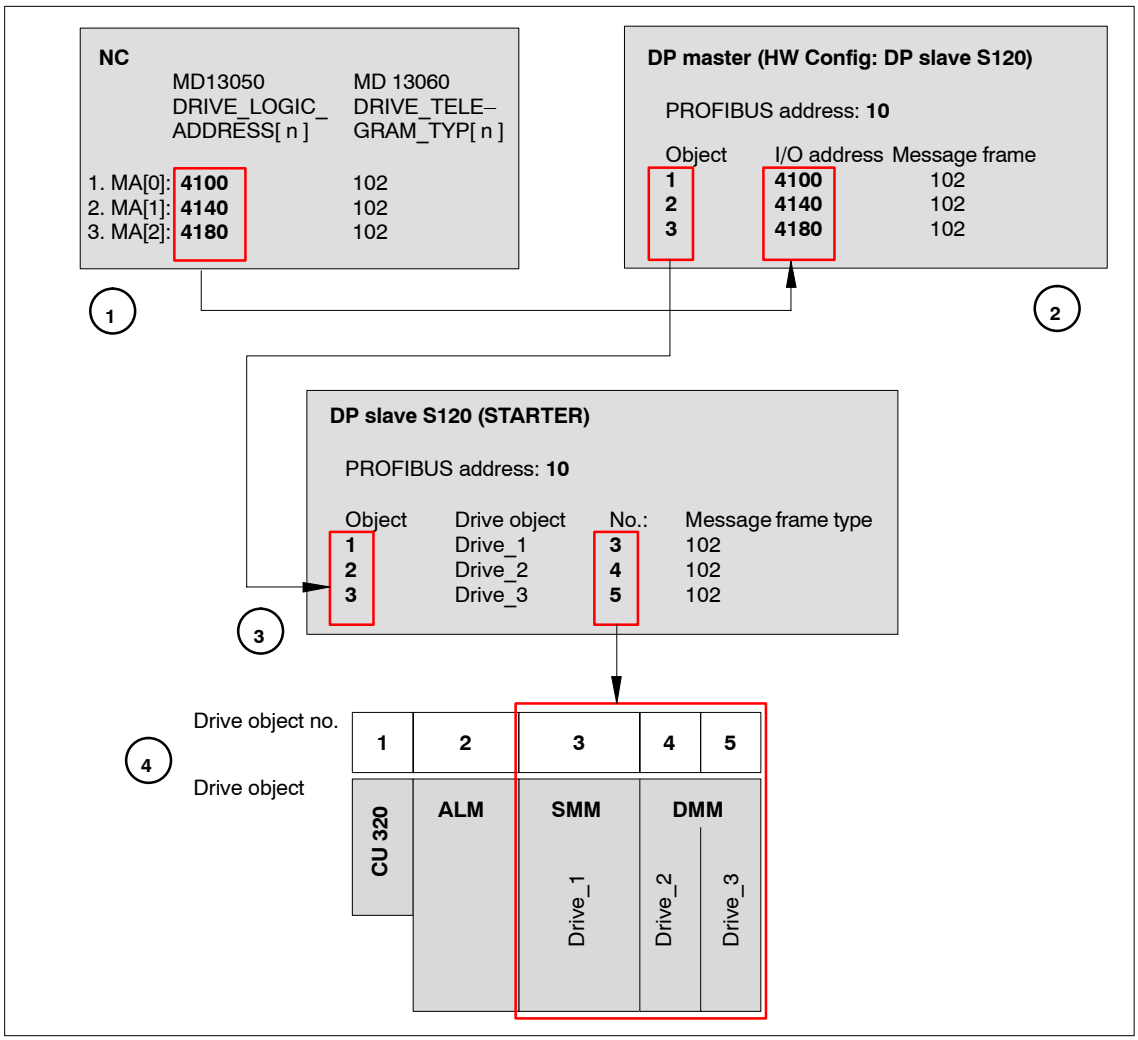


Fig. 8-22 Dependencies: NC, PLC/DP master and DP slave S120

(1) NC

The NC writes/reads the process data for machine axes 1 to 3 from the I/O addresses and message frames assigned parameters in machine data:

- MD13050: DRIVE_LOGIC_ADDRESS[n]
- MD13060: DRIVE_TELEGRAM_TYP[n]

1st machine axis:	I/O address	**4100**
	Message frame	**102**
2nd machine axis:	I/O address	**4140**
	Message frame type	**102**
3rd machine axis:	I/O address	**4180**
	Message frame type	**102**

For configuring the drive within the framework of the NC commissioning, please refer to Section 11.5.3, Page 11-314.

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(2) DP master

The DP master periodically transfers the isochronous process data to/from DP slaves S120 based on the configuration set in SIMATIC STEP 7 HW Config:

PROFIBUS address: **10**

Object	I/O address	Message frame
1	**4100**	102
2	**4140**	102
3	**4180**	102

Transferring process data to DP slave S120
The process data for the machine axes are read from the configured I/O addresses by the DP master and transferred to the DP slave S120 in the PROFIBUS message frame according to the configured object sequence.

Reading process data from DP slave S120
The process data for the machine axes are read from the PROFIBUS message frame by the DP master in the configured object sequence and transferred to the corresponding I/O addresses.

(3) DP slave S120

DP slave S120 interprets the PROFIBUS message frames received from the DP master based on the STARTER configuration:

PROFIBUS address: **10**

Object	Drive object	No.	Message frame type
1	Drive_1	**3**	SIEMENS message frame 102
2	Drive_2	**4**	SIEMENS message frame 102
3	Drive_3	**5**	SIEMENS message frame 102
4	Infeed	2	Free message frame configuration with BICO
5	Control Unit	1	Free message frame configuration with BICO

Transferring process data to the drive object
The process data (message frame type) are read from the PROFIBUS message frame by DP slave S120 in the configured object sequence (object) and transferred to the corresponding drive object according to the drive object number.

Example:
The process data for the first object is read to the PROFIBUS message frame according to message frame 102. The process data is transferred to the drive object: ”Drive_1”, drive object No. 3.

Reading process data from the drive object
The process data (message frame type) are read from the corresponding drive object by DP slave S120 in the configured object sequence (object) based on the drive object number and transferred to the PROFIBUS message frame.

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8.10 DP slave: SIMODRIVE drives

Parameterization of the configuration with regards to the SIMODRIVE drives:

- SIMODRIVE 611 universal or universal E
- SIMODRIVE POSMO CD/CA
- SIMODRIVE POSMO SI

is exemplified here by parameterization of the SIMODRIVE 611 universal.

8.10.1 SlaveOM

The drives are assigned parameters using the SlaveOM for SINUMERIK 840Di sl (for installation of the SlaveOM, see Section 8.1, Page 8-175: **DriveOM**/**SlaveOM**).

Note

To simplify parameterization of the isochronous communication on the PROFIBUS DP, you must first insert all the DP slaves (drives, ADI4, I/O modules, etc.) you require into the configuration before parameterization of the DP drives, before you set the times for isochronous DP communication.

8.10.2 Inserting the DP slave

To insert a DP slave 611U into the configuration, open the hardware catalog using the menu command **View > Catalog**.

The DP slave 611U is to be found at:

- Profile: **Default**

  PROFIBUS DP > SIMODRIVE > SIMODRIVE 611 universal, PROFIBUS DP1

Select DP slave 611U by clicking it with the left mouse button and drag it to the DP master system in the Station window holding down the mouse button.

The DP master system is displayed in the station window with the following symbol:

When you release the left mouse button, the DP slave 611U is inserted into the configuration.

Note

Make sure that the cursor, which appears as a crossed–out circle when dragging the DP slave, is positioned exactly on the DP master system so that the DP slave is inserted into the configuration.

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Expanded message frame configuration

In SW 2.2 and higher, ”expanded message frame configuration” has been provided to transfer drive data to the NC in the cyclic PROFIBUS message frame in addition to the process data (PDA) for the selected standard message frame type (102 to 107).

The expanded message frame configuration is described in Section 18.2, Page 18-501.

8.10.3 Parameterizing DP slaves

Parameterization of the DP slave 611U is divided into 2 steps:

- Step 1
  In Step 1, DP slave 611U–specific parameter settings are made for:
  - PROFIBUS address
  - Number of axes and encoders (message frame type)
  - I/O addresses
  - Expanded message frame configuration (SW 2.2 and higher)

  Step 1 should first be carried out for **all** DP slaves 611U required for the configuration.
- Step 2
  Step 2 includes parameterization of isochronous DP communication. Step 2 can be carried out **finally**, for **any** DP slave 611U.

  The settings made during the operational sequence above can be transferred to all of the remaining DP slaves 611U using the matching function of SlaveOM.

PROFIBUS address

Inserting a DP slave 611U into the configuration will open the dialog for parameterizing the PROFIBUS DP properties.

SlaveOM sets the PROFIBUS address to the next free PROFIBUS address automatically.

The PROFIBUS address can generally be freely selected. It must, however, match the PROFIBUS address set in the drive (e.g. with SimoCom U) (parameter P0918).

Notice

The PROFIBUS address of DP slave 611U, which is set on the SlaveOM, must match with the PROFIBUS address set in the drive:

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration of DP slave 611U
   PROFIBUS address
2. SIMODRIVE 611 universal
   Parameter P0918 (PROFIBUS node address)

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Dialog box

Dialog box: Properties – PROFIBUS Interface SIMODRIVE 611U DP2, DP3
Tab card: Parameter
Address: **PROFIBUS address**

OK

Message frame type

After this dialog has been confirmed using the button: ”OK”, the dialog box: ”DP Slave Properties” dialog opens.

Depending on the drive functionality to be used, you must select the correct message frame type from the listbox: Default. The selected message frame type only defines the number of cyclically transferred process data units within the cyclic message frames.

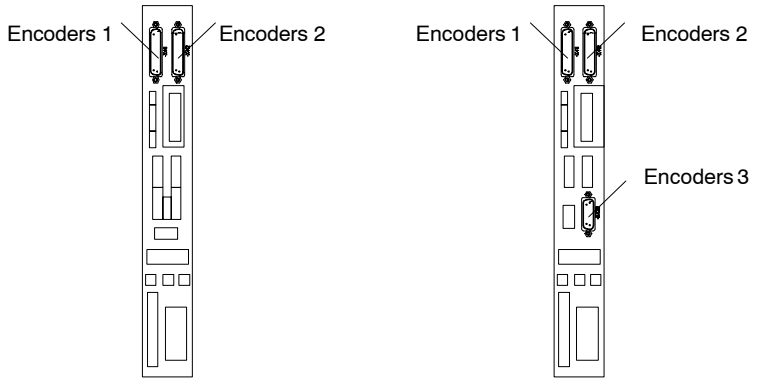
The number of cyclically transferred process data units depends on:

- The number of axes per drive module
- The number of encoders used per axis
- The drive functionality used

The following message frame types are predefined for parameterization of the DP slave 611U:

Table 8-8 Message frame types

Frame type		Description
1 axis,	Message frame type 102, PDA 6/10	nset interface with encoder 1
2 axes,	Message frame type 102, PDA 6/10	nset interface with encoder 1
1 axis,	Message frame type 103/104, PDA 7/15	nset interface with encoders 1 and 2 (103) or encoders 1 and 3 (104)
2 axes,	Message frame type 104, PDA 7/15	nset interface with encoders 1 and 3
1 axis,	Message frame type 105, PDA 10/10	nset interface with DSC and encoder
2 axes,	Message frame type 105, PDA 10/10	nset interface with DSC and encoders 1 and 2
1 axis,	Message frame type 106/107, PDA 7/15	nset interface with DSC and encoders 1 and 2 (106) or encoders 1 and 3 (107)
2 axes,	Message frame type 106/107, PDA 7/15	nset interface with DSC and encoders 1 and 2 (106) or encoders 1 and 3 (107)
PDA x/y	Number of process data words, x: Setpoints, y: Actual values	
DSC	Functionality ”Dynamic Servo Control”	



SIMODRIVE 611 universal SIMODRIVE 611 universal **E**

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Dialog box

Dialog box: DP slave properties
Tab card: Configuration
Default: <**Frame type**>

OK

Notice

The message frame type of DP slave 611U, which is set on the SlaveOM, must match with the PROFIBUS address set on the NC and the drive:

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration DP slave 611U
   Message frame type
2. SINUMERIK 840Di sl NC
   MD13060 DRIVE_TELEGRAM_TYP
3. SIMODRIVE 611 universal
   Parameter P0922 (PROFIBUS message frame type selection)

For a detailed description of the different message frame types, please see:

- SIMODRIVE 611 universal and universal E:
  References: /FBU/ Description of Functions SIMODRIVE 611 universal
- SIMODRIVE POSMO SI/CD/CA
  References: /POS3/ User Manual SIMODRIVE POSMO SI/CD/CA

in each case in Section: Communication on PROFIBUS DP.

I/O addresses

Communication between the NC and the individual axes of the DP slaves 611U in the SINUMERIK 840Di sl can only take place if the I/O addresses for the set-point and actual value of an axis are the same.

This prerequisite is taken into account by SlaveOM automatically when inserting a DP slave 611U into a configuration.

Notice

- The I/O addresses for set and actual values of an axis must be the same.

  I/O address actual value = = I/O address setpoint

  If a DP slave 611U is inserted into an S7 project due to a copying process (e.g. from another S7 project), the I/O addresses are assigned exclusively under the control of ”HW Config”.

  This may have the consequence that an axis is assigned different I/O addresses for set and actual values. In this case, the I/O addresses must be corrected manually.

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Notice

The I/O address set by the SlaveOM for an axis must match the I/O address set in the NC.

There is **no automatic adjustment!**

The following data must agree:

1. SIMATIC configuration of DP slave 611U
   I/O address
2. SINUMERIK 840Di sl NC
   MD13050 DRIVE_LOGIC_ADDRESS[n], (logical drive address)

Note

To avoid any subsequent modifications to the I/O addresses in NCK machine data:

- MD 13050 DRIVE_LOGIC_ADDRESS[n]

it is recommended to use the default values of the machine data when configuring the I/O addresses within the configuration:

1st axis: Default I/O address = 4100

mth axis: Default I/O address = 4100 + (m–1)*40

The default setting for the machine data is described in Section 11.5.1, Page 11-310.

Dialog box

Dialog box: DP slave properties
Tab card: Configuration
Entry in table: PROFIBUS Partner, I/O address: <**I/O address**>

OK

After you have confirmed this dialog box using the button: ”OK”, the dialog box: ”DP slave properties” closes. Step 1 of parameterization of DP slave 611U is then complete.

Consistency

The default setting with regard to the consistency of the I/O data is **whole length**.

This setting results in:

- Direct accesses from the PLC user program (e.g. byte, word or double word) to this address range are not permitted by the PLC operating system.
- Accesses to this address range must be carried out using the system functions SFC 14 and SFC 15.
- The system functions SFC 14 and SFC 15 ensure consistent reading/writing of the data of an axis, e.g.:
  - Message frame type 102: 6 words for the set value or 10 words for the actual value

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- Because DP slaves 611U can be assigned both to the NC and to the PLC, check system functions SFC 14 and SFC 15 when writing data to see whether the drive belongs to the writing component. If this is not the case, the data access is denied.

8.10.4 Dependencies of PROFIBUS DP communication

The overview example shows the interrelations or interdependencies when configuring the PROFIBUS DP communication between the components:

- NC
- DP master
- DP Slave 611U

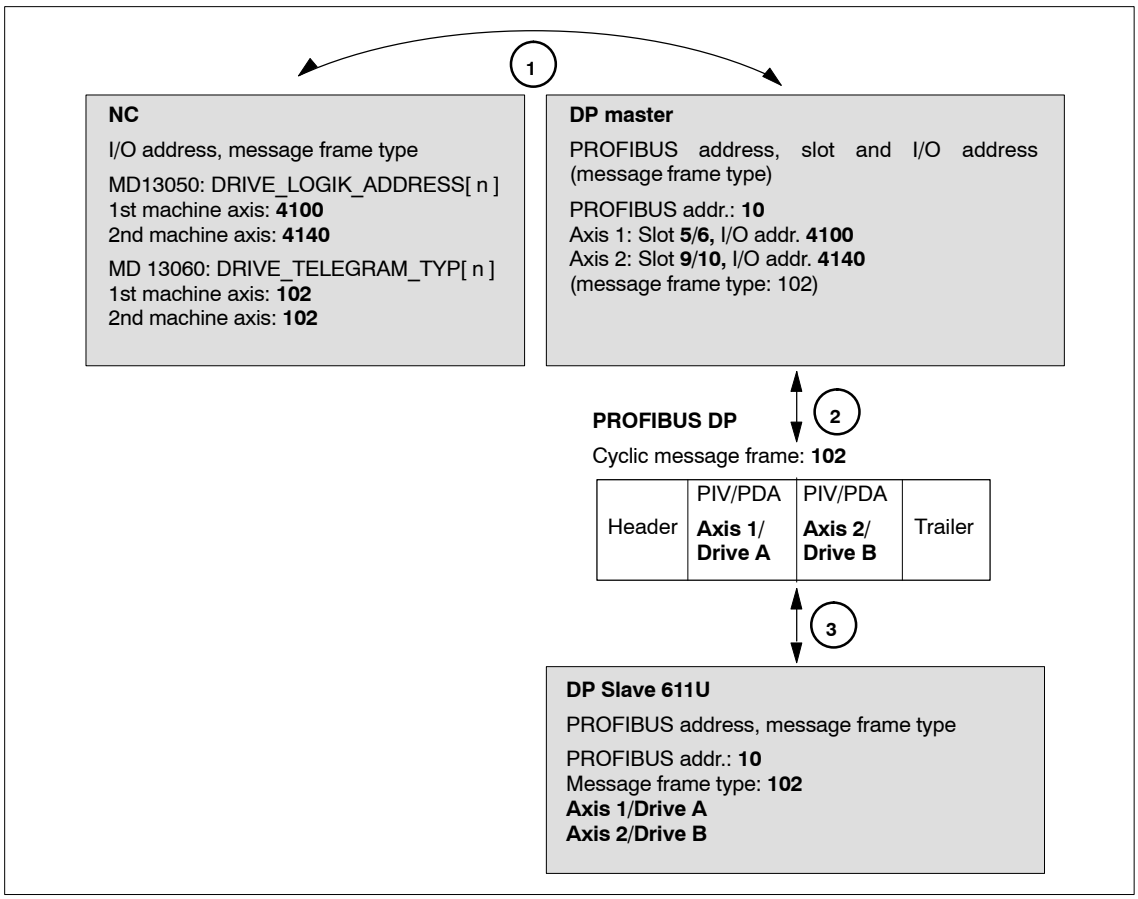


Fig. 8-23 Dependencies: NC, PLC/DP master and DP slave (SIMODRIVE 611 universal)

1 NC

The NC reads/writes the axis data in the relevant I/O area of the PLC/DP master on the basis of the I/O address entered in

- MD13050: DRIVE_LOGIC_ADDRESS[n]
- MD13060: DRIVE_TELEGRAM_TYP[n]

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and the message frame type of the machine axis:

1st machine axis:	I/O address	**4100**
	Message frame type	**102**
2nd machine axis:	I/O address	**4140**
	Message frame type	**102**

For configuring the drive within the framework of the NC commissioning, please refer to Section 11.5.3, Page 11-314.

(2) DP master

The information regarding the individual DP slaves are known to the DP masters from the PROFIBUS SDB generated from the configuration.

DP master transfers the data to/from the DP slaves in isochronous cycles using the following information:

PROFIBUS addr. **10**:	Setpoint:	Slot **5**,	I/O address **4100**
	Actual value:	Slot **6**,	I/O address **4100**
	Setpoint:	Slot **9**,	I/O address **4140**
	Actual value:	Slot **10**,	I/O address **4140**

Message frame type **102**

For a 2 axis–closed–loop control module of a SIMODRIVE 611 universal, the following assignment applies:

- **Slot 5/6** => **Axis 1** or **Drive A**
- **Slot 9/10** => **Axis 2** or **Drive B**

(3) DP Slave 611U

DP slave interprets the message frames received from the DP master because of the drive parameters

- Parameter P0922 (PROFIBUS message frame type selection)

Message frame type set:

Message frame type **102**

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8.11 DP slave: Diagnostic repeater for PROFIBUS DP

8.11.1 Function

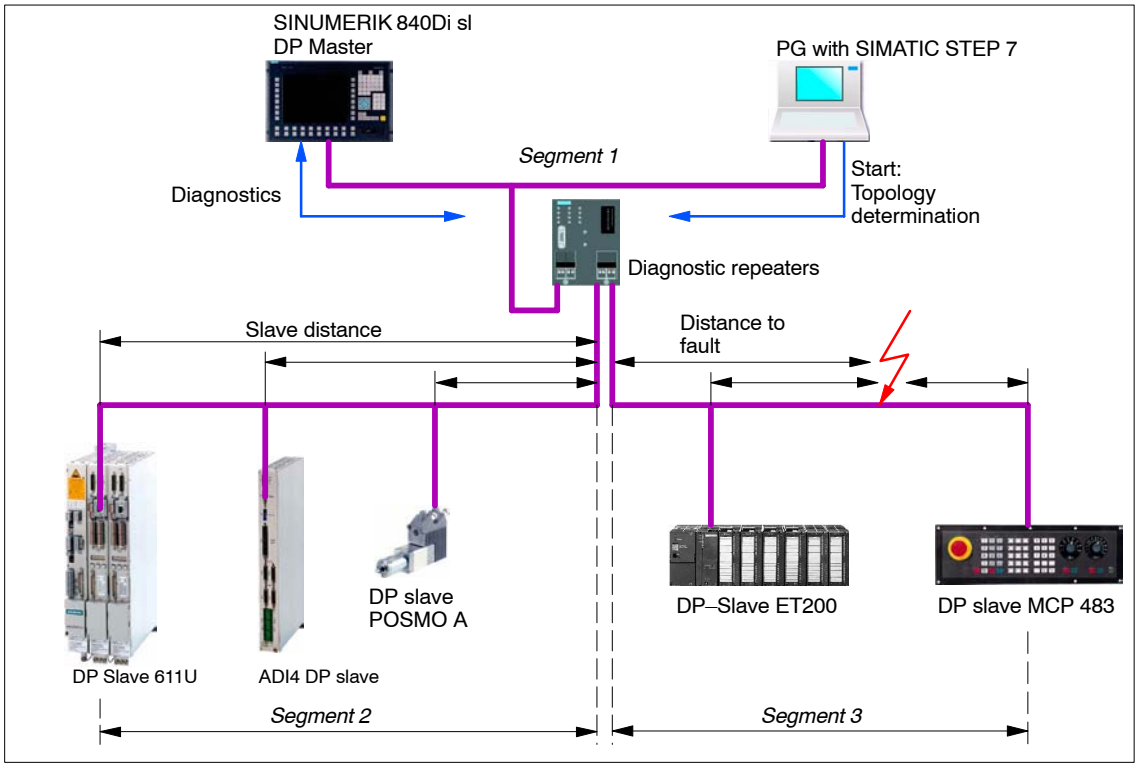


Fig. 8-24 Example: PROFIBUS topology with diagnostic repeater

A diagnostic repeater can monitor the segment of an RS 485 PROFIBUS subnet (copper cable) during normal operation and report line faults in a diagnostic message frame to the DP master. Used together with the SINUMERIK 840Di sl it is possible to display the location and cause of the fault in plaintext.

The diagnostic repeater primarily performs the following tasks:

- Diagnostic functions for two PROFIBUS segments (DP2 and DP3):
  The diagnostic function supplies the location and causes of cable faults such as wire breaks or missing terminating resistors.
- Repeater functions for three PROFIBUS segments (DP1, DP2, DP3):
  The diagnostic repeater amplifies the data signals on the bus cables and connects up individual RS 485 segments.
- Galvanic separation of the PG interface:
  Galvanically or electrically isolating the PG interface prevents interference with the other bus segments of the PROFIBUS DP if the PG connecting cable is inserted or removed, even at high baud rates.
- Monitoring functions of the clock–synchronous PROFIBUS

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8.11.2 Application range

A diagnostic repeater is required if one or more of the following requirements exist:

- Cable diagnosis of PROFIBUS network during operation
- Connection of more than 32 nodes on a PROFIBUS line
- Implementation of branches
- Electrical isolation of two segments
- Ungrounded operation of bus segments
- Visualization of bus topology with STEP 7 (Version 5.2 and higher)

8.11.3 Connection and commissioning

You will find a detailed description of how to connect and commission a diagnostic repeater in:

References:

SIMATIC
Manual: Diagnostic repeater for PROFIBUS DP

Drawing number: A5E00352937–01, 10/2004 Edition

Order number (MLFB): 6ES7972–0AB00–8AA0

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Space for your notes

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Drive Commissioning (SINAMICS) 9

9.1 Requirements

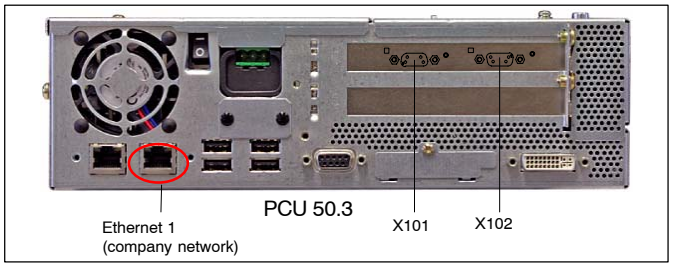
9.1.1 Basic requirements

The following are the basic requirements for commissioning SINAMICS S120 drive systems:

- The electronic power supply of PG/PC, SINUMERIK 840Di sl and SINAMICS S120 is switched ON.
- The mechanical and electrical elements of the SINAMICS drives are set up and connected correctly, including DRIVE CliQ connections.

  References
  SINAMICS S120 Commissioning Manual,
  Section: Preparations for Commissioning

- The SINAMICS STARTER drive commissioning tool is installed on the PG/PC. Version: At least V4.0
- PG/PC and SINUMERIK 840Di sl communicate:
  - Ethernet (**recommended**)
    The Ethernet interface of the PG/PC is connected to the ”Ethernet 1” interface of the PCU and Ethernet communication is parameterized. See Commissioning of the PLC (Section 6, Page 6-129)

  - MPI/DP
    The MPI/DP interface of the PG/PC (options communications processor CP 5x11) is connected with the MPI/DP interface of the MCI board (X102) and the MPI/DP communication is parameterized. See Commissioning of the PLC (Section 6, Page 6-129)
- SINUMERIK 840Di sl and SINAMICS S120 communicate:
  - PROFIBUS
    The PROFIBUS interface of the MCI board (X101) is connected to the PROFIBUS interface of the SINAMICS S120 and the PROFIBUS communication is parameterized. See PROFIBUS communication (Section 8, Page 8-175)

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9.1.2 Safety information

Danger

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

Please follow the instructions on the component!

Caution

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

Reason:
STARTER should only be used to store the safety parameters of **a single** Safety Integrated monitoring channel within a project. Loading the project into a drive unit with active safety functions would result in differences in both Safety Integrated monitoring channels and subsequently in alarms.

Notice

Before switching on the drive for the first time, check that the screws of the DC link busbars are tightened to the specified torque (see SINAMICS S120 Equipment Manual).

Residual risk

A risk assessment enables machine manufacturers to determine the residual risk for their machine with respect to the drive units. The following residual risks are defined:

- Unexpected drive movement from standstill:

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

  This residual risk can be significantly reduced through the ”Safe standstill” safety function (Safety Integrated).

- Unexpected change in speed/velocity during operation:

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

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9.2 ONLINE commissioning

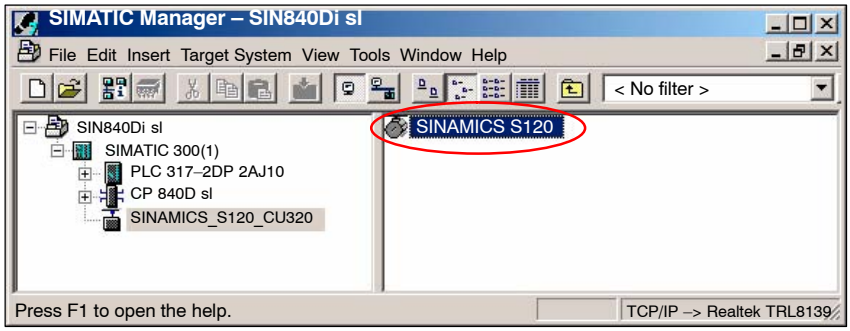
The SINAMICS STARTER drive commissioning tool can be started directly or indirectly from the SIMATIC STEP 7 project created in Section 6.3, Page 6-139ff for commissioning a drive unit.

Starting STARTER directly

If the SINAMICS STARTER drive commissioning tool is started directly (e.g. from the Windows taskbar: Start > SIMATIC > STEP 7 > STARTER), a new project must first be created. Continue with: Section 9.2.1, Page 9-244.

Starting STARTER from STEP 7

If the SINAMICS STARTER drive commissioning tool is started indirectly from a SINAMICS STEP 7 project (double–click on the drive object in the detailed view of the SIMATIC Manager), the automatic recording of the component topology and the configuration can be started immediately. Continue with: Section 9.2.2, Page 9-247.



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9.2.1 Creating a new project

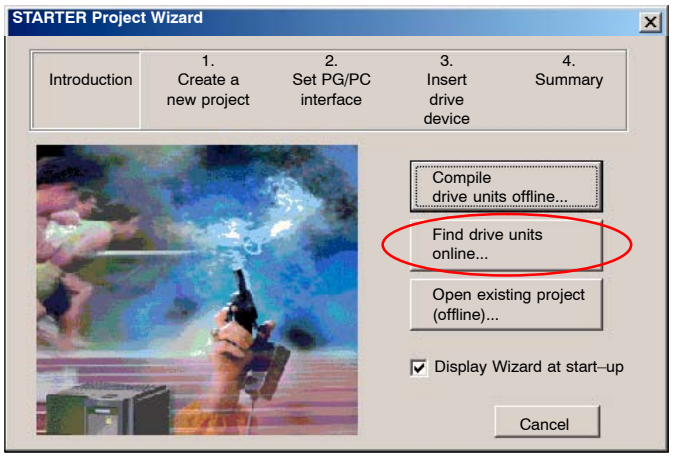
Execution

Perform the following actions to create a new project:

1. Start the STARTER drive commissioning tool using the icon on the user interface or the Windows taskbar: **Start > SIMATIC > STEP 7 > STARTER**).

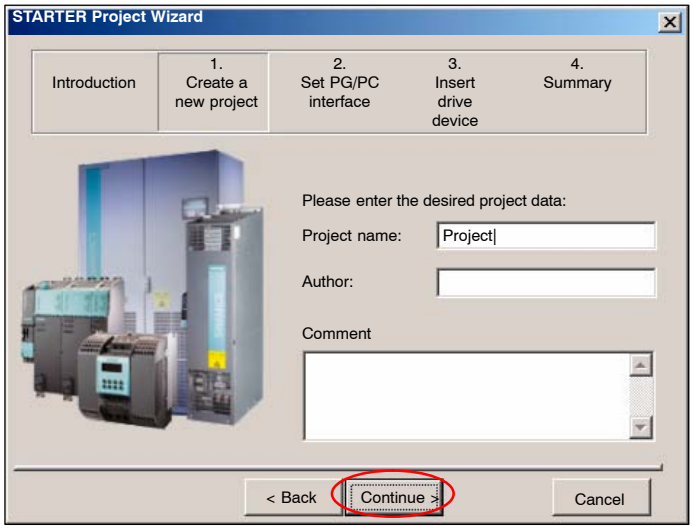
   If the Project Wizard for creating a new project is not opened automatically when initiating the STARTER, open it using menu command: **Project > New with Wizard**

   Then click button: ”Find drive units online”.



2. Enter the desired project data. You can enter any of the data.

   Then click button: ”Next>”

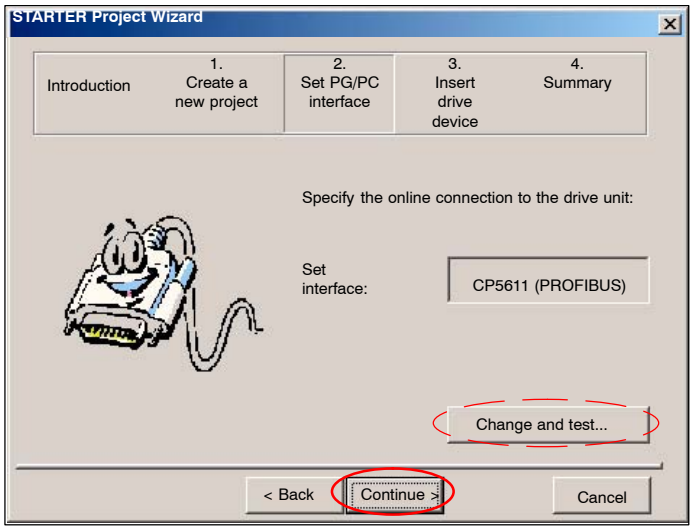


3. Set the PG/PC interface if required and test whether all SINAMICS drive units connected to the PROFIBUS which are to be commissioned as part of this project are accessible via the PG/PC interface. To proceed to the next dialog box click the button: ”Change and test...”.

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Note
The stations accessible via the PG/PC interface are displayed in the SIMATIC NET diagnostic screen.

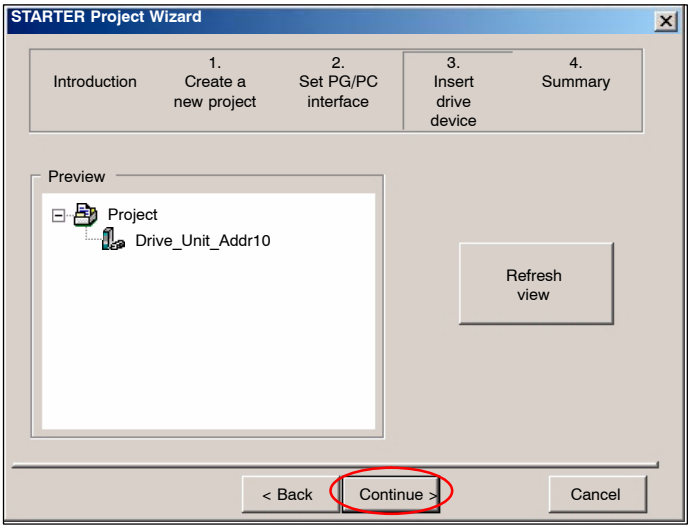
Then click button: ”Next>”



4. Add the accessible SINAMICS drive units to the project.

   The drive units found are displayed in the preview window. In the example, a drive unit: ”Drive_Unit_Addr10” has been located.

   Then click button: ”Next>”



Note

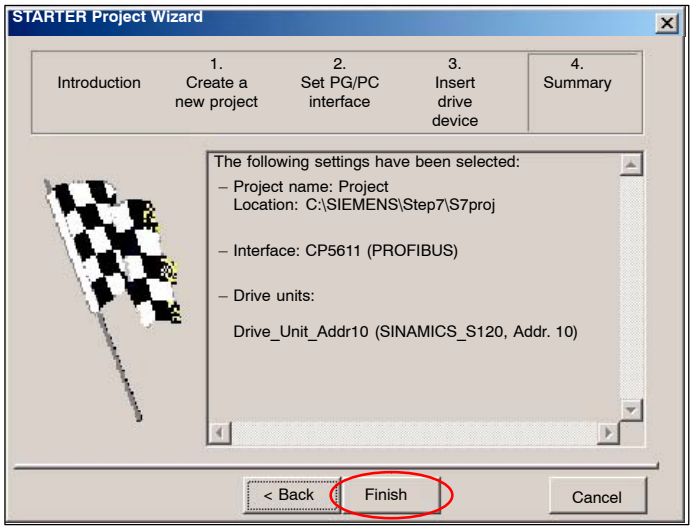
Only Control Units are located when searching for SINAMICS drive units. All of the other available components of a drive unit (infeed, motor module, etc.) are not taken into account at this stage.

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5. You have now created the project. The Project Wizard then displays a summary of project data.

   Located drive units are displayed in the preview. In the example, a drive unit: ”Drive_Unit_Addr10” has been located.

   Then click button: ”Finish”.

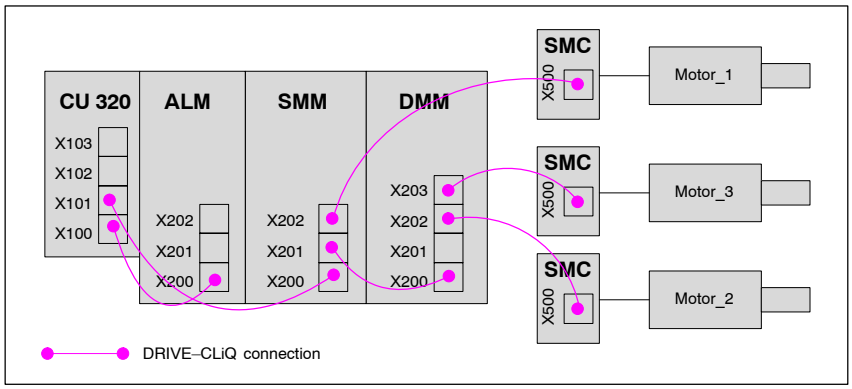


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9.2.2 Drive unit: Acquiring the component topology and configuring automatically

The following example format illustrates the configuration of a drive unit:

- Control Unit: CU 320
- Infeed: Active Line Module (ALM)
- Power module 1: Single Motor Module (SMM)
- Power module 2: Double Motor Module (DMM)
- Sensor module 1 – 3: Sensor Module Cabinet (SMC)
- Motor 1 – 3: Standard motor without DRIVE–CliQ connection



Note

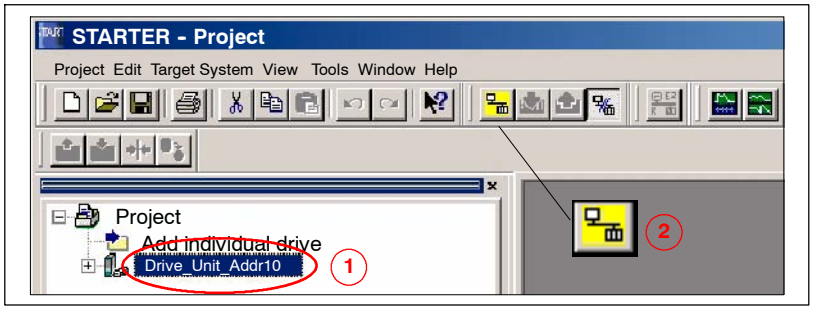
The following actions refer to recording of the component topology online and configuring a drive unit. If there are several drive units in a project, you must perform the actions for each additional drive unit.

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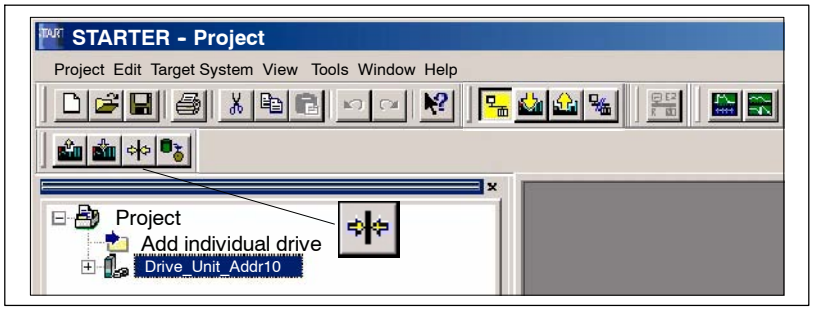
Execution

Perform the following actions:

1. To create the online connection, select the corresponding drive unit in the project navigator (1) and click the ”Connect to target system” button (2).



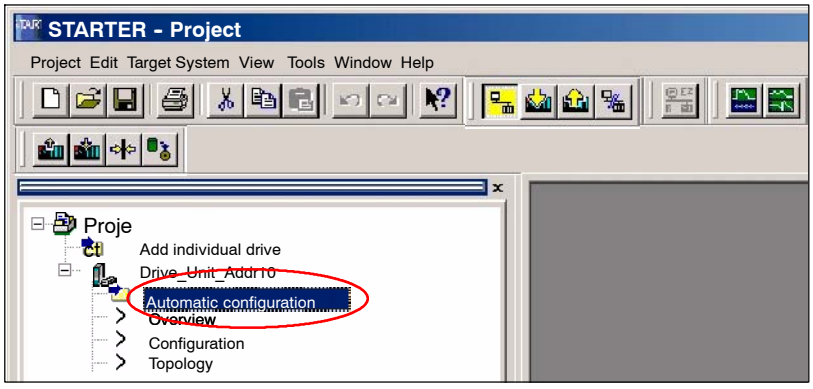
2. After the online connection to the drive unit has been established, click button: ”Restore factory settings”.



Confirm the following dialog with OK to restore the factory settings.

3. Double-click ”Automatic configuration” in the project navigator.

The navigator then searches for all components connected to the drive unit and loads these into the STARTER.



- In the following dialog box: ”Automatic configuration” click the button: ”Start automatic configuration”.
- In the following dialog box: ”Drive object type” select the type: ”Servo” and click the button: ”Finish”.

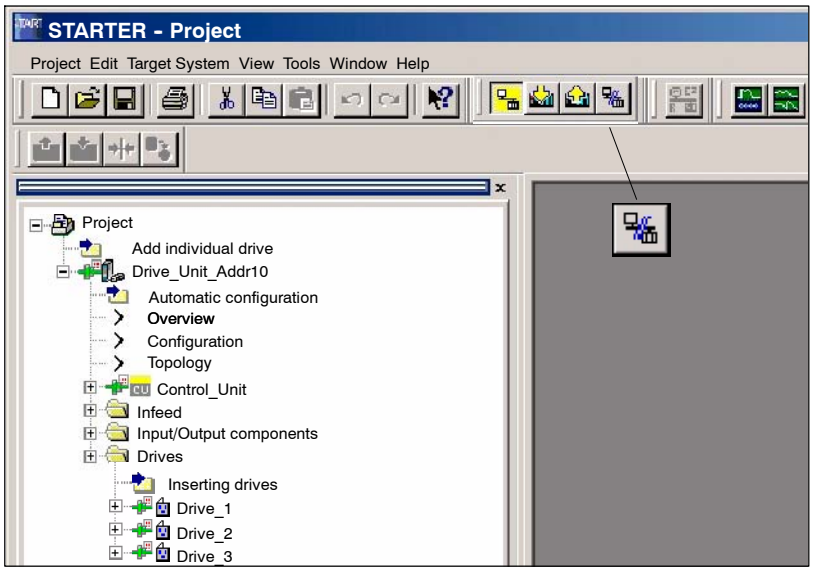
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- The following note lists the drives that require offline motor configuration because the corresponding data cannot be determined online. Confirm with OK.

  Note
  Motors with DRIVE CliQ interfaces do not require subsequent offline configuration as the appropriate parameters can be determined online by the STARTER.

- Finally in the dialog box ”Automatic configuration” click the button: ”Close”.

4. Go offline before configuring the motors and encoder (see next section).
   To do this click the button: ”Disconnect from target system”.



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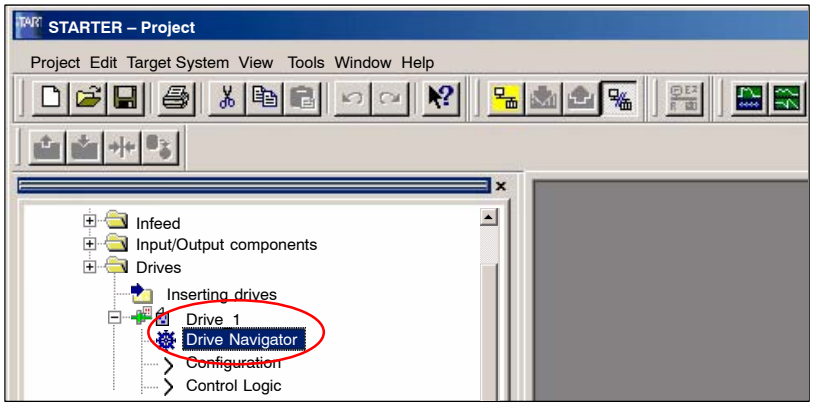
9.2.3 Drive: Configuring the motors and encoders

Since no motors/encoders are used in the project with DRIVE CliQ interface, they must be configured manually because the data cannot be determined automatically without DRIVE CliQ.

Execution

Perform the following actions for **all drives** of the drive units (Drive_1..._3):

1. In the project navigator select Project > <Drive_Unit_Addr10> >Drives > <*Drive*> and double–click Drive Navigator.



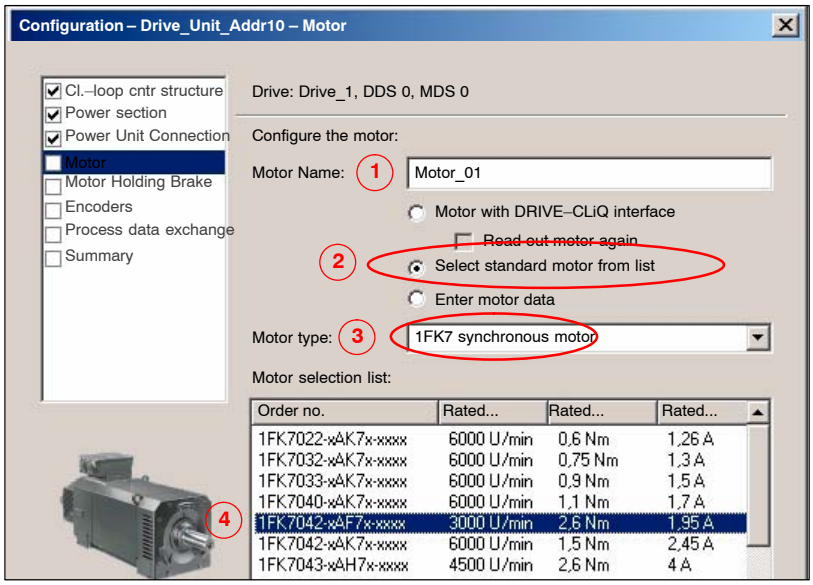
Then in the Drive Navigator dialog box, click the ”Device configuration” button and in the Device Configuration dialog box the ”Configure the drive” button.

Run through the following dialogs for configuring the drive unit using the ”Next >” button without making any changes until you reach the motor dialog.

2. Enter a unique name for the motor in the ”Motor name” field in the motor configuration dialog box (1).

   Select the configuration type:

   – Select standard motor from list (2)
   – Direct entry of motor data



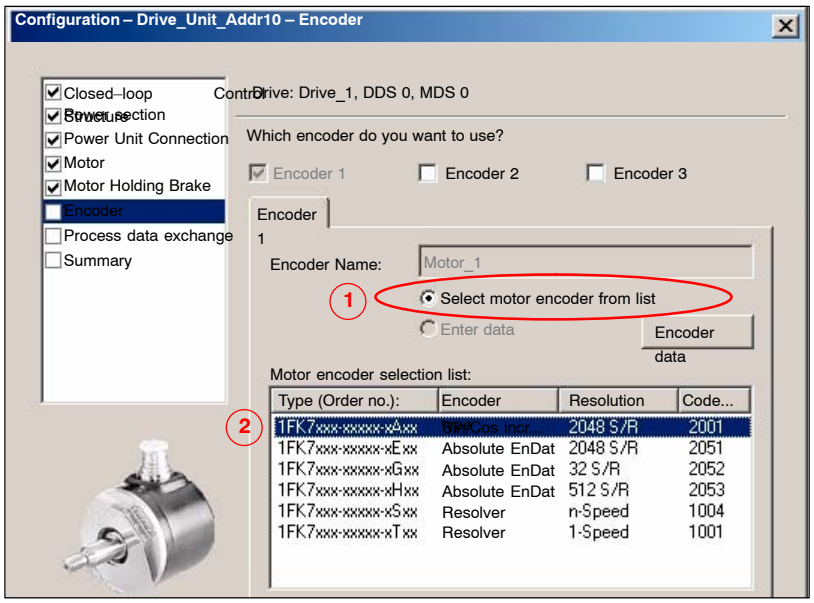
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Select the motor type, e.g. 1FK7 synchronous motor (3), from the drop–down list and the current motor from the corresponding list based on the order number (MLFB) (4).

Skip through the following dialogs using the "Next >" button without making any changes until you reach the encoder dialog.

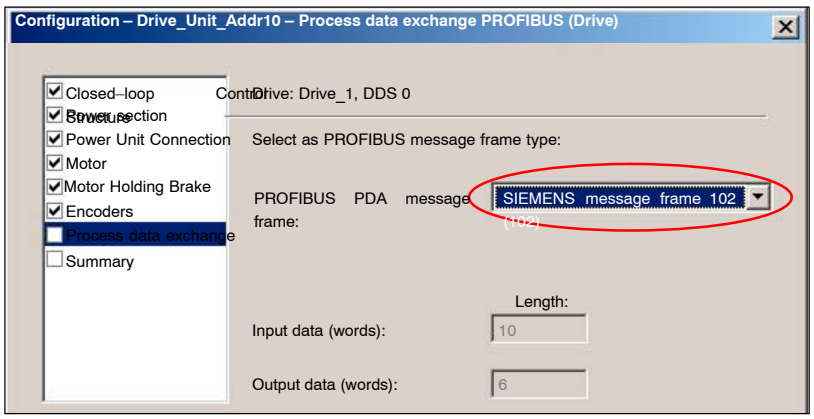
3. Encoder 1 is activated by default and must be configured. Encoders 2 and 3 are optional. Select the configuration type:
   – Select motor encoder from list (1)
   – Enter data

   Select the current encoder from the list based on the order number (MLFB) (2).



Exit the dialog box by clicking the "Next >" button.

4. In the configuration dialog for process data exchange, select the message frame according to the PROFIBUS configuration of the drive unit as DP slave S120 with STEP 7 HW Config from Section 8.9, Page 8-223et sqq.



Exit the dialog box by clicking the "Next >" button.

5. Check the data entered for the drive in the following "Summary" dialog. Close the dialog by clicking the "Finish" button.

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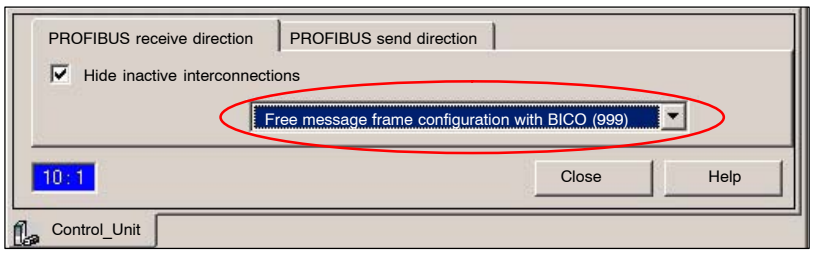
9.2.4 Control Unit: Selecting the PROFIBUS message frame

Control Unit error acknowledgement is currently performed via the BICO interconnection. As a result, you must configure free message frame configuration with BICO as the PROFIBUS message frame.

Execution

Perform the following actions:

1. In the project navigator, select Project > Drive_Unit_Addr10> Control_Unit > Communication and double–click PROFIBUS
2. Select from the list: "Message frame selection": "Free message frame configuration with BICO (999)"



9.2.5 Infeed: Selecting the PROFIBUS message frame

Error acknowledgement and infeed release is currently performed via the BICO interconnection. As a result, you must configure free message frame configuration with BICO as the PROFIBUS message frame.

Execution

Perform the following actions:

1. In the project navigator select Project > Drive_Unit_Addr10> Infeed > Communication and double–click PROFIBUS
2. Select from the list: "Message frame selection": "Free message frame configuration with BICO (999)"

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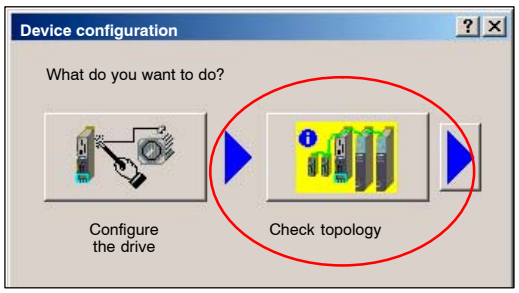
9.2.6 Drive unit: Checking the configuration

After configuring all of the drives, we recommend checking the DRIVE–CliQ interconnection recognized by the STARTER during automatic configuration with the drive unit interconnection.

Execution

Perform the following actions for each drive unit:

1. Open the topology tree via: Project navigator > Any drive > Drive navigator (double–click) > dialog box: ”Device Configuration” > button: ”Check topology”



2. Compare the DRIVE–CliQ topology displayed in the STARTER with the topology of the drive unit.

   The following rules must be observed with regard to the DRIVE–CliQ interconnection of the components:

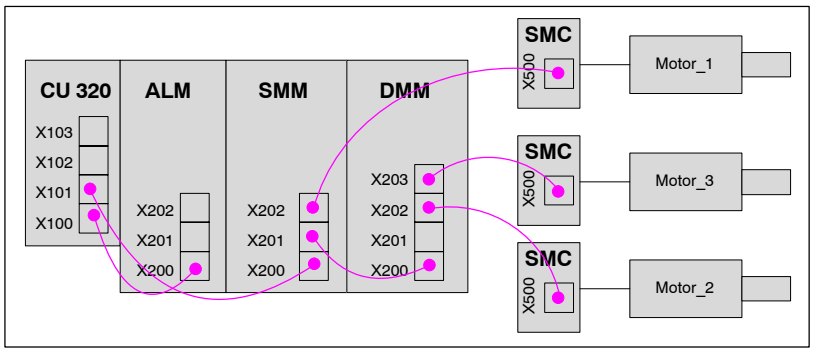
   – The DRIVE–CliQ cable from the Control Unit to the first power module must be connected to interface X200.

   – The DRIVE–CLiQ connections between each of the power modules should be connected from interface X201 to X200 on the next component.

   – The motor encoder must be connected to the associated Motor Module:

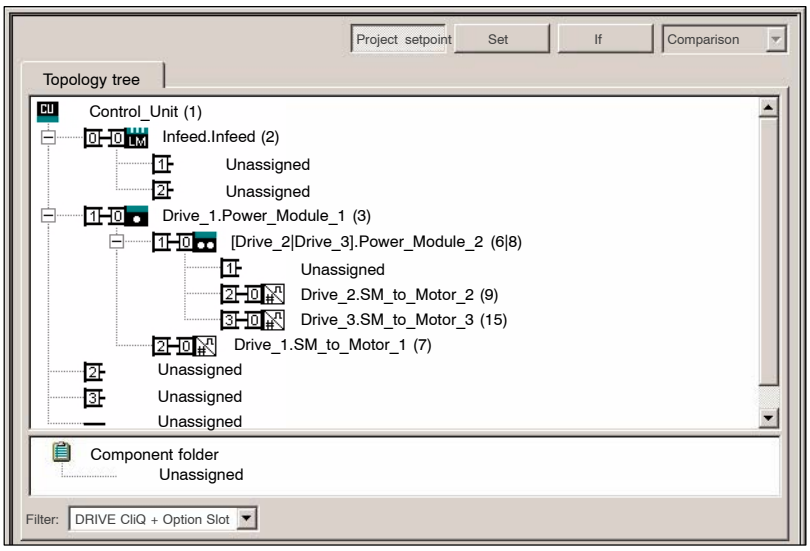
Component	Motor encoder connection
Single Motor Module (booksize)	X202
Double Motor Module (booksize)	Motor connection X1: encoder to X202 Motor connection X2: encoder to X203

   DRIVE–CliQ interconnection of the example structure:



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The corresponding DRIVE–CliQ topology in the STARTER must appear as follows:



Note

Differences must be corrected manually. Click the appropriate component then, keeping the left–hand mouse button depressed, drag it to the correct connection. If the connection is already assigned, you can use a free connection in the topology or the component folder as a buffer.

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9.2.7 Drive unit: Configuring the PROFIBUS message frame

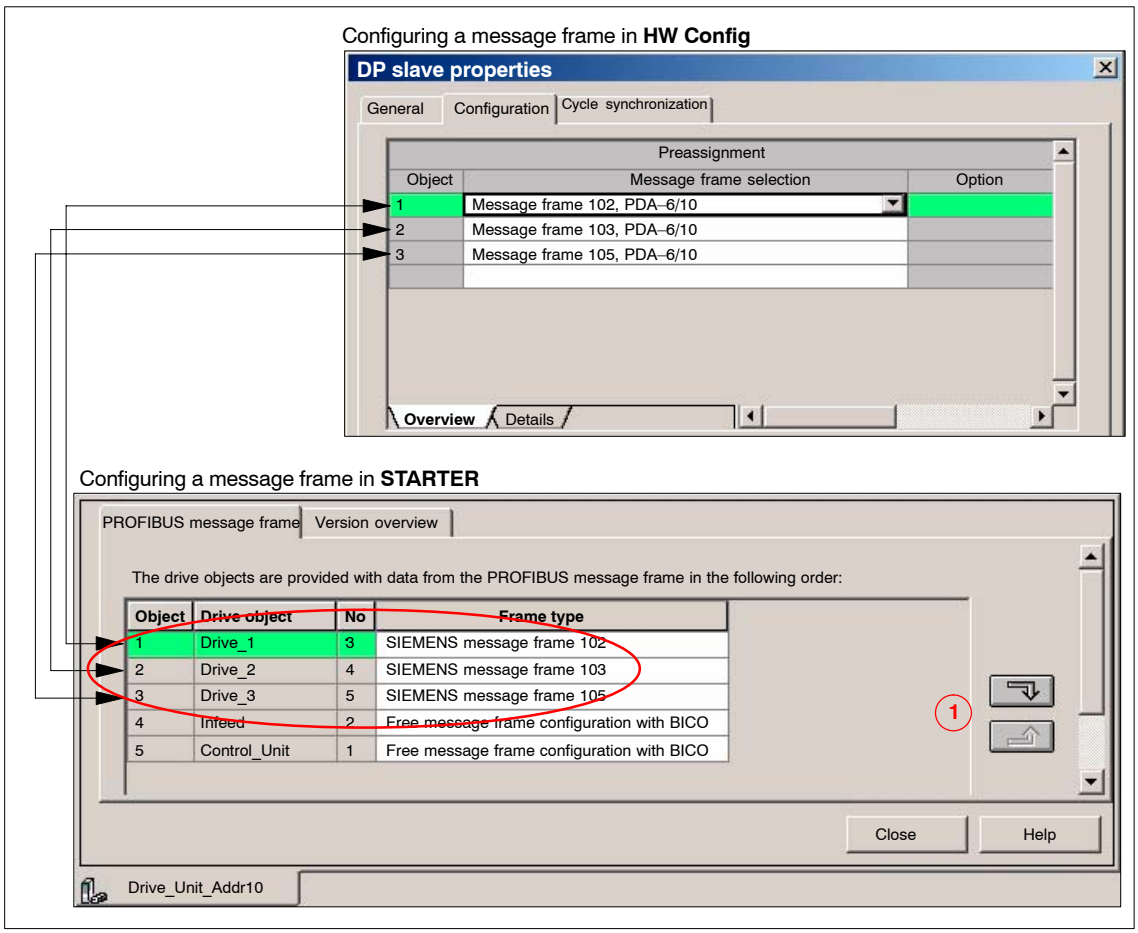
When configuring the PROFIBUS message frame of a drive unit, the following must be considered:

- The process data of the drive objects: ”Drives” must be available before the process data of all other drive objects (Control Unit, infeed, etc.).
- The structure of the process data for the PROFIBUS message frame configured in the STARTER (object sequence and message frame type) must be identical to the structure configured in HW Config (see Section 8.9, Page 8-223).

Execution

Perform the following actions for each drive unit:

1. Double–click Project > Drive_Unit_Addr10 > **Configuration** to open PROFIBUS message frame configuration in the project navigator..
2. Move the drive objects using the buttons (1) according to the guidelines specified above.



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9.2.8 Control Unit: Error acknowledgement (BICO interconnection)

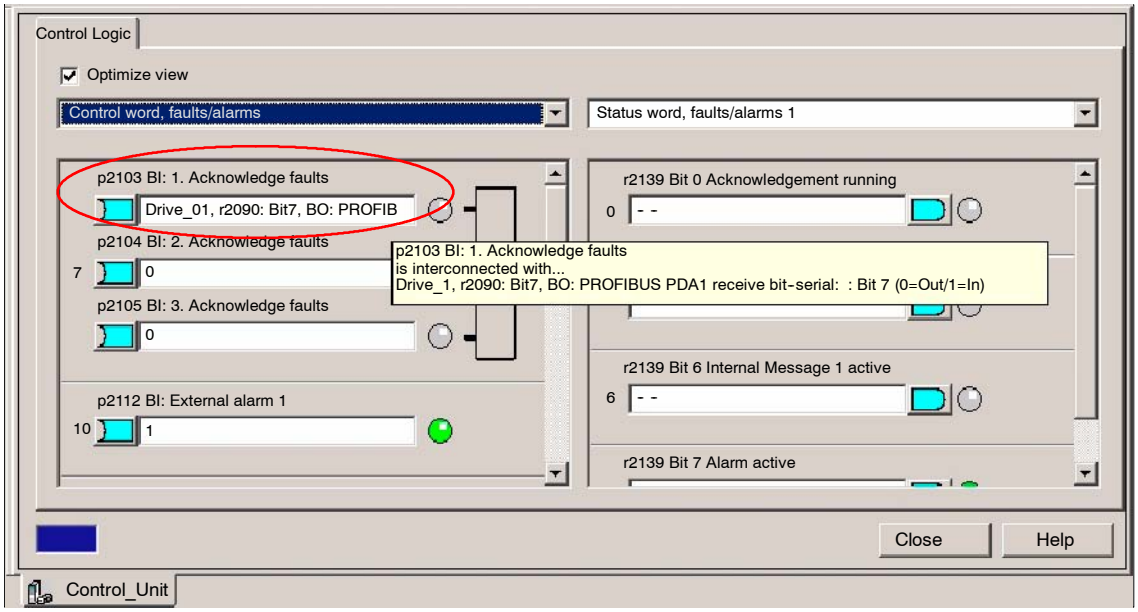
To acknowledge an error for the Control Unit, use the ”PROFIBUS PDA1 received” signal from the first drive.

- Control Unit: p2103 BI: 1. Acknowledge faults
- Drive: Drive_1, r2090: Bit7, BO: PROFIBUS PZD1 receive bit-serial

Execution

Perform the following actions:

1. Double-click Project > Drive_Unit_Addr10 > Control Unit > **Control Logic** to open control logic configuration in the project navigator..
2. Click the binector input symbol of signal ”p2103 BI: 1. Acknowledge faults” and from the list select Drive_1 > Further interconnections > r2090: Bit7, BO: PROFIBUS PZD1 receive bit-serial



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9.2.9 Control Unit: Infeed operation (BICO interconnection)

To output the ”Infeed operation” signal at terminal X132.7 of the Control Unit, parameter: ”r863 Bit 0” of the infeed must be connected to parameter: ”p742” of the Control Unit via BICO interconnection:

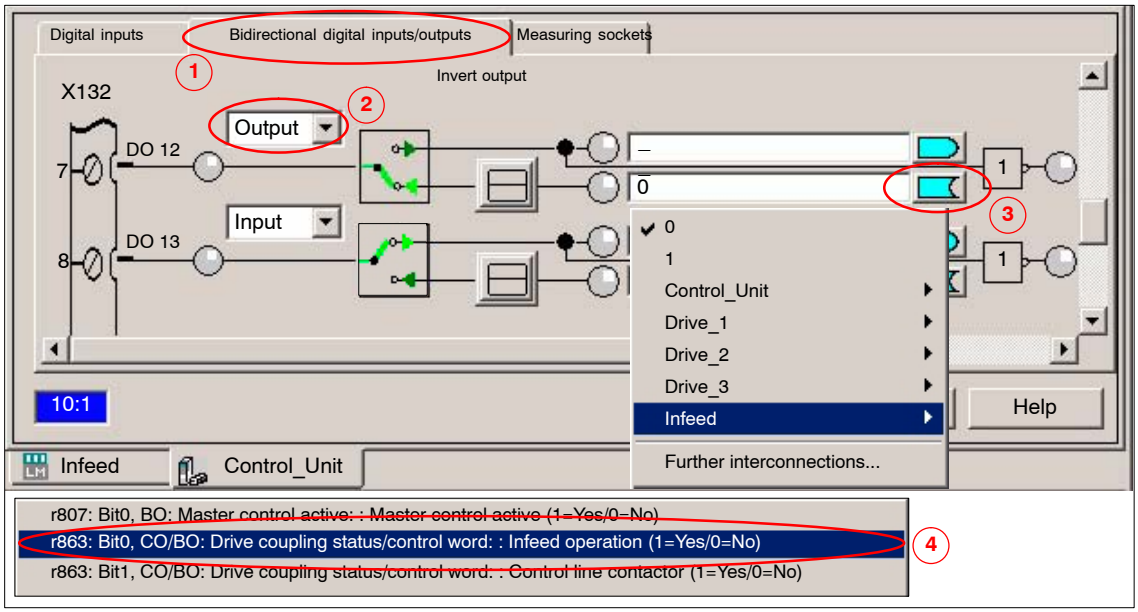
- Infeed: r863 Bit 0: Infeed operation
- Control Unit: p742, BI: CU signal source for terminal DI/DO 12

and terminal X132.7 of the Control Unit must then be parameterized as output DO12.

Execution

Perform the following actions:

1. Double–click Project > Drive_Unit_Addr10 > Control Unit > **Inputs/Outputs** to open the terminal configuration in the project navigator.
2. In the ”Bidirectional digital inputs/outputs” tab (1), change the status for terminal X132.7 to ”Output” (2)
3. Click the binector input symbol of terminal X132.7, DO12 (3) and select the signal: Infeed > ”r863: Bit0, ... Infeed operation” (4).



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9.2.10 Control Unit: Infeed ready to start (BICO interconnection)

To output the ”Infeed ready to start” signal at terminal X132.8 of the Control Unit, parameter: ”r899, Bit 0” of the infeed must be connected to parameter: ”p743” of the Control Unit via BICO interconnection:

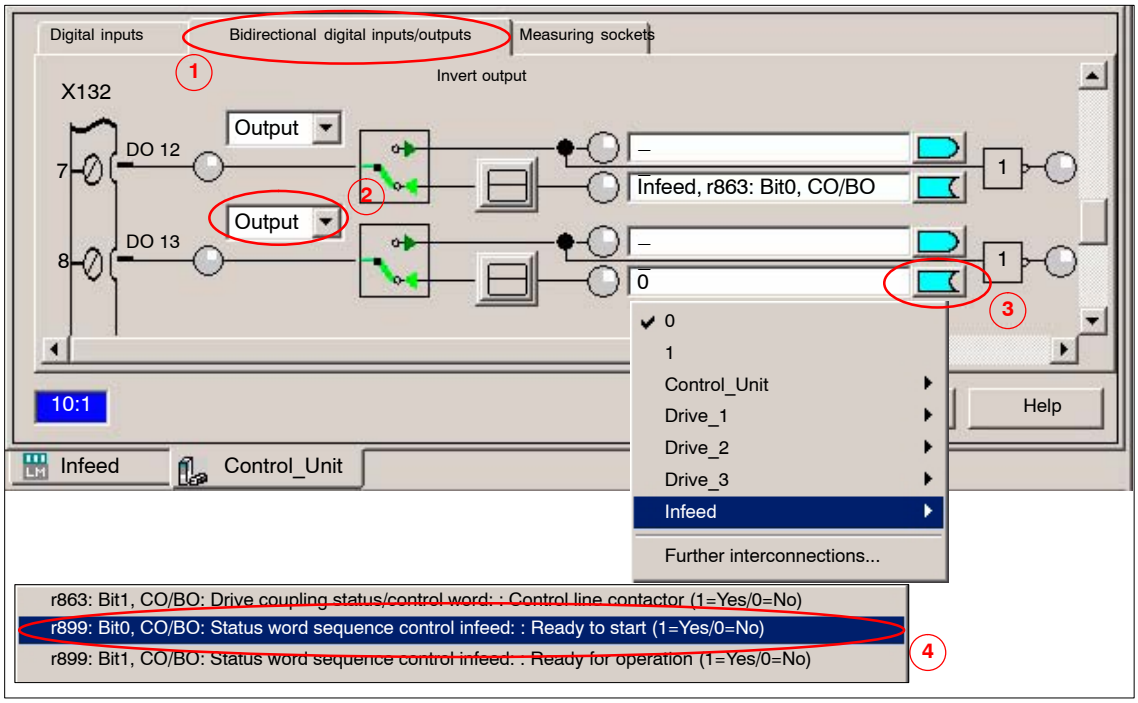
- Infeed: r899 Bit 0: Ready to start
- Control Unit: p743, BI: CU signal source for terminal DI/DO 13

and terminal X132.8 of the Control Unit must then be parameterized as output DO13.

Execution

Perform the following actions:

1. Double–click Project > Drive_Unit_Addr10 > Control Unit > **Inputs/Outputs** to open the terminal configuration in the project navigator.
2. In the ”Bidirectional digital inputs/outputs” tab (1), change the status for terminal X132.8 to ”Output” (2)
3. Click the binector input symbol of terminal X132.8, DO13 (3) and select the signal: Infeed > ”r899: Bit0, ... Infeed ready to start” (4).



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9.2.11 Infeed: Error acknowledgement(BICO interconnection)

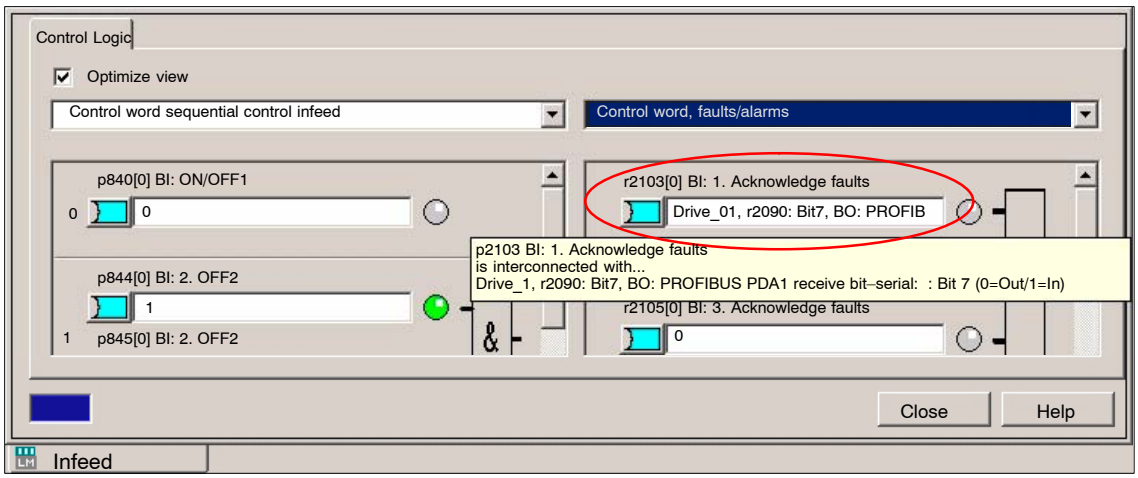
To acknowledge an error for the infeed, use the ”PROFIBUS PDA1 received” signal from the first drive.

- Infeed: p2103[0] BI: 1. Acknowledge faults
- Drive: Drive_1, r2090: Bit7, BO: PROFIBUS PZD1 receive bit–serial

Execution

Perform the following actions:

1. Double–click Project > Drive_Unit_Addr10 > Infeeds > Infeed > **Control Logic** to open control logic configuration in the project navigator.
2. Click the binector input symbol of signal ”p2103[0] BI: 1. Acknowledge faults” and from the list select Drive_1 > Further interconnections > r2090: Bit7, BO: PROFIBUS PZD1 receive bit–serial



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9.2.12 Infeed: Enable (BICO interconnection)

To be able to release and stop the drives externally, e.g. via a PLC user program, connect digital input X122.1 on the Control Unit and use the BICO interconnection with parameter "p840[0] BI: ON/OFF1" to connect:

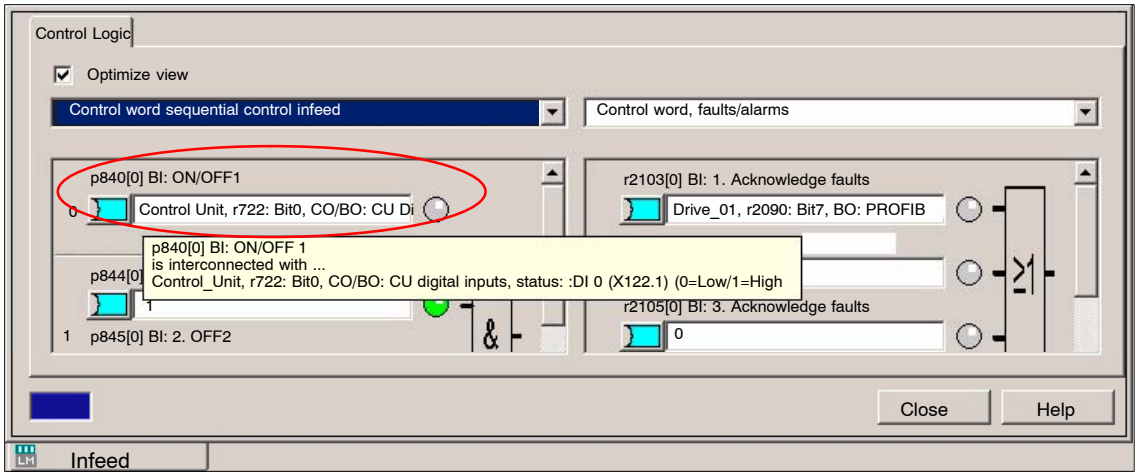
- Infeed: p840[0] BI: ON/OFF1
- Control Unit: Control_Unit, r722: Bit0, CO/BO: CU digital inputs, status: :DI 0 (X122.1) (0=Low/1=High)

Note
With reference to SIMODRIVE drives, this corresponds to the effect of digital input X122.1 on terminal 63 (pulse enable).

Execution

Perform the following actions:

1. Double–click Project > Drive_Unit_Addr10 > Infeeds > Infeed > **Control Logic** to open control logic configuration in the project navigator.
2. Click the binector input symbol of signal "p840[0] BI: ON/OFF1" and from the list select Control_Unit > Further interconnections > r722: Bit0, CO/BO: CU digital inputs, status: :DI 0 (X122.1)



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9.2.13 Drive: Enable OFF3 (BICO interconnection)

To be able to release and stop the drive externally, e.g. via a PLC user program, connect digital input X122.2 on the Control Unit and use the BICO interconnection with parameter ”p849[0] BI: 2. OFF3” to connect:

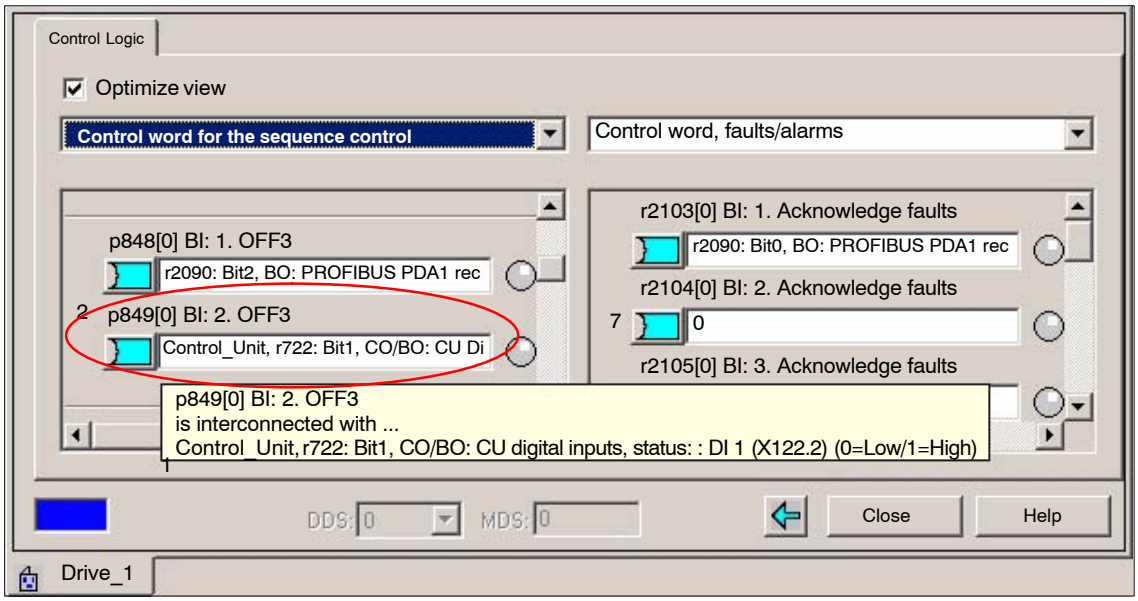
- Drive: p849[0] BI: 2. OFF3
- Control Unit: Control_Unit, r722: Bit1, CO/BO: CU digital inputs, status: : DI 1 (X122.2) (0=Low/1=High)

With reference to SIMODRIVE drives this corresponds to the effect of digital input X122.1 on terminal 663 (pulse enable) with prior deceleration of the drive. The OFF3 braking ramp can be configured drive–specifically via the parameters: p1135, p1136 and p1137.

Execution

Perform the following actions for each drive:

1. Double–click Project > Drive_Unit_Addr10 > Drives > <*Drive*> > **Control Logic** to open control logic configuration in the project navigator.
2. Click the binector input symbol of signal ”p845[0] BI: 2. OFF2” and from the list select Control_Unit > Further interconnections > r722: Bit1, CO/BO: CU digital inputs, status: : DI 1 (X122.2) (0=Low/1=High)



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9.2.14 Drive unit: Saving parameters

After completing the configuration, you must load and save the parameters in the drive unit.

Execution

Perform the following actions for each drive unit:

1. Access the drive unit with the PG/PC online.
2. Now load the project data into the drive unit: Right–click Drive_Unit_Addr10 > Target system > Load to target system... in the project navigator.
3. Save the project data in the drive unit on the CF card: Click Drive_Unit_Addr10 > Target system > Copy RAM to ROM... in the project navigator.

9.2.15 Drive: Running the motor

You can test the configuration loaded into the drive unit by running the motors of the drives using the operator control panel in the STARTER.

This can be done once the pulses have been enabled for the infeed and line/DC link identification has been activated. The infeed then switches to operational mode.

Note

For more information about the operator control panel: see **SINAMICS S120 Getting Started with the STARTER Commissioning Tool**.

For more information about line/DC–link identification, see **SINAMICS S120 Function Manual**.

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9.2.16 Settings of specific parameters

General

It is recommended that you use or check the corresponding settings for the parameters listed in the table.

Table 9-1 Recommended parameter values: General

	Parameter	Value	Description
Control Unit (CU320)			
	9906	2	Topology comparison level of all components, 2: low; comparison of the component type
Servo			
	922	102	PROFIBUS PDA Message frame selection, SIEMENS Message frame 102, PDA–6/10
	857	2000	Power module monitoring time [ms]
	1520	⩾ 0	Upper force limit/motor, **Attention** Negative values when setting the upper torque limit can lead to motor ”runaway”.
	1521	< 0	Lower force limit/generator, **Attention** Positive values when setting the lower torque limit can lead to motor ”runaway”.
	1780	0	Motor model adaptation configuration
	2038	1	PROFIBUS STW/ZSW Interface Mode Note For p0922 = 100 ... 199, p2038 is automatically set to 1 and p2038 can no longer be changed.
Infeed (ALM)			
	922	999	PROFIBUS PDA Message frame selection, Free message frame configuration with BICO

Technology: Grinding

For all drives used as spindles on which grinding wheels are used, OFF2 ”Internal/external pulse disable” (coast down) is recommended as fault reaction when fault 7841 ”” occurs.

Note

Fault reaction OFF3 ”Brakes on the OFF3 return ramp and subsequent pulse disable” (brakes on the current limit) can lead to the destruction of the grinding wheel.

Table 9-2 Recommended parameter values: Grinding technology

	Parameter	Value	Description
Servo			
	2100	7841	Setting the fault number for fault response
	2101	2	OFF2: Internal/external pulse disable

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9.3 Example for systems with more than 6 drives

9.3.1 Installation and basic commissioning

One control unit ”CU 320” can control max. 6 drives in ”Servo” mode. The following example shows which drive components are required and how they are interconnected to operate more than 6 drives in one configuration.

Requirement

- Control of 9 drives in ”Servo” mode.

Components used

- 1. Control Unit: CU 320 (Control_Unit_1)
- 2. Control Unit: CU 320 (Control_Unit_2)
- Infeed: Active Line Module (ALM)
- Power module 1: Single Motor Module (SMM), (Drive_1)
- Power module 2: Double Motor Module (DMM), (Drive_2 and Drive_3)
- Power module 3: Double Motor Module (DMM), (Drive_4 and Drive_5)
- Power module 4: Double Motor Module (DMM), (Drive_6 and Drive_7)
- Power module 5: Double Motor Module (DMM), (Drive_8 and Drive_9)
- Sensor module 1 – 9: Sensor Module Cabinets (SMC) (not shown)
- Motor 1 – 9: Standard motor without DRIVE–CliQ connection (not shown)

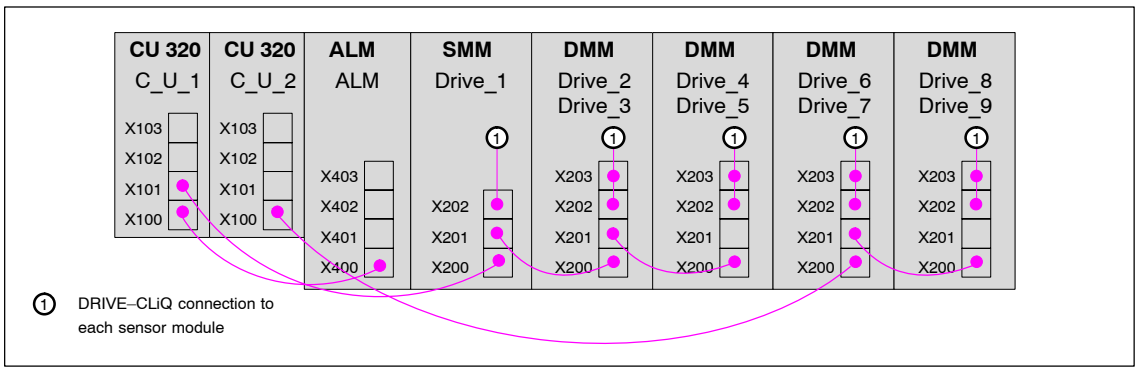


Fig. 9-1 Example configuration for 9 drives

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Creating a project

The project should be created according to the description from Section 9.2, Page 9-243. Both drive units must be displayed in the preview window.

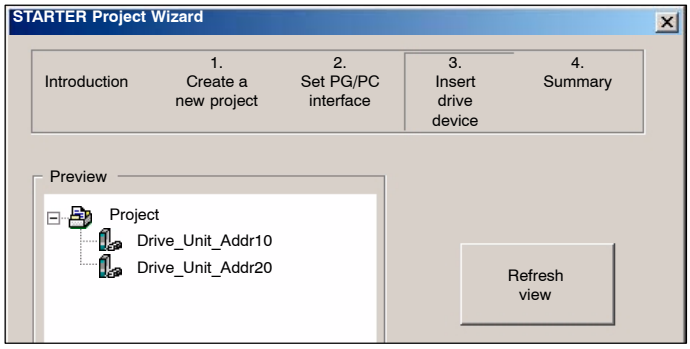


Fig. 9-2 STARTER: Project Wizard (excerpt)

Component topology

The automatic acquisition of the component topology and configuration is performed for each drive unit according to Section 9.2.2, Page 9-247.

Commissioning

The commissioning of the drive components must be performed in accordance with the sections listed above: 9.2.3, Page 9-250 to Section 9.2.15, Page 9-262.

Infeed: Operation

Parameter ”p864, BI: Infeed operation” of all drives must be interconnected to the corresponding signal of the infeed ”r863: Bit0, Infeed operation”.

- Control_Unit_1
  Drives controlled by Control_Unit_1 (Drive_1..._5) are interconnected automatically.
- Control_Unit_2
  Drives controlled by Control_Unit_2 (Drive_6..._9) must be manually interconnected (see the following section).

9.3.2 Drives of Control Unit 2: Additional BICO interconnection

The infeed can be connected with a Control Unit via DRIVE CliQ. Since Control_Unit_1 is connected with the infeed, it is not possible to make a BICO interconnection from drive parameter ”p864, BI: Infeed operation” to the infeed signal ”r863: Bit0, Infeed operation” for the drives controlled by Control_Unit_2 (Drive_6..._9).

- Drive: p864, BI: Infeed operation
- Infeed: r863: Bit0, Infeed operation

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General procedure

In order to use the infeed signal for the drives controlled by Control_Unit_2, it must be transferred via an external interconnection from an output terminal of Control_Unit_ to an input terminal of Control_Unit_2.

Execution

The following input/output terminals of the control units are used as an example for the following description:

- Control_Unit_1: p738, BI: CU signal source for terminal DI/DO 8 (X122.7)
- Control_Unit_2: r722: Bit0. CO/BO: CU digital inputs, status: :DI 0 (X122.1)

Perform the following actions to interconnect the drive parameters with the infeed signal:

1. Use a BICO interconnection to connect infeed signal ”r863: Bit0, Infeed operation”:
   – Project > Drive_Unit_Addr10 > Infeeds > Infeed > Diagnostics > Interconnections > Tab: ”BO/CO” > Signal: ”r863: Bit0, Infeed operation”

   with the parameter for the output terminal (X122.7) of the Control_Unit_1:
   – p738, BI: CU signal source for terminal DI/DO 8

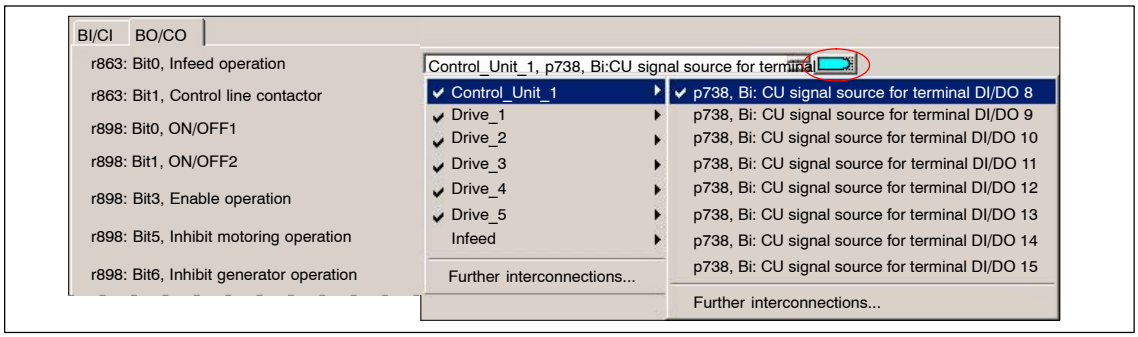


Fig. 9-3 STARTER: Work area (excerpt)

2. Configure the bidirectional digital input/output: ”DO 8” (X122.7) of Control_Unit_1 as output:
   – Project > Drive_Unit_Addr10 > Control_Unit_1 > Double–click: ”Inputs/outputs” > Tab: ”Bidirectional digital inputs/outputs” > DO 8 or X122.7 = output

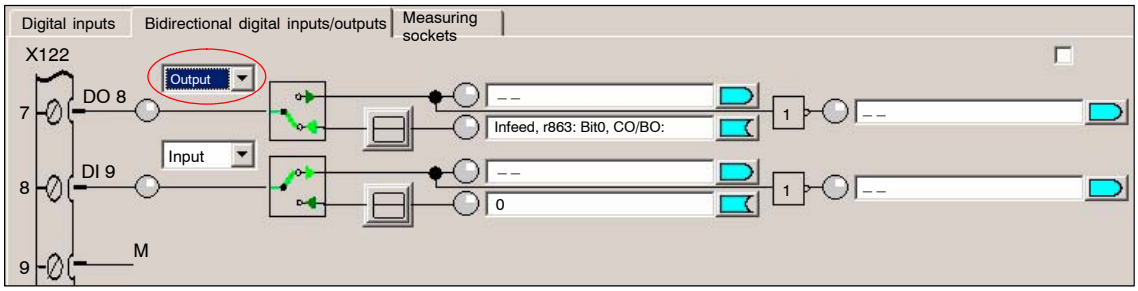


Fig. 9-4 STARTER: Work area (excerpt)

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3. Via a BICO interconnection, connect to Control_Unit_2 the parameter ”r722: Bit0. CO/BO: CU digital inputs, status: :DI 0” of the input terminal: ”DI 0” (X122.1):

   – Project > Drive_Unit_Addr10 > Control_Unit_1 > Double–click: ”Inputs/ outputs” > Tab: Digital inputs” > Digital input 0 (1)

   for **all drives** of Control_Unit_2 with the parameter:

   – p864, BI: Infeed operation (2)

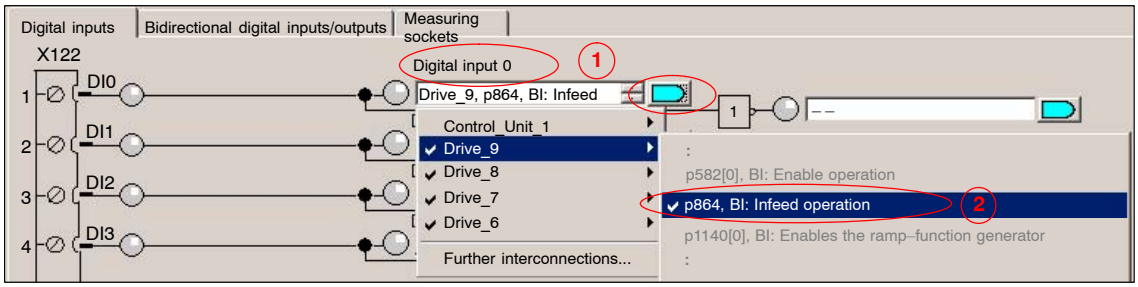


Fig. 9-5 STARTER: Work area (excerpt)

4. Connect the output terminal ”DO 8” (X122.7) of Control_Unit_1 to the input terminal ”DI 0” (X122.1) of Control_Unit_2 via an external interconnection.
5. The output terminal of Control_Unit_1 must be wired to an input terminal of Control_Unit_2.
6. Via BICO interconnection, the input terminal of Control_Unit_2 must be interconnected to the drive parameters ”p864, BI: Infeed operation” of all Control_Unit_2 drives.
7. There is no DRIVE CliQ connection between the infeed and Control_Unit_2.

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9.4 Further terminal assignments

Note

The further terminal assignments should only be considered as recommendations that can be adapted to the requirements of the actual automation system.

9.4.1 Proposal for terminal assignment: 1st CU (X122)

Table 9-3 Terminal assignment of 1st CU (X122)

Pin no.	Function	Assignment	BICO source/sink	
1	Input[1)]	ON/OFF1 infeed for: Line Module with DRIVE CLiQ connection See Subsection 9.2.12, Page 9-260.	CU: r 0722.0	Infeed p 0840
		"Infeed ready signal" for: Line Module without DRIVE CLiQ connection	SLM X21.1	Drive p 0864
2	Input	"OFF3 – rapid stop" See Subsection 9.2.13, Page 9-261.	CU: r 0722.1	Each drive 2nd OFF3, p 0849
3	Input	SH/SBC 1 – Group 1 SINAMICS Safety Integrated (SH enable = p9601)	CU: r 0722.2	p9620 (all drives in the group)
4	Input	SH/SBC 1 – Group 2 SINAMICS Safety Integrated (SH enable = p9601)	CU: r 0722.3	p9620 (all drives in the group)
5	Ground for pins 1...4			
6	Ground for pins 7, 8, 10, 11			
7	Output	SH/SBC 1 – Group 1 SINAMICS Safety Integrated	CU: p 0738	p 9774 Bit 1 BICO from CU after the first drive in the group
8	Output	SH/SBC 1 – Group 2 SINAMICS Safety Integrated	CU: p 739	p 9774 Bit 1 BICO from CU after the first drive in the group
9	Ground for pins 7, 8, 10, 11			
10	Input	Bero 1 – zero mark substitute	CU: r 0722.10	Drive p 0495 = 2
11	—	—	—	—
12	Ground for pins 7, 8, 10, 11			
1) Low – high edge required				

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9.4.2 Proposal for terminal assignment: 1st CU (X132)

Table 9-4 Terminal assignment of 1st CU (X132)

Pin no.	Function	Assignment	BICO source/sink	
1	—	—	—	—
2	—	—	—	—
3	—	—	—	—
4	Input	Line contactor, feedback signal	CU: r 0722.7	LM : p 0860
5	Ground for pins 1...4			
6	Ground for pins 7, 8, 10, 11			
7	Output	Infeed operation (LM with DRIVE CLiQ connection) See Subsection 9.2.9, Page 9-257.	LM : r 0863.0	p 0742
8	Output	Infeed ready to start (LM with DRIVE CLiQ connection) See Subsection 9.2.10, Page 9-258.	LM : r 0899.0	p 0743
9	Ground for pins 7, 8, 10, 11			
10	Output	Line contactor control	LM : r 0863.1	CU: p 0744
	Input	Bero 2 – zero mark substitute	CU: r 0722.14	Drive p 0495 = 5
		2nd OFF 2	CU: r 0722.14	Drive p 0845
11	—	—	—	—
12	Ground for pins 7, 8, 10, 11			

9.4.3 Proposal for terminal assignment: 2nd – nth CU (X122)

Table 9-5 Terminal assignment of 2nd – nth CU (X122)

Pin no.	Function	Assignment	BICO source/sink	
1	Input	"Infeed ready signal"	2nd – nth CU: r 0722.0	Drive p 0864
2	Input	"OFF3 – rapid stop" Function: Braking with a configurable OFF3 ramp (p1135, p1136, p1137); thereafter, pulse suppression and starting lockout. The drive stops controlled. The braking response can be set separately for each servo. Behavior similar to terminal 64	2nd – nth CU: r 0722.1	Each drive 2. OFF3, p 0849
3	Input	SH/SBC 1 – Group 1 SINAMICS Safety Integrated (SH enable = p9601)	2nd – nth CU: r 0722.2	p9620 (all drives in the group)
4	Input	SH/SBC 1 – Group 2 SINAMICS Safety Integrated (SH enable = p9601)	2nd – nth CU: r 0722.3	p9620 (all drives in the group)
5	Ground for pins 1...4			
6	Ground for pins 7, 8, 10, 11			
7	Output	SH/SBC 1 – Group 1 SINAMICS Safety Integrated	2nd – nth CU: p 0738	p 9774.1 BICO from CU after the first drive in the group

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Table 9-5 Terminal assignment of 2nd – nth CU (X122)

Pin no.	Function	Assignment	BICO source/sink	
8	Output	SH/SBC 1 – Group 2 SINAMICS Safety Integrated	2nd – nth CU: p 739	p 9774.1 BICO from CU after the first drive in the group
9	Ground for pins 7, 8, 10, 11			
10	Input	Bero 1 – zero mark substitute	CU: r 0722.10	Drive p 0495 = 2
11	Input	Bero 2 – zero mark substitute	CU: r 0722.11	Drive p 0495 = 3
		2nd OFF 2	CU: r 0722.11	Drive p 0845
12	Ground for pins 7, 8, 10, 11			

9.4.4 Proposal for terminal assignment: 1st CU with 2nd – nth CU

Note

The interconnection proposal refers to the terminal assignment proposals made in the previous sections.

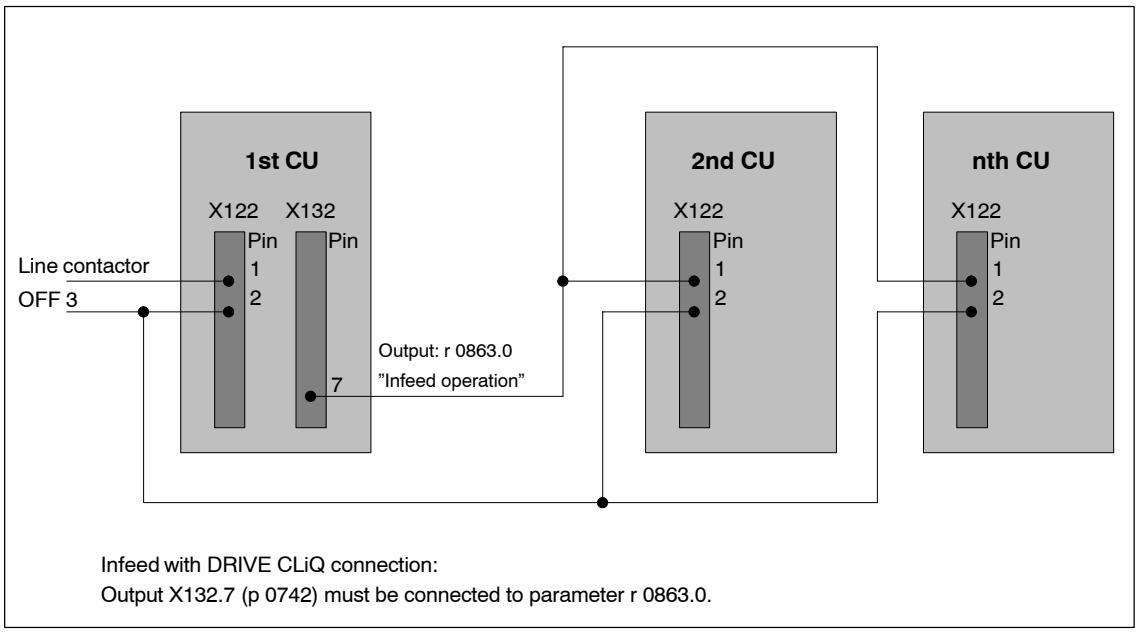


Fig. 9-6 Proposal for terminal assignment: 1st CU with 2nd – nth CU

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9.4.5 Example: CU interconnection with line contactor

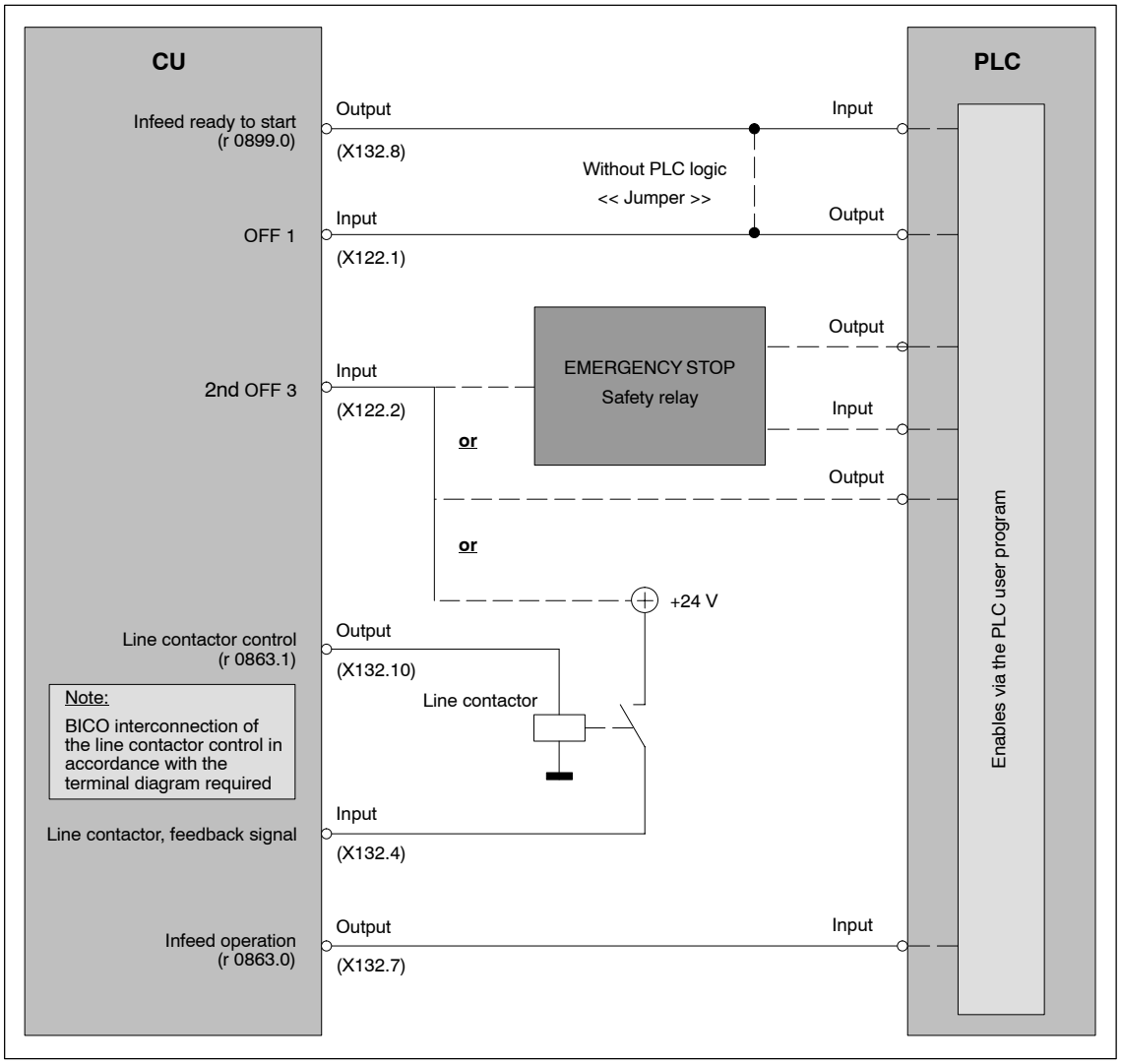


Fig. 9-7 Example: CU interconnection with line contactor

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9.5 Fundamentals

9.5.1 Drive unit: Firmware upgrade

The firmware of a drive unit is upgraded using the STARTER commissioning tool.

Requirements

This procedure requires a functional project and a CF card with the new firmware.

Execution

Perform the following actions to upgrade the firmware:

1. Create a network link between the PG/PC and the drive unit.
2. Access the drive unit with the PG/PC online and load the current project into the PG/PC from the drive unit.
3. Save the project with a new project name by selecting ”Save As...” and close the old project.
4. Click the drive unit in the project view to convert the project to the new version and select ”Target system” > ”Device version...” (1) from the menu.

   In dialog box: ”Device version”, select the version to which the project should be upgraded (2) and start the conversion process using the button: ”Change version” (3).

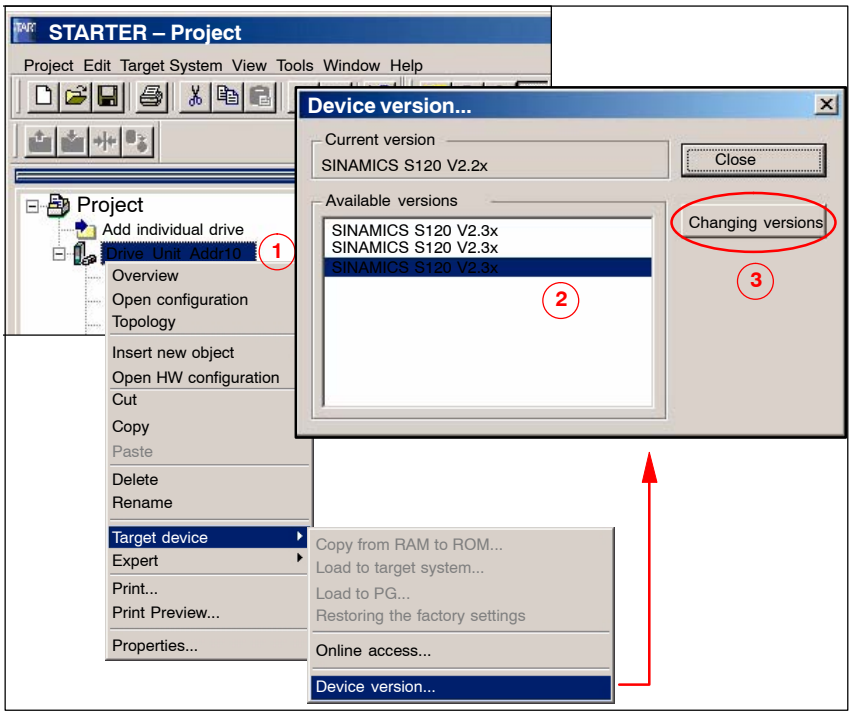


Fig. 9-8 Convert Project

5. Switch off the Control Unit and insert the CF card with the new firmware version. Then switch the Control Unit on again.

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6. Go online once again with the PG/PC and load the converted project into the drive by selecting ”Load to target system”.

   The first time the project is loaded into the drive it will perform internal calculations. To revert to the current view of the project, select ”Load to PG” immediately after ”Load to target system”.

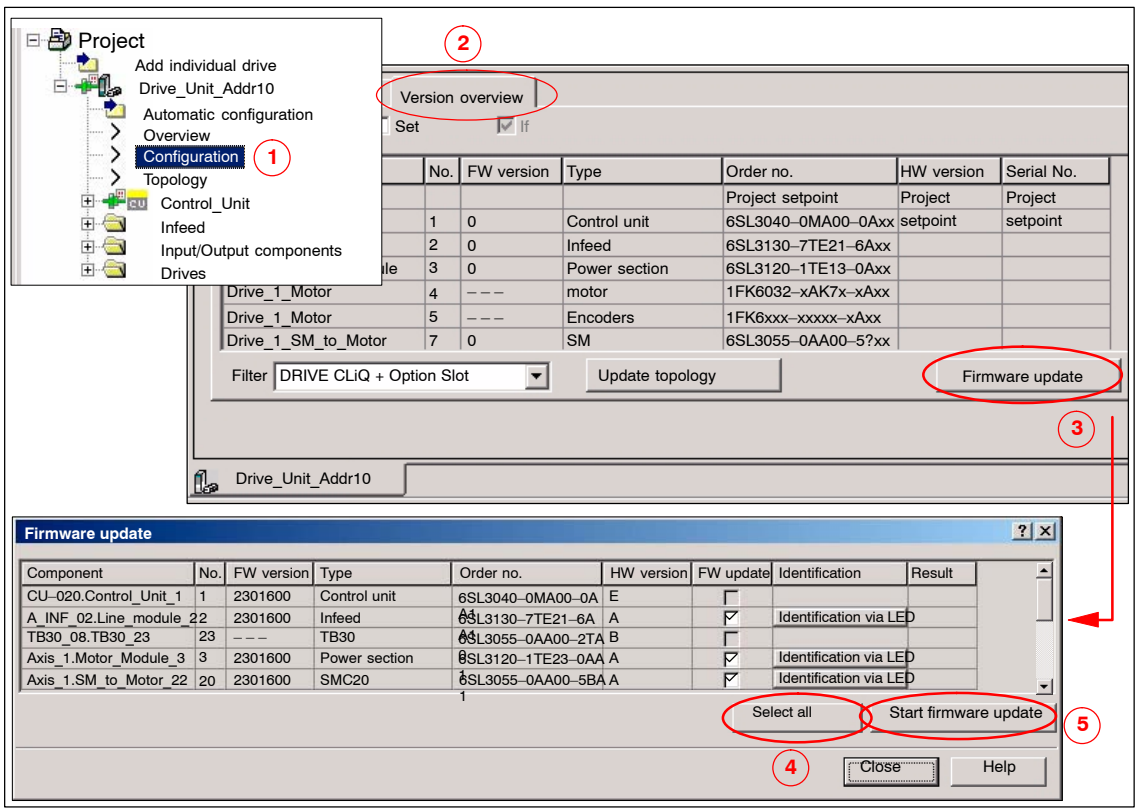
   The firmware and project on the **Control Unit** are now upgraded.

7. If the CF card contains later firmware versions for the components (infeed, Motor Module, etc.) you must now upgrade these as well. To do this, open the device unit in the project view and double–click ”Configuration” (1).

8. Select the ”Version overview” (2) tab from the configuration view and click ”Firmware update” (3).

   Click ”Select all” (4) to upgrade all components, followed by ”Start firmware update” (5).

   Note
   The drive recognizes whether the CF card contains a later firmware version and prevents an upgrade to an unsupported version.



9. Reload the project by selecting ”Load to PG”.

10. We recommend testing the drive unit after upgrading the firmware.

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Drive Commissioning (SIMODRIVE) 10

Section ”Drive commissioning (preconditions)” describes the **preconditions** of the SINUMERIK 840Di sl for optimum commissioning of the drives in terms of material and cost.

It is **not** the section’s objective to explain in detail how a drive is commissioned. For commissioning of the drive, please refer to the relevant drive documentation.

10.1 SIMODRIVE 611 universal/E, POSMO CD/CA and SI

10.1.1 Commissioning variants

The following distinction is made between commissioning of the above SIMODRIVE drives:

- First commissioning
- Standard commissioning

First commissioning

A first commissioning must only be carried out if no matching parameter record is available for the drive in the form of the parameter file.

Standard commissioning

A standard commissioning can be carried when a matching parameter record is available for the drive in the form of the parameter file.

The parameter file is then loaded to the drive using SimoCom U in online mode (for online mode, see: Section 10.1.2, Page 10-277).

Possible procedures

The possible ways of commissioning a drive are:

- Using a display and operator unit directly on the drive (611U/E only)
- Using SimoCom U:
  1. SimoCom U is installed on any PG/PC with a serial interface and is direct connected to the corresponding drive using a RS–232 cable.
  2. SimoCom U is installed on any PG/PC with a PROFIBUS DP interface and connected to all drives using a PROFIBUS cable:
     - PG 740 or PCU 50 with integrated PROFIBUS DP interface
     - Standard PC with CPU module, e.g. CP 5611

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3. SimoCom U is installed on the SINUMERIK 840Di sl and is routed from the PLC to the PROFIBUS. Via the PROFIBUS DP interface of the MCI board, SimoCom U is connected to all drives using a PROFIBUS cable.

Recommended procedure

Within the framework of SINUMERIK 840Di sl, the procedure described above (Point 3.) is recommended:

The advantages of this procedure are:

- SimoCom U is always available for:
  – commissioning
  – diagnosis
  – controller optimization
  – software upgrade of drive firmware
  – software upgrade of option module firmware
- No additional PG/PC required
- No additional cables required

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10.1.2 Preconditions for an online connection

To be able to establish an online connection between SimoCom U and the SIMODRIVE 611 universal drives connected to a SINUMERIK 840Di sl using PROFIBUS DP, the following preconditions must be fulfilled:

- **SimoCom U** must be installed.
  - For installing SimoCom U, see Section 10.2, Page 10-283
- A **PROFIBUS connection** must exist from the PROFIBUS interface of the MCI board to all drives.
  - For network rules, see Section 8.1.5, Page 8-178
- With all drives, the **PROFIBUS address** must be set.
  - For SIMODRIVE 611 universal/E see Section 10.1.3, Page 10-277
  - For SIMODRIVE POSMO CD/CA and SI, see Section 10.1.4, Page 10-279
- The **MPI** interface of the SINUMERIK 840Di sl **PLC** must be networked
  - For networking the MPI interface, see Section 6.3.7, Page 6-145
- The **configuration** must be loaded into the PLC.
  - For creating an S7 project, see Section 6.3, Page 6-139
  - For loading the PLC, see Section 8.3.3, Page 8-185
- The **MPI interface** must be set on the ”SINUMERIK MCI Card (MPI)”.
  - For setting the MPI interface, see Section 10.1.5 , Page 10-280
- The **routing information** must be set.
  - For setting the routing Information, see Section 10.1.6, Page 10-281

10.1.3 Setting a PROFIBUS address (SIMODRIVE 611 universal/E)

For SimoCom U to be able to enter online operation with the SIMODRIVE drives connected to the PROFIBUS, the PROFIBUS address specified in the S7 project (see Section 6.3, Page 6-139f) must be set on DP slave 611U or UE in question using the display and operator unit.

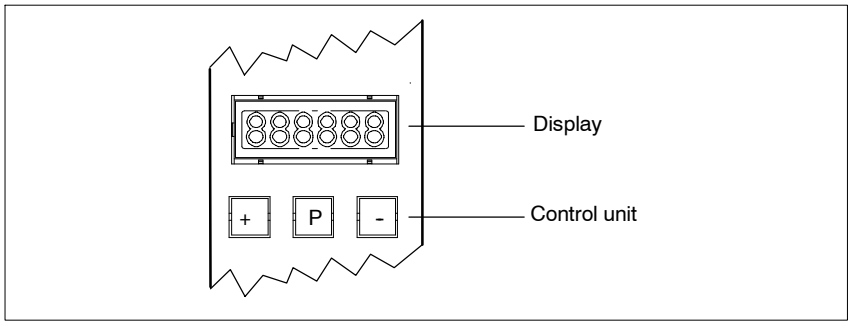


Fig. 10-1 Display and control unit

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Requirements

The precondition for setting the PROFIBUS address on the control unit is that no faults or warnings are displayed.

If faults or warnings are displayed (display: E_xxxx), press the "**–**" key to switch from the alarm mode to parameterization mode.

Sequence of operations

To set the PROFIBUS address, proceed as follows:

1. Setting the PROFIBUS address (parameter P0918)
   - Hold down key "**P**" longer than 3 seconds.

     => The current value of the parameter P0918 (PROFIBUS address) is displayed.
   - Use keys "**+**" and "**–**" to set the desired PROFIBUS address.
   - Press "**P**" again to quit the input mode.
2. Saving the PROFIBUS node address in the FEPROM
   - Press the "**+**" or "**–**" key

     => Parameter P0652 (acceptance into FEPROM) is displayed
   - Press "**P**" again to call the input mode.
   - Use the "**+**" key to change the value to 1 (start writing)
     and wait until the write process is acknowledged with 0 on the display.
3. Carrying out POWER ON Reset
   - Push the "**POWER ON–RESET**" button on the front panel of the drive module.

     => After power–up, the set PROFIBUS address is active.

References

For detailed information on commissioning of SIMODRIVE 611 universal drives, refer to:

/FBU/ SIMODRIVE 611 universal Description of Functions
Section: Parameterizing the Module
Parameterization via display and control unit

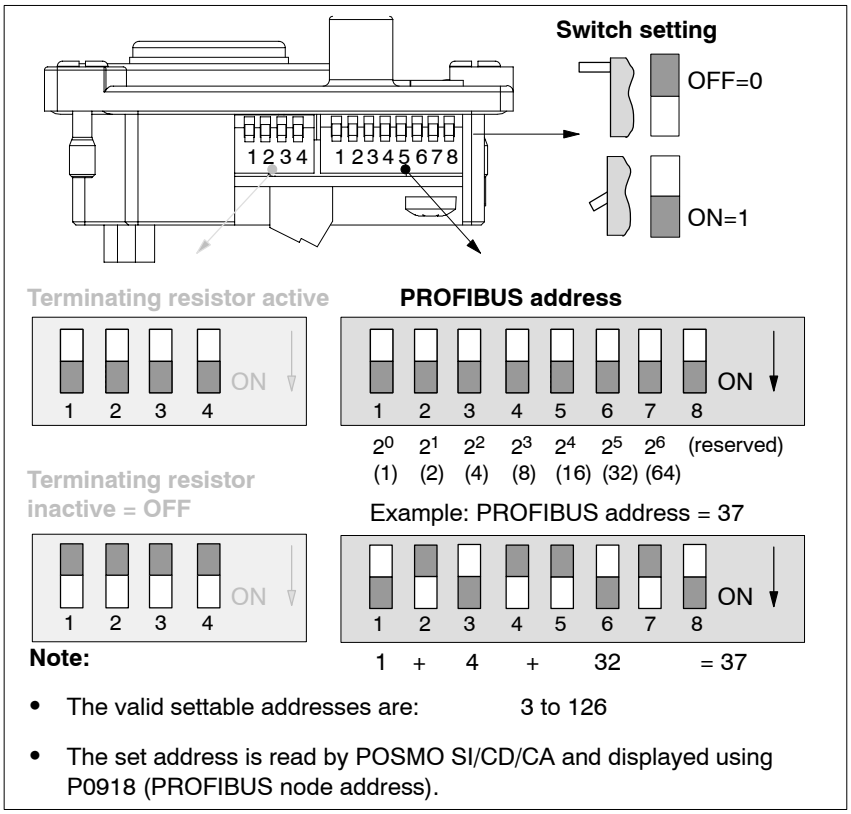
and

Section: PROFIBUS DP master settings
Commissioning

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10.1.4 Setting PROFIBUS address (SIMODRIVE POSMO SI/CD/CA)

For SimoCom U to be able to enter online operation with the SIMODRIVE drives connected to the PROFIBUS, the PROFIBUS address specified in the S7 project (see Section 6.3, Page 6-139f) must be set on DP slave POSMO SI/CD/CA in question using the DIL switches of the PROFIBUS unit in question.



Note:

- The valid settable addresses are: 3 to 126
- The set address is read by POSMO SI/CD/CA and displayed using P0918 (PROFIBUS node address).

Fig. 10-2 Setting the PROFIBUS address and terminating resistor

Notice

To set the PROFIBUS address and terminating resistor it is necessary to remove the PROFIBUS unit.

References

For detailed information on commissioning of SIMODRIVE POSMO CD/CA and SI universal drives, refer to:

/POS3/ SIMODRIVE POSMO SI/CD/CA User Manual
Section: Connecting the PROFIBUS unit

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10.1.5 Setting the MPI interface

The MPI interface through which SimoCom U accesses the drives connected to PROFIBUS by means of routing, must be parameterized as follows:

- Access point of application
  S7ONLINE STEP7 —> SINUMERIK MCI board (MPI)
- Interface parameterization
  SINUMERIK MCI board (MPI)

The MPI interface can be parameterized direct from SimoCom U. To do so, proceed as follows:

1. Start SimoCom U from the WINDOWS NT taskbar:
   Start > Programs > SimoComU > SimoComU
2. In SimoCom U, open the interface dialog using the menu command:
   Tools > Communication

SimoCom U dialog box: Start

Dialog box: Interface
Radio button: "**Route through S7–CPU**" ⦿
Button: "Set PG/PC interface..."

PG/PC interface dialog box: Start

Dialog box: Setting the PG/PC interface
Tab card: Access path
Access point of the application:
S7ONLINE STEP7 —> SOFTMC
Interface parameter assignment used:
SOFTMC

If "SINUMERIK MCI board (MPI)" cannot be selected for the interface parameterization, the interface has to be installed first.

PG/PC interface dialog box: End

Button: "Select..."

Dialog box: Install/remove interface
Selection: **SOFTMC**
Button: "Install—>"
Close

OK

Finally, the routing information must be set in the interface dialog of SimoCom U.

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10.1.6 Setting the routing information

Setting the routing information:

- MPI address of the PLC
- PROFIBUS subnet ID

The easiest method to do so is the expert mode after resetting the routing information.

Notice

To use the PLC as a router between MPI and PROFIBUS DP, the MPI networking of the PLC must be parameterized in the S7 project. See Section 6.3.3, Page 6-141.

SimoCom U dialog box: End

Button: "**Reset routing information...**"
Radio button: Export mode ☑
MPI No: **2** (see note)
PROFIBUS: **<Subnet ID>** (see below)
OK *or* Go online

Notice

With SINUMERIK 840Di sl, the routing of the MPI interface to the PROFIBUS DP is provided by the PLC. Therefore, the MPI address of the PLC must be specified as the "**MPI No**".

With SINUMERIK 840Di sl, the PLC always has the MPI address **2**.

PROFIBUS S7 subnet ID entering

Enter the 8–digit PROFIBUS S7 subnet ID of DP master (S7 project) in the 12–digit input form of the SimoCom U dialog box as follows:

Example:

S7 project: 8–digit S7 subnet ID:

0010	–	0005

SimoCom U: 12–digit S7 subnet ID:

00	10	00	00	00	05

PROFIBUS S7 subnet ID determining

If you do not have the PROFIBUS S7 subnet ID, you can call it using the SIMATIC Manager STEP 7.

To do so, proceed as follows:

- Open the appropriate S7 project in the SIMATIC Manager S7.
- Select the appropriate station (in the example project: SIMATIC 300)

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- Open the hardware configuration of the station (double–click with left mouse button on: **Hardware**; ”HW Config” will be started)
- Open DP master (in the example project: DP master) (double–click with left mouse button on DP master)
- You will find the subnet ID as follows using the Properties dialog box of the DP master:

Dialog box

Dialog box: Properties – DP Master
Tab card: General
Group box: Interface
Type: PROFIBUS
Address: 2
Button: ”Properties...”

Dialog box: Properties – PROFIBUS DP Master interface
Tab card: Parameter
Subnet: **PROFIBUS**
Button: ”Properties...”

Dialog box: Properties PROFIBUS
Tab card: General
S7 subnet ID: 0010 – 0005 (Example)
Cancel

Cancel

Cancel

The online operation with the drives connected to PROFIBUS can now be started.

10.1.7 Starting online operation

After parameterization of the MPI interface and entry of the routing information, SimoCom U can enter online operation with the SIMODRIVE drives.

Start search

To start the search for any drives connected,

– quit the above dialog box for setting the MPI interface with button: **”Go online”**

or

– use menu command **Commission > Search for online drives**

Display of the drives

The SIMODRIVE drives with which SimoCom U could start the online operation are displayed in the SimoCom U main screen:

– **Drive and dialog browser** (left window)
– **Status overview** (upper status bar)

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10.2 Installing SimoCom U

Installation

SimoCom U is part of the 611U toolbox supplied with the SINUMERIK 840Di sl.

- Installation directory: See Section 1.2, Page 1-33ff
  Engineering Tools > SIMODRIVE 611 Universal Toolbox > SimoCom U

To install SimoCom U, start file **setup.exe** and follow the further installation instructions.

Note

Before you install SimoCom U please consult the relevant notes in the readme.txt file in the installation directory.

Scope of functions

SimoCom U provides the following functions:

- Make an online connection to the drives
- Upgrade the firmware
- Optimize the control parameters
- Traversing the axes
- Diagnose the drive status

Online help

After installation, the documentation for SimoCom U is available electronically. Use the menu command **Help** in SimoCom U to call information on the topics:

- Short introduction...
- How to Use WINDOWS Help...
- Help Topics...
- Key Operation...
- Wiring...
- About SimoCom U...

References

You will also find a detailed description about SimoCom U in:

/FBU/ SIMODRIVE 611 universal Description of Functions

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NCK Commissioning with HMI Advanced 11

11.1 General procedure

The NCK is parameterized for the connected machine by setting system variables.

These system variables are called:

- Machine data (MD)
- Setting data (SD).

11.2 Machine and setting data

Machine data

Machine data are system variables used to adapt the NCK to the machine.

Identifier

The identifier of a machine data is subject to the scheme:

$ M k _*IdentifierString*

where the following applies:

- **$** System variable
- **M** Machine data
- **k** Component

k identifies the components of the NCK parameterizing the appropriate machine data:

- **N** NCK
- **C** Channel
- **A** Axis
- **D** Drive
- **M** MMC

Effectivity

Activation when referring to a machine data indicates the NCK status in which a change to a machine data becomes active.

Activation categories are:

- POWER ON
- Reconfiguration
- Reset
- Effective immediately.

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Setting data

Setting data are system variables that indicate the current machine properties to the NCK.

Identifier

The identifier of a setting data is subject to the scheme:

$ S k _*IdentifierString*

where the following applies:

- **$** System variable
- **S** Setting data
- **k** Component

k identifies the components of the NCK parameterizing the appropriate machine data:

- **N** NCK
- **C** Channel
- **A** Axis

Effectivity

Unlike machine data, changes to setting data always become effective **immediately**.

Overview of machine data

The machine data are divided into the following areas:

Table 11-1 Overview of machine data

Area	Designation
from 1000 to 1799	Machine data for drives ($MD_....)
from 9000 to 9999	Machine data for operator panel ($MM_....)
from 10000 to 18999	NCK–specific machine data ($MN_....)
from 19000 to 19999	Reserved
from 20000 to 28999	Channel–specific machine data ($MC_....)
from 29000 to 29999	Reserved
from 30000 to 38999	Axis–specific machine data ($MA_....)
from 39000 to 39999	Reserved
from 51000 to 61999	General machine data for compile cycles
from 62000 to 62999	Channel–specific machine data for compile cycles
from 63000 to 63999	Axis–specific machine data for compile cycles

Overview of setting data

The setting data are divided into the following areas:

Table 11-2 Overview of setting data

Area	Designation
from 41000 to 41999	General setting data ($SN_....)
from 42000 to 42999	Channel–specific setting data ($SC_....)
from 43000 to 43999	Axis–specific setting data ($SA_....)

Data description

For a detailed description of the machine or setting data, please refer to the description of the function that uses the machine data in question, e.g.:

References: /FB/ Description of Functions – Basic Functions
/FB/ Description of Functions – Extended Functions
/FB/ Description of Functions – Special Functions

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A concise table of all machine and setting data is to be found in:

References: /LIS/ Lists
Machine and Setting Data

Note

To search for information regarding machine and setting data, it is recommended to use the search functions in the electronic documentation: SINUMERIK DOConCD.

11.2.1 Display and input

Machine data screen forms

To display and input machine data, appropriate screen forms are provided.

The screen forms are found on the HMI Advanced user interface at:

Area Switchover –> Commissioning –> Machine Data.

Notice

To input machine data, at least the password of protection level 2 (default: ”EVENING”) must be set.

Bit editor

To facilitate the input of machine data in the bit format (HEX), a bit editor is provided.

If the input cursor is on a machine data in HEX format in the MD list, you can call up the editor by pressing the toggle key (in the middle of the cursor keys).

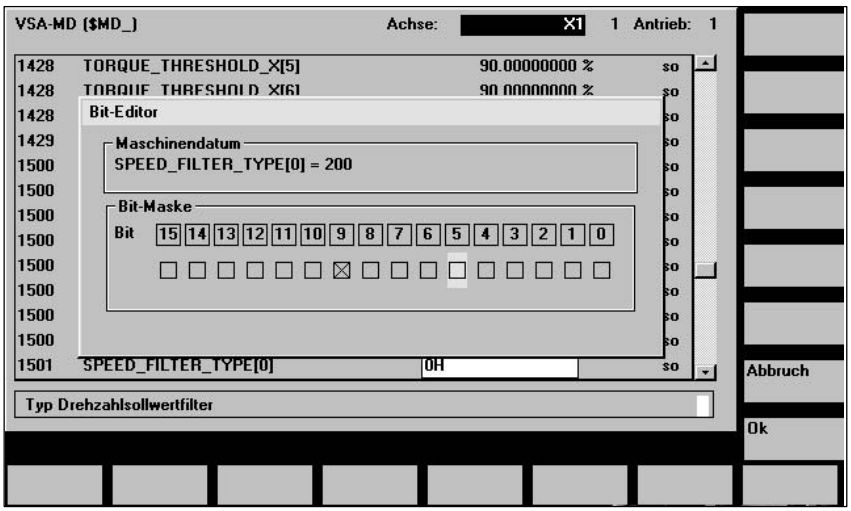


Fig. 11-1 Input screen form of the bit editor for HEX machine data

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You can set or reset single bits by clicking them with the mouse or by selecting them with the cursor keys and then pressing the toggle key.

- With the softkey **OK**, you can terminate the bit editor and accept the value set.
- With the softkey **Abort**, you can quit the bit editor and discard the value set. The previous setting is then valid again.

11.2.2 Protection levels

Access rights

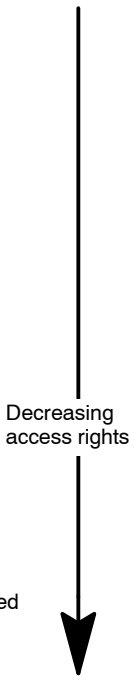
Access to programs, data and functions is useroriented and controlled via 8 hierarchical protection levels. These are divided into (see table 11-3):

- 4 password levels for Siemens, machine manufacturer and end user
- 4 key switch positions for end user

This provides a multilevel safety concept for controlling access rights.

Table 11-3 Protection levels

Protection level	Type	Users	Access to (examples)
0	Pass–word	Siemens	All functions, programs, and data
1	Pass–word	Machine manufacturer: Development	Defined functions, programs and data; for example: Enter options
2	Pass–word	Machine manufacturer: Commissioning engineer	Defined functions, programs, and data; for example: Majority of machine data
3	Pass–word	End user: Service	Assigned functions, programs, and data
4	Key–switch Pos. 3	End user: Programmer machine setter	Lower than protection level 0 to 3; Defined by machine manufacturer or End user
5	Key–switch Pos. 2	End user: qualified user, who does not program	Lower than protection level 0 to 3; Defined by end user
6	Key–switch Pos. 1	End user: Trained user, who does not program	Example: Program selection only, Tool wear input and input of zero offset
7	Key–switch Pos. 0	End user: Semi–skilled operator	Example: No inputs or program selection possible, only machine control panel can be operated



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Setting the password

For the four possible password levels with their access permissions, the passwords can be entered in the control area DIAGNOSIS by actuating the softkey **SET PASSWORD**.

References: /BA/ Operator's Guide

Resetting the password

Please note that a password remains valid until access authorization is reset with the softkey **DELETE PASSWORD**.
Access authorization is therefore not automatically deleted during POWER ON!

Possible characters

Up to eight characters are possible for a password. We recommend that you restrict yourself to the character set of the operator panel in selecting a password. Where a password consists of less than eight characters, the additional characters are interpreted as blanks.

Default passwords

The following default passwords have been set for protection levels 1 to 3:

- Protection level 1: SUNRISE
- Protection level 2: EVENING
- Protection level 3: CUSTOMER

Notice

A system power–up with loading the default machine data (after "Delete NCK data", e.g. using 840Di Start–up) will reset the passwords to the default values.

These passwords should be changed to ensure effective access protection.

Redefining protection levels

The protection levels of machine and/or setting data can be modified both with respect to complete machine or setting data ranges and for single data.

Data areas

Table 11-4 Protection levels: Machine data

Number	Identifier	Name	Reference
MMC machine data ($MM_....)			
9200	USER_CLASS_READ_TOA	Read tool offsets	
9201	USER_CLASS_WRITE_TOA_GEO	Write tool geometry	
9202	USER_CLASS_WRITE_TOA_WEAR	Write tool wear data	
9203	USER_CLASS_WRITE_FINE	Write Fine	
9204	USER_CLASS_WRITE_TOA_SC	Change additive tool offsets	
9205	USER_CLASS_WRITE_TOA_EC	Change tool setup offsets	
9206	USER_CLASS_WRITE_TOA_SUPVIS	Change tool monitoring limit values	
9207	USER_CLASS_WRITE_TOA_ASSDNO	Change D No. assigned to a tool edge	
9208	USER_CLASS_WRITE_MAG_WGROUP	change wear group magazine location/mag.	
9209	USER_CLASS_WRITE_TOA_ADAPT	Tool adapter data	
9210	USER_CLASS_WRITE_ZOA	Write settable zero offset	
9213	USER_CLASS_OVERSTORE_HIGH	Extended overstore	
9214	USER_CLASS_WRITE_PRG_CONDIT	Program control	

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Number	Identifier	Name	Refer-ence
9215	USER_CLASS_WRITE_SEA	Write setting data	
9218	USER_CLASS_SELECT_PROGRAM	Program selection	
9219	USER_CLASS_TEACH_IN	TEACH IN	
9220	USER_CLASS_PRESET	PRESET	
9221	USER_CLASS_CLEAR_RPA	Deleting R parameters	
9222	USER_CLASS_WRITE_RPA	Write R parameters	
9231	USER_CLASS_WRITE_RPA_1	Write protection for first RPA area	
9232	USER_BEGIN_WRITE_RPA_1	Start of the first RPA area	
9233	USER_END_WRITE_RPA_1	End of the first RPA area	
9234	USER_CLASS_WRITE_RPA_2	Write protection for second RPA area	
9235	USER_BEGIN_WRITE_RPA_2	Start of the second RPA area	
9236	USER_END_WRITE_RPA_2	End of the second RPA area	
9237	USER_CLASS_WRITE_RPA_3	Write protection for third RPA area	
9238	USER_BEGIN_WRITE_RPA_3	Start of the third RPA area	
9239	USER_END_WRITE_RPA_3	End of the third RPA area	
9240	USER_CLASS_WRITE_TOA_NAME	Change tool designation and duplo	
9241	USER_CLASS_WRITE_TOA_TYPE	Change tool type	
9247	USER_CLASS_BASE_ZERO_OFF_PA	Basic offset PA	
9248	USER_CLASS_BASE_ZERO_OFF_MA	Basic offset MA	

References: /FB/ Description of Functions, Basic Functions:
A2 Various Interface Signals
Section: MMC machine data for protection levels

Individual data

The protection level of individual machine and/or setting data can be modified in the file SGUD.DEF.

Example:

The axial machine data item CTRLOUT_SEGMENT_NR requires protection level 3 for reading and protection level 2 for writing.

Syntax:
REDEF $*Machine data string* APR *n* APW *m*
APR n: Defining the protection level for reading (Read) the data
APW m: Defining the protection level for writing (Write) the data

File SGUD.DEF:

```
%_N_SGUD_DEF
  ;$PATH=/_N_DEF_DIR
  REDEF $MA_CTRLOUT_SEGMENT_NR  APR 3  APW 2
M30
```

References: /PGA/ Programming Guide Advanced
Section: File and Program Management
Defining protection levels for user data (GUD)

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11.2.3 Machine data display filter

Through the use of the machine data display filter, it is possible to reduce the number of displayed machine data of a certain area, e.g. general machine data or channel machine data, for special purposes.

Machine data areas

Display filters are provided for the following machine data areas:

- General machine data
- Channel–specific machine data
- Axis–specific machine data
- Drive machine data

Display filter

To parameterize the display filter of a machine data area, use the vertical softkey **Display Options...** in the appropriate machine data area.

Example:

Display filter for channel machine data

Operating area: Commissioning –> Machine Data –> Channel MD –> Display Options...

Note

The parameter: Display Filter of the corresponding machine data description indicates to which display group a machine data item belongs.

Reference: /LIS/ Lists

Display groups

A display group contains machine data within a machine data area that belong to the same topic.

By selecting/deselecting the display groups, the number of displayed machine data of the current machine data area increases or decreases.

Expert mode

If the **Expert mode** display filter is disabled, only the machine data of a machine data range are displayed that are required for the basic functionality of the NCK.

Index from to

The index filter refers to the machine data **fields**. On the display, these machine data can be identified by the field index attached to the machine data string.

Example: 10000 AXCONF_MACHAX_NAME_TAB[***index***]

If the index filter is activated, machine data fields are only displayed in the specified index area.

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11.3 System data

11.3.1 Resolutions

The following types of resolution, e.g. resolution of linear and angular positions, velocities, accelerations and jerk, must be differentiated as follows:

- the **input resolution**, i.e. the input of data from the user interface or using the part programs.
- the **display resolution**, i.e. the display of data on the user interface.
- the **computational resolution**, i.e. the internal representation of the data input through the user interface or the part program.

Input and display resolution

The input and display resolution is determined by the control unit used whereby the display resolution for position values can be modified using the MD 9004: DISPLAY_RESOLUTION (display resolution).

MD 9011: DISPLAY_RESOLUTION_INCH (INCH unit system display resolution) can be used to configure the display resolution for position values with inch setting. This allows you to display up to six decimal places with the inch setting.

For the programming of part programs, the input resolutions listed in the Programming Guide apply.

Computational resolution

The computational resolution defines the maximum number of effective decimal places for all data the physical unit of which is referred to a length or an angle, e.g. position values, velocities, tool offsets, zero offsets, etc.

The desired computational resolution is defined using the machine data

- MD 10200: INT_INCR_PER_MM (computational resolution for linear positions)
- MD 10210: INT_INCR_PER_DEG (computational resolution for angle positions).

The default assignment is:

- 1000 increments/mm
- 1000 increments/degrees

The computational resolution thus also determines the maximum achievable precision for positions and selected offsets. However, it is essential that the measuring system is adapted to this degree of precision.

Note

Although the computational resolution is generally independent of the input/display resolution, it should have at least the same resolution.

Rounding

The precision of angle and linear positions is limited to the computational resolution by rounding the product of the programmed value with the computational resolution to an integer number.

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Example of rounding:

Computational resolution:	1000 increments/mm
Programmed path:	97.3786 mm
Effective value =	97.379 mm

Note

To keep rounding easily understandable, it is better to use powers of 10 for the computational resolution (100, 1000, 10,000).

Display resolution

In MD 9004: DISPLAY_RESOLUTION you can set the number of decimal places after the decimal point for the position values on the operator panel.

Input and display limit values

The input value limitation depends on the display options and input options of the operator panel.
This limit is 10 decimal places plus decimal point plus sign.

Example of programming in the $^1/_{10}$ – µm range:

All the linear axes of a machine are to be programmed and traversed within the value range 0.1 ... 1000 µm.

To position to 0.1 µm accuracy, the computational resolution must be set to $\geq 10^4$ incr./mm:
MD 10200: INT_INCR_PER_MM = 10000 [incr./mm]:

Example of related part program:

N20 G0 X 1.0000 Y 1.0000 ;	Traverse axis to position X=1.0000 mm, Y=1.0000 mm;
N25 G0 X 5.0002 Y 2.0003 ;	Traverse axis to position X=5.0002 mm, Y=2.0003 mm

Machine data

Table 11-5 Resolutions: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
9004	DISPLAY_RESOLUTION	Display resolution	G2
9011	DISPLAY_RESOLUTION_INCH	Display resolution for INCH system of measurement	G2
10200	INT_INCR_PER_MM	Computational resolution for linear positions	G2
10210	INT_INCR_PER_DEG	Computational resolution for angular positions	G2

References

/**FB**/ **Description of Functions, Basic Functions**
G2 Velocities, Traversing Ranges, Accuracies,
Section: Input/display resolution, computational resolution

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11.3.2 Normalization of physical quantities of machine and setting data

Default

Machine and setting data having a physical unit are interpreted in the input/output units listed in Table 11-6 by default, depending on the scaling system (metric/inch).

The internally used units which the NCK uses are independent and fixed.

Table 11-6 Normalization of phys. units of machine data and setting data

Physical unit	Input/output units for the default scaling system		Internally used Unit
	Metric	Inch	
Linear position	1 mm	1 inch	1 mm
Angular position	1 degrees	1 degrees	1 degrees
Linear velocity	1 mm/min	1 inch/min	1 mm/s
Angular velocity	1 rpm	1 rpm	1 deg./s
Linear acceleration	1 m/s^2	1 $inch/s^2$	1 mm/s^2
Angular acceleration	1 rev/s^2	1 rev/s^2	1 $degree/s^2$
Linear jerk	1 m/s^3	1 $inch/s^3$	1 mm/s^3
Angular jerk	1 rev/s^3	1 rev/s^3	1 $degree/s^3$
Time	1 s	1 s	1 s
Position controller servo gain	1 s^{-1}	1 s^{-1}	1 s^{-1}
Rev. feedrate	1 mm/rev	1 inch/rev	1 mm/degree
Compensation value linear position	1 mm	1 inch	1 mm
Compensation value angular position	1 degrees	1 degrees	1 degrees

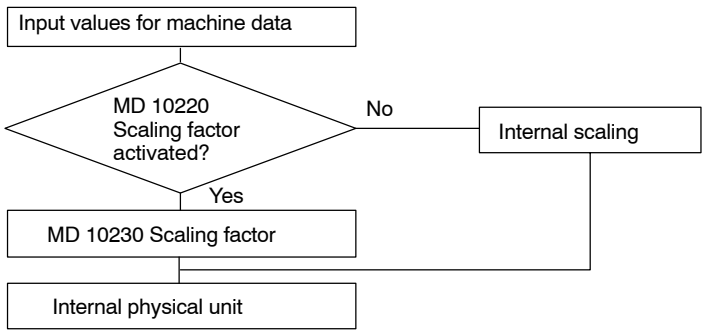
User–defined

The user can define different input/output units for machine and setting data.

For this purpose,

- MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors) and
- MD 10230: SCALING_FACTORS_USER_DEF[n] (scaling factors of the physical quantities)

allow you to set the adaptation between the newly selected input/output units and the internal units.



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The following applies:

Defined input/output unit =

MD : *SCALING_FACTORS_USER_DEF*[*n*] * *internal unit*

Enter the actual value corresponding to the approached position in MD 10230: SCALING_FACTORS_USER_DEF[n].

Table 11-7 Bit number and index for user definition

Physical unit	MD 10220: Bit number	MD 10230: Index n
Linear position	0	0
Angular position	1	1
Linear velocity	2	2
Angular velocity	3	3
Linear acceleration	4	4
Angular acceleration	5	5
Linear jerk	6	6
Angular jerk	7	7
Time	8	8
K_V factor	9	9
Rev. feedrate	10	10
Compensation value linear position	11	11
Compensation value angular position	12	12

Example 1:
Machine data input/output of the linear velocities is to be in m/min instead of mm/min (initial setting). The internal unit is mm/s.

MD 10220: SCALING_USER_DEF_MASK Bit2 = 1 is used to enter the scaling factor for linear velocities as a user–defined value.

The scaling factor is calculated using the following formula:

$$MD : SCALING_FACTORS_USER_DEF[n] = \frac{Defined\ input/output\ unit}{internal\ unit}$$

$$MD : SCALING_FACTORS_USER_DEF[n] = \frac{1\frac{m}{min}}{1\frac{mm}{s}} = \frac{\frac{1000mm}{60s}}{1\frac{mm}{s}} = \frac{1000}{60} = 16.667;$$

$$\Rightarrow MD : SCALING_FACTORS_USER_DEF[2] = 16.667$$

Index 2 specifies the ”linear velocity” (see above).

Example 2:
In addition to the change of example 1, the machine data input/output of linear accelerations, is to be performed in ft/s^2, instead of m/s^2 (default). (the internal unit is mm/s^2).

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$$MD : SCALING_USER_DEF_MASK = 'H14'; \text{ (bit no. 4 and bit no. 2 of example 1 as hex value)}$$

$$MD : SCALING_FACTORS_USER_DEF[n] = \frac{1\frac{ft}{s^2}}{1\frac{mm}{s^2}} = \frac{12 * 25.4\frac{mm}{s^2}}{1\frac{mm}{s^2}} = 304.8;$$

$$\Rightarrow MD : SCALING_FACTORS_USER_DEF[4] = 304.8$$

Index 4 specifies the ”linear acceleration” (see above).

Machine data

Table 11-8 Normalization of phys. units of machine data and setting data: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
10220	SCALING_USER_DEF_MASK	Activation of scaling factors	
10230	SCALING_FACTORS_USER_DEF[n]	Scaling factors of physical quantities	
10240	SCALING_SYSTEM_IS_METRIC	Basic system metric	
10250	SCALING_VALUE_INCH	Conversion factor for switch–over to inch system	
10260	CONVERT_SCALING_SYSTEM	Basic system switch–over active	
10270	POS_TAB_SCALING_SYSTEM	Measuring system of position tables	T1
10290	CC_TDA_PARAM_UNIT	Physical units of the tool data for CC	
10292	CC_TOA_PARAM_UNIT	Physical units of the tool edge data for CC	

11.3.3 Changing scaling machine data

The scaling of machine data having physical units is defined by the following machine data:

- MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors)
- MD 10230: SCALING_FACTORS_USER_DEF (scaling factors of physical quantities)
- MD 10240: SCALING_SYSTEM_IS_METRIC (basic system metric)
- MD 10250: SCALING_VALUE_INCH (conversion factor for switchover to INCH system)
- MD 30300: IS_ROT_AX (rotary axis)

When scaling machine data are modified, all machine data affected by this modification due to their physical unit are converted with the next NCK reset.

Example: Redefining an A1 axis from linear to rotary axis.

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The control has been commissioned with default values. Axis A1 is declared as a linear axis.

- MD30300: IS_ROT_AX[A1] = 0 (no rotary axis)
- MD32000: MAX_AX_VELO [A1] = 1000 [mm/min] (max. axis velocity).

Axis A1 is now declared as a rotary axis containing the following machine data:

- MD30300: IS_ROT_AX[A1] = 1 (rotary axis)
- MD32000: MAX_AX_VELO [A1] = 1000 [mm/min] (max. axis velocity).

With the next NCK reset, the control system recognizes that axis A1 is defined as a rotary axis and rescales MD32000: MAX_AX_VELO to [rev./min] with reference to a rotary axis.

- MD30300: IS_ROT_AX[A1] = 1 (rotary axis)
- MD32000: MAX_AX_VELO [A1]= 2.778 [rev./min].

Note

If a scaling machine data item is altered, then the control outputs alarm ”4070 Scaling data changed”.

Modifying manually

The following procedure is recommended when modifying scaling machine data manually:

1. Set all scaling machine data
2. Carry out NCK reset
3. Set all dependent machine data after the NCK has powered up.

11.3.4 Loading default machine data

The default machine data can be loaded in different ways.

840Di start–up

With SINUMERIK 840Di sl standard user interface 840Di start–up:
Menu command **Window > Diagnosis > NC/PLC**

- Button: ”Delete NCK Data”
- Button: ”NCK RESET”

Notice

With deleting the NCK data, all user data are lost.

To avoid data loss, a series startup file should be created before the NCK data are deleted. How to create a series startup file is described in Section 15.2, Page 15-460.

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MD11200: INIT_MD

The input values in MD11200: INIT_MD (loading the default machine data with the ”next” NCK boot), which are listed below, various data areas can be loaded when the NCK boots next time.

After setting the machine data, NCK reset must be carried out twice:

1. NCK RESET: The machine data is activated.
2. NCK RESET: Depending on the input value, the appropriate machine data are set to their default values and MD11200: INIT_MD is reset again to the value ”0”.

Input values

MD11200: INIT_MD = **1**
On the next NCK boot, all machine data (with the exception of the memory configuring data) are overwritten with default values.

MD11200: INIT_MD = **2**
On the next NCK boot, all memory–configuring machine data are overwritten with default values.

11.3.5 Switching over the measuring system

The unit system is switched over for the entire machine using a softkey in the HMI Advanced operating area ”MACHINE”. The switchover is only accepted if:

- MD10260: CONVERT_SCALING_SYSTEM=1.
- Bit 0 of MD20110: RESET_MODE_MASK is enabled in every channel.
- All channels are in the Reset state.
- Axes are not traversing with JOG, DRF or PLC control.
- Constant grinding wheel peripheral speed (GWPS) is not active.

Actions such as part program start or mode change are disabled for the duration of the switchover.

If the switchover cannot be performed, this is indicated by a message in the user interface. These measures ensure that a consistent set of data is always used for a running program with reference to the system of measurement.

The actual switchover of the system of measurement is performed internally by writing all the necessary machine data and subsequently activating them with a Reset.

MD10240: SCALING_SYSTEM_IS_METRIC and the corresponding settings G70/G71/G700/G710 in MD20150: GCODE_RESET_VALUES are automatically switched over consistently for all configured channels.

During this process, the value specified in MD20150: GCODE_RESET_VALUES[12] alternates between G700 and G710.

This process takes place independently of the protection level currently set.

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System data

When the system of measurement is changed, all lengthrelated parameters are automatically converted to the new system of measurement from the perspective of the operator. This includes:

- Positions
- Feed rates
- Acceleration rates
- Jerk
- Tool offsets
- Programmable, settable and work offsets external and DRF offsets
- Compensation values
- Protection zones
- Machine data
- Jog and hand wheel factors

After switching, all above mentioned data are available in the physical units as described in Section 11.3.2, Page 11-294.

Data for which no unique physical units are defined, such as:

- Arithmetic variables
- GUDs (**G**lobal **U**ser **D**ata)
- LUDs (**L**ocal **U**ser **D**ata)
- PUDs (**P**rogram global **U**ser **D**ata)
- Analog inputs/outputs
- Data exchange via FC21

are not converted automatically. In this case, the user must allow for the current system of measurement in MD 10240: SCALING_SYSTEM_IS_METRIC.

The current system of measurement setting can be read at the PLC interface via the ”inch system” signal DB10.DBX107.7. DB10.DBB71 can be used to read out the ”system of measurement change counter”.

Machine data

Table 11-9 Switching over the unit system: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
10240	SCALING_SYSTEM_IS_METRIC	Basic system metric	
10250	SCALING_VALUE_INCH	Conversion factor for switch–over to inch system	
10260	CONVERT_SCALING_SYSTEM	Basic system switch–over active	
Axis–specific ($MA_ ...)			
32711	CEC_SCALING_SYSTEM_METRIC	System of measurement of sag compensation	G2

References

/**FB**/ **Description of Functions, Basic Functions**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Section: Metric/inch measuring system

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11.3.6 Traversing ranges

Computational resolution and Traversing ranges

The range of values of the traversing ranges directly depends on the selected computational resolution (see Section 11.3.1, Page 11-292).

With the default assignment of the machine data for the computational resolution

- 1000 inc./mm
- 1000 inc./deg.

the following traversing ranges result:

Table 11-10 Traversing ranges

	Traversing range in the metric system	Traversing range in the inch system
Linear axes	± 999,999.999 [mm; deg.]	± 399,999.999 [inch; deg.]
Rotary axes	± 999,999.999 [mm; deg.]	± 999,999.999 [inch; deg.]
Interpolation parameters I, J, K	± 999,999.999 [mm; deg.]	± 399,999.999 [inch; deg.]

11.3.7 Positioning accuracy

Computational resolution and traversing ranges

The positioning accuracy depends on:

- the computational accuracy (internal increments/(mm or degrees))
- the actual-value resolution (encoder increments/(mm or degrees)).

The rougher resolution of both determines the positioning accuracy of the NCK.

The input resolution, the position control and interpolation clock do not affect the accuracy.

Machine data

Table 11-11 Positioning accuracy: Machine data

Number	Identifier	Name/remarks	Refer-ence
General ($MN_ ...)			
10200	INT_INCR_PER_MM	Computational resolution for linear positions	G2
10210	INT_INCR_PER_DEG	Computational resolution for angular positions	G2
Axis-specific ($MA_ ...)			
31020	ENC_RESOL[n]	Encoder pulses per revolution	

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11.3.8 Cycle times

On the SINUMERIK 840Di sl, the system clock cycle, the position controller cycle and the interpolation cycle of the NCK are based on the DP cycle time configured in STEP 7 "HW Config" (see Section 6.3, Page 6-139f).

System basic cycle

The DP cycle time configured in STEP 7 is taken as the system clock cycle and displayed in the machine data:

- MD10050: $MN_SYSCLOCK_CYCLE_TIME (system clock) = DP cycle time

---

Note

The DP cycle time configured in STEP 7 "HW Config" is only taken as the system clock cycle from the NCK if at least one real machine axis is parameterized in the NCK machine data.

If no real machine axis is parameterized, the value of the machine data functions as the system clock cycle:

- MD10050: $MN_SYSCLOCK_CYCLE_TIME

Position controller cycle

The ratio from position controller cycle to system clock cycle for SINUMERIK 840Di sl is always 1:

- MD10060: $MN_POSCTRL_SYSCLOCK_TIME_RATIO = 1

Note

The machine data is not displayed for 840Di sl,

Position controller cycle offset

The position controller cycle offset (T_M) must be set so that the following conditions are fulfilled within a DP cycle (T_{DP}):

- The cyclic communication with the DP slaves (drives) must be completed before the position controller is started.
  Condition: $T_M > T_{DX}$
- The position controller must be completed before the DP cycle is completed.
  Condition: $T_M + T_{Pos} < T_{DP}$

The following setting is recommended as approximate value for the position control cycle offset:

$T_M = T_{DP} - 3*T_{pos\ max}$

- T_{DP}
  The DP cycle time is equivalent to the position controller cycle of the SINUMERIK 840Di sl.
- $T_{pos\ max}$
  Display using HMI Advanced (optional):
  Operating area switchover> Diagnosis > Service displays > System resources

- MD10062: $MN_POSCTRL_CYCLE_DELAY (position control cycle delay) = T_M

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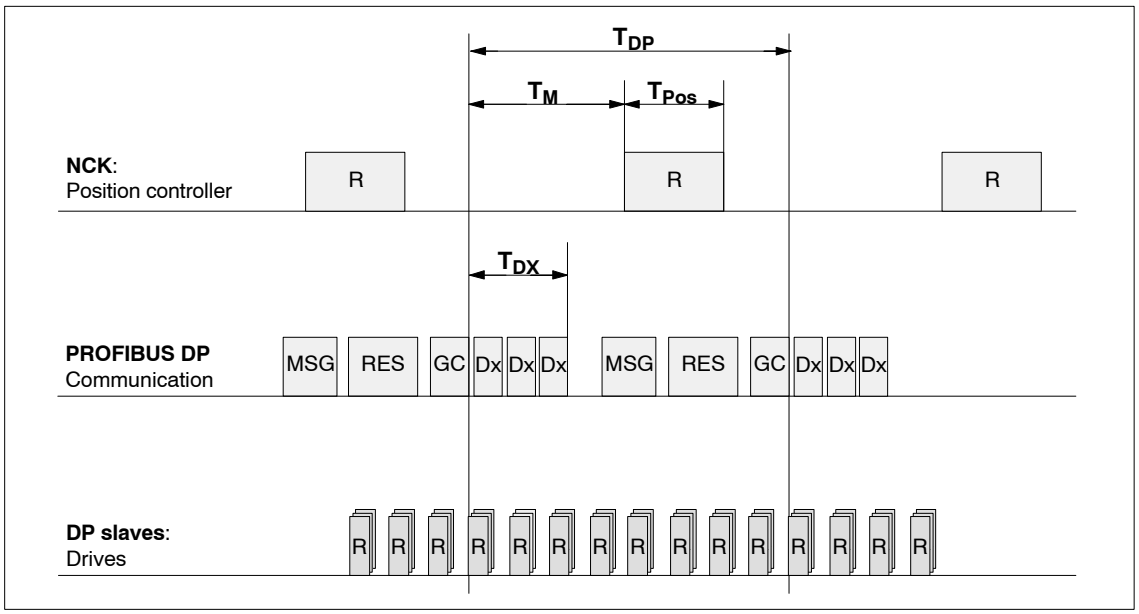


Fig. 11-2 Position control cycle offset compared to PROFIBUS DP cycle

Key to Fig. 11-2:

T_{Pos}	CPU time required by position controller
T_{DP}	DP cycle time: DP cycle time
T_{DX}	Data exchange time: Sum of transfer times of all DP slaves
T_M	Master time: Offset of the start time for NCK position control
GC	Global control: Broadcast message for cyclic synchronization of the equidistance between DP master and DP slaves
R	CPU time
Dx	Exchange of user data between DP master and DP slaves
MSG	Acyclic services (e.g. DP/V1, pass token)
RES	Reserve: ”active break” until the equidistant cycle has elapsed

Interpolation cycle

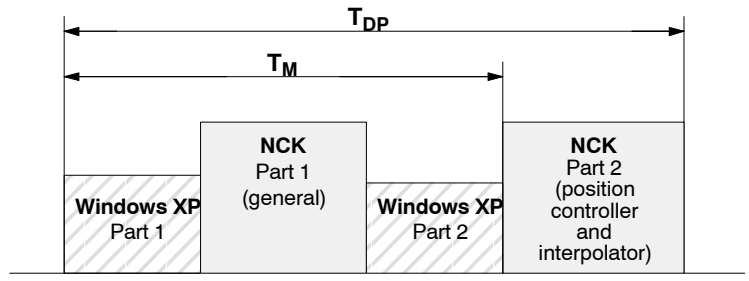
The interpolator cycle may be chosen freely as a whole multiple of the position control cycle.

- MD10070: $MN_IPO_SYSCLOCK_TIME_RATIO (factor for interpolator cycle)

NCK CPU time share

The processor power of the PCU must be shared between the NCK and Windows XP. The parameterized CPU time share of the NCK is the maximum value that the NCK will only use in the worst case. If the NCK requires less CPU time in cyclical operation, it will cede it dynamically to Windows XP.

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T_{DP} DP cycle time: DP cycle time

T_M Master time: Offset of the start time for NCK position controller

Fig. 11-3 CPU time division between Windows XP and NCK

- MD10185: $MN_NCK_PCOS_TIME_RATIO (CPU time component NCK)

Individual setting

The default value for the NCK CPU time share is 50%. An individual setting can only be made by the following formula:

MD10185 >= 300 * ($T_{pos\ max}$ * MD10070 + $T_{IPO\ max}$ + 0.2 ms) / MD10071

with:

– $T_{pos\ max}$ and $T_{IPO\ max}$
$T_{pos\ max}$ [ms] and $T_{IPO\ max}$ [ms] are the maximum net run time of each position controller or interpolator. The data are displayed by with HMI Advanced (option) under:
Operating area switchover > Diagnosis > Service displays > System resources

– MD10070: IPO_SYSCLOCK_TIME_RATIO (factor for interpolation clock pulse)

– MD10071: IPO_CYCLE_TIME (interpolator clock pulse) [ms]

Note

The values displayed in menu: System resources of HMI Advanced refer to the total power of the CPU, not to the CPU time share of the NCK set in MD 10185: NCK_PCOS_TIME_RATIO.

The values for $T_{pos\ max}$ and $_{IPO\ max}$ are considerably influenced by applications active under Windows XP due to cache effects of the PCU processor. To calculate these value, it is therefore necessary to activate Windows XP applications demanding a lot of CPU time in parallel with execution of NC part programs.

When the maximum values for T_{pos} and T_{IPO} displayed as you proceed as described above no longer change, you can calculate the above formula with a value of 200 instead of 300.

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The maximum value for the NCK CPU time share of 75 % must not be exceeded. A value greater than 75 % can lead to significant impairment (slowing down) of Windows XP applications. If necessary, the values must be adapted to the system clock cycle/position controller cycle (DP cycle time) and/or interpolation cycle.

References /**FB**/ **Description of Functions, Special Functions**
G3 Cycle Times

Machine data

Table 11-12 Cycle times: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
10050	SYSCLOCK_CYCLE_TIME	System clock cycle/only display data; is always equal to the equidistant PROFIBUS DP cycle. Note: **With 840Di sl, only for display!**	
10060	POSCTRL_SYSCLOCK_TIME_RATIO	Factor for the position control cycle/is set fixed to the factor 1. Note: **Is not displayed with the 840Di sl!**	
10062	POSCTRL_CYCLE_DELAY	Position control cycle offset	
10070	IPO_SYSCLOCK_TIME_RATIO	Factor for the interpolator cycle/can be freely selected in integer multiples.	



Caution

If you change the cycle times, check the behavior of the drive in all operating modes before you finish commissioning.

Note

The smaller the cycle times (PROFIBUS DP cycle) chosen, the greater the control quality for the drive and the better the surface quality on the workpiece.

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11.3.9 Velocities

Max. axis velocity or spindle speed

The maximum possible axis velocities and spindle speeds depend on the machine design, drive dynamics and the encoder limit frequency of the individual drives.

Max. progr. path velocity

The maximum programmable tool path velocity results from the maximum axis velocities of the axes involved in the path programmed.

Max. tool path velocity

The maximum tool path velocity at which traversing is possible within a part program block results as follows:

$$V_{max} = \frac{\textit{progr. path length in the part program block [mm or degrees]}}{\textit{IPO cycle [s]}}$$

Upper limit

To guarantee that part program blocks are executed continuously (control margin), the NCK limits the tool path velocity within a part program block to 90% of the max. possible tool path velocity as follows:

$$V_{max} \leq \frac{\textit{progr. path length in the part program block [mm or degrees]}}{\textit{IPO cycle [s]}} * 0.9$$

For example, in the case of part programs generated by means of CAD system, which contain extremely short blocks, this limiting of the path velocity can result in a strong reduction of the path velocity over several part program blocks.

The function ”Online compressor” can help to avoid such sudden velocity dips.

References: /PGA/ Programming Guide, Advanced
Section: Compressor COMPON/COMPCURVE

Lower limit

The minimum tool path or axis velocity at which traversing is possible results from:

$$V_{min} \geq \frac{10^{-3}}{\textit{calculation precision}[\frac{\textit{incr.}}{\textit{mm or degrees}}] * \textit{IPO cycle [s]}}$$

(for the computational resolution, see: Section 11.3.1, Page 11-292)

If V_{min} is not reached, no traversing movement is carried out.

References

/**FB**/ **Description of Functions, Basic Functions**
G2 Velocities, Traversing Ranges, Accuracies
Section: Velocities

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11.4 Memory configuration

Hardware configuration

The dynamic (DRAM) or static (SRAM) memory available depends on the hardware configuration of the components used (PCU and MCI board) and the memory available for SINUMERIK 840Di sl.

	SDRAM Maximum	DRAM for 840Di sl [1]	SRAM
PCU 50.3–C/1.5 GHz	512 MB	Approx. 16 MB	–
PCU 50.3–P/2.0 GHz	1024 MB	Approx. 16 MB	–
MCI board	–	–	5 MB [2]

1) DRAM component (main memory) occupied by SINUMERIK 840Di sl and thus no longer available for Windows XP.

2) The SRAM memory of the MCI board is divided into:
   – Part programs and manufacturer cycles: 3 MB
   – User data: 1 MB
   – Siemens cycles: 1 MB

User data

The individual memory areas of the user data are set to reasonable default values during general reset of the NCK. To obtain optimum utilization of the user memory the size of the individual data areas can be set for, e.g.:

- Part programs
- Tool management
- Tool offsets
- User data
- Arithmetic variables
- Compensations
- Protection zones
- Frames

(see Section 11.4.2, Page 11-308):

The memory must be sectionalized before commencement of the actual NCK commissioning because all user data (e.g. part programs, tool offsets) will be lost during the changes.

Machine data, setting data, and option data are not lost when the memory is reorganized.

Effectivity

The machine data of the memory configuration are activated by power ON.

References: /FB/ Description of Functions
S7 Memory Configuration

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11.4.1 DRAM memory

Free memory

The free DRAM memory is displayed in machine data

- MD18050: INFO_FREE_MEM_DYNAMIC (free dynamic memory).

The free DRAM should not be less than 15,000 bytes.

Caution

Before you enlarge DRAM areas, you should first check whether the free memory is sufficient:

- MD18050: INFO_FREE_MEM_DYNAMIC (free dynamic memory)

If more dynamic memory is requested than is available, the SRAM and therefore **all user data will be cleared** without prior warning on the next NCK start–up!

To avoid data loss, a series startup file should be created before reconfiguration (see Section 15.2, Page 15-460).

Machine data

Table 11-13 Machine data required to configure the DRAM

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
18050	INFO_FREE_MEM_DYNAMIC	Display data of the free dynamic memory	
18170	MM_NUM_MAX_FUNC_NAMES	Number of miscellaneous functions	
18180	MM_NUM_MAX_FUNC_PARAM	Number of additional parameters	
18210	MM_USER_MEM_DYNAMIC	User memory in DRAM	
18240	MM_LUD_HASH_TABLE_SIZE	Hash table size for user variables	
18242	MM_MAX_SIZE_OF_LUD_VALUE	Maximum field size of the LUD variables	
18250	MM_CHAN_HASH_TABLE_SIZE	Hash table size for channel–specific data	
18260	MM_NCK_HASH_TABLE_SIZE	Hash table size for global data	
18340	MM_NUM_CEC_NAMES	Number of LEC tables	
18342	MM_CEC_MAX_POINTS	Max. table size for sag compensation	
18500	MM_EXTCOM_TASK_STACK_SIZE	Stack size for external communication task	
18510	MM_SERVO_TASK_STACK_SIZE	Stack size of servo task	
18520	MM_DRIVE_TASK_STACK_SIZE	Stack size of drive task	
Channel–specific ($MC_ ...)			
20096	T_M_ADDRESS_EXIT_SPINO	Spindle number as address extension	/FBW/, W1
27900	REORG_LOG_LIMIT	Percentage of IPO buffer for log file enable	
28000	MM_REORG_LOG_FILE_MEM	Memory size for REORG	/FB/, K1
28010	MM_NUM_REORG_LUD_MODULES	Number of modules for local user variables with REORG	
28020	MM_NUM_LUD_NAMES_TOTAL	Number of local user variables	

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Number	Identifier	Name/remarks	Refer-ence
28040	MM_LUD_VALUES_MEM	Memory size for local user variables	
28060	MM_IPO_BUFFER_SIZE	Number of NC blocks in the IPO buffer	
28070	MM_NUM_BLOCKS_IN_PREP	Number of blocks for block preparation	
28090	MM_NUM_CC_BLOCK_ELEMENTS	Number of block elements for Compile cycles	
28100	MM_NUM_CC_BLOCK_USER_MEM	Size of block memory for Compile cycles	
28105	MM_NUM_CC_HEAP_MEM	Heap memory for compile cycle applications	
28210	MM_NUM_PROTECT_AREA_ACTIVE	Number of simultaneously active protection zones	/FB/, A3
28500	MM_PREP_TASK_STACK_SIZE	Stack size of preparation task	
28510	MM_IPO_TASK_STACK_SIZE	Stack size of IPO task	
28550	MM_PRSATZ_MEM_SIZE	Available memory for internal blocks	
Axis–specific ($MA_ ...)			
38010	MM_QEC_MAX_POINTS	Number of values for quadrant error compensation	/FB/, K3 /IAD/

11.4.2 SRAM memory

Free memory

The free SRAM memory is displayed in machine data

- MD18060: INFO_FREE_MEM_STATIC (free static memory)

The free SRAM should not be less than 15,000 bytes to ensure that data (e.g. tool offsets) can be read in at all times.

Reconfiguation of the SRAM memory

Modifying the machine data listed in Table 11-14 results in a reconfiguration of the SRAM with a loss of all user data. Before the change becomes effective in the NCK, the following alarm message is generated:

- Interrupt: ”4400 MD change results in reorganization of the buffered memory (loss of data!)”

Notice

When reconfiguring the SRAM memory, all user data are lost. To avoid data loss, a series startup file should be created before reconfiguration (see Section 15.2, Page 15-460).

Machine data

Table 11-14 Machine data required to configure the SRAM

Number	Identifier	Name/remarks	Refer-ence
General ($MN_ ...)			
18060	INFO_FREE_MEM_STATIC	Display data of the free static memory	
18080	MM_TOOL_MANAGEMENT_MASK	Screen form for reserving memory for the tool management	/FBW/
18082	MM_NUM_TOOL	Number of tools managed by NCK	

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General ($MN_ ...)			
18084	MM_NUM_MAGAZINE	Number of magazines managed by NCK	/FBW/
18086	MM_NUM_MAGAZINE_LOCATION	Number of magazine locations	/FBW/
18090	MM_NUM_CC_MAGAZINE_PARAM	Compile cycles of tool management: Number of magazine data	/FBW/
18092	MM_NUM_CC_MAGLOC_PARAM	Compile cycles of tool management: Number of magazine location data	/FBW/
18094	MM_NUM_CC_TDA_PARAM	Compile cycles of tool management: Number of TDA data	/FBW/
18096	MM_NUM_CC_TOA_PARAM	Compile cycles of tool management: Number of TOA data	/FBW/
18098	MM_NUM_CC_MON_PARAM	Compile cycles of tool management: Number of monitor data	/FBW/
18100	MM_NUM_CUTTING_EDGES_IN_TOA	Number of tool offsets	
18118	MM_NUM_GUD_MODULES	Number of GUD modules	
18120	MM_NUM_GUD_NAMES_NCK	Number of global user variables	
18130	MM_NUM_GUD_NAMES_CHAN	Number of channel–specific user variables	
18140	MM_NUM_GUD_NAMES_AXIS	Number of axis–specific user variables	
18150	MM_GUD_VALUES_MEM	Memory reserved for global user variables	
18160	MM_NUM_USER_MACROS	Number of macros	
18190	MM_NUM_PROTECT_AREA_NCK	Number of protection areas	/FB/, A3
18230	MM_USER_MEM_BUFFERED.	User memory in SRAM	
18270	MM_NUM_SUBDIR_PER_DIR	Number of subdirectories	
18280	MM_NUM_FILES_PER_DIR	Number of files per directory	
18290	MM_FILE_HASH_TABLE_SIZE	Hash table size for files in a directory	
18300	MM_DIR_HASH_TABLE_SIZE	Hash table size for subdirectories	
18310	MM_NUM_DIR_IN_FILESYSTEM	Number of directories in passive file system	
18320	MM_NUM_FILES_IN_FILESYSTEM	Number of files in passive file system	
18330	MM_CHAR_LENGTH_OF_BLOCK	Max. length of an NC block	
18350	MM_USER_FILE_MEM_MINIMUM	Minimum NC program memory	
28050	MM_NUM_R_PARAM	Number of channel–specific R parameters	
28080	MM_NUM_USER_FRAMES	Number of settable frames	
28085	MM_LINK_TOA_UNIT	Allocation of a TO unit to a channel	/FBW/, W1
28200	MM_NUM_PROTECT_AREA_CHAN	Number of modules for channel–specific protection zones	/FB/, A3
Axis–specific ($MA_ ...)			
38000	MM_ENC_COMP_MAX_POINTS	Number of intermediate points with interpolatory compensation	/FB/, K3

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11.5 Axes and spindles

11.5.1 Axis configuration

Definition

The term ”axis” is often used either as a single term in conjunction with SINUMERIK 840Di sl or in a compound, e.g. machine axis, channel axis, etc. To provide an overview of the philosophy used as the basis, here is a brief explanation of this term.

There are basically 3 types of axes:

1. Coordinate axes
2. Machine axes
3. Geometry and special axes

Coordinate axes

Coordinate axes (abscissa, ordinate, applicate) are the axes of a Cartesian coordinate system.

Machine axes

Machine axes are the motion units existing on a machine, which can also be designated as linear or rotary axes, depending on their usable movement.

Geometry axes

The geometry axes constitute the rectangular Cartesian basic coordinate system of a channel.

Generally, (Cartesian arrangement of the machine axes) direct imaging of the geometry axes to the machine axes is possible. If the arrangement of the machine axes, however, is not Cartesian at right angles, the imaging is performed using a kinematic transformation.

Special axes

Special axes are all axes of a channel that are not geometry or machine axes. Unlike for geometry axes (Cartesian coordinate system), no geometric context is defined for additional axes, neither between additional axes or with respect to geometry axes.

Channel axes

The total of all machine, geometry and special axes assigned to a channel is designated as channel axes.

The geometry and special axes represent the programming side of the machining process, i.e. they are used for programming in the part program.

The machine axes constitute the physical part of the machining process, i.e. they carry out the programmed traversing movements on the machine.

Axis assignment

The assignment of drives, machine axes, channel axes and geometry axes using the corresponding machine data is shown in the following Fig. 11-4:

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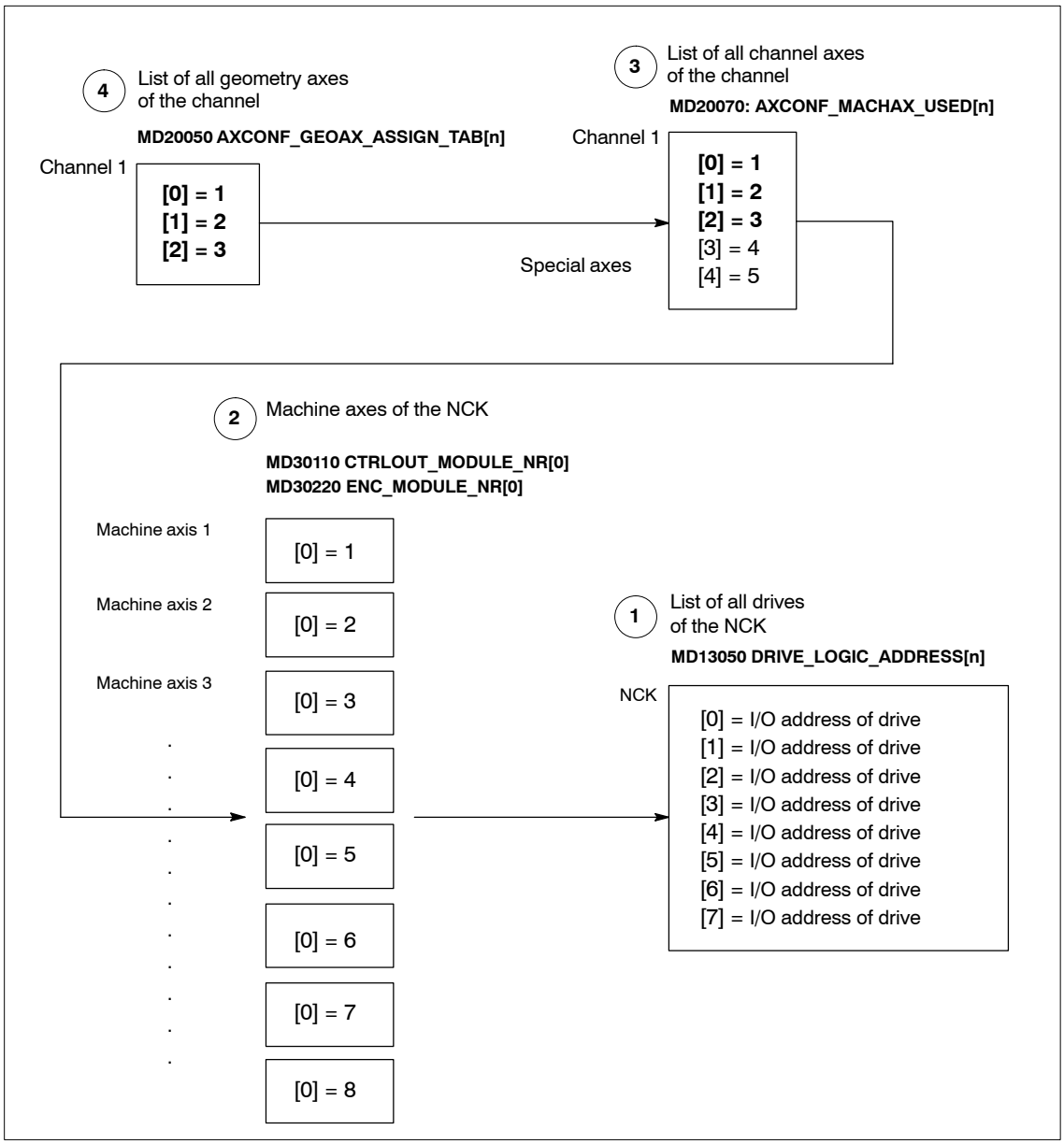


Fig. 11-4 Axis assignment

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(1) Machine data

- MD13050: DRIVE_LOGIC_ADDRESS[n] (I/O address of the drive)

tells the NCK the I/O addresses of the drives defined in the S7 project using "HW Config".

The machine data index (n+1) is the logical drive number for the NCK.

(2) The machine data

- MD30110: MODULE_NR[0] (setpoint assignment)
- MD30220: ENC_MODULE_NR[0] (actual–value assignment)

are used to assign each individual machine axis to a drive.

The logical drive number m to be entered in the two machine data refers to the entry with the index n=(m–1) in the list described under Point 1 MD13050: DRIVE_LOGIC_ADDRESS[n].

(3) Machine data

- MD20070: AXCONF_MACHAX_USED[n] (machine axis number valid in channel)

defines explicitly which channel axis and which machine axis is used and defines implicitly how many channel axes exist in the channel.

The machine axis number m to be entered in the machine data (with m=1,2,3...) is referred to the appropriate machine axis m.

(4) Machine data

- MD20050: AXCONF_GEOAX_ASSIGN_TAB[n] (assignment geometry axis – channel axis) (n = 0...2)

defines explicitly which channel axis is a geometry axis and defines implicitly how many geometry axes exist in the channel.

The channel axis number k to be entered in the machine data (k=1,2,3...) is referred to the entry with the index n (n=(k–1)=0,1,2...) in the list of the channel axes MD20070: AXCONFIG_MACHAX_USED[n] (see Point 3).

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Machine data

Table 11-15 Axis configuration: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
13050	DRIVE_LOGIC_ADDRESS	I/O address of drive	
Channel–specific ($MC_ ...)			
20050	AXCONF_GEOAX_ASSIGN_TAB	Assignment of geometry axis to channel axis	
20070	AXCONF_MACHAX_USED	Machine axis number valid in channel	
Axis–specific ($MA_ ...)			
30110	CTRLOUT_MODULE_NR	Setpoint assignment	
30220	ENC_MODULE_NR	Actual–value assignment	

References /**FB**/ **Description of Functions, Basic Functions**,
K2 Axes, Coordinate Systems, Frames, Workpiece Actual–Value System,
Chapter: Axes

11.5.2 Axis names

Each machine, channel and geometry axis can/must be assigned an individual name unambiguously identifying it in its name range.

Machine axes

Machine data

- MD10000: AXCONF_MACHAX_NAME_TAB [n] (machine axis name)

is used to define the machine axis names.

Machine axis names must be unambiguous for the entire NCK.

The names and the corresponding index defined in the machine data above is used for

- Accessing axis–specific machine data (loading, saving, displaying)
- Reference point approach from the part program G74
- Measurement
- Test point traversing from the part program G75
- Traversing the machine axis from PLC
- Display of axis–specific alarms
- Display in the actual–value system (machine–related)
- DRF handwheel function

Channel axes

Machine data

- MD20080: AXCONF_CHANAX_NAME_TAB[n] (name of the channel axis in the channel)

is used to define the channel axis names. Channel axis names must be unambiguous for the entire channel.

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Geometry axes

Machine data

- MD20060: AXCONF_GEOAX_NAME_TAB[n] (name of the geometry axis in the channel)

is used to define the geometry axis names. Geometry axis names must be unambiguous for the entire channel.

The axis names for channel and geometry axes are used in the part program for programming general traversing movements or to describe the workpiece contour. The axis names are used for

- Path axes
- Synchronized axes
- Positioning axes
- Command axes
- Spindles
- Gantry axes
- Coupled axes
- Guide value coupling axes

Machine data

Table 11-16 Axis names: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
10000	AXCONF_MACHAX_NAME_TAB	Machine axis name	
Channel–specific ($MC_ ...)			
20060	AXCONF_GEOAX_NAME_TAB	Geometry axis name in channel	
20080	AXCONF_CHANAX_NAME_TAB	Channel axis name/special axis name in channel	

References

/**FB**/ **Description of Functions, Basic Functions**,
K2 Axes, Coordinate Systems, Frames, Workpiece Actual–Value System,
Chapter: Axes

11.5.3 Drive configuration

The following data must be assigned parameters in the NCK for the cyclic process data exchange between the NCK and the DP slave drives:

- I/O address of the drives
- I/O address of the Control Units (optional, only SINAMICS)
- Message frame

I/O addresses

The I/O address tells the NCK the data areas via which cyclic process data exchange occurs with the drive or the Control Unit.

The I/O addresses assigned in the SIMATIC S7 project are entered in the following machine data:

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- MD13050 $MM_DRIVE_LOGIC_ADDRESS[n] (logical I/O address)
- MD13120 $MM_CONTROL_UNIT_LOGIC_ADDRESS (logical I/O address for the Control Unit (SINAMICS))

To parameterize the PROFIBUS communication for the drives, see:

- SINAMICS: Section 8.9, Page 8-223
- SIMODRIVE: Section 8.10, Page 8-231

Default values: Axes

The default values for the I/O addresses of the axes are designed so that there is sufficient clearance per axle, starting at I/O address 4100, each with a measuring circuit:

- MD13050 $MM_DRIVE_LOGIC_ADDRESS[n] = 4100 + n * 40

Notice

Any changes in the I/O addresses must be carried out consistently:

- **SIMATIC S7 project**
  HW Config: I/O address for actual value and setpoint
- **NCK**: MD13050 $MM_DRIVE_LOGIC_ADDRESS[n]
  or
  MD13120 $MM_CONTROL_UNIT_LOGIC_ADDRESS

  There is **no automatic adjustment!**

Message frame

The process data transferred between the NCK and the drives or Control Unit during cyclic process data exchange are defined via the message frame.

To select the message frame, see:

- SINAMICS: Section 8.9, Page 8-223
- SIMODRIVE: Section 8.10, Page 8-231

Note

You will find a detailed description of the message frame in each case in Section: ”Communication via PROFIBUS”:

- SINAMICS S120
  References: SINAMICS S120 Commissioning Manual
- SIMODRIVE 611 universal and universal E:
  References: /FBU/ Description of Functions SIMODRIVE 611 universal
- SIMODRIVE POSMO A
  References: /POS1/ User Manual SIMODRIVE POSMO A
- SIMODRIVE POSMO SI/CD/CA
  References: /POS3/ User Manual SIMODRIVE POSMO SI/CD/CA
- ADI4
  References: /Section 8.8; Page 8-222.

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The message frames set in the SIMATIC S7 project are entered in the following machine data:

- MD13060: DRIVE_TELEGRAM_TYPE[n] (drive message frame type)

Default values

The default values for the machine data are based on the following message frame:

- 102; Speed control with torque reduction, 1 position encoder

---

Notice

1. A change of the message frame type has to be carried out consistently:
   - **SIMATIC S7 project**, HW Config: Frame type
   - **NCK**: MD13060: DRIVE_TELEGRAM_TYPE[n]
   - **SINAMICS S120** or **SIMODRIVE 611 universal**:
     Parameter P0922 PROFIBUS message frame selection

     There is **no automatic adjustment!**
2. The order of the drives to which reference is made in the machine data
   - MD13050: DRIVE_LOGIC_ADDRESS[n]
   - MD13060: DRIVE_TELEGRAM_TYPE[n]

   must be identical in both machine data.

SIMODRIVE 611U functions

If a PROFIBUS drive does not support individual SIMODRIVE 611U–specific functions that are active by default, they must be deactivated on the NCk via the following drive–specific machine data:

- MD13070: DRIVE_FUNCTION_MASK[n] (used DP functions)

Bit	Function
0	Deactivation of the 611U–specific drive alarm generation
1	Deactivation of the 611U–specific drive type detection
2	Deactivation of the 611U–specific parameter accesses encoder drivers
3	Deactivation of the 611U–specific parameter accesses output drivers
4	Reserved
5	Deactivation of 611U–specific drive parking (STW2.7/STA2.7)
6	Deactivation of the 611U–specific travel to fixed stop (STW2.8/STA2.8)
7	Deactivation of the 611U–specific motor switchover internal (STW2.9 to 2.11)
8	Deactivation of the 611U–specific ramp block (STW1.11+13)
9	Deactivation of the 611U–specific function generator bits (STW1.8/STA1.13)
10	Deactivation of the parking brake control (STW1.12/STA2.5)
11	Deactivation of the effect of OFF2/OFF3 on driveReady (DB31,... DBB93, Bit5)
14	Selection of non–cyclic DP communication: 0 = DPT; 1 = DPV1
15	Deactivation of the consistency check of the PROFIBUS message frame configuration

ADI4

With an ADI4 module you can operate up to 4 drives with analog setpoint interface on an isochronous PROFIBUS.

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The 611U–specific functions (Bit0 – Bit3) and effects of OFF2/OFF3 on the signal ”driveReady” (Bit11) must be disabled for these drives. The machine data must be set for every drive operated via ADI4:

- MD13070: DRIVE_FUNCTION_MASK[n] = **80F**$_H$

Notice

The 611U–specific functions (Bit0 – Bit3) and effects of OFF2/OFF3 on the signal ”driveReady” (Bit11) must be disabled for all drives connected via ADI4.

- MD13070: DRIVE_FUNCTION_MASK[n] = 80F$_H$

Drive type DP

The NCK attempts to ascertain the drive type for each parameterized PROFIBUS drive. The drive type is shown in the following machine data:

- MD13080: DRIVE_TYP_DP[n] (drive type PROFIBUS DP)

The following drive types are displayed by the NCK:

– 1 FSD (SRM: Synchronous Rotary Motor)
– 2 MSD (ARM: Asynchronous Rotary Motor)
– 3 Linear drive

If the drive type cannot be ascertained by the NCK because, for example, the drive does not support acyclic communication or it has been deactivated via machine data:

- MD13070: DRIVE_FUNCTION_MASK (DP functions being used)

the following value is displayed:

– 0 No drive or drive type not known

Drive type DP: 4

If drive type 0 is displayed for a parameterized PROFIBUS drive, the value can be manually set to:

– 4 Drive does not support acyclic communication

Setting the drive type to value 4 has the following effects in HMI Advanced:

- **Drive parameters**
  No drive parameters are read.
- **Current and speed controller cycles**
  The current and speed controller cycles are not displayed.
- **Drive type**
  ANA is displayed as the drive type.
- **Speed control loop**
  The dialog box for measuring the speed control loop only offers measurements of the reference frequency response and setpoint step change.
- **Current control loop**
  The dialog box for measuring the current control loop is not offered.

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ADI4

Because a ADI4 module does not support acyclic communication on the PROFIBUS, we recommend entering value 4 as the drive type for any drive operated via ADI4:

- MD13080: DRIVE_TYP_DP[n] = **4**

Note

We recommend entering drive type 4 manually for drives connected via ADI4:

- MD13080: DRIVE_TYP_DP[n] = 4

Machine data

Table 11-17 Drive configuration: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
13050	DRIVE_LOGIC_ADDRESS[n]	Logical I/O address of drive	G2
13060	DRIVE_TELEGRAM_TYPE[n]	Drive message frame type for the drives connected to PROFIBUS DP	G2
13070	DRIVE_FUNCTION_MASK[n]	611U–specific DP functions in use	G2
13080	DRIVE_TYPE_DP[n]	Drive type PROFIBUS DP	G2

11.5.4 Setpoint/actual value channels

Note

In order to guarantee that the control runs up reliably, all machine axes are declared as simulation axes (without hardware).

- MD30130: CTRLOUT_TYPE (output type of setpoint value) = 0
- MD30240: ENC_TYPE (actual–value acquisition mode) = 0

Traversing of the axes in servo mode is simulated without speed setpoint output, and no hardware–specific alarms are output.

Machine data

- MD30350: SIMU_AX_VDI_OUTPUT (output of axis signals with simulation axes)

can be used to select whether the interface signals of a simulation axis are output at the PLC interface (e.g. during program test, if there is no drive hardware).

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Assignment of the setpoint/actual–value channels

For each machine axis that a drive is to be assigned,

- a setpoint channel and
- at least one actual–value channel

must be parameterized.

A second actual–value channel can be set up as an option.

Notice

The motor measuring system is always used for the speed control function. Motor and motor measuring system must therefore always be connected to the same drive module.

In the two axis–specific machine data:

- MD30110: CTRLOUT_MODULE_NR[0] (setpoint assignment: logic drive number)
- MD30220: ENC_MODUL_NR[n] (actual–value assignment: logic drive number)

must always be entered the same logic drive number m of the drive representing the machine axis.

The input value m refers to the drive whose I/O address is defined under the index n = (m–1) in MD13050: DRIVE_LOGIC_ADDRESS[n] (see Section 11.5.3, Page 11-314).

NCK reset

Once the drive configuration and setpoint/actual value assignment have been parameterized, an NCK reset must be executed to initiate a warm restart. After the NCK has booted, the new configuration becomes effective.

Measuring system switchover

The interface signals

- DB31, ... DBX1.5 (position measuring system 1 selected)
- DB31, ... DBX1.6 (position measuring system 2 selected)

can be used to switch from the PLC between the two position measuring systems of a machine axis.

References: /FB/ Description of Functions, Basic Functions
A2 Various Interface Signals

Machine data

Table 11-18 Setpoint/actual value channels: Machine data

Number	Identifier	Name/remarks	Reference
Axis–specific ($MA_ ...)			
30100	CTRLOUT_SEGMENT_NR	Setpoint assignment: Drive type 5 = PROFIBUS DP	
30110	CTRLOUT_MODULE_NR	Setpoint assignment: Logical drive number	

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Number	Identifier	Name/remarks	Refer-ence
30130	CTRLOUT_TYPE	Output type of setpoint 0 = simulation 1 = speed setpoint output	
30200	NUM_ENCS	Number of measuring channels 1 = one position measuring system installed 2 = two position measuring systems installed	
30210	ENC_SEGMENT_NR[0]	Actual value assignment Drive type 5 = PROFIBUS DP	
30220	ENC_MODULE_NR[0]	Actual value assignment: Logic drive number for position measuring system **1**	
30220	ENC_MODULE_NR[1]	Actual value assignment: Logic drive number for position measuring system **2**	
30230	ENC_INPUT_NR[0]	Actual value assignment: Position measuring system **1** 1 = motor measuring system 2 = direct measuring system	
30230	ENC_INPUT_NR[1]	Actual value assignment: Position measuring system **2** 1 = motor measuring system 2 = direct measuring system	
30240	ENC_TYPE[0]	Actual–value acquisition modes 0 = simulation 1 = incremental encoder 4 = absolute encoder with EnDat interface	

Interface signals

Table 11-19 Switching over the position measuring system: Interface signals

DB Number	Bit, byte	Name	Refer-ence
Axis/spindle–specific		**Signals from PLC to axis/spindle**	
31, ...	1.5	Position measuring system 1	
31, ...	1.6	Position measuring system 2	

References

/FB/ **Description of Functions, Basic Functions**
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Section: Setpoint/Actual Value System

/FB/ **Description of Functions, Basic Functions**
A2 Various Interface Signals
Section: Interface signals to axis/spindle

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11.5.5 Incremental measuring system settings

Rotary measuring system

The diagrams below show the general possibilities of arranging a rotary incremental measuring system with regard to motor and load, as well as the resulting values for the appropriate machine data.

Linear axis with encoder at motor

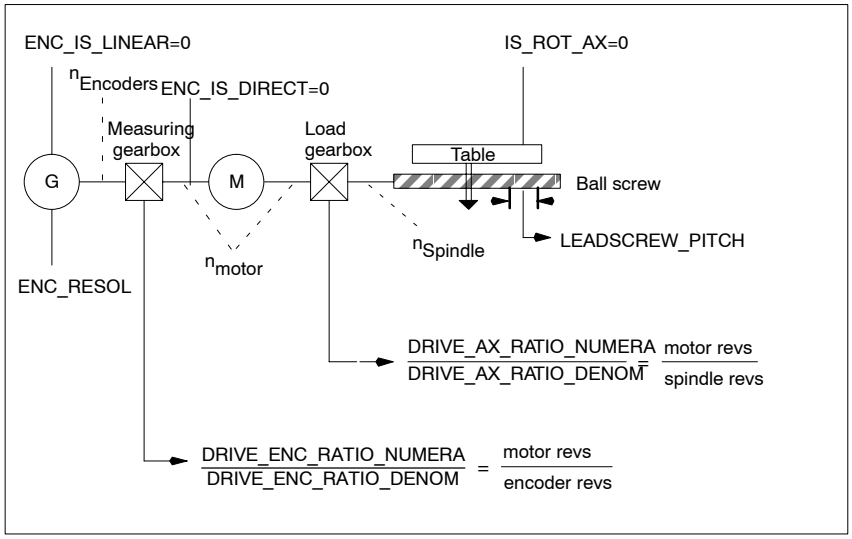


Fig. 11-5 Linear axis with encoder on motor

Linear axis with encoder on the machine

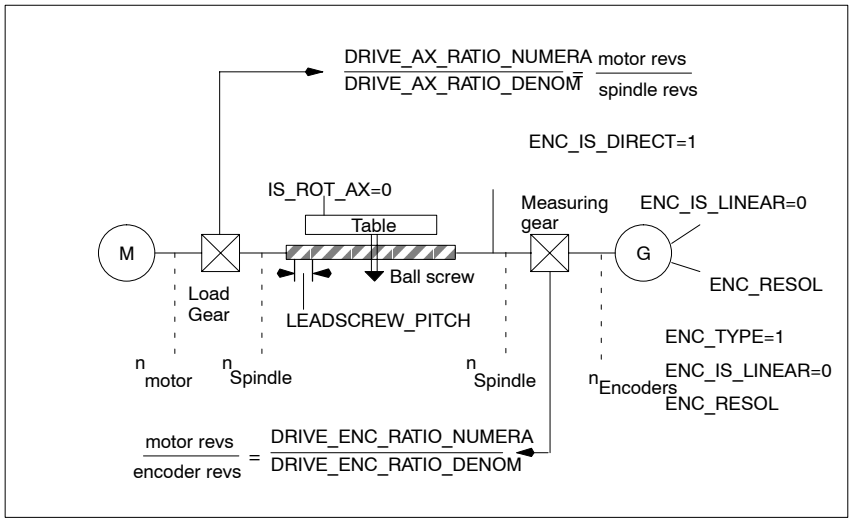


Fig. 11-6 Linear axis with encoder on the machine

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Rotary axis with encoder on motor

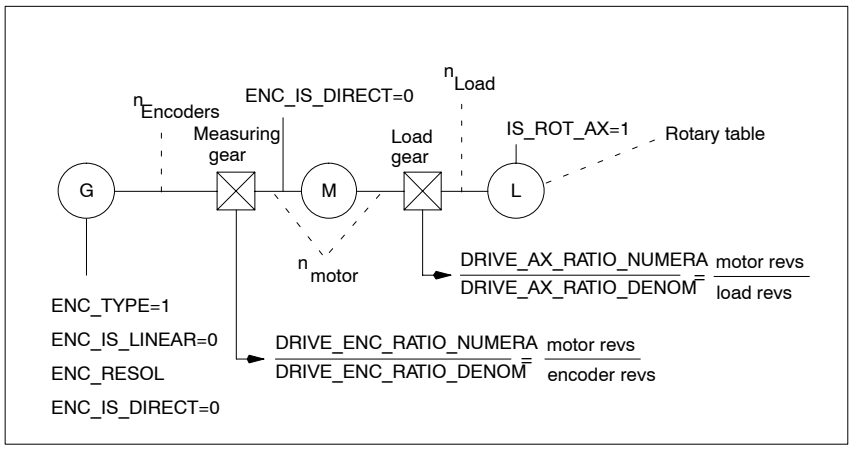


Fig. 11-7 Rotary axis with encoder on motor

Rotary axis with encoder on the machine

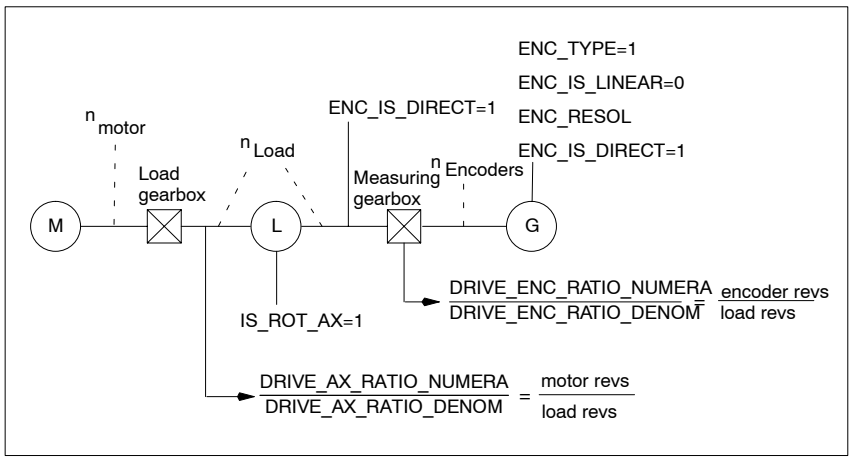


Fig. 11-8 Linear axis with encoder on the machine

Machine data

Table 11-20 Incremental measuring systems: Machine data

Number	Identifier	Name/remarks	Refer-ence
Axis–specific ($MA_ ...)			
30240	ENC_TYPE[n]	Actual–value acquisition modes 1 = incremental signal generator	
30242	ENC_IS_INDEPENDENT[n]	Encoder is independent	
30300	IS_ROT_AX	Rotary axis	R2
31000	ENC_IS_LINEAR[n]	Direct measuring system (linear scale)	
31020	ENC_RESOL[n]	Encoder pulses per revolution	
31030	LEADSCREW_PITCH	Leadscrew pitch	
31040	ENC_IS_DIRECT[n]	Encoder is connected directly to the machine	
31050	DRIVE_AX_RATIO_DENOM[n]	Denominator load gearbox	
31060	DRIVE_AX_RATIO_NUMERA[n]	Numerator load gearbox	
31070	DRIVE_ENC_RATIO_DENOM[n]	Denominator of resolver gearbox	
31080	DRIVE_ENC_RATIO_NUMERA[n]	Numerator of resolver gearbox	

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Linear measuring system

The diagrams below show the general possibilities of arranging a rotary incremental measuring system with regard to motor and load, as well as the resulting values for the respective machine data.

Linear axis with linear scale

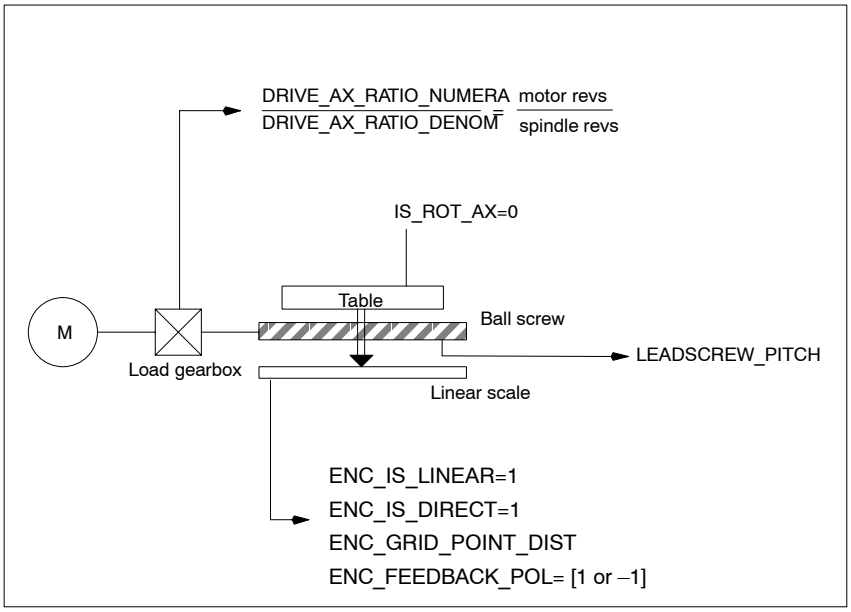


Fig. 11-9 Linear axis with linear scale

Machine data

Table 11-21 Linear measuring systems: Machine data

Number	Identifier	Name/remarks	Reference
Axis–specific ($MA_ ...)			
30240	ENC_TYPE[n]	Actual–value acquisition modes 1 = incremental signal generator	
30242	ENC_IS_INDEPENDENT[n]	Encoder is independent	
30300	IS_ROT_AX	Rotary axis	R2
31000	ENC_IS_LINEAR[n]	Direct measuring system (linear scale)	
31010	ENC_GRID_POINT_DIST[n]	Distance between reference marks on linear scales	
31030	LEADSCREW_PITCH	Leadscrew pitch	
31040	ENC_IS_DIRECT[n]	Encoder is connected directly to the machine	
31050	DRIVE_AX_RATIO_DENOM[n]	Denominator load gearbox	
31060	DRIVE_AX_RATIO_NUMERA[n]	Numerator load gearbox	
32110	ENC_FEEDBACK_POL[n]	Sign actual value (feedback polarity)	

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11.5.6 Parameterization of absolute measuring systems

Encoder types

The following encoder types are currently supported:

- Single–turn absolute value encoder
- Multi–turn absolute value encoder

with EnDat protocol and incremental sinusoidal encoder signals A and B, e.g. Haidenhain EQN 1325.

EQN 1325

The absolute value encoder EQN 1325 from Heidenhain has the following properties:

- EnDat protocol
- PPR count: 2048 = 2^{11} (encoder fine resolution)
- Positions/revolution: 8192 (13 bits)
- Differentiable revolutions: 4096 (12 bits)
- Encoder signals A/B: 1Vpp sin/cos

Calibration

Synchronization of the measuring system with the machine positions is performed by calibration of the absolute value encoder in absolute measuring systems. For calibration of the absolute value encoder, see Section 11.5.19, Page 11-362.

Rotary measuring systems

An absolute encoder can currently exclusively be used as a motor encoder (indirect measuring system).

Linear axis with rotary absolute encoder

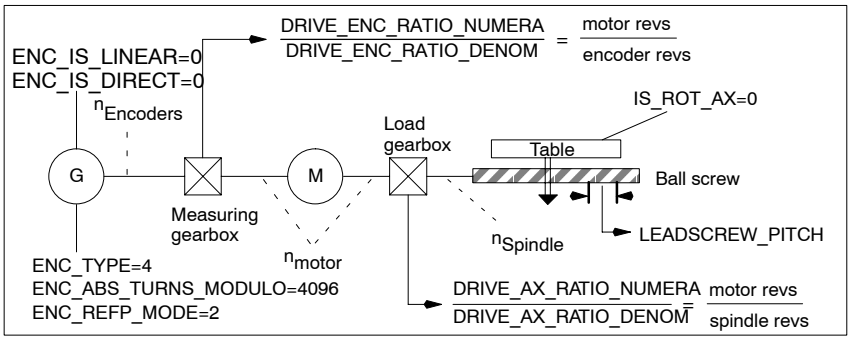


Fig. 11-10 Linear axis with absolute value encoder on motor

Rotary axis with absolute value encoder on motor

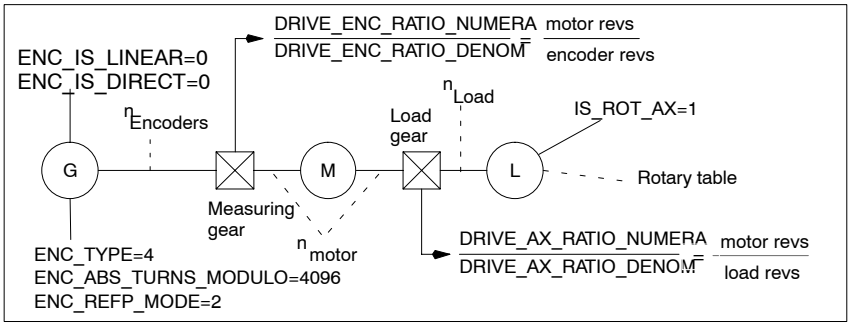


Fig. 11-11 Rotary axis with absolute value encoder on motor

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(ADI4)

For a machine axis whose measuring system consists of an absolute encoder on an ADI4 module, the following must be taken into consideration:

- Absolute encoder with SSI interface
  Since the ADI4 transfers the data from the absolute encoder to the NCK in EnDat format, encoder type "Absolute encoder gen." must be entered as the encoder type:
  – MD30240: $MA_ENC_TYPE (encoder type) = **4** (absolute encoder gen.)

  References

  /ADI4/ Analog drive port for 4 axes
  Section: Function parameters (SINUMERIK 840Di sl) and (SIMOTION)
  Encoder type

- Encoder fine resolution
  The fine resolution configured in the ADI4 (reserved bits for fine resolution) of the absolute encoder must be assumed by the NCK:
  – MD30260: $MA_ABS_INC_RATIO[n] (encoder fine resolution)

  References

  /ADI4/ Analog drive port for 4 axes
  Section: Function parameters (SINUMERIK 840Di sl) and (SIMOTION)
  Reserved bits for fine resolution

Boot with non–calibrated encoder

For axes with non–calibrated absolute encoder:

- MD34210 $MA_ENC_REFP_STATE == 0 (encoder not calibrated)

an alarm is displayed each time the NCK is booted:

- Alarm: "25022 axis <*Axis identifier*> Encoder <*Number*> Alarm 0"

Machine data

Table 11-22 Incremental measuring systems: Machine data

Number	Identifier	Name/remarks	Refer-ence
Axis–specific ($MA_ ...)			
30240	ENC_TYPE[n]	Actual–value acquisition modes	
30242	ENC_IS_INDEPENDENT[n]	Encoder is independent	
30260	ABS_INC_RATION[n]	Encoder fine resolution (absolute value encoder)	
30300	IS_ROT_AX[n]	Rotary axis	R2
31000	ENC_IS_LINEAR[n]	Direct measuring system (linear scale)	
31030	LEADSCREW_PITCH[n]	Leadscrew pitch	
31040	ENC_IS_DIRECT[n]	Encoder is connected directly to the machine	
31050	DRIVE_AX_RATIO_DENOM[n]	Denominator load gearbox	
31060	DRIVE_AX_RATIO_NUMERA[n]	Numerator load gearbox	
31070	DRIVE_ENC_RATIO_DENOM[n]	Denominator measuring gearbox	
31080	DRIVE_ENC_RATIO_NUMERA[n]	Numerator measuring gearbox	
34200	ENC_REFP_MODE[n]	Referencing mode	
34210	ENC_REFP_STATE[n]	Status of absolute value encoder	
34220	ENC_ABS_TURNS_MODULO[n]	Absolute value encoder range for rotary encoders (multi–turn resolution)	R2

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11.5.7 Parameterization of a 2nd measuring system with ADI4

Up to 2 measuring system can be parameterized for a machine axis. If it is not possible to connect the 2nd measuring system directly to the associated drive module, it is possible to use a ADI4 module.

Note

Detailed information about the measuring systems that can be connected to the ADI4 is to be found in:

References: /ADI4/ Analog drive interface for four axes
Section: Hardware Description

Parameterization example

The following parameterization example illustrates the basic procedure for parameterizing the NCK for a 2nd measuring system of a machine axis connected via ADI4. It assumes the following:

- **NCK**
  2 measuring systems are to be parameterized for the 1st machine axis.
  - 1st measuring system: ”motor measuring system” of the drive
  - 2nd measuring system: ”direct measuring system”
- **Drive**
  SIMODRIVE 611U 1 axis module is used as the drive with a connection option for a measuring system (motor encoder).
- **ADI4**
  The 2nd measuring system is connected via the encoder interface of the 1st axis of an ADI4 module. (Connection is possible via any axis of the ADI4 module.)

Configuration

The configuration is shown in Fig. 11-12.

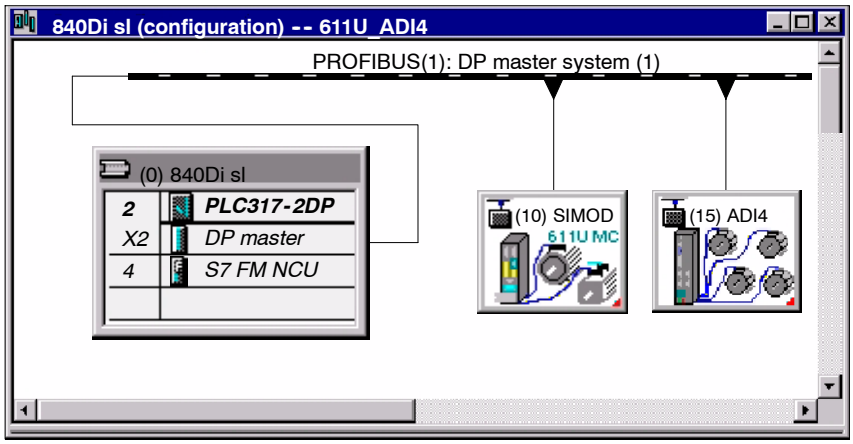


Fig. 11-12 Configuration: Axis with 2nd measuring system on ADI4

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I/O addresses and message frame types

The I/O addresses and message frame types for the drive and ADI4 axis are set to the following values in the configuration:

Drive

- Message frame type: Message frame 102
- I/O address: 4100

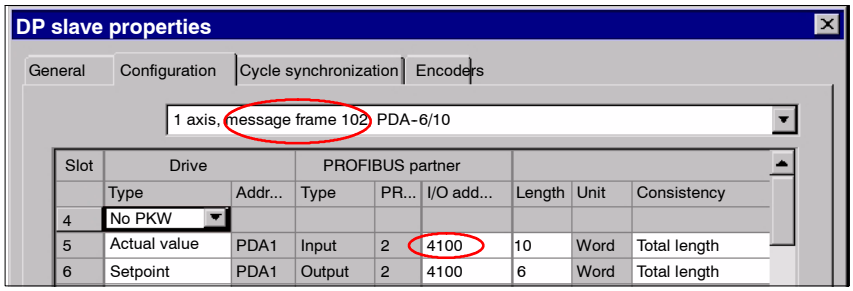


Fig. 11-13 DP slave properties: SIMODRIVE 611U

ADI4

- Message frame type: Standard message frame 3
- I/O address: 4200

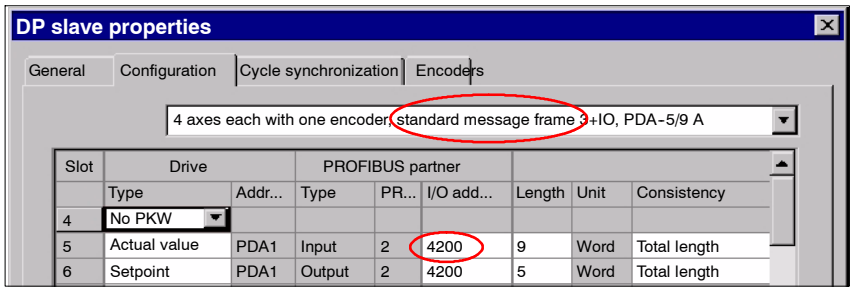


Fig. 11-14 DP slave properties: ADI4

NCK machine data

The general and axis-specific NCK machine data should be set as follows:

Drive assignment

The axis of the SIMODRIVE 611U drive module is assigned to the NCK as the 1st machine axis. This requires entry of its I/O address and message frame type under index 0:

- MD13050: DRIVE_LOGIC_ADRESS[**0**] = 4100
- MD13060: DRIVE_TELEGRAM_TYPE[**0**] = 102

The I/O address and the message frame type of the 1st axis of the ADI4 module will be entered in the next free machine data (e.g. Index 3):

- MD13050: DRIVE_LOGIC_ADRESS[**3**] = 4200
- MD13060: DRIVE_TELEGRAM_TYPE[**3**] = 3

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Assignment of the actual value channels

Assignment of the 1st measuring system (index 0) of the machine axis to the measuring circuit input of the SIMODRIVE 611U drive module is performed via the axis–specific machine data:

- MD30220: ENC_MODUL_NR[**0**] = **1**
  with 1 = (Index 0 of the corresponding MD13050 + 1)

Assignment of the 2nd measuring system (index 1) of the machine axis to the measuring circuit input of the ADI4 module is performed via the axis–specific machine data:

- MD30220: ENC_MODUL_NR[**1**] = **4**
  with 4 = (Index 3 of the corresponding MD13050 + 1)

See Section 11.5.4, Page 11-318.

Machine data

Table 11-23 Drive configuration: Machine data

Number	Identifier	Name/remarks	Reference
General ($MN_ ...)			
13050	DRIVE_LOGIC_ADDRESS[n]	Logical I/O address of drive	G2
13060	DRIVE_TELEGRAM_TYPE[n]	Drive message frame type for the drives connected to PROFIBUS DP	G2
30220	ENC_MODULE_NR[0]	Actual value assignment: Logic drive number for position measuring system **1**	
30220	ENC_MODULE_NR[1]	Actual value assignment: Logic drive number for position measuring system **2**	

Interface signals

Table 11-24 Switching over the position measuring system: Interface signals

DB Number	Bit, byte	Name	Reference
Axis/spindle–specific	**Signals from PLC to axis/spindle**		
31, ...	1.5	Position measuring system 1	
31, ...	1.6	Position measuring system 2	

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11.5.8 DSC (Dynamic Servo Control)

The DSC function eliminates the deadtime that necessarily exists at the speed–setpoint interface normally used between the NCK and drive due to relocation of the position controller into the drive.

That results in the following advantages for an axis operated with DSC:

- Considerably improved fault response/stability of the position control loop
- Improved control behavior (contour precision) if the higher servo gain (KV factor) that can be set in conjunction with DSC is used.
- A reduction of the cyclic communication load on the PROFIBUS, if the position control cycle/PROFIBUS cycle is reduced by adjusting the above parameters, even if the control loop performance is the same.

Note

The speed feedforward control can be used in conjunction with DSC.

Requirements

Before you can activate DSC mode, the following preconditions must be fulfilled:

- DSC–capable drive, e.g.:
  - SINAMICS S120
  - SIMODRIVE 611 universal
  - SIMODRIVE POSMO CD/CA
  - SIMODRIVE POSMO SI distributed servo drive
- A DSC–capable message frame type has been parameterized in the S7 project for the drive (see Section 8.9, Page 8-223).

Switch ON/OFF

The DSC function is switched ON via the following axis–specific NCK machine data:

- MD32640: STIFFNESS_CONTROL_ENABLE (dyn. stiffness control)

If DSC operation is switched ON or OFF, it might be necessary to adjust the following machine data:

- MD32200: POSCTRL_GAIN (KV factor)
- MD32610: VELO_FFW_WEIGHT (feedforward control factor)
- MD32810: EQUIV_SPEEDCTRL_TIME (substitute time const. of the closed speed control loop).

Notice

Before you can switch off DSC operation you might have to adapt (reduce) the KV factor of the axis. Otherwise, instability of the position control loop might result.

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Speed setpoint filter

If you use DSC, a speed setpoint filter for rounding the speed setpoint steps is no longer necessary. The speed setpoint filter is then only of any use with difference injection to support the position controller, for example, to suppress resonance.

Measuring system

DSC is only possible in conjunction with the motor measuring system.

Machine data

Table 11-25 DSC: Machine data

Number	Identifier	Name	Reference
Axis–specific ($MA_ ...)			
32640	STIFFNESS_CONTROL_ENABLE	Dyn. stiffness control	DD2
32200	POSCRTL_GAIN	KV factor	G2

11.5.9 Drive optimization

Optimization of the control loop (current, speed, and position control loop) of the drives can be performed with:

- HMI Advanced (see Section 14, Page 14-427)
  - Depending on the installation version: SINAMICS S120 or SIMODRIVE drives
- SINAMICS STARTER commissioning tool
  - SINAMICS S120
- SIMODRIVE SimoCom U commissioning tool
  - SIMODRIVE 611 universal/E
  - SIMODRIVE POSMO CD/CA
  - SIMODRIVE POSMO SI distributed servo drive

Note

Detailed information on measuring the filter frequency response and optimizing torque/current and speed control loop can be found in:

- SINAMICS
  Online Help for Commissioning Tool: STARTER > Contents > Diagnostics functions
- SIMODRIVE 611 universal/E, POSMO CD/CA and SI
  Online Help for SimoCom U Commissioning Tool > Index:
  - Measuring function
  - Optimization of speed control loop

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11.5.10 Rotary axes

Rotary axes

A machine axis is parameterized as a rotary axis in

- MD30300: IS_ROT_AX (rotary axis) = 1

The machine data is a scaling machine data. A change results in a conversion of all machine data of the machine axis with length–related units.

For the recommended procedure with respect to scaling machine data, please refer to Section 11.3.3, Page 11-296.

Modulo display

Machine data

- MD30320: DISPLAY_IS_MODULO (modulo 360 degrees display for rotary axes)

is used to display the rotary axis position modulo 360 degrees.

Endlessly rotating rotary axis

The machine data

- MD30310: ROT_IS_MODULO (modulo conversion for rotary axis)

is used to traverse the rotary axis modulo 360 degrees. The limit switches are not monitored during this process. The rotary axis can thus rotate endlessly.

Machine data

Table 11-26 Rotary axes: Machine data

Number	Identifier	Name	Refer-ence
General ($MN_ ...)			
10210	INT_INCR_PER_DEG	Computational resolution for angular positions	G2
Axis–specific ($MA_ ...)			
30300	IS_ROT_AX	Axis is rotary axis	
30310	ROT_IS_MODULO	Modulo conversion for rotary axis	
30320	DISPLAY_IS_MODULO	Actual value display modulo	
36100	POS_LIMIT_MINUS	software limit switch minus	A3
36110	POS_LIMIT_PLUS	Software limit switch plus	A3

Setting data

Table 11-27 Rotary axes: Setting data

Number	Identifier	Name	Refer-ence
General ($SN_ ...)			
41130	JOG_ROT_AX_SET_VELO	JOG speed for rotary axes	H1
Axis–specific ($SA_ ...)			
43430	WORKAREA_LIMIT_MINUS	Working area limitation minus	A3
43420	WORKAREA_LIMIT_PLUS	Working area limitation plus	A3

References

/**FB**/ **Description of Functions – Extended Functions**
R2 Rotary axes

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11.5.11 Positioning axes

Positioning axes are channel axes traversing parallel to the path axes without interpolating with them.

Positioning axes can be traversed either from the part program or from the PLC.

Concurrent positioning axes

The machine data

- MD30450: IS_CONCURRENT_POS_AX (concurr. positioning axis) = 1

is used to assign the PLC a channel axis by default. To traverse it from the part program later, it must be requested explicitly using a part program statement (GET).

Positioning axis feed

If a positioning axis is programmed in the part program without specifying an axis–specific feedrate, the feedrate entered in

- MD32060: POS_AX_VELO (initial setting for positioning axis velocity)

will apply to this axis automatically.

This feedrate will apply until an axis–specific feedrate is programmed in the part program for this axis.

Machine data

Table 11-28 Positioning axes: Machine data

Number	Identifier	Name	Refer-ence
Channel–specific ($MC_ ...)			
22240	AUXFU_F_SYNC_TYPE	Output timing of F functions	H2
Axis–specific ($MA_ ...)			
30450	IS_CONCURRENT_POS_AX	Concurrent positioning axis	
32060	POS_AX_VELO	Feedrate for positioning axis	

Interface signals

Table 11-29 Positioning axes: Interface signals

DB number	Bit, byte	Name	Refer-ence
Axis/spindle–specific		**Signals from PLC to axis/spindle**	
31,...	0	Feedrate override, axis–specific	
31,...	2.2	Delete distance–to–go, axis–specific	
		Signals from axis/spindle to PLC	
31,...	74.5	Positioning axis	
31,...	78–81	F function (feedrate) for positioning axis	

References

/FB/ **Description of Functions – Extended Functions**, P2 Positioning axes

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11.5.12 Indexing axes

Indexing axis are rotary or linear axes that may only be traversed within their traversing range to defined positions, the indexing positions.

Traversing to indexing positions using the part program or manually is only effective if the corresponding machine axis has been successfully referenced.

The indexing positions are stored in tables.

Indexing axis

Machine data

- MD30500: INDEX_AX_ASSIGN_POS_TAB[n] (axis is indexing axis)

assigns the machine axis the relevant table of indexing positions and also defines the machine axis as an indexing axis.

Indexing position tables

The indexing positions are stored in one of 2 possible tables.

- MD10900: INDEX_AX_LENGTH_POS_TAB_1 (number of positions of indexing table 1)
- MD10910: INDEX_AX_POS_TAB_1[n] (indexing position table 1)
- MD10920: INDEX_AX_LENGTH_POS_TAB_2 (number of positions of indexing table 2)
- MD10930: INDEX_AX_POS_TAB_2[n] (indexing position table 2)

Machine data

Table 11-30 Indexing axes: Machine data

Number	Identifier	Name	Reference
General ($MN_ ...)			
10260	CONVERT_SCALING_SYSTEM	Basic system switch–over active	G2
10270	POS_TAB_SCALING_SYSTEM	Measuring system of position tables	
10900	INDEX_AX_LENGTH_POS_TAB_1	Number of indexing positions used in Table 1	
10910	INDEX_AX_POS_TAB_1[n]	Indexing position table 1	
10920	INDEX_AX_LENGTH_POS_TAB_2	Number of indexing positions used in Table 2	
10930	INDEX_AX_POS_TAB_2[n]	Indexing position table 2	
Axis/spindle–specific ($MA_ ...)			
30300	IS_ROT_AX	Rotary axis	R2
30310	ROT_IS_MODULO	Modulo conversion for rotary axis	R2
30320	DISPLAY_IS_MODULO	Position display modulo 360°	R2
30500	INDEX_AX_ASSIGN_POS_TAB	Axis is indexing axis	
30501	INDEX_AX_NUMERATOR	Numerator for indexing axes with equidistant positions	

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Interface signals

Table 11-31 Indexing axes: Interface signals

DB number	Bit, byte	Name	Reference
Axis/spindle–specific		**Signals from axis/spindle to PLC**	
31,...	60.4, 60.5	Referenced/synchronized 1, referenced/synchronized 2	R1
31,...	76.6	Indexing axis in position	

References /FB/ **Description of Functions, Extended Functions**, T1 Indexing axes

11.5.13 Parameter sets of axis/spindle

Per machine axis, 6 parameter sets are available. They are used as follows

- on an axis:
  for accommodation of the own dynamic response to another machine axis, e.g. when tapping or thread cutting.
- on a spindle:
  quick accommodation of the position controller to modified properties of the machine during operation, e.g. when switching the gearbox.

Tapping, thread cutting

The following applies to axes:

- For a machine axis that is not involved in tapping or thread cutting, the 1st set of parameters (index=0) is active in all cases.

  All other parameter sets do not need to be taken into account.
- Machine axes involved in tapping or thread cutting: the parameter set is activated in accordance with the current gear stage.

  All parameter sets must be assigned parameters according to the gear stages of the spindle.

The following applies to spindles:

- With spindles, each gear stage is assigned a parameter set of its own. The parameter set is selected from the PLC using the interface signal DB31, ... DBX16.0 – 16.2 (actual gear stage).

  All parameters sets must be assigned parameters according to the gear stages of the spindle.

For example, in HMI Advanced, the active parameter set of a machine axis is displayed in the control area ”DIAGNOSIS” in the screen form ”Service Axis”.

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Parameter set no.	Axis	Spindle	Spindle gear stage
0	Default	Axis mode	As specified by manufacturer
1	Axis interpolates with spindle (G33)	Spindle mode	1.
2	Axis interpolates with spindle (G33)	Spindle mode	2.
3	Axis interpolates with spindle (G33)	Spindle mode	3.
4	Axis interpolates with spindle (G33)	Spindle mode	4.
5	Axis interpolates with spindle (G33)	Spindle mode	5.

Fig. 11-15 Validity of parameter sets for axis and spindle modes

Machine data

The following machine data of a machine axis depend on the parameter set:

n = parameter set number (0 ... 5)

Table 11-32 Parameter–set–dependent machine data

Number	Identifier	Name	Reference
Axis/spindle–specific ($MA_ ...)			
31050	DRIVE_AX_RATIO_DENOM[n]	Denominator load gearbox	
31060	DRIVE_AX_RATIO_NUMERA[n]	Numerator load gearbox	
32200	POSCTRL_GAIN [n]	K_V factor	
32810	EQUIV_SPEEDCTRL_TIME [n]	Equivalent time constant, of speed control loop for feed forward control	
32910	DYN_MATCH_TIME [n]	Time constant for dynamic matching	
35110	GEAR_STEP_MAX_VELO[n]	Maximum speed for gear change	
35120	GEAR_STEP_MIN_VELO[n]	Minimum speed for gear change	
35130	GEAR_STEP_MAX_VELO_LIMIT[n]	Maximum speed of gear stage	
35140	GEAR_STEP_MIN_VELO_LIMIT[n]	Minimum speed of gear stage	
35200	GEAR_STEP_SPEEDCTRL_ACCEL[n]	Acceleration in speed control mode	
35210	GEAR_STEP_POSCTRL_ACCEL[n]	Acceleration in position control mode	
36200	AX_VELO_LIMIT [n]	Threshold value for velocity monitoring	

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11.5.14 Position controller

Control loops

The closed–loop control of a machine consists of the cascaded closed–loop control circuits of current controller, speed controller and position controller.

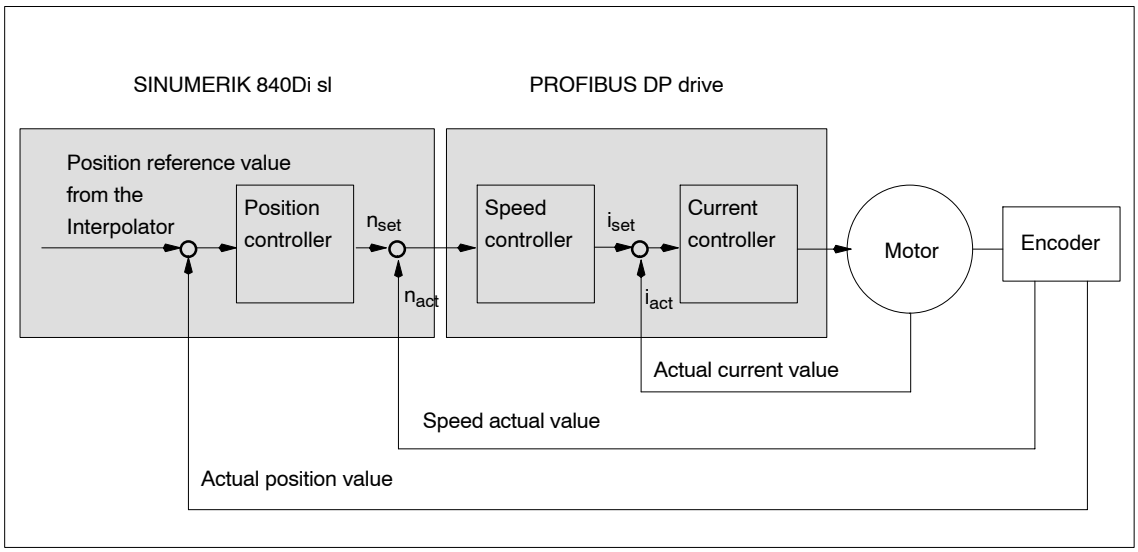


Fig. 11-16 Control loops

Traversing direction

If the axis does not traverse into the desired direction, the appropriate adaptation is made in

- MD32100: AX_MOTION_DIR (traversing direction)

The value ”–1” reverses the direction of motion.

Control direction

If the control direction of the position measuring system is incorrect, it can be adjusted with

- MD32110: ENC_FEEDBACK_POL (sign of actual value)

Servo gain

To obtain high contour accuracy, a high loop gain (K_V factor) of the position controller is required. However, an excessively high K_V factor causes overshoot, instability and impermissibly high machine loads.

The maximum permissible K_V factor is dependent on the dynamic response of the drive and the mechanical system of the machine.

If ”0” is entered for the loop gain factor, the position controller will be disconnected.

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Definition of K_V factor

The servo gain factor is defined as the ratio of velocity in m/min and the resulting following error in mm

$$K_V = \frac{\text{Velocity}}{\text{Following error}} \quad \left[\frac{\text{[m/min]}}{\text{[mm]}}\right]$$

i.e. with a Kv factor of 1 and a velocity of 1 m/min, the following error will be 1 mm.

Via

- MD32200: POSCTRL_GAIN (Kv factor)

is used to specify the Kv factor of the machine axis.

Note

To adapt the input/output unit of the Kv factor selected by default to the internal unit [1/s], the following machine data are assigned by default:

- MD10230: SCALING_FACTORS_USER_DEF[9] = 16.666667
- MD10220: SCALING_USER_DEF_MASK = 'H200'; (bit no 9 as hex value).

When entering the servo gain factor it is important to check that the gain factor of the whole position control loop is still dependent on other parameters of the controlled system.

These factors are:

- MD32260: RATED_VELO
- MD32250: RATED_OUTVAL
- Tacho adjustment on the speed controller
- Tacho generator on drive.

Notice

Machine axis that interpolate one with another must have the same following error at the same velocities.

This can be achieved by setting the same K_V factor or dynamic response adaptation in:

- MD32900: DYN_MATCH_ENABLE
- MD32910: DYN_MATCH_TIME

The real servo gain factor can be checked with the following error in the service display.

- e.g. HMI Advanced: Operating area "DIAGNOSIS" > Service displays > Service axis.

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Checking the loop gain

If a K_V factor is already known for a machine type in question, this can be set and checked. For checking, reduce the acceleration of the axis in

- MD32300: MAX_AX_ACCEL (axis acceleration)

to make sure that the drive does not reach its current limit when accelerating and decelerating.

The K_V factor must also be checked for high speeds of the rotary axis and spindle (e.g. for spindle positioning, tapping).

The approach behavior at various speeds can be checked by means of a storage oscilloscope or the HMI Advanced servo trace software. The speed setpoint is recorded for this purpose.

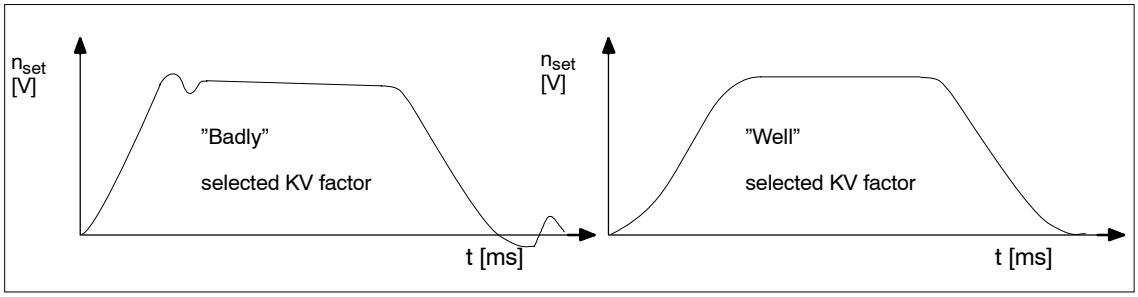


Fig. 11-17 Speed setpoint characteristic

No overshoots may occur while the drive is approaching the static states; this applies to all speed ranges.

Overshoot in the control loop

The reasons for an overshoot in the control loop can be:

- Acceleration too high (current limit is reached)
- Rise time too long (re–optimization necessary)
- Mechanical backlash
- Mechanical components canted

For safety reasons, set the K_V factor to a little less than the maximum possible value.

The real K_V factor must precisely match that set because monitoring functions are derived from the K_V factor that would otherwise respond (e.g. contour monitoring).

Acceleration

The machine axes are accelerated and decelerated with the acceleration entered in

- MD32300: MAX_AX_ACCEL (axis acceleration)

This value should allow the axes to be accelerated and positioned rapidly and accurately while ensuring that the machine is not unduly loaded.

Default values

The default values of the acceleration are in the range from 0.5 m/s^2 to 2 m/s^2

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Checking the acceleration

The sign of a properly adjusted acceleration of a machine axis is acceleration and positioning free from overshoot at rapid traverse rate and maximum load (heavy workpiece).

After the acceleration has been entered, the axis is traversed rapidly and the actual current values and current setpoint are recorded.

Note

- SINAMICS
  The current actual value/setpoint can be recorded using the STARTER trace function.
- SIMODRIVE
  The current actual value/setpoint can be recorded using the SimoCom–U trace function.

The online help provides more detailed information.

This recording shows whether the drive reaches the current limit. Here, the current limit can be reached for a short time.

However, the current must be well below the current limit before the rapid traverse velocity or the final position is reached.

Load changes during machining must not cause the current limit to be reached. Excessive current during machining causes falsification of the contour. For this reason, the acceleration value should be a little bit less than the maximum acceleration value.

Machine axes can have different acceleration values, even if they interpolate with each other.

Machine data

Table 11-33 Position control: Machine data

Number	Identifier	Name/remarks	Reference
Axis–specific ($MA_ ...)			
32100	AX_MOTION_DIR[n]	Traversing direction	
32110	ENC_FEEDBACK_POL[n]	Actual value sign	
32200	POSCTRL_GAIN [n]	Servo gain factor Kv	
32300	MAX_AX_ACCEL[n]	Axis acceleration	
32900	DYN_MATCH_ENABLE[n]	Dynamic response adaptation	
32910	DYN_MATCH_TIME [n]	Time constant for dynamic matching	

References

/FB/ **Description of Functions, Basic Functions**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Section: Closed–loop control

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11.5.15 Speed setpoint matching

In the case of speed setpoint comparison, the NCK is informed, which speed setpoint corresponds to which motor speed in the drive, for parameterizing the axial control and monitoring. Speed setpoint matching can be performed automatically or manually.

Automatic adjustment

Automatic speed setpoint matching can be performed for the following drives:

- SINAMICS S120
- SIMODRIVE 611 universal/E
- SIMODRIVE POSMO CD/CA
- SIMODRIVE POSMO SI distributed servo drive

If the value 0 is entered in machine data

- MD32250: RATED_OUTVAL (rated output voltage) [%]

(default value on SINUMERIK 840Di sl), the speed setpoint is automatically matched between the NCK and drive when the NCK is started up.

Note

If automatic speed setpoint matching fails for one axis, the following message is output on a traverse request for this axis:

- Message: ”Wait, axis enable missing”

This axis and any axes that interpolate with it are not traversed.

Manual adjustment

If a value not equal to 0 is entered in machine data:

- MD32250: RATED_OUTVAL (rated output voltage) [%]

no automatic speed setpoint matching is performed. Speed setpoint matching must be performed manually using the following axis-specific machine data:

- MD32250: RATED_OUTVAL (rated output voltage) [%]
- MD32260: RATED_VELO (rated motor speed) [rev/min]

The rated motor speed entered in axis-specific machine data: MD32260: RATED_VELO with reference to 100% must be equal to the speed evaluation parameterized in the drive:

$$\frac{\textbf{SINUMERIK 840Di sl NCK}\ \text{MD32260: RATED_VELO}}{\text{MD32250: RATED_OUTVAL}} * 100 = \textbf{Drive}\ \text{Drive-related speed evaluation}$$

ADI4

Because ADI4 does not support acyclic services on the PROFIBUS DP, manual speed setpoint matching must be performed.

The axis-specific machine data:

- MD32260: RATED_VELO (rated motor speed) [rev/min]

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- MD32250: RATED_OUTVAL (rated output voltage) [%]

the reference between the speed setpoint set by the NCK and the associated output voltage at the setpoint output of the ADI4 is established (reference voltage = 10 V).

SINUMERIK 840Di sl NCK		ADI4
MD32260: RATED_VELO	≙	$10\ V * \frac{\text{MD32250: RATED_OUTVAL}}{100}$

Note

The max. upper limit for the speed setpoint is set in machine data

- MD36210: CTRLOUT_LIMIT (max. speed setpoint) [%]

Values greater than 100 % make sense in connection with ADI4 because the DACs of the ADI4 limit the output voltage to 10 V.

Calculation of the motor speed

If the motor speed required for speed setpoint matching is not known directly, it can be calculated as follows with reference to the required axis velocity (linear axis) or load speed (rotary axis/spindle):

Motor speed for linear axis

$$n_{Motor} = \frac{v_{Axis} * \frac{\text{MD31060: DRIVE_RATIO_NUMERA}}{\text{MD31050: DRIVE_RATIO_DENOM}}}{\text{MD31030: LEADSCREW_PITCH}}$$

Motor speed for rotary axis/spindle

$$n_{Motor} = n_{Load} * \frac{\text{MD31060: DRIVE_RATIO_NUMERA}}{\text{MD31050: DRIVE_RATIO_DENOM}}$$

- v_{Axis} [mm/min]
- MD31060: DRIVE_RATIO_NUMERA (numerator load gearbox)
- MD31050: DRIVE_RATIO_DENOM (denominator load gearbox)
- MD31030: LEADSCREW_PITCH (pitch of the ball screw) [mm/rev]
- n_{Motor} [rpm]
- n_{Load} [rpm]

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Checking of matching

Incorrect speed setpoint matching has a negative impact on the real servo gain of the axis.

To check speed setpoint matching it is necessary for a defined traverse velocity to compare the actual following error with the desired following error that should be set if speed setpoint matching is correct.

$$\text{Desired following error} = \frac{\text{Traverse rate}}{\text{MD32200: POSCTRL_GAIN}}$$

- Desired following error [mm]
- Traversing velocity [m/min]
- MD32200: POSCTRL_GAIN (Kv factor) [(m/min)/mm]

The actual following error is shown in the axis–specific service data:

HMI Advanced:
Operating area switchover > Diagnosis > Service displays > Service axis/spindle

Machine data

Table 11-34 Speed setpoint matching: Machine data

Number	Identifier	Name/remarks	Refer-ence
Axis–specific ($MA_ ...)			
32250	RATED_OUTVAL	Rated output voltage	G2
32260	RATED_VELO[n]	Rated motor speed	G2

References

/**FB**/ **Description of Functions, Basic Functions**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Section: Velocities, traversing ranges, accuracies

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11.5.16 Drift compensation

Digital drives

Digital drives are not subject to drift or compensate for it automatically.

ADI4

Because ADI4 does not support acyclic services on the PROFIBUS DP, drift compensation must be performed manually by entering the appropriate compensation value in the axial machine data

- MD36720 DRIFT_VALUE (basic drive value)

Manual drift compensation

Manual drift compensation is performed with the axis **at zero speed** as follows:

Requirements

– Zero speed of the axis
– Axis enables pending

- Speed–controlled axis

  The drift causes constant traversing of the axis. To compensate for the drift, the compensation value is incremented/decremented step by step depending on the direction of the drift until the axis reaches zero speed.

- Position–controlled axis

  The drift causes a constant following error or position setpoint ≠ 0. To compensate for the drift, the compensation value is incremented/decremented step by step depending on the direction of the drift until following error or position setpoint = 0 is displayed.

  HMI Advanced:
  Operating area switchover > Diagnosis > Service displays > Service axis/spindle



Warning

If an axis is used for the function DSC (Direct Servo Control)

- MD32640: STIFFNESS_CONTROL_ENABLE (dyn. stiffness control) = 1

no drift compensation may be enabled for that axis.

Drift compensation causes extreme speed fluctuations during switch–on/off of the DSC function.

Machine data

Table 11-35 Drift compensation: Machine data

Number	Identifier	Name/remarks	Reference
Axis–specific ($MA_ ...)			
36720	DRIFT_VALUE	Basic drift value	G2

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11.5.17 Velocity matching (axis)

Max. axis velocity

The value entered in machine data

- MD32000: MAX_AX_VELO[n] (max. axis velocity)

is the limit velocity up to which a machine axis can accelerate (rapid traverse limiting). It depends on the machine and drive dynamics and the limit frequency of actual–value acquisition.

The max. axis velocity is used for traversing in the part program when rapid traverse (G00) is programmed.

Depending on MD30300: IS_ROT_AX[n], the maximum linear and rotary axis velocity must be entered in the machine data.

Rapid traverse in JOG mode

The value entered in machine data

- MD32010: JOG_VELO_RAPID[n] (rapid traverse in JOG mode)

or

- MD32040: JOG_REV_VELO_RAPID[n] (revolutional feedrate in JOG mode with rapid traverse override)

is the velocity at which the machine axis traverses in JOG mode with the rapid traverse override key actuated and with an axial feedrate override of 100%.

The entered value may not exceed the max. permissible axis velocity.

This machine data will not be used for the programmed rapid traverse G00.

Axis velocity in JOG mode

The value entered in machine data

- MD32020: JOG_VELO[n] (axis velocity in JOG mode) or
- MD32050: JOG_REV_VELO[n] (revolutional feedrate in JOG mode)

is the velocity at which the machine axis traverses in JOG mode with an axial feedrate override of 100%.

The velocity defined in MD32020: JOG_VELO[n] or MD32050: JOG_REV_VELO[n] will only be used if

- for linear axes: SD41110: JOG_SET_VELO = 0
- for rotary axes: SD41130: JOG_ROT_AX_SET_VELO = 0

or

- at revolutional feed: SD41120: JOG_REV_SET_VELO = 0.

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If the above mentioned setting data are unequal to 0, the JOG velocity results as follows:

1. SD: JOG_REV_IS_ACTIVE (revolutional feedrate in JOG mode) = 0
   => linear feed (G94)
   - Linear axes:
     JOG velocity = SD41110: JOG_SET_VELO (JOG velocity for G94)
   - Rotary axes:
     JOG velocity = SD41130: JOG_ROT_AX_SET_VELO (JOG velocity for rotary axes)
2. SD: JOG_REV_IS_ACTIVE (revolutional feedrate in JOG mode) = 1
   - JOG velocity = SD41120: JOG_REV_SET_VELO (JOG speed with G95)

The entered value may not exceed the max. permissible axis velocity.

Notice

- Depending on MD30300: IS_ROT_AX[n], the velocities have to be entered in mm/min, inch/min, or rpm.
- If the velocities change, MD36200: AX_VELO_LIMIT[n] (threshold value for velocity monitoring) must be adapted accordingly.

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Machine data

Table 11-36 Velocities: Machine data

Number	Identifier	Name/remarks	Reference
Axis–specific ($MA_ ...)			
30300	IS_ROT_AX[n]	Rotary axis	
32000	MAX_AX_VELO[n]	Maximum axis velocity	G2
32010	JOG_VELO_RAPID[n]	Rapid traverse in JOG mode	
32020	JOG_VELO[n]	JOG axis velocity	
32040	JOG_REV_VELO_RAPID[n]	Revolutions feedrate in JOG mode with rapid traverse override	
32050	JOG_REV_VELO[n]	Revolutional feedrate in JOG mode	
32060	POS_AX_VELO[n]	Initial setting for positioning axis velocity	P2
32250	RATED_OUTVAL	Rated output voltage	
32260	RATED_VELO[n]	Rated motor speed	

Setting data

Table 11-37 Velocities: Setting data

Number	Identifier	Name/remarks	Reference
General ($SN_ ...)			
41100	JOG_REV_IS_ACTIVE	Revolutional feedrate in JOG mode active	
41110	JOG_SET_VELO	JOG velocity for linear axes (for G94)	
41120	JOG_REV_SET_VELO	JOG velocity (for G95)	
41130	JOG_ROT_AX_SET_VELO	JOG speed for rotary axes	
41200	JOG_SPIND_SET_VELO	JOG velocity for the spindle	

References

/**FB**/ **Description of Functions, Basic Functions**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Section: Velocities, Traversing Ranges, Accuracies

/**FB**/ **Description of Functions, Extended Functions**,
H1 Jog with/without Handwheel

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11.5.18 Monitoring functions (axis)

Static monitoring functions

The static monitoring functions with reference to a machine axis are:

Exact stop coarse

Window around the setpoint position within which exact stop coarse is detected.

- MD36000: STOP_LIMIT_COARSE (exact stop coarse)
- IS: DB31,... DBX60.6 (Position reached with exact stop coarse)

Exact stop fine

Window around the setpoint position within which exact stop fine is detected.

- MD36010: STOP_LIMIT_FINE (exact stop fine)
- IS: DB31,... DBX60.7 (position reached with exact stop coarse)

Delay time Exact stop fine

Delay time after which the actual value must have reached the tolerance window "Exact stop fine" when the setpoint position is reached.

- MD36020: POSITIONING_TIME (delay time exact stop fine)
- Interrupt: "25080 Positioning monitoring" and follow–up mode.

Standstill tolerance

Position tolerance which a standing machine axis may not leave.

- MD36030: STANDSTILL_POS_TOL (zero speed tolerance)
- Interrupt: "25040 Zero speed control" and follow–up mode.

Delay time Standstill (zero–speed) monitoring

Delay time after which the actual value must have reached the tolerance window "Zero speed tolerance" when the setpoint position is reached.

- MD36040: STANDSTILL_DELAY_TIME (delay time zero speed control)
- Interrupt: "25040 Zero speed control" and follow–up mode.

Clamping tolerance

Tolerance window for a standing machine axis while the signal "Clamping active" is present at the PLC interface.

- MD36050: CLAMP_POS_TOL (clamping tolerance)
- IS: DB31,... DBX2.3 (clamping active)
- Interrupt: "26000 Clamping monitoring"

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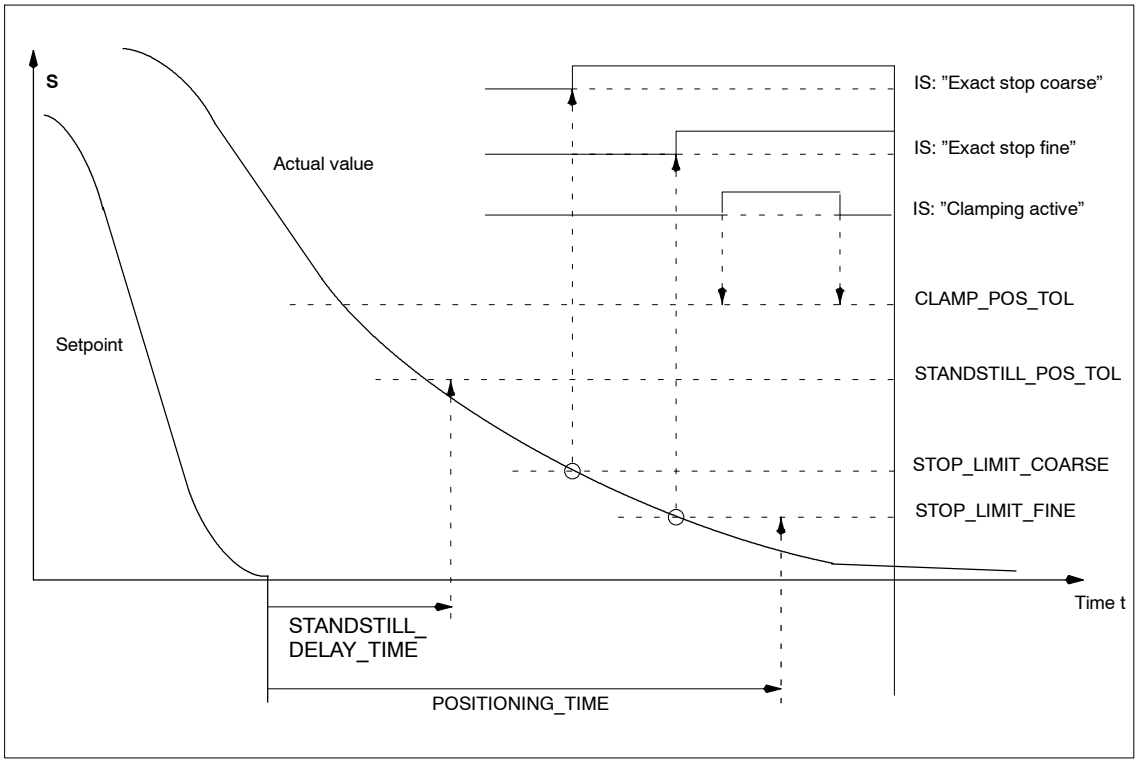


Fig. 11-18 Static monitoring functions

Working area limitation

The permissible working area of the machine axes can be adapted to the particular machining situation using the "dynamic" working area limitation.

- SD43400: WORKAREA_PLUS_ENABLE (working area limitation active in the positive direction)
- SD43410: WORKAREA_PLUS_ENABLE (working area limitation active in the negative direction)
- SD43420: WORKAREA_LIMIT_PLUS (working area limitation plus)
- SD43430: WORKAREA_LIMIT_MINUS (working area limitation minus)
- Interrupt: "10630 Axis reaching operating range limit +/–"
- Interrupt: "10631 Axis is at operating range limit +/– (JOG)"
- Interrupt: "10730 Progr. end point is behind working area limitation +/–"

Software limit switch

Two software limit switch pairs are provided per machine axis. The active software limit switch pair is selected in the PLC.

- MD36100: POS_LIMIT_MINUS (1st software limit switch minus)
- MD36110: POS_LIMIT_PLUS (1st software limit switch plus)
- MD36120: POS_LIMIT_MINUS2 (2nd software limit switch minus)

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- MD36130: POS_LIMIT_PLUS2 (2nd software limit switch plus)
- IS: DB31,... DBX12.2 (2nd software limit switch minus)
- IS: DB31,... DBX12.3 (2nd software limit switch plus)
- Interrupt: ”10620 Axis reaching software limit switch +/–”
- Interrupt: ”10621 Axis is at software limit switch +/– (JOG)”
- Interrupt: ”10720 Progr. end point is behind software limit switch +/–”

Notice

All position monitoring functions are only active with valid reference point of the corresponding reference point of the machine axis.

Hardware limit switch

If the PLC signals that a hardware limit switch has been reached, the machine axis is stopped with the parameterized brake response.

- IS: DB31, ... DBX12.1 (Hardware limit switch plus)
- IS: DB31, ... DBX12.0 (Hardware limit switch minus)
- MD36600: BRAKE_MODE_CHOICE (brake response at the hardware limit switches)
  0 = brake characteristic is observed
  1 = rapid deceleration with setpoint ”0”
- Interrupt: ”21614 hardware limit switch [+/–]”

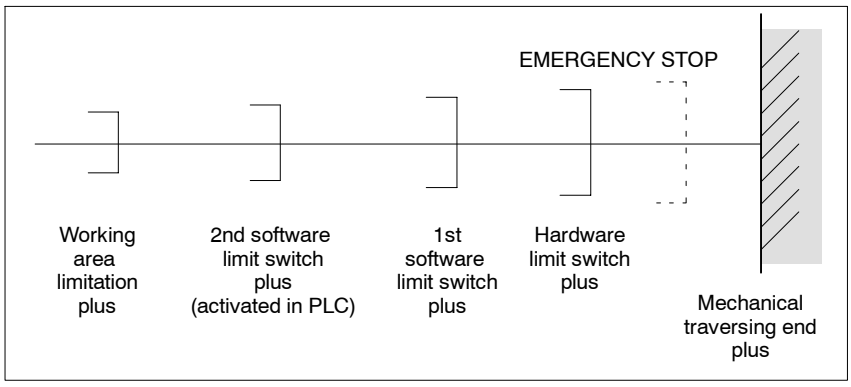


Fig. 11-19 Overview of end limitations

Dynamic monitoring functions

The dynamic monitoring functions with reference to a machine axis are:

Speed setpoint monitoring

The speed setpoint monitoring prevents that the max. admissible motor speed is exceeded.

It must be set such that the max. velocity (rapid traverse) can be reached and, in addition, a certain control margin remains.

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- MD36210: CTRLOUT_LIMIT[n] (maximum speed setpoint in %)

SIMODRIVE 611 universal

The max. permissible motor speed is specified in P1401:0 ”Speed for max. useful motor speed” of the SIMODRIVE 611 universal assigned to the machine axis.

SIMODRIVE 611 universal

MD36210: CTRLOUT_LIMIT[n] corresponds to P1405:0 ”Monitoring speed of motor” of the SIMODRIVE 611 universal assigned to the machine axis.

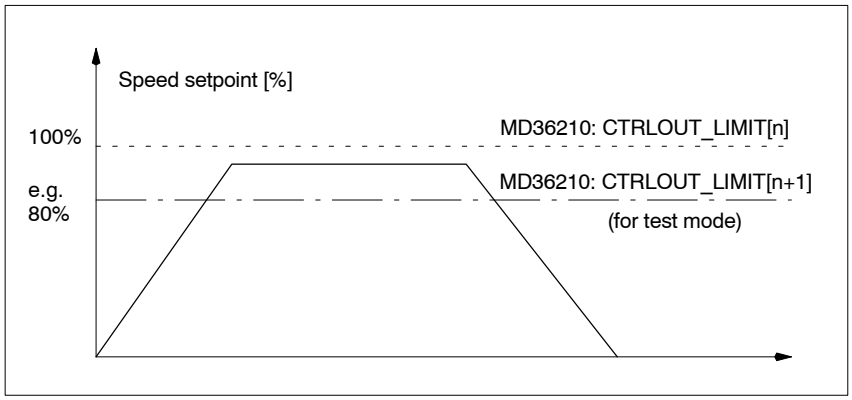


Fig. 11-20 Speed setpoint limitation

- MD36220: CTRLOUT_LIMIT_TIME[n] (delay time for speed setpoint monitoring)

defines how long the speed setpoint may remain within the limits before the speed setpoint monitoring responses.

Error response

- Interrupt: ”25060 Speed setpoint limiting”

and stopping the machine axis using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (Time for braking ramp when an error occurs)

Cause of errors/error handling

- A control loop or drive error is present.
- Setpoints are too high (accelerations, velocities, reducing factors)
- Obstacle in work area (e.g. positioning on a working table)
  => Remove obstacle.

The speed setpoint consists of the speed setpoint of the position controller and the feedforward control parameter (if feedforward control is active).

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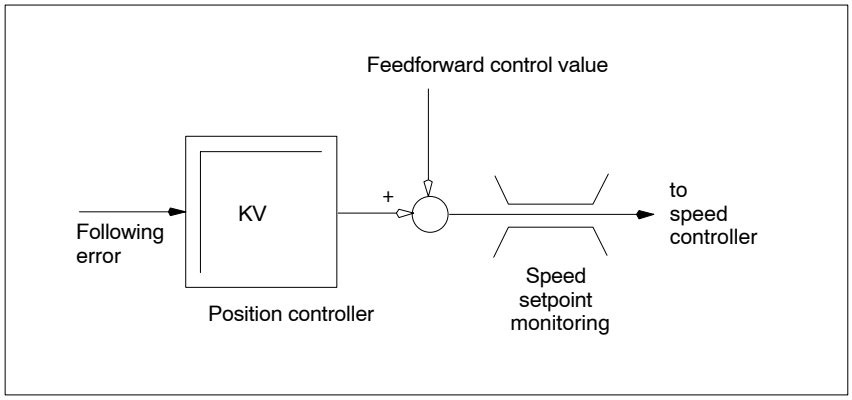


Fig. 11-21 Speed setpoint calculation

Notice

The limitation of the speed setpoint will turn the control loop into a nonlinear control loop.

Generally, this will result in deviations from the contour and longer dwelling of the machine axis within the speed setpoint limitation.

Actual velocity monitoring

Monitoring due to the actual velocity of the machine axis determined based on the encoder values

- MD36020: AX_VELO_LIMIT (threshold value for velocity monitoring)

Error response

- Interrupt: ”25030 Alarm limit of actual velocity”

and stopping the machine axis using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (Time for braking ramp when an error occurs)

Cause of errors/error handling

- Check speed setpoint cable
- Check actual values
- Check position control direction (control sense)
- Threshold value for velocity monitoring is possibly too low.

Contour monitoring

Monitoring of the difference between following error measured and following error calculated from the position setpoint.

- MD36400: CONTOUR_TOL (tolerance band for contour monitoring)

Error response

- Interrupt: ”25050 Contour monitoring”

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and stopping the machine axis using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (Time for braking ramp when an error occurs)

Cause of errors/error handling

Contour errors are caused by signal distortions in the position control loop.

Remedy:

- Increase the tolerance band
- Check the Kv factor.
  The real servo gain must correspond to the desired servo gain set by MD32200: POSCTRL_GAIN[n](Kv factor).

  HMI–Advanced
  Operating area **DIAGNOSIS > Service displays > Service of axis**
- Check optimization of the speed controller
- Check smooth running of the axes
- Check machine data for traversing movements
  (feed override, acceleration, max. speeds, ...)
- for operation with feedforward control:
  MD32810: EQUIV_SPEEDCTRL_TIME (equivalent time constant of speed control loop for feedforward control)
  If the machines are set too inexactly,
  MD 36400: CONTOUR_TOL must be increased.

Encoder limit frequency monitoring

Monitoring of the limit frequency of the encoder of a machine axis.

- MD36300: ENC_FREQ_LIMIT (encoder limit frequency)

Error response

- Interrupt: ”21610 Encoder frequency exceeded”
- IS: DB31, ... DBX60.2 ”Encoder limit frequency exceeded 1”
- IS: DB31, ... DBX60.3 ”Encoder limit frequency exceeded 2”

and stopping the machine axis using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (Time for braking ramp when an error occurs)

Cause of errors/error handling

The position control resumes automatically after the axes have stopped.

Notice

The axis affected must be rereferenced.

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Encoder zero mark monitoring

The zero mark monitoring of the encoder of a machine axis checks whether pulses were lost between two zero mark passes. Via

- MD36310: ENC_ZERO_MONITORING (zero mark monitoring)

is used to enter the number of detected zero mark errors at which the monitoring is to respond.

Special feature:
A value of 100 will additionally disable the hardware monitoring of the encoder.

Error response

- Interrupt: ”25020 Zero mark monitoring”

and stopping the machine axes using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (Time for braking ramp when an error occurs)

Cause of errors/error handling

- MD36300: ENC_FREQ_LIMIT [n] (encoder limit frequency) set too high.
- Encoder cable damaged.
- Encoder or encoder electronics defective.

Position tolerance when switching over the encoder

It is possible to switch over between the two possible encoders or position measuring systems of a machine axis at any time. The permissible position difference between the two position measuring systems is monitored.

- MD36500 ENC_CHANGE_TOL (Max. tolerance on position actual value switchover)

Error response

- Interrupt: ”25100 Measuring system cannot be switched over”

The requested switchover to another encoder is not carried out.

Cause of errors/error handling

- The specified permissible tolerance is too small.
- The measuring system to which you will switch over is not referenced.

Continue monitoring of the encoder position tolerance

The position difference between the two encoders or position measuring systems of a machine axis is monitored with:

- MD36510 ENC_DIFF_TOL (measuring system synchronism tolerance)

Error response

- Interrupt: ”25105 Measuring systems are not synchronous”

and stopping the machine axes using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (Time for braking ramp when an error occurs)

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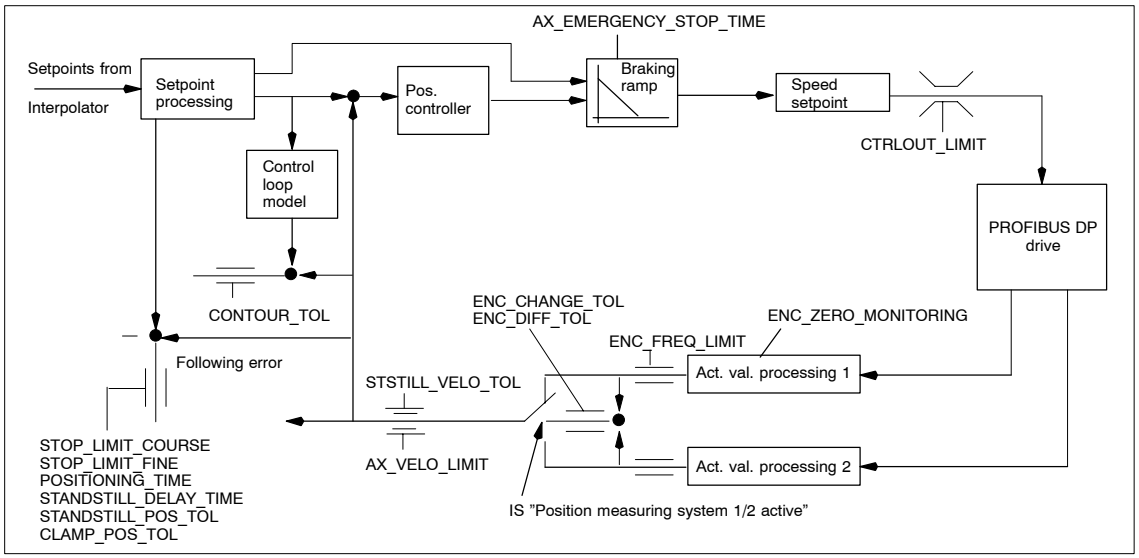


Fig. 11-22 Monitoring for SINUMERIK 840Di sl

Notice

- MD36620: SERVO_DISABLE_DELAY_TIME (servo enable cutout delay)

must always be selected greater than

- MD36610: AX_EMERGENCY_STOP_TIME (Time for braking ramp when an error occurs)

If this is not the case, the braking ramp cannot be kept.

References /**FB**/ **Description of Functions, Basic Functions**, A3 Axis Monitoring, Protection Zones

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11.5.19 Referencing an axis

Referencing

When referencing a machine axis, the actual position value system of the machine axis is synchronized with the machine geometry. Depending on the encoder type used, the machine axis is referenced with or without traversing movements.

Reference point approach

For all machine axes which are not equipped with an encoder providing an absolute actual position value, referencing is carried out by traversing the machine axis, the so–called reference point approach.

The reference point approach can be carried out either manually in JOG mode, submode REF or using a part program. Reference point approach is started using traverse direction keys PLUS or MINUS (depending on the parameterized reference point approach direction).

Incremental measuring systems

With incremental measuring systems, referencing is carried out using a reference point approach divided into 3 phases:

1. Traversing to the reference cam
2. Synchronizing to the encoder zero marker
3. Approach reference point

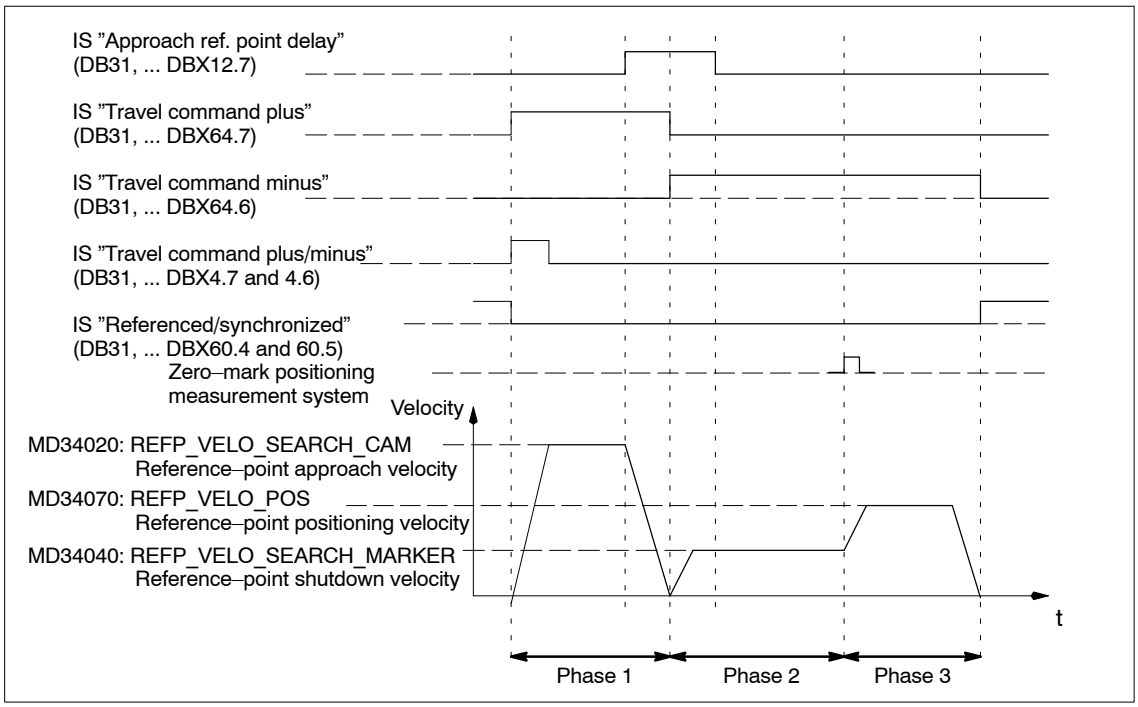


Fig. 11-23 Signal chart: Referencing with an incremental measuring system (principle)

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Phase–independent data

The following **machine data** and **interface signals** are independent with respect to the individual phases of reference point approach:

- MD11300: JOG_INC_MODE_LEVELTRIGGRD (INC/REF in jog mode)
- MD34000: REFP_CAM_IS_ACTIVE (axis with reference cam)
- MD34110: REFP_CYCLE_NR (axis sequence for channel–specific reference point approach)
- MD30240: ENC_TYPE (encoder type)
- MD34200: ENC_REFP_MODE (referencing mode)
- IS: DB21, ... DBX1.0 (”Activate referencing”)
- IS: DB21, ... DBX33.0 (”Referencing active”)

Phase 1: Traversing to the reference cam

The following **machine data** and **interface signals** are important:

- MD34010: REFP_CAM_DIR_IS_MINUS (approach reference cam in negative direction)
- MD34020: REFP_VELO_SEARCH_CAM (reference cam approach velocity)
- MD34030: REFP_MAX_CAM_DIST (maximum distance to reference cam)
- MD34092: REFP_CAM_SHIFT (electr. cam offset, incremental measuring systems with equidistant zero markers)
- IS: DB21, ... DBX36.2 (”all axes with obligatory reference point are referenced”)
- IS: DB31, ... DBX4.7/DBX4.6 (”Traversing keys plus/minus”)
- IS: DB31, ... DBX12.7 (”Reference point approach delay”)
- IS: DB31, ... DBX60.4, DBX60.5 (”Referenced/synchronized 1, 2”)

Properties of phase 1:

- The feed rate override (feed rate switch) is active.
- The feed stop (channel–specific and axis–specific) is active.
- The machine axis can be stopped and restarted with NC–Stop/NC–Start.
- If the machine axis traverses a distance defined in
  – MD34030: REFP_MAX_CAM_DIST (max. distance to the reference cam)
  without reaching the reference cam
  – IS: DB31, ... DBX12.7 (”Reference point approach delayed”) = 0
  the axis stops, and
  – alarm 20000 ”Reference cam not reached”
  is output.

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Warning

If the reference cam is not calibrated exactly, it is possible that a wrong zero marker is evaluated after the reference cam has been left. As a result, the control system will take a wrong machine zero.

Software limit switches, protection areas and work area limits will thus also be active for the wrong positions. The difference is equivalent to ± one encoder revolution in each case.

Danger for man and machine exists.

Phase 2:
Synchronizing to the encoder zero marker

The following **machine data** and **interface signals** are important:

- MD34040: REFP_VELO_SEARCH_MARKER (creep velocity)
- MD34050: REFP_SEARCH_MARKER_REVERSE (direction reversal to reference cam)
- MD34060: REFP_MAX_MARKER_DIST (maximum distance from cam to reference mark)

Properties of phase 2:

- Feed override (the feed override switch) is not active.
  If a feed override of 0% is selected via the feed override switch, the traverse movement is stopped.
- Feed stop (channel–specific and axis–specific) is active.
  On a feed stop, the traverse movement is stopped and the following alarm displayed:
  - Alarm 20005 ”Reference point approach canceled”
- NC–Stop/NC–Start is inactive.
- If the machine axis travels as from exiting the reference cam:
  - IS: DB31, ... DBX12.7 (”Reference point approach delay”) = 0

  a max. distance parameterized in the machine data:
  - MD34060: REFP_MAX_MARKER_DIST (max. distance to the reference mark)

  without the zero mark being detected, the machine axis stops and the following alarm is displayed:
  - Alarm 20002 ”Zero mark missing”

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Phase 3:
Traversing to the reference point

The following **machine data** and **interface signals** are important:

- MD34070: REFP_VELO_POS (reference point positioning velocity)
- MD34080: REFP_MOVE_DIST (reference point distance to zero mark)
- MD34090: REFP_MOVE_DIST_CORR (reference point offset, additive)
- MD34100: REFP_SET_POS (reference point value)
- IS: DB31, ... DBX2.4, 2.5, 2.6, 2.7 (”Reference point value 1...4”)
- IS: DB31, ... DBX60.4, DBX60.5 (”Referenced/synchronized 1, 2”)

Properties of phase 3:

- Feed override (the feed override switch) is active.
- Feed stop (channel–specific and axis–specific) is active.
- NC–Stop/NC–Start are active.

References

/**FB1**/ **Description of Functions, Basic Functions**,
R1 Reference point approach
Section: Referencing with incremental measurement systems

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Distance–coded Reference marks

When clearance–coded reference marks are used, referencing is divided into 2 phases:

1. Synchronize by overriding 2 reference marks
2. Traverse to target point

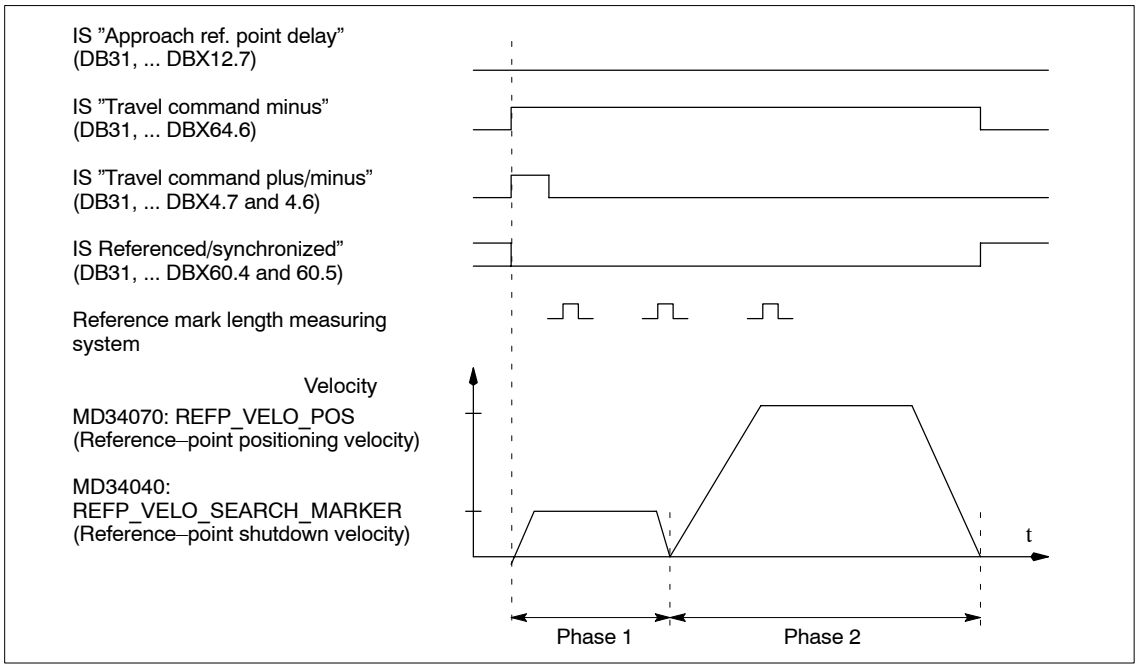


Fig. 11-24 Signal chart: Distance–coded reference marks (principle)

Phase–independent data

The following **machine data** and **interface signals** are independent with respect to the individual phases of reference point approach:

- MD11300: JOG_INC_MODE_LEVELTRIGGRD (INC/REF in jog mode)
- MD34000: REFP_CAM_IS_ACTIVE (axis with reference cam)
- MD34110: REFP_CYCLE_NR (axis sequence for channel–specific reference point approach)
- MD30240: ENC_TYPE (encoder type)
- MD34200: ENC_REFP_MODE (referencing mode)
- MD34310: ENC_MARKER_INC (interval between two reference marks)
- MD34320: ENC_INVERS (inverse measuring system)
- IS: DB21, ... DBX1.0 ("Activate referencing")
- IS: DB21, ... DBX33.0 ("Referencing active")

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Phase 1:
Synchronize by overriding 2 reference marks

The following **machine data** and **interface signals** are important:

- MD34010: REFP_CAM_DIR_IS_MINUS (approach reference cam in negative direction)
- MD34040: REFP_VELO_SEARCH_MARKER (referencing velocity)
- MD34060: REFP_MAX_MARKER_DIST (maximum distance between 2 reference marks)
- MD34300: ENC_REFP_MARKER_DIST (reference marker distance)
- IS: DB21 .. 30, DBX36.2 (”All axes to be referenced are referenced”)
- IS: DB31, ... DBX4.7/DBX4.6 (”Traversing keys plus/minus”)
- IS: DB31, ... DBX12.7 (”Reference point approach delay”)
- IS: DB31, ... DBX60.4, DBX60.5 (”Referenced/synchronized 1, 2”)

Properties of phase 1

- If the machine axis traverses a distance defined in
  – MD34300: REFP_MARKER_DIST (max. distance to the reference mark)
  without overtraveling the two reference marks, the machine axis stops and
  – alarm 20004 ”Reference mark missing”
  is output.

Phase 2:
Traversing to the target point

The following **machine data** and **interface signals** are important:

- MD34070: REFP_VELO_POS (reference point positioning velocity)
- MD34090: REFP_MOVE_DIST_CORR (absolute offset)
- MD34100: REFP_SET_POS (target point)
- MD34330: REFP_STOP_AT_ABS_MARKER (with/without target point)
- IS: DB31, ... DBX60.4, DBX60.5 (”Referenced/synchronized 1, 2”)

Properties of phase 2

- The feed rate override (feed rate switch) is active.
- The feed stop (channel–specific and axis–specific) is active.
- The machine axis can be stopped and restarted with NC–Stop/NC–Start.

Determining the absolute offset

To determine the absolute offset between the measuring system zero point and the machine zero, the following procedure is recommended:

1. Determining the actual position of the measuring system
   After two reference marks following one after the other (synchronized) have been overtraveled, the actual position of the length measuring system can be read on the user interface at ”Actual position”.
   The absolute offset must be zero at this time:
   - MD34090: REFP_MOVE_DIST_CORR = 0

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2. Determine the absolute machine actual position

   Determining the absolute machine actual position, e.g., can be performed by traversing the machine axis to a known position (fixed stop). Alternatively, it can be measured at any position (laser interferometer).

3. Calculating the absolute offset

– Linear measurement system noninverse to machine system:

Absolute offset = machine actual position + actual position of the measuring system

– Linear measurement system inverse to machine system:

Absolute offset = machine actual position – actual position of the measuring system

- MD34090: REFP_MOVE_DIST_CORR (reference point/absolute offset)



Warning

After you have determined the absolute offset and made an entry in

- MD34090: REFP_MOVE_DIST_CORR (absolute offset)

the position measuring system must be re–referenced.

References

/**FB1**/ **Description of Functions, Basic Functions**,
R1 Reference point approach
Section: Referencing on linear measuring systems with distance–coded reference marks

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Absolute encoders

Initial referencing of the measuring system of a machine axis with absolute value encoder is performed by calibrating the encoder.

Follow–up referencing

Follow–up referencing of a machine axis is performed automatically during NCK booting without axis movement. The following conditions must be fulfilled:

- The machine axis measuring system which is active after the NCK has booted works with the absolute value encoder.
- The absolute encoder is calibrated:
  MD34210: ENC_REFP_STATE[n] = **2** (absolute value encoder is calibrated)

Calibration

To calibrate the the absolute encoder, the actual value of the encoder is matched with the machine zero once and then enabled.

The SINUMERIK 840D sl supports the following types of calibration:

- Operator–assisted calibration
- Automatic calibration using probe
- Calibration using BERO

The calibration using the probe and BERO is described in:

References: /FB/, Description of Functions, Basic Functions
R1 Reference point approach
Section: Automatic calibration using probe
Calibration with BERO

Operator–assisted calibration

During operator–assisted calibration, the machine axis of the absolute value encoder is move to the known machine position (reference position). The position value of the reference position is assume by the NCK as the reference point value.

Recommended procedure

1. Parameterization of referencing mode
   - MD34200: $MA_ENC_REFP_MODE[n] = 0
2. Approaching referencing position
   Traversing the machine axis to the referencing position in JOG mode. Approach direction according to machine data:
   - MD34010: $MA_REFP_CAM_DIR_IS_MINUS (reference point approach in minus direction) (0 = positive, 1 = negative approach direction)

Notice

To avoid the actual position of the machine axis being falsified by backlash in the drive train, reference point approach must be performed at low velocity and always from the same direction.

---

3. Assumption of the reference position in the NCK
   The reference position is entered in the machine data:
   - MD34100: $MA_REFP_SET_POS[n] (reference point value)

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4. Enabling encoder calibration
   Encoder calibration is performed in the machine data:
   - MD34210: $MA_ENC_REFP_STATE[n] = **1**
5. Activate changed machine data by NCK reset.
6. Completing encoder calibration
   When the NCK has started up, encoder calibration is completed in mode: JOG > REF for the machine axis by once more pressing the direction key as described in point 2.:
   – Select JOG > REF mode
   – Select machine axis
   – Press traverse direction key

Note

Pressing the traverse direction key does not move the machine axis!

The NCK then calculates the reference point offset and enters it in the machine data:

- MD34090: $MA_REFP_MOVE_DIST_CORR[n] (reference point offset)

To indicate that calibration has been completed, the value in the machine data changes from 1 = enable encoder calibration to 2 = encoder calibrated:

- MD34210: $MA_ENC_REFP_STATE[n] = **2**

The value from the machine data is shown as the actual position of the machine axis on the user interface:

- MD34100: $MA_REFP_SET_POS[n] (reference point value)

Calibrating several absolute value encoders

For time–optimized calibration of the absolute value encoders of several machine axes, the following procedure is recommended:

1. Depending on the machine design, move all or several machine axes to their reference position. See above: Items 1. – 4.
2. Perform an NCK reset. See above: Item 5.
3. Complete encoder calibration for all machine axes. See item 6.

Recalibration

Recalibration of the absolute encoder is required after:

– Gear change between load and absolute encoder
– Set actual values (PRESETON)
– Removal/installation of the absolute value encoder
– Removal/installation of the motor with the absolute value encoder
– SRAM data loss of the NCK
– Battery failure

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Notice

Since the absolute encoder must be recalibrated, the NCK only detects the following events:

- Gear change with change of gear ratio
- Response to zero mark monitoring (alarm 25020)
- New encoder serial number after replacing the absolute encoder

The status of the absolute encoder is also reset by the NCK to 0 (encoder not calibrated):

- MD34210: $MA_ENC_REFP_STATE[n] = **0**

In **all other cases**, it is the sole responsibility of the user to indicate the uncalibrated state of the absolute encoder by manually resetting the status to 0 (Encorder not calibrated) and to repeat the calibration.

References

/**FB1**/ **Description of Functions, Basic Functions**,
R1 Reference point approach
Section:Referencing with absolute value encoders

Interface signals

Table 11-38 Referencing: Interface signals

DB number	Bit, byte	Name	Reference
Mode group–specific		**Signals from PLC to mode group**	
11, ...	0.7	Mode group reset	K1
11, ...	1.2	Machine function REF	K1
Mode group–specific		**Signals from mode group to PLC**	
11, ...	5.2	Active machine function REF	K1
Channel–specific		**Signals from PLC to channel**	
21, ...	1.0	Activate referencing	
Channel–specific		**Signals from channel to PLC**	
21, ...	28.7	(MMC ⟶ PLC) REF	K1
21, ...	33.0	Referencing active	
21, ...	35.7	Reset	K1
21, ...	36.2	All axes that must have a reference point are referenced	
Axis–specific		**Signals from PLC to axis/spindle**	
31, ...	1.5/1.6	Position measurement system 1/Position measurement system 2	A2
31, ...	2.4–2.7	Reference point value 1 to 4	
31, ...	4.6/4.7	Traversing keys minus/plus	H1
31, ...	12.7	Reference point approach delay	
Axis–specific		**Signals from axis/spindle to PLC**	
31, ...	60.4/60.5	Referenced, synchronized 1/Referenced, synchronized 2	
31, ...	64.6/64.7	Traverse command minus/plus	H1

Machine data

Table 11-39 Referencing: Machine data

Number	Identifier	Name	Reference
General ($MN_ ...)			
11300	JOG_INC_MODE_LEVELTRIGGRD	INC/REF in jog/continuous mode	H1

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Number	Identifier	Name	Reference
Channel–specific ($MC_ ...)			
20700	REFP_NC_START_LOCK	NC–Start disable without reference point	
Axis–specific ($MA_ ...)			
30200	NUM_ENCS	Number of encoders	G2
30240	ENC_TYP	Actual value encoder type	
30242	ENC_IS_INDEPENDENT	Encoder is independent	G2
31122	BERO_DELAY_TIME_PLUS	BERO delay time in plus direction	S1
31123	BERO_DELAY_TIME_MINUS	BERO delay time in minus direction	S1
34000	REFP_CAM_IS_ACTIVE	Axis with reference cam	
34010	REFP_CAM_DIR_IS_MINUS	Reference point approach in minus direction	
34020	REFP_VELO_SEARCH_CAM	Reference point approach velocity	
34030	REFP_MAX_CAM_DIST	Maximum distance to reference cam	
34040	REFP_VELO_SEARCH_MARKER	Reference point creep speed	
34050	REFP_SEARCH_MARKER_REVERSE	Direction reversal to reference cam	
34060	REFP_MAX_MARKER_DIST	Maximum distance to reference mark; Maximum distance to 2 reference marks with distance–coded scales	
34070	REFP_VELO_POS	Reference point positioning velocity	
34080	REFP_MOVE_DIST	Reference point distance/destination point for distancecoded system	
34090	REFP_MOVE_DIST_CORR	Reference point/absolute offset, distancecoded	
34092	REFP_CAM_SHIFT	Electronic reference cam shift for incremental measurement systems with equidistant zero marks.	
34100	REFP_SET_POS	Reference point value	
34102	REFP_SYNC_ENCS	Actual value adjustment to the referencing measurement system	
34110	REFP_CYCLE_NR	Axis sequence for channel–specific referencing	
34120	REFP_BERO_LOW_ACTIVE	Polarity change of BERO	
34200	ENC_REFP_MODE	Referencing mode	
34210	ENC_REFP_STATE	Status of absolute value encoder	
34220	ENC_ABS_TURNS_MODULO	Absolute value encoder range for rotary encoders	R2
34300	ENC_REFP_MARKER_DIST	Reference marker distance with distancecoded scales	
34310	ENC_MARKER_INC	Interval between two reference marks with distancecoded scales	
34320	ENC_INVERS	Linear measurement system inverse to machine system	
34330	REFP_STOP_AT_ABS_MARKER	Distance–coded linear measurement system without target point	
35150	SPIND_DES_VELO_TOL	Spindle speed tolerance	S1
36302	ENC_FREQ_LIMIT_LOW	Encoder limit frequency resynchronization	
36310	ENC_ZERO_MONITORING	Zero mark monitoring	
30250	ACT_POS_ABS	Absolute encoder position at time of deactivation.	

References /**FB**/ **Description of Functions, Basic Functions**, R1 Reference point approach

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11.5.20 Spindle basic data

The spindle mode of a machine axis is a subset of the general axis functionality. For this reason, the machine data required to commission an axis have also to be set for a spindle.

The machine data to parameterize a spindle are therefore to be found under the axis-specific machine data (from MD 35000 onwards).

Notice

After the default machine data have been loaded, no spindle is defined.

Spindle definition

By setting the machine data

- MD30300: IS_ROT_AX (rotary axis/spindle)
- MD30310: ROT_IS_MODULO (modulo conversion for rotary axis/spindle)
- MD30320: DISPLAY_IS_MODULO (modulo 360 degrees display for rotary axis/spindle)

a machine axis is declared to be an endlessly rotating rotary axis whose programming and display is carried out modulo 360 degrees.

The machine axis is converted to a spindle by defining the spindle number x (with x = 1, 2, ...max. number of channel axes) in machine data

- MD35000: SPIND_ASSIGN_TO_MACHAX (spindle number)

The spindle number must be unambiguous within the channel axes of the channel to which the spindle is assigned, i.e. several spindles can be defined with spindle number 1 provided they are assigned different channels (for assigning machine axes to channels, please refer to Section 11.5.1, Page 11-310).

Spindle modes

The diagram below illustrates the spindle modes and possible transitions between them.

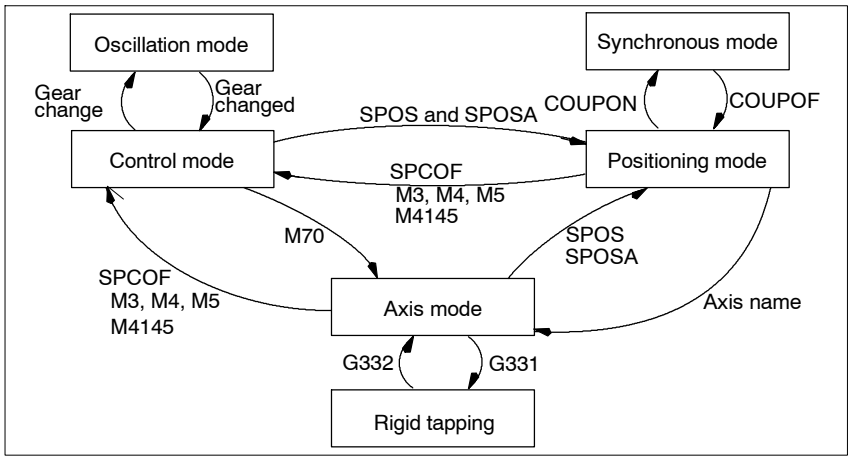


Fig. 11-25 Spindle modes

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Default mode

The machine data

- MD35020: SPIND_DEFAULT_MODE (spindle park position)
- MD35030: SPIND_DEFAULT_ACT_MASK (effective time of spindle park position)

can be used to define the default mode of a spindle at a defined time:

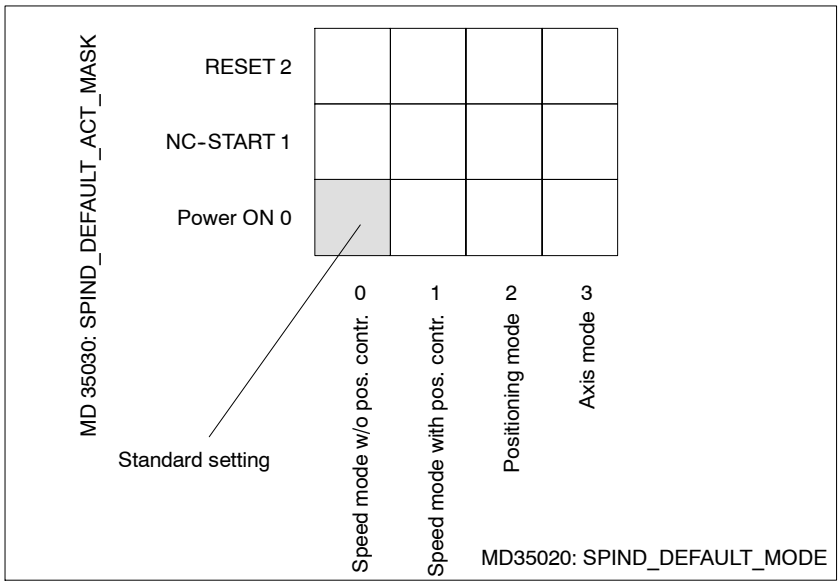


Fig. 11-26 Default setting of spindle mode

Axis mode

It is possible to switch directly from spindle mode to axis mode provided the same drive is used for both modes.

1. Transition to axis mode by programming the spindles using their axis names or by M70.
2. If the axis is not synchronized, e.g. position control enabled with M70, the axis has to be referenced with G74 first. Only then does the mechanical position match the programmed one.
3. It is switched over to the current feedforward control mode marked by the machine data and commands FFWON and FFWOF.

Special features

The following characteristics apply to the axis mode of a spindle:

1. The feed override switch is active.
2. IS "Reset" (DB21, ... DBX7.7) does not terminate axis mode as standard.
3. The interface signals DBB16 to DBB19 and DBB82 to DBB91 in DB31, ... are of no significance if the IS "Axis/no spindle" (DB31, ... DBX60.0) is set to zero.
4. Axis mode can be activated in all gear steps. If the position actual value encoder is installed on the motor (indirect measurement system), the positioning and contouring accuracy can vary for the different gear stages.

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5. The gear step cannot be changed when the axis mode is active. The spindle must be switched to control mode This is done using M41 ... M45.
6. In axis mode, the machine data of the 1st parameter record (index zero) will apply to be able to make adaptations.

Master spindle

To be able to use various spindle functions, such as

- Revolutional feed (G95)
- Tapping with compensation chuck (G63)
- Thread cutting (G33)
- Dwell time in spindle revolutions (G4 S...)

in a channel, a master spindle has to be defined in the corresponding channel:

- MD20090: SPIND_DEF_MASTER_SPIND (master spindle initial setting in channel)

In machine data

- MD35000: SPIND_ASSIGN_TO_MACHAX (spindle number)

the defined spindle number of the spindle of the channel is entered, which will be the master spindle.

Spindle reset

Machine data

- MD35040: SPIND_ACTIVE_AFTER_RESET (spindle active after reset)

defines whether the spindle is to remain active beyond

- Reset (IS: DB21,... DBX7.7)
- End of program (M02/M30).

To cancel spindle movements, an independent spindle reset is required:

- IS: DB31,... DBX2.2 (spindle reset)

References

/**FB1**/ **Description of Functions, Basic Functions**, S1 Spindles

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11.5.21 Setpoint/actual value channels of spindle

Parameterization of the setpoint/actual value channels of a spindle is identical to parameterization of the setpoint and actual value channels of an axis. See above, Section 11.5.4, Page 11-318.

11.5.22 Gear stages

Release gear stage change

The gear stage change is generally carried out in

- MD35010: GEAR_STEP_CHANGE_ENABLE (gear stage change possible, spindle has several gear stages)

If the machine data is not set, the system assumes that the spindle has no gear stages.

Parameter sets

When a spindle is in **Spindle mode** the NCK selects the parameter set which corresponds with the current gear stage.

Gear stage x => parameter set (x+1) => index [x]

In **Axis mode** of a spindle, the NCK always selects the 1st parameter set (index [0]), independent of the current gear stage.

The machine data listed in the following are gear stage–dependent machine data of a spindle:

- MD35110: GEAR_STEP_MAX_VELO[n] (n_{max} for gear stage change)
- MD35120: GEAR_STEP_MIN_VELO[n] (n_{min} for gear stage change)
- MD35130: GEAR_STEP_MAX_VELO_LIMIT[n] (n_{max} for gear stage)
- MD35140: GEAR_STEP_MIN_VELO_LIMIT[n] (n_{min} for gear stage)
- MD35200: GEAR_STEP_SPEEDCTRL_ACCEL[n] (acceleration in speed–control mode)
- MD35210: GEAR_STEP_POSCTRL_ACCEL[n] (acceleration in position control mode)

For further information on parameter sets, see Section 11.5.13, Page 11-334.

References

/**FB1**/ **Description of Functions, Basic Functions**,
S1 Spindles
Section: Gear stage change

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11.5.23 Measuring systems of spindle

Encoder matching

When parameterizing the measuring systems of spindles, the same conditions apply as for parameterization of the measuring systems of rotary axes. This multiple is 2048.

For incremental measuring systems, see above, Section 11.5.5, Page 11-321.

For absolute measuring systems, see above, Section 11.5.6, Page 11-324.

Notice

If the motor encoder is used for actual–value sensing, the encoder matching data must be entered in the machine data for each individual gear stage if several gear stages are present.

Pulse multiplication factor

The maximum multiplication of the appropriate drive is always used as the multiplication of the increments.

SIMODRIVE 611 universal

The pulse multiplication with SIMODRIVE 611 universal is **128**.

Examples of encoder adaptation

Example A: encoder on the Spindle

Suppose the following conditions are provided:

- The incremental encoder is mounted on the spindle.
- Encoder pulses = 500 [pulses/rev.]
- Pulse multiplication = 128
- Internal precision = 1000 [increment/degree]
- Encoder gear stage = 1:1
- Load gear stage = 1:1

The machine data are set acc. to the values above:

- MD10210: INT_INC_PER_DEG (computational resolution) = 1,000 [incr./degree]
- MD31020: ENC_RESOL (encoder resolution) = 500 [pulses/rev.]
- MD31050: DRIVE_AX_RATION_DENOM (load rev. denominator) = 1
- MD31060: DRIVE_AX_RATION_NUMERA (load rev. numerator) = 1
- MD31070: DRIVE_ENC_RATION_DENOM (load rev. denominator) = 1
- MD31080: DRIVE_ENC_RATION_NUMERA (load rev. numerator) = 1

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$$\text{Internal resolution} = \frac{360 \text{ degrees}}{\text{MD31020} * \text{pulse rev.}} * \frac{\text{MD31080}}{\text{MD31070}} * \frac{\text{MD31050}}{\text{MD31060}} * \text{MD10210}$$

$$\text{Internal resolution} = \frac{360}{500 * 128} * \frac{1}{1} * \frac{1}{1} * 1000 = 5.625 \frac{\text{int. increments}}{\text{encoder pulse}}$$

One encoder increment corresponds to 5.625 internal increments.

One encoder increment corresponds to 0.005625 degrees (highest possible positioning resolution).

Example B: encoder at motor

Suppose the following conditions are provided:

- The incremental encoder is mounted on the motor.
- Encoder pulses = 2048 [pulses/rev.]
- Pulse multiplication = 128
- Internal precision = 1000 [increment/degree]
- Encoder gear stage = 1:1
- Load gear stage 1= 2.5:1 [motor rev./spindle rev.]
- Load gear stage 2= 1:1 [motor rev./spindle rev.]

Gear stage 1

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{\text{MD31020} * \text{pulse rev.}} * \frac{\text{MD31080}}{\text{MD31070}} * \frac{\text{MD31050}}{\text{MD31060}} * \text{MD10210}$$

$$\text{Internal resolution} = \frac{360}{2048 * 128} * \frac{1}{1} * \frac{1}{2.5} * 1000 = 0.54932 \frac{\text{int. increments}}{\text{encoder pulse}}$$

One encoder increment corresponds to 0.54932 internal increments.

One encoder increment corresponds to 0.00054932 degrees (highest possible positioning resolution).

Gear stage 2

$$\text{Internal resolution} = \frac{360}{2048 * 128} * \frac{1}{1} * \frac{1}{1} * 1000 = 1.3733 \frac{\text{int. increments}}{\text{encoder pulse}}$$

One encoder increment corresponds to 1.3733 internal increments.

An encoder increment corresponds to 0.0013733 degrees (highest possible positioning resolution).

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11.5.24 Speeds and setpoint adjustment for spindle

Speeds, gear stages

In SINUMERIK 840Di sl, data for five gear stages are implemented. These stages are defined by a minimum and maximum speed for the stage itself and by a minimum and maximum speed for the automatic gear stage changeover.

A new set gear stage is output only if the new programmed speed cannot be traversed in the current gear stage. For the sake of simplification, the oscillation times for gear stage changeovers can be specified directly in the NCK; otherwise the oscillation function must be implemented in the PLC. The oscillation function is initiated via the PLC.

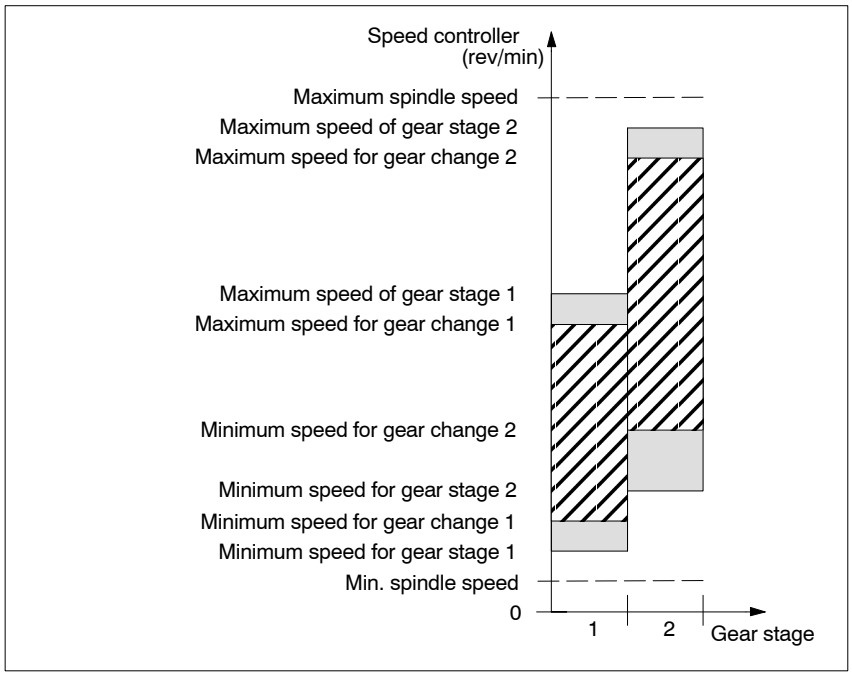


Fig. 11-27 Example for speed ranges for automatic gear stage selection (M40)

Speeds for conventional operation

The speeds of the spindle in conventional mode are entered in the machine data:

- MD32010: JOG_VELO_RAPID (rapid traverse in JOG mode)
- MD32020: JOG_VELO (JOG axis velocity)

The direction of rotation is specified via the appropriate directional keys for the spindle on the MCP.

Direction of rotation

The direction of rotation of a spindle corresponds to the traversing direction of an axis.

Setpoint matching

The speeds must be transferred with standardized values for the drive controller. The values are scaled in the NCK using the selected load gear and the appropriate drive parameter.

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SIMODRIVE 611 universal

Drive parameter P0880: PROFIBUS speed evaluation

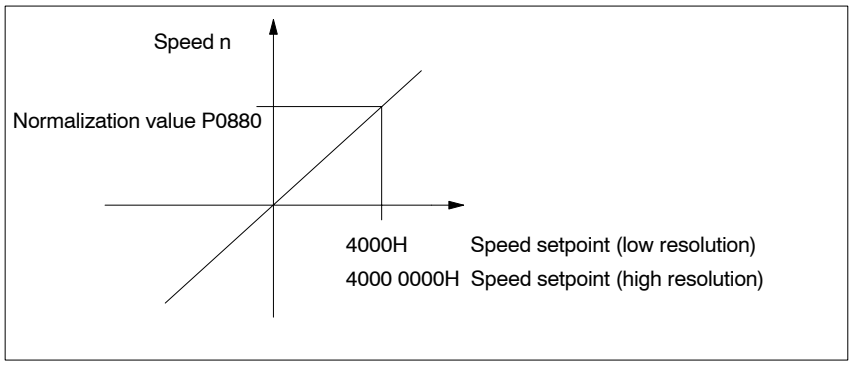


Fig. 11-28 Speed setpoint normalization

The desired speed on the spindle is obtained using a mechanical gear stage.

Machine data

Table 11-40 Speeds and setpoint adjustment for spindle: Machine data

Axis–specific ($MA_ ...)			
31050	DRIVE_AX_RATIO_DENOM	Denominator load gearbox	G2
31060	DRIVE_AX_RATIO_NUMERA	Numerator load gearbox	G2
32010	JOG_VELO_RAPID	Rapid traverse in JOG mode	
32020	JOG_VELO	JOG axis velocity	
35010	GEAR_STEP_CHANGE_ENABLE	Gear stage change possible	
35020	SPIND_DEFAULT_MODE	Basic spindle setting	
35030	SPIND_DEFAULT_ACT_MASK	Activate initial spindle setting	
35040	SPIND_ACTIVE_AFTER_RESET	Spindle active after reset	
35200	GEAR_STEP_SPEEDCTRL_ACCEL[n]	Acceleration in speed control mode	
35220	ACCEL_REDUCTION_SPEED_POINT	Speed limit for reduced acceleration	
35230	ACCEL_REDUCTION_FACTOR	Reduced acceleration	
35400	SPIND_OSCILL_DES_VELO	Reciprocating speed	
35410	SPIND_OSCILL_ACCEL	Oscillation acceleration	
35430	SPIND_OSCILL_START_DIR	Starting direction during oscillation	
35440	SPIND_OSCILL_TIME_CW	Oscillation time for M3 direction	
35450	SPIND_OSCILL_TIME_CCW	Oscillation time for M4 direction	

Interface signals

Table 11-41 Speeds and setpoint adjustment for spindle: Interface signals

DB number	Bit, byte	Name	Reference
Axis–specific		**Signals from PLC to axis/spindle**	
31, ...	4.6	Traversing keys minus	
31, ...	4.7	Traversing keys plus	

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Axis–specific		Signals from PLC to axis/spindle	
31, ...	16.2–16.0	Actual gear step	
31, ...	16.3	Gear changed	
31, ...	16.6	No speed monitoring when changing the gear	
31, ...	18.4	Oscillation via PLC	
31, ...	18.5	Reciprocating speed	
Axis–specific		**Signals from axis/spindle to PLC**	
31, ...	82.2–82.0	Set gear step	
31, ...	82.3	Change gear stage	
31, ...	84.7	Active spindle control mode	
31, ...	84.6	Active spindle mode oscillation mode	

11.5.25 Position spindle

The NCK provides an oriented spindle stop function with which the spindle can be moved into a certain position and held there (e.g. for tool changing purposes). Several programming commands are available for this function which define the approach and program processing.

References: /PA/ Programming Guide
S1 Spindles

Functionality

- To absolute position (0–360 degrees)
- Incremental position (+/– 999999.99 degrees)
- Block change when position reached
- Block change on block end criterion

The control brakes the spindle down to creep speed at the acceleration rate for speed operation.

If the creep speed has been reached (INT ”Spindle in setpoint range”), the control branches into position control mode and the acceleration rate for position control mode and the K_V factor become active.

The interface signal ”Exact stop fine” is output to indicate that the programmed position has been reached (block change when position reached).

The acceleration rate for position control mode must be set such that the current limit is not reached. The acceleration rate must be entered separately for each gear stage.

If the spindle is positioned from zero speed, it is accelerated up to a maximum speed corresponding to creep speed; the direction is defined via machine data. The contour monitoring function is activated as soon as the control mode switches to position control.

Machine data

Table 11-42 Spindle positioning: Machine data

Axis–specific ($MA_ ...)			
35300	SPIND_POSCTRL_VELO	Shutdown speed	
35350	SPIND_POSITIONING_DIR	Direction of rotation when positioning from the standstill	
35210	GEAR_STEP_POSCTRL_ACCEL	Acceleration in position control mode	

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Axis–specific ($MA_ ...)			
36000	STOP_LIMIT_COARSE	Exact stop coarse	
36010	STOP_LIMIT_FINE	Exact stop fine	
32200	POSCTRL_GAIN	K_V factor	
36400	CONTOUR_TOL	Contour monitoring	

Interface signals

Table 11-43 Spindle positioning: Interface signals

DB number	Bit, byte	Name	Reference
Axis–specific		**Signals from axis/spindle to PLC**	
31, ...	60.6	Position reached with exact stop ”fine”	
31, ...	60.7	Position reached with exact stop ”coarse”	
31, ...	84.5	Positioning mode	

11.5.26 Synchronizing spindle

To allow the spindle to be positioned from the NCK, its position has to be adjusted using the measuring system. This operation is called ”synchronization”.

As a rule, synchronizing is done to the zero mark of the connected encoder or to a BERO as zero mark substitute.

Machine data

- MD34100: REFP_SET_POS (reference point value)

defines the actual position of the spindle at the zero mark position.

The machine data

- MD34090: REFP_MOVE_DIST_CORR (reference–point offset)

is used to enter the zero mark offset.

Machine data

- MD34200 ENC_REFP_MODE (Referencing mode)

specifies which signal is used for synchronization:
1 = encoder zero mark
2 = BERO.

SIMODRIVE 611 universal

The drive SIMODRIVE 611 universal supports the connection of a BERO as a zero mark substitute for synchronizing the spindle.

For the exact procedure of operating a BERO on SIMODRIVE 611 universal, see:

References: /FBU/ Descriptions of Functions SIMODRIVE 611 universal
Section: Motion Control with PROFIBUS DP (as from SW 3.1)
Zero mark substitute via PROFIBUS

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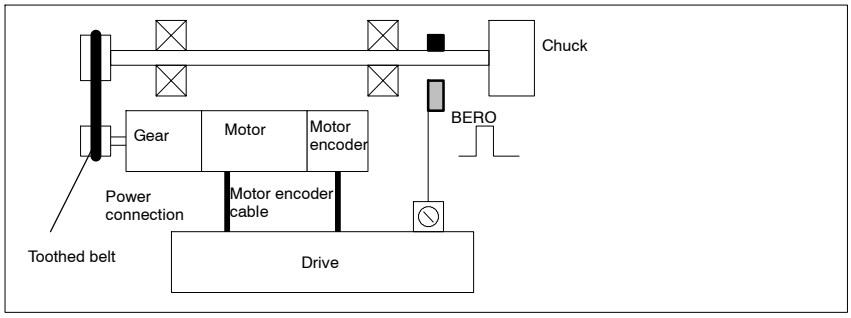


Fig. 11-29 Synchronization using BERO

When is synchronization necessary?

The spindle will be synchronized:

- after the NCK has booted, when the spindle is moved using a programming command
- after a request to resynchronize from the PLC
  NST DB31,... DBX16.4 (Resynchronize spindle 1)
  NST DB31,...DBX16.5 (Resynchronize spindle 2)
- after each gear stage change when an indirect measuring system is used
  MD31040: ENC_IS_DIRECT (direct measuring system) = 0
- when the encoder limit frequency falls below the programmed value after a speed has been programmed which is above the encoder limit frequency.

Notice

- To synchronize the spindle, it must always be rotated using a programming command (e.g. M3, M4, SPOS). The specification of a spindle speed using the direction keys of the machine control panel is not sufficient.
- If the spindle encoder is not mounted directly on the spindle and there are speed-transforming gears between the encoder and spindle (e.g. encoder mounted on motor), then a BERO signal connected to the drive module must be used for synchronization.

  The control then automatically resynchronizes the spindle after each gear change. No manual intervention is required on the part of the user.
- In general, backlash, gearbox elasticity and reference cam hysteresis reduce the accuracy achievable during synchronization.

Machine data

Table 11-44 Synchronizing spindle: Machine data

Axis-specific ($MA_ ...)			
34100	REFP_SET_POS	Reference point value	
34090	REFP_MOVE_DIST_CORR	Reference point offset	
34200	REFP_MODE	Referencing mode	

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Interface signals

Table 11-45 Synchronizing spindle: Interface signals

DB number	Bit, byte	Name	Refer-ence
Axis–specific		**Signals from PLC to axis/spindle**	
31, ...	16.4	Synchronize spindle 1	
31, ...	16.5	Synchronize spindle 2	
Axis–specific		**Signals from axis/spindle to PLC**	
31, ...	60.4	Referenced/synchronized 1	
31, ...	60.5	Referenced/synchronized 2	

11.5.27 Spindle monitoring

Axis/spindle at a standstill

If the actual speed entered in machine data

- MD36060: STANDSTILL_VELO_TOL (maximum velocity/speed for ”axis/ spindle stopped”)

falls below the programmed velocity/speed, the interface signal

- IS DB31,... DBX61.4 (axis/spindle stationary)

is set. If

- MD35510: SPIND_STOPPED_AT_IPO_START (feed enable for ”Spindle stopped”) is set,

the path feed is enabled.

Spindle in set range

If the spindle reaches the tolerance range specified in machine data

- MD35150: SPIND_DES_VELO_TOL (spindle speed tolerance)

interface signal

- IS DB31,... DBX83.5 (spindle in setpoint range)

is set. If

- MD35510: SPIND_STOPPED_AT_IPO_START (feed enable for ”Spindle stopped”) is set,

the path feed is enabled.

Max. spindle speed

The maximum spindle speed is entered in machine data

- MD35100: SPIND_VELO_LIMIT (max. spindle speed)

The NCK limits the spindle speed to this value.

Error response

If the speed is nevertheless exceeded by the speed tolerance (drive error), the following signal is output:

- IS DB31,... DBX83.0 (speed limit exceeded) = 1
- Alarm ”22150 Maximum number of chucks exceeded”

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Machine data

- MD36200: AX_VELO_LIMIT (threshold value for velocity monitoring)

also limits the speed of the spindle. When the speed is exceeded, an alarm is generated.

In position–controlled mode (e.g. SPCON), the NCK limits the specified maximum speed specified in machine or setting data to 90% of the maximum value (control reserve).

Gear stage speed min./max.

The max./min. gear stage speed is entered in:

- MD35130: GEAR_STEP_MAX_VELO_LIMIT (maximum speed for gear stage)
- MD35140: GEAR_STEP_MIN_VELO_LIMIT (minimum speed for gear stage)

The speed cannot leave this range when the appropriate gear stage is engaged.

Progr. spindle speed limitations

The functions

- G25 S... (min. spindle speed)
- G26 S... (max. spindle speed)

can be used to specify a spindle speed limitation in a part program. The limitation is active in all operating modes.

The function LIMS=...

- LIMS=... (speed limitation (G96))

can be used to specify a spindle speed limit for G96 (constant cutting rate). This limitation is operative only when G96 is active.

Encoder cut–off frequency

If the encoder cut–off frequency

- MD36300: ENC_FREQ_LIMIT (encoder limit frequency)

is exceeded, the synchronization of the spindle is lost and the spindle functionality reduced (thread, G95, G96).

The spindle will be resynchronized once the encoder frequency falls below the value defined in machine data

- MD36302: ENC_FREQ_LIMIT_LOW (encoder limit frequency at which the encoder is turned on again).

The encoder limit frequency value must be such that the mechanical encoder speed limit is not exceeded or else the synchronization from high speeds will be incorrect.

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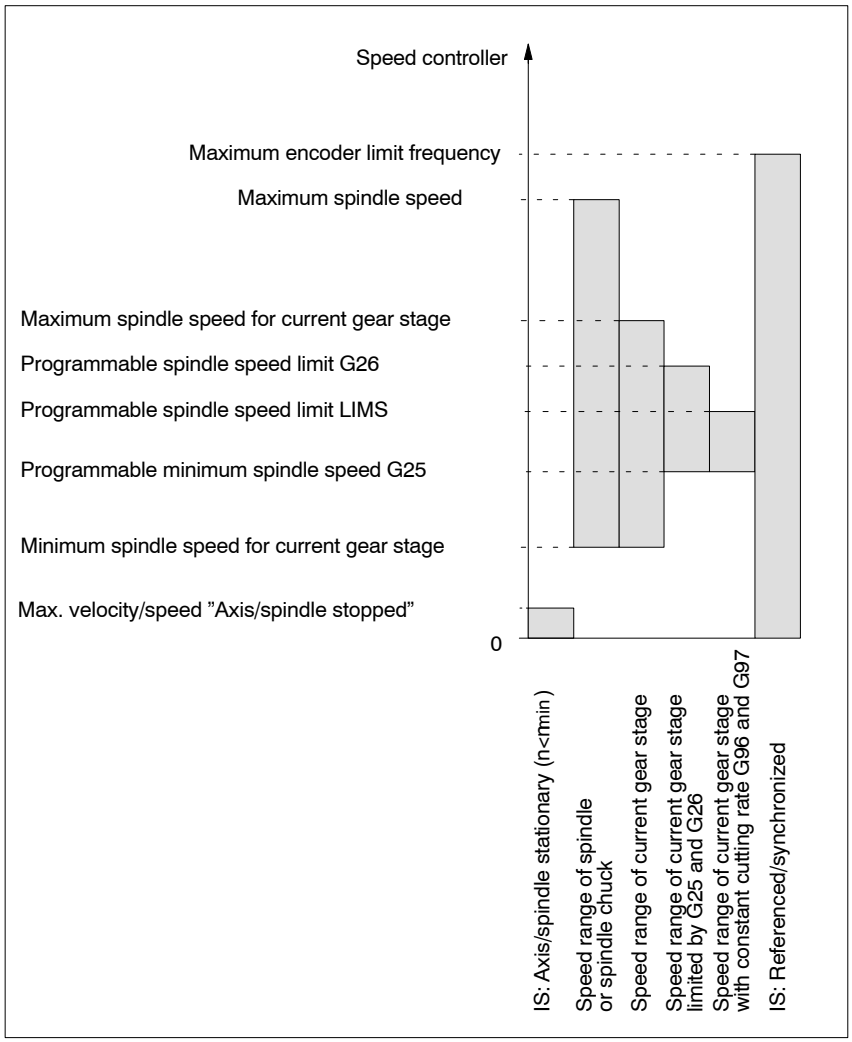


Fig. 11-30 Ranges of spindle monitoring functions/speeds

References

/**FB1**/ **Description of Functions, Basic Functions**,
S1 Spindles
Section: Spindle monitoring

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11.5.28 Spindle data

Machine data

Table 11-46 Spindle: Machine data

Number	Identifier	Name	Refer-ence
General ($MN_ ...)			
12060	OVR_SPIND_IS_GRAY_CODE	Spindle override with Gray coding	V1
12070	OVR_FACTOR_SPIND_SPEED	Evaluation of spindle speed override switch	V1
12080	OVR_REFERENCE_IS_PROG_FEED	Override reference velocity	V1
Channel–specific ($MC_ ...)			
20090	SPIND_DEF_MASTER_SPIND	Initial setting for master spindle on channel	
20092	SPIND_ASSIGN_TAB_ENABLE	Enabling/disabling of spindle converter	
20118	GEOAX_CHANGE_RESET	Allow automatic geometry axis change	
22400	S_VALUES_ACTIVE_AFTER_RESET	S function active after RESET	
Axis–specific ($MA_ ...)			
30300	IS_ROT_AX	Rotary axis	R2
30310	ROT_IS_MODULO	Modulo conversion	R2
30320	DISPLAY_IS_MODULO	Position display	R2
31050	DRIVE_AX_RATIO_DENOM	Denominator load gearbox	G2
31060	DRIVE_AX_RATIO_NUMERA	Numerator load gearbox	G2
31122	BERO_DELAY_TIME_PLUS	BERO delay time in plus direction	
31123	BERO_DELAY_TIME_MINUS	BERO delay time in minus direction	
32200	POSCTRL_GAIN	KV factor	G2
32810	EQUIV_SPEEDCTRL_TIME	Equivalent time constant speed control loop for feedforward control	K3
32910	DYN_MATCH_TIME	Time constant for dynamic matching	G2
34040	REFP_VELO_SEARCH_MARKER	Reference point creep speed	R1
34060	REFP_MAX_MARKER_DIST	Monitoring of zero mark distance	R1
34080	REFP_MOVE_DIST	Reference point distance/destination point for distancecoded system	R1
34090	REFP_MOVE_DIST_CORR	Reference point offset/absolute offset, distancecoded	R1
34100	REFP_SET_POS	Reference point value	R1
34200	ENC_REFP_MODE	Referencing mode	R1
35000	SPIND_ASSIGN_TO_MACHAX	Assignment of spindle to machine axis	
35010	GEAR_STEP_CHANGE_ENABLE	Gear stage change possible	
35012	GEAR_STEP_CHANGE_POSITION	Gear stage change position	
35020	SPIND_DEFAULT_MODE	Basic spindle setting	
35030	SPIND_DEFAULT_ACT_MASK	Activate initial spindle setting	
35040	SPIND_ACTIVE_AFTER_RESET	Spindle active after reset	
35100	SPIND_VELO_LIMIT	Maximum spindle speed	
35110	GEAR_STEP_MAX_VELO[n]	Maximum speed for gear change	
35120	GEAR_STEP_MIN_VELO[n]	Minimum speed for gear change	
35130	GEAR_STEP_MAX_VELO_LIMIT[n]	Maximum speed of gear stage	
35140	GEAR_STEP_MIN_VELO_LIMIT[n]	Minimum speed of gear stage	
35150	SPIND_DES_VELO_TOL	Spindle speed tolerance	
35160	SPIND_EXTERN_VELO_LIMIT	Spindle speed limitation via PLC	
35200	GEAR_STEP_SPEEDCTRL_ACCEL[n]	Acceleration in speed control mode	

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Number	Identifier	Name	Refer-ence
Axis–specific ($MA_ ...)			
35210	GEAR_STEP_POSCTRL_ACCEL[n]	Acceleration in position control mode	
35220	ACCEL_REDUCTION_SPEED_POINT	Speed limit for reduced acceleration	
35230	ACCEL_REDUCTION_FACTOR	Reduced acceleration	
35300	SPIND_POSCTRL_VELO	position control activation speed	
35350	SPIND_POSITIONING_DIR	Positioning direction of rotation for non–synchronized spindle	
35400	SPIND_OSCILL_DES_VELO	Reciprocating speed	
35410	SPIND_OSCILL_ACCEL	Oscillation acceleration	
35430	SPIND_OSCILL_START_DIR	Starting direction during oscillation	
35440	SPIND_OSCILL_TIME_CW	Oscillation time for M3 direction	
35450	SPIND_OSCILL_TIME_CCW	Oscillation time for M4 direction	
35500	SPIND_ON_SPEED_AT_IPO_START	Feed enable with spindle in setpoint range	
35510	SPIND_STOPPED_AT_IPO_START	Feed enable with stationary spindle	
35590	PARAMSET_CHANGE_ENABLE	Parameter set definition possible from PLC	A2
36060	STANDSTILL_VELO_TOL	Threshold velocity ”Axis/spindle stationary”	A3
36200	AX_VELO_LIMIT	Threshold value for velocity monitoring	A3

Setting data

Table 11-47 Spindle: Setting data

Number	Identifier	Name	Refer-ence
Spindle–specific ($SA_ ...)			
42600	JOG_FEED_PER_REF_SOURCE	Revolutional feedrate control in JOG mode	V1
42800	SPIND_ASSIGN_TAB	Spindle number converter	
42900	MIRROR_TOOL_LENGTH	Mirror tool length offset	W1
42910	MIRROR_TOOL_WEAR	Mirror wear values of tool length compensation	W1
42920	WEAR_SIGN_CUTPOS	Mirror wear values of machining plane	W1
42930	WEAR_SIGN	Invert sign of all wear values	W1
42940	TOOL_LENGTH_CONST	Retain the assignment of tool length compo-nents when changing the machining plane (G17 to G19)	W1
43210	SPIND_MIN_VELO_G25	progr. Spindle speed limiting G25	
43220	SPIND_MAX_VELO_G26	progr. Spindle speed limiting G26	
43230	SPIND_MAX_VELO_LIMS	progr. spindle speed limitation with G96	
43300	ASSIGN_FEED_PER_REF_SOURCE	Rotational feedrate for positioning axes/spindles	V1, P2

Interface signals

Table 11-48 Spindle: Interface signals

DB number	Bit, byte	Name	Refer-ence
Axis–specific	**Signals from PLC to axis/spindle**		
31, ...	0	Feed override	V1
31, ...	1.7	Override active	V1

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Axis–specific		Signals from PLC to axis/spindle	
31, ...	1.6	Position measuring system 2	A2
31, ...	1.5	Position measuring system 1	A2
31, ...	1.4	Followup mode	A2
31, ...	1.3	Axis/spindle disable	A2
31, ...	2.2	Spindle reset/delete distancetogo	A2
31, ...	2.1	Controller enable	A2
31, ...	3.6	Velocity/spindle speed limitation	A3
31, ...	16.7	Delete S value	
31, ...	16.5	Resynchronize spindle 2	
31, ...	16.4	Resynchronize spindle 1	
31, ...	16.3	Gear changed	
31, ...	16.2–16.0	Actual gear stage A to C	
31, ...	17.6	Invert M3/M4	
31, ...	17.5	Resynchronize spindle during positioning 2	
31, ...	17.4	Resynchronize spindle during positioning 1	
31, ...	18.7	Direction of rotation setpoint left	
31, ...	18.6	Direction of rotation setpoint right	
31, ...	18.5	Reciprocating speed	
31, ...	18.4	Oscillation via PLC	
31, ...	19.7 – 19.0	Spindle offset H – A	V1
Axis–specific		**Signals from axis/spindle to PLC**	
31, ...	60.7	Position reached with exact stop fine	B1
31, ...	60.6	Position reached with exact stop coarse	B1
31, ...	60.5	Referenced/synchronized 2	R1
31, ...	60.4	Referenced/synchronized 1	R1
31, ...	60.3	Encoder limit frequency exceeded 2	A3
31, ...	60.2	Encoder limit frequency exceeded 1	A3
31, ...	60.0	Axis/no spindle	
31, ...	61.7	Current controller active	A2
31, ...	61.6	Speed control loop active	A2
31, ...	61.5	Position controller active	A2
31, ...	61.4	Axis/spindle stationary ($n < n_{min}$)	A2
31, ...	82.3	Change gear stage	
31, ...	82.2–82.0	Set gear stage AC	
31, ...	83.7	Actual direction of rotation clockwise	
31, ...	83.5	Spindle in setpoint range	
31, ...	83.2	Setpoint speed increased	
31, ...	83.1	Setpoint speed limited	
31, ...	83.0	Speed limit exceeded	
31, ...	84.7	Active spindle control mode	
31, ...	84.6	Active spindle mode oscillation mode	
31, ...	84.5	Active spindle positioning mode	
31, ...	84.3	Rigid tapping active	
31, ...	86 and 87	M function for spindle	
31, ...	88–91	S function for spindle	

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11.6 Handwheels

11.6.1 General

Connection options

Handwheels can be connected to a SINUMERIK 840Di sl via the following interfaces:

- PROFIBUS DP (only via MCI board interface X101)
- Ethernet
- Cable distributor (via MCI board extension)

In order to operate handwheels of a SINUMERIK control system, they have to be parameterized via NCK machine data. If handwheels are not connected via a cable distributor, additional measures may be required. For example, with connection via PROFIBUS DP, the module must also be configured with SIMATIC STEP 7, HW Config.

Note

- Only six handwheels can be parameterized on a SINUMERIK 840Di sl.
- It is possible to operate handwheels that are connected via different interfaces (cable distributor, PROFIBUS, Ethernet) at the same time.

11.6.2 Connection via cable distributor

Parameterization

Parameterization of handwheels connected via cable distributor is done via the following NCK machine data:

- MD11350 $MN_HANDWHEEL_SEGMENT[x] = 1
  with x = *Handwheel_No._in_NCK* – 1
  When connected via cable distributor, the hardware segment has always to be entered as 1 (local hardware segment).
- MD11351 $MN_HANDWHEEL_MODULE[x] = 1
  with x = *Handwheel_No._in_NCK* – 1
  When connected via cable distributor, the hardware module has always to be entered as 1.
- MD11352 $MN_HANDWHEEL_INPUT[x] = < *Handwheel connection* >
  with x = *Handwheel_No._in_NCK* – 1
  Handwheel connection used: 1 or 2

Note

A maximum of two handwheels can be connected via the cable distributor.

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Example Direct connection of 2 handwheels via a cable distributor.

Table 11-49 Assignment of handwheels in NCK machine data

	Value	
		1st handwheel
MD11350 $MN_HANDWHEEL_SEGMENT[0]	1	Connection via cable distributor always 1
MD11351 $MN_HANDWHEEL_MODULE[0]		Connection via cable distributor always 1
MD11352 $MN_HANDWHEEL_INPUT[0]		1st handwheel connection at cable distributor
		2nd handwheel
MD11350 $MN_HANDWHEEL_SEGMENT[1]		Connection via cable distributor always 1
MD11351 $MN_HANDWHEEL_MODULE[1]		Connection via cable distributor always 1
MD11352 $MN_HANDWHEEL_INPUT[1]		2nd handwheel connection at cable distributor

11.6.3 Connection via PROFIBUS

Parameterization Parameterization of handwheels connected via PROFIBUS modules, e.g. machine control table ”MCP 483”, is done with the following NCK machine data:

- MD11350 $MN_HANDWHEEL_SEGMENT[x] = 5
  with x = *Handwheel_No._in_NCK* – 1

  When connected via PROFIBUS module, the hardware segment has always to be entered as 5 (PROFIBUS).

- MD11351 $MN_HANDWHEEL_MODULE[x] = < *Index* + *1* >
  with x = *Handwheel_No._in_NCK* – 1

  The reference to: MD11353 $MN_HANDWHEEL_LOGIC_ADDRESS[< *Index*>] must be entered, which contains the logical base address of the handwheel slot.

- MD11352 $MN_HANDWHEEL_INPUT[x] = < *Number_in_handwheel_slot* >
  with x = *Handwheel_No._in_NCK* – 1

  A handwheel slot can contain several handwheels. The number of the handwheel within the handwheel slot has to entered: 1, 2, ...

- MD11353 $MN_HANDWHEEL_LOGIC_ADDRESS[< *Index* >] = 1
  < *logical base address*>

  The logical base address of the handwheel slot, specified in SIMATIC STEP 7, HW Config, has to be entered.

Handwheel slot The PROFIBUS module must be configured besides the parameterization of handwheels in the NCK machine data in STEP 7. Among others the logical address of the handwheel slot is specified.

The handwheel slot is situated at the following slot of the PROFIBUS module:

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PROFIBUS module	Slot
Machine control panel MCP 438	2
Machine control panel MCP 310	2
Handwheel connection module	1

Example

Parameterization of 5 handwheels, connected via 4 machine control tables ”MCP 483”. Two handwheels can be connected to a machine control table ”MCP 483”.

Handwheel number in NCK	Machine data set (Index)	Terminal
1	0	1st MCP, 1st handwheel in handwheel slot
2	1	1st MCP, 2nd handwheel in handwheel slot
3	2	2nd MCP, 1st handwheel in handwheel slot
5	4	3rd MCP, 1st handwheel in handwheel slot
6	5	4th MCP, 2nd handwheel in handwheel slot

The fourth handwheel in NCK has not been used (gap in machine data).

Note

Machine data gaps are allowed when parameterizing handwheels in NCK machine data.

Machine control tables have been configured in SIMATIC STEP 7, HW Config as follows:

Table 11-50 Configuration

	Slot	DP ID	Order number/ designation	I address	O address
1st MCP	1	55	Standard+Handwheel	0 ... 7	0 ... 7
	2	*2AE*	*–> Standard+Handwheel*	288 ... 291	
	3	*1*	*–> Standard+Handwheel*		
2nd MCP	1	55	Standard+Handwheel	8 ... 15	8 ... 15
	2	*2AE*	*–> Standard+Handwheel*	304 ... 307	
	3	*1*	*–> Standard+Handwheel*		
3rd MCP	1	55	Standard+Handwheel	16 ... 23	16 ... 23
	2	*2AE*	*–> Standard+Handwheel*	3320 ... 323	
	3	*1*	*–> Standard+Handwheel*		
4th MCP	1	55	Standard+Handwheel	24 ... 29	24 ... 29
	2	*2AE*	*–> Standard+Handwheel*	330 ... 333	
	3	*1*	*–> Standard+Handwheel*		

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Parameterizing in the NCK machine data:

Table 11-51 Handwheel assignment

Machine data	Value	Description
		1st handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[0]	5	Hardware segment: PROFIBUS
MD11351 $MN_HANDWHEEL_MODULE[0]	1	Reference to logical base address of the handwheel slot of the 1st MCP
MD11352 $MN_HANDWHEEL_INPUT[0]	1	1st handwheel in handwheel slot
		2nd handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[1]	5	Hardware segment: PROFIBUS
MD11351 $MN_HANDWHEEL_MODULE[1]	1	Reference to logical base address of the handwheel slot of the 1st MCP
MD11352 $MN_HANDWHEEL_INPUT[1]	2	2nd handwheel in handwheel slot
		3rd handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[2]	5	Hardware segment: PROFIBUS
MD11351 $MN_HANDWHEEL_MODULE[2]	2	Reference to logical base address of the handwheel slot of the 2nd MCP
MD11352 $MN_HANDWHEEL_INPUT[2]	1	1st handwheel in handwheel slot
		3rd handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[3]	0	No handwheel parameterized
MD11351 $MN_HANDWHEEL_MODULE[3]	0	No handwheel parameterized
MD11352 $MN_HANDWHEEL_INPUT[3]	0	No handwheel parameterized
		4th handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[4]	5	Hardware segment: PROFIBUS
MD11351 $MN_HANDWHEEL_MODULE[4]	6	Reference to logical base address of the handwheel slot of the 3rd MCP
MD11352 $MN_HANDWHEEL_INPUT[4]	1	1st handwheel in handwheel slot
		5th handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[5]	5	Hardware segment: PROFIBUS
MD11351 $MN_HANDWHEEL_MODULE[5]	5	Reference to logical base address of the handwheel slot of the 4th MCP
MD11352 $MN_HANDWHEEL_INPUT[5]	2	2nd handwheel in handwheel slot

Table 11-52 Logical base addresses

Machine data	Value	Description
MD11353 $MN_HANDWHEEL_LOGIC_ADDRESS [0]	288	Logical base address handwheel slot 1st MCP
MD11353 $MN_HANDWHEEL_LOGIC_ADDRESS [1]	304	Logical base address handwheel slot 2nd MCP
MD11353 $MN_HANDWHEEL_LOGIC_ADDRESS [4]	330	Logical base address handwheel slot 4th MCP
MD11353 $MN_HANDWHEEL_LOGIC_ADDRESS [5]	320	Logical base address handwheel slot 3rd MCP

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11.6.4 Connection via Ethernet

Parameterization

Parameterization of handwheels connected via Ethernet modules, e.g. machine control table ”MCP 483C IE”, is done with the following NCK machine data:

- MD11350 $MN_HANDWHEEL_SEGMENT[< *Handwheel_No. – 1*>] = 7

  When connected via Ethernet module, the hardware segment has always to be entered as 7 (Ethernet).

Note

The following machine data are not evaluated with connection via Ethernet:

- MD11351 $MN_HANDWHEEL_MODULE (handwheel module)
- MD11352 $MN_HANDWHEEL_INPUT (handwheel input)

Handwheel assignment

Handwheel assignment of handwheels connected via Ethernet modules cannot be changed.

Handwheel number in NCK	Machine data set (Index)	Terminal
1	0	1st MCP, 1st handwheel connection (X60)
2	1	1st MCP, 2nd handwheel connection (X61)
3	2	2nd MCP, 1st handwheel connection (X60)

The fourth handwheel in NCK has not been used (gap in machine data).

Example

Parameterization of 2 handwheels, connected via a machine control table ”MCP 483C IE”.

Table 11-53 Handwheel assignment

Machine data	Value	Description
		1st handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[0]	7	Hardware segment: Ethernet
		2nd handwheel in NCK
MD11350 $MN_HANDWHEEL_SEGMENT[1]	7	Hardware segment: Ethernet

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Call parameter of the function module FB1 in organization module OB100:

Parameter	Value	Comment
MCPNum	:= 1	// MCP available
MCP1In	:= P#E0.0	// Address of the input data
MCP1Out	:= P#A0.0	// Address of the output data
MCP1StatSend	:= P#A8.0	// Address of the send status data
MCP1StatRec	:= P#A12.0	// Address of the receive status data
MCP1BusAdr	:= 192	// "Address" set via switch S2
		// on the MCP
MCPBusType	:= b#16#55	// Bus type: Ethernet

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11.7 Digital and analog I/O devices

The following digital and analog signal modules are available:

Digital I/O modules

- MCI board extension module (option)
  On the MCI board extension module (option) there are 4 digital inputs/ outputs (Section 2.3, Page 2-53).
- PP 72/48
  The I/O module PP 72/48 has 72 digital inputs and 48 digital outputs (Section 2.11, Page 2-79).
- ADI4
  The ADI4 has two digital input and output bytes that are used for ADI4–internal functions and as I/O signals at the interfaces of the module (Section 2.12, Page 2-91).
- SIMATIC S7: ET200 modules
  Via the PROFIBUS DP it is possible to connect all subtypes of SIMATIC–S7 I/O modules of type ET200 (e.g. ET200M) as long as they support a data transmission rate of 12 Mbaud.

Analog I/O modules

- SIMATIC S7: ET200 modules
  See above.

Notice

The digital and analog input/outputs connected via the PROFIBUS DP are equally available to both the NCK and PLC.

It is the sole responsibility of the user to avoid access conflicts:

- On the NCK side: Part program/synchronized action
- On the PLC side: PLC user program

References /**FB**/ **Description of Functions, Extended Functions**, A4 Digital and Analog NCK I/Os

11.7.1 Parameterization of the number of inputs/outputs used

Max. number

The maximum number of digital or analog input/outputs that can be used for the NCK is:

	Total	MCI board extension	PROFIBUS Modules
Analog inputs	8	–	8
Analog outputs	8	–	8
Digital inputs	36	4	32
Digital outputs	36	4	32

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Note

The first digital input and output **byte** is permanently assigned to the MCI board extension module (option). Therefore you can connect a maximum of 4 additional input/output **bytes** to the PROFIBUS DP via signal modules. See configuration example Section 11.7.6, Page 11-394.

Machine data

The number of used analog and digital inputs/outputs is set in the following machine data parameters:

Analog I/Os

- MD10300: FASTIO_ANA_NUM_INPUTS ("Number of active analog NCK inputs")
- MD10310: FASTIO_ANA_NUM_OUTPUTS ("Number of active analog NCK outputs")

Digital input/outputs

- MD10350: FASTIO_DIG_NUM_INPUTS ("Number of active digital NCK input **bytes**")
- MD10360: FASTIO_DIG_NUM_OUTPUTS ("Number of active digital NCK output **bytes**")

11.7.2 Assignment of inputs/outputs to the signal modules

On the NCK side, the analog and digital inputs/outputs are assigned to the respective signal modules on the PROFIBUS DP via the appropriate I/O addresses in the machine data:

Machine data

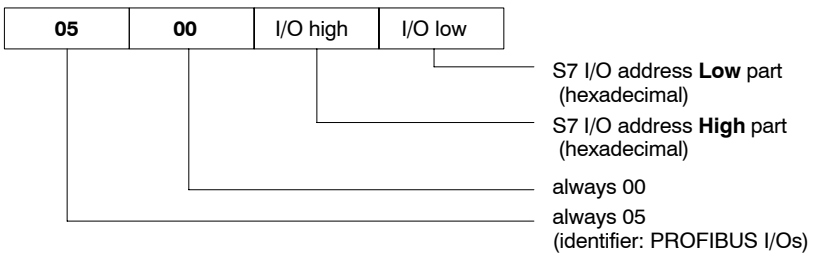
Analog I/Os

- MD10362: HW_ASSIGN_ANA_FASTIN[n] ("hardware assignment of external analog inputs"), per input, where n = 0–7
- MD10364: HW_ASSIGN_ANA_FASTOUT[n] ("hardware assignment of external analog outputs"), per output, where n = 0–7.

Digital input/outputs

- MD10366: HW_ASSIGN_DIG_FASTIN[n] ("hardware assignment of external digital inputs"), per input **byte**, where n = 0–3
- MD10368: HW_ASSIGN_DIG_FASTOUT[n] ("hardware assignment of external digital outputs"), per output **byte**, where n = 0–3

Input format



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Note

- The **first** *digital* input/output **bytes** defined via machine data:
  - MD10350: FASTIO_DIG_NUM_INPUTS
  - MD10360: FASTIO_DIG_NUM_OUTPUTS

  always refers to the 4 digital input/outputs on the **MCI board extension** module. Explicit assignment in machine data is not possible. Therefore, the machine data required to assign the digital and analog input/outputs refer exclusively to the signal modules connected via the **PROFIBUS DP**.
- The I/O address to be entered in the machine data **hexadecimally** is the **decimal** I/O address of the respective signal module slot allocated by ”HW Config” or set manually.
- If a slot comprises several I/O bytes or addresses, the NCK occupies the entire slot when an I/O byte is assigned. This means I/O bits not used for the NCK cannot be written by the PLC user program .

11.7.3 System variable $A_...[n]

The digital and analog input/outputs are available in the NCK (part program, ASUP, synchronized action, etc.) in the form of system variables.

Analog inputs/outputs

- $A_INA[n] (”Read analog input n, where n=1...8”)
- $A_OUTA[n] (”Write analog output n, where n=1...8”)

Digital input/outputs

- $A_IN[n] (”Read digital input (Bit) n, where n=1...4 and 9...40”)
- $A_OUT[n] (”Write digital output n, where n=1...4 and 9...40”)

Hardware assign machine data	System variables
Analog inputs/outputs	
MD10362: HW_ASSIGN_ANA_FASTIN[0–7]	$A_INA[1–8]
MD10364: HW_ASSIGN_ANA_FASTOUT[0–7]	$A_OUTA[1–8]
Digital inputs/outputs	
MCI board extension: Digital inputs 1–4	$A_IN[1–4]
MD10366: HW_ASSIGN_DIG_FASTIN[0–3]	$A_IN[9–40]
MCI board extension: Digital outputs 1–4	$A_OUT[1–4]
MD10368: HW_ASSIGN_DIG_FASTOUT[0–3]	$A_OUT[9–40]

Note

The **digital** input/outputs are organized as follows:

- Hardware assign machine data: Byte by byte
- System variables: Bit by bit

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11.7.4 Digital input/output bytes and system variables

Digital inputs

The following configuration example shows the relationship between digital input bytes and system variables by means of the configuration of 3 digital inputs bytes.

This configuration example requires the following:

- MCI board extension module: 1 input byte
- PROFIBUS DP signal modules: 2 input bytes

The MCI board extension module is always assigned to a digital input byte. Digital input bytes of external signal modules must therefore always be counted as additional input bytes:

- MD10350: FASTIO_DIG_NUM_INPUTS = 1 + m,
  where m = number of inputs bytes of external signal modules

Because the 1st input byte is permanently assigned to the MCI board extension module, only the input bytes of the external signal modules have to be explicitly assigned to the system variables.

- MD10366: HW_ASSIGN_DIG_FASTIN[**0**] –> **1st** external input byte
- MD10366: HW_ASSIGN_DIG_FASTIN[**1**] –> **2nd** external input byte

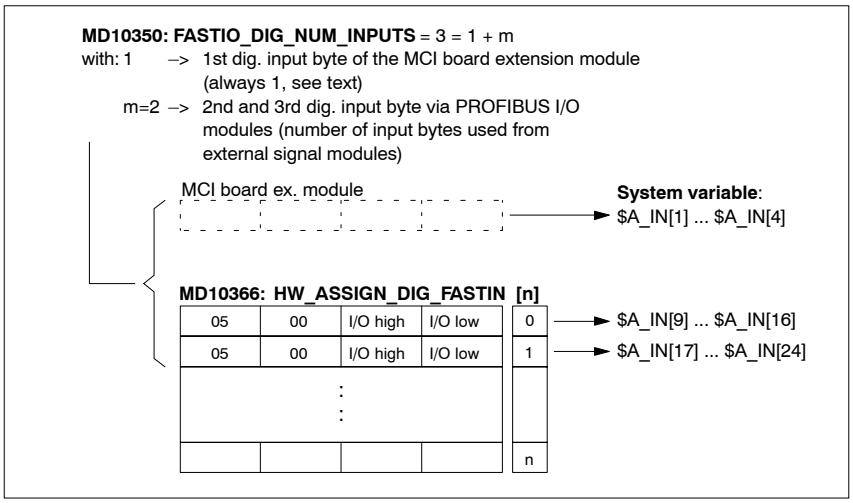


Fig. 11-31 Configuration example: 3 digital input bytes

If the optional MCI board extension module does not exist, assignment in the machine data must still be made as stated because the 1st input byte is internally permanently assigned to this module. System variables $A_IN[1] to $A_IN[4] do not then contain information.

Digital outputs

Digital outputs must be configured as described above for digital inputs.

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11.7.5 Time–based reaction

After the system variables have been set, e.g. $A_OUT[8] for setting the 8th digital output of the NCK on a SIMATIC S7 signal module connected via the PROFIBUS DP, the system variable is transferred from DP master to the signal module via the PROFIBUS DP **during the next position controller cycle**.

The signal module will then provide the signal to the appropriate with the output **next output cycle**. The PROFIBUS DP cycle and the cycle of the signal module are **not** synchronized during this process.

The transmission cycle described is illustrated in Fig. 11-32, Page 11-393.

The time properties when reading in a digital or analog input are analogously to the properties described above.

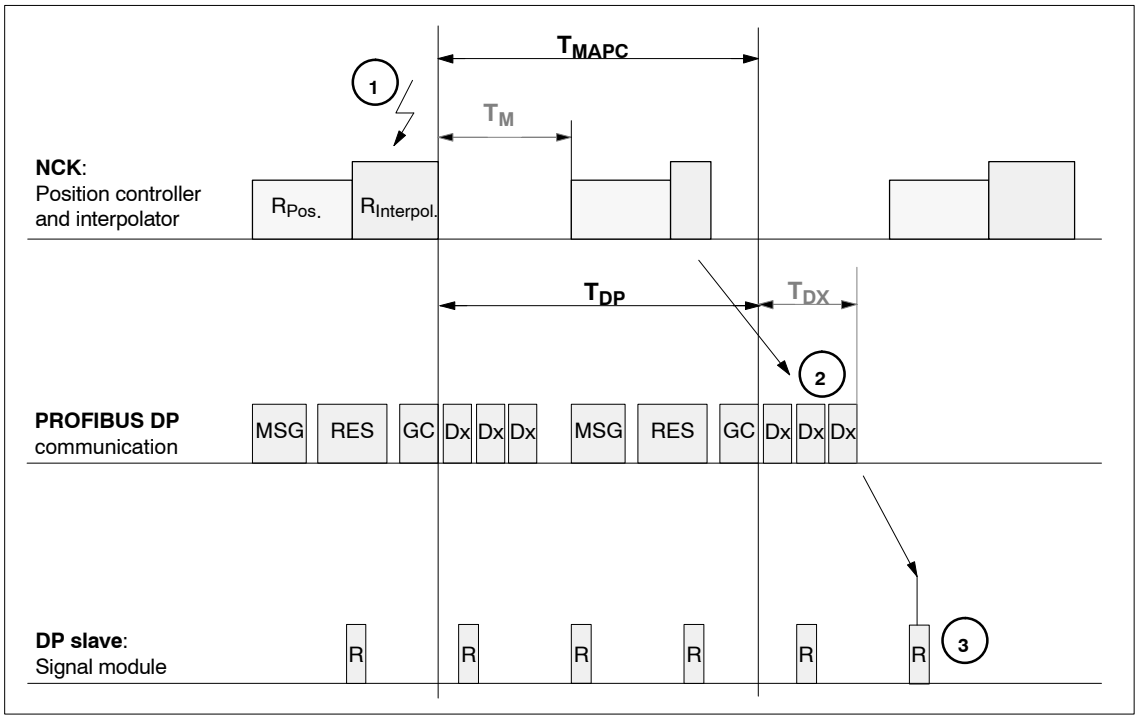


Fig. 11-32 Time response when outputting an output signal with optimized DP cycle

Key to Fig. 11-32:

T_{MAPC}	Master application cycle: NCK position control cycle The following always applies for SINUMERIK 840Di sl: $T_{MAPC} = T_{DP}$
T_{DP}	DP cycle time: DP cycle time
T_{DX}	Data exchange time: Sum of transfer times of all DP slaves
T_M	Master time: Offset of the start time for NCK position control
GC	Global control: Broadcast message for cyclic synchronization of the equidistance between DP master and DP slaves

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R	Computational time of position controller and/or signal module
Dx	Exchange of user data between DP master and DP slaves
MSG	Acyclic services (e.g. DP/V1, pass token)
RES	Reserve: ”active break” until the equidistant cycle has elapsed
(1)	Set the system variables, e.g. $A_OUT[8] in the part program or synchronized action
(2)	Transmit the output signal to the signal module on PROFIBUS DP
(3)	Connect the signal to the output of the module.

11.7.6 Configuration example

In the following configuration example, the following digital input/outputs are available to the NCK:

ET200

- 24 digital inputs
- 16 digital outputs

ADI4

- 8 digital inputs
- 16 digital outputs

Note

- The I/O addresses of the modules are assigned automatically by ”HW Config” (manual adjustment is possible).
- Each I/O address refers to an input/output **byte**.

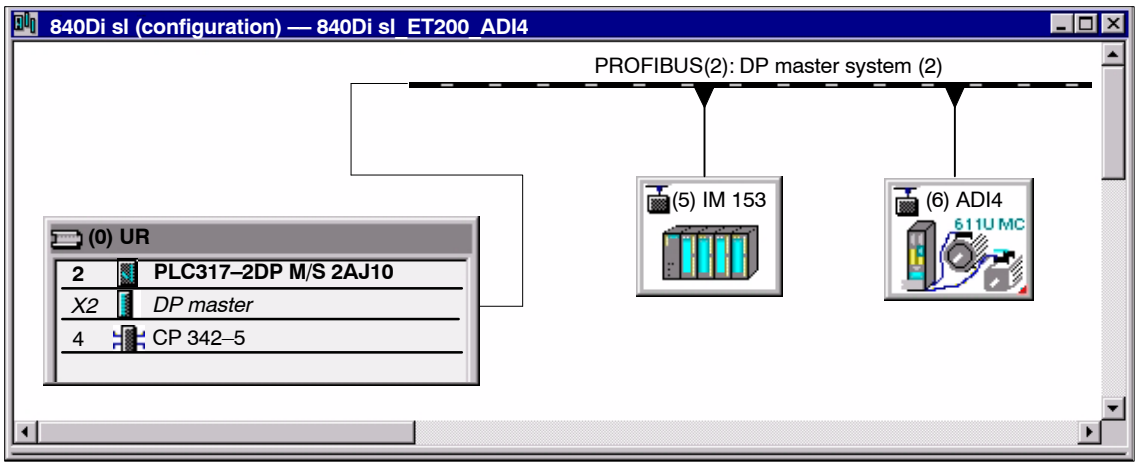


Fig. 11-33 Example configuration: SINUMERIK 840Di sl with ET200 and ADI4

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ET200 I/Os: IM 153

Slot	Module	I address	O address	Comment
4	SM 322 **DO16**xDC24V/0.5A	–	128...129	
5	SM 322 **DO32**xDC24V/0.5A	–	130...133	
6	SM 321 **DI16**xDC24V/0.5A	128...129	–	
7	SM 321 **DI32**xDC24V/0.5A	130...133	–	

ADI4

Slot	Module	I address	O address	Comment
4	Drive data			
5	Drive data	4288...4305		1st axis
6	Drive data		4288...4305	1st axis
7	Drive data			
8	Drive data			
9	Drive data	4306...4323		2nd axis
10	Drive data		4306...4323	2nd axis
11	Drive data			
12	Drive data			
13	Drive data	4324...4341		3rd axis
14	Drive data		4324...4341	3rd axis
15	Drive data			
16	Drive data			
17	Drive data	4342...4359		4th axis
18	Drive data		4342...4359	4th axis
19	Drive data			
20	Drive data			
21	Drive data	4360...3461		I word
22	Drive data		4360...4361	O word
Note: The structure of the PROFIBUS message frame is described in Section 8.8, Page 8-222f.				

Machine data

Parameterization of the NCK machine data is shown below:

Number of inputs bytes

ET200

3 input bytes

ADI4

1 input byte

Note

Although only 4 input bytes are used, 5 must be declared. The 1st input byte is **always** assigned to the MCI board extension module even if it is not installed:

– MD10350: FASTIO_DIG_NUM_INPUTS = **5**

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Number of outputs bytes

ET200

2 output bytes

ADI4

2 output bytes

Note

Although only 4 output bytes are used, 5 must be declared. The 1st output byte is **always** assigned to the MCI board extension module even if it is not installed:

- MD10360: FASTIO_DIG_NUM_OUTPUTS = **5**

Hardware assignment: input bytes

The following input bytes are used by the NCK:

ET200

Both input bytes of the input module (slot 6)

- MD10366: HW_ASSIGN_DIG_FASTIN[0] = **H05000080** (128_D)
- MD10366: HW_ASSIGN_DIG_FASTIN[1] = **H05000081** (129_D)

The 4th of the 4 input bytes of the signal module (slot 7)

- MD10366: HW_ASSIGN_DIG_FASTIN[2] = **H05000085** (133_D)

ADI4

The high byte of the input word (slot 21)

- MD10366: HW_ASSIGN_DIG_FASTIN[3] = **H050010E7** (4327_D)

Hardware assignment: output bytes

The following output bytes are used by the NCK:

ET200

The 1st output byte of the output modules (slots 4 and 5)

- MD10368: HW_ASSIGN_DIG_FASTOUT[0] = **H05000080** (128_D)
- MD10368: HW_ASSIGN_DIG_FASTOUT[1] = **H05000082** (130_D)

ADI4

Both output bytes of the output word (slot 22)

- MD10366: HW_ASSIGN_DIG_FASTOUT[2] = **H050010E6** (4326_D)
- MD10366: HW_ASSIGN_DIG_FASTOUT[3] = **H050010E7** (4327_D)

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Machine data

Table 11-54 Digital and analog I/Os: Machine data

Number	Identifier	Name	Reference
General ($MN_ ...)			
10300	FASTIO_ANA_NUM_INPUTS	Number of active analog NCK inputs	
10310	FASTIO_ANA_NUM_OUTPUTS	Number of active analog NCK outputs	
10320	FASTIO_ANA_INPUT_WEIGHT	Weighting factor for analog NCK inputs	
10330	FASTIO_ANA_OUTPUT_WEIGHT	Weighting factor for analog NCK outputs	
10350	FASTIO_DIG_NUM_INPUTS	Number of active digital NCK input bytes	
10360	FASTIO_DIG_NUM_OUTPUTS	Number of active digital NCK output bytes	
10362	HW_ASSIGN_ANA_FASTIN	Hardware assignment of external analog NCK inputs	
10364	HW_ASSIGN_ANA_FASTOUT	Hardware assignment of external analog NCK outputs	
10366	HW_ASSIGN_DIG_FASTIN	Hardware assignment of external digital NCK inputs	
10368	HW_ASSIGN_DIG_FASTOUT	Hardware assignment of external digital NCK outputs	
10380	HW_UPDATE_RATE_FASTIO	Update rate of clock–synchronous external NCK I/Os	
10382	HW_LEAD_TIME_FASTIO	Rate time for clock–synchronous external NCK I/Os	
10384	HW_CLOCKED_MODULE_MASK	Clock–synchronous processing of external NCK I/Os	
10394	PLCIO_NUM_BYTES_IN	Number of directly readable input bytes of the PLC I/Os	
10395	PLCIO_LOGIC_ADDRESS_IN	Start address of the directly readable input bytes of the PLC I/Os	
10396	PLCIO_NUM_BYTES_OUT	Number of directly writeable output bytes of the PLC I/Os	
10397	PLCIO_LOGIC_ADDRESS_OUT	Start address of the directly writable output bytes of the PLC I/Os	
10530	COMPAR_ASSIGN_ANA_INPUT_1	Hardware assignment of NCK analog inputs for comparator byte 1	
10531	COMPAR_ASSIGN_ANA_INPUT_2	Hardware assignment of NCK analog inputs for comparator byte 2	
10540	COMPAR_TYPE_1	Parameterization for comparator byte 1	
10541	COMPAR_TYPE_2	Parameterization for comparator byte 2	
Channel–specific ($MC_ ...)			
21220	MULTFEED_ASSIGN_FASTIN	Assignment of input bytes of NCK I/Os for ”multiple feedrates in one block”	V1

Setting data

Table 11-55 Digital and analog I/Os: Setting data

Number	Identifier	Name	Reference
General ($SN_ ...)			
41600	COMPAR_THRESHOLD_1	Threshold values for comparator byte 1	
41601	COMPAR_THRESHOLD_2	Threshold values for comparator byte 2	

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Interface signals

Table 11-56 Digital and analog I/Os: Interface signals

DB number	Bit, byte	Name	Reference
General	**Signals from PLC to NCK**		
10	0, 122, 124, 126, 128	Disable digital NCK inputs	
10	1, 123, 125, 127, 129	Setting on PLC of digital NCK inputs	
10	4, 130, 134, 138, 142	Disable digital NCK outputs	
10	5, 131, 135, 139, 143	Overwrite mask for digital NCK outputs	
10	6, 132, 136, 140, 144	Setting value from PLC for the digital NCK outputs	
10	7, 133, 137, 141, 145	Setting mask for digital NCK outputs	
10	146	Disable analog NCK inputs	
10	147	Setting mask for analog NCK inputs	
10	148–163	Setting value from PLC for the analog NCK inputs	
10	166	Overwrite mask for analog NCK outputs	
10	167	Setting mask for analog NCK outputs	
10	168	Disable analog NCK outputs	
10	170–185	Setting value from PLC for the analog NCK outputs	
Signals from NCK to PLC			
10	60, 186–189	Actual value for digital NCK inputs	
10	64, 190–193	Setpoint for digital NCK outputs	
10	194–209	Actual value for analog NCK inputs	
10	210–225	Setpoint for analog NCK outputs	

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11.8 Loadable compile cycles

Brief description

Compile cycles are functional expansions of the NCK system software that can be created by the operator and/or by Siemens and then imported in the control later.

As part of the open NCK system architecture, compile cycles have comprehensive access to data and functions of the NCK system level via defined software interfaces. Therefore, you can use compile cycles to expand the functionality of the NCK as much as you require or redefine it as far as allowed by the interfaces.

Including a compile cycle in the NCK system software is performed by loading the compile cycle into the file system of the NCK. The compile cycle can be loaded at any time.

Siemens compile cycles

The following technological functions and more are available from Siemens as compile cycles:

- 1D/3D Distance control in the position controller cycle
  References: /FB3/ Description of Functions Special Functions Section Distance Control (TE1)
- Continue machining at the contour (Retrace Support)
  References: /FB3/ Description of Functions – Special Functions Section Retrace Support (TE7)
- Fast laser switching signal
  References: /FB3/ Description of Functions – Special Functions Section Unclocked Path–Synchronous Switching Signal Output TE8

When you order one of the listed technological functions, you are given the corresponding software license number. To obtain the compile cycle in the form of a loadable file (.ELF extension for executable and linking format), please contact your regional Siemens sales partner.

Note

Compile cycles created by Siemens are options that require explicit activation and licensing.

References: Ordering information in Catalog NC 61

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11.8.1 Loading a compile cycle

Requirements

To transfer the compile cycle to the control, the following requirements must be met:

- There is a network connection (TCP/IP) between the PCU and an external computer (PC/PG) on which the compile cycle is located.
- Storage media can be connected to the PCU (e.g. USB FlashDrive) on which the compile cycle is saved.

Execution

Perform the following operation to load one or more compile cycles into the NCK:

1. End the active SINUMERIK user interface (e.g., HMI Advanced) and activate the SINUMERIK desktop (see Section 5.4.1, Page 5-117).
2. Use Windows Explorer to copy the compile cycle file (e.g. ccresu.elf) from the external computer (PC/PG) or the CD/disk drive to the following directory on the PCU: **F:\card\oem\sinumerik\oa**
3. Trigger a NCK reset to load the compile cycles into the NCK system software.

11.8.2 Interface version compatibility

A SINUMERIK–specific interface is used for communication between the compile cycle and NCK system software. Therefore, the interface version of a loaded compile cycle must be compatible with the interface version of the NCK system software. Each interface version is displayed under:

- Interface version of the NCK system software

  HMI Advanced:
  Diagnosis > Service displays > Version > NCU Version

  Display (excerpt)

  CC Interface Version:
  @NCKOPI . . . .**@Interfaces=*<1st digit>.<2nd digit>*** . . . .
  Loaded Compile Cycles:
  . . . .

- Interface version of a compile cycle that has not yet been loaded

  HMI Advanced (excerpt):
  Services > <*Medium*> > Softkey: "Properties"

  Display:

  Contents: Loadable compile cycle
  Interface: . . . . **@Interfaces=*<1st digit>.<2nd digit>*** . . . .

- Interface version of a loaded compile cycle

  HMI Advanced:
  Diagnosis > Service displays > Version > NCU Version

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Display (excerpt)

CC Interface Version:
@NCKOPI . . . .
Loaded Compile Cycles:
<Identifier> <Version> <Date generated>
CC start address
_N_*<Identifier><Version>***IF<*1st digit*><*2nd digit*>**_ELF . . .

Example:
_N_CLC407**IF003001**_ELF corresponds to interface version: 3.1

dependencies

The following dependencies exist between the interface versionsof a compile cycle and the NCK system software:

- 1st digit of the interface version number
  The 1st digit of the interface version number of a compile cycle and the NCK system software must be **equal**.
- 2nd digit of the interface version number
  The 2nd digit of the interface version number of a compile cycle must be **less than or equal** to the 2nd digit of the NCK system software.

Caution

If alarm 7200 is displayed after the NCK has booted, this means **no** compile cycle has been loaded!

11.8.3 Software version of a compile cycle

The software version of a compile cycle is displayed under:

HMI Advanced:
Diagnosis > Service displays > Version > NCU Version

Display (excerpt)

CC Interface Version:
@NCKOPI . . . .
Loaded Compile Cycles:
<Identifier> <Version> <Date generated>
CC start address
_N_*<Identifier>***<Version>**IF*<1st digit>.<2nd digit>*_ELF . . .
Code=*<Address>* Data=*<Address>* . . .

Example:
_N_CLC**407**IF003001_ELF corresponds to SW version: 4.7

Note

The display of code and data range start addresses of a compile cycle are provided for diagnostics purposes only and have no significance in normal operation.

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11.8.4 Supplementary conditions

The following checks are performed for all loaded compile cycles when the NCK boots:

Interface versions

If the interface version of the compile cycle is incompatible with the interface version of the NCK system software, the following alarm is displayed:

- Alarm ”7200 Version_conflict_with_CCNCKInterfaceVersion”.

dependencies

If one compile cycle has a functional dependency on another, and this has not been loaded in the NCK, the following alarm is issued:

- Alarm ”7200 CC<name>_ELF Loader_problem_from_dFixup”

System enables

If the compile cycle is not enabled in conjunction with SINUMERIK 840Di sl/840DiE sl, the following alarm is issued:

Not enabled for SINUMERIK 840Di sl

- Alarm ”7200 CC<name>_ELF NO_840Di”

Not enabled for SINUMERIK 840DiE sl:

- Alarm ”7200 CC<name>_ELF NO_EMBARGO”

Notice

If alarm ”7200 . . . ” is present after an NCK start–up, none of the loaded compile cycles is active.

11.8.5 Activating and licensing technology functions

Activating and licensing the option

To activate the technological function loaded onto the NCK by means of the compile cycle, the respective option must be set and licensed.

For information about how to activate and license options, please see Section 5.7, Page 5-127.

Activating the technological function

Each loaded compile cycle generates a technological function–specific global machine data:

- $MN_CC_ACTIVE_IN_CHAN_<*name*>[n], where n = 0, 1

in the machine data number range 60900 to 60999.

You can activate the entire technological function in the individual channels or individual subfunctions via the general NCK machine date mentioned above.

For a description of the machine data, please see Section 11.8.6, Page 11-403.

References

The individual technological functions are described in:

/**FB3**/ **Description of Functions Special Functions**
Sections TE1 to TE8

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11.8.6 Data descriptions (MD)

General machine data

60900 + i where i = 0. 1. 2. 3 ... MD number	**CC_ACTIV_IN_CHAN_XXXX[n] with: XXXX = function identifier, n = 0 or 1 n = 0: Activating the technology function in channels n = 1: Additional functions within the technology function**		
Default setting: 0	Min. input limit: 0	Maximum input limit: FFFF	
Changes effective after RESET	Protection level: 2/7	Units: –	
Data type: UINT16	Applies from SW version: 2.2		
Significance:	Activating the technology function in the channels: The technology function is activated in the channels by means of index n = 0. Bit 0 = 1: Technology function activated in channel 1 Bit n = 1: Technology function activated in channel n+1 For more details about which channels a technological function can be activated, please refer to the manuals below. Additional functions within the technology function: The MD with index n = 1 activates additional functions within the relevant technology function. See References below. **References**: /FB3/ Description of Functions Special Functions TE1 – TE8.		

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11.9 PROFIBUS DP

11.9.1 Setting the parameters for the shut–down behavior

If DP slaves respond to a shutdown in the PROFIBUS communication, e.g. NCK reset during operation, with fault conditions, you can assign parameters for a successive shutdown of the PROFIBUS communication using the following machine data:

- MD11250 $MN_PROFIBUS_SHUTDOWN_TYPE (PROFIBUS shutdown handling)

Note

The drives:

- SINAMICS S120
- SIMODRIVE 611U/UE, POSMO SI/CD/CA

can be operated in mode 0 (immediate shutdown).

11.9.2 Data descriptions (MD)

General machine data

11250 **MD number**	**PROFIBUS_SHUTDOWN_TYPE** **PROFIBUS shutdown handling**		
Default setting: 0	Min. input limit: 0	Maximum input limit: 2	
Changes effective after RESET	Protection level: 2/7	Units: –	
Data type: UINT8	Applies from SW version: 2.2		
Significance:	Shut–down modes of PROFIBUS DP communication: 0 = PROFIBUS DP communication is shut down at the DP master end without any warning. 1 = The PROFIBUS DP is put into status CLEAR for at least 20 cycles. Then PROFIBUS DP communication is deactivated. If it is not possible to put the PROFIBUS DP in status CLEAR, proceed as described under 2. Use this procedure with: SINUMERIK 840D with DP–Link module. 2 = Zero values are transmitted for at least 20 clock cycles for all DP slave drives connected to PROFIBUS DP for the following frame data: – Control word 1 – Control word 2 PROFIBUS DP communication is then shut down. To be used for: SINUMERIK 840Di sl in conjunction with external drives.		

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11.10 Initial settings

Concept

The status of an NCK function, e.g. G codes, tool length compensation, transformation, coupled motion, etc., which is taken in a certain status of a channel is a default setting.

Channel states for which default settings can be parameterized are:

1. Power up (NCK reset), reset (channel or mode group reset) and end of part program

and

2. Part program start

The default setting of an NCK function remains stored until it is explicitly changed by operation or programming.

Initial settings parameter assignment

The machine data:

- MD20110: RESET_MODE_MASK (”Definition of the control default settings in case of reset”)
- MD20112: START_MODE_MASK (”Definition of the control default settings in case of NC–Start”)
- MD20150: GCODE_RESET_VALUES (”Reset position of the G groups”)
- MD20152: GCODE_RESET_MODE (”G code initial setting in case of reset”)

are used to define the relevant default settings.

Table 11-57 Default settings that can be parameterized through MD

State	parameterizable through MD
Power up (POWER ON)	MD20110: RESET_MODE_MASK MD20150: GCODE_RESET_VALUES
RESET/part program end	MD20110: RESET_MODE_MASK MD20150: GCODE_RESET_VALUES MD20152: GCODE_RESET_MODE
Part program start	MD20112: START_MODE_MASK MD20110: RESET_MODE_MASK

References

/**FB1**/ **Description of Functions, Basic Functions**,
K2 Axes, Coordinate System, Frames, Workpiece Actual–Value System
Chapter: Workpiece–related actual value system/reset response

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11.11 NCK/PLC diagnostics

11.11.1 Menu: Diagnostics

Operating path

The menu of the NCK/PLC diagnostics is in the following operating path:

- Operating area switchover > Diagnosis > NC/PLC Diagnosis > Diagnosis

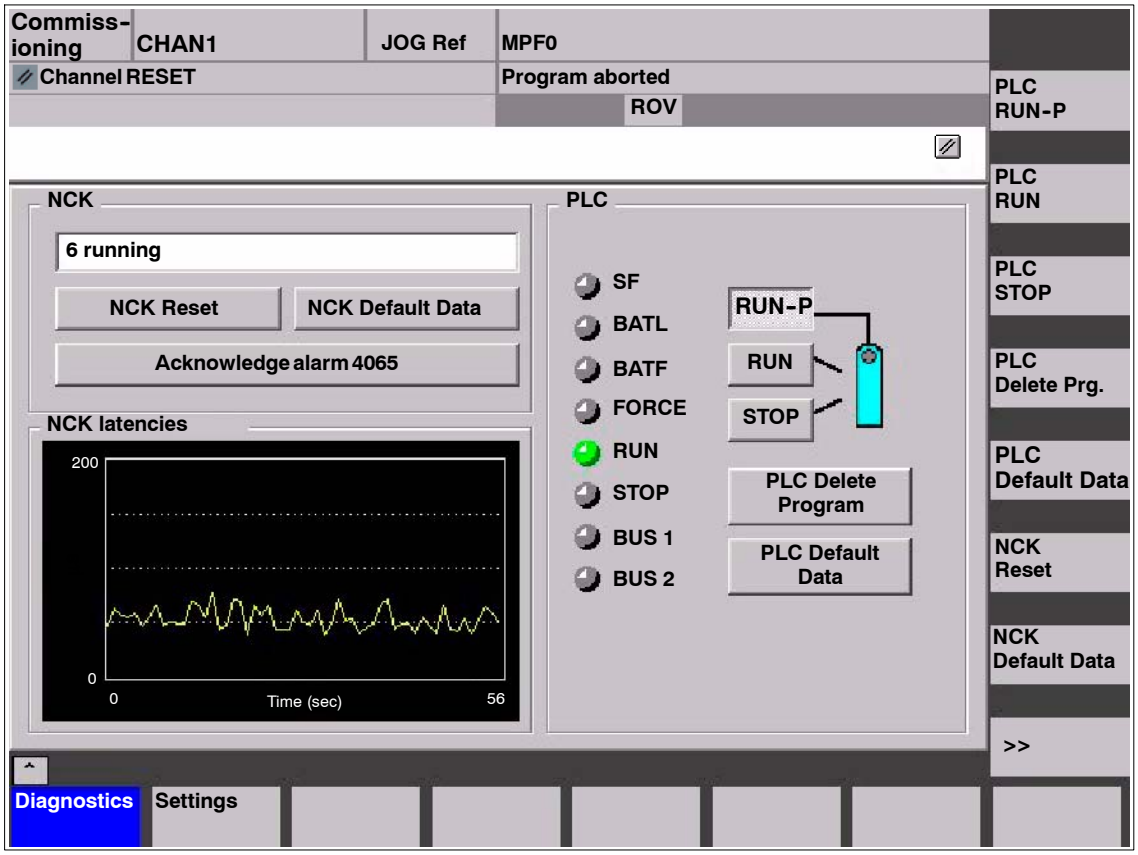


Fig. 11-34 Menu: NCK/PLC diagnostics

Group box: NCK

The following functions are grouped together in the NCK group box:

- **NCK state**

  The current state of the NCK is displayed via the output field:
  - 0 not started
  - 1 started
  - 2 initializing data
  - 3 initializing data
  - 4 start-up
  - 5 waiting for PLC
  - 6 running
  - F NCK error

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- **NCK Reset**

  Via the ”NCK reset” button, an NCK POWER ON reset is triggered.

  On a NCK POWER ON reset, all active machining operations are stopped. Drives that are in motion are not decelerated on their acceleration ramp but at that their current limit.

  After start–up, the NCK is in the reset state. Machine and user data are not changed.

- **NCK Default Data**

  Via the ”NCK reset” button, an NCK POWER ON reset is triggered followed by NCK general reset. All active machining operations are stopped as described under ”NCK Reset”.

  After start–up, the NCK is in the reset state. All machine and user data are deleted and standard machine data are loaded.

Notice

After ”NCK Default Data” has been triggered, the NCK must be commissioned again or a series startup file read in (see Section 15, Page 15-459).

- **Acknowledge alarm 4065**

  Via button ”Acknowledge alarm 4065”:

  - Interrupt: ”4065 Battery–backed memory has been restored from back–up copy. (possible data loss!)”

  is acknowledged and an NCK–POWER ON reset is triggered.

  To acknowledge the alarm via softkey, it is first necessary to switch to the follow–up softkey bar with the ”ETC” key.

Note

Alarm 4065 is also acknowledged by NCK–POWER ON reset via ”NCK Default Data”. Then the NCK must be commissioned again or a series startup file read in (see Section 15, Page 15-459).

Group box: PLC

The following functions are grouped together in the PLC group box:

- **PLC RUN–P**

  With the ”PLC RUN–P” button, the PLC is put in the ”RUN–PROGRAMMING” state. In this operating state, changes can be made to the PLC user program without activation of the password.

- **PLC RUN**

  With the ”PLC RUN” button, the PLC is put in the ”RUN” state. Only read accesses are possible via a programming device (PG) in this mode. It is not possible to make changes to the PLC user program until the password has been set.

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- **PLC STOP**

  With the ”PLC STOP” button, the PLC is put in the STOP state. Processing of the PLC user program has stopped and all outputs are set to substitute values.

- **PLC Delete Program**

  The PLC is put in the STOP state with ”PLC Delete Program” button and then PLC general reset (default data) is performed. The following actions are performed by the PLC:

  1. The PLC disconnects all links.
  2. The user data are deleted (data and program blocks)
  3. The system data blocks (SDB) are deleted.
  4. Battery–backed data are copied back into the RAM area from the PLC after general reset.
  5. The diagnostics buffer, the MPI parameters, the clock time, and the operating hours counter are not reset.

- **PLC default data**

  The PLC is put in the STOP state via the ”PLC Default Data” button and then an extended PLC general reset is performed. The actions stated above under item 1. – 4. and those under item 5. are reset.

- **Status displays**

  The status displays, which are made to look like LEDs, indicate the following:

  - **SF** (System Fault)
    lights up on PLC system errors, such as: Hardware, programming, parameterizating, computing, time, battery, and communication errors.
  - **BATL** (Battery Low)
    lights up if the 5 V power supply (back–up battery) falls below its permissible value.
  - **BATF** (Battery Fault)
    lights up on failure of the 5 V power supply (back–up battery).
  - **FORCE**
    lights up if the FORCE function is active.

    The FORCE function sets user variables to permanent values that cannot be overwritten by the user program. For detailed information on this, see the Online Help of the SIMATIC Manager STEP 7.
  - **RUN**: See Table 11-58 below.
  - **STOP**: See Table 11-58 below.
  - **BUS 1**
    lights up in case of a bus/interface error on PROFIBUS (1) (interface X101)
  - **BUS 2**
    lights up in case of a bus/interface error on MPI or PROFIBUS (2) (depends on configuration of interface X102)

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Table 11-58 PLC operating state display by means of RUN/STOP evaluation

RUN	STOP	PLC operating state
On	Off	RUN: The PLC program is being processed.
Off	On	STOP: The PLC program is not being processed. STOP can be triggered by the PLC program, an error, or an operator input.
Flashes at 0.5 Hz	On	HALT: The PLC user program has been halted (triggered by a test function)
Flashes at 2 Hz	On	RESTART: A PLC start–up is performed (transition from STOP to RUN). Transition to STOP occurs on start–up abort.
Off	– lit – 3 sec off – lit	MEMORY RESET: A general reset is requested.
Off	– lit – flashing at 2 Hz for at least 3 sec – lit	MEMORY RESET: A general reset is active

Group box: NCK latency

The following information is grouped together in the NCK latency group box:

- **NCK latency**

  The basis of the SINUMERIK 840Di sl real–time property is activation of the NCK system software cyclically in defined time intervals.

  Because the NCK and Windows XP share the available PCU processor power, delays (latencies) may occur when invoking the NCK. If latencies are longer than 200µs, they are considered real–time violations, as a result of which the NCK functionality can no longer be guaranteed.

  On the NCK latency display it is possible to observe the NCK's latency behavior continuously for a period of 50 seconds. This can be used, for example, ascertaining to what extent the real–time response of the NCK has been affected after replacing or expanding hardware and/or software components.

Note

For detailed information about the real–time properties of the SINUMERIK 840Di sl, see Section 1.1.5, Page 1-26.

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11.11.2 Menu: Settings

Operating path

The menu for the SINUMERIK 840Di sl specific settings is in the following operating path:

- Operating area switchover > Commissioning > NC/PLC Diagnosis > Settings

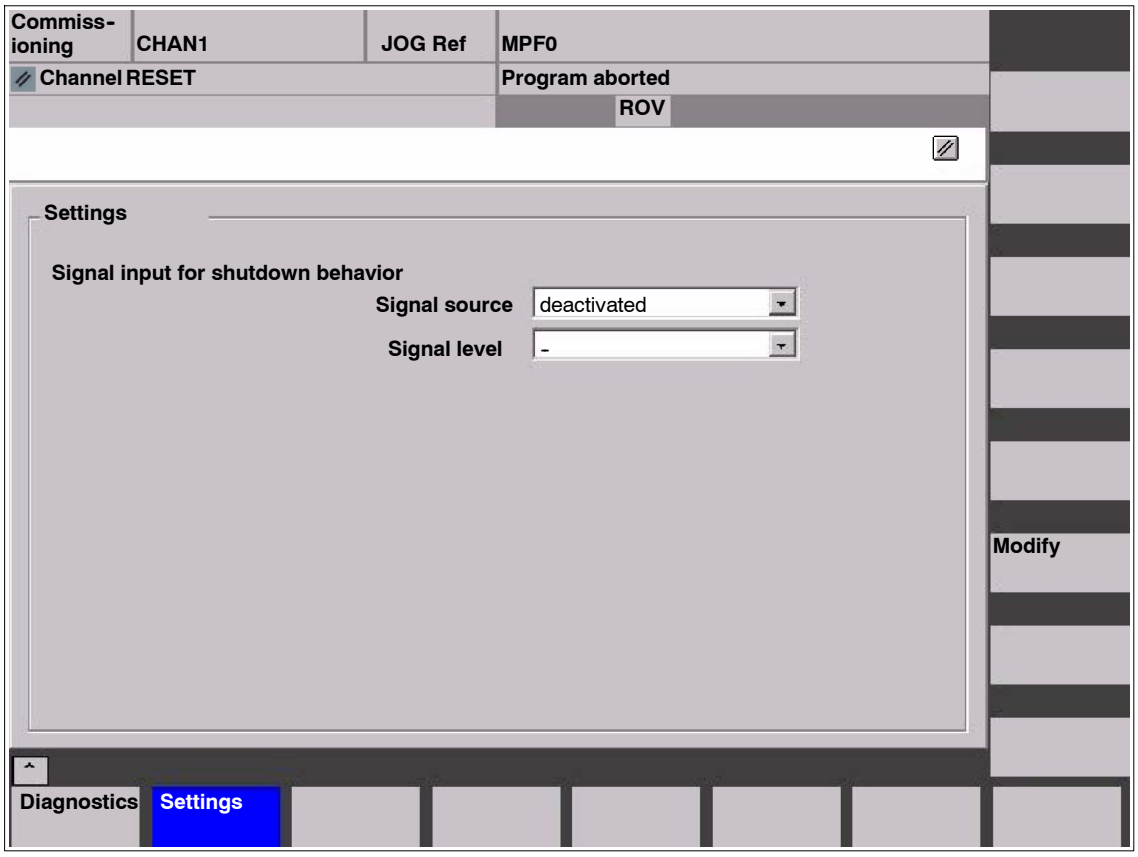


Fig. 11-35 Menu: Settings

Modifying data

When switching to the menu the data displayed become read-only. To change the data, press the "Change" softkey first.

Group box: Settings

The following functions are grouped together via the "Settings" group box:

- **Signal input for shutdown behavior: Signal source**

  This selection field is for configuring the digital input used for the shutdown signal of the UPS:

  - **deactivated**

    No input signal is present.

  - **NCK input 0...3**

    The shutdown signal of the UPS is connected to the configured digital input of the MCI board extension module (See Section 2.3.3, Page 2-57).

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- **Signal input for shutdown behavior: Signal level**

  This selection field is for configuring the level of the shutdown signal of the UPS:

  - **Low active**

    Upon detection of the low level (0) at the configured input, first the SINUMERIK 840Di sl NCK/PLC and then Windows XP are closed.

  - **High active**

    Upon detection of the high level (1) at the configured input, first the SINUMERIK 840Di sl NCK/PLC and then Windows XP are closed.

Making changes

To apply the changes you have made, press the ”Accept” softkey. The message box that is then displayed has to be acknowledged again with the ”Accept” softkey.

The ”Cancel” softkey rejects all changes and displays the original settings again.

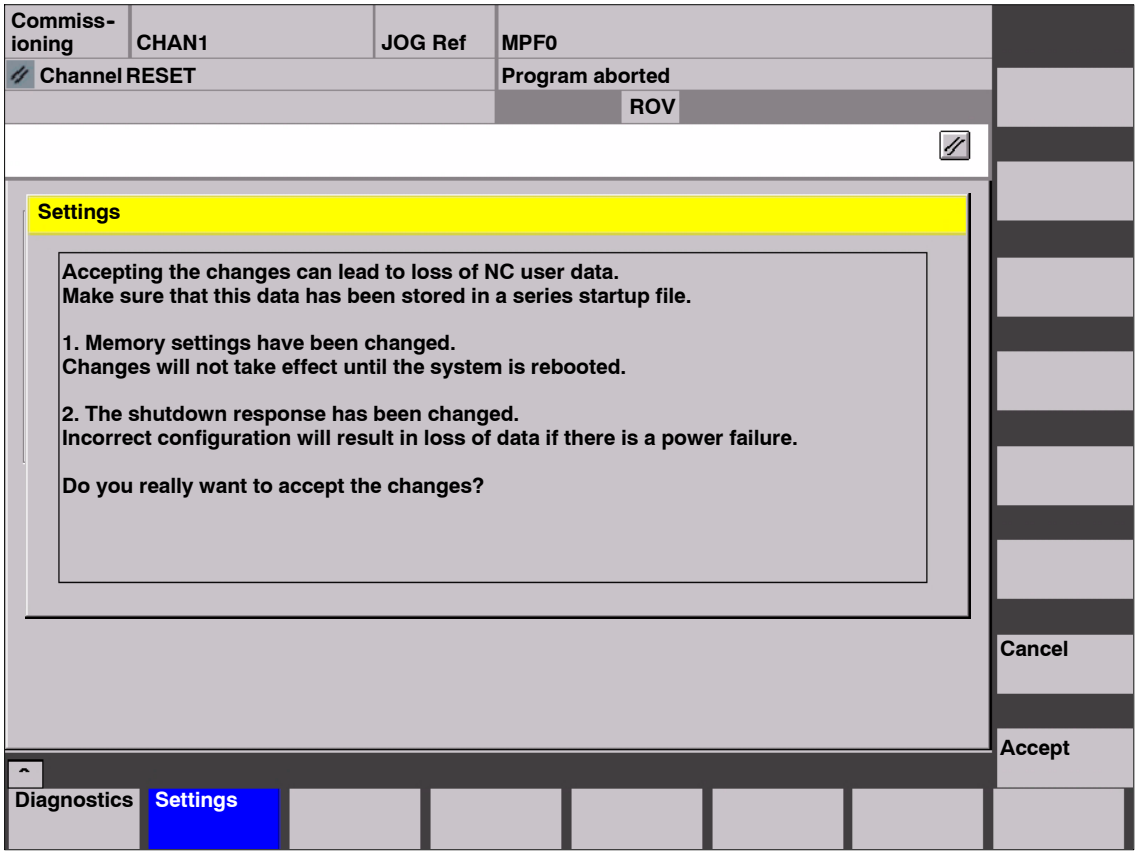


Fig. 11-36 Making settings

Notice

We urgently recommend creating a series startup file before changing the data described above. See Section 15, Page 15-459.

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12 Alarm and Message Texts

12.1 Alarm and message texts

To enable easy adaptation of alarm and message texts to the specific requirements of an automation system, the alarm and message texts are stored in freely accessible ASCII text files.

The alarm and message texts contained in the text files are used commonly by all SINUMERIK user interfaces:

- SinuCom NC
- 840Di start–up
- HMI Advanced

By changing/modifying the texts or files or by creating new texts/files, a flexible adaptation to the current requirements is possible.

Storing the text files

Files containing the alarm and message texts are stored on the hard disk in directory **<installation path>\dh\mb.dir**.

12.1.1 Configuration file MBDDE.INI

Structure of the file MBDDE.INI

The alarm and message texts to be used are set in the file **<installation path>\mmc2\mbdde.ini**. For this purpose, the appropriate paths to the application–specific standard and user files must be stored in the [Textfiles] section of file MBDDE.INI.

Extract from file ”MBDDE.INI”:

```
...
[Textfiles]
MMC=   <installation path>\dh\mb.dir\alm_
NCK=   <installation path>\dh\mb.dir\aln_
PLC=   <installation path>\dh\mb.dir\plc_
ZYK=   <installation path>\dh\mb.dir\alz_
CZYK=  <installation path>\dh\mb.dir\alc_
UserMMC=
UserNCK=
UserPLC= <installation path>\dh\mb.dir\myplc_
UserZyk=
UserCyk=
...
```

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12.1.2 Standard text files

Standard text files

The standard alarm and message texts in ASCII format are stored in the following files on the hard disk:

- MMC : <installation path>\dh\mb.dir\alm_XX.com
- NCK : <installation path>\dh\mb.dir\aln_XX.com
- PLC : <installation path>\dh\mb.dir\alp_XX.com
- ZYK : <installation path>\dh\mb.dir\alz_XX.com
- CZYK : <installation path>\dh\mb.dir\alc_XX.com

”XX” stands for the abbreviation of the appropriate language (see Table 12-1, Page 12-415).

The **standard text files** should **not** be modified for adaptation of the alarm and message texts. In the case of a software update, the inserted or modified user–specific texts would be lost by overwriting the existing data. It is therefore urgently recommended to store user–specific alarm and message texts in separate user text files.

12.1.3 User text files

User text files

You can replace the alarm and message texts stored in the standard text files by your own user–specific text files or extend them.

Note

To edit the text files, any **ASCII editor** can be used.

When editing the text files with a different editor, make sure that they are then stored in ASCII format.

The alarm and message texts from the user files replace the standard texts with the same alarm and message numbers.

Texts for alarm or message numbers not contained in the standard texts are additionally provided.

Notice

The maximum length of an alarm or message text displayed over two lines is 110 characters.

Storage path

The user–specific text files must be copied with operating area:
Services into directory:
<installation path> \dh\mb.dir

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Language–specific nature of alarm texts

Language assignment of the user–specific alarm texts is achieved via the name of the text file. The appropriate code and the file extension **.com** are added to the user file name entered in MBDDE.INI:

Table 12-1 Language codes

Language	Abbreviation
German	gy
English	uk
French	fr
Italian	it
Spanish	sp

Announcement in the system

The user–specific text files that are now in the directory: <installation path>\dh\mb.dir are announced to the system using an appropriate entry in the file **MBDDE.INI**.

Note

To make sure that the modified file MBDDE.INI is not overwritten when the software is updated, it is strictly recommended to store it in the intended **USER** path(**<installation path>\user**\mbdde.ini).

Example

Example of adding an additional text file MYPLC_GR.COM:

Note

If the text file MYPLC_GR.COM is created on an external PC and then read in through the serial interface (e.g. with PCIN), the following lines must be contained at the beginning of the file:

```
%_N_MYPLC_GR_COM
;$Path=/_N_MB_DIR
```

MYPLC_GR.COM: user–spec. file for user's own German PLC alarm texts

```
%_N_MYPLC_GR_COM
;$Path=/_N_MB_DIR
700000   0   0  "DB2.DBX180.0 set"
700001   0   0  "Lubrication pressure missing"
....
```

MBDDE.INI:

```
[Textfiles]
UserPLC= <installation path>\dh\mb.dir\myplc_
```

Notice

Any modifications to alarm texts come only into effect after the appropriate user interface has been rebooted.

When creating text files, make sure that the date and time are correctly set on the PCU. Otherwise, the user texts may not appear on screen.

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12.1.4 Syntax for alarm text files

Alarm numbers

The following alarm numbers are available for the cycle, compile cycle and PLC alarms:

Table 12-2 Alarm numbers for cycle, compile cycle and PLC alarms

Number range	Designation	Effect	Delete
60000 – 60999	Cycle alarms (Siemens)	Display, interlocking NC start	Reset
61000 – 61999		Display, NC start disable, axis/spindle standstill	Reset
62000 – 62999		Display	Cancel
63000 – 64999	Reserved		
65000 – 65999	Cycle alarms (user)	Display, interlocking NC start	Reset
66000 – 66999		Display, NC start disable, axis/spindle standstill	Reset
67000 – 67999		Display	Cancel
68000 – 69000	Reserved		
70000 – 79999	Compile cycle alarms		
400000 – 499999	PLC alarms general		
500000 – 599999	PLC alarms for channel		
600000 – 699999	PLC alarms for axis and spindle		
700000 – 799999	PLC alarms for users		
800000 – 899999	PLC alarms for sequence cascades/graphs		

Format of the text file for cycle alarm texts

The structure of the text file for cycle and compile cycle alarms is as follows:

Table 12-3 Structure of text file for cycle alarm texts

Alarm number	Display	Help ID	Text or alarm number
60100	1	0	”No D number %1 is programmed”
60101	1	0	60100
...	...	...	...
65202	0	1	”Axis %2 in channel %1 is still moving”
// Alarm text file for cycles in English			

References: /FB/, Description of Functions, Basic Functions
P3 PLC Basic Program
Section: Lists

Alarm number

List of alarm numbers

Display

This number defines the alarm display type:
0: Display in alarm line
1: Display in a dialog box

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Help ID

The default assignment ”0” means:
The help file supplied by Siemens provides a detailed description of the alarm.

A value between 1 and 9 uses an assignment entry in the MBDDE.INI file to refer to a help file created by the user. See also Section 12.1.5, Page 12-418, Section: HelpContext.

Text or alarm number

The associated text is given in inverted commas with the position parameters.

- Characters ” and # must not be used in alarm texts.
  The % character is reserved for displaying parameters.
- If an existing text is to be used, this can be done with a reference to the corresponding alarm. 5–digit alarm number instead of ”text”.
- The alarm file can contain comment lines, these must start with ”//”. The maximum length of the alarm text is 110 characters for a 2–line display. If the text is too long, it is truncated and the symbol ”***** is added to indicate missing text.
- Parameter ”%1”: Channel number
  Parameter ”%2”: Block number

Format of the text file for PLC alarm texts

The ASCII file for PLC alarm texts has the following structure:

Table 12-4 Structure of text file for PLC alarm texts

Alarm no.	Display	Help ID	Text	Text on MMC
510000	1	0	”Channel %K FDDIS all”	Channel 1 FDDIS all
600124	1	0	”Feed disable axis %A”	Feed disable axis 1
600224	1	0	600124	Feed disable axis 2
600324	1	0	600224	Feed disable axis 3
703210	1	1	”User Text”	User Text
...				
703211	1	1	” User text%A ...”	User Text Axis 1 ...
// Alarm text file for PLC alarm				

References: /FB/, Description of Functions, Basic Functions
P3 PLC Basic Program

Display

This number defines the alarm display type:
0: Display in alarm line
1: Display in a dialog box

Help ID

Default setting ”0” means:
The help file supplied by Siemens provides a detailed description of the alarm.

A value between 1 and 9 uses an assignment entry in the MBDDE.INI file to refer to a help file created by the user. See also Section 12.1.5, Page 12-418, Section: HelpContext.

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Text or alarm number

The associated text is given in inverted commas with the position parameters.

- Characters ” and # must not be used in alarm texts.
  The % character is reserved for displaying parameters.
- If an existing text is to be used, this can be done with a reference to the corresponding alarm. 6–digit alarm number instead of ”text”.
- The alarm file can contain comment lines, these must start with ”//”. The maximum length of the alarm text is 110 characters for a 2–line display. If the text is too long, it is truncated and the symbol ”*” is added to indicate missing text.
- Parameter ”%K”: Channel number (2nd digit of alarm number)
  Parameter ”%A”: The parameter is replaced by the signal group no. (e.g. axis no., user area no., sequence cascade no.)
  Parameter ”%N”: Signal number
  Parameter ”%Z”: Status number

12.1.5 Setting the alarm log properties

In addition to the current alarms, an alarm log showing the alarms occurred hitherto is displayed on the user interface in the form of a list. The properties of the alarm list can be changed in the MBDDE.INI file.

Table 12-5 Sections of the MBDDE.INI file

Section	Significance
Alarms	General information about the alarm list: e.g. time/date format of messages
TextFiles	Path/file specification of the alarm/text files: e.g. UserPLC = <installation path>\dh\mb.dir\myplc_
HelpContext	Name and path of help files: e.g. File0 = hlp\alarm_
DEFAULTPRIO	Priority of various alarm types: e.g. POWERON = 100
PROTOCOL	Properties of the protocol: e.g. file=.\proto.txt <name and path of the protocol file>)
KEYS	Information about keys that can be used to delete alarms: e.g. Cancel = +F10 <Deleting alarms with key combination Shift+F10>

For further details of the file entries, refer to

References: /BN/ User Guide: OEM package for MMC

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Section: [Alarms]

The settings in this section define the following alarm list properties:

- **TimeFormat**
  Here, the pattern is entered which is to be used for output of date and time.
  It is the same as the CTime::Format of the Microsoft Foundation Classes.
- **MaxNo**
  Defines the maximum size of the alarm list.
- **ORDER**
  Defines the sequence in which alarms are sorted in the alarm list:
  FIRST places the most recent alarms at the top of the list,
  LAST places the most recent alarms at the bottom of the list.

Example

Example for the section: [Alarms]

– Time format: day.month.year hour:minute:second
– Maximum size of alarm list: 50
– Order: New alarms are to be put at the end of the list

```
[Alarms]
    TimeFormat=%d.%m.%y %H:%M:%S
    MaxNr=50
    ORDER=FIRST
```

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Axis and Spindle Test Run 13

13.1 Prerequisites

Enabling signals must be set to allow an axis to be traversed directly from the control:

- Drive: Parameters and terminals
- NCK: Interface signals

13.1.1 Drives: SINAMICS S120

Infeed		
	Parameter/Terminal	**Significance**
	p0840	ON/OFF1
	p0844	1st OFF2
	p0845	2nd OFF2
	p0852	Enable operation
	X21.3 (+24 V) and X21.4 (ground)	EP terminals enable (pulse enable)
Drive		
	Parameter/Terminal	**Significance**
	p0840	ON/OFF1
	p0844	1st OFF2
	p0845	2nd OFF2
	p0848	1st OFF3
	p0849	2nd OFF3
	p0852	Enable operation
	X21.3 (+24 V) and X21.4 (ground)	EP terminals enable (pulse enable)
	p0864	Infeed enable
	p1140	Ramp–function generator enable
	p1141	Ramp–function generator Start
	p1142	Setpoint enable

References SINAMICS S120 Commissioning Manual
/GH2/ Booksize Power Modules Manual

13.1.2 Drives: SIMODRIVE

Applies to the following SIMODRIVE drives:

- SIMODRIVE 611 universal/universal E
- SIMODRIVE POSMO SI, CD/CA

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The following terminals must be connected:

I/RF module		
	Terminal	**Significance**
	63	Impulsfreigabe
	64	Drive enable
	48	DC–link start
Drive Module		
	Terminal	**Significance**
	663	Impulsfreigabe
Signal TRUE: +24 V (e.g. from terminal 9)		

References /FBU/ SIMODRIVE 611 universal Description of Functions
/POS3/ SIMODRIVE SI/CD/CA User Manual

13.1.3 NCK/PLC interface signals

The following NCK/PLC interface signals must be set:

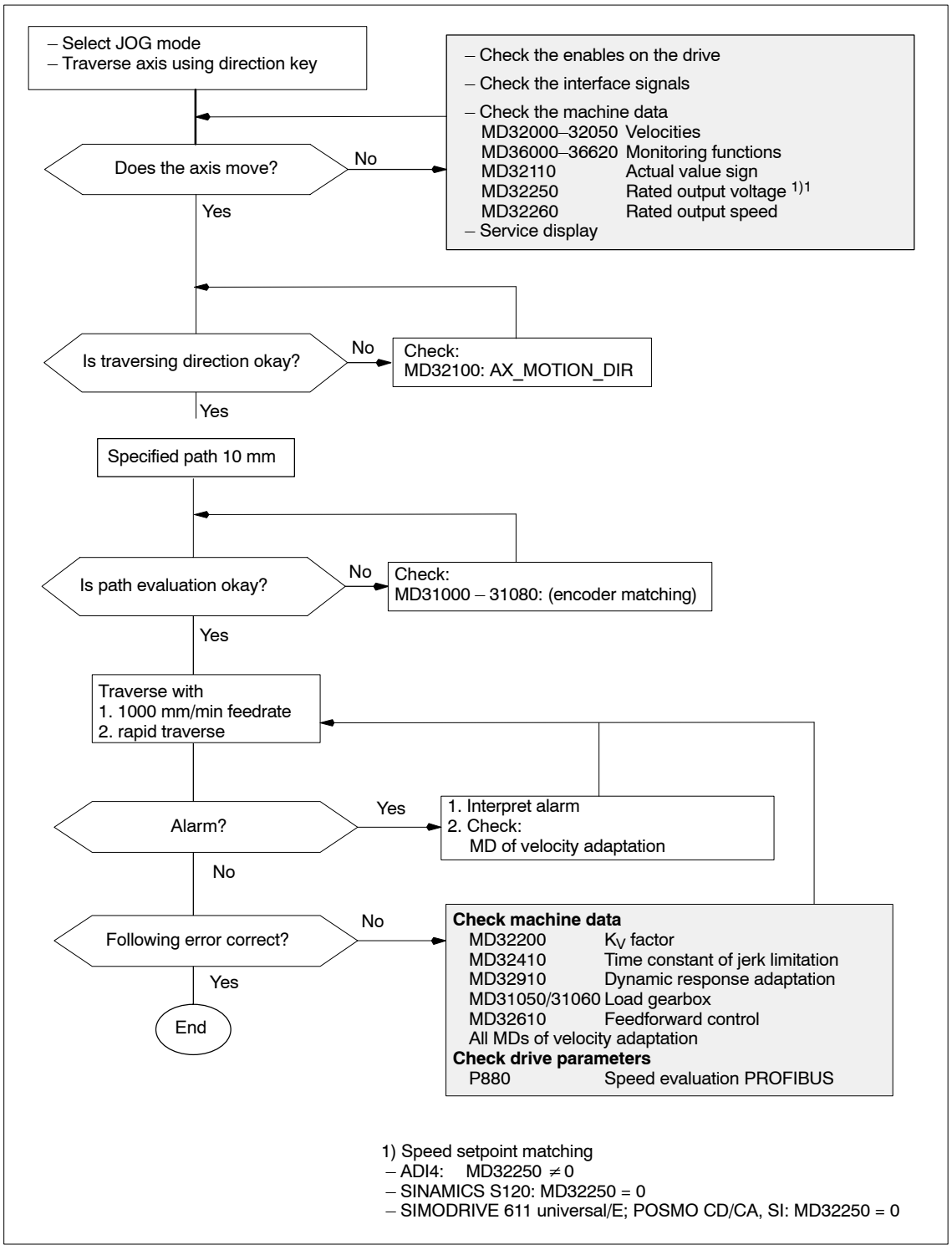
DB number	Byte.Bit	Value	Significance
31, ...	0	<> 0%	Feedrate/spindle override
31, ...	1.3	FALSE	Axis/spindle disable
31, ...	1.4	FALSE	Followup mode
31, ...	1.5	TRUE	Position measuring system 1 1)
31, ...	1.6	TRUE	Position measuring system 2 1)
31, ...	1.7	TRUE	Override active
31, ...	2.1	TRUE	Controller enable
31, ...	2.2	FALSE	Distance–to–go/Spindle reset
31, ...	4.3	FALSE	Feed stop/spindle stop
31, ...	4.4	FALSE	Traversing–key lock
31, ...	4.6	3)	Traversing key –
31, ...	4.7	3)	Traversing key +
31, ...	5.0 – 5.5	3)	JOG/INC
31, ...	12.0	2)	Hardware limit switch PLUS
31, ...	12.1	2)	Hardware limit switch MINUS
31, ...	20.1	FALSE	Rampfunction generator rapid stop
31, ...	21.7	TRUE	Impulsfreigabe

1) Alternative
2) Checking the function of the hardware limit switch and the relevant interface signals
3) Function–dependent

References /FB1/ Description of Functions Basic Functions
A2 Various Interface Signals and Functions

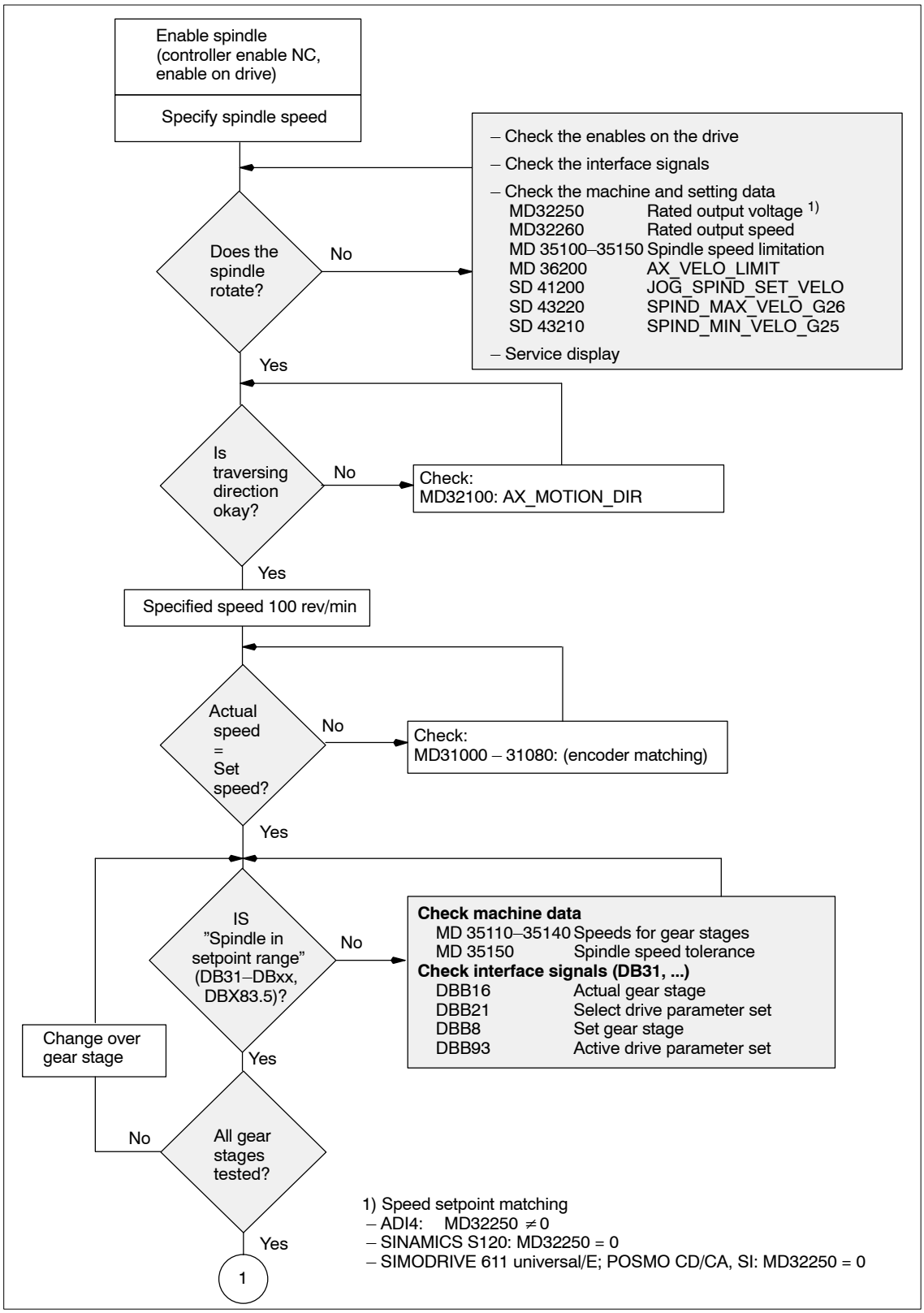
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13.2 Axis dry run

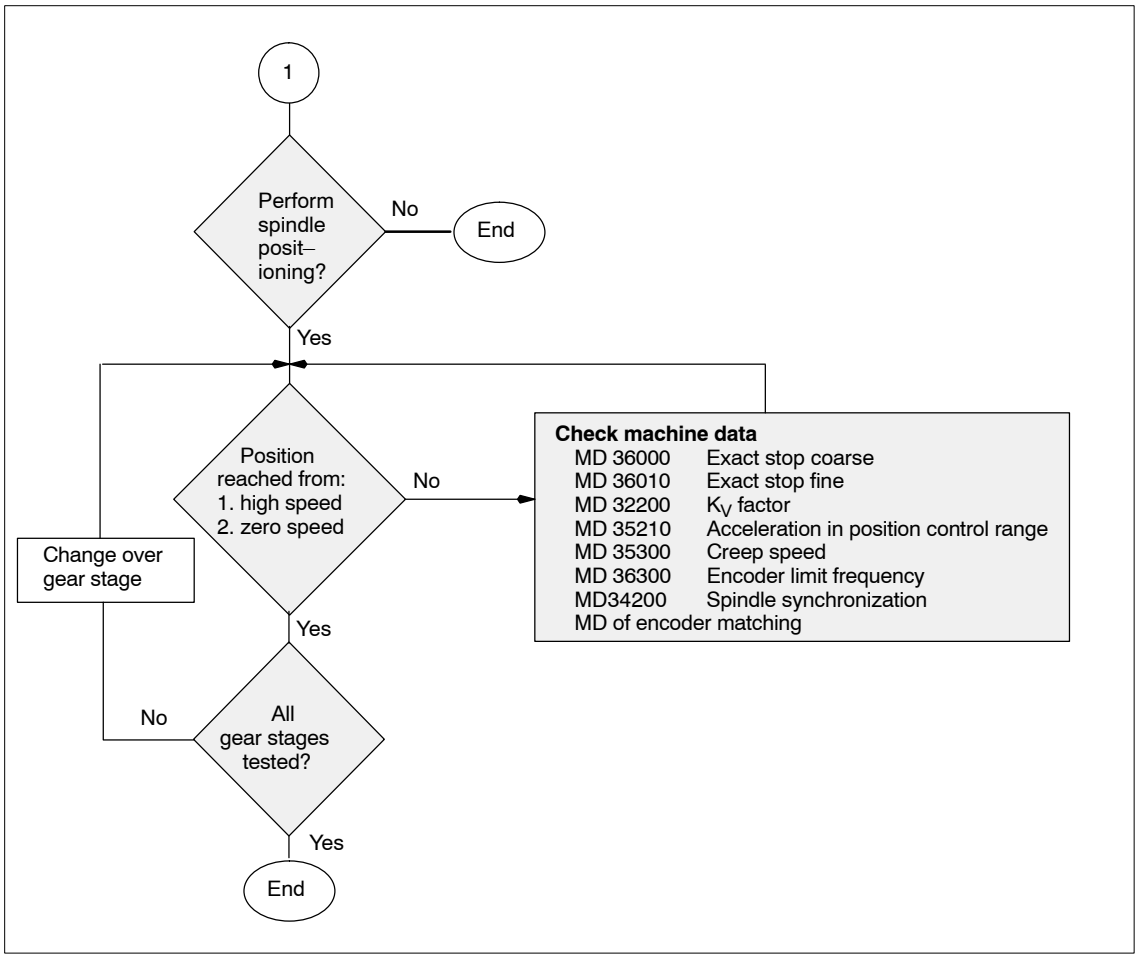


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13.3 Spindle dry run



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Space for your notes

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Drive Optimization with HMI Advanced 14

14.1 Overview

HMI Advanced offers comprehensive functions for analyzing controller action of drives connected to a SINUMERIK 840Di sl:

- Frequency response measurements for current, speed and position control loop
- Automatic controller setting
- Function generator
- Circularity test
- Servo trace

Measuring functions

The measuring functions make it possible to assess the automatic controller action of the respective control loop (frequency response) by the integrated FFT analysis (Fast Fourier Transformation) without external measuring equipment.

The measurement results are represented graphically as a Bode diagram. HMI Advanced file functions can be used to archive the diagrams for documentation purposes and to simplify remote diagnostics.

Circularity test

The circularity test serves to analyze the contour accuracy on the quadrant transitions of circular contours achieved by means of friction compensation (conventional or neural quadrant error compensation).

References: /FB/, Description of Functions
K3 Compensation
Section: Circularity test

Servo trace

Servo trace provides a graphically assisted analysis of the time response of position controller and drive data.

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14.2 Measuring functions

Explanation

A range of measuring functions allows the time and/or frequency response of drives and closed–loop controls to be displayed in graphic form on the screen. For this purpose, test signals with an adjustable interval are connected to the drives.

Measurement/ signal parameters parameters

The test setpoints are adapted to the application in question by means of measurement or signal parameters, the units of which are determined by the relevant measuring function or operating mode. The measurement or signal parameter units are subject to the following conditions:

Table 14-1 Quantity and units for measurement or signal parameters

Size	Unit
Velocity	Metric system: Data in mm/min or rev/min for translation and rotation respectively Inch system: Data in inch/min or rev/min for translation and rotation respectively
Distance	Metric system: Data in mm or degrees for translation and rotation respectively Inch system: Data in mm or degrees for translation and rotation respectively
Time	Specified in ms
Frequency	Specified in Hz

Note

The default setting for all parameters is 0.

Preconditions for starting measuring functions

To ensure that no erroneous traversing movements due to part programs can be carried out, the measuring functions have to be started in **JOG** mode.



Caution

When traversing movements are carried out within the framework of measuring functions, no **software limit switches** and **working area limitations** are monitored, since these are carried out in follow–up mode.

Prior to starting traversing motions, the user must therefore ensure that the axes are positioned such that the traversing limits specified within the framework of the measuring functions are sufficient to prevent collision with the machine.

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Starting measuring functions

Measuring functions initiating a traversing movement are only selected using the specific softkey. The actual start of the measuring function and thus of the traversing movement is always carried out with NC START on the machine control panel.

If the main screen of the measuring function is quitted without the traversing motion being initiated, the selection of the traversing function is canceled.

Once the traversing function has been started, the main screen can be quitted without any affect on the traversing motion.

Note

JOG mode must be selected when measuring functions are started.

Further safety notices

The user must ensure that when the measuring functions are used:

- The **EMERGENCY STOP** button is always within the reach.
- No obstacles are in the traversing range.

Canceling measuring functions

The following events will cancel active measuring functions:

- Hardware limit switch reached
- Traversing range limits exceeded
- Emergency stop
- Reset (mode group, channel)
- NC STOP
- No controller enabling command
- Canceling drive enable
- Canceling traversing enable
- Selection of parking (in position–controlled operation).
- Feed override = 0%
- Spindle override = 50%
- Change in operating mode (JOG) or operating mode JOG not selected
- Actuation of traversing keys
- Actuation of handwheel
- Alarms leading to axis shutdown

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14.3 Miscellaneous functions

Interface signals: Drive test Traversing request, Traversing enable

In conjunction with the measuring functions, another 2 axis–specific interface signals are provided:

- DB31–DBx, DBX61.0 ”Drive test traversing request”
- DB31–DBx, DBX1.0 ”Drive test traversing enable”

In the PLC user program, therefore, an additional axis–specific traversing enable command may be given in conjunction with measuring functions.

Activating

The interface signals are activated from the main menu of the appropriate measuring function in the group ”Drive test traversing enable”. See Fig. 14-1, page 14-430.

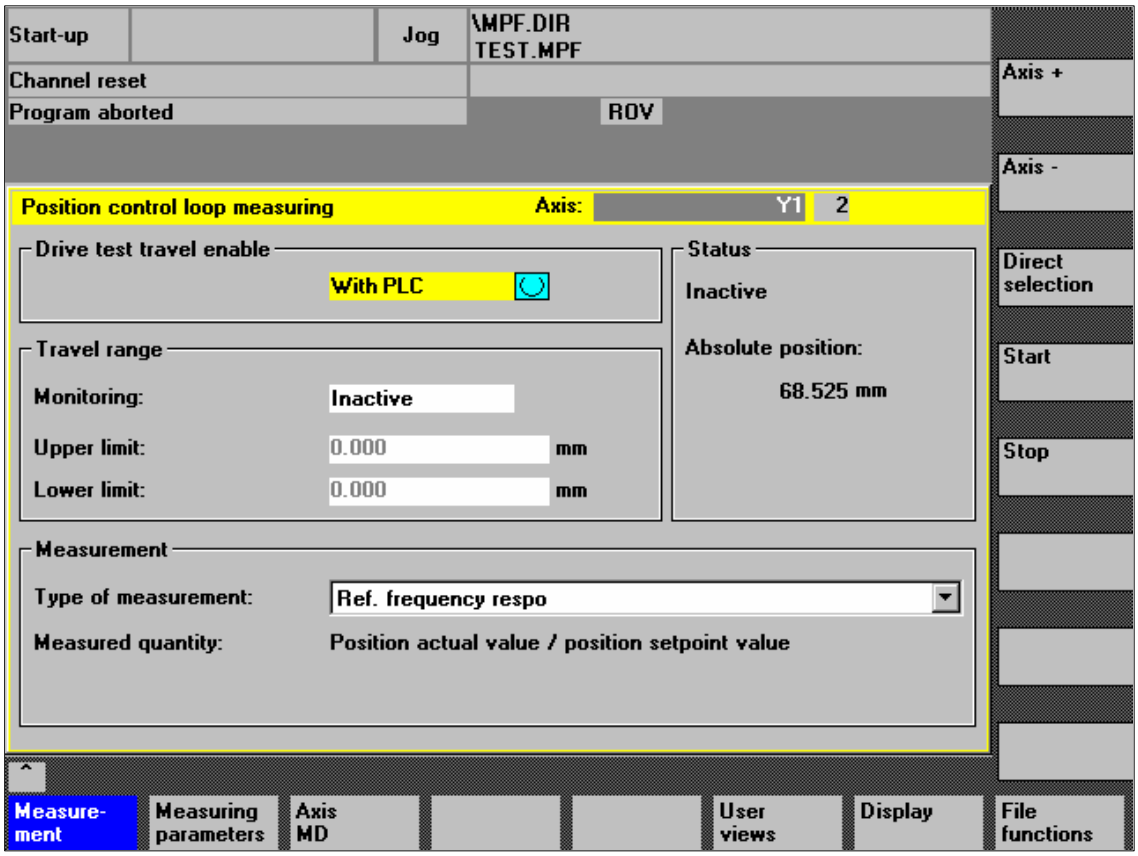


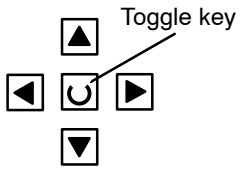
Fig. 14-1 Main menu: Position control loop measurement

Choose the type of traversing enable function from the selection list either by using the toggle key or by double–clicking the selection with the right–hand mouse button:

– Without PLC
Traversing of the axis to be measured is enabled depending on the interface signals typical for JOG mode (servo enable, pulse enable, etc.).

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– With PLC
Traversing of the axis to be measured is enabled in addition to the interface signals typical for JOG mode depending on the interface signal. ”Drive test traversing enable”.



Traversing range monitoring

The measuring functions have their own traversing range monitoring. With this monitoring function the traverse range of an axis can be limited or monitored without having to reference this axis.

The basis is the absolute axis position displayed in the ”Status” group at the time of measurement.

Activating

The traversing range monitoring is activated from the main menu of the appropriate measuring function in the group ”Traversing range”. See Fig. 14-1, page 14-430.

Choose the traversing range monitoring from the selection list ”Monitoring” via the Toggle key or by clicking with the right–hand mouse button on the required monitoring type:

– Inactive
The axis is traversed without monitoring of the traversing range.

– Active
The axis is traversed with monitoring of the traversing range, depending on the traversing range limits set:

  – Upper limit

  – Lower limit

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14.4 Frequency response measurements

You can measure both digital and analog drives. However, the bandwidth available for measuring is limited by the position controller or PROFIBUS cycles.

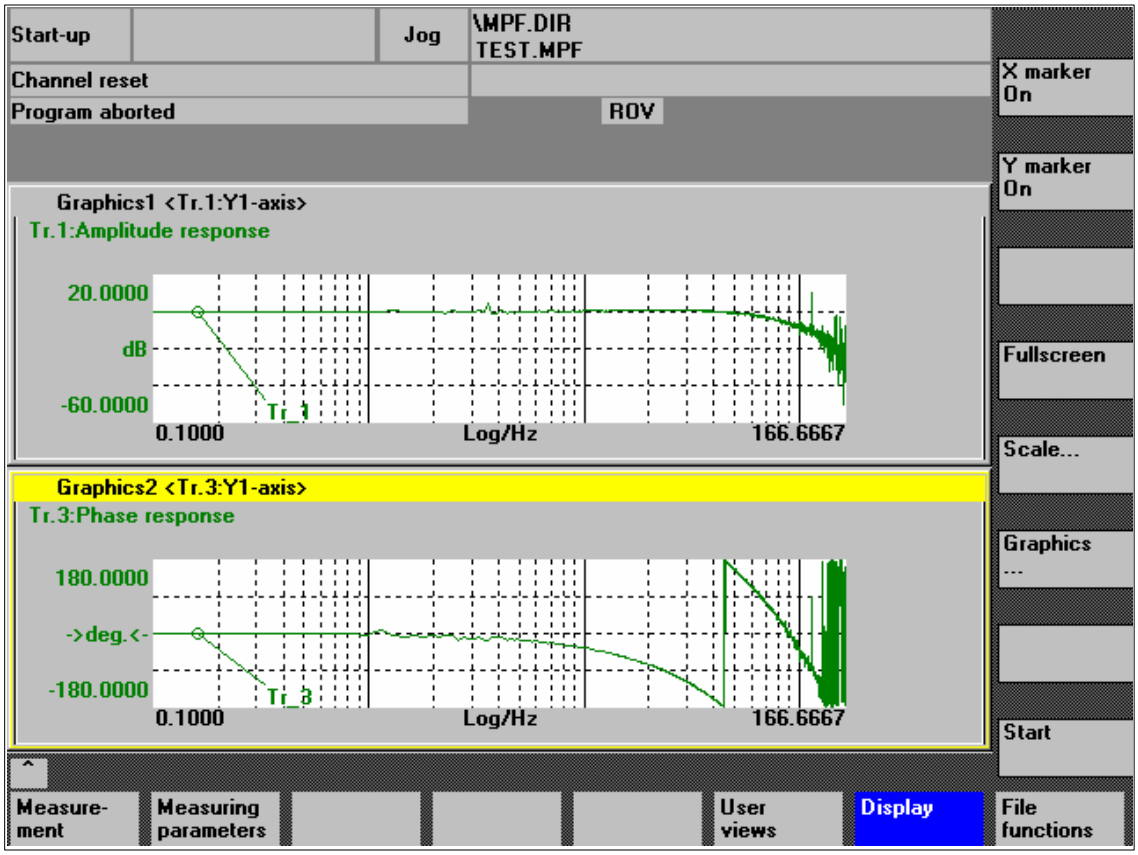


Fig. 14-2 Example: Measurement results, speed control loop, reference frequency response

Note

Additional information on the measurement functions or how to optimize the torque/current and speed control loop can be found in:

- SINAMICS S120
  Online Help for Commissioning Tool: STARTER > Contents > Diagnostics functions
- SIMODRIVE 611 universal
  Online Help for Commissioning Tool SimoCom U > Index:
  – Measuring function
  – Optimization of speed control loop

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14.4.1 Measurement of current control loop

Functionality

The current control loop only needs to be measured for diagnostic purposes if there is a fault or if no standard data was used for the motor/power module combination, and which resulted in unsatisfactory speed controller frequency responses.

Caution

The user must take special safety measures when measuring the current control loop (e.g. secure drive clamping) for hanging axes without external counterweight.

Operating path

Operating path for measuring the current control loop: **Operating area switchover > Commissioning > Optimization/test > Current control loop**

Measuring functions

The following measurement functions are available for measuring the current control loop:

Measuring type	Measured variable
Reference frequency response (downstream of the current setpoint filter)	Torque–generating. Actual current value/Torque–generating. Current setpoint
Setpoint step change (downstream of the current setpoint filter)	Measured variable 1: Torque–generating. Current setpoint Measured variable 2: Torque–generating. Actual current value

Measurement

The measurement sequence is divided into the following steps:

1. Setting the traverse range monitoring and the enable logic.
2. Selecting the measurement type
3. Setting the parameters, softkey ”Measuring parameters”
4. Displaying the measurement results, softkey ”Display”

Measuring parameters

- Amplitude
  Magnitude of the test signal amplitude. Given in percent of the peak torque. Values from 1 through 5% are suitable.
- Bandwidth
  The frequency range analyzed with the measurement. The larger this value, the finer the frequency resolution and the longer the measurement time. The maximum value is given by the position control cycle ($T_{position\ controller}$):
  $Bandwidth_{max}$ [Hz] = 1 / (2 * $T_{position\ controller}$ [sec])
  Example:
  Position control cycle: 2 ms
  $Bandwidth_{max} = 1 / (2 * 2*10^{-3}) = 250$ Hz
- Averaging
  The accuracy of the measurement and measurement duration increase with this value. A value of 20 is normally suitable.
- Settling time
  This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of approx. 10 ms is recommended. A settling time which is too low will result in frequency response and phase diagrams distortions.

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14.4.2 Speed control loop measurement

Functionality

The response characteristics for the motor measuring system are analyzed when measuring the speed control loop. Various measurement parameter lists are available depending on the basic measurement setting which has been selected.

Operating path

Operating path for measuring the speed control loop: **Operating area switchover > Commissioning > Optimization/test > Speed control loop**

Measuring functions

The following measurement functions are available for measuring the speed control loop:

Measuring type	Measured variable
Reference frequency response (downstream of the speed setpoint filter)	Speed actual value motor encoder/speed setpoint after filter
Reference frequency response (upstream of the speed setpoint filter)	Speed actual value motor encoder/speed setpoint after filter
Setpoint step change (downstream of the speed setpoint filter)	Measured variable 1: – Speed setpoint after filter – Torque actual value Measured variable 2: Speed actual value motor encoder
Interference frequency response (fault downstream of the current setpoint filter)	Speed actual value motor encoder/torque setpoint value fct. generator
Disturbance variable step change (fault downstream of the current setpoint filter)	Measured variable 1: – Torque setpoint value fct. generator – Torque actual value Measured variable 2: Speed actual value motor encoder
Speed–controlled system (excitation downstream of the current setpoint filter)	Speed actual value motor encoder/torque actual value
Frequency response of the mechanical parts [1]	Speed actual value measuring system 1/speed actual value measuring system 2

1) The machine axis in question must have both a direct and an indirect measuring system to determine the frequency response of the mechanical parts.

Measurement

The measurement sequence is divided into the following steps:

1. Setting the traverse range monitoring and the enable logic.
2. Selecting the measuring type and measured variable
3. Setting the parameters, softkey ”Measuring parameters”
4. Displaying the measurement results, softkey ”Display”

Measurement: Reference and interference frequency response

The reference frequency response measurement determines the transmission ratio of the speed controller.

The response range should be as wide as possible and without resonance. It may be necessary to use bandstop or low–pass filters. Particular care must be taken to prevent resonance within the speed controller limit frequency range (stability limit approx. 200–500 Hz).

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Alternatively, the interference frequency response can be recorded in order to assess how well the control suppresses interference.

Measuring parameters

- Amplitude
  This parameter determines the magnitude of the test signal amplitude. This should give rise to only a very low speed of a few (approximately 1 to 2) rev/min at the motor end.
- Bandwidth
  The bandwidth parameter is used to set the analyzed frequency range. The larger this value, the finer the frequency resolution and the longer the measurement time. The maximum value is given by the position control cycle ($T_{position\ controller}$): $Bandwidth_{max}$ [Hz] = 1 / (2 * $T_{position\ controller}$ [sec])

  Example:
  Position control cycle: 2 ms
  $Bandwidth_{max} = 1 / (2 * 2*10^{-3}) = 250$ Hz
- Averaging
  The accuracy of the measurement and measurement duration increase with this value. A value of 20 is normally suitable.
- Settling time
  This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of between 0.2 and 1 s is recommended. Do not set too low a value for the settling times or the frequency response and phase diagrams will be distorted.
- Offset
  The measurement requires a slight speed offset of a few motor revolutions per minute. The offset must be set to a higher value than the amplitude.
  - The offset is run up via an acceleration ramp.
  - The acceleration value is defined for one
    Axis: MD 32300: MAX_AX_ACCEL
    Spindle: MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL
    MD 35210: GEAR_STEP_POSCTRL_ACCEL
  - The following applies: Acceleration value = 0, no ramp
    Acceleration value > 0, ramp active
  - The actual measuring function becomes active only when the offset value is reached.

Measurement setpoint/ disturbance step changes

The transient response (response to setpoint changes or disturbances) of the speed control in the time range can be assessed with the step stimulation function. The test signal is connected to the speed controller output for recording of the response to disturbances.

Measuring parameters

- Amplitude
  Magnitude of the setpoint or disturbance step change.
- Measurement time
  The period of time recorded (maximum: 2048 speed controller cycles).

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- Offset
  To exclude the influence of static friction, an offset of a few motor revolutions per minute is sufficient.
  - The offset is run up via an acceleration ramp.
  - The acceleration value is defined for one
    Axis: MD 32300: MAX_AX_ACCEL
    Spindle: MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL
    MD 35210: GEAR_STEP_POSCTRL_ACCEL
  - The following applies: Acceleration value = 0, no ramp
    Acceleration value > 0, ramp active
  - The actual measuring function becomes active only when the offset value is reached.
- Settling time
  This value represents the delay between measured data recording/setpoint output and the injection of the offset.

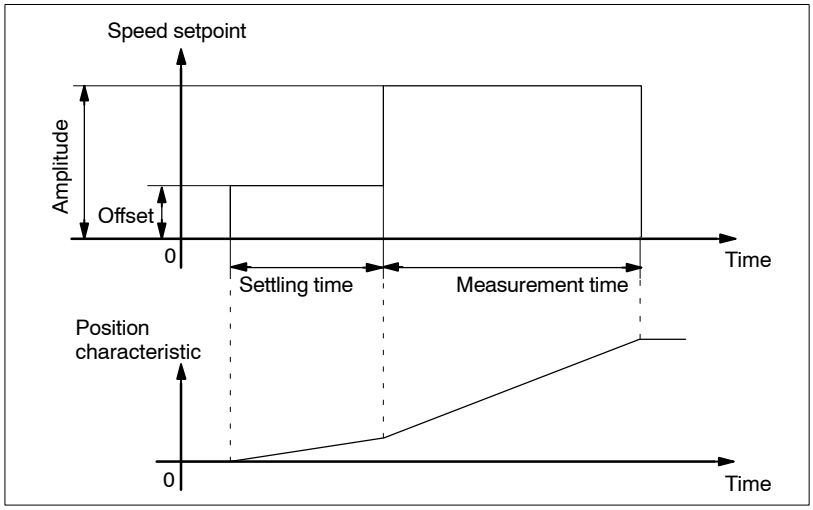


Fig. 14-3 Setpoint course for speed control loop/step response measuring function

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14.4.3 Position control measurement

Functionality

This measurement function basically analyzes the response to the active position measuring system. If the function is activated for a spindle without a position measuring system, an alarm is displayed. Depending on the measured variable selected, various measurement parameter lists are displayed.

Operating path

Operating path for measuring the speed control loop: **Operating area switchover > Commissioning > Optimization/test > Speed control loop**

Measuring functions

The following measurement functions are available for measuring the position control loop:

Measuring type	Measured variable
Reference frequency response	Actual position/position setpoint
Setpoint step change	Measured variable 1: Position reference value Measured variable 2: – Position actual value – Control deviation – Following error – Speed actual value
Setpoint ramp	Measured variable 1: Position reference value Measured variable 2: – Position actual value – Control deviation – Following error – Speed actual value

Measurement

The measurement sequence is divided into the following steps:

1. Setting the traverse range monitoring and the enable logic.
2. Selecting the measuring type and measured variable
3. Setting the parameters, softkey ”Measuring parameters”
4. Displaying the measurement results, softkey ”Display”

Measurement: Reference frequency response

The reference frequency response measurement determines the transmission ratio of the position controller in the frequency range (active position measuring system).

The setpoint filters, control loop gain (K_v factor) and feedforward control must be parameterized such that resonance is avoided wherever possible over the entire frequency range. In the case of dips in the frequency response, the setting of the feedforward control balancing filters should be checked.

Measuring parameters

- Amplitude
  This parameter determines the magnitude of the test signal amplitude. It should be set to the smallest possible value (e.g. 0.01 mm).
- Bandwidth
  The bandwidth parameter is used to set the analyzed frequency range. The larger this value, the finer the frequency resolution and the longer the measurement time. The maximum value is given by the position control cycle ($T_{position\ controller}$): $Bandwidth_{max}$ [Hz] = 1 / (2 * $T_{position\ controller}$ [sec])
  Example:
  Position control cycle: 2 ms
  $Bandwidth_{max}$ = 1 / (2 * $2*10^{-3}$) = 250 Hz

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- Averaging
  The accuracy of the measurement and measurement duration increase with this value. A value of 20 is normally suitable.
- Settling time
  This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of between 0.2 and 1 s is recommended. Do not set too low a value for the settling times or the frequency response and phase diagrams will be distorted.
- Offset
  The measurement requires a slight speed offset of a few motor revolutions per minute. The offset must be set such that no speed zero crossings occur at the set amplitude.

Measurement: Setpoint step change and setpoint ramp

The transient or positioning response of the position control in the time range, and in particular the effect of setpoint filters, can be assessed with the step and ramp stimulation functions.

Possible measured variables:

- Position actual value (active position measuring system)
- Control deviation (following error)

Measuring parameters

- Amplitude
  Determines the magnitude of the specified setpoint step change or ramp.
- Measurement time
  This parameter determines the period of time to be recorded (maximum: 2048 position controller cycles).
- Settling time
  This value represents the delay between measured data recording/test setpoint output and the injection of the offset.
- Ramp time
  The position reference value is specified with the ”Setpoint ramp” basic measurement according to the set ramp time. In this case, the acceleration limits which currently apply to the axis or spindle are effective.

  A jerk–controlled motion can be set for a specific axis with:

  – MD 32400 AX_JERK_ENABLE (axial jerk limitation) =**1**
  – MD34210 AX_JERK_TIME (time constant for the axial jerk filter).

  The position setpoint and the actual value of the active measuring system are recorded in each case.
- Offset
  The step is stimulated from standstill or starting from the constant traverse speed set in this parameter.

  If an offset value other than zero is input, the step change is stimulated during traversal. For the sake of clarity, the displayed position actual value does not include this speed offset.

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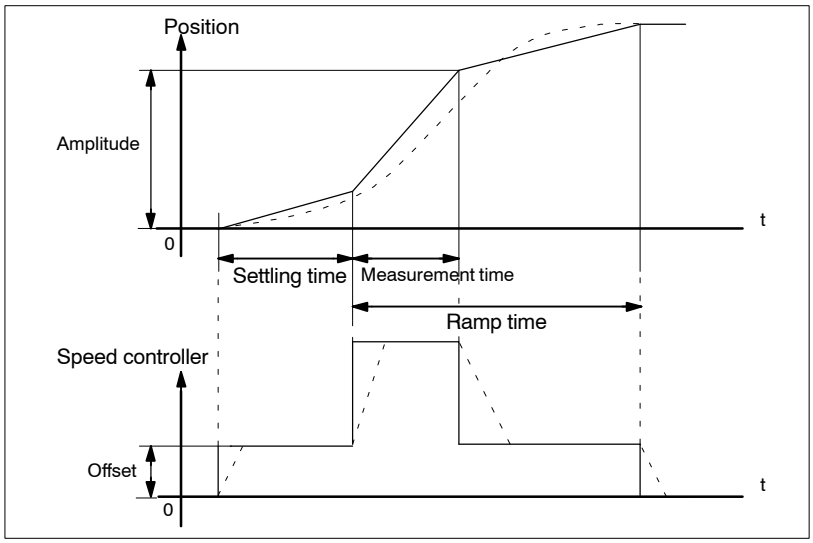


Fig. 14-4 Signal chart for position setpoint/ramp measuring function

At maximum axis velocity, there is a (virtual) step change in the velocity (continuous line).

The curves represented by the dashed line correspond to a realistic, finite value. The offset component is excluded from the display graphic in order to emphasize the transient processes.

Measurement: Setpoint step change

To avoid overloading the mechanical system of the machine, the step height is limited to the value specified in the machine data during the ”Setpoint step change” measurement:

- MD 32000 MAX_AX_VELO (maximum axis velocity)

This may result in failure to achieve the desired step height.

Measurement: Setpoint ramp

With measurement: ”Setpoint ramp”, the following machine data influence the measurement result:

- MD 32000 MAX_AX_VELO (max. axis velocity)
  The maximum axis velocity limits the ramp slope (velocity limiter). The drive does not reach the programmed end position (amplitude).
- MD 32300 MAX_AX_ACCEL (max. axis acceleration)
  The maximum axis acceleration limits the change in speed (acceleration limiter). This leads to ”rounding” on the transitions at the beginning and end of the ramp.

Caution

In normal cases the machine data correspond exactly with the load capacity of the machine kinematics and should not be changed (increased) as part of the measurements:

- MD 32000 MAX_AX_VELO (maximum axis velocity)
- MD 32300 MAX_AX_ACCEL (max. axis acceleration)

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14.5 Graphic display

Displaying the measurement results

You can have the measurement results displayed by pressing softkey **Display** in the relevant **main menu** of the measuring function after completion of measurement.

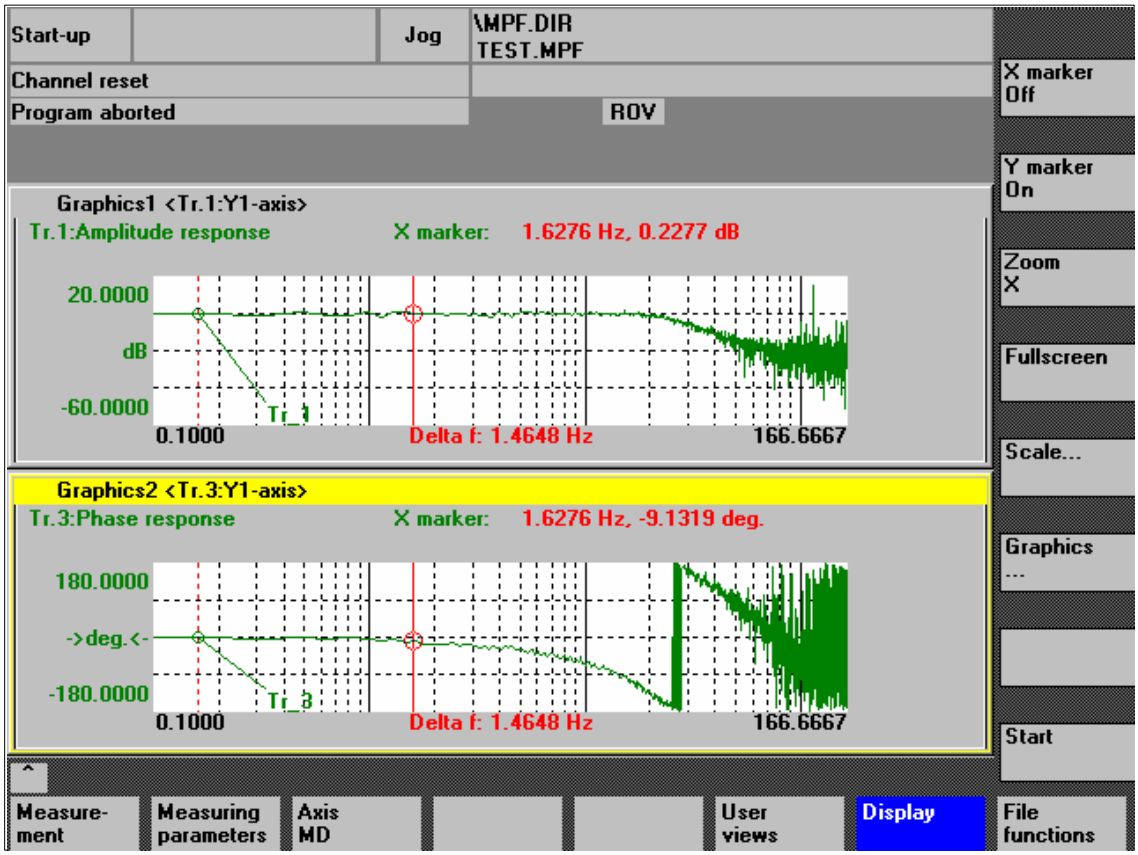


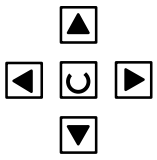
Fig. 14-5 Menu: Display of measurement with marker X = ON

Softkeys:
X marker ON
Y marker ON

When the softkeys **X marker ON** and **Y marker ON** are pressed, a vertical or horizontal red line with a circle is displayed the measurement curve.

The corresponding values, e.g., for damping, frequency, phase displacement, etc. are displayed in red in the appropriate diagram.

Use the cursor keys to move the markers:



– slowly: **Cursor key**
– fast: **Shift key** + **cursor key**

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Softkeys: 2nd marker, zoom, fullscreen

If a marker is active, a 2nd line is shown in the diagram via the **2nd marker** softkey. These two lines define the range that you can then have displayed over the entire display range by pressing softkey **Zoom**.

The process of zooming a range (marker ON, 2nd marker, zoom) can be repeated as often as desired until the maximum size of representation is reached.

Use the softkey **Fullscreen** to switch the display of the diagrams back to their original size.

Note

X and Y markers can be active at a time.

Softkey: Scale

Use the softkey **Scale** to change the scaling of the traces and of the marker ranges in the two graphs.

The scaling can be switched over between **auto** (default setting) and **fixed**. The Y range (Y min/max) to be displayed can only be changed in fixed mode.

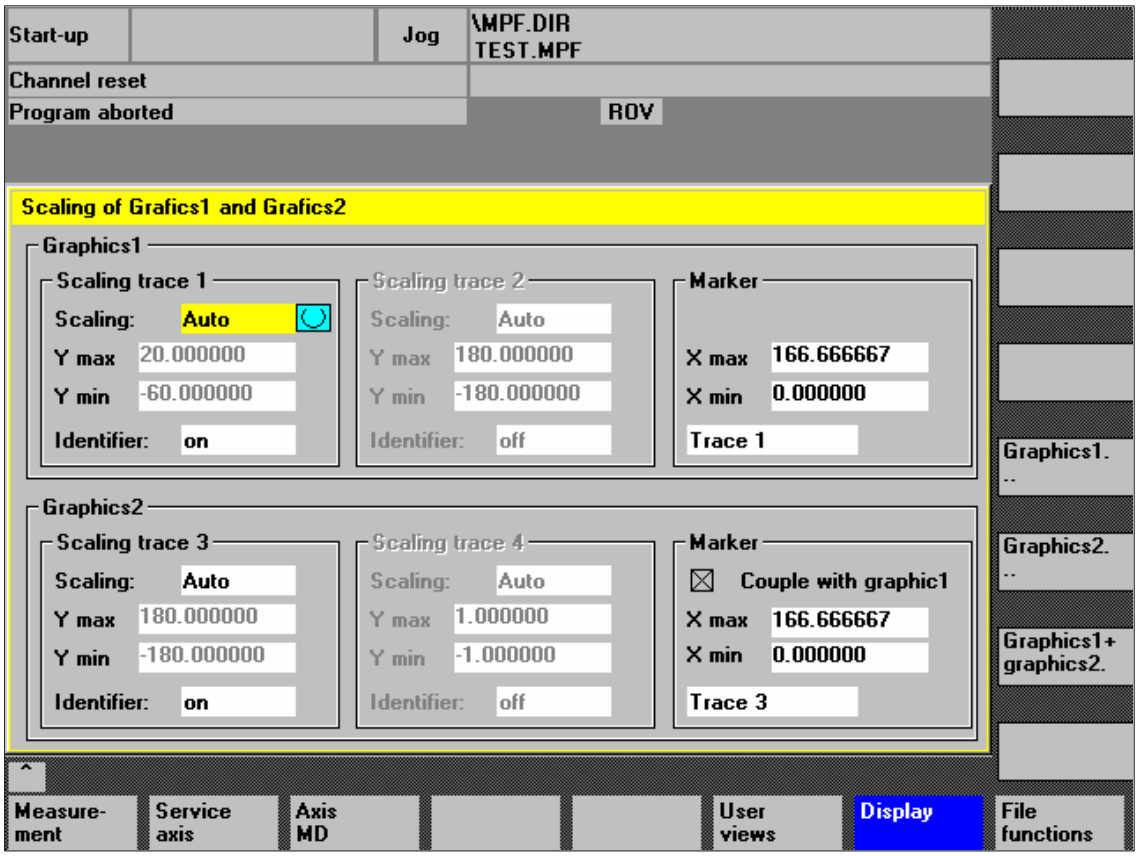


Fig. 14-6 Menu: Scaling of graphics

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Softkeys:
Graphics ...

Use the **Graphics ...** softkey shown in Fig. 14-5, Page 14-440 to call the following functions:

- Switching over the display from double to single graphics and vice versa (this function also exists in the scaling menu Fig. 14-6, Page 14-441)
- Printing graphics
  Printing the graphics into a file (bitmap) or output to a connected printer.
- Printer selection
  Selecting the output of the graphics to a bitmap file or to a connected printer.

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14.6 Trace function

14.6.1 Trace function properties

The trace function with a graphical user interface serves to record the time change of data (values, signals, states, etc.) in the servo range and partially in the range of the drives, too.

You can select measuring signals and set the measuring parameters with softkeys and drop–down lists.

The function is operated using the mouse or keyboard.

Function overview

The trace function offers the following features:

- Four trace buffers with up to 2,048 values each
- Selection of SERVO and drive signals (in position control cycle)
- Trace/trigger signals can be set using absolute address and value masking
- Different trigger conditions to start recording (triggering always on Trace 1)
- Both pre– and post–triggering.
- Measuring signal display.
- Selection of fixed Y scaling for each trace.
- Marker function selectable for each trace
- Expand function in the time axis
- Selective loading and saving of the measurement parameters and traces

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14.6.2 Main menu and operation

Basic display Servo trace

You can access the main screen of this trace function using the softkeys **Area switchover > Commissioning > Drives/servo > Servo trace**.

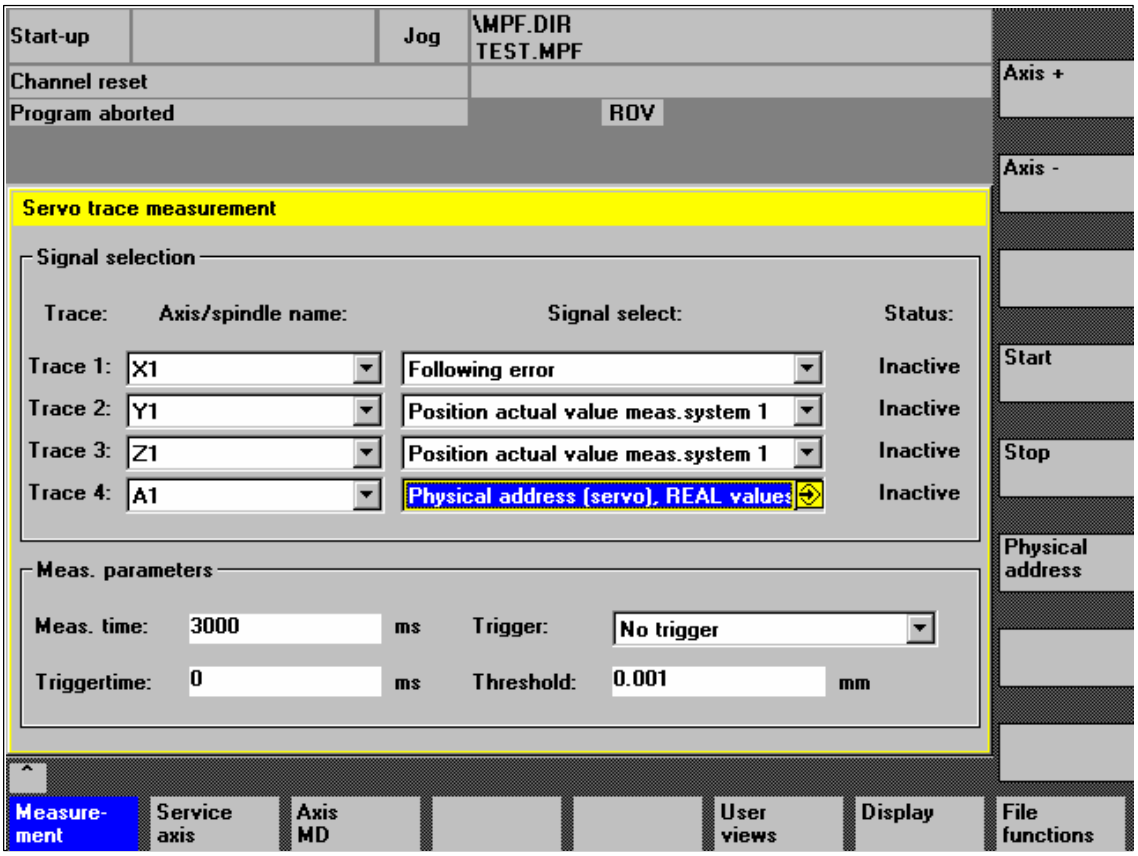


Fig. 14-7 Main menu: Servo trace

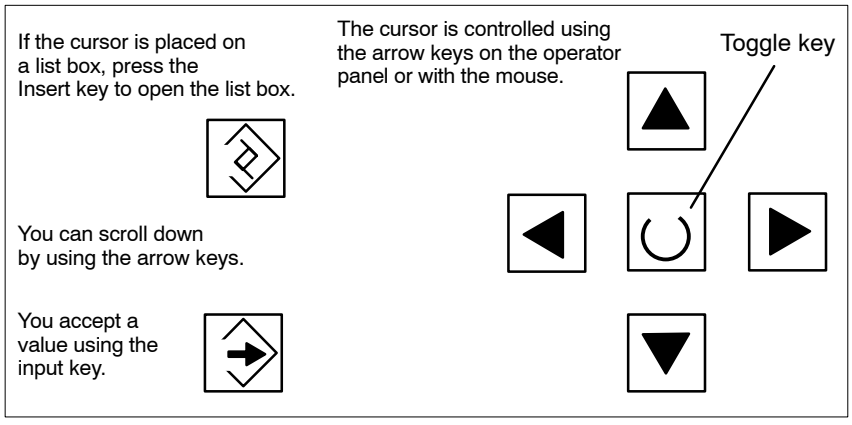


Fig. 14-8 Cursor operation

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14.6.3 Parameterization

Basic screen settings

The following settings have to be made in the basic screen

- The axis/spindle to be measured
- The signal to be measured
- Measurement time
- Trigger time
- Trigger type
- Trigger threshold

Signal selection

Input field: Axis/spindle name

The cursor must be positioned on the **Axis**/**spindle name** list box of the trace concerned. You can select it with the softkeys **Axis+** and **Axis–** or by accepting a value from the dropdown list.

Input field: Signal selection

The cursor must be positioned on the **Signal selection** list box of the trace concerned. Then activate the desired items by selecting them from the list box.

Measuring parameters

Input field: Measurement time

The measuring time is written directly into the **Measuring duration** input field.

Input field: Trigger time

Direct input of pretriggering or posttriggering.
With negative input values (leading sign minus –) recording begins at the set time before the trigger event.

With positive input values (without sign) recording starts the time set after the triggering event.

Condition: Trigger time + measuring period ≧ 0.

Input field: Trigger

You can select the trigger type from the **Trigger** drop–down list.
The trigger always refers to Trace 1. If the trigger conditions are met traces 2 to 4 are started simultaneously.

Settable trigger conditions:

- No trigger, i.e. measurement starts when you operate the softkey **Start** (all traces are started in synchronism).
- Positive edge
- Negative edge

Input field: Threshold

Direct input of the trigger threshold.

The threshold is only effective with trigger types ”Positive edge” and ”Negative edge”.
The unit refers to the selected signal.

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Softkey:
Axis +
Axis –

To select the axis/spindle, position the cursor on the appropriate ”Axis/spindle name” list field.

You can also select the axis/spindle directly in the list box from the dropdown list using the cursor.

Softkey:
Start
Stop

With the **Start** softkey, trace function recording is started.

With the **Stop** or RESET softkey, you can cancel a running measurement.

Softkey:
Physical address

Within the framework of the trace function, it is also possible to select data using its physical address.

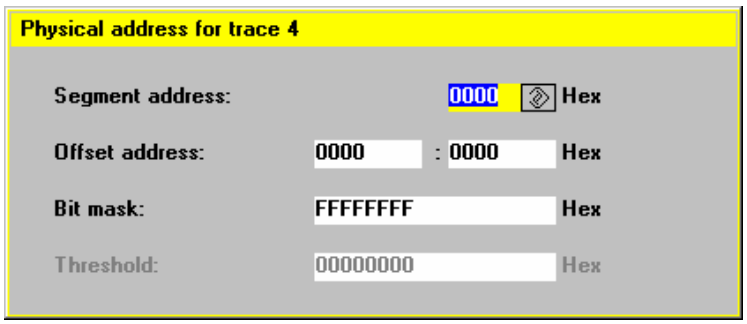


Fig. 14-9 Menu: Physical address for trace x

To do so, proceed as follows:

- Choose the signal type **Physical address** from the desired trace.
- Press the softkey **Physical address.**
- Enter the desired values in the input screen form.
- Press the softkeys **OK** to complete your input.

Notice

This function is only required in exceptional cases, for example, if the information provided by the known signals (see **Signal selection** list field) is not adequate.

Before using this function, you should contact the SINUMERIK hotline.

The input of **all** parameters is carried out in the **hexadecimal** number format.

Input field:
Screen form

This screen form is used to select the data format to be evaluated when recording.

- Byte: 0000 00FF
- Word: 0000 FFFF
- Double word: FFFF FFFF

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– Individual bits: xxxx xxxx
  – 1: selected
  – 0: not selected.

By default, all bits are selected.

Input field: Threshold

The input field **Threshold** is only used to enter the triggering threshold for the physical address of **trace 1**. If you exit the input screen form with the **Ok** softkey, this hex value is then entered in the field **Threshold** of the main screen of the trace function.

14.6.4 Performing the measurement

Softkey: Start

After parameterization has been completed, you then enable measurement by pressing softkey **Start**.

The measurement is carried out once the set trigger condition of trace 1 is fulfilled.

Terminating the measurement

The measurement is completed after the set measurement duration is expired.

The graphics are generated automatically when the measurements are finished. Use the Display softkey to call the display functions of the graphics (see next Section).

Softkey: Stop

With the Stop softkey, you can cancel a running measurement at any time.
A canceled measurement cannot be displayed.

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14.6.5 Display function

If you press the **Display** softkey after the set measurement time has expired and the measurement results have been prepared automatically, you can call the graphical display function of the measurement results.

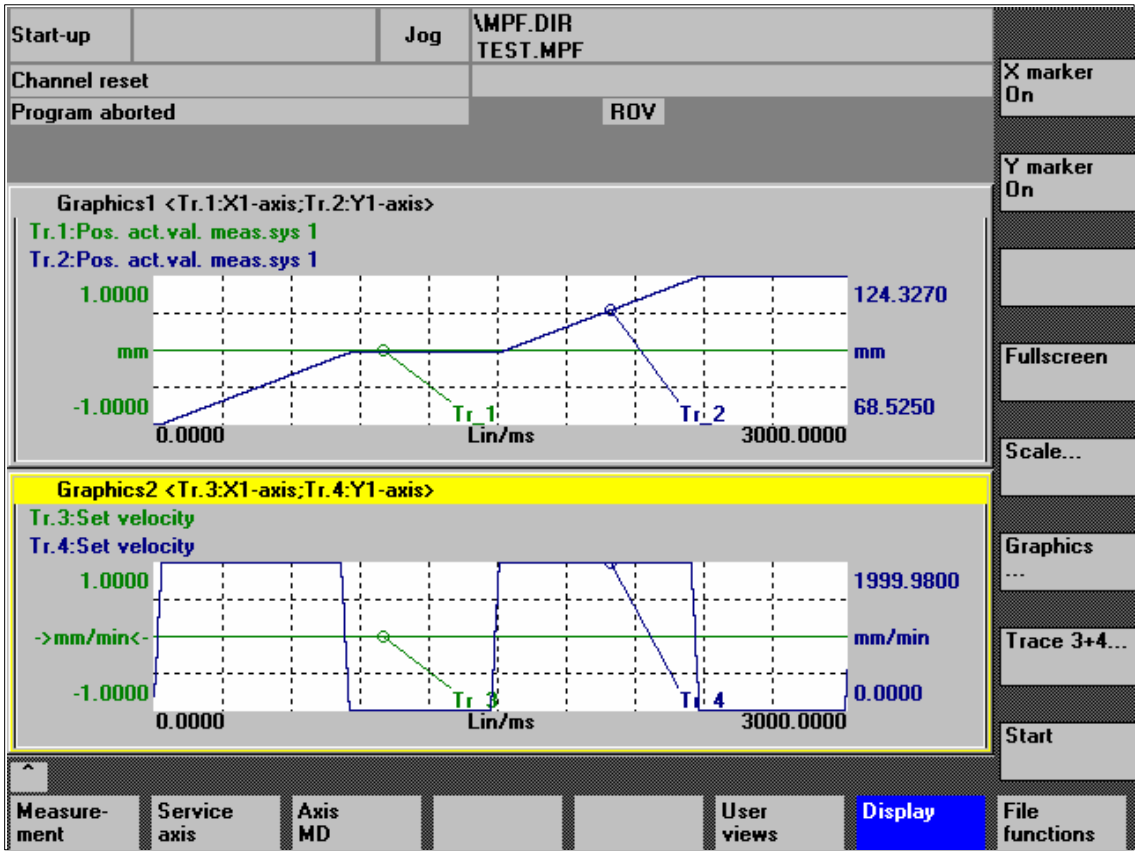


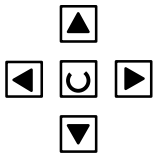
Fig. 14-10 Measurement results: Trace function

Softkeys:
X marker ON
Y marker ON

When the softkeys **X marker ON** and **Y marker ON** are pressed, a vertical or horizontal line with a circle is displayed on the measurement curve.

The corresponding values, e.g. for damping, frequency, degrees, etc. are displayed in the appropriate diagram.

Use the cursor keys to move the markers:



– slowly: **Cursor key**
– fast: **Shift key** + **cursor key**

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Softkeys: 2nd marker, zoom, fullscreen

If a marker is active, a 2nd line is shown in the diagram via the **2nd marker** softkey. These two lines define the range that you can then have displayed over the entire display range by pressing softkey **Zoom**.

The process of zooming a range (marker ON, 2nd marker, zoom) can be repeated as often as desired until the maximum size of representation is reached.

Use the softkey **Fullscreen** to switch the display of the diagrams back to their original size.

Note

X and Y markers can be active at a time.

Softkey: Scale

Use the softkey **Scale** to change the scaling of the traces and of the marker ranges in the two graphs.

The scaling can be switched over between **auto** (default setting) and **fixed**. The Y range (Y min/max) to be displayed can only be changed in fixed mode.

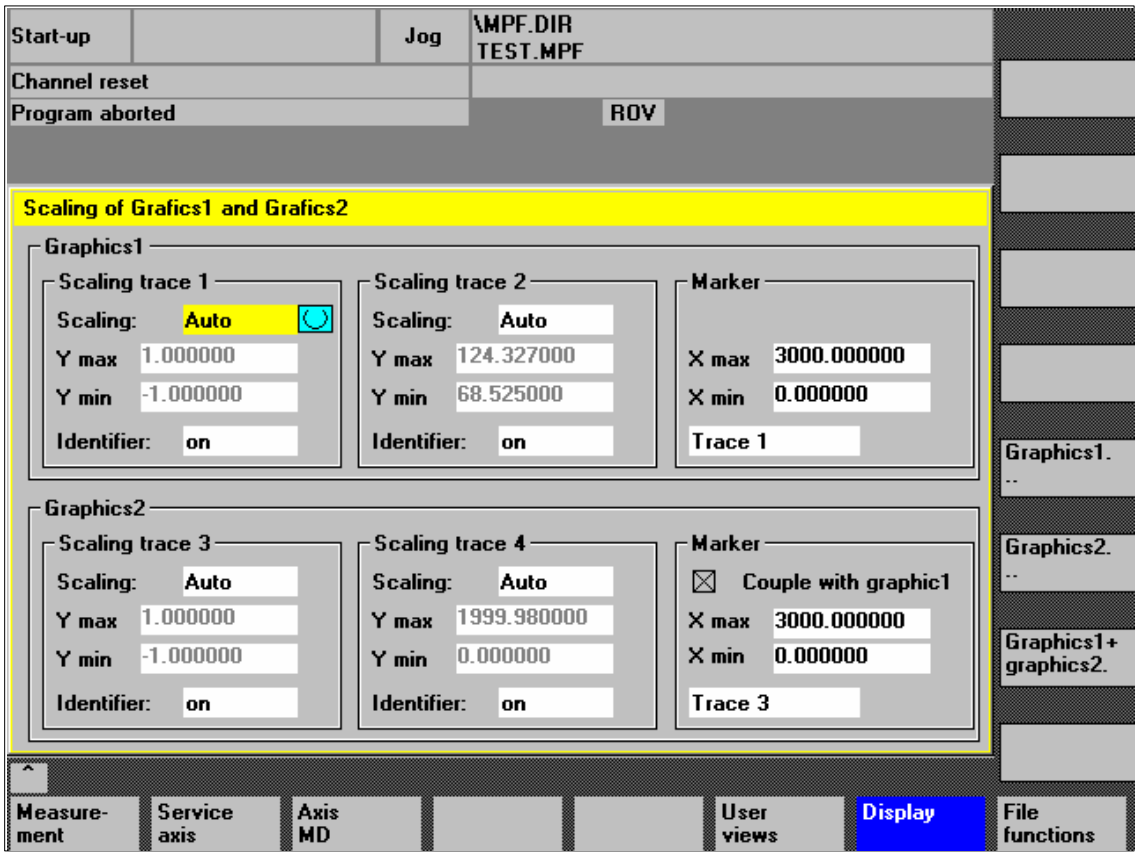


Fig. 14-11 Menu: Scaling of graphics

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Softkeys:
Graphics ...

Use the **Graphics ...** softkey shown in Fig. 14-10, Page 14-448 to call the following functions:

- Switching over the display from double to single graphics and vice versa (this function also exists in the scaling menu Fig. 14-11, Page 14-449)
- Printing graphics
  Printing the graphics into a file (bitmap) or output to a connected printer.
- Printer selection
  Selecting the output of the graphics to a bitmap file or to a connected printer.

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14.7 File function

Description

Use the **File functions** softkey to call the appropriate screen form.

The parameters set for the measurements, axis–specific machine data and measurement result can be saved, loaded and deleted here.

The file functions are not intended as a replacement for a complete copy of the system and user data, e.g. for archiving or standard commissioning, but only for the simplified and flexible management of the specific measurement data.

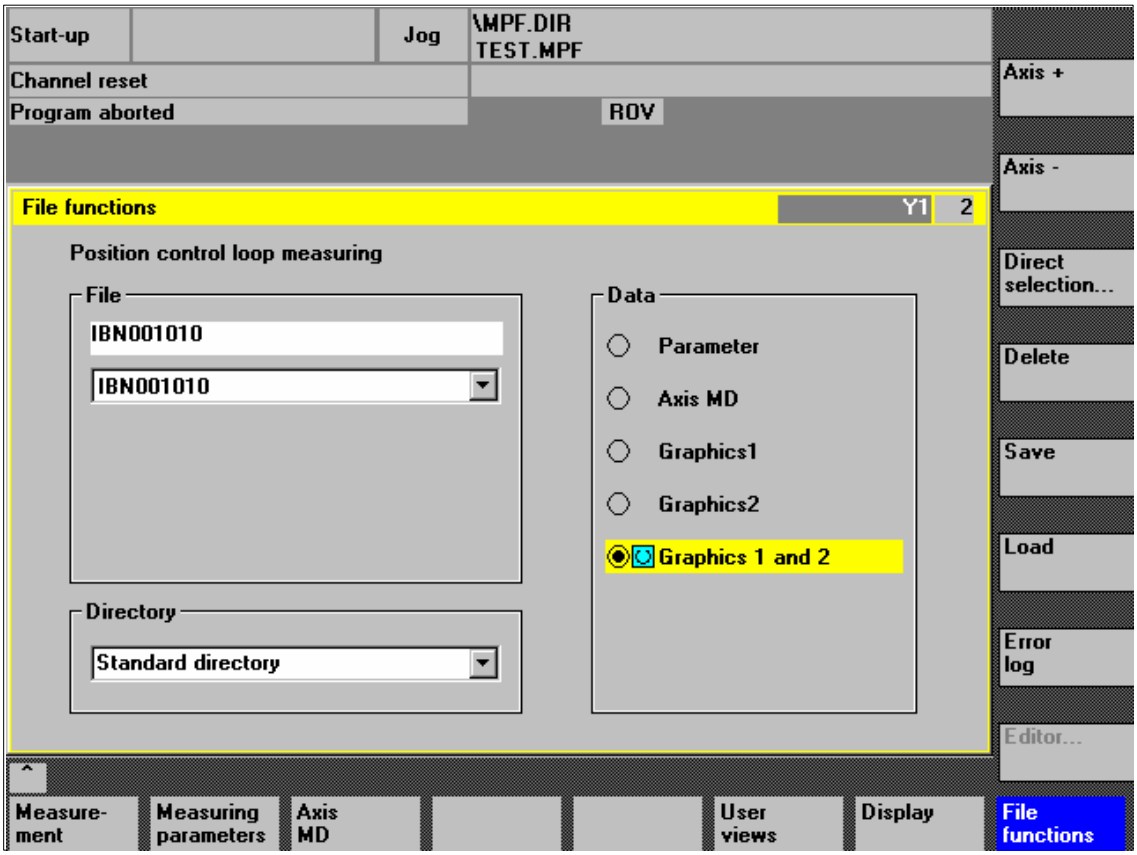


Fig. 14-12 Menu: File functions

Naming files

In the **File** group, you can select an existing file from the drop–down list or enter one in the text field underneath.

Selecting the directory

In the **Directory** group, you can select the directory where you want to save the file. This can also be a directory in the **Services** operating area you have created by yourself or the basic directory of the data management (list entry: Standard directory).

Selecting data type

In the **Data** group, you can select the data you want to save.

Only one data type can be selected at once. Use either the mouse button or the cursor or toggle key for selection.

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Creating subdirectories

If you do not wish the data of the trace function to be stored in the ”default directory”, you can create user–specific directories.

New directories are created in the operating area **Operating area switchover > Services > Manage data**. New subdirectories can be created below the **Diagnosis** directory.

For the description of the operating area **Services**, please refer to:

References: /BA/ Operator’s Guide

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14.8 Print graphic

Printer selection

The softkey **Graphics** in the main screens of the measuring functions opens the menu to select the printer and to print the graphics.

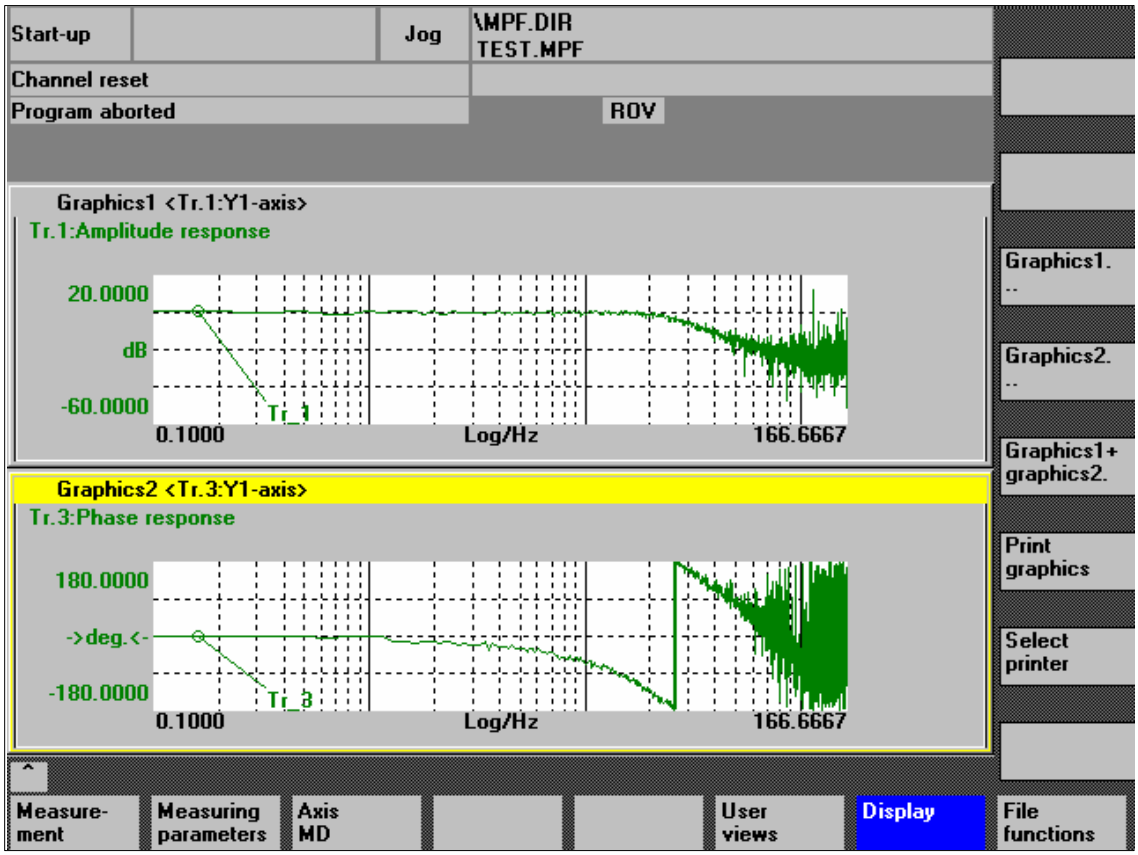


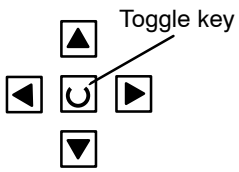
Fig. 14-13 Graphics softkeys

Softkey: Printer selection

Use the softkey **Printer selection** to open the appropriate menu, Fig. 14-14, Page 14-454.

Choose the type of file output from the selection list of the menu ”Select printer” using either the **Toggle** key or by double–clicking with the right mouse button on the desired file output type:

- Bitmap file
- Printer



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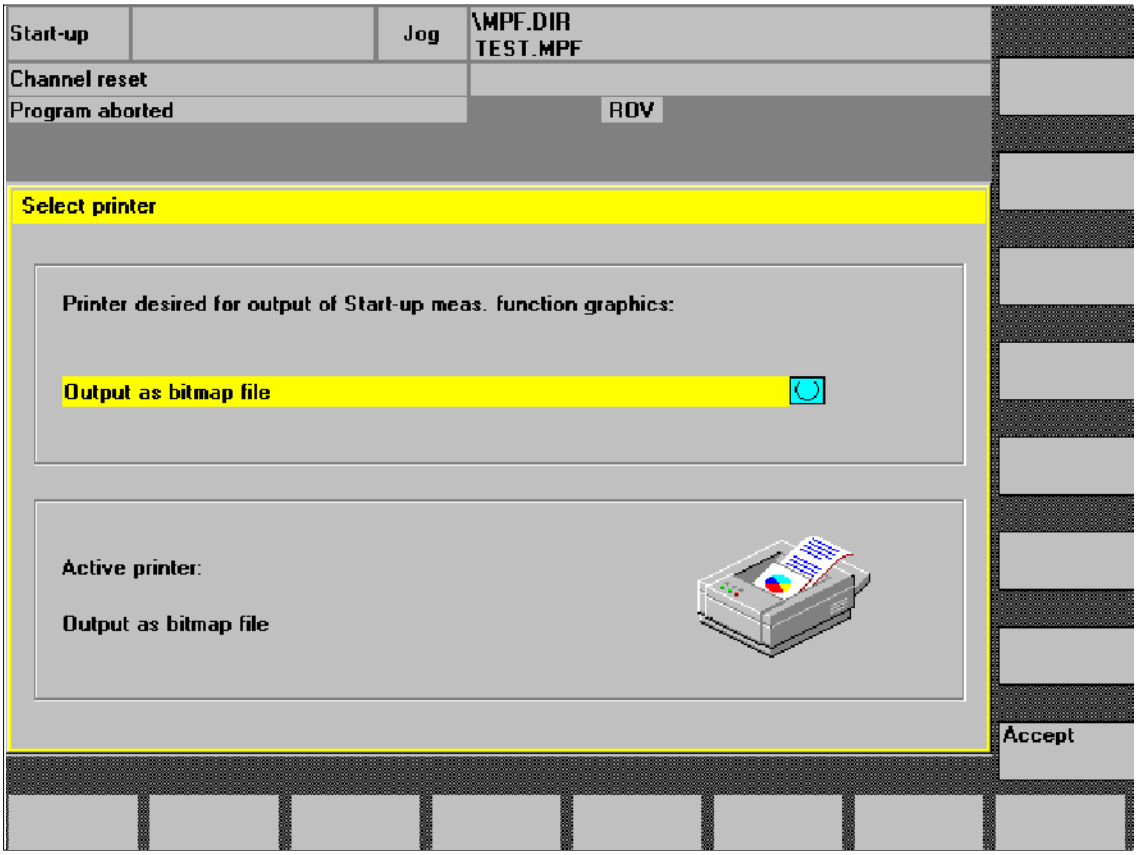


Fig. 14-14 Menu: Printer selection

Output to printer

Choose the printer to which you wish the file to be output from the list field using either the **Toggle** key or by double-clicking with the right mouse button on the desired printer.

Output as a bitmap file

The graphics is to be saved in a bitmap file (*.bmp):

- In the selection field for printer setting, set **Output as bitmap file**
- Press the softkey **Print graphics**
- Enter a file name.
  You can enter a new file name or select an existing file from the drop-down list.

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Softkey: Print graphic

Use the softkey **Print graphics** Fig. 14-13, Page 14-453 to output the graphics to the set medium:

- Printer
- Bitmap file

Printer

The graphics is output directly to the selected printer.

Bitmap file

If you wish to output the graphics to a bitmap file, the following specifications are still required in the submenu ”File name for bitmap printout”:

- File names
- Folder

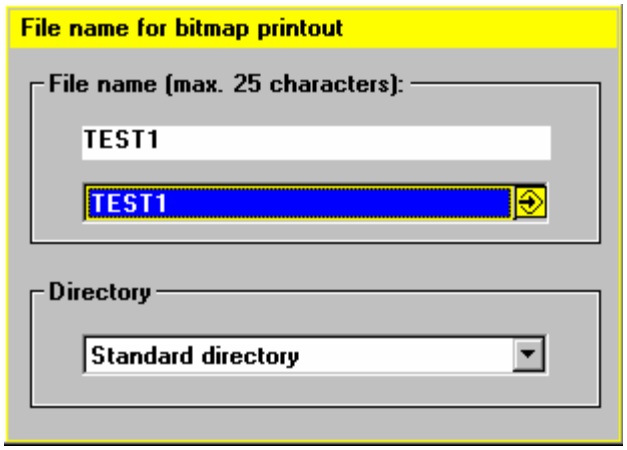


Fig. 14-15 Menu: File name for bitmap printing

Naming files

In the **File name** group, you can select an existing file from the drop–down list or enter one in the text field underneath.

Selecting the directory

In the **Directory** group, you can select the directory where you want to save the file.

This can also be a directory in the operating area **Services > Data** you have created by yourself or the basic directory of the data management (list entry: Standard directory).

For the description of the operating area **Services**, please refer to:

References: /BA/ Operator’s Guide

- The file is saved using the softkey **OK**.
- With the softkey **Cancel** you can return to the current graphic display.

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14.9 Automatic controller setting

14.9.1 Drives: SINAMICS S120

Functionality

The automatic controller setting of the speed control loop offers the following functionality:

- Determining the gain and reset time in these cases:
  - Standard setting
  - Critical damping
  - Good damping
- Determining current setpoint filters which may be required
- Display of the measured or calculated frequency responses

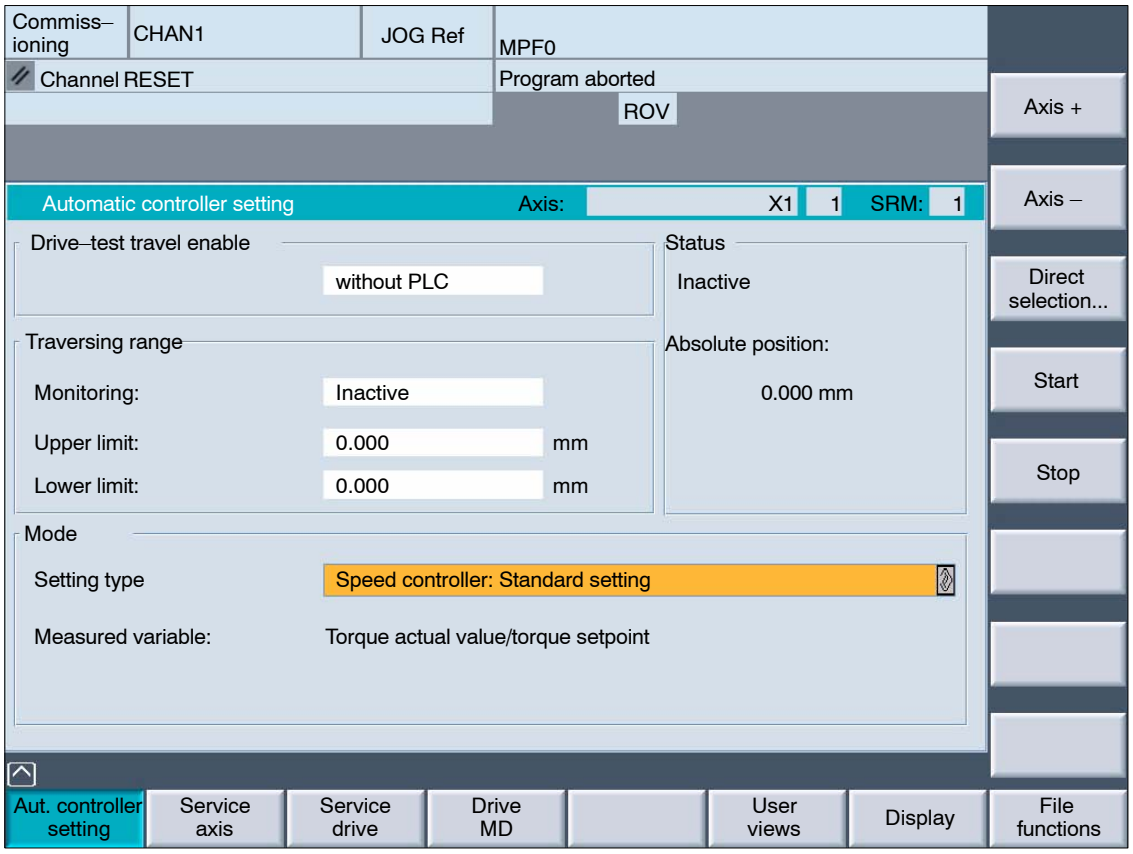


Fig. 14-16 Menu: Automatic controller setting

Operating path

Operating path of the automatic controller setting: **Operating area switchover > Commissioning > Optimization/test > ">" > Aut. controller setting**

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Measurement

The sequence of the automatic controller setting is divided into the following steps:

1. Starting the automatic controller setting.
2. Measuring the mechanical system Part 1.
   For the measurement, you can retain the standard parameters specified by the control or enter your own. Start the measurement with the ”OK” softkey. Enable the traversing movement via NC START.
3. Measuring the mechanical system Part 2.
   Set the measuring parameters, start the measurement and enable the traversing movement as for 2..
4. Measuring the current control loop.
   Set the measuring parameters, start the measurement and enable the traversing movement as for 2..
5. Calculating the controller data.
   Set the measuring parameters for gain and reset time. Start the calculation with the ”OK” softkey.
6. Optional: Retentive storage of the newly calculated drive parameters in the drive
7. Measuring the speed control loop.
   Set the measuring parameters, start the measurement and enable the traversing movement similar to point 2..
8. Check the controller setting based on the displayed measurement results.

14.9.2 Drives: SIMODRIVE 611 universal

An automatic controller setting of SIMODRIVE 611 universal drives is only currently possible with the SimoCom U drive commissioning tool.

References: /FBU/ Description of Functions, SIMODRIVE 611 universal
Section: Description of Functions
Optimization of the Current and Speed Controller

SimoCom U Online Help

■

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Space for your notes

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User Data Backup/Standard Commissioning 15

15.1 Explanations on data backup

User data

User data refers to all data or data fields that can be entered by the user to achieve the specific functionality of the SINUMERIK 840Di sl and the connected drives.

In the case of a data backup, e.g. after commissioning of the control system, the user data selected through the user interface are written to a so–called series startup file.

After a series startup file has been read in, the control system is in its original status again as it was at the time of data backup.

Times for data backup

The past has shown that the following times are recommended to carry out data backups:

- After commissioning
- After changing machine–specific settings
- After service, e.g., after replacement of a hardware component, software upgrade, etc.
- Before activation of memory–configuring machine data. A warning prompting you to back up is displayed automatically.

Data backup of various components

You can save user data using one of the following applications:

- SINUMERIK user interfaces: HMI Advanced (option).
- Commissioning tool: SinuCom NC

You can save user data for the following components either individually or together.

- NCK
- PLC
- HMI
- SIMODRIVE PROFIBUS drives

SINAMICS S120

Currently, the user data (projects) for SINAMICS S120 drive units must be saved separately with the STARTER commissioning tool.

For detailed information on data backup, please refer to:

References: **SinuCom NC**:
Online Help

HMI Advanced:
/BAI/ Operator's Guide HMI Advanced

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15.2 Creating a series commissioning file

15.2.1 General

Note

Because of its file extension ".arc", the series startup file is also called archive.

Archive content

The following components can be selected as the content of a series commissioning file:

- NCK with/without compensation data (see below: Note)
- PLC
- HMI
- SIMODRIVE PROFIBUS drives

When selecting, any combinations are possible. However, it is recommended to save the individual components separately in separate series startup files. It is thus possible to reload them independently of each other and with maximum flexibility.

Note

Machine–specific **compensation data** only needs to be archived if the series startup file is to be reloaded into the same control system (backup).

NCK

The contents of a series startup file created for the NCK comprises mainly the following data:

- Machine data
- Setting data
- Option data
- Global (GUD) and local (LUD) user data
- Tool and magazine data
- Protection zone data
- Arithmetic variables
- Work offsets
- Compensation data
- Display machine data
- Workpieces, global part programs and subroutines
- Standard and user cycles
- Definitions and macros

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PLC

The contents of a series startup file created for the PLC comprise all blocks loaded at the time when the data backup was made:

- OB (organization blocks)
- FB (function blocks)
- SFB (system function blocks)
- FC (functions)
- SFC (system functions)
- DB (data blocks)
- SDB (system data blocks).

HMI

The contents of a series startup file created for the HMI Advanced comprise all data stored in the HMI database in the directory **dh** at the moment when the data backup was made.

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15.2.2 HMI Advanced (option)

The creation of a series startup file with HMI Advanced is divided into the following steps:

1. Open the menu to create a series startup file:
   Operating area switchover > Services > ETC key ”>” > Standard commissioning > Create commissioning archive
2. Selection of components to be backed up (see figure: archive content)
3. Assignment of a filename (see figure: archive name)
4. Setting of the series startup file via the vertical ”Archive” softkey. The series startup file is stored in the archive directory on the hard disk of the PCU.

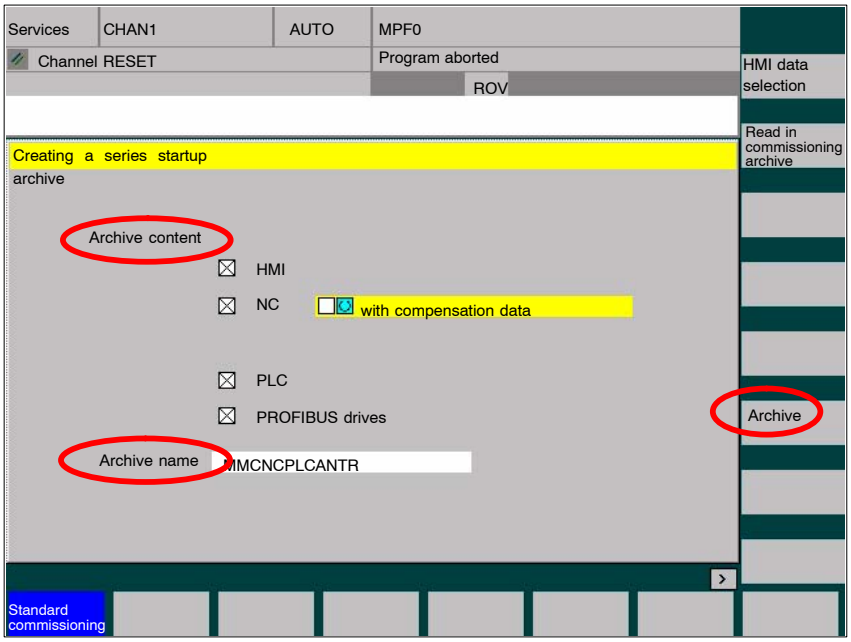


Fig. 15-1 Menu: Creating a series startup archive

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15.2.3 SinuCom NC

Start

SinuCom NC can be started as follows to create a series startup file:

- SINUMERIK Desktop (see Section 5.4, Page 5-117)
  Windows XP taskbar: **Start > Programs > SinuCom NC > SinuCom NC**
- HMI Advanced
  Operating area switchover > ETC key ">" SinuCom NC

Creating a new file

Creating a series startup file with SinuCom NC is subdivided into the following steps (see Fig. 15-2 below):

1. Starting SinuCom NC
2. Selecting the storage location
3. Selecting the components to back up (archive content)
4. Continuing ("Next >")

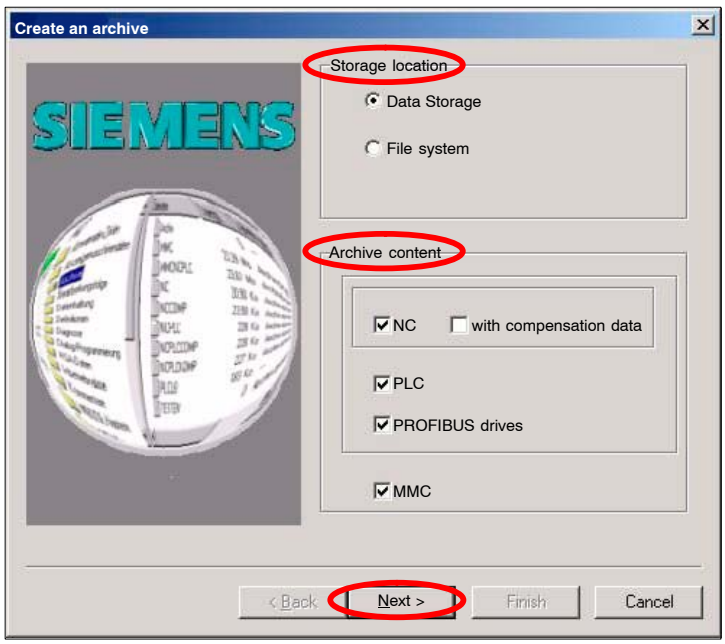


Fig. 15-2 Menu: Creating a series startup archive

5. The following data can be selected in the following menus, depending on the selected components:
   – NCK: Part programs
   – MMC: MMC archives
6. Creating the series startup file ("Finish")

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15.3 Considerations when saving PLC data

When creating a series startup file that contains PLC data, the PLC image that is saved during this process is dependent on the status of the PLC at the time of creation.

Depending on the status of the PLC, the following PLC images result:

- Original image
- Instantaneous image
- Inconsistent image

Original image

The original image of the PLC is represented by the PLC data immediately after loading the S7 project into the PLC.

Operating sequence:

1. Set the PLC to the operating status **STOP**
2. Load the appropriate S7 project into the PLC using the SIMATIC Manager STEP 7
3. Create a series startup file with PLC data
4. Set the PLC to the operating status **RUN**

Instantaneous image

If you cannot use the procedure described above, you can use the following alternative procedure to save an original image:

Operating sequence:

1. Set the PLC to the operating status **STOP**
2. Archive PLC data
3. Set the PLC to the operating status **RUN**

Inconsistent image

An inconsistent image results if a series startup file with PLC data is created and the PLC is in the status **RUN** (cyclic operation).

The data blocks of the PLC are saved at different times with contents that under certain circumstances may meanwhile have changed. This may result in a data inconsistency that after copying the data backup back into the PLC may under certain circumstances result in PLC stop in the user program.

Notice

The creation of a series–commissioning file with PLC data while the PLC is in the RUN status (cyclic operation) may result in an inconsistent PLC image in the series commissioning archive.

After this series startup file has been copied back, this data inconsistency in the PLC user program may under certain circumstances result in the stop of the PLC.

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Changing the PLC operating status

To change the PLC operating status, proceed as follows:

- With 840Di start–up:
  - Start 840Di start–up **Windows XP taskbar > Start > Programs > SINUMERIK 840Di > 840Di Start–up**.
  - Open the dialog box: Menu command **Window > Diagnosis > NC/PLC**.
- With HMI Advanced
  - Open the dialog box: **Operating area switchover > Commissioning > NC/PLC Diagnosis**
- Change the PLC operating state: Group box PLC, buttons: "**STOP**" and "**RUN**".
- NCK and PLC must then be resynchronized: Group box PLC, buttons: "**NC Reset**".

15.4 Reading in a series startup file with HMI Advanced

The process of reading in a series startup file is broken down into the following steps:

1. Open the menu to read in a series startup file:
   Operating area switchover > Services > key: ">" > Standard commissioning > Read in commissioning archive
2. Select the series startup file
3. Start read in: **Start**

Note

Because of the file extension ".arc" of the series startup file, this is also called archive.

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15.5 SINAMICS S120 standard commissioning with STARTER

A project must be available, created or loaded from a drive unit into the programming device for the standard commissioning of SINAMICS S120. This project is loaded as a reference project in the other drive units still to be commissioned.

Requirements

The following conditions must be fulfilled:

- The reference drive unit is fully configured.
- You can create an online connection to all drive units.
- The reference project is loaded into the STARTER.

Execution

Perform the following actions in the STARTER for each drive unit to be commissioned.

1. Create a backup copy of the project: **Project > Save As...**
2. Access the drive unit online: **Project > Connect to target system**
3. Load the project into the drive unit: **Target system > Load > Load to target system**

   The drive unit applies the serial number from the previously located components in the reference topology. This results in an inconsistency, which is displayed in the project navigator.
4. Read the project back into the programming device: **Target system > Load > Load fully into the programming device (all p and r parameters)**
5. Save your project: **Project > Save**

   The configuration is now consistent, i.e., the same project states exist in the target system and in the project.

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Software Installation/Update and Data Backup 16

16.1 PTP network connection

The functions described in this section (software installation/update) require a network connection to an external computer (PG/PC) which contains an enabled network access directory.

If the SINUMERIK 840Di sl is not part of a larger network (WAN, LAN), a simple PTP (peer–to–peer) connection via Ethernet and TCP/IP can be established for service applications.

16.1.1 Establishing a network connection

For the network link, the PCU 50.3 is connected with the external computer directly via a crossed Ethernet cable (twisted pair crossed 10baseT/100baseTX Ethernet cable).

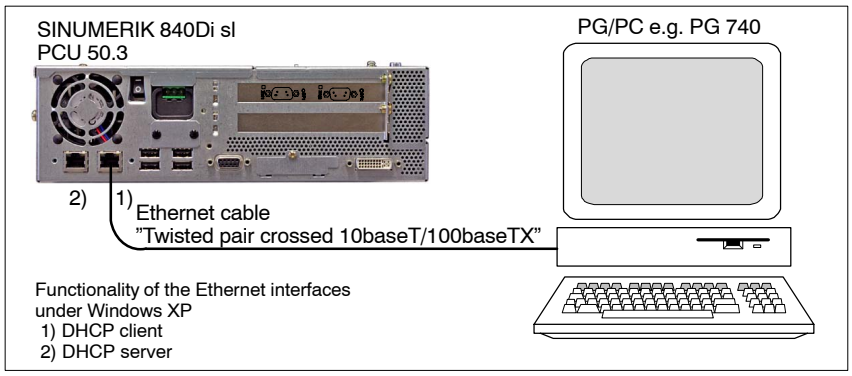


Fig. 16-1 PTP link: PCU 50.3 – External computer (PG/PC)

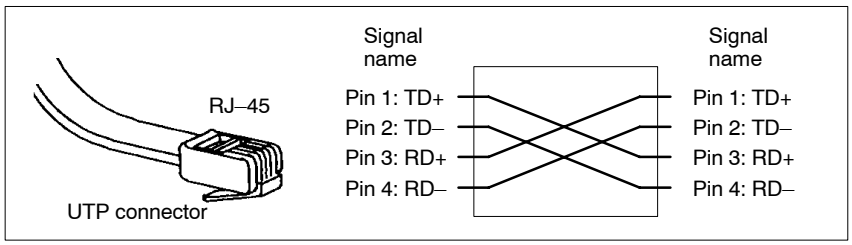


Fig. 16-2 Crossed Ethernet cable (twisted pair crossed 10baseT/100baseTX)

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Network protocol TCP/IP

The network protocol used is: TCP/IP. TCP/IP permits high data transmission rates and it is simple to configure. TCP/IP is already pre–configured in the basic PCU software.

Requirements on the ext. computer

The following requirements must apply on the external computer:

- A network adapter is installed.
- The TCP/IP network protocol is installed.
- The external computer is connected to the PCU via a crossed Ethernet cable.
- The IP address of the external computer is within the same subnet as the PCU.
- A directory is shared as the network drive.

16.1.2 Configuring the external computer (Windows NT)

This section illustrates how to make and check settings for network configuration on the external computer:

- TCP/IP protocol
- IP address and subnet mask
- Computer name and workgroup
- Service: ”Server service”
- Directory sharing

TCP/IP protocol

Go to the network dialog box on the control panel (Windows task bar: **Start > Settings > Control Panel >> Network**) to display the installed network protocols on the ”Protocols” tab. If the TCP/IP protocol is not shown, it can be installed now.

Dialog box: Start

Dialog box: Network
Tab card: Protocols
Button: ”Add...”
Dialog box: Network protocol selection
Network protocol: **TCP/IP protocol**
Note
The question about DHCP must be answered ”No”.
OK

IP address and subnet mask

After installation of the protocol and to simplify setting up communication with the PCU, it is necessary to check the IP address and the subnet mask and set them, if necessary:

IP address

We recommend using an IP address from the address range used by Windows XP for automatic configuration, if no DHCP server is accessible (Automatic Private IP Addressing: 169.254.x.x).

The last two digits must be in the range 1 – 254.

- 169.254. 10. 1

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Subnet mask

The subnet mask must be permanently set to the specified value:

- 255.255. 0. 0

Dialog box: Continuation

Dialog box: Network
Tab card: Protocols
Button: "Properties..."
Dialog box: Properties of Microsoft TCP/IP
◉ Specify IP address
IP address: <***169.254. 10. 1***>
Subnet mask: <***255.255. 0. 0***>
OK

Computer name and workgroup

Because it is a PTP link, any computer name and workgroup may be selected.

Dialog box: Continuation

Tab: Identification
Button: "Change..."
Dialog box: Identification change
Computer name: <***COMPUTER NAME***>
◉ Workgroup: <***WORKGROUP***>
OK

Server service

The "Services" tab card must contain "Server service". This corresponds to general sharing: "File and Printer Sharing" under Windows 9x or Windows XP. If this service is not active, no directories can be shared.

If the service is not running, it can be installed now:

Dialog box: End

Tab: Services
Button: "Add..."
Dialog box: Network service selection
Network service: **Server service**
OK
OK

Directory sharing

Network access is enabled in properties dialog> tab card: "Enable" of the directory in question (select the directory with the right mouse key)

The directory name is the default name for sharing. If a different sharing name is specified, it must be stated on activating the directory connection.

Authorization

Access authorization to the drive is "Everyone" and "Full access" by default.

Dialog box

Dialog box: Properties of <*directory*>
Tab card: Sharing
◉ Shared as:
Sharing name: <***SHARED AS***>
OK

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16.1.3 Configuring the external computer (Windows XP)

This section illustrates how to make and check settings for network configuration on the external computer:

- TCP/IP protocol
- IP address and subnet mask
- Computer name and workgroup
- Service: ”File and Printer Sharing”
- Directory sharing

TCP/IP protocol

Go to the properties dialog box of the local network links (Windows task bar: **Start > Settings > Network Connections >> Local Area Connections**) to have the installed network protocols displayed on the ”General” tab card.

The TCP/IP protocol must be installed and active:

Dialog box

Dialog box: Local Area Connections Properties
Tab card: General
☑ **Internet Protocol (TCP/IP)**
OK

If the protocol is not shown, it can be installed now.

IP address and subnet mask

The IP address and the subnet mask are automatically set by Windows XP on connection Precondition is that the ”Automatic Private IP Addressing” function is active.

the function is activated in the properties dialog of protocol: TCP/IP (function is active by default).

Dialog box

Dialog box: Internet Protocol (TCP/IP) Properties
Tab card: Alternate Configuration
◉ Automatic Private IP Address
OK

Computer name and workgroup

Because it is a PTP link, any computer name and workgroup may be selected.

The setting is made via the properties dialog box of the Control Panel. Windows taskbar: **Start > Control Panel > System**.

Dialog box

Dialog box: System Properties
Tab card: Computer Name
Button: ”Change...”
Dialog box: Change Computer Name
Computer name: <***COMPUTER NAME***>
◉ Workgroup: <***WORKGROUP***>
OK

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Service: ”File and Printer Sharing”

Go to the properties dialog box of the local network links (Windows task bar: **Start > Settings > Network Connections >> Local Area Connections**) to have the installed services displayed on the ”General” tab card.

Service: ”File and Printer Sharing for Microsoft Networks” must be installed and active:

Dialog box

Dialog box: Local Area Connections Properties
Tab card: General
☑ **File and Printer Sharing for Microsoft Networks**
OK

If the service is not running, it can be installed now.

Option: ”Simple File Sharing”

To simplify enabling of directories, go to the Windows Explorer, menu item: Tools > Folder Options, and select option: and activate ”Simple File Sharing”.

Dialog box

Dialog box: Folder Options
Tab card: View
☑ **Use simple file sharing (Recommended)**
OK

Directory sharing

Network access is enabled in properties dialog> tab card: ”Sharing” of the directory in question (select the directory with the right mouse key)

The directory name is the default name for sharing. If a different sharing name is specified, it must be stated on activating the directory connection.

Authorization

To allow files to be created in the directory, the appropriate authorization must be set.

Dialog box

Dialog box: <*Directory*> Properties
Tab card: Sharing
☑ **Share this folder on the network**
☑ **Allow network users to change my files**
OK

16.1.4 Configuring the PCU

The PCU basic software is preconfigured for a PTP network link with protocol: TCP/IP. If changes have been made or a network link cannot be established, settings regarding:

- TCP/IP protocol
- IP address and subnet mask
- Computer name and workgroup

must be made or checked as described in Section 16.1.3, Page 16-470.

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16.2 Partitioning of the PCU hard disk

The PCU hard disk is divided into 4 partitions (3 primary partitions and an extended partition). For data security purposes, the SINUMERIK 840Di sl system software, the Windows system software and the Service software are installed on different partitions.

Partitions

The diagram below shows the partitioning of the hard disk when the control system is supplied:

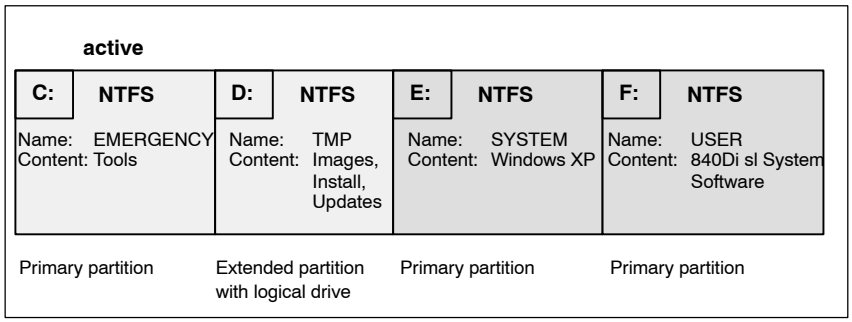


Fig. 16-3 Partitioning the hard disk

1st partition/drive C:

Drive C: is reserved for service tasks under WinPE 2005.

2nd partition/drive D:

Drive D: contains the following directories:

- **Images**
  Contains preinstalled and own images
- **Install**
  The software to be installed is first copied into this directory before actual installation under Windows XP.
- **Update**
  The directory is used for subsequent installation of Windows XP system software.

3rd partition/drive E:

Drive E: is reserved for the Windows XP system software.

4th partition/drive F:

Drive F: contains the SINUMERIK–specific applications, e.g. the SINUMERIK 840Di sl system software.

It is also used for installing user–specific applications, e.g. SINUMERIK user interfaces, HMI OEM applications or SIMATIC STEP7.

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16.3 Software installation/update (Windows)

Brief description

This section describes how to install/update software via a Windows–based network link to an external computer (PC/PG) in which a directory is shared for this purpose.

The entire procedure is carried out from the SINUMERIK desktop. To activate the SINUMERIK desktop, see Section 5.4.1, Page 5-117.

Using the applications

- **NT desktop**
  Autostart of the HMI application: OFF
- **HMI desktop**
  Autostart of the HMI application: ON

it is possible to activate the SINUMERIK desktop permanently and deactivate it again after completion of service actions. These applications are part of the SINUMERIK 840Di sl basic software

Compatibility list

Before installing/updating software components, check they are compatible with existing software components. See the compatibility list for your SINUMERIK 840Di sl software version on the Internet:

http://www.siemens.de/sinumerik> SINUMERIK 840Di sl > Link Box > Support > Update > Tab: Update > SINUMERIK 840Di sl: Delivery Release System Software ... > Compatibility list: Compatibility_List.PDF

Notice

We urgently recommend checking compatibility of new software components with existing software components before installing/updating them (compatibility list).

Requirements

The following condition must be fulfilled:

- Network link with an external computer. See Section 16.1, Page 16-467.

Recommended procedure

This is the recommended procedure for installing/updating software on the PCU:

1. Back up the NCK and PLC user data by creating a series startup file. See Section 15, Page 15-459f.
2. Establish a network link to a shared directory of an external computer (PG/PC) containing the software to be installed. See Section 16.1, Page 16-467.
3. Perform installation/updating of the software via the network link.
4. Initialize the control with ”Delete NCK data” and ”PLC memory reset”. See Section 6.2.1, Page 6-134.
5. Import the series startup file created in Step 1. See Section 15.4, Page 15-465.

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16.4 Restoring the as–delivered state

If the current installation has been damaged o such an extent that it is no longer possible to continue working, the factory settings of partitions C: (WinPE), E: (Windows XP) and F: (840Di sl System) of the PCU hard drive can be restored.

This section describes the actions for:

- Restoring the partitions
- Installation of the SINUMERIK 840Di sl applications

Notice

When restoring the hard disk to the ex–works state, all data on the partitions C:, E: and F: are lost.

16.4.1 Requirements

To restore the ex–works state, the following files supplied with the SINUMERIK 840Di sl must be saved locally on the PCU hard disk:

- D:\IMAGES\base_ou.gho (image file)
- D:\IMAGES\base_ou.inf

Image file

The image file *.gho contains the data to be restored.

Info file

The info file *.inf contains the description of the data to be restored.

The information in this file is required by the services menu to configure the image program Norton Ghost™.

Notice

If the info file is not available, the service menu cannot restore the partitions.

16.4.2 Restoring the partitions

The procedure for restoring partitions C:, E: and F: from a local image file is described in:

References

/IAM2/ CNC Commissioning Part 5
Section: IM8
4 Backing up and restoring data
Save/restore local partitions

Select the image file from which the partitions are to be restored in accordance with the existing SINUMERIK 840Di sl software version:

- Basic software <*Version*> <*Date*>

After the partitions have been restored, the SINUMERIK 840Di sl applications must be reinstalled.

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16.4.3 Installation of the SINUMERIK 840Di sl applications

The installation programs for the SINUMERIK 840Di sl applications saved on D:\INSTALL are not executed automatically after partition restoration, as was the case during the initial boot. To do this manually in the correct sequence, proceed as follows:

1. On next PCU start–up after restoration of the partitions, you are prompted to enter the password for the SINUMERIK desktop.

   Start the Windows Explorer on the SINUMERIK desktop and open the directory:

   - D:\SETUP\APPS

   The subdirectories contained in directory APPS contain:
   - \001 Installation directories of the 1st application
   - \002 Installation directories of the 2nd application
   - . . . .
   - \xxx Installation directories of the xxxth application

   The numbers in the directory name indicate order in which the applications have to be installed.

2. Next open directory:

   - D:\SETUP\APPS\001

   The subdirectories contained in directory \001 contain:
   - \000 Installation directories of the application
   - \001 – \xxx Installation directories of options, patches, etc.

   The numbers in the directory name indicate order in which the installation programs have to be run.

3. Next open directory:

   - D:\SETUP\APPS\001\000

   and start the installation program in the directory (SETUP.EXE).

   Then following the installation instructions shown.

Notice

If you are prompted to reboot during installation, always confirm this with ”Yes” and reboot.

---

4. Proceed with all (existing) directories

   - D:\SETUP\APPS\001**001** to **xxx**

   as described in item 3.

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5. Proceed with all (existing) directories

   - D:\SETUP\APPS**002** to **xxx**

   as described in item 2.

Once all the installation programs have been executed in the described sequence, partitions C:, E:, and F: of the PCU hard disk are once again restored to their as delivered state.

Example

Fig. 16-4 shows an example of a directory structure under directory D:\SETUP\APPS with 2 applications and the resulting installation sequence. The first application contains 3, the second application 2 installation programs.

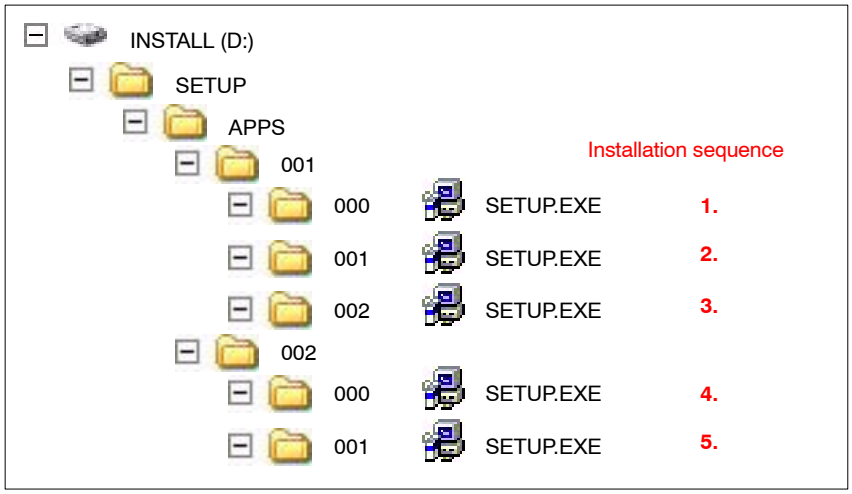


Fig. 16-4 Installation sequence

■

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License Management

17

17.1 Fundamentals

17.1.1 Important terms

The terms below are important for understanding the license management of SINUMERIK software products.

Term	Description
Software product	A software product is generally used to describe a product that is installed on a piece of hardware to process data. Within the license management of SINUMERIK software products, a corresponding license is required to use each software product.
Hardware	Hardware in the framework of the license management of SINUMERIK software products is a SINUMERIK control (CNC). With SINUMERIK 840Di sl represented by the appropriate MCI board.
License	A license gives the user a legal right to use the software product. Evidence of this right is provided by the following: • CoL (Certificate of License) • License key
CoL (Certificate of License)	The CoL is the proof of the license. The product may only be used by the holder of the license or authorized persons. The CoL includes the following data relevant for the license management: • Product name • License number • Delivery note number • Hardware serial number **Note** The hardware serial number is located only on a CoL of the system software or if the license was ordered bundled, in other words the system software came together with options.
License number	The license number is the feature of a license that is used for its unique identification.
MCI board	The MCI board represents, as the carrier of all the remanent data of a SINUMERIK solution line control system, the identity of this control system. The MCI board includes the following data relevant for the license management: • Hardware serial number • License information including the License Key
Hardware serial number	The hardware serial number is a permanent part of the MCI board. It is used to identify a control system uniquely. The hardware serial number can be determined by: • CoL (see: Certificate of Lincense ”Note”) • SINUMERIK user interface: HMI Advanced or HMI Embedded • SINUMERIK Commissioning tool: SinuCom NC • Automation License Manager • Inscription on the MCI board

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Term	Description
License key	The License Key is the ”technical representative” of the sum of all the licenses that are assigned to one particular piece of hardware, which is uniquely marked by its hardware serial number.
Option	One option is a SINUMERIK software product that is not contained in the basic version and which requires the purchase of a license for its use.
Product	A product is marked by the data below within the license management of SINUMERIK software products: • Product Name: • Order number • License number

17.1.2 Overview

The use of the installed system software and the options activated on a SINUMERIK control system require that the licenses purchased for this purpose are assigned to the hardware. In the course of this assignment, a License Key is generated from the license numbers of the system software, the options, as well as the hardware serial number. Here, access occurs to a license database administered by Siemens A&D via the Internet. Finally, the license information including the License Key is transferred to the hardware.

There are two ways to access the license database:

- Web License Manager
- Automation License Manager

Note

Using SINUMERIK software products for testing purposes

SINUMERIK software products may be temporarily activated and used for testing purposes on a SINUMERIK control system, even without the corresponding License Key.

On the SINUMERIK user interface, e.g. HMI Advanced, the License Key is then displayed as ”not sufficient” in the ”Overview” dialog box. Also the control system will repeatedly display a corresponding message.

17.1.3 Web License Manager

By using the Web License Manager, you can assign licenses to hardware in a standard Web browser. To conclude the assignment, the License Key must be entered manually at the control system via the HMI user interface.

Internet address The Internet address of the Web License Managers is:
http://www.siemens.com/automation/license

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17.1.4 Automation License Manager

Via the Automation License Manager, individual licenses can be assigned and the automatic assignment of all the licenses required for a piece of hardware can be carried out (license requirement alignment). The transfer of the license information including the License Key occurs electronically via Ethernet.

Preconditions:

- The Automation License Manager must be installed on the computer (PC/PG) that is used to assign the licenses to the hardware.
- The computer (PC/PG) must be able to connect to the license database and the SINUMERIK control system via Ethernet link (TCP/IP):
  - License database: Internet connection
  - SINUMERIK control system: Intranet or PTP connection (Ethernet, Peer–To–Peer)

17.1.5 License database

The license database contains all the customer–specific, relevant license information for the license management of SINUMERIK software products. The central management of the license information in the license database ensures that the existing license information regarding a piece of hardware is always up to date.

The following functions are available:

- Management of the hardware purchased with the related licenses assigned
- Management of the licenses purchased and not yet assigned to any hardware
- Assignment of licenses to a piece of hardware according to the current license requirement (license requirement alignment)
- Assignment of individual licenses to a piece of hardware
- Generating license keys
- Transferring license information including the License Key into a control system

License database access

License database access occurs via:

- Direct access

  The direct access occurs with:
  - Delivery note number
  - License number

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The direct access enables the direct assignment of licenses for which the license numbers are available, e.g., in the form of a CoL. In the Web License Manager you can also assign all other licenses provided in relation to this delivery note.

- Customer login

  The customer login occurs with:

  – User name

  – Password

  The customer login enables the assignment of all the licenses available to the user that are delivered at the time of the login and have not yet been assigned to any hardware. Here, the license numbers of licenses that can still be assigned need not be directly at hand, instead these are displayed from within the license database.

Note

- You can obtain a customer login via Siemens A&D Mall at menu item: ”Registration”. The Internet address is: http://mall.automation.siemens.com/

  Currently, access is not yet possible for all countries.

- Browser settings for using the A&D Mall, see Section 17.1.8, Page 17-482.

Various license information

As indicated above, only the license information in the license database represents the current status regarding a piece of hardware. Differences may arise between the license information available for a piece of hardware and that of the license database due to:

- loading older archive data into the NCK (data restoration from a series–commissioning file after a service job)
- assigning licenses to hardware without transferring the modified license information for the hardware control system (online)

As a result, a more limited license requirement (possibly no license requirement) may be displayed than indicated on the HMI user interface of the control system for a license requirement alignment by Automation License Manager.

To align the license information, a transfer should be carried out for the current license information of the license database for the hardware control system (online).

17.1.6 MCI board and hardware serial number

In addition to the retentive system and user data, the MCI board contains the data of a control system relevant for the license management of SINUMERK software products:

- Hardware serial number
- License information including the License Key

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The MCI board thus represents the identity of a SINUMERIK control system. For this reason, assigning licenses to a control system always occurs using the hardware serial number.

This has the advantage that the MCI board can be slotted into a replacement PCU in the event of failure and all data, including licensing information, are retained.

Automation License Manager

Thus, the hardware serial number is always decisive during the transfer of license information to a control system in Automation License Manager and not the set IP address of the control system with which Automation License Manager is currently communicating.

Determining the hardware serial number

The hardware serial number is a permanent part of the MCI board. It is used to identify a control system uniquely. The hardware serial number can be determined by:

- CoL (Certificate of License) (see note)
- SINUMERIK user interfaces: HMI Advanced or HMI Embedded
- SINUMERIK Commissioning tool: SinuCom NC
- Inscription on the MCI board
- Automation License Manager: Control system file data
  - Control system (online)
  - Control image (offline)

Note

- Hardware serial number and CoL
  The hardware serial number is located only on a CoL of the system software or if the license was ordered bundled, in other words the system software came together with options.
- SINUMERIK 840Di sl
  On the SINUMERIK 840Di sl the MCI board is used to save data and print the hardware serial number.

17.1.7 SINUMERIK License Key

Basic information on License Keys

If a license is required for a product, then with the purchase of the license the purchaser receives a CoL as proof of the rights to use this product and a corresponding License Key as the ”technical representative” of this license. In conjunction with software products, the License Key usually must be available on the hardware on which the software product executed.

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SINUMERIK License Keys

Depending on the software product, there are License Keys with different technical properties. The essential properties of a SINUMERIK License Key are:

- Hardware reference
  The hardware serial number included in the SINUMERIK License Key provides a direct link between the License Key and the hardware on which it can be used. In other words, a License Key created for the hardware serial number of a specific MCI board is only valid for this MCI board and will be rejected on other MCI board as invalid.
- Total number of assigned licenses
  A SINUMERIK License Key not only refers to one single license, instead it is the ”technical representative” of all licenses that are assigned to the hardware at the time of its generation.

Copying SINUMERIK License Keys

By the fixed reference to certain hardware, a SINUMERIK License Key may, for example, be copied to various computers (PC/PG) and/or storage media for security or archiving purposes.

17.1.8 Browser settings for using the A&D Mall

The browser settings required to use the A&D Mall are provided below based on Microsoft Internet Explorer 6.0.x. When using another browser the settings should be modified as necessary.

Session cookies

Session cookies must be enabled to use the A&D Mall. The corresponding setting can be activated using the slider control for the general security settings. If you are using custom security settings, you must explicitly allow session cookies.

Settings

- General security settings:
  Menu bar: Tools > Internet Options > Tab: ”Security” >Slider control: ”**medium**” or ”**medium–high**”.
- Custom security settings:
  Menu bar: Tools > Internet Options > Tab: ”Security” > Group ”Settings”: Button: ”Advanced...” > Group ”Cookies”: Select ”Always allow session cookies”.

Note

A cookie is a small text file, which is transferred from a Web server to the Web browser. The text file cannot exceed 4000 characters (bytes) and is never executed as a program by the Web browser. Session cookies are a specific application format of cookies, which are not saved permanently on the computer, but instead are deleted immediately when the user ends the session.

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JavaScript

In addition to session cookies, you must also allow the execution of JavaScript programs to use A&D Mall.

As the running of JavaScript programs is critical to security, you should only activate the ”Active Scripting” option for Web pages from trusted sources. Internet Explorer 6.0 x offers four different zones for this.

Settings

- Add Internet sites from Siemens to the ”Trusted Sites” zone:
  Menu bar: Tools > Internet Options > Tab: ”Security”> Zone: ”Trusted Sites” > Button: ”Sites...” > ”Add this Web site to the zone”: ”***.siemens.com**” > Button: ”Add”
- Enable ”Active Scripting”:
  Menu bar: Tools > Internet Options > Tab: ”Security”> Zone: ”Trusted Sites” > Button: ”Custom Level...” > Zone: ”Scripting” > ”Active Scripting” = ”**Enable**”

17.1.9 Proxy settings for the download of license information

As part of licensing, the Automation License Manager downloads license information, including the License Key, from the license database to the local computer via the download server. You should apply the settings for long–distance data transmission/VPN and LAN so that you can access the download server via port 80 and port 443:

- Internet address: http://software–download.automation.siemens.com
- IP address: 146.254.187.20

Settings

In Internet Explorer 6.0 x via:
Menu command: ”Tools” > ”Internet Options...” > Tab: ”Connections” >
Group: ”Dial–up and Virtual Private Network settings” and ”Local Area Network (LAN) settings”

Note

The Automation License Manager must be allowed to establish an Internet connection to the download server. To do this you may need to enable a firewall for the download server.

In the event of queries and problems, please contact your local system administrator.

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17.2 Assigning via Web License Manager

17.2.1 You can execute an assignment via direct access as follows

Background

For direct access, log on to a computer connected to the Internet (PC/PG) with the delivery note and license number in the Web License Manager. All licenses of the delivery note numbers entered at the login may then be assigned to a piece of hardware. After completing the assignment process, the new License Key is displayed. This must then be entered in the licensing dialog of the HMI components used.

Requirements

The following prerequisites must be met in order to assign a license to a piece of hardware via direct access and HMI user interfaces:

- The HMI component is connected with the control system (NCU) on which the license should be assigned. Both components have been booted.
- A computer (PC/PG) with Internet connection and browser is available.
- The login data for the direct access (e.g., per CoL) are available:
  - License number
  - Delivery note number

Execution

Assigning a license to a piece of hardware:

1. Determine the HW serial number and the product name (HMI Advanced/HMI Embedded: ”Type of hardware”) via the HMI Licensing dialog box.

   HMI Advanced/HMI Embedded:

   Operating–area switchover: Commissioning > key: etc. (”>”) > Licenses > Overview

---

Note

Ensure that the hardware serial number displayed is also really the one you want to make the assignment for. The assignment of a license to a piece of hardware cannot be reversed via the Web License Manager.

---

2. Go to the Internet page of the Web License Manager: http://www.siemens.com/automation/license
3. Login via ”Direct access”:
   - License number
   - Delivery note number
4. Follow the additional instructions in the Web License Manager.

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5. After completing the assignment process, enter the License Key displayed on the Web License Manager into the licensing dialog of the HMI user interface.

   HMI Advanced/HMI Embedded:

   Operating–area switchover: Commissioning > key: etc. (”>”) > Licenses > Overview

6. Confirm the entry of the new License Key by pressing the softkey: ”Transfer”.

17.2.2 You can execute an assignment via customer login as follows

Background

For the customer login, log on to a computer connected to the Internet (PC/PG) with the user name and password in the Web License Manager. All licenses released for this user name in the framework of the license management may then be assigned to a piece of hardware. After completing the assignment process, the new License Key is displayed. This must then be entered in the licensing dialog of the HMI components used.

Requirements

The following prerequisites must be met in order to assign a license to a piece of hardware via customer login and HMI user interface:

- The HMI component is connected with the control system (NCU) on which the license should be assigned. Both components have been booted.
- A computer (PC/PG) with Internet connection and browser is available.
- The login data for the customer login is available:
  - User name
  - Password

Execution

Assigning a license to a piece of hardware:

1. Determine the HW serial number and the product name (HMI Advanced/HMI Embedded: ”Type of hardware”) via the HMI Licensing dialog box.

   HMI Advanced/HMI Embedded:

   Operating–area switchover: Commissioning > key: etc. (”>”) > Licenses > Overview

---

Note

Ensure that the hardware serial number displayed is also really the one you want to make the assignment for. The assignment of a license to a piece of hardware cannot be reversed via the Web License Manager.

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2. Go to the Internet page of the Web License Manager:
   http://www.siemens.com/automation/license
3. Login via ”Customer login”:
   – User name
   – Password
4. Follow the additional instructions in the Web License Manager.

Note

If you have an e–mail address, you have the option (checkbox) of receiving the License Key by e–mail. Advantage: the entry of the License Key to the control system is simplified.

---

5. After completing the assignment process, enter the License Key displayed on the Web License Manager into the licensing dialog of the HMI user interface.

   HMI Advanced/HMI Embedded:

   Operating–area switchover: Commissioning > key: etc. (”>”) > Licenses > Overview
6. Confirm the entry of the new License Key by pressing the softkey: ”Transfer”.

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17.3 Assigning via Automation License Manager

17.3.1 Overview of the functions

The following figure provides an overview of the functions available and the sequence in which they should be applied.

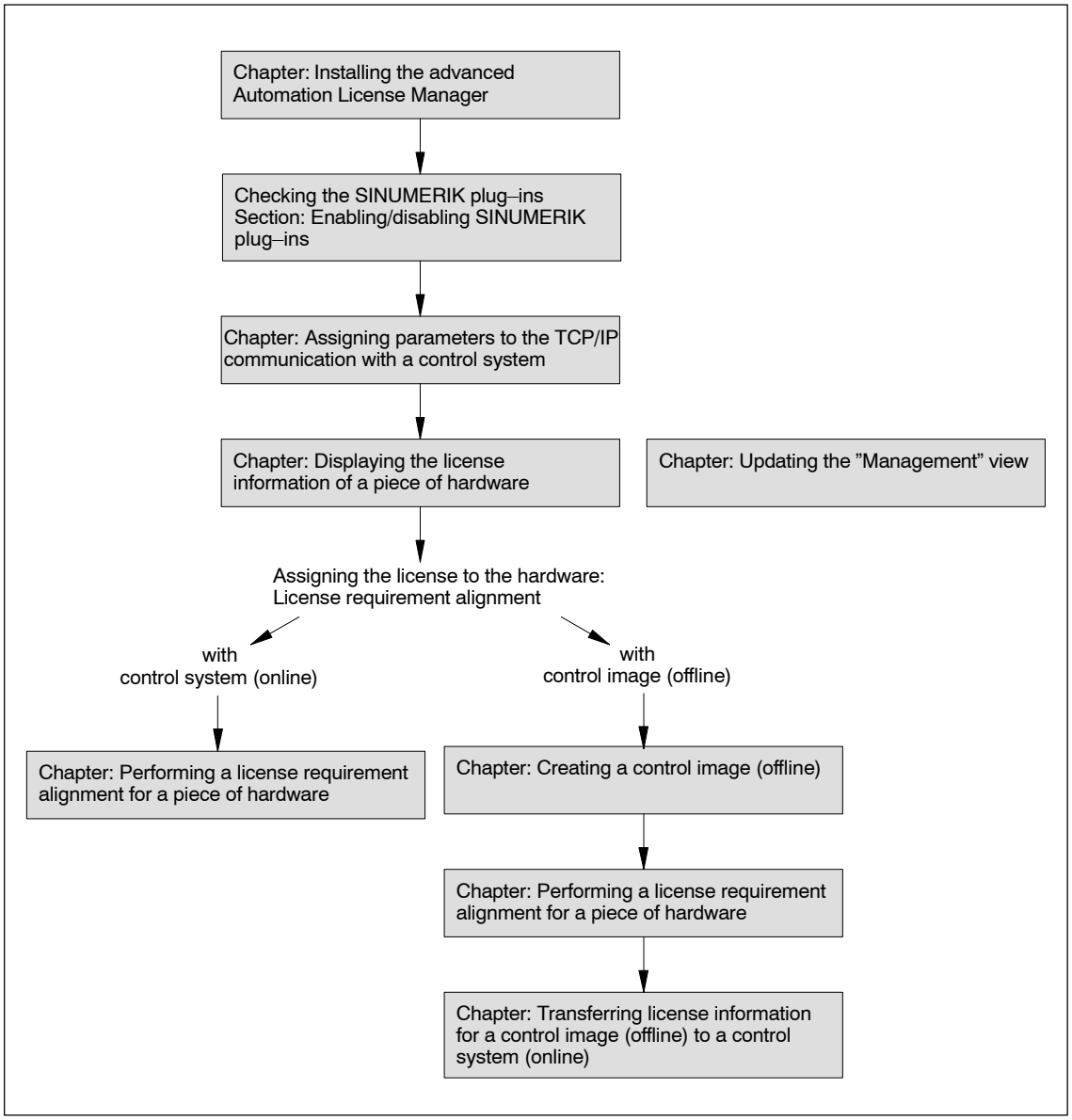


Fig. 17-1 Function overview

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17.3.2 Installing the Automation License Manager

Background

As a basic software component, the Automation License Manager comprises the Automation License Manager itself, as well as additional SINUMERIK–specific plug–ins and the HMI basic software component, HMI basic software, for the license management of SINUMERIK License Keys.

Note

The basic software component, Automation License Manager, is used for all Siemens A&D products, e.g., SIMATIC STEP7. Versions of the basic software component, Automation License Manager, are upward compatible. We recommend always using the version with the highest version number, irrespective of the source of supply (e.g., SINUMERIK or SIMATIC product CD, download via A&D Mall, etc.).

The following components are installed:

- Basic software component: Automation License Manager (optional)
  The basic software component is only installed if not already installed on the computer or if a version with a lower version number is installed on the computer (PC/PG).
- SINUMERIK plug–ins
- HMI basic software (optional)
  The HMI basic software component is only installed if not already installed on the computer or if a version with a lower version number is installed on the computer (PC/PG).

System requirements

Hardware

- Computer: Industrial PC, programming device, etc.
- Work memory: >= 128 MB
- Free hard–disk storage:
  5 MB or above (SINUMERIK plug–ins)
  + 32 MB (Automation License Manager)
  + 300 MB (HMI basic software)

Operating system

The Automation License Manager, SINUMERIK plug–ins and HMI basic software are 32–Bit Windows programs executable on the following operating systems:

- Windows 2000
- Windows XP

Execution

Launch the installation program for the Automation License Manager ”SETUP.EXE” and follow the instructions for the installation.

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Further settings

Please note the following settings:

- Browser settings for using the A&D Mall:
  Section 17.1.8, Page 17-482.
- Proxy settings for the download of license information:
  Section 17.1.9, Page 17-483

17.3.3 Enabling/disabling SINUMERIK plug–ins

Background

All plug–ins enabled for the Automation License Manager scan the communication interfaces when booting according to specific operations. If there is a large number of enabled plug–ins, this can result in a significantly longer boot and refresh time for the user interface.

To prevent this delay, you can disable the plug–in installed for handling the SINUMERIK License Keys in dialog: ”Connect to target system”.

Execution

Perform the following actions to enable/disable the SINUMERIK plug–ins:

1. Start the Automation License Manager
2. Open the ”Connect to target system” dialog via menu command: **Edit > Connect to target system> PlugIn SINUMERIK**
3. In the dialog, open tab: **Settings**
4. Enable/disable the plug–in by selecting/deselecting the appropriate checkbox.
5. Close the dialog box with OK

Result

The Automation License Manager displays the data in the navigation and object area according to the status of the SINUMERIK plug–in.

The folder symbols and names are displayed in the navigation area depending on the status of the SINUMERIK plug–in and the communication link to the SINUMERIK control:

- SINUMERIK plug–in disabled:
   PlugIn SINUMERIK – – – – disabled – – – –
- SINUMERIK plug–in enabled, but no communication link with SINUMERIK control:
   SINUMERIK – online – – – – no link available – – – –
   SINUMERIK – offline – – – – no data available – – – –
- SINUMERIK plug–in enabled, communication link established with SINUMERIK control:
   SINUMERIK <Control type> – <Hardware serial number>

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Note

If the view is not automatically refreshed, you can refresh the view manually.
See Section 17.3.5, Page 17-493.

17.3.4 Assigning parameters to the TCP/IP communication with a control system

Background

To be able to read or transfer license information to or from the MCI board of a control system, the Automation License Manager must communicate with the control system via TCP/IP.

Requirements

- HMI basic software is installed
- SINUMERIK–specific plug–ins are enabled

Note

If the SINUMERIK user interface "**HMI Advanced**" is installed on the same computer (PC/PG) as the Automation License Manager you can set the IP address using the user interface.

The IP address for the control system with which both HMI Advanced as well as the Automation License Manager communicate is set via the following dialog:
Operating area switchover > Installation > HMI > NCU connection

This requires at least the password of protection level 2 (manufacturer) to be set.

General communication parameters
The default general communication parameters for the HMI basic software are stored in the following initialization file:
<Installation drive>:\Siemens\Sinumerik\HMI–Advanced\mmc2\MMC.INI

User–specific communication parameters
The user–specific communication parameters for the HMI basic software are stored in the following initialization file:
<Installation drive>:\Siemens\Sinumerik\HMI–Advanced\user\MMC.INI

During evaluation of the initialization data when booting the HMI basic software, user–specific communication parameters have priority over general communication parameters.

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Sections of the initialization file: MMC.INI
The parameters relevant to TCP/IP communication with SINUMERIK control systems are stored in the following sections:

- [GLOBAL]
  Section: [GLOBAL] specifies the section (e.g. *AddressParameter*) that contains the communication parameters for the current SINUMERIK control system.
- [*AddressParameter*]
  The name of this section can be any unique ASCII string within the file. The specified IP address is crucial for communication with the current SINUMERIK control system: *IP address*.

```
[GLOBAL]
NcddeMachineName = AddressParameter
NcddeDefaultMachineName = AddressParameter
NcddeMachineNames = AddressParameter

[AddressParameter]
ADDRESS0 = IP–Address, LINE=10, NAME=/NC,      SAP=030d, PROFILE=CLT1__CP_L4_INT
ADDRESS1 = IP–Address, LINE=10, NAME=/PLC,     SAP=0201, PROFILE=CLT1__CP_L4_INT
ADDRESS2 = IP–Address, LINE=10, NAME=/DRIVE0, SAP=0900, PROFILE=CLT1__CP_L4_INT
ADDRESS3 = IP–Address, LINE=10, NAME=/DRIVE1, SAP=0a00, PROFILE=CLT1__CP_L4_INT
ADDRESS4 = IP–Address, LINE=10, NAME=/DRIVE2, SAP=0b00, PROFILE=CLT1__CP_L4_INT
ADDRESS5 = IP–Address, LINE=10, NAME=/DRIVE3, SAP=0c00, PROFILE=CLT1__CP_L4_INT
ADDRESS6 = IP–Address, LINE=10, NAME=/DRIVE4, SAP=0d00, PROFILE=CLT1__CP_L4_INT
ADDRESS7 = IP–Address, LINE=10, NAME=/DRIVE5, SAP=0e00, PROFILE=CLT1__CP_L4_INT
```

Fig. 17-2 User–specific file: MMC.INI

Multiple SINUMERIK control systems
If you require communication with multiple SINUMERIK control systems you must create a section [*AddressParameter*] with a unique name e.g., [840D_001], [840D_002], etc. for each control system with the relevant IP address.

In the [GLOBAL] section, you must specify the section name for the SINUMERIK control system, e.g. [840D_001], with which communication should occur once the Automation License Manager has booted.

Notice

The IP address specified in the user–specific initialization file MMC.INI influences not only the Automation License Manager but also all other applications installed on the same computer (PC/PG) that use HMI basic software (e.g. HMI Advanced).

To apply the change to the active IP address, you must close all active applications using HMI basic software (e.g. HMI Advanced). Once you have closed all applications, restart the computer to activate the new IP address.

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Requirements

The following conditions must be fulfilled:

- HMI Basic is installed on the computer (PC/PG) on which the Automation License Manager is running.
- The IP addresses of the SINUMERIK control systems with which the Automation License Manager must communicate are known.

Procedure: Creating parameters for the first time

Perform the following actions when creating user–specific communication parameters for the first time:

1. Create the text file:
   <Installation drive>:\Siemens\Sinumerik\HMI–Advanced\user\MMC.INI if it does not already exist.
2. Open the file MMC.INI with a text editor.
3. Copy the [GLOBAL] section from the table given above: ”User–specific file: MMC.INI” to the open file MMC.INI.
4. Copy the [AddressParameter] section from the table given above: ”User–specific file: MMC.INI” to the open file MMC.INI according to the number of available SINUMERIK control systems.
5. For all [AddressParameter] sections replace the string: ”AddressParameter” with a unique name.
6. In all [AddressParameter] sections replace the string: ”IP–Address” with the relevant IP address for the corresponding SINUMERIK control system.
7. In the [GLOBAL] section replace the string: ”AddressParameter” with the section name for the SINUMERIK control system with which the Automation License Manager should communicate after booting. (See note ”Changing the IP address” above.)

Procedure: Changing the active control system (online)

Perform the following actions to change the active control system (online), i.e., the SINUMERIK control system with which the Automation License Manager communicates:

1. Close the Automation License Manager.
   (See note ”Changing the IP address” above.)
2. Open the file: <Installation drive>:\Siemens\Sinumerik\HMI–Advanced\user\MMC.INI with a text editor.
3. In the [GLOBAL] section, replace the current address string with the section name for the SINUMERIK control system with which the Automation License Manager should communicate after booting.
4. Start the Automation License Manager.

Result

After booting the Automation License Manager communicates with the SINUMERIK control system defined in the user–specific communication parameters.

The control system to which you have switched is represented by an ”online” control system file in the navigation area of the Automation License Manager.

The control system to which the Automation License Manager was connected before switching is represented by an ”offline” control system file, if a control image (offline) exists.

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17.3.5 How to refresh the navigation view: ”Manage”

Background

After actions which add or remove elements in the navigation area of the navigation view: ”Manage” of the Automation License Manager (e.g. deletion of a control image (offline), enabling/disabling of plug–ins), the view is normally refreshed automatically. If the view does not refresh automatically after an operation, you can refresh the view manually.

Execution

Perform the following actions to manually refresh the navigation view: ”Manage” manually:

1. Select the following nodes in the navigation area of the Automation License Manager: **My Computer**
2. Refresh the view using one of the following options:
   - Menu command: **View > Refresh**
   - Key **F5**
   - Toolbar: 

Result

The navigation view of the Automation License Manager is refreshed: All sub–nodes under the node: **My Computer** are closed.

The object view of the Automation License Manager shows the current nodes and drives of the navigation area.

17.3.6 Displaying the license information of a piece of hardware

Background

To perform one of the following tasks with the Automation License Manager:

- Check the license information for the hardware
- Ascertain the license requirement for the hardware and align if necessary
- Assign new licenses to hardware and transfer updated license information including License Keys to the hardware

you must display the license information for a piece of hardware.

Requirements

The license information can only be displayed if the Automation License Manager is communicating with the relevant SINUMERIK control system. A description of how to assign parameters for TCP/IP communication with a control system is given in Section 17.3.4, Page 17-490.

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Procedure with current control system (online)

Perform the following actions to display the license information for the control system currently connected to the Automation License Manager:

1. Open the control system file in the navigation area of the Automation License Manager and select the control system (online).
2. Enable the default object view: ”SINUMERIK”.

Procedure with control system change over (online)

Perform the following actions to display the license information for a control system not connected to the Automation License Manager:

1. Exit the Automation License Manager and all other applications using HMI basic software (e.g. HMI Advanced).
2. Switch the active communication parameters to the required control system. For a detailed description see Section 17.3.4, Page 17-490.
3. Start the Automation License Manager
4. Open the control system file in the navigation area of the Automation License Manager and select the control system (online).

Result

The license information for the control system is displayed in the object area of the Automation License Manager.

17.3.7 Creating a control image (offline)

Background

It is essential to create a control image (offline) for the following reasons:

- The license information must be later transferred to the hardware.
- The control system (online) is not connected to the Internet, e.g., for security reasons. Consequently, the license information must be transferred to the hardware in three individual stages.
- Internet or PTP link: Creating a control image (offline) in the Automation License Manager
  - Internet: Transferring license information to the control image (offline) by means of a license requirement alignment
  - Internet or PTP link: Transferring license information from the control image (offline) to the control system (online) in the Automation License Manager
- The license information for a control system should be saved as an archive file for the purpose of archiving or customer support.

Requirements

A control image (offline) can only be created if the Automation License Manager is communicating with the control system.

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A detailed description of how to establish TCP/IP communication with the control system is given in Section 17.3.4, Page 17-490.

A PTP link (Peer–To–Peer) via Ethernet and TCP/IP requires a crossed Ethernet cable (twisted pair crossed 10baseT/100baseTX Ethernet cable).

Procedure using menu command: ”Upload from target system”

Perform the following actions to create a control image (offline) using menu command: ”Upload from target system”:

1. Open the ”online” control system file in the navigation area of the Automation License Manager and select the control system (online).
2. Create the control image (offline) using menu command: License Key > Upload from target system

Result

The control image (offline) is displayed in the ”online” control system file with the current license information for the control system. If a control image (offline) already exists in the ”online” control system file, the image is overwritten with the current license information.

17.3.8 Performing a license requirement alignment for a piece of hardware

Background

If one or more options are active on a SINUMERIK control system, you must assign each license to the hardware. Next, the updated license information including the License Key is transferred to the hardware.

Via the function: ”Align requirement” you can perform the alignment automatically for all required licenses based on the control system (online) or a control image (offline). The following actions are performed:

- Determining the hardware serial number for the control system
- Determining the license requirement for the control system
- Taking the required licenses from the customer–specific licenses and assigning these to the hardware
- Transferring the updated license information including License Key to the control system (online) or the control image (offline)

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Requirements

The following requirements must be met for the license requirement alignment:

- The address data for the customer login (personalized login) is available:
  - User name
  - Password
- Control system (online) or control image (offline)
  An ”online” control system file or an ”offline” control system file with the relevant control image (offline) is available.
  The procedure for creating a control image (offline) is described in Section 17.3.7 Page 17-494.

  A description of how to assign parameters for TCP/IP communication with a control system is given in Section 17.3.4, Page 17-490.

Execution

Perform the following actions for license requirement alignment with a control system (online) or a control image (offline):

1. Open the corresponding control system file in the navigation area of the Automation License Manager and select the control system (online) or the control image (offline).
2. Select the menu command: License Key > Align requirement
3. Login via your customer login.
4. Start the Automation License Manager and perform the following actions: ”Align requirement”, ”Confirm requirement list” and ”Transfer licenses”. Follow the instructions displayed on the screen.

Notice

Carefully check the suggested license assignment. An adjustment may be required if:

- you wish to use a license number that differs from the number suggested
- you wish to use a license package rather than single licenses
- you wish to assign greater or fewer licenses than suggested for any reason

You can **no** longer undo the assignment independently.

The procedure for transferring the updated license information from a control image (offline) to a control system (online) is described in Section 17.3.9 Page 17-497.

Result

The license information for the control system (online) or control image (offline) is now identical to the information for the relevant hardware in the license database, including the License Key.

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17.3.9 Transferring license information for a control image (offline) to a control system (online)

Background

It is essential to transfer the license information for a control image (offline) to a control system (online), i.e., the hardware for a SINUMERIK control, for the following reasons:

- The control system (online) is not connected to the Internet, e.g., for security reasons. License information is initially only updated based on a control image (offline). The computer on which the Automation License Manager is running is then disconnected from the Internet and connected to the relevant SINUMERIK control system to transfer the license information.
- After a service call, the license information should be transferred from an archive file to a SINUMERIK control system.

Requirements

To transfer license information for a control image (offline) to a control system (online) the following requirements must be met:

- The Automation License Manager must communicate with the control system.
  A detailed description of how to establish TCP/IP communication with the control is given in Section 17.3.4, Page 17-490.
- The hardware serial number of the control image (offline) and the control system (online) must be identical.

Procedure using drag and drop

Perform the following actions to transfer a control image (offline) to the hardware using drag and drop:

1. Open the ”online” control system file in the navigation area of the Automation License Manager and select the control image (offline).
2. Select any line from the license information displayed in the object area.
3. Drag the selected line to the control system (online) release the mouse key.

Procedure using menu commands

Perform the following actions to transfer a control image (offline) to the hardware using menu command: ”Download to target system”:

1. Open the ”online” control system file in the navigation area of the Automation License Manager and select the control image (offline).
2. To transfer the control image (offline) to the hardware, select menu command: **License Key > Download to target system**

Result

The license information for the hardware is now identical to the information for the control image (offline), including the License Key.

■

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Space for your notes

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840Di sl–specific Data and Functions 18

18.1 Interface signals

For detailed information on interface signals, please refer to the descriptions of functions:

- /FB1/ Description of Functions – Basic Functions
- /FB2/ Description of Functions – Extended Functions
- /FB3/ Description of Functions – Special Functions
- /FBSY/ Description of Functions – Synchronized Actions

For a complete list of all existing interface signals, please refer to:

- /LIS/ Lists, Section: Interface signals

18.1.1 840Di sl–specific interface signals

DB number	Byte, bit	Name	Doc. reference
Signals from NC to PLC			
10	108.2	MMC ready, communication via MPI	
10	108.3	MMC ready, communication via Softbus	
10	109.4	PC OS fault	
10	57.3	PC shutdown	

18.1.2 Interface signals not supported

DB number	Byte, bit	Name	Doc. reference
Axis/spindlespecific	**Signals from PLC to axis/spindle**		
31, ...	20.0	Acceleration switch V/Hz operation	
31, ...	20.2	Torque limit 2	
Safety Integrated signals from PLC to axis/spindle			
31, ...	22.0	Deselection of safe velocity and zero speed (deselection of SBH/SG)	
31, ...	22.1	Deselection of safe operational stop (deselection of SBH)	
31, ...	22.3	Velocity limit, bit value 0 (SG selection)	
31, ...	22.4	Velocity limit, bit value 1	
31, ...	23.0–23.2	Ration selection, bit value 0 to bit value 2	
31, ...	23.5	Enable limit switch pair 2	
31, ...	23.7	Activate test stop	
Signals from axis/spindle to PLC			
31, ...	92.0	Setting–up mode active	
31, ...	92.2	Torque limit 2 active	

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DB number	Byte, bit	Name	Doc. reference
Safety Integrated signals from axis/spindle to PLC			
31, ...	108.0	Safe velocity or zero speed (SBH/SG active)	
31, ...	108.2	Clear status pulses	
31, ...	108.7	Axis safely referenced	
31, ...	109.0–109.7	Cam signals of plus and minus cams (SN1+/1– to SN4+/4–)	
31, ...	110.1	Safe operational stop active (SBH active)	
31, ...	110.3–110.4	Safe velocity active, bit value 0 to bit value 1	
31, ...	110.5	$n < n_x$	
31, ...	111.1	Safe operational stop active (SBH active)	
31, ...	111.4–11.7	Stop A/B to Stop E active	

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18.2 Expanded message frame configuration/evaluation of internal drive variables

18.2.1 Description of the function

To ensure that the internal drive variables are available for evaluation in the NCK, these are transferred from the drive as additional process data (PDA) during cyclic PROFIBUS communication and saved by the operating system in system variables.

The additional PDA is appended at the end of the standard message frame.

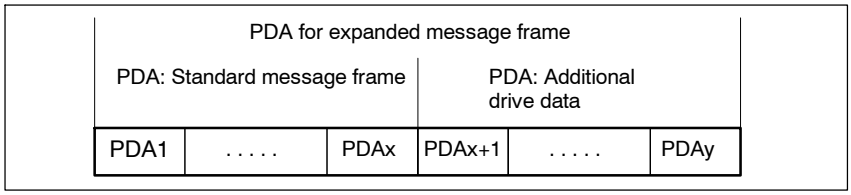


Fig. 18-1 Standard message frame with additional process data (PDA)

NC system variables

According to the selected functionality, for each axis the additional PDA is available on the NCK side in individual specified system variables or the entire frame as an array of neutral data words via a general system variable. In both cases, the system variables are read-only.

Select the required setting in the NC machine data:

- MD 36730: DRIVE_SIGNAL_TRACKING[n] (acquisition of additional drive actual values)

Specific system variables

To transfer drive variables to individual system variables you must set the following machine data:

- MD 36730: DRIVE_SIGNAL_TRACKING[n] = **1**

The additional PDA must be configured in the message frame in the exact sequence specified in table 18-1.

Table 18-1 Specific drive variables

PZD	Drive variables	System variables
x+1	Load	$AA_LOAD
x+2	Smoothed torque setpoint (Mset)	$AA_TORQUE
x+3	Active power (Pact)	$AA_POWER
x+4	Smoothed torque-producing current Iq (IqGl)	$AA_CURR

General system variable

The entire message frame with standard process data and additional process data is transferred in a general system variable as an array of 16-bit integer data words via:

- MD 36730: DRIVE_SIGNAL_TRACKING[n] = **2**
- System variable: $VA_DP_ACT_TEL[n, a]
  where n = Index: 0.2,...15
  a = machine axis identifier.

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Note

- The message frame configuration must meet the following condition:

  (Standard PDA + Additional PDA) – 1 ≤ n

  where n = maximum possible index for system variable $VA_DP_ACT_TEL
- When using the system variables $VA_DP_ACT_TEL[n, a] in a user program, it is only permissible to use one **constant** as index **n**.

Application example for system variables in a synchronized action:

IDS=1 DO $AC_MARKER[0] = $VA_DP_ACT_TEL[12, X]

Data formats

The user must take the following points into account with regard to the data formats of the process data stored in the system variables:

- The process data are transferred in the message frame in the following format:
  - unsigned 16–bit integer (UINT16)

  are transferred. They are stored in the system variables in the format
  - signed 32–bit integer (INT32)

  In the necessary format conversion, bit 15 of the unsigned 16–bit integer PDA value is transferred to bits 16 to 31 of the signed 32–bit integer value in the system variable. For the physical unit as well as the drive–end weighting of the drive actual values transferred in the additional PDA, please refer to the data description of the specific drive documentation.
- Drive actual values composed of 2 PDAs (both 16–bit) e.g.
  - Encoder 2 position actual value 1 (G2_XACT1)
  - Encoder 2 position actual value 2 (G2_XACT2)

  are mapped on two separate data words (both 32–bit) in the system variable $VA_DP_ACT_TEL.

Fig. 18-2 shows how the process data of the message frame are mapped onto system variable $VA_DP_ACT_TEL:

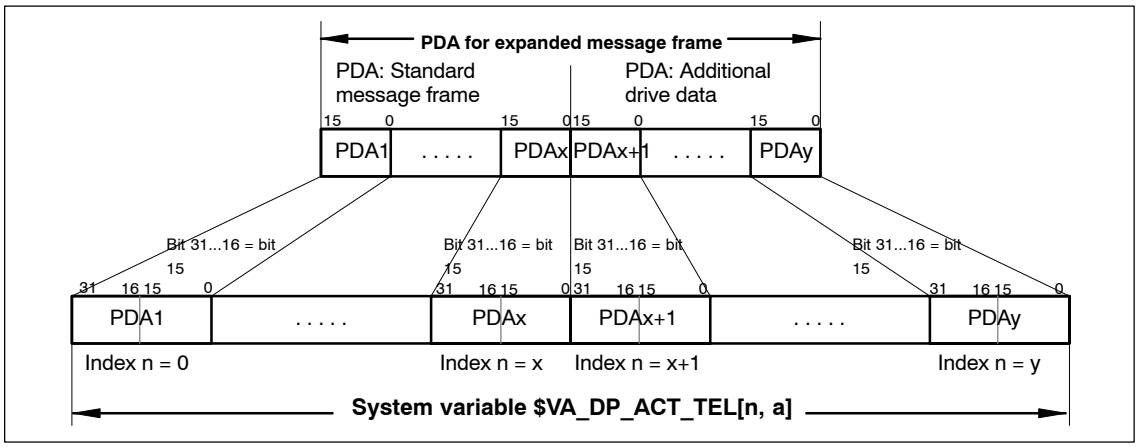


Fig. 18-2 Mapping principle: PDA on system variable $VA_DP_ACT_TEL

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Notice

The responsibility for possibly necessary format conversions or correct interpretation of the physical unit and significance of a system variable used in part programs or synchronized actions lies exclusively with the user. Due to system restrictions, it is not possible for the NC to perform a consistency check.

18.2.2 Requirements

The following conditions must be fulfilled for the transfer of additional drive variables:

- Drive
  The drive must support SIEMENS message frame 116 or free message frame configuration.
- DP master/SIMATIC STEP 7
  No additional requirements
- SINUMERIK 840Di sl NCK
  - The following option must be available:
    ”Evaluation of internal drive”,
    Order No. (MLFB): 6FC5 251–0AB17–0BA0
  - The following must be set in the NCK machine data:
    - MD 36730: DRIVE_SIGNAL_TRACKING[n] (acquisition of additional drive actual values)

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18.2.3 Configuring: SINAMICS S120 and SIEMENS message frame 116

When using SIEMENS message frame 116 no further measures are required other than those applied for standard configuration.

18.2.4 Configuring: SINAMICS S120 and expanded message frame configuration

Standard configuration

Before configuring the additional drive variables, please define the following:

- The SIEMENS message frame that is to be used.
- The additional drive variables/PDA that are to be transferred.

Note

When transferring additional drive variables to the specific system variables, we recommend always using SIEMENS message frame 116.

Recommended configuration sequence

When configuring the components included in the frame, we recommend the following sequence:

1. DP master
2. DP slave S120/Drive
3. SINUMERIK 840Di sl NCK

1. Configuring the DP master

Standard configuration

When using the extended message frame configuration, you must first apply the standard configuration to the DP master with respect to the DP slave S120 with the SIEMENS message frame required for cyclic communication.

For information on how to perform a standard configuration of the DP master, please see Section 8.9, Page 8-223et sqq.

Expanded message frame configuration

Perform the following actions to configure the additional PDA:

1. Open the dialog: ”DP slave properties” for the drive unit by double–clicking the relevant DP slave S120 in the HW Config station window.
2. Expand the length of the PDA already configured with the SIEMENS message frame in the actual value slot of the relevant drive by the length of the additional PDA.
3. The setpoint and actual value of an axis must have the same I/O address. If HW Config changes the I/O address of the actual value slot as a result of expanding the PDA, you must modify the I/O address of the setpoint slot accordingly.

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Dialog box

Dialog box: DP slave properties
Tab card: Configuration
Tab: Details

Actual value > Length: <**Length standard PDA + length additional PDA PDA**>

Setpoint > I/O address: <**I/O address actual value**> *(see above 2.)*

OK

Notice

- The setpoint and actual value of a drive must have the same I/O address.

  Actual value: I/O address = = Setpoint: I/O address

- The I/O address configured in HW Config for a drive must match the I/O address set in the NCK.

  There is **no automatic adjustment!**

  The following data must agree:

  1. SIMATIC S7 configuration of DP slave S120
     I/O address
  2. SINUMERIK 840Di sl NCK
     MD13060: DRIVE_LOGIC_ADDRESS[n] (logical drive address)

Note

After increasing the length of the actual value PDA (dialog box: DP slave properties > Configuration > Details > Actual value > Length), when the Properties dialog box is opened again, in message frame type:

Dialog box: DP slave properties
Tab card: Configuration
Tab: Overview
Default: <**Frame type**>

the message frame type that was originally selected is no longer displayed, but the message frame that matches the modified PDA or no message frame type.

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2. Configuring the DP slave S120/drive

Before performing the extended message frame configuration in the STARTER commissioning tool, you must first perform the standard configuration or commissioning of the drive.

Standard configuration

For the standard configuration or commissioning of the drive, please see:

- Commissioning (requirements)
  - Section 9.1, Page 9-241
- Standard configuration or commissioning
  - **References** SINAMICS S120 Commissioning Manual

Expanded message frame configuration

Perform the following actions to configure the additional PDA:

1. Open the PROFIBUS dialog for the drive.
   Project navigator: Project > <*Drive unit* > > Drives > <*Drive*> > Communication > PROFIBUS (double–click)
2. Open the tab: ”PROFIBUS send direction” (1).
3. Select the option ”Hide inactive interconnections” (2).
4. Under message frame type select: ”Free message frame configuration with BICO (999)” (3).
5. Interconnect the free PDA with the relevant drive variables.

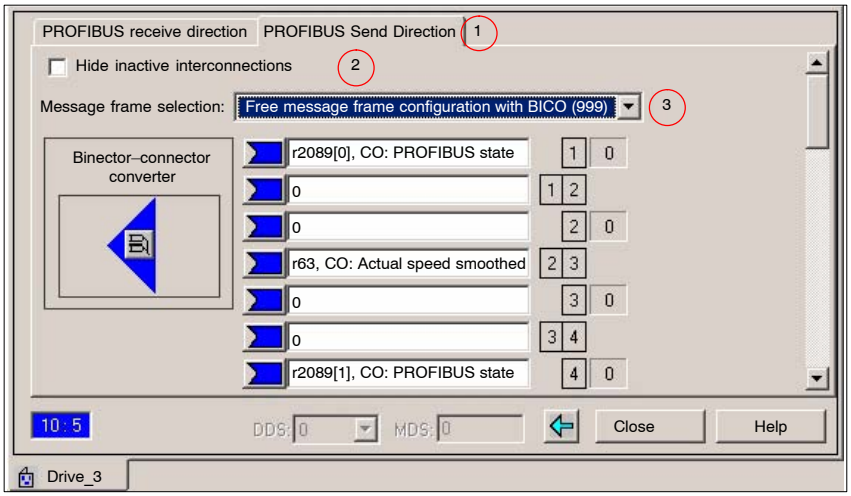


Fig. 18-3 Free message frame configuration with BICO (999)

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3. Configuring the NCK

Before configuring the expanded message frames, you first need to perform the standard configuration on the NCK for the drive.

Standard configuration

How to proceed with the standard configuration of a drive is described in Section 11.5.3, Page 11-314.

Expanded message frame configuration

Perform the following actions to transfer the additional PDA to the general system variables:

1. Select the option: ”Evaluation of internal drive variables”.
2. Activate the transfer to general system variable:
   - MD36730: $MA_DRIVE_SIGNAL_TRACKING[n] = 2

Note

After configuring the expanded message frames, the original configured message frame for the cyclic communication of the drive is only explicitly visible in the following machine data:

- MD13060: $MN_DRIVE_TELEGRAM_TYP[n] (drive message frame type)

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18.2.5 Configuring: SIMODRIVE

Expanded message frame configuration in relation to drives:

- SIMODRIVE 611 universal or universal E
- SIMODRIVE POSMO CD/CA
- SIMODRIVE POSMO SI

is illustrated on the basis of an example using SIMODRIVE 611 universal (DP slave 611U). Please adapt your procedure for the other SIMODRIVE drives.

Standard configuration

Before performing the expanded message frame configuration, please define the following:

- The standard message frame that is to be used for the DP slave drive.
- How many drive actual values/PDA are also to be transferred.

Note

It is advisable to configure each component first with the standard message frame and then expand the frame by the additional PDA.

Recommended configuration sequence

When configuring the components included in the expanded message frame configuration, we recommend the following sequence:

1. DP master
2. DP Slave 611U
3. SINUMERIK 840Di sl NCK

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Step 1: Configuring the DP master

Before performing the expanded message frame configuration, you need to configure the DP slave 611U with the standard message frame required for this drive.

Standard configuration

For information on how to perform a standard configuration of the DP master, please see Section 8.10, Page 8-231et sqq.

Extended message frame configuration

To transfer the additional process data, you need to change the configuration of the DP slave 611U as follows:

1. The length of the PDA ,which is already configured with the standard message frame, must be expanded by the length of the additional PDA.
2. As the I/O address of setpoint and the actual value of an axis must be the same, change the I/O address of the setpoint to the I/O address of the actual value which is automatically adapted by the HW Config if necessary.

Dialog box

Dialog box: DP slave properties
Tab card: Configuration
Actual value > length: <**Length standard PDA + length additional PDA**>
Setpoint > I/O address: <**I/O address actual value**> *(see above 2.)*

OK

Notice

- The I/O address for setpoint and actual values of an axis must be the same.

  I/O address actual value = = I/O address setpoint

- The I/O address set by the SlaveOM for an axis must match the I/O address set in the NC.

  There is **no automatic adjustment!**

  The following data must agree:

  1. SIMATIC S7 configuration of DP slave 611U
     I/O address
  2. SINUMERIK 840Di sl NC
     MD13060: DRIVE_LOGIC_ADDRESS[n] (logical drive address)

Note

After increasing the length of the actual value PDA (dialog box: DP slave Properties > Configuration > Actual value > Length), when the Properties dialog box is opened again, in message frame type:

Dialog box: DP slave properties
Tab card: Configuration
Default: <**Frame type**>

the message frame type that was originally selected is no longer displayed, but the message frame that matches the modified PDA or no message frame type.

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Step 2: Configuring the DP slave 611U

Before performing the extended message frame configuration, you must first perform the standard configuration or commissioning of the drive.

Standard configuration

For the standard configuration or commissioning of the drive, please see:

- Commissioning (requirements)
  - Section 9.1, Page 9-241
- Standard configuration or commissioning
  - SIMODRIVE 611 universal and universal E:
    References: /FBU/ Description of Functions SIMODRIVE 611 universal
  - SIMODRIVE POSMO SI/CD/CA
    References: /POS3/ User Manual SIMODRIVE POSMO SI/CD/CA
  - SimoCom U commissioning tool
    References: Online help for SimoCom U.

Extended message frame configuration

To configure the additional drive actual values, modify the standard configuration of the drive e.g. starting at standard message frame 102 as follows with the SimoCom U commissioning tool:

Notice

Before configuring the additional drive actual values, please ensure that the correct drive – and if using a multiple axis module, the correct axis – was selected in the SimoCom U commissioning tool.

- Activating the customizable message frame configuration.

  To activate the customizable message frame configuration, replace the message frame type of the selected standard message frame in the menu: PROFIBUS Parameter Settings (menu command **Commissioning > Parameterization Views > PROFIBUS Parameter Settings**) with ”0”.

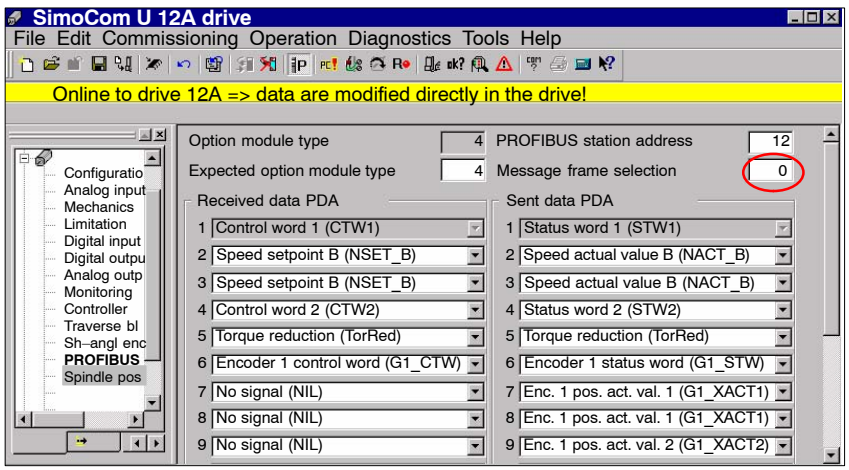


Fig. 18-4 Activating the customizable message frame configuration

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- Configuring the additional drive actual values

  The drive utilization for PDA11 is configured via the selection list of the corresponding parameter (PROFIDrive parameter P0916[x]) in Fig. 18-5.

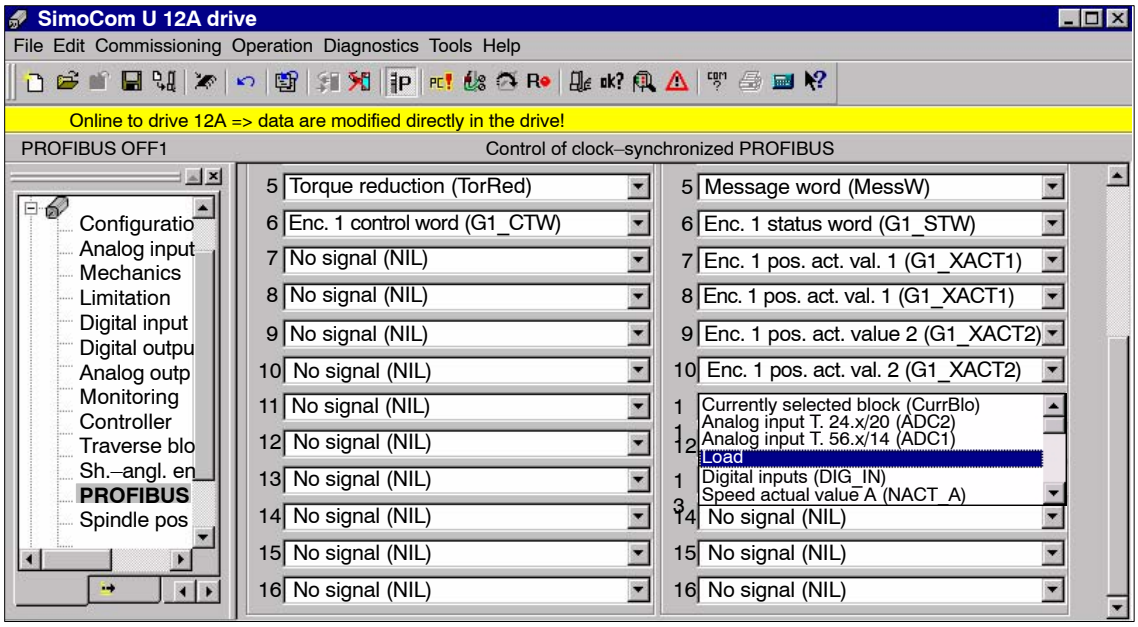


Fig. 18-5 Configuring the additional drive actual values

Step 3: Configuring the NC

Before configuring the extended message frames, you must first perform the standard configuration on the NC for the drive.

Standard configuration

How to proceed with the standard configuration of a drive is described in Section 11.5.3, Page 11-314.

Extended message frame configuration

On the NC for the expanded message frame configuration, you only need to activate PDA transfer in the respective system variable.

– Option: ”Evaluation of internal drive variables”,
  Order number (MLFB): 6FC5 251–0AB17–0BA0
– NC machine data for activating the data transmission in the system variables:
  - MD 36730: DRIVE_SIGNAL_TRACKING[n] (acquisition of additional drive actual values)

Note

After configuring the expanded message frames, the standard message frame with which the axis is driven is only explicitly visible in the NC machine data:

- MD 13060: DRIVE_TELEGRAM_TYPE[n] (drive message frame type)

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18.2.6 Constraints

Slot assignment

Die NC always occupies an entire slot. The data of the slot not used by the NCK, e.g. data from the extended message frame configuration, cannot by written by the PLC user program.

Restrictions

The following restrictions are applicable with regard to the ”expanded message frame configuration” function:

- Additional data can only be transferred from the drive to the SINUMERIK 840Di sl NC (actual value channel). You cannot transfer data in the other direction, i.e. from the NC to the DP slave drive (setpoint channel).
- You can only have read access to the drive data stored in the system variables.

Check consistency

When the SINUMERIK 840Di sl boots, the NCK checks the consistency of the parameters relevant to the process data configuration of the cyclic PROFIBUS communication:

- NC
  - MD 13060: DRIVE_TELEGRAM_TYPE[n] (drive message frame type)
- DP master (configuration)
  - DP slave properties: Setpoint: **Length**
  - DP slave properties: Actual value: **Length**
- Drive
  - Message frame selection
  - PDA setpoint assignment
  - PDA actual value assignment

If the number of process data expected from the NCK set in the message frame type parameter in the NC machine data:

- MD 13060: DRIVE_TELEGRAM_TYPE[n] (drive message frame type)

is greater than the number of process data configured with STEP7: HW Config for the DP slave drive:

- DP slave properties: Setpoint: **Length**
- DP slave properties: Actual value: **Length**

or if the process data configuration for the drive parameters does not match the message frame type for the NCK machine data, the following message is displayed:

- Alarm 26015 ”Axis *axis identifier* machine data $MN_DRIVE_TELEGRAM_TYPE[*index*] value not permissible”.

No acyclic communication possible

If acyclic communication is not supported by a drive, or if acyclic communication was not explicitly deactivated for a drive via the axis–specific NCK machine data:

- MD13070: $MN_DRIVE_FUNCTION_MASK[n] (used DP functions)

then responsibility lies solely with the commissioning engineer to perform a consistency check on the above–mentioned data.

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Warning

For system purposes, the consistency check, which is performed when the SINUMERIK 840Di sl boots and which is based on acyclic communication with the drive, is performed in conjunction with the cyclical communication – which is already active – between NCK and drive.

As setpoint and actual values are already being exchanged between the NCK position control and drive as part of the cyclic communication, uncontrolled system states can occur on the part of the drive due to faulty process data configurations which cannot be detected yet at this point in time.

The same applies if acyclic communication is not supported by a drive, or if acyclic communication was deactivated for a drive via the axis–specific NC machine data:

- MD13070: $MN_DRIVE_FUNCTION_MASK[n] (used DP functions)

and therefore it is not possible for the NCK to perform a consistency check.

Therefore, the responsibility lies with the commissioning engineer to implement suitable measures to avoid uncontrolled traversing of the drives during start–up, caused by inconsistencies in the above mentioned data.

An error can present a risk of danger to person or machine.

18.2.7 Data descriptions (MD, system variable)

General machine data

13070 MD number	**DRIVE_FUNCTION_MASK** Bit–coded screen for selecting the functional scope expected by the NCK with PROFIBUS drives		
Default setting: 0	Min. input limit: 0	Maximum input limit: FFFF FFFF	
Changes effective after POWER ON	Protection level: 2/7	Units: –	
Data type: DWORD	Applies from SW version: 2.1		
Significance:	Meaning of set bits: Bit 0: Deactivation of the 611U–specific drive alarm mapping Bit 1: Deactivation of the 611U–specific drive type detection Bit 2: Deactivation of the 611U–specific parameter accesses encoder drivers Bit 3: Deactivation of the 611U–specific parameter accesses output drivers Bit 4: Activation third–party drive: DSC bits (STW1.12/STA1.12) Bit 5: Deactivation of the 611U–specific drive parking (STW2.7/STA2.7) Bit 6: Deactivation of the 611U–specific travel to fixed stop (STW2.8/STA2.8) Bit 7: Deactivation of the 611U–specific internal motor switchover (STA2.9–11) Bit 8: Deactivation of the 611U–specific ramp block (STW1.13) Bit 9: Deactivation of the 611U–specific function generator functions (STW1.8/STA1.13) Bit 14: Selection of non–cyclic DP communication: 0=DPT; 1=DPV1 Bit 15: Deactivation of consistency check for PROFIBUS message frame configuration CTW: Control word (PDA word in the PROFIDrive message frame to DP slave) STW: Status word (PDA word in the PROFIDrive message frame from DP slave) PDA: Process data		
MD irrelevant for ...	——		

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Axis-specific machine data

36730 MD number	**DRIVE_SIGNAL_TRACKING** Detection of additional drive actual values		
Default setting: 0	Min. input limit: 0	Maximum input limit: 4	
Changes effective after POWER ON	Protection level: 2/7	Units: -	
Data type: BYTE	Applies from SW version: 2.1		
Significance:	MD: DRIVE_SIGNAL_TRACKING (acquisition of additional drive actual values) informs the NC which additional drive actual values are transferred in the PROFIDrive message frame and in which system variables they should be stored. Coding: 0: No additional drive actual values 1: The following drive actual values are transmitted and stored in system variables: *Actual value* — *System variable* Load — $AA_LOAD Torque setpoint — $AA_TORQUE Active power — $AA_POWER Current actual value — t$AA_CURR 2: The entire PROFIDrive message frame is stored in a system variable: *Actual value* — *System variable* PROFIDrive message frame — $VA_DP_ACT_TEL		
MD irrelevant for ...	---		

System variables

Name	**$VA_DP_ACT_TEL[n, a]**			
Significance	Word by word mapping of the PROFIBUS message frame from the DP slave			
Data type	INTEGER			
Range of values	[0, 65535]			
Indices	n: Array index	Range of values	[0.20]	
	a : Machine axis	Range of values	Machine axis identifier	
Accesses	Part program	Synchronous action	OPI	
	Read	Read	Read	
Attributes	Implicit preprocessing stop		Cross-channel	
	Read		Yes	

18.2.8 Alarms

Detailed information on the individual alarms can be found in:

References: /DA/ Diagnostics Guide

For systems with HMI Advanced you can refer to the online help.

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18.3 Travel to fixed stop with high–resolution torque reduction

The full description of functions for ”Travel to fixed stop” can be found in:

References: /FB1/ Description of Functions, Basic Functions
Section: F1 Travel to fixed stop

18.3.1 Description of the function

As part of the NCK function ”Travel to fixed stop”, you specify the reduction of the drive torque effective in the drive (terminal torque) via the part program instruction FXST. The torque reduction value specified via FXST is transferred cyclically to the drive in the PROFIBUS message frame as ”MomRed” process data.

The effective drive torque M_{set} is calculated from:

$$M_{set} = M_{max} * MAXIMUM(0; 1 - \frac{\text{Drive parameters[\%]}}{100} * \frac{\text{MomRed}}{16384})$$

M_{max}: Maximum possible drive torque from rated motor torque and parameter P1230 Torque limit value.

MomRed: Control word in cyclic PROFIBUS message frame;
$16384_D = 4000_H \triangleq 1$, i.e., if MomRed = 16384 the drive torque will be reduced by the value of the drive parameter

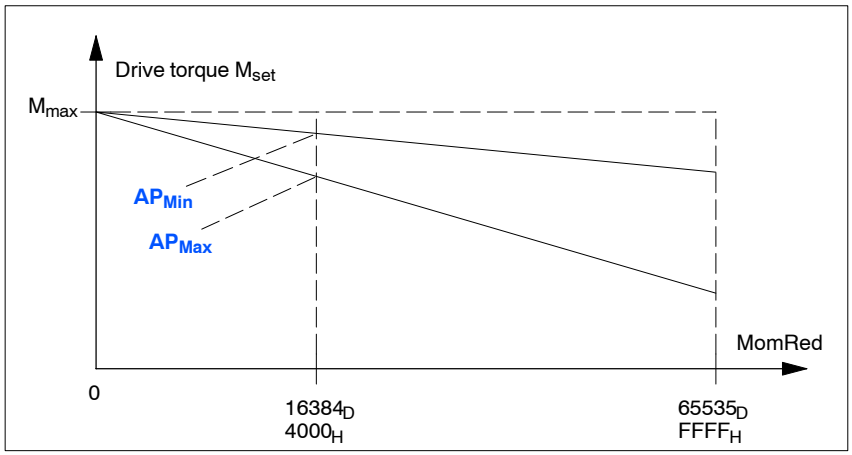


Fig. 18-6 Drive torque for the evaluation (drive parameter AP) and torque reduction (MomRed) (Not true to scale)

The evaluation of the torque reduction must be identical in the drive and in the NCK. The settings range for torque reduction is defined by the limit values (0.005% to 10%) for the NCK machine data:

- MD37620: $MA_PROFIBUS_TORQUE_RED_RESOL

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18.3.2 Comparison

Automatic adjustment

To simplify the torque reduction commissioning, the SINUMERIK 840Di sl NC tries to perform, as standard, an automatic adjustment using the torque reduction evaluation configured in the drive. To do this the NCK reads the relevant drive parameters and applies the value converted to NCK format in the machine data:

- MD37620: $MA_PROFIBUS_TORQUE_RED_RESOL

The following requirements must be met:

- The drive supports acyclic PROFIBUS communication.
- The drive has a parameter to standardize torque reduction.
- In the NCK, acyclic communication with the drive is enabled with:
  - MD13070: $MN_DRIVE_FUNCTION_MASK[n], Bit 15 == 1

Manual comparison

If the requirements for automatic adjustment of the NCK and drive are not met, the adjustment must be performed manually in the drive and NCK.

18.3.3 Parameterization: SINAMICS S120

Message frame

The drive must be operated with one of the following message frames:

- Message frame 102, 103, 105, 106 ,116

Drive parameters

The evaluation of torque reduction is set using the parameter:

- p1544 Torque reduction evaluation [%]

  Normalization: 1% $\triangleq 16384_D = 4000_H$

18.3.4 Parameterization: SIMODRIVE

The following SIMODRIVE drives support high–resolution torque reduction:

- SIMODRIVE 611 universal, universal E
- SIMODRIVE POSMO SI, CD, CA

Message frame

The drive must be operated with one of the following message frames:

- Message frame 102 to 107

Drive parameters

The evaluation of torque reduction is set using the parameter:

- P0881 Torque reduction evaluation [%]

  Normalization: 1% $\triangleq 16384_D = 4000_H$

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18.3.5 Parameterization: External drives

If third–party drives are used, please read the manufacturer's documentation to see whether and how to set the parameters on the drive.

18.3.6 Parameter assignment: SINUMERIK 840Di sl NCK

In the SINUMERIK 840Di sl NCK system, the parameters for evaluating torque reduction are assigned via the axis–specific machine data:

- MD37620: $MA_PROFIBUS_TORQUE_RED_RESOL

Automatic adjustment

During automatic adjustment, the NCK attempts to read the drive parameters in the following system states:

– SINUMERIK 840D sl boot.
– Status: "Incoming station" of the DP slave drive

If the value set for the drive does not match the parameter assigned in the NCK evaluation, the value defined by the drive is applied to the NCK machine data. The resulting renormalization of the machine axis in question is shown by the following message:

- Alarm 26024 "Axis *axis identifier* machine data $MA_PROFIBUS_TORQUE_RED_RESOL value adapted".

If the value of the drive parameter converted into NCK format lies outside the machine data limit values, the value set in the machine data is retained. No message is displayed.

Note

You can disable automatic adjustment via:

- MD13070: $MN_DRIVE_FUNCTION_MASK[n], Bit 15 = 0

Manual parameterization

If any of the aforementioned requirements for automatic adjustment is not met, the NCK machine data and drive parameters must be adjusted manually.

- MD37620: $MA_PROFIBUS_TORQUE_RED_RESOL = drive parameter: "Torque reduction evaluation"

Example for SIMODRIVE 611U

Assumptions:

– Machine axis X1 corresponds to drive 12A
– The torque reduction evaluation is to be 0.1%

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Assigning parameters for the DP slave 611U/Drive 12A

SimoCom U commissioning tool: menu command **Commissioning > Additional Parameters > Expert List > Number > 881**

Torque reduction: P0881 = 1638.40 (≙ 0.1%)

The parameter is immediately effective.

Assigning parameters for the SINUMERIK 840Di sl NCK

Machine axis X1:

- MD37620: $MA_PROFIBUS_TORQUE_RED_RESOL == 0.1

18.3.7 Constraints

No message is displayed in the following cases:

- If any of the requirements are not met, no automatic adjustment can be performed for the SINUMERIK 840Di sl NCK.
- The parameter assigned in the drive for the torque reduction evaluation lies outside of the NCK machine data limit values.
- The torque reduction is not renormalized for the NCK.

Irrespective of whether or not a message is displayed, the following NCK machine data is effective in all cases:

- MD37620: $MA_PROFIBUS_TORQUE_RED_RESOL

Notice

It is the commissioning engineer's responsibility to ensure that the parameter settings are consistent in the SINUMERIK 840Di sl NCK and all relevant drives for which torque reduction is being performed.

The following data must be consistent in terms of values and meaning:

1. SINUMERIK 840Di sl NCK machine data
   MD37620: $MA_PROFIBUS_TORQUE_RED_RESOL
2. Drive
   - Automatic adjustment:
     Parameter for torque reduction evaluation:
     – **SINAMICS: p1544**
     – **SIMODRIVE: P0881**
   - Manual adjustment:
     Drive parameter for torque reduction evaluation.

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18.3.8 Data description (MD)

General machine data

13070 MD number	**DRIVE_FUNCTION_MASK** Bit–coded screen for selecting the functional scope expected by the NCK with PROFIBUS drives		
Default setting: 0	Min. input limit: 0	Maximum input limit: FFFF FFFF	
Changes effective after POWER ON	Protection level: 2/7	Units: –	
Data type: DWORD	Applies from SW version: 2.1		
Significance:	Meaning of set bits: Bit 0: Deactivation of the 611U–specific drive alarm mapping Bit 1: Deactivation of the 611U–specific drive type detection Bit 2: Deactivation of the 611U–specific parameter accesses encoder drivers Bit 3: Deactivation of the 611U–specific parameter accesses output drivers Bit 4: Activation third–party drive: DSC bits (STW1.12/STA1.12) Bit 5: Deactivation of the 611U–specific drive parking (STW2.7/STA2.7) Bit 6: Deactivation of the 611U–specific travel to fixed stop (STW2.8/STA2.8) Bit 7: Deactivation of the 611U–specific internal motor switchover (STA2.9–11) Bit 8: Deactivation of the 611U–specific ramp block (STW1.13) Bit 9: Deactivation of the 611U–specific function generator functions (STW1.8/STA1.13) Bit 14: Selection of non–cyclic DP communication: 0=DPT; 1=DPV1 Bit 15: Deactivation of consistency check for PROFIBUS message frame configuration CTW: Control word (PDA word in the PROFIDrive message frame to DP slave) STW: Status word (PDA word in the PROFIDrive message frame from DP slave) PDA: Process data		

Axis–specific machine data

37620 **MD number**	**PROFIBUS_TORQUE_RED_RESOL** **Torque reduction resolution on PROFIBUS (LSB weighting)**		
Default setting: 1	Min. input limit: 0.005	Maximum input limit: 10	
Change valid after NEWCONF	Protection level: 2/7	Units: %	
Data type: DOUBLE	Applies from SW version: 2.2		
Significance:	The default value 1% refers to the original weighting: The torque limit value is transferred to the PROFIBUS in increments of 1%; the value 100 in the corresponding PROFIBUS data cell signifies full torque reduction (i.e. without power). Bu changing the torque to 0.005%, for example, you can specify value increments of 0.005%, i.e., the torque limit value is incremented more precisely by a factor of 200. In this case the value 0 is transferred to limit the value to the rated torque. A full torque reduction (i.e. without power) is given by the value 10000. To prevent an incorrect adaptation, the set value of the torque must be selected to match the interpretation of the torque reduction value configured and defined for the drive.		

18.3.9 Alarms

Detailed information on the individual alarms can be found in:

References: /DA/ Diagnostics Guide

For systems with HMI Advanced you can refer to the online help.

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Space for your notes

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Small SINAMICS Glossary

A

Active line module
Controlled, self–commutating feed/feedback unit (with –>"IGBT"s in feed/feedback device), which supplies the DC link voltage for the –>"Motor module"s.

Basic infeed
Overall functionality of an infeed with –> Basic Line Module, including the required additional components (filters, switching devices, etc.).

Basic line module
Unregulated line infeed unit (diode bridge or thyristor bridge, without feedback) for rectifying the line voltage of the –>DC Link.

Compact Flash card
Memory card for non–volatile storage of the drive software and corresponding –> Parameters. The memory card can be plugged into the –>"Control unit" from outside.

Control unit
Central control module in which the closed–loop and open–loop functions for one or more –> "SINAMICS" –> "Line module"s and/or –> "Motor module"s are implemented.
There are three types of Control Units:
– SINAMICS Control Units, e.g.. –> "CU320"
– SIMOTION Control Units, e.g. –> "D425" and –> "D435"
– SINUMERIK solution line Control Units, e.g. NCU710, NCU720 and NCU730

Control word
Bit–coded –> "Process data" word. –> which "PROFIdrive" transmits at cyclic intervals to control the drive states.

Double motor module
Two motors can be connected to and operated with a double motor module. See –> "Motor module" –> "Single motor module" Former name: –> "Double–axis module"

Drive
The drive includes the motor (electric or hydraulic), the actuator (converter, valve), the control unit, measuring system, and supply components (line infeed module, pressure reservoir). For electric drives, a distinction is made between a converter system and an inverter system. With a converter system (e.g. –> MICROMASTER 4), from the point of view of the user the line infeed, actuator, and control component form a single device; with an inverter system (e.g. –> SINAMICS S), the supply is ensured by means of –> Line Modules, thereby realizing a DC line to which the –> Inverters (–> Motor Modules) are connected. The –>"Control unit" is implemented as a separate device and connected to the other components by means of –>"DRIVE–CLiQ".

DRIVE CLiQ
Abbreviation of "Drive Component Link with IQ".
Communication system for connecting the different components of a SINAMICS drive system (e.g. –> "Control Unit", –> "Line Module"s, –> "Motor Module"s, –> "Motor"s, and speed/position encoders.
The DRIVE–CLiQ hardware is based on the Industrial Ethernet standard with twisted–pair lines. The DRIVE–CLiQ line provides the transmit and receive signals, as well as the +24 V power supply.

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Drive component Hardware component connected to a –>”Control unit” via –>”DRIVE–CLiQ”, for example. Drive components include: –> ”Motor Module”s, –> ”Line Module”s, –> ”Motor”s, – > ”Sensor Module”s and –> ”Terminal Module”s. The overall layout of a Control Unit together with the connected drive components is called –> ”Drive unit”.

Drive group A drive line–up comprises a –>”Control unit” and the –>”Motor module”s and –>”Line module”s connected via –>”DRIVE–CLiQ”.

Drive object A drive object is an autonomous, individual software function with its own –>”Parameter”s. It may also have its own –>”Fault”s and –>”Alarm”s. The drive objects may exist by default (e.g. On Board I/O) and may be easy to create (e.g. –> Terminal Board 30, TB30). It may also be possible to create them more than once (e.g. –> Servo Control). As a rule, each drive object has its own window for parameterization and diagnostic purposes.

Drive parameters Parameters of a drive axis that include, for example, the parameters of the corresponding controllers, as well as the motor and encoder data. The parameters of the higher–level technology functions (positioning, ramp–function generator), however, are called –>Application Parameters. See –>Basic Unit System.

Drive system The drive system includes all the components in a product family (e.g. SINAMICS). A drive system comprises, for example, –>”Line module”s, –>”Motor module”s, –>”Encoder”s, –>”Motor”s, –>”Terminal module”s, and –>”Sensor module”s, as well as additional components (reactors, filters, cables, etc.). See –>”Drive unit”

Drive unit The drive unit includes all the components connected via –>”DRIVE–CLiQ” that are required for carrying out drive tasks: –>”Motor module” –>”Control unit” –>”Line module”, and the required –>”Firmware” and –>”Motor”s, but not additional components (such as filters or reactors). Several –>”Drive”s can be implemented in a drive unit. See –>”Drive system”

Encoders Records and makes positions available for electronic processing. Depending on the mechanical construction, encoders can be integrated in the –>”Motor” (–>”Motor encoder”) or mounted on the external mechanics (–>”External encoder”). Depending on the type of movement, a distinction is made between rotary encoders (”rotary transducers”) and translatory encoders (e.g. –> Linear Encoders). In terms of measured value provision, a distinction is made between –>”Absolute encoder”s (code sensors) and –>”Incremental encoder”s. See –> ”Incremental encoder TTL/HTL” –> ”Incremental encoder sin/cos 1 Vpp” –> ”Resolver”

External encoder Position encoder that is not built in or mounted on the –> Motor, but via a mechanical transmission element or mechanical intermediate element. The external encoder (see –>”Externally–mounted encoder”) is used for –>”Direct position detection”.

Infeed Input component of a converter system for generating a DC link voltage to supply one or more –> ”Motor module”s, including all the required components (e.g. –> ”Line module”s, fuses, reactors, line filters, and firmware, as well as proportional computing power (if required) in a –> ”Control unit”.

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Line module

A line module is a power component that generates the DC link voltage for one or more –> ”Motor module”s from a three–phase mains voltage. The following three line module types are used for SINAMICS: –> Basic Line Module, –> Smart Line Module and –> Active Line Module.
The overall function of an infeed, including the required additional components such as –> Line Reactor, proportional computing power in a –> Control Unit, switching devices, etc. is called –> Basic Infeed, –> Smart Infeed, and –> Active Infeed.

Motor

For the electric motors that can be driven by –> SINAMICS, a basic distinction is made between rotary and linear motors in terms of direction of motion, and between synchronous and induction motors in terms of electromagnetic operating principle. For SINAMICS, the motors are connected to a –>Motor Module. See –> ”Synchronous motor” –> ”Induction motor” –> ”Built–in motor” –> ”Motor encoder” –> ”External encoder” –> ”Third–party motor”

Motor encoder

An –> ”Encoder” (e.g. –> ”Resolver”, –> ”Incremental encoder TTL/HTL” or –> ”Incremental encoder sin/cos 1 Vpp”), which is integrated in or attached to the motor. The encoder detects the motor speed and, in the case of synchronous motors, also the rotor position angle (of the commutation angle for the motor currents). For drives without an additional –> Direct Position Measuring System, it is also used as a –> Position Encoder for position control. In addition to the motor encoders, –> External Encoders for –> Direct Position Sensing are available.

Motor module

A motor module is a power component (DC–AC inverter) that supplies the power for the connected motor(s). Power is supplied through the –>”DC link” of the –>”Drive unit”. A motor module must be connected to a > Control Unit via a –> DRIVE–CLiQ. The open–loop and closed–loop control functions of the motor module are stored in the control unit. –>”Single motor module”s and –>”Double motor module”s are available.

Option slot

Slot for an optional module (e.g. in the –> Control Unit).

Parameters

Variable quantity within the drive system that the user can read and, in some cases, write. For –>SINAMICS, all specifications defined in the –> PROFIdrive profile are defined by a parameter. See –>”Visualization parameter” –>”Adjustable parameter”

PROFIBUS

Field bus to IEC 61158, Sections 2 to 6. The suffix ”DP” is no longer included because PROFIBUS FMS is not standardized and PROFIBUS PA (for Process Automation) is now part of the ”general” –> PROFIBUS.

Sensor module

Hardware module for evaluating speed/position encoder signals and providing detected actual values as numerical values at a –>”DRIVE–CLiQ socket”.
There are 3 mechanical versions of sensor modules:
SMCxx = Sensor Module Cabinet Mounted = Sensor modules for cabinet mounting
SME = Sensor Module Externally Mounted = Sensor modules with a high degree of protection for mounting outside the cabinet

Servo control

For –> ”Motor”s equipped with a –>”Motor encoder”, this control type allows operation with a high level of –>”Accuracy” and –>”Dynamic response”.
In addition to speed control, position control can be implemented.

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Servo drive

An electric servo drive comprises a motor, a –> ”Motor Module”, a –> ”Servo Control” and, in most cases, a speed and position –> ”Encoder”. Electric servo drives are normally extremely precise and have a high dynamic response. They are designed for cycle times to less than 100 ms, and often have a short–time overload capacity, which enables quick acceleration. Servo drives are available as rotary and linear drives and are used for machine tools, handling robots, and packaging machines.

SITOP power

–> ”Electronic power supply” component. Example: 24 V DC

Smart line module

Unregulated line infeed/feedback unit with a diode bridge for the infeed and stall–protected, line–commutated feedback via –> ”IGBT”s. The Smart Line Module supplies the DC link voltage for the –> ”Motor Module”s.

Status word

Bit–coded –> ”Process data” word. –> which ”PROFIdrive” transmits at cyclic intervals to control the drive states.

Vector control

Vector control (field–oriented control) is a high–performance control type for induction machines. It is based on an exact model calculation of the motor and two current components that simulate and accurately control the flux and torque by means of software algorithms, thereby enabling predefined speeds and torques to be observed and limited accurately and with a good dynamic response. Two vector control types exist: The frequency control (–> ”Sensorless vector control”) and the speed–torque control with speed feedback (–> ”Encoder”).

■

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Abbreviations

B

ADI4	Analog drive interface for 4 axes
ALM	Active line module
ARM	Asynchronous rotary motor
AS	Automation system
ASCII	American Standard Code for Information Interchange: American coding standard for the exchange of information
ASUB	Asynchronous subroutine
BA	Operating mode
BAG	Mode group
BB	Ready
BCD	Binary Coded Decimals: Decimals with each digit coded in binary
BERO	Proximity limit switch
BHT	Handheld unit
BI	Binector input
BICO	Binector connector
BO	Binector output
BP	Basic program
CF card	Compact Flash card
CI	Connector input
CNC	Computerized numerical control
CO	Connector output
CoL	Certificate of License
COM	Communication
CP	Communication processor
CPU	Central processing unit
CRC	Cutter radius correction
CU	Control unit

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DAC	Digital–to–analog converter
DB	Data block
DBB	Data block byte (currently 8 bits)
DBX	Data block bit
DHCP	Dynamic Host Configuration Protocol: Protocol for automatic assignment of IP addresses from a DHCP server to a client computer
DO	Drive object
DPR	Dual–Port RAM
DRAM	Dynamic memory (volatile)
DRF	Differential Resolver Function: Differential function for handwheel signaling
DRIVE CLiQ	Drive Component Link with IQ
DRY	Dry Run: Dry run feedrate
DSC	Dynamic servo control
DSR	Data Send Ready: Signal to indicate that serial data interfaces are ready
DW	Data word
DWORD	Double word (currently 32 Bit)
EMC	Electromagnetic compatibility
EN	European Standard
EPROM	Erasable Programmable Read–Only Memory
EQN	Designation for an absolute encoder with 2048 sine signals per revolution
ESD	Electrostatic Sensitive Device
ETC	ETC key ”>”; extension of softkey menu in the same menu
FC	Function Call, function block on the PLC
FDD	Feed drive
FEPROM	Flash EPROM: Read and write memory
FIFO	First In, First Out: Memory that works without address specification and whose data are read in the same order in which they were stored.
FIPO	Fine interpolator
FST	Feed stop
GC	Global control
GEO	Geometry
GND	Signal ground

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GPUD	Global Program User Data
GSD	Device master file
GUD	Global User Data
HASH	Software procedure for mapping a large quantity of identifiers onto a finite memory area
HEX	Hexadecimal number
HMI	Human machine interface
HW	Hardware
HW Config	SIMATIC S7 Tool to configure and parameterize S7 hardware within an S7 project
HW limit switch	Hardware limit switch
IBN	Commissioning
INC	Increment
INI	INI (**Ini**tializing Data)
INTV	Internal multiplication
IPO	Interpolator
IS	Interface signal
ISO code	Special punched tape code, number of holes per character always even
JOG	JOG mode: Manual mode for setting up the machine
K1	Channel 1
K_{UE}	Transmission ratio
K_V	Servo gain factor
LAN	Local Area Network
LEC	Leadscrew error compensation
LEDs	Light emitting diode
LSB	Least Significant Bit
LUD	Local User Data
MAC	Media Access Control
MCI	Motion control interface
MCIS	Motion control information system
MCP	Machine control panel
MCS	Machine coordinate system
MD	Machine data

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MDI	Manual Data Automatic: NC mode for entering and processing individual part program blocks or block sequences
MELDW	Message word
MLFB	Machine–readable product designation: Order No.
MM	Motor module
MMC	Man machine communication
MPF	Main program file: NC part program (main program)
MPI	Multi Point Interface: Multi–point serial interface
MSD	Main spindle drive
NC	Numerical control
NCK	Numerical Control Kernel: NC kernel with block preparation, traversing range, etc.
NCU	Numerical Control Unit: NC module
NX	Numerical eXtension (axis extension module)
OB	Organization block: Block type of PLC basic or user program
OLP	Optical Link Plug: Fibre–optic bus connector
PCMCIA	Personal Computer Memory Card International Association
PCU	PC unit
PCW	Program control word
PG	Programming device
PID	Parameter identification: Part of a PIV
PII	Process image of inputs
PIV	Parameter identification: Value: Parameterizing part of a PPO
PLC	Programmable Logic Control
PMS1	Position measuring system 1
PMS2	Position measuring system 2
PNO	PROFIBUS user organization
PO	Power ON
POI	Process image of outputs
POSMO A	Positioning Motor Actuator: positioning motor
POSMO CA	Request to send, Positioning Motor Compact AC: Complete drive unit with integrated power and control module as well as positioning unit and program memory; AC infeed.

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POSMO CD	Positioning Motor Compact DC: Like CA but with DC infeed
POSMO SI	Positioning Motor Servo Integrated: Positioning motor, DC infeed
PPO	Parameter Process data Object Cyclic data message frame for PROFIBUS DP transmission and ”Variable speed drives” profile
PROFIBUS	Process Field Bus: Serial data bus
PRT	Program test
PZD	Process data: Process data part of a PPO
RAM	Program Memory, i.e. program memory that can be read and written to
REF	Reference point
RES	Reset
ROV	Rapid Override: Rapid traverse override
RPA	R Parameter Active: Identifier for R parameters
RS–232–C	Serial interface
RTCP	Real Time Control Protocol
RTS	Request To Send: control signal on serial data interfaces
SBC	Safe brake activation
SBL	Single block
SD	Setting data
SEA	Setting Data Active: Identifier for setting data
SH	Safe standstill
SIM	Single inline module
SIOM	Compact I/O module (PLC I/O module)
SK	Softkey
SKP	Skip block
SLM	Synchronous linear motor
SMC	Sensor Module Cabinet Mounted
SME	Sensor Module Externally Mounted
SPF	Sub Program File: Subroutine
SRAM	Static RAM (non–volatile)
SRM	Synchronous rotary motor
SSI	Synchronous Serial Interface (interface type)

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STW	Control word
SW	Software
SW limit switch	Software limit switch
T	Tool
TC	Tool change
TCPIP	Transport Control Protocol – Internet Protocol
TCU	Thin Client Unit
TEA	Testing Data Active: Identifier for machine data
TO	Tool offset
TOA	Tool Offset Active: Identifier for tool offsets
TRC	Tool radius compensation
TTL	Transistor–Transistor Logic (interface type)
USB	Universal Serial Bus
VDE	Association of Electrical Engineering, Electronics and Information Technology (Germany)
VDI	VDI interface: Data interface between NC and PLC
VI	Voltage input
VO	Voltage output
WCS	Workpiece coordinate system
ZO	Zero offset
ZOA	Zero Offset Active: Identifier for zero offsets
ZSW	Status word (of drive)
µC	Micro controller

■

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References

C

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EC Declaration of Conformity

D

In order to provide the most recent version, the EC Declaration of Conformity is no longer included as part of this manual.

The EC Declaration of Conformity is available in PDF format under Product ID on Siemens A&D Product Information page: **15257461**.

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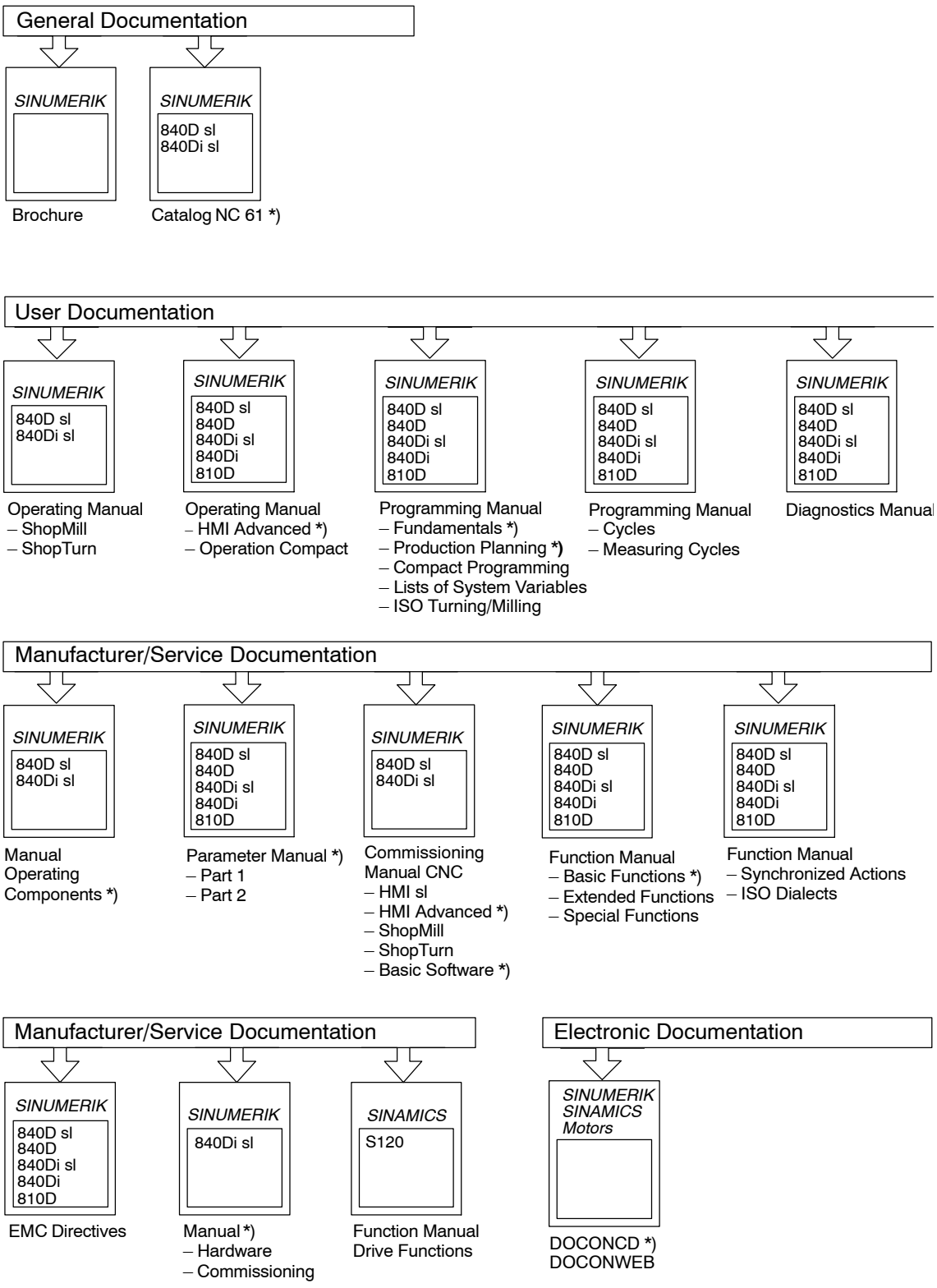
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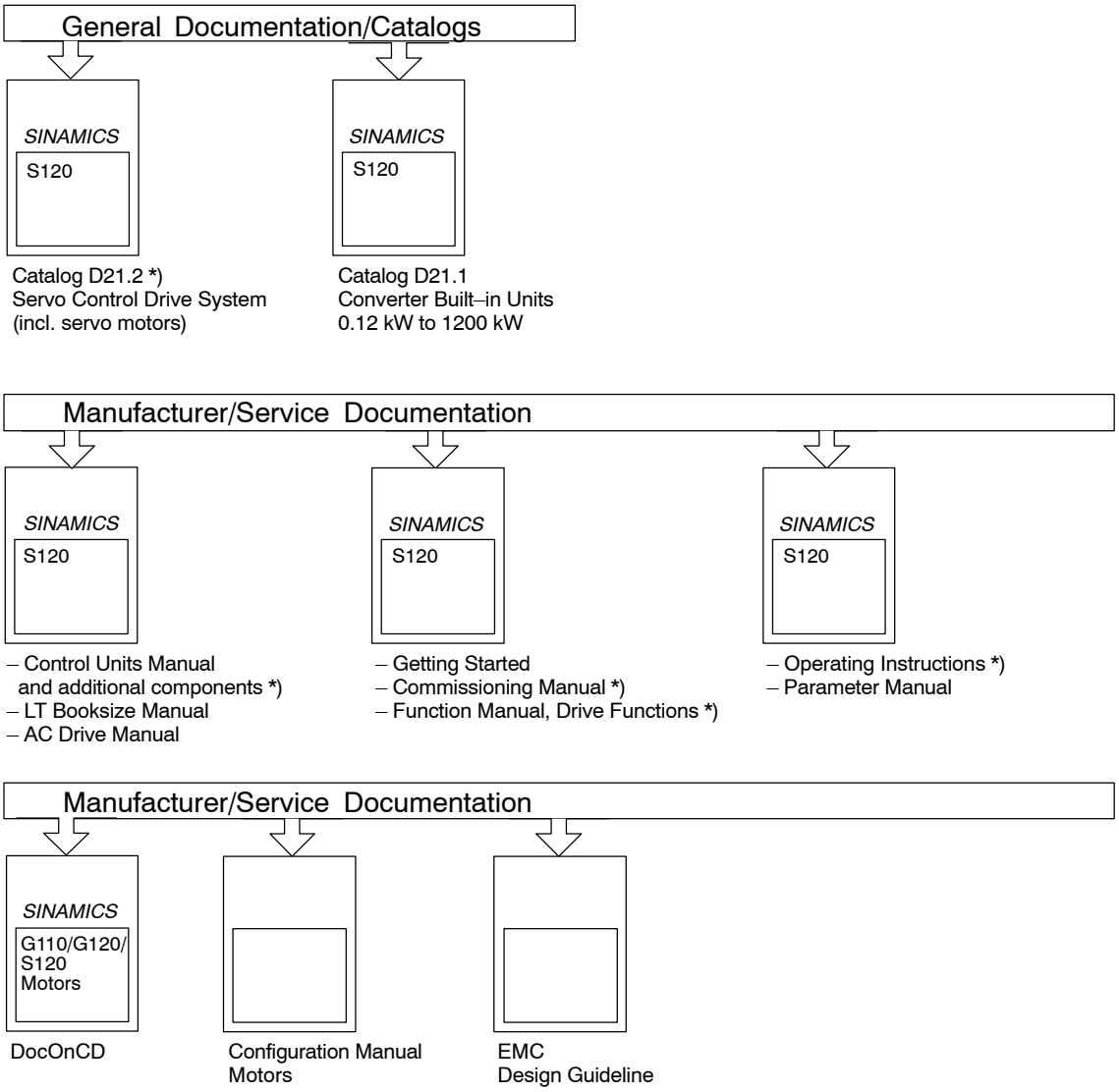
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