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sinumerik

SINUMERIK 840Di

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SINUMERIK 840Di

Manual

Valid for

Control	*Software Version*
SINUMERIK 840DiE/840Di	3

Edition 03.2004

SINUMERIK® Documentation

Printing history

Brief details of this edition and previous editions are listed below.

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

Status code in the ”Remarks” column:

A . . . . . New documentation.
B . . . . . Unrevised reprint with new order no.
C . . . . . Revised edition with new status.
If factual changes have been made on the page since the last edition, this is indicated by a new edition coding in the header on that page.

Edition	Order No.	Remarks
07.00	6FC5 297–5AE60–0BP1	**A**
09.01	6FC5 297–6AE60–0BP0	**C**
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This manual is included in the documentation available on CD–ROM (**DOCONCD)**

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03.04	6FC5 298–7CA00–0BG0	**C**

Further information is available on the Internet under:
http://www.siemens.de/sinumerik

This publication was produced with Interleaf V 7.

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.

We have checked that the contents of this document correspond to the hardware and software described. Nevertheless, differences might exist and therefore we cannot guarantee that they are completely identical. The information given in this publication is reviewed at regular intervals and any corrections that might be necessary are made in subsequent editions. We welcome suggestions for improvement.

Subject to technical changes without prior notice.

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INTRODUCTION

Notes for the Reader

The SINUMERIK documentation is organized in 4 parts:

- General Documentation
- User Documentation
- Manufacturer/Service documentation
- OEM Documentation

This document is designed for machine tool manufacturers.

The manual is only valid for the specific software version or up to the software version specified. When a new software version is released, the Description of Functions for that version must be ordered. Old manuals are only partly applicable for new software versions.

More detailed information about other SINUMERIK 840D/840Di/810D brochures, and brochures for all SINUMERIK controllers (e.g. universal interface, measuring cycles, etc.) can be obtained from your local Siemens representative.

Notice

It may be possible to run functions that are not described in this document in your controller. This does not, however, represent an obligation to supply such functions with a new control or when servicing.

Hotline

If you have any questions on the control, please get in touch with our hotline:

A&D Technical Support
Phone: +49 (180) 5050 222
Fax: +49 (180) 5050–223
E–mail: adsupport@siemens.com

Please send any queries about the documentation (suggestions or corrections) to the following fax number:
Fax: +49 (9131) 98–2176
E–mail: motioncontrol.docu@erlf.siemens.de

Fax form: See the reply form at the end of the brochure

Internet address SINUMERIK 840Di

www.siemens.de/sinumerik

Then navigate further with: SINUMERIK 840Di.

Link Box

The Link Box at the SINUMERIK 840Di end gives you direct access to all important information about the product.

Objective

This manual provides detailed information on the specific hardware and installation and start–up of a SINUMERIK 840Di system.

This manual provides information about the control system design and the interfaces of the individual components. Furthermore, the procedure for starting up the SINUMERIK 840Di with PROFIBUS DP drives (for example, SIMODRIVE 611 universal) is 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.).

User–oriented activities such as the creation of parts programs and control operating procedures are described in detail in separate documentations (Programming Guide, Operator's Guide, etc.).

Separate descriptions are likewise provided of the tasks to be performed by the tool manufacturer such as configuring, design and PLC programming.

Target groups

The manual contained in the function descriptions is designed for:

- Design engineers
- PLC programmers who create PLC user programs
- Start–up engineers once the system has been configured and set up
- Maintenance personnel inspecting and interpreting status signals and alarms

Who are qualified personnel

For the purpose of this manual and product labels, a qualified person is one who is familiar with the installation, mounting, start–up and operation of the equipment and the hazards involved.

- Training and instruction, i.e. authority to switch on and off, to earth and to label circuits and equipment according to safety regulations.
- Trained in the proper care and use of protective equipment in accordance with established safety procedures and first aid.

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 symbol (without a warning triangle) indicates that damage to property may result if proper precautions are not taken.

Notice

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

Other Information

Explanation of symbols

!

Important

This notice indicates important facts that must be taken into consideration.

Notice

Is an important item of information about the product, handling of the product or section of the documentation which requires particular attention.

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

When operating electrical devices, it is impossible to avoid applying hazardous voltages to certain parts of the equipment.

Unqualified operator action of the device/system 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.

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 lines should be installed so that inductive and capacitive interference does not in any way impair the automation functions.

ESD notices

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 earthed.
- 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 earthed by means of an antistatic chain,
  - you are wearing ESD boots or ESD boots with earthing 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, 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).

Intended use

The device must only be put to the uses prescribed in the manual and only in conjunction with third party devices and components recommended or approved by SIEMENS (e.g. SINUMERIK 840D/FM–NC).

Notes

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General Notes on the SINUMERIK 840Di 1

1.1 Overview of SINUMERIK 840Di

With the SINUMERIK 840Di, Siemens can provide a complete PC–integrated control that controls the drive units and I/Os through the standard field bus 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 especially designed for applications

- where decentralized automation solutions are required in the fields of PLC I/Os and drives

and/or

- a complete PC–integrated control system is preferred, since this solution better fits into the intended or existing automation environment.

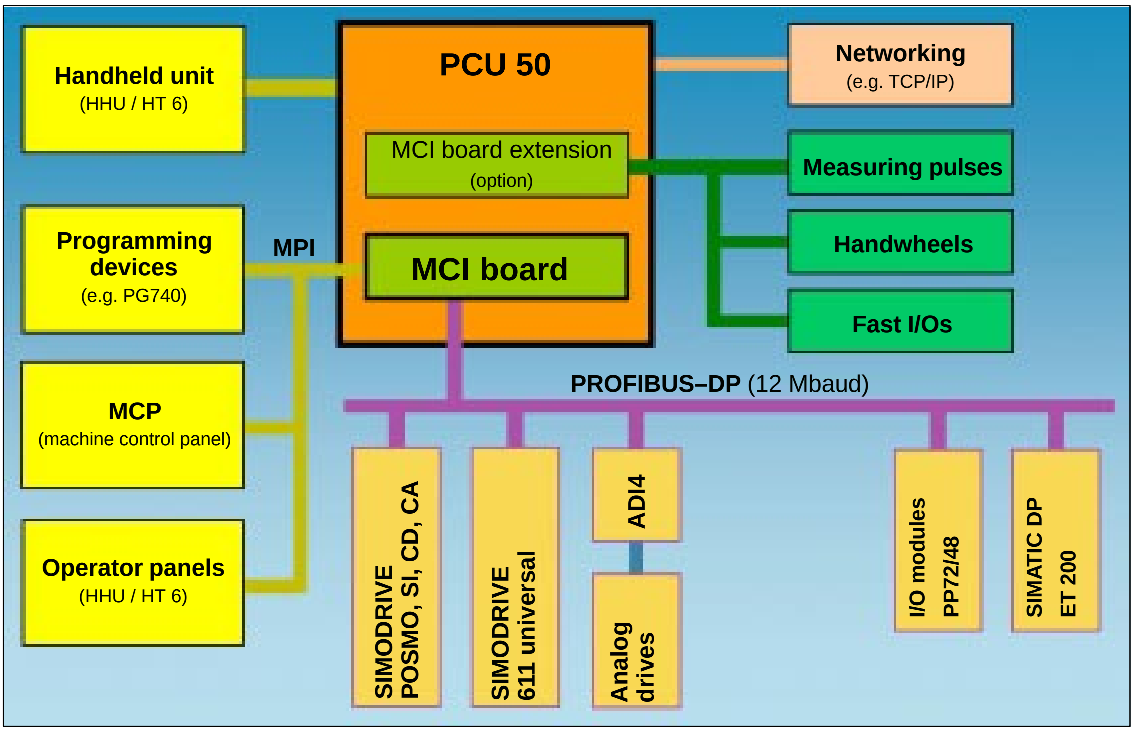


Fig. 1-1 SINUMERIK 840Di System Overview

1.1.1 System components

This manual refers to the following system components:

System components	Version
SINUMERIK 840Di system software	SW 3.1
SINUMERIK Industrial PC	PCU 50: Celeron 566 MHz, 256 Mbytes DRAM PCU 50: Celeron 1.2 GHz, 256 Mbytes DRAM
PC operating system	Windows XP Pro, ServicePack 1
MCI board	MCI2 board

Notice

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

1.1.2 System software packages and performance options

System software packages

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

System software		Order No.: 1)
Basic	Standard	6FC5 258–□BX10–□A□□
	Export	6FC5 258–□BY10–□A□□
Universal	Standard	6FC5 258–□BX20–□A□□
	Export	6FC5 258–□BY20–□A□□
Plus	Standard	6FC5 258–□BX30–□A□□
	Export	6FC5 258–□BY30–□A□□

1) . . .– **0** . . . –**0**B**F0** current software version on the hard disk
. . .– ***X*** . . . –***Y*** B**F0** specific software version on hard disk
. . .– **0** . . . –**0**B**G1** single license without data medium
. . .– **0** . . . –**0**B**G2** software update service on data medium
. . .– ***X*** . . . –***Y*** B**G3** particular software version on CD–ROM without license.

- Single license without data medium (previously copy license)
  If a single license without data medium is purchased only the ”Certificate of License” (CoL) is supplied on paper. This allows you to install the system software from a data medium on any number of SINUMERIK 840Di machines and then license them as a single license.
- Specific software version: e.g. SW 3.1: ***X*** = 3, ***Y*** = 1
  for more detailed information, please refer to: Ordering information in Catalog NC 60

Quantity framework

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

	Basic		**Universal**		**Plus**	
	Basic	Max.	Basic	Max.	Basic	Max.
Axes	5	6	5	10	5	18
Channels	1	2	1	2	1	6
Mode groups	1	2	1	2	1	6
Channels per mode group	1	2	1	2	1	6

Basic: Number of components available in the basic version
Max.: Maximum possible number of components with additional options

Performance options

In addition to the system software packages, the SINUMERIK 840Di can be adapted to requirements using various Performance options

- Option: Advanced Processing 1
- Option: Advanced Processing 2

IIPO cycles

The following minimum IPO cycle times can be set with various system software packages or using the performance options:

	Basic	Universal	Plus
Basic version	8 ms	8 ms	8 ms
Adv. Processing 1	–	4 ms	4 ms
Adv. Processing 2	–	–	2 ms
– Option not available			

Position controller cycles

The position controller cycle times are not subject to any restrictions concerning system software packages or performance options.

1.1.3 Hardware components

The hardware basis for the SINUMERIK 840Di 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 is available with the following PCU variants, each with 24 V power supply:

- Celeron 566 MHz, 256 MB SDRAM, 2 expansion slots
- Celeron 1.2 GHz, 256 MB SDRAM, 2 expansion slots

PCU interfaces

The PCU 50 features interfaces to connect the new SINUMERIK front panels (OP 0xx) as well as standard PC interfaces for connecting, e.g. monitor, keyboard, mouse, and Ethernet connection.

PCU expansion slots

The PCU 50 has the following expansion slots:

- 1 x shared ISA/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 card with integrated SIMATIC S7 compatible CPU:

- PLC317–2 DP

as a routing–capable DP Master. It has the following external interfaces:

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

PROFIBUS DP interface

The PROFIBUS DP interface can be used to connect drives and ext. I/Os to the SINUMERIK 840Di in a distributed system by means of the PROFIBUS DP interface with Motion Control capability (synchronous and equidistant data exchange between DP master and DP slaves).

MPI interface

Machine control panels, handheld operator and programming units such as the ”PG 740” can be connected via the MIP 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 occupies a slot in the PCU. But the slot is used for mechanical connection only. The electrical connection to the system is made with a ribbon cable to the MCI board.

Drives

For interpolating traversing of axes on the PROFIBUS, the SINUMERIK 840Di uses the functionality defined in the PROFIDrive profile drive technology (Version 1.4.2, 01. Sept. 00) called ”Motion Control mit PROFIBUS DP”.

For this purpose, Siemens offers the following drives:

– **SIMODRIVE 611 universal**
  with option module **MotionControl mit PROFIBUS DP**
– **SIMODRIVE 611 universal E**
  with option module **MotionControl with PROFIBUS DP**
– **SIMODRIVE POSMO CD/CA**
– **SIMODRIVE POSMO SI**

In addition to traversing axes with interpolation, it is also possible to have the drives positioned at PROFIBUS automatically and independently of other drives (operating mode: positioning).

For this purpose, Siemens offers the following drives:

– **SIMODRIVE 611 universal**
  with option module **MotionControl mit PROFIBUS DP**
– **SIMODRIVE 611 universal E**
  with option module **MotionControl with PROFIBUS DP**
– **SIMODRIVE POSMO CD/CA**
– **SIMODRIVE POSMO SI**
– **SIMODRIVE POSMO A**

To operate drives with an analog setpoint interface, the following PROFIBUS 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 low–cost **I/O module PP 72/48** are available.

Operator panel front

Choose one of the new operator panel fronts from the SINUMERIK range (**OP 010, OP 010C, OP 010S, OP 012, OP 015**) as an operator component.

1.1.4 Software components

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

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 1-32.

Windows XP

The operating system basis of the SINUMERIK 840Di is Windows XP.

Windows XP is the platform on which all applications, such as the individual user interfaces of the HMI modular system and the start–up 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.

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.

NCK

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

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 standard user interface 840Di start–up:
  Menu command **Window > Diagnosis > NC/PLC**

– The NCK is automatically ended when Windows XP is ended.

– When the NCK is ended, it writes the SRAM data from NC and PLC to the hard disk of the PCU as a backup copy.

– The maximum share CPU time allotted to the NCK can be specified via an NC machine data unselect.

Distribution of CPU time

Windows XP and the NCK share the available processor power. The CPU time share used by the NCK (standard 65%) can be altered in the machine data. See Subsection 10.3.8, Page 10-247 ”Cycle times”.

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 starting up the SINUMERIK 840Di NC using the possibilities for the:

– interactive parameterization of the NC

– option management and license management

– management of series machine start–up files.

840Di start–up

The Windows–based user interface 840Di start–up (see Section 1.5, Page 1-37) has the basic operation functionality to allow the operator to become familiar with the SINUMERIK 840Di.

840Di start–up is part of the scope of supply of a SINUMERIK 840Di 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). This gives the OEM the greatest possible flexibility to design user interfaces using standard development tools (for example Visual C++).

  The HMI programming package essentially contains a description of the interfaces and relevant example applications. Detailed information on the OPC interface can be called from the Internet at the address of OPC Foundation (http://www.opcfoundation.org.).

1.1.5 Real–time properties

As already mentioned, 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 1-37) or the NC/PLC diagnostics of HMI Advanced (see Subsection 10.10, Page 10-350).

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. Screen resolutions greater than 1024*768 pixels are not supported.

- Color depth
  The default color depth setting is 256 colors. Higher values can, in certain circumstances, increase the CPU time used by Windows XP and occasionally also by the real–time operating system.

  For safe operation in all real–time operating modes, the permissible color depth is restricted to 65536 colors.

  In unfavorable situations, e.g. if the software causes a high load on the CPU (e.g. due to a large number of axes or short interpolation cycles), sporadic real–time violations or a time–out on the interpolation level of the NCK can occur.

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.

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

Please pay attention to the following points with regard to the screen resolution and depth of color of the PCU.

- The maximum color depth is restricted to 65536 colors and the maximum screen resolution is restricted to 1024*768 pixels. Otherwise, in unfavorable situations, e.g. if the NC software causes a high load on the CPU, sporadic real–time violations or a time–out on the interpolation level of the NCK can occur.
- Changing the screen resolution and/or depth of color
  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 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.

In the case of any modifications to or expansions of PC components (hardware or software), no binding statements can be made regarding compliance with the product features if any amendments are made by third persons. These are the sole responsibility of the OEMs or the user who has made the modifications.

Certification of extensions

A PC generally constitutes an open system, and expansions of and/or modifications to the software and hardware to achieve a certain functionality are in some cases inevitable.

SIEMENS therefore offers testing and documentation of the real–time response of system configurations for systems deviating from the factory settings as a service.

Please contact your local SIEMENS sales representative.

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 retentive NC and PLC data to be stored.

– the NC and PLC to be ended.

Note

For a brief description of the ”PC OS fault” and ”PC shutdown” interface signals, please refer to Subsection 16.1.1, Page 16-449.

You can configure the response of Windows XP to a fatal exception error in the control panel (Windows start menu: **Start >Settings > Control Panel > System**).

Dialog box

Dialog box: System Properties
Tab card: Advanced
Button: ”Settings”

Dialog box: Startup/Recovery Properties
Group box: System failure
Radio button: ”Automatically restart”
OK

OK

Option: ”Automatically restart”

– Not selected: Stop (blue screen) (*default*)
– Selected: Automatic restart (reboot)

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 msecs is detected by the POWER FAIL functionality of the SINUMERIK 840Di as a fault scenario and the following actions are initiated:

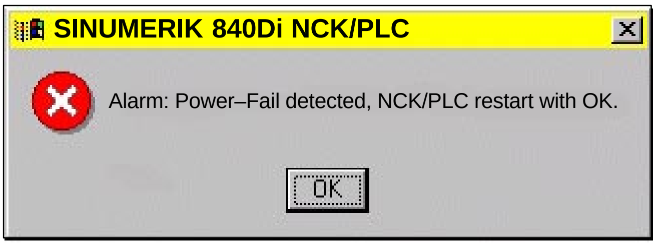
– The background lighting of the operator panel display is switched off

– The NC and PLC are shut 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 after the next SINUMERIK 840Di power–up. The SINUMERIK 840Di 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:



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

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 1-30).

3. **Replacing the MCI board or 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 its battery is replaced after a power failure, this will result in a data loss of the user data battery–backed on the SRAM of the MCI board. How to proceed further: see Subsection 5.3.4, Page 5-109.

Overtemperature

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

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

Error response

- Alarm: "2110 NCK temperature alarm"
- Logbook entry: "Alarm: Critical temperature values: Case *<Temp.>*°C, CPU module *<Temp.>*°C, CPU *<Temp.>*°C"

  On a temperature alarm, a logbook entry records the temperature measured in the following components: case, CPU module and CPU.

Cause of errors / error handling

One of the three monitored temperatures has reached or exceeded its threshold. The temperature must fall to at least 7 °C below the threshold before the alarm is reset.

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

1.1.8 Switching off

Windows XP

To ensure safe operation of the SINUMERIK 840Di, WINDOWS NT 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 16.1.1, Page 16-449

Failure to shut down Windows XP correctly can damage the Windows XP installation, leaving the SINUMERIK 840Di unable to operate.

NC and PLC

On correct shutdown of Windows XP the following occurs:

– The SINUMERIK 840Di 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 Windows XP having been correctly shut down, the SINUMERIK 840Di'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

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 1-30).

3. **Replacing the MCI board or 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 its battery is replaced after incorrect shutdown of Window 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 5.3.4, Page 5-109.

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 2.9, Page 2-73). 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:

Table 1-1 Connection options of the UPS system

Connection	Signal to	Remarks
1) UPS > PCU depending on the UPS type used: – Serial link – USB link	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 10.10.2, Page 10-354). Advantage: also works in the event of a fatal exception error of Windows XP (BlueScreen) and when the PLC user program is not active. Preconditions: MCI board extension (option)
Note re 3) For power–up response of the SINUMERIK 840Di with pending shutdown signal, see Subsection 5.3.9, Page 5-113.		

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)**

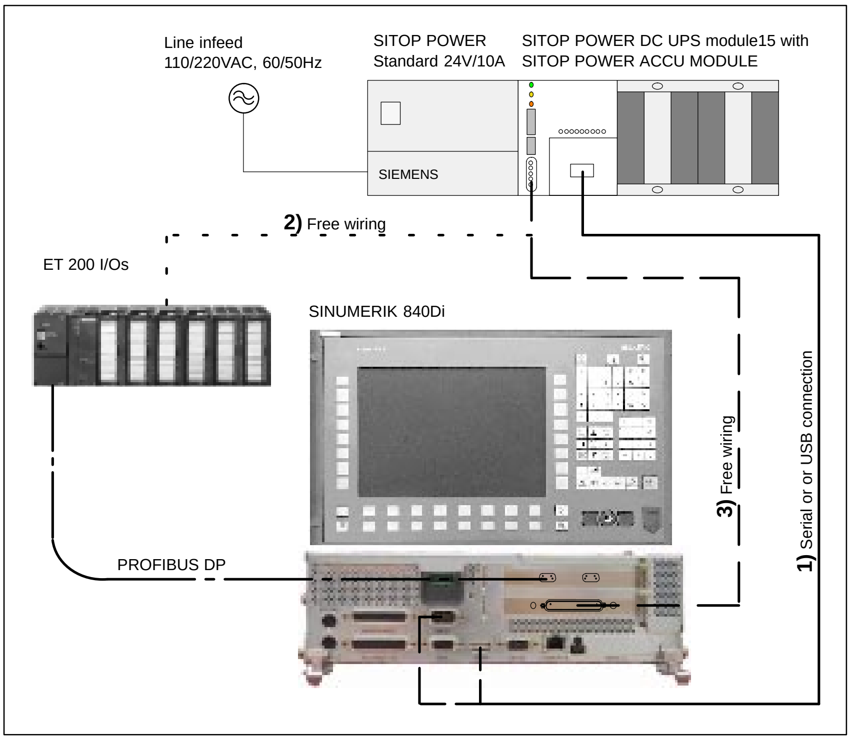


Fig. 1-2 Possible connections: UPS

Configuration

The UPS functionality can be configured as follows:

- When using SITOP POWER DC UPS MODULE 15 (see Subsection 2.9, Page 2-73) with a special software tool.

  Download: **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 close HMI Advanced before the PCU is shut down.

1.2 Overview of software components

The software components listed below are part of the SINUMERIK 840Di system software. The first time the PCU is powered up, all the software components required to operate the SINUMERIK 840Di 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 Subsection 5.4.10, Page 5-119, for how to determine the installation path of the SINUMERIK 840Di 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 Base** as from Version 03.00.01.00 *(installed)*
  - NCK–specific real–time drivers
  - 840Di–specific MPI drivers
  - 840Di start–up
- **PLC** as from Version 20.72.09.00 *(installed)*
- **NCK** as from Version 06.05.05.00 *(installed)*
- **PCU Base** as from Version 07.03.02.04 *(installed)*
  - Windows XP Pro, SP 1, English version
  - Internet Explorer 6, English version
  - HMI Explorer
  - MS–DOS
  - MPI driver
  - Norton Ghost™
  - Norton GhostWalker™
  - Service menu
  - PCU–specific drivers
- **HMI Base** as from Version 06.03.14.00 *(installed)*
  - HMI–specific display and communications drivers

Engineering Tools

The Engineering Tools include applications for start–up of the SINUMERIK 840Di NC and SIMODRIVE drives:

- **SinuCom NC** *(installed)*
  Start–up tool for SINUMERIK 840Di NC
- **SIMODRIVE 611 universal tool box**
  Contents:
  - PLC Toolbox as from Version 06.05.01
    Various files for parameterizing an S7 configuration with SIMODRIVE drives (611U, POSMO SI, CD, CA) and PROFIdrive communicaiton (see readme.txt)
    (example files: <CD path>\611utb\toolbox\<version>\<file>)

– SimoCom U as from Version 06.03.07
  start–up 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)

SIMATIC S7 add–on software

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

- **PLC toolbox**
  Content:
  – PLC basic program
  – NC variable selector
  – PLC sample programs
  (installation software: <CD path>\installs\add_on\plc_tb\Setup.exe)
- **SlaveOM** for SINUMERIK 840Di as from Version 05.03
  Object Manager for the dialog–based configuration of PROFIBUS DP drives using SIMATIC Manager STEP7 especially for SINUMERIK 840Di.
  (Installation software SlaveOM: <CD path>\installs\add_on\slaveom\setup.exe)
- **GSD file** for **I/O modules PP72/48**
  Device master file with the information in ASCII format required for integration of the I/O module PP72/48 into a SIMATIC S7 project as DP slave.
  (DMF file: <CD path>\support\siem80a2.gsd)
- **PLC application example**
  Sample application of a SIMATIC S7 project for SINUMERIK 840Di with SIMODRIVE 611 universal drives and SIMATIC ET200 I/Os
  (ZIP file: <CD path>\support\840dismp\840dismp.zip)
  (archive file: <CD path>\support\840dismp\plc_smp.arc)

Note

The components supplied as SIMATIC S7 add–on software
– PLC basic program
– SlaveOM

must be installed on the computer (PG/PC) on which the SIMATIC Manager S7 is installed for creating the S7 project for the SINUMERIK 840Di.

1.3 Notes on start–up

This SINUMERIK 840Di manual describes start–up of the following components:

- **SINUMERIK 840Di NC** and **PLC**
- **MPI** bus
- **PROFIBUS DP**

For start–up of the components used with the SINUMERIK 840Di, such as:

- operator panel fronts (e.g. **SINUMERIK OP 012**)
- PROFIBUS DP drives (e.g. **SIMODRIVE 611 universal**),

please refer to the relevant documentation.

Notice

We recommend performing start–up of the SINUMERIK 840Di in the order of the sections of this manual.

Software

To start up the SINUMERIK 840Di, the following software is needed, which is part of a SINUMERIK 840Di:

- To start up the SINUMERIK 840Di NC:
  – **840Di start–up**
  – **SinuCom NC**
- To start up PLC, MPI, and PROFIBUS DP communication:
  – **DriveOM**
  – **SlaveOM**
  – **PLC basic program**
- To start up SIMODRIVE 611 universal drives
  – **SinuCom U**

Additional software

To start up the SINUMERIK 840Di, the following software is needed, which is **not** part of a SINUMERIK 840Di:

- To start up PLC, MPI, and PROFIBUS DP communication:
  – **SIMATIC Manager STEP7**: as from Version 5.2, Service Pack 2

Additional hardware

To start up the SINUMERIK 840Di, the following additional hardware components are needed:

- a programming device with MPI interface, e.g. PG740:

  – for creating a SIMATIC S7 project to start up the SINUMERIK 840Di PLC, the MPI, and PROFIBUS DP communication
  – for installing additional software on the PCU.
- an MPI cable for connecting the PCU to the programming unit

---

Note

A programming device is not needed if:

– the SIMATIC Manager STEP 7 is installed on the PCU of the SINUMERIK 840Di

– an existing PC is used to install additional software.

For installing software on the PCU, see Chapter 15, Page 15-411.

Documentation

The following documentation is required for start–up:

- /BH/ Operator Components Manual
  – Operator panel fronts
  – Component PCU 50
  – Machine control panels
  – Operator panel, handheld terminal HT6

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

- /FB/ Description of Functions – Basic Machine
- /FB/ Description of Functions – Extended Functions
- /FB/ Description of Functions – Special Functions

The list of references in the Appendix provides an overview of the contents of the individual Descriptions of Functions.

- /LIS/ Lists
  – Overview of functions
  – Machine, Setting Data and Variables
  – Interface Signals and PLC Blocks.
- /DA/ Diagnostics Guide, Contents:
  – Alarms

1.4 Standard/export version

Export license requirement

Because certain control functions require an export license acc. to the German Export List, the SINUMERIK 840Di is available in two variations.

The **standard** version **SINUMERIK 840Di** 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,** 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:

- The sag compensation is limited to traversing a maximum distance of 10 mm.

Note

For a complete overview of the options not available with the **export** version, please refer to SINUMERIK Order Catalog NC 60.

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 installation and start–up 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.

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 is intended as an initial introduction to SINUMERIK 840Di functionality.

Overview of functions

The user interface comprises the following functions:

- Display of main screens
- Display of alarms and messages
- Management of parts programs
- ASCII editor
- NC, PLC, and PROFIBUS diagnoses
- Log book

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 parts 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.

1.5.1 Menu command: Window

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

Menu command	Functionality
Window	
Basic 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 – Feed – Override Switchover of the position display between: – MCS – WCS
Current block display	Display of: – Parts 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 parts 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

Menu command	Functionality
Part programs	• Management of parts programs Menu command **File** – New ... – Open – Deletion – Exit Menu command **Edit** – Copy – Paste – Load – Unload – Select • Editing parts 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

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
Log book	Display of SINUMERIK 840Di system messages

■

Hardware Descriptions

2

2.1 Overview of hardware components

SINUMERIK 840Di: Complete system

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

- **SINUMERIK 840Di**
  PCU 50 with Celeron 566 MHz, 256 MB DRAM and MCI2 board,
  24 V power supply
  Order number: 6FC5 220–0AA21–2AA0
- **SINUMERIK 840Di**
  PCU 50 with Celeron 1.2 GHz, 256 MB DRAM and MCI2 board,
  24 V power supply
  Order number: 6FC5 220–0AA22–2AA0

SINUMERIK 840Di: Spare parts

The following hardware components are available as spare parts:

- **SINUMERIK PCU 50**
  Celeron 566MHz, 256MB DRAM and Windows XP and MC12 board,
  24 V power supply
  Spare part order number: 6FC5 210–0AA21–2AA0
- **SINUMERIK PCU 50**
  Celeron 1.2 GHz, 256MB DRAM and Windows XP and MC12 board,
  24 V power supply
  Spare part order number: 6FC5 210–0AA22–2AA0
- **MCI2 board**
  Spare part order number: 6FC5 222–0AA02–1AA0
- **Backup battery** for MCI board
  Spare part order number: 6FC5 247–0AA18–0AA0

Note

The SINUMERIK 840Di can be ordered both as a first order and with spare part orders (replacement of PCU), where necessary, together with the SINUMERIK 840Di system software installed on the hard disk of the PCU (see Subsection 1.1.2, Page 1-20).

Optional components

The following hardware components can be ordered as options:

MCI board extension

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

Operation and display

- SINUMERIK operator panel fronts
  - **OP 010**
    Order number: 6FC5 203–0AF00–0AA0
  - **OP 010C**
    Order number: 6FC5 203–0AF01–0AA0
  - **OP 010S**
    Order number: 6FC5 203–0AF04–0AA0
  - **OP 012**
    Order number: 6FC5 203–0AF02–0AA0
  - **OP 015**
    Order number: 6FC5 203–0AF03–0AA0

External memory medium

- **Floppy disk drive 3.5’’** incl. 0.5 m connecting cable
  Order number: 6FC5 235–0AA05–0AA1

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 931–2EC11
- **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 211–0BA01–0AA1

Drives

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

For detailed ordering information on various drives, see:

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

2.2 MCI2 board

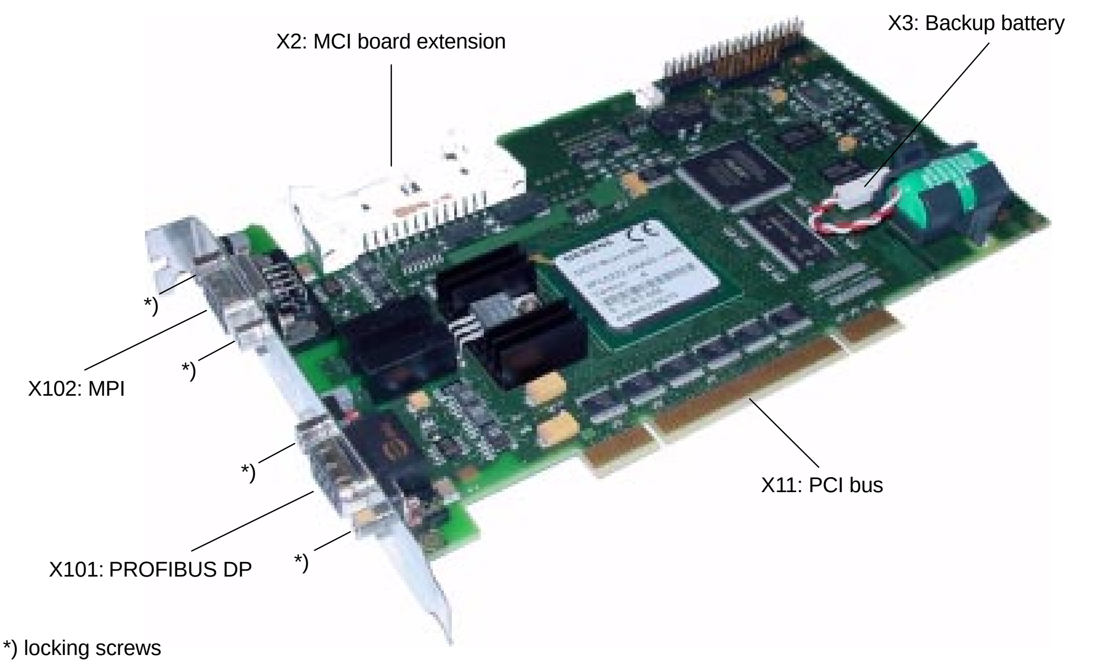
2.2.1 Module

The MC12 board is a short 32–bit PCI slot card. The MCI2 board referred to below simply as MCI board (Motion Control Interface) provides the following interfaces:

- PROFIBUS DP with Motion Control Functionality
- MPI (Multi–Point Interface)
- 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.



*) locking screws
Internal thread: UNC 4–40

Fig. 2-1 Module: MCI2 board

Caution

Some parts of the MCI board are always live because of the backup battery. To avoid short circuits, do not place the MCI board on electrically conductive materials.

Order number: MCI2 board

Description	Order number (MLFB)
MCI2 board (as spare part)	6FC5 222–0AA02–1AA0

Order number: Bus connector

Description	Order number (MLFB)
Bus connector RS–485 for PROFIBUS DP and MPI	
Cable outlet 180°	6GK1 500–0EA02
Cable outlet 35°, without PG connection socket	6ES7 972–0BA40–0XA0
Cable outlet 35°, with PG connection socket	6ES7 972–0BB40–0XA0
Cable outlet 90°, without PG connection socket	6ES7 972–0BA11–0XA0
Cable outlet 90°, with PG connection socket	6ES7 972–0BB11–0XA0

Order number: Backup battery

Description	Order number (MLFB)
Backup battery	6FC5 247–0AA18–0AA0

2.2.2 Interface description

Interface overview

Interfaces of the MCI board module

Table 2-1 Interface overview: MCI board

Interface	Description	Type
PROFIBUS DP	X101	Socket
MPI	X102	Socket connector
MCI board extension	X2	Plug connector
Backup battery	X3	Plug connector
PCI bus	X11	Direct connector

Battery connection (X3)

Interface description of the battery connection (X3):

- Connection: 2–pin plug connector
- Pin assignment

Table 2-2 Pin assignment: Battery connection (X3)

Pin	Description	Type 1)	Function
1	BATT–	VI	Minus pole of the battery
2	BATT+	VI	Plus pole of the battery
1) VI Voltage Input			

PROFIBUS DP interface (X101)

Interface description PROFIBUS DP interface (X101):

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

Table 2-3 Pin assignment: PROFIBUS DP interface (X101)

Pin	Description	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. 5 V 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 Subsection 3.3.1, Page 3-96

MPI interface (X102)

Interface description MPI interface (X102):

In principle, interface X102 can be operated as a PROFIBUS DP or an MPI interface. In the SINUMERIK 840Di it is only used as an MPI interface.

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

Table 2-4 Pin assignment: MPI interface (X102)

Pin	Description	Type 1)	Function
1	Not assigned	–	–
2	Not assigned	–	–
3	RS–MPI	B	RS–485 differential signals
4	RTS	O	Request to Send
5	GNDext	VO	External ground 2)
6	P5ext	VO	ext. 5 V power supply 2)
7	Not assigned	–	–
8	XRS–MPI	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 Subsection 3.3.1, Page 3-96

Notice

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

2.2.3 Replacing the battery

Battery type

3 V lithium battery

Order number

Description	Order number (MLFB)
Backup battery	6FC5 247–0AA18–0AA0

Service life

Typical battery service life: > 3 years

General for handling

Please observe the following general rules when handling batteries:

- Do not recharge them
- Do not heat or throw into fires
- Do not pierce or crush
- Do not tamper with mechanically or electrically in any way!

Caution

Improper handling of backup batteries results in the hazard of inflammation, burning or explosion.

Criteria for replacing the battery

The 3 V lithium battery to back up the SRAMs and the clock module is monitored in stages:

Battery voltage	Signal
2.7 – 2.9 V	Alarm: ”2100 NCK battery warning threshold reached”
2.4 – 2.6 V	Alarm: ”2101 NCK battery alarm” Alarm: ”2102 NCK battery alarm”

The alarm ”2101 NCK battery alarm” is output if battery low voltage is detected in cyclic operation.

The alarm ”2102 NCK battery alarm” is output if battery low voltage is detected during power–up.

Replacing the battery

As soon as alarm ”2100 NCK battery warning threshold reached” is output and certainly no later than output of alarm ”210x NCK battery alarm”, you should replace the battery on the MCI board to avoid loss of data.

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).

Warning

When operating electrical devices, it is impossible to avoid applying hazardous voltages to certain parts of the equipment.

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.

To change the battery, proceed as follows:

1. Changing the battery (SRAM is not backed up during this time) can result in data loss in the SRAM of the MCI board. To avoid an expensive new start–up, make sure that an appropriate series machine start–up file (NC and PLC) exists prior to the battery change.

   For information on how to create a series machine start–up file, please refer to Chapter 14, Page 14-403.

2. Shut down the SINUMERIK 840Di and Windows XP correctly.
   Use one of the following methods to do this:

   - Windows XP taskbar: Start > Shut Down
   - Interface signal: "PC shutdown", see Subsection 16.1.1, Page 16-449

3. Disconnect your PC from power supply.
4. Remove the screws from the cover of the housing (Fig. 2-2) and open the housing of your PC, following the relevant safety regulations.

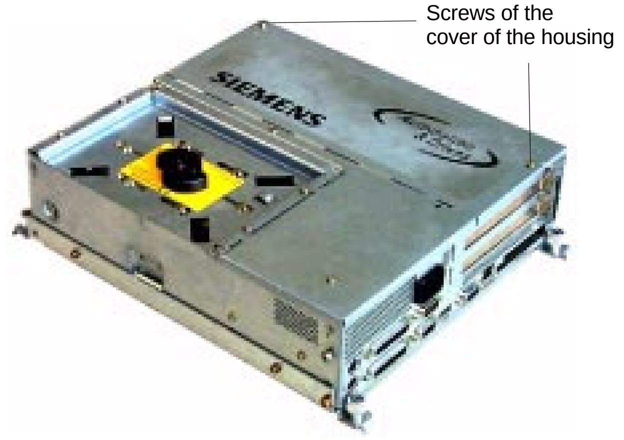


Fig. 2-2 Cover of the housing of the PCU 50

5. Optional:
   Remove interconnecting cable to the MCI board extension module, interface X2.
6. Remove the fastening screw of the module holding–down device (Fig. 2-3) and remove the module holding–down device.

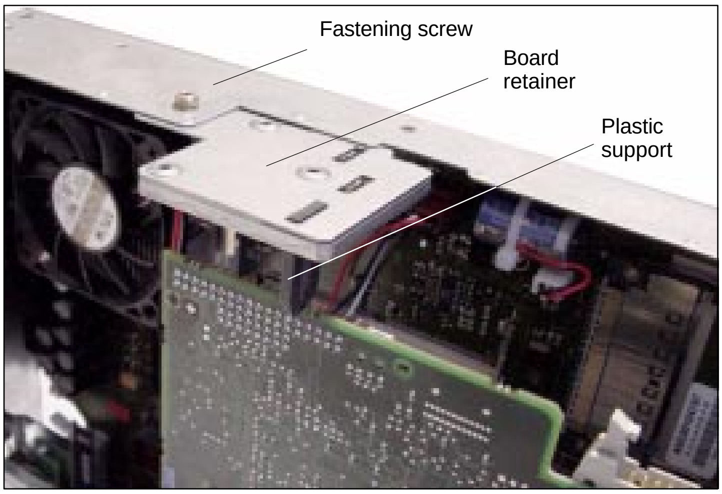


Fig. 2-3 Mounting of the module

7. Remove the fastening screw of the cover plate of the module.
8. Remove the module, observing the ESD measures.
9. Undo the battery receptacle using a suitable screw driver (see Fig. 2-4).

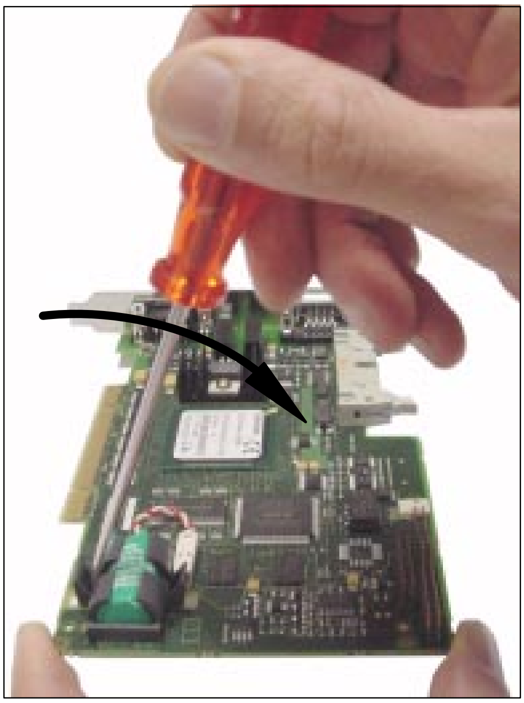


Fig. 2-4 Undo the battery receptacle

10. Remove the cable connection X3 (battery connector) from the module.
11. Remove the used battery and dispose of it acc. to the relevant standards.
12. Install the new battery and plug the battery connector onto the connection contacts without applying force (X3).

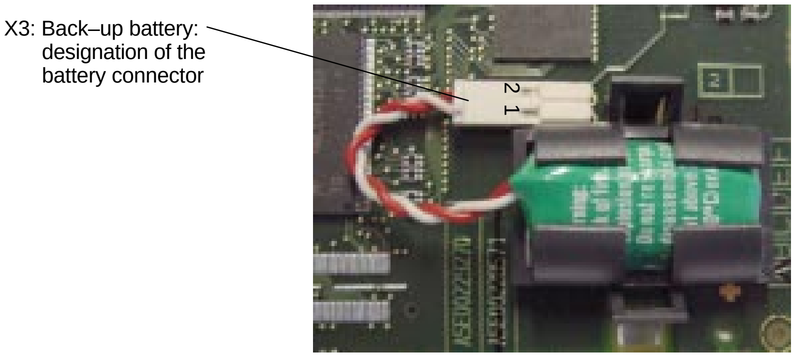


Fig. 2-5 Battery connector

13. Secure the battery to the module again with the battery receptacle.

    Note
    The terminals must snap into position audibly.

14. Insert the module into the appropriate slot on the mother board and fasten it using the fastening screw on the cover plate.
15. Mount the board retainer.
16. Close the cover of the computer housing and fasten it with the two housing screws.

    Caution!
    Before you put back the cover make sure that the foam plastic pad has been placed on the rear of the module.

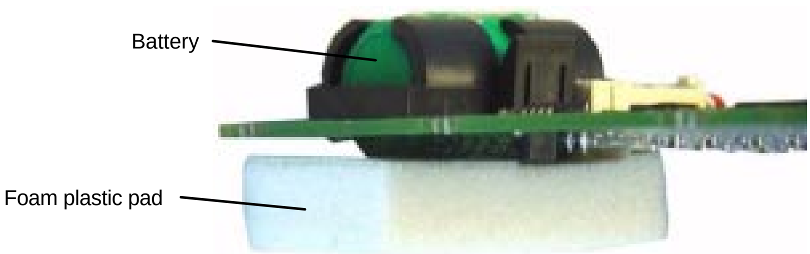


Fig. 2-6 Foam plastic pad

17. Connect your PC to power supply again and start it.

2.2.4 Module replacement

Module replacement involves installing and removing a module in more or less the same way as changing the battery (see Subsection 2.2.3, Page 2-47).

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. 2-7).

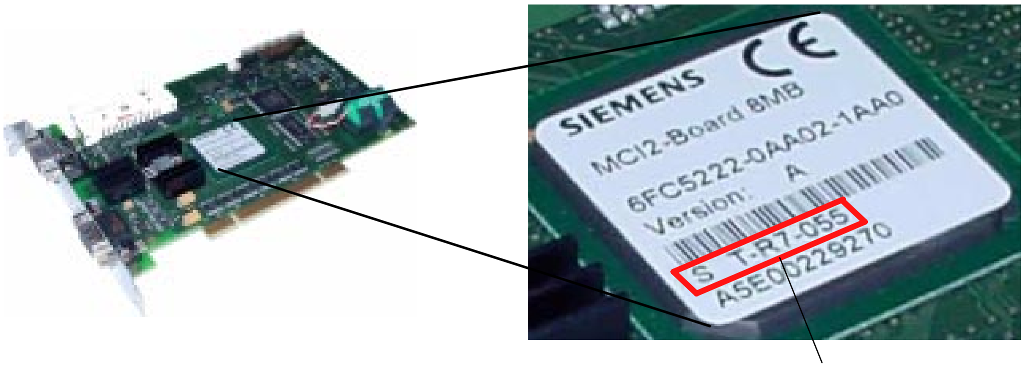


Fig. 2-7 MCI2 board: HW series number

For instructions on how to enter the license key, see Subsection 5.7, Page 5-130.

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.

2.2.5 Technical data

Safety		
Degree of protection	IP 00	
Protective class	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	
Climatic ambient conditions		
Heat dissipation	Open circuit ventilation	
Temperature limiting values	**Operation**	**Transportation/storage**
– MCI board alone	–	–40 ... 70 °C
– MCI board in PCU 50	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	
Relative air humidity limits	5 ... .80 %	5 ... .95 %
Tested to	DIN IEC 68–2–30	
	Per minute	**Per hour**
Rate of temperature change	max. 1 K	max. 10 K
Condensation	not permissible	
Quality assurance	acc. to ISO 9001	
Vibrational load during operation		
Class	3M4	
Frequency range	10 ... 58 Hz / 58... 200 Hz	
Const. excursion / acceleration	0.075 mm / 1 g	
Tested to – module in PCU 50	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	DIN EN 60068–2–6	

Notice

The specified safety regulations, certifications, degree of protection and class of protection only apply if the module is plugged into a SINUMERIK PCU 50.

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.

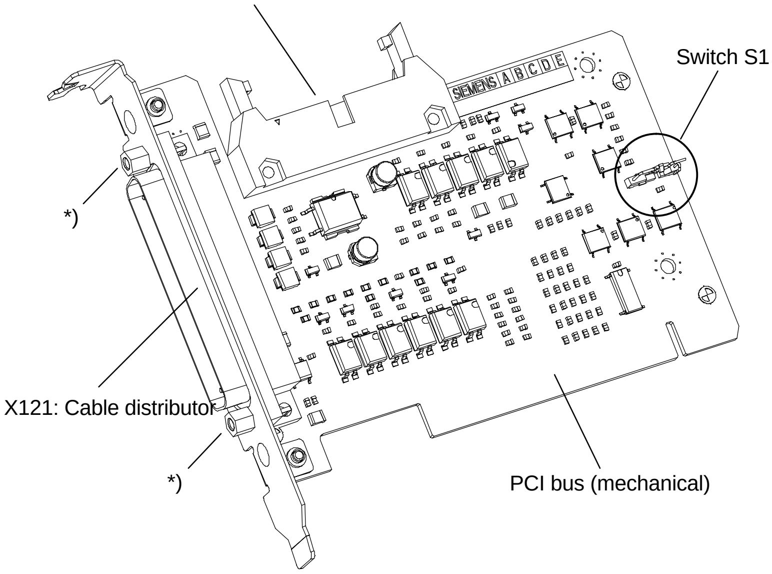


Fig. 2-8 MCI board extension slot variation

Order number:

Description	Order number (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.

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 (as–delivered state)

– TTL handwheels:
  switch S1 open

Differential or TTL handwheels can only be operated alternately.

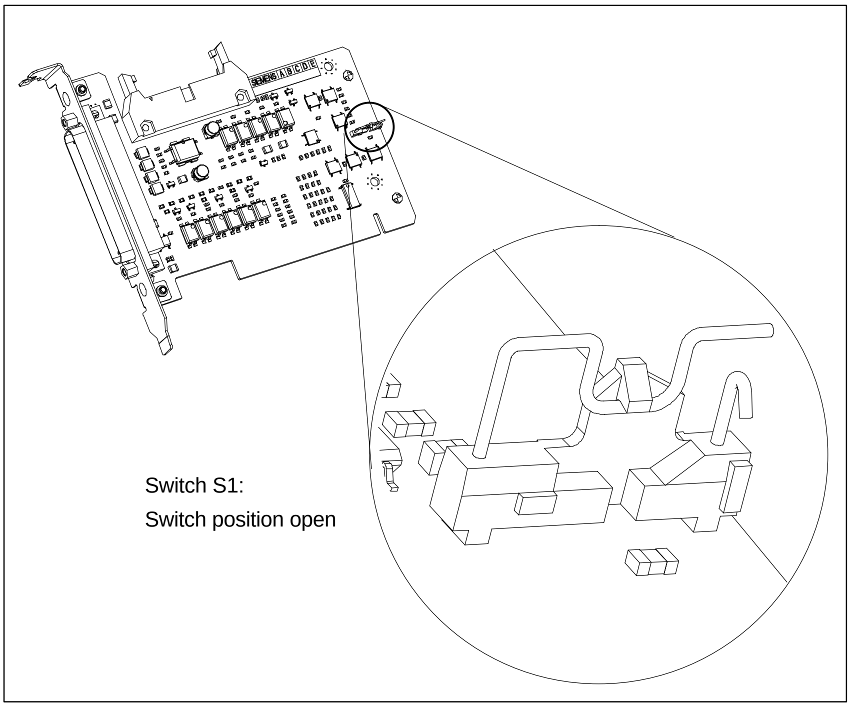


Fig. 2-9 Switch S1 switch position open (TTL handwheels)

Notice

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

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.

Mounting

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

Warning

When operating electrical devices, it is impossible to avoid applying hazardous voltages to certain parts of the equipment.

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 and Windows XP correctly.
   Use one of the following methods to do this:
   - Windows XP taskbar: Start > Shut Down
   - Interface signal: ”PC shutdown”, see Subsection 16.1.1, Page 16-449
2. Disconnect your PC from power supply.
3. Remove the screws from the cover of the housing (Fig. 2-10) and open the housing of your PC, observing the relevant safety regulations.

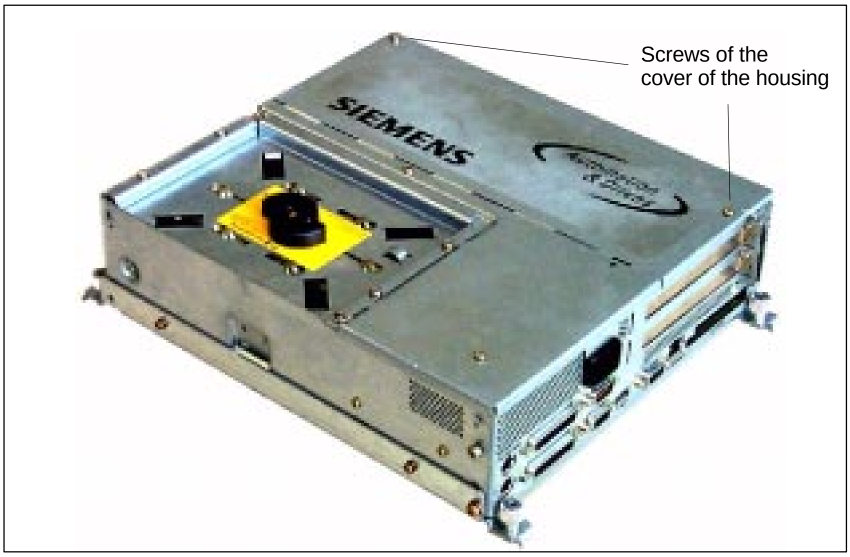


Fig. 2-10 Cover of the housing of the PCU 50

4. Remove the fastening screw of the module holding–down device (Fig. 2-11) of the MCI board and remove the module holding–down device.

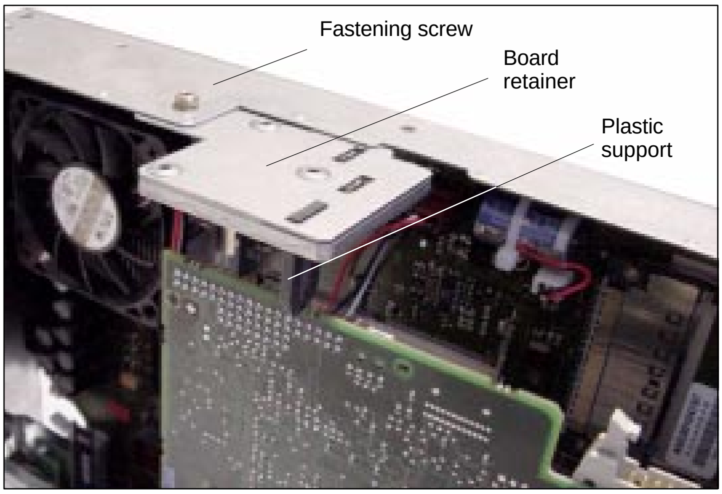


Fig. 2-11 Mounting of the module

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.

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	Description	Type
Cable distributor	X121	Male connector
MCI board extension	X4	Plug connector

Cable distributor (X121)

Interface description of the cable distributor interface (X121):

- Connector: 37–way Sub D connector
  (see cable distributor Section 2.4, Page 2-61)
- Pin assignment:

Table 2-6 Pin assignment: Interface X121

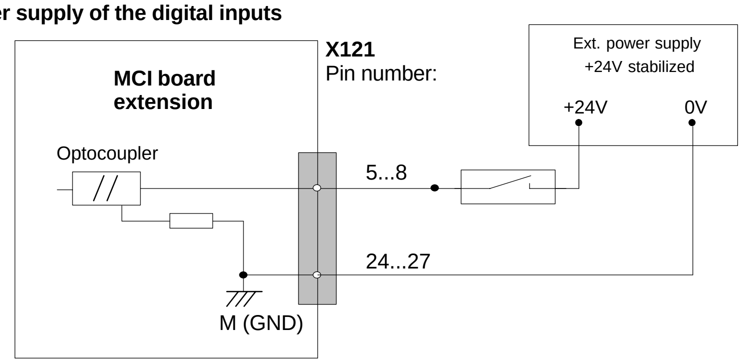
Pin	Description	Type 1)	Function
1	M24EXT	VI/VO	24 V ground, 24 V output ground
2	M24EXT	VI/VO	24 V ground, 24 V output ground
3	DOUT_CON(1)	O	2nd output 24 V
4	DOUT_CON(0)	O	1st output 24 V
5	DIN_CON(3)	I	4th output 24 V
6	DIN_CON(2)	I	3rd output 24 V
7	DIN_CON(1)	I	2nd input 24 V
8	DIN_CON(0)	I	1st 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 (GND)	VO	Handwheel PS ground, TTL handwh. ground

Table 2-6 Pin assignment: Interface X121

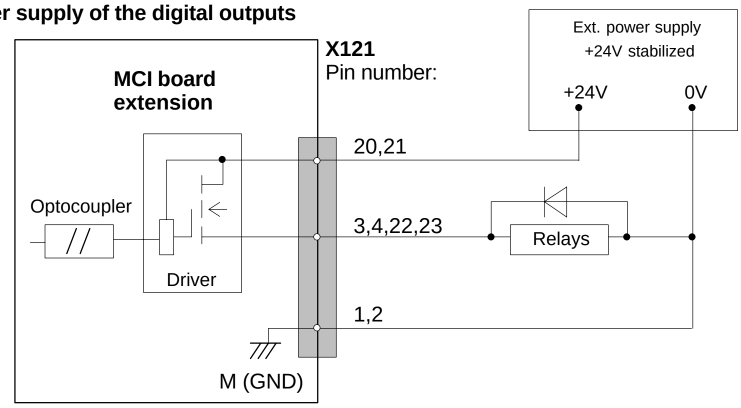
Pin	Description	Type 1)	Function
32	M (GND)	VO	Handwheel PS ground, TTL handwh. ground
33	MPG1_B	I	Input 2nd handwheel, track B
34	MPG0_A	I	Input 1st handwheel, track A
35	M (GND)	VO	Handwheel PS ground, TTL handwh. ground
36	M (GND)	VO	Handwheel PS ground, TTL handwh. ground
37	MPG0_B	I	Input 1st handwheel,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



- The maximum cable length is 25 m for all functions.

Digital inputs

Please note the following points about the digital inputs:

– Isolated from the board electronics
– Connected to the same ground (MEXT)

Digital outputs

Please note the following points about the digital outputs:

– Isolated from the board electronics
– Connected to the same ground (GND24EXT), as is their the external 24V power supply

Handwheels

The handwheels are not isolated from the board electronics.

- In the case of differential handwheels, the following signals are used:
  – MPGx_A
  – MPGx_B
  – MPGx_XA
  – MPGx_XB
- In the case of TTL handwheels, the following signals are used:
  – MPGx_A
  – MPGx_B
  – M (GND)

Notice

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

Sensor probes

Please note the following points about sensor probes:

– The sensor probes are isolated from each other and from all other potential areas (board electronics, dig. inputs, dig. outputs, and handwheels)

Sensor probes

The sensor probes are isolated among themselves and from the board electronics.

2.3.4 Technical data

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

Safety		
Degree of protection	IP 20	
Protective class	Protection 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	1 A	500 mA
Mechanical data		
Dimensions	Short PCI card	
Weight	110 g	
Climatic ambient conditions		
Heat dissipation	Open circuit ventilation	
	Operation	**Transportation/storage**
Temperature limiting values	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	
Relative air humidity limits	5 ... .80 %	5 ... .95 %
Tested to	DIN IEC 68–2–30	
	Per minute	**Per hour**
Rate of temperature change	max. 1 K	max. 10 K
Condensation	not permissible	
Quality assurance	acc. to ISO 9001	
Vibrational load during operation		
Class	3M4	
Frequency range	10 ... 58 Hz / 58... 200 Hz	
Const. excursion/acceleration	0.075 mm / 1 g	
Tested to – module in PCU 50	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	DIN EN 60068–2–6	

Notice

The specified safety regulations, certifications, degree of protection and class of protection only apply if the module is plugged into a SINUMERIK PCU 50.

2.4 Cable distributor

Order number

Description	Order number (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.

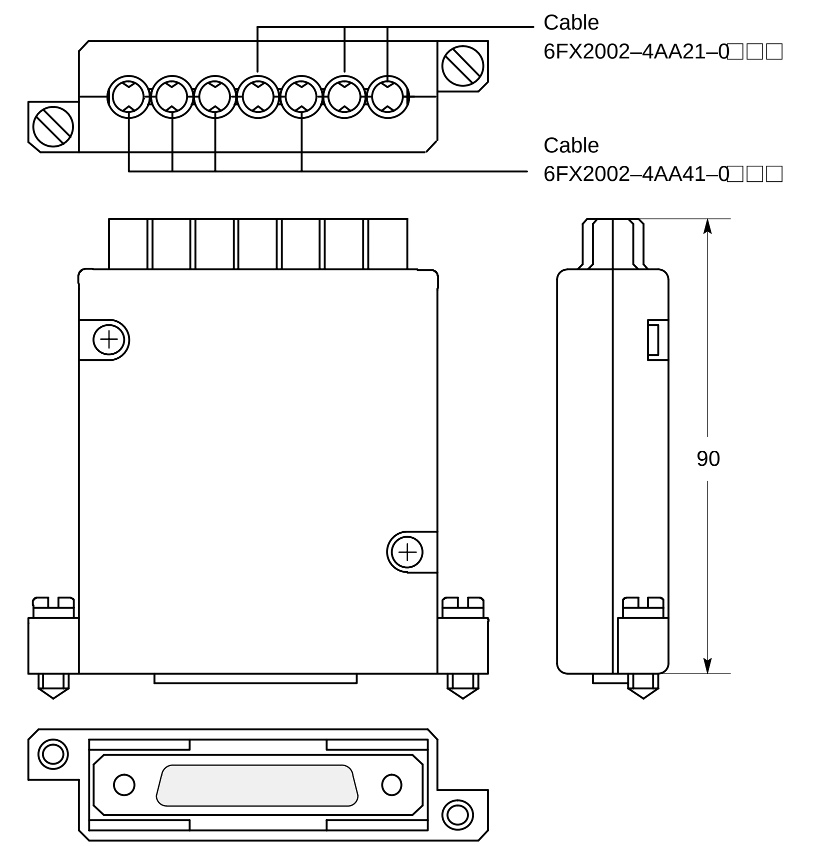


Fig. 2-12 Cable distributor

Plug the appropriate single cable into the opened cable distributor and connect it to the associated connector X1 to X10. When doing so, place the cable into the appropriate cable entry.

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. 2-13, 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.

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

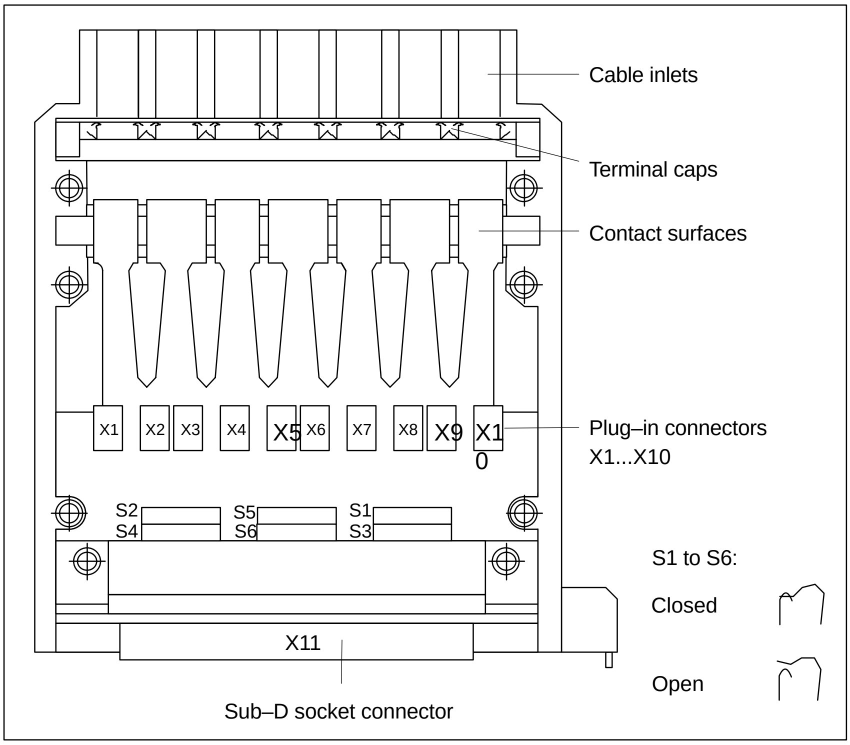


Fig. 2-13 Position of the interfaces of the cable distributor

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

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

Connector assignments

Table 2-9 Connector assignments

Connector No.	Cable No.	I/Os
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.

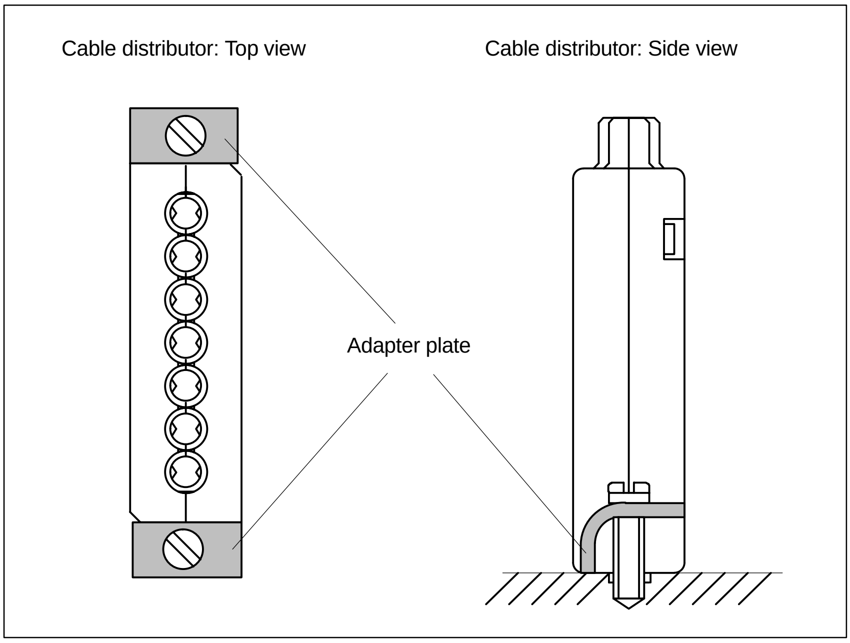


Fig. 2-14 Mounting the cable distributor

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 bn bk shield	1st probe 1st probe	Signal+24V Reference 0 V
1 20 2 21	M24EXT P24EXT M24EXT P24EXT	X9/2 X9/1 X9/4 X9/3	6	41–0□□□	rd or bn 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 bn 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 bn bk gn ye vt bu 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 bn 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 bn bk gn ye vt bu 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 bn bk gn ye vt bu shield	1st handwheel 6FC9320–5DB	XA A 5 V 0 V 5 V 0 V XB B

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.

Colors

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

2.5 SINUMERIK Industrial PC

2.5.1 SINUMERIK PCU 50

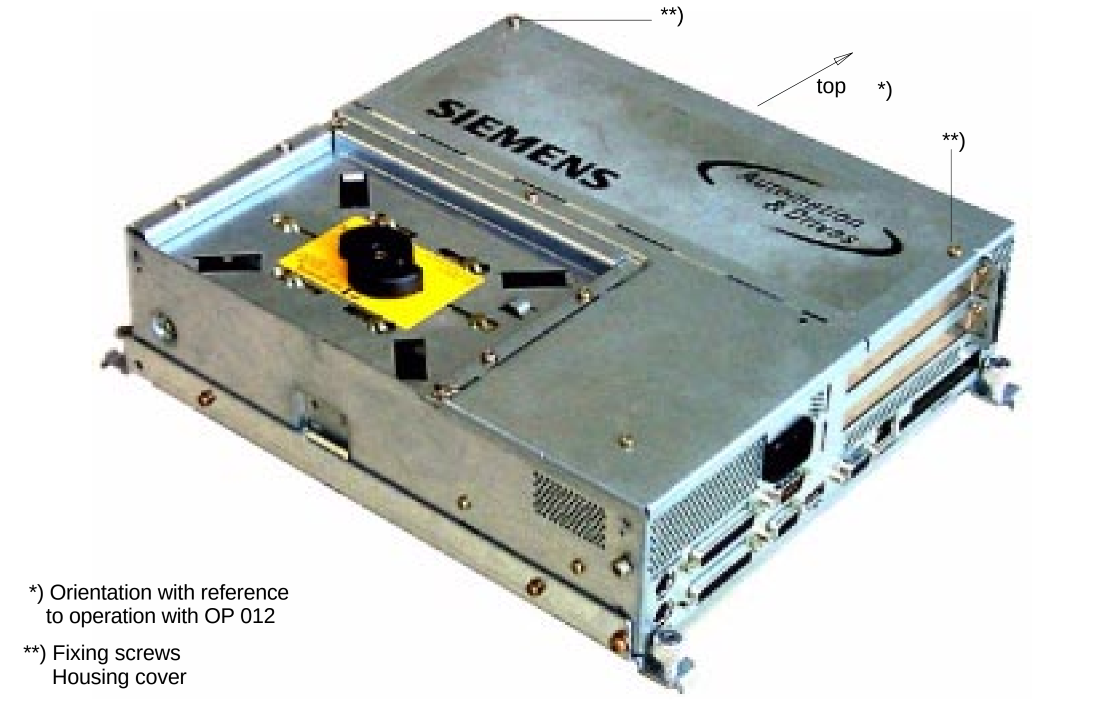


Fig. 2-15 PCU 50: Perspective view with installed hard disk drive

Order number

PCU as spare part with MCI board:

Description	Order number (MLFB)
PCU 50 with Windows XP and MCI board:	
Celeron 566 MHz, 256 MB DRAM	6FC5 220–0AA21–2AA0
Celeron 1.2 GHz, 256 MB DRAM	6FC5 220–0AA22–2AA0

Features

The SINUMERIK Industrial PC ”PCU 50” provides together with the MCI board the basis for the SINUMERIK 840Di. The PCU 50 has the following important features:

- Versions:
  - Celeron 566 MHz, 256 MB DRAM
  - Celeron 1.2 GHz, 256 MB DRAM
- Hard disk min. 4.8 GB (replaceable)
- Operating system Windows XP US
- Robust design (continuous operation, high noise immunity)
- Space–saving installation thanks to compact dimensions (LxWxH): 296x267x100 mm
- Easy installation with four screws on the rear of the operator panel front

- Mounting position and location to a large degree variable
- Screen resolution 640 x 480 (VGA), up to 1024 x 768 (XGA)
- Power supply: 24 V DC
- Interfaces:
  - Parallel interface LPT1
  - Serial interfaces: 1 x RS–232–C (25–pin), 1 x RS–232–C (9–pin)
  - PS/2 keyboard interface
  - PS/2 mouse interface
  - MPI/PROFIBUS DP (max. 12 Mbaud)
  - VGA interface for external monitor
  - Ethernet connection 10/100 Mbaud
  - Interfaces for operator panel:
    LVDS interface for SINUMERIK–OP,
    USB interface for SINUMERIK–OP (internal)
  - USB interfaces:
    with Celeron 566 MHz/1.2 GHz: 2 x USB interfaces
- Expansion slots
  - 1 expansion slot (length: max. 265 mm, occupied by the MCI board)
  - 1 x shared ISA/PCI expansion slot (length: max. 175 mm, occupied with option MCI board extension and MCI board extension slot variant)

Options

The following options are offered:

- External floppy disk drive
- Memory extension up to max. 512 MB DRAM.
- Distributed configuration of PCU and operator panel front via video link
  References: /BH/ Operator Components Manual
  Distributed configuration

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

The complete documentation on the PCU 50 is to be found in:

References: /BH/ Operator Components Manual
Component PCU 50

2.6 SINUMERIK operator panel fronts

Overview

The individual SINUMERIK operator panel fronts can be connected using the PCU interfaces for TFT and STN displays:

– OP 010
– OP 010C
– OP 010S
– OP 012
– OP 015

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

2.6.1 Operator panel front OP 012

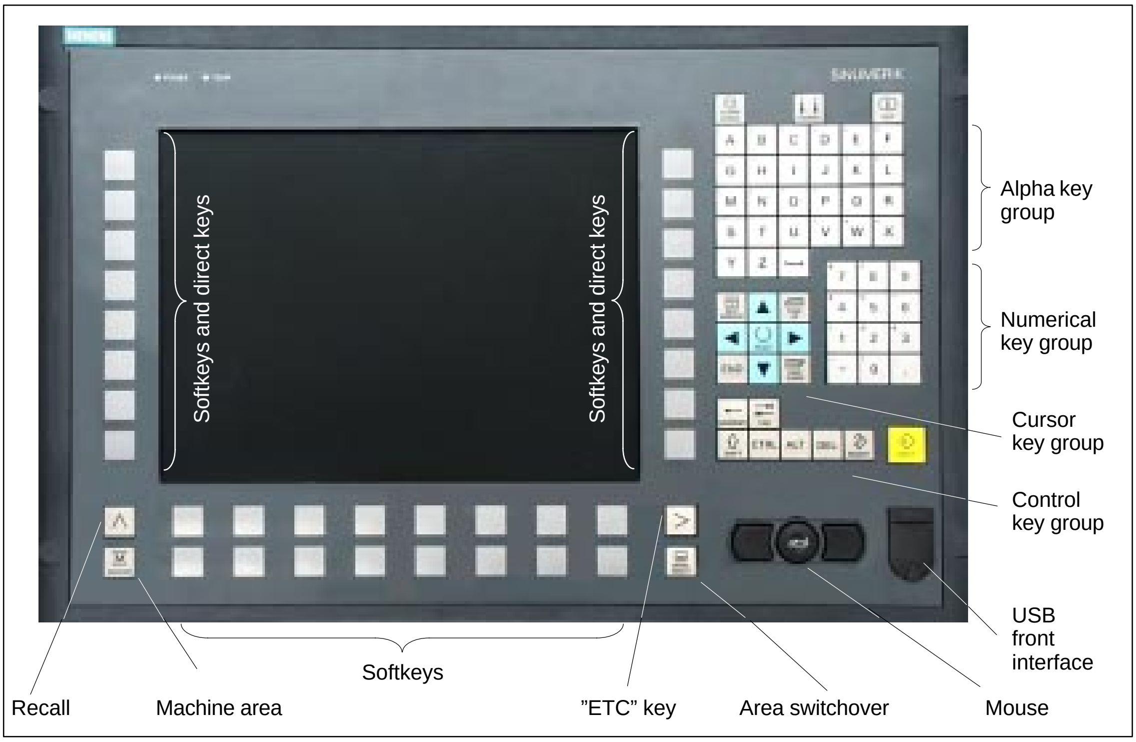


Fig. 2-16 View of OP 012 operator panel front

Order number

Description	Order number (MLFB)
SINUMERIK OP 012	6FC5 203–0AF02–0AA0

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 key group
- Soft keys/direct keys:
  - 2 x 8 horizontal rows of keys with softkey function
  - 2 x 8 vertical key rows with softkey and direct key functions
  - 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 port at front
- Degree of protection IP65
- Can be combined with the component PCU 50
- 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

2.7 Floppy disk drive 3.5’’

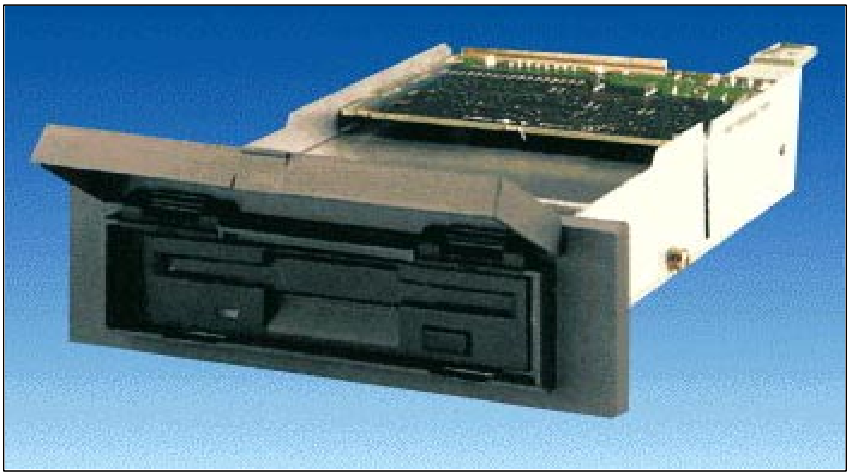


Fig. 2-17 External floppy disk drive 3.5”

Order number

Description	Order number (MLFB)
Floppy disk drive 3.5” incl. 0.5 m cable	6FC5 235–0AA05–0AA1
Accessories: Cover of floppy disk drive with shutter, cover and bearing block	6FC5 247–0AA20–0AA0

Features

The AT–compatible floppy disk drive serves to archive data and programs on 3.5” diskettes. It can be installed, e.g. in the front panel of the control cubicle.

- Input voltage — 24 V DC
- Power consumption, max. — 5 W
- Degree of protection to DIN EN 60529 (IEC 60529) — IP 54 (front), IP 00 (rear)
- Humidity rating based on DIN EN 60721–3–3 — Cl. 3K5 without condensation and ice formation. Lowest air temperature 0 °C

References

For a complete description of the external 3.5’’ floppy disk drive, please refer to:

References: /BH/ Operator Components Manual
3.5” diskette drive

2.8 Power supply

2.8.1 SITOP POWER standard 24V/10A

Fig. 2-18 View: SITOP POWER standard 24V/10A

Order number

Description	Order number (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 %

- 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

2.9 Uninterruptible power supply (UPS)

2.9.1 SITOP POWER DC UPS MODULE 15

Fig. 2-19 View: SITOP POWER, DC–UPS MODULE 15

Order number

Description	Order number (MLFB)
SITOP POWER DC UPS module 15 (serial interface)	6EP1 931–2EC31
SITOP POWER DC UPS module 15 (USB interface)	6EP1 931–2EC41

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
  – 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

Serial interface

In the version with serial interface the connection to the PC is implemented with a 1:1 interconnected 9–pin SUB–D connecting cable (connector/socket). Only poles 2, 3, and 7 are required:

Table 2-11 Signal assignment of 9–pin SUB–D–connector

Pin	Signal	Description
2	RxD	Data cable
3	TxD	Negative supply voltage
7	RTS	Positive supply voltage

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	Description
1	VBUS	Supply voltage
2	D–	Transmitted data
3	D+	Transmitted data
4	GRD	Ground

2.9.2 SITOP POWER ACCU MODULE 24V DC/10A/3,2AH

Fig. 2-20 View: SITOP POWER lead–acid battery module

Order number

Description	Order number (MLFB)
SITOP POWER ACCUMODULE 24VDC/10A/3,2AH	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

2.10 I/O module PP72/48

2.10.1 Module

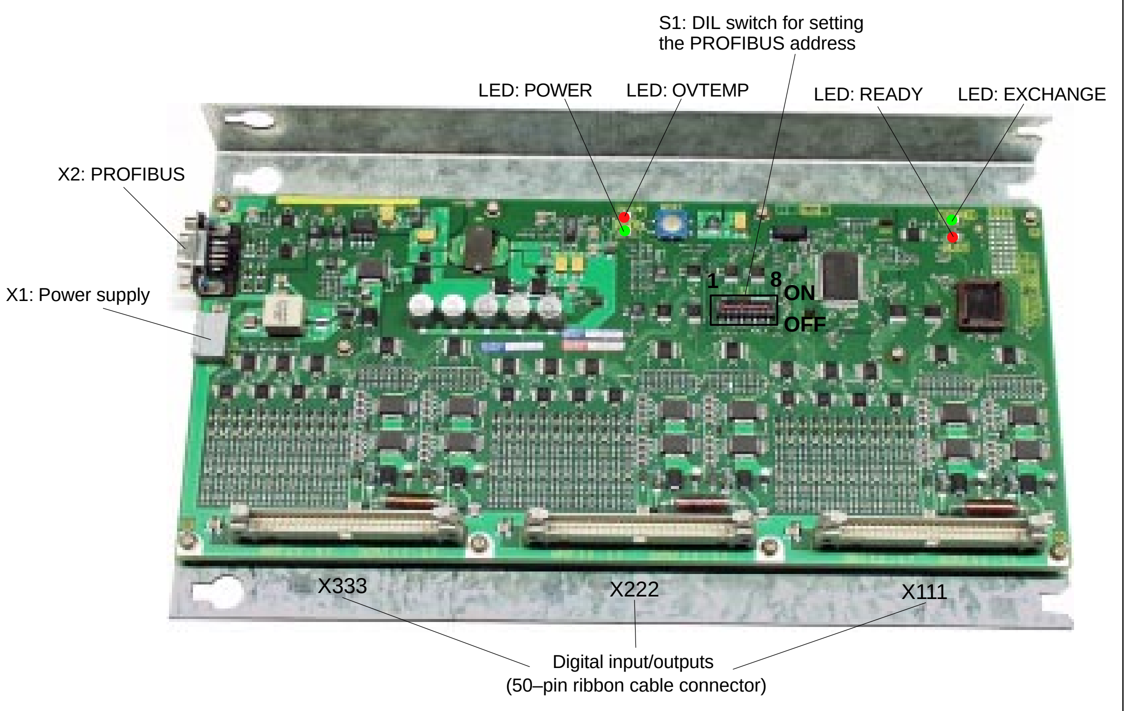


Fig. 2-21 I/O module PP72/48

Order number

Description	Order number (MLFB)
I/O module PP72/48	6FC5 611–0CA01–0AA0

Features

The I/O module PP72/48 is a simple and low–cost 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), specified by:
  PROFIDrive profile drive technology version 3,
  Draft V1.4.2, 01. September 00
- 72 digital inputs and 48 digital outputs
- On–board 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.

2.10.2 Interface description

Interface overview

Interfaces of I/O module PP72/48

Table 2-13 Interfaces of the I/O Module PP72/48

Interface	Description	Type
Power supply connection	X1	Screw–terminal block
PROFIBUS DP	X2	Socket connector
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	Description	Type 1)	Function
1	P24	VI	External power supply of the module (+ 24 V)
2	M24	VI	Reference for external supply
3	PE	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 2.10.3, Page 2-84.

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	Description	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			

- Male connector
  - 6ES7972–0BA40–0XA0; cable outlet 35°, without PC socket connector
  - 6ES7972–0BB40–0XA0; cable outlet 35°, with PC socket connector
  - 6ES7972–0BA11–0XA0; cable outlet 90°, without PG socket connector
  - 6ES7972–0BB11–0XA0; cable outlet 90°, 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

Switches	Meaning
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 ON.

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 (GND)	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

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.

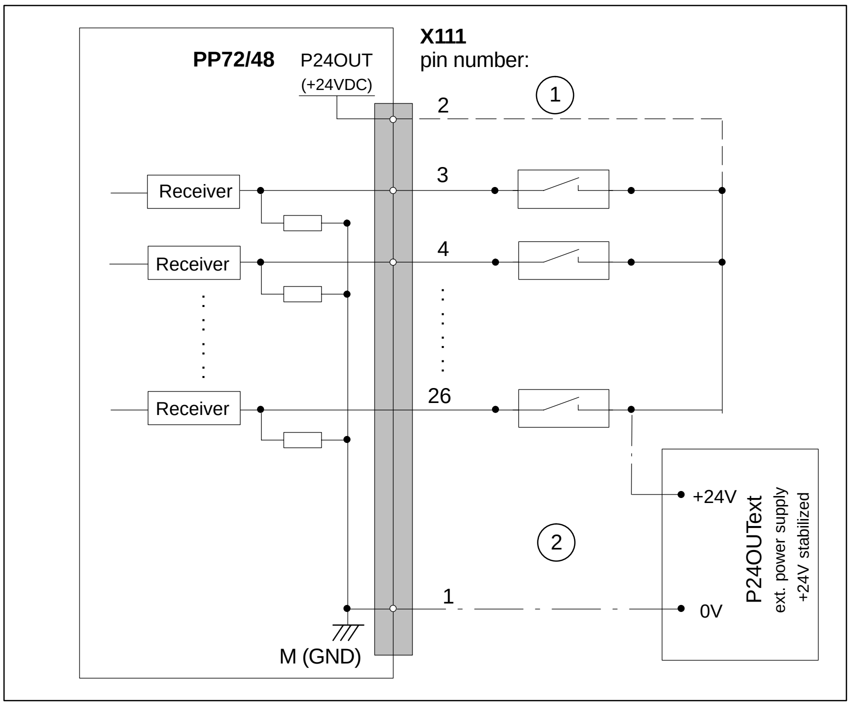


Fig. 2-22 Terminal assignment for the digital inputs

1 If you are using the internal power supply P24OUT

2 If you are using an external power supply P24OUText

- 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 2.10.3, Page 2-84

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 (P24OUText)
  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 1 (P24OUT) then remains open.

  For specification of the external power supply, see Subsection 2.10.3, Page 2-84.

- 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 outputs	**min.**	**Typical**	**max.**	**Nominal**
Voltage at high level ($V_{H)}$	15 V	1)	30 V	24 V
Input current I_{IN} at V_H	2 mA	–	15 mA	–
Voltage at low level ($V_{lo)}$	–30 V	–	+5 V	0 V
Signal delay time T_{PHL} 2)	0.5 ms	–	3 ms	–

- Supply voltage for digital inputs
  1) typical output voltage: $V_{CC} – I_{OUT} * R_{ON}$
  V_{CC}: current 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.

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.

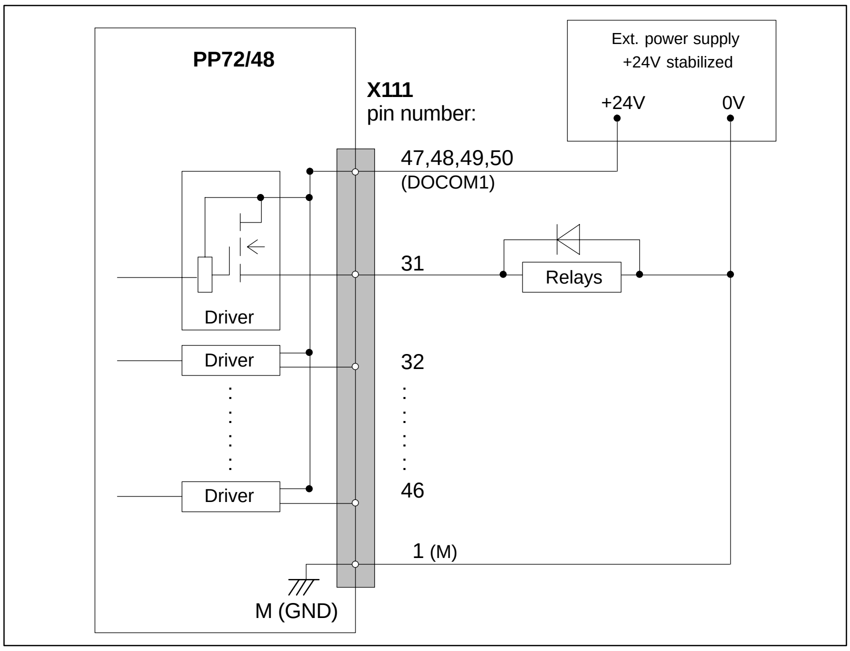


Fig. 2-23 Terminal assignment for the digital outputs

- Connecting cable: The required connecting cables (ribbon cables) must be provided by the user.
- Supply voltage:
  To power the digital outputs, an external 24VDC 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 2.10.3, Page 2-84.

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.

- Electrical specification of the digital outputs:

Table 2-19 Electrical specification of the digital outputs

Digital outputs	**min.**	**Typical**	**max.**	**Nominal**
Voltage at high level ($V_{H)}$)	V_{CC} – 3 V	1)	V_{CC}	24 V
Output voltage I_{OUT}	–	–	500 mA	–
Voltage at low level ($V_{lo)}$)	–	–	–	Output open
Leakage current at low level	–	50 μA	400 μA	–
Signal delay time T_{PHL} 2)	–	0.5 ms	–	–
max. switching frequency 2)				
Resistive load	100 Hz	–	–	–
Inductive load	2 Hz	–	–	–
Lamp	11 Hz	–	–	–

- Supply voltage for digital outputs
  1) typical output voltage: $V_{CC} – I_{OUT} * R_{ON}$
  V_{CC}: current operating voltage
  max. output voltage I_{OUT}: 250 mA at simultaneity factor 100 %
  500 mA at simultaneity factor 50 %
  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.
- Incorrect polarization causes neither high level nor destruction of the outputs.

- General electrical properties
  - Galvanic isolation using optocouplers
  - Current limitation to a maximum of 500 mA
  - Protection from: short circuit, overtemperature, and loss of ground
  - Autom. shutdown on undervoltage

LED: Status display

The module has 3 LEDs through which the module status is displayed.

Table 2-20 LED: Status display

Description	Color	Description
POWER	Green	Supply voltage
OVTEMP	Red	Overtemperature indication
EXCHANGE	Green	cycl. data exchange with DP master in progress
READY	Red	Ready for cycl. data exchange with DP master

2.10.3 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 2.10.2, Page 2-77.

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 (+24VDC)

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.

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).

2.10.4 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.

2.10.5 Dimension drawing

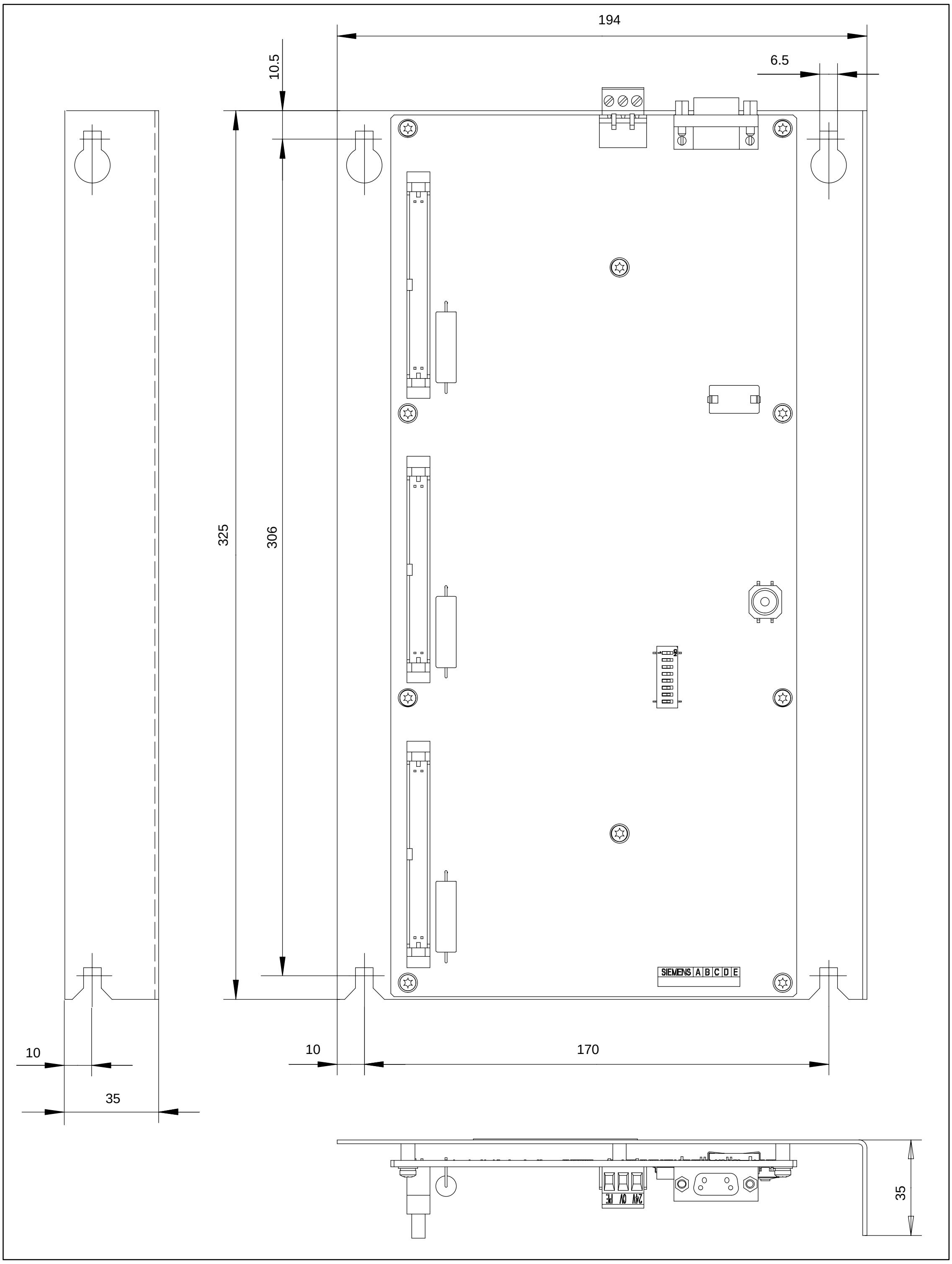


Fig. 2-24 Dimension drawing: I/O module PP72/48

2.10.6 Technical data

Technical data of I/O module PP72/48

Safety		
Degree of protection	IP 00	
Protective class	Protection 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	11 W	
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
Climatic ambient conditions		
Heat dissipation	Open circuit ventilation	
	Operation	**Transportation/storage**
Temperature limiting values	0 ... 50 °C	–20 ... 55 °C/–40 ... 70 °C
Relative air humidity limits	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	

2.11 ADI4 (Analog Drive Interface for 4 Axes)

2.11.1 Module

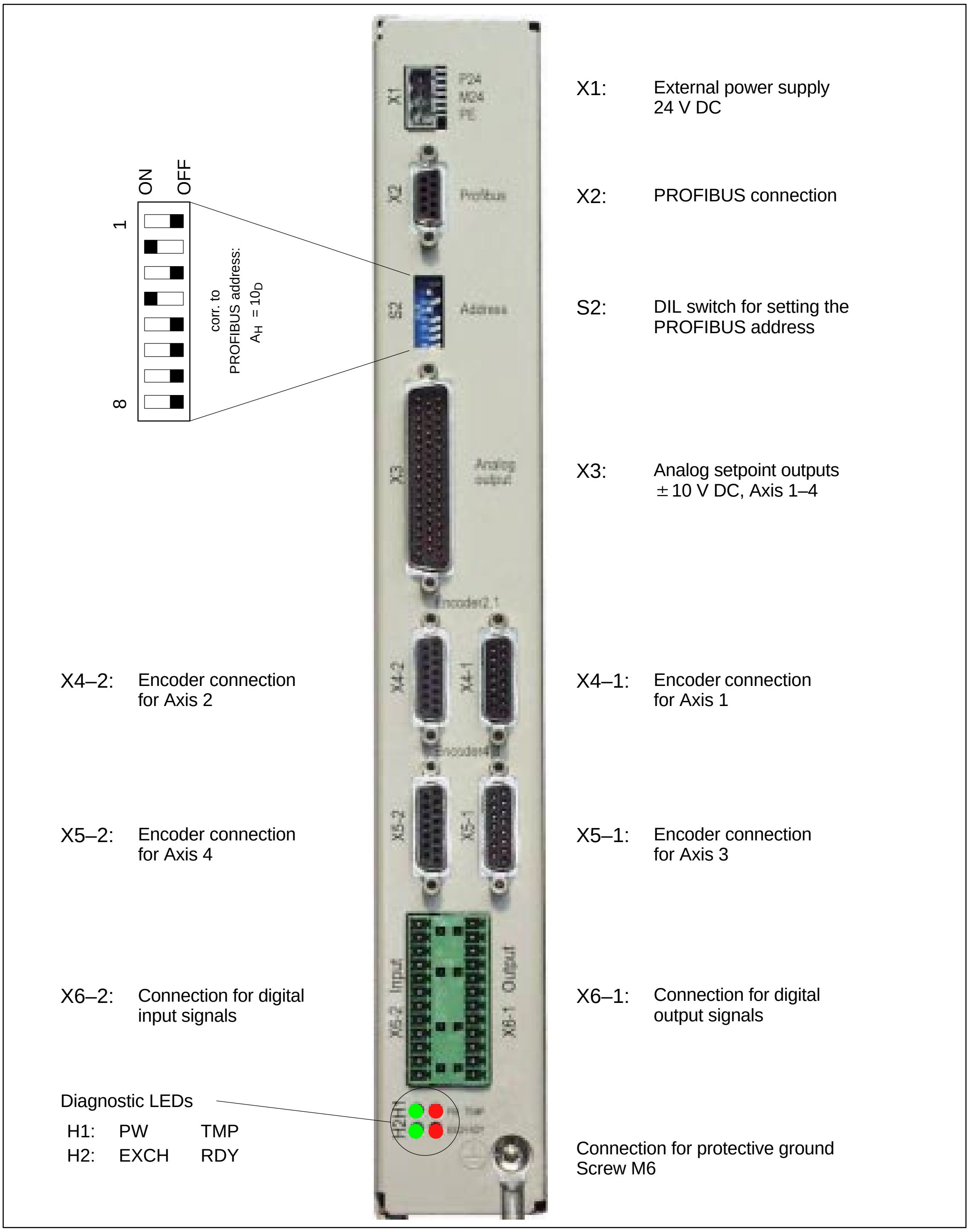


Fig. 2-25 Connection overview for ADI4

Order number

Description	Order number (MLFB)
ADI4	6FC5 211–0BA01–0AA1

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 important features:

- PROFIBUS–DP connection (max. 12 Mbits/s), specified by:
  PROFIDrive profile drive technology version 3,
  Draft V1.4.2, 01. September 00
- 4 servo interfaces each with one:
  - Input: TTL/SSI encoder for incremental and absolute measuring systems
  - Output ±10 V analog
- General and drive–specific digital input/output signals
- On–board 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 8.3.4, Page 8-206).
- 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

■

Notes

Design

3

3.1 System overview

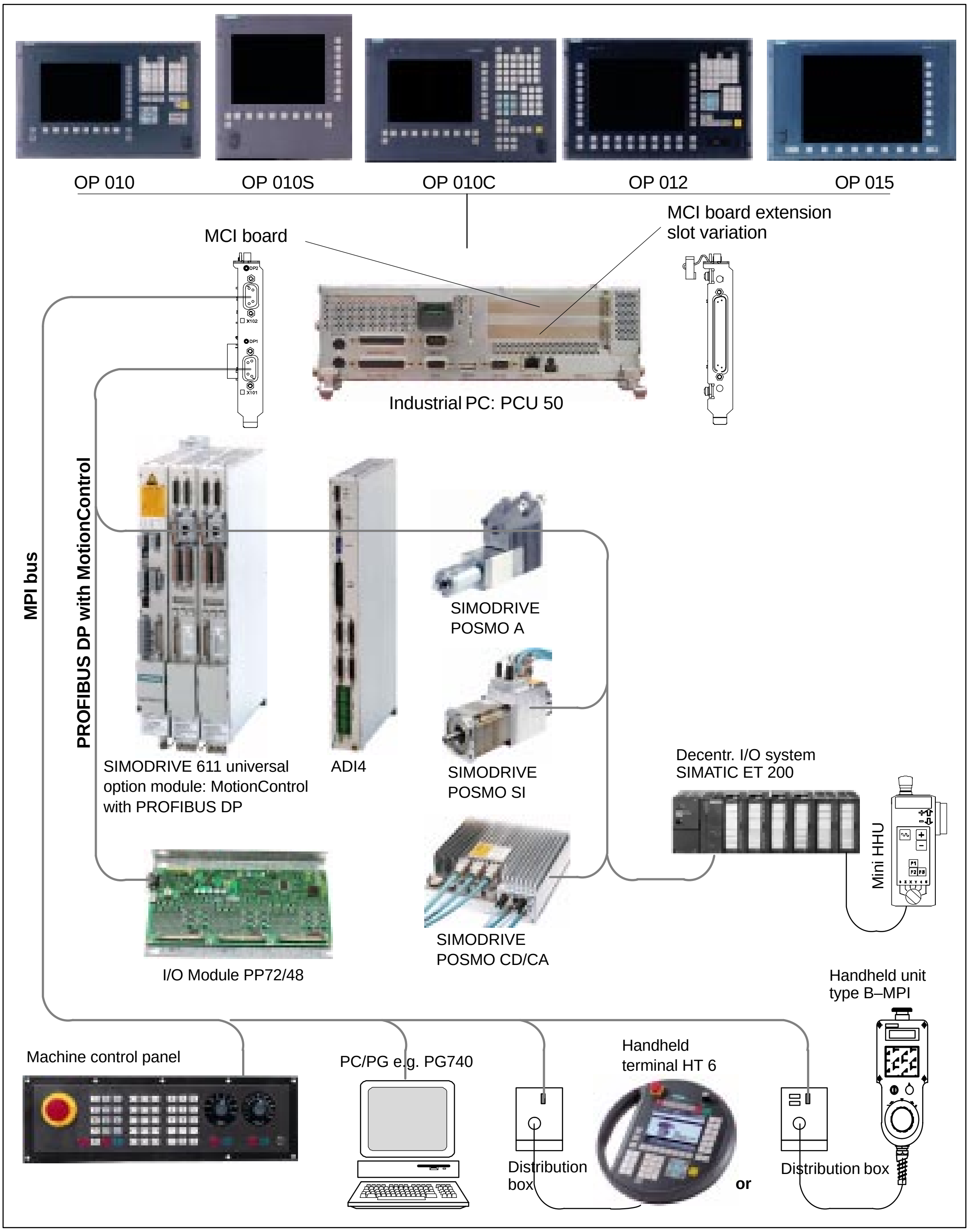


Fig. 3-1 SINUMERIK 840Di system overview: PROFIBUS DP and MPI (as a diagram)

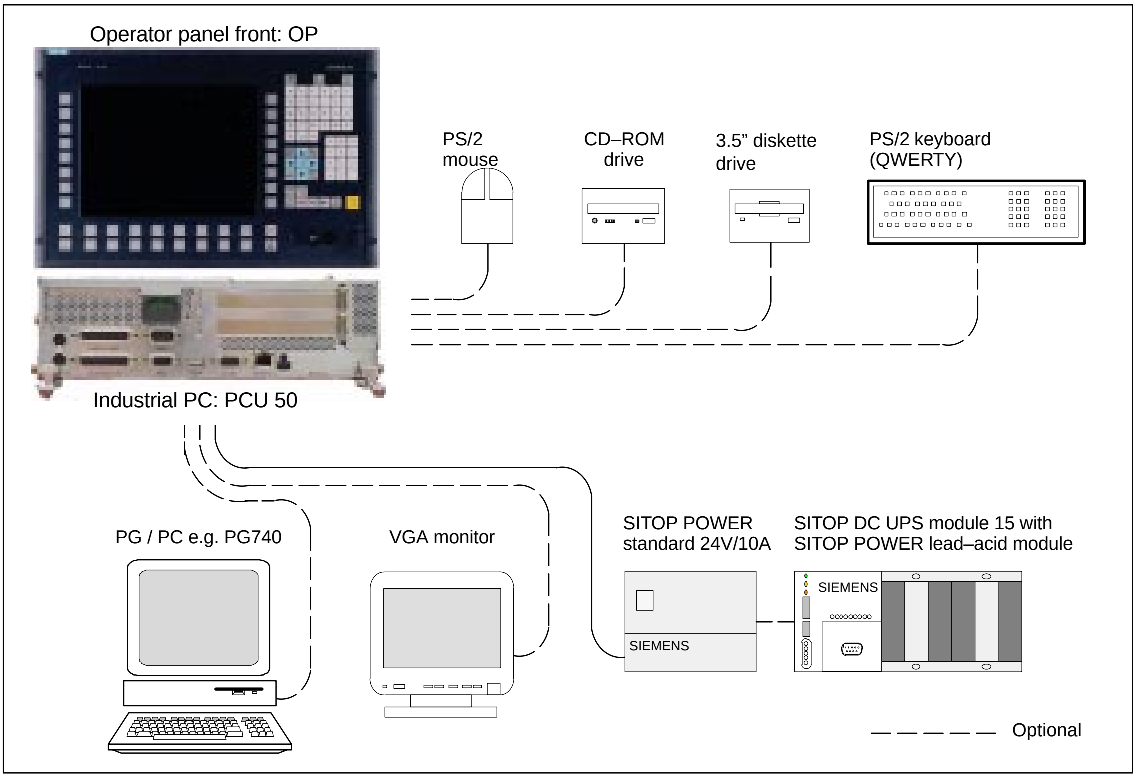


Fig. 3-2 System overview: PCU components (as a diagram)

3.2 Electrical design

Note

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

References: /Z/ Catalog NC Z**,** Accessories and Equipment

3.2.1 MCI board and PROFIBUS DP

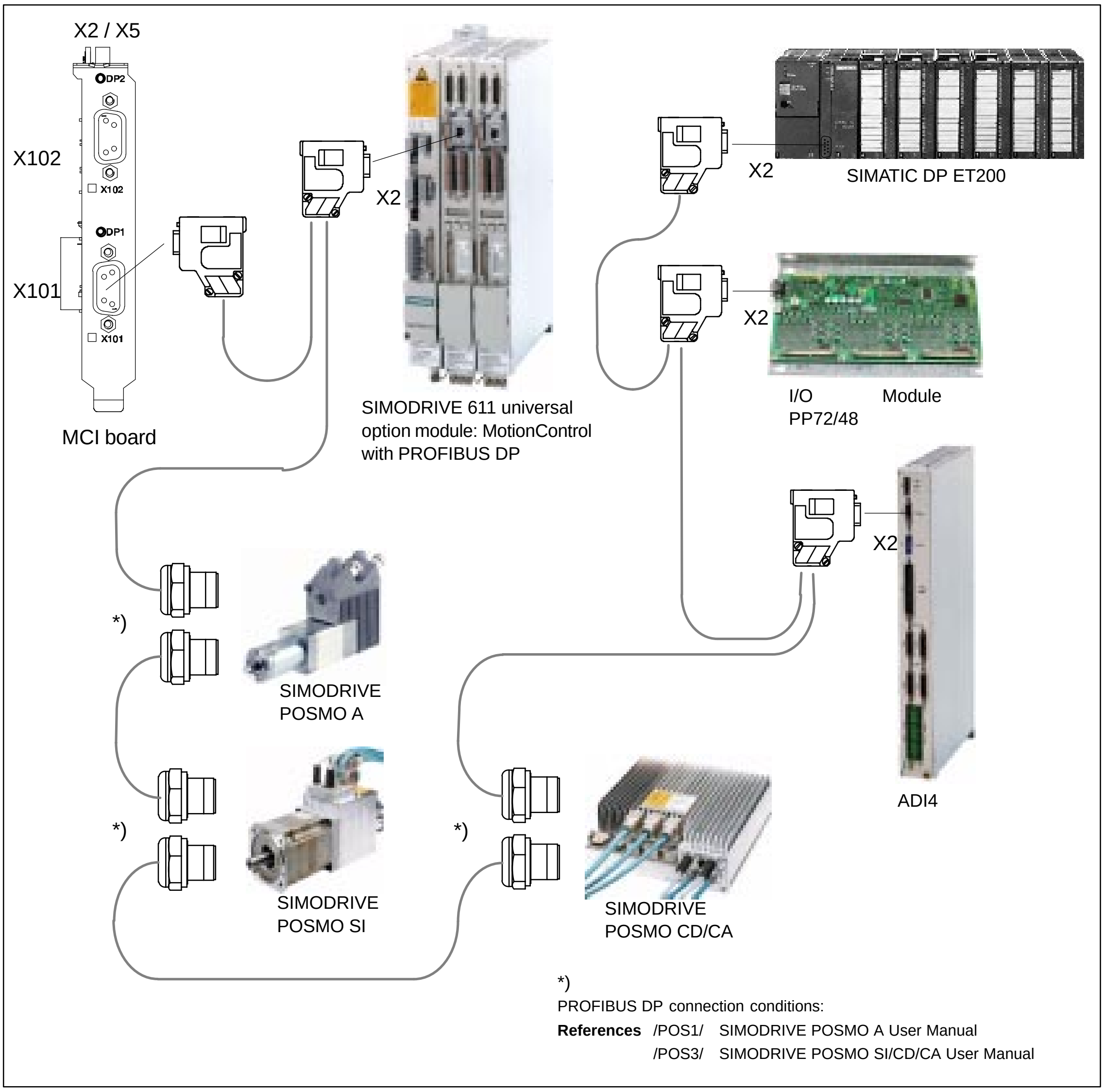


Fig. 3-3 SINUMERIK 840Di MCI board and PROFIBUS DP components

3.2.2 MCI board and MPI bus

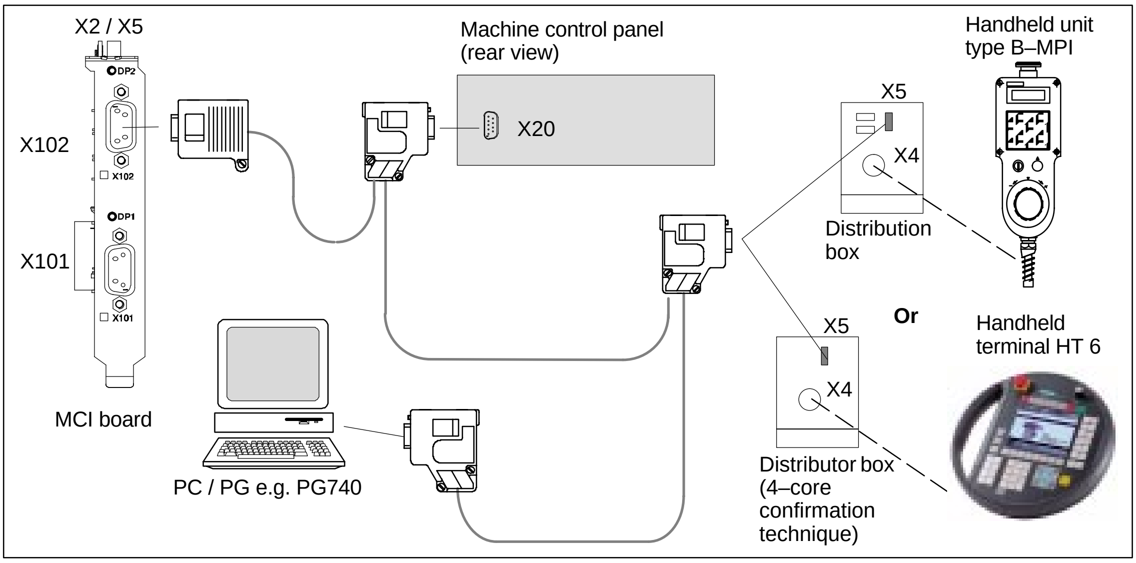


Fig. 3-4 SINUMERIK 840Di MCI board and MPI bus components

3.2.3 MCI board extension

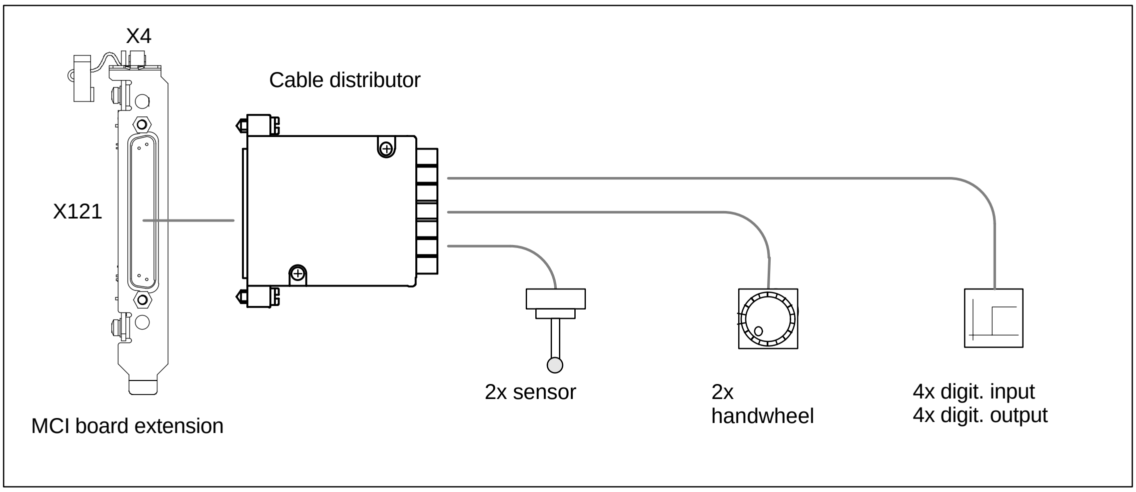


Fig. 3-5 SINUMERIK 840Di MCI Board Extension

3.2.4 PCU 50

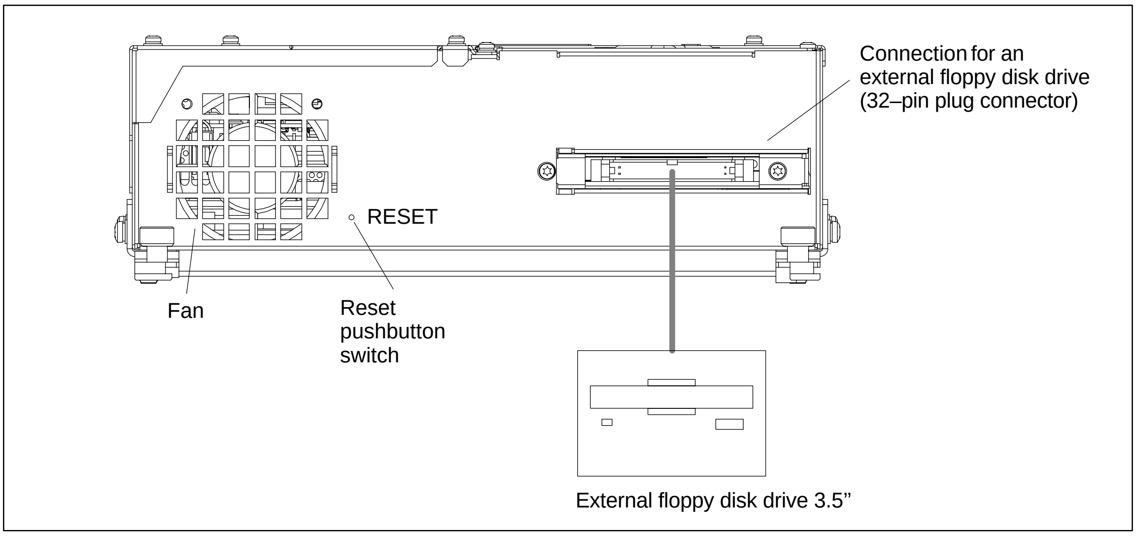


Fig. 3-6 SINUMERIK 840Di PCU 50, left housing side

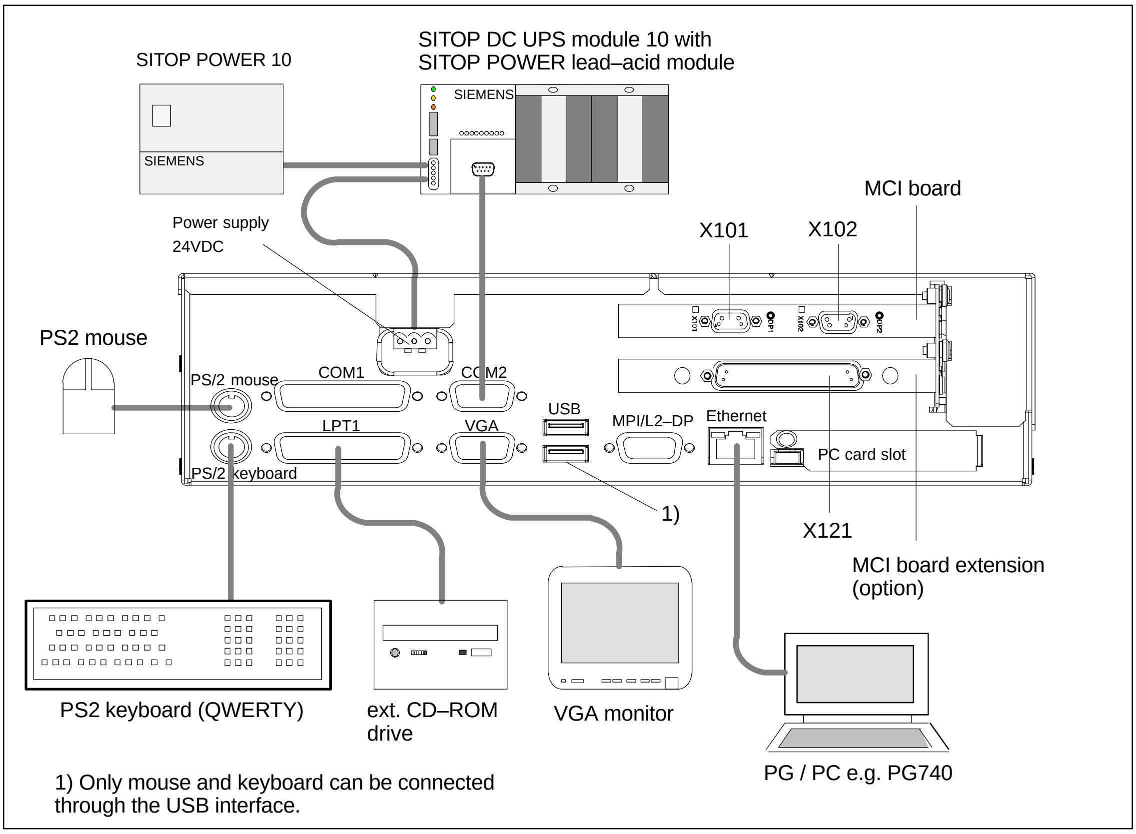


Fig. 3-7 SINUMERIK 840Di PCU 50 (right housing side)

3.3 Overview of connections

3.3.1 PCU50, MCI board and MCI board extension

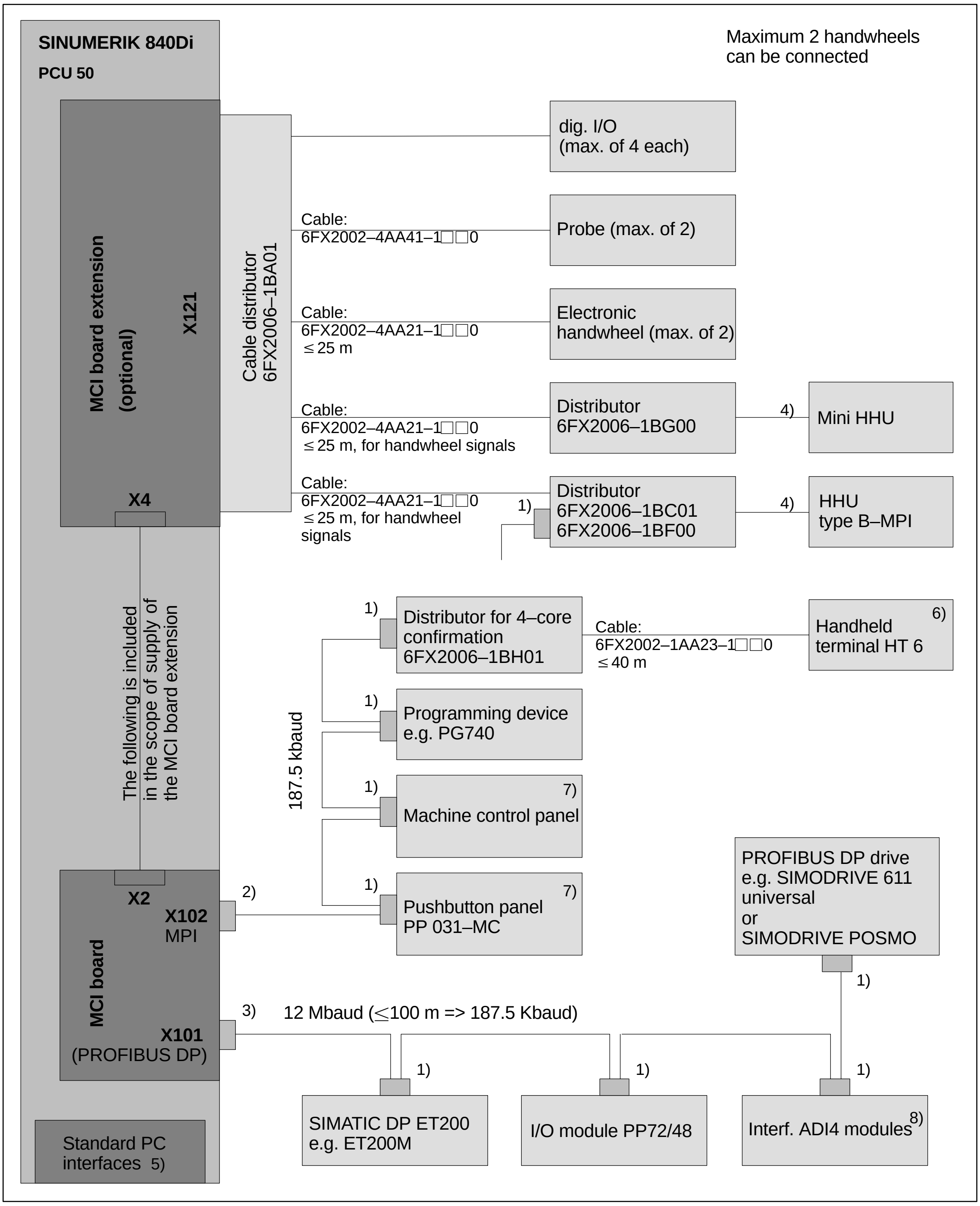


Fig. 3-8 Connection overview: PCU 50, MCI board, and MCI board extension

1) Connector:
6ES7972–0BA40–0XA0; cable outlet 35°, without socket connector for programming device
6ES7972–0BB40–0XA0; cable outlet 35°, with socket connector for programming device
6ES7972–0BA11–0XA0; cable outlet 90°, without socket connector for programming device
6ES7972–0BB11–0XA0; cable outlet 90°, with socket connector for programming device

Cable:
6XV1830–0EH10; available by the meter, not trailable
6XV1830–3BH10; available by the meter, trailable

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

Cable:
6XV1830–0EH10; available by the meter, not trailable
6XV1830–3BH10; available by the meter, trailable

3) Connector:
6ES7972–0BB40–0XA0; cable outlet 35°, without socket connector for programming device
6ES7972–0BB11–0XA0; cable outlet 90°, with socket connector for programming device

Cable:
6XV1830–0EH10; available by the meter, not trailable
6XV1830–3BH10; available by the meter, trailable

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

5) For an overview of the standard PC interfaces, see Fig. 3-6, Page 3-95 and Fig. 3-7, Page 3-95.
References: /BH/ Operator Components Manual
Component PCU 50

6) – HT 6 always connected: Max. 200 m from connector X102 to HT 6
– HT 6 not always connected: Max. 200 m from connector X102 to HT 6
with repeater: RS485 (6ES7972–0AA01–1XA0)
without repeater: Total length from connector X102 to distributor ≤ 5 m
– The line –4EA04 is not permitted.
Always connect the HT 6 at the end of the MPI line (integrated bus termination).

Note

The HT 6 can also be connected to a distributor with **3–core** confirmation.

– Distributor: 6FX2006–1BC01
– Cable: 6FX2002–1AA83–1□□0

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7) Machine control panel and pushbutton panel: PP 031–MC can be operated together.

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

Note

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

References: /BU/ SINUMERIK 840D/840Di/810D/FM–NC
Ordering information
Catalog NC 60 · 2000/2001

For conditions that may be applicable to the individual accessories, please refer to:

References: /Z/ SINUMERIK, SIROTEC, SIMODRIVE
Accessories and Equipment for Special–Purpose Machines
Catalog NC Z

■

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 connected at one end.

  These 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

To ensure that the entire installation (control, power section, machine) has the greatest possible immunity to interference, the following EMC measures must be taken:

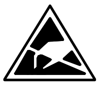
- Signal cables and load cables must be routed at the greatest possible distance from one another.
- Only use SIEMENS signal cables for connecting to and from the NC or PLC.
- Signal cables may not be routed close to strong external magnetic fields (e.g. motors and transformers).
- Pulse–carrying HC/HV 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 Installation Guide.

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, 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.

Power–On and Power–Up 5

5.1 Preparing for start–up

5.1.1 Checklist

SINUMERIK 840 Di

The following checklist will help you to start up 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.

SIMODRIVE 611 universal

With regard to the SIMODRIVE 611 universal inverter systems, some additional points must be observed. For more detailed information, please refer to the following references:

References: /FBU/ Description of Functions, SIMODRIVE 611 universal.

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
– Climatic ambient conditions
– Transportation/storage
– Shock stressing
– Vibration stressing
– Ambient temperature

5.1.2 Recommended sequence for first start–up

The individual steps for first start–up 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
   - 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 completely on first booting (Chapter 5.2, Page 5-103)
4. Create the PLC default program (basic PLC program, PLC user program and configuration) supplied for the PLC or your own SIMATIC S7 project and load it into the PLC (Chapter 8, Page 8-195)
5. Prepare the SIMODRIVE 611 universal drives for communication on PROFIBUS DP (Chapter 9, Page 9-221)
6. Perform start–up of the NC (channels, axes and spindles, etc. (Chapter 10.5, Page 10-260))
7. Set up the alarm texts (Chapter 11, Page 11-357)
8. Carry out start–up of the SIMODRIVE 611 universal drives through PROFIBUS DP using SimoCom U

   References: /FBU/ Description of Functions, SIMODRIVE 611 universal.
9. Carry out a dry run for all axes and the spindle (Chapter 12, Page 12-365)
10. Carry out the drive optimization of the SIMODRIVE 611 universal drives using HMI Advanced (Chapter 13, Page 13-371) and/or SimoCom U
11. Carry out a user data backup (series machine start–up file) (Chapter 14, Page 14-403)
12. If necessary, also carry out a complete data backup (partition and/or hard disk image) (Section 15.5, Page 15-425)

5.2 First power–up

5.2.1 Basic start–up of the system software

Objective of basic start–up

After the basic start–up described in the following two chapters, the following conditions should apply:

- SINUMERIK 840Di–NC and PLC are operated in cyclic 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.

As–delivered state

On delivery, the hard disk of the PCU is already partitioned for running SINUMERIK 840Di and any other SINUMERIK applications. The software applications included in the delivery are ready for installation and are located on the hard disk under D:\Setup\Apps\<*Application1*> . . <*Application n*>.

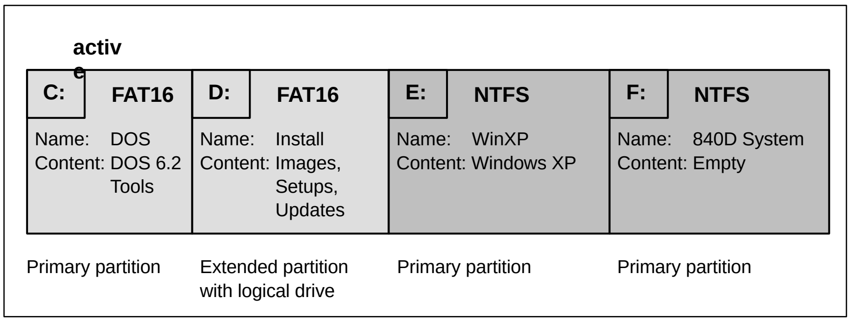
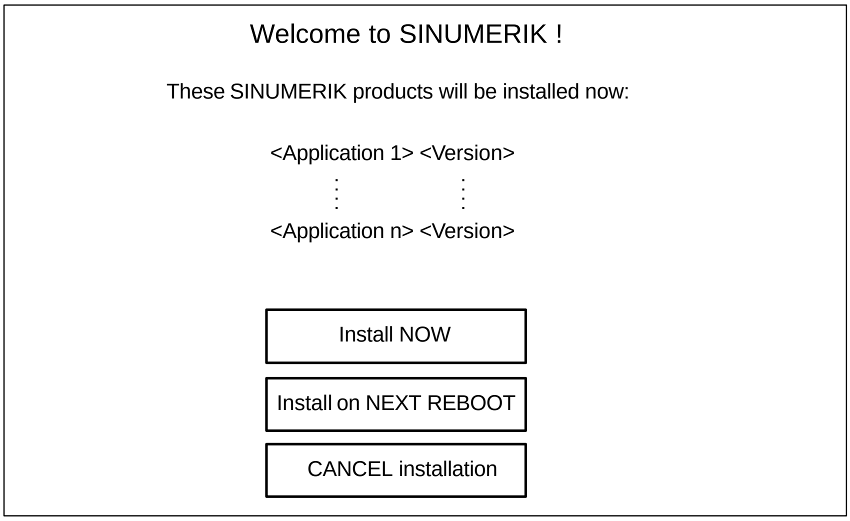


Fig. 5-1 Partitioning of the harddisk

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.

Notice

You must not switch off the PCU during the entire installation procedure. Loss of data !

- **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.
  Attention! It is not possible to repeat the installation process at a later time.

Notice

The installation menu is **not** displayed the next time the PCU is booted. It is **not** possible to repeat the installation process.

Completion

Once the PCU has powered up again, you can continue with the basic start–up procedure of the PLC (Subsection 5.2.2, Page 5-105).

5.2.2 Basic start–up of the PLC

SINUMERIK desktop

When installation is complete rebooting automatically starts. In the next PCU power–up the boot manager menu is displayed (see Subsection 5.3.1, Page 5-107).

To start the SINUMERIK desktop (Windows XP), confirm the active selection (SINUMERIK) with the input key or wait the preset time until the boot process is automatically continued.

SinuCom NC

Once the SINUMERIK desktop is active only the supplied PLC series machine start–up has to be loaded into the PLC for basic start–up.

To do so, proceed as follows:

1. Start the ”SinuCom NC” start–up tool from the Windows taskbar: **Start > Programs > SinuCom NC > SinuCom NC**
2. Use SinuCom NC to load the supplied series machine start–up file **PLC_SMP.ARC** into the PLC.

   Menu command: **File > SeriesStart–up archive > ReadIn**

   Dialog box: Read–in archive

   – Radio button: Data management
   – Button: ”NEXT”
   – Select file PLC_SMP.ARC in directory Archive
   – Button: ”FINISH”.

The PLC is now ready. NC and PLC run in cyclic mode.

If a machine control panel is connected, the LEDs of the machine control panel should now no longer flash and no more alarms should be present on the NC.

5.2.3 Machine control panel (MCP) boot

System software test

When you press the keys ”Feed Start” and ”Feed Stop” when the machine control panel powers up (all LEDs flash), the software version of the machine control panel is displayed.

This means that the system software of the machine control panel has booted correctly and waits until the cyclic communication is established by the PLC.

Check the MPI communication

Whether the machine control panel on the MPI bus is detected, can be checked as follows:

- **SIMATIC Manager STEP7**
  The active nodes at the MPI bus are displayed using the SIMATIC Manager STEP7 by menu command **Target system > Display accessible nodes**.

MPI standard addresses

The MPI default addresses of the individual components are:

- PLC = 2
- NC = *2* (PLC routes to the NC)
- 1st machine control panel or HT 6 = 14
  See default configuration Chapter 7.6, Page 7-163.
- HHU = 15

If the machine control panel is displayed as an MPI node with the correct address, it has been detected correctly.

5.2.4 Power–up SIMODRIVE 611 universal drives

For detailed information on the power–up of SIMODRIVE 611 universal drives, please refer to:

References: /FBU/ SIMODRIVE 611 Universal, Description of Functions

5.3 Booting

5.3.1 Boot manager

The PCU powers up and the menu of the boot manager is displayed:

```
OS Loader ...

Please select the operating system to start:

   SINUMERIK
   Service Menu (not visible)

Use ↑ and ↓ to move the highlight to your choice.
Press Enter to choose.
```

Make your selection with the cursor keys: and

Your selection is automatically started when you press the Enter key or after expiry of a defined time.

The following functions are available:

- **SINUMERIK** (normal case)
  See Section 5.4, Page 5-114.
- **Service menu** (service case)
  See Section 5.5, Page 5-120.
  Note
  The functions of the service menu are password protected. You require a password for protection levels 0 – 2.
  – System
  – Manufacturer
  – Service

5.3.2 SRAM handling

The user data of the NC (machine data, setting data, user variables, parts 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 also be saved to the hard disk of the PCU as an SRAM backup.

In certain error or service cases, it is also possible to use the SRAM image or backup to be able to continue work immediately without recommissioning the SINUMERIK 840Di.

Table 5-1 SRAM handling

Serial No. 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 Subsection 5.3.4; case 1
Known	no	no	Yes	BACKUP / *message box and alarm;* see Subsection 5.3.4; case 2
Known	no	no	no	Start–up / *Restart–up required*
Unknown	Yes	Yes	not applicable	MCI or IMAGE / *Request carried out;* See Section 5.3.6
Unknown (SW update)	Yes	not applicable	not applicable	MCI / *message box;* See Subsection 5.3.5
Unknown	Yes	no	Yes	MCI or BACKUP / *Request carried out; if BACKUP is selected, message box and alarm will occur;* see Subsection 5.3.4; case 2
Unknown	Yes	no	no	MCI / *message box;* See Subsection 5.3.5
Unknown	no	Yes	not applicable	IMAGE / *MessageBox;* see Subsection 5.3.4; case 1
Unknown	no	no	Yes	BACKUP / *message box and alarm;* see Subsection 5.3.4; case 2
Unknown	no	no	no	Start–up / *Restart–up required*

Serial no. of MCI board

known: The serial no. of the MCI board complies with the serial number last stored on the PCU.

unknown: The serial no. of the MCI board does **not** comply with 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 it runs up 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.
2. . Windows XP must be shut down correctly (for this, POWER FAIL mechanism of the SINUMERIK 840Di 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 O.K.

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.

Start–up The user data of the NC are deleted and default machine data loaded.

5.3.3 Start–up after battery replacement (backup battery of the MCI board)

Correct shutdown

Before you replaced the backup battery of the MCI board, the SINUMERIK 840Di 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 Subsection 16.1.1, Page 16-449

Inverting SRAM memory cells

If SRAM memory cells are inverted when changing the battery, this will be detected during power–up. In this case, the SRAM image will be written back to the SRAM of the MCI board and the SINUMERIK 840Di is thus ready immediately.

Responses

None.

Notice

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

The SINUMERIK 840Di must then be restarted.

5.3.4 Start–up after replacement of the MCI board

After the MCI board has been changed, the further procedure depends on the past history. The following cases are distinguished:

1. An up–to–date SRAM image exists
2. An up–to–date SRAM image does <u>not</u> exist.

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 serial number. The SRAM image will then be written back to the SRAM of the MCI board. The SINUMERIK 840Di 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 detected defective during the power–up of the SINUMERIK 840Di, the last SRAM image is kept when shutting down Windows XP. After the MCI board has been changed, proceed as described above.
2. If the MCI board is changed due to a supposed or an actual error (in the case of suspected errors, sporadic errors, etc.), we recommend starting up the SINUMERIK 840Di–NC and PLC; otherwise, data errors could be taken over from the SRAM image.

Case 2: An up–to–date SRAM image does not exist

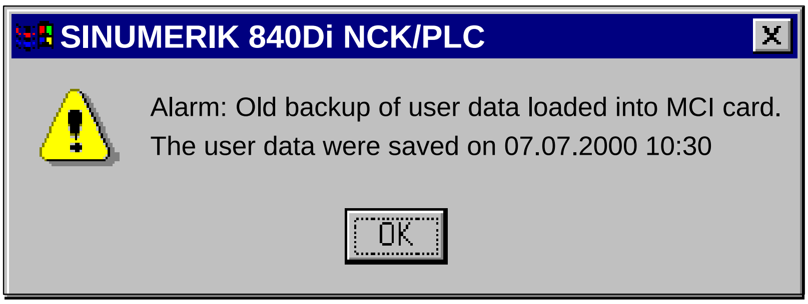
A defect of the MCI board has occurred during operation of the SINUMERIK 840Di. Windows XP has possibly been shut down correctly, but no SRAM image could be created.

After the MCI board has been changed, it will be identified as ”unknown” using the serial number. Since no up–to–date SRAM image exists, the SRAM backup is written back into the SRAM of the MCI board. The SINUMERIK 840Di is thus ”ready” again immediately.

The user data or the operating state of the SINUMERIK 840Di must be checked to see whether they are suitable to be worked with in the future. It might be necessary to perform commissioning of the SINUMERIK 840Di NC and PLC again.

Responses

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



In addition, an NC alarm is output, which is displayed on the appropriate user interface of the SINUMERIK 840Di (840Di start–up, HMI Advanced, etc.):

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

To acknowlege the alarm you must first acknowledge the alarm itself with a special operation before executing the required NCK POWER ON Reset. See Subsection 10.10.1, Page 10-350ff.

5.3.5 Start–up after replacement of the PCU (new) or reinstallation/Update of the 840Di software

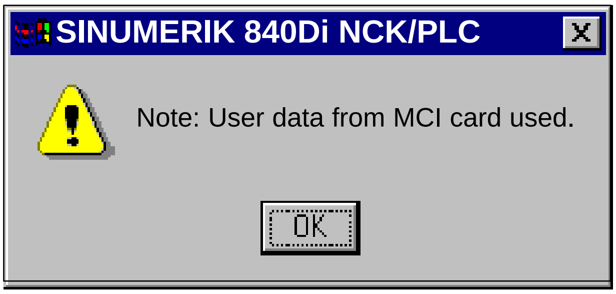
If an MCI board used in a **new** PCU once is further used or if the 840Di software is reinstalled on a SINUMERIK 840Di that is already started up, the battery–backed user data in the SRAM of the MCI board are kept.

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 is thus ready again immediately.

Responses

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



Notice

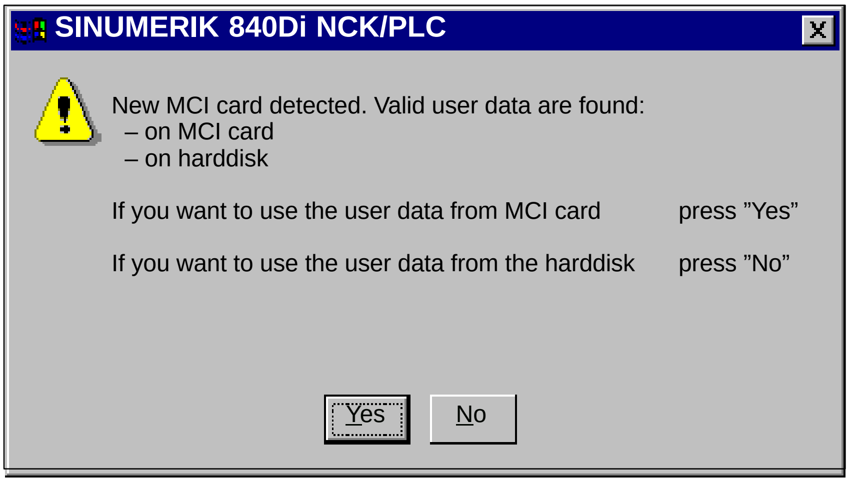
If you do not wish to use the battery–backed user data further, you must repeat start–up of the SINUMERIK 840Di.

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

If it is detected during the power–up that both the SRAM image on the hard disk of the PCU and the SRAM of the MCI board have battery–backed valid, but different user data (both components were already used in a SINUMERIK 840Di), it is not possible to make an automatic selection.

Responses

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



5.3.7 Start–up after importing a backup copy

If a backup copy (ghost image) of a SINUMERIK 840Di already started up is loaded into the PCU again, the battery–backed user data in the SRAM of the MCI board will be used further.

The SINUMERIK 840Di is thus ready again immediately.

5.3.8 Start–up after power failure / Power Fail

Case 1: SRAM saved

In case of a power failure, the SINUMERIK 840Di will save the user data in the SRAM of the MCI board thanks to the Power Fail detection integrated in the PCU. 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 is thus ready again immediately.

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
Chapter: Component PCU 50

Case 2: SRAM not saved

If the SINUMERIK 840Di has been operated outside its defined specifications, it is under certain circumstances possible that the user data could not be saved in the SRAM. Therefore, proceed as described in Subsection 5.3.4, Page 5-109 case 2.

5.3.9 Power–up with shutdown signal

If the SINUMERIK 840Di is operated with a UPS unit the shutdown signal must be configured accordingly. See Subsection 10.10.2, Page 10-354. If a shutdown signal is pending first the NC and PLC and then Windows XP are shut down correctly.

1. Power–up

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

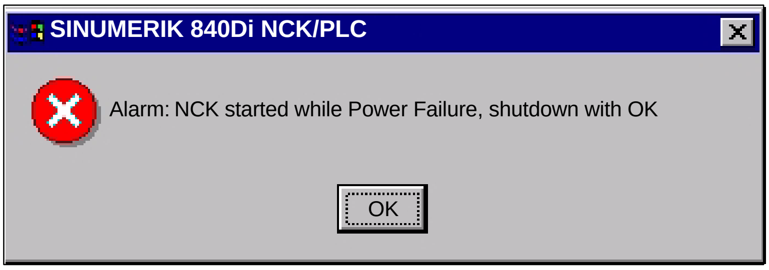
From 2nd power–up

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 Subsection 10.10.2, Page 10-354) 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.

5.4 SINUMERIK desktop

The SINUMERIK desktop is used for servicing and offers various SINUMERIK 840Di specific functions at Windows level together with Windows specific standard functions.

5.4.1 Activating the SINUMERIK desktop

During the standard PCU power–up procedure the boot manager activates the SINUMERIK desktop after a set delay (see Subsection 5.3.1, Page 5-107) and the relevant HMI application is started automatically. In normal cases, therefore, the SINUMERIK desktop is not visible to the machine operator.

Activation

The SINUMERIK desktop is activated from the service menu. See Subsection 5.5.4, Page 5-122.

Functions

The following SINUMERIK 840Di specific functions can be accessed from the SINUMERIK desktop:

- **Readme**
  Notes and conditions concerning the installed SINUMERIK 840Di system software.
- **Windows desktop**
  Autostart of the HMI application: OFF
- **HMI desktop**
  Autostart of the HMI application: ON
- **HMI Explorer**
  The HMI Explorer is used to display the version and install or post–install the supplied SINUMERIK application.
- **Original SINUMERIK HMI Environment**
  Deactivates the user–specific extensions of the SINUMERIK HMI application (as–delivered state). See Subsection 5.4.3, Page 5-115.
- **Current SINUMERIK HMI Environment**
  Activates the user–specific extensions of the SINUMERIK HMI application (as–delivered state). See Subsection 5.4.3, Page 5-115.
- **Check SINUMERIK System**
  Checks all SINUMERIK relevant system data. See Subsection 5.4.4, Page 5-115.
- **STEP 7 Authorizing**
  Authorizes a SIMATIC STEP 7 installed on the PCU. See Subsection 5.4.10, Page 5-119.
- **SINUMERIK 840Di Startup**
  Simple SINUMERIK 840Di–specific user interface.

Note

When Windows NT starts up the SINUMERIK 840Di NC system software is automatically started in the background.

5.4.2 Setting the power–up response for the SINUMERIK desktop

After the service menu has been activated (see Subsection 5.5.4, Page 5-122), the SINUMERIK desktop is displayed the next time the PCU is started up.

When the PCU is next started after that the HMI application is automatically started again.

If this response is not desired, for example, when servicing, the response of the PCU after power–up can be set with the following applications on the SINUMERIK desktop:

- **Windows desktop**
  Autostart of the HMI application: OFF
- **HMI desktop**
  Autostart of the HMI application: ON

5.4.3 Setting the SINUMERIK HMI environment

The data of the user–specific HMI system environment are located in the following directories:

- F:\ADD_ON
- F:\USER
- F:\OEM
- C:\RUNOEM

The following functions are available as script files on the SINUMERIK desktop for setting the HMI system environment:

- **Original HMI environment**
  Before the HMI application is started the HMI system environment is restored to its as delivered state. For this the content of the above mentioned directories are saved. Then the directories are cleared.
- **Current HMI environment**
  Before the HMI application is started the user–specific HMI system environment is loaded. For this, the saved data are loaded into the above mentioned directories.

Note

This function can be also be run from the service menu (Chapter 5.5.4, Page 5-122).

5.4.4 Testing system components

The following function on the SINUMERIK desktop is used to check the system components

- Check SINUMERIK System

and is available as a script file. The function tests the following system components:

– Harddisk of PCU
  Partitions C:, D:, E: and F: are tested.

Note

This function can be also be run from the service menu (Subsection 5.5.5, Page 5-122).

5.4.5 Authorizing SIMATIC STEP 7

For authorizing SIMATIC STEP 7 software previously installed on the PCU, you can use the function on the SINUMERIK desktop

- STEP 7 authorizing

which is available as a script file.

Note

This function can be also be run from the service menu (Subsection 5.5.2, Page 5-121).

5.4.6 Serial mouse

The two COM interfaces of the PCU are by default set in such a way that serial devices (except for a serial mouse) can be used connected to them.

Serial mouse Activating

The following settings are required to operate a mouse:

- Modify the boot.ini file:
  – With a Windows standard editor open file: **C:\boot.ini**
  – In section: [*operating systems*]
    remove the option: **/NoSerialMice**
  – Save and close the changed file.
- Adjust the system setting to ”serial mouse”:
  – Select the serial mouse used in the Mouse Properties dialog box from the Control Panel: **Start > Settings > Control > Mouse**

Dialog box

Dialog box: Mouse Properties
    Tab card: General
        Button: ”Change...”

            Dialog box: Select Device
                Radio button: ”Show all devices
                    Select relevant serial mouse
            OK

OK

Note

After you have activated the serial mouse, a PS/2 mouse that you were previously using will no longer work.

5.4.7 System information after ”Fatal exceptional error”

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

- D:\Memory.dmp.

5.4.8 OEM configuration

OEM directories

OEM configuration provides the possibility of running Windows programs before starting the SINUMERIK system software. The Windows programs or links must be routed to special directories.

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

Note

Sequentially means that a program is not launched until the previous program has been closed.

3. C:\RunOEM\ParOnce
   Programs stored here are started once. They run parallel with the HMI system software.
4. C:\RunOEM\Par
   Programs stored here are started on each start–up. They run parallel with the HMI system software.

Order of execution

Subdirectories and programs are executed in the order listed above.

- Subdirectories
  The subdirectories are executed in the order 1. to 4. listed above.
- Programs
  The programs within a subdirectory are started in 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

5.4.9 User–specific background images

User–specific background images can be displayed while the control is powering up. The background images in question must be stored in bitmap format (*.BMP) in a defined directory structure. Depending on the NCK type and screen resolution, the HMI application then automatically selects the relevant file.

Directory structure

The directory must be structured as follows:

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

Parameter: *NCK type*

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

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

- **default**
  If a directory: default is created, the background image stored under this directory will always be stored irrespective of the existing NCK type.
- **5000**
  Background images stored under directory: 5000 (ID for SINUMERIK 840Di) are only displayed by the HMI application together with a SINUMERIK 840Di.

Parameter: *Screen resolution*

The different screen resolutions of the individual display units are displayed depending on the directory name.

The following values may be used as directory names:

- **640**
  ID for screen resolution: 640 x 480
- **800**
  ID for screen resolution: 800 x 600
- **1024**
  ID for screen resolution: 1024x 768

Note

Directory: *Screen resolution* may only contain one file.

Parameter: *File name*

You can choose any file name.

5.4.10 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.)

– Installation directory

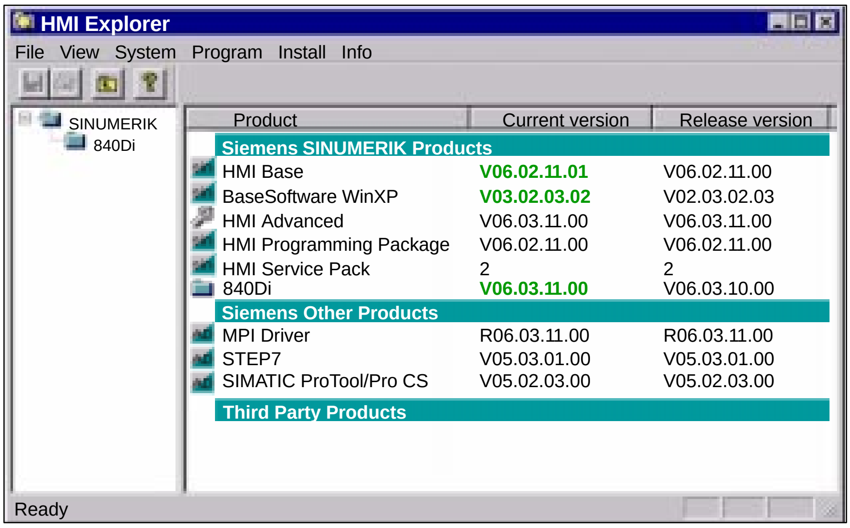


Fig. 5-2 HMI Explorer: Product/Version Display (Example)

Version display

The following versions are displayed for each software application:

- Current version
  Current version number
- Release version
  Version number with which 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**

5.4.11 SW installation/update

The SINUMERIK desktop allows you to install or update software directly from an external computer using a specially configured network link. For a detailed description see Chapter 15, Page 15-411.

5.5 Service menu

```
PLEASE SELECT
    1   Install/Update SINUMERIK System
    2   SINUMERIK Tools and Options
    3   DOS Shell
    4   Start Windows XP (service mode)
    5   SINUMERIK System Check
    7   Backup/Restore
    8   Start PC Link

    9   Reboot (warm restart)

    E   Restore Windows Partition E (Emergency)
    P   840Di Services

Your Choice [1,2,3,4,5,7,8,9,E,P] ?
```

Fig. 5-3 Main menu

Activation

The service menu is opened from the boot manager with operating sequence ”Cursor down” and ”Enter” (see Subsection 5.3.1, Page 5-107).

A password of protection levels 0 – 2 is required to execute the service menu:

– System
– Manufacturer
– Service

Functions

The service menu provides the following functions at DOS level:

- Install/update SINUMERIK system
  Installation and addition or updating of the SINUMERIK system
  See Subsection 5.5.1, Page 5-121.
- SINUMERIK tools and options
  Loading additional tools and enabling options.
  See Subsection 5.5.2, Page 5-121.
- DOS Shell
  The DOS command interpreter is started.
  See Subsection 5.5.3, Page 5-121.
- Start Windows
  The Windows operating system is started
  See Subsection 5.5.4, Page 5-122.
- SINUMERIK System Check
  Consistency test and, if necessary, recovery (SCANDISK) of the file system
  See Subsection 5.5.5, Page 5-122.
- Backup/Restore
  Hard disk backup/restore with Norton Ghost™
  See Subsection 5.5.6, Page 5-123.
- Start PC Link
  Installation of the PC link software (interlink/interserve) for data transmission via the parallel interface (no longer recommended)
- Reboot
  Restart of the system
- 840Di services
  Activate 840Di–specific functions
  See Subsection 5.5.8, Page 5-123.

5.5.1 Install/update SINUMERIK system

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **Install/Update SINUMERIK System** with key ”**1**”.

You will find a detailed description of the function: SW–Installation/Update in Section 15.4, Page 15-424.

5.5.2 SINUMERIK tools and options

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **SINUMERIK Tools and Options** with key ”**2**”.

Following menu:

```
PLEASE SELECT
        1 Activate Step7 for PCU

        9 Return to Main Menu

Your Choice [1, 9] ?
```

Functions

You can execute the following functions via the menu:

- Activate Step7 for PCU
  SIMATIC STEP7 is authorized automatically when the PCU is next started up under Windows.

Note

SIMATIC STEP7 will only be authorized on the PCU if the SIMATIC STEP7 software has already been installed on the PCU.

Authorization can also be performed on the SINUMERIK desktop by starting the function ”STEP7 Authorizing”.

5.5.3 DOS Shell

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **DOS Shell** with key ”**3**”.

The DOS command interpreter is started.

To leave the DOS Shell enter ”exit” and conclude the command with the ”Return” key.

Version display: Basic software

The version of the basic software is displayed with the command:

- C:\BaseVers.txt.

5.5.4 Starting Windows (service mode)

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **Start Windows (ServiceMode)** with key ”**4**”.

Following menu:

```
PLEASE SELECT
          1 Standard Windows (without starting SINUMERIK HMI)
          4 Original SINUMERIK HMI environment
          5 Current SINUMERIK HMI environment

          9 Return to Main Menu

Your Choice [1,4,5,9] ?
```

Functions

You can execute the following functions via the menu:

- Standard Windows (without starting SINUMERIK HMI)
  After the PCU has started up, Windows is started without starting any SINUMERIK HMI application.
- Original SINUMERIK HMI environment
  SINUMERIK HMI is started in the as–delivered state, i.e. the content of the directories:
  – F:\ADD_ON
  – F:\USER
  – F:\OEM
  – C:\RUNOEM
  has been backed up and the directories then cleared.
- Current SINUMERIK HMI environment
  Before SINUMERIK HMI is started, the backed up files from the above directories are loaded.

After you have selected the function, the system is rebooted. The function is actually executed during the ensuing start–up of Windows before the HMI system software is started.

Note

The HMI environment can also be set on the SINUMERIK desktop by starting the functions:

– Original SINUMERIK HMI Environ
– Current SINUMERIK HMI Environ

5.5.5 SINUMERIK System Check

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **SINUMERIK System CHECK** with key ”**5**”.

Functions

You can execute the following functions via the menu:

- Hard disk of the PCU
  Partitions C:, D:, E: and F: are tested.

After you have selected the function, the system is rebooted. The function is actually executed during the ensuing start–up of Windows before the HMI system software is started.

Note

You can also starting testing of the system components from the SINUMERIK desktop by starting the function ”Check SINUMERIK System”.

5.5.6 Backup/Restore

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **Backup/Restore** with key ”**7**”.

You will find a detailed description of the backup/restore functions (data backup) in Section 15.5, Page 15-425.

5.5.7 Restore Windows Partition E (Emergency)

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **Restore Windows Partition E (Emergency)** with key ”**E**”.

A detailed description of the restore function is to be found in Subsection 15.2.7, Page 15-422.

5.5.8 840Di services

Operator action

Starting from the main menu (see Fig. 5-3, Page 5-120) select **840Di–Services** with key ”**P**”.

Following menu:

```
PLEASE SELECT
        1 Set PLC–Mode to STOP
        2 Set PLC–Mode to RUN
        3 Set PLC–Mode to RUNP
        4 Initialize NCK Data (You will loose all NCK user data)
        5 Boot without starting NCK / PLC

        9 Return to Main Menu

Your Choice [1,2,3,4,9] ?
```

Functions

You can execute the following functions via the menu:

- Set PLC Mode to STOP
- Set PLC Mode to RUN

- Set PLC Mode to RUNP
- Initialize NCK Data (You will loose all NCK user data)
  Notice!
  This function deletes all user data.
- Boot without starting NCK / PLC

After you have selected the function, the system is rebooted. The function is actually executed when the PCU is next started up.

The following message box is displayed to show that 840Di Service is being executed:

The message box must be acknowledged with ”OK”.

The selected function is executed after start–up of the corresponding SINUMERIK 840Di component.

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

5.6.1 Configuring the network link (Windows XP)

To perform service functions (software instllation/update) the SINUMERIK 840Di 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 15.1, Page 15-411.

LAN/WAN link

The PCU basic software is preconfigured for a PTP network link via Ethernet with the TCP/IP protocol.

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 card: General
  - IP address via DHCP
    Option: Obtain an IP address automatically
  - Automatic DNS server address
    Option: Obtain a DNS server address automatically
- Tab card: 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.

5.6.2 Configuring the network link (DOS / Service menu)

To perform service functions (create/import data backup) the SINUMERIK 840Di requires an active link under DOS / service menu 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 15.2, Page 15-416.

LAN/WAN link

An example of how to configure a PCU network link in a larger network (LAN/WAN) using the service menu is given below. You must set and check the following parameters:

- Machine name (computer name)
- User name
- Workgroup / domain
- TCP/IP protocol
- TCP/IP parameters (IP address, subnet mask, etc.)

Note

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

Service menu

The service menu is activated by the boot manager when the PCU is started up. See Subsection 5.3.1, Page 5-107.

The main menu of the service menu is displayed when start–up is complete:

```
PLEASE SELECT
    1   Install/Update SINUMERIK System
    2   SINUMERIK Tools and Options
    3   DOS Shell
    4   Start Windows (service mode)
    5   SINUMERIK System Check
    7   Backup/Restore
    8   Start PC Link

    9   Reboot (Warmstart)

    P   840Di Services

Your Choice [1,2,3,4,5,7,8,9,P] ?
```

Network settings

One after the other select:

– Key ”**7**”: **Backup/Restore**

– Key ”**1**”: **Harddisk Backup/Restore with Ghost**

– Key ”**1**”: **Configure Ghost Parameters**

– Key ”**6**”: **Manage Network Drives**

– Key ”**4**”: **Change Network Settings**

The following menu appears:

```
CURRENT NETWORK SETTINGS
      Machine Name            : <COMPUTER_NAME>
      User Name               : auduser
      Transport Protocol      : TCP/IP
      Logon to Domain         : No

                  PLEASE SELECT
                        1   Change Machine Name (for DOS–Net only)
                        2   Change User Name
                        3   Toggle Protocol (NetBEUI / TCP/IP)
                        4   Toggle logon to Domain (Yes or No)
                  [     5   Change Domain Name ] displayed only when 4 = Yes
                  [     6   Change TCP/IP Settings ] displayed only when 3 = TCP/IP

                        9   Back to previous menu

                  Your Choice [1,2,3,4,5,7,8,9,P] ?
```

Machine name (computer name)

The current computer name is displayed under CURRENT NETWORK SETTINGS: Machine Name. The default name is: ”PCUXXXXXXX”. You can change the computer name under **Change Machine Name** with key ”**1**”.

In normal circumstances the computer name displayed is identical to that valid under windows, unless it has been changed with menu item: ”Change Machine Name (for DOS–Net only)”. However, this change is only valid at DOS level until the PCU is next started up.

Restrictions

- You can choose any computer name.
- The computer name must be unique in the domain to which the PCU is linked.

User name

The current user name is displayed under CURRENT NETWORK SETTINGS: User Name. The default name is: ”auduser”. You can change the logon name under **Change User Name** with key ”**2**”.

With domain server

If the PC is registered in a particular domain the user (logon name) and the password must be known to the domain server to allow a network link to an enabled directory of an external computer.

Without domain server

If the PCU is <u>not</u> registered in a domain the user (logon name) must be set up as the local user on the external computer to allow a network link to an enabled directory of an external computer.

Workgroup / domain

The workgroup of the PCU is permanently set to Windows default: WORKGROUP and <u>cannot</u> be changed.

Logon of the PCU in a domain is deactivated by default. Shown under CURRENT NETWORK SETTINGS: Logon to domain = No.

Workgroup

If the PCU is a node of a network without a domain server the workgroup names of the external computers to which a network link is to be established must be set to WORKGROUP.

Domain

The PCU is logged into a domain with ”**Toggle logon to domain**” with key ”**4**”. In the following dialog you must enter the domain name and the user password of the user entered under the logon name.

You can change the domain name under **Change Domain Name** with key ”**5**”.

Protocol: TCP/IP

Protocol: TCP/IP is set by default. If NetBEUI is displayed, you must switch to TCP/IP under **Toggle Protocol (NetBEUI / TCP/IP)** and key ”**3**”.

Note

If a network link already existed with the displayed protocol the alternative protocol is not activated until the next time the PCU is started up (restart).

Setting the TCP/IP parameters

To set or check the TCP/IP parameters select **Change TCP/IP Settings** with key ”**6**”.

The following menu appears:

```
PLEASE SELECT
      1   Toggle ”Get IP Adress” (automatically or manually)
      2   Change IP Address
      3   Change Subnetmask
      4   Change Gateway
[     5   Domain Name Server
[     6   Change DNS Extension

      9   Back to previous menu

Your Choice [1,2,3,4,5,7,8,9] ?
```

Automatic IP addressing (DHCP)

If the IP address is assigned for the PCU automatically via a DHCP server, set ”automatically” under **toggle ”Get IP Address”** with key ”**1**”:

The following TCP/IP parameters only have to be set manually because the relevant data are sent by the DHCP server.

– Subnet mask
– Gateway
– Domain name server
– DNS extension

The network link with DHGP is now configured.

Confirm the query whether you want to store the network parameters when you exit the menu with key ”**Y**” (the settings are stored).

Manual IP addressing

If the IP address is assigned for the PCU manually because no DHCP server exists in the network, set ”manually” under**toggle ”Get IP Address”** with key ”**1**”.

The following TCP/IP parameters must then be set manually:

- **IP address**

  Select **Change IP Address** with key ”**2**”.

  Enter the IP address of the PCU.

  Syntax

  In the service menu the IP address of the PCU must be entered with a blank used as the tuple separator.

  Example

  IP address: `169 254 10 1`

- **Subnet mask**

  Select **Change Subnetmask** with key ”**3**”.

  Enter the subnet mask. Together with the subnet mask the IP address specifies which network the PCU belongs to.
  For information on syntax see above: IP address.

- **Gateway** (optional)

  Select **Change Gateway** with key ”**4**”.

  Enter the IP address of the standard gateway via which the PCU can exchange data with other networks.
  For information on syntax see above: IP address.

- **Domain Name Server** (optional)

  If a domain name server exists in the network, select **Domain Name Server** with key ”**5**”.

  Enter the IP address of the Domain Name Server that is to be contacted when a connection is established to the external computer.
  For information on syntax see above: IP address.

- **DNS extension** (optional)

  If a domain name server exists in the network, select **Change DNS Extension** with key ”**6**”.

  Enter the DNS extension to be used to extend the name of the external computer to its full domain name.

  Example

  Computer name: COMPUTER_1
  DNS extension: COMPANY.COM

  Domain name of external computer: COMPUTER_1.COMPANY.COM

The network link using manual parameterization is now configured.

Confirm the query whether you want to store the network parameters when you exit the menu with key ”**Y**” (the settings are stored).

5.7 License management

To use SINUMERIK 840Di system software and the activated options, you need to assign the corresponding software licenses to the SINUMERIK 840Di hardware. During the assignment procedure, you will be given a license key that electronically links the software (system software or options) to the SINUMERIK 840Di 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.

Ordering up to entering the license key of an option is performed as follows:

1. Order and purchase of the relevant license packages and/or single licenses:
   Order catalog: NC 60
2. Activate the options
   SinuCom NC on the relevant SINUMERIK 840Di
3. Obtain the license key for the required control.
   Web License Manager through the Internet on the SINUMERIK 840Di or external PC under: www.siemens.com/automation/license
4. Complete the entry procedure for the license key:
   SinuCom NC on the relevant SINUMERIK 840Di

SinuCom NC

Control–spec. administration of the options and licenses is performed exclusively through SinuCom NC on the SINUMERIK 840Di in question.

Start SinuCom NC from the Windows taskbar: **Start > Programs > SinuCom NC > SinuCom NC**

Option menu

To license the options you can with the SINUMERIK 840Di you can access the machine data block by double–clicking with the left mouse button as soon as SinuCom NC has established the online link (Fig. 5-4).

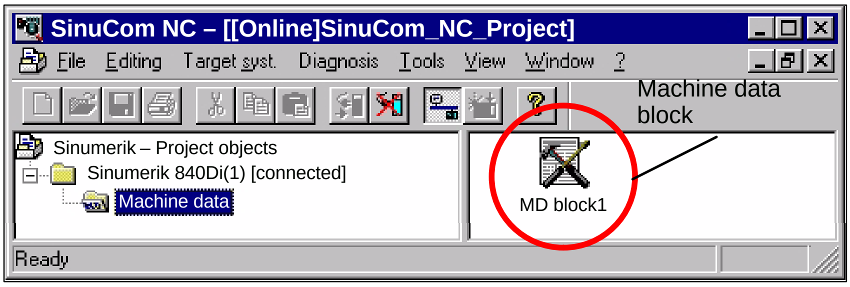


Fig. 5-4 SinuCom NC: Main menu

License key

The option menu allows setting of new and additional options in the appropriate input fields (Fig. 5-5).

The procedure described above (Items 1. to 4.) is triggered with button ”Get a new License Key” (Fig. 5-5). The follow further instructions in the following dialog boxes.

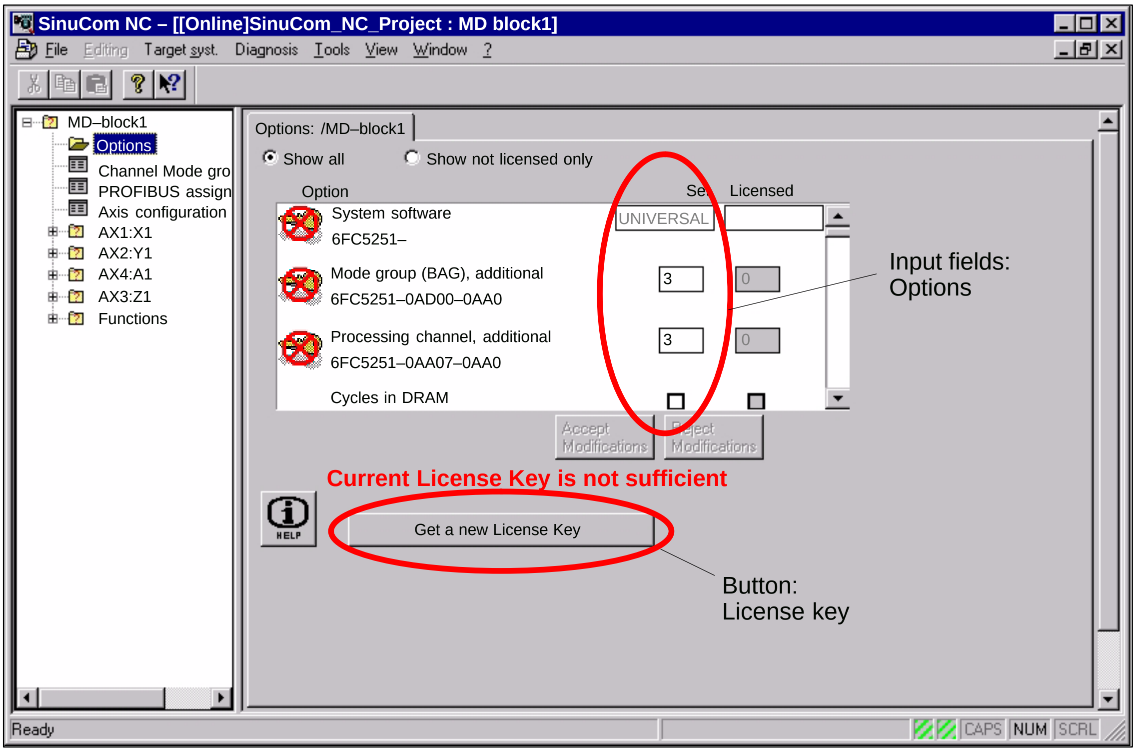


Fig. 5-5 SinuCom NC: Option menu

■

Notes

PLC Start-Up

6

6.1 General

6.1.1 Compatibility

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

6.1.2 Performance data

The PLC of the SINUMERIK 840Di 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 kbytes
Data block memory		max. 256 kbytes
Memory submodule		No
Bit memories		32768
Timers		512
Counters		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 kbytes
Max. block length FC, FB		64 kbytes
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

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 modular in design. 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.

– **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 Machine
Chapter: 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 basic PLC program must be installed on that computer on which the SIMATIC manager required to install the S7 project is already installed.

6.1.5 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.

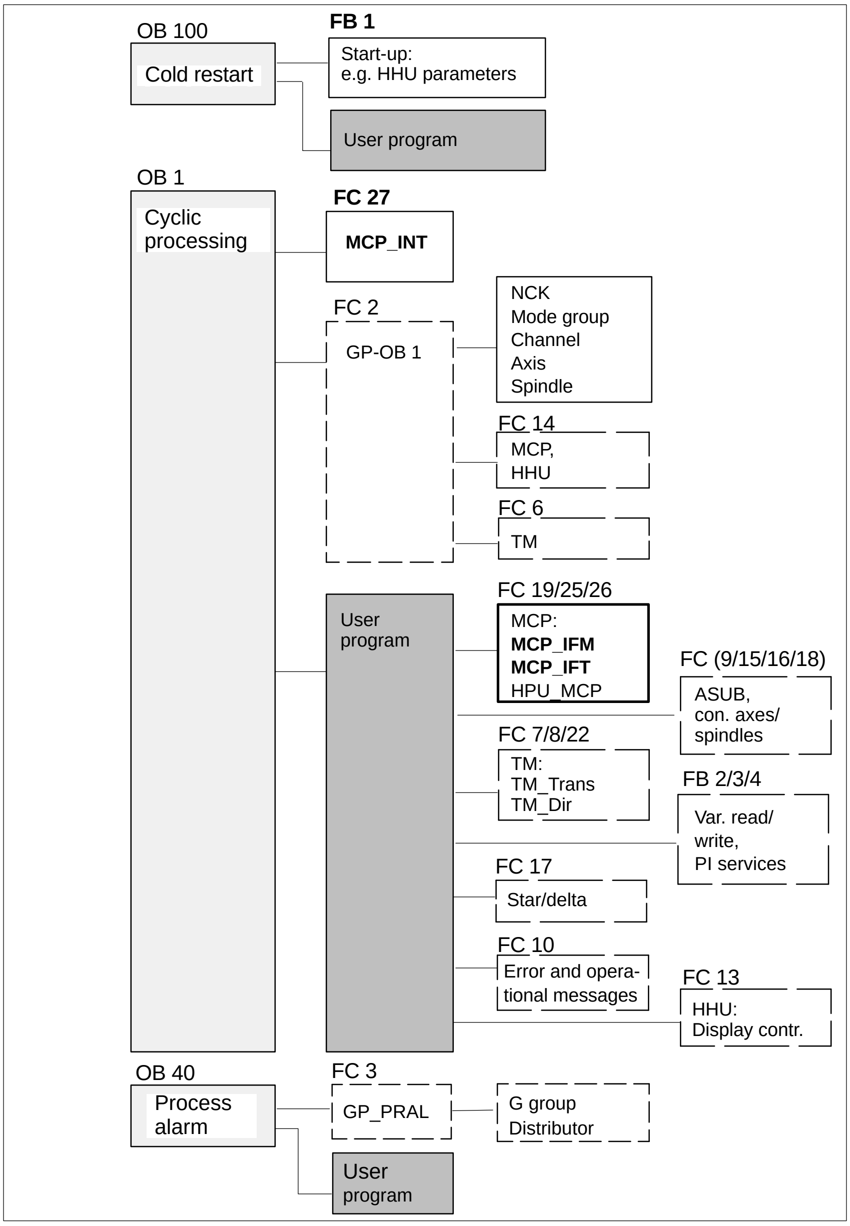


Fig. 6-1 Structure of the PLC program

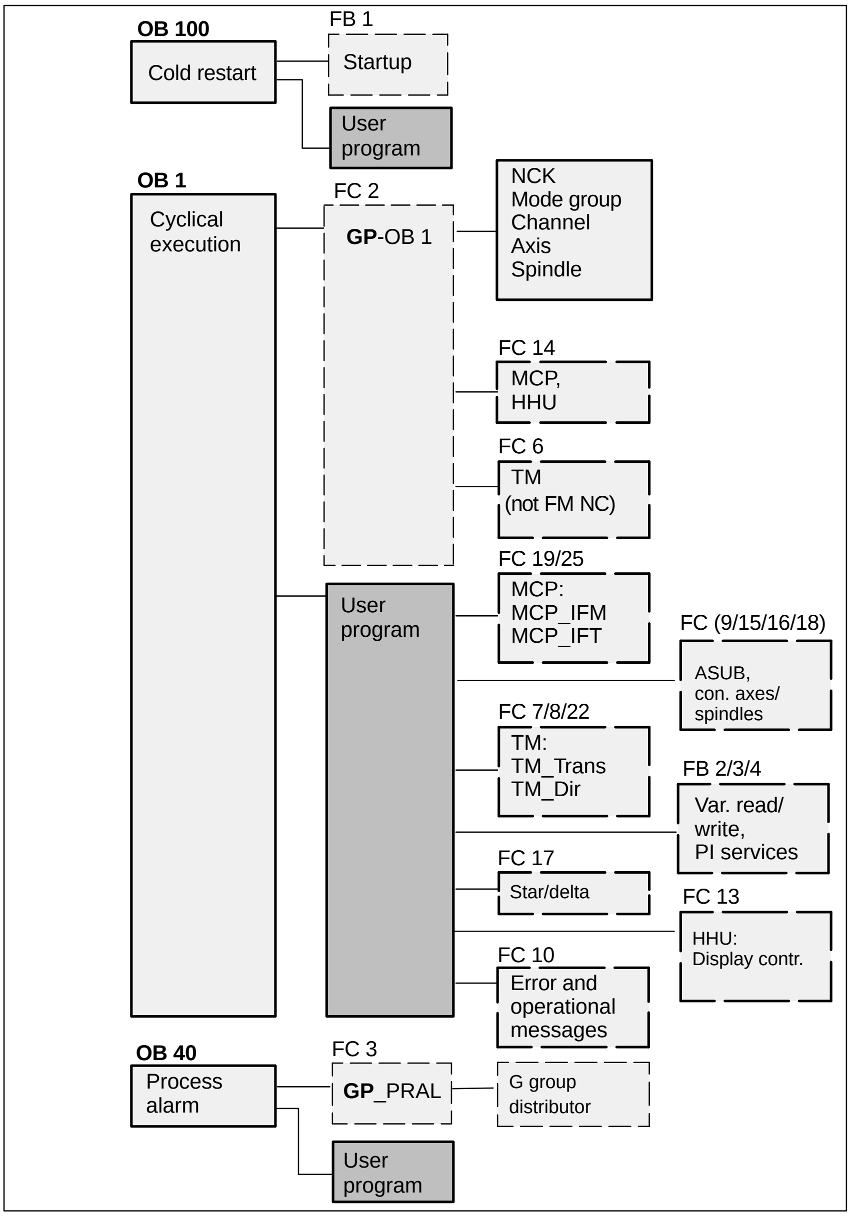


Fig. 6-2 Structure of the PLC program

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**

6.2 Startup

The PLC can be started up 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 and basic parameterization of MPI and PROFIBUS communication please refer to Section 6.3, Page 6-141.
- Loading an existing series start-up file.
  For how to create and read in a series start-up file please refer to Chapter 14, Page 14-403.

6.2.1 Basic requirements

The following basic requirements for PLC start-up must be met:

- SIMATIC STEP 7
- SINUMERIK 840Di has powered up
- NC in cyclic mode
- PLC in status: RUN

The NC and PLC status can be checked with:

- User interface 840Di startup
  See corresponding online help
- Start-up tool: SinuCom NC
  See relevant online help
- User interface HMI-Advanced (optional)
  See Section 10.10, Page 10-350.

6.2.2 MPI connection

To load the configuration into the PLC you must ensure that the MPI connection is established. We distinguish between the following situations:

- SIMATIC STEP 7 on external computer (PC/PG)
- SIMATIC STEP 7 on SINUMERIK 840Di (PCU)

External computer

If the configuration is to be loaded onto the PLC from an external computer (PG/PC), the following conditions must be fulfilled:

- An MPI card exists (e.g. CP5611)
- MPI driver is installed
- Parameterization of the PG/PC interface: **CP5611 (MPI)**
- Data transfer rate: **187.5 kbaud**
- The MPI interface of the PG/PC is linked to the MPI interface of the MPI board via an MPI cable.

SINUMERIK 840Di

If the configuration is to be loaded onto the PLC from the SINUMERIK 840Di the following conditions must be fulfilled:

- MPI driver is installed
- Parameterization of the PG/PC interface: **SINUMERIK MCI board (MPI)**
- Data transfer rate: **187.5 kbaud**

Parameterizing the MPI interface

Parameterization of the MPI interface is carried out with the **SIMATIC Manager** using menu command **Tools > Set PG/PC Interface**.

Dialog box

Dialog box: Setting the PG/PC interface
  Tab card: Access Path
    Interface parameter assignment used:
      With ext. PG/PC: **CP5611 (MPI)**
      or
      With local PC: **SOFTMC**
    Button: “Properties”

    Dialog box: Properties
      Group box: Network parameters
        Transmission rate: **187.5 kbaud**
    OK

OK

Note

Parameterization of the MPI interface can be effected or changed from the **SIMATIC Manager** at any time.

PLC status and MPI interface checked

The PLC status and therefore also the MPI connection to the PLC can be chekked from “HW Config” via menu: **Target system > Status**.

– If the current operating status of the PLC is displayed, the MPI connection is operating correctly.

– If the current operating status of the PLC is not displayed, the MPI interface 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
  – Start 840Di start-up: **Windows XP taskbar > Start > Programs > SINUMERIK 840Di > 840Di Startup**.
  – Open the dialog box: Menu command **Window > Diagnosis > NC/PLC**.
- HMI Advanced (option)
  – Open the dialog box: **Operating area switchover > Start-up > 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.

6.2.3 First start-up

On initial start-up of the PLC, a general reset of the PLC has to be performed after the SINUMERIK 840Di 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 NT 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 > Start-up > NC/PLC Diagnosis**

Dialog box

Proceed as follows in the dialog boxes:

1. PLC general reset
   PLC group
   Button: **“PLC Delete Program”**

Notice

The following parameters are reset by the PLC general reset:

– MPI address of the PLC = 2

– MPI data transfer rate = 187.5 kbaud

---

2. Delete NC data
   NC group
   Button: **“NCK Default Data”**

3. Trigger NC reset

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

The subsequent SINUMERIK 840Di power-up 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:

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

These alarms have no influence on how to continue.

6.3 Creating a SIMATIC S7 project

This section describes the creation of an S7 project for basic start-up of the PLC, the MPI and PROFIBUS interface, 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 the MPI interface
- Parameterize the PROFIBUS interface
- Parameterize the input/output data areas of the NC

MPI

When setting up the station, parameterization of the MPI communication is limited to parameterization of the MPI addresses of the PLC and NC and the data transfer rate in the MPI bus (see Subsection 6.3.4, Page 6-144).

A full description of how to parameterize the MPI communication is given in Chapter 7, Page 7-157.

PROFIBUS DP

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

- Equidistant PROFIBUS DP cycle
- Equidistance time on PROFIBUS DP

A full description of how to parameterize the PROFIBUS communication is given in Chapter 8, Page 8-195.

Note

The instructions given in this chapter are essentially limited to the special characteristics of the SINUMERIK 840Di. For more details on working with the SIMATIC Manager please refer to the relevant SIMATIC documentation or online help.

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)
- 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**.

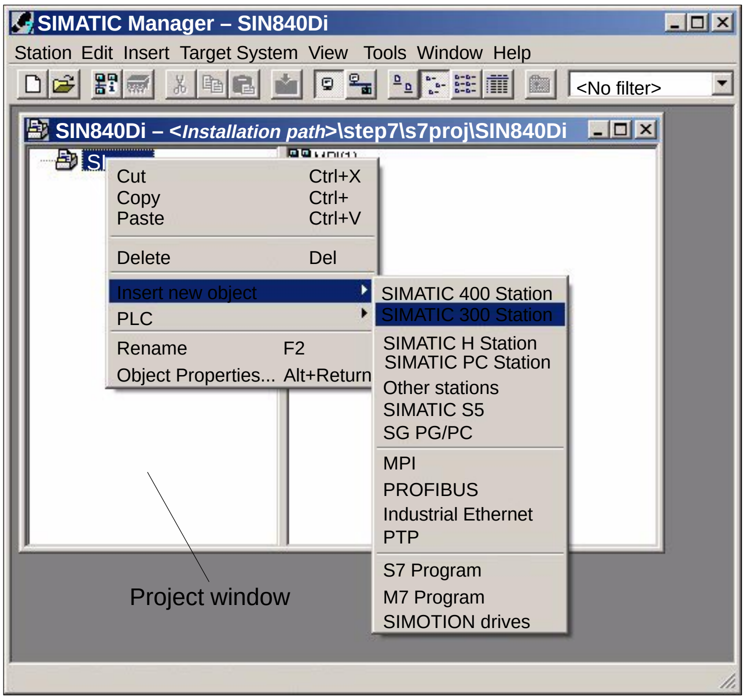


Fig. 6-3 Inserting the SIMATIC 300 station

Starting HW–Config

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

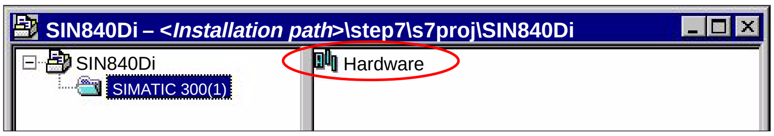


Fig. 6-4 Inserting the SIMATIC 300 station

We recommend giving the inserted station 300 a meaningful name, for example, *840Di*.

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**.

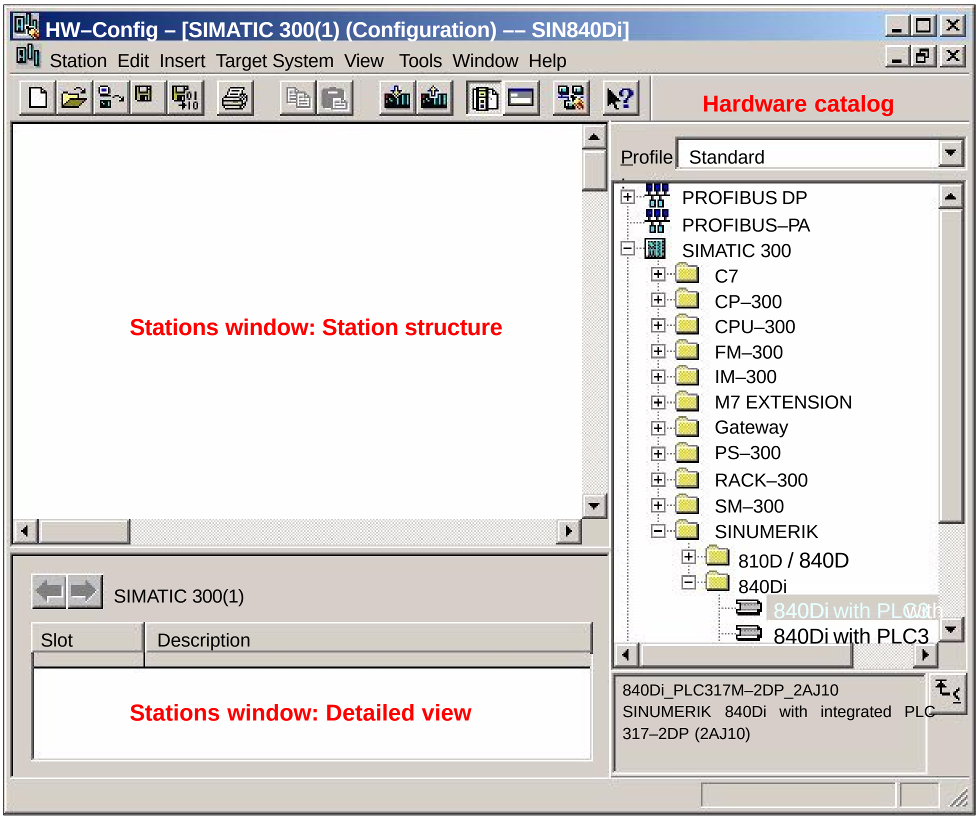


Fig. 6-5 HW-Config: Names of the main areas

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. Put down 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.

6.3.4 Inserting 840Di Rack

840Di Rack contains the already partially preconfigured components:

- SINUMERIK 840Di PLC
  Standard designation: PLC317-2DP 2AJ10
- MPI/DP interface
  Standard designation: MPI/DP
- PROFIBUS DP interface
  Standard designation: DP
- SINUMERIK 840Di NC
  Standard designation: S7 FM NCU

Inserting 840Di Rack

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

Profile: **Default**
SIMATIC 300 > SINUMERIK > 840Di > 840Di with PLC317-2AJ10

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

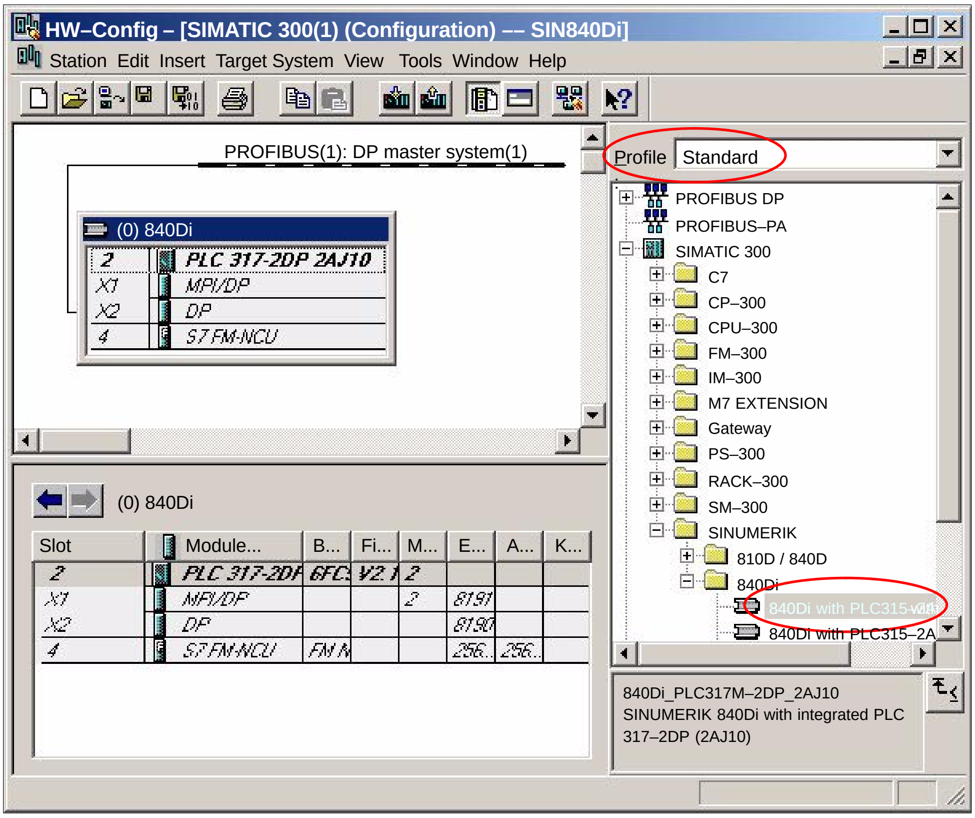


Fig. 6-6 HW-Config: SINUMERIK 840Di Rack

6.3.5 Parameterizing the PROFIBUS interface

When you have inserted the 840Di Rack, the dialog box for configuring the PROFIBUS interface opens automatically. 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.
- Subnetwork
- Equidistant DP cycle
- Equidistant time

Equidistant time

The SINUMERIK 840Di will accept the set **equidistant 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 interface DP
Tab card: Parameter
Address: **2**
Subnetwork:
Button: “New...”

Dialog box: Properties – New PROFIBUS Subnetwork
Tab card: General
S7 subnetwork ID: <***Subnetwork ID***> (see below: Note)
Tab card: Network settings
Data transfer rate: **12 Mbits/s**
Profile: **DP**
Button: “Options...”

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

OK

OK

Note

We recommend making a note of the **S7 subnetwork ID**, since it will be needed later to parameterize the routing settings of the drive start-up tool **SimoCom U**. See Subsection 9.1.6, Page 9-227.

6.3.6 Parameterizing the MPI interface

When you have completed the “Properties – PROFIBUS Interface DP” dialog box (see previous Subsection 6.3.5, Page 6-145) the 840Di Rack is displayed in the station window.

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

- Interface type
- Data transfer rate

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

Dialog box

Dialog box: MPI/DP Properties

Tab card: General
Group box: Interface
Type: **MPI**
Button: “Properties...”

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

OK

OK

Notice

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

6.3.7 Parameterizing the NC (I/O data)

To parameterize the input/output data storage areas of the NC you will have to set the following parameters:

- Beginning of input data
- Beginning of output data

To do that, open the Properties dialog box by double-clicking on the NC: *S7 FM-NCU*, slot *4* in the 840Di Rack.

Dialog box

Dialog box: Properties – S7 FM-NCU
Tab card: Addresses
Group box: Inputs
Beginning: **256**
Group box: Outputs
Beginning: **256**

OK

Notice

The MPI address of the NC and PLC have a fixed relation to each other.

- MPI bus
  The PLC routes to the NC:

  MPI address of the NC = MPI address of the PLC

- Softbus

  MPI address der NC = (MPI address of the PLC) + 1

Notice

The beginning of the address range of the input/output data of the NC must be set to 256. There is no monitoring.

- Part program processing in der NC
  If the value is not equal to 256, auxiliary functions that are transferred from the NC to the PLC cannot be acknowledged by the PLC. As a result, part program processing is not continued by the NC. No alarm or error message is output.

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* you have created, open the library installed in Subsection 6.1.4, Page 6-134 with menu item: **Open > File**.

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

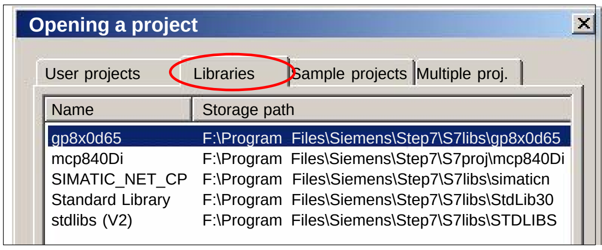


Fig. 6-7 Opening the library of the PLC basic program

Copying blocks

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

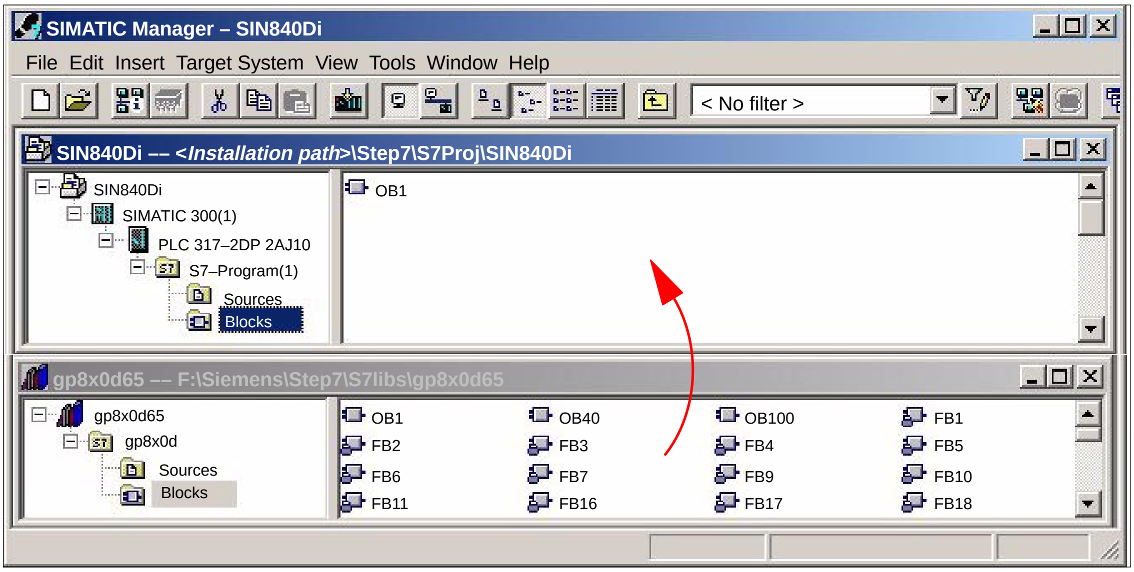


Fig. 6-8 Inserting blocks of the PLC basic program

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”.

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 Create an MPI configuration

Creation of an MPI configuration is described in a separate chapter. See Chapter 7, Page 7-157.

6.6 Creating a PROFIBUS configuration

Creation of a PROFIBUS configuration is described in a separate chapter. See Chapter 8, Page 8-195.

6.7 Loading the configuration

6.7.1 Preconditions

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

- An MPI connection exists between STEP 7 and the PLC.
- The configuration to be loaded corresponds to the actual station configuration.
- SINUMERIK 840Di is active:
  - NC is in cyclic mode
  - PLC in RUN or STOP status

6.7.2 Loading the configuration

Note

You are recommended to check consistency of the configuration before loading it.

Supplementary 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.

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-Startup” user interface. In “840Di-Startup” select menu item: **Window > Diagnostics > NC/PLC**:

Dialog box

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

6.7.3 Series machine start-up file

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

– **SinuCom NC** (component of the SINUMERIK 840Di installation)

– **HMI Advanced** (optional)

For detailed information about data back-up please refer to Chapter 14, Page 14-403 or:

References

SinuCom NC
Online Help

HMI Advanced
/BAD/ Operator’s Guide HMI Advanced
Chapter: Start-up functions

6.8 Testing the PLC program

6.8.1 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 start

With SINUMERIK 840Di the start-up type of the PLC is permanently set to COLD 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 card **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

6.8.2 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 "OB 1". 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:

- Alarm: "2000 sign-of-life monitoring for PLC"

6.8.3 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.

- **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 ...

6.8.4 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.

Table 6-2 Input field: **Operand**

Syntax	Meaning
In.x	Input byte n, bit x
IBn	Input byte n
IWn	Input word n
IDn	Input double-word n
DBn.**DBX**m.x	Data block n, byte m, bit x
DBn.**DBB**m	Data block n, byte m
DBn.**DBW**m	Data block n, word m
DBn.**DBD**m	Data block n, double word m
On	Output n
Fn	Flag n
Tn	Timer n
Cn	Counter n

Table 6-3 Input field: **Format**

Syntax	Meaning
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 soft key **Accept**, the entered values are written to the variables and processed in the PLC program.

■

Notes

MPI Communication 7

7.1 Special features of SINUMERIK 840Di

Data transfer rate

The data transfer rate at the MPI bus of the SINUMERIK 840Di must be set to 187.5 kbaud.

Notice

The data transmission rate must be set to **187.5** kbaud.

Insertion/removal

No nodes must be plugged in or removed from the MPI bus of the SINUMERIK 840Di while it is in operation.

Notice

No nodes must be plugged in or removed during operation.

7.2 Networking rules

Observe the following rules when installing an MPI network:

1. A unique bus address in the range 0...31 must be assigned to every bus node.
2. An MPI bus line must be terminated at both ends. To this aim, enable the terminating resistor in the MPI connector of the first and last nodes and disable the remaining terminating resistors.
3. At least one MPI line termination must be supplied with a 5 V voltage.

   Note
   An MPI connector with terminating resistor inserted to an energized device must be connected to supply the MPI line with the necessary 5 V voltage. For this purpose, the MPI connection on the MPI board of the SINUMERIK 840Di can be used.
4. Stubs (feeding cable from the bus segment to the node) should be as short as possible, i.e. < 5m. Any spur lines that are not assigned should be removed if possible.

   Note
   Spur lines should be avoided where possible.
5. Every MPI node must first be connected to the bus and then activated. The node must first be deactivated before it is removed. Then you can disconnect the node from the bus.

6. A maximum of 2 of the following components can be connected per bus segment:
   – Machine control panel (MCP)
   – Handheld unit (HHU)
   – Handheld terminal 6 (HT 6)
7. Do **not** enable the bus terminating resistors at the distributor boxes of an HHU or HT 6, since they are already built into the appropriate device.
8. Maximum cable lengths:
   - 200 m per bus segment
   - 2,000 m overall length with RS-485 repeater

Example

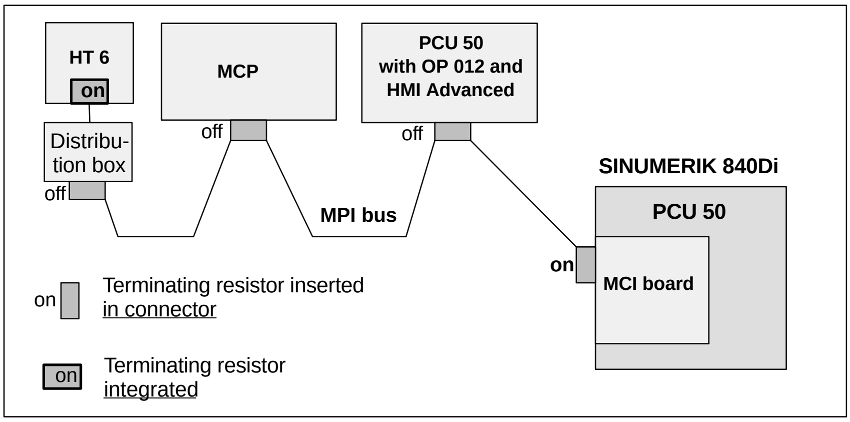


Fig. 7-1 MPI network with terminating resistors

Communication interference

If no communication can be established as a whole or with individual nodes at the MPI bus, check the following:

- Is the data transfer rate of all nodes whose data transfer rate is set manually (DIP switches) set to 187.5 kbaud.
- Do all nodes have a unique consistent MPI bus address.
  – In the S7 configuration
  – MPI address set on node
- Are there any loose cable connections.
- Are all bus segments terminated correctly.

Notice

The terminating resistor is built into some components:

- Handheld unit (HHU)
- Handheld terminal 6 (HT 6)

7.3 Global data communication

General

GD communication is a simple form of communication integrated in the operating system of the PLC that permits cyclic data exchange between the CPUs via the MPI interface. Data exchange is executed with the normal process image. Transfer of global data is a system service and therefore not programmed.

GD communication is ordered by GD circles. A GD circle is uniquely identified by its GD circle number. A GD identifier is structured as follows: GD x.y.z

– x = GD circle number

– y = GI number

– z = Object number

Global data

Global data such as are used for GD communication are the following operand ranges of a CPU:

– Inputs, outputs (from the process image!)

– Markers

– Ranges from data blocks

– Timers, counters
Not recommended because the values at the receiver end are no longer up to date; can only be configured as send operand ranges!

I/O ranges and local data cannot be used for GD communication.

Data transmission procedure

GD communication is performed according to the broadcast principle, i.e. GD reception is not acknowledged! The sender receives no information whether a recipient and which recipient has received the transmitted global data.

GD table

The operand ranges participating in global data communication are configured in a GD table with STEP 7:

Once the GD table has been filled, compiled and the participating CPUs loaded, these CPUs send and receive cyclically via these operand ranges at the cycle control point (i.e. at the same time when process image updating is taking place).

– Each column is assigned to exactly one CPU, i.e. the columns represent the CPUs participating in data exchange (maximum 15 CPUs)

– Each row (more precisely: Each editable field of a row) represents the operand ranges via which exactly one CPU sends and one or several CPUs receive

Default configuration

GD communication is configured with STEP 7. To simply installation and start-up, a default configuration of the GD communication is included in the supply of a SINUMIERK 840Di. The default configuration allows the connection of the following components to the MPI bus without further configuration of the GD communication:

– Machine control panel (MCP) and/or interface customer operator panel

– Handheld terminal, e.g. HT 6

– Handheld unit, e.g. B-MPI

7.4 Preconditions

As a condition for creating an MPI configuration using the default configuration the following components are required:

- SIMATIC STEP 7
- Archive file: mcp840di.zip
  The archive file contains data and function blocks for a default configuration of the GD communication. The archive file is included in the supply of the SINUMERIK 840Di.

SIMATIC STEP 7

SIMATIC STEP 7 (option) is required in the following version or later:

- SIMATIC STEP 7 as from Version 5.2, Service Pack 1

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

SINUMERIK 840Di

If SIMATIC STEP 7 is installed in the SINUMERIK 840Di, no additional MPI cable is required to load the configuration into the PLC because Windows applications that are executed on the SINUMERIK 840Di have direct access to the PLC via the internal MPI interface on the MCI board.

Installation of additional software on the SINUMERIK 840Di is described in detail in Chapter 15, Page 15-411.

External computer

If SIMATIC STEP 7 is installed on an external computer (PG/PC), it must fulfill the following conditions:

- MPI interface parameterized with 187.5 kbaud
- MPI connection between external computer and SINUMERIK 840Di

Archive file: mcp840di.zip

To be able to use the blocks of GD communication in a separate SIMATIC S7 project, the archive must first be dearchived via the SIMATIC Manager.

Storage path

The archive file is stored at the following address on the PCU's hard disk:

- D:\SUPPORT\mcp840di.zip

To dearchive in the SIMATIC Manager please use menu item: **File > Dearchive**. In dialog box: “Select target directory” select the directory into which you want to unpack the archive. The existing default setting: “S7Proj” can be kept.

7.5 Creating an MPI configuration

7.5.1 Precondition

S7 project

The procedure for creating an MPI configuration described in this chapter is based on an S7 project created using the description in Section 6.3, Page 6-141.

The following status of the S7 project is required:

– S7 project is has been set up (name: SIN840Di)

– Station 300 has been set up

– MPI interface is parameterized

– PROFIBUS interface is parameterized

– Input/output data areas of the NC are parameterized

Note

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

Archive file: mcp840di.zip

The archive file: *mcp840di* has been dearchived using the SIMATIC Manager See previous Section 7.4, Page 7-160.

7.5.2 Inserting the default configuration into the S7 project

Opening the library

To insert the default configuration in S7 project: *SIN840Di* you have created, open the library dearchived in Section 7.4, Page 7-160 with menu command: **Open > File**.

Select library *mcp840Di* and confirm the dialog box with OK.

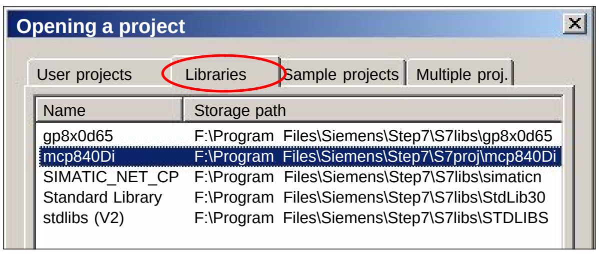


Fig. 7-2 Opening the library of the default configuration

In the library open directory: "Blocks" of S7 program: *mcp4mci2*. The S7 program contains the following blocks:

– System data: SDB210

– Function block: FC27

– Data block: DB77

Copy all blocks of the library into the block directory of the PLC of project: *SIN840Di*.

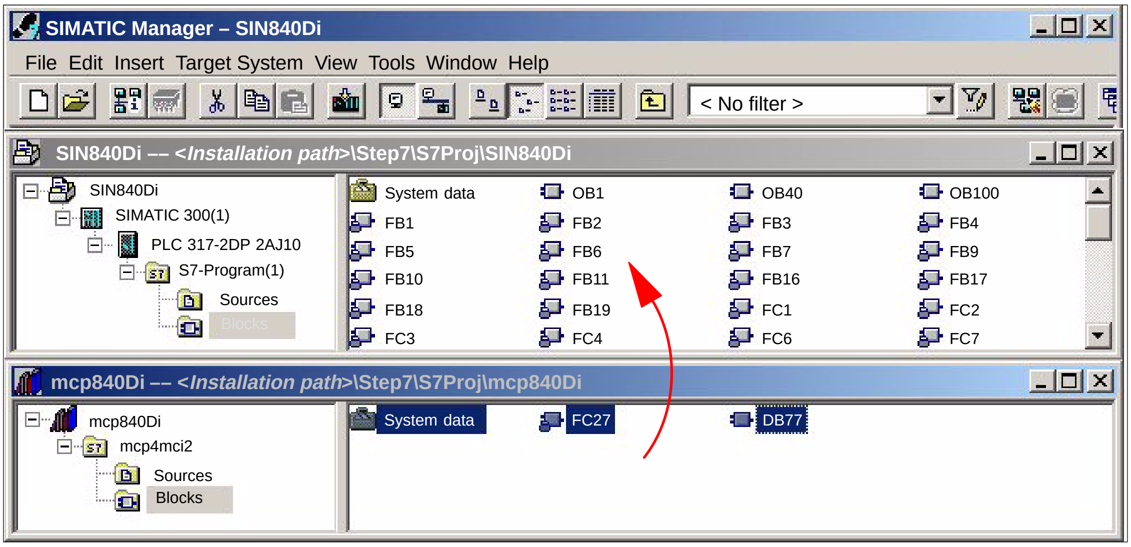


Fig. 7-3 Inserting library: *mcp849Di* (already contains PLC basic program)

7.5.3 Adapting organization block OB100

The following call parameters must be adapted in organization block OB100 for calling function block B1 “RUN_UP”:

– **MCP1BusAdr** (MPI address of 1st machine control panel)
  Settable addresses according to default configuration: 13, 14, 15
  Recommended address: **14** (default MPI address of handheld terminal HT 6)

– **MCPSDB210** (system data block SDB210 exists)
  The parameter must be set to value: **TRUE**.

7.5.4 Adapting organization block OB1

In organization block OB1, first function block FC27 “MCP_INT” must be called up. In the 1st line of OB1 enter call:

CALL FC27

7.5.5 Loading the configuration into the PLC

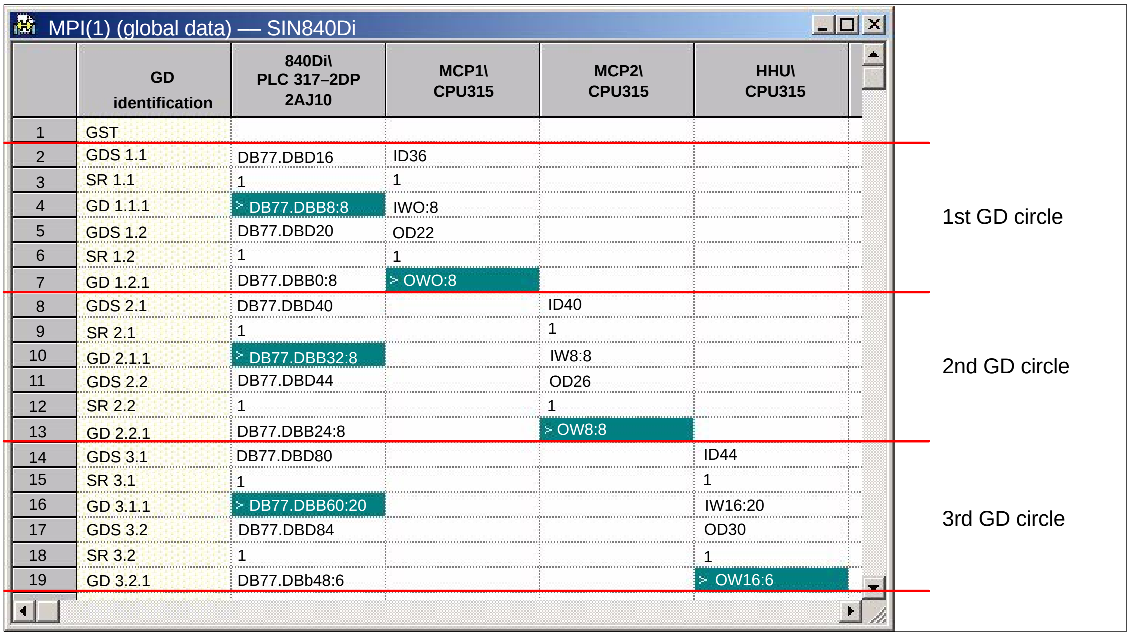
Once you have inserted and adapted the blocks you can load the configuration into the PLC.

Loading of the configuration is described in detail as part of PLC installation and start-up in Section 6.7, Page 6-150.

7.6 Default configuration

7.6.1 GD circle parameters

The following 3 GD circles are parameterized in the default configuration:



MPI(1) (global data) — SIN840Di

	GD identification	840Di\ PLC 317–2DP 2AJ10	MCP1\ CPU315	MCP2\ CPU315	HHU\ CPU315
1	GST				
2	GDS 1.1	DB77.DBD16	ID36		
3	SR 1.1	1	1		
4	GD 1.1.1	> DB77.DBB8:8	IWO:8		
5	GDS 1.2	DB77.DBD20	OD22		
6	SR 1.2	1	1		
7	GD 1.2.1	DB77.DBB0:8	> OWO:8		
8	GDS 2.1	DB77.DBD40		ID40	
9	SR 2.1	1		1	
10	GD 2.1.1	> DB77.DBB32:8		IW8:8	
11	GDS 2.2	DB77.DBD44		OD26	
12	SR 2.2	1		1	
13	GD 2.2.1	DB77.DBB24:8		> OW8:8	
14	GDS 3.1	DB77.DBD80			ID44
15	SR 3.1	1			1
16	GD 3.1.1	> DB77.DBB60:20			IW16:20
17	GDS 3.2	DB77.DBD84			OD30
18	SR 3.2	1			1
19	GD 3.2.1	DB77.DBb48:6			> OW16:6

Fig. 7-4 Default configuration

7.6.2 GD identifiers and MPI addresses

Correlation

In the case of the following components there is a defined correlation between the MPI address and the GD identifiers which must be taken into account when setting the MPI address and configuring the GD circles:

- Machine control panel
- MPI interface for customer operator panel
- Handheld terminal e.g. HT 6

Table 7-1 Correlation: MPI address / GD circle parameters

MPI address	GD identification	
	Receive	**Send**
13, 14, 15	1.1.1	1.2.1
11, 12	2.1.1	2.2.1
9, 10	3.1.1	3.2.1
7, 8	4.1.1	4.2.1
4, 5	5.1.1	5.2.1
0, 1, 2, 3, 6	Reserved	

Default configuration

Because of the GD circle parameterization of the default configuration the following MPI addresses must be used for the above components (see Table 7-2, Page 7-164):

Table 7-2 Default configuration: MPI address / GD circle parameters

Component	MPI address	Default MPI address
Machine control panel	13, 14, 15	6 1)
MPI interface for customer operator panel		6 1)
Handheld terminal, e.g. HT 6		14
Machine control panel	11, 12	6 1)
MPI interface for customer operator panel		6 1)
Handheld unit, e.g. B-MPI	9, 10	15 1)
1) **CAUTION**: The default MPI addresses must be adapted!		

7.6.3 Recommended MPI addresses

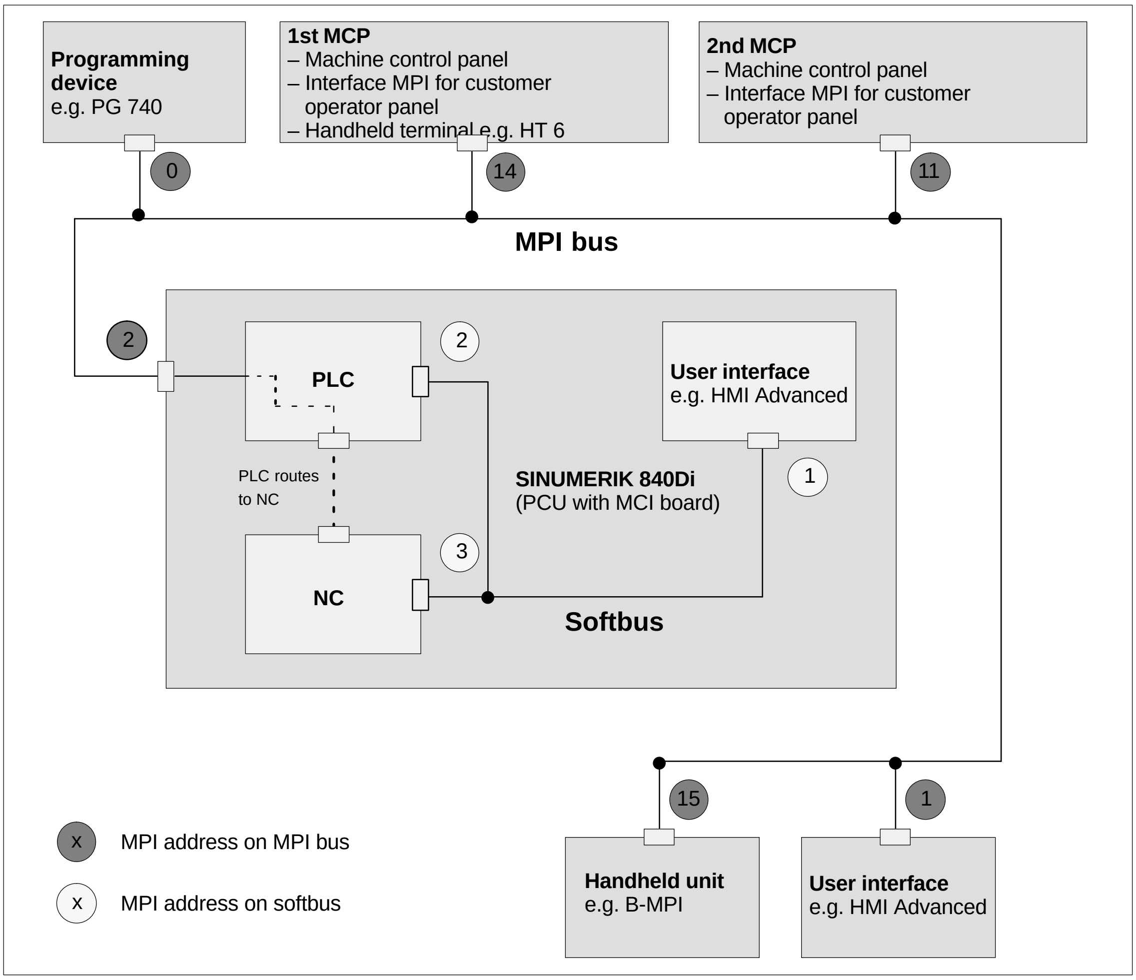


Fig. 7-5 Recommended MPI addresses for SINUMERIK 840Di

7.7 Machine control panel (MCP)

Fig. 7-6 Machine control panel front side; example: Version T (turning machine)

7.7.1 Conditions for start-up

Hardware

To start up an MCP you require the following hardware:

MPI bus cable
The MCP is connected to the SINUMERIK 840Di through the MPI bus. A terminating resistor for the MPI bus is not integrated in the MCP.

Programming device (e.g. PG740)
A programming device is required for the **SIMATIC Manager STEP7** as the platform to match the basic PLC or PLC user program to the requirements of the appropriate automation system with regard to the operation of an MCP and to **load** it then into the **PLC**.

Note

A programming device is not required if the SIMATIC Manager is installed on the SINUMERIK 840Di. How to install additional software is described in Chapter 15, page 15-411.

Software

To start up an MCP, the following software is required:

MCP firmware
At least MCP firmware **Version 4.1.5** is required. The version number can be checked when the MCP powers up.

Basic PLC program
The MCP 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 PLC basic program is included on the SINUMERIK 840Di installation CD. The installation of the basic PLC program as a SIMATIC S7 library is described in Section 6.4 (page 6-148) in detail.

SIMATIC Manager
SIMATIC Manager is used for adapting the basic PLC and user programs (e.g. call of FC 25).

References

The following manuals are required to start up an MCP:

/FB1/ Description of Functions, Basic Machine P3, Basic PLC Program
Description of the program structure and modules of the PLC basic program.

/BH/ Operator Components Manual
Description of MCP (interfaces, electrical connection, etc.)

/Z/ Catalog NCZ
Connection Components: Cables, connectors, etc.

Automation system

To start up the MCP, the automation system must be completely electrically and mechanically connected with respect to NCK, PLC and MCP.

The drives must be secured against accidental moving.

7.7.2 Parameterization of the MCP

Interfaces

Fig. 7-7 below shows the interfaces on the rear of the module:

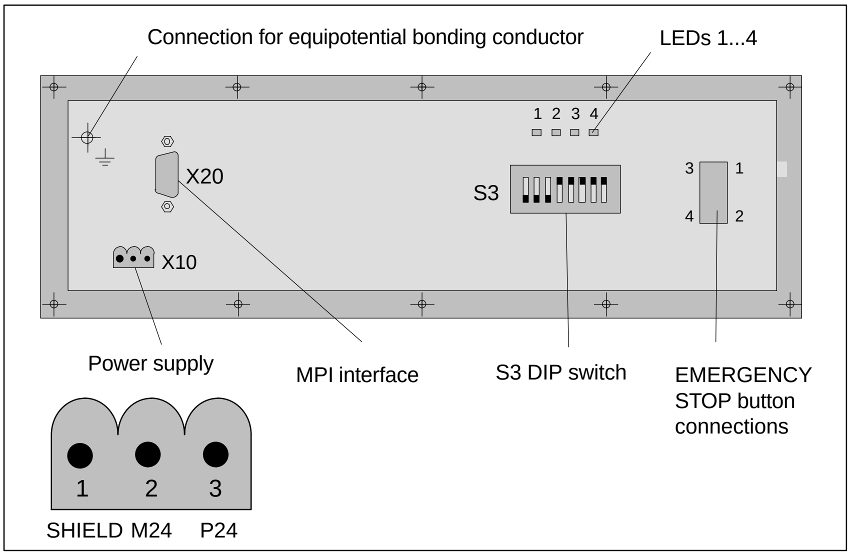


Fig. 7-8 Position of interfaces on rear panel of MCP

For a detailed description of the electrical and mechanical design and of the MCP interfaces, please refer to:

References: /BH/ Operator Components, Manual
Chapter: Machine control panel (MCP)

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. 7-9), version number **V 4.1.5** is displayed.

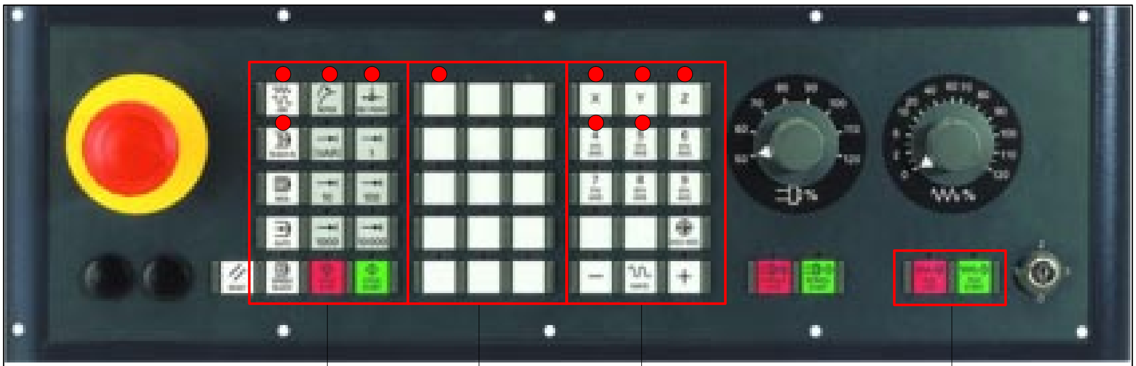


Fig. 7-9 MCP software version display

Data transfer rate

The data transfer rate on the MPI bus of the SINUMERIK 840Di is 187.5 kbaud. The factory setting of the data transfer rate is 1.5 Mbaud. You can make the setting on switch S3: See Table 7-3, Page 7-168.

Notice

To operate the module on a SINUMERIK 840Di you must set the data transfer rate to **187.5 kbaud**.

MPI address

The MPI address factory setting on the machine control panel is 6. This default setting is not suitable for operation on a SINUMERIK 840Di with default configuration.

- **Default configuration**

  If the default configuration is used the MPI address of the machine control panel must be set to one of the following values:
  - As 1st machine control panel: 13, 14, 15
  - As 2nd machine control panel: 11, 12

Notice

The factory setting default MPI address 6 is not suitable of operation of the machine control panel on a SINUMERIK 840Di.

- **Plant-specific configuration**

  If the module is operated in an MPI configuration other than the standard configuration the GD circle parameterization used will define the MPI address to be set. See Subsection 7.6.3, Page 7-164.

You can set the MPI address on switch S3: See Table 7-3 below, Page 7-168.

Switch S3

Set parameters:

- Data transfer rate
- Transmission frequency and receive monitoring
- MPI address
- Operator component type

with switch S3 on the rear of the MCP.

Table 7-3 Meaning of the S3 switch

1	2	3	4	5	6	7	8	Meaning:
on **off**								Data transfer rate = 1.5 Mbaud Data transfer rate = 187.5 kbaud
	on **off** off	off **on** off						200 ms Cyclic transmission frequency / 2400 ms Reception monitoring 100 ms Cyclic transmission frequency / 1200 ms Reception monitoring 50 ms Cyclic transmission frequency / 600 ms Reception monitoring
			on **on** **on** **on** **on** on on on off off off off off off off off	**on** **on** **on** **on** **off** off off off on on on on off off off off	**on** **on** **off** **off** **on** on off off on on off off on on off off	**on** **off** **on** **off** **on** off on off on off on off on off on off		MPI address: **15** (1st machine control panel) **14** (1st machine control panel) **13** (1st machine control panel) **12** (2nd machine control panel) **11** (2nd machine control panel) 10 9 8 7 6 (default setting) 5 4 3 2 1 0
							on	Type = interface to customer operator panel
							off	Type = machine control panel
on	off	on	off	on	on	off	off	As-delivered state
off	**off**	**on**	**on**	**on**	**on**	**off**	**off**	**Recommended setting for 840Di** Data transfer rate: 187.5 kbaud Cyclic transmission frequency: 100 ms MPI address: 14 (1st machine control panel) Type: Machine control panel

7.7.3 Parameterization of the PLC

Program structure

The PLC program is modular in design. It comprises function blocks:

- Startup and synchronization (OB 100)
- Cyclical mode (OB 1)
- Process interrupt handling (OB 40)

The user (machine manufacturer) must call the appropriate section of the basic program in OBs 1, 40, and 100 (see Fig. 7-10).

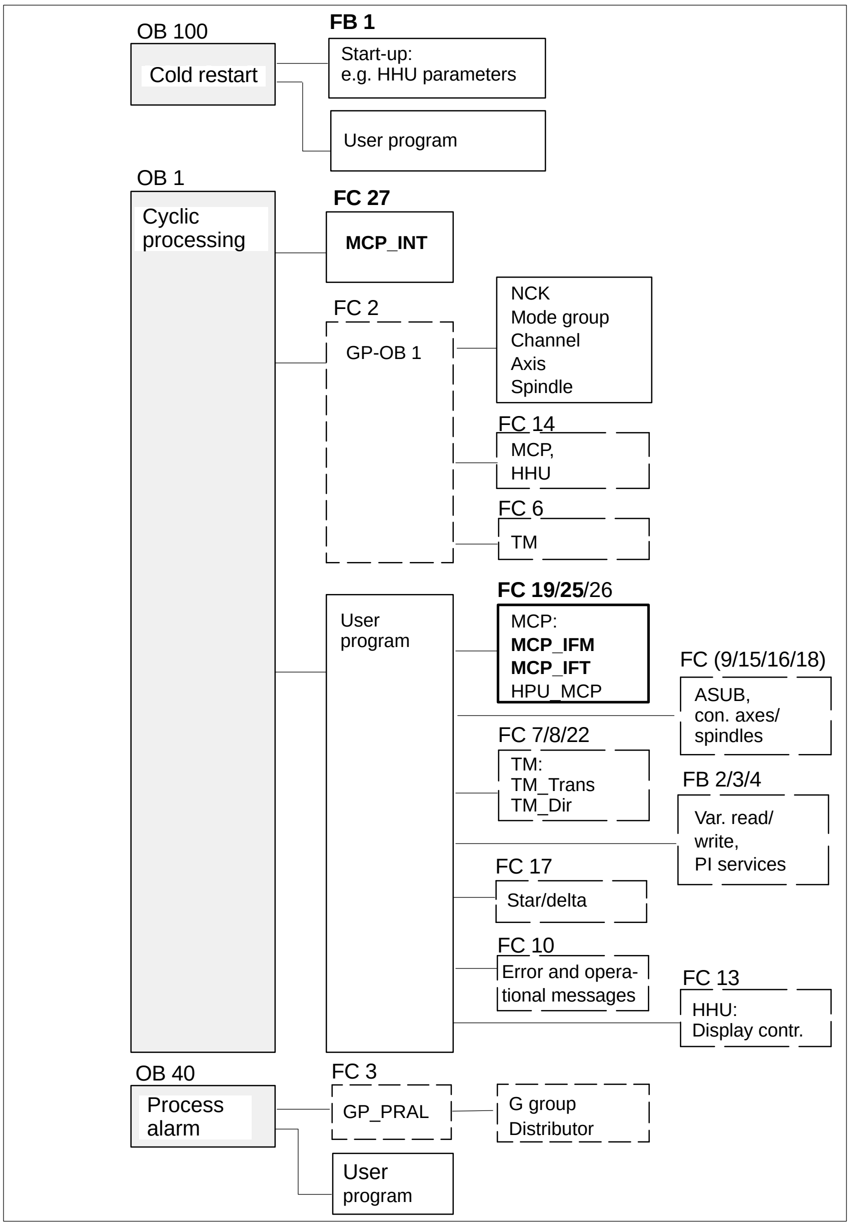


Fig. 7-10 Structure of the PLC program

Setting the communication parameters (FB1)

The communication parameters of the MCP are denoted MCPx... (where x = 1 or 2) in function block FB1.

In addition to a first MCP, a second MCP or an HT 6 (for HT 6, see Section 7.10, page 7-183) can be active as another operator component at the same time.

To synchronize several operator components, the PLC program must be adapted accordingly. This is the user's (machine manufacturer's) responsibility.

```
/MCPNum:        INT         // Number of active operator components
                            // MCP/HT 6 (default = 1; max. = 2)

MCP1In:         POINTER     // Address of MCP 1 input signals
MCP1Out:        POINTER     // Address of MCP 1 output signals

MCP1StatSend:   POINTER     // Addr. of MCP 1 send status data
MCP1StatRec:    POINTER     // Addr. of MCP 1 receive status data

MCP1BusAdr:     INT         // Default MPI address of MCP

MCP1Timeout:    S5TIME      // Default setting should be kept
MCP1Cycl:       S5TIME      // Default setting should be kept

MCPMPI:         BOOL        // MCP/HT 6 operated on "extended" MPI
                            // bus
```

The MCP2... parameters are only needed if in addition to the 1st MCP, a 2nd MCP or HT 6 is used:

```
MCP2In:         POINTER     // Address of input signals MCP/HT 6 2
MCP2Out:        POINTER     // Address of output signals MCP/HT 6 2

MCP2StatSend:   POINTER     // Addr. of MCP/HT 6 2 send status data
MCP2StatRec:    POINTER     // Addr. of MCP/HT 6 2 receive status data

MCP2BusAdr:     INT         // MPI address

MCP2Timeout:    S5TIME      // Default setting should be kept
MCP2Cycl:       S5TIME      // Default setting should be kept
```

The parameters listed below serve to synchronize two operator components:

```
MCP1Stop:       BOOL        // Transfer of each operator component:
MCP2Stop:       BOOL        // FALSE = start; TRUE = stop

MCP1NotSend:    BOOL        // Send and receive operation of each
MCP2NotSend:    BOOL        // operator component:
                            // FALSE = send and receive active
                            // TRUE = only receive active
```

The following parameter is used to announce that an MPI configuration exists in system data block SDB210:

```
MCPSDB210:      BOOL        // MPI configuration via SDB210
```

Notice

A maximum of two MCP/HT 6 can be operated on an MPI line. To be able to use MCP and HT 6 on an automation system alternately or simultaneously, the user (machine manufacturer) has to adapt the PLC program accordingly.

References

For a detailed description of the basic PLC program or of function block FB 1, please refer to:

/FB1/ Description of Functions, Basic Machine P3, Basic PLC Program
Chapter: FB 1: RUN_UP Basic program, startup section

NC interface parameter assignment

FC 19 (for version “M” MCP, milling) or FC 25 (for version “T” MCP, turning) transfers the signals of the MCP to the NC through the interface.

Notice

Block FC 19 or FC 25 is part of the basic PLC program. It is the user’s (machine manufacturer’s) responsibility to call the block correctly and/or assign the interface the appropriate parameters.

References

For a detailed description of FC 19 and FC 25, please refer to:

/FB1/ Description of Functions, Basic Machine P3 PLC Basic Program
Section: FC 19 MCP_IFM Transfer of MCP signals to the interface
Section: FC 25 MCP_IFT Transfer of MCP signals to the interface

7.7.4 Example: Connecting an MCP to SINUMERIK 840Di

1. Connect the MCP electrically.

   Use the terminating resistor integrated in the MPI connector according to the general rules for connecting components to the MPI bus.

   As function block FB1 is not yet parameterized in the basic PLC program, communication with the PLC is not yet established and all LEDs on the MCP front panel flash.
2. Checking the software version
   Simultaneously pressing the keys “Feed stop” and “Feed enable” displays the software version with the LEDs located on the front side.
3. Set call parameters of function block FB 1 in organization block OB 100.

   Example of a machine control panel parameterization:

```
MCPNum         := 1              // An MCP is available

MCP1In         := P#E 0.0        // Address of input data (8 bytes)
MCP1Out        := P#A 0.0        // Address of output data (8 bytes)

MCP1StatSend   := P#A 8.0        // Address of send status data (4 bytes)
MCP1StatRec    := P#A 12.0       // Address of receive status data (4 bytes)

MCP1BusAdr     := 14             // Standard address

MCP1Timeout    := S5T#700MS      // Default setting
MCP1Cycl       := S5T#200MS      // Default setting
```

```
MCPMPI       := FALSE   // MCP/HT 6 operated on “extended” MPI bus

MCP1Stop     := FALSE
MCP1NotSend  := FALSE

MCPSDB210    := TRUE    // MPI configuration via SDB210
```

4. Insert call of function block FC27 as 1st line in organization block FB1.
5. Insert block FC 19 or FC 25 in cyclic part of the PLC program (see Fig. 7-10, Page 7-169).
6. Load the modified blocks into the PLC and then restart the PLC.
7. After communication with the PLC has been established, the LEDs on the MCP front stop flashing. The LED of the basic settings for:
   – Mode: Referencing
   – Spindle stop
   – Feed stop

   light up continuously.

7.8 MPI interface for customer operator panel

Application

The “Interface MPI for customer operator panel” is a module for connecting custom made operator panels to a SINUMERIK 840Di.

To this aim, the module provides 3 I/O interfaces with a total of 64 digital outputs with C-MOS level (5V).

Startup

Start-up of an “Interface MPI module” is to a large degree identical to start-up of a machine control panel (MCP), Section 7.7, Page 7-165.

Therefore, only the differences from an MCP start-up are explained below.

7.8.1 Parameterization of the MPI interface

Interfaces

Fig. 7-11 below shows the interfaces on the rear of the module:

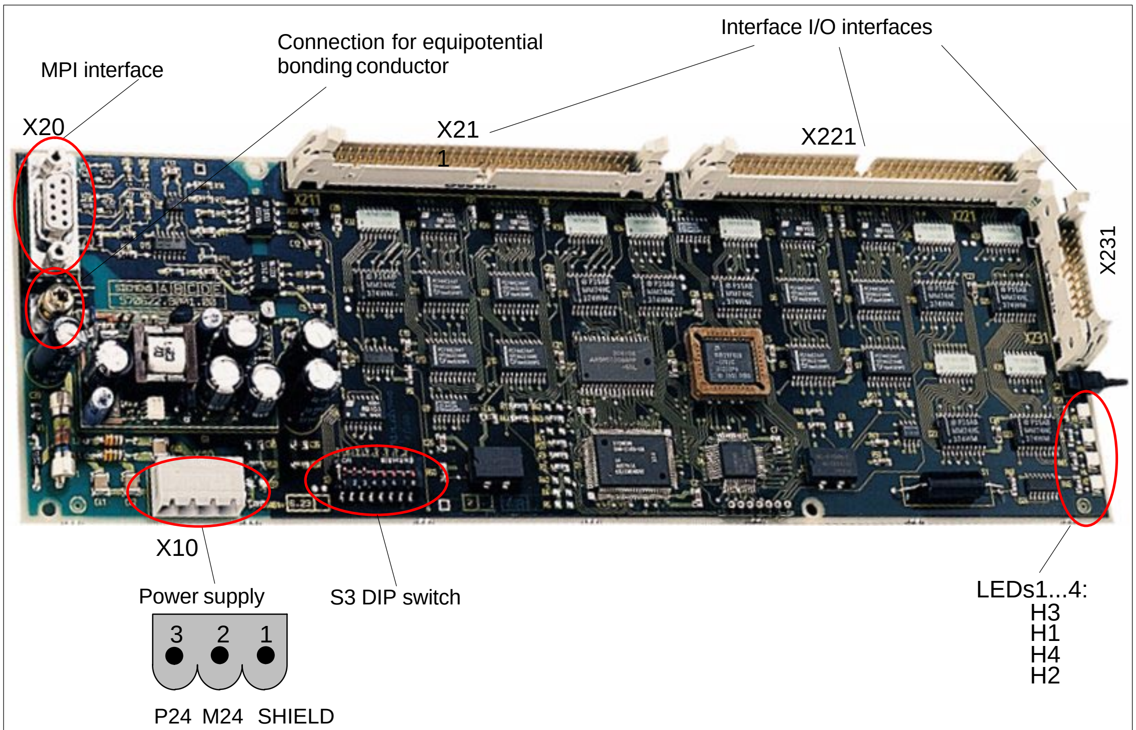


Fig. 7-11 Interfaces of the interface MPI for customer operator panels

For a detailed description of the electrical and mechanical design and interfaces of the module, please refer to:

References: /BH/ Operator Components, Manual
Chapter: Multi-point interface (MPI) for the customer operator panel

Display of the software version

A label indicating the current software version is to be found on the firmware EPROM.

Data transfer rate

The data transfer rate is set with switch S3. The data transfer rate set on the MPI bus of the SINUMERIK 840Di is 187.5 Kbaud.
You can make this setting on switch S3 on the rear of the module (see below).

MPI address

The MPI address factory setting on the module is 6. This default setting is not suitable for operation on a SINUMERIK 840Di with default configuration. The parameters are set using switch S3 on the rear side of the module (see below).

- **Default configuration**

  If the default configuration is used the MPI address of the module must be set to one of the following values:
  - As 1st machine control panel: 13, 14, 15
  - As 2nd machine control panel: 11, 12

Notice

The factory setting default MPI address 6 is not suitable of operation of the module on a SINUMERIK 840Di.

- **Plant-specific configuration**

  If the module is operated in an MPI configuration other than the standard configuration the GD circle parameterization used will define the MPI address to be set. See Subsection 7.6.3, Page 7-164.

Switch S3

See Table 7-3, Page 7-168 for settings of switch S3.

7.9 Handheld unit (B-MPI)

Fig. 7-12 Handheld unit (B-MPI) with distributor box

7.9.1 Conditions for start-up

Hardware

The following hardware components are required to start up the handheld unit (HHU):

Distributor box
The distributor box incorporates the MPI module interface, the HHU interface, as well as a terminal block for connecting EMERGENCY STOP, enable keys, handwheel and 24 V power supply.

HHU connection cable
The HHU is connected to the distributor box using the HHU cable.

MPI bus cable
Under no circumstances may the MPI connector for connecting the HHU contain an integrated bus terminating resistor, since a bus terminating resistor is already integrated in the HHU.

Programming device (e.g. PG740)
A programming device is required for the SIMATIC Manager as the platform to match the basic PLC or PLC user program to the requirements of the appropriate automation system with regard to the operation of an MCP and to load it then into the PLC.

Note

A programming device is not required if the SIMATIC Manager is installed on the SINUMERIK 840Di. How to install additional software is described in Chapter 15, page 15-411.

Software

The following software components are required to start up the HHU:

Basic PLC program
The PLC basic program is included on the SINUMERIK 840Di installation CD. This must be installed before the PLC basic program can be used. See Subsection 6.1.4, Page 6-134.

Blocks of the PLC basic program relevant to the HHU of the PLC are:

– FB1 (HHU parameters)
– FC13 (display control)

SIMATIC Manager
The SIMATIC Manager is used for adapting the PLC basic and user programs (e.g. call of FC 13).

References

The following manuals are required to start up the HHU:

/BH/ Operator Components Manual
Description of HHU (interfaces, electrical connection, etc.)

/FB1/ Description of Functions, Basic Machine P3, Basic PLC Program
Description of the program structure and modules of the PLC basic program.

/Z/ Catalog NCZ
Connection Components: Cables, connectors, etc.

Automation system

To start up the HHU, 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.

7.9.2 Electrical connection

Connecting the HHU electrically

To connect HHU electrically and for MPI communication, a distributor box is used. The distributor box has an interface to the MPI bus, as well as a terminal block for connecting EMERGENCY STOP, enable keys, handwheel and 24 V power supply.

Connecting several HHUs

If you wish to connect more than two HHUs to a bus segment or if the HHU cannot be connected at the bus end, it is generally recommended to use a PROFIBUS repeater for connecting the HHUs.

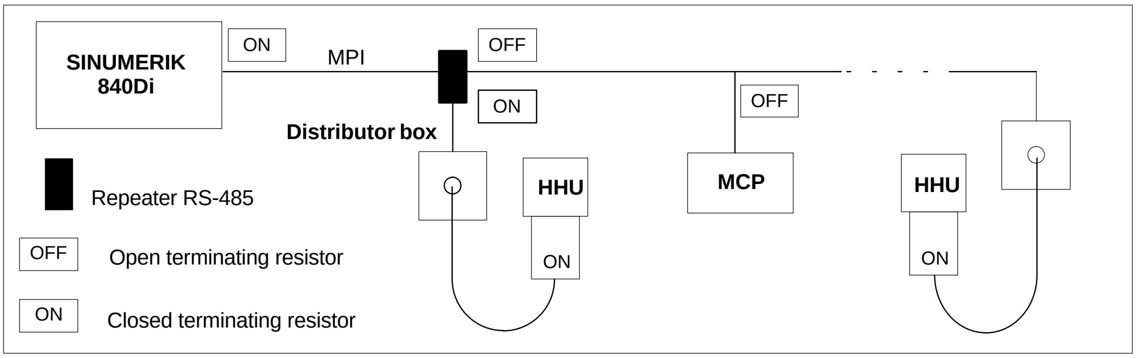


Fig. 7-13 Connecting using a repeater

Note

If a HHU is connected to the bus end, no repeater is required.

For a detailed description of the electrical and mechanical design, as well as for the interfaces of the HHU module, please refer to:

References: /BH/ Operator Components, Manual
Chapter: Handheld Unit and Distributor Box

7.9.3 MPI parameters of the HHU

Setting the MPI parameters

The HHU parameters required for MPI communication:

– MPI address
– Data transfer rate
– IDLE time

are set as follows:

– Up to SW V04.01.01: Via DIP switch on the HHU
– As from SW V04.01.01: By means of the HHU display

To check or modify the parameters, disconnect the HHU from mains. After loosening the fastening screws, you can remove the HHU front plate.

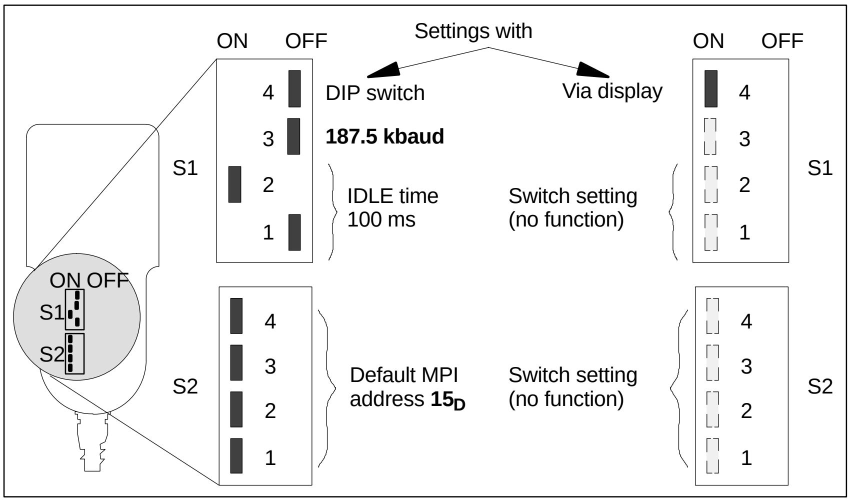


Fig. 7-14 Settings required on the HHU for SINUMERIK 840Di

Data transfer rate

The data transfer rate must be set together with the SINUMIERK 840Di to 187.5 kbaud.

Notice

To operate the HHU on the MPI bus of the SINUMERIK 840Di the data transfer rate has to be set to 187.5 kbaud.

MPI address

The MPI address is set to $F_H = 15_D$ by default. This address can normally be kept.

Table 7-4 MPI addresses that can be set using S2

S2				MPI address
1	2	3	4	
on	**on**	**on**	**on**	F_H = **15_D** (**default address**)
on	on	on	off	$E_H = 14_D$
on	on	off	on	$D_H = 13_D$
on	on	off	off	$C_H = 12_D$
on	off	on	on	$B_H = 11_D$
on	off	on	off	$A_H = 10_D$
on	off	off	on	9
on	off	off	off	8
off	on	on	on	7
off	on	on	off	6
off	on	off	on	5
off	on	off	off	4
off	off	on	on	3
off	off	on	off	2
off	off	off	on	1
off	off	off	off	0

Display of software version and MPI address

After the HHU has been electrically connected the following message is displayed until communication is established between HHU and PLC: “Waiting for PLC”, together with the software version and the MPI address.

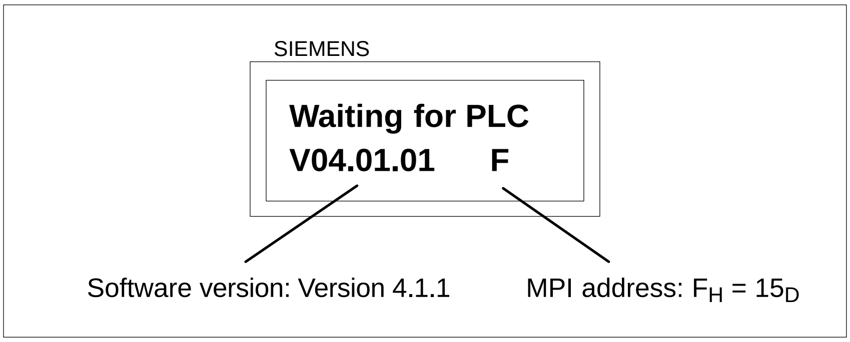


Fig. 7-15 Software version and MPI address

7.9.4 MPI parameterization of the PLC

Program structure

The PLC program has a modular structure. It comprises function blocks:

– Startup and synchronization (OB 100)

– Cyclical mode (OB 1)

– Process interrupt handling (OB 40)

The user (machine manufacturer) must call the appropriate section of the basic program in OBs 1, 40, and, 100 (see Fig. 7-16, Page 7-179).

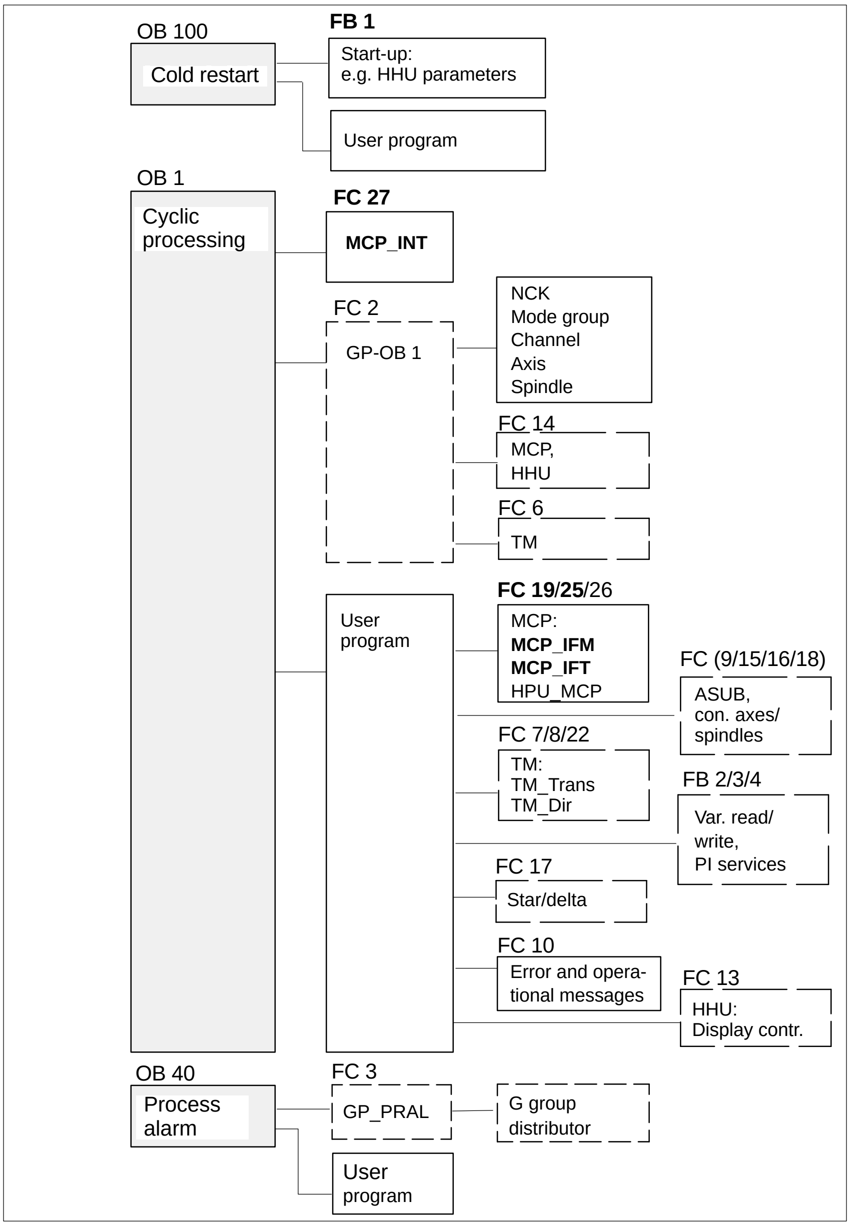


Fig. 7-16 Structure of the PLC program

Setting the MPI parameters (FB 1)

The MPI parameters are set on the PLC side in function block FB 1. Since the data transfer rate of the MPI bus with SINUMERIK 840Di is 187.5 kbaud, the parameters have to be set as follows:

HHU:	INT:= 2;	// The HHU is operated on an MPI bus with
BHGMPI	BOOL:= FALSE	// 187.5 kbaud

Notice

To be able to use HHU on an automation system alternately or simultaneously together with MCP/HT 6, the user (machine manufacturer) has to adapt the PLC program accordingly.

References

For a detailed description of the PLC basic program, please refer to:

/FB1/ Description of Functions, Basic Machine PLC Basic Program P3
Chapter: FB 1: RUN_UP Basic program, start-up section
Chapter: FC 13: BHGDisp Display control for handheld unit

7.9.5 GD circle parameters of the HHU

Default values

The GD circle parameters of the HHU are assigned the following default values. The default values cannot be kept if the default configuration is used.

Table 7-5 GD circle parameters

Parameters		Description	HHU Display	Default value	Value range
1	Receive	GD circle No.	Rec-GD-No:	2	1–16
2		GI No.	Rec-GI-No:	1	–
3		Object No.	Rec-Obj-No:	1	–
4	Send	GD circle No.	Send-GD-No:	2	1–16
5		GI No.	Send-GI-No:	2	–
6		Object No.	Send-Obj-No:	1	–
7		Baud rate	Baud rate:	1.5M	187.5K/ 1.5M
8		MPI bus address	Bus address:	15	0–31

Setting the GD circle parameters

The current values of the GD circle parameters of the HHU can be set and/or checked on the HHU display (see Fig. 7-17, Page 7-180).

- **Activate display**
  While the message “Waiting for PLC” is displayed on the HHU display, the uppermost right and left keys must be pressed simultaneously (see Fig. 7-17). Then the first GD circle parameter is displayed.
- **Modify value**
  The value of a GD circle parameter can be modified within its admissible range of values using the + or – keys (see Fig. 7-17).
- **Display next parameter**
  Press the 2nd key from the left in the uppermost key row (see Fig. 7-17) to advance to the next parameter. After the last GD circle parameter has been reached, the set values will be automatically saved in the Flash-EPROM of the HHU.

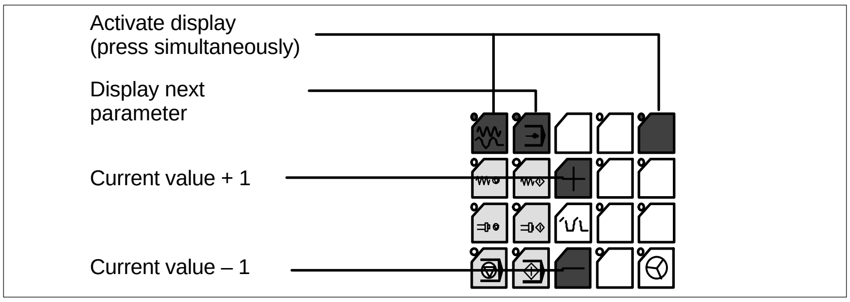


Fig. 7-17 Displaying and modifying GD circle parameters

Default configuration

If the default configuration is used the GD circle parameters must be set to the following values:

– Send: 3.2.1

– Receive: 3.1.1

7.9.6 GD circle parameterization of the PLC

Setting the GD circle parameters (FB 1)

The GD circle parameters on the side of the PLC are set side in function block FB 1. For editing FB1, it has to be loaded into SIMATIC Manager STEP 7.

The HHU GD circle parameters of FB1 must comply with the GD circle parameters set in the HHU.

In this context, you should note that the GD circle parameters for sending and receiving HHU and PLC (FB1) must be identical *one across the other*, i.e. the *send* parameters of the HHU are the *receive* parameters of the PLC and the *receive* parameters of the HHU are *send* parameters of the PLC.

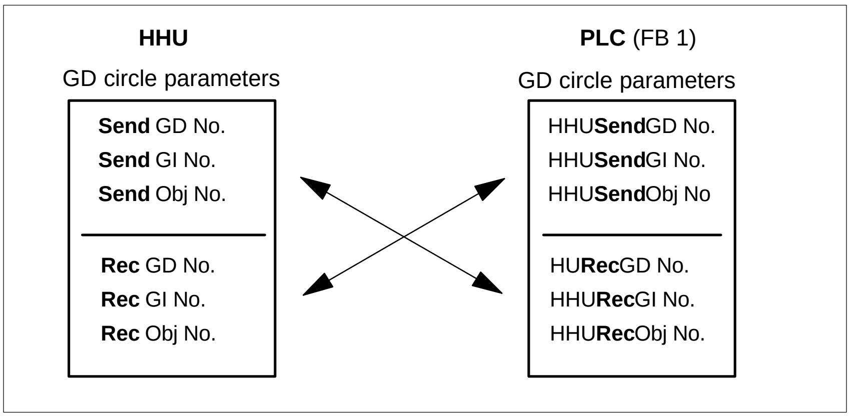


Fig. 7-18 Crosswise coincidence of GD circle parameters

Notice

The GD circle parameters of sender and receiver must be identical *crosswise*.

7.9.7 Example: Connecting a HHU to SINUMERIK 840Di

1. Checking the HHU for MPI bus capability:
   "B-MPI" must be indicated on the rating plate attached to the HHU's rear.
2. Check and, if necessary, set the MPI/GD circle parameters:
   – Data transfer rate = 187.5 kbaud
   – IDLE TIME = 100 ms
   – MPI address = 15_D
3. The terminating resistor in the MPI bus connector on the distributor box for connecting the HHU must be disabled. (The HHU has an integrated MPI bus terminator).

4. Connect the distributor box electrically to the HHU.
   As soon as the HHU is under power, message:
   Waiting for PLC
   V 04.01.01 F
   is displayed.
5. Setting the HHU GD circle parameters (see: Fig. 7-17, Page 7-180) according to the values of the default configuration.
6. Set call parameters of function block FB 1 in organization block OB100 according to the values of the default configuration.

```
HHU             := 2            // (HHU is operated on an MPI bus
BHGMPI          := TRUE         // with 187.5 kbaud)

BHGIn           := P#E 0.0      // Address of input data
BHGOut          := P#A 8.0      // Address of output data
                                // (Caution! See below: Note)

BHGInLen        := B#16#6       // Length of input data (6 bytes)
BHGOutLen       := B#16#14      // Length of output data (20 bytes)

BHGStatSend     := P#A 28.0     // Addr. of send status data (4 bytes)
BHGStatRec      := P#A 32.0     // Addr. of receive status data (4 bytes)

BHGTimeout      := S5T#700MS
BHGCycl         := S5T#400MS

BHGRecGDNo      := 3            // GD circle parameters of HHU:
BHGRecGBZNo     := 2            // Send (default configuration)
BHGRecObjNo     := 1

BHGSendGDNo     := 3            // GD circle parameters of HHU:
BHGSendGBZNo    := 1            // Receive (default configuration)
BHGSendObjNo    := 1

MCPSDB210       := TRUE         // MPI configuration via SDB210
```

Notice

BIT7 in 1st output byte (parameter: HHUOut; in the example, O 8.7), **must** be permanently set to **1**.

---

7. Insert call of function block FC27 as 1st line in organization block OB1.
8. Load the modified function blocks into the PLC and then restart the PLC.
9. After communication with the PLC has been established, the message "Waiting for PLC ..." will disappear from the HHU display.
   Now, the display set by way of the block FC13 will appear on the display.

References: /FB1/ Description of Functions Fundamentals: P3,
Basic PLC Program
Chapter: FC 13: BHGDisp Display control for handheld unit

7.10 Handheld Terminal HT 6

The HT 6 (Handheld Terminal with 6” screen diagonal) is a compact operator component consisting of an HMI and a machine control panel component.

Fig. 7-19 Handheld Terminal HT 6 front side

7.10.1 Conditions for start-up

Hardware

The following hardware components are required to start up the HT 6:

Distributor box
The distributor box incorporates the MPI module interface, the HT 6 interface, as well as a terminal block for connecting EMERGENCY STOP, enable keys, handwheel and 24 V power supply. For the distributor box, see Section 3.3, Page 3-96.

HT 6 connection cable
The HT 6 is connected to the distributor box using the HT 6 cable. For the HT 6 connection cable, see Section 3.3, Page 3-96.

MPI bus cable
Under no circumstances may the MPI bus cable contain an integrated bus terminating resistor, since a bus terminating resistor is already integrated in the HT 6. For the MPI cable, see Section 3.3, page 3-96.

Programming device (e.g. PG740)
A programming device/PC is required for the **SIMATIC Manager STEP 7** as the platform to match the basic PLC or PLC user program to the requirements of the appropriate automation system with regard to the operation of an HT 6 and to **load** it then into the **PLC**. For adapting the basic PLC or PLC user program, see Chapter 6, Page 6-133.

Note

A programming device/PC is not required if the SIMATIC Manager STEP7 is installed on the SINUMERIK 840Di.

The installation of additional software on the SINUMERIK 840Di is described in Chapter 15, page 15-411.

A PC/programming device is also required if the HT 6 user interface or the MPI address is modified using the HT 6 system software and the whole modified software is then to be loaded into the HT 6.

Software

The following software components are required to start up the HT 6:

Basic PLC program
The basic PLC program is included on the SINUMERIK 840Di installation CD. HT 6-relevant modules of the basic PLC program are FB 1 (HT 6/PLC communication) and FC 26 (NC/PLC communication).

For the archiving location of the basic PLC program, please refer to Section 1.2, Page 1-33.
For use of the PLC basic program see Chapter 6, Page 6-133.

SIMATIC Manager STEP7
SIMATIC Manager STEP7 is used for adapting the PLC basic program (e.g. parameterization of FB 1).

HT 6 system software (optional)
The HT 6 system software (CD-ROM) provides the following possibilities:

- Language selection for the 1st and 2nd Language
- Creation of the user's alarm texts
- Modification of the MPI address

Order No.: 6FK5 453-☐AX10-☐AG0 (version dependent)

References

The following manuals are required to start up the HT 6:

/BH/ Operator Components Manual
Description of the HT 6 interfaces, electrical connection at the distributor, interface signals etc.

/Z/ Catalog NC Z
Connection Components: Cables, connectors, etc.

Further references on the HT 6

/FBPH/ Description of Functions HT 6
Configuring the HT 6 user interface

/IAM BE1/ Description of Functions HT 6
Expanding the user interface

Automation system

To start up the HT 6, the automation system must be completely electrically and mechanically connected with respect to NC, PLC and HT 6.

The drives must be secured against accidental moving.

7.10.2 Parameterization of the HT 6

Electrical connection

To connect HT 6 electrically and for the MPI communication, a distributor box is used.

Notice

Under no circumstances may the MPI connector for connecting the HT 6 be enabled, since the HT 6 already contains an integrated bus terminator.

Please observe the warning notices with respect to the MPI cables and the EMERGENCY STOP jumper. (For a detailed description, please refer to the relevant references).

For a detailed description of the electrical and mechanical design of the distributor box, as well as for the electrical and data interfaces of the HT 6, please refer to:

References: /BH/ Operator Components, Manual
Chapter: Handheld Terminal HT 6

Data transfer rate

The HT 6 detects the data transfer rate at the MPI bus automatically.

MPI address

The factory-set MPI address of the HT 6 is 14_D (decimal). The default address can only be modified using the HT 6 system software.

Display of the software version

The current software version of the HT 6 is displayed in a menu of the user interface. After power-up of the HT 6, you will get to this menu using the following sequence of operations:

1. Key **MENU SELECT**
2. Softkeys **Diagnosis > Service display > Version > Vers. MMC**

7.10.3 Parameterization of PLC

Program structure

The PLC program is modular in design. It comprises function blocks:

- Startup and synchronization (OB 100)
- Cyclical mode (OB 1)
- Process interrupt handling (OB 40)

The user (machine manufacturer) must call the relevant part of the basic program in the OBs 1, 40 and 100, as shown in Fig. 7-20.

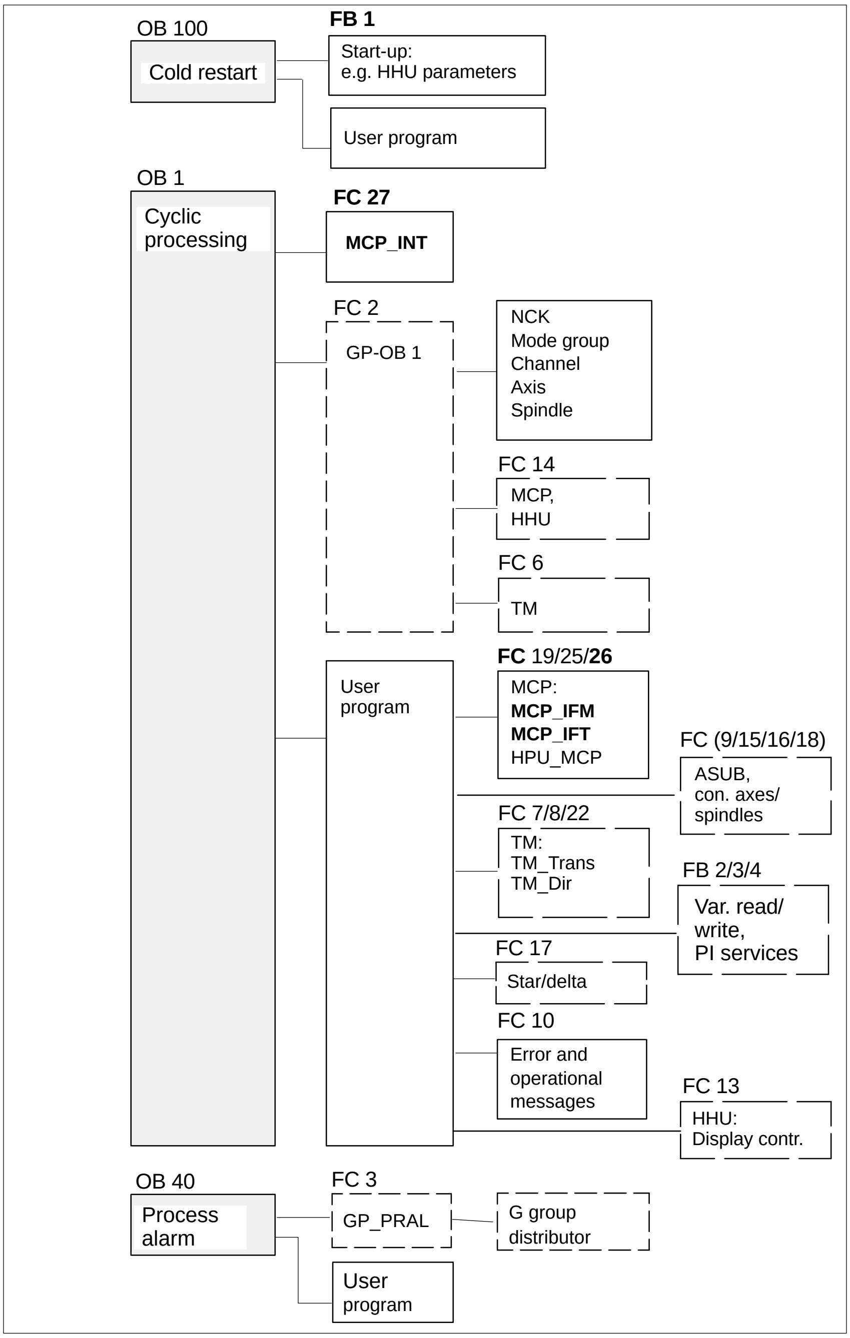


Fig. 7-20 Structure of the PLC program

Setting the communication parameters (FB1)

The HT 6 is parameterized as a machine control panel (MCP) in organization block OB 100 in the call parameters of function block FB 1.

The HT 6 can be operated either as an MCP substitute or, in addition to an MCP, as a 2nd operator component.

To synchronize several operator components, the PLC program must be adapted accordingly. This is the user's (machine manufacturer's) responsibility.

MCPNum:	INT	// 1: 1 operator component MCP/HT 6 (default) // 2: 2 operator components MCP/HT 6
MCP1In:	POINTER	// Address of input signals MCP/HT 6 1
MCP1Out:	POINTER	// Address of output signals MCP/HT 6 1
MCP1StatSend:	POINTER	// Addr. of MCP/HT 6 1 send status data
MCP1StatRec:	POINTER	// Addr. of MCP/HT 6 1 receive status data
MCP1BusAdr:	INT	// MPI address of HT 6
MCP1Timeout:	S5TIME	// Default setting should be kept
MCP1Cycl:	S5TIME	// Default setting should be kept
MCPMPI:	BOOL	// MSTT/HT 6 operated on “extended” // MPI bus

The MCP2... parameters are only needed if in addition to the 1st MCP/HT 6 a HT 6 is additionally used:

MCP2In:	POINTER	// Address of input signals MCP/HT 6 2
MCP2Out:	POINTER	// Address of output signals MCP/HT 6 2
MCP2StatSend:	POINTER	// Addr. of MCP/HT 6 2 send status data
MCP2StatRec:	POINTER	// Addr. of MCP/HT 6 2 receive status data
MCP2BusAdr:	INT	// MPI address
MCP2Timeout:	S5TIME	// Default setting should be kept
MCP2Cycl:	S5TIME	// Default setting should be kept

The parameters listed below serve to synchronize two operator components:

MCP1Stop:	BOOL	// 0: Start trans. of MCP/HT 6 signals
MCP2Stop:	BOOL	// 1: Stop transfer of MCP/HT 6 signals
MCP1NotSend:	BOOL	// 0: Send and receive mode is active
MCP2NotSend:	BOOL	// 1: Only reception of MCP/HT 6 signals

The following parameter is used to announce that an MPI configuration exists in system data block SDB210:

MCPSDB210:	BOOL	// MPI configuration via SDB210

Notice

A maximum of two MCP/HT 6 can be operated on an MPI line. To be able to use MCP and HT 6 on an automation system alternately or simultaneously, the user (machine manufacturer) has to adapt the PLC program accordingly.

References

For a detailed description of the PLC basic program or of function block FB1, please refer to:

/FB1/ Description of Functions, Basic Machine P3, Basic PLC Program
Chapter: FB 1: RUN_UP Basic program, startup section

Parameter assignment of the NC interface (FC 26)

The FC 26 transfers the signals of the HT 6 with regard to:

– Mode groups
– WCS/MCS switchover commands
– Traversing keys
– Override

to the NC through the PLC interface.

Notice

Block FC 26 or FC is 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

For a detailed description of FC 26 and FC, please refer to:

/FB1/ Description of Functions, Basic Machine P3, Basic PLC Program
Chapter: FC 26 HPU_MCP Transfer of HT 6 signals to interface

7.10.4 Example: Connecting an HT 6 to SINUMERIK 840Di

1. Connect the distributor box electrically to the HT 6.

   The terminating resistor in the MPI bus connector on the distributor box for connecting the HHU must be disabled. (An MPI bus terminating resistor is a permanent part of the HT 6.)

   Once power is present on the HT 6, the start screen for communication with the HT 6 system software is displayed for some seconds. (Press key "6" below the keyboard label "PARAM" to open the selection menu for the data transmission rate of the serial interface of the HT 6)

   After a short time or pressing the key, message:
   Waiting for PLC
   V 04.01.01 *date time*
   is displayed.

   As function block FB 1 in the PLC basic program is not yet parameterized, no communication is established with the PLC.

2. Setting the call parameters of function block FB 1 in organization block OB 100. HT 6 is parameterized as the first and only MCP as an example:

```
MCPNum          := 1          // One HT 6 exists

MCP1In          := P#E 0.0    // Address of input data (8 bytes)
MCP1Out         := P#A 0.0    // Address of output data (8 bytes)

MCP1StatSend    := P#A 8.0    // Address of send status data (4 bytes)
MCP1StatRec     := P#A 12.0   // Address of receive status data (4 bytes)

MCP1BusAdr      := 14         // Default MPI address of the HT 6
```

MCP1Timeout	:= S5T#700MS	// Default setting
MCP1Cycl	:= S5T#200MS	// Default setting
MCPMPI	:= FALSE	// The HT 6 is operated at the “extended” // MPI bus
MCP1Stop	:= FALSE	
MCP1NotSend	:= FALSE	
MCPSDB210	:= TRUE	// MPI configuration via SDB210

3. Insert call of function block FC27 as 1st line in organization block FB1.
4. Insert call of function block FC 26 into the cyclic parts of the PLC program (see Fig. 7-20, Page 7-186).
5. Load the modified blocks into the PLC and then restart the PLC.
6. After communication with the PLC has been established, the message “Waiting for PLC ...” will disappear from the HT 6 main screen.

   The MMC user interface is displayed.

7.10.5 Connecting and disconnecting the HT 6 during operation

To be able to connect an HT 6 to or disconnect from an automation system without any trouble during operation, make the following arrangements:

- The EMERGENCY STOP of the HT 6 must be enabled or jumpered
- The HT 6 must be connected to the MPI bus through a PROFIBUS repeater

References

For a detailed description of the actions to be taken and the devices required, please refer to:

/BH/ Handheld Terminal HT 6
Chapter: Handheld Terminal HT 6
Connecting and disconnecting the HT 6 during operation

7.11 HMI Advanced

Depending on where the user interface is implemented, a distinction is made between internal and external HMI Advanced:

- Internal HMI Advanced
  SINUMERIK 840Di and HMI Advanced are performed on the same PCU.
- External HMI Advanced
  SINUMERIK 840Di and HMI Advanced are performed on different PCU.

7.11.1 Conditions for start-up

Internal

If internal HMI Advanced is used the following conditions must be fulfilled:

- **Hardware**
  No special requirements need to be fulfilled.
- **Software**
  Please observe the compatibility list available from the Internet. See Section 15.4, Page 15-424.

External

If external HMI Advanced is used the following conditions must be fulfilled:

- **Hardware**
  To start up an external HMI, Advanced the following hardware is required:

  MPI bus cable
  The external computer (PCU) is connected to the SINUMERIK 840Di through the MPI bus. A terminating resistor for the MPI bus is not integrated in the MCP.
- **Software**
  Please observe the compatibility list available from the Internet. See Section 15.4, Page 15-424.

References

The following manuals are required to start up HMI Advanced:

/IAM/ Installation and Start-Up Guide HMI/MMC
Installation and Start-Up Guide HMI Advanced (IM4)

/Z/ Catalog NCZ
Connection Components: Cables, connectors, etc.

7.11.2 Parameterization

Parameterization is performed in menu “Operator panel interface parameters”:
Operating area switchover > Installation > MMC > Operator panel

Internal

When an internal HMI Advanced is parameterized the following conditions must be fulfilled:

- **Connection**
  Only a 1:1 connection is possible. Function M:N (M SINUMERIK 840Di communicate with N HMI Advanced) is not enabled for SINUMERIK 840Di.
- **Bus**
  Set “Softbus MC” as the bus type.
- **Highest bus address**
  31 is the highest permissible bus address.
- **MMC address**
  The bus address set here must match the corresponding bus address of the configuration loaded in the SINUMERIK 840Di PLC. This is not checked.
- **NCK address**
  See MMC address above.
- **PLC address**
  See MMC address above.

External

When an external HMI Advanced is parameterized the following conditions must be fulfilled:

- **Connection**
  Only a 1:1 connection is possible. Function M:N (M SINUMERIK 840Di communicate with N HMI Advanced) is not enabled for SINUMERIK 840Di.
- **Bus**
  Set “MCI2 (840Di-187.5 kbaud)” as the bus type.
- **Highest bus address**
  31 is the highest permissible bus address.
- **MMC address**
  The bus address set here must match the corresponding bus address of the configuration loaded in the SINUMERIK 840Di PLC. This is not checked.
- **NCK address**
  You do not have to define an NCK address because communication to/from the NCK is routed via the PLC.
- **PLC address**
  See MMC address above.

7.11.3 Default languages

Language switchover

To be able to switch between the two configured languages even when the operator is not familiar with the selected language, the switchover between the languages must be performed “blindly”:

1. Select menu bar
2. Select Start-up (3rd horizontal soft key from right)
3. Switch to the highest level with RECALL
4. Select Change language (3rd vertical soft key from top)

HMI Advanced

HMI Advanced offers several possibilities to switch over the language during operation:

- Switchover between two preset languages.
- Online change of the second language.

Language switchover concept

The displayable languages are set and managed in a file. When the language is switched in online operation, the first language remains as originally set and only the second language can be changed.

Switching between two languages

The vertical soft key labeled “Change language” in the “Start-up” display is used to switch between two languages. The switchover takes effect immediately. This key can only be used to switch between two predefined languages.

Online change of the 2nd language

Different languages are selected in the “Start-up/MMC/Languages” display (provided that languages are loaded).

This screen displays a list from which the user can choose the desired language(s). The user selects the desired language and acknowledges his/her selection with “OK”. The user can then change over between the first language and the language just set by selecting the “Change language” soft key in the “Start-up” display.
The 2nd language can always be changed in online mode.

Installing languages packages

HMI Advanced contains the languages German and English as default languages. Supplementary packages 1 and 2 are also available.

Supplementary package 1: European languages:

GR	German (default)
SP	Spanish
FR	French
UK	English (default)
IT	Italian

Supplementary package 2: Asian languages:

KO	Korean logographic language, (Korea)
TW	Chinese logographic language, (Taiwan)
CH	Chinese logographic language, (Mainland China)

Definition of usable languages

The languages to be used on the MMC are configured in file **c:<Installations-pfad>\mmc2\mmc.ini**. Any modifications to the file described in the following can be made using the editor provided to the user under **Start-up/MMC**.

Presettings without activation of logographic languages

Two languages can be set from selection of several optional languages:

GR	German (default)
SP	Spanish
FR	French
UK	English (default)
IT	Italian

Example:
1st language German, 2nd language English

File MMC.INI must be altered as shown below.

Extract from MMC.INI:

...
[LANGUAGE]
Language=**GR**
LanguageFont=Europe
Language2=**UK**
LanguageFont2=Europe
...

Notice

When editing the MMC.INI file, please make sure you only change the highlighted (bold print) texts. Make sure that your entries are spelled correctly.

Default setting with logographic activation

Two languages can be set from selection of several optional languages:

GR	German (Standard)
SP	Spanish
FR	French
UK	English (default)
IT	Italian
TW	Chinese characters, (Taiwan)
CH	Chinese characters, (Mainland China)

Example:
1st language German, 2nd language Chinese

File MMC.INI must be altered as shown in the figure.

Extract from MMC.INI:

```
...
[LANGUAGE]
Language=GR
LanguageFont=Europe
Language2=CH
LanguageFont2=China

;LanguageList=GR, SP, FR, UK, IT
;FontList=Europe, Europe, Europe, Europe, Europe
;LBList=espanol, francais, english, italiano

LanguageList=GR, CH, TW, SP, FR, UK, IT
FontList=Europe, China, China, Europe, Europe, Europe, Europe
LBList=chinese, taiwan, espanol, francais, english, italiano
AddOnProd=c:\cstar20\cstar20.exe
...
```

Add-on products

To be able to operate the control with pictographic languages, the appropriate add-on product must be installed for each selectable language. Languages based on different add-on products cannot be configured at the same time.

Notice

When you change the “LanguageList”, “FontList”, “LBList” and “AddOnProd” lines, make sure that you only manipulate (shift, delete) the “**;**” character representing the comment.
When editing file MMC.IN only change highlighted text. Make sure that your entries are spelled correctly.

■

PROFIBUS DP Communication 8

8.1 General

8.1.1 PROFIBUS DP with Motion Control option

PROFIBUS DP

PROFIBUS DP is an international, open field bus standard defined in the European field bus standard EN 50170 Part 2. PROFIBUS DP is optimized for fast, time-critical data communication on the field level.

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):
     This term denotes central master devices that exchange information with the slaves within defined message cycles.
     Examples: SIMATIC S5, SIMATIC S7, etc.
   - DP master, class 2 (DPMC2):
     These are devices for configuring, start-up, operation and monitoring during running bus operation.
     Examples: Programming devices, operator control and monitoring devices
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 expansion

Communication between SINUMERIK 840Di (NC and PLC), as the master, and the slave components on PROFIBUS DP is based on PROFIBUS DP with the MotionControl extension.

The MotionControl extension is characterized by:

- Configurable equidistant 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

8.1.2 Message frame structure for cyclic DP communication

This is the message frame structure for cyclic DP communication using the drive “SIMODRIVE 611 universal”.

Message frame structure

The message frames for cyclic data transmission have the following basic structure:

	Drive A		Drive B		
	Useful data (PPO)		**Useful data (PPO)**		
Protocol frame (header)	**Parameter identifier value (PIV)**	**Process data (PDA)**	**Parameter identifier value (PIV)**	**Process data (PDA)**	Protocol frame (trailer)

Note:
The useful data for drive B are only transmitted when “DP slave 611U” is operated as a double-axis module.

Fig. 8-1 Message frame structure for cyclic data transmission

Useful data structure

The useful data for cyclic operation are termed 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)

  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)

8.1.3 Description of a DP cycle

Actual values

At time T_I, the current actual values are read from all equidistant drives (DP slaves). 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 setpoints on the basis of the transferred actual positions.

Setpoints

At the start of the next DP cycle, the speed setpoints are transferred from the DP master to the DP slaves (drives) in the time T_{DX}.

At time T_O, the speed setpoints are taken as new specified values for all drive controllers.

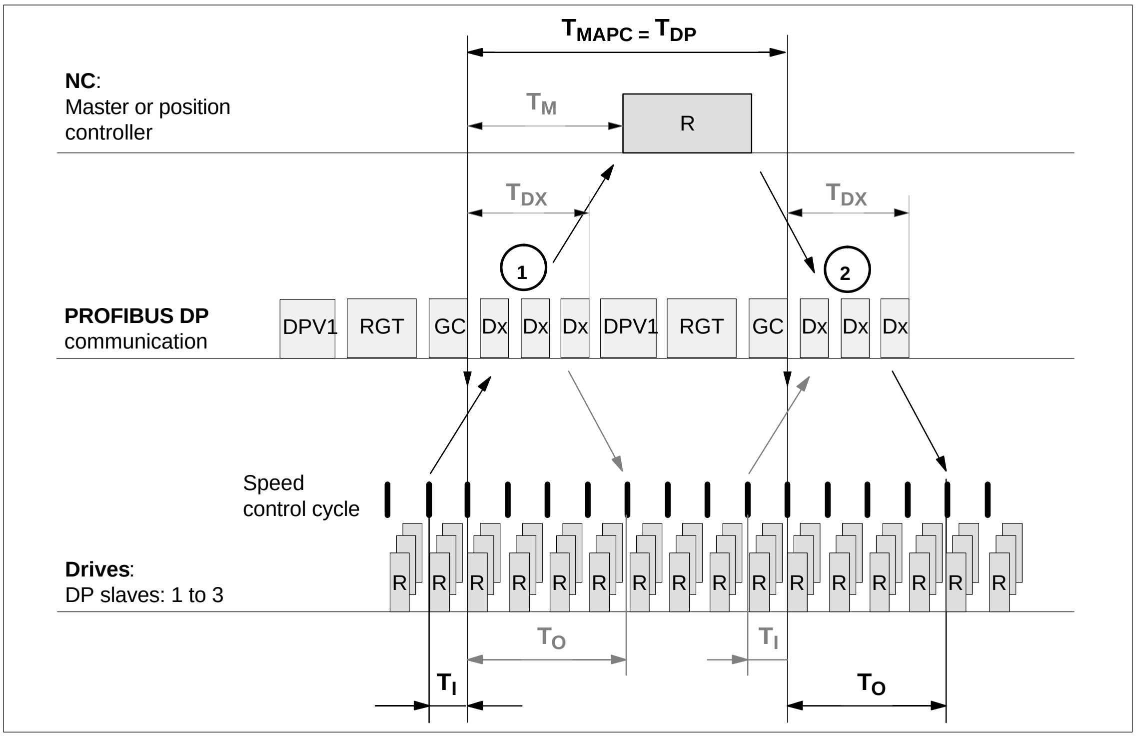


Fig. 8-2 Example: Optimized DP cycle with 3 DP 611U slaves

Key to Fig. 8-2:

T_{MAPC}	Master application cycle NC position control cycle the following always applies for SINUMERIK 840Di: $T_{MAPC} = T_{DP}$
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
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) to the cyclic synchronization of the equidistance between the DP master and DP slaves
R	Computation time for speed position control
Dx	Exchange of user data between DP master and DP slaves
DPV1	After cycl. 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.
GAP	An attempt is made during GAP to accept new active stations.
TOKEN	The token passing is either to itself or other masters.
RES	The reserve is used as an “active pause” for the station to send the token to itself until the equidistant cycle is terminated.

1 The actual values for the current DP cycles / 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

8.1.4 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**.

Example: PROFIBUS DP network installation

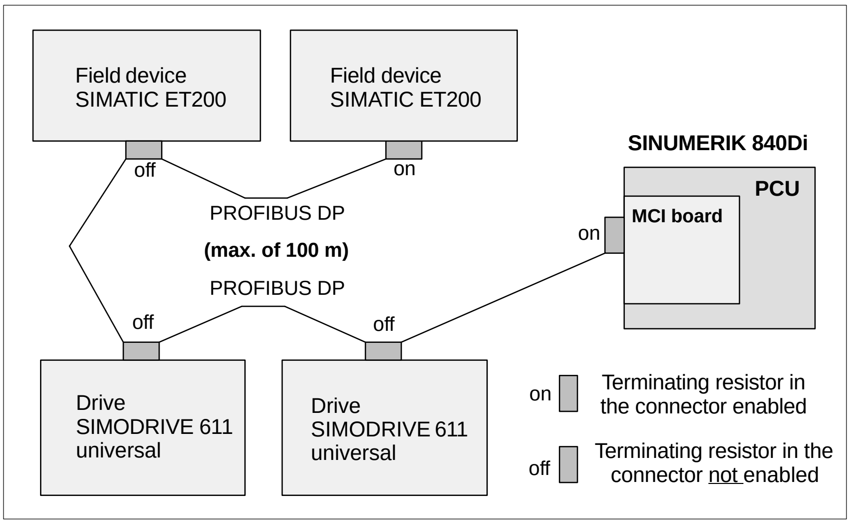


Fig. 8-3 Example of a PROFIBUS DP network installation

8.2 Preconditions

As a condition for creating a PROFIBUS configuration using the default configuration the following components are required:

- SIMATIC STEP 7
- 840Di Rack
  (a SIMATIC S7-300 station preconfigured for SINUMERIK 840Di. Part of the PLC basic program)
- SlaveOM
  (part of the scope of supply of a SINUMERIK 840Di: SIMATIC S7 add-on Software)

SIMATIC STEP 7

SIMATIC STEP 7 (option) is required in the following version or later:

- SIMATIC STEP 7 as from Version 5.2, Service Pack 1

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

SINUMERIK 840Di

If SIMATIC STEP 7 is installed on the SINUMERIK 840Di no additional MPI cable is required to load the configuration onto the PLC.

Windows applications executed on the SINUMERIK 840Di have direct access to the PLC through the internal MPI interface of the MCI board.

Installation of additional software on the SINUMERIK 840Di is described in detail in Chapter 15, Page 15-411.

External computer

If SIMATIC STEP 7 is installed on an external computer (PG/PC), it must fulfill the following conditions:

- MPI interface parameterized with 187.5 kbaud
- MPI connection between external computer and SINUMERIK 840Di

840Di Rack

The 840Di Rack us a SIMATIC S7-300 station preconfigured for SINUMERIK 840Di. The following version is available in the hardware catalog of HW-Config:

- **840Di with PLC 317-2DP 2AJ10**
  – SINUMERIK 840Di PLC
    Standard designation: PLC317-2DP M/S 2AJ10
  – PROFIBUS DP Master
    Standard designation: DP master
  – SINUMERIK 840Di NC
    Standard designation: S7 FM NCU

Installation

The 840Di Rack is part of the PLC Toolbox. When the PLC basic program which is also included in the PLC toolbox is installed it is automatically installed in SIMATIC STEP7, too.

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 Rack can be accessed in the hardware catalog of SIMATIC STEP 7, "HW-Config":

- "HW-Config" hardware catalog:
  Profile: **Default**
  SIMATIC 300 > SINUMERIK > 840Di > 840Di with PLC317-2AJ10

SlaveOM

The SlaveOM (Slave Object Manager) for SINUMERIK 840Di permits dialog-based configuration of the following PROFIBUS drives:

- SIMODRIVE 611 universal or universal E
- SIMODRIVE POSMO CD/CA
- SIMODRIVE POSMO SI
- 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 configuration and no system data blocks are generated.

Installation

The Slave OM is included in the supply of the SINUMERIK 840Di. Once you have installed the SlaveOM the specified DP slave drives are available at the following location in the hardware catalog of "HW-Config":

- "HW-Config" hardware catalog:
  Profile: **Standard**
  - **PROFIBUS DP > SIMODRIVE > SIMODRIVE 611 universal**
  - **SIMODRIVE POSMO CD**
  - **SIMODRIVE POSMO CA**
  - **SIMODRIVE POSMO SI**
  - **SIMODRIVE POSMO A**
  - **PROFIBUS DP > SINUMERIK > ADI4**

Note

The slaveOM must be installed on the same computer as SIMATIC STEP 7. To install the Object Managers, please refer to the appropriate notes in the file:

- <*Installation path*>**\importantinfo.rtf**

DMF 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 DMF 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 DMF file. To do that, use menu command **Tools > Install new DMF file**.

As soon as you have installed the DMF 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 DMF files must be installed on that computer on which the SIMATIC STEP 7 required to install the S7 project is already installed.

To install a DMF file, please refer to the appropriate notes in the file:
<*Installation path*>**\importantinfo.rtf**

8.3 Creating a PROFIBUS configuration

8.3.1 Precondition

S7 project

The procedure described in this section for setting up the PROFIBUS configuration as well as the parameterization of various components (for example, SIMODRIVE drives, AD14), is based on an S7 project created using the description in Section 8.3, Page 8-202.

The following status of the S7 project is required:

– S7 project is has been set up (name: SIN840Di)
– Station 300 has been set up
– MPI interface is parameterized
– PROFIBUS interface is parameterized
– Input/output data areas of the NC are parameterized

Note

The instructions given in this chapter are essentially limited to the special characteristics of the SINUMERIK 840Di. 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 on 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.

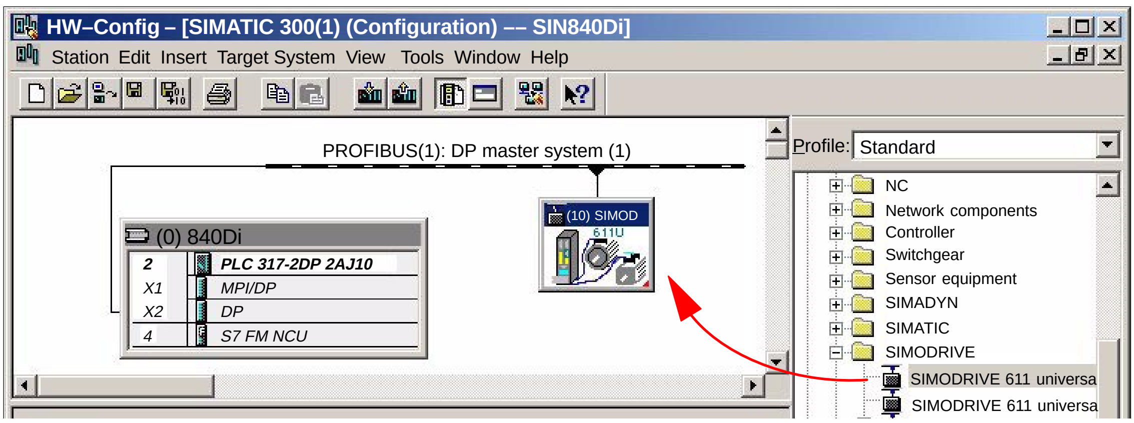


Fig. 8-5 HW-Config: Insert modules e.g. SIMODRIVE 611universal

8.3.2 SIMATIC S7 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 equidistant communication on the PROFIBUS DP, you must first insert all the SIMATIC S7 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. Put down 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.

8.3.3 DP slave: I/O Module PP72/48

DMF file

A PP72/48 I/O module is parameterized with a DMF file.

– The DMF file is part of the SINUMERIK 840Di software. See Section 1.2, Page 1-33: SIMATIC S7 AddOn software > **DMF file** for **I/O module PP72/48**

– For installation of the DMF file, see Subsection 8.1.4., Page 8-201 **DMF files**.

Note

To make parameterization of equidistant communication with PROFIBUS DP easier, we recommend inserting all required DP slaves 611U into the configuration before setting the times for equidistant communication.

Insert

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.

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

– Data transfer 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 2.10, Page 2-76).

There is **no automatic adjustment**!

The following data must match.

1. SIMATIC S7 configuration of DP slave PP72/48
   PROFIBUS address
2. I/O module PP72/48
   PROFIBUS address (switch S1)

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
Data transfer rate: **12 Mbaud**
Profile: **DP**
OK

OK

I/O addresses

Wen 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.

8.3.4 DP slave: ADI4

Notice

The ADI4 DP slave can only be operated on an **equidistant** PROFIBUS DP.

SlaveOM

Parameterization of the configuration with regard to the ADI4 interface modules, called DP slave ADI4 here, is performed with the SlaveOM for SINUMERIK 840Di.

For how to install the slaveOM, see below: References.

Note

To simplify parameterization of the equidistant 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 equidistant communication.

DP slave ADI4 inserting

To insert an AD14 DP slave in the configuration, open the hardware catalog via the menu command **View > Catalog**.

The DP slave ADI4 is to be found at:

- Profile: **Standard**

  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
Chapter: Parameterization

8.3.5 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.

SlaveOM

The drives are parameterized using the SlaveOM for SINUMERIK 840Di (for installation of the SlaveOM, see Section 8.1, Page 8-195: **DriveOM / SlaveOM**).

Note

To simplify parameterization of the equidistant 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 equidistant DP communication.

DP Slave 611U inserting

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: **Standard**

  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.

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 16.2, Page 16-451.

DP slave 611U parameterization

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 equidistant 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 match.

1. SIMATIC S7 configuration of DP slave 611U
   PROFIBUS address
2. SIMODRIVE 611 universal
   Parameter P0918 (PROFIBUS node address)

Dialog box

Dialog box: Properties – PROFIBUS Interface SIMODRIVE 611U DP2, DP3
Tab card: Parameter
Address: **PROFIBUS address**

OK

Message frame type

After this dialog box has been confirmed using the button: “OK”, the dialog box: “DP Slave Properties” 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

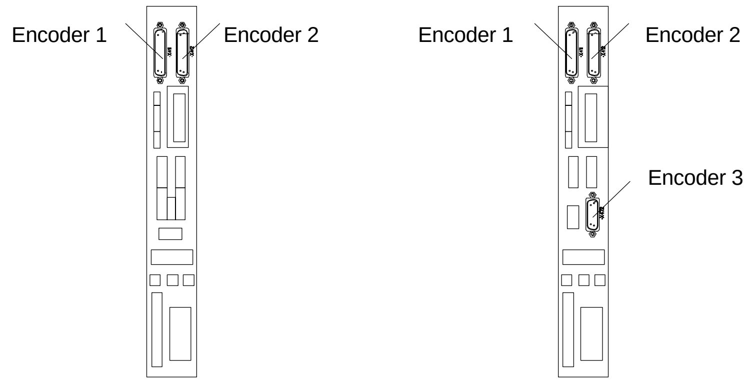
– The number of encoders used per axis

– The drive functionality used

The following message frame types are predefined for parameterization of the DP slave 611U:

Table 8-1 Message frame types

Message 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**

Dialog box

Dialog box: DP slave properties
Tab card: Configuration
Default: <**Message 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 match.

1. SIMATIC S7 configuration DP slave 611U
   Message frame type
2. SINUMERIK 840Di-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 NC and the individual axes of the DP slaves 611U in the SINUMERIK 840Di can only take place if the I/O addresses for setpoint 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 one axis are assigned different I/O addresses for set and actual values. In this case, the I/O addresses must be corrected manually.
- To avoid access conflicts between PROFIBUS DP drives and I/O modules, you need to set values $\geq$ **272** for ADI4 DP slave 611U I/O addresses.

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 match.

1. SIMATIC S7 configuration of DP slave 611U
   I/O address
2. SINUMERIK 840Di-NC
   MD13060 DRIVE_LOGIC_ADDRESS[n], (logical drive address)

Note

To avoid any modifications to the I/O addresses in NC 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 = 272

mth axis: Default I/O address = 272 + (m–1)*20

The default setting for the machine data is described in Subsection 10.5.1, Page 10-260.

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 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.

Dependencies: 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

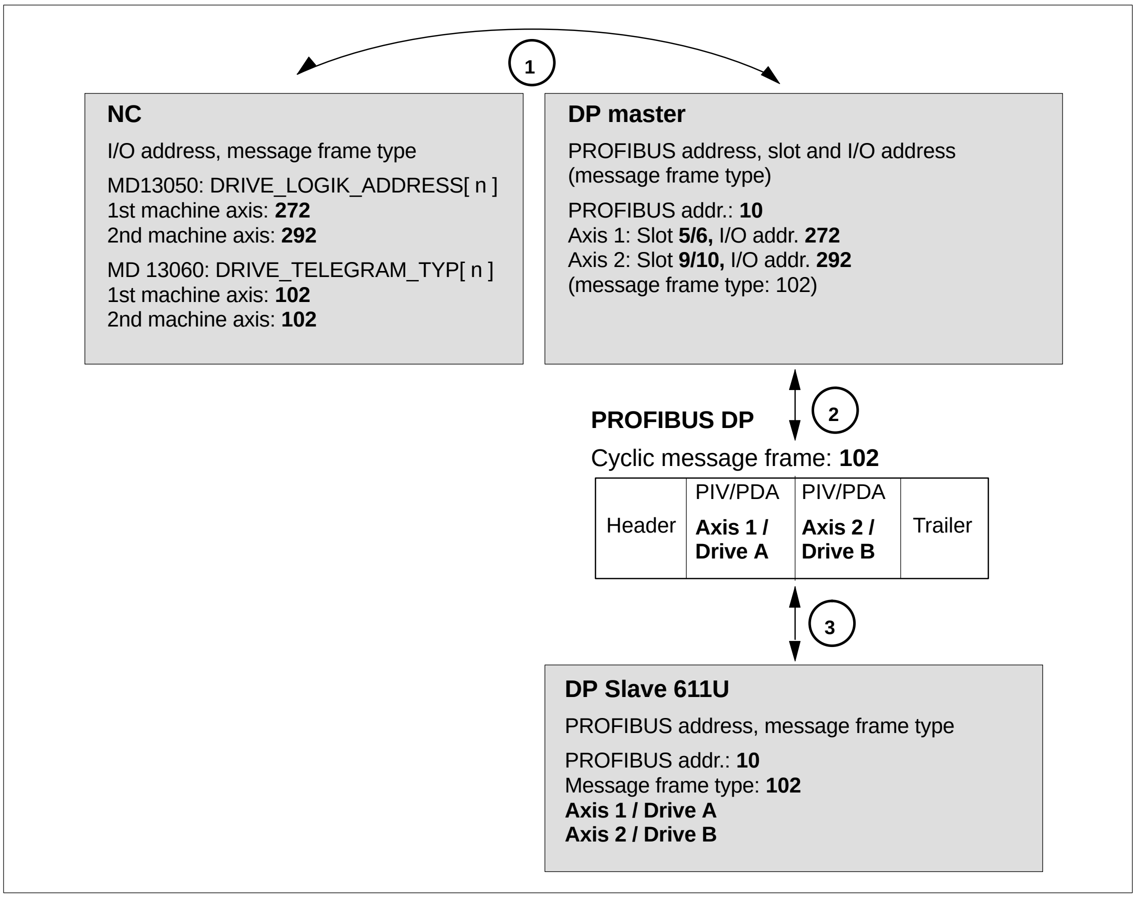


Fig. 8-6 Dependencies: NC, PLC/DP master and DP slave (SIMODRIVE 611 universal)

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]
- MD 31060: DRIVE_TELEGRAM_TYP[n]

and the message frame type of the machine axis:

1st machine axis:	I/O address	**272**
	Message frame type	**102**
2nd machine axis:	I/O address	**292**
	Message frame type	**102**

For configuring the drive within the framework of the NC start-up, please refer to Subsection 10.5.3, page 10-264.

(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 equidistantly transfers the data to/from the DP slaves cyclically using the following information:

PROFIBUS addr. **10**:	Setpoint:	Slot **5**,	I/O address **272**
	Actual value:	Slot **6**,	I/O address **272**
	Setpoint:	Slot **9**,	I/O address **292**
	Actual value:	Slot **10**,	I/O address **292**

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**

Final parameterization

After all PROFIBUS components (drives, ADI4, I/O devices, etc.) have been inserted into the configuration and parameterized, the equidistant DP cycle is parameterized in the final step.

8.3.6 Final parameterization of the equidistant DP slaves

After all the planned DP slaves have been inserted into the configuration and parameterized individually, the following parameters of the equidistant DP slaves are set in two separate steps for final parameterization of the equidistant DP communication:

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 8-197.

Note

The procedure of final parameterization of equidistant DP communication is exemplified by one DP slave 611U. For other equidistant DP slaves, e.g. SIMODRIVE POSMO SI, CD/CA; ADI4; etc., proceed analogously.

Notice

If a project you want to perform final parameterization on contains DP slave ADI4 interfaces certain boundary conditions must be observed. See also:

References /ADI4/ ADI4 Analog drive interface for four axes
Chapter: Parameterization
Parameterization of DP communication
Boundary conditions

Activation of the equidistant DP cycle

If you double-click on a DP slave 611U in the station window, the dialog box: “DP Slave Properties” opens.

We recommend activating the equidistant DP cycle for all DP slaves 611U by activating the equidistant DP cycle within the selected DP slave 611U and finally adjusting.

During adjustment all the values displayed in dialog box:

- DP Slave Properties
  Tab card: Cycle clock synchronization

are transferred to all DP slaves of the same type in the configuration, here DP slave 611U.

Dialog box:
Start

Dialog box: DP slave properties
Tab card: Cycle clock synchronization
Radio button: “Synchronize drive to equidistant DP cycle” ☑
Button: “**Adjust**”

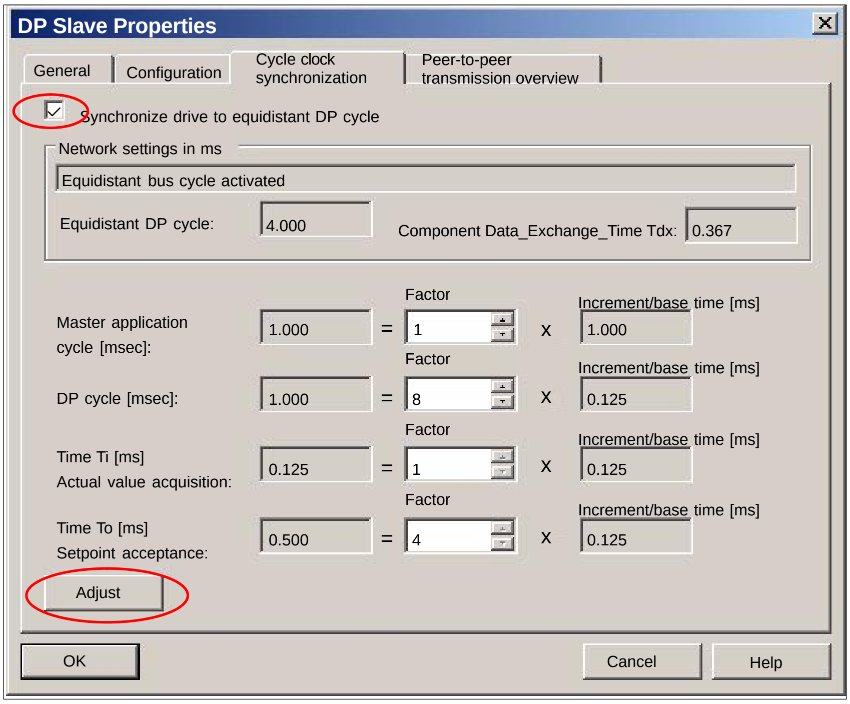


Fig. 8-7 Enabled equidistant DP cycle

Notice

If there are different types of equidistant DP slaves in a S7 project, e.g. different SIMODRIVE 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 go on to set the other parameters.

Equid. master cycl. percentage T_{DX}

After synchronization to the equidistant 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 equidistant bus cycle.

Dialog box:
Continuation

Tab card: General
Group box: Station/Master System
Button: “PROFIBUS...”

Dialog box: Properties – PROFIBUS Interface SIMODRIVE ...
Tab card: Parameter
Button: “Properties...”

Dialog box: Properties PROFIBUS
Tab card: Network settings
Button: “Options...”

Dialog box: Options
1st radio button: Activate equidistant bus cycle ☐
2nd radio button: Activate equidistant bus cycle ☑

Equidistant DP cycle T_{DP}

When calculating the cyclic portion of the PROFIBUS communication, the time for the equidistant DP cycle is automatically changed to the time required as the minimum. This change must be undone by reentering the time intended for the equidistant DP cycle.

Dialog box:
Continuation

Group box: Equidistant time in ms
Equidistant DP cycle: ***Equidistant time***
OK

OK

OK

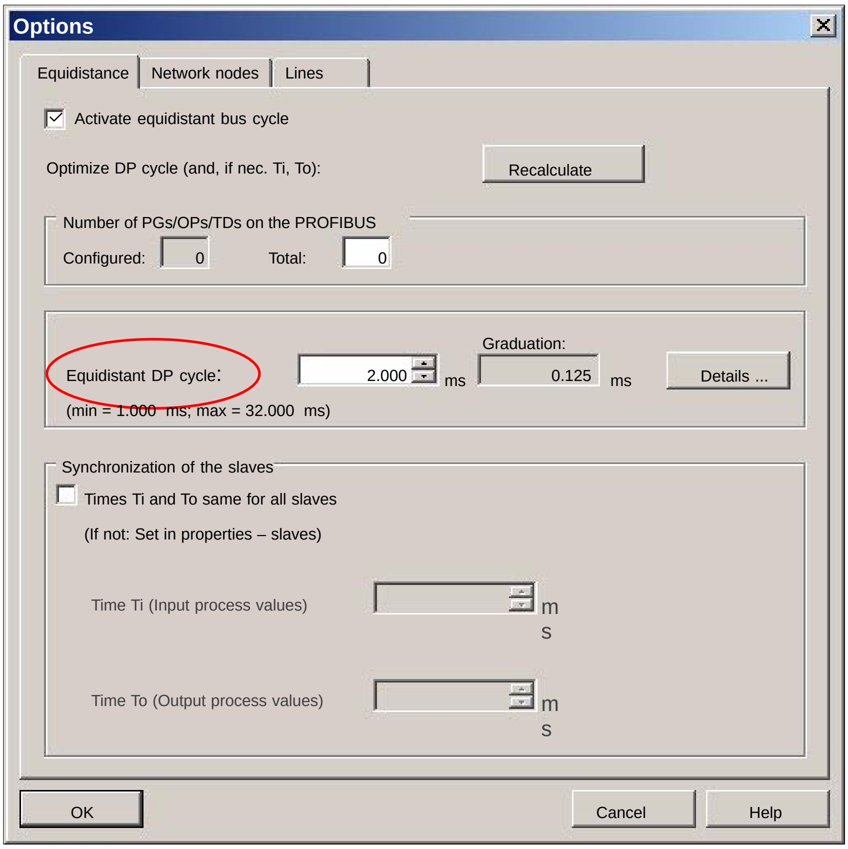


Fig. 8-8 Dialog box: Options

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 acceptance T_o

with switch S3 on the rear of the MCP.

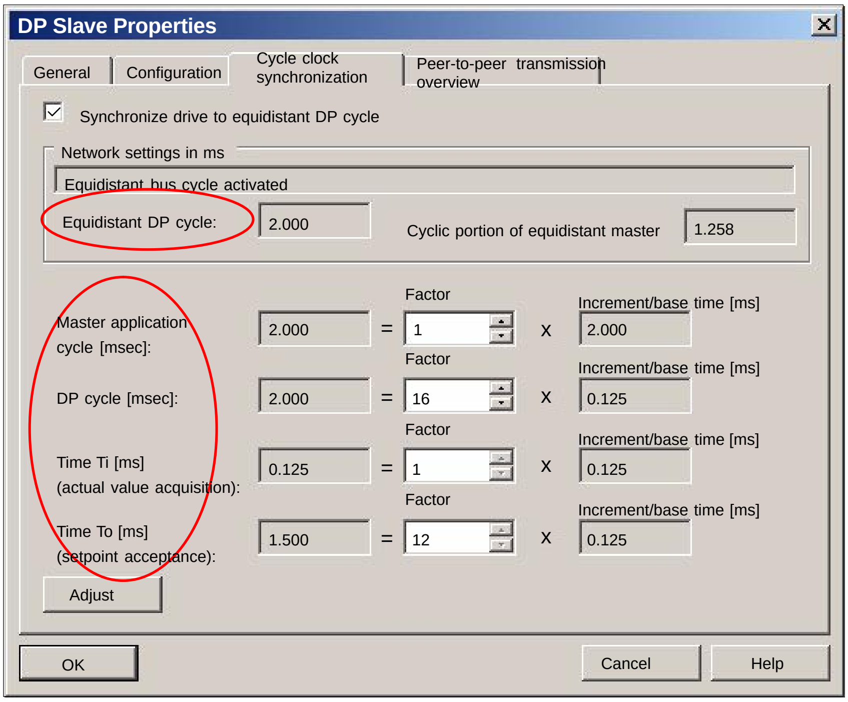


Fig. 8-9 Dialog box: DP Slave Properties

DP cycle T_{DP}

The “DP cycle” of DP slave 611U must be set to the cycle time of the DP master displayed under > “Equidistant DP cycle” in group box “Network settings in ms”.

Notice

For DP cycle time T_{DP} the following condition must be fulfilled:

DP cycle = equidist. DP cycle

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 equidistant 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 611U used with SINUMERIK 840Di, 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 card: Clock synchronization
Master application cycle [msec]:
Factor: **1**

Actual value acquisition Ti

Via parameter: Actual-value sensing Ti defines the time at which the actual value (actual position value) can be read in from a DP slave 611U.

Note

You are strongly recommended to use the same value for the time of actual value acquisition Ti for all DP slaves 611U, 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 card: 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 611U.

Note

You are strongly recommended to use the same value for the time of setpoint acceptance To for all DP slaves 611U, in particular if the axes interpolate.

Notice

The following condition must be observed for the time of setpoint acceptance T_O:

DP cycle >= setpoint accept. >= equidistant master cycl. percentage + base time

Dialog box: Continuation

Tab card: Clock synchronization
Setpoint acceptance [ms]:
Factor: **Factor**

Adjustment

Activating button: Adjust transfers the values displayed in the “Clock Synchronization” of current DP slave 611U to all other DP slaves 611U of 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 card: Clock synchronization
Button: **“Adjust”**
OK

Notice

If there are different types of equidistant DP slaves in a S7 project, e.g. different SIMODRIVE 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.

8.3.7 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 configuration** in HW Config.

If inconsistencies are detected in the configuration an error dialog box is displayed and the relevant 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” the system data blocks are located at:

- SIN840Di
  SIMATIC 300(1)
  PLC317-2DP 2AJ10
  S7 Program(3)
  Blocks > **System data**

The current system data blocks can be displayed by double-clicking on 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.

8.3.8 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 installation and start-up in Section 6.7, Page 6-150.

■

Drive Start–Up (Preconditions) 9

Section ”Drive start–up (preconditions)” describes the **Preconditions** of the SINUMERIK 840Di for optimum start–up of the drives as regards material and cost.

It is **not** the section’s objective to explain in detail how a drive is started up. For start–up of the drive, please refer to the relevant drive documentation.

9.1 SIMODRIVE 611 universal/E, POSMO CD/CA and SI

9.1.1 Start–up variants

The following distinction is made between start–up of the above SIMODRIVE drives:

- Initial start–up
- Series start–up

Initial start–up

A first start–up must only be carried out if no matching parameter record is available for the drive in the form of the parameter file.

Series start–up

A series machine start–up must only be carried out if no matching parameter record is available for the drive in the form of the parameter file.

The parameter file is then loaded into the drive to be started up using SimoCom U in online mode (for online mode, see: Subsection 9.1.2, page 9-223).

Possible procedures

The possible ways of starting up 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

3. SimoCom U is installed on the SINUMERIK 840Di 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, the procedure described above (Point 3.) is recommended:

The advantages of this procedure are:

- SimoCom U is always available for:
  – start–up
  – diagnosis
  – controller optimization
  – software upgrade of drive firmware
  – software upgrade of option module firmware
- No additional PG/PC required
- No additional cables required

9.1.2 Preconditions for an online connection

To be able to establish an online connection between SimoCom U and the SIMODRIVE 611 universal drives connected using PROFIBUS DP, the following preconditions must be fulfilled:

- **SimoCom U** must be installed.
  - For installing SimoCom U, see Section 9.2, Page 9-229
- A **PROFIBUS connection** must exist from the PROFIBUS interface of the MCI board to all drives.
  - For network rules, see Subsection 8.1.4, Page 8-198
- With all drives, the **PROFIBUS address** must be set.
  - For SIMODRIVE 611 universal/E see Subsection 9.1.3, Page 9-223
  - For SIMODRIVE POSMO CD/CA and SI see Subsection 9.1.4, Page 9-225
- The SINUMERIK 840Di **PLC** must be networked using MPI.
  - For networking the PLC, see Subsection 6.3.3, Page 6-143
- The **configuration** must be loaded into the PLC.
  - For creating an S7 project, see Section 6.3, Page 6-141
  - For loading the PLC, see Subsection 8.3.6, Page 8-214
- The **MPI interface** must be set on the ”SINUMERIK MCI Card (MPI)”.
  - For setting the MPI interface, see Subsection 9.1.5 , Page 9-226
- The **routing information** must be set.
  - For setting the routing Information, see Subsection 9.1.6, Page 9-227

9.1.3 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 6-141f) must be set on DP slave 611U or UE in question using the display and operator unit.

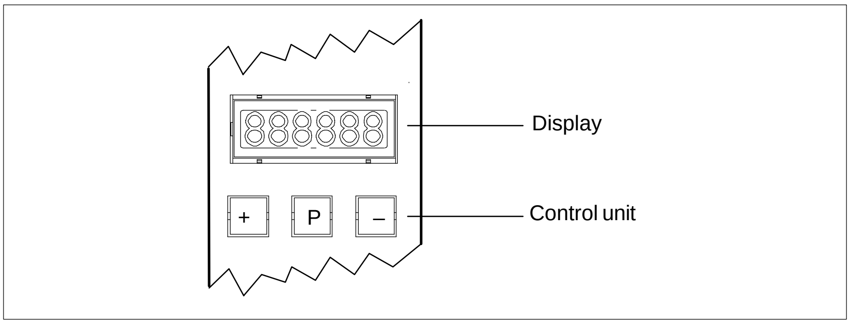


Fig. 9-1 Display and control unit

Preconditions

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 start–up of SIMODRIVE 611 universal drives, refer to:

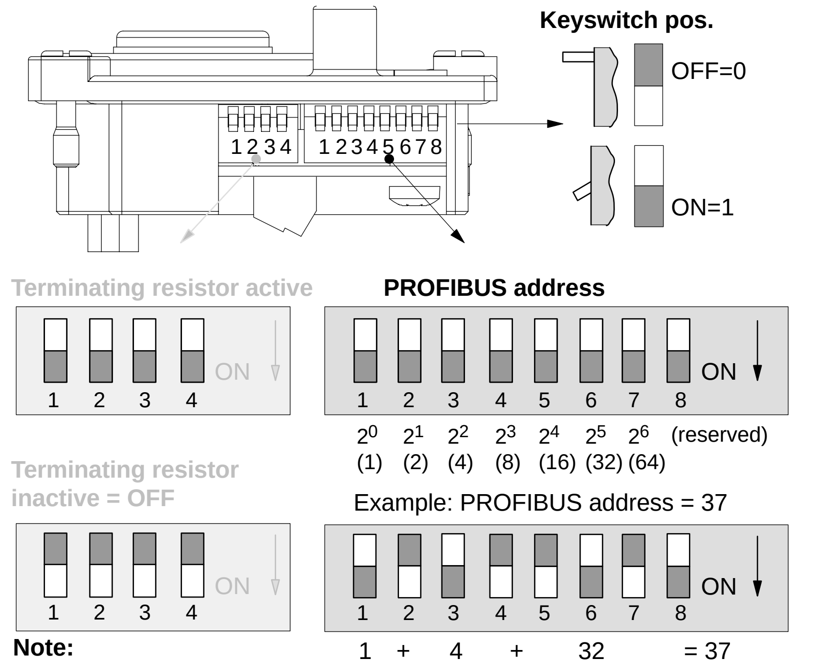
/FBU/ SIMODRIVE 611 universal Description of Functions
Chapter: Parameterizing the Module
Parameterization via display and control unit

and

Chapter: PROFIBUS–DP master settings
Start–up

9.1.4 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 6-141f) 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 address are: 3 to 126
- The set address is read by POSMO SI/CD/CA and displayed using P0918 (PROFIBUS node address).

Fig. 9-2 Setting the PROFIBUS address and terminating resistor

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Notice

To set the PROFIBUS address and terminating resistor it is necessary to remove the PROFIBUS unit.

References

For detailed information on start–up of SIMODRIVE POSMO CD/CA and SI universal drives, refer to:

/POS3/ SIMODRIVE POSMO SI/CD/CA User Manual
Chapter: Connecting the PROFIBUS unit

9.1.5 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.

9.1.6 Setting the routing information

Setting the routing information:

– MPI address of the PLC

– PROFIBUS subnetwork 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 Subsection 6.3.3, Page 6-143.

SimoCom U dialog box: End

Button: "**Reset routing information...**"
Radio button: Export mode ☑
MPI No: **2** (see note)
PROFIBUS: **<Subnetwork ID>** (see below)
OK *or* Go online

Notice

With SINUMERIK 840Di, 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, the PLC always has the MPI address **2**.

Entering the PROFIBUS S7 subnetwork ID

Enter the 8–digit PROFIBUS S7 subnetwork 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 subnetwork ID:

0010	–	0005

SimoCom U: 12–digit S7 subnetwork ID:

00	10	00	00	00	05

Determining the PROFIBUS S7 subnetwork ID

If you do not have the PROFIBUS S7 subnetwork 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)

- 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 subnetwork 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 interface DP Master
        Tab card: Parameter
          Subnetwork: **PROFIBUS**
          Button: ”Properties...”

          Dialog box: Properties PROFIBUS
            Tab card: General
              S7 subnetwork ID: 0010 – 0005 (Example)
          Cancel

      Cancel

Cancel

The online operation with the drives connected to PROFIBUS can now be started.

9.1.7 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 **Start–up > 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).

9.2 Installing SimoCom U

Installation

SimoCom U is part of the 611U toolbox supplied with the SINUMERIK 840Di in directory:

- Installation directory: See Section 1.2, Page 1-32ff
  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
– Traverse 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

■

Notes

NC Start–Up with HMI Advanced

10

10.1 General procedure

The NC is parameterized for the connected machine by setting system variables.

These system variables are called:

- Machine data (MD)
- Setting data (SD).

10.2 Machine and setting data

Machine data

Machine data are system variables used to adapt the NC to the machine.

Name of identifier

The identifier of a machine data is subject to the scheme:

$ M k *_IdentifierString*

where the following applies:

- – **$** System variable
- – **M** Maschine data
- – **k** Component

k identifies the components of the NC parameterizing the appropriate machine data:

- – **N** NC
- – **C** Channel
- – **A** Axis
- – **D** Drive
- – **M** MMC

Activation

Activation when referring to a machine data indicates the NC status in which a change to a machine data becomes active.

Activation categories are:

- POWER ON
- Reconfiguration
- Reset
- Effective immediately.

Setting data

Setting data are system variables that indicate the current machine properties to the NC.

Name of 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 NC parameterizing the appropriate machine data:

– **N** NC
– **C** Channel
– **A** Axis

Activation

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 10-1 Overview of machine data

Range	Description
from 1000 to 1799	Machine data for drives ($MD_....)
from 9000 to 9999	Machine data for operator panel ($MM_....)
from 10000 to 18999	NC–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 10-2 Overview of setting data

Range	Description
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 Machine
/FB/ Description of Functions – Extended Functions
/FB/ Description of Functions – Special Functions

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.

10.2.1 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 –> Start–up –> 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).

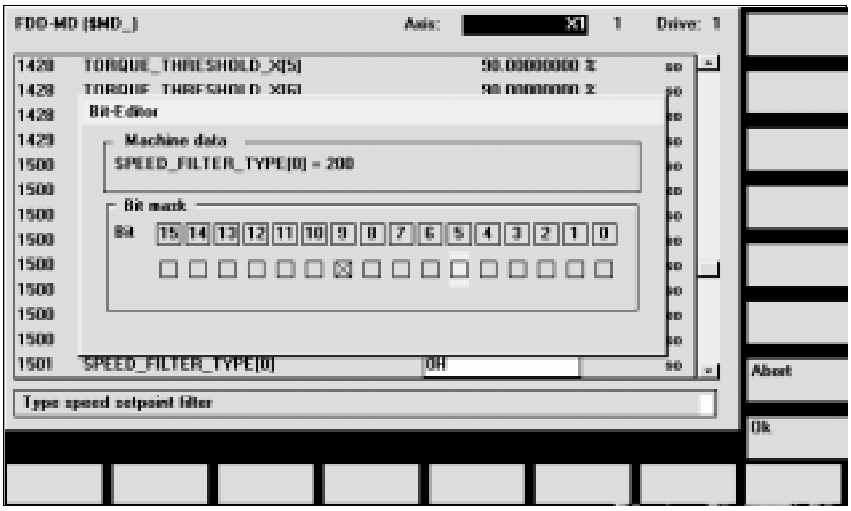


Fig. 10-1 Input screen form of the bit editor for HEX machine data

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 soft key **OK**, you can terminate the bit editor and accept the value set.
- With the soft key **Abort**, you can quit the bit editor and discard the value set. The previous setting is then valid again.

10.2.2 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 10-3):

- 4 password levels for Siemens, machine manufacturer and end user
- 4 keyswitch positions for end user

This provides a multilevel safety concept for controlling access rights.

Table 10-3 Protection levels

Protection level	Type	User	Access to (examples)
0	Key word	Siemens	All functions, programs, and data
1	Key word	Machine manufacturer: Development	Defined functions, programs and data; for example: Enter options
2	Key word	Machine manufacturer: Start–up engineer	Defined functions, programs, and data; for example: Majority of machine data
3	Key word	End user: Service	Assigned functions, programs, and data
4	Key pos. Pos. 3	End user: Programmer machine setter	Lower than protection level 0 to 3; Defined by machine manufacturer or End user
5	Key pos. Pos. 2	End user: qualified user, who does not program	Lower than protection level 0 to 3; Defined by end user
6	Key pos. Pos. 1	End user: Trained user, who does not program	Example: Program selection only, Tool wear input and input of zero offset
7	Key pos. Pos. 0	End user: Semi–skiller operator	Example: No inputs or program selection poss., only machine control panel can be operated

Decreasing access rights

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 soft key **SET PASSWORD**.

References: /BA/ Operator's Guide

Resetting the password

Please note that a password remains valid until access authorization is reset with the soft key **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 10-4 Protection levels: Machine data

Number	Name of 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	

Number	Name of identifier	Name	Refe-rence
9214	USER_CLASS_WRITE_PRG_CONDIT	Program control	
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	Delete R variables	
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 Machine:
A2 Various Inteface Signals
Chapter: 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

Datei SGUD.DEF:

```
%_N_SGUD_DEF
  ;$PATH=/_N_DEF_DIR
  REDEF $MA_CTRLOUT_SEGMENT_NR  APR 3  APW 2
M30
```

References: /PGA/ Programming Guide Advanced
Chapter: File and Program Management
Defining protection levels for user data (GUD)

10.2.3 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
- Channelspecific machine data
- Axisspecific machine data
- Drive machine data

Display filter

To parameterize the display filter of a machine data area, use the vertical soft key **Display Options...** in the appropriate machine data area.

Example:

Display filter for channel machine data

Operating area: Start–up –> 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.

References: /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 NC.

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.

10.3 System data

10.3.1 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 parts 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 parts 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).

The 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 parts 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.

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 linear axes of a machine should be programmed and traversed in 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 parts program:

N20 G0 X 1.0000 Y 1.0000 ;	Traverse axis to positon 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 10-5 Resolutions: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
General ($MN_ ...)			
9004	DISPLAY_RESOLUTION	Display resolution	G2
9011	DISPLAY_RESOLUTION_INCH	Display resolution for INCH system of measure-ment	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 Machine**
G2 Velocities, Traversing Ranges, Accuracies,
Section: Input/display resolution, computational resolution

10.3.2 Normalization of phys. quantities of Machine and Setting data

Standard

Machine and setting data having a physical unit are interpreted in the input/output units listed in Table 10-6 by default, depending on the scaling system (metric/inch).

The internally used units which the NC uses are independent and fixed.

Table 10-6 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 deg.	1 deg.	1 deg.
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 deg.	1 deg.	1 deg.

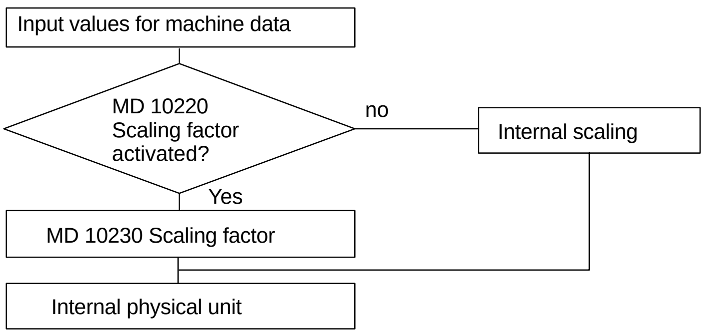
User–defined

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.



The following applies:

$$\textit{Selected input/output unit} =$$
$$\textit{MD: SCALING\_FACTORS\_USER\_DEF}[n] * \textit{Internal unit}$$

Enter the actual value corresponding to the approached position in MD 10230: SCALING_FACTORS_USER_DEF[n].

Table 10-7 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:

$$\textit{MD: SCALING\_FACTORS\_USER\_DEF}[n] = \frac{\textit{Selected input/output unit}}{\textit{Internal unit}}$$

$$\textit{MD : SCALING\_FACTORS\_USER\_DEF[n]} = \frac{1\frac{m}{min}}{1\frac{mm}{s}} = \frac{\frac{1000mm}{60s}}{1\frac{mm}{s}} = \frac{1000}{60} = 16.667;$$

$$\Rightarrow \textit{MD : SCALING\_FACTORS\_USER\_DEF[2]} = 16.667$$

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).

$$MD : SCALING\_USER\_DEF\_MASK = 'H14'; \text{ (bit no. 4 **and** bit no. 2 from example 1 as hex value)}$$

$$MD : SCALING\_FACTORS\_USER\_DEF[n] = \frac{1\frac{ft}{s^2}}{1\frac{mm}{s^2}} = \frac{12 * 25.4\frac{mm}{s^2}}{1\frac{mm}{s^2}} = 304.8;$$

$$\Rightarrow MD : SCALING\_FACTORS\_USER\_DEF[4] = 304.8$$

Index 4 specifies the ”linear acceleration” (see above).

Machine data

Table 10-8 Normalization of phys. units of machine data and setting data: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
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 switchover to inch system	
10260	CONVERT_SCALING_SYSTEM	Basic system switchover active	
10270	POS_TAB_SCALING_SYSTEM	System of measurement 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	

10.3.3 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.

The control has been started up 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 NC has powered up.

10.3.4 Loading default machine data

The default machine data can be loaded in different ways.

840Di start–up

With SINUMERIK 840Di 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 machine start–up file should be created before the NCK data are deleted. How to create a series machine start–up file is described in Section 14.2, Page 14-404.

MD11200: INIT_MD

The input values in MD11200: INIT_MD (loading the default machine data with the ”next” NC boot), which are listed below, various data areas can be loaded when the NC 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 NC power–up, all machine data (with the exception of the memory configuring data) are overwritten with default values.

MD11200: INIT_MD = **2**
On the next NC power–up, all memory–configuring machine data are overwritten with default values.

10.3.5 Switching over the measuring system

The unit system is switched over for the entire machine using a soft key 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 parts 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.

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
- Feedrates
- Acceleration rates
- Jerk
- Tool offsets
- Programmable, settable and work offsets external and DRF offsets
- Compensation values
- Protection zones
- Machine data
- Jog and handwheel factors

After switching, all above mentioned data are available in the physical units as described in Subsection 10.3.2, Page 10-240.

Data for which no unique physical units are defined, such as:

- R parameters
- GUDs (**G**lobal **U**ser **D**ata)
- LUDs (**L**ocal **U**ser **D**ata)
- PUDs (**P**rogram global **U**ser **D**ata)
- Analog I/Os
- 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 10-9 Switching over the unit system: Machine data

Number	Name of identifier	Name / remarks	Reference
General ($MN_ ...)			
10240	SCALING_SYSTEM_IS_METRIC	Basic system metric	
10250	SCALING_VALUE_INCH	Conversion factor for switchover to inch system	
10260	CONVERT_SCALING_SYSTEM	Basic system switchover active	
Axis specific ($MA_ ...)			
32711	CEC_SCALING_SYSTEM_METRIC	System of measurement of sag compensation	G2

References

/FB/ **Description of Functions, Basic Machine,**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Chapter: Metric/inch measuring system

10.3.6 Traversing ranges

Computational resolution and traversing ranges

The range of values of the traversing ranges directly depends on the selected computational resolution (see Subsection 10.3.1, Page 10-238).

With the default assignment of the machine data for the computational resolution

- 1000 inc./mm
- 1000 inc./deg.

the following traversing ranges result:

Table 10-10 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.]

10.3.7 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 NC.

The input resolution, the position control and interpolation clock do not affect the accuracy.

Machine data

Table 10-11 Positioning accuracy: Machine data

Number	Name of identifier	Name / remarks	Reference
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	

10.3.8 Cycle times

On the SINUMERIK 840Di the system clock cycle, the position controller cycle, and the interpolation cycle of the NC are based on the DP cycle time configured in STEP 7 ”HW Config”. See Section 6.3, Page 6-141f.

System basic cycle

The system clock cycle is set fixed to the ratio of 1:1 with regard to the DP cycle time. In the machine data, the active value is displayed. It cannot be changed.

- MD10050: SYSCLOCK_CYCLE_TIME (system clock cycle).

Position control cycle

The position control cycle is set to the fixed ratio 1:1 with respect to the system clock cycle. It cannot be changed.

Position control cycle offset

The position controller cycle offset ($_M$) must be set such that the following conditions are fulfilled within a PROFIBUS DP/system clock cycle:

– 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/system clock is completed.
  Condition: $T_M + T_{Pos} < T_{DP}$

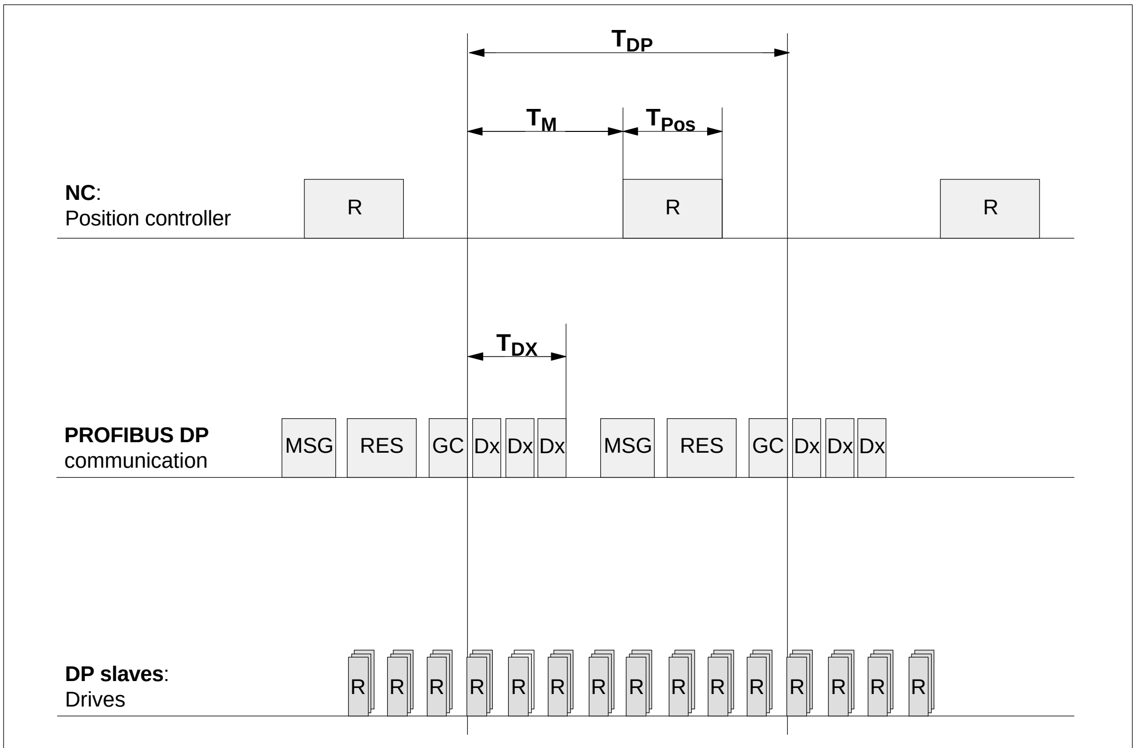


Fig. 10-2 Position control cycle offset compared to PROFIBUS DP cycle

Key to Fig. 10-2:

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 NC 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

- MD10062 POSCTRL_CYCLE_DELAY (position control cycle offset)

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
- $T_{pos\ max}$
  Display using HMI Advanced (optional):
  Operating area switchover> Diagnosis > Service displays > System resources

Error response

- Alarm: ”380005 PROFIBUS DP: Bus access conflict, type t, counter z”

Cause of errors / error handling

- t = 1
  The position control cycle offset chosen is too small. The cyclic PROFIBUS DP communication with the drives was not yet completed with the start of the position controller.

  Remedy: Increase the position control cycle offset.
- t = 2
  The position control cycle offset selected is too large. The cyclic PROFIBUS DP communication with the drives started before the position controller was completed. The position controller requires more computational time than available within the DP cycle.
  - Remedy: Decrease the position control cycle offset

  Or
  - Remedy: Increase the DP cycle time.
    The DP cycle time is set using STEP7 ”HW-Config”. See Section 6.3, Page 6-141f.

Interpolation cycle

The interpolator cycle may be chosen freely as a whole multiple of the position control cycle.

- MD10070 IPO_SYSCLOCK_TIME_RATIO (factor for the interpolation cycle)

NCK CPU time share

The processor power of the PCU must be shared between the NC and Windows XP. By default, the NC is assigned 65 %.

The value for the CPU time share of the NC is the maximum value that the NC will only use in the worst case. If the NCK requires less CPU time, it will cede it dynamically to Windows XP.

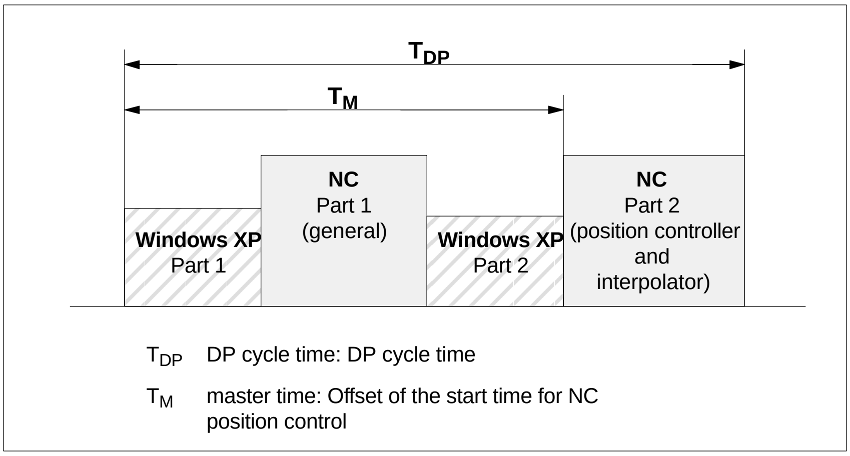


Fig. 10-3 CPU time division between Windows XP and NC

Default value

Via machine data item

- MD10185: NCK_PCOS_TIME_RATIO (CPU time component NCK)

the maximum CPU time share of the NC is set with reference to a DP cycle. The default value is 65 %.

Individual setting

An individual setting can only be made by the following formula:

MD10185 >= 300 * ($T_{pos\ max}$ * MD10070 + $T_{IPO\ max}$ + 0.2 ms) / MD10071

where:

– $T_{pos\ max}$ 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 parts 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.

  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.

Error response

- Alarm: ”4240 CPU time overflow on the IPO or position controller level”

Cause of errors / error handling

The DP cycle time/position controller cycle, the interpolation cycle, or the NC CPU time share is set in such a way that not enough CPU time is available for one of the two cyclic levels of the NC (position controller or interpolator).

Remedial action:
Calculate the maximum values for $T_{pos\ max}$ and $T_{IPO\ max}$ (see above) and adapt the following machine data:

- MD10185: NCK_PCOS_TIME_RATIO (CPU time component NCK)
- MD10070: IPO_SYSCLOCK_TIME_RATIO (factor for interpolator cycle)
- MD10050: SYSCLOCK_CYCLE_TIME (system basic time)

Note

You must adjust the **system clock cycle** by changing the DP cycle time using STEP7 ”HW-Config”. To do that, proceed as you would for final parameterization of a DP slave 611U. See Subsection 8.3.5, Page 8-207f.

References

/FB/ **Description of Functions – Special Functions**
G3 Cycle Times

Machine data

Table 10-12 Cycle times: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
General ($MN_ ...)			
10050	SYSCLOCK_CYCLE_TIME	System clock cycle/only display data; is always equal to the equidistant PROFIBUS DP cycle. Note: **with 840Di, 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**!	
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.

10.3.9 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 parts program block results as follows:

$$V_{max} = \frac{\textit{Programmed path length in parts program block [mm or degrees]}}{\textit{IPO cycle [s]}}$$

Upper limit

To guarantee that parts program blocks are executed continuously (control margin), the NC limits the tool path velocity within a parts program block to 90% of the max. possible tool path velocity as follows:

$$V_{max} \leq \frac{\textit{Programmed path length in parts program block [mm or degrees]}}{\textit{IPO cycle [s]}} * 0.9$$

For example, in the case of parts 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 parts program blocks.

The function ”Online compressor” can help to avoid such sudden velocity dips.

References: /PGA/ Programming Guide, Advanced
Chapter: Compressor COMPON/COMPCURVE

Lower limit

The minimum tool path or axis velocity at which traversing is possible results from:

$$V_{min} \geq \frac{10^{-3}}{\textit{Computational resolution}[\frac{\textit{incr.}}{\textit{mm or degrees}}] * \textit{IPO cycle [s]}}$$

(for the computational resolution, see: Subsection 10.3.1, Page 10-238)

If V_{min} is not reached, no traversing movement is carried out.

References

/FB/ Description of Functions Basich Machine
G2 Velocities, Traversing Ranges, Accuracies,
Chapter: Velocities

10.4 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.

	DRAM Maximum	**DRAM for 840Di 1)**	**SRAM 2)**
PCU 50	256 MB	approx.16 MB	–
MCI board	–	–	5 MB

1) DRAM component (main memory) occupied by SINUMERIK 840Di and thus no longer available for Windows XP.

2) 5 Mbytes of the SRAM memory of the MCI board are available to the user.

User data

The individual memory areas of the user data are set to reasonable default values during general reset of the NC. To obtain optimum utilization of the user memory the size of the indvidual data areas can be set for, e.g.:

- Part programs
- Tool management
- Tool offsets
- User variables
- R parameters
- Compensation
- Protection zones
- Frames

(see Subsection 10.4.2, Page 10-255):

The memory must be sectionalized before commencement of the actual NC start–up process because all battery–backed user data (e.g. part programs, tool offsets) are lost when the memory is reallocated.

Machine data, setting data, and option data are not lost when the memory is reorganized.

Activation

The MDs for the memory configuration are activated by power ON.

References: /FB/ Description of Functions
S7 Memory Configuration

10.4.1 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!

Machine data

Table 10-13 Machine data required to configure the DRAM

Number	Name of identifier	Name / remarks	Refe-rence
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	
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	

Number	Name of identifier	Name / remarks	Refe-rence
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/

10.4.2 SRAM memory

Free memory

The free SRAM memory is displayed in machine data

- MD18060: INFO_FREE_MEM_DYNAMIC (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 10-14 results in a reconfiguration of the SRAM with a loss of all user data. Before the change comes into effect in the NC, the following alarm message is output:

- Alarm: ”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 machine start–up file should be created before reconfiguration (see Section 14.2, Page 14-404).

Machine data

Table 10-14 Machine data required to configure the SRAM

Number	Name of identifier	Name / remarks	Refe-rence
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	
18084	MM_NUM_MAGAZINE	Number of magazines managed by NCK	/FBW/
18086	MM_NUM_MAGAZINE_LOCATION	Number of magazine locations	/FBW/

General ($MN_ ...)			
18090	MM_NUM_CC_MAGAZINE_PARAM	Compile cycles of tool management: Number of magazine data	/FBW/
18092	MM_NUM_CC_MAGLOC_PARAM	Compile cycles of tool management: Number of magazine location data	/FBW/
18094	MM_NUM_CC_TDA_PARAM	Compile cycles of tool management: Number of TDA data	/FBW/
18096	MM_NUM_CC_TOA_PARAM	Compile cycles of tool management: Number of TOA data	/FBW/
18098	MM_NUM_CC_MON_PARAM	Compile cycles of tool management: Number of monitor data	/FBW/
18100	MM_NUM_CUTTING_EDGES_IN_TOA	Number of tool offsets in NCK	
18118	MM_NUM_GUD_MODULES	Number of GUD modules	
18120	MM_NUM_GUD_NAMES_NCK	Number of global user variables	
18130	MM_NUM_GUD_NAMES_CHAN	Number of channel–specific user variables	
18140	MM_NUM_GUD_NAMES_AXIS	Number of axis–specific user variables	
18150	MM_GUD_VALUES_MEM	Memory reserved for global user variables	
18160	MM_NUM_USER_MACROS	Number of macros	
18190	MM_NUM_PROTECT_AREA_NCK	Number of protection zones in NCK	/FB/, A3
18230	MM_USER_MEM_BUFFERED.	User memory in SRAM	
18270	MM_NUM_SUBDIR_PER_DIR	Number of subdirectories	
18280	MM_NUM_FILES_PER_DIR	Number of files per directory	
18290	MM_FILE_HASH_TABLE_SIZE	Hash table size for files in a directory	
18300	MM_DIR_HASH_TABLE_SIZE	Hash table size for subdirectories	
18310	MM_NUM_DIR_IN_FILESYSTEM	Number of directories in passive file system	
18320	MM_NUM_FILES_IN_FILESYSTEM	Number of files in passive file system	
18330	MM_CHAR_LENGTH_OF_BLOCK	Max. length of an NC block	
18350	MM_USER_FILE_MEM_MINIMUM	Minimum NC program memory	
28050	MM_NUM_R_PARAM	Number of channel–specific R parameters	
28080	MM_NUM_USER_FRAMES	Number of settable frames	
28085	MM_LINK_TOA_UNIT	Allocation of a TO unit to a channel	/FBW/, W1
28200	MM_NUM_PROTECT_AREA_CHAN	Number of modules for channel–specific protection zones	/FB/, A3
Axis–specific ($MA_ ...)			
38000	MM_ENC_COMP_MAX_POINTS	Number of intermediate points with interpolatory compensation	/FB/, K3

10.4.3 DRAM file system

Function

For historical reasons, the passive file system of the NCK in which the user data, such as parts programs, user cycles, etc. are located is in the SRAM area of the NCK.

The SINUMERIK 840Di has retained this system architecture, among other reasons, because of the increased data security:

– Data retention also in case of a power fail event

– Protection from overwriting because no access to this memory area is possible by Windows XP applications.

The function DRAM file system permits relocation of data areas are in the SRAM area of the NCK by default into the DRAM file system by activating a machine data. The memory that that releases in the SRAM can be used, for example, for more or larger parts programs.

Retentive background memory

Because when you switch off the NCK, the memory content of the DRAM is lost, the DRAM file system requires a retentive background memory. The DRAM file system is reloaded from this retentive background memory every time the NCK is booted. On the SINUMERIK 840Di, the hard disk of the PCU is used as the background memory.

Clearing the NC memory

To ensure data consistency, not only the entire SRAM but also the retentive background memory of the DRAM file system is cleared with the function ”Clear NC data”, for example, before restart–up of the NCK.

Machine data

The maximum size of the DRAM file system in Kbytes can be set in the machine data:

- MD18351: MM_DRAM_FILE_SIZE (size of DRAM file system)

To ensure system compatibility with the SINUMERIK 840D, the DRAM file system of the SINUMERIK 840Di requires configuration of a flash file system (FFS). The size of the FFS in Kbytes can be set in the machine data:

- MD18332: MM_FLASH_FILE_SYSTEM_MEM_SIZE (size of the FFS)

Notice

The size of the DRAM file system and the FFS should currently be set to be equal, but in any case, the FFS must be greater than or equal to the DRAM file system.

The max. size per file system is 4MB.

Cycles

In SW 2.2 and higher, standard and/or user cycles can be relocated to the DRAM file system. Relocation does not change the way cycles are used.

Option

Relocation of cycles into the DRAM file system is an option:

”Cycle storage separate from the CNC user memory”

Relocation of cycles

The cycle areas that are to be relocated into the DRAM file system are selected in the machine data:

- MD11290: DRAM_FILESYSTEM_MASK (selection of directories in the DRAM)
  - Bit 0 = 1: Siemens cycles (CST)
  - Bit 1 = 1: Machine manufacturer cycles (CMA)
  - Bit 2 = 1: User cycles (CUS)

Backing up cycles

Cycle areas to be saved to the retentive background memory on NCK POWER–ON Reset (warm restart) or when Windows NT is properly shut down are selected by machine data:

- MD11291: DRAM_FILESYST_SAVE_MASK (selection of directories in the DRAM)
  - Bit 0 = 1: Siemens cycles (CST)
  - Bit 1 = 1: Machine manufacturer cycles (CMA)
  - Bit 2 = 1: User cycles (CUS)

The machine data default setting ensures that all specified cycle areas are saved to the retentive background memory by default.

Loading of cycles

When loading a serial start–up file or a single cycle into the NCK, if the function is activated, the cycles are first written to the retentive background memory and then loaded into the DRAM file system.

Changing external cycles

Cycles relocated into the DRAM file system can be changed (edited). The changes take effect immediately. Retentive storage of the changes in the background memory is not effected until the next:

- ”NCK–power ON reset” (warm start)
- Proper shutdown of Windows NT

Notice

If the SINUMERIK 840Di is switched off or if a ”serious exception” (blue screen) has occurred although

- ”NCK–power ON reset” (warm start)
- Proper shutdown of Windows NT

has not been performed, all changes to the cycles made until that time will be lost.

Alarms

The following error status can occur in connection with relocation of cycles into the DRAM file system:

- Too little memory available in the DRAM file system

During start–up of the NCK, the cycles are loaded from the background memory into the DRAM file system. If the configured memory is no longer sufficient during loading, from this time on cycles still to be loaded will be loaded into the SRAM file system. If there is insufficient space in the SRAM, too, loading is stopped and the following alarm is output:

– Alarm: ”6690 cycles from the NC card cannot be copied into the passive file system”

Remedy:
Adapt the DRAM file system size in the machine data:

– MD18351: MM_DRAM_FILE_MEM_SIZE (size of DRAM file system)

- Too little memory available in the FFS
When a cycle is stored in the DRAM file system, it is also stored in the FFS. If there is not enough free space in the FFS, the following alarm is output:

– Alarm: ”6691 cycles in the passive file system cannot be saved to the NC card”

Remedy:
Adapt the FFS size in the machine data:

– MD18332: MM_FLASH_FILE_SYSTEM_SIZE (size of the FFS)

or deletion of cycles from the DRAM file system (the cycles are also deleted from the FFS).

11290: DRAM_FILESYSTEM_MASK (select directories in DRAM)

- Changed cycles cannot be saved in the background memory.
If the control is switched off although the cycles have not been saved in the background memory, the following alarm is output the next time the NC starts up:

– Alarm: ”6692 cycle has been lost”

Machine data

Table 10-15 Machine data required to configure the FFS

Number	Name of identifier	Name / remarks	Reference
General ($MN_ ...)			
11290	DRAM_FILESYSTEM_MASK	Select directories in DRAM	
Memory–spec. ($MM_ ...)			
18332	FLASH_FILE_SYSTEM_SIZE	Size of flash file system (FFS)	
18351	DRAM_FILE_MEM_SIZE	Size of DRAM file system	

10.5 Axes and spindles

10.5.1 Axis configuration

Definition

The term "axis" is often used either as a single term in conjunction with SINUMERIK 840Di 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.

Generally, 3 types of axes are distinguished:

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.

Channel axes

The total of all machine, geometry and special axes assigned to a channel is designated as channel axes.

In this context, the geometry and special axes constitute the program–technological part of the machining process, i.e. they are used for programming in the parts program.

The machine axes constitute the physical part of the machining process, i.e. they carry out the programmed traversing movements on the machine.

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

Additional axes are all other channel axes that are not geometry 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.

Axis assignment

The assignment of drives, machine axes, channel axes and geometry axes using the corresponding machine data is shown in the following Fig. 10-4:

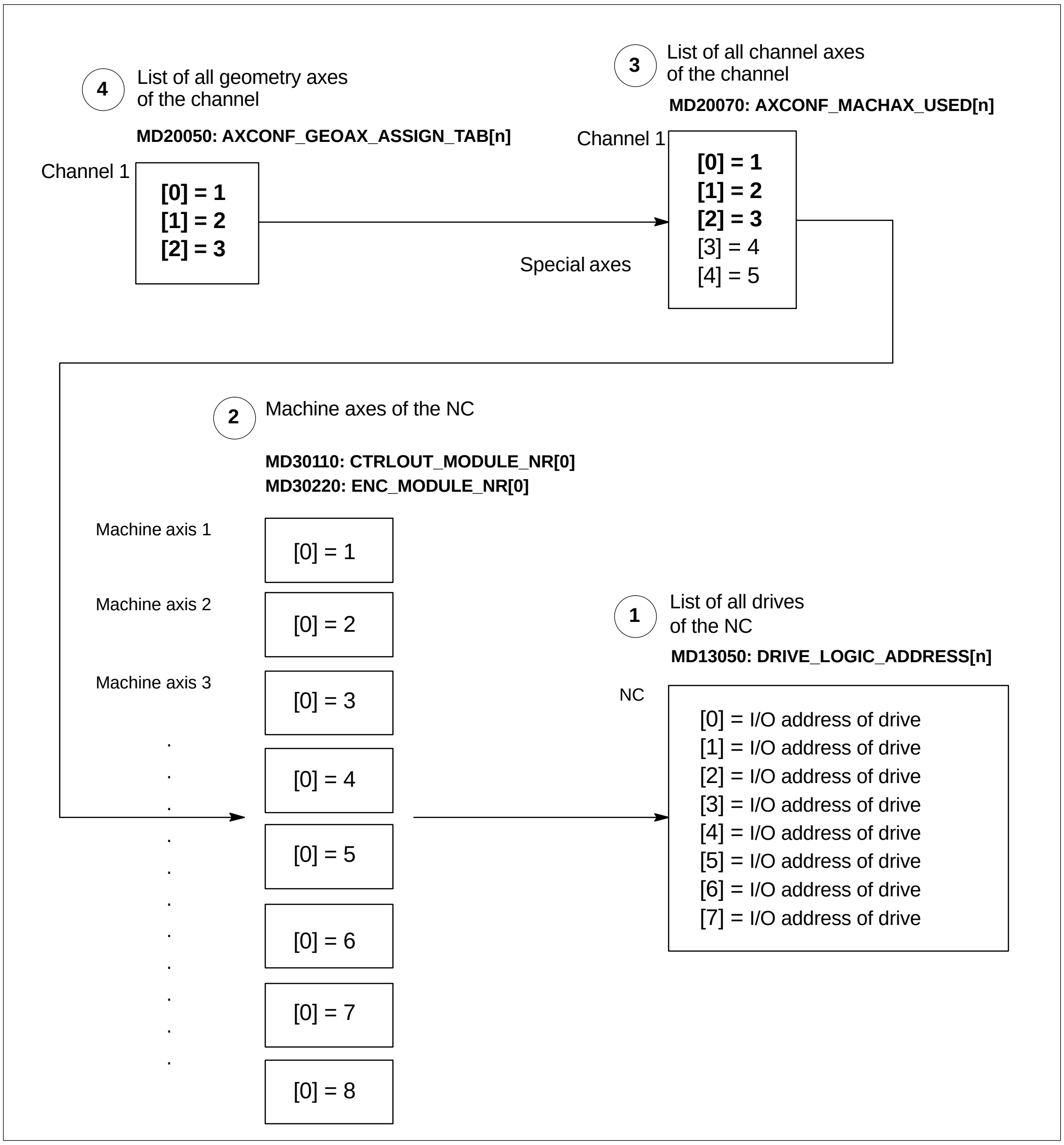


Fig. 10-4 Axis assignment

1

Machine data

- MD13050: DRIVE_LOGIC_ADDRESS[n] (I/O address of the drive)

tells the NC 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 NC.

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).

Machine data

Table 10-16 Axis configuration: Machine data

Number	Name of identifier	Name / remarks	Refe- rence
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 Machine,**,
K2 Axes, Coordinate Systems, Frames, Actual–Value System for Workpiece,
Chapter: Axes

10.5.2 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 NC.

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 parts program G74
- Measuring
- Test point traversing from the parts 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.

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 parts 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 10-17 Axis names: Machine data

Number	Name of 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 Machine,**,
K2 Axes, Coordinate Systems, Frames, Actual–Value System for Workpiece,
Chapter: Axes

10.5.3 Drive configuration

I/O addresses

To allow the NC to communicate with the drives connected to PROFIBUS DP, it must know the I/O addresses of setpoint and actual value of the axes.

The I/O addresses of the axes set in the SIMATIC S7 project are entered in

- MD13050: DRIVE_LOGIC_ADDRESS[n] (logical I/O address)

For parameterizing the drives with regard to PROFIBUS DP, see Subsection 8.3.5, page 8-207.

Default values

The default values of the machine data are dimensioned such that they leave sufficient distance per axis with one measuring circuit each, beginning from I/O address 272 (the I/O addresses from 256 plus 16 bytes for the PLC are reserved for the PROFIBUS drives):

Default values

- MD13050: DRIVE_LOGIC_ADDRESS[n] = 272 + n*20

Notice

Any changes in the I/O addresses must be carried out consistently:

- **DP slave 611U** (SIMATIC S7 project, HW Config): I/O address for setpoint and actual value
- **NC**: MD13050: DRIVE_LOGIC_ADDRESS[n]

No automatic adjustment takes place!

Message frame type

The message frame type describes the data volume and the data structure of the message frames exchanged between NC and drive on PROFIBUS DP during the cyclic communication.

For parameterizing the message frame type, see Section 6.3, page 6-141f.

Note

You will find a detailed description of the message frame structure of each message frame type in the following documents, in each case in Section: Communication on PROFIBUS DP:

- 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: /Subsection 8.3.4; Page 8-206.

The message frame type defined in the S7 project is entered in machine data

- MD13060: DRIVE_TELEGRAM_TYPE[n] (drive message frame type)

Default values

The default values of the machine data refer to the default message frame type of SIMODRIVE 611 universal with 1 or 2 axes per drive module and 1 motor encoder per axis.

Notice

1. A change of the message frame type has to be carried out consistently:
   - **DP slave 611U** (SIMATIC S7 project, HW Config): Message frame type
   - **NC**: MD13060: DRIVE_TELEGRAM_TYPE[n]
   - **SIMODRIVE 611 universal**: Parameter P0922 message frame selection PROFIBUS

   No automatic adjustment takes place!

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 fucntions that are active by default, they must be deactived on the NC side 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	*Activation third–party drive: DSC functions (Direct Servo Control)*
5	Deactivation of 611U–specific drive parking
6	Deactivation of the 611U–specific travel to fixed stop
7	Deactivation of the 611U–specific motor switchover internal
8	Deactivation of the 611U–specific ramp block

ADI4

With an ADI4 module you can operate up to 4 drives with analog setpoint interface on an isochronous PROFIBUS.

For these drives, the 611U–specific functions are deactivated according to the machine data bits 0 to 3. This requires that the value $0F_H$ be entered for each drive operated via ADI4:

- MD13070: DRIVE_FUNCTION_MASK[n] = $\mathbf{0F_H}$

Notice

For all drives connected via ADI4, the 611U–specific functions are deactivated according to the machine data bits 0 to 3.

- MD13070: DRIVE_FUNCTION_MASK[n] = $0F_H$

Drive type DP

The NC 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 shown by the NC:

- 1 FSD (SRM: Synchronous Rotary Motor)
- 2 MSD (ARM: Asynchronous Rotary Motor)
- 3 Linear drive

If the drive type cannot be ascertained by the NC 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.

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 recommand entering drive type 4 manually for drives connected via ADI4:

- MD13080: DRIVE_TYP_DP[n] = 4

Machine data

Table 10-18 Drive configuration: Machine data

Number	Name of 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

10.5.4 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

- MD 30350: 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).

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 entered 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 Subsection 10.5.3, Page 10-264).

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 NC has powered up, the set configuration is 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 Machine
A2 Various Inteface Signals

Machine data

Table 10-19 Setpoint/actual value channels: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
Axis-specific ($MA_ ...)			
30100	CTRLOUT_SEGMENT_NR	Setpoint assignment: Drive type 5 = PROFIBUS DP	
30110	CTRLOUT_MODULE_NR	Setpoint assignment: Logical drive number	
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	

Number	Name of identifier	Name / remarks	Refe-rence
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 10-20 Switching over the position measuring system: Interface signals

DB number	Bit, byte	Name	Refe-rence
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 Machine,**
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Chapter: Setpoint/Actual Value System

/FB/ **Description of Functions Basic Machine**
A2 Various Interface Signals
Chapter: Interface signals to axis/spindle

10.5.5 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

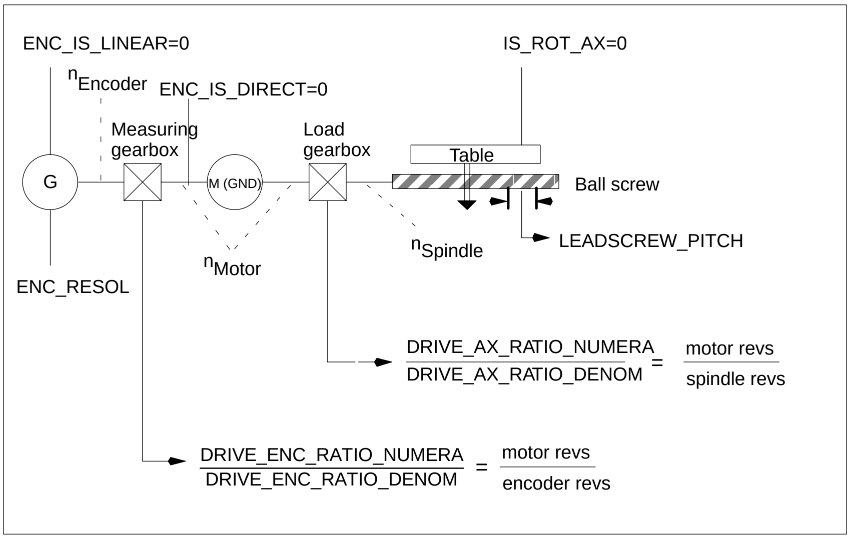


Fig. 10-5 Linear axis with encoder on motor

Linear axis with encoder on the machine

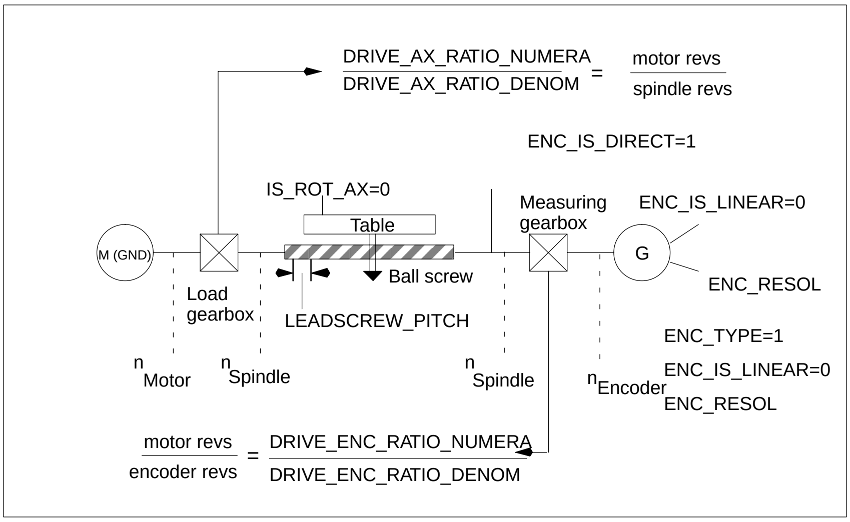


Fig. 10-6 Linear axis with encoder on the machine

Rotary axis with encoder on motor

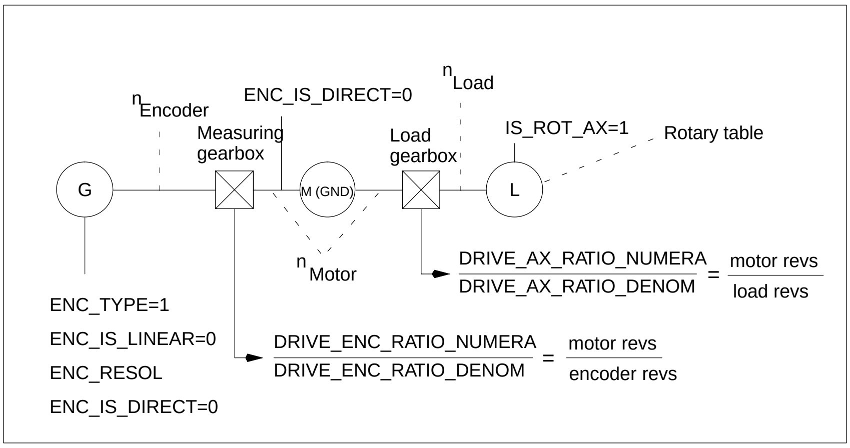


Fig. 10-7 Rotary axis with encoder on motor

Rotary axis with encoder on the machine

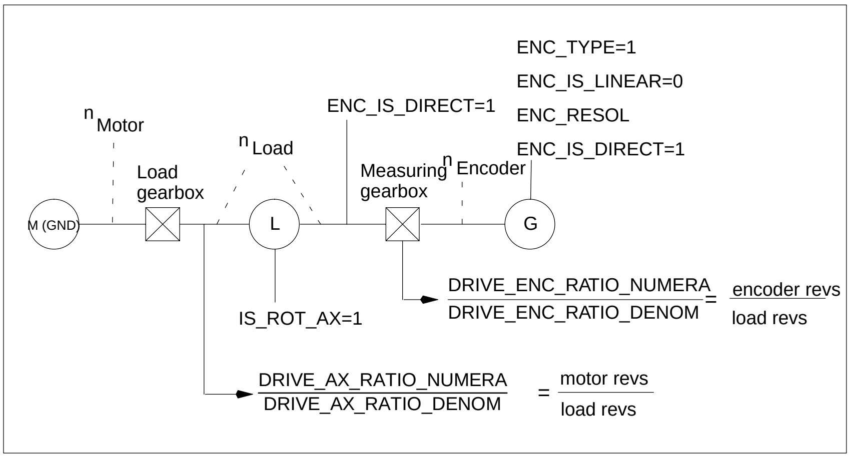


Fig. 10-8 Linear axis with encoder on the machine

Machine data

Table 10-21 Incremental measuring systems: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
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	

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

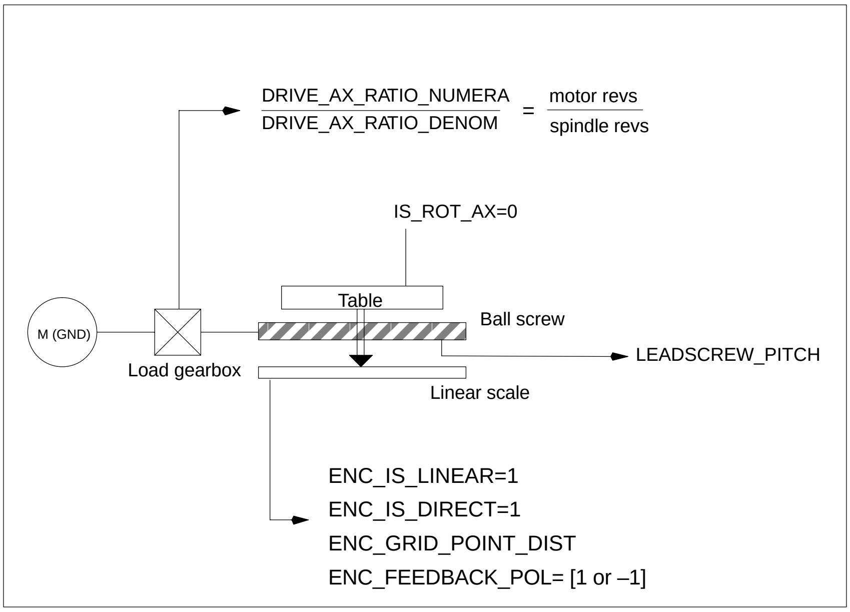


Fig. 10-9 Linear axis with linear scale

Machine data

Table 10-22 Linear measuring systems: Machine data

Number	Name of 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)	

10.5.6 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 Subsection 10.5.19, Page 10-312.

Rotary measuring systems

An absolute encoder can currently exclusively be used as a motor encoder (in-direct measuring system).

Linear axis with rotary absolute encoder

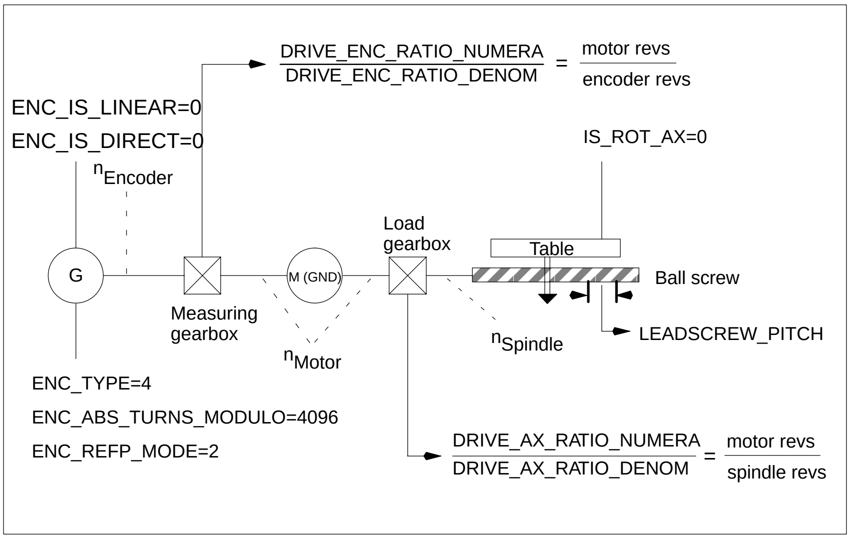


Fig. 10-10 Linear axis with absolute value encoder on motor

Rotary axis with absolute value encoder on motor

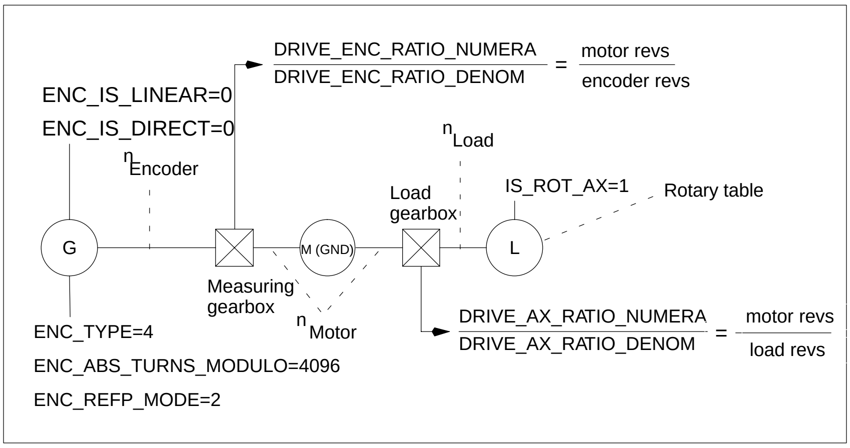


Fig. 10-11 Rotary axis with absolute value encoder on motor

(ADI4)

On a machine axis whose measuring system consists of an absolute value encoder on an ADI4 module, the fine resolution configured in the ADI4 must be entered in the machine data:

- MD30260: $MA_ABS_INC_RATIO[n] (encoder fine resolution)

References: /ADI4/ Analog drive interface for four axes
Chapter: Function parameters (SINUMERIK 840Di) and (SIMOTION)
Reserved bits for fine resolution

Machine data

Table 10-23 Incremental measuring systems: Machine data

Number	Name of identifier	Name / remarks	Reference
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 sytem (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]	State of absolute encoder	
34220	ENC_ABS_TURNS_MODULO[n]	Absolute value encoder range for rotary encoders (multi–turn resolution)	R2

10.5.7 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
Chapter: Hardware Description

Parameterization example

The following parameterization examples illustrates the basic procedure for parameterizing the NC for a 2nd measuring system of a machine axis connected via ADI4. It assumes the following:

- **NC**
  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. 10-12.

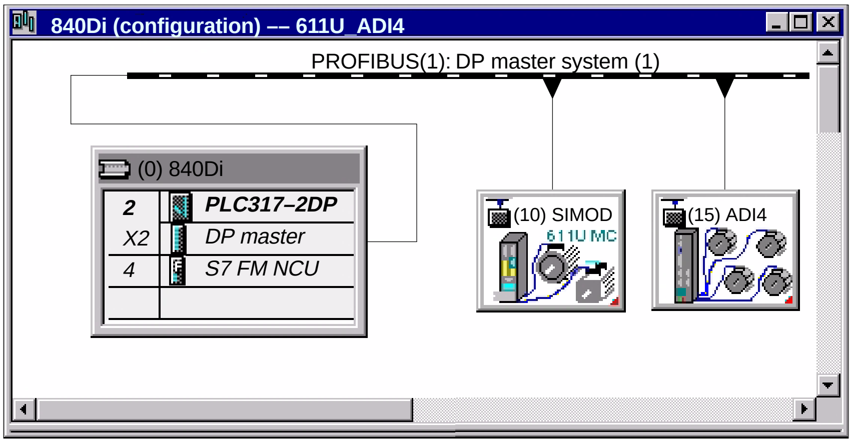


Fig. 10-12 Configuration: Axis with 2nd measuring system on ADI4

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

– I/O address: 258

– Message frame type: Message frame 102

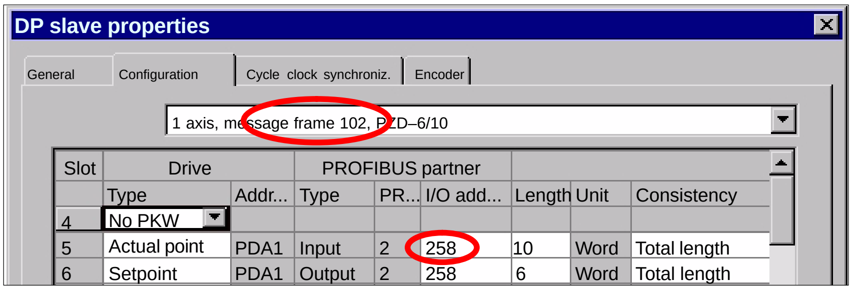


Fig. 10-13 DP slave properties: SIMODRIVE 611U

ADI4

– I/O address: 472

– Message frame type: Standard message frame 3

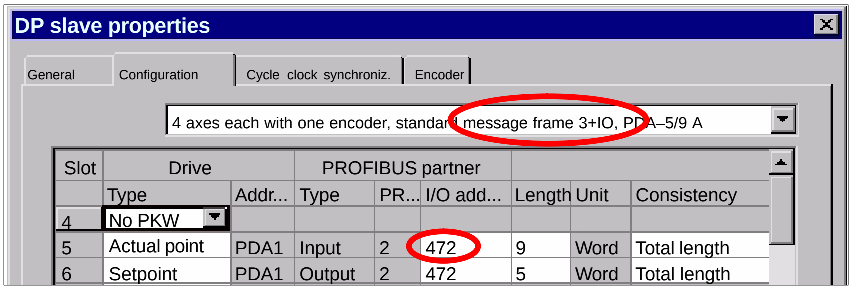


Fig. 10-14 DP slave properties: ADI4

NC machine data

The general and axis–specific NC machine data are then set as follows:

Drive assignment

The axis of the SIMODRIVE 611U drive module is assigned to the NC 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**] = 258
- 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**] = 472
- MD13060: DRIVE_TELEGRAM_TYPE[**3**] = 3

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 Subsection 10.5.4, Page 10-268.

Machine data

Table 10-24 Drive configuration: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
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 10-25 Switching over the position measuring system: Interface signals

DB Number	Bit, byte	Name	Refe-rence
Axis-/spindle-specific	**Signals from PLC to axis/spindle**		
31, ...	1.5	Position measuring system 1	
31, ...	1.6	Position measuring system 2	

10.5.8 DSC (Dynamic Servo Control)

The DSC function eliminates the deadtime that necessarily exist at the speed setpoint interface normally used between the NC 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 controller 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.

Preconditions

Before you can activate DSC mode, the following preconditions must be fulfilled:

- DSC–capable drive, e.g.:
  - SIMODRIVE 611 universal
  - SIMODRIVE POSMO CD/CA
  - SIMODRIVE POSMO SI
- A DSC–capable message frame type has been parameterized in the S7 project for the drive (see Subsection 8.3.5, Page 7-163).

Switch ON/OFF

The DSC function is switched ON in the axis–spec. NC machine data

- MD32640: STIFFNESS_CONTROL_ENABLE (dyn. stiffness control)

activated.

If DSC operation is switched ON or OFF, it might be necessary to adjust the following machine data:

- MD32200: POSCRTL_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.

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 10-26 DSC: Machine data

Number	Name of identifier	Name	Refe-rence
Axis-specific ($MA_ ...)			
32640	STIFFNESS_CONTROL_ENABLE	Dyn. stiffness control	DD2
32200	POSCRTL_GAIN	Servo gain factor (Kv)	G2

10.5.9 Drive optimization

Optimization of the control loop (current, speed, and position control loop) of the drives can be performed with:

- HMI Advanced (see Chapter 13, Page 13-371)
  - All drives
- Start–up tool SimoCom U
  - SIMODRIVE 611 universal / E
  - SIMODRIVE POSMO CD/ CA
  - SIMODRIVE POSMO SI

Note

You will find detailed information about frequency measurement and optimization of the SIMODRIVE 611 universal/E, POSMO CD/CA and SI drives in the online help of the start–up tool SimoCom U under:

Menu command: **Help > Help topics > Index**

- Measuring function
- Optimization of speed control loop

10.5.10 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 Subsection 10.3.3, Page 10-242.

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

- MD 30310: 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 10-27 Rotary axes: Machine data

Number	Name of identifier	Name	Reference
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 10-28 Rotary axes: Setting data

Number	Name of identifier	Name	Reference
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

10.5.11 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 parts 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 parts program later, it must be requested explicitly using a parts program statement (GET).

Positioning axis feed

If a positioning axis is programmed in the parts 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 parts program for this axis.

Machine data

Table 10-29 Positioning axes: Machine data

Number	Name of identifier	Name	Reference
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 10-30 Positioning axes: Interface signals

DB number	Bit, byte	Name	Reference
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

10.5.12 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 parts 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

- MD 30500: 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 10-31 Indexing axes: Machine data

Number	Name of identifier	Name	Refe-rence
General ($MN_ ...)			
10260	CONVERT_SCALING_SYSTEM	Basic system switchover active	G2
10270	POS_TAB_SCALING_SYSTEM	System of measurement of position tables	
10900	INDEX_AX_LENGTH_POS_TAB_1	Number of indexing positions used in Table 1	
10910	INDEX_AX_POS_TAB_1[n]	Indexing position table 1	
10920	INDEX_AX_LENGTH_POS_TAB_2	Number of indexing positions used in Table 2	
10930	INDEX_AX_POS_TAB_2[n]	Indexing position table 2	
Axis-/spindle-specific ($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 360º	R2
30500	INDEX_AX_ASSIGN_POS_TAB	Axis is indexing axis	
30501	INDEX_AX_NUMERATOR	Numerator for indexing axes with equidistant positions	

Interface signals

Table 10-32 Indexing axes: Interface signals

DB number	Bit, byte	Name	Refe-rence
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

10.5.13 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.

  The other parameter sets can be ignored.
- Machine axes involved in tapping or thread cutting: the parameter set for the current gear stage is activated.

  All sets of parameters corresponding to the gear stages of the spindle have to be parameterized.

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 sets of parameters corresponding to the gear stages of the spindle have to be parameterized.

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”.

Parameter set no.	Axis	Spindle	Spindle gear stage
0	Standard	Axis mode	As specified by manufacturer
1	Axis interpolates with spindle (G33)	Spindle mode	1st
2	Axis interpolates with spindle (G33)	Spindle mode	2nd
3	Axis interpolates with spindle (G33)	Spindle mode	3rd
4	Axis interpolates with spindle (G33)	Spindle mode	4th
5	Axis interpolates with spindle (G33)	Spindle mode	5th

Fig. 10-15 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 10-33 Parameter–set–dependent machine data

Number	Name of 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 feedforward 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	

10.5.14 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.

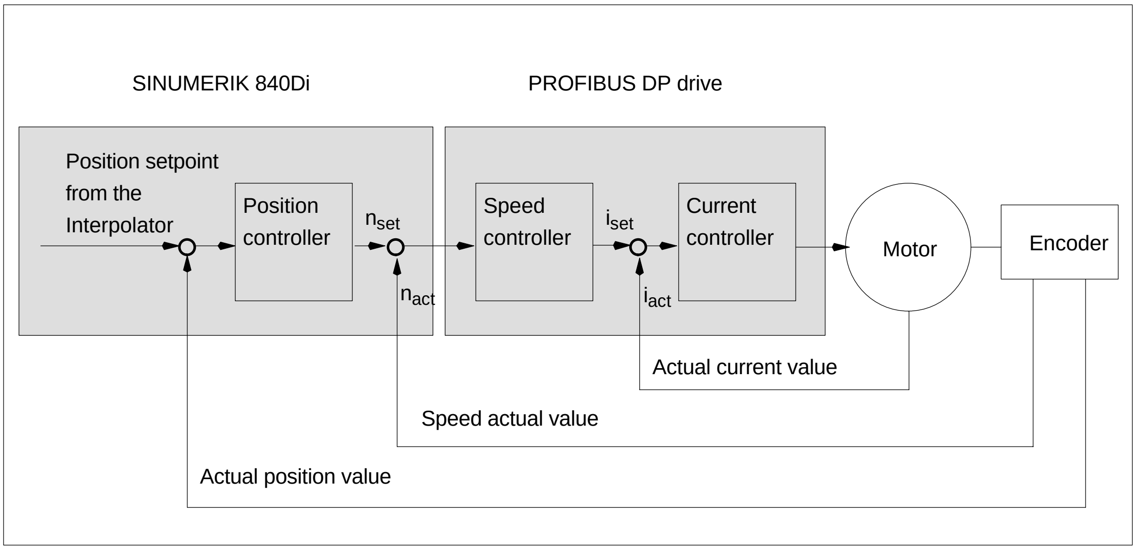


Fig. 10-16 Control loops

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)

adapted.

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.

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/sec], 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.

Checking the loop gain

If a K_V factor is already known for a machine 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.

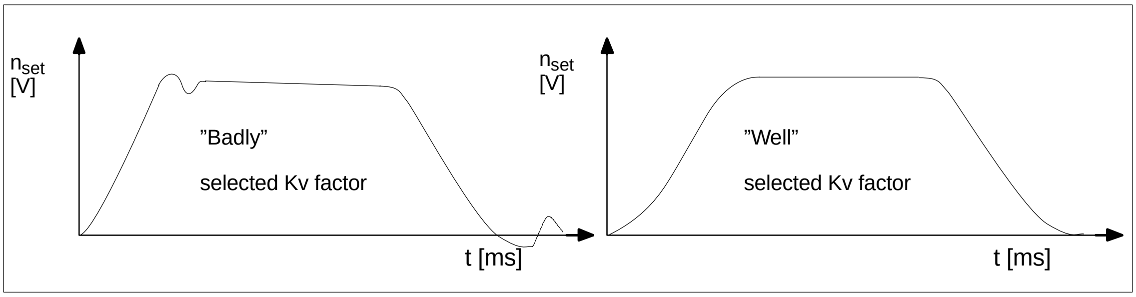


Fig. 10-17 Speed setpoint characteristic

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

- MD 32300: 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.

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

With SIMODRIVE 611 universal drives, the current actual value and the current setpoint can be recorded using the SimoCom U start–up tool (trace function). For further information, please refer to the online help of SimoCom U.

This recording shows whether the drive reaches the current limit. During this, 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 10-34 Position control: Machine data

Number	Name of 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 Machine,**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Chapter: Closed–loop control

10.5.15 Speed setpoint matching

In speed setpoint matching the NC is informed for parameterization of the axial control and monitoring which motor speed in the drive corresponds to which speed setpoint. Speed setpoint matching can be performed automatically or manually.

Automatic matching

It is possible to perform automatic speed setpoint matching if the drive supports acyclic services on the PROFIBUS DP

Acyclic services on the PROFIBUS DP are supported by the following SIMODRIVE drives:

- SIMODRIVE 611 universal / E
- SIMODRIVE POSMO CD/CA
- SIMODRIVE POSMO SI

and the value 0 must be entered in machine data:

- MD32250: RATED_OUTVAL (rated output voltage) [%]

During start–up of the NC, speed setpoint matching between the NC and the drive is then performed automatically.

Note

If automatic speed setpoint matching fails for one axis, the following message is output on a traverse request for his axis:

- Message: ”Wait, axis enable missing”

This axis and any axes that interpolate with it are not traversed.

Manual matching

If a value not equal to 0 is entered in machine data

- MD32250: RATED_OUTVAL (rated output voltage) [%]

the NC assumes that speed setpoint matching will be performed manually.

SIMODRIVE
611 universal / E
POSMO CD/CA
POSMO SI

The rated motor speed entered in axis–specific matching data:

- MD32260: RATED_VELO (rated motor speed) [rev/min]

with reference to 100% must be equal to the speed evaluation entered in the drive (P880):

- P880: Speed evaluation PROFIBUS [rpm] (ARM/SRM) or [m/min] (SLM)

SINUMERIK 840Di NC			SIMODRIVE 611 universal
MD32260: RATED_VELO / MD32250: RATED_OUTVAL	* 100	=	P880

ADI4

Because ADI4 does not support acyclic services on the PROFIBUS DP, manual speed setpoint matching must be performed.

Via the two axis–specific NC machine data:

- MD32260: RATED_VELO (rated motor speed) [rev/min]
- MD32250: RATED_OUTVAL (rated output voltage) [%]

the reference between the speed setpoint set by the NC and the associated output voltage at the setpoint output of the ADI4 is established (reference voltage = 10 V).

SINUMERIK 840Di NC		ADI4
MD32260: RATED_VELO	≙	$10V * \frac{\text{MD32250: RATED\_OUTVAL}}{100}$

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]

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.

$$\text{Desired following error} = \frac{\text{Traversing velocity}}{\text{MD32200: POSCTRL\_GAIN}}$$

– 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 10-35 Speed setpoint matching: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
Axis specific ($MA_ ...)			
32250	RATED_OUTVAL	Rated output voltage	G2
32260	RATED_VELO[n]	Rated motor speed	G2

References

/FB/ **Description of Functions, Basic Machine,**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Chapter: Velocities, traversing ranges, accuracies

10.5.16 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:

Preconditions

– 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 $\neq$ 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

drift compensation must not be enabled for that axis.

Drift compensation causes extreme speed fluctuations during switch–on/off of the DSC function.

Machine data

Table 10-36 Drift compensation: Machine data

Number	Name of identifier	Name / remarks	Reference
Axis specific ($MA_ ...)			
36720	DRIFT_VALUE	Basic drift value	G2

10.5.17 Velocity matching (axis)

Max. axis velocity

The value entered in machine data

- MD32000: MAX_AX_VELO[n] (max. axis velocity)

entered value 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 parts 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.

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, MD 36200: AX_VELO_LIMIT[n] (threshold value for velocity monitoring) must be adapted accordingly.

Machine data

Table 10-37 Velocities: Machine data

Number	Name of identifier	Name / remarks	Refe-rence
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 tra-verse 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 10-38 Velocities: Setting data

Number	Name of identifier	Name / remarks	Refe-rence
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 Machine,**,
G2 Velocities, Setpoint/Actual Value Systems, Closed–Loop Control,
Chapter: Velocities, traversing ranges, accuracies

/FB/ **Description of Functions – Extended Functions**,
H1Jog with/without Handwheel

10.5.18 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)
- Alarm: ”25080 Positioning monitoring” and follow–up mode.

Zero speed tolerance

Position tolerance which a standing machine axis may not leave.

- MD36030: STANDSTILL_POS_TOL (zero speed tolerance)
- Alarm: ”25040 Zero speed control” and follow–up mode.

Delay time 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)
- Alarm: ”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)
- Alarm: ”26000 Clamping monitoring”

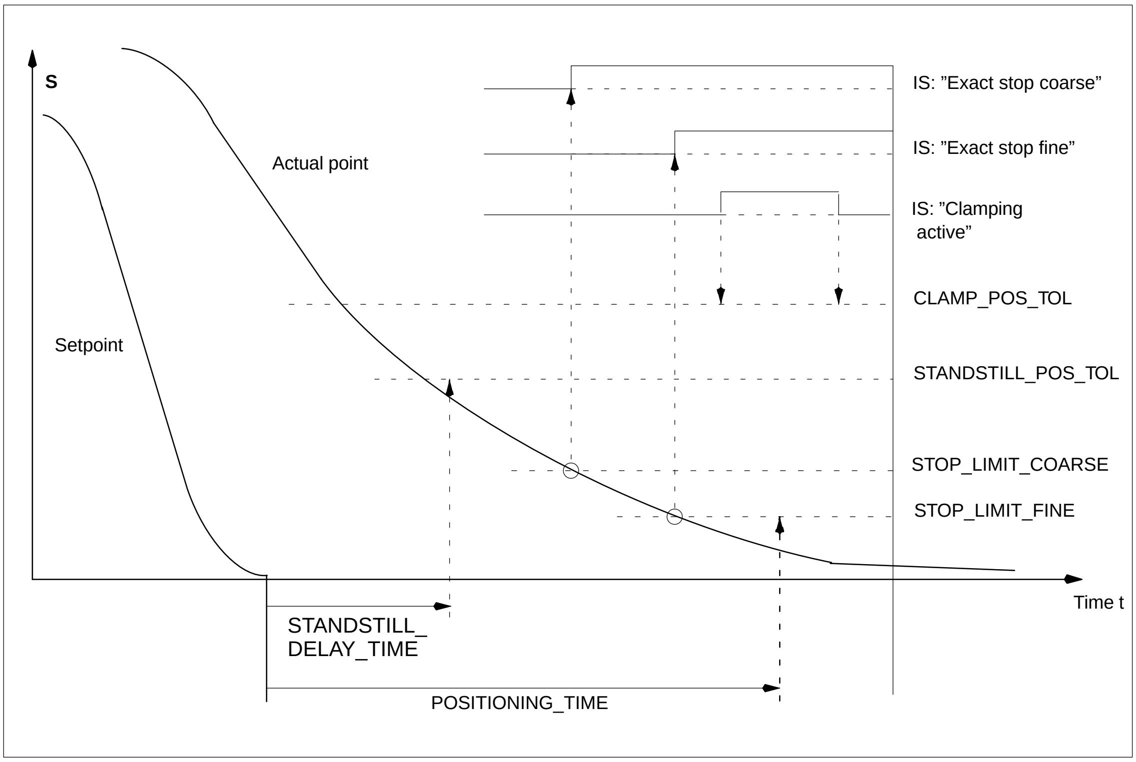


Fig. 10-18 Static monitoring functions

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)
- Alarm: ”10630 Axis reaching operating range limit +/–”
- Alarm: ”10631 Axis is at operating range limit +/– (JOG)”
- Alarm: ”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)

- 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)
- Alarm: ”10620 Axis reaching software limit switch +/–”
- Alarm: ”10621 Axis is at software limit switch +/– (JOG)”
- Alarm: ”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”
- Alarm: ”21614 hardware limit switch [+/–]”

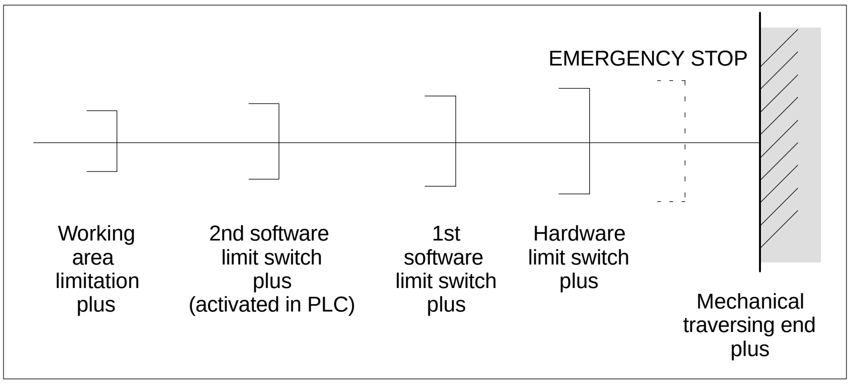


Fig. 10-19 Overview of end limitations

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. speed (rapid traverse) can be reached and, in addition, a certain control margin remains.

- 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.

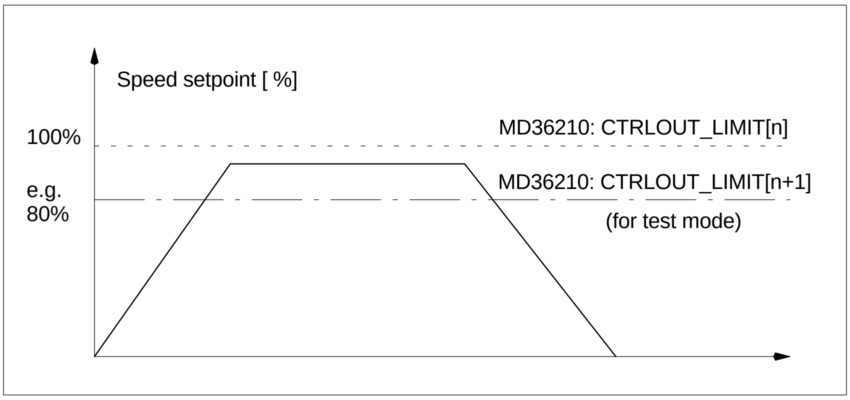


Fig. 10-20 Speed setpoint monitoring

Where

- MD 36220: 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

- Alarm: ”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.
- Too high setpoint specifications (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).

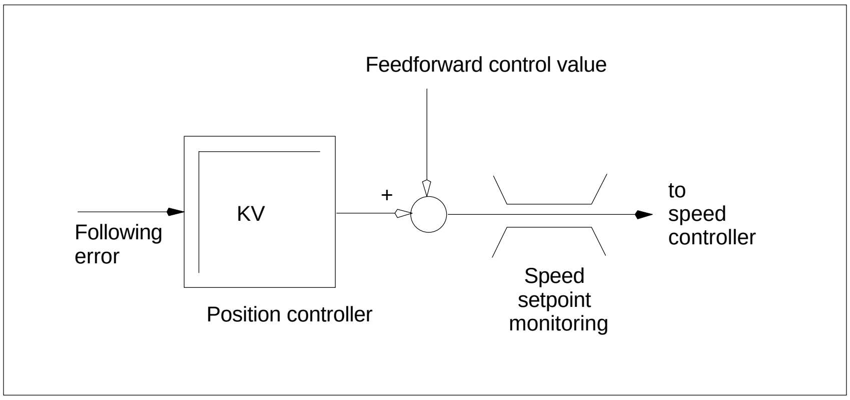


Fig. 10-21 Speed setpoint calculation

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

- Alarm: ”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
- 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 (contour monitoring tolerance band)

Error response

- Alarm: ”25050 Contour monitoring”

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 due to 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 MD 32200: POSCTRL_GAIN[n].

  HMI Advanced
  operation 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, ...)
- Operation with feedforward control:
  MD 32810: 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.

- MD 36300: ENC_FREQ_LIMIT (encoder limit frequency)

Error response

- Alarm: ”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.

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

- MD 36310: 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

- Alarm: "25020 Zero mark monitoring"

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

- 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.

- MD 36500 ENC_CHANGE_TOL (maximum tolerance when switching over the actual position value)

Error response

- Alarm: "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 position measuring system to which you will switch over is not referenced.

Cycl. monitoring of the encoder Position tolerance

The position difference between the two encoder or position measuring systems of a machine axis is monitored with

- MD36510 ENC_DIFF_TOL (measuring system synchronism tolerance)

Error response

- Alarm: "25105 Measuring systems are not synchronous"

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).

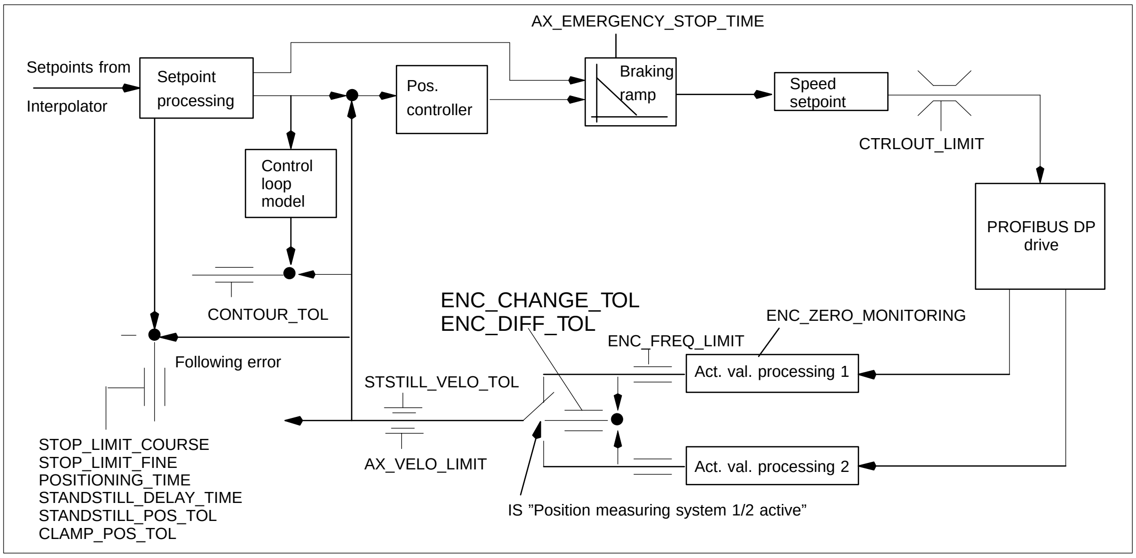


Fig. 10-22 Monitoring functions with SINUMERIK 840Di

Notice

- MD 36620: SERVO_DISABLE_DELAY_TIME (servo enable cutout delay)

must always be selected greater than

- MD 36610: 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 Machine**, A3 Axis Monitoring, Protection Zones

10.5.19 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 parts 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

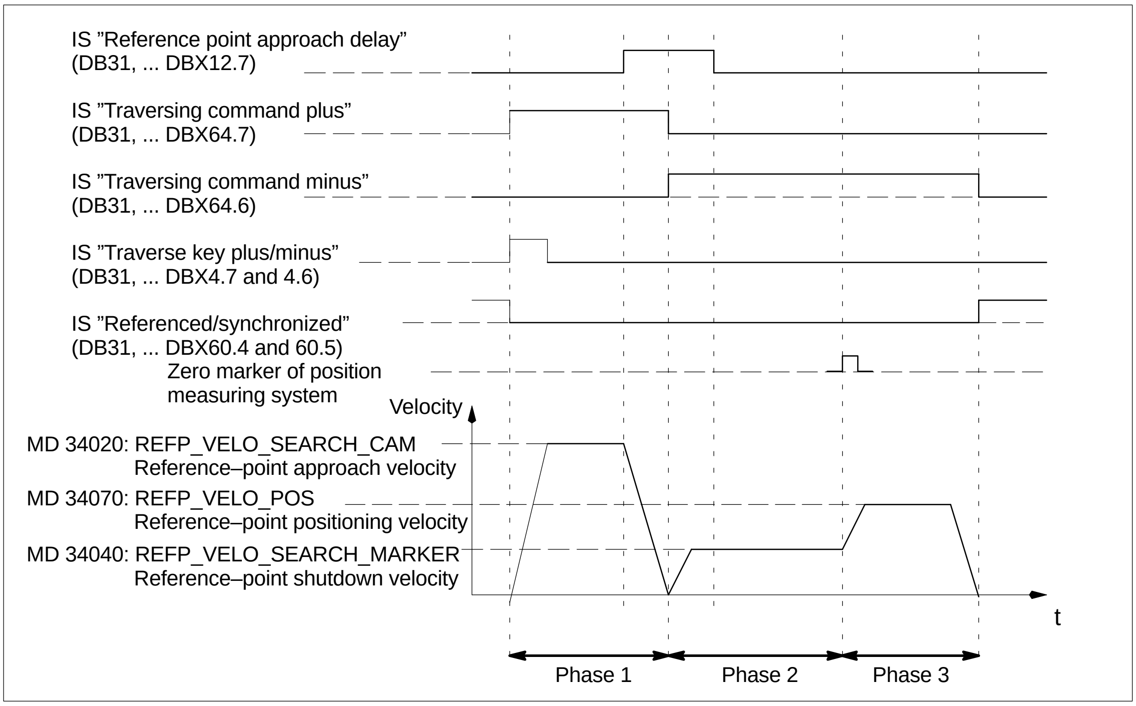


Fig. 10-23 Signal chart: Referencing with an incremental measuring system (principle)

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 channelspecific 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_MARKER_DIST (maximum distance to reference cam)
- MD 34092: REFP_CAM_SHIFT (electr. cam offset, incremental measuring systems with equidistant zero markers)
- IS: DB21, ... 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:

- The feedrate override (feedrate 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
  - – MD 34030: 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.

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:

- MD 34040: REFP_VELO_SEARCH_MARKER (creep velocity)
- MD 34050: REFP_SEARCH_MARKER_REVERSE (direction reversal to reference cam)
- MD 34060: 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 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:
  - MD 34060: 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”

Phase 3:
Approach 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 values 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 Machine**,
R1 Reference point approach
Chapter: Referencing with incremental measurement systems

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

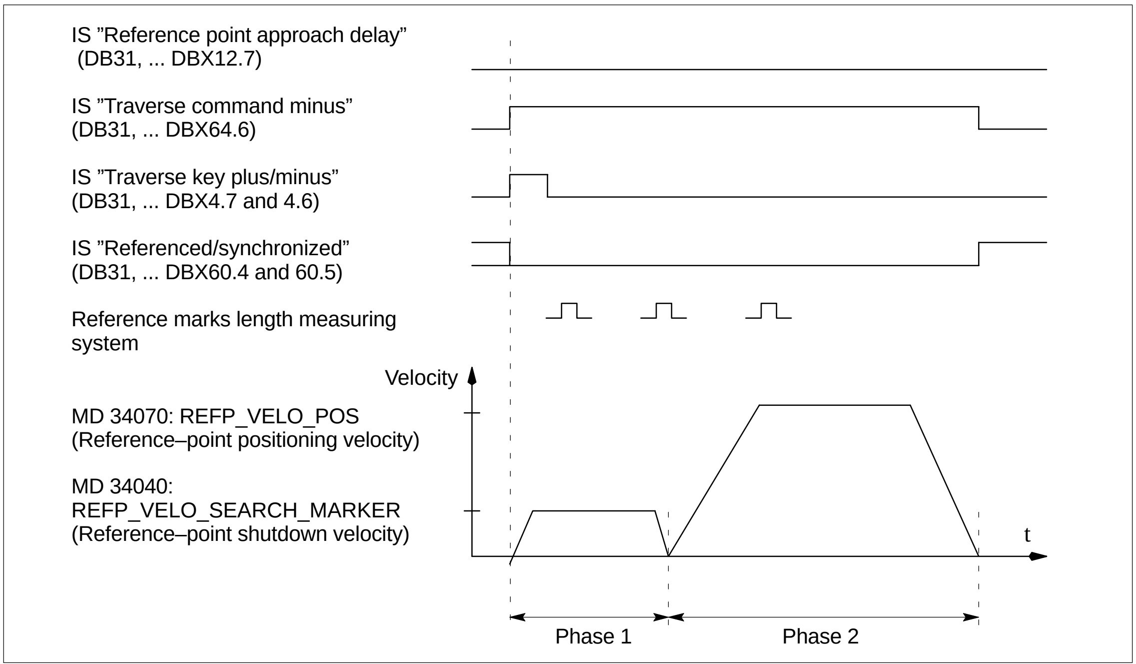


Fig. 10-24 Signal chart: Distance–coded reference marks (principle)

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)
- MD 34310: ENC_MARKER_INC (interval between two reference marks)
- MD 34320: ENC_INVERS (inverse measuring system)
- IS: DB21, ... DBX1.0 (”Activate referencing”)
- IS: DB21, ... DBX33.0 (”Referencing active”)

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 MD
  – MD 34300: 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:

- MD 34070: REFP_VELO_POS (reference point positioning velocity)
- MD 34090: REFP_MOVE_DIST_CORR (absolute offset)
- MD 34100: REFP_SET_POS (target point)
- MD 34330: REFP_STOP_AT_ABS_MARKER (with/without target point)
- IS: DB31, ... DBX60.4, DBX60.5 (”Referenced/synchronized 1, 2”)

Properties of phase 2

- The feedrate override (feedrate 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:

   - MD 34090: REFP_MOVE_DIST_CORR = 0

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). Or it can be measured at any position (laser interferometer).

3. Calculate 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 Machine**,
R1 Reference point approach
Chapter: Referencing on linear measuring systems with distance–coded reference marks

Absolute encoder

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 while the NC starts up without axis movement. The following conditions must be fulfilled:

- The measuring system of the machine axis active after NC start–up works with the absolute value encoder
- The absolute value encoder is calibrated:
  MD 34210: 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 840Di 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 Machine
R1 Reference point approach
Chapter: 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 taken over by the NC 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. Taking over the reference position into the NC
   The reference position is entered in the machine data:
   - MD34100: $MA_REFP_SET_POS[n] (reference point value)
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

   To complete encoder calibration after NC start–up, it is necessary to press the same traverse direction key for the machine axis as under item 2. in JOG > REF mode:

   – Select JOG > REF mode

   – Select machine axis

   – Press traverse direction key

Note

Pressing the traverse direction key does not move the machine axis!

The NC 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

– Removal/installation of the absolute value encoder

– Removal/installation of the motor with the absolute value encoder

– NC SRAM data loss, battery voltage failure, and PRESET

Notice

The status of the absolute value encoder is only automatically reset to 0 = ”encoder not calibrated” by the NC on gear change:

- MD34210: $MA_ENC_REFP_STATE[n] = **0**

In all other cases, it is the sole responsibility of the NC user to indicated the uncalibrated state of the absolute value encoder by setting the status to 0 = ”encoder not calibrated” manually and to perform calibration again.

References

/FB1/ **Description of Functions, Basic Machine**,
R1 Reference point approach
Chapter: Referencing with absolute value encoders

Interface signals

Table 10-39 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 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 10-40 Referencing: Machine data

Number	Name of identifier	Name	Reference
General ($MN_ ...)			
11300	JOG_INC_MODE_LEVELTRIGGRD	INC/REF in jog/continuous mode	H1
Channel-specific ($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[n]	Reference point creep speed [encoder number]	
34050	REFP_SEARCH_MARKER_REVERSE[n]	Direction reversal at reference cam [encoder number]	
34060	REFP_MAX_MARKER_DIST[n]	Maximum distance to reference mark; Maximum distance to 2 reference marks with distance-coded scales [encoder number]	
34070	REFP_VELO_POS	Reference point start velocity	
34080	REFP_MOVE_DIST[n]	Reference point distance/destination for distance-coded system [encoder number]	
34090	REFP_MOVE_DIST_CORR[n]	Reference point/absolute offset, distance-coded [encoder number]	
34092	REFP_CAM_SHIFT	Electronic reference cam shift for incremental measurement systems with equidistant zero marks.	
34100	REFP_SET_POS[n]	Reference point value [reference point number]	
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[n]	Referencing mode [encoder number]	
34210	ENC_REFP_STATE[n]	Status of absolute value encoder [encoder number]	
34220	ENC_ABS_TURNS_MODULO	Absolute value encoder range for rotary encoders	R2
34300	ENC_REFP_MARKER_DIST[n]	Reference marker distance with distance-coded scales [encoder number]	
34310	ENC_MARKER_INC[n]	Differential distance between two reference markers with distance-coded scales [encoder no.]	
34320	ENC_INVERS[encoder]	Linear measuring system inverse to machine system [encoder number]	
34330	REFP_STOP_AT_ABS_MARKER[n]	Distance-coded linear measurement system without destination point [encoder number]	
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 Machine**,
R1 Reference point approach

10.5.20 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 start up 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 Subsection 10.5.1, Page 10-260).

Spindle modes

The diagram below illustrates the spindle modes and possible transitions between them.

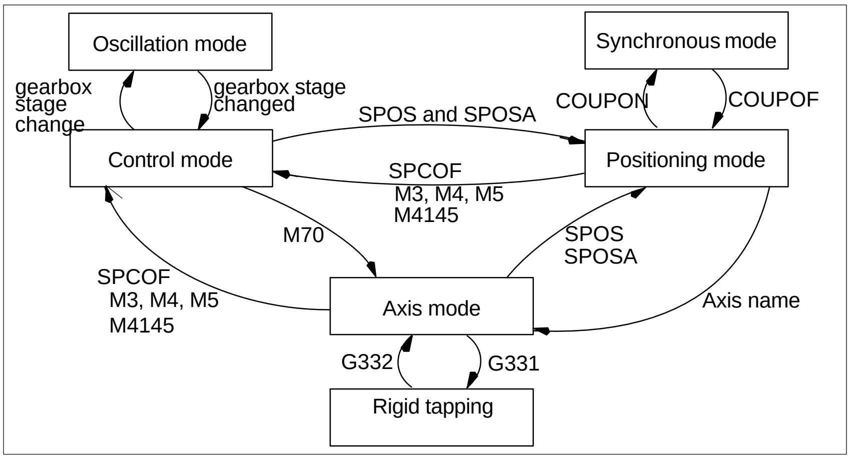


Fig. 10-25 Spindle modes

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:

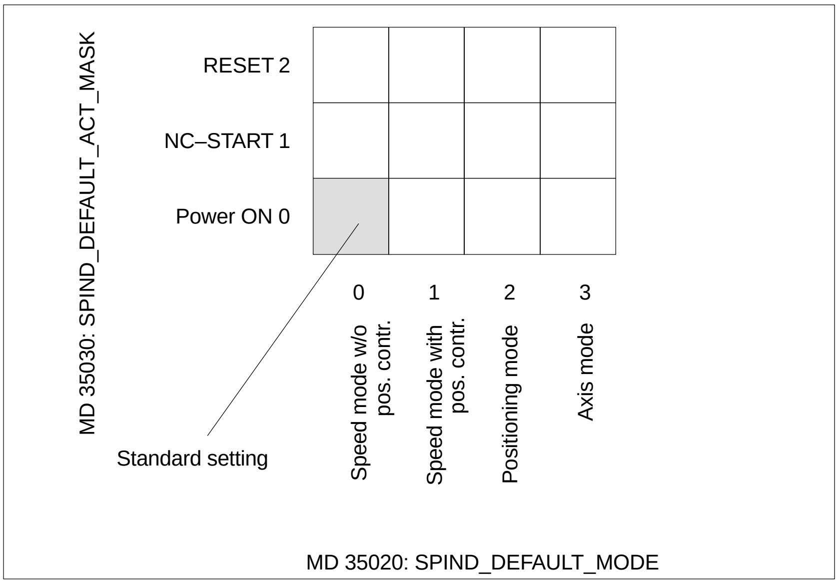


Fig. 10-26 Default setting of spindle mode

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 points to be noted

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 <u>not</u> terminate the axis mode.
3. The interface signals DBB16 to DBB19 and DBB82 to DBB91 in DB31, ... are not important if the IS ”Axis/no spindle” (DB31, ... DBX60.0) is set to zero.
4. Axis mode can be activated in all gear stages. 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.

5. The gear stage 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

- MD 35040: SPIND_ACTIVE_AFTER_RESET (spindle active via 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 Machine**,
S1 Spindles

10.5.21 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, Subsection 10.5.4, Page 10-268.

10.5.22 Gear stages

Enabling of 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 this machine data is not set, the system assumes that the spindle has no gear stages.

Parameter sets

In **Spindle mode** of a spindle, the NC will select the parameter set that suits the current gear stage best.

Gear stage x => parameter set (x+1) => index [x]

In **axis mode** of a spindle, the NC 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 above, Subsection 10.5.13, Page 10-284.

References

/FB1/ **Description of Functions, Basic Machine**,
S1 Spindles
Chapter: Gear step change

10.5.23 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, Subsection 10.5.5, Page 10-271.

For absolute measuring systems, see above, Subsection 10.5.6, Page 10-274.

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

Supposed 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

$$\text{Internal resolution} = \frac{360\ \text{deg.}}{\text{MD31020 * pulse rev.}} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * \text{MD10210}$$

$$\text{Internal resolution} = \frac{360}{500 * 128} * \frac{1}{1} * \frac{1}{1} * 1000 = 5.625\ \frac{\text{int. increments}}{\text{encoder pulse}}$$

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

Supposed 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

$$\text{Internal resolution} = \frac{360\ \text{deg.}}{\text{MD 31020 * pulse rev.}} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * \text{MD10210}$$

$$\text{Internal resolution} = \frac{360}{2048 * 128} * \frac{1}{1} * \frac{1}{2.5} * 1000 = 0.54932\ \frac{\text{int. increments}}{\text{encoder pulse}}$$

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).

10.5.24 Speeds and setpoint adjustment for spindle

Speeds, gear stages

In SINUMERIK 840Di, 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 NC; the oscillation function must otherwise be implemented in the PLC. The oscillation function is initiated via the PLC.

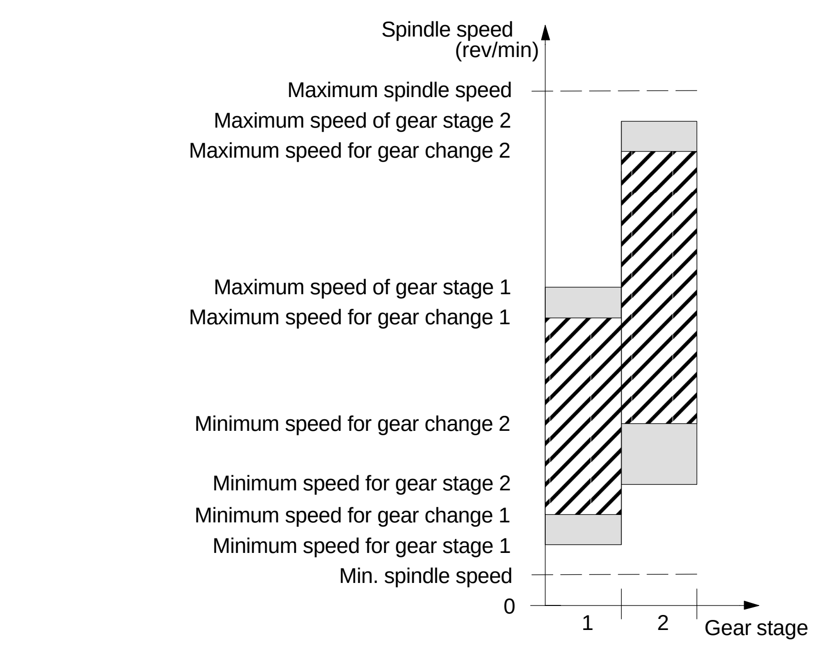


Fig. 10-27 Example for speed ranges for automatic gear stage selection (M40)

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 NC using the selected load gear and the appropriate drive parameter.

SIMODRIVE 611 universal

Drive parameter P0880: PROFIBUS speed evaluation

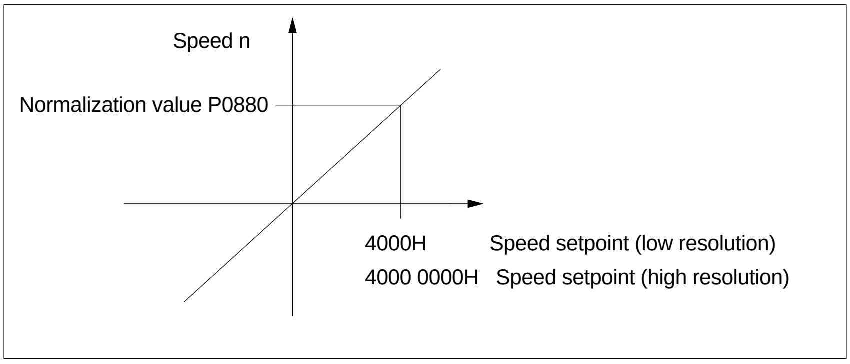


Fig. 10-28 Speed setpoint normalization

The desired speed on the spindle is obtained using a mechanical gear stage.

Machine data

Table 10-41 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	Oscillation speed	
35410	SPIND_OSCILL_ACCEL	Oscillation acceleration	
35430	SPIND_OSCILL_START_DIR	Oscillation start direction	
35440	SPIND_OSCILL_TIME_CW	Oscillation time for M3 direction	
35450	SPIND_OSCILL_TIME_CCW	Oscillation time for M4 direction	

Interface signals

Table 10-42 Speeds and setpoint adjustment for spindle: Interface signals

DB number	Bit, byte	Name	Refe-rence
Axis-specific		**Signals from PLC to axis/spindle**	
31, ...	4.6	Traversing keys minus	
31, ...	4.7	Traversing keys plus	

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	Oscillation speed	
Axis-specific		**Signals from axis/spindle to PLC**	
31, ...	82.2–82.0	Set gear step	
31, ...	82.3	Change gear	
31, ...	84.7	Active spindle control mode	
31, ...	84.6	Active spindle mode oscillation mode	

10.5.25 Position spindle

The NC 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 10-43 Spindle positioning: Machine data

Axis-specific ($MA_ ...)			
35300	SPIND_POSCTRL_VELO	Creep speed	
35350	SPIND_POSITIONING_DIR	Direction of rotation when positioning from the standstill	
35210	GEAR_STEP_POSCTRL_ACCEL	Acceleration in position control mode	

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 10-44 Spindle positioning: Interface signals

DB number	Bit, byte	Name	Refe-rence
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	

10.5.26 Synchronizing spindle

To allow the spindle to be positioned from the NC, 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

- MD 34200 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
Chapter: Motion Control with PROFIBUS–DP
(as from SW 3.1)
Zero mark substitute via PROFIBUS

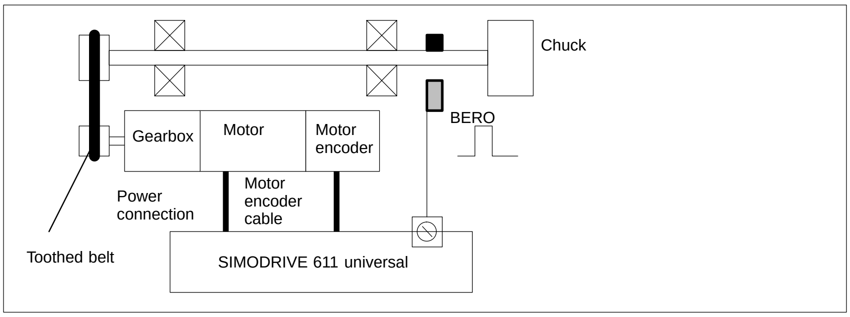


Fig. 10-29 Synchronization using BERO

When is synchronization necessary?

The spindle will be synchronized:

- after the NC has powered up when the spindle is moved using a programming command
- after request for resynchronizing from the PLC
  IS DB31,... DBX16.4 (resynchronize spindle 1)
  IS DB31,... DBX16.5 (resynchronize spindle 2)
- after each gear stage change when an indirect measuring system is used
  MD 31040: 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 proximity switch hysteresis reduce the accuracy achievable during synchronization.

Machine data

Table 10-45 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	

Interface signals

Table 10-46 Synchronizing spindle: Interface signals

DB number	Bit, byte	Name	Refe-rence
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	

10.5.27 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 NC 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”

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 NC 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 parts 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.

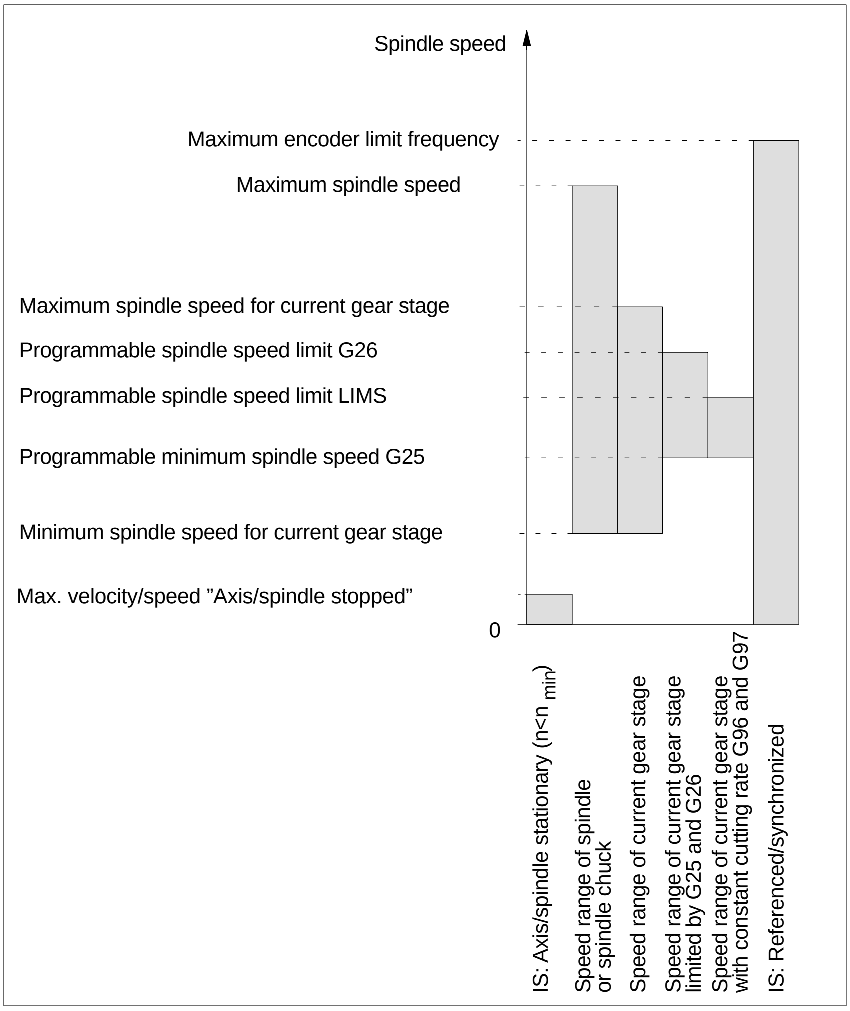


Fig. 10-30 Ranges of spindle monitoring functions/speeds

References

/FB1/ **Description of Functions, Basic Machine**,
S1 Spindles
Chapter: Spindle monitoring

10.5.28 Spindle data

Machine data

Table 10-47 Spindle: Machine data

Number	Name of identifier	Name	Refe-rence
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	Servo gain factor (Kv)	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 distance-coded system	R1
34090	REFP_MOVE_DIST_CORR	Reference point offset/absolute offset, distance-coded	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	

Number	Name of identifier	Name	Refe-rence
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	Oscillation speed	
35410	SPIND_OSCILL_ACCEL	Oscillation acceleration	
35430	SPIND_OSCILL_START_DIR	Oscillation start direction	
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 10-48 Spindle: Setting data

Number	Name of identifier	Name	Refe-rence
Spindle-specific ($SS_ ...)			
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 components when changing the machining plane (G17 to G19)	W1
43210	SPIND_MIN_VELO_G25	Progr. spindle speed limitation G25	
43220	SPIND_MAX_VELO_G26	Progr. spindle speed limitation 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 10-49 Spindle: Interface signals

DB number	Bit, byte	Name	Refe-rence
Axis-specific		**Signals from PLC to axis/spindle**	
31, ...	0	Feed override	V1
31, ...	1.7	Override active	V1

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 distance-to-go	A2
31, ...	2.1	Servo 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	Oscillation 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	
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	

10.6 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 2.10, Page 2-76).
- 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 2.11, Page 2-88).
- 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 on PROFIBUS DP are provided for both NC and PLC.

It is the sole responsibility of the user to avoid access conflicts:

- On the side of the NC: Parts program/synchronized action
- On the side of the PLC: PLC user program

References

/FB/ **Description of Functions, Extended Functions**, A4 Digital and Analog NCK I/Os

10.6.1 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 NC 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

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 Subsection 10.6.6, Page 10-339.

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 NC inputs")
- MD10310: FASTIO_ANA_NUM_OUTPUTS ("Number of active analog NC outputs")

Digital input/outputs

- MD10350: FASTIO_DIG_NUM_INPUTS ("Number of active digital NC input **bytes**")
- MD10360: FASTIO_DIG_NUM_OUTPUTS ("Number of active digital NC output **bytes**")

10.6.2 Assignment of inputs/outputs to the signal modules

On the NC 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

05	**00**	I/O high	I/O low

I/O low: S7 I/O address **Low** part (hexadecimal)
I/O high: S7 I/O address **High** part (hexadecimal)
00: always 00
05: always 05 (identifier: PROFIBUS I/Os)

Note

- The **first** digital input/outputs **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 slot of the signal module allocated by "HW-Config" or set manually.

10.6.3 System variable $A_...[n]

The digital and analog input/outputs are available in the NC (parts program, ASUP, synchronized action, etc.) in the form of system variables.

Analog I/Os

- $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 I/Os	
MD10362: HW_ASSIGN_ANA_FASTIN[0–7]	$A_INA[1–8]
MD10364: HW_ASSIGN_ANA_FASTOUT[0–7]	$A_OUTA[1–8]
Digital I/Os	
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

10.6.4 Digital input/output bytes and system variables

Digital inputs

The following configuration example shows the relation 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

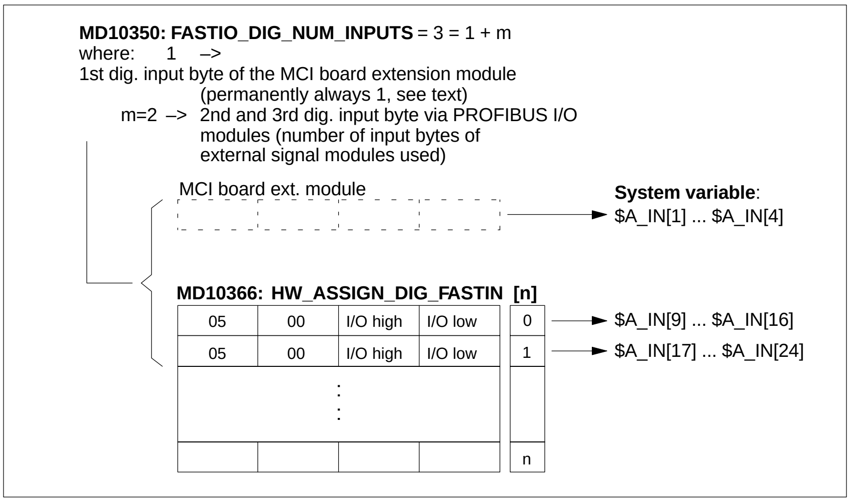


Fig. 10-31 Configuration example: 3 digital input bytes

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.

10.6.5 Dynamic response

After the system variables have been set, e.g. $A_OUT[8] for setting the 8th digital output of the NC on a SIMATIC S7 signal module connected on PROFIBUS DP, the system variable is transferred from DP master to the signal module along 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. 10-32, Page 10-338.

The time properties when reading in a digital or analog input are analogously to the properties described above.

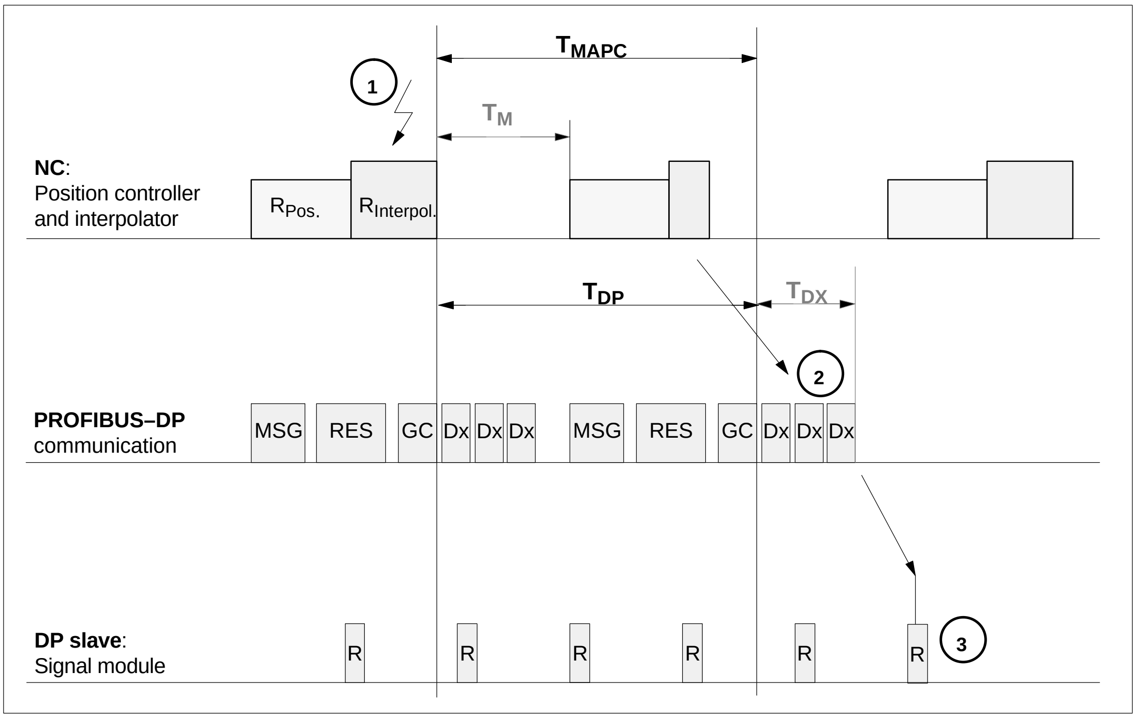


Fig. 10-32 Time response when outputting an output signal with optimized DP cycle

Key to Fig. 10-32:

T_{MAPC}	Master application cycle: NC position control cycle the following always applies for SINUMERIK 840Di: $T_{MAPC} = T_{DP}$
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
GC	Global control: Broadcast message for cyclic synchronization of the equidistance between DP master and DP slaves

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 parts 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.

10.6.6 Configuration example

In the following configuration example the following input/outputs are available to the NC:

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**.

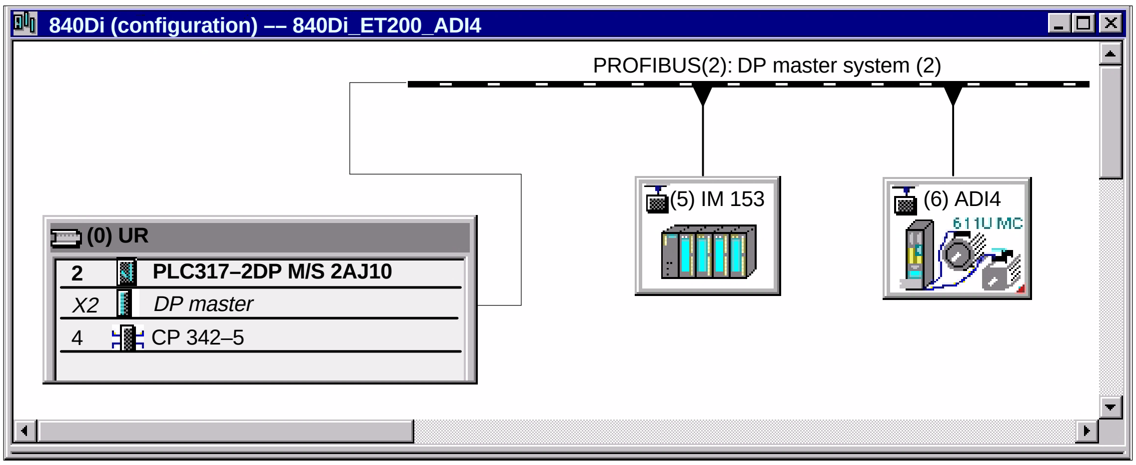


Fig. 10-33 Example configuration: SINUMERIK 840Di with ET200 and ADI4

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 modules			
5	Drive modules	258...275		1st axis
6	Drive modules		258...267	1st axis
7	Drive modules			
8	Drive modules			
9	Drive modules	332...349		2nd axis
10	Drive modules		332...341	2nd axis
11	Drive modules			
12	Drive modules			
13	Drive modules	350...367		3rd axis
14	Drive modules		350...359	3rd axis
15	Drive modules			
16	Drive modules			
17	Drive modules	312...329		4th axis
18	Drive modules		312...321	4th axis
19	Drive modules			
20	Drive modules			
21	Drive modules	330...331		I word
22	Drive modules		330...331	O word
Note: The structure of the PROFIBUS message frame is described in Subsection 8.3.4, Page 8-206f.				

Machine data

Parameterization of the NC 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 does not exist:

– MD10350: FASTIO_DIG_NUM_INPUTS = **5**

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 NC:

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] = **H0500014B** (331_D)

Hardware assignment: output bytes

The following output bytes are used by the NC:

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] = **H0500014A** (330_D)
– MD10366: HW_ASSIGN_DIG_FASTOUT[3] = **H0500014B** (331_D)

Machine data

Table 10-50 Digital and analog I/Os: Machine data

Number	Name of identifier	Name	Refe-rence
General ($MN_ ...)			
10300	FASTIO_ANA_NUM_INPUTS	Number of active analog NC inputs	
10310	FASTIO_ANA_NUM_OUTPUTS	Number of active analog NC outputs	
10320	FASTIO_ANA_INPUT_WEIGHT	Weighting factor for analog NC inputs	
10330	FASTIO_ANA_OUTPUT_WEIGHT	Weighting factor for analog NC outputs	
10350	FASTIO_DIG_NUM_INPUTS	Number of active digital NC input bytes	
10360	FASTIO_DIG_NUM_OUTPUTS	Number of active digital NC output bytes	
10362	HW_ASSIGN_ANA_FASTIN	Hardware assignment of the external analog NC inputs	
10364	HW_ASSIGN_ANA_FASTOUT	Hardware assignment of the external analog NC outputs	
10366	HW_ASSIGN_DIG_FASTIN	Hardware assignment of the external digital NC inputs	
10368	HW_ASSIGN_DIG_FASTOUT	Hardware assignment of the external digital NC outputs	
10380	HW_UPDATE_RATE_FASTIO	Update rate of the synchronous external NC I/Os	
10382	HW_LEAD_TIME_FASTIO	Lead time of the synchronous external NC I/Os	
10384	HW_CLOCKED_MODULE_MASK	Synchronous processing of the external NC I/Os	
10394	PLCIO_NUM_BYTES_IN	Number of directly readable input bytes of the PLC I/Os	
10395	PLCIO_LOGIC_ADDRESS_IN	Start address of the directly readable input bytes of the PLC I/Os	
10396	PLCIO_NUM_BYTES_OUT	Number of directly writeable output bytes of the PLC I/Os	
10397	PLCIO_LOGIC_ADDRESS_OUT	Start address of the directly writeable output bytes of the PLC I/Os	
10530	COMPAR_ASSIGN_ANA_INPUT_1	Hardware assignment of the NC analog inputs for comparator byte 1	
10531	COMPAR_ASSIGN_ANA_INPUT_2	Hardware assignment of the NC analog inputs for comparator byte 2	
10540	COMPAR_TYPE_1	Parameterization for comparator byte 1	
10541	COMPAR_TYPE_2	Parameterization for comparator byte 2	
Channel-specific ($MC_ ...)			
21220	MULTFEED_ASSIGN_FASTIN	Assignment of the input bytes of the NC I/Os for ”Several feedrates in a block”	V1

Setting data

Table 10-51 Digital and analog I/Os: Setting data

Number	Name of identifier	Name	Refe-rence
General ($SN_ ...)			
41600	COMPAR_THRESHOLD_1	Threshold values for comparator byte 1	
41601	COMPAR_THRESHOLD_2	Threshold values for comparator byte 2	

Interface signals

Table 10-52 Digital and analog I/Os: Interface signals

DB number	Bit, byte	Name	Reference
General		**Signals from NC to PLC**	
10	0, 122, 124, 126, 128	Disable digital NC inputs	
10	1, 123, 125, 127, 129	Set digital NC inputs from the PLC	
10	4, 130, 134, 138, 142	Disable digital NC outputs	
10	5, 131, 135, 139, 143	Overwrite screen form of digital NC outputs	
10	6, 132, 136, 140, 144	Setting value of digital NC outputs from PLC	
10	7, 133, 137, 141, 145	Setting screen form of digital NC outputs	
10	146	Disable analog NC inputs	
10	147	Setting screen form of analog NC inputs	
10	148–163	Setting value for analog NC inputs from PLC	
10	166	Overwrite screen form of analog NC outputs	
10	167	Setting screen form of analog NC outputs	
10	168	Disable analog NC outputs	
10	170–185	Setting value for analog NC outputs from PLC	
		Signals from NC to PLC	
10	60, 186–189	Actual value of digital NC inputs	
10	64, 190–193	Setpoint of digital NC outputs	
10	194–209	Actual value of analog NC inputs	
10	210–225	Setpoint of analog NC outputs	

10.7 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.

The generating step that used to be necessary to link the compile cycle with the NCK system software to form a complete system is no longer required.

Siemens compile cycles

The following technological functions are available from Siemens as loadable compile cycles:

– 1D/3D clearance control in position controller cycle
Order No.: 6FC5 251–0AC05–0AA0
References: /FB3/ Description of Functions Special Functions
Chapter Distance Control (TE1)

– Continue Machining at the Contour (Retrace Support)
Order No.: 6FC5 251–0AE72–0AA0
References: /FB3/ Description of Functions Special Functions
Chapter Retrace Support (TE7)

– Fast Laser Switching Signal
Order No.: 6FC5 251–0AE74–0AA0
References: /FB3/ Description of Functions Special Functions
Chapter 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 60

User compile cycles

To create your own compile cycles, in addition to the necessary NCK–specific development environment, you need the SINUMERIK Open Architecture component ”OA package NCK”.

Note

To use the SINUMERIK Open Architecture component ”OA package NCK”, you need to conclude an OEM contract.

10.7.1 Loading compile cycles

Preconditions: Control

The following requirements must be met to enable loading a compile cycle to the NCK:

1. A flash file system (FFS) of at least 512KB is set up on the NCK.
   - MD18332: MM_FLASH_FILE_SYSTEM_MEM_SIZE (size of the FFS)
2. To transfer the compile cycle to the control, you need one of the following transfer media:
   – Floppy disk drive (option)
   – Network connection via the Ethernet interface of the PCU with the external PC/PG containing the compile cycles file.
3. To copy the compile cycle to the FFS of the NCK, you need SinuCom NC Version 6.2.12 or higher.

Loading

Proceed as follows to transfer a compile cycle to the NCK:

1. Exit any active HMI Advanced windows and activate the Windows desktop.
2. Use the Windows Explorer to copy the compile cycle file (e.g. ccresu.elf) from the diskette drive or external PC/PG to a directory of your choice on the PCU hard disk, (e.g. F:\techfunctions)
3. Copy the compile cycle file with SinuCom NC from the directory used in Step 2 on the PCU hard disk to the NCK FFS.

   SinuCom NC menu command: **File > Load compile cycle**

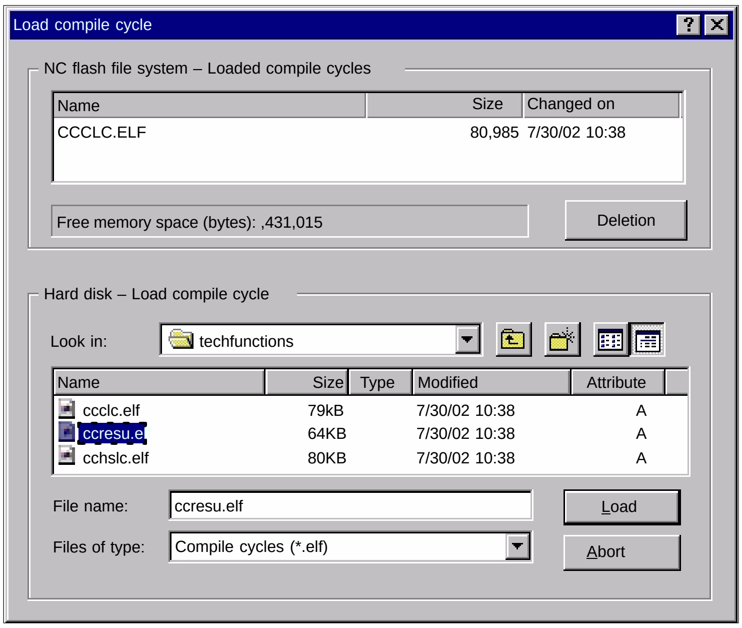


Fig. 10-34 SinuCom NC: Loading a compile cycle

After copying the compile to the FFS, you need to reset the NCK. The compile cycle is loaded in the NCK system software the time the NCK is booted.

Note

Several compile cycles can be copied to the NCK FSS in succession; you do not need to perform an NCK reset after each copy procedure.

10.7.2 Restrictions

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 issued:

- Alarm ”7200 Version_conflict_with_CCNCKInterfaceVersion”.

Dependencies

If a compile cycle has a functional dependency on another one which is not loaded to 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/840DiE, the following alarm is issued:

Not enabled for SINUMERIK 840Di

- Alarm ”7200 CC<name>_ELF NO_840Di”

Not enabled for SINUMERIK 840DiE

- Alarm ”7200 CC<name>_ELF NO_EMBARGO”

Notice

If alarm ”7200 . . . ” is pending after an NCK start–up, none of the loaded compile cycles is active.

10.7.3 Activating and licensing technology functions

Activating and licensing the option

To activate the technological function loaded with the compile cycle to the NCK, you need to set and license the respective option.

For information about how to activate and license options, please see Section 5.7, Page 5-130.

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 NC channels or individual subfunctions via the above mentioned general NCK machine date.

For a description of the machine data, please see Subsection 10.7.4, Page 10-347.

References

The individual technological functions are described in:

/FB3/ Description of Functions Special Functions
Chapters TE1 to TE8

Version display: HMI Advanced (option)

The compile cycles loaded in the FSS NCK are displayed together with the respective version of HMI Advanced (option) in the following menu:

Operating area switchover > Service > Version > Compile cycles

10.7.4 Data descriptions (MD)

General Machine data

60900 + i where i = 0. 1. 2. 3 ... MD number	**CC_ACTIV_IN_CHAN_XXXX[n]** where: XXXX = function identifier, n = 0 or 1 n = 0: Activate technology function in NC channels n = 1: Additional functions within the technology function		
Default setting: 0	Minimum input limit: 0	Maximum input limit: FFFF	
Changes effective after RESET	Protection level: 2 / 7	Unit: –	
Data type: UINT16	Applies as from SW version: 2.2		
Meaning:	Activate technology function in NC channels: The technology function is activated in the NC channels by means of index n = 0. Bit 0 = 1: Technology function activated in NC channel 1 Bit n = 1: Technology function activated in NC channel n+1 For more details about which NC 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.		

10.8 PROFIBUS–DP

10.8.1 Setting the parameters for the shut–down behavior

If specific DP slaves react to an abrupt shut–down of PROFIBUS DP communication with error states, e.g. in response to a power–on NC reset (warm restart), machine data:

- MD11250 PROFIBUS_SHUTDOWN_TYPE (PROFIBUS shutdown handling)

can be used to configure the staged shut–down of PROFIBUS DP communication.

Note

The drives available for SINUMERIK 840Di:

– SIMODRIVE 611U / UE

– SIMODRIVE POSMO SI / CD / CA

can be operated by default with mode 0 (abrupt shut–down of PROFIBUS DP communication). This corresponds to the initialized default setting of the machine data (see Subsection 10.8.2, Page 10-348).

10.8.2 Data descriptions (MD)

General Machine data

11250 MD number	**PROFIBUS_SHUTDOWN_TYPE** PROFIBUS shutdown handling	
Default setting: 0	Minimum input limit: 0	Maximum input limit: 2
Changes effective after RESET	Protection level: 2 / 7	Unit: –
Data type: UINT8	Applies as from SW version: 2.2	
Meaning:	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 in the CLEAR state for at least 20 cycles. Then PROFIBUS–DP communication is deactivated. If PROFIBUS–DP cannot be put in the CLEAR state, proceed as described under 2. To be used for: SINUMERIK 840D with DP–Link module. 2 = Null vales 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 with PLC 315–2DP, 314–2C, 317–2DP.	

10.9 Initial settings

Concept

The status of an NC function, e.g. G codes, tool length compensation, transformation, coupled motion (of an axis) 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 parts program

and

2. Parts program start

The default setting of an NC function remains stored until it is explicitly changed by operation or programming.

Initial settings parameterization

The machine data:

- MD20110: RESET_MODE_MASK (”Definition of the control default settings in case of reset”)
- MD 20112: 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 10-53 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/parts program end	MD20110: RESET_MODE_MASK MD20150: GCODE_RESET_VALUES MD20152: GCODE_RESET_MODE
Parts program start	MD20112: START_MODE_MASK MD20110: RESET_MODE_MASK

References

/FB1/ **Description of Functions, Basic Machine**,
K2 Axes, Coordinate Systems, Frames, Actual–Value System for Workpiece
Chapter: Workpiece–related actual value system/reset behavior

10.10 NC/PLC Diagnosis

10.10.1 Menu: Diagnostics

Operating path

The menu of the NC/PLC diagnostics is in the following operating path:

- Operating area switchover > Diagnosis > NC/PLC Diagnosis > Diagnosis

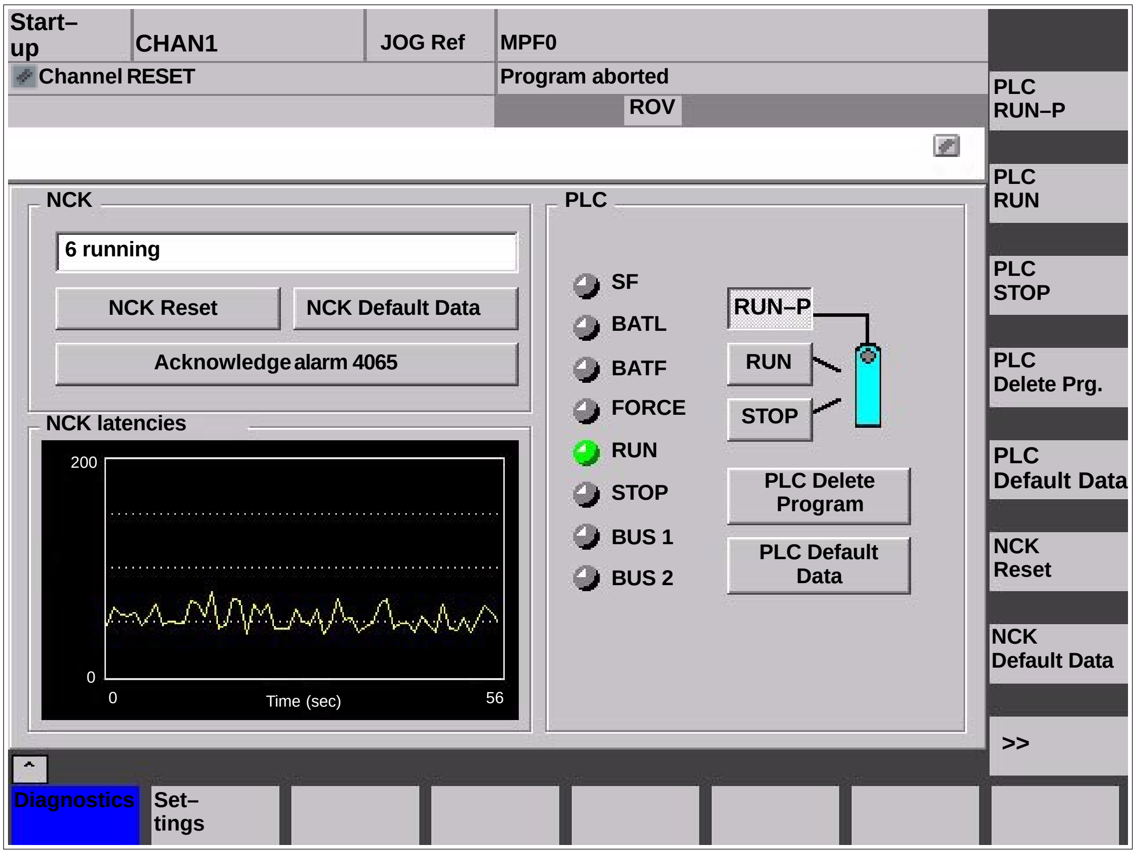


Fig. 10-35 Menu: NC/PLC Diagnosis

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

- **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 NC 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 NC 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 NC must be started up again or a series start–up file read in (see Chapter 14, Page 14-403).

- **Acknowledge alarm 4065**

  Via button ”Acknowledge alarm 4065”:

  - Alarm: ”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 NC must be started up again or a series start–up file read in (see Chapter 14, Page 14-403).

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.

- **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 <u>not</u> reset.

- **PLC default data**

  The PLC is put in the STOP state with ”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** (<u>S</u>ystem <u>F</u>ault)
    lights up on PLC sytem errors, such as: Hardware, programming, parameterizating, computing, time, battery, and communication errors.
  - **BATL** (<u>B</u>attery <u>L</u>ow)
    lights up if the 5 V power supply (back–up battery) falls below its permissible value.
  - **BATF** (<u>B</u>attery <u>F</u>ault)
    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 10-54 below.
  - **STOP**: See Table 10-54 below.
  - **BUS 1** (<u>G</u>roup <u>f</u>ault–<u>D</u>istributed<u>I</u>/Os)
    lights up on an error signaled by the distributed I/Os.
  - **BU 2F** (<u>B</u>us <u>f</u>ault)
    lights up on PROFIBUS–DP e.g.:
    – Bus fault (e.g. short–circuit or interruption)
    – Interface error (e.g. error in S7 parameterization)

Table 10-54 PLC operating state display by means of RUN/STOP evaluation

RUN	STOP	PLC operating state
lights up	Off	RUN: The PLC program is being processed.
Off	lights up	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	lights up	HALT: The PLC user program has been halted (triggered by a test function)
Flashes at 2 Hz	lights up	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 realtime property is activation of the NC system software cyclically in defined time intervals.

  Because the NC and Windows XP share the available processor power of the PCU, delays, called latencies, may occur when calling the NCK. If latencies are longer than 200µs they are considered to be violation of realtime with which the NC functionality is now longer ensured.

  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 realtime response of the NCK has been affected after replacing or expanding hardware and/or software components.

Note

For detailed information about the realtime properties of the SINUMERIK 840Di, see Subsection 1.1.5, Page 1-24.

10.10.2 Menu: Settings

Operating path

The menu for the SINUMERIK 840Di specific settings is in the following operating path:

- Operating area switchover > Diagnosis > NC/PLC Diagnosis > Settings

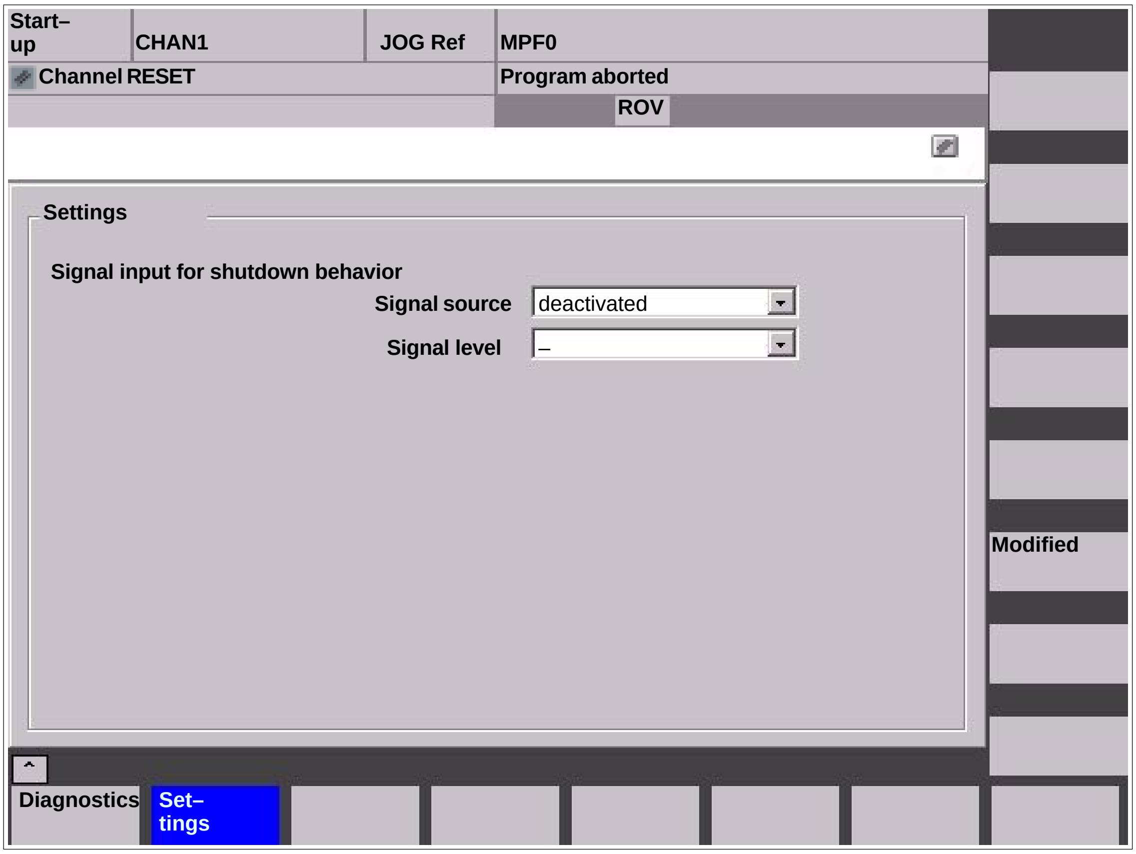


Fig. 10-36 Menu: Settings

Modifying data

After switching to the menu, the displayed data are 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 Subsection 2.3.3, Page 2-57).

- **Signal input for shutdown behavior: Signal level**

  This selection field is for configuring the level of the shutdown signal of the UPS:

  - **Low active**

    On detection of the low level (0) at the configured input, SINUMERIK 840Di NCK / PLC and then Windows XP is ended.

  - **High active**

    On detection of the high level (1) at the configured input, SINUMERIK 840Di NCK / PLC and then Windows XP is ended.

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” soft-key.

The ”Cancel” softkey rejects all changes and displayes the original settings again.

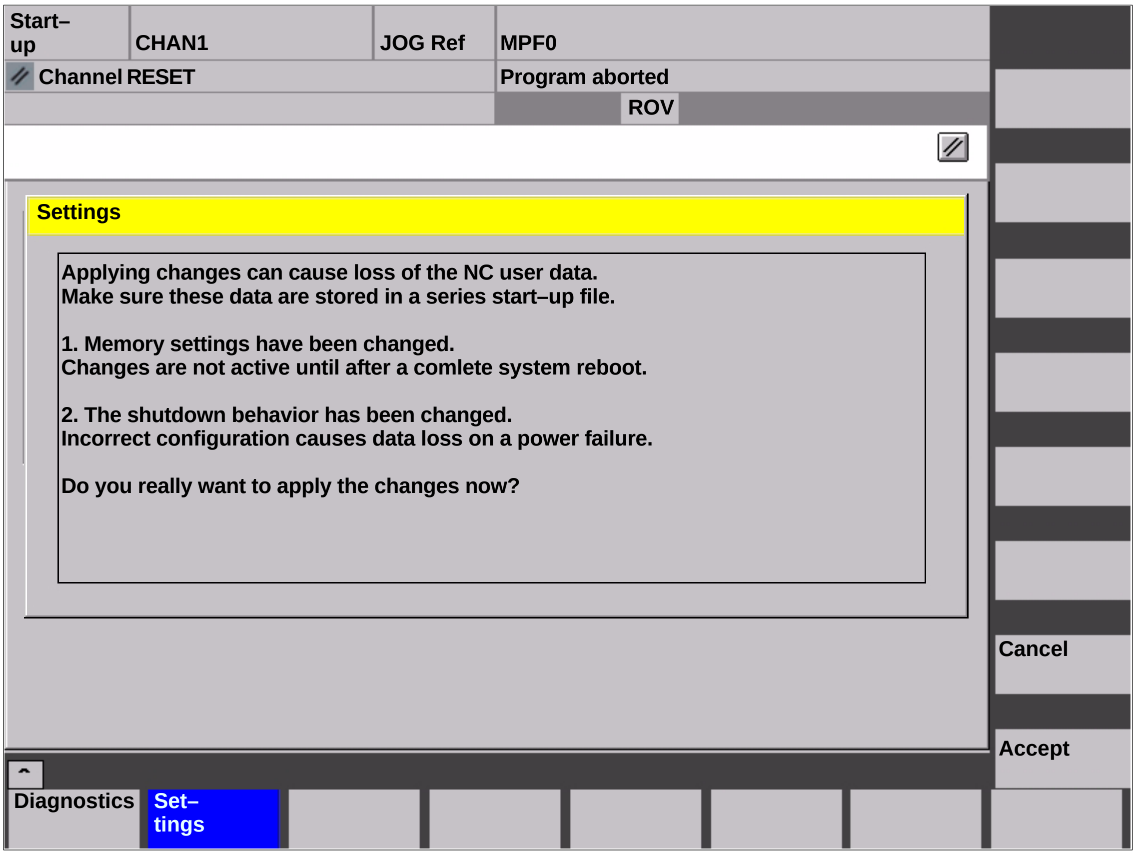


Fig. 10-37 Making settings

Notice

We urgently recommend creating a series start–up file before changing the data described above. See Chapter 14, Page 14-403.

■

Notes

Alarm and Message Texts

11

11.1 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**.

11.1.1 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=
UserCZyk=
...
```

11.1.2 Standard text files

Default 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 11-1, Page 11-359).

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.

11.1.3 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
.

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 11-1 Language codes

Language	Abbreviation
German	gr
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.

11.1.4 Syntax for alarm text files

Alarm numbers

The following alarm numbers are available for the cycle, compile cycle and PLC alarms:

Table 11-2 Alarm numbers for cycle, compile cycle and PLC alarms

Number range	Description	Effect	Deletion
60000 – 60999	Cycle alarms (Siemens)	Display, NC start disable	Reset
61000 – 61999		Display, NC start disable, axis/spindle standstill	Reset
62000 – 62999		Display	Cancel
63000 – 64999	Reserved		
65000 – 65999	Cycle alarms (user)	Display, NC start disable	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 user		
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 11-3 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 German			

References: /FB/, Description of Functions, Basic Machine
P3 PLC Basic Program
Chapter: 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

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 Subsection 11.1.5, Page 11-362, 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 11-4 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 FDDISd 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 Machine
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 Subsection 11.1.5, Page 11-362, 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. 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

11.1.5 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 11-5 Sections of the MBDDE.INI file

Section	Meaning
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 with which alarms can be reset: e.g. Cancel = +F10 <deletes alarms with key combination Shift+F10>

For further details of the file entries, refer to

References: /BN/ User Guide: OEM package for MMC

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
```

■

Notes

Axis/Spindle Dry Run 12

12.1 Preconditions

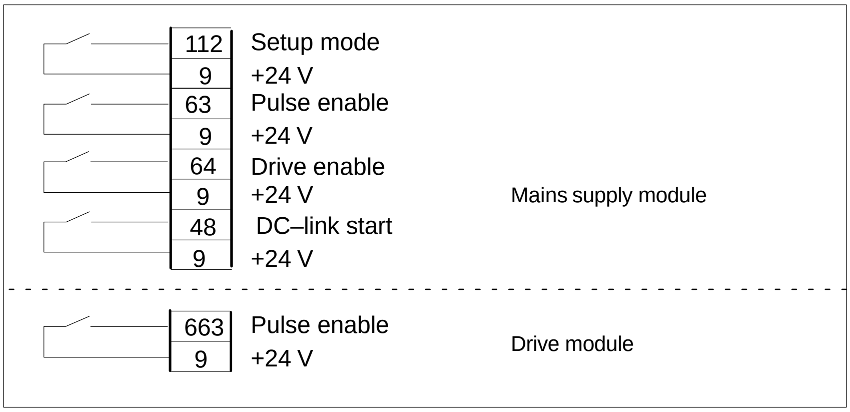
Enables for axes

To allow an axis to be traversed from the control system, it is necessary to supply enabling terminals on the drive and to set enabling bits on the interface.

DBxx

The data block designated DBxx depends on the maximum configuration of the machine axes currently validated for SINUMERIK 840Di.

Enables
on the drive



References: /FBU/ SIMODRIVE 611 universal, Description of Functions

Enabling through
PLC interface

The following signals must be made available at the PLC interface for axis or spindle:

IS ”Servo enable”	(DB31–DBxx, DBX2.1)
IS ”Pulse enable”	(DB31–DBxx, DBX21.7)
IS ”Position measuring system 1 or 2”	(DB31–DBxx, DBX1.5, DBX 1.6)

The following signals on the interface must **not** be set or else the axis/spindle motion will be disabled:

IS ”Feed/spindle override switch”	(DB31–DBxx, DBB0) not at 0%
IS ”Axis/spindle lock”	(DB31–DBxx, DBX1.3)
IS ”Follow–up mode”	(DB31–DBxx, DBX1.4)
IS ”Distance to go/spindle reset”	(DB31–DBxx, DBX2.2)
IS ”Feed stop/Spindle stop”	(DB31–DBxx, DBX4.3)
IS ”Traversing key lock”	(DB31–DBxx, DBX4.4)
IS ”Ramp–function generator lock”	(DB31–DBxx, DBX20.1)

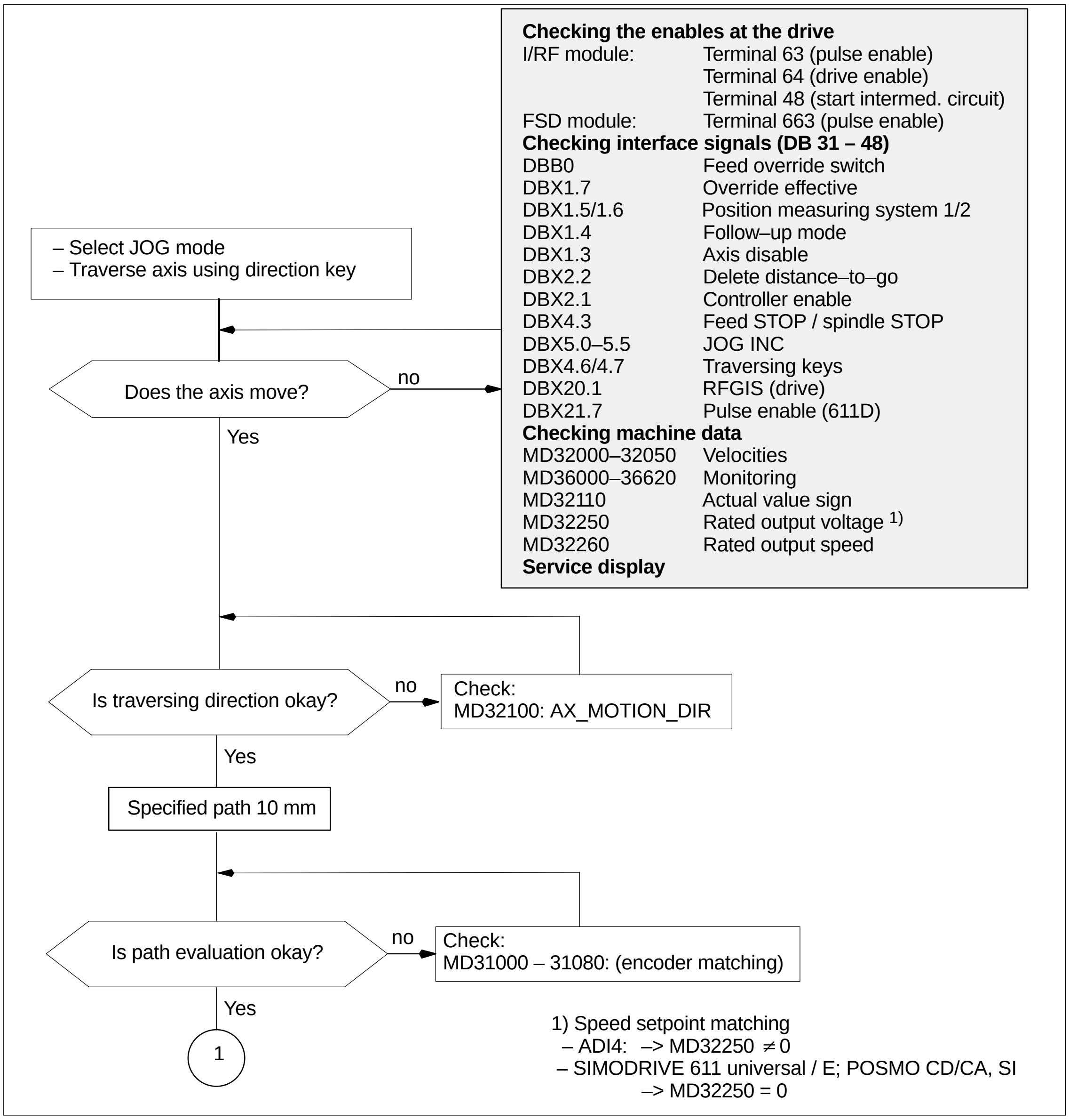
References /FB/ Description of Functions Basic Machine:
A2 Various Interface Signals and Functions

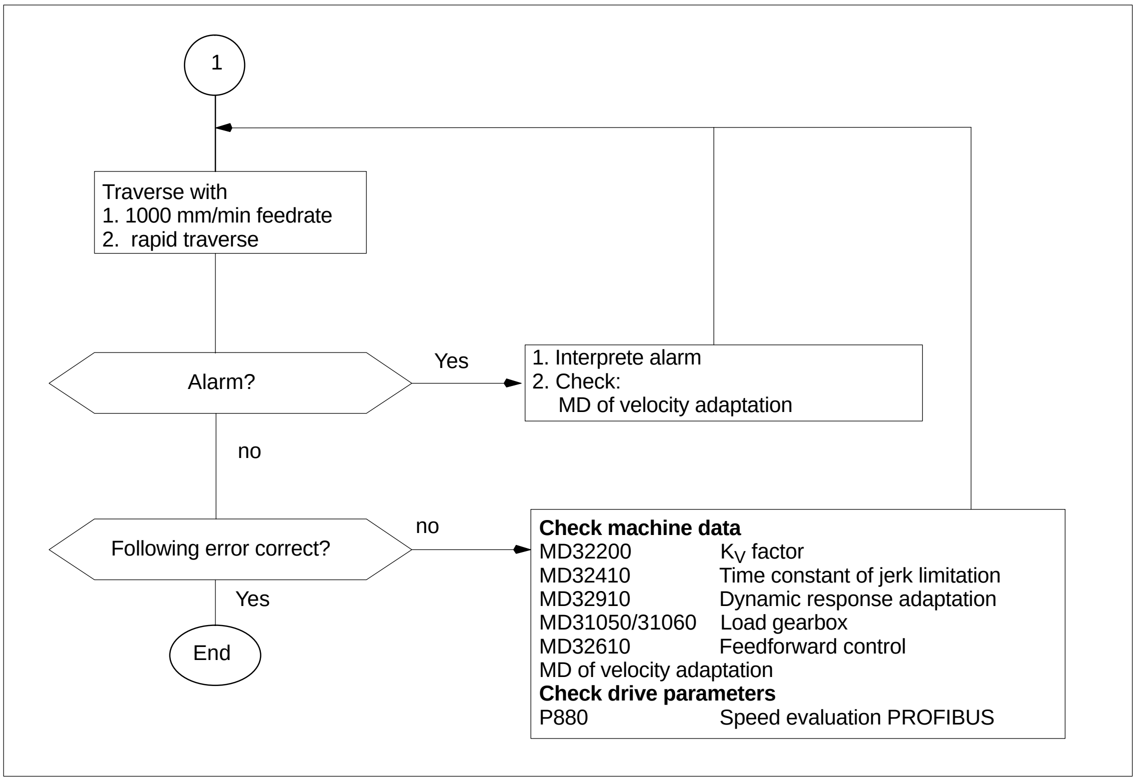
Limit switch

Setting of hardware limit switches and interface signal check:

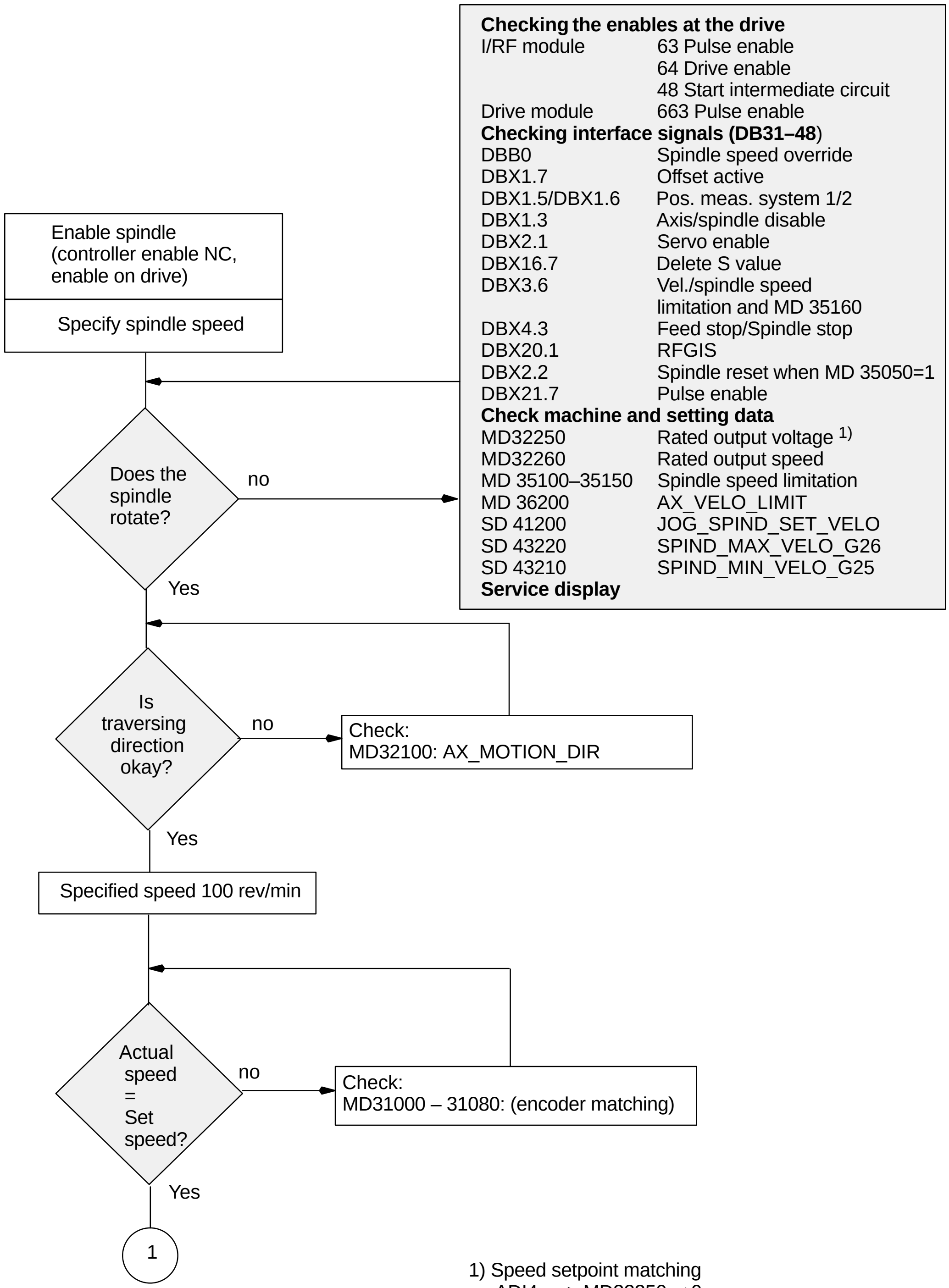
- Hardware limit switch PLUS DB31–DBxx.DBX12.1
- Hardware limit switch MINUS DB31–DBxx.DBX12.0.

12.2 Axis dry run

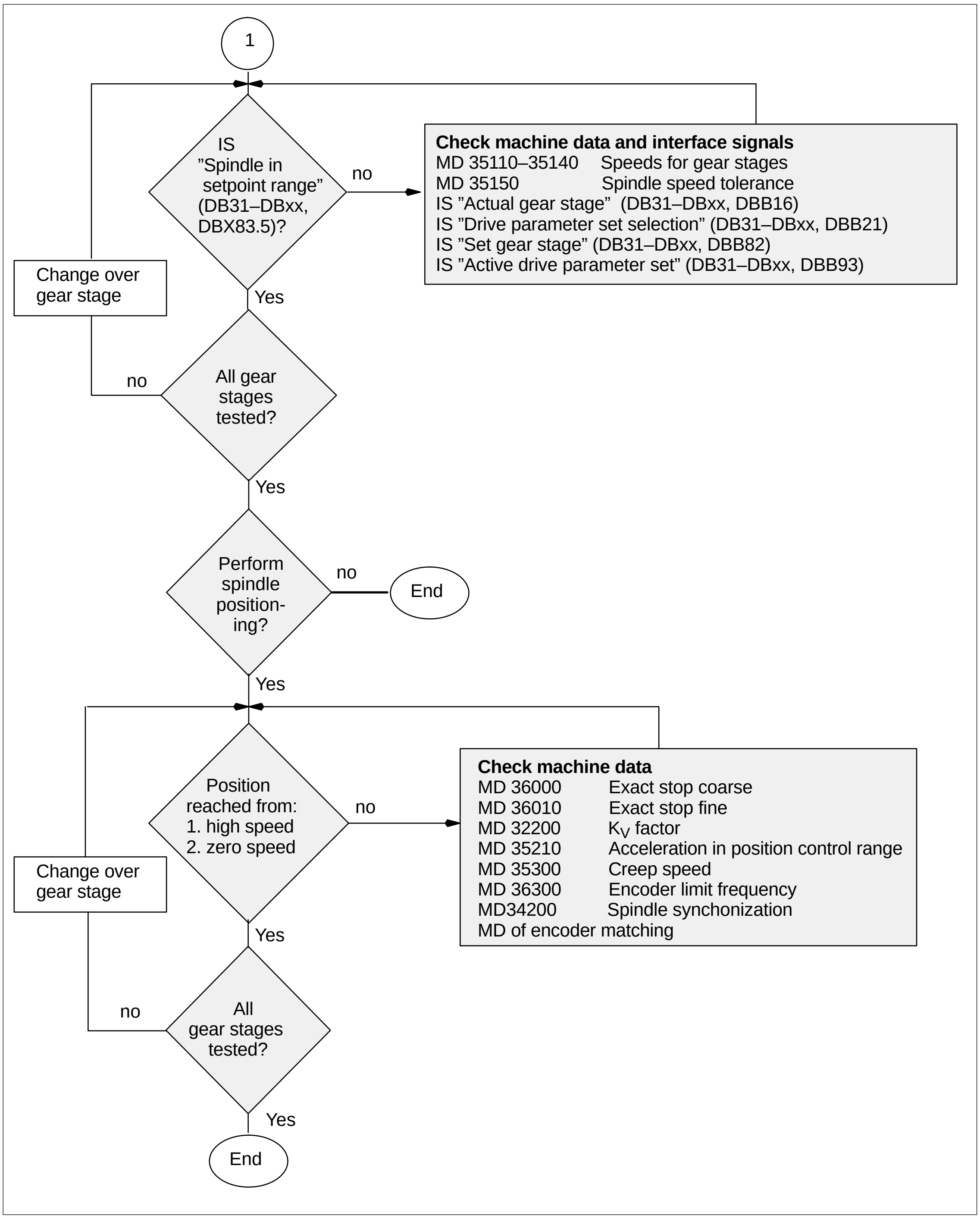



1
Traverse with
1. 1000 mm/min feedrate
2. rapid traverse
Alarm?
Yes
1. Interprete alarm
2. Check:
MD of velocity adaptation
no
Following error correct?
no
Check machine data
MD32200 K_V factor
MD32410 Time constant of jerk limitation
MD32910 Dynamic response adaptation
MD31050/31060 Load gearbox
MD32610 Feedforward control
MD of velocity adaptation
Check drive parameters
P880 Speed evaluation PROFIBUS
Yes
End

12.3 Spindle dry run



1) Speed setpoint matching
– ADI4: –> MD32250 ≠ 0
– SIMODRIVE 611 universal / E; POSMO CD/CA, SI –> MD32250 = 0


1
IS ”Spindle in setpoint range” (DB31–DBxx, DBX83.5)?
no
Check machine data and interface signals
MD 35110–35140 Speeds for gear stages
MD 35150 Spindle speed tolerance
IS ”Actual gear stage” (DB31–DBxx, DBB16)
IS ”Drive parameter set selection” (DB31–DBxx, DBB21)
IS ”Set gear stage” (DB31–DBxx, DBB82)
IS ”Active drive parameter set” (DB31–DBxx, DBB93)
Yes
Change over gear stage
no
All gear stages tested?
Yes
Perform spindle position-ing?
no
End
Yes
Position reached from:
1. high speed
2. zero speed
no
Check machine data
MD 36000 Exact stop coarse
MD 36010 Exact stop fine
MD 32200 K_V factor
MD 35210 Acceleration in position control range
MD 35300 Creep speed
MD 36300 Encoder limit frequency
MD34200 Spindle synchronization
MD of encoder matching
Change over gear stage
Yes
no
All gear stages tested?
Yes
End

■

Notes

Drive optimization with HMI Advanced 13

13.1 Overview

Start–up: drive/servo

In the operating area **Start–up** of HMI Advanced, the following functions can be chosen from the menu item **Drives/Servo** for analyzing speed and position controller of a drive, as well as individual drive/servo data:

- Frequency response measurement of speed control loop
- Frequency response measurement of position control loop
- Function Generator
- Circularity test
- Servo trace

Notice

A measurement of the torque control loop with HMI Advanced is not possible within the framework of SINUMERIK 840Di.

Measuring functions

The measuring functions make it possible to evaluate the most important speed and position control loop quantities in the time and frequency range of a drive without any external measuring instruments.

Integrated FFT analysis

The integrated FFT analysis (Fast Fourier Transformation) provides a powerful means to assess the control loop quality and, in addition, also to analyze the given mechanical properties.

The FFT analysis should be used whenever:

– unsteady speed or position signal curves indicate problems with stability

– only long rise times can be obtained in the speed loop.

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
Chapter: Circularity test

Servo trace

Servo trace provides a graphically assisted analysis of the time response of servo and drive data. For example:

- Actual position value
- Position setpoint
- Following error
- Contour deviation

Saving measurement results

The diagrams determined can be archived using file functions. Thus, they can be used both for documenting the machine settings and to facilitate remote diagnosis.

13.2 Measuring functions

Explanation

A range of measuring functions allow 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

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 13-1 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
Path	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 parts 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.

Starting measuring functions

Measuring functions initiating a traversing movement are only selected using the specific soft key. 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

13.3 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, this **can** be used in conjunction with measuring functions to realize an additional axis–specific traversing enable.

Activation

The interface signals are activated from the main menu of the appropriate measuring function in the group ”Drive test traversing enable”. See Fig. 13-1, Page 13-375.

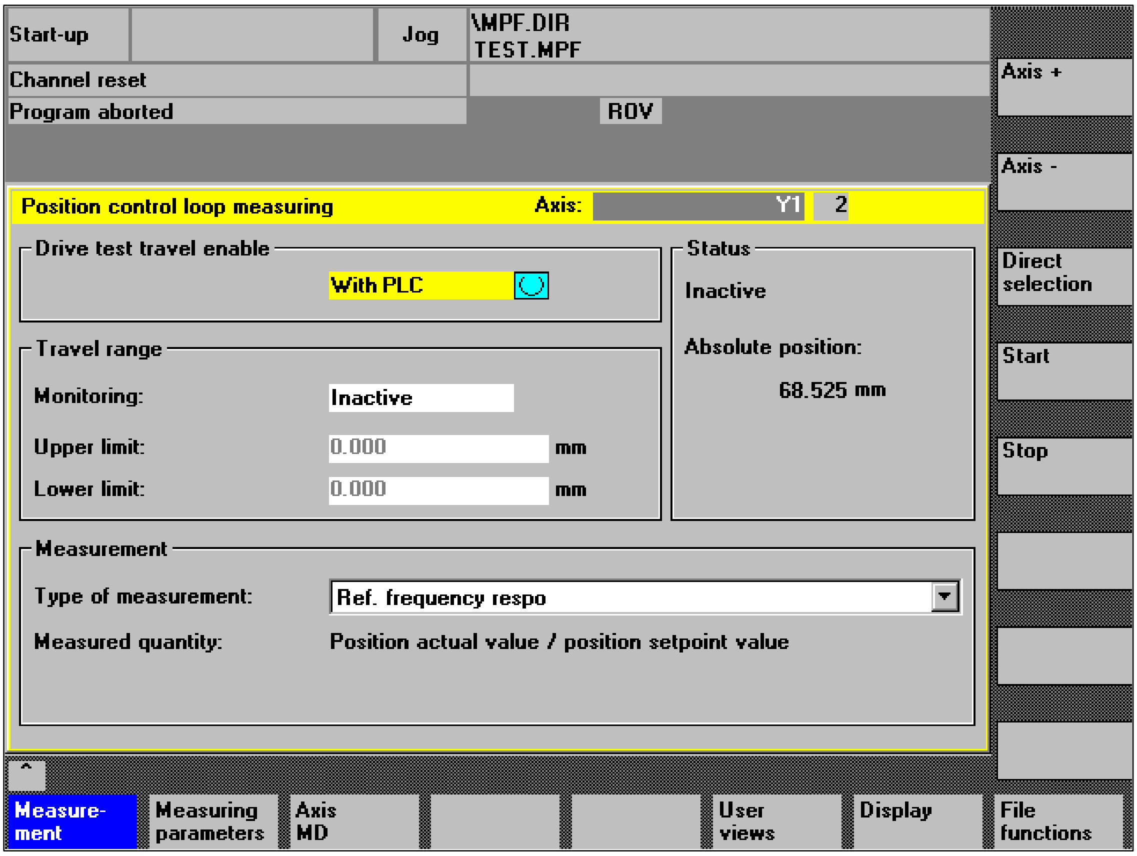
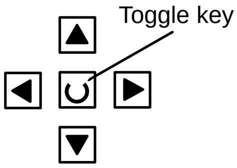


Fig. 13-1 Main menu: Position control loop measurement

Choose the type of traversing enable from the selection list either by using the **Toggle** key or by clicking with the right mouse button on the desired enable type:

– 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.).

– 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. This traversing range monitoring **can** be used to limit or monitor the traversing range of an axis to be measured without referencing this axis.

The basis is the absolute axis position displayed in the ”Status” group at the time of measurement.

Activation

The traversing range monitoring is activated from the main menu of the appropriate measuring function in the group ”Traversing range”. See Fig. 13-1, Page 13-375.

Choose the type of traversing range monitoring from the selection list ”Monitoring” either using the **Toggle** key or by clicking with the right mouse button on the desired type of traversing range monitoring:

– 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
  – Voltage limit

13.4 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.

Note

You will find detailed information about frequency measurement and optimization of the torque/current and speed control loop of the SIMODRIVE 611 universal/E, POSMO CD/CA and SI drives in the online help of the start–up tool SimoCom U:

Menu command: **Help > Help topics > Index**

– Measuring function
– Optimization of speed control loop

13.4.1 Torque control loop measurement

A measurement of the torque control loop with HMI Advanced is not possible within the framework of SINUMERIK 840Di.

13.4.2 Speed control loop measurement

Note

You will find information about optimization of the torque/current and speed control loop of the SIMODRIVE 611 universal/E, POSMO CD/CA and SI drives in the online help of the start–up tool SimoCom U, Index: "Optimization of speed control loop"

Functionality

This measurement function basically analyses the response to the motor measuring system. Depending on which basic measurement setting has been selected, various measurement parameters lists as described below are made available.

Procedure

The traversing range monitoring function is set and the enabling logic (external/internal) selected in the speed control loop measurement main screen.

1. Setting the traverse range monitoring and the enable logic in the **main screen.**
   One of four possible measurements can be selected:
   – Reference frequency response
   – Setpoint step change
   – Interference frequency response
   – Disturbance step change
   – Speed controlled system

2. Set the required parameters in the **measurement parameter screen.**
3. Display of the measurement result on the screen with the soft key **Display**.

Measurement: Reference 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).

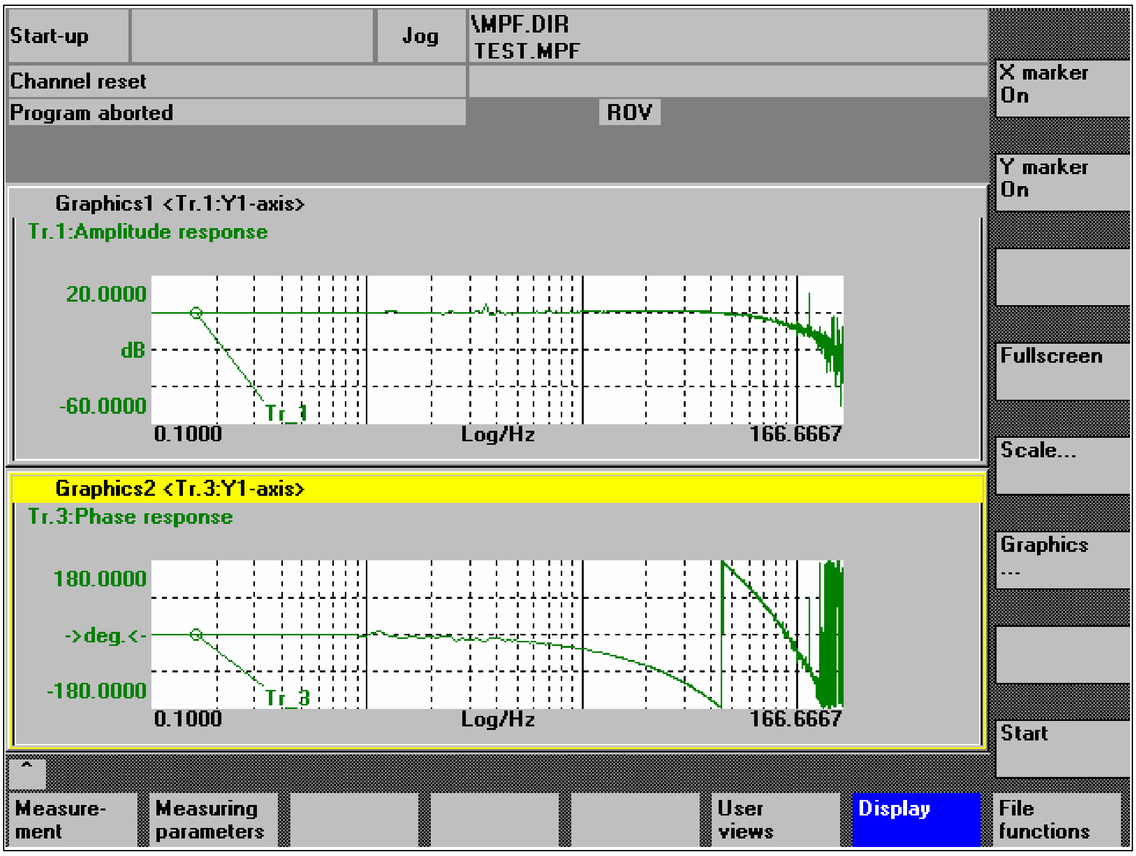


Fig. 13-2 Example: Measurement results of a reference frequency response measurement

Measurement: Interference frequency response

Alternatively, the interference frequency response can be recorded in order to assess how well the control suppresses interference.

Measurement parameters: Reference and interference frequency response

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 ($T_{position\ controller}$).

$$Bandwidth_{max}\ [\ Hz\ ] = 1\ /\ (2 * T_{position\ controller}\ [\ s\ ])$$

Example: Position controller cycle: 2 ms

$$Bandwidth_{max} = 1\ /\ (2 * 2*10^{-3}\ ) = 250Hz$$

Averaging
The accuracy of the measurement, but the measurement duration, too, will 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 parameters: 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.

Amplitude
This parameter determines the magnitude of the specified setpoint or disturbance step change.

Measurement time
This parameter determines the period of time to be recorded (maximum of 2048 x speed controller cycles).

Offset
A low offset of a few motor revolutions per minute can be selected to rule out an influence of the static friction.

- 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/test setpoint output and the injection of the offset.

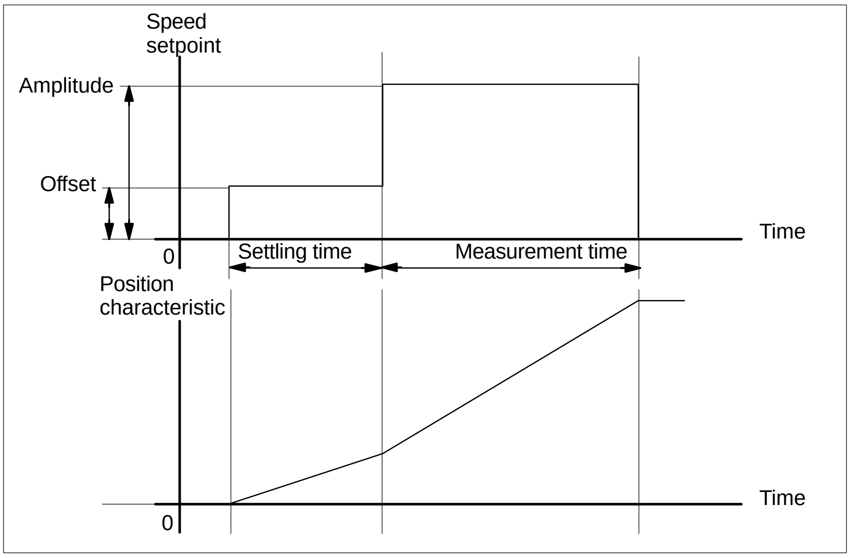


Fig. 13-3 Setpoint signal for speed control loop/step response measuring function

Additional information

The measurement parameters and measurement results (diagrams) can be loaded and saved via the soft key **File functions**.

13.4.3 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, the NCK generates an error message. Depending on which basic measurement setting has been selected, various measurement parameters lists as described below are made available.

Procedure

1. Setting the traverse range monitoring and the enable logic in the **main screen.**
   One of three possible measurements can be selected:
   - Reference frequency response
   - Setpoint step change
   - Setpoint ramp
2. Set the required parameters in the **measurement parameter screen.**
3. Display of the measurement result on the screen with the soft key **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, K_V value 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. Excessive resonance requires

1. Decrease of the K_V value
2. Decrease of the feedforward control value
3. Use of setpoint filters

The effects of these measures can also be checked in the time range.

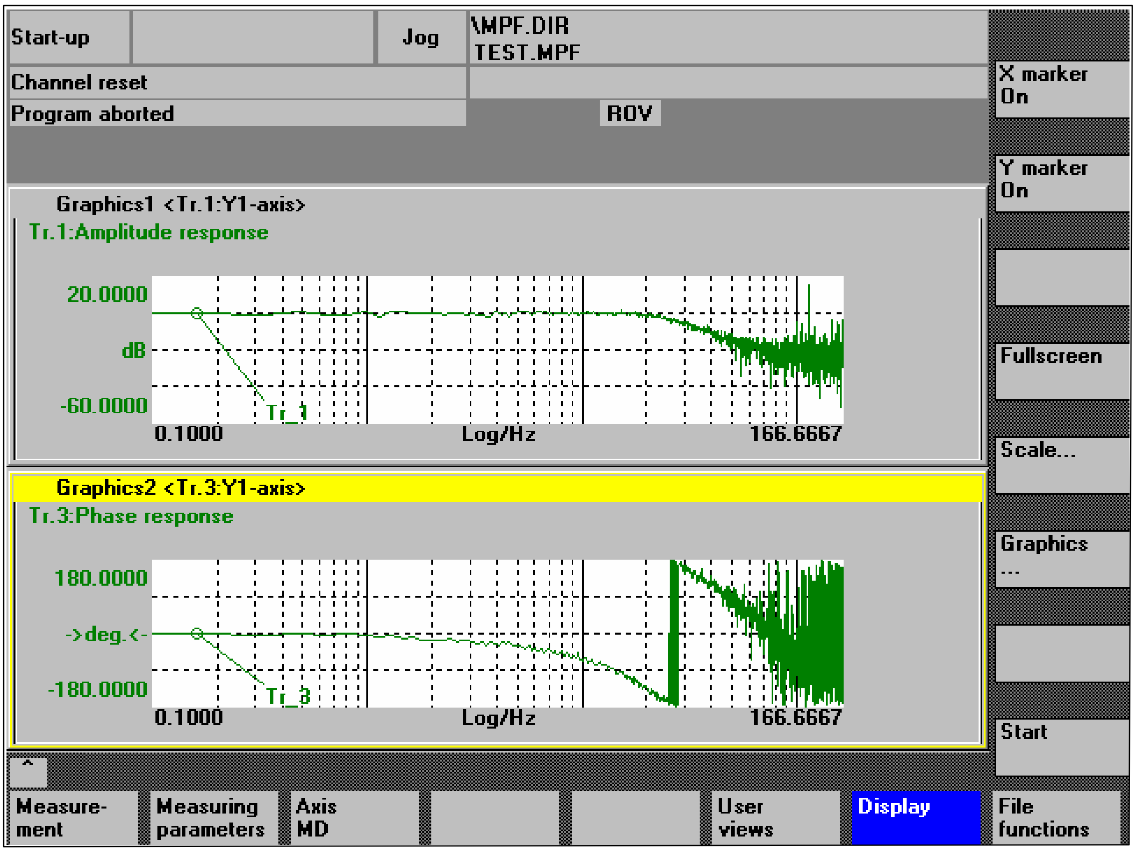


Fig. 13-4 Example: Measurement results of a reference frequency response measurement

Measurement parameters: Reference frequency response

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 ($T_{position\ controller}$).

$$\text{Bandwidth}_{max} \text{ [Hz]} = 1 / (2 * T_{position\ controller} \text{ [sec]})$$

Example: Position controller cycle: 2 ms

$$\text{Bandwidth}_{max} = 1 / (2 * 2*10^{-3}) = 250\text{Hz}$$

Averaging
The accuracy of the measurement, but the measurement duration, too, will 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 parameters: 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.

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. The following quantities can be measured:

– Actual position value (active position measuring system)

– Control deviation (following error)

Amplitude
This parameter 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 duration
In basic setting **Setpoint ramp** the position setpoint is preset according to the set ramp duration. In this case, the acceleration limits which currently apply to the axis or spindle are effective.

A jerk–controlled motion can be set axis–specifically 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.

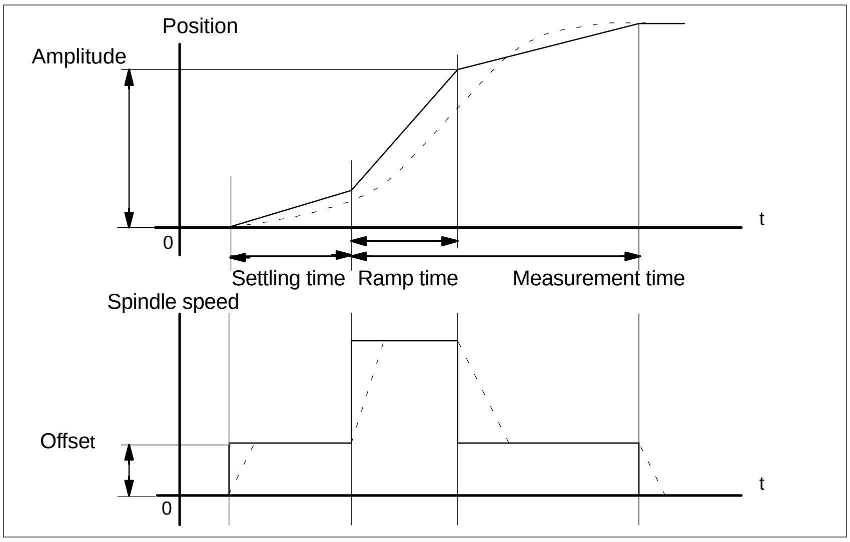


Fig. 13-5 Signal chart for position setpoint/ramp measuring function

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.

Step height

To avoid damage to the machine, the step height for the setpoint step change is limited to the value specified in

- MD 32000 MAX_AX_VELO (maximum axis velocity).

This can prevent the desired step height from being achieved.

Similarly, the following apply to the setpoint ramp in the ramp range:

- MD 32000 MAX_AX_VELO (maximum axis velocity)
- MD 32300 MAX_AX_ACCEL (max. axis acceleration)

The max. axis velocity limits the ramp rate of rise (velocity limitation) whereby the drive does not reach the programmed end position (amplitude).
The acceleration limitation caused by the max. acceleration ”rounds” the transition at the beginning and end of the ramp.

Caution

Changing:

- MD 32000 MAX_AX_VELO (maximum axis velocity).
- MD 32300 MAX_AX_ACCEL (max. axis acceleration)

may only be carried out with utmost care, e.g. by a certain step height. These machine data are exactly matched with the machine!

13.5 Graphic display

Display of measurement results

You can have the measurement results displayed by pressing soft key **Display** in the relevant **main menu** of the measuring function after completion of measurement.

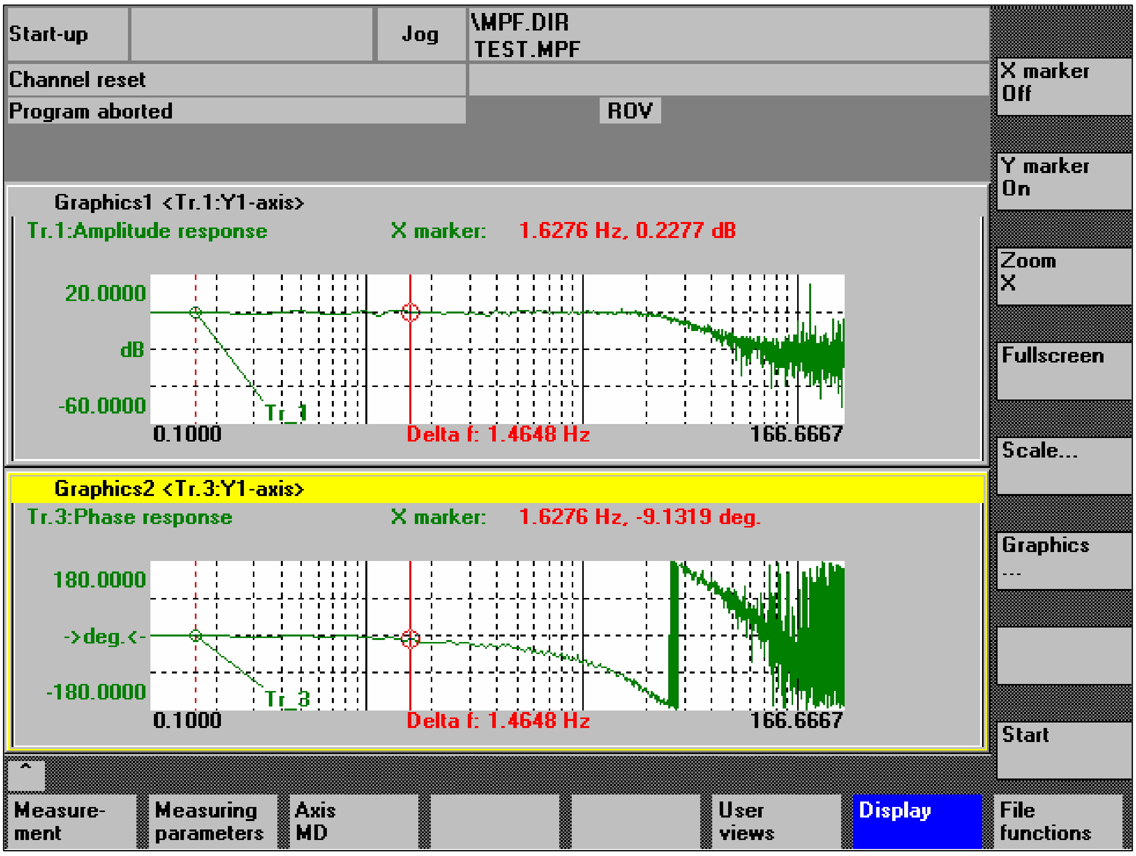


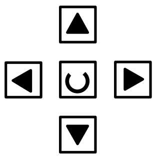
Fig. 13-6 Menu: Display of measurement with marker X = ON

Soft keys:
X marker ON
Y marker ON

When the soft keys **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**

Soft keys: 2nd marker, zoom, fullscreen

If a marker is active, a 2nd line is shown in the diagram via the **2nd marker** soft-key. These two lines define the range that you can then have displayed over the entire display range by pressing soft key **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 soft key **Fullscreen** to switch the display of the diagrams back to their original size.

Note

X and Y markers can be active at a time.

Soft key: Scale

Use the soft key **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.

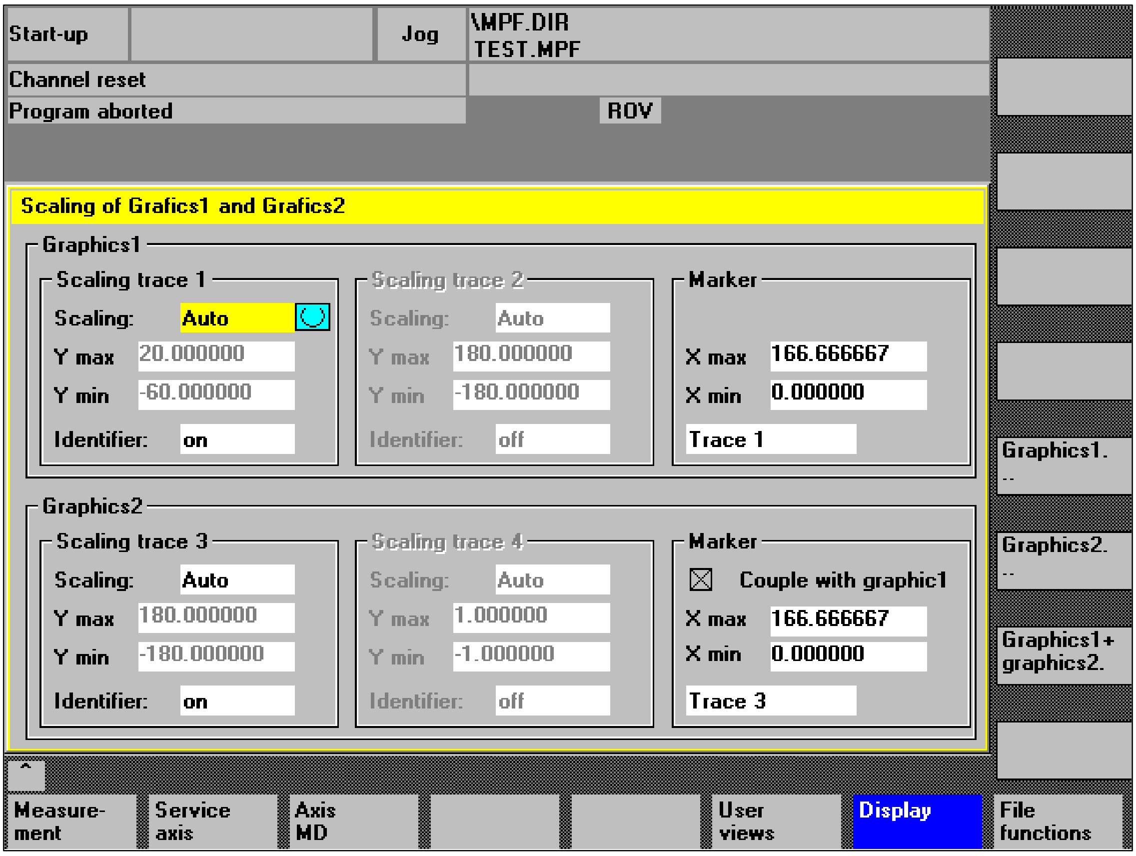


Fig. 13-7 Menu: Scaling of graphics

Soft keys:
Graphics ...

Use the **Graphics ...** soft key shown in Fig. 13-6, Page 13-385 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. 13-7, Page 13-386)

– 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.

13.6 Trace function

13.6.1 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 soft keys 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

13.6.2 Main menu and operation

Basic display Servo trace

You can access the main screen of this trace function using the soft keys **Area switchover > Start–up > Drives/servo > Servo trace**.

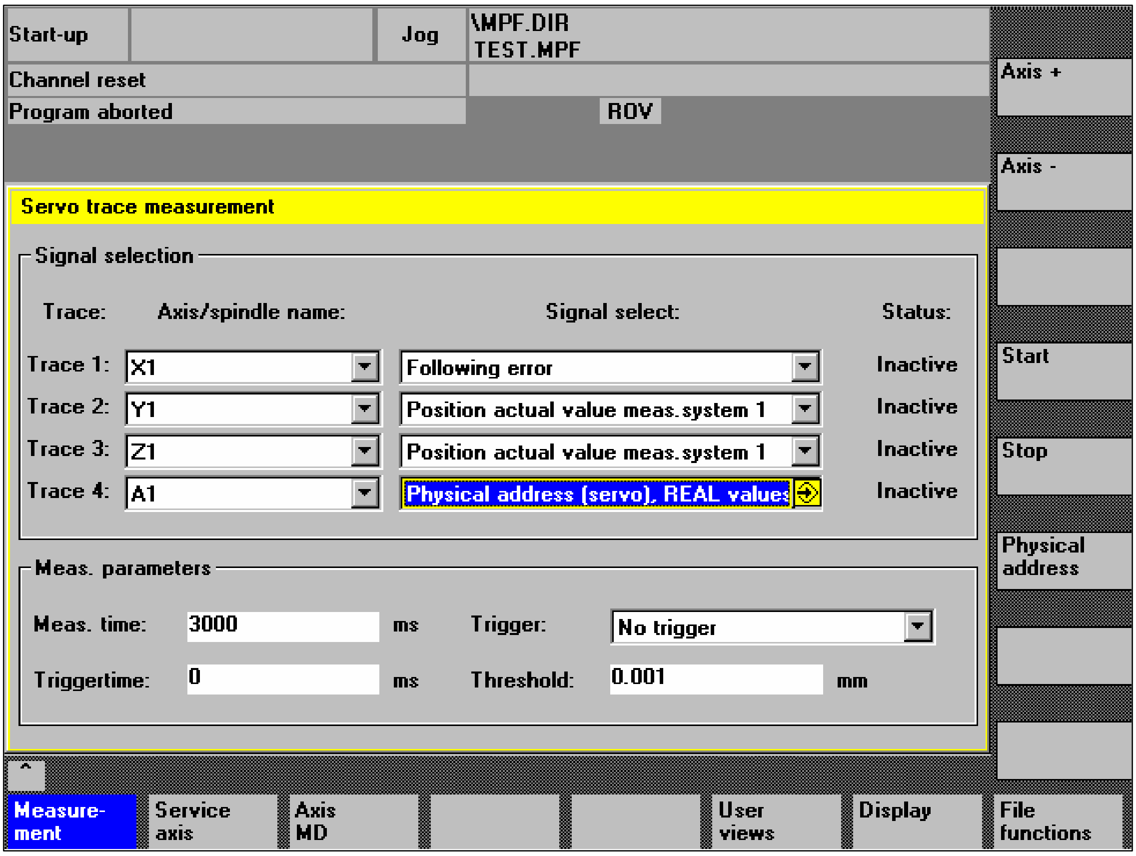


Fig. 13-8 Main menu: Servo trace

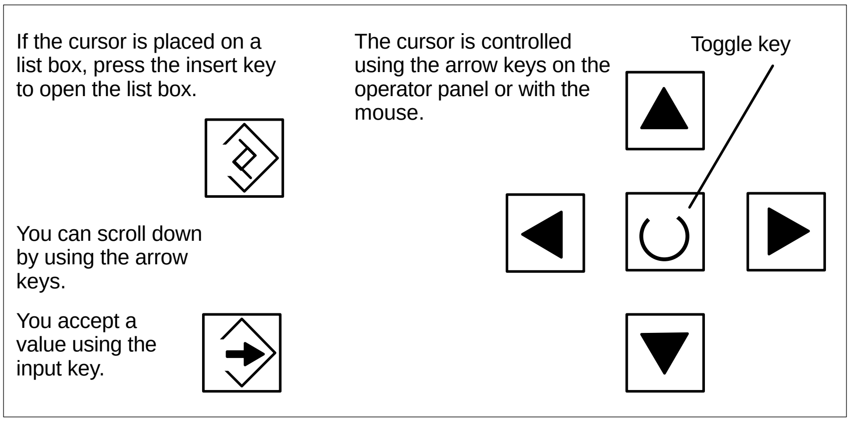


Fig. 13-9 Cursor operation

13.6.3 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 soft keys **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 pre– or post–triggering.
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

The triggering mode is selected from the **Trigger** dropdown list.
The trigger always refers to trace 1. After the trigger condition has been fulfilled, traces 2 to 4 are started simultaneously.

Settable trigger conditions:

- No trigger, i.e. measurement starts when you operate the soft key **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.

Soft key:
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.

Soft key:
Start
Stop

With the **Start** soft key, trace function recording is started.

With the **Stop** or RESET soft key, you can cancel a running measurement.

Soft key:
Physical
Address

Within the framework of the trace function, it is also possible to select data using its physical address.

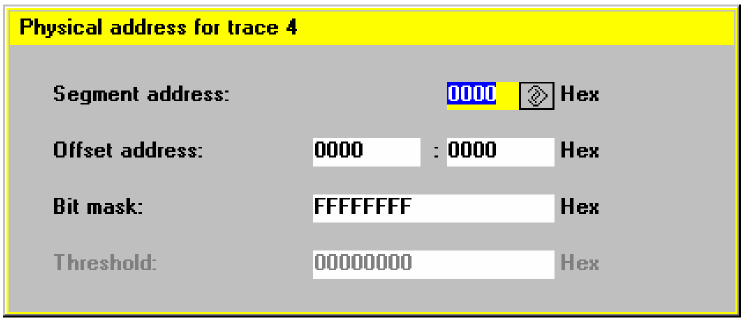


Fig. 13-10 Menu: Physical address for trace x

To do so, proceed as follows:

– Choose the signal type **Physical address** from the desired trace.
– Press the soft key **Physical address.**
– Enter the desired values in the input screen form.
– Press the soft keys **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

  - 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** soft key, this hex value is then entered in the field **Threshold** of the main screen of the trace function.

13.6.4 Performing the measurement

Soft key:
Start

After parameterization has been completed, you then enable measurement by pressing soft key **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.

With the end of the measurement, the graphics are prepared automatically. Use the Display soft key to call the display functions of the graphics (see next Section).

Soft key:
Stop

With the Stop soft key, you can cancel a running measurement at any time.
A canceled measurement cannot be displayed.

13.6.5 Display function

If you press the **Display** soft key 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.

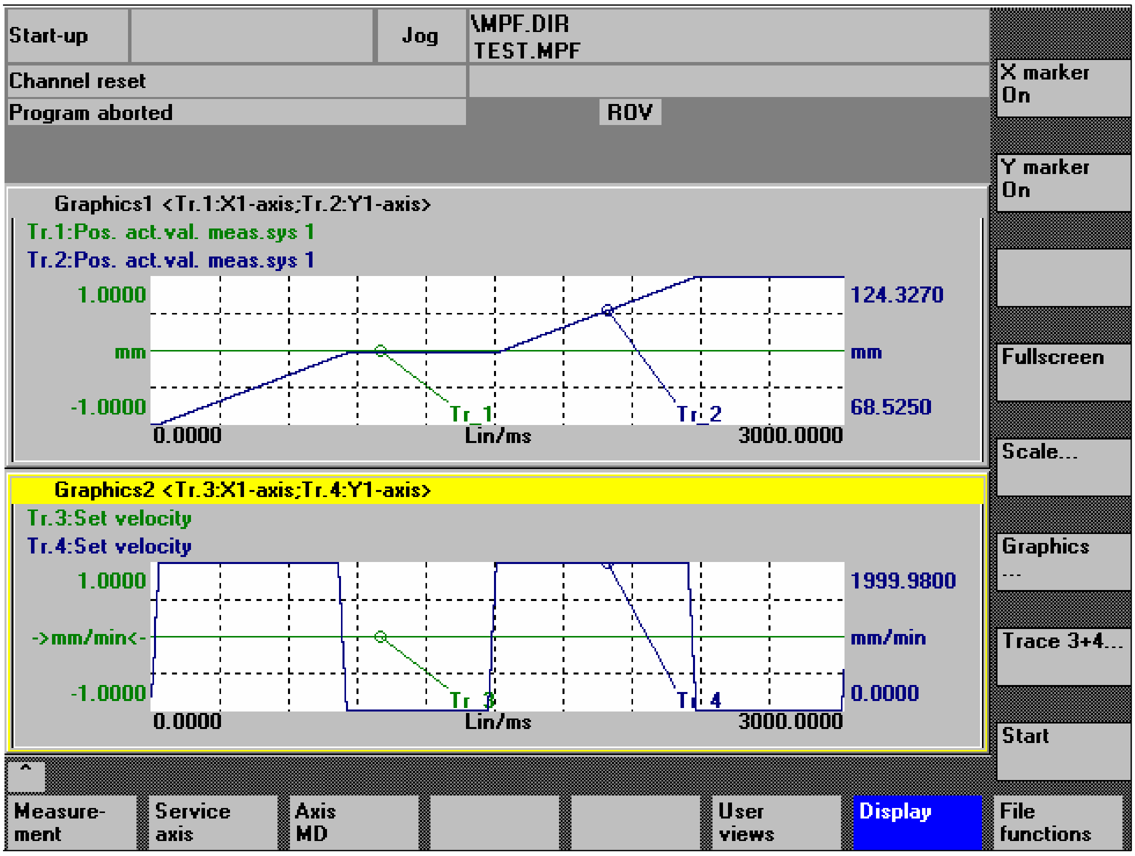


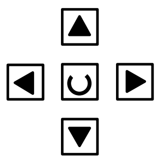
Fig. 13-11 Measurement results: Trace function

Soft keys:
X marker ON
Y marker ON

When the soft keys **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**

Soft keys: 2nd marker, zoom, fullscreen

If a marker is active, a 2nd line is shown in the diagram via the **2nd marker** soft-key. These two lines define the range that you can then have displayed over the entire display range by pressing soft key **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 soft key **Fullscreen** to switch the display of the diagrams back to their original size.

Note

X and Y markers can be active at a time.

Soft key: Scale

Use the soft key **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.

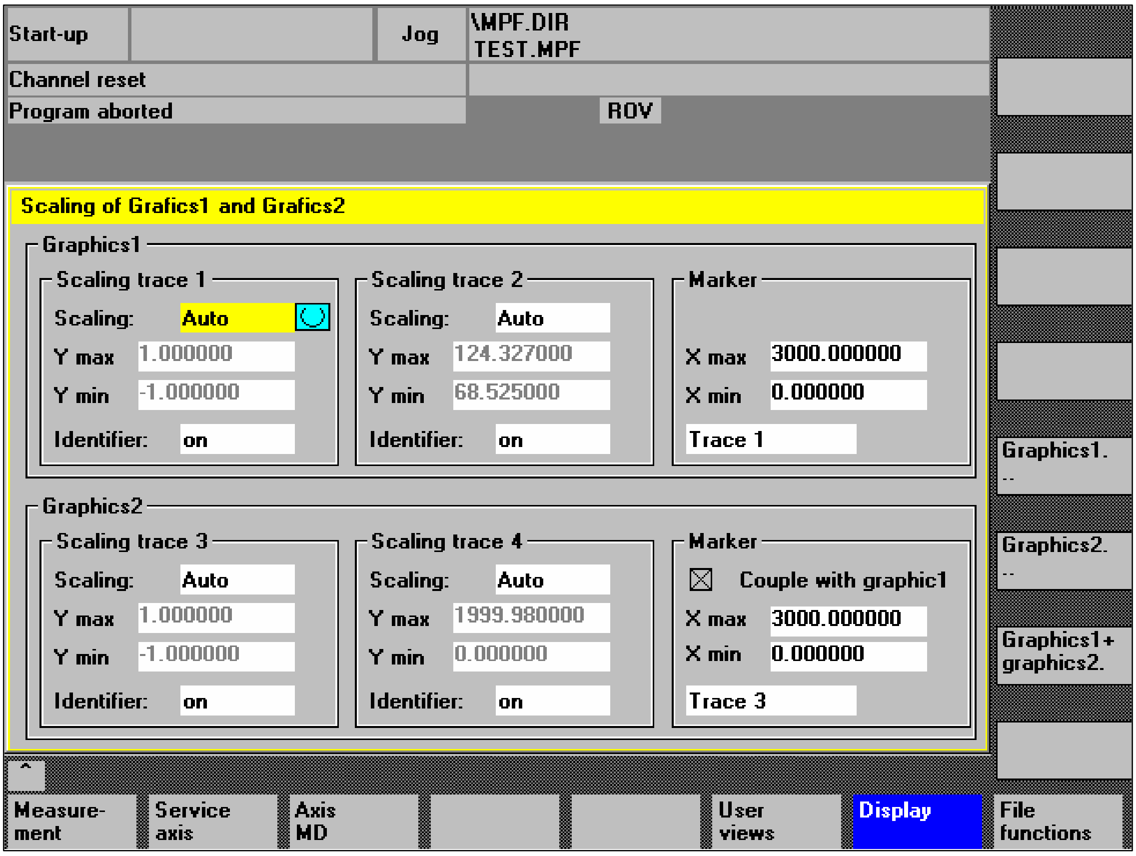


Fig. 13-12 Menu: Scaling of graphics

Soft keys:
Graphics ...

Use the **Graphics ...** soft key shown in Fig. 13-11, Page 13-393 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. 13-12, Page 13-394)

– 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.

13.7 File function

Description

Use the **File functions** soft key to call the appropriate screen form.

This is where the parameters set for the measurements, axis–specific machine data, and measurement results are stored, loaded, and deleted.

The file functions are not intended as a replacement for a complete copy of the system and user data, e.g. for archiving or series machine start–up, but only for the simplified and flexible management of the specific measurement data.

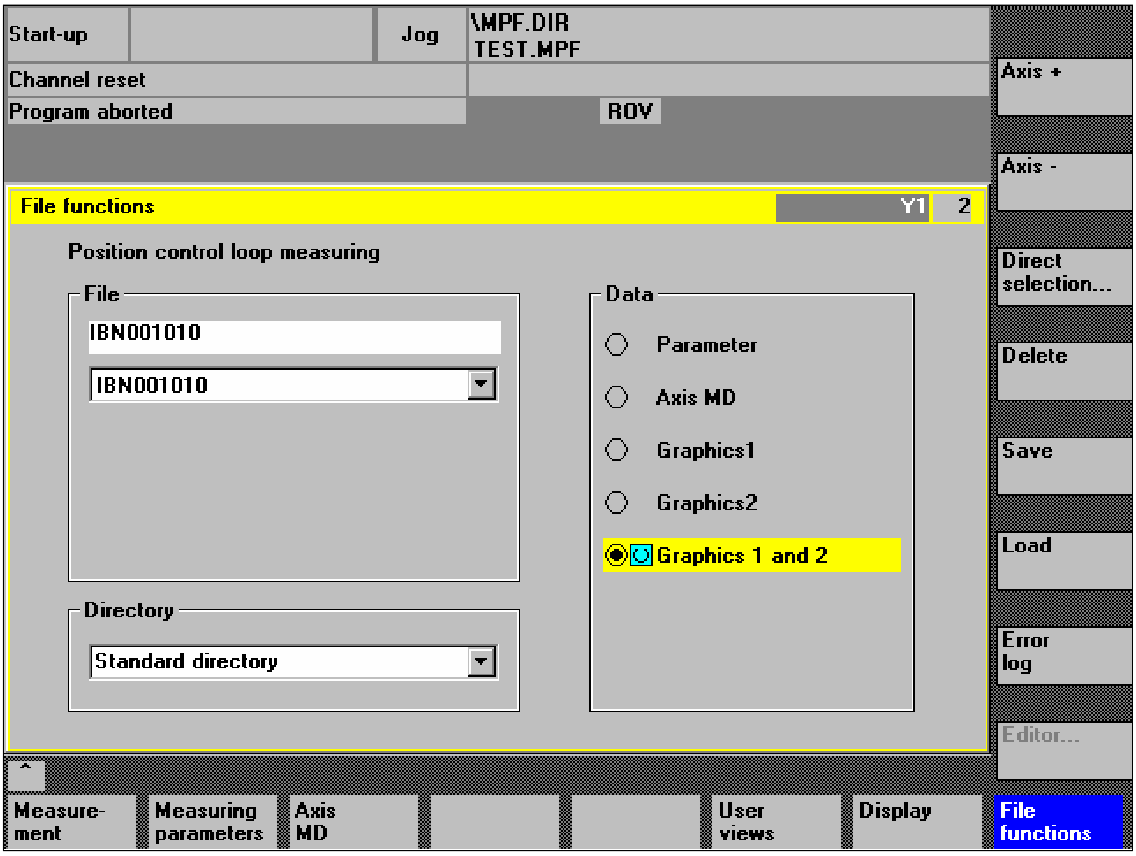


Fig. 13-13 Menu: File functions

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.

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

13.8 Print graphic

Printer selection

The soft key **Graphics** in the main screens of the measuring functions opens the menu to select the printer and to print the graphics.

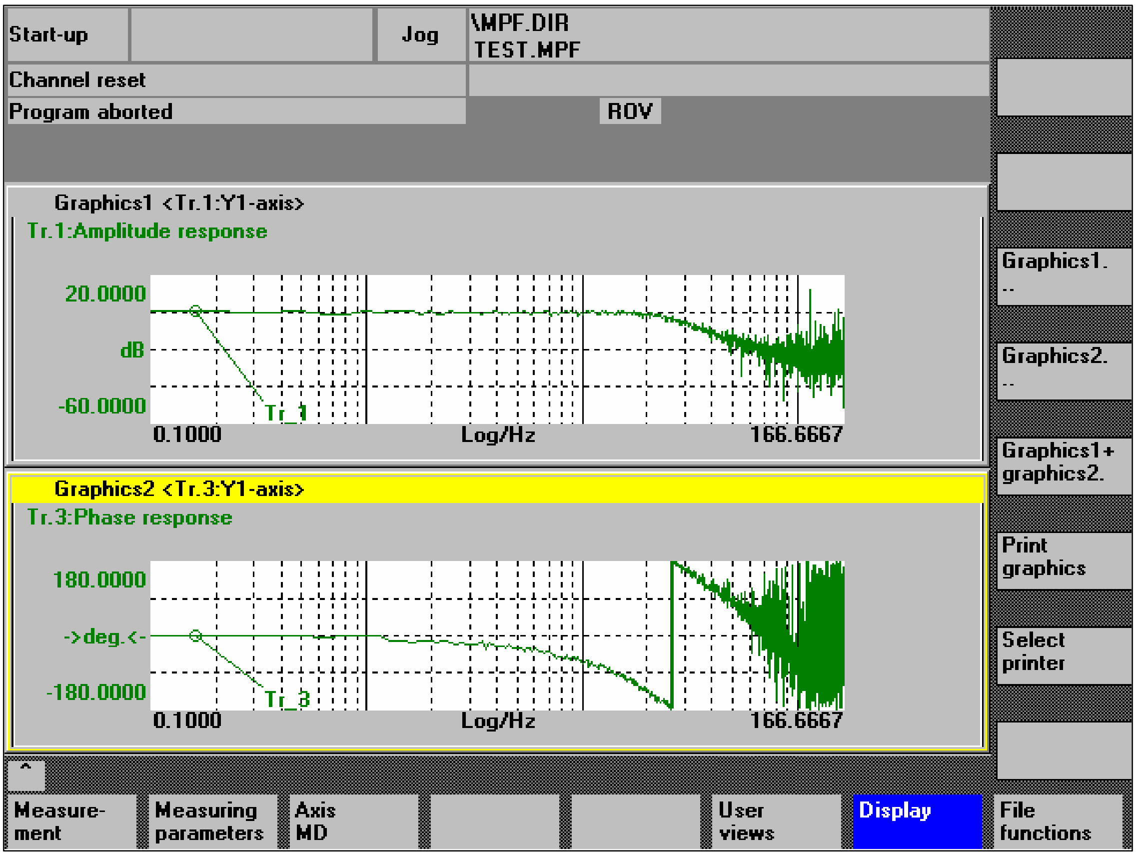


Fig. 13-14 Graphics soft keys

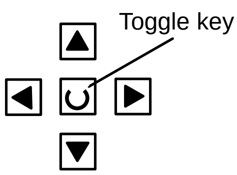
Soft key: Printer selection

Use the soft key **Printer selection** to open the appropriate menu, Fig. 13-15, Page 13-399.

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



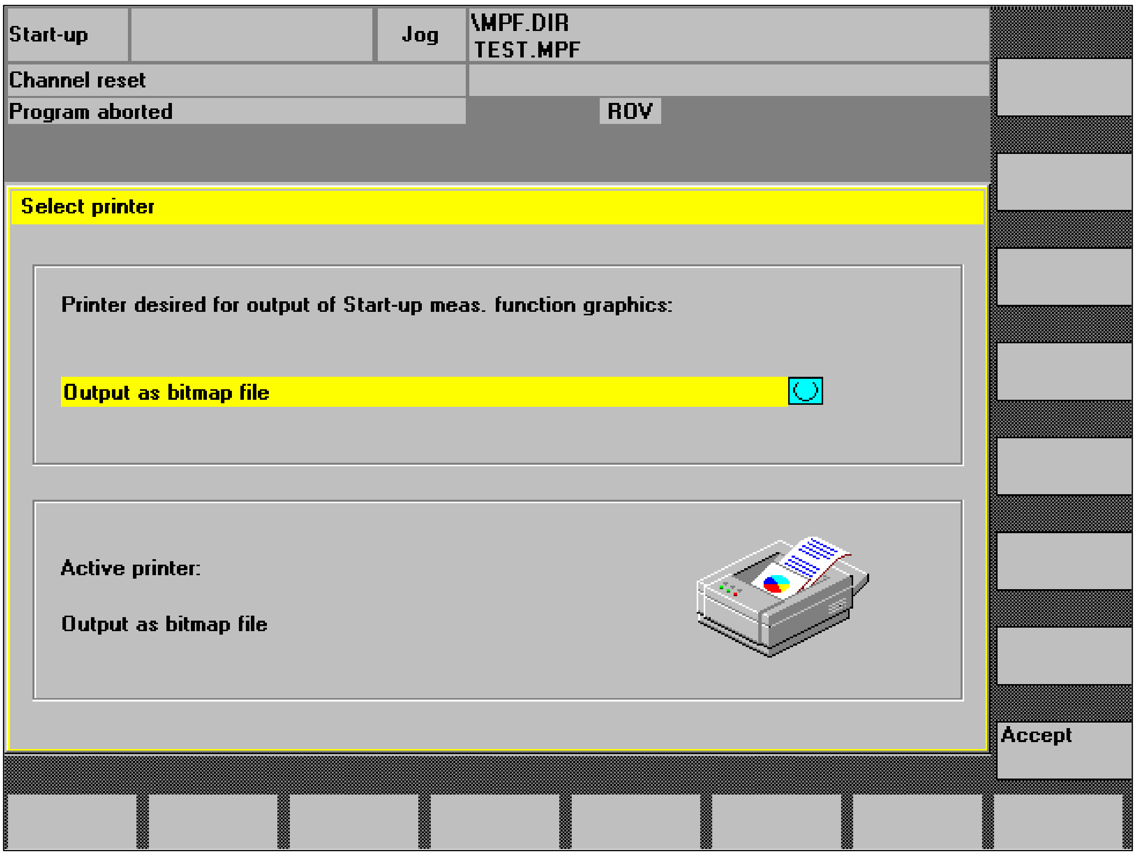


Fig. 13-15 Menu: Printer selection

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 to bitmap file**
- Press the soft key **Print graphics**
- Enter the required file name.
  You can enter a new file name or choose an existing file from the drop–down list.

Soft key: Print graphic

Use the soft key **Print graphics** Fig. 13-14, Page 13-398 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 the graphics to be output to a bitmap file, the following specifications are still required in the submenu "File name for bitmap printout":

– File names

– Directory

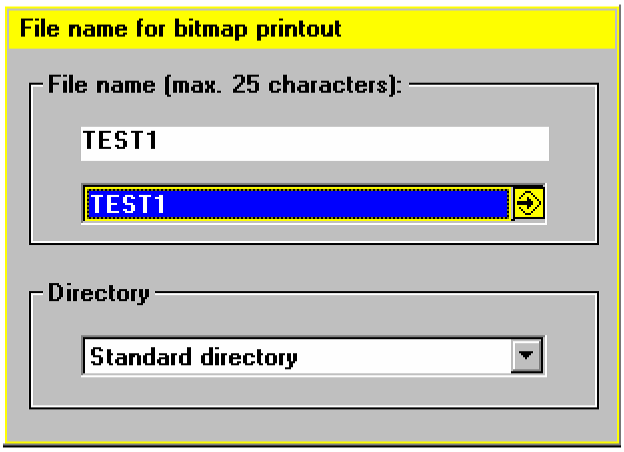


Fig. 13-16 Menu: File name for bitmap printing

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 soft key **OK**.
- With the soft key **Cancel** you can return to the current graphic display.

13.9 Automatic controller setting

An automatic controller adjustment with HMI Advanced is not possible within the framework of SINUMERIK 840Di.

SIMODRIVE 611 universal

For a description how to carry out an automatic controller adjustment of SIMODRIVE 611 universal drives, please refer to:

References: /FBU/ Description of FunctionsSIMODRIVE 611 universal
Section: Description of Functions
Optimization of the Current and Speed Controller

■

Notes

User Data Backup/Series Machine Start-Up 14

14.1 Explanations on data backup

User data

User data are called all data or data areas that can be entered by the user to achieve the specific functionality of the SINUMERIK 840Di or the connected SIMODRIVE drives.

In the case of a data backup, e.g. after start–up of the control system, the user data selected through the user interface are written to a so–called series machine start–up file.

After a series machine start–up 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 start–up

– After changing machine–specific settings

– After service, e.g. after replacment 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

Data back–up is performed with one of the applications:

- HMI Advanced (option).
- SinuCom NC

For the components of a SINUMERIK 840Di:

– NC

– PLC

– HMI

– SIMODRIVE PROFIBUS drives

data back–up can be performed separately for each component or jointly.

For detailed information on data backup, please refer to:

References: **SinuCom NC**:
Online Help

HMI Advanced:
/BAI/ Operator's Guide HMI Advanced

14.2 Creating a series commissioning file

14.2.1 General

Note

Because of its file extension ”.arc”, the series machine start–up file is also called archive.

Archive content

The following components can be selected as the content of a series commissioning file:

- NC 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 machine start–up 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 machine start–up file is to be reloaded into the same control system (backup).

NC

The contents of a series machine start–up file created for the NC 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
- R parameters
- Work offsets
- Compensation data
- Display machine data
- Workpieces, global part programs and subroutines
- Standard and user cycles
- Definitions and macros

PLC

The contents of a series machine start–up 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 machine start–up 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.

14.2.2 HMI Advanced (option)

The creation of a series machine start–up file with HMI Advanced is divided into the following steps:

1. Open the menu to create a series machine start–up file:
   Operating area switchover > Services > ETC key ”>” > Series machine start–up > Create start–up archive
2. Selection of components to be backed up (see figure: archive content)
3. Assignment of a filename (see figure: archive name)
4. Create the series machine start–up file by selecting the device to which you wish the file to be output (see figure):
   – RS–232–C (parameterizable COM1 or COM2)
     Output to a device connected to the serial interface.
   – PG (parameterizable COM1 or COM2)
     Output to a programming device (e.g. PG740) or PC.
   – Diskette
     Output to diskette drive that can optionally be connected to the 840Di.
   – Archive
     Storeage of the file in the archive directory on the hard disk of the PCU.

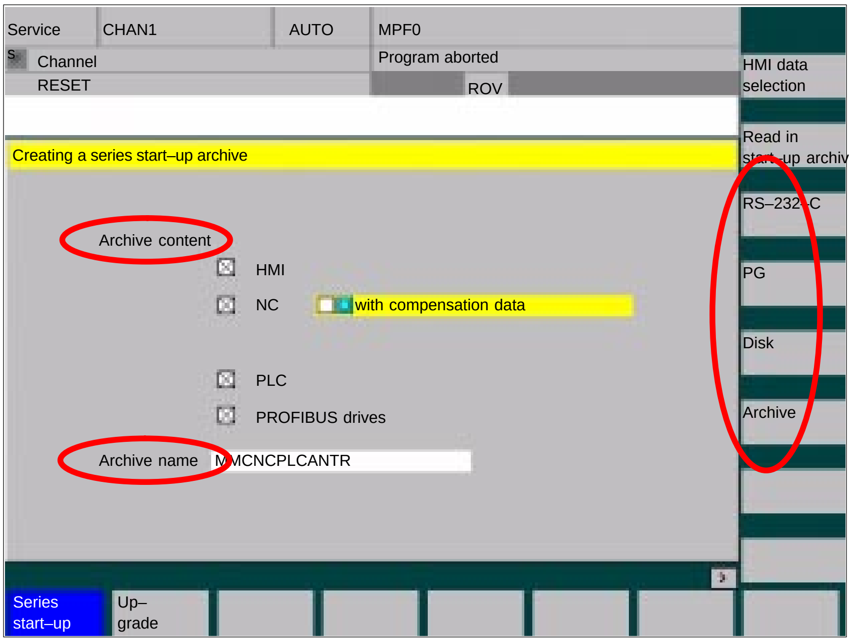


Fig. 14-1 Menu: Creating a series start–up archive

14.2.3 SinuCom NC

Starting

SinuCom NC can be started as follows to create a series start–up file:

- SINUMERIK Desktop (see Section 5.4, Page 5-114)
  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 start–up file with SinuCom NC is subdivided into the following steps (see Fig. 14-2 below):

1. Starting SinuCom NC
2. Selecting the storage location
3. Selecting the components to back up (archive content)
4. Continuing ("Next >")

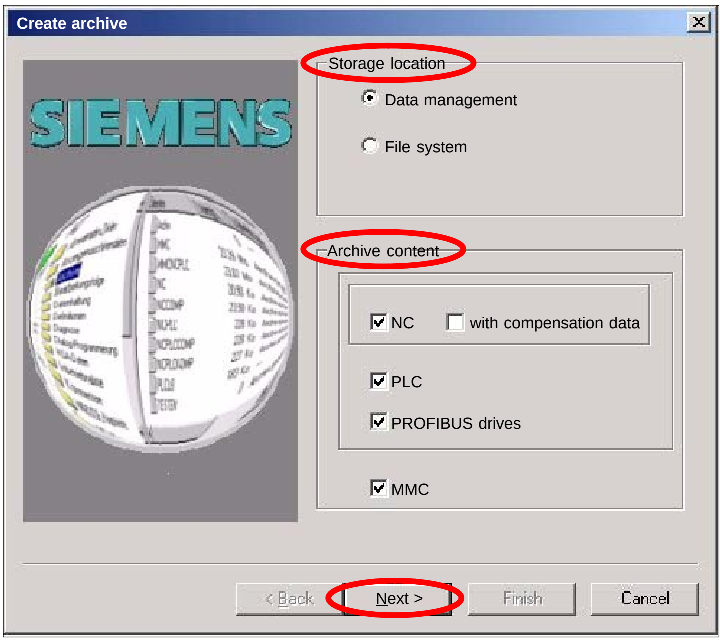


Fig. 14-2 Menu: Creating a series start–up archive

5. The following data can be selected in the following menus, depending on the selected components:
   – NC: part programs
   – MMC: MMC archives
6. Creating the series start–up file ("Finish")

14.3 Considerations when saving PLC data

When creating a series machine start–up 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 machine start–up 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 machine start–up 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 machine start–up file with PLC data while the PLC is in the RUN status (cyclic operation) may result in an inconsistent PLC image in the series machine start–up archive.

After this series machine start–up file has been copied back, this data inconsistency in the PLC user program may under certain circumstances result in the stop of the PLC.

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 Startup**.
  - Open the dialog box: Menu command **Fenster > Diagnosis > NC/PLC**.
- With HMI Advanced (840Di SW 2.2 and higher and HMI Advanced SW 6.2 and higher)
  - Open the dialog box: **Operating area switchover > Start–up > NC/PLC Diagnosis**
- Change the PLC operating state: Group box PLC, buttons: "**STOP**" and "**RUN**".
- NC and PLC must then be resynchronized: Group box PLC, buttons: "**NC Reset**".

14.4 Reading in a series machine start–up file with HMI Advanced

Reading in a series machine start–up file is divided into the following steps:

1. Open the menu to read in a series machine start–up file:
   Operating area switchover > Services > key: ">" > Series machine start–up > Read in start–up archive
2. Select the series machine start–up file
3. Start read in: **Start**

Note

Because of the file extension ".arc" of the series machine start–up files, this is also called archive.

■

Notes

Software Installation/Update and Data Backup 15

15.1 PTP network link (Windows)

Brief description

The functions described in this section (software installation/update) require a network link with an external computer (PG/PC) on which a directory is shared for network access.

If the SINUMERIK 840Di is not part of a larger network (WAN, LAN), a simple PTP (peer–to–peer) link via Ethernet and TCP/IP can be established for service applications.

15.1.1 Network link

For the network link, the PCU 50 is connected with the external computer directly via a crossed Ethernet cable (twisted pair crossed 10baseT/100baseTX ethernet cable).

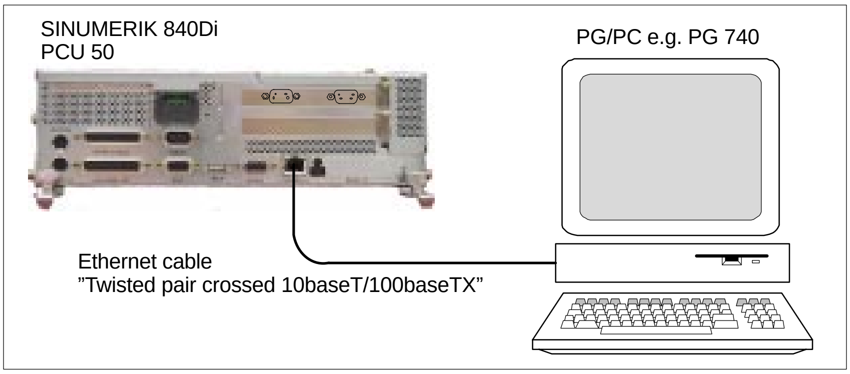


Fig. 15-1 PTP link: PCU 50 – external computer (PG/PC)

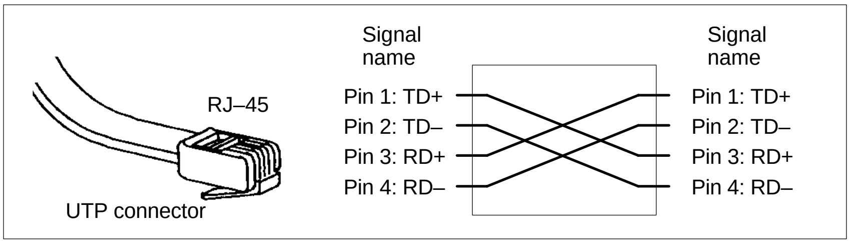


Fig. 15-2 Crossed Ethernet cable (twisted pair crossed 10baseT/100baseTX)

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 preconfigured both in the PCU basic software and in the service menu.

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 with the PCU via 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.

15.1.2 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

Via the network dialog box of the Control Panel (Windows taskbar: **Start > Settings > Control Panel >> Network**), the installed network protocols are shown on the ”Protocols” tab card. 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

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 card: Identification
Button: ”Change...”
Dialog box: Identification change
Computer name: <***COMPUTER NAME***>
◉ Workgroup: <***WORKGROUP***>
OK

Server service

The ”Server service” must be run on the ”Services” tab card. 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 card: Services
Button: ”Add...”
Dialog box: Network service selection
Network service: **Server service**
OK
OK

Directory sharing

Sharing for network access is effected in the properties dialog box > ”Share” tab card of the directory in question (directory selected with the right mouse button)

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

15.1.3 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

The installed network protocols can be viewed on the ”General” tab card of the properties dialog box for the local area connections (Windows taskbar: **Start > Settings > Network Connections >> Local Area Connections**).

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. This requires that the function: ”Automatic Private IP Addressing” be active.

The function of the properties dialog box of the protocol: TCP/IP is activated (the 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

Service: ”File and Printer Sharing”

The installed services can be viewed on the ”General” tab card of the properties dialog box for the local area connections (Windows taskbar: **Start > Settings > Network Connections >> Local Area Connections**).

The ”File and Printer Sharing for Microsoft Networks” service 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 directory sharing, the ”Simple File Sharing” option should be activated under menu item: Tools > Folder Options in the Windows Explorer.

Dialog box

Dialog box: Folder Options
Tab card: View
☑ **Use simple file sharing (Recommended)**
OK

Directory sharing

Sharing for network access is set in the properties dialog box > tab card: ”Sharing” of the directory in question (directory selected with the right mouse button)

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

15.1.4 Configuring PCU (Windows XP)

The basic PCU software is preconfigured for a PTP network link via the TCP/IP protocol. 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 Subsection 15.1.3, Page 15-414.

15.2 PTP network link (service menu/DOS)

Brief description

Some of the functions described in this section (data back–up) require a network link with an external computer (PG/PC) on which a directory is shared for network access.

If the SINUMERIK 840Di is not part of a larger network (LAN, WAN), a simple PTP (peer–to–peer) link via Ethernet and TCP/IP can be established for service applications.

Note

A network link to the PCU already configured under Windows cannot be used for the service menu under DOS. For the service menu under DOS, a new network link has to be configured.

15.2.1 Network link

For the network link of the external computer, refer to Subsection 15.1.1, Page 15-411.

15.2.2 Configuring the external computer (Windows NT)

For the configuration of the external computer, refer to Subsection 15.1.2, Page 15-412.

15.2.3 Configuring the external computer (Windows XP)

For the configuration of the external computer, refer to Subsection 15.1.3, Page 15-414.

15.2.4 Configuring the PCU (DOS / Service menu)

For data back–up a network link with an external computer must be configured in the service menu under DOS. The basic PCU software is preconfigured for a PTP network link via the TCP/IP protocol. If changes have been made or a network link cannot be established, the following settings must be checked:

- Machine name (computer name)
- Workgroup
- TCP/IP protocol
- TCP/IP parameter (IP address, subnet mask, etc.)

Service menu

After the PCU has been switched on, the menu of the boot manager is displayed. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The main service menu is displayed after PCU start–up. Select one after the other from the main menu:

– Key ”**7**”: **Backup/Restore**
– Key ”**1**”: **Harddisk Backup/Restore with Ghost**
– Key ”**1**”: **Configure Ghost Parameters**
– Key ”**6**”: **Manage Network Drives**
– Key ”**4**”: **Change Network Settings**

The following menu appears:

```
CURRENT NETWORK SETTINGS
    Machine Name          : <COMPUTER_NAME>
    User Name             : auduser
    Transport Protocol    : TCP/IP
    Logon to Domain       : No

           PLEASE SELECT
              1   Change Machine Name (for DOS–Net only)
              2   Change User Name
              3   Toggle Protocol (NetBEUI / TCP/IP)
              4   Toggle logon to Domain (Yes or No)
           [  5   Change Domain Name ] displayed only when 4 = Yes
           [  6   Change TCP/IP Settings ] displayed only when 3 = TCP/IP

              9   Back to previous menu

           Your Choice [1,2,3,4,5,7,8,9,P] ?
```

Machine name (computer name)

The current computer name is displayed under CURRENT NETWORK SETTINGS: Machine Name. The default name is: ”PCUXXXXXXX”. You can change the computer name under **Change Machine Name** with key ”**1**”. You can choose any computer name.

User name

The current user name is displayed under CURRENT NETWORK SETTINGS: User Name. The default name is: ”auduser”. You can change the logon name under **Change User Name** with key ”**2**”.

Because a PTP link does not use a domain server, which would process the password query automatically in the background, the user (login name) must be set up as the local user on the external computer.

Workgroup

The workgroup of the PCU is permanently set to Windows default: WORKGROUP and cannot be changed. The workgroup name of the PCU and the external computer must be identical.

Domain

Logon of the PCU in a domain is deactivated by default. Shown under CURRENT NETWORK SETTINGS: Logon to domain = No.

If the current computer name is displayed under CURRENT NETWORK SETTINGS: Logon to domain = Yes, connection with the domain must be deactivated with ”**Toggle logon to domain**” with key ”**4**”.

Protocol: TCP/IP

Protocol: TCP/IP is set by default. If NetBEUI is displayed, you must switch to TCP/IP under **Toggle Protocol (NetBEUI / TCP/IP)** and key ”**3**”.

Note

If a network link already existed with the displayed protocol the alternative protocol is not activated until the next time the PCU is started up (restart).

Setting the TCP/IP parameters

To set or check the TCP/IP parameters select **Change TCP/IP Settings** with key ”**6**”.

The following menu appears:

```
PLEASE SELECT
      1   Toggle ”Get IP Adress” (automatically or manually)
      2   Change IP Address
      3   Change Subnetmask
      4   Change Gateway
[     5   Domain Name Server
[     6   Change DNS Extension

      9   Back to previous menu

Your Choice [1,2,3,4,5,7,8,9] ?
```

IP address

The IP address for the PCU is assigned manually. Via **Toggle ”Get IP Address”**, it is therefore necessary to set ”manually” with key ”**1**”.

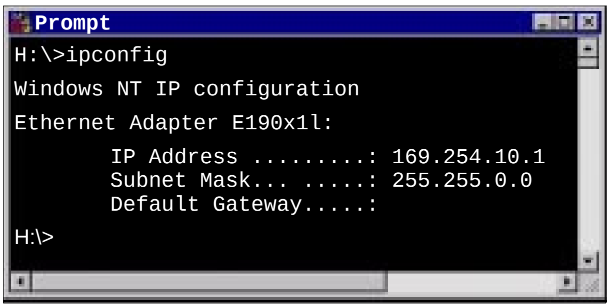
The following TCP/IP parameters must be set:

- **IP address**

  Select **Change IP Address** with key ”**2**”.

  The IP address of the PCU must be in the same subnet as the IP address of the external computer.

  Open a DOS prompt on the external computer to ascertain its IP address and the subnet mask. Command: ”ipconfig” shows the parameters in question:



Note

”ipconfig /all” shows all parameters of the IP configuration and the Ethernet adapter.

Restrictions

The IP address of the PCU must be different from that of the external computer, but must be in the same subnet. The IP address of the PCU must differ by at least one digit that is 0 in the subnet mask and all digits that are not 0 must be identical.

Example

External computer
IP address: `169.254.`**`10.1`**
Subnet mask: `255.255.` **`0.0`**

PCU
IP address: `169.254.`**`10.2`**

Syntax

In the service menu the IP address of the PCU must be entered with a blank used as the tuple separator.

Example

IP address: `169 254 10 2`

- **Subnet mask**

  Select **Change Subnetmask** with key ”**3**”.

  Enter the subnet mask of the external computer determined via command ”ipconfig” for the PCU, too.
  For information on syntax see above: IP address.

- **Gateway**

  No gateway must be specified for a PTP network link.

- **Domain name server**

  No domain name server must be specified for a PTP network link.

- **DNS extension**

  No DNS extension must be specified for a PTP network link.

This completes configuration of the PTP network link.

Confirm the query whether you want to store the network parameters when you exit the menu with key ”**Y**” (the settings are stored).

15.2.5 Show connected network drives

Service menu

After the PCU has been switched on, the menu of the boot manager is displayed. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The main service menu is displayed after PCU start–up. Select one after the other from the main menu:

- Key ”**1**”: **Install/update SINUMERIK system**
  - Key ”**3**”: **Install from Network Drive**
    - Key ”**1**”: **Manage Network Drives**

Or

- Key ”**7**”: **Backup/Restore**
  - Key ”**1**”: **Harddisk Backup/Restore with Ghost**
    - Key ”**1**”: **Configure Ghost Parameters**
      - Key ”**6**”: **Manage Network Drives**

The following menu appears:

```
PLEASE SELECT:
    1   Connect to Network Drive
    2   Show connected Network Drives
    3   Disconnect from all Network Drives

    9   Back to previous Menu

Your Choice [1,2,3,9] ?
```

Choose **Show Connected Network Drives** using the key ”**2**”.

Following menu:

Status	**Local Name**	**Remote Name**
OK	<*Drive*>:	\\<*Sharing name*>

All currently connected drives are displayed.

15.2.6 Disconnecting from network drives

Service menu

After the PCU has been turned on, the menu of the boot manager is displayed. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The main service menu is displayed after PCU start–up. Select one after the other from the main menu:

– Key ”**1**”: **Install/update SINUMERIK system**

– Key ”**3**”: **Install from Network Drive**

– Key ”**1**”: **Manage Network Drives**

Or

– Key ”**7**”: **Backup/Restore**

– Key ”**1**”: **Harddisk Backup/Restore with Ghost**

– Key ”**1**”: **Configure Ghost Parameters**

– Key ”**6**”: **Manage Network Drives**

The following menu appears:

```
PLEASE SELECT:
    1   Connect to Network Drive
    2   Show connected Network Drives
    3   Disconnect from all Network Drives

    9   Back to previous Menu

Your Choice [1,2,3,9] ?
```

Choose **Disconnect form all Network Drives** using the key ”**3**”.

Following menu:

```
Connected Network Drives (last):          –none–
```

All network drives have been disconnected.

15.2.7 Restoring partition E: (Windows) from the emergency image file

Brief description

This subsection describes how to restore the operating system partition E: from an emergency image file.

You may have to restore the operating system partition. This may be necessary if Windows is no longer bootable, or if the realtime properties of the SINUMERIK 840Di are no longer ensured because subsequently installed unsuitable software can no longer be uninstalled.

Preconditions

The following conditions must be fulfilled:

- An image file must be present locally on the hard disk of the PCU under D:\IMAGES (see Subsection 15.5.4, Page 15-436).
- An image file must have been seelcted as the emergency image file (see Subsection 15.5.9, Page 15-443).

Service menu

After the PCU has been switched on, the menu of the boot manager is displayed. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The following menu appears:

```
PLEASE SELECT
    1   Install/Update SINUMERIK System
    2   SINUMERIK Tools and Options
    3   DOS Shell
    4   Start Windows XP (Service Mode)
    5   SINUMERIK System Check
    7   Backup/Restore
    8   Start PC Link

    9   Reboot

    E   Restore Windows Partition E (Emergency)
    P   840Di Services

Your Choice [1,2,3,4,5,7,8,9,E,P] ?
```

Choose **Restore Windows Partition E (Emergency)** using key ”**E**”.

The system prompts you to enter a password: You require a password for protection level 0 –3:

- System
- Manufacturer
- Service
- Customer

For safety reasons, the following warning is shown before the partition is overwritten:

Caution: Partition E: will be overwritten!

After you have acknowledged this, partition E: will be restored from the emergency image file.

On next start–up of the PCU under Windows, partition E: is checked by the CHKDISK diagnostic program.

After completion of the check, the system with the restored backup copy is active.

15.3 Partitioning of the PCU harddisk

The PCU harddisk is divided into 4 partitions (3 primary partitions and an extended partition). For reasons of data security, the SINUMERIK 840Di system software, the Windows system software and the Service software are installed in different partitions.

Partitions

The diagram below shows the partitioning of the harddisk when the control system is supplied:

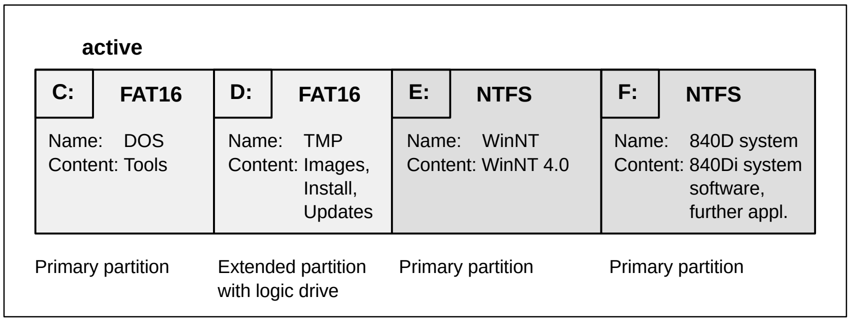


Fig. 15-3 Partitioning of the harddisk

1st partition / drive C:

Drive C: contains MS DOS 6.2, tools (e.g. Norton Ghost™) and scripts implemented by the service menu.

2nd partition / drive D:

Drive D: contains:

– The **Images** directory with the images preinstalled and created by the user.

– The **Install** directory into which the software to be installed is to be copied first before the installation process itself is carried out under Windows XP.

– The **Update** directory for later 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 Windows XP applications, e.g. the SINUMERIK 840Di system software.

Further applications, such as HMI system software, HMI–OEM applications, SIMATIC Manager STEP7 or customer–specific applications (e.g. user interfaces created using Protocol/Pro MC), will also be installed here.

15.4 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 operation is performed via the SINUMERIK desktop (Windows user interface) of the SINUMERIK 840Di. The SINUMERIK desktop is activated from the service menu. See Subsection 5.5.4, Page 5-122.

Using the applications

- **Windows 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's 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 software version in the Internet:

www.siemens.de/sinumerik> SINUMERIK 840Di > Link Box > Support > Update > Tab card: Update > SINUMERIK 840Di: 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).

Preconditions

The following condition must be fulfilled:

- Network link with an external computer. See Section 15.1, Page 15-411.

Recommended procedure:

This is the recommended procedure for installing/updating software on the PCU:

1. Back up the NC and PLC user data by creating a series machine start–up file. See Chapter 14, Page 14-403f.
2. Establish a network link to a shared directory of an external computer (PG/PC) containing the software to be installed. See Section 15.1, Page 15-411.
3. Perform installation/updating of the software via the network link.
4. Initialize the control with "Delete NC data" and "PLC memory reset". See Subsection 6.2.1, Page 6-137.
5. Import the series machine start–up file created in Step 1. See Section 14.4, Page 14-409.

Note

For historical reasons, it is still possible to install/update software via the service menu. However, it is not recommended.

15.5 Data back–up (DOS/service menu)

15.5.1 Backing up the hard disk contents in an image file

Brief description

This subsection describes backing up the contents of the hard disk of the PCU by means of a hard disk image. The image file is transferred to a shared directory on an external computer (PC/PG) via a DOS–based network link.

The entire operation is performed via the service menu (DOS user interface) of the SINUMERIK 840Di.

Preconditions

The following condition must be fulfilled:

- Network link with an external computer. See Section 15.1, Page 15-411.
- There is sufficient free space in the shared directory.

Notice

Before transferring hard disk back–up (image file), make sure there is enough free space on the drive of the external computer (PC/PG).

Operator actions

After the PCU has been switched on, the menu of the boot manager is displayed.

1. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The following menu appears:

```
PLEASE SELECT
     1   Install/Update SINUMERIK System
     2   SINUMERIK Tools and Options
     3   DOS Shell
     4   Start Windows XP (Service Mode)
     5   SINUMERIK System Check
     7   Backup/Restore
     8   Start PC Link

     9   Reboot

     E   Restore Windows Partition E (Emergency)
     P   840Di Services

Your Choice [1,2,3,4,5,7,8,9,E,P] ?
```

2. Choose **Backup/Restore** with key ”**7**”.

   The system prompts you to enter a password: You require a password for protection level 0 –2:
   – System
   – Manufacturer
   – Service

Following menu:

```
PLEASE SELECT
     1   Harddisk Backup/Restore with GHOST
     4   Partitions Backup/Restore with GHOST

     9   Back to previous Menu

Your Choice [1,4,9] ?
```

3. Choose **Harddisk Backup/Restore with Ghost** with key ”**1**”.

Following menu:

```
PLEASE SELECT
     1   Configure GHOST Parameters
     2   Harddisk Backup to <PATH>, Mode...
     3   Harddisk Backup from <PATH>, Mode...

     9   Back to previous Menu

Your Choice [1,2,3,9] ?
```

4. If necessary, to check or configure the ghost parameters, select **Configure GHOST Parameters** with key ”**1**”.

   Configuration of the ghost parameters is described in Subsection 15.5.3, Page 15-432.

```
PLEASE SELECT
     1   Configure GHOST Parameters
     2   Harddisk Backup to H:\<PATH>\SICHER01.GHO, Mode LOCAL
     3   Harddisk Backup from H:\<PFAD>\SICHER01.GHO, Mode LOCAL

     9   Back to previous Menu

Your Choice [1,2,3,9] ?
```

5. To start the data transfer, choose **Hard disk Backup to ...** with key ”**2**”.

Following menu:

```
PLEASE SELECT
     1   Backup WITHOUT Local Images
     2   Backup WITH Local Images

     9   Back to previous Menu

Your Choice [1,2,9] ?
```

6. If you do not want also to back up the image files of backed–up partitions on the hard disk of the PCU (partition image: see Subsection 15.5.4, Page 15-436), select:

   – **Backup WITHOUT Local Images** with key ”**1**”.

   Otherwise, choose:

   – **Backup WITH Local Images** with key ”**2**”.

   A message box appears:

   – You are prompted to check that the connection between the PCU and the external computer is up.

   – The destination path is displayed at which the backup copy will be stored on the external computer.

   – Press ”**Y**” to start backup.

   Backup is now performed by Norton Ghost™.

   The following information is shown in the message box:

   – Transmission progress

   – Paths used

   – Data volume

Size of backup copy with compression: 4.8 GB harddisk –> approx. 330 B image file

Time for transfer: approx. 15 min

15.5.2 Restoring hard disk contents from an image file

Brief description

This subsection describes how to restore the hard disk contents of the PCU from a hard disk image created as described in Subsection 15.5.1, Page 15-425. The image file is read from a shared directory on an external computer (PC/PG) via a DOS–based network link.

Preconditions

The following condition must be fulfilled:

- Network link with an external computer. See Section 15.1, Page 15-411.

Operator actions

After the PCU has been switched on, the menu of the boot manager is displayed.

1. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The following menu appears:

```
PLEASE SELECT
    1  Install/Update SINUMERIK System
    2  SINUMERIK Tools and Options
    3  DOS Shell
    4  Start Windows XP (Service Mode)
    5  SINUMERIK System Check
    7  Backup/Restore
    8  Start PC Link

    9  Reboot

    E  Restore Windows Partition E (Emergency)
    P  840Di Services

Your Choice [1,2,3,4,5,7,8,9,E,P] ?
```

2. Choose **Backup/Restore** with key ”**7**”.

   The system prompts you to enter a password: You require a password for protection level 0 –2:
   – System
   – Manufacturer
   – Service

Following menu:

```
PLEASE SELECT
    1  Harddisk Backup/Restore with GHOST
    4  Partitions Backup/Restore with GHOST

    9  Back to previous Menu

Your Choice [1,4,9] ?
```

3. Choose **Harddisk Backup/Restore with Ghost** with key ”**1**”.

Following menu:

```
PLEASE SELECT
    1  Configure GHOST Parameters
    2  Harddisk Backup to <PATH>, Mode...
    3  Harddisk Backup from <PATH>, Mode...

    9  Back to previous Menu

Your Choice [1,2,3,9] ?
```

4. If necessary, to check or configure the ghost parameters, select **Configure GHOST Parameters** with key ”**1**”.

   Configuration of the ghost parameters is described in Subsection 15.5.3, Page 15-432.

```
PLEASE SELECT
    1  Configure GHOST Parameters
    2  Harddisk Backup to H:\<PATH>\SICHER01.GHO, Mode LOCAL
    3  Harddisk Backup from H:\<PATH>\SICHER01.GHO, Mode LOCAL

    9  Back to previous Menu

Your Choice [1,2,3,9] ?
```

5. Select **Harddisk Backup from...** with key ”**3**”.

Following menu:

```
For partitioning the disk it’s important to know the
SYSTEM BASE of the imaged configuration.
Please select the SYSTEM BASE the image was created by!

PLEASE SELECT
    1  Windows XP
    2  Windows NT
    3  Win95
    4  WfW3.11
    5  DOS (sparepart)

    9  Back to previous Menu

Your Choice [1,2,3,4,5,9] ?
```

6. Choose the operating system used as the basis for the backup copy. For SINUMERIK 840Di, this is in the current version, excluding Windows XP. Therefore, choose **Windows XP** with key ”**1**”.

Following menu:

```
What kind of disk partitioning do you want?
    1  Standard Partitioning (default)
    2  User–defined Partitioning
    3  Image–Partitioning

Your Choice [1,2,3] ?
```

– **Standard Partitioning (default)**
  The hard disk partitioning of the PCU is set to the default partitioning of the as–delivered state.
– **User–defined Partitioning**
  The hard disk partitioning of the PCU can be set manually.
– **Image–Partitioning**
  The hard disk partitioning is set according to the partition size of the image file.

Answer the confirmation question with ”**Y**” to start restoring.

Norton Ghost™ is now started. The following information is displayed in the message box that opens:

– Transmission progress
– Paths used
– Data volume

Size of backup copy with compression: 4.8 GB harddisk –> approx. 330 MB image file

Time for transfer: approx. 15 min

Notice

If you cancel transfer, data on the PCU will be inconsistent and it might not be possible to boot the system. In that case, special boot diskettes with DOS, Norton Ghost™, and network software are required.

1. You can make your own boot diskettes using an application supplied. The application and a description of how to use it are on the hard disk of the PCU in directory: D:/EBOOT
2. You will find diskettes available for downloading from A&D MC eSupport at: eSupport > Download > Sinumerik Software > 840d/810d/fm–nc > add-on tools > bootdisk > Bootdisk 02.05.00

Norton Ghost™ closes automatically when the importing is completed.

7. With restoring the backup copy to the PCU, the last valid computer name with which the PCU has been identified on the network has been overwritten.

   To make sure that the PCU is assigned a valid computer name again, you must type a new name of the computer. The following menu appears:

```
PLEASE SELECT
    1   Input Machine Name MANUALLY
    2   Input Machine Name RANDOMLY

    9   Abort

Your Choice [1,2,9] ?
```

- **Input Machine Name MANUALLY**
  Type the new **10–digit** computer name into the input screen form displayed. When you confirm the new name using the Input key, the computer name is taken over into the system.
- **Input Machine Name RANDOMLY**
  A random computer name is generated and taken over into the system.
- **Abort**
  The computer name taken over with the image is kept.

The computer name can be changed using **Norton Ghost Walker**™.

Note

In networks where the function: ”Microsoft Domain Security” is active, changing the computer name causes new system and user IDs to be generated even if the same computer name is used. The computer and local user must then be re–administered in the network.

---

8. After Norton Ghost Walker™ has updated the computer name, the following menu is displayed:

```
It seems, that Ghost Restore succeeded.

Hit any Key to reboot the System.
```

The next time the PCU is booted under Windows XP, partitions E: and F: will be checked one after the other by the diagnostic program CHKDISK. The PCU automatically reboots between checks.

After completion of the check, the system with the restored backup copy is active.

15.5.3 Configuring the Ghost parameters

Brief description

This subsection describes how to configure the Ghost parameters for transmission of image files during hard disk back–up from/to a shared directory on an external computer.

Preconditions

No special requirements need to be fulfilled.

Operator action

After the PCU has been switched on, the menu of the boot manager is displayed. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The main service menu is displayed after PCU start–up. Select one after the other from the main menu:

– Key ”**7**”: **Backup/Restore**

– Key ”**4**”: **Partitions Backup/Restore with Ghost (locally)**

The following menu appears:

```
PLEASE SELECT
    1  Configure GHOST Parameters
    2  Harddisk Backup to <PATH>, Mode...
    3  Harddisk Backup from <PATH>, Mode...

    9  Back to previous Menu

Your Choice [1,2,3,9] ?
```

Choose **Configure GHOST parameters** with key ”**1**” to set the following parameters:

– **Machine name (computer name)**

– **Phone line type**

– **Network parameters**

– **Network connection**

– **Path** and **file name**

– **Split mode**

Following menu:

```
PLEASE SELECT
    1  Set Connection Mode PARALLEL
    2  Set Connection Mode LOCAL
    3  Change Backup Image Filename
    4  Change Restore Image Filename
    5  Change Machine Name (for Windows and DOS net)
    6  Manage Network Drives

    9  Back to previous Menu

Your Choice [1,2,3,4,5,6,9] ?
```

- **Computer name**
  To change the computer name, choose **Change Machine Name (for Windows and DOS net)** with key ”**5**”.

  The computer name is changed at the Windows and DOS levels.

  This function permits assignment of a unique computer name, e.g. on first start–up by importing a hard disk image (series start–up) or when replacing a defective hard disk on a PCU.

Note

In networks where the function: ”Microsoft Domain Security” is active, changing the computer name causes new system and user IDs to be generated. This even applies of the same computer name is used again. The computer and local user must then be re–administered in the network.

- **Phone line type**
  To set the connection mode ”Network Connection”, choose the menu item **Set Connection Mode LOCAL** with key ”**2**”.

- **Network parameters**
  If network parameters have not yet been set for the PCU, you can make the settings now.

  To set the network parameters of the PCU, choose **Manage Network Drives** with key ”**6**” and then **Change Network Settings** with key ”**4**”.

Following menu:

```
CURRENT NETWORK SETTINGS
    Machine Name                  : <COMPUTER_NAME>
    User Name                     : auduser
    Transport Protocol            : TCP/IP
    Logon to Domain               : No
    Connect Network Drive (last)  :

            PLEASE SELECT

                1   Change Machine Name (for DOS–Net only)
                2   Change User Name
                3   Toggle Protocol (NetBEUI / TCP/IP)
                4   Toggle logon to Domain (Yes or No)
            [   5   Change Domain Name ] displayed only when 4 = Yes
            [   6   Change TCP/IP Settings ] displayed only when 3 = TCP/IP

                9   Back to previous menu

            Your Choice [1,2,3,4,5,7,8,9,P] ?
```

Setting network parameters for a PTP network link is described in Section 15.2, Page 15-416.

Return to the next highest menu level after setting the parameters with **Back to previous menu** by hitting key ”**9**”. Be sure to save the parameter settings.

Following menu:

CURRENT NETWORK SETTINGS

Machine Name	: *<COMPUTER_NAME>*
User Name	: auduser
Transport Protocol	: TCP/IP
Logon to Domain	: No
Connect Network Drive (last)	:

PLEASE SELECT:

1 Connect to Network Drive
2 Show connected Network Drives
3 Disconnect from all Network Drives
4 Change Network Settings

9 Back to previous Menu

Your Choice [1,2,3,9] ?

- **Network link**
  Choose **Connect to Network Drive** with key ”**1**”.
  – TYPE YOUR PASSWORD
  Enter the **Password** for accessing the external computer. For later verification, you may be prompted to confirm saving of the password.

Note

Under Windows NT / XP the password entered must belong to a local user set up on the external computer.

– LETTER FOR NETWORK DRIVE
Specify the drive letter under which the shared directory is to be accessed from the PCU (e.g. ”H”).

– DIRECTORY TO BE MOUNTED
Enter the computer name and the directory or sharing name of the shared directory:

****<*COMPUTER_NAME*>****<*SHARING_NAME*>

Example: \\R3344\MY_BACKUP

The network link is displayed.

Connected Network Drive (last)	H: (\\R3344\MY_BACKUP)

Note

Instead of the computer, it is also possible to use the IP address of the external computer:

****<*IP_ADDRESS*>****<*SHARING_NAME*>

Example: \\169.254.10.1\MY_BACKUP

For how to set or ascertain the network parameters of an external computer, see Section 15.2, Page 15-416.

Return to the next highest menu level after setting the parameters with **Back to previous menu** by hitting key ”**9**”. Be sure to save the parameter settings.

Following menu:

```
PLEASE SELECT
    1   Set Connection Mode PARALLEL
    2   Set Connection Mode LOCAL
    3   Change Backup Image Filename
    4   Change Restore Image Filename
    5   Change Machine Name (for Windows and DOS net)
    6   Manage Network Drives

    9   Back to previous Menu

Your Choice [1,2,3,4,5,6,9] ?
```

- **Path** and **file name**
  To set the path or the file name under which you wish the backup copy to be stored on the external computer, select the menu option **Change Backup Image Filename** with key ”**3**”.

  Always state the entire path:

  <*drive letter*>:<*full path*\\><*file name*.GHO>

  – **Drive letter**
    The drive letter to specify is the drive letter stated under LETTER FOR NETWORK DRIVE above. In this example: H

  – **Full path** (optional)
    If applicable, enter the path. This allows you to place the back–up copy in a subdirectory under the shared drive/directory of the external computer, e.g. \SERVICE\PCU\

  – **File name**
    The image file is stored in this file name, e.g.
    SICHER01.GHO

  Example: H:\SERVICE\PCU\SICHER01.GHO

- **Split mode**
  To set that size of files to split the hard disk image into, choose **Change Split Mode** with key ”**7**”.

  Default file size: 640 Mbytes

  Maximum file size: 2048 Mbytes (2 Gbytes)

  Splitting: <*file name*>.GHO, <*file name*>.001, <*file name*>.002, etc.

  Return to the next highest menu level after setting the parameters with **Back to previous menu** by hitting key ”**9**”. Be sure to save the parameter settings.

15.5.4 Backing up partitions C:, E:, and F: to a local image file

Brief description

This subsection describes how to create an image file of partitions C:, E:, and F:. The image file is stored under D:\IMAGES.

The image files can be back up onto an external medium (hard disk of an external computer, CD, DVD, etc.) while backing up the entire contents of the hard disk (see Subsection 15.5.1, Page 15-425).

Preconditions

The following conditions must be fulfilled:

- Partition D: must contain enough free space because the image files are always stored under D:\IMAGES.
- The maximum number of possible partition backups may not yet be reached.

Operator actions

After the PCU has been turned on, the menu of the boot manager is displayed.

1. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The following menu appears:

```
PLEASE SELECT
     1   Install/Update SINUMERIK System
     2   SINUMERIK Tools and Options
     3   DOS Shell
     4   Start Windows XP (Service Mode)
     5   SINUMERIK System Check
     7   Backup/Restore
     8   Start PC Link

     9   Reboot

     E   Restore Windows Partition E (Emergency)
     P   840Di Services

Your Choice [1,2,3,4,5,7,8,9,E,P] ?
```

2. Choose **Backup/Restore** with key "**7**".

   The system prompts you to enter a password: You require a password for protection level 0 –2:
   - System
   - Manufacturer
   - Service

Following menu:

```
PLEASE SELECT
     1   Harddisk Backup/Restore with GHOST
     4   Partitions Backup/Restore with GHOST (locally)
     5   ADDM Backup/Restore

     9   Back to previous Menu

Your Choice [1,4,5,9] ?
```

3. Choose **Partitions Backup/Restore with Ghost (locally)** with key ”**4**”.

Following menu:

```
Ghost Connection Mode:      LOCAL
Maximum Backup Images:      <Max_number>
Current Backup Images:      <Cur_number>

        PLEASE SELECT

           1   Configure GHOST Parameters
           2   Partitions Backup, Mode LOCAL
           3   Partitions Restore, Mode LOCAL
           4   Partition E (only Windwow) Restore, Mode LOCAL
           8   Delete Image

           9   Back to previous Menu

        Your Choice [1,2,3,4,8,9] ?
```

Make sure that the displayed **max. number** of possible partition backups is not yet reached.

Note

– Changing the max. number of partition back–ups: Subsection 15.5.5, Page 15-438.

– Deleting partition back–ups: Subsection 15.5.6, Page 15-439.

4. Choose **Partitions Backup, Mode LOCAL** with key ”**2**”.

Following menu:

```
You must specify the image name (max. 7 characters long):

Image Name:
```

5. Type the **name** under which you wish the partition backup to be stored (max. 7 characters). In the example: IBNZWST

   If more than one partition backup is possible, the input option of a **description** is offered.

```
You can store a description text along with the image:

Description [Local Backup]:
```

When you select a partition backup to restore it, this description is displayed together with date and time to identify the partition backup.

To facilitate the identification of the partition backup, a clear description should be used. In the example: Start–up intermediate version 1.

When you confirm the specifications above, the partition backup will be started.

After the partition backup has been made, a check can then be carried out using CRC Check.

Storing a partition backup

Saving each of the partitions C:, E:, and F: creates a separate image file under D:\IMAGES. Its name starts with the name of the partition backup, e.g.:

- for partition **C**: IBNZWST.GH**1**
- for partition **E**: IBNZWST.GH**3**
- for partition **F**: IBNZWST.GH**4**

When restoring the partition backup, however, the 3 individual files will be addressed as one partition backup with the description entered under Item 5.

15.5.5 Changing the maximum number of local image files

Service menu

After the PCU has been switched on, the menu of the boot manager is displayed. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The main service menu is displayed after PCU start–up. Select one after the other from the main menu:

- Key ”**7**”: **Backup/Restore**
- Key ”**4**”: **Partitions Backup/Restore with Ghost (locally)**
- Key ”**1**”: **Configure Ghost Parameters**

The following menu appears:

```
GHOST Connection Mode:    LOCAL
Maximum Backup Images:    <Max_number>
Current Backup Images:    <Cur_number>

     PLEASE SELECT

        1   Change maximum Backup Images
        2   Define Emergency Backup Image

        9   Back to previous Menu

     Your Choice [1,2,9] ?
```

Choose **Change maximum Backup Images** with key ”**1**”.

Enter the new maximum number of possible image files in the following menu and confirm the query to back up the Ghost parameters with key ”**Y**”.

15.5.6 Deleting local image files

Service menu

After the PCU has been switched on, the menu of the boot manager is displayed. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The main service menu is displayed after PCU start–up. Select one after the other from the main menu:

- Key ”**7**”: **Backup/Restore**
  - Key ”**4**”: **Partitions Backup/Restore with Ghost (locally)**

The following menu appears:

```
Ghost Connection Mode:      LOCAL
Maximum Backup Images:      <Max_number>
Current Backup Images:      <Cur_number>

     PLEASE SELECT

        1   Configure GHOST Parameters
        2   Partitions Backup, Mode LOCAL
        3   Partitions Restore, Mode LOCAL
        4   Partition E (only Windows) Restore, Mode LOCAL
        8   Delete Image

        9   Back to previous Menu

     Your Choice [1,2,3,4,8,9] ?
```

Choose **Delete Image** with key ”**8**”.

Following menu:

```
            PLEASE SELECT
               1   PCU Base Software V06.01.04 Win NT 4.0
                   [05.09.2000; 05.30.32pm]
               2   Start–up intermediate status 1 [05–10–2000; 04:03:15pm]
  EMERG        3   Data backup1 [06–11–2000; 10:34:17am]
            :
            :
            :
               9   Back to previous Menu

            Your Choice [1,2,3. . . .,9] ?
```

Select the partition back–up to be deleted and confirm the query with key ”**Y**”.

15.5.7 Restoring partitions C:, E:, and F: from a local image file

Brief description

This subsection describes how to restore partitions C:, E:, and F: from an image file.

Preconditions

The following conditions must be fulfilled:

- The image file must be present locally on the hard disk of the PCU under D:\IMAGES (see Subsection 15.5.4, Page 15-436).

Operator actions

After the PCU has been switched on, the menu of the boot manager is displayed.

1. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The following menu appears:

```
PLEASE SELECT
     1   Install/Update SINUMERIK System
     2   SINUMERIK Tools and Options
     3   DOS Shell
     4   Start Windows XP (Service Mode)
     5   SINUMERIK System Check
     7   Backup/Restore
     8   Start PC Link

     9   Reboot

     E   Restore Windows Partition E (Emergency)
     P   840Di Services

Your Choice [1,2,3,4,5,7,8,9,E,P] ?
```

2. Choose **Backup/Restore** with key ”**7**”.

The system prompts you to enter a password: You require a password for protection level 0 –2:
- System
- Manufacturer
- Service

Following menu:

```
PLEASE SELECT
     1   Harddisk Backup/Restore with GHOST
     4   Partitions Backup/Restore with GHOST (locally)
     5   ADDM Backup/Restore

     9   Back to previous Menu

Your Choice [1,4,5,9] ?
```

3. Choose **Partitions Backup/Restore with Ghost** with key ”**4**”.

Following menu:

```
Ghost Connection Mode:      LOCAL
Maximum Backup Images:      <Max_number>
Current Backup Images:      <Cur_number>

        PLEASE SELECT

             1   Configure GHOST Parameters
             2   Partitions Backup, Mode LOCAL
             3   Partitions Restore, Mode LOCAL
             4   Partition E (only Windows) Restore, Mode LOCAL
             8   Delete Image

             9   Back to previous Menu

        Your Choice [1,2,3,4,8,9] ?
```

4. Choose **Partitions Restore, Mode LOCAL** with key ”**3**”.

Following menu:

```
              PLEASE SELECT
                  1   Base software V07.03.02 Win XP
                      [05.09.2004; 05.30.32pm]
                  2   Start–up intermediate status 1 [05–10–2004; 04:03:15pm]
     EMERG        3   Data backup1 [06–11–2004; 10:34:17am]
              :
              :
              :
                  9   Back to previous Menu

              Your Choice [1,2,3. . . .,9] ?
```

5. The descriptions that have been specified for the individual partition bakkups are displayed. Select the partition back up that you want to import now, e.g. ”Start–up intermediate version 1” with key ”**2**”.

   After confirmation, a warning is displayed:

   Caution: All data will be overwritten!

   If you confirm again, the partitions of the harddisk are restored.

Following menu:

```
It seems, that Ghost Restore succeeded.

Hit any Key to reboot the System.
```

On next start–up of the PCU under Windows, partitions E: and F: are checked by the CHKDISK diagnostic program. After partition E: has been checked, rebooting is performed automatically.

After completion of the check of partition F:, the system with the restored back-up copy is active.

15.5.8 Restoring partition E: (Windows) from a local image file

Brief description

This subsection describes how to restore the operating system partition E: exclusively from an image file.

Preconditions

The following conditions must be fulfilled:

- The image file must be present locally on the hard disk of the PCU under D:\IMAGES (see Subsection 15.5.4, Page 15-436).

Operator actions

Proceed as described in Subsection 15.5.7, Page 15-440: Item 1. to item 3.

The following menu appears:

```
Ghost Connection Mode:      LOCAL
Maximum Backup Images:      <Max_number>
Current Backup Images:      <Cur_number>

          PLEASE SELECT

             1    Configure GHOST Parameters
             2    Partitions Backup, Mode LOCAL
             3    Partitions Restore, Mode LOCAL
             4    Partition E (only Windows) Restore, Mode LOCAL
             8    Delete Image

             9    Back to previous Menu

          Your Choice [1,2,3,4,8,9] ?
```

Choose **Partition E (only Windows) Restore, Mode LOCAL** with key ”**4**”.

Following menu:

```
               PLEASE SELECT

                  1    PCU Base Software V06.01.04 Win NT 4.0
                       [05.09.2000; 05.30.32pm]
                  2    Start–up intermediate status 1 [05–10–2000; 04:03:15pm]
   EMERG          3    Data backup1 [06–11–2000; 10:34:17am]
               :
               :
               :
                  9    Back to previous Menu

               Your Choice [1,2,3. . . .,9] ?
```

To complete partition restoration, proceed as described in Subsection 15.5.7, Page 15-437: item 5.

15.5.9 Defining an emergency image for partition E: (Windows)

Brief description

This subsection describes how to define an image file as an emergency image to restore operating system partition E:, if necessary.

You may have to restore the operating system partition. This may be necessary if Windows is no longer bootable, or if the realtime properties of the SINUMERIK 840Di are no longer ensured because subsequently installed unsuitable software can no longer be uninstalled.

Preconditions

The following conditions must be fulfilled:

- At least one image file must be present locally on the hard disk of the PCU under D:\IMAGES (see Subsection 15.5.4, Page 15-436).

Operator actions

After the PCU has been switched on, the menu of the boot manager is displayed.

1. Select the menu option **Service menu** *(hidden)* using the CursorDown key and then press the Input key.

The following menu appears:

```
PLEASE SELECT
    1   Install/Update SINUMERIK System
    2   SINUMERIK Tools and Options
    3   DOS Shell
    4   Start Windows XP (Service Mode)
    5   SINUMERIK System Check
    7   Backup/Restore
    8   Start PC Link

    9   Reboot

    E   Restore Windows Partition E (Emergency)
    P   840Di Services

Your Choice [1,2,3,4,5,7,8,9,E,P] ?
```

2. Choose **Backup/Restore** with key ”**7**”.

The system prompts you to enter a password: You require a password for protection level 0 – 2:

- System
- Manufacturer
- Service

Following menu:

```
PLEASE SELECT
    1   Harddisk Backup/Restore with GHOST
    4   Partitions Backup/Restore with GHOST (locally)
    5   ADDM Backup/Restore

    9   Back to previous Menu

Your Choice [1,4,5,9] ?
```

3. Choose **Partitions Backup/Restore with Ghost** with key ”**4**”.

Following menu:

```
Ghost Connection Mode:       LOCAL
Maximum Backup Images:       <Max_number>
Current Backup Images:       <Cur_number>

          PLEASE SELECT

               1    Configure GHOST Parameters
               2    Partitions Backup, Mode LOCAL
               3    Partitions Restore, Mode LOCAL
               4    Partition E (only Windows) Restore, Mode LOCAL
               8    Delete Image

               9    Back to previous Menu

          Your Choice [1,2,3,4,8,9] ?
```

4. Choose **Partitions Restore, Mode LOCAL** with key ”**3**”.

15.6 Restoring the as–delivered state

If the current installation has become unusable for some reason, it is possible to restore the as–delivered state of partitions C: (DOS), E: (Windows XP), and F: (840Di System) of the PCU hard disk.

This sections describes the basic steps:

- Up to **SW 2.1**
  - Restoring the partitions
- As from **SW 2.2**
  - Restoring the partitions
  - Installation of the SINUMERIK 840Di applications

Notice

If the as–delivered state is restored, all data will be lost on the following partitions of the PCU hard disk:

- C: (DOS)
- E: (Windows XP)
- F: (840Di System)

15.6.1 Preconditions

The precondition that must be met before restoring the as–delivered state is that the following files supplied with the SINUMERIK 840Di be stored locally on the hard disk of the PCU:

- Up to **SW 2.1**
  - D:\IMAGES\sin840di.gho (image file)
  - D:\IMAGES\sin840di.inf
- As from **SW 2.2**
  - 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.

15.6.2 Restoring the partitions

The procedure for restoring partitions C:, E:, and F: from a local image file is described in Subsection 15.5.7, Page 15-440.

Select the image file from which the partitions are to be restored in accordance with the existing SINUMERIK 840Di software version:

- Name up to **SW 2.1**
  - Sinumerik 840Di Software <*Version*> <*Date*>
- Name as from **SW 2.2**
  - Basic software <*Version*> <*Date*>

SW 2.1 and lower

On a SINUMERIK 840Di SW 2.1 and lower, restoring the as–delivered state is now complete because the image file also contains the SINUMERIK 840Di applications.

SW 2.2 and higher

On a SINUMERIK 840Di SW 2.2 and higher, the SINUMERIK 840Di applications have to be installed as described in the following Sections after the partitions have been restored.

15.6.3 Installation of the SINUMERIK 840Di applications

The installation programs of the SINUMERIK 840Di applications under D:\INSTALL are not executed automatically after restoration of the partitions as they were on initial start–up of the PCU. 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.

5. Proceed with all (existing) directories

   - D:\SETUP\APPS**002** to **xxx**

   as described in item 2.

If all installation programs are executed in the described order, partitions C:, E:, and F: of the PCU hard disk will be in their as–delivered state after the final reboot.

Example

Fig. 15-4 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.

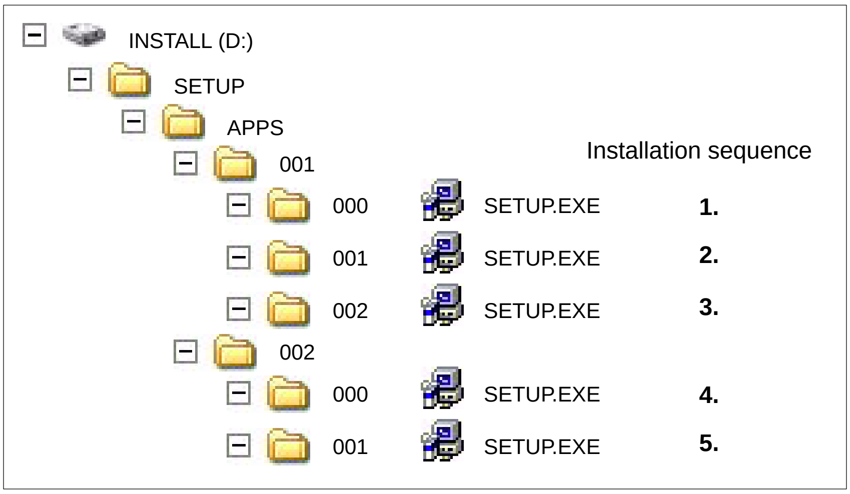


Fig. 15-4 Installation sequence

■

Notes

840Di–Specific Data and Functions 16

16.1 Interface signals

For detailed information on interface signals, please refer to the descriptions of functions:

- /FB1/ Description of Functions – Basic Machine
- /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, Chapter: Interface signals

16.1.1 840Di–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	

16.1.2 Interface signals not supported

DB number	Byte, bit	Name	Doc. reference
Axis-/spindle-specific		**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	Enable test stop	
		Signals from axis/spindle to PLC	
31, ...	92.0	Setup mode active	
31, ...	92.2	Torque limit 2 active	

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 referenced safely	
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	

16.2 Expanded message frame configuration

16.2.1 Description of functions

The PROFIdrive profile provides two different possibilities for defining the quantity and meaning of message frame data transferred between the DP master and DP slave drives within the framework of the cyclic PROFIBUS communication:

1. Select a predefined standard message frame

   You can uniquely define the quantity and meaning of the transferred data by selecting a standard message frame type in the associated components DP slave drive, DP master and NC.

2. Customizable message frame configuration

   With customizable message frame configuration, a user–specific frame type is defined, in which you need to separately inform each associated component – DP slave, DP master and NC – of the quantity and meaning of the transferred data.

SINUMERIK 840Di supports extended message frame configuration. By combining standard message frame and free message frame configuration, it is possible to transmit not only the process data (PDA) configured in the standard message frame but also additional drive data cyclically from the drive (DP slave) to the NC (DP master).

Message frame structure

The drive data transferred in addition to the standard message frame process data must always be appended at the end of the standard message frame.

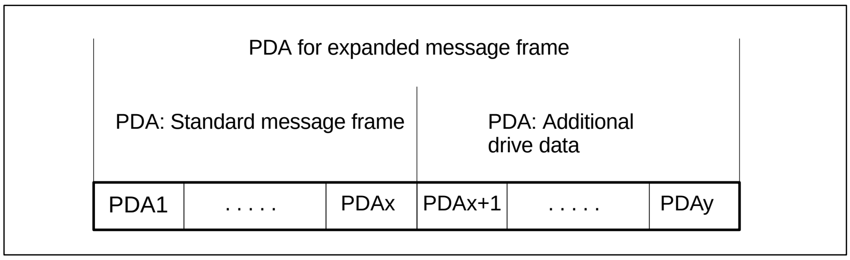


Fig. 16-1 Standard message frame with additional process data (PDA)

NC system variables

According to the selected functionality, for each axis the additional drive data is available on the NC 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

The specific drive data listed below is transferred in individually specified system variables with the machine data setting:

- MD 36730: DRIVE_SIGNAL_TRACKING[n] = **1**

The drive data must be configured as additional process data on the drive with the exact meaning in the exact order specified in Table 16-1.

Table 16-1 Specific drive data

PDA	Drive data	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

Note

Transfer of specific drive data can only take place if the following is applicable:

Standard message frame data + additional data $\leq$ max. number process data.

Currently a message frame can contain up to 16 process data items (PDA1 to PDA16).

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.

Note

When using the system variable $VA_DP_ACT_TEL[n, a], it is only permissible to use a **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)
  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 items (both 32–bit) in the system variable $VA_DP_ACT_TEL.

Fig. 16-2 shows how the process data of the message frame are mapped onto system variable $VA_DP_ACT_TEL:

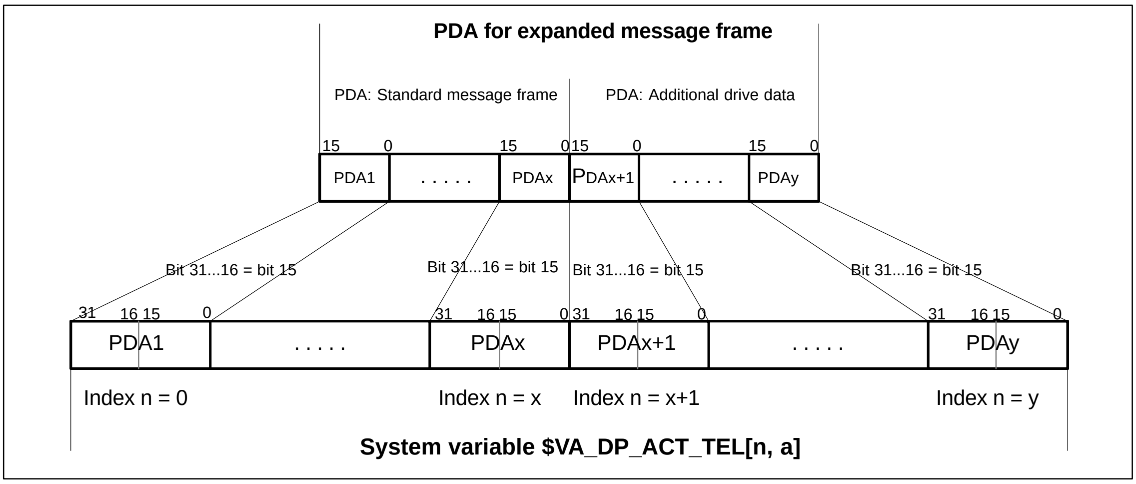


Fig. 16-2 Mapping principle: PDA on system variable $VA_DP_ACT_TEL

Notice

The responsibility for possibly necessary format conversions or correct interpretation of the physical unit and significance of a system variable used in parts 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.

16.2.2 Preconditions

The following conditions must be met to configure an expanded message frame:

- Drive
  The drive to be used for the expanded message frame configuration must support customizable message frame configuration in addition to selection of standard message frames.

- DP master / SIMATIC STEP 7
  No additional requirements
- SINUMERIK 840Di NC
  - Option: ”Evaluation of internal drive variables”,
    Order No. (MLFB): 6FC5 251–0AB17–0BA0
  - NC machine data for activating the data transfer for the additional PDA in the system variables:
    - MD 36730: DRIVE_SIGNAL_TRACKING[n] (acquisition of additional drive actual values)

16.2.3 Configuring SIMODRIVE drives

Expanded message frame configuration in relation to SIMODRIVE 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.

Recommended configuration sequence

We recommend proceeding in the following order to configure the components included in the expanded message frame configuration:

1. Configure the DP master with SIMATIC STEP 7
2. Configure the DP slave 611U with the start–up tool: SimoCom U
3. SINUMERIK 840Di NC with start–up tool: SinuCom NC or the user interface: HMI Advanced (option).

Default configuration

Before performing the expanded message frame configuration, please define the following:

- Which standard message frame the drive axis/axes is supposed to operate with.
- How many additional drive actual values/PDA are to be transferred.

Note

It is advisable to configure each component first with the appropriate standard message frame and then expand the frame by the additional PDA.

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.

Default configuration

For information on how to perform a standard configuration of the DP master, please see Subsection 8.3.5, Page 8-207ff.

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 been 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 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 match:

  1. SIMATIC S7 configuration of DP slave 611U
     I/O address
  2. SINUMERIK 840Di–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: <**Message 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.

Step 2: Configuring the DP slave 611U

Before performing expanded message frame configuration, you first need to perform the standard configuration or start–up of the drive.

Default configuration

For the standard configuration/start–up of the drive, please see:

- Start–up (requirements)
  - Section 9.1, Page 9-221
- Standard configuration/start–up
  - 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 start–up 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 start–up 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 start–up 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 **Start–up > Parameterization Views > PROFIBUS Parameter Settings**) with ”0”.

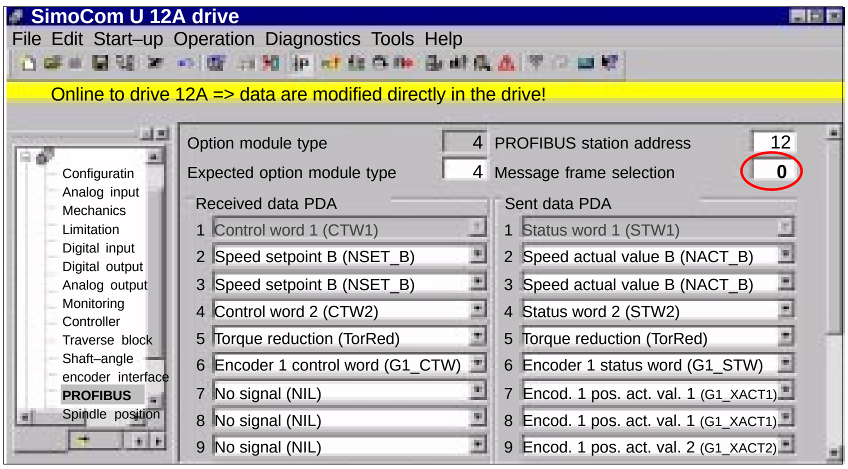


Fig. 16-3 Activating the customizable message frame configuration

- 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. 16-4.

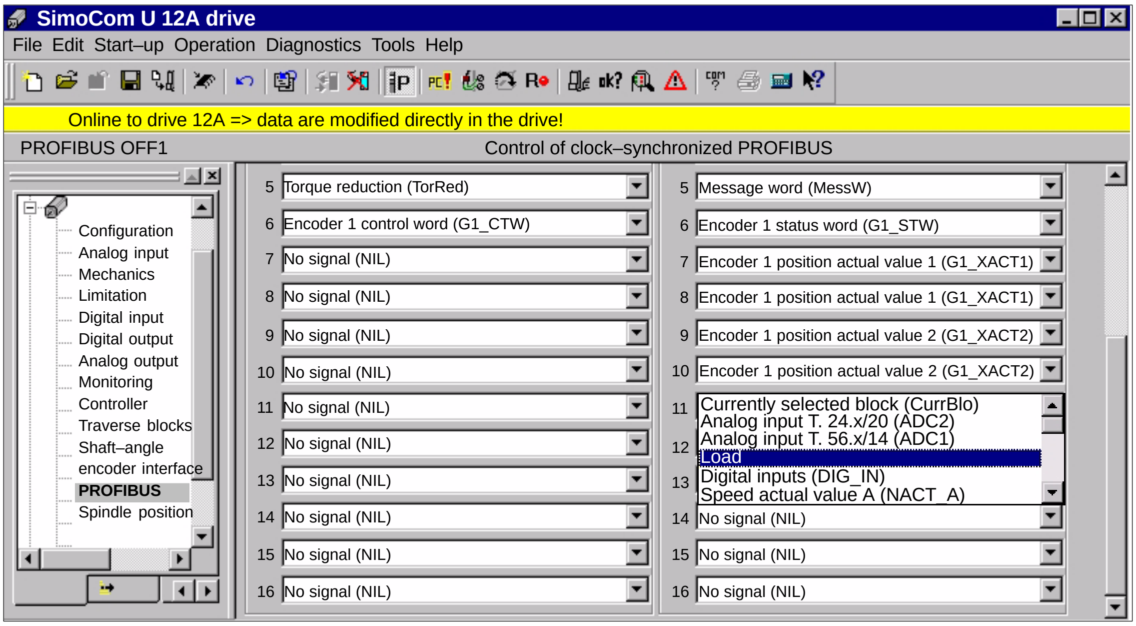


Fig. 16-4 Configuring the additional drive actual values

Step 3: Configuring the NC

Before configuring the expanded message frames, you first need to perform the standard configuration on the NC for the drive.

Default configuration

How to proceed with the standard configuration of a drive is described in Subsection 10.5.3, page 10-264.

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 transfer 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)

16.2.4 Restrictions

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 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.

Consistency check

At SINUMERIK 840Di boot, the NC checks the consistency of the process data configuration (PDA) of the parameters relevant to the cyclic PROFIBUS communication:

- NC
  – MD 13060: DRIVE_TELEGRAM_TYPE[n] (drive message frame type)
- DP master (configuration)
  – DP Slave Properties > Configuration > Setpoint: **Length**
  – DP Slave Properties > Configuration > Actual Value: **Length**
- Drive
  – Parameter P0922 message frame selection
  – Parameter P0915[x] PDA setpoint assignment
  – Parameter P0916[x] PDA actual value assignment.

If the number of process data expected from the NC set in the message frame (telegram) 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 > Configuration > Setpoint: **Length**
- DP Slave Properties > Configuration > Actual Value: **Length**

or if the process data configuration determined at the drive–end from the drive parameters:

- P0922 message frame selection
- P0915[x] PDA setpoint assignment
- P0916[x] PDA actual value assignment

does not match the message frame type of the NC machine data, then the following alarm is issued:

- 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 NC machine data:

- MD 13070: DRIVE_FUNCTION_MASK[n] (used DP functions)

then responsibility lies solely with the start–up engineer to perform a consistency check on the above data.

Warning

For reasons relating to the system, the consistency check – which is performed during SINUMERIK 840Di boot and based on acyclic communication with the drive – runs parallel in time with the already active cyclic communication between NC and drive.

As setpoint and actual values are already being exchanged between the NC position control and drive as part of the cyclic communication, uncontrolled system states can occur on the drive side 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:

- MD 13070: DRIVE_FUNCTION_MASK[n] (used DP functions)

and therefore it is not possible for the NC to perform a consistency check.

Therefore, the responsibility lies with the start–up engineer to implement suitable measures (e.g. connecting terminals 64/65A/65B/ 663) 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.

16.2.5 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	Minimum input limit: 0	Maximum input limit: FFFF FFFF	
Changes effective after POWER ON	Protection level: 2/7	Unit: –	
Data type: DWORD	Applies as from SW version: 2.1		
Meaning:	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	—–		

Axis-specific machine data

<table>
<tr><td colspan="2">36730
MD number</td><td colspan="4">DRIVE_SIGNAL_TRACKING
Detection of additional drive actual values</td></tr>
<tr><td colspan="2">Default setting: 0</td><td colspan="2">Minimum input limit: 0</td><td colspan="2">Maximum input limit: 4</td></tr>
<tr><td colspan="3">Changes effective after POWER ON</td><td colspan="2">Protection level: 2/7</td><td>Unit: –</td></tr>
<tr><td colspan="3">Data type: BYTE</td><td colspan="3">Applies as from SW version: 2.1</td></tr>
<tr><td>Meaning:</td><td colspan="5">The 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</td></tr>
<tr><td>MD irrelevant for ... ...</td><td colspan="5">––</td></tr>
</table>

System variables

Name	$VA_DP_ACT_TEL[n, a]			
Meaning	Word by word mapping of the PROFIBUS message frame from the DP slave			
Data type	INTEGER			
Value range	[0, 65535]			
Indices	n: Array index	Value range	[0,20]	
	a : Machine axis	Value range	Machine axis identifier	
Accesses	Parts programs	Synchronized action	OPI	
	Read	Read	Read	
Attribute	Implicit preprocessing stop		Cross–channel	
	Read		Yes	

16.2.6 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.

16.3 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 Machine
Chapter: F1 Travel to fixed stop

16.3.1 Description of Functions

With travel to fixed stop, you specify the torque reduction of the drive torque effective in the drive (terminal torque) via the parts program instruction FXST.

For PROFIBUS drives, up to now the torque reduction was at a resolution of 1% and could not be changed. You can now set the torque reduction in the range from 0.01% to 10% providing the required NC and drive parameters have been set.

16.3.2 Preconditions

Basic requirements

The following basic requirements must be met to set the parameters for torque reduction resolution:

– There must be a parameter in the drive via which the resolution for the torque reduction can be set at the drive end.

– The drive is operating with a message frame type containing the control word: TorRed (torque reduction) e.g. SIMODRIVE standard message frame 102 to 107.

Automatic adjustment

To simplify the start–up of torque reduction, the SINUMERIK 840Di NC carries out an automatic matching procedure using the torque reduction resolution parameterized in the drive. The following requirements must be met:

– The drive supports acyclic communication and it is enabled on the NC side. For information on how to enable acyclic communication on the NC, please see the description of NC machine data:

  - MD 13070: DRIVE_FUNCTION_MASK[n] (used DP functions)

– Parameter P881 is present in the drive with the corresponding meaning and a scaling of 16384 $\triangleq$ 1%.

During SINUMERIK 840Di boot and in the state: ”Incoming station” of the DP slave 611U, the SINUMERIK 840Di NC cyclically reads parameter P881 from the drive and transfers it to the appropriate axis–specific NC machine data:

- MD 37620: PROFIBUS_TORQUE_RED_RESOL (torque reduction resolution on PROFIBUS (LSB weighting)).

Manual comparison

If the requirements are not met for automatic adjustment, then the parameters can be set manually for the SINUMERIK 840Di NC if the resolution of the torque reduction is parameterized in principle in the mappable range (0.01% to 10%).

16.3.3 Setting parameters for SIMODRIVE drives

The requirements for an automatic or manual adjustment of the following SIMODRIVE drives:

- SIMODRIVE 611 universal or universal E
- SIMODRIVE POSMO CD/CA
- SIMODRIVE POSMO SI

are met with SW 4.1 and higher.

The following describes the function on the basis of a SIMODRIVE 611 universal (DP slave 611U) drive. Please adapt your procedure for the other SIMODRIVE drives.

Note

If third–party drives are used, please read the manufacturer's documentation to see whether and how to set the parameters on the drive.

Parameter P0881

The resolution of the torque reduction is parameterized in the DP slave 611U in parameter:

- P0881 Torque reduction evaluation

Normalization

As standard, in the DP slave parameter P0881 is scaled to: 16384.00 $\triangleq$ 1%

Examples for other resolutions:

- 1638.40 $\triangleq$ 0.1%
- 163.84 $\triangleq$ 0.01%

Setpoint torque T_{set}

Setpoint torque T_{set} of the drive is therefore calculated by:

$$T_{set} = T_{max} * \left(1 - \frac{P0881 * TorRed[\%]}{16384 * 100\%} \right)$$

M_{max}:
Maximum possible drive torque from rated motor torque and parameter P1230 Torque limit value.

MomRed:
The percent specified via FXST for the reduced drive (control word in SIMODRIVE standard message frame 102 to 107).

16.3.4 Setting parameters for the SINUMERIK 840Di NC

In the SINUMERIK 840Di NC system, the parameters for the resolution of the torque reduction are set via the axis–specific machine data:

- MD 37620: PROFIBUS_TORQUE_RED_RESOL (torque reduction resolution on PROFIBUS (LSB weighting)).

Automatic parameterization

To simplify the start–up of torque reduction, as standard the NC tried to perform an automatic matching procedure. The adjustment is carried out in the following system states:

– SINUMERIK 840Di boot
– ”Incoming station” of the DP slave 611U.

The NC reads the resolution set in the parameters on the drive via parameter P0881 using acyclic communication and transforms the read value into the format of the above mentioned machine data.

If the detected drive–end resolution is not equal to the resolution currently set in the parameters in the NC machine data, the value determined by the drive is transferred to the NC machine data. The resulting NC–end rescaling of the torque reduction for this machine axis is indicated in the following alarm:

- Alarm 26024 ”Axis *axis identifier* machine data $MA_PROFIBUS_TORQUE_RED_RESOL value adapted”.

If the value of parameter P0881 converted into NC format lies outside the admissible limit values, the value set in the NC machine data is retained. An alarm is then not issued.

Note

You can disable automatic adjustment via:

- MD 13070: DRIVE_FUNCTION_MASK[n], bit 15 = 0

Manual parameterization

If one of the requirements listed above for automatically adjusting the torque reduction resolution is not met, it is possible to set the parameters manually to achieve consistence if the torque reduction resolution was parameterized in the mappable range (0.01% to 10%).

Example

The following conditions apply:

– Machine axis X1 corresponds to drive 12A
– The torque reduction resolution is to be 0.1%.

Parameterizing the DP slave 611U

The value 1638.40 is entered in parameter P0881.

The parameters are set with the start–up tool SimoCom U: menu command **Start–up > Additional Parameters > Expert List > Number > 881**

The parameter is immediately effective.

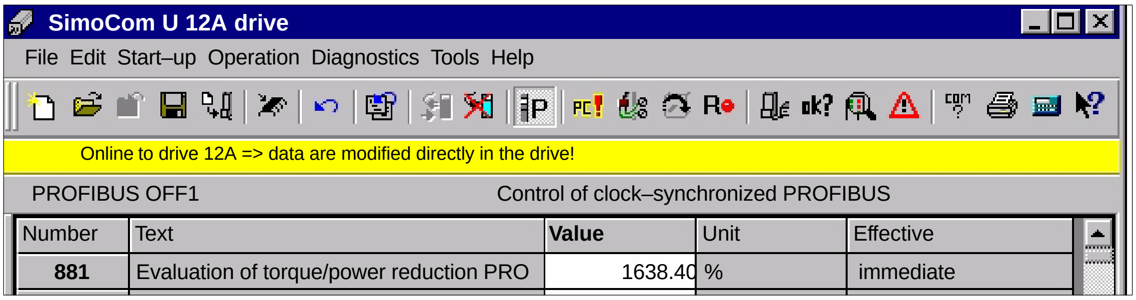


Fig. 16-5 Set parameter P0881

Setting parameters for the SINUMERIK 840Di NC

In the axis–specific machine data of machine axis X1

- MD 37620: PROFIBUS_TORQUE_RED_RESOL (torque reduction resolution on PROFIBUS (LSB weighting)).

the value 0.1 is entered.

The machine data is effective after NC reset (warm restart).

16.3.5 Restrictions

Notice

It is the start–up engineer's responsibility to ensure that the parameter settings are consistent in the SINUMERIK 840Di NC 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 NC machine data
   MD 37620: PROFIBUS_TORQUE_RED_RESOL (torque reduction resolution on PROFIBUS (LSB weighting)).
2. Drive

   with automatic adjustment:
   Parameter P0881 Torque reduction evaluation

   with manual adjustment:
   The parameter corresponding in meaning to the DP slave 611U: parameter P0881

If automatic adjustment cannot be performed by the SINUMERIK 840Di NC due to requirements that are not met, of if the drive returns a value for parameter P0881 that lies beyond the NC machine data limit values, or if the torque reduction is not rescaled on the NC end, no alarm is issued. The machine data

- MD 37620: PROFIBUS_TORQUE_RED_RESOL (torque reduction resolution on PROFIBUS (LSB weighting)).

is effective in all cases independently.

16.3.6 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	Minimum input limit: 0		Maximum input limit: FFFF FFFF	
Changes effective after POWER ON		Protection level: 2/7		Unit: –
Data type: DWORD			Applies as from SW version: 2.1	
Meaning:	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	—–			

Axisspecific machine data

37620 **MD number**	**PROFIBUS_TORQUE_RED_RESOL** **torque reduction resolution on PROFIBUS (LSB weighting)**			
Default setting: 1	Minimum input limit: 0.01		Maximum input limit: 10	
Change valid after NEWCONF		Protection level: 2 / 7		Unit: %
Data type: DOUBLE			Applies as from SW version: 2.2	
Meaning:	For the drives connected via PROFIBUS, the MD defines the resolution of the torque reduction transferred in the cyclic SIMODRIVE standard message frames 102 to 107 (control word: TorRed). The torque reduction is e.g. required as part of the function ”Travel to fixed stop” (FXST). At automatic adjustment, the machine data must be set so that it is consistent with the meaning of drive parameter P0881: ”Torque reduction evaluation”; or with manual adjustment with the drive–end interpretation of the control word: TorRed. The default value of 1% corresponds to the resolution that was valid prior to SW 2.2.			

16.3.7 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.

■

Notes

Abbreviations

A

ADI4	Analog Drive Interface for 4 Axis
ARM	Asynchronous Rotary Motor
ASCII	American Standard Code for Information Interchange: American coding standard for the exchange of information
ASUB	Asynchronous Subroutine
BA	Mode
BAG	Mode group
BB	Ready
BCD	Binary Coded Decimals: Decimals with each digit coded in binary
BP	Basic Program
COM	Communication
CPU	Central Processor Unit
CRC	Cutter Radius Correction
DAC	Digital–to–Analog Converter
DB	Data Block
DBB	Data Block Byte
DBX	Data Block Bit
DHCP	Dynamic Host Configuration Protocol: Protocol for automatic assignment of IP addresses from a DHCP server to a client computer
DPR	Dual–Port RAM
DRAM	Dynamic memory (volatile)
DRF	Differential Resolver Function
DRY	Dry Run: Dry run feedrate
DSR	Data Send Ready: Signal to indicate that serial data interfaces are ready
DW	Data Word
EFP	Compact I/O module (PLC I/O module)
EPROM	Erasable Programmable Read–Only Memory

ETC	ETC key > extension of softkey menu in the same menu
FC	Function Call, function block on the PLC
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
FSD	Feed Drive
FST	Feed Stop
GEO	Geometry
GND	Signal GRouNd
HASH	Software procedure for mapping a large quantity of identifiers onto a finite memory area
HEX	Hexadecimal number
HHU	Handheld Unit
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
INC	INCrement
INI	**INI**tializing data
INTV	Internal multiplication
IS	Interface Signal
ISO code	Special punched tape code, number of holes per character always even
JOG	Jogging: Setup mode
K1	Channel 1
K_V	Servo gain factor
K_{UE}	Transmission ratio
LEC	Leadscrew Error Compensation
LED	Light Emitting Diode
LSB	Least Significant Bit
MCI	Motion Control Interface
MCP	Machine Control Panel

MCS	Machine Coordinate System
MD	Machine Data
MDA	Manual Data Automatic: NC mode for entering and processing individual part program blocks or block sequences
MLFB	Machine–readable product designation: Order number
MMC	Man–Machine Communication: SINUMERIK operator interface for operating, programming, and simulation
MPF	Main Program File: NC part program (main program)
MPI	Multi–Point 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
OB	Organization Block: Block type of PLC basic or user program
PCMCIA	Personal Computer Memory Card International Association
PCW	Program Control Word
PD	Process Data: Process data part of a PPO
PG	Programming device
PID	Parameter identification: Part of a PIV
PIV	Parameter identification value: Parameterizing part of a PPO
PLC	Programmable Logic Controller
PMS1	Position measuring system 1
PMS2	Position measuring system 2
PNO	PROFIBUS user organization
PO	Power ON
POSMO A	Positioning Motor Actuator
POSMO CA	Positioning Motor Compact AC: Complete drive unit with integrated power and control modul as well as positioning unit and program memory; AC infeed.
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
RAM	Random Access Memory, i.e. program memory that can be read and written to
ROV	Rapid OVerride:Rapid traverse override
RPA	R Parameter Active: Identifier for R parameters
RS–232–C	Serial interface
RTS	Request To Send: Request to send, control signal on serial data interfaces
SBL	Single BLock
SEA	Setting Data Active: Identifier for setting data
SD	Setting Data
SK	SoftKey
SKP	SKiP: Skip block
SLM	Synchronous Linear Motor
SPF	Sub Program File: Subroutine
SRAM	Static RAM (non–volatile)
SRM	Synchronous Rotary Motor
SSI	Synchronous Serial Interface (interface type)
STW	Status word
SW	SoftWare
SW limit switch	Software limit switch
T	Tool
TC	Tool Change
TEA	Testing Data Active: Identifier for machine data
TO	Tool Offset: Tool Compensation
TOA	Tool Offset Active: Identifier for tool offsets
TRC	Tool Radius Compensation
TTL	Transistor–Transistor Logic (interface type)
VDI interface	Data interface between NC and PLC
WCS	Workpiece Coordinate System

ZO	Zero Offset
ZOA	Zero Offset Active: Identifier for zero offsets
μ**C**	Micro Controller

■

Notes

References

B

General Documentation

/BU/ SINUMERIK & SIMODRIVE, Automation Systems for Machine Tools
Catalog NC 60
Order number: E86060–K4460–A101–A9–7600

/IKPI/ Industrial Communication and Field Devices
Catalog IK PI
Order number: E86060–K6710–A101–B2–7600

/ST7/ SIMATIC
Products for Totally Integrated Automation and Micro Automation
Catalog ST 70
Order number: E86060–K4670–A111–A8–7600

/Z/ MOTION–CONNECT
Cable, Connectors & System Components for SIMATIC, SINUMERIK, Masterdrives, and SIMOTION
Catalog NC Z
Order number: E86060–K4490–A001–B1–7600

Electronic Documentation

/CD1/ The SINUMERIK System (11.03 edition)
DOC ON CD
(includes all SINUMERIK 840D/840Di/810D/802SC and SIMODRIVE publications)
Order number: 6FC5298–7CA00–0BG4

User Documentation

/AUK/
SINUMERIK 840D/810D (09.99 edition)
Short Guide **AutoTurn** Operation
Order number: 6FC5298–4AA30–0BP2

/AUP/
SINUMERIK 840D/810D (02.02 edition)
Operator's Guide AutoTurn **Graphic Programming System**
Programming/Setup
Order number: 6FC5298–4AA40–0BP3

/BA/
SINUMERIK 840D/810D (10.00 edition)
Operator's Guide **MMC**
Order number: 6FC5298–6AA00–0BP0

/BAD/
SINUMERIK 840D/840Di/810D (11.02 edition)
Operator's Guide: **HMI Advanced**
Order number: 6FC5298–6AF00–0BP2

/BAH/
SINUMERIK 840D/840Di/810D (11.02 edition)
Operator's Guide **HT 6**
Order number: 6FC5298–0AD60–0BP2

/BAK/
SINUMERIK 840D/840Di/810D (02.01 edition)
Short Operating Guide
Order number: 6FC5298–6AA10–0BP0

/BAM/
SINUMERIK 840D/810D (08.02 edition)
Operation/Programming **ManualTurn**
Order number: 6FC5298–6AD00–0BP0

/BAS/
SINUMERIK 840D/840Di/810D (11.02 edition)
Operation/Programming ShopMill
Order number: 6FC5298–6AD10–0BP1

/BAT/
SINUMERIK 840D/810D (06.03 edition)
Operation/Programming ShopTurn
Order number: 6FC5298–6AD50–0BP2

/BEM/
SINUMERIK 840D/810D (11.02 edition)
Operator's Guide **HMI Embedded**
Order number: 6FC5298–6AC00–0BP2

/BNM/	SINUMERIK 840D/840Di/810D **User's Guide Measuring Cycles** Order number: 6FC5298–6AA70–0BP2	(11.02 edition)
/BTDI/	SINUMERIK 840D/840Di/810D Motion Control Information System (MCIS) User's Guide **Tool Data Information** Order number: 6FC5297–6AE01–0BP0	(04.03 edition)
/CAD/	SINUMERIK 840D/840Di/810D Operator's Guide **CAD Reader** Order number: (included in online help)	(03.02 edition)
/DA/	SINUMERIK 840D/840Di/810D **Diagnostics Guide** Order number: 6FC5298–6AA20–0BP3	(11.02 edition)
/KAM/	SINUMERIK 840D/810D Short Guide **ManualTurn** Order number: 6FC5298–5AD40–0BP0	(04.01 edition)
/KAS/	SINUMERIK 840D/810D Short Guide **ShopMill** Order number: 6FC5298–5AD30–0BP0	(04.01 edition)
/KAT/	SINUMERIK 840D/810D Short Guide **ShopTurn** Order number: 6FC5298–6AF20–0BP0	(07.01 edition)
/PG/	SINUMERIK 840D/840Di/810D Programming Guide **Fundamentals** Order number: 6FC5298–6AB00–0BP2	(11.02 edition)
/PGA/	SINUMERIK 840D/840Di/810D Programming Guide **Advanced** Order number: 6FC5298–6AB10–0BP2	(11.02 edition)
/PGK/	SINUMERIK 840D/840Di/810D Short Guide **Programming** Order number: 6FC5298–6AB30–0BP0	(10.00 edition)

/PGM/ SINUMERIK 840D/840Di/810D (11.02 edition)
Programming **Guide ISO Milling**
Order number: 6FC5298–6AC20–0BP2

/PGT/ SINUMERIK 840D/840Di/810D
Programming **Guide ISO Turning** (11.02 edition)
Order number: 6FC5298–6AC10–0BP2

/PGZ/ SINUMERIK 840D/840Di/810D (11.02 edition)
Programming Guide **Cycles**
Order number: 6FC5298–6AB40–0BP2

/PI / **PCIN 4.4**
Software for Data Transfer to/from MMC Modules
Order number: 6FX2060 4AA00–4XB0 (English, German, French)
Order from: WK Fürth

/SYI/ SINUMERIK 840Di (02.01 edition)
System Overview
Order number: 6FC5298–6AE40–0BP0

Manufacturer/Service Documentation

a) Lists

/LIS/ SINUMERIK 840D/840Di/810D (09.03 edition)
SIMODRIVE 611D
Lists
Order number: 6FC5297–6AB70–0BP4

b) Hardware

/ASAL/ SIMODRIVE (06.03 edition)
Planning Guide General Information for **Asynchronous Motors**
Order number: 6SN1197–0AC62–0BP0

/APH2/ SIMODRIVE (07.03 edition)
Planning Guide **1PH2 Asynchronous Motors**
Order number: 6SN1197–0AC63–0BP0

/APH4/ SIMODRIVE (07.03 edition)
Planning Guide **1PH4 Asynchronous Motors**
Order number: 6SN1197–0AC64–0BP0

/APH7/	SIMODRIVE Planning Guide **1PH7 Asynchronous Motors** Order number: 6SN1197–0AC65–0BP0	(06.03 edition)
/APL6/	SIMODRIVE Planning Guide **1PL6 Asynchronous Motors** Order number: 6SN1197–0AC66–0BP0	(07.03 edition)
/BH/	SINUMERIK 840D/840Di/810D **Operator Components Manual** (HW) Order number: 6FC5297–6AA50–0BP3	(09.03 edition)
/BHA/	SIMODRIVE **Sensor** User's Guide (HW) **Absolute Position Sensor with Profibus DP** Order number: 6SN1197–0AB10–0YP2	(03.03 edition)
/EMV/	SINUMERIK, SIROTEC, SIMODRIVE Planning Guide (HW) **EMC Installation Guide** Order number: 6FC5297–0AD30–0BP1 The current Declaration of Conformity is available unter the following Internet address: **http://www4.ad.siemens.de** Please enter the ID No.: 15257461 in the "Search" field (top right) and click on "go".	(06.99 edition)
/GHA/	SINUMERIK/SIMOTION **ADI4 – Analog Drive Interface for 4 Axes** Manual Order number: 6FC5297–0BA01–0BP1	(09.03 edition)
/PFK6/	SIMODRIVE Planning Guide **1FK6 Three–Phase AC Servomotors** Order number: 6SN1197–0AD05–0BP0	(05.03 edition)
/PFK7/	SIMODRIVE Planning Guide **1FK7 Three–Phase AC Servomotors** Order number: 6SN1197–0AD06–0BP0	(01.03 edition)
/PFS6/	MASTERDRIVES Planning Guide **1FS6 Three–Phase AC Servomotors** Order number: 6SN1197–0AD08–0BP0	(07.03 edition)
/PFT5/	SIMODRIVE Planning Guide **1FT5 Three–Phase AC Servomotors** Order number: 6SN1197–0AD01–0BP0	(05.03 edition)

/PFT6/ SIMODRIVE (05.03 edition)
Planning Guide **1FT6 Three–Phase AC Servomotors**
Order number: 6SN1197–0AD02–0BP0

/PFU/ SINAMICS, SIMOVERT MASTERDRIVES (09.03 edition)
MICROMASTER
SIEMOSYN Motors 1FU8
Order number: 6SN1197–0AC80–0BP0

/PHC/ SINUMERIK 810D
Configuring Manual CCU (HW) (11.02 edition)
Order number: 6FC5297–6AD10–0BP1

/PHD/ SINUMERIK 840D (11.03 edition)
Configuring Manual NCU (HW)
Order number: 6FC5297–6AC10–0BP3

/PJAL/ SIMODRIVE 611 / Masterdrives MC (01.03 edition)
Planning Guide **Three–Phase AC Servomotors**
General Part
Order number: 6SN1197–0AD07–0BP0

/PJAS/ SIMODRIVE (07.03 edition)
Planning Guide **Asynchronous Motors** (Compendium)
Order number: 6SN1197–0AC61–0BP0

/PJFE/ SIMODRIVE (02.03 edition)
Planning Guide **1FE1 Built–In Synchronous Motors**
Three–Phase AC Motors for Main Spindle Drives
Order number: 6SN1197–0AC00–0BP4

/PJF1/ SIMODRIVE (12.02 edition)
Installation Guide **1FE1 051.–1FE1 147. Built–In Synchronous Motors**
Three–Phase AC Motors for Main Spindle Drives
Order number: 610.43000.02

/PJLM/ SIMODRIVE (06.02 edition)
Planning Guide **1FN1, 1FN3 Linear Motors**
ALL General Information on the Linear Motor
1FN1 1FN1 Three–Phase AC Linear Motor
1FN3 1FN3 Three–Phase AC Linear Motor
CON Connections
Order number: 6SN1197–0AB70–0BP4

/PJM/ SIMODRIVE (11.00 edition)
Planning Guide **Motors**
Three–Phase Servo Motors for Feed and Main Spindle Drives
Order number: 6SN1197–0AC20–0BP0

/PJM2/ SIMODRIVE (07.03 edition)
Planning Guide **Servomotors**
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Order number: 6SN1197–0AA20–0BP4

/PJTM/ SIMODRIVE (05.03 edition)
Planning Guide **1FW6 Integrated Torque Motors**
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/PJU/ SIMODRIVE 611 (02.03 edition)
Planning Guide **Converters**
Order number: 6SN1197–0AA00–0BP6

/PKTM/ SIMODRIVE (09.03 edition)
Planning Guide **1FW6 Complete Torque Motors**
Order number: 6SN1197–0AC70–0BP0

/PMH/ SIMODRIVE **Sensor** (07.02 edition)
Configuring/Installation Guide (HW)
Hollow–Shaft Measuring System SIMAG H
Order number: 6SN1197–0AB30–0BP1

/PMHS/ SIMODRIVE (12.00 edition)
Installation Guide **Measuring System for Main Spindle Drives**
SIZAG 2 Toothed–Wheel Encoder
Order number: 6SN1197–0AB00–0YP3

/PMS/ SIMODRIVE (02.03 edition)
Planning Guide **ECO Motor Spindle** for Main Spindle Drives
Order number: 6SN1197–0AD04–0BP1

/PPH/ SIMODRIVE (12.01 edition)
Planning Guide **1PH2, 1PH4, 1PH7 Motors**
AC Induction Motors for Main Spindle Drives
Order number: 6SN1197–0AC60–0BP0

/PPM/ SIMODRIVE (11.01 edition)
Planning Guide **Hollow–Shaft Motors**
1PM4 and **1PM6** for Main Spindle Drives
Order number: 6SN1197–0AD03–0BP0

c) Software

/FB1/	SINUMERIK 840D/840Di/810D Description of Functions **Basic Machine (Part 1)** (the various sections are listed below) Order number: 6FC5297–6AC20–0BP3	(11.03 edition)

A2	Various Interface Signals
A3	Axis Monitoring, Protection Zones
B1	Continuous Path Mode, Exact Stop and Look Ahead
B2	Acceleration
D1	Diagnostic Tools
D2	Interactive Programming
F1	Travel to Fixed Stop
G2	Velocites, Setpoint/Actual Value Systems, Closed–Loop Control
H2	Output of Auxiliary Functions to PLC
K1	Mode Group, Channels, Program Operation Mode
K2	Axes, Coordinate Systems, Frames, Actual Value System for Workpiece, External Zero Offset
K4	Communication
N2	EMERGENCY STOP
P1	Transverse Axes
P3	Basic PLC Program
R1	Reference Point Approach
S1	Spindles
V1	Feeds
W1	Tool Offset

/FB2/	SINUMERIK 840D/840Di/810D (CCU2) Description of Functions **Extended Functions (Part 2)** including FM–NC: Turning, Stepper Motor (the various sections are listed below) Order no.: 6FC5297–6AC30–0BP2	(11.02 edition)

A4	Digital and Analog NCK I/Os
B3	Several Operator Panels and NCUs
B4	Operation via PG/PC
F3	Remote Diagnostics
H1	JOG with/without Handwheel
K3	Compensations
K5	Mode Groups, Channels, Axis Replacement
L1	FM–NC Local Bus
M1	Kinematic Transformation
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N3	Software Cams, Position Switching Signals
N4	Punching and Nibbling
P2	Positioning Axes
P5	Oscillation
R2	Rotary Axes
S3	Synchronous Spindles
S5	Synchronized Actions (up to and including SW 3)
S6	Stepper Motor Control
S7	Memory Configuration
T1	Indexing Axes
W3	Tool Change
W4	Grinding

/FB3/

SINUMERIK 840D/840Di/810D (11.02 edition)
Description of Functions **Special Functions (Part 3)**
(the various sections are listed below)
Order number: 6FC5297–6AC80–0BP2

F2	3–Axis to 5–Axis Transformation
G1	Gantry Axes
G3	Cycle Times
K6	Contour Tunnel Monitoring
M3	Coupled Motion and Leading Value Coupling
S8	Constant Workpiece Speed for Centerless Grinding
S9	Setpoint Switching (S9)
T3	Tangential Control
TE0	Installation and Activation of Compile Cycles
TE1	Clearance Control
TE2	Analog Axis
TE3	Master–Slave for Drives
TE4	Transformation Package Handling
TE5	Setpoint Exchange
TE6	MCS Coupling
TE7	Retrace Support
TE8	Path–Synchronous Switch Signal
V2	Preprocessing
W5	3D Tool Radius Compensation

/FBA/

SIMODRIVE 611D/SINUMERIK 840D/810D (11.02 edition)
Description of Functions **Drive Functions**
(the various sections are listed below)
Order number: 6SN1197–0AA80–1BP0

DB1	Operational Messages/Alarm Reactions
DD1	Diagnostic Functions
DD2	Speed Control Loop
DE1	Extended Drive Functions
DF1	Enable Commands
DG1	Encoder Parameterization
DL1	Linear Motor MD
DM1	Calculation of Motor/Power Section Parameters and Controller Data
DS1	Current Control Loop
DÜ1	Monitors/Limitations

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SINUMERIK 840D/SIMODRIVE 611 digital (02.00 edition)
Description of Functions **ANA Module**
Order number: 6SN1197–0AB80–0BP0

/FBD/

SINUMERIK 840D (07.99 edition)
Description of Functions **Digitizing**
Order number: 6FC5297–4AC50–0BP0

DI1	Start–Up
DI2	Scanning with Tactile Sensors (scancad scan)
DI3	Scanning with Lasers (scancad laser)
DI4	Milling Program Generation (scancad mill)

/FBDM/ SINUMERIK 840D/840Di/810D (09.03 edition)
Description of Functions NC Program Management
DNC Machines
Order number: 6FC5297–1AE81–0BP0

/FBDN/ SINUMERIK 840D/840Di/810D (03.03 edition)
Motion Control Information System (MCIS)
Description of Functions **DNC NC Program Management**
Order number: 6FC5297–1AE80–0BP0

DN1 DNC Plant / DNC Cell
DN2 DNC IFC SINUMERIK, NC Data Transfer via Network

/FBFA/ SINUMERIK 840D/840Di/810D (11.02 edition)
Description of Functions **ISO Dialects for SINUMERIK**
Order number: 6FC5297–6AE10–0BP3

/FBFE/ SINUMERIK 840D/840Di/810D (04.03 edition)
Description of Functions **Remote Diagnosis**
Order number: 6FC5297–0AF00–0BP2

FE1 Remote Diagnosis ReachOut
FE3 Remote Diagnosis pcAnywhere

/FBH/ SINUMERIK 840D/840Di/810D (11.02 edition)
HMI Configuring Package
Order number: (supplied with the software)

Part 1 User's Guide
Part 2 Description of Functions

/FBH1/ SINUMERIK 840D/840Di/810D (03.03 edition)
HMI Configuring Package
ProTool/Pro Option SINUMERIK
Order number: (supplied with the software)

/FBHL/ SINUMERIK 840D/SIMODRIVE 611 digital (09.03 edition)
Description of Functions **HLA Module**
Order number: 6SN1197–0AB60–0BP4

/FBIC/ SINUMERIK 840D/840Di/810D (06.03 edition)
Motion Control Information System (MCIS)
Description of Functions **TDI Ident Connection**
Order number: 6FC5297–1AE60–0BP0

/FBMA/ SINUMERIK 840D/810D (08.02 edition)
Description of Functions **ManualTurn**
Order number: 6FC5297–6AD50–0BP0

/FBO/ SINUMERIK 840D/810D (09.01 edition)
Description of Functions **Configuring OP 030 Operator Interface**
Order number: 6FC5297–6AC40–0BP0

BA	Operator's Guide
EU	Development Environment (Configuring Package)
PS	Online only: Configuring Syntax (Configuring Package)
PSE	Introduction to Configuring of Operator Interface
IK	Screen Kit: Software Update and Configuration

/FBP/ SINUMERIK 840D (03.96 edition)
Description of Functions **C–PLC Programming**
Order number: 6FC5297–3AB60–0BP0

/FBR/ SINUMERIK 840D/810D (09.01 edition)
IT Solutions
Description of Functions **Computer Link** (SinCOM)
Order number: 6FC5297–6AD61–0BP0

NFL	Host Computer Interface
NPL	PLC/NCK Interface

/FBSI/ SINUMERIK 840D / SIMODRIVE 611 digital (09.03 edition)
Description of Functions **SINUMERIK Safety Integrated**
Order number: 6FC5297–6AB80–0BP2

/FBSP/ SINUMERIK 840D/840Di/810D (08.03 edition)
Description of Functions **ShopMill**
Order number: 6FC5297–6AD80–0BP1

/FBST/ SIMATIC (01.01 edition)
Description of Functions **FM STEPDRIVE/SIMOSTEP**
Order number: 6SN1197–0AA70–0YP4

/FBSY/ SINUMERIK 840D/840Di/810D (10.02 edition)
Description of Functions **Synchronized Actions**
Order number: 6FC5297–6AD40–0BP2

/FBT/ SINUMERIK 840D/810D (06.03 edition)
Description of Functions **ShopTurn**
Order number: 6FC5297–6AD70–0BP2

/FBTC/ SINUMERIK 840D/810D (01.02 edition)
IT Solutions
SINUMERIK Tool Data Communication SinTDC
Description of Functions
Order number: 6FC5297–5AF30–0BP0

/FBTD/
SINUMERIK 840D/810D (02.01 edition)
IT Solutions
Tool Information Systems (SinTDC) with Online Help
Description of Functions
Order number: 6FC5297–6AE00–0BP0

/FBTP/
SINUMERIK 840D/840Di/810D (01.03 edition)
Motion Control Information System (MCIS)
Description of Functions **TPM Total Productive Maintenance**, Version 3.0
Order number: Document is supplied with the software

/FBU/
SIMODRIVE 611 universal/universal E (07.03 edition)
Closed–Loop Control Component for Speed Control and Positioning
Description of Functions
Order number: 6SN1197–0AB20–0BP7

/FBU2/
SIMODRIVE 611 universal (04.02 edition)
Installation Guide (enclosed with SIMODRIVE 611 universal)

/FBW/
SINUMERIK 840D/840Di/810D (11.02 edition)
Description of Functions **Tool Management**
Order number: 6FC5297–6AC60–0BP1

/HBA/
SINUMERIK 840D/840Di/810D (03.02 edition)
Manual **@Event**
Order number: 6AU1900–0CL20–0BA0

/HBI/
SINUMERIK 840Di (09.03 edition)
Manual
Order number: 6FC5297–6AE60–0BP2

/INC/
SINUMERIK 840D/840Di/810D (06.03 edition)
System Description Commissioning Tool **SINUMERIK SinuCOM NC**
Order number: (an integral part of the online help for the start–up tool)

/PJE/
SINUMERIK 840D/810D (08.01 edition)
Description of Functions **Configuring Package HMI Embedded**
Software Update, Configuration, Installation
Order number: 6FC5297–6EA10–0BP0
(the document PS Configuring Syntax is supplied with the software and available as a pdf file)

/POS1/
SIMODRIVE **POSMO A** (05.03 edition)
User Guide **Distributed Positioning Motor on PROFIBUS DP**
Order number: 6SN2197–0AA00–0BP5

/POS2/ SIMODRIVE **POSMO A** (04.02 edition)
Installation Guide (enclosed with POSMO A)

/POS3/ SIMODRIVE **POSMO SI/CD/CA** (07.03 edition)
User Guide **Distributed Servo Drive Systems**
Order number: 6SN2197–0AA20–0BP5

/POS4/ SIMODRIVE **POSMO SI** (04.02 edition)
Installation Guide (enclosed with POSMO SI)

/POS5/ SIMODRIVE **POSMO CD/CA** (04.02 edition)
Installation Guide (enclosed with POSMO CD/CA)

/S7H/ SIMATIC S7–300 (2002 edition)
– Manual: **CPU data** (Hardware)
– Reference Manual: **Module Data**
– Manual: **Technological Functions**
– Installation Manual
Order number: 6ES7398–8FA10–8BA0

/S7HT/ SIMATIC S7–300 (03.97 edition)
Manual: STEP 7, **Fundamentals**, V. 3.1
Order number: 6ES7 10–4CA02–8BA0

/S7HR/ SIMATIC S7–300 (03.97 edition)
Manual: STEP 7, **Reference Manuals**, V. 3.1
Order number: 6ES7810–4CA02–8AR0

/S7S/ SIMATIC S7–300 (04.02 edition)
FM 353 Positioning Module for Stepper Drive
Order together with configuring package

/S7L/ SIMATIC S7–300 (04.02 edition)
FM 354 Positioning Module for Servo Drive
Order together with configuring package

/S7M/ SIMATIC S7–300 (01.03 edition)
FM 357–2 Multimodule for Servo and Stepper Drives
Order together with configuring package

/SP/ SIMODRIVE **611–A/611–D**
SimoPro 3.1
Program for Configuring Machine–Tool Drives
Order number: 6SC6111–6PC00–0AA□, Order from: WK Fürth

d) Installation and Start–up

/BS/
SIMODRIVE 611 analog (10.00 edition)
Description **Start–Up Software for Main Spindle and Asynchronous Motor Modules Version 3.20**
Order number: 6SN1197–0AA30–0BP1

/IAA/
SIMODRIVE 611A (10.00 edition)
Installation and Start–Up Guide
Order number: 6SN1197–0AA60–0BP6

/IAC/
SINUMERIK 810D (11.02 edition)
Installation and Start–Up Guide
(incl. description of SIMODRIVE 611D start–up software)
Order number: 6FC5297–6AD20–0BP0

/IAD/
SINUMERIK 840D/SIMODRIVE 611 digital (11.02 edition)
Installation and Start–Up Guide
(incl. description of SIMODRIVE 611 digital start–up software)
Order number: 6FC5297–6AB10–0BP2

/IAM/
SINUMERIK 840D/840Di/810D (09.03 edition)
Installation and Start–Up Guide HMI / MMC
Order number: 6FC5297–6AE20–0BP3

AE1	Updates/Supplements
BE1	Expanding the Operator Interface
HE1	Online Help
IM2	Starting up HMI Embedded
IM4	Starting up HMI Advanced
TX1	Creating Foreign Language Texts

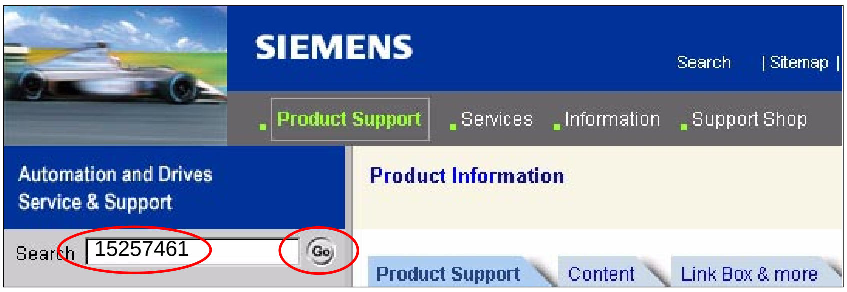
EU Declaration of Conformity

C

In order to provide the most recent version, the EC Declaration of Confirmity 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**.

– Internet address: www.siemens.de/sinumerik > Support > Service > Automation & Drives Service & Support > Product Support > Search: **15257461** > Go



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Suggestions and/or corrections

Overview of SINUMERIK 840Di Documentation (03.2004)

General Documentation

- *SINUMERIK* 840D/810D — Brochure
- *SINUMERIK* 840D/840Di/810D/ — Catalog Ordering Info. NC 60 ***)**
- *SINUMERIK SIROTEC SIMODRIVE* Accessories — Catalog Accessories NC–Z

User Documentation

- *SINUMERIK* 840D/840Di 810D — Operating Instructions **– HT 6**
- *SINUMERIK* 840D/840Di/ 810D — **Diagnostics Guide *)**
- *SINUMERIK* 840D/840Di/ 810D — **Operating Instructions *)**
  – Short Guide
  – HMI Embedded
  – HMI Advanced
- *SINUMERIK* 840D/840Di/ 810D — **Program. Guide**
  – Short Guide
  – Fundamentals ***)**
  – Advanced ***)**
  – Cycles
  – Measuring Cyles
  – ISO Turning/Milling
- *SINUMERIK* 840Di — **System Overview**

Manufacturer/Service Documentation

- *SINUMERIK* 840D/840Di/ 810D — **Description of Functions**
  – Basic Machine ***)**
  – Extended Functions
  – Special Functions
- *SINUMERIK* 840D/840Di/ 810D — Description of Functions **Tool Management**
- *SINUMERIK* 840D/840Di/ 810D — **Operator Components** (HW) ***)**
- *SINUMERIK* 840D/810D — Description of Functions
  – **ManualTurn**
  – **ShopMill**
  – **ShopTurn**
- *SINUMERIK* 840D/840Di/ 810D — Description of Functions **Synchronized Actions**
- *SINUMERIK SIMODRIVE* 840D/840Di/ 810D 611D — **Lists *)** **Lists System Var.**
- *MOTION CONTROL SYSTEMS* — **EMC** directive

Manufacturer/Service Documentation

- *SINUMERIK* 840D/840Di/ 810D — Description of Functions **ISO Dialects** for SINUMERIK
- *SINUMERIK* 840Di — **Manual *)** (HW + Installation and Start–Up)
- *SINUMERIK* 840D/840Di/ 810D — **Manual @ Event**

Electronic Documentation

- *SINUMERIK SIMODRIVE* 840D/840Di/ 810D/ 611D/ Motors — **DOC ON CD *)** The SINUMERIK System

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***)** Recommended minimum scope of documentation

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