Manual 06/2003 Edition

sinumerik

SINUMERIK 840Di

SIEMENS

SIEMENS

SINUMERIK 840Di

Manual

Valid for

Control	*Software version*
SINUMERIK 840DiE/840Di	1.1
SINUMERIK 840DiE/840Di	2.1
SINUMERIK 840DiE/840Di	2.2
SINUMERIK 840DiE/840Di	2.3

06.2003 Edition

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**
09.02	6FC5 297-6AE60-0BP1	**C**
06.03	6FC5 297-6AE60-0BP2	**C**

This manual is included in the documentation available on CD-ROM **(DOCONCD)**

Edition	Order No.	Remarks
11.03	6FC5 298-6CA00-0BG4	**C**

Trademarks
SIMATIC®, SIMATIC HMI®, SIMATIC NET®, SIROTEC®, SINUMERIK® and SIMODRIVE® are Siemens trademarks. The other designations in this publication may also be trade marks, the use of which by third parties may constitute copyright violation.

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

This publication was produced with Interleaf V7.

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. Nonetheless, differences might exist. The information contained in this document is, however, reviewed regularly and any necessary changes will be included in the following edition. We welcome suggestions for improvement.

Subject to technical changes without prior notice

Order No. 6FC5 297-6AE60-0BP2
Printed in Germany

Siemens Aktiengesellschaft

PREFACE

Notes for the Reader

The SINUMERIK documentation is divided into three levels:

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

For more information about the SINUMERIK 840D/810D/FM-NC documentation as well as documentation for all SINUMERIK controls, please contact your local SIEMENS office.

Hotline

If you have any questions about the control, please contact the hotline:

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

Please send any questions about the documentation (suggestions forimprovement, corrections) to the following fax number:
Fax: +49 (9131) 98–2176

Fax form: see reply at the end of the manual

Internet address SINUMERIK

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

SW version

The SW versions stated in the documentation apply for the SINUMERIK 840Di control.

Target readers

- Configuring engineers,
- Electricians and start-up specialists
- Service and operating personnel.

Objective

This manual provides detailed information on the specific hardware and start-up/installation 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 (in particular 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.

Definition: 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 education i.e. authority to switch on and off, to earth and tolabel circuits and devices according to safety technology standards.
- Training and education in maintenance and use of adequate safety equipment according to safety technology standards.
- First aid training.

Warning notes

The following warning notes with graded degrees of importance are used in this documentation: Explanation of symbols

Danger

Indicates an imminently hazardous situation which, if not avoided **will** result in death or serious injury or in substantial property damage.

Warning

Indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury or in substantial property damage.

Caution

Used with the safety alert symbol indicates a potentially hazardous situation which, if not avoided, **may** result in minor or moderate injury or in propertydamage.

Caution

Used without safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Notice

Used without the safety alert symbol indicates a potential situation which, if not avoided, **may** result in an undesirable result or state.

Further notes

Explanation of symbols

!

Important

Important indicates an important or especially relevant item of information.

Notice

Notice refers to an important item of information about the product, handling of the product or part of the documentation which is particularly relevant in the current context.

Machine manufacturer

This symbol appears in this documentation whenever the machine manufacturer can influence or modify the described functional behavior. Please observe the information provided by the machine manufacturer!

Warnings and safety information

To safeguard your own personal safety as well as protect the product described and all connected equipment and machines against damage, please read and observe the following warnings and safety information.

Warning

Operational electrical equipment has parts and components which are athazardous voltage levels.

Allowing **unqualified** persons access to the equipment/system or failure to heed the safety information could result in serious physical injury or substantial property damage. Only properly **qualified personnel** who have been trained to erect, install, start up or operate the product should be allowed to work on theequipment/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 must be used.

Warning

- Repairs to equipment supplied by Siemens must always be carried out by **SIEMENS after-sales service personnel** or by repair centers **authorized by SIEMENS**. Parts or components must always be replaced by parts or components specified in the spare parts list.
- Always disconnect the power supply before you open the unit.
- EMERGENCY STOP devices in compliance with EN 60204 IEC 204 (VDE 0113) must remain operative in all operating modes of the automationdevice. Resetting the EMERGENCY STOP device must not result in any uncontrolled or undefined system restart.
- Wherever faults in the automation device have the potential to cause substantial material damage or even human injury, i.e. they can present adanger, additional external precautions must be taken or devices provided which will guarantee or enforce a safe operating state in the event of a fault (e.g. through independent limit value switches, mech. interlocks, etc.).

Caution

- Connecting and signal leads must be installed such that inductive and capacitive interference cannot impair automation functions.

ESD instructions

Components that can be destroyed by Electrostatic Sensitive Devices

!

Important

Handling of ESD modules:

- When you are handling ESD-sensitive devices, make sure that you, your workplace and the device packaging are grounded well.
- As a general rule, electronic boards should only be touched when absolutely necessary. Never hold PCBs in such a way that you touch the module pins or printed conductors.
- Do not touch ESD-sensitive components unless
  - you are grounded by means of an antistatic wristband,
  - you wear antistatic footwear or ground straps when walking on an antistatic floor.
- Place sensitive modules only on high-resistance, conductive surfaces (table with antistatic surface, conductive antistatic foam or antistatic packaging).
- Do not bring ESD-sensitive modules into the vicinity of visual display units, monitors or TV sets (minimum distance to the 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 ESD-sensitive modules may only be carried out if
  - the measuring equipment is grounded (e.g. via the protective conductor) or
  - in the case of floating measuring instruments, the probe is briefly discharged before a measurement is taken (e.g. through contact with bare control housing).

Proper use

The unit may be used only for the applications described in the catalog, and only in combination with the equipment and components recommended and approved by SIEMENS (e.g. SINUMERIK 840D/FM-NC).

Notes

Contents

General 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.

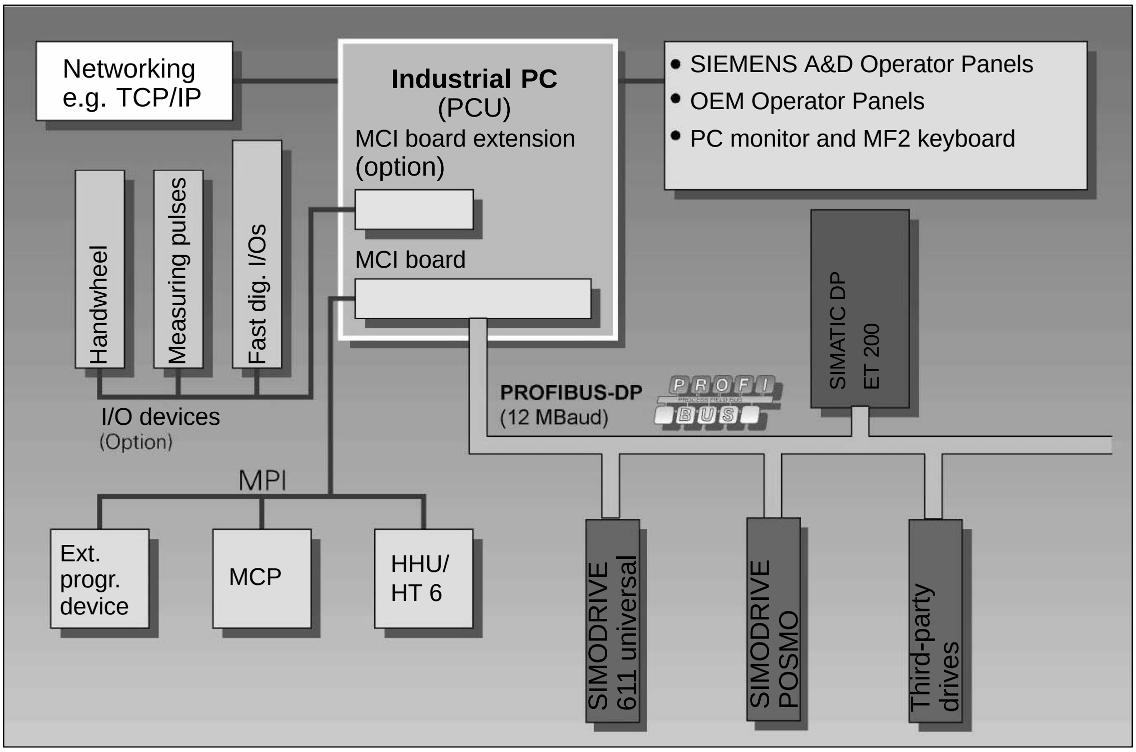


Fig. 1-1 SINUMERIK 840Di System Overview

1.1.1 System software packages and options (SW 2.1 and higher)

System software packages

For optimum adaptation of the SINUMERIK 840Di to the automation task, Siemens can provide various system software packages:

- System software Basic
- System software Universal
- System software Plus (requires PCU variant with CPU ⩾500MHz).

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	1)
Mode groups	1	2	1	2	1	1)
Channels per mode group	1	2	1	2	1	1)

Basic: Number of components available in the basic version
Max.: Maximum possible number of components with additional options
1. SW 2.1 and higher: 4
SW 2.2 and higher: 6

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 2)
Basic version	8ms	8ms	8ms
Adv. Processing 1	1)	4ms	4ms
Adv. Processing 2	1)	1)	2ms

1) Option not available
2) Requires PCU variant with CPU ⩾500MHz

Position controller cycles

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

1.1.2 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 24V power supply:

- PCU 50
  - Pentium II 333MHz, 128MB SDRAM, 2 expansion slots
  - Pentium III 500MHz, 128MB SDRAM, 2 expansion slots
  - Celeron 566MHz, 128MB SDRAM, 2 expansion slots
  - Celeron 1.2GHz, 256MB SDRAM, 2 expansion slots
- PCU 70
  - Pentium III 500MHz, 128MB SDRAM, 4 expansion slots.

PCU Interfaces

The PCU 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 has the following expansion slots:

- PCU 50 and PCU 70
  1x shared ISA/PCI (length: max. 175mm, occupied with option MCI board extension and MCI board extension slot variant)
- PCU 50
  1x PCI (length: max. 265mm, occupied by the MCI board)
- PCU 70
  3x PCI (length: max. 265mm, one occupied by the MCI board).

MCI board

The MCI board is a 2/3 long PCI plug-in card (265mm) with integrated SIMATIC S7-compatible PLC315-2DP as a routing-capable DP master. In addition, it has interfaces for:

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

PROFIBUS DP interface

Drives and external I/Os are connected 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 panel, handheld operator and programming units (e.g. PG 740) are connected through the MPI interface.

MCI board extension (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.

The MCI board extension occupies mechanically one slot in the PCU. The electrical connection, however, is exclusively made using a ribbon cable connected to both sides.

MCI board extension slot variation (option as from 11.00)

The MCI board extension slot variation is an electrically compatible successor version to the MCI board extension module described above. It was extended by the option of operating differential handwheels or TTL handwheels.

MCI board extension external variation (option as from 02.01)

The MCI board extension external variation is a module that is electrically identical with the MCI board extension internally. To free the PCI slot of the PCU, which is normally already taken up, for other purposes, in this variation mechanical fixture is implemented in a modified housing cover of the PCU.

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) “Motion Control with PROFIBUS DP”.

To this aim, Siemens offers the following drives:

– **SIMODRIVE 611 universal**
  with option module **MotionControl with 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).

To this aim, Siemens offers the following drives:

– **SIMODRIVE 611 universal**
  with option module **MotionControl with 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 Axis).**

I/Os

For use as distributed I/Os, the module range **SIMATIC DP ET 200** (for the 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.

1.1.3 Software components

The software basis of the SINUMERIK 840Di consists of the components listed below.

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 NT

The operating system basis of the SINUMERIK 840Di is **Windows NT 4.0**.

Windows NT is the platform on which all applications, such as the individual user interfaces of the **HMI** modular system and the **start-up tools** run.

Since Windows NT, however, is only conditionally real-time capable, as known (in this context, the term “soft real time” is used), SIEMENS has developed a method that allows the operation of the **NC system software** in hard real time, without modifying Windows NT.

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 as they occur in conjunction with machining centers, handling and mounting, up to 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 NT powers up.
- The NCK cyclically runs in the background.
- The current status of the NCK is displayed on the SINUMERIK 840Di standard user interface 840Di start-up:
  Menu command **Window > Diagnostics > NC/PLC.**
- The NCK is automatically quitted when Windows NT is quitted.
- When the NCK is quitted, it will write the SRAM data from NC and PLC to the hard disk of the PCU as a backup copy.
- The maximum portion of NCK computation can be specified using an NC machine data unselect.

Distribution of computation time

Windows NT 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 10-290 “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 1-38) 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** (option)
  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.

  An operator interface configured in this way can only be run if the ProTool/ProRuntime System is installed.
- **SINUMERIK HMI Programming Package**
  The HMI Programming Package can be used to integrate OEM high-level language applications using standardized interfaces (COM/OPC). The OEM provides maximum flexibility for creating operator interfaces using standard development tools (such as Visual C++).

  The HMI Programming Package comprises mainly the description of the interfaces and appropriate sample applications. Detailed information on the OPC interface can be called from the Internet at the address of OPC Foundation (http://www.opcfoundation.org.) .

1.1.4 Real-time properties

As already mentioned, Windows NT 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 in Windows NT as a so-called Kernel mode driver and thus has its own integrated real-time system that parallel to Windows NT provides for the appropriate real-time prerequisites.

Real-time violations

Real-time violations occur when unsuitable PC components 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 a negative influence on the real-time behavior due to too long interrupt disable times or PCI bus disables in conjunction with PCI bus mastering.

With real-time violations exceeding 200μsec, we cannot guarantee that the NC system software will operate correctly. Depending on the size of the real-time violation, an appropriate system reaction will occur:

– Display of an error message

– Alarm with axis stop from the NC

– Alarm and drive-independent axis stop.

The real-time behavior can be monitored using the system diagnosis included in 840Di start-up. (see Section 1.5, Page 1-38) or the NC/PLC diagnosis of the HMI Advanced (see Section 10.10, Page 10-395).

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 amount of processor time used by Windows NT and sporadically 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 switchover

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 from the Windows NT Control Panel. Otherwise a malfunction may occur in the real-time response.

Terminating the NCK

The NCK is integrated in Windows NT as a “LogB Service”. To exit or start the function, go to:

Windows NT start bar: **Start > Settings > Control Panel > Services > “LogB Service” > Exit** or **Start**

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 NT service “LogB Service” in the control panel. Otherwise a malfunction may occur in the real-time response.

1.1.5 System integrity

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

To this aim, the system components used are subject to a certification procedure with Siemens as the system manufacturer. This is to certify and document the compliance with the real-time capability of the whole configuration in important operating modes.

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 expansions

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.

1.1.6 Failure safety

Fatal exceptional error (Blue Screen)

If Windows NT detects a fatal exceptional error during the operation of the NC system software, the following steps are carried out:

- Windows NT will stop.
- An error message will appear on the screen.
- NC and PLC will continue to operate as normally.

- The NC will signal the detected fatal exceptional error to the PLC by means of the interface signal “PC OS fault”.

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

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

Due to the interface signal “PC shutdown”:

- the retentive NC and PLC data are stored
- NC and PLC ended.

Note

For a brief description of the interface signals “PC OS fault” and “PC shutdown”, please refer to Subsection 16.1.1, Page 16-499.

The further sequence is as defined in the Windows NT configuration (settable in the System Properties, tab: Start/shutdown):

- Stop (Blue Screen) (*default*)
- Automatic restart (reboot).

Notice

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

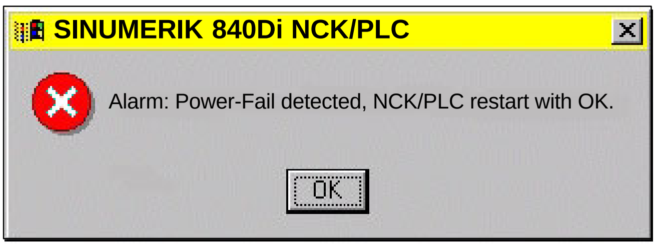
Loss of voltage

A loss of voltage lasting more than five 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 correctly
- The NC and PLC user data are saved in the SRAM of the MCI board.

With the next power-up of the SINUMERIK 840Di, the battery-backed user data are available again. The SINUMERIK 840Di is thus immediately ready again without data loss.

If the power supply is recovered before final shutdown of the PCU, the following message box will be displayed:



Notice

1. Data consistency after a loss of voltage can only be ensured if the **power supply** of the PCU is **at least 24V**.
2. In the remaining time left by the internal power backup, Windows NT can no longer be ended correctly. This implies the risk that the Windows NT installation can be damaged so that the SINUMERIK 840Di can no longer be run. It is therefore urgently recommended to use an **uninterruptible power system (UPS)** (see Subsection 1.1.8, page 1-29).
3. If the MCI board or its battery is replaced after a loss of voltage, 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 6.3.4, page 6-183.

Overtemperature

With the SINUMERIK 840Di, three different temperatures are monitored for reaching their appropriate threshold values:

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”

  When a temperature alarm is issued, the temperature measured for the following components is displayed in the logbook entry: case, CPU module and CPU.

Error causes/remedy

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

If the temperature alarm occurs, the user and/or the machine manufacturer (PLC program) must decide whether he interrupts the machining and quits or turns off the SINUMERIK 840Di.

1.1.7 Power OFF

Windows NT

To guarantee safe operation of the SINUMERIK 840Di, WINDOWS NT must be shut down correctly before the PCU is switched off.

Note

Windows NT is shut down correctly as follows:

- Windows NT start bar: **Start > Shutdown**
- PLC interface signal: “PC shutdown”, see Subsection 16.1.1, page 16-499.

If Windows NT is shut down not correctly, the Windows NT installation can be damaged so that the SINUMERIK 840Di can no longer be operated.

NC and PLC

On correct shutdown of Windows NT 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 NT having been correctly shut down, with the POWER FAIL functionality or the SINUMERIK 840Di:

– end NC and PLC correctly

– save 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 NT, please observe the following:

1. Data consistency of the NC and PLC user data can only be ensured if the **power supply** of the PCU is **at least 24V**.

   References /BH/ Operator Components, Manual
   Chapter: PCU 50

2. In the remaining time left by the internal power backup, Windows NT can no longer be ended correctly. This implies the risk that the Windows NT installation can be damaged so that the SINUMERIK 840Di can no longer be run. It is therefore urgently recommended to use an **uninterruptible power system (UPS)** (see Subsection 1.1.8, page 1-29).

3. If the MCI board or its backup battery is replaced after the PCU has been switched off, 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 6.3.4, page 6-183.

1.1.8 Uninterruptible power system (UPS)

Physical SRAM

The PCU has POWER FAIL detection that, in conjunction with the NC system software, ensures that on a loss of voltage or power-off of the PCU without Windows NT first having been shut down correctly the NC and PLC user data are backed up in the SRAM of the MCI board.

However, in the remaining time left by the internal power backup, Windows NT can no longer be ended correctly.

This can be avoided by using a UPS, e.g. SITOP POWER DC UPS MODULE 15 (see Section 2.11, page 2-90). 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.

During this time, the user can correctly shut down Windows NT manually, or automatically by means of a status message from the UPS to the PLC, which then passes the interface signal “PC shutdown” to the NC.

Virtual SRAM

In conjunction with the virtual SRAM (see Subsection 10.4.3, Page 10-300), it is absolutely necessary to use a UPS system. Furthermore, when parameterizing the time for which the UPS is to maintain the voltage supply, the time required by Windows NT to produce the memory dump to the hard disk of the PCU after detecting a serious exception (Blue Screen) should be considered.

Connection options

The stated UPS has the following options for connections to signal the current status to the SINUMERIK 840Di:

Table 1-1 Connection option of the UPS

Connection	Message to	Comment
1) RS232-interface of the UPS –> serial interface of the PCU (COMx)	Windows NT	Configuration of the UPS functionality is performed using the Windows NT standard function UPS Windows NT task bar: **Start > Settings > Control panel > UPS** Advantage: Also works if the PLC application program is not active. Disadvantage: Does not work in the event of serious exceptions from Windows NT (BlueScreen)
2) Message terminals via free wiring –> S7 I/O inputs	PLC	The UPS functionality is configured using the PLC user program. Advantage: Also works in the event of serious exceptions from Windows NT (BlueScreen) Disadvantage: PLC user program must be active
3) Message terminals via free wiring –> MCI board extension inputs	NC (SW 2.3 and higher)	The UPS functionality is configured using the menu. Settings in HMI Advanced (see Subsection 10.10.2, Page 10-399). Advantage: Also works in the event of serious exceptions from Windows NT (BlueScreen) and not if the PLC application program is active. Prerequisite: MCI board extension (option)
Notes Re.: 3) For details of the start/up behavior of SINUMERIK 840Di with shutdown signal present, refer to Subsection 6.3.9, Page 6-187.		

Notice

One of the follwoing connection variants must be used for full back-up protection:

– Variant 1: Connection **1)** and **2)**

or

– Variant 2: Connection **3)**

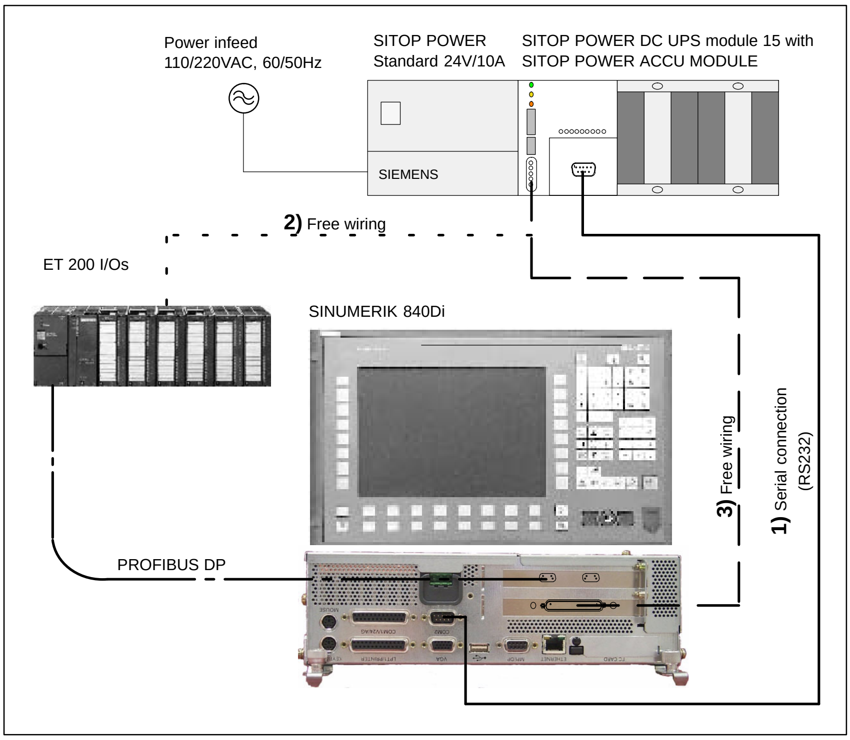


Fig. 1-2 Connection options: UPS

1.2 Overview of software components

SINUMERIK 840Di System software

A range of different system software packages are available for the SINUMERIK 840Di system:

- **Basic system software**
  maximum of 6 axes
  Order No.: see Table 1-2
- **Universal system software**
  maximum of 10 axes
  Order No.: see Table 1-2
- **Plus system software**
  maximum of 18 axes
  Order No.: see Table 1-2

Table 1-2 Order numbers for the SINUMERIK 840Di system software

System software		Order No.	PCU hardware				
			PCU 50 333MHz	PCU 50 500MHz	PCU 50 566MHz	PCU 50 1.2GHz	PCU 70 500MHz
Basic	Standard 840Di	6FC5 258-□AX10-□A□□	✓	✓	✓	✓	✓
	Export 840DiE	6FC5 258-□AY10-□A□□	✓	✓	✓	✓	✓
Universal	Standard 840Di	6FC5 258-□AX20-□A□□	✓	✓	✓	✓	✓
	Export 840DiE	6FC5 258-□AY20-□A□□	✓	✓	✓	✓	✓
Plus	Standard 840Di	6FC5 258-□AX30-□A□□	–	✓	✓	✓	✓
	Export 840DiE	6FC5 258-□AY30-□A□□	–	✓	✓	✓	✓

□ 6FC5 258-**0** . . .-**0**A**F0**, current software version on the hard disk
6FC5 258-***X*** . . .-***Y***A**F0**, specific software version on the hard disk
6FC5 258-**0** . . .-**0**A**G2**, software maintenance/update service on CD-ROM
6FC5 258-***X*** . . .-***Y***A**G3**, update when order placed, specific software version, on CD-ROM
specific software version: e.g. 2.1: ***X*** = 2, ***Y*** = 1
for more detailed information, please refer to: Ordering information Catalog NC 60
✓ possible
– not possible

Additional software components

The following software components are included in the scope of delivery of the SINUMERIK 840Di system and are either installed on the PCU hard disk or provided on CD for installation:

Basic software

The basic SINUMERIK 840Di software encompasses the following components:

- **Basic PCU software**
  - Windows NT 4.0
  - Service menu
  - PCU-specific drivers

  (installed)
- **Basic 840Di software**
  - 840Di start-up
  - NCK-specific real-time drivers

    – 840Di-specific MPI drivers

  (installed)

- – **Basic HMI software**
    – HMI-specific display and communications drivers

  (installed)

Engineering Tools

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

- – **SinuCom NC**
  Start-up tool for SINUMERIK 840Di NC
  (installed)
- – **SIMODRIVE 611 universal tool box**
  Contents:
    - – SimoCom U
      Start-up tool for SIMODRIVE 611 universal / E and SIMODRIVE POSMO SI, CD/CA drives
      (installed/must still be installed: F:\SimoComU\<version>\Setup.exe)
    - – SIMODRIVE 611 universal drive firmware
      (firmware file: F:\Sys611U\<version>\611u.ufw)
    - – SIMODRIVE 611 universal option module: “Motion Control with PROFIBUS DP” firmware
      (firmware file: F:\611UToolbox\dpc31\<version>\v1sl.ufw)
    - – SIMODRIVE POSMO SI, CD/CA drive firmware
      (firmware file: F:\SysPosmo\<version>\posmo.ufw)

SIMATIC S7 AddOn software

The SIMATIC S7 AddOn software contains sample programs and sample applications:

- SIMATIC S7-AddOn software
    - – **PLC Toolbox**
      Contents:
        - – Basic PLC program
        - – NC variable selector
        - – PLC sample programs

      (installation software: F:\840DiTools\plcToolbox\<version>\Setup.exe)
    - – **DriveOM** and **SlaveOM** for SINUMERIK 840Di
      Object Manager for the dialog-based configuration of PROFIBUS DP drives using SIMATIC Manager STEP7 especially for SINUMERIK 840Di.
      (DriveOM installation software: F:\840DiTools\support\DriveOM\setup.exe)
      (SlaveOM installation software: F:\840DiTools\support\slaveom\setup.exe)
    - – **DMF file** for **I/O module PP72/48**
      Device master file with the required information in the ASCII format for integration of the I/O module PP72/48 into a SIMATIC S7 project as DP slave.
      (DMF file: F:\840DiTools\siem80a2.gsd)

– **Sample PLC application**
  Sample application of a SIMATIC S7 project for SINUMERIK 840Di with SIMODRIVE 611 universal drives and SIMATIC ET200 I/Os
  (ZIP file: F:\840DiTools\support\840dibsp\840dibsp.zip)

Note

The components supplied as SIMATIC S7 add-on software

– Basic PLC program
– DriveOM
– SlaveOM

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

Note

Before installing the software, please read the information (*.txt, *.rtf, *.wri) contained in the directory of the respective application.

1.3 Notes on start-up

The present SINUMERIK 840Di manual describes the start-up of the following components:

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

For the start-up of the components used in conjunction 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

It is recommended to carry out the start-up of the SINUMERIK 840Di in the order of the sections of the present 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**
  - **Basic PLC 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**: Version 5, Service Packs 1 and 2.

Additional hardware

To start up the SINUMERIK 840Di, the following hardware components are additionally 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 STEP7 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 15-455.

Documentation

The following documentation is required for start-up:

- /BH/ Operator Components Manual
  - SINUMERIK Operator Panels
  - SINUMERIK Industrial PCs
  - Machine Control Panels
  - Handheld Operator and Programming Units.

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

Duty to obtain an export approval

Since certain control functions require an export approval acc. to the German Export List, the SINUMERIK 840Di is offered 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 four axes
- 5-axis machining package
- Helix interpolation 2D + n (n greater than 2)
- OEM package

The following restrictions apply to useable options:

- 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 the SINUMERIK Order Catalog NC 60.

Although the relevant option bits can be set, they are not effective (alarm when programming these functions). With regard to its **type**, the export version does not require an export approval.

(This does not pertain to an export approval that may result from the **intended purpose of application**, and this can additionally result.)

The configuration of the control system is determined by the system software that is offered in two versions (standard and export), i.e. the duty to obtain an approval for the system software (for the relevant information, see delivery note and/or invoice) is transferred to the control system with the particular installation.

This must also be observed, in particular, in the case of updates/upgrades of the system software, since this may have an influence on the duty to obtain an export approval.

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 they must be stuck into the control logbook. In the case of license orders, an appropriate number of adhesive labels is supplied, which must be handled in the same manner.

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

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

The identification of the control variation obtained by these measures is important for service personnel and can also be helpful in providing evidence of conformance for exports, in particular when making use of the negative certificates that are 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 a first introduction to the 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. in all cases, only the functions are offered which are possible, depending on the window currently active.

Example:

- The parts program management window is selected. The menu command **Edit** provides the following functions:
  – Copy
  – Insert
  – 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	
Main screen	
General data	Display of: – Channel state – Program state
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 as they occurred in time order

Menu command	Functionality
Parts programs	• Management of parts programs Menu command **File** – New ... – Open – Delete – Exit Menu command **Edit** – Copy – Insert – Load – Unload. – Select • Editing parts programs: – Menu command **File > Open** – **Double-click** with the left mouse button on the file
Editor	Editing files Start the editor with: – Menu command **File > Open** – **Double-click** with the left mouse button on the file Menu command **File** – Open – Close – Cut – Exit Menu command **Edit** – Copy – Insert – 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 at 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

■

Notes

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 Pentium II 333MHz, 128MB RAM and MCI board, 24V power supply
  Order No.: 6FC5 220-0AA00-1AA0
- **SINUMERIK 840Di**
  PCU 50 with Pentium III 500MHz, 128MB RAM and MCI board, 24V power supply
  Order No.: 6FC5 220-0AA01-1AA0
- **SINUMERIK 840Di**
  PCU 50 with Celeron 566MHz, 128MB RAM and MCI board,
  24V power supply
  Order No.: 6FC5 220-0AA20-0AA0
- **SINUMERIK 840Di**
  PCU 50 with Celeron 1.2GHz, 256MB RAM and MCI board,
  24V power supply
  Order No.: 6FC5 220-0AA22-0AA0
- **SINUMERIK 840Di**
  PCU 70 with Pentium III 500MHz, 128MB RAM and MCI board,
  24V power supply
  Order No.: 6FC5 220-0AA02-1AA0

SINUMERIK 840Di: Spare parts

The following hardware components are available as spare parts:

- **SINUMERIK PCU 50**
  Pentium II 333MHz, 128MB RAM and Windows NT 4.0 US,
  24V power supply
  Spare part Order No.: 6FC5 210-0DF01-0AA0
- **SINUMERIK PCU 50**
  Pentium III 500MHz, 128MB RAM and Windows NT 4.0 US,
  24V power supply
  Spare part Order No.: 6FC5 210-0DF05-0AA0
- **SINUMERIK PCU 50**
  Celeron 566MHz, 128MB RAM and Windows NT 4.0 US,
  24V power supply
  Spare part Order No.: 6FC5 210-0DF20-0AA0
- **SINUMERIK PCU 50**
  Celeron 1.2GHz, 256MB RAM and Windows NT 4.0 US,
  24V power supply
  Spare part Order No.: 6FC5 210-0DF22-0AA0

- **SINUMERIK PCU 70**
  Pentium III 500MHz, 128MB SDRAM and Windows NT 4.0 US, 24V power supply
  Spare part Order No.: 6FC5 210-0DF04-0AA0
- **MCI board**
  Spare part Order No.: 6FC5 222-0AA00-1AA0
- **Backup battery** for MCI board
  Spare part Order No.: 6FC5 247-0AA18-0AA0

Optional components

The following hardware components can be ordered as options:

Expansion of the Motion Control Interface

- SINUMERIK 840Di **MCI Board Extension**
  Order number: 6FC5 222-0AA00-0AA0
- SINUMERIK 840Di **MCI Board Extension Slot Variation**
  Order number: 6FC5 222-0AA00-0AA1
- SINUMERIK 840Di **MCI Board Extension External Variation**
  Order number: 6FC5 222-0AA01-0AA0

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. 0.5m interconnecting cable
  Order number: 6FC5 235-0AA05-0AA1

Power supply of the PCU

- **SITOP POWER standard 24V/10A**
  Order No.: 6EP1 334-1SH01

Uninterruptible power supply (UPS)

- **SITOP POWER DC UPS module 15**
  Order No.: 6EP1 931-2EC11
- **SITOP POWER ACCUMODULE 24VDC/10A/3,2AH**
  Order No.: 6EP1 935-6MD11

PROFIBUS DP Modules

S7 I/O modules

- **SIMATIC ET 200** (distributed I/O system)
  You will find detailed ordering information:

  References: /ST7/ SIMATIC S7 Programmable Logic Controllers
  Catalog ST 70

- **I/O Modules 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 with 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 60.2002

2.2 MCI board

2.2.1 Module

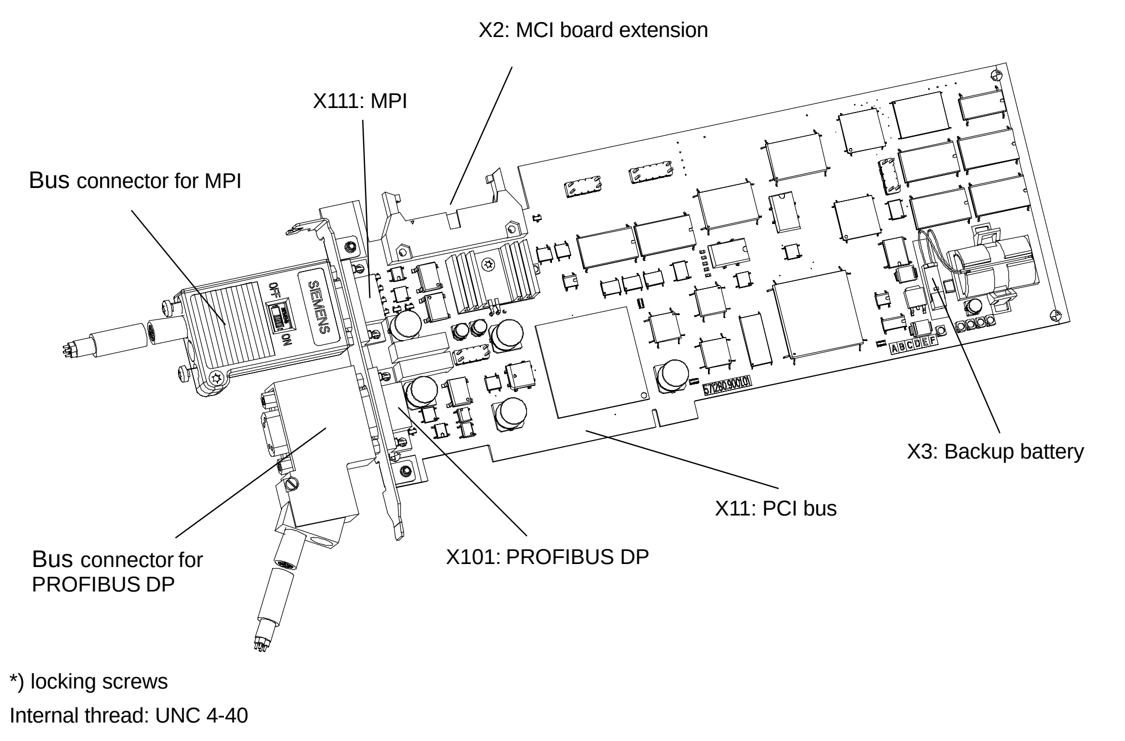


Fig. 2-1 MCI board with bus connector

**Order No.:
MCI board**

Designation	Order No. (MLFB)
MCI board (as a spare part)	6FC5 222-0AA00-1AA0

Caution

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

Order No.: bus connector

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

Order No.: Backup battery

Designation	Order No. (MLFB)
Backup battery	6FC5 247-0AA18-0AA0

Notice

For MPI connection on the MCI board, you **must** use a connector with straight cable outlet (180°).

2.2.2 Interface description

Interface overview

Interfaces of the MCI board module

Table 2-1 Interface overview: MCI board

Interface	Designation	Type
PROFIBUS DP	X101	Socket connector
MPI	X111	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	Designation	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	Designation	Type 1)	Function
1	Not assigned	–	–
2	Not assigned	–	–
3	RS-DP	B	RS-485 differential signals
4	RTS	O	Request to Send
5	GNDext	VO	External ground 2)
6	P5ext	VO	Ext. 5V power supply 2)
7	Not assigned	–	–
8	XRS DP	B	RS-485 differential signals
9	Not assigned	–	–
1st VO Voltage Output O Output B Bidirectional 2) Pins 5 and 6 are only allowed to be used to supply power to the bus terminators			

- Connection cable
  see Subsection 3.3.1, Page 3-131.

MPI interface (X111)

Interface description MPI interface (X111):

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

Table 2-4 Pin assignment: MPI interface (X111)

Pin	Designation	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. 5V 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) Pins 5 and 6 are only allowed to be used to supply power to the bus terminators

- Connection cable
see Subsection 3.3.1, Page 3-131.

Notice

The MPI and PROFIBUS DP interfaces are isolated both to one another and with regard to the PCU.

2.2.3 Changing the battery

Battery type

3V lithium battery

Order No.

Designation	Order No. (MLFB)
Backup battery	6FC5 247-0AA18-0AA0

Service life

Typical battery service life: > 3 years

General rules for handling

Please observe the following general rules when handling batteries:

- Do not charge them!
- Do not heat or burn them!
- Do not drill or squeeze them!
- Do not manipulate them in any other fashion neither mechanically, nor electrically!

Caution

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

Criteria for changing the battery

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

Battery voltage	Message
2.7 ... 2.9V	Alarm: “2100 NCK battery warning threshold reached”
2.4 ... 2.6V	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.

Changing the battery

To avoid data loss, the battery on the MCI board should be changed at the latest if the alarm “2100 NCK battery warning threshold reached” has occurred for the first time.

Warning

When operating electrical devices, certain parts of these devices are inevitably under hazardous voltage.

Improper handling of these devices may therefore result in loss of life, severe personal 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 accordingly qualified personnel.
– Before starting any maintenance and service work, disconnect the device from mains.
– Use only spare parts approved by the manufacturer.
– 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. To do so, touch an earthed, conductive object (e.g. blank cubicle parts, socket protection contact) immediately before starting work on the module.

In order to change the battery, proceed as follows:

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

   For information on how to create a series machine start-up file, please refer to Chapter 14, Page 14-449.

2. Shut down the SINUMERIK 840Di and Windows NT correctly.
   To do so, use one of the following possibilities:

   - Windows NT taskbar: Start > Shut Down
   - Interface signal: “PC shutdown”; see Subsection 16.1.1, page 16-499

3. Disconnect your PC from mains.

4. Remove the screws from the cover of the housing (Fig. 2-2) and open the housing of your PC, observing the relevant safety regulations.

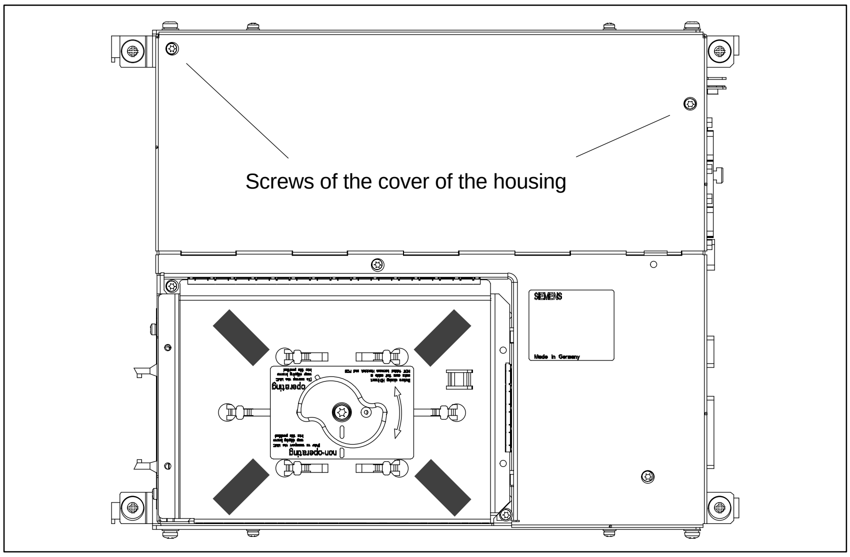


Fig. 2-2 Cover of the housing of the PCU 50

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.

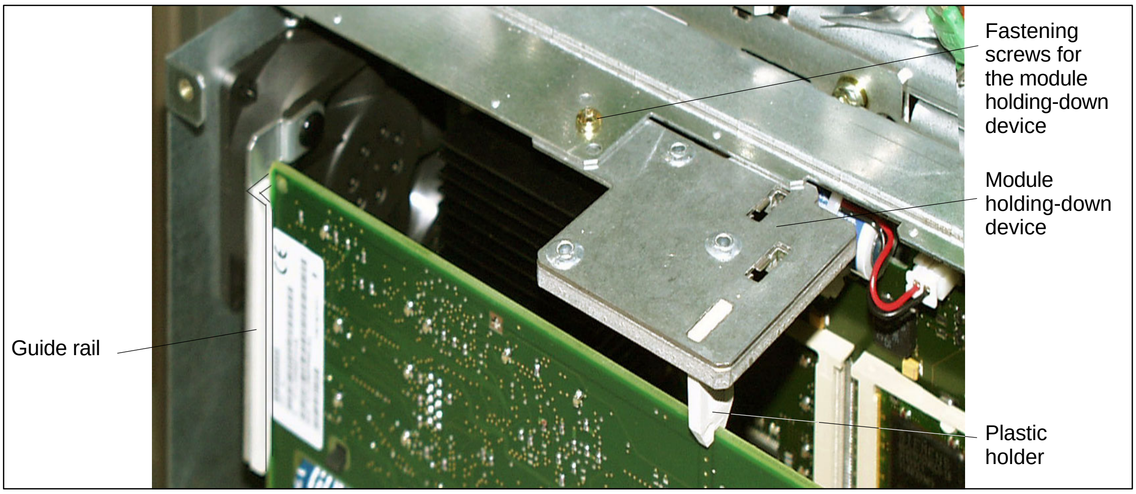


Fig. 2-3 Mounting of the module

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

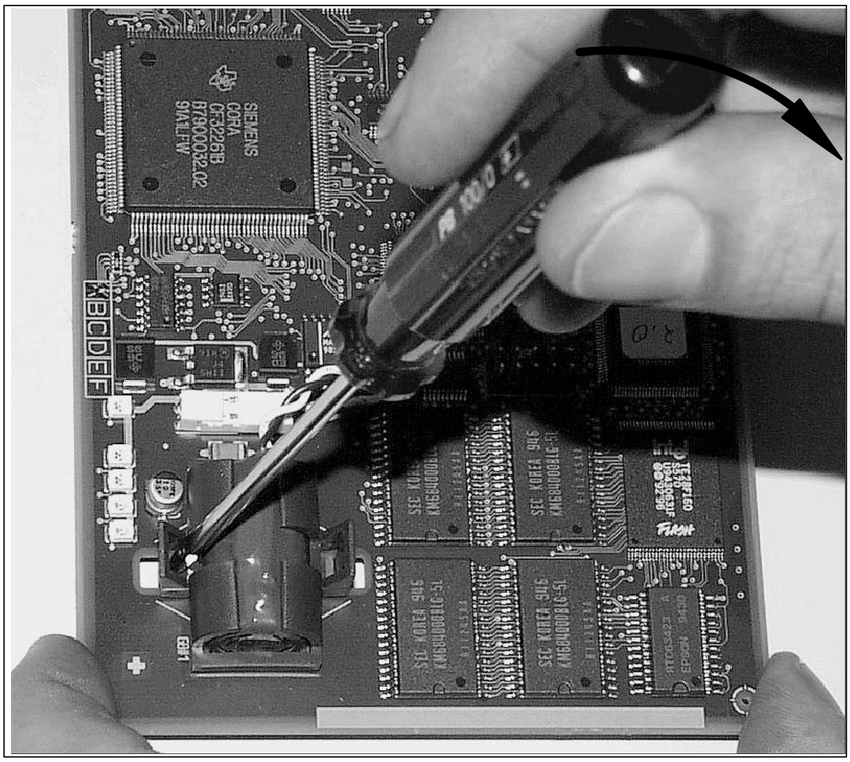


Fig. 2-4 Remove the battery receptacle

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).

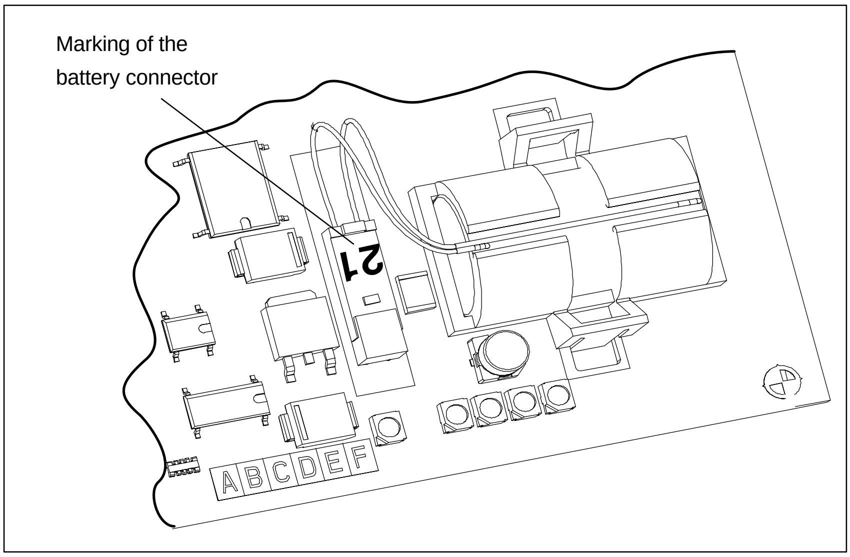


Fig. 2-5 Battery connector

13. Locate the battery on the module using the battery receptacle.
    Note:
    The clamps must lock into place 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 module holding-down device.
16. Close the cover plate of the housing of your PC and fasten it using the two housing screws.
17. Connect your PC to mains again and start it.

2.2.4 Module replacement

For module replacement, a module is installed and removed in an analogous way to changing the battery (see Subsection 2.2.3, page 2-50).

2.2.5 Technical Data

Safety		
Degree of protection	IP 20	
Class of protection	Class of protection I, acc. to VDE 0106 P1: 1982 (IEC 536)	
Safety regulations	EN61131-1	
Certifications	CE, UL, CSA	
Power consumption	**5V**	**3.3V**
Typically	4.7W	50mW
Max.	6W	200mW
Mechanical data		
Dimensions	PCI card, 2/3 length	
Weight	198g	
Climatic environmental conditions		
Heat dissipation	Open-circuit cooling	
Temperature limit values	**Operation**	**Storage/transportation**
– 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	
Limit values of rel. humidity	5 ... .80%	5 ... .95%
Tested to	DIN IEC 68-2-30	
	per min.	**per hour**
Temperature change	max. 1K	max. 10K
Condensation	not admissible	
Quality assurance	acc. to ISO 9001	
Vibrational load during operation		
Class	3M4	
Frequency range	10 ... 58Hz/58... 200Hz	
Const. excursion/acceleration	0.075mm / 1g	
Tested to – module in PCU 50	DIN EN 60068-2-6	
Shock load during operation		
Acceleration	50m/sec^2	
Duration of nominal shock	30msecs	
Tested to – module in PCU 50	DIN EN 60068-2-6	

Notice

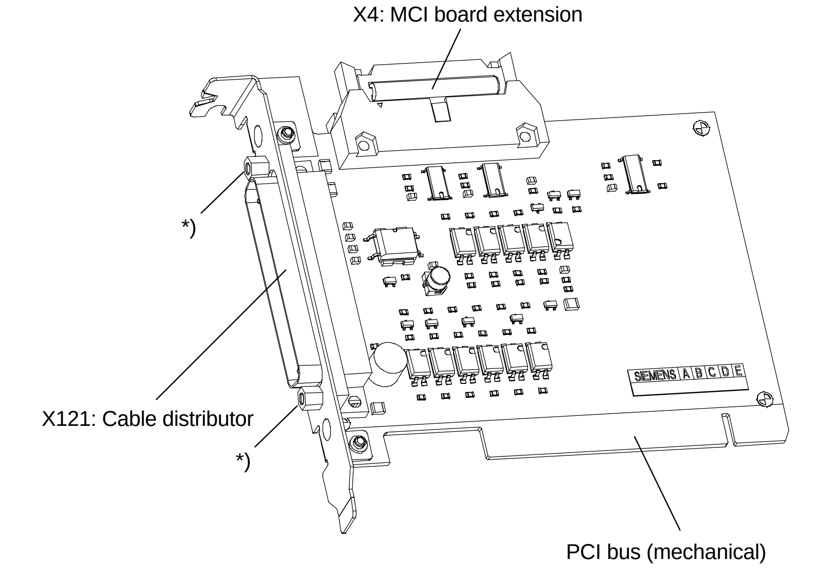
The specified safety regulations, certifications, degree of protection and class of protection only apply for the case that the module is plugged in a SINUMERIK PCU 50.

2.3 MCI board extension

2.3.1 Module

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

- Four binary inputs (isolated)
- Four binary outputs (isolated)
- Two measuring inputs (isolated)
- Two handwheels (non-isolated).



*) locking screws
Internal thread: UNC 4-40

Fig. 2-6 MCI board extension

Order number:

Designation	Order No. (MLFB)
MCI board extension (option)	6FC5 222-0AA00-0AA0

Caution

Never **plug** or **remove the cable distributor** at the X121 interface of the module under **voltage**.

Before you plug or remove the cable connector, switch off the PCU (shut down Windows NT correctly!). Otherwise, short circuits might occur on the module, as a result of which the module could be destroyed.

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.

Installation

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

Warning

When operating electrical devices, certain parts of these devices are inevitably under hazardous voltage.

Improper handling of these devices may therefore result in loss of life, severe personal 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 accordingly qualified personnel.

– Before starting any maintenance and service work, disconnect the device from mains.

– Use only spare parts approved by the manufacturer.

– 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. To do so, touch an earthed, conductive object (e.g. blank cubicle parts, socket protection contact) immediately before starting work on the module.

---

1. Shut down the SINUMERIK 840Di and Windows NT correctly.
   To do so, use one of the following possibilities:
   - Windows NT taskbar: Start > Shut Down
   - Interface signal: “PC shutdown”; see Subsection 16.1.1, page 16-499
2. Disconnect your PC from mains.
3. Remove the screws from the cover of the housing (Fig. 2-7) and open the housing of your PC, observing the relevant safety regulations.

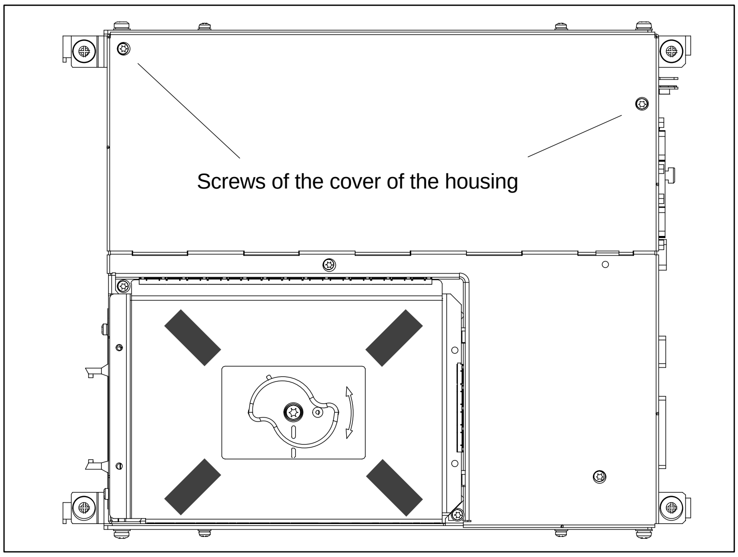


Fig. 2-7 Cover of the housing of the PCU 50

4. Remove the fastening screw of the module holding-down device (Fig. 2-8) of the MCI board and remove the module holding-down device.

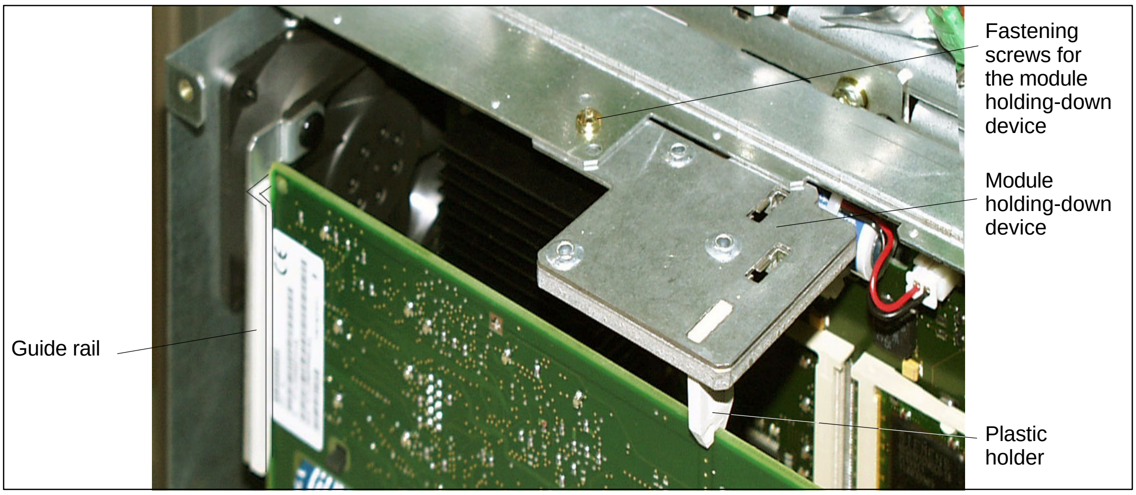


Fig. 2-8 Fixing the MCI board

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

Table 2-5 Interfaces of the MCI board

Interface description	Connector designation	Connector type
Cable distributor	X121	37-pin Sub-D connector
MCI board extension	X4	26-pin plug connector

Pin assignment: X121 Cable distributor

Maximum cable length: 25m for all functions

Special features: Four binary inputs (isolated)
Four binary outputs (isolated)
Two measuring inputs (isolated)
Two handwheels (non-isolated)

Table 2-6 Pin assignment of connector X121

Pin	Signal designation	Signal type	Pin	Signal designation	Signal type
1	M24EXT	VI	20	P24EXT	VI
2	M24EXT	VI	21	P24EXT	VI
3	OUTPUT 1	O	22	OUTPUT 3	O
4	OUTPUT 0	O	23	OUTPUT 2	O
5	INPUT 3	I	24	MEXT	VI
6	INPUT 2	I	25	MEXT	VI
7	INPUT 1	I	26	MEXT	VI
8	INPUT 0	I	27	MEXT	VI
9	MEPUS 0	I	28	MEPUS 1	I
10	MEPUC 0	I	29	MEPUC 1	I
11	MPG1 XA	I	30	MPG1 A	I
12	MPG1 5V	VO	31	MPG1 0V	VO
13	MPG1 5V	VO	32	MPG1 0V	VO
14	MPG1 XB	I	33	MPG1 B	I
15	MPG0 XA	I	34	MPG0 A	I
16	MPG0 5V	VO	35	MPG0 0V	VO
17	MPG0 5V	VO	36	MPG0 0V	VO
18	MPG0 XB	I	37	MPG0 B	I
19	Not assigned				

Signal designations

MPGs 0, 1 5V	Supply voltage 1 / 2nd Handwheel 0, 5V
MPG 0, 1 0V	Supply voltage 1 / 2nd Handwheel 0 V
MPG 0, 1 A, XA	1st / 2nd Differential handwheel input, A, XA
MPG 0, 1 B, XB	1st / 2nd Differential handwheel input, B, XB
MEPUS 0, 1	1. / 2nd Sensor probe input (signal: 24V)
MEPUC 0, 1	1st / 2nd Sensor probe input, (reference: 0V)
INPUT [0...3]	1st to 4th Binary NC input ...
GNDEXT	External ground (reference ground for binary NC inputs)
OUTPUT [0...3]	1st to 4th Binary NC output
M24EXT	External 24V supply (–) for binary NC outputs
P24EXT	External 24V supply (+) for binary NC outputs

Signal type

O	Output
VO	Voltage Output
I	Input
VI	Voltage Input

Notice

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

2.3.4 Technical Data

Table 2-7 Technical data for MCI board extension

Safety		
Degree of protection	IP 20	
Class of protection	Class of protection I, acc. to VDE 0106 P1: 1982 (IEC 536)	
Safety regulations	EN61131-1	
Certifications	CE, UL, CSA	
Electrical data		
	Max.	typical
Power consumption without I/Os	500mW	350mW
Power consumption with I/Os	2.1W	85 0mW
	both handwheels	per handwheel
Max. current-carrying capacity of the 5V power supply	1A	500mA
Mechanical data		
Dimensions	Short PCI card	
Weight	110g	
Climatic environmental conditions		
Heat dissipation	Open-circuit cooling	
	Operation	**Storage/transportation**
Temperature limit 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	
Limit values of rel. humidity	5 ... .80%	5 ... .95%
Tested to	DIN IEC 68-2-30	
	per min.	**per hour**
Temperature change	max. 1K	max. 10K
Condensation	not admissible	
Quality assurance	acc. to ISO 9001	
Vibrational load during operation		
Class	3M4	
Frequency range	10 ... 58Hz/58... 200Hz	
Const. excursion/acceleration	0.075mm / 1g	
Tested to – module in PCU 50	DIN EN 60068-2-6	
Shock load during operation		
Acceleration	50m/sec^2	
Duration of nominal shock	30msecs	
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 for the case that the module is plugged in a SINUMERIK PCU 50.

2.4 MCI board extension slot variation (SW 11.00 and higher)

The MCI board extension slot variation is an electrically compatible successor version of the MCI board extension module described in Section 2.3, page 2-56. The module has been extended by the option of operating differential handwheels or TTL handwheels.

2.4.1 Module

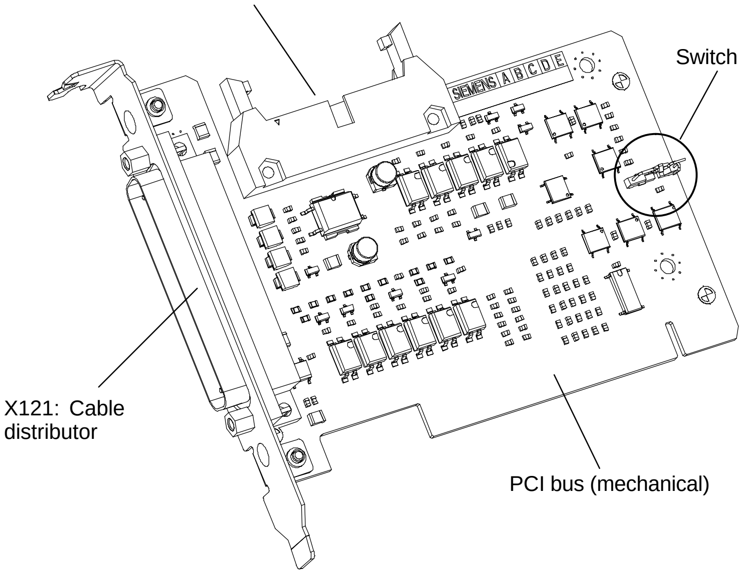


Fig. 2-9 MCI board extension slot variation

Order number:

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

Caution

Never **plug** or **remove the cable distributor** at the X121 interface of the module under **voltage**.

Before you plug or remove the cable connector, switch off the PCU (shut down Windows NT correctly!). Otherwise, short circuits might occur on the module, as a result of which the module could be destroyed.

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 handwheel:
  Switch S1 open.

Differential or TTL handwheels can only be operated alternately.

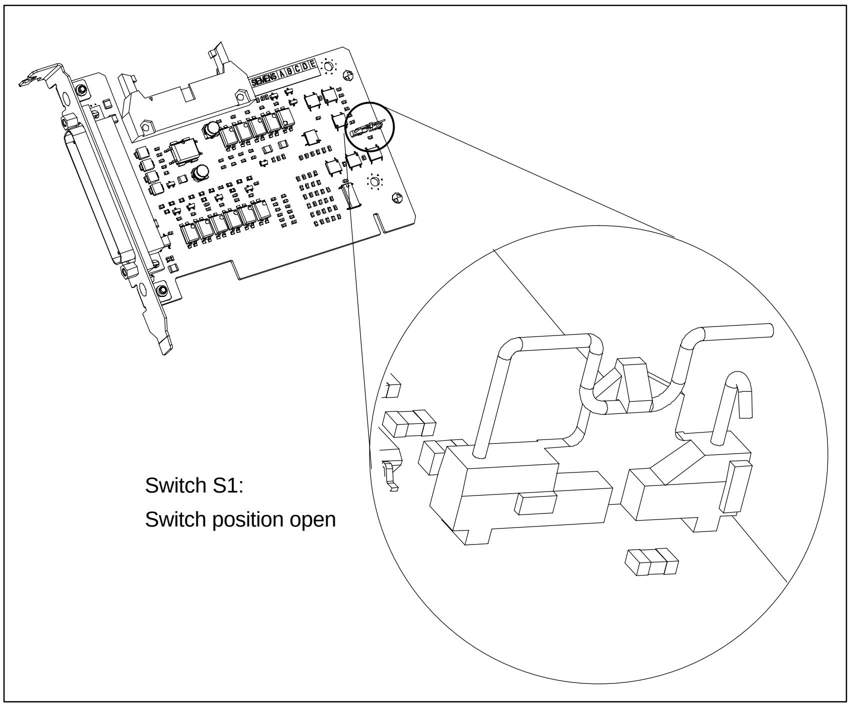


Fig. 2-10 Switch S1 switch position open (TTL handwheels)

Notice

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

2.4.2 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.

Installation

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

Warning

When operating electrical devices, certain parts of these devices are inevitably under hazardous voltage.

Improper handling of these devices may therefore result in loss of life, severe personal 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 accordingly qualified personnel.

– Before starting any maintenance and service work, disconnect the device from mains.

– Use only spare parts approved by the manufacturer.

– 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. To do so, touch an earthed, conductive object (e.g. blank cubicle parts, socket protection contact) immediately before starting work on the module.

---

1. Shut down the SINUMERIK 840Di and Windows NT correctly.
   To do so, use one of the following possibilities:
   - Windows NT taskbar: Start > Shut Down
   - Interface signal: “PC shutdown”; see Subsection 16.1.1, page 16-499
2. Disconnect your PC from mains.
3. Remove the screws from the cover of the housing (Fig. 2-11) and open the housing of your PC, observing the relevant safety regulations.

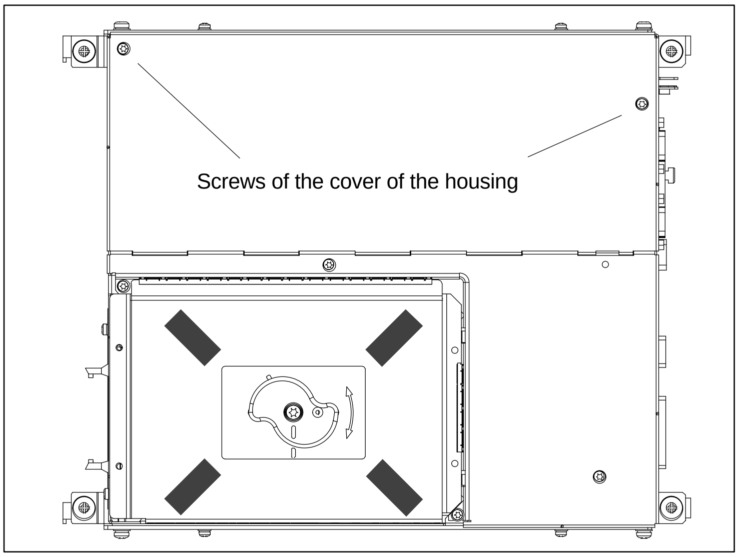


Fig. 2-11 Cover of the housing of the PCU 50

4. Remove the fastening screw of the module holding-down device (Fig. 2-12) of the MCI board and remove the module holding-down device.

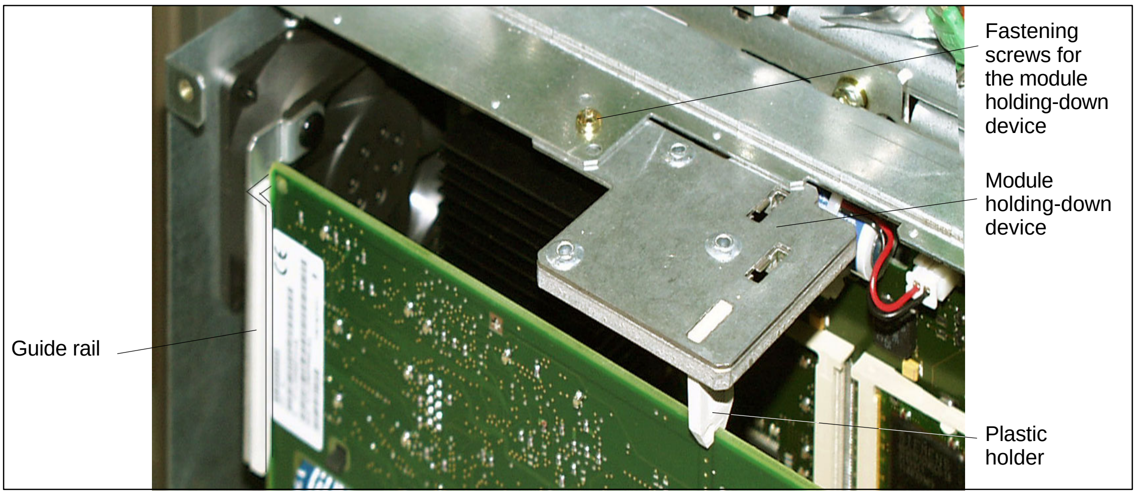


Fig. 2-12 Fixing the MCI board

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.

2.4.3 Interface description

Interface overview

Interfaces of the MCI board extension slot variation

Table 2-8 Interfaces of the MCI board extension slot variation

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

Cable distributor (X121)

Interface description of the cable distributor interface (X121):

- Connector: 37-way Sub D connector
  (see cable distributor Section 2.6, page 2-76)
- Pin assignment:

Table 2-9 Pin assignment: Interface X121

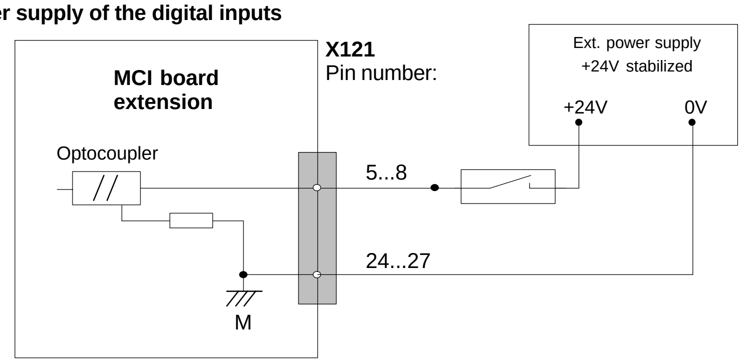
Pin	Designation	Type [1)]	Function
1	M24EXT	VI/VO	24V ground, 24V output ground
2	M24EXT	VI/VO	24V ground, 24V output ground
3	DOUT_CON(1)	O	2nd 24V output
4	DOUT_CON(0)	O	1st 24V output
5	DIN_CON(3)	I	4th 24V input
6	DIN_CON(2)	I	3rd 24V input
7	DIN_CON(1)	I	2nd 24V input
8	DIN_CON(0)	I	1st 24V input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

Table 2-9 Pin assignment: Interface X121

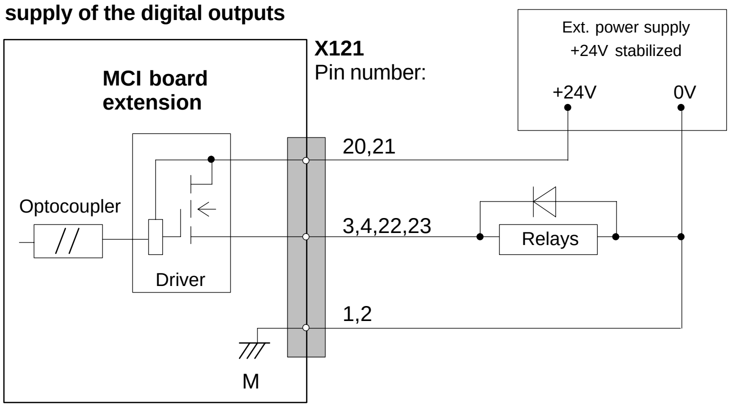
Pin	Designation	Type 1)	Function
30	MPG1_A	I	input 2nd Input handwheel, track A
31	M	VO	Hand wheel PS ground, TTL handwh. ground
32	M	VO	Hand wheel PS ground, TTL handwh. ground
33	MPG1_B	I	input 2nd Input handwheel, track B
34	MPG0_A	I	input 1st Input handwheel, track A
35	M	VO	Hand wheel PS ground, TTL handwh. ground
36	M	VO	Hand wheel PS ground, TTL handwh. ground
37	MPG0_B	I	input 1st Input 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 25m for all functions.

Digital inputs

Please note the following points about the digital inputs:

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

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

Notice

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

Sensor probes

Please note the following points about sensor probes:

– The sensor probes are isolated among themselves 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.

2.4.4 Technical Data

Table 2-10 Technical data for MCI board extension, slot version

Safety		
Degree of protection	IP 20	
Class of protection	Class of protection I, acc. to VDE 0106 P1: 1982 (IEC 536)	
Safety regulations	EN61131-1	
Certifications	CE, UL, CSA	
Electrical data		
	Max.	typical
Power consumption without I/Os	500mW	350mW
Power consumption with I/Os	2.1W	850mW
	both handwheels	per handwheel
Max. current-carrying capacity of the 5V power supply	1A	500mA
Mechanical data		
Dimensions	Short PCI card	
Weight	110g	
Climatic environmental conditions		
Heat dissipation	Open-circuit cooling	
	Operation	**Storage/transportation**
Temperature limit 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	
Limit values of rel. humidity	5 ... .80%	5 ... .95%
Tested to	DIN IEC 68-2-30	
	per min.	**per hour**
Temperature change	Max. 1K	Max. 10K
Condensation	not admissible	
Quality assurance	acc. to ISO 9001	
Vibrational load during operation		
Class	3M4	
Frequency range	10 ... 58Hz/58... 200Hz	
Const. excursion/acceleration	0.075mm/1g	
Tested to – module in PCU 50	DIN EN 60068-2-6	
Shock load during operation		
Acceleration	50m/sec^2	
Duration of nominal shock	30msecs	
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 for the case that the module is plugged in a SINUMERIK PCU 50.

2.5 MCI board extension external variation (SW 02.01 and higher)

The MCI board extension external variation, like the slot variation, is an electrically compatible successor version of the MCI board extension described in Section 2.3, page 2-56. The module has been extended by the option of operating differential handwheels or TTL handwheels.

To free the PCI slot of the PCU, in this MCI board extension variation mechanical fixture is implemented in a modified housing cover of the PCU.

2.5.1 Module

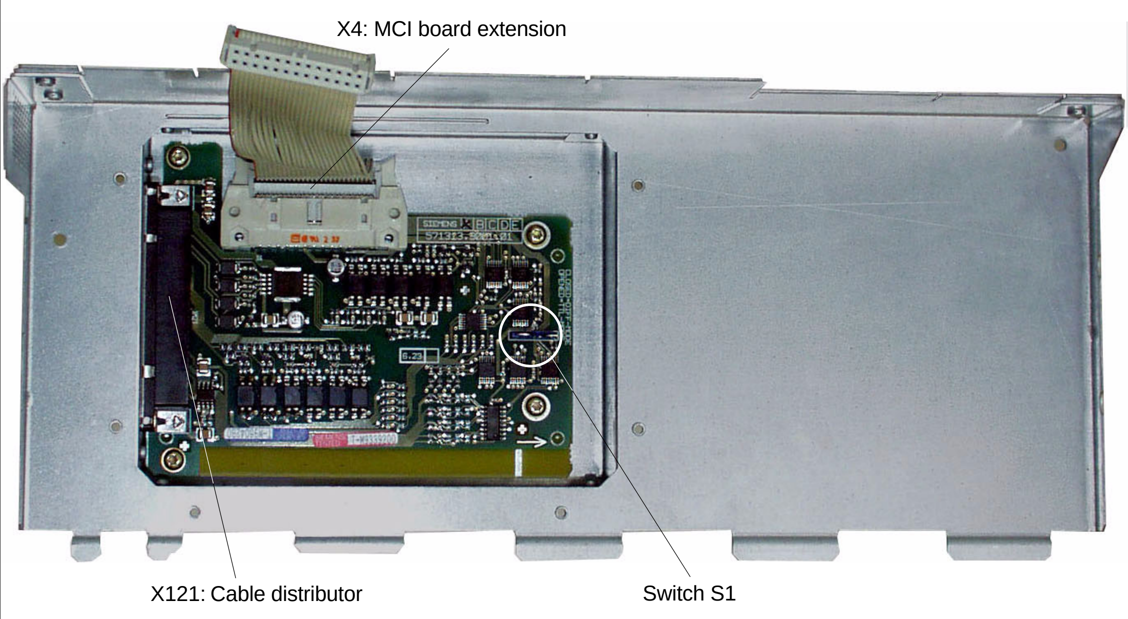


Fig. 2-13 Module with a modified housing cover

Order number:

Designation	Order No. (MLFB)
MCI board extension external variation (option)	6FC5 222-0AA01-0AA0

Caution

Never **plug** or **remove the cable distributor** at the X121 interface of the module under **voltage**.

Before you plug or remove the cable connector, switch off the PCU (shut down Windows NT correctly!). Otherwise, short circuits might occur on the module, as a result of which the module could be destroyed.

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 handwheel:
  Switch S1 open.

Differential or TTL handwheels can only be operated alternately.

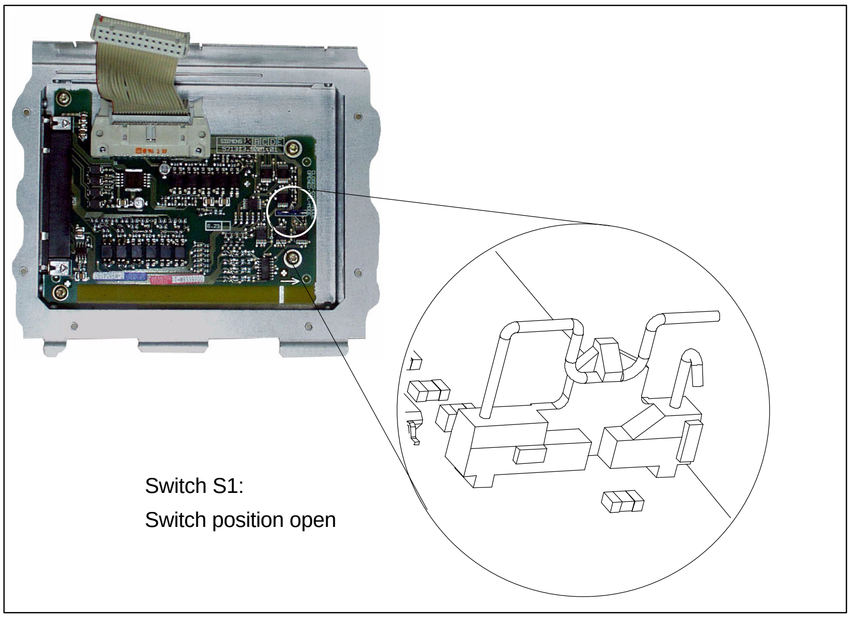


Fig. 2-14 Switch S1 switch position open (TTL handwheels)

Notice

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

2.5.2 Installation instructions

Performing installation

The MCI board extension external variation is already supplied in the modified housing cover. The connecting cable with the MCI board is part of the scope of supply and is already plugged into the MCI board extension external variation.

Before you can operate the MCI board extension external variation, you must remove any internal MCI board extension module and replace the housing cover.

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

Warning

When operating electrical devices, certain parts of these devices are inevitably under hazardous voltage.

Improper handling of these devices may therefore result in loss of life, severe personal 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 accordingly qualified personnel.
– Before starting any maintenance and service work, disconnect the device from mains.
– Use only spare parts approved by the manufacturer.
– 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. To do so, touch an earthed, conductive object (e.g. blank cubicle parts, socket protection contact) immediately before starting work on the module.

---

1. Shut down the SINUMERIK 840Di and Windows NT correctly.
   To do so, use one of the following possibilities:
   - Windows NT taskbar: Start > Shut Down
   - Interface signal: “PC shutdown”; see Subsection 16.1.1, page 16-499
2. Disconnect your PC from mains.

3. Remove the screws from the cover of the housing (Fig. 2-15) and open the housing of your PC, observing the relevant safety regulations.

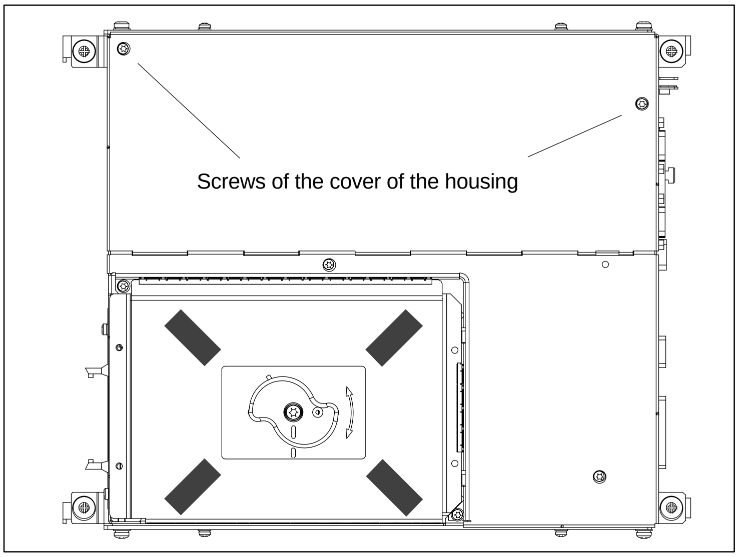


Fig. 2-15 Cover of the housing of the PCU 50

4. Optional: If there is an internal MCI board extension module
   – Remove interconnecting cable to the internal MCI board extension module, interface X2.
   – Remove the fastening screw of the module holding-down device and remove the module holding-down device.
   – Unscrew the fixing screw of the end plate of the internal MCI board extension module and remove the module, observing ESD precautions.
   – Mount the module holding-down device again.
5. Insert the modified housing cover into the guide slot of the PCU and close the housing to the extent that the connecting cable can be plugged into the MCI board extension interface (X2).

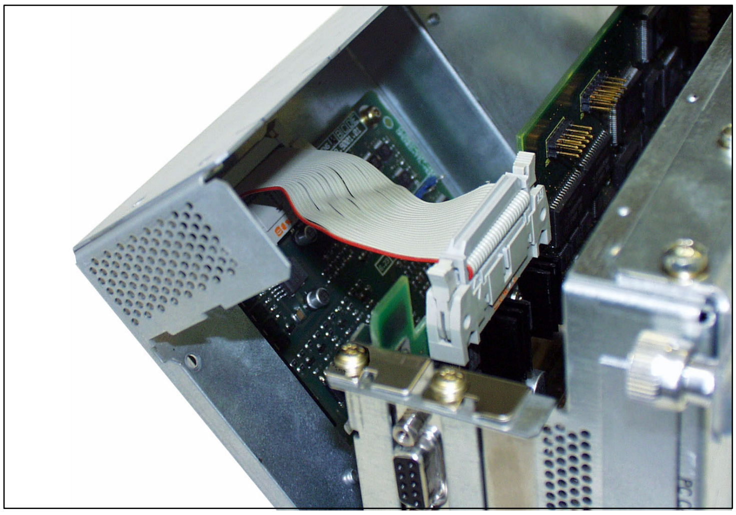


Fig. 2-16 Modified housing cover with MCI board extension external variation

6. Make sure that the latches of the connectors have securely engaged on both modules.
   – MCI board: Interface X2
   – MCI board extension: Interface X4
7. Close the housing completely and fix it again with the two housing screws.
8. Connect your PC to mains again and start it.

Fig. 2-17 PCU 50 with MCI board extension external variation

2.5.3 Dimension drawing

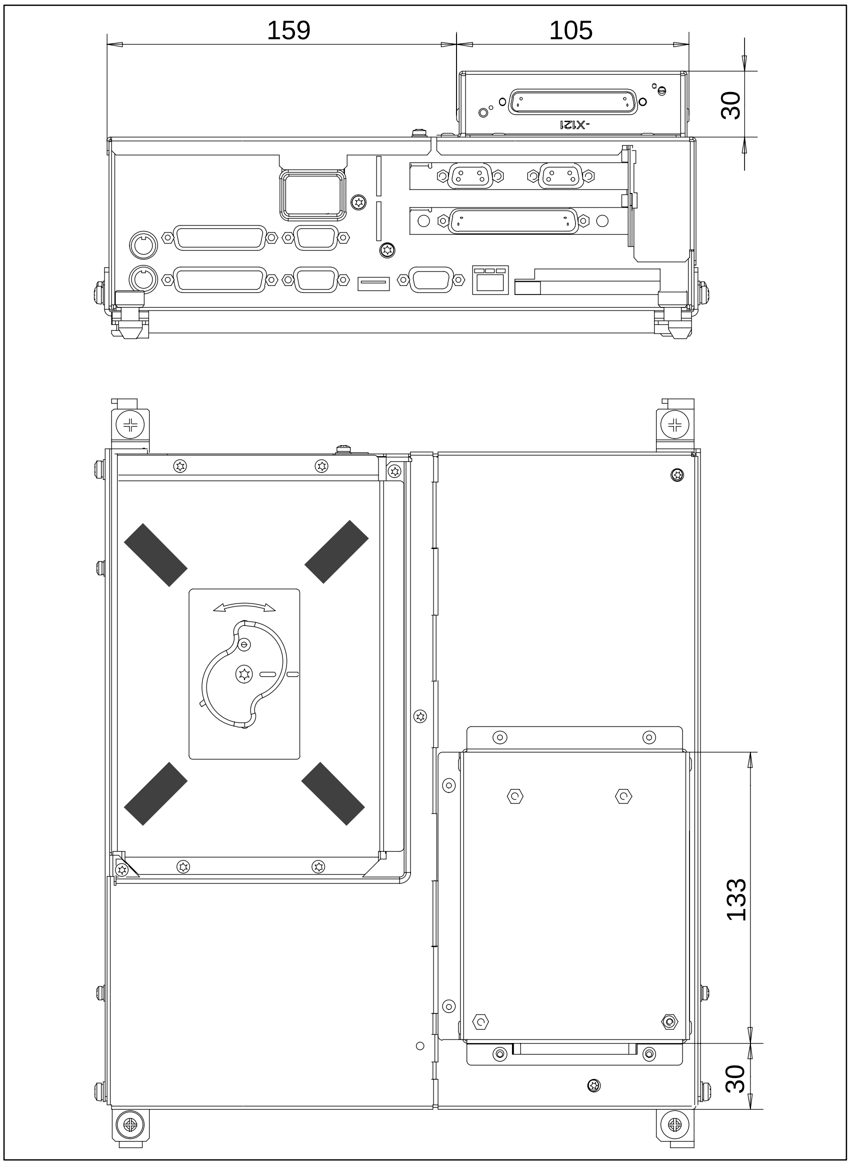


Fig. 2-18 PCU 50 with MCI board extension external variation

2.5.4 Interface description

The interfaces of the MCI board extension external variation are identical with those of the MCI board extension slot variation. See Subsection 2.4.3, page 2-66.

2.5.5 Technical data

The technical data of the MCI board extension external variation are identical with those of the MCI board extension slot variation. See Subsection 2.4.4, page 2-69.

2.6 Cable distributor

Order No.

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

Cable connection

The cable distributor consists of a connector jacket for a 37-pin Sub-D connector with enlarged interior. The cable distributor is used to split the I/O electronic handwheel extension interface (X121) to a maximum of 7 single cables. These must be connected in the order shown in Table 2-12, page 2-78.

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

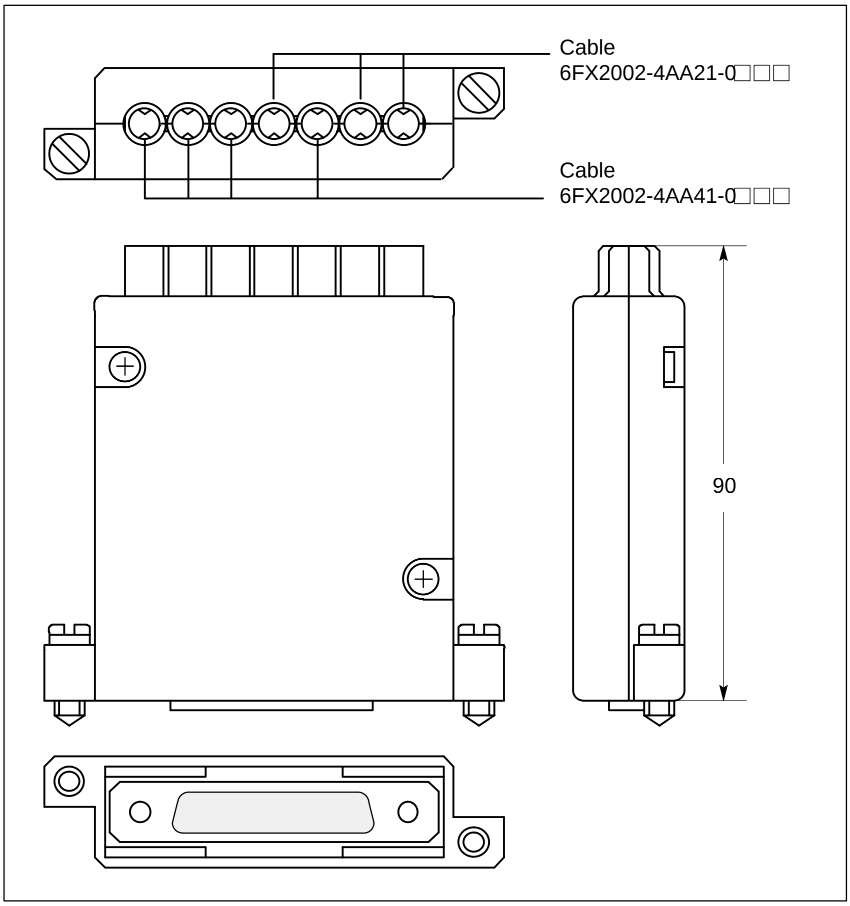


Fig. 2-19 Cable distributor

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. 2-20, Page 2-77. Install the upper terminal clamp such that its “teeth” point towards the "teeth" of the lower terminal clamp and then fasten the upper part of the housing.

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.

Position of the interfaces

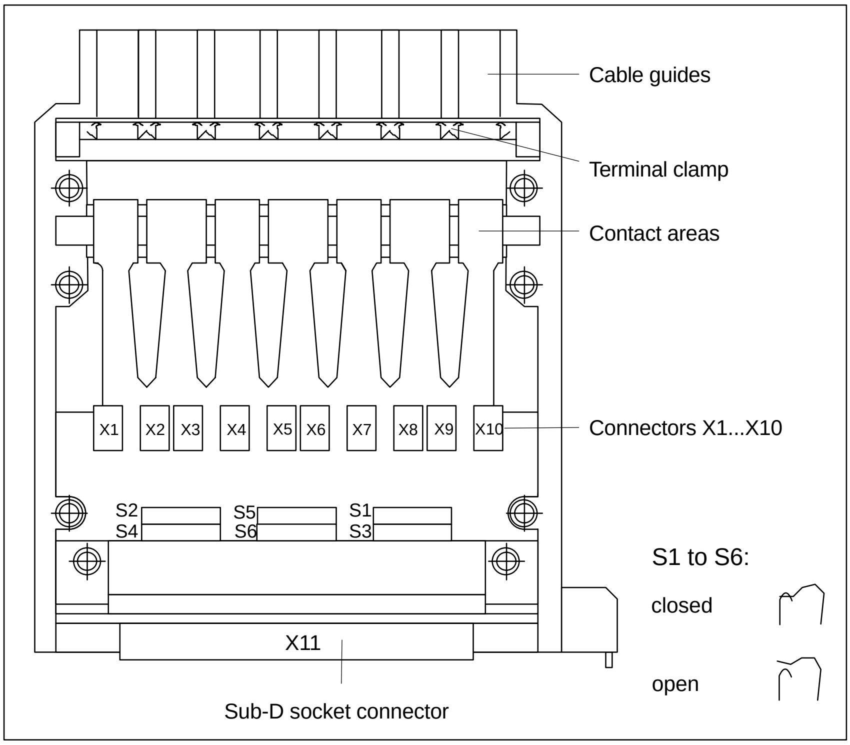


Fig. 2-20 Position of the interfaces of the cable distributor

DIP-FIX switches

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

Table 2-11 Setting the DIP-FIX switches in the cable distributor

Switch	S1	S2	S3	S4	S5	S6
open	X	X	X	X		
closed					X	X

Connector assignment

Table 2-12 Connector assignment

Connector No.	Cable No.	I/O
X1	1 (top)	1. 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)	1. 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.

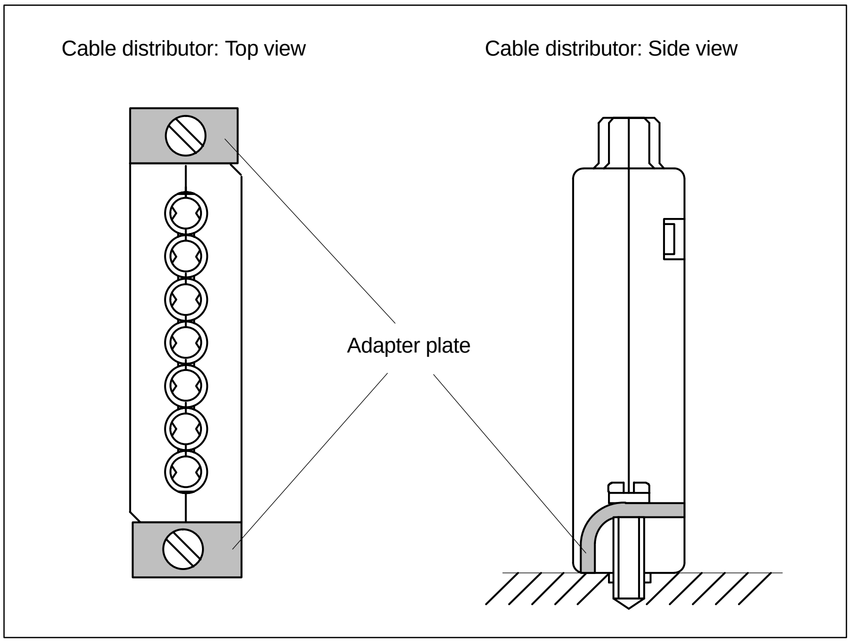


Fig. 2-21 Mounting the cable distributor

Connector pin assignment

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

Table 2-13 Connector pin assignment of the cable distributor

Pin no. 37-pin connec-tor	Signal name	DU-BOX connector no./pin	Cable no.	Cable order no. 6FX2002-4AA....	Core color	I/O device	Terminal
 9 10	– MEPUS 0 – MEPUC 0	X10/2 X10/1 X10/4 X10/3	7	41–0□□□	RD OG BN BK Shield	First probe 1. probe	Signal +24V Reference 0V
1 20 2 21	M24EXT P24EXT M24EXT P24EXT	X9/2 X9/1 X9/4 X9/3	6	41–0□□□	RD OG BN BK Shield	Supply of the 4 binary outputs of the MPI connector	Ground 24V Ground 24V
3 22 4 23	OUTPUT 1 OUTPUT 3 OUTPUT 0 OUTPUT 2	X8/2 X8/1 X8/4 X8/3	5	41–0□□□	RD OG BN BK Shield	4 binary outputs	2nd output 4th output 1st output 3rd output
5 24 6 25 7 26 8 27	INPUT 3 GNDEXT INPUT 2 GNDEXT INPUT 1 GNDEXT INPUT 0 GNDEXT	X7/2 X7/1 X7/4 X7/3 X6/2 X6/1 X6/4 X6/3	4	21–0□□□	RD OG 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 OG BN BK Shield	2nd probe 2nd probe	Signal +24V Reference 0V
11 30 12 31 13 32 14 33	MPG1 XA MPG1A 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 OG BN BK GN YE VT BU Shield	2nd handwheel 6FC9320-5DB	XA A 5V 0V 5V 0V 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 OG BN BK GN YE VT BU Shield	1st handwheel 6FC9320-5DB	XA A 5V 0V 5V 0V XB B

Signal names

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

Notice

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

Colors

RD	red
OG	orange
BN	brown
BK	black
GN	green
YE	yellow
VT	violet
BU	blue

2.7 SINUMERIK Industrial PC

2.7.1 SINUMERIK PCU 50

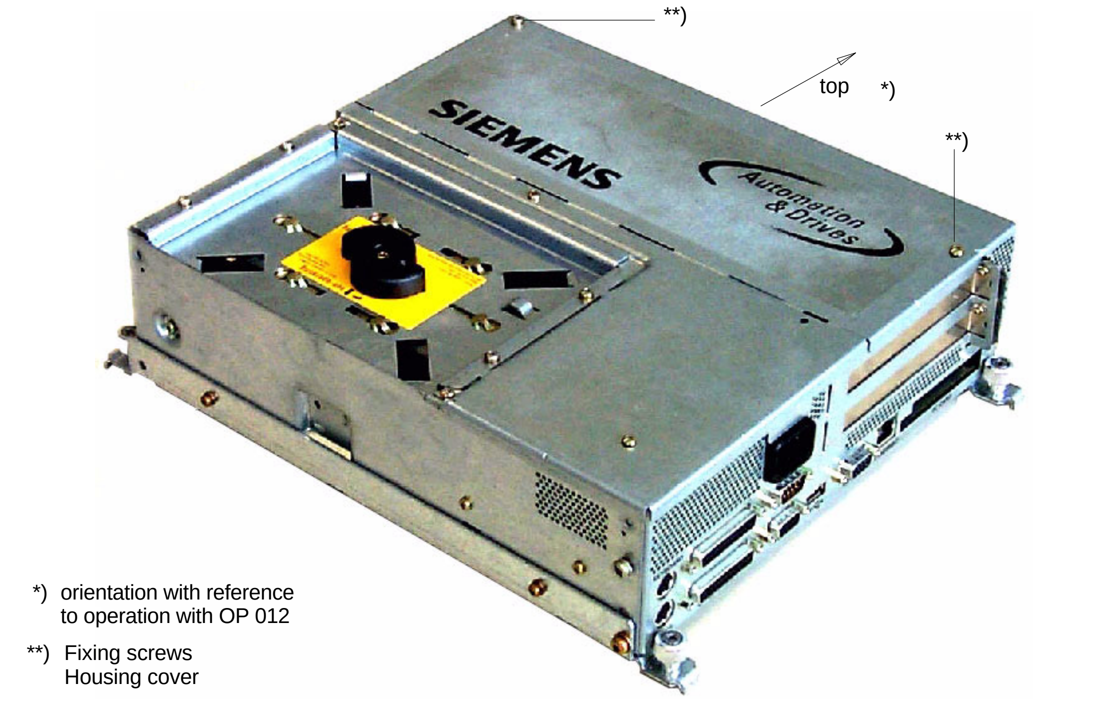


Fig. 2-22 PCU 50: Perspective view with installed hard disk drive

Order number

Designation	Order No. (MLFB)
PCU 50 as spare part with Windows NT 4.0 US, without MCI board:	
PCU 50 333MHz, 128MB	6FC5 210-0DF01-0AA0
PCU 50 500MHz, 128MB	6FC5 210-0DF05-0AA0
PCU 50 566MHz, 128MB	6FC5 210-0DF20-0AA0
PCU 50 1.2GHz, 256MB	6FC5 210-0DF22-0AA0

Features

Together with the MCI board, the SINUMERIK industrial PC “PCU 50” serves as the basis for the SINUMERIK 840Di control system. The key features of the PCU 50 are as follows:

- Processor versions:
  - Pentium II 333MHz, 128MB SDRAM
  - Pentium III 500MHz, 128MB SDRAM
  - Celeron 566MHz, 128MB SDRAM
  - Celeron 1.2GHz, 256MB SDRAM
- Hard disk min. 4.8GB (replaceable)
- Windows NT 4.0 operating system US version

- Robust design (continuous operation, high noise immunity)
- Space-saving installation thanks to compact dimensions (LxWxH): 296x267x100mm
- Easy installation with four screws on the rear of the operator panel front
- Mounting position and location to a large degree variable
- Screen resolution 640x480 (VGA), up to 1024x768 (XGA)
- Power supply: 24VDC
- Interfaces:
  - Parallel interface LPT1
  - Serial interfaces 1 x RS-232-C (25–pole), 1 x RS–232–C (9–pole)
  - 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 to the operator panel:
    LVDS interface for SINUMERIK-OP,
    USB interface for SINUMERIK-OP (internal)
  - USB interfaces:
    with Pentium II/III 366/500MHz: 1 x USB interface
    with Celeron 566MHz/1.2GHz: 2 x USB interfaces
- Expansion slots
  - 1 PCI expansion slot (length: max. 265mm, occupied by the MCI board)
  - 1 x shared ISA/PCI expansion slot (length: max. 175mm, 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. 512MB.

References

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

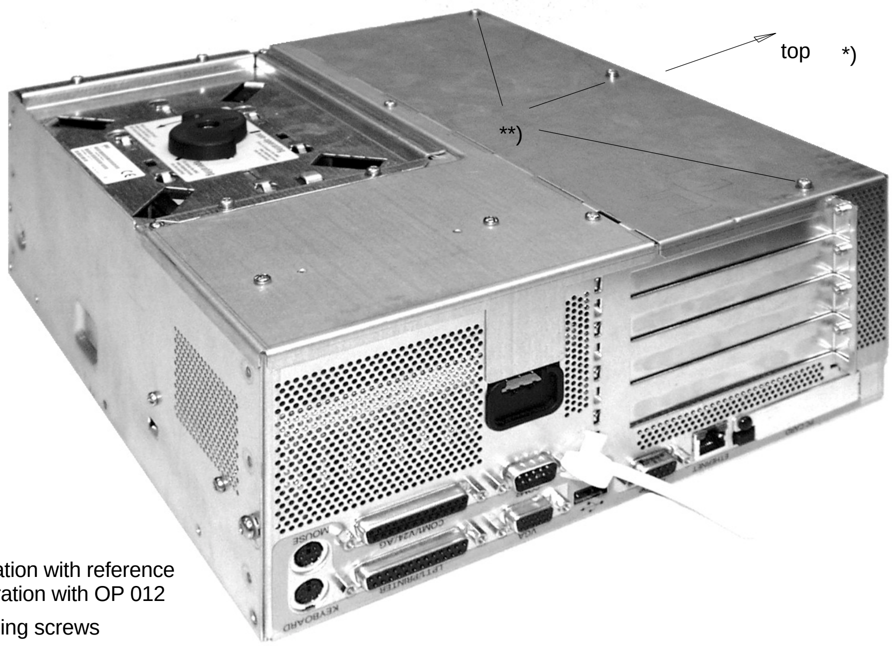
References: /BH/ Operator Components Manual
Component PCU 50.

(SW 2.2 and higher)

In SW 2.2 and higher, distributed connection of PCU and operator panel is possible via Videolink (option).

References: /BH/ Operator Components Manual
Distributed configuration

2.7.2 SINUMERIK PCU 70



*) Orientation with reference to operation with OP 012

**) Fastening screws Housing cover

Fig. 2-23 PCU 70: Perspective view with installed hard disk drive

Order No.

Designation	Order No. (MLFB)
PCU 70 as spare part with Windows NT 4.0 US, without MCI board:	
PCU 70 500MHz, 128MB	6FC5210-0DF04-0AA0

Features

The PCU 70 is essentially a PCU 50 with two extra expansion slots (PCI). It has the following features:

- Processor min. Pentium III, 500MHz
- User memory (RAM) max. 512MB
- Hard disk min. 10.4GB (swappable)
- Windows NT 4.0 operating system US version
- Robust design (continuous operation, high noise immunity)
- Dimensions (W x H x D): 297x267x122mm
- Easy-to-service design
- Screen resolution 640x480 (VGA), up to 1024x768 (XGA)
- Power supply: 24VDC
- Interfaces:
  – Parallel interface LPT1

  - 2 x RS-232 serial interfaces
  - PS/2 keyboard interface
  - PS/2 mouse interface
  - MPI/DP (max. 12 MBaud)
  - VGA interface for external monitor
  - Ethernet connection 10/100 Mbaud
  - PC card slot
  - Interfaces to the operator panel:
    LVDS interface for SINUMERIK-OP,
    USB interface for SINUMERIK-OP (internal)
  - USB interface
- Expansion slots
  - Three PCI expansion slots (length: max. 265mm); 1 expansion slot occupied by the MCI board)
  - 1 x shared ISA/PCI expansion slot (length: max. 175mm, 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. 512MB.

References

The complete documentation on the PCU 70 is to be found in:

References: /BH/ Operator Components Manual
Component PCU 70.

(SW 2.2 and higher)

In SW 2.2 and higher, distributed connection of PCU and operator panel is possible via Videolink (option).

References: /BH/ Operator Components Manual
Distributed configuration

2.8 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.

2.8.1 Operator panel front OP 012

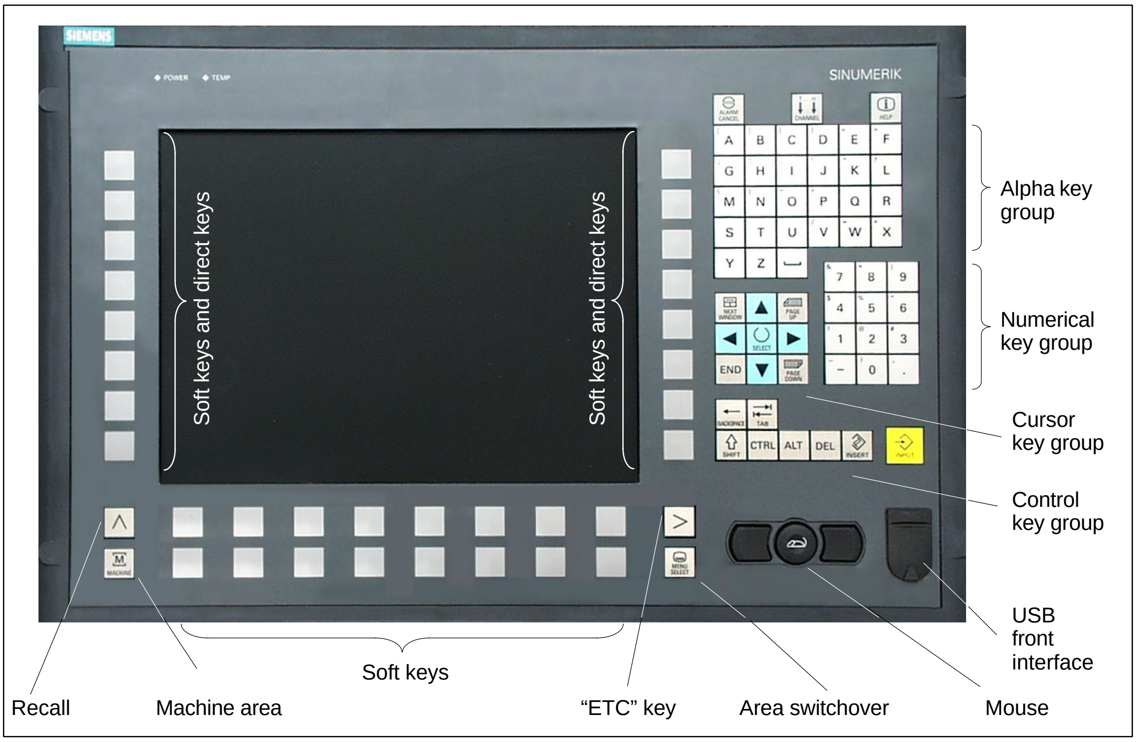


Fig. 2-24 View of OP 012 operator panel front

Order No.

Designation	Order No. (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: 800x600
- Membrane keyboard with alpha, numeric, cursor and control key groups
- Soft keys/direct keys:
  - 2x8 horizontal key rows with soft key functions
  - 2x8 vertical key rows with soft key 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
- Front USB interface
- Degree of protection IP65
- Can be combined with the component PCU 50
- External floppy disk drive can be connected.

References

A complete documentation of the OP 012 operator panel front is to be found in:

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

2.9 Floppy disk drive 3.5”

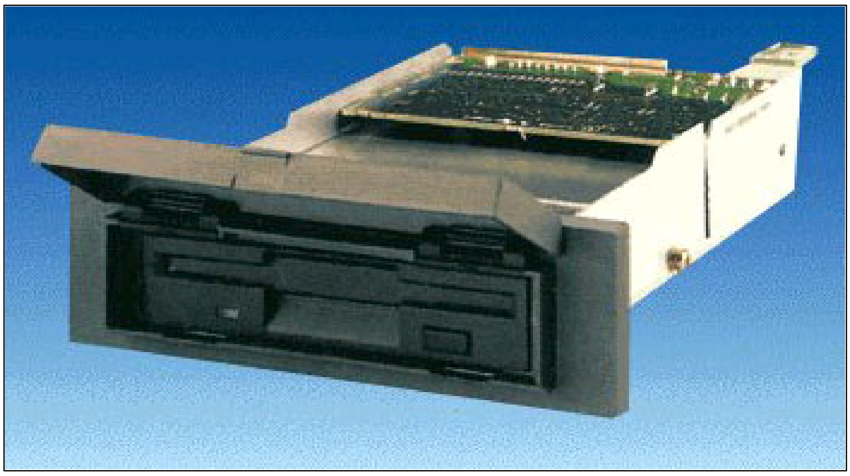


Fig. 2-25 External floppy disk drive 3.5”

Order No.

Designation	Order No. (MLFB)
Floppy disk drive 3.5” incl. 0.5m cable	6FC5 235-0AA05-0AA1
Accessories: Cover of floppy disk drive with shutter, cover and bear-ing 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 — 24VDC
- Power consumption, max. — 5W
- Degree of protection to DIN EN 60529 (IEC 60529) — IP 54 (front) IP 00 (rear)
- Humidity classification acc. to DIN EN 60721-3-3 — Term. 3K5 condensation and formation of ice excluded 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
floppy disk drive 3.5”

2.10 Power supply

2.10.1 SITOP POWER Standard 24V/10A

Fig. 2-26 View: SITOP POWER Standard 24V/10A

Order No.

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

Features

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

- Input voltage nominal value 120/230VAC
- Input voltage range 93 ... 132V/187 ... 264V
- Mains buffering > 20msecs
- Mains frequency nominal value 50/60Hz
- Mains frequency range 47 ... 63Hz
- Input current nominal value 3.5/1.7A
- Inrush current (25° C) 55A
- Output voltage nominal value 24VDC
- Output voltage tolerance ± 3%
- Efficiency > 87%

- Output current nominal value 10A
- 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

2.11 Uninterruptible power supply (UPS)

2.11.1 SITOP POWER DC UPS module 15

Fig. 2-27 View: SITOP POWER, DC-UPS MODULE 10

Order number

Designation	Order No. (MLFB)
SITOP POWER DC UPS module 15	6EP1 931-2EC11

Features

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

- Compact design
- Input voltage 24VDC
- Nominal output power 240W
- High efficiency approx. 96%
- Class of protection (IEC 536; VDE 1006 T1) Class III
- Degree of protection (VDE 0470, IEC 529) IP 20
- Absolutely uninterruptible mains buffering
- Immediate electronic connection of the accumulator once the load voltage or the voltage present between the connections L+/M of the DC-UPS module falls below the value of the connection threshold (18 to 26V).

- Settable buffer time by DIP switches in the range between 5 to 315 sec. or up to enforced shutdown by deep discharging.
- In case of increased load current requirements (e.g. when connecting incandescent lamps, contactor relays with DC autotransformer winding, DC motors, DC/DC converters, electronic modules with high input capacity), high, electronically limited peak currents are delivered automatically.
- After a power failure, the battery module is automatically electronically disconnected from the loads and quickly recharged with a constant current of 0.7A (U/I characteristic with 27V end-of-charge voltage).
- Exhaustive discharge protection
- ON/OFF control circuit
- Signaling
- LED green/LED yellow and floating changer for mains/battery operation
- LED red and floating changer for readiness for backup existing (LED OFF)/ alarm (LED ON).
- RS-232 interface (serial interface) for the additional output of all signals to a PC.

Serial interface

The connection from the SITOP POWER DC-UPS module 15 to the serial interface of the PC is made using a 9-pin SUB-D interconnecting cable:

- Design **connector/socket connector**
- The individual cables are connected **1:1** to the appropriate pins.

Table 2-14 Pin assignment of the 9-pin SUB-D connectors

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

2.11.2 SITOP POWER storage battery module 24VDC/10A/3.2AH

Fig. 2-28 View: SITOP POWER lead-acid battery module

Order number

Designation	Order No. (MLFB)
SITOP POWER storage battery module 24VDC/10A/3.2AH	6EP1 935-6MD11

Features

The SITOP POWER LEAD-ACID MODULE 24VDC/10A/3.2AH provides the following features:

- 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 15A/32V)
- Class of protection (IEC 536; VDE 1006 T1) Class III
- Degree of protection (EN 60 529; VDE 0470 T1) IP 00

2.12 I/O Module PP72/48

2.12.1 Module

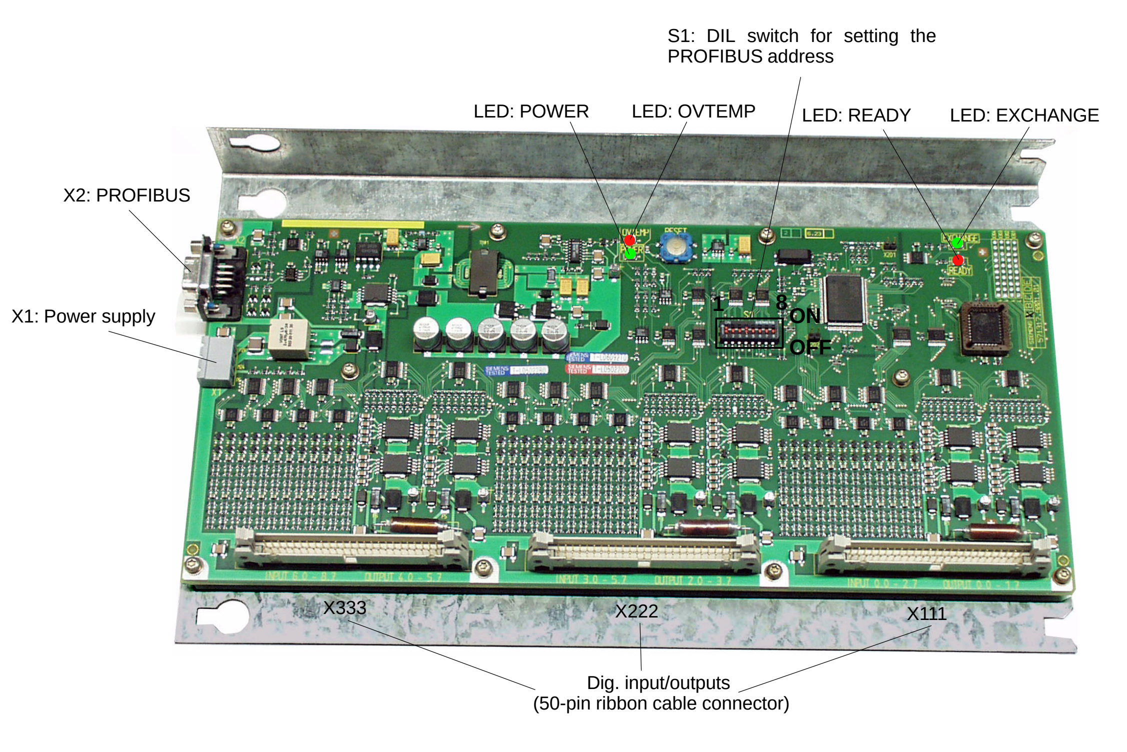


Fig. 2-29 I/O Module PP72/48

Order number

Designation	Order No. (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 four diagnostic LEDs

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

2.12.2 Interface description

Interface overview

Interfaces of the I/O modules PP72/48

Table 2-15 Interfaces of the I/O Module PP72/48

Interface	Designation	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 2-16 Pin assignment: Ext. power supply (X1)

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

1. VI Voltage Input

- Connecting cable
  The required connecting cables must be provided by the user:
  – Wire, conductor cross-section: 1.0–1.5mm^2 (AWG17–AWG16)
- Power supply
  For data concerning the power supply, see Subsection 2.12.3, page 2-101.

PROFIBUS DP (X2)

Interface description of the PROFIBUS DP interface (X2):

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

Table 2-17 Pin assignment: PROFIBUS DP (X2)

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

1) VO Voltage Output
O Output
B Bi-directional

- Connector
  - 6ES7972-0BA40-0XA0; cable outlet 35^{0}, without PG socket connector
  - 6ES7972-0BB40-0XA0; cable outlet 35^{0}, with PG socket connector
  - 6ES7972-0BA11-0XA0; cable outlet 90^{0}, without PG socket connector
  - 6ES7972-0BB11-0XA0; cable outlet 90^{0}, with PG socket connector
- Cables:
  - 6XV1830-0EH10; by the meter, non-trailable
  - 6XV1830-3BH10; by the meter, trailable
- Further technical data

  Maximum possible data transmission rate: 12 Mbit/sec.

PROFIBUS address (S1)

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

Table 2-18 Meaning of switch S1

Switch	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 input/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 2-19 Pin assignment (X111/X222/X333)

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

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

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.

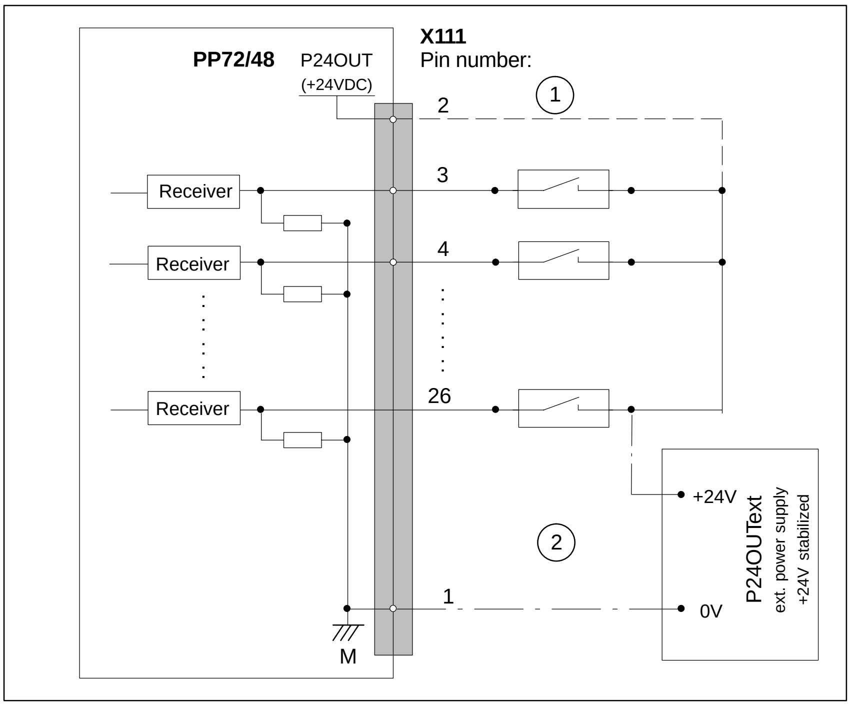


Fig. 2-30 Terminal assignment for the digital inputs

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 Subsection 2.12.3, page 2-101.

Caution

A max. current of I_{out} = 0.5A 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 (GND).

  X111, X222, X333: Pin 1 (P24OUT) then remains open.

For specification of the external power supply, see Subsection 2.12.3, page 2-101.

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

Table 2-20 Electrical specification of the digital inputs

Digital outputs	**min.**	**typical**	**max.**	**nominal**
Voltage at high level ($V_{hi)}$)	15V	1)	30V	24V
Input current I_{IN} at VU_{hi}	2mA	–	15mA	–
Voltage at low level ($V_{lo)}$)	–30V	–	+5V	0V
Signal delay time T_{PHL} 2)	0.5msec	–	3msec	–

- Power supply of the 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}: 500mA per pin
  Max. short-circuit current: 4A (max. 100μsec, V_{CC} = 24V)
  Internal resistance R_{ON}: 0.4Ω
- 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.

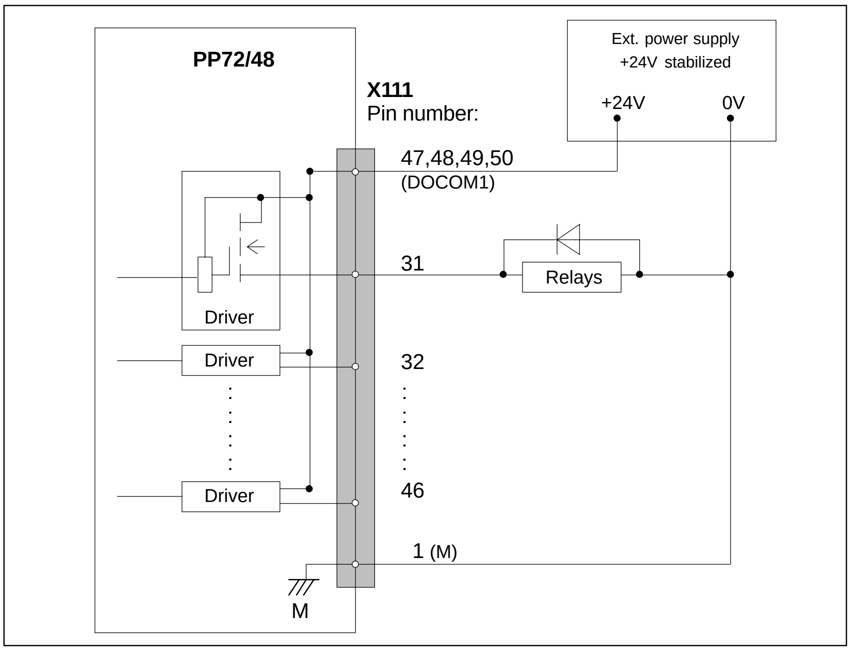


Fig. 2-31 Terminal assignment for the digital outputs

- 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: Pins 47, 48, 49, 50).

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

  For further data, see Subsection 2.12.3, page 2-101.

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 1A.

The power supply (+24VDC) 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 2-21 Electrical specification of the digital outputs

Digital outputs	min.	typical	max.	nominal
Voltage at high level ($V_{hi)}$)	V_{CC} – 3V	1)	V_{CC}	24V
Output current I_{OUT}	–	–	500mA	–
Voltage at low level ($V_{lo)}$)	–	–	–	Output open
Leakage current at low level	–	50μA	400μA	–
Signal delay time T_{PHL} 2)	–	0.5msec	–	–
Max. switching frequency 2)				
Ohmic load	100Hz	–	–	–
Inductive load	2Hz	–	–	–
Lamp	11Hz	–	–	–

- Power supply of the digital outputs
  1) typical output voltage: $V_{CC} – I_{OUT} * R_{ON}$
  V_{CC}: Current operating voltage
  Max. output current I_{OUT}: 250mA for a simultaneity factor of 100%
  500mA for a simultaneity factor of 50%
  Max. short-circuit current: 4A (max. 100μsec, V_{CC} = 24V)
  Internal resistance R_{ON}: 0.4Ω
- 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 max. 500mA
  – Protection from: short-circuit, overtemperature, and loss of ground
  – Autom. shutdown on undervoltage.

LED: Status display

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

Table 2-22 LED: Status display

Designation	Color	Description
POWER	green	Supply voltage
OVTEMP	red	Overtemperature display
EXCHANGE	green	Cyclic data exchange with DP master in progress
READY	red	Ready for cyclic data exchange with DP master

2.12.3 Power supply

The supply voltage (24VDC) of the I/O module PP72/48 is connected to the screw terminal block X1. See Subsection 2.12.2, page 2-94.

ADI4 module

To power the ADI4 module (+24VDC), an external power supply source is required. The power supply is connected through the screw terminal block X1.

Digital outputs

To power the digital outputs (+24VDC), 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 (+24VDC) 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 2-23.

Table 2-23 Specification of the power supply voltage P24OUT,

Voltage	
minimum	20.4V
nominal	24V
max.	28.8V
minimum (dynamic)	18.5V
maximum (dynamic)	30.2V
Non-cyclic overvoltage	
max. (absolute, transient)	35V
max. duration	500msecs
min. recovery time	50secs
max. events per h	10
Voltage failure for min. power supply voltage	
max. duration [1)]	50msecs
min. recovery time	1s
max. events per h	10
Power consumption	
max.	approx. 40W

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

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

2.12.4 Grounding

The installation of the module must be performed acc. 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 >10mm^2).

Caution

A protective conductor must be connected.

2.12.5 Dimension drawing

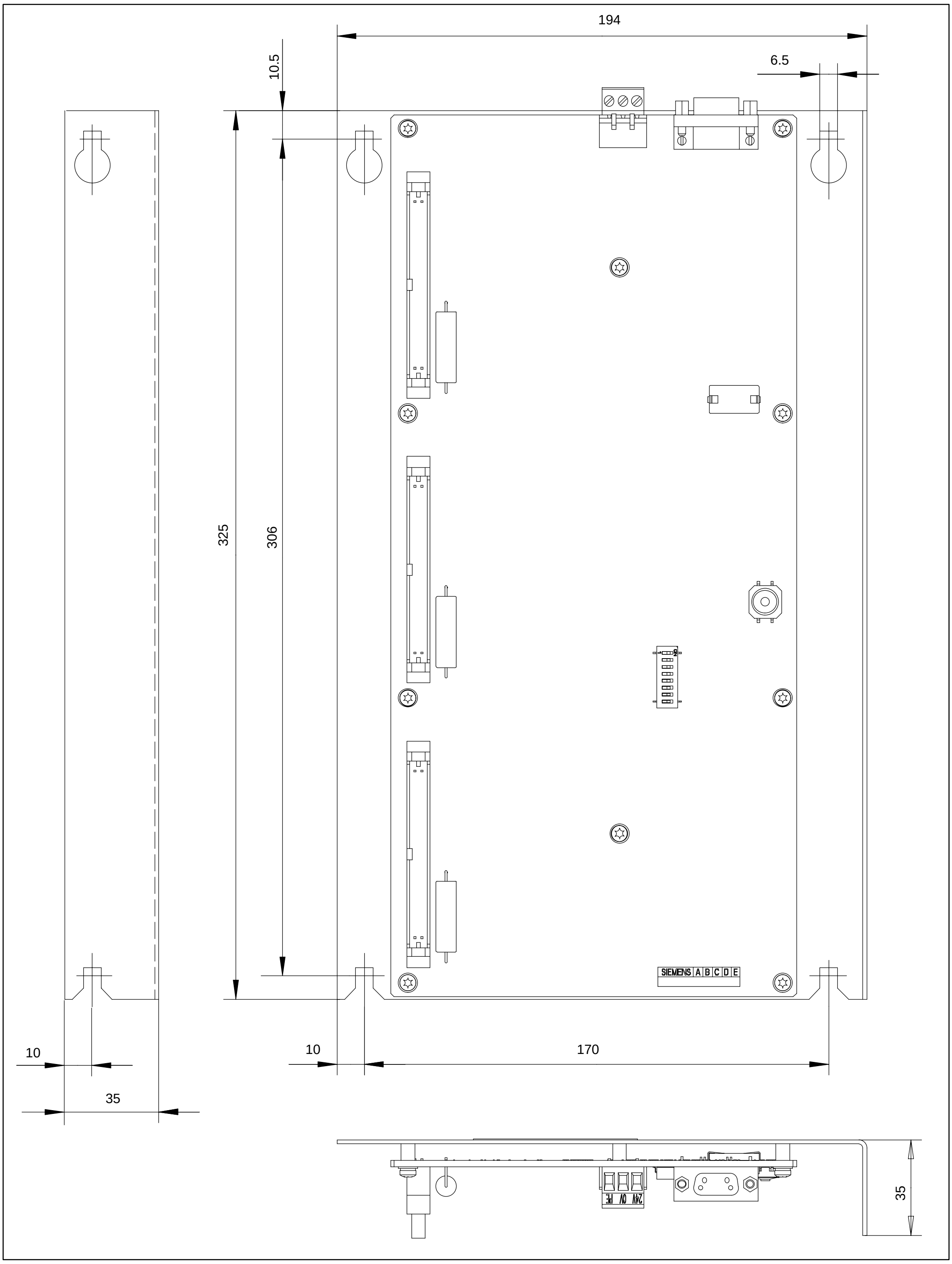


Fig. 2-32 Dimension drawing: I/O Module PP72/48

2.12.6 Technical data

Technical data of the I/O modules PP72/48

Safety		
Degree of protection	IP 00	
Class of protection	Class of protection I, acc. to VDE 0106 P1: 1982 (IEC 536); Protection against ingress of solid foreign bodies and water to IEC 529	
Certifications	CE/CSA, CE	
Power consumption		
At nominal load	11W	
Mechanical data		
Dimensions WxHxD [mm]	194x325x35	
Weight	approx. 0.3kg without mounting plate	approx. 1.2kg with mounting plate
Climatic environmental conditions		
Heat dissipation	Open-circuit cooling	
	Operation	**Storage/transportation**
Temperature limit values	0 ... 50°C	–20 ... 55°C/–40 ... 70°C
Limit values of rel. humidity	5 ... 95% not condensing	5 ... 95% not condensing
Condensation	not admissible	
Atmospheric pressure	700 ... 1060 hPa	700 ... 1060 hPa
Transportation height	–	–1000 ... 3000m
Shock loading during transportation		
Free fall in transport package	≤ 1000mm	

2.13 ADI4 (analog drive interface for 4 axes) (SW 09.01 and higher)

2.13.1 Module

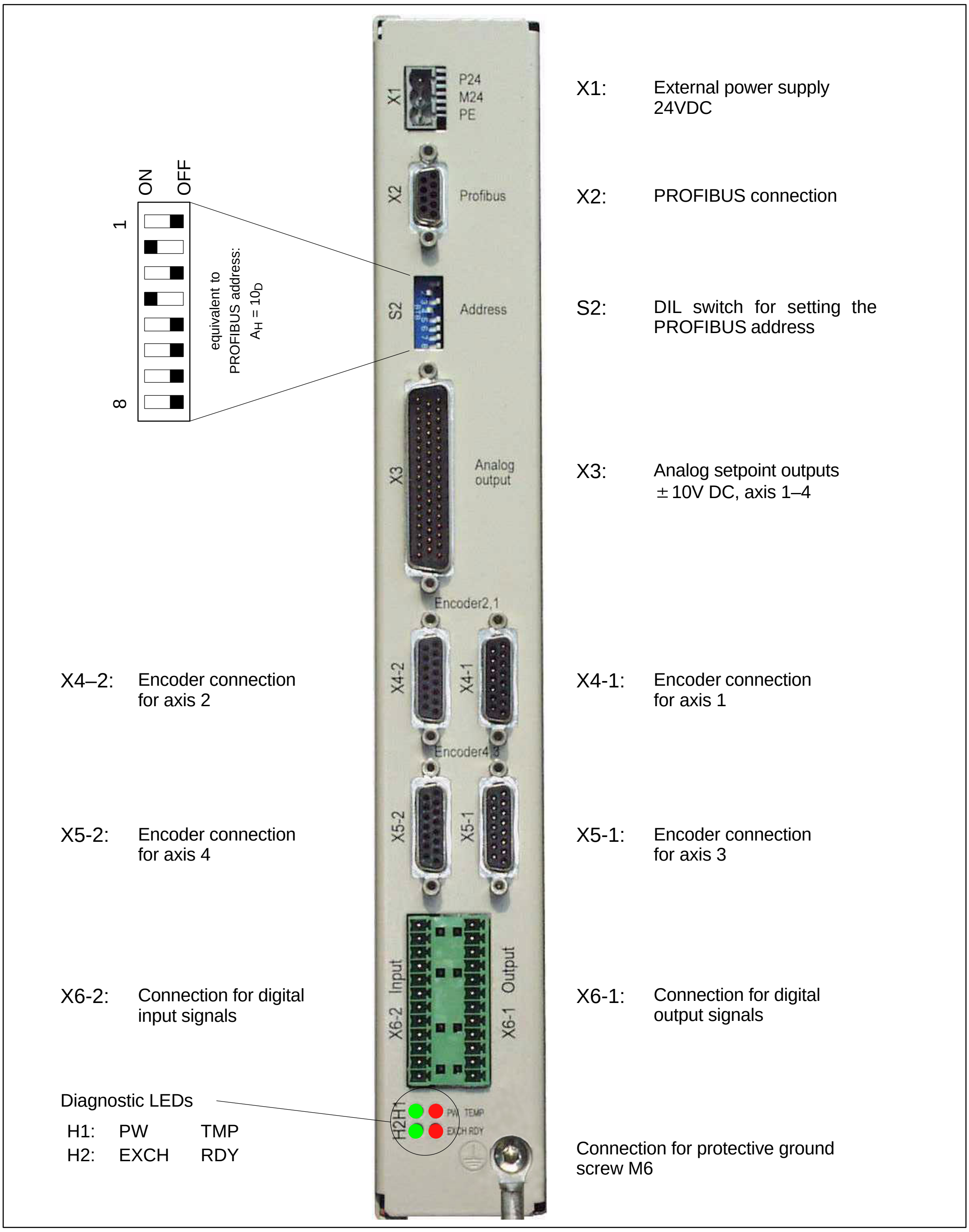


Fig. 2-33 Connection overview ADI4

Order No.

Designation	Order No. (MLFB)
ADI4	6FC5 211-0BA01-0AA1

Features

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

The module has the following important features:

- PROFIBUS DP connection (max. 12 Mbit/s), in accordance with:
  PROFIDrive profile drive technology version 3,
  Draft V1.4.2, 01. September 00
- Four servo interfaces each with one:
  - Input: TTL/SSI encoder for incremental and absolute measuring systems
  - Output ±10V analog
- General and drive-specific digital input/output signals
- On-board status display by means of four diagnostic LEDs

To power the module and the digital outputs, an external power supply source (+24VDC) 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 7.3.6, page 7-220).
- 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.

2.13.2 Interface description

Interface overview

Interfaces of the ADI4 module

Table 2-24 Interface overview: ADI4

Interface	Designation	Type
External power supply +24V	X1	Connector
PROFIBUS DP	X2	Socket connector
PROFIBUS DP address	S2	DIL switch
Analog setpoint interface	X3	Connector
Encoder connection for axis 1	X4-1	Socket connector
Encoder connection for axis 2	X4-2	Socket connector
Encoder connection for axis 3	X5-1	Socket connector
Encoder connection for axis 4	X5-2	Socket connector
Digital outputs	X6-1	Connector
Digital inputs	X6-2	Connector
Module status	H1/H2	LEDs

External power supply (X1)

Interface description of the external power supply (X1):

- Connector: Three-way connector MSTB 2.5/3-ST-5.08, Phoenix
- Pin assignment.

Table 2-25 Pin assignment: Ext. power supply (X1)

Pin	Designation	Type 1)	Function
1	P24EXT1	VI	External power supply of the module (+24V)
2	M24EXT1	VI	Reference for external power supply
3	PE	VI	Protective conductor of the external power supply
1) VI Voltage Input			

- Connecting cable
  The required connecting cables must be provided by the user:
  – Wire, conductor cross-section: 1.0–1.5mm^2 (AWG17–AWG16)
- Supply voltage
  For specification of the supply voltage, see Subsection 2.13.4, page 2-119.

PROFIBUS DP (X2)

Interface description of the PROFIBUS DP interface (X2)

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

Table 2-26 Pin assignment: PROFIBUS DP (X2)

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

1) VO Voltage Output
O Output
B Bi-directional

- Connector
  - 6ES7 972-0BA41-0XA0; 35^0 angle for cable outlet, without PG connection socket
  - 6ES7 972-0BB41-0XA0; 35^0 angle for cable outlet, with PG connection socket
  - 6ES7 972-0BA12-0XA0; 90^0 angle for cable outlet, without PG connection socket
  - 6ES7 972-0BB12-0XA0; 90^0 angle for cable outlet, with PG connection socket
- Cables:
  - 6XV1 830–0EH10; by the meter, non-trailable
  - 6XV1 830–3EH10; by the meter, trailable
- Further technical data

  Maximum possible data transmission rate: 12 Mbps.

PROFIBUS address (S2)

The PROFIBUS address of the ADI4 can be set in the range 1 to 127 using switch S2.

Table 2-27 Meaning of switch S2

Switch	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.

Analog setpoint interface (X3)

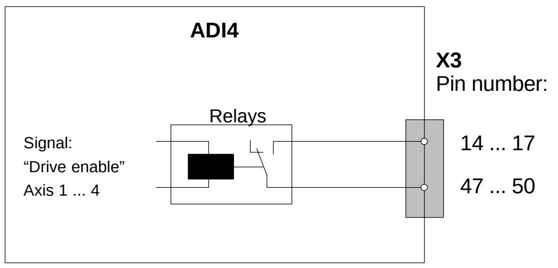
Interface description of the analog setpoint interface (X3):

- Connection: 50-way SUB D connector
- Pin assignment.

Table 2-28 Pin assignment: Analog setpoint interface (X3)

Pin	Designation	Type 1)	Function
1	SW1	VO	Setpoint axis 1 (±10V)
2	BS2	VO	Reference for setpoint axis 2
3	SW3	VO	Setpoint axis 3 (±10V)
4	BS4	VO	Reference for setpoint axis 4
5–13	–	–	–
14	RF1_1	K 2)	"Drive enable" axis 1, relay contact 1
15	RF2_1	K 2)	"Drive enable" axis 2, relay contact 1
16	RF3_1	K 2)	"Drive enable" axis 3, relay contact 1
17	RF4_1	K 2)	"Drive enable" axis 4, relay contact 1
18–33	–	–	–
34	BS1	VO	Reference for setpoint axis 1
35	SW2	VO	Setpoint axis 2 (±10V)
36	BS3	VO	Reference for setpoint axis 3
37	SW4	VO	Setpoint axis 4 (±10V)
38–46	–	–	–
47	RF1_2	K 2)	"Drive enable" axis 1, relay contact 2
48	RF2_2	K 2)	"Drive enable" axis 2, relay contact 2
49	RF3_2	K 2)	"Drive enable" axis 3, relay contact 2
50	RF4_2	K 2)	"Drive enable" axis 4, relay contact 2

1) VO Voltage Output
K Relay contact
2) Max. current carry capacity: 2A with 150VDC or 125VAC



- Preassembled cables
  - Order No. (MLFB) 6FX2 002-3AD01-1☐☐0
    Cable length: ≤35m

  Data about the length codes are to be found in:

  References: /Z/ Catalog NC Z.

Encoder interface (X4-1/X4-2) (X5-1/X5-2)

Interface description of the encoder interfaces (X4-1/X4-2/X5-1/X5-2):

- Connection: 15-pin SUB-D socket connector
- Pin assignment of the encoder interfaces:

Table 2-29 Pin assignment: Encoder interface axes 1 – 4 (X4-1/X4-2/X5-1/X5-2) for incremental encoder (TTL) and absolute encoder (SSI)

Pin	Designation[1)]		Type[2)]	Function
	incremental	absolute (SSI)		
1	Not assigned		–	–
2	–	CLSx	O	SSI shift cycles
3	–	CLSx_N	O	SSI shift cycles negated
4	P5MS		VO	Power supply voltage 5VDC
5	P24SSI		VO	Power supply voltage 24VDC
6	P5MS		VO	Power supply voltage 5VDC
7	GNDEXT		VO	Reference for power supply
8	Not assigned		–	–
9	GNDEXT		VO	Reference for power supply
10	Rx_S	–	I	Zero mark signal
11	XRx_S	–	I	Zero mark signal negated
12	XBx_S	–	I	Encoder signal track B negated
13	Bx_S	–	I	Encoder signal track B
14	XAx_S	–	I	Encoder signal track A negated
	–	DATAx_N	I	SSI data inverted
15	Ax_S	–	I	Encoder signal track A
	–	DATAx	I	SSI data

1) X Number of the encoder interface with X4-1=1, X4-2=2, X5-1=3, X5-2=4
2) VO Voltage Output
I Signal Input
O Signal Output

- Preassembled cables with use of:
  - Incremental encoder (TTL) with RS422 (5V or 24V) 6FX2 001–2...
    Order No.: 6FX8 002-2CD01-1☐☐0 (5V)
    Order No. (MLFB): 6FX5 002-2CD24-1☐☐0 (24V)
    Cable length: See below “Maximum cable lengths”.
  - Absolute value encoder with SSI 6FX2 001-5...
    Order No. (MLFB): 6FX8 002-2CC11-☐☐☐0
    Cable length: See below “Maximum cable lengths”.
  - 1FT5 motor with installed ROD320 encoder
    Order No. (MLFB): 6FX8 002-2CE02-1☐☐0
    Cable length: See below “Maximum cable lengths”.

  Data about the length codes are to be found in:

  References: /Z/ Catalog NC Z.

- Maximum cable lengths
  The max. cable length depends on the following parameters:

  1st encoder power supply

Supply voltage 5VDC		
Tolerance	**Power consumption**	**Max. cable length**
4.75V – 5.25V	≦ 300 mA	25m
4.75V – 5.25V	≦ 220 mA	35m
Supply voltage 24VDC		
Tolerance	**Power consumption**	**Max. cable length**
20.4V – 28.8V	≦ 300 mA	100m
11V – 30V	≦ 300 mA	300m

  2nd transmission frequency

Encoder type	Supply voltage	Frequency	Max. cable length
incremental (TTL)	5V	1MHz	10m
		500kHz	35m
	24V	500kHz	150m
absolute (SSI)	24V	1.5 Mbps	10m
		187.5 Kbps	250m

Note

If cable lengths longer than 25m or 35m are required with incremental encoders, you can use encoder types with a supply voltage of +24VDC instead.

Caution

To ensure error-free transmission of encoder data, do not exceed the max. cable lengths shown in the table.

- Specification of the encoder supply voltages:

Table 2-30 Specification of the encoder supply voltages

	Supply voltage 1)	
	P5MS	**P24SSI**
Voltage		
minimum	5.1V	20.4V
nominal	5V	24V
max.	5.3V	28.8V
Ripple		
max.	3.6Vpp	
Current load		
per encoder connection	0.3A	
max.	1.35A	1A
1) P5MS: Supply voltage for encoders (+5VDC) P24SSI: Supply voltage for encoders (+24VDC)		

- Connectable measuring systems:

  Incremental encoders (TTL)

  – Differential transmission with RS-422 (5V or 24V):
  Track A as a true and negated signal (U_{a1}, $\overline{U_{a1}}$)
  Track B as a true and negated signal (U_{a2}, $\overline{U_{a2}}$)
  Zero signal N as a true and negated signal (U_{a0}, $\overline{U_{a0}}$)
  – Max. output frequency: 1.5MHz
  – Phase shift of track A to B: $90^\circ \pm 30^\circ$
  – Power consumption: max. 300mA

  Absolute encoder (SSI)

  – Transmission procedure: Synchronous-serial interface (SSI) with 5V
  Differential signal transmission (RS-422 standard):
  Output signal: Data as a true and negated signal
  Input signal: Shift cycles as a true and negated signal
  – Resolution: max. 25 bits
  – Max. transmission frequency: 1 Mbps
  – Power consumption: max. 300mA

Notice

Only SSI Multiturn encoders can be used as absolute measuring systems.

Further measuring systems:

– Encoders with SINE/COSINE signals (e.g. 1Vpp) can be connected through external pulse shaper electronics (EXE) that convert the signals to 5V TTL levels.

Digital outputs (X6-1)

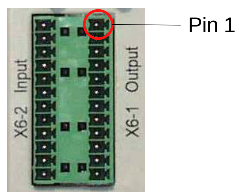
Interface description of the digital output interface (X6-1):

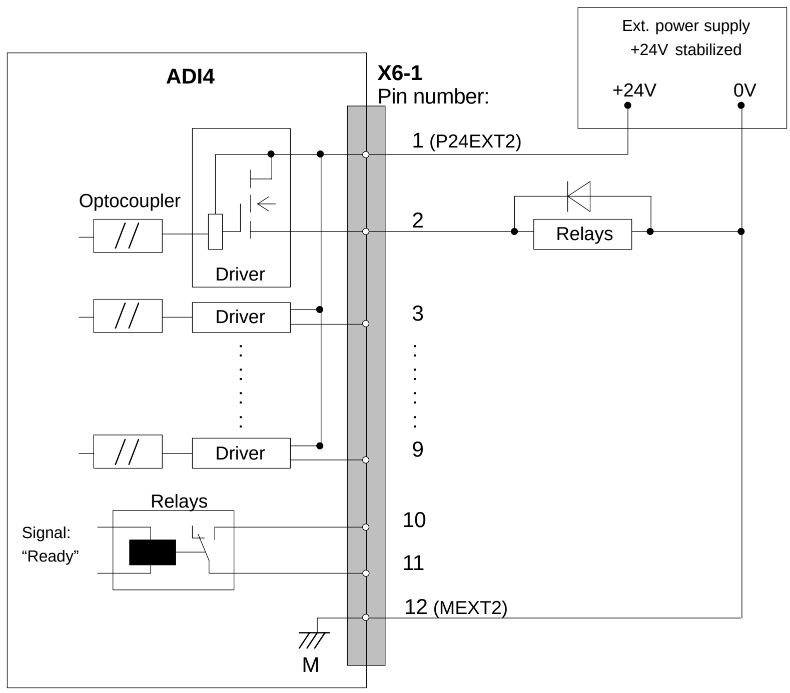
- Connector: two 12-way connector FK-MCP 1,5/15-ST-3.81, Phoenix (together with X6–2)
- Pin assignment:

Table 2-31 Pin assignment: Digital output interface (X6-1)

Pin	Designation	Type [1]	Function
1	P24EXT2	VI	Ext. Power supply voltage 24VDC
2	Q0	DO	1. Digital output signal
3	Q1	DO	2nd Digital output signal
4	Q2	DO	3rd Digital output signal
5	Q3	DO	4th Digital output signal
6	DIR1	DO	5th Digital output signal or axis-specific direction signal axis 1 [3]
7	DIR2	DO	6. Digital output signal or axis-specific direction signal axis 2 [3]
8	DIR3	DO	7. Digital output signal or axis-specific direction signal axis 3 [3]
9	DIR4	DO	8. Digital output signal or axis-specific direction signal axis 4 [3]
10	RDY1	K [2]	Ready signal “Ready” relay contact 1
11	RDY2	K [2]	Ready signal “Ready” relay contact 2
12	MEXT2	VI	Reference of ext. Supply voltage

1) VI Voltage Input
DO Digital Output (24V)
K Relay contact
2) Max. current carry capacity: 2A for 150VDC or 125VAC
3) in the case of function “unipolar spindle”





- Supply voltage:
  An external power supply source 24VDC must be connected to the power supply of the digital outputs at X6-1, pin 1 (P24EXT2).

  The reference ground of the external power supply source must be connected with X6-1, pin 12 (MEXT2).

  For further data, see Subsection 2.13.8, page 2-124.

- Electrical specification of the digital outputs:

Table 2-32 Electrical specification of the digital outputs

Digital outputs	min.	typical	max.	nominal
Voltage at high level (V_{hi})	V_{CC} – 3V	1)	V_{CC}	24V
Output current I_{OUT}	–	–	500mA	–
Voltage at low level (V_{lo})	–	–	–	0V
Leakage current at low level	–	50µA	400µA	–
Signal delay T_{PHL} and T_{PLH} 2)	–	0.5msec	–	–

- Power supply of the digital outputs
  1) typical output voltage: $V_{CC} – I_{OUT} * R_{ON}$ – 0.65V
  V_{CC}: Current operating voltage P24EXT2
  Max. output current I_{OUT}: 500mA
  Max. short-circuit current: 4A (max. 100µsec, V_{CC} = 24V)
  Internal resistance R_{ON}: 0.4Ω
- 2) The PROFIBUS communication time and the application cycle time must also 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 max. 500mA
  - Protection from: short-circuit, overtemperature, and loss of ground
  - Automatic shutdown on undervoltage.

- Relay contact Ready signal “Ready”

  The relay contact remains open/is opened if one of the follwoing states is present in the module:
  - Initialization after Power On
  - Power Failure or NMI
  - No cyclic communication to DP master
  - PLL error
  - Synchronization error
  - Overtemperature

  The relay contact is closed when the following conditions are satisfied:
  - Module status “Ready”
  - Cyclic communication with the DP master

- Connecting cable: The required connecting cables must be provided by the user.
  - Power supply voltage X6-1, pins 1 and 12 (P24EXT2):
    Wire, conductor cross-section 1.5mm^2 (AWG16)
  - Digital outputs X6-1, pins 2–9:
    Wire, conductor cross-section 0.5–1.5mm^2 (AWG20–AWG16)
  - NC Ready X6-2, pins 10 and 11:
    Wire, conductor cross-section 1.5–3.5mm^2 (AWG16–AWG12)

Notice

The lengths of the digital signal lines must not exceed 30m.

Digital inputs (X6-2)

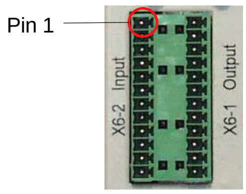
Interface description of the digital input interface (X6-2):

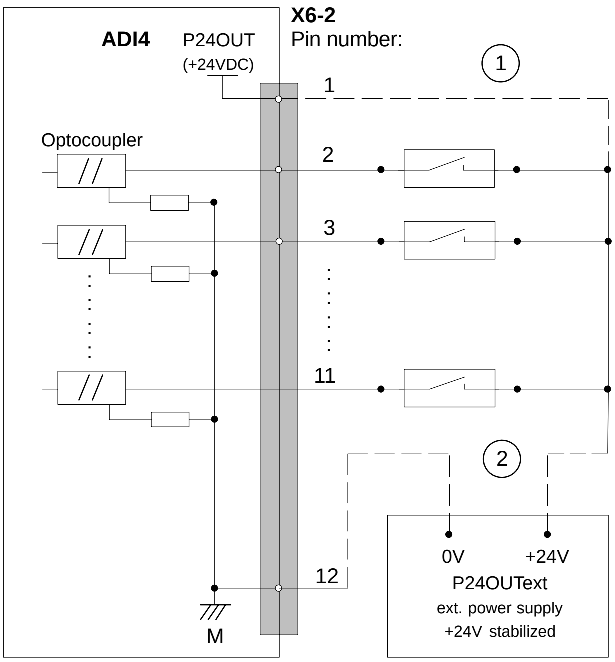
- Connector: 2x12-way connector FK-MCP 1.5/15-ST-3.81, Phoenix (together with X6-1)
- Pin assignment:

Table 2-33 Pin assignment: Digital input interface (X6-2)

Pin	Designation	Type [1)]	Function
1	P24OUT	VI	Power supply voltage 24VDC
2	BERO1	DI	Input signal BERO1
3	BERO2	DI	Input signal BERO2
4	BERO3	DI	Input signal BERO3
5	BERO4	DI	Input signal BERO4
6	MEPU1	DI	Measuring signal 1st sensor probe
7	MEPU2	DI	Measuring signal 2nd sensor probe
8	DRV1_RDY	DI	Ready signal “Drive Ready” axis 1
9	DRV2_RDY	DI	Ready signal “Drive Ready” axis 2
10	DRV3_RDY	DI	Ready signal “Drive Ready” axis 3
11	DRV4_RDY	DI	Ready signal “Drive Ready” axis 4
12	MOUT	VI	Reference of the power supply

1) VI Voltage Input
DI Digital Input (24V)





(1) Connection if the internal power supply voltage P24OUT is used;
the connection to (2) is then no longer necessary.

(2) Connection if an external power supply is used

P24OUText; the connection to (1) is then no longer necessary.

- Internal power supply P24OUT
  The power supply available for digital inputs at X6-2, pin 1 is specified as follows:

Table 2-34 Specification of the power supply voltage P24OUT

Voltage	
minimum	20.4V
nominal	24V
max.	28.8V
Ripple	
max.	3.6Vpp
Current load	
typical	0.1A
max.	1A
Power consumption	
typical	3.02W
max.	30.2W
Insulation class	A, acc. to DIN 57110b
• Typical output voltage:	$V_{CC} – I_{OUT} * R_{ON}$ – 0.65V
V_{CC}:	Current P24OUT operating voltage
max. output current I_{OUT}:	1A
Internal resistor R_{ON}:	0.4Ω
• The power supply P24OUT is short-circuit-proof	

- External power supply P24OUText
  If an external power supply Is used for the digital inputs, its reference ground must be connected to X6-2, pin 12 (GND).

  X6-2, pin 1 (P24OUT) then remains open.

- Electrical specification of the digital inputs

Table 2-35 Electrical specification of the digital inputs

Digital inputs	min.	typical	max.	nominal
Voltage at high level (V_{hi})	15V	1)	30V	24V
Input current I_{IN} at VU_{hi}	3.7mA	–	7.5mA	–
Voltage at low level (V_{lo})	–30V	–	+5V	0V
Signal delay T_{PHL} and T_{PLH} 2)	–	3μsecs	–	–

- 1) see Table 2-34, page 2-117
- 2) The PROFIBUS communication time and the application cycle time must also be taken into account.
- Polarity reversal causes neither high level nor destruction of the inputs.

- Connecting cable: The required connecting cables must be provided by the user.

– Power supply X6-2, pin 1 (P24OUT), external power supply P24OUText:
  Wire, conductor cross-section 1.5mm^2 (AWG16)
– Digital inputs X6-2, pins 2–11:
  Wire, conductor cross-section 0.5–1.5mm^2 (AWG20–AWG16)

- General electrical properties
  – Galvanic isolation using optocouplers
  – Active current limitation of the inputs
  – Protection from negative input voltage.

Module status (H1/H2)

The module status is displayed on 4 diagnostic LEDs on the front of the module.

Table 2-36 Diagnostic LEDs (H1/H2)

Designation		Color	Description
H1	POWER	green	Supply voltage
	OVTEMP	red	Overtemperature display
H2	EXCHANGE	green	Cyclic data exchange with DP master in progress
	READY	red	Ready for cyclic data exchange with DP master

2.13.3 Cabinet mounting

Mounting

The housing of the ADI4 module must be connected with the back wall of the cabinet and this, in turn, to the motors/machine through a low-resistance contact for high-frequency interference currents. The ideal way of mounting the module is on an unpainted mounting wall. The mounting wall must be connected to the motors/machine by a large-area and conductive contact. Painted cabinet walls and DIN rails, or similar mounting accessories with a small contact area do not fulfill this requirement.

Cable routing

Power and signal cables must always be laid apart. All signal cables of the I/O interfaces (X6-1/X6-2) must be routed together. Single cores whose signals are related must be twisted. Signal cables and encoder cables must ideally be laid separately.

All cables within the cabinet must be routed as close as possible to the cabinet walls, long routing through the open space can cause interference (antenna effect). The vicinity of sources of interference (contactors, transformators, etc.) must be avoided, placing a shield plate between the cable and the source of interference, if necessary. Cable extension through terminals, etc. must be avoided. To protect interference from external sources, signal cables must be shielded.

Warning

The ADI4 is designed for operation in an enclosed cabinet. Operation outside an enclosed cabinet is not permissible.

2.13.4 Power supply

ADI4 module

To power the ADI4 module (+24VDC), an external power supply source is required. The power supply source is connected through terminal X1 (P24EXT1) on the front panel of the ADI4 module. See Subsection 2.13.2, page 2-107.

Digital outputs

To power the digital outputs (+24VDC), an external power supply source is required. The power supply is connected through terminal X6-1, pin 1 (P24EXT2). See Subsection 2.13.2, page 2-107.

Digital inputs

If the internal power supply from X6-2, Pin 1 (P24OUT) is not used to power the digital inputs, it can be replaced by an external power supply source (+24VDC, max. 1A) as an option.

The reference ground (GND) of the external power supply source must be connected with X6-2, pin 12. X6-2, pin 1 (P24OUT) remains open.

Specification of the power supplies (+24VDC)

The external power supplies for the ADI4 module, the digital outputs, and optionally the digital inputs must meet the specifications in Table 2-30.

Table 2-37 Specification of the external power supplies

	Supply voltage 1)		
	P24EXT1	**P24EXT2**	**P24OUText**
Voltage			
minimum	18.5V		
nominal	24V		
max.	30.2V		
Ripple			
max.	3.6Vpp		
Current load			
typical	0.5A	–	0.1A
max.	1A	8A	1A
Power consumption			
typical	12W	–	3.02W
max.	30.2W	241.6W	30.2W

1) P24EXT1: Supply voltage of the ADI4 module
P24EXT2: Supply voltage for the digital outputs
P24OUText: Optional supply voltage for the digital inputs

Caution

The external power supply voltages must be generated as functional extra-low voltages with safe electrical isolation (DIN EN 60204-1, Section 6.4, PELV).

On the module side, power supplies P24EXT1 and P24EXT2 must be protected against:

- Overvoltage
- Short-circuit (elec. current limitation of the outputs)
- Polarity reversal
- Overload
  - P24EXT1: Fuse 2.5A/250V
  - P24EXT2: Fuse 8A/125V.

2.13.5 Grounding

The installation of the module must be performed acc. to EN 60204.

The user must ground the power supply voltages. From terminal X1, pin 2 (MEXT1) or X6-1, pin 12 (MEXT2) it is necessary to establish a link with a central grounding point of the system.

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

Caution

A protective conductor must be connected.

The housing front has an M6 screw bottom right for connecting the protective conductor. See Subsection 2.13.1, page 2-105.

2.13.6 Connection overview

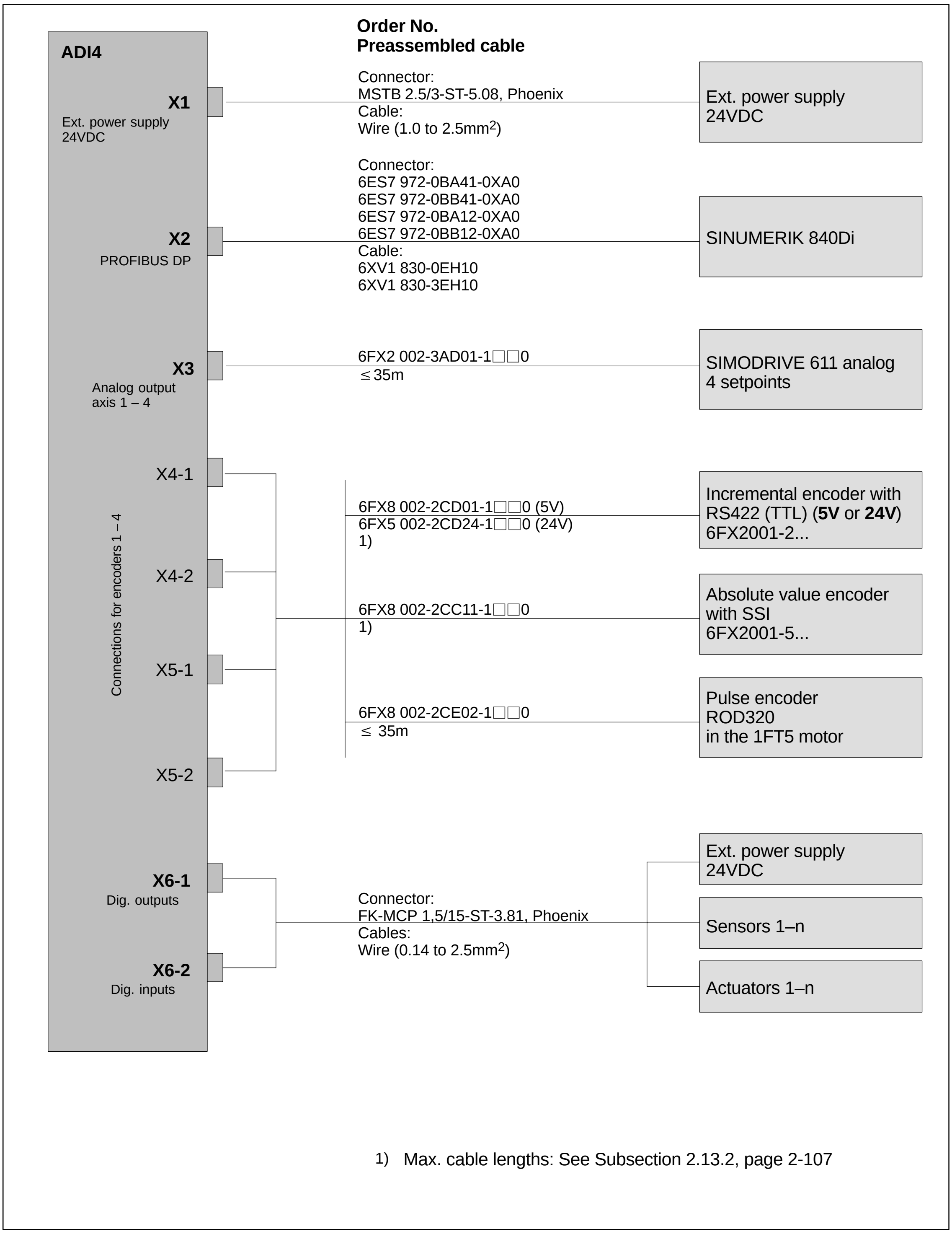


Fig. 2-34 ADI4 connection overview

2.13.7 Dimension drawing

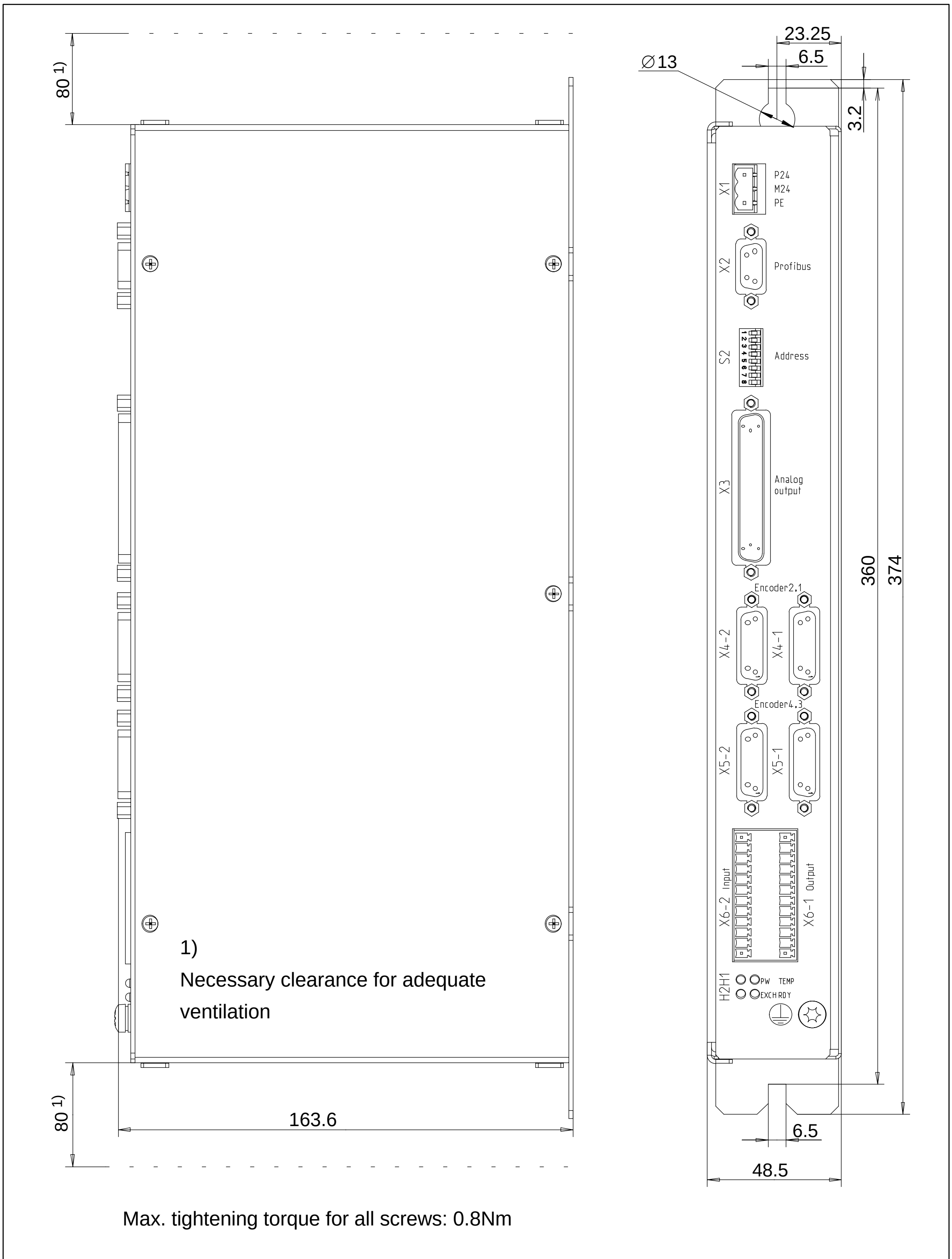


Fig. 2-35 Dimension drawing: ADI4

2.13.8 Technical data

Table 2-38 Technical data of the ADI4 module

Safety		
Degree of protection	IP20	
Class of protection	Class of protection I, acc. to VDE 0106 P1: 1982 (IEC 536); Protection against ingress of solid foreign bodies and water to IEC 529	
Certifications	CE/CSA, CE	
Power consumption		
Nominal load	12W	
Max.	30.2W	
Mechanical data		
Dimensions WxHxD [mm]	154.4x325x48.5	
Weight	approx. 1.5kg	
Climatic environmental conditions		
Heat dissipation	Open-circuit cooling	
	Operation	**Storage/transportation**
Temperature limit values	0 ... 55°C	–20 ... 55°C/–40 ... 70°C
Limit values of rel. humidity	5 ... 95% not condensing	5 ... 95% not condensing
	per min.	**per hour**
Condensation	not admissible	
Atmospheric pressure	700 ... 1060hPa	700 ... 1060hPa
Transportation height	–	–1000 ... 3000m
Shock loading during transportation		
Free fall in transport package	≤ 1000mm	

■

3 Design

3.1 System overview

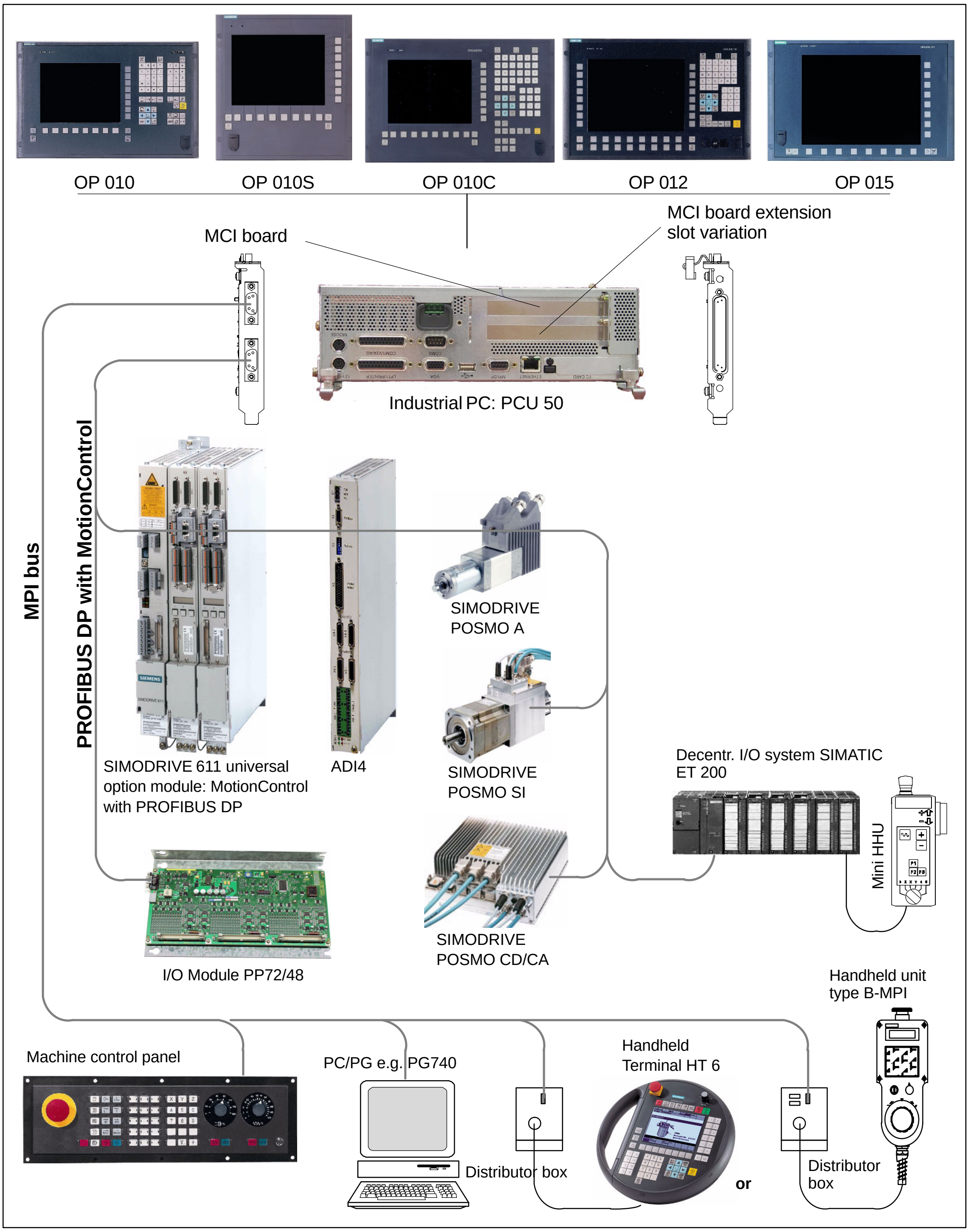


Fig. 3-1 SINUMERIK 840Di system overview: PROFIBUS DP and MPI (as a diagram)

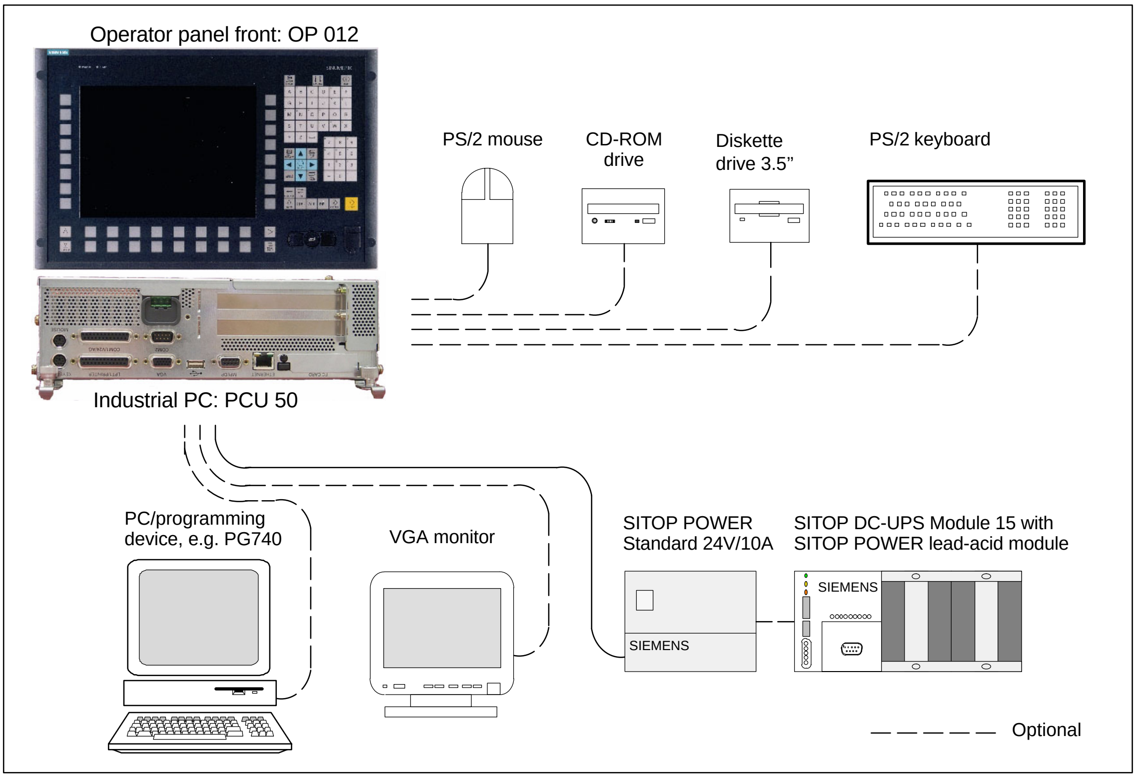


Fig. 3-2 System overview: PCU components (as a diagram)

3.2 Electrical design

Note

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

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

3.2.1 MCI board and PROFIBUS DP

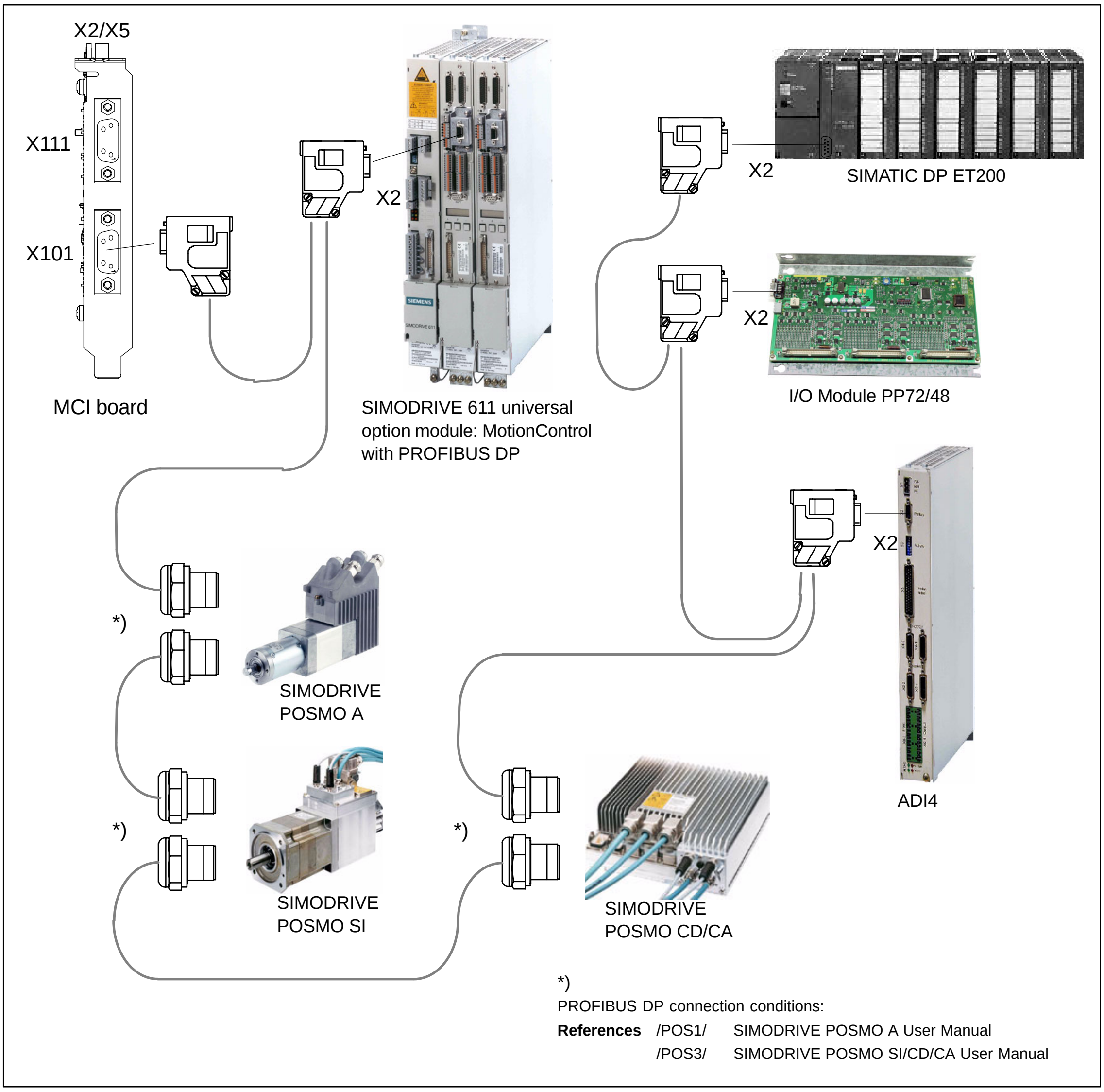


Fig. 3-3 SINUMERIK 840Di MCI board and PROFIBUS DP components

3.2.2 MCI board and MPI bus

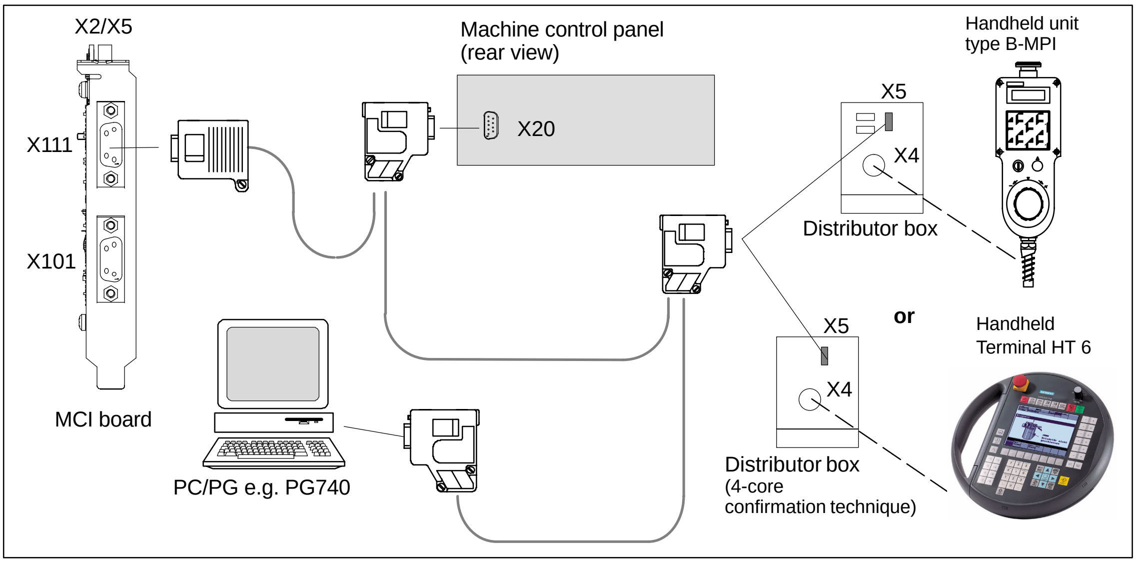


Fig. 3-4 SINUMERIK 840Di MCI board and MPI bus components

3.2.3 MCI board extension

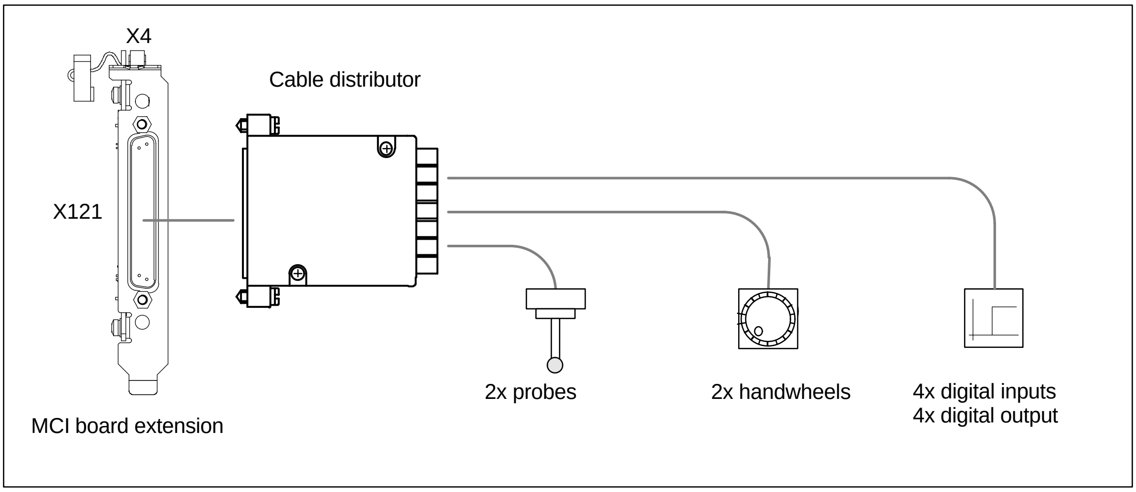


Fig. 3-5 SINUMERIK 840Di MCI board extension

3.2.4 PCU 50

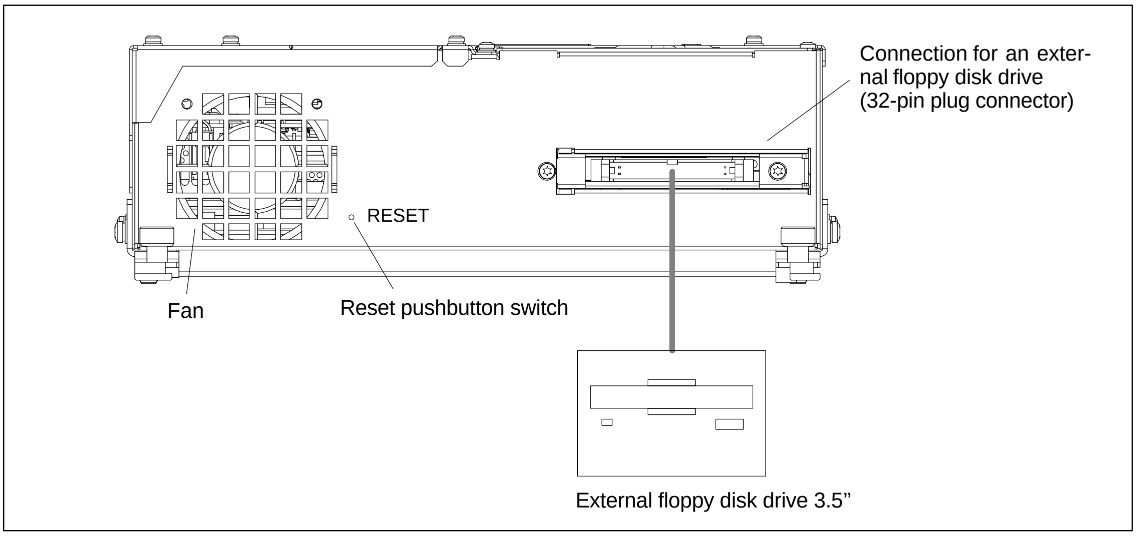


Fig. 3-6 SINUMERIK 840Di PCU 50, left housing side

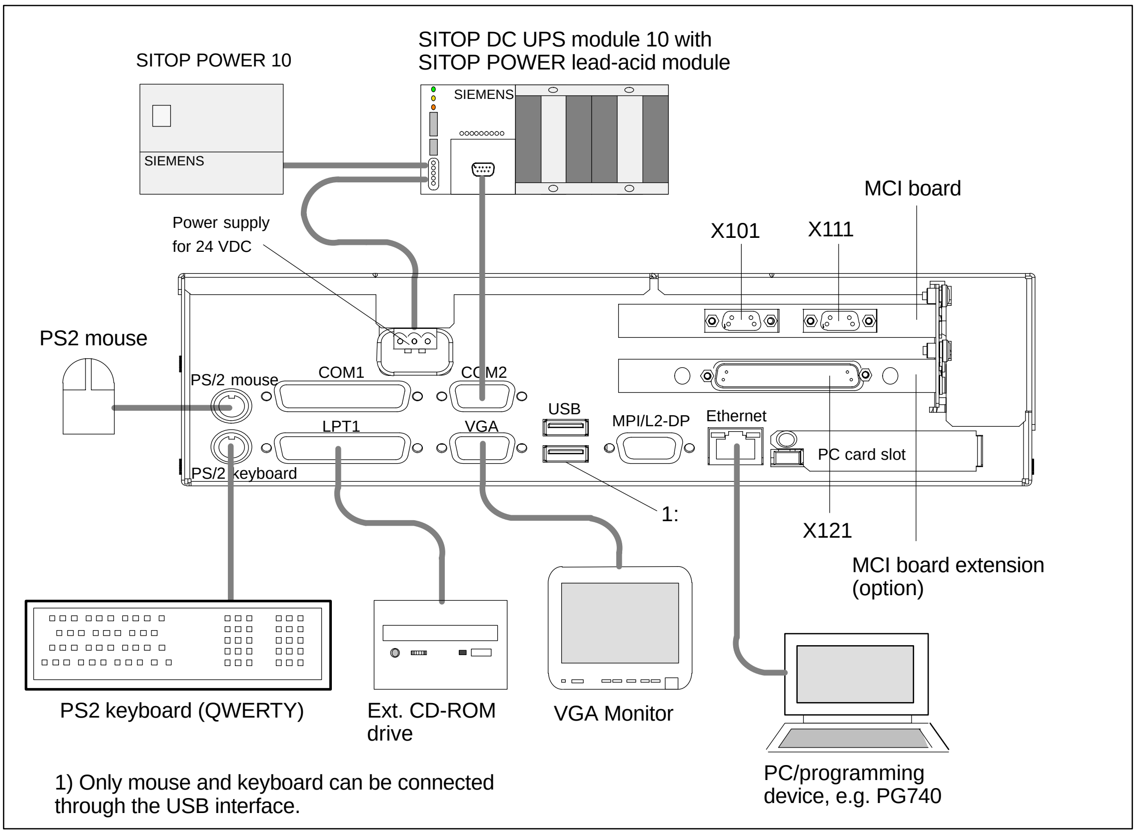
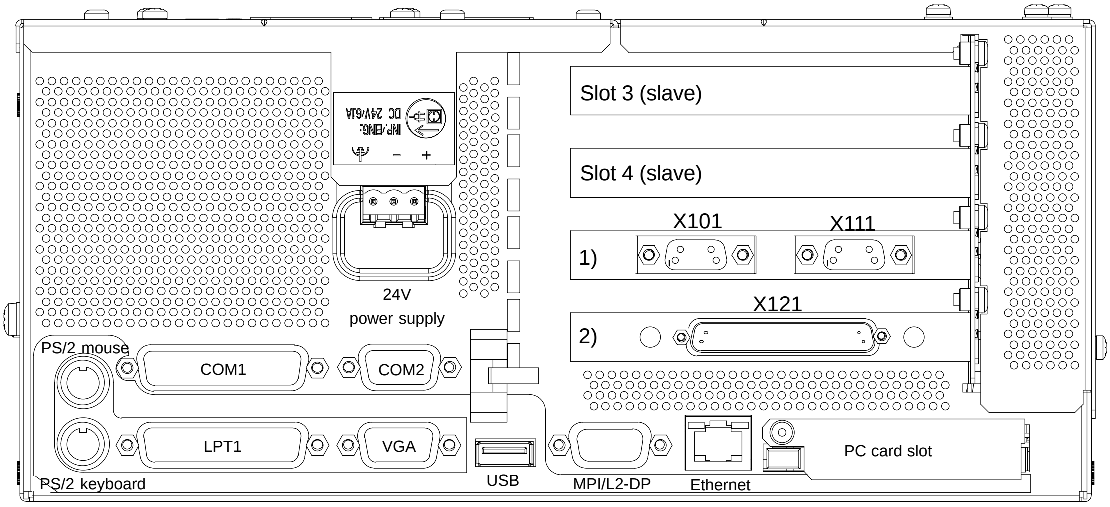


Fig. 3-7 SINUMERIK 840Di PCU 50 (right housing side)

3.2.5 PCU 70



Connections
Assignment as with PCU 50

Expansion slots

1) Slot 1 (Master/slave)
   Note
   The MCI board must only be run in slot 1
2) Slot 2 (master/slave)
   MCI board extension (option)

Fig. 3-8 SINUMERIK 840Di PCU 70 (right housing side)

Note

The connections of the PCU 70 correspond to those of the PCU 50.

3.3 Connection overview

3.3.1 PCU 50, MCI board and MCI board extension

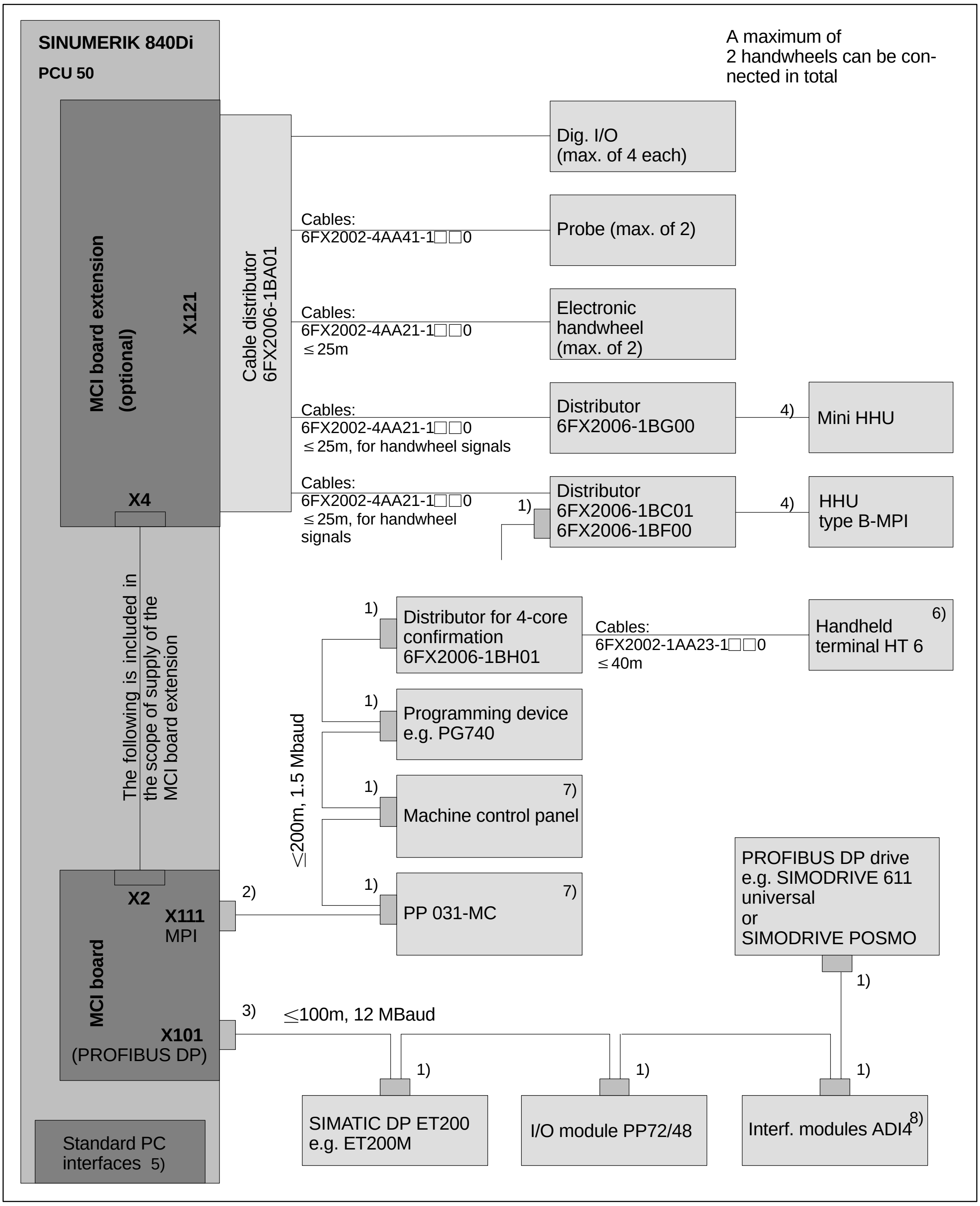


Fig. 3-9 Connection overview PCU 50, MCI board and MCI board extension

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

Cable:
6XV1830-0EH10; yard ware, non-trailable
6XV1830-3BH10; yard ware, trailable

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

Cable:
6XV1830-0EH10; yard ware, non-trailable
6XV1830-3BH10; yard ware, trailable

3) Connector:
6ES7972-0BB40-0XA0; cable outlet 35^0, with socket connector for programming device
6ES7972-0BB11-0XA0; cable outlet 90^0, with socket connector for programming device

Cable:
6XV1830-0EH10; yard ware, non-trailable
6XV1830-3BH10; yard ware, trailable

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

5) For an overview of the standard PC interfaces, see Fig. 3-6, page 3-129 and Fig. 3-7, page 3-129.

References: /BH/ Operator Components Manual
Component PCU 50.

6) – HT 6 always plugged: Max. of 200m from connector X111 to HT 6
– HT 6 not always plugged: Max. of 200m from connector X111 to HT 6
With repeater only:
RS485 (6ES7972-0AA01-1XA0)
Otherwise, total length of MPI from connector X111 to distributor $\leq$ 5m

– The line -4EA04 is not permitted.

Always connect the HT 6 at an end of the MPI path (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

---

7) Machine control panel and PP 031-MC can be operated together.Subsection3.3.1

8) For a more detailed connection overview of the ADI4, please refer to Subsection 2.13.6, page 2-122.

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 supplementary conditions (if any) applicable to the individual accessories, please refer to:

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

■

Notes

EMC and ESD Measures

4

4.1 Interference suppression measures

Shielded signal cables

Only use the cables specified in the individual diagrams to ensure safe interference-free operation of the system. Generally, the shield must be conductively connected to the housings on both ends.

Exception:

- If third-party devices are connected (printer, programming devices etc.), it is also possible to use standard shield cables connected to the housing to one end only.

  These devices, however, may not be connected to the control system during normal operation. If the operation of third-party devices is inevitable, the shields must be connected to both ends. In addition, the third-party device must be connected to the control system using an equipotential bonding conductor.

Installation rules

In order to achieve maximum noise immunity of the whole system (control system, power section, machine), observe the following EMC measures:

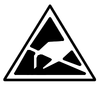
- Observe maximum clearance between signal and load cables.
- Use only the cables offered by SIEMENS as the signal lines from and to the NC or PLC.
- Make sure that the signal lines have a sufficient clearance from strong magnetic fields (e.g. motors and transformers).
- Pulse-loaded high-current/high-voltage cables must always be routed completely separated from any other cables.
- If a sufficient clearance is not possible, signal lines must be routed in shielding cable channels (metal).
- Make sure that the distance (interference injection area) between the cables listed below is as low as possible:
  – Signal line and signal line
  – Signal line and appropriate equipotential bonding conductor
  – Equipotential bonding conductor and appropriate protective conductor.

!

Important

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

4.2 ESD measures



Notice

Handling of ESD modules:

- When you are handling ESD-sensitive devices, make sure that you, your workplace and the device packaging are grounded well.
- Do not touch electronic modules unless it is absolutely essential for the work to do on it. When handling p.c. boards, never touch the module pins or printed conductors.
- Do not touch ESD-sensitive components unless
  - you are grounded by means of an antistatic wristband,
  - you wear antistatic footwear or ground straps when walking on an antistatic floor.
- Place sensitive modules only on high-resistance, conductive surfaces (table with antistatic surface, conductive antistatic foam or antistatic packaging).

  Notice
  An exception are modules with their own power supplies (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.
- Do not bring ESD-sensitive modules into the vicinity of visual display units, monitors or TV sets (minimum distance to the 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 ESD-sensitive modules may only be carried out if
  - the measuring instrument is grounded (e.g. using a protective conductor) or
  - the measuring head is discharged for a short time prior to the measurement (e.g. by touching a bright control housing).

■

MPI Communication 5

5.1 General

Notice

On the SINUMERIK 840Di, nodes must not be plugged in or removed during operation on the MPI bus.

MPI bus addresses

Each node at the MPI bus must have a bus address in the range (0...31).

Data transfer rate

Notice

The data transfer rate at the MPI bus of the SINUMERIK 840Di must be set to 1.5 Mbaud.

Communication does not start

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 1.5 Mbaud?
- Are there any loosen cable connections?
- Are all bus segments terminated correctly?
  With the MPI bus operating at 1.5 Mbaud, bus segments not terminated correctly will certainly result in disturbances of communication.

Notice

In some components (e.g. HHU and HT 6), the terminating resistor is installed fixed.

5.2 Network rules

Observe the following rules when installing an MPI network:

1. An MPI bus line must be terminated on **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.

Notice

- The Handheld Unit (HHU) and the Handheld Terminal 6 (HT 6) have **integrated** terminating resistors.

2. **At least** one termination must be supplied with a **5V voltage**.
   To this aim, an MPI connector with the terminating resistor enabled must be connected to an enabled device. To this aim, the MPI connection on the MPI board of the SINUMERIK 840Di can be used.
3. Stubs (feeding cable from the bus segment to the node) should be as short as possible, i.e. < 5m. Stubs not used should be removed if possible.

Notice

If possible do not use stubs at all.

4. Each MPI node must be connected first to the bus and then be enabled. When disconnecting the node, first disable the node. Then you can disconnect the node from the bus.
5. 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)
6. Do **not** enable the bus terminating resistors at the distributor boxes of an HHU or HT 6, since they are already integrated in the appropriate device.
7. Maximum cable lengths:
   - 200m per bus segment
   - 2,000m overall length with RS-485 repeater.

Example

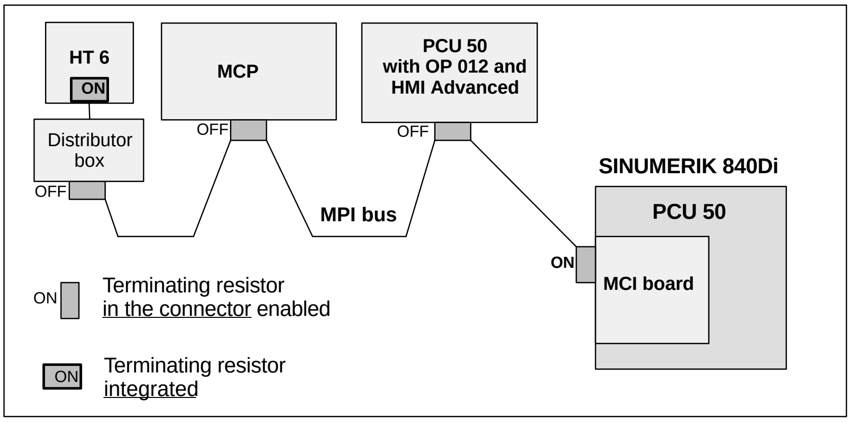


Fig. 5-1 MPI network with terminating resistor

5.3 Default address assignment

Standard MPI addresses

The following figure 5-2 shows a SINUMERIK 840Di with the user interface running on the PCU:

- 840Di start-up or HMI Advanced

and the further components connected on the MPI bus:

- Machine control panel (MCP) or interface customer operator panel
- Handheld terminal (HT 6)
- SIMATIC programming device PG 740

with standard assignment of the MPI addresses.

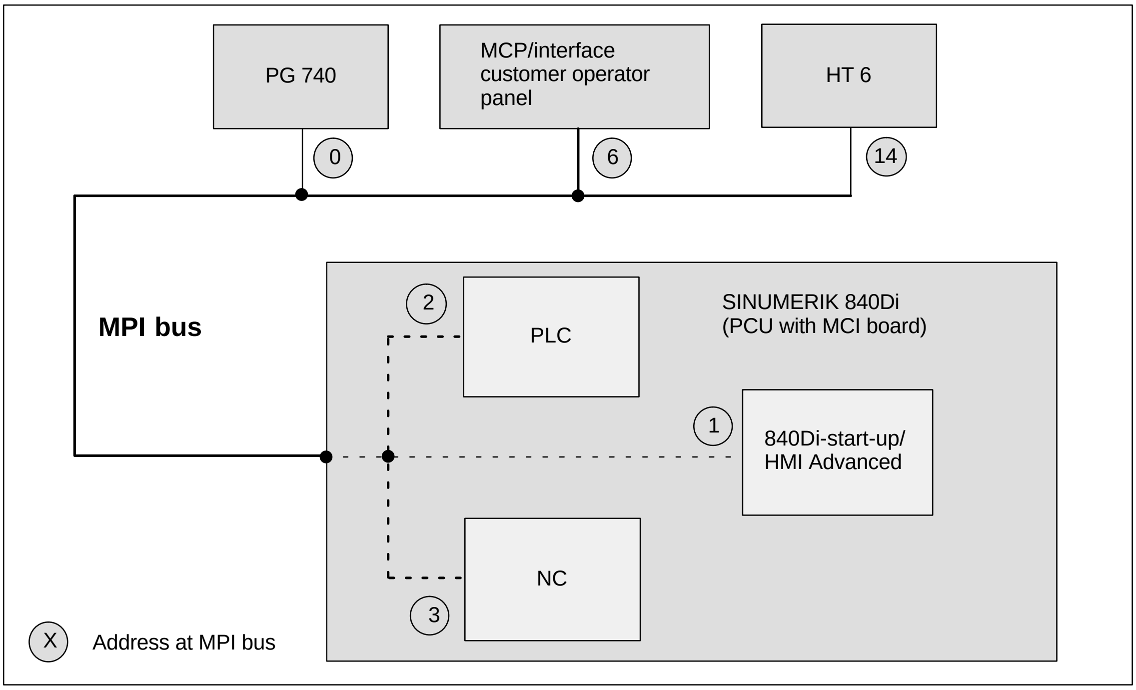


Fig. 5-2 Default addresses at the MPI bus with SINUMERIK 840Di

5.4 Machine control panel (MCP)

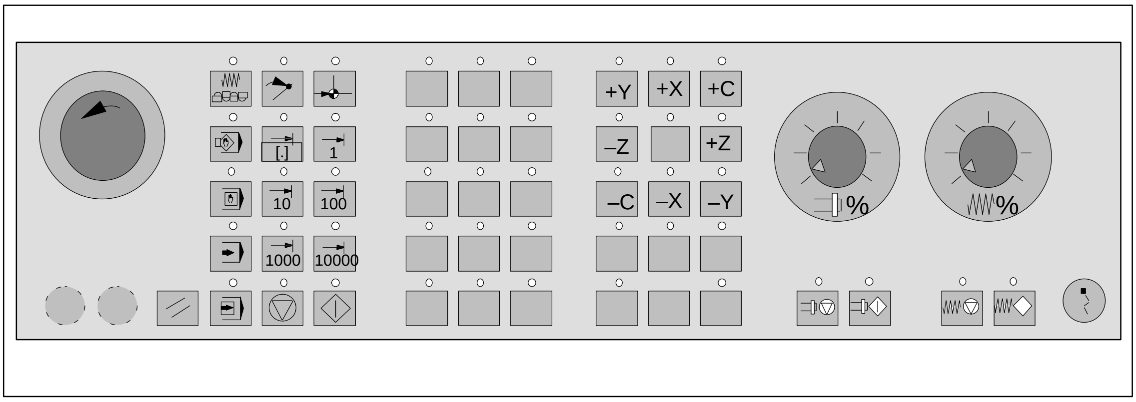


Fig. 5-3 Machine control panel front side; example: Version T (turning machine)

5.4.1 Prerequisites for start-up

Hardware

In order to start up an MCP, the following hardware is required:

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 in order 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 STEP7 is installed on the SINUMERIK 840Di.

How to install additional software is described in Chapter 15, page 15-455.

Software

In order 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 basic PLC program is part of the SINUMERIK 840Di installation.

The installation of the basic PLC program as a SIMATIC S7 library is described in Subsection 8.2.2 (page 8-251) in detail.

SIMATIC Manager STEP7
SIMATIC Manager S7 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 basic PLC program.

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

/Z/ Catalog NC Z
Components required for connection: Cables, connectors, etc.

Automation system

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

The drives must be secured against accidental moving.

5.4.2 Parameterization of the MCP

Electrical connection

The MCP's electrical connections and connections for MPI communication are made using the interfaces on the rear side of the MCP.

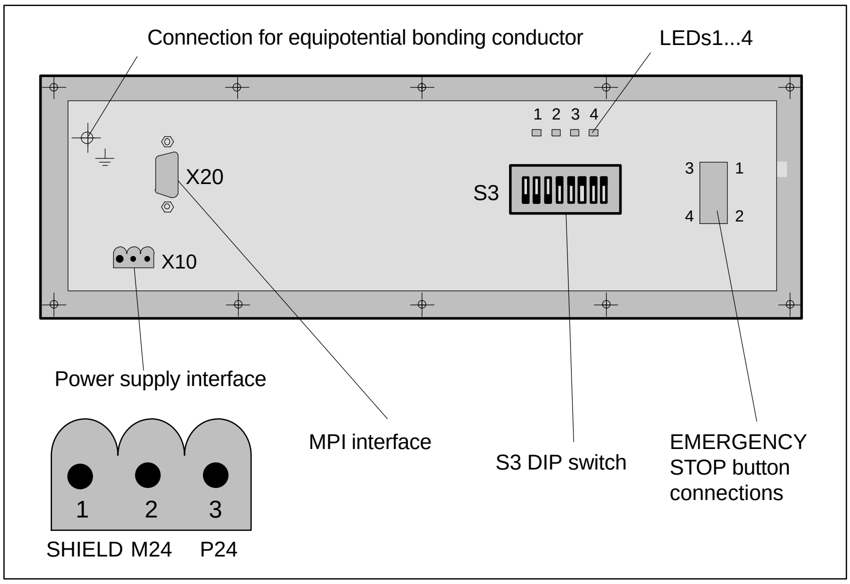


Fig. 5-4 Position of interfaces on rear panel of MCP

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

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

Display of software version

After the MCP has been electrically connected, all LEDs on the front side of the MCP flash until no communication takes place 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 lighting LEDs in the left LED group”
“Number of lighting LEDs in the middle LED group”
“Number of lighting LEDs in the right LED group”

Version number **V4.1.5** is displayed in the example (Fig. 5-5).

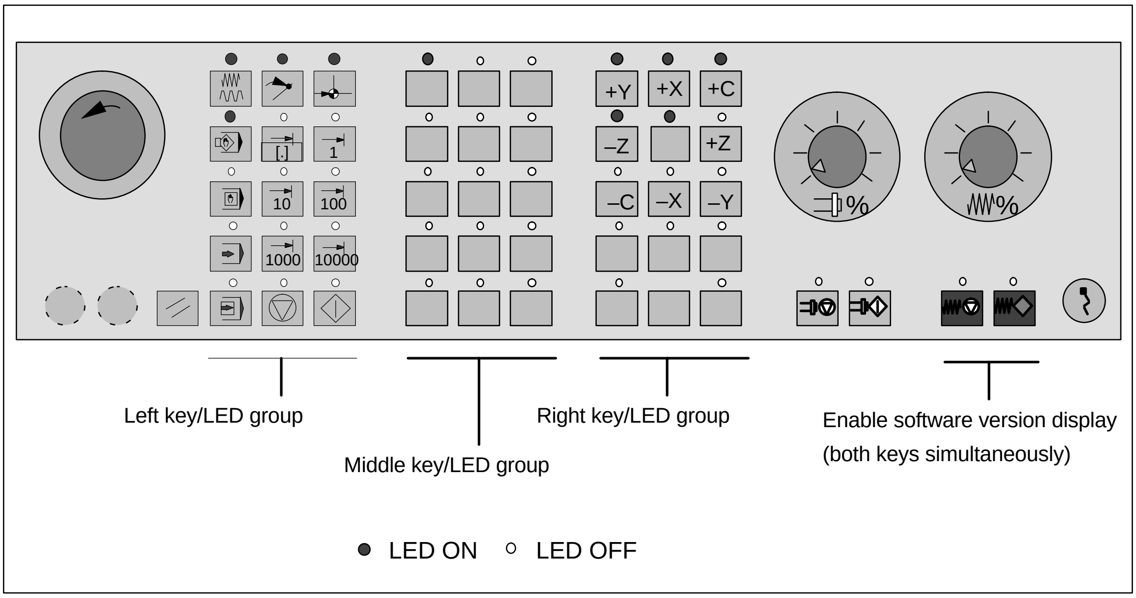


Fig. 5-5 MCP software version display

Data transfer rate

The data transfer rate is set using switch S3 on the rear side of the MPI module. It is 1.5 Mbaud on the MPI bus of the SINUMERIK 840Di.
Setting on S3: see Table 5-1, page 5-143.

MPI address

The factory-set MPI address of the MCP is 6_D (D = decimal).

The MPI address of the MCP can be set using switch S3 on the rear side of the MCP.
Setting on S3: see Table 5-1, page 5-143.

S3 switch

The parameters are set using switch S3 on the rear side of the MCP.

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

Table 5-1 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						200msecscycle transmit pattern/2400msecs receive monitoring 100msecscycle transmit pattern/1200msecs receive monitoring 50msecscycle transmit pattern/ 600msecs receive 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 14 13 12 11 10 9 8 7 6 (default setting) 5 4 3 2 1 0
							ON	Type = interface to customer operator panel
							OFF	Type = MCP
ON	OFF	ON	OFF	ON	ON	OFF	OFF	Default setting
ON	**OFF**	**ON**	**OFF**	**ON**	**ON**	**OFF**	**OFF**	**Default setting for 840Di** Data transfer rate: 1.5 Mbaud Cyclical transmit pattern: 100msecs MPI address: 6 Type: MCP

5.4.3 Parameterization of the PLC

Program structure

The PLC program has a modular structure. It consists of the following function blocks:

- Runup and synchronization (OB 100)
- Cyclic operation (OB 1)
- Process alarm processing (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. 5-6.

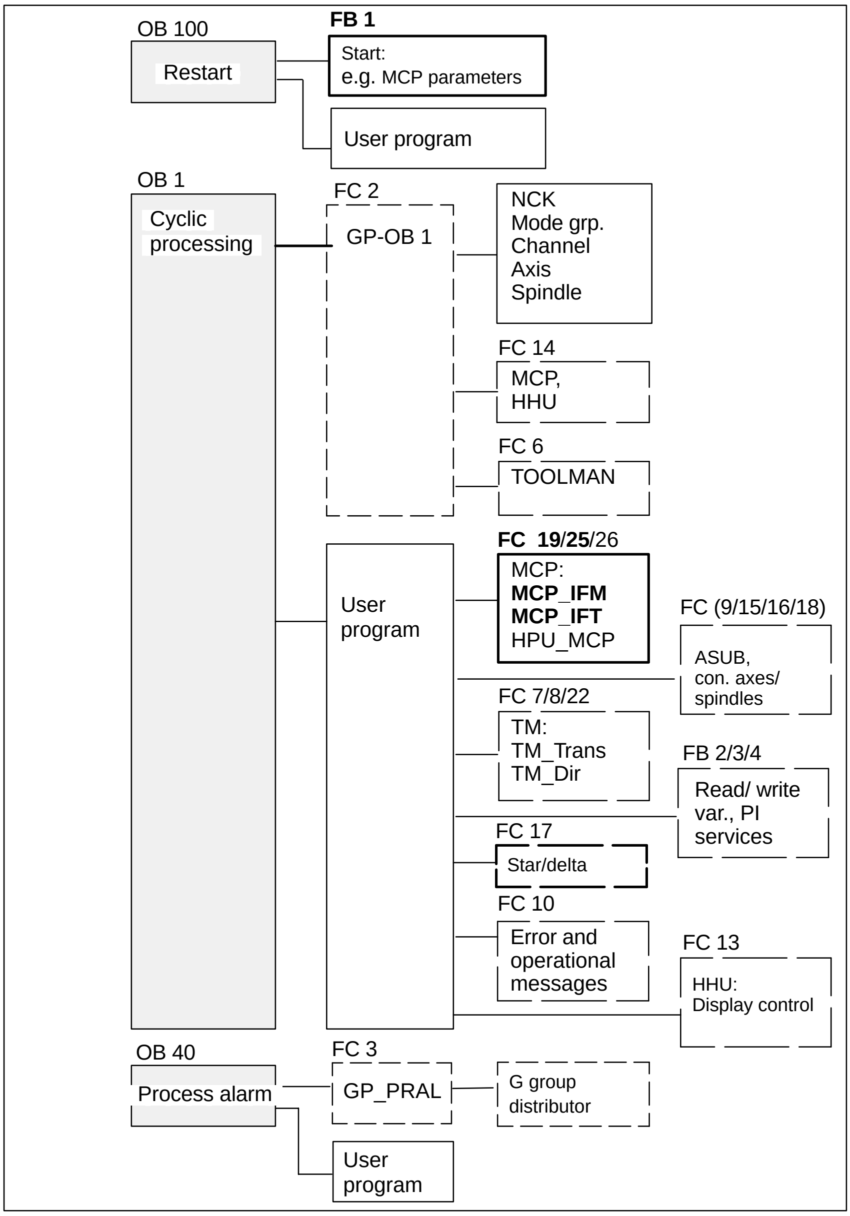


Fig. 5-6 Structure of PLC program

Setting the communication parameters (FB1)

The MCP communication parameters are designated in function block FB1 with MCPx... (with x = 1 or 2).

In addition to a first MCP, a second MCP or an HT 6 (for HT 6, see Section 5.7, page 5-161) can be active as another operator component at the same time.

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

```
MCPNum:          INT:=  1;          // 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 the MCP1 send status data
MCP1StatRec:     POINTER;           // Addr. of the MCP1 receive status data

MCP1BusAdr:      INT:=  6;          // default MPI address of the MCP

MCP1Timeout:     S5TIME:= S5T#700MS; // should be kept
MCP1Cycl:        S5TIME:= S5T#200MS; // should be kept

MCPMPI:          BOOL:= FALSE;      // MCP/HT 6 is operated at the "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 the MCP/HT 6 2 input signals
MCP2Out:         POINTER;           // address of the MCP/HT 6 2 output signals

MCP2StatSend:    POINTER;           // Addr. of the send status data MCP/HT 6 2
MCP2StatRec:     POINTER;           // Addr. of the MCP1 receive status data MCP/
                                    // HT 6 2

MCP2BusAdr:      INT;               // MPI address

MCP2Timeout:     S5TIME:= S5T#700MS; // should be kept
MCP2Cycl:        S5TIME:= S5T#200MS; // should be kept
```

The parameters listed below serve to synchronize two operator components:

```
MCP1Stop:        BOOL:= FALSE;      // transfer of the relevant operator component:
MCP2Stop:        BOOL:= FALSE;      // FALSE = start;  TRUE = stop

MCP1NotSend:     BOOL:= FALSE;      // Send and receive mode of the corresponding
MCP2NotSend:     BOOL:= FALSE;      // Operator component:
                                    // FALSE = send and receive is active
                                    // TRUE = only receive is active
```

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
Section: FB 1: RUN_UP Basic program, start-up 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, Basic PLC Program
Section: FC 19: MCP_IFM Transmission of MCP signals tointerface
Section: FC 25: MCP_IFT Transfer of MCP/OP signals tointerface

5.4.4 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.

   Since function block FB1 is not yet parameterized in the basic PLC program, communication with the PLC does not yet take place 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 using the LEDs located on the front side.
3. Parameterizing function block FB 1 (editing the FB 1 parameters in OB 100 using the SIMATIC Manager STEP7)

   The MCP will be parameterized as the first and only MCP as an example:

```
MCPNum:          INT:=  1;             // one MCP is connected

                                       // P# = pointer to
MCP1In:          P#E 0.0;              // address of input data (8 bytes)
MCP1Out:         P#A A 0.0;            // address of input data (8 bytes)

MCP1StatSend:    P#A 8.0;              // address of the send status data (4 bytes)
MCP1StatRec:     P#A 12.0;             // address of receive status data (4 bytes)

MCP1BusAdr:      INT:=  6;             // default address

MCP1Timeout:     S5TIME:= S5T#700MS; // should be kept
MCP1Cycl:        S5TIME:= S5T#200MS; // should be kept

MCPMPI:          BOOL:= FALSE;         // MCP/HT 6 is operated at the “extended”
                                       // MPI bus
MCP1Stop:        BOOL:= FALSE;
MCP1NotSend:     BOOL:= FALSE;
```

4. Insert block FC 19 or FC 25 into the cyclic part of the PLC program (see Fig. 5-6).

5. Load the modified blocks into the PLC and then restart the PLC.
6. 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 hold

   light up continuously.

5.5 MPI interface

Use

The MPI (multi-point interface) 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).

Start-up

Start-up of an Interface MPI module is to a large degree identical to start-up of a machine control panel (MCP), Section 5.4, page 5-140.

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

5.5.1 Parameterization of the MPI interface

Electrical connection

The MPI module's electrical connections and connections for MPI communication are made using the interfaces on the rear side of the module.

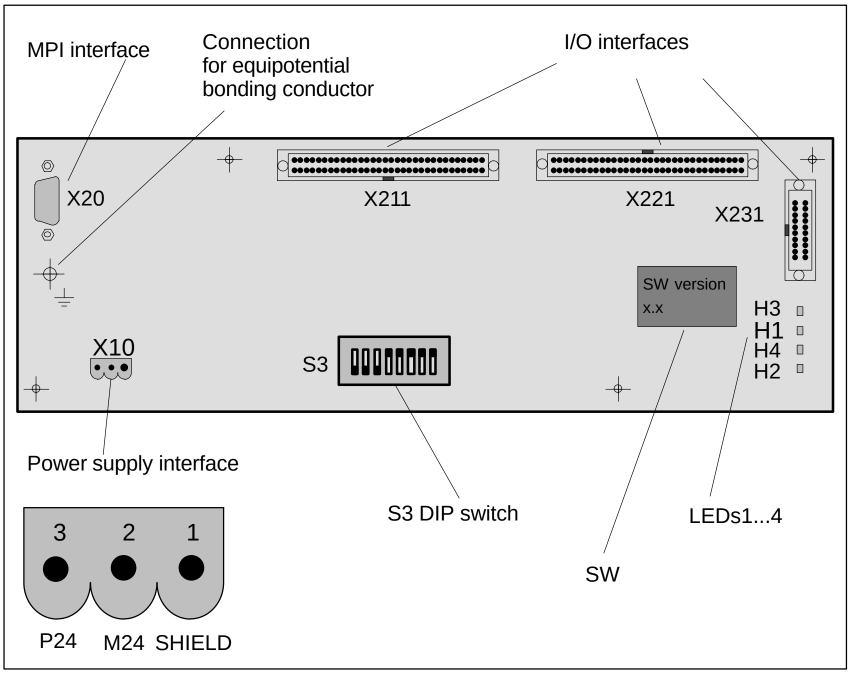


Fig. 5-7 Position of the interfaces on the rear side of the MPI module

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

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

Display of software version

A label indicating the current software version is to be found on the firmware EPROM (see Fig. 5-7).

Data transfer rate

The data transfer rate is set using switch S3 on the rear side of the MPI module. It is 1.5 Mbaud on the MPI bus of the SINUMERIK 840Di.
Setting on S3: see Table 5-2, page 5-149.

MPI address

The factory-set MPI address of the MCP is 6_D (D = decimal).

The MPI address of the MCP can be set using switch S3 on the rear side of the MCP.
Setting on S3: see Table 5-2, page 5-149.

Switch S3

The data transfer rate is set using switch S3 on the rear side of the MPI module.

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

Table 5-2 Meaning of 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						200msecs cycle transmit pattern/ 2400msecs receive monitoring 100msecs cycle transmit pattern/ 1200msecs receive monitoring 50msecs cycle transmit pattern/ 600msecs receive 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 14 13 12 11 10 9 8 7 6 (default setting) 5 4 3 2 1 0
							ON	Type = MPI module
							OFF	Type = MCP

Table 5-2 Meaning of S3 switch

1	2	3	4	5	6	7	8	Meaning:
ON	OFF	ON	OFF	ON	ON	OFF	ON	Default setting
ON	**OFF**	**ON**	**OFF**	**ON**	**ON**	**OFF**	**ON**	**Default setting for 840Di** Data transfer rate: 1.5 Mbaud Cyclical transmit pattern: 100msecs MPI address: 6 Type: MPI module

5.6 Handheld unit (HHU)

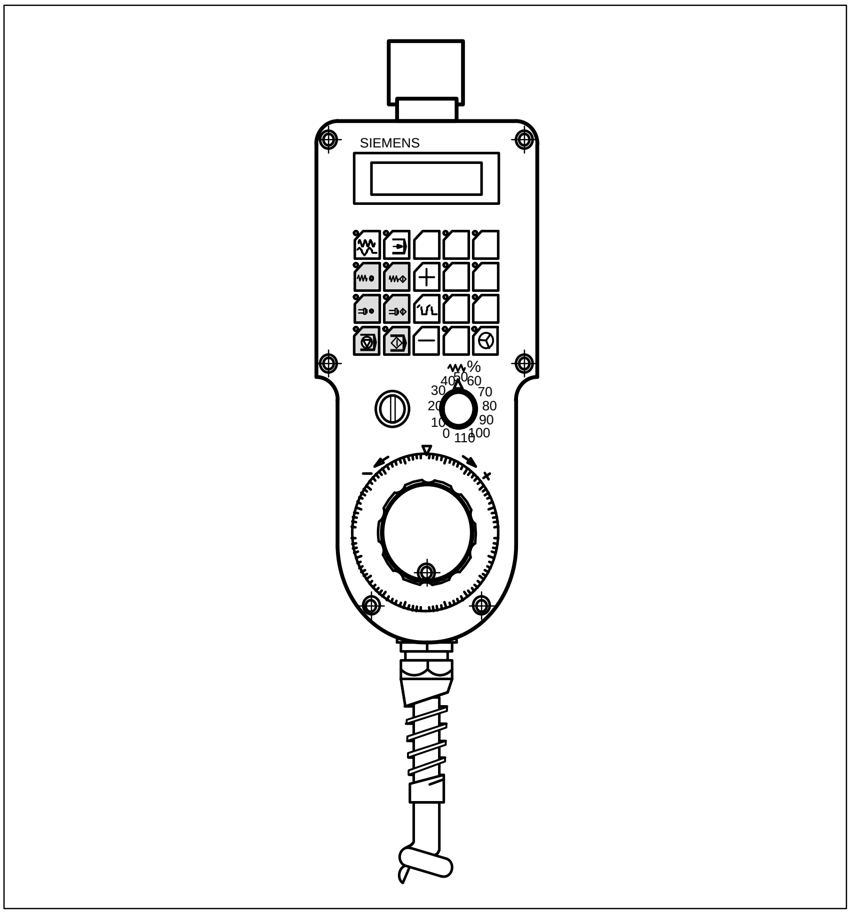


Fig. 5-8 Handheld unit (HHU), front

5.6.1 Prerequisites for start-up

Hardware

The following hardware components are required to start up the 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 24V 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 STEP7** as the platform in order 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 STEP7 is installed on the SINUMERIK 840Di.

How to install additional software is described in Chapter 15, page 15-455.

Software

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

Basic PLC program
The basic PLC is included on the SINUMERIK 840Di installation CD. (Start setup.exe; Products –> Basic PLC Program.)
HHU-related blocks of the basic PLC program are FB1 (HHU parameter) and FC13 (display control).

SIMATIC Manager STEP7
SIMATIC Manager S7 is used for adapting the basic PLC 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 basic PLC program.

/Z/ Catalog NC Z
Components required for connection: Cables, connectors, etc.

Automation system

In order to start up the HHU, the automation system must be electrically and mechanically connected completely with respect to NC, PLC and MCP.

The drives must be secured against accidental moving.

5.6.2 Electrical connection

Connecting the HHU electrically

In order to connect HHU electrically and for communication along the MPI bus, 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 24V 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.

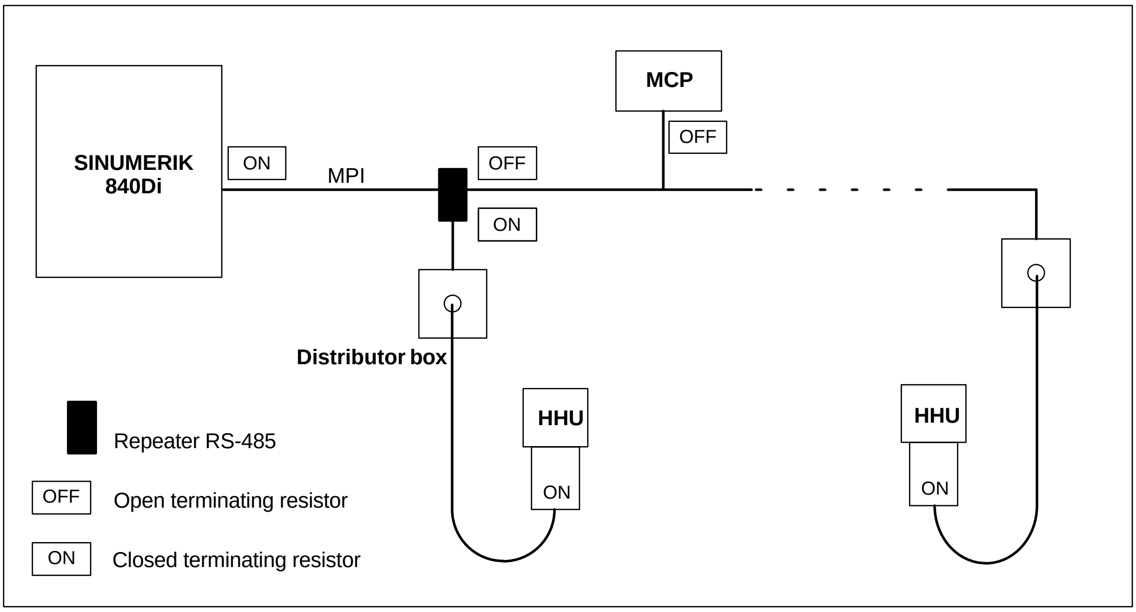


Fig. 5-9 Connecting using a repeater

Note

If a HHU is connected to the bus ends, 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
Section: Handheld Unit and Distributor Box.

5.6.3 MPI parameterization of the HHU

Setting the MPI parameters

The relevant parameters for the MPI communication of the HHU:

- MPI address
- Data transfer rate
- IDLE time

are set using DIP switches. The relevant DIP switches S1 and S2 are integrated in the HHU.

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

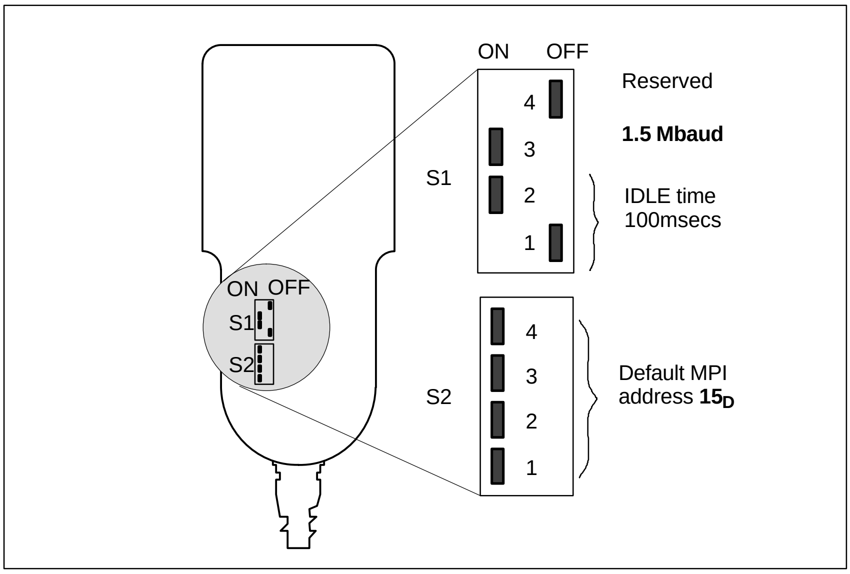


Fig. 5-10 Settings required on the HHU for SINUMERIK 840Di

Data transfer rate

The data transfer default setting must be changed from 187.5 kbaud to 1.5 Mbaud. To do so, set switch 3 of DIP switch S1 to ON.

Notice

To run the HHU on the MPI bus of the SINUMERIK 840Di, the data transfer rate has to be set to 1.5 Mbaud.

MPI address

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

Table 5-3 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 message: “Waiting for PLC”, the software version and the MPI address are displayed on the screen until no communication between HHU and PLC takes place.

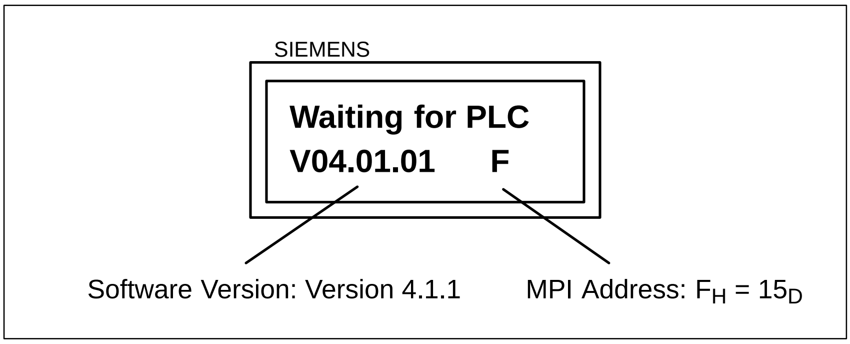


Fig. 5-11 Software version and MPI address

5.6.4 MPI parameterization of the PLC

Program structure

The PLC program has a modular structure. It consists of the following function blocks:

- Runup and synchronization (OB 100)
- Cyclic operation (OB 1)
- Process alarm processing (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. 5-12.

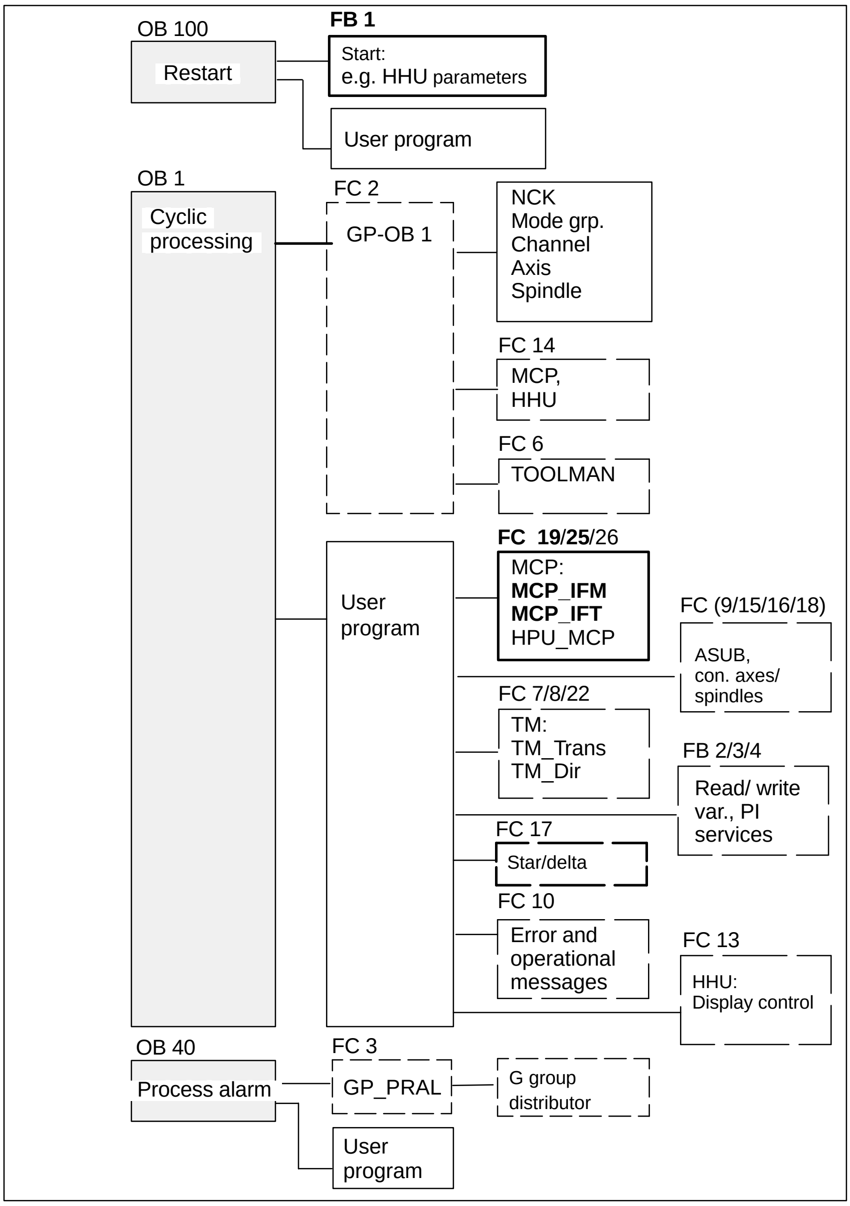


Fig. 5-12 Structure of PLC program

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 1.5 Mbaud, the parameters have to be set as follows:

```
HHU:        INT:=  2;       // the HHU is operated on an MPI bus
HHU MPI     BOOL:= FALSE    // at 1.5 Mbaud
```

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 basic PLC program or of function block FB 1, please refer to:

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

5.6.5 GD circle parameterization of the HHU

Global data

GD stands for global data. Global data serve to exchange smaller volumes of data between two or several automation components.

The data exchange is carried out by the operating systems of the automation components involved. This has the advantage that no further programming is required with respect to this communication.

GD circle

Communication using global data is arranged by so-called GD circles. A GD circle is unambiguously marked by its GD circle number.

GD circle parameters

The GD circle parameters of a node (here: HHU) must be set for SEND and RECEIVE separately.

- GD circle number
- GBZ number
- Object number.

Default setting

The GD circle parameters of the HHU are assigned default values. Normally, these default values can be kept.

Table 5-4 Default values and range of values of GD circle parameters

	Designation	HHU display	Default value	Value range
Receive	GD circle No.	Rec-GD-No:	2	1–16
	GBZ No.	Rec-GBZ-No:	1	1–255
	Object No.	Rec-Obj-No:	1	1–255
Send	GD circle No.	Send-GD-No:	2	1–16
	GBZ No.	Send-GBZ-No:	2	1–255
	Object No.	Send-Obj-No:	1	1–255

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. 5-13).

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. 5-13). 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. 5-13).

Display next parameter

Use the 2nd key from the left in the uppermost key row (see Fig. 5-13) to advance to the next parameter. After the last GD circle parameter has been reached, the set values will be automatically saved in the HHU (flash EPROM).

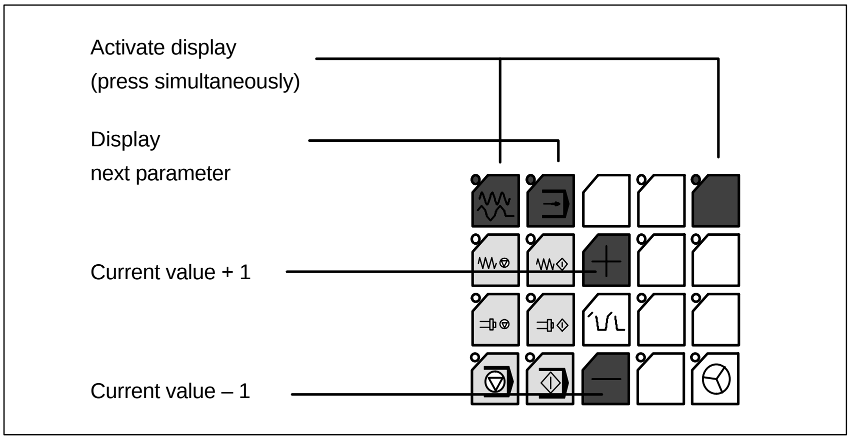


Fig. 5-13 Displaying and modifying GD circle parameters

5.6.6 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 STEP7.

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 the *send* parameters of the PLC.

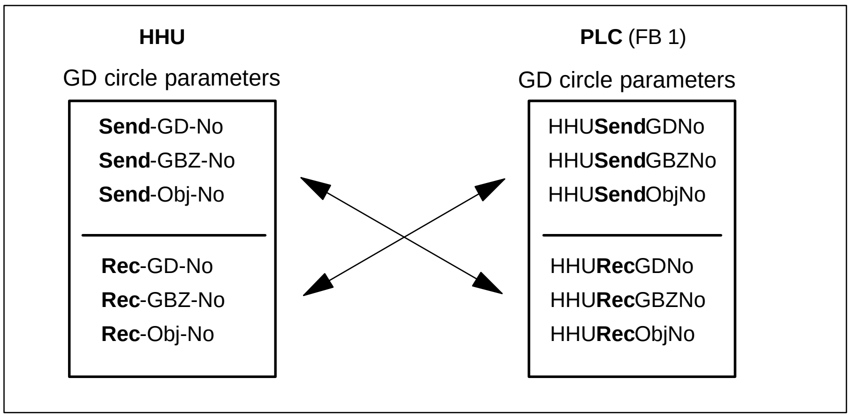


Fig. 5-14 Crosswise coincidence of GD circle parameters

Notice

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

5.6.7 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. Open the HHU to check and set (as necessary) the DIP switches S1 and S2 in the HHU:
   – Data transfer rate = 1.5 Mbaud
   – IDLE time = 100msecs
   – 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. Make the electrical connections on the distribution box and HHU.
   Once the HHU is connected to the power, the following message is displayed:

   Waiting for PLC
   V04.01.01 F
5. Check the HHU GD circle parameters (see: Fig. 5-13, page 5-158).
   (The GD circle parameters displayed here must be imported to FB1 (see Point 6.). The example uses default values).
6. Parameterizing function block FB1 (loading and editing in SIMATIC Manager STEP7):

```
HHU:=              2             // (the HHU is operated on an MPI bus
HHUMPI:=           FALSE         // with 1.5 Mbaud)

HHUIn              P#E 0.0       // address of input data
HHUOut:            P#A 8.0       // address of input data
                                 // (Notice! 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)
HHUStatRec         P#A 32.0      // Addr. of receive status data (4 bytes)

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

BHGRecGDNo:=       2             // acc. to the GD circle parameters
BHGRecGBZNo:=      2             // of the HHU for sending
BHGRecObjNo:=      1

BHGSendGDNo:=      2             // acc. to the GD circle parameters
HHUSendGBZNo:=     1             // of the HHU for receiving
BHGSendObjNo:=     1
```

Notice

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

---

7. Load the modified function block into the PLC and then restart the PLC.
8. 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, Basic Machine: P3, Basic PLC Program
Section: FC 13: HHUDisp Display control for handheld unit

5.7 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. 5-15 Handheld terminal HT 6 front side

5.7.1 Prerequisites 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 24V power supply. For the distributor box, see Section 3.3, page 3-131.

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 3-131.

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 3-131.

Programming device (e.g. PG740)
A programming device/PC is required for the **SIMATIC Manager STEP7** as the platform in order 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 8, page 8-249.

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 15-455.

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 1-32.
For the use of the basic PLC program, please refer to Chapter 8, page 8-249.

SIMATIC Manager STEP7
SIMATIC Manager S7 is used for adapting the basic PLC user 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. (MLFB): 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
Completing the user interface

Automation system

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

The drives must be secured against accidental moving.

5.7.2 Parameterization of the HT 6

Electrical connection

In order 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
Section: Handheld Terminal HT 6

Data transfer rate

The HT 6 detects the data transfer rate at the MPI bus automatically. With the SINUMERIK 840Di, it is 1.5 Mbaud.

MPI address

The factory-set MPI address of the HT 6 is 14 by 14_D (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. Soft keys **Diagnosis > Service display > Version > Vers. MMC.**

5.7.3 Parameterization of the PLC

Program structure

The PLC program has a modular structure. It consists of the following function blocks:

- Runup and synchronization (OB 100)
- Cyclic operation (OB 1)
- Process alarm processing (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. 5-16.

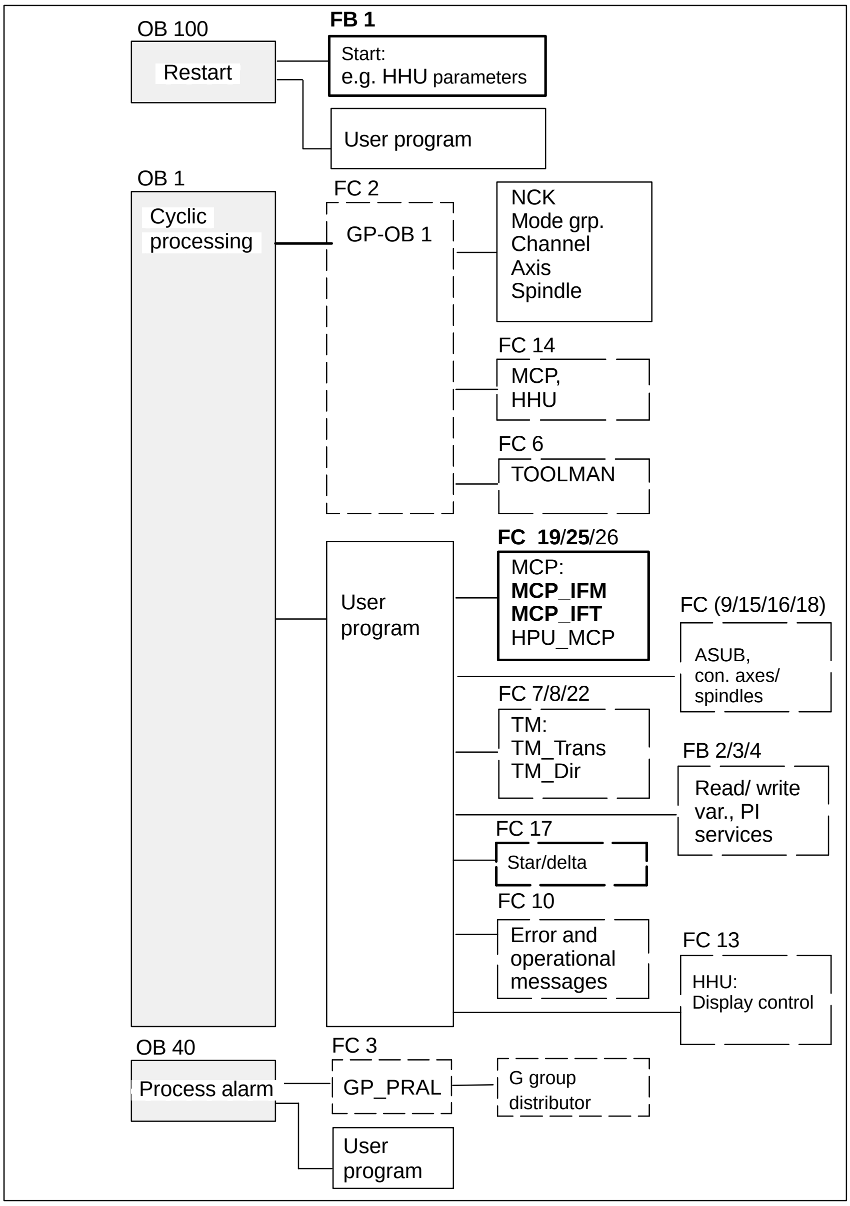


Fig. 5-16 Structure of PLC program

Setting the communication parameters (FB 1)

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.

In order 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: 1 operator component MCP/HT 6 (default)
                                   // 2: Two operator components MCP/HT 6

MCP1In:         POINTER;           // address of the MCP/HT 6 1 input signals
MCP1Out:        POINTER;           // address of the MCP/HT 6 1 output signals

MCP1StatSend:   POINTER;           // Addr. of the send status data MCP/HT 6 1
MCP1StatRec:    POINTER;           // Addr. of the MCP1 receive status data MCP/
                                   // HT 6 1

MCP1BusAdr:     INT:=  14;         // default MPI address of the HT 6

MCP1Timeout:    S5TIME:= S5T#700MS; // should be kept
MCP1Cycl:       S5TIME:= S5T#200MS; // should be kept

MCPMPI:         BOOL:= FALSE;      // MCP/HT 6 is operated at the "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 the MCP/HT 6 2 input signals
MCP2Out:        POINTER;           // address of the MCP/HT 6 2 output signals

MCP2StatSend:   POINTER;           // Addr. of the send status data MCP/HT 6 2
MCP2StatRec:    POINTER;           // Addr. of the MCP1 receive status data MCP/
                                   // HT 6 2

MCP2BusAdr:     INT;               // MPI address

MCP2Timeout:    S5TIME:= S5T#700MS; // should be kept
MCP2Cycl:       S5TIME:= S5T#200MS; // should be kept
```

The parameters listed below serve to synchronize two operator components:

```
MCP1Stop:       BOOL:= FALSE;      // 0: Start transfer of the MCP/HT 6 signals
MCP2Stop:       BOOL:= FALSE;      // 1: Start transfer of the  MCP/HT 6 signals

MCP1NotSend:    BOOL:= FALSE;      // 0: Send and receive mode is active
MCP2NotSend:    BOOL:= FALSE;      // 1: Only reception of the MCP/HT 6 signals
```

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 FB1, please refer to:

/FB1/ Description of Functions, Basic Machine: P3, Basic PLC Program
Section: FB 1: RUN_UP Basic program, start-up section

Parameter assignment of the NC interface (FC 26)

The FC 26 transfers the signals of the HT 6 with regard to:

- Operating modes
- WCS/MCS switchover
- Traversing keys
- Override

to the NC through the PLC interface.

Notice

Block FC 26 or FC 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 26 and FC, please refer to:

/FB1/ Description of Functions, Basic Machine: P3, Basic PLC Program
Section: FC 26 HPU_MCP Transfer of HPU signals tointerface

5.7.4 Example: Connecting an HT 6 to SINUMERIK 840Di

1. Make the electrical connections on the distribution box and HT 6.

   The terminating resistor in the MPI bus connector on the distributor box for connecting the HHU must be disabled. (The HT 6 has an integrated MPI bus terminating resistor).

   Once power is present on the HT 6, the start screen for communication with the HT 6 system software is displayed for some seconds. (Use key "6" beneath the key labeling "PARAM" to get to the data transfer rate selection menu of the serial interface of the HT 6).

   After the waiting time has expired or pressing a key, the message:
   Waiting for PLC
   V04.01.01 ***date time***
   is displayed.

   Since function block FB 1 in the basic PLC program is not yet parameterized, communication with the PLC does not yet take place.

2. Parameterizing function block FB 1 (editing FB 1 in SIMATIC Manager STEP7).
   The HT 6 is parameterized as the first and only MCP as an example:

```
MCPNum:         INT:=  1;            // one HT 6 exists

                                     // P# = pointer to
MCP1In:         P#E 0.0;             // address of input data (8 bytes)
MCP1Out:        P#A A 0.0;           // address of input data (8 bytes)

MCP1StatSend:   P#A 8.0;             // address of the send status data (4 bytes)
MCP1StatRec:    P#A 12.0;            // address of receive status data (4 bytes)

MCP1BusAdr:     INT:=  14;           // default MPI address of the HT 6

MCP1Timeout:    S5TIME:= S5T#700MS; // should be kept
MCP1Cycl:       S5TIME:= S5T#200MS; // should be kept

MCPMPI:         BOOL:= FALSE;        // the HT 6 is operated at the "extended"
                                     // MPI bus
MCP1Stop:       BOOL:= FALSE;
MCP1NotSend:    BOOL:= FALSE;
```

3. Insert block FC 26 into the cyclic part of the PLC program (see Fig. 5-16).
4. Load the modified blocks into the PLC and then restart the PLC.
5. 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.

5.7.5 Connecting and disconnecting an HT 6 during running 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/ Operator Components Manual
Section: Handheld Terminal HT 6
Connecting and disconnecting the HT 6 during operation.

5.8 External operator panel (PCU with HMI Advanced)

5.8.1 General settings

Data transfer rate

With the SINUMERIK 840Di, the data transfer rate at the MPI bus is 1.5 Mbaud.

- **HMI Advanced**
  With HMI Advanced, the data transfer rate must be set to 1.5 Mbaud in the menu “Start-up/MMC/operator panel”.

Screen

MD 9000: LCD_CONTRAST (contrast)
The contrast setting can be entered directly in the machine data or selected by means of the “LCD brighter” or “LCD darker” soft key in the “Diagnosis” menu.

MD 9001: DISPLAY_TYPE (monitor type)
The monitor type (e.g. LCD monochrome, LCD color) is entered in this machine data (for MMC 100).

Language

MD 9003: FIRST_LANGUAGE (foreground language for MMC 100)

- **HMI Advanced**
  HMI Advanced is always supplied with several languages; default language is English.

Display resolution

MD 9004: DISPLAY_RESOLUTION
The display resolution for position values on the screen is entered in this machine data. The maximum number of digits on the screen is 10, before or after the decimal point (e.g.: 4 places after decimal point, max. display = +/– 999999.9999).

Protection levels User data

The protection levels for the user data are set in the machine data 9200 to 9299.

RS-232 interfaces

The RS-232 interface settings are stored from MD 9300 onwards. The settings for three different devices are made in the “Services” menu using an input display.

5.8.2 Language default setting

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 “blindfolded”:

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 selectable 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.

Switchover 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 language packages

HMI Advanced contains the languages German and English as default languages. The two supplementary packages (1 and 2) are also available.

Supplementary package 1: European languages:

GR	German (standard)
SP	Spanish
FR	French
UK	English (standard)
IT	Italian

Supplementary package 2: Asian languages:

KO	Korean (Korea) pictographic language
TW	Chinese (Taiwan) pictographic language
CH	Chinese (Mandarin) pictographic language

Defining useable languages

In the file **c:<installation path>\mmc2\mmc.ini**, the languages that can be used in the MMC are configured. Any modifications to the file described in the following can be made using the editor provided to the user under **Start-up/ MMC**.

Default setting without activating pictographic languages

Two languages can be configured from the languages listed below:

GR	German (standard)
SP	Spanish
FR	French
UK	English (standard)
IT	Italian

Example:
First language German, second language English

File MMC.INI must be altered as shown below:

Excerpt from mmc.ini:

...
[LANGUAGE]
Language=**GR**
LanguageFont=Europe
Language2=**UK**
LanguageFont2=Europe
...

Notice

When editing file MMC.INI, take care to ensure that you change only the highlighted (bold print) texts. Make sure that your entries are spelled correctly.

Default setting with pictographic languages

Two languages can be configured from the languages listed below:

GR	German (standard)
SP	Spanish
FR	French
UK	English (standard)
IT	Italian
TW	Chinese (Taiwan) pictographic language
CH	Chinese (Mandarin) pictographic language

Example:
First language German, second language Chinese

File MMC.INI must be altered as shown below:

Excerpt 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
...

AddOn products

To be able to operate the control with pictographic languages, the appropriate AddOn product must be installed for each selectable language. Languages based on different AddOn 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.INI, take care to ensure that you change only the highlighted (bold print) texts. Make sure that your entries are spelled correctly.

■

Notes

Turning On and Ramp Up 6

6.1 Preparing for ramp-up

6.1.1 Checklist

SINUMERIK 840 Di

The following checklist will help you to start up the supplied components without undue problems and to guarantee 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 transport.

In particular, the following must be observed:

– Mains conditions
– Pollution burden
– Hazardous gases
– Climatic environmental conditions
– Storage/transportation
– Shock load
– Vibratory load
– Ambient temperature.

6.1.2 Recommended order when commissioning

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

1. The whole plant is mechanically and electrically connected and tested acc. to the checklist (see above) for errors.
   - 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 (Section 6.2, page 6-175).
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 7, page 7-203).
5. Prepare the SIMODRIVE 611 universal drives for communication on PROFIBUS DP (Chapter 9, page 9-263).
6. Carry out ramp-up of the NC (channels, axes and spindles, etc.) (Section 10.5, page 10-308)
7. Setting up the alarm texts (Chapter 11, page 11-403).
8. Carry out ramp-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 for the spindle (Chapter 12, page 12-411).
10. Carry out the drive optimization of the SIMODRIVE 611 universal drives using HMI Advanced (Chapter 13, page 13-417) and/or SimoCom U
11. Carry out a user data backup (series machine ramp-up file) (Chapter 14, page 14-449).
12. If necessary carry out also a complete data backup (partition and/or hard disk image) (Section 15.3, page 15-471).

6.2 First ramp-up

6.2.1 Basic ramp-up of the system software (SW 2.2 and higher)

Objective of basic ramp-up

After a basic start-up described in the following, the following prerequisites must be provided:

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

Delivery state

At 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*>.

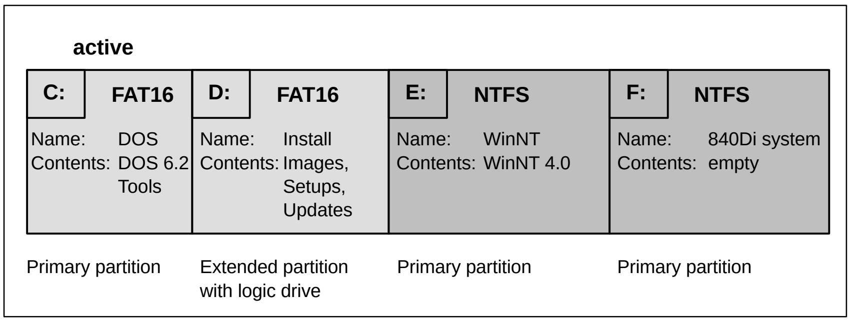
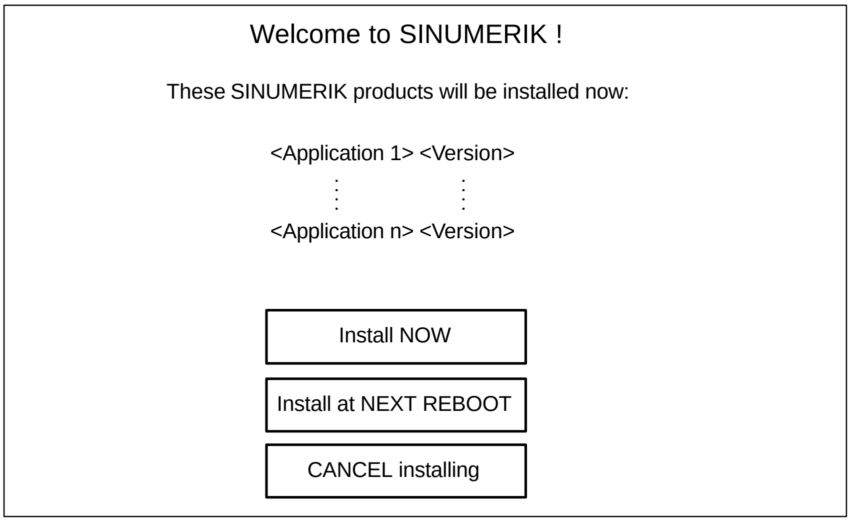


Fig. 6-1 Partitioning of the harddisk

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 at NEXT REBOOT

  None of the listed applications are installed and you go to the NT Desktop. The installation menu is displayed again the next time the PCU is booted.

- CANCEL installing

  None of the listed applications are installed.

  Notice! 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 6.2.3, page 6-179).

6.2.2 Basic start-up of the system software (SW 2.1 and lower)

Objective of basic start-up

After a basic start-up described in the following, the following prerequisites must be provided:

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

Loading the system software

The first step of basic start-up is to copy the SINUMERIK 840Di system software and Windows NT to the PCU hard disk.

On delivery, the hard disk of the PCU is already partitioned for operation of the SINUMERIK 840Di and any further SINUMERIK applications, and the software required for basic start-up is installed:

- The boot software and further software required for start-up is to be found at C:
- The disk image with the SINUMERIK 840Di system software and Windows NT are to be found at D:\Images

The drives E: and F: are empty.

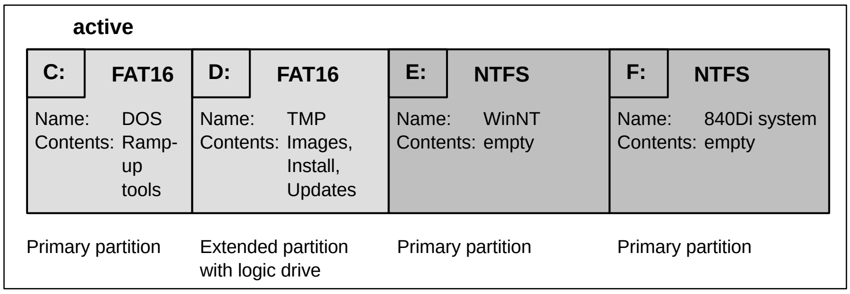


Fig. 6-2 Partitioning of the harddisk

Selecting the version

When the PCU is booted for the first time, the following menu appears:

Please Select SINUMERIK HMI Version to install:

1 SINUMERIK 840Di Software <version>

9 Service menu

Your Choice [1,9]?

Use the appropriate key "**1**" ... "**8**" to select the version you want to install and then press "**Y**" to confirm.

After your confirmation, the appropriate disk image is copied to the hard disk (drives C:, E: and F:) .

The contents of the hard disk will then be as follows:

1st partition/drive C:

The drive C: contains:

- MS DOS 6.2

– Service menu software
– Norton Ghost
– Norton Ghost Walker

2nd partition/drive D:

The **Images** directory contains both the supplied image files and the image files you have created for yourself.

The **Install** directory contains for example Windows NT drivers that can be installed later or for updating.

3rd partition/drive E:

Drive E: is exclusively intended for the Windows NT system software.

4th partition/drive F:

Drive F: is intended for Windows NT applications, such as

– SINUMERIK 840Di
– SINUMERIK HMI Advanced.

Service menu

Use the key “**9**” to call the service menu.

```
Service menu <version>

        Please select:
           3    DOS Shell
           5    SINUMERIK System Check
           6    Reboot System (warm restart)
           7    Backup/Restore
           8    Start PC Link

           9    Exit

        Your Choice [3,5,6,7,8,9] ?
```

SINUMERIK System Check

The menu item **5 SINUMERIK System Check** will grant you access to a following menu to choose the error checks:

– Logic check of the directory/file system
– Physical check of the hard disk.

Backup/Restore

Using the menu item **7 Backup/Restore** to:

- **Backup**
  create ghost images of individual partitions or of the entire hard disk and to save them locally under D:\Images or to transfer them to an external computer using a parallel or network connection.
- **Restore**
  load ghost images from an external computer using a parallel or network connection.

The backup/restore process is described in detail in Section 15.3, page 15-471.

6.2.3 Basic start-up of the PLC

Starting the SINUMERIK Desktop

After installing the system software (SW 2.1 and lower)/completing the installation procedure (SW 2.2 and higher), a the system is automatically rebooted. The PCU will then power up and the default menu of the boot manager is displayed:

SINUMERIK *Service menu (hidden)*

To start the SINUMERIK desktop (Windows NT), press the input key to confirm or wait the preset time until the boot process is started automatically.

Carrying out basic start-up

After the SINUMERIK desktop (Windows NT) has appeared, only the supplied PLC series machine start-up must 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 NT taskbar:
   Start > Programs > SinuCom NC > SinuCom NC
2. Use SinuCom NC to load the supplied series machine start-up file **PLC_BSP.ARC** into the PLC.

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

   Dialog: Read-in archive

   – Optional field: Data management

   – Button: “NEXT”

   – Select the file PLC_BSP.ARC from the Archive folder.

   – Button: “FINISH”.

Basic start-up has then been completed. 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.

6.2.4 Ramp-up of the machine control panel (MCP)

Testing the system software

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:

- **HMI Advanced**
  With HMI Advanced, the active nodes at the MPI bus are displayed with operating area **Start-up > MMC > Operator panel > Bus node**.
- **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 default addresses

The MPI default addresses of the individual components are:

– PLC = 2

– NC = 3

– Machine control panel = 6.

If the machine control panel is displayed as an MPI node with address 6, it has been detected correctly.

Error note

If the machine control panel continues to flash, check the parameterization of the PLC block FB1, Subsection 5.4.3, page 5-143.

6.2.5 Ramp-up of the SIMODRIVE 611 universal drives

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

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

6.3 Ramp-up

6.3.1 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.
```

With the menu you can choose between:

- SINUMERIK desktop (normal case)
  See Section 6.4, page 6-188.
- Service menu (password protected)
  See Section 6.5, page 6-193.

6.3.2 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 NT 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 6-1 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 ramp-up*
Known	no	yes	not applicable	IMAGE / *no message box or alarms;* see Subsection 6.3.4; case 1
Known	no	no	yes	BACKUP / *message box and alarm;* see Subsection 6.3.4; case 2
Known	no	no	no	Start-up / *Restart-up required*
Unknown	yes	yes	not applicable	MCI or IMAGE / *Request carried out;* see Subsection 6.3.6
Unknown (SW update)	yes	not applicable	not applicable	MCI / *message box;* see Subsection 6.3.5
Unknown	yes	no	yes	MCI or BACKUP / *Request carried out; if BACKUP is selected, message box and alarm will occur;* see Subsection 6.3.4; case 2
Unknown	yes	no	no	MCI / *message box;* see Subsection 6.3.5
Unknown	no	yes	not applicable	IMAGE / *MessageBox;* see Subsection 6.3.4; case 1
Unknown	no	no	yes	BACKUP / *message box and alarm;* see Subsection 6.3.4; 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: (SW update) 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 after performing a 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 software version of SRAM image or backup must comply with the installed software version.
2. Windows NT must be shut down correctly (to do so, the 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 of the SRAM image must be O.K.

Used user data

MCI: The battery-backed user data in the SRAM of the MCI board will be used.

IMAGE: The user data battery-backed in the SRAM image on the hard disk of the PCU will be used.

BACKUP: The user data battery-backed in the SRAM backup on the hard disk of the PCU will be used.

Start-up The user data of the NC will be deleted and default machine data will be loaded.

6.3.3 Ramp-up after battery replacement (backup battery of the MCI board)

Correct shutting down

Before you change the backup battery of the MCI board, the SINUMERIK 840Di or Windows NT **must** be shut down **correctly**.

For shutting down, use one of the following options:

- Windows NT taskbar: Start > Shut Down
- Interface signal: "PC shutdown"; see Subsection 16.1.1, page 16-499.

Inverting SRAM memory cells

If SRAM memory cells are inverted when changing the battery, this will be detected during ramp-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.

Reactions

None.

Notice

If Windows NT 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.

6.3.4 Ramp-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 NT could not be shut down correctly. An up-to-date SRAM image is thus provided.

During ramp-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.

Reactions

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 ramp-up of the SINUMERIK 840Di, the last SRAM image is kept when shutting down Windows NT. 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.), it is recommended to restart 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 <u>not</u> exist

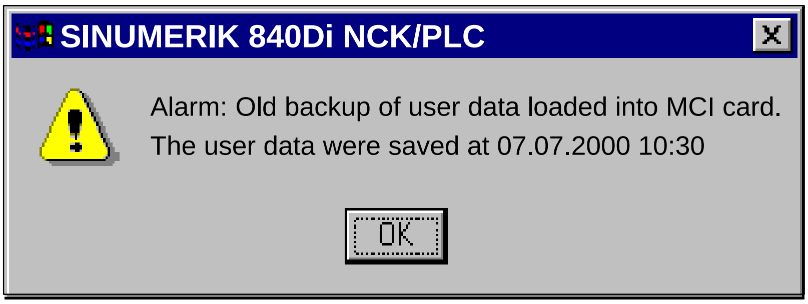
A defect of the MCI board has occurred during operation of the SINUMERIK 840Di. Windows NT has possibly been shut down correctly, but no SRAM image could be created.

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.

Reactions

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)”

For safety reasons, the alarm must be acknowledged explicitly by the operator before performing the necessary NCK power ON reset.
See Subsection 10.10.1, page 10-395.

6.3.5 Ramp-up after replacement of the PCU (new) or reinstallation/ update of the 840Di software

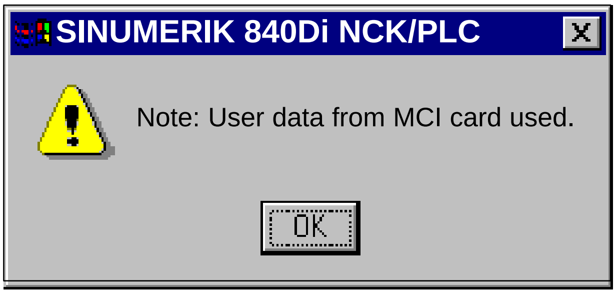
If an MCI board used in a **new** PCU once is further used or if the 840Di software is reinstalled on a SINUMERIK 840Di that is already started up, then the battery-backed user data in the SRAM of the MCI board are kept.

To achieve this, it is essential that the current NC and PLC software version of the SINUMERIK 840Di 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.

Reactions

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



Notice

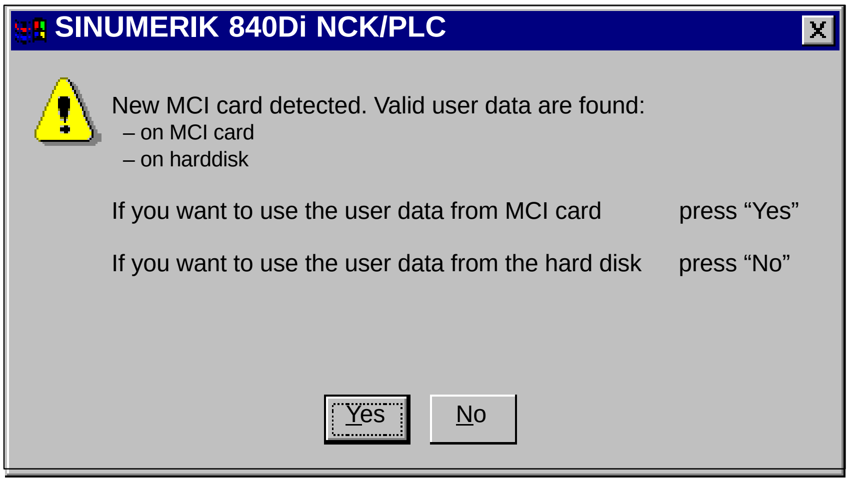
If you do not wish to use the battery-backed user data further, you must repeat ramp-up of the SINUMERIK 840Di.

6.3.6 Ramp-up after replacement of the PCU or the MCI board

If it is detected during the ramp-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.

Reactions

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



6.3.7 Ramp-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.

6.3.8 Ramp-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 ramp-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
Section: 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 6.3.4, page 6-183 case 2.

6.3.9 Ramp-up with shutdown signal (SW 2.3 and higher)

If the SINUMERIK 840Di is operated with a UPS system, the shutdown system must be configured appropriately. See Subsection 10.10.2, page 10-399. When the shutdown signal is present, the NC and PLC are terminated first and Windows NT then shut down correctly.

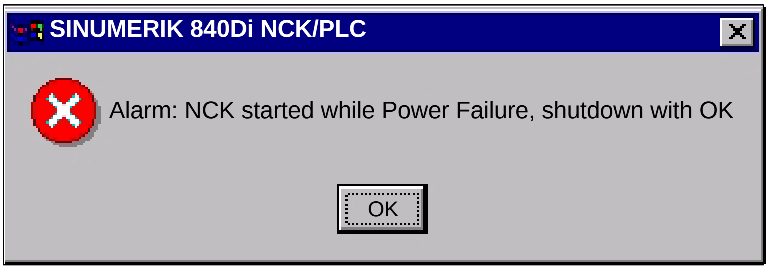
1. Ramp-up

If ramp-up takes place while the shutdown signal is present, Windows NT is shutdown again straight away.

as of 2nd. ramp-up

As of 2nd ramp-up with shutdown signal present produces the following system behavior:

- Windows NT is not shut down correctly again
- NC and PLC are not started
- The following message box appears:



The circuit on the MCI board extension module and the configuration of the shutdown signal (see Subsection 10.10.2, Page 10-399) can be checked and modified if necessary.

If the shutdown signal is no longer present after acknowledging the message box, the NC and PLC are started. Otherwise, Windows NT is shut down correctly.

6.4 SINUMERIK desktop

The SINUMERIK desktop is intended for service and provides the following functionality on the Windows NT level:

- Network operation for installing/updating system software
- Setting the system environment
- Authorization of the SIMATIC STEP7 software
- Test functions for system components.

6.4.1 Network operation

The PCU contains a network connection by default.

In order to operate the PCU in a network (Internet, Intranet), in addition to connect the Ethernet cable to the PCU, the following settings are required:

- Computer Name
- Network protocol
- IP address.

Note

To obtain the required specifications required for network operation, please contact the appropriate network administration.

Computer name

In order to set the computer name of the PCU, open the control panel using the Windows NT task bar **Start > Settings > Control Panel**.

In the control panel, open **Network** and type the name of the new computer.

Dialog

Dialog: Network
  Register: Identification
    Computer Name: <**COMPUTER NAME**>
OK

TCP/IP

In order to establish a network connection using the TCP/IP protocol, the PCU must be assigned an unambiguous IP address in the network.

To do so, choose: **Start > Settings > Control Panel**.

In the “Control Panel”, open **Network**. From the register: “Protocols” select the TCP/IP protocol and click the button: “Properties” to call the Properties dialog:

- If a DHCP server exists in the network, select:

  “Obtain an IP address form a DHCP server”

- If no DHCP server exists in the network, select:

  “Specify an IP address”

  and enter the appropriate specifications (see above: Note).

6.4.2 Software installation/update

The SINUMERIK desktop provides various ways of installing and updating software:

- Installation/updating is started directly from the SINUMERIK desktop by executing the appropriate file (usually install.exe).
- The installation/update package is copied into the D:\INSTALL directory. The next time the PCU is started up, installation/updating is started automatically. After installation/updating has been completed, the system software can be started immediately.

Note

This function can be also be run from the service menu (Chapter 15, page 15-455).

6.4.3 Setting the SINUMERIK HMI environment

The SINUMERIK desktop provides the functions

- Original SINUMERIK HMI Environ
- Current SINUMERIK HMI Environ

as script files for setting the required HMI system environment.

Original HMI environment

Before starting SINUMERIK HMI, the HMI-spec. system environment is put in the as-delivered state. For that purpose, the content of directories

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

is backed up and then the directories are cleared.

Current HMI environment

Before SINUMERIK HMI is started, the backed up files from the above directories are loaded.

Note

This function can be executed through the service menu (Subsection 6.5.4, page 6-195).

6.4.4 Authorizing SIMATIC STEP7

For authorizing the SIMATIC STEP7 software previously installed on the PCU, you can use the function

- STEP7 authorizing

in the form of a script file.

Note

This function can be executed through the service menu (Subsection 6.5.2, page 6-194).

6.4.5 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.

Activating serial mouse

The following settings are required to operate a mouse:

- Alter file boot.ini:
  – Open the following file with a Windows NT standard editor (e.g. Start > Programs > Accessories > Notepad): **C:\boot.ini**
  – Remove section: [*operating systems*]
    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

Dialog: Mouse Properties
    Tab: General
        Button: "Change..."
            Dialog: Select Device
                Optional field: "Show all devices"
                    Select the corresponding 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.

6.4.6 Fault analysis

Testing system components

The following function is available for testing system components

- Check SINUMERIK System

in the form of a script file. The function tests the following system components:

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

Note

This function can be executed through the service menu (Subsection 6.5.5, page 6-196).

System information

If a “serious exception” (blue screen) occurs, system information is written to the following file:

- D:\Memory.dmp.

Basic software version

Version information about:

- System components of the service menu
- Windows NT

are contained in the file:

- C:\BaseVers.txt.

HMI system software version

Versions information about:

- HMI system software packages
- Windows NT

are obtained using the Windows program

- HMI Explorer

It is also (in some cases) possible to run and uninstall HMI applications.

6.4.7 OEM configuration

OEM directories

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

1. C:\RunOEM\SeqOnce
   Programs stored here are run <u>once</u> and <u>sequentially</u>[1)].

2. C:\RunOEM\Seq

   Programs stored here are run on each ramp-up and sequentially[1)].

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

3. C:\RunOEM\ParOnce

   Programs stored here are run once. They run parallel with the HMI system software.

4. C:\RunOEM\Par

   Programs stored here are run on each ramp-up . They run parallel with the HMI system software.

Order of execution

- Subdirectories

  The subdirectories are executed in the order listed above.

- Programs

  The programs within a subdirectory are started in the order in which they have been placed in the subdirectory chronologically.

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:

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

6.4.8 Replacing the SINUMERIK background image

During ramp-up of the PCU, a SINUMERIK background image is displayed until the HMI software starts. The SINUMERIK background image is stored in the following file:

- Alter file E:\WINNT.40\System32\MMC840D.bmp

  Format: 800x600 pixels

6.4.9 Information and constraints concerning the basic software

You will find information and constraints on the current basic software on the SINUMERIK desktop in files:

- SIEMENSD (German)
- SIEMENSE (English)

6.5 Service menu

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

     9   Reboot (warm restart)

     P   840Di Services

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

Functions

The service menu provides the following functions at DOS level:

- Install/Update SINUMERIK System
  Installation and addition or updating of the SINUMERIK system
- SINUMERIK Tools and Options
  Loading additional tools and enabling options
- DOS Shell
  The DOS command interpreter is started
- Start Windows NT
  WinNT is started
- SINUMERIK System Check
  Consistency test and, if necessary, recovery (SCANDISK) of the file system
- Backup/Restore
  Hard disk backup/restore with Norton Ghost™
- Start PC Link
  Installation of PC link software (Interlink/Interserve) using CD-ROM
- Reboot
  Restart of the system
- 840Di services
  Activating 840Di-specific functions

  The service menu is started with the operating sequence “Cursor down” and “Enter”.

Activation

The service menu is started from the boot manager with the operating sequence “Cursor down” and “Enter”.

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

- System
- Manufacturer
- Service.

6.5.1 Install/Update SINUMERIK System

A detailed description of the software installation/update is to be found in Section 15.2, page 15-460.

6.5.2 SINUMERIK Tools and Options

```
PLEASE SELECT
     1    Install/Update SINUMERIK System
     2    SINUMERIK tools and options
     3    DOS Shell
     4    Start Windows NT (Service Mode)
     5    SINUMERIK System Check
     7    Backup/Restore
     8    Start PC Link

     9    Reboot (warm restart)

     P    840Di Services

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

Under menu item: Two SINUMERIK Tools and Options, you can execute the following actions:

- Authorizing SIMATIC STEP7.

Authorizing SIMATIC STEP7

Requirements

The following requirement must be fulfilled:

- The SIMATIC STEP7 software has already been installed on the PCU.

Operator action

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] ?
```

To request authorization press key "1".

Actual authorization is performed automatically during ensuring ramp-up of the PCU under Windows NT.

Note

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

6.5.3 DOS Shell

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

     9  Reboot (warm restart)

     P  840Di Services

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

Operator action

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.

6.5.4 Start Windows NT (Service Mode)

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

     9  Reboot (warm restart)

     P  840Di Services

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

Under menu item: 4 Start Windows NT (Service Mode), you can perform the following actions:

- Standard Windows NT (without starting SINUMERIK HMI)
  After the PCU has started up, Windows NT is started without any SINUMERIK HMI
- 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 you start SINUMERIK HMI, the backed up files of the above directories are loaded.

Operator action

Select **Start Windows NT (ServiceMode)** with key “**4**”.

Following menu:

```
PLEASE SELECT
          1 Standard Windows NT (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] ?
```

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

Note

- The SINUMERIK desktop can also be started if you press key “3” while SINUMERIK background image is being displayed during ramp-up of the PCU (time range: 3 sec).
- The HMI environment can also be set on the SINUMERIK desktop by starting the functions:
  – Original SINUMERIK HMI Environ
  – Current SINUMERIK HMI Environ.

6.5.5 SINUMERIK System Check

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

     9    Reboot (warm restart)

     P    840Di Services

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

Under menu item: SINUMERIK System CHECK, the following system components are checked:

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

Operator action

Select **SINUMERIK System CHECK** with key “**5**”.

After you have selected the function, the system is rebooted. The function is actually executed during the ensuing start-up of Windows NT 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”.

6.5.6 Backup/Restore

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

    9   Reboot (warm restart)

    P   840Di Services

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

You will find a detailed description of the backup/restore functions (data backup) in Section 15.3, page15-471.

6.5.7 840Di services

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

    9   Reboot (warm restart)

    P   840Di services

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

Under menu item: 840Di Services, 840Di-spec. functions are requested that are then executed during the ensuing ramp-up of the SINUMERIK 840Di NC or PLC.

PLC functions:

- Set PLC Mode to STOP
- Set PLC Mode to RUN
- Set PLC Mode to RUNP
- Set PLC Mode to MRES
  Notice! This function deletes all PLC data.

Operator action

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

        9 Return to Main Menu

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

After you have selected the function, the system is rebooted. While the PCU is started up, the following message box is displayed indicating execution of an 840Di Service:

The message box must be acknowledged with “OK”.

The selected function is executed after ramp-up of the corresponding SINUMERIK 840Di component.

6.6 Configuring PTP link on an external computer (PG/PC)

6.6.1 Ext. computer with Windows 9x

In order to establish a PTP (point-to-point) connection between a PCU 50 and an external computer (PG/PC) under Win9x, the following preconditions must be fulfilled with regard to the **external computer**:

1. The Ethernet cable is connected to the Ethernet interface of the external computer and the PCU
   – Point-to-point connections require an Ethernet cable of the type “Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable”.

Notice

A **point-to-point** connection between PCU 50 and an external computer (PG/PC) requires an Ethernet cable of the type “Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable”.

---

2. The network protocol **NetBEUI** is installed on the external computer.
3. I want to be able to give others access to my files.
4. The **computer name** of the external computer is known.
5. Access to the drive/folder of the external computer you want to access must be shared by the PCU, and the **sharing name** must be known.

Network protocol: NetBEUI

In order to check whether the network protocol **NetBEUI** is installed, open control panel using the Windows 9x task bar **Start > Settings > Control Panel** on the external computer.

Open **Network** in the control panel. The network components installed are displayed in the “Configuration” tab. If the network protocol NetBEUI is not displayed between them, it must now be installed.

Dialog:
Start

Dialog: Network
    Tab: Configuration
        Button: “Add...”

Dialog: Select network component type

Choose from the list: Protocol
Button: “Add...”

Dialog: Select Network Protocol
    Choose from the “Manufacturers” list: Microsoft
    Choose from the “Network protocols” list: NetBEUI
OK

Sharing file access

In order to check or share access to files for other users, select the: Configuration tab and click there the button: “File and Print Sharing...”

Dialog:
cont'd.

Tab: Configuration
Button: “File and Print Sharing...”:

Dialog: “File and Print Sharing...”
☑ I want to be able to give others access to my files.
OK

Computer name and workgroup

In the case of a point-to-point connection, the computer name and the designation of the workgroup of the external computer is random.

To determine or set the computer name and the workgroup, select the tab: “Identification”:

Dialog:
End

Tab: Identification
Computer name: <**COMPUTER NAME**>
Workgroup: <**WORKGROUP**>
OK

Sharing access to the drive/directory or determining sharing names

In order to share access to the drive/directory or determine the sharing name, start the Windows **Explorer** on the external computer and select the drive/directory to be released for shared access for the PCU.

Note

The access control is set in the Windows Explorer in the tab: “Access control” of the Properties dialog of a drive/directory. If the tab: “Access control” is not displayed, the computer is or was part of a Domain network and the system administration has switched off the tab display for safety reasons.

In order to be able to make the settings required for the point-to-point connection, the tab must be unhidden. This can be done using the program “poledit.exe”. Poledit.exe is to be found on the Win9x CD under: admin\apptools\poledit or available for free download under http://www.microsoft.com/windows95/downloads.

Open the Properties dialog (**right mouse button > Properties**) of the drive/directory and define the **sharing name** and the **access rights**.

Dialog

Dialog: Properties of <drive>/<directory>
Tab: Share access
Optional field: Choose “Shared As:”
Sharing name: <**SHARED AS**>
Button: “Rights...”

Dialog: Access by share access rights
Button: “Add...”

Dialog: Add users and groups
Names: *Choose a name from the list*
e.g. “User” or “Everybody”
Button: “Add”
OK

Access type: <**Read**>
OK

OK

6.7 Subsequent installation of Windows NT components

The directory **D:\Updates\WinNT\I386** of the PCU hard disk contains the subdirectory **I386** of the Windows NT installation CD.

This subdirectory can be used to additionally install, e.g. Windows NT drivers.

6.8 License management (SW 2.1 and higher)

With SW 2.1 and higher, before using the 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 which electronically links the software to the SINUMERIK 840Di hardware. This assignment is performed over the Internet.

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.

Option selection up to entering the license key is performed as follows:

1. Select the required options; order and obtain the corresponding license packages and/or single-user licences:

   Order catalog: NC 60.2002

2. Activate the options

   SinuCom NC at the SINUMERIK 840Di in question

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 at the SINUMERIK 840Di in question

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 NT 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. 6-3).

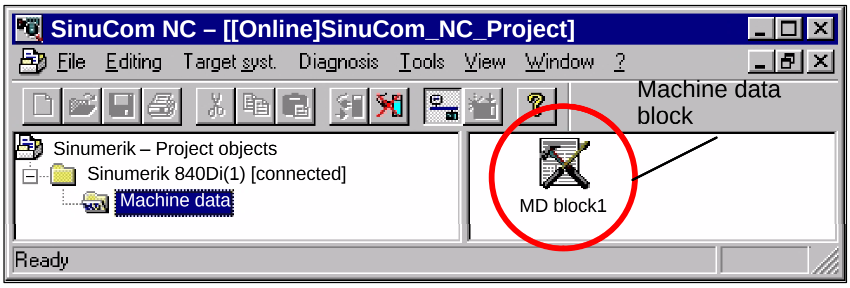


Fig. 6-3 SinuCom NC: Basic menu

License key

The option menu allows setting of new and additional options in the appropriate input fields (Fig. 6-4).

The procedure described above (Items 1. to 4.) is triggered with button "Get a new License Key" (Fig. 6-4). The follow further instructions in the following dialog boxes.

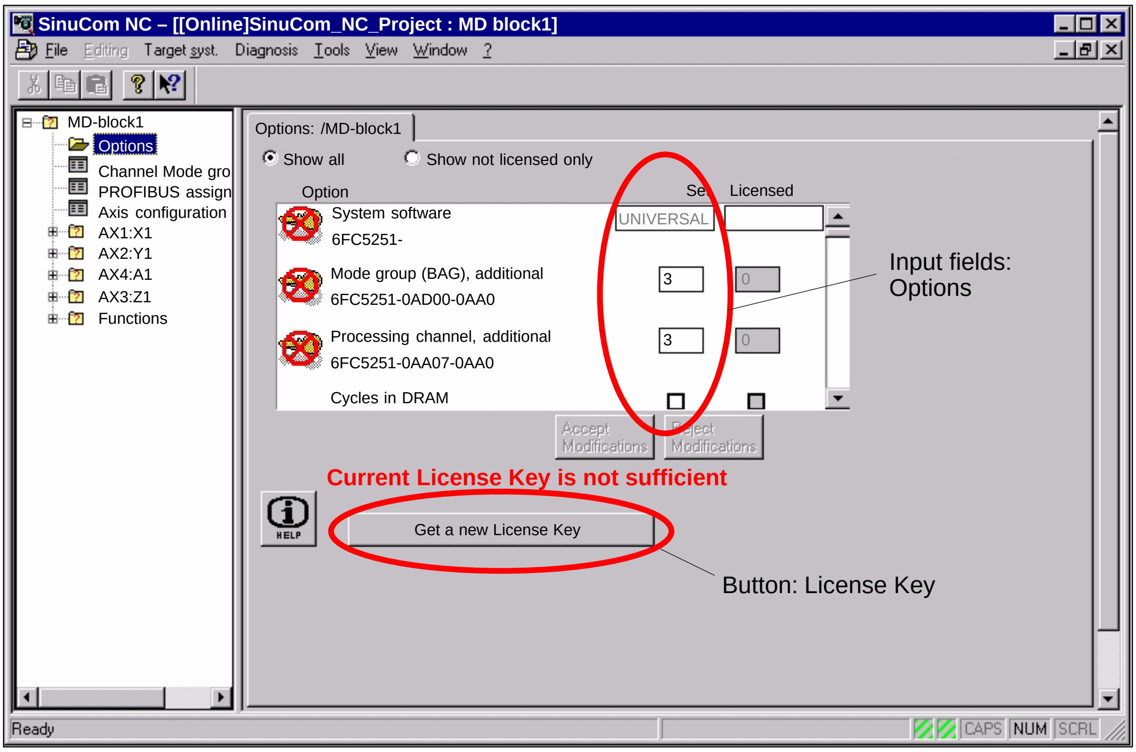


Fig. 6-4 SinuCom NC: Option menu

■

PROFIBUS DP Communication 7

7.1 General

PROFIBUS DP

PROFIBUS DP is an international, open field bus standard laid down 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 on PROFIBUS DP are subdivided into master and 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 is the designation for central master devices exchanging information with the slaves within defined message cycles.
     Examples: SIMATIC S5, SIMATIC S7, etc.
   - DP master, class 2 (DPMC2):
     These are devices for configuring, starting up, operating and watching 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.

PROFIBUS DP with Motion Control extension

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
- Synchronization of the DP slaves by the DP master using a GlobalControl message frame in every DP clock
- Automatic maintenance of the equidistant clock by the DP slaves during a short communication failure.

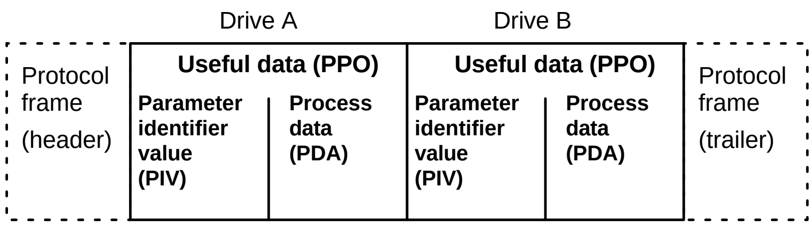
References: /PPA/ PROFIDrive Profile Drive Technology Version 3, Draft V1.4.2, 01. September 00

7.1.1 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 cycle data transmission have the following basic structure:



Note:

The useful data for drive B are only transmitted when “DP slave 611U” is operated as a double-axis module.

Fig. 7-1 Message frame structure for cyclic data transmission

Useful data structure

The useful data for cyclic operation are termed parameter process data objects (PPO). The 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).

7.1.2 Description of a DP cycle

Actual values

At the time T_I, all equidistant drives (DP slaves) read in the current actual position values. In the next DP cycle, at time T_{DX}, the actual values are transferred to the DP master.

Position controller

At the time $T_{M,}$ with $T_M > T_{DX,}$ the NC position controller is started, calculating the new speed setpoints using the actual position values transferred.

Setpoints

At the beginning of the next DP cycle at time T_{DX}, the speed setpoints are transferred from DP master to the DP slaves (drives).

At the time T_O, the speed setpoints are accepted by all servo drive controls as the new default.

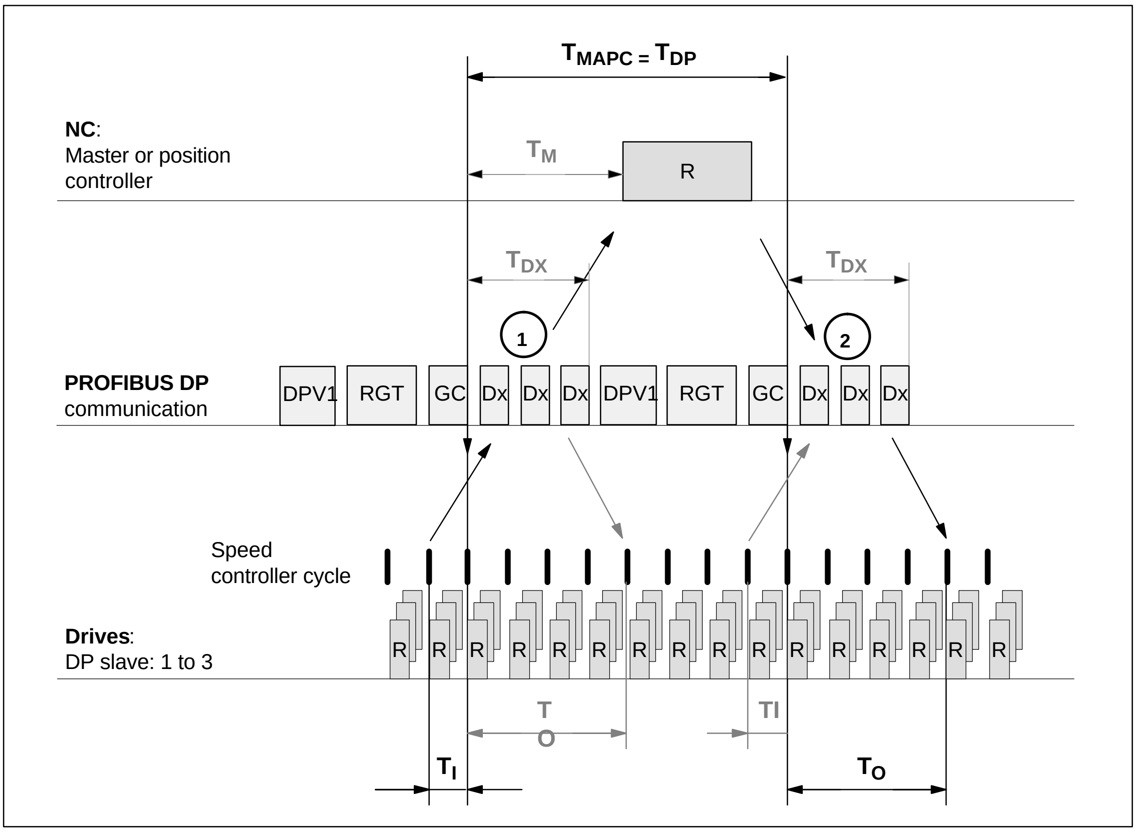


Fig. 7-2 Example: Optimized DP cycle with 3 DP slaves 611U

Explanations regarding Fig. 7-2:

T_{MAPC}	Master Application Cycle: NC position controller cycle With SINUMERIK 840Di, the following applies in all cases: $T_{MAPC} = T_{DP}$
T_{DP}	DP cycle time: DP cycle time
T_{DX}	Data Exchange Time: Total of transfer times of all DP slaves

T_M	Master Time: Shift of starting time of the NC position control
T_I	Input Time: Time of actual-value sensing The actual values are transferred to the DP master in the next DP cycle.
T_O	Output Time: Time of setpoint acceptance. The setpoints were created by the DP master application in the previous DP cycle.
GC	Global Control Message Frame Type (Broadcast Message Frame) for cyclic synchronization of the isosynchronism between DP Master and DP slaves
R	Computing time of speed and/or position controller
Dx	User data exchange between DP master and DP slaves
DPV1	After cyclic communication an acyclic service is sent, if the token holding time T_{TH} was not exceeded. T_{TH} is calculated by the configuring system.
GAP	An attempt is made during GAP to accept new active stations.
TOKEN	Token passing is either performed from the station to itself or to 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 cycle/position controller cycle are transferred from the DP slave drives to the NC position controller.
2	The setpoints calculated by the NC position controller are transferred to the DP slave drives.

7.1.3 SINUMERIK 840Di with PROFIBUS DP

PROFIBUS DP and SIMATIC S7

The configuration of PROFIBUS DP is carried out within the framework of a SIMATIC S7 project (further referred to as S7 project).

To create an S7 project for a SINUMERIK 840Di, the following components are needed:

- SIMATIC Manager STEP7
- SINUMERIK 840Di
- Programming device/PC with MPI connection (e.g. PG740) and MPI cable (not required if the SIMATIC Manager is installed on the SINUMERIK 840Di)
- Basic PLC program
- 840Di rack
  (a SIMATIC S7-300 station preconfigured for SINUMERIK 840Di)
- DriveOM/SlaveOM.

Programming device (PG)/PC

The SIMATIC Manager STEP7 required to create the S7 project can be installed on any PG/PC with MPI connection, which fulfills the following requirements:

- CD-ROM drive
- MPI connection with 1.5 Mbaud.

To transfer the S7 project to the PLC of the SINUMERIK 840Di, the PG/PC must be linked with the MPI interface of the MCI board.

SINUMERIK 840Di

The SIMATIC Manager STEP7 required to create the S7 project can also be installed on the SINUMERIK 840Di.

(The installation of additional software on the SINUMERIK 840Di is described in detail in Chapter 15, page 15-455).

Windows applications executed on the SINUMERIK 840Di have direct access to the PLC through the internal MPI interface of the MCI board. To transfer the S7 project into the PLC of the SINUMERIK 840Di, no additional MPI cable is therefore needed.

SIMATIC Manager STEP7

For creating the S7 project for the SINUMERIK 840Di, a SIMATIC Manager STEP7 is required:

- SIMATIC Manager STEP7 Version 5.1 and higher, Service Pack 3.

Notice

The SIMATIC Manager STEP7 is not included in the scope of supply of the SINUMERIK 840Di.

840Di Rack

The 840Di Rack is a SIMATIC-300 station preconfigured for the requirements of the SINUMERIK 840Di. The following versions are available in the hardware catalog of HW config.:

- 840Di with PLC 315-2DP 2AF03
  - SINUMERIK 840Di PLC
    standard designation: PLC315-2DP M/S 2AF03
  - PROFIBUS DP Master
    standard designation: DP master
  - SINUMERIK 840Di NC
    standard designation: S7 FM NCU.

The 840Di Rack is part of the PLC Toolbox and is automatically installed in the SIMATIC Manager STEP7 when installing the basic PLC program also included in the PLC Toolbox.

Notice

The basic PLC program must be installed on that computer on which the SIMATIC Manager STEP7 required to install the S7 project is already installed. For installing the basic PLC program, please observe the appropriate notes in the file:

– <installation path>\readme.txt.

After the basic PLC program has been successfully installed, the 840Di Rack is already available in the hardware catalog of "HW Config" (configuration tool in the SIMATIC Manager STEP7) in order to be integrated into the S7 project:

- "HW Config" hardware catalog:
  Profile: **Standard**
  SIMATIC 300 > SINUMERIK > 840Di > 840Di with PLC315-2AF03
  or (SW 2.1 and higher)
  . . . > 840Di with PLC315-2AF03, P/C bus

DriveOM/ SlaveOM

The SlaveOM (Slave Object Manager) for SINUMERIK 840Di allows dialog-based configuration of the following drives in conjunction with a SINUMERIK 840Di:

– SIMODRIVE 611 universal or universal E
– SIMODRIVE POSMO CD/CA
– SIMODRIVE POSMO SI
– SIMODRIVE POSMO A
– ADI4 (Analog Drive Interface for Four 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.

The two Object Managers DriveOM and SlaveOM are part of the SINUMERIK 840Di installation. Before using the SlaveOM, first both Object Managers must be installed in the defined order.

1. Install the DriveOM
2. Install the SlaveOM.

Notice

The Object Managers DriveOM and SlaveOM must be installed on that computer on which the SIMATIC Manager STEP7 for creating the S7 project is already installed.

To install the Object Managers, please refer to the appropriate notes in the file:

– <installation path>\readme.txt.

After the SlaveOM has been installed, the following DP slave drives are available in the hardware catalog of “HW Config” (hardware configuration tool within the SIMATIC Manager) for being inserted into the S7 project:

- “HW Config” hardware catalog:

  Profile: **Default**

  – **PROFIBUS DP > SIMODRIVE > SIMODRIVE 611 universal**
  – **SIMODRIVE POSMO CD**
  – **SIMODRIVE POSMO CA**
  – **SIMODRIVE POSMO SI**
  – **SIMODRIVE POSMO A**
  – **PROFIBUS DP > SINUMERIK > ADI4**

DMF file

All properties of a DP slave are stored in a DMF file (device master file) in ASCII format. STEP7 requires one 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, its specific DMF file must be installed in “HW Config” using the menu command **Tools > Install new DMF file**.

After the DMF file has been installed, the DP slave is available in the hardware catalog of “HW Config” for being inserted into the S7 project:

- “HW Config” hardware catalog:
  Profile: **Standard**
  PROFIBUS DP > further field units > ...

Notice

The DMF files must be installed on that computer on which the SIMATIC Manager STEP7 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>\readme.txt.

7.2 Network rules

The following basic rules must be observed:

1. The bus line must be terminated on **both ends**. To this aim, 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 terminator must be supplied with **5V voltage**.
   For this, the PROFIBUS DP connector with inserted terminating resistor must be connected to a powered device.
3. No tap lines may be routed along PROFIBUS DP.
4. Each PROFIBUS node must **first** be connected and then enabled.
   When disconnecting a node, **first** disable the connection, then remove the connector.
5. The **cable length** of a PROFIBUS DP bus segment may be **max. 100m**.

Example: PROFIBUS DP network installation

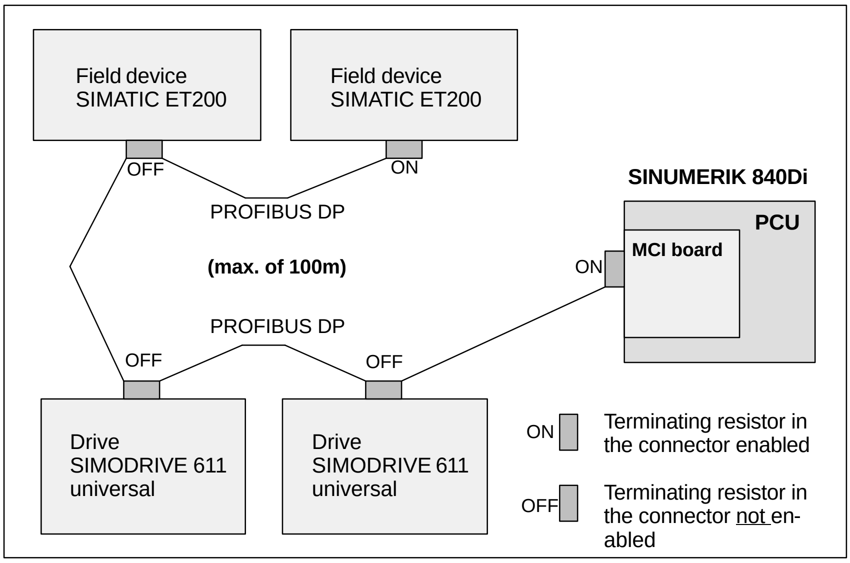


Fig. 7-3 Example of a PROFIBUS DP network installation

7.3 SIMATIC S7 project

The instructions regarding the configuration of PROFIBUS DP, which are provided in the following, are mainly limited to the special features with respect to SINUMERIK 840Di.

Note

For details regarding the creation and editing of SIMATIC S7 projects, please refer to the Documentation on SIMATIC Manager STEP7 or the corresponding online help.

7.3.1 Creating an S7 Project

To configure PROFIBUS DP for equidistant communication between master and slaves, an S7 project must be created.

The following definitions are made within the framework of this S7 project:

- Hardware configuration
- PROFIBUS addresses: DP master and DP slaves
- Equidistant PROFIBUS DP cycle
- Equidistant time.

Creating an S7 project

A new S7 project is created in the SIMATIC Manager using the menu command **File > New Project**.

Type a name you want to assign the project and click OK to confirm the dialog. The Project window will appear where the structure of the S7 project is displayed.

Inserting a 300 station

To insert the hardware into the S7 project, first a SIMATIC 300 station must be chosen and pasted to the project:

1. Possibility
   – Position the cursor on the Project window
   – Right mouse button **Insert New Object > SIMATIC Station-300**
2. Possibility
   Menu command **Insert > Station > SIMATIC Station-300.**

Open the station and start “HW Config” by double-clicking the hardware icon.

7.3.2 HW Config

Hardware catalog

The user interface of “HW Config” mainly contains:

– Menu bar
– Station window
– Hardware catalog.

If the hardware catalog is not displayed, open it using the menu command **View > Catalog**.

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.

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.

7.3.3 840Di Rack

840Di Rack contains the already partially preset modules:

- SINUMERIK 840Di PLC
  standard designation: PLC315-2DP M/S 2AF03
- PROFIBUS DP Master
  standard designation: DP master
- SINUMERIK 840Di NC
  standard designation: S7 FM NCU.

Inserting

The 840Di rack is to be found in the hardware catalog under:

Profile: **Standard**
SIMATIC 300 > SINUMERIK > 840Di > 840Di with PLC315-2AF03

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.

Configuring the DP master

After 840Di Rack has been inserted, the dialog box for configuring DP master opens automatically.

Use the Properties dialog box of DP master to make the following settings:

- 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 that can be set for the equidistant DP cycle depends on:

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

Dialog

Dialog: Properties – PROFIBUS Interface DP Master
- Tab: Parameters
  - Address: **2**
  - Subnetwork:
    - Button: “New...”

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

          Dialog: Options
          - Tab “Isosynchronism”
            - Enabling the equidistant bus cycle: ☑
            - Equidistant DP cycle: ***<Isosynchronous time>***

          OK

      OK

OK

Note

It is recommended to put down the **S7 subnetwork ID**, since it will be needed later to parameterize the routing settings of the axis start-up tool **SimoCom U**. See Subsection 9.1.6, page 9-269.

Configuring the PLC

After DP master has been configured, 840Di Rack with PROFIBUS DP is now displayed in the Station window.

Parameterizing the MPI interface

You can use the axis start-up tool **SimoCom U** to start up all DP slaves 611U connected to PROFIBUS from a SINUMERIK 840Di. To allow this, the PLC must route SimoCom U to PROFIBUS. This requires that the MPI interface of the PLC is networked.

To do so, open the Properties dialog box by double-clicking on the PLC in 840Di Rack.

The following settings are made in the dialog box:

- Interface type
- Address
- Data transfer rate.

Dialog

Dialog: Properties of PLC315-2DP M/S 2AF03

Tab: General
Group: Interface
Button: “Properties...”

Dialog: Properties – MPI Interface PLC315-2DP M/S 2AF03
Tab: Parameters
Address: **2** (see Note)
Subnetwork: **MPI**
Button: “Properties...”

Dialog: Properties – MPI
Tab “Network Settings”
Data transfer rate: **1.5 Mbps**
OK

OK

OK

Notice

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

Configuring the NC

The NC installed in the 840Di Rack is called S7 FM NCU. To allow communication between NC and PLC, the following setting are required:

- MPI address of the NC: PLC address + 1
- Input address and output address: 256
- Length of data: 2 (preset, no input possible).

To this aim, open the Properties dialog by double-clicking on the NC in 840Di Rack.

Dialog

Dialog: Properties – S7 FM-NCU
  Tab: General
    Group: Backplane connection
      MPI address: **3** (see Note)
  Tab: Addresses
    Group: Inputs
      Start: **256**
      Length: 2
    Group: Outputs
      Start: **256**
      Length: 2

OK

Notice

The MPI address of NC and PLC are tightly connected one to another.

MPI addr. of NC = (MPI addr. of PLC) + 1

Notice

The input/output address of the NC must be set to 256.

In the case of values other than 256, auxiliary functions provided from the PLC will no longer be acknowledged to the NC and the parts program execution is thus no longer continued.

7.3.4 SIMATIC S7 I/O devices

The SIMATIC I/O devices of the series ET200, e.g. ET200M, are integrated into the S7 project as usual 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.

7.3.5 I/O module PP72/48

The configuration with regard to the I/O modules PP72/48 is carried out using the DMF file SIEM80A2.DMF.

For installation of the DMF file, see Subsection 7.1.3., page 7-209 **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.

Inserting

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 > IO > PP input/output module

Click with the left mouse button on the DP slave PP72/48 in the hardware catalog (see Note) and drag it onto the DP master system in the station window, holding down the left mouse button.

Note

As DP slave PP72/48, the directory symbol with the designation “PP input/output module” and not the module symbol beneath with the designation “universal module” must be selected.

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.

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.

Selecting the set configuration

When inserting DP slave PP72/48 into the configuration, the set configuration of the module must be selected with regard to the I/O addresses.

The dialog 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.

PROFIBUS Parameters

After the dialog to choose the set configuration, the dialog “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 with the PROFIBUS address set on the module using switch S1 (see Section 2.12, page 2-93).

No automatic adjustment takes place!

The following data must be identical.

1. SIMATIC S7 configuration of DP slave PP72/48
   PROFIBUS address
2. I/O module PP72/48
   PROFIBUS address (switch S1)

Dialog

Dialog: PROFIBUS properties Interface PP input/output
Register: Parameters
Address: **<PROFIBUS–Adresse>**
Button: “Properties...”
Dialog: Properties – PROFIBUS
Tab: Network settings
Data transfer rate: **12 Mbps**
Profile: **DP**
OK
OK

Setting the I/O addresses

After the dialog has been quitted, the DP slave PP72/48 is inserted into the DP master system. Inserting of the detail view makes visible DP slave PP72/48 in the station window.

The I/O addresses are assigned by “HW Config” automatically. These I/O addresses should be modified in view of the following supplementary conditions:

- I/O address range of the NC
- Selective access to the input/outputs by the PLC.

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

In the case of I/O addresses > 256, the PLC cannot access the individual input/outputs. The input/output data must first be copied to internal flags of the PLC. To this aim, use 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.

7.3.6 ADI4 (SW 2.1 and higher)

Notice

The ADI4 DP slave can only be operated on an **equidistant** PROFIBUS DP.

SlaveOM

Parameterization of the configuration with regard to the ADI4 modules, called DP slave ADI4 here, is performed with the SlaveOM for SINUMERIK 840Di.

For installing the SlaveOM, see Section 7.1, page 7-203f: **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 communication.

ADI4 DP slave Insertion

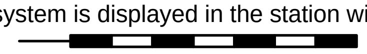
To insert an DP slave in the configuration, open the hardware catalog via the menu command **View > Catalog**.

The DP slave ADI4 is to be found at:

- Profile: **Default**

  PROFIBUS DP > SINUMERIK > ADI4.

Select DP slave ADI4 by clicking with the left mouse button on it and drag it to the DP master system in the Station window while holding down the mouse button.

The DP master system is displayed in the station window with the following symbol: 

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.

Parameterizing DP slave ADI4

Parameterization of DP slave ADI4 is divided into 2 main steps:

Step 1: Start

Step 1 includes the DP slave ADI4-specific parameterization of:

- PROFIBUS parameters
  – PROFIBUS address

  – Number of axes and encoders (message frame type)
  – I/O addresses
- Function parameters
  – Encoder type
  – Unipolar spindle
  – Shutdown ramp
  – Shutdown delay time.

Step 1 should first be carried out for **all** DP slaves ADI4 required for the configuration.

Step 2

Step 2 includes parameterization of the times for equidistant cyclic communication. Step 2 should be carried out **finally**, for **any** DP slave ADI4.

The settings made during the operational sequence above can be transferred to all of the remaining DP slaves ADI4 using the matching function of SlaveOM.

PROFIBUS parameters

PROFIBUS address

On insertion of a DP slave ADI4 into the configuration, the dialog: Properties – PROFIBUS Interface ADI4 opens.

SlaveOM has set the PROFIBUS address to the next free PROFIBUS address. Any PROFIBUS address is possible but it must match the address set on the ADI4 using DIP switch S2.

Notice

The PROFIBUS address of DP slave ADI4, which is set on the SlaveOM, must match with the PROFIBUS address set in the drive:

No automatic adjustment takes place!

The following data must be identical.

1. SIMATIC S7 configuration of DP slave ADI4
   PROFIBUS address
2. ADI4 module DIP switch S2
   PROFIBUS address

Dialog

Dialog: Properties – PROFIBUS interface ADI4
  Tab card: Parameters
    Address: **PROFIBUS address**

OK

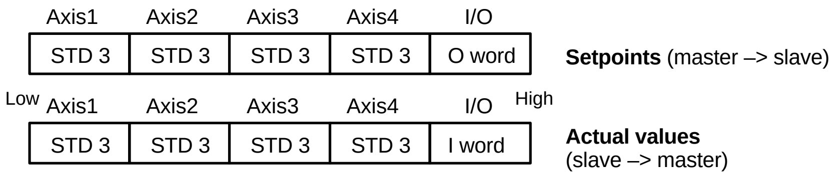
After you have confirmed this dialog using the button: “OK”, the dialog: “DP Slave properties” opened.

Message frame type

The ADI4 DP slave is operated with the specific message frame type: Four axes each with an encoder (standard message frame 3) and I/O data:

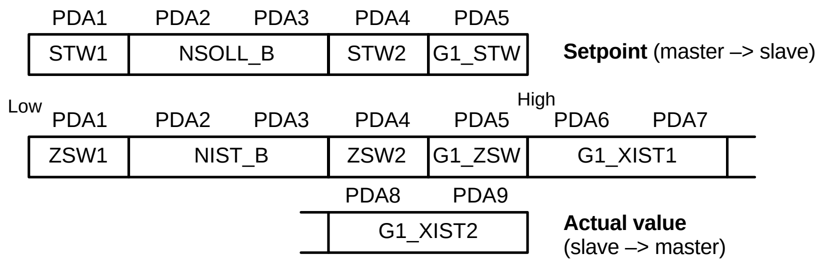
Message frame type	Description
4 axes each with an encoder, standard message frame 3 + IO, PDA-5/9 O/I 1/1	4 x standard message frame 3 and 1 PDA word each for digital I/O data
PDA x/y number of process data **words**, x: Setpoint, y: Actual value	

ADI4 message frame structure

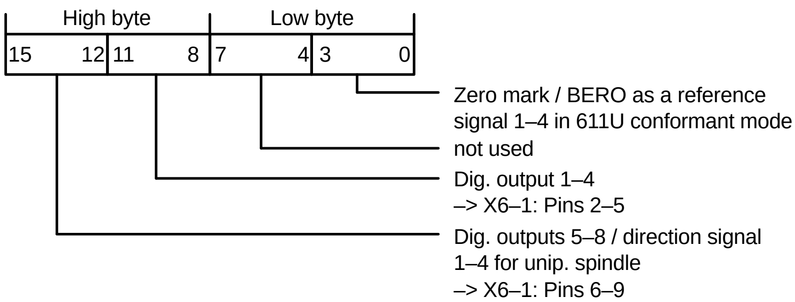


STD 3: Standard message frame 3 acc. to PROFIDrive specification V3.0
O word: Digital output data (16 bits)
I word: Digital input data (16 bits)

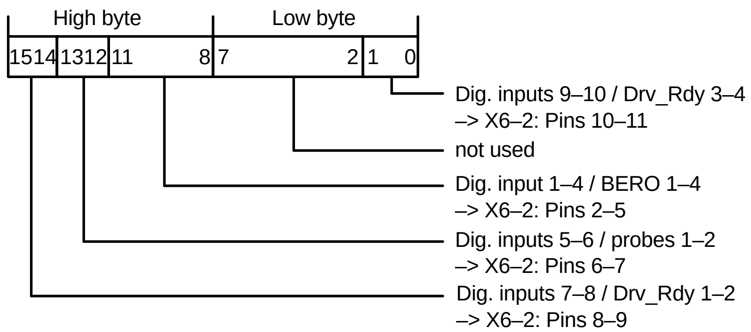
Standard message frame 3: Speed setpoint interface 32 bits with 1 encoder



O word (dig. output data 16 bits) 1)



I word (dig. input data 16 bits) 1)



1) Note:
To use the I/O words within the NC: See Section 10.6, page 10-379

Notice

The message frame type of DP slave ADI4, which is set on the SlaveOM, must match with the PROFIBUS address set on the NC.

No automatic adjustment takes place!

The following data must be identical.

1. SIMATIC S7 configuration DP slave ADI4
   Message frame type (3)
2. SINUMERIK 840Di–NC
   MD13060 DRIVE_TELEGRAM_TYP (3)

Dialog

Dialog: DP Slave Properties
  Tab: Configuration
    Default: <**Message Frame Type**>

OK

I/O addresses

A communication between NC and the individual axes of the DP slaves ADI4 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 ADI4 into a configuration.

The standard default of the NC machine data:

- MD13050 DRIVE-LOGIC_ADDRESS[n], (logical drive address)

is described in Subsection 10.5.1, page 10-308.

Dialog

Dialog: DP Slave Properties
  Tab: Configuration
    PROFIBUS partner, I/O addr.: <**I/O address**>

OK

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 ADI4 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 ≥ **272** for ADI4 DP slave I/O addresses.

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.

Note

The terms isochronous, clock-synchronous, and equidistant (same length) are used as synonyms in various documents.

Function parameters

In dialog box: DP slave properties –> Encoder tab, the function parameters are entered (see Fig. 7-4 with sample values for the individual parameters).

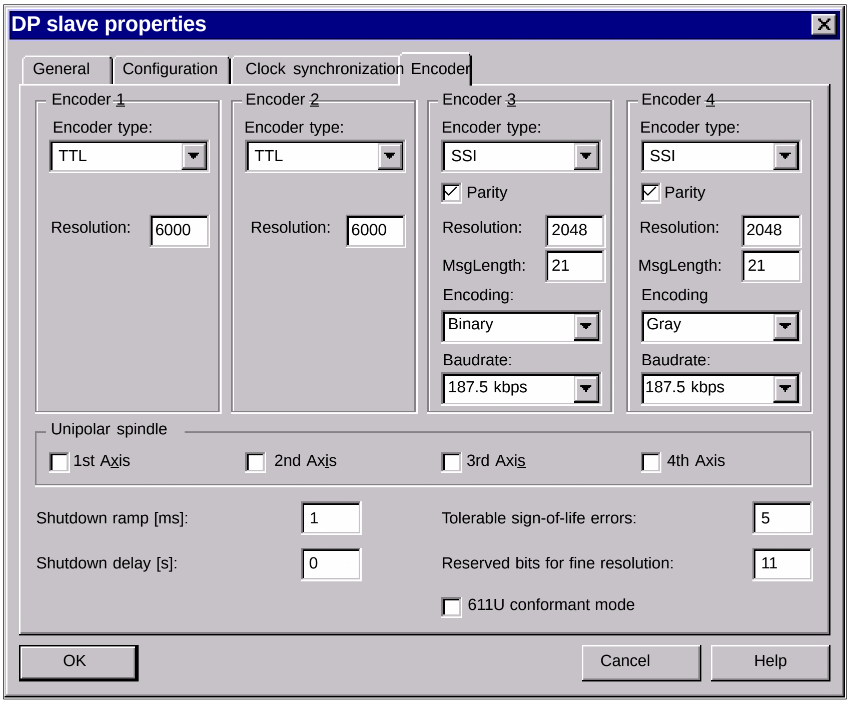


Fig. 7-4 Dialog: DP slave properties, tab card: Encoder

Encoder

The encoder parameters depend on the encoder type.

Encoder type: Does not exist

Encoder type “does not exist” for encoder x means that axis x does not exist or must not be used. In the PROFIBUS message frame, empty useful data are transmitted for this axis.

Encoder type: TTL

Encoder parameters:

- Resolution
  Number of encoder lines [encoder lines/revolution]

Note

Both rotary and linear incremental measuring systems can be used, as the specific parameters of the measuring system are set in den NC machine data (see Subsection 10.5.5, page 10-317ff).

Encoder type: SSI

Encoder parameters:

- Parity
  Select this radio button if the encoder data are to be transmitted from the encoder to the ADI4 with a parity bit.
- Resolution
  Number of encoder lines [encoder lines/revolution]
- MsgLength
  Number of useful data bits transmitted by the encoder
- Encoding
  The following encoder codes are supported:
  - Binary
  - Gray
- Baudrate
  The following baudrates are supported:
  - 187.5 kbps
  - 375 kbps
  - 750 kbps

Notice

The baudrate must be set identically for all SSI encoders. If different baudrates are set, the baudrate of the SSI encoder with the highest encoder number is used.

Encoder control word G1_STW

Description of the encoder control word (extract) with regard to:

- Reference mark search
- In-process measurement.

<table>
<tr><th>Bit</th><th colspan="2">Name</th><th colspan="2">Signal state, description</th></tr>
<tr><td>0
1
2
3</td><td rowspan="3">Reference mark search

or

In-process measure-ment.</td><td>Func-tions</td><td colspan="2">Bit 7 = 0 => Request: Reference mark search
Bit Meaning
0 Function 1: Referencing using a zero mark (except for “611U conformant mode”)
1 Function 2: Referencing using a rising edge of the associated BERO
2 Function 3: Referencing using a falling edge of the associated BERO
3 Function 4: not used

Bit 7 = 1 => Request: In-process measurement.
Bit Meaning
0 Function 1: Sensor 1 rising edge
1 Function 2: Sensor 1 falling edge
2 Function 3: Sensor 2 rising edge
3 Function 4: Sensor 2 falling edge
Tip:
• Bit x = 1 Function requested
Bit x = 0 Function not requested
• If more than one function is activated, then:
The values for all functions can only be read when each activated function has been terminated and this has been confirmed with the corresponding status bit (G1_ZS Bit0 / 3 “0” signal again).
• In-process measurement.
A rising and falling edge can be activated simultaneously.
The sensor signal is detected depending on the direction. The values are read out one after the other.</td></tr>
<tr><td>4
5
6</td><td>Com-mand</td><td colspan="2">Bit 6, 5, 4 Meaning
000 Basic setting
001 Activate function x
010 Read value x
011 Cancel function x</td></tr>
<tr><td>7</td><td>Mode</td><td>0
1</td><td>Reference mark search (zero mark or BERO)
In-process measurement.</td></tr>
</table>

Unipolar spindle

With radio button “Unipolar spindle” the voltage range of the analog output voltage is switched over:

- Radio button “Unipolar spindle” not selected:
  Output voltage: –10V to +10V
- Radio button “Unipolar spindle” selected:
  Output voltage: 0V to +10V

  If the function: “Unipolar spindle” of the ADI4 is activated, the direction of rotation is output through a digital output and depends on the current speed setpoint:

  – Direction of rotation signal for axis 1 –> digital output X6-1, Pin 6

  – Direction of rotation signal for axis 2 –> digital output X6-1, Pin 7

  – Direction of rotation signal for axis 3 –> digital output X6-1, Pin 8

  – Direction of rotation signal for axis 4 –> digital output X6-1, Pin 9.

Shutdown ramp

You can set a linear time function in parameter “Shutdown ramp”. When this time period is exceeded, if an error is detected in ADI4, all drives of ADI4 are decelerated to setpoint 0.

If you set the parameter to 0, the drives coast to standstill.

- Unit: [msec]

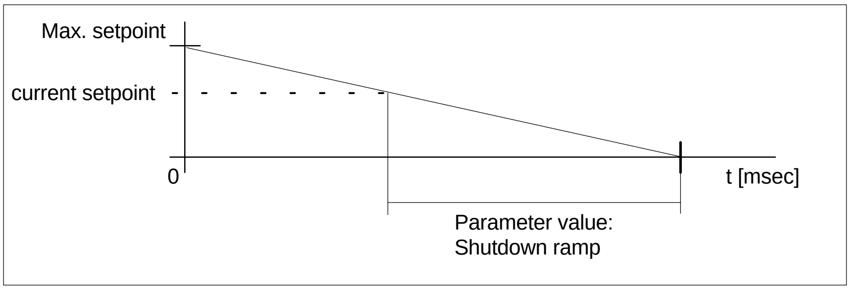


Fig. 7-5 Parameter: Shutdown ramp

Shutdown delay time

In the “Shutdown delay time” parameter you can set a time delay after which all drives of ADI4 are decelerated to setpoint 0 if a temperature alarm occurs.

After the “Shutdown delay time” has elapsed the “Shutdown ramp” parameter is taken into account.

- Unit: [sec]

Tolerable sign-of-life failures

Parameter “Tolerable sign-of-life failures” states the number of tolerable sign-of-life failures of the DP master. If the parameterized number is exceeded, the setpoint interfaces of all drives are shut down to value 0 using the “Shutdown ramp”.

Reserved bits for fine resolution

Via the parameter “Additional substitute bits for fine resolution”, you can specify the desired pulse multiplication of the encoder increments currently read in the encoder increments and transferred in the encoder actual value G1_XIST1.

In conjunction with SINUMERIK 840Di, the number of additional bits for fine resolution should currently be set to the value 11. This corresponds to a pulse multiplication of: $2^{11} = 2048$.

Transferred encoder actual value G1_XIST1

31		10 ... 0
Overflows	current encoder increments	**Reserved bits for fine resolution:**

Notice

- Parameter "Additional substitute bits for fine resolution" must currently always be set to 11.
- In accordance with the parameter "Additional substitute bits for fine resolution,
  - MD30260: ABS_INC_RATIO (ratio of absolute resolution to incremental resolution)

  the value: $2^{\text{“Additional substitute bits for fine resolution”}} = 2^{11} = 2048$ must be entered in the machine data.

611U conformant mode

With parameter "611U conformant mode" is used for selection of the signal source conformant with SIMODRIVE 611 universal for referencing the axis.

In 611U conformant mode, the signal source for referencing the axes (zero mark or BERO) is no longer set in the standard message frame (encoder control word G1_STW, page 7-226), but with the digital output word.

- Digital output word, bits 8–11 (see O word, page 7-222)
  Referencing the axis:
  - Bit 8 = 0 –> axis 1 with zero mark of encoder 1 (X4–1)
  - Bit 8 = 1 –> axis 1 with rising edge of BERO 1 (X6–2, Pin 2)
  - Bit 9 = 0 –> axis 2 with zero mark of encoder 2 (X4–2)
  - Bit 9 = 1 –> axis 2 with rising edge of BERO 2 (X6–2, Pin 3)
  - Bit 10 = 0 –> axis 3 with zero mark of encoder 3 (X4–3)
  - Bit 10 = 1 –> axis 3 with rising edge of BERO 3 (X6–2, Pin 4)
  - Bit 11 = 0 –> axis 4 with zero mark of encoder 4 (X4–4)
  - Bit 11 = 1 –> axis 4 with rising edge of BERO 4 (X6–2, Pin 5).

Step 1: End

When you terminate the dialog box "DP slave properties" with the button: "OK", the data are transferred and the dialog box is closed. Step 1 of parameterization of DP slave 611U is then complete.

Setting the final parameters for ADI4

Once the components (drives, ADI4, I/O devices, etc.) have been inserted in the configuration and parameterized, the parameters are set for the equidistant DP cycle while taking the framework conditions listed below into consideration, (see Subsection 7.3.8, page 7-238).

Boundary conditions (SW 2.1 and higher)

When setting the parameters for the equidistant DP cycle, with ADI4 it is necessary to take the following framework conditions into account:

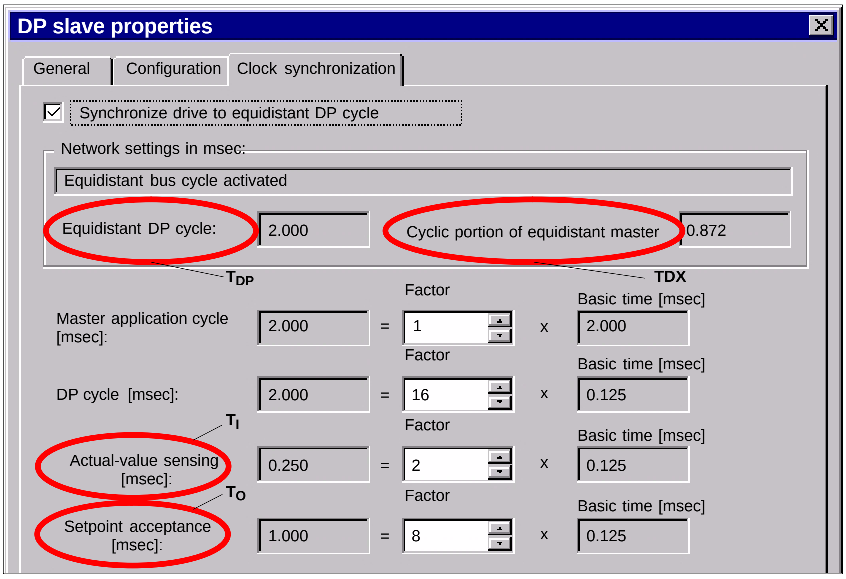


Fig. 7-6 Dialog: DP slave properties (cutout)

1. Equidistant DP cycle (T_{DP})
   $\mathbf{T_{DP}}$ = 2* n * 125µsec; where n $\geq$ 4 (=> minimum T_{DP} = 1 msec)
2. Setpoint acceptance (T_o)
   (TDX + 125µsec) $\leq$ $\mathbf{T_O}$ $<$ T_{DP}; where TDX = T_{DX}, rounded up to an integral multiple of 125µsec
3. Actual-value sensing (T_i)
   250µsec $\leq$ $\mathbf{T_I}$ $\leq$ T_{DP}
4. T_I and T_O must not be in the same 125µsec cycle
   $\Delta T \neq 0$; where $\Delta T = T_{DP} - \mathbf{T_I} - \mathbf{T_O}$
5. If $\mathbf{T_O}$ == (T_{DP} – 125µsec)
   Then the following must be valid for T_I: $\mathbf{T_I}$ $>$ 3 * 125µsec
6. If $\mathbf{T_O}$ == (TDX + 125µsec)
   Then the following must be valid for ($T_I + T_O$): $(\mathbf{T_I} + \mathbf{T_O}) \neq (T_{DP}$ + 125µsec)

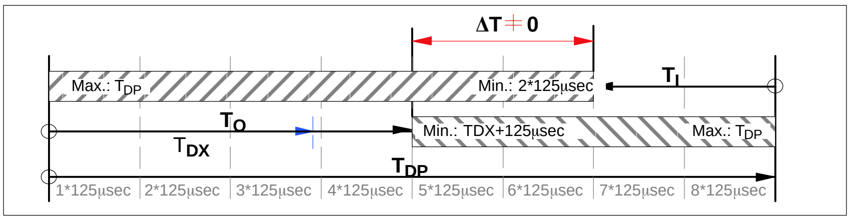


Fig. 7-7 Graphical illustration of the boundary conditions

For a description of a full DP cycle, refer to Subsection 7.1.2, Page 7-205.

Typical values

Typical parameter values are as follows:

– Equidistant DP cycle (T_{DP}): 2,000 msecs
– Actual-value sensing (T_i) 0.250 msecs
– Setpoint acceptance (T_o) 1,000 msecs

Notice

DP slaves ADI4:

– Order No.: 6FC5 211–0BA01–0AA**0**

– Order No.: 6FC5 211–0BA01–0AA**1**

exhibit different behavior with respect to parameterization of the actual value recording (T_i) and setpoint acceptance (T_o) that deviates from one of the above–mentioned boundary conditions.

- DP slave ADI4 with MLFB ...–0AA**0**
  A parameterization that deviates from one of the above mentioned boundary conditions is ignored by this DP slave ADI4, since the parameters are set permantenly internally. The DP slave ADI4 starts communication with the DP master using the values that deviate from he parameterized values without issuing an error message.
- DP slave ADI4 with MLFB ...–0AA**1**
  If a configuration that deviates from the above/mentioned boundary conditions is loaded to this DP slave ADI4, the DP slave ADI4 does not start cyclic communication with the DP master.

7.3.7 SIMODRIVE drives

Parameterization of the configuration with regards to the SIMODRIVE drives:

– SIMODRIVE 611 universal and 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 7.1, page 7-203: **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.

Inserting DP slave 611U

In order to insert a DP slave 611U into the configuration, open the hardware catalog using the menu command **View > Catalog**.

The DP slave 611U is to be found at:

- Profile: **Default**

  PROFIBUS DP > SIMODRIVE > SIMODRIVE 611 universal, PROFI–BUS DP, MC

Select DP slave 611U by clicking with the left mouse button on it and drag it to the DP master system in the Station window while holding down the mouse button.

The DP master system is displayed in the station window with the following symbol:

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 (SW 2.2 and higher)

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 for the selected standard message frame type (102 to 107).

The expanded message frame configuration is described in Section 16.2, page 16-501.

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:

No automatic adjustment takes place!

The following data must be identical.

1. SIMATIC S7 configuration of DP slave 611U
   PROFIBUS address
2. SIMODRIVE 611 universal
   Parameter P0918 (PROFIBUS node address.)

Dialog

Dialog: Properties – PROFIBUS Interface SIMODRIVE 611U DP2, DP3
    Tab: Parameters
        Address: **PROFIBUS address**

OK

Message frame type

After this dialog has been confirmed using the button: “OK”, the dialog: “DP Slave properties” opened.

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

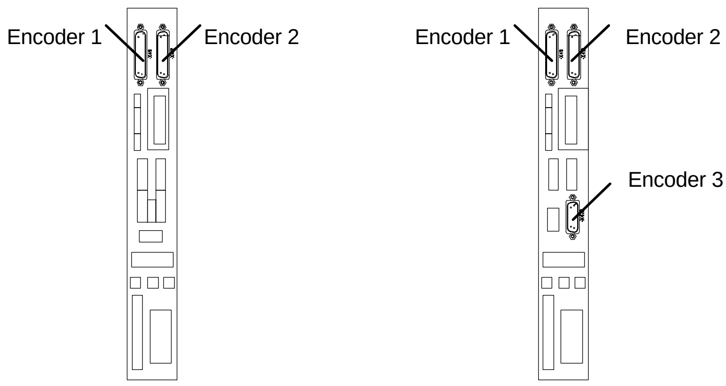
– The number of encoders used per axis

– The drive functionality used.

The following message frame types are predefined for parameterization of the DP slave 611U:

Table 7-1 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,	Massage 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 DSC	number of process data words, x: setpoints, y: actual values Functionality “Dynamic Servo Control”	



SIMODRIVE 611 universal SIMODRIVE 611 universal **E**

Dialog

Dialog: DP Slave Properties
Tab: 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:

No automatic adjustment takes place!

The following data must be identical.

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/ SIMODRIVE 611 universal, Description of Functions
- 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

A 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.

No automatic adjustment takes place!

The following data must be identical.

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:

1. 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 10-308.

Dialog

Dialog: DP Slave Properties
Tab: Configuration
Table entry: PROFIBUS partner, I/O addr.: <**I/O address**>

OK

After you have confirmed this dialog using the button: “OK”, the dialog: “DP slave properties” closed. 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

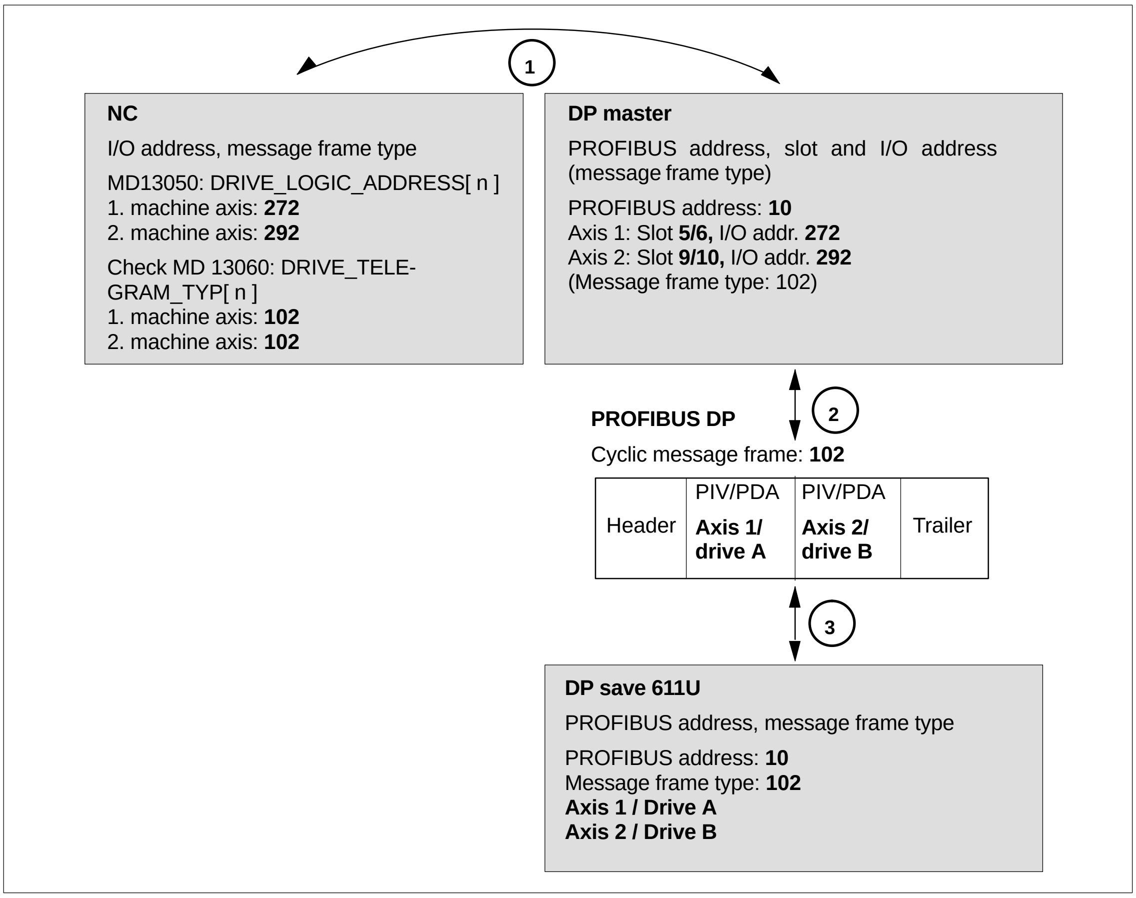


Fig. 7-8 Dependencies: NC, PLC/DP master and DP slave (SIMODRIVE 611 universal)

(1) **NC**

Due to the I/O address and the message frame type of the machine axis, which are entered in the machine data:

- MD13050: DRIVE_LOGIC_ADDRESS[n]
- MD13060: DRIVE_TELEGRAM_TYP[n]

the NC reads and writes the axis data from/into the appropriate I/O range of the PLC/DP master:

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 10-313.

(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:

- **Slots 5/6** => **Axis 1** or **drive A**
- **Slots 9/10** => **Axis 2** or **drive B**

(3) **DP save 611U**

DP slave interprets the message frames received from the DP master because of the drive parameters

- Parameter P0922 (message frame selection PROFIBUS)

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.

7.3.8 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:

- Enabling of the equidistant DP cycle
- Master cyclic portion $T_{DX.}$

Step2:

- Equidistant DP cycle T_{DP}
- Master application cycle T_{MAPC}
- Actual-value sensing T_I
- Setpoint acceptance $T_{O.}$

An overview of the various times of a DP cycle is shown in Fig. 7-2, page 7-205.

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, please observe the boundary conditions for the following parameters:

- Equidistant DP cycle T_{DP}
- Master cyclic portion $T_{DX.}$
- Actual-value sensing T_I
- Setpoint acceptance $T_{O.}$

See also: ADI4-specific boundary conditions, page 7-229.

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 <u>all</u> DP slaves 611U by activating the equidistant DP cycle within the selected DP slave 611U and finally adjusting.

During the adjustment, all:

- DP slave properties
  displayed in the tab: Clock Synchronization

are transferred to all DP slaves of the same type in the configuration, here DP slave 611U.

Dialog:
Start

Dialog: DP Slave Properties
Tab: Clock synchronization
Optional field: “Synchronize drive to equidistant DP cycle” ☑
Button: “**Adjust**”

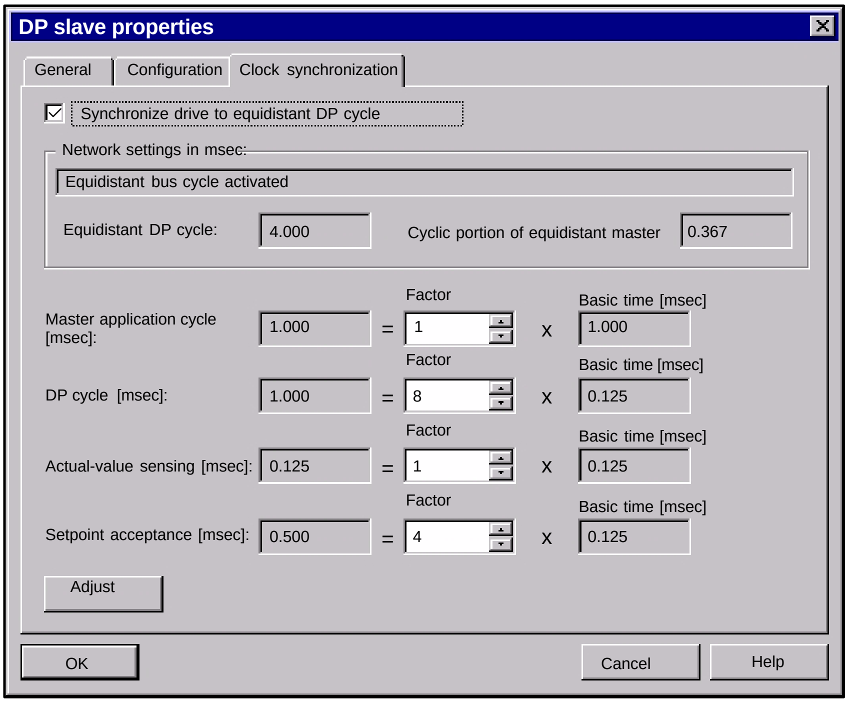


Fig. 7-9 Enabled equidistant DP cycle

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. Adjust

must be performed for each type of DP slave first before you can go on to set the other parameters.

Equidistant master cyclic portion 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: cont'd.

Tab: General
Group: Node
Button: “PROFIBUS...”

Dialog: Properties – PROFIBUS Interface SIMODRIVE ...
Tab: Parameters
Button: “Properties...”

Dialog: Properties PROFIBUS
Tab: Network settings
Button: “Options...”

Dialog: Options
1st Optional field: Enable equidistant bus cycle ☐
2nd Optional field: Enable 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: cont'd.

Group: Equidistant time in msec
Equidistant DP cycle: **Equidistant time**
OK

OK

OK

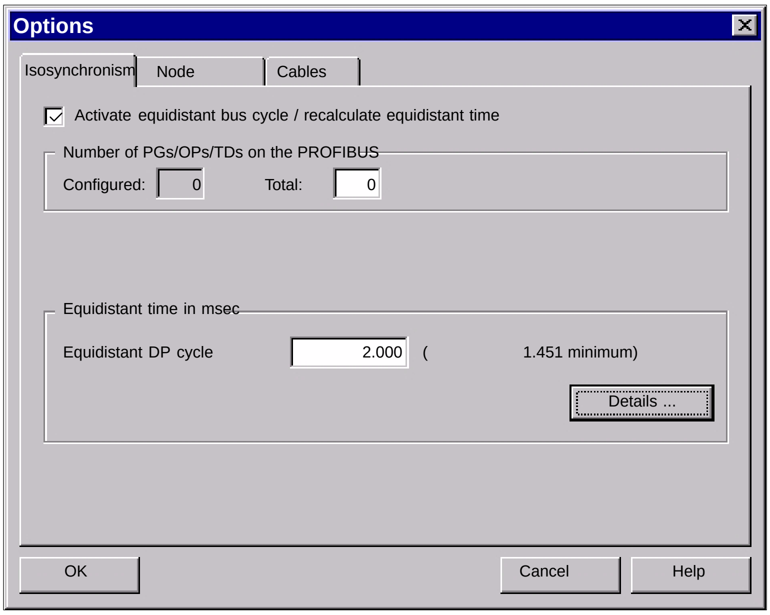


Fig. 7-10 Dialog: Options

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 sensing T_I
- Setpoint acceptance T_O.

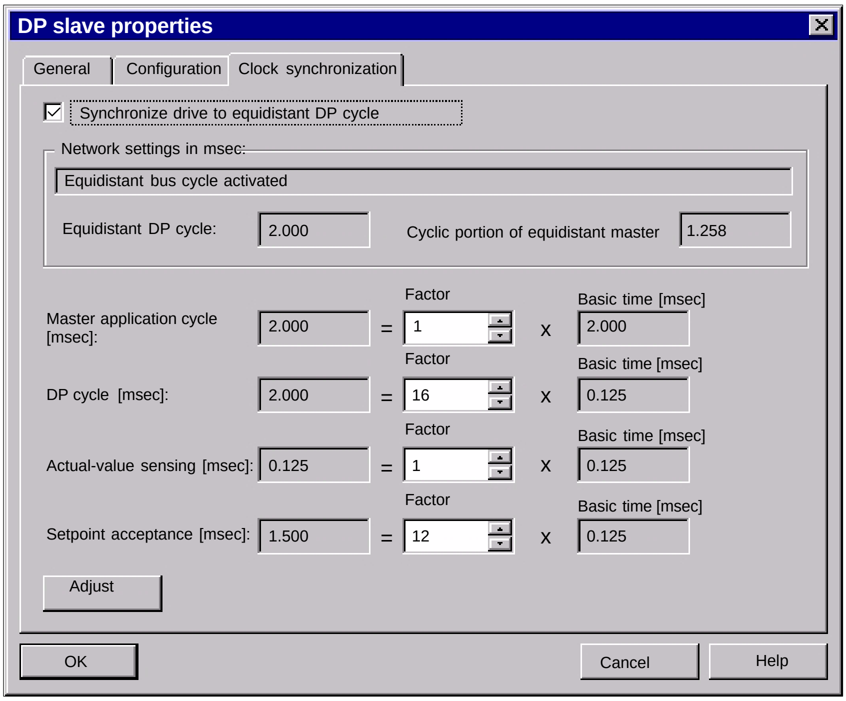


Fig. 7-11 Dialog: DP slave properties

DP cycle T_{DP}

The DP cycle time of the DP slave 611U must be set to the cycle time of the DP master displayed under "equidistant DP cycle".

Notice

For DP cycle time T_{DP} the following condition must be fulfilled:

DP cycle = isosynch. DP cycle

Master application cycle T_{MAPC}

The 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: cont'd.

Tab: Clock synchronization
Master application cycle [msec]:
Factor: **1**

Actual-value sensing T_I

The 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.

It is recommended to use the same value for the time of actual-value sensing 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 >= basic time

Dialog: cont'd.

Tab: Clock synchronization
Actual-value sensing [msec]:
Factor: **Factor**

Setpoint acceptance T_O

The parameter: Setpoint Acceptance To defines the time when the speed setpoint of the NC position controller is accepted by a DP slave 611U.

It is 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 acceptance >= equidistant master cycl. portion + basic time

Dialog: cont'd.

Tab: Clock synchronization
Setpoint acceptance [msec]:
Factor: **Factor**

Adjustment

Press the button: Adjust, to transfer the values shown on tab card: “Clock Synchronization” of the current DP slave 611U to the other DP slaves 611U of the configuration.

This adjustment must be carried out at the end, and the dialog must then be confirmed with OK.

Dialog:
End

Tab: 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 sensing T_I
- Setpoint acceptance $T_{O.}$

must be set for each type of DP slave as described above and adjustment must be performed.

By adjustment, the values displayed on tab card: “Clock Synchronization” are only transmitted to the DP slave **of the same** type.

7.3.9 Loading a configuration into the PLC

Prerequisites for loading

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

- “HW Config” is active
- Current system data blocks are available
- An MPI connection is established between “HW Config” and the PLC
- SINUMERIK 840Di is active, i.e. the NC is in cyclic operation and the PLC in either of the states RUN or STOP.

Generating system data blocks

The system data blocks (SDB) are generated by compiling the current configuration using “HW Config”. They contain the relevant information required for communication of the module with the entire system.

Consistency check

Before saving and compiling the current configuration, it is recommended to check the consistency of the configuration using the menu command **Station > Check Consistency**.

If “HW Config” finds any inconsistencies within the configuration, an error dialog box appears, which displays the appropriate error messages and possible remedies.

Save and Compile

The menu command **Station > Save and Compile** saves the current configuration in S7 as an object: **Station** and is then compiled. The compilation includes a consistency check of the parameterized settings.

System data blocks

If no inconsistencies are contained within the current configuration, the system data blocks are generated and stored in the folder **Blocks** of the corresponding module.

The system data blocks for the created configuration are to be found at:

- PLC315-2DP M/S 2AF0
  S7 program
  Sources
  Blocks –> **System Data**

Display of current system data blocks:

- Double-click with the left mouse button on “System Data”:
  Dialog: System Data Blocks

Note

System data blocks cannot be edited separately, but always only in its entity as a configuration.

Making the MPI connection

Before loading the configuration (system data blocks) into the PLC, first the required MPI connection must be established.

HW Config on an **external** PG/PC

If the configuration is transferred from an external PG/PC (e.g. PG740), the following requirements must be fulfilled:

- An MPI card exists (e.g. CP5611)
- The MPI drivers are installed
- Current interface parameterization: **CP5611(MPI)**
- Data transfer rate: **1.5 Mbps**
- The MPI interface of the PG/PC is linked with the MPI interface of the MPI board (X111) using an MPI cable.

HW Config on a **local** PC

If the configuration is transferred from the PC in which the MCI board is installed (e.g. SINUMERIK 840Di with PCU50), the following requirements must be fulfilled:

- The MPI drivers are installed
- Current interface parameterization: **SINUMERIK MCI board (MPI)**
- Data transfer rate: **1.5 Mbps**

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

Dialog: Setting the PG/PC Interface
    Register: Access Path
        Interface parameter set used:
            with ext. PG/PC: **CP5611(MPI)**
            or
            with local PC: **SINUMERIK MCI board (MPI)**
        Button: “Properties”

        Dialog: Properties
            Group: Network Parameters
                Transmission rate: **1.5 Mbps**
        OK

OK

Note

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

Checking PLC status and MPI interface

The PLC status and thus also the MPI connection to the PLC can be checked from “HW Config” using the menu command **Target System > Status**.

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

If the current status of the PLC is not displayed, first check the MPI interface for correct parameterization. If no connection is established to the PLC despite correctly set MPI interface, an overall reset of the PLC must be carried out.

General PLC 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 NT taskbar > Start > Programs > SINUMERIK 840Di > 840Di start-up**.
  - Open the dialog box: Menu command **Window > Diagnosis > NC/PLC**.
- HMI Advanced (840Di SW 2.2 and higher and HMI Advanced SW 6.2)
  - Open the dialog box: **Operating area switchover > Start-up > NC/PLC Diagnosis**
- To initiate a general PLC reset, activate the button: **“MRES”**.

At completion of this general reset, the PLC is in the RUN state (RUN LED lights in green).

Loading the configuration

The configuration is loaded in “HW Config” using the menu command **Target system > Load into module**.

For loading a configuration, the PLC must be in the STOP state. If “HW Config” detects on loading that the PLC is still in the RUN state, a dialog box will appear where you can set the PLC to the STOP state.

From the dialog box “Choose Target Module”, choose the module into which you want to load the current configuration. In this case: PLC315-2DP M/S 2AF03.

Dialog

Dialog: Choose Target Module
  Target modules:
    Module: **PLC315-2DP M/S 2AF03**
OK

Operating a PLC with a new configuration (RUN)

To load the configuration, put the PLC in the STOP condition. The STOP condition of the PLC is interpreted by the NC as a failure of the PLC, and an appropriate alarm response is output.

After the configuration has been loaded into the PLC successfully, for resynchronization of NC and PLC, NC reset must be initiated, e.g. using 840Di start-up:

- Start 840Di start-up
  - Windows NT taskbar: **Start > Programs > SINUMERIK 840Di > 840Di Start-up**
- Carry out NC reset
  - Menu command: **Window > Diagnostics > NC/PLC**

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

■

Notes

PLC Start-Up 8

PLC module The PLC integrated on the MCI board of the SINUMERIK 840Di is compatible with the SIMATIC S7-PLC: AS315-2 DP.

8.1 Start-up prerequisites

Start-up of the PLC differs, depending on whether start-up has already been carried out and on whether the PLC program is to be loaded as an S7 project using the SIMATIC Manager STEP7 or as a series machine start-up file.

In order to start up the PLC, generally, the following prerequisites have to be fulfilled:

1. SINUMERIK 840Di is turned on and booted
2. NC in cyclic mode
3. PLC is in the RUN condition
4. The PLC program to be loaded is available either as an S7 project or as a series machine start-up file.

8.1.1 Commissioning

When commissioning the PLC, first a general reset of the PLC has to be carried out after the SINUMERIK 840Di has been turned on and booted.

In order to obtain a defined initial state of the whole system (NC and PLC), it is recommended also to delete the NC data when commissioning the PLC.

General PLC reset

General reset brings the PLC to a defined initial state by deleting and initializing all system and user data.

Deleting NC data

After a request to delete NC data, all user data (zero offsets, tool offsets, etc.) are deleted and the system data (machine data) are reinitialized with the next ramp-up of the NC.

General reset of PLC and 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 (840Di SW 2.2 and higher and HMI Advanced SW 6.2)
  - Open the dialog box: **Operating area switchover > Start-up > NC/PLC Diagnosis.**

Dialog

Proceed as follows in the dialog boxes:

1. General PLC reset

   PLC group
   Button: **“MRES”**

Notice

The following parameters are reset by the general PLC reset:

- MPI address of the PLC = 2
- MPI data transfer rate = 1.5 Mbit/s

---

2. Delete NC data

   NC group
   Button: **“General NCK reset”**

3. Trigger NC reset

   In order to start cyclic operation or NC/PLC communication, NC reset (button: “NCK Reset”) must be initiated:

The subsequent power up of the SINUMERIK 840Di is successfully completed if the following display appears in the dialog:

- NC status:
  NC group
  6 NCs in cyclic operation
- PLC status:
  PLC group
  LED **RUN** lights continuously.

Note

Since no PLC program is executed after general PLC 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.

8.2 PLC program

PLC program

The PLC program has a modular structure and is differed by:

– Basic program

– User program.

Basic PLC program

The basic PLC program provides the data and function blocks for the basic communication between PLC and NC.

The modules of the basic PLC program are part of a SIMATIC S7 library supplied with SINUMERIK 840Di. Before you can use it in an S7 project, the library must be installed in the SIMATIC Manager STEP7.

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 or extended.

User memory

The user memory provided for basic PLC and user programs of the PLC integrated on the MCI board: AS315-2 DP, amounts to 64KB by default.

Optionally, a user memory of up to 288KB is possible.

8.2.1 Performance data of the PLC315-2DP

The PLC315-2DP complies with the following performance data regarding the max. number of blocks and their max. length:

Table 8-1 Block performance data of the PLC315-2DP

Block type	Max. no.	Max. length per block
FC	192	16420 bytes
FB	192	16420 bytes
DB	255	16420 bytes

8.2.2 Installing the basic PLC program

Installation

The basic PLC program is part of the PLC toolbox supplied with SINUMERIK 840Di. To be able to use the blocks of the basic PLC program in a SIMATIC S7 project, the library has to be installed in SIMATIC Manager STEP7 first.

Notice

The basic PLC program must be installed on that computer on which the SIMATIC Manager STEP7 required to install the S7 project is already installed.

For installing the basic PLC program, please observe the appropriate notes in the file:

– <installation path>\readme.txt.

Using basic PLC program modules

In order to be able to use the blocks of the basic PLC program in your own S7 project, these have to be copied from the supplied library into the folder: **Blocks** of the corresponding **module**.

Note

The example project mentioned in the following refers to the S7 project created within the framework of the PROFIBUS DP configuration, Section 7.3, page 7-211.

To do so, proceed as follows:

1. Start the SIMATIC Manager STEP7.
2. Open the S7 project.
3. Open the station (in the example project: SIMATIC 300)
4. Open the module (in the example project: PLC315-2DP M/S 2AF03)
5. Open the folder: S7 Program > Blocks
6. Open the installed library: gp8x0<language><version>
   e.g.: **gp8x0d53**
   SIMATIC Manager: Menu command **File > Open File**

Dialog

   Dialog: Open
      Optional field: **Select** libraries
         Library: **gp8x0d52** select
   OK

7. The library is displayed in a new window.
   To copy the required block of the basic PLC program, open the Blocks folder, e.g. **pg8x0d53 > gp8x0d > blocks**
8. Choose the required blocks of the basic PLC program and copy them into the S7 project to **Station** (in the example project: SIMATIC 300) **> Module** (in the example project: PLC315-2DP M/S 2AF03) **> S7 Program > Blocks**

Description of the basic PLC program

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
Section: P3, Basic PLC Program

8.2.3 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.

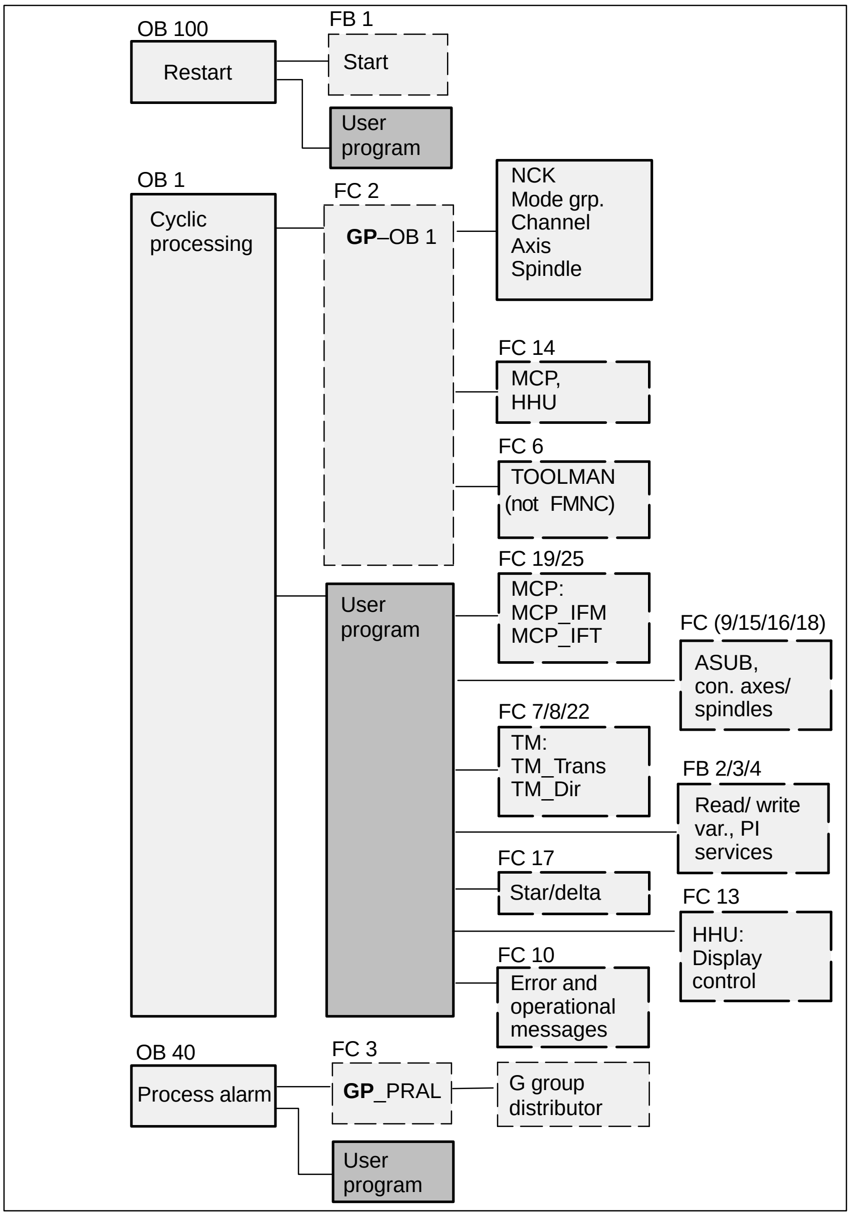


Fig. 8-1 Structure of PLC program

Processing modules

The individual blocks in the basic PLC program can be processed in the SIMATIC Manager STEP7:

- 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 with the left mouse button on the block.
- Edit the block using the LAD/STL/CSF editor
  Switch over the block display using the menu command **View > LAD** or **STL** or **CSF.**

8.3 Loading the PLC program

8.3.1 S7 project

Prerequisites for loading

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

- SIMATIC Manager STEP7 is active
- The current PLC program is present.
- An MPI connection is established between SIMATIC Manager and PLC.
- SINUMERIK 840Di is active, i.e. the NC is in cyclic operation and the PLC in either of the states RUN or STOP.

Making the MPI connection

Before loading the configuration (system data blocks) into the PLC, first the required MPI connection must be established.

SIMATIC Manager STEP7 on an external PG/PC

If the configuration is transferred from an external PG/PC (e.g. PG740), the following prerequisites must be fulfilled:

- An MPI card exists (e.g. CP5611)
- The MPI drivers are installed
- Current interface parameterization: **CP5611(MPI)**
- Data transfer rate: **1.5 Mbps**
- The MPI interface of the PG/PC is linked with the MPI interface of the MPI board (X111) using an MPI cable.

SIMATIC Manager STEP7 on SINUMERIK 840Di

If the configuration is transferred from the SINUMERIK 840Di, the following requirements must be fulfilled:

- The MPI drivers are installed
- Current interface parameterization: **SINUMERIK MCI board (MPI)**
- Data transfer rate: **1.5 Mbps**

Parameterizing the MPI interface

Parameterization of the MPI interface is carried out with the **SIMATIC Manager STEP7** using menu command **Tools > Set PG/PC Interface.**

Dialog

Dialog: Setting the PG/PC Interface
Register: Access Path
Interface parameter set used:
with ext. PG/PC: **CP5611(MPI)**
or
with local PC: **SINUMERIK MCI board (MPI)**
Button: “Properties”

Dialog: Properties
Group: Network Parameters
Transmission rate: **1.5 Mbps**
OK

OK

Note

Parameterization of the MPI interface can be effected or changed from the **SIMATIC Manager STEP7** at any time.

Operating status: STOP

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.

To load the PLC program, it is therefore recommended to set the PLC to the STOP operating status.

To this aim, choose the module (in the example project: PLC315-2DP M/S 2AF03) from the SIMATIC manager. Using the menu command **Target System > Operating Status**, the dialog box **Operating Status** opens. Use the button **“STOP”** to bring the PLC to the required operating status.

Dialog

Dialog: Operating Status
Button: **“STOP”**
OK

Loading the PLC program

To load the entire PLC program, choose the folder **Blocks** of the corresponding module from the SIMATIC Manager using the left mouse button.

Use the menu command **Target System > Load** to load the PLC program into the corresponding module.

If the folder “Blocks” of the appropriate module contains system data blocks, you will be asked at the end of the loading process whether you want to load them, too.

– **No**: The loaded configuration remains stored.

– **Yes**: The new configuration is loaded.

Operating status: RUN

After the PLC program has been loaded, the PLC has to be brought to the RUN operating status again.

To this aim, choose the module (in the example project: PLC315-2DP M/S 2AF03) from the SIMATIC manager. Using the menu command **Target System > Operating Status**, the dialog box **Operating Status** opens. Use the button **“RUN”** to bring the PLC to the required operating status.

Dialog

Dialog: Operating Status
Button: **“RUN”**
OK

Triggering NC reset

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.

After the PLC program has been loaded successfully, for re-synchronization of NC and PLC, NC reset must be initiated, e.g. using 840Di start-up:

- 840Di start-up
  Dialog: **NC/PLC Diagnosis**
  Group **NC**
  Button: **"NC-Reset"**

8.3.2 Series machine start-up file

The creation and loading of a series machine start-up file within the framework of data backup can be carried out using

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

or

– **HMI Advanced** (option).

For detailed information on data backup, please refer to:

References: **SinuCom NC**
Online Help

HMI Advanced:
/IAM/ MMC/HMI Installation and Start-Up Guide

8.4 Testing the PLC program

8.4.1 Start-up behavior

The start-up behavior of a SIMATIC-CPU module can be set for the following start-up modes:

- Restart
- Cold restart (warm restart)
- Cold start.

The start-up mode of a module is set using the dialog **Properties,** Register **Start-up** of module.

Notice

The menu command **Edit > Object Properties** in the SIMATIC STEP7 Manager can only be used for reading access to the module properties.

To modify the properties, open the dialog in “HW Config” after you have selected the module using the menu command **Edit > Object Properties** or by double-clicking on the module.

SINUMERIK 840Di PLC

The start-up mode of the PLC with SINUMERIK 840Di is **fixed** to **COLD RESTART**. This setting cannot be modified.

Boot type: COLD RESTART

In the case of **COLD RESTART**, OB 100 is passed prior to the cyclic processing (OB 1). Then the cyclic operation starts with calling OB 1.

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 **Properties,** register **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.

8.4.2 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 (OB 40).

Sign-of-life monitoring

A cyclic, mutual sign-of-life monitoring function is activated between PLC and NCK once ramp-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”.

8.4.3 Monitor/control using the SIMATIC Manager STEP7

The SIMATIC Manager STEP7 provides an 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**".

"Monitor and control variable" can be used to:

- Display the current values of individual variables of the PLC user program or the CPU module: **Monitor variables.**
- Assign individual variables of the PLC user program or the CPU module fixed values: **Control variables.**
- Assign individual I/O outputs of the PLC user program or the CPU module fixed values in the STOP operating status: **Enable PO** and **activate control values**.
- Assign individual variables of the PLC user program or the CPU module fixed values which cannot be overwritten by the PLC user program: **Force variables.**

Variable types

You can specify or display values of the following variable types:

- Inputs, outputs, flags, timers and counters
- Contents of data blocks
- I/O.

Summarize the variables you want to display or control in **variable tables**.

When and how often variables are monitored or overwritten with values, is defined by **Triggering Point** and **Trigger Condition**.

Further test functions

The menu command **Target System > ...** provides the following further test functions:

- Display accessible nodes
- CPU messages ...
- Display force values
- Diagnose hardware
- Module status ...
- Operating status ...

8.4.4 Monitor/control using HMI Advanced

PLC status display

Use the soft keys **Operating Area Switchover > Diagnosis > PLC Status** to call the dialog box **PLC Status Display**.

The dialog **PLC Status Display** serves to monitor and control variables of:

- Inputs, outputs, flags, timers and counters
- Contents of data blocks

Input syntax:
– Operand
– Format

The following two tables show the input syntax of the fields: **Operand** and **Format** of the PLC status display.

Table 8-2 Input field: **Operand**

Syntax	Meaning
En.x	Input byte n, bit x
IBn	Input byte n
IBn	Input word n
IBn	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 8-3 Input field: **Format**

Syntax	Meaning
H	Hexadecimal
D	Decimal
B	Binary
F	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 soft key **Change** to switch over to the **Control** mode. Now you can use the field **Value** to specifynew values for the displayed variables.

The entered value must be within the definition range of the set format.

Controlling: End

As long as the **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.

■

Drive Start-Up (Preconditions) 9

Section “Drive start-up (requirements)” describes the **Requirements** 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 variations

The following distinction is made between start-up of the above SIMODRIVE drives:

- First start-up
- Series start-up.

First 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 machine 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 9-265).

Possible ways of proceeding

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

In order 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 9-271
- A **PROFIBUS connection** must exist from the PROFIBUS interface of the MCI board to all drives
  - For network rules, see Section 7.2, page 7-210
- With all drives, the **PROFIBUS address** must be set
  - For SIMODRIVE 611 universal/E see Subsection 9.1.3, page 9-265
  - For SIMODRIVE POSMO CD/CA and SI see Subsection 9.1.4, page 9-267
- The SINUMERIK 840Di **PLC** must be networked using MPI
  - For networking the PLC, see Subsection 7.3.2, page 7-212
- The **configuration** must be loaded into the PLC
  - For creating an S7 project, see Section 7.3, page 7-211
  - For loading the PLC, see Subsection 7.3.8, page 7-238
- The **MPI interface** must be set on the “SINUMERIK MCI Card (MPI)”
  - For setting the MPI interface, see Subsection 9.1.5, page 9-268
- The **routing information** must be set
  - For setting the routing Information, see Subsection 9.1.6, page 9-269.

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 7.3, page 7-211f) must be set on DP slave 611U or UE in question using the display and operator unit.

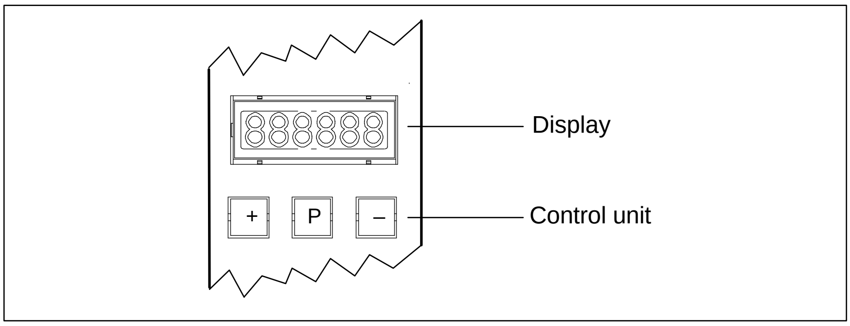


Fig. 9-1 Display and control unit

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 the “**P**” key longer than 3 seconds.

     => The current value of the parameter P0918 (PROFIBUS address) is displayed.

   – Use the keys “**+**” and “**–**” to set the desired PROFIBUS address.

   – Press the “**P**” again to quit the input mode.
2. Saving the PROFIBUS node address in the FEPROM
   – Press the “**+**” or “**–**” key

     => The parameter P0652 (acceptance into FEPROM) is displayed.

   – Press the “**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:

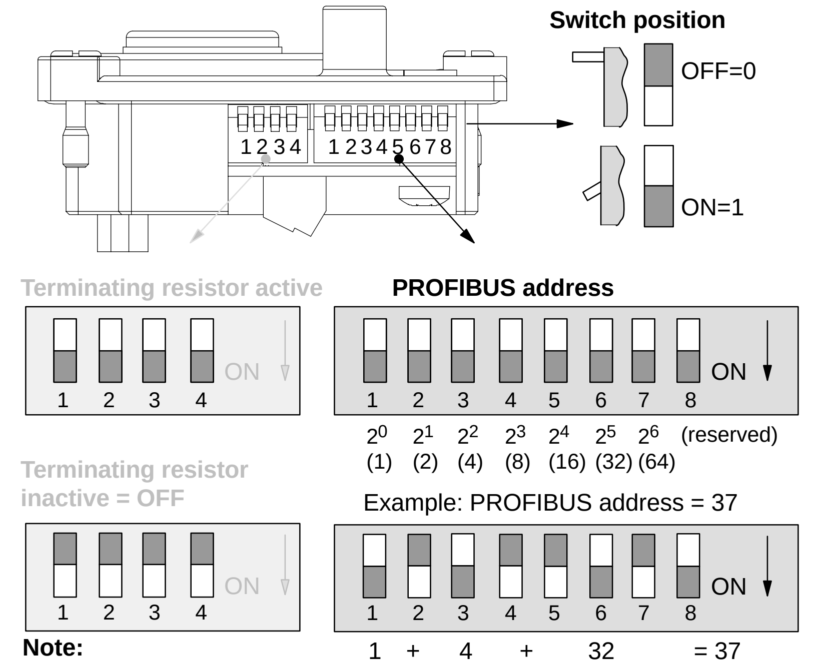
/FBU/ SIMODRIVE 611 universal, Description of Functions
Section: Parameterizing the board
Parameterization using the display and operator unit

and

Section: 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 7.3, page 7-211f) 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

---

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
Section: 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: Start

Dialog: Interface
Option field: “**Route through S7 CPU**” ◉
Button: “Set PG/PC Interface...”

PG/PC interface dialog: Start

Dialog: Setting the PG/PC Interface
Register: Access Path
Access point of application:
S7ONLINE STEP7 ––> SINUMERIK MCI board (MPI)
Interface parameter set used:
SINUMERIK MCI board (MPI).

If “SINUMERIK MCI board (MPI)” cannot be selected for the interface parameterization, the interface has to be installed first.

PG/PC interface dialog: End

Button: “Install...”

Dialog: Install / Remove Interface
Selection: **SINUMERIK MCI Board (MPI)**
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.For network rules, see Subsection 7.3.2, page 7-212.

SimoCom U dialog: End

Button: “**Reset routing information...**”
Radio button: Expert 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 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 screen form of the SimoCom U dialog 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 PROFIBUS S7 subnetwork ID

If you do not have the PROFIBUS S7 subnetwork ID, you can call it using the SIMATIC Manager STEP7

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 property dialog of DP master:

Dialog

Dialog: Properties – DP Master
Tab: General
Group: Interface
Type: PROFIBUS
Address: 2
Button: "Properties..."

Dialog: Properties – PROFIBUS Interface DP Master
Tab: Parameters
Subnetwork: **PROFIBUS**
Button: "Properties..."

Dialog: Properties PROFIBUS
Tab: 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 mentioned dialog for setting the MPI interface using the button: **"Go online"**

or

– use the 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:

- **<Installationspfad>\siemens\611UToolbox\SimoComU**

To instal SimoCom U on the PCU, start file **setup.exe** and follow the further installation instructions.

Note

Before installing SimoCom U, please observe the appropriate notes in the file: <installation path>\readme.txt.

Scope of available 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

In addition, for a detailed description on SimoCom U, please refer to:

/FBU/ SIMODRIVE 611 Universal, Description of Functions

■

Notes

NC Start-Up with HMI Advanced

10

10.1 General procedure

The NC is parameterized with respect to the connected machine is 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.

Identifier

The identifier of a machine data is subject to the scheme:

$ M k *_IdentifierString*

The letters/characters have the following meaning:

- **$** System variable
- **M** Machine 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

The activation with respect to a machine data specifies in which status of the NC a change of a machine data becomes active.

Activation categories are:

- Power ON
- Reconfiguration
- Reset
- Effective immediately.

Setting data

Setting data are system variables telling the NC the current machine properties.

Identifier

The identifier of a setting data is subject to the scheme:

$ S k *_IdentifierString*

The letters/characters have the following meaning:

- **$** 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

In contrast to machine data, changes of setting data always come **immediately** into effect.

Overview of machine data

The machine data are divided into the following areas:

Table 10-1 Overview of machine data

Area	Designation
from 1000 to 1799	Machine data for drives ($MD_....)
from 9000 to 9999	Machine data for operator panel ($MM_....)
from 10000 to 18999	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

Area	Designation
from 41000 to 41999	General setting data ($SN_....)
from 42000 to 42999	Channel-specific setting data ($SC_....)
from 43000 to 43999	Axis-specific setting data ($SA_....)

Data description

For a detailed description of the machine or setting data, please refer to the description of the function that uses the machine data in question, e.g.:

References: /FB/ Description of Functions – Basic Machine
/FB/ Description of Functions – Extended Functions
/FB/ Description of Functions – Special Functions

A brief 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).

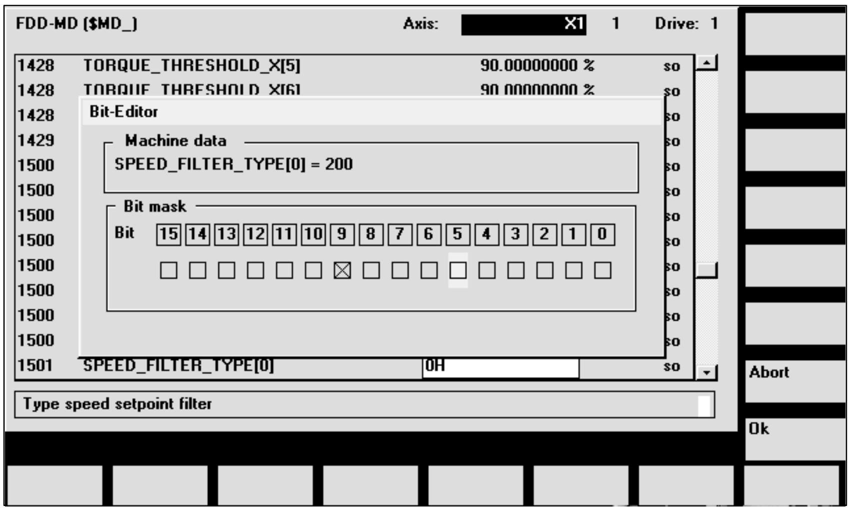


Fig. 10-1 Input screen form of the bit editor for HEX machine data

You can set or reset single bits by clicking them with the mouse or by selecting them with the cursor keys by 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

The access to programs, data and functions is protected user-oriented using eight hierarchical protection levels. These are divided into (see Table 10-3):

- Four password levels for SIEMENS, machine manufacturers and final users
- Four keyswitch positions for end users.

This provides a multi-stage safety concept to manage the access rights.

Table 10-3 Protection levels

Protection level	Type	User	Access to (examples)
0	Pass–word	SIEMENS	All functions, programs and data
1	Pass–word	Machine manufacturer: Development	Defined functions, programs and data; e.g.: Enter options
2	Pass–word	Machine manufacturer: System start-up engineer	Defined functions, programs and data; e.g.: Majority of machine data
3	Pass–word	Final user: Service	Assigned functions, programs and data;
4	Key–switch pos. 3	Final user: Programmer setter	Less than protection levels 0 to 3; defined either by machine manufacturer or end user
5	Key–switch pos. 2	Final user: Qualified operator who will not program	Less than protection levels 0 to 3; defined by the end user Descending access rights
6	Key–switch pos. 1	Final user: Trained operator who will not program	Example: Only program selection, input of tool wear and zero offsets
7	Key–switch pos. 0	Final user: Semiskilled operator	Example: No inputs, no program selection only possible if the machine control panel can be operated

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 rights are thus not automatically deleted by power ON!

Possible characters

Up to eight characters are possible for a password. When choosing the password, it is recommended to limit yourself to the character set of the operator panel. If the character has less than 8 characters, the remaining characters are interpreted as a blank.

Default passwords

The following default passwords are defined for the protection levels 1 though 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.

In order to provide safe access protection, the default passwords should be modified.

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	Identifier	Name	Ref.
MMC machine data ($MM_....)			
9200	USER_CLASS_READ_TOA	Protection level “Read tool offsets”	
9201	USER_CLASS_WRITE_TOA_GEO	Protection level “Write tool geometry”	
9202	USER_CLASS_WRITE_TOA_WEAR	Protection level “Write tool wear data”	
9203	USER_CLASS_WRITE_FINE	Protection level “Write fine”	
9204	USER_CLASS_WRITE_TOA_SC	Protection level “Change additive tool offsets”	
9205	USER_CLASS_WRITE_TOA_EC	Protection level “Change tool setup offsets”	
9206	USER_CLASS_WRITE_TOA_SUPVIS	Protection level “Change tool monitoring limit values”	
9207	USER_CLASS_WRITE_TOA_ASSDNO	Change assigned D-No. of a tool edge	
9208	USER_CLASS_WRITE_MAG_WGROUP	Change wear group magazine location/mag.	
9209	USER_CLASS_WRITE_TOA_ADAPT	Protection level “Tool adapter data”	
9210	USER_CLASS_WRITE_ZOA	Protection level “Write settable zero offset”	
9213	USER_CLASS_OVERSTORE_HIGH	Protection level “Extended overstore”	
9214	USER_CLASS_WRITE_PRG_CONDIT	Protection level “Program control”	
9215	USER_CLASS_WRITE_SEA	Protection level “Write setting data”	
9218	USER_CLASS_SELECT_PROGRAM	Protection level “Program selection”	
9219	USER_CLASS_TEACH_IN	Protection level “TEACH IN”	
9220	USER_CLASS_PRESET	Protection level “PRESET”	
9221	USER_CLASS_CLEAR_RPA	Protection level “Delete R parameters”	
9222	USER_CLASS_WRITE_RPA	Protection level “Write R parameters”	
9231	USER_CLASS_WRITE_RPA_1	Protection level for the 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	Protection level for the second RPA area	

Number	Identifier	Name	Ref.
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	Protection level for the 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 name and duplo	
9241	USER_CLASS_WRITE_TOA_TYPE	Change tool type	
9247	USER_CLASS_BASE_ZERO_OFF_PA	IAM, IM1 availability of the basic offset in the Parameter operating area	
9248	USER_CLASS_BASE_ZERO_OFF_MA	IAM, IM1 availability of the basic offset in the Machine operating area	

References: /FB/ Description of Functions – Basic Machine:
A2, Various Interface Signals
Section: MMC machine data for protection levels

Single data

The protection level of individual machine and/or setting data can be modified in the file SGUD.DEF.

Example:

The axial machine data item CTRLOUT_SEGMENT_NR requires protection level 3 for reading and protection level 2 for writing.

Syntax:
REDEF $*machine data string* APR *n* APW *m*
APR n: Defining the protection level for reading (Read) the data
APW m: Defining the protection level for writing (Write) the data

File SGUD.DEF:

```
%_N_UGUD_DEF
  ;$PATH=/_N_DEF_DIR
  REDEF $MA_CTRLOUT_SEGMENT_NR  APR 3  APW 2
M30
```

References: /PGA/ Programming Guide Advanced
Section: File and Program Management
Defining protection levels for user data (GUD)

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

- Channel-specific machine data
- Axis-specific machine data
- Drive machine data.

Display filter

To parameterize the display filter of a machine data area, use the vertical 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 to.

References: /LIS/ Lists

Display groups

A display group contains machine data within a machine data area which 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 which 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 resolutions of linear and angle positions, velocities, accelerations and jerk differ by:

- 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).

MD 9011: DISPLAY_RESOLUTION_INCH (INCH unit system display resolution) can be used to configure the display resolution for position values with inch setting. With inch setting, it is thus possible to display up to six digits after the comma.

For programming in parts programs, the input resolutions indicated in the Programming guide.

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

- Check MD 10200: INT_INCR_PER_MM (computational resolution for linear positions)
- Check MD 10210: INT_INCR_PER_DEG (computational resolution for angle positions).

The default assignment is:

- 1,000 increments/mm
- 1,000 increments/degree.

The computational resolution thus also determines the maximum achievable accuracy for positions and selected offsets. However, it is essential that the measuring system is adapted to this degree of accuracy.

Tip

Although the computational resolution is generally independent of the input/display resolution, it should have at least the same resolution.

Rounding

The accuracy 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:	1,000 increments/mm
Programmed path:	97.3786mm
Effective value =	97.379mm

Tip

To keep the executed rounding more traceable, it is reasonable to use powers to the 10th 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.

Limit values for input and display

The limitation of the input limits depends on the display and input possibilities on the operator panel.
This limit is reached at 10 digit positions plus decimal point plus sign.

Examples of programming in the $^{1}/_{10}\mu$m-range:

Supposed all linear axes of a machine will be programmed and traversed within the range of values 0.1 ... 1,000µm.

To position exactly to 0.1µm, the computational resolution must be set to

$\geq 10^4$ incr. /mm.
Check MD 10200: INT_INCR_PER_MM = 10,000 [incr. /mm]:

Example of related parts program:

N20 G0 X 1.0000 Y 1.0000 ;	Axes move to position X=1.0000mm, Y=1.0000mm;
N25 G0 X 5.0002 Y 2.0003 ;	Axes move to position X=5.0002mm, Y=2.0003mm

Machine data

Table 10-5 Resolutions: Machine data

Number	Identifier	Name/remarks	Ref.
General ($MN_ ...)			
9004	DISPLAY_RESOLUTION	Display resolution	G2
9011	DISPLAY_RESOLUTION_INCH	Display resolution for INCH unit system	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, calculation resolution

10.3.2 Normalization of phys. quantities of Machine and Setting data

Default

Machine and setting data having a physical unit are interpreted in the input/output units listed in Table 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 quantity	Input/output units for the default scaling system		Internally used Unit
	Metric	**Inch**	
Linear position	1 mm	1 inch	1 mm
Angular position	1 degree	1 degree	1 degree
Linear velocity	1 mm/min	1 inch/min	1 mm/sec
Angular velocity	1 rpm	1 rpm	1 degree/sec
Linear acceleration	1 m/sec^2	1 $inch/sec^2$	1 mm/sec^2
Angular acceleration	1 $rev./sec^2$	1 $rev./sec^2$	1 $degree/sec^2$
Linear jerk	1 m/sec^3	1 $inch/sec^3$	1 mm/sec^3
Angular jerk	1 $rev./sec^3$	1 $rev./sec^3$	1 $degree/sec^3$
Time	1 sec	1 sec	1 sec
Position controller loop gain	1 sec^{-1}	1 sec^{-1}	1 sec^{-1}
Rotational feedrate	1 mm/rev.	1 inch/rev.	1 mm/degree
Compensation value of linear position	1 mm	1 inch	1 mm
Compensation value of angle position	1 degree	1 degree	1 degree

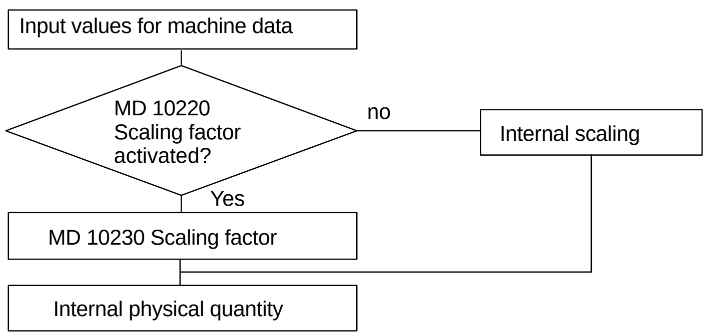
User-defined

The user can define different input/output units for machine and setting data.

To this aim, an adaptation between newly selected input/output units and the internal units must be made in

- MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors) and
- MD 10230: SCALING_FACTORS_USER_DEF[n] (scaling factors of physical quantities)

.



The following applies:

$$\text{Selected input/output unit} = $$
$$\text{MD : SCALING\_FACTORS\_USER\_DEF}[n] * \text{internal unit}$$

Enter the selected input/output unit expressed in the internal units 1mm, 1 degree and 1 sec in MD 10230: SCALING_FACTORS_USER_DEF[n].

Table 10-7 Bit number and index for user definition

Physical quantity	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
Timer	8	8
KV factor	9	9
Rotational feedrate	10	10
Compensation value of linear position	11	11
Compensation value of angle position	12	12

Example 1:
The machine data input/output of linear velocities is to be carried out in m/min, instead of mm/min (default). The internal unit is mm/sec.

Via 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:

$$\text{MD : SCALING\_FACTORS\_USER\_DEF}[n] = \frac{\text{Selected input/output unit}}{\text{internal unit}}$$

$$\text{MD : SCALING\_FACTORS\_USER\_DEF[n]} = \frac{1\frac{\text{m}}{\text{min}}}{1\frac{\text{mm}}{\text{secs}}} = \frac{\frac{1000\text{mm}}{60\text{secs}}}{1\frac{\text{mm}}{\text{secs}}} = \frac{1000}{60} = 16,667;$$

$$\Rightarrow \text{MD : SCALING\_FACTORS\_USER\_DEF[2]} = 16,667$$

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/sec^2, instead of m/sec^2 (default).
(The internal unit is mm/sec^2.)

$$MD : SCALING\_USER\_DEF\_MASK \;=\; 'H14';\; (bit - No.\,4\ \textbf{and}\ bit - No.\,2\ \text{of example } 1 \text{ as hex value})$$

$$MD : SCALING\_FACTORS\_USER\_DEF[n] = \frac{1\frac{ft}{secs^2}}{1\frac{mm}{secs^2}} = \frac{12 * 25,4\frac{mm}{secs^2}}{1\frac{mm}{secs^2}} = 304,8;$$

$$\Rightarrow MD : SCALING\_FACTORS\_USER\_DEF[4] = 304,8$$

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	Identifier	Name/remarks	Ref.
General ($MN_ ...)			
10220	SCALING_USER_DEF_MASK	Activating the scaling factors	
10230	SCALING_FACTORS_USER_DEF[n]	Scaling factors of the physical units	
10240	SCALING_SYSTEM_IS_METRIC	Metric scaling system	
10250	SCALING_VALUE_INCH	Conversion factor for switchover to the inch system	
10260	CONVERT_SCALING_SYSTEM	Basic system switch active	
10270	POS_TAB_SCALING_SYSTEM	Unit system of position tables	T1
10290	CC_TDA_PARAM_UNIT	Physical units of tool data for CC	
10292	CC_TDA_PARAM_UNIT	Physical units of cutting 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.

- MD 30300: 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:

- MD 30300: IS_ROT_AX = 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.

- MD 30300: IS_ROT_AX = 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

Via the 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 14-451.

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 switch will only be accepted if:

- MD10260: CONVERT_SCALING_SYSTEM=1
- Bit 0 of MD20110: RESET_MODE_MASK is set in each channel
- all channels are reset
- the axes are not traversed with JOG, DRF or the PLC
- constant grinding wheel peripheral speed (GWPS) is not active.

For the duration of the switching, actions, such as parts program start or mode change, are blocked.

If the switch cannot be carried out, this is indicated by an appropriate message on the operator interface. This definition ensures that the program currently executed always finds a consistent data record with reference to the unit system.

The switch to the unit system itself is internally carried out by writing of all machine data required and then activating them by RESET.

MD10240: SCALING_SYSTEM_IS_METRIC and the corresponding settings G70/G71/G700/G710 in MD20150: GCODE_RESET_VALUES are switched for all channels configured automatically.

During this process, the value specified in MD20150: GCODE_RESET_VALUES[12] changes between G700 and G710.

This process is carried out irrespective of the protection level currently set.

System data

When switching over the unit system, from the view of the user, all length-related specifications are converted to the new unit system automatically. These data include:

- Positions
- Feedrates
- Accelerations
- Jerk
- Tool offsets
- Programmable, settable and external zero offsets, DRF offsets
- Compensation values
- Protection zones
- Machine data
- Jog and handwheel weightings.

After switching, all above mentioned data are available in the physical quantities as specified in Subsection 10.3.2 (page 10-283).

Data for which no unambiguous physical quantities are defined, such as:

- R parameters
- GUDs (**G**lobal **U**ser **D**ata)
- LUDs (**G**lobal **U**ser **D**ata)
- PUDs (**P**rogram global **U**ser **D**ata)
- Analog input/outputs
- Data exchange through the FC21

will not be subject to automatic conversion. It is the user's task to take into account the unit system currently active (MD 10240: SCALING_SYSTEM_IS_METRIC).

The unit system setting currently active can be read from the PLC interface using the signal "Inch unit system" DB10.DBX107.7. The unit system change counter can be read in DB10.DBB71.

Machine data

Table 10-9 Switching over the unit system: Machine data

Number	Identifier	Name/remarks	Ref.
General ($MN_ ...)			
10240	SCALING_SYSTEM_IS_METRIC	Metric scaling system	
10250	SCALING_VALUE_INCH	Conversion factor for switchover to the inch system	
10260	CONVERT_SCALING_SYSTEM	Basic system switch active	
Axis-specific ($MA_ ...)			
32711	CEC_SCALING_SYSTEM_METRIC	Unit system of sag compensation	G2

References

/FB/ **Description of Functions, Basic Machine**,
G2 Velocities, Setpoint/Actual Value Systems, Closed-Loop Control,
Section: 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 10-281).

With the default assignment of the machine data for the computational resolution

- 1,000 increments/mm
- 1,000 incr/degr.

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; degrees]	± 399,999.999 [Inch; degrees]
Rotary axes	± 999,999.999 [mm; degrees]	± 999,999.999 [inch; degrees]
Interpolation parameters I, J, K	± 999,999.999 [mm; degrees]	± 399,999.999 [Inch; degrees]

10.3.7 Positioning accuracy

Computational accuracy 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	Identifier	Name/remarks	Ref.
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 lines 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 STEP7 “HW Config”. See Section 7.3, page 7-211f.

System clock 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. This setting cannot be modified.

- MD10050: SYSCLOCK_CYCLE_TIME (system clock cycle).

Position controller cycle

The position controller cycle is set fixed to the ratio of 1:1 with regard to the system clock cycle. This setting cannot be modified.

Position controller cycle offset

The position controller cycle offset (T_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: $T_M + T_{Pos} < T_{DP}$

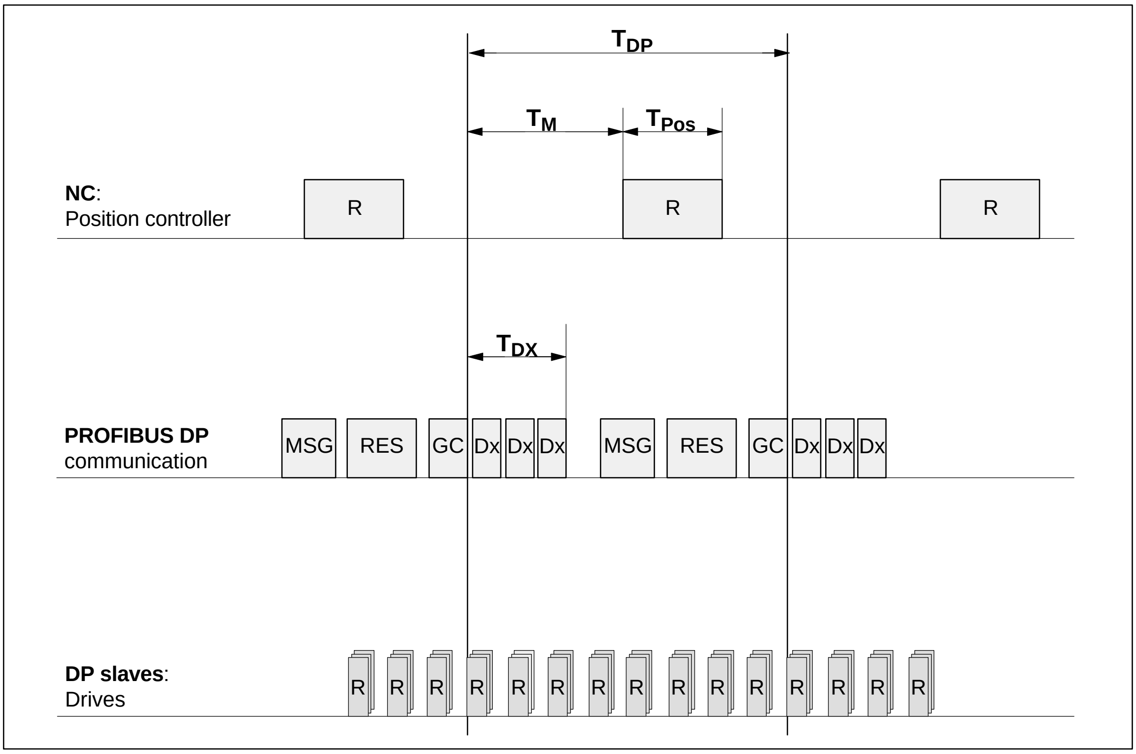


Fig. 10-2 Position controller cycle offset to the PROFIBUS DP cycle

Explanations regarding Fig.10-2:

T_{Pos}	Computational time required by the position controller
T_{DP}	DP cycle time: DP cycle time
T_{DX}	Data exchange time: Total of transfer times of all DP slaves
T_M	Master time: Shift of starting time of the NC position control
GC	Global Control: Broadcast message frame for cyclic synchronization of the isosynchronism between DP master and DP slaves
R	Computational time
Dx	User data exchange between DP master and DP slaves
MSG	Acyclic services (e.g. DP/V1, token transfer)
RES	Reserve: “active break” until the equidistant cycle has elapsed

- MD10062 POSCTRL_CYCLE_DELAY (position control cycle offset)

The following setting is recommended as the orientation value for the position control cycle offset:

$T_M = T_{DP} – 3*T_{pos\ max}$

- T_{DP}
  The DP cycle time is equivalent to position controller cycle of the SINUMERIK 840Di
- $T_{pos\ max}$
  Display using HMI Advanced (Option):
  Operating area switchover > Diagnosis > Service displays > System resources

Error response

- Alarm: “380005 PROFIBUS DP: Bus access conflict, type t, counter z”

Error causes/remedy

- t = 1
  The position controller cycle offset has been chosen too small. The cyclic PROFIBUS DP communication with the drives was not yet completed with the start of the position controller.

  Remedy: Increasing the position controller cycle offset.

- t = 2
  The position controller cycle offset has been chosen 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: Reducing the position controller cycle offset

  or

  – Remedy: increasing the DP cycle time.
  The DP cycle time is set using STEP7 “HW Config”. See Section 7.3, page 7-211f.

Interpolation cycle

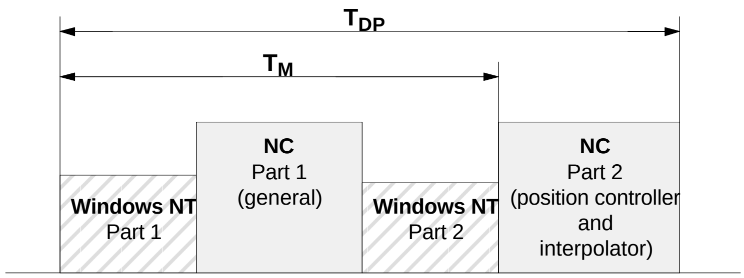
The interpolation cycle can be freely selected in integer multiples of the position controller cycle.

- 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 NT. 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 computation time, it will cede it dynamically to Windows NT.



T_{DP} DP cycle time: DP cycle time

T_M Master time: Shift of starting time of the NC position control

Fig. 10-3 CPU time sharing between Windows NT and NC

Default value

In NC machine data

- MD10185: NCK_PCOS_TIME_RATIO (NCK computation time portion)

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 + $T_{IPO\ max}$ + 0.2msecs) / MD10071

with:

– $T_{pos\ max}$ [ms] and $T_{IPO\ max}$ [ms]: maximum netruntimes of the position controller or interpolator.
  Display on HMI Advanced (optional):
  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 $T_{IPO\ max}$ are considerably influenced by applications active under Windows NT due to cache effects of the PCU processor. To calculate these value, it is therefore necessary to activate Windows NT 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 NT 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”

Error causes/remedy

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).

Remedy:
Calculate the maximum values for $T_{pos\ max}$ and $T_{IPO\ max}$ (see above) and adjust the following machine data:

- MD10185: NCK_PCOS_TIME_RATIO (NCK computation time portion)
- MD10070: IPO_SYSCLOCK_TIME_RATIO (factor for interpolation cycle)
- MD10050: SYSCLOCK_CYCLE_TIME (system clock cycle).

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 7.3.7, page 7-231f.

References /FB/ **Description of Functions, Special Functions**
G3 Cycle Times

Machine data

Table 10-12 Cycle times: Machine data

Number	Identifier	Name/remarks	Ref.
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 have changed the time cycles, check that the operating response of the control is correct in all operating modes before ending the start-up process.

Note

The smaller the cycle times (PROFIBUS DP cycle) are selected, the higher is the control quality of the drive and the surface finish of 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. tool 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:

$$V_{max} = \frac{\textit{progr. path length in parts program [mm or degrees]}}{\textit{IPO cycle [secs]}}$$

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:

$$V_{max} \leq \frac{\text{progr. path length in parts program [mm or degrees]}}{\text{IPO cycle [secs]}} * 0,9$$

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
Section: Compressor COMPON/COMPCURVE

Lower limit

The minimum tool path or axis velocity at which traversing is possible results from:

$$V_{min} \geq \frac{10^{-3}}{\text{Computational resolution}[\frac{\text{Incr.}}{\text{mm or degrees}}] * \text{IPO cycle [secs]}}$$

(for the computational resolution, see: Subsection 10.3.1, page 10-281)

If V_{min} is not reached, no traversing movement is carried out.

References

/FB/ Description of Functions, Basic Machine
G2 Velocities, Traversing Ranges, Accuracies,
Section: Velocities

10.4 Memory configuration

Hardware configuration

The dynamic (DRAM) or static (SRAM) memory available in each case depends on the hardware configuration of the components used (PCU and MCI board) and the memory available for SINUMERIK 840Di.

	DRAM max.	DRAM for 840Di 1)	SRAM physical	SRAM virtual 2)
PCU 50	256MB	Approx. 16MB	–	3MB
MCI board	–	–	1MB	–

1) DRAM component (main memory) occupied by SINUMERIK 840Di and thus no longer available for Windows NT.

2) Virtual SRAM resides in main memory (DRAM) during operation of the SINUMERIK 840Di and retentive on the hard disk of the PCU.

User data

The memory areas of the user data are preset to expedient values during general reset of the NC. The size of the individual areas can be set for optimized utilization of the user memory, e.g. for:

- Parts programs
- Tool management
- Tool offset
- User variables
- R parameters
- Compensation
- Protection zones
- Frames.

(see Subsection 10.4.2, Page 10-298):

Memory allocation must take place before actual commissioning of the NC, since all user data are lost when changes to the memory allocation are made (e.g. parts programs, tool offsets)!

Machine data, setting data and option data are retained after a memory reorganization.

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	Identifier	Name/remarks	Ref.
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 an address extension	/FBW/, W1
27900	REORG_LOG_LIMIT	Percentage of IPO buffer for enabling the log file	
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	Identifier	Name/remarks	Ref.
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.

Reconfiguration of the SRAM

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 non–volatile memory (loss of data!)”

Notice

When reconfiguring the SRAM memory, all user data are lost. To prevent data loss, a series machine start-up file should be created prior to reconfiguration (see Section 14.2, Page 14-451).

Machine data

Table 10-14 Machine data required to configure the SRAM

Number	Identifier	Name/remarks	Ref.
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/
18090	MM_NUM_CC_MAGAZINE_PARAM	Compile cycles of tool management: Number of magazine data	/FBW/

General ($MN_ ...)			
18092	MM_NUM_CC_MAGLOC_PARAM	Compile cycles of tool management: Number of magazine location data	/FBW/
18094	MM_NUM_CC_TDA_PARAM	Compile cycles of tool management: Number of TDA data	/FBW/
18096	MM_NUM_CC_TOA_PARAM	Compile cycles of tool management: Number of TOA data	/FBW/
18098	MM_NUM_CC_MON_PARAM	Compile cycles of tool management: Number of monitor data	/FBW/
18100	MM_NUM_CUTTING_EDGES_IN_TOA	Number of tool offsets in NCK	
18118	MM_NUM_GUD_MODULES	Number of GUD modules	
18120	MM_NUM_GUD_NAMES_NCK	Number of global user variables	
18130	MM_NUM_GUD_NAMES_CHAN	Number of channel-specific user variables	
18140	MM_NUM_GUD_NAMES_AXIS	Number of axis-specific user variables	
18150	MM_GUD_VALUES_MEM	Memory reserved for global user variables	
18160	MM_NUM_USER_MACROS	Number of macros	
18190	MM_NUM_PROTECT_AREA_NCK	Number of protection zones in NCK	/FB/, A3
18230	MM_USER_MEM_BUFFERED	User memory in SRAM	
18270	MM_NUM_SUBDIR_PER_DIR	Number of subdirectories	
18280	MM_NUM_FILES_PER_DIR	Number of files per directory	
18290	MM_FILE_HASH_TABLE_SIZE	Hash table size for files in a directory	
18300	MM_DIR_HASH_TABLE_SIZE	Hash table size for subdirectories	
18310	MM_NUM_DIR_IN_FILESYSTEM	Number of directories in passive file system	
18320	MM_NUM_FILES_IN_FILESYSTEM	Number of files in passive file system	
18330	MM_CHAR_LENGTH_OF_BLOCK	Max. length of an NC block	
18350	MM_USER_FILE_MEM_MINIMUM	Minimum parts program memory	
28050	MM_NUM_R_PARAM	Number of channel-specific R parameters	
28080	MM_NUM_USER_FRAMES	Number of settable frames	
28085	MM_LINK_TOA_UNIT	Allocation of a TO unit to a channel	/FBW/, W1
28200	MM_NUM_PROTECT_AREA_CHAN	Number of modules for channel-specific protection zones	/FB/, A3
Axis-specific ($MA_ ...)			
38000	MM_ENC_COMP_MAX_POINTS	Number of intermediate points with interpolatory compensation	/FB/, K3

10.4.3 Virtual SRAM (SW 2.3 and higher)

Virtual SRAM

If more user memory is required than is available via the SRAM of the MCI board, the function “Virtual SRAM” can be used with SW 2.3 and higher.

The “Virtual SRAM” function is activated via HMI Advanced (option) (see Subsection 10.10.2, Page 10-399).

Mode of functioning

During operation of the NCK, the memory area of the virtual SRAM is physically located in the main memory (DRAM) of the PCU. When Windows NT is shut down correctly, this memory area is written to the hard disk of the PCU as retentive memory.

During start–up of the NCK, the “SRAM” data are loaded from the hard disk of the PCU to the main memory (DRAM) of the PCU and made available to the NCK again as virtual SRAM. The status of the “SRAM” corresponds to the status at the time of last proper shutdown.

Notice

On loss of voltage or on deactivation of the PCU without proper shutdown of Windows NT beforehand, all user data stored in the virtual SRAM will be lost. A UPS system (see Subsection 1.1.8, Page 1-29) is therefore absolutely necessary in conjunction with the virtual SRAM.

System security

The Windows NT system settings stated below can generally prevent loss of data in the event of a serious exception (Blue Screen) detected by Windows NT.

The necessary Windows NT system settings are check during start/up of the SINUMERIK 840Di. If setting are incorrect, a message box appears with the appropriate text.

The necessary Windows NT system settings have already been made for all new SINUMERIK 840Di systems delivered. The following systems are exceptions:

– PCU50 333MHz / 500MHz with more than 128MB main memory

– PCU50 566MHz / 1,2GHz with more than 256MB main memory

With these systems, the relevant Windows NT system settings must be made manually during the commissioning phase.

Windows NT system settings

The following Windows NT system settings are required:

1. **Startup / Shutdown**

   Windows NT start bar: **Start > Settings > Control Panel > System > Tab: Startup/Shutdown**

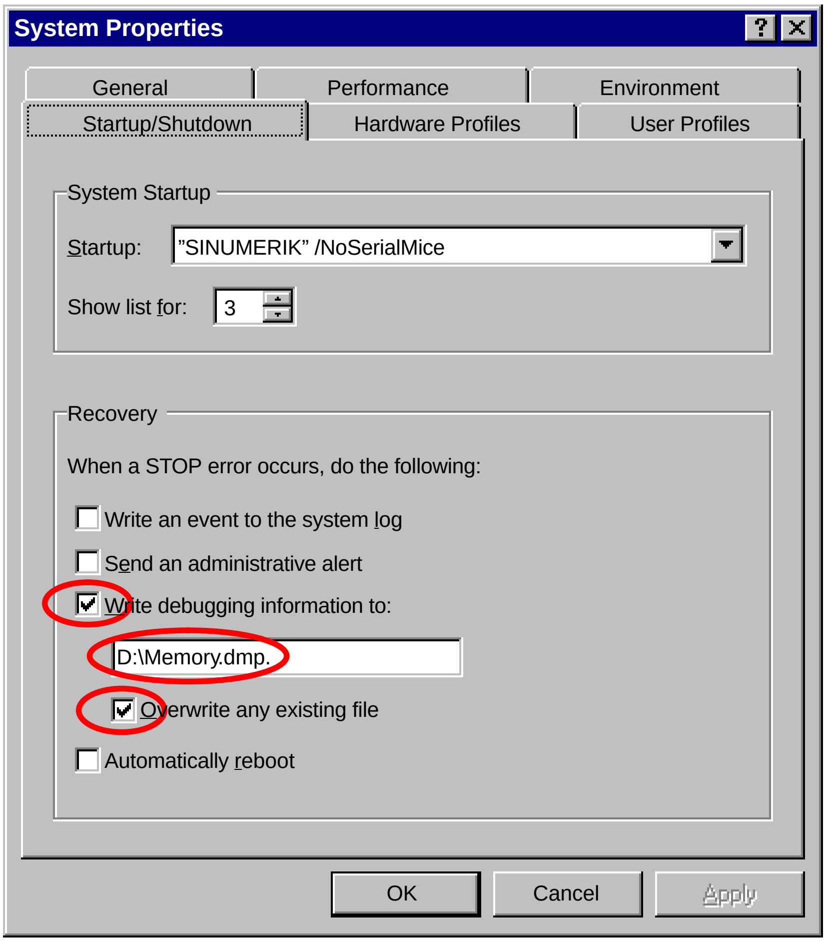


Fig. 10-4 Dialog: Windows NT system settings

The following settings must be made:

– Option: "Write debugging information to:" selected
– Drive and file specified.
  The file should preferably reside on drive D: to prevent it being stored in a ghost image, and the file name must be valid according to Windows NT file name conventions.
– Option: "Overwrite any existing file" selected

If settings are incorrect, the following message box appears:

2. **Virtual Memory**

Windows NT start bar: **Start > Settings > Control Panel > System > Performance > Virtual Memory**

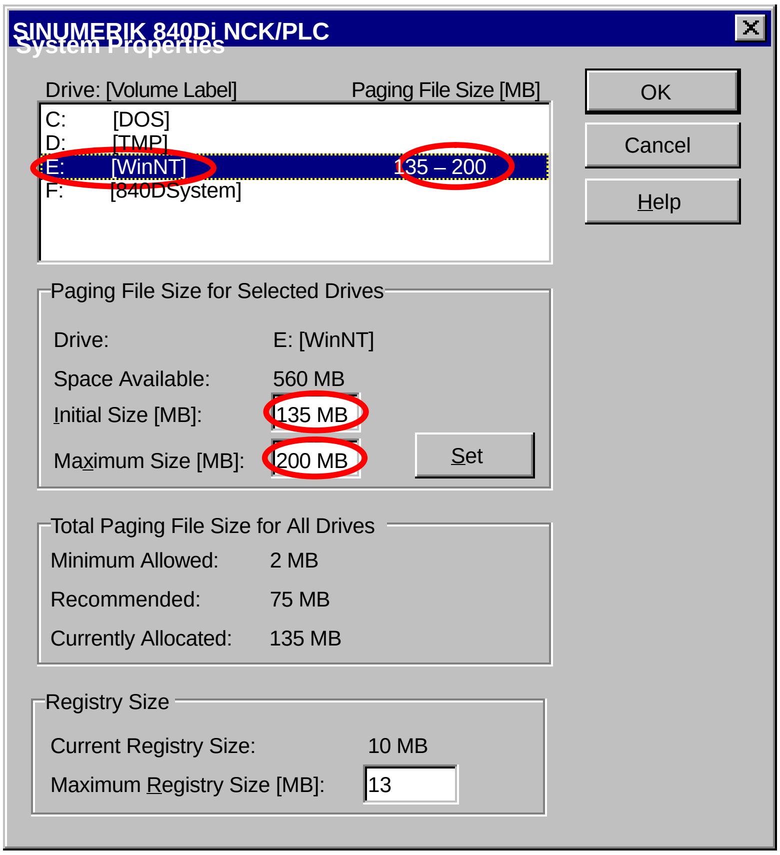
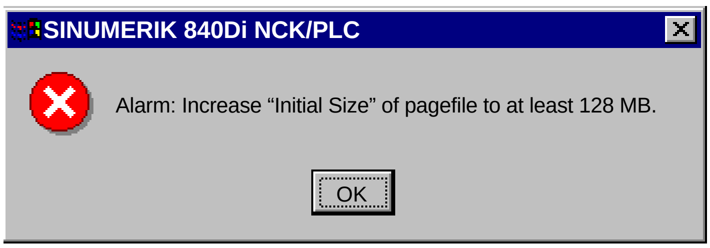


Fig. 10-5 Dialog: Windows NT system settings

The following setting must be made:

– The size of the Paging Files set ("Paging File Size [MB]") on the Windows NT drive (E: [WinNT])must correspond <u>at least</u> ("Initial Size [MB]") to the size of the main memory of the PCU.

If settings are incorrect, the following message box appears:



3. **Hard disk storage space**

   There must be sufficient free space on the hard disk of the PCU to save the file (D:\Memory.dmp) specified at 1.. If free space is insufficient, the following message box appears:

Note

To ensure that there is also sufficient storage space o n the hard disk of the PCU in the event of an error, the storage space required for the function "Virtual SRAM" is reserved immediately on selection of the function
(see Subsection 10.10.2, Page 10-399).

Notice

After acknowledging the relevant message box, start–up of the SINUMERIK 840Di is continued. Following start–up, the control operates normally, even if the settings that caused the alarm are not corrected.

The user data will then be lost however if a subsequent serious exception Windows NT (Blue Screen) then occurs. In the start–up of the SINUMERIK 840Di that follows, the last valid version on the user data are loaded to the virtual SRAM and the follwoing alarm issued (also refer to **Loss of data**, Page 10-304):

- Alarm: "4065 non–volatile memory restored from hard disk (data loss possible)"

Serious exception (Blue Screen)

If a serious exception (Blue Screen) occurs, an appropriate message box appears. SINUIMERIK 840Di NCK and PLC continue to operate normally. To prevent loss of user data, Windows NT must be terminated by one of the following means:

- Interface signal: "PC shutdown" (see Subsection 16.1.1, Page 16-499)
- UPS signal: "Shutdown" (see Subsection 10.10.2, Page 10-399ff)

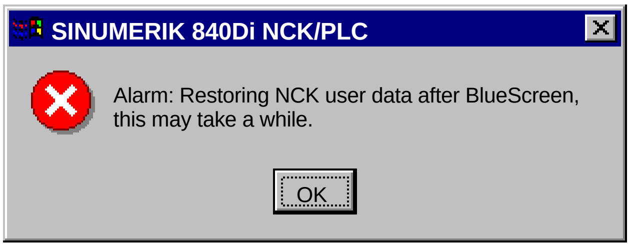
The SINUMERIK 840Di must not be deactivated until the all the required data have been saved on the hard disk of the PCU.

The following sequence of operations must be observed:

1. After the occurence of a serious exception (Blue Screen), the user has unlimited time to switch off the SINUMERIK 840Di
   (the serious exception and further processing of the SINUMERIK 840Di NCK and PLC are displayed to the user via a message on screen).

2. At the time when the user switches off the system, the UPS takes charge of the supply voltage for the SINUMERIK 840Di. Correct termination of Windows NT must now be requested via one of the shutdown signals described above.
3. After request for correct shutdown of Windows NT by the shutdown signal, the standard Windows NT Blue Screen appears with a message to indicate that the memory dump has been started:
   – Beginning dump of physical memory
   – Dumping physical memory to disk:
4. On completion of the memory dump, Windows NT issues the following message:
   – Physical memory dump complete
   – Contact your system administrator or technical support group
5. The UPS can now switch off the power to the SINUMERK 840Di.

The next start–up of the SINUMERIK 840Di takes considerably longer due to the necessary restoring activities. The following message box appears to inform the user:



Notice

The control must not be switched off / terminated until start–up of the SINUMERIK 840Di is complete. Otherwise, all user data will be lost (requiring re/commissioning of the SINUMERIK 840Di–NCK and PLC).

Data loss

If the memory area of the virtual SRAM could not be written to the hard disk of the PCU, e.g. because the control was switched off without correctly terminating Windows NT, the current user data are lost.

During the next start–up of the SINUMERIK 840Di that follows, the last valid version on the user data are loaded to the virtual SRAM. 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.

The following alarm is displayed:

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

For safety reasons, the alarm must be acknowledged explicitly by the operator before performing the necessary NCK POWER ON reset.
See Subsection 10.10.1, Page 10-395ff.

10.4.4 DRAM file system (SW 2.2 and higher)

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 NT 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, Siemens, machine manufacturer and user cycles can be swapped to the DRAM file system. This swapping has no effect on the use of the cycles.

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)

Saving cycles

Selection of the cycle areas to be saved to retentive background memory on a NCK power ON reset (reboot) or correct termination of Windows–NT is carried out per machine data:

- MD11291: DRAM_FILESYST_SAVE_MASK (select directory backup to DRAM)
  - Bit 0 = 1: Siemens cycles (CST)
  - Bit 1 = 1: Machine manufacturer cycles (CMA)
  - Bit 2 = 1: User cycles (CUS)

On account of the preset value of the machine data, all cycle areas are saved in the retentive background memory per default.

Loading cycles

On loading a series machine start-up file or one of the individual cycles to the NCK, the cycles are first written to the retentive background memory and then load to the DRAM file system when the function is selected.

Changing relocated 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:
Adaptation of 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 on the NC card”

  Remedy:
  Adaptation of 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 (selection of directories in the 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	Identifier	Name/remarks	Ref.
General ($MN_ ...)			
11290	DRAM_FILESYSTEM_MASK	Select directories in DRAM	
($MM_ ...)			
18332	FLASH_FILE_SYSTEM_SIZE	Size of the Flash File System (FFS)	
18351	DRAM_FILE_MEM_SIZE	Size of the 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 as a compound, e.g. machine axis, channel axis, etc. To provide an overview of the philosophy used as the basis, this term will be explained here in brief.

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 useable movement.

Geometry and special axes

The geometry and special axes serve to program traversing movements in parts programs.

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.

Additional axes

Additional axes are all other channel axes that are not geometry axes. Unlike for geometry axes (Cartesian coordinate system), for additionalaxes, no geometrical relation is defined, neither between special axes, nor with respect to the geometry axes.

The assignment of drives, machine axes, channel axes and geometry axes using the corresponding machine data is shown in the illustration below.

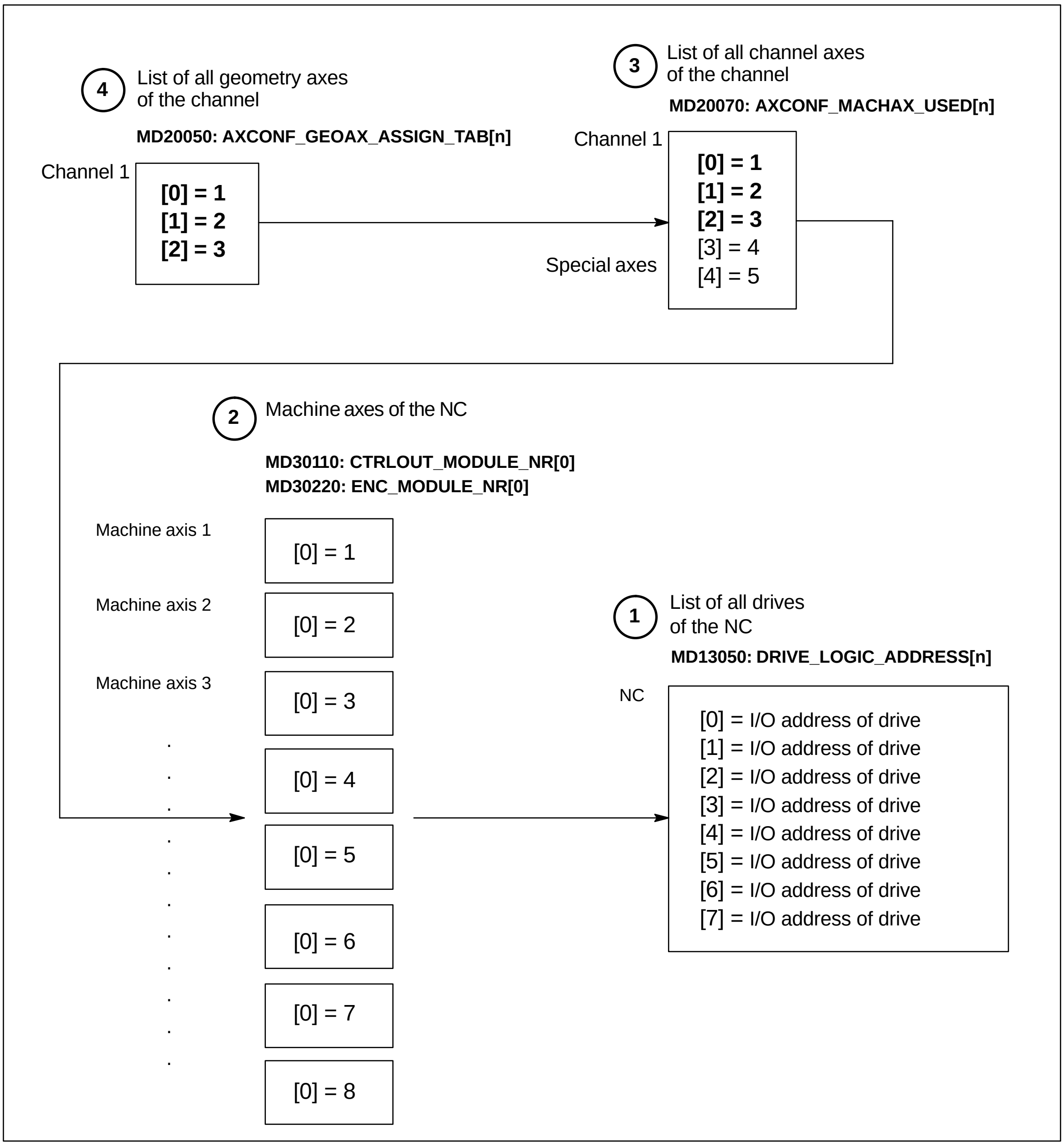


Fig. 10-6 Axis assignment

1

The 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) constitutes the logical drive number for the NC.

2

The machine data

- MD 30110: #MODULE_NR[0] (setpoint assignment)
- MD 30220: 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

The machine data

- MD 20070: 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

The machine data

- MD 20050: 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	Identifier	Name/remarks	Ref.
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 IWS, Section: 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

The 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

The machine data

- MD 20080: 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

The machine data

- MD 20060: 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-motion axes
- master value coupling axes.

Machine data

Table 10-17 Axis names: Machine data

Number	Identifier	Name/remarks	Ref.
General ($MN_ ...)			
10000	AXCONF_MACHAX_NAME_TAB[n]	Machine axis name	
Channel-specific ($MC_ ...)			
20060	AXCONF_GEOAX_NAME_TAB	Geometry axis in the channel	
20080	AXCONF_CHANAX_NAME_TAB	Name of channel axis/special axis in the channel	

References

/FB/ **Description of Functions, Basic Machine**,
K2 Axes, Coordinate Systems, Frames, Actual-Value System for Workpiece IWS,
Section: Axes

10.5.3 Drive configuration

I/O addresses

TIn order 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 7.3.7, page 7-231.

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 7.3, page 7-211.

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/ SIMODRIVE 611 universal, Description of Functions
- 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 7.3.6; page 7-220.

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

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!

Notice

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.

ADI4

With an ADI4 module you can operate up to 4 drives with analog setpoint interface on an isochronous PROFIBUS.

In addition to performing the above mentioned drive configuration, for these drives you also need to deactivate all the SIMODRIVE 611U-specific DP functions that are active by default. In the drive-specific machine data:

- MD13070: DRIVE_FUNCTION_MASK (DP functions being used)

you must enter the hexadecimal value **0F**$_H$ for each drive operated via ADI4.

Machine data

Table 10-18 Drive configuration: Machine data

Number	Identifier	Name/remarks	Ref.
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	

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).

- MD 30130: CTRLOUT_TYPE (setpoint output type) = 0
- MD 30240: 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.

The 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:

- MD 30110: CTRLOUT_MODULE_NR[0] (setpoint assignment: logic drive number)
- MD 30220: 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 10-313).

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 Interface Signals

Machine data

Table 10-19 Setpoint/actual-value channels: Machine data

Number	Identifier	Name/remarks	Ref.
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	Setpoint output type 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 encoder **1** 1 = motor measuring system 2 = direct measuring system	
30230	ENC_INPUT_NR[1]	Actual-value assignment: Position measuring system **2** 1 = motor measuring system 2 = direct measuring system	
30240	ENC_TYPE[0]	Actual-value acquisition modes 0 = simulation 1 = incremental encoder 4 = absolute encoder with EnDat interface	

Interface signals

Table 10-20 Switching over the position measuring system: Interface signals

DB Number	Bit, Byte	Name	Ref.
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
Section: Setpoint/actual-value system

/FB/ **Description of Functions, Basic Machine**
A2 Various Interface Signals
Section: Interface signals to axis/spindle

10.5.5 Parameterization of incremental measuring systems

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 rotary encoder on the motor

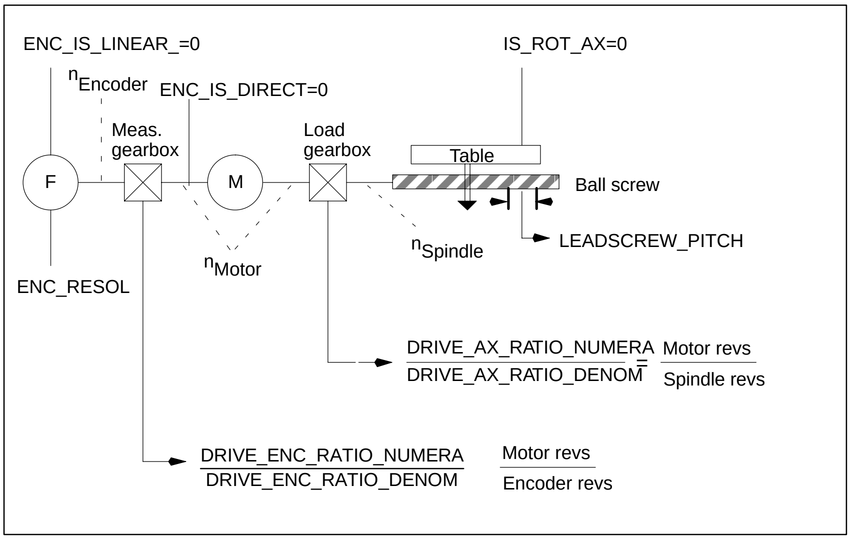


Fig. 10-7 Linear axis with motor-mounted rotary encoder

Linear axis with rotary encoder on the machine

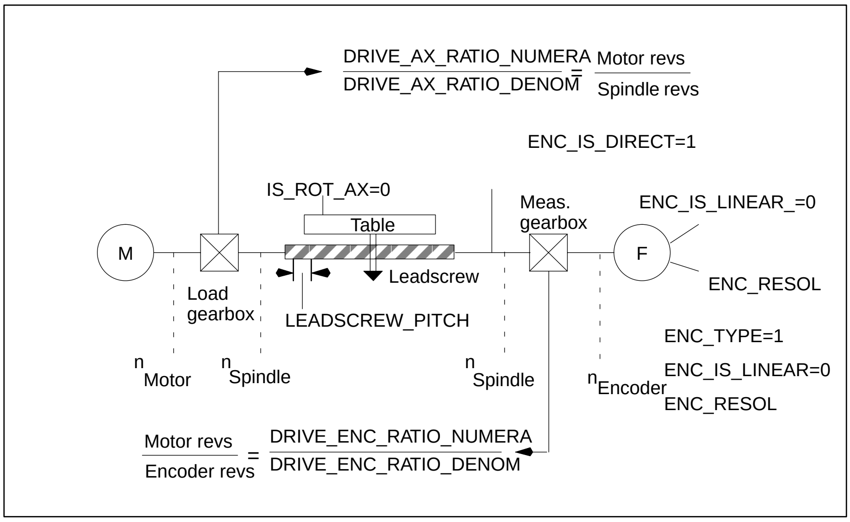


Fig. 10-8 Linear axis with machine-mounted rotary encoder

Rotary axis with motor-mounted rotary encoder

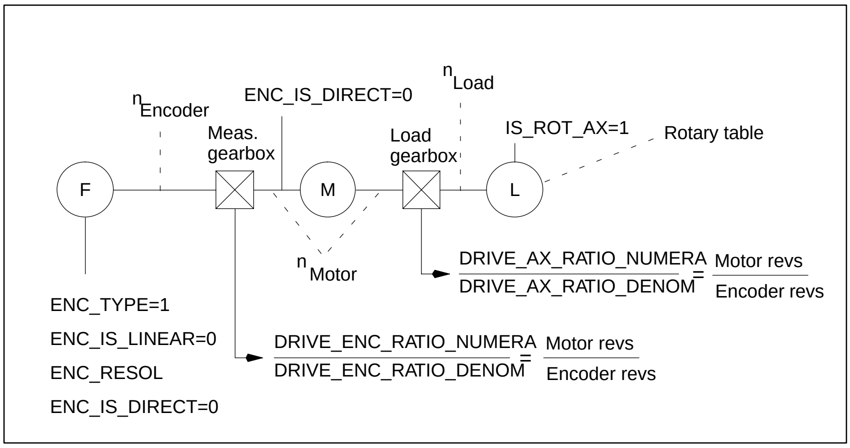


Fig. 10-9 Rotary axis with motor-mounted rotary encoder

Rotary axis with machine-mounted rotary encoder

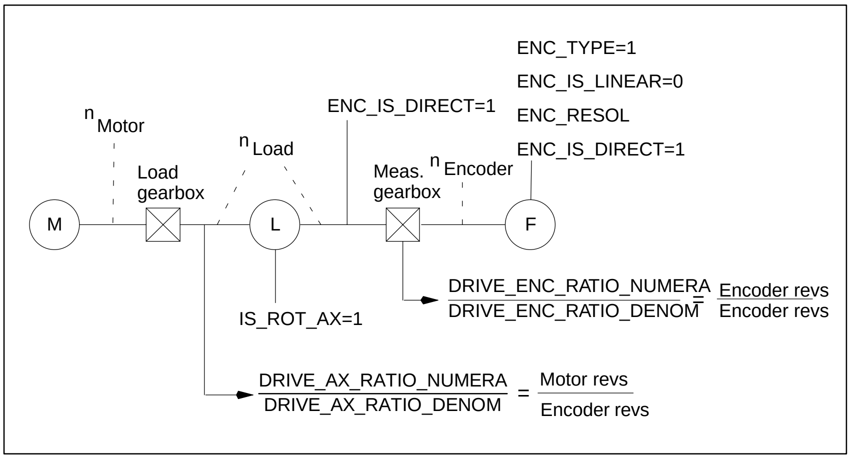


Fig. 10-10 Rotary axis with machine-mounted rotary encoder

Machine data

Table 10-21 Incremental measuring systems: Machine data

Number	Identifier	Name/remarks	Ref.
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 lines per revolution	
31030	LEADSCREW_PITCH	Leadscrew pitch	
31040	ENC_IS_DIRECT[n]	Encoder is directly mounted on the machine	
31050	DRIVE_AX_RATIO_DENOM[n]	Load gear denominator	
31060	DRIVE_AX_RATIO_NUMERA[n]	Load gear numerator	
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 appropriate machine data.

Linear axis with linear scale

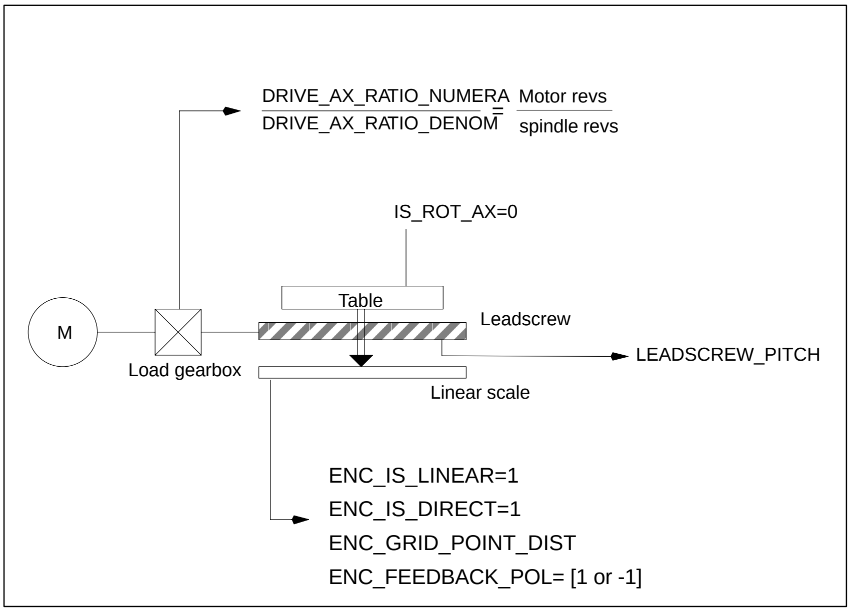


Fig. 10-11 Linear axis with linear scale

Machine data

Table 10-22 Linear measuring system: Machine data

Number	Identifier	Name/remarks	Ref.
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]	Pitch period for linear scales	
31030	LEADSCREW_PITCH	Leadscrew pitch	
31040	ENC_IS_DIRECT[n]	Encoder is directly mounted on the machine	
31050	DRIVE_AX_RATIO_DENOM[n]	Load gear denominator	
31060	DRIVE_AX_RATIO_NUMERA[n]	Load gear numerator	
32110	ENC_FEEDBACK_POL[n]	Sign of actual value (control direction)	

10.5.6 Parameterization of absolute measuring systems

Encoder types

SINUMERIK 840Di currently supports the following absolute encoders:

- EQN 1325

EQN 1325

Manufacturer of the absolute encoder EQN 1325 is Heidenhain. It is also possible to use compatible encoders of other manufacturers.

The absolute encoder EQN 1325 has the following properties:

- Voltage signals sin/cos 1Vpp
- EnDat interface
- 2,048 pulses/revolution
- 4,096 revolutions.

Measuring systems

An absolute encoder can currently exclusively be used as a motor encoder (indirect measuring system).

Linear axis with motor-mounted

rotary absolute encoder

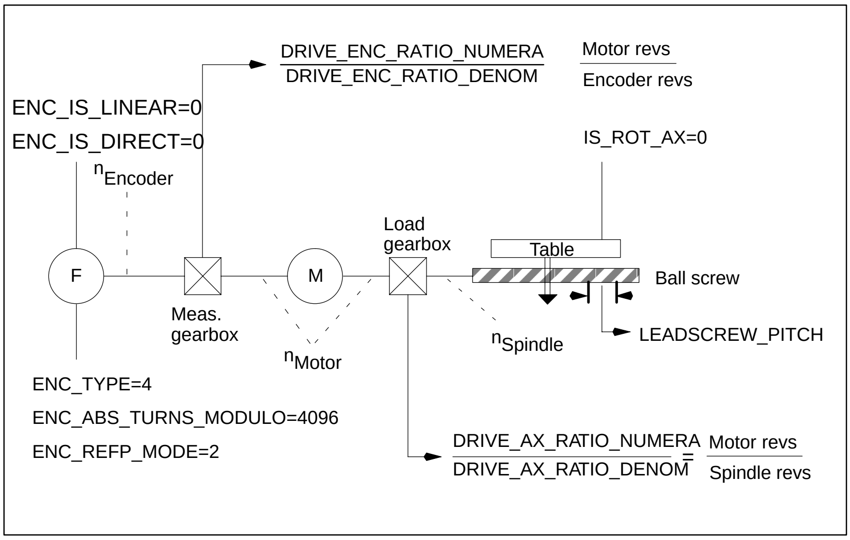


Fig. 10-12 Linear axis with motor-mounted rotary absolute encoder

Rotary axis with motor-mounted rotary absolute encoder

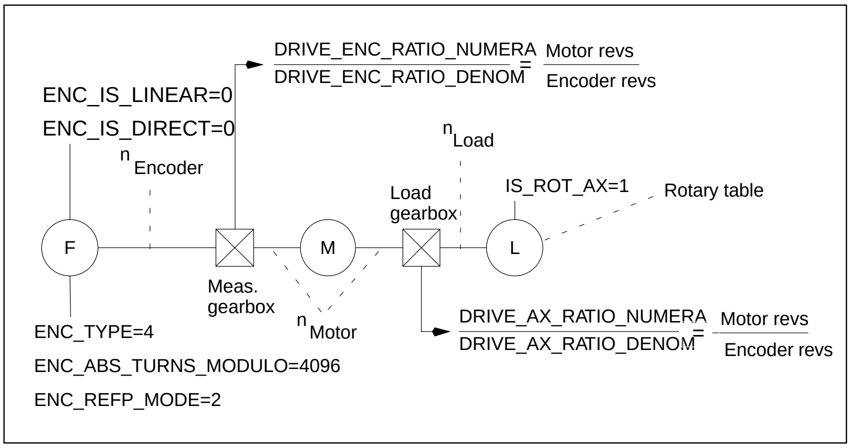


Fig. 10-13 Rotary axis with motor-mounted rotary absolute encoder

Machine data

Table 10-23 Incremental measuring systems: Machine data

Number	Identifier	Name/remarks	Ref.
Axis-specific ($MA_ ...)			
30240	ENC_TYPE[n]	Actual-value acquisition modes 4 = absolute encoder with EnDat interface	
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)	
31030	LEADSCREW_PITCH	Leadscrew pitch	
31040	ENC_IS_DIRECT[n]	Encoder is directly mounted on the machine 0=motor-mounted encoder	
31050	DRIVE_AX_RATIO_DENOM[n]	Load gear denominator	
31060	DRIVE_AX_RATIO_NUMERA[n]	Load gear numerator	
31070	DRIVE_ENC_RATIO_DENOM[n]	Resolver gearbox denominator	
31080	DRIVE_ENC_RATIO_NUMERA[n]	Resolver gearbox numerator	
34200	ENC_REFP_MODE[n]	Referencing mode 2=absolute encoder	
34210	ENC_REFP_STATE[n]	State of absolute encoder 0 = encoder not adjusted (default setting) 1 = encoder adjustment enabled; encoder not yet adjusted 2 = encoder adjusted	
34200	ENC_ABS_TURNS_MODULO[n]	Range of absolute encoder with rotary encoders	R2

10.5.7 Parameterization of a 2nd measuring systems with ADI4

A maximum of 2 measuring systems can be configured for one machine axis. If direct connection of the 2nd measuring system to the associated drive module is not possible, an ADI4 module can be used for this purpose.

Note

For detailed information on measuring systems that can be connected to the ADI4, please refer to:

References: /ADI4/ Analog Drive Interface for 4 Axes
Section: Hardware Description

Sample configuration

The sample configuration below illustrates the general procedure for configuring the NC for a 2nd measuring system of a machine axis connected via ADI4. The following assumptions are made:

- **NC**
  2 measuring systems should be parameterized for the 1st machine axis.
  - 1st measuring system: Motor measuring system of drive
  - 2nd measuring system: Direct measuring system
- **Drive**
  A SIMODRIVE 611U 1 axis module with connection option for a measuring system (motor sensor) is used as a drive.
- **ADI4**
  The 2nd measuring system is connected via the sensor interface of the 1st axis of an ADI4 module (generally, connection is possible to any axis of the ADI4 module)

Configuration

The associated configuration is shown in Fig. 10-14.

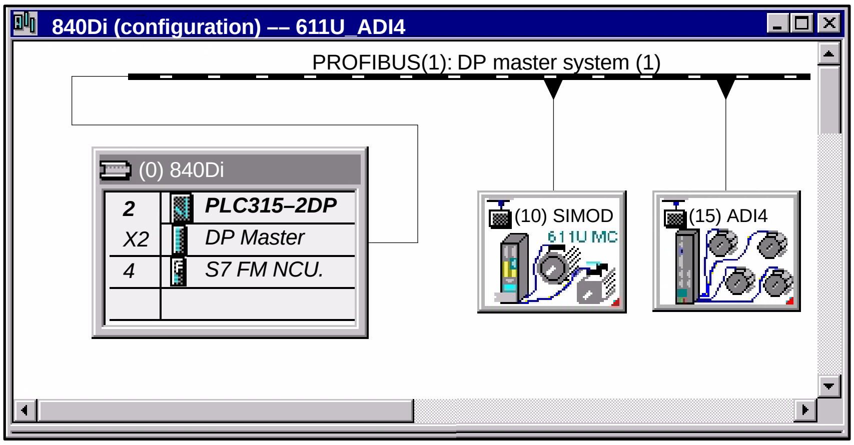


Fig. 10-14 Configuration Axis with 2nd measuring systems on ADI4

I/O addresses and message frame types

The I/O addresses and messages frame types for the drive and ADI4 axis are set to the following values during configuration:

Drive

– I/O address: 258
– Message frame type: Message frame 102

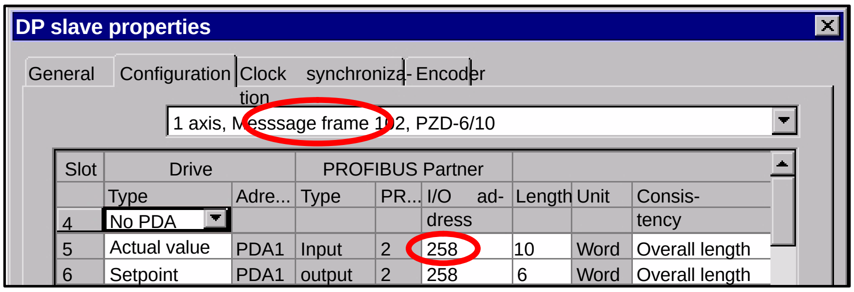


Fig. 10-15 DP slave properties: SIMODRIVE 611U

ADI4

– I/O address: 472
– Message frame type Standard message frame 3

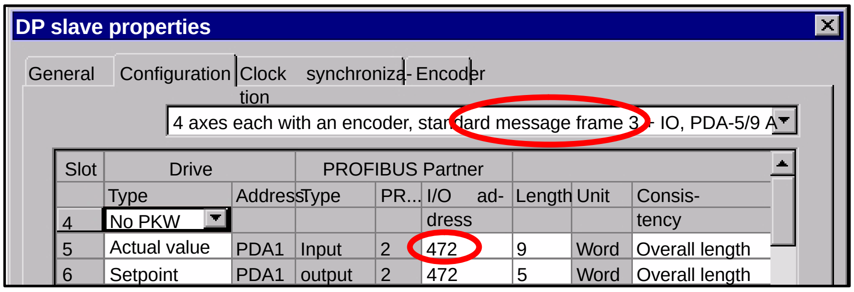


Fig. 10-16 DP slave properties: ADI4

NC machine data

The general and axis–specific NC machine data must then be set as follows:

Drive assignment

The axis of the SIMODRIVE 611U drive module is assigned to the NC as 1st machine axis. This is done by entering its I/O address and the 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 is entered in the next free machine data (e.g. Index 3):

- MD13050: DRIVE_LOGIC_ADRESS[**3**] = 472
- MD13060: DRIVE_TELEGRAM_TYPE[**3**] = 3

Assigning the actual value channels

The 1st measuring system (Index 0) of the machine axis on the measuring input of the SIMODRIVE 611U drive module is assigned via the axis–specifiec machine data:

- MD 30220: ENC_MODUL_NR[**0**] = **1**
  where 1 = (Index 0 of the relevant MD13050 + 1)

The 2nd measuring system (Index 1) of the machine axis on the measuring circuit input of the ADI4 module is assigned via the axis–specific machine data:

- MD 30220: ENC_MODUL_NR[**1**] = **4**
  where 4 = (Index 3 of the relevant MD13050 + 1)

Also refer to Subsection 10.5.4, Page 10-315.

Machine data

Table 10-24 Drive configuration: Machine data

Number	Identifier	Name/remarks	Ref.
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	Ref.
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) (SW 2.1 and higher)

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.

Prerequisites

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 7.3.7, page 7-233).

Switch ON/OFF

The DSC function is switched ON in the axis-spec. NC machine data

- MD32640: STIFFNESS_CONTROL_ENABLE (dyn. stiffness control)

If DSC operation is switched ON or OFF, it might be necessary to adjust the following machine data:

- MD32200: 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	Identifier	Name	Ref.
Axis-specific ($MA_ ...)			
32640	STIFFNESS_CONTROL_ENABLE	dyn. stiffness control	DD2
32200	POSCRTL_GAIN	KV factor	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 13-417)
  - 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

- MD 30300: IS_ROT_AX = 1 (rotary axis)

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 10-285.

Modulo display

The machine data

- MD30300: 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	Identifier	Name	Ref.
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	Identifier	Name	Ref.
General ($SN_ ...)			
41130	JOG_ROT_AX_SET_VELO	JOG speed for rotary axes	H1
Axis-specific ($SA_...)			
43430	WORKAREA_LIMIT_MINUS	Work area limiting minus	A3
43420	WORKAREA_LIMIT_PLUS	Work area limiting 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.

Concurring 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 feedrate

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	Identifier	Name	Ref.
Channel-specific ($MC_ ...)			
22240	AUXFU_F_SYNC_TYPE	Output time for F functions	H2
Axis-specific ($MA_ ...)			
30450	IS_CONCURRENT_POS_AX	Concurring positioning axis	
32060	POS_AX_VELO	Feedrate for positioning axis	

Interface signals

Table 10-30 Positioning axes: Interface signals

DB number	Bit, Byte	Name	Ref.
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

The 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	Identifier	Name	Ref.
General ($MN_ ...)			
10260	CONVERT_SCALING_SYSTEM	Basic system switch active	G2
10270	POS_TAB_SCALING_SYSTEM	Unit system of position tables	
10900	INDEX_AX_LENGTH_POS_TAB_1	Number of indexing positions used in Table 1	
10910	INDEX_AX_POS_TAB_1[n]	Indexing position table 1	
10920	INDEX_AX_LENGTH_POS_TAB_2	Number of indexing positions used in Table 2	
10930	INDEX_AX_POS_TAB_2[n]	Indexing position table 2	
Axis/spindle-specific ($MA_ ...)			
30300	IS_ROT_AX	Rotary axis	R2
30310	ROT_IS_MODULO	Modulo conversion for rotary axis	R2
30320	DISPLAY_IS_MODULO	Position display “Modulo 360°”	R2
30500	INDEX_AX_ASSIGN_POS_TAB	Axis is indexing axis	
30501	INDEX_AX_NUMERATOR	Counter for indexing axes with equidistant positions	

Interface signals

Table 10-32 Indexing axes: Interface signals

DB number	Bit, Byte	Name	Ref.
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:

- with one axis:
  for accommodation of the own dynamic response to another machine axis, e.g. when tapping or thread cutting.
- with a spindle:
  quick accommodation of the position controller to modified properties of the machine during operation, e.g. when switching the gearbox.

Tapping, thread cutting

The following applies to axes:

- For a machine axis that is not involved in tapping or thread cutting, the 1st set of parameters (index=0) is active in all cases.

  All further sets of parameters need not be taken into account.
- For machine axes involved in tapping or thread cutting, the parameter sets corresponding to the current gear stage of the spindle becomes active.

  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	Default	Axis mode	As specified by manufacturer
1	Axis interpolates with spindle (G33)	Spindle mode	1.
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. 10-17 Validity of parameter sets in 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	Identifier	Name	Ref.
Axis/spindle-specific ($MA_ ...)			
31050	DRIVE_AX_RATIO_DENOM[n]	Load gear denominator	
31060	DRIVE_AX_RATIO_NUMERA[n]	Load gear numerator	
32200	POSCTRL_GAIN[n]	K_V factor	
32810	EQUIV_SPEEDCTRL_TIME[n]	Equivalent time constant of speed control loop for feed-forward control	
32910	DYN_MATCH_TIME[n]	Time constant of dynamic adaptation	
35110	GEAR_STEP_MAX_VELO[n]	Max. speed for gear stage change	
35120	GEAR_STEP_MIN_VELO[n]	Min. speed for gear stage change	
35130	GEAR_STEP_MAX_VELO_LIMIT[n]	Max. speed of gear stage	
35140	GEAR_STEP_MIN_VELO_LIMIT[n]	Min. 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

Closed-loop control circuits

The closed-loop control of a machine consists of the cascaded closed-loop control circuits of current controller, speed controller and position controller.

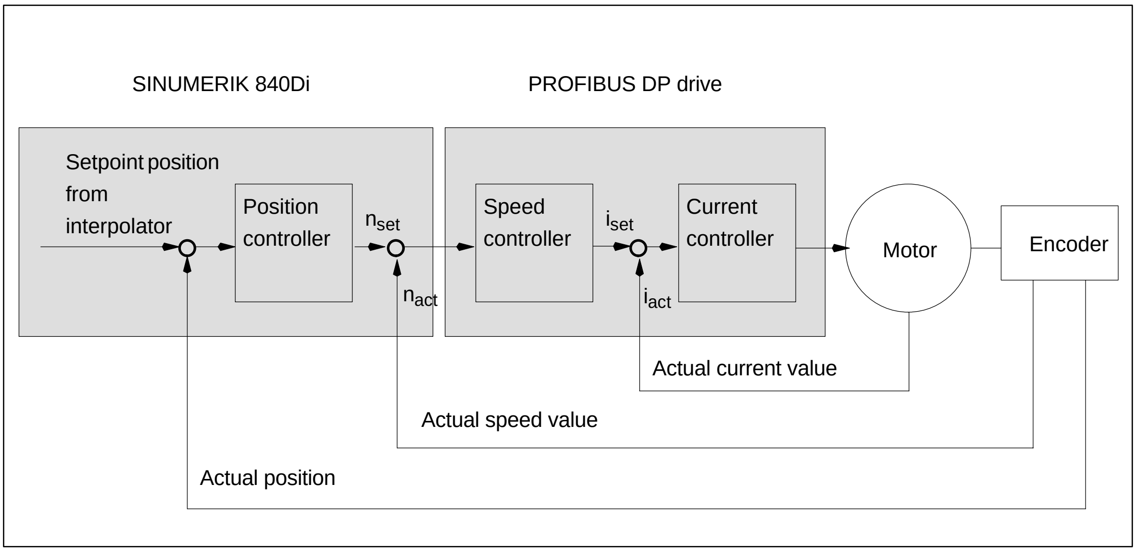


Fig. 10-18 Closed-loop control circuits

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).

Loop gain

In order 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 the 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.

- MD32200: POSCTRL_GAIN[n] (loop gain)

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:

- MD 10230: SCALING_FACTORS_USER_DEF[9] = 16.666667
- MD 10220: SCALING_USER_DEF_MASK = ’H200’; (bit no. 9 as a hexadecimal value)

When entering the servo gain factor, take into account that the amplification factor of the entire position control loop is also 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 servo gain

If a K_V factor is already known for the 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 check is made on the basis of the speed setpoint.

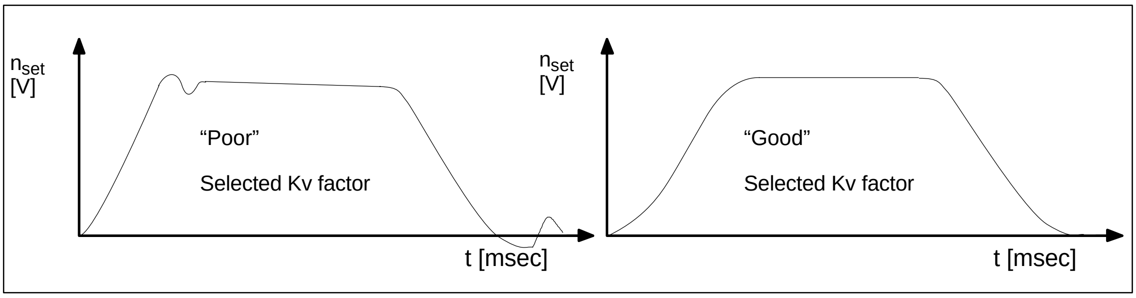


Fig. 10-19 Speed setpoint curve

No overshoots may occur while the drive is approaching the static statuses; 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)
- Error in speed controller (reoptimization 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 at 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/sec^2 to 2 m/sec^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.

Slight 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	Identifier	Name/remarks	Ref.
Axis-specific ($MA_ ...)			
32100	AX_MOTION_DIR[n]	Traversing direction	
32110	ENC_FEEDBACK_POL[n]	Sign of actual value	
32200	POSCTRL_GAIN[n]	Servo gain	
32300	MAX_AX_ACCEL[n]	Axis acceleration	
32900	DYN_MATCH_ENABLE[n]	Dynamic adaptation	
32910	DYN_MATCH_TIME[n]	Time constant of dynamic adaptation	

References

/FB/ **Description of Functions, Basic Machine**,
G2 Velocities, Setpoint/Actual-Value Systems, Closed-Loop Control, Section: 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.
$\frac{\text{MD32260: RATED\_VELO}}{\text{MD32250: RATED\_OUTVAL}} * 100$	=	P880

ADI4

Because ADI4 does not support acyclic services on the PROFIBUS DP, manual speed setpoint matching must be performed.

In 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 = 10V).

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

- MD 36210: 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 10V.

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

$$n_{Motor} = \frac{v_{Axis} * \frac{\text{MD 31060: DRIVE\_RATIO\_NUMERA}}{\text{MD31050: DRIVE\_RATIO\_DENOM}}}{\text{MD31030: LEADSCREW\_PITCH}}$$

Motor speed for rotary axis/spindle

$$n_{Motor} = n_{Load} * \frac{\text{MD 31060: DRIVE\_RATIO\_NUMERA}}{\text{MD31050: DRIVE\_RATIO\_DENOM}}$$

– 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 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 displayed 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	Identifier	Name/remarks	Ref.
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, Section: 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:

Requirements

– Zero speed of the axis
– Axis enables pending

- Speed-controlled axis

  The drift causes constant traversing of the axis. To compensate for the drift, the compensation value is incremented/decremented step by step depending on the direction of the drift until the axis reaches zero speed.

- Position-controlled axis

  The drift causes a constant following error or position setpoint $\neq$ 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	Identifier	Name/remarks	Ref.
Axis-specific ($MA_ ...)			
36720	DRIFT_VALUE	Basic drift value	G2

10.5.17 Velocity adaptation of axis

Max. axis velocity

The value entered in machine data

- MD32000: MAX_AX_VELO[n] (max. axis velocity)

is the limit velocity up to which a machine axis can accelerate (rapid traverse limiting). It depends on the machine and drive dynamics and the limit frequency of actual-value acquisition.

The max. axis velocity is used for traversing in the 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

- MD 32010: 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 <u>not</u> 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 speed = SD41110: JOG_SET_VELO (JOG velocity for G94)

   - Rotary axes:
     JOG speed = SD41130: JOG_ROT_AX_SET_VELO (JOG velocity for rotary axes)

2. SD: JOG_REV_IS_ACTIVE (revolutional feedrate in JOG mode) = 1

   - JOG speed 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	Identifier	Name/remarks	Ref.
Axis-specific ($MA_ ...)			
30300	IS_ROT_AX[n]	Rotary axis	
32000	MAX_AX_VELO[n]	Maximum axis velocity	G2
32010	JOG_VELO_RAPID[n]	Conventional rapid traverse	
32020	JOG_VELO[n]	Conventional axis velocity	
32040	JOG_REV_VELO_RAPID[n]	Revolutions feedrate in JOG mode with rapid traverse override	
32050	JOG_REV_VELO[n]	Revolutional feedrate in JOG mode	
32060	POS_AX_VELO	Reset position 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	Identifier	Name/remarks	Ref.
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,
Section: Velocities, traversing Ranges, accuracies

/FB/ **Description of Functions – Extended Functions**,
H1JOG with/without handwheel

10.5.18 Monitoring functions of 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.

- MD 36010: 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.

- MD 36020: POSITIONING_TIME (exact stop fine delay time)
- Alarm: “25080 Positioning monitoring” and follow-up mode”.

Standstill position tolerance

Position tolerance which a standing machine axis may not leave.

- MD36030: STANDSTILL_POS_TOL (standstill position tolerance)
- Alarm: “25040 Zero speed control” and follow-up mode”.

Delay time
Zero speed control

Delay time after which the actual value must have reached the tolerance window “Standstill position tolerance” when the setpoint position is reached.

- MD36040: STANDSTILL_DELAY_TIME (zero speed control delay time)
- Alarm: “25040 Zero speed control” and follow-up mode”.

Clamping tolerance

Tolerance window for a standing machine axis while the signal “Clamping process running” is present at the PLC interface.

- MD36050: CLAMP_POS_TOL (clamping tolerance)
- IS: DB31,... DBX2.3 (clamping process running)
- Alarm: “26000 Clamping monitoring”.

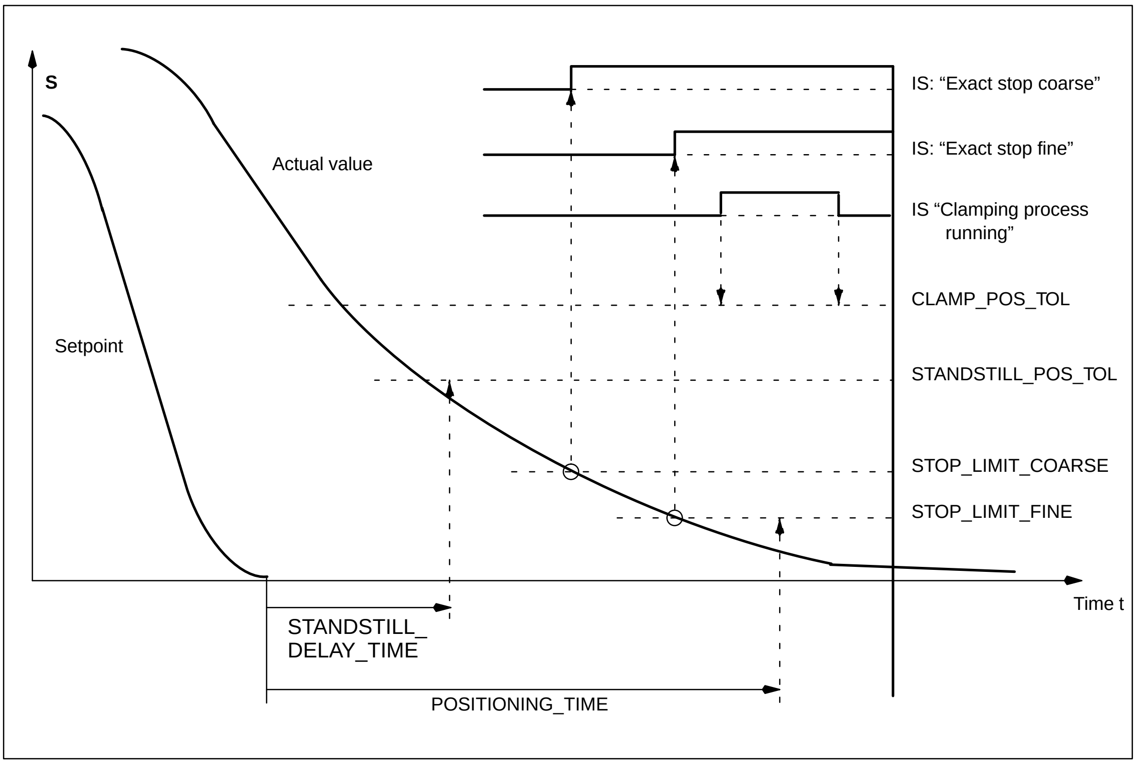


Fig. 10-20 Static monitoring functions

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 operating range limit +/–”.

Software limit switches

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_MINUS (2nd software limit switch minus)

- MD36130: POS_LIMIT_PLUS (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 switches

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)
- MD 36600: 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 [+/–]”.

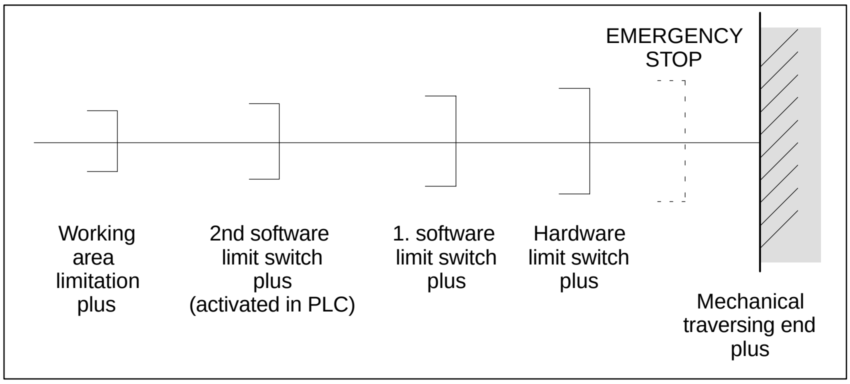


Fig. 10-21 Overview of end limitations

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.

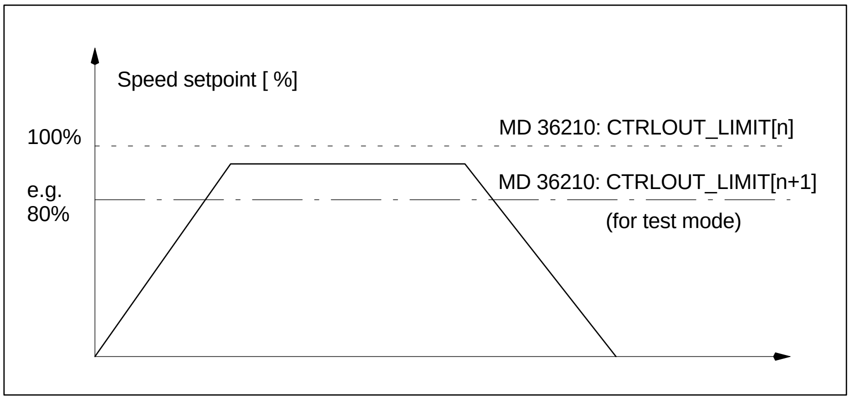


Fig. 10-22 Speed setpoint limiting

- 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 of brake ramp in case of error conditions).

Error causes/remedy

- 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).

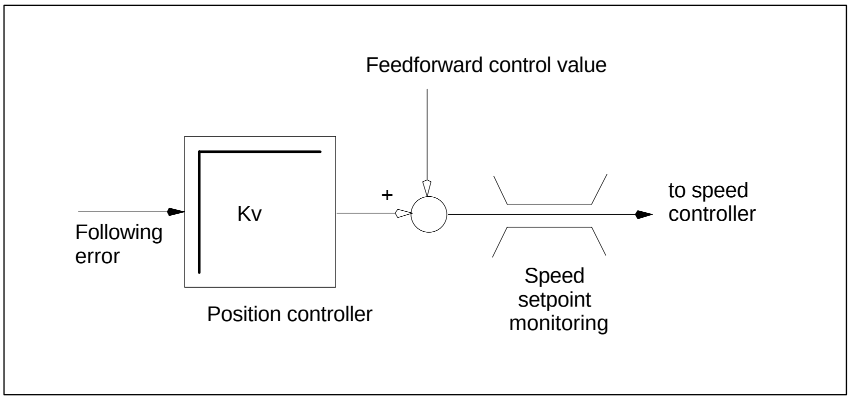


Fig. 10-23 Speed setpoint calculation

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

- MD 36020: AX_VELO_LIMIT (threshold value for speed 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 of brake ramp in case of error conditions).

Error causes/remedy

- Check speed setpoint cable
- Check actual values
- Check direction of position control
- 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 of brake ramp in case of error conditions).

Error causes/remedy

Contour errors are due to signal distortions in the position-control loop.

Remedy:

- Enlarge 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
  Operating area: **DIAGNOSIS > Service displays > Service of axis**
- Check optimization of speed controller
- Check easy movement of axes
- Check machine data for traversing movements
  (feed override, acceleration, max. speeds, ...)
- When operating 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 cut-off frequency monitoring

Monitoring of the cut-off frequency of the encoder of a machine axis.

- MD 36300: ENC_FREQ_LIMIT (encoder cut-off frequency)

Error response

- Alarm: “21610 Encoder frequency exceeded”
- IS: DB31, ... DBX60.2 “Encoder cut-off frequency exceeded 1”
- IS: DB31, ... DBX60.3 “Encoder cut-off frequency exceeded 2”

and stopping the machine axis using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (time of brake ramp in case of error conditions).

Error causes/remedy

The position control resumes automatically after the axes have stopped.

Notice

The axis concerned must be re-referenced.

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.

- 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 axes using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (time of brake ramp in case of error conditions).

Error causes/remedy

- 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.

Error causes/remedy

- The specified permissible tolerance is too small
- The position measuring system to which you will switch over is not referenced.

Cycl. monitoring of 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 axes using a speed setpoint ramp whose characteristic is set in

- MD36610: AX_EMERGENCY_STOP_TIME (time of brake ramp in case of error conditions).

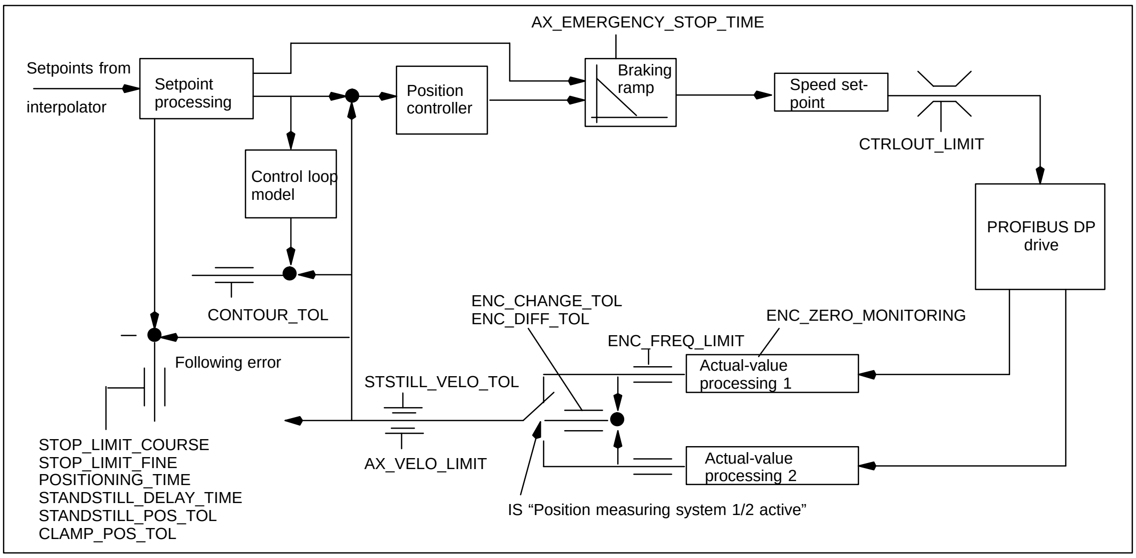


Fig. 10-24 Monitoring functions with SINUMERIK 840Di

Notice

- MD 36620: SERVO_DISABLE_DELAY_TIME (servo enable cutout delay)

must always be selected greater than

- MD 36610: AX_EMERGENCY_STOP_TIME (time of brake ramp in case of error conditions).

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 traversing 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.

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 with channel-specific reference point approach)
- MD 30240: ENC_TYPE (encoder type)
- Set MD 34200: ENC_REFP_MODE (referencing mode)
- IS: DB21, ... DBX1.0 (“Activate referencing”)
- IS: DB21, ... DBX33.0 (“Referencing active”).

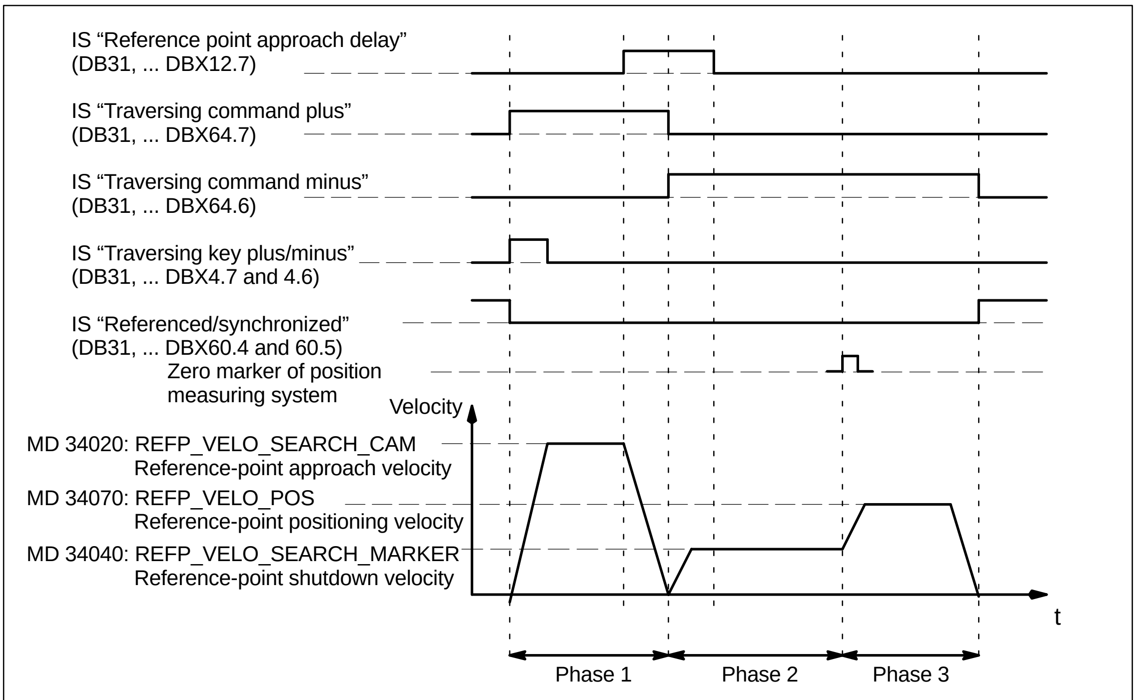


Fig. 10-25 Referencing sequence with incremental measuring system (example)

Phase 1:
Traversing to the reference cam

The following **machine data** and **interface signals** are important:

- MD34010: REFP_VELO_SEARCH_CAM (reference cam approach in the 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 feed override (the feed override switch) is active
- The feed stop (channel-specific and axis-specific) is active
- The machine axis can be stopped and started again using 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 adjusted 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 corresponds to ± one encoder revolution.

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 (shutdown speed)
- MD 34050: REFP_SEARCH_MARKER_REVERSE
  (direction reversal to reference cam)
- MD 34060: REFP_MAX_MARKER_DIST
  (maximum path from cam to reference mark).

Properties of phase 2:

- Feed override (the feed override switch) is not active.
  100% is fixed, an abortion is carried out at 0%
- Feed stop (channel-specific and axis-specific) is active. On feed stop the axis stops and
  – Alarm 20005 “Reference point approach canceled”
  is output
- The machine axis cannot be stopped or restarted using NC Stop/NC Start
- If the machine axis travels a distance defined in MD 34060:
  DB31, ... DBX12.7 (“Reference point approach delayed”) = 0

  – MD 34060: REFP_MAX_MARKER_DIST (max. distance to the reference mark)
  and the zero mark is not detected, the machine axis stops and

– Alarm 20002 “Zero mark missing”
is output.

Phase 3:
Traversing to the reference point

The following **machine data** and **interface signals** are important:

- MD34070: REFP_VELO_POS (reference-point positioning velocity)
- MD34080: REFP_MOVE_DIST (reference point distance to the 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.
- The machine axis can be stopped and started again using NC Stop/NC Start.

References

/FB1/ **Description of Functions, Basic Machine**,
R1 Reference Point Approach
Section: Referencing with incremental measurement systems

Clearance-coded reference marks

When clearance-coded reference marks are used, referencing is divided into 2 phases:

1. Synchronizing by overtraveling 2 reference marks
2. Traversing to target point

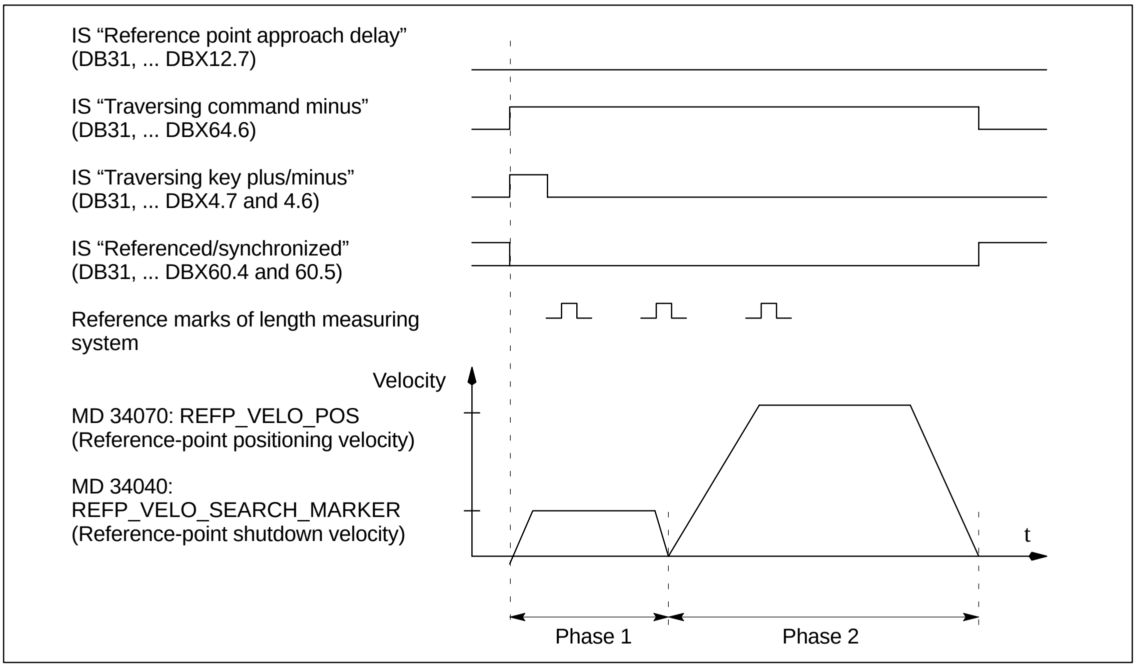


Fig. 10-26 Clearance-coded reference marks

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 with channel-specific reference point approach)
- MD 30240: ENC_TYPE (encoder type)
- Set MD 34200: 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:
Synchronizing by overtraveling 2 reference marks

The following **machine data** and **interface signals** are important:

- MD34010: REFP_VELO_SEARCH_CAM (reference cam approach in the negative direction)

- MD 34040: REFP_VELO_SEARCH_MARKER (referencing speed)
- MD34060: REFP_MAX_MARKER_DIST
(maximum path between two reference marks)
- MD34300: ENC_REFP_MARKER_DIST
(distance between reference marks)
- 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
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 (target point positioning velocity)
- MD 34090: REFP_MOVE_DIST_CORR (absolute offset)
- Set 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 feed override (the feed override switch) is active.
- The feed stop (channel-specific and axis-specific) is active.
- The machine axis can be stopped and started again using NC Stop/NC Start.

Determining the absolute off-set

To determine the absolute offset between the measuring system zero point and the machine zero, the following procedure is proposed:

1. Determine 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”.

MD 34090: REFP_MOVE_DIST_CORR (reference point/absolute offset) must be zero at this time.

2. Determine the absolute machine actual position

Traverse the machine axis to a position at which the actual machine position can be exactly measured with reference to machine zero, e.g. using a laser interferometer.

3. Calculate the absolute offset.

– length measurement system equidirectional to the machine system:

Absolute offset = machine actual position + actual position of the measuring system

– length measurement system opposite to the 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 (reference point/absolute offset)

the position measuring system must be re-referenced.

References

/FB1/ **Description of Functions, Basic Machine**,
R1 Reference Point Approach
Section: Referencing with linear measurement systems with distance-coded reference marks

Absolute encoder

Referencing of an axis with absolute encoders is carried out automatically when the NC powers up if the corresponding axis is detected adjusted.

The following two requirements must be fulfilled:

- The absolute encoder is adjusted.
  Sign: MD 34210: ENC_REFP_STATE[n] = 2
- The measuring system of the machine axis, which is active when the NC powers up, uses the absolute encoder.

The acceptance of the absolute encoder is carried out without axis movement.

Adjustment

In the case machine axes are equipped with absolute encoders, the measuring system is not synchronized by approaching a reference point, but it is adjusted.

When adjusting the axis, the actual value of the absolute encoder is matched with the machine zero once during the start-up and then enabled.

The adjustment can be carried out in three different ways:

- Operator-assisted adjustment
- Automatic adjustment with probe
- Adjustment with BERO.

Any other kinds of referencing with absolute encoders will not be supported.

The "operator-assisted adjustment" will be described in the following. For the other two kinds of adjustment, see:

References: /FB/, Description of Functions, Basic Machine
R1, Reference Point Approach
Section: Automatic calibration with probe
Adjustment with BERO.

Operator-assisted adjustment

The machine axis to be adjusted is moved to a defined machine position, and then the appropriate actual value is set in the NC.

Chronological sequence

1. Parameterize the referencing mode to "No reference point approach; acceptance of MD34100: REFP_SET_POS" by setting value "0" in:
   - MD34200: ENC_REFP_MODE[n] (referencing mode)
2. Approach a known machine position
   Traverse the machine axis in JOG mode to a known position.
   The direction in which the position is approached must correspond to the direction set in
   - MD34010: REFP_CAM_DIR_IS_MINUS (ref. point approach in the minus direction)

   (0 = positive direction, 1 = negative direction).

Notice

This known position must be approached at slow velocity and always from the same direction to make sure that the actual value is not invalidated by the backlash in the drive system.

---

3. Enter the approached machine position in the machine data:
   - MD34100: REFP_SET_POS[n] (ref. point value) = machine position

   (This value can be a value specified from the design (e.g. fixed stop) or be determined using a measuring instrument)
4. Enable "adjustment" in the NC by entering the value 1 ("enable encoder adjustment") in:
   - MD34210: ENC_REFP_STATE[n] (status of absolute encoder)
5. Carry out "NCK RSET" to enable the changed machine data.
6. After the NC has powered up, switch over to JOG/REF mode and select there the appropriate machine axis.
7. Calculation of the reference point offset
   Press the traversing key already used in Step 2 to calculate the offset between the actual machine position and the actual encoder position and enter itin
   - MD34090: REFP_MOVE_DIST_CORR[n] (reference point offset).

   The machine axis is marked adjusted by the NC by the change of the displayed value in the axis-specific machine data:
   - MD34210: ENC_REFP_STATE[n] (status of absolute encoder)

   from 1 = "Encoder adjustment enabled" to 2 = "Encoder is adjusted".

Notice

The axis will not move if the traversing key is pressed!

The value entered in MD34100: REFP_SET_POS[n] (ref. point value) is displayed on the actual-value display of the appropriate traversing key.

8. The adjustment of the absolute encoder of this machine axis is thus completed.

Adjusting several axes

For time-optimized adjustment of several machine axes, the following procedure is recommended:

1. Traverse all or several machine axes (as far as permitted by the machine design) to the adjustment point (see above, Points 1 – 5).
2. Switch over to: JOG/REF mode (Point 6).
3. Carry out the adjustment for each machine axis (Point 7).

Readjustment

A readjustment of the absolute encoder is required:

- after dismantling/installing the encoder or the motor with absolute encoder or,
- if data are lost in the NC SRAM, battery voltage failure, PRESET,
- in the case of gear change between load and absolute encoder.

Notice

The status in
- MD34210: ENC_REFP_STATE[n] (status of absolute encoder)

is only reset by the NC automatically in the case of gear change.

In all the other cases, the user must reset the status to 0 = “Encoder not adjusted” by himself/herself and provide for readjustment.

Interface signals

Table 10-39 Referencing: Interface signals

DB number	Bit, Byte	Name	Ref.
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 to be referenced are referenced.	

Axis-specific		Signals from PLC to axis/spindle	
31, ...	1.5/1.6	Position measuring system 1/position measuring system 2	A2
31, ...	2.4–2.7	Reference point values 1 to 4	
31, ...	4.6/4.7	Traversing keys minus/plus	H1
31, ...	12.7	Delayed reference-point approach	
Axis-specific		**Signals from axis/spindle to PLC**	
31, ...	60.4 / 60.5	Referenced, synchronized 1/referenced, synchronized 2	
31, ...	64.6/64.7	Traversing command minus/plus	H1

Machine data

Table 10-40 Referencing: Machine data

Number	Identifier	Name	Ref.
General ($MN_ ...)			
11300	JOG_INC_MODE_LEVELTRIGGRD	INC/REF in inching mode/continuous mode	H1
Channel-specific ($MC_ ...)			
20700	REFP_NC_START_LOCK	NC start lock 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	Max. distance to be traversed to the 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]	Max. distance to be traversed to the reference cam; max. distance to 2 reference marks with distance-coded measurements [encoder number]	
34070	REFP_VELO_POS	Reference point positioning velocity	
34080	REFP_MOVE_DIST[n]	Reference point distance/target point with distance-coded system [encoder number]	
34090	REFP_MOVE_DIST_CORR[n]	Distance-coded reference point/absolute offset [encoder number]	
34092	REFP_CAM_SHIFT	Electronic reference cam offset for incremental measuring 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 measuring system	
34110	REFP_CYCLE_NR	Axis order on 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 encoder [encoder number]	

Axis-specific ($MA_ ...)			
34220	ENC_ABS_TURNS_MODULO	Range of absolute encoder with rotary encoders	R2
34300	ENC_REFP_MARKER_DIST[n]	Reference marker distance with distance-coded measurements [encoder number]	
34310	ENC_MARKER_INC[n]	Interval between two reference marks with distance-coded measurements[encoder no.]	
34320	ENC_INVERS[encoder]	Linear measuring system inverse to the machine system [encoder number]	
34330	REFP_STOP_AT_ABS_MARKER[n]	Distance-coded linear measuring system without target point [encoder number]	
35150	SPIND_DES_VELO_TOL	Spindle speed tolerance	S1
36302	ENC_FREQ_LIMIT_LOW	Encoder limit frequency for re-synchronization	
36310	ENC_ZERO_MONITORING	Zero mark monitoring	
30250	ACT_POS_ABS	Absolute encoder position on switching off	

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

- MD 30300: IS_ROT_AX (rotary axis/spindle)
- MD 30310: ROT_IS_MODULO (modulo conversion for rotary axis/spindle)
- MD 30320: 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

- MD 35000: 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 10-308).

Spindle modes

The diagram below illustrates the spindle modes and possible transitions between them.

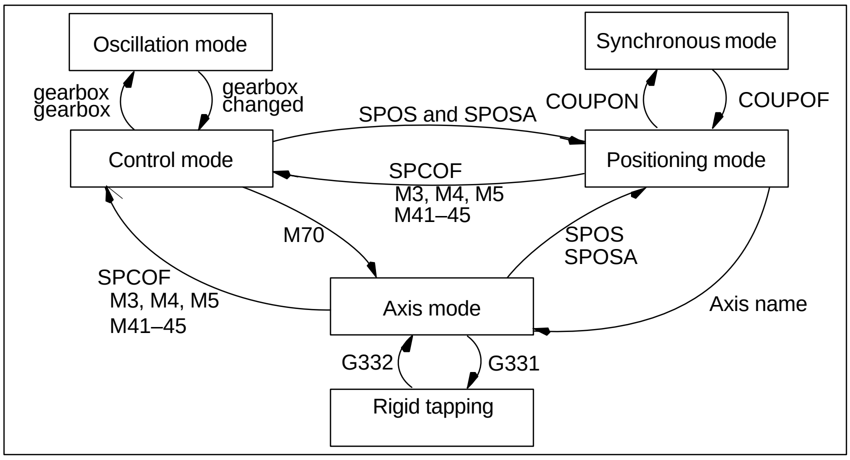


Fig. 10-27 Spindle modes

Default mode

The machine data

- MD 35020: 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:

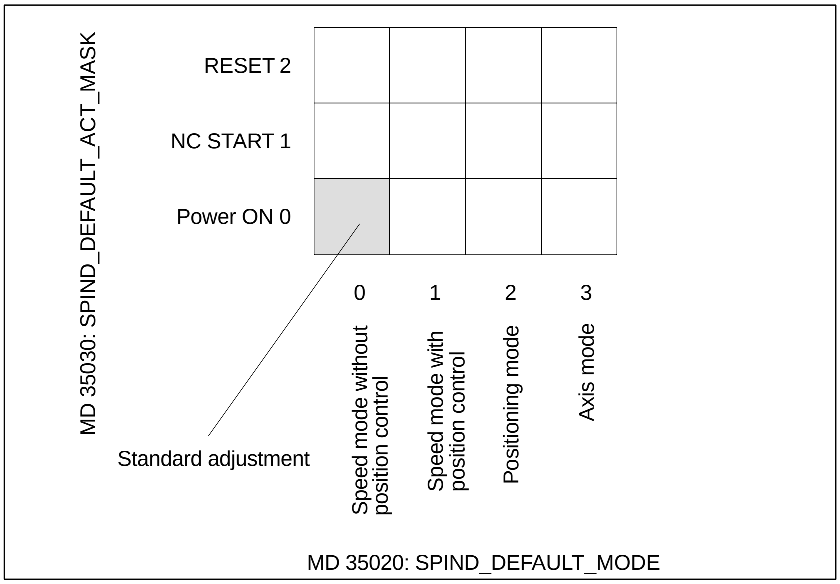


Fig. 10-28 Default setting of spindle mode

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 the mechanical position will coincide with the programmed position.
3. It is switched over to the current feedforward control mode marked by the machine data and commands FFWON and FFWOF.

Special features

The following characteristics apply to the axis mode of a spindle:

1. The feed override switch is valid.
2. The IS “Reset” (DB21, ... DBX7.7) does not end axis mode by default.
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. The axis mode can be enabled in any gear stage. If the positional actual-value encoder is mounted on the motor (indirect measuring system), different positioning and contour accuracies may result between the gear stages.

5. If axis mode is active, it is not possible to switch over the gear stage. To this aim, it is necessary to switch over to control mode using M41 to 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 in a channel, such as

- Revolutional feed (G95)
- Tapping with compensation chuck (G63)
- Thread cutting (G33)
- Dwell time in spindle revolutions (G4 S...)

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

- MD 35000: 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

The machine data

- MD 35040: SPIND_ACTIVE_AFTER_RESET (spindle active with 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 10-315.

10.5.22 Gear stages

Enabling 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 with respect to parameter records, see above, Subsection 10.5.13, page 10-330.

References

/FB1/ **Description of Functions, Basic Machine**,
S1 Spindles
Section: Gear stage change

10.5.23 Measuring systems of spindle

Adapting the encoder

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 10-317.

For absolute measuring systems, see above, Subsection 10.5.6, page 10-320.

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

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: Spindle-mounted encoder

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
- MD 31060: 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

$$\text{Internal resolution} = \frac{\text{360 degrees}}{\text{MD31020 * pulse rev.}} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * \text{MD10210}$$

$$\text{Internal resolution} = \frac{360}{500 * 128} * \frac{1}{1} * \frac{1}{1} * 1000 = 5.625 \frac{\text{int. increments}}{\text{Encoder pulse}}$$

The encoder increment corresponds to 5.625 internal increments.

An encoder increment corresponds to 0.005625 degrees (highest possible positioning resolution).

Example B: Motor-mounted encoder

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

$$\text{Internal resolution} = \frac{\text{360 degrees}}{\text{MD 31020 * pulse rev.}} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * \text{MD10210}$$

$$\text{Internal resolution} = \frac{360}{2048 * 128} * \frac{1}{1} * \frac{1}{2.5} * 1000 = 0.54932 \frac{\text{int. increments}}{\text{Encoder pulse}}$$

One encoder increment corresponds to 0.54932 internal increments.

An 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 sped for the automatic gear stage changeover.

A new gear stage is output only if the newly programmed speed setpoint cannot be traversed in the present 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 in the PLC.

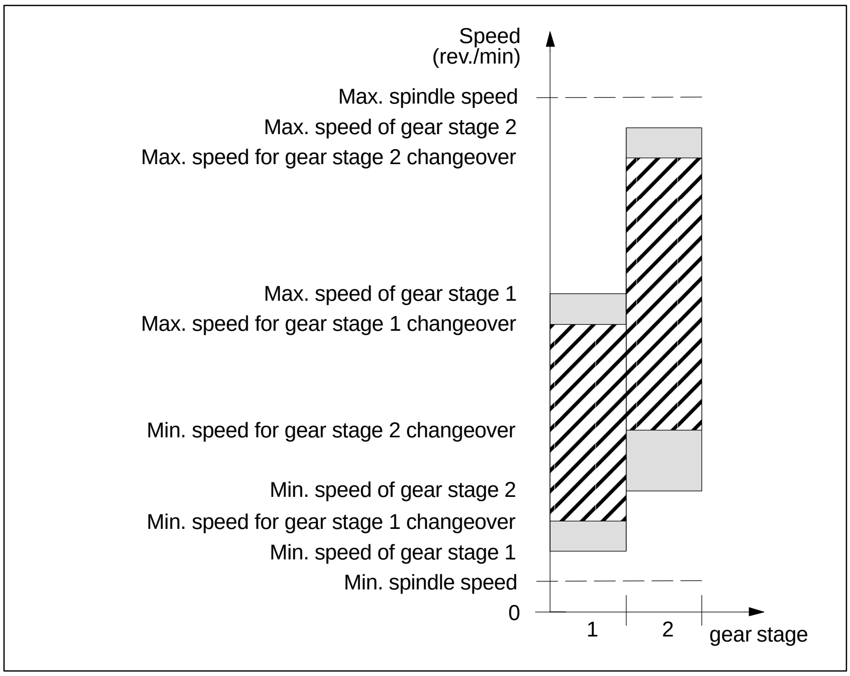


Fig. 10-29 Example of speed ranges with automatic gear stage selection (M40)

Velocities for conventional operation

The speeds of the spindle in conventional mode are entered in the machine data:

- MD 32010: JOG_VELO_RAPID (conventional rapid traverse) or
- MD32020: JOG_VELO (conventional axis velocity).

The direction of rotation is specified using 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 adjustment

The speeds for drive control must be transferred to the drive as scaled values. 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

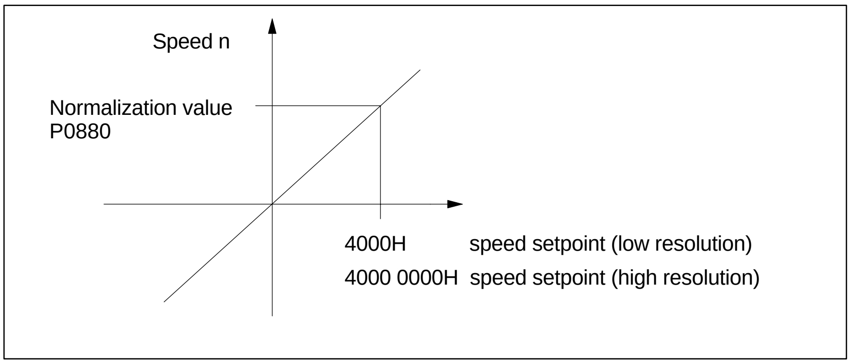


Fig. 10-30 Speed setpoint normalization

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	Load gear denominator	G2
31060	DRIVE_AX_RATIO_NUMERA	Load gear numerator	G2
32010	JOG_VELO_RAPID	Conventional rapid traverse	
32020	JOG_VELO	Conventional axis velocity	
35010	GEAR_STEP_CHANGE_ENABLE	Gear stage change possible	
35020	SPIND_DEFAULT_MODE	Spindle park position	
35030	SPIND_DEFAULT_ACT_MASK	Activate spindle park position	
35040	SPIND_ACTIVE_AFTER_RESET	Spindle activated by 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	Acceleration on oscillation	
35430	SPIND_OSCILL_START_DIR	Start direction on oscillation	
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	Ref.
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 stage	
31, ...	16.3	Gear switched	
31, ...	16.6	No speed monitoring when changing the gear	
31, ...	18.4	Oscillation by the PLC	
31, ...	18.5	Oscillation speed	
Axis-specific		**Signals from axis/spindle to PLC**	
31, ...	82.2–82.0	Set gear stage	
31, ...	82.3	Switch gear	
31, ...	84.7	Active spindle mode “Control mode”	
31, ...	84.6	Active spindle mode “Oscillation mode”	

10.5.25 Positioning the 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 “Fine exact stop” 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 in 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	KV factor	
36400	CONTOUR_TOL	Contour monitoring	

Interface signals

Table 10-44 Spindle positioning: Interface signals

DB number	Bit, Byte	Name	Ref.
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 the 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.

The machine data

- Set MD 34100: 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.

The 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/ SIMODRIVE 611 universal, Description of Functions
Section: Motion Control with PROFIBUS DP
(from SW 3.1)
Zero mark substitute on PROFIBUS

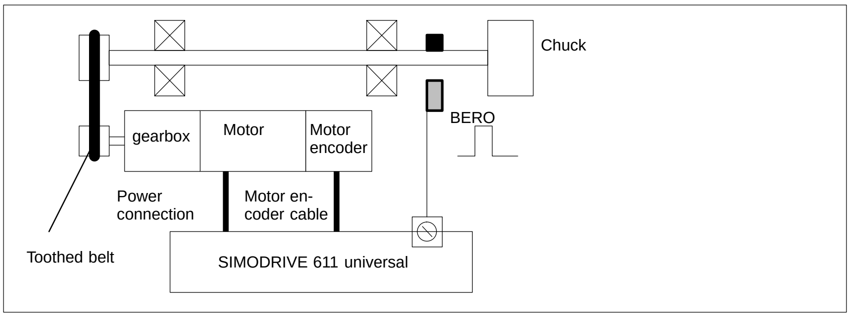


Fig. 10-31 Synchronization using BERO

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 cut-off frequency falls below the programmed value after a speed has been programmed which is above the encoder cut-off 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. motor-mounted encoder), 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	Ref.
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 Monitoring functions of the spindle

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 stopped)

is set. If

- MD 35110: SPIND_STOPPED_AT_IPO_START (feed enable for “Spindle stopped”) is set,

the path feed is enabled.

Spindle in setpoint range

If the spindle reaches the tolerance range specified in machine data

- MD35150: SPIND_DES_VELO_TOL (spindle speed tolerance)

the interface signal

- IS DB31,... DBX83.5 (spindle in setpoint range)

is set. If

- MD 35110: 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 (maximum 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”

The machine data

- MD36200: AX_VELO_LIMIT (threshold value for speed 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 (max. speed of gear stage)
- MD35140: GEAR_STEP_MAX_VELO_LIMIT (max. speed of 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=... (spindle 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 cut-off 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 cut-off 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.

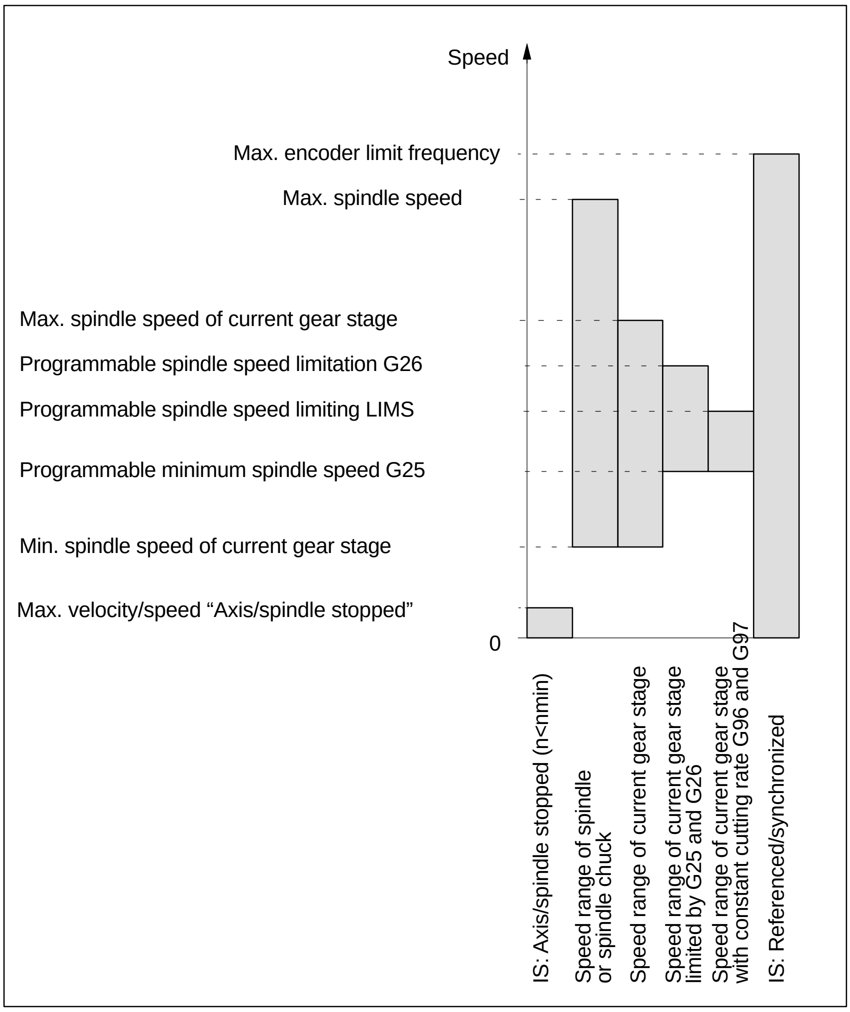


Fig. 10-32 Ranges of spindle monitoring functions/speeds

References **/FB1/** **Description of Functions, Basic Machine**,
S1 Spindles
Section: Spindle monitoring

10.5.28 Spindle data

Machine data

Table 10-47 Spindle: Machine data

Number	Identifier	Name	Ref.
General ($MN_ ...)			
12060	OVR_SPIND_IS_GRAY_CODE	Spindle override, Gray-coded	V1
12070	OVR_FACTOR_SPIND_SPEED	Evaluation of the spindle speed override switch	V1
12080	OVR_REFERENCE_IS_PROG_FEED	Override reference speed	V1
Channel-specific ($MC_ ...)			
20090	SPIND_DEF_MASTER_SPIND	Initial setting of master spindle in the channel	
20092	SPIND_ASSIGN_TAB_ENABLE	Enable/disable spindle converter	
20118	GEOAX_CHANGE_RESET	Permit automatic geometry axis change	
22400	S_VALUES_ACTIVE_AFTER_RESET	S function effective with 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	Load gear denominator	G2
31060	DRIVE_AX_RATIO_NUMERA	Load gear numerator	G2
31122	BERO_DELAY_TIME_PLUS	BERO delay time in plus direction	
31123	BERO_DELAY_TIME_MINUS	BERO delay time in minus direction	
32200	POSCTRL_GAIN	KV factor	G2
32810	EQUIV_SPEEDCTRL_TIME	Equivalent time constant of speed control loop for feedforward control	K3
32910	DYN_MATCH_TIME.	Time constant of dynamic adaptation	G2
34040	REFP_VELO_SEARCH_MARKER	Reference shutdown speed	R1
34060	REFP_MAX_MARKER_DIST	Monitoring of zero reference mark distance	R1
34080	REFP_MOVE_DIST	Reference point distance/target position with clearance-coded system	R1
34090	REFP_MOVE_DIST_CORR	Reference point offset/absolute offset clearance-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	Spindle park position	
35030	SPIND_DEFAULT_ACT_MASK	Activate spindle park position	
35040	SPIND_ACTIVE_AFTER_RESET	Spindle activated by reset	
35100	SPIND_VELO_LIMIT	Max. spindle speed	
35110	GEAR_STEP_MAX_VELO[n]	Max. speed for gear stage change	
35120	GEAR_STEP_MIN_VELO[n]	Min. speed for gear stage change	
35130	GEAR_STEP_MAX_VELO_LIMIT[n]	Max. speed of gear stage	
35140	GEAR_STEP_MIN_VELO_LIMIT[n]	Min. speed of gear stage	
35150	SPIND_DES_VELO_TOL	Spindle speed tolerance	
35160	SPIND_EXTERN_VELO_LIMIT	Spindle speed limiting from PLC	
35200	GEAR_STEP_SPEEDCTRL_ACCEL[n]	Acceleration in speed control mode	

Number	Identifier	Name	Ref.
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 threshold speed	
35350	SPIND_POSITIONING_DIR	Direction of rotation when positioning with the spindle not synchronized	
35400	SPIND_OSCILL_DES_VELO	Oscillation speed	
35410	SPIND_OSCILL_ACCEL	Acceleration on oscillation	
35430	SPIND_OSCILL_START_DIR	Start direction on oscillation	
35440	SPIND_OSCILL_TIME_CW	Oscillation time for M3 direction	
35450	SPIND_OSCILL_TIME_CCW	Oscillation time for M4 direction	
35500	SPIND_ON_SPEED_AT_IPO_START	Feedrate enable for spindle in setpoint range	
35510	SPIND_STOPPED_AT_IPO_START	Feed enable with the spindle stopped	
35590	PARAMSET_CHANGE_ENABLE	Parameter set specification possible from PLC	A2
36060	STANDSTILL_VELO_TOL	Threshold speed “Axis/spindle stopped”	A3
36200	AX_VELO_LIMIT	Threshold value for velocity monitoring	A3

Setting data

Table 10-48 Spindle: Setting data

Number	Identifier	Name	Ref.
Spindle-specific ($SA_ ...)			
42600	JOG_FEED_PER_REF_SOURCE	Revolutional feedrate control in JOG mode	V1
42800	SPIND_ASSIGN_TAB	Spindle number converter	
42900	MIRROR_TOOL_LENGTH	Mirror tool length compensation	W1
42910	MIRROR_TOOL_WEAR	Mirror wear data of tool length compensation	W1
42920	WEAR_SIGN_CUTPOS	Mirror wear data of processing level	W1
42930	WEAR_SIGN	Invert signs of all wear data	W1
42940	TOOL_LENGTH_CONST	Keep the assignment of the tool length components when changing the processing level (G17 to G19).	W1
43210	SPIND_MIN_VELO_G25	Programmable spindle speed limiting G25	
43220	SPIND_MAX_VELO_G26	Programmable spindle speed limiting G26	
43230	SPIND_MAX_VELO_LIMS	Programmable spindle speed limiting G96	
43300	ASSIGN_FEED_PER_REF_SOURCE	Revolutional feedrate for positioning axes/spindles	V1, P2

Interface signals

Table 10-49 Spindle: Interface signals

DB number	Bit, Byte	Name	Ref.
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	Follow-up mode	A2
31, ...	1.3	Axis/spindle disable	A2
31, ...	2.2	Spindle reset/delete distance-to-go	A2
31, ...	2.1	Controller enabling command	A2
31, ...	3.6	Velocity/spindle speed limiting	A3
31, ...	16.7	Delete S value	
31, ...	16.5	Resynchronize spindle 2	
31, ...	16.4	Resynchronize spindle 1	
31, ...	16.3	Gear switched	
31, ...	16.2–16.0	Actual gear stages A to C	
31, ...	17.6	Invert M3/M4	
31, ...	17.5	Resynchronize spindle when positioning 2	
31, ...	17.4	Resynchronize spindle when positioning 1	
31, ...	18.7	Set direction of rotation CCW	
31, ...	18.6	Set direction of rotation CCW	
31, ...	18.5	Oscillation speed	
31, ...	18.4	Oscillation by the PLC	
31, ...	19.7–19.0	Spindle override 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 controller active	A2
31, ...	61.5	Position controller active	A2
31, ...	61.4	Axis/spindle stopped ($n < n_{min}$)	A2
31, ...	82.3	Switch gear	
31, ...	82.2–82.0	Set gear stage A–C	
31, ...	83.7	Actual direction of rotation CW	
31, ...	83.5	Spindle within set range	
31, ...	83.2	Set speed increased	
31, ...	83.1	Set speed limited	
31, ...	83.0	Speed limit exceeded	
31, ...	84.7	Active spindle mode “Control mode”	
31, ...	84.6	Active spindle mode “Oscillation mode”	
31, ...	84.5	Active spindle mode “Positioning mode”	
31, ...	84.3	Tapping without compensating chuck 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 2.4, page 2-62).

– PP 72/48
  The I/O module PP 72/48 has 72 digital inputs and 48 digital outputs (Section 2.12, page 2-93).

– 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 2.13, page 2-105).

– 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 Setting parameters for the number of inputs/outputs in use

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 10-384.

Machine data

The number of used analog and digital inputs/outputs is set in the following machine data parameters:

Analog input/outputs

- 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_INPUTS (“Number of active digital NC output **bytes**”)

10.6.2 Assignment of the 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

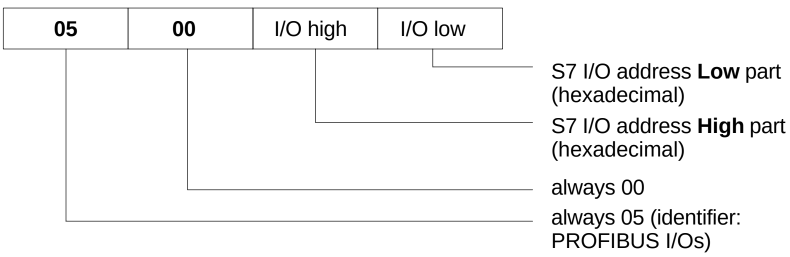
Analog inputs/outputs

- 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



Note

- The **first** digital I/O **bytes** defined in each case via machine data:
  - MD10350: FASTIO_DIG_NUM_INPUTS
  - MD10360: FASTIO_DIG_NUM_OUTPUTS

  always refer 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 input/outputs

- $A_INA[n] ("Read analog input n, with n=1...8")
- $A_OUTA[n] ("Write analog output n, with n=1...8")

Digital input/outputs

- $A_IN[n] ("Read digital input (Bit) n, with n=1...4 and 9...40")
- $A_OUT[n] ("Write digital output n, with n=1...4 and 9...40")

Hardware assign machine data	System variable
Analog input/outputs	
MD10362: HW_ASSIGN_ANA_FASTIN[0–7]	$A_INA[1–8]
MD10364: HW_ASSIGN_ANA_FASTOUT[0–7]	$A_OUTA[1–8]
Digital input/outputs	
MCI board extension: Digital inputs 1–4	$A_IN[1–4]
MD10366: HW_ASSIGN_DIG_FASTIN[0–3]	$A_IN[9–40]
MCI board extension: Digital outputs 1–4	$A_OUT[1–4]
MD10368: HW_ASSIGN_DIG_FASTOUT[0–3]	$A_OUT[9–40]

Note

The digital input/outputs are organized as follows:

- Hardware assign machine data: Byte by byte
- System variables: Bit by bit

10.6.4 Digital I/O bytes and system variables

Digital inputs

The following example uses the configuration of 3 digital input bytes to illustrate the connection between digital input bytes and system variables.

The following prerequisites apply for the sample configuration:

– MCI board extension module: 1 input byte.

– PROFIBUS–DP signal modules: 2 input bytes

The MCI board extension module always uses one digital input byte. Digital input bytes from external signal modules must therefore always be counted as additional input bytes:

- MD10350: FASTIO_DIG_NUM_INPUTS = 1 + m,
  where m = number of input bytes from external signal modules

Since the 1st input byte is internally permanently assigned to the MCI board extension module, only the input bytes of the external signal modules need to be explicitly assigned to the system variables.

- MD10366: HW_ASSIGN_DIG_FASTIN[**0**] –> **1.** external input byte
- MD10366: HW_ASSIGN_DIG_FASTIN[**1**] –> **2.** external input byte

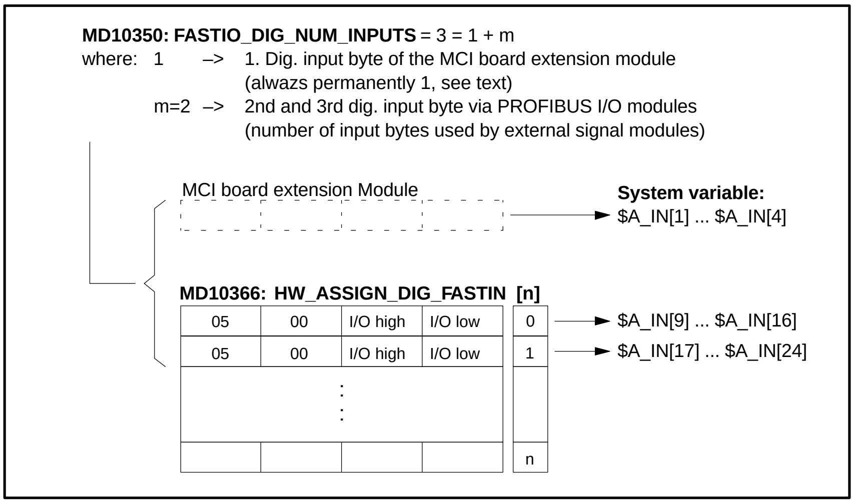


Fig. 10-33 Sample configuration: 3 digital input bytes

If the optional MCI board extension module is not present, the assignment in the machine data must still be carried out as specified, since the 1st input byte is permanently assigned internally in this module. The system variables $A_IN[1] bis $A_IN[4] then do not contaion any information.

Digital outputs

The configuration of digital outputs is analogous to the example described above for digital inputs.

10.6.5 Time behavior

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. 10-34, page 10-383.

The time properties when reading in a digital or analog input are analogously to the properties described above.

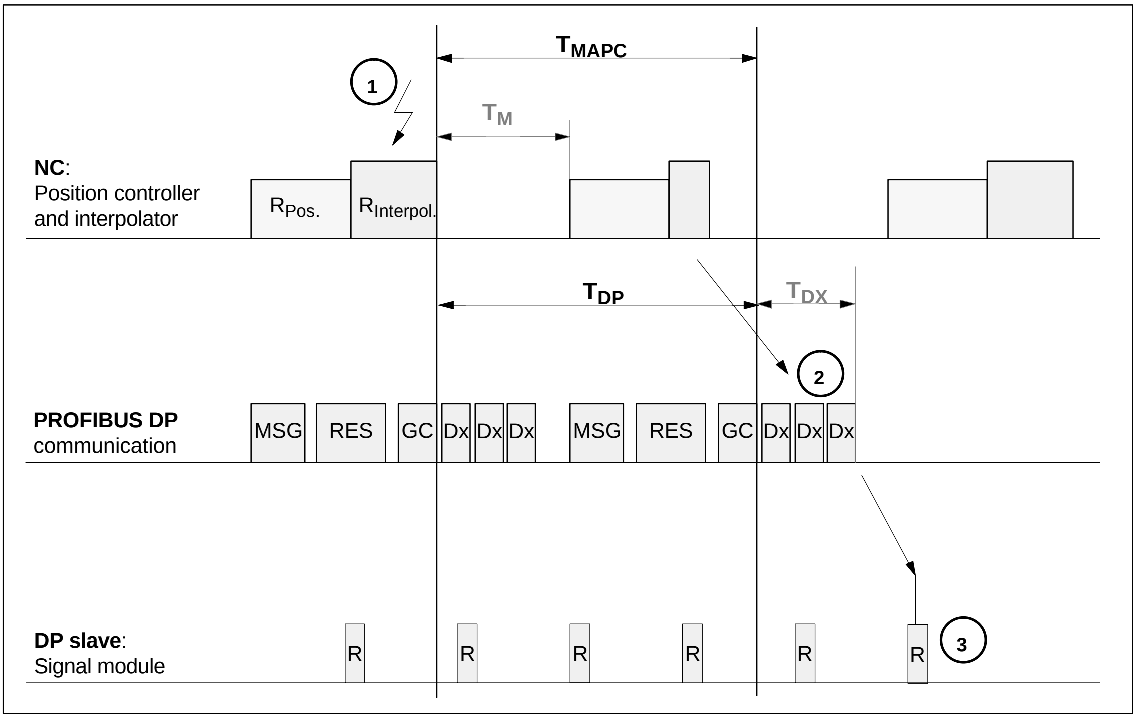


Fig. 10-34 Time behavior when outputting an output signal with optimized DP cycle

Explanations regarding Fig. 10-34:

T_{MAPC}	Master application cycle: NC position controller cycle With SINUMERIK 840Di, the following applies in all cases: $T_{MAPC} = T_{DP}$
T_{DP}	DP cycle time: DP cycle time
T_{DX}	Data exchange time: Total of transfer times of all DP slaves
T_M	Master time: Shift of starting time of the NC position control
GC	Global Control: Broadcast message frame for cyclic synchronization of the isosynchronism between DP master and DP slaves

R	Computational time of position controller and/or signal module
Dx	User data exchange between DP master and DP slaves
MSG	Acyclic services (e.g. DP/V1, token transfer)
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**.

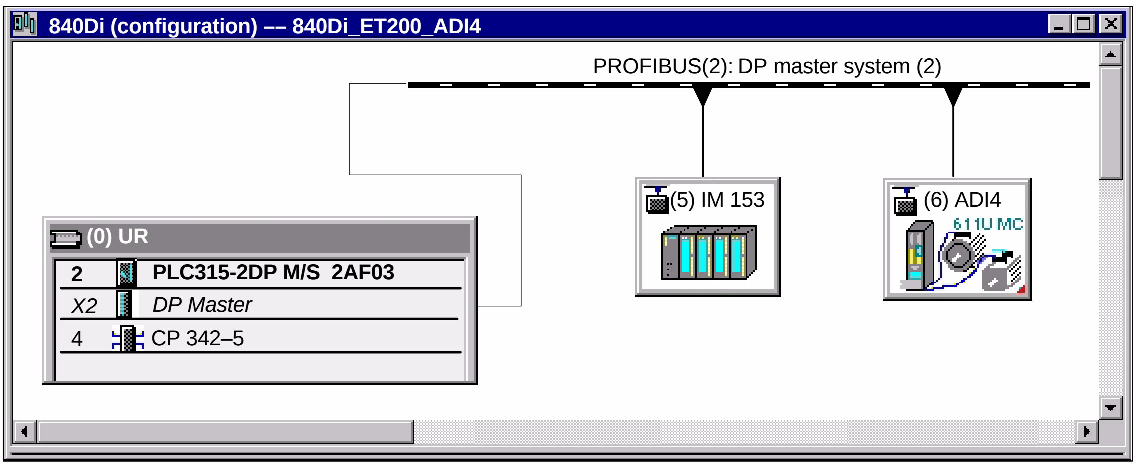


Fig. 10-35 Example configuration: SINUMERIK 840Di with ET200 and ADI4

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		1. Axis
6	Drive modules		258...267	1. 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 7.3.6, page 7-220f.				

Machine data

Parameterization of the NC machine data is shown below:

Number of input bytes

ET200

3 input bytes

ADI4

1 input byte.

Note

Although only four input bytes are used, five 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 output bytes

ET200

2 output bytes

ADI4

2 output bytes.

Note

Although only four output bytes are used, five 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	Identifier	Name	Ref.
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	Identifier	Name	Ref.
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	Ref.
General	**Signals from PLC to NC**		
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 (SW 2.2 and higher)

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.

Until now, integrating a compile cycle in the control required an additional generation process to bind the compile cycle to the NCK system software to achieve a complete system.

With SW 2.2 and higher, the compile cycles are no longer integrated in the NCK by means of an additional generation process; instead they can be loaded in the control at any time.

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
  Section clearance control (TE1)

– Continue Machining at the Contour (Retrace Support)
  Order No.: 6FC5 251-0AE72-0AA0
  References: /FB3/ Description of Functions Special Functions
  Section Continue Machining-Retrace Support (TE7)

– Fast Laser Switching Signal
  Order No.: 6FC5 251-0AE74-0AA0
  References: /FB3/ Description of Functions Special Functions
  Section Cycle-Independent 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 itself as a loadable file (extension .ELF for executable and linking format), please contact your local Siemens sales representative.

Note

Compile cycles created by Siemens are options that require explicit activation and licensing.

References: Ordering information Catalog NC 60.2002

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

Requirements: 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.

Transfer

Proceed as follows to transfer a compile cycle to the NCK:

1. Exit any active HMI Advanced windows and activate the NT desktop.
2. Use the Windows NT 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**

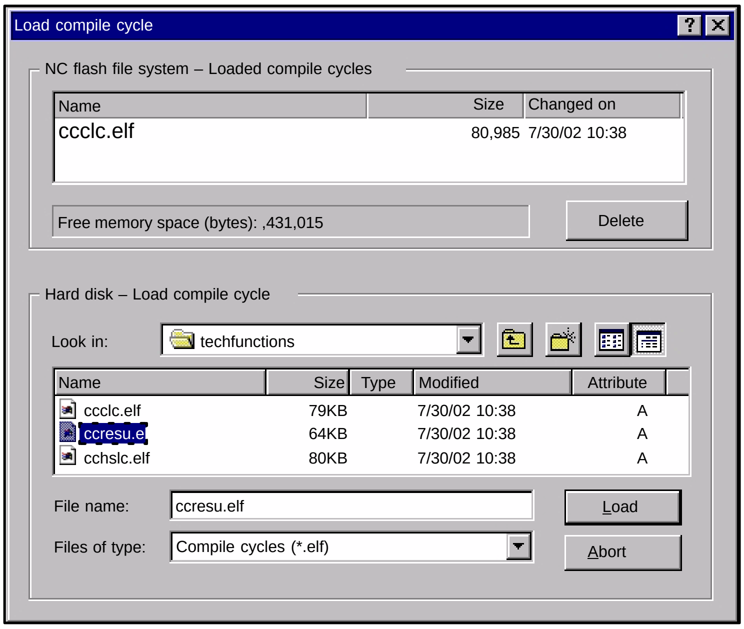


Fig. 10-36 SinuCom NC: Load compile cycle

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 don't need to perform an NCK reset after each copy procedure.

10.7.2 Boundary conditions

The following checks are performed for all loaded compile cycles when the NCK boots:

Interface versions

If the interface version of the compile cycle is incompatible with the interface version of the NCK system software, the following alarm is 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<Identifier>_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<identifier>_ELF NO_840Di"

Not enabled for SINUMERIK 840DiE

- Alarm "7200 CC<identifier>_ELF NO_EMBARGO".

Notice

If after booting the NCK, alarm "7200 . . ." appears, then none of the loaded compile cycles are active.

10.7.3 Activating and licensing the technological 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 6.8, page 6-201.

Activating the technological function

Each loaded compile cycle generates a technological function-specific global machine data:

- $MN_CC_ACTIVE_IN_CHAN_<*identifier*>[n], with 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 10-392.

References

The individual technological functions are described in:

/FB3/ Description of Functions Special Functions
Sections 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

<table>
<tr><td colspan="2">60900 + i
with i = 0. 1. 2nd 3 ...
MD number</td><td colspan="4">CC_ACTIV_IN_CHAN_XXXX[n]
with: XXXX = function identifier, n = 0 or 1
n = 0: Activation of the technological function in the NC channels
n = 1: Additional functions within the technological function</td></tr>
<tr><td colspan="2">Default settings: 0</td><td colspan="2">min. input limit: 0</td><td colspan="2">max. input limit: FFFF</td></tr>
<tr><td colspan="3">Changes valid after RESET</td><td colspan="2">Protection level: 2 / 7</td><td>Unit: –</td></tr>
<tr><td colspan="4">Data type: UINT16</td><td colspan="2">valid from SW: 2.2</td></tr>
<tr><td colspan="2">Meaning:</td><td colspan="4">Activation of the technological function in the NC channels
The technological function is activated in the NC channels via the MD with the index n = 0.
Bit 0 = 1: Technological function activated in NC channel 1
Bit n = 1: Technological 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 technological function:
Additional functions within the individual technological function can be activated via the MD with the index n = 1. See References below.
References: /FB3/ Description of Functions Special Functions TE1 – TE8.</td></tr>
</table>

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 on 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 10-393).

10.8.2 Data descriptions (MD)

General machine data

<table>
<tr><td>11250
MD number</td><td colspan="3">PROFIBUS_SHUTDOWN_TYPE
PROFIBUS shutdown handling</td></tr>
<tr><td>Default settings: 0</td><td>min. input limit: 0</td><td colspan="2">max. input limit: 2</td></tr>
<tr><td colspan="2">Changes valid after RESET</td><td>Protection level: 2 / 7</td><td>Unit: –</td></tr>
<tr><td colspan="2">Data type: UINT8</td><td colspan="2">valid from SW: 2.2</td></tr>
<tr><td>Meaning:</td><td colspan="3">Shut-down modes of PROFIBUS DP communication:
0 = PROFIBUS DP communication is shut down at the DP master end without any warning.
1 = PROFIBUS DP is switched to CLEAR mode for at least 20 clock cycles. PROFIBUS DP communication is then shut down. If it is not possible to switch the PROFIBUS DP to CLEAR mode, the procedure described in step 2 is followed. 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.</td></tr>
</table>

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.

Parameterizing default settings

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_MODcE
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 IWS
Section: Workpiece-related actual value system/reset behavior

10.10 NC/PLC diagnosis (840Di SW 2.3 and higher)

10.10.1 Menu: Diagnostics

Operating path

The menu for NC/PLC diagnosis is located under the follwoing operating path:

- Operating area switchover > Diagnosis > NC/PLC Diagnosis > Diagnosis

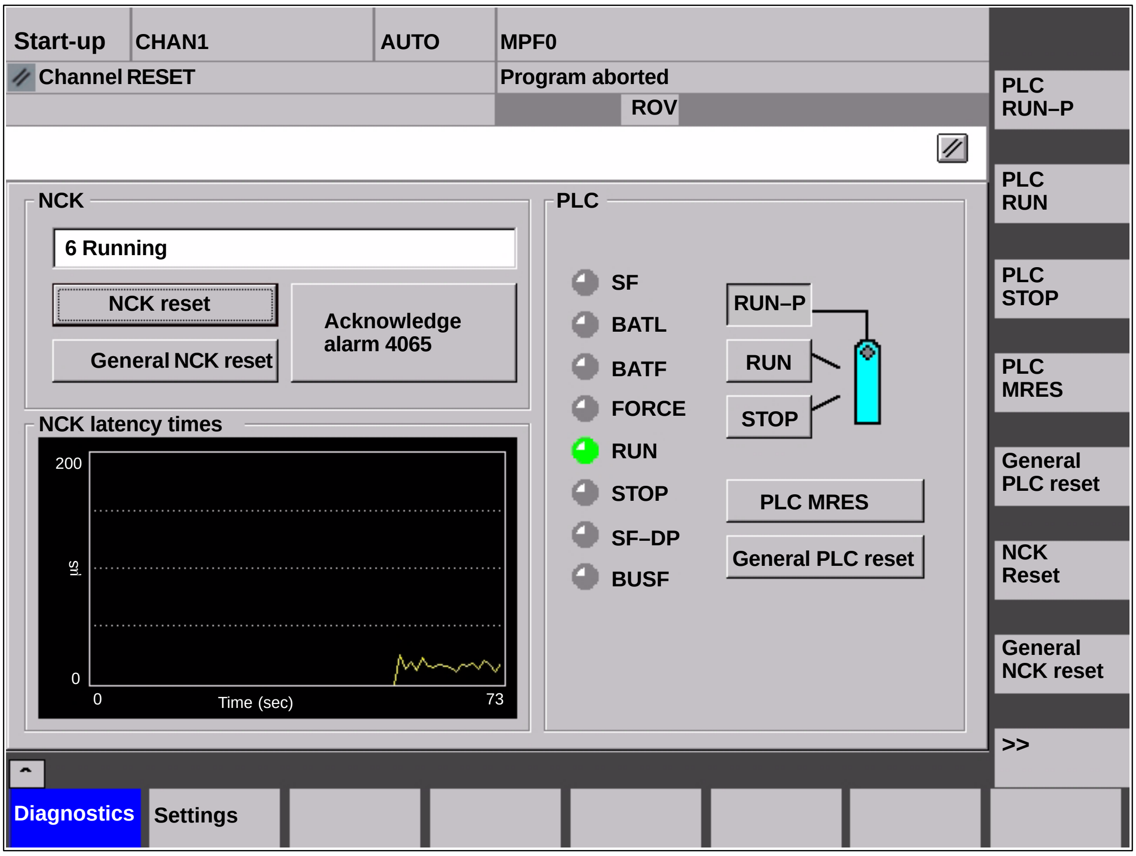


Fig. 10-37 Menu: NC/PLC diagnosis

Group: NCK

The NCK group combines the following functions:

- **NCK status**

  The output field displays the current status of the NCK:

  – 0 not started
  – 1 started
  – 2 Initialize data
  – 3 Initialize data
  – 4 Start–up
  – 5 Wait for PLC
  – 6 Running
  – F NCK error

- **NCK reset**

  The “NCK Reset” button initiates an NCK POWER ON reset.

  On NCK POWER ON reset, all machining activities are aborted. Maximum deceleration for drives in motion does not take place at the acceleration characteristic but at the current limit.

  After start–up, the NC status is Reset. Machine and user data are not changed.

- **General NCK reset**

  The “General NCK reset” button initiates a NCK–POWER ON reset followed by ageneral NCK reset.

  All active machining processes are aborted as described for “NCK reset”.

  After start–up, the NC status is Reset. All machine and user data have been deleted and the standard machine data loaded.

Notice

After “General NCK resetart”, it is necessary to recommission the NC or load a series start–up file (see Section 14, Page 14-449).

- **Acknowledging Alarm 4065**

  The “Acknowledge Alarm 4065” acknowledges alarm:

  - Alarm: “4065 Battery-backed memory has been restored from the backup copy disk (possible data loss)”

  and triggers a NCK–POWER ON reset.

  To acknowledge the alarm per soft key, it is necessary to switch to the next soft key bar per ETC.

Note

Alarm 4065 can also be acknowledged with a NCK–POWER ON reset per “General NCK reset”. Then, the NC must be recommissioned or a series machine start-up file (see Chapter 14, Page 14-449) loaded.

Group: PLC

The PLC group combines the following functions:

- **PLC RUN–P**

  Use the button PLC “RUN–P” to bring the PLC to the status ”RUN–PROGRAMMING”. In this state, it is possible to modify the PLC user program without activating the password.

- **PLC RUN.**

  Use the button “PLC RUN” to bring the PLC to the ”RUN” status. Only read access via a programming unit is possible in this operating state. Changes cannot be made to the PLC user program until the password has been set.

- **PLC STOP**

  Use the button “PLC STOP” to bring the PLC to the status ”STOP”. Processing of the PLC program is halted and all outputs are set to alternative values.

- **PLC MRES**

  Use the button “PLC MRES” to bring the PLC to the “STOP” state and then perform a general PLC reset. The follwoing actions are carried out by the PLC:

  1. The PLC deactivates all existing connections.
  2. The user data are deleted (data and program blocks)
  3. The system data blocks (SDB) are deleted.
  4. Non–volatile data are copied to RAM again by the PLC after the general reset.
  5. The diagnosis buffer, MPI parameters, time and operating hour counter are not reset.

- **General PLC reset**

  Use the button “General PLC reset” to bring the PLC to the “STOP” state and then perform an extended general PLC reset. The actions stated above at 1. – 4. are performed and the parameters stated at 5. also reset.

- **Status displays**

  The states displayed by the LEDs proivde the following information:

  - **SF** (System Fault)
    Lights up on PLC system fault, e.g. hardware, programming, parameterization, computation, timing, battery and communication faults.
  - **BATL** (Battery Low)
    Lights up if the 5 V supply voltage (buffer battery) falls below it minimum permissible value.
  - **BATF** (Battery Fault)
    Lights up if the 5 V supply voltage fails (buffer battery).
  - **FORCE**
    Lights up when the FORCE function is active.

    Use the FORCE function to set user variable to fixed values that the user program must not exceed. Detailed information is provided in the online help of the SIMATIC Manager STEP 7.
  - **RUN**: see Table 10-54 below.
  - **STOP**: see Table 10-54 below.
  - **SF–DP** (Groupfault–Distributed I/Os)
    Lights up if one of the distributed I/Os signals a fault.
  - **BUSF** (Bus fault)
    Lights up in connection with PROFIBUS–DP, e.g.:
    – Bus fault (e.g. short/circuit or interruption)
    – Interface error (e.g. error in S7 configuration)

Table 10-54 PLC operating state display per RUN/STOP evaluation

RUN	STOP	PLC operating state
lit	off	RUN The PLC program is running.
off	lit	STOP: The PLC program is not running. STOP can be triggered by the PLC program, by an error or per user operation.
Flashes at 0.5 Hz	lit	HOLD: The PLC user program was halted (triggered by a test function).
Flashes at 2 Hz	lit	RESTART: A PLC start–up is performed (transition from STOP to RUN). If the action is aborted, a transition to STOP take place.
off	– lit – off for 3 secs – lit	General reset: General reset requested.
off	– lit – flashes at 2Hz for at least. 3 secs – lit	General reset: General reset active

Group: NCK latency time

The NCK latency time group combines the following information:

- **NCK latency time**

  The foundation for the SINUMERIK 840Di Real–time property is the cyclic activation of the NC system software at defined intervals.

  Since the NC and Windows NT share the available processor resources of the PLC, there can be delays (latency times) when calling the NCK. Latency times greater than 200µsecs are Real–time violations, for which the functional integrity of the NC is not longer guaranteed.

  The latency time display of the NCK can be used to continuously monitor the latency behavior of the NCK over a period of 50 seconds. Following replacement of extension of the HW and/or SW components, it is thus possible to determine whether, and if so to what extent, these have an effect on the real–time behavior of the NCK.

Note

For details of real–time properties of the SINUMERIK 840Di, refer to Subsection 1.1.4, Page 1-24.

10.10.2 Menu: Settings

Operating path

The menu for the SINUMERIK 840Di–specific settings is located under the foll-woing operating path:

- Operating area switchover > Diagnosis > NC/PLC Diagnosis > Settings

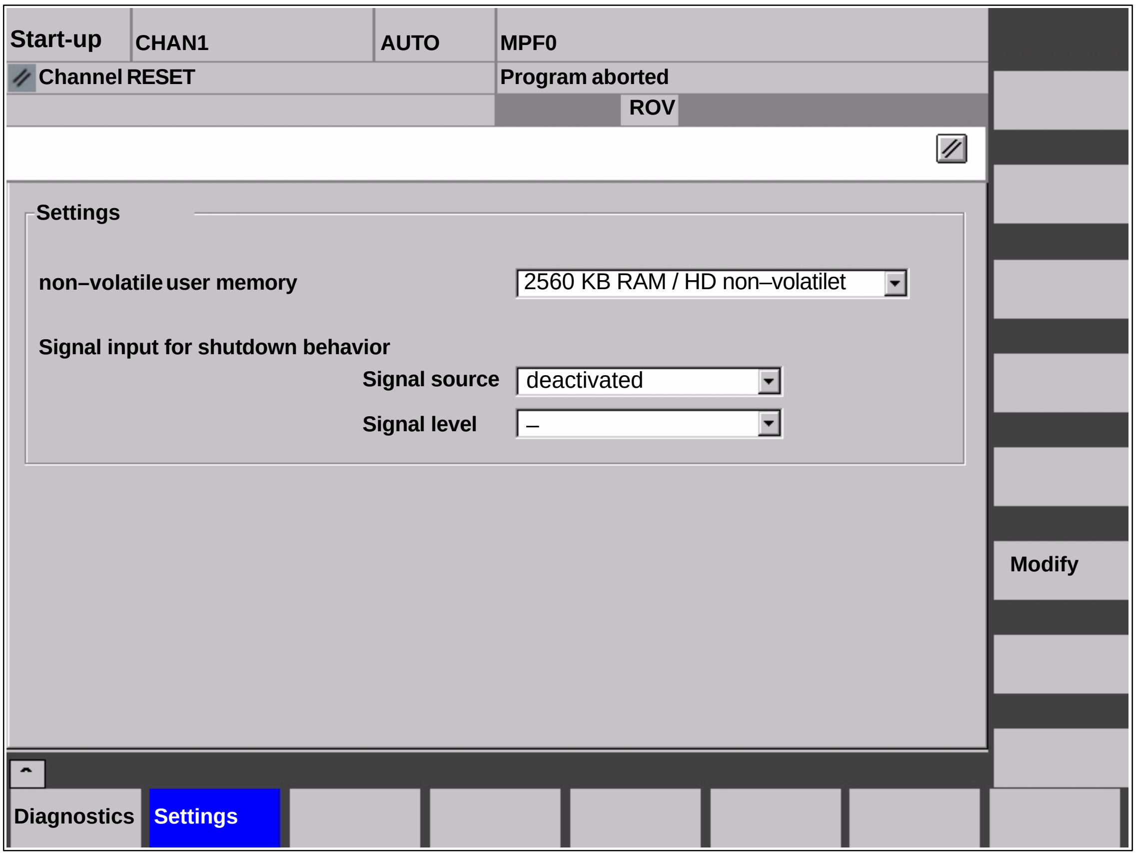


Fig. 10-38 Menu: Settings

Modifying data

On switchover to the menu, the data displayed are read–only. To modify the data, first press the soft key: Modify.

Group: Settings

The Settings group combines the following functions:

- **Non–volatile user memory**

  Use the list box to select the size of the non–volatile user memory:

Note

The siye of the SRAM memory area is displayed in the following machine data:

- MD 18060: INFO_FREE_MEM_DYNAMIC (free static memory).

- **512KB SRAM**
  This selection option assigns the 1 MB physical SRAM SRAM of the MCI boards to the NCK for storing retentive data. Approx. 512KB, depending on the configuration of the NCK (number of channels, number of axes, etc.) are available to the user as user memory.
- **2560KB RAM / HD non–volatile**
  This selection option assigns 3MB of virtual SRAM (see Subsection 10.4.3, Page 10-300) to the NCK for storing retentive data. Approx. 2560KB, depending on the configuration of the NCK (number of channels, number of axes, etc.) are available to the user as user memory.

Notice

On loss of voltage or if the PCU is deactivated without terminating Window NT correctly, all user data are lost. A UPS system (see Subsection 1.1.8, Page 1-29) is therefore absolutely necessary in conjunction with the virtual SRAM.

- **Signal input for Shutdown behavior: Signal source**

  Use the list box to configure the digital input used for the shutdown signal of the UPS:

  - **deactivated**
    No input signal present
  - **NCK inputs 0...3**
    The shutdown signal of the UPS is connected to the digital input of the MCI board extension module (see Subsection 2.4.3, Page 2-66).
- **Signal input for shutdown behavior: Signal level**

  Use the list boc to configure 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 NT are terminated
  - **High active**
    On detection of the high level (1) at the configured input,
    SINUMERIK 840Di NCK / PLC and then Windows NT are terminated.

Accept changes

To accept the changes made press the soft key: Accept. The message box that appears must also be confirmed by pressing the soft key: Accept.

Use the soft key: Abort to discard all changes and display the original settings again.

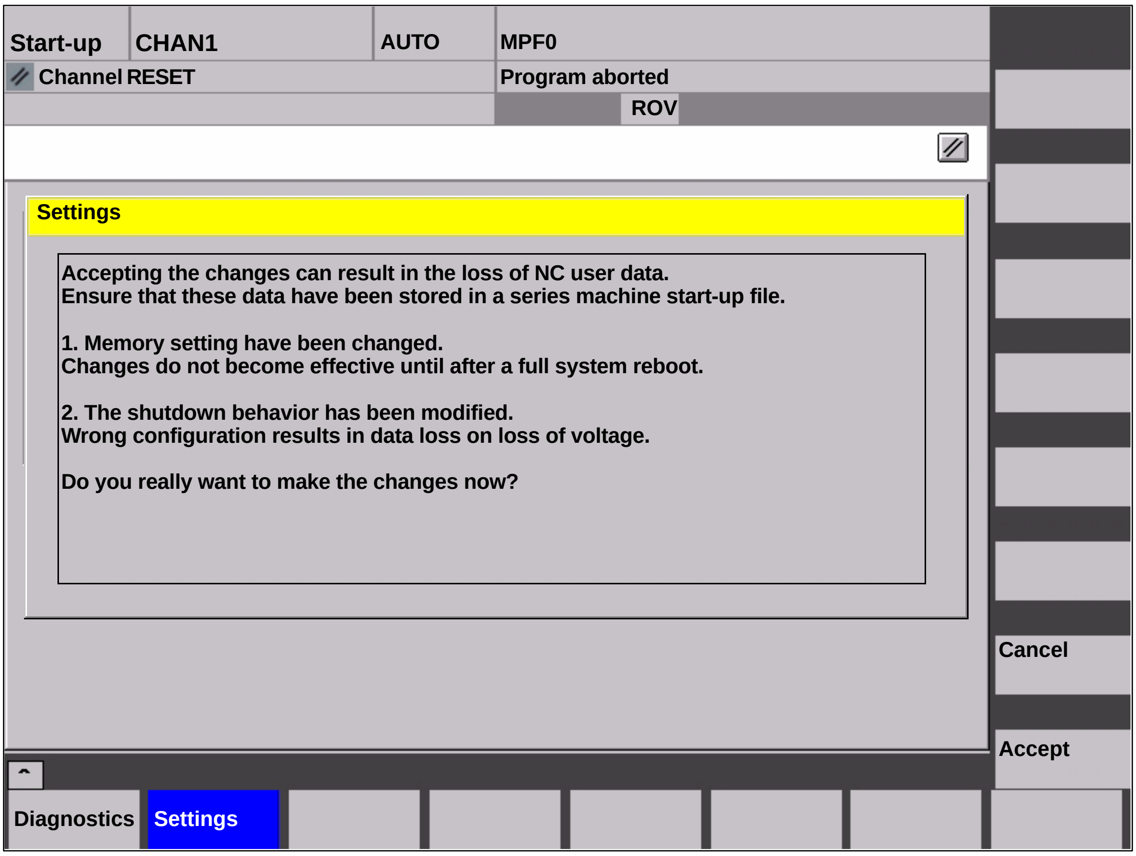


Fig. 10-39 Accepting settings

Notice

It is strongly recommended that you create a series machine start-up file as described above prior to making any changes. See Chapter 14, page 14-449.

■

Notes

Alarm and Message Texts 11

11.1 Alarm and message texts

In order to be able to easily adapt 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.

Storage of 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**. To this aim, the appropriate paths to the application-specific standard and user files must be stored in the section [Textfiles] of the file MBDDE.INI.

Extract of the 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

Standard text files

The standard alarm and message texts in ASCII format are stored in the following files on the hard disk:

– MMC : <installation path>\dh\mb.dir\alm_XX.com

– NCK : <installation path>\dh\mb.dir\aln_XX.com

– PLC : <installation path>\dh\mb.dir\alp_XX.com

– ZYK : <installation path>\dh\mb.dir\alz_XX.com

– CZYK : <installation path>\dh\mb.dir\alc_XX.com

“XX” stands for the abbreviation of the appropriate language (see Table 11-1, page 11-405).

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 the directory:
<installation path> \dh\mb.dir.

Language dependency of the alarm texts

The language assignment of the user-specific alarm texts is done using 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 in the case of a software update, 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-specific file for user-specific, 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 might not be displayed on the screen correctly.

11.1.4 Syntax for alarm text files

Alarm numbers

The following alarm numbers are available for alarms relating to cycles, compile cycles and the PLC:

Table 11-2 Alarm numbers for cycle, compile cycle and PLC alarms

Number range	Designation	Effect	Delete
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 sequential controllers/graphs		

Format of the text file for cycle alarm texts

The text file for cycle and compile cycle alarms has the following structure:

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 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 Basic PLC Program
Section: Lists

Alarm number

Alarm number list

Display

This number defines the alarm display type:
0: Display in alarm line
1: Display in a dialog box

Help ID

The 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 11-408, section: HelpContext.

Text or alarm number

The associated text is given in inverted commas with the position parameters.

- The characters ” and # must not be used in alarm texts.
  The character % is reserved for displaying parameters.
- If the user wishes to use an existing text, he can insert a reference to the appropriate alarm text. 5-digit alarm number instead of “text”.
- The alarm text file may contain comment lines which 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 cut off and the symbol “*****” 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 FDDIS all
600124	1	0	“Feed disable axis %A”	Feed disable axis 1
600224	1	0	600124	Feed disable axis 2
600324	1	0	600224	Feed disable axis 3
703210	1	1	“User text”	User text
...				
703211	1	1	“User text%A ...”	User text Axis 1 ...
// Alarm text file for PLC alarms				

References: /FB/, Description of Functions, Basic Machine P3, Basic PLC Program

Display

This number defines the alarm display type:
0: Display in alarm line
1: Display in a dialog box

Help ID

The 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 11-408, section: HelpContext.

Text or alarm number

The associated text is given in inverted commas with the position parameters.

- The characters ” and # must not be used in alarm texts.
  The character % is reserved for displaying parameters.
- If the user wishes to use an existing text, he can insert a reference to the appropriate alarm text. 6-digit alarm number instead of “text”.
- The alarm text file may contain comment lines which 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 cut off and the symbol “*” 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., sequential controller 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 Section of the file MBDDE.INI

Section	Meaning
Alarms	General information on the alarm list: e.g. time/date format of the messages
TextFiles	Path/file specification of the alarm/text files: e.g. UserPLC = <installation path>\dh\mb.dir\myplc_
HelpContext	Names and paths of the help files: e.g. File0=hlp\alarm_
DEFAULTPRIO	Priorities of the various alarm types: e.g. POWERON=100
PROTOCOL	Log properties: e.g. file=.\proto.txt <name and path of log file>)
KEYS	Information on keys that can be used to delete alarms: e.g. Cancel = +F10 <Use key combination Shift+F10 to delete an alarm>

You will find further details of file entries in:

References: /BN/ User’s Guide: OEM package for MMC

Section: [Alarms]

The settings in this section define the following properties of the alarm list:

- **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 order in which the alarms are included in the alarm list:

  FIRST puts more recent alarms at the head of the list,
  LAST puts more recent alarms at the end 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
    MaxNo=50
    ORDER=FIRST
```

■

Notes

Dry Run of Axis and Spindle 12

12.1 Preconditions

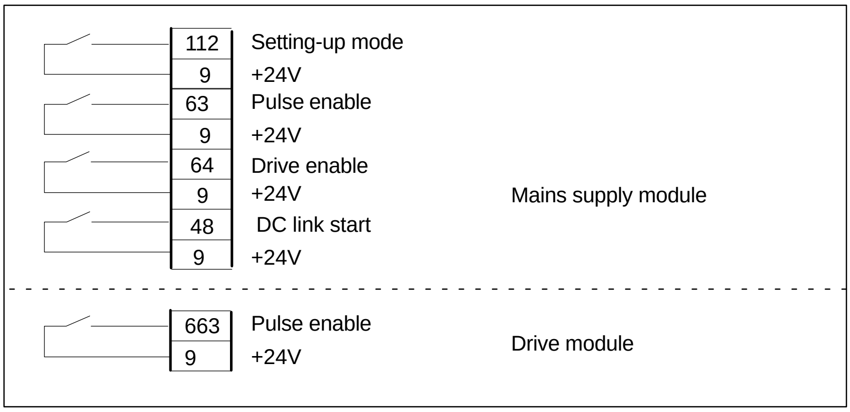
Axis enabling

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)

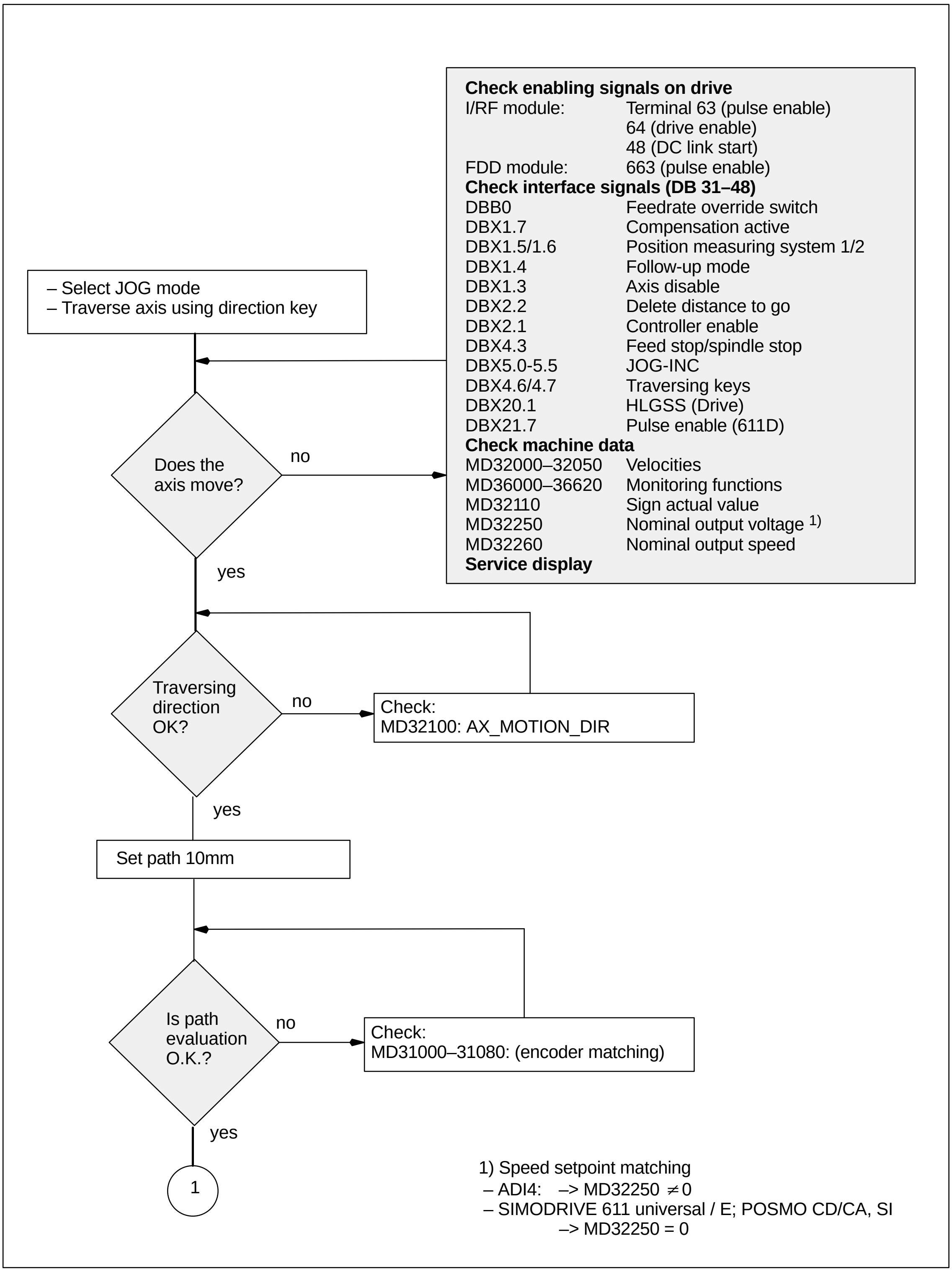
References: /FB/ Description of Functions, Basic Machine
A2, Various Interface Signals and Functions

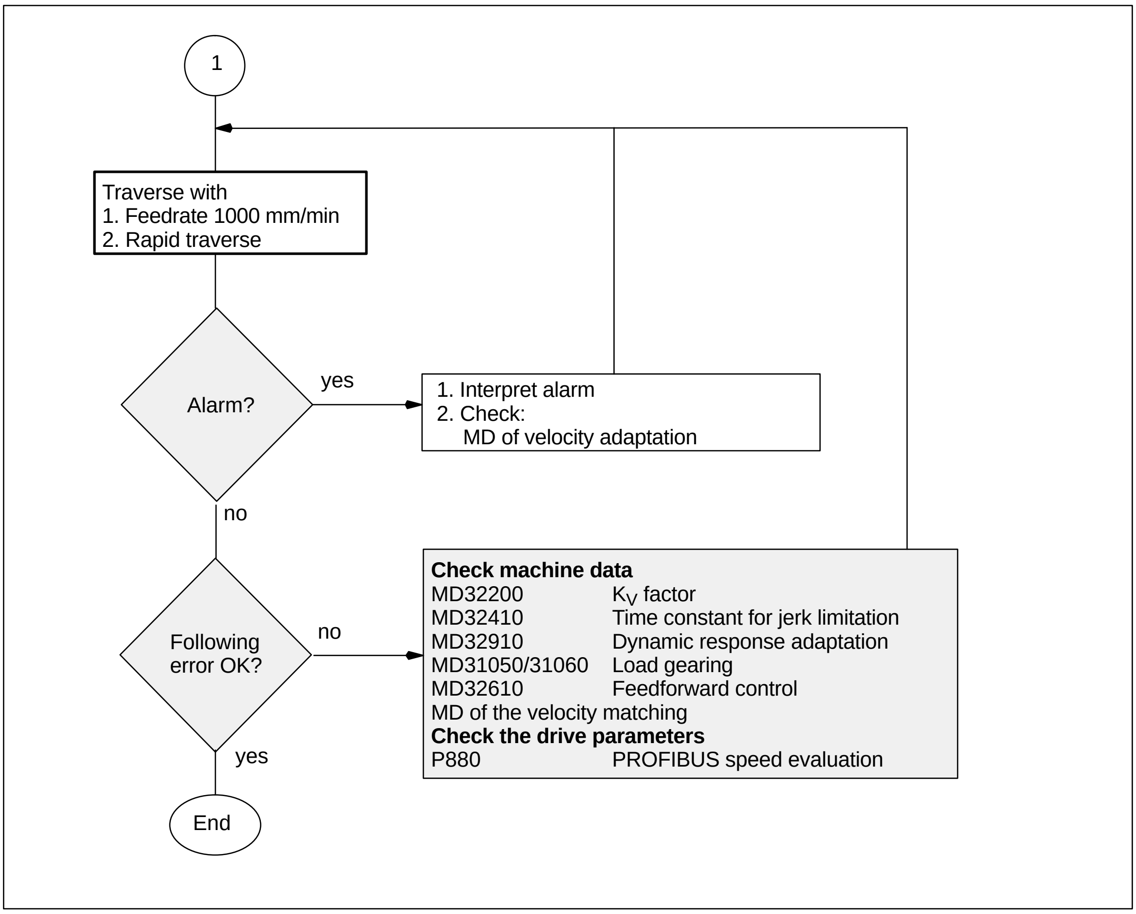
Limit switches

Setting the limit switches and checking the interface signals:

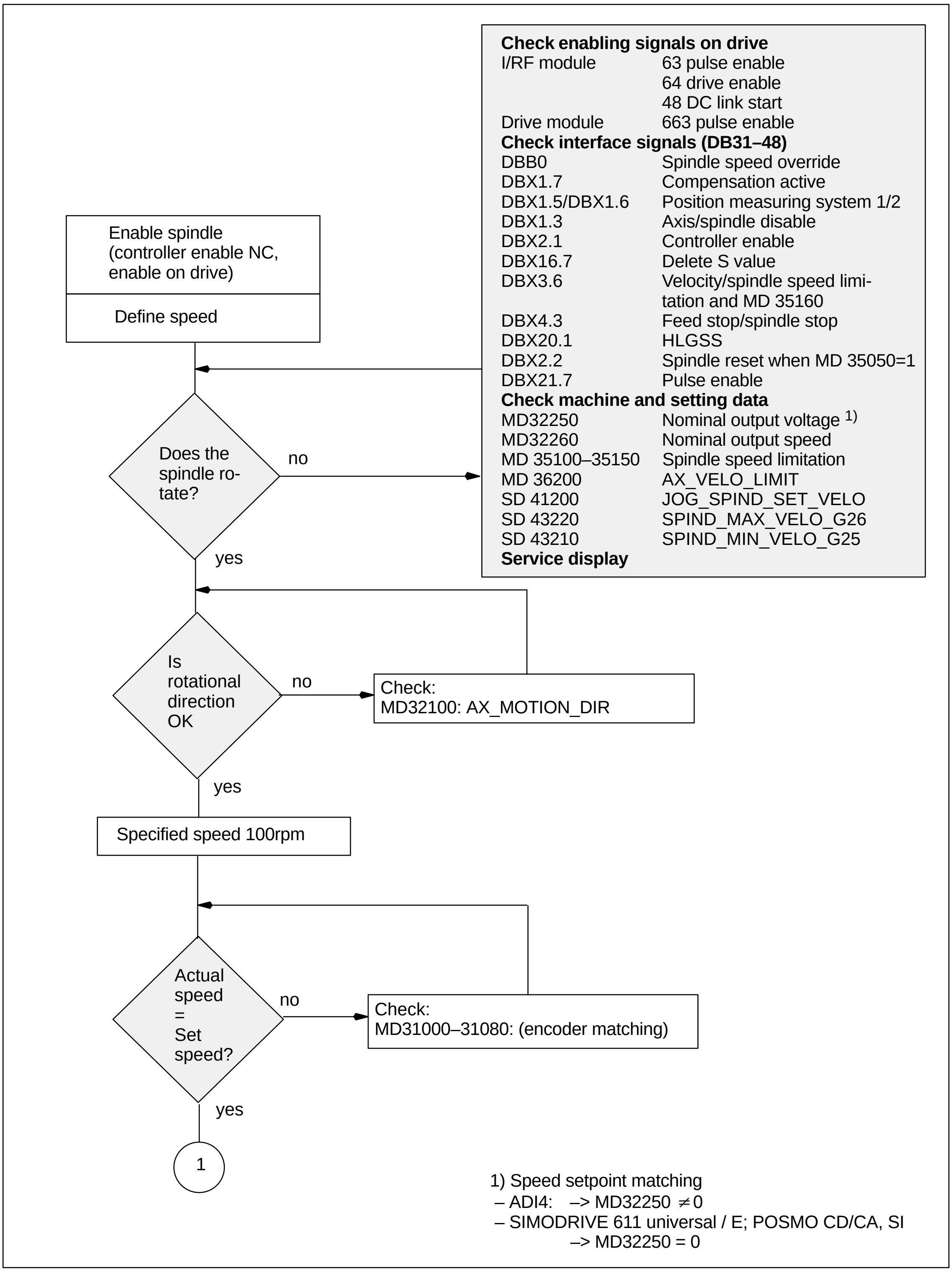
- Hardware limit switch PLUS DB31-DBxx.DBX12.1
- Hardware limit switch MINUS DB31-DBxx.DBX12.0.

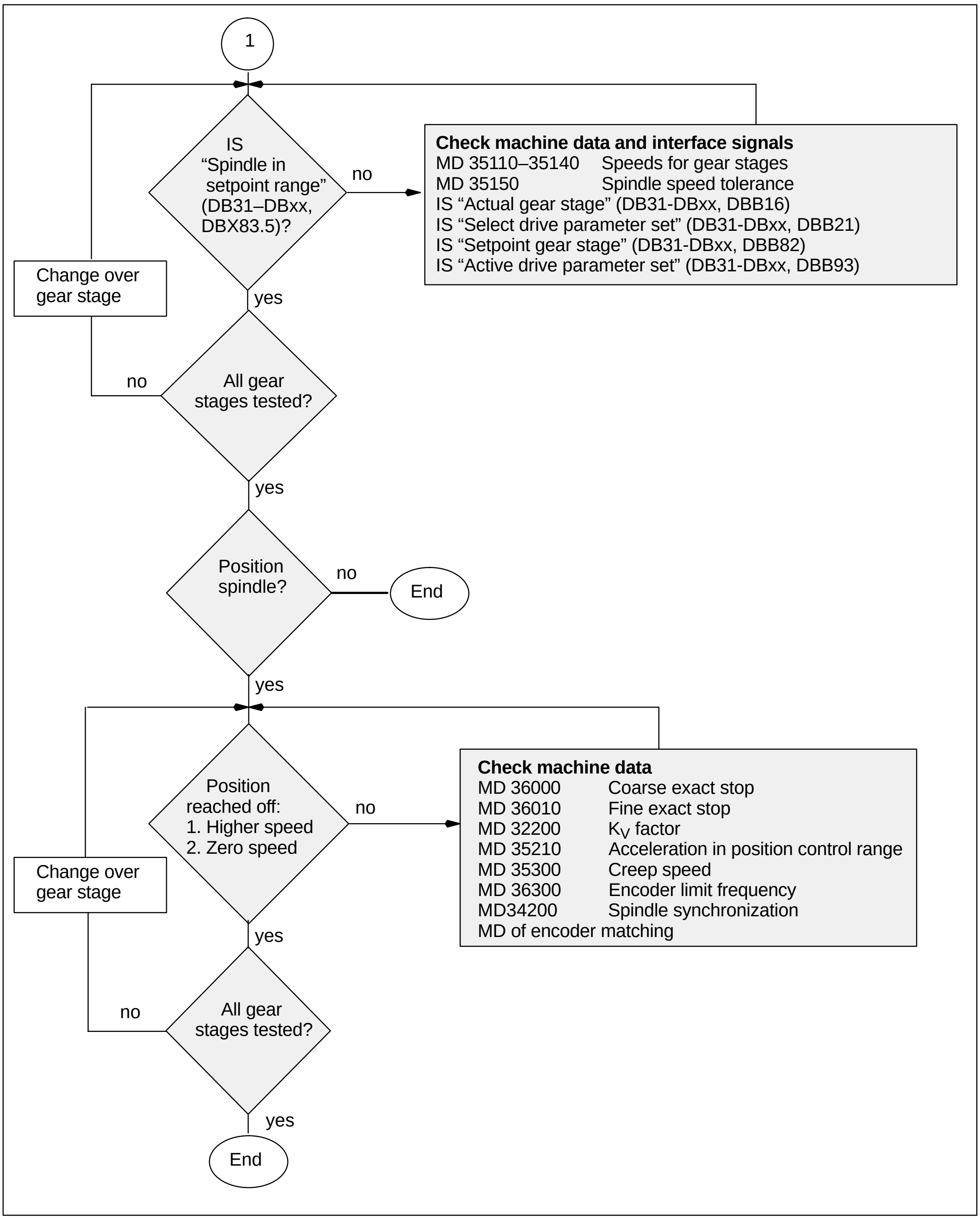
12.2 Dry run of axis




1
Traverse with
1. Feedrate 1000 mm/min
2. Rapid traverse
Alarm?
yes
1. Interpret alarm
2. Check:
MD of velocity adaptation
no
Following error OK?
no
Check machine data
MD32200 K_V factor
MD32410 Time constant for jerk limitation
MD32910 Dynamic response adaptation
MD31050/31060 Load gearing
MD32610 Feedforward control
MD of the velocity matching
Check the drive parameters
P880 PROFIBUS speed evaluation
yes
End

12.3 Dry run of spindle




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 “Select drive parameter set” (DB31-DBxx, DBB21)
IS “Setpoint gear stage” (DB31-DBxx, DBB82)
IS “Active drive parameter set” (DB31-DBxx, DBB93)
yes
Change over gear stage
no
All gear stages tested?
yes
Position spindle?
no
End
yes
Position reached off:
1. Higher speed
2. Zero speed
no
Check machine data
MD 36000 Coarse exact stop
MD 36010 Fine exact stop
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

■

Drive Optimization using 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, Extended Functions
K3, Compensations
Section: Circularity test

Servo trace

Servo trace provides a graphically assisted analysis of the time response of servo and drive data. For example:

- Actual position
- Setpoint position
- 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

Several measuring functions are provided to display the time and/or frequency response of drives and closed-loop controls 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 Quantities and units of measurement and signal parameters

Size	Unit
Velocity	Metric system: Specified in mm/min or rev/min for translatory or rotary motions Inch system: Specified in inch/min or rev/min for translatory or rotary motions
Distance	Metric system: Specified in mm or degrees for translatory or rotary motions Inch system: Specified in inches or degrees for translatory or rotary motions
Time	Specified in msec
Frequency	Specified in Hz

Note

The default setting for all parameters is 0.

Prerequisites 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 Additional 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. 10-37, page 10-395.

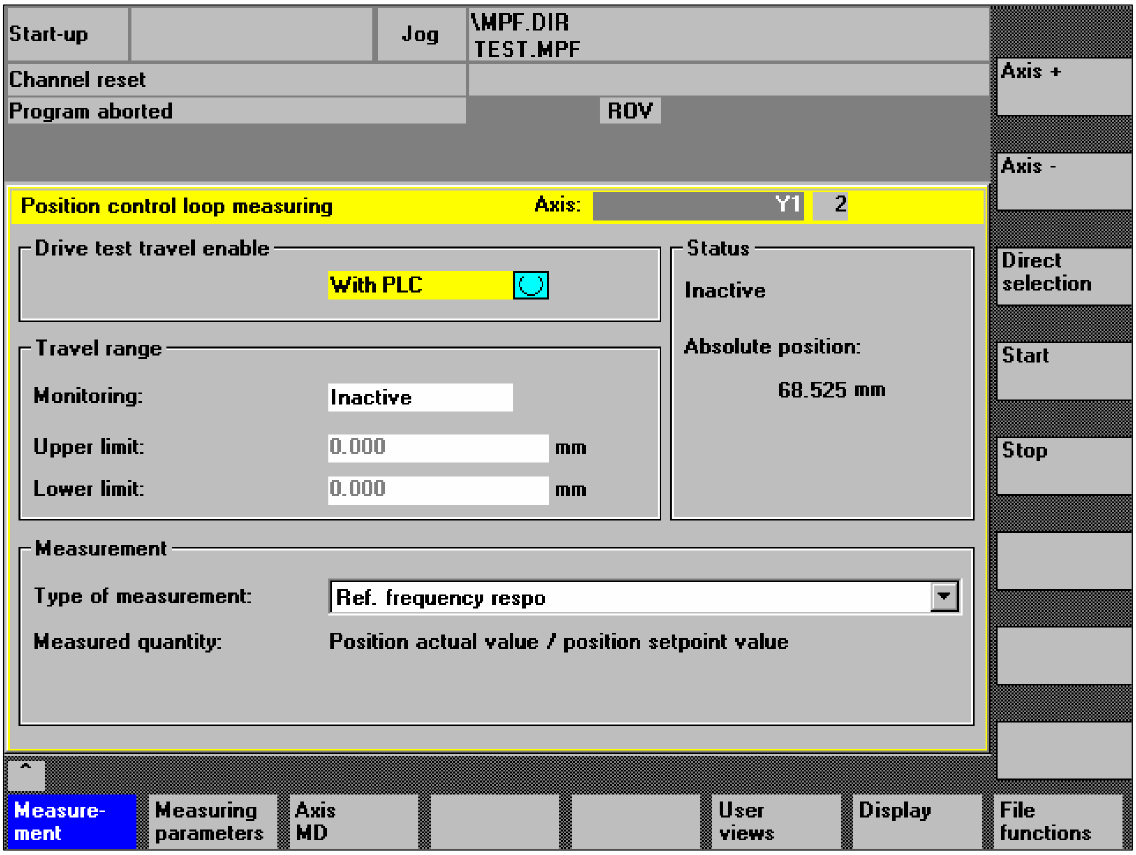
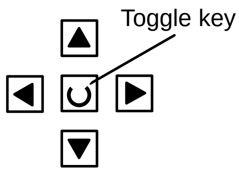


Fig. 13-1 Main menu: Position control loop measurement

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. 10-37, page 10-395.

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
  – Lower limit.

13.4 Frequency response measurement

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 Measurement of the torque control loop

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. Set the traversing range monitoring function and enabling logic in the **main menu.**
   Four different types of measurement are available for testing the speed control loop:

   – Reference frequency response

   – Setpoint step change

   – Interference frequency response

   – Disturbance step change

   – Speed controller 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 response of the speed controller.

The response range should be as wide as possible and without resonance. It may be necessary to install stop or low-pass filters. Particular care must be taken to prevent resonance within the speed controller limit frequency range (stability limit approx. 200–500Hz).

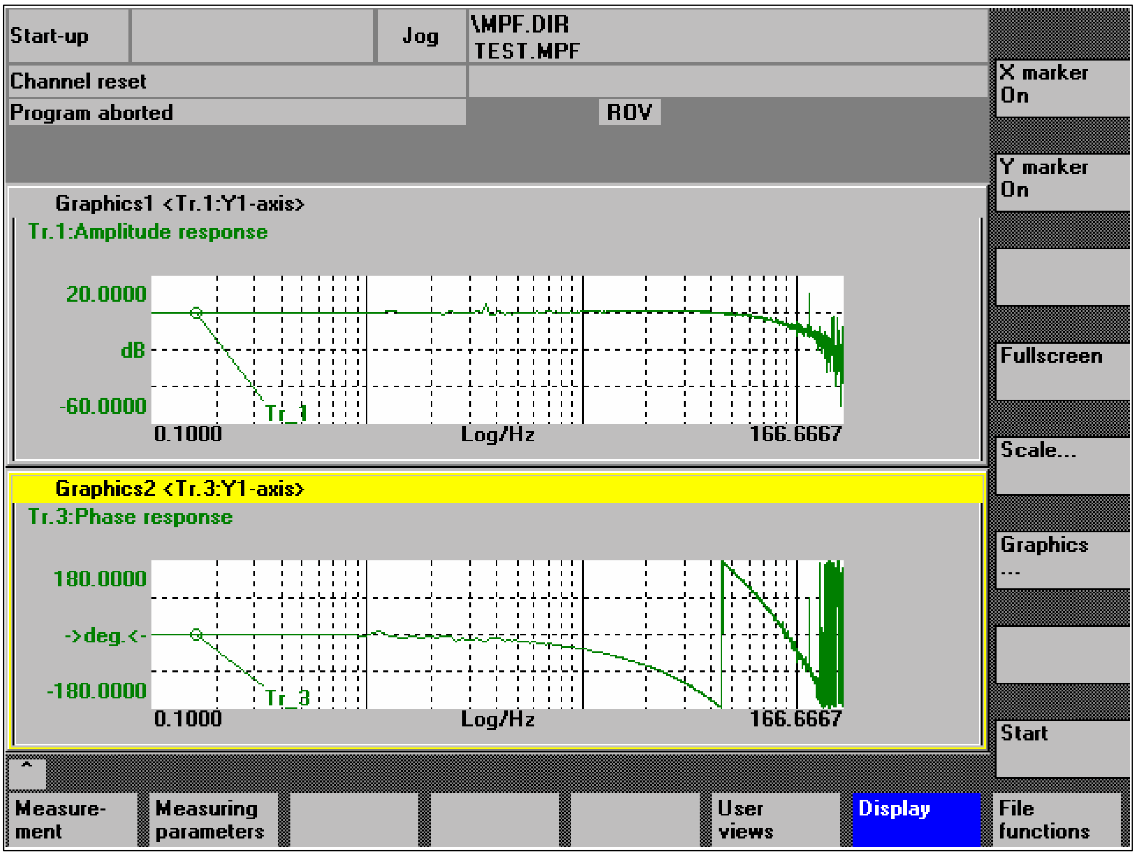


Fig. 13-2 Example: Measurement results of a reference frequency response measurement

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 height of the test signal amplitude. This should give rise to only a very low speed of a few (approximately 1 to 2) revs/min at the motor end.

Bandwidth
The bandwidth parameter is used to set the analyzed frequency range. The larger this value, the finer the frequency resolution and the longer the measurement time. The maximum value is given by the position control cycle ($T_{position\ controller}$).

$$Bandwidth_{max} [\ Hz\ ] = 1 / (2 * T_{position\ controller} [\ sec\ ])$$

Example: Position controller cycle: 2msec

$$Bandwidth_{max} = 1 / (2 * 2*10^{-3}) = 250Hz$$

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 1sec 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 using an acceleration ramp.
- The acceleration value is defined for one
  axis: check MD 32300: MAX_AX_ACCEL
  spindle: check 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 and disturbance setpoint change

The transient response (command behavior or disturbance characteristic) of the speed control in the time range can be assessed using the step excitation. The test signal is connected to the speed controller output for recording of the response to disturbances.

Amplitude
This parameter determines the height of the preset setpoint step change or disturbance change.

Measuring time
This parameter determines the recorded time range (maximum 2048 x speed controller cycles).

Offset
A low offset of a fed motor revolutions per minute can be selected to rule out an influence of the static friction.

- The **Offset** is run up using an acceleration ramp.
- The acceleration value is defined for one
  axis: check MD 32300: MAX_AX_ACCEL
  spindle: check 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.

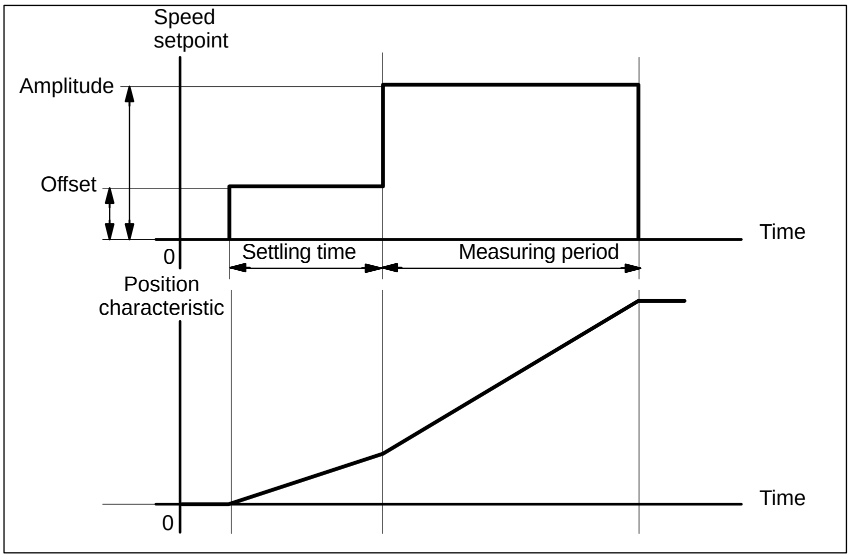


Fig. 13-3 Setpoint signal with measuring function speed control loop – step response

Additional information

The measurement parameters and the measurement results (diagrams) can be loaded and/or saved using the soft key **File functions**.

13.4.3 Position control loop measurement

Functionality

This measurement function basically analyses the response to the motor position measuring system. If the function is activated for a spindle without position measuring system, the NCK will generate an error message. Depending on which basic measurement setting has been selected, various measurement parameters lists as described below are made available.

Procedure

1. Set the traversing range monitoring function and enabling logic in the **main menu.**
   One of three different types of measurement 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 determines the transmission response of the position controller in the frequency (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.

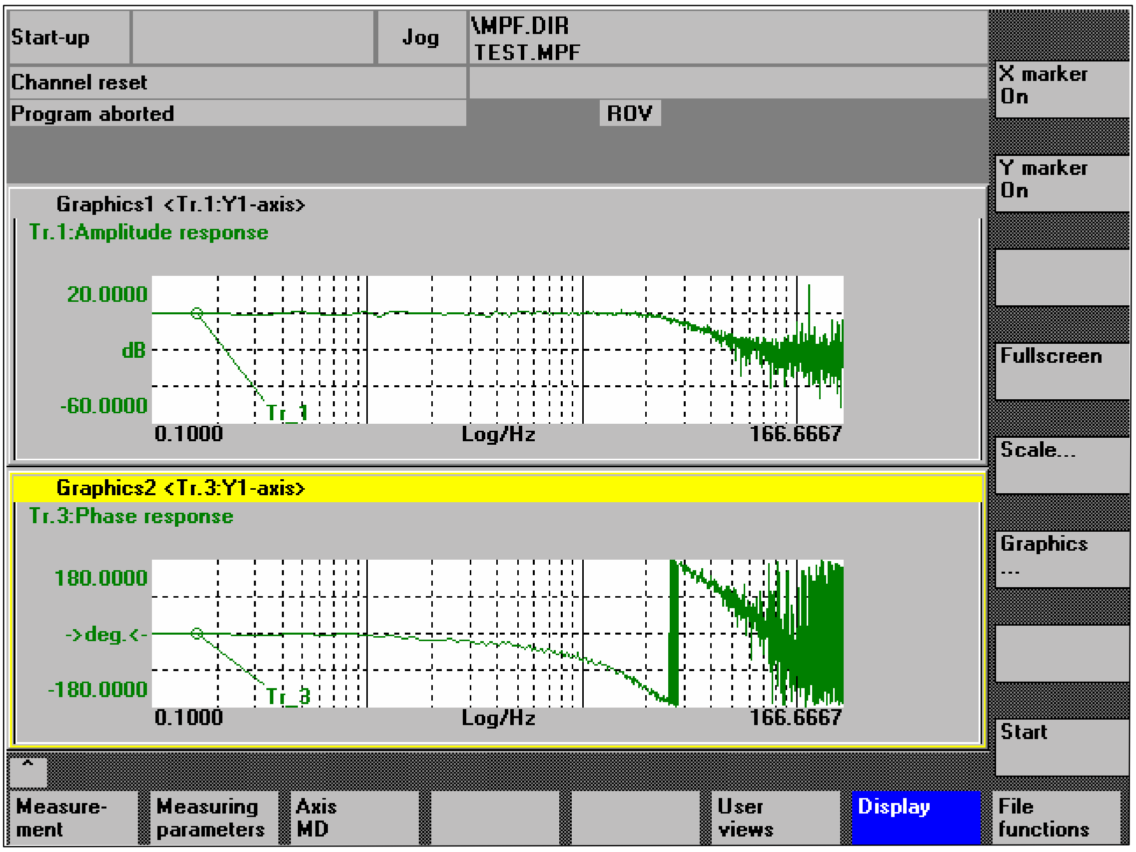


Fig. 13-4 Example: Measurement results of a reference frequency response measurement

Measurement parameters: Reference frequency response

Amplitude
This parameter determines the height of the test signal amplitude. It should be set to the smallest possible value (e.g. 0.01mm).

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 ($T_{position\ controller}$).

$$Bandwidth_{max} \text{ [Hz]} = 1 / (2 * T_{position\ controller} \text{ [sec]})$$

Example: Position controller cycle: 2msec

$$Bandwidth_{max} = 1 / (2 * 2*10^{-3}) = 250Hz$$

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 1sec 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 response and positioning response of the servo loop in the time range, in particular, the effect of setpoint filters, can be assessed using the step excitation and the ramp excitation.

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 measurement quantities are possible:

– Actual position value (active position measuring system)

– Control deviation (following error)

Amplitude
This parameter determines the height of the preset setpoint step change or ramp.

Measurement time
This parameter determines the period of time to be recorded (maximum value: 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 using

- 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.

Offset
The step is stimulated from standstill or starting from the constant traverse speed set in this parameter.

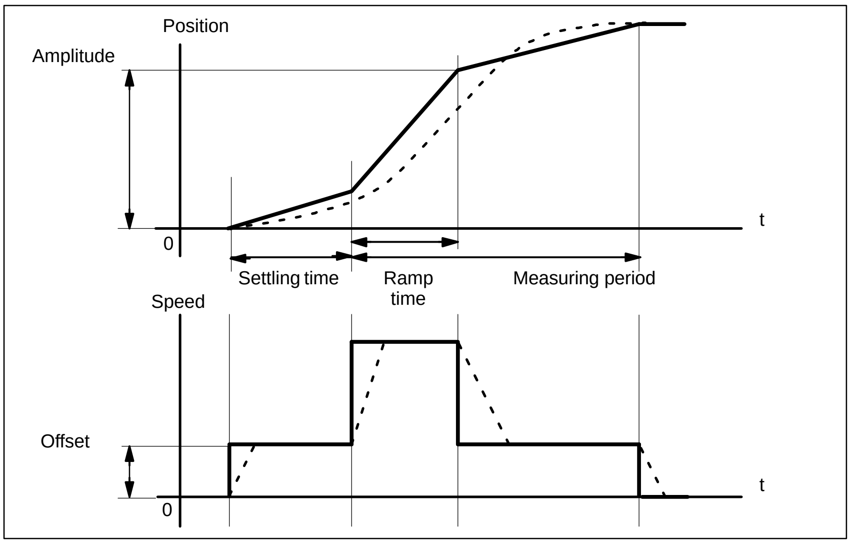


Fig. 13-5 Signal curve with measuring function position setpoint/ramp

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

In order 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 lead to not achieving the desired step height.

Just as well, the

- MD 32000 MAX_AX_VELO (maximum axis velocity)
- MD 32300 MAX_AX_ACCEL (max. axis acceleration)

are effective with the setpoint ramp in the range of the ramp. 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.

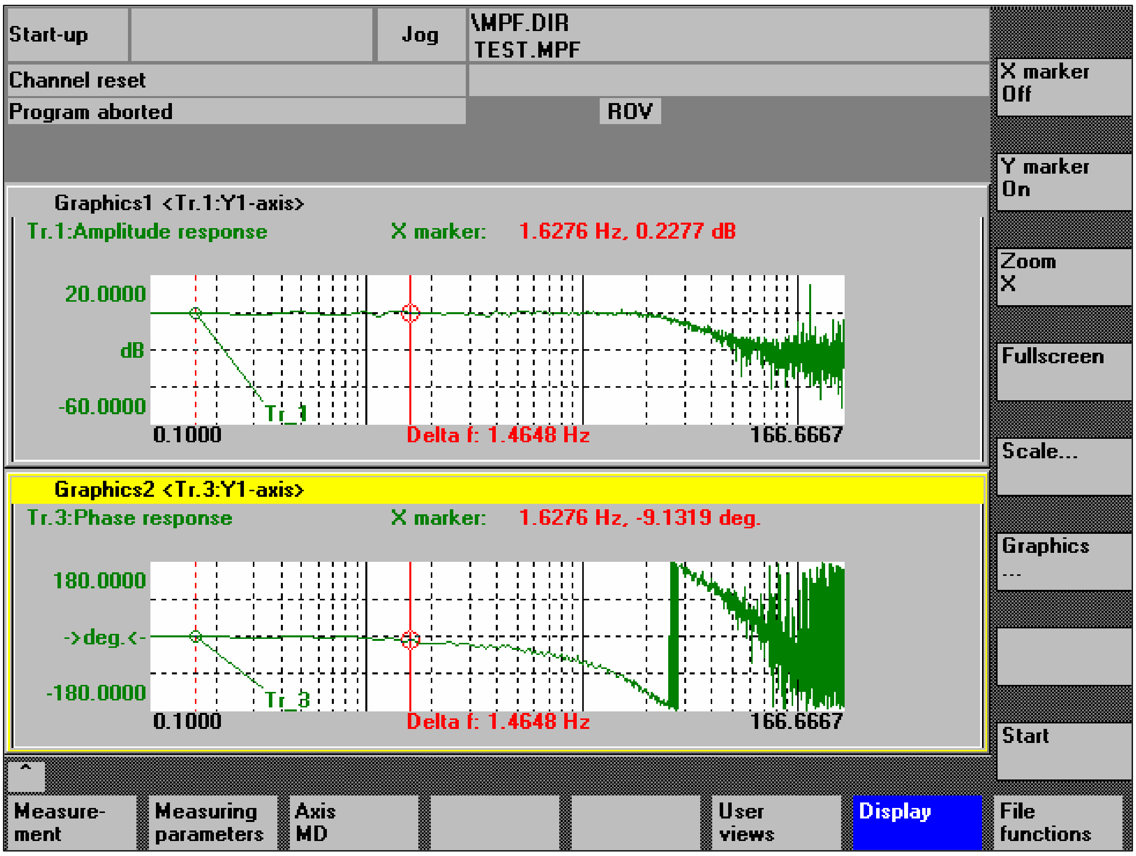


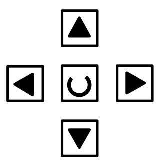
Fig. 13-6 Menu: Display of measurement with marker X = ON

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, pressing the soft key **2nd marker** will display a 2nd line in the diagram. 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.

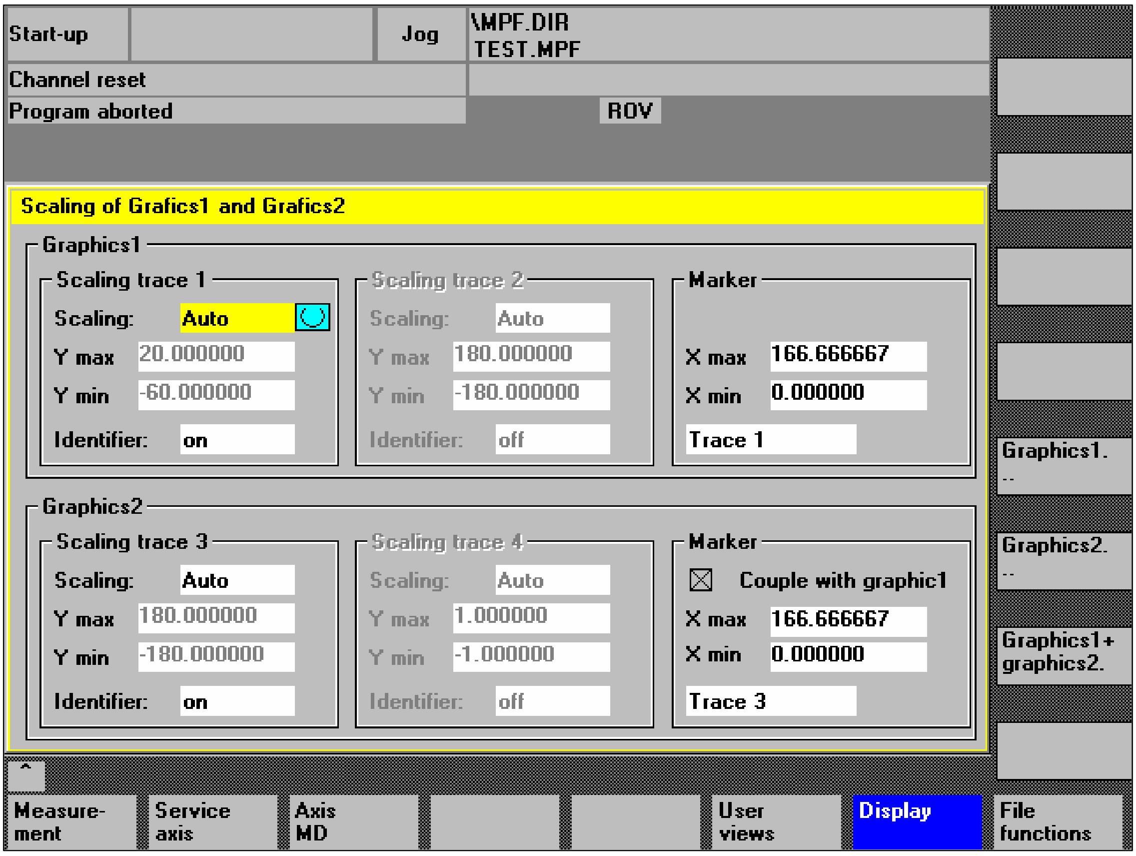


Fig. 13-7 Menu: Scaling of graphics

Soft keys:
Graphics ...

Use the **Graphics ...** soft key shown in Fig. 13-6, page 13-431 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 13-432)

– 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

Individual functions of the trace function

- 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)
- Pretriggering and posttriggering possible
- Measuring signal display
- Fixed Y-scaling selectable 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

Main menu Servo trace

You can access the main screen of this trace function using the soft keys **Area switchover > Start-up > Drives/servo > Servo trace**.

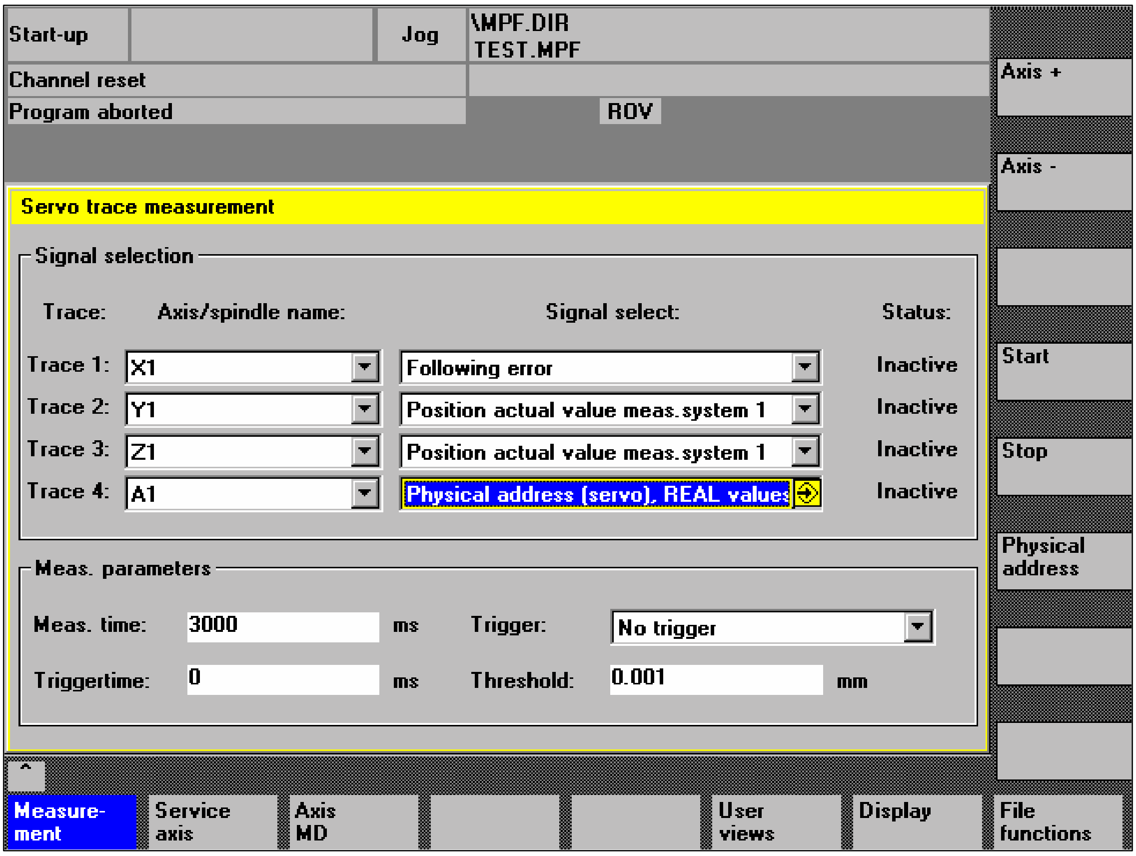


Fig. 13-8 Main menu: Servo trace

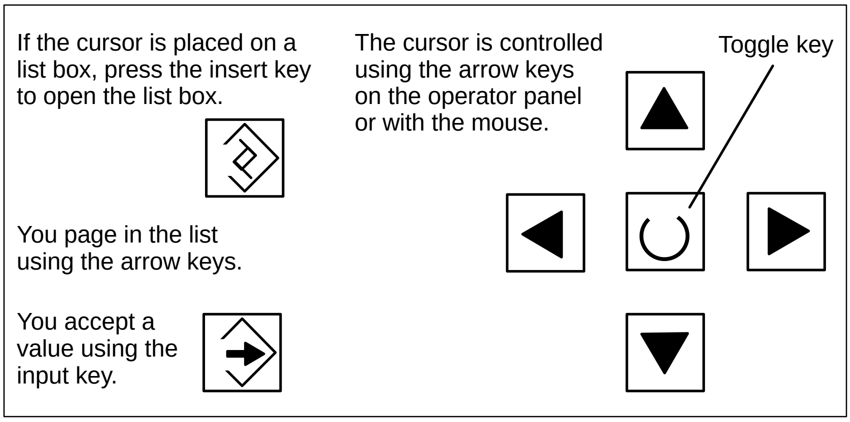


Fig. 13-9 Cursor control

13.6.3 Parameterization

Parameterization in the main menu

In the main menu you can select

- the axis/spindle to be measured
- the signal to be measured
- the measuring period
- the triggering time
- the type of triggering
- the triggering 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 drop-down list.

Input field:
Signal selection

The cursor must be positioned on the **“Signal selection”** list box of the trace concerned. You can select a value by accepting it from the drop-down list.

Measurement parameters

Input field:
Measuring duration

The measuring time is written directly into the **“Measuring duration”** input field.

Input field:
Triggering time

Direct input of pretriggering and posttriggering.
With negative input values (sign minus –) recording starts in advance of the triggering event by the time set.

With positive input values (without sign) recording starts the time set after the triggering event.

Boundary condition: Trigger time + measurement duration ≧ 0.

Input field:
Trigger

The trigger type is chosen from the drop-down list **Trigger**.
The trigger always refers to trace 1. Once the triggering conditions are fulfilled traces 2 to 4 are started simultaneously.

Settable triggering 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 triggering threshold.

The threshold is only active with the types of triggering “Positive edge” and “Negative edge”.
The unit refers to the signal selected.

Soft key:
Axis +
Axis –

Selection of axis/spindle when the cursor is positioned on the appropriate list field “Axis/spindle name”.

You can also select the axis/spindle directly in the list box from the drop-down list using the cursor.

Soft key:
Start
Stop

The soft key **Start** starts recording of the trace function.

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.

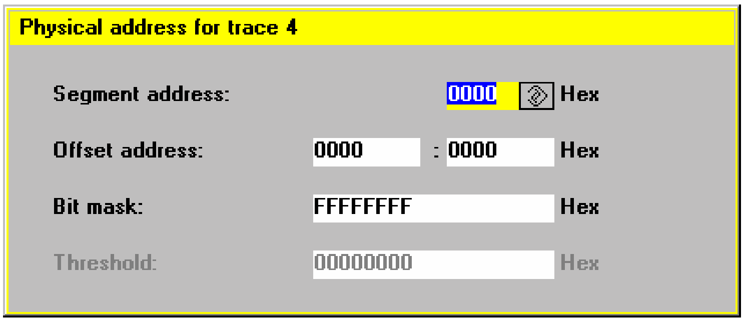


Fig. 13-10 Menu: Physical address for trace x

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 Measuring

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.

End of 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.

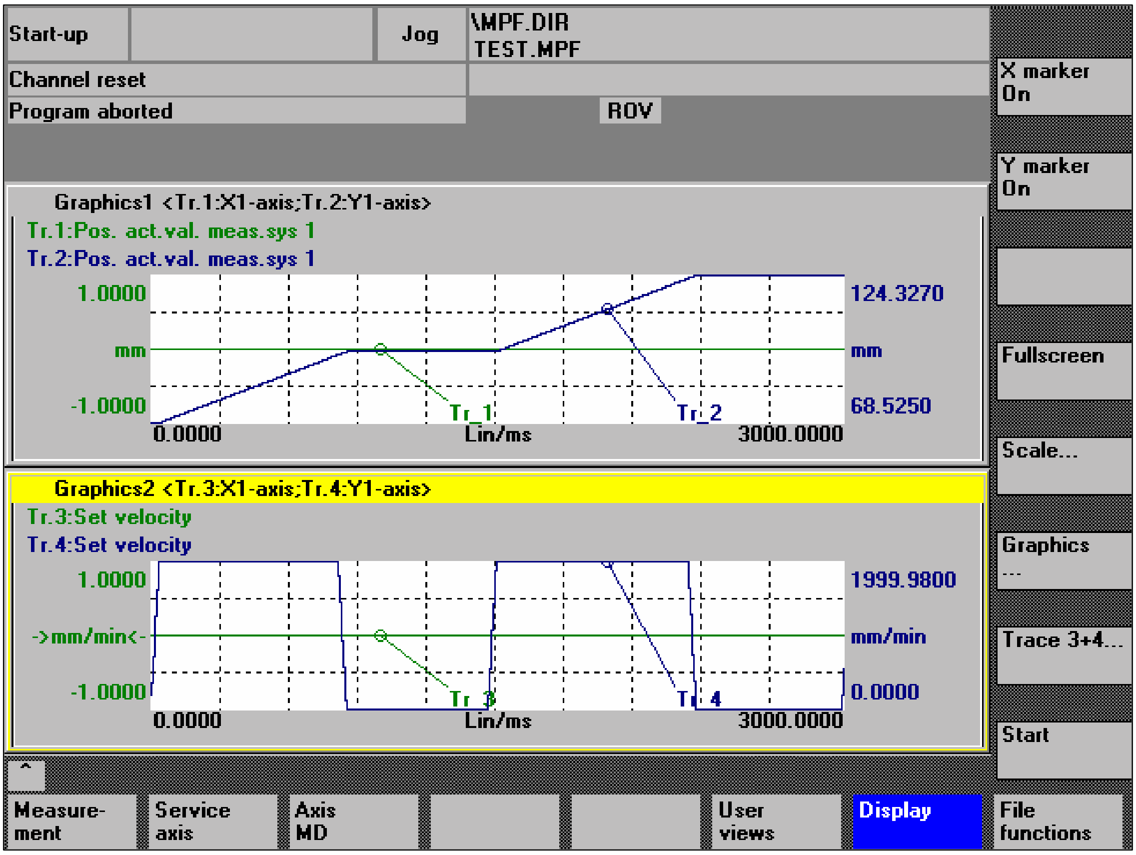


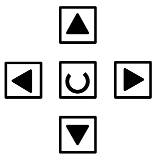
Fig. 13-11 Measurement results: Trace function

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, pressing the soft key **2nd marker** will display a 2nd line in the diagram. 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.

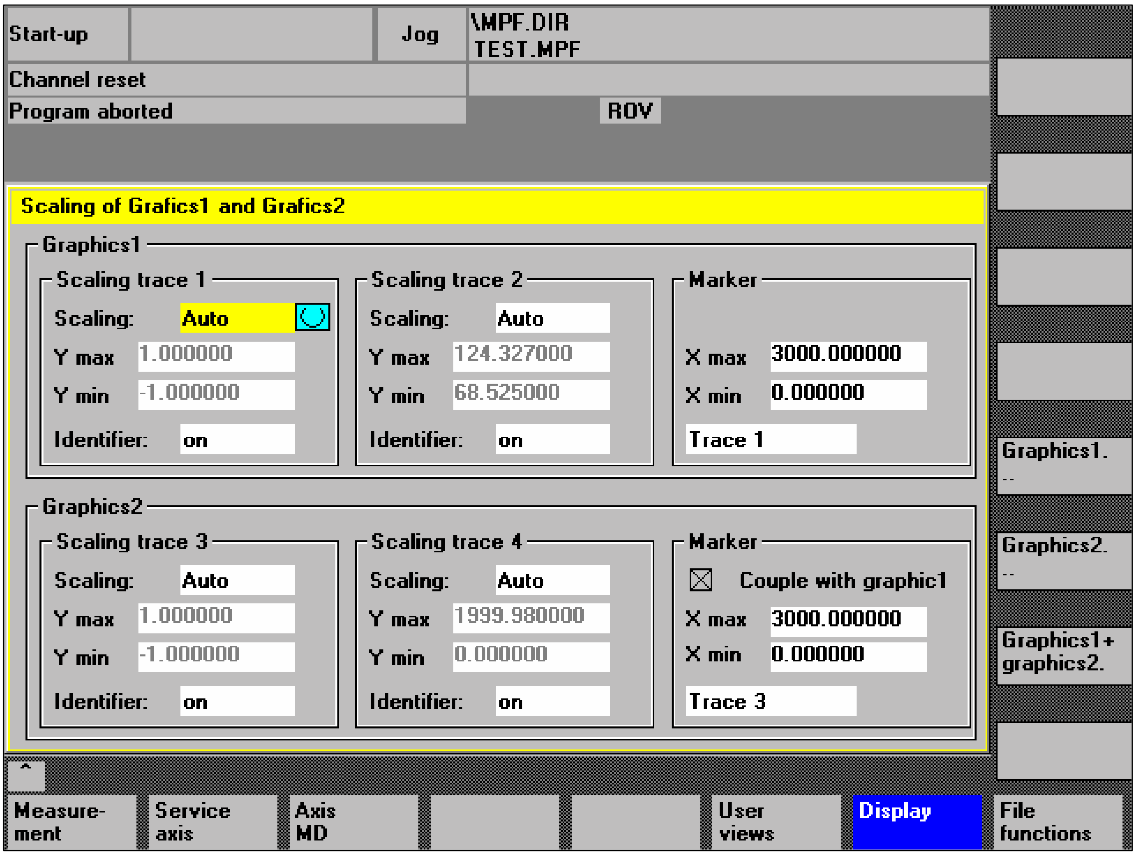


Fig. 13-12 Menu: Scaling of graphics

Soft keys:
Graphics ...

Use the **Graphics ...** soft key shown in Fig. 13-11, page 13-439 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 13-440)
- 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.

Here you can save, load and delete the parameters, axis-specific machine data and measurement results set for the measurements.

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.

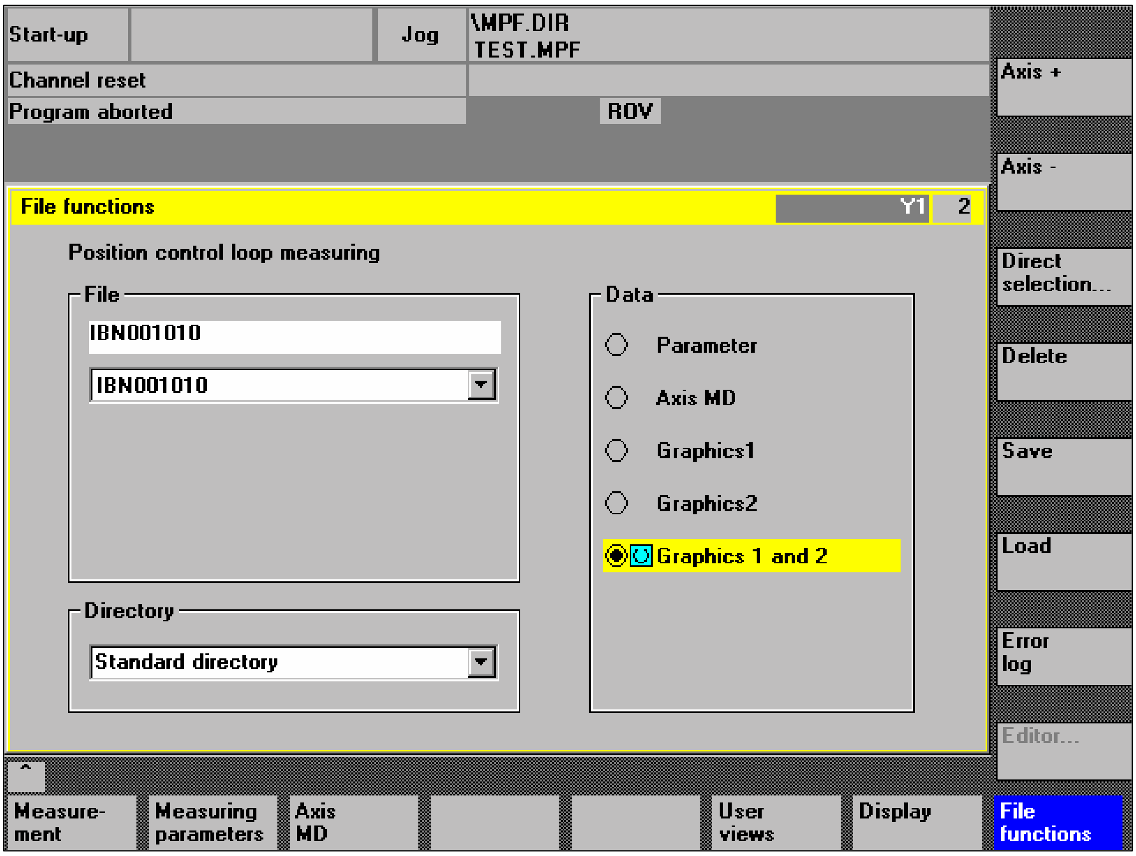


Fig. 13-13 Menu: File functions

Assigning file names

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 the data type

In the **Data** group, you can select the data you want to save.

You can only select one data type. 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 graphics

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.

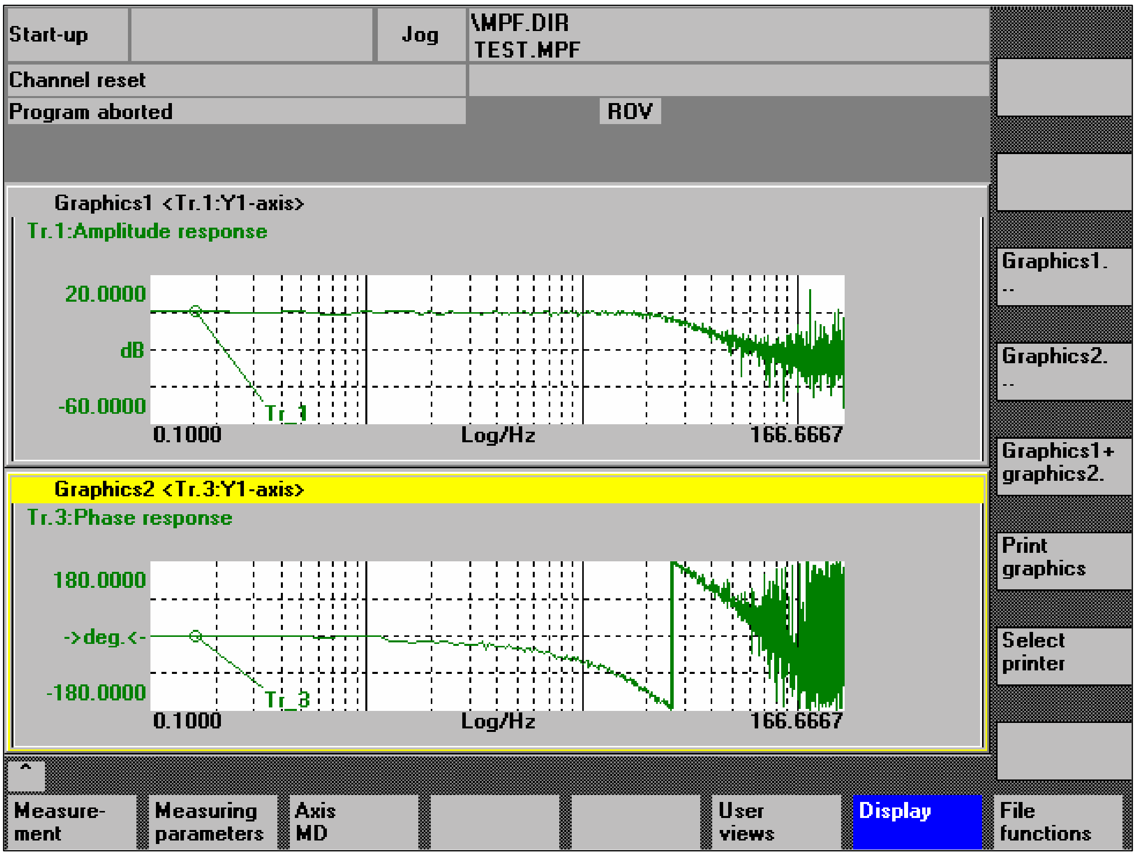


Fig. 13-14 Graphics soft keys

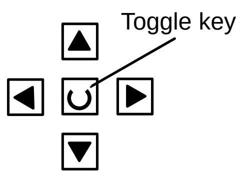
Soft key: Printer selection

Use the soft key **Printer selection** to open the appropriate menu, Fig. 13-15, page 13-445.

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



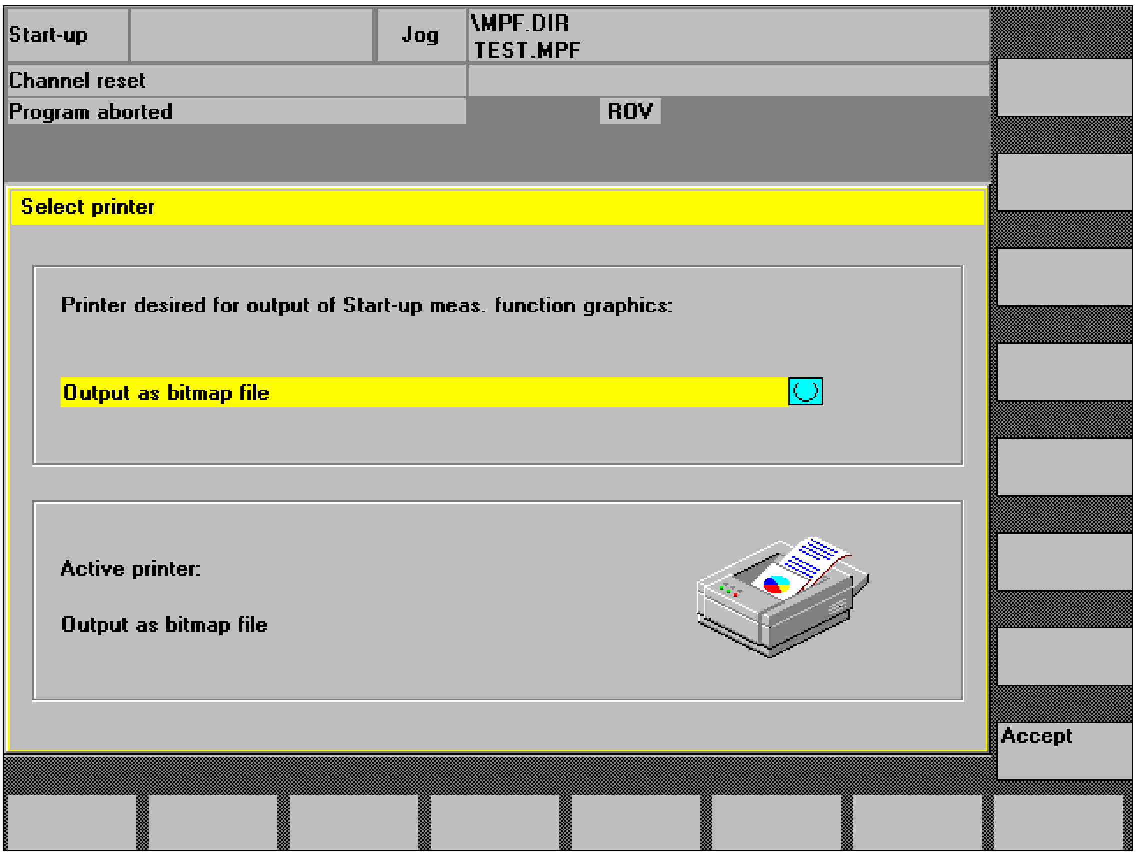


Fig. 13-15 Menu: Printer selection

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 desired file name.
  You can enter a new file name or choose an existing file from the drop-down list.

Soft key: Print graphics

Use the soft key **Print graphics** Fig. 13-14, page 13-444 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.

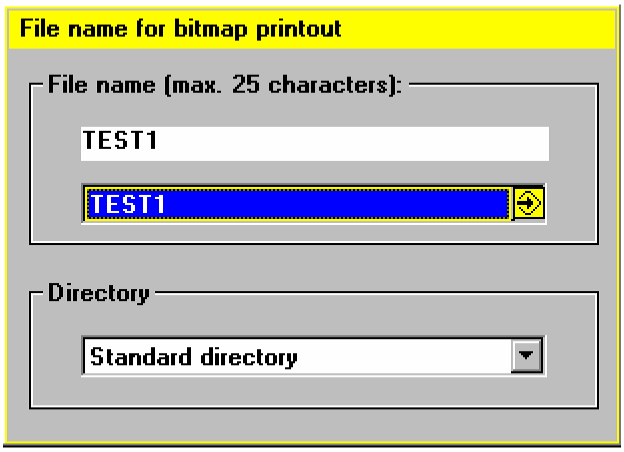


Fig. 13-16 Menu: File name for bitmap printing

Assigning file names

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**.
- Use the soft key **Abort** to 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 SIMO-DRIVE 611 universal drives, please refer to:

References: /FBU/ SIMODRIVE 611 Universal, Descriptions of Function
Section: Description of Functions
Optimizing current and speed controllers

■

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 SIMODRIVE 611 universal 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 the 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,
- In service cases (e.g. after a hardware replacement, software upgrade, etc.), to resume production without longer downtimes.

Before activating memory-configuring machine data (a warning appears), a data backup **must** be carried out.

Data backup of various components

A data backup can currently not yet be carried out uniformly for all components (SINUMERIK 840Di-NC, PLC, HMI Advanced (option) and SIMODRIVE 611 universal).

A data backup must therefore be carried out separately for the following components:

- **NC**, **PLC** and **HMI Advanced** (option)
- **SIMODRIVE 611 universal.**

NC, PLC, HMI user data

The data backup with respect to the NC, PLC and HMI Advanced (option) user data is carried out with

- **SinuCom NC** (part of the SINUMERIK 840Di installation)
- **HMI Advanced** (option).

For detailed information regarding the data backup of the components mentioned above, please refer to:

References: **SinuCom NC**:
Online help

HMI Advanced:
/BAI/ Operator's Guide – HMI Advanced

SIMODRIVE 611 universal drive data

A data backup with respect to SIMODRIVE 611 universal drives is carried out using the start-up tool **SimoCom U**. When doing so, one parameter file each is saved per drive on the hard disk of the PCU.

SimoCom U is part of the SINUMERIK 840Di installation.

For detailed information on the data backup of SIMODRIVE 611 universal drives, please refer to:

References: /FBU/ SIMODRIVE 611 Universal, Description of Functions
Section: Closed-loop control unit for rpm servo control and positioning

and

SimoCom U: Online help

14.2 Creating a series machine start-up file using HMI Advanced

The creation of a series machine start-up file is divided into the following steps:

1. Open the menu to create a series machine start-up file:
   Operating area switchover > Services > key:up “>” > Series machine start-up > Create start-up archive
2. Select the contents and assign the file name
3. Create the series machine start-up file by selecting the device to which you wish the file to be output

---

Note

Because of its file extension “.arc”, the series machine start-up file is also called archive.

Selecting contents

A series machine start-up file can be created for the following components:

- NC with/without compensation data
- PLC
- HMI

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

Compensation data must only 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:

- Configuration data
- Option data
- Machine data
- Setting data
- Tool offset
- Workpieces
- Parts programs
- Cycle programs
- GUDs (Global User Data).

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.

Creation and starting output

The creation and output of the series machine start-up file is started with selecting the component to which the file is to be output.

Components that can be selected:

- **RS-232-C**
- **PG** (programming device, e.g. PG740)
- **Floppy disk drive** (option)
- **Archive** (HMI data management on the hard disk of the PCU)
- **NC Card.**

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 STEP7
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 the 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 NT taskbar > Start > Programs > SI-NUMERIK 840Di > 840Di start-up**.
  – Open the dialog box: Menu command **Window > 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 PLC, buttons: "**STOP**" and "**RUN**".
- NC and PLC must then be resynchronized: Group 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:up ">" > 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.

■

SW Installation/Update and Data Backup 15

15.1 General requirements

Short description

This section describes installation or updating of software applications and data backup of the entire hard disk (disk images) or partitions (partition images) of the PCU on the basis of preinstalled PCU basic software.

All actions described here are started from the **Service Menu** under **MS DOS**.

The Service menu is selected from the menu of the **Boot Manager** that is displayed when booting after turning on the PCU.

15.1.1 PCU basic software

Scope of basic software

The PCU basic software that is already preinstalled on the PCU hard disk when the SINUMERIK 840Di is supplied comprises:

- Windows NT 4.0, Service Pack 6, English version
- Internet Explorer 5, English version
- MS-DOS SW 6.21 and higher
- MPI driver SW 5 and higher
- Norton Ghost™ Version 6 and higher
- Norton GhostWalker™ Version 6 and higher.

Note

For information on the PCU basic software, please refer to the file *C:\Siemensd.rtf.*

For the versions of the system components contained in the PCU basic software, please refer to the file *C:\BaseVers.txt.*

15.1.2 Partitioning of the hard disk

The PCU hard disk is divided into four partitions (three primary partitions and an extended partition).

- For reasons of data security, the SINUMERIK 840Di system software, the Windows NT system software and the Service software are installed in different partitions.
- A boot manager is provided so that you can boot the system either with Windows NT (SINUMERIK 840Di user interface) or MS DOS (Service menu).

Partitions

The diagram below shows the partitioning of the hard disk when the control system is supplied:

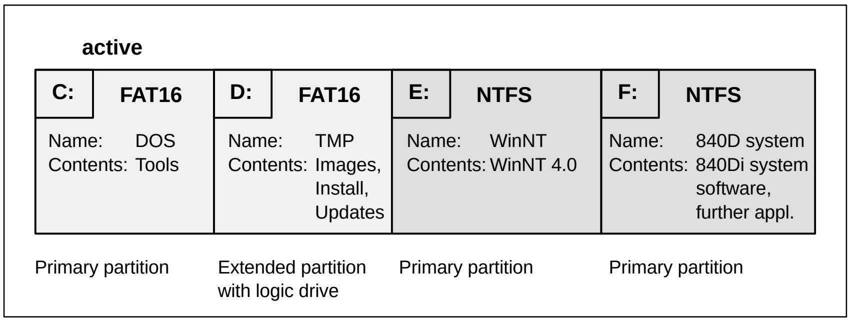


Fig. 15-1 Partitioning of the hard disk

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 NT.
- The **Update** directory for later installation of Windows NT system software.

3rd partition/drive E:

Drive E: is reserved for the Windows NT system software.

4th partition/drive F:

Drive F: contains the Windows NT applications, e.g. the SINUMERIK 840Di system software.

Further applications, such as HMI system software, HMI-OEM applications, SIMATIC Manager S7/M7 or customer-specific applications (e.g. user interfaces created using Protool/Pro MC), will also be installed here.

15.1.3 Boot manager

Boot manager menu

When booting the PCU, the boot manager menu offers the following options to choose from:

- **SINUMERIK**
- **Service menu *(hidden).***

SINUMERIK

Select the menu item **SINUMERIK** and you will get to the Windows NT desktop.

Under Windows NT you can:

- start the SINUMERIK 840Di user interface
- install system software using the network link (Ethernet) (e.g. the HMI software)
- install optional software (e.g. additional languages)
- change INI files/hardware configuration (e.g. install drivers).

Note

With power-up under Windows NT, the NC system software is automatically started in the background.

Service menu *(hidden)*

Select the hidden menu option **Service menu** (**CursorDown** key and **Input** key) to start the SINUMERIK service software.

In the Service menu under MS DOS, you can:

- establish the connection to an external computer (programming device/PC)
  - through the parallel interface
  - through the network connection (log: NetBEUI)
- install and update Windows NT applications
- make backup copies (GHOST images) of the entire hard disk or of individual partitions and restore them.

15.1.4 Setting/determining the network parameters of an external computer

In order to be able to establish a network connection to an external computer, the following requirements must be fulfilled with respect to the **external computer**:

1. The Ethernet cable is connected to the Ethernet interface of the external computer and the PCU.
   – Point-to-point connections require a “twisted” Ethernet cable (Converted Twisted Pair).

Notice

Point-to-point connections require a “twisted” Ethernet cable (**Converted Twisted Pair**).

---

2. The network protocol **NetBEUI** must be installed on the external computer.
3. The **computer name** of the external computer must be known.
4. Access to the drive/folder of the external computer you want to access must be shared by the PCU, and the **sharing name** must be known.

Installing the network protocol NetBEUI

To install the network protocol **NetBEUI**, open Control Panel using the Windows 95/NT taskbar **Start > Settings > Control Panel** on the external computer.

Open **Network** in the Control Panel.

Dialog

Dialog: Network
  Register: Protocols
    Button: “Add...”

    Dialog: Select Network Protocol
      Network Protocol <**NetBEUI protocol**>
    OK

OK

Determining the computer name

To determine the computer name, open the Windows 95/NT taskbar **Start > Settings > Control Panel** on the external computer.

In the “Control Panel”, open **Network**.

Dialog

Dialog: Network
  Register: Identification
    Computer Name: <**COMPUTER NAME**>
OK

Notice

Various SINUMERIK OPs allow to enter uppercase letters. Therefore, to enter the user name and the password of the external computer (PG/PC), either use only uppercase letters or connect a standard PC keyboard to the PCU.

Sharing access to the drive/directory or determining sharing names

In order to share access to the drive/directory or determine the sharing name, start the Windows **Explorer** on the external computer and select the drive/directory to be released for shared access for the PCU.

Open the Properties dialog (**right mouse button > Properties**) of the drive/directory and define the **sharing name** and the **access rights**.

Dialog

Dialog: Properties of <drive>/<directory>
Tab: Share access
Optional field: Choose “Shared As:”
Sharing name: <**SHARED AS**>
Button: “Rights...”

Dialog: Access by share access rights
Button: “Add...”

Dialog: Add users and groups
Names: *Choose a name from the list*
e.g. “User” or “Everybody”
Button: “Add”
OK

Access type: <**Read**>
OK

OK

15.2 Software installation/update

15.2.1 Software installation//updating SINUMERIK 840Di system software

Brief description

The following describes the necessary operator actions to install/update SINUMERIK 840Di system software on the PCU from an external computer (PG/PC).

Operating actions

1. Backup the NC and PLC user data by creating a series machine start-up file. See Chapter 14, page 14-449.
2. Install//update the SINUMERIK 840Di system software. According to your requirements, please see:
   – Parallel link and external FAT16 drive:
   Subsection 15.2.2, page 15-460.
   – Parallel link and external FAT32 drive:
   Subsection 15.2.3, page 15-463.
   – Network link (Ethernet):
   Subsection 15.2.4, page 15-466.
3. Initialize the control by deleting NC data and performing a general PLC reset. See Subsection 8.1.1, page 8-249.
4. Read in the series machine start-up file created in Step 1. See Section 14.4, page 14-454.

15.2.2 Parallel link and external FAT16 drive

Brief description

The operator actions explained in the following will copy software from an external computer (PG/PC) from a FAT16 drive into the installation directory D:\INSTALL on the PCU by means of a parallel link.

When the control is booted for the next time under Windows NT, the software (setup.exe) contained in the installation directory D:\INSTALL is installed automatically.

Requirements

The following requirements must be fulfilled:

- The software to be installed is to be found in a **FAT16** drive called **MMC102** directory of the external computer.
- The operating system of the external computer is either:
  – **Windows 95**
  – **Windows 3.11**
  – **DOS.**

Notice

Before you copy the software into the D:\Install directory make sure that sufficient **free memory space** is available.

Operating actions

1. Power OFF the PCU.
2. Use a parallel data transfer cable (PC-Link or LapLink cable) to link the parallel port of the external PC (LPT1) with the parallel port of the PCU (LPT1).
3. Copy the software to be installed on the PCU into the directory **C:\MMC102** (create it if it does not yet exist) of the external computer (PG/PC).

   If not enough space is available on drive C: or C: is not a FAT16 drive, you can also use another local drive (e.g. D:) .

   Note:
   Direct installation from CD is not possible.
4. On an external computer (PG/PC), start the program intersrv.exe under DOS or under Windows 95 from a DOS prompt. As the parameter, specify the **drive** on which the software to be installed is found.

   intersrv <drive> (e.g. C:)

The following menu will appear:

```
Microsoft   Interlnk   Server   Version   <version>
     This Computer              Other Computer
        (Server)                   (Client)

     C: <size>


Transfer   |   Port:     Speed:   |   Alt + F4=Exit
```

Notice

The PCU must be switched OFF. If the PCU is switched ON, switch it OFF now.

5. Now switch on the PCU (again) and choose the menu item “Service menu” *(hidden)* from the menu of the boot manager.

The following menu will appear:

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

     9    Reboot (warm restart)

     P    840Di Services

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

6. Choose **Install/Update SINUMERIK System** using the key “**1**”.

The system prompts you to enter a password:

7. Type one of the passwords of protection levels 0–2.
   - System
   - Manufacturer
   - Service.

Following menu:

```
PLEASE SELECT MEDIUM:
     1    Install from Floppy Disk
     2    Install via Serial/Parallel Line
     3    Install from Network Drive

     5    REBOOT

     9    Return to Main Menu

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

8. From the following menu, choose the menu item **Install via Serial/Parallel Line** using the key “**2**”.

   The software to be installed is now transferred from the ext. computer (PG/PC) to the PCU into the directory D:\INSTALL.

   If the transfer is completed, a power-up of the PCU following the Windows NT procedure is carried out and the software that is to be found under D:\INSTALL is installed automatically.

9. Exit the Server mode on the external computer (PG/PC):
   Key combination: **Alt** + **F4**

15.2.3 Parallel link and external FAT32 drive

Brief description

The operator actions explained in the following will copy software from an external computer (PG/PC) from a FAT32 drive to the installation directory D:\INSTALL of the PCU using a parallel link using the tool: Interserve/Interlink.

When the control is booted for the next time under Windows NT, the software (setup.exe) contained in the installation directory D:\INSTALL is installed automatically.

Requirements

The following requirements must be fulfilled:

- The software to be installed is on a **FAT32** drive of the external computer (PG/PC).
- The operating system of the external computer (PG/PC) is:
  - **Windows 95**
  - **Windows 3.11**
  - **DOS.**
- To transfer the software to be installed on the PCU, the program interlnk.exe must be installed on the external computer (PG/PC).
- The PCU is equipped with a full keyboard.

Notice

Before you copy the software into the D:\Install directory make sure that sufficient **free memory space** is available.

Operating actions

1. Make sure that the program interlnk.exe is installed on the ext. computer (PG/PC).

   Windows 95 / Windows 3.11
   dir c:\windows\command\interlnk.exe

   DOS
   dir c:\dos\interlnk.exe.

   If the program interlnk.exe is not installed, copy it (e.g. from the HMI102 directory of the HMI installation CD) into the appropriate directory.

   Add the following line to the file **CONFIG.SYS**:

   device=c:\windows\command\interlnk.exe /AUTO

   Now, switch the ext. computer off.

2. Use a parallel data transfer cable (PC-Link or LapLink cable) to link the parallel port of the external PC (LPT1) with the parallel port of the PCU (LPT1).

3. Now, turn on the PCU and choose the menu option “Service menu” *(hidden)* from the menu of the boot manager using the CursorDown key and then press the Input key.

The following menu will appear:

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

     9   Reboot (warm restart)

     P   840Di Services

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

4. Select **Start PC Link** using the key “**8**”.

The system prompts you to enter a password:

5. Type one of the passwords of protection levels 0–2.
   – System
   – Manufacturer
   – Service.

The following menu will appear:

```
Microsoft   Interlnk   Server   Version   <version>
     This Computer            Other Computer
        (Server)                 (Client)

     C: <size>
     D: <size>
     LPT1:

Transfer   |   Port:     Speed:   |   Alt + F4=Exit
```

6. Now, restart the ext. computer (PG/PC).
7. After the ext. computer (PG/PC) has been booted, the PCU automatically reestablishes the connection to it.

The following menu will appear:

```
Microsoft   Interlnk   Server   Version   <version>
     This Computer            Other Computer
        (Server)                 (Client)

     C: <size>                F:
     D: <size>                G:
     LPT1:

Transfer   |   Port:     Speed:   |   Alt + F4=Exit
```

The drive display in the menu under "Client", e.g. as G: means that drive D: of the PCU can be addressed from the ext. computer (PG/PC) as drive G: .

8. Now copy the software to be installed from the ext. computer into the drive D:\INSTALL of the PCU.

   copy <path>*.* G:\INSTALL\

9. If the copying process is complete, exit INTERSVR on the PCU (key combination: Alt + F4).

When the control is booted for the next time under Windows NT, the software (setup.exe) contained in the installation directory D:\INSTALL of the PCU is installed automatically.

15.2.4 Network link (Ethernet)

Brief description

The operator actions explained in the following will copy software from an external computer (PG/PC) into the installation directory D:\INSTALL on the PCU using a network link (Ethernet).

For data transfer, a local point-to-point connection between the external computer and the PCU is established using the standard Ethernet cable of the type “Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable”.

When the control is booted for the next time under Windows NT, the software (setup.exe) contained in the installation directory D:\INSTALL is installed automatically.

Requirements

The following requirements must be fulfilled:

- The operating system of the external computer is
  - Windows NT 4.0
  - Windows 95.
- The Ethernet cable is connected to the Ethernet interface of the external computer and the PCU.

Notice

A **point-to-point** connection between PCU 50 and an external computer (PG/PC) requires an Ethernet cable of the type “Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable”.

- The network parameters of the external computer are set or known:
  - Network Protocol NetBEUI
  - Computer Name
  - Shared As.

  How to set or determine the network parameters of an external computer is described in Subsection 15.1.4 (page 15-458).
- The drive/directory of the ext. computer (PG/PC) where the software you wish to copy is to be found for sharing with the PCU.

Notice

Before you copy the software into the D:\Install directory make sure that sufficient **free memory space** is available.

Operating 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 will appear:

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

     9   Reboot (warm restart)

     P   840Di Services

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

2. Choose **Install/Update SINUMERIK System** using the key "**1**".

The system prompts you to enter a password:

3. Type one of the passwords of protection levels 0–2.
   – System
   – Manufacturer
   – Service.

Following menu:

```
PLEASE SELECT MEDIUM:
     1   Install from Floppy Disk
     2   Install via Serial/Parallel Line
     3   Install from Network Drive

     5   REBOOT

     9   Return to Main Menu

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

4. Choose **Install from Network Drive** using the key "**3**".

Following menu:

```
PLEASE SELECT:
     1   Connect to Network Drive
     2   Show Connected Network Drives
     3   Disconnect from all Network Drives
     4   Change install directory
     5   Install from F:\INSTALL

     9   Return to previous Menu

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

5. Choose **Connect to Network Drive** using the key "**1**".
   – Type the **user name** and the **password** you want to use for access to the external computer.

     Windows NT 4.0
     User name and password of the local user of the PG/PC

Windows 95
Any user name; if a password is required, type the password you have specified to share access to the directories.

– For later verification, you may be prompted to confirm saving of the password.

– Specify the drive letter under which the external drive is to be accessed from the PCU (e.g. “H”).

– DIRECTORY TO BE MOUNTED:
Please type a name of the computer and the access name of the drive/ directory of the external computer:

****<COMPUTER NAME>****<SHARED AS>
e.g. \\r3344\MY_INSTALL

How to set or determine the network parameters of an external computer is described in Subsection 15.1.4 (page 15-458).

The set network information is now displayed on the PCU.

```
Connected network drive (last)      H: (\\R3344\MY_INSTALL)
Install Directory                   F:\INSTALL
```

6. The default setting of the directory where the software is to be installed on the **external computer** (Install Directory) is F:\INSTALL.

   If the software is in a different directory, what is normally the case, this setting must be adapted accordingly.

```
PLEASE SELECT:
    1   Connect to Network Drive
    2   Show Connected Network Drives
    3   Disconnect form all Network Drives
    4   Change Install Directory
    5   Install from F:\INSTALL

    9   Return to previous Menu

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

To this aim, choose **Change Install Directory** using the key “**4**”.

In the input screen form that now appears, type the appropriate drive letter (in the example: “H:”) and possibly any further path if the software is not installed directly in the shared drive/directory (in the example: R3344\MY_INSTALL), but in a subdirectory of MY_INSTALL.

```
Old Install Directory               F:\INSTALL
New Install Directory               H:\<PATH>
```

The complete network settings are displayed in the Service menu, and the installation directory in the menu item **Install from ...**, (in the example: H:<PATH>).

Connected Network Drive (last)	**H: (\\R3344\MY_INSTALL)**
Install Directory	**H:\<PATH>**

PLEASE SELECT:

1 Connect to Network Drive
2 Show Connected Network Drives
3 Disconnect from all Network Drives
4 Change install directory
5 Install from H:<PFAD>

9 Return to previous Menu

Your Choice [1,2,3,5,9] ?

7. To start the data transfer, choose **Install from H:<PATH>** using the key “**5**”.
   – When the transmission is complete, the PCU will reboot.

When the control is booted for the next time under Windows NT, the software (setup.exe) contained in the installation directory D:\INSTALL is installed automatically.

SHOW connected network drives

Use the menu item **Show connected Network Drives** to display all network drives currently linked with the PCU.

```
PLEASE SELECT:
    1   Connect to Network Drive
    2   Show Connected Network Drives
    3   Disconnect from all Network Drives
    4   Change install directory
    5   Install from H:<PATH>

    9   Return to previous Menu

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

Choose **Show Connected Network Drives** using the key “**2**”.

Status	Local Name	Remote Name
OK	H:	\\R3344\MY_INSTALL

DISCONNECT from all Network Drives

Use the menu item **Disconnect from all Network Drives** to disconnect all links to network drives.

```
PLEASE SELECT:
    1   Connect to Network Drive
    2   Show connected Network Drives
    3   Disconnect from all Network Drives
    4   Change install directory
    5   Install from H:<PATH>

    9   Return to previous Menu

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

Choose **Disconnect form all Network Drives** using the key “**3**”.

The network connections are then displayed in the Service menu as -none-.

Connected Network Drives (last):	-none-
Install Directory:	H:\<PATH>

15.3 Data backup

15.3.1 Hard disk backup using a parallel link

Brief description

The operating actions explained in the following are intended to make a backup copy of the entire hard disk of the PCU (disk image) and to transfer it to an external computer (PG/PC) using a parallel link.

Requirements

The following requirements must be fulfilled:

- The program Norton Ghost™ (Version 6 or higher) is installed on the PCU and on the ext. computer.
- The operating system of the external computer is
  - DOS
  - Windows 3.11
  - Windows 95.
- A directory for the backup copy is installed on the external computer and enough memory capacity is provided.
- In the BIOS of the PCU and of the external computer, the parallel interface is set to EPP or ECP.

Notice

Before you transfer the backup copy (disk image), make sure that enough **free memory space** is available on the ext. computer (PG/PC).

Operating 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 will appear:

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

    9   Reboot (warm restart)

    P   840Di Services

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

2. Choose **Backup/Restore** using the key “**7**”.

The system prompts you to enter a password:

3. Type one of the passwords of protection levels 0–2.
   – System
   – Manufacturer
   – Service.

Following menu:

```
PLEASE SELECT
    1   Hard disk Backup/Restore with GHOST
    4   Partitions Backup/Restore with GHOST

    9   Back to previous Menu

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

4. Choose the menu item **Hard disk Backup/Restore with Ghost** using the key "**1**".

Following menu:

```
PLEASE SELECT
    1   Configure Ghost Parameters
    2   Hard disk Backup to <PATH>, Mode...
    3   Hard disk Backup from <PATH>, Mode...

    9   Back to previous Menu

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

5. Now select the menu option **Configure GHOST parameters** using the key "**1**" to set the following parameters:
   – **Connection type** (PARALLEL)
   – **Path** or **File name** under which you wish the backup copy to be stored on the external computer.

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
    6   Manage Network Drives

    9   Back to previous Menu

Your Choice [1,2,3,4,5,6,9]?
```

- To set the connection mode "Parallel link", choose the menu item **Set Connection Mode PARALLEL** using the key "**1**".
- 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** using the key "**3**".

– Specify the complete path, e.g.:

  C:\SIN840DI\PCU\

  and the appropriate file name, e.g.:

  SICHER01.GHO

  under which the backup copy will be stored on the external computer.

Use the key “**9**” to return to the previous menu after you have confirmed the modified GHOST parameters.

Following menu:

```
PLEASE SELECT

   1   Configure GHOST Parameters
   2   Hard disk Backup to <PATH>\SICHER01.GHO, Mode PARALLEL
   3   Hard disk Backup from <PATH>\SICHER01.GHO, Mode PARALLEL

   9   Back to previous Menu

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

6. Choose the menu item **Hard disk Backup to ...** using the key “**2**”.
7. This item will only apply if local images exist. Otherwise, Point 8. is displayed immediately.

Following menu:

```
PLEASE SELECT

   1   Backup WITHOUT Local Images
   3   Backup WITH Local Images

   9   Back to previous Menu

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

If you do not wish to save the local backup copies of saved partitions available on the hard disk of the PCU, then choose:

– **Backup WITHOUT Local Images** using the key “**1**”.

Otherwise, choose:

– **Backup WITH Local Images** using the key “**2**”.

8. A message window appears:

   – You will be prompted to check whether the connection between the PCU and the external computer is established.

   – The path and the file name under which the backup copy will be stored on the external computer is displayed. In the example:

     C:\SIN840DI\PCU\SICHER01.GHO

   – Now start Norton Ghost™ on the external computer (PG/PC) under DOS or Windows 95/ 3.11 in a DOS prompt window with:

     ghost –lps

   – Then press the “**Y**” key to start the backup process.

9. Norton Ghost™ now initiates data transfer.

   The following information is displayed in the Ghost message window:

   – The progress of the data transfer is displayed.
   – The paths are displayed.
   – The volume of data to be transferred is displayed.

Size of backup copy with compressing: 4.8GB hard disk –> approx. 330MB file

Time for transfer: approx. 50min.

15.3.2 Restoring the hard disk backup using parallel link

Brief description

The operating actions explained in the following are intended to restore a backup copy of the entire hard disk of the PCU (disk image) from an external computer using a network link.

Requirements

The following requirements must be fulfilled:

- The program Norton Ghost™ (Version 6 or higher) is installed on the PCU and on the ext. computer.
- The operating system of the external computer is:
  - **Windows 95**
  - **Windows 3.11**
  - **DOS.**
- A directory for the backup copy is installed on the external computer and enough memory capacity is provided.
- In the BIOS of the PCU and of the external computer, the parallel interface is set to EPP or ECP.

Operating 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 will appear:

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

      9   Reboot (warm restart)

      P   840Di Services

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

2. Choose **Backup/Restore** using the key “**7**”.

The system prompts you to enter a password:

3. Type one of the passwords of protection levels 0–2.
   - System
   - Manufacturer
   - Service.

Following menu:

```
PLEASE SELECT
     1   Hard disk Backup/Restore with GHOST
     4   Partitions Backup/Restore with GHOST

     9   Back to previous Menu

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

4. Choose the menu item **Hard disk Backup/Restore with Ghost** using the key “**1**”.

Following menu:

```
PLEASE SELECT
     1   Configure Ghost Parameters
     2   Hard disk Backup to <PATH>, Mode...
     3   Hard disk Backup from <PATH>, Mode...

     9   Back to previous Menu

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

5. Now select the menu option **Configure GHOST parameters** using the key “**1**” to set the following parameters:
   – **Connection type** (PARALLEL)
   – **Path** or **File name** under which you wish the backup copy to be stored on the external computer.

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
     6   Manage Network Drives

     9   Back to previous Menu

Your Choice [1,2,3,4,5,6,9]?
```

- To set the connection mode “Network Connection”, choose the menu item **Set Connection Mode PARALLEL** using the key “**1**”.
- To set the path or the file name of the backup copy to be restored, choose the menu item **Change Backup Image Filename** using the key “**4**”.
  – Specify the complete path, e.g.:

    C:\SIN840DI\PCU\

    and the appropriate file name, e.g.:

    SICHER01.GHO

    under which the backup copy will be stored on the external computer.

Use the key “**9**” to return to the previous menu after you have confirmed the modified GHOST parameters.

Following menu:

```
PLEASE SELECT
    1   Configure Ghost Parameters
    2   Hard disk Backup to <PFAD>\SICHER01.GHO, Mode PARALLEL
    3   Hard disk Backup from <PATH>\SICHER01.GHO, Mode PARALLEL

    9   Back to previous Menu

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

6. Choose the menu item **Hard disk Backup from...** using the key "**3**".

Following menu:

```
PLEASE SELECT
    1   Windows NT
    2   Win95
    3   WfW3.11
    4   DOS

    9   Back to previous Menu

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

7. Use this menu to choose the operating system used as the basis for the backup copy. In the case of SINUMERIK 840Di, this is exclusively Windows NT. Therefore, choose **Windows NT** using the key "**1**".

Following menu:

```
What kind of disk partitioning do you want?
    1   Standard Partitioning (default)
    2   User-defined Partitioning

Your Choice [1,2]?
```

Standard partitioning (default)
The hard disk partitioning of the PCU is set to the initial state by automatic parameterization by Norton Ghost™.

User-defined partitioning
You can adapt the sizes of the hard disk partitions on the PCU manually in Norton Ghost™.

A message window appears during the choice:

– You will be prompted to check whether the connection between the PCU and the external computer is established.

– The path and the file name under which the backup copy will be stored on the external computer is displayed. In the example:

  C:\SIN840DI\PCU\SICHER01.GHO

– You will be prompted to check whether the backup copy exists on the external computer.

– Now start Norton Ghost™ on the external computer (PG/PC) under DOS or Windows 95/ 3.11 in a DOS prompt window with:

  ghost –lps

– Then press the "**Y**" key to start the backup process.

8. The backup copy is now imported by Norton Ghost™. The following information is displayed in the Ghost message window:
   – The progress of the data transfer is displayed.
   – The paths are displayed.
   – The volume of data to be transferred is displayed.

Size of backup copy with compressing: 4.8GB hard disk –> approx. 330MB file

Time for transfer: approx. 50min.

Notice

If you abort the transfer, inconsistent data will be available on the PCU, and the system can possibly no longer be booted.

To boot the PCU, you will need a boot diskette.

Norton Ghost™ closes automatically when the import process is completed.

9. 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 will appear:

```
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 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.

Changes to the computer name and system ID are made using the program **Norton Ghost Walker**™.

Notice

The network settings can be later modified/determined under Windows NT.

Windows NT taskbar: **Start > Settings > Control Panel: Network**

---

10. After Norton Ghost Walker™ has updated the computer name and system ID, the following menu is displayed:

```
It seems, that Ghost Restore succeeded.

Hit any Key to reboot the System.
```

When the PCU is booted for the next time under Windows NT, the partitions E: and F: will be checked by the diagnostic program CHKDISK in succession whereby the PCU is rebooted automatically.

After completion of the check, the system with the restored backup copy is active.

15.3.3 Saving the hard disk using a network link (Ethernet)

Brief description

The operating actions explained in the following are intended to make a backup copy of the entire hard disk of the PCU (disk image) and to transfer it to an external computer (PG/PC) using a network connection.

For data transfer, a local point-to-point connection between the external computer and the PCU is established using the standard Ethernet cable of the type “Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable”.

Requirements

The following requirements must be fulfilled:

- The operating system of the external computer is
  - Windows NT 4.0
  - Windows 95.
- The Ethernet cable is connected to the Ethernet interface of the external computer and the PCU.

Notice

A **point-to-point** connection between PCU 50 and an external computer (PG/PC) requires an Ethernet cable of the type “Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable”.

- The network parameters of the external computer are set or known:
  - Network Protocol NetBEUI
  - Computer Name
  - Shared As.

How to set or determine the network parameters of an external computer is described in Subsection 15.1.4 (page 15-458).

Notice

Before you transfer the backup copy (disk image), make sure that enough **free memory space** is available on the ext. computer (PG/PC).

Operating 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 will appear:

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

   9   Reboot (warm restart)

   P   840Di Services

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

2. Choose **Backup/Restore** using the key “**7**”.

The system prompts you to enter a password:

3. Type one of the passwords of protection levels 0–2.
   - System
   - Manufacturer
   - Service.

Following menu:

```
PLEASE SELECT
   1   Hard disk Backup/Restore with GHOST
   4   Partitions Backup/Restore with GHOST

   9   Back to previous Menu

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

4. Choose the menu item **Hard disk Backup/Restore with Ghost** using the key “**1**”.

Following menu:

```
PLEASE SELECT
   1   Configure Ghost Parameters
   2   Hard disk Backup to <PATH>, Mode...
   3   Hard disk Backup from <PATH>, Mode...

   9   Back to previous Menu

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

Fig. 15-2 Main menu for saving/restoring hard disks

5. Now select the menu option **Configure GHOST parameters** using the key “**1**” to set the following parameters:
   - **Connection type** (LOCAL)
   - **Network parameters** of the PCU
   - **Path** or **File name** under which you wish the backup copy to be stored on the external computer.

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
    6  Manage Network Drives

    9  Back to previous Menu

Your Choice [1,2,3,4,5,6,9]?
```

Fig. 15-3 Main menu for configuring the Ghost parameters

- To set the connection mode “Network Connection”, choose the menu item **Set Connection Mode LOCAL** using the key “**2**”.

- To set the network parameters of the PCU, choose the menu item **Manage Network Drives** using the key “**6**”.

Following menu:

```
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 **Connect to Network Drive** using the key “**1**”.

– Type the **user name** and the **password** you want to use for access to the external computer using the network connection.

  Windows NT 4.0
  User name and password of the local user of the PG/PC

  Windows 95
  Any user name; if a password is required, type the password you have specified to share access to the directories.

– For later verification, you may be prompted to confirm saving of the password.

– Specify the drive letter under which the external drive is to be accessed from the PCU (e.g. “H”).

– DIRECTORY TO BE MOUNTED:
  Please type a name of the computer and the access name of the drive/directory of the external computer:

  ****<COMPUTER NAME>****<SHARED AS>
  e.g. \\R3344\MY_BACKUP

  How to set or determine the network parameters of an external computer is described in Subsection 15.1.4 (page 15-458).

The set network information is displayed.

```
Connected network drive (last) H: (\\R3344\MY_BACKUP)
```

Use the key "**9**" to return to the "Main menu for configuring the Ghost parameters" Fig. 15-3 (page 15-482).

- 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** using the key "**3**".
  - Specify the network drive (in the example: "H:") under which the backup copy will be stored on the external computer.

    If necessary you can enter an additional path specification that will be added to the path specification of the network drive. In this way, you can store the backup copy in a subdirectory, with reference to the shared drive/directory of the external computer.
  - Type the desired file name under which you wish to store the backup copy: e.g. SICHER01.GHO

  Use the key "**9**" to return to the "Main menu for configuring the Ghost parameters" Fig. 15-3 (page 15-482).

Use the key "**9**" to return to the "Main menu for saving/restoring hard disks" after you have confirmed the confirmation warning regarding the modified GHOST parameters.

Following menu:

```
PLEASE SELECT
    1   Configure GHOST Parameters
    2   Hard disk Backup to H:\<PATH>\SICHER01.GHO, Mode LOCAL
    3   Hard disk Backup from H:\<PATH>\SICHER01.GHO, Mode LOCAL

    9   Back to previous Menu

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

6. To start the data transfer, choose the menu item **Hard disk Backup to ...** using the key "**2**".

Following menu:

```
PLEASE SELECT
    1   Backup WITHOUT Local Images
    3   Backup WITH Local Images

    9   Back to previous Menu

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

7. If you do not wish to save the local backup copies of saved partitions (see next section) available on the hard disk of the PCU, then choose:

   – **Backup WITHOUT Local Images** using the key “**1**”.

Otherwise, choose:

   – **Backup WITH Local Images** using the key “**2**”.

A message window appears:

   – You will be prompted to check whether the connection between the PCU and the external computer is established.
   – The destination path in which the backup copy will be stored on the external computer is displayed.
   – Press “**Y**” to start the backup process.

The actual backup process is now carried out by Norton Ghost™.

The following information is displayed in the message window that opens:

   – The progress of the data transfer is displayed.
   – The paths are displayed.
   – The volume of data to be transferred is displayed.

Size of backup copy with compressing: 4.8GB hard disk –> approx. 330MB image file.

Time for transfer: approx. 15min.

SHOW connected network drives

Use the menu item **Show connected Network Drives** to display all network drives currently linked with the PCU.

```
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**".

Status	Local Name	Remote Name
OK	H:	\\R3344\MY_BACKUP

DISCONNECT from all Network Drives

Use the menu item **Disconnect from all Network Drives** to disconnect all links to network drives.

```
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**".

```
Connected Network Drives (last):          -none-
```

15.3.4 Restoring the hard disk backup using a network link (Ethernet)

Brief description

The operating actions explained in the following are intended to make a backup copy of the entire hard disk of the PCU (disk image) and to restore it from an external computer (PG/PC) using a network connection.

For data transfer, a local point-to-point connection between the external computer and the PCU is established using the standard Ethernet cable of the type "Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable".

Requirements

The following requirements must be fulfilled:

- The operating system of the external computer is
  - Windows NT 4.0
  - Windows 95.
- The Ethernet cable is connected to the Ethernet interface of the external computer and the PCU.

Notice

A **point-to-point** connection between PCU 50 and an external computer (PG/PC) requires an Ethernet cable of the type "Twisted Pair Crossed 10baseT/100baseTX Ethernet Cable".

- The network parameters of the external computer are set or known:
  - Network Protocol NetBEUI
  - Computer Name
  - Shared As.

How to set or determine the network parameters of an external computer is described in Subsection 15.1.4 (page 15-458).

Operating actions

After the PCU has been turned on, the menu of the boot manager is displayed.

1. Choose the menu item **Service Menu** *(hidden).*

The following menu will appear:

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

    9   Reboot (warm restart)

    P   840Di Services

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

2. Choose **Backup/Restore** using the key “**7**”.

The system prompts you to enter a password:

3. Type one of the passwords of protection levels 0–2.
   – System
   – Manufacturer
   – Service.

Following menu:

```
PLEASE SELECT
    1   Hard disk Backup/Restore with GHOST
    4   Partitions Backup/Restore with GHOST

    9   Back to previous Menu

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

4. Choose the menu item **Hard disk Backup/Restore with Ghost** using the key “**1**”.

Following menu:

```
PLEASE SELECT
    1   Configure Ghost Parameters
    2   Hard disk Backup to <PATH>, Mode...
    3   Hard disk Backup from <PATH>, Mode...

    9   Back to previous Menu

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

Fig. 15-4 Main menu for saving/restoring hard disks

5. Now select the menu option **Configure GHOST parameters** using the key “**1**” to set the following parameters:
   – **Connection type** (LOCAL)
   – **Network parameters** of the PCU
   – **Path** or **File name** under which you wish the backup copy to be stored on the external computer.

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
     6   Manage Network Drives

     9   Back to previous Menu

Your Choice [1,2,3,4,5,6,9]?
```

Fig. 15-5 Main menu for configuring the Ghost parameters

- To set the connection mode “Network Connection”, choose the menu item **Set Connection Mode LOCAL** using the key “**2**”.
- To set the network parameters of the PCU, choose the menu item **Manage Network Drives** using the key “**6**”.

Following menu:

```
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 **Connect to Network Drive** using the key “**1**”.

– Type the **user name** and the **password** you want to use for access to the external computer using the network connection.

  Windows NT 4.0
  User name and password of the local user of the PG/PC

  Windows 95
  Any user name; if a password is required, type the password you have specified to share access to the directories.

– For later verification, you may be prompted to confirm saving of the password.

– Specify the drive letter under which the external drive is to be accessed from the PCU (e.g. “H”).

– DIRECTORY TO BE MOUNTED:
  Please type a name of the computer and the access name of the drive/directory of the external computer:

  ****<COMPUTER NAME>****<SHARED AS>
  e.g. \\R3344\MY_BACKUP

  How to set or determine the network parameters of an external computer is described in Subsection 15.1.4 (page 15-458).

The set network information is displayed.

Connected network drive (last)	H: (\\R3344\MY_BACKUP)

Use the key “**9**” to return to the “Main menu for configuring the Ghost parameters” Fig. 15-5 (page 15-488).

- 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** using the key “**4**”.
  - Specify the network drive (in the example: “H”) under which the backup copy will be stored on the external computer.

    If necessary you can enter an additional path specification that will be added to the path specification of the network drive. In this way, you can restore the backup copy from a subdirectory, with reference to the shared drive/directory of the external computer.
  - Type the desired file name under which you wish to store the backup copy: e.g. SICHER01.GHO

  Use the key “**9**” to return to the “Main menu for configuring the Ghost parameters” Fig. 15-5 (page 15-488).

Use the key “**9**” to return to the “Main menu for saving/restoring hard disks” after you have confirmed the confirmation warning regarding the modified GHOST parameters.

Following menu:

PLEASE SELECT

1 Configure Ghost Parameters
2 Hard disk Backup to H:\<PFAD>\SICHER01.GHO, Mode LOCAL
3 Hard disk Backup from H:\<PATH>\SICHER01.GHO, Mode LOCAL

9 Back to previous Menu

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

6. Choose the menu item **Hard disk Backup from...** using the key “**3**”.

Following menu:

PLEASE SELECT

1 Windows NT
2 Win95
3 WfW3.11
4 DOS

9 Back to previous Menu

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

7. Use this menu to choose the operating system used as the basis for the backup copy. In the case of SINUMERIK 840Di, this is exclusively Windows NT. Therefore, choose **Windows NT** using the key “**1**”.

Following menu:

```
What kind of disk partitioning do you want?
    1   Standard Partitioning (default)
    2   User-defined Partitioning

Your Choice [1,2]?
```

Standard partitioning (default)
The hard disk partitioning of the PCU is set to the initial state by automatic parameterization by Norton Ghost™.

User-defined partitioning
You can adapt the sizes of the hard disk partitions on the PCU manually in Norton Ghost™.

Answer the confirmation question with "**Y**" to start restoring.

Norton Ghost™ is now started. The following information is displayed in the message window that opens:

- The progress of the data transfer is displayed.
- The paths are displayed.
- The volume of data to be transferred is displayed.

Size of backup copy with compressing: 4.8GB hard disk –> approx. 330MB image file

Time for transfer: approx. 15min.

Notice

If you abort the transfer, inconsistent data will be available on the PCU, and the system can possibly no longer be booted.

To boot the PCU, you will need a boot diskette.

Norton Ghost™ closes automatically when the import process is completed.

8. 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 will appear:

```
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 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.

Changes to the computer name and system ID are made using the program **Norton Ghost Walker**™.

Note

The network settings can be later modified/determined under Windows NT.

Windows NT taskbar: **Start > Settings > Control Panel: Network**

---

9. After Norton Ghost Walker™ has updated the computer name and system ID, the following menu is displayed:

```
It seems, that Ghost Restore succeeded.

Hit any Key to reboot the System.
```

When the PCU is booted for the next time under Windows NT, the partitions E: and F: will be checked by the diagnostic program CHKDISK in succession whereby the PCU is rebooted automatically.

After completion of the check, the system with the restored backup copy is active.

15.3.5 Display connected drives

From the menu displayed in the Subsection 15.3.4 under Point 5. (page 15-487), select

```
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] ?
```

the menu option **Show Connected Network Drives** using the key “**2**”.

Following menu:

Status	Local Name	Remote Name
OK	H:	\\R3344\MY_BACKUP

All currently connected drives are displayed.

15.3.6 Disconnecting connected drives

From the menu displayed in the Subsection 15.3.4 under Point 5. (page 15-487), select

```
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] ?
```

the menu option **Disconnect form all Network Drives** using the key “**3**”.

```
Connected Network Drives (last):          -none-
```

15.3.7 Saving partitions (local)

What is to be done?

The operating actions explained in the following are intended to make a backup copy of the partitions C:, E: and F: of the PCU hard disk (partition image) and to transfer it to D:\IMAGES.

Requirements

The following requirements must be fulfilled:

- Sufficient free hard disk capacity must be available on drive D:
- The maximum number of possible partition backups may not yet be reached.

Operating actions

After the PCU has been turned on, the menu of the boot manager is displayed.

1. Choose the menu item **Service Menu** *(hidden).*

The following menu will appear:

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

     9   Reboot (warm restart)

     P   840Di Services

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

2. Choose **Backup/Restore** using the key “**7**”.

The system prompts you to enter a password:

3. Type one of the passwords of protection levels 0–2.
   – System
   – Manufacturer
   – Service.

Following menu:

```
PLEASE SELECT
     1   Hard disk Backup/Restore with GHOST
     4   Partitions Backup/Restore with GHOST

     9   Back to previous Menu

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

4. Choose the menu option **Partitions Backup/Restore with Ghost** using key “**4**”.

Following menu:

```
Ghost Connection Mode:      LOCAL
Maximum Backup Images:      <max. number>
Actual Backup Images:       <act. number>

            PLEASE SELECT
               1   Configure GHOST Parameters
               2   Partitions Backup, Mode LOCAL
               3   Partitions Restore, Mode LOCAL
               4   Delete Image

               9   Back to previous Menu

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

Make sure that the displayed **max. number** of possible partition backups is not yet reached.

How to change the max. number, see Subsection 15.3.8 (page 15-495).

To delete partition backups, see Subsection 15.3.9 (page 15-496).

5. Choose the menu item **Partitions Backup, Mode LOCAL** using key “**2**”.

Following menu:

```
            You must specify the image name (max. 7 characters long):

            Image Name:
```

6. 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

When saving a partition **C:**, **E:** and **F:** an independent image file with the name of the partition backup in front of it is created under D:\IMAGES for each of the 3 saved partitions, e.g.:

- for partition C: IBNZWST.GH1
- for partition E: IBNZWST.GH3
- for partition F: IBNZWST.GH4

When restoring the partition backup, however, the 3 individual files will be addressed as one partition backup with the description entered under Point 6.

15.3.8 Changing the number of partition backups

From the menu displayed in the Subsection 15.3.7 under Point 4. (page 15-493), select

```
Ghost Connection Mode:      LOCAL
Maximum Backup Images:      <max. Anzahl>
Actual Backup Images:       <akt. Anzahl>

        PLEASE SELECT
           1   Configure Ghost Parameters
           2   Partitions Backup, Mode LOCAL
           3   Partitions Restore, Mode LOCAL
           4   Delete Image

           9   Back to previous Menu

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

the menu option **Configure GHOST Parameters** using key “**1**”.

Following menu:

```
        PLEASE SELECT
           1   Change Maximum Backup Images

           9   Back to previous Menu

        Your Choice [1,9]?
```

Choose the menu item **Change Maximum Backup Images** using key “**1**”.

Type the new number in the following menu and confirm the question: “Save GHOST parameters” with “Yes”.

15.3.9 Deleting partition backups

From the menu displayed in the Subsection 15.3.7 under Point 4. (page 15-493), select

```
Ghost Connection Mode:      LOCAL
Maximum Backup Images:      <max. Anzahl>
Actual Backup Images:       <akt. Anzahl>

          PLEASE SELECT
             1   Configure Ghost Parameters
             2   Partitions Backup, Mode LOCAL
             3   Partitions Restore, Mode LOCAL
             4   Delete Image

             9   Back to previous Menu

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

Choose the menu item **Delete Image** using key “**4**”.

Choose the partition backup you want to delete from the next following menu and confirm the warning questions with “Yes”.

15.3.10 Restoring a partition backup (local)

Brief description

Use the operator actions explained in the following to restore a partition backup of the partitions C:, E: and F: of the PCU hard disk (partition image).

Requirements

No special requirements need to be fulfilled.

Operating 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 will appear:

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

     9   Reboot (warm restart)

     P   840Di Services

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

2. Choose **Backup/Restore** using the key “**7**”.

The system prompts you to enter a password:

3. Type one of the passwords of protection levels 0–2.
   – System
   – Manufacturer
   – Service.

Following menu:

```
PLEASE SELECT
     1   Hard disk Backup/Restore with GHOST
     4   Partitions Backup/Restore with GHOST

     9   Back to previous Menu

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

4. Choose the menu option **Partitions Backup/Restore with Ghost** using key “**4**”.

Following menu:

```
PLEASE SELECT
    1   Configure Ghost Parameters
    2   Partitions Backup, Mode LOCAL
    3   Partitions Restore, Mode LOCAL
    4   Delete Image

    9   Back to previous Menu

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

5. Choose the menu item **Partitions Backup, Mode LOCAL** using key "**3**".

Following menu:

```
PLEASE SELECT
    1   PCU Basic Software V06.01.04 Win NT 4.0
        [05.09.2000;05.30.32pm]
    2   Start-up intermediate version 1
        [05.10.2000; 04.03.15pm]

    9   Back to previous Menu

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

6. The descriptions that have been specified for the individual partition backups are displayed. Choose the partition backup you want to restore.

   In the example: "Start-up intermediate version 1" using the key "**2**".

   After confirmation, a warning is displayed:

   CAUTION: All data will be overwritten!

   If you confirm again, the partitions of the hard disk are restored.

Following menu:

```
It seems, that Ghost Restore succeeded.

Hit any Key to reboot the System.
```

When the PCU is booted for the next time under Windows NT, the partitions E: and F: will be checked by the diagnostic program CHKDISK in succession whereby the PCU is rebooted automatically.

After completion of the check, the system with the restored backup copy is active.

■

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, Section: 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 shared memory communication	
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	Ramp-function switch U/F mode	
31, ...	20.2	Torque limit 2	
Safety Integrated signals from PLC to axis/spindle			
31, ...	22.0	Deselection of safe velocity and safe operational stop (SBH/SG deselection)	
31, ...	22.1	Deselection of safe operational stop (SBH deselection)	
31, ...	22.3	Velocity limit – bit value 0 (SG selection)	
31, ...	22.4	Velocity limit – bit value 1	
31, ...	23.0–23.2	Ratio selection – bit value 0 through bit value 2	
31, ...	23.5	Enable limit position 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	
Safety Integrated signals from axis/spindle to PLC			

DB number	Byte, bit	Name	Doc. Reference
31, ...	108.0	Safe velocity or safe operational stop active (SBH/SG active)	
31, ...	108.2	Delete status pulses	
31, ...	108.7	Axis referenced reliably	
31, ...	109.0–109.7	Cam signals of plus and minus cams (SN1+/1– through SN4+/4–)	
31, ...	110.1	Safe operational stop active (SBH active)	
31, ...	110.3–110.4	Safe velocity active – bit value 0 through 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 through Stop E active	

16.2 Expanded message frame configuration (SW 2.2 and higher)

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.

With SW 2.2 and higher, the SINUMERIK 840Di system offers expanded message frame configuration which allows you to cyclically transfer drive data in addition to process data from the drive (DP slave) to the NC (DP master) by combining standard message frames and customized message frame configuration.

Message frame configuration

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.

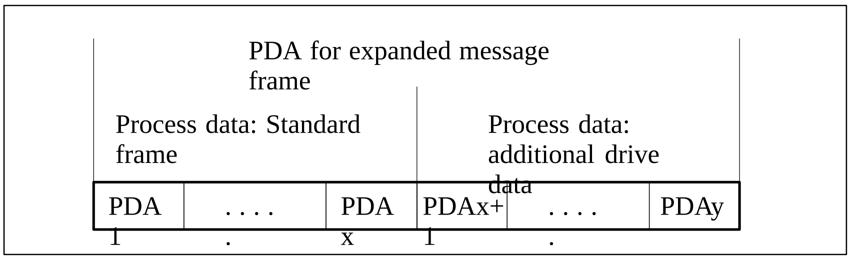


Fig. 16-1 Standard message frame with additional process data (PDA)

NC system variable

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

Process data	Drive data	System variable
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 ≤ 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]
  with 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:

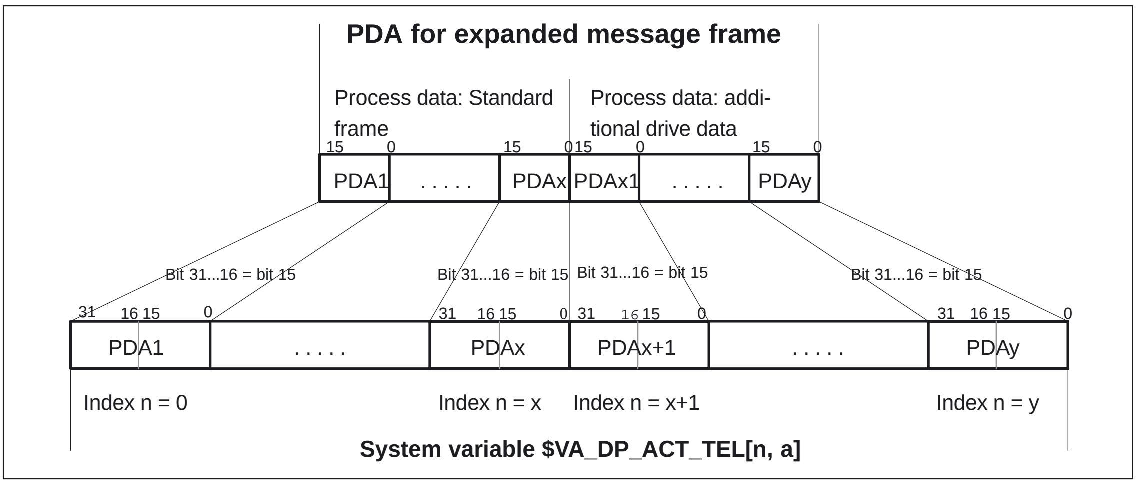


Fig. 16-2 Mapping principle: PDA on system variable $VA_DP_ACT_TEL

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 Requirements

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
  - SW 2.2 and higher
  - Option: "Evaluation of internal drive variables",
    Order No.: 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/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).

Standard 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.

Standard configuration

For information on how to perform a standard configuration of the DP master, please see Subsection 7.3.7, page 7-231ff.

Expanded 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

Dialog: DP Slave Properties
Tab: Configuration
Actual value > length: <**Length standard PDA + length additional PDA**>
Setpoint > I/O address: <**I/O address actual value**> *(see above 2.)*

OK

Notice

- The I/O address for setpoint and actual values of an axis must be the same.

  I/O address actual value = = I/O address setpoint

- The axis I/O address set via the SlaveOM must match the I/O address set in the NC.

  No automatic adjustment takes place!

  The following data must be identical.

  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: DP slave properties
Tab: 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.

Standard configuration

For the standard configuration/start-up of the drive, please see:

- Start-up (requirements)
  - Subsection 8.1, page 8-249
- Standard configuration/start-up
  - SIMODRIVE 611 universal and universal E:
    References: /FBU/ SIMODRIVE 611 universal, Description of Functions
  - 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.

Expanded 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”.

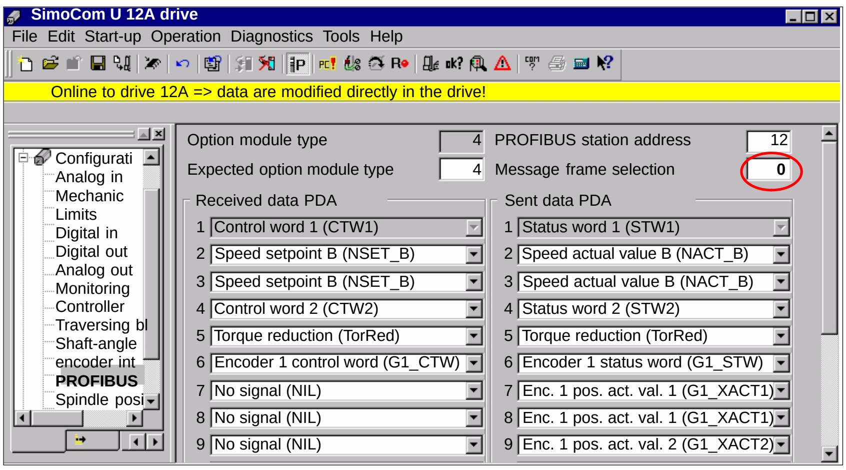


Fig. 16-3 Activating the customizable message frame configuration

- 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.

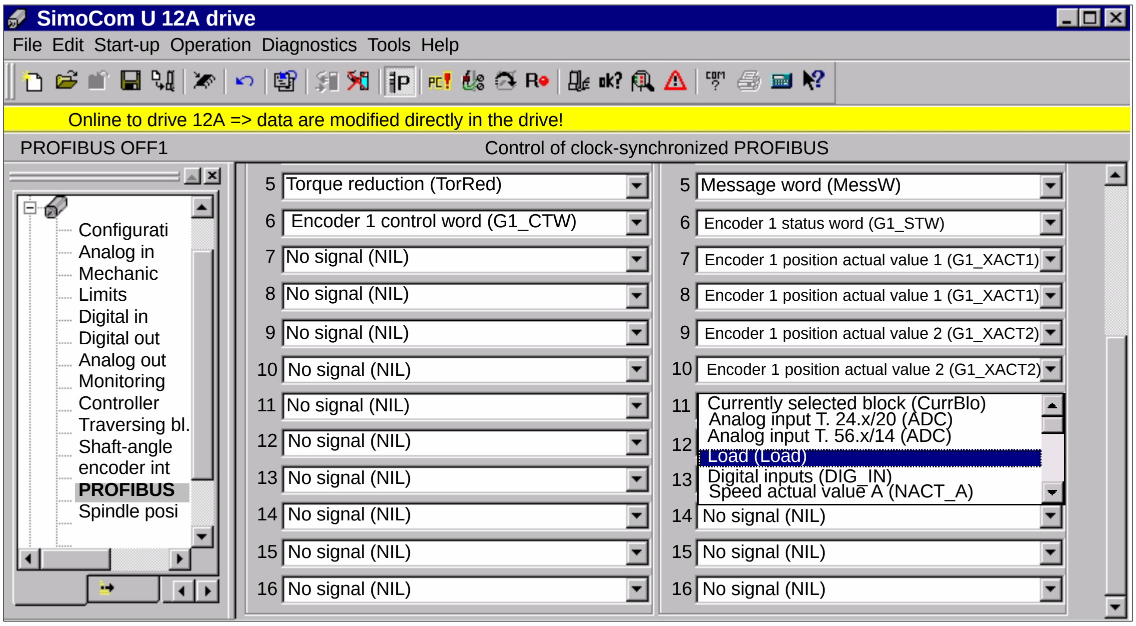


Fig. 16-4 Configuring the additional drive actual values

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.

Standard configuration

How to proceed with the standard configuration of a drive is described in Section 10.5.3, page 10-313.

Expanded 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 No.: 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 Boundary conditions

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 settings: 0	min. input limit: 0	max. input limit: FFFF FFFF
Changes effective after power ON	Protection level: 2/7	Unit: –
Data type: DWORD	valid from SW: 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 (CTW1.12/STW1.12) Bit 5: Deactivation of the 611U-specific drive parks (CTW2.7/STW2.7) Bit 6: Deactivation of the 611U-specific travel to fixed stop (CTW2.8/STW2.8) Bit 7: Deactivation of the 611U-specific motor changeover internal (STW2.9–11) Bit 8: Deactivation of the 611U-specific ramp block (CTW1.13) Bit 9: Deactivation of the 611U-specific function generator functions (CTW1.8/STW1.13) 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 with	—–	

Axis-specific machine data

36730 MD number	**DRIVE_SIGNAL_TRACKING** Detection of additional drive actual values				
Default settings: 0		min. input limit: 0		max. input limit: 4	
Changes effective after power ON			Protection level: 2/7		Unit: –
Data type: BYTE			valid from SW: 2.1		
Meaning:	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 transferred and stored in system variables: *Actual value* — *System variable* Load — $AA_LOAD Torque setpoint — $AA_TORQUE Active power — $AA_POWER Current actual value — t$AA_CURR 2: The entire PROFIDrive message frame is stored in a system variable: *Actual value* — *System variable* PROFIDrive message frame — $VA_DP_ACT_TEL				
MD irrelevant with	——				

System variable

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]			
Indexes	n: Array index	Value range	[0,20]	
	a: Machine axis	Value range	Machine axis identifier	
Accesses	Parts program	Synchronized action	OPI	
	Read	Read	Read	
Attributes	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 (SW 2.2 and higher)

The full description of functions for “Travel to fixed stop” can be found in:

References: /FB1/ Description of Functions, Basic Machine
Section: 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. With SW 2.2 and higher, you can 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 Requirements

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 adjustment

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/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

Scaling

As standard, in the DP slave parameter P0881 is scaled to: 16384.00 ≙ 1%

Examples for other resolutions:

– 1638.40 ≙ 0.1%

– 163.84 ≙ 0.01%.

Setpoint torque T_{set}

Setpoint torque T_{set} of the drive is therefore calculated by:

$$T_{set} = T_{max} * \left(1 - \frac{P0881 * TorRed[\%]}{16384 * 100\%} \right)$$

T_{max}:

Maximum possible drive torque from rated motor torque and parameter P1230 Torque limit value.

TorRed:

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_PROFI-BUS_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.

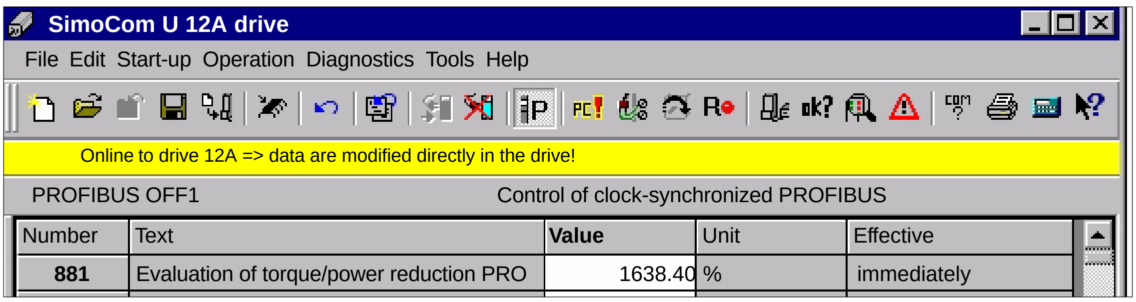


Fig. 16-5 Set parameter P0881

Setting parameters for the SINUMERIK 840Di NC

Enter value 0.1 in the axis-specific machine data of machine axis X1

- MD 37620: PROFIBUS_TORQUE_RED_RESOL (torque reduction resolution on PROFIBUS (LSB weighting)).

The machine data is effective after NC reset (warm restart).

16.3.5 Boundary conditions

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.

Notice

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 settings: 0	min. input limit: 0	max. input limit: FFFF FFFF	
Changes effective after power ON	Protection level: 2/7	Unit: –	
Data type: DWORD	valid from SW: 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 (CTW1.12/STW1.12) Bit 5: Deactivation of the 611U-specific drive parks (CTW2.7/STW2.7) Bit 6: Deactivation of the 611U-specific travel to fixed stop (CTW2.8/STW2.8) Bit 7: Deactivation of the 611U-specific motor changeover internal (STW2.9–11) Bit 8: Deactivation of the 611U-specific ramp block (CTW1.13) Bit 9: Deactivation of the 611U-specific function generator functions (CTW1.8/STW1.13) 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 with	—–		

Axis-specific machine data

37620 MD number	**PROFIBUS_TORQUE_RED_RESOL** torque reduction resolution on PROFIBUS (LSB weighting)		
Default settings: 1	min. input limit: 0.01	max. input limit: 10	
Changes effective after NEWCONF	Protection level: 2 / 7	Unit: %	
Data type: DOUBLE	valid from SW: 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
ASUP	Asynchronous subprogram
BA	Operating Mode
BAG	Operating mode group
BB	Ready
BCD	Binary Coded Decimals: Decimal numbers encoded in binary format
BP	Basic program
COM	Communication
CPU	Central Processing Unit:
DAC	Digital-Analog converter
DB	Data Block
DBB	Data Block Byte
DBX	Data Block Bit
DHCP	Dynamic Host Configuration Protocl: Protocol for automatical assignment of IP addresses from a DHCP server to a client computer
DPR	Dual-Port RAM
DRAM	Dynamic memory (not non-volatile)
DRF	Differential Resolver Function
DRY	Dry Run: Probelaufvorschub
DSR	Data Send Ready: Message to indicate that serial data interfaces are ready
DW	Data Word
EFP	Simple I/O module (PLC I/O module)
EPROM	Erasable Programmable Read-Only Memory
ETC	ETC key > extension of soft key bar in the same menu

FC	Function Call on the PLC
FDD	Feed drive
FEPROM	Flash EPROM: Readable and writable memory
FIFO	First in First Out: Memory that operates without addresses where the data are always read out in the same order in which they were stored.
FIPO	Fine interpolator
FRK	Milling radius correction
FST	Feed Stop: Feed hold
GEO	Geometry
GND	Ground signal
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	Initialization (**Ini**tializing Data)
INTV	Internal multiplication
IS	Interface signal
ISO Code	Special punchtape code, number of punched holes per character always even
JOG	Jogging: Setting-up mode
K1	Channel 1
K_{UE}	Transmission ratio
K_V	Servo gain factor
LED	Light Emitting Diode:
LSB	Last 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 No.
MMC	Human Machine Communication: SINUMERIK operator interface for operating, programming and simulation
MPF	Main Program File: NC parts program (main program)
MPI	Multi Point Interface:
MSD	Main Spindle Drive
NC	Numerical Control:
NCK	Numerical Control Kernel: Numerical Control Kernel with block preparation, travel range etc.
NCU	Numerical Control Unit: NC-Modul
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 unit
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: 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: as CA, however, with DC infeed
POSMO SI	Positioning Motor Servo Integrated: Positioning motor, DC infeed
PPO	Parameter Process data ObjectCyclic data message frame for PROFIBUS DP transmissionand “Variable speed drives” profile
PROFIBUS	Process Field Bus: Serial data bus

PRT	Program test
RAM	Random Access Memory in which data can be read and written
ROV	Rapid Override
RPA	R-Parameter Active: Identifier for R parameters
RS-232	Serial interface
RTS	Request To Send: Control signal on serial data interfaces
SBL	Single Block
SD	Setting data
SEA	Setting Data Active: Identifier for setting data
SK	Soft key
SKP	Skip: Skip block
SLM	Synchronous Linear Motor
SPF	Sub Program File
SRAM	Static RAM (non-volatile)
SRM	Synchronous Rotary Motor
SSFK	Spindle pitch for error compensation
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
TOA	Tool Offset Active: Identifier for tool offsets
TRC	Tool Radius Offset
TTL	Transistor-Transistor Logic (interface type)
VDI interface	Data interface between NC and PLC
WCS	Tool Coordinate System
ZOA	Zero Offset Active: Identifiere for zero offset

ZV Zero Offset (work offset)

µ**C** Microcontroller

■

Notes

References

B

General Documentation

/BU/ SINUMERIK & SIMODRIVE, Automation Systems for Machine Tools
Catalog NC 60
Order No.: E86060-K4460-A101-A9-7600

/IKPI/ Industrial Communication and Field Devices
Catalog IK PI
Order No.: E86060-K6710-A101-B2-7600

/ST7/ SIMATIC
Products for Totally Integrated Automation and Micro Automation
Catalog ST 70
Order No.: E86060-K4670-A111-A8-7600

/Z/ MOTION-CONNECT
Cable, Connectors & System Components for SIMATIC, SINUMERIK, Masterdrives and SIMOTION
Catalog NC Z
Order No.: E86060-K4490-A001-B1-7600

Electronic Documentation

/CD1/ The SINUMERIK System (11.02 Edition)
DOC ON CD
(includes all SINUMERIK 840D/840Di/810D/802D/802SC and SIMODRIVE publications)
Order No.: 6FC5298-6CA00-0BG3

User Documentation

/AUK/ SINUMERIK 840D/810D (09.99 Edition)
Short Guide **AutoTurn Operation**
Order No.: 6FC5298-4AA30-0BP2

/AUP/ SINUMERIK 840D/810D (02.02 Edition)
Operator's Guide **AutoTurn Graphic Programming System**
Programming/Setup
Order No.: 6FC5298-4AA40-0BP3

/BA/ SINUMERIK 840D/810D (10.00 Edition)
Operator's Guide **MMC**
Order No.: 6FC5298-6AA00-0BP0

/BAD/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Operator's Guide **HMI Advanced**
Order No.: 6FC5298-6AF00-0BP2

/BAH/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Operator's Guide **HT 6**
Order No.: 6FC5298-0AD60-0BP2

/BAK/ SINUMERIK 840D/840Di/810D (02.01 Edition)
Short Guide **Operation**
Order No.: 6FC5298-6AA10-0BP0

/BAM/ SINUMERIK 840D/810D (08.02 Edition)
Operation/Programming ManualTurn
Order No.: 6FC5298-6AD00-0BP0

/BAS/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Operation/Programming ShopMill
Order No.: 6FC5298-6AD10-0BP1

/BAT/ SINUMERIK 840D/810D (06.03 Edition)
Operation/Programming ShopTurn
Order No.: 6FC5298-6AD50-0BP2

/BEM/ SINUMERIK 840D/810D (11.02 Edition)
Operator's Guide **HMI Embedded**
Order No.: 6FC5298-6AC00-0BP2

/BNM/ SINUMERIK 840D/840Di/810D (11.02 Edition)
User's Guide **Measuring Cycles**
Order No.: 6FC5298-6AA70-0BP2

/BTDI/ SINUMERIK 840D/840Di/810D (04.03 Edition)
Motion Control Information System (MCIS)
User's Guide **Tool Data Information**
Order No.: 6FC5297-6AE01-0BP0

/CAD/ SINUMERIK 840D/840Di/810D (03.02 Edition)
Operator's Guide **CAD Reader**
Order No.: (included in online help)

/DA/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Diagnostics Guide
Order No.: 6FC5298-6AA20-0BP3

/KAM/ SINUMERIK 840D/810D (04.01 Edition)
Short Guide **ManualTurn**
Order No.: 6FC5298-5AD40-0BP0

/KAS/ SINUMERIK 840D/810D (04.01 Edition)
Short Guide **ShopMill**
Order No.: 6FC5298-5AD30-0BP0

/KAT/ SINUMERIK 840D/810D (07.01 Edition)
Short Guide **ShopTurn**
Order No.: 6FC5298-6AF20-0BP0

/PG/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Programming Guide **Fundamentals**
Order No.: 6FC5298-6AB00-0BP2

/PGA/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Programming Guide **Advanced**
Order No.: 6FC5298-6AB10-0BP2

/PGK/ SINUMERIK 840D/840Di/810D (10.00 Edition)
Short Guide **Programming**
Order No.: 6FC5298-6AB30-0BP0

/PGM/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Programming Guide **ISO Milling**
Order No.: 6FC5298-6AC20-0BP2

/PGT/
SINUMERIK 840D/840Di/810D
Programming Guide **ISO Turning** (11.02 Edition)
Order No.: 6FC5298-6AC10-0BP2

/PGZ/
SINUMERIK 840D/840Di/810D (11.02 Edition)
Programming Guide **Cycles**
Order No.: 6FC5298-6AB40-0BP2

/PI/
PCIN 4.4
Software for Data Transfer to/from MMC Module
Order No.: 6FX2060 4AA00-4XB0 (English, French, German)
Order from: WK Fürth

/SYI/
SINUMERIK 840Di (02.01 Edition)
System Overview
Order No.: 6FC5298-6AE40-0BP0

Manufacturer/Service Documentation

a) Lists

/LIS/
SINUMERIK 840D/840Di/810D (11.02 Edition)
SIMODRIVE 611D
Lists
Order No.: 6FC5297-6AB70-0BP3

b) Hardware

/ASAL/
SIMODRIVE (06.03 Edition)
Planning Guide **General Information for Asynchronous Motors**
Order No.: 6SN1197-0AC62-0BP0

/APH2/
SIMODRIVE (07.03 Edition)
Planning Guide **1PH2 Asynchronous Motors**
Order No.: 6SN1197-0AC63-0BP0

/APH4/
SIMODRIVE (07.03 Edition)
Planning Guide **1PH4 Asynchronous Motors**
Order No.: 6SN1197-0AC64-0BP0

/APH7/
SIMODRIVE (06.03 Edition)
Planning Guide **1PH7 Asynchronous Motors**
Order No.: 6SN1197-0AC65-0BP0

/APL6/ SIMODRIVE (07.03 Edition)
Planning Guide **1PL6 Asynchronous Motors**
Order No.: 6SN1197-0AC66-0BP0

/BH/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Operator Components Manual (HW)
Order No.: 6FC5297-6AA50-0BP2

/BHA/ SIMODRIVE **Sensor** (03.03 Edition)
User's Guide (HW) **Absolute Position Sensor with Profibus-DP**
Order No.: 6SN1197-0AB10-0YP2

/EMV/ SINUMERIK, SIROTEC, SIMODRIVE (06.99 Edition)
Planning Guide (HW) **EMC Installation Guide**
Order No.: 6FC5297-0AD30-0BP1

The current Declaration of Conformity is available under 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'.

/GHA/ SINUMERIK/SIMOTION
ADI4 – Analog Drive Interface for 4 Axes (02.03 Edition)
Manual
Order No.: 6FC5297-0BA01-0BP1

/PFK6/ SIMODRIVE (05.03 Edition)
Planning Guide **1FK6 Three-Phase AC Servomotors**
Order No.: 6SN1197-0AD05-0BP0

/PFK7/ SIMODRIVE (01.03 Edition)
Planning Guide **1FK7 Three-Phase AC Servomotors**
Order No.: 6SN1197-0AD06-0BP0

/PFS6/ MASTERDRIVES (07.03 Edition)
Planning Guide **1FS6 Three-Phase AC Servomotors**
Order No.: 6SN1197-0AD08-0BP0

/PFT5/ SIMODRIVE (05.03 Edition)
Planning Guide **1FT5 Three-Phase AC Servomotors**
Order No.: 6SN1197-0AD01-0BP0

/PFT6/ SIMODRIVE (05.03 Edition)
Planning Guide **1FT6 Three-Phase AC Servomotors**
Order No.: 6SN1197-0AD02-0BP0

/PHC/ SINUMERIK 810D
Configuring Manual CCU (HW) (11.02 Edition)
Order No.: 6FC5297-6AD10-0BP1

/PHD/ SINUMERIK 840D (09.03 Edition)
Configuring Manual NCU (HW)
Order No.: 6FC5297-6AC10-0BP2

/PJAL/ SIMODRIVE 611 / Masterdrives MC (01.03 Edition)
Planning Guide **Three-Phase AC Servomotors**
General Part
Order No.: 6SN1197-0AD07-0BP0

/PJAS/ SIMODRIVE (07.03 Edition)
Planning Guide **Asynchronous Motors** (Compendium)
Order No.: 6SN1197-0AC61-0BP0

/PJFE/ SIMODRIVE (02.03 Edition)
Planning Guide **1FE1 Built-In Synchronous Motors**
Three-Phase AC Motors for Main Spindle Drives
Order No.: 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 No.: 610.43000.02

/PJLM/ SIMODRIVE (06.02 Edition)
Planning Guide **1FN1, 1FN3 Linear Motors**
ALL General Information about Linear Motors
1FN1 1FN1 Three-Phase AC Linear Motor
1FN3 1FN3 Three-Phase AC Linear Motor
CON Connections
Order No.: 6SN1197-0AB70-0BP4

/PJM/ SIMODRIVE (11.00 Edition)
Planning Guide **Motors**
Three-Phase AC Servo Motors for Feed and Main Spindle Drives
Order No.: 6SN1197-0AC20-0BP0

/PJM2/ SIMODRIVE (07.03 Edition)
Planning Guide **Servomotors**
Three-Phase AC Motors for Feed and Main Spindle Drives
Order No.: 6SN1197-0AA20-0BP4

/PJTM/ SIMODRIVE (05.03 Edition)
Planning Guide **1FW6 Integrated Torque Motors**
Order No.: 6SN1197-0AD00-0BP0

/PJU/ SIMODRIVE 611 (02.03 Edition)
Planning Guide **Inverters**
Order No.: 6SN1197-0AA00-0BP6

/PKTM/ SIMODRIVE (09.03 Edition)
Planning Guide **1FW3 Complete Torque Motors**
Order No.: 6SN1197-0AC70-0BP0

/PMH/ SIMODRIVE **Sensor** (07.02 Edition)
Configuring/Installation Guide (HW)
Hollow-Shaft Measuring System SIMAG H
Order No.: 6SN1197-0AB30-0BP1

/PMHS/ SIMODRIVE (12.00 Edition)
Installation Guide **Measuring System for Main Spindle Drives**
SIZAG2 Toothed-Wheel Encoder
Order No.: 6SN1197-0AB00-0YP3

/PMS/ SIMODRIVE (02.03 Edition)
Planning Guide **ECO Motor Spindle** for Main Spindle Drives
Order No.: 6SN1197-0AD04-0BP1

/PPH/ SIMODRIVE (12.01 Edition)
Planning Guide **1PH2, 1PH4, 1PH7 Motors**
AC Induction Motors for Main Spindle Drives
Order No.: 6SN1197-0AC60-0BP0

/PPM/ SIMODRIVE (11.01 Edition)
Planning Guide **Hollow-Shaft Motors**
for **1PM4** and **1PM6** Main Spindle Drives
Order No.: 6SN1197-0AD03-0BP0

c) Software

/FB1/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Description of Functions **Basic Machine (Part 1)**
(the various sections are listed below)
Order No.: 6FC5297-6AC20-0BP1

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	Velocities, Setpoint/Actual-Value Systems, Closed-Loop Control
H2	Output of Auxiliary Functions to PLC
K1	Mode Group, Channel, 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) (11.02 Edition)
Description of Functions **Extended Functions (Part 2)**
including FM-NC: Turning, Stepper Motor
(the various sections are listed below)
Order No.: 6FC5297-6AC30-0BP2

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
M5	Measurement
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(CCU2) (11.02 Edition)
Description of Functions **Special Functions (Part 3)**
(the various sections are listed below)
Order No.: 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
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 No.: 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

/FBAN/ SINUMERIK 840D/SIMODRIVE 611 digital (02.00 Edition)
Description of Functions **ANA MODULE**
Order No.: 6SN1197-0AB80-0BP0

/FBD/ SINUMERIK 840D (07.99 Edition)
Description of Functions **Digitizing**
Order No.: 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)

/FBDN/ SINUMERIK 840D/840Di/810D (03.03 Edition)
Motion Control Information System (MCIS)
Description of Functions **DNC NC Program Management**
Order No.: 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 No.: 6FC5297-6AE10-0BP3

/FBFE/ SINUMERIK 840D/840Di/810D (04.03 Edition)
Description of Functions **Remote Diagnosis**
Order No.: 6FC5297-0AF00-0BP2

FE1	Remote Diagnosis ReachOut
FE3	Remote Diagnosis pcAnywhere

/FBH/ SINUMERIK 840D/840Di/810D (11.02 Edition)
HMI Configuring Package
Order No.: (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 No.: (supplied with the software)

/FBHL/ SINUMERIK 840D/SIMODRIVE 611 digital (11.02 Edition)
Description of Functions **HLA Module**
Order No.: 6SN1197-0AB60-0BP3

/FBIC/ SINUMERIK 840D/840Di/810D (06.03 Edition)
Motion Control Information System (MCIS)
Description of Functions **TDI Ident Connection**
Order No.: 6FC5297-1AE60-0BP0

/FBMA/ SINUMERIK 840D/810D (08.02 Edition)
Description of Functions **ManualTurn**
Order No.: 6FC5297-6AD50-0BP0

/FBO/ SINUMERIK 840D/810D (09.01 Edition)
Description of Functions **Configuring OP 030 Operator Interface**
Order No.: 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 No.: 6FC5297-3AB60-0BP0

/FBR/ SINUMERIK 840D/810D (09.01 Edition)
IT Solutions
Description of Functions **Computer Link** (SinCOM)
Order No.: 6FC5297-6AD60-0BP0

NFL Host Computer Interface
NPL PLC/NCK Interface

/FBSI/ SINUMERIK 840D / SIMODRIVE 611 digital (11.02 Edition)
Description of Functions **SINUMERIK Safety Integrated**
Order No.: 6FC5297-6AB80-0BP1

/FBSP/ SINUMERIK 840D/840Di/810D (08.03 Edition)
Description of Functions **ShopMill**
Order No.: 6FC5297-6AD80-0BP1

/FBST/ SIMATIC (01.01 Edition)
Description of Functions **FM STEPDRIVE/SIMOSTEP**
Order No.: 6SN1197-0AA70-0YP4

/FBSY/ SINUMERIK 840D/840Di/810D (10.02 Edition)
Description of Functions **Synchronized Actions**
Order No.: 6FC5297-6AD40-0BP2

/FBT/ SINUMERIK 840D/810D (06.03 Edition)
Description of Functions **ShopTurn**
Order No.: 6FC5297-6AD70-0BP2

/FBTC/ SINUMERIK 840D/810D (01.02 Edition)
IT Solutions
SINUMERIK Tool Data Communication SinTDC
Description of Functions
Order No.: 6FC5297-5AF30-0BP0

/FBTD/ SINUMERIK 840D/810D (02.01 Edition)
IT Solutions
Tool Information System (SinTDI) with Online Help
Description of Functions
Order No.: 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 No.: 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 No.: 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 No.: 6FC5297-6AC60-0BP1

/HBA/ SINUMERIK 840D/840Di/810D (03.02 Edition)
Manual @Event
Order No.: 6AU1900-0CL20-0BA0

/HBI/ SINUMERIK 840Di (06.03 Edition)
Manual
Order No.: 6FC5297-6AE60-0BP2

/INC/ SINUMERIK 840D/840Di/810D (06.03 Edition)
System Description Commissioning Tool **SINUMERIK SinuCOM NC**
Order No.: (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 No.: 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's Guide **Distributed Positioning Motor on PROFIBUS DP**
Order No.: 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's Guide **Distributed Servo Drive Systems**
Order No.: 6SN2197-0AA20-0BP4

/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 No.: 6ES7398-8FA10-8BA0

/S7HT/ SIMATIC S7–300 (03.97 Edition)
Manual: STEP 7, **Fundamentals**, V. 3.1
Order No.: 6ES7 10-4CA02-8BA0

/S7HR/ SIMATIC S7–300 (03.97 Edition)
Manual: STEP 7, **Reference Manuals**, V. 3.1
Order No.: 6ES7810-4CA02-8BR0

/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 No.: 6SC6111-6PC00-0BA□, 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 No.: 6SN1197-0AA30-0BP1

/IAA/ SIMODRIVE 611A (10.00 Edition)
Installation and Start-Up Guide
Order No.: 6SN1197-0AA60-0BP6

/IAC/ SINUMERIK 810D (11.02 Edition)
Installation and Start-Up Guide
(incl. description of SIMODRIVE 611D start-up software)
Order No.: 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 No.: 6FC5297-6AB10-0BP2

/IAM/ SINUMERIK 840D/840Di/810D (11.02 Edition)
Installation and Start-Up Guide HMI/MMC
Order No.: 6FC5297-6AE20-0BP2

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

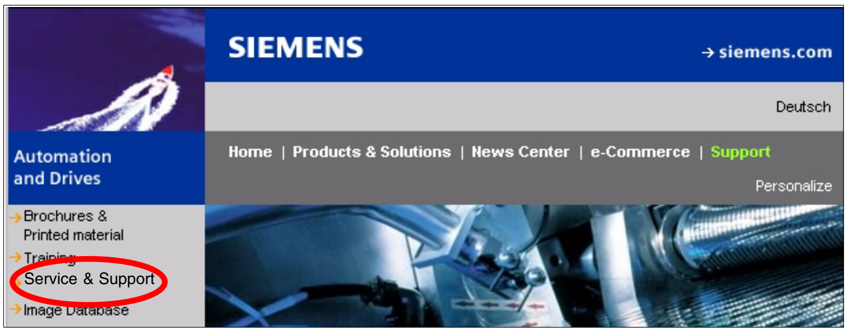
EC Declaration of Conformity

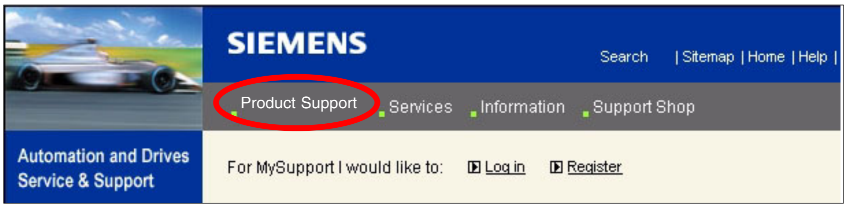
C

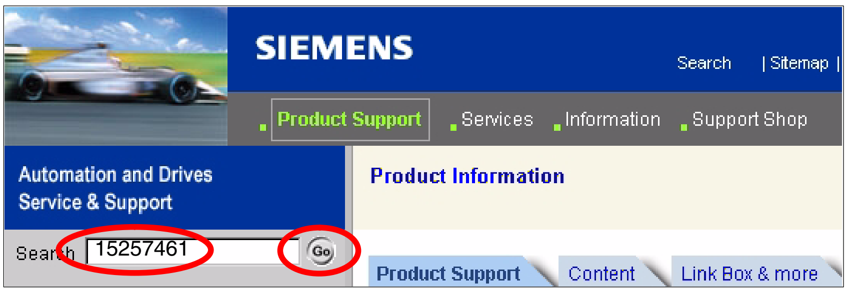
In order to provide the most recent version, the EC Declaration of Conformity is no longer included as part of this manual.

The EC Declaration of Conformity is available in PDF format under Product ID on Siemens A&D Product Information page: **15257461**.

– Internet address: www.ad.siemens.de > Support > Service & Support > Produkt Support > Search: **15257461** > Go







■

Notes

Index

Numbers

A

B

E

F

G

H

I

L

M

N

O

P

R

S

T

U

To
SIEMENS AG
A&D MC BMS
P.O. Box 3180

D-91050 Erlangen/Germany

(Tel. ++49–(0)180 / 5050–222 [Hotline]
Fax: ++49–(0)9131 / 98–2176 [Documentation]
email: motioncontrol.docu@erlf.siemens.de)

Suggestions

Corrrections

for publication:

SINUMERIK 840Di

Manufacturer/Service documentation

Manual

Order No.: 6FC5 297-6AE60-0BP2
Edition: 06.2003

From

Name

Company/Department

Address

ZIP: Town:

Phone: /

Telefax: /

Should you come across any printing errors when reading this publication, please notify us on this sheet. Suggestions for improvement are also welcome.

Suggestions and/or corrections

Overview of SINUMERIK 840D/840Di/810D Documentation

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/810D/FM-NC — **AutoTurn**
  – Short Guide
  – Programming/Setup
- *SINUMERIK* 840D/840Di/810D — Operator's Guide **– HT 6**
- *SINUMERIK* 840D/840Di/810D — **Diagnostics Guide *)**
- *SINUMERIK* 840D/840Di/810D — **Operator's Guide *)**
  – Short Guide
  – HMI Embedded
  – HMI Advanced

User Documentation

- *SINUMERIK* 840D/840Di/810D — **Program. Guide**
  – Short Guide
  – Fundamentals ***)**
  – Advanced ***)**
  – Cycles
  – Measuring Cycles
  – ISO Turning/Milling
- *SINUMERIK* 840D/810D — Operator's Guide
  – **ManualTurn**
  – Short Guide ManualTurn
  – **ShopMill**
  – Short Guide ShopMill
  – **ShopTurn**
  – Short Guide ShopTurn
- *SINUMERIK* 840Di — **System Overview**

Manufacturer/Service Documentation

- *SINUMERIK* — **Configuring** (HW) ***)**
  – 810D
  – 840D
- *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**

Manufacturer/Service Documentation

- *SINUMERIK SIMODRIVE* 611D 840D/810D — Description of Functions **Drive Functions *)**
- *SINUMERIK* 840D/840Di/810D — **Description of Functions**
  – Basic Machine ***)**
  – Extended Functions
  – Special Functions
- *SINUMERIK* 840D/840Di/810D — Description of Functions **Tool Management**
- *SINUMERIK* 840D/810D — **Configuring Kit** HMI Embedded
- *SINUMERIK* 840D/810D — Description of Functions Operator Interface **OP 030**
- *SINUMERIK* 840D/840Di/810D — **Motion Control Information System**
  – Computer Link SinCom
  – Tool Information System SinTDI
  – DNC NC Program Management
  – Tool Data Inform./TDI Ident Connec.
  – Tool Data Information Communication

Manufacturer/Service Documentation

- *SINUMERIK SIMODRIVE* — Description of Functions SINUMERIK **Safety Integrated**
- *SINUMERIK* 840D — Description of Functions **Digitizing**
- *SINUMERIK SIMODRIVE* — **Installation & Start-Up Guide *)**
  – 810D
  – 840D/611D
  – HMI
- *SINUMERIK SIMODRIVE* 840D/840Di 810D 611D — **Lists *)**
- *SINUMERIK SIMODRIVE* 840D 611D — Description of Functions **Linear Motor**
- *SINUMERIK SIMODRIVE* 840D 611D — Description of Functions
  – Hydraulics Module
  – Analog Module
- *SINUMERIK SIMODRIVE SIROTEC* — **EMC** Guidelines

Electronic Documentation

- *SINUMERIK SIMODRIVE* 840D/840Di/810D 611, Motors — **DOC ON CD *)** The SINUMERIK System

Manufacturer/Service Documentation

- *SINUMERIK* 840D/840Di/810D — Description of Functions **ISO Dialects** for SINUMERIK
- *SINUMERIK* 840Di — **Manual** (HW + Installation and Start-Up)
- *SINUMERIK* 840D/810D — Description of Functions **Remote Diagnosis**
- *SINUMERIK* 840D/840Di/810D — **Manual @ Event**

***)** These documents are a minimum requirement

Siemens AG
Automation & Drives
Motion Control Systems
P.O. Box 3180, D-91050 Erlangen
Germany

www.ad.siemens.de

Order No.: 6FC5297-6AE60-0BP2

Printed in Germany