SIEMENS

SINUMERIK 840D/810D
SIMODRIVE 611 digital

Start-Up Guide

Valid for

Control	*Version*
SINUMERIK 840D/810D powerline	6
SINUMERIK 840DE/810DE powerline (export variant)	6
Drive	*Version*
SIMODRIVE 611 digital	5

03/2006 Edition

SINUMERIK® documentation

Key to editions

The editions listed below have appeared before this edition.

The letters in the “Note” column indicate which status the previously published editions have.

Identification of the status in the “Notes” column:

A . . . . . New documentation.
B . . . . . Unchanged reprint with new order number.
C . . . . . Revised version with new edition number.

Edition	Order no.	Notes
03/2006	6FC5 297-6AB20-0BP0	**A**

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Order no: 6FC5297-6AB20-0BP0

Siemens AG 2006
Subject to technical modifications.

Preface

Structure of the documentation

The SINUMERIK documentation is divided into three levels:

- General documentation
- User documentation
- Manufacturer/service documentation

A monthly updated list of publications with the available language versions can be found on the Internet at:

http://www.siemens.com/motioncontrol

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The Internet edition of the DOConCD – the DOConWEB – can be found at:
http://www.automation.siemens.com/doconweb

Information about training courses and FAQs (frequently-asked questions) can be found on the Internet at:
http://www.siemens.com/motioncontrol , select the “Support” option.

Target group

This documentation is intended for use by start-up engineers.

Benefits

The Start-Up Guide will enable the intended target group to test the product/ system or plant and to bring it into service correctly and safely.

Standard scope

This Start-Up Guide describes the functionality of the standard scope. Additions or modifications made by the machine manufacturer will be documented by the machine manufacturer.

Other functions not explained in this document may also run on the control. However, no claims to these functions exist in the event of replacement and/or maintenance.

For the sake of clarity, this documentation does not contain all the detailed information about all types of the product, and also cannot take account of every possible situation for installation, operation and maintenance.

Technical Support

If you have any questions, please contact the following hotline:

Europe and Africa time zones:
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Note

Country-specific telephone numbers for technical advice can be found on the Internet:

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

Questions about this Guide

If you have any questions about the documentation (suggestions or corrections), please send a fax or e-mail to the following address:

Fax: +49 (0) 9131 / 98 – 63315
E-Mail: mailto:motioncontrol.docu@siemens.com

Fax form: see Feedback sheet at the end of this document.

SINUMERIK web site

http://www.siemens.com/sinumerik

EU Declaration of Conformity

The EU Declaration of Conformity about the EMC Directive can be found/ obtained

- on the Internet:
  http://www.ad.siemens.com/csinfo
  under product/order number 15257461
- from the responsible branch of the A&D MC Division of Siemens AG

Object of the book

The publication illustrates the structure of the control system and the interfaces to the individual components. It also describes the procedure for starting up SINUMERIK 810D, and lists all the data, signals and PLC modules.

User-oriented activities such as the creation of part programs and control operation procedures are described in detail in separate documents.

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

Safety instructions

This manual contains instructions that you must follow to ensure your own personal safety and to avoid damage to property. The instructions that concern your personal safety are indicated by a warning triangle. Instructions that concern only damage to property have no warning triangle. The warnings labels are illustrated in descending order according to the level of risk.

Danger

means that death or severe injury will occur if the specified precautionary measures are not taken.

Warning

means that death or severe injury may occur if the specified precautionary measures are not taken.

Caution

with warning triangle means that slight injury may occur if the specified precautionary measures are not taken.

Caution

without a warning triangle means that damage to property may occur if the specified precautionary measures are not taken.

Notice

means that an unwanted result or state may occur if the specified instructions are not followed.

If several levels of risk apply, the warning instructions always indicate the highest level. If a warning of personal injury is given in a warning notice with the warning triangle, there may also be a warning about damage to property in the same warning notice.

Qualified personnel

The associated device/system must only be set up and operated in conjunction with this documentation. A device/system must only be brought into service and operated by **qualified personnel**. Qualified personnel as specified in the safety instructions in this documentation are people who are authorized to bring into service, earth and identify devices, systems and power circuits in accordance with the recognized safety standards.

Use as prescribed

Please note the following points:

Warning

The device must only be used for the purposes described in the catalog and in the technical description, and then only in conjunction with non-Siemens devices and components that are recommended or approved by Siemens. Correct and safe operation of the product requires it to have been transported, stored, installed and assembled correctly and carefully operated and maintained.

Further notes

Note

The “Note” symbol is displayed in this document to draw your attention to information relevant to the subject.

Technical information

Notations

The following notations and abbreviations are used in this documentation:

- PLC interface signals –> NST “signal name” (signal data)
  Examples:
  - IS “MMC CPU1 ready” (DB10, DBX108.2), i.e. the signal is stored in data block 10, data byte 108, bit 2.
  - IS “Feedrate override” (DB31, ... DBB0), i.e. the signals are stored in data blocks 31 to 38, data block byte 0.
- Machine data –> MD: NUMMER, MD_NAME (German designation)
- Setting data –> SD: NUMMER, SD_NAME (German designation)
- The character “≙” means “corresponds to”.

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Contents

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Notes

1 General preparation

1.1 Preconditions

Introduction

This Installation and Start-Up Guide describes the procedure for starting up the basic control functions including drive-related functions. Further reference material on special NCK, HMI, PLC or drive functions can be found in the Function Descriptions/Manuals (see “Documentation required”).

Software required

You will need the following software for starting up the SINUMERIK 840D:

1. SinuComNC start-up/service tools

   Supplied on CD-ROM with:

   – SinuCom NC
   – SinuCom FFS
   – SinuCom ARC
   – SinuCom PCIN
   – Start-up tool
2. SIMATIC Step7
3. Tool-Box for SINUMERIK powerline with:
   – Basic PLC program
   – NC variable selector
   – Sample programs
4. For HMI Embedded, application diskette or CompactFlash card for creating PLC alarm texts and transferring them to the PCU (supplied with the HMI system software).

Required devices and accessories

You will need the following devices and accessories for starting up the SINUMERIK 840D:

1. PC/PG for SinuComNC start-up/service tools and SIMATIC Step7
2. MPI cable for PC/PG
3. V24 cable with 9-pin connector (socket)

Documentation required

You will need the following documentation for starting up the SINUMERIK 840D. A detailed description of the mechanical and electrical structure of the individual components can be found in:

1. /BU/ Catalog of automation systems for machine tools
2. /PHD/ Device Manual, NCU Configuration

   SINUMERIK 840D
3. /PHC/ Device Manual, CCU Configuration

   SINUMERIK 810D
4. /PJU/ Converter Configuration Manual

   SIMODRIVE 611 digital
5. /BH/ Device Manual, Operating Components

   SINUMERIK 840D/840Di/810D
6. /FB1/ Function Guide for Basic Machine
7. /FBA/ Function Guide for Drive Functions
8. /LIS1/ Lists
9. /PI/PCIN Description
10. /DA/ Diagnostic Instructions
11. /IAM/ HMI Start-up Guide

1.2 Standard/export variants

Export permits required

2 variants of the SINUMERIK 840D/810D can be configured due to the requirement to obtain approval for certain control functions as listed in the German export list.

The standard variant (840D/810D) can contain the full range of functions of the control, but is therefore subject to the requirement to obtain approval.

With the export variant (840DE810DE), certain options are not available.

Current information about the type and scope of the options is contained in **Reference material**: /BU/ Catalog of automation systems for machine tools

(This shall not affect any requirement to obtain approval with respect to the **intended usage** which may also arise).

The specific version of the control is determined by the system software, which is thus available in two variants (standard and export). This means that the requirement to obtain approval for the system software (further information may be given on the delivery note or invoice) is 'inherited' when it is installed on the control system. This point should be noted, particularly for conversions/ upgrades of the system software, since this may change the requirement to obtain export approval for the control.

Identification of the control

The hardware components supplied with system software are, in addition to any information on the delivery note and invoice, clearly identified by as standard or export variants by means of stickers.

Note

The additional stickers supplied in the packaging are intended to identify the control after start-up, and should be stuck into the control's logbook. When licenses are ordered, a corresponding number of stickers is supplied. These should be used in the same way.

Once the control has powered up, the export variant can be identified by the additional letter 'E' on the Service screen (NCK information). It is important for Service to be able to identify the control variant in this way. It can also serve to provide the necessary verification for exports, particularly if existing negative certificates for the export variant are used.

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Notes

Structure

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Reference material

A detailed description of the mechanical and electrical structure can be found in the following documents:

- /PHD/ Device Manual, NCU Configuration

  SINUMERIK 840D
- /PHC/ Device Manual, CCU Configuration

  SINUMERIK 810D
- /PJU/ Converter Configuration Manual

  SIMODRIVE 611 digital
- /BH/ Device Manual, Operating Components

  SINUMERIK 840D/840Di/810D

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Notes

Settings, MPI/BTSS

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3.1 MPI network rules for SINUMERIK 840D

The following basic rules should be followed when installing a network.

1. The bus line must be terminated at both ends. To do this, activate the terminating resistor in the MPI connector of the first and last node,and deactivate the remaining terminating resistors.

Note

- Only two resistors are permissible.
- With HHU, bus terminating resistors are hard-wired into the device.

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2. There must be at least 1 termination at the supply voltage. This occurs automatically when the MPI connector with active terminating resistor is connected to a live device.
3. Spur lines (lead cables from the bus segment to the node) should be as short as possible.

Note

Any spur lines that are not assigned should be removed if possible.

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4. Each MPI node must be connected before being activated. When an MPI node is disconnected, the connection must be deactivated before the connector can be pulled out.
5. One or two HHU may be connected per bus segment. No bus terminators may be connected to the distributor boxes of an HHU. If necessary, an intermediate repeater can be used to connect more than one HHU to a bus segment.
6. The following cable lengths for the standard MPI without repeater must not be exceeded:

   MPI (187.5 kBaud): max. total cable length 1000 m

Note

Piggy-back connectors are not recommended for power connections.

Example A

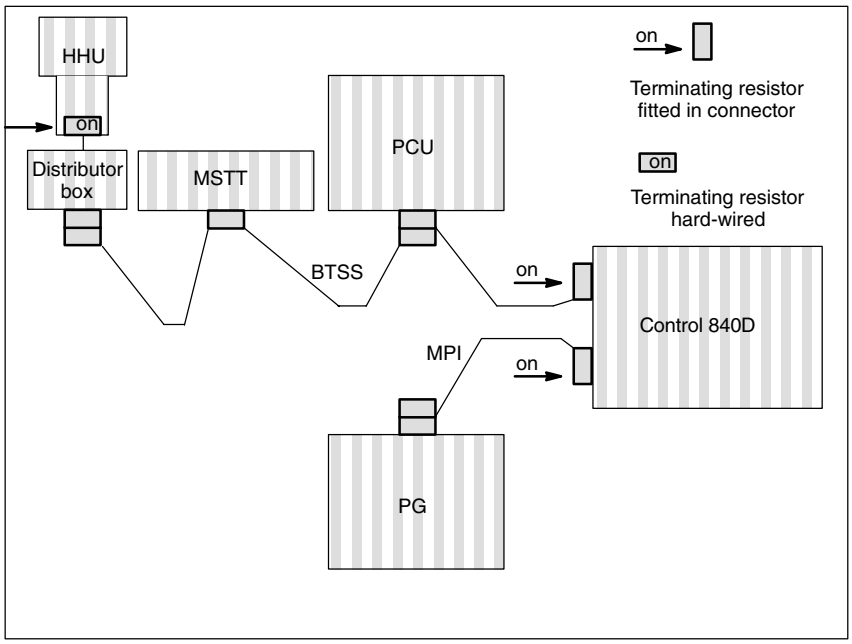

Fig. 3-1 Network installation with two terminating resistors in
MPI: PG, control 840D
BTSS: HHU, control 840D

Example B

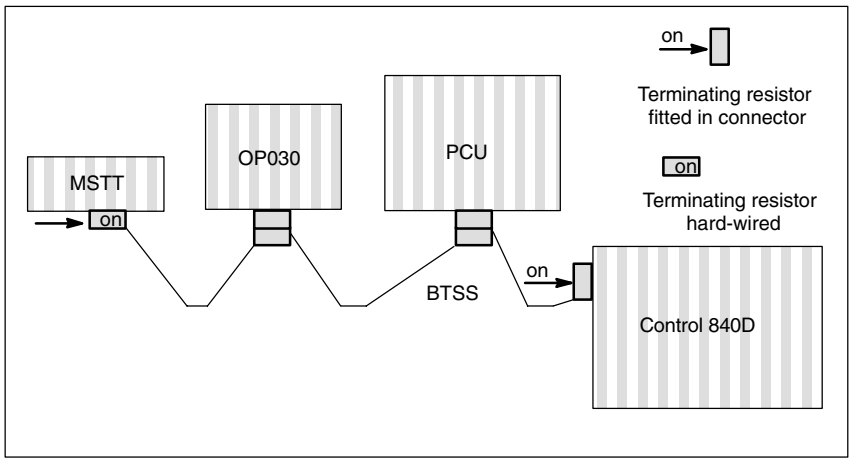

Fig. 3-2 Network installation with two terminating resistors in BTSS:
MSTT, control 840D

3.1.1 Communication equipment

The components involved in MPI and BTSS communication are PLC, NCK, COM and PCU/HMI. They allow communication between the active nodes. Communication between passive nodes, e.g. GD circuit communication, is not discussed here.

The aforementioned component perform the following tasks concerning MPI and BTSS communication:

- PLC and NCK
  PLC and NCK are both servers that provide communication links to client components and execute jobs via these client components upon request. The number of possible communication links from the server to the clients and the number of parallel function jobs (Read variables, Write variables, etc.) are limited.
- HMI
  An HMI component is a client that requests communication links from one or more servers and sends jobs to them.
- COM
  The COM component is a router that allows communication between various component via different communication links (MPI, BTSS and Dual Port RAM).

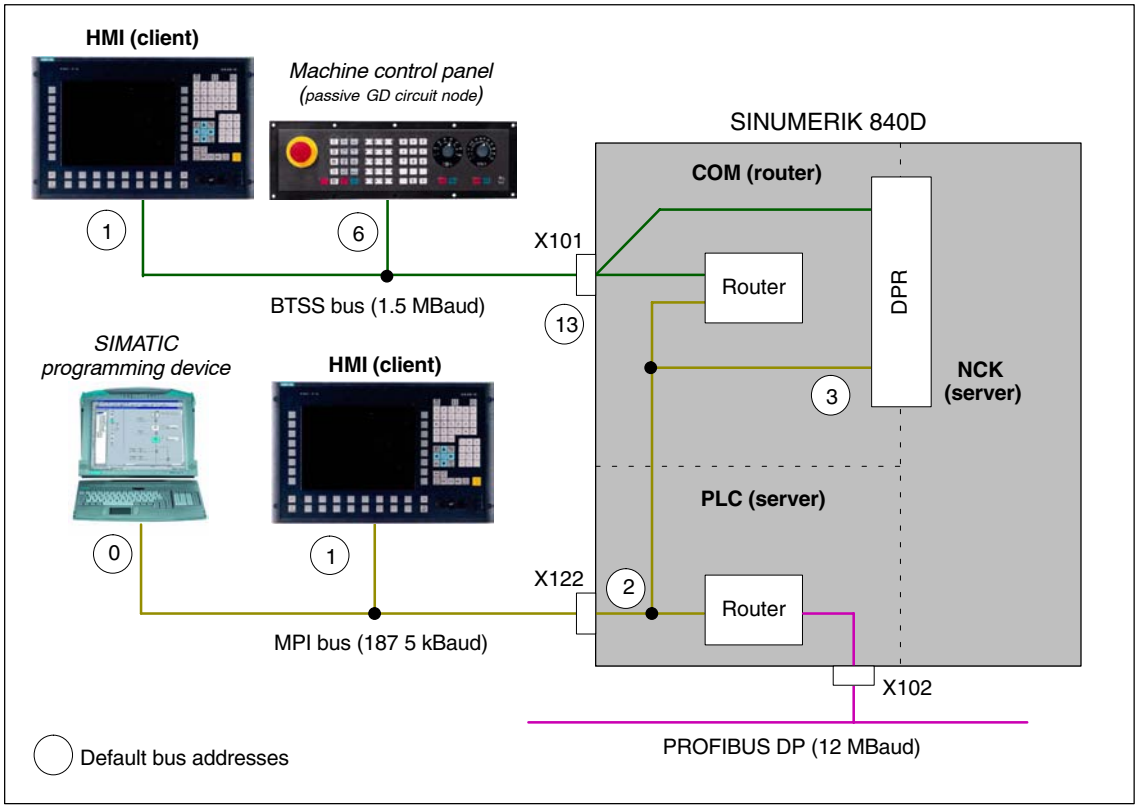

Fig. 3-3 Default application for SINUMERIK 840D

HMI communication: BTSS bus

An HMI component logs on onto the NCK and PLC servers as a client via the COM module and is allocated communication resources by them as a result of logging on.

Jobs with a bus address/job ID for NCK are routed by the COM module directly to the NCK. Jobs with different bus addresses/job IDs are routed to the PLC. This response is implicit routing, and no special routing information is required in the COM module about other communication nodes on adjacent bus systems.

HMI communication: MPI bus

An HMI component logs onto the NCK server as a client indirectly via the COM module and directly at the server PLC is allocated communication resources by them as a result of logging on.

Jobs with a bus address/job ID for NCK are routed by the COM module directly to the NCK. Jobs with different bus addresses/job IDs are ignored by the COM module. This response is also implicit routing, and no special routing information is required in the COM module about other communication nodes on adjacent bus systems.

Associated conditions for STEP 7

It is not possible to configure the entire communication setup illustrated in Fig. 3-3 in SIMATIC STEP7. Thus, STEP7 and any other engineering tools will not provide all the possible communication links. In particular, the COM module that acts as the link between the MPI and BTSS buses cannot be configured.

Logon IDs

When a connection is established, a client component logs onto the PLC with its logon ID. Typical logon IDs include programming device: “PG” and operator panel: “OP”. One communication link on the PLC is reserved for a component with the logon ID “PG” and one for the “OP” logon ID. For historical reasons, an HMI component with the logon ID: “PG” by default. For the “M to N” function, it logs on with the logon ID: “OP”.

Communication links

The NCK, COM and PLC components allow the following maximum number of possible communication links:

Component		Number
NCK		5
COM		
	from BTSS bus to NCK	3
	from BTSS bus to PLC	3
	from MPI bus to NCK	3
PLC 1)		
	PLC 315-2DP (contained in: CCU3 and NCU*.3)	4
	PLC 314C-2DP (contained in NCU*.4)	12
	PLC 317-2DP (contained in NCU*.5)	32
	from MPI bus to PLC	2)
1) One communication link is reserved by default for connecting a programming device (PG) e.g. for diagnostics with STEP7.		
2) The number results from the maximum number of PLCs integrated into the NCU, minus the active PLC communication links on the BTSS bus.		

Each client component requires the following communication links for communication with the NCK and PLC servers:

Component		Number
HMI Advanced or HMI Embedded		
	To NCK	1
	To PLC	1
Shopmill/Shopturn on HMI Advanced or HMI Embedded		
	To NCK 1)	+1
	To PLC 1)	+1
STEP 7 on HMI		
	To PLC 1)	+1
1) In addition to the HMI communication link		

Note

A Protool configuration does not need an additional communication link for ProtoolPro with the “SINUMERIK” option.

Equipment required

The following tables illustrate the communication equipment required for the individual components: NCK, PLC and COM

Table 3-1 NCK equipment required

Resource unit		Machine data
Max. number of HMI resource units 1)	10	$MN_MM_NUM_MMC_UNITS

1) HMI Embedded and HMI Advanced require 2 resource units per communication link.

Table 3-2 PLC equipment required

	PLC 314	PLC 315-2AF00	PLC 315-2AF01	PLC 315-2AF03	PLC 314C-2DP	PLC 317-2DP
Communication links						
max. possible number	4	4	4	4	12	32
Reserved for programming device	1	1	1	1	1	1
Available for HMI components	3	3	3	3	11	31

Table 3-3 COM equipment required

	PLC	NCK
Links 1)		
BTSS bus: max. possible number	3	3
MPI bus: max. possible number	1)	3

1) Note: The MPI links are not routed via the COM module. They go directly to the PLC.

3.2 MPI network rules for SINUMERIK 810D

Please take the following basic rules into account when undertaking network installations:

1. The bus line must be terminated at both ends. To do this, activate the terminating resistor in the MPI connector of the first and last node, and deactivate the remaining terminating resistors.

Note

- Only two resistors are permissible.
- With HHU, bus terminating resistors are hard-wired into the device.

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2. It is necessary to apply 5 V voltage to at least 1 terminator. This occurs automatically when the MPI connector with active terminating resistor is connected to a live device.
3. Spur lines (lead cables from the bus segment to the node) should be as short as possible.

Note

Any spur lines that are not assigned should be removed if possible.

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4. Each MPI node must be connected before being activated. When disconnecting an MPI node, the connection must be deactivated before the connector can be pulled out.
5. You can either connect one HHU and one HT6, or two HHUs or HT6s per bus segment. It is not permissible to connect bus terminators to the distributor boxes of an HHU or HT6.

   If necessary, an intermediate repeater can be used to connect more than one HHU/HT6 to a bus segment.
6. The following cable lengths for the standard MPI without repeater must not be exceeded:

   MPI (187.5 kBaud): max. total cable length 1000 m

Note

Piggy-back connectors are not recommended for power connections.

Example A

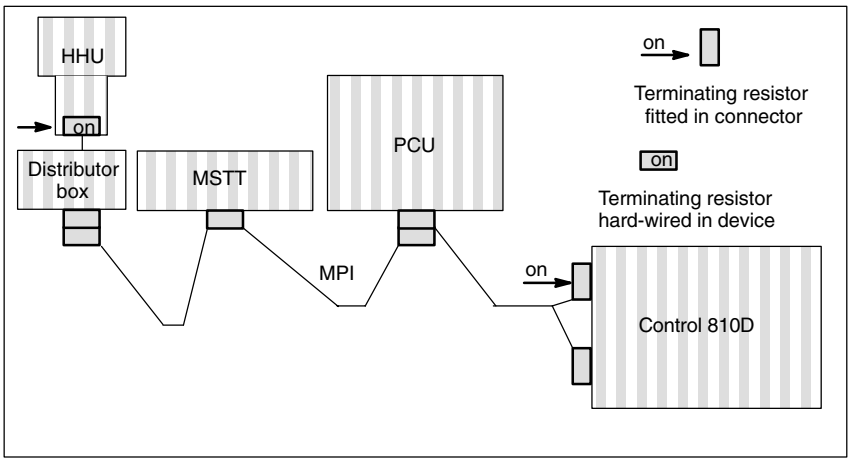


Fig. 3-4 Network installation with two terminating resistors in MPI: BHG, control 810D

Example B

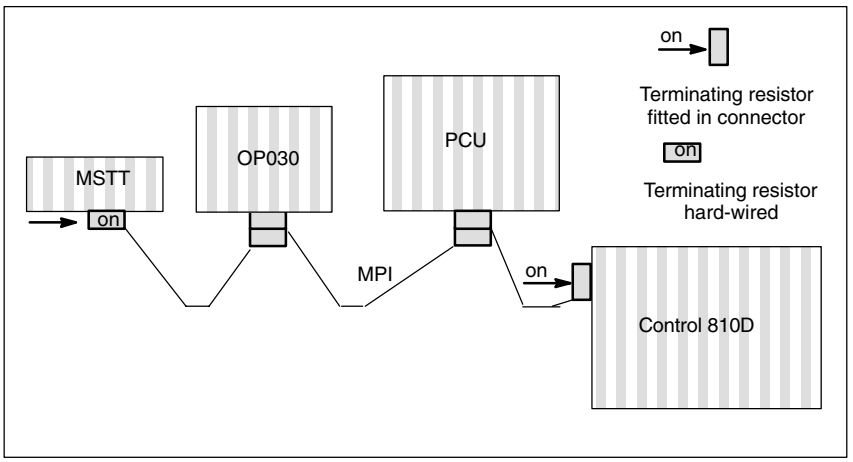


Fig. 3-5 Network installation with two terminating resistors in MPI: MSTT, control 810D

3.3 MPI default configuration for SINUMERIK 840D

One or two machine control panels (interface for customer's operating panels, PP 031) and/or HHU are connected by means of parameter settings in the PLC basic program (FB1). In this case, parameter settings using the STEP7 tool "Communication Configuration" are no longer required.

Reference material: /FB1/ P3 PI, Function manual for basic machines, PLC basic program powerline

Standard application

SINUMERIK 840D with one PCU and one machine control panel (MSTT) or interface for customer's operating panel on the BTSS.

Requirement for the hardware

At least firmware release V 03_01_01 for

- MCP
- interface for customer's operating panel/PP 031

Bus addresses

Every node on the MPI/BTSS bus must have a bus address (0...31).

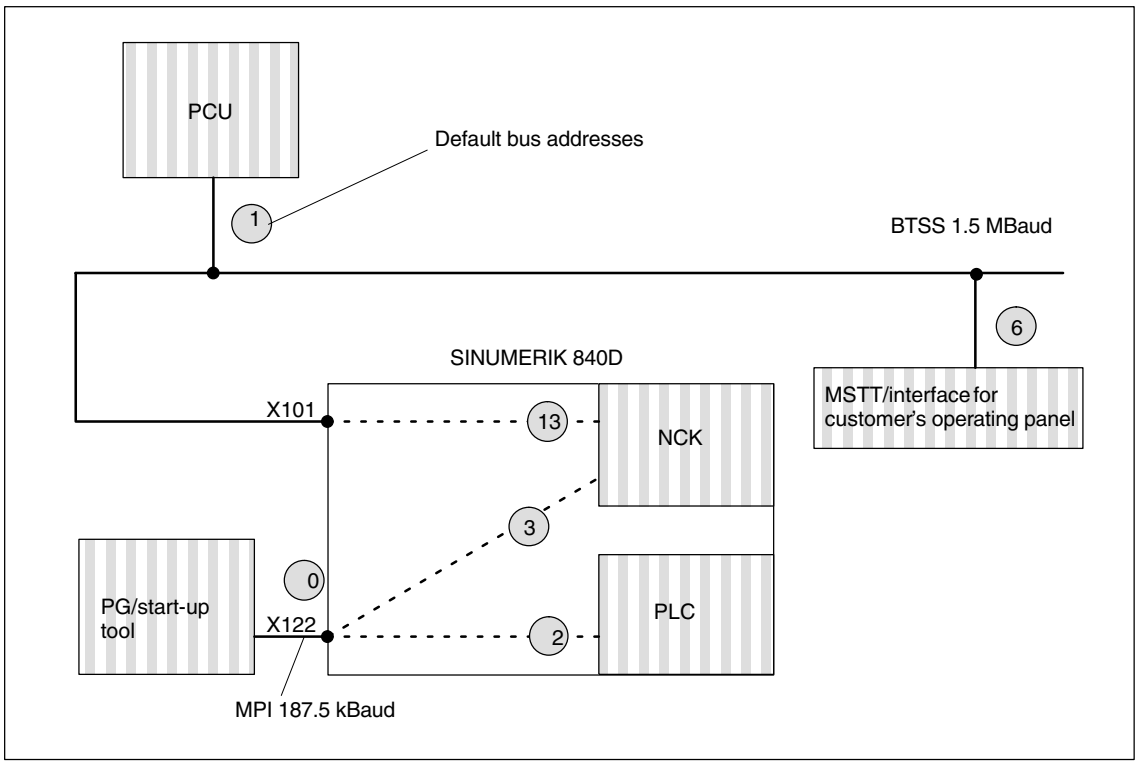


Fig. 3-6 Default application for SINUMERIK 840D

Bus address and GD circuit

Note

The parameter settings for the bus address (on the machine control panel) or the GD circuit parameters (on the HHU) in the PLC basic program are used for the logical addressing of the components. The physical addressing on the BTSS/MPI is always done via the GD circuits, however. Each machine control panel, interface for customer's operating panel, etc, must be addressed with a separate GD circuit.

In the control, the bus address in the associated GD circuit is converted via the PLC program.
On the machine control panel, the bus address, and thus the associated GD circuits, are set via the DIP-FIX switches.

On the MPI, the same GD circuits are set, however, for the machine control panel, interface for customer's operating panel and PP031 components, even if the bus addresses are different. This should be noted if more than one machine control panel, etc, is used.

The following table illustrates the interaction.

Table 3-4 Interaction between bus address and GD circuit

Bus addresses on the MPI	GD circuit
15, 14, 13	1
12, 11	2
10, 9	3
8, 7	4
6	8
5, 4	5

Example:
2 machine control panels (MSTTs) are to be connected to the MPI on a control. The first MSTT can be connected to bus address 15 (GD circuit 1) and the second to bus address 12 (GD circuit 2).

MPI interface and GD circuit

Note

If the "Communication Configuration" STEP7 tool is to be used to establish PLC-PLC cross-communication on the MPI, for example, and if one or more MSTTs are connected to the MPI, then the GD circuits assigned must be unique. The "Communication Configuration" STEP 7 tool assigns the GD circuits, starting with GD circuit 1 in ascending order. If the MSTTs are connected to the BTSS, then this has no effect on the PLC–PLC communication on the MPI.

Example:
GD circuits 1 and 2 are assigned by “Communication Configuration” as a result of the PLC–PLC cross-communication. A first MSTT on the MPI can then be assigned to GD circuit 3 (bus address 9 or 10), and a second MSTT on the MPI to GD circuit 4 (bus address 7 or 8).

3.4 MPI default configuration for SINUMERIK 810D

Standard application

SINUMERIK 810D with PCU and one machine control panel (MSTT) or interface for customer’s operating panel

Hardware requirements

At least firmware release V 03_01_01 for

- MCP
- interface for customer’s operating panel

STEP7

from version 2.x

MPI baud rate

All MPI bus nodes operate at 187.5 kbaud.

Bus addresses

Every node on the MPI bus must have a bus address (0...15).

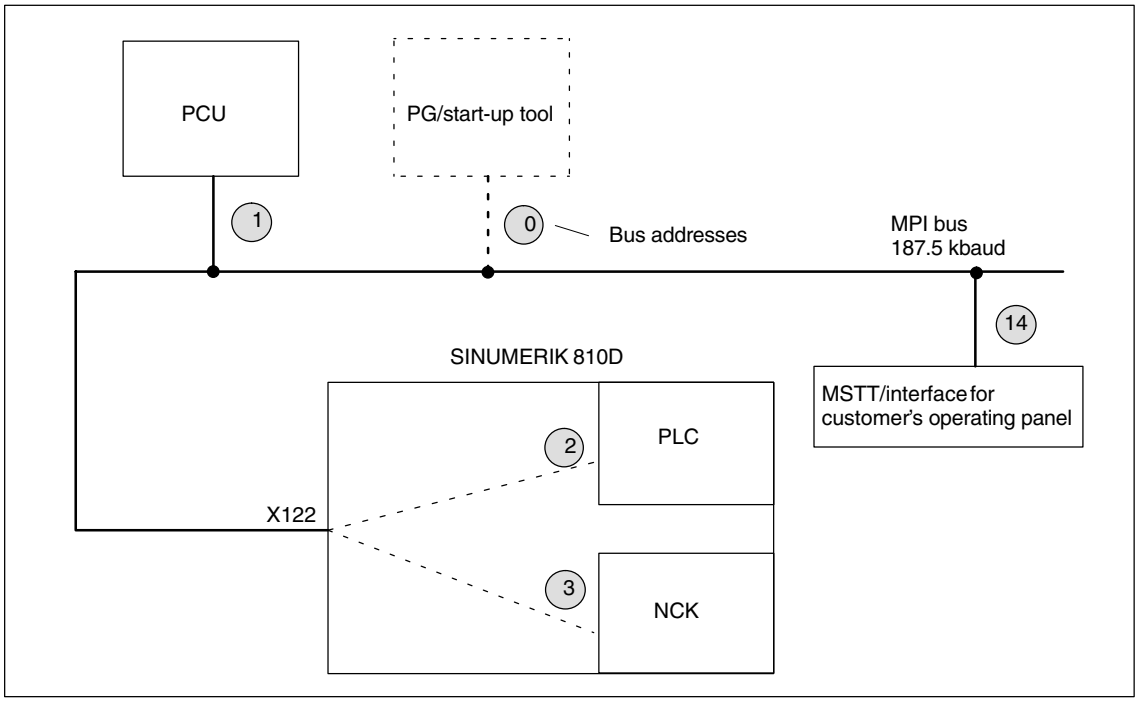


Fig. 3-7 Standard application for SINUMERIK 810D

Communication parameters

Configuration via FB1

If the MSTT/interface for customer's operating panel is set to MPI address 14 and with SDB210 from the basic program diskette, the communication starts when the PLC is restarted (LEDs stop flashing).

Note

The STEP7 project manager (S7 TOP) does not display the SDB as standard. To display the SDB, select "All blocks with SDBs" in menu **View/Set filters**.

Assigned inputs/ outputs in the PLC–CPU

The following bytes in the PLC CPU are then assigned to the MSTT or interface for customer's operating panel:

- Input byte 0–7
- Output byte 0–7
- Status bytes for error detection output bytes 12–15 (evaluated by basic program)

Parameterization on FB1 (basic program) for the MCP is already preset for the standard application.

Communication does not start

If communication does not commence after a PLC reset (LEDs flashing), the following points should be checked:

- The firmware release of the MSTT/interface for customer's operating panel must be at least V03_01_01.

  Scan:
  The firmware version is displayed on the left, central and right LED block of the machine control panel if the keys "Feed start" and "Feed hold" are pressed simultaneously while the machine control panel is powering up.
- MPI cable and connector wiring
- DIP switch S3 (default setting)

SDB 210 must not be loaded.

3.5 Deviation from standard configuration

Required documentation

The following additional publications are required:

Reference material: /BH/ Device Manual, Operating Components
/FB/ P3, PLC basic program
/S7HT/ Manual, Application of Tools

Example

A configuration may be non-standard owing to one of the following:

- Change of address assignment
  for the input, output or status bytes, or
  for the flag area or data block
- Additional connection of a handheld unit (HHU)
- Connection of a 2nd MSTT or handheld terminal (HT 6)

In such cases, you must adjust the communications parameters and possibly the switch settings (addresses) of the bus nodes.

Procedure
SIMATIC STEP7, version 2.1

A new configuration is entered via the Define global data soft key. The following description of how to proceed is based on the assumption that you already know how to use this menu.

1. Set up new project and CPU programs using the STEP7 tool. A separate CPU program should be set up for each component of the plant (PLC, MSTT, HHU, 2.MSTT, HT 6, ...).
2. Connect the MPI nodes, i.e. network CPU programs with MPI address.
3. Activate the “Global Data” menu command in the following soft key sequence File Manager/MPI Network/Extras/Global Data and enter the desired configuration.
4. Compile this configuration. A new SDB is generated for each CPU program.
5. Set the cyclical transmission grid. Once the configuration has been compiled successfully for the first time, the “Conversion factor” and “Status” can be activated and then input.
6. Now compile your configuration again.
7. Transfer the SDB (from the CPU program of the PLC) to the PLC.
8. You must parameterize call FB1, DB7 in OB 100 in the basic PLC program for all operator control components (MPI nodes).
9. You must configure the status pointer (double word) for every component in FB1 for monitoring purposes.

Note

For a description of the “Global data” menu and the application, see

Reference material: /S7HT/ SIMATIC Step7 Manual,
Starting up MPI bus nodes

3.6 MPI interface for customer's operating panel

Interface

The interface is used to connect a customer's operating panel. The module has 64 digital inputs and 64 digital outputs with C-MOS level (5V) for this purpose.

The module must have at least firmware release V 03_01_01.

Position of the interfaces

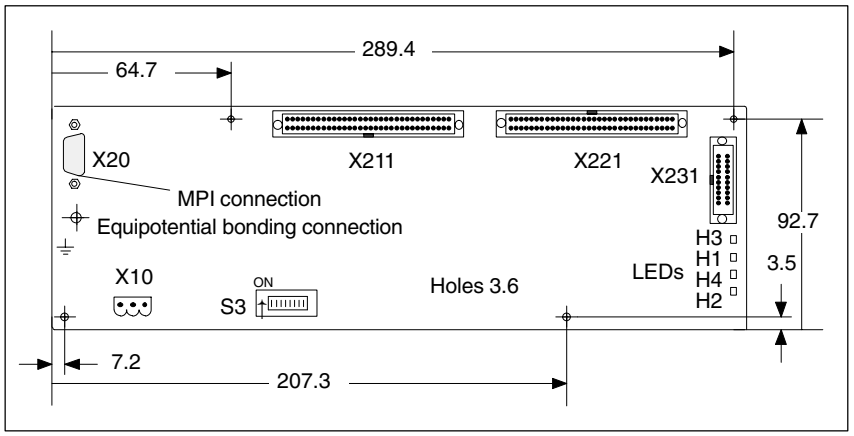


Fig. 3-8 Front view of MPI interface for customer's operating panel

Switch S3, default setting for SINUMERIK 840D

If only the customer's operating panel is connected, the bus address should be set to 6 as for the MSTT (standard application).

Table 3-5 Setting for 840D: switch S3 interface for customer's operating panel

1	2	3	4	5	6	7	8	Meaning:
on	off	on	off	on	on	off	on	Baud rate: 1.5 MBaud (BTSS) Cyclical transmission interval: 100 ms Bus address: 6

Switch S3, default setting for SINUMERIK 810D

If only the customer's operating panel is connected, the bus address should be set to 14 as for the MSTT (standard application).

Table 3-6 Setting for 810D: switch S3 interface for customer's operating panel

1	2	3	4	5	6	7	8	Meaning:
off	off	on	on	on	on	off	on	Baud rate: 187.5 kBaud Cyclical transmission interval: 100 ms Bus address: 14

Power supply interface

Connector designation: **X10**
Connector type: 3-pin Phönix terminal block, straight

Table 3-7 Assignment of connector X10 on interface for customer's operating panel

X10		
Pin	**Name**	**Type**
1	SHIELD	VI
2	M24	VI
3	P24	VI

Reference material: /BH/ Device Manual, Operating Components

3.7 2nd machine control panel

SINUMERIK 840D/810D can be used to operate 2 machine control panels. The 2nd MSTT parameters must be set in the basic program parameters at FB1.

3.8 PCU 20/50/50.3/70

3.8.1 Settings with HMI Embedded/HMI Advanced for SINUMERIK 840D

BTSS (standard)

The operating panel interface (BTSS) is the default setting (1.5 MBaud).

- PCU 20 with HMI Embedded
  HMI Embedded automatically adjusts to the baud rate.
- PCU 50/50.3/70 with HMI Advanced
  The HMI Advanced must be set to a baud rate of 1.5 MBaud in the “Start-up/ HMI/Operating panel” menu.

Setting the display machine data

The display machine data (BTSS settings) are set via the user interface of the HMI in the Start-up area “Start-up” –> “Machine data”.

Language

- PCU 20 with HMI Embedded
  The HMI Embedded software is available in six languages by default (English, German, French, Italian, Spanish and simplified Chinese).
- PCU 50/50.3/70 with HMI Advanced
  HMI Advanced is always supplied as a multilingual version. The default setting is English.

Screen saver mode

MD 9006 (for HMI Embedded):
This MD is used to enter the time after which the screen saver mode is activated if no key is pressed on the operating panel within the specified time.

A detailed description of the functions and parameter settings can be found in the following documentation:

Reference material: /IAM/ Start-up Guide, IM2, HMI Embedded
IM4, HMI Advanced

3.8.2 Settings with HMI Embedded/HMI Advanced for SINUMERIK 810D

Setting the MPI interface

For the SINUMERIK 810D, the MPI interface is set to 187.5 kBaud.

- PCU 20 with HMI Embedded
  The PCU automatically adjusts to the baud rate.
- PCU 50/50.3/70 with HMI Advanced
  The PCU must be set to a transmission speed of 187.5 kBaud in the "Start-up/HMI/Operating panel" menu.

Setting the display machine data

The display machine data (BTSS settings) are set via the user interface of the HMI in the Start-up area "Start-up" –> "Machine data".

Language

- PCU 20 with HMI Embedded
  The HMI Embedded software is available in six languages by default (English, German, French, Italian, Spanish and simplified Chinese).
- PCU 50/50.3/70 with HMI Advanced
  The PCU with HMI Advanced is always supplied as a multilingual version. The default setting is English.

Screen saver mode

MD 9006: This MD is used to enter the time after which the screen saver mode is activated if no key is pressed on the operating panel within the specified time.

The settings for 3 different devices are made via the HMI in an input box in the "Services" menu.

A detailed description of the functions and parameter settings can be found in the following documentation:

Reference material: /IAM/ Start-up Guide, IM2, HMI Embedded
IM4, HMI Advanced

■

EMC and ESD Measures

4

4.1 RI suppression measures

Shielded signal cables

To ensure safe, interference-free operation of the installation, it is essential to use the cables specified in the individual diagrams. Both ends of the shield must always have a conductive connection to the housing.

Exception:

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

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

Construction rules

The following EMC measures must be followed to ensure maximum immunity to interference in the overall plant (control, power section, machine).

- The signal and load cables must be kept as far apart as possible.
- Only original SIEMENS cables should be used as the signal cables from and to the NCK and PLC.
- Signal cables must not be routed close to strong external magnetic fields (e.g. motors and transformers).
- Pulse-carrying HC/HV cables must always be laid completely separately from all other cables.
- If signal cables cannot be laid at a sufficient distance from other cables, then they must be installed in shielded cable ducts (metal).
- The distance (interference liability surface) between the following cables must be kept to a minimum:
  - Signal cable and signal cable
  - Signal cable and associated equipotential bonding conductor
  - Equipotential bonding conductor and PE conductor (routed together)

!

Important

For further notes on noise suppression and the connection of shielded cables, see
Reference material: /EMV/ Configuration Guide, EMC installation guidelines

4.2 ESD measures

Important

Handling of modules containing devices sensitive to electrostatic discharge:

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

4.3 Heat dissipation

Please note:

Caution

A ventilation clearance of 100 mm must be left above and below the drive combination when it is installed.

■

Power-On and Power-Up

5

5.1 Start-up order

Start-up sequence

The mechanical and electrical assembly work on the plant must be complete. Before you commence starting up the control, you must ensure that it powers up correctly with all its components and that it has been installed in compliance with the EMC Guidelines.

The start-up procedure is detailed below. The order in which the individual steps are taken is not mandatory, but recommended:

1. Power up and check the SINUMERIK 840D (chapter 5)
2. Basic settings (subsection 6.6.1) and
   Entering the memory configuration (section 6.7)
3. Scaling machine data (section 6.8)
4. Setting the axis configuration (subsection 6.9.1)
5. Configuration and parameter settings for the drives (subsection 6.9.2)
6. Setting axis and spindle-specific machine data
   - Axis speeds (subsection 6.9.9)
   - Axis monitoring devices (subsection 6.9.11)
   - Axis reference point approaches (subsection 6.9.12)
   - Spindle data (subsection 6.9.13)
   - Sensor matching for spindle (subsection 6.9.15)
   - Spindle speeds (subsection 6.9.16)
   - Positioning the spindle (subsection 6.9.17)
   - Spindle monitoring devices (subsection 6.9.19)
7. Transferring PLC user program and alarm texts (chapter 7/8)
8. Axis and spindle test run (chapter 9)
9. Drive optimization (chapter 10)
   - Frequency response measurements for speed and position control loops (section 10.5)
   - Analog output (section 10.8)
10. Data back-up (chapter 11)
11. Replacing hardware and software (chapter 12)

5.2 NCU controls and displays

Important controls and displays for power up

Fig. 5-1 below shows the controls and displays on the NCU that are important for powering on and powering up the SINUMERIK 840D:

- Various error and status LEDs
- 7-segment status display (H3)
- NMI button (S2)
- RESET button (S1)
- NC start-up switch (S3)
- PLC start-up switch (S4)
- PCMCIA slot

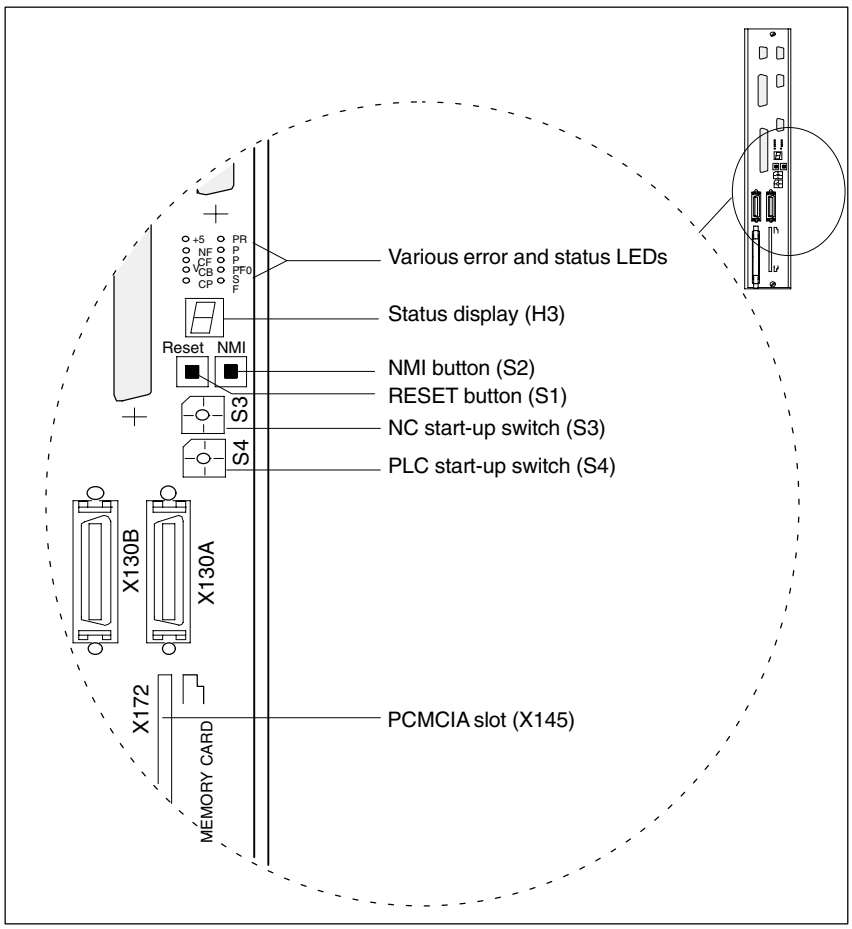


Fig. 5-1 SINUMERIK 840D controls and displays on the NCU

A detailed description of the controls and displays can be found in the following documentation:

Reference material: /PHD/ Device Manual, NCU Configuration

5.3 CCU controls and displays

Important controls and displays for power up

Fig. 5-2 below shows the controls and displays on the CCU that are important for powering on and powering up the SINUMERIK 810D:

- Various errorand status LEDs (H1/H2)
- 7-segment display (H3)
- RESET button (S1)
- NC start-up switch (S3)
- PLC start-up switch (S4)
- PCMCIA slot

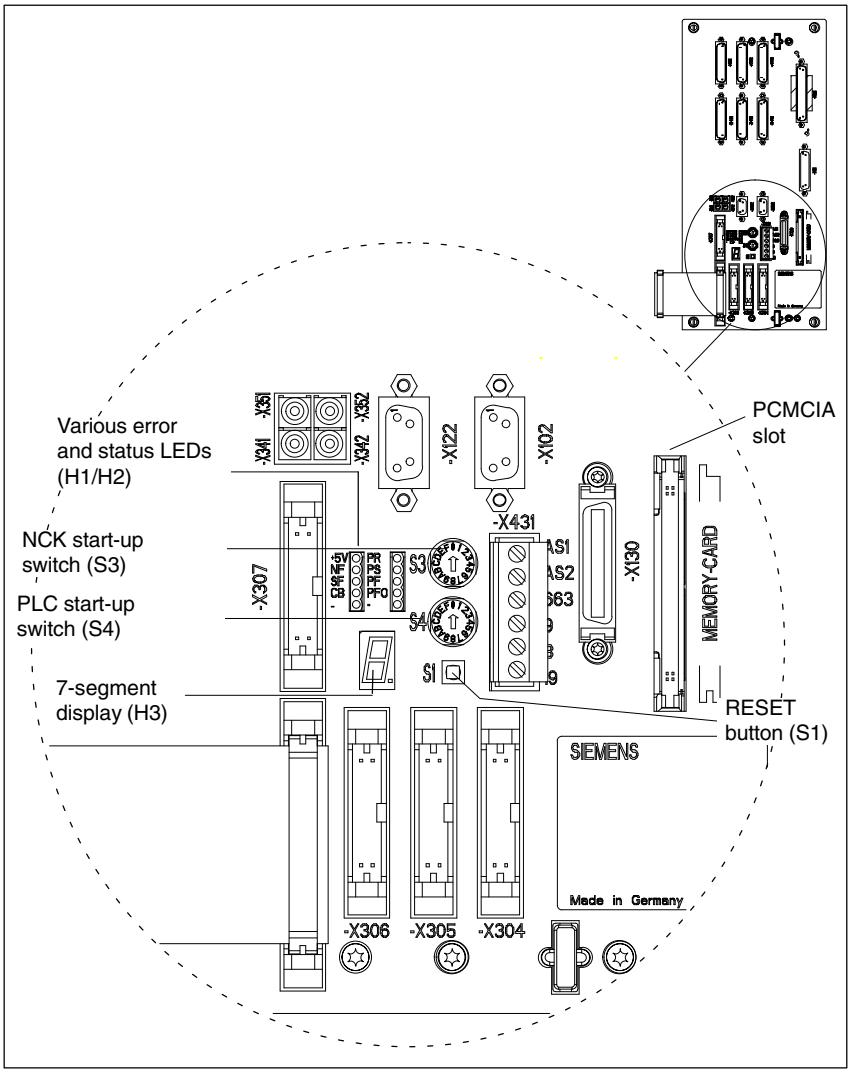


Fig. 5-2 SINUMERIK 810D controls and displays on the CCU

A detailed description of the controls and displays can be found in the following documentation:

Reference material: /PHC/ Device Manual, CCU Configuration

5.4 Power-On and Power-Up

5.4.1 Power-On

Visual inspection

A visual inspection of the plant should be carried out in order to detect obvious faults. Make sure that the mechanical installation of components is correct and that electrical connections are firmly in place (e.g. in the DC link). Make sure that all electrical connections have been made correctly before switching on the power supply. Check the 230 VAC and 24 VDC supply voltages as well as the shields and earthing connections.

Wiring blocks

The relevant wiring blocks on the MSTT, HHU, PLC I/O components should be wired up and checked for start-up.

Reference material: /BH/ Device Manual, Operating Components

Power-on sequence

The MSTT, HHU and PCU components may be switched on in any order if they are physically present.

Power-on

Switch on the power supply on all components and on the mains supply module. No enabling signals need be present initially on the mains supply module. The LEDs on the NE module must not indicate any faults in the power supply.

Danger

Before switching on, make sure that the protective cover and connector X181 are attached to the power supply unit.

5.4.2 Power-Up

After the power supply has been connected, the control system powers up. The HMI Embedded/HMI Advanced system software is installed on the PCU when the system is delivered, but it can also be installed via a PCMCIA card.

Note

The use of modules via L2-DP and certain CP modules means that the power up time is longer than a standard configuration.

NCK general reset

To bring the control system into a defined initial state, initialization (NCK general reset) is required when the power is first connected. To do this, turn the start-up switch S3 on the NCU/CCU to position “1” and switch the control on. The control then powers up, the SRAM memory is erased and the machine data are preset to the default values.

Table 5-1 For the significance of the NCK start-up switch S3 (see Fig. 5-1)

Setting	Meaning
0	**Normal mode**: Power-up with the set data.
1	**Start-up MODE**: The data in the buffered RAM (SRAM) is cleared and the default machine data is loaded.
2–7	Reserved

End of NCK power-up

Once the NCK has powered up correctly, the number “6” appears on the NCU status display. The LEDs “+5V” and “SF” (SINUMERIK READY) light up.
Now switch NC start-up switch S3 back to the “0” position.

Status display during power-up

During power-up, the various power-up phases appear on the status display (7-segment display) on the NCU module.

Table 5-2 Power-up phases on the status display (7-segment display)

Power-up phase	Situation
.	An error was identified in the cyclical operation.
0	Real mode may have been switched to Protected mode.
1	Start of download from the PCMCIA card.
Number with decimal point	The number of the module that has just been downloaded appears on the status display.
2	Download from the PCMCIA card has ended successful.
3	The debug monitor is initialized.
4	Operating system was downloaded successfully.
5	Operating system has started up.
6	NCK software is initialized.

Note

No display means:
The CPU self-test did not work. Defective module.

A flashing display means:
A FATAL ERROR occurred when the system was powered up. The cause of the error can be identified from the combination of flashes.

PLC general reset

Use GENERAL RESET to clear the PLC's program memory.
The diagnostics buffer of the PLC is not erased.
Once the NCK has powered up, a general reset should be carried out to return the PLC to its basic state. There are two ways of doing this:

1. By means of the programming device with SIMATIC Step7
2. Using the PLC start-up switch S4 on the NCU/CCU module

Table 5-3 Settings with the PLC start-up switch S4 (see Fig. 5-1)

Setting	Meaning
0	**PLC-RUN-PROGRAMMING:** RUN operating state. It is possible to intervene in the PLC program.
1	**PLC-RUN:** RUN operating state. The program can only be accessed for reading via the programming devices.
2	**PLC-STOP:** STOP operating state.
3	**MRES:** This setting is used for a module reset (general reset function).

Note

When starting up for the first time, or replacing a module, or when a battery fails, or the PLC requests a MRES, or the PLC operating system is upgraded, the complete memory reset is **absolutely necessary**:

1. Set PLC start-up switch S4 to position "3".
2. Turn NCK start-up switch S3 to position 1 (which will clear the DRAM between the NCK and PLC).
3. Perform POWER ON and hardware RESET.
4. PLC general reset:

Actions for PLC restart

The following step will RESTART the PLC:

- Turn PLC start-up switch S4 from position "2" (STOP mode) to position "1" or "0" (RUN mode).
- Perform POWER ON and hardware RESET.

Actions for PLC general reset

The following steps with the PLC start-up switch S4 will cause a PLC GENERAL RESET:

1. Turn to position “2” (STOP operating state)
   ⇒ PS LED lights up.
2. Turn to position “3” (MRES operating state, request general reset) and hold in this position (for approx. 3 second) until the PS STOP LED lights up again.
   ⇒ PS LED goes out and comes on again.
3. Within 3 second, turn to the STOP-MRES-STOP (“2”–“3”–“2”) positions
   ⇒ PS LED PS first flashes at approx. 2 Hz and then lights up again
   ⇒ PF LED lights up
4. Once the PS and PF LEDs are lit, turn the switch S4 to position “0”
   ⇒ The PS and PF LEDs goes out and the PR LED (green) lights up
   ⇒ A general reset of the PLC is complete. It is now in cyclical mode.

Note

If a hardware RESET or POWER ON is initiated in switch position 3 on PLC start-up switch 4 the entire SRAM contents of the PLC are initialized, the diagnostic buffer contents are not deleted. All user data have to be transferred again.

If setting “3” (MRES) is selected for less than 3 seconds, then no general reset is requested. The STOP LED does not light up if the switch is not changed from setting STOP to MRES to STOP within 3 seconds after a general reset has been requested.

Reference material: /S7H/ SIMATIC Step7-300

5.4.3 PCU power-up

PCU power-up

After the power supply has been switched on, the PCU powers up automatically. The system software is installed in the factory and is ready to run. The basic display appears on the screen if the MMC has powered up successfully.

Problems during power-up

PCU 20

If the PCU is unable to establish a connection to the NCK, the message “wait for NCU-connection:“x” seconds”, “x” = 1 to 60 appears. If no connection is established after this time, the PCU is quickly rebooted.
Check the following:

- Is the NCU module on standby?
  (number 6 on H3)
- Is the MPI cable inserted, is cable attached properly to connector?
- Are other MPI stations (machine control panel, handheld unit, ...) disturbing MPI communication? (Remove connections to test.)
- If the reset button on the NCU was pressed again during power-up (e.g. as for software upgrade [Position 1/PLC Reset]), the control must be switched off and on again for the PCU power-up to be successful.

PCU 50/50.3/70

If the PCU does not power up and the screen remains dark, then check the 24 V DC power supply. If the power supply at the PCU’s power supply unit is correct and the 7-segment display on the back remains dark, then the PCU is faulty.

If the PCU powers up, but is unable to establish a connection to the NCK, then the message “Communication with NCK failed” appears in the bottom message line.
In this case, please check the following:

- Is the NCU module on standby (number 6 on H3)?
- Is the MPI cable inserted, is cable attached properly to connector?
- Is the baud rate in menu Start-up/HMI/operator panel front set correctly? It must be set to 187.5 (password for protection level 2 required).
- Are other MPI stations (machine control panel, handheld unit, ...) disturbing MPI communication? (Remove connections to test.)

5.4.4 Error while Control power-up

Display on the status display

During power-up, various status messages appear on the display (7-segment display) on the NCU/CCU. The digit “6” is output when the control has finished powering up.

Problems while powering up NC

If the display does not read “6” after approx. 2 minutes, and:

- another number appears,
- the display remains dark,
- the display flashes,

then proceed as follows:

1. Repeat the NCK general reset.
2. The switch S3 (NCU) must be reset to “0”.
3. If the NCK general reset is unsuccessful, replace the PCMCIA card and reinstall the software.
4. If these actions are unsuccessful, replace the NCU module.

Status displays on the PLC

The front panel of the NCU module (see Fig. 5-1) contains the following LEDs to indicate the operating states of the PLC:

PR	PLC-RUN (green)
PS	PLC-STOP (red)
PF	PLC-Watchdog (red)
PFO	PLC-FORCE (yellow)
–	Profibus (yellow)

PR and PSLEDs

Table 5-4 Status displays of the PR and PSLEDs

LED PR	lights up	off	flashes 0.5 Hz	flashes at 2 Hz	off	off
LED PS	off	lights up	lights up	lights up	– lights up – for 3 sec. off – lights up	– lights up – flashes at 2 Hz (at least 3 sec.) – lights up
Meaning	RUN	STOP	HALT	RE-START	GENERAL RE-SET requested	GENERAL RE-SET in progress

RUN:
The PLC program is being processed.
STOP:
The PLC program is not being processed. STOP can be set by the PLC program, error identifiers or an operator input.
HALT:
“Halt” of the PLC user program (initiated by test function).

RESTART:
The control is started (transition from STOP to RUN state). If the start process is aborted, the control switches back to the STOP state.

PF LED — This LED lights up when the PLC watchdog has responded.

PFO LED — A defined value is assigned to a variable by means of the FORCE function. The variable is write-protected and cannot be changed from any location. The write protection remains effective until it is canceled by the UNFORCE function. If the PFO LED is out, then no FORCE job is present.

Profibus — The Profibus LED corresponds to the BUSF LED on the SIMATIC CPU 315-DP. See the CPU data installation guide for a description.

Note

If all 4 LEDs on the status display flash after the NCU hardware is replaced, then you must power up the NCK again. A PLC general reset can then be carried out if necessary.

5.4.5 Power-up of machine control panel (MSTT)

Software release

Press the “Start feed” and “Stop feed” buttons while the machine control panel is powering up (all the LEDs flash) to display the version number of the software on the machine control panel. This means that the system software on the machine control panel has started up correctly and is waiting for the PLC to start cyclical communication.

A detailed description of the machine control panel used can be found in the following documentation:
Reference material: /BH/ Device Manual, Operating Components

5.4.6 Powering up the drives

Power-up

After a NCK general reset, the drives are disabled and there are no data records for the drives (known as boot files). The “SF” LEDs on the NCU module and on the 611D controller light up.

Detailed information on powering up SIMODRIVE 611 universal drives can be found in the following document:
Reference material: /FBU/ SIMODRIVE 611 universal function guide

5.4.7 PCU/HMI Advanced BIOS setup

The default settings in the BIOS of the PCU/HMI Advanced can be displayed directly on screen during power-up.

- Start the control
- At the prompt, press the BIOS setup key <F2> or horizontal soft key 2 on the OP. The BIOS setup menu appears.

Note

The settings for the BIOS default parameters are described in the following documentation:

Reference material: /IAM/ IM4, HMI Advanced Start-up Guide
/BH/ Device Manual, Operating Components

■

Notes

Programming the control

6

6.1 Machine and setting data

Programming

The control is matched to the machine by means of machine and setting data.

Machine data

The machine data (MD) is classified as follows:

- General machine data
- Channel-specific machine data
- Axis-specific machine data
- Display machine data (machine data for front control panel)
- Machine data for feed drive
- Machine data for main spindle drive

Setting data

The setting data (SD) is classified as follows:

- General setting data
- Channel-specific data
- Axis-specific setting data

Option data

Used to enable options. Option data is supplied with the specific option.

Overview of machine and setting data

The machine and setting data is divided into the following areas:

Table 6-1 Overview of machine and setting data

Area	Designation
from 1000 to 1799	Machine data for SIMODRIVE drives
from 5000 to 6000	Machine data for the hydraulic module
from 9000 to 9999	Display machine data
from 10000 to 18999	General machine data
from 19000 to 19999	Reserved
from 20000 to 28999	Channel-specific machine data
from 29000 to 29999	Reserved

Table 6-1 Overview of machine and setting data, continued

Area	Designation
from 30000 to 38999	Axis-specific machine data
from 39000 to 39999	Reserved
from 41000 to 41999	General setting data
from 42000 to 42999	Channel-specific data
from 43000 to 43999	Axis-specific setting data
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

Entering machine data

Menus are provided for entering the machine data. How to select displays:
Press the “MENÜ SELECT” button: The menu bar with the following areas appears on screen: Machine, Parameters, Program, Services, Diagnostics and Start-Up.
Press the “Start-up” soft key and the “Machine data” soft key.

Bit editor for HEX machine data

A bit editor is implemented for setting certain machine data bits. If the input cursor in the MD list is on a machine data item in HEX format, the editor can be called up by pressing the Toggle key.

Note

The bit editor for HEX machine data is only available in conjunction with the HMI.

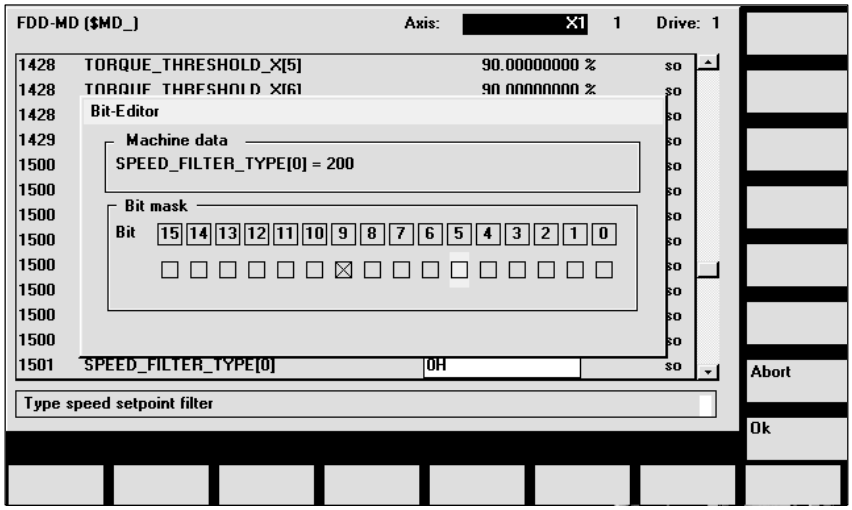


Fig. 6-1 Input screen in the bit editor for HEX machine data

The individual bits can be set or reset by clicking on them with the mouse. Alternatively they can be selected using the cursor keys and then pressing the Toggle key.

- Press the “OK” soft key to exit the bit editor and accept the set value.
- Press the “Cancel” soft key to exit the bit editor and reject the set value. The previous setting is restored.

6.2 Handling machine and setting data

Number and identifier

MD and SD are addressed by number or by name (identifier). The number and name are displayed on the HMI user interface. The following must also be noted:

- Active
- Protection level
- Unit
- Default value
- Value

Active

The levels at which a data item takes effect are listed below in order of priority. A change to the data takes effect after:

- POWER ON (po) NCK-RESET
- NEW_CONF (cf) – “Activate MD” soft key on the HMI
  – “RESET” button on the MSTT
  – Changes in program mode at the start and end of records possible
- RESET (re) – at the end of program M2/M30, or
  – “RESET” button on the MSTT
- IMMEDIATELY (so) after entering the value

Protection levels

Protection levels are identified by numbers and are used to enable data areas. A more detailed explanation can be found in the next section: Protection level concept.

Unit

The unit refers to the default setting for the machine data:

- MD_$MN_10220_SCALING_USER_DEF_MASK (activates the scaling factors)
- MD_$MN_10230_SCALING_FACTORS_USER_DEF (scaling factors for the physical variables)
- MD_$MN_10240_SCALING_SYSTEM IS METRIC=1 (basic system is metric)

If the MD is not based on any physical unit, then the field contains a “–”.

Default value

This value is used to set the machine or setting data to its default.

Note

On the HMI, input is limited to 10 digits plus decimal point and sign.

Range of values

Indicates the input limits. If no range of values is specified, the data type determines the input limits and the field is identified with "***".

A detailed explanation of the machine data and a list of all the machine and setting data can be found in the following documentation:

Reference material: /LIS1/ Lists

6.3 Protection level concept

Protection levels

In SINUMERIK 840D there is a protection level concept to enable data areas. Protection levels range from 0 to 7, 0 representing the highest and 7 the lowest level.

The lock for protection levels

- 0 to 3 is set with a password in the "Start-up" operating area.
- 4 to 7 is set directly with key switch positions 3 to 0 on the machine control panel (MSTT).

Protection level 4 (key switch position 3) and higher is required to display machine data.

The appropriate protection level must generally be enabled by means of password "EVENING" to start up the system.

Table 6-2 Protection level concept with the relevant data areas

Protection level	Locked by	data areas
0	Password	Siemens
1	Password: SUNRISE (default)	Machine manufacturer
2	Password: EVENING (default)	Commissioning engineer, Service
3	Password: CUSTOMER (default)	End user
4	Key switch position 3	Programmer, machine setter
5	Key switch position 2	Qualified operator
6	Key switch position 1	Trained operator
7	Key switch position 0	Semi-skilled operator

Protection levels 0–3

Protection levels 0 to 3 require a password to be entered. The password for level 0 provides access to all data areas. For protection levels 1 to 3, default passwords are defined when the system is powered up in start-up mode (NCK start-up switch in position 1). To guarantee secure access, these default passwords MUST be changed once they have been activated. If, for example, the passwords have been forgotten, then the system must be reinitialized (NCK general reset). This resets all passwords to the standard of this software version.

In the Start-up area “Start-up”, you can change the set password using a soft key. The password remains valid until it is reset with the soft key DELETE PASSWORD. A POWER ON does not reset the password.

Reference material: /BAD/ HMI Advanced User Guide
BEM/ HMI Embedded User Guide

Protection level 4–7 key switch

Protection levels 4 to 7 each require a different key switch position on the machine control panel. Three keys of different colors are provided for this purpose. Each of these keys is capable of providing access to particular data areas.

Table 6-3 Meaning of key switch positions

Key color	Switch position	Protection level
(no key inserted)	0 = Remove key position	7
Black	0 and 1	6–7
Green	0 to 2	5–7
Red	0 to 3	4–7

Note

The associated interface signals can be found in DB10, DBX56.4–7, see
Reference material: /FB1/ A2, Basic machine function guide,
Various NC/PLC interface signals,
Section: Key switch position

Redefining protection levels

The user can modify the protection levels for reading and writing data. This prevents display and input of certain data. Only protection levels of lower priority can be assigned to the machine data, setting data can also be assigned protection levels of higher priority. The commands APR and APW are used to change the protection levels.

The protection levels of individual machine or setting data can be changed in the SGUD.DEF file.

Example SGUD.DEF file:

```
%_N_SGUD_DEF
;$PATH=/_N_DEF_DIR
REDEF $MA_CTRLOUT_SEGMENT_NR APR 2 APW 2 (APR ... read rights)
REDEF $MA_ENC_SEGMENT_NR APR 3 APW 2      (APW ... write rights)
REDEF $SN_JOG_CONT_MODE_LEVELTRIGGRD APR 7 APW 2
M30
```

The file becomes active when the next _N_INITIAL_INI is read in. Different protection levels are specified for writing (changing) or reading (part program or PLC).

Example:
MD 10000 is protected by levels 2/7, i.e. writing requires protection level 2 (corresponding to password) and reading requires protection level 7. To be able to enter the machine data area you need at least key switch position 3.

Reference material: /PGA/ Programming Guide: Preparing for work
/FB1/ A2, “Various interface signals”

6.3.1 Protection levels for NC language commands (REDEF)

Access rights to execute NC commands

The existing protection level concept for accessing machine and setting data and GUDs has been extended to include executing certain part program commands and write access to system variables. Individual part program commands are thus associated with a corresponding right of use.

The default setting for the current right of use corresponds to the access right that is active on the control, i.e. to key switch position 0 to 3 or passwords for end users through to Siemens, as shown in Table 6-2.

To allow the programs stored in the cycle directories to be used via a range of commands that are independent of the rights of use of a particular operator, the right of use is implicitly modified while these programs are running. To do this, when programs are called from the cycle directories, the right of use is set to the values stored in machine data MD 11160 to MD 11162, provided that a higher access right has not already been set on the control by key switch or password.

Table 6-4 Modifying rights of use for the cycle directories

Assign defined rights of use	to the cycle directory
MD 11160: ACCESS_EXEC_CST	/_N_CST_DIR (standard cycles)
MD 11161: ACCESS_EXEC_CMA	/_N_CMA_DIR (manufacturer's cycles)
MD 11162: ACCESS_EXEC_CUS	/_N_CUS_DIR (user cycles)

Allocation of protection levels with REDEF command

NC language commands are assigned protection levels using the REDEF command. The following language constructs may be protected:

- G codes (list of G functions/preparatory functions)
- Predefined procedures and functions (predefined subprograms)
- "DO" instructions for synchronous actions only
- Write or read access to machine and setting data
- Write access to system variables (part program and synchronous actions)
- Cycle identifiers (PROC instruction)
- Language commands that were generated via the compile cycle interfaces.

Once the part program commands have been activated, they are not executed unless the relevant right of use exists. If this is not the case, then processing of the part program is canceled and alarm 14018 is output.

Activating the protection levels

As with the GUD definitions, separate definition files are provided for programming the REDEF instruction:

Siemens system applications /_N_DEF_DIR/_N_SACCESS_DEF,
Machine manufacturer /_N_DEF_DIR/_N_MACCESS_DEF and
End user /_N_DEF_DIR/_N_UACCESS_DEF

When the control is powered up, these are evaluated in order, from /_N_DEF_DIR/_N_SACCESS_DEF to /_N_DEF_DIR/_N_UACCESS_DEF. Protection levels can only be allocated in these definition files. Apart from these files, processing of the REDEF command is rejected and alarm 14018 is output.

Defining write protection for definition files

To be able to check whether the REDEF instructions programmed in the definition files are correct, the write protection for each definition file is evaluated. It must be equal to or greater than the

protection level specified in the REDEF command **and** the protection level currently assigned to the part program command or the machine or setting data.

Alarms 7500 and 15180 are triggered if these conditions are not fulfilled.

The write protection for the definition files is set via MD 11170 to MD 11172. Values between –1 and 7 are possible. If the value is –1, the value currently set in the relevant definition file is retained.

Table 6-5 Setting write protection for the definition files

Machine data	Associated definition directories
MD 11170: ACCESS_WRITE_SACCESS	/_N_DEF_DIR/_N_SACCESS_DEF
MD 11171: ACCESS_WRITE_MACCESS	/_N_DEF_DIR/_N_MACCESS_DEF
MD 11172: ACCESS_WRITE_UACCESS	/_N_DEF_DIR/_N_UACCESS_DEF

Subprograms may be called in the above definition files. They must have the extension _SPF or _MPF and be located in the search path for subprogram calls or be called with the absolute path. They inherit the write protection of the definition files set with MD 11170-11172: ACCESS_WRITE_xACCESS. For the REDEF command,

see **Reference material:** /PGA/ Programming Guide for Work Preparation, Section: 3

Defining write protection for cycle directories

To ensure that the implicit right to use the cycle directories is not misused, write protection for these directories can be matched to the specific right of use with MD 11165-11167.

Table 6-6 Setting the write protection for cycle directories

Machine data	Associated cycle directories
MD 11165: ACCESS_WRITE_CST	/_N_CST_DIR (standard cycles)
MD 11166: ACCESS_WRITE_CMA	/_N_CMA_DIR (manufacturer's cycles)
MD 11167: ACCESS_WRITE_CUS	/_N_CUS_DIR (user cycles)

Note

The data back-up ensures that the protection levels set for the definition files and cycle directories are also backed up and can be restored during standard system start-up. See section 11 “Data back-up” and

Reference material: /BAD/ User Guide,
Section: Services area, Start-up functions
/BEM/ User Guide,
Section: Services area , Standard system start-up

6.3.2 Configurable parameter areas for GUD blocks

Configuring parameter areas

Individual GUD blocks can be supplemented with the following machine data to provide additional, channel-specific parameter areas:

MD 18660: MM_NUM_SYNACT_GUD_REAL[index] = <value>
MD 18661: MM_NUM_SYNACT_GUD_INT[index] = <value>
MD 18662: MM_NUM_SYNACT_GUD_BOOL[index] = <value>

Fields are created with the following properties:

- Synact GUD of data type REAL, INT or BOOL with predefined names SYG_....
- The field size corresponds to the <value> of the relevant machine data
- The new parameters may be read and written to both by the part program and via synchronous actions. Once the relevant machine data has been set, they are available the next time the control is powered up, and thus behave like R parameters.

Table 6-7 Configuring additional parameter areas

$MN_MM_NUM_SYNACT_GUD			Supplements
MD 18660	**MD 18661**	**MD 18662**	**GUD block**
REAL[0]=<value>	INT[0]=<value>	BOOL[0]=<value>	SGUD block
REAL[1]=<value>	INT[1]=<value>	BOOL[1]=<value>	MGUD block
REAL[2]=<value>	INT[2]=<value>	BOOL[2]=<value>	UGUD block
REAL[3]=<value>	INT[3]=<value>	BOOL[3]=<value>	GUD4 block
REAL[4]=<value>	INT[4]=<value>	BOOL[4]=<value>	GUD5 block
REAL[5]=<value>	INT[5]=<value>	BOOL[5]=<value>	GUD6 block
REAL[6]=<value>	INT[6]=<value>	BOOL[6]=<value>	GUD7 block
REAL[7]=<value>	INT[7]=<value>	BOOL[7]=<value>	GUD8 block
REAL[8]=<value>	INT[8]=<value>	BOOL[8]=<value>	GUD9 block

Table 6-8 Predefined names for the additional parameters

Predefined names for Synact_GUD of type Real, Int and Bool						Synact-GUD in
SYG_RS[ ]	Real	SYG_IS[ ]	Int	SYG_BS[ ]	Bool	SGUD block
SYG_RM[ ]	Real	SYG_IM[ ]	Int	SYG_BM[ ]	Bool	MGUD block
SYG_RU[ ]	Real	SYG_IU[ ]	Int	SYG_BU[ ]	Bool	UGUD block
SYG_R4[ ]	Real	SYG_I4[ ]	Int	SYG_B4[ ]	Bool	GUD4 block
SYG_R5[ ]	Real	SYG_I5[ ]	Int	SYG_B5[ ]	Bool	GUD5 block
SYG_R6[ ]	Real	SYG_I6[ ]	Int	SYG_B6[ ]	Bool	GUD6 block
SYG_R7[ ]	Real	SYG_I7[ ]	Int	SYG_B7[ ]	Bool	GUD7 block
SYG_R8[ ]	Real	SYG_I8[ ]	Int	SYG_B8[ ]	Bool	GUD8 block
SYG_R9[ ]	Real	SYG_I9[ ]	Int	SYG_B9[ ]	Bool	GUD9 block

Access, display and operation

The new parameters are

- displayed in the “Parameter area” on the HMI. Even if no GUD definition files are effective, the new parameters are still available in the relevant GUD block.
- Deletion is handled as follows:
  If the content of a certain GUD definition file is reactivated, then the old GUD data block in the active file system is first deleted. The new parameters are also reset.
  If this operation takes place via the HMI in the “Services area” under Manage data using the Define and Activate user data (GUD), then the contents of the variable are saved to INI files and are restored at the end of the operation.

Keywords

The protection level assignments that are possible using the APR and APW keywords in a GUD definition file continue to relate only to the GUDs defined in this GUD definition file.

Protection levels for Synact GUDs are assigned via the REDEF command.

Values assigned with checksums

The protection levels assignments take effect when the power up is complete. If, during a standard system start-up, for example, it should be possible to run initialization files with value assignments on protected variables without having to modify the access right, then the value assignments must be protected by checksums.

This method is already used when initializing machine data, setting data and GUDs. Setting Bit0 in MD 11230: MD_FILE_STYLE means that, when initialization files are generated, a checksum is generated for each value assignment in these files.

Note

From software version 7.1 onwards, this checksum is generated for all data to be protected via initialization files.
Exception: R parameters.

Example of a value assignment with checksum:
N18120 $MN_MM_NUM_GUD_NAMES_NCK=20 '620c
(Checksum 620c preceded by an apostrophe)
When the initialization file is downloaded, there is a check to ensure that the checksum is valid. If this is the case, the associated value assignment is executed, even if the access right set on the control is not sufficient.

Complete start-up

The complete start-up procedure for the function is as follows:

1. Create the definition files
   /_N_DEF_DIR/_N_SACCESS_DEF Siemens system applications
   /_N_DEF_DIR/_N_MACCESS_DEF Machine manufacturer or
   /_N_DEF_DIR/_N_UACCESS_DEF End user
2. Set the write protection for the definition files to the value required for redefinition as follows using the machine data:
   MD 11170: ACCESS_WRITE_SACCESS Siemens system applications
   MD 11171: ACCESS_WRITE_MACCESS Machine manufacturer and
   MD 11172: ACCESS_WRITE_UACCESS End user
3. Modify the rights to use the cycle directories as follows if the protected commands are to be permitted there.
   _N_CST_DIR, _N_CMA_DIR and _N_CUS_DIR
   via machine data:
   MD 11160: ACCESS_EXEC_CST Standard cycles
   MD 11161: ACCESS_EXEC_CMA Manufacturer's cycles and
   MD 11162: ACCESS_EXEC_CUS User cycles
4. Modify the write protection for the cycle directories to the right to use set above as follows so that the implicit right to use the cycle directories cannot be misused.
   _N_CST_DIR, _N_CMA_DIR and _N_CUS_DIR
   via machine data:
   MD 11165: ACCESS_WRITE_CST Standard cycles
   MD 11166: ACCESS_WRITE_CMA Manufacturer's cycles and
   MD 11167: ACCESS_WRITE_CUS User cycles

Examples

Machine data

```
Right to use cycle directories:                    ;
MD 11160: ACCESS_EXEC_CST = 2                      ; Machine manufacturer
MD 11161: ACCESS_EXEC_CMA = 2                      ; Machine manufacturer
MD 11162: ACCESS_EXEC_CUS = 3                      ; End user

Write protection for cycle directories:            ;
MD 11165: ACCESS_WRITE_CST = 2                     ; Machine manufacturer
MD 11166: ACCESS_WRITE_CMA = 2                     ; Machine manufacturer
MD 11167: ACCESS_WRITE_CUS = 3                     ; End user

Write protection for definition files:             ; set to value
MD 11171: ACCESS_WRITE_MACCESS = 1                 ; Machine manufacturer
MD 11172: ACCESS_WRITE_UACCESS = 3                 ; End user
```

Definition file for the machine manufacturer

```
%_N_MACCESS_DEF                 File for machine manufacturer
;$PATH=/_N_DEF_DIR

; Write protection for file is set to value 1 for machine manufacturer.

N010                            ; Predefined procedures:
N020 REDEF CONTPRON APX 1       ; Record preparation for cutting cycle,
                                ; Protection level: Machine manufacturer

N030 REDEF GEOAX APX 3          ; Geo axis assignment,
                                ; Protection level: End user

N110                            ; Predefined functions:
N120 REDEF INTERSEC APX 1       ; Point of intersection calculation
                                ; Protection level: Machine manufacturer

                                ; Write access to
N110                            ; System variables:
N120 REDEF $P_CHBFR APW 3       ; Write basic frame
N130 REDEF $TC_MAP1 APW 3       ; Magazine data for tool management
                                ; Write protection level: End user

N210                            ; Synchronous actions
N220 REDEF DO APX 2             ; Protection level: Start-up engineer, Service

                                ; Machine data
                                ; $MC_GCODE_RESET_VALUES for
N310                            ; Protection level: Enable key switch 0
N320 REDEF $MC_GCODE_RESET_VALUES APR 7 APW 7
M17
```

Definition file for the end user

```
%_N_UACCESS_DEF                 File for end user
;$PATH=/_N_DEF_DIR

; Write protection for file is set to value 3 for end user.

                                ; Protection level for writing
                                ; $MC_GCODE_RESET_VALUES for
                                ; set end user
N510 REDEF $MC_GCODE_RESET_VALUES APR 7 APW 3
M17
```

6.4 Display filter for machine data

6.4.1 Function

Using the display filter allows the number of machine data items displayed to be reduced to a specific number, and thus adapted to suit the user's needs.

All machine data in the following areas:

- General machine data
- Channel-specific machine data
- Axis-specific machine data
- Drive machine data (FDD/MSD)

are assigned to specific groups.

You can tell which group specific machine data belongs to by referring to the machine data list.

Reference material: /LIS1/ Lists

- Each area has its own group assignment.
- Each machine data in the different areas can be assigned to several groups.

6.4.2 Selecting and setting the display filter

Selecting the list screens

The filter is selected and activated via a list screen which is opened using the "Display options" vertical soft key in the relevant machine data areas.

The display will vary according to which HMI software you are using. See:

Reference material: /BAD/ HMI Advanced User Guide
/BEM/ HMI Embedded User Guide

Display criteria

If the user's access rights (password) are not sufficient, then the machine data is not displayed. If the access rights are sufficient, there is a check to see if any display filters are active.

Note

You can tell which group specific machine data belongs to by referring to the machine data list.

Table 6-9 Display criteria

Display filter active	• Inactive: All the machine data is displayed. • Active: Test for group filter
Expert mode	• Inactive: the MD is assigned to Expert mode => MDis not displayed • Active: the MD is assigned to Expert mode => MD is displayed (note index)
Group filters	• Inactive: MD is assigned to the group => MDis not displayed • Active: MD is assigned to the group => MD is displayed (note index)
All others	• Inactive: for MDs that are not assigned to any group => MDis not displayed • Active: for MDs that are not assigned to any group => MD is displayed (note index)
Index from to	• Inactive: all subparameters of the MD are displayed • Active: only the specified subparameters of the MD are displayed

Activating group filters via checkboxes

The checkboxes are selected using the cursor keys and are checked/ unchecked with the toggle key.

- If a filter is disabled (not checked), then the corresponding machine data is not displayed.
- If a filter is enabled (checked), the corresponding machine data is displayed. However, it is necessary to pay attention to the “Index from to” filter.

Note

If the “Index from to” filter is active, note the following point:
If only the “first” index (0) is to be displayed, then the other settings for the override switch (MD 12000.1: OVR FACTOR_AX_SPEED), for example, will also be hidden.

Vertical soft keys

- “Select all” soft key
  The checkboxes for the groups are set to active.
  The soft key does not affect the following checkboxes:
  – Filter active
  – Expert mode
  – Index from to
  – All others

- "Deselect all" soft key
  The checkboxes for the groups are set to inactive.
  The soft key does not affect the following checkboxes:
  – Filter active
  – Expert mode
  – Index from to
  – All others
- "Cancel" soft key
  – Returns to the machine data screen.
  – The former filter settings remain valid
  – Any changes are discarded
- "OK" soft key
  – Modified filter settings are saved.
  – The machine data screen is refreshed
  – The input field is positioned on the current MD again.
  If the MD was hidden, then it is positioned on the first MD.

Expert mode

The "Expert mode" setting is intended to simplify and give a clearer overview of the initial start-up process.

Procedure:

- Activate all filters (check)
- Activate display filters (check)
- Disable expert mode (do not check)
- Only the machine data required for the basic functions are displayed (e.g. proportional gain, reset time, filters).
  Machine data for adaptation, the reference model, etc, is not displayed.

Hide all machine data

If the filter setting hides all the machine data in an area, when this area is selected, the following message appears:
"Unable to display machine data with the current access rights and the current filter setting".
Press the "OK" soft key to acknowledge and blank machine data screen appears.

6.5 Example of a start-up concept

Objective

1. Simple standard system start-up for the initial start-up
2. Inclusion of machine options (e.g. rotary tables or 2nd spindle)
3. Shorter start-up time
4. Simplified machine data handling by means of user screens for mechanics or measuring engineers.
5. Standardized PLC program for the entire series of machines

Basic machine

The following upgrade variants are available, e.g. for a milling machine with one or two rotary tables or spindles.
Starting from a basic variant

- with three axes (X11,Y11,Z11),
- magazine axis (B11),
- spindle (C11)

a standard system start-up file is created.

When the machine data is declared for this basic machine, all the possible optional axes are declared in the machine axis data.
This affects one or two rotary tables (A11, A22) or/and a second spindle (C22).

When all the possible machine axes for the series are declared, all the axis data blocks are also set up in the PLC (DB 31 – 38).
The axis assignment remains the same, regardless of which axes are actually on the machine.
This is the requirement for a standardized PLC program.

Machine data

```
N10000 $MN_AXCONF_MACHAX_NAME_TAB[0]="X11"   Axis X
N10000 $MN_AXCONF_MACHAX_NAME_TAB[1]="Y11"   Axis Y
N10000 $MN_AXCONF_MACHAX_NAME_TAB[2]="Z11"   Axis Z
N10000 $MN_AXCONF_MACHAX_NAME_TAB[3]="A11"   1st rotary table
N10000 $MN_AXCONF_MACHAX_NAME_TAB[4]="A22"   2nd rotary table
N10000 $MN_AXCONF_MACHAX_NAME_TAB[5]="B11"   Magazine axis
N10000 $MN_AXCONF_MACHAX_NAME_TAB[6]="C22"   2nd spindle
N10000 $MN_AXCONF_MACHAX_NAME_TAB[7]="C11"   1st spindle
```

Machine data files are set up for the individual machine options. These only contain the modified machine data.

Example file

```
%_N_COMPLETE_TEA_INI;

OPTION 5 AXES [X,Y,Z,A11,B] 1 SPINDLE [C];  Rotary axis A11 with double axis module.
CHANDATA(1);      OPTION 5 AXES 1 SPINDLE
N13000 $MN_DRIVE_IS_ACTIVE[0]=1
N13000 $MN_DRIVE_IS_ACTIVE[1]=1
N13000 $MN_DRIVE_IS_ACTIVE[2]=1
N13000 $MN_DRIVE_IS_ACTIVE[3]=1
N13000 $MN_DRIVE_IS_ACTIVE[4]=1
N13000 $MN_DRIVE_IS_ACTIVE[5]=1
N13000 $MN_DRIVE_IS_ACTIVE[6]=0
N13000 $MN_DRIVE_IS_ACTIVE[7]=0
N13010 $MN_DRIVE_LOGIC_NR[0]=8
N13010 $MN_DRIVE_LOGIC_NR[1]=1
N13010 $MN_DRIVE_LOGIC_NR[2]=3
N13010 $MN_DRIVE_LOGIC_NR[3]=2
N13010 $MN_DRIVE_LOGIC_NR[4]=6
N13010 $MN_DRIVE_LOGIC_NR[5]=4
N13010 $MN_DRIVE_LOGIC_NR[6]=5
N13010 $MN_DRIVE_LOGIC_NR[7]=0
N13030 $MN_DRIVE_MODULE_TYPE[0]=1
N13030 $MN_DRIVE_MODULE_TYPE[1]=2
N13030 $MN_DRIVE_MODULE_TYPE[2]=2
N13030 $MN_DRIVE_MODULE_TYPE[3]=2
N13030 $MN_DRIVE_MODULE_TYPE[4]=2
N13030 $MN_DRIVE_MODULE_TYPE[5]=2
N13030 $MN_DRIVE_MODULE_TYPE[6]=2
N13030 $MN_DRIVE_MODULE_TYPE[7]=9

CHANDATA(1)
N20000 $MC_CHAN_NAME=“Milling machine”
N20070$MC_AXCONF_MACHAX_USED[0]=1
N20070$MC_AXCONF_MACHAX_USED[1]=2
N20070$MC_AXCONF_MACHAX_USED[2]=3
N20070$MC_AXCONF_MACHAX_USED[3]=4
N20070$MC_AXCONF_MACHAX_USED[4]=6
N20070$MC_AXCONF_MACHAX_USED[5]=8
N20070$MC_AXCONF_MACHAX_USED[6]=0
N20070$MC_AXCONF_MACHAX_USED[7]=0
N20080 $MC_AXCONF_CHANAX_NAME_TAB[0]=“X”
N20080 $MC_AXCONF_CHANAX_NAME_TAB[1]=“Y”
N20080 $MC_AXCONF_CHANAX_NAME_TAB[2]=“Z”
N20080 $MC_AXCONF_CHANAX_NAME_TAB[3]=“A1”
N20080 $MC_AXCONF_CHANAX_NAME_TAB[4]=“B1”
N20080 $MC_AXCONF_CHANAX_NAME_TAB[5]=“C1”
N20080 $MC_AXCONF_CHANAX_NAME_TAB[6]=“”
N20080 $MC_AXCONF_CHANAX_NAME_TAB[7]=“”
M17
```

Sequence for initial start-up

1. Read in streamer tape with all the machine option files
2. Start the standard system start-up file for the basic machine in the Services/ Archive area
3. Start the PLC standard system start-up file
4. Start the machine option file (e.g. for 6 axes), NCK reset
5. Set the PLC options in the PLC dialog

When these steps are complete, the machine is in full working order with the basic data.

Time required: 1 hour

Size of the tool magazine

The files for the machine options also include the size of the tool magazine (36, 48, ..places).

```
N10900 $MN_INDEX_AX_LENGTH_POS_TAB_1=36
N10910 $MN_INDEX_AX_POS_TAB_1[0]=0
N10910 $MN_INDEX_AX_POS_TAB_1[1]=10
N10910 $MN_INDEX_AX_POS_TAB_1[2]=20
.....
```

Axis scan/ corrections

The next initial start-up step is to scan the axes and for the mechanic or test engineer to enter the relevant corrections (e.g. batches).
Suitable user screens may be created in the “Start-up/Machine data” area to make this easier to use.
Example: User screens “MECHANIC” and “QSK”

Data back-up

Once the initial start-up is completed, all the data is saved to a standard system start-up file. This file is then specifically for the machines that have been brought into service and can be used later if there are any problems in restoring the machine to its as-delivered state.
The files in the Services/Archive area for the basic machine and machine options are no longer required and are therefore deleted.

The correction data (e.g. spindle pitch) is saved separately from the Services/ Active NCK data area to the archive.

The last step in the start-up is to stream off all the HMI data.

6.6 System data

6.6.1 Basic settings

Control clock cycles

The control works on the basis of clock cycles that are defined via machine data. The system basic cycle is specified in seconds; the other cycle times are obtained as multiples of the system basic cycle.

The clock cycles are optimized by default and should only be changed if the requirements of the NCK cannot be met with the default values.

The following cycle times are used by default:

Table 6-10 Clock cycles – default values for the control

Cycle	840D NCU 571	840D NCU 572	840D NCU 573	Setting via MD
System basic cycle in s	6 ms	4 ms	4* / 8# ms	MD 10050: SYSCLOCK_CYCLE_TIME
Position control cycle as a factor	6 ms	4 ms	4* / 8# ms	MD 10060: POSCTRL_SYSCLOCK_TIME_RATIO
Interpolator cycle as a factor	18 ms	12 ms	12* / 40# ms	MD 10070: IPO_SYSCLOCK_TIME_RATIO

* with 2 channel and 12 axes
\# with > 2 channels

General example for cycle settings

The machine data for cycle times is set as follows:

If MD ... = ...	Then the ... = ...
SYSCLOCK_CYCLE_TIME = 0.002	System basic cycle = 2 ms
POSCTRL_SYSCLOCK_TIME_RATIO = 1	Position control cycle = 2 ms (1 · 2 ms)
IPO_SYSCLOCK_TIME_RATIO = 3	Interpolator cycle = 6 ms (3 · 2 ms)

Warning

If you have changed the clock cycles, check that the operating response of the control is correct in all operating modes before ending the start-up process.

Switching from metric to Inch

A control is switched from the metric system to an inch system with
MD 10240: SCALING_SYSTEM_IS_METRIC (basic system is metric).
The additional conversion factor is specified in
MD 10250: SCALING_VALUE_INCH (conversion factor for switching to the INCH system, factor = 25.4).
After power ON the existing data is converted to inches and displayed. After switchover data must be entered in inches.

It is also possible to switch the scaling system via MD 10260.

Requirement:

- Set MD 10260: CONVERT_SCALING_SYSTEM=1
- Bit 0 of MD 20110: RESET_MODE_MASK is set in each channel
- Automatic conversion of NCK active data when the scaling system is changed.
- Data backup with detection of current system of units.
- Effect of MD 10240: SCALING_SYSTEM_IS_METRIC is reset.
- Configuring of the scaling system for sag compensation via MD 32711: CEC_SCALING_SYSTEM_METRIC.

The programmed basic settings can be changed over (G70, G71, G700, G710) for specific channels in MD 20150: GCODE_RESET_VALUES [12]. If the soft key is used to change via the HMI, the value toggles between G700 (inch) and G710 (metric).

With G700/G710, additional feeds (inch/min or mm/min) are interpreted in the scaling system, in addition to the specified lengths.

Internal physical variables

The physical variables in the machine data are set to the following units by default:

Bit no./Physical variable	metric	inch
0 Linear position	1 mm	1 inch
1 Angular position	1 degree	1 degree
2 Linear velocity	1 mm/min	1 inch/min
3 Angular velocity	1 rpm	1 rpm
4 Linear acceleration	1 m/s^2	1 $inch/s^2$
5 Angular acceleration	1 $rev./s^2$	1 $rev./s^2$
6 Linear jerk	1 m/s^3	1 $inch/s^3$
7 Angular jerk	1 $rev./s^3$	1 $rev./s^3$
8 Time	1 s	1 s
9 Position controller loop gain	1/s	1/s
10 Feedrate per revolution	1 mm/rev.	1 inch/rev.
11 Linear position (correction value)	1 mm	1 degree
12 Angular position (correction value)	1 degree	1 degree
13 Cutting speed	1 m/min	1 foot/min

Physical variables for input/output

The physical variables for the input/output of machine and setting data may be defined across the system via

MD10220: SCALING_USER_DEF_MASK (activates the scaling factors) and

MD 10230: SCALING_FACTORS_USER_DEF (scaling factors for the physical variables).

If the corresponding activation bit is not set in MD 10220, then the scaling takes place internally with the conversion factors listed below (default setting, exception K_V factor).
If all the bits are set in MD 10220 and the default setting is to be retained, then the following scaling factors must be entered in MD 10230.

Index No.	Physical variable	Input/output	Internal unit	Scaling factor
0	Linear position	1 mm	1 mm	1
1	Angular position	1 degree	1 degree	1
2	Linear velocity	1 mm/min	1 mm/s	0.016666667
3	Angular velocity	1 rev/min	1 degree/s	6
4	Linear acceleration	1 m/s^2	1 mm/s^2	1000
5	Angular acceleration	1 rev/s^2	1 $degree/s^2$	360
6	Linear jerk	1 m/s^3	1 mm/s^3	1000
7	Angular jerk	1 rev/s^3	1 $degree/s^3$	360
8	Timer	1 s	1 s	1
9	Position controller loop gain	1 m/min∗mm	1/s	16.66666667
10	Revolutional feedrate	1 mm/rev	1 mm/degree	1/360
11	Linear position (compensation value)	1 mm	1 mm	1
12	Angular position (compensation value)	1 degree	1 degree	1
13	Cutting velocity	1 m/min	1 m/min	1

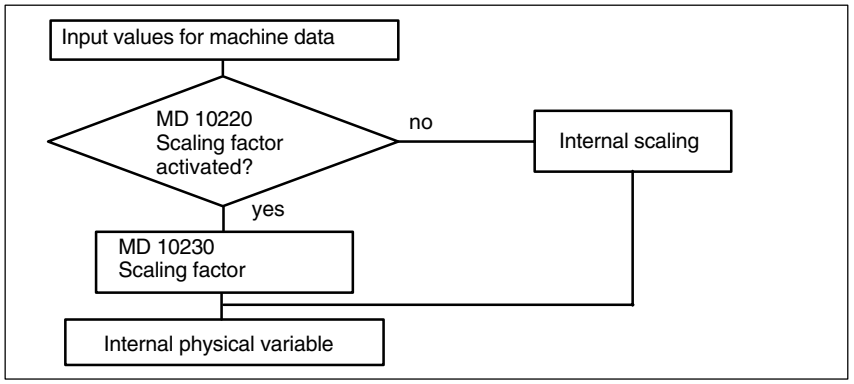


Fig. 6-2 Changing physical variables

Example

In our example the user wishes to enter the linear velocity in m/min.

The internal physical variable is mm/s.

The scaling factor is calculated using the following formula:

$$[m/min] = \frac{1\ m * 1000\ mm * 1\ min}{min * 1\ m * 60\ s} = 1000/60\ [mm/s] = 16.666667$$

The machine data must be entered as follows:
MD 10220: SCALING_USER_DEF_MASK = ‘H4’ (activates the new factor) and
MD 10230: SCALING_FACTORS_USER_DEF [2] = 16.6666667 (scaling factor for linear velocity in m/min)

The machine data is automatically converted to these physical variables after input of the new scale and power ON. The new values are displayed and can then be saved.

The unit of the physical variables for programming in the part program is specified in the Programming Guide.

Internal Calculation resolution

The internal calculation resolutions for the control are entered in MD 10200: INT_INCR_PER_MM (calculation resolution for linear positions) and MD 10210: INT_INCR_PER_DEG (calculation resolution for angular positions).

The default value for this machine data is “1000”. The control thus calculates as standard in 1/1000 mm or 1/1000 degrees. If greater accuracy is required, only these two machine data need to be changed. It is useful to enter machine data in powers of 10 (100, 1000, 10000). Rounding if required (and thus also falsification) of the internal values can only be achieved using smaller units. However, it is essential that the measuring system is adapted to this degree of accuracy. The internal calculation resolution also determines the accuracy with which positions and selected compensation functions are calculated. Changes to the MD have no influence on the velocities and cycle times which can be attained.

Display resolution

The number of decimal places for the position values on the front operating panel should be set in MD 9004: DISPLAY_RESOLUTION.

Limit values for input and display

The limits placed on input values depends on the display option and on the input options on the front operating panel.
This limit is reached at 10 digit positions plus decimal point plus sign.

Reference material /FB1/ G2, Basic machine functions manual, Section “Input/display resolution, calculation resolution”

6.7 Memory configuration

Hardware structure

The following table shows the hardware structure of the available NCK CPU:

	D-RAM	S-RAM	PCMCIA
NCU 561.4	32 MB	4 MB	8 MB
NCU 571.3	2 x 4 MB	4 MB	8 MB
NCU 571.4	32 MB	4 MB	8 MB
NCU 572.3	32 MB	2 MB	8 MB
NCU 572.4	32 MB	4 MB*	8 MB
NCU 573.4	64 MB	4 MB	8 MB
NCU 573.5	64 MB*	3 MB*	8 MB

*) Can be ordered as options, see Catalog NC 60

Memory areas

The memory areas for user data in the NCK are set to the appropriate defaults after an NCK general reset. The following areas can be adjusted to achieve optimum utilization of the available RAM:

- Part programs
- Tool management
- Tool offsets
- Global user data
- Curve tables
- Compensations (e.g. LEC)
- File system/program memory
- Protection areas

The memory breakdown must take place before the NC is actually started up since, if it is divided up again, all the buffered user data will be lost (e.g. part programs, drive data).
Machine data, setting data and options are not erased.

Effectiveness

The machine data for the memory configuration takes effect at Power-On.

Caution

Before increasing the size of DRAM areas (e.g. local user variables or function parameters), first check whether the available memory is sufficient (MD 18050 must be greater than 15000). If more dynamic memory is required than is available, then at the next power-up, the SRAM will be deleted as well **without warning** and the following user data will be lost:

– Drive machine data
– Part programs
– Memory configuration data
– Configurable memory areas

Reference material: /FB 2/ S2, Description of the extended functions, memory configuration, Section: Determining the memory required.

Displaying and editing system resources

The HMI user interface can be used to display the system resources currently in use in the NCK and HMI areas. They can also be edited if the user has the necessary access rights.

Procedure:
Press the “Start-up” soft key on the HMI user interface.

The “NC memory” soft key also appears when the Extended key is pressed. When the soft key is pressed, an overview of the current RAM allocation is displayed:

- Static RAM (SRAM)
- Dynamic RAM (DRAM)

To view the memory for configured machine data in greater detail, further areas can be displayed by pressing the “SRAM” or “DRAM” soft keys.

Reference material: /IAM/ IM2, Start-up Guide, HMI Embedded, Section: Displaying and editing system resources

6.7.1 Dynamic RAM

Set the following machine data:

Table 6-11 MD for DRAMmemory breakdown

MD for DRAM	Meaning
MD 18242: MM_MAX_SIZE_OF_LUD_VALUE	This data is set to 8192 bytes for “cycle 95”.This MD can be reduced to 2048 if cycle 95 is not used.
MD 18351: MM_DRAM_FILE_MEM_SIZE	Size of the part program memory in DRAM
MD 28040: MM_LUD_VALUE_MEM	Memory size for local user variables. Do not increase this MD 28040 from 25 kByte (default setting) to 35–50 kByte unless you need more than 2048 bytes in MD 18242.

Checking the DRAM

Check the free DRAM against MD18050. Values greater than 15000 must be displayed. If the value is smaller, the memory resources are exhausted and there is a risk that user data will be lost if DRAM continues to be allocated.

6.7.2 Static RAM

Set the following machine data:

Table 6-12 MD for SRAM breakdown

MDs for SRAM	Meaning
MD 18120: MM_NUM_GUD_NAMES_NCK	Number of global user variables
MD 18130: MM_NUM_GUD_NAMES_CHAN	Number of channel-specific global user variables
MD 18080: MM_TOOL_MANAGEMENT_MASK	Memory breakdown for tool managementSet the tool management to suit the requirements of the machine. If you are not using the TM function, set MD 18084 and 18086 to “0” to free more memory for part programs.
MD 18082: MM_NUM_TOOL	Number of tools according to machine
MD 18100: MM_NUM_CUTTING_EDGES_IN_TOA	Number of tool cutting edges per TOA module according to requirements of end customer
MD 18160: MM_NUM_USER_MACROS	Number of macros
MD 18190: MM_NUM_PROTECT_AREA MD 28200: MM_NUM_PROTECT_AREA_CHAN MD 28210: MM_NUM_PROTECT_AREA_ACTIV	Number of files for machine-related protection areas Number of files for channel-specific protection areas Number of protected areas on a channel that are active at the same time
MD 28050: MM_NUM_R–PARAM	Number of R parameters required
MD 28080: MM_NUM_USER_FRAMES	Number of frames required
MD 38000: MM_ENC_COMP_MAX_POINTS	Number of compensation points required

SRAM with 2 MB module

If the NCU is used with a larger memory, this memory must be enabled.

- Enter the value 1900 in MD 18230: MM_USER_MEM_BUFFERED.
- Stream off a standard system start-up file.
- POWER ON (to reorganize the memory).
- Download the standard system start-up file to the control once more.

Check SRAM

MD 18060 shows how much RAM is still free.

Recommendation:
Values > 15000 should be displayed so that data (e.g. tool offsets) can be read in at any time.

Note

For normal applications, leave all other memory settings unchanged.

Deleting SRAM by changing the MD

Changing the following machine data causes the control SRAM to be reconfigured. In the event of a change, the “4400 MD change caused reorganisation of the buffered memory (data lost!)” alarm is output. When this alarm is output, all data must be saved because all buffered user data will be erased during the next booting.

Table 6-13 Machine data for the memory configuration

MD Number	MD name	Meaning
MD 18020	MM_NUM_GUD_NAMES_NCK	Number of global user variables
MD 18030	MM_NUM_GUD_NAMES_CHAN	Number of global user variables
MD 18080	MM_TOOL_MANAGEMENT_MASK	Tool management memory
MD 18082	MM_NUM_TOOL	Number of tools
MD 18084	MM_NUM_MAGAZINE	Number of magazines
MD 18086	MM_NUM_MAGAZINE_LOCATION	Number of magazine locations
MD 18090	MM_NUM_CC_MAGAZINE_PARAM	Number of magazine data items
MD 18092	MM_NUM_CC_MAGLOC_PARAM	Number of magazine location data items
MD 18094	MM_NUM_CC_TDA_PARAM	Number of tool-specific data items
MD 18096	MM_NUM_CC_TOA_PARAM	Number of TOA data items
MD 18098	MM_NUM_CC_MON_PARAM	Number of monitoring data items
MD 18100	MM_NUM_CUTTING_EDGES_IN_TOA	Number of cutting edges per TOA block
MD 18110	MM_NUM_TOA_MODULES	Number of TOA blocks
MD 18118	MM_NUM_GUD_MODULES	Number of GUD files
MD 18120	MM_NUM_GUD_NAMES_NCK	Number of global user variables
MD 18130	MM_NUM_GUD_NAMES_CHAN	Number of channel-specific user variables
MD 18140	MM_NUM_GUD_NAMES_AXIS	Number of axis-specific user variables
MD 18150	MM_GUD_VALUES_MEM	Memory location for user variables
MD 18160	MM_NUM_USER_MACROS	Number of macros

Table 6-13 Machine data for the memory configuration

MD Number	MD name	Meaning
MD 18190	MM_NUM_PROTECT_AREA_NCKC	Number of protected areas
MD 18230	MM_USER_MEM_BUFFERED	RAM in SRAM
MD 18270	MM_NUM_SUBDIR_PER_DIR	Number of subdirectories
MD 18280	MM_NUM_FILES_PER_DIR	Number of files
MD 18290	MM_FILE_HASH_TABLE_SIZE	Hash table size for files in a directory
MD 18300	MM_DIR_HASH_TABLE_SIZE	Hash table size for subdirectories
MD 18310	MM_NUM_DIR_IN_FILESYSTEM	Number of directories in the passive file system
MD 18320	MM_NUM_FILES_IN_FILESYSTEM	Number of files in the passive file system
MD 18330	MM_CHAR_LENGTH_OF_BLOCK	Max. length of an NC block
MD 18350	MM_USER_FILE_MEM_MINIMUM	Minimum RAM in SRAM
MD 28050	MM_NUM_R_PARAM	Number of channel-specific R parameters
MD 28080	MM_NUM_USER_FRAMES	Number of variable frames
MD 28085	MM_LINK_TOA_UNIT	Allocation of a TO unit to a channel
MD 28200	MM_NUM_PROTECT_AREA_CHAN	Number of files for protection areas
MD 38000	MM_ENC_COMP_MAX_POINTS [n]	Number of interpolating point for interp. compensation

6.8 Scaling machine data

Download scaling machine data

The machine data also includes data that defines the scaling of machine data in relation to its physical unit (e.g. velocities).

This is in relation to the scaling for the following machine data, for example:

- MD 10220: SCALING_USER_DEF_MASK (activates the scaling factors)
- MD 10230: SCALING_FACTORS_USER_DEF (scaling factors for the physical variables)
- MD 10240: SCALING_SYSTEM_IS_METRIC (basic system is metric)
- MD 10250: SCALING_VALUE_INCH (conversion factor for switching to the INCH system)
- MD 30300: IS_ROT_AX (rotary axis)

When machine data is loaded (via HMI, RS-232 interface, program), it is scaled according to the physical unit which is currently valid. If this record contains a new scaling (e.g. a rotary axis declaration), then the machine data that is dependent on the scaling will be converted to the new scaling at the next POWER-ON. The MD then does not contain the expected values (e.g. rotary axis traverses at very low F values).

Example:

The control was started up with default values. The MD file to be downloaded defines the 4th axis as a rotary axis and contains the following machine data:
$MA_IS_ROT_AX[A1] = 1 (rotary axis)
$MA_MAX_AX_VELO [A1]= 1000 [rev./min] (maximum axis speed)

When the MD block is downloaded, the velocity is interpreted in relation to a linear axis (default setting $MA_IS_ROT_AX[A1]=0) and scaled to the linear velocity.

During the next Power-on process, the control detects that this axis is defined as a rotary axis and normalizes the velocity with reference to rev/min. The value in the machine data is then no longer “1000”, but “2.77777778” (1000/360).

If the machine data file is downloaded again, the axis is already defined as a rotary axis and the velocity is interpreted and scaled as a rotary axis velocity, The MD then contains the value “1000” that is interpreted in rev/min by the control system.

Gradual downloading of machine data

Either

- Change the relevant machine data manually via HMI (MD 10220, 10230, 10240, 10250, 30300) and then power-up the NCK. Then read in the MD record and trigger the NCK power-up, or
- Generate an MD record with the scaling machine data (MD 10220, 10230, 10240, 10250, 30300). Load this MD record and initiate an NCK power-up. Then read in the complete MD record and trigger the NCK power-up, or
- Alternatively, an MD record may be downloaded twice, each time with an NCK power-up.

Note

If a scaling MD is altered, then the control outputs alarm “4070 Scaling data changed”.

Download standard data

Standard machine data can be downloaded in different ways.

- Turn switch S3 on the NCU module to position 1 and reset the NCK.

Note

This will reinitialize the entire SRAM of the NCU module. All the user data will be lost.

- MD 11200: INIT_MD (download standard MD at “next” power-up)

Via certain input values in the MD: INIT_MD can be downloaded with standard values to various data areas at the next NCK power-up. The machine data is displayed in HEX format. After setting the MD: INIT_MD must initiate a POWER-ON twice.

- The MD is activated at the 1st power-on.
- The 2nd power-on executes the function and resets the MD to the value “0”.

Significance of the input values in MD 11200

Value “0”
The saved machine data is downloaded at the next power-up.
Value “1”
All the MDs, apart from the memory-configuring data, are overwritten with the default values at the next power-up.
Value “2”
All memory-configuring MDs are overwritten with the default values at the next power-up.
Value “4”
Reserved

6.9 Axes and spindles

6.9.1 Description of the axis configuration

The SINUMERIK 840D is supplied as standard with the following configuration:

- NCU 571: 1 channel and 5 axes.
- NCU 572/573: 2 channels and 8 axes with simulated setpoint and actual value channels.

Note

With SINUMERIK 840D, this depends on the hardware/software version
up to 12 axes/spindles are permitted per channel
up to 31 axes or 20 spindles are permitted per NCU
Reference material: /BU/ Order documents, catalog NC 60

If DMP compact modules are used, then the number of axes, including DMP modules, is limited to 31 in the axis configuration with NCU 573.3. If a DMP compact module is used with 31-axis software, for example, then there are 30 axes available.

Number of channels

With the SINUMERIK 840D there are >2 channels available.

Machine axes

This means all the axes present on the machine. They are defined as geometry axes or special axes.

Geometry axes

The workpiece geometry is programmed with the geometry axes. The geometry axes form a rectangular coordinate system (2D or 3D).

Special axes

Unlike geometry axes, there is no geometrical connection for special axes, e.g. for:
– Rotary axes
– Revolver axes
– Position-controlled spindles

Axis configuration

The axis configuration is defined on three levels:

1. Machine level
2. Channel level
3. Program level

1. Machine level

MD 10000: AXCONF_MACHAX_NAME_TAB
Here, an axis name is defined in
MD 10000: AXCONF_MACHAX_NAME_TAB for each machine axis.

Example:

Lathe
with X, Z, C axis/spindle

MD 10000	X1	Z1	C1		
Index	0	1	2	3	4

Milling machine
4 axes+spindles/C axis

	X1	Y1	Z1	A1	C1
	0	1	2	3	4

Example for a milling machine: MD10000
AXCONF_MACHAX_NAME_TAB[0] = X1
AXCONF_MACHAX_NAME_TAB[1] = Y1
AXCONF_MACHAX_NAME_TAB[2] = Z1
AXCONF_MACHAX_NAME_TAB[3] = A1
AXCONF_MACHAX_NAME_TAB[4] = C1

2. Channel level

- MD 20070: AXCONF_MACHAX_USED[0...7]
  The channel-specific MDs are used to assign the machine axes to a geometry channel.

Lathe

1	2	3	0	0

Milling machine

1	2	3	4	5

- MD 20080: AXCONF_CHANAX_NAME_TAB[0...7]
  The MD defines the names of the axes on the channel. Enter the names of the geometry and additional axes here.

X	Z	C		

X	Y	Z	A	C

3. Program level

- MD 20060: AXCONF_GEOAX_NAME_TAB[0...2]
  The MD defines the names that are used in the part programs for the geometry axes (machine-independent workpiece axes).

X	Y*	Z		

X	Y	Z		

* For a transformation e.g. TRANSMIT the 2nd geometry coordinates must also be given a name (e.g. “Y”)

- MD 20050: AXCONF_GEOAX_ASSIGN_TAB[0...2]
  Defines the allocation of geometry axes to the axes of the channel (MD20070) without transformation. For allocation while transformation is active, see:

Reference material: /FB1/ K2, Functional description of the basic machines, Axes, coordinate systems, frames

Note the relationship with the inclusion of tool offsets in the calculation (G17, G18, G19).

1	0	2		

1	2	3		

During program execution, the coordinates that are not assigned via MD 20060/MD 20050 are always mapped directly onto the axes of the channel (in the milling machine example below, axes A and C).

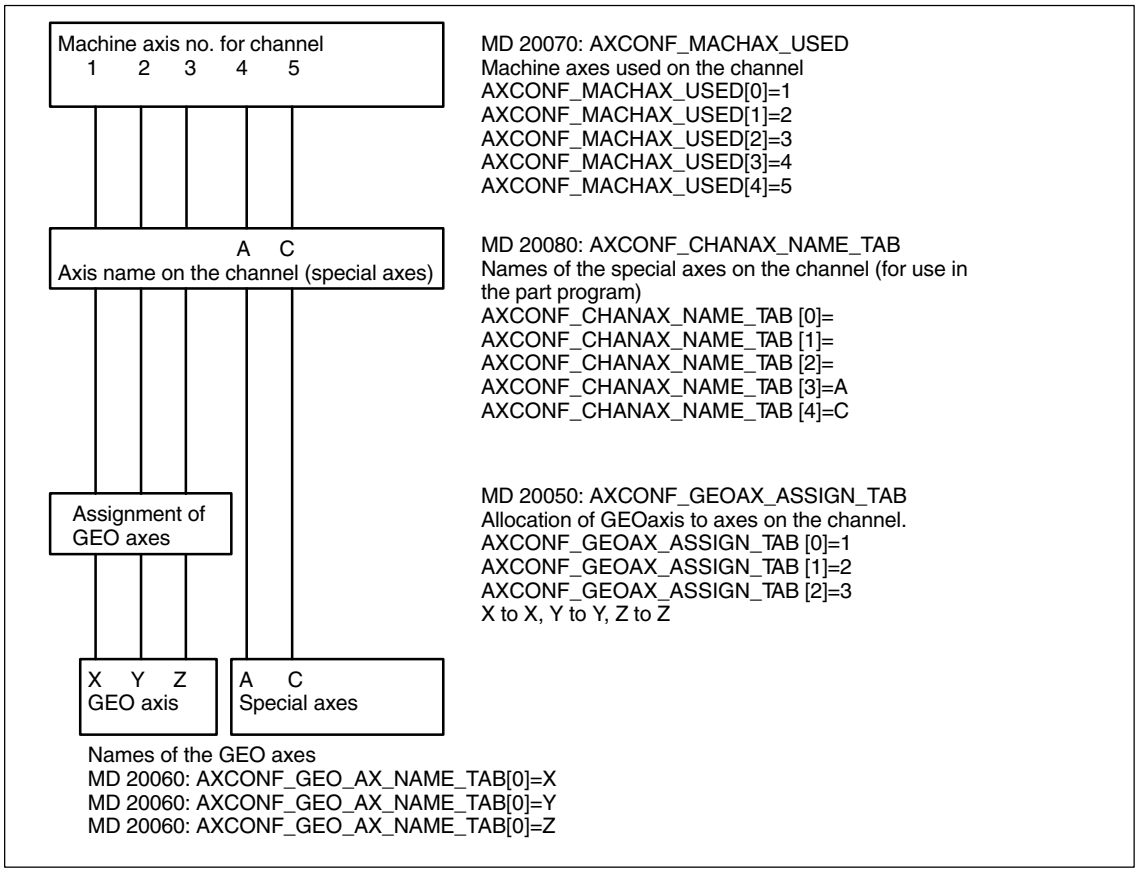


Fig. 6-3 Example of milling machine: 4 axes + spindle/C axis

Define axis identifier

The name defined in MD 10000: AXCONF_MACHAX_NAME_TAB or the associated index is used for:

- Accessing axis-specific machine data (loading, saving, displaying)
- Reference point approach G74
- Measurements
- Test point runs G75
- Traversing commands from PLC
- Display of axis-specific alarms
- Display of actual-value system (machine-related)
- DRF handwheel function

Note

Leading zeros are generally ignored in user-defined axis identifiers.

Examples:
MD 10000: AXCONF_MACHAX_NAME_TAB[0] = X01 corresponds to X1
MD 10000: AXCONF_MACHAX_NAME_TAB[1] = A01 corresponds to A1
MD 10000: AXCONF_MACHAX_NAME_TAB[2] = C01 corresponds to C1

6.9.2 Drive configuration (VSA, SLM, HSA)

Note

The drive configuration and start-up of synchronous linear motors (SLM) are described in the next section.

There are no drive parameters stored in the control in the delivery state or after a general reset.

Before the drives can be programmed, the drive structure available on the control (power sections and motors) must first be entered and the axes declared with MD 20070: AXCONF_MACHAX_USED/
MD 10000: AXCONF_MACHAX_NAME_TAB must be allocated.

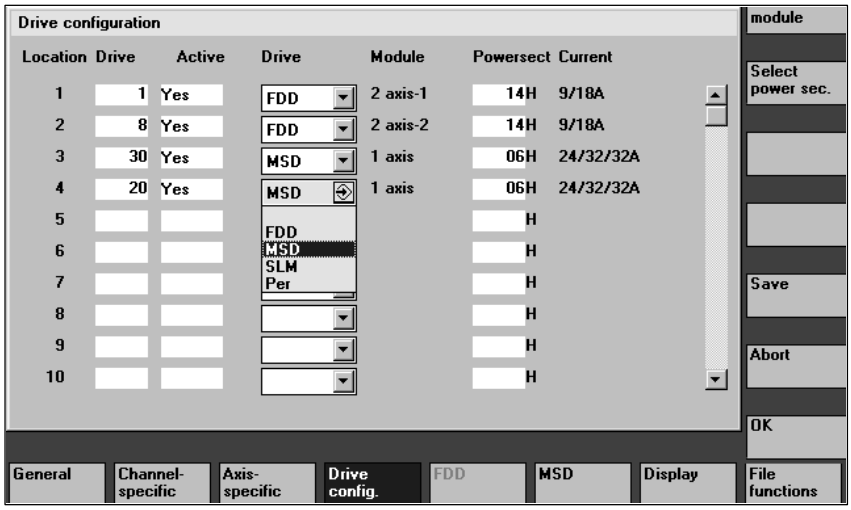


Fig. 6-4 Drive configuration screen with HMI Advanced

Note

The settings made in the “Drive configuration” screen are described individually below.

Setting the drive configuration

The drive configuration is entered in the “Drive configuration” screen using the operating panel or at the 611D Start-up Tool. The screen is accessed using the “Machine data” –> “Drive configur.” soft keys.

- Each power section is physically assigned a slot number.
- If a slot is not used or if it does not contain a power section, then it should be identified as passive.
- A logical address via which the relevant drive is addressed (setpoint/actual value assignment, access to parameters) is assigned to each slot used.

Power section selection

Once you have defined the drive type (VSA, SLM, HSA), you must then select the associated power section.
This can be defined by:

- Entering the power section code directly (e.g. from Table 6-9)
- Selecting from the power section list (MLFB numbers) stored on the control using the “Pow.sect.sel...” vertical soft key, selecting the power section using the cursor keys, then press the “OK” soft key to confirm and then automatically returning to the configuration screen.

  Requirement: The cursor must be on the same line as the desired slot.

Table 6-14 Allocating the drive/power section/power section code

Drive type	Amperage	Power section	Code
MSD	3 / 3 / 3 A	8 A	01
MSD	5 / 5 / 8 A	15 A	02
MSD	8 / 10 / 16 A	25 A	04
MSD	24 / 32 / 32 A	50 A	06
MSD	30 / 40 / 51 A	80 A	07
MSD	45 / 60 / 76 A	108 A	0D
MSD	45 / 60 / 76 A	120 A	08
MSD	60 / 80 / 102 A	160 A	09
MSD	85 / 110 / 127 A	200 A	0A
MSD	120 / 150 / 193 A	300 A	0B
MSD	200 / 250 / 257 A	400 A	0C
FDD	3 / 6 A	8 A	11
FDD	5 / 10 A	15 A	12
FDD	9 / 18 A	25 A	14
FDD	18 / 36 A	50 A	16
FDD	28 / 56 A	80 A	17
FDD	56 / 112 A	160 A	19
FDD	70 / 140 A	200 A	1A
FDD	140 / 210 A	400 A	1C

Example 1 of a machine SINUMERIK 840D with 3 axes and one spindle

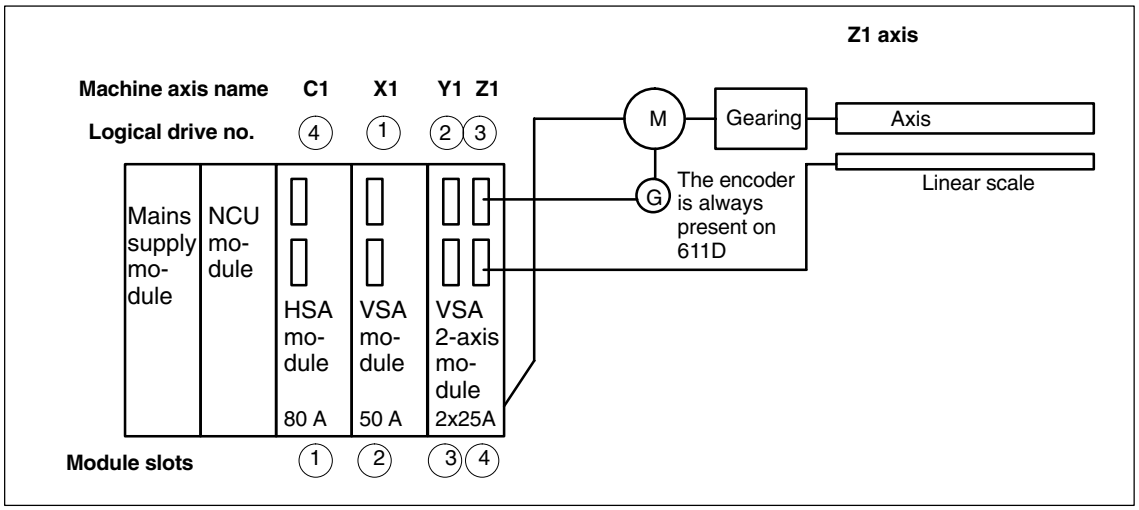


Fig. 6-5 Example 1 of a SINUMERIK 840D with 3 axes and 1 spindle

Table 6-15 Data for the example in the figure above:

Slot	Power section module	Drive	Logical drive no.	Direct measuring system	Position measuring system 1	Position measuring system 2
1	80 A	MSD	4	no	Motor encoder	no
2	50 A	FDD	1	no	Motor encoder	no
3	25 A	FDD	2	no	Motor encoder	no
4	25 A	FDD	3	yes	Linear scale	no

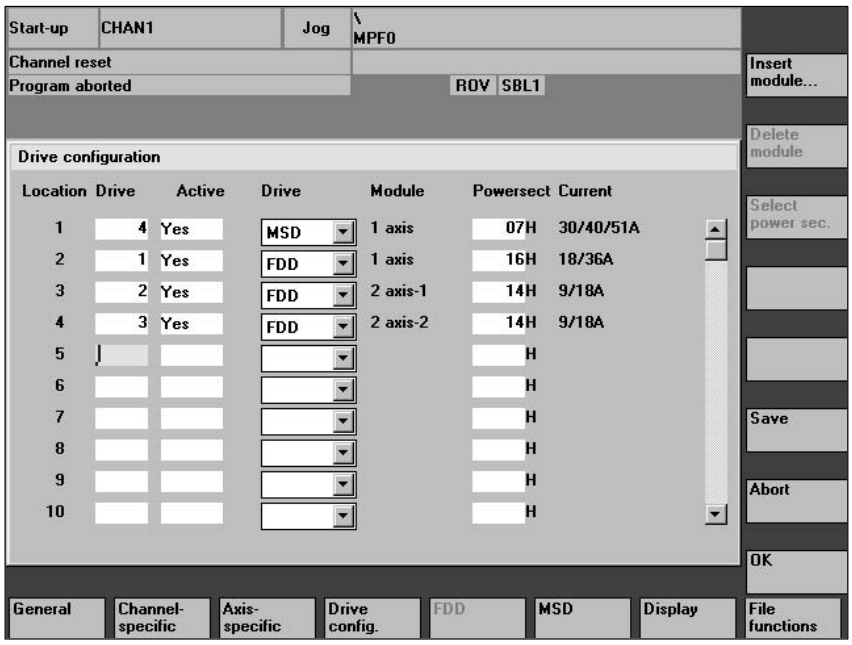


Fig. 6-6 Drive configuration

6.9.3 Programming axis-specific setpoint/actual values

Assigning the setpoint/actual value channels

A setpoint value channel (i.e. a logical drive number) and at least one actual value channel must be assigned to each axis/spindle for the position measuring system. An optional second channel may be specified for a second position measuring system.

The motor measuring system is always used for the speed regulation (X411). The following fixed assignment is used between the motor connection and the motor measuring system connection: The motor and motor measuring system must always be connected to the same module.

Assigning the setpoint channel (axis-specific)		
MD	**Meaning**	**Input for example 1** (see Fig. 6-6)
MD 30110: CTRLOUT_MODULE_NR	Assignment of a logical drive no. to setpoint channel	X1="1" Slot 2 Y1="2" Slot 3 Z1="3" Slot 4 C1="4" Slot 1
MD 30130: CTRLOUT_TYPE	Setpoint channel exists	"1"

Assignment actual value channel (axis-specific)		
MD	**Meaning**	**Input for example 1**
MD 30200: NUM_ENCS	Number of measuring channels "1" if there is just one position measuring system ("2" if there are two position measuring systems)	X1="1" Y1="1" Z1="1" C1="1"
MD 30240: ENC_TYPE[0]	Encoder type "1" for incremental encoders ("4" for absolute encoders with EnDat interface)	X1="1" Y1="1" Z1="1" C1="1"
MD 30220: ENC_MODULE_NR[0]	Allocation of a logical drive no. to the actual value channel for **position measuring system 1**	X1="1" Slot 2 Y1="2" Slot 3 Z1="3" Slot 4 C1="4" Slot 1
MD 30220: ENC_MODULE_NR[1]	Allocation of a logical drive no. to the actual value channel for **position measuring system 2**	Position measuring system 2 is not used
MD 30230: ENC_INPUT_NR[0]	Allocation for position measuring system 1 "1" for motor measuring system "2" for direct measuring system	X1="1" Y1="1" Z1="2" C1="1"
MD 30230: ENC_INPUT_NR[1]	Allocation for position measuring system 2 "1" for motor measuring system "2" for direct measuring system	Position measuring system 2 is not used

Note

Each logical drive number may be entered only once in the configuration display. All activated slots must be assigned to an axis (setpoint channel).

If axes/spindles are to remain switched off temporarily during start-up, then MD 30240: ENC_TYPE, MD 30130 CTRLOUT_TYPE should be set to “0” and the assigned power section slot should be declared as passive.

The default setting for MD 30100: CTRLOUT_SEGMENT_NR=1, MD 30210: ENC_SEGMENT_NR =1 should be retained.

MD 30350: SIMU_AX_VDI_OUTPUT can be used to select whether the interface signals of a simulated axis should be output at the PLC interface (e.g. for testing programs when there is no drive hardware present).

Restart

Once the drive configuration and setpoint/actual value assignment have been entered, NCK reset must be used to restart the control so that the set configuration can take effect.

The message “Start-up required” appears for all activated drives, prompting to set the drive data parameters.

6.9.4 Setting drive parameters (FDD, MSD)

Setting drive parameters

A motor type should be set for all drives via the control panel or SIMODRIVE 611 Start-up Tool using the"Machine data FDD" or "Machine data MSD" menu (see vertical soft key bar). The type is selected from a list via the motor MLFB (1FT6□□□-□□□□, 1FT7□□□-□□□□, 1PH□□□-□□□□ see rating plate).

- For FDD, only the selection of motor 1 is visible.
- For MSD, the choice of motor 1 and motor 2 can be seen (e.g. for switching between Y/Δ), while for the Performance 2 controller, there are 4 motor records available.
  To avoid setting the MSD parameters incorrectly, the "OK" soft key remains disabled until a valid motor or a non-Siemens motor is selected for motor 1.
- After selecting the motor, press the "OK" soft key to confirm and a menu for entering the encoder data appears.
- The most important control data is assigned defaults when the motor type is selected.

Acknowledge the "Motor selection" screen and the "Measuring system data" screen appears.

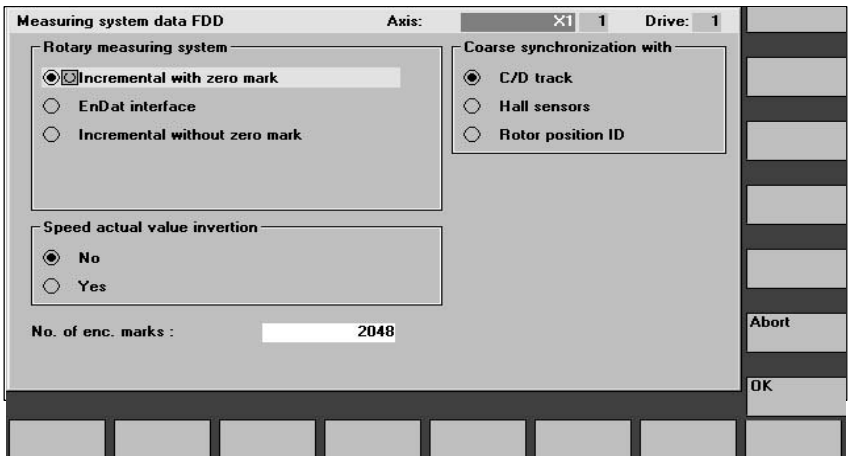


Fig. 6-7 Example of measuring system data for the motor selection for FDD

This screen is used to select the measuring system used in the motor: incremental encoder or absolute encoder with EnDat interface. Once the measuring system is selected, all the other necessary values are filled in automatically. Press "OK" to confirm these.

Example:

- Incremental motor encoder (ERN1387)
  1F□6□□□-□□□□-□A□□
  Incremental with zero marker: Press "OK" to accept the screen, since the other parameters are set to the correct defaults for standard motors.
- Absolute motor encoder (EQN1325)
  1F□6□□□-□□□□-□E□□
  EnDat interface: Press "OK" to accept the screen, since the other parameters are set to the correct defaults for standard motors.

Note

For 1FK6 motors with optical encoders, optimum torque utilization is supported by automatic identification methods. Traversing motions <±5 degrees are not exceeded mechanically. The identification procedure is performed on every power-up.

Non-Siemens motor

If a non-Siemens motor is used, press the **"**Non-Siemens motor" soft key to open the menu for entering the non-Siemens motor data. When you have entered the data and returned to the motor selection menu, "Non-Siemens motor" is automatically entered in the checkbox for motor 1 or motor 2.

Reference material: /FBA/ DM1, Functional description for basic machines, Calculating motor, power section and controller data

Once the motor has been selected, the drive record must be saved for each axis/spindle using the "Save boot file" operation. The record is saved as a file VSAxx.BOT or HSAxx.BOT in the RAM (SRAM) of the NC module.

6.9.5 Parameter settings for incremental measuring systems

Rotary encoders

The following table lists all the parameters which have to be entered for encoder adjustment.

Table 6-16 Machine data for matching rotary encoders

Machine data	Linear axis		Rotary axis	
	Encoder on motor	Encoder on machine	Encoder on motor	Encoder on machine
30300: IS_ROT_AX	0	0	1	1
31000: ENC_IS_LINEAR	0	0	0	0
31040: ENC_IS_DIRECT	0	1	0	1
31020: ENC_RESOL	Marks/rev	Marks/rev	Marks/rev	Marks/rev
31030: LEADSCREW_PITCH	mm/rev	mm/rev	–	–
31080: DRIVE_ENC_RATIO_NUMERA	Motor rev.	Load rev.	Motor rev.	Load rev.
31070: DRIVE_ENC_RATIO_DENOM	Encoder rev.	Encoder rev.	Encoder rev.	Encoder rev.
31060: DRIVE_AX_RATIO_NUMERA	Motor rev.	Motor rev.	Motor rev.	Motor rev.
31050: DRIVE_AX_RATIO_DENOM	Spindle rev.	Spindle rev.	Load rev.	Load rev.

Linear axis with rotary encoder at the motor

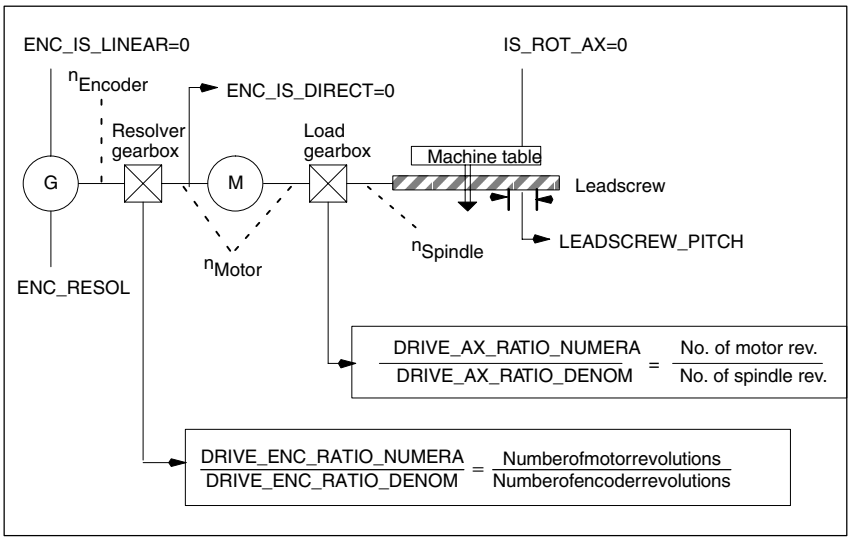


Fig. 6-8 Linear axis with motor-mounted rotary encoder

Linear axis with rotary encoder at the machine

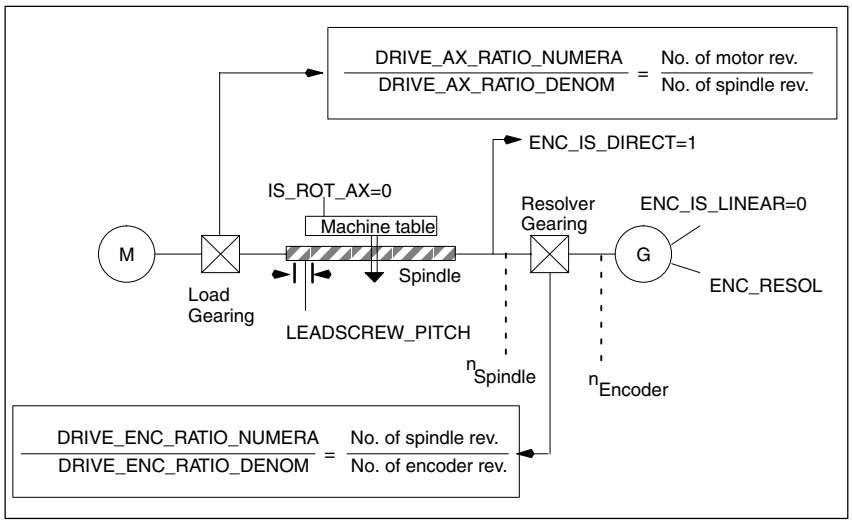


Fig. 6-9 Linear axis with machine-mounted rotary encoder

Rotary axis with rotary encoder at the motor

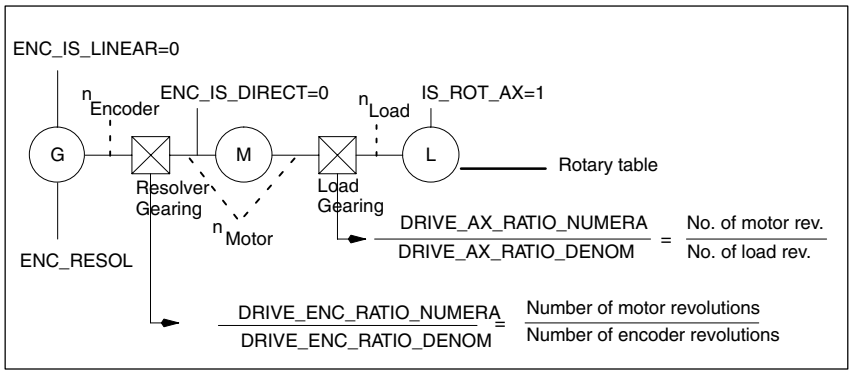


Fig. 6-10 Rotary axis with motor-mounted rotary encoder

Rotary axis with rotary encoder at the machine

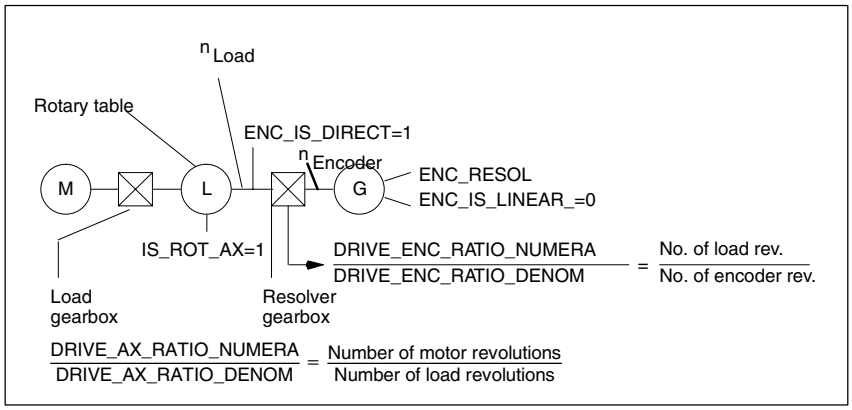


Fig. 6-11 Rotary axis with machine-mounted rotary encoder

Adapting encoders for linear measuring systems

The following tables list all the data that must be entered for linear measuring systems.

Table 6-17 Machine data for adapting encodersfor linear measuring systems

Machine data	Linear axis
MD 30300: IS_ROT_AX	0
MD 31000: ENC_IS_LINEAR	0
MD 31030: LEADSCREW_PITCH	mm/rev
MD 31040: ENC_IS_DIRECT	Encoder on motor: 0 Encoder on the machine: 1
MD 31010: ENC_GRID_POINT_DIST	Graduation
MD 32110: ENC_FEEDBACK_POL	Sign for actual value (control direction) [1; –1]
MD 31060: DRIVE_AX_RATIO_NUMERA	Motor revolution
MD 31050: DRIVE_AX_RATIO_DENOM	Spindle revolution

Linear axis with linear scale

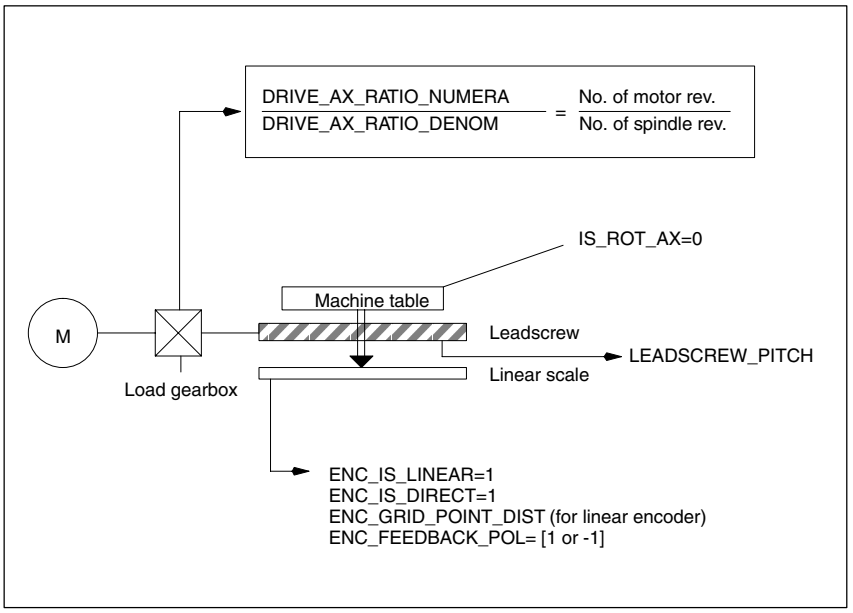


Fig. 6-12 Linear axis with linear scale

6.9.6 Parameter settings for absolute measuring systems (EnDat interface)

Requirement

TO adapt the absolute encoder to the machine conditions, follow the procedure described for a rotary or linear incremental encoder.

The following additional axis machine data must be observed for absolute value encoders:

Table 6-18 Axis machine data for absolute value encoders

Rotary absolute value encoders			Linear absolute value encoders
MD	**at the motor**	**at the machine**	**at the machine**
1005: ENC_RESOL_MOTOR	Marks/rev (standard motor 2048) *)	–	–
1007: ENC_RESOL_DIRECT	–	Marks/rev	Graduation in [nm]
1011: ACTUAL_VALUE_CONFIG	Bit 3 *)	–	–
1030: ACTUAL_VALUE_CONFIG_DIRECT	–	Bit 3	Bit 3 + Bit 4
34200: ENC_REEP_MODE [n]: 0...max. No. of encoders –1	0	0	0
34220: ENC_ABS_TURNS_MODULO [n]: 0...max. No. of encoders –1	Multiturn resolution (Standard motor 4096)	Multiturn resolution	–

*) Measuring system parameters were set automatically when the motor was selected.

Setting up the absolute encoder

To set the encoder, determine the offset between the machine zero and the zero of the absolute encoder and save it to the SRAM of the NC module.
The adjusted state is identified by MD 34210: ENC_REFP_STATE = 2.

Reference material: /FB1/ R1, Functional description of the basic machine, Reference point approach

Readjustment

When the machine is started up, the absolute encoder must be set up once the axes are ready to move. However, it may also be necessary to readjust the encoder at a later point in time, e.g.

- after dismantling/installing the encoder or the motor with absolute encoder or,
- in general if the mechanical connection between the encoder and load was separated and, when it was joined together again, the remaining deviation is outside the tolerances
- if data is lost from the SRAM of the NCK, battery power lost, PRESET
- if gearbox is switched between the load and absolute encoder
  MD 34210: ENC_REFP_STATE deleted

Note

In all other cases, the user is responsible for switching
MD 34210: ENC_REFP_STATE to “0” or “1” and for carrying out the re-adjustment.

In the event of “position buffering after power off”, entering REFP_STATE=1 only causes value 2 to change if it has already been referenced.

To exit this mode, REFP_STATE must = 0, otherwise this referenced/adjusted status is retained forever, even after REFP_MODE and Power Off are changed.

Readjusting the absolute encoder

The following MDs should be noted before adjustment:
MD 34200: ENC_REFP_MODE=0 (for absolute encoder: accept REFP_SET_POS)
MD 34220: ENC_ABS_TURNS_MODULO (only needed for rotary axes)

Sequence

1. Set MD 30240: ENC_TYPE=4
2. Set MD 34200: ENC_REFP_MODE=0
3. Execute NCK reset
4. Move axis to reference position after entering MD 34010: REFP_CAM_DIR_IS_MINUS according to the approach direction.
   (If the axis is traversed in the negative direction towards the reference position, then MD 34010 must be set to 1.)
5. Set MD 34100: REFP_SET_POS to the actual value of the reference position.
6. Set MD 34210: ENC_REFP_STATE to 1 to start the adjustment.
7. Select the axis that has been compared at the MCP and press the RESET key on the MCP.
8. Select JOG/REF mode, give feed enabling command for axis.
9. Start the adjustment process with the traversing key “+” or “–” according to MD 34010: REFP_CAM_DIR_IS_MINUS and the direction of approach to the reference position. (Backlash has been eliminated.)
   The axis does not traverse. Instead, the offset between the correct actual value (reference position) and the actual value supplied by the encoder is entered in MD 34090: REFP_MOVE_DIST_CORR. The current actual value appears in the basic display, the axis signals “referenced”. The value 2 is entered in MD 34210 as the result.
   Example:
   MD 34010 = 1 (negative) and reference position has been traversed in negative direction. In this case, the “–” key on the MCP must also be pressed.

Rotary absolute encoder with large traveling range

The encoder EQN 1325 can represent 4096 revolutions. This means that the detected positional value is unique over the maximum specified ranges:

- Rotary axis, encoder on load: 4096 load revolutions
- Rotary axis, encoder on motor: 4096 motor revolutions
- Linear axis, encoder on motor: 4096 * eff. spindle pitch
  For a linear axis with an effective spindle pitch of 10 mm, a traveling range of 40.96 m is covered.

Note

The traveling range is the same as for the incremental encoders.

The user must ensure that, when the encoder is switched off (Power Off/On, Park), the axis moves less than half of the absolute encoder numerical range that can be clearly represented.

In this case, the software can reconstruct the new position by detecting the shortest route.

Apart from this, changes of position with an active encoder are possible without restriction over the entire traveling range.

NCK-RESET

A further NCK reset is required after entering and saving all the drive records. The SF LED then goes out and the drives can be traversed after PLC start-up (speed controller preset).

After the axis-specific velocity and travel range limits have been adapted, the speed control preset values should be optimized.

6.9.7 Overview of the drive parameters

Optimize the drive by means of the following parameters (see also Chapter 10):

Table 6-19 Speed controller settings

No.	Identifier	Name	Drive
1401	MOTOR_MAX_SPEED[0...7]	Setpoint scaling	FDD/MSD
1001	SPEEDCTRL_CYCLE_TIME[DRx]	Speed controller clock cycle	FDD/MSD
1407	SPEEDCTRL_GAIN_1[0...7,DRx]	Speed controller P gain	FDD/MSD
1409	SPEEDCTRL_INTEGRATOR_TIME_1[0...7,DRx]	Speed controller reset time	FDD/MSD
1413	SPEEDCTRL_ADAPT_ENABLE[DRx]	Selection speed controller adaptation	FDD/MSD
1408	SPEEDCTRL_GAIN_2[0...7,DRx]	P gain for upper adaptation speed	FDD/MSD
1410	SPEEDCTRL_INTEGRATOR_TIME_2[0...7,DRx]	Reset time upper adaptation speed	FDD/MSD
1411	SPEEDCTRL_ADAPT_SPEED_1[DRx]	Lower adaptation speed	FDD/MSD
1412	SPEEDCTRL_ADAPT_SPEED_2[DRx]	Upper adaptation speed	FDD/MSD
1421	SPEEDCTRL_INTEGRATOR_FEEDBK[0...7,DRx]	Time constant integrator feedback	FDD/MSD

Table 6-20 Field weakening for MSD

No.	Identifier	Name	Drive
1142	FIELD_WEAKENING_SPEED[DRx]	Threshold speed field weakening	MSD

Table 6-21 Setpoint current filter

No.	Identifier	Name	Drive
1200	NUM_CURRENT_FILTERS[0...7,DRx]	Select setpoint current filter	FDD/MSD
1201	CURRENT_FILTER_CONFIG[0...7,DRx]	Setpoint current filter type	FDD/MSD
1202	CURRENT_FILTER_1_FREQUENCY[0...7,DRx]	Natural freq. setp. current filter 1	FDD/MSD
1203	CURRENT_FILTER_1_DAMPING[0...7,DRx]	Damping setpoint current filter 1	FDD/MSD
1204	CURRENT_FILTER_2_FREQUENCY[0,..7,DRx]	Natural freq. setp. current filter 2	FDD/MSD
1205	CURRENT_FILTER_2_DAMPING[0...7,DRx]	Damping setpoint current filter 2	FDD/MSD
1206	CURRENT_FILTER_3_FREQUENCY[0...7,DRx]	Natural freq. setp. current filter 3	FDD/MSD
1207	CURRENT_FILTER_3_DAMPING[0...7,DRx]	Damping setpoint current filter 3	FDD/MSD
1208	CURRENT_FILTER_4_FREQUENCY[0...7,DRx]	Natural freq. setp. current filter 4	FDD/MSD
1209	CURRENT_FILTER_4_DAMPING[0...7,DRx]	Damping setpoint current filter 4	FDD/MSD
1210	CURRENT_FILTER_1_SUPPR_FREQ[0...7,DRx]	Blocking freq. setpoint current filter 1	FDD/MSD
1211	CURRENT_FILTER_1_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 1	FDD/MSD
1212	CURRENT_FILTER_1_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 1	FDD/MSD
1213	CURRENT_FILTER_2_SUPPR_FREQ[0...7,DRx]	Blocking freq. setpoint current filter 2	FDD/MSD
1214	CURRENT_FILTER_2_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 2	FDD/MSD
1215	CURRENT_FILTER_2_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 2	FDD/MSD
1216	CURRENT_FILTER_3_SUPPR_FREQ[0...7,DRx]	Blocking freq. setp. current filter 3	FDD/MSD
1217	CURRENT_FILTER_3_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 3	FDD/MSD
1218	CURRENT_FILTER_3_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 3	FDD/MSD
1219	CURRENT_FILTER_4_SUPPR_FREQ[0...7,DRx]	Blocking freq. setpoint current filter 4	FDD/MSD
1220	CURRENT_FILTER_4_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 4	FDD/MSD
1221	CURRENT_FILTER_4_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 4	FDD/MSD

Table 6-22 Setpoint speed filter

No.	Identifier	Name	Drive
1500	NUM_SPEED_FILTERS[0...7,DRx]	Number of setpoint speed filters	FDD/MSD
1502	SPEED_FILTER_1_TIME[0...7,DRx]	Time constant setpoint speed filter 1	FDD/MSD

Table 6-23 Main monitoring and limiting functions

No.	Identifier	Name	Drive
1145	STALL_TORQUE_REDUCTION[DRx]	Stall torque reduction factor	MSD
1230	TORQUE_LIMIT_1[0...7,DRx]	1st torque limit	FDD/MSD
1239	TORQUE_LIMIT_FOR_SETUP[DRx]	Torque limit for set-up mode	FDD/MSD
1235	POWER_LIMIT_1[0...7,DRx]	1st power limit value	FDD/MSD
1237	POWER_LIMIT_GENERATOR[DRx]	Maximum output generator mode	FDD/MSD
1105	MOTOR_MAX_CURRENT_REDUCTION[DRx]	Reduction in max. motor current	FDD
1238	CURRENT_LIMIT[DRx]	Current limit value	MSD
1605	SPEEDCTRL_LIMIT_TIME[DRx]	Timer n controller at limit	FDD/MSD
1606	SPEEDCTRL_LIMIT_THRESHOLD[DRx]	Threshold n controller at limit	FDD/MSD
1405	MOTOR_SPEED_LIMIT[0...7,DRx]	Motor monitoring speed	FDD/MSD
1420	MOTOR_MAX_SPEED_SETUP[DRx]	Max. motor speed set-up mode	FDD/MSD
1147	SPEED_LIMIT[DRx]	Speed limitation	FDD/MSD

Table 6-24 Major messages

No.	Identifier	Name	Drive
1417	SPEED_THRESHOLD_X[0...7,DRx]	nx for ‘nact<nx’ message	FDD/MSD
1418	SPEED_THRESHOLD_MIN[0...7,DRx]	nmin for ‘nact>nmin’ message	FDD/MSD
1426	SPEED_DES_EQ_ACT_TOL[0...7,DRx]	Toler. band for ‘nset=nact’ message	FDD/MSD
1428	TORQUE_THRESHOLD_X[0...7,DRx]	Threshold torque Mdx	FDD/MSD
1602	MOTOR_TEMP_WARN_LIMIT[DRx]	Motor temp. warning threshold	FDD/MSD

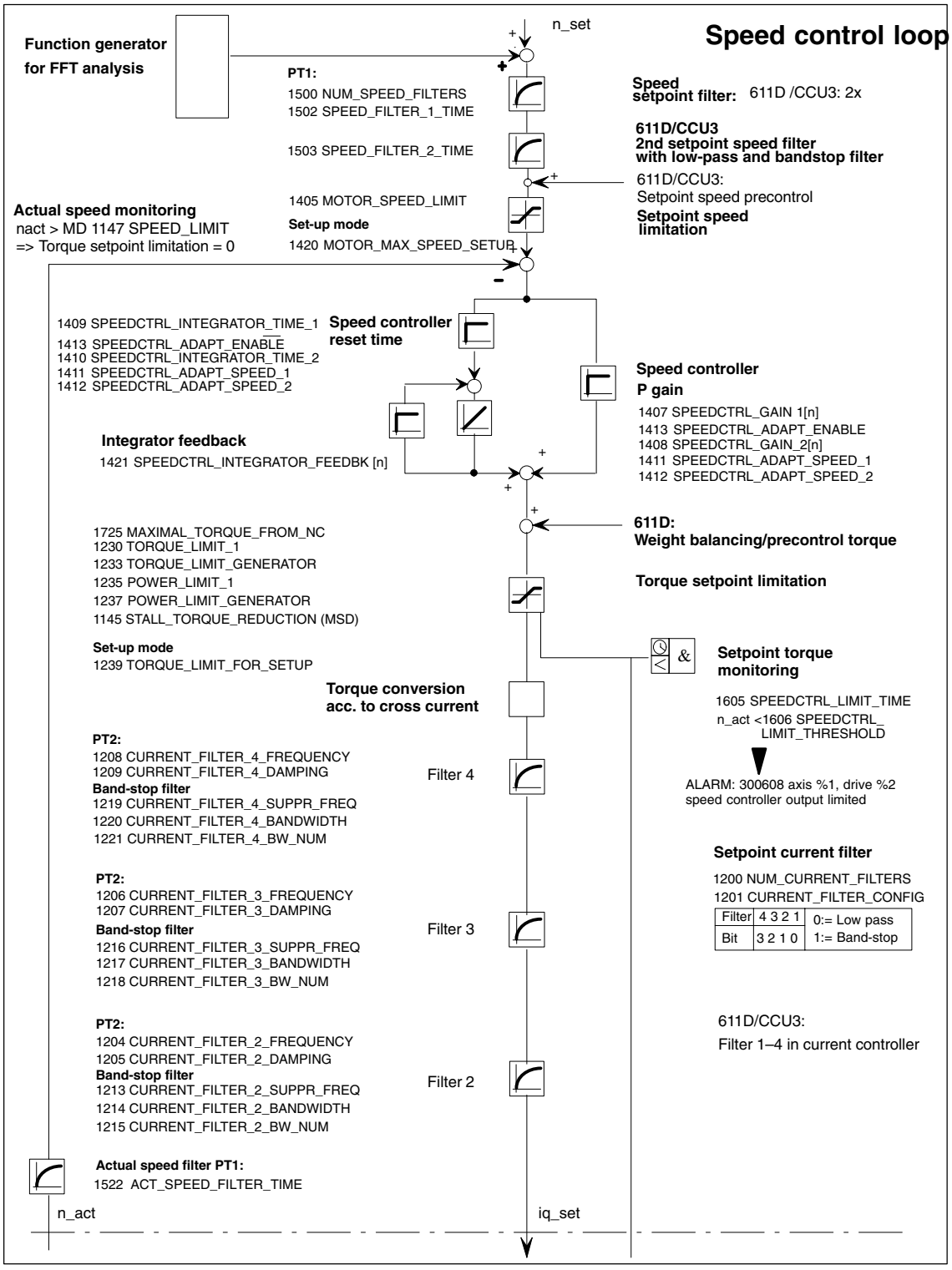


Fig. 6-13 Speed controller with the most important properties

Reference material: /FBA/ DD2, Description of the drive functions, Speed control loop

Note

For monitoring and limitation, see

Reference material /FBA/ DÜ1, Description of the drive functions, Monitoring/limiting devices

Note

Changes to the FDD MD or MSD MD will be erased by an NCK reset if “Save boot file(s)” is not performed beforehand.

6.9.8 Axis data

For SINUMERIK 840D, 8 (or 5 for NCU 571) linear axes, which are assigned to channel 1 (or 2), are active by default. The rotary axis and spindle must be assigned during start-up.

Distinguishing between linear axis and rotary axis

For a rotary axis, the MD 30300: IS_ROT_AX must be set. This setting causes the setpoint unit to be switched over from mm to degrees. The display for the rotary axis is programmed in relation to 360 degrees, MD 30320: DISPLAY_IS_MODULO (modulo 360 degree display for rotary axes), MD 30310: ROT_IS_MODULO (modulo conversion for rotary axis).

These MD are activated after power-on. When MD 30300 is set followed by power-on, the active axis machine data (e.g. for velocity, acceleration, jerk) are converted automatically to the new physical unit.

Example

Velocity = 10000 mm/min for linear axis MD 30300: IS_ROT_AX=0
After conversion to rotary axis, this MD contains the value 27.77777778 and the unit is now rev./min.

Axis types

Indexing axis

MD 30500: INDEX_AX_ASSIGN_POS_TAB (indexing axis assignment) must specify which global list (generally MD 10900: INDEX_AX_LENGTH_POS_TAB1 or MD 10910: INDEX_AX_POS_TAB1 should be used for list 1 and MD 10920 or MD 10930 for list 2) with indexing positions.

Concurrent positioning axis

MD 30450: IS_CONCURRENT_POS_AX is used to define the axis as a “Concurrent positioning axis”.

Reference material: /FB2/ P2, Description of the advanced functions, Positioning axes

Parameter sets

For machine data with the field parameter “Controller parameter set no.”, the first field is used for normal axis operation. For interpolation involving a spindle, e.g. for G331 (tapping without compensating chuck), the selected gear determines the corresponding field of the axes involved (1st gear ——> field index 1). This applies to all machine axes which can be traversed via geometry axes. See Section 6.9.2.

Axis

For axes that interpolate together with a spindle during thread cutting (G33, G34, G35, G331, G332), the machine data must also be supplied with corresponding values with the indices [1]...[5].

Spindle

All existing gear steps must be parameterized for rotary axes that are to be operated as a spindle with gear step change. (Indices [1]...[5].)

Parameter set	Axis	Spindle	Spindle gear step
0	Standard	Spindle in axis mode	As specified by manufacturer
1	Axis interpolates with spindle (G33)	Spindle mode	1st
2	Axis interpolates with spindle (G33)	Spindle mode	2nd
3	Axis interpolates with spindle (G33)	Spindle mode	3rd
4	Axis interpolates with spindle (G33)	Spindle mode	4th
5	Axis interpolates with spindle (G33)	Spindle mode	5th

Fig. 6-14 Validity of parameter sets in axis and spindle modes

MD 31050: DRIVE_AX_RATIO_DENOM (denominator for load gearbox)
MD 31060: DRIVE_AX_RATIO_NUMERA (numerator for load gearbox)
MD 32200: POSCTRL_GAIN (K_V factor)
MD 32800: EQUIV_CURRCTRL_TIME (equivalent time constant of current control circuit for bias control)
MD 32810: EQUIV_SPEEDCTRL_TIME (equivalent time constant for speed control circuit for bias control)
MD 32910: DYN_MATCH_TIME (time constant for dynamic matching)
MD 36200: AX_VELO_LIMIT (threshold for velocity monitoring)

Note

The following machine data must be entered consistently. This applies across all axes if one encoder was activated for several axes (function has not been released):
MD 31050: DRIVE_AX_RATIO_DENOM
MD 31060: DRIVE_AX_RATIO_NUMERA
MD 32000: MAX_AX_VELO
MD 35100: SPIND_VELO_LIMIT
MD 35110 – 35140: GEAR_STEP_ ...
MD 36200: AX_VELO_LIMIT
MD 36300: ENC_FREQ_LIMIT

Example

MD 32200: POSCTRL_GAIN [0,Z1] = 1 (K_V for normal axis operation)
MD 32200: POSCTRL_GAIN [1,Z1] = 1 (K_V for G331, spindle gear step 1)
MD 32200: POSCTRL_GAIN [3,Z1] = 1 (K_V for G331, spindle gear step 3)
MD 32200: POSCTRL_GAIN [0,X1] = 1 (K_V for normal axis operation)
MD 32200: POSCTRL_GAIN [1,X1] = 1 (K_V for G331, spindle gear step 1)
MD 32200: POSCTRL_GAIN [3,X1] = 1 (K_V for G331, spindle gear step 3)

Note

In order to ensure reliable power-up of the control, all activated axes are declared as simulation axes (without hardware) during initialization.

MD 30130: CTRLOUT_TYPE = 0
MD 30240: ENC_TYPE = 0
The control loop is simulated while traversing the axes, and no hardware-specific alarms are output. For starting up an axis or spindle, the value “1” or the corresponding value of the hardware identifier should be entered in this MD.
MD 30350: SIMU_AX_VDI_OUTPUT can be used to select whether the interface signals of a simulated axis should be output at the PLC interface (e.g. for testing programs when there is no drive hardware present).

Interface signals for measuring system changeover

Interface signals are used to select the active measuring system for the position control.
NST “Position measuring system 1 selected” (DB31, ... DBX1.5)
NST “Position measuring system 2 selected” (DB31, ... DBX1.6)
If both signals are set, then position measuring system 1 was selected.

Reference material: /FB1/ A2, Functional description of the basic machines, Various NC/PLC interface signals and functions

6.9.9 Axis velocity matching

Machine data for velocity matching

The following machine data must be defined:
MD 32000: MAX_AX_VELO (maximum axis velocity)
MD 32010: JOG_VELO_RAPID (conventional rapid feed)
MD 32020: JOG_VELO (conventional axis velocity)
MD 34020: REFP_VELO_SEARCH_CAM (reference point approach velocity)
MD 34040: REFP_VELO_SEARCH_MARKER [n] (cut-out velocity)
MD 34070: REFP_VELO_POS (reference point move-in velocity)

Note

When new velocities are entered, the velocity monitoring (MD 36200: AX_VELO_LIMIT) must also be matched.

For axis drives, the motor speed at which the velocity MAX_AX_VELO (MD 32000) is achieved must be set in MD 1401.

For the setpoint scaling, the load gearbox must always be entered correctly.
MD 31060: DRIVE_AX_RATIO_NUMERA (number of motor revolutions)
MD 31050: DRIVE_AX_RATIO_DENOM (number of load revolutions)

6.9.10 Axis position control data

Control loops

The controller for an axis consists of the speed control loop, the current control loop and a higher-level position control loop.

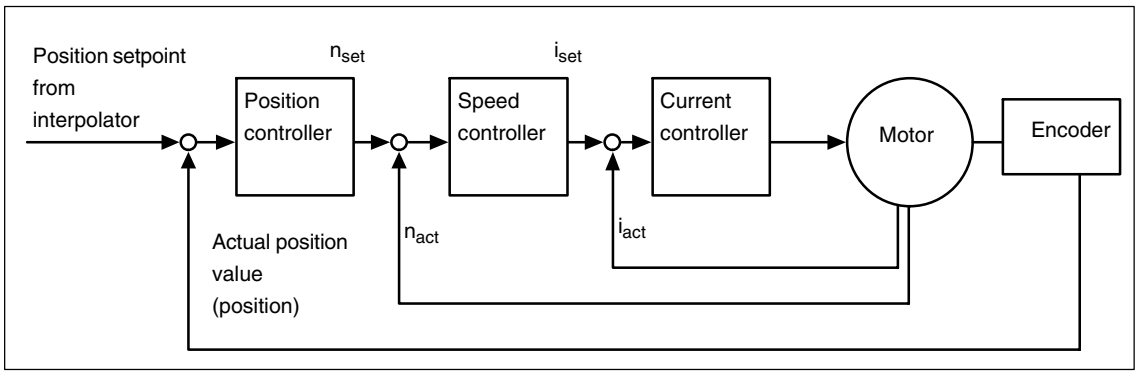


Fig. 6-15 Control loops

Traversing direction

If the axis does not move in the desired direction, it is adapted via MD 32100: AX_MOTION_DIR (traversing direction). The value "–1" reverses the direction of motion. Allowance is made internally for the control direction of the position controller. If the control direction of the position measuring system is the wrong way around, this is corrected with MD 32110: ENC_FEEDBACK_POL (actual sign value).

Loop gain

In order to obtain high contour accuracy with an interpolation, the loop gain factor (K_V factor) of the position controller must be large. If the K_V factor is too high, on the other hand, this leads to overshooting, instability and inadmissibly high loading of the machine. The maximum permissible K_V factor is dependent on the design and dynamic response of the drive and the mechanical quality of the machine.

Definition of the K_V (loop gain) factor

$$K_V = \frac{\text{Velocity}}{\text{Following error}} \qquad \frac{[\text{m/min}]}{[\text{mm}]}$$

Automatic scaling

For the K_V factor 1 (m/min)/mm numerical value 1 must be entered in MD 32200: POSCTRL_GAIN.

The correct scaling of the Kv factor is automatically activated by the following machine data.
MD 10220: SCALING_USER_DEF_MASK

The correct physical size is taken into account by the following machine data:
MD 10230: SCALING_FACTORS_USER_DEF .

The loop gain is converted using the following formula:

$$K_{V\,(s^{-1})} = K_V * \frac{[m/min]}{[mm]} * 16.66667$$

Checking the loop gain

If a K_V factor is already known for the machine type, it can be set and checked. For the check, the acceleration of the axis is reduced via MD 32300: MAX_AX_ACCEL to ensure that the drive does not reach its current limit while accelerating and braking.

In the case of rotary axes and spindles, the K_V factor must also be checked at high speeds (e.g. for spindle positioning, tapping).

The loop gain should always be checked.
If it is not correct, the right Kv factor, e.g. the factor 16.667 is entered in MD 32200 POSCTRL_GAIN.

The static check of the K_V factor is done using the “Service axis” soft key from the “Service display” menu. The actual K_V factor must correspond exactly to the set value, as the K_V factor is used for monitoring functions and otherwise other responses may be caused (e.g. contour monitoring).

For continuous-path operation, all the axes involved in the interpolation must have the same dynamic behavior.

Note

Axes which interpolate with one another must have the same following error at the same velocities. This can be achieved by setting the same K_V factor or by dynamic matching via the following machine data:

MD 32900: DYN_MATCH_ENABLE (dynamic matching) and
MD 32910: DYN_MATCH_TIME (time constant for dynamic matching)

Reference material: /FB1/ G2, Functional description of the basic machines, Velocities, setpoint/actual value systems, control

Checking the positioning response

A storage oscilloscope or the start-up software SIMODRIVE 611D/ start-up/drives/servo/servo trace is used to check the positioning response at different velocities. The speed setpoint is recorded for this purpose.

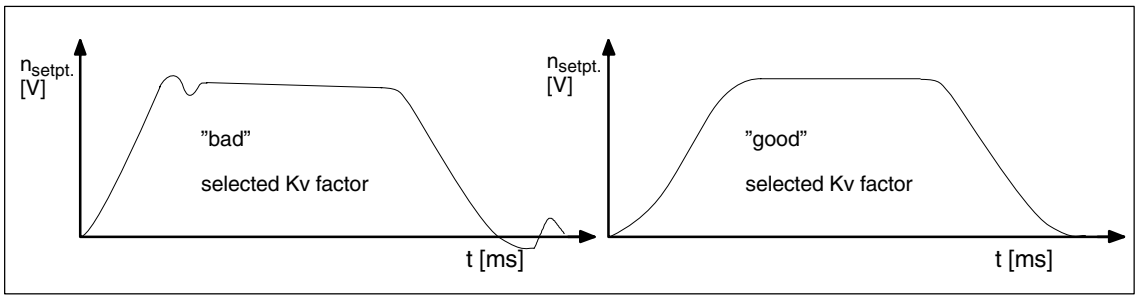


Fig. 6-16 Speed setpoint curve

No overshoots may occur while the drive is approaching the static states; this applies to all speed ranges.

The start-up software SIMODRIVE 611D provides additional options for checking the K_V factor (e.g. frequency response measurement, scanning the speed and position control loops).

Reasons for overshooting in the position control loop

- K_V factor is set too high
- Acceleration too high (current limit is reached)
- Rise time too long (re-optimization necessary)
- Mechanical backlash
- Mechanical components canted

For reasons of safety, the K_V factor should be set slightly lower than the maximum permissible value.

Acceleration

The axes are accelerated and braked with the acceleration specified in MD 32300: MAX_AX_ACCEL. This value should allow the axes to be accelerated and positioned rapidly and accurately while ensuring that the machine is not unduly loaded. The acceleration default settings are in the 0.5 m/s^2 to 2 m/s^2 range.

Checking and calculating acceleration values

The acceleration data entered can be either empirical values or the maximum permissible acceleration values which the user must calculate. The data must always be checked after entry for which the SIMODRIVE 611D start-up software and an oscilloscope are required.

Setting

MD 32300: MAX_AX_ACCEL

Identification

Overshoot-free acceleration and positioning with rapid traverse velocity under maximum load (heavy workpiece).

Measurement

Via analog outputs (section 10) or start-up software for SIMODRIVE 611D.

After the acceleration has been entered, the axis is traversed rapidly and the actual current values and current setpoint are recorded. This recording shows whether the drive reaches the current limit. While traversing rapidly, the drive may reach the current limit briefly. However, the current must be well below the current limit before rapid traverse velocity or the final position is reached.

Load changes during machining must not cause the current limit to be reached. Excessive current during machining causes falsification of the contour. It is therefore advisable in this case as well to enter a slightly lower acceleration value in the MD than the maximum permissible value. Axes can be assigned different acceleration values even if they do interpolate with one another.

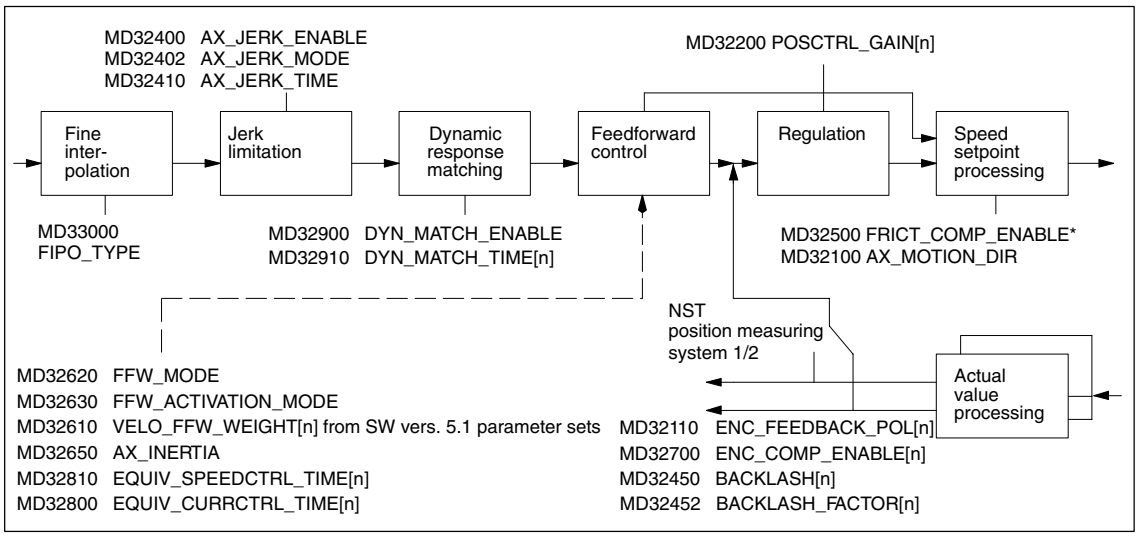


Fig. 6-17 Additional parameters for position control

*Further machine data for friction compensation FRICT... can be found in:
Reference material: /FB2/ K3, Description of the advanced functions, Compensation

Optimizing the control

Control of an axis can be optimized as follows with respect to the speed control loop, current control loop and the higher-level position control loop:

Positional deviation feedforward

The positional deviation feedforward takes place on the NCK side within the position control cycle and is designed to improve the stability and positioning response of axes with at least two encoders (load and motor encoder) by actively damping oscillations.

- The function is activated with MD 32950: POSCTRL_DAMPING ≠0 and is available for all controls that use SIMODRIVE_611 D drives.

Bias control

If bias control is active for speed and torque, the position setpoint is routed via a new balance filter before it reaches the actual controller in order to improve the oscillatory response of the axis. It also achieves greater accuracy at curved contours.

- The speed bias control is activated with MD 32620: FFW_MODE = 3.
- The torque bias control is activated with MD 32620: FFW_MODE = 4.

The MD 32620: FFW_MODE = 1 and = 2 settings remain available and behave as before. The response of the axis can be improved with the new settings for MD 32620 = 3 and MD 32620 = 4.

New jerk filter (position setpoint filter)

Smoothing the position setpoint can help to reduce machine oscillations. A new type of filter for filter time constants of approx. 20–40ms achieves largely symmetrical smoothing by averaging while giving little consideration to the contour accuracy.

- The new jerk filter is activated with MD 32402: AX_JERK_MODE = 2.

For reasons of compatibility, MD 32402: AX_JERK_MODE = 1 by default. On new machines, the new filter MD 32402: = 2 is generally recommended.

Extending the parameter set

From software version 5.1, the following parameter sets are also available for backlash compensation, bias control factor, exact positioning limits and zero-speed tolerance.

MD 32450: BACKLASH (backlash compensation)
MD 32610: VELO_FFW_WEIGHT (bias control factor)
MD 36000: STOP_LIMIT_COARSE (coarse exact stop)
MD 36010: STOP_LIMIT_FINE (fine exact stop)
MD 36030: STANDSTILL_POS_TOL (zero-speed tolerance)

Weighting factor

The following machine data with suitable weighting factors is available for the parameter set-specific machine data mentioned above.

MD 32452: BACKLASH_FACTOR[n] (backlash compensation) affects:

- MD 32450: BACKLASH (backlash compensation)

MD 36012: STOP_LIMIT_FACTOR[n] (exact stop limit and zero-speed tolerance) affects:

- MD 36000: STOP_LIMIT_COARSE (coarse exact stop)
  MD 36010: STOP_LIMIT_FINE (fine exact stop)
  MD 36030: STANDSTILL_POS_TOL (zero-speed tolerance)

The machine data MD 32452: BACKLASH_FACTOR[n] and MD 36012: STOP_LIMIT_FACTOR[n] are set to the weighting factor [n] = 1 by default.

Example

Effects of various parameter sets on backlash compensation

MD 32450: BACKLASH[AX1] = 0.01
MD 32452: BACKLASH_FACTOR[0,AX1] = 1.0 Parameter set 1
MD 32452: BACKLASH_FACTOR[1,AX1] = 2.0 Parameter set 2

In parameter set 1 (index 0) for the first axis (AX1), a backlash compensation factor with the value 1.0 has the following effect:

1.0 * MD 32450: BACKLASH = 0.01 mm (or inch or degree)
2.0 * MD 32450: BACKLASH = 0.02 mm (or inch or degree).

6.9.11 Monitoring for axis

Reference material: /FB1/ Functional description of the basic machines
/A3/ Axis monitoring, protected areas
/B1/ Continuous-path operation, exact stop and LookAhead
/G2/ Velocities, setpoint/actual value systems, control

Monitoring the positioning

For positioning, the monitoring ensures that the axis reaches the position window (exact stop). It also checks whether an axis for which no traversing command has been issued remains within a certain tolerance window (zero speed control, clamping tolerance).

MD 36000 STOP_LIMIT_COARSE (coarse exact stop)
- IS “Position reached with coarse exact stop” (DB31, ... DBX60.6)

MD 36010 STOP_LIMIT_FINE (fine exact stop)
- IS “Position reached with fine exact stop” (DB31, ... DBX60.7)

MD 36012 STOP_LIMIT_FACTOR[n] (factor for parameter set-independent evaluation of the exact stop (coarse or fine) and zero-speed monitoring)
- The ration between the three following values remains the same at all times:
  MD 36000: STOP_LIMIT_COARSE
  MD 36010: STOP_LIMIT_FINE
  MD 36030: STANDSTILL_POS_TOL

MD 36020 POSITIONING_TIME (fine exact stop delay)
- The MD represents the delay time after which the actual value must have reached the “exact stop fine” tolerance window when the setpoint position at the block end is attained.
- If the value does not reach the exact stop fine window within this time, the “25080 axis [name] positioning monitoring” alarm is generated.

  The control switches to follow-up mode.

MD 36030 STANDSTILL_POS_TOL (zero-speed tolerance)
- The machine data specifies the position tolerance which a standing axis must adhere to.
- If the axis leaves the position tolerance window, the “25040 axis [name] zero-speed control” alarm is output. The control switches to follow-up mode.

MD 36040 STANDSTILL_DELAY_TIME (delay time zero-speed control)
- The MD represents the delay after which the actual value must have reached the “zero-speed tolerance” window when the setpoint position at the block end is attained.
- If the position tolerance is not reached within this time, the “25040 axis [name] zero-speed control” alarm is generated.

  The control switches to follow-up mode.

MD 36050 CLAMP_POS_TOL (clamping tolerance)
- Position tolerance while the “clamping active” signal is present at the PLC interface. When the tolerance is exceeded, the alarm “26000 axis [name] clamping monitoring” is generated.
- IS “clamping active” (DB31, ... DBX2.3)

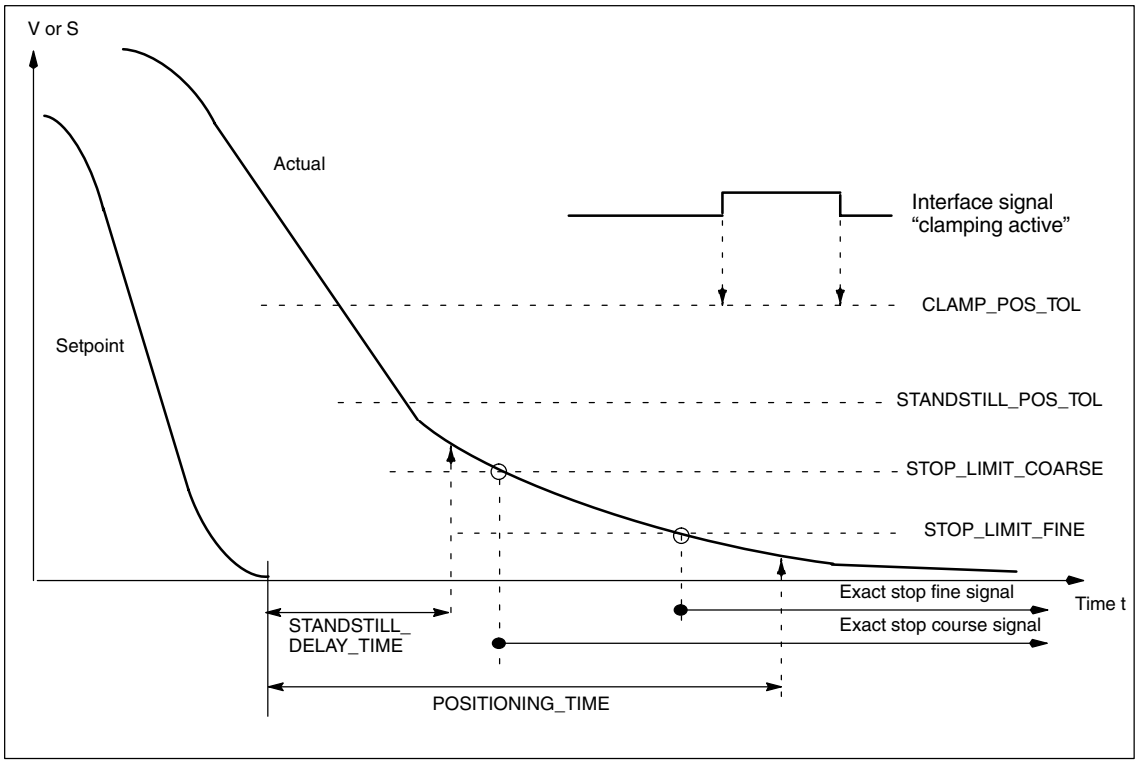


Fig. 6-18 Positioning, zero-speed and clamping monitoring

Monitoring of positions via Hardware limit switch

For each axis, it is possible to carry out the monitoring via the PLC interface. A signal exists for every traversing range limit informing the NC that the corresponding traversing range limit has been approached. When the limit switch is reached, the axis or the axes used for interpolation are stopped. Braking can be set via MD 36600: BRAKE_MODE_CHOICE (braking response with hardware limit switches).

Machine data, interface signals and alarms

MD 36600: BRAKE_MODE_CHOICE = 1 (fast braking with setpoint “0”)
MD 36600: BRAKE_MODE_CHOICE = 0 (braking characteristic is maintained)
NST “Hardware limit switch minus” (DB31, ... DBX12.0)
NST “Hardware limit switch plus” (DB31, ... DBX12.1)
Alarm “21614 channel [name1] axis [name2] hardware limit switch [+/–]”. The axis must be retracted in JOG operating mode.

Monitoring of positions via software limit switches

Two software limit switch values may be entered in the machine data for each axis. The active software limit switch is selected via the PLC. The axis does not traverse beyond the software limit switch. The monitoring function is activated after reference point approach and is deactivated after PRESET.

Machine data, interface signals and alarms

MD 36100: POS_LIMIT_MINUS (1st software limit switch minus)
MD 36110: POS_LIMIT_PLUS (1st software limit switch plus)
MD 36120: POS_LIMIT_MINUS2 (2nd software limit switch minus)
MD 36130: POS_LIMIT_PLUS2 (2nd software limit switch plus)

NST “2nd software limit switch minus” (DB31, ... DBX12.2)
NST “2nd software limit switch plus” (DB31, ... DBX12.3)

Machine data, interface signals and alarms

MD 36100: POS_LIMIT_MINUS (1st software limit switch minus)
MD 36110: POS_LIMIT_PLUS (1st software limit switch plus)
MD 36120: POS_LIMIT_MINUS2 (2nd software limit switch minus)
MD 36130: POS_LIMIT_PLUS2 (2nd software limit switch plus)
NST “2nd software limit switch minus” (DB31, ... DBX12.2)
NST “2nd software limit switch plus” (DB31, ... DBX12.3)
Alarm “10620 channel [name1] set [no.] axis [Name2] reaches software limit switch +/–”
Alarm “10621 channel [name1] axis [name2] is at software limit switch +/– (JOG)”
Alarm “10720 channel [name1] set [no.] axis [name2] programmed limit is after software limit switch +/–”

Monitoring of positions via work area limits

With geometry axes, the setting data or part program (with G25/G26) can be used to set and activate work area limits. These are is activated via setting data or from the program. The monitoring is active after machine referencing.

Setting data and alarms

SD 43400: WORKAREA_PLUS_ENABLE (work area limits active in the positive direction)
SD 43410: WORKAREA_MINUS_ENABLE (work area limits active in the negative direction)
SD 43420: WORKAREA_LIMIT_PLUS (work area limit plus)
SD 43430: WORKAREA_LIMIT_MINUS (work area limit minus)
Alarm “10630 channel [name1] set [no.] axis [Name2] reaches work area limit +/–”
Alarm “10631 channel [name1] axis [name2] is at work area limit +/– (JOG)”
Alarm “10730 channel [name1] set [no.] axis [name2] programmed limit is after work area limit +/–”

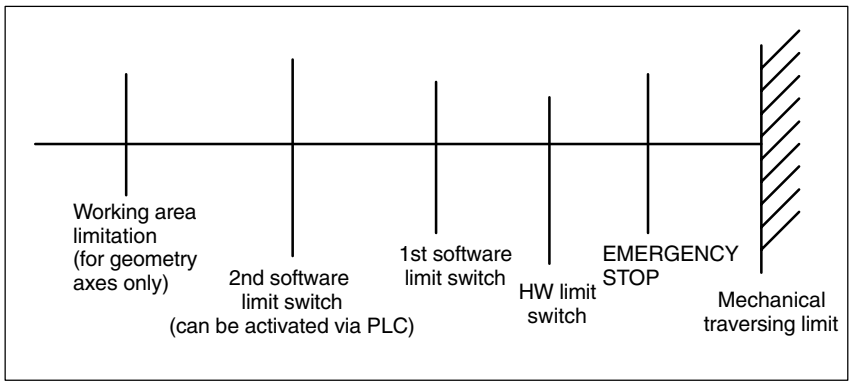


Fig. 6-19 Overview of end limitations

Dynamic monitoring functions

Velocity limitation

The velocity matching takes place inside the SINUMERIK 840D. The setpoint is limited as a percentage via MD 36210: CTRLOUT_LIMIT in relation to the speed entered in MD 1401: MOTOR_MAX_SPEED. An alarm is generated if the setpoint is exceeded for the set time MD 36220: CTRLOUT_LIMIT_TIME. The axes are stopped with the open position control loop via a braking ramp, MD 36610: AX_EMERGENCY_STOP_TIME. This MD must contain the time within which the axis can brake to zero from maximum velocity.

MD 36210: CTRLOUT_LIMIT (maximum speed setpoint)
MD 36220: CTRLOUT_LIMIT_TIME (monitoring time for maximum speed setpoint)
MD 36610: AX_EMERGENCY_STOP_TIME (duration of the braking ramp in error states)
Alarm “25060 axis [name] speed setpoint limitation”

Velocity monitoring

The monitoring is intended to ensure that axes whose theoretical velocity is limited by mechanical conditions (e.g. by the mechanical limit frequency of the pulse encoder) run without error. The actual velocity monitoring is always active if at least one encoder is configured on the axis (MD 30200 NUM_ENCS < > 0) and this is below its limit frequency. Alarm 25030 is output if the threshold is exceeded.

MD 36020: AX_VELO_LIMIT (threshold for velocity monitoring)
MD 36610: AX_EMERGENCY_STOP_TIME (duration of the braking ramp in error states)
Alarm “25030 axis [name] actual velocity alarm limit”

Contour monitoring

This monitoring is based on an ongoing comparison of the measured following error and the error calculated in advance from the NCK position setpoint. Contour monitoring is always active in position-controlled mode. If the tolerance band is violated, then the alarm “Contour monitoring” is generated and the axes are braked along a set braking ramp.

MD 36400: CONTOUR_TOL (contour monitoring tolerance band)
MD 36610: AX_EMERGENCY_STOP_TIME (duration of the braking ramp in error states)
Alarm “25050 axis [name] contour monitoring”.

Encoder monitoring (encoder limit frequency monitoring)

The frequency entered in MD: ENC_FREQ_LIMIT is monitored. If this is exceeded, the alarm “Encoder frequency exceeded” is output and the axes braked to zero speed. The interface signal “Referenced/synchronized” is reset (DB31, ... DBX60.4, DBX60.5).

Example:
Encoder with 2048 pulses directly on the motor, limit frequency 200 kHz,
$n_{max} = (f_{limit}/\text{pulses}) * 60\ \text{sec} = 5900\ 1/\text{min}$

Result:
It must be ensured that this speed is not reached at maximum axis velocity (MAX_AX_VELO).

MD 36300: ENC_FREQ_LIMIT (encoder limit frequency),
NST “Encoder limit frequency exceeded 1” (DB31, ... DBX60.2),
NST “Encoder limit frequency exceeded 2” (DB31, ... DBX60.3),
Alarm “21610 channel [name] axis [name] Encoder frequency exceeded”.

Encoder monitoring (zero marker monitoring)

MD 36310: ENC_ZERO_MONITORING > 0 activates the zero marker monitoring. The value indicates the number of pulses that may be lost.

Special feature:
Value = 100, i.e. the hardware monitoring for the encoder is also switched off.

MD 36310: ENC_ZERO_MONITORING (zero marker monitoring)
MD 36610: AX_EMERGENCY_STOP_TIME (duration of the braking ramp in error states)
Alarm “25020 axis [name] zero marker monitoring”.

Encoder monitoring (tolerance for encoder switchover)

It is possible to define two actual value branches with SINUMERIK 840D. These actual values must then, however, be present in the hardware. The actual value branch which is active for the position control can then be selected via the PLC interface. When this switchover takes place, the actual position value difference is evaluated. If this difference is greater than the value entered in MD 36500: ENC_CHANGE_TOL, then “Measuring system changeover not possible” alarm is generated and the changeover is prevented.

MD 36500 ENC_CHANGE_TOL (max. tolerance for actual position changeover)
NST “Position measuring system 1” (DB31, ... DBX1.5)
NST “Position measuring system 2” (DB31, ... DBX1.6),
Alarm “25100 axis %1 Measuring system changeover not possible”.

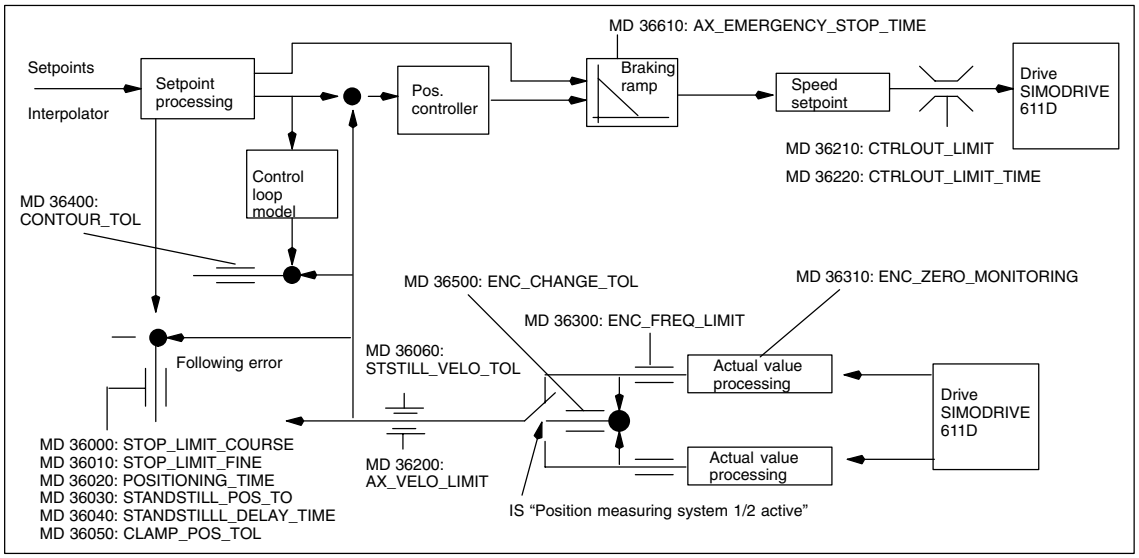


Fig. 6-20 Monitoring with SINUMERIK 840D

Note

The time set in MD 36620: SERVO_DISABLE_DELAY_TIME (cut-out delay for controller enable) should always be larger than the time set in MD 36610: AX_EMERGENCY_STOP_TIME (duration of the braking ramp for error states). If this is not the case, the braking ramp in MD 36610 cannot take effect.

6.9.12 Referencing an axis

Once the control has been switched on, it must be synchronized (referenced) with the position measuring system of each machine axis.
Referencing must be carried out for axes with incremental measuring systems and with distance-coded reference marks.

Referencing is started after selection of the “REF” function with traversing key PLUS or MINUS (depending on reference point approach direction).

Reference material: /FB1/ R1 Functional description of the basic machines, Referencing

General machine data and interface signals

MD 34000: REFP_CAM_IS_ACTIVE (axis with reference cam)
MD 34110: REFP_CYCLE_NR (order of the axes for channel-specific referencing)
MD 30240: ENC_TYPE (encoder type)
MD 34200: ENC_REFP_MODE (referencing mode)
NST “Activate referencing” (DB21, ... DBX1.0)
NST “Referencing active” (DB21, ... DBX33.0)

Referencing for incremental measuring systems

Referencing for incremental measuring systems is divided into 3 phases:
Phase 1: Move onto reference cam
Phase 2: Synchronize with zero marker
Phase 3: Move to reference point

Machine data and interface signals for phase 1

MD 11300: JOG_INC_MODE_LEVELTRIGGRD (INC/REF in Jog mode)
MD 34010: REFP_CAM_DIR_IS_MINUS (approach reference cam in minus direction)
MD 34020: REFP_VELO_SEARCH_CAM (reference cam approachvelocity)
MD 34030: REFP_MAX_CAM_DIST (maximum distance from reference cam)
NST “Traverse buttons plus/minus” (DB31, ... DBX4.7/DBX4.6)
NST “Referencing delay” (DB31, ... DBX12.7)

Machine data for phase 2

MD 34040: REFP_VELO_SEARCH_MARKER (cut-out velocity)
MD 34050: REFP_SEARCH_MARKER_REVERSE (change of direction at reference cam)
MD 34060: REFP_MAX_MARKER_DIST (maximum distance from cam to reference marker)

Machine data and interface signals for phase 3

MD 34070: REFP_VELO_POS (reference point move-in velocity)
MD 34080: REFP_MOVE_DIST (distance from reference point to zero marker)
MD 34090: REFP_MOVE_DIST_CORR (reference point move, additive)
MD 34100: REFP_SET_POS (reference point value)
NST “Reference point value 1...4” (DB31, ... DBX2.4, 2.5, 2.6, 2.7)
NST “Referenced/synchronized” 1, 2” (DB31, ... DBX60.4, DBX60.5)

Actual value buffering via Power Off

It is possible to continue to operate a conventional machine tool, for example, with the original position information without explicitly rereferencing after Power Off/On.

To ensure that axes can continue operating properly referenced after the power has been switched off and on again, it is essential that they are not moved while the power is switched off.

When the encoder is switched on, NCK then synchronizes with an internally buffered old absolute value (condition: MD 34210: ENC_REFP_STATE=2).

Axis motions are internally disabled until this synchronization process is terminated; spindle operation can continue.

Note

This functionality is permanently linked to the axis signal “Exact stop fine”. Axes or spindles not using this signal cannot use this functionality.

Referencing with distance-coded reference markers

Referencing with axes with distance-coded reference markers is divided into 2 phases:

Phase 1:	Synchronize by traveling over 2 reference markers
Phase 2:	Move to target

General machine data

MD 34310: ENC_MARKER_INC (distance between two reference markers)
MD 34320: ENC_INVERS (measuring system in opposite direction)

Machine data and interface signals for phase 1

MD 11300: JOG_INC_MODE_LEVELTRIGGRD (INC and REF in Jog mode)
MD 34040: REFP_VELO_SEARCH_MARKER (referencing velocity)
MD 34060: REFP_MAX_MARKER_DIST (maximum distance between 2 reference markers)
MD 34300: ENC_REFP_MARKER_DIST (distance from reference marker)
NST “Traverse buttons plus/minus” (DB31, ... DBX4.7/DBX4.6)
NST “Referenced/synchronized 1, 2” (DB31, ... DBX60.4, DBX60.5)

Machine data and interface signals for phase 2

MD 34070: REFP_VELO_POS (target move-in velocity)
MD 34090: REFP_MOVE_DIST_CORR (absolute move)
MD 34330: REFP_STOP_AT_ABS_MARKER (with/without target)
NST “Referenced/synchronized 1, 2” (DB31, ... DBX60.4, DBX60.5)
MD 34100: REFP_SET_POS (target) if referencing on target.

Referencing with absolute encoders

If an axis uses an absolute encoder as its measuring system, then it only needs to be referenced when the encoder is readjusted.

Note

For absolute encoder, see subsection 6.9.6.

6.9.13 Spindle data

In the SINUMERIK 840D control system, the spindle is a sub-function of the entire axial functionality. The machine data for the spindle are therefore located among the axis machine data (from MD 35000 onwards). For this reason, data must be entered for a spindle which are described in the Sections relating to axis start-up. The following description contains merely a cross-reference to this MD.

Note

No spindle is defined after a NCK general reset.

Reference material: /FB1/ S1, Functional description of the basic machines, Spindles

Spindle definition

The following machine data is needed for a spindle definition.

- MD 30300: IS_ROT_AX (rotary axis)
- MD 30310: ROT_IS_MODULO (rotary axis with modulo programming)
- MD 30320: DISPLAY_IS_MODULO (display in relation to 360 degrees, if required)
- MD 35000: SPIND_ASSIGN_TO_MACHAX (declaration of the axis as a spindle). Input of the spindle number, with which the spindle is to be addressed, e.g. “1” means spindle name “S1”.

Spindle modes

The spindle operating modes are as follows:

- Open-loop control mode (M3, M4, M5)
- Oscillation mode (support for gear changing operations)
- Positioning mode (SPOS, M19 and SPOSA)
- Synchronous mode
- Rigid tapping

In spindle mode, the feedforward control switches on as standard (FFW mode = 1). Exception: If tapping without a compensating chuck, the bias control only takes effect if it is explicitly activated (e.g. via the FFWON programming command).

The set of parameters is selected that corresponds to the current gear step.

Example:
2nd gear step → parameter set [2]

Axis mode

It is possible to switch directly from spindle mode into axis mode provided that the same drive is used for both modes. The machine data for one axis must be applied in axis operation. In axis mode, the first parameter set (index [0]) is selected irrespective of the current gear step.
After the spindle has been positioned, the rotary axis can be programmed directly with the axis name.
NST “axis/spindle” (DB31, ... DBX60.0 = 0).

General machine data definitions

MD 20090: SPIND_DEF_MASTER_SPIND (reset position for master spindle on channel)

MD 35020: SPIND_DEFAULT_MODE (default spindle position)
The MD can be used to define a default spindle position.

The following are possible:

- Speed servo control without/with position servo control
- Positioning mode
- Axis mode

The time at which the default spindle position takes effect is defined in MD 35030: SPIND_DEFAULT_ACT_MASK.

The following are possible:

- Power-on
- Power-on and program start
- Power-on, program start and reset

MD 35040: SPIND_ACTIVE_AFTER_RESET (own spindle RESET)
The MD defines whether it is a RESET or a program end that should stop the spindle. If the MD has been set, a termination of the spindle functions must be initiated explicitly via a program command or the IS “Spindle reset” (DB31, ... DBX2.2).

MD 35010: GEAR_STEP_CHANGE_ENABLE (gear step change possible. Spindle has several gear steps).
If this machine data is not set, the system assumes that the spindle has no gear steps. A gear step change is therefore impossible.

Parameter sets

In the following machine data with the field parameters “Gear step no.” and “Control parameter set no.”, the selected gear step determines the corresponding field index. The field with the index [0] is not used for the spindle machine data! (See above in the “Axis data” section).

MD 31050: DRIVE_AX_RATIO_DENOM	(denominator for load gearbox)
MD 31060: DRIVE_AX_RATIO_NUMERA	(numerator for load gearbox)
MD 32200: POSCTRL_GAIN	(K_V factor)
MD 32810: EQUIV_SPEEDCTRL_TIME[n]	(equivalent time constant of speed control loop for bias control)
MD 32910: DYN_MATCH_TIME[n]	(time constant for dynamic matching)
MD 32452: BACKLASH_FACTOR	(weighting factor for backlash)
MD 35110: GEAR_STEP_MAX_VELO	(n_{max} for gear step change)
MD 35120: GEAR_STEP_MIN_VELO	(n_{min} for gear step change)
MD 35130: GEAR_STEP_MAX_VELO_LIMIT	(n_{max} for gear step)
MD 35140: GEAR_STEP_MIN_VELO_LIMIT	(n_{min} for gear step)
MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL	(acceleration in speed control mode)
MD 35210: GEAR_STEP_POSCTRL_ACCEL	(acceleration in position control mode)
MD 36200: AX_VELO_LIMIT (threshold for velocity monitoring)	

Example

MD 35110: GEAR_STEP_MAX_VELO [0,A1] = 500 (not used for spindle)
MD 35110: GEAR_STEP_MAX_VELO [1,A1] = 500
(n_{max} for gear step change, gear step 1)
MD 35110: GEAR_STEP_MAX_VELO [2,A1] = 1000
(n_{max} for gear step change, gear step 2)

6.9.14 Spindle configuration

Machine data for setpoint and actual values

Setpoints: MD 30100: CTRLOUT_SEGMENT_NR
MD 30110: CTRLOUT_MODULE_NR
MD 30120: CTRLOUT_NR
MD 30130: CTROUT_TYPE

Actual values MD 30210: ENC_SEGMENT_NR
MD 30220: ENC_MODULE_NR
MD 30230: ENC_INPUT_NR
MD 30240: ENC_TYPE

Note

Further information about the spindle configuration can be found in the “Drive configuration” section above.

6.9.15 Spindle encoder matching

Encoder matching via machine data

The machine data for matching the spindle encoder is the same as for the axis. For spindles, it is always MD 30300: IS_ROT_AX and MD 30310: ROT_IS_MODULO that should be set so that the encoder matching relates to one revolution. To always view the display in relation to 360 degrees, set MD 30320: DISPLAY_IS_MODULO as well. If the motor encoder of the 611D is used for the encoder matching, then the matching must be entered for each gear step if there are several gear steps present. The maximum multiple of the 611D drive is always used as the maximum multiple of encoder markings. This multiple is 2048.

Table 6-25 Machine data for encoder matching

Machine data	Spindle	
	Encoder on motor	Encoder on spindle
30300: IS_ROT_AX	1	1
31000: ENC_IS_LINEAR	0	0
31020: ENC_RESOL	Marks/rev.	Marks/rev.
31040: ENC_IS_DIRECT	0	1
31050: DRIVE_AX_RATIO_DENOM	Load rev.	See following note
31070: DRIVE_ENC_RATIO_DENOM	encoder rev.	encoder rev.
31080: DRIVE_ENC_RATIO_NUMERA	Motor rev.	Load rev.
31060: DRIVE_AX_RATIO_NUMERA	Motor rev.	See following note
31050: DRIVE_AX_RATIO_DENOM	Load rev.	See following note

Note

These MD are not required to match the encoder, but they must be entered correctly for the sake of setpoint calculation. The load revolutions are entered in MD 31050: DRIVE_AX_RATIO_DENOM and the motor revolutions in MD 31060: DRIVE_AX_RATIO_NUMERA.

Example A for encoder matching

Spindle with raw signal encoder (500 pulses) attached directly to the spindle. Internal multiple = 2048. Internal calculation resolution = 1000 increments per degree.

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{\text{MD 31020} * 2048} * \frac{\text{MD 31080}}{\text{MD 31070}} * 1000$$

$$\text{Internal resolution} = \frac{360 * 1 * 1000}{500 * 2048 * 1} \quad 0{,}3515$$

One encoder increment corresponds to 0.3515 internal increments. One encoder increment corresponds to 0.0003515 degrees (highest possible positioning resolution).

Example B for encoder matching

Spindle with rotary encoder on the motor (2048 pulses), internal multiple = 2048,
There are 2 gear steps:
Gear step 1: Motor/spindle = 2.5/1
Gear step 2: Motor/spindle = 1/1

Gear step 1

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{\text{MD 31020} * 2048} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * 1000 \text{ incr/degr.}$$

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{2048 * 2048 \text{ pulses}} * \frac{1}{1} * \frac{1}{2{,}5} * 1000 \text{ pulses/degr.} = 0.034332$$

One encoder increment corresponds to 0.034332 internal increments. One encoder increment corresponds to 0.000034332 degrees (highest possible positioning resolution).

Gear step 2

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{\text{MD 31020} * 2048} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * 1000 \text{ incr/degr.}$$

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{2048 * 2048 \text{ pulses}} * \frac{1}{1} * \frac{1}{1} * 1000 \text{ pulses/degr.} = 0.08583$$

One encoder increment corresponds to 0.08583 internal increments. One encoder increment corresponds to 0.00008583 degrees (highest possible positioning resolution).

6.9.16 Velocities and setpoint matching for spindles

Velocities, gear steps

With the SINUMERIK 840D, the spindle speed is output in the NCK. The control contains the data for 5 gear steps. These stages are defined by a minimum and maximum speed for the stage itself and by a minimum and maximum speed for the automatic gear step changeover. A new gear step is output only if the newly programmed speed setpoint cannot be traversed in the present gear step. For the gear step change, the oscillation times can be specified directly in the NCK for the sake of simplicity, otherwise the oscillation function must be implemented in the PLC. The oscillation function is initiated via the PLC.

Speeds for conventional operation

The spindle speeds for conventional operation are entered in axis machine data MD 32010: JOG_VELO_RAPID (conventional rapid feed) and MD 32020: JOG_VELO (conventional axis velocity). The direction of rotation is specified via the appropriate directional keys for the spindle on the MCP.

Direction of rotation

The direction of rotation for a spindle corresponds to the traversing direction for an axis.

Setpoint matching

The speeds for controlling the drives must be passed to the drives with scaled values. Scaling in the NCK takes place via the selected load gearbox and via the drive MD 1401: MOTOR_MAX_SPEED (maximum motor working speed). In the case of a spindle drive, the maximum motor speed is entered in MD 1401. The spindle attains the desired speed via the mechanical gear step.

Machine data and interface signals

MD 35500: SPIND_ON_SPEED_AT_IPO_START
(feed enable for spindles in the setpoint range)
MD 35450: SPIND_OSCILL_TIME_CCW (oscillation time for M4 direction)
MD 35440: SPIND_OSCILL_TIME_CW (oscillation time for M3 direction)
MD 35430: SPIND_OSCILL_START_DIR (starting direction for oscillation)
MD 35410: SPIND_OSCILL_ACCEL (acceleration during oscillation)
MD 35400: SPIND_OSCILL_DES_VELO (oscillation speed)
MD 35230: ACCEL_REDUCTION_FACTOR
(reduced acceleration)
MD 35220: ACCEL_REDUCTION_SPEED_POINT
(speed for reduced acceleration)
MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL
(acceleration in speed control mode)
MD 35140: GEAR_STEP_MIN_VELO_LIMIT
(minimum speed for gear step)
MD 35130: GEAR_STEP_MAX_VELO_LIMIT
(maximum speed for gear step)
MD 35120: GEAR_STEP_MIN_VELO
(minimum speed for gear step change)
MD 35110: GEAR_STEP_MAX_VELO
(maximum speed for gear step change)
MD 32020: JOG_VELO (conventional axis velocity)
MD 32010: JOG_VELO_RAPID (conventional rapid feed)
MD 31060: DRIVE_AX_RATIO_NUMERA (numerator for load gearbox)
MD 31050: DRIVE_AX_RATIO_DENOM (denominator for load gearbox)
NST “control mode” (DB31, ... DBX84.7)
NST “oscillation mode” (DB31, ... DBX84.6)
NST “spindle in setpoint range” (DB31, ... DBX83.5)
NST “change gear” (DB31, ... DBX82.3)
NST “setpoint gear step A to C” (DB31, ... DBX82.0 to DBX82.2)
NST “spindle stop” (DB31, ... DBX61.4)

NST “setpoint direction anticlockwise” (DB31, ... DBX18.7)
NST “setpoint direction clockwise” (DB31, ... DBX18.6)
NST “oscillating speed” (DB31, ... DBX18.5)
NST “oscillation by the PLC” (DB31, ... DBX18.4)
NST “no speed monitoring while changing gear” (DB31, ... DBX16.6)
NST “gear was changed” (DB31, ... DBX16.3)
NST “actual gear step A to C” (DB31, ... DBX16.0 to DBX16.2)
NST “traverse buttons plus” (DB31, ... DBX4.7)
NST “traverse buttons minus” (DB31, ... DBX4.6)
NST “spindle stop” (DB31, ... DBX4.3)

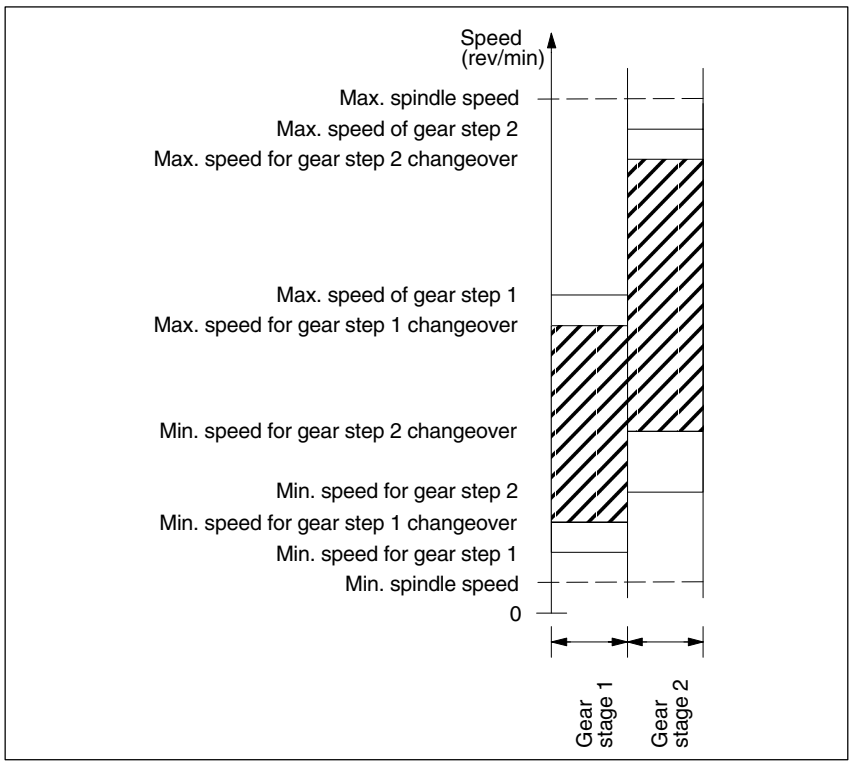


Fig. 6-21 Example of speed ranges for automatic gear step selection (M40)

6.9.17 Spindle positioning

The control 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.

Reference material: /PG/ Programming instructions, basic principles

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 (IS “Spindle in setpoint range”), the control branches into position control mode and the acceleration rate for position control mode and the K_V factor become active. The interface signal “Exact stop fine” is output to indicate that the programmed position has been reached (block change when position reached). The acceleration rate for position control mode must be set such that the current limit is not reached. The acceleration rate must be entered separately for each gear step. If the spindle is positioned from zero speed, it is accelerated up to a maximum speed corresponding to creep speed; the direction is defined via machine data. The contour monitoring function is activated as soon as the control mode switches to position control.

Machine data and interface signals

MD 36400: CONTOUR_TOL (contour monitoring)
MD 36050: CLAMP_POS_TOL (clamping tolerance)
MD 36030: STANDSTILL_POS_TOL (zero-speed tolerance)
MD 36020: POSITIONING_TIME (fine exact stop delay)
MD 36010: STOP_LIMIT_FINE (fine exact stop)
MD 36000: STOP_LIMIT_COARSE (coarse exact stop)
MD 35350: SPIND_POSITIONING_DIR
(direction of rotation while positioning from zero speed)
MD 35300: SPIND_POSCTRL_VELO (cut-out speed)
MD 35210: GEAR_STEP_POSCTRL_ACCEL
(acceleration in position control mode)
MD 35012: GEAR_STEP_CHANGE_POSITION
(gear step change position from software version 5.3)
MD 35010: GEAR_STEP_CHANGE_ENABLE
(gear step change options from software version 5.3
to fixed position)
MD 32200: POSCTRL_GAIN (K_V factor)

MD 20850: SPOS_TO_VDI (output “M19” to the VDI interface)

NST “positioning mode” (DB31, ... DBX84.5)
NST “position reached with fine/coarse exact stop” (DB31, ... DBX60.6/60.7)
NST “spindle resynchronized while positioning” (DB31, ... DBX17.4/17.5)
NST “clamping active” (DB31, ... DBX2.3)

Parameter sets for exact stop limits

The fine and coarse exact stop limits can be set for specific parameter sets using MD 36012: STOP_LIMIT_FACTOR[n] not equal to [1.0].

6.9.18 Spindle synchronization

The spindle must synchronize its position with the measuring system. It is always synchronized with the zero marker of the encoder or with a sensor signal that is connected to the drive module of the SIMODRIVE 611D. MD 34200 ENC_REFP_MODE is used to specify which signal is used for the synchronization (zero marker (0) or sensor (1))

When is synchronization necessary?

- After activation of the control if the spindle is moved with a programming command.
- The “Resynchronize spindle 1/2” signal removes the “Referenced/Synchronized 1/2” signal that resynchronizes the spindles with the next reference signal.
- After every gear step change (MD 31040: ENC_IS_DIRECT=0)
- The spindle goes out of synchronism if a speed above the encoder limit frequency is programmed. When the speed drops to below the encoder limit frequency, the spindle is re-synchronized. If the synchronized state has been lost, it is impossible to implement functions such as rotational feedrate, constant cutting velocity, tapping with and without compensating chuck, positioning and axis modes.

Machine data and interface signals

MD 34100: REFP_SET_POS (reference point value, zero marker position). This MD is used to enter the position of the reference signal for synchronization.
MD 34090: REFP_MOVE_DIST_CORR (reference point move, zero marker move)
The zero mark offset resulting from the synchronization process is entered here.
MD 34200: ENC_REFP_MODE (position measuring system type)
NST “Resynchronize spindle 1, 2” (DB31, ... DBX16.4 or 16.5)
NST “Referenced/synchronized” 1, 2” (DB31, ... DBX60.4 or 60.5)

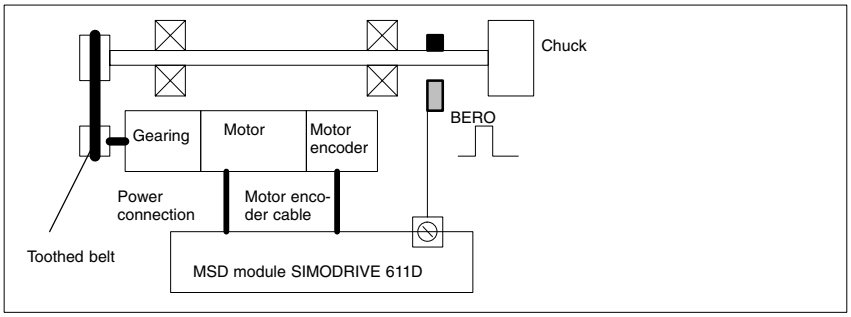


Fig. 6-22 Synchronization via an external reference signal (BERO)

Note

If the spindle encoder is not attached directly to the spindle and there are gear ratios between the encoder and the spindle (e,g, encoder on motor), then the synchronization must take place via a signal from a BERO sensor connected to the drive module. The control then automatically re-synchronizes the spindle position after every gear step changeover. The user need not take any further measures in this respect. The attainable accuracy is impaired by backlash, elasticity in the gearing and the BERO signal hysteresis, during the synchronization progress.

If a BERO sensor is used, MD 34200: ENC_REFP_MODE must be set to 2.

6.9.19 Spindle monitoring

Axis/spindle stopped

If the velocity specified in MD 36060: STANDSTILL_VELO_TOL is undershot, this is indicated via the “Axis/spindle” interface signal.

If MD 35510: SPIND_STOPPED_AT_IPO_START is set, the tool feed is enabled.

Spindle in setpoint range

If the spindle reaches the tolerance range specified in MD 35150: SPIND_DES_VELO_TOL, then the “Spindle in setpoint range” signal is output. If MD 35500: SPIND_ON_SPEED_AT_IPO_START is set, the tool feed is enabled.

Maximum spindle speed

The maximum spindle speed is entered in MD 35100: SPIND_VELO_LIMIT. The NCK limits the speed to this value. If, however, the speed is exceeded by the speed tolerance in spite of the NCK limitation (drive fault), then the IS “Speed limit exceeded” is output together with the alarm “22150 channel [name] block [number] spindle [number] maximum chuck speed exceeded”. MD 36200: AX_VELO_LIMIT also monitors the speed of the spindle. An alarm is generated if the speed is exceeded. In position-controlled mode (e.g. SPCON) a limitation is set within the control to 90% of the maximum speed specified by the MD or setting data (control reserve).

Minimum/ maximum gear step speed

The maximum speed of the gear step is entered in MD 35130: GEAR_STEP_MAX_VELO_LIMIT and the minimum speed is entered in MD 35140: GEAR_STEP_MIN_VELO_LIMIT. The speed cannot leave this range when the appropriate gear step is engaged.

Programmable spindle speed limits

The functions G25 S... are used to set a minimum spindle speed and G26 S... to set a maximum spindle speed limit via the program. The limitation is active in all operating modes.
Function LIMS=... allows a spindle speed limit for G96 (constant cutting velocity) to be specified. This limitation is operative only when G96 is active.

Maximum encoder limit frequency

The maximum encoder limit frequency (MD 36300: ENC_FREQ_LIMIT) is monitored. If this limit is exceeded, the synchronization is lost and the spindle functionality reduced (thread, G95, G96). It is resynchronized automatically for the position measuring systems that have become unsynchronized as soon as the encoder frequency falls below the value in MD36302: ENC_FREQ_LIMIT_LOW. The encoder limit frequency value must be set such that the mechanical encoder speed limit is not exceeded or else the synchronization from high speeds will be incorrect.

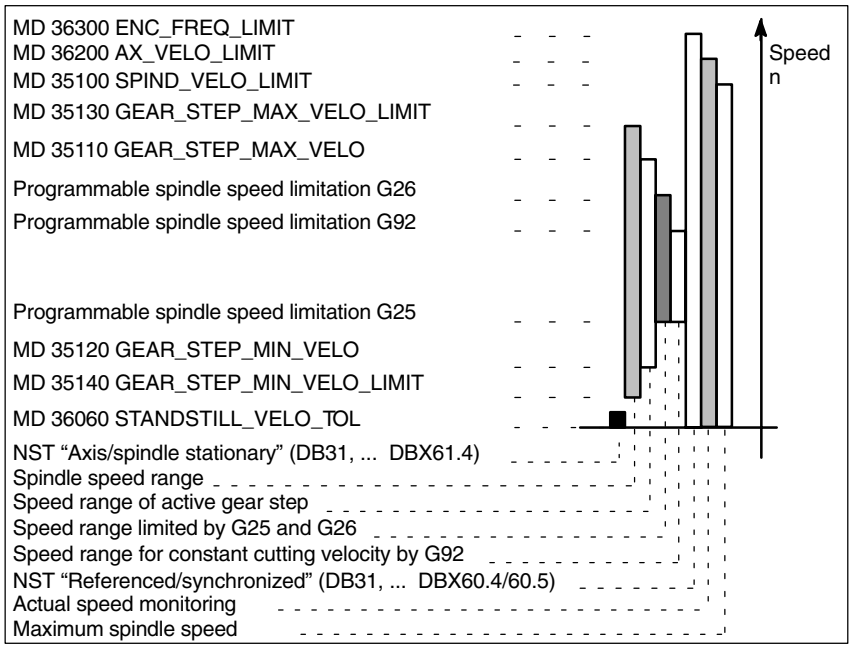


Fig. 6-23 Areas for spindle monitoring

6.9.20 Example: Starting up NCK I/Os

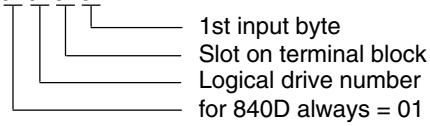
Table 6-26 Starting up NCK I/Os, drive no.: 4

Analog Out	Analog In	Analog In	8 Bits Out	16 Bits Out	16 Bits In
OUTA [1]	INA [1]	INA [2]	OUT [9]	OUT [18]	IN [9]
			...	...	...
			OUT [17]	OUT [33]	IN [17]

1. Assign the logical drive number: 4,
   select the module type: DMP-C.
2. To connect to the bus, set NCK Reset.
3. Set the number of analog inputs and outputs:
   analog inputs: MD10300 = 2, analog outputs: MD 10310 = 1.

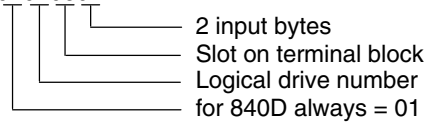
   Set the number of digital inputs and output bytes:
   3 bytes dig. inputs, of which 2 bytes are external, 1 byte internal:
   MD10350 = 3,
   4 bytes dig. outputs, of which 3 bytes are external, 1 byte internal:
   MD10360 = 4.
4. Assign the analog inputs to the hardware:

   MD 10362 [0] = 01040201

   MD 10362 [1] = 01040301
5. Assign the analog outputs to the hardware:
   MD 10364 [0] = 01040101
6. Assign the digital inputs to the hardware:

   MD 10366 [0] = 01040602

7. Assign the digital outputs to the hardware:
   MD 10368 [0] = 01040401
   MD 10368 [1] = 01040502
8. Set the weighting factors for the analog inputs / outputs:
   MD 10320 = 10000
   MD 10330= 10000
9. Set the option: Programmed analog output
10. Program:
    $A_OUTA [1] = 5000

```
(Set analog output 1 to 5000 mV)

FROM $A_INA [1] > 4000 DO $A_OUT [9] = TRUE
(If analog input 1 > 4000 mV, set output 9)

R1 = $A_INA [1]
(Set value of analog input 1 in R parameter 1)

DO $A_OUT [9] = FALSE
(Reset digital output 9)

DO $A_OUTA [1] = 0
(Set analog output 1 to 0 mV)
```

6.10 Linear motors (1FN1 and 1FN3 motors)

6.10.1 General information for starting up linear motors

Recommended reading

Detailed information about linear motors, encoder and power connections, and configuration and monitoring can be found in:

Reference material: /PJLM/ Configuration guide for linear motor

Checks in de-energized state

The following should be checked:

1. General linear motor check
   - Which linear motor is used?
   - Is the motor included in the list?

     If yes, type: 1FN_ _ _ _-_ _ _ _ _-_ _ _ _

     If no, determine the manufacturer's data for the non-Siemens linear motor
   - Is the cooling system functional and is the correct coolant mixture in use? (Recommended mixture: 75% water, 25% Tyfocor).
2. Mechanical system
   - Can the axis travel freely across the entire traversing range?
   - Do the installation dimensions of the motor and the air gap between the primary and secondary sections comply with the manufacturer's specifications?
   - Vertical axis:
     If the axis has a counterweight, is it functional?
   - Brake:
     If a brake is fitted, is it being applied and released properly?
   - Travel limitation:
     Are mechanical limit stops installed at both ends of the travel path and bolted securely in position?
   - Are the moving cables installed properly in a cable trailing device?

3. Measuring system

   Is an incremental or an absolute (EnDat) measuring system installed?

   a) Incremental measuring system:

      – Grid size _ _ _ _ _ _ µm

      – Number of zero markers _ _ _ _ _ _

   b) Absolute measuring system:

      – Grid size _ _ _ _ _ _ µm

   Determine the positive drive direction:

   Which is the positive counting direction of the measuring system? (see subsection 6.10.6)
   —> Invert actual velocity value? ☐ yes ☐ no

4. Wiring

   – Power section (connection with phase sequence UVW, clockwise rotation)

   – PE conductor connected?

   – Shield attached?

   – Various methods of temperature sensor evaluation

      a) Evaluation by KTY84 via SIMODRIVE 611Donly

      b) Evaluation via SIMODRIVE 611D and external

      c) External evaluation only

   Note:
   In case a) a temperature sensor coupling lead (dongle) must be connected between –X411 and the measuring system.

   Reference material: /PJLM/CON/ General notes on connections: “Encoder connection” section

5. Measuring system cable

   Check whether the measuring system cable is correctly attached to connector X411 or to the adapter on the temperature sensor coupling lead.
   See also:

   Reference material: /PJLM/CON/ General notes on connections: “Encoder connection” section

6.10.2 Start-up: linear motor with a primary section

Start-up procedure

Linear motors with one primary section (single motor) must be started up using the start-up tool as described below:

Warning

For safety reasons, the pulse enabling signal on the closed-loop control unit (term. 663) must be switched off initially before the drive is switched on.

1. Configure the drive:
   - Select drive type: “SLM” (synchronous linear motor) —> Add module
   - Select the power section

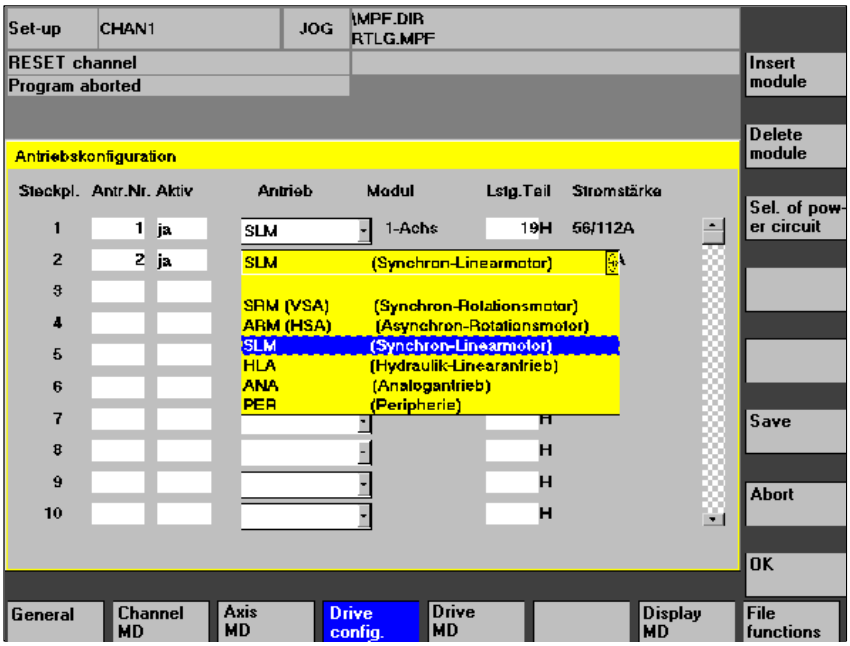


Fig. 6-24 Drive configuration for synchronous linear motor

2. Adapt the axis-specific machine data (MD) as for feed drive

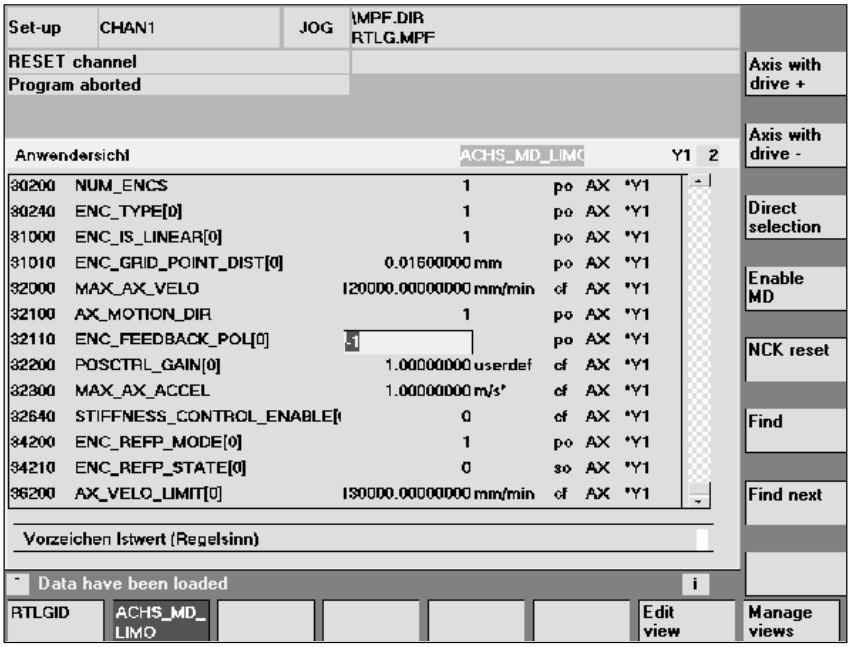


Fig. 6-25 Minimum selection of axis machine data for linear motor

Please observe the following safety information:

Note

You must check the following before activating the pulse and servo enables:

- Ensure that the encoder parameters are correct, especially if it is necessary to invert the actual speed or velocity value.

  Check that the actual speed or velocity value has the correct sign and that the actual position value counts up or down correctly by pushing the motor manually.

  Note that the speed inversion should also be programmed on the NCK side (axis-specific data, MD 32110 – ENC_FEEDBACK_POL[0] = –1).

- When performing initial trials with rotor position identification based on a moving system, it is advisable to reduce the current for safety reasons, e.g. to 10% (MD 1105 = 10%). The current reduction does not take effect until the identification is effective.

3. Select the motor

   Message 300701: “Start-up required” must appear before the motor is selected (Fig. 6-26).

   a) Is the linear motor included in the list of linear motors?

      If yes: Select the motor

      (parallel-connected linear motors start with 2x1FN. ...)

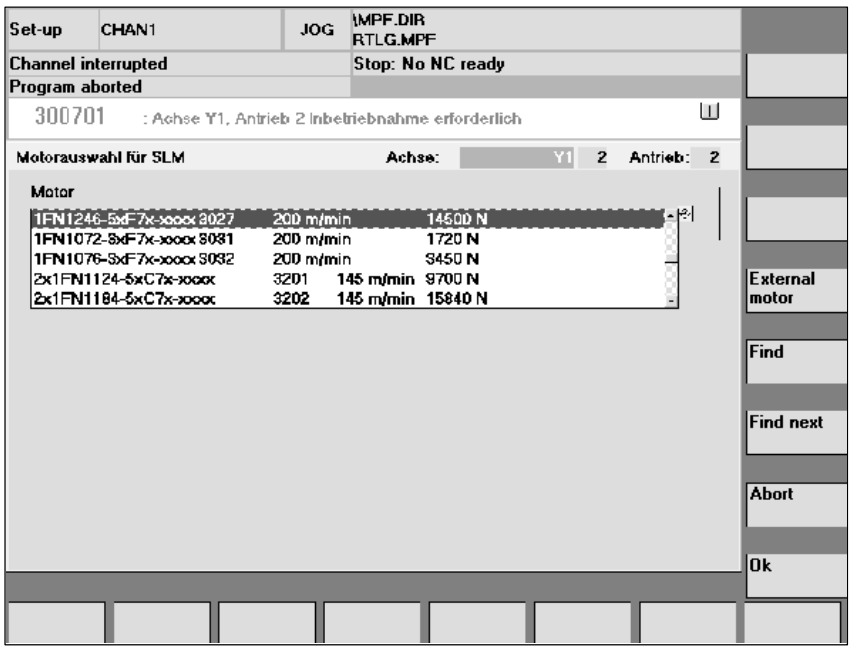


Fig. 6-26 Selecting a motor for which the data is already listed

b) Is the linear motor not included in the list of linear motors?
—> “Non-Siemens motor”

“Motor” field —> enter data

Note

If a smaller identification current is needed (<40%), alarm 300753 must be hidden with bit 5 in MD 1012.

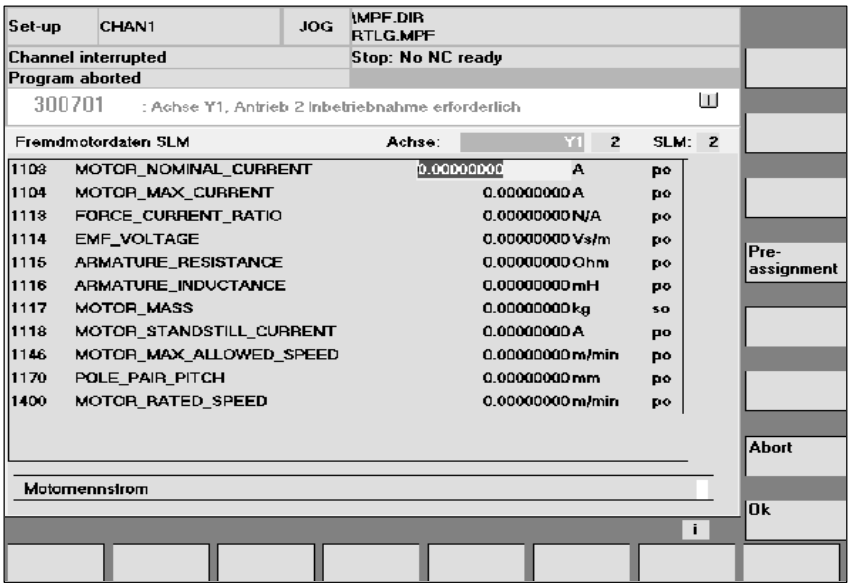


Fig. 6-27 Entering the unlisted motor, the data is not yet specified

Enter the motor data:

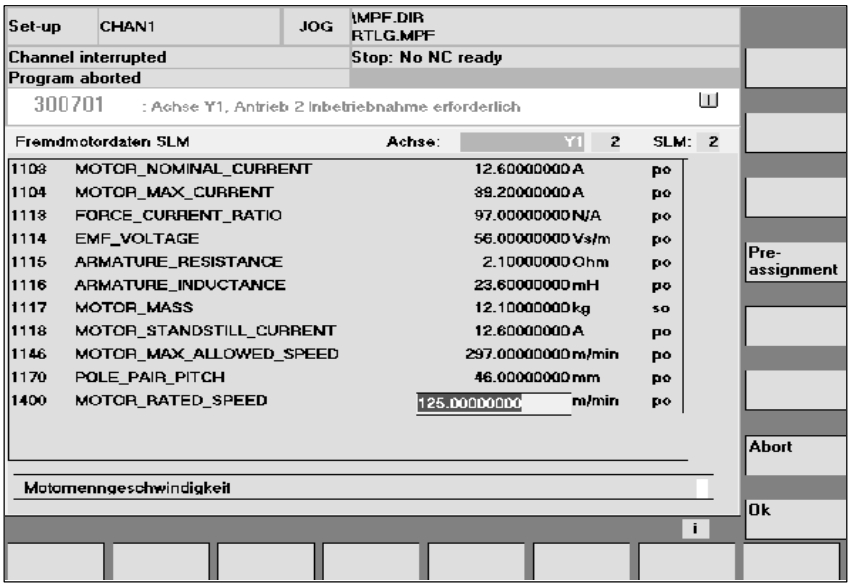


Fig. 6-28 Entering data for an “unlisted motor”

4. “Measuring system/encoder” dialog

   Select the motor measuring system and enter the encoder data

   a) Incremental encoder

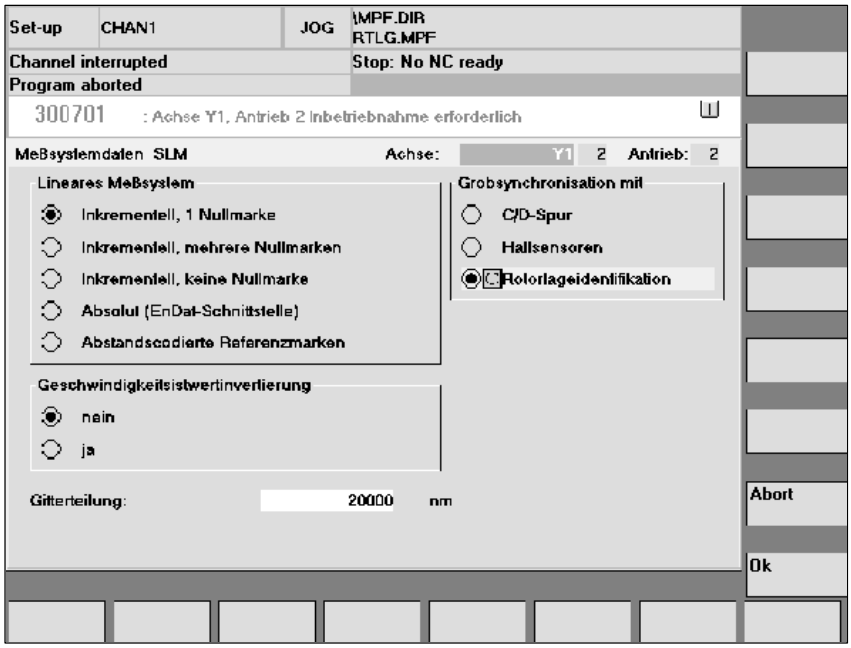


Fig. 6-29 Data entry for incremental measuring system with rotor position identification

Enter encoder data

The following selection can be made in the “Linear measuring system” field:

– Incremental – one zero marker
  There is an incremental measuring system with 1 zero marker in the traveling range.
– Incremental – several zero markers
  There is an incremental measuring system with several zero markers in the traveling range.
– Incremental – no zero marker
  There is an incremental measuring system with no zero marker in the traveling range.

“Invert actual velocity value”: yes/no (section 6.10.6)

Enter “Graduations” of measuring system

“Coarse synchronization with” field:

– Rotor position identification: yes (for incremental measuring system only)

Confirm acceptance of data with OK —> “Save bootfile” and select “NCK reset”.

b) Absolute encoder (EnDat)

An absolute measuring system (EnDat interface) is installed.

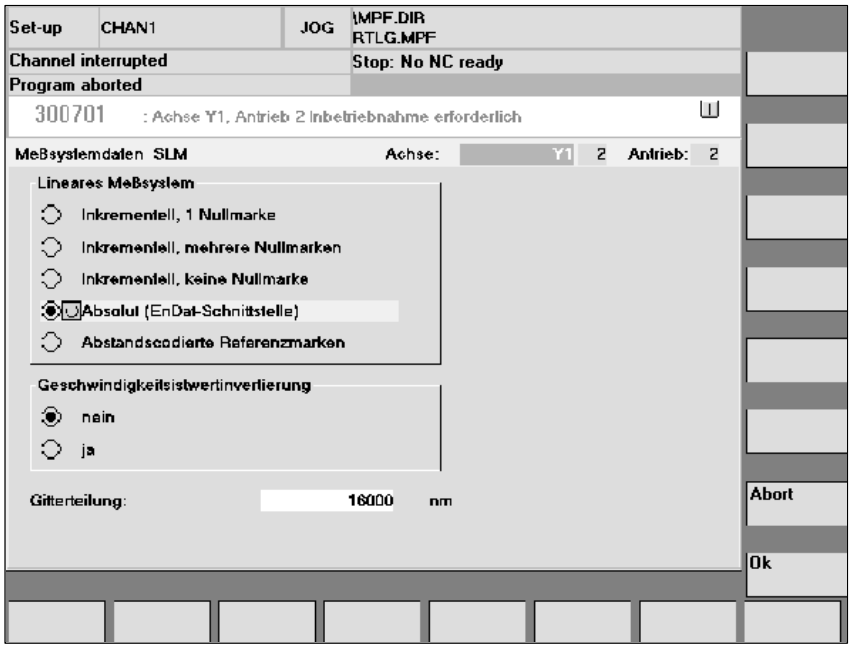


Fig. 6-30 Data entry for absolute measuring system, e.g. LC181

The following data must be entered:

– Select Absolute (EnDat interface) from the “Linear measuring system” box.

– “Invert actual velocity value” (subsection 6.10.6)

– Enter “Graduations” of measuring system

Confirm acceptance of data with OK —> “Save bootfile” and select “NCK reset”.

5. Fixed temperature?

   If the temperature monitor is evaluated not via the drive, but by an external device (see subsection 6.10.5), the monitoring function must be switched off by entering a fixed temperature > 0.

   – MD 1608 e.g. 80° Monitoring off

   – MD 1608 e.g. 0° Monitoring on

6. Reduce maximum motor current for safety reasons

   – MD 1105 (maximum motor current) = e.g. enter 20%

Danger

Linear drives are capable of significantly higher acceleration rates and velocities than conventional drives.

The traversing range must be kept clear of obstacles at all times to protect operating personnel and the machine itself.

7. Determine the commutation angle offset

   The commutation angle offset is determined as follows:

   a) Select identification method via MD 1075. Possibly adapt other machine data for rotor position identification.

   b) Save the boot files and perform NCK reset.

   c) Depending on which measuring system is used, continue as follows:

Incremental measuring system

With an incremental measuring system:

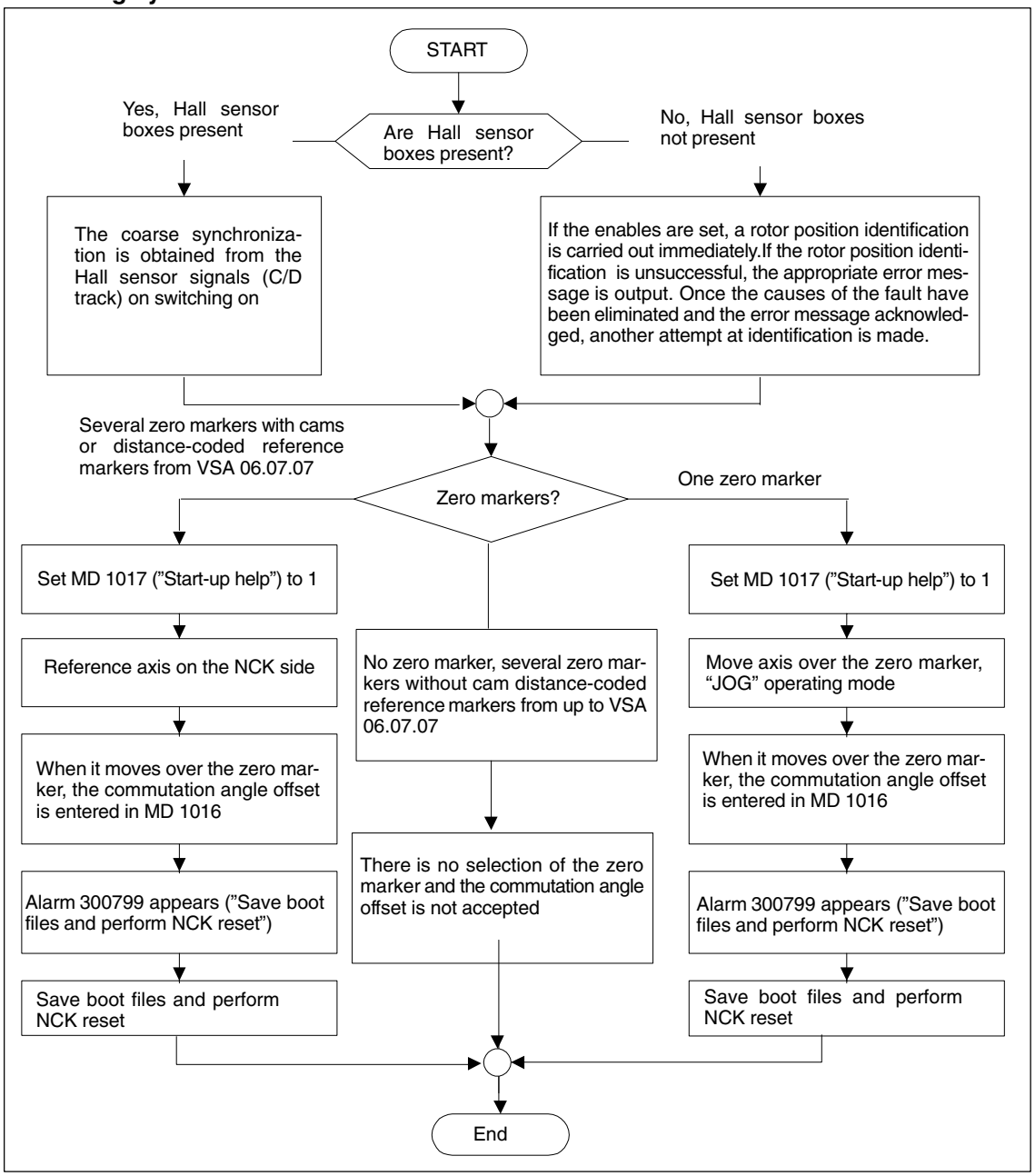


Fig. 6-31 Incremental measuring system

Absolute measuring system

With an absolute measuring system:

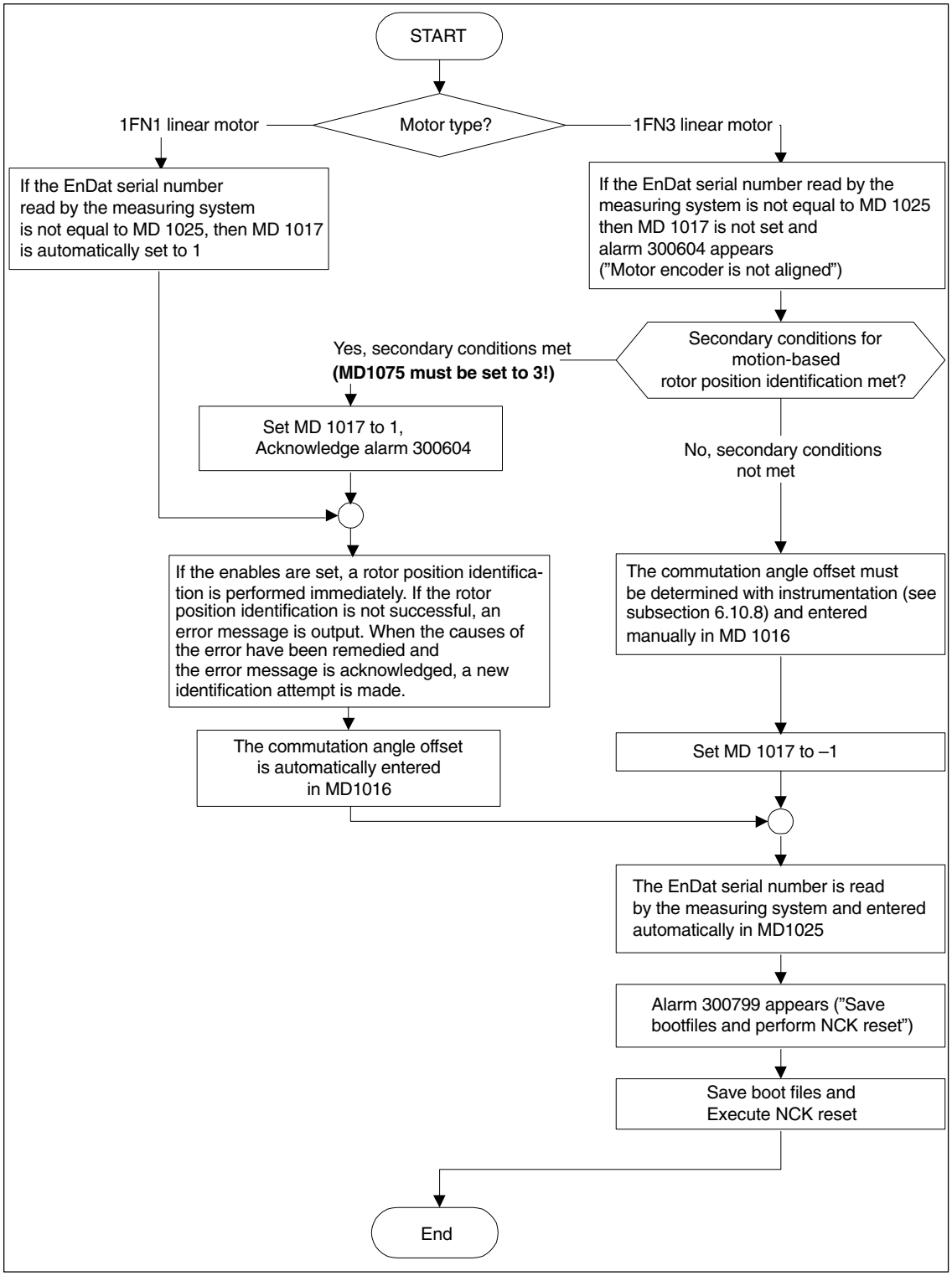


Fig. 6-32 Absolute measuring system

Distance-coded measuring system

This measuring system is not supported by the SIMODRIVE 611D. Several zero markers must be selected incrementally.

Note

With non-Siemens motors, the rotor position identification method cannot be guaranteed to determine the commutation angle offset. Depending on the design of the motor, the following methods may be used for both types of measuring system:

- Method based on saturation
- Method based on motion
- With an absolute measuring system: determine the commutation angle offset using instruments (see subsection 6.10.8).

When the start-up is complete, the commutation angle offset MUST be checked using instruments.

---

8. Check and adjust the rotor position identification if a Hall sensor is not used

---

Note

If a Hall sensor is used it is only possible to verify the results with the aid of instrumentation (see subsection 6.10.8).

To verify the rotor position identification, a test function can be used to determine the difference between the detected rotor position angle and the actual angle used by the closed-loop control system. Proceed as follows:

– Run the test function several times and evaluate the difference

Start Set MD 1736 (test rotor position identification) = 1

Difference MD 1737 (difference in rotor position identification)
= _ _ _ _ , _ _ _ _ , _ _ _ _ , _ _ _ _ , _ _ _ _

– Is the spread of measured values less than 10 degrees electrical?

No: Increase MD 1019 (e.g. by 10 %) and repeat measurements.

If the repetition is OK, then determine the commutation angle offset once more as follows:

– With an incremental measuring system:

a) Incremental – one zero marker
as for point 7. (Determine commutation angle offset)

b) Incremental – no or several zero markers
Press “Save boot file” and “NCK-Reset”

– With an absolute measuring system:

  Switch off drive (NCK-Reset)
  Switch on drive with pulse and controller enabling signals inhibited
  Set MD 1017 = 1

  Activate on pulse and controller enable signals

  —> The angle offset is automatically entered in MD 1016

  —> Alarm 300799 appears

  —> Save boot files and perform NCK reset

Example for rotor position identification (see figure below):

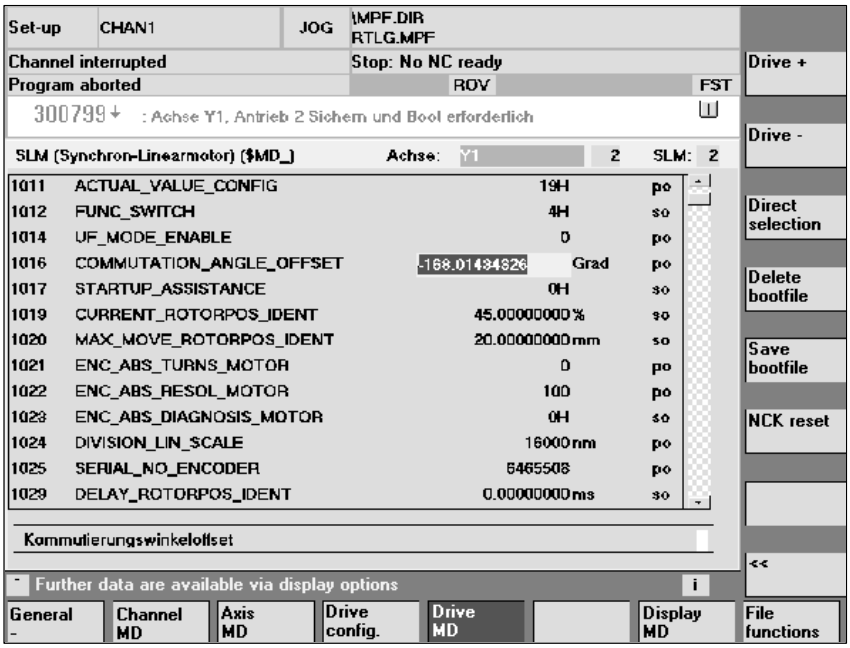


Fig. 6-33 Result of rotor position identification with absolute measuring system

9. Move axis and check correct function

   Does the axis traverse in the correct direction with a positive velocity setpoint?

   – No Change MD 32100 (traversing direction)

   Is the distance traversed correct? (input = 10 mm —> distance = 10 mm)

10. Set and perform referencing/adjustment

   – Incremental measuring system:
     Referencing (see subsection 6.9.12)

   – Absolute measuring system:
     Adjust (see subsection 6.9.6)

11. Set software limit switch (see subsection 6.9.11 under the heading of "Monitoring positions via software limit switches")
12. Optimize axis controller settings

    Note:
    The automatic controller setting does not produce any useful results for linear motors since the measuring system mounting has a significant effect on the control characteristic.

    – Current and speed controllers (see Chapter 10)
    – Position controller (see Chapter 10)

6.10.3 Start-up: linear motors with 2 identical primary sections

General

If it is certain that the EMFs of both motors have the same phase relation, then the motors can be operated on one drive if they have parallel connecting cables.

The start-up procedure for paralleled linear motors is based on the start-up operation for a single linear motor.

Initially only one linear motor (motor 1) is connected to the drive and started up as a single motor (1FNx...). The commutation angle offset is determined either automatically or with instruments (see subsection 6.10.8) and is noted.

Motor 2 is then connected in place of motor 1 and operated as a single motor. Again, the commutation angle offset is determined either automatically or with instruments (see subsection 6.10.8) and is noted.

If the difference between the commutation angle offsets of motor 1 and motor 2 is less than 10 degrees electrical, both motors may be connected to the drive in parallel and may be operated as a parallel circuit with 2 linear motors (e.g. 2x 1FN. ...).

Procedure for starting up paralleled linear motors

The start-up sequence for paralleled linear motors is as follows:

1. Disconnect the paralleled motors

   Connect only motor 1 to the power section.

2. Start up motor 1 as if it were a single motor

   —> Note the information in subsection 6.10.1

   —> Start up as described in subsection 6.10.2 (including point 7.)

   —> Check the rotor position identification and set (see subsection 6.10.2, point 8.)

3. Move axis and check correct function
4. Note the commutation angle offset of motor 1

   – MD 1016 (motor 1) = _ _ _ _ _ _ _ _ degrees electrical

5. Switch off and wait until DC link has discharged
6. Connect motor 2 to the power section instead of motor 1

   Warning:
   In a back-to-back arrangement (see section 6.10.7), remember to swap over phase U and V.
7. Switch on motor with pulse and controller enabling signals inhibited
8. Determine the commutation angle offset of motor 2
   - With an incremental measuring system:
     (see subsection 6.10.2, point 7.: “Determining the commutation angle offset”)
   - With an absolute measuring system:
     Switch off drive (NCK-Reset)
     (see subsection 6.10.2, point 7.: “Determining the commutation angle offset”)
9. Move axis and check correct function
   (see subsection 6.10.2, step 9.)
10. Note the commutation angle offset of motor 2
    - MD 1016 (motor 2) = _ _ _ _ _ _ _ _ degrees electrical
11. Difference between step 4. (motor 1) and step 10. (motor 2)

    if ≤ 10 degrees —> OK

    if > 10 degrees —> Check mechanical structure and correct
    (see subsections 6.10.4 and 6.10.7)
    Delete motor data for individual motor —> Deleted boot file
12. Switch off and wait until DC link has discharged
13. Set up parallel connection of the 2 linear motors again

    Connect both motors to the power section again.
14. Switch on motors with pulse and controller enabling signals inhibited
15. Start-up of paralleled linear motors
    - Carry out the complete start-up procedure described in subsection 6.10.2
    - Select the paralleled motor from the “Motor selection” dialog.
      (2x1FN. ...) or:
      Enter the data for the paralleled non-Siemens motor (as described under the heading of “Non-Siemens motors – parameters for SLM”).
16. Compare the commutation angle offset between motor 1 and 2
    - Check connection between motor cable and power section, correct if necessary and determine the commutation angle offset.
      With an incremental or absolute measuring system:
      As described in subsection 6.10.2, point 7.: “Determining the commutation angle offset”.

6.10.4 Mechanical system

Check the installation dimensions and air gap

Installation dimension e_1 or e_2 can be checked, for example, by means of gauge blocks and feeler gauges before the motor is installed.

Note

The applicable installation dimensions can be found in the following documents:

- /PJLM/ Configuration guide for linear motor
- The data sheet of the appropriate 1FN1 or 1FN3 motor.

Please note with respect to installation dimension and air gap:
The electrical and system-related properties of the linear motor are guaranteed solely as a function of the installation dimension and not the measurable air gap. The air gap must be large enough to allow the motor to move freely.

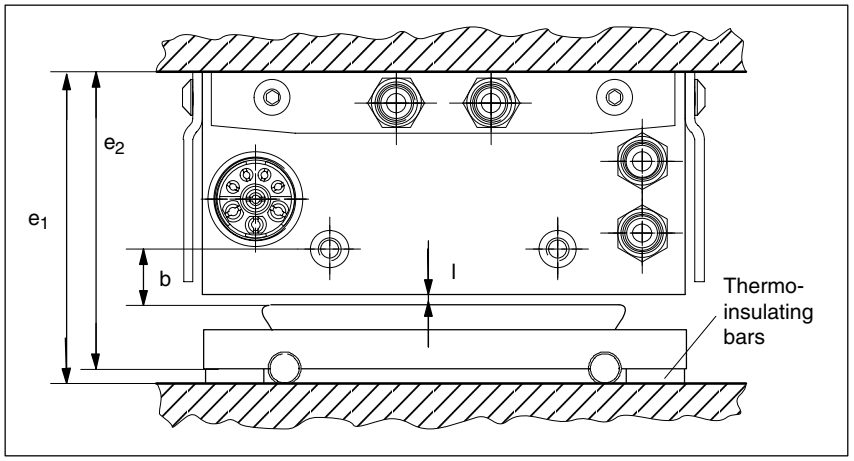


Fig. 6-34 Check dimensions for motor installation illustrated by a 1FN1 motor

Table 6-27 Check dimensions for installation dimension and air gap for a 1FN1 linear motor

Linear motors / Check dimensions	1FN1 ...	
	1FN1 07□	1FN1 12□ 1FN1 18□ 1FN1 24□
Installation dimension e_1 [mm]	80,7 ± 0,3	106,7 ± 0,3
Installation dimension e_2 [mm] (without thermo-insulating bars)	76,7 ± 0,3	101,7 ± 0,3
Measurable air gap l [mm] (not including installation dimension tolerance)	$1.1\ ^{+0.3}/_{-0.45}$	$1.1\ ^{+0.3}/_{-0.45}$
Distance b [mm] (not including installation dimension tolerance)	13 ± 1	13 ± 1

For installation dimensions of 1FN3 linear motors, see dimension drawings in appendix of 1FN Planning Guide, mounting height h_M or h_{M1}.

6.10.5 Temperature sensors for 1FN1 and 1FN3 motors

Description for 1FN1

The following temperature sensing system is integrated in the primary section of 1FN1 motors:

1. Temperature sensor (KTY 84)

   The KTY 84 temperature sensor has an approximately linear characteristic (580 ohms at 20 °C and 2.6 kohms at 300 °C).

2. Temperature switch (3 series-connected NC contacts)

   A switch with a two-position characteristic and an operating temperature of 120 °C fitted for each winding overhang.

   The temperature switch is generally only used for parallel connections or protective separation.

   The switches can be evaluated additionally by a higher-level external control (e.g. a PLC). This option is recommended if the motor is frequently loaded at maximum force at standstill.

   As a result of different current levels in the 3 phases, different temperatures (by as much as 15 K) may occur in the individual winding overhangs; only temperature switches are capable of sensing them reliably.

Description for 1FN3

The following temperature sensing system is integrated in the primary section of 1FN3 motors:

1. Temperature sensor (KTY 84)

   The KTY 84 temperature sensor has an approximately linear characteristic (580 ohms at 20 °C and 2.6 kohms at 300 °C).

2. PTC thermistor detector

   A temperature sensor for each phase is integrated in the winding overhangs.

   The operating temperature of the PTC sensor is 120 °C.

   The 3RN1 thermistor motor protection control unit is the preferred option for evaluating PTC detectors.

Note

If the temperature sensors or switches are not connected, they must be short-circuited and connected to PE as protection against electrical damage and high touch voltages.

!

Important

When connecting up the temperature monitoring circuits, please read the specifications according to DIN EN 50178 regarding protective separation.

For information about protective separation, please refer to:

Reference material: /PJLM/ Configuration guide for linear motor

---

How are the temperature sensors evaluated?

The signal leads for motor temperature monitoring on 1FN motors are installed not in the encoder cable, but in the motor power cable. In order to sense the winding temperature of the drive, the temperature sensor signal leads must be looped into the encoder cable (temperature sensor coupling lead).

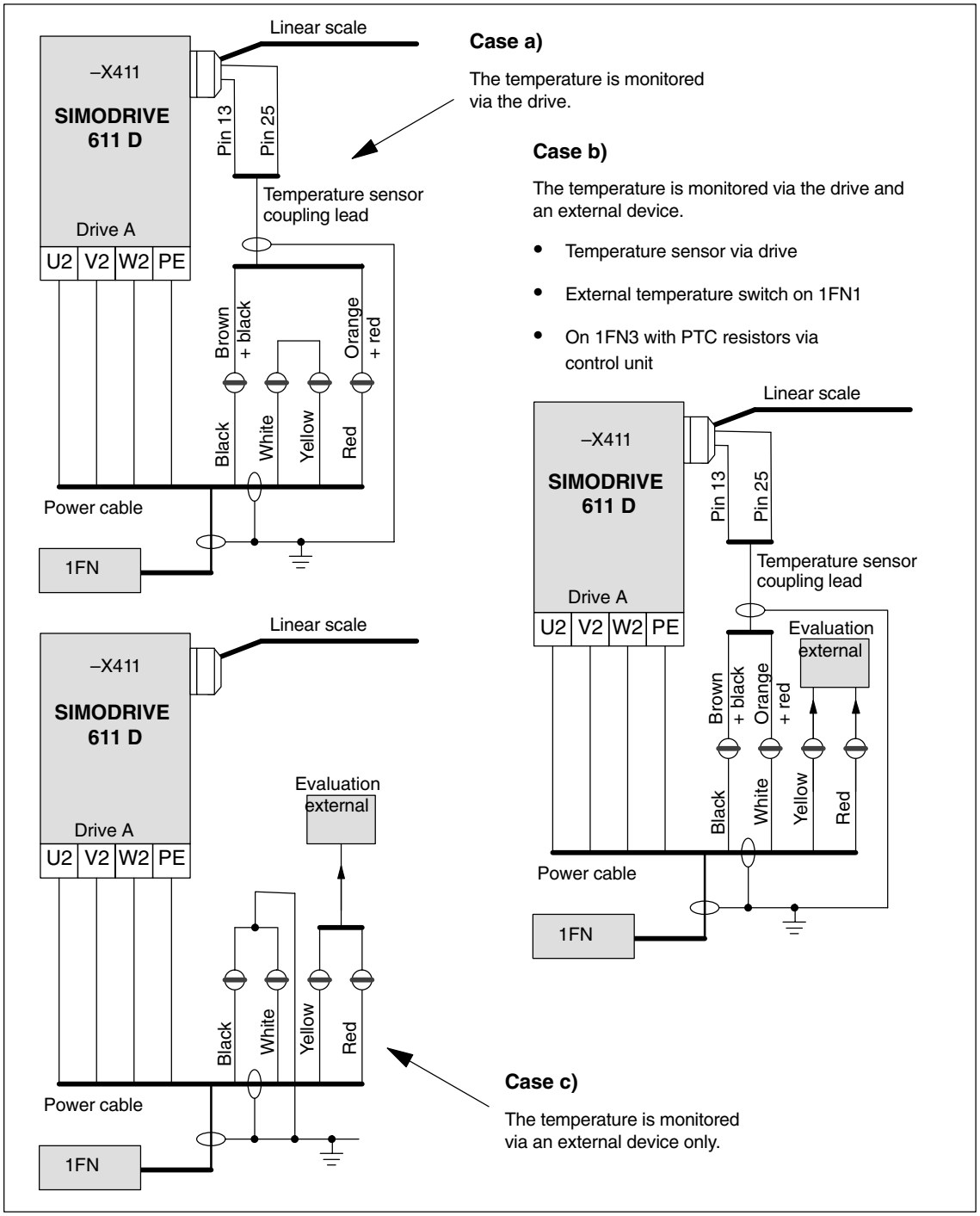


Fig. 6-35 Evaluation of KTY temperature sensor (black/white) and switch or PTC (yellow/red) (whether temperature switch or PTC resistor depends on motor type, i.e. 1FN1 or 1FN3)

Note

The outer and inner shielding of the signal lines in the power cable and the shielding for the temperature sensor coupling lead MUST be laid flat on the shielding connecting plate.

Failure to connect the shield correctly can result in high touch voltages, malfunctions and sporadic errors or irreparable damage to the closed-loop control module.

Table 6-28 Assignments of temperature sensor coupling lead

Signal	Power cable	Temperature sensor coupling lead (dongle)	–X411 on drive
Temperature sensor +	Black core	Brown + black core	Pin 13
Temperature sensor –	White core	Orange + red core	Pin 25
Temperature switch/PTC	Yellow core	–	–
Temperature switch/PTC	Red core	–	–

6.10.6 Measuring system

Determining the control direction

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

Note

The instructions for determining the drive direction apply only to Siemens motors (1FNx motors).

If the positive direction of the drive and the positive counting direction of the measuring system **do not coincide**, then the actual speed value must be inverted in the “Measuring system/Encoders” dialog during start-up (MD 32110).

It is also possible to check the control direction by parameterizing the drive first and then moving it manually with the enabling signals inhibited.
If the axis is moved in a positive direction (see definition in Fig. 6-36), then the actual velocity value must be counted positively.

Determining the drive direction

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

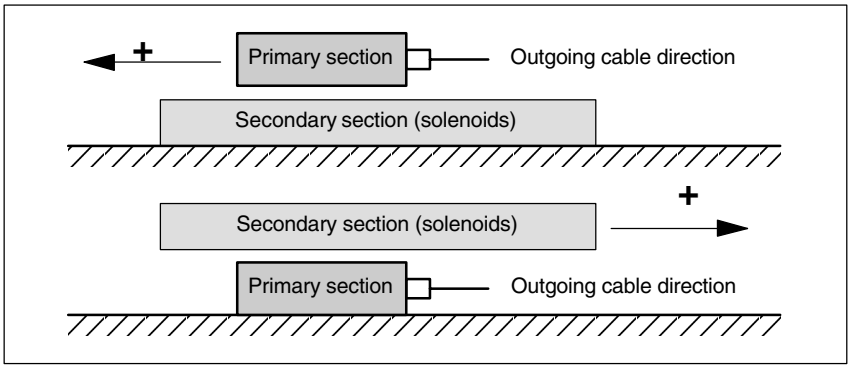


Fig. 6-36 Determining the positive direction of the drive

Determining the count direction of the measuring system

The method by which the count direction is determined depends on the measuring system itself.

1. Heidenhain measuring systems

Note

The count direction of the measuring system is positive if the distance between the scanning head and the rating plate increases (see Fig. 6-37).

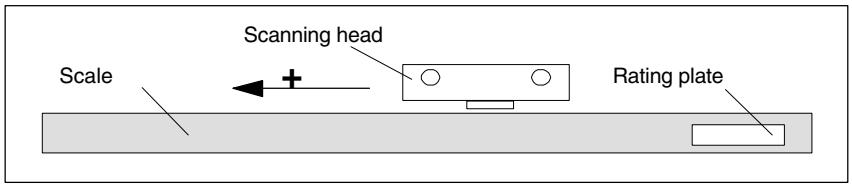


Fig. 6-37 Determining the count direction of Heidenhain measuring systems

2. Renishaw measuring systems (e.g. RGH22B)

   The RGH22B measuring system from Renishaw (grid size = 20 µm) is not compatible for connection to Heidenhain systems until serial number G69289. The zero marker on earlier scanning head models cannot be evaluated. Since the reference marker on the Renishaw RGH22B has a direction-dependent position, encoder signals BID and DIR must be parameterized such that the reference marker is output in only one direction. The direction (positive/negative) is dependent on the geometric configuration on the machine and the reference point approach direction.

Table 6-29 Signal and pin assignments, routing on 1FN linear motor

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

The count direction of the measuring system is positive if the scanning head moves in the direction of the outgoing cable in relation to the gold strip.

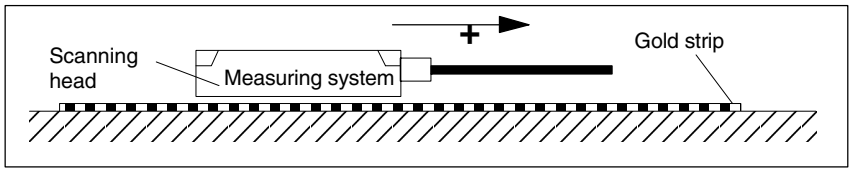


Fig. 6-38 Determining the count direction of Renishaw measuring systems

Note

If the scanning head is mechanical connected to the primary section, then the cable exit direction must be different. Otherwise invert the actual value!

Temperature sensor coupling lead (= dongle)

This connection variant has proved to extremely immune to interference and should always be employed.

If an incremental measuring system is used, the drive is synchronized coarsely using the rotor position identification routine.

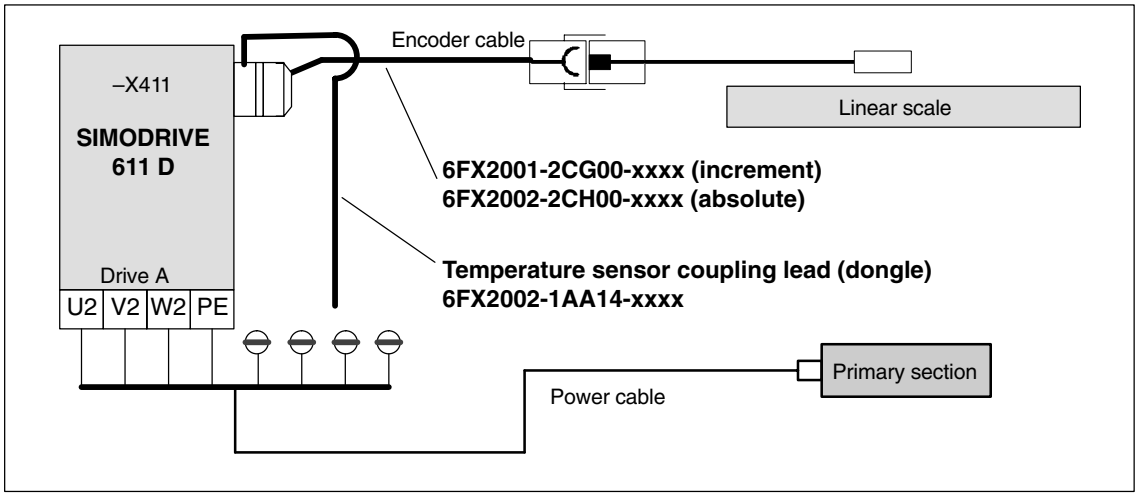


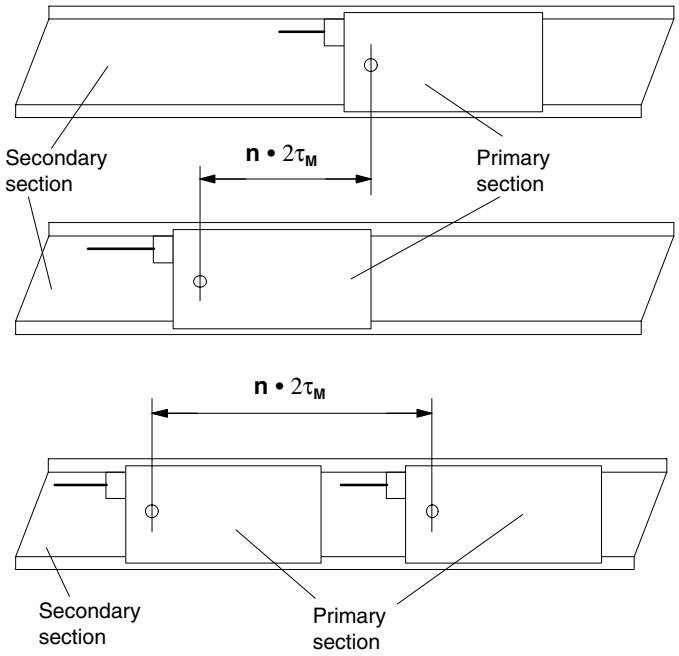
Fig. 6-39 Temperature sensor coupling lead (recommended standard connection)

6.10.7 Parallel connection of linear motors

Mechanical structure

The distances between the motor primary sections must ensure an identical phase relation of the motor EMFs.

All primary sections are therefore connected cophasally in parallel to the converter.



Note:

Same outgoing cable direction

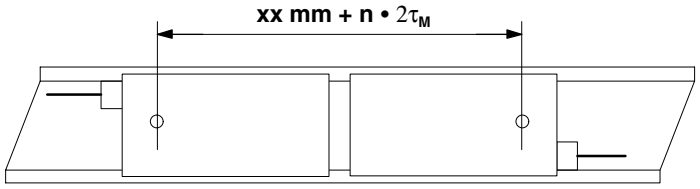
τ_M: Pole-pair width (see MD 1170)

n: 0, 1, 2, ...

Fig. 6-40 Parallel connection of linear motors (standard configurations)

Back-to-back arrangement (special type of parallel circuit)

With this parallel circuit (back-to-back arrangement), the cables exit from the individual motors in opposite directions.



Note:

Different cable exit directions

τ_M: Pole-pair width (see MD 1170), 1FN107x: τ_M = 28.2 mm, 1FN11xx and 1FN12xx: τ_M = 36 mm

n: 0, 1, 2, ...

xx: Constant dimension (see data sheet from motor manufacturer)

Fig. 6-41 Parallel connection of linear motors (Janus configuration, special type)

Temperature sensor and electrical wiring (see subsection 6.10.5)

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

- Temperature sensor
  - Motor 1: Evaluation via the drive
  - Motor 2: not connected (short-circuited and connected to PE)
- Temperature switch or PTC
  - Motor 1 and 2: External evaluation

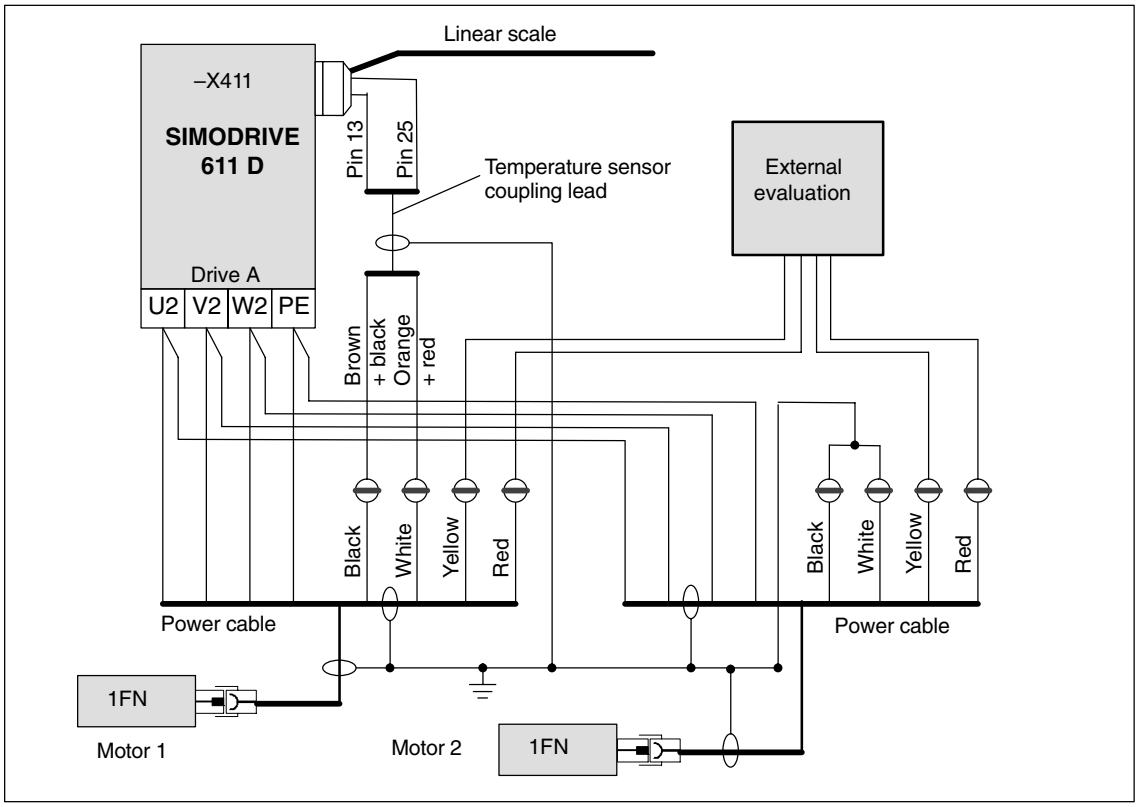


Fig. 6-42 Wiring of parallel-connected linear motors

6.10.8 Test measurements on linear motors

Why measure?

If the linear motor has been started up in accordance with instructions, but inexplicable error messages still appear, it will be necessary to test all signals by means of an oscilloscope.

Checking the phase sequence U-V-W

When the primary sections are connected in parallel, EMF_U for motor 1 must be in phase with EMF_U for motor 2.
The same applies to EMF_V and EMF_W.

This in-phase condition must be checked by means of test measurements.

Procedure for taking test measurement:

- Isolate terminals 48 and 63 on the NE module and terminal 663 on the closed-loop control unit.
- Warning: Wait until the DC link circuit has fully discharged.
- Disconnect power cable from drive. Separate any parallel connection of primary sections.
- Create an artificial neutral point using 1 kohm resistors.

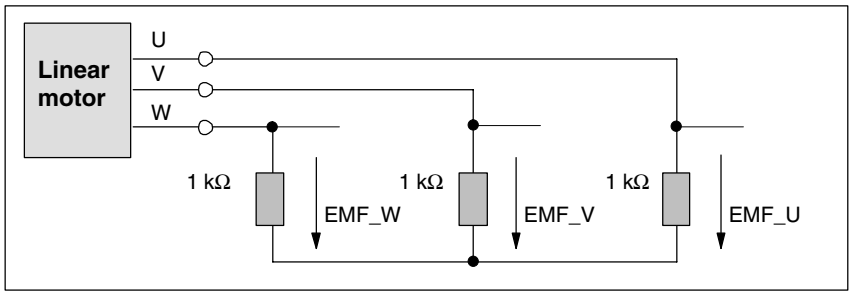


Fig. 6-43 Arrangement for test measurements

The phase sequence must be U-V-W with a positive traversing direction.

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

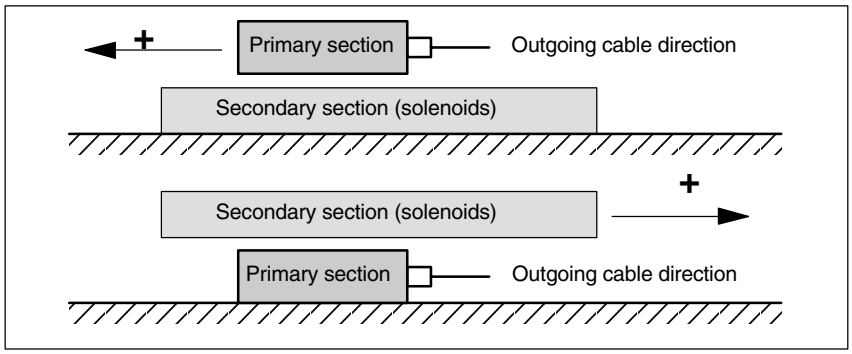


Fig. 6-44 Determining the positive direction of the drive (CW rotating field)

Determining the commutation angle

After connecting the oscilloscope, first move the drive over the zero marker that the drive is synchronized.

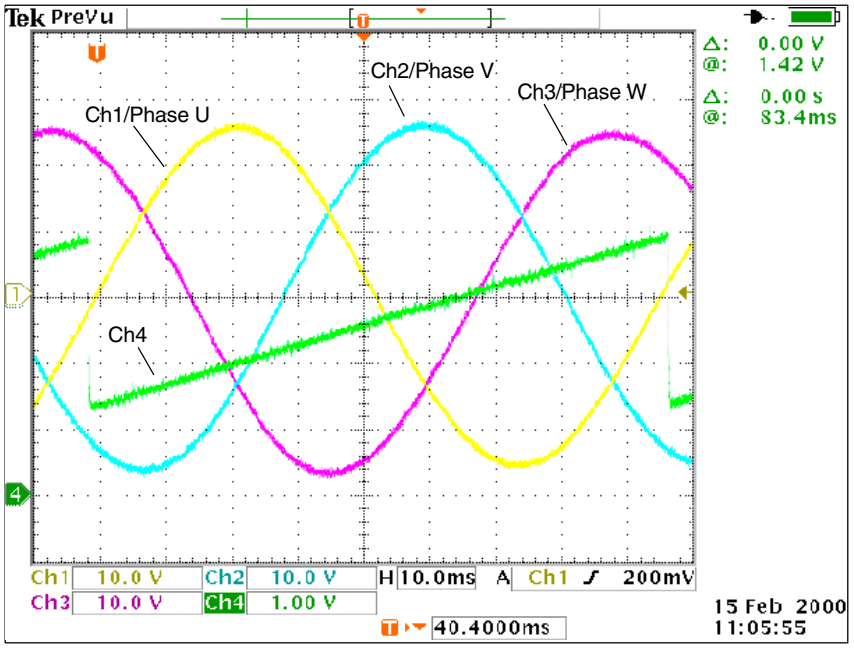


Fig. 6-45 Determining the commutation angle offset by measuring the EMF and normalized electrical rotor position via DAC in a positive drive direction

Definition of channels (Ch1 ... Ch4):

- Ch1: EMF Phase U to star point
- Ch2: EMF Phase V to star point
- Ch3: EMF Phase W to star point
- Ch4: Scaled electrical rotor position via DAU measured signal

Note

If you select the “Scaled, electrical rotor position” measured signal, the SHIFT factor should be changed from 7 to 8 and the offset value from –1.25V to –2.5V.

For a synchronized drive, the difference between the EMF/phase U and the electrical rotor position should not exceed ± 10°.

If the difference is greater, the position of the zero marker must be moved in the software in MD 1016 “COMMUTATION_ANGLE_OFFSET”.

6.11 AM/U/F function

Note

The AM/ U/F function is described in

Reference material	/FBA/	DE1, Description of the drive functions, Advanced drive functions
	/POS3/	SIMODRIVE POSMOfunction guide
	/FBU/	SIMODRIVE 611 universal function guide

6.12 System settings for power-up, RESET and starting part programs

Concept

The response of the control changes after the following actions:

- Power-up (POWER-ON),
- Reset/end of part program and
- Start of part program

The following machine data settings affect the above actions:
MD 20110: RESET_MODE_MASK (define the basic control settings after power-up and reset) and
MD 20112: START_MODE_MASK (define the basic control settings after start of part program)

Table 6-30 Changing system settings with MD

Status	can be changed by MD
Power-up (POWER-ON),	RESET_MODE_MASK
RESET/end of part program	RESET_MODE_MASK
Start of part program	START_MODE_MASK and RESET_MODE_MASK

Procedure

Select the required system response.

- after power-up (POWER-ON)
  MD 20110: RESET_MODE_MASK, Bit 0 = 0 or 1

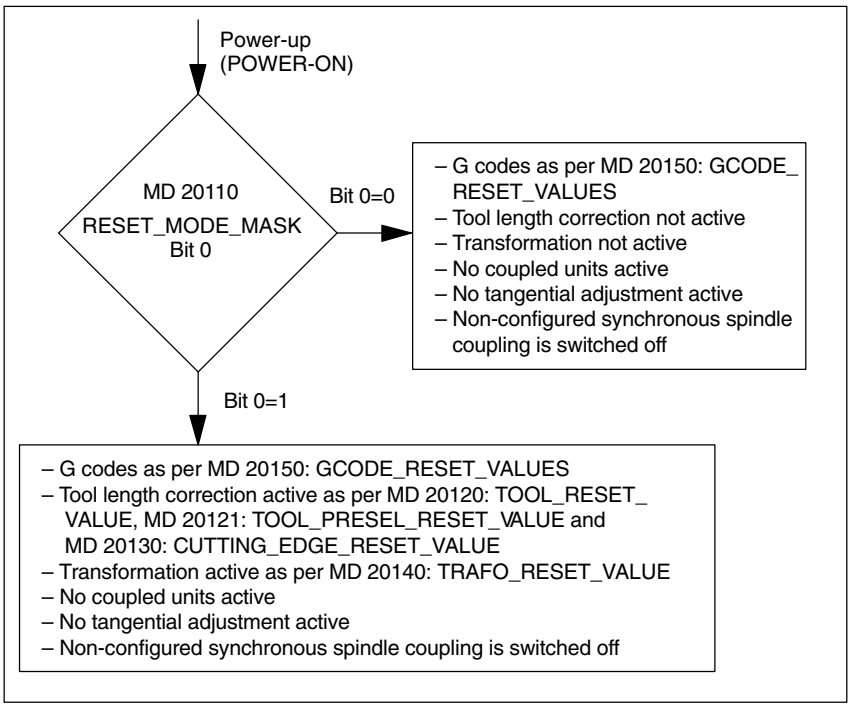


Fig. 6-46 System settings after power-up

- after RESET/end of part program
  MD 20110: RESET_MODE_MASK, Bit 4–10 = 0 or 1

  Bits 4 – 10 may be combined as required.

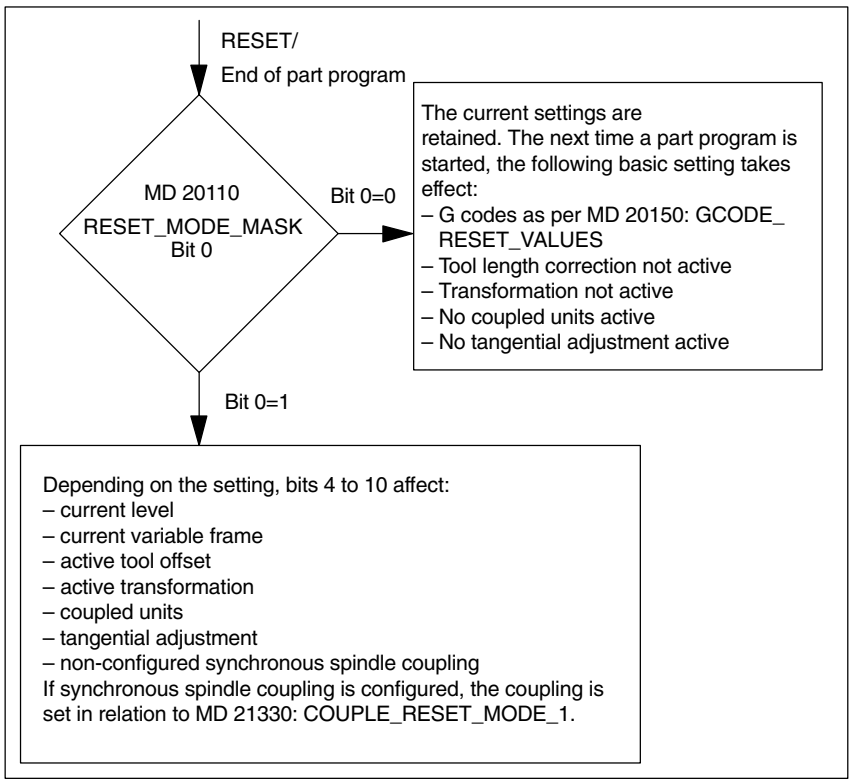


Fig. 6-47 System settings after RESET/end of part program

- after start of part program

MD 20112: START_MODE_MASK, Bit 4–10 = 0 or 1

Bits 4 – 10 may be combined as required.

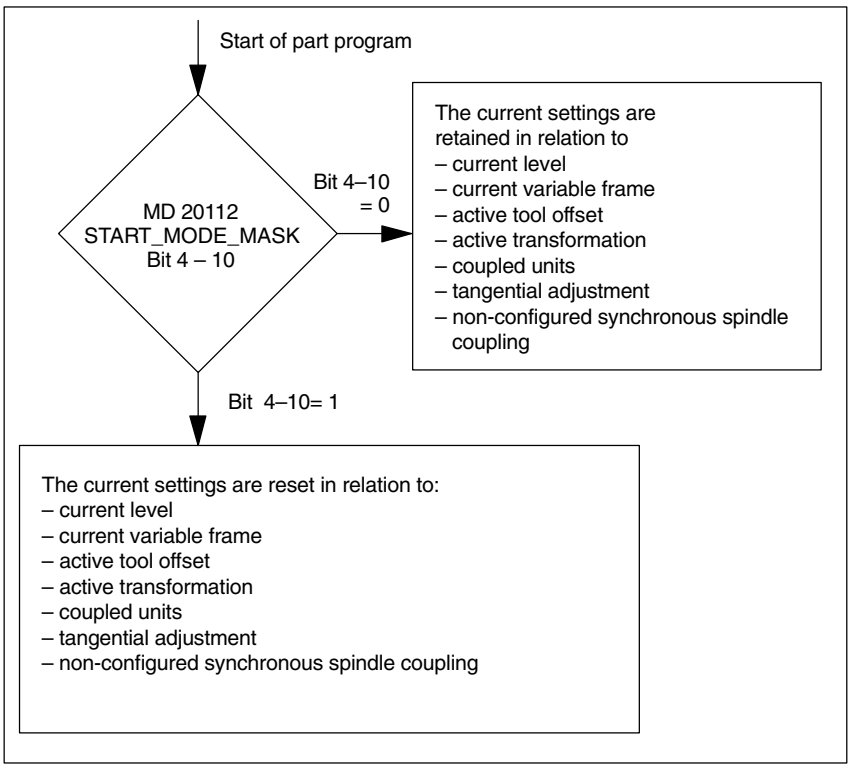


Fig. 6-48 System settings after start of part program

Reference material: /FB1/ K2, Functional description of the basic machines, Axes, coordinate systems, frames, Section: Actual value system in vicinity of workpiece

■

Notes

PLC Description

7

7.1 PLC start-up

PLC module

The PLC in the 840D is compatible with the SIMATIC Step7 AS314.
The basic model has 64 KB of memory, which can be upgraded with another 32 KB to make a total of 96 KB (option).

Basic program and user program

The PLC program is divided into the basic program and the user program. The entry points for the user program are marked in OBs 1, 40 and 100 of the basic program.

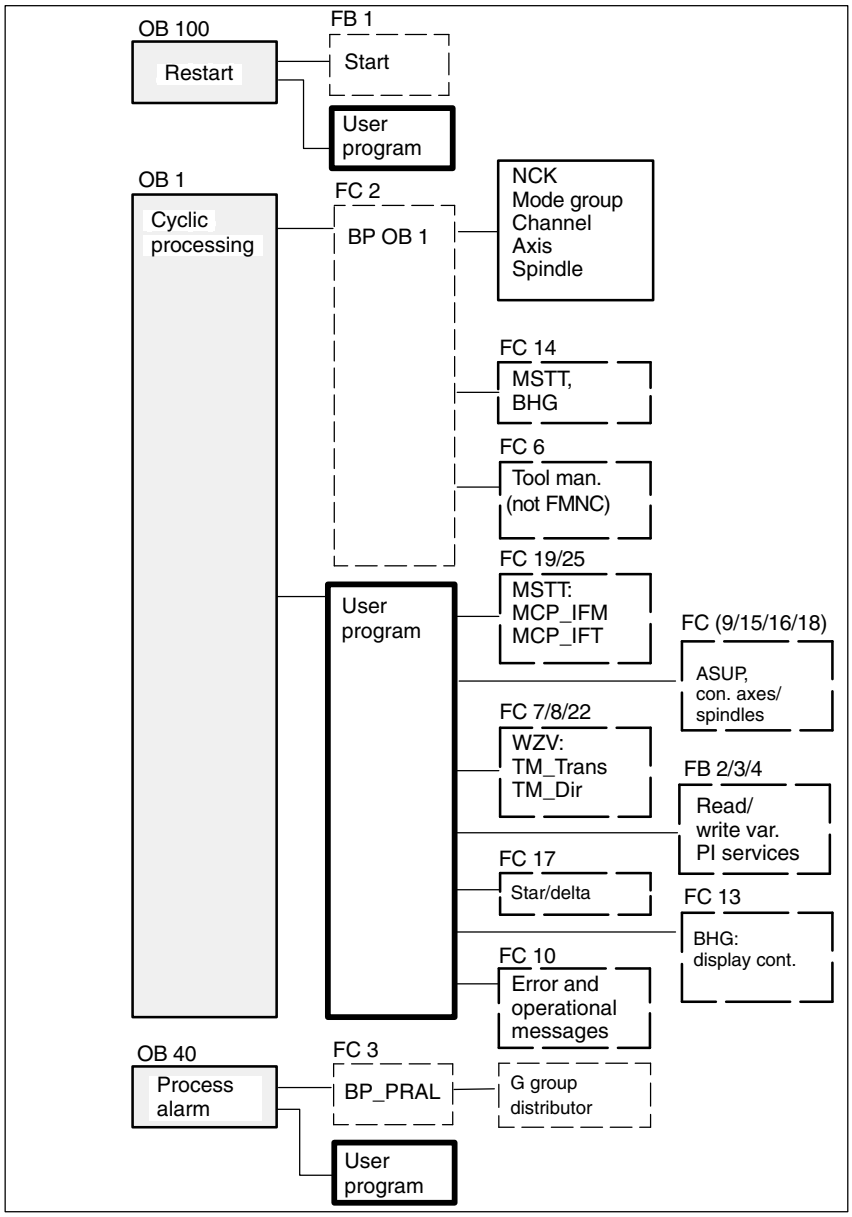


Fig. 7-1 Structure of the basic program

Tool box

The basic PLC program is an integral component of the SINUMERIK 840D tool box.

PLC memory

Set the “PLC memory” option if necessary.

Download PLC program

There are two ways to download the finished PLC program:

1. Load, test and change the PLC program with SIMATIC STEP7 HiGraph (also see Readme file on the basic program disk).
2. Download an archived PLC program with PCIN or from the HMI

Note

The STEP7 project manager (S7 TOP) does not display the SDB as standard. To display the SDB, select “All blocks with SDBs” from the “View” –> “Set filters” menu.

PLC status

The “Diagnostics” menu includes the PLC status option for controlling and monitoring PLC inputs, outputs, flags, etc.

Starting characteristics of the PLC

The PLC always powers up in RESTART mode, i.e. the PLC operating system runs through OB100 after initializing and then starts cyclical operation at the start of OB1. No re-entry takes place at the interruption point (e.g. after power failure).

RESTART mode

For the flags, timers and counters there are both retentive and non-retentive areas. Both area types are contiguous, but are separated by a parameterizable limit, the area with the higher-order address being designated as the non-retentive area. Data blocks are always retentive.

If the retentive area is not buffered (back-up battery empty), then start-up is blocked. The following operations are performed during a restart:

- Delete IStack, BStack and non-retentive flags, timers and counters
- Delete process output image (POI)
- Reject process and diagnostic alarms
- Update system status list
- Evaluate parameterization objects of modules (from SD100 onwards) or output default parameters to all modules in single-processor mode
- Process restart OB (OB100)
- Read in process input image (PII)
- Cancel command output disable (BASP)

Cyclical operation

The basic program before the PLC user program is processed. In cyclic operation, the NC/PLC interface is fully processed. At the process alarm level, the current G functions are transferred to the PLC, if this function is active.

Sign-of-life monitoring

A cyclic monitoring function is activated between the PLC and NCK once power-up and the first OB1 cycle have been completed. When the PLC fails, alarm “2000 sign of life monitoring PLC” is displayed.

Reference material: /FB1/ P3, Function guide,
PLC basic program powerline
/S7H/ SIMATIC S7-300

Parameters for FB1

FB 1 (power-up block for the PLC basic program) must be supplied with variables.

For an exact description of variables and options for changing parameter settings, please refer to

Reference material: /FB1/ P3, Function guide, PLC basic program powerline

Note

Timers T0 to T9 are used by the basic program.

7.2 Overview of the organizational blocks, function blocks, DBs

Reference material: /FB1/ P3, Function guide, PLC basic program powerline

■

Alarm and Message Texts

8

To allow alarm and message texts to be easily modified to suit the requirements of a specific automation system, the alarm and message texts are stored in ASCII format in freely accessible text files.

8.1 Alarm text files for HMI Embedded

Description

When the HMI Embedded application diskette is installed (see chapter 12), the

- configuration settings,
- texts,
- the configured interface and
- the user software

are transferred from the update directory on your PC/PG to the PCU 20 hardware. The ways in which the alarm text files can be adapted beforehand are described here.

Preconditions

- PC with DOS 6.x
- V.24 cable between the COM1 port on the PCU (X6) and the COM1 or COM2 port on your PC
- Approx. 3 MB free space on hard disk
- The following description assumes that you have already transferred the software from the HMI Embedded application diskette (diskette 2) to the hard disk of the PC/PG (as described in chapter 12).

Alarm texts/ message texts

The texts are stored with the Siemens defaults n the selected drive on your PC. For the sake of simplicity, it is assumed that this is always C: in the following description. The directory is:

C:\mmc 100 pj\proj\text\<LANGUAGE DIRECTORY>
Depending on the selected language, one of the following letters stands for <LANGUAGE DIRECTORY>:

D	for German
G	for English
F	for French
E	for Spanish
I	for Italian.

Files

The text file names start with “a” and end in the extension .txt.

- ALZ.TXT Cycle alarm texts
- ALC.TXT Compile cycle alarm texts
- ALP.TXT PLC alarm/message texts

Editor

The DOS editor “edit” should be used for editing.
The standard texts contained in the text files can be overwritten by user-specific texts. An ASCII editor, e.g. DOS editor, must be used for this purpose. New entries can be added to alarm text files.
Please refer to Section 8.3 for the applicable syntax rules.

Multiple languages

HMI Embedded may be set up online with two languages. These are referred to as the foreground and background languages.

The foreground and background languages of the HMI system can be changed using the application diskette, as described in chapter 12, “Changing the Software and Hardware”.

During installation, it is possible to select any combination of two of the languages on the application disk as the foreground and background languages.

Master language

The master language is German. It defines the number and order of the alarm/message texts for the languages selected by the user.

The number and order of the alarm/message texts in the selected languages must be identical to those of the master language.

Converting and transferring

Once you have made the changes, you must then convert the text files and transfer them to the PCU 20 (chapter 12).

Note

For the user, 128 KB are available for additional text files.

8.2 Alarm text files for HMI Advanced

Storing the text files

The files with the error texts are stored in the C:\dh\mb.dir\ directory on the hard disk. The error text files intended for use are activated in file c:\mmc2\mbdde.ini.

Structure of MBDDE.INI

Extract from mbdde.ini, of relevance for configuring the alarm text files:

```
...
[Text files]
MMC=c:\dh\mb.dir\alm_
NCK=c:\dh\mb.dir\aln_
PLC=c:\dh\mb.dir\alp_
ZYK=c:\dh\mb.dir\alc_
CZYK=c:\dh\mb.dir\alz_
UserHMI=
UserNCK=
UserPLC=c:\dh\mb.dir\myplc_
UserZyk=
UserCZyk=
...
```

Standard text files

The standard texts are stored in ASCII format in the following files on the hard disk of the PCU 50/ 50.3/ 70.

HMI	C:\dh\mb.dir\alm_XX.com
NCK	C:\dh\mb.dir\aln_XX.com
PLC	C:\dh\mb.dir\alp_XX.com
ZYK	C:\dh\mb.dir\alc_XX.com
CZYK	C:\dh\mb.dir\alz_XX.com

In these file names, “XX” stands for the code of the appropriate language.

The standard files should not be changed by the user to store his or her own error texts. If these files were replaced with new files during a software upgrade of the HMI, any added or modified user-specific alarms will be lost. The user should store his own error texts in user files.

User files

The user can replace the error texts contained in the standard files with his own texts or add new texts. To do this, the additional files must be downloaded to the c:\dh\mb.dir directory (MBDDE alarm texts) via the Utilities area. The names of these text files are set in file c:\mmc2\mbdde.ini The “Diagnostics” –> “Start-up” –>“HMI” area contains an editor for this purpose.

Sample configurations for two additional user files (texts for PLC alarms, modified alarm texts NCK) in the MBDDE.INIfile

```
...
User HMI =
User NCK = C:\dh\mb.dir\mynck_
User PLC = C:\dh\mb.dir\myplc_
User ZYK =
User CZYK =
...
```

The texts from the user files overwrite standard texts with the same alarm number. Alarm numbers which do not already exist in the standard texts are added.

Editor

An ASCII editor (e.g. the DOS editor “edit”) must be used for editing files.

Language-specific nature of the alarm texts

The language for the user alarm texts is assigned via the name of the text file. The appropriate code and the extension .com are added to the user file name entered in mbdde.ini:

Language	Code
German	gr
English	uk
French	fr
Italian	it
Spanish	sp

Example

myplc_gr.com File for German PLC alarm texts
mynck_uk.com File for English NCK alarm texts

Note

Changes to alarm texts do not take effect until the HMI has powered up again.

When you create the text files, make sure that the date and time are set correctly on the PC, otherwise the user texts may not be displayed on screen.

Example for HMI Advanced

File with German user texts, PLC:

myplc_gr.com
700000 0 0 “DB2.DBX180.0 set”
700001 0 0 “No lubrication pressure”

The maximum length of an alarm text is 110 characters for a 2-line display.

8.3 Syntax for alarm text files

Alarm numbers

The following alarm numbers are available for the cycle, compile cycle and PLC alarms:

Table 8-1 Alarm numbers for cycle, compile cycle and PLC alarms

Number range	Designation	Effect	Clear
60000–60999	Cycle alarms (Siemens)	Display, lock NCK start	Reset
61000–61999		Display, lock NCK start, motion stopped	Reset
62000–62999		Display	Cancel
63000–64999	Reserved		
65000–65999	Cycle alarms (user)	Display, lock NCK start	Reset
66000–66999		Display, lock NCK start, motion stopped	Reset
67000–67999		Display	Cancel
68000–69000	Reserved		
70000–79999	Compile cycle alarms		
400000–499999	PLC alarms general		
500000–599999	PLC alarms for channel		
600000–699999	PLC alarms for axis and spindle		
700000–799999	PLC alarms for user		
800000–899999	PLC alarms for sequence cascades/graphs		

Format of the text file for cycle alarm texts

The range of numbers given in the list is not available with every number, see

Reference material: /FB1/ P3, PLC basic program powerline,
/LIS1/ Lists

Table 8-2 Structure of text file for cycle alarm texts

Alarm number	Display	Help ID	Text or alarm number
60100	1	0	“No D number %1 is programmed”
60101	1	0	60100
...	...	...	...
65202	0	1	“Axis %2 in channel %1 is still moving”
// Alarm text file for cycles in German			

Alarm number List of alarm numbers

Display

This number defines the alarm display type:
0: Display on the alarm line
1: Display in a dialog box

Help ID

HMI Advanced only (PCU 50/ 50.3/ 70, with hard disk): The default assignment of “0” means that the WinHelp file supplied by Siemens gives a detailed explanation of the alarm. A value between 1 and 9 refers to a WinHelp file created by the user via an allocation table in the MBDDE.INI file. See also Subsection 8.3.1, HelpContext.

Text or alarm number

The associated text is given in inverted commas with the position parameters.

- You must not use the “ and # characters in alarm texts.
  The % character is reserved for displaying parameters.
- If an existing text is to be used, this can be done with a reference to the corresponding alarm. 6-digit alarm number instead of “Text”.
- The alarm 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 truncated and the symbol “*” added to indicate missing text.
- Parameter “%K”: Channel number (2nd digit of the alarm number)
  Parameter “%A”: The parameter is replaced by the signal group number (e.g. axis no., user range no., sequence no.)
  Parameter “%N”: Signal number
  Parameter “%Z”: Status number

Format of the text file for PLC alarm texts

The ASCII file for PLC alarm texts has the following structure:

Table 8-3 Structure of text file for PLC alarm texts

Alarm no.	Display	Help ID	Text	Text in HMI
510000	1	0	“Channel %K FDDIS all”	Channel 1 FDDISd all
600124	1	0	“Feed disable axis %A”	Feed disable axis 1
600224	1	0	600124	Feed disable axis 2
600324	1	0	600224	Feed disable axis 3
703210	1	1	“User Text”	User Text
...				
703211	1	1	“User Text %A ...”	User Text Axis 1 ...
// Alarm text file for PLC alarm				

Alarm number

The alarm number is made up of the event number (2 digits), signal group (2 digits) and the signal number(2 digits). These parameters are components of a diagnostic element on the AS315.

Reference material: /FB1/ Function manual for basic machines, P3: PLC basic program powerline (P3 PI)

Event number	Signal group		Signal number
5 x (for channels)	00–03 11–16 21–28	(inhibits) (GEO axes) (additional axes)	00–99
60 (for axis and spindle)	01–18	(axis no.)	00–99
70 (for user)	00–09	(user no.)	00–99
80 (status graph alarms)	00–99	(graph group)	00–99 (graph no.)

Display

This number defines the alarm display type:
0: Display on the alarm line
1: Display in a dialog box

8.3.1 Alarm list properties

In addition to the current alarms, the user interface also displays an alarm log containing all the alarms that have previously occurred in the form of a list. You can modify the properties of the alarm list in the MBDDE.INI file.

Table 8-4 Sections of the MBDDE.INIfile:

Section	Meaning
Alarms	General information about the alarm list (e.g. time/date format of messages)
Text files	Path/file of the text lists for the alarms (e.g. MMC=..\dh\mb.dir\alm_ <signal block in the mb dir.)
HelpContext	Name and path name of the help files (e.g. File0=hlp\alarm_)
DEFAULTPRIO	Priorities of various alarm types (e.g. POWERON=100)
PROTOCOL	Properties of the protocol (e.g. File=.\proto.txt <name and path of log file>)
KEYS	Information on keys that can clear alarms (e.g. Cancel+F10 <delete alarm using the key combination Shift+F10>)

For further details of the file entries, refer to

Reference material: /BN/ HMI Programming Package, Part 1

"Alarms"

The settings in this section define the following alarm list properties:

- TimeFormat
  Enter the format to be used when outputting the date and time. This corresponds to the CTime::format from the Microsoft Foundation Classes.

- MaxNo
  Defines the maximum size of the alarm list.
- ORDER
  Defines the order in which the alarms are added to the alarm list:
  FIRST means that more recent alarms are placed at the top of the list,
  LAST means that new alarms are placed at the end.
- PLCTIME
  Siemens internal variable for PLC software releases older than 3.2. Do not change the PLCTIME setting.

Example:

```
[Alarms]
TimeFormat=%d.%m.%y %H:%M:%S
MaxNo=50
ORDER=LAST
PLCTIME=5000
```

■

Axis/Spindle Dry Run

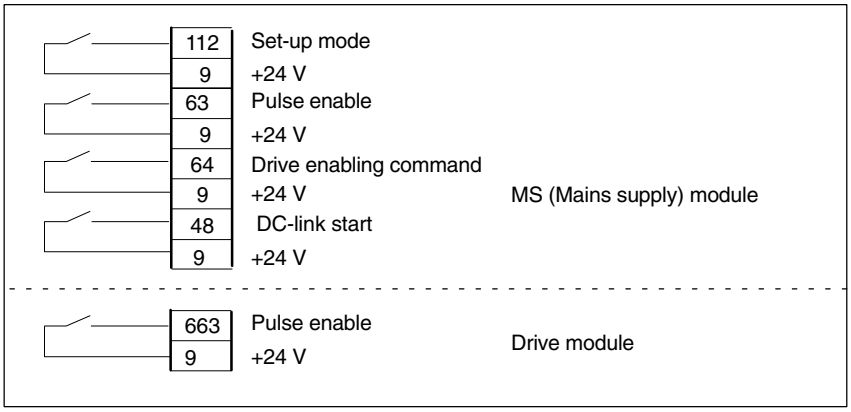
9

9.1 Requirements

Enables for axes

To allow an axis to be moved by the control, enabling terminals on the drive must be powered and enable bits set at the interface.

Enables on the drive



Reference material: /PJU/ Converter Configuration Guide

Warning

Despite the “Axis disable” command via terminal 663, dangerous voltages may still be present at the drive control output terminals.

The “Axis disable” command via terminal 663 is not suitable for electrical isolation or for use as a drive deactivation mechanism.

Enabling via PLC interface

The following signals must be made available at the PLC interface for axis or spindle:

NST “Controller enable”	(DB31–61, DBX2.1)
NST “Pulse enable”	(DB31–61, DBX21.7)
NST “Position measuring system 1 or 2”	(DB31–61, DBX1.5, DBX 1.6)

The following signals on the interface must not be set or else the axis/spindle motion will be disabled:

NST “Feed/spindle correction switch”	(DB31–61, DBB0) not set to 0%
NST “Axis/spindle disable”	(DB31–61, DBX1.3)
NST “Adjustment mode”	(DB31–61, DBX1.4)
NST “Remaining distance/spindle reset”	(DB31–61, DBX2.2)
NST “Feed stop/ spindle stop”	(DB31–61, DBX4.3)
NST “Travel button disable”	(DB31–61, DBX4.4)
NST “Power-up sensor disable”	(DB31–61, DBX20.1)

Reference material: /FB1/ A2, Function Guide,
Various NC/PLC interface signals and functions
Section: Interface signals from and at axis/spindle

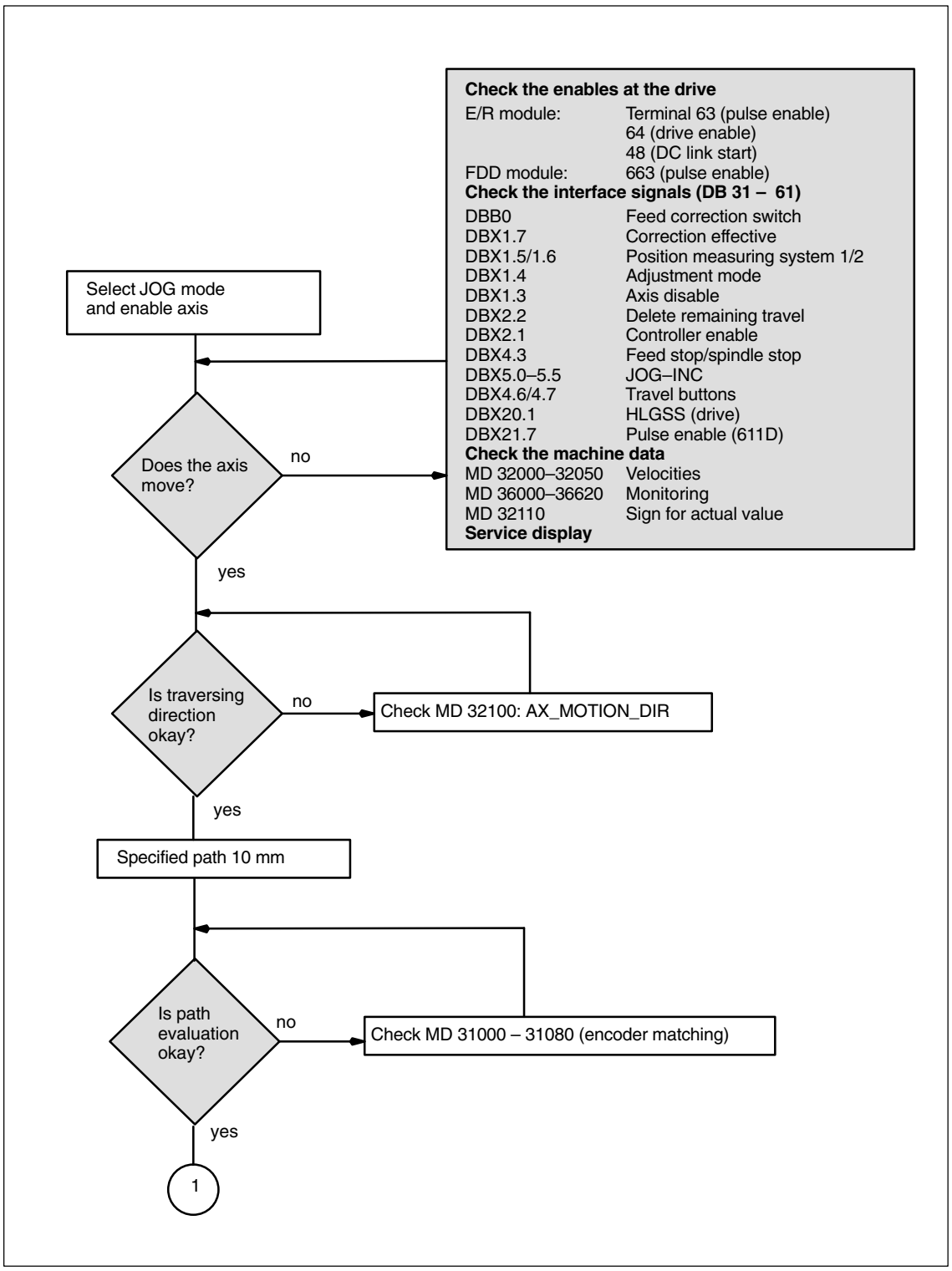
Limit switch

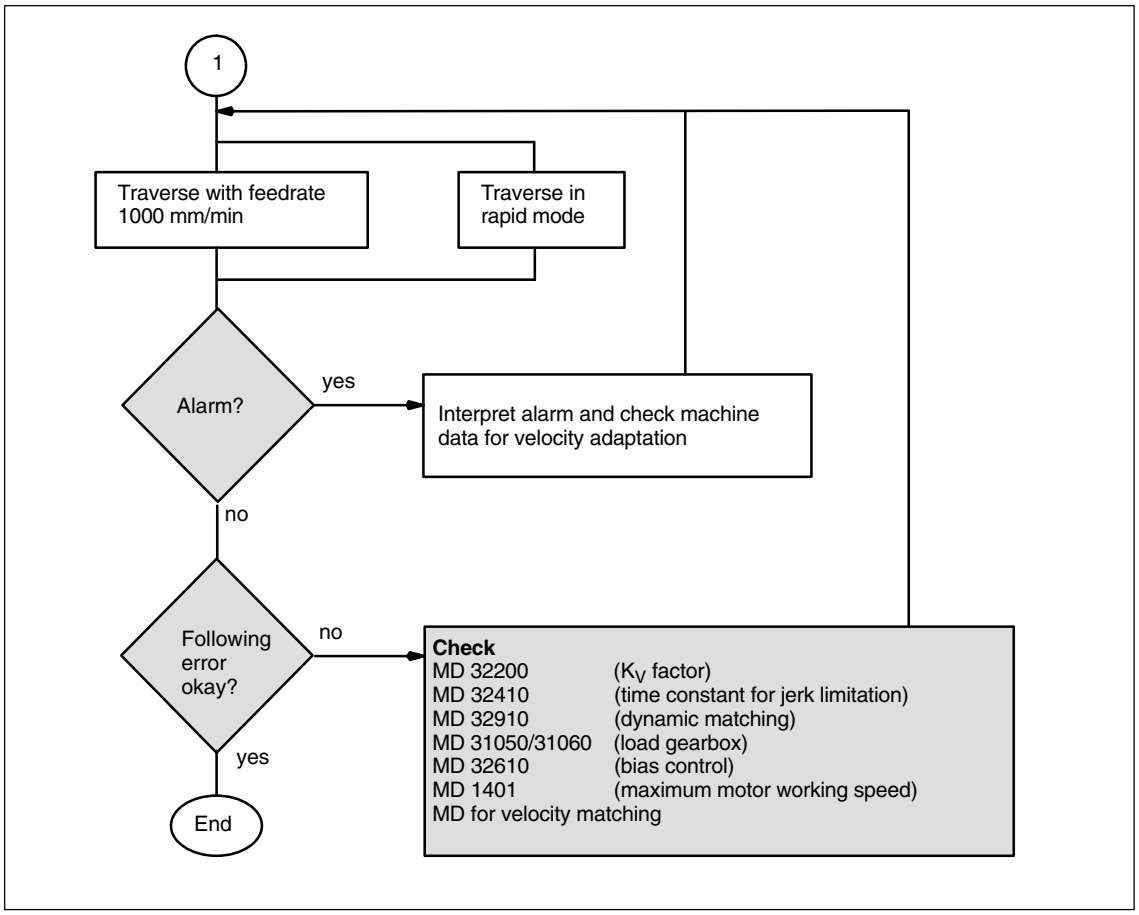
Setting of hardware limit switches and interface signal check:

- Hardware limit switch PLUS DB31–61.DBX12.1
- Hardware limit switch MINUS DB31–61.DBX12.0

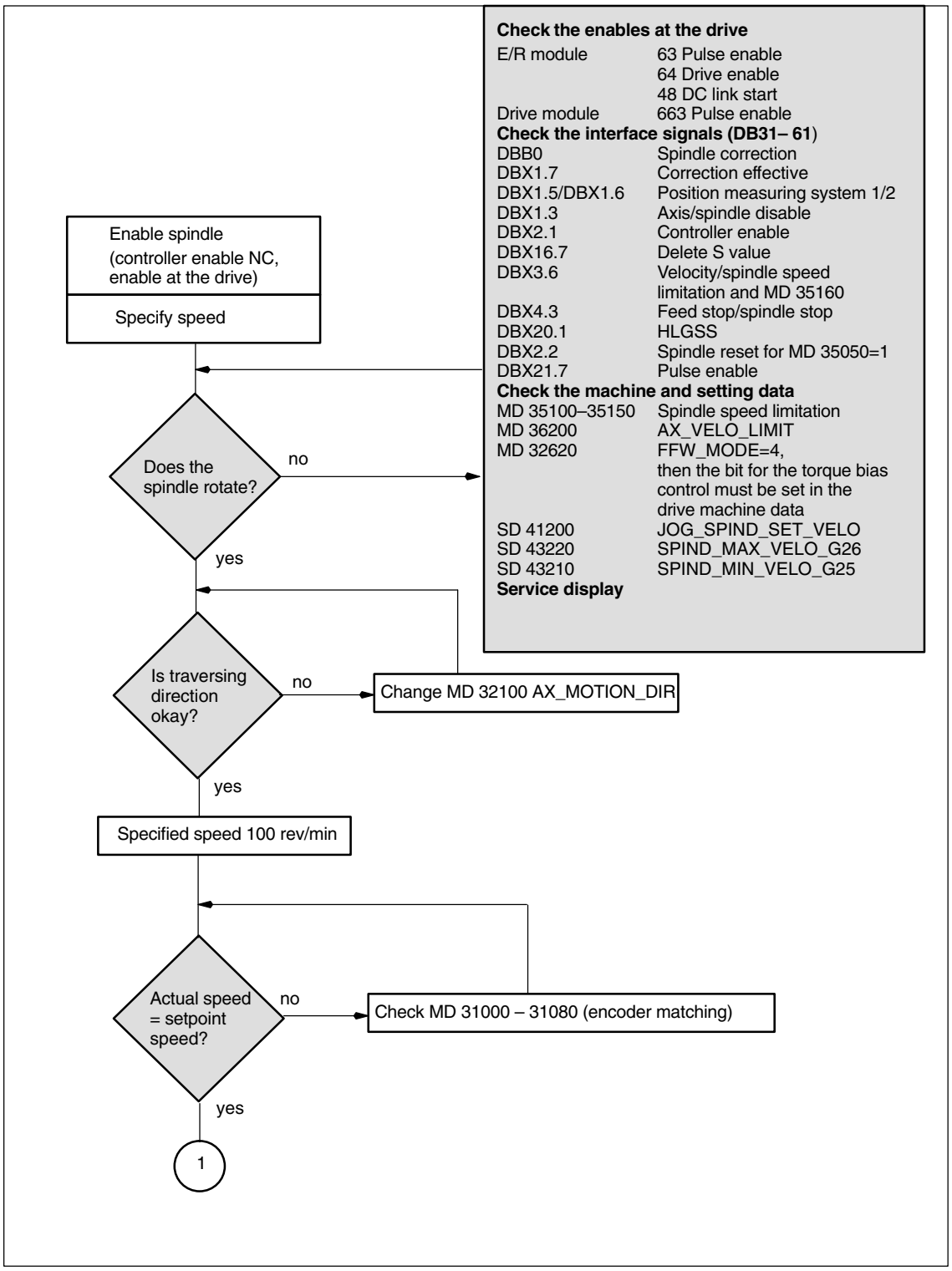
Reference material: /FB1/ A3, Function Guide
Axis monitoring, protection areas,
Section: Monitoring of static limits

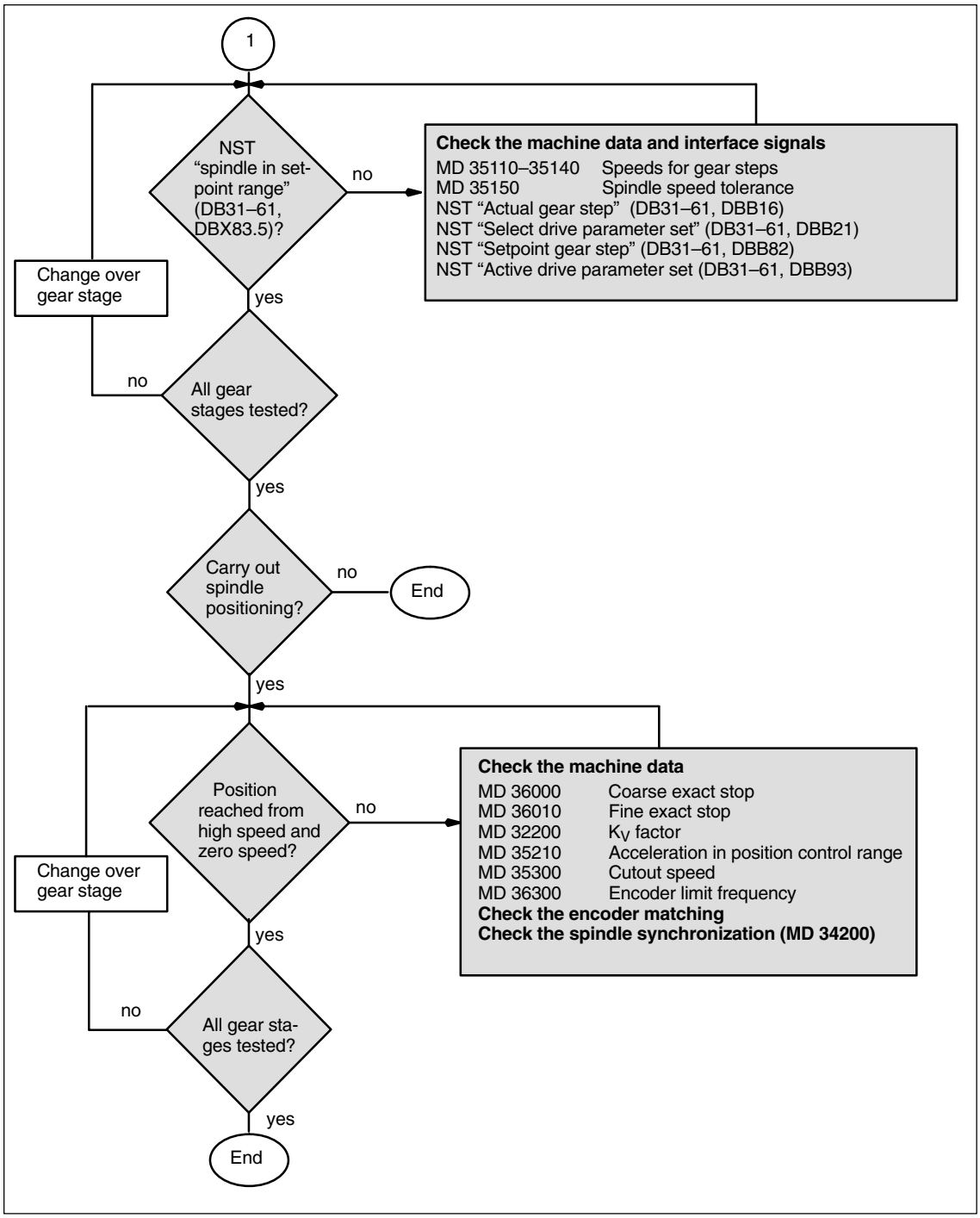
9.2 Axis dry run





9.3 Test of the spindle





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Drive Optimization

10

10.1 Overview

This tool can be used during initial start-up to input the drive configuration and assign drive parameters with standard data sets as determined by the motor/ power section combination. It also allows the drive and control data to be archived on the PG or PC.

Further functions are also provided to assist optimization and diagnosis.

HMI Embedded

With HMI Embedded, the “Start-up Tool” start-up software is used to configure and assign parameters to the drives.

HMI Advanced

With HMI Advanced, you have the option of carrying out the tuning directly via the user interface in the “Start-up” area under the “Drives/Servo” menu option.

Start-up: Drives/Servo

The following functions are available:

- Frequency response measurement, speed control loop
- Frequency response measurement, position control loop
- Function generator
- Circularity test
- Servo trace

Measuring functions

The measuring functions are used to evaluate the most important speed and position control loop quantities, and to control the torque in the time and frequency range. This is displayed on-screen and no external measuring instruments are necessary.

Analog output

All important control loop signals on the position, speed and torque levels can also be output with the DAC configuration on external equipment (e.g. oscilloscope, signal recorder) via test sockets on the 810D (611D control).

FFT analysis (Fourier analysis)

Apart from the usual method of optimizing the control loop machine data based on transient response, i.e. time characteristics, a particularly powerful tool for assessing the control loop setting is provided in the form of the integrated Fourier analysis (FFT) function which also be applied to analyze the given mechanical characteristics. This tool must be used if

- unsteady current, 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 is used to analyze the contour accuracy at the quadrant transitions of circular contours achieved by means of friction compensation (conventional or neural quadrant error compensation).

Reference material: /FB3/ K3 Function manual for advanced functions Compensation, section: Circularity test

Servo trace

The servo trace is used to analyze the changes over time in servo and drive data with the aid of graphs. For example:

- Actual position value
- Position setpoint
- Following error
- Contour deviation

Saving measurement results

Saving measurement resultsThe measurement diagrams can be archived via file functions, allowing machine settings to be documented and facilitating remote diagnostics.

10.2 Measuring functions

Explanation

There are a range of measuring functions for displaying the time and frequency behavior of drives and controls in graph form on screen. Test signals of variable duration are applied to the drives for this purpose.

Measuring/signal parameters

The test setpoints are adapted to the application by means of measuring and signal parameters. The units of these parameters depend on the measuring function or operating mode. The following conditions apply for the units of these measuring and signal parameters:

Table 10-1 Quantities and units for measuring and signal parameters

Quantity	Unit
Torque	Specified in percent referred to the peak torque of the power section used. The torque is calculated for the power section from: MD 1108 x MD 1113
Velocity/speed	Metric system: Specified in mm/min or rev/min for linear or rotary motions Inch system: Specified in inch/min or rev/min for linear or rotary motions
Distance	Metric system: Specified in mm or degrees for linear or rotary motions Inch system: Specified in inches or degrees for linear or rotary motions
Time	Specified in ms
Frequency	Specified in Hz

Note

All the parameters are preceded with 0.

Requirements for starting measuring functions

The measuring functions must be started in “JOG” mode to ensure that there are no accidental traversing motions due to part programs.

Caution

During the traversing motions made as part of measuring functions, no software limit switches or working field limits are monitored since this is done in follow-up mode.

Before starting the measuring functions, the user must therefore ensure that the axes are positioned so that the traveling range limits specified for the measuring functions are sufficient to prevent collision with the machine.

Starting measuring functions

Measuring functions that trigger a traversing motion can only be selected via the specific soft key. The measuring function and thus the traversing motion are always actually started via “NC-START” on the machine control panel.

If you exit the main screen for the measuring function without starting the traversing motion, the selected traversing function will be canceled.

Once the traversing function has been started, you can exit the main screen without affecting the function.

Note

“JOG” mode must be selected in order to start measuring functions.

Other safety instructions

The user is to ensure that, while the measuring functions are in use, that:

- the “Emergency stop” button is within range
- there are no obstacles in the traveling range

Canceling measuring functions

The following event cause active measuring functions to be canceled:

- Hardware limit switch reached
- Traversing range limits exceeded
- Emergency stop
- Reset (mode group, channel)
- NC stop
- Removal of controller enable
- Removal of drive enable
- Removal of travel enable
- Park function is selected (in position-controlled mode)
- Feed override 0%
- Spindle override 50%
- Change of operating mode (JOG) or JOG operating mode not selected
- Pressing the Travel buttons
- Turning the handwheel
- Alarms that cause the axes to stop

10.3 Interface signals: Drive test travel request and Travel enable

Explanation

Axes with a mechanical brake may need the brake to be activated in some cases. This is done using the **Enable with PLC** function from the main screen of the travel function concerned.

In the PLC user program, this can be done with the **travel request** (NCK→PLC) signal that is generated when the measuring function is selected.

– DB31–DB61, ... DBX61.0 “Drive test travel request”

and the acknowledgment signal for the **motion enable** (PLC→NCK)

– DB31–DB61, ... DBX1.0 “Drive test travel enable”

can then be linked in the PLC user program as follows.

This safety mechanism can be deselected via the **Enable option without PLC**.

Reference material: /FB1/ A2, Various NC/PLC interface signals and functions

Deactivating monitoring

The traversing range monitoring function can be deactivated for axes with an infinite traversing range.

10.4 Frequency response measurement

10.4.1 Scanning the torque control loop

Functionality

It is only necessary to scan the torque control loop for diagnostic purposes in the event of an error or if standard data was not used for the particular motor/ power section combination, leading to unsatisfactory speed controller frequency responses.

Note

The user must take special safety precautions before measuring the torque control loop for vertical axes that have no external weight compensation (drive must be securely clamped).

Procedure

1. Setting the traveling range monitoring and the enabling logic on the **main screen.**
2. Setting the necessary parameters on the **measuring parameters screen**
3. Displaying the measurement result on screen using the **Display** soft key

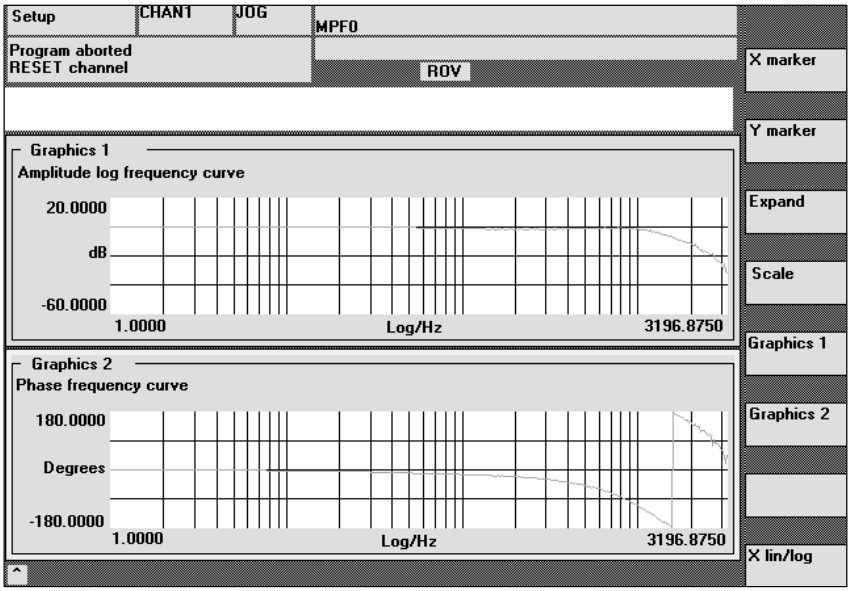


Fig. 10-1 Display diagram: Example of a current control loop

Measuring parameters

Amplitude
This parameter determines the test signal amplitude (unit: specify the peak torque as %). Values between 1 and 5% are suitable.

Bandwidth
Analyzed frequency range

- 4.0 kHz for 840D, double axis modules (scanning frequency 16.0 kHz).
- 8.0 kHz for 840D (scanning frequency 16.0 kHz).

Averaging
This value increases both the accuracy of the measurement and the measuring duration. A value of 20 is normally suitable.

Settling time
Recording of the measured data starts after a delay equal to the set settling time after activation of the test setpoint. A value of approximately 10 ms is recommended.

Additional information

The measuring parameters and measurement results (diagrams) can be loaded or saved using the **File functions** soft key.

10.4.2 Scanning the speed control loop

Functionality

The behavior when transferring to the motor measuring system is always analyzed. Various lists of measuring parameters are offered depending on which basic setting is selected for the measurement.

Procedure

The traversing range monitoring function is set and the enabling logic (external/ internal) selected in the **main screen**.

1. Setting the traveling range monitoring and the enabling logic on the **main screen**. One of four different types of measurement can be selected:
   - Reference frequency response
   - Interference frequency response
   - Setpoint step change
   - Disturbance step change
2. Setting the necessary parameters on the **measuring parameters screen**
3. Displaying the measurement result on screen using the **Display** soft key

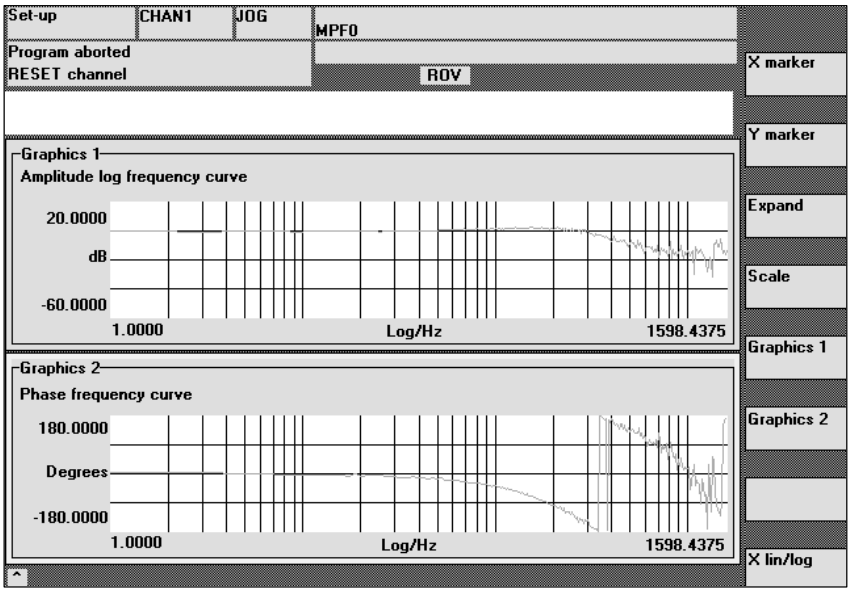


Fig. 10-2 Display diagram: Example of speed control loop

Guide frequency response

The guide 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 also be necessary to use stop or low-pass filters (611D). Particular care must be taken to prevent resonance within the speed controller limit frequency range (stability limit approx. 200-500 Hz).

Interference frequency response

Alternatively, the interference frequency response can be recorded to evaluate the noise suppression of the controller.

Measuring parameters for guide and interference frequency response

Amplitude
This parameter determines 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.

Offset
The measurement requires a low speed offset of just a few motor revolutions per minute. The set offset must be greater than the amplitude.

From SW 4.1:

- The **offset** is started up via an acceleration ramp.
- The acceleration value is defined for an
  Axis: MD 32300: MAX_AX_ACCEL
  Spindle: MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL
  MD 35210: GEAR_STEP_POSCTRL_ACCEL
- Where: Acceleration value = 0, no ramp
  Acceleration value > 0, ramp active
- The actual measuring function is not activated until the offset value is reached.

Bandwidth
Analyzed frequency range

- 4.0 kHz for 840D (scanning frequency 8.0 kHz).

Averaging
This value increases both the accuracy of the measurement and the measuring duration. A value of 20 is normally suitable.

Settling time
Recording of the measured data starts after a delay equal to the value set here after activation of the test setpoint. A value of between 0.2 and 1 s is recommended.

Setpoint and interference variable step change

Initiation of the step change can be used to assess the transient response (response to setpoint changes or response to interference) of the speed controller within the time range. The test signal is connected to the speed controller output for recording of the response to interference.

Measuring parameters for setpoint and interference variable step changes

Amplitude
This parameter determines the magnitude of the set setpoint or interference step change

Measuring time
This parameter determines the recorded period (up to 2048 x speed controller cycles).

Offset
A small offset of a few motor revolutions per minute may be set to eliminate the influence of adhesive friction.

- The **offset** is started up via an acceleration ramp.
- The acceleration value is defined for an axis/spindle:

Axis:	MD 32300: MAX_AX_ACCEL
Spindle:	MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL MD 35210: GEAR_STEP_POSCTRL_ACCEL
Where:	Acceleration value = 0, no ramp Acceleration value > 0, ramp active

- The actual measuring function is not activated until the offset value is reached.

Settling time
Recording of the measured data and outputting of the test setpoint start after a delay equal to this value after the offset is activated.

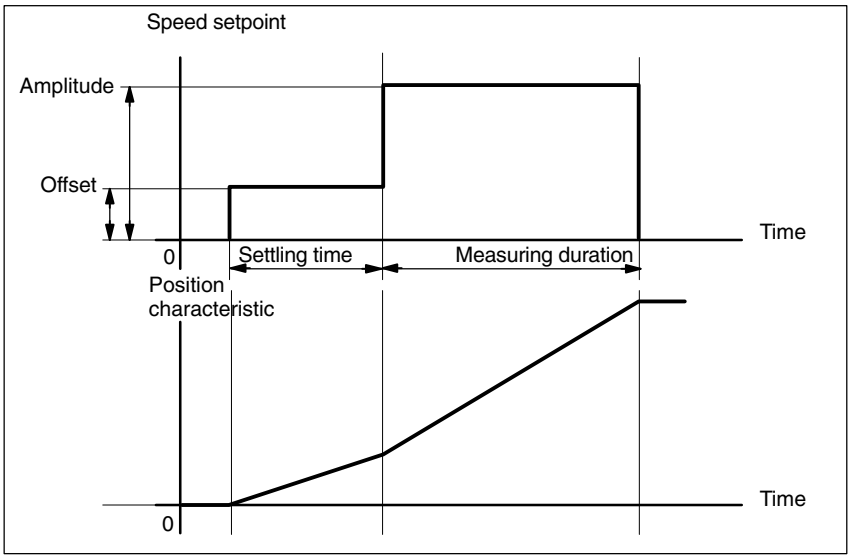


Fig. 10-3 Setpoint signal for the speed control loop – step response measuring function.

Additional information

The measuring parameters and measurement results (diagrams) can be loaded or saved using the **File functions** soft key.

10.4.3 Scanning position control loop

Functionality

The behavior when transferring to the active position measuring system is always analyzed. The NCK generates an error message if the function is activated for a spindle without position measuring system. Various lists of measuring parameters are offered depending on which basic setting is selected.

Procedure

1. Setting the traveling range monitoring and the enabling logic on the **main screen.**
   One of three different types of measurement can be selected:

- Reference frequency response
- Setpoint step change
- Setpoint ramp

2. Setting the necessary parameters on the **measuring parameters screen**
3. Displaying the measurement result on screen using the **Display** soft key

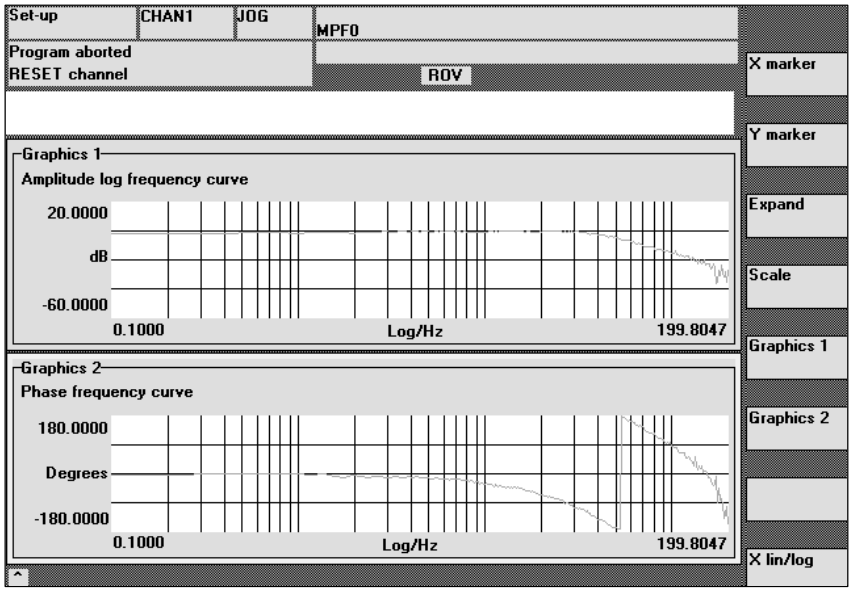


Fig. 10-4 Display diagram: Example of a position control loop

Reference frequency response

The reference frequency response measurement determines the transmission response of the position controller in the frequency range (active position measuring system). The parameters for the setpoint filters, K_v value and bias control should be set to ensure there is as little resonance as possible throughout the 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 in K_V value
2. Canceling the bias control value
3. Use of setpoint filters

The effects of these measures can also be checked in the time range.

Measuring parameters for reference frequency response

Amplitude

This parameter determines the test signal amplitude. It should be set to the smallest possible value (e.g. 0.01 mm).

Offset
The measurement requires a low speed offset of just a few motor revolutions per minute. The offset must be chosen so that the speed does not pass through zero at all at the set amplitude.

Bandwidth
Setting for the analyzed frequency range (no more than half the position controller scanning frequency). The lower this value, the finer the frequency resolution and the longer the measurement time. The maximum value corresponds to half the position controller sampling rate (e.g. 200 kHz with position controller sampling time of 2.5 ms).

Averaging
This value increases both the accuracy of the measurement and the measuring duration. A value of 20 is normally suitable.

Settling time
Recording of the measured data starts after a delay equal to the value set here after the offset and test setpoint are activated. A value of between 0.2 and 1 s is recommended. Do not set too low a value for the settling times or the frequency response and phase diagrams will be distorted.

Setpoint step change and setpoint ramp

Initiation of the step change and the ramp can be used to assess the transient response or positioning response of the position control within the time range, particularly the effect of setpoint filters. 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 measured variables are possible:

- Actual position value (active position measuring system)
- Control deviation (following error)

Measuring parameters for setpoint step change and ramp

Amplitude
This parameter determines the magnitude of the set setpoint step change or ramp.

Offset
The step change is initiated from the stopped state or starting from the constant traveling speed set with this parameter.

Measuring time
This parameter determines the recorded period (up to 2048 x position controller cycles).

Settling time
Recording of the measured data and outputting of the test setpoint start after a delay equal to this value after the offset is activated.

Ramp time
For the **Setpoint ramp** basic setting, the position setpoint is set according to the set ramp duration. In this case, the acceleration limits which currently apply to the axis or spindle are effective.

A jerking motion can be set using the axis-specific NC-MD 32410 AX_JERK_TIME (if NC-MD 32400 AX_JERK_ENABLE is set to 1).

The position setpoint and the actual value of the active measuring system are recorded.

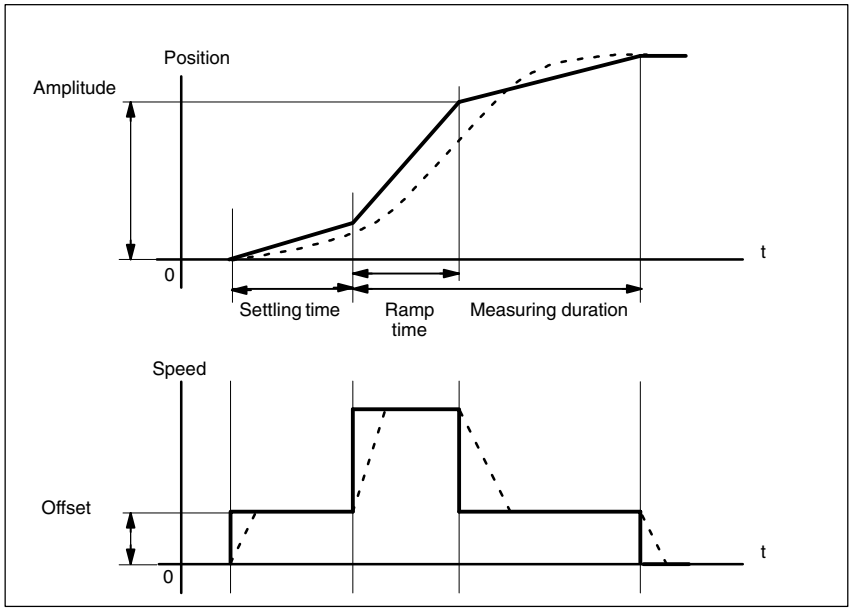


Fig. 10-5 Signal curve for the position setpoint/ramp measuring function

At maximum axis velocity, there is a (virtual) step change in the velocity (continuous line).

The curves represented by the dashed line correspond to a realistic, finite value. The offset part is calculated from the displayed graph in order to highlight the transition processes.

Step height

To avoid damaging the machine, the step height for the setpoint step change is limited to the value specified in MD 32000 MAX_AX_VELO. As a result, the desired step height may not be reached.

The MD 32000 MAX_AX_VELO and MD 32300 MAX_AX_ACCEL have a similar effect for the setpoint ramp in the ramp area.
The MD 32000 MAX_AX_VELO limits the ramp inclination (speed limit), whereby the drive does not reach the programmed amplitude.
The restriction in acceleration caused by the MD 32300 MAX_AX_ACCEL "smoothes" the transition at the start and end of the ramp.

Danger

Do not make changes to the MD 32000 MAX_AX_VELO and MD 32300 MAX_AX_ACCEL (e.g. to achieve a certain pitch) without carefully considering the consequences. These have been matched exactly to the machine!

10.5 Measuring function for coupled axes

Functionality

Composite axes were not supported by the previous “Measuring function” and “Function generator” start-up aids. With version 5 of the software package, the existing HMI user interface has been upgraded:
it is now possible to easily optimize by scanning individual axes. This is done by setting certain “measuring parameters”.

The upgraded HMI user interface allows the start-up engineer to scan each individual axis

- of the Composite gantry
- the coupled master and slaves (from software version 6.4)
- and mixed master–slave combinations coupled to gantry axes (from software version 6.4)

with due regard to the permitted measuring parameters.

The HMI programs the axes with the same values so that they perform identical movements.
The user can record the results for one or 2 axes at the same time. This corresponds to the previous measuring function for 2 independent axes. With mixed coupled units, the leading axis always taken from the gantry composite axis. All further axes are then synchronizing axes with the same parameters.

Start-up functions

The HMI user interface provides further measuring functions as aids to start-up. Soft keys can be used to determine whether a certain axis configuration should be used for scanning in the

- Power control loop
- Speed control loop
- Position control loop

10.5.1 Interconnected gantry axes only or master–slave couplings

Parameter settings

The Function generator and Measure start-up functions are still programmed via PI services. The traversing motion is started for all programmed axes by pressing the MSTT button NC-Start in JOG operating mode.

On the “Function generator in interconnected gantry” screen, the user interface displays an image in which you can enter 2 amplitude values and a period duration, pulse width, offset and limitation.

On the “Measuring function in interconnected gantry” screen, in addition to the 2 amplitude values, you can enter a bandwidth, averaging, settling time and an offset. The first amplitude value applies to the measured access and the second to the other, coupled axes.

Measuring parameters in the speed control loop

In the reference frequency response for the speed control loop, actual and setpoint speed values may be entered as the following measuring parameters for both interconnected gantry/axes and master/slave couplings.

Amplitude of leading axis or **master axis**
This parameter determines the magnitude of the test signal amplitude for the gantry leading or guiding axis or master axis in mm/min. On the motor side, this should cause a slow speed of just a few (approx. 1 to 2) rpm.

Amplitude of synchronizing axis(es) or **slave axis(es)**
Edited measured variables for the amplitude of the gantry synchronizing axis(es) or slave axis(es) in mm/min.

Bandwidth
Analyzed frequency range
4.0 kHz for 840D (scanning frequency 8.0 kHz).

Averaging
This value increases both the accuracy of the measurement and the measuring duration. A value of 20 is normally suitable.

Settling time
Recording of the measured data starts after a delay equal to the value set here after activation of the test setpoint. A value of between 0.2 and 1 s is recommended.

Offset
The offset is started up via an acceleration ramp.

The acceleration value is defined for an

Axis:	MD 32300: MAX_AX_ACCEL
Spindle:	MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL
	MD 35210: GEAR_STEP_POSCTRL_ACCEL
Where:	Acceleration value = 0, no ramp
	Acceleration value > 0, ramp active

The actual measuring function is not activated until the offset value is reached.

Example of a pure master–slave coupling

Speed control loop: All the axes are on a 1-axis module.

Axis X1	(1) Master axis
Axis Z1	(3) Slave axis
Axis A1	(4) Slave axis
Axis	(7) Slave axis

In a pure coupling mode, the displayed texts change if a different coupling mode was previously active. The structure of the entire user interface does not change. An axis is displayed as a master axis and all the other axes are then the slave axes.

Important

Only the coupling axes **for the selected** axis are displayed.

If there are **two axes** on a double-axis module, neither the gantry nor the master/slave are displayed in a pure coupling mode.

It should be noted that only one measuring function can ever be started per module.

Scanning in the position control loop

If a scan is carried out in the position control loop, **only gantry axes** are included. None of the master/slave axes involved have a PI service, so are not initiated on the NC side.

Caution

If **two** measuring functions are detected on a module, the coupling is cleared internally and only one 1 PI service is sent to the selected axis. Particular caution is required since another axis may also be used internally.

Amplitude of leading axis
This parameter determines the magnitude of the test signal amplitude of the gantry leading axis in mm. It should be as small as possible (e.g. 0.01 mm).

Amplitude of synchronizing axis(es)
Edited measured variables for the amplitude of the gantry synchronizing axis(es) in mm/min.

Bandwidth
Setting for the analyzed frequency range (no more than half the position controller scanning frequency). The lower this value, the finer the frequency resolution and the longer the measurement time. The maximum value corresponds to half the position controller sampling rate (e.g. 200 kHz with position controller sampling time of 2.5 ms).

Averaging:
This value increases both the accuracy of the measurement and the measuring duration. A value of 20 is normally suitable.

Settling time
Recording of the measured data starts after a delay equal to the value set here after activation of the offset and test setpoint. A value of between 0.2 and 1 s is recommended. Do not set too low a value for the settling times or the frequency response and phase diagrams will be distorted.

Offset
The measurement requires a low speed offset of just a few motor revolutions per minute. The offset must be chosen so that the speed does not pass through zero at all at the set amplitude.

10.5.2 Mixed couplings of master/slave and gantry axes

As with pure interconnected gantry axes or master/slave couplings, only two axes may be selected for scanning. If more than two axes are selected, a message appears when the scan starts.

Example in the speed control loop

Gantry axis X1 is coupled to master axis A1. The gantry synchronizing axis Z1 is in turn coupled to a slave axis.

Axis X1	(1) Gantry leading axis (this is always a gantry axis)
Axis Z1	(3) Gantry synchronizing axis
Axis A1	(4) Master axis
Axis	(7) Slave axis

All the axes are on a 1-axis module. All the axes of the interconnected coupling are displayed. No more than one leading axis and two synchronizing axes are ever visible. Nevertheless, all the axes can be used for navigation.

10.6 Graphical display

Explanation

The graph is displayed by pressing the **Display** soft key in the main screen for the measuring function.

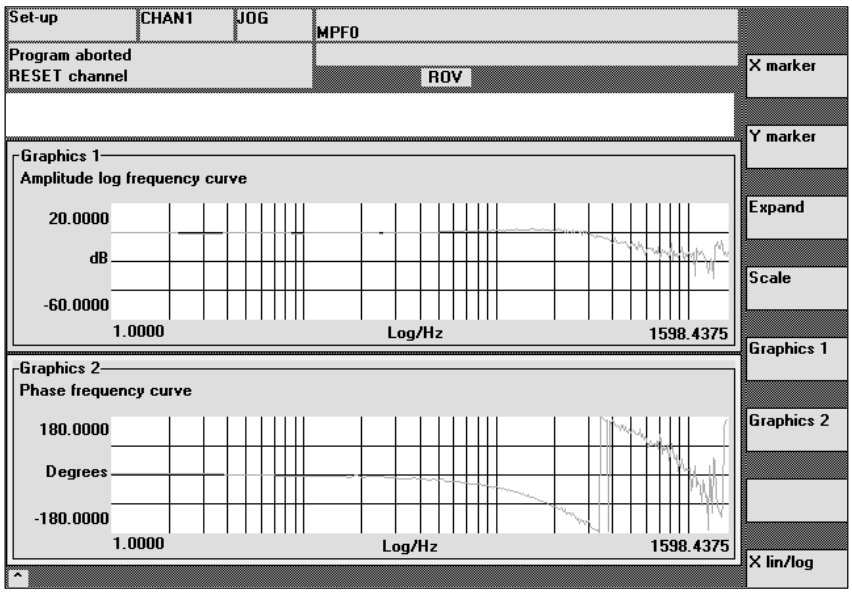


Fig. 10-6 Display diagrams 1 and 2 of speed control loop

X marker and Y marker On/Off soft keys

These soft keys are used to display a vertical or horizontal line representing the abscissa or ordinate in the selected diagram. The associated coordinates are also output. The soft key **X marker** or **Y marker** must be selected again in order to deselect the markers. The markers are moved by means of the cursor keys.

2nd marker X and 2nd marker Y zoom and full screen soft keys

A 2nd X marker or 2nd Y marker may be overlaid in order to highlight differences. The absolute position of the selected cursor and the delta values between the relevant cursor lines are thus highlighted.

The “Zoom” soft key can be used to gradually increase the area between the cursors. Use the Select button to change cursor.

The “Full screen” soft key is used to return to the optimum representation.

Scale...

Scaling is normally automatic. The **Scale** soft key can also be used to manually set the scaling for the individual traces.

X marker and Y marker Y zoom and full screen soft keys

These soft keys are used to display a vertical or horizontal line representing the abscissa or ordinate in the selected diagram. The associated coordinates are also output. The soft key **X marker** or **Y marker** must be selected again in order to deselect the markers. The markers are moved by means of the cursor keys.

Graph...

This soft key is used to toggle between the individual representations and the double graph. You can then use the “Print graph” soft key to store the graph (Print to file) or output it at the selected printer.

Trace...

Individual traces can be displayed and hidden in graph 1 and graph 2. The soft key always takes effect in the currently selected window.

Start

The “Start” soft key is used to start a new measurement.

10.6.1 Associated conditions for gantry axes

From software version 5.1

SIMODRIVE 611 digital drives: Only one function generator or one measuring function can be activated on a multiple module, which means that the new functionality is available if the gantry axes are on different modules.

Reference material: /FB3/ G1, Description of the special functions Gantry axes

10.7 Trace function

A trace represents monitored values and signals over a given time interval. Servo trace provides functions with a graphical user interface for checking and monitoring drive/servo signals and statuses.

Function overview

The trace function offers the following features:

- 4 trace buffers with up to 2048 values each.
- Choice of SERVO, safety integrate and 611D signals (in position control cycles)
- Trace and trigger signals can be set through absolute addresses and value masking.
- Different trigger conditions for starting the recording.
  Triggering always on trace 1.
- Both pre- and post-triggering.
- Measuring signal display
- Fixed Y scaling can be selected for each trace or automatic scaling
- Marker function can be selected in order to delimit areas of detail for each trace. Expand function on the time axis (Zoom X).
- Selectively loads and saves the measuring parameters and traces
- Up to 10 signal tracks per trace for bit-coded signals from Safety Integrated
- Options for modifying the trace display and print-out.

Note

The trace function can only be used with HMI Advanced or the Start-up tool. It is possible to represent bit-coded signals from Safety Integrated on ten tracks over the measuring interval for HMI Advanced from software version 6.2.

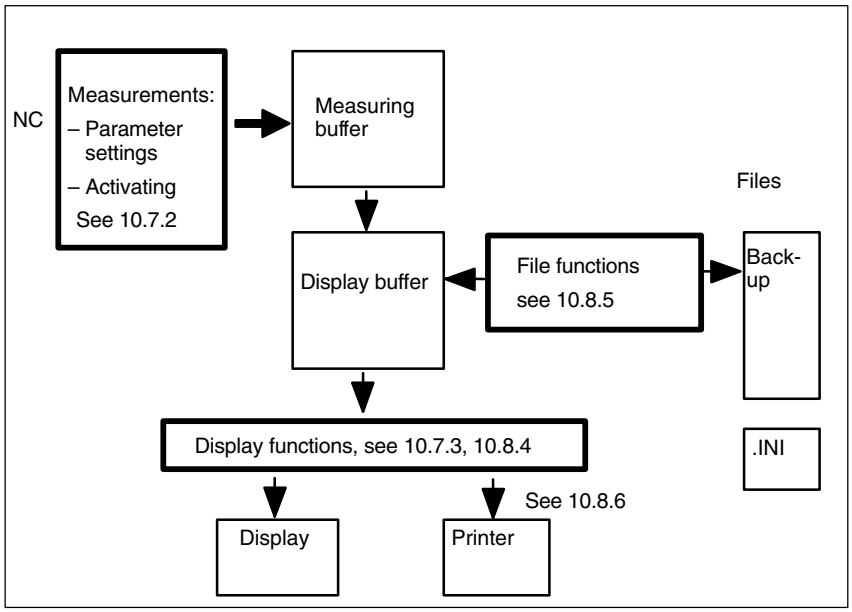


Fig. 10-7 Overview of the function groups

The measuring signals are selected and the measuring parameters are set using soft keys and drop-down lists. Operation is either via mouse or via keyboard.

Operation

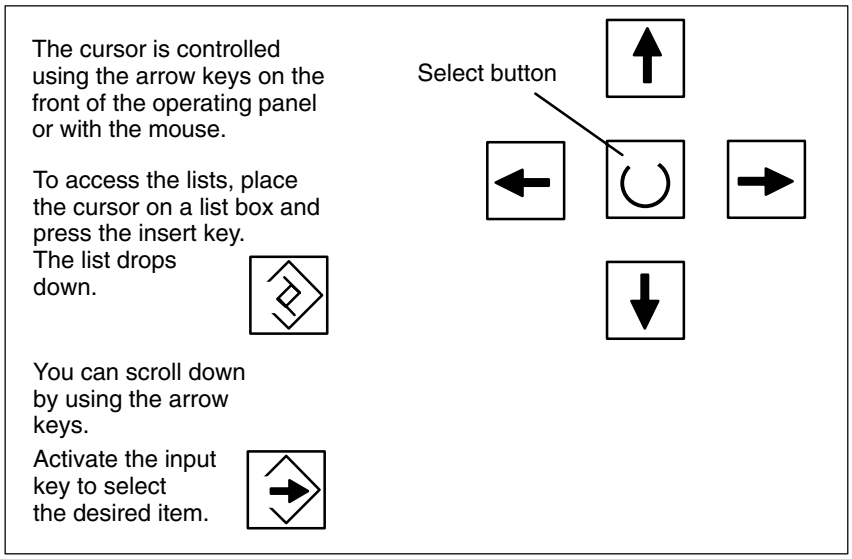


Fig. 10-8 Cursor operation

10.7.1 Main screen

Main screen Servo trace

The main screen for the trace function is accessed using the **Drives/Servo** \ **Servo trace** soft keys.

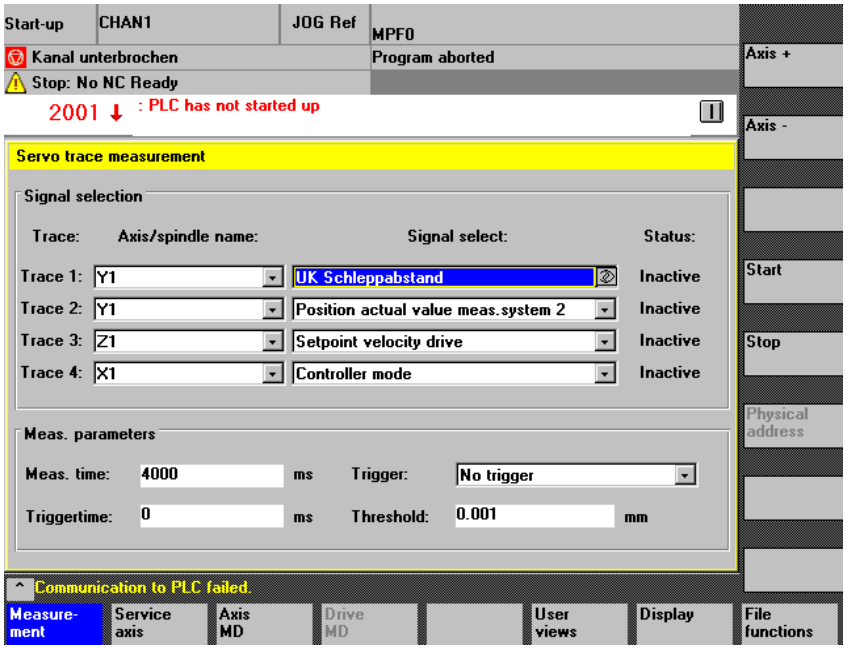


Fig. 10-9 Basic servo trace screen

10.7.2 Programming and activating measurements

Programming on the main screen

The main screen is used to select

- The axis/spindle to be measured
- The signal to be measured
- The measuring duration
- Trigger time
- Trigger type
- Trigger threshold

Signal selection

Input box Axis/spindle name

The cursor must be positioned on the “Axis/spindle name” list box for the trace concerned. The selection is then made by using the **Axis+** and **Axis–** soft keys or by activating the desired item in the drop-down list box.

Signal selection input box

The cursor must be positioned on the “Signal selection” list box for the trace concerned. Then activate the desired items by selecting them from the list box.

The options available for selection depend on the configuration and on which functions are activated.

Measuring parameters

Measuring duration input box

The measuring time is entered directly in the “Measuring duration” input box.

Trigger time input box

Direct input of pre- and post-triggering. With negative input values (leading sign minus –) recording begins at the set time before the trigger event.

With positive input values (without leading sign) recording begins after the trigger event.

Associated condition: Trigger time + measuring duration ≧ 0.

Trigger input box

The trigger type is selected from the “Trigger” drop-down list. The trigger always relates to trace 1. Once the trigger condition has been fulfilled, traces 2 to 4 are started at the same time.

Settable trigger conditions:

- No trigger, i.e. measurement begins when the **Start** soft key is activated (all traces are started time-synchronized).
- Positive edge
- Negative edge
- Trigger event from the sub-program

Threshold input box

Used to enter the trigger threshold directly.

The threshold is only effective with trigger types “Positive edge” and “Negative edge”.
The unit refers to the selected signal.

Soft keys
Axis +
Axis –

Used to select the axis/spindle when the cursor is on the relevant “Axis/spindle name” list box.

You can also select the axis/spindle by using the cursor in the drop-down list.

Start and Stop soft keys

To start the trace function recording, press the **Start** soft key. The current message is aborted by activating the **Stop** soft key or RESET.

Physical address soft key

The entries are made in the servo trace function basic screen.

- The “Physical address” signal type must be selected in the desired trace.
- The cursor in the desired trace must be positioned in the associated signal selection box (on Physical address).

The physical address dialog box is overlaid when you activate the **Physical address** soft key.

Note

This function is only required in special cases when the information from the usual signals (see “Signal selection” list field) is insufficient. Please contact the SIMODRIVE hotline to discuss how to proceed.

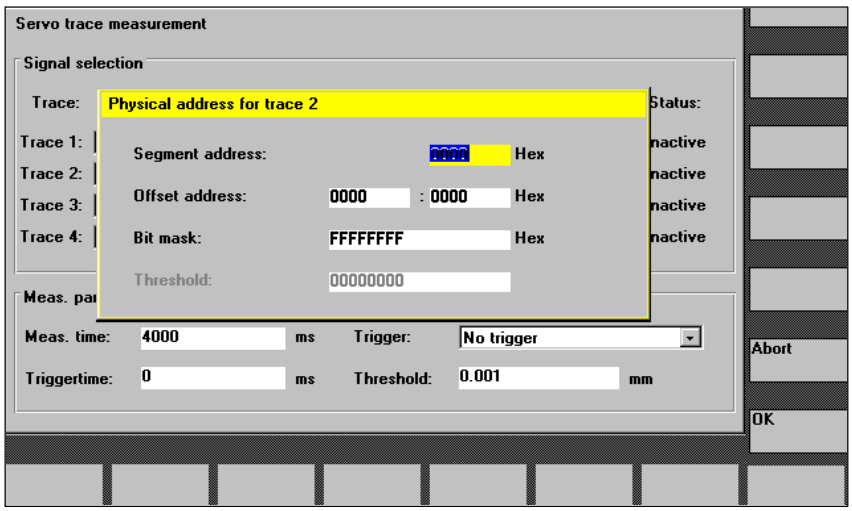


Fig. 10-10 Input screen for setting the physical address parameters.

All parameters settings are entered in hexadecimal format.

Segment address input box

Direct input of the segment address of the signal to be logged.

Offset address input box

Direct input of the offset address of the signal to be logged.

Mask input box

If you want to display certain bits only, select them in this dialog box.

Threshold input box

In the “Threshold” input box, you can only set the trigger threshold for the physical address of trace 1. If you exit the input box by activating the **OK** soft key, this hexadecimal value is entered in the “Threshold” field of the servo trace basic display.

Start of measurement

Once the parameters have been set, start the measurement by pressing the **Start** soft key. Execution is dependent on the condition specified in the Measuring parameters and “Trigger” input box.

Terminating the measurement

Measurement is terminated after the time specified in the Measuring parameters/“Measuring time” input box has expired or was interrupted by pressing the **Stop** soft key.
Results of a canceled measurement cannot be displayed (soft key display).
The end of the measurement is signaled to the user with a suitable message in the dialog line.

General

If the user has carried out measurements with values/signals, these are stored in the measured value buffer and remain valid until they are replaced by measured value files using the file functions or by the measured values supplied when a measurement was restarted by the NCK.

10.7.3 Display function

When the measurement is complete, the result can be displayed in a graph. The horizontal soft key **Display** calls up the screen (Fig. 10-11).
The measured traces are shown as diagrams.

Graph1 shows trace 1 green and trace 2 (blue), while graph2 contains trace 3 green and trace 4 (blue).

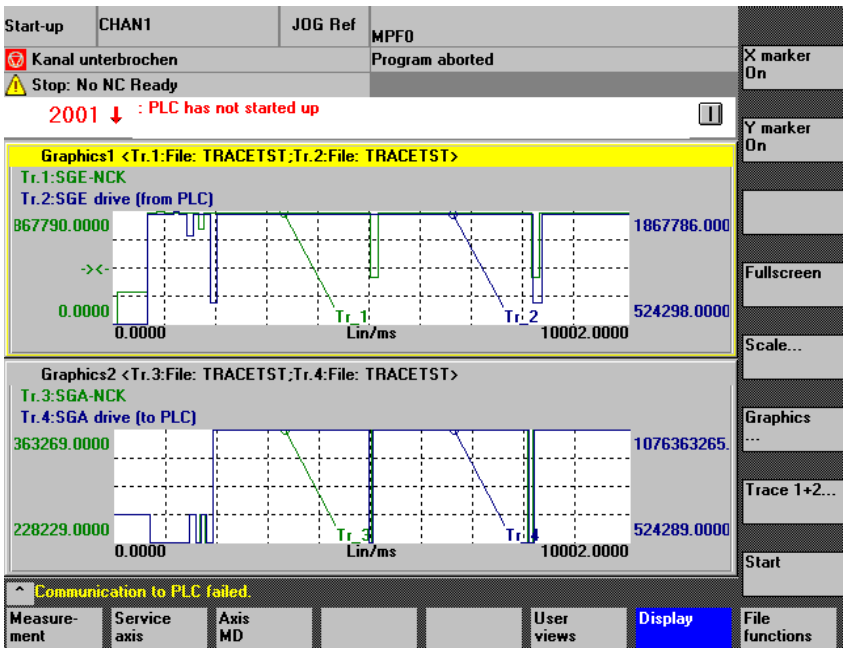


Fig. 10-11 Graph1 and graph2 each shown with 2 traces

X marker and Y marker soft keys

The X/Y markers are activated or deactivated in the active graph. The corresponding position value is shown in the graph. The markers are moved by means of the cursor keys.

Full screen soft key

After the zoom function has been used (see below), this soft key returns to the original display as shown in Fig. 10-11.

Soft key Scale...

When you press the soft key, Fig. 10-12, Y axis scaling, appears. You can scale the traces in this window.

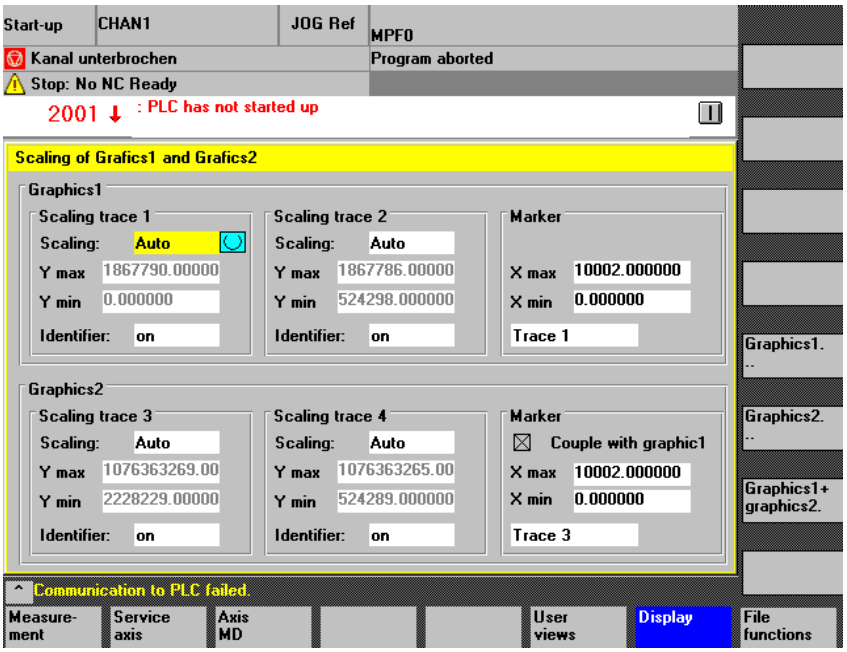


Fig. 10-12 Scaling of Graph1 and Graph2

Vert. SK for scale...

The scaling options include automatic scaling and fixed scaling (Select button) for the Y axis for each trace channel:

auto
Automatically determines the minimum and maximum values from the measured values

Y Min, Y Max boxes
If auto is selected, these display the limit values originating from the measurement.

fixed
The user selects the minimum and maximum values for the trace channel himself.

Y Min, Y Max input boxes
May be set to fixed values set by the user.

The entries are only transferred to the graph when you exit the screen form if “fixed” is set in the scaling field.

For the markers, it can be specified that they should move at the same time in both graphs (“Couple with graph 1” set for graph 2) or that each graph has separate markers.

The image can be exited using the vertical soft keys “Graph1...” or “Graph2...” or “Graph 1 + Graph 2...”.

Graph ... soft key

The vertical Graph ... soft key in Fig. 10-11 leads to a submenu containing the following functions:

- Bit selection, see 10.7.4
- Graph 1, 2 selection for enlarged view
- Print graph, see also 10.7.6
- Printer selection (real printer or bitmap file in the dh\dg.dir\bitmap.dir directory).

The following menu appears:

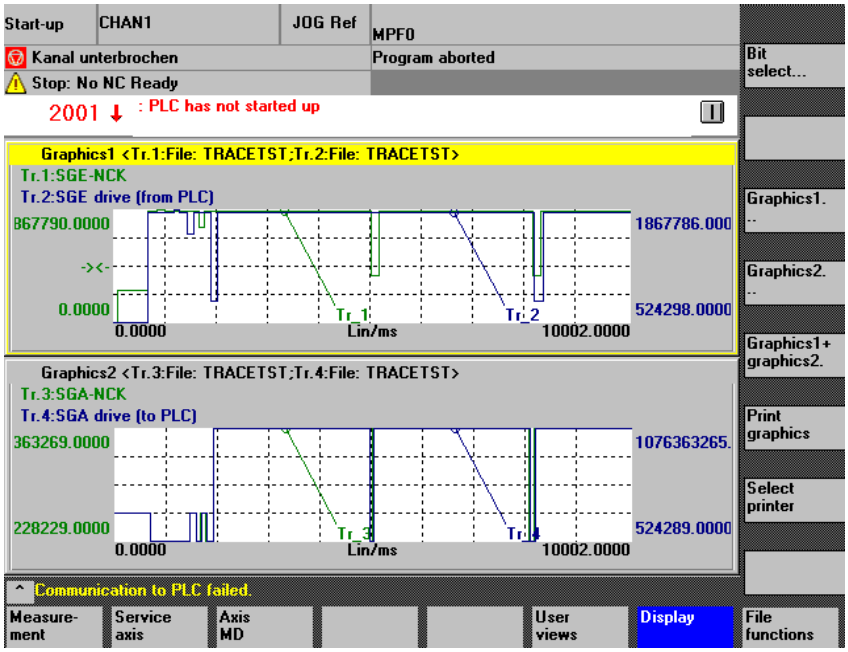


Fig. 10-13 Graph ...menu

Soft key Trace 1+2 Trace 3+4

The **Trace 1+2 ...** soft key is used to select an individual trace from the graph with the focus for more detailed examination.

Press once to focus on trace 1 alone in graph 1.
Press twice to focus on trace 2 alone in graph 1.
Press three times to focus on trace 1 + 2 together in graph 1.

If the focus is on graph 2, the soft key is labeled Trace 3+4 ... It is used in the same way for trace 3 and trace 4.

Switch between graph 1 and 2

The active graph out of 2 traces is highlighted (focus). Press CTRL-TAB to activate the other graph.

Zoom on time axis

The operations described above included the setting of a marker. Once an X marker has been set, the third vertical soft key offers the option of setting a 2nd X marker. This is used to define a time interval from the trace. The third vertical soft key then has the label “Zoom X”.

When you press this soft key, the area between the two X markers is extended over the time axis so that it fills the entire available area of the display. This allows signal curves to be monitored in more detail.

Zoom in Zoom
Further markers can be set in the extended image and, once another time interval has been specified, to zoom using 2 X markers.

Move measurement curves

If measured value curves (trace1, trace 2 or trace 3, trace 4) coincide in the display, making them difficult to evaluate, the activated trace can be moved to a suitable position using Cursor Up or Cursor Down.

10.7.4 Display bit graph for SI signals

Function

10 tracks from 10 signal bits from Safety Integrated can be displayed in graphs over the measurement period. They are triggered and measured as described in the previous sections.

Procedure

- Selection of the signals
- Assignment of signal bits to tracks
- Signals displayed as bit graphs

Requirement

If Signal selection was used to select a bit-coded SI signal, there is a vertical soft key called “Bit selection trace i” for the corresponding trace.

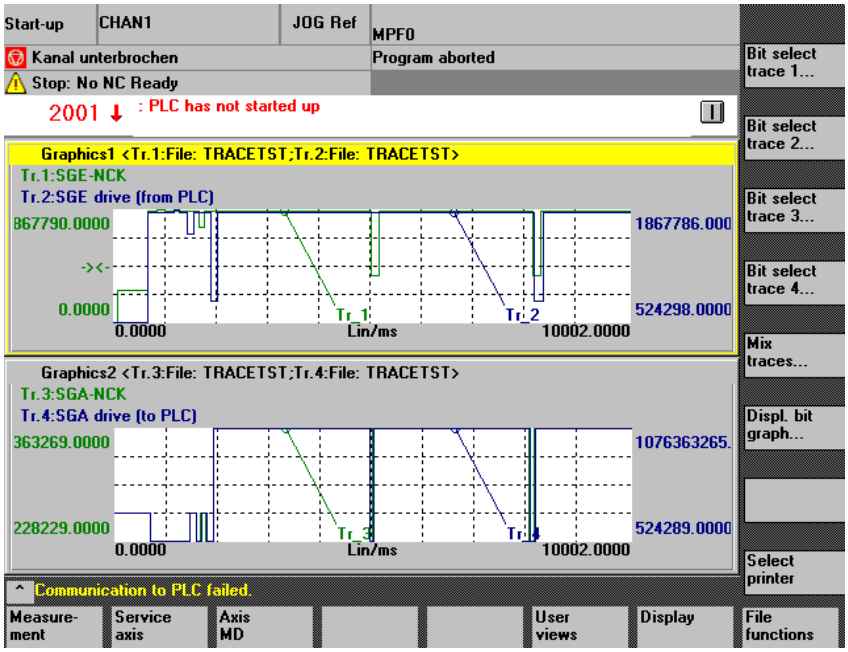


Fig. 10-14 Selected bit-coded SI signals

Bit selection Trace i

When you press this soft key, a screen appears in which you can assign the individual signal bits to display tracks.

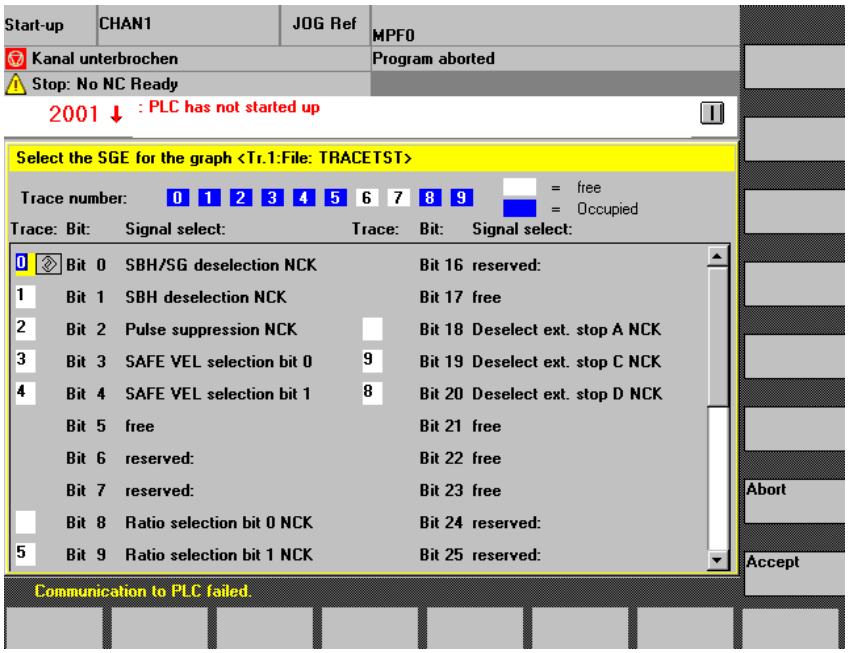


Fig. 10-15 Assigning signals to tracks (example of trace 1)

Procedure

For every non-free/reserved bit of the signal, you can enter a track number 0 – 9 corresponding to tracks 0 – 9 in the allocated input box. The “Track number:” line indicates which of the tracks are already assigned and which are still free. Scroll vertically to display bits > 25.

The file HMI_ADV\IBSVTSI.INI contains starting values for the allocation which can be modified in the screen shown in Fig. 10-15.

Accept soft key

The current assignment is transferred to the HMI_ADV\IBSVTSI.INI file and is suggested again the next time the signal is selected.

Cancel soft key

Used to exit the screen without transferring the changes to the HMI_ADV\IBSVTSI.INI file.

Mix traces

From a maximum of 4 individual traces, the bit traces of which were assigned as described above, you can select up to 10 traces and display them together in an image for comparison purposes.

When evaluating traces and trace mixes, always make sure that the measured values under consideration are from the same trigger event and take over the same measuring duration. See also subsection 10.7.5.

Mix traces soft key

The soft key can be accessed from Fig. 10-14. This gives the following screen:

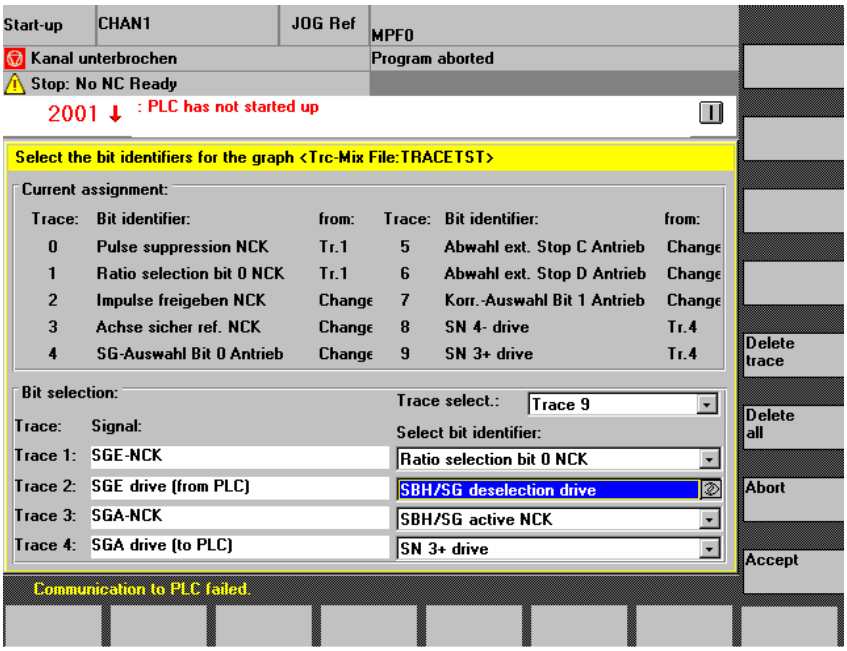


Fig. 10-16 Compiling a trace mix

The top part of the screen shows how the traces are currently assigned in the joint trace mix.

In the Bit selection part of the screen, select the relevant bit identifier from the drop-down menu for each of the traces, the signals from which are to be transferred to the trace mix and, in the “Track selection:” input box, enter the desired track from the trace mix or select it from the drop-down list.

Delete track soft key The selected signal no longer belongs to the trace mix.

Delete all soft key All assignments of signals to tracks in the trace mix are deleted.

Cancel soft key Used to exit the screen without transferring the changes to the HMI_ADV\IBSVTSI.INI file.

Accept soft key The current assignment is transferred to the HMI_ADV\IBSVTSI.INI file and is suggested again the next time the trace mix is selected.

Display bit graph ... soft key

The soft key can be accessed from Fig. 10-14. This gives the following screen:

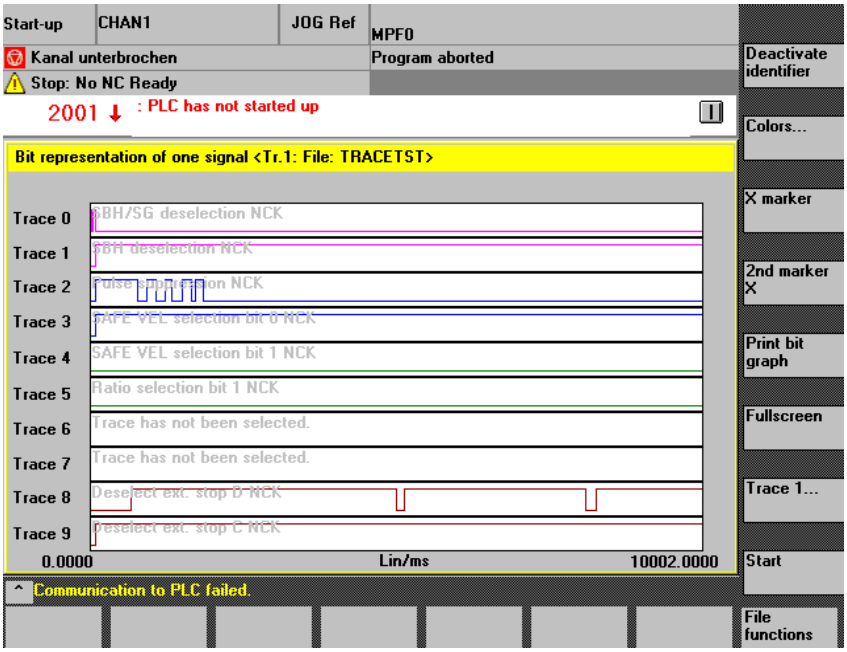


Fig. 10-17 Bit graph – example of trace 1

The signals from up to 10 tracks are represented over the duration of the measuring interval. Vertical soft keys can be used to change the view as required or to print out the bit graph.

Hide identifiers soft key

Shows/hides the signal identifiers overlaid over the signal curve. The function is also available in the extended view. See the “Zoom X” soft key.

Colors soft key

Opens a submenu from which you can select:

- User
- VGA
- VGA positive
- Monochrome
- Monochrome positive

under “Color scheme”, The color palette corresponding to your selection is displayed. You can then select different colors for each track.

There is a common color available for all signal identifiers.

Procedure:

1. Use Cursor Up/Down Track/Word select “Identifier”, palette receives focus
2. Use Cursor Up/Down/Right/Left select color
3. Select Input/Return to accept.

Vertical soft keys under Color settings:

Save:	Current color settings are accepted without exiting the screen.
Cancel:	Exits the screen without saving the changes to the color settings.
OK	Accepts the current color settings and exits the screen

Click on Cancel or OK to return. The 10-track view of the trace is displayed once more, as shown in Fig. 10-17.

X marker soft key

A vertical marker is added to the bit graph. It can be moved along the time axis using Cursor Left/Right, e.g. to the start of an “interesting” signal occurrence. The time at the marker position and the measured value interpreted as a number is displayed in the header over track 0.

The soft key is used to toggle between On and Off. If X marker Off is activated, then the marker is deleted once more,

2nd X marker soft key

A second vertical marker of a different color is added to the bit graph. It can be moved along the time axis using Cursor Left/Right, e.g. to the end of an “interesting” signal occurrence. The soft key is used to toggle and switches to the other market if pressed again.

If 2 markers are used to describe a time interval, the size is displayed as delta t: ...ms in the footer. The 4th vertical soft key switches to “Zoom X”.

Zoom X soft key

The interval between the markers is extended to the full width of the available display area. The “X marker On” soft key is available once more in the zoomed image. This allows another marker to be set in the extended view.

The “Zoom X” soft key has the same effect as for trace mix.

Full screen soft key

This soft key is used to return from a zoomed view to the original view of the signal curve.

Trace 1 ... soft key

The 7th vertical soft key is used to switch from trace 1 to trace 4 and Trace Mix one after the other.

Print bit graph soft key

The function works in the same way as “Print graph” for bit graphs. See also subsection 10.7.6.

User bit names

For Safety Integrated, the signals with fixed bit names are supplemented with the following signals, whose names can be defined/redefined by the user:

Table 10-2 SI signals with variable bit identifiers

SI signal German	Bit	Identifier English
ext. NCK–SPL interface inputs	0..31	EXT_NCK_SPL_INPUT_0 ... EXT_NCK_SPL_INPUT_31
	32..63	EXT_NCK_SPL_INPUT_32 ... EXT_NCK_SPL_INPUT_63
ext. NCK–SPL interface outputs	0..31	EXT_NCK_SPL_OUTPUT_0 ... EXT_NCK_SPL_OUTPUT_31
	32..63	EXT_NCK_SPL_OUTPUT_32 ... EXT_NCK_SPL_OUTPUT_63
int. NCK–SPL interface inputs	0..31	INT_NCK_SPL_INPUT_0 ... INT_NCK_SPL_INPUT_31
	32..63	INT_NCK_SPL_INPUT_32 ... INT_NCK_SPL_INPUT_63
int. NCK–SPL interface outputs	0..31	INT_NCK_SPL_OUTPUT_0 ... INT_NCK_SPL_OUTPUT_31
	32..63	INT_NCK_SPL_OUTPUT_32 ... INT_NCK_SPL_OUTPUT_63
ext. PLC–SPL interface inputs	0..31	EXT_PLC_SPL_INPUT_0 ... EXT_PLC_SPL_INPUT_31
	32..63	EXT_PLC_SPL_INPUT_32 ... EXT_PLC_SPL_INPUT_63
ext. PLC–SPL interface outputs	0..31	EXT_PLC_SPL_OUTPUT_0 ... EXT_PLC_SPL_OUTPUT_31
	32..63	EXT_PLC_SPL_OUTPUT_32 ... EXT_PLC_SPL_OUTPUT_63
int. PLC–SPL interface inputs	0..31	INT_PLC_SPL_INPUT_0 ... INT_PLC_SPL_INPUT_31
	32..63	INT_PLC_SPL_INPUT_32 ... INT_PLC_SPL_INPUT_63
int.PLC–SPL interface outputs	0..31	INT_PLC_SPL_OUTPUT_0 ... INT_PLC_SPL_OUTPUT_31
	32..63	INT_PLC_SPL_OUTPUT_32 ... INT_PLC_SPL_OUTPUT_63

Table 10-2 SI signals with variable bit identifiers

SI signal German	Bit	Identifier English
NCK–SPL marker	0..31	NCK_SPL_MARKER_0 ... NCK_SPL_MARKER_31
	32..63	NCK_SPL_MARKER_0 ... NCK_SPL_MARKER_31
PLC–SPL marker	0..31	PLC_SPL_MARKER_0 ... PLC_SPL_MARKER_31
	32..63	PLC_SPL_MARKER_32 ... PLC_SPL_MARKER_63

Operation

When a trace log for signals from the above table is loaded, you can use:

Display/Graph/<Trace i>

A screen with the selected signal and its bits is displayed, with track assignment if appropriate. For example:

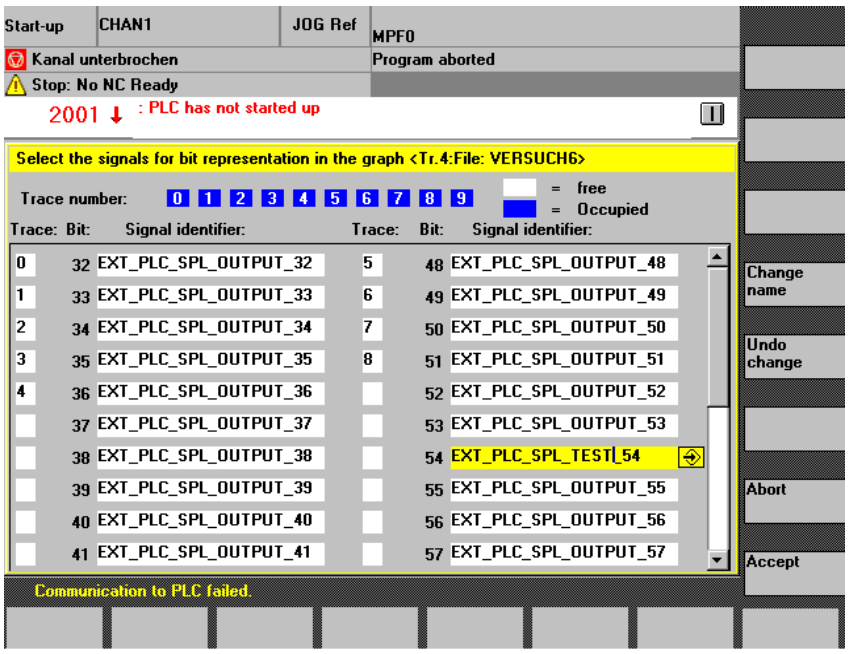


Fig. 10-18 Name changed for bit 54

Vertical soft keys

Change names

Use the cursor keys to move to the signal identifiers to be changed and enter a new identifier. Press the Input button to confirm.

Undo change

The identifier changes are canceled.

Accept

The changed identifiers are transferred to the HMI_ADV\IBSVTSI.INI file and are then displayed once more in connection with this trace.

Cancel

Exits the screen without saving the changes to the identifiers.

10.7.5 File functions

Description

The **File functions** soft key is used to switch to the “File functions” screen.

Here you can save/load/delete the measurement settings and measured values for the trace function.

The file functions are not intended to be a substitute for making a copy of all system and user data, e.g. for archiving or series start-up purposes.

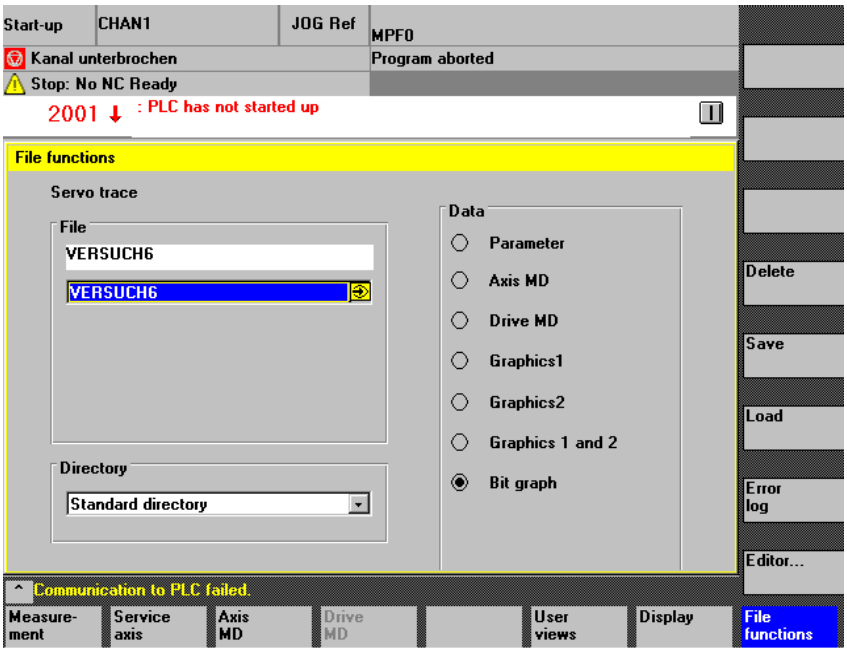


Fig. 10-19 Servo trace file function

Naming files

You can select an existing file from the drop-down list in the “File” field, or enter one in the text box below.

Selecting the directory

In the “Directory” field, you select the directory in which the file is to be saved. This may be a directory you created yourself under “Services” or the main data storage directory (list entry: Default directory).

Selecting data type

In the “Data” field, you select the files to be stored. Only one data type can be selected at once. Use the cursor keys for selecting the data type and enable using the toggle key.

Vertical soft keys

Delete
The selected file with measured values and parameters is deleted.

Save
The displayed measured values and the parameters used for the measurement are saved to the set file. They are then available to display, prepare (e.g. Zoom) and print out using the “Load” function.

Load

A file that was previously saved with the “Save” soft key is fetched to the display buffer and then displayed when the “Display” horizontal soft key is pressed.

The file names of any traces displayed in the header are shown once the display has been created from a file.

A submenu asks whether the existing display buffer should be replaced.

- If you select “Cancel”, nothing is loaded. This means that the existing measurement can be saved using the “Save” soft key before a new file is loaded.
- Use “Replace” to accept measured values and parameters from the file as the current trace data. Measured data from the last measurement will be lost if it is not first saved to a file using “Save”.

Creating subdirectories

New subdirectories are created in the “Services” area.

You can create a subdirectory there in “Manage data” mode in the “Diagnostics” directory.

See also:

Reference material: /BAD/ User Guide for HMI Advanced, Section: Services area

10.7.6 Print graph

Printer settingsThe printer selection screen is called up by pressing the **HMI\Printer selection** soft keys (Fig. 10-20).

Use the toggle key to select whether the displayed graphics are to be sent directly to the printer by activating the **Print graphs** soft key, or output it in a bitmap file instead.

Fig. 10-20 Basic screen for printer selection

Output directly to printer

The printer must be set up under MS WINDOWS.

You can set “Print” in the printing options.
Upon activation of the **Print graphs** soft key in the “Display” screen, the displayed graphics are printed on the active printer.

Output as bitmap file

If you want to save the graph to a bitmap file (*.bmp), proceed as follows:

Set “Output as bitmap file” in the selection field for the printer setting.
When you press the **Print graph** soft key on the “Display” screen, the screen for entering a file name appears (Fig. 10-21). Enter a new name in the drop-down list or select an existing file name for overwriting.

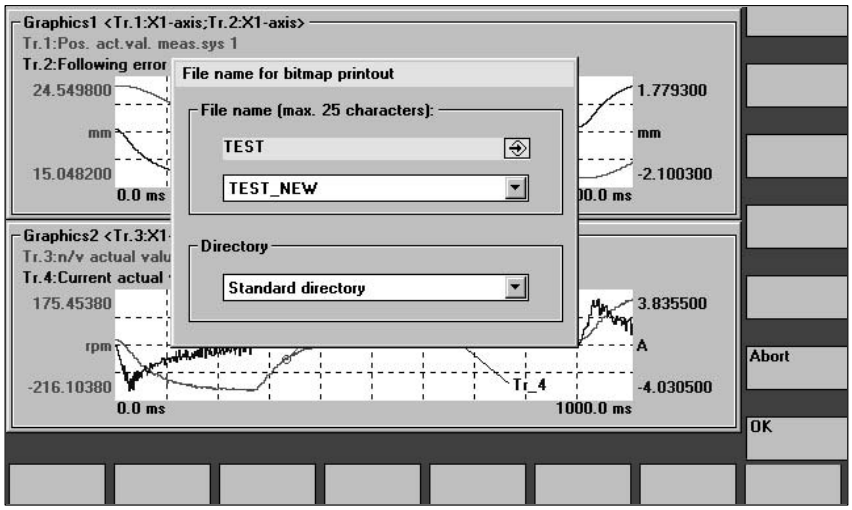


Fig. 10-21 File name box for bitmap output

Naming files

You can select an existing file from the drop-down list in the “File name” field, or enter one in the text box below.

Selecting the directory

In the “Directory” field, you select the directory in which the file is to be saved.

This may be a directory you created yourself under “Services” or the main data storage directory (list entry: Default directory).

Activate the **OK** soft key to save the file.

Return to the current graphics screen by activating the **Abort** soft key.

10.8 Analog output (DAC)

Note

The DAU function is described in:

Reference material /FBA/ DD1, Description of the drive functions, Diagnostic functions

10.9 Automatic controller settings (HMI Advanced only)

Functionality

Functions for automatic speed controller adjustment:

- Three variants for determining the gain and reset time.
- Independent determination of any required current filters (max. three bandstop filters).
- Displaying the measured or calculated frequency responses, as for the measuring functions.

Note

Where the table has a very low natural resonant frequency (< 20 Hz), the reset time should be checked manually. The reset time setting may be too low.

Procedure

In the “Start-up” area, select the “Drives/servo” soft key.

a) Normal case

In the extended menu, press the “Aut. ctrl setting” soft key. The main “Automatic controller setting” display appears.

Aut. ctrl setting

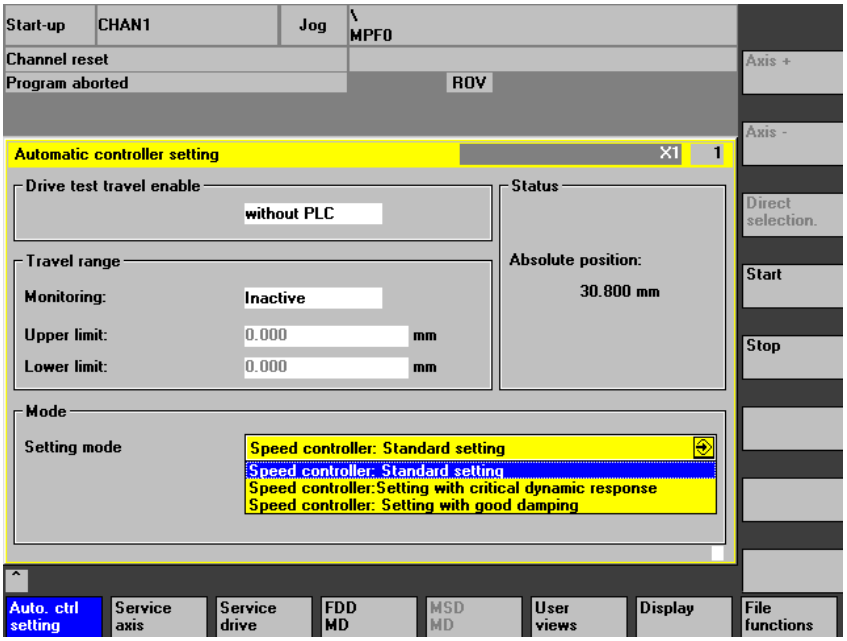


Fig. 10-22 Main “Automatic controller setting” display

10

The input in the “Drive test enable travel” and “Traveling range” window areas has the same significance as for the measuring functions.
The setting type is defined in the “Mode” function area.

1. Select the type of setting from the “Operating mode” function area.
   “**Variant 1**” off.
2. Press the “Start” soft key.
3. Follow the instructions in the menu-driven dialog (see the gray boxes in the flowchart below).
4. Press the “OK” soft key when requested to do so.
5. Press the “NC Start” soft key when requested to do so.
   Warning: With NC Start, the axis performs a traversing motion.

To optimize further axes, select the axes with the “Axis+” or “Axis–” soft key and repeat the procedure from step 1.

b) Special case: Modify parameters

You can use the controller settings integrated into the control to

- change the parameter settings,
- start,
- display and
- store the settings of the integrated controller.

The setting type is defined in the “Mode” function area. Three different variants are available:

- Variant 1: Default setting
- Variant 2: Setting with critical dynamic response
- Variant 3: Setting with good damping

Vertical soft keys

“Axis+” soft key:
Selects the next axis to be optimized.

Soft key “Axis–”:
Selects the previous axis to be optimized.

Soft key “Direct selection”:
Selects the axis to be optimized directly in a dialog window.

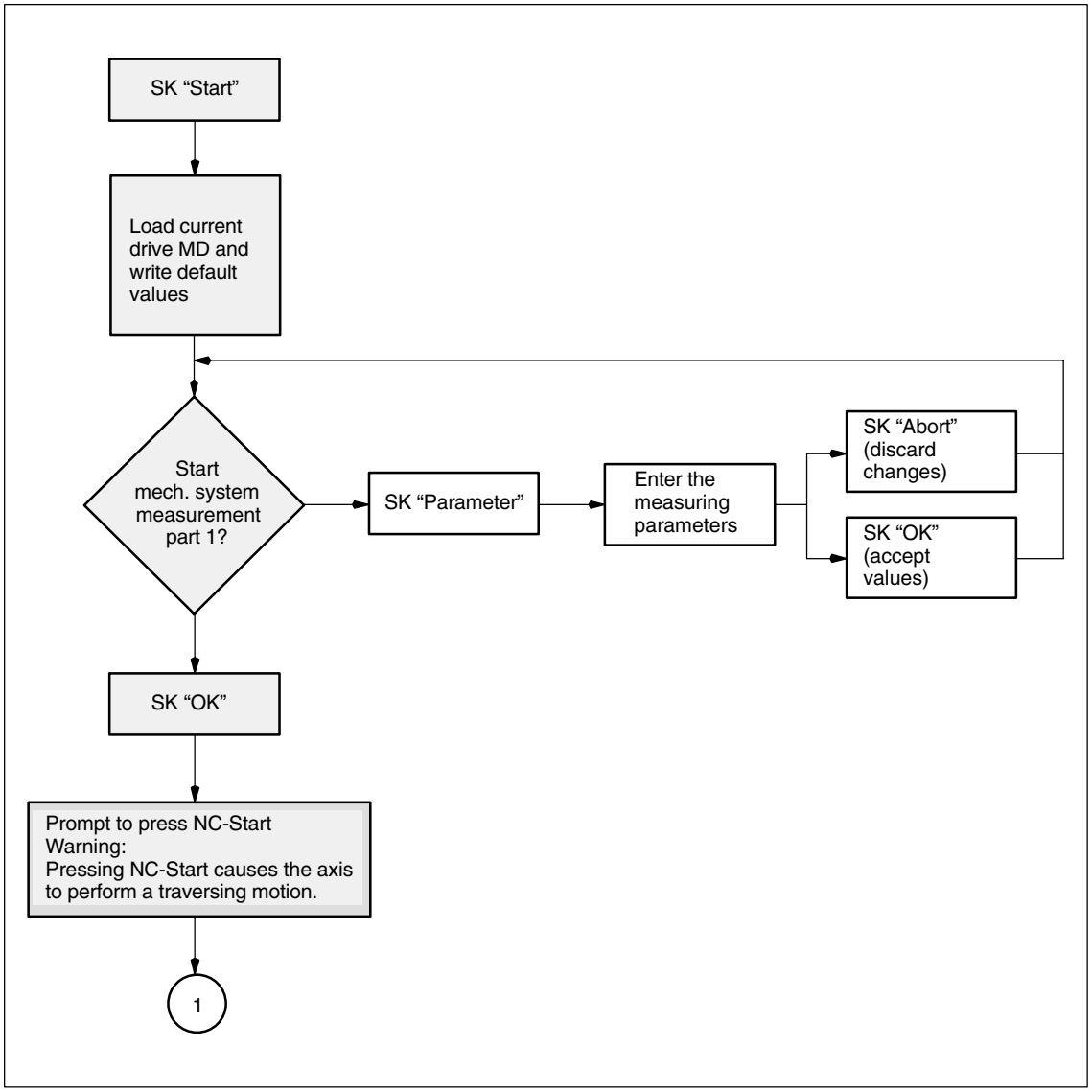
Soft key “Start”:
Starts the automatic controller setting for the selected axis.

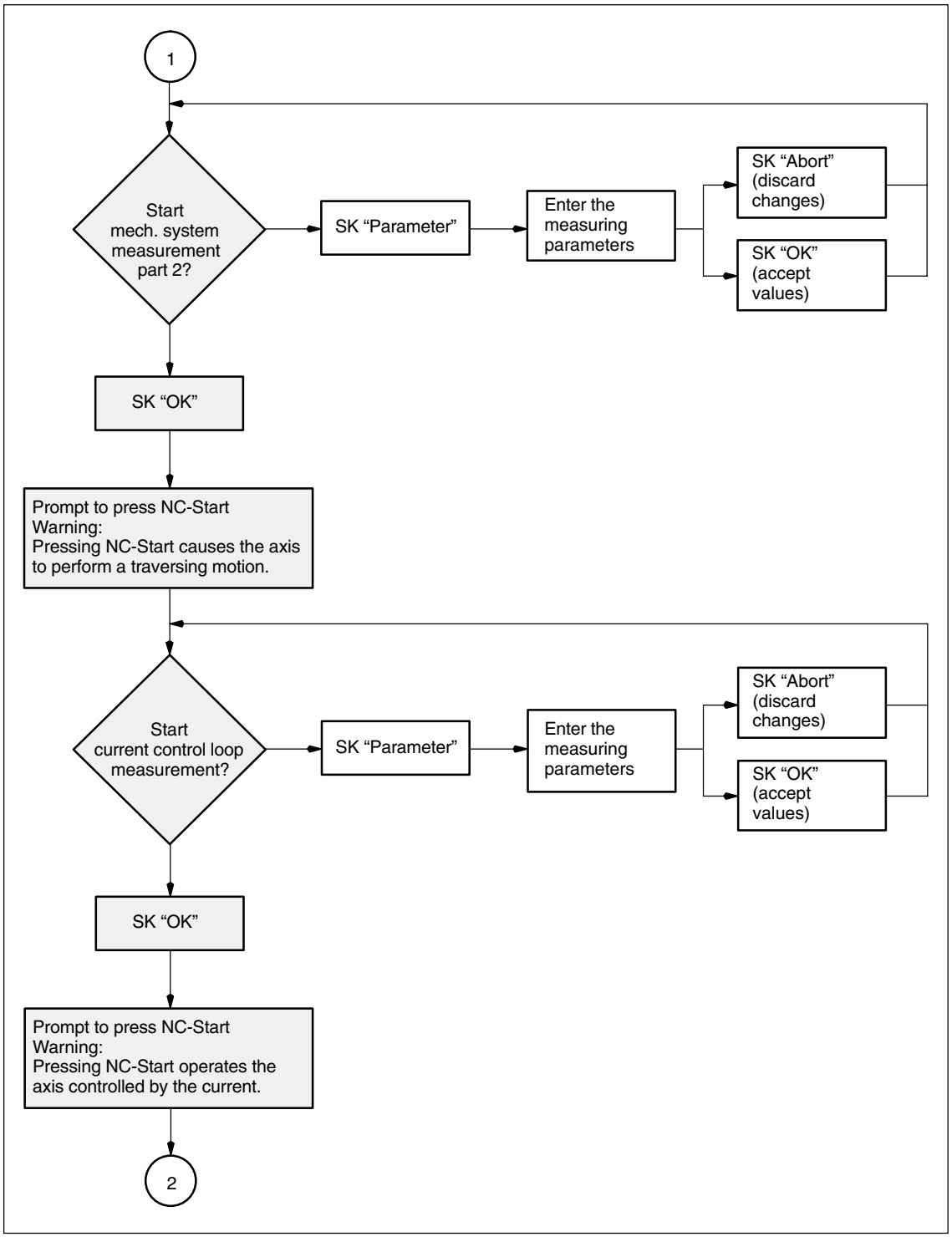
Soft key “Stop”:

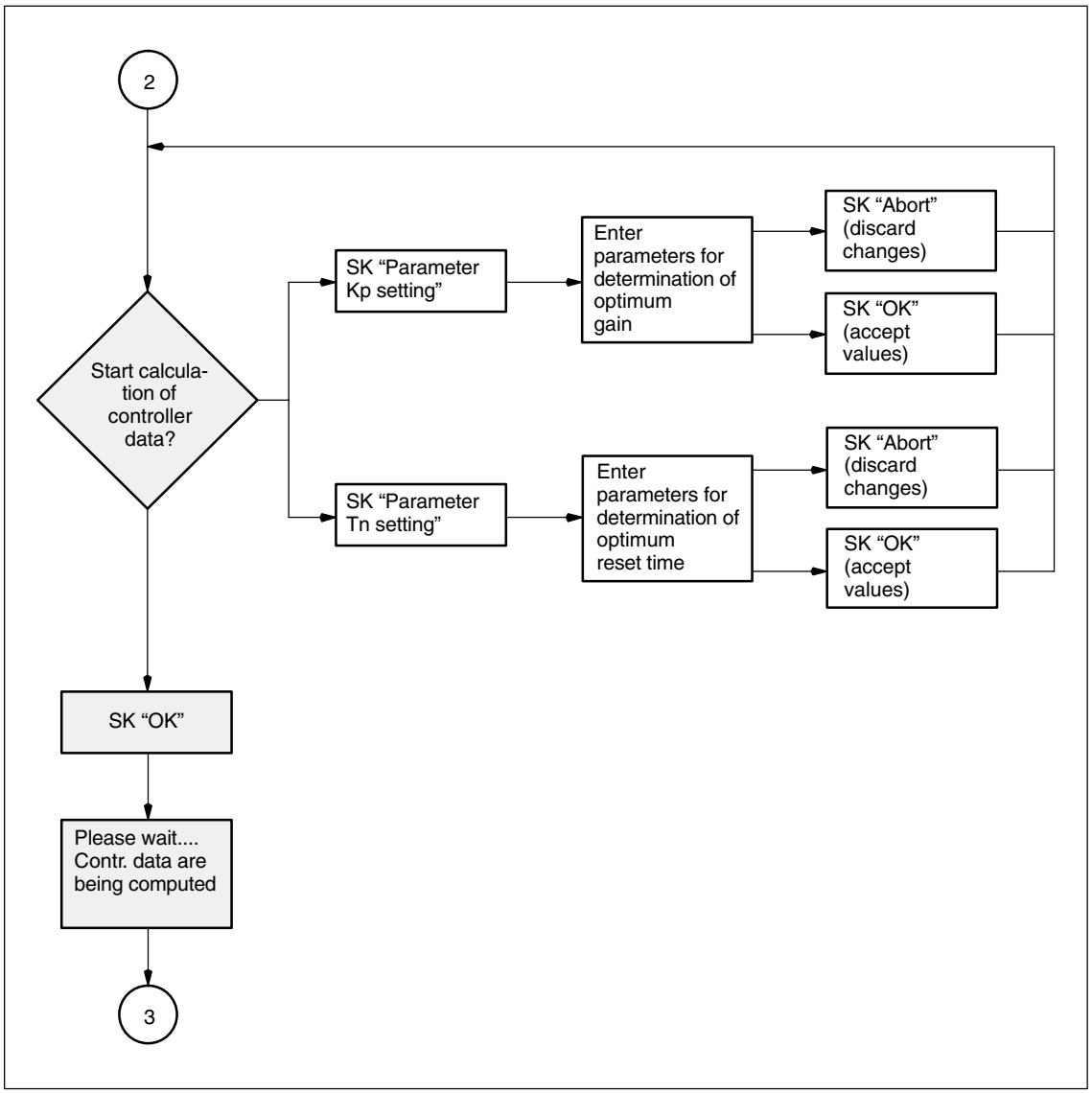
Stops the automatic controller setting for the affected axis (if a measuring function is active).

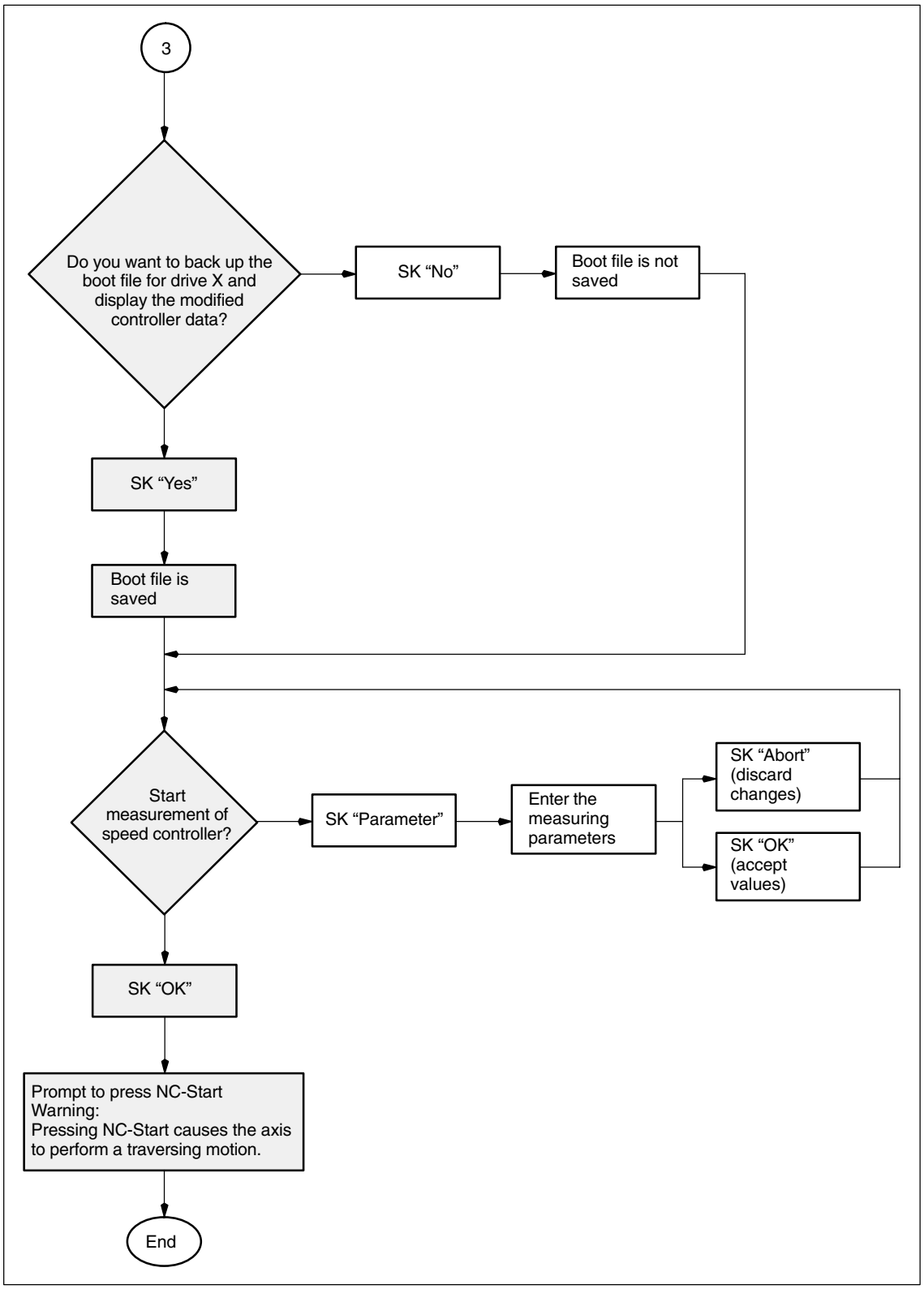
10.9.1 Flowchart for self-optimization

The self-optimization can be terminated at any time by pressing the “Abort” soft key.









10.9.2 Input possibilities for self-optimization

Mechanical system measurement

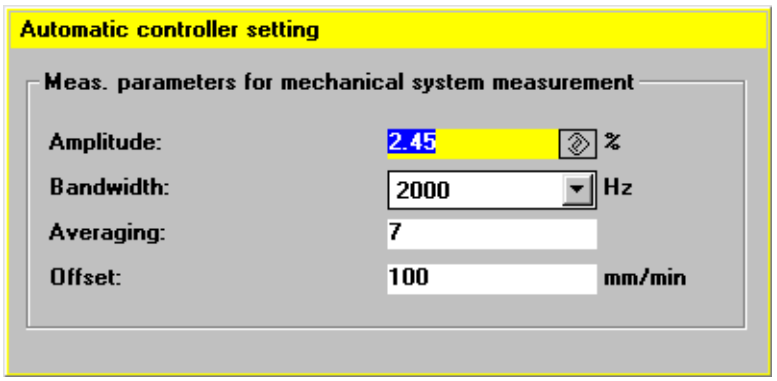


Fig. 10-23 Mechanical system measurement

Amplitude:
Input in % of maximum current of power section.

Bandwidth:
The bandwidth should only be changed if the previous optimization routines did not return satisfactory results (can only be changed in mechanical system part 1).

Averaging:
Should only be reduced if the traversing range of the machine is insufficient.

Offset:
Constant velocity during the measurement (alternate positive/negative sign for optimum utilization of the traversing range).

Current control loop measurement

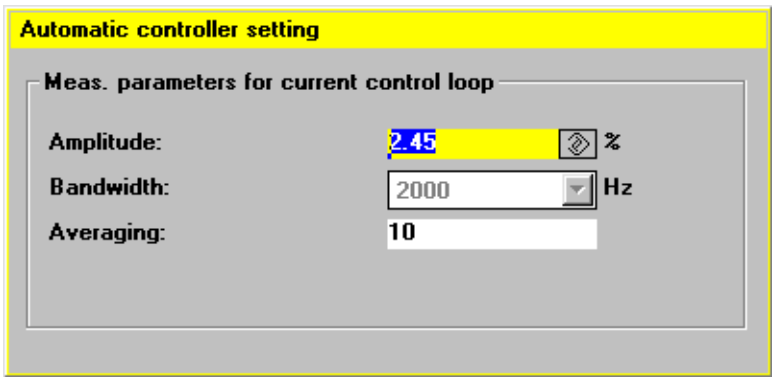


Fig. 10-24 Current control loop measurement

Amplitude:
Input in % of maximum current of power section.

Bandwidth:
The bandwidth can only be changed in mechanical system measurement part 1.

Averaging:
Does not normally have to be changed. Affects the quality of the measurement.

Determination of the proportional gain

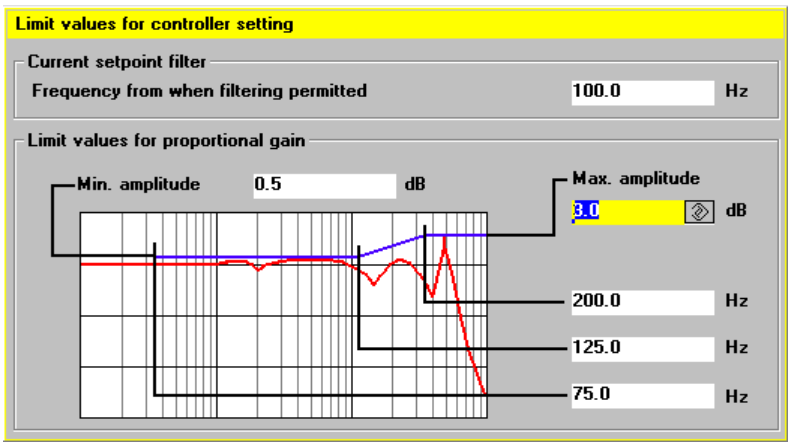


Fig. 10-25 Determination of the proportional gain

Frequency at or above which a filter can be used:
Current filters are not used below this frequency.

Min. amplitude:
This figure may not be exceeded between the minimum frequency and the average frequency (lower adaptation limit).

Max. amplitude:
This figure may not be exceeded at or above the upper frequency limit.

The three frequency entries can be used to modify the starting point and adaptation range.

Determination of the reset time

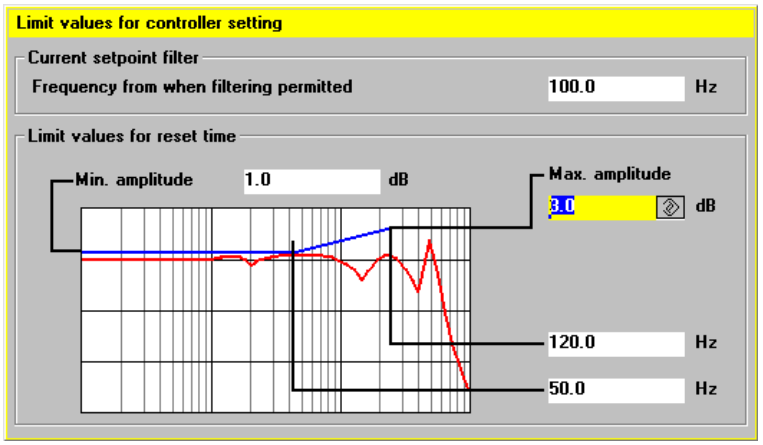


Fig. 10-26 Determination of the reset time

Frequency at or above which a filter can be used:
Current filters are not used below this frequency.

Min. amplitude:
This figure may not be exceeded between the minimum frequency and the lower frequency limit (lower adaptation limit).

Max. amplitude:
This figure may not be exceeded at or above the upper frequency limit.

The two frequency entries can be used to modify the adaptation range.

Speed control loop measurement

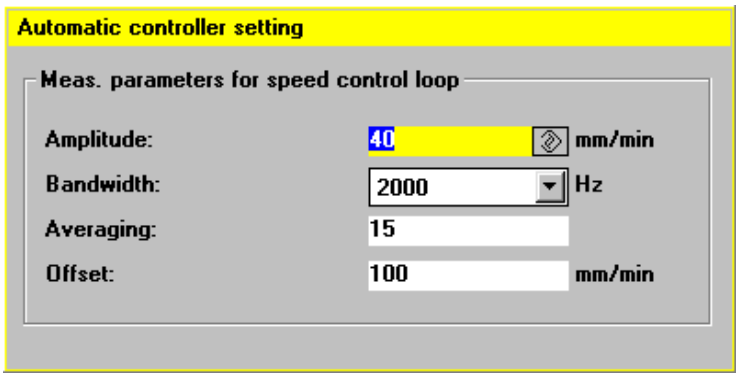


Fig. 10-27 Speed control loop measurement

Amplitude:
Enter the loading speed in mm/min (should be max. 50% of the offset).

Bandwidth:
Any bandwidth can be selected from the default values in order to check the automatic controller setting.

Averaging:
Affects the quality of the measurement.

Offset:
Enter the loading speed in mm/min (should be at least twice the amplitude).

■

Data Back-up

11

11.1 General

Implementation:

A data back-up is needed

- after start-up
- after changes to machine-specific settings,
- after servicing (e.g. after hardware is replaced or a software upgrade), to ensure that operation can quickly be resumed,
- during start-up before altering the memory configuration to make sure that no data are lost during start-up.

NCK/PLC/HMI

The complete data back-up routine for SINUMERIK 840D is subdivided into the following:

1. Data back-up for NCK, drive and front operating panel settings
2. Data back-up for PLC and data back-up for HMI

Standard system start-up/archiving by area

The following data back-up methods are used. They have different purposes:

1. Standard system start-up
   So-called standard system start-up files are created to ensure that a certain configuration can be transferred entirely to other controls running the same software releases (e.g. running on the same type of machine) as easily as possible. This type of file cannot be modified externally using an ASCII editor. Series start-up files contain all relevant settings (except for compensation data). Standard system start-up files should be created for NCK, PLC and for the HMI
2. Series start-up with compensation data
3. Software upgrade
4. Archiving by area
   – Archiving by area is the exception since both machine data 11210 and the standard system start up allow you to define whether modified machine data should be backed up.

   The data on the PLC and the HMI data are not broken down further.

The data back-up ensures that the protection levels set for the definition files and cycle directories are also backed up and can be restored during standard system start-up.

Required accessories

You will need the following accessories in order to back up the data:

- PCIN data transmission program for PG/PC
- V24 cable 6FX2002-1AA01-0BF0
  Reference material: /Z/ Catalog NC Z (Accessories)
- PG or PC (DOS)

Structure of the file names

_N_	Area	Unit	_	Type

- The area specifies which data are to be backed up or retrieved (general, channel-specific or axis-specific).
- The unit defines the channel, the axis or the TOA area. The unit is omitted if the entire area has been selected.
- The type determines the type of data. For a data back-up, the file name are generated and output automatically.

Areas

NC	general NC-specific data
CH	channel-specific data (unit corresponds to the channel number)
AX	axis-specific data (unit corresponds to the number of the machine axis)
TO	tool data
COMPLETE	all the data in an area
INITIAL	data for all areas (_N_INITIAL_INI)

Types

TEA	machine data
SEA	setting data
OPT	option data
TOA	tool data
UFR	user input frames: variable NPV, rotations, etc.
EEC	measuring system error offset
CEC	sag/angularity compensation
QEC	quadrant error offset
PRO	protection area
RPA	R parameters
GUD	Global user data
INI	general initialization program (all the data for the active filter system)

Examples

_N_COMPLETE_TEA	archiving of all machine data
_N_AX_TEA	archiving of all axis machine data
_N_CH1_TEA	archiving of the machine data for channel 1
_N_CH1_GUD	archiving of the machine data for channel 1
_N_INITIAL_INI	archiving of all the data in the active file system

11.2 Data back-up via HMI Embedded

With a PCU 20, the data is backed up via the user interface of the HMI Embedded software.

Details of the procedure can be found in the following documentation:

reference material: /IAM/ IM2, HMI EmbeddedStart-up Guide
/BEM/ Operator's Guide, HMI Embedded

11.3 Data back-up via HMI Advanced

With a PCU 50/50.3/70 , the data is backed up via the user interface of the HMI Advanced software.

Details of the procedure can be found in the following documentation:

Reference material: /IAM/ IM4, HMI AdvancedStart-up Guide
/BAD/ Operator's Guide, HMI Advanced

11.4 Data back-up via PG/PC

Via RS-232

The following data can be backed up via the RS-232 interface:

- **Standard system start-up**: with selection options for the following areas:
  - NCK (complete)
  - PLC (complete)
  - HMI (with option of saving only partial areas of the HMI data)
- **Archiving by area**: Backing up or reloading of individual data areas ("Data in", "Data out" and "Data selection" soft keys)

Error and operator message texts and cycle alarm texts

These texts are parts of the front operating panel system software. They must be reloaded after hardware component replacement or software upgrading. The messages must be in the correct format (see chapter 13, "Upgrading PCU 20 software"). The texts cannot be read out of the control.

Operating procedure (data back-up)

1. Connect the PG/PC
2. In the “Services” area of the HMI,
3. select “RS-232 PG/PC” interface (vertical soft key).
4. Select “Settings” and check or enter the parameter settings of the RS-232 interface (default setting).

Device type:	RTS/CTS
Baud rate:	9600 Baud
Parity:	no
Data bits:	8
Stop bits:	1
XON character:	11H(ex)
XOFF character:	13H(ex)
End of text character:	1AH(ex)
Format:	– Punched tape format **unchecked** for standard system start-up or for backing up drive data by area (boot files) – Punched tape format **checked** for backing up all other data by area.

11.5 Data back-up via machine data

Modified values, backing up, MD 11210

MD 11210: UPLOAD_MD_CHANGES_ONLY (machine data back-up for modified machine data only) can be used to define, when backing up machine and setting data, whether all the data or just data that differs from the default setting should be output via the V24 interface.

11210 MD Number	**UPLOAD_MD_CHANGES_ONLY** MD back-up of changed MD only		
Standard default: 0	Min. input limit: 0	Max. input limit: 1	
Change valid: immediately	Protection level: 2/4	Unit: –	
Data type: BYTE	Valid from software version: 1 or 4		
Meaning:	Selects a differential MD upload: Bit 0 (LSB) Effectiveness of the differential upload on TEA files **0**: All data is output **1**: Only machine data that differs from the default is output (only applies to INITIAL_INI). If a value in data stored in the form of an array is changed, the complete MD array is always output (e.g. MD 10000: AXCONF_MACHAX_NAME_TAB). Bit 1 Effectiveness of the differential upload on INI files **0**: All data is output **1**: Only MDs that have change compared to the compiled value are output Bit 2 Change to a field element **0**: The complete array is output **1**: Only the changed field elements of an arrays are output Bit 3 R parameters (for INITIAL_INI only) **0**: all R parameters are output **1**: only R parameters not equal to zero are output Bit 4 Frames (for INITIAL_INI only) **0**: all frames are output **1**: only frames that are not zero frames are output Bit 5 Tool data, cutting parameters (for INITIAL_INI only) **0**: all tool data is output **1**: only tool data that is not equal to zero is output Bit 6 Buffered system variables ($AC_MARKER[ ], $AC_PARAM[ ] for INITIAL_INI only) **0**: all system variables are output **1**: only system variables that are not equal to zero are output Bit 7 Synchronous action GUD (for INI files only) **0**: all Syna GUDs are output **1**: only Syna GUDs that are not equal to zero are output Effectiveness: The change to the data takes effect when the upload for the next area starts.		
corresponds to			

Note

- It **may** be useful to perform a data saving operation in which only altered machine data are saved prior to upgrading software in cases where the defaults in the new software are not the same as those in the earlier version. This applies particularly to machine data which are assigned SIEMENS protection level 0.

Recommendation

MD 11210 UPLOAD_MD_CHANGES_ONLY should be set to “1” or the corresponding bits set to “1”. With this setting, the transferred files contain only those data which deviate from the default. This is advantageous for future software upgrades.

Continue from “Standard system start-up” or “Archiving by area”.

11.5.1 Standard system start-up

Standard system start-up (data back-up)

5. HMI interface configuration (see above, punched tape format unchecked)
6. Start PCIN data transmission program (“Data In”) on PC/PG.
7. If “Start-up data” is selected via the HMI (HMI “Services” area, data output “Data Out”), the NCK and PLC areas are suggested when you press the “Input” key.
8. First select “NCK” (”NCK” is suggested as the name of the archive file) and start reading the data (“Start” soft key). Follow exactly the same procedure for the “PLC” data set.

Archiving by area

5. HMI interface configuration (see above: Check punched tape format, apart from for drive data)
6. Start the PCIN data transfer program (“Data In”) on the PC/PG.Enter file names.
7. On the HMI, select the data area to be output (HMI “Services” area, data output “Data Out”):
8. Press the “Data selection” soft key and select the areas to be read. The “NC-active data” area, for example, contains the following data:
   - Machine data
   - Setting data
   - Option data
   - Global and local user data
   - Tool and magazine data
   - Protection areas
   - R parameters
   - Zero offsets
   - Drive data
   - Compensation data
   - Display machine data
   - Workpieces, global part programs/subroutines
   - Standard and user cycles
   - Definitions and macros

   When the areas are output, the internal area identifier used in each case appears on the top line of the display.
9. Start reading the data (“Start” soft key) and acknowledge any input prompts.

Note

For the PLC, data back-up can be executed with the SIMATIC tools HiGraph.

Note filter setting for SDBs!

Reference material: /S7HT/ Manual, Application of Tools

These tools are useful in ensuring portability of the PLC programs.

Downloading archive data

To read in a complete configuration, a general reset of the control must be carried out first.

1. Set the protection level to “User” (Password CUSTOMER)
2. Connect the PG/PC to port X6 on the PCU.
3. On the HMI, select the “Services” area. Continue with steps listed under “Reading in series start-up” or “Reading in area-specific archive data”.

Standard system start-up

4. Select the interface configuration “V24-PG/PC” as described above (punched tape format unchecked).
5. Start the PCIN data transfer program on the PG/PC.

   Press the “Data out” soft key to start transferring the NCK standard system start-up file to be transferred to the control.
   On the HMI, select the “Services” area,
   press the “Data in” soft key and
   press the “Start” soft key to start reading.
   Acknowledge any input prompts.
6. Carry out an NCK reset and general reset of the PLC, then repeat the procedure with the PLC standard system start-up file.
7. Carry out another NCK reset. The control will start up with the new data.

Note

The NCK series start-up file must always be imported before the PLC series start-up file.

Archiving by area

4. Select the interface configuration “V24-PG/PC” as described above and set “punched tape format” (unless for drive data).
   - Start the PCIN data transmission program on the PG/PC. Select the archive file to be read into control under “Data Out” for transmission.
   - On the HMI, select the “Services” area,
     press the “Data in” soft key and
     press the “Start” soft key to start reading. The data is detected automatically and downloaded accordingly.
     Acknowledge any input prompts.

5. Read in the option data and carry out an NCK reset.
6. Load the machine data file and press “NCK-Reset”. If any messages are then received about reconfiguring the memory or rescaling machine data, the machine data file must be read in again and the control reset. It is generally necessary to repeat this two or three times.
7. If global user data is activated, the ”N_INITIAL_INI” file (Table 11-1) should be read. It is read out through selection of the setting “All data” as for area-specific archiving.
8. Read in archive file for global user data (MAC.DEF and GUD.DEF).
9. Reload the backed up “N_INITIAL_INI” file to activate the global user data.
10. Then load the other areas.
11. The PLC area must be loaded last after a PLC general reset.

Note

- When you are loading drive data, deselect the tape format as well as all special functions on the right of the display of interface settings.

  Do not actuate soft key “Back up boot file” in the drive data menu until you have reset the control once after loading the drive archive data.
- Check/correct the interface settings after display of a message regarding memory reconfiguration.

Transmission errors

If the transmission is canceled with errors, check the following:

- If the password set to the correct protection level.
- Are the interface parameters (V24-PG/PC) correct.
- When reading in LEC data, first
  set MD 32700 ENC_COMP_ENABLE to 0.
- Set MD11220 INI_FILE_MODE to 1 or 2 (see the “Response to cancellation when reading in machine data” section below).

Table 11-1 Data in _N_INITIAL_INI file

File _N_INITIAL_INI	Data not contained in file _N_INITIAL_INI
• Option data • Machine data • Setting data • Tool offsets • Zero offsets • Global user data • Local user data • R parameters • Flags in SRAM • Sync.action parameters in SRAM	• Drive machine data • Compensation data – Leadscrew error offset – Quadrant error offset – Sag compensation • Display machine data • Workpieces • Global part programs • Global subprograms • User cycles • Standard cycles • Definitions and macros

11.6 Data back-up via V24

Hardware and software required

- PG, PC
- RS-232 cable
- PCIN

System overview

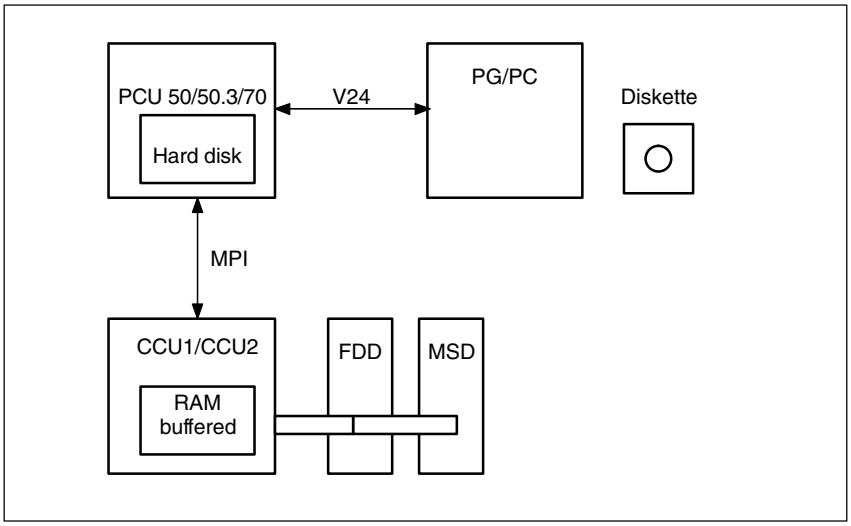


Fig. 11-1 System overview

What data does the system contain?

Drive data	NC data	PLC data	HMI data

Where are the data stored?

The data is normally stored in the buffered RAM of the NC or PLC. All the data can also be stored in certain directories on the hard disk of the PCU 50/50.3/70.

Setting for the V24 interface

When the data is output via the V24 interface, only the archive format is permitted for certain data. This applies to data with the extension ARC and the FDD and MSD boot files.
If remote diagnostics is active, another RS-232 interface must be used for reading out the data.

Select the "Services" area

The "Services" area of HMI Advanced contains an overview of all the programs or data contained in the NC, PLC, drive and on the hard disk. To view all the directories, you must first go to the "Select file" screen and set the display accordingly. Only then are the required data displayed to you.

Outputting data

The sequence of operations for outputting data via the V24 interface applies to all data. Proceed as follows:

1. Place the cursor on the required data.
2. Press the “Data out” soft key.
3. Press the “V24” or “PG” soft key.
4. Press the “OK” soft key.
5. Read the error log if errors occur while outputting the data.

What do you want to save?

When backing up data via RS-232 it is not advisable to save all the directories. Only the data required from re-commissioning are to be output. Use a streamer for a full back-up of all data.

11.7 Data output

11.7.1 Outputting the drive data via V24

Drive data

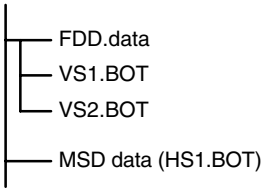
Drive data consists of:

- Boot files (MSD.BOT)
- Boot files (FDD.BOT)
- Drive machine data (*.TEA)

Data	Directory	Name	Meaning
Boot file	Diagnosis\FDD data	VS1.BOT	Boot file, 1st axis
Boot file	Diagnosis\MSD data	HS1.BOT	Boot file, 1st spindle
Drive MD FDD	DIAGNOSIS\MachDat/FDD	*.TEA	Drive machine data file for FDD saved under Start-up/MD/File functions. Name must be assigned.
Drive MD MSD	DIAGNOSIS\MachDat/MSD	*.TEA	Drive machine data file for MSD saved under Start-up/MD/File functions. Name must be assigned.

Where are the boot files located

The boot files are located in directories FDD data and MSD data.

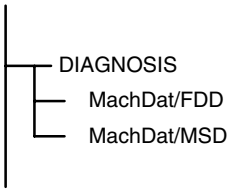


Note

The boot files can only be output as binary files with the V24 “Archive format” setting. The boot files must be backed up before they are output (“Save boot files” soft key). The data back-up for the boot files (in binary format) can only be reloaded to the same software release.

Drive machine data

The drive machine data must first be backed up in the “Start-up” –> “Machine data” –> “File functions” area before these files can be output via the V24.



11.7.2 Outputting the NC data via V24

NC data

By NC data we mean all data that is located in the SRAM of the NC (without part programs and cycles).

The following data is stored in the “NC active data” directory:

- NC machine data (MD11210 UPLOAD_MD_CHANGES_ONLY =1)
- Option data
- Setting data
- Tool/machine data
- Work offset
- R parameters
- Global user data
- Protection areas
- Compensation data
  - Measuring system error offset (EEC)
  - Beam sag/angular compensation (CEC)
  - Quadrant error offset (QEC)

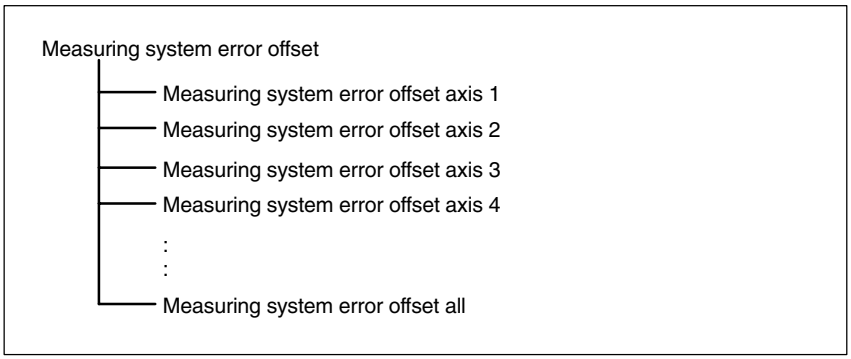
Structure of the file header

The file header starts with **“%_N”** and ends with **“_INI”**. If you are outputting all the global user data, the file header is as follows: **%_N_COMPLETE_GUD_INI.** In the display NC active data the “central section” of the file header is displayed, depending on the current cursor position. Look to the right of “Program/Data”.

Example 1

Outputting the measuring system error offset data. If you wish to output the EEC compensation data via RS-232 you can proceed in two ways:

1. Read out EEC data in their entirety (all axes).
2. Axis-specific output of EEC data.

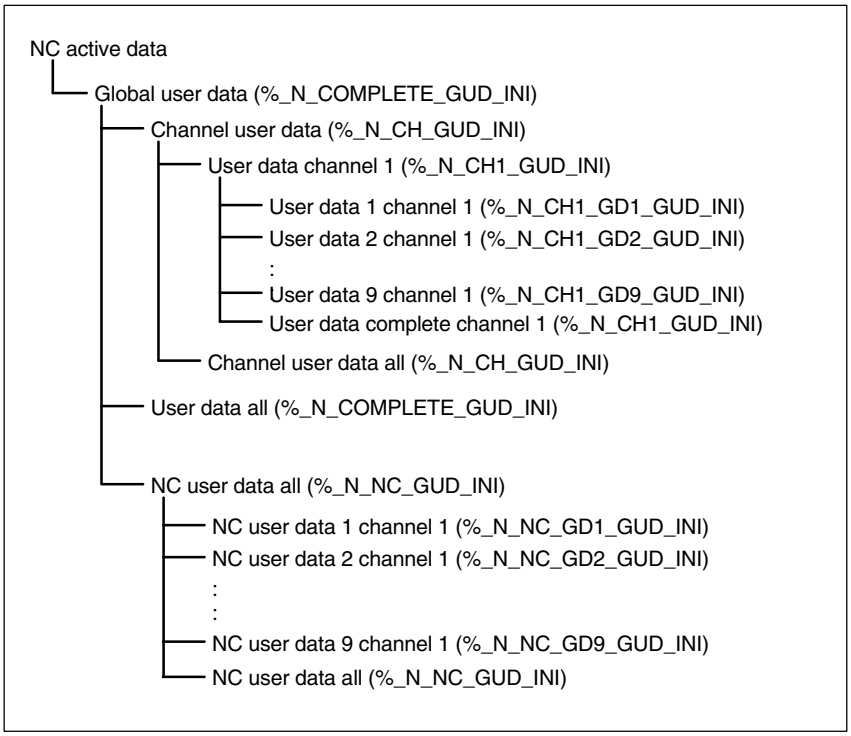


If you wish to read out all data, place the cursor on **Measuring system error offset all**, otherwise on the relevant axis.
The file header then looks like this:

Measuring system error offset, complete:	%_N_AX_EEC_INI
Measuring system error offset, axis 1:	%_N_AX1_EEC_INI

Example 2

Outputting global user data (GUD). The file header that is sent together with the data output is shown here, too.



The middle part of the file header, which is sent when the file is read, is displayed at the top of the Program/Data screen: __NC_ACT\GUD.DIR

Outputting the initialization program (INI)

Position the cursor on the **Initialization program (INI)** directory. Press the “V24” soft key. The initialization program “**%_N_INITIAL_INI**” is output with the following data:

- Global user data
- Option data
- Protection areas
- R parameters
- Setting data
- Machine data
- Tool/magazine data
- Zero offsets

No

  – Compensation data (EEC, QEC, CEC)
  – Part programs
  – Definition data and macros
  – Part programs, workpieces, cycles
  – PLC programs and data
  – Display machine data, drive machine data

If you place the cursor on “NC active data” and start outputting the data “via V24”, an initialization program called **%_N_INITIAL_INI** is also output, although this contains all the data in the “NC active data” directory, i.e. with compensations.

11.7.3 Outputting the PLC data via V24

PLC data

The PLC data must first be saved as an archive file before it can be output via the V24 interface.

Procedure

1. Press the “Standard start-up” soft key.
2. Simply select “PLC”.
3. Press the “Archive” soft key.
4. The display is changed and the job log displayed. The “PLC.ARC” file is created.
5. If the “Job finished” message appears, then press the “Data out” soft key.
6. Select “PLC.ARC” from the “Archive” directory and press the “Interface” soft key.
7. Make the following settings for V24 with archive format: “Binary format (PC format)”.
   Press “OK”.
8. Now press the “V24” soft key.
   Press the “OK” soft key to start outputting the data.

11.7.4 Outputting the HMI data via V24

Display machine data

With the HMI, the display machine data (MD 9000, ...) should be backed up via the file functions in the “Start-up” area. This machine data is located in the HMI Advanced RAM, in the “Diagnostics” –> “MachDat” –> “Operating panel” directory. The file name assigned when the data were being stored is displayed in the directory.
To output the display machine data, place the cursor on the desired file, then press the “V24” soft key and press the “OK” soft key to confirm. The display machine data can be output in punched tape format.

Definitions

The “Definitions” directory contains the definitions for the macros and global user data. These are, for example:

- SMAC.DEF (%_N_SMAC_DEF)
- MMAC.DEF (%_N_MMAC_DEF)
- UMAC.DEF (%_N_UMAC_DEF)
- SDUD.DEF (%_N_SGUD_DEF)
- MGUD.DEF (%_N_MGUD_DEF)
- UGUD.DEF (%_N_UGUD_DEF)

The definitions can be output via the V24 interface.

Example of GUD data:
Define OTTO as String
Define HANS as bool
Define NAME as char

When installing, the definitions must be read in before the INITIAL_INI file. Only when the definitions are known to the NC can the actual user data be read in.

Tool management data

The data for tool management can be found in the **Tool management** directory in HMI Advanced.This directory has three subdirectories:

- Magazine configuration (BEISPIEL_DOKU.INI)
- Tool management configuration (TT110.WMF,....)
- Tool management data (WZACCESS.MDB,....)

The PARAMTM.INI file for configuring the displays and access levels is located in directory **Diagnosis\HMI Initialization\...**

11.7.5 Outputting the standard system start-up file via V24

Preparing for standard start-up

The data selection for standard system start-up must be defined before a standard system start-up file can be defined. Press the “Standard start-up” soft key and define which data (HMI, NC, PLC) should be backed up.

Selecting the data

Press the “HMI data selection” vertical soft key. In this display you define which directories are to be contained in the series start-up file.

Creating an archive file

Select the data.
Press the “OK” soft key. The screen changes.
Press the “Archive” soft key to start creating the “HMINCPLC.ARC” archive file.
When the “Job finished” message appears, the “HMINCPLC.ARC” in the Archive directory file can be output via the V24 interface.
Set the V24 interface to PC format.
You can also create and output the areas HMI, PLC, NC separately in the form of series start-up files. The file name then is as follows:

HMI:	HMI.ARC
NC:	NC.ARC
PLC:	PLC.ARC

Note

The compensation data EEC, QEC, CEC are not contained in the series setup file. Reason: Every machine has its own compensation data.

11.8 Backing up the hard disk with Norton Ghost®

11.8.1 Hard disk back-up/restore

Functions

- Simple Back-up/Restore of the hard disks of the PCU 50/50.3/70 locally. System software, add-on software and user-specific records are all backed up.
- HD image (HD image saved as file) can be saved on a data carrier (e.g. CD) for long-term purposes.
- Loading of master images (images for series start-up) remains with the machine manufacturer.
- Upgrading or downgrading can be executed by the machine manufacturer (master image) irrespective of what is supplied by Siemens.
- The Norton Ghost ® back-up program is installed on every PCU.

Norton Ghost®

Using the "Norton Ghost®" software, the entire content of a PCU hard disk is stored as a disk image. This disk image can be stored on various data carriers for a later restoration of the hard disk. Norton Ghost® is supplied from the factory on every PCU 50/50.3/70 module.
For further information please see Internet under web site "www.ghost.com".

PCU 50

The next section describes how to back up an entire PCU hard disk so that both user and system data remains available and consistent if servicing is required:

- **Back up hard disk**
- **Back up user data**
- **Copy data to hard disk**

Operating instructions

while program is running with Norton Ghost®

HMI BIOS

To enter and make changes in BIOS, you require a keyboard with a PS/2 connector (a PG keyboard also works).
From Bios 3.04, press the "DEL" key when powering up the HMI. Loading the "BIOS Setup Defaults" allows BIOS settings to be reversed.

PCU

With the PCU, in the event of a hard disk restore, the "Virus Warning: Disabled" setting must be made in the BIOS. This change is not needed for the back-up.

Memory required on the PC/PG

The PC/PG hard disk must have around 70% of the PCU hard disk space as free memory for the back-up image file.

Back-up/Restore via parallel cable

on the PG/PC

- PC/PG with bidirectional interface, EPP setting
- LapLink–Siemens parallel cable (Order no. 6FX2002-1AA02-1AD03) commercial LapLink cable
- For PCU, set the parallel port to EPP (Bios), which will increase the transmission speed of the parallel interface by approximately 10%.

Supplementary conditions

1. Back-up/restore at the file level is done using HMI Advanced in the “Services” area, e.g. by selectively backing up start-up and machine data, etc. (via V.24, network, PC card)
2. Individual software components are installed/reinstalled either via PC card or via the parallel port (InterInk/ InterSrv). Please take note of the BIOS updating problems.
3. If you back-up/restore via the parallel port of network, the power saving circuit of the external PC/PG must be switched off.
4. After backing up/restoring with Ghost, the parallel cable should be unplugged to avoid unpredictable HMI operating states.
5. If the external PC is equipped with an AMD K6 processor, problems may arise with the parallel connection if the processor cycle is >233 MHz. In this case, both computers (PCU and PC) should be operated with the LPT Bios setting “ECP”.
6. Occasionally, access problems to the CD ROM drive are encountered with some PGs. In this case, a ghost connection abort may incur after a direct restore of an image file from a CD ROM.
   Remedy: Copy the image file from the CD to the PG hard disk.

Functions of **Norton Ghost®**

- Saving of complete hard disks in an image file
- Restoring hard disks from an image file
- Compressing of image files
- In-built coupling via LPT port master/slave, e.g. from PCU with PG (without InterInk/Intersrv)
- Supporting long file names
- Disk integrity and image file “Integrity Check”
- Reloading of image files to unformatted hard disk (“on-the-fly formats”)
- New target hard disk can be larger or smaller (if data volume not too large) than the original
- When copying hard disks with several partitions, the size of the partitions can be changed.
- Command interface for the integration of batch files
- Menu interface for interactive operation

11.8.2 Saving user data

The “Services” area of the HMI can be used to back up PLC, NC and HMI data using the “Standard system start-up” function.

Reference material: /BAD/ HMI AdvancedUser Guide

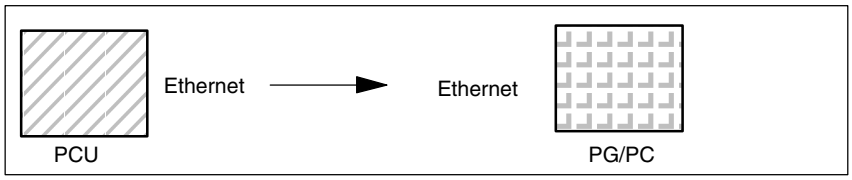
Requirement: Set password

1. Select the “Services” area.
2. Press the “Standard start-up” soft key.
3. Press the “HMI data selection” soft key.
4. Select the data to be archived.
5. Select the destination to start archiving:
   – “Archive” directory on the hard disk
   – “Archive” directory on the NC card
6. The soft key label changes to “...Stop”. The Standard system start-up archive is created.

11.8.3 Backing up the hard disk

Requirement:

- Norton Ghost version 6.x/7.x (Windows XP required, >= 7.x) must be installed on the PCU and on the PG/PC.
- The Ghost versions must be the same on the PCU and PG/PC.
- Directory where the image file is to be stored exists on PG/PC.
- There must be enough free memory on the PG/PC.
- Any version of Windows running on the PG/PC.
- PCU and PG/PC are connected with the Ethernet cable.



1. Switch off and on control and select setup mode (press key 6 if DOS window appears)
2. Select menu “7: Back-up/Restore”
3. Enter the password
4. Select menu “1 hard disk back-up/restore with ghost”
5. < only if presetting is not correct >
   Set parameter for Norton Ghost program:
   – < 1 > configure ghost parameters:

     If you wish to change the preset directory path or the type of interface, choose menu item 1 from:

     * Change interface (set connection mode):

     <1> PARALLEL (default setting)

     <2> LOCAL select and confirm the relevant option

     * Change path:

     <3> Change back-up image file name (set up directory for back-up file on the PG, e.g. C:\SINUBACK\PCU\HMI.gho)

     <4> Change restore image file name (set up complete path for restore file “MMC.GHO” on the HMI, e.g. D:\SINUBACK\HMI\MMC.GHO)
     select the relevant option, enter and confirm the path

   – Prompt: Save GHOST parameters? answer “Yes”.

     <5> Back to previous menu
     Return to main menu

6. Execute hard disk back-up
   – < 2 > Hard disk back-up to <path name>, Mode: LOCAL/NETWORK
     * When you select this menu, a message appears:
       You are prompted to check whether a connection has been established between the HMI and PG/PC.
       The destination path for the HMI image directory is displayed.
       The back-up is to be generated from this directory.
     * PG/PC:
       Start the Ghost program in a DOS window or at the DOS level using the command **ghost –lps**.

* PCU:
  Click on “Y” to acknowledge the prompt and start the back-up.
* PCU:
  A Norton Ghost message window appears. This contains:
  The transfer progress
  The paths used
  Information about the amount of data to be transferred

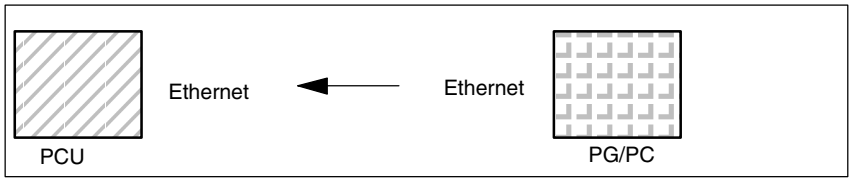
PCU

If the back-up is canceled, a prompt appears:
Do you want to try to back-up again [Y,N] ?
Click on N to acknowledge and call up the main menu.
Click on “Y” to restart the back-up.

– **< 4 > Back** to previous menu
  Return to main menu

11.8.4 Copy data to hard disk

- Version 6.x/7.x of the Ghost program is installed on the PCU and on the PG/PC.
- The directory for storing the restore image has been created on the PG/PC.
- Any version of Windows is installed on the PG/PC.
- PCU and PG/PC are connected with the Ethernet cable.



1. Switch on the PG and insert CD into drive.
2. Switch off and on control and select setup mode (press key 6 if DOS window appears).
3. Select menu “7: Back-up/Restore”
4. Enter the password
5. Select menu “1 hard disk back-up/restore with ghost”
6. Set the parameters for the Norton Ghost program:
   – <1> Configure GHOST Parameters:

     see above
7. Restore contents of hard disk
   – < 2 > Hard disk back-up to <path name>, Mode: LOCAL/NETWORK

* When you select this menu, a message appears:
  You are prompted to check whether a connection has been established between the HMI and PG/PC.
  The destination path for the HMI image directory is displayed.
  The back-up is to be generated from this directory.
* PG/PC:
  Start the Ghost program in a DOS window or at the DOS level using the command **ghost –lps**.
* PCU:
  Click on “Y” to acknowledge the prompt and start the back-up.
* PCU:
  A Norton Ghost message window appears. This contains:
  The transfer progress
  The paths used
  Information about the amount of data to be transferred

PCU

If the back-up is canceled, a prompt appears:
Do you want to try to back-up again [Y,N] ?
Click on N to acknowledge and call up the main menu.
Click on “Y” to restart the back-up.

– **< 4 > Back** to previous menu
  Return to main menu

8. The system boots automatically after a successful restore operation.

Duration: approx. 15–20 minutes

Note

Back-up of user data, machine data and start-up files is an integral feature of the HMI in the Services operating area.
The storage location and format of the data to be saved, and the medium on which they can be stored or restored from, are displayed in the File Manager.

Reference material: /IAM/ IM4, HMI AdvancedStart-up Guide

11.9 Backing up the current image of the latest software

Backing up the latest software

If you wish to create an image of your current software, proceed as follows:
Requirement:
The Ghost program must be installed on the PCU.

1. Switch on the control and select setup mode (press key 6 if the DOS window appears).
2. Select menu “7: Back-up/Restore”
3. Enter the password
4. Select menu “4: Partitions Back-up/Restore”
5. Change the maximum number of available images if necessary:
   Menu “1: Configure Ghost Parameter”
   Then use menu “1: Change Maximum Back-up Images” to define how many images you want to allow. Up to 7 images are possible. Default setting: 1.
6. To save the current software, select
   Menu “2: Partitions Back-up” and enter a descriptive text that will help you to find the image in future in order to restore it.
7. The backed up software is stored in the “D:\Images” directory and is listed when you select Menu “3: Partitions Restore”.

Restoring the latest software

If you wish to use an image you have created of your current software, proceed as follows:
Requirement:
The Ghost program must be installed on the PCU.

1. Switch on the control and select setup mode (press key 6 if the DOS/ Windows window appears).
2. Select menu “7: Back-up/Restore”
3. Enter the password
4. Select menu “4: Partitions Back-up/Restore”
5. To restore the image, select
   Menu “3: Partitions Restore”
6. Choose a software version from the list of available versions.
7. The system boots automatically after a successful restore operation.

Deleting a software image from the “Images” directory

If you wish to delete a software image from the “Images” directory, proceed as follows:
Requirement:
The Ghost program must be installed on the PCU.

1. Switch on the control and select setup mode (press key 6 if the DOS/ Windows window appears).
2. Select menu “7: Back-up/Restore”
3. Enter the password
4. Select menu “4: Partitions Back-up/Restore”

5. To delete a software image, select
   Menu “4: Delete Image”
6. Choose a software version from the list of available versions.
7. The deleted software image is removed from the “D:\Images” directory and is no longer listed when you select Menu “3: Partitions Restore”.

Norton Ghost

Two versions of the Norton Ghost software are available on the control:

- Norton Ghost version 5.1b (default)
- Norton Ghost version 6.01

From Norton Ghost version 5.1c onwards, the data format has changed, which means that earlier versions of Norton Ghost, i.e. < V 5.1c, are unable to read the new data format.

If the latest version 6.01 is required (because a more recent version is installed on the PG/PC, for example), this can be activated via the Service menu.

1. Switch on the control and select setup mode (press key 6 if the DOS/ Windows window appears).
2. Select menu “7: Back-up/Restore”
3. Enter the password
4. Select “Switch to other version of GHOST”. The active version of Norton Ghost appears at the top of the screen.

Transfer using LPT parallel port

For a transfer using the LPT parallel port, the Norton Ghost software **cannot be mixed** with old (< V 5.1c) and new (>V 5.1b) versions. During the transfer, it should be ensured that a compatible data format is transferred:

- Norton Ghost V5 up to and including V5.1b or
- Norton Ghost V5.1c up to and including V6.x

11.10 Installing a replacement hard disk

PCU 50/70

The next section describes how to restore the data back-ups of an entire PCU 50/70 hard disk so that both user and system data remains available and consistent if servicing is required.

Norton Ghost®

Using the "Norton Ghost®" software, the entire content of a PCU 50/70 hard disk is stored as a disk image with HMI Advanced. This disk image file can be stored on various data carriers for later restoration of the hard disk.

Norton Ghost® is supplied from the factory on every PCU 50/70 module and the spare hard disk.

For further information please see web site "www.ghost.com" or the previous chapter.

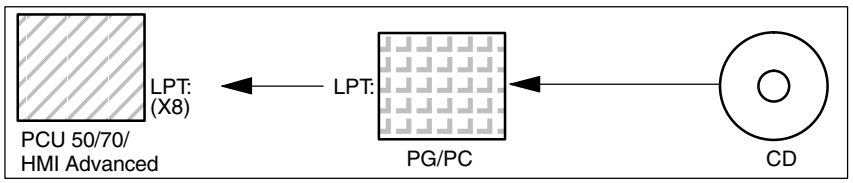
Recommendation

Archive the hard disk back-up (image), including the "Norton Ghost" program, on a CD.

Restore back-up copy

Requirement:

- Ghost program is installed on the PG.
- A new replacement hard disk is installed.
- Connect the PCU to the PC/PG using a parallel cable
- One of the operating systems Windows 3.x, Windows 95 and a CD drive is available on the PC/PG.



1. Fit the new spare hard disk in the PCU 50/70
   (see enclosed instructions)
   - Place hard disk onto hinges
   - Plug in the connecting cable from the hard disk to PCU
   - Mount hard disk using the 4 knurled screws
   - Release the transport retainer: turn to "operating" until it engages.

Note

The Windows operating system and HMI system software are not installed on the replacement hard disk.

2. Switch on the PG and insert CD into drive.
3. Switch off and on control and select setup mode (press key 6 if DOS window appears).
4. Select menu “4: Back-up/Restore”
5. Enter the password
6. Select menu option 1 “Hard disk back-up/restore with ghost”
7. Set the parameters for the Norton Ghost program:
   – **< 1 > configure ghost parameters**:

     see above

   – **<3> Hard disk restore** from <path name>, PARALLEL mode

     * When you select this menu, a message appears:
       You are prompted to check whether a connection has been established between the control and PG/PC.
       The image file is displayed for the control onto which the restore is to be loaded.
     * PG/PC:
       Start Norton Ghost in a DOS window or at the DOS level by entering the command **ghost –lps** to start the program.
     * HMI:
       Acknowledge (Yes) the message window to start the restore.
     * HMI:
       A Norton Ghost message window appears. This contains:
       The transfer progress
       The paths used
       Information about the amount of data to be transferred

Note

If the data transfer is interrupted during the restore operation, the system on the hard disk is incomplete. A control boot diskette is therefore needed. This must contain the MS-DOS $\geq$ 6.X boot and the Norton Ghost software.

   – **< 4 > Back** to previous menu
     Return to main menu
8. After a successful restore, the control is automatically rebooted.

Duration: approx. 15–20 minutes
to generate a compressed disk image = 130 MB of a 540 MB hard disk via LPT.

11.11 Data back-up with VALITEK streamer with the PCU 50

What can you back up?

Using the VALITEK streamer you can

- back up all data on hard disk C (Back-up all)
- back up the user data (archive format) in directory C:\DH\ARC.DIR (Back-up User Data)
- restore the data back-up (Restore from Tape)

Streamer connection

The VALITEK streamer is connected to the parallel port X8 (25-pin) on the PCU 50/70 using only the SIEMENS cable 6FC9 344-4x□. No other data back-up device can be connected since the software is designed to operate with the VALITEK streamer.

Operation

While the HMI is booting (after switching on the control system) when the message **Starting MS DOS appears:**

1. Press the **6** key once briefly on the front operating panel keyboard.

The following menu is displayed:

```
                PLEASE SELECT:

                1 Install/Update MMC System
                2 MMC Configuration Tool
                3 DOS Shell
                4 Start Windows (Service Mode)
                5 MMC System Check
                6 Reboot System (Warmboot)
                7 Back-up / Restore
                8 Start PC Link
                9 End (Load MMC)


Your Choice [1,2,3,4,5,6,7,8]?
```

2. Press key **7**.

The system asks you to enter a password:

```
passwd:
```

3. Enter a password for level 0 to 2.
   – System
   – Manufacturer
   – Service

The following menu is displayed:

```
                    PLEASE SELECT:

                    1 Select VALITEK Streamer Type
                    2 Test Connection to Streamer
                    3 Back-up System
                    4 Back-up Userdata
                    5 Restore from Tape
                    6 Uninstall MMC102/103 (Delete Files)
                    7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?
```

4. Press key **1**

The following menu is displayed:

```
                    *** No Streamer configured ***

                    Please select (new) Streamer type:
                    1 Valitek PST-160
                    2 Valitek PST2-M1200
                    3 Return to previous Menu

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

5. Select the streamer type, e.g. No. 2.Valitek PST^2-M1200. The streamer type is then selected and you return to the selection menu.

```
                    PLEASE SELECT:

                    1 Select VALITEK Streamer Type
                    2 Test Connection to Streamer
                    3 Back-up System
                    4 Back-up Userdata
                    5 Restore from Tape
                    6 Uninstall MMC102/103 (Delete Files)
                    7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?
```

6. You can also select the streamer connection. To do this, select menu option **2**
   The message for the selected streamer type is displayed:

```
      *** Current Configuration: Valitek PST2-M1200 ***

Press any key to continue ...
```

The test run then starts.

```
Valitek PST2 system                                    Verify Connection

Activity                        Repetitions            Connection
Reading Status                      500                    0
Sending Test Data Blocks            500                    0
Receiving Test Data Blocks          500                    0

Selected Port : lpt1        Rom Version 85 Revision B      <esc>–Abort

      Test complete. The connection is functional. Press a key ...
```

7. You can now, for example, create a complete back-up of all system data. To do this, select 3, Back-up System means hard disk C.

```
                    PLEASE SELECT:

                    1 Select VALITEK Streamer Type
                    2 Test Connection to Streamer
                    3 Back-up System
                    4 Back-up Userdata
                    5 Restore from Tape
                    6 Uninstall MMC102/103 (Delete Files)
                    7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?
```

The following message appears on the screen:

```
      *** Current Configuration: Valitek PST2–M1200 ***

     Backing up Partition C: ....
      Continue ?

Your Choice: [Y,N]?Y
```

Start the data back-up by pressing Y.

8. By pressing key **4**, Back-up User Data, you opt to create a back-up of the user data, i.e. batch file C:\TOOLS\BACK_USR.BAT is executed. All archive files under C:\DH\ARC.DIR are backed up as standard. If you want to back up additional files, then you must enter other directories in file C:\TOOLS\ BACK_USR.BAT.

```
                    PLEASE SELECT:

                    1 Select VALITEK Streamer Type
                    2 Test Connection to Streamer
                    3 Back-up System
                    4 Back-up Userdata
                    5 Restore from Tape
                    6 Uninstall MMC102/103 (Delete Files)
                    7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?4
```

BACK_USR.BAT

The file may only be modified at the point indicated. The content of file BACK_USR.BAT is as follows:

```
~~C:\
REM Save Archives in DH:\ARC.DIR
>> c:\dh\arc.dir\
*.*
REM Save this file
>> c:\tools\
back_usr.bat

[ ...Here you can specify the directories that are to be backed up, e.g.  >>
c:\dh\mb\
*. *]

REM The following line must be the last !
$$
```

The following message appears on the screen:

```
      *** Current Configuration: Valitek PST2-M1200 ***

        Backing up User Data ....
      Continue ?

Your Choice: [Y,N]?Y
```

Start the data back-up by pressing Y.

9. You can opt to restore the backed up data by selecting option **5**.

```
                    PLEASE SELECT:

                    1 Select VALITEK Streamer Type
                    2 Test Connection to Streamer
                    3 Back-up System
                    4 Back-up Userdata
                    5 Restore from Tape
                    6 Uninstall MMC102/103 (Delete Files)
                    7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?5
```

The following message appears on the screen:

```
      *** Current Configuration: Valitek PST2-M1200 ***

        Restoring from Tape ....
      Continue ?

Your Choice: [Y,N]?Y
```

You can start restoring the back-up data from tape by selecting Y.

10. Press **6** to delete the HMI Advanced System, including stored data

```
                    PLEASE SELECT:

                    1 Select VALITEK Streamer Type
                    2 Test Connection to Streamer
                    3 Back-up System
                    4 Back-up Userdata
                    5 Restore from Tape
                    6 Uninstall HMI (Delete Files)
                    7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?6
```

```
      Do You REALLY want to delete Your HMI Advanced system ?
Your Choice: [Y,N]?Y
```

Y will delete all the data in the C:\HMI*.* and C:\DH*.* directories. MS-DOS and WINDOWS operating systems are not deleted.

11.12 Line checksums and MD numbers in MD files

Line checksums have been introduced when creating back-up files for machine data (INI and TEA files). This means that they can not be checked.

The introduction of MD (machine data numbers) into the back-up files makes it easier to understand the machine data values when servicing is required and, if necessary, allows machine data back-up files to be processed automatically.

By backing up the files, the “Manufacturer” write access right can be avoided when restoring.

The two sections below give detailed information about line checksums and machine data numbers.

11.12.1 Line checksums (MD 11230 MD_FILE_STYLE)

Properties of line checksums

A line checksum

- is generated only for lines with machine data assignments.
- is positioned directly after the machine data assignment, preceded by a blank and apostrophe.
- comprises 4 HEXA characters.
- is only generated by the control when a machine data back-up file is generated. It is not created by external editors on the PC or PG.
- is activated via MD 11230 MD_FILE_STYLE.
- can be output together with machine data numbers.
- “; <comment >” can be added later without affecting the sum check.

MD 11230 MD_FILE_STYLE

If MD 11230=	then output of	Example
0	MD name	$MC_AXCONF_MACHAX_USED[0]=1
1	MD name with line checksum	$MC_AXCONF_MACHAX_USED[0]=1 **’2F34**
2	MD name and MD number	N20070$MC_AXCONF_MACHAX_USED[0]=1
3	MD name, MD number and line checksum	N20070$MC_AXCONF_MACHAX_USED[0]=1 **’2F34**

Evaluating line checksums

When machine data files are read in with valid line checksums, no write access right is needed.

"Manufacturer" rights are needed to read in the following data:

- machine data without line checksum
- modified machine data values with deleted line checksum

When loading machine data files, you can choose how the system must react to errors in the machine data file. See Abort procedure subsection 11.12.3.

If the file contains errored values, then the current values are never overwritten.

11.12.2 Machine data numbers

Archive files

- Machine data numbers formally precede a machine data assignment line as block numbers (e.g. N20070).
- There is a blank between the machine data number and machine data assignment.
- The machine data number relates to the machine data record as a whole. Any existing field values are not reflected in the machine data number.
- The generation of machine numbers in front of machine assignment lines in INI and TEA files can be activated or deactivated.
  - MD 11230 MD_FILE_STYLE Bit 1 = 1 Generate machine data number
  - MD 11230 MD_FILE_STYLE Bit 1 = 0 Do not generate machine data number

Evaluating MD numbers

When machine data files are restored, the control evaluates the machine numbers as follows:

- If errors are identified in the machine files as they are read in, then the machine number is displayed as a **block number** with the corresponding alarm.

11.12.3 Response to canceling while reading in machine data

Response to canceling

When machine data files (INI files)

- which contain errors
- which do not match the checksum

are read into the control, alarms are generated. The import operation may be aborted. The following responses by the control can be selected by setting machine data MD 11220 INI_FILE_MODE:

MD 11220 value	Response to errors
0	Output an alarms, cancel on detecting the 1st error. (As for SW versions 1 and 2.)
1	Output of an alarm, import continues, output of number of errors at file end by an alarm.
2	Import continues to file end in spite of any errors. Output of number of errors at file end by an alarm.

In all cases with at least one error in the machine data file, the name of the affected file is output with the first alarm (alarm 15180).

Further reactions:

- Defective machine data does not overwrite current machine data.
- If an attempt is made to load machine data without line checksums without sufficient authorization, the machine data is not overwritten.
- CHANDATA instructions for non-implemented channels (machine data for multiple channels is not set) causes processing to be canceled.
- Invalid file end aborts the import operation.

MD 11220 INI_FILE_MODE

MD 11220 INI_FILE_MODE must be reset explicitly. An earlier setting is not validated in the course of series start-ups.

Example:

- Read in machine data and output alarms generated while reading in.
- % character represents the file name and number of errors.
- MD 11220 = 1, i.e. output an alarm in response to every error, continue import, output number of errors at end of file through an alarm.

Machine data file	Alarms
CHANDATA(1)	
$MC_AXCONF_GEOX_NAME_TAB[0]=”X”	
$MC_AXCONF_GEOX_NAME_TAB[1]=”Y”	
	15180 Cannot process program % as an INI file
$MC_AXCONF_GEOX_NAME_TAB[99]=”A”	17020 Illegal array index1
$MC_MM_REORG_LOG_FILE_MEM=1000	17090 Value higher than upper limit
$MC_AXCONF_GEOX_NAME_TAB=”X”	12400 Element does not exist
$MC_MM_REORG_LOG_FILE_MEM[1]=100	12400 Element does not exist
$MN_UNKNOWN_MD=1	12550 Name % not defined
M17	
	15185% Error detected in INI file

Upgrade from software version 6.4

Machine data for non-activated channels is ignored and does not cause the reading of an archive to be canceled.

Channels are activated by the settings in machine data
MD 10010: ASSIGN_CHAN_TO_MODE_GROUP.

Channel machine data for channels for which a BAG=0 is assigned are ignored when read.

The alarm generation options via MD 11220: INI_FILE_MODE also apply here. Errors only relate to the data errors that are read in for channels to be downloaded.

Application:
Standard system start-up for various machines via a standardized archive file that was created for the largest machine of a class of machines. For the smaller machines, only the
MD 10010: ASSIGN_CHAN_TO_MODE_GROUP is set so that only those channels that can be processed by smaller machines are activated.

Changing the archive file:
The SinuCom ARC program can be used to change the archive file in
MD 10010: ASSIGN_CHAN_TO_MODE_GROUP.This program is part of the SinuCom NC start-up software which is described in

Reference material: /INC/ Start-up Tool SINUMERIK SinuCOM NC.

ALARM:
If machine data that should be ignored is identified when the archive is read in, warning alarm 15025: “Channel %1 block %2 CHANDATA: Channel is not active. %3 data will be ignored” is output.

11.13 Machine/setting data

The machine/setting data is listed in
Reference material: /LIS/ Lists

11.14 Back up PLC data

Original image of project

The consistency of the PLC data back-up is guaranteed only if you take the following steps in the given order:

1. Switch PLC to PLC STOP (set PLC switch S4 to position 2)
2. Transfer PLC data from PG to control
3. Archive PLC data
4. Switch PLC to PLC-RUN (set PLC switch S4 to position 0)

If you following this sequence of steps, an original image of the project will be generated in the data management system.

Instantaneous image of PLC-CPU

If you cannot perform the operations described above, you can – as an alternative – switch the PLC from PLC-RUN to PLC-STOP:

1. Switch PLC to PLC STOP (set PLC switch S4 to position 2)
2. Archive PLC data
3. Switch PLC to PLC-RUN (set PLC switch S4 to position 0)

If you following this sequence of steps, an instantaneous image of the PLC-CPU content will be generated in the data management system.

Note

If you back up the PLC data while the PLC is operating in cyclic mode (PLC-RUN), the data blocks are not backed up at the same time. This may result in a data inconsistency that causes the PLC to stop in the user program.

■

Replacing Software and Hardware 12

12.1 Software update

Note

Sequence for updating software during start-up or software replacement

1. Upgrade HMI
2. Upgrade NCK software

Please note the information in the ReadMe file sent with the ToolBox.

Naming convention for the PCMCIA card

A PCMCIA card is used for the NCU. On the outside, this looks just like the card with the HMI software, so it is easy to confuse the two. To help distinguish between the two, the PCMCIA card

- for the NCU is called the "**NC card**" below and
- the one for the HMI is called the "**PC card**".

Every time the software is supplied, the ToolBox contains a ReadMe file that describes the latest control upgrade.

12.1.1 Standard upgrade

Sequence

The software can be updated, without having to open the device, via the card drawer unit on the front panel.

- Please save all control and user data before commencing with the upgrade (see Chapter 11, “Data Backup”).
- Switch the control off.
- Place the PCMCIA card with the new firmware into the card drawer.

Carry out the following steps:

1. Turn switch S3 to 2 (Export software is updated)
2. Switch on power
3. During booting, the firmware is transferred from the memory card to the device
4. Wait until “9” appears on the display
5. Turn switch S3 to 1 (standard software is updated)
6. Wait until “6” appears on the display
7. Set switch S3 to 0
8. General reset of the PLC: turn switch S4 to “2”, and then to “3”. Switch into positions (“2”–“3”–“2”) within 3 seconds. After the PS and PF LEDs light up, set switch S4 to position “0” (see Section 5.2 Power-On/Power-Up).
9. Then proceed as described in Section 11.2 (Series start-up) to import the saved data again. Read any notes about the new software release.

Note

If the digit “6” is not displayed, then an error has occurred:

– Invalid card?

– The software and hardware do not match (e.g. PC card NC with software for NCU 572.2 inserted in a NCU 573.2)

– Card or hardware is defective

The PCMCIA card with the system software must remain inserted during operation

Removing and inserting the PCMCIA card under voltage can lead to data losses.

12.2 Software upgrade for HMI Embedded

Form supplied

The entire HMI Embedded software package is supplied on a CD-ROM. The software is loaded using the Service menu.

The software upgrade procedure is described in the following publication:

Reference material: /IAM/ IM2, HMI EmbeddedStart-up Guide

12.3 Software upgrade for HMI Advanced

Form supplied

The entire HMI Advance software package is supplied on a CD-ROM. The software is loaded using the Service menu.

The software upgrade procedure is described in the following publication:

Reference material: /IAM/ IM4, HMI AdvancedStart-up Guide

12.4 Standard system start-up via NC card

The free memory on the NC card (PCMCIA card) can be used to save a start-up archive there. The archive can be copied to the NC card using SINUCOPY-FFS (on an external PG/PC).

Possible applications:

1. After replacing an NC module (or another form of data loss), the user can restore the machine to its original state as it was supplied by the manufacturer using the archive stored on the NC card or

2. The machine manufacturer can provide the cycles and data in the archive on the NC card when he supplies the machine or a software upgrade.

You have the option of transferring Siemens and/or machine manufacturer cycles from the flash file system on the NC card to the DRAM when the control powers up and running them from there. The configuration for this and the behavior of the DRAM cycles are described in 12.4.1.

Sequence of operations

A) Create a start-up file on the NC card

Requirement:
The SINUCOPY_FFS software has been loaded.

1. Output series start-up data from NC/PLC via RS-232 to a PG/PC.
2. Store series start-up data on the PG/PC as ORIGINAL.ARC file (e.g. in \tmp).
3. Call SINUCOPY-FFS on the PG/PC.
4. Insert the NC card in the PCMCIA slot.
5. Copy the NC SW to the PC card.
6. Choose “Area settings” in the NC card menu.
   Enter 0 under “FFS Startadr” and “FFS Endadr”.
7. Choose the “Create new FFS” field and click on the field “Detect automatically”.
8. Format the FFS on the NC card.
9. Choose the “Create DIR” field in the FFS menu and create and open the directory _N_ARC_DIR.
10. Call the “Save FFS from hard disk to card [Archive/part programs]”. The data are loaded to the NC card.

Note

The created start-up file can be saved directly to the NC card.

B) Load the start-up file from the NC card

Requirement:
The start-up archive called _N_ORIGINAL_ARC can be found on the NC card (under the _N_NC_CARD_DIR_N_ARC_DIR directory).

1. Insert the NC card in the NCU module
   Start-up switch =1 (NCK general reset)
   Press NCK reset and wait until the 7-segment display reads “6”
   Start-up switch =0 (NCK general completed)
   When the “6” appears, the start-up switch can be set to default position “0”
2. Set a password
3. Press the “ETC key” in Services basic display and press the “Original status” soft key.

   This soft key is only available if the NC card contains the above-mentioned start-up archive and access level 3 (User) has been set at the control.
4. When the soft key is pressed, the log window appears with the prompt: “Standard start-up archive: Run standard system start-up?”. Confirm to load the data.

Note

If no PLC program is active, it takes longer to input the data (because the PLC timeout is effective).

Caution

The complete data of the NC (and PLC, if included in the start-up archive) of the user is deleted and replaced by the data in the start-up archive.

12.4.1 DRAM for storing cycles and programs

Cycles

Cycles remain generally unchanged after running in.

They are therefore suitable for processing from the DRAM, which is available from software version 6 onwards. This means that scarce SRAM memory can be used for other purposes.

Programs

The option of processing programs from the DRAM should only be used if there are no more changes to be made and it is important to save on RAM usage.

The “Processing from DRAM” function is available as an option.

Loading

The cycles are located in the flash file system FFS on the NC card in the following directories:

_N_CST_DIR	Siemens cycles
_N_CMA_DIR	Machine manufacturer's cycles

from software version 6.4:

_N_CUS_DIR	User cycles
_N_MPF_DIR	Part programs
_N_SPF_DIR	Subprograms
_N_WKS_DIR	Workpieces

are also provided or loaded by the HMI software.

Selection for DRAM processing

The objects to be processed from the DRAM are specified by MD 11290: DRAM_FILESYSTEM_MASK. If the MD is set to 0, then the objects are processed from SRAM as standard.

Bit = 0 The files in the directory are processed from SRAM

Bit = 1 The files in the directory are processed from DRAM

Assignment of bits to the directories

Bit 0	Siemens cycles, CST directory
Bit 1	Machine manufacturer cycles, CMA directory
Bit 2	User cycles, CUS directory
Bit 3	Part programs, MPF directory
Bit 4	Subprograms, SPF directory
Bit 5	Workpieces, WKS directory

Backing up to a background memory

From software version 6.4, you can decide whether the files to be processed from the DRAM should be backed up to the Flash file system of the NC card so that they are available in DRAM once more after the NC is powered on. If you choose not to do this, they will have to be loaded again from the HMI.

The type of back-up is controlled by MD 11291 : DRAM_FILESYST_SAVE_MASK.

Bit = 0 The files in the directory are not backed up

Bit = 1 The files in the directory are backed up to the Flash file system of the NC card

Assignment of bits to the directories

Bit 0	Siemens cycles, CST directory
Bit 1	Machine manufacturer cycles, CMA directory
Bit 2	User cycles, CUS directory
Bit 3	Part programs, MPF directory
Bit 4	Subprograms, SPF directory
Bit 5	Workpieces, WKS directory

The default is to back up all cycle directories.

Size of the DRAM area

The amount of DRAM to be reserved for the cycle/program processing from the DRAM area must be defined in MD 18351: MM_DRAM_FILE_SIZE.

If the DRAM area is too small for the objects to be processed, then the objects for which there is insufficient space in the DRAM area are saved to the SRAM, but are still treated as DRAM objects. See below.

Handling of objects in DRAM

The directories defined in MD 11290: DRAM_FILESYSTEM_MASK are loaded into the previously cleared DRAM when the control powers up. There they are part of the passive file system.

When an object is loaded by the MMC/HMI software, the NC also saves it to the FFS at the same time if the relevant bit for the directory was set in MD 11291: DRAM_FILESYST_SAVE_MASK. In this way, the object can be made available once more in DRAM after power up. It should be noted that writing to the FFS is slow.

Changes to objects in DRAM

The changes go directly into DRAM as they are made. The changes are not written to the backed up image in the FFS until the editor is closed.

While they are being saved to the FFS, a sign-of-life symbol is displayed on the front operating panel (fan blade). To ensure that DRAM objects are not lost while powering up, the NC must not be switched off until saving to the FFS is complete.

Deleting SRAM

When the SRAM is deleted, the NCK automatically deletes all the DRAM backup files in the FFS on the NC card as well. This means that, when a standard start-up file is read in, none of the old cycles are retained.

12.4.2 SINUCOPY-FFS

The SINUCOPY-FFS program can be used to write to and read NC cards for the NCU on a PC with an active PCMCIA slot, both with the SINUMERIK system software (NC) and with a Flash file system (FFS).

FFS: Flash file system

A Flash file system is comparable to a DOS data medium. Before data can be stored, the system must be formatted. Directory structures can then be created and files can be saved in any format.

The data medium is an electrically erasable EPROM. This means that the relevant area must be deleted before writing. Algorithms specially matched to the module identification are required for deleting and writing. They essentially define the speed at which the data can be written.

An FFS can normally be read directly by DOS/WINDOWS. Since the NC card also stores the NC system software, which is not present in FFS format, this is possible only with SINUCOPY-FFS.

Software/hardware requirement

- The following PCMCIA card drivers/hardware are supported:
  - CSM OMNI97 (external PCMCIA device operated at the parallel interface of the PC)
  - PG740/PG720C (with CSM driver CISIO-S)
  - LAPTOPS with PCMCIA slots (with Intel driver ICARDRV3 – only for cards up to a max. of 4 MB)
  - CSM PCJB slots (only for cards up to a max. of 4 MB)
- The program runs under Windows 95. Also under Windows NT if CSM OMNI97 is used.

Functions

SINUCOPY-FFS can perform the following functions on the FFS area of the NC card independently of the SINUMERIK system software (NC):

- read
- modify
- re-write
- re-format
- create new directories
- copy a file to directories and subdirectories
- read and write system SW
- write data to an NC card

Expert mode

In Expert mode, and FFS image is generated in the PC memory. This can be written to the inserted NC card or saved as a file.

Normal mode

In Normal mode, every action (read/write/delete) is carried out directly on the NC card.

Independently of the FFS, the NC system can be

- re-written (Requirement: the space above the FFS start address is not used by the NC system).
- duplicated
- output and saved as a file.
- NC cards can be duplicated fully (NC + FFS).

It is possible to display the version of the NC system of the inserted card.

The storage capacity of the inserted NC card is determined automatically and displayed. Similarly, the limit memory addresses for the FFS.

Operation

The functions of the program can be called via the menu bar or directly by pressing buttons on the user interface. Help is available for all actions and can be accessed with the “Help” menu.

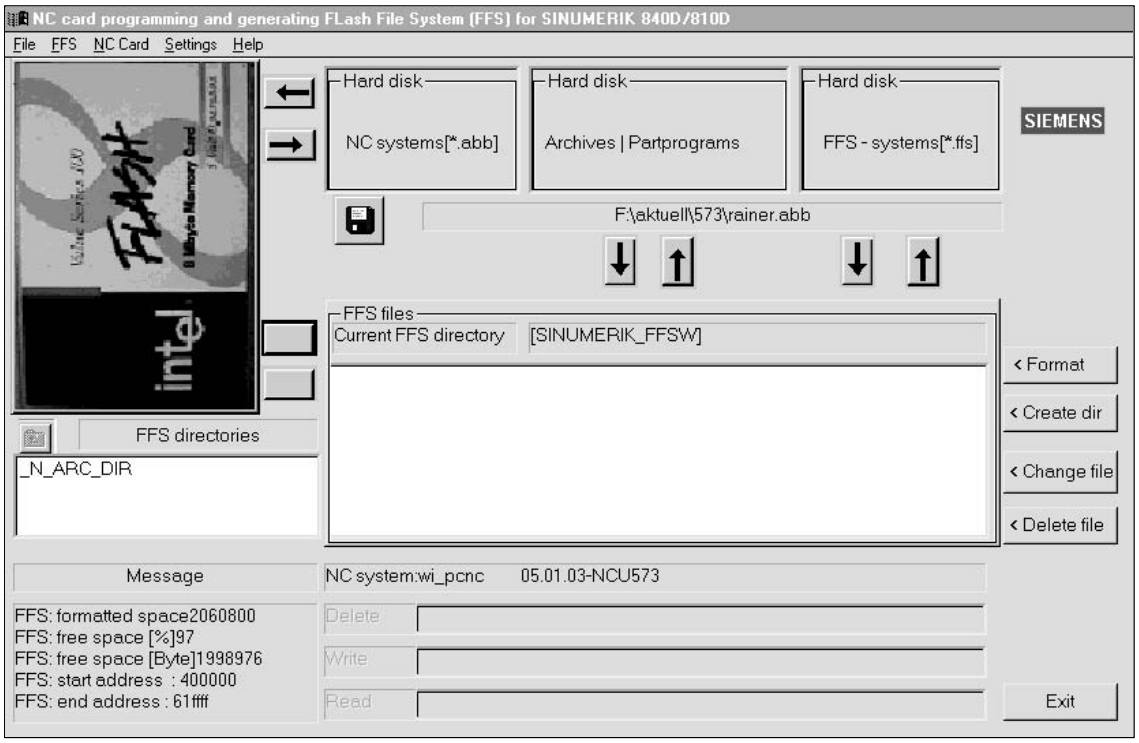


Fig. 12-1 SINUCOPY-FFS operator interface

- Display card contents:
  Click on the NC card image with the **left** mouse button (menu: NC card /version display for the NC system)
- Display card info with card and FFS data
  Click on a free space (not a button or image, e.g. top right) with the **right** mouse button (as for the NC Card/ID Info menu).
- The arrows can be used as menu commands:
  - Read/write NC system. Including read/write FFS system.
  - Copy files from hard disk to the FFS system.
  - Copy files back from the FFS system to the hard disk.
  - Load or store complete FFS systems in RAM image.
- List boxes (Explorer)
  On the left of the list boxes are the FFS directories available for selection. On the right is the content of the selected directory. Double click on the directory name to select it. Use the “Backspace key” to move up a level. Before you can use the “Modify file” or “Delete file” button, a file must be selected in the right list field.
- Info box bottom left
  Once the FFS system has been formatted, the Info box at the bottom left shows the formatted memory, the free space as a % and as a number of bytes.

Note

Note that the date in the Info field are gross data. Subtract approx. 8% for overhead.

- FFS system detection
  If the program is started with a card inserted, it detects whether an FFS system is supported. If there are no IDs on the card for the FFS start and end addresses, the system automatically recommends the best ones.

Note

If you change this card, this is detected automatically. The contents of the card (FFS) are displayed.

Installation

1. Start the “sinucopy-ffs.exe” file
2. Enter the password
3. Dialog: Specify a temporary directory for unzipping the files
4. Dialog: Specify the hardware configuration
5. Dialog: Select the components to be installed
6. Dialog: Specify a directory for the installation
7. The SW is installed
8. Message: “driver installed”
9. Dialog: “Select the name of the program folder”
10. Dialog: Please read the README file
11. Dialog: Restart now or later
12. Following restart, you can use the SINUCOPY-FFS function

Tool: ARCEDIT

This tool is intended for use by experts.

- Read archive data
- Delete/insert files
- Modify files (if editable)

Tool: SICARD

This tool is intended for use by experts.

- Read and write NC cards
- Duplicate NC cards

Note

1. PG with SINUCOPY (previous version)
   The installation can fail if the driver “cisio-s” is entered in the “config.sys” file and this is detected during power up: error message. Remedy:
   – Delete the line “Device ...cisio.exe, cisio.ini”.
   – Enter a free interrupt number in HEX format in the “cisio.ini” file in the line IRQ=....
   A free interrupt number can be determined via the “System properties” menu of the “Device manager”.
2. If an NC card with FFS is copied with previous version of SINUCOPY, only the NC system (not the FFS part) is transferred to the copy.
3. Any drive may be designated for the OMNI97 device: Simply enter the drive letter in the “Control Panel/Device Manager/Drives/OMNI97” menu.
   Windows NT: Enter the drive letter in the “OmniControl/DriveLetter” menu.

Tool: SINUCOPY

The SINUCOPY program can be used to

- write to, duplicate and read NC cards for the NCU on a PC with an active PCMCIA slot and the SINUMERIK system software (NC). The version IDs of the programs can be displayed (as for the version display for the SINUMERIK control).
- Data can be read from and written to the PC cards of the PCU with the SINUMERIK system software (HMI).
- Data from the NC is written to the NC card.

Operation

The functions of the program can be called via the menu bar or directly by pressing buttons on the user interface. Help is available for all actions and can be accessed with the “Help” menu.

Note

NC data can be written to the NC card; for instructions see:
/BAD/ HMI Advanced User Guide, Services area.

12.4.3 Associated conditions for replacing software

The following NCUs are available for software version 6:

- NCU 571.2
- NCU 572.3
- NCU573.3

The following points should be noted during an NC upgrade:

1. If an NCU 5xx with software version 5 is upgraded to version 6, the NCU must also be replaced with a current NCU that is available for software version 6.
2. If an NC card equipped with software version 6 is plugged into an earlier hardware variant (e.g. NCU 572.2), the system will not power up. The status display flashes in the sequence 0 – 1 – 6.
3. If an NC card equipped with software version 5 is plugged into a current hardware variant (e.g. NCU 572.3), the system will not power up. The status display flashes in the sequence 0 – 1 – 6.
4. If an NC card for an NCU 573.2 equipped with software version 5 is plugged into a current hardware variant (NCU 571.2), the system will power up and can run.

12.5 Hardware replacement

You can replace all components that are ordered via a machine-readable product designation number.

Please save data before removing any hardware component.

Note

The NCU module can be removed from the NCU box without loss of data since the data is buffered by a capacitor for approx. 15 minutes.

Reference material: /PHD/ SINUMERIK 840D Device Manual, NCUConfiguration
/PJU/ Converter Configuration Manual
/BH/ Operator Components Manual

12.6 Replacing batteries and fans

Caution

Do not attempt to reactivate discharged batteries by heating them or other means. The batteries must not be charged as this can lead to leaks and/or explosion.

Ignoring this instruction may result in injury or damage to property.

Details of the procedure can be found in the following documentation:

Reference material: /PHD/ SINUMERIK 840D Device Manual, NCUConfiguration

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Notes

HMI

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The content of this section can be found in

/IAM/ **Start-up Guide for HMI**, IM2 and IM4

The HMI Start-up Guide is divided into 6 books:

AE1	Updates/Supplements
BE1	Upgrading the user interface
HE1	Online help
IM2	Starting up HMI Embedded
IM4	Starting up HMI Advanced
TX1	Creating foreign language texts

Notes

14 Miscellaneous

14.1 Tool box software package

14.1.1 Contents of the tool box

Content

Supplied on CD-ROM with

- Basic PLC program
- NC variable selector
- Sample programs
- ReadMe file for the current 840D software release

Software requirements

The following software is required for data communication:

- PCIN software
- SIMATIC Step7 for the PLC programs

Hardware requirements

Programming device and cable

- Programming device PG/PC
- Cable for V24 PG/PC-NC: 6FX2 002-1AA01-0BF0
- Cable for MPI bus: 6ES7 901-0BF00-0AA0

14.1.2 Application of the Tool box

PLC basic program

Reference material: /FB1/ P3, Function Guide for Basic Machine, PLC basic program

NC variable selector

You will need the NC variable selector to read and write NCK variables.

Reference material: /FB1/ P3, Function Guide for Basic Machine, PLC basic program
/LIS2/ Lists, section: Variables

14.2 Machine data access via part program

Data identifiers

With the HMI, the designation of the machine data is displayed. The internal data designation requires further identifiers. If the machine data is modified by programming or read in via the serial port, then these identifiers must be specified.

Data areas

$MM_	Display machine data (operating panel data)	
$MN_/$SN_	General machine data/setting data	
$MC_/$SC_	Channel-specific machine data/setting data	
$MA_/$SA_	Axis-specific machine data/setting data	
$MD_	Drive machine data	
Where:	$	System variable
	M	Machine data
	S	Setting data
	M, N, C, A, D	Partial area (second letter)

Axis data is addressed via the axis name. The internal axis designation (AX1, AX2 ... AX5) or the designation specified via MD 10000: AXCONF_NAME_TAB may be used as the axis name.

e.g.: $MA_JOG_VELO[Y1]=2000

The JOG speed of axis Y1 is 2000 mm/min.

If the contents of the machine data is a STRING (e.g. X1) or a hexadecimal value (e.g. H41), then the content must be given between " ' " (e.g. 'X1' or 'H41').

e.g.: $MN_DRIVE_INVERTER_CODE[0]='H14'

FDD module 9/18 A at drive slot 1 of the drive bus.

To address the various contents of a machine data, identifying data must be specified in square brackets.

e.g.: $MA_FIX_POINT_POS[0,X1]=500.000

The 1st fixed point position of axis X1 is 500
(0=1st, 1=2nd, 2=3rd etc.)

Examples

$MN_AUXFU_GROUP_SPEC[2]='H41'
Time at which the auxiliary functions of the 3rd auxiliary function group are output.

$MN_AXCONF_MACHAX_NAME_TAB[0]='X1'
Name of the 1st machine axis is X1.

$MA_REF_SET_POS[0,X1]=100.00000
The 1st reference point value of axis X1 is 100 mm.

Assignment of channel-specific machine data:

CHANDATA(1)	Assignment for channel 1
$MC_CHAN_NAME='CHAN1'	Channel name for channel 1
$MC_AXCONF_GEOAX_NAME_TAB[1]='Y'	Name of the 2nd geometry axis on channel 1 is Y
...	
R10 = 33,75	R10 of channel 1

```
...
CHANDATA(2)                          Assignment for channel 2
$MC_CHAN_NAME=‘CHAN2‘                Channel name for channel 2
...
R10 = 96,88                          R10 of channel 2
...
```

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Notes

Abbreviations

A

ASCII	American Standard Code for Information Interchange
ASUB	Asynchronous subroutine
BA	Operating mode
BAG	Mode group
BB	Ready
BCD	Binary Coded Decimal
BHG	Hand-held terminal
BOOTFILE	Boot file for SIMODRIVE 611D
CC	Compiler Cycles
CCU	Compact Control Unit
COM	Communication
CPU	Central Processing Unit
CTS	Clear To Send message for serial data interfaces
DAU	Digital-analog converter
DB	Data block
DBB	Data block byte
DBX	Data block bit
DEE	Data terminal
DÜE	Data transmission device

DPR	Dual-port RAM
DRAM	Dynamic RAM (unbuffered)
DRF	Differential Resolver Function
DRY	Dry Run
DSR	Data Send Ready message from serial data interfaces
DW	Data word
EFP	Simple I/O module (PLC I/O module)
EPROM	Electrically-Programmable Read-Only Memory
ETC	ETC key > Extension to the soft key bar in the same menu
FC	Function Call, function block in the PLC
FEPROM	Flash EPROM: Readable and writable memory
FIFO	First In First Out: memory that works without having to specify an address. The data is read in the order in which it was saved.
FRK	Cutter radius correction
FST	Feed Stop
FIPO	Fine interpolator
GEO	Geometry
GND	Signal ground (reference point)
GP	Basic program
HASH	A software method for mapping a large number of names onto a finite memory area
HEX	Abbreviation for hexadecimal number
HMI	Human Machine Interface: SINUMERIK operating function for operation, programming and simulation. The meaning of HMI is identical with MMC.
HSA	Main spindle drive
HW limit switch	Hardware limit switch

INC	Increment
INI	Initializing data
INTV	Internal duplication
ISO code	Special punched tape code, the number of holes per character is always even
JOG	Jogging: set-up mode
K1	Channel 1
K_V	Servo gain factor
$K_Ü$	Speed ratio
K BUS	Communication bus
LED	Light Emitting Diode
LMS1	Position measuring system 1
LMS2	Position measuring system 2
LPFC	Low Priority Frequency Channel
LSB	Least Significant Bit
MD	Machine data
MDA	Manual Data Automatic
MMC	Man Machine Communication: SINUMERIK operating function for operation, programming and simulation. The meaning of HMI is identical with MMC.
MPF	Main Program File: NC part program (main program)
MPI	Multi-Port Interface
MSTT	Machine control panel
NC	Numerical Control
NCK	Numerical Control Kernel
NCU	Numerical Control Unit
NPFK	Low-priority frequency channel

NST	Interface signal
NV	Zero shift
OB	Organizational block in the PLC
OPI	Operator Panel Interface
P-BUS	I/O bus
PCMCIA	Personal Computer Memory Card International Association
PG	Programming device
PLC	Programmable Logic Control
PRT	Program test
RAM	Random-Access Memory (read and write)
ROV	Rapid Override: input correction
RPA	R Parameter Active: Identifier for R-parameters
RTS	Request To Send: switch on transmitter, control signal from serial data interfaces
SBL	Single Block
SEA	Setting Data Active
SD	Setting data
SK	Soft key
SKP	Skip: hide block
SLM	Synchronous Linear Motor
SPF	Sub Program File
SRAM	Static RAM (buffered)
SSFK	Leadscrew error compensation
SW limit switch	Software limit switch
TEA	Testing Data Active: identifier for machine data

TO	Tool Offset
TOA	Tool Offset Active: identifier for tool offsets
VSA	Feed drive
V24	Serial interface (definition for the lines used to exchange data between DEE and DÜE)
VDI	Interface between PLC and NC
WKZ	Tool
WRK	Tool radius offset
WZ	Tool
WZK	Tool offset
WZW	Tool change
ZOA	Zero Offset Active
µC	Micro-controller

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Recommendations

Corrections

for publication:

SINUMERIK 840D/810D
SIMODRIVE 611 digital

Manufacturer/Service Documentation

Start–up Guide

Order no.: 6FC5297-6AB20-0BP0
Edition: 03/2006

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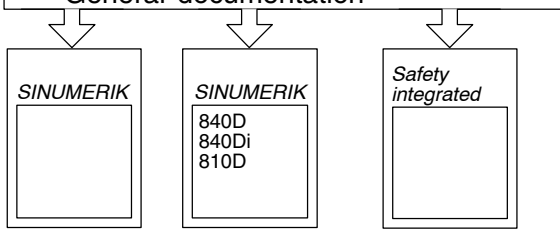
Documentation overview SINUMERIK 840D/840Di/810D (03/2006)

General documentation

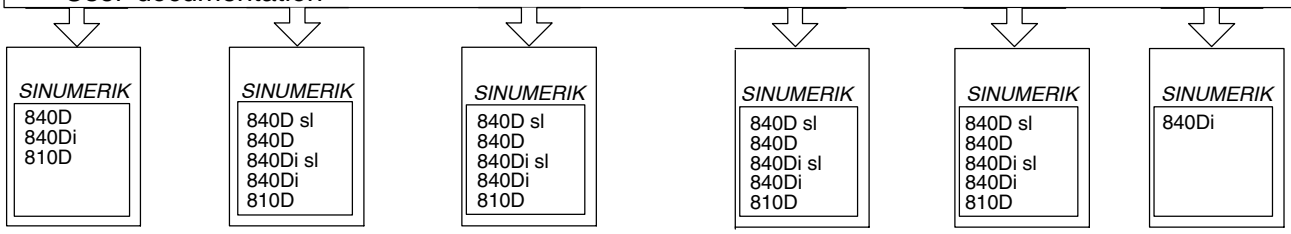


Brochure

Catalog NC 60 ***)**

Safety Integrated Application Manual

User documentation



Operating Manual
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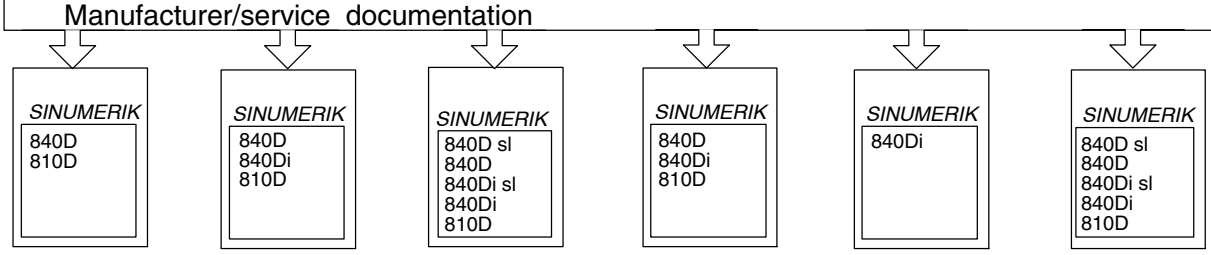
Manufacturer/service documentation



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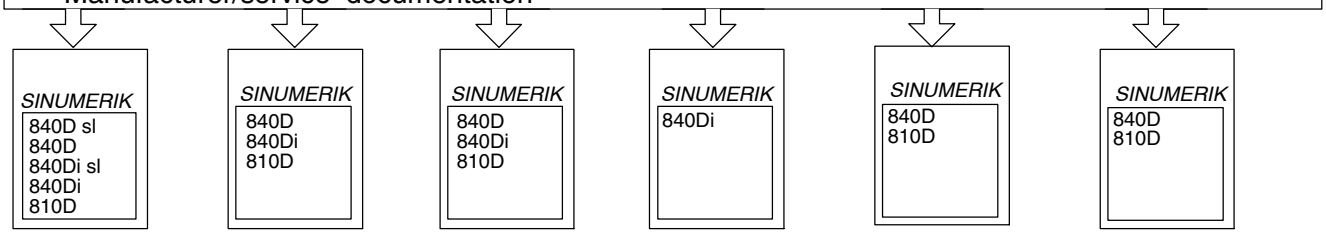

Function Manual
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MCIS
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– NC Data Management
– NC Data Transfer
– Tool Data Communication

Electronic Documentation

DOCONCD ***)**
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***)** Recommended minimum scope of documentation