Installation and Start-Up Guide 11/2002 Edition

sinumerik

SIEMENS

CCU3

Software Version 6

SINUMERIK 810D

SIEMENS

SINUMERIK 810D

Installation and Start-Up Guide

Valid for

Control	*Version*
SINUMERIK 810D powerline	6
SINUMERIK 810DE powerline	6

11.02 Edition

SINUMERIK® Documentation

Printing history

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

The status of each edition is shown by the code in the "Remarks" columns.

Status code in the "Remarks" column:

A . . . . . New documentation.
B . . . . . Unrevised reprint with new Order No.
C . . . . . Revised edition with new status.
If factual changes have been made on the page within the same software version, this is indicated by a new edition coding in the header on that page.

Edition	Order No.	Remarks
12.95	6FC5 297-1AD20-0BP0	A
07.96	6FC5 297-1AD20-0BP1	C
08.97	6FC5 297-2AD20-0BP0	C
12.97	6FC5 297-2AD20-0BP1	C
12.98	6FC5 297-3AD20-0BP0	C
08.99	6FC5 297-3AD20-0BP1	C
04.00	6FC5 297-3AD20-0BP2	C
10.00	6FC5 297-4AD20-0BP0	C
10.01	6FC5 297-4AD20-0BP1	C
03.02	6FC5 297-6AD20-0BP0	C
11.02	6FC5 297-6AD20-0BP1	C

This book is part of the documentation on CD-ROM **(DOCONCD)**

Edition	Order No.	Remarks
11.02	6FC5 298-6CA00-0BG3	C

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

This publication was produced with Interleaf V7.

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

We have checked that the contents of this publication agree with the hardware and software described here. Nevertheless, differences might exist and therefore we cannot guarantee that they are completely identical. The information given in this publication is reviewed at regular intervals and any corrections that might be necessary are made in the subsequent printings. Suggestions for improvement are welcome at all times.

Subject to changes without prior notice

Order No. 6FC5297–6AD20–0BP1
Printed in Germany

Siemens Aktiengesellschaft

PREFACE

Structure of the documentation

The SINUMERIK documentation is divided into three different levels:

- General documentation
- User documentation
- Manufacturer/service documentation.

For more information about SINUMERIK 810D publications and general publications for SINUMERIK controls, please contact your local SIEMENS office.

Target group

This document is intended for manufacturers of machine tools incorporating SINUMERIK 810D and SIMODRIVE 611digital systems.

Hotline

If you have any questions, please contact the hotline:

A&D Technical Support Phone: +49 (0)180-5050-222

Fax: ++49 (0)180-5050-223

e-mail: adsupport@siemens.com

Please send any questions about the documentation (suggestions or corrections) to the following fax number or e-mail address:

Fax: ++49 (0)(9131)-98-2176

e-mail: motioncontrol.docu@erlf.siemens.de

Fax form: see reply sheet at the end of the manual.

Internet address

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

SINUMERIK 810D powerline

As from 12.2001, the

- SINUMERIK 810D powerline and
- SINUMERIK 810DE powerline

are available with enhanced performance. You will find a list of available **powerline** modules in the following reference manual:

References: /PHC/, Manual Configuring SINUMERIK 810D

Notice about software and hardware designations

The following software and hardware is used with the SINUMERI 810D:

- MMC 103 software –> **HMI Advanced**
- MMC 100 software –> **HMI Embedded**
- MMC 103 hardware –> **PCU 50**
- MMC 100 hardware –> **PCU 20**

All components affected by these changes have been changed in this Installation & Start-up Guide.

Objective

The Installation and Start-Up Guide gives all the relevant information required to start-up, install and service SINUMERIK 810D systems.

Standard scope

This documentation provides information about the control system and the interfaces of the individual components. It also describes the start-up and installation procedure for SINUMERIK 810D.

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

User-oriented activities such as the creation of 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.

Search aids

In addition to the table of contents and indexes of figures and tables, we have provided the following information in the Appendix for your assistance:

1. Index of abbreviations
2. List of references
3. Index.

For a complete list and description of SINUMERIK 810D alarms, please refer to

References: /DA/, Diagnostics Guide.

Further information about installation and start-up as well as troubleshooting is given in

References: /FB/, D1, “Diagnostic Tools”.

Notes

The following symbols with special significance are used in the documentation:

Note

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

!

Important

This symbol is always displayed in this document to draw your attention to an important item of information.

Ordering data option

In this documentation you will find the symbol shown on the left with a reference to an ordering data option. Please note that the function described can operate only if the specified option is installed in the control system.

Warnings

The following warnings with varying levels of severity are used in this document:

Danger

This symbol indicates that death, serious injury or substantial property damage **will** occur if the appropriate precautions are not taken.

Warning

This symbol indicates that death, serious injury or substantial property damage **may** occur if the appropriate precautions are not taken.

Caution

This symbol indicates that minor injuries or property damage **may** occur if the appropriate precautions are not taken.

Caution

This warning indicates that property damage **may** occur if the appropriate precautions are not taken.

Notice

This warning indicates that an undesirable event **may** occur if the relevant notice is not heeded.

Technical information

Trademarks

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Notations

The following notations and abbreviations are used in this documentation:

- PLC interface signals -> IS “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: NUMBER, MD_NAME (English designation)
- Setting data -> SD: NUMBER, SD_NAME (English designation)
- The symbol “≙” means “equivalent to”.

Contents

Notes

General Preparations

1

Introduction

This Installation and Start-Up Guide describes the procedure for starting up the basic control functions including drive-related functions. For further information about special NCK, HMI, PLC or drive functions, please refer to the Descriptions of Functions/Manuals (see ”Required Documentation”).

Required software

You require the following software for SINUMERIK 810D start-up:

1. SinuComNC Startup/service tools
   Order No. 6FC5250-AY00-AG (German, English)
   Supplied on CD-ROM with:
   - SinuCom FFS
   - SinuCom ARC
   - SinuCom PCIN
2. SIMATIC STEP 7 HiGraph
3. Tool box for SINUMERIK 810D
   Order No. 6FC5 452-0AX00-0AB0
   Supplied on 3.5” disks with:
   - Basic PLC program
   - Standard machine data sets
   - NC variable selector
4. Application disk for the creation of PLC alarm texts and transfer to the PCU 20 (supplied with the HMI system software).

Required equipment and accessories

To start up the SINUMERIK 810D, you will require the following equipment and accessories:

1. Programming unit with MPI interface (PG740)
2. MPI cable for PG740
3. RS-232 cable with 9-pin connector (socket)

Required documentation

You will require the following documentation for start-up of the SINUMERIK 810D:

1. Catalog NC 60, Ordering Document. /BU/
   Order No.: E86060-K4460-A101-A9
2. Configuration Manual /PHC/
   Order No.: 6FC5 297-6AD10-0AP0

3. Operator Components Manual /BH/
   Order No.: 6FC5 297-6AA50-0BP1
4. Description of Functions, Basic Machine (Part 1) /FB/
   Order No.: 6FC5 297-5AC20-0BP1
5. Description of Functions, Drive Functions /FBA/
   Order No.: 6SN1 197-0AA80-0BP7
6. Lists /LIS/
   Order No.: 6FC5 297-6AB70-0BP1
7. Description PCIN 4.4 /PI/
   Order No.: 6FX2 060-4AA00-4XB0
8. Diagnostics Guide /DA/
   Order No.: 6FC5 298-6AA20-0BP1

Export approval

As a consequence of the approval required for certain control functions according to the German Export List, two versions of the SINUMERIK 810D are available.

The **standard** version (810D) can include the **full** functional scope of the control, but is subject to **type** approval.

Several options are not available in the **Export** Version (810**DE**).

Current data on the type and scope of options are provided in
Reference: /BU/ Catalog NC 60.

■

2 Configuration

2.1 Mechanical configuration

2.1.1 Overview

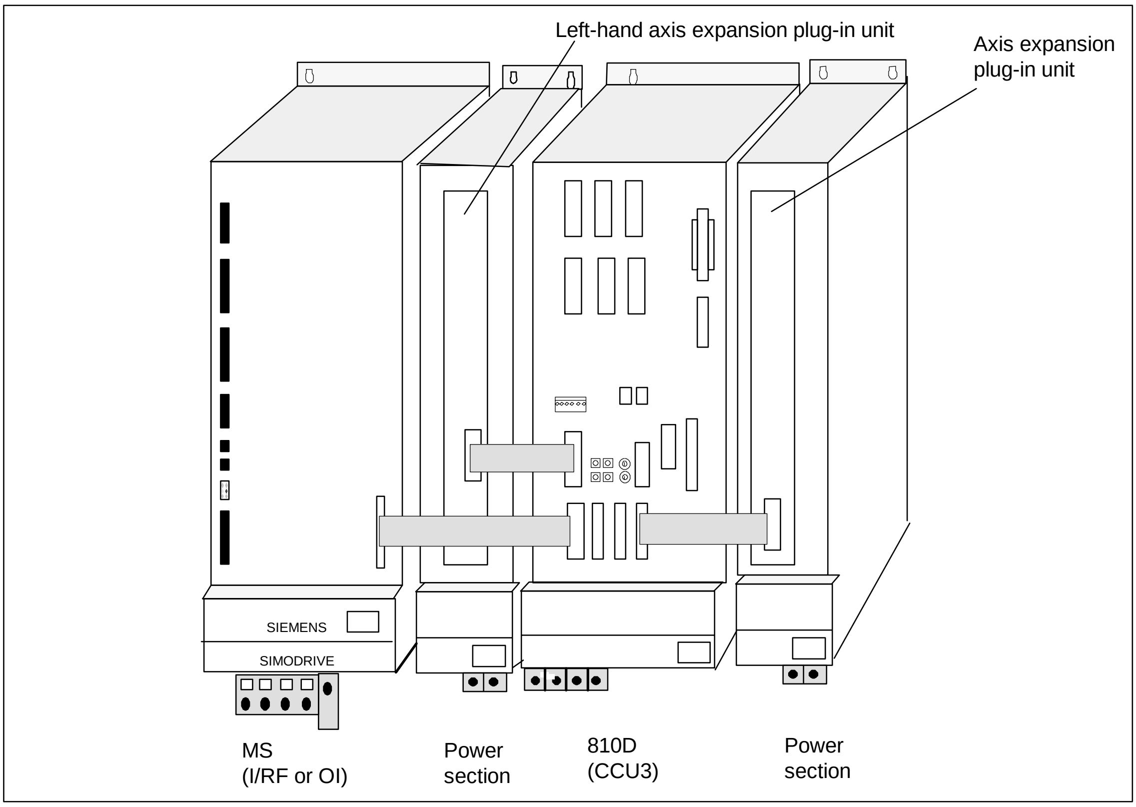


Figure 2-1 Overall configuration of SINUMERIK 810D with SIMODRIVE 611 power module

Caution

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

2.1.2 Mains supply module (MS)

Mains supply module

The mains supply module performs the following tasks:

- Supplies power for the SINUMERIK 810D and axis expansion units
- Generates the DC link voltage for the motors
- Regenerative braking (I/RF) or braking resistor (OI) for generator-mode operation.

Open-loop control infeed module OI

The 10 or 28 kW version of the open-loop control infeed module is recommended for use as an unregulated power supply. If the internal braking resistor is not sufficient, then pulsed resistor modules can be added.

Note

The 28 kW version of the open-loop control infeed module does not have an internal braking resistor!

Infeed/regenerative feedback module I/RF

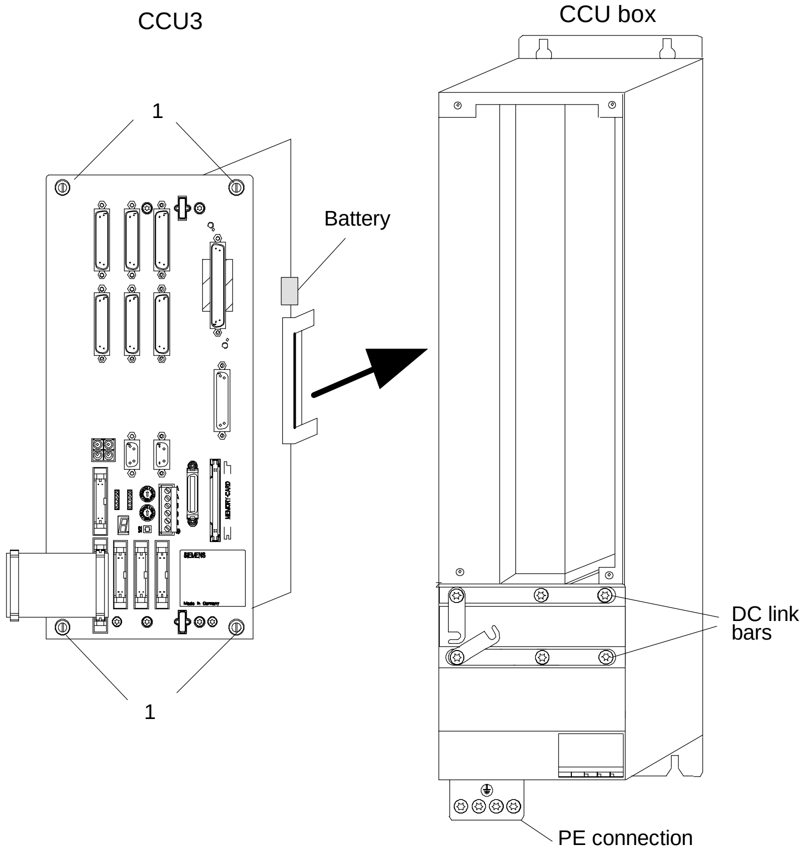
The I/RF module feeds the excess DC link energy back into the supply system during braking operations. The following versions are available:

- 16 kW
- 36 kW
- 55 kW
- 80 kW
- 120 kW.

Position of mains supply module

The I/RF or OI module is positioned as the first module on the left in the general configuration.

2.1.3 CCU3 with CCU box



These screws (1) must always be tightened securely (EMC).

Figure 2-2 Assembly of the SINUMERIK 810D

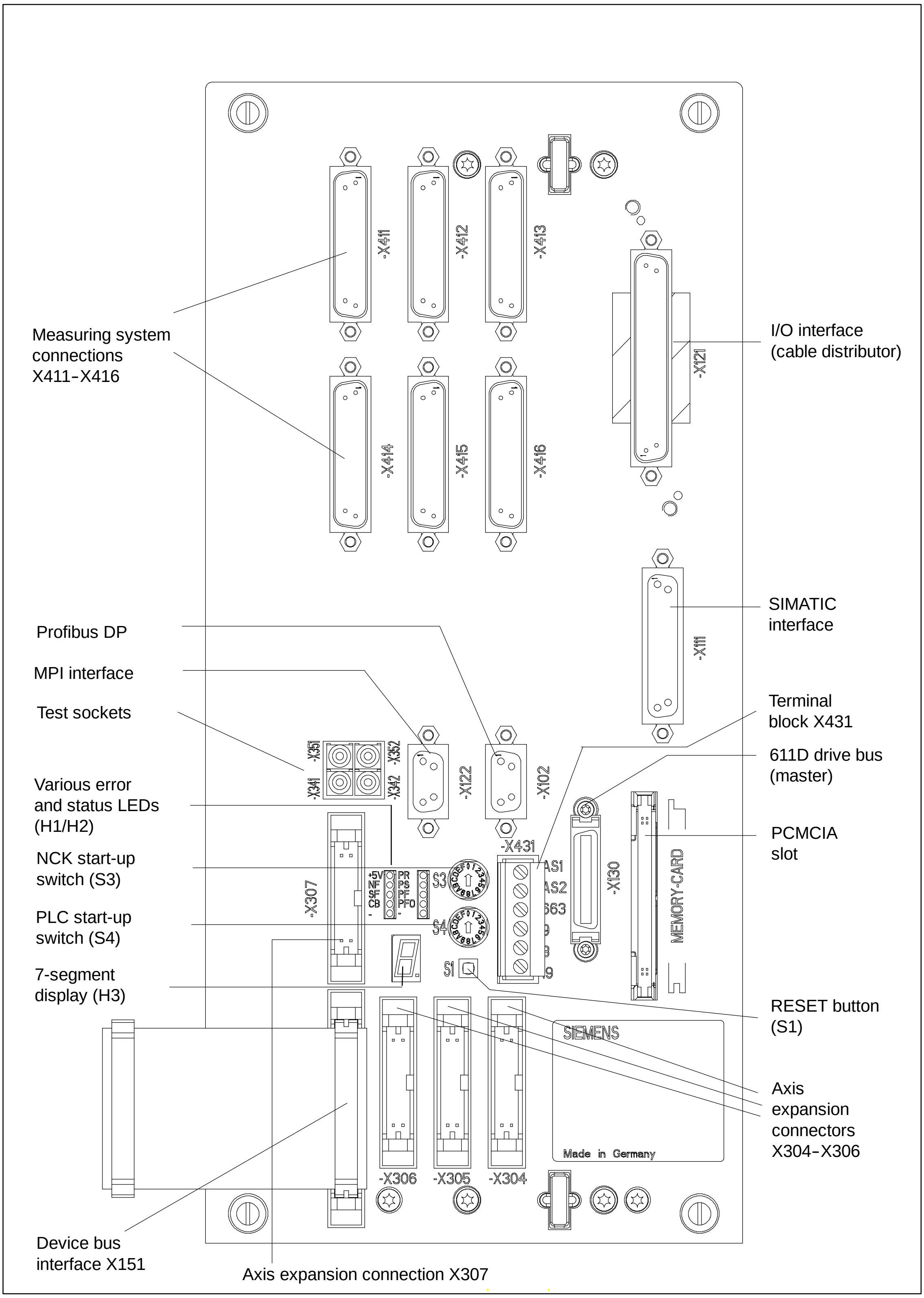


Figure 2-3 SINUMERIK 810D with CCU3, location of interfaces, operator control and display elements

2

2.1.4 Axis expansion with axis expansion plug-in unit

Axis expansion plug-in unit

The axis expansion plug-in units are mounted in a SIMODRIVE 611 power module and then connected to axis expansion terminals X304–X306 on the SINUMERIK 810D. The axis expansion plug-in unit is designed to hold 1-axis and 2-axis power modules. The left-hand axis expansion plug-in unit is designed to hold 1-axis power modules.

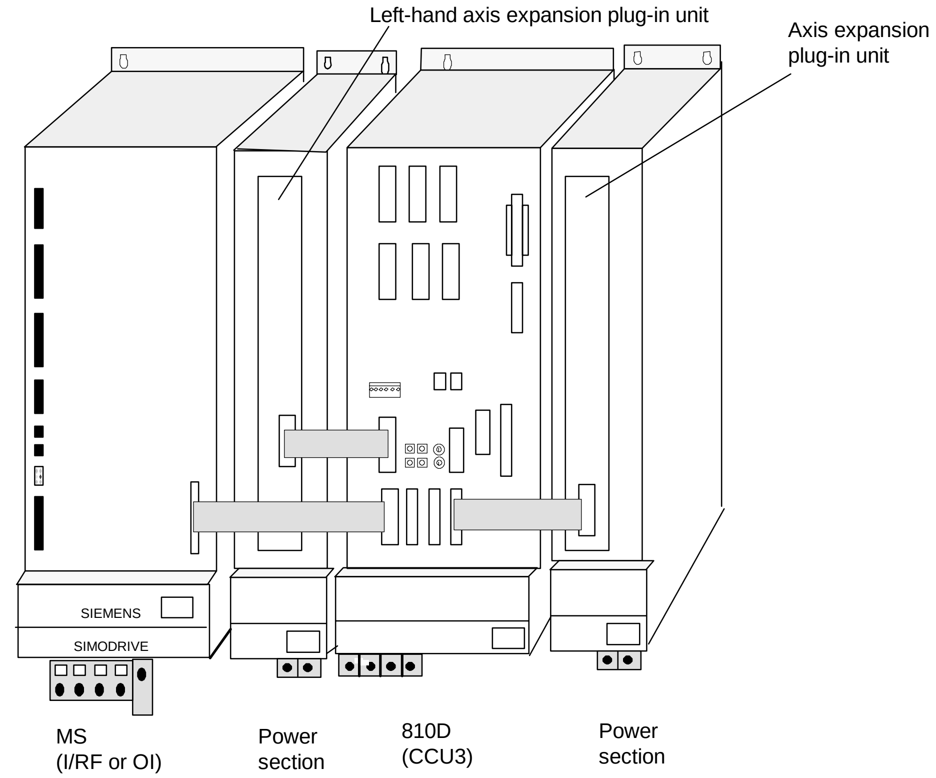


Figure 2-4 Axis expansion with SIMODRIVE 611 single-axis power module with left-hand axis expansion plug-in unit and axis expansion plug-in unit

Note

Hybrid operation between external closed-loop control and the power section in the axis expansion plug-in unit is possible.

Connecting the axis expansion plug-in unit

The axis expansion plug-in unit has two connectors, X301 and X302. X301 must be used to connect a 1-axis power section. If a 2-axis power section is installed, X301 must be used for the 1st axis and X302 for the 2nd axis.
The left-hand axis expansion plug-in unit has one connector.

Table 2-1 Ribbon cable connectors on axis expansion plug-in unit

Ribbon cable connector	1-axis power section	2-axis power section
X301	1st Axis	1st Axis
X302	Unused	2nd Axis

Mounting the axis expansion plug-in unit

Plug the axis expansion unit into the power module.

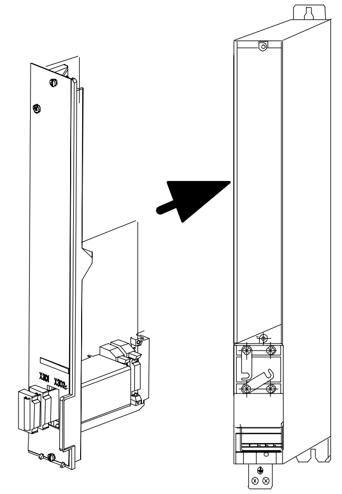


Figure 2-5 Mounting the axis expansion plug-in unit into the power section

Connect the ribbon cables to the CCU3 (X304–X306). Then push any excess cable length into the space provided under the metal cover on the axis expansion plug-in unit.

Mounting the left-hand axis expansion plug-in unit

Plug the axis expansion unit into the power module.

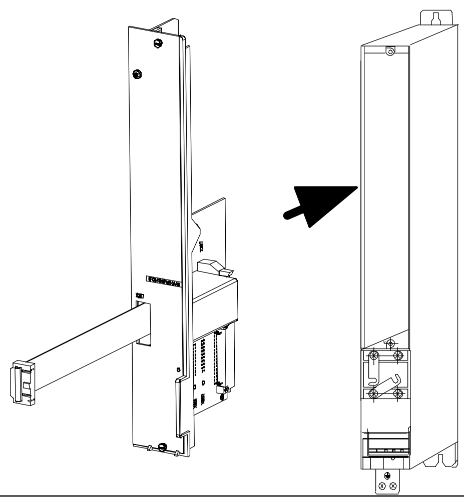


Figure 2-6 Mounting the left-hand axis expansion plug-in unit in the power section with the CCU3 (X307)

Connect the ribbon cables to the CCU3 (X304–X306). Then push any excess cable length into the space provided under the metal cover on the axis expansion plug-in unit.

2.1.5 Axis expansion with SIMODRIVE 611 closed-loop control module

Application

Axis expansion via SIMODRIVE 611D closed-loop control module is only implemented if the number of measuring channels in the SINUMERIK 810D is inadequate or a higher measuring system multiple is needed.

Mounting

The SIMODRIVE 611D module should be mounted as the first module to the right of the SINUMERIK 810D.

Connection

A special cable set is required to connect the SIMODRIVE 611D module. This cable set includes the connection to the drive bus and another device bus cable.

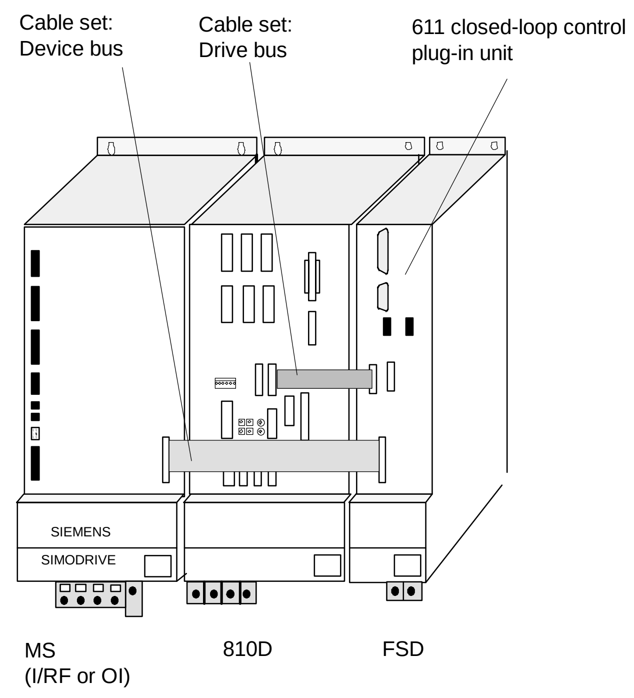


Figure 2-7 Axis expansion with SIMODRIVE 611 power section and external 611D control

2.1.6 Options for operating 6 axes with the CCU 3

CCU 3 with 3-axis CCU box plus
2-axis power module to right of CCU
1-axis power module to right of CCU

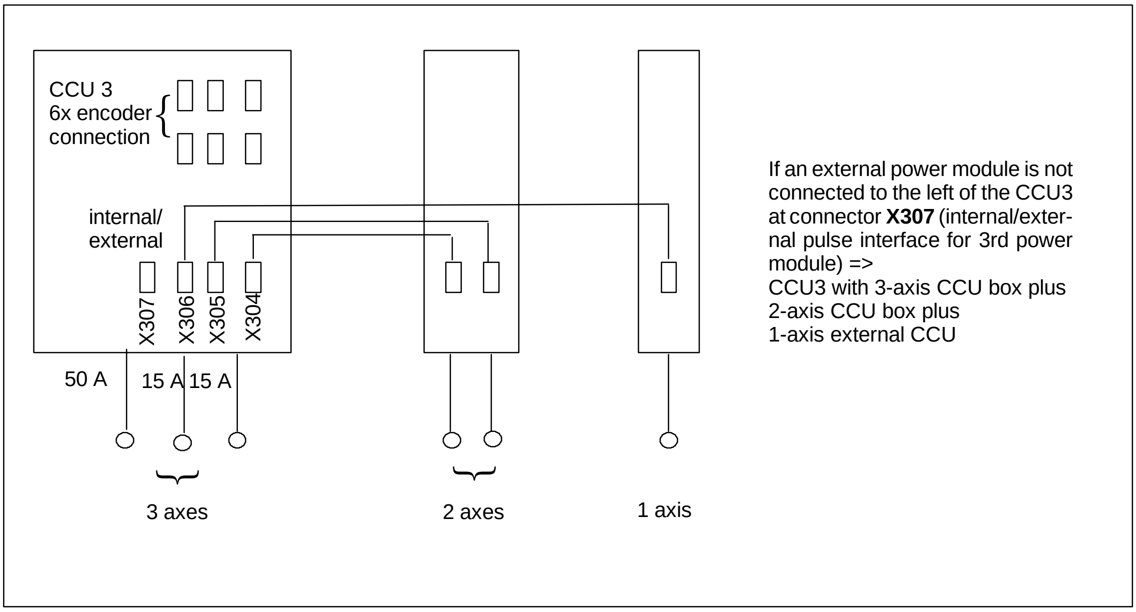


Figure 2-8 First option for operating 6 axes for CCU 3 with internal 3-axis CCU box

CCU 3 with 3-axis CCU box or 2-axis CCU box plus
2-axis power module to right of CCU
1-axis power module to right of CCU
1-axis power module to left of CCU

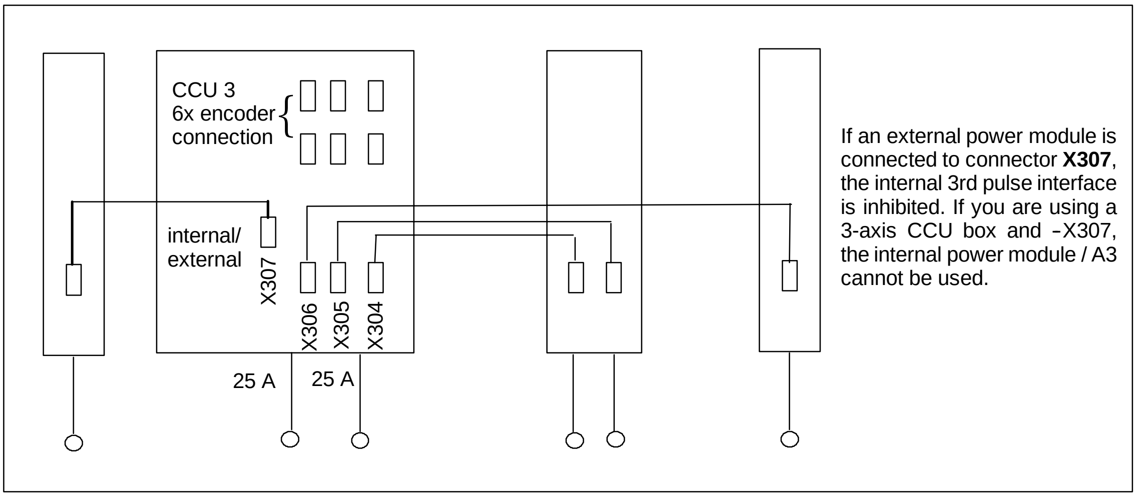


Figure 2-9 Second option for operating 6 axes for CCU 3 with 2-axis CCU box

2.2 Electrical configuration

2.2.1 Connection of components

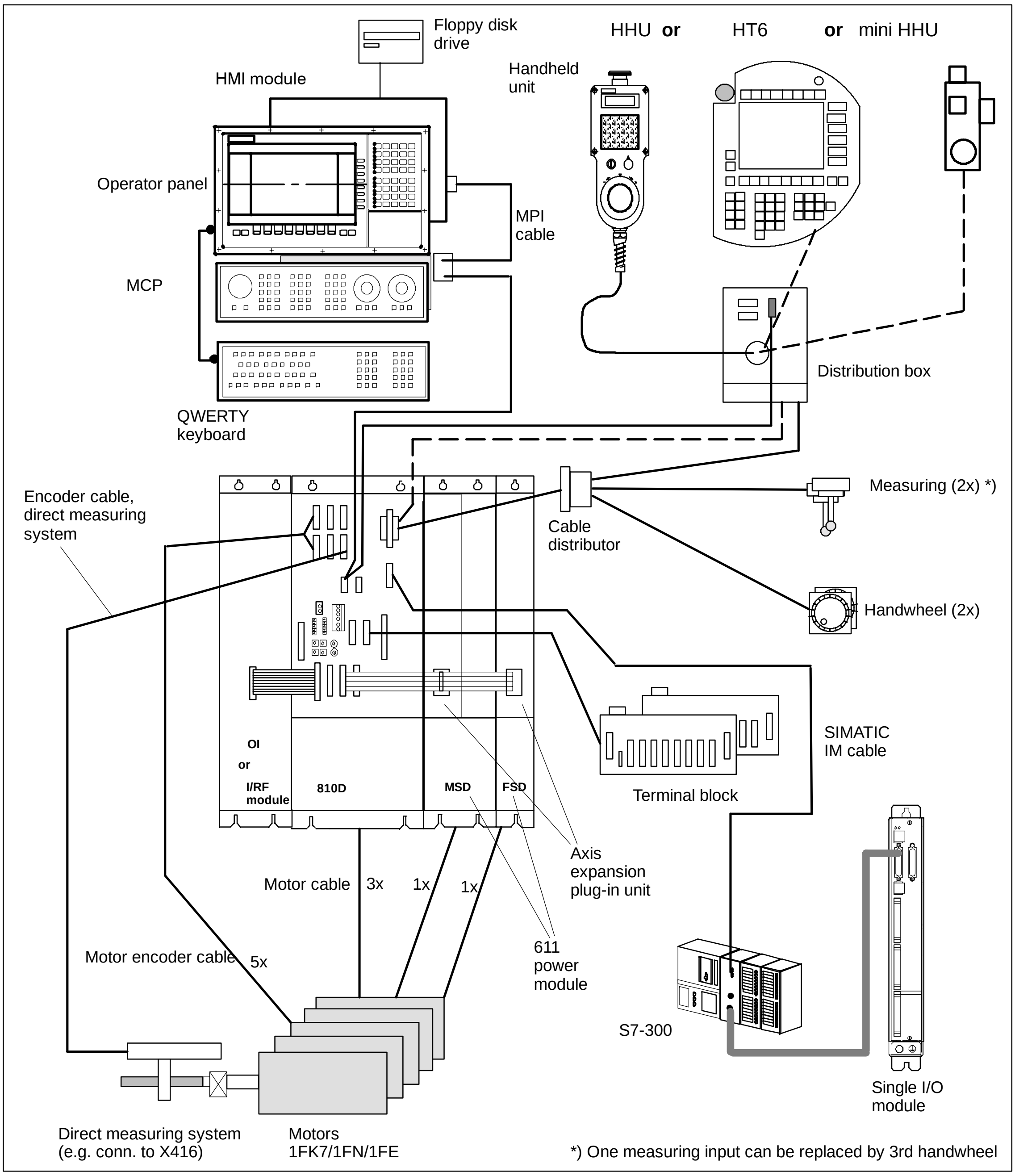


Figure 2-10 SINUMERIK 810D system

Note

For cables and connectors, please refer to
References: /PHC/, Configuring Manual.

2.2.2 Connection of power supply (OI, I/RF)

Overview of connections

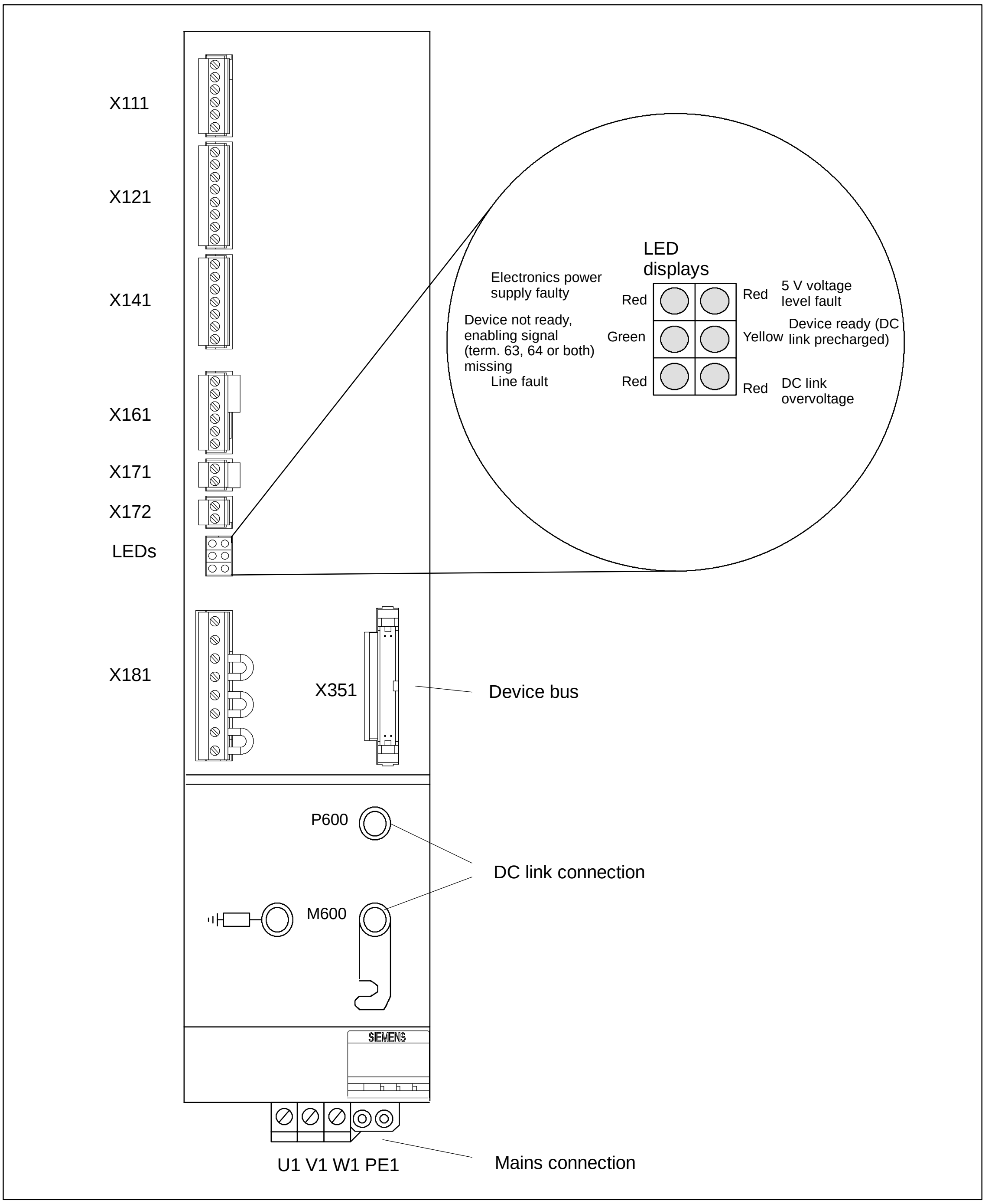


Figure 2-11 Interfaces for OI and 10-120 kW I/RF module

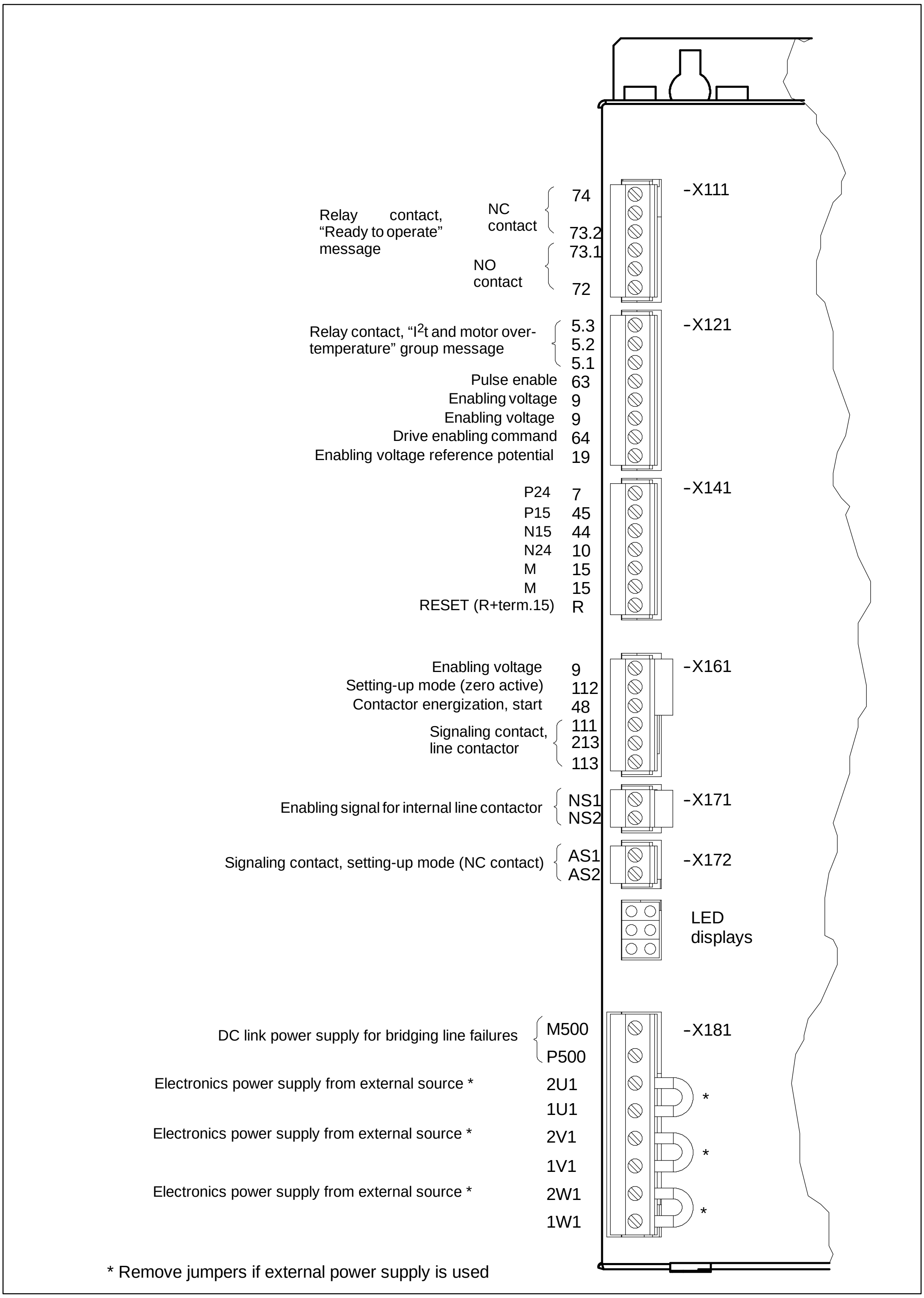


Figure 2-12 Terminals for SIMODRIVE 611 main supply module 10–120 kW

Connection example

I/RF module

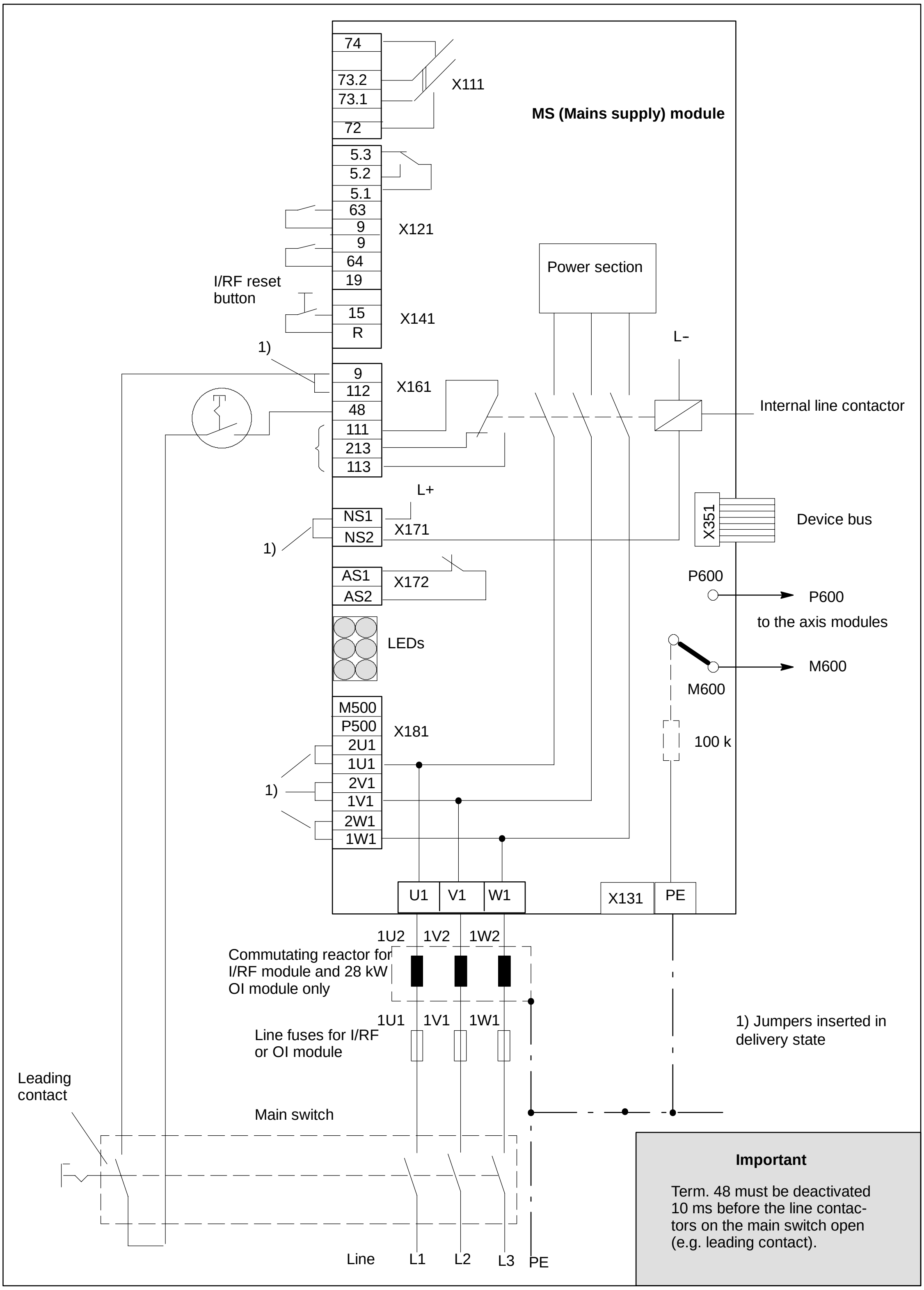


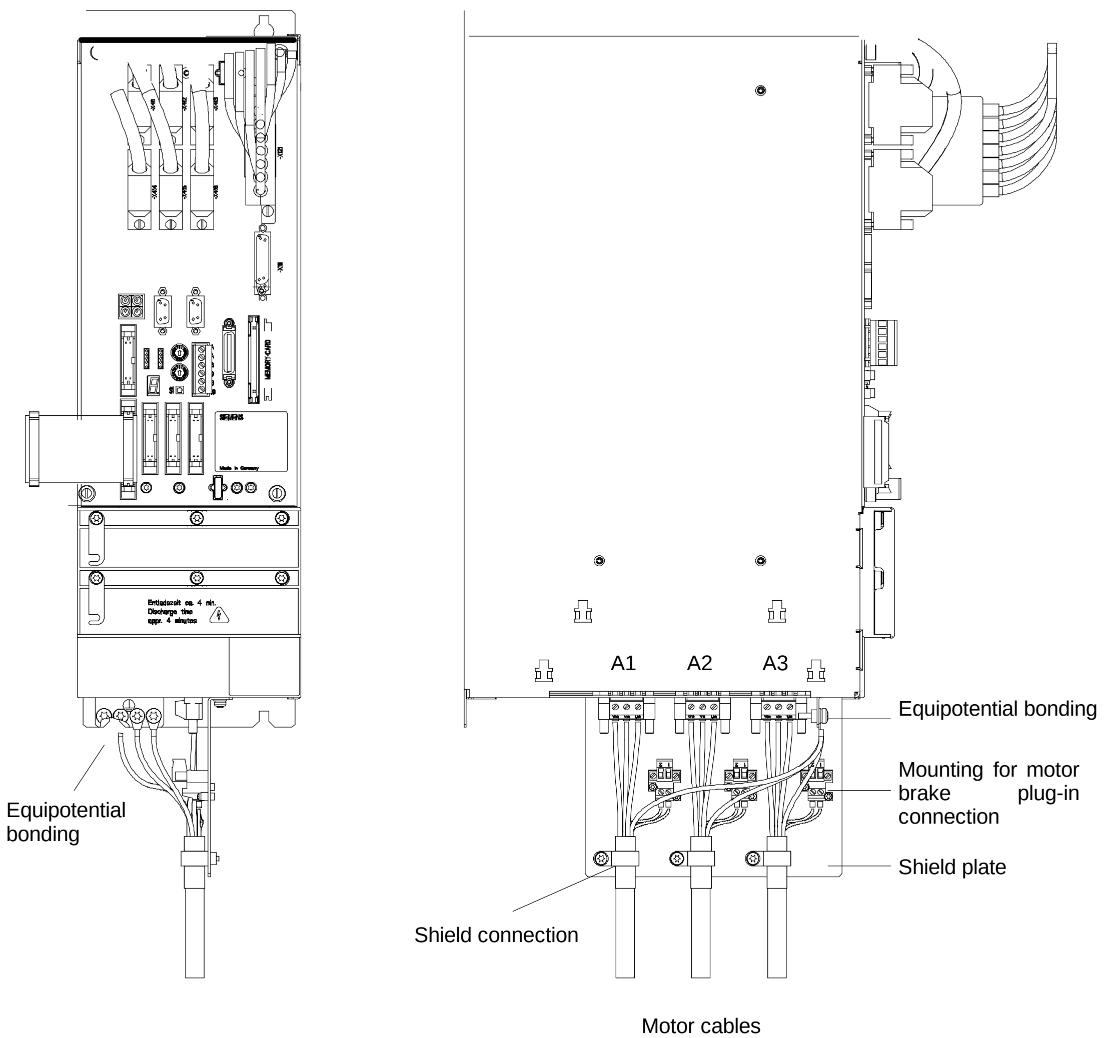
Figure 2-13 Example for three-wire connection (standard circuit)

2

2.2.3 Motor connection

Table 2-2 Assignment between motor connection and power module (CCU3-axis CCU box)

Motor connection	Power section variant
A1 (rear)	18A/36A (FSD) or 24A/32A/40A (MSD)
A2 (center)	6A/12A (only as FSD)
A3 (front)	6A/12A (only as FSD)



Type of connector for motor brake plug-in connection*:

PHOENIXType: MSTB 2.5/2-STF-5.08-BD1-2SO Order No.: 1863 631
Type: MVSTBU 2.5/2-GFB-5.08 Order No.: 1788 347

* Contained in scope of supply with SIEMENS motor cable

Figure 2-14 Motor connection for SINUMERIK 810D CCU box with 2-axis power module

2.2.4 Encoder connection

Motor measuring system and motor connection

A specific motor connection is permanently assigned to each motor measuring system.

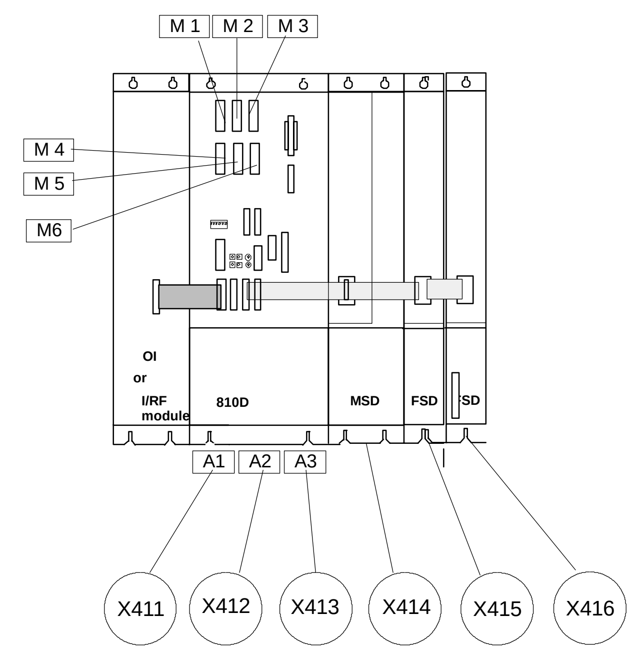


Figure 2-15 Assignment of motor measuring system to motor connection

Warning

The assignment of the motor measuring system to the motor connection must never be changed, even for test purposes.

Table 2-3 Assignment between measuring system and motor connection or axis expansion

Measuring system connection	Motor connection	Axis expansion connection
X411	A1	–
X412	A2	–
X413	A3	–
X414	–	X304
X415	–	X305
X416	–	X306

Warning

If pulse interface X307 is used (external power module to left of CCU), output A3 cannot be used for the 3-axis power module. The motor encoder remains connected to X413.

2.2.5 Single PLC I/O module (EFP)

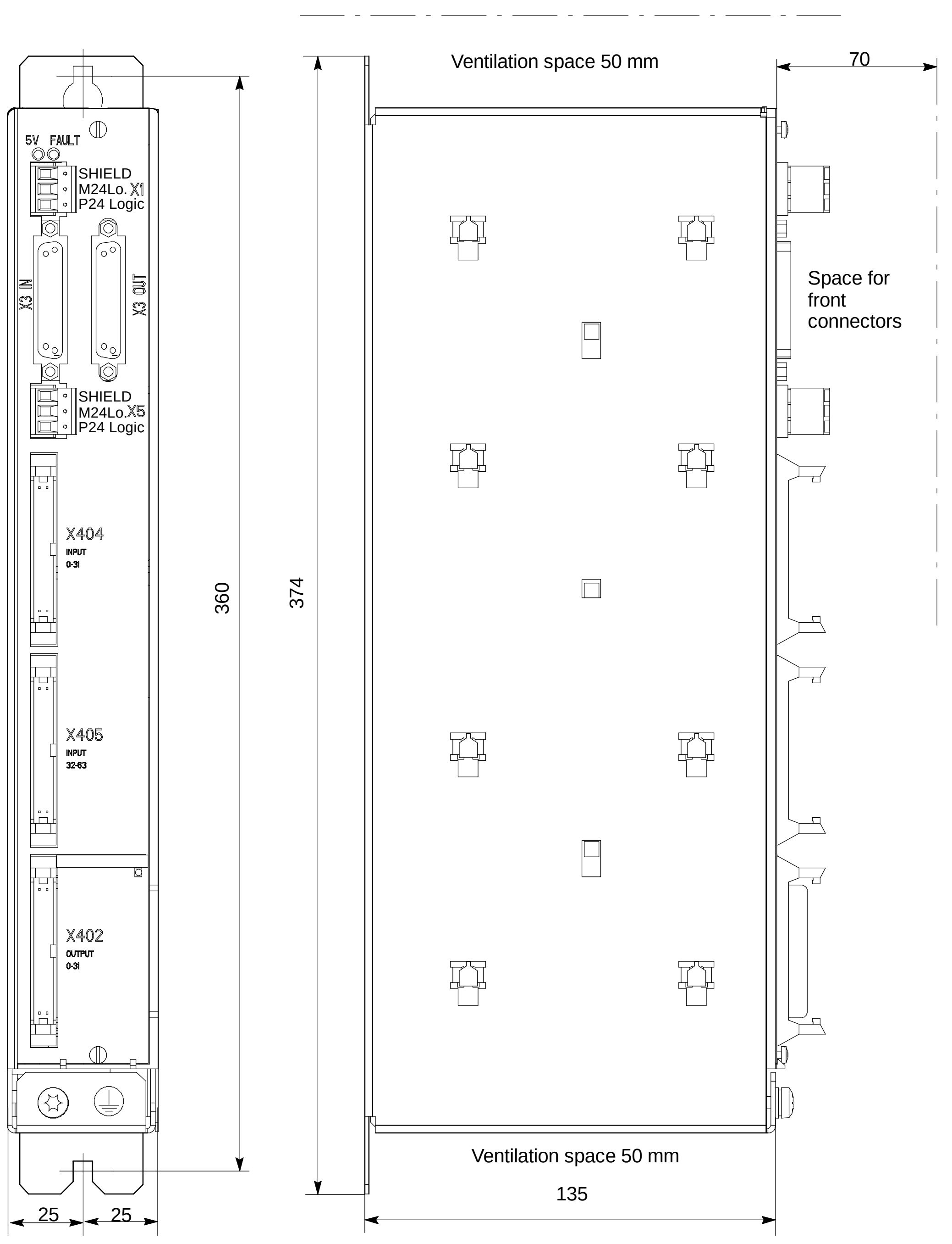


Figure 2-16 Dimension drawing single I/O module

Connection to S7-300 bus

The single I/O module is connected via plug X3 IN to SINUMERIK 810D connector X111. The maximum cable length is 10 m.

Up to 3 EFP submodules can be connected, while a mixed operation of EFP submodules and SIMATIC S7-300 lines (total of 3 lines) is allowed.

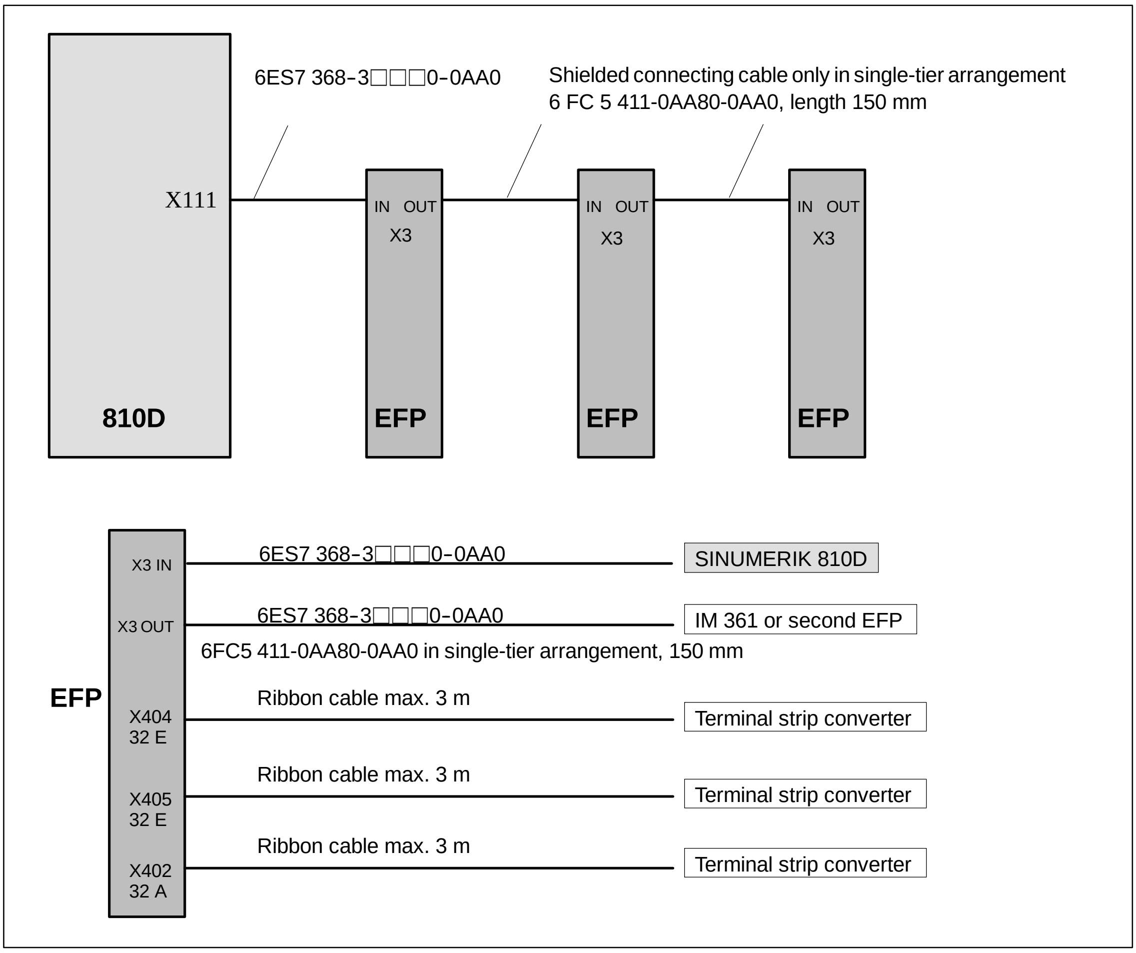


Figure 2-17 Overview of connections on single I/O module with 810D

Connection of the electronics power supply

The 24 VDC power supply is connected via a 3-pin, angular screw-type terminal connector (2.5 mm^2) to X1.

Table 2-4 Pin assignment of connector X1

X1 LOGIC power supply	
Pin	Name
1	P24 Logic
2	M24 Logic
3	SHIELD

Connection of the load power supply

The 24 VDC load power supply is connected via a 3-pin, angular screw-type terminal connector (2.5 mm^2) to X5.

Table 2-5 Pin assignment of connector X5

X1 POWER power supply	
Pin	Name
1	P24 Power
2	M24 Power
3	SHIELD

Connection of the inputs/outputs

Inputs/outputs are connected via ribbon cables up to a maximum of 3 m in length. Terminal strip converters can be used for this purpose.
The status of the inputs/outputs is not displayed on the module. If a display is required, then a terminal strip converter with LEDs should be used.
E.g. ribbon cable 6FC9340-8L☐
Terminal strip converter, without LED: 6FC9302-2AA
Terminal strip converter with red LED: 6FC9302-2AB (0.5 A)
6FC9302-2AL (2 A)
Terminal strip converter, with green LED:
6FC9302-2AD

References: /Z/ Catalog NCZ

The ribbon cable assignment is compatible with the I/O (logic) modules of the SINUMERIK 810D.

Meaning of LEDs

The module status of the single I/O module is signaled by means of two LEDs.

LED green: 5 V power OK

LED red: Group fault

2.2.6 Overview of connections on PCU 20 and PCU 50

PCU 20

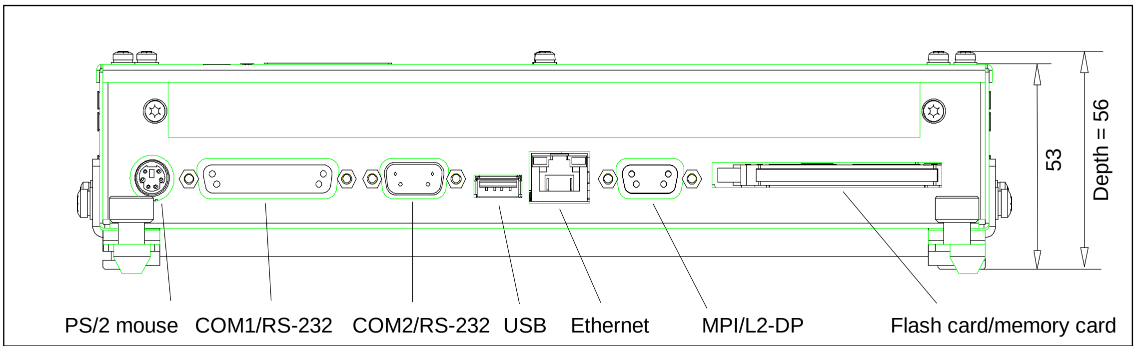


Figure 2-18 PCU 20 side view from right with interfaces

Table 2-6 Interfaces on right side of housing

Connection	Function
COM1/RS-232	Serial interface 1 (RS-232), 25-pin sub D socket connector
COM2/RS-232	Serial interface 1 (RS-232), 9-pin sub D socket connector
PS/2 mouse/keyboard	PS/2 mouse/keyboard connector
USB	External connection for Universal Serial Bus
MPI/DP (RS-485)	Multi-Point Interface/Profibus DP connection Connection of an S7 PLC, 9-pin sub D socket connector
Ethernet	Connection for local area network (LAN), software option
Memory card	Slot for ATA flash card/memory card or Flash Card 100/200 Type I/II
Power supply	24 VDC

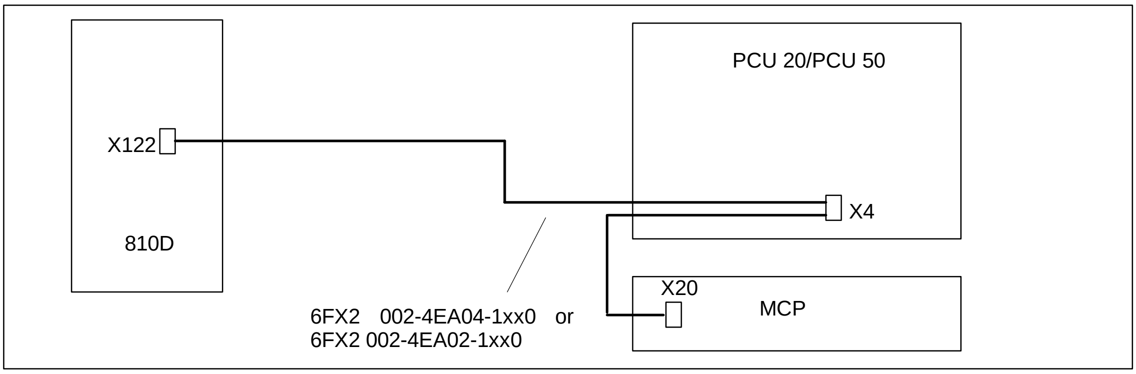


Figure 2-19 Connecting the PCU 20/PCU 50 to the SINUMERIK 810D

PCU 50

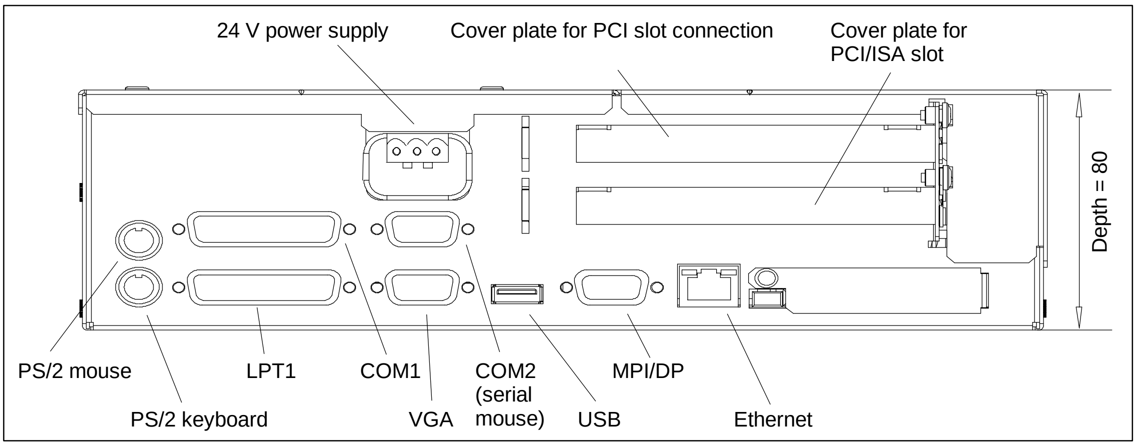


Figure 2-20 PCU 50 side view from right with interfaces

Table 2-7 Interfaces on right side of housing

Connection	Function
LPT1/Printer	Parallel interface (e.g. printer), 25-pin sub D socket connector
COM1/RS-232	Serial interface 1 (RS-232 or TTY [1]), 25-pin sub D socket connector
COM2	Serial interface 2 (RS-232), 9-pin male sub D connector
Keyboard	PS/2 trackball keyboard connection
Mouse	PS/2 mouse connector
USB	External connection for Universal Serial Bus
MPI/DP (RS-485)	Multi-Point Interface/Profibus DP connection Connection of an S7 PLC, 9-pin sub D socket connector
VGA	VGA interface for external monitor, 15-pin female sub D connector
Ethernet	Connection for local area network (LAN)
PCI slot	Slot for expansion boards [2]
PCI/ISA slot	Slot for expansion boards [2]
Power supply	24 VDC

1) TTY for 500 MHz version only

2) If expansion boardsare installed, the cover plates in Fig. 2-18 are replaced by the front plates of the boards.
Please refer to the module documentation for more details.

Interfaces

The interfaces (e.g. pin assignment) are shown and described in detail in

References: /BH/, Operator Components Manual

■

Settings, MPI Bus Nodes

3

3

3.1 MPI network rules

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.
- Bus terminating resistors are **integral** components of HHU and HPU units.

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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.

---

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): Total cable length max. 10 m

Note

Piggy-back connectors are not recommended for power connections.

Example A

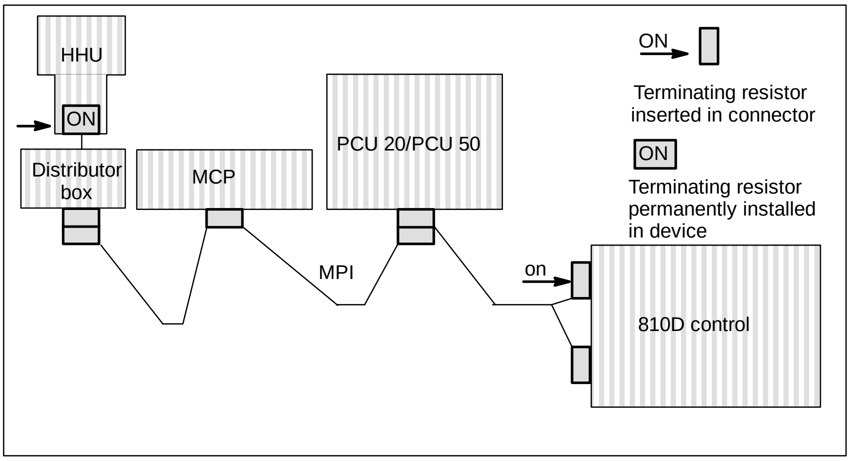

Figure 3-1 Network installation with two terminating resistors in
MPI: HHU, 810D control

Example B

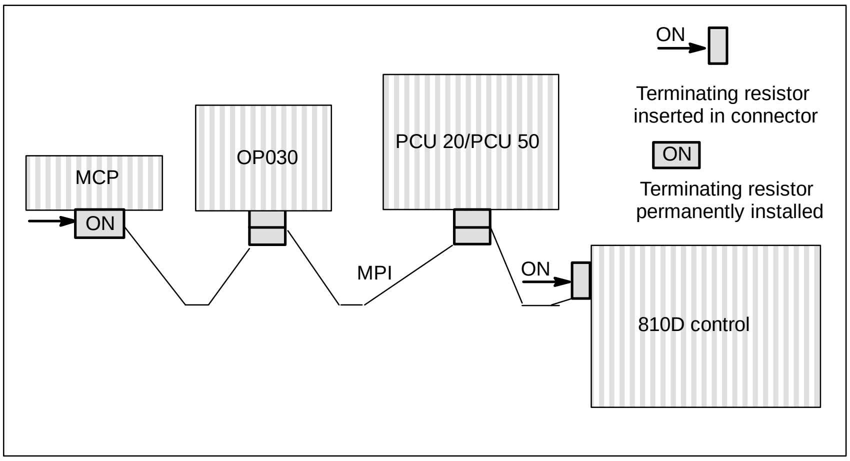

Figure 3-2 Network installation with two terminating resistors in
MPI: MCP, 810D control

3.2 Standard MPI configuration

Standard application

SINUMERIK 810D with PCU 20/PCU 50 and one machine control panel (MCP) or interface customer operator panel

Hardware requirements

At least firmware release V 03_01_01 for

- MCP
- Interface to customer operator panel

STEP7

as of 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).

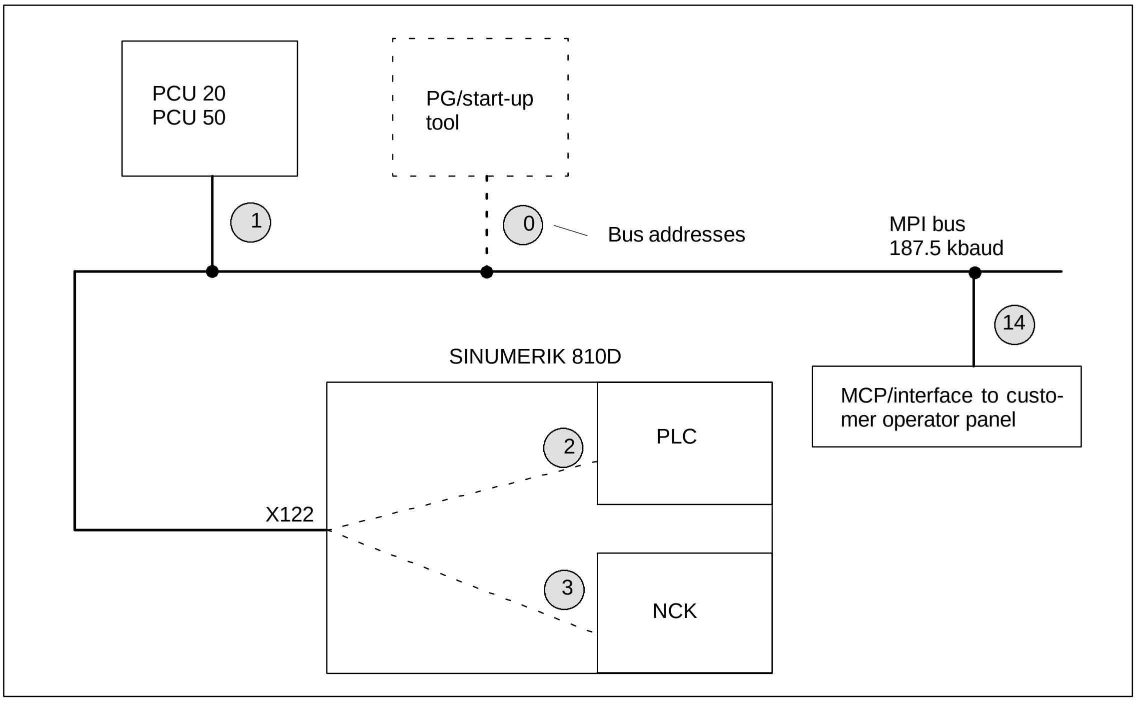

Figure 3-3 Standard application for SINUMERIK 810D

Communication parameters

Configuration via FB1

With the MCP/interface to customer operator panel set to MPI address 14 and the SDB210 from the basic program diskette, communication commences after a PLC restart (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 for the MCP or interface to customer operator 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:

- Firmware version of MCP/interface to customer operator panel must be V03_01_01 or higher.
  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.

3.3 Deviation from standard configuration

Required documentation

The following additional publications are required:
References: /BH/ Operator Components Manual
/FB/, P3, Basic PLC Program
/S7HT/ Manual, Application of Tools

Example

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

- Changes to address assignment
  of input, output or status bytes, or flag area or data block
- Additional connection of a handheld unit (HHU)
- Connection of a 2nd MCP **or** a handheld terminal (HT6)

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 soft key **Define global data**. 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. You must set up a CPU program for each component in the installation (PLC, MCP, HHU, 2nd MCP, HT6, etc.).
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, please refer to
References: /S7HT/ SIMATIC STEP7 Manual, Start-Up MPIBus Nodes.

3.3.1 MPI bus nodes

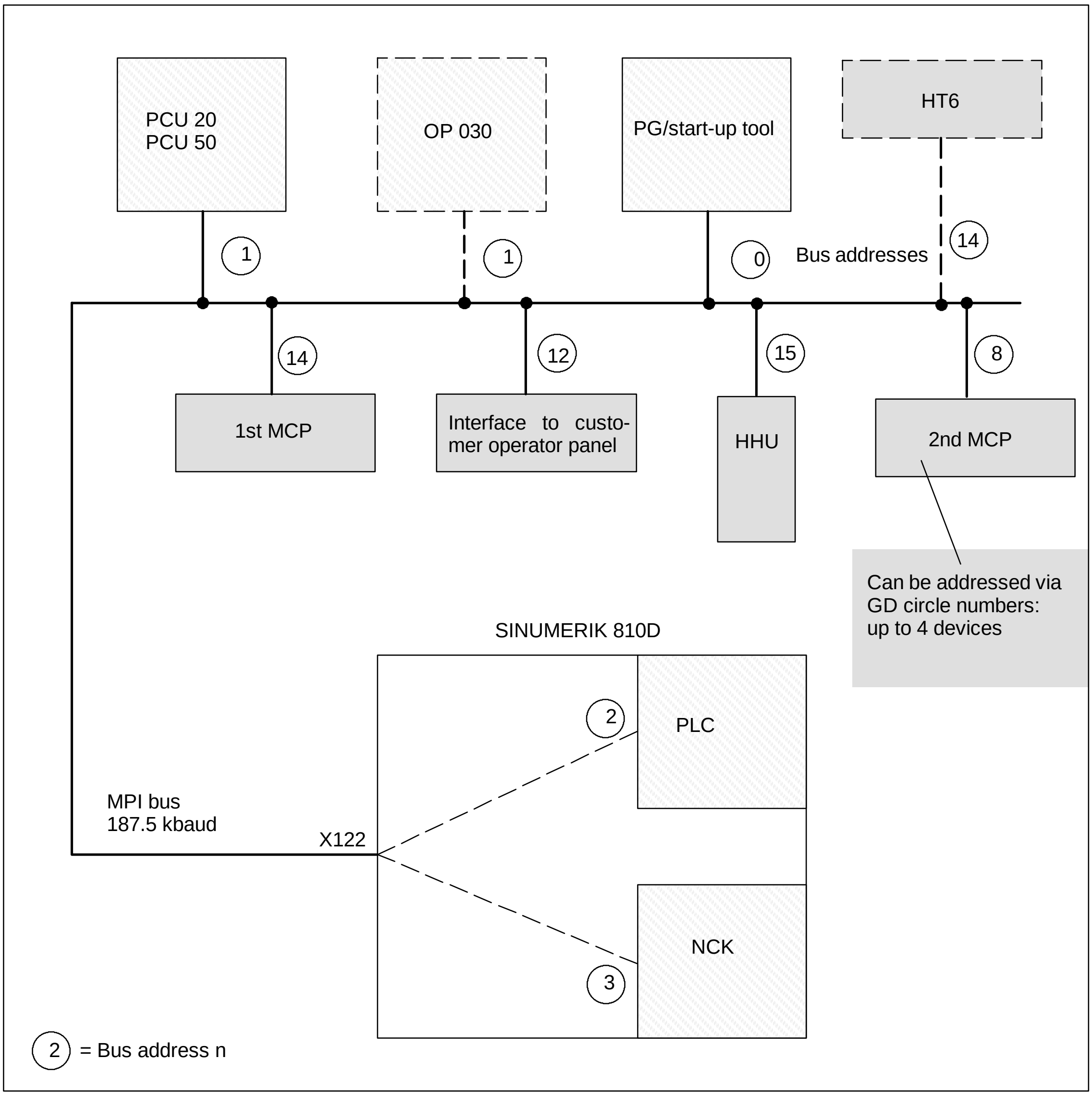

Figure 3-4 Example: MPI bus nodes with standard bus addresses

Bus addresses

The following MPI nodes are addressed via the bus address:

- PCU 20/PCU 50
- HT6
- HHU
- OP 030
- PG/start-up tool
- PLC module.

GD circles, SDB

User data frames are exchanged cyclically between the nodes. This takes place within the GD circles. The GD circles are set up via the SDB parameter block (in the SDB container) in the PLC (send cycle, data areas, source and destination addresses). Although the following MPI nodes have an MPI address, they are addressed by the PLC via the “GD circle number”.

- MCP
- HT6
- HHU
- Interface to customer operator panel

Note

The PLC in the SINUMERIK 810D is capable of addressing up to 4 devices via GD circle numbers (MCP, HHU, customer operator panel and, for example, 2nd MCP or HT6).

Setting of MPI bus addresses

The MPI bus addresses should be set as follows:

Table 3-1 Default setting for MPI bus addresses with 810D

MPI address	Standard address assignments
0	Programming device or start-up tool
1	PCU 20, PCU 50 or OP030
2	PLC module (AS315-2DP)
3	NCK
4	
5	
6	
7	
8	2nd machine control panel
9	
10	
11	
12	Interface to customer operator panel
13	
14	1st machine control panel (MCP) or handheld terminal (HT6)
15	Handheld unit (HHU)

In order to establish communication between the PLC and the MCP, HHU, HT6 and customer operator panel devices, it is necessary to configure a GD assignment. This is performed via the STEP7 tool “Communication Configuration”. It is not sufficient to set the GD parameters on the MCP, HT6, HHU or customer operator panel.

3.3.2 Example of an MCP/HT6 and HHU configuration via global data

SDB

The SDB supplied in the basic PLC program is valid for the 1st MCP or the HPU.

Invoking Communication Configuration

Run the Communication Configuration tool and create a new file.
"**Table 1**" appears.

Table 1

You now need to call the CPU programs in this **Table 1**.

1. Using the mouse, click on the field next to GD identifiers (the column is then color-highlighted).
2. Click on "**Select CPU module**" under menu item "AS Functions".
3. A window headed "Select CPU" appears. Click on project Example and the 3 CPU programs are displayed: AS315, hhu, mcp.
4. Select AS315.
5. Table 1 appears with the entry **AS315//CPU1::**
6. Click on empty field to the right of it and repeat steps 2 to 5 above in the order given for CPU programs mcp and hhu.
7. The result will be **Table 1** containing the 3 CPU programs.

Table 1			
GD identifiers	**AS315//CPU1::**	**mcp//CPU1::**	**hhu//CPU1::**
GD			
GD			
GD			
GD			

Enter areas for send and receive

Now make the entries for the MCP and HHU in **Table 1**.

1. Start in column **AS315//CPU1::** by selecting the first field.
2. Enter data area for sending and receiving from Fig. 3-4

   For **mcp//CPU1::**
   Receive area: qb0 : 8 8 bytes are sent from qb0 from the PLC to the MCP.
   Send area: ib0 : 8 8 bytes are received by ib0 fromthe MCP.

   For **hhu//CPU1::**
   Receive area: mb0 : 20 20 bytes are sent from mb0 from the PLC to the HHU.
   Send area: mb20 : 6 6 bytes are received by mb20 fromthe MCP.

3. Declare the send and receive areas to be such.
   The send area is then marked with “ **»** ”.
4. When the entries have been completed, **Table 1** looks as follows:

Table 1

GD identifiers	AS315//CPU1::	mcp//CPU1::	hhu//CPU1::
GD	»qb0:8	qb0:8	
GD	ib0:8	»ib0:8	
GD	»mb0:20		mb0:20
GD	mb20:6		»mb20:6

Note

Please note that the order in which the entries are made (send, receive) affects the assignment of GD identifiers.

Compilation

You now need to select compilation.
The GD identifiers are generated during compilation. After generation, the BD identifiers are displayed in **Table 1**:

Table 1			
GD identifiers	**AS315//CPU1::**	**mcp//CPU1::**	**hhu//CPU1::**
GD 1.1.1	»qb0:8	qb0:8	
GD 1.2.1	ib0:8	»ib0:8	
GD 2.1.1	»mb0:20		mb0:20
GD 2.2.1	mb20:6		»mb20:6

Setting the scan rate

Click on the **View/Scan Rate** menu command. **Table 1** is overlaid as shown below with the SR parameters:

Table 1			
GD identifiers	**AS315//CPU1::**	**mcp//CPU1::**	**hhu//CPU1::**
SR 1.1	8	8	
GD 1.1.1	»qb0:8	qb0:8	
SR 1.2	8	8	
GD 1.2.1	ib0:8	»ib0:8	
SR 2.1	8		8
GD 2.1.1	»mb0:20		mb0:20
SR 2.2	8		8
GD 2.2.1	mb20:6		»mb20:6

Changing SR parameters

The transmission rate for the MCP and HHU must be set.The default setting is one transmission every 8 PLC cycles. With a PLC cycle time of 25 ms, the default then corresponds to a key scan of 200 ms. This may be too slow for some applications. To reduce the transmission rate, the “scan rate”, i.e. the SR parameters, need to be changed.
You must specify the value 1, 2 4 or 8; only 4 and 8 are permitted as transmission settings. The transmission to and from the MCP is then activated at a corresponding frequency (e.g. every 4th PLC cycle).
Sample **Table 1** with modified SR parameters:

3

Table 1			
GD identifiers	**AS315//CPU1::**	**mcp//CPU1::**	**hhu//CPU1::**
SR 1.1	**4**	**1**	
GD 1.1.1	»qb0:8	qb0:8	
SR 1.2	**1**	**4**	
GD 1.2.1	ib0:8	»ib0:8	
SR 2.1	**4**		**1**
GD 2.1.1	»mb0:20		mb0:20
SR 2.2	**1**		**4**
GD 2.2.1	mb20:6		»mb20:6

When you have changed the SR parameters, you must compile your configuration again.

Activate status

Click on the **View/Status** menu command. The **Table 1** shown below is displayed:

Table 1			
GD identifiers	**AS315//CPU1::**	**mcp//CPU1::**	**hhu//CPU1::**
GST			
GDS 1.1			
SR 1.1	4	1	
GD 1.1.1	»qb0:8	qb0:8	
GDS 1.2			
SR 1.2	1	4	
GD 1.2.1	ib0:8	»ib0:8	
GDS 2.1			
SR 2.1	4		1
GD 2.1.1	»mb0:20		mb0:20
GDS 2.2			
SR 2.2	1		4
GD 2.2.1	mb20:6		»mb20:6

You now need to specify the status double words for GDS1.2 and GDS2.2. Detail from **Table 1**:

Table 1			
GD identifiers	**AS315//CPU1::**	**mcp//CPU1::**	**hhu//CPU1::**
GDS 1.2	**qd12**		
GDS 2.2	**md26**		

Once you have entered the status, you must compile your configuration again.

SDB210

The SDB210s are generated during compilation. Now transfer the SDB 210 for the CPU program **AS315** to the PLC CPU (PLC must be in the STOP state).

Procedure:

1. Click on the **File/Download to PLC**.
2. Download window appears. Select **AS315//CPU1::** and confirm with OK.
3. Put PLC into RUN mode (restart).

Set MCP and HHU

MPI address 14 on the MCP must be set according to GD parameters 1.1.1–1.2.1. The default MPI address 15 can be left unchanged on the HHU, only the GD parameters at 2.1.1–2.2.1 must be set.

Setting the basic PLC program parameters for FB1

The following parameter settings must be made at FB1 for operator components MCP and HHU.

MCPNum:=1	(one MCP)
MCP1In:=P#E0.0	(input signals MCP)
MCP1Out:=P#A0.0	(output signals MCP)
MCPStatRec:=P#A12.0	(status double word)
HHU:=1	(HHU on MPI bus)
HHUIn:=P#M20.0	(input signals HHU)
HHUOut:=P#M0.0	(output signals HHU)
HHUStatRec:=P#M26.0	(status double word)

Set HHU QBm bit 0.7 to “1”

The handheld unit will only function if bit QBm 0.7 is set to “1” in the defined output image. In this example, output 0.7 has to be set.
References: /BH/ Operator Components Manual

3.4 Handheld unit (HHU)

Displaying the HHU's software version

The software version installed on the HHU is displayed after power up if no communication is taking place between the PLC and the HHU.

Example: display on the HHU

Waiting for PLC
V04.01.01 F / 1.5 M *)

→ The software version of the HHU is V04.01.01
→ Bus address of the HHU is F_{hex} (15_{dec}) } *) Display changes
→ Baud rate of the HHU is 1.5 Mbaud } between **F** and **1.5 M**

3.4.1 Settings in the HHU

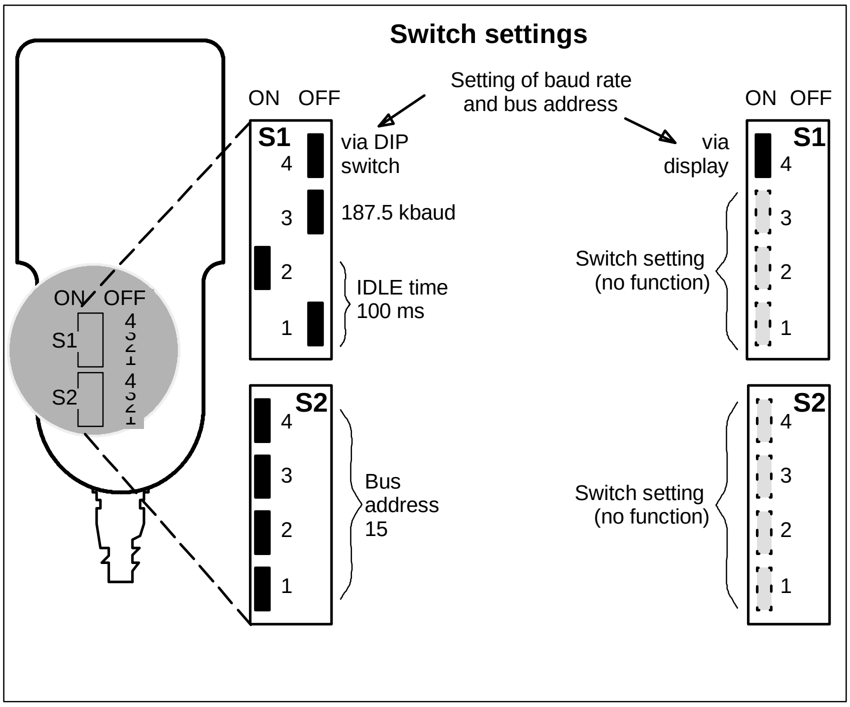

Figure 3-5 DIP switches in the HHU (left: default)

DIP switch setting for 810D

The default setting (delivery state) should be used to operate the HHU on the 810D control.

Table 3-2 Settings on switches S1 and S2 in HHU

Meaning		S1 1	S1 2	S1 3	S1 4	S2 1	S2 2	S2 3	S2 4
Setting of IDLE time, baud rate and bus address	via display (SW 4.1.1 only)				ON				
	via DIP switches (all SW versions)				OFF				
IDLE time *)	100 ms	OFF	ON						
Baud rate *)	1.5 Mbaud			ON					
	187.5 kbaud			OFF					
Bus address *)	15					ON	ON	ON	ON
	14					ON	ON	ON	OFF
	13					ON	ON	OFF	ON
	12					ON	ON	OFF	OFF
	11					ON	OFF	ON	ON
	10					ON	OFF	ON	OFF
	9					ON	OFF	OFF	ON
	8					ON	OFF	OFF	OFF
	7					OFF	ON	ON	ON
	6					OFF	ON	ON	OFF
	5					OFF	ON	OFF	ON
	4					OFF	ON	OFF	OFF
	3					OFF	OFF	ON	ON
	2					OFF	OFF	ON	OFF
	1					OFF	OFF	OFF	ON
	0					OFF	OFF	OFF	OFF
Delivery state		OFF	ON	OFF	ON	ON	ON	ON	ON

*) If S1.4 = **on** and SW version ≥ V04.01.01: Switch has no function

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Note

The maximum possible baud rate on the SINUMERIK 810D is 187.5 kbaud. Therefore set switch S1.3 to “OFF” before start-up.

With switch position S1.4 = **on** and software version ≥ V04.01.01, bus addresses from 0 to 31 can be set, i.e. up to 32 nodes can be supported on the OPI/MPI.

Bus addresses that are already assigned are preceded by the * character on the display.

3.4.2 Configuring the handheld unit, setting the interface parameters

It is necessary to set the GD parameters for the submodule to communicate via the MPI interface. The setting can be activated during power-up (i.e. while waiting for the first GD message frame from the PLC (“Waiting for PLC” state) via the HHU interface by means of key combination Jog (top far left) and T2 (top far right). The individual parameters are then interrogated via the HHU display and entered via the HHU keyboard. The default values can be changed within the permissible value range by means of keys + and –. The next parameter can be selected by means of the Automatic key. Selection of the next parameter causes the preceding parameter to be stored in the flash EPROM. The parameters need therefore only be set during start-up and when interfaces are changed. If after switching on the interface parameterization is not activated, then the stored values are accepted or the default values (see table) loaded.

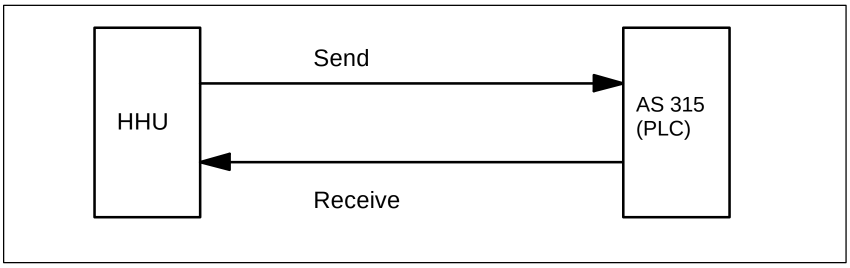

Figure 3-6 Sending and receiving seen from the HHU

Meaning of GD parameters

There are separate GD parameters for sending and receiving.

GD 1. 1. 1

- Object number
- GBZ number = global identifier number
- GD circle number (global data number)

Figure 3-7 Meaning of GD parameters

Note

The GD parameters of the HHU and AS315 or PLC block FB1/OB100 must all match.

Table 3-3 Value range for the GD parameters on the HHU

	Designation	Display HHU	PLC: FB1 parameter	Default value	Value
	Receive GD circle number	Rec-GD-No:	HHUSendGDNo	2	1–16
	Receive global identifier number	Rec-GBZ-No:	HHUSendGBZNo	1	1–255
	Object number for receive global identifier number	Rec-Obj-No:	HHUSendObjNo	1	1–255
	Send GD circle number	Send-GD-No:	HHURecGDNo	2	1–16
	Send global identifier number	Send-GBZ-No:	HHURecGBZNo	1	1–255
	Object number for send global identifier number	Send-Obj-No:	HHURecObjNo	1	1–255
SW 4 and higher	Baud rate	Baud rate:		1.5 Mbaud	187.5 kBaud/ 1.5 Mbaud
	Bus address	Bus address:		15	0–31

3.5 Handheld terminal HT6

The SINUMERIK HT6 (**H**andheld **T**erminal with approx. **6**" screen diagonal) is an operator control and programming device and can be used in conjunction with SINUMERIK 810D, 840D, FM 357-2H and 840Di controls.

References: /BAH/ Operator's Guide HT6 (new HPU);
/BH/ Operator Components Manual

Function blocks

- 80486DX4 microprocessor
- Memory:
  - SDRAM 16 MB
  - FLASH 8 MB
  - PC memory card: 8 MB FLASH, can be plugged in externally
- LCD with
  - 5.7" screen diagonal, monochrome (blue) STN, 320 * 240 pixels (1/4 VGA), backlit, adjustable brightness and contrast
  - 16 to 20 characters per line (depending on configuration)
- Membrane keyboard with
  - Machine control keypad: RESET, ALARM CANCEL, JOG, TEACH, AUTO, CONTROL PANEL FUNCTION, STOP, START, 12 traversing keys (6+ and 6– with slide-in user labels)
  - Horizontal soft key bar with 8 keys
  - Numerical keypad (12 keys, can be switched to letters with Shift keys)
  - Cursor keypad (9 keys)
  - Custom keys: S1, S2, U1, ..., U8 (with slide-in user labels)
  - Function keys: Operating area (MENU SELECT), HELP, Recall (^)
- Rotary override button (19 positions with stop)
- EMERGENCY STOP button
- At the rear of the device:
  - Enable keys (2 keys, 2 channels each, with two positions suitable for safety category 3)
  - HT6 cable connection
  - Serial RS-232 interface
  - PC memory card interface
  - PS/2 keyboard interface
  - Reset button
  - Safety strap
  - Two M5 threaded holes for custom-made holder.

The only parameters for FC 26 are "BAGNo" and "ChanNo". Therefore, the information which is otherwise transferred to the calling instance through the "FeedHold" and "SpindleHold" parameters must be determined by the user.

3.6 Machine control panel (MCP)

Interfaces, switches and display elements

The following interfaces, switches and display elements are located on the rear panel of the machine control panel:

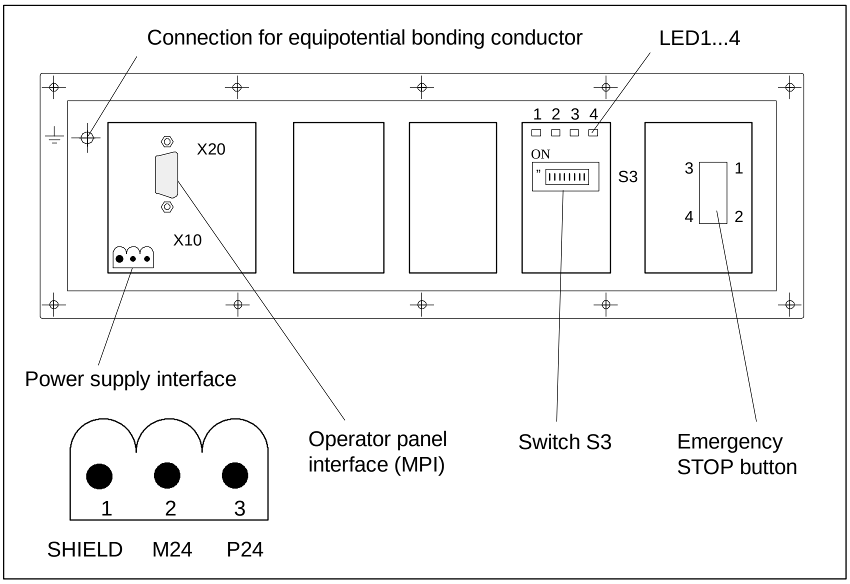

Figure 3-8 Position of interfaces on rear panel of MCP

Interfaces

The interfaces (e.g. pin assignment) are shown and described in detail in

References: /BH/, Operator Components Manual

LED 1...4

Table 3-4 Meaning of LEDs 1...4 on rear panel of MCP

Designation	Meaning
LEDs 1 and 2	Reserved
LED 3	POWER: Lights up when voltage (24 V) is present
LED 4	SEND: Changes status after transmission of data

Display software version of MCP

If keys “Feed start” and “Feed stop” are pressed simultaneously while the MCP is powering up, the SW version is output on the left-hand, centre and right-hand LED blocks.
The module must have firmware version **3_01_01** or later.

Example

After activating the software version display,the 3/1/1 LEDs in the left/middle/ right LED group light up
--> SW v03_01_01 is installed.

Switch S3, GD parameter settings

The GD circle numbers are linked to the bus address for the MCP and interface to customer operator panel with firmware version V3_01_01 and higher. Switch S3 can be used to set the baud rate, transmission cycle time, hardware variant and bus address.

Table 3-5 Meaning of switch S3 for machine control panel

1	2	3	4	5	6	7	8	Meaning:
ON OFF								Baud rate: 1.5 Mbaud Baud rate: 187.5 kbaud
	ON OFF OFF	OFF ON OFF						200 ms cyclical transmission grid/ 2400ms reception monitoring 100ms cyclical transmission grid/ 1200ms reception monitoring 50ms cyclical transmission grid/ 600ms reception monitoring
			ON ON ON ON ON ON ON ON OFF OFF OFF OFF OFF OFF OFF OFF	ON ON ON ON OFF OFF OFF OFF ON ON ON ON OFF OFF OFF OFF	ON ON OFF OFF ON ON OFF OFF ON ON OFF OFF ON ON OFF OFF	ON OFF ON OFF ON OFF ON OFF ON OFF ON OFF ON OFF ON OFF		Bus address: 15 Bus address: 14 Bus address: 13 Bus address: 12 Bus address: 11 Bus address: 10 Bus address: 9 Bus address: 8 Bus address: 7 Bus address: 6 Bus address: 5 Bus address: 4 Bus address: 3 Bus address: 2 Bus address: 1 Bus address: 0
							ON	Interface to customer operator panel
							OFF	MCP
ON	**OFF**	**ON**	**OFF**	**ON**	**ON**	**OFF**	**OFF**	**Delivery state**
OFF	**OFF**	**ON**	**ON**	**ON**	**ON**	**OFF**	**OFF**	**Default setting for 810D** Baud rate: 187.5 kbaud Cyclical transmission grid: 100 ms Bus address: 14

Table 3-6 Association between GD parameters and MPI bus addresses for MCP

GD parameters Receive – Send	Associated MPI bus addresses
1 . 1 . 1–1 . 2 . 1	13, 14, 15
2 . 1 . 1–2 . 2 . 1	11, 12
3 . 1 . 1–3 . 2 . 1	9, 10
4 . 1 . 1–4 . 2 . 1	7, 8
5 . 1 . 1–5 . 2 . 1	4, 5
Reserved	0, 1, 2, 3, 6

Several MPI addresses are used to set a GD parameter set, e.g. GD parameters 1.1.1–1.2.1 are set with addresses 13, 14 or 15. Since at least 2 addresses are always provided for one GD parameter set, it is possible to change to a different address if the required address is already assigned.

Note

2nd MCP:
SINUMERIK 810D can be used to operate 2 machine control panels. The MPI nodes must be parameterized by means of the “Communication Configuration” tool. The 2nd MCP must be parameterized in the basic program parameters in FB1.

3.7 MPI interface for customer operator panel

MPI interface

A customer operator panel can be connected via the MPI interface. 64 digital inputs and 64 digital outputs with CMOS level (5) are available on the module for this purpose.
The module must have firmware version **3_01_01** or later.

Layout of the interfaces

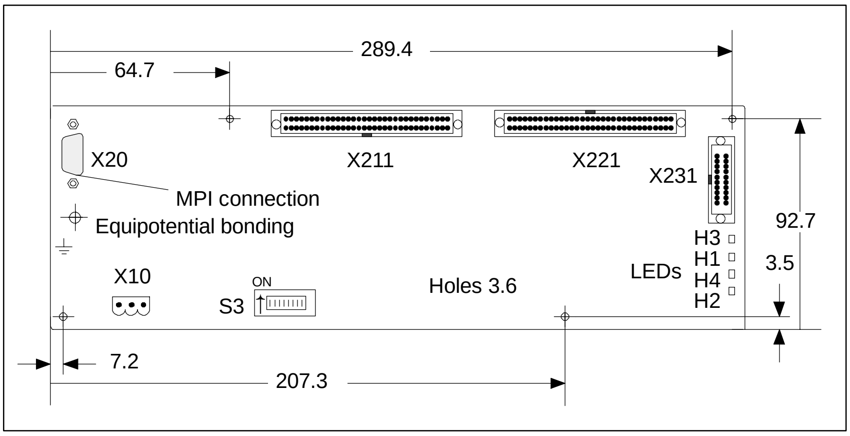

Figure 3-9 Front view of the MPI interface customer operator panel

Switch S3

To set the GD parameters for the MCP, please refer to Tables 3-5 and 3-6.

Standard setting for 810D

If only the customer operator panel is to be connected, then the bus address must be set to 14 as for the MCP (standard application).

Table 3-7 Setting for 810D: Switch S3 on interface for customer operator 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 grid: 100 ms** **Bus address: 14**

Power supply interface

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

Table 3-8 Pin assignment of connector X10 on interface to customer operator panel

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

3.8 PCU 20/PCU 50 operator panel

3.8.1 Settings on the PCU

Setting the MPI interface

The MPI interface must be set to 187.5 kbaud for the SINUMERIK 810D.

- **PCU 20**
  The PCU 20 sets itself automatically to the correct baud rate.
- **PCU 50**
  The PCU 50 must be set to a baud rate of 187.5 kbaud in the “Start-Up/HMI/ Operator Panel” menu.

Screen

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

MD 9001: DISPLAY_TYPE (monitor type)
The monitor type (i.e. LCD monochrome, LCD color) is entered in this machine data (for PCU 20).

Language

MD 9003: FIRST_LANGUAGE (foreground language for PCU 20)

- **PCU 20**
  One of two languages can be selected on the PCU 20.
- **PCU 50**
  The PCU 50 is always supplied with multi-lingual capability. English is the default setting.

Display resolution

MD 9004: DISPLAY_RESOLUTION (display resolution) and
MD 9010: SPIND_DISPLAY_RESOLUTION (display resolution for spindles)
The display resolution for position values on the screen is entered in this machine data. The maximum number of digits on the screen is 10 plus the decimal point and sign (e.g.: 4 places after decimal point,
max. display = +/– 999999.9999).

Screen saver

MD 9006: The time period after which the screen saver function is activated, i.e. during which no keys on the operator panel are actuated, is entered in this machine data.

User data protection levels

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

RS-232 interfaces

The settings of the RS-232 interface on the HMI for data backup are stored from MD 9300 onwards. The settings for 3 different devices are made in the “Services” menu via an input display.

3.8.2 Selecting the language

Changing the language

To be able to switch between the two configured languages even when the operator is not familiar with the selected language, the switchover between the languages must be performed “blindly”:

1. Select menu bar
2. Select “Start-up” (3rd horizontal soft key from right)
3. Switch to the highest level with RECALL
4. Select “Change language” (3rd vertical software from top).

PCU 20

One of two languages can be selected on the PCU 20. These are defined while the HMI software is being loaded. While the control is in operation, the operator can switch between these two languages only. He does so by selecting the soft key “Change language” in the “Start-up” display.

PCU 50

On the PCU 50, there are several methods by which the operator can switch language while the control is in operation:

- Switchover between two preset languages.
- Changeover of the second language.

Switchover concept

The selectable languages are set and managed in a file. When the language is switched in online operation, the first language remains as originally set (1st language) and only the second language can be changed.

Switching between two languages

You can switch between languages by using the vertical “Change language” soft key in the “Start-up” operator control area. The switchover takes effect immediately. This key can only be used to switch between two predefined languages.

Changing the 2nd language

Different languages are selected in the “Start-up/HMI/Languages” operating area (provided that languages have been loaded!). This display provides you with a list of the available languages. Select one language and confirm the selection with “OK”. You can then change over between the first language and the language you have just set by selecting the “Change language” soft key in the “Start-up” area.
You can change the 2nd language at any time.

Language packages for installation

The PCU 50 is supplied with the English and German languages.
Two supplementary packages (1 and 2) are also available.

Supplementary package 1:	**European languages:**
GR	German (standard)
SP	Spanish
FR	French
UK	English (standard)
IT	Italian

Supplementary package 2:	**Asian languages**
KO	Logographic language Korean
TW	Logographic language Chinese (Taiwan)
CH	Logographic language Chinese (Mandarin)

Definition of usable languages

The languages that can be used on the HMI are configured in the **c:\mmc2\mmc.ini** file. The required changes in the file described below can be made with the editor which can be called under **Start-up/MMC**.

Presettings without activation of logographic languages

Two languages can be set from a number of optional languages:

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

Example:
1st language German, 2nd language English

File MMC.INI must be altered as shown below:

Excerpt from mmc.ini:
...
[LANGUAGE]
Language=**GR**
LanguageFont=Europe
Language2=**UK**
LanguageFont2=Europe
...

Note

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

Presettings with activation of logographic languages

Two languages can be configured from a number of optional languages:

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

Example:
1st language German, 2nd language Chinese

File MMC.INI must be altered as shown below:

(Excerpt from mmc.ini:)
...
[LANGUAGE]
Language=**GR**
LanguageFont=**Europe**
Language2=**CH**
LanguageFont2=**China**

;LanguageList=GR, SP, FR, UK, IT
;FontList=Europe, Europe, Europe, Europe, Europe
;LBList=español, français, english, italiano

LanguageList=GR, CH, TW, SP, FR, UK, IT
FontList=Europe, China, China, Europe, Europe, Europe, Europe
LBList=chinese, taiwan, español, français, english, italiano
AddOnProd=c:\cstar20\cstar20.exe
...

Add-on products

To be able to operate the control with logographic languages, the appropriate add-on product must be installed for each language that can be selected. Languages based on different add-on products cannot be configured at the same time.

Note

When you change lines “LanguageList”, “FontList”, “LBList” and “AddOnProd”, make sure that you only manipulate (shift, delete) the “**;**” character for the comment.
When editing the MMC.INI file, please make sure you only change the highlighted (bold print) texts. Make sure that your entries are spelled correctly.

■

Notes

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 be connected conductively with the housings.

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.

Precautionary measures

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

- Signal cables and load cables must be routed at the greatest possible distance from one another.
- Only use SIEMENS signal cables for connecting to and from the NC or PLC.
- Signal cables 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 information about interference suppression measures and connection of shielded cables, please refer to
References: /EMC/, EMC 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 allowed to come into contact with electrically insulating materials such as plastic films, insulating table tops or clothing made of synthetic fibers.
- 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 Ramp-Up

5

5.1 Start-up sequence

5

Start-up sequence

All mechanical and electrical installation work 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. Check the ramp-up of the SINUMERIK 810D (Chapter 5)
2. Enter the basic settings and the memory configuration (Subsection 6.5.1/Section 6.6)
3. Scaling machine data (Section 6.7)
4. Transfer the PLC user program and the alarm texts (Chapters 7 and 8)
5. Set the axis configuration (Section 9.1)
6. Configure and parameterize the drives (Section 9.2)
7. Set the axis and spindle machine data (Subsection 9.2.x)
   - Velocities axis (Subsection 9.2.6)
   - Position controller data axis (Subsection 9.2.7)
   - Monitoring axis (Subsection 9.2.8)
   - Reference point axis (Subsection 9.2.9)
   - Spindle data, rotary axis (Subsection 9.2.10)
   - Spindle configuration (Subsection 9.2.11)
   - Encoder adaptation spindle (Subsection 9.2.12)
   - Velocities and setpoint adaptation spindle (Subsection 9.2.13)
   - Position and synchronize spindle (Subsections 9.2.14 and 9.2.15)
   - Monitoring spindle (Subsection 9.2.16)
8. Test run for axes and spindles (Chapter 10)
9. Drive optimization (Chapter 11)
   - Frequency response measurements (Section 11.6)
   - Analog output (Section 11.9)
10. Data backup (Chapter 12)
11. HMI (Chapter 14).

5.2 Power ON and Ramp-Up

5.2.1 Power ON

Visual inspection

The installation should be inspected visually for any obvious faults or defects. 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.

Note

Check whether the battery on the CCU module is connected. It is not connected in the delivery state (discharged). Make sure that you observe the rules for handling ESD-sensitive components when dealing with modules.

Device settings

Before commencing with start-up, check that the address and switch settings on the MCP, HHU and PLC I/O devices are correct (see Chapter 3).

References: /BH/, Operator Components Manual

Power ON sequence

The components can be switched on in any desired sequence.

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. However, the LEDs on the I/RF module may not indicate any errors/ faults in the power supply. There are no enabling signals on the PCU module, ramp-up is started immediately.

Danger

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

5.2.2 NC ramp-up

After the power supply has been connected, the control system powers up. The system software is stored on an internal flash EPROM in the delivery state. If a PCMCIA card (containing system software) is inserted, the control powers up with the system software on this card.

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 execute an NCK reset, turn start-up switch S3 on the CCU to position 1 and switch on the control. The control then powers up, the SRAM memory is erased and the machine data are preset to the default values.

Table 5-1 Meaning of NCK start-up switch (S3) settings

Setting	Meaning
0	**Normal mode:** The control powers up with the set data.
1	**Start-up mode:** The data in the buffered RAM (SRAM) are erased and standard (default) machine data loaded.
2	**Software update**: Software download from PCMCIA card only possible for CCU3 export version
3–7	Reserved

End of NCK ramp-up

After an error-free run-up, the number “6” is output on the status display of the CCU. The LEDs “+5V” and “SF” (SINUMERIK READY) light up.
Now switch the NCK start-up switch S3 back to setting 0.

General PLC reset

With MEMORY RESET, the program memory of the PLC is erased.
The diagnostics buffer of the PLC is not erased.
After the NC has powered up, the PLC must be set to its initial state by means of a general reset. There are two ways of doing this:

1. By means of the programming device with SIMATIC STEP 7
2. Via the PLC start-up switch S4 on the CCU module

Table 5-2 Settings with the PLC start-up switch S4

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

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. Perform Power ON and hardware RESET.
3. PLC general reset:
4. Set NC start-up switch S3 to position 1 (this erases the DRAM between the NC and PLC).

Operation for PLC restart

The following step generates a NEW START of the PLC:

Turn PLC start-up switch S4 from position “2” (STOP mode) to position “1” or “0” (RUN mode).

Operation for general PLC reset

The following steps with the PLC start-up switch S4 generate a MEMORY RESET of the PLC:

1. Turn to position “2” (STOP mode)
   LED PS lights.
2. Turn to position “3” (MRES mode, request memory reset) and hold in this position (for approximately 3 seconds) until the STOP LED PS comes on again
   LED PS goes off and lights again.
3. Within three seconds, turn to the positions STOP-MRES-STOP (“2”-“3”-“2”)
   LED PS flashes initially at about 2 Hz and then lights again
   LED PF lights
4. After the PS and PF LEDs light up, set switch S4 to the 0 position
   LED PS and LED PF go out again and LED PR (green) lights up
   The PLC is now initialized and running in cyclic operation mode

---

Note

If a hardware RESET or Power ON is initiated in switch position 3 on PLC start-up switch S4 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.

References: /S7H/, SIMATIC S7-300

5.2.3 PCU 20 – PCU 50 ramp-up

PCU ramp-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 ramp-up

PCU 20
If the PCU 20 is not able to establish a connection to the NC, the following message appears: “wait for NCU connection: “x” seconds”, “x” = 1 to 60.
If a connection has still not been established after this time, then rebooting takes place soon after. Check the following:

- Is the SINUMERIK 810D (CCU module) ready to operate (digit 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 ramp-up (e.g. as for software upgrade [Position 1 / PLC Reset]), the control must be switched off and on again for the PCU ramp-up to be successful.

PCU 50
If the PCU 50 does not boot, i.e. the screen remains dark, check the 24 VDC power supply. If the power supply is present at the power unit of the PCU 50 and the seven-segment display on the rear panel does not light up, then the PCU 50 module is defective.

If the PCU 50 powers up, but cannot establish a connection to the NC, then the message “Communication to NC failed” is output in the message line at the bottom.
In this case, please check the following:

- Is the SINUMERIK 810D (CCU module) ready to operate (digit 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.)

5.2.4 Error during control ramp-up (NC)

Messages on status display

Various status messages are output on the CCU display (7-segment display H3) during ramp-up. The digit “6” is output when the control has finished powering up.

Problems during NCK ramp-up

If the “6” is not displayed after approximately 1 minute, but:

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

then proceed as follows:

1. Repeat the NCK initial clear.
2. Switch S3 (CCU) must be returned to position “0”.
3. If the initial clear procedure is unsuccessful, re-install the NCK software. See Section “SW/HW Replacement”.
4. If these actions prove to be unsuccessful, replace the CCU module.

Note

Only the software of the CCU3 export version can be loaded into the internal flash EPROM (switch position 2). This function is not possible with the CCU3 standard software.

Status displays of the PLC

The following LEDs are located on the front plate of the CCU module. They display the PLC operating states.
PR PLC RUN (green)
PS PLC STOP (red)
PF PLC watchdog (red)
PFO PLC FORCE (yellow)

LED PR and LED PS

Table 5-3 Statuses displayed by LEDs PR and PF

LED PR	lights up	OFF	flashes at 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 (min. 3 s) 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.

LED PF

This LED lights up when the PLC watchdog has responded.

LED PFO

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 LED PFO is out, then no FORCE job is present.

Note

If all 4 LEDs on the status display flash simultaneously after the CCU3 hardware has been replaced, then another NCK ramp-up must be initiated. A PLC general reset can then be executed if required.

5.2.5 Ramp-up of the drives

Ramp-up of the drives

After an NCK general reset the drives are deactivated. No data sets (so-called boot files) are available for the drives. The “SF” LEDs on the CCU3 module and the 611D closed-loop control module (if installed) light up.

Start-up of drives

PCU 20:
The drives must be configured and parameterized with the SinuCom NC start-up tool.
PCU 50:
The drive must be configured and parameterized in the **Start-up** operating area.

Note

The “SF” LEDs on the CCU3 and the red LED on the 611D closed-loop control module do not go out until the drives have been started up successfully.

■

Notes

Parameterizing the Control

6

6.1 Machine and setting data

6

Parameterizing

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

Machine data

The machine data (MD) are classified as follows:

- General machine data
- Channel-specific machine data
- Axis-specific machine data
- Machine data for operator panel
- Machine data for feed drive
- Machine data for main spindle drive.

Setting data

The setting data (SD) are classified as follows:

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

Option data

The option data are included in the scope of supply of the option concerned.

Overview of machine and setting data

The machine and setting data are classified in the following areas:

Table 6-1 Overview of machine and setting data

Area	Designation
from 1000 to 1799	Machine data for drives
from 9000 to 9999	Machine data for operator panel
from 10000 to 18999	General machine data
from 19000 to 19999	Reserved
from 20000 to 28999	Channel-specific machine data

Table 6-1 Overview of machine and setting data

Area	Designation
from 29000 to 29999	Reserved
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

References: /LIS/, Lists

Entering machine data

Appropriate input boxes are displayed for entering machine data. How to select displays:
When you select the “Area Switchover” key on the HMI, the menu bar with the areas Machine, Parameters, Program, Services, Diagnosis and Start-up is displayed. Select “Start-up” and then “Machine data”.

Note

The password of protection level 2 “EVENING” must be set before MD can be entered.

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. The following must also be noted:

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

Active

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

- POWER ON (po) NCK RESET
- NEW_CONF (cf) – "Set MD active" softkey on HMI
  – "RESET" key on MCP
  Changes at block ends in program mode possible
- RESET (re) – M2/M30 at program end or
  – "RESET" key on MCP
- IMMEDIATE (so) After entry of value

Protection levels

Protection level 4 or higher (keyswitch position 3) must be activated to display machine data.
The appropriate protection level must generally be enabled by means of password "EVENING" to start up the system.

Unit

The unit refers to the default setting of the machine data:
MD 10220: SCALING_FACTOR_USER_DEF_MASK, (activation of scaling factor)
MD10230: SCALING_FACTOR_USER_DEF (scaling factors of physical quantities)
MD10240: SCALING_SYSTEM IS METRIC = 1 (basic system metric)

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

Default value

This is the preset value for the MD or SD.

Note

When entered via the HMI, the value is limited to 10 places plus decimal point and sign.

Value range (minimum and maximum)

Specifies the input limits. If no value range is specified, the data type determines the input limits and the field is marked with "***".

6.3 Protection level concept

Protection levels

In SINUMERIK 810D 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. Protection levels 0 to 3 must be disabled by means of a password. Levels 4 to 7 are disabled by means of keyswitch positions. The operator only has access to information protected by one particular level and the levels below it. The machine data is assigned different protection levels as a standard measure.

Protection level 4 (keyswitch 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.

Note

For information about changing protection levels, please refer to
References: /BAD/ Operator's Guide HMI Advanced
/FB1/ A2, Various Interface Signals.

Table 6-2 Protection level strategy

Protection level	Locked by	Area
0	Password	Siemens
1	Password: SUNRISE (default)	Machine manufacturer
2	Password: EVENING (default)	Installation engineer
3	Password: CUSTOMER (default)	End user, service engineer
4	Keyswitch position 3	Programmer, machine setter
5	Keyswitch position 2	Qualified operator
6	Keyswitch position 1	Trained operator
7	Keyswitch position 0	Semi-skilled operator

Protection levels 0–3

Protection levels 0 to 3 require the input of a password. The password for level 0 provides access to all data areas. The passwords can be changed after activation (not recommended). 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.

The password remains valid until it is reset with the softkey DELETE PASSWORD. A POWER ON does not reset the password.

Protection levels 4–7

Protection levels 4 to 7 require a particular keyswitch setting 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. The associated interface signals are located in DB10DBB56.

Table 6-3 Meaning of keyswitch positions

Key color	Switch position	Protection level
Key not inserted	0 = Remove key position	7
Black	0 and 1	6–7
Green	0 to 2	5–7
Red	0 to 3	4–7

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.

Example:

```
%_N_UGUD_DEF
File for global variables
;$PATH=/_N_DEF_DIR
REDEF $MA_CTRLOUT_SEGMENT_NR APR 2 APW 2
                    (APR ... read authorization)
REDEF $MA_ENC_SEGMENT_NR APR 2 APW 2
                    (APW ... write authorization)
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.

References: /PGA/, Programming Guide, Advanced
/FB1/, A2, “Various Interface Signals”

6.4 Machine data masking filter

6.4.1 Function

The masking filter enables a selective reduction of the quantity of machine data displayed on the screen, thus data display can be tailored to the user's individual needs and requirements.

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.
References: /LIS/ 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 masking filter

Selecting the list screenform

Filters are selected and activated via a list screenform which is accessed using the vertical softkey **Display options**. These screenforms are displayed in the respective machine data storage areas.

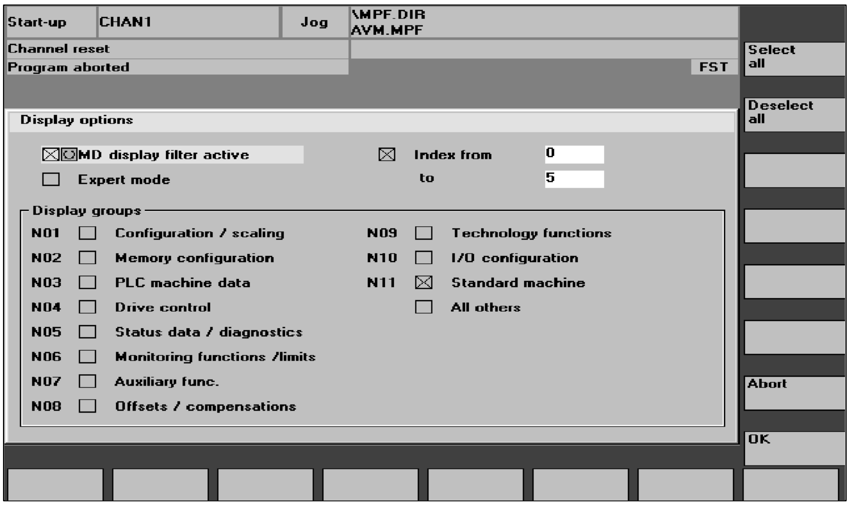

Figure 6-1 Screen: display options for setting masking filters

Display criteria

If the user's level of access authorization (password) is insufficient, the machine data is not displayed. If access authorization criteria are fulfilled, then a verification is performed to see if the masking filters are active.

Note

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

Table 6-4 Display criteria

Filter type	Meaning
Masking filter active	• Inactive: all machine data are displayed • Active: checking for group filters
Expert mode	• Inactive: the MD is assigned to expert mode => MD is not displayed • Active: the MD is assigned to expert mode => MD is displayed (see index)
Group filters	• Inactive: the MD is assigned to the group => MD is not displayed • Active: the MD is assigned to the group => MD is displayed (see index)
All others	• Inactive: with MD which is not assigned to any group => MD is not displayed • Active: with MD which is not assigned to any group => MD is displayed (see index)
Index from to	• Inactive: all subparameters of the MD are displayed • Active: only the specified subparameters of the MD are displayed

Activating the group filters via checkboxes

Use the cursor keys to select the checkboxes and check them using the toggle key.

- If a filter is disabled (not checked), then the corresponding machine data are 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, please note:
If only the "first" index (0) is to be displayed, then all subsequent settings, for example, for the override switch (MD 12000.1: OVR FACTOR_AX_SPEED), are not visible either.

Vertical softkeys

- **Select all softkeys**
  All checkboxes in the group are activated.
  The softkey does not influence the following checkboxes:
  – Filter active
  – Expert mode
  – Index from to
  – All others
- **Deselect all softkeys**
  All checkboxes in the group are deactivated.
  The softkey does not influence the following checkboxes:
  – Filter active
  – Expert mode
  – Index from to
  – All others
- **Abort softkey**
  – Return to machine data screen
  – The former filter settings remain valid
  – Any changes are discarded
- **OK softkey**
  – Changed filter settings are saved
  – The machine data screen is created again
  – The input field is positioned on the current MD again.
  If the MD was masked, the first MD is used instead.

Expert mode

The “Expert mode” setting facilitates the first start-up by providing a clearer overview.
Recommended procedure:

- Activate all filters (check)
- Enable masking filter (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).

Masking all machine data

If the filter option is set to mask all machine data in a specific area, then the following message is output upon selection of this area:
“Unable to display machine data with the current access rights and the current filter setting”.
After confirming with the OK softkey, an empty machine data display window is overlaid.

6.4.3 Saving the filter settings

Saving

The filter settings are saved in specific areas in the C:\MMC2\IB.INI file. You have to make a backup copy of this file before upgrading the software on the HMI and copy it back after upgrading, in order retain the settings.

For information of data backup, refer to Chapter 12, Data Backup.

6.5 System data

6.5.1 Basic settings

Control cycle times

The control operates according to the cycle times defined in the machine data. The system basic cycle is specified in seconds; the other cycle times are obtained as multiples of the system basic cycle.

The time cycles are set as standard to an optimum and should only be changed if the requirements of the NC cannot be fulfilled with the preset values.

Table 6-5 Control time cycles

Machine data	Name	Example
MD 10050: SYSCLOCK_CYCLE_TIME	System clock cycle	MD 10050 = 0.0025 s --> 2.5 ms
MD 10060: POSCTRL_SYSCLOCK_TIME_RATIO (protected with protection level 0)	Factor for position control cycle	MD 10060 = 1 (1 * 2.5 ms = 2.5 ms) *
MD 10070: IPO_SYSCLOCK_TIME_RATIO	Factor for interpolator clock cycle	MD 10070 = 4 (4 * 2.5 ms =10 ms)
MD 10072: COM_IPO_TIME_RATIO	Communication cycle factor	MD 10072 = 0.5 (10 ms * 0.5 = 5 ms)

* The factor for the position control cycle is set permanently to 1; thus the position control cycle corresponds to the system clock cycle from MD 10050 SYSCLOCK_CYCLE_TIME.

Warning

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

Switchover from metric to inch system

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

The setting MD 10260: CONVERT_SCALING_SYSTEM=1 considerably simplifies switchover of the scaling system as SW 3.

- Availability of an HMI softkey in the “MACHINE” area for switching over the dimension system.
- Automatic conversion of active NC data on switchover of the scaling system.
- 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.

Channel-specific switchover of the basic program setting (G70, G71, G700, G710) in MD 20150: GCODE_RESET_VALUES [12] For softkey switchover via HMI, the value toggles between G700 (inch) and G710 (metric).

G700/G710 also interprets the feed rates (inch/min or mm/min) as well as the linear data in the scaling system as of SW 3.

Internal physical variables

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

Physical variable	Metric	Inch
Linear position	1 mm	1 inch
Angular position	1 degree	1 degree
Linear velocity	1 mm/min	1 inch/min
Angular velocity	1 rev/min	1 rev/min
Linear acceleration	1 mm/s^2	1 inch/s^2
Angular acceleration	1 rev/s^2	1 rev/s^2
Linear jerk	1 mm/s^3	1 inch/s^3
Angular jerk	1 rev/s^3	1 rev/s^3
Timing	1 s	1 s
K_V factor	1/s	1/s
Rotational feedrate	1 mm/rev	1 inch/rev
Linear position (compensation value)	1 mm	1 inch
Angular position (compensation value)	1 degree	1 degree

Physical variables for input/output

The physical variables for input/output of the machine and setting data (RS-232, HMI) can be defined via MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors) and
MD 10230: SCALING_FACTORS_USER_DEF (physical variables scaling factors).

If the appropriate activation bit is not set in MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors), then scaling is implemented internally with the conversion factors listed below (default setting, exception K_V factor).
If all bits are set in MD 10220 and if the default settings are to remain valid, then the following scaling factors must be entered in MD 10230: SCALING_FACTORS_USER_DEF.

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	K_V factor	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

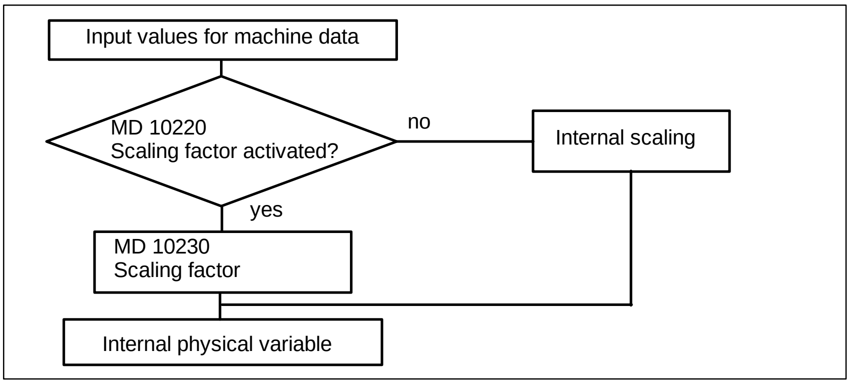

Figure 6-2 Changing physical variables

Example

In our example the user wishes to enter the linear velocity in m/min. The internal physical variable is mm/s.

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

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

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

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

Internal precision

The internal calculation resolutions are specified 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

In MD 9004: DISPLAY_RESOLUTION you can set the number of decimal places after the decimal point for the position values on the operator panel.

Limit values for input and display

The input value limitation depends on which values can be displayed and input on the operator panel.
This limit is reached at 10 digit positions plus decimal point plus sign.

6.6 Memory configuration

Memory areas

The memory areas for user data in the NC are preset to suit most user requirements during an NCK general reset. The following areas can be adjusted to achieve optimum utilization of the available user memory:

- Tool management
- Tool offsets
- User variables
- R parameters
- Compensations (e.g. LEC)
- Protection areas
- Frames.

The memory must be structured before commencement of the actual start-up process because all buffered user data (e.g. part programs, drive data) are cleared when the memory is re-allocated!
Machine data, setting data and options are not erased.

Static RAM

Set the following machine data:

Table 6-6 MDs for allocating SRAM

MDs for SRAM	Meaning
MD18080 MM_TOOL_MANAGEMENT_MASK	Memory allocation for tool management. Set the tool management parameters according to machine requirements. If you are not using the TM function, set MD 18084 and 18086 to “0” to free more memory for part programs.
MD18082 MM_NUM_TOOL	Number of tools according to machine
MD18084 MM_NUM_MAGAZINE	Tool management only if tool management MD and tool management option is enabled: Number of magazines which the NCK can manage
MD18086 MM_NUM_MAGAZINE_LOCATION	Tool management only if tool management MD and tool management option is enabled: Number of magazine locations which the NCK can manage
MD18088 MM_NUM_TOOL_CARRIER	Maximum number of toolholders
MD18090 MM_NUM_CC_MAGAZINE_PARAM	Number of OEM magazine data
MD18092 MM_NUM_CC_MAGLOC_PARAM	Number of OEM magazine location data
MD18094 MM_NUM_CC_TDA_PARAM	Number of OEM tool data
MD19096 MM_NUM_CC_TOA_PARAM	Number of OEM data per cutting edge
MD18098 MM_NUM_CC_MON_PARAM	Number of OEM monitoring data

Table 6-6 MDs for allocating SRAM

MDs for SRAM	Meaning
MD18100 MM_NUM_CUTTING_EDGES_IN_TOA	Number of tool cutting edges per TOA module according to requirements of end customer
MD18102 MM_TYPE_OF_CUTTING_EDGE	Type of D number programming
MD18104 MM_NUM_TOOL_ADAPTER	Tool adapter in TO area
MD18108 MM_NUM_SUMCORR	Sum offset in TO area
MD18114 MM_ENABLE_ORIENT	Assign orientation to tool cutting edges
MD18116 MM_NUM_TOOL_ENV	Total number of tool environments
MD18118 MM_NUM_GUD_MODULES	Number of GUD data blocks
MD18120 MM_NUM_GUD_NAMES_NCK	Number of global user variables
MD18130 MM_NUM_GUD_NAMES_CHAN	Number of channel-specific global user variables
MD18140 MM_NUM_GUD_NAMES_AXIS	Number of axis GUD definitions
MD18150 MM_GUD_VALUES_MEM	Memory location for GUD values
MD18190 MM_NUM_PROTECT_AREA	Number of data for machine-related protection areas
MD18200 MM_NUM_CCS_MAGAZINE_PARAM	Number of Siemens OEM magazine data
MD18202 MM_NUM_CCS_MAGLOC_PARAM	Number of Siemens OEM magazine location data
MD18204 MM_NUM_CCS_TDA_PARAM	Number of Siemens OEM tool data
MD18206 MM_NUM_CCS_TOA_PARAM	Number of Siemens OEM data per cutting edge
MD18208 MM_NUM_CCS_MON_PARAM	Number of Siemens OEM monitoring data
MD18230 MM_USER_MEM_BUFFERED	User memory in SRAM
MD18310 MM_NUM_DIR_IN_FILESYSTEM	Directories in passive file system
MD18320 MM_NUM_FILES_IN_FILESYSTEM	Files in passive file system
MD18342 MM_CEC_MAX_POINTS	Interpolation points for sag compensation
MD18350 MM_USER_FILE_MEM_MINIMUM	Minimum NC program memory
MD18400 MM_NUM_CURVE_TABS	Number of curve tables
MD18402 MM_NUM_CURVE_SEGMENTS	Number of curve segments
MD18404 MM_NUM_CURVE_POLYNOMS	Number of curve table polynomials
MD18600 MM_FRAME_FINE_TRANS	Fine offset for FRAME
MD18601 MM_NUM_GLOBAL_USER_FRAMES	Number of global pre-defined user frames
MD18602 MM_NUM_GLOBAL_BASE_FRAMES	Number of global basic frames
MD18782 MM_LINK_NUM_OF_MODULES	Number of NCU link modules
MD18800 MM_EXTERN_LANGUAGE	Activation of external NC language
MD28050 MM_NUM_R_PARAM	Number of R parameters required
MD28080 MM_NUM_USER_FRAMES	Number of frames required
MD28081 MM_NUM_BASE_FRAMES	Number of channel-specific basic frames per channel
MD28082 MM_SYSTEM_FRAME_MASK	Bitmask for configuring channel-specific system frames which are included in the channel calculation
MD28085 MM_LINK_TOA_UNIT	Allocation of a TO unit to a channel

Table 6-6 MDs for allocating SRAM

MDs for SRAM	Meaning
MD28200 MM_NUM_PROTECT_AREA_CHAN	Number of files for channel-specific protection areas
MD28254 MM_NUM_AC_PARAM	Number of $AC_PARAM parameters for motion-synchronous actions
MD28255	
MD28256 MM_NUM_AC_MARKER	Number of $AC_MARKER markers for motion-synchronous actions
MD28257	
MD38000 MM_ENC_COMP_MAX_POINTS	Number of compensation points required
MD38010 MM_QEC_MAX_POINTS	Values for quadrant error compensation

SRAM check

MD18060: INFO_FREE_MEM_STATIC shows how much user memory is available.

Note

For normal applications, leave all other memory settings unchanged.

Caution

It is not permissible to transfer axis-specific or channel-specific configuration data (archive data) from the SINUMERIK 840D.

Erasing SRAM through MD change

The following machine data cause a reconfiguration of the control SRAM when their contents are changed. When a change is made, the alarm “4400 MD alteration will cause reorganization of buffer (data loss!)” is displayed. When this alarm is output, all data must be saved because all buffered user data will be erased during the next booting.

Reading in global user data and macros

The following machine data must be set in order to read the definition data of global user data and macros:

MD 18118: MM_NUM_GUD_MODULES (number of GUD files in SRAM)
MD 18120: MM_NUM_GUD_NAMES_NCK (number of global user variables in SRAM)
MD 18130: MM_NUM_GUD_NAMES_CHAN (number of channel-specific user variables in SRAM)
MD 18140: MM_NUM_GUD_NAMES_AXIS (number of axis-specific user variables in SRAM)
MD 18150: MM_GUD_VALUES_MEM (memory available for user variables in Kbytes in SRAM)
MD 18160: MM_NUM_USER_MACROS (number of macros in SRAM)

As soon as the memory settings have been activated (Power On) the definition files can be transferred.

- %_N_SGUD_DEF (Siemens)
- %_N_MGUD_DEF (machine manufacturer)
- %_N_UGUD_DEF (user)
- %_N_SMAC_DEF (Siemens)
- %_N_MMAC_DEF (machine manufacturer)
- %_N_UMAC_DEF (user)

Activating the GUD and MAC data

In order to activate the definition files in the NC you must read in the file %_N_INITIAL_INI. Only then is the data type of the variables known to the NC and the global user data %_N_COMPLETE_GUD_INI can then be read in.

6.7 Scaling machine data

Loading of standard machine data

The machine data also contain data that standardize the machine data relative to their physical units (e.g. velocities).

Relative to the scaling system, these are the following machine data

- MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors)
- MD 10230: SCALING_FACTORS_USER_DEF (scaling factors of physical quantities)
- MD 10240: SCALING_SYSTEM_IS_METRIC (basic system metric)
- MD 10250: SCALING_VALUE_INCH (conversion factor for switchover to INCH system)
- MD 30300: IS_ROT_AX (rotary axis)

6

When machine data are loaded (via HMI, RS-232 interface, program), they are scaled according to the physical unit which is currently valid. If this data set contains a new scale (e.g. rotary axis declaration), those machine data which are dependent upon scaling data are converted to the new scale after the next “Power ON”. The MD do not then contain the expected values (e.g. rotary axis traverses at very low F values).

Example:

The control has been started up with default values. The 4th axis is defined as a rotary axis in the MD file to be loaded and contains the following machine data:
$MA_IS_ROT_AX[A1] = 1 (rotary axis)
$MA_MAX_AX_VELO [A1] = 1000 [rev/min] (maximum axis velocity)

When the MD set is loaded, the velocity is interpreted with respect to a linear axis (default setting $MA_IS_ROT_AX[A1]=0) and normalized according 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 MD file is loaded again, the axis is already defined as a rotary axis and the velocity is interpreted as the rotary axis velocity. The MD then contains the value “1000” that is interpreted in rev/min by the control system.

Suggestions for step-by-step loading of machine data

1. Change the appropriate machine data manually via HMI (MD 10220, 10230, 10240, 10250, 30300) and reboot the NCK. Import the MD set via the RS-232 interface and then initiate another NCK ramp-up.
2. Generate an MD set with the scaling machine data (MD 10220, 10230, 10240, 10250, 30300). Load this MD set and initiate an NCK ramp-up. Read in the complete MD set and then initiate another NCK ramp-up.
3. As an alternative to the options listed above, an MD block can also be loaded twice (via RS-232), with an NCK start-up in each case.

Note

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

Loading of standard data

Standard machine data can be loaded in several ways.

- **Set switch S3 on the CCU module to position 1 and initiate an NCK reset**.

Note

During this operation, the entire SRAM on the CCU module is re-initialized. All user data are erased.

- **MD 11200: INIT_MD** (load standard MD at “next” ramp-up)

By entering certain values in MD: INIT_MD, it is possible to load various data areas with default values when the NCK next powers up. The machine data is displayed in HEX format. After MD: INIT_MD has been set, “Power ON” must be executed twice:

- The MD is activated when the power is switched on the first time.
- The function is executed and the MD reset to “0” when the power is switched on the second time.

Meaning of input values in MD11200

Value “0”
The stored machine data is loaded during the next run-up.
Value “1”
During the next run-up, all machine data (with the exception of the memory-configuring data) will be overwritten with default values.
Value “2”
During the next run-up, all memory-configuring MD will be overwritten with default values.
Value “4”
Reserved.

■

7 PLC Description

7.1 PLC start-up

PLC module

The PLC in the 810D is compatible with SIMATIC STEP7 AS315-2DP.
The basic model has a memory configuration of 96 KB that can be extended by 64 KB to a total of 288 KB (option).

Basic program user program

The PLC program is split up into a basic program and a user program. The entry points for the user program are marked in OBs 1, 40 and 100 of the basic program.

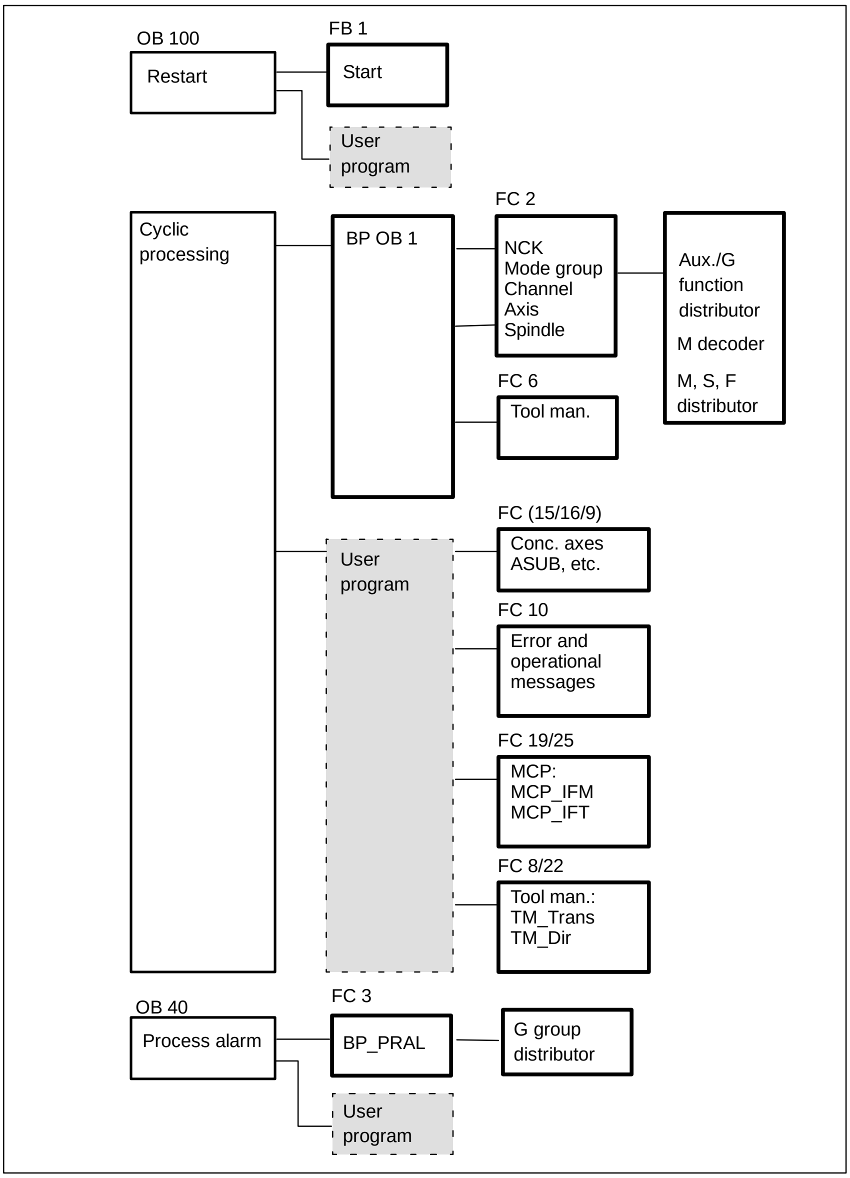

Figure 7-1 Structure of the PLC program

Tool box

The basic PLC program is an integral component of the SINUMERIK 810D tool box.

PLC memory

Set the “PLC memory” option if appropriate.

Loading the PLC program

There are two ways to load 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. Load an archived PLC program with PCIN or from the PCU.

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**.

PLC status

The PLC status can be displayed from the “Diagnosis” menu for control and monitoring of the PLC inputs, outputs, bit memories, etc.

PLC starting characteristics

The PLC always powers up in RESTART mode, i.e. the PLC operating system runs through OB100 after initialization and then commences cyclic operation at the beginning of OB1. **No re-entry** takes place at the interruption point (e.g. after power failure).

RESTART mode

Flags, timers and counters have 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 image of outputs (PIQ)
- 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 image of inputs (PII)
- Cancel command output disable (BASP)

Cyclic operation

In chronological terms, the basic program is executed before the PLC user program. In cyclic operation, the NC/PLC interface is fully processed. The current G functions are transferred to the PLC (provided function is activated) on the process alarm level.

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.

References: /FB1/, P3, “Basic PLC program”
/S7H/, SIMATIC STEP7-300

Parameters of FB1 The following variables must be passed to FB 1 (power-up block of basic PLC program).

Table 7-1 Parameters of power-up block (FB 1)

Signal	Cat.	Type	Value	Remarks
MCPNum	E	Int	0 to 2	Number of active MCPs 0: No MCP installed
MCP1In MCP2In	E	Pointer	I0.0 to I120.0 or F0.0 to F248.0 or DBn.DBX0.0 to DBXm.0	Start address for input signals of relevant machine control panel 1)
MCP1Out MCP2Out	E	Pointer	Q0.0 to Q120.0 or F0.0 to F248.0 or DBn.DBX0.0 to DBXm.0	Start address for output signals of relevant machine control panel 1)
MCP1StatRec MCP2StatRec	E	Pointer	Q0.0 to Q124.0, F0.0 to F252.0 or DBn.DBX0.0 to DBXm.0	Start address for status double word for receiving data from machine control panel; DW#16#00040000:Timeout, otherwise 0 1)
MCP1Timeout MCP2Timeout	E	S5time	Recommendation: 700 ms	Cyclical sign-of-life monitoring for machine control panel
HHU	E	Int		Hand-held unit interface 0 – No HHU 1 – HHU at MPI
HHUIn	E	Pointer	I0.0 to I124.0, F0.0 to F252.0 or DBn.DBX0.0 to DBXm.0	Start address PLC received data from handheld unit 2)
HHUOut	E	Pointer	Q0.0 to Q124.0, F0.0 to F252.0 or DBn.DBX0.0 to DBXm.0	Start address PLC transmitted data to handheld unit 2)
HHUStatRec	E	Pointer	Q0.0 to Q124.0, F0.0 to F252.0 or DBn.DBX0.0 to DBXm.0	Start address for status double word for receiving data from handheld unit: DW#16#00040000: Time-out, otherwise 0 2)
HHUTimeout	E	S5time	Recommendation: 700 ms	Cyclical sign-of-life monitoring for handheld unit
NCCyclTimeout	E	S5time	Recommendation: 200 ms	Cyclical sign-of-life monitoring NCK
NCRunupTimeout	E	S5time	Recommendation: 50 s	Power-up monitoring NCK
ListMDecGrp	E	INT	0	
NCKomm	E	Bool		PLC to NC communications services (FB 2/3/4/5:Put/Get/PI/GETGUD) 1: Active
MMCToIF	E	Bool		Transmission of HMI signals to the interface (operating modes, program control, etc.) true: Active
HWheelMMC	E	Bool		True: Handwheel selection via HMI False: Handwheel selection by user prog.

Table 7-1 Parameters of power-up block (FB 1)

Signal	Ca t.	Type	Value	Remarks
MsgUser	E	Int	0...25	Number of user areas for messages (DB2)

1)
To ensure BP monitoring of the MCP(s), the addresses must be specified as set in SDB 210 with the 810D. The start address is set via SDB 210 with the 810D. IB0 is specified as the start address for input signals and QB0 as the start address for output signals on the supplied SDB 210. If other start addresses are desired, then they must be entered via the “Communication Configuration” STEP 7 package.
2)
For monitoring the handheld unit from the basic program, the addresses on the 810D must be specified identically to the settings in SDB 210.

For an exact description of variables and options for changing parameter settings, please refer to

References: /FB1/, P3, “Basic PLC Program”

Note

Timers T0 to T9 are used by the basic program.

7

Migrating from 840D PLC programs

Programs from 840D controls (software version 6) can be used for SINUMERIK 810D once the FB1 power-up block call (i.e. the parameter settings) has been modified.

Note

Keep a note of the available memory resources.

7.2 Overview of organization blocks, function blocks and DBs

References: /FB1/, P3, “Basic PLC Program”

■

Creating Alarm Text Files

8

8.1 Alarm text files for PCU 20

Description

The installation routine stored on the PCU 20 application disk (see Chapter 13) transfers

- configuration settings,
- texts,
- the configured interface and
- the user software

from the update directory on your PC/PG onto the PCU 20 hardware. The ways in which the alarm text files can be adapted beforehand are described here.

8

Requirements

- PC with DOS 6.x
- RS-232 cable between the COM1 interface of the PCU 20 (X6) and the COM1 or COM2 interface of your PC
- Approx. 3 MB free space on hard disk
- The following description is based on the assumption that you have already transferred the software from the supplied PCU 20 application disk (disk 2) to the hard disk of your PC/PG as described in Chapter 13.

Alarm texts/ message texts

The **texts** are stored on the PC with the Siemens standard entries.
You can select the hard disk you want to store them on. To simplify matters, this disk drive is always referred to as 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 alarm 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 to edit the files.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 8.4 for the applicable syntax rules.

More than one language

The PCU 20 can be equipped with two languages online. These are referred to as the **foreground** and **background languages**.
It is possible to exchange the foreground and background languages of the HMI system using the application disk as described in Chapter 13 Software and Hardware Replacement.

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 by definition 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 downloading

After the text contents have been modified, the text files must be converted and downloaded onto the HMI (Chapter 13 Software and Hardware Replacement).

Note

For the user, 128 KB are available for additional text files.

8.2 Alarm text files for PCU 50

Storing the text files

Files containing error texts are stored in directory C:\dh\mb.dir\ 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, relevant for configuration of alarm text files:

```
...
[Textfiles]
MMC=c:\dh\mb.dir\alm_
NCK=c:\dh\mb.dir\aln_
PLC=c:\dh\mb.dir\plc_
ZYK=c:\dh\mb.dir\alc_
CZYK=c:\dh\mb.dir\alz_
UserMMC=
UserNCK=
UserPLC=c:\dh\mb.dir\myplc_
UserZyk=
UserCZyk=
...
```

8

Standard files

The standard texts are stored in ASCII format in the following files on the hard disk of the PCU 50:

MMC	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 are replaced by new ones when upgrading the software of the PCU 50, then the added or modified user-specific alarms will be lost. Users should store their alarm texts in user files.

User files

Users can replace the error texts stored in the standard files by their own texts or add new ones to them. To do so, they must load additional files to directory **c:\dh\mb.dir** via the “Services” operating area. The names of these text files are set in file **c:\mmc2\mbdde.ini** by means of an editor provided in the **Diagnosis/ Start-up/MMC** area.

Examples of configuration of two additional user files (texts for PLC alarms, altered alarm texts NCK) in file mbdde.ini:

```
...
User MMC =
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

You have to use an **ASCII editor** (e.g. the DOS editor **edit**) for editing files.

Language-dependent alarm texts

The name of the text file is used to assign the user alarm texts. 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 creating text files, make sure that the correct date and time are set on the PC. Otherwise, the user texts may not appear on screen.

Example for PCU 50

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 Alarm text files for HT6

The alarm text files for the NC and for the PLC are created and included in the same way as for the PCU 20.

Description

The installation procedure “HPUSETUP” of the HT6 system disk transfers

- configuration settings,
- texts,
- the configured interface and
- the user software

from the update directory on your PC/PG onto the HT6 hardware. The ways in which the alarm text files can be adapted beforehand are described here.

Requirements

- PC with DOS 6.x
- RS-232 cable between the COM1 interface of the HT6 and the COM1 or COM2 interface of your PC
- Approx. 3 MB free space on hard disk
- The following description is based on the assumption that you have already transferred the software from the supplied system disk to the hard disk of your PC/PG as described in READ.ME file supplied.

Procedure

1. Call HPUSETUP
2. After copying the SW files to the hard disk, abort the installation (“NO”).
3. Modify the alarm texts in <installation directory>\proj_hpu\text\al\...
4. When you have made your changes convert the text files (“Mkalarm”) and transfer them to the HT6.
5. Call INSTALL in the directory <installation directory>.

Alarm texts/ message texts

The **texts** are stored on the PC with the Siemens standard entries. You can select the hard disk you want to store them on. To simplify matters, this disk drive is always referred to as C: in the following description. The directory is:

C:\hpu_dvk\proj_hpu\text\al\<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

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Files

The alarm 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.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 8.4 for the applicable syntax rules.

More than one language

The HPU can be assigned two languages in online mode. These are referred to as the **foreground** and **background languages**.
The foreground and background language of the HMI system can be replaced with the aid of the system disk.

During installation, it is possible to select any combination of two of the languages on the system disk as the foreground and background languages.

Master language

The master language is by definition 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

After the text contents have been modified, the text files must be converted and transferred to the HT6.

8.4 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, NC start disable	Reset
61000–61999		Display, NC start disable, axis/spindle standstill	Reset
62000–62999		Display	Cancel
63000–64999	Reserved		
65000–65999	Cycle alarms (user)	Display, NC start disable	Reset
66000–66999		Display, NC start disable, axis/spindle standstill	Reset
67000 – 67999		Display	Cancel
68000–69000	Reserved		
70000–79999	Compile cycle alarms		
400000–499999	PLC alarms general		
500000–599999	PLC alarms for channel		
600000–699999	PLC alarms for axis and spindle		
700000–799999	PLC alarms for user		
800000–899999	PLC alarms for sequence cascades/graphs		

Format of the text file for cycle alarm texts

The number range in the list is not available with every number.
References: /FB1/P3: Lists

The structure of the text file for cycle and compile cycle alarms is as follows:

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			

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Alarm number — List of alarm numbers

Display — This number defines the alarm display type:
0: Display in alarm line
1: Display in a dialog box

Help ID — PCU 50 only (with hard disk):
The default assignment “0” means that the WinHelp file provided by Siemens gives a full description 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 8.4.1, 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.
- The alarm text file may contain comment lines which must start with “//”. The maximum length of the alarm text is 110 characters for a 2-line display. If the text is too long, it is cut off and the symbol “*****” added to indicate missing text.
- Parameter “%1”: Channel number
  Parameter “%2”: Block number.

Format of the text file for PLC alarm texts

The ASCII file for PLC alarm texts has the following structure:

Table 8-3 Structure of text file for PLC alarm texts

Alarm no.	Display	Help ID	Text	Text on 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 consists 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.

References: /FB1/, P3, “Basic PLC Program”

Event number	Signal group	Signal number
5 x (for channels)	00–03 (disable) 11–16 (GEO axes) 21–28 (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 in alarm line
1: Display in a dialog box

Help ID

PCU 50 only (with hard disk): The default assignment “0” means that the WinHelp file provided by Siemens gives a full description 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 8.4.1, 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. 7-digit alarm number instead of “Text”.
- The alarm text file may contain comment lines which must start with “//”. The maximum length of the alarm text is 110 characters for a 2-line display. If the text is too long, it is cut off and the symbol “*” added to indicate missing text.
- Parameter “%K”: Channel number (2nd digit of alarm number)
  Parameter “%A”: The parameter is replaced by the signal group no.
  (e.g. axis no., user area no., sequence cascade no.)
  Parameter “%N”: Signal number
  Parameter “%Z”: Status number.

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8.4.1 Alarm list properties

You can modify the properties of the alarm list in the MBDDE.INI file.

Table 8-4 Sections of the MBDDE.INI file

Section	Meaning
Alarms	General information about the alarm list (e.g. time/date format of messages)
Text files	Path/file specification of text lists for the alarms (e.g. MMC=..\dh\mb.dir\alm_ <message block in directory mb>)
HelpContext	Name and pathname 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

References: /BN/, User Guide: OEM package HMI.

“Alarms”

The settings in this section define the following alarm list properties:

- TimeFormat
  This is for entering the format to be used to display date and time. It corresponds to the CTime::Format of Microsoft Foundation Classes.
- MaxNr
  Defines the maximum size for the alarm list.
- ORDER
  Defines the order in which alarms are to be listed in the alarm list:
  FIRST causes new alarms to appear at the top of the list
  LAST causes new alarms to appear at the bottom of the list.

Example:
[Alarms]
TimeFormat=%d.%m.%y %H:%M:%S
MaxNr=50
ORDER=LAST

■

Adapting the Machine Data

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9.1 Axis configuration

The SINUMERIK 810D is supplied as standard with the following configuration:
1 channel and 5 axes with simulated setpoint or actual value channel.

Number of channels

The number of channels depends on the CCU used.

- CCU3: max. 2 channels

Machine axes

Are all the axes present at the machine. They are defined as geometry axes or additional axes.

Geometry axes

The workpiece geometry is programmed with the geometry axes. The geometry axes form a rectangular coordinate system (2D or 3D). Tool offsets are only included in calculations for geometry axes.

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Special axes

Unlike geometry axes, there is no geometrical connection for special axes, e.g. for:
– rotary axes
– revolver axes
– position-controlled spindle.

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 [0..4] (machine axis name)
An axis name is defined for each machine axis.

Example:

Turning machine
with X, Z, C axis/spindle

MD 10000	X1	Z1	C1		
Index [0..4]	0	1	2	3	4

Milling machine
4 axes + spindle/C axis

MD 10000	X1	Y1	Z1	A1	C1
Index [0..4]	0	1	2	3	4

Example for milling machine: MD 10000
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

With channel-specific **MD 20070: AXCONF_MACHAX_USED[0...4]** (machine axis number valid in channel) serves to assign the machine axes to a geometry channel.

	Turning machine					Milling machine				
MD 20070	1	2	3	0	0	1	2	3	4	5
Index [.]	0	1	2	3	4	0	1	2	3	4

This **MD 20080: AXCONF_CHANAX_NAME_TAB[0...4**] (channel axis name in channel) specifies the names of the axes in the channel. Enter the names of the geometry and additional axes here.

MD 20080	X	Z	C			X	Y	Z	A	C
Index [.]	0	1	2	3	4	0	1	2	3	4

3. Program level

MD 20060: AXCONF_GEOAX_NAME_TAB[0...4] (geometry axis name in channel) specifies the names to be used in the part programs for the geometry axes (workpiece axes not specific to machine).

MD 20060	X	Y	Z			X	Y	Z		
Index [.]	0	1	2	3	4	0	1	2	3	4

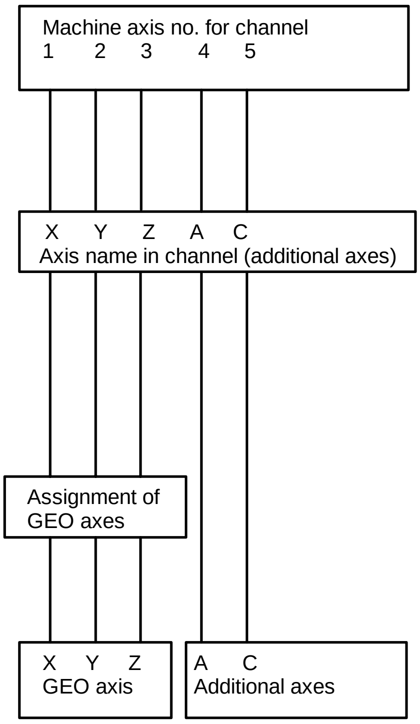
* The 2nd geometry axis coordinate
  must also be assigned a name (e.g. "Y")
  for a transformation, e.g. TRANSMIT.

MD 20050: AXCONF_GEOAX_ASSIGN_TAB[0...4] (assignment geometry axis to channel axis) specifies the assignment of the geometry axes to the channel axes (MD20070) **without transformation**. (For assignment with an active transformation, please refer to: References: /FB/, K2.)

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

MD 20050	1	0	2			1	2	3		
Index [.]	0	1	2	3	4	0	1	2	3	4

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).



MD 20070: AXCONF_MACHAX_USED [0..4]
Machine axes used in channel
MD 20070: AXCONF_MACHAX_USED[0]=1
MD 20070: AXCONF_MACHAX_USED[1]=2
MD 20070: AXCONF_MACHAX_USED[2]=3
MD 20070: AXCONF_MACHAX_USED[3]=4
MD 20070: AXCONF_MACHAX_USED[4]=5

MD 20080: AXCONF_CHANAX_NAME_TAB [0..4]
Name of additional axes in channel (for use in part program)
MD 20080: AXCONF_CHANAX_NAME_TAB [0]=X
MD 20080: AXCONF_CHANAX_NAME_TAB [1]=Y
MD 20080: AXCONF_CHANAX_NAME_TAB [2]=Z
MD 20080: AXCONF_CHANAX_NAME_TAB [3]=A
MD 20080: AXCONF_CHANAX_NAME_TAB [4]=C

MD 20050: AXCONF_GEOAX_ASSIGN_TAB [0..4]
Assignment of GEO axis to axes in channel
MD 20050: AXCONF_GEOAX_ASSIGN_TAB [0]=1 (1. to X)
MD 20050: AXCONF_GEOAX_ASSIGN_TAB [1]=2 (2. to Y)
MD 20050: AXCONF_GEOAX_ASSIGN_TAB [2]=3 (3. to Z)

MD 20060: AXCONF_GEO_AX_NAME_TAB[0..4]
Name of GEO axes
MD 20060: AXCONF_GEO_AX_NAME_TAB[0]=X
MD 20060: AXCONF_GEO_AX_NAME_TAB[1]=Y
MD 20060: AXCONF_GEO_AX_NAME_TAB[2]=Z
The axes which are not assigned as geometry axes are additional axes with the axis name of the channel, e.g. A and C.

Figure 9-1 Example of milling machine: 4 axes + spindle/C axis

The names defined in MD 10000: AXCONF_MACHAX_NAME_TAB (machine axis name) or the associated index are used for

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

9.2 Drive configuration and parameterization (MSD, FSD)

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

Before the drives can be parameterized, the drive configuration (power sections and motors) connected to the control system must be entered and assigned to the axes declared in MD 20070: AXCONF_MACHAX_USED/MD 10000: AXCONF_MACHAX_NAME_TAB.

Machine data for drive configuration

The drive configuration is input via the drive configuration display on the HMI or the SimuCom NC start-up tool.

A slot number is allocated to each power section.

The SINUMERIK 810D always occupies the first 6 power section slots. The integrated power sections are located in slots 1-3. The codes for these are entered as default settings and are already activated.

If a slot is not used or no power section installed, then it must be coded as passive (default setting for slots 4-6).

A logical address via which the relevant drive is addressed (setpoint/actual value assignment, access to parameters) is assigned to each slot used.

MD 13000 to 13040 are parameterized by means of inputs in the drive configuration display. These MD can also be entered directly. The drive configuration is stored as a table with data for each individual slot number (n):

MD	Meaning	Default setting
MD 13000: DRIVE_IS_ACTIVE [0]	Slot active/passive	None active
MD 13010: DRIVE_LOGIC_NR [0]	Assignment of a logical drive no.	1/2/3/4/5/6
MD 13020: DRIVE_INVERTER_CODE [0]	Power section code (amperage), 3-axis CCU box	0EH/13H/13H/-/-/-
MD 13020: DRIVE_INVERTER_CODE [0]	Power section code (amperage), 2-axis CCU box	14H/14H/-/-/-/-
MD 13030: DRIVE_MODULE_TYPE [0]	MODULE: 810D (“6”) or 611 (“1” for 1-axis module or “2” for 2-axis module)	6/6/6/6/6/6
MD 13040: DRIVE_TYPE [0]	Drive: 1=FSD or 2= MSD	2/1/1/-/-/-

Power sections Internal

3-axis CCU box

Slot	Code	Drive type	Amperage	Power section
1	E	MSD	24 / 32 / 40 A	50 A
	1E	FSD	18 / 36 A	50 A
2	13	FSD	6 / 12 A	15 A
3	13	FSD	6 / 12 A	15 A

2-axis CCU box

Slot	Code	Drive type	Amperage	Power section
1	14	FSD	9 / 18 A	25 A
2	14	FSD	9 / 18 A	25 A

External power sections

Power section	Drive type	Code	Amperage
8 A	MSD/FSD	11	3 / 6 A
15 A	MSD/FSD	12	5 / 10 A
25 A	MSD/FSD	14	9 / 18 A
50 A	MSD/FSD	6	24 / 32 / 32 A
50 A	MSD/FSD	16	18 / 36 A
80 A	MSD/FSD	7	30 / 40 / 51 A
80 A	MSD/FSD	17	28 / 56 A
108 A	MSD/FSD	D	45 / 60 / 76 A
120 A	MSD/FSD	8	45 / 60 / 76 A
160 A	MSD/FSD	19	56 / 112 A
200 A	MSD/FSD	A	85 / 110 / 127 A
200 A	MSD/FSD	1A	70 / 140 A
300 A	MSD/FSD		6 / 12 A
400 A	MSD/FSD		6 / 12 A

Note

PS 300 and PS 400 A may only be mounted to the left of the CCU3 (current carrying capacity of CCU3).

Possible axis expansions

1. With axis expansion plug-in unit (X304–X306): slots 4–6.
2. With external control (X130): slots 7–9.
3. Additional pulse interface (axis 3), connector designation X307.

Measuring systems

Up to 3 measuring systems can be connected on the SINUMERIK 810D.

1. Motor encoder for speed control (permanent, hardware assignment)
2. 1st position measuring system for the NC. MD 30200: NUM_ENCS (number of encoders) = 1
3. 2nd position measuring system for the NC. MD 30200: NUM_ENCS (number of encoders) = 2.

Motor measuring system and position control

The motor measuring system can also be used for position control. Usually, this is the 1st position measuring system. For this, the logical drive no. of the actual value input of the motor encoder must be entered in MD 30220: ENC_MODULE_NR[0].

Assignment of setpoint/actual value channels

A setpoint channel (i.e. a logical drive no.) and at least one actual value channel for the position measuring system (i.e. the log. drive no. of an encoder input X411–416 on the CCU3 or on an external 611 control must be assigned to each axis/spindle). Optionally, a second channel can be defined for a second position measuring system.

The motor measuring system is always used for speed control. There are no MD for defining the motor measuring system connection. The following permanent assignment exists between the motor connection and the motor measuring system connection:

Motor connection/ axis expansion connection (slot)	Motor measuring system connection
A1 (1)	X411
A2 (2)	X412
A3 (3)	X413
X304 (4)	X414
X305 (5)	X415
X306 (6)	X416
X307 (3)	X413

Warning

The assignment of the motor measuring system to the motor connection must never be changed, even for test purposes.

Example 1

Example of parameterization of a SINUMERIK 810D with 4 axes + 1 spindle
Drive configuration:
MSD (integrated) Slot 1
FSD (integrated) Slot 2
FSD (integrated) Slot 3
FSD (external) Slot 4 (9/18A power section module)
FSD (external) Slot 5 (9/18A power section module)

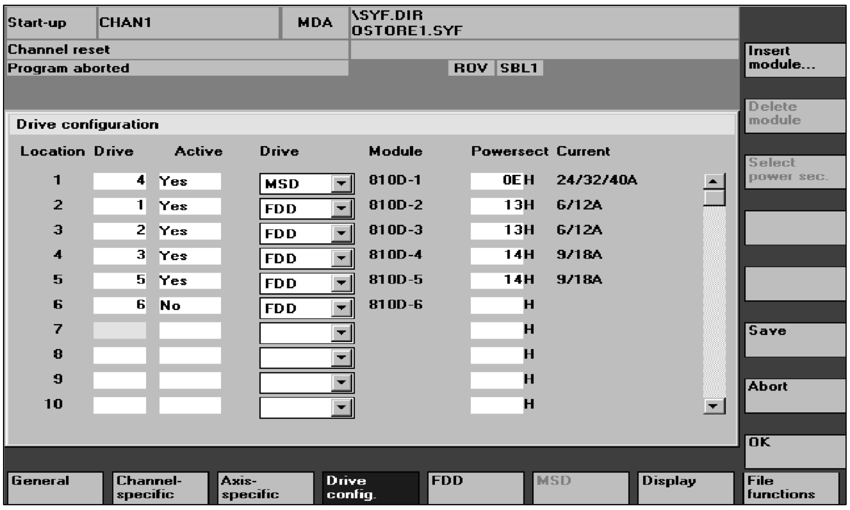


Figure 9-2 Drive configuration display for example 1

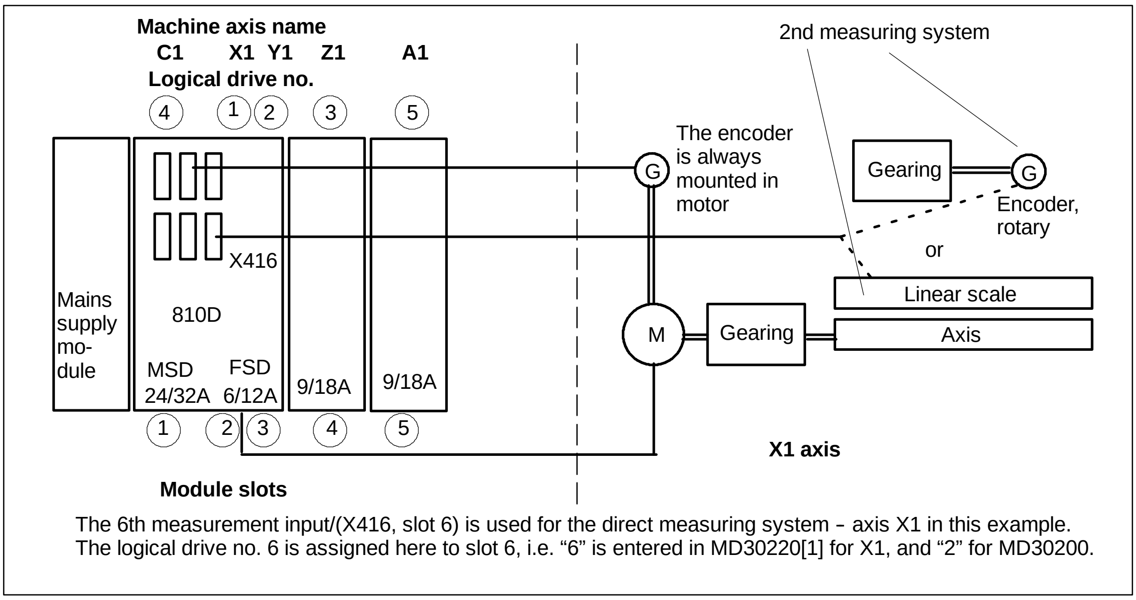


Figure 9-3 Example 1: Drive layout with 2 axis expansion plug-in units and one direct measuring system

Assignment setpoint channel (axis-specific)		
MD	**Meaning**	**Input for example 1**
MD 30110: CTRLOUT_MODULE_NR	Assignment of a logical drive no. to setpoint channel	X1=“1” for CCU-A2 (6/12A) Slot 2 Y1=“2” for CCU-A3 (6/12A) Slot 3 Z1=“3” for CCU-X304 Slot 4 A1=“5” for CCU-X305 Slot 5 C1=“4” for CCU-A1 (24/32A) 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 only one position measuring system (motor encoder or linear scale) is available for the NC “2” if two position measuring systems are available
MD 30240: ENC_TYPE[0]	Encoder type	“1” for signal generator (“4” for absolute value encoder with EnDat interface)
MD 30220: ENC_MODULE_NR[0]	Assignment of a logical drive no. to the actual value channel for position measuring system 1	X1 =“1” for CCU-X416 Slot 2 Y1 =“2” for CCU-X413 Slot 3 Z1 =“3” for CCU-X414 Slot 4 A1 =“5” for CCU-X415 Slot 5 C1 =“4” for CCU-X411 Slot 1 (“7” for measuring channel of the first external control)
MD 30220: ENC_MODULE_NR[1]	Assignment of a logical drive no. to actual value channel for position measuring system 2	X1(1) =“6” for CCU-X416 Slot 6
MD 30230: ENC_INPUT_NR[0] MD 30230: ENC_INPUT_NR[1]	Assignment position measuring system 1 Assignment position measuring system 2	“1” for CCU-X411-416 “1” for CCU-X411-416 “2” for 611 direct measuring system input at external 611D control

Example 2

Example of parameterization of a SINUMERIK 810D with 4 axes + 1 spindle
Drive configuration
MSD (integrated) Slot 1
FSD (integrated) Slot 2
FSD (integrated) Slot 3
FSD (external) Slot 7 (motor connection A1)
FSD (external) Slot 8 (motor connection A2)

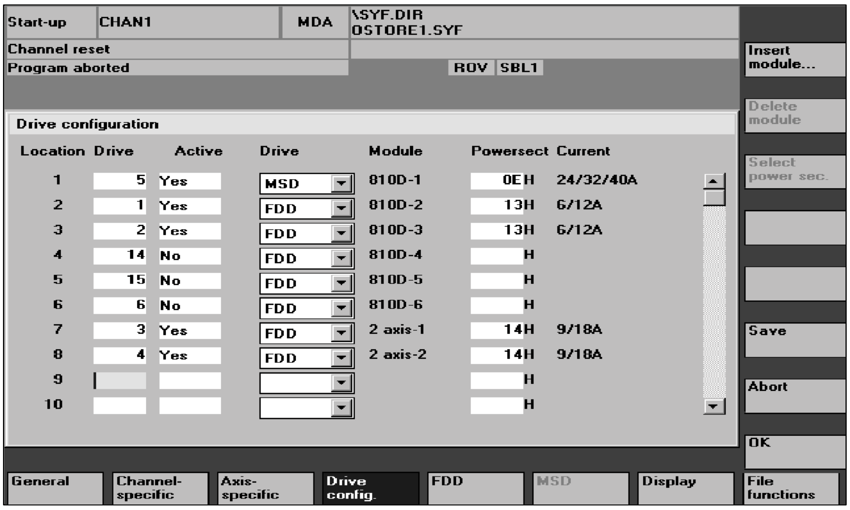


Figure 9-4 Drive configuration display for example 2

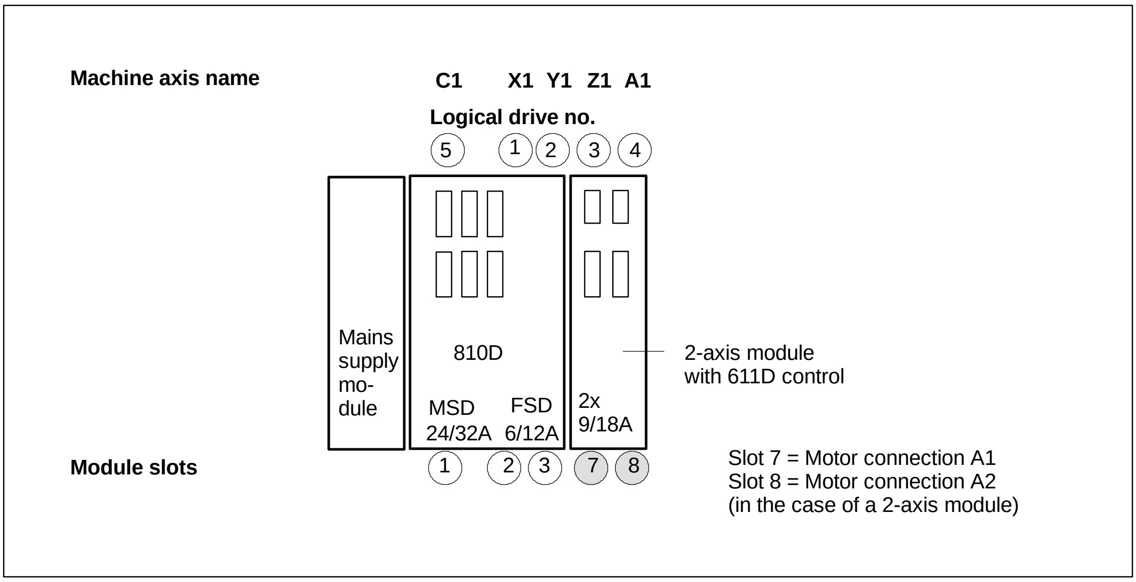


Figure 9-5 Example 2: Parameterizing a CCU3 with an external controller with a 2-axis module and 611 control

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 be temporarily inactive during start-up, MD 30240: ENC_TYPE and MD 30130: CTRLOUT_TYPE must be set to “0” and the assigned power section slot declared as “passive”.
- The default settings of MD 30100: CTRLOUT_SEGMENT_NR=1, MD 30210: ENC_SEGMENT_NR” =1 must not be changed.

Note

If external 611D drive modules are used along with SINUMERIK 810D, the measuring loop inputs of the 810D can then be used as additional direct measuring loops of the 611D drive modules if not needed for the axes/spindles controlled by the 810D. The initialization is carried out implicitly using the MD for such 810D axes, which do not have a direct measuring system; i.e. free measuring loops on the 810D 6-axis module can only be used for external drive modules, if the drive configuration in the 810D 6-axis module still has free capacity for “unused direct measuring system assignments”.

NCK reset

After the drive configuration has been entered and the setpoint/actual values assigned, you must perform an NCK reset to restart the control so that the configuration becomes effective.

The message “Start-up required” requesting parameterization of the drive data is output for all activated drives. If other alarms are pending, the message “Start-up necessary” does not appear. The cause of these alarms must be remedied before start-up can be continued.

Note

When alarms indicating encoder problems occur, check that the DIP-FIX switch settings are correct if you have installed cable distributor 6FX2006-1BA01 in addition to checking the actual-value leads. An incorrectly set DIP-FIX switch can cause the encoder power supply to short circuit. Table 9-1 below shows the correct setting of DIP-FIX switch S1–S6.

Table 9-1 Setting of DIP-FIX switches (S1...S6) in cable distributor

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

9.2.1 Setting drive parameters (FSD, MSD)

Drive settings

A motor type must be specified for all drives via PCU 50 or SIMODRIVE 611 start-up tool in the “Machine data FSD” or “Machine data MSD” menu (see vertical softkey bar). The selection is made by means of the motor MLFB (1FT6□□□-□□□□, 1FT7□□□-□□□□, 1PH□□□-□□□□ refer to rating plate) from a list.

- For FSD, only the selection of motor 1 is visible.
- For MSD, the selection of motor 1 to motor 4 is visible (e.g. for Y/Δ switchover).
  To prevent incorrect parameter setting for MSD, the **OK** softkey is disabled until a valid motor or an external motor has been selected for motor 1.
- When you have selected the motor, press the **OK** softkey to access a menu where you can input the encoder data.
- The most important control data are assigned defaults when the motor type is selected.

When you acknowledge the “Motor selection” display, the “Measuring system data” display appears.

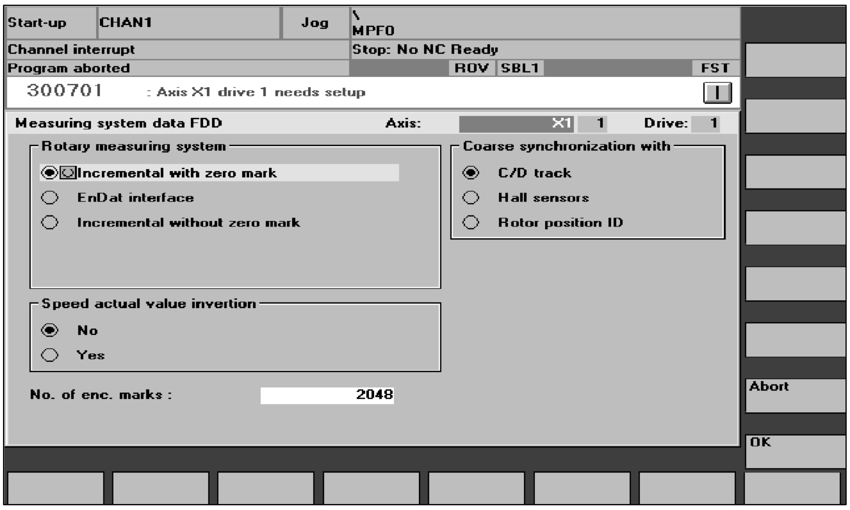


Figure 9-6 Example of measuring system data for motor selection for FSD

The measuring system installed in the motor must be selected in this display: Incremental encoder or absolute encoder with EnDat interface When you select the measuring system, the other values required are preassigned automatically. Press “OK” to confirm these.

Note

The setting “without measuring system” is also possible for MSD.

Example:

- Incremental motor encoder (ERN1387)
  1F□6□□□–□□□□–□A□□
  Incremental with zero mark: Press “OK” to accept the display, since the preset values for the other parameters are correct for standard motors.
- Absolute motor encoder (EQN1325)
  1F□6□□□–□□□□–□E□□
  EnDat interface: Press “OK” to accept the display, since the preset values for the other parameters are correct for standard motors.

Note

On encoder systems without an absolute track (C/D track), an automatic identification procedure can be used to determine the electrical rotor position. Traversing motions <±5 degrees are not exceeded mechanically. The identification procedure is performed on every power-up.

External motor

If an external motor is used, the menu for inputting the external motor data must be opened with the **External motor** softkey. When you have input the data and returned to the motor selection menu, “external motor” is automatically entered in the checkbox for motor 1 or motor 2.

References: /FBA/ DM1, Motor, Power Section Parameters

Saving the boot file

After the motor has been selected, the drive data set for each axis/spindle must be backed up with file “Save boot file”. The data set is stored as file FSDxx.BOT or MSDxx.BOT in the user memory (SRAM).

Once all drive data sets have been entered and stored, the NCK must be reset again. The SF LED then goes out and the drives can be traversed after PLC start-up and after the speed controller has been preset.

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

9.2.2 Incremental measuring system settings

Rotary encoders

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

Table 9-2 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

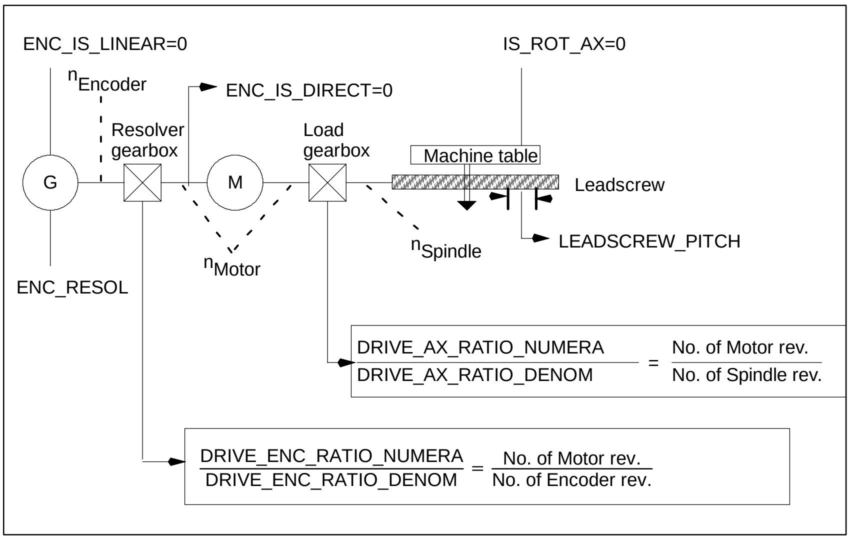


Figure 9-7 Linear axis with motor-mounted rotary encoder

Linear axis with rotary encoder at the machine

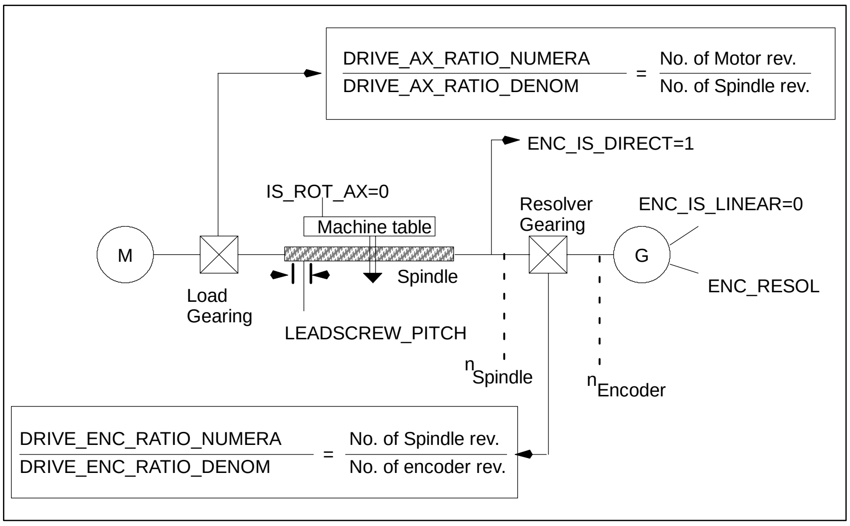


Figure 9-8 Linear axis with machine-mounted rotary encoder

Rotary axis with rotary encoder at the motor

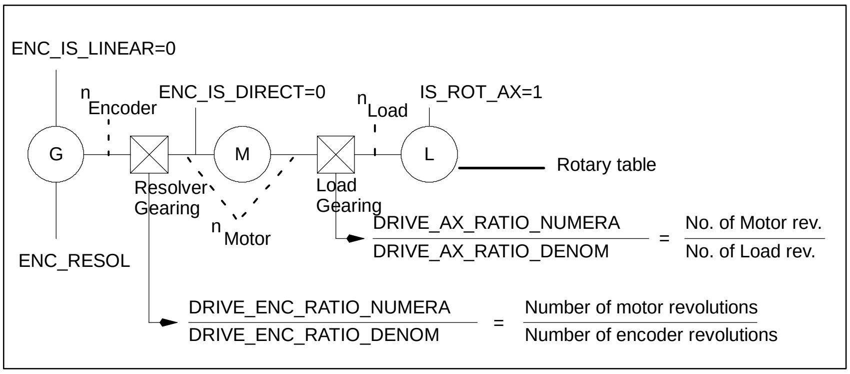


Figure 9-9 Rotary axis with motor-mounted rotary encoder

Rotary axis with rotary encoder at the machine

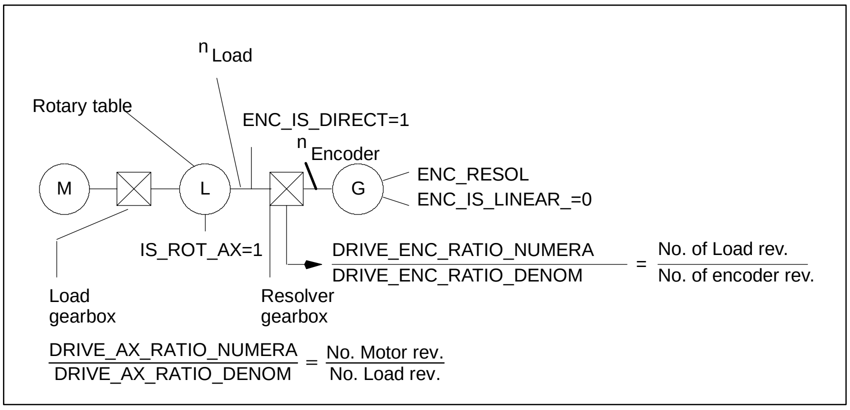


Figure 9-10 Rotary axis with machine-mounted rotary encoder

Encoder matching for linear measuring systems

All the data which have to be entered for linear measuring systems are listed in the tables below.

Table 9-3 Machine data for encoder matching with 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 at motor: 0 Encoder at the machine: 1
MD 31010: ENC_GRID_POINT_DIST	Graduation
MD 32110: ENC_FEEDBACK_POL	Sign 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

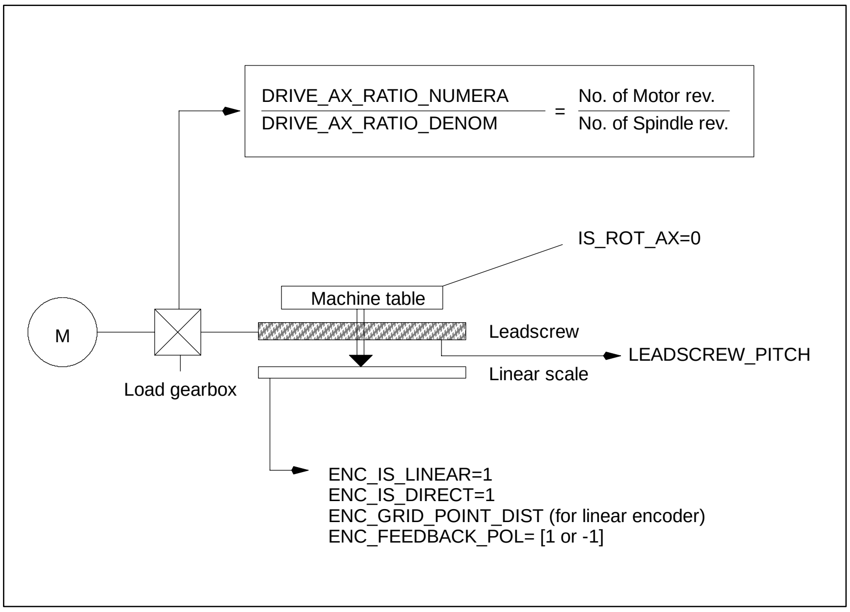


Figure 9-11 Linear axis with linear scale

9.2.3 Absolute measuring system settings (EnDat interface)

Requirement

In order to match the absolute encoder to the machine conditions, it is necessary to follow an encoder matching procedure which is similar to that for a rotary incremental encoder.

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

Table 9-4 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_REFP_MODE [n]: 0...max. No. Encoder -1	0	0	0
34220: ENC_ABS_TURNS_MODULO [n]: 0...max. No. Encoder -1	Multiturn resolution (standard motor 4096)	Multiturn resolution	–

*) Measuring system parameters have already been set automatically when the motor was selected.

Setting up the absolute encoder

To set the encoder, the offset between the machine zero and the zero of the absolute encoder is determined and stored in the SRAM of the NC module. The adjusted state is identified by the control through MD 34210: ENC_REFP_STATE = 2.

References: /FB1/, R1, “Reference Point Approach”

Readjusting

It is necessary to set up the absolute encoder during start-up of the machine when the axes are ready for traversing. 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,
- generally speaking, if the mechanical connection between the encoder and load has been separated and an unacceptable deviation remains when the two are joined together again, or
- when SRAM data of the NC are lost, battery power failure, PRESET
- after a gear stage changeover between load and absolute encoder MD 34210: ENC_REFP_STATE is deleted.

9

Note

In all other cases, the user him/herself is responsible for ensuring that MD 34210: ENC_REFP_STATE (status absolute encoder) switches to “0” or “1” and for readjusting the encoder.

Readjusting the absolute encoder

The following MDs must be observed prior to adaptation:
MD 34200: ENC_REFP_MODE=0 (for absolute value encoders: accept REFP_SET_POS)
MD 34220: ENC_ABS_TURNS_MODULO (only necessary for rotary axes)

Sequence of operations

1. MD 30240: set ENC_TYPE=4
2. MD 34200: set ENC_REFP_MODE=0
3. Execute NCK reset
4. Move axis to reference position, after setting 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. MD 34100: set REFP_SET_POS to the actual value of the reference position.
6. MD 34210: set ENC_REFP_STATE = 1 to activate the adjusted settings.
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. The adjustment process must be initiated with traversing key “+” or “–” according to MD 34010 REFP_CAM_DIR_IS_MINUS and in accordance with the direction of approach towards 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 travel range

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 * effective spindle lead
  In the case of a linear axis with an effective spindle lead of 10 mm, a traversing range of 40.96 m is covered.

NCK RESET

After you have input and stored all the drive data blocks, you must carry out an NCK reset again. 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.

9.2.4 Overview of drive parameters

Optimize the drive by means of the following parameters (see also Chapter 11):

Table 9-5 Current controller setting

No.	Identifier	Name	Drive
1000	CURRCTRL_CYCLE_TIME External performance-2-control: MD 1000=5 External performance-1-control: MD 1000=4	Current controller cycle	FSD/MSD
1101	CTRLOUT_DELAY	Dead time of current control loop	FSD/MSD
1120	CURRSTRL_GAIN	P gain of current controller	FSD/MSD
1121	CURRCTRL_INTEGRATOR_TIME	Integrator time of current controller	FSD/MSD
1124	CURRCTRL_REF_MODEL_DELAY	Reference model current control loop balancing	FSD/MSD
1122	MOTOR_LIMIT_CURRENT	Motor limit current	FSD/MSD
1180	CURRCTRL_ADAPT_CURRENT_1	Lower current adaptation limit	FSD

Table 9-6 Speed controller settings

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

Table 9-7 Field weakening with MSD

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

Table 9-8 Setpoint current filter

No.	Identifier	Name	Drive
1200	NUM_CURRENT_FILTERS[0...7,DRx]	Select setpoint current filter	FSD/MSD
1201	CURRENT_FILTER_CONFIG[0...7,DRx]	Setpoint current filter type	FSD/MSD
1202	CURRENT_FILTER_1_FREQUENCY[0...7,DRx]	Natural freq. setp. current filter 1	FSD/MSD
1203	CURRENT_FILTER_1_DAMPING[0...7,DRx]	Damping setpoint current filter 1	FSD/MSD
1204	CURRENT_FILTER_2_FREQUENCY[0,..7,DRx]	Natural freq. setp. current filter 2	FSD/MSD
1205	CURRENT_FILTER_2_DAMPING[0...7,DRx]	Damping setpoint current filter 2	FSD/MSD

Table 9-8 Setpoint current filter

No.	Identifier	Name	Drive
1206	CURRENT_FILTER_3_FREQUENCY[0...7,DRx]	Natural freq. setp. current filter 3	FSD/MSD
1207	CURRENT_FILTER_3_DAMPING[0...7,DRx]	Damping setpoint current filter 3	FSD/MSD
1208	CURRENT_FILTER_4_FREQUENCY[0...7,DRx]	Natural freq. setp. current filter 4	FSD/MSD
1209	CURRENT_FILTER_4_DAMPING[0...7,DRx]	Damping setpoint current filter 4	FSD/MSD
1210	CURRENT_FILTER_1_SUPPR_FREQ[0...7,DRx]	Blocking freq. setpoint current filter 1	FSD/MSD
1211	CURRENT_FILTER_1_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 1	FSD/MSD
1212	CURRENT_FILTER_1_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 1	FSD/MSD
1213	CURRENT_FILTER_2_SUPPR_FREQ[0...7,DRx]	Blocking freq. setpoint current filter 2	FSD/MSD
1214	CURRENT_FILTER_2_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 2	FSD/MSD
1215	CURRENT_FILTER_2_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 2	FSD/MSD
1216	CURRENT_FILTER_3_SUPPR_FREQ[0...7,DRx]	Blocking freq. setp. current filter 3	FSD/MSD
1217	CURRENT_FILTER_3_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 3	FSD/MSD
1218	CURRENT_FILTER_3_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 3	FSD/MSD
1219	CURRENT_FILTER_4_SUPPR_FREQ[0...7,DRx]	Blocking freq. setpoint current filter 4	FSD/MSD
1220	CURRENT_FILTER_4_BANDWIDTH[0...7,DRx]	Bandwidth setpoint current filter 4	FSD/MSD
1221	CURRENT_FILTER_4_BW_NUM[0...7,DRx]	Numerat. bandw. setp. current filter 4	FSD/MSD

Table 9-9 Speed setpoint filters

No.	Identifier	Name	Drive
1500	NUM_SPEED_FILTERS[0...7,DRx]	Number of setpoint speed filters	FSD/MSD
1501	SPEED_FILTER_TYPE[0...7,DRx]	Setpoint speed filter type	FSD/MSD
1502	SPEED_FILTER_1_TIME[0...7,DRx]	Time constant setpoint speed filter 1	FSD/MSD
1506	SPEED_FILTER_1_FREQUENCY[0...7,DRx]	Natural freq. setp. speed filter	FSD/MSD
1507	SPEED_FILTER_1_DAMPING	Damping setpoint speed filter 1	FSD/MSD
1514	SPEED_FILTER_1_SUPPR_FREQ0...7,DRx]	Blocking freq. setpoint speed filter 1	FSD/MSD
1515	SPEED_FILTER_1_BANDWIDTH[0...7,DRx]	Bandwidth setpoint speed filter 1	FSD/MSD
1516	SPEED_FILTER_1_BW_NUMERATOR[0...7,DRx]	Numerat. bandw. setp. speed filter 1	FSD/MSD
1520	SPEED_FILTER_1_BS_FREQ[0...7,DRx]	Natural frequency bandstop speed filter 1	FSD/MSD
1503	SPEED_FILTER_2_TIME[0...7,DRx]	Time constant setpoint speed filter 2	FSD/MSD
1508	SPEED_FILTER_2_FREQUENCY[0...7,DRx]	Natural freq. setp. speed filter 2	FSD/MSD
1509	SPEED_FILTER_2_BS_DAMPING[0...7,DRx]	Damping setpoint speed filter 2	FSD/MSD
1517	SPEED_FILTER_2_SUPPR_FREQ[0...7,DRx]	Blocking freq. setp. speed filter 2	FSD/MSD
1518	SPEED_FILTER_2_BANDWIDTH[0...7,DRx]	Bandwidth setpoint speed filter 2	FSD/MSD
1519	SPEED_FILTER_2_BW_NUMERATOR[0...7,DRx]	Numerat. bandw. setp. speed filter 2	FSD/MSD
1521	SPEED_FILTER_2_BS_FREQ[0...7,DRx]	Natural frequency bandstop speed filter 2	FSD/MSD

Table 9-10 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 value	FSD/MSD
1239	TORQUE_LIMIT_FOR_SETUP[DRx]	Torque limit for set-up mode	FSD/MSD
1235	POWER_LIMIT_1[0...7,DRx]	1st power limit value	FSD/MSD
1237	POWER_LIMIT_GENERATOR[DRx]	Maximum output generator mode	FSD/MSD

1105	MOTOR_MAX_CURRENT_REDUCTION[DRx]	Reduction in max. motor current	FSD
1238	CURRENT_LIMIT[DRx]	Current limit value	MSD

1605	SPEEDCTRL_LIMIT_TIME[DRx]	Timer n controller at limit	FSD/MSD
1606	SPEEDCTRL_LIMIT_THRESHOLD[DRx]	Threshold n controller at limit	FSD/MSD

1405	MOTOR_SPEED_LIMIT[0...7,DRx]	Motor monitoring speed	FSD/MSD
1420	MOTOR_MAX_SPEED_SETUP[DRx]	Max. motor speed set-up mode	FSD/MSD

1147	SPEED_LIMIT[DRx]	Speed limitation	FSD/MSD

Table 9-11 Major messages

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

9

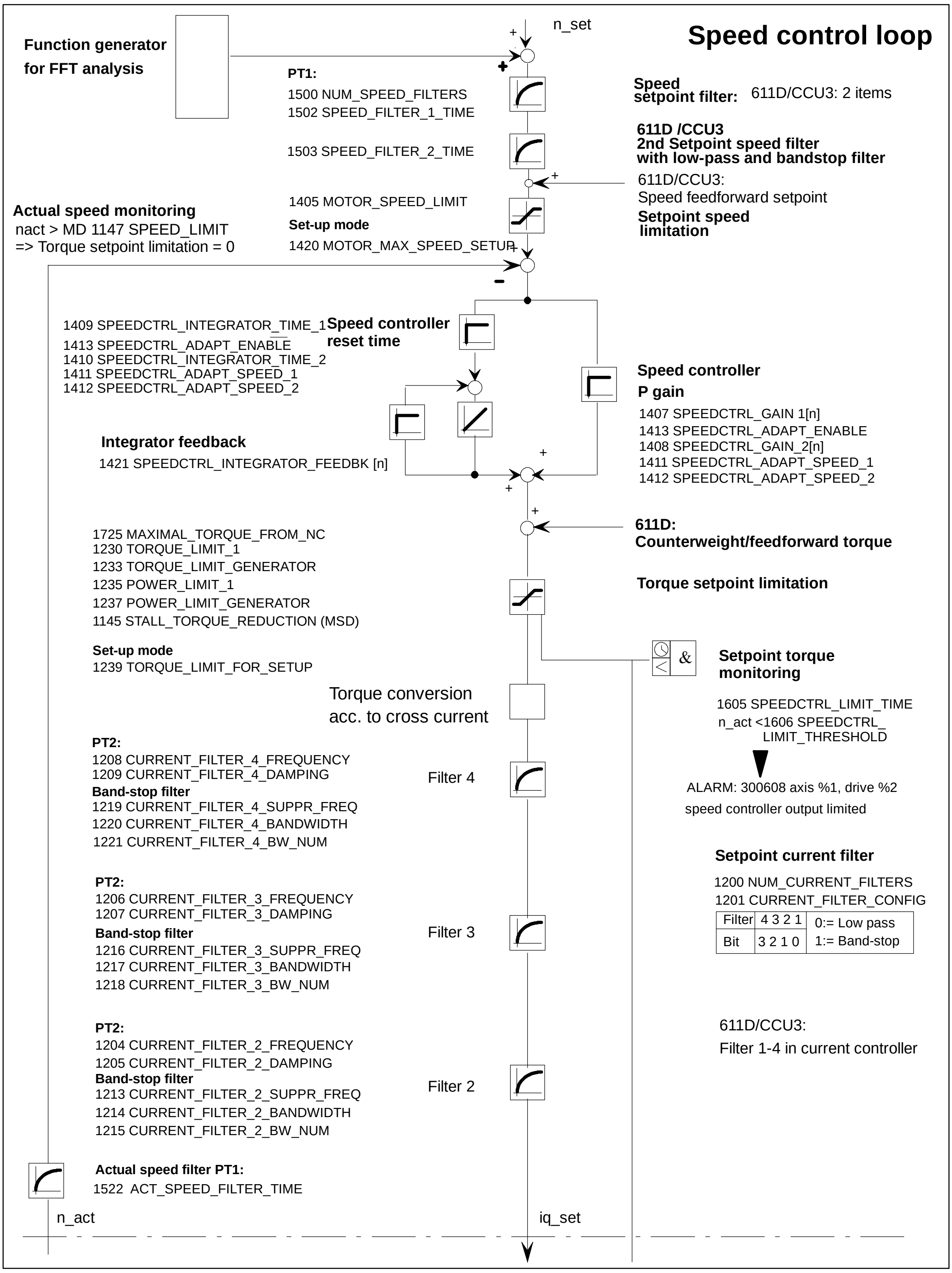


Figure 9-12 Speed controller with the most important parameters

References: /FBA/, DD2, Speed Control Loop

Note

For more detailed information on messages and alarms, please refer to
References: /FBA/, DÜ1, Diagnosis and Monitoring Functions.

Note

Changes to the FSD MD or MSD MD will be erased by an NCK reset if “Save boot file(s)” is not performed beforehand.
Make sure that “ERN 1387” is specified on the rating plate of 1PH motors with optical encoder – only these types of motor can be operated with the SINUMERIK 810D control.

For information about main spindle motors with other encoders, please refer to
References: /HPU/ Configuring 810D.

9.2.5 Axis data

With the SINUMERIK 810 D, 4 linear axes are active as standard. These axes are assigned to channel 1. The rotary axis and spindle must be assigned during start-up.

Distinction between linear axis and rotary axis

MD 30300: IS_ROT_AX must be set for a rotary axis. This setting causes the setpoint unit to be switched over from mm to degrees. The rotary axis display is programmed with reference to 360 degrees,
MD 30320: DISPLAY_IS_MODULO (modulo 360 degrees 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 the conversion to rotary axis, the value 27.77777778 is entered in this MD, and the unit is now rev/min.

Axis types

Indexing axis

The user must specify in MD 30500: INDEX_AX_ASSIGN_POS-TAB (indexing axis assignment) which global list (general machine data 10900: INDEX_AX_LENGTH_POS_TAB1 or MD 10910: INDEX_AX_POS_TAB1 for list 1 and MD 10920 or MD 10930 for list 2) with indexing positions is to be used.
Value 3 –> equidistant indexing.

Parameter sets

In the case of machine data with field parameter “Control parameter set no.”, the first field is used for normal axis operation. In the case of interpolations which include one spindle, e.g. with G331 (tapping without compensating chuck), the selected gear stage determines the appropriate field of the axes involved (1st gear stage –––> field index 1). This applies to all machine axes which can be traversed via geometry axes.
See Section 9.1.

Axis

In the case of axes which interpolate with a spindle during thread cutting operations (G33, G331, G332), the machine data with indices [1]...[5] must also be supplied with appropriate values.

Spindle

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

Parameter set	Axis	Spindle	Spindle gear stage
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

Figure 9-13 Validity of parameter sets in axis and spindle modes

Table 9-12 Machine data for which the parameter set is switched over when the gear stage is changed

MD Number	Axis mode Parameter set 0 Index	Spindle mode Parameter set 1-5 Index	Meaning
MD 31050: DRIVE_AX_RATIO_DENOM	[0]	[1..5]	Denominator load gearbox
MD 31060: DRIVE_AX_RATIO_NUMERA	[0]	[1..5]	Numerator load gearbox
MD 32200: POSCTRL_GAIN	[0]	[1..5]	K_V factor
MD 32452: BACKLASH_FACTOR	[0]	[1..5]	Weighting factor for backlash
MD 32800: EQUIV_CURRCTRL_TIME	[0]	[1..5]	Equivalent time constant current control loop for feedforward control

Table 9-12 Machine data for which the parameter set is switched over when the gear stage is changed

MD Number	Axis mode Parameter set 0 Index	Spindle mode Parameter set 1-5 Index	Meaning
MD 32810: EQUIV_SPEEDCTRL_TIME	[0]	[1..5]	Equivalent time constant speed control loop for feedforward control
MD 32910: DYN_MATCH_TIME	[0]	[1..5]	Time constant for dynamic response adaptation
MD 35310: SPIND_POSIT_DELAY_TIME	[0]	[1..5]	Positioning delay time
MD 35500: DRILL_VELO_LIMIT	[0]	[1..5]	Maximum speeds for tapping
MD 36012: STOP_LIMIT_FACTOR	[0]	[1..5]	Exact stop coarse/fine and zero speed factor
MD 36200: AX_VELO_LIMIT	[0]	[1..5]	Threshold value for velocity monitoring

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 stage 1)
MD 32200: POSCTRL_GAIN [3,Z1] = 1 (K_V for G331, spindle gear stage 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 stage 1)
MD 32200: POSCTRL_GAIN [3,X1] = 1 (K_V for G331, spindle gear stage 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 (setpoint channel exists)
MD 30240: ENC_TYPE = 0 (encoder type)
When the axes are traversed, the control loop is simulated and no hardware-specific alarms are output. For the purpose of axis or spindle start-up, the value “1”, or the value corresponding to the hardware identifier, must be entered in this MD.
The user can select in MD 30350: SIMU_AX_VDI_OUTPUT (output of axis signals with simulation axes) whether the interface signals of a simulation axis are output at the PLC interface (e.g. during program test, if there is no drive hardware).

Interface signals for measuring system switchover

DB31 reserved for axis 1
DB32 reserved for axis 2
DB33 reserved for axis 3

References: /FB1/A2, Various Interface Signals

9.2.6 Axis velocity matching

Machine data for velocity matching

The following machine data must be set:

MD 32000: MAX_AX_VELO (maximum axis velocity)
MD 32010: JOG_VELO_RAPID (rapid traverse in jog mode)
MD 32020: JOG_VELO (JOG axis velocity)
MD 34020: REFP_VELO_SEARCH_CAM (reference point approach velocity)
MD 34040: REFP_VELO_SEARCH_MARKER [n] (creep velocity)
MD 34070: REFP_VELO_POS (reference point positioning velocity)

Note

If you change the max. axis velocity MD 32000: MAX_AX_VELO, the velocity monitoring (MD 36200: AX_VELO_LIMIT) must also be adapted.

Maximum motor speed

With axis drives, it is necessary to enter the motor speed in MD 1401: MOTOR_MAX_SPEED[n] at which the maximum velocity (MD 32000: MAX_AX_VELO) is reached.

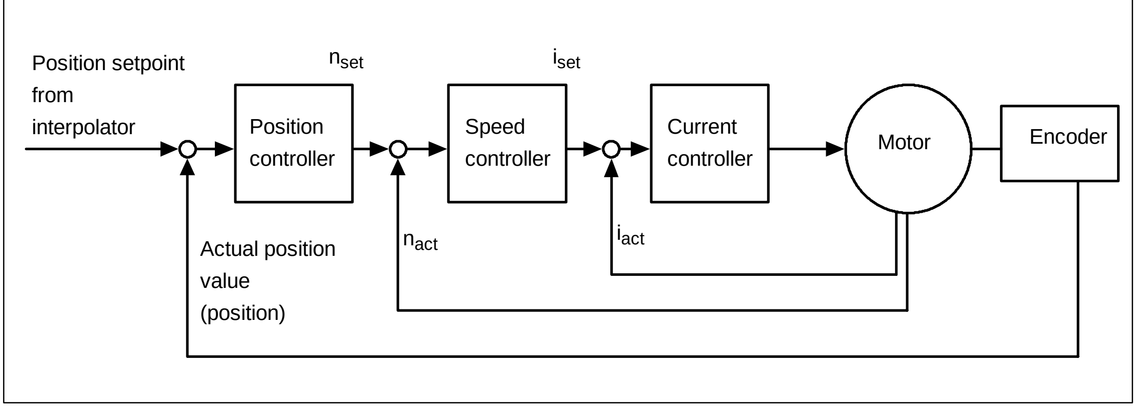
Setpoint scaling

In order to ensure correct setpoint scaling, it is essential to enter the correct load gearing data!
MD 31060: DRIVE_AX_RATIO_NUMERA (number of motor revolutions)
MD 31050: DRIVE_AX_RATIO_DENOM (number of load revolutions)

9.2.7 Axis position control data

Control loops

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



Travel direction

If the axis does not traverse in the correct direction, the direction can be changed in 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 incorrect, it can be adjusted with MD 32110: ENC_FEEDBACK_POL (actual value sign).

Servo gain

In order to obtain high contour accuracy with an interpolation, the servo gain factor (K_V factor) of the position controller must be large. However, an excessively high servo $_{gain}$ factor causes overshoot, instability and impermissible high machine loads. 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 servo gain factor (K_V factor)

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

Conversion of units:

$$K_V \left[\frac{\text{m/min}}{\text{mm}}\right] = 1 \text{ corresponds to } K_V\left[s^{-1}\right] = 16,66\overline{6}$$

The default of MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors) and MD 10230: SCALING_FACTORS_USER_DEF (scaling factor of the physical variables) is preset so that the $K_V$factor MD 32200:

POSCTRL_GAIN (K V factor) $\left[\frac{\text{m/min}}{\text{mm}}\right]$ has to be entered.

For a K V factor of 1, the numerical value must be entered in MD 32200: POSCTRL_GAIN. Allowance for the factor 16.66666667 is made by
MD 10220: SCALING_USER_DEF_MASK = 200hex (bit 9=1) and
MD 10230: SCALING_FACTORS_USER_DEF= 16.66666667.

Enter K V factor in s-1

If the K_V factor is entered in [s^{-1}], then MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors) and MD 10230: SCALING_FACTORS_USER_DEF (scaling factors of physical quantities) must be set accordingly.
Example: MD 10220 = 200hex and MD 10230 [9]= 1

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 means of dynamic response adaptation.
MD 32900: DYN_MATCH_ENABLE (dynamic response) and
MD 32910: DYN_MATCH_TIME (time constant of dynamic response).

References: /FB1/, G2, "Velocities, Actual Value Systems, Cycle Times"

Checking the servo gain

If a K_V factor is already known for a machine in question, this can be set and checked. To check the factor, the axis acceleration must be reduced via MD 32300: MAX_AX_ACCEL in order to ensure that the drive does not reach its current limit during acceleration 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).

You can check the positioning response at various speeds by using a storage oscilloscope or the start-up software of the SIMODRIVE 611D (already integrated in PCU 50). The position setpoint and the actual position value are recorded.

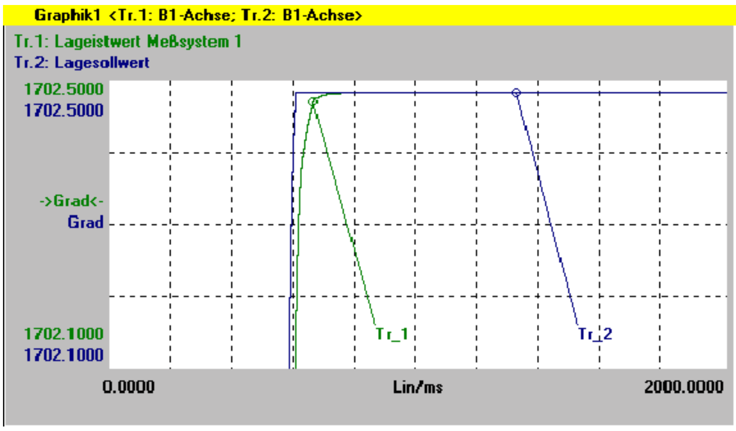


Figure 9-14 Moving into position/positioning

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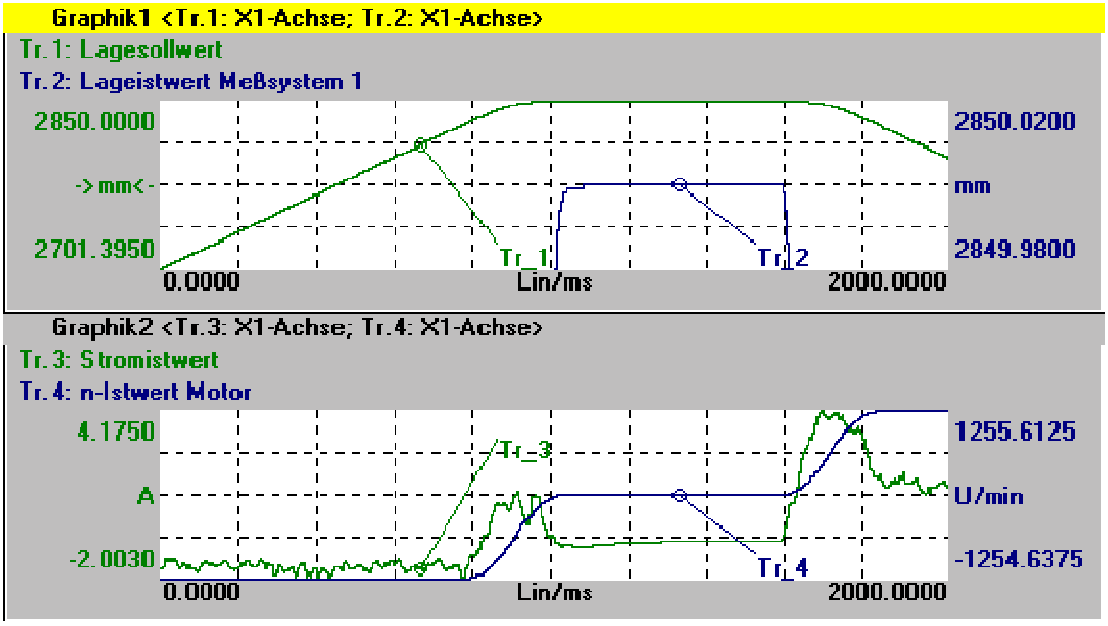

Figure 9-15 Speed setpoint characteristic – moving into position/positioning

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

The SIMODRIVE 611D start-up software offers various methods of checking the K_V factor (e.g. frequency measurement, speed and position control loop measurement).

Causes of overshoots in position control loops

- 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. A static check of the K_V factor can be executed by selecting the “Service axis” softkey in 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).

Acceleration

The axes are accelerated and braked with the acceleration entered 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 (acceleration)

Identification

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

Measurement

Via analog outputs (Chapter 11) 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.

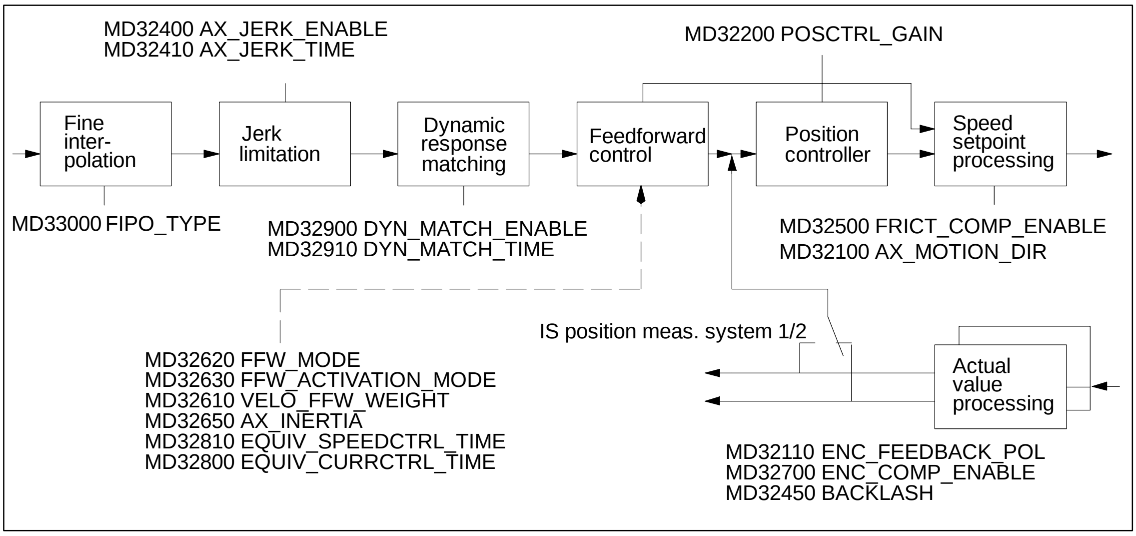

Figure 9-16 Additional parameters for position control

9.2.8 Axis monitoring

References: /FB1/, A3, “Axis Monitoring Functions”

Monitoring the position

When an axis is being positioned, a monitoring function checks whether it 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 course exact stop” (DB31, ... DBX60.6)

MD 36010

STOP_LIMIT_FINE (fine exact stop)

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

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)

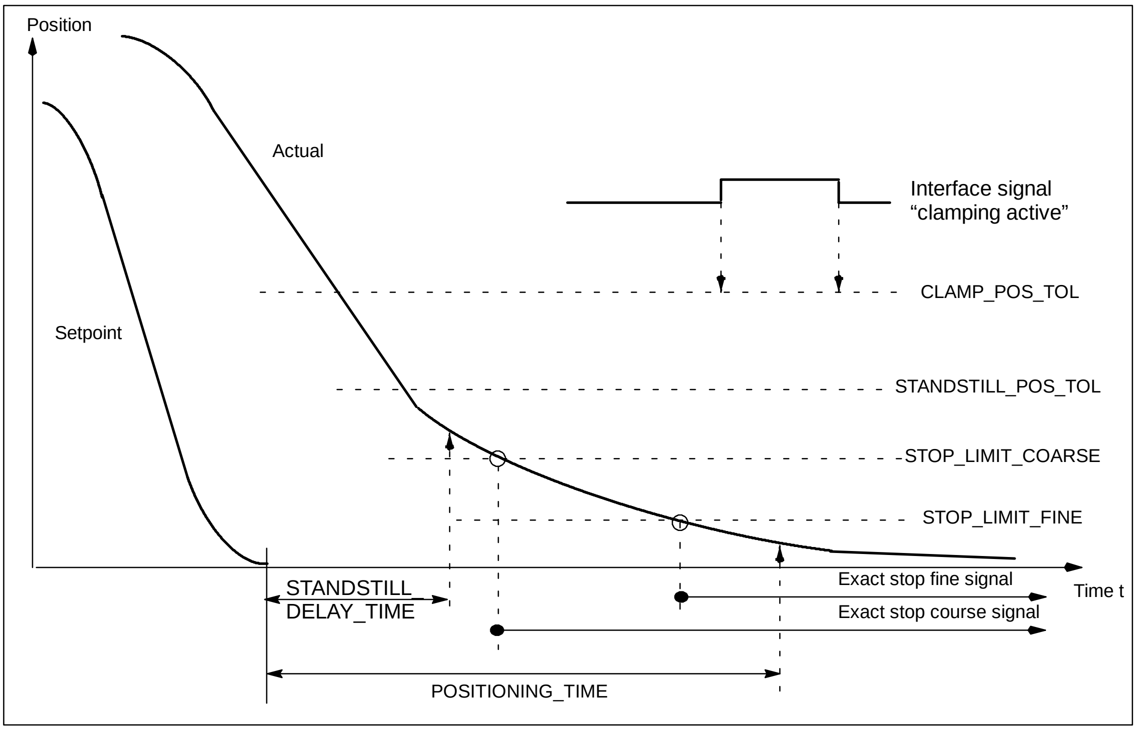

Figure 9-17 Positioning, zero speed and clamping tolerance monitoring

Monitoring of positions usinghardware limit switch

You can monitor each axis 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. Deceleration can be set via MD 36600: BRAKE_MODE_CHOICE (deceleration behavior with hardware limit switch).

Machine data, interface signals and alarms

MD 36600: BRAKE_MODE_CHOICE = 1 (rapid braking with setpoint “0”)
MD 36600: BRAKE_MODE_CHOICE = 0 (braking according to characteristic)

IS “Hardware limit switch minus” (DB31, ... DBX12.0)
IS “Hardware limit switch plus” (DB31, ... DBX12.1)

Alarm “21614 Channel [Name1] Axis [Name2] Hardware limit switch [+/–]”
The axis must be retracted in the opposite direction in JOG mode.

Monitoring of positions using software limit switch

You can enter 2 software limit switches for each axis in the machine data. 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_MINUS (2nd software limit switch minus)
MD 36130: POS_LIMIT_PLUS (2nd software limit switch plus)

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

Alarm “10620 channel [name1] block [no.] axis [name2] reaches software limit switch +/–”
Alarm “10621 channel [name1] axis [name2] stationary at software limit switch +/– (JOG)”
Alarm “10720 channel [name1] block [no.] axis [name2] programmed end point is behind software limit switch +/–”

Monitoring of positions via working area limitation

For geometry axes, a working area limitation can be specified via setting data or from the part program (with G25/G26). It 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 (working area limitation active in pos. direction)
SD 43410: WORKAREA_MINUS_ENABLE (working area limitation active in neg.direction)
SD 43420: WORKAREA_LIMIT_PLUS (working area limitation plus)
SD 43430: WORKAREA_LIMIT_MINUS (working area limitation minus)

Alarm “10630 channel [name1] block [no.] axis [name2] reaches working area limitation +/–”
Alarm “10631 channel [name1] axis [name2] stationary at working area limitation +/– (JOG)”
Alarm “10730 channel [name1] block [no.] axis [name2] programmed end point is behind working area limitation +/–”

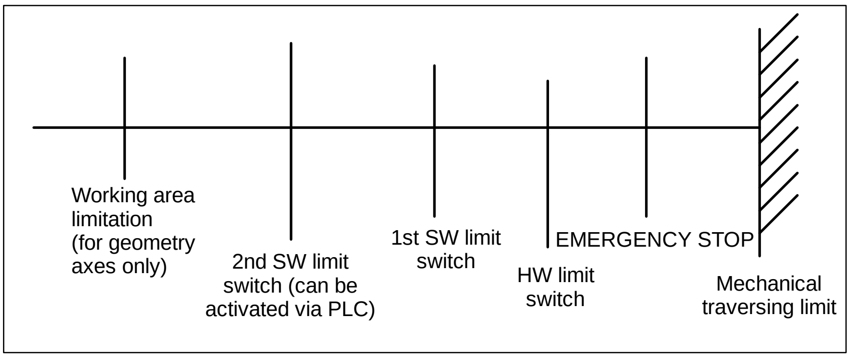

Figure 9-18 Overview of end limitations

Dynamic monitoring functions

Speed limitation

Speed limitation is carried out internally in the SINUMERIK 810D. The setpoint is limited on a percentage basis in MD 36210: CTRLOUT_LIMIT (max. speed setpoint) with reference to the speed value entered in MD 1401: MOTOR_MAX_SPEED. An alarm is generated if the setpoint is exceeded for the time period set in MD 36220: CTRLOUT_LIMIT_TIME (delay time for speed setpoint monitoring). The axes are braked down to zero speed along a braking ramp when the position control loop is open MD 36610: AX_EMERGENCY_STOP_TIME (time of the braking ramp). 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 (braking ramp time in event of faults)
Alarm “25060 axis [name] speed setpoint limitation”.

Velocity monitoring

The monitoring is intended as a means of ensuring trouble-free operation of axes for which the theoretical velocity is limited for mechanical reasons (e.g. by the mechanical limit frequency of the pulse encoder). The actual velocity monitoring function is always active provided, however, that the selected encoder is operating below its limit frequency. Alarm 25030 is output when the threshold value is exceeded.

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

Contour monitoring

Contour monitoring refers to the continuous comparison of the measured following error and that pre-calculated from the NC setpoint position. Contour monitoring is always active in position-controlled operation. 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 (braking ramp time in the event of faults)
Alarm “25050 axis [name] contour monitoring”

Encoder monitoring (encoder limit frequency monitoring)

The frequency entered in MD 36300: 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 mounted directly on motor, limit frequency 200 kHz, $n_{max} = (f_{limit} / \text{pulses}) * 60 \text{ sec} = 5900$ rev/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),
IS “Encoder limit frequency exceeded 1” (DB31, ... DBX60.2),
IS “Encoder limit frequency exceeded 2” (DB31, ... DBX60.3),
Alarm “21610 channel [name] axis [name] encoder frequency exceeded”.

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Encoder monitoring (zero mark monitoring)

Zero mark monitoring is activated with MD 36310: ENC_ZERO_MONITORING=1. If pulses are lost, then the alarm “Zero mark monitoring” is generated and the axes are braked down to zero speed.

MD 36310: ENC_ZERO_MONITORING (zero mark monitoring)
MD 36610: AX_EMERGENCY_STOP_TIME (braking ramp time in the event of Alarm “25020 axis [name] zero mark monitoring”

Encoder monitoring (tolerance for encoder switchover)

It is possible to define two actual value branches with SINUMERIK 810D. 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 the alarm “Measuring system switchover not possible” is generated and the switchover process blocked.

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

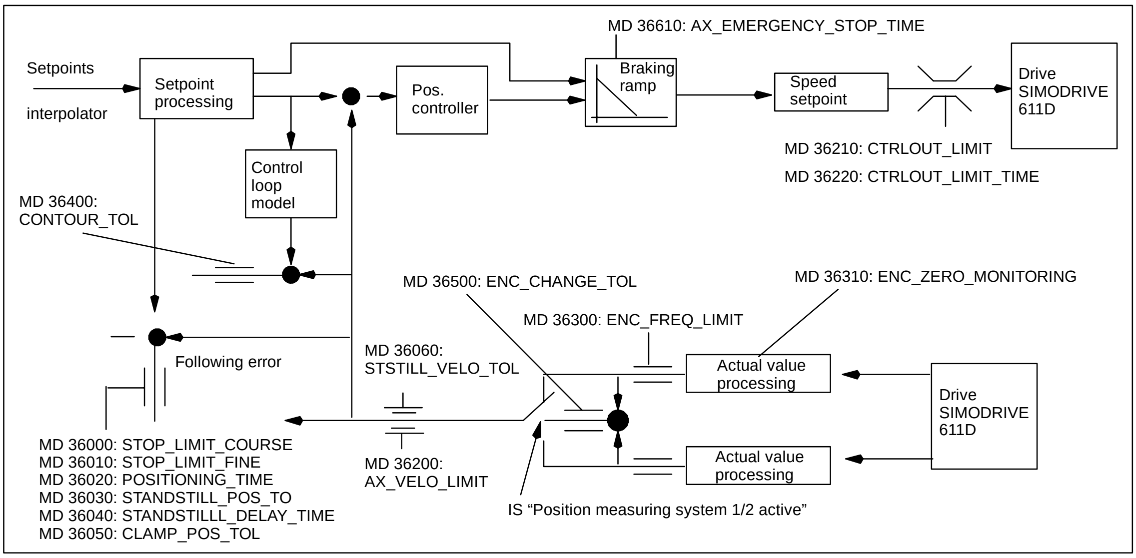

Figure 9-19 Monitoring with SINUMERIK 810D

Note

The time set in MD 36620: SERVO_DISABLE_DELAY_TIME (cutout delay servo enable) must always be set to a higher time than the setting in MD 36610: AX_EMERGENCY_STOP_TIME (braking ramp time in event of faults). If this is not the case, the braking ramp in MD 36610 cannot become operative.

9.2.9 Axis reference point approach

After the control has been switched on, it must be synchronized (referenced) with the position measuring system of every 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).

References: /FB/, R1, “Reference Point Approach”

General machine data and interface signals

MD 34000: REFP_CAM_IS_ACTIVE	(axis with reference cam)
MD 34110: REFP_CYCLE_NR	(axis sequence for channel-specific reference point approach)
MD 30240: ENC_TYPE	(encoder type)
MD 34200: ENC_REFP_MODE	(reference mode)
IS “Activate referencing”	(DB21, ... DBX1.0)
IS “Referencing active”	(DB21, ... DBX33.0)

Reference point approach for incremental measuring systems

Reference point approach for incremental measuring systems is divided into 3 phases:
Phase 1: Approach reference cam
Phase 2: Synchronize with zero mark
Phase 3: Approach 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 negative direction)
MD 34020: REFP_VELO_SEARCH_CAM (reference cam approach velocity)
MD 34030: REFP_MAX_CAM_DIST (maximum distance to reference cam)
IS “Approach keys plus/minus” (DB31, ... DBX4.7/DBX4.6)
IS “Reference point approach delay” (DB31, ... DBX12.7)

Machine data for phase 2

MD 34040: REFP_VELO_SEARCH_MARKER (creep velocity)
MD 34050: REFP_SEARCH_MARKER_REVERSE (direction reversal to reference cam)
MD 34060: REFP_MAX_MARKER_DIST (maximum distance from cam to reference mark)

Machine data and interface signals for phase 3

MD 34070: REFP_VELO_POS (reference point positioning velocity)
MD 34080 REFP_MOVE_DIST (reference point distance to zero mark)
MD 34090: REFP_MOVE_DIST_CORR (reference point offset, additive)
MD 34100: REFP_SET_POS (reference point value)
IS “Reference point value 1...4” (DB31, ... DBX2.4, 2.5, 2.6, 2.7)
IS “Referenced/synchronized 1, 2” (DB31, ... DBX60.4, DBX60.5)

Actual value buffering after power OFF

Software Version 2.1 and higher allows you to continue operation of, e.g. a conventional machine tool, using the initial position information and without explicit new-referencing 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 activated, the NC synchronizes with an internally buffered previous 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.

Reference point approach for distance-coded reference marks

Reference point approach for axes with distance-coded reference marks is divided into 2 phases:
Phase 1: Synchronize by overriding 2 reference marks
Phase 2: Traverse to target point

General machine data

MD 34310: ENC_MARKER_INC (interval between two reference marks)
MD 34320: ENC_INVERS (measuring system inverted)

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 marks)
MD 34300: ENC_REFP_MARKER_DIST (reference marker distance)

IS "Traversing keys plus/minus"	(DB31, ... DBX4.7, DBX4.6)
IS "Referenced/synchronized 1, 2"	(DB31, ... DBX60.4, DBX60.5)

Machine data and interface signals for phase 2

MD 34070: REFP_VELO_POS (reference point positioning velocity)
MD 34090: REFP_MOVE_DIST_CORR (absolute offset)
MD 34330: REFP_STOP_AT_ABS_MARKER (with/without target point)
MD 34100: REFP_SET_POS (target point), if referencing on target point

IS "Referenced/synchronized 1, 2"	(DB31, ... DBX60.4, DBX60.5)

Reference point approach 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

See Chapter 10 for traverse enabling commands.

9.2.10 Spindle data

In the SINUMERIK 810D 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.

References: /FB1/, S1, “Spindle”

Spindle definition

The following machine data must be set 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 (displayed referred to 360 degrees)
- MD 35000: SPIND_ASSIGN_TO_MACHAX (axis declared as spindle), e.g. “1” means spindle name “S1”. Input of the spindle number, with which the spindle is to be addressed, e.g. “1” means spindle name “S1”.

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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, SPOSA)
- Synchronous mode
- Rigid tapping.

In spindle mode, the feedforward control switches on **as standard (FFW mode = 1)**. Exception: In the case of rigid tapping, the feedforward control acts only when activated explicitly (e.g. by means of the programming command FFWON).

The set of parameters is selected that corresponds to the current gear stage. Example: 2nd Gear stage → Set of parameters [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 stage.
After the spindle has been positioned, the rotary axis can be programmed directly with the axis name.
IS “Axis/spindle” (DB31, ... DBX60.0 = 0)

General machine data definitions

MD 20090: SPIND_DEF_MASTER_SPIND (master spindle reset position in channel)

MD 35020: SPIND_DEFAULT_MODE (spindle initial setting)
This MD allows a basic spindle setting to be defined.
The following are possible:

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

The time at which the basic spindle setting is effective 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 (independent spindle reset)
This MD determines whether the spindle must be stopped by a RESET or a program end. 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 stage changeover possible. Spindle has several gear stages).
If this machine data is not set, the system assumes that the spindle has no gear stages. A gear stage changeover is therefore impossible.

Parameter sets

In the case of the machine data below with the "Gear stages no." and "Control parameter set no." field parameters, the gear stage selected determines the relevant field index. The field with the **index [0]** is **not** used for the spindle machine data!

MD 31050: DRIVE_AX_RATIO_DENOM	(denominator load gearbox)
MD 31060: DRIVE_AX_RATIO_NUMERA	(numerator load gearbox)
MD 32200: POSCTRL_GAIN	(K_V factor)
MD 32452: BACKLASH_FACTOR	(weighting factor for backlash)
MD 35110: GEAR_STEP_MAX_VELO	(n_{max} for gear stage change)
MD 35120: GEAR_STEP_MIN_VELO	(n_{min} for gear stage change)
MD 35130: GEAR_STEP_MAX_VELO_LIMIT	(n_{max} for gear stage)
MD 35140: GEAR_STEP_MIN_VELO_LIMIT	(n_{min} for gear stage)
MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL	(acceleration in speed control mode)
MD 35310: SPIND_POSIT_DELAY_TIME	(positioning delay time)
MD 35210: GEAR_STEP_POSCTRL_ACCEL	(acceleration in position control mode)

MD 35500: DRILL_VELO_LIMIT (maximum speeds for tapping)

MD 36012: STOP_LIMIT_FACTOR (Factor for exact stop coarse/fine and zero speed)

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 stage change, gear stage 1)

MD 35110: GEAR_STEP_MAX_VELO [2,A1] = 1000
(n_{max} for gear stage change, gear stage 2)

9.2.11 Spindle configuration

Machine data for setpoint and actual values

Setpoint values:
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 Section 9.2.

9.2.12 Spindle encoder matching

Machine data for encoder matching

The same machine data as for the axis must be observed for matchingthe spindle encoder. MD 30300: IS_ROT_AX must always be set for the spindle so that the encoder is always matched in relation to one revolution. In order to obtain a display which is always referred to 360 degrees, MD 30320: DISPLAY_IS_MODULO must be set. If the motor encoder of the 611D drive is used for the purpose of encoder matching, then the encoder matching data must be entered for each individual gear stage if several gear stages are present. The maximum multiple of the 611D drive is always used as the maximum multiple of encoder markings. This multiple is 128.

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Table 9-13 Machine data for encoder matching

Machine date	Spindle	
	Encoder on motor	Encoder on spindle
30300: IS_ROT_AX	1	1
31000: ENC_IS_LINEAR	0	0
31040: ENC_IS_DIRECT	0	1
31020: ENC_RESOL	Marks/rev.	Marks/rev.
31080: DRIVE_ENC_RATIO_NUMERA	Motor rev.	Load rev.
31070: DRIVE_ENC_RATIO_DENOM	encoder rev.	encoder 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 1 for encoder matching

Spindle with signal generator (500 pulses) mounted directly on the spindle. Internal multiple = 128. Internal calculation resolution = 1000 increments per degree.

$$\text{Internal resolution} = \frac{\text{360 degrees}}{\text{MD 31020 * 128}} * \frac{\text{MD 31080}}{\text{MD 31070}} * 1000$$

$$\text{Internal resolution} = \frac{360 * 1 * 1000}{500 * 128 * 1} \quad 5.624$$

One encoder increment corresponds to 5.624 internal increments. An encoder increment corresponds to 0.005624 degrees (highest possible positioning resolution).

Example 2 for encoder matching

Spindle with rotary encoder on motor (2048 pulses), internal multiple = 128.
With 2 gear stages:
Gear stage 1: Motor/spindle = 2.5/1
Gear stage 2: Motor/spindle = 1/1

Gear stage 1

$$\text{Internal resolution} = \frac{360\ \text{degrees}}{\text{MD 31020 * 128}} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * 1000\ \text{incr/degr.}$$

$$\text{Internal resolution} = \frac{360\ \text{degrees}}{128 * 2048\ \text{pulses}} * \frac{1}{1} * \frac{1}{2.5} * 1000\ \text{pulses/degr.} = 0.549312$$

One encoder increment corresponds to 0.549312 internal increments. One encoder increment corresponds to 0.000549312 degrees (highest possible positioning resolution).

Gear stage 2

$$\text{Internal resolution} = \frac{360\ \text{degrees}}{\text{MD 31020 * 128}} * \frac{\text{MD 31080}}{\text{MD 31070}} * \frac{\text{MD 31050}}{\text{MD 31060}} * 1000\ \text{incr/degr.}$$

$$\text{Internal resolution} = \frac{360\ \text{degrees}}{128 * 2048\ \text{pulses}} * \frac{1}{1} * \frac{1}{1} * 1000\ \text{pulses/degr.} = 1.37328$$

One encoder increment corresponds to 1.37328 internal increments. One encoder increment corresponds to 0.0137328 degrees (highest possible positioning resolution).

9.2.13 Velocities and setpoint matching for spindle

Velocities, gear stages

In the SINUMERIK 810D the output of the spindle speed is implemented in the NC. The control contains the data for 5 gear stages. These stages are defined by a minimum and maximum speed for the stage itself and by a minimum and maximum speed for the automatic gear stage changeover. A new gear stage is output only if the newly programmed speed setpoint cannot be traversed in the present gear stage. For the sake of simplification, the oscillation times for gear stage changeovers can be specified directly in the NC; the oscillation function must otherwise be implemented in the PLC. The oscillation function is initiated via the PLC.

Speeds for conventional operation

The speeds of the spindles for conventional operation are entered in the axis machine data MD 32010: JOG_VELO_RAPID (conventional rapid traverse) 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 of a spindle corresponds to the traversing direction of an axis.

Setpoint matching

The speeds must be transferred with standardized values for the drive controller. The values are scaled in the NC via the selected load gear and via the drive MD 1401: MOTOR_MAX_SPEED (maximum motor operating 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 stage.

Machine data and interface signals

MD 35110: GEAR_STEP_MAX_VELO (maximum speed for gear stage change)
MD 35120: GEAR_STEP_MIN_VELO (maximum speed for gear stage change)
MD 35130: GEAR_STEP_MAX_VELO_LIMIT (maximum speed for gear stage) MD 35140: GE-
AR_STEP_MIN_VELO_LIMIT (maximum speed for gear stage) MD 35200: GE-
AR_STEP_SPEEDCTRL_ACCEL (acceleration in speed-controlled operation)

MD 35220: ACCEL_REDUCTION_SPEED_POINT (speed for acceleration reduction)
MD 35230: ACCEL_REDUCTION_FACTOR (reduced acceleration)

MD 35400: SPIND_OSCILL_DES_VELO (oscillation speed)
MD 35410: SPIND_OSCILL_ACCEL (acceleration in oscillation mode)
MD 35430: SPIND_OSCILL_START_DIR (start direction in oscillation mode)
MD 35440: SPIND_OSCILL_TIME_CW (oscillation time for M3 direction)
MD 35450: SPIND_OSCILL_TIME_CCW (oscillation time for M4 direction)

MD 31060: DRIVE_AX_RATIO_NUMERA (numerator load gearbox)
MD 31050: DRIVE_AX_RATIO_DENOM (denominator load gearbox)

MD 32010: JOG_VELO_RAPID (rapid traverse in jog mode)
MD 32020: JOG_VELO (JOG axis feedrate)

IS “Gear change” (DB31, ... DBX82.3)
IS “Setpoint gear stage” (DB31, ... DBX82.0 ... DBX82.2)
IS “No speed monitoring for gear change” (DB31, ... DBX16.6)
IS “Gear changed” (DB31, ... DBX16.3)
IS “Setpoint gear stage” (DB31, ... DBX16.0 to DBX16.2)
IS “Oscillation speed” (DB31, ... DBX18.5)
IS “Oscillation via PLC” (DB31, ... DBX18.4)

IS “Oscillation mode” (DB31, ... DBX84.6)
IS “Open-loop control mode” (DB31, ... DBX84.7)
IS “Traversing keys minus” (DB31, ... DBX4.6)
IS “Traversing keys plus” (DB31, ... DBX4.7)

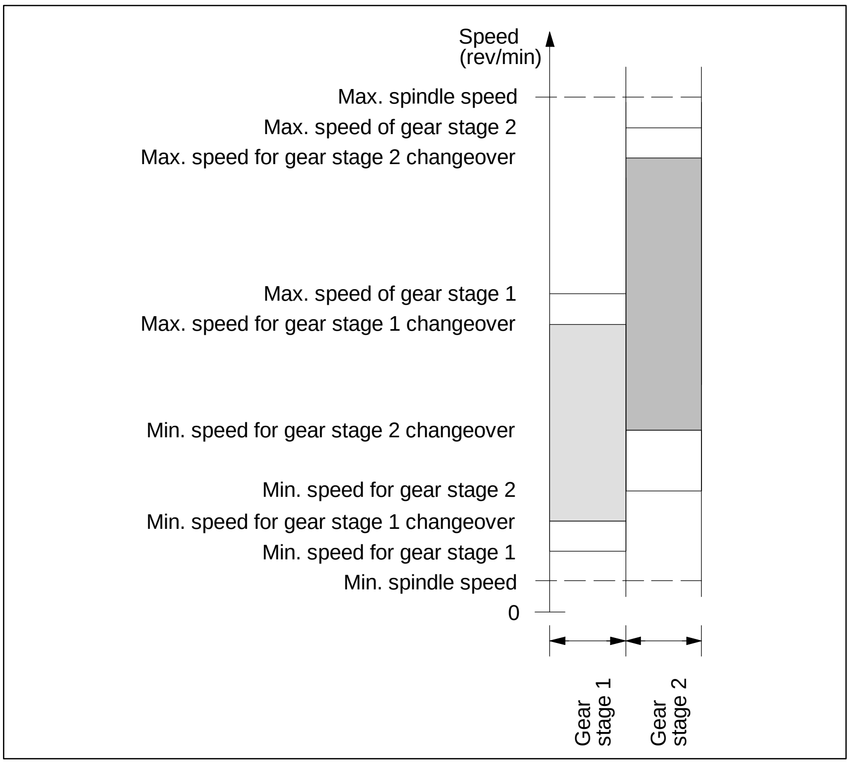

Figure 9-20 Example for speed ranges for automatic gear stage selection (M40)

9.2.14 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.

References: /PA/, Programming Guide

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 stage. If the spindle is positioned from zero speed, it is accelerated up to a maximum speed corresponding to creep speed; the direction is defined via machine data. The contour monitoring function is activated as soon as the control mode switches to position control.

Machine data and interface signals

MD 35300: SPIND_POSCTRL_VELO	(creep speed)
MD 35350: SPIND_POSITIONING_DIR	(direction of rotation on positioning from zero speed)
MD 35210: GEAR_STEP_POSCTRL_ACCEL	(acceleration in position control mode)
MD 36000: STOP_LIMIT_COARSE	(exact stop coarse)
MD 36010: STOP_LIMIT_FINE	(exact stop fine)
MD 32200: POSCTRL_GAIN	(K_V factor)
MD 36400: CONTOUR_TOL	(contour monitoring)
IS "Position reached with exact stop fine/course"	(DB31, ... DBX60.6/60.7)
IS "Positioning mode"	(DB31, ... DBX84.5)

9.2.15 Spindle synchronization

The spindle must synchronize its position with the measuring system. The spindle position is always synchronized with the zero mark of the encoder or with a Bero signal connected to the CCU3 hardware or drive module of the SIMODRIVE 611D.
It is specified in MD 34200: ENC_REFP_MODE through which signal synchronization takes place (zero marker (0) or Bero (1)).

When is synchronization necessary?

- After activation of the control if the spindle is moved with a programming command.
- The interface signal “Re-synchronize spindle 1/2” always cancels the “Referenced/synchronized 1/2” interface signal; the spindle is re-synchronized with the next reference signal.
- After every gear stage changeover if 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, eand axis modes.

To synchronize the spindle, it must always be turned via a programming command (e.g. M3, M4, SPOS). It is not sufficient to enter a spindle speed via the directional keys of the appropriate axis on the machine control panel.

Machine data and interface signals

MD 34100: REFP_SET_POS (reference point value, zero mark position)
The position of the reference signal during synchronization is entered in this MD.
MD 34090: REFP_MOVE_DIST_CORR (reference point offset, zero mark offset).
The zero mark offset resulting from the synchronization process is entered here.
MD 34200: ENC_REFP_MODE (position measuring system type)
IS “Re-synchronize spindle 1, 2” (DB31, ... DBX16.4 or 16.5)
IS “Referenced/synchronized 1, 2” (DB31, ... DBX60.4 or 60.5)

9

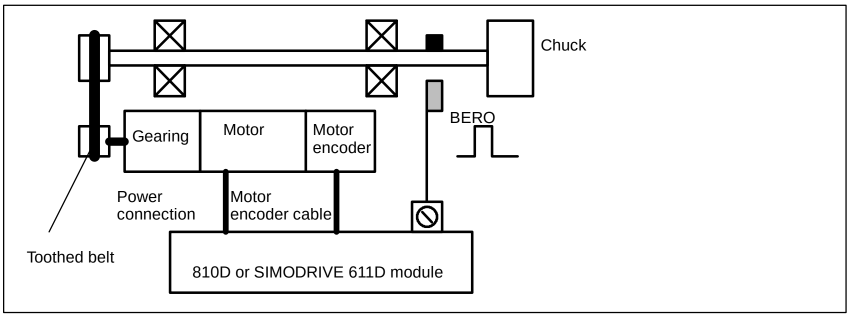

Figure 9-21 Synchronization via an external reference signal (BERO)

Note

If the spindle encoder of the motor encoder is not mounted directly on the spindle and there are gear ratios between the encoder and spindle, the spindle must be synchronized via an external reference signal (e.g. BERO). The zero mark of the motor encoder is not evaluated. The control then automatically re-synchronizes the spindle position after every gear stage 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 is used, MD 34200: ENC_REFP_MODE (positioning measuring system type) is set to 2.

9.2.16 Spindle monitoring

Axis/spindle stationary

If the speed exceeds the value specified in MD 36060: STANDSTILL_VELO _TOL, then the interface signal “Axis/spindle stationary” (DB31, ... DBX61.4) is output.
The path feed is then enabled if MD 35510: SPIND_STOPPED_AT_IPO _START (feed enable when spindle stops) is set.

Spindle in setpoint range

When the spindle reaches the tolerance range specified in MD 35150: SPIND_DES_VELO_TOL (spindle speed tolerance), then the interface signal “Spindle in setpoint range” (DB31, ... DBX83.5) is output.
The path feed is then enabled if MD 35500: SPIND_ON_SPEED_AT_IPO_START (feed enable if spindle in set range) is set.

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”.
The spindle speed is also monitored by MD 36200; AX_VELO_LIMIT[0..5] (threshold for velocity monitoring); an alarm is generated if the set value 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 and maximum gear stage speed

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

Programmable spindle speed limits

Functions G25 S... and G26 S... allow a minimum and maximum spindle speed limit to be specified 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). The position measuring systems which are out of synchronism are automatically re-synchronized as soon as the frequency drops below the encoder limit frequency again. 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.

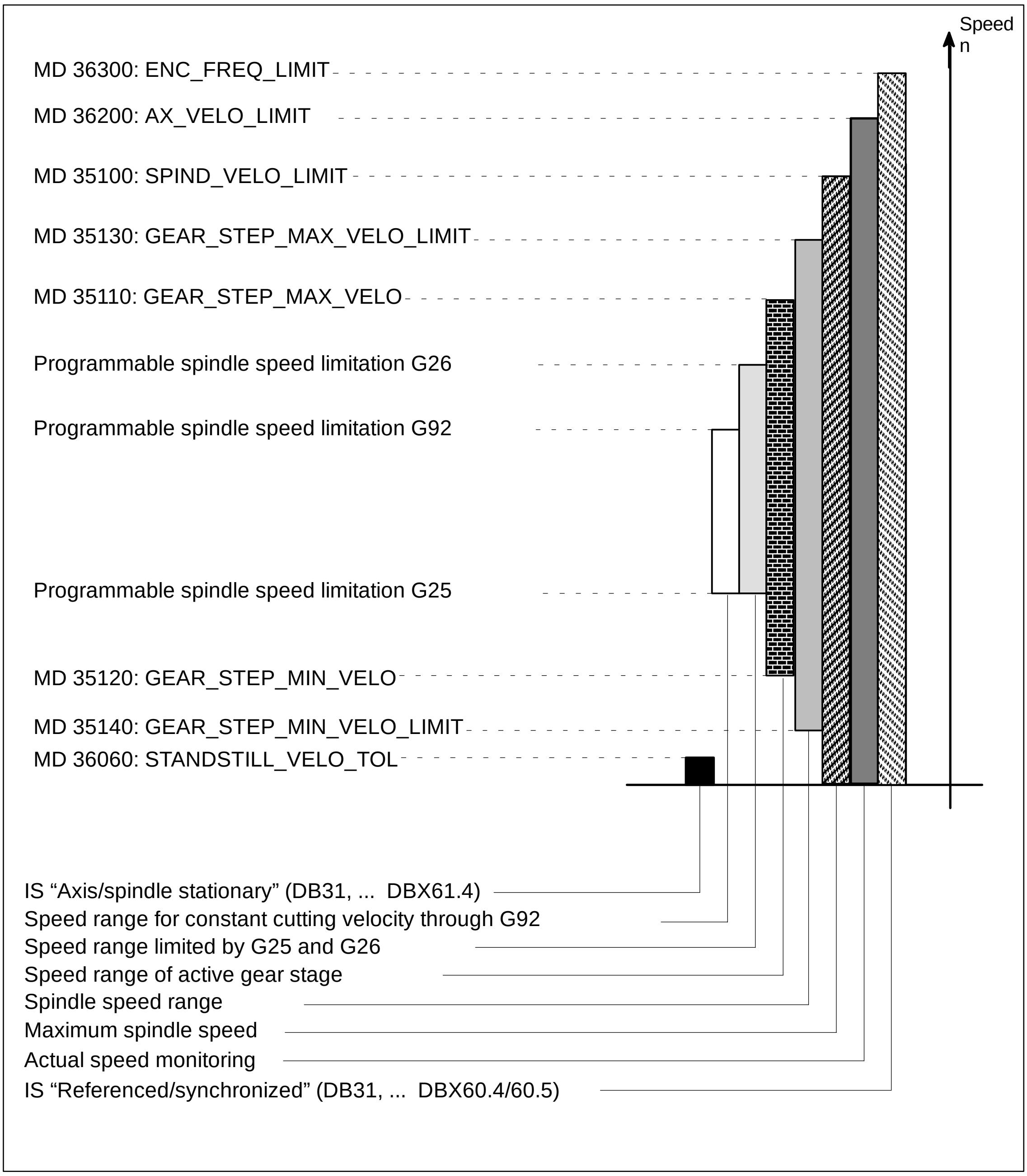

Figure 9-22 Areas for spindle monitoring

9.3 Linear motors (1FN1 and 1FN3 motors)

9.3.1 General information for starting up linear motors

Note to the reader

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

References: /PJLM/ Planning Guide Linear Motors
Manufacturer/Service Documentation

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 and enter the manufacturer data for the "external" 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 mounting 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:

      – Graduation _ _ _ _ _ _ μm

      – Number of zero markers _ _ _ _ _ _

   b) Absolute measuring system:

      – Graduation _ _ _ _ _ _ μm

   Determine the positive drive direction:

      Which is the positive counting direction of the measuring system? (see Subsection 9.3.6)
      --> invert the 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) KTY84 evaluation via SIMODRIVE 611D only

      b) Evaluation via SIMODRIVE 611D and external devices

      c) Evaluation by external devices only

      Note:
      In case a) a temperature sensor coupling lead (dongle) must be connected between –X411 and the measuring system.
      (See also PJLM/CON/Connections: Section “Encoder connection”).

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 PJLM/CON/Connections:Section “Encoder connection”).

9.3.2 Start-up: Linear motors with one 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 the power section
   - Select drive type: "SLM" (synchronous linear motor)

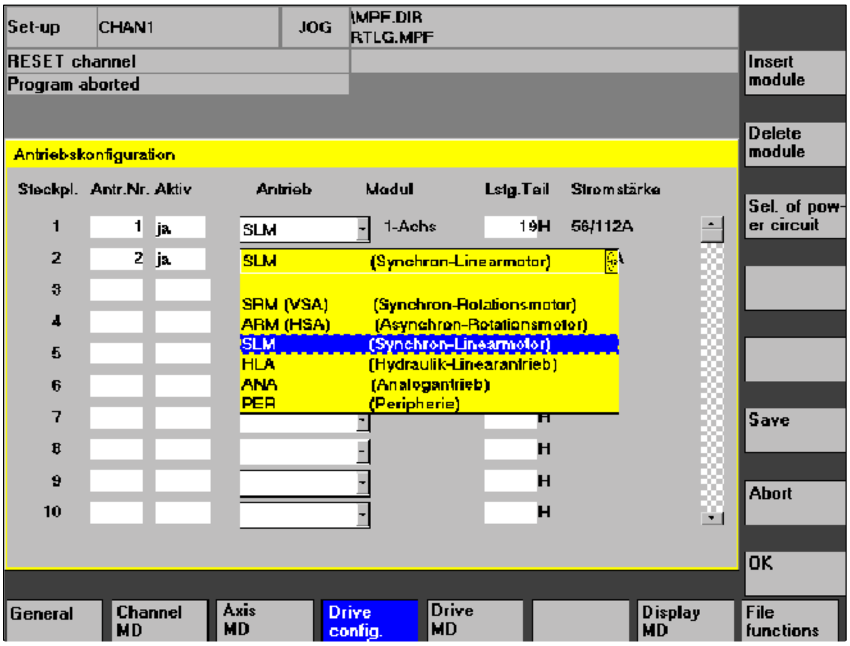

Figure 9-23 Drive configuration for synchronous linear motor

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

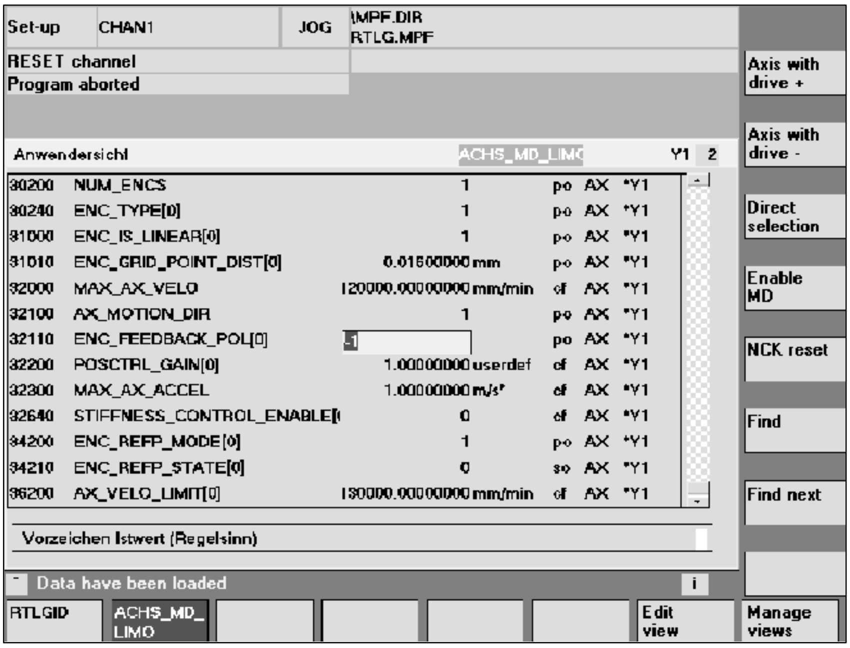

Figure 9-24 Minimum selection of axis machine data for linear motor

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.

  Please remember that the speed inversion parameter must be set at the NC end (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.

9

3. Select the motor

   Before the motor is selected, message 300701: “Start-up required” must be displayed. (Fig. 9-25)

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

      If yes: Select the appropriate motor

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

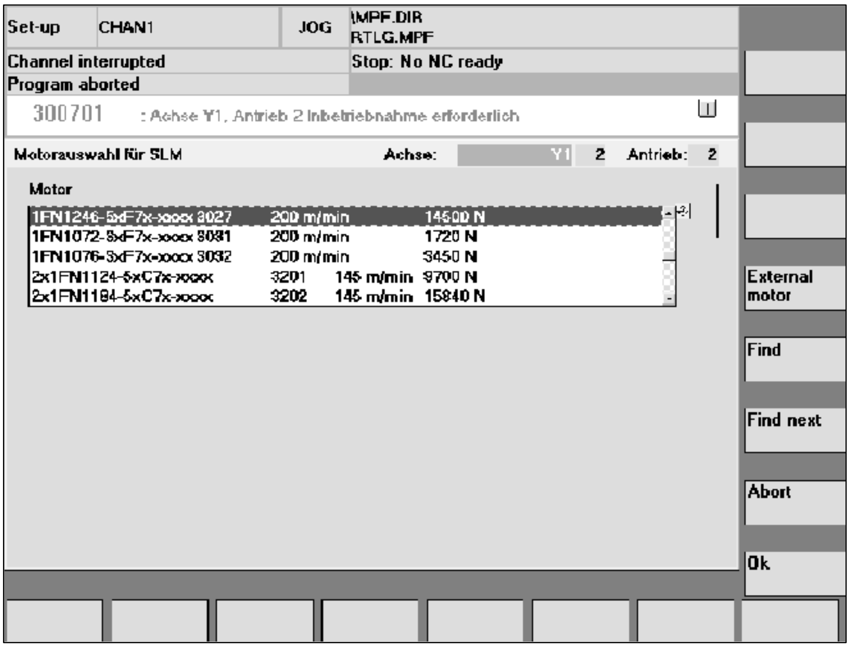

Figure 9-25 Selecting a motor for which the data are already listed

b) Is the linear motor not included in the list of linear motors? --> **unlisted motor**

"Motor" field --> enter data

Note

If a smaller identification current is required (<40%) with procedure 1 (MD1075=1), alarm 300753 must be masked in MD 1012 with bit 5.

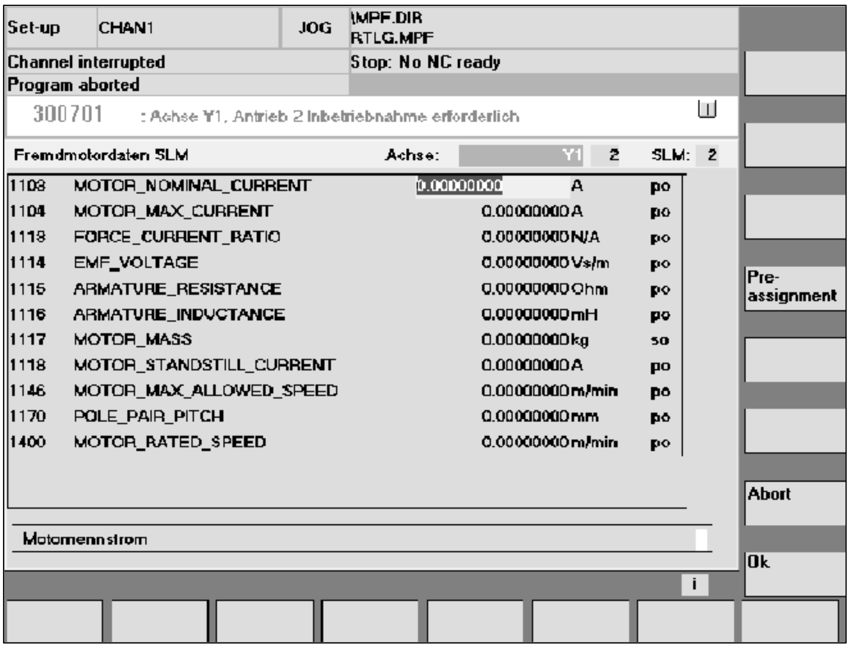

Figure 9-26 Entering the unlisted motor, the data are not yet specified

Enter the motor data:

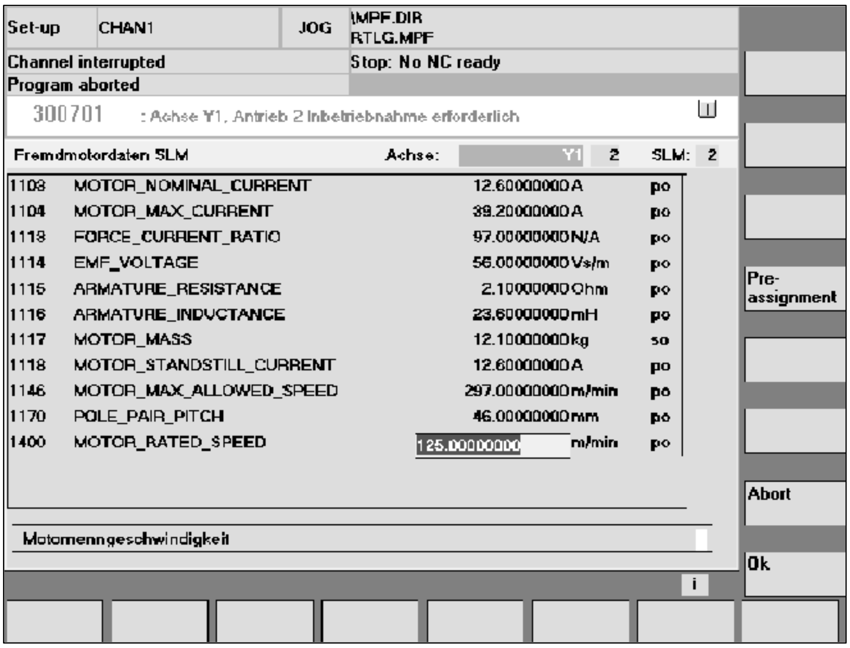

Figure 9-27 Entering data for an "unlisted motor"

4. “Measuring system/encoder” dialog

   Select the motor measuring system and enter the encoder data

   a) Incremental encoder

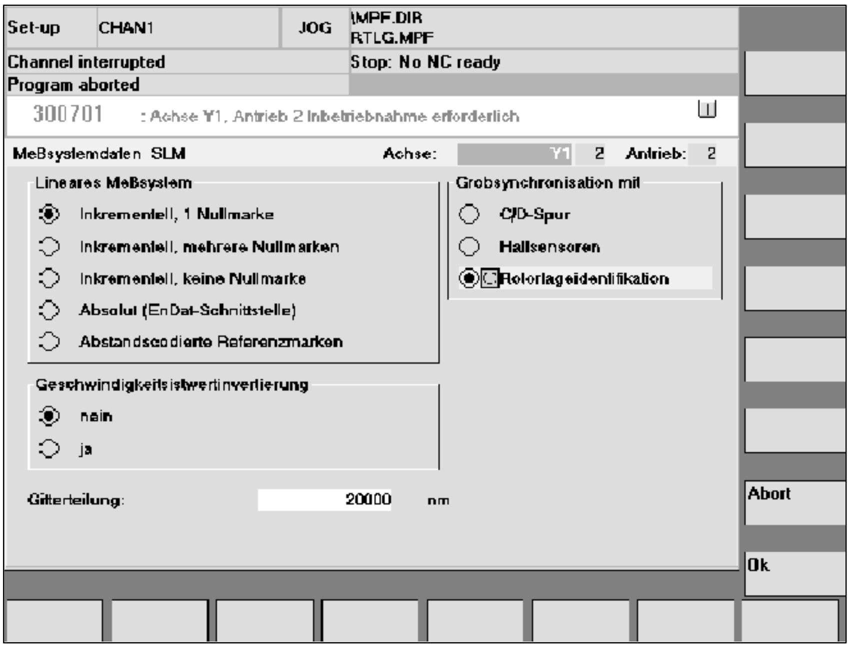

Figure 9-28 Data entry for incremental measuring system with rotor position identification

Enter encoder data

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

- Incremental – one zero marker
  An incremental measuring system with one zero marker is installed in the traversing range.
- Incremental – several zero markers
  An incremental measuring system with several zero markers is installed in the traversing range.
- Incremental – no zero marker
  An incremental measuring system without a zero marker is installed in the traversing range.

“Invert actual velocity value”: yes/no (Subsection 9.3.6)

Enter “Graduations” of measuring system

“Coarse synchronization with” field:

- Rotor position identification: yes (applies only to incremental measuring system)

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

b) Absolute encoder (EnDat)

An absolute measuring system (EnDat interface) is installed.

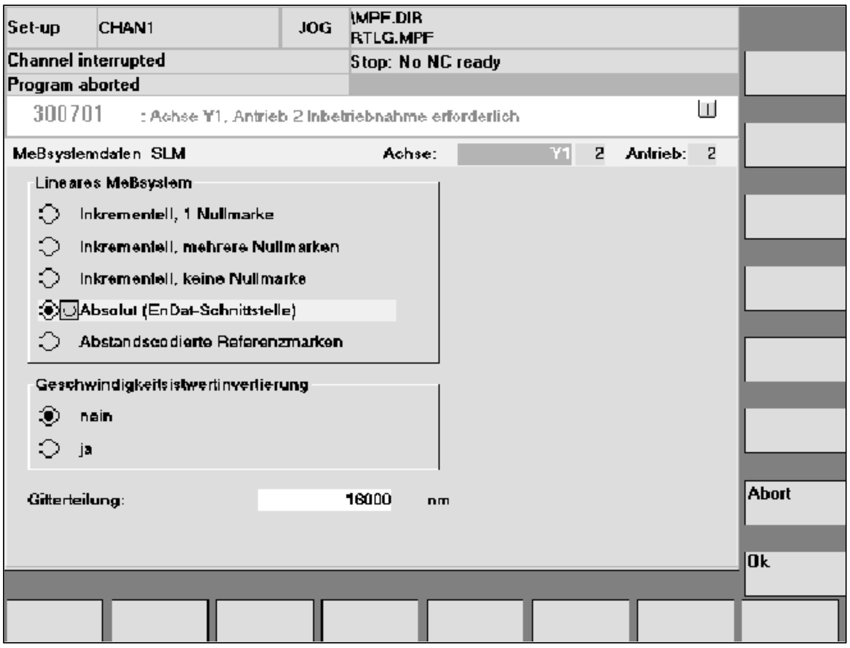

Figure 9-29 Data entry for absolute measuring system, e.g. LC181

The following data must be entered:

- In “Linear measuring system” field: Select absolute (EnDat interface)
- “Invert actual velocity value” (Subsection 9.3.6)
- 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 9.3.5), 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 the identification procedure via MD 1075. Possibly adapt other machine data for rotor position identification.

   b) Save bootfiles and perform NCK reset.

   c) Continue as described below, depending on which measuring system is installed:

Incremental measuring system

With an incremental measuring system:

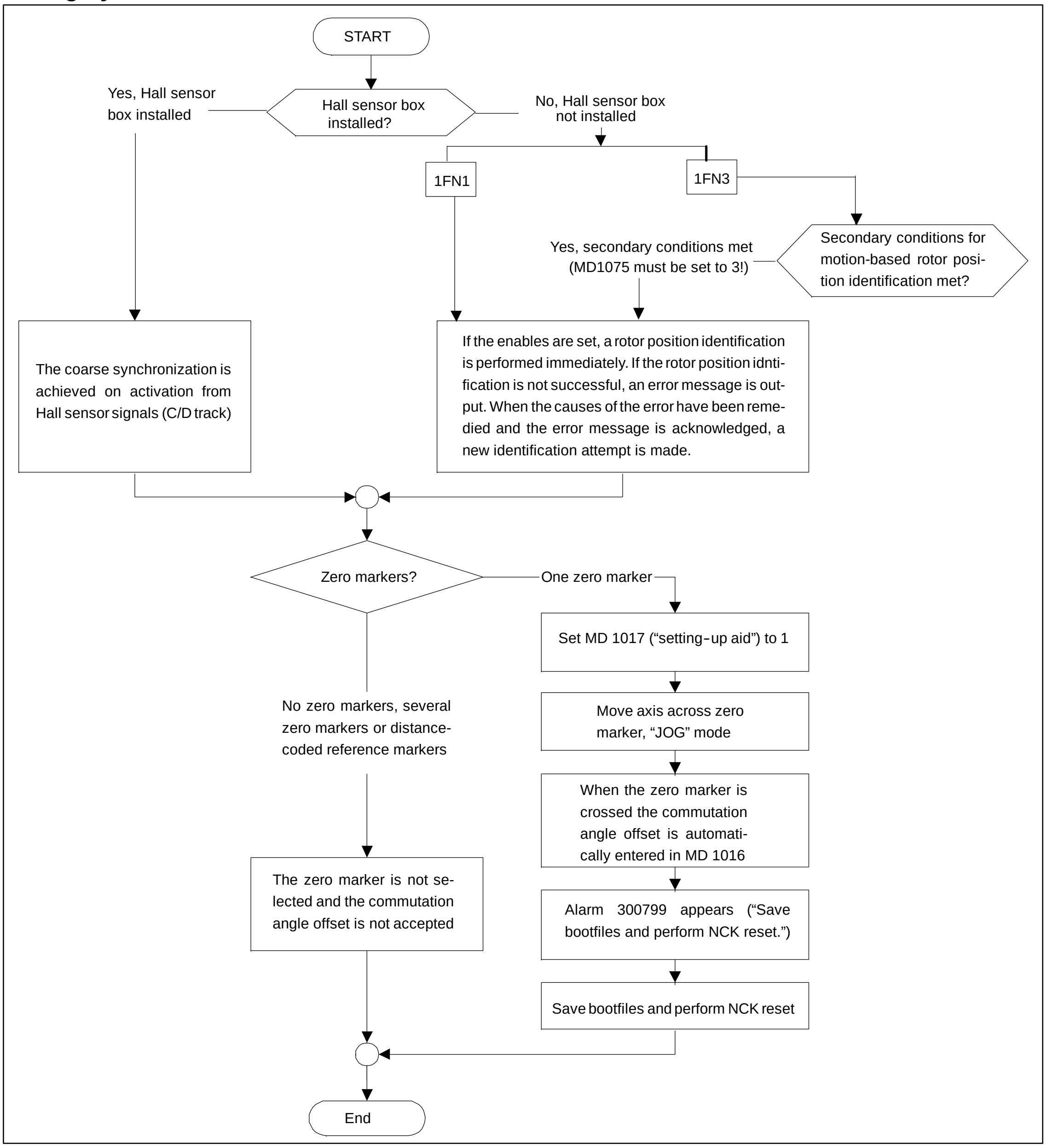

Figure 9-30 Incremental measuring system

Absolute measuring system

With an absolute measuring system:

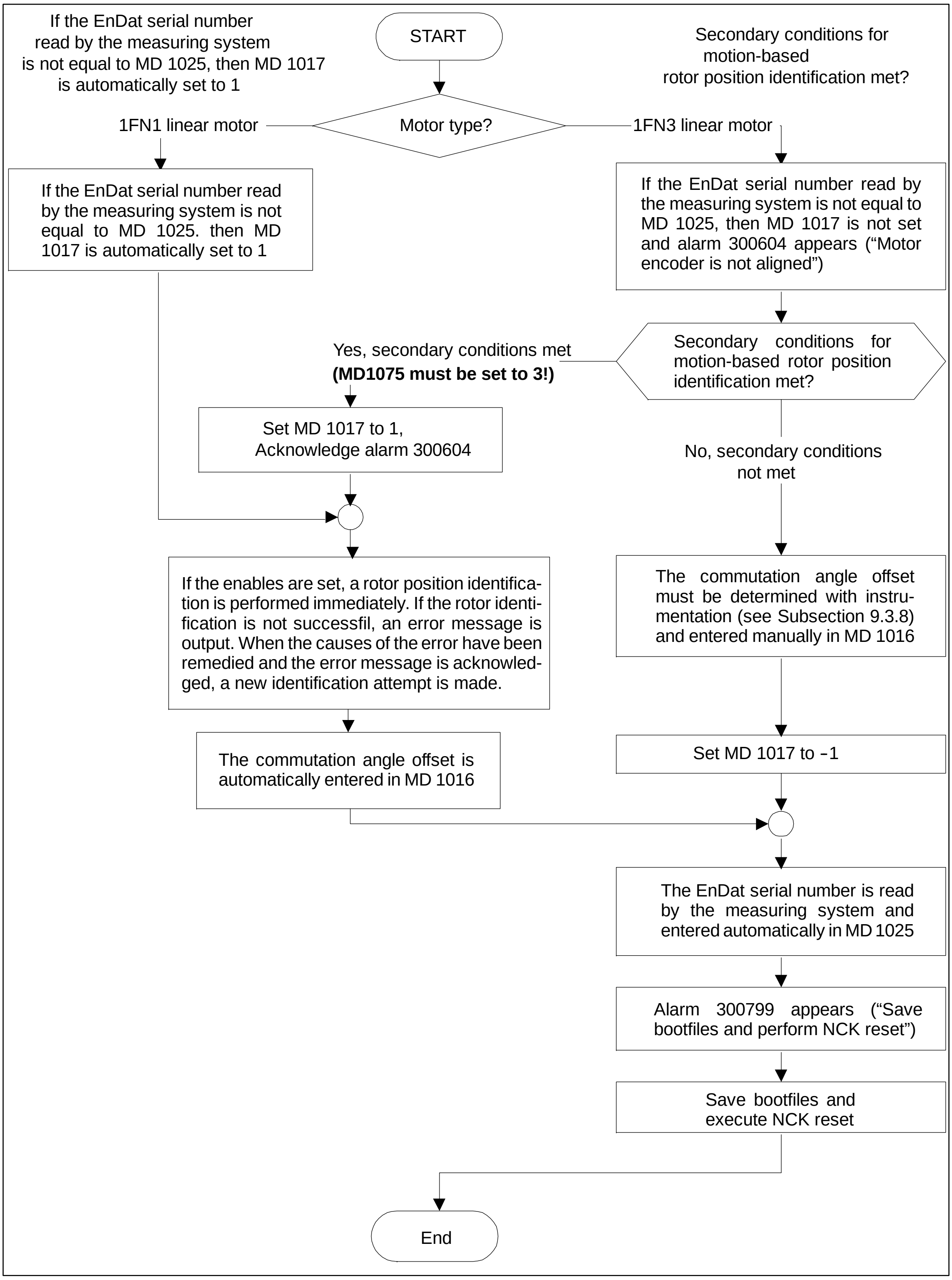

Figure 9-31 Absolute measuring system

Distance-coded measuring system

This measuring system is not supported by the SIMODRIVE 611D.
Several zero markers must be selected incrementally.
(see Fig. 9-28)

Note

There is no guarantee that rotor identification systems will detect the commutation angle offset correctly on non-Siemens motors. 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: instrumentation-aided measurement of the commutation angle offset (see Subsection 9.3.8).

At the end of the start-up procedure, it is essential to check the commutation angle offset with the aid of instrumentation!

---

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

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Note

If a Hall sensor is used it is only possible to verify the results with the aid of instrumentation (see Subsection 9.3.8).

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 (Rotor position identification difference)
= _ _ _ _ , _ _ _ _ , _ _ _ _ , _ _ _ _ , _ _ _ _

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

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

If okay after repeating, then determine the <u>commutation angle offset</u> again as follows:

– With an incremental measuring system:

a) Incremental – one zero marker
See step 7. (determine commutation angle offset)

b) Incremental – no zero markes or several zero markers
Select “Save bootfile” and “NCK reset”

– With an absolute measuring system:

Switch off the drive (NCK reset)
Switch on the drive, deactivate pulse or servo enable set MD 1017 = 1

Activate pulse and servo enables
--> The angle offset is automatically entered in MD 1016
--> Alarm 300799 appears

--> Save bootfile, perform NCK reset

Example for rotor position identification (see figure below):

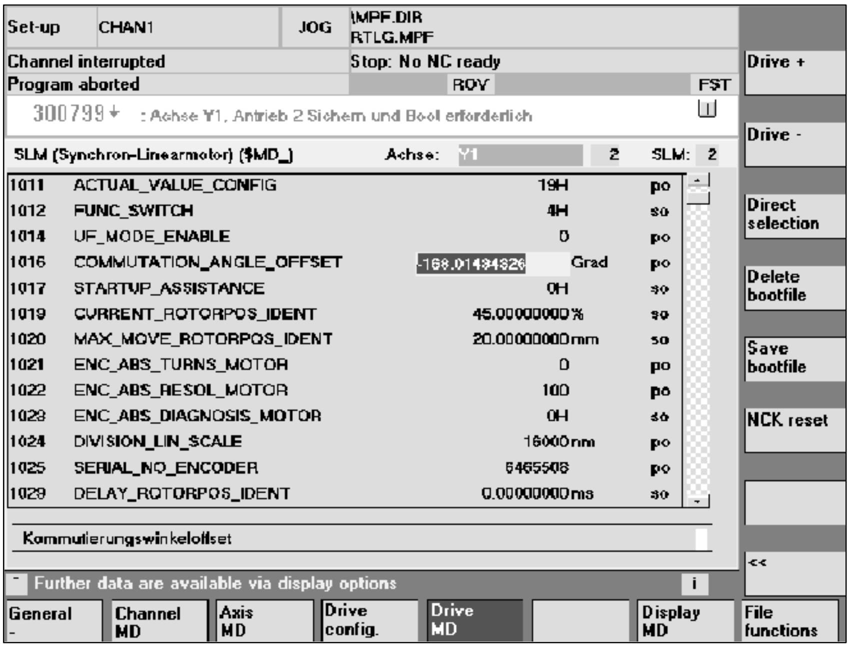


Figure 9-32 Result of rotor position identification with absolute measuring system

9. Move axis and check correct function

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

   – No Change MD 32100 (travel direction)

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

10. Set and perform referencing/adjustment

   – Incremental measuring system:
     Referencing

   – Absolute measuring system:
     Adjustment

11. Set 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)

9.3.3 Start-up: Linear motors with 2 identical primary sections

General information

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 paralleled 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 automatically calculated and noted during this phase (see Subsection 9.3.8).

Motor 2 is then connected in place of motor 1 and operated as a single motor. The commutation angle offset for this motor is also calculated automatically and noted (see Subection 9.3.8).

If the difference between the commutation angle offsets of motors 1 and 2 is less than 10 degrees electrical, both motors can be connected in parallel to the drive and started up as a parallel connection of 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 information in Subsection 9.3.1

   --> Start up the linear motor as described in Subsection 9.3.2 (up to and including step 7.)

   --> Check and set rotor position identification (see Subsection 9.3.2, step LEERER MERKER)

3. Move axis and check correct function

4. Note 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

   Notice:
   In the case of a Janus configuration (see Subsection 9.3.7), interchange phases 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 9.3.2, step 7.: “Determine the commutation angle offset”)
   - With an absolute measuring system:
     Switch off the drive (NCK reset)
     (see Subsection 9.3.2, step 7.: “Determine the commutation angle offset”)
9. Move axis and check correct function
   (Subsection 9.3.2, 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 and correct mechanical assembly
    (see Subsections 9.3.4 and 9.3.7)
    Delete motor data of single motor --> delete bootfile
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 9.3.2
    - Select the paralleled motor (2x1FN...) in the “Motor selection” dialog
      or:
      enter the data for the paralleled unlisted motor (as described under “Unlisted motor - parameters for SLM”).
16. Compare commutation angle offset between motors 1 and 2
    - Check motor cable connection on power section, adjust if necessary and determine the commutation angle offset.
    - With an incremental or absolute measuring system:
      Refer to Subsection 9.3.2, step 7.: “Determine the commutation angle offset”

9.3.4 Mechanical system

Checking the mounting dimensions and air gap

Mounting 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 mounting dimensions can be found in the following documents:

- /PJLM/ SIMODRIVE Planning Guide Linear Motor
- The data sheet of the appropriate 1FN1 or 1FN3 motor.

Please note with respect to mounting dimension and air gap:
The electrical and system-related properties of the linear motor are guaranteed solely as a function of the mounting dimension and not the measurable air gap. The air gap must be large enough to allow the motor to move freely.

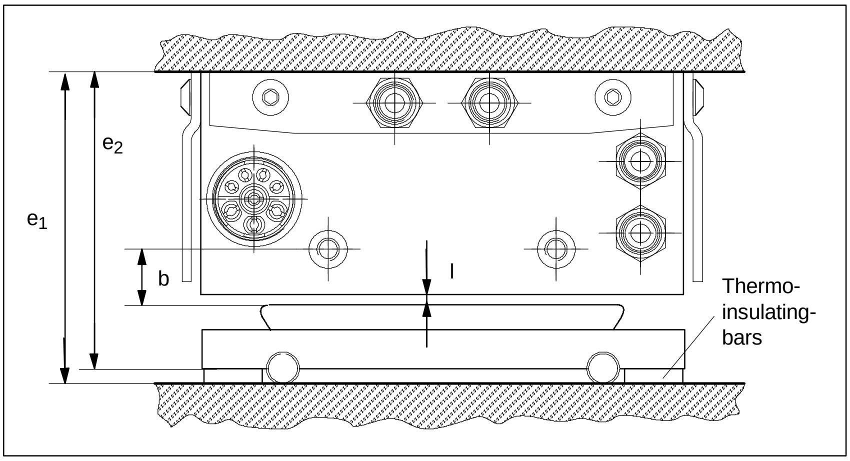


Figure 9-33 Check dimensions for motor installation illustrated by a 1FN1 motor

Table 9-14 Check dimensions for mounting dimension and air gap for a 1FN1 linear motor

Linear motors / Check dimensions	1FN1 ...	
	1FN1 07☐	1FN1 12☐ 1FN1 18☐ 1FN1 24☐
Mounting dimension e_1 [mm]	80.7 ± 0,3	106.7 ± 0,3
Mounting dimension e_2 [mm] (without thermo-insulating bars)	76.7 ± 0,3	101.7 ± 0,3
Measurable air gap l [mm] (not including mounting dimension tolerance)	$1.1\ ^{+0.3}/_{-0.45}$	$1.1\ ^{+0.3}/_{-0.45}$
Distance b [mm] (not including mounting dimension tolerance)	13 ± 1	13 ± 1

For mounting dimensions of 1FN3 linear motors, see dimension drawings in appendix of 1FN Planning Guide, mounting height h_M or h_{M1}.

9.3.5 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:

References: /PJLM/ Planning Guide Linear Motors.

9

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).

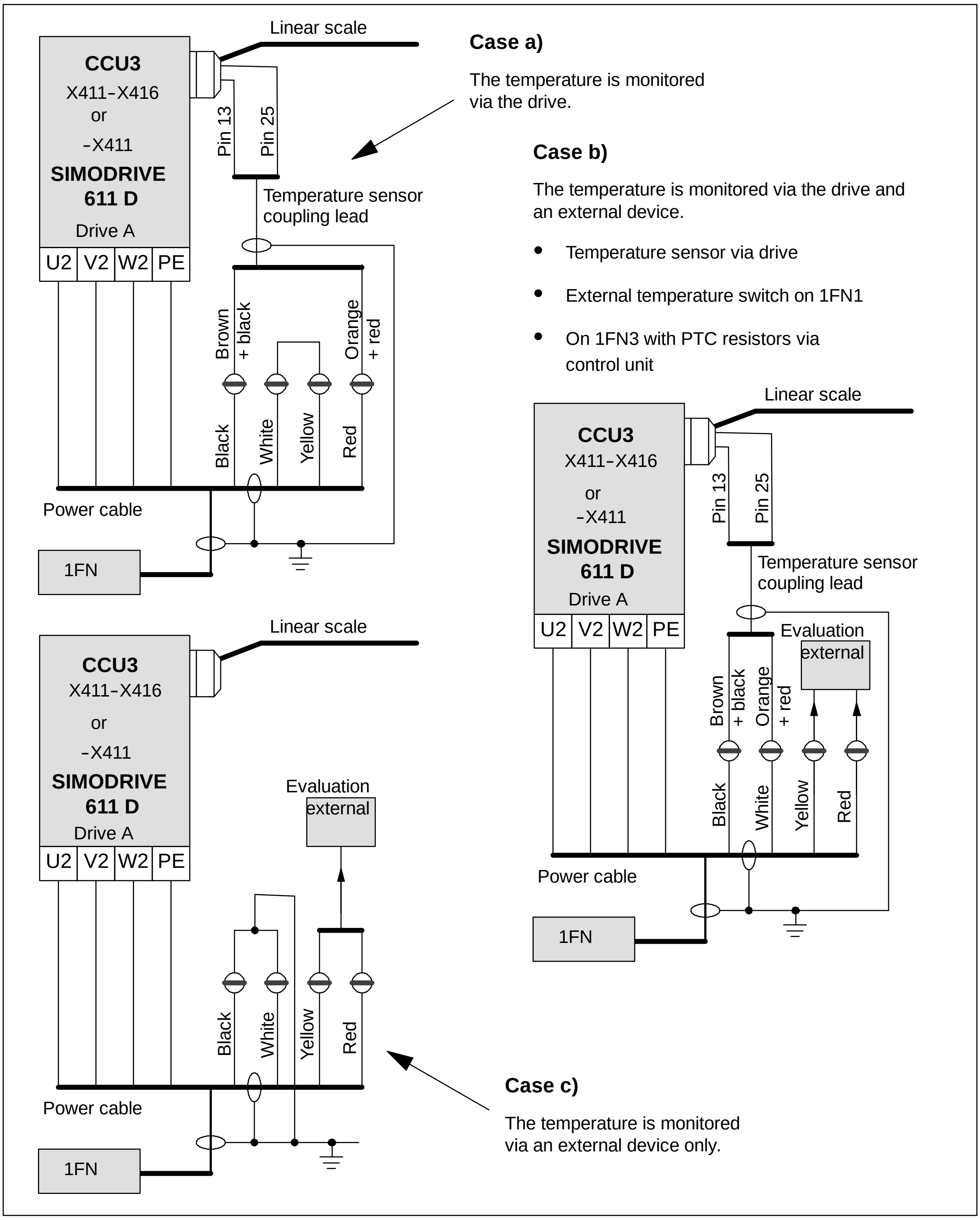


Figure 9-34 Evaluation of KTY temperature sensor (black/white) and switch or PTC (yellow/red) (whether temperature switch or PTC resistor depends on motor type, i.e. 1FN1 or 1FN3)

Note

The outer and inner shield of the signal leads in the power cable and the shield of the temperature sensor coupling lead must be attached in a 360-degree connection with the shield connection 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 9-15 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	–	–

9.3.6 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 positive count direction of the measuring system **do not coincide**, then the actual speed value must be inverted in the “Measuring system/encoder” dialog during start-up.

6It 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. 9-35), 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.

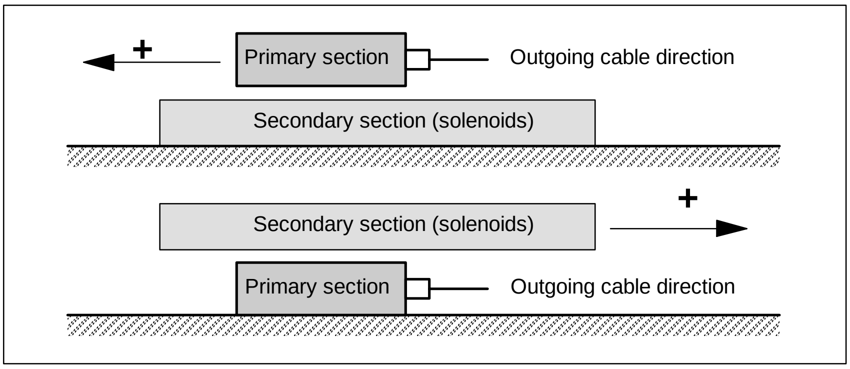


Figure 9-35 Determining the positive direction of the drive

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. 9-36)

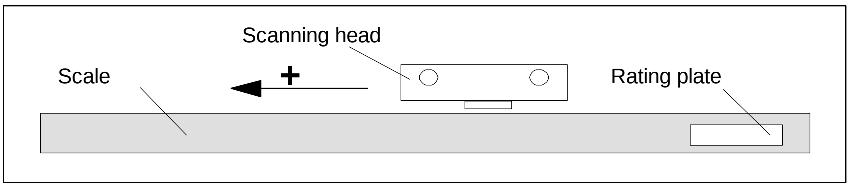


Figure 9-36 Determining the count direction of Heidenhain measuring systems

2. Renishaw measuring systems (e.g. RGH22B)

   The Renishaw RGH22B measuring system (graduations = 20 m) has compatible connections with the Heidenhain products from serial number G69289 onwards. 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 9-16 Signal and pin assignments, routing on 1FN linear motor

Signal	Cable color	Circular 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.

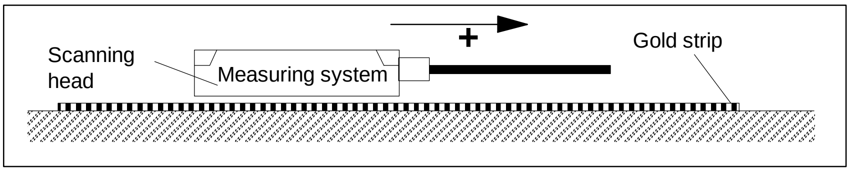


Figure 9-37 Determining the count direction of Renishaw measuring systems

Note

If the scanning head is mechanically coupled to the primary section, the outgoing cable 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 roughly using the rotor position identification routine.

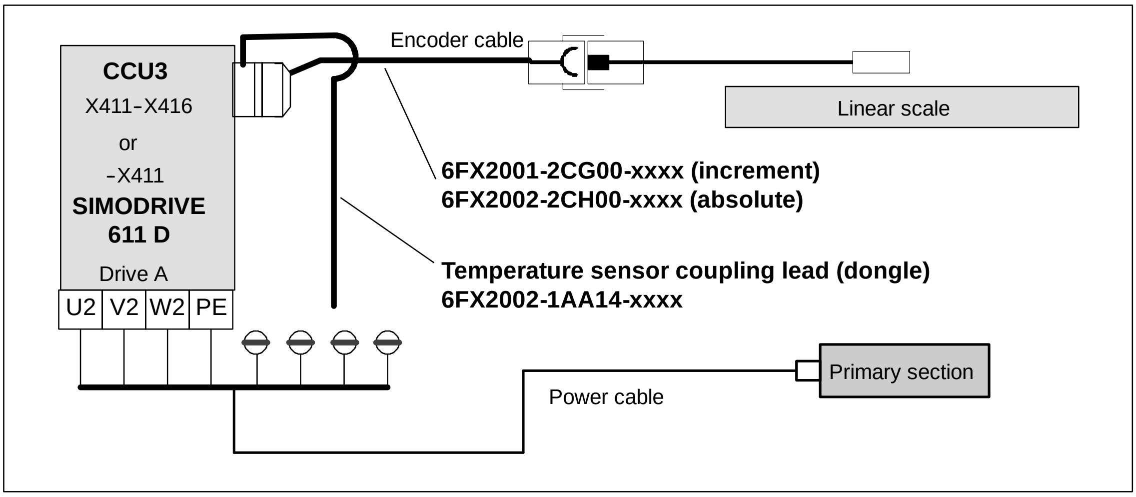
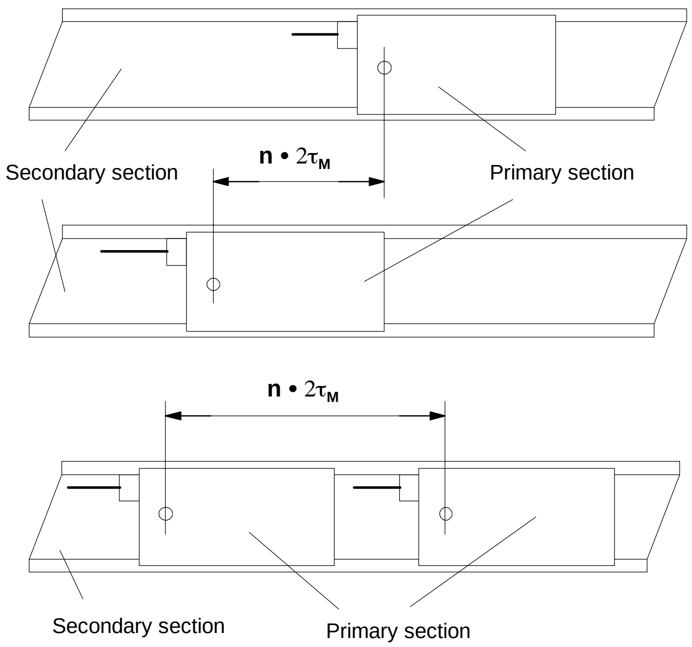


Figure 9-38 Temperature sensor coupling lead (recommended standard connection)

9.3.7 Parallel connection of linear motors

Mechanical design

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

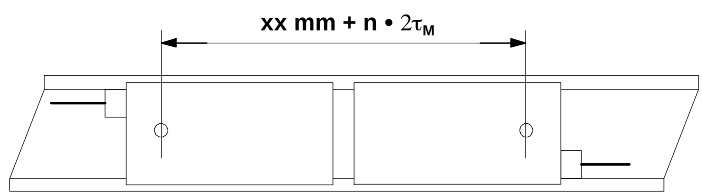
τ_M: Pole pair width (see MD1170)

n: 0, 1, 2, ...

Figure 9-39 Parallel connection of linear motors (standard configurations)

Janus configuration (special type of parallel connection)

With this type of parallel connection (Janus configuration), the outgoing cable directions of the individual motors are opposed.



Note:

Different outgoing cable directions
τ_M: Pol pair width (see MD1170), 1FN107x: τ_M = 28.2 mm, 1FN11xx and 1FN12xx: τ_M = 36 mm
n: 0, 1, 2, ...
xx: Constant dimensions (see data sheet of motor manufacturer)

Figure 9-40 Parallel connection of linear motors (Janus configuration, special type)

Temperature sensor and electrical wiring (see Subsection 9.3.5)

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

- Temperature sensor
  - Motor 1: Evaluation via the drive
  - Motor 2: Not connected (shorted-circuited or connected to PE)
- Temperature switch or PTC
  - Motors 1 and 2: External evaluation

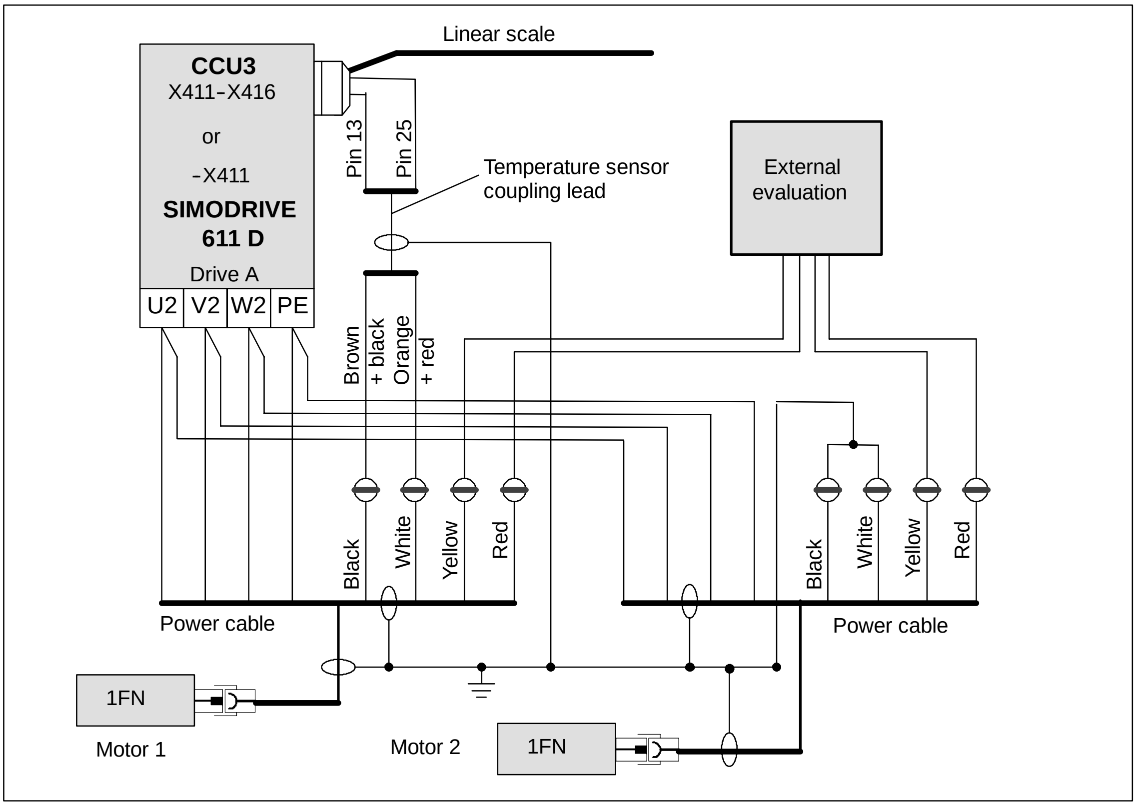


Figure 9-41 Wiring of parallel-connected linear motors

9.3.8 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 of motor 1 must be in phase with EMF_U of 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.
- Notice: Wait for DC link to fully discharge!
- Disconnect power cable from drive.
  Separate any parallel connection of primary sections.
- Create an artificial neutral point using 1 kohm resistors.

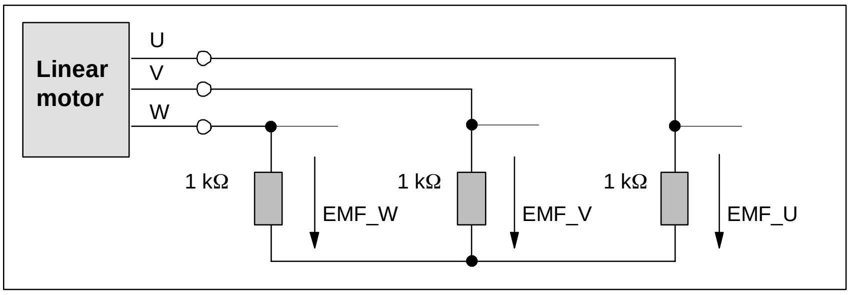


Figure 9-42 Arrangement for test measurements

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.

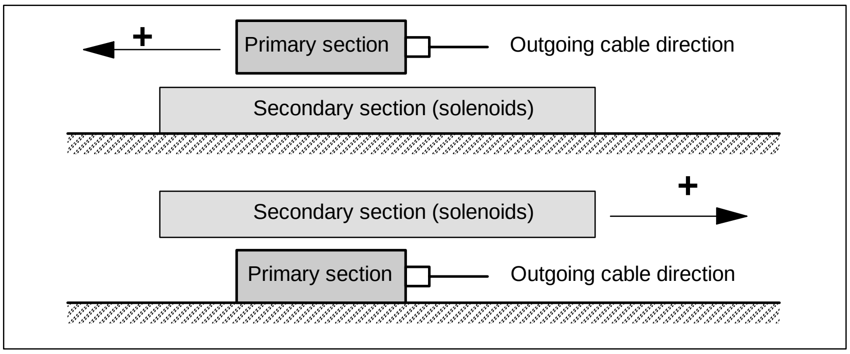


Figure 9-43 Determining the positive direction of the drive (CW rotating field)

Determining the commutation angle

After the oscilloscope has been connected, the drive must be made to cross the zero marker first in order to synchronize it.

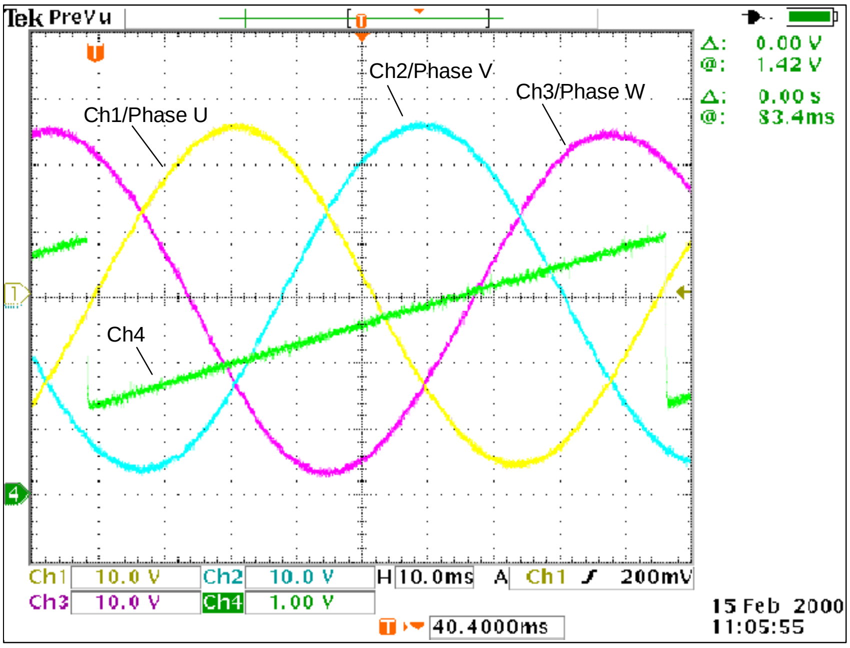


Figure 9-44 Determining the commutation angle offset by measuring the EMF and normalized electrical rotor position via DAC in a positive drive direction.

Definition of channels (Ch1 ... Ch4):

- Ch1: EMF phase U to neutral point
- Ch2: EMF phase V to neutral point
- Ch3: EMF phase W to neutral point
- Ch4: Normalized electrical rotor position via DAC measuring signal.

Note

When selecting the measuring signal “Normalized, electrical rotor position”, the shift factor should be changed from 7 to 8 and the offset value changed from –1.25 V to –2.5 V.

With a synchronized drive, the difference between EMF/phase U and the electrical rotor position must 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”.

9.4 AM operation with induction motors

9.4.1 Description

AM operation

The AM function permits a pure induction motor operation or mixed main spindle/induction motor operation.

The AM mode of the SIMODRIVE 611D main spindle drive is used to control the speed of induction motors in 4 quadrants, without using speed or rotor position encoders. Induction motor operation permits higher requirements regarding the dynamic control requirements and the stall stability than conventional converter drives with V/f characteristic control. In comparison to drives with rotor position encoder, the speed accuracy is somewhat lower, and thus, in the low speed range, there will be some restriction as far as the dynamic performance and the smooth running characteristics are concerned.

The AM mode is mainly used in the area of high-speed special motors, for grinding applications and for punch drives and press drives.

Control

As the dynamic performance in AM mode is less than in the main spindle drive mode with speed controller a speed torque frequency pre-control is implemented, in order to improve the dynamic performance. This pre-control is only active in the AM mode. Provided with information regarding the drive torque and taking into account the existing torque and current limits as well as the load, the necessary torque for a required speed change is controlled optimally from a time perspective. Thus, with the correct parameterization, overshoot is eliminated and the control dynamic performance enhanced.

A smoothing time can be parameterized via MD 1459: TORQUE_ SMOOTH_ TIME_AM for the torque pre-control. For induction motor operation, the speed controller is parameterized using its own machine data due to the low dynamic performance (MD 1451 and MD 1453).

In the vicinity of low speeds, for pure AM operation, the actual speed, orientation and actual value flux can no longer be computed due to the accuracy of the measured values and the parameter sensitivity of the technique. Thus, an open-loop current/frequency control is selected. The changeover threshold is set in MD 1466: SWITCH_SPD_OPEN_LOOP_AM , which implements a 5% hysteresis. In order to also accept a higher load torque in the open-loop controlled range, the motor current can in this case be increased via MD 1458: DES_CURRENT_OPEN_LOOP_AM.

Response after pulse suppression

When the pulses are suppressed and the drive is in a pure AM mode, the drive converter does not have any information regarding the motor actual speed. When the pulses are subsequently enabled, the speed actual value must first be searched for. It is possible to specify whether the search starts at the setpoint speed (bit 7=0) or at speed 0 (bit 7=1), using MD 1012: FUNC_SWITCH, bit 7.
When the motor is at a standstill and MD 1012: FUNC_SWITCH, bit 7 = 0 a high setpoint should not be input before the pulses are enabled.

MSD/AM operation

The AM function allows the control behavior to be changed over from MSD to AM control online. This is performed automatically using a speed threshold. The changeover speed is defined in MD 1465: SWITCH_SPEED_MSD_AM.

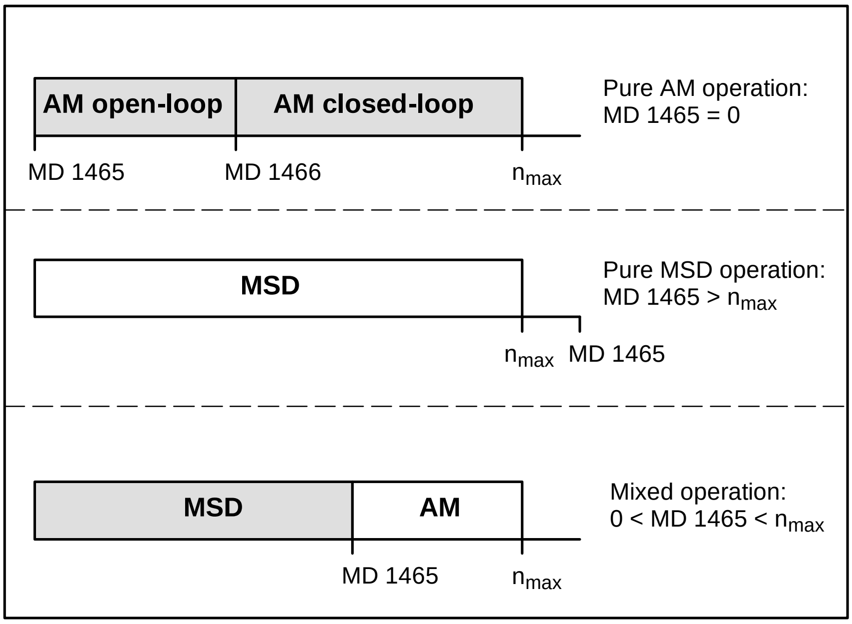


Figure 9-45 MSD/AM operating ranges

Note

In pure AM operation, it is possible to operate without a rotor position encoder. In this case, there is generally no temperature sensing, a fixed temperature must thus be selected in MD 1608: MOTOR_FIXED_TEMPERATURE, and the motor temperature threshold appropriately assigned in MD 1602: MOTOR_TEMP_WARN_LIMIT. For induction motor operation, only pulse frequencies of 4 and 8 kHz are permissible in MD 1100: PWM_FREQUENCY.

Operating modes

The operating modes are displayed in MD 1730: OPERATING_MODE.

Bit 0: FSD, closed-loop controlled
Bit 4: MSD operation
Bit 8: AM, open-loop controlled
Bit 9: AM, closed-loop controlled
Bit 12: V/f mode

Series reactor

When using special high-speed motors or other low leakage induction motors, a series reactor may be required to provide stable operation of the closed-loop current controller. The reactor is taken into account in the current model through MD 1119: SERIES_INDUCTANCE.

Motor changeover

The star/delta changeover of main spindle drive operation can, in the induction motor mode, be used to change over between two physically different motors.

Note

To perform a motor changeover, MD 1401: MOTOR_MAX_SPEED and MD 2401: MOTOR_MAX_SPEED must have the same value for both motors.

9.4.2 Start-up of standard motors

Start-up of (standard) induction motors without speed and rotor position encoders or main spindle motors with encoder. The drive module is configured as spindle (main spindle drive) in the drive group. Further steps for induction motor start-up are described below.

Selecting motors from the MLFB list

The motor/power section data display is reached using the **Diagnosis \ Start-up \ Machine data \ MSD** softkeys.

An MLFB list of the available motors is displayed using the **Motor/controller** and **Select motor** softkeys. Select a motor using the cursor keys and confirm the selection with **OK** (the **Calculate controller data** function is executed automatically). The motor/power section-specific data must be entered manually if the motor type is not in the list (third-party motor).

Encoder

The encoder type and number of encoder marks can also be entered under **Select motor**. If neither motor 1 nor motor 2 has an encoder, then “No encoder” must be selected for the encoder type.

Even if there is no encoder, a practical value must be entered for the number of encoder marks (e.g. 2048).

Manual entry of motor data (unlisted motor)

If all of the motor data are known (rating plate and equivalent circuit diagram data), they can be entered in the appropriate parameters.

Rating plate data

If only the motor rating plate data are known (manufacturer’s data according to DIN VDE 0530, Part 1), then the equivalent circuit diagram data are calculated approximately using an integrated conversion program.

Table 9-17 Rating plate data to be entered

MD no.	Identifier	Description
MD 1103	MOTOR_NOMINAL_CURRENT	Rated motor current
MD 1119	SERIES_INDUCTANCE	Series reactor inductance
MD 1129	POWER_FACTOR_COS_PHI	cos φ power factor
MD 1130	MOTOR_NOMINAL_POWER	Rated motor power
MD 1132	MOTOR_NOMINAL_VOLTAGE	Rated motor voltage
MD 1134	MOTOR_NOMINAL_FREQUENCY	Rated motor frequency
MD 1146	MOTOR_MAX_ALLOWED_SPEED	Max. motor speed
MD 1400	MOTOR_RATED_SPEED	Rated motor speed

Equivalent circuit diagram data

If the equivalent circuit diagram data are known, they can be entered in the parameters listed below. If the equivalent circuit diagram data are not known, they must be determined from the rating plate data by activating the **Calculate equivalent circuit diagram data** softkey. The calculated values are then assigned to the following machine data.

Table 9-18 Calculated equivalent circuit diagram data

MD no.	Identifier	Description
MD 1117	MOTOR_INERTIA	Motor moment of inertia
MD 1135	MOTOR_NOLOAD_VOLTAGE	Motor no-load voltage
MD 1136	MOTOR_NOLOAD_CURRENT	Motor no-load current
MD 1137	STATOR_COLD_RESISTANCE	Stator cold resistance
MD 1138	ROTOR_COLD_RESISTANCE	Rotor cold resistance
MD 1139	STATOR_LEAKAGE_REAKTANCE	Stator leakage reactance
MD 1140	ROTOR_LEAKAGE_REAKTANCE	Rotor leakage reactance
MD 1141	MAGNETIZING_REAKTANCE	Magnetizing reactance
MD 1142	FIELD_WEAKENING_SPEED	Threshold speed field weakening

Calculating the controller data

The controller data are calculated from the motor data (rating plate and equivalent circuit diagram data) when you press the **Calculate controller data** softkey. These include the controller settings, in particular. If necessary, the controller parameters can be optimized manually later for the machine.

After the controller data has been computed, induction motor mode is activated by entering the MSD/AM changeover speed (MD 1465). The following machine data
must also be adapted for induction motor mode:

- MD 1100: PWM_FREQUENCY
- MD 1602: MOTOR_ TEMP_WARN_LIMIT
- MD 1608: MOTOR_FIXED_TEMPERATURE.

Table 9-19 AM mode parameters

MD no.	Identifier	Description
MD 1451	SPEEDCTRL_GAIN_1_AM	P gain, AM speed controller
MD 1453	SPDEECTRL_INTEGR_TIME_1_AM	Integral action time, AM speed controller
MD 1458	DES_CURRENT_OPEN_LOOP_AM	Current setpoint open-loop controlled range, AM
MD 1459	TORQUE_SMOOTH_TIME_AM	Torque smoothing time constant, AM
MD 1465	SWITCH_SPEED_MSD_AM	Changeover speed, MSD/AM
MD 1466	SWITCH_SPD_OPEN_LOOP_AM	Changeover speed, closed-loop/ open-loop control, AM

Note

The controller data must be re-calculated if the motor data change.

9.4.3 Start-up of third-party motors (self start-up)

Danger

During self-installation, the motor is caused to move by the drive until it reaches its maximum speed.
The EMERGENCY STOP functions must be fully functional during start-up. The relevant safety regulations must be observed in order to prevent risk of injury or damage to the machines.

Self-installation

Self-installation supports the connection of third-party induction motors to the SIMODRIVE 611D drive system.

The installer often only knows the rating plate (manufacturer data as per DIN VDE 0530, Part 1) of the motor. Using the tool “Calculate equivalent circuit diagram data” implemented as of SW 3.0, further motor data are calculated from the rating plate.
The result of the calculation is merely a rough estimate. The self-installation function is used to improve the result.

During self-installation, voltage, current and speed setpoint patterns are sent to the motor and the reaction of the motor used to obtain data for the equivalent circuit diagram data.

Preconditions for start-up

- Pulse and controller enable signals are required
- Self-installation is possible in MSD and AM modes.
  For MSD, there is no need to determine the moment of inertia.
- For motor changeover, the self installation can be carried out separately for each motor; the motor must be selected via PLC.
  During self installation, motor changeover is disabled.

Flow chart for start-up of third-party motors

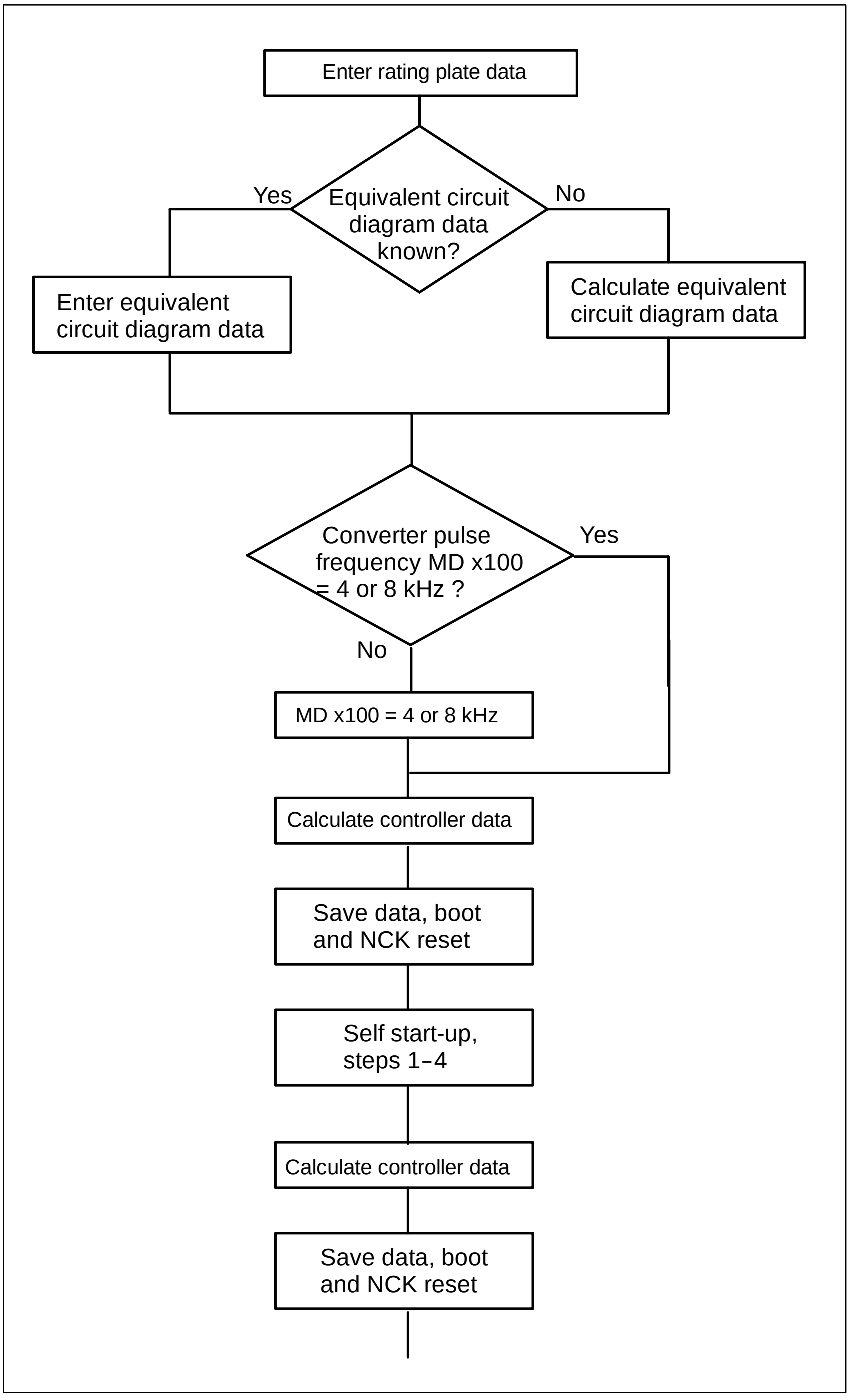


Figure 9-46 Flow chart for start-up of third-party motors

9.4.4 Motor data optimization, steps 1 to 4

Optimization with SIMODRIVE611digital start-up tool

Motor data optimization is supported by the SIMODRIVE611digital start-up tool.

When you select “Motor data optimization”, a menu appears with the “Settings” selection box. You can select the following optimization steps and start them successively with the “Start” button:

1. Step 1: Ascertaining resistances and reactances
2. Step 2: Fine adjustment no-load current, magnetizing reactance
3. Step 3: Determine speed at which field weakening starts
4. Step 4: Determine the moment of inertia.

The result of the optimization steps is updated in the machine data listed in the menu display.

Interactive menu for AM/MSD self start-up

The main menu for self start-up is called up by pressing softkeys **Drives/servo / Self-opt**. AM/MSD.

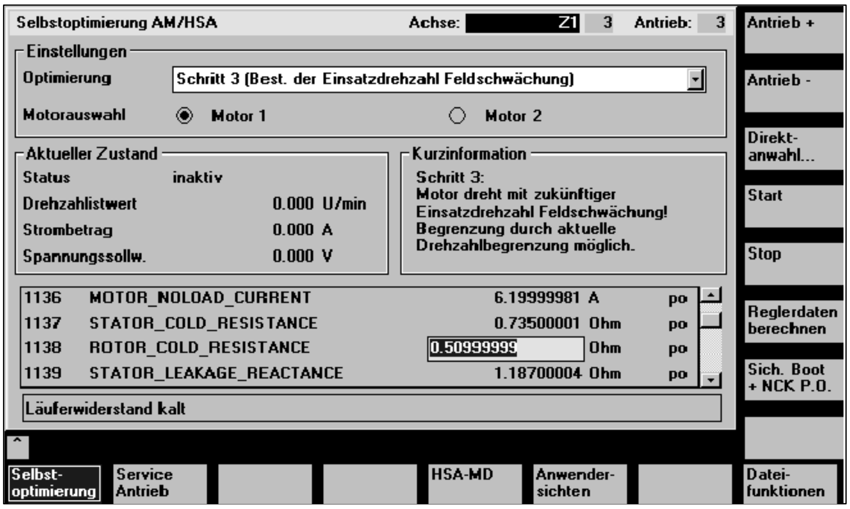


Figure 9-47 Main AM/MSD self start-up screen

Parameter settings

Spindle selection

The axis/spindle can be selected via the **Drive+** and **Drive-** softkeys and via the **Direct selection** softkey. The axis and drive number are displayed during “Self-optimization AM/MSD”.

Selecting the optimization step

The desired optimization step is selected when entering the settings via the “Optimization” list. You can select individual or all optimization steps.

Selecting the motor

The desired motor is selected when entering the settings for the motor selection. You can activate the “Motor 1” or “Motor 2” selection fields with the toggle key when the cursor is positioned on the fields.

A list of machine data is displayed, in which the equivalent circuit diagram data can be entered directly or viewed.

The status of the function (active, inactive) and the start-up step are displayed in “Actual state” and “Brief information”.

Calculate controller data

When you press the softkey, a warning is output for “Calculate controller data”. It is then possible to

- start or
- cancel the function or
- display further information about the “Calculate controller data” function by pressing the **Help** softkey.

Save boot + NCK P.O.

The axis/spindle can be selected via the **Drive+** and **Drive–** softkeys and also via the **Direct selection** softkey. The axis and drive number are displayed during “Self-optimization AM/MSD”.

User views

The display switches to “User views”. A return is possible only with the **RECALL** softkey.

File functions

A display for loading/deleting/storing the MSD machine data is selected.

9

Start-up step 1

Determine the resistances and reactances of the motor and an improved value for the no-load current.

Note

- The motor is not moved during this measurement.
- Monitoring is not possible since there is no encoder in AM operation.

Supplementary conditions

- The motor must not move during this measurement.
  Repeat this step if necessary.
- Enter the series reactor in MD x119: SERIES_INDUCTANCE.
- AC rectifier pulse frequency = 4 kHz or 8 kHz
  (MD 1100: PWM_FREQUENCY)
- MD x238: CURRENT_LIMIT = 150% for the measurement or maximum possible value. Observe the load limit for the motor winding.

Executing step 1

Step 1 is started with softkey **Start** and the NC Start key. The current status is displayed while this step is in progress.

You can abort the optimization procedure with the **Stop** softkey or with RESET.

Modified machine data

The following machine data are calculated/written:

- MD x136: MOTOR_NOLOAD_CURRENT
- MD x137: STATOR_COLD_RESISTANCE
- MD x138: ROTOR_COLD_RESISTANCE
- MD x139: STATOR_LEAKAGE_REACTANCE
- MD x140: ROTOR_LEAKAGE_REACTANCE
- MD x141: MAGNETIZING_REACTANCE.

Start-up step 2

Determine the no-load current and magnetizing reactance.

The no-load current is set so that at rated speed the no-load voltage is set at the motor terminals.

Danger

The motor is accelerated with positive rotating field direction up to the rated motor speed.

Executing step 2

Step 2 is started with softkey **Start** and the NC Start key. The current status is displayed while this step is in progress.

You can abort the optimization procedure with the **Stop** softkey or with RESET.

Modified machine data

The following machine data are calculated/written:

- MD x136: MOTOR_NOLOAD_CURRENT
- MD x141: MAGNETIZING_REACTANCE.

Start-up step 3

Determine the threshold speed for field weakening.

When traveling at the threshold speed for field weakening with DC link voltage $V_{DC\ link\ voltage}$ the rectifier output voltage is set to 380V.
If $V_{DC\ link\ voltage}$ < 600 V, the rectifier output voltage is reduced by the factor V_{DC} / 600 V.

Danger

The motor is accelerated with positive rotating field direction up to the threshold speed for field weakening, but not higher than the current effective speed limit.

Executing step 3

Step 3 is started with softkey **Start** and the NC Start key. The current status is displayed while this step is in progress.

You can abort the optimization procedure with the **Stop softkey** or with RESET.

Modified machine data

The following machine data is calculated/written:

- MD x142: FIELD_WEAKENING_SPEED

Start-up step 4

Determine the moment of inertia

The moment of inertia is set such that there is no I component in the speed controller when accelerating to maximum speed.

Danger

The motor is accelerated to maximum speed several times with positive rotating field direction.

Note

This step is omitted when self start-up is executed in MSD mode.

Supplementary conditions

- If a significant load moment of inertia is present during later operation, perform the step with linked load.

Executing step 4

Step 4 is started with softkey **Start** and the NC Start key. The current status is displayed while this step is in progress.

You can abort the optimization procedure with the **Stop** softkey or with RESET.

Modified machine data

The following machine data is calculated/written:

- MD x117: MOTOR_INERTIA

Errors during self start-up

Errors which occur during a self start-up routine cause the function to be aborted. The step must be repeated after remedying the cause of the error.

References: /DA/ Diagnostics Guide SINUMERIK 840D/810D/FM-NC

9.4.5 Messages during self start-up

The following error messages may appear at the start of or during self start-up.

- **Start-up step (in current status) not permissible**
  You have selected a start-up step that is not defined or not permissible in the current operating status.
- **Pulse rate of 4kHz or 8kHz required**
  An inverter frequency of 4kHz or 8kHz is required for step 1
  (MD x100: PWM_FREQUENCY).
- **Controller and pulse enable missing**
- **Speed setpoint < > 0**
  A setpoint has been input via the NC or the function generator.
- **Motor changeover active**
  A motor changeover was in progress at the commencement of identification.
- **Leakage inductance < 0**
  A value of < 0 has been measured for the leakage inductance.
  The reason for this could be an incorrect entry for the series reactor
  (MD x119: SERIES_INDUCTANCE).
- **V/f operation active**
  If V/f operation is selected
  (MD 1014: UF_MODE_ENABLE = 1), is not possible to perform self start-up.
- **Incorrect motor selected**
  The motor selected via the MMC is not the same as the motor selected via the PLC (control word/status word).
- **Nmax too low for measurement**
  The operating speed for the self start-up step must be greater than the currently parameterized maximum speed (MD x146: MOTOR_MAX_ALLOWED_SPEED).
- **Switchover speed under open-loop/closed-loop control too high**
  When determining the “threshold speed for field weakening” it was not possible to operate in the speed-controlled range for pure AM operation due to an excessively high switchover speed setting
  (MD x466: SWITCH_SPD_OPEN_LOOP_AM).

9.4.6 Machine data

1451	SPEEDCTRL_GAIN_1_AM				Cross reference: -
	P gain, AM speed controller			Related to: AM	Protection level: 2/4
Unit: Nms/rad	Default: 0.3	Minimum: 0.0	Maximum: 100 000.0	Data type: FLOAT	Active: immediately

Enter the P gain of the speed control loop in the induction motor mode or set (initialize) it automatically via the **Calculate controller data** operator action.

1453	SPDCTRL_INTEGR_TIME_1_AM				Cross reference: -
	Integral action time, AM speed controller			Related to: AM	Protection level: 2/4
Unit: ms	Default: 140.0	Minimum: 0.0	Maximum: 500.0 6 000.0 (SW 4.2 or higher)	Data type: FLOAT	Active: immediately

Enter the speed controller integral action time in the induction motor mode or set (initialize) it automatically via the **Calculate controller data** operator action.

1458	DES_CURRENT_OPEN_LOOP_AM				Cross reference: -
	Current setpoint open-loop controlled mode, AM			Related to: AM	Protection level: 2/4
Unit: %	Default: 90.0	Minimum: 0.0	Maximum: 150.0	Data type: FLOAT	Active: immediately

In pure AM mode (MD 1465 = 0), the drive operates in the current-frequency open-loop controlled mode below the changeover speed (MD 1466). In order to accept a high load torque, the motor current can be increased in this range using MD 1458. The input is a percentage referred to the rated motor current (MD 1103). The current is limited to 90% of the current limit value (MD 1238).

1459	TORQUE_SMOOTH_TIME_AM				Cross reference: -
	Torque smoothing time constant AM			Related to: AM	Protection level: 2/4
Unit: ms	Default: 4.0	Minimum: 0.0	Maximum: 100.0	Data type: FLOAT	Active: immediately

In AM operation, a pre-control for the speed torque frequency is implemented on account of the low dynamics. The pre-control value for the torque is smoothed using MD 1459.

9

1465	SWITCH_SPEED_MSD_AM				Cross reference: -
Changeover speed, MSD/AM				Related to: MSD/AM	Protection level: 2/4
Unit: rpm	Default: 50 000.0	Minimum: 0.0	Maximum: 100 000.0	Data type: FLOAT	Active: immediately

The drive operates in AM mode above the speed set here.

$n = 0$ →pure induction motor operation
$0 < n < n_{max}$ →mixed main spindle drive/induction motor operation
$n > n_{max}$ →only main spindle drive operation

If AM operation is selected, only pulse frequencies (MD 1100) of 4 kHz and 8 kHz are permissible.
With the **Calculate controller data** operator action, MD 1465 is set to 0, if a “no” is entered in MD 1011.5, motor measuring system available.

1466	SWITCH_SPD_OPEN_LOOP_AM (SW 3.1 or higher)				Cross reference: -
Changeover speed, control system AM				Related to: MSD/AM	Protection level: 2/4
Unit: rpm	Default: 300.0	Minimum: 150.0	Maximum: 100 000.0	Data type: FLOAT	Active: immediately

The current-frequency, open-loop controlled mode is used for pure AM operation (MD 1465=0), below the speed set here. MD 1466 is assigned a value with the **Calculate controller data** operator action.

For further information, please see

References: /FBA/ Drive Functions, DE1 Expanded Drive Functions.

9.5 Permanently excited spindle

9.5.1 Description

The permanently excited spindle (PE-MSD) is a specially designed synchronous motor (similar to FSD motors) with high armature inductance.

Weakening the magnetic field of the permanently excited armature achieves high speeds for spindle operation (analogous to the field weakening in inductance motors).

The advantages of the PE-MSD are:

- Higher power density
- Virtually no rotor losses and therefore low thermal load on the entire motor construction.

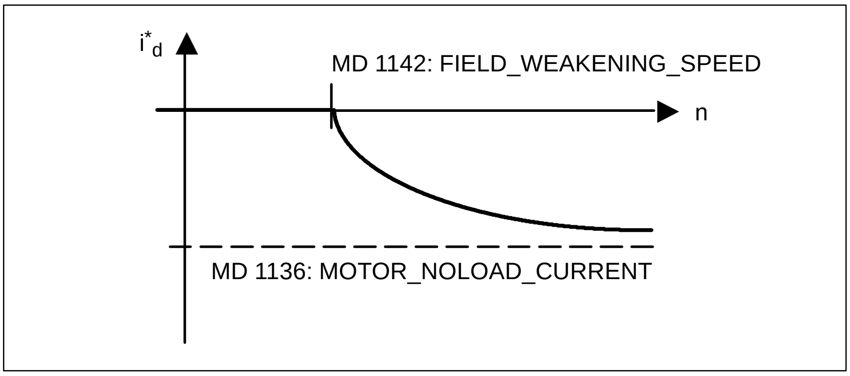


Figure 9-48 Field weakening characteristic

9.5.2 PE-MSD with MSD power section data

The PE-MSD is started up with drive type SRM (synchronous rotating motor).

When you select the power section, the FSD power section data are initialized

- MD 1108 Thermal limit current for power section
- MD 1111 Rated current for power section

in addition to the following additional MSD power section data for PE-MSD operation (MD 1015=1):

- MD 1175 (equivalent to MD 1108 for drive type ARM)
- MD 1176 (equivalent to MD 1109 for drive type ARM)
- MD 1177 (equivalent to MD 1111 for drive type ARM).

If PE-MSD operation is set (MD 1015=1), machine data MD 1175, MD 1176 and MD 1177 must contain valid values. Otherwise error message 301719: “Power section data incomplete” appears.

These data are initialized on each new start-up when you select the power section.

To enable PE-MSD operation (MD 1015=1) with the 120 A power section, this power section has been included in the FSD power section selection with power section code number 18H.

In FSD mode (MD 1015=0), drive alarm 301718 “Motor/power section combination invalid” is output with this power section.

9.5.3 Control parameters

If the PE-MSD is enabled (MD 1015) and a motor is selected from the list, the following machine data are initialized when you run the “Calculate controller data” function:

- MD 1147: SPEED_LIMIT
- MD 1401: MOTOR_MAX_SPEED
- MD 1403: PULSE_SUPPRESSION_SPEED
- MD 1404: PULSE_SUPPRESSION_DELAY
- MD 1405:MOTOR_SPEED_LIMIT[n]
- MD 1606: SPEEDCTRL_LIMIT_THRESHOLD
- MD 1610: DIAGNOSIS_ACTIVATION_FLAGS
- MD 1612: ALARM_REACTION_POWER_ON
- MD 1613: ALARM_REACTION_RESET.

9.5.4 Encoders

Encoder types

The following types of encoder can be used:

- Incremental encoder
- Absolute encoder (e.g. EQN 1325)
- Toothed wheel encoder.

Rotor position synchronization

- The encoders must provide position identification.
  The rotor position is synchronized after power-up.
- For encoders that have no C/D track (e.g. toothed wheel encoder), the rotor position identification must be activated.

  References: /DG1/, Rotor Position Identification

9.5.5 Machine data

1015	**PEMSD_MODE_ENABLE (SW 4.2 or higher)**				**Cross reference:** -
	Activate PE-MSD			Related to: FSD/MSD	Protection level: 2/4
Unit: -	Default: 0	Minimum: 0	Maximum: 1	Data type: FLOAT DWORD	Active: Power On

Bit 0	PE-MSD function	0: Function inactive 1: Function active

1136	**MOTOR_NOLOAD_CURRENT**				**Cross reference:** -
	Motor no-load current			Related to: FSD/MSD	Protection level: 2/4
Unit: A (eff.)	Default: 0.0	Minimum: 0.0	Maximum: 500.0	Data type: FLOAT	Active: immediately

The no-load current is assigned when the motor is selected from the list of motors or set according to the data sheet of the motor manufacturer.
If the manufacturer of the motor has not specified the no-load current, the following formula may be used to calculate the value:

MD 1136 = MD 1114 $\times$ 60 [sec] / (1000 $\times$ $\sqrt{3}$ $\times$ MD 1112 $\times$ MD 1116)

MD 1112: NUM_POLE_PAIRS
MD 1114: EMF_VOLTAGE
MD 1116: ARMATURE_INDUCTANCE

1142	**FIELD_WEAKENING_SPEED**				**Cross reference:** -
	Threshold speed field weakening			Related to: FSD/MSD	Protection level: 2/4
Unit: rpm	Default: 0.0	Minimum: 0.0	Maximum: 50 000.0	Data type: FLOAT	Active: immediately

The threshold speed for field weakening is assigned when the motor is selected from the list of motors or set according to the data sheet of the motor manufacturer.
If the manufacturer of the motor has not specified the threshold speed for field weakening, the following formula may be used to calculate the value:

MD 1142 = 380 V $\times$ 1000 [rpm] / MD 1114

MD 1114: EMF_VOLTAGE

Notes

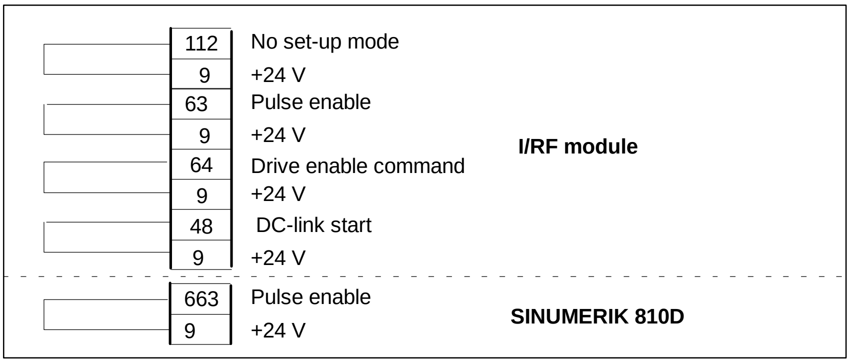
Axis/Spindle Dry Run

10.1 Preconditions

Enabling signals for axes

To allow an axis to be traversed from the control system, it is necessary to supply signals to the enabling terminals on the drive and to set the enabling bits on the interface.

Enabling terminals on drive



References: /PJU/, Planning Guide Inverters

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:

IS “Controller enable”	(DB31, ... DBX2.1)
IS “Pulse enable”	(DB31, ... DBX21.7)
IS “Position measuring system 1 or 2”	(DB31, ... DBX1.5, DBX 1.6)

The following signals on the interface must **no**t be set or else the axis/spindle motion will be disabled:

IS “Feed/spindle offset switch”	(DB31, ... DBB0) not to 0%
IS “Axis/spindle disable”	(DB31, ... DBX1.3)
IS “Follow-up mode”	(DB31, ... DBX1.4)
IS “Distance to go/spindle reset”	(DB31, ... DBX2.2)
IS “Feed stop/spindle stop”	(DB31, ... DBX4.3)
IS “Traversing key disable”	(DB31, ... DBX4.)
IS “Ramp-function generator disable”	(DB31, ... DBX20.1)

References: /FB1/, A2, “Various Interface Signals and Functions”
Interface signals from and to axis/spindle

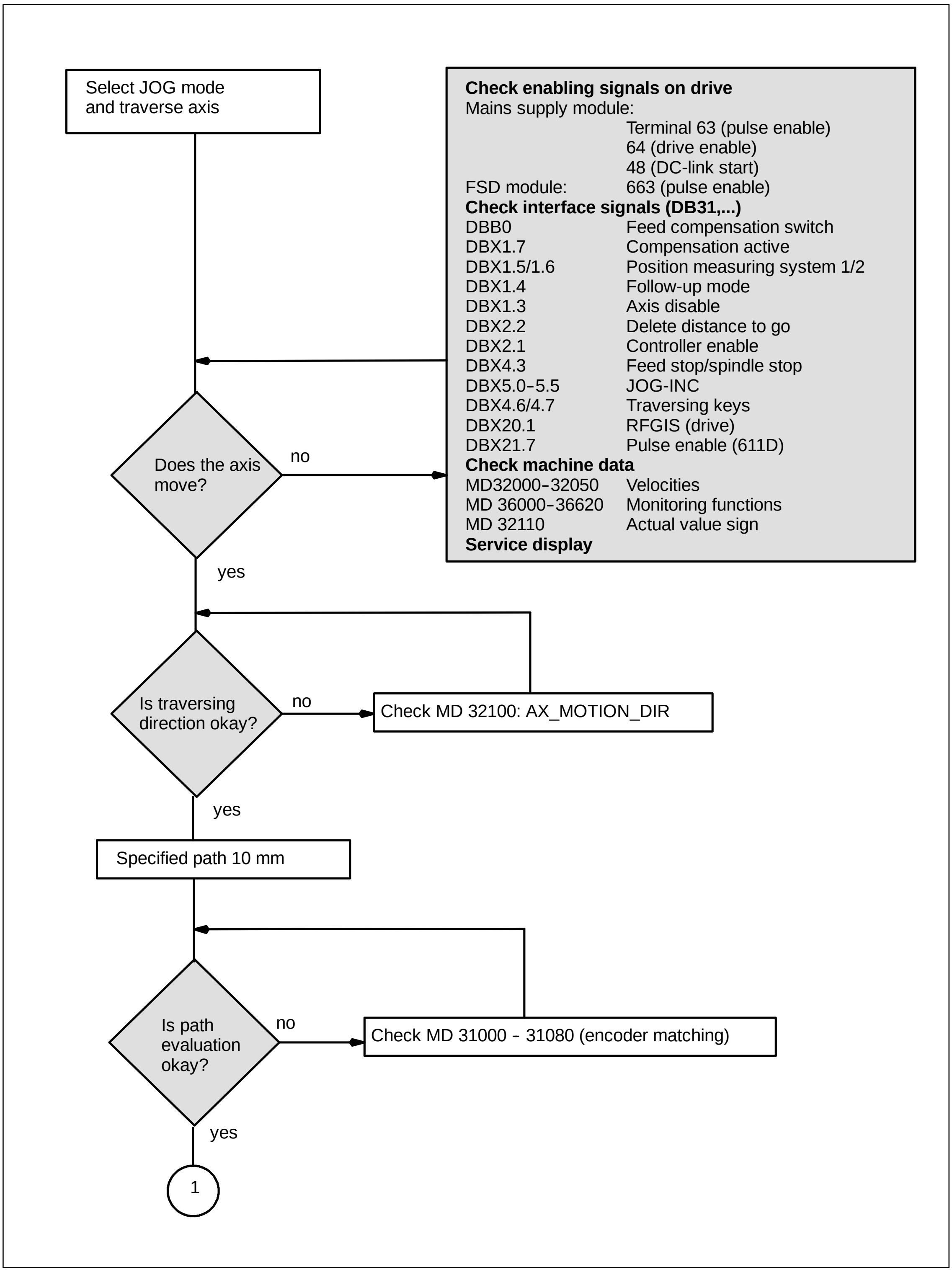
Limit switch

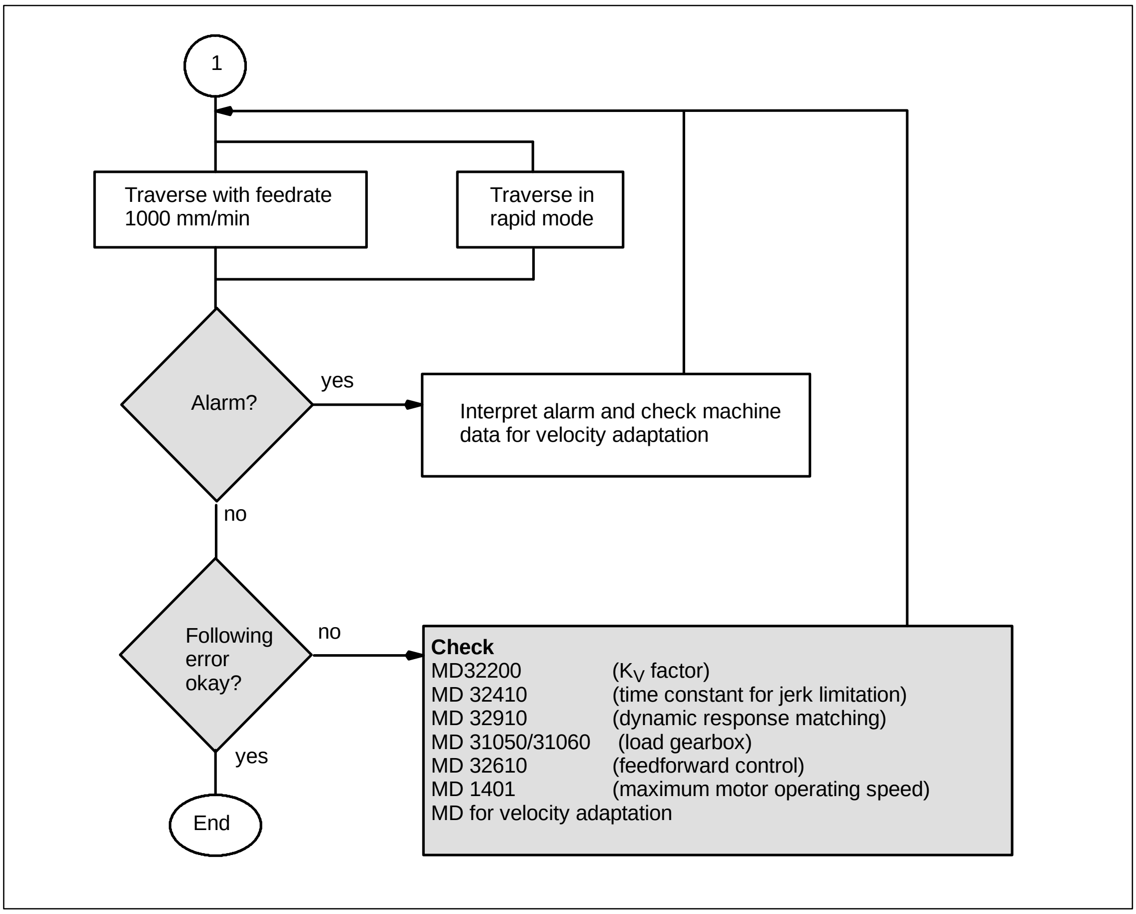
Setting of hardware limit switches and interface signal check:

- Hardware limit switch PLUS
  DB31, ... DBX12.1
- Hardware limit switch MINUS
  DB31, ... DBX12.0

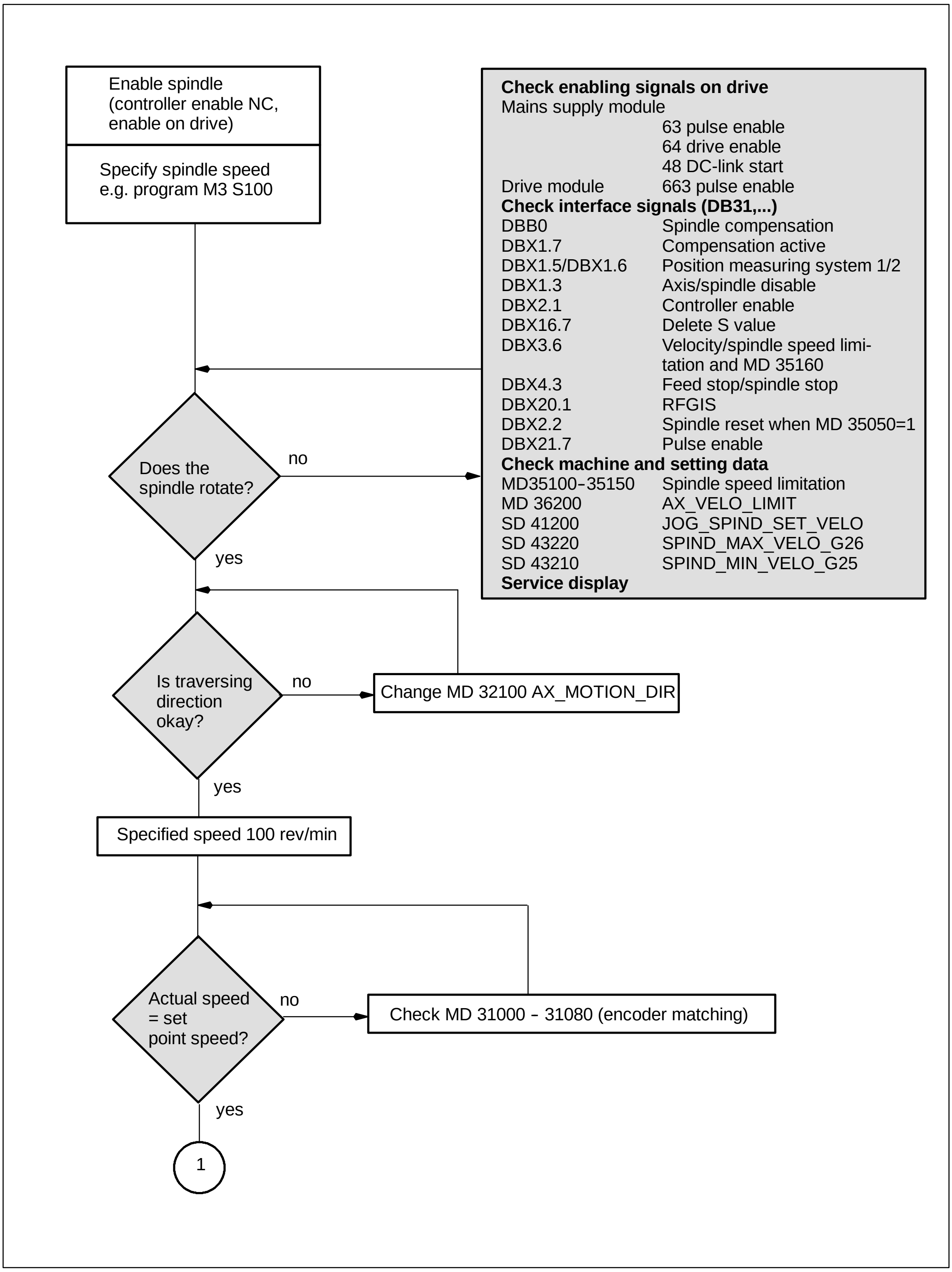
References: /FB1/, A3, “Axis Monitoring, Protection Zones”
Monitoring of static limits

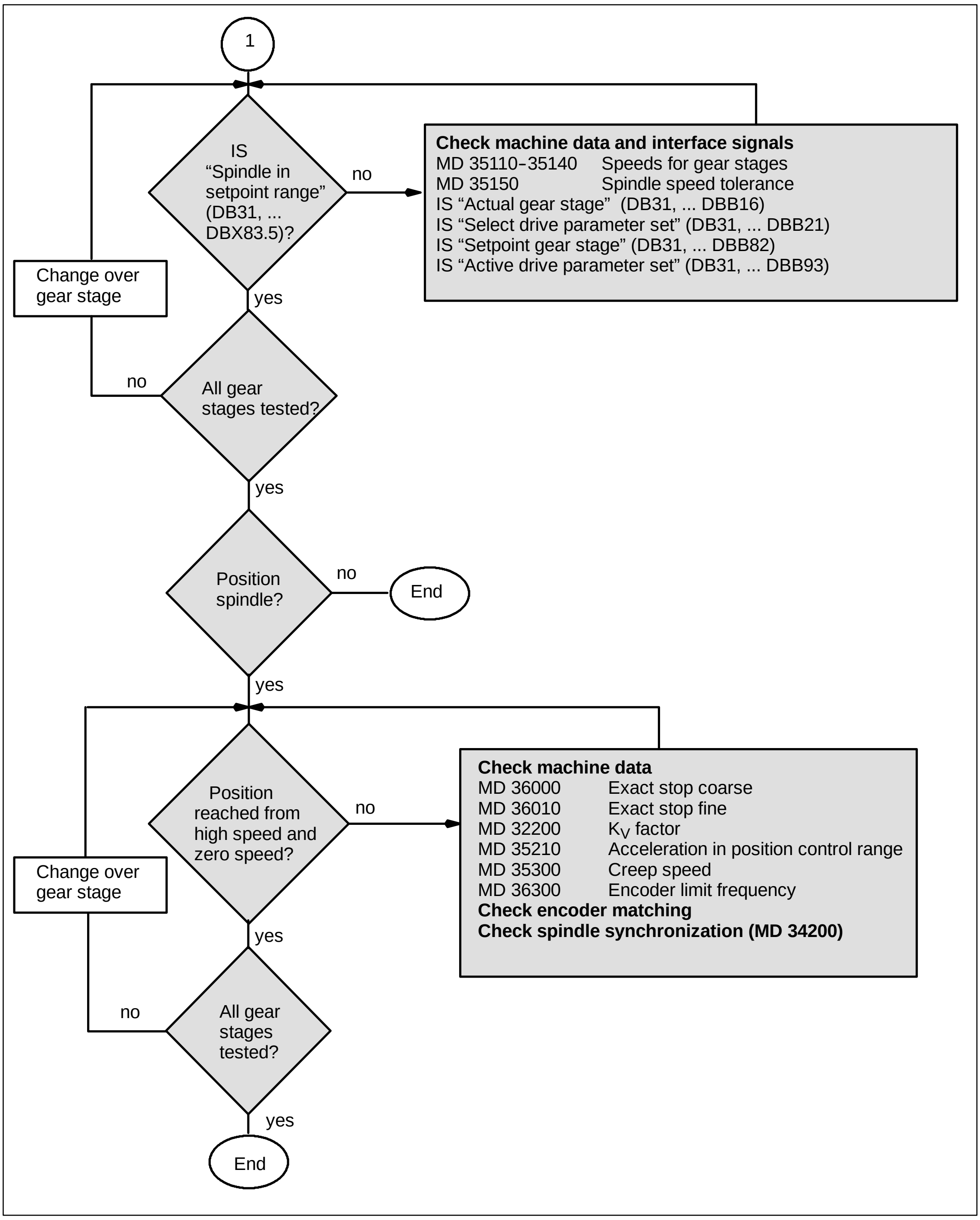
10.2 Axis dry run




1
Traverse with feedrate 1000 mm/min
Traverse in rapid mode
Alarm?
yes
Interpret alarm and check machine data for velocity adaptation
no
Following error okay?
no
Check
MD32200 (KV factor)
MD 32410 (time constant for jerk limitation)
MD 32910 (dynamic response matching)
MD 31050/31060 (load gearbox)
MD 32610 (feedforward control)
MD 1401 (maximum motor operating speed)
MD for velocity adaptation
yes
End

10.3 Test spindle




1
IS “Spindle in setpoint range” (DB31, ... DBX83.5)?
no
Check machine data and interface signals
MD 35110–35140 Speeds for gear stages
MD 35150 Spindle speed tolerance
IS “Actual gear stage” (DB31, ... DBB16)
IS “Select drive parameter set” (DB31, ... DBB21)
IS “Setpoint gear stage” (DB31, ... DBB82)
IS “Active drive parameter set” (DB31, ... DBB93)
yes
Change over gear stage
no
All gear stages tested?
yes
Position spindle?
no
End
yes
Position reached from high speed and zero speed?
no
Check machine data
MD 36000 Exact stop coarse
MD 36010 Exact stop fine
MD 32200 KV factor
MD 35210 Acceleration in position control range
MD 35300 Creep speed
MD 36300 Encoder limit frequency
Check encoder matching
Check spindle synchronization (MD 34200)
yes
Change over gear stage
no
All gear stages tested?
yes
End

■

Drive Optimization with the Start-up Tool 11

11.1 Information for use

Scope of application

The start-up software "Start-up tool" is used to configure and parameterize drive systems which are controlled by a SINUMERIK 810D or 840D control.

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.

Measuring functions

The measuring functions allow evaluation of the most important speed and position control loop quantities, as well as of the torque control 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. oscillo-scope, 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.

References: /FBA/, DD2, Speed Control Loop

Saving measurement results

The measurement diagrams can be archived via file functions, allowing machine settings to be documented and facilitating remote diagnostics.

11.1.1 System requirements

Hardware requirements

The start-up software requires the following hardware:

- IBM® AT-compatible PG/PC with DX486 microprocessor, e.g. SIMATIC PG 740
- At least 4 MB of main memory
- Disk drive (3 1/2” or 5 1/4”)
- Hard disk drive for managing data
- Monochrome or color monitor (VGA)
- Keyboard
- MPI interface
- Mouse
- MPI connecting cable.

Software requirements

Software configuration

- Start-up tool in Version 1.0 or higher: WINDOWS™ user interface version 3.1 or higher
- Start-up tool in Version 3.6 or higher: WINDOWS™95 + STEP7 version $\geq$ 2.1.

11.1.2 Installation

Please observe the contents of the readme file supplied.

To install the software, please follow the procedure detailed below:

Requirement

The memory area of the MPI card must be excluded from use by memory managers (files: CONFIG.SYS, SYSTEM.INI).

Call

Insert the first installation disk and start the SETUP.BAT file in the WINDOWS™ File Manager. The installation program requests all further necessary inputs and disk changes in user dialog.

11.1.3 Starting the program

Program call

Start the start-up tool in the program group.

Setting the MPI interface

Set the MPI interface on the operator panel to 187.5 kbaud (Start-up\HMI\Operator panel).
If no connection is established, check the items in Subsection 5.2.3 PCU start-up.

11.1.4 Closing the program

Deselecting the program

The start-up tool is deselected in the order described below:

- Press function key **F10**.
- A horizontal softkey bar with softkeys **Diagnosis** and **Exit** appears on the screen.
- You can terminate the program by selecting the **Exit** softkey.

11.2 Measuring functions

Explanation

A range of measuring functions allow the time and/or frequency response of drives and closed-loop controls to be displayed in graphic form on the screen. For this purpose, test signals with an adjustable interval are connected to the drives.

The test setpoints are adapted to the application in question by means of measurement or signal parameters, the units of which are determined by the relevant measuring function or operating mode. The measurement or signal parameter units are subject to the following conditions:

Table 11-1 Quantity and units for measurement or signal parameters

Quantity	Unit
Torque	Specified in percent referred to the peak torque of the power section used. The torque calculation for the power section is based on: 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

Additional information

The default setting for all parameters is 0. (See file functions for default setting.)

Functions which initiate a traversing motion are selected via the softkey menu; they are all actually started by means of the **NC START** key on the machine control panel. If the basic display for the function is deselected without the traversing motion being initiated, then the function selection is reset.

Once the traversing function has been started, the basic display can be deselected without any affect on the traversing motion.

File functions

Useful parameter default settings (torque, velocity, path, ...) are stored here for the individual measurements. The values can be loaded by activating the **File Functions** softkey and selecting a file.

!

Important

The NCK is in the “Follow-up” state during traversing motions with the start-up tool.
Neither the software limit switches **nor** the working field limitations are **monitored** in this state.
Prior to initiating traversing motions with the start-up tool, the start-up engineer must position the axes in such a way that the start-up tool traversing range limits (**which are monitored**) are not exceeded. Thus collisions on the machine can be prevented.

Note

The user must ensure that

- the **EMERGENCY STOP** switch is within his/her reach and
- there are no obstacles in the traversing path.

Traversing motions can normally be aborted with

- **NC STOP** key
- **RESET** key
- Softkey **STOP** in the relevant basic display

or by canceling the

- controller enabling command
- Drive enabling command
- traverse enabling signal
- feed or spindle enabling command

or by setting the feedrate override switch to 0%.

NCK or drive alarms (e.g. “Function abort by NC”) likewise cause a traversing motion to be aborted. For further details, please refer to the section entitled “Abortion of measuring functions” or in:
References: /DA/, Diagnostics Guide.

!

Important

The NC **JOG** mode must be selected when measuring functions are started, thus ensuring that no axis or spindle can be moved by the part program.

11.3 Interface signals: Drive test travel request and traverse enable

Explanation

Axes with a mechanical brake may need the brake to be activated in some cases. The enable logic **Enable with PLC** in the basic display of the relevant function is provided for this purpose.

The request signal **Traverse request** (NCK→PLC) can be generated in the PLC user program when the measuring function is selected

- DB31–DBxx, ... DBX61.0 “Drive test traverse request”

and the acknowledgement signal **Motion enable** (PLC→NCK)

- DB31–DBxx, ... DBX1.0 “Drive test traverse enable”

can then be linked in the PLC user program as follows.

This safety mechanism can be deselected via the **Enable option without PLC**.

References: /FB1/, A2, “Various Interface Signals and Functions”

Deactivating monitoring

The traversing range monitoring function can be deactivated for axes with an endless traversing range.

11.4 Function abort for measuring functions

The active measuring function is disabled or aborted by:

- EMERGENCY STOP
- NC stop
- Reset (mode group, channel)
- No enabling commands (feed override = 0, spindle override = 50)
- No controller enabling command
- JOG operating mode not selected or deselected
- Traversing keys actuated
- Handwheel selected
- **Enable with PLC** selected and no interface signal “Motion enable drive test”
- Alarm leading to axis shutdown
- Hardware limit switch reached
- Traversing range limits exceeded
- Parking (in position-controlled operation).

11.5 Frequency response measurements

11.5.1 Function generator (FG)

Overview

The function generator can be used to

- deactivate the effect of superimposed control loops selectively.
- compare the dynamic response of coupled drives.
- set and repeat a simple curve form (traverse profile) as a setpoint without programming a motion program.

The function generator creates setpoints in different formats (rectangular, stair-step, triangular, PRBS or sine-wave) and outputs this setpoint command, according to the mode setting, as a current setpoint, disturbing torque or speed setpoint.

Danger

The traverse path is not monitored while the function generator is active.

Start/stop

The “Machine configuration” window is displaced in the main “Start-up” screen. The Drives/Servo softkey can be used to access special functions for drive/servo start-up. The function generator can be started and terminated from there.

11.5.2 Circularity test

The circularity test is used to check the contour precision achieved with the friction torque compensation. The actual positions during a circular movement are measured and deviations from the programmed radius are displayed graphically (in particular at the quadrant transitions).

Procedure

The circle contour for the axes involved is specified by an NC program. A sample NC program is provided in order to make the circularity test as simple as possible. This program can be adapted by the commissioning engineer to meet the needs of the application.

Circular movements with different accelerations are performed by leaving the circle contour unchanged and using the feedrate override switch to alter the feedrate.

The actual position values of the axes are recorded for the duration of the circular movement and saved in a “trace” in the passive file system.

Parameterization

The axis names or axis numbers whose actual position values are to be recorded in the circular movement are selected from this menu.

When entering the settings in the “Radius” and “Feedrate” input fields, you should enter the values from the part program which controls the circular movement of the axes, allowing for the feedrate override switch.
The measuring period for recording the actual position values during the circular movement is calculated from the “Radius” and “Feedrate” values and displayed in the “Measuring time” display field.

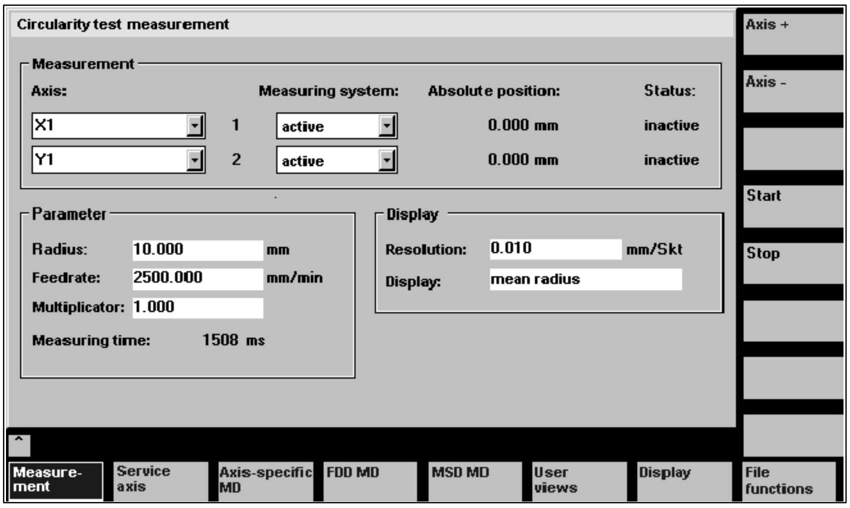


Figure 11-1 Circularity test measurement menu

Starting the measurement

The user must start the part program containing the circular movement for the selected axes by pressing NC Start (AUTOMATIC or MDA mode).

The measuring function is started with the vertical softkey **Start**.

The sequence of operations (NC Start for part program and Start measurement) can be chosen by the user according to the application.

When the circularity test is active for the specified axes, the message “active” appears in the “Status” display field.

Stopping the measurement

The measurement can be stopped at any time by pressing the **Stop** key. Any incomplete measurement recordings are best displayed by selecting the **Display** softkey. There is no monitoring in this respect.

To allow direct access to the required controller parameters, the softkeys **Axis-specific MD, FSD-MD** and **MSD-MD** are displayed. The vertical softkeys **Axis+** and **Axis–** can be used to select the desired axis.

The “Service axis” display is displayed when you press the **Service Axis** softkey. The following service data are displayed here for commissioning of the friction torque compensation:

- QEC learning active yes/no?
- Current position and actual speed values.

Display

When you press the **Display** softkey, the display switches to the graphical view of the recorded circle diagram.

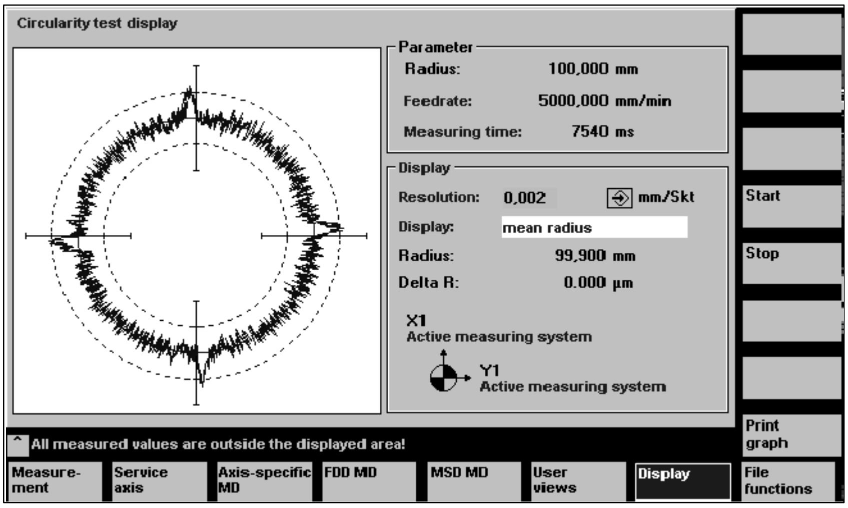


Figure 11-2 Circularity test display menu

This screen displays the measurements of the two actual position values as a circle with the set resolution.

The programmed radius, the programmed feedrate and the measuring time derived from these values are also displayed for documentation purposes (for subsequent storage of the measured circle characteristics in file format).

The operator can enter a finer scale for the diagram axes in the **Resolution** input field, e.g. in order to emphasize the transitions at the quadrants. The circle diagram is refreshed with the new resolution when you press the **Display** softkey.

You can find further information about the storage of measurement results and tips for fast start-up in:

References: /FB2/, K3 Description of Functions – Extended Functions

11.5.3 Torque control loop measurement

Functionality

The torque control loop need only be measured for diagnostic purposes in the event of an error or in cases where no standard data are available for the motor/power section combination used, resulting in 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

The traversing range monitoring function is set and the enabling logic (PLC) selected in the **basic display**. The parameters required for this purpose are set in the **Measurement parameter display**. On completion of the measurement, the results can be called to the screen for assessment via the **Display** softkey.

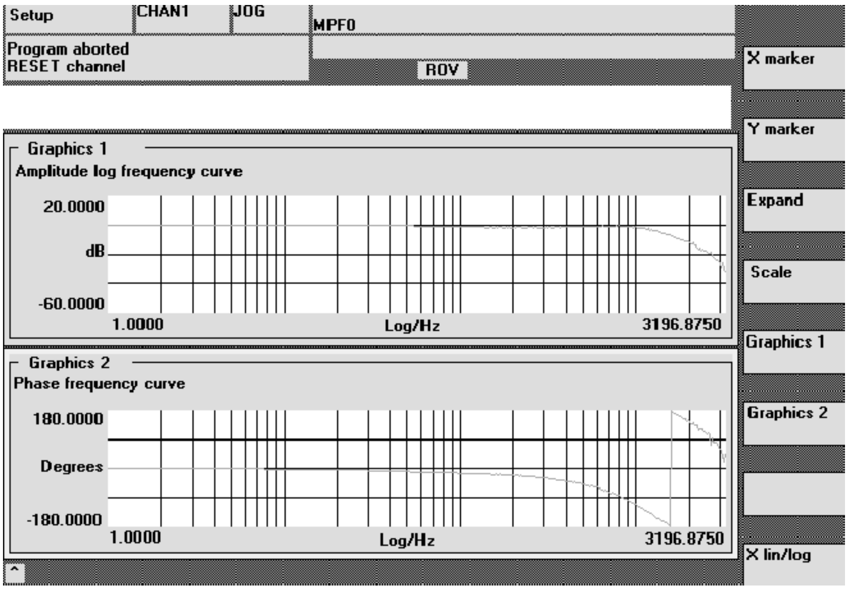


Figure 11-3 Display diagram: Example of current control loop

Measuring parameters

Amplitude
This parameter determines the magnitude of the test signal amplitude (unit: peak torque specified in %). Values between 1 and 5% are suitable.

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Bandwidth
The available bandwidth is specified by halving the current controller sampling time (e.g. 156 µs –> 3.2 kHz).

Averaging operations
The accuracy of the measurement, but also the measurement time, are increased with this value. A value of 20 is normally suitable.

Settling time
This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of approximately 10 ms is recommended.

Additional information

The measurement parameters and measurement results (diagrams) can be loaded and saved via the softkey **File functions**.

11.5.4 Setpoint current filter

1200	NUM_CURRENT_FILTERS[n]				Cross reference: -
	Number of current setpoint filters [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: –	Default: 1	Minimum: 0	Maximum: 4	Data type: UNS. WORD	Active: immediately

Enters the number of current setpoint filters. You can choose between bandstop filters and 2nd degree low-pass filters set in MD 1201: CURRENT_FILTER_CONFIG.

Table 11-2 Selection of the number of current filters

0	No current filter active
1	Filter 1 active
2	Filters 1 and 2 active
3	Filters 1, 2 and 3 active
4	Filters 1, 2, 3 and 4 active

1201	CURRENT_FILTER_CONFIG[n]				Cross reference: -
	Type of current filter [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: HEX 810D 840D	Default: Low pass 0 0	Minimum: Low pass 0 0	Maximum: Bandstop filter F FFFF	Data type: WORD	Active: immediately

Enters the configuration of 4 current filters. You can choose between bandstop filters and low-pass filters. The filter parameters are entered in associated machine data.

With a bandstop filter, a Z transformation (zeroes and poles) is activated by setting bit 15 in MD 1201.

If bit 15 = 0, only a transformation of zeroes is activated.

Bilinear transformation is the default setting.

Note

The filter machine data must be assigned before the filter type is configured.

Using low-pass and bandstop filters

Low-pass and bandstop filters are used to attenuate resonant frequencies at or above the stability limit of the speed control loop (see the diagrams below).

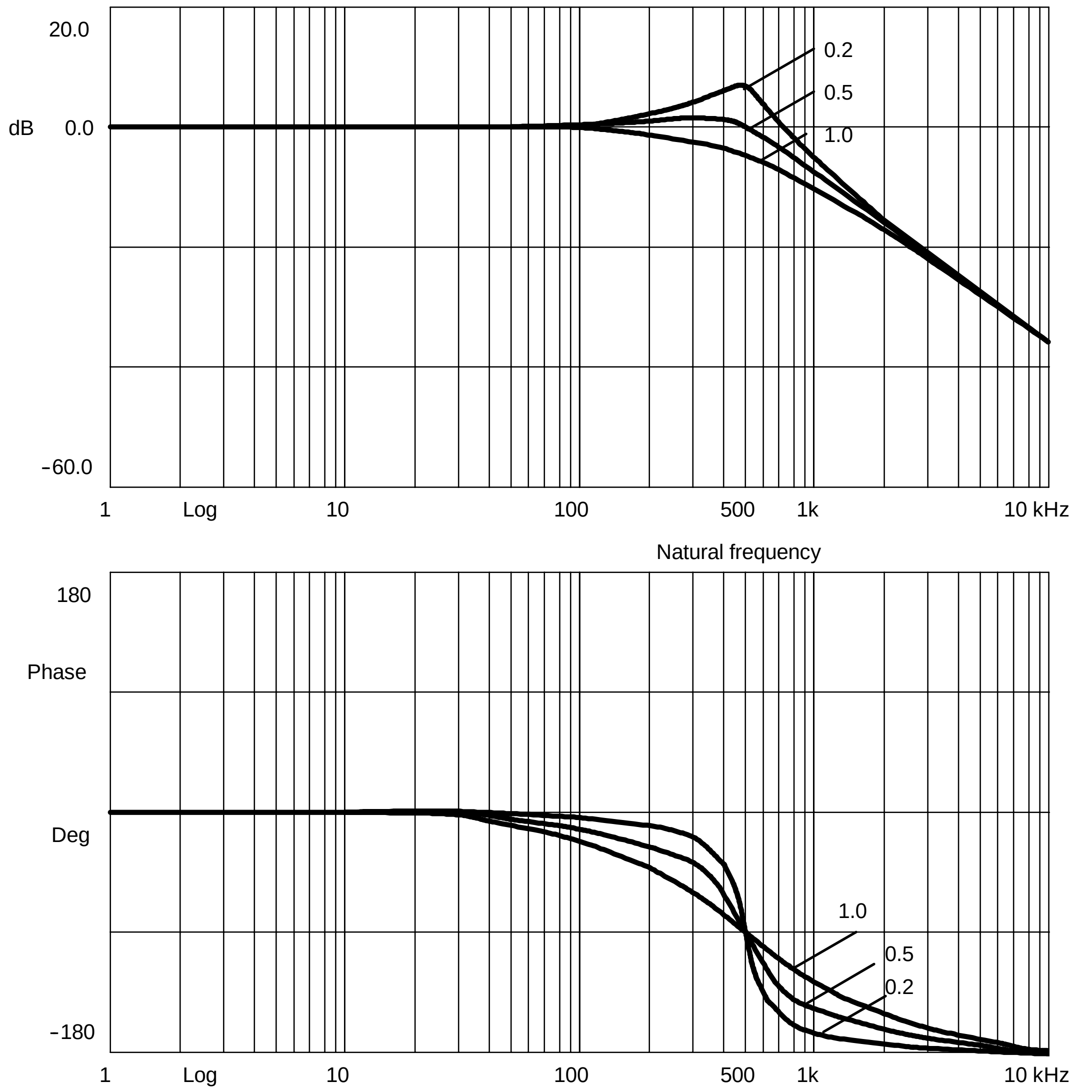

Figure 11-4 Low-pass characteristics at natural frequency 500 Hz with various attenuations

Bandstop characteristics for Z transformation

When bit 15 is set in MD 1201 and/or MD 1501, the zeroes (blocking frequency) and the poles (bandstop natural frequency) are transformed true to frequency. This is necessary if higher-degree filters (e.g. CAUER filters) are to be used. Several bandstop filters must be combined in series for this purpose.

The poles and zeroes of the individual bandstop filters must be represented true to frequency in order to arrive at the desired overall transformation. Bit 15 = 1 must be set for this purpose. **The default setting is bit 15 = 0 due to compatibility reasons.**

Example:

A CAUER current setpoint filter which produces an amplitude reduction of 20 dB at frequencies of 700 Hz and above is to be configured. This requires, for example, a series circuit with 3 bandstop filters. The parameters for such filters can, at the present time, only be calculated using external resources (e.g. Matlab).

The parameters were calculated as follows:

Table 11-3 Parameter example

	Filter 1	**Filter 2**	**Filter 3**
Blocking frequency	MD 1210: 705.5 Hz	MD 1213: 789.9 Hz	MD 1216: 1647.6 Hz
Bandwidth	MD 1211: 887.6 Hz	MD 1214: 185.6 Hz	MD 1217: 26.7 Hz
Numerator bandwidth	MD 1212: 0.1 Hz	MD 1215: 32.2 Hz	MD 1218: 659.0 Hz
BSF natural frequency	MD 1222: 89.6 %	MD 1223: 85.5 %	MD 1224: 41.5 %

The following figures show the transformation functions of the individual bandstop filters (Fig. 11-5) and the overall transformation function (series circuit, Fig. 11-6).

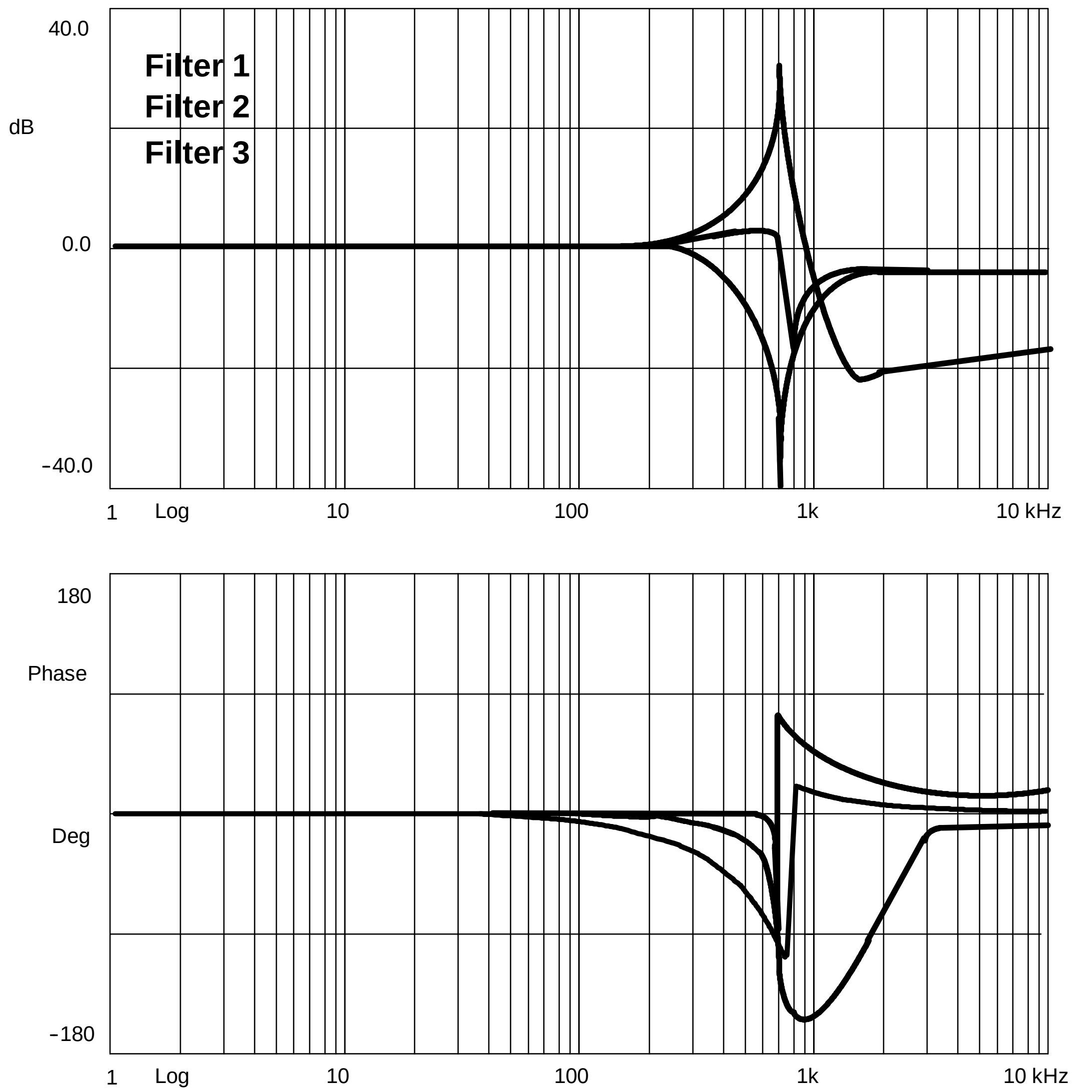

Figure 11-5 Transformation functions of the individual bandstop filters

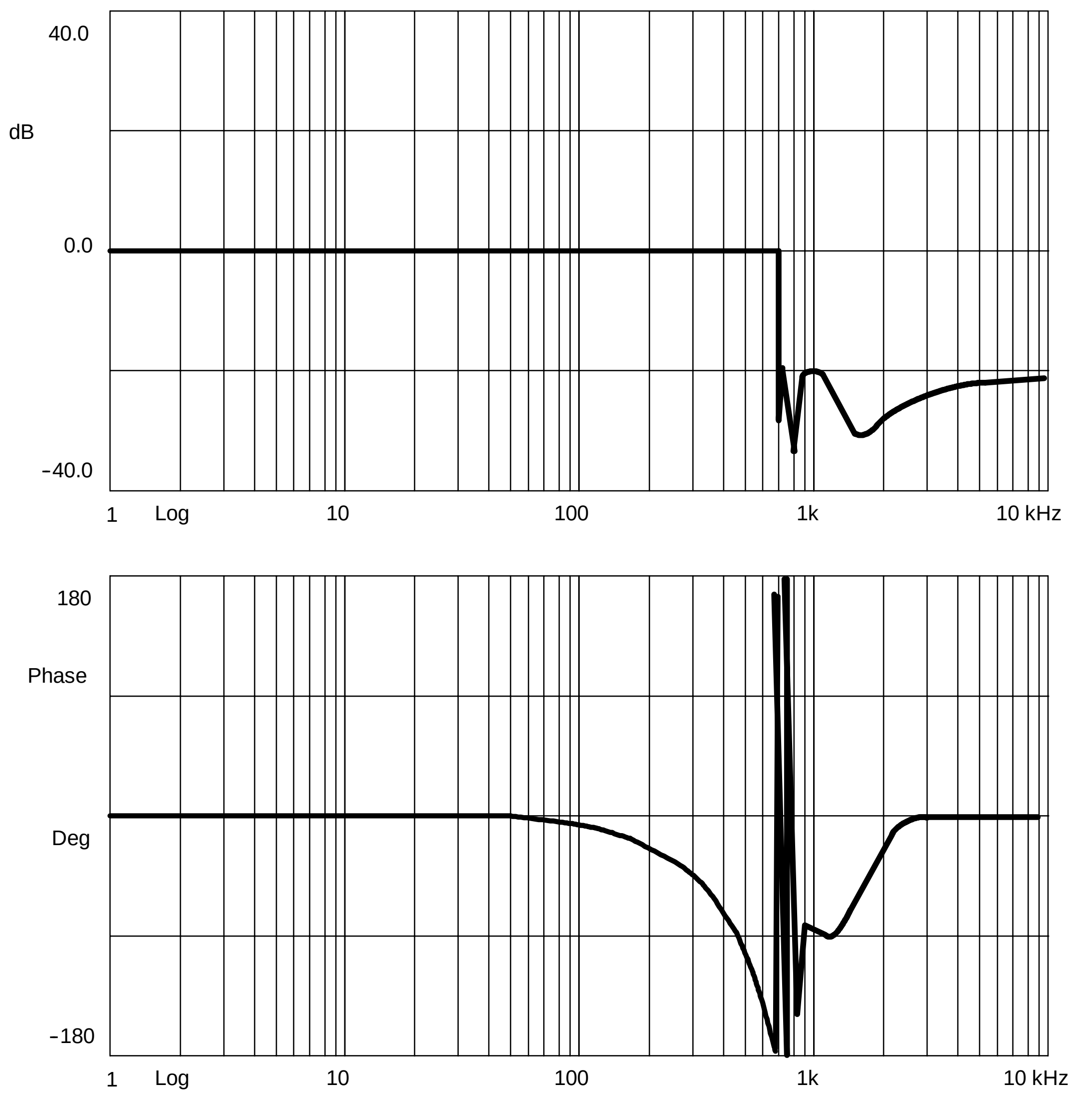

Figure 11-6 Overall transformation function (series circuit)

Bandstop filter

Default: Blocking frequency 1 kHz with 500 Hz and 1 kHz bandwidth

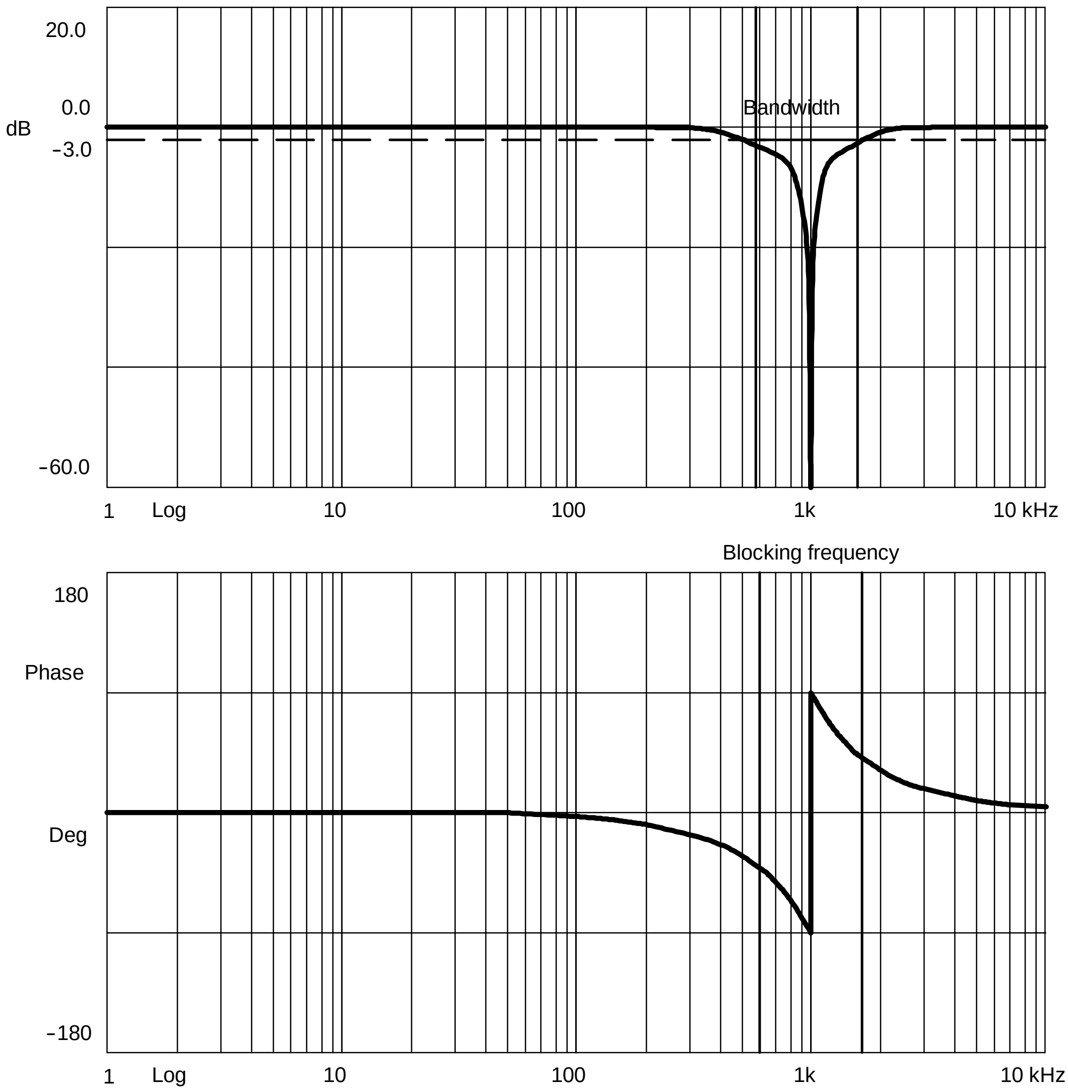

Figure 11-7 Bandstop characteristic at blocking frequency 1 kHz with 1 kHz bandwidth

The bandwidth is the difference between the two frequencies with 3 dB amplitude drop.

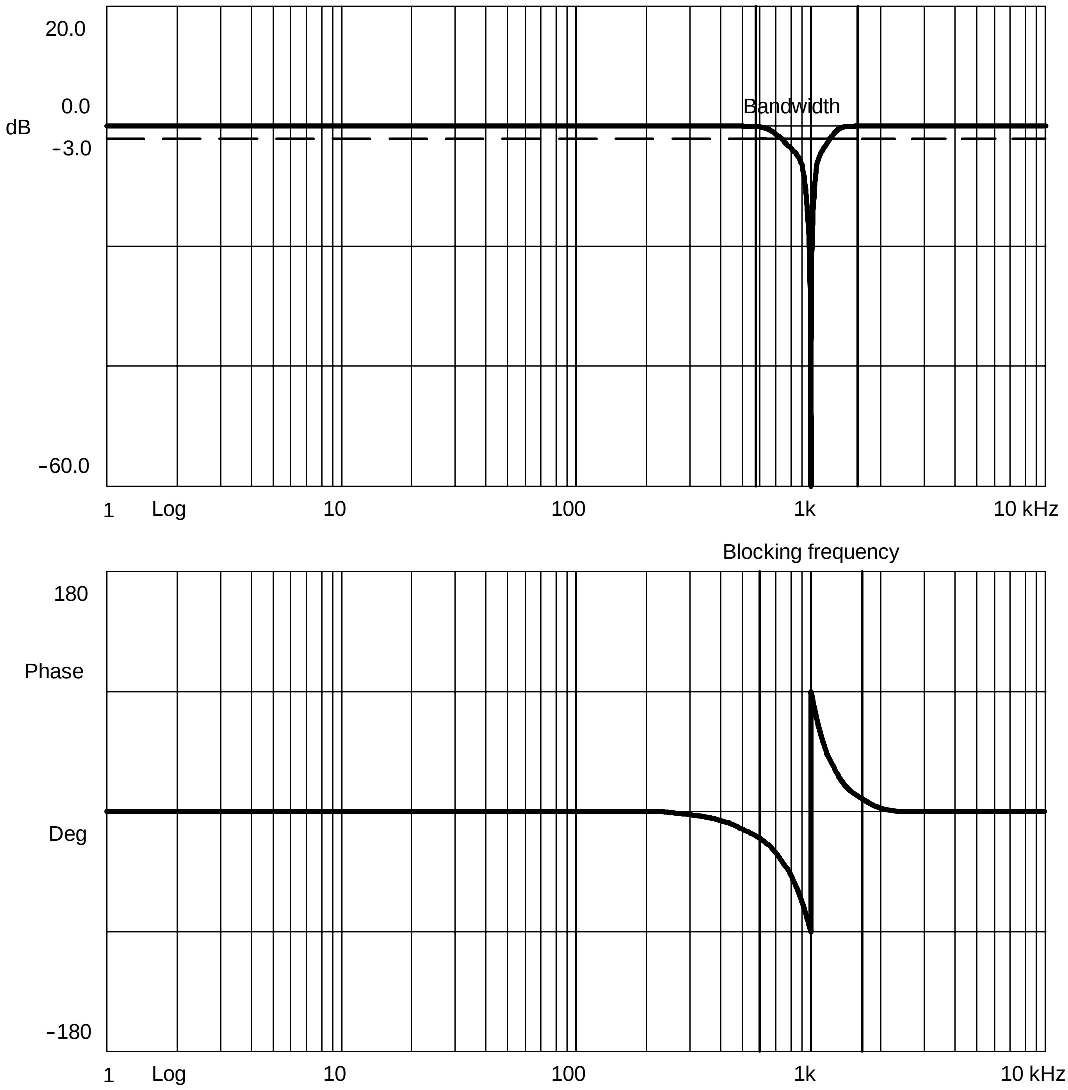

Figure 11-8 Bandstop characteristic at blocking frequency 1 kHz with 500 Hz bandwidth

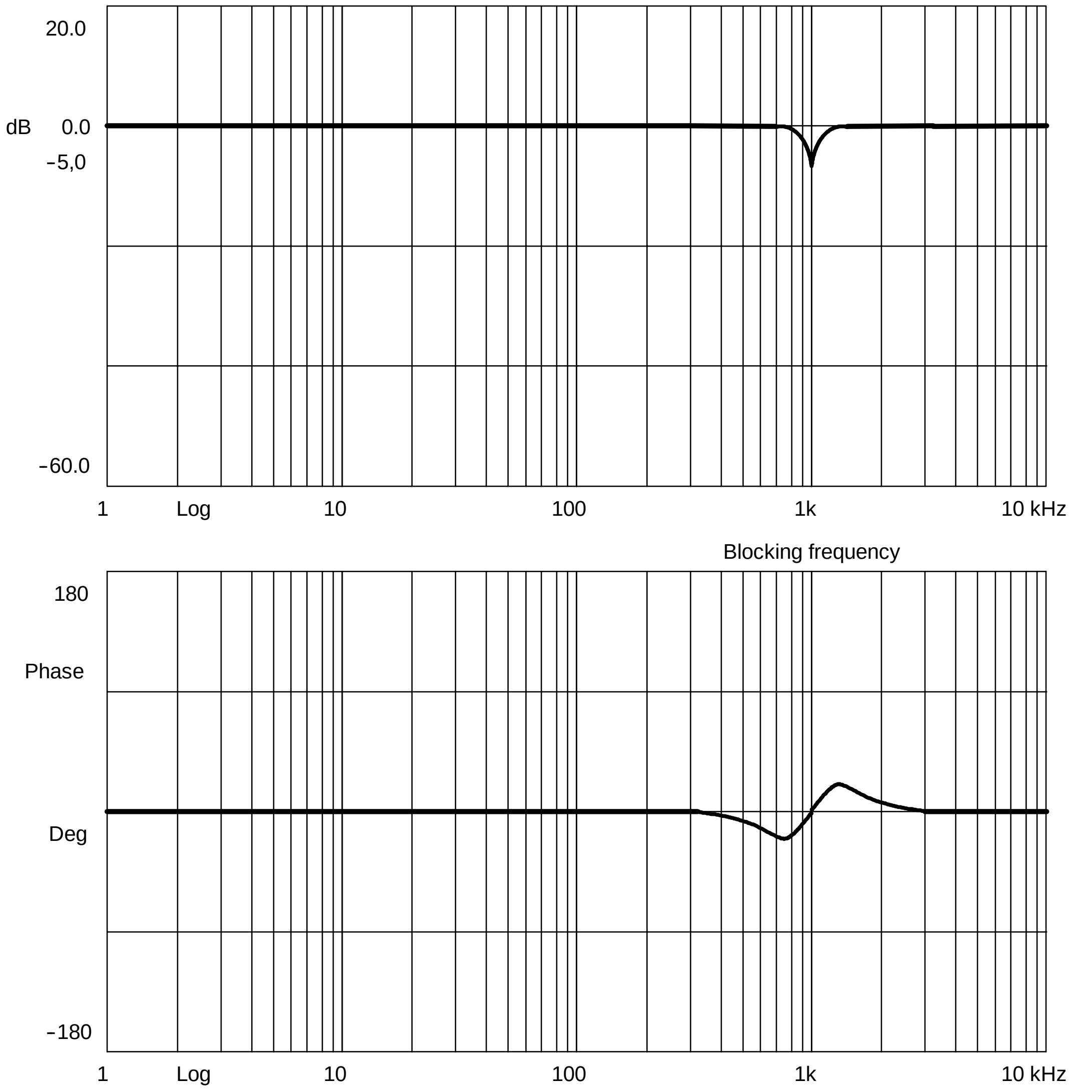

Figure 11-9 Bandstop characteristic at blocking frequency 1 kHz, 500 Hz bandwidth and 250 Hz numerator bandwidth

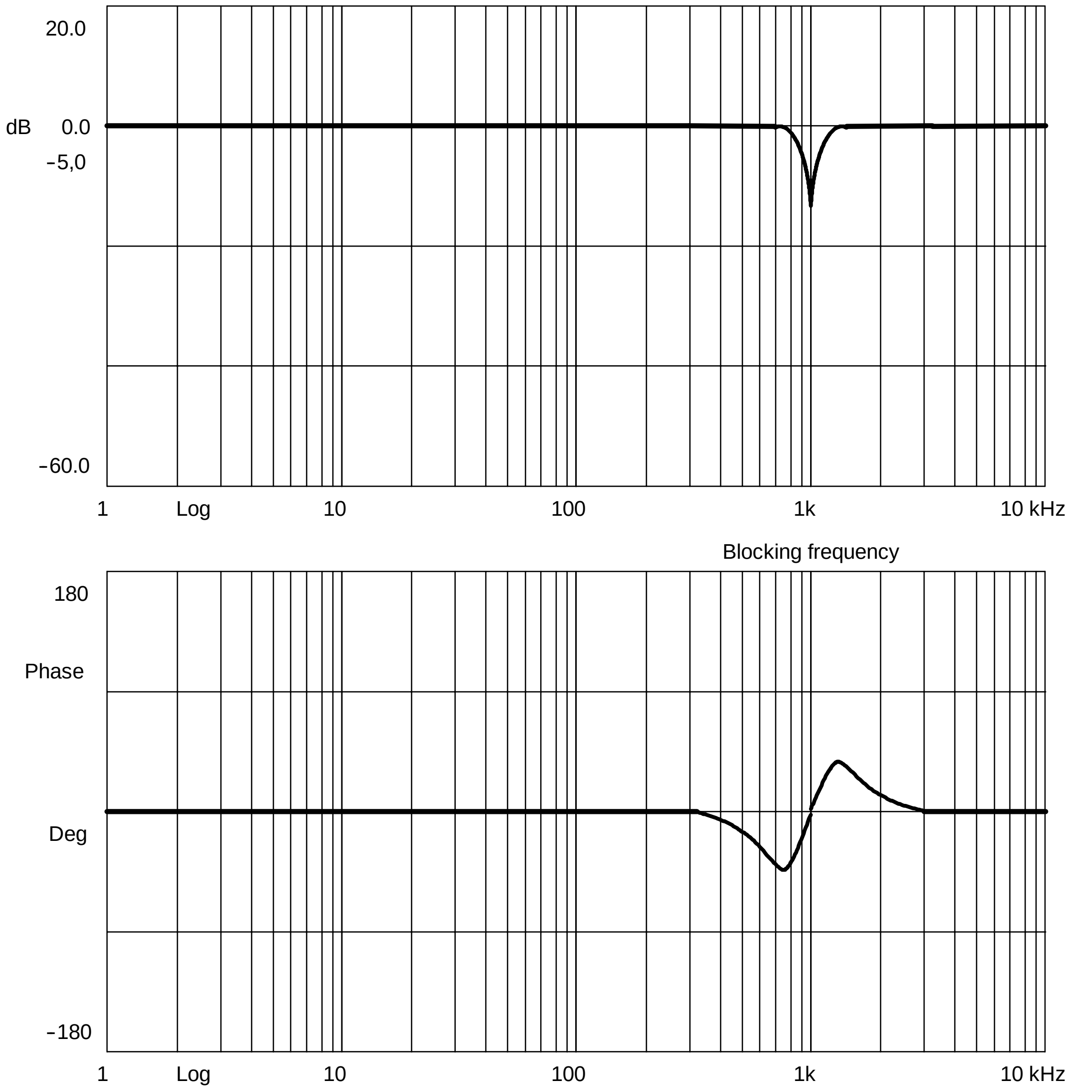

Figure 11-10 Bandstop characteristic at blocking frequency 1 kHz, 500 Hz bandwidth and 125 Hz numerator bandwidth

1202	CURRENT_FILTER_1_FREQUENCY[n]				Cross reference: -
	Natural frequency, current filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 0.0 0.0	Minimum: 0.0 0.0	Maximum: 3 999.0 8 000.0	Data type: FLOAT DWORD	Active: immediately

Enters the natural frequency for current setpoint filter 1 (PT2 low-pass). An entry with the value < 10 Hz for the natural frequency of the low pass deactivates the filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1203	CURRENT_FILTER_1_DAMPING[n]				Cross reference: -
	Damping of current filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: –	Default: 0.7	Minimum: 0.05	Maximum: 5.0	Data type: FLOAT DWORD	Active: immediately

Enters the damping factor for current setpoint filter 1 (PT2 low-pass). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1204	CURRENT_FILTER_2_FREQUENCY[n]				Cross reference: -
	Natural frequency, current filter 2 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 0.0 0.0	Minimum: 0.0 0.0	Maximum: 1 999.0 8 000.0	Data type: FLOAT DWORD	Active: immediately

Enters the natural frequency for current setpoint filter 2 (PT2 low-pass). An entry with the value < 10 Hz for the natural frequency of the low pass deactivates the filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1205	CURRENT_FILTER_2_DAMPING[n]				Cross reference: -
	Damping of current filter 2 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: –	Default: 1.0	Minimum: 0.05	Maximum: 5.0	Data type: FLOAT DWORD	Active: immediately

Enters the damping factor for current setpoint filter 2 (PT2 low-pass). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1206	CURRENT_FILTER_3_FREQUENCY[n]				Cross reference: -
	Natural frequency, current filter 3 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 0.0 0.0	Minimum: 0.0 0.0	Maximum: 1 999.0 8 000.0	Data type: FLOAT DWORD	Active: immediately

Enters the natural frequency for current setpoint filter 3 (PT2 low-pass). An entry with the value < 10 Hz for the natural frequency of the low pass deactivates the filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1207	CURRENT_FILTER_3_DAMPING[n]				Cross reference: -
	Damping of current filter 3 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: –	Default: 1.0	Minimum: 0.05	Maximum: 5.0	Data type: FLOAT DWORD	Active: immediately

Enters the damping factor for current setpoint filter 3 (PT2 low-pass). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1208	CURRENT_FILTER_4_FREQUENCY[n]				Cross reference: -
	Natural frequency, current filter 4 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 0.0 0.0	Minimum: 0.0 0.0	Maximum: 1 999.0 8 000.0	Data type: FLOAT DWORD	Active: immediately

Enters the natural frequency for current setpoint filter 4 (PT2 low-pass). An entry with the value < 10 Hz for the natural frequency of the low pass deactivates the filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1209	CURRENT_FILTER_4_DAMPING[n]				Cross reference: -
	Damping of current filter 4 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: –	Default: 1.0	Minimum: 0.05	Maximum: 5.0	Data type: FLOAT DWORD	Active: immediately

Enters the damping factor for current setpoint filter 4 (PT2 low-pass). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1210	CURRENT_FILTER_1_SUPPR_FREQ[n]				Cross reference: -
	Blocking frequency for current filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz	Default:	Minimum:	Maximum:	Data type: FLOAT DWORD	Active: immediately
810D	1 600.0	1.0	3 999.0		
840D	3 500.0	1.0	8 000.0		

Enters the blocking frequency for current setpoint filter 1 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1211	CURRENT_FILTER_1_BANDWIDTH[n]				Cross reference: -
	Bandwidth, current filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz	Default: 400.0	Minimum: 5.0	Maximum: 3 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the –3 dB bandwidth for current setpoint filter 1 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG. An input value of 0 for the bandwidth deactivates the filter.

1212	CURRENT_FILTER_1_BW_NUM[n]				Cross reference: -
	Numerator bandwidth, current filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz	Default:	Minimum:	Maximum:	Data type: FLOAT DWORD	Active: immediately
810D	0.0	0.0	3 999.0		
840D	0.0	0.0	7 999.0		

Enters the numerator bandwidth for the attenuated bandstop filter. Entering a value of 0 initializes the filter as an unattenuated bandstop filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1213	CURRENT_FILTER_2_SUPPR_FREQ[n]				Cross reference: -
	Blocking frequency, current filter 2 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz	Default: 1 200.0	Minimum: 1.0	Maximum: 1 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the blocking frequency for current setpoint filter 2 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1214	CURRENT_FILTER_2_BANDWIDTH[n]				Cross reference: -
	Bandwidth, current filter 2 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 400.0 500.0	Minimum: 5.0 5.0	Maximum: 1 999.0 7 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the –3 dB bandwidth for current setpoint filter 2 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG. An input value of 0 for the bandwidth deactivates the filter.

1215	CURRENT_FILTER_2_BW_NUM[n]				Cross reference: -
	Numerator bandwidth, current filter 2 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 0.0 0.0	Minimum: 0.0 0.0	Maximum: 1 999.0 7 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the numerator bandwidth for the attenuated bandstop filter. Entering a value of 0 initializes the filter as an unattenuated bandstop filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1216	CURRENT_FILTER_3_SUPPR_FREQ[n]				Cross reference: -
	Blocking frequency, current filter 3 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 1 200.0 3 500.0	Minimum: 1.0 1.0	Maximum: 1 999.0 7 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the blocking frequency for current setpoint filter 3 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1217	CURRENT_FILTER_3_BANDWIDTH[n]				Cross reference: -
	Bandwidth, current filter 3 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 400.0 500.0	Minimum: 5.0 5.0	Maximum: 1 999.0 7 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the –3 dB bandwidth for current setpoint filter 3 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1218	CURRENT_FILTER_3_BW_NUM[n]				Cross reference: -
	Numerator bandwidth, current filter 3 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 0.0 0.0	Minimum: 0.0 0.0	Maximum: 1 999.0 7 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the numerator bandwidth for the attenuated bandstop filter. Entering a value of 0 initializes the filter as an unattenuated bandstop filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1219	CURRENT_FILTER_4_SUPPR_FREQ[n]				Cross reference: -
	Blocking frequency, current filter 4 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 1 200.0 3 500.0	Minimum: 1.0 1.0	Maximum: 1 999.0 7 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the blocking frequency for current setpoint filter 4 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

1220	CURRENT_FILTER_4_BANDWIDTH[n]				Cross reference: -
	Bandwidth, current filter 4 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz 810D 840D	Default: 400.0 500.0	Minimum: 5.0 5.0	Maximum: 1 999.0 7 999.0	Data type: FLOAT DWORD	Active: immediately

Enters the –3 dB bandwidth for current setpoint filter 4 (bandstop). The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG. An input value of 0 for the bandwidth deactivates the filter.

1221	CURRENT_FILTER_4_BW_NUM[n]				Cross reference: -
	Numerator bandwidth, current filter 4 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz	Default:	Minimum:	Maximum:	Data type: FLOAT DWORD	Active: immediately
810D	0.0	0.0	1 999.0		
840D	0.0	0.0	7 999.0		

Enters the numerator bandwidth for the attenuated bandstop filter. Entering a value of 0 initializes the filter as an unattenuated bandstop filter. The filter is activated by MD 1200: NUM_CURRENT_FILTERS and MD 1201: CURRENT_FILTER_CONFIG.

11.5.5 Speed control loop measurement

Functionality

This measurement function basically analyses the response to the motor measuring system. Depending on which basic measurement setting has been selected, various measurement parameters lists as described below are made available.

Procedure

The traversing range monitoring function is set and the enabling logic (external/ internal) selected in the **basic display**.

One of six different types of measurement can be selected:

- Reference frequency response
- Interference frequency response
- Setpoint step change
- Disturbance step change
- Speed controlled system
- Mechanical frequency response (IMS and DMS must be installed).

The parameters required for this purpose are set in the **Measurement parameter display**. On completion of the measurement, the results can be called to the screen for assessment via the **Display** softkey.

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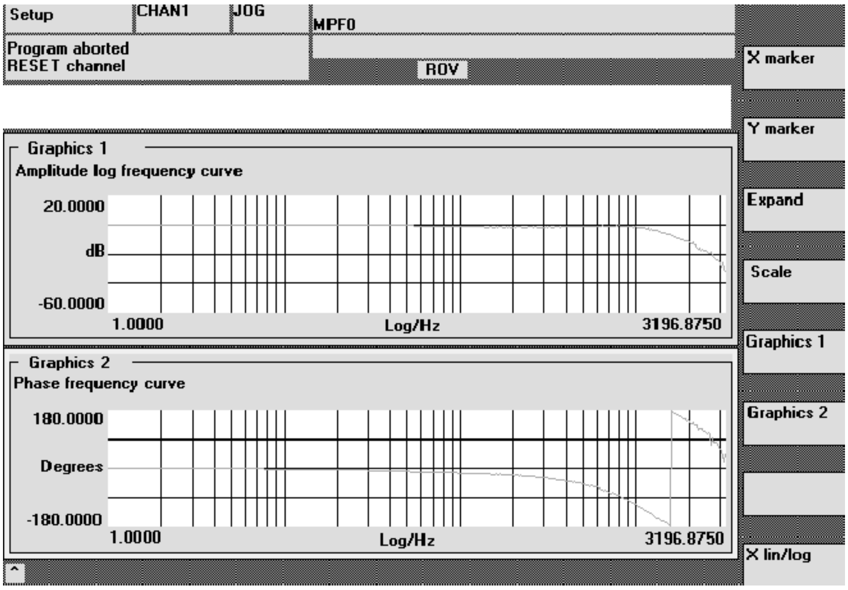

Figure 11-11 Display diagram: Example of speed control loop

Reference frequency response

The reference frequency response measurement determines the transmission ratio of the speed controller. The response range should be as wide as possible and without resonance. It may be necessary to use bandstop or low-pass filters. Particular care must be taken to prevent resonance within the speed controller limit frequency range (stability limit approx. 200–500 Hz).

Interference frequency response

Alternatively, the interference frequency response can be recorded to evaluate the noise suppression of the controller.

Measuring parameters for reference and interference frequency response

Amplitude
This parameter determines the magnitude of the test signal amplitude. This should give rise to only a very low speed of a few (approximately 1 to 2) revs/min at the motor end.

Offset
The measurement requires a slight speed offset of a few motor revolutions per minute. The offset must be set to a higher value than the amplitude.

Bandwidth
The available bandwidth is specified by halving the speed controller sampling time (e.g. 312 s –> 1.6 kHz).

Averaging operations
The accuracy of the measurement, but also the measurement time, are increased with this value. A value of 20 is normally suitable.

Settling time
This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of between 0.2 and 1 s is recommended.

Setpoint and disturbance changes

The transient response (response to setpoint changes or disturbances) of the speed control in the time range can be assessed with the step stimulation function. The test signal is connected to the speed controller output for recording of the response to disturbances.

Measurement parameters for setpoint/disturbance step change

Amplitude
This parameter determines the magnitude of the specified setpoint or disturbance step change.

Measurement time
This parameter determines the period of time to be recorded (maximum of 2048 x speed controller cycles).

The offset is applied to the amplitude after the settling time.

Settling time
This value represents the delay between measured data recording and test setpoint output.

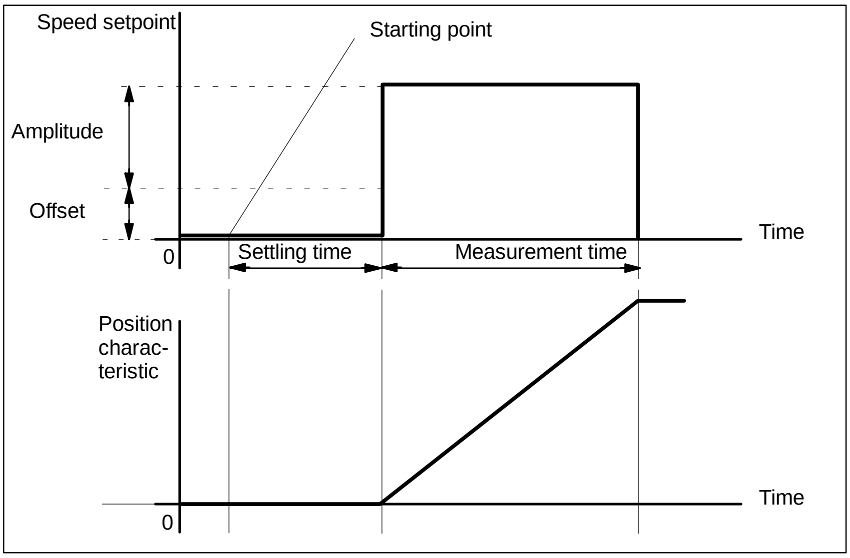

Figure 11-12 Setpoint signal for speed control loop/step response measuring function

Additional information

The measurement parameters and measurement results (diagrams) can be loaded and saved via the softkey **File functions**.

11.5.6 Speed setpoint filters

1500	**NUM_SPEED_FILTERS[n]**				**Cross reference:** -
	Number of speed setpoint filters [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: –	Default: 0	Minimum: 0	Maximum: 2	Data type: UNS. WORD	Active: immediately

Enters the number of speed setpoint filters.
810D: low–pass PT1
840D/611D: low-pass PT1, low-pass PT2 or bandstop

Table 11-4 Selection of the number of speed setpoint filters.

0	No speed filter active
1	Filter 1 active
2	Filters 1 and 2 active

The 1st filter as PT1 or PT2 is effective only when activated by PLC. The speed filter is measured during the FFT speed control loop measurement. If the 1st filter is configured as a bandstop filter (and it is active), this filter is always used, regardless of the PLC signal.

1501	**SPEED_FILTER_TYPE[n]**				**Cross reference:** -
	Type of speed setpoint filters [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hex	Default: 0000	Minimum: 0000	Maximum: 0303	Data type: UNS. WORD	Active: immediately

Enters the configuration of 2 speed filters. You can choose between bandstop filters and low passes (PT2/PT1). The filter parameters are entered in associated machine data.

With bandstop filters, a Z transformation (zeroes and poles) is activated by setting bit 15 in MD 1201.

If bit 15 = 0, only a transformation of zeroes is activated.

Bilinear transformation is the default setting.

Applications:
Damping of mechanical resonant frequencies in position feedback loop (bandstop filter). Depending on the requirement, the “bandstop filter” function can be set in three configurations:
- simple bandstop filter. MD 1514/MD 1517 and MD 1515/MD 1518
- bandstop filter with settable damping of amplitude response, in addition MD 1516/MD 1519
- bandstop filter with settable damping of the amplitude response and increase and decrease of the amplitude response after the blocking frequency. In addition MD 1520/MD 1521.

Interpolation of speed setpoint stairs – the speed setpoints are output in the position controller cycle, which can be chosen to be far larger than the speed controller cycle (low pass).

Table 11-5 Selection of the number of speed setpoint filters.

Low pass/bandstop filter	Filter 1	Bit 0	0	Low pass (refer to MD 1502/1506/1507)
			1	Bandstop filter (refer to MD 1514/1515/1516)
	2nd Filter	Bit 1	0	Low pass (refer to MD 1502/1508/1509)
			1	Bandstop filter (refer to MD 1517/1518/1519)
PT2/PT1 with low pass	1st Filter	Bit 8	0	PT2 low pass (refer to MD /1506/1507)
			1	PT1 low pass (refer to MD 1502)
	2nd Filter	Bit 9	0	PT2 low pass (refer to MD 1508/1509)
			1	PT1 low pass (refer to MD 1503)

Note

The filter machine data must be assigned before the filter type is configured.

1502	**SPEED_FILTER_1_TIME[n]**				**Cross reference:** -
	Time constant, speed filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: ms	Default: 0.0	Minimum: 0.0	Maximum: 500.0	Data type: FLOAT DWORD	Active: immediately

Enters the time constant for speed setpoint filter 1 (PT1 low-pass). Entering a value of 0 deactivates the filter.

1506	SPEED_FILTER_1_FREQUENCY[n]				Cross reference: -
	Natural frequency, speed filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: Hz	Default: 2000.0	Minimum: 10.0	Maximum: 8000.0	Data type: FLOAT DWORD	Active: immediately

Enters the natural frequency for speed setpoint filter 1 (PT2 low-pass). An entry with a value < 10 Hz for the natural frequency of the low pass initializes the filter as a proportional element with a gain of 1 irrespective of the associated damping.
The filter is activated by the “speed setpoint smoothing” interface signal DB 31–48.DBX 20.3.

Note

The speed setpoint filters for interpolating axes should be configured identically.

1507	SPEED_FILTER_1_DAMPING[n]				Cross reference: -
	Damping, speed filter 1 [drive parameter set]: 0 ... 7			Related to: FSD/MSD	Protection level: 2/4
Unit: –	Default: 0.7	Minimum: 0.2	Maximum: 5.0	Data type: FLOAT DWORD	Active: immediately

Enters the damping for speed setpoint filter 1 (PT2 low-pass).
The filter is activated by the “speed setpoint smoothing” interface signal DB 31–48.DBX 20.3.

Note

The speed setpoint filters for interpolating axes should be configured identically.

The input of damping values within the range of the minimum input limit causes oscillation in the time range up to a factor of $\leq$ 2. This effect increases exponentially if 2 low-pass filters are configured with the same parameter settings. In the small signal range, these filters continue to have a linear response. In the large signal range, the filter states can, in certain individual cases, be restricted by the maximum numerical formats (defined by the processor register width). The filter characteristic is non-linear for a short period. Overflows and unstable reactions do not occur.

1521	SPEED_FILTER_2_BS_FREQ		840D only		Cross reference: -
	Natural frequency bandstop speed filter 2			Related to: FSD/MSD	Protection level: 2/4
Unit: %	Default: 100.0	Minimum: 1.0	Maximum: 141.0	Data type: FLOAT	Active: immediately

Description

Percentage input of natural frequency for the general bandstop filter with reference to MD 1517 (blocking frequency).
For MD 1521 = 100% the filter is initialized as an attenuated bandstop filter.

If the resulting natural frequency (MD 1521 x MD 1517) exceeds the Shannon frequency defined by the speed controller sampling rate, the input is rejected and a parameter error is indicated.

Formula

$$\frac{1 + s \times (2 \times \pi \times fbz/(2 \times \pi \times fz)^2) + s^2 \times 1/(2 \times \pi \times fz)^2)}{1 + s \times (2 \times \pi \times fbn/(2 \times \pi \times fn)^2) + s^2 \times 1/(2 \times \pi \times fn)^2)} =$$

$$\frac{1 + s \times (2 \times Dz/(2 \times \pi \times fz)) + s^2 \times 1/(2 \times \pi \times fz)^2}{1 + s \times (2 \times Dn/(2 \times \pi \times fn)) + s^2 \times 1/(2 \times \pi \times fn)^2}$$

Conversion

fz	: blocking frequency	MD 1514/MD 1517
Dz	: damping numerator	
fbz = 2 × Dz × fz	: bandwidth numerator	MD 1515/MD 1518
Dn	: damping denominator	
fbn = 2 × Dn × fn	: bandwidth denominator	MD 1516/MD 1519
fn = MD 1520(%) × fz	: BSF natural frequency	MD 1520/MD 1521

11

From Performance 2

1522	ACT_SPEED_FILTER_TIME		SW 6.1 or higher		Cross reference: -
	Time constant revolutions actual value filter Time constant speed actual value filter			Related to: FSD/MSD/SLM	Protection level: 2/4
Unit: ms	Default: 0.0	Minimum: 0.0	Maximum: 500.0	Data type: FLOAT DWORD	Active: Power ON

The smoothing time constant is set in MD 1522.

It is applicable to low-resolution encoders (such as 32 increments per revolution (–> $T_{GL} \approx 1$ ms).

Example

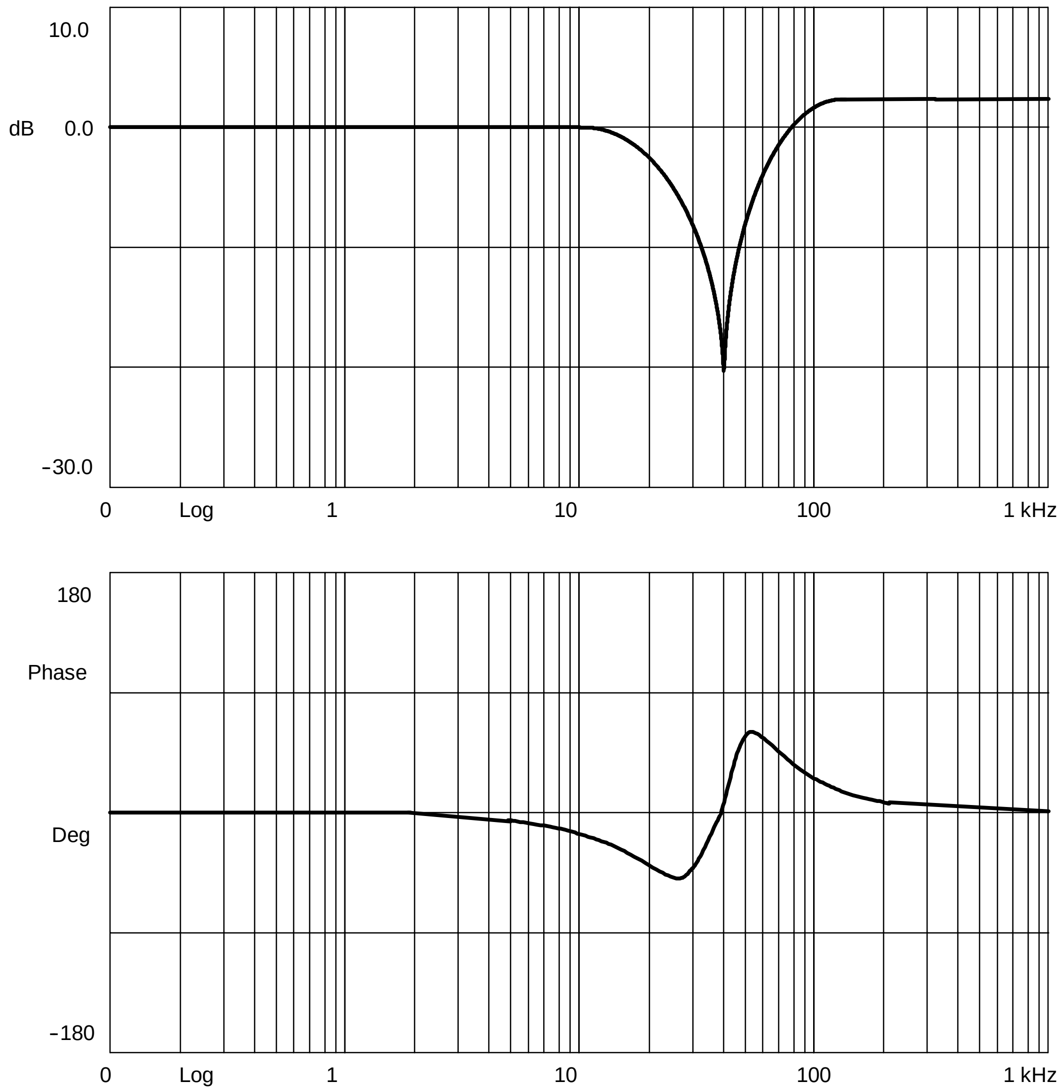

Figure 11-13

fz = 54 Hz
Dz = 10%
fn = 40 Hz
Dn = 70%

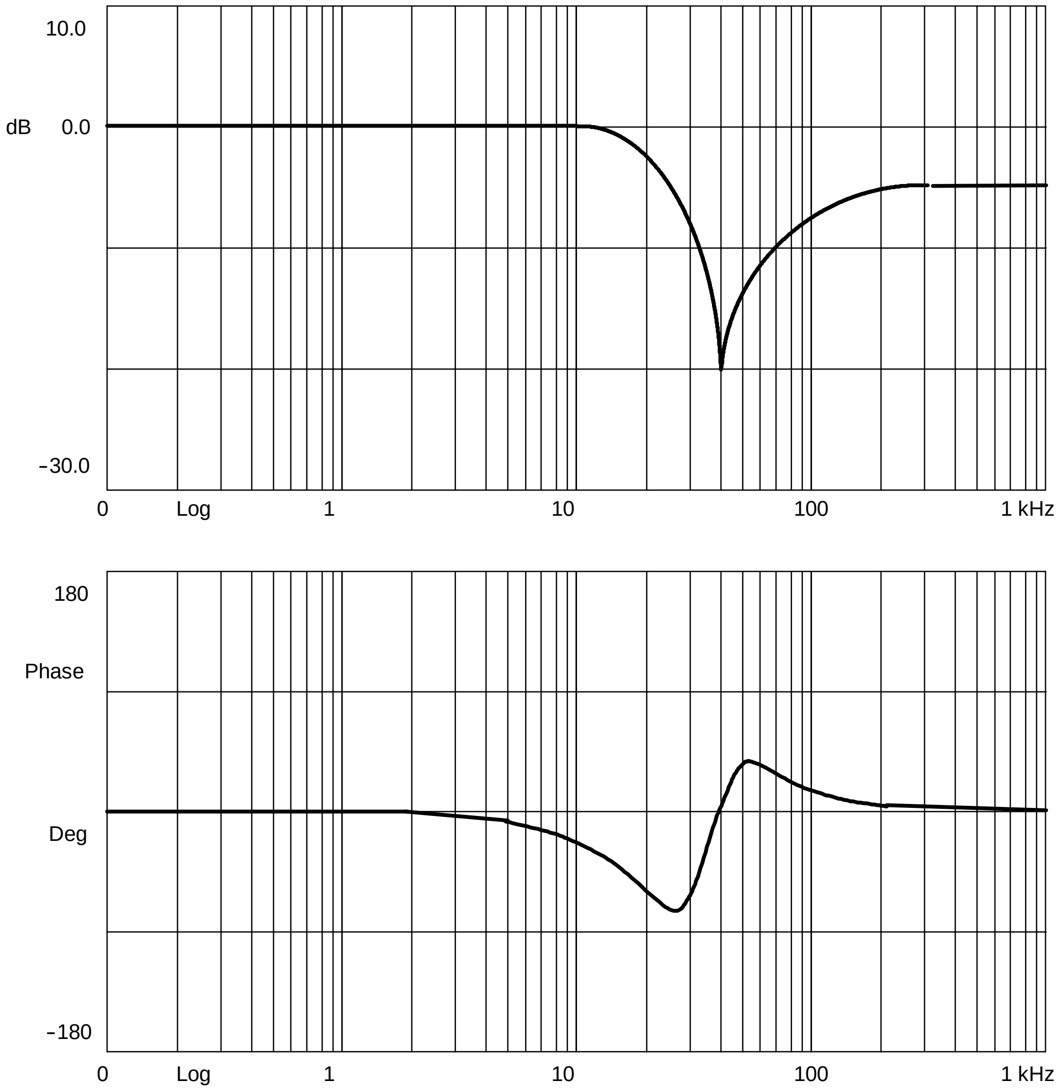

Figure 11-14

fz = 35 Hz
Dz = 6%
fn = 40 Hz
Dn = 70%

11.5.7 Position control measurement

Functionality

This measurement function basically analyzes the response to the active position measuring system. If the function is activated for a spindle without a position measuring system, the NCK generates an error message. Depending on which basic measurement setting has been selected, various measurement parameters lists as described below are made available.

Procedure

The traversing range monitoring function is set and the enabling logic (external/internal) selected in the **basic display**.

One of three different types of measurement can be selected:

- Reference frequency response
- Setpoint step change
- Setpoint ramp.

The parameters required for this purpose are set in the **Measurement parameter display**. On completion of the measurement, the results can be called to the screen for assessment via the **Display** softkey.

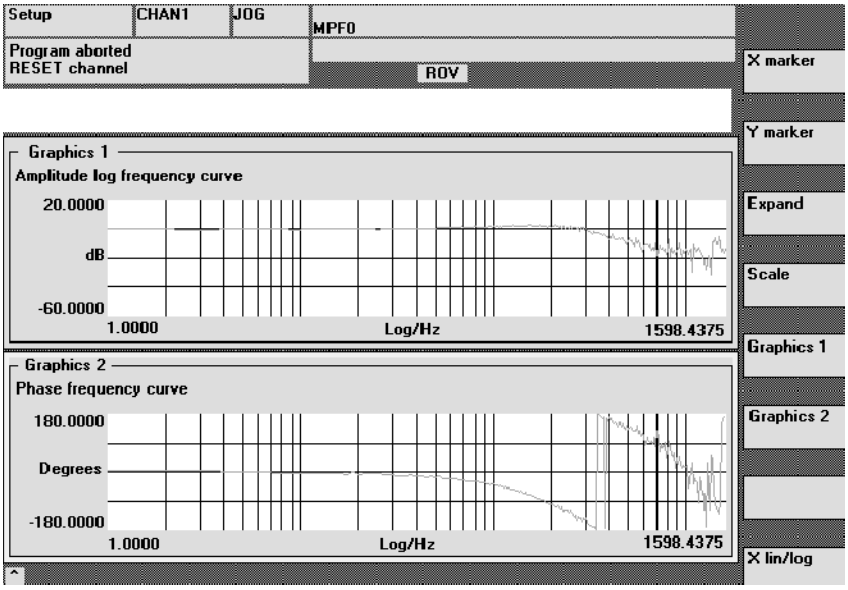

Figure 11-15 Display diagram: Example of position control loop

Reference frequency response

The reference frequency response measurement determines the transmission ratio of the position controller in the frequency range (active position measuring system). The setpoint filters, K_V value and feedforward control must be parameterized in such a way that overshoot is avoided wherever possible over the entire frequency range. In the case of dips in the frequency response, the setting of the feedforward control balancing filters should be checked.
Excessive resonance requires

1. Decrease in K_V value
2. Adaptation of the equivalent time constant of the speed control loop
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 magnitude of the test signal amplitude. It should be set to the smallest possible value (e.g. 0.01 mm).

Offset
The measurement requires a slight speed offset of a few motor revolutions per minute. The offset must be set such that no speed zero crossings occur at the set amplitude.

Bandwidth
Setting of analyzed frequency range (maximum setting = half the position controller sampling 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 operations
The accuracy of the measurement, but also the measurement time, are increased with this value. A value of 2 is normally suitable.

Settling time
This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of between 0.2 and 1 s is recommended. Do not set too low a value for the settling times or the frequency response and phase diagrams will be distorted.

Setpoint step change and setpoint ramp

The transient or positioning response of the position control in the time range, and in particular the effect of setpoint filters, can be assessed with the step and ramp stimulation functions. If an offset value other than zero is input, the step change is stimulated during traversal. For the sake of clarity, the displayed position actual value does not include this speed offset. The following quantities can be measured:

- Actual position value (active position measuring system)
- Control deviation (following error).

Measuring parameters for setpoint step change and setpoint ramp

Amplitude
This parameter determines the magnitude of the specified setpoint step change or ramp.

Offset
The step is stimulated from standstill or starting from the constant traverse speed set in this parameter.

Measurement time
This parameter determines the period of time to be recorded (maximum: 2048 position controller cycles).

Settling time
This value represents the delay between measured data recording and test setpoint output and the injection of the offset.

Ramp time
With basic setting **Setpoint ramp**, the position setpoint is specified according to the set ramp time. In this case, the acceleration limits which currently apply to the axis or spindle are effective.

The position setpoint and the actual value of the active measuring system are recorded in each case.

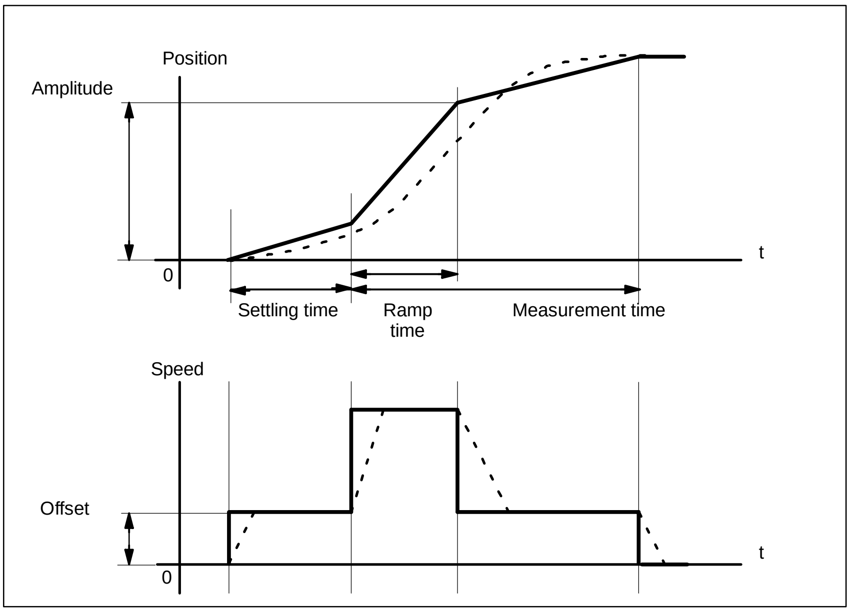

Figure 11-16 Signal chart for position setpoint/ramp measuring function

At maximum axis velocity, there is a (virtual) step change in the velocity (continuous line).

The curves represented by the dashed line correspond to a realistic, finite value. The offset component is excluded from the display graphic in order to emphasize the transient processes.

Jerk limitation check

The jerk limitation function cannot be checked with the measuring functions. Reason: The measuring function setpoint does not take effect until after jerk limitation. However, jerk limitation can be optimized via program or JOG operation by output of the DAC signals (position actual value, following error, ...).

Step height

To avoid damage to the machine, the setpoint step change is limited to the value specified in MD 32000 MAX_AX_VELO. This can result in the desired pitch not being 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!

11.6 Graphical display of measuring functions

Explanation

This display appears when the softkey **Display** is selected in the relevant measuring function basic display.

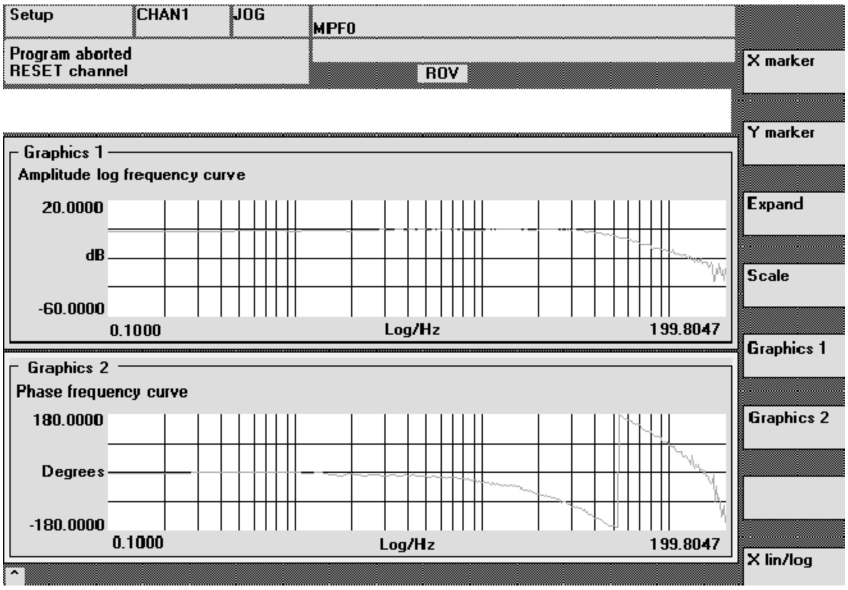

Figure 11-17 Display diagrams 1 and 2 of speed control loop

Softkeys Graphics 1, Graphics 2

These softkeys are used to switch backwards and forwards between the two single graphic displays and the screen output with both graphics.

Softkeys X marker and Y marker

When these softkeys are selected, a vertical or horizontal line, which marks the abscissa or ordinate, appears in the selected diagram. The associated coordinates are also output. The softkey **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.

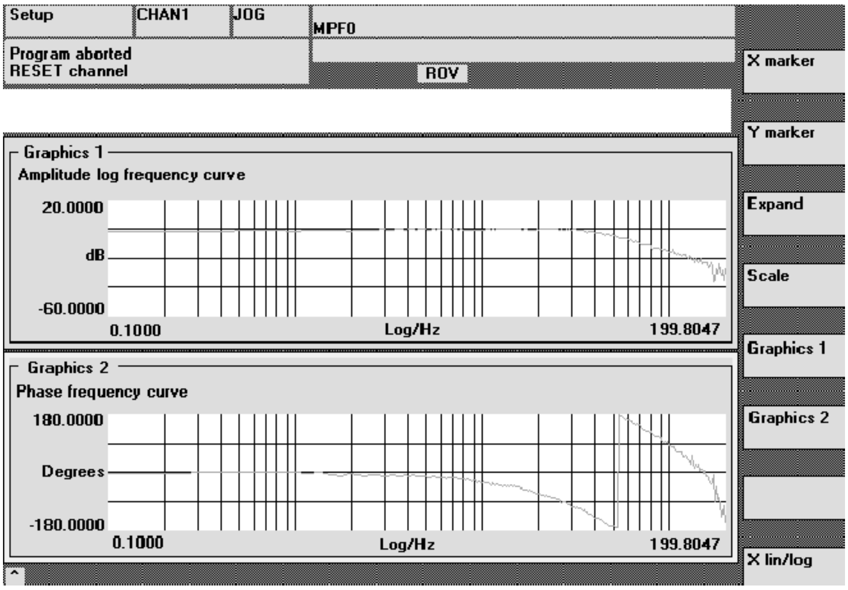

Figure 11-18 Display diagram: Application of X or Y marker

Softkey Expand

To match the time scale, use the **Expand** softkey to mark the current position of the X marker as the start of the range to be expanded. If the **Expand** softkey is selected again, you can move the X marker to the end point of the range to be expanded and select **Expand** again to show the marked area as a full-width display. If the **Expand** softkey is selected again, the display returns to its normal state. The Expand function is active only in the currently selected diagram.

Softkey X lin/log

By selecting the **X lin/log** softkey, it is possible to switch between the linear and logarithmic abscissa of the selected diagram.

Y scale

The Y scale is normally processed automatically. The softkey **Scale** can, however, be selected to allow manual input of the scale.

11.7 Trace function

Note

The trace function can only be used with the PCU 50.

11.7.1 Description

Servo trace function with graphic user interface for monitoring drive/servo signals and states. Measuring signals are selected and measuring parameters set using softkeys and drop-down menus. Operation is either via mouse or via keyboard.

Function overview

The trace function offers the following features:

- 4 trace buffers with up to 2048 values each.
- Signal selection of servo signals (output in position control cycle) or drive signals (output in speed control cycle).
- 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.
- Selection of fixed Y scaling for each trace.
- Selection of marker function for each trace. Expand function in the time axis.
- Selective loading and storing of measuring parameters and traces.

11.7.2 Operation, main screen

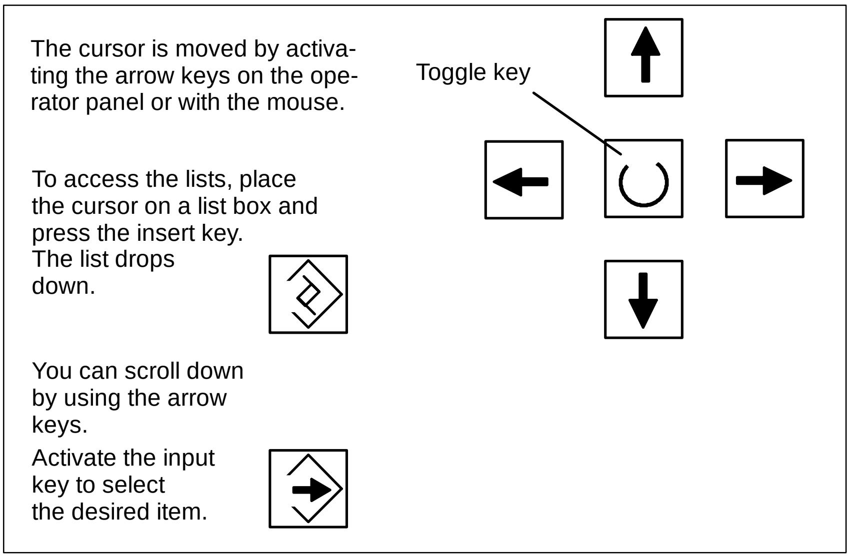

Figure 11-19 Cursor operation

Basic servo trace screen

The basic screen of the trace function is displayed by pressing the **Drives/servo** \ **Servo trace** softkeys.

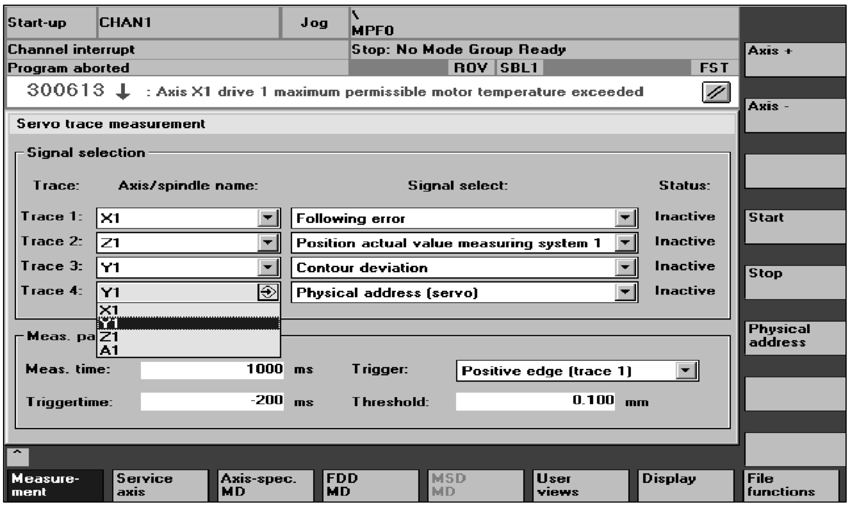

Figure 11-20 Basic servo trace screen

11.7.3 Parameter settings

Basic screen settings

The following settings have to be made in the basic screen:

- The axis/spindle to be measured
- The signal to be measured
- Measurement time
- Trigger time
- Trigger type
- Trigger threshold.

Signal selection

Axis/spindle name input field

The cursor must be positioned on the “Axis/spindle name” list box of the respective trace. The selection is then made by using the **Axis+** and **Axis–** softkeys or by activating the desired item in the drop-down list box.

Signal selection input field

The cursor must be positioned on the “Signal selection” list box associated with the trace. Then activate the desired items by selecting them from the list box.

Measuring parameters

Measurement time input field

The measurement time is entered directly in the “Measurement time” input field.

Trigger time input field

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.

Marginal condition: Trigger time + measuring period $\geqq$ 0.

Trigger input field

The trigger type is selected in the “Trigger” drop-down list.
The trigger always relates to trace 1. After the trigger conditions are met, traces 2 and 4 are started simultaneously.
Trigger from part program (example trigger start from part program for axis X1: $AA_SCTRACE[X1]=1).

Settable trigger conditions:

- No trigger, i.e. measurement begins when the **Start** softkey is activated (all traces are started time-synchronized).
- Positive edge
- Negative edge.

Threshold input field

Direct input of the trigger threshold.

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The threshold is only effective with trigger types “Positive edge” and “Negative edge”.
The unit refers to the selected signal.

Axis + and axis – softkeys

To select the axis/spindle, position the cursor on the appropriate “Axis/spindle name” list field.

You can also select the axis/spindle by using the cursor in the drop-down list.

Start and Stop softkeys

To start the trace function recording, activate the **Start** softkey. The current message is aborted by activating the **Stop** softkey or RESET.

Physical address softkey

The entries are made in the servo trace function basic screen.

- Signal type “Physical address” has to be activated in the desired trace.
- Position the cursor in the signal selection field that corresponds to the desired trace (on physical address).

The physical address dialog box is overlaid when you activate the **Physical address** softkey.

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.

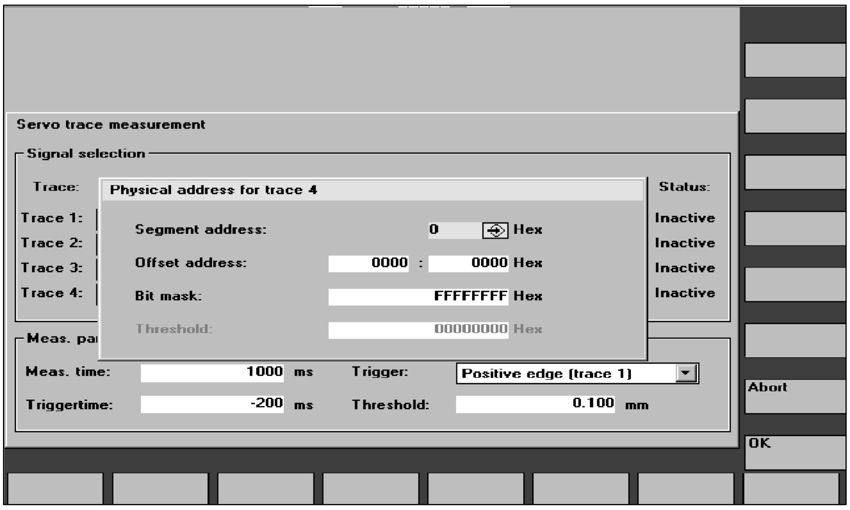

Figure 11-21 Input screen form for setting the physical address.

All parameters settings are entered in hexadecimal format.

Segment address input field

Direct input of the segment address of the signal to be logged.

Offset address input field

Direct input of the offset address of the signal to be logged.

Mask input field

If you want to display certain bits only, select them in this dialog box.

Threshold input field

In the “Threshold” input field, you can only set the trigger threshold for the physical address of trace 1. If you exit the input field by activating the **OK** softkey, this hexadecimal value is entered in the “Threshold” field of the servo trace basic display.

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11.7.4 Performing the measurement

Starting the measurement

After setting the parameters, activate the **Start** softkey to initiate the measurement process. Execution is dependent on the condition specified in the Measuring parameters and “Trigger” input field.

Terminating the measurement

Measurement is terminated after the time specified in the Measuring parameters/“Measuring time” input field has expired or was interrupted by activation of the **Stop** softkey.
It is not possible to display an interrupted measurement (Display softkey).

11.7.5 Display function

The results can be graphically displayed after measurement has been successfully completed.
The horizontal softkey **Display** calls up the screen (Fig. 11-22).The measured traces are shown as diagrams.

Trace 1 and 2 are displayed in Graphics1, and trace 3 and 4 in Graphics2.

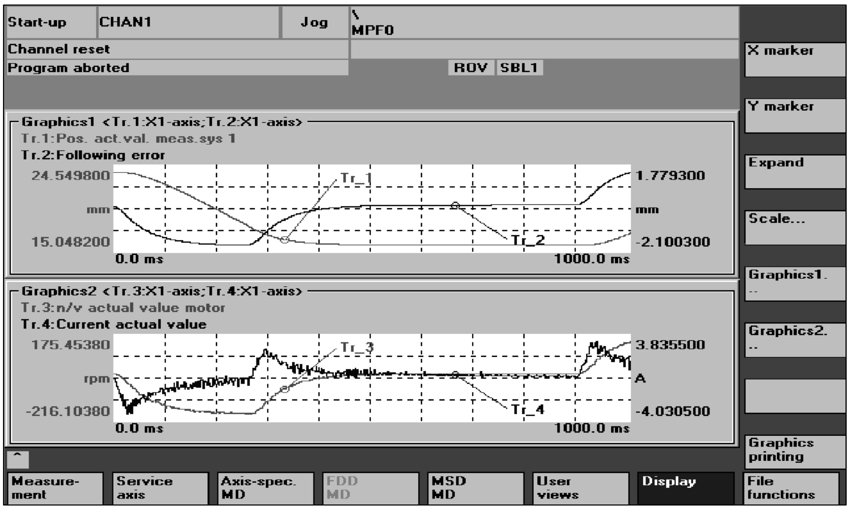

Figure 11-22 Display of Graphics1 and Graphics2

X marker and Y marker softkeys

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.

Expand softkey

Expand function for the X coordinate. The X marker must be activated.

When the **Expand** softkey is first activated, a second X marker is displayed. The first X marker remains stationary in the current position; the second marker can be moved by means of the cursor keys.

By pressing the **Expand** softkey once again, the area between the markers is expanded. This allows you to zoom in on sections.

Softkey Scale...

When you press the softkey, Fig. 11-23, Y axis scaling, appears. You can scale the traces in this window.

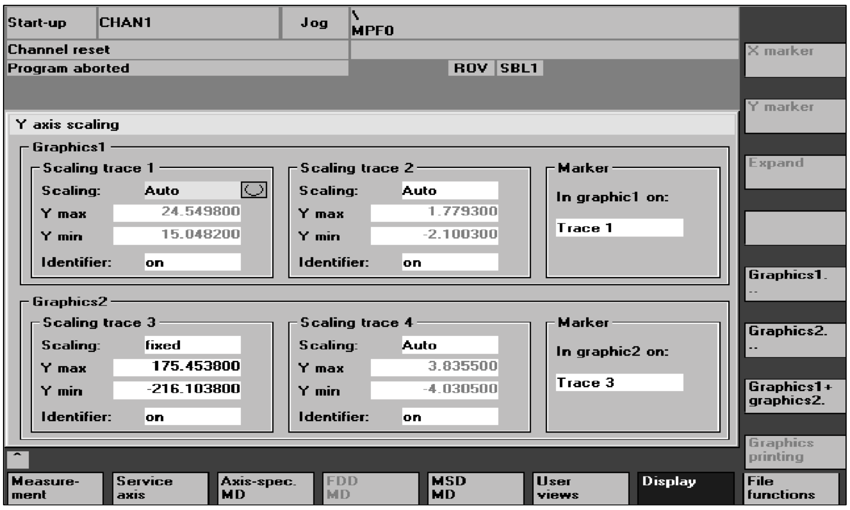

Figure 11-23 Scaling of Graphics1 and Graphics2

Parameterizing the graphs

Scaling input field

You can choose between automatic and manual (fixed) scaling by activating the toggle key on the “Scaling” field.

Y max and Y min input fields

You can enter the scaling value in the Y max and Y min input fields.

These input fields can only be activated if scaling type “fixed” is set.

The entries are only transferred to the graph when you exit the screen form if “fixed” is set in the scaling field.

Marker input field

Use the toggle key to assign the marker to the appropriate traces in the “Marker” field.

In Graphics1, the marker can be selected for trace 1 or trace 2; in Graphics2 for trace 3 or trace 4.

Graphics1... and Graphics2... softkeys

The **Graphics1** or **Graphics2** softkey serves to display the individual graphs in full-screen size. Return to previous screen by activating the vertical softkey **Graphics1 + Graphics2.**

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Print graphics softkey

Upon activation of the **Print graphics** softkey the current graphics display is printed on the printer selected in the print setup (Graphics1/Graphics2 or single screen).

11.7.6 File functions

Description

The **File functions** softkey serves to switch over to the “File functions” screen.

This is where the measurement settings and the measured values of the trace function can be saved, loaded or deleted.

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.

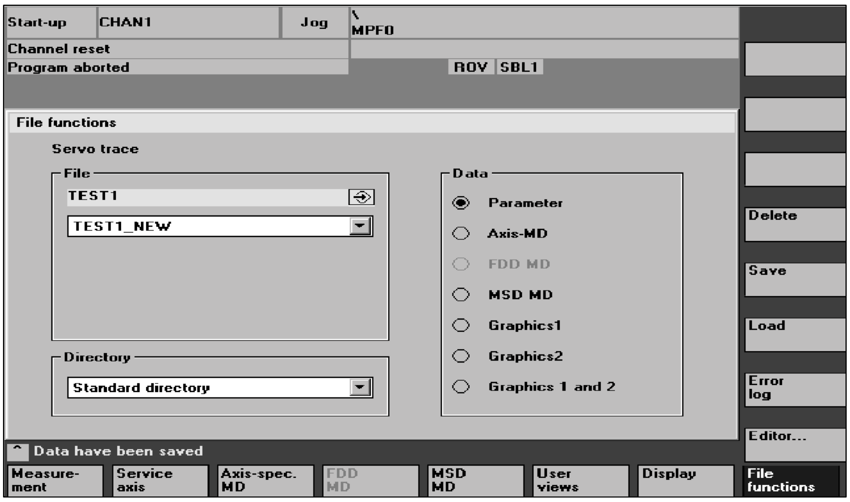

Figure 11-24 Servo trace file function

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 can be a directory you have created yourself under “Services” or the standard directory for data management (list entry: Standard 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.

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 Services operating area.
References: /BAD/ Operator’s Guide HMI Advanced

11.7.7 Print graphic

Printer settings

The printer selection screen is called up by pressing the **HMI\Printer selection** softkeys (Fig. 11-25).

Use the toggle key to select whether the displayed graphics are to be sent directly to the printer by activating the **Print graphics** softkey, or output it in a bitmap file instead.

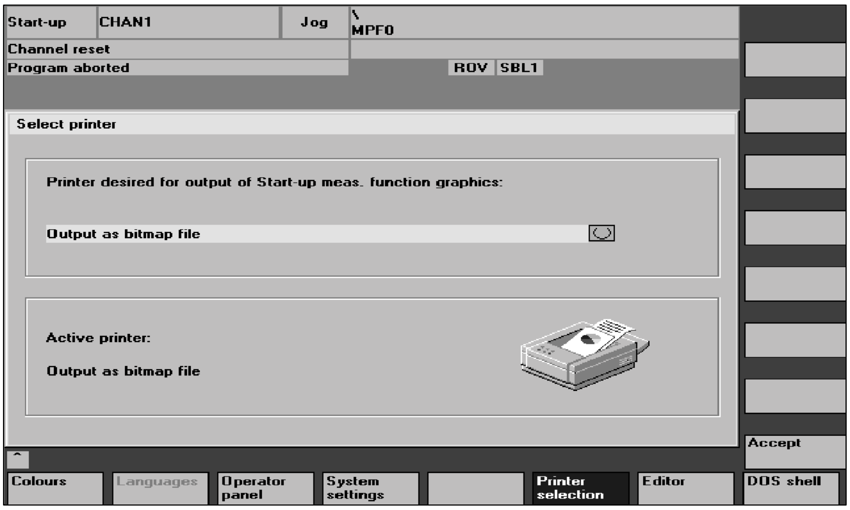

Figure 11-25 Basic screen for printer selection

Direct output on printer

Prerequisite: The printer must be set up under MS-WINDOWS.

You can set “Print” in the printing options.
Upon activation of the **Print graphics** softkey 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.
Upon activation of the **Print graphics** softkey in the “Display” screen, a new screen form is overlaid prompting you to enter a file name (Fig. 10-15). Enter a new name in the drop-down list or select an existing file name for overwriting.

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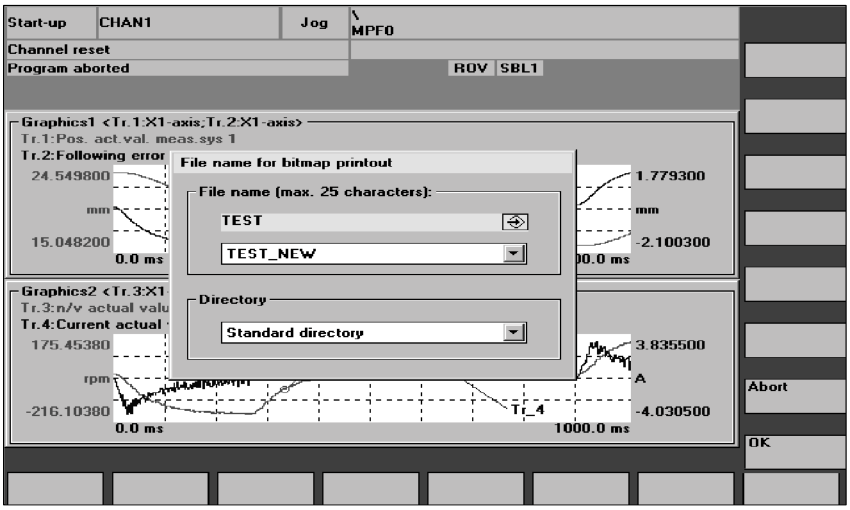

Figure 11-26 File name box for bitmap output

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 can be a directory you have created yourself under “Services” or the standard directory for data management (list entry: Standard directory).

Activate the **OK** softkey to save the file.
Return to the current graphics screen by activating the **Abort** softkey.

11.8 Automatic controller setting (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).
- Display of the measured or calculated frequency responses analogous to 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” softkey.

a) Normal case

Aut. ctrl setting

In the extended menu, press the “Aut. ctrl setting” softkey. The main “Automatic controller setting” display appears.

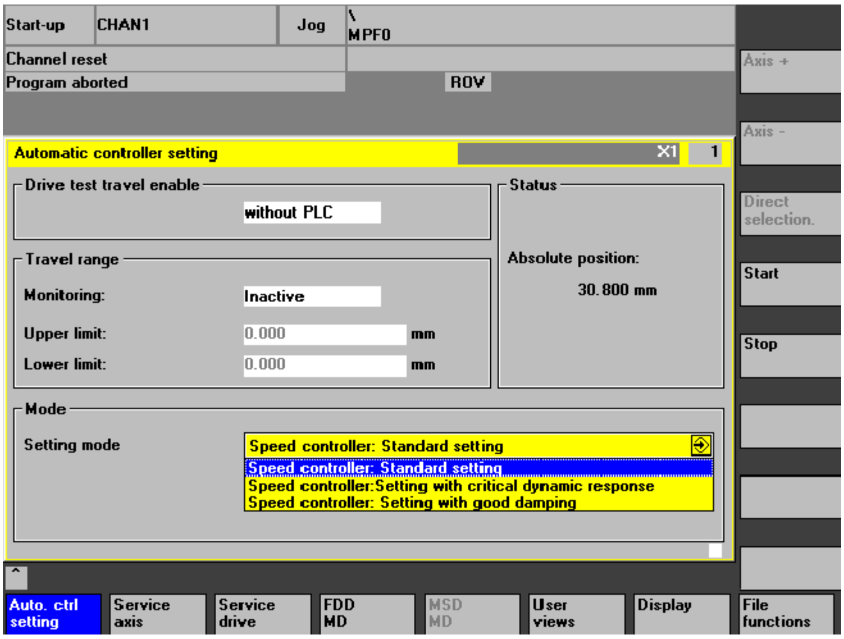

Figure 11-27 Main “Automatic controller setting” display

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The meaning of the input values in the “Drive test travel enable” and “Traversing range” areas of the window is the same as for the measuring functions.
The setting type is defined in the “Mode” function area.

1. In the “Mode” function area, select ”**Variant 1**”.
2. Press the “Start” softkey.
3. Follow the instructions in the menu-driven dialog (see the gray boxes in the flowchart below).
4. Press the “OK” softkey when requested to do so.
5. Press the “NC Start” softkey when requested to do so.
   Notice: The axis starts to move when you press NC Start!

To optimize further axes, select the axes with the “Axis+” or “Axis–” softkey and repeat the procedure from step 1.

b) Special case: Changing parameters

You can

- 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 attenuation.

Vertical softkeys

Softkey “Axis+”:
Selects the next axis to be optimized.

Softkey “Axis–”:
Selects the previous axis to be optimized.

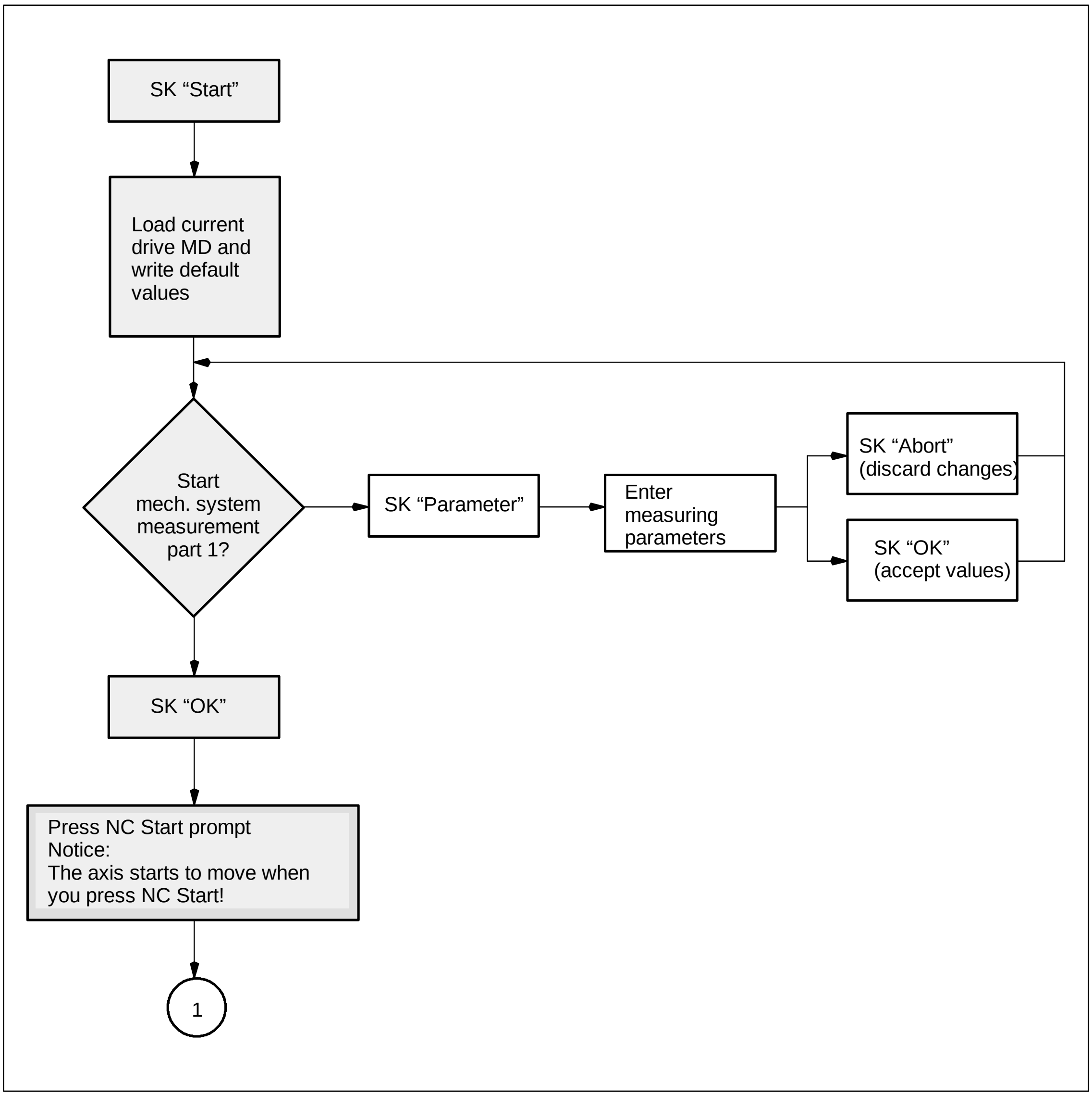
Softkey “Direct selection”:
Selects the axis to be optimized directly in a dialog window.

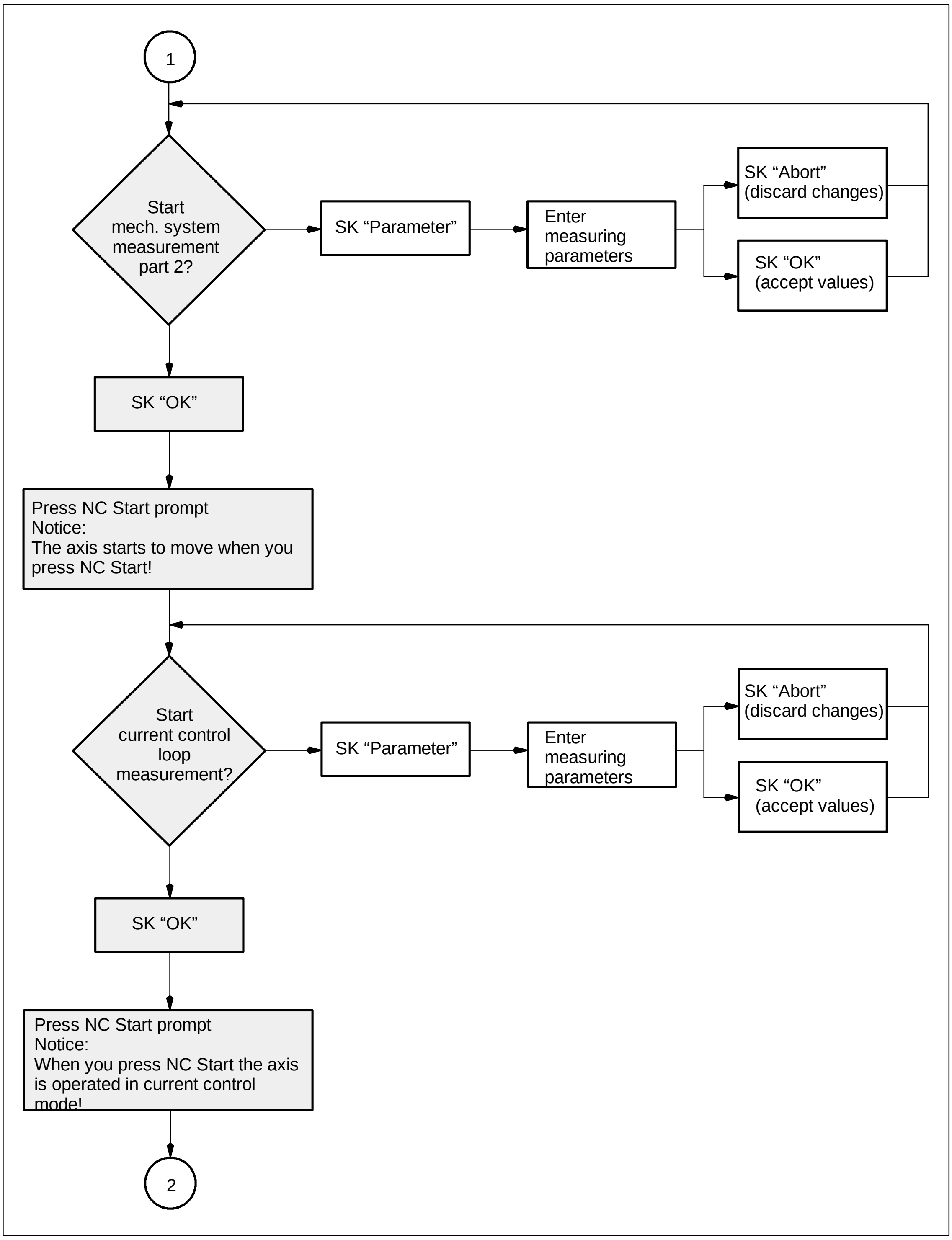
Softkey “Start”:
Starts the automatic controller setting for the selected axis.

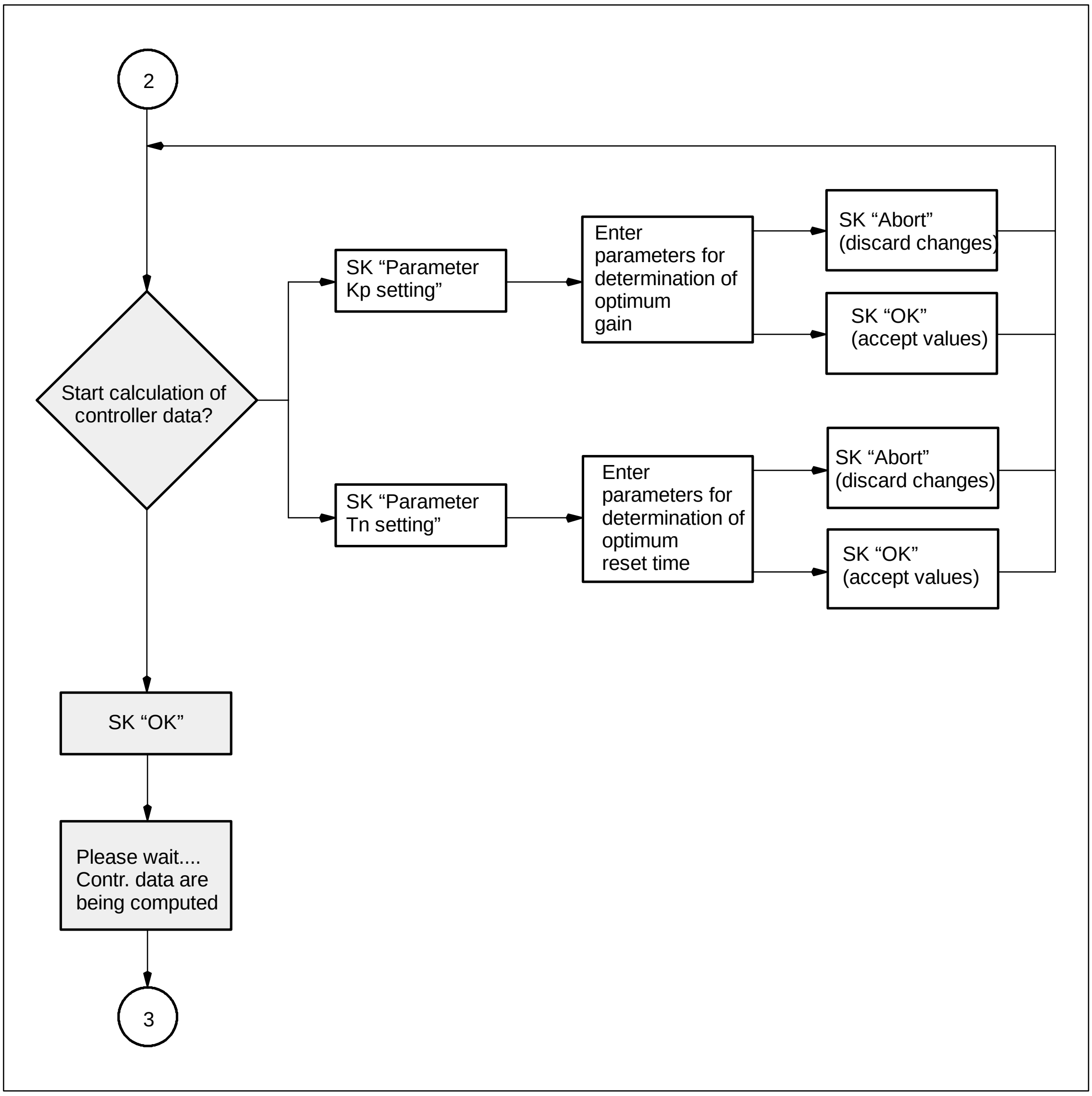
Softkey “Stop”:
Stops the automatic controller setting for the selected axis (if a measuring function is active).

11.8.1 Flowchart for self-optimization

The self-optimization can be terminated at any time by pressing the “Abort” soft-key.




1
Start mech. system measurement part 2?
SK “Parameter”
Enter measuring parameters
SK “Abort” (discard changes)
SK “OK” (accept values)
SK “OK”
Press NC Start prompt
Notice:
The axis starts to move when you press NC Start!
Start current control loop measurement?
SK “Parameter”
Enter measuring parameters
SK “Abort” (discard changes)
SK “OK” (accept values)
SK “OK”
Press NC Start prompt
Notice:
When you press NC Start the axis is operated in current control mode!
2


2
Start calculation of controller data?
SK "Parameter Kp setting"
Enter parameters for determination of optimum gain
SK "Abort" (discard changes)
SK "OK" (accept values)
SK "Parameter Tn setting"
Enter parameters for determination of optimum reset time
SK "Abort" (discard changes)
SK "OK" (accept values)
SK "OK"
Please wait.... Contr. data are being computed
3

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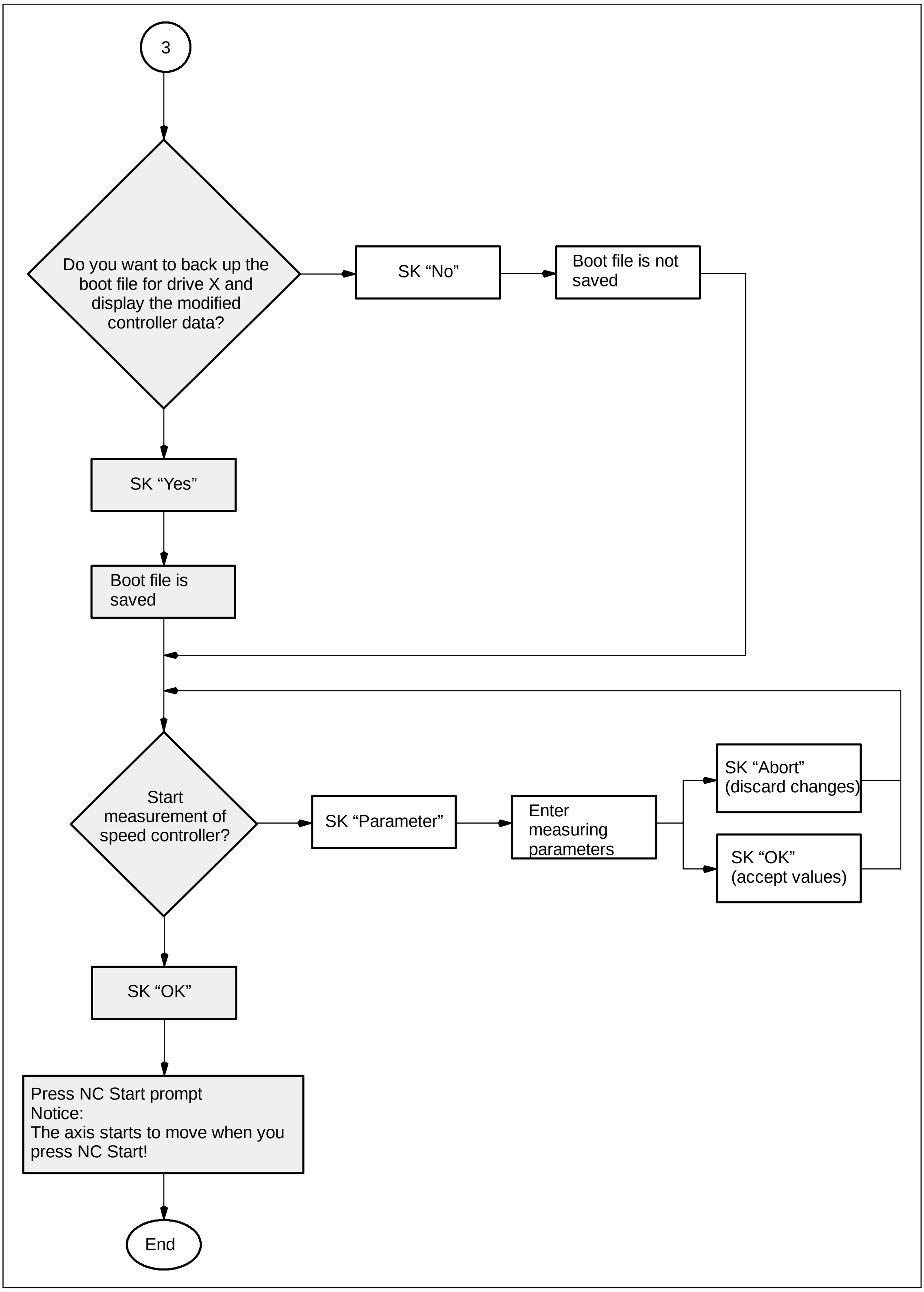

3
Do you want to back up the boot file for drive X and display the modified controller data?
SK “No”
Boot file is not saved
SK “Yes”
Boot file is saved
Start measurement of speed controller?
SK “Parameter”
Enter measuring parameters
SK “Abort” (discard changes)
SK “OK” (accept values)
SK “OK”
Press NC Start prompt
Notice:
The axis starts to move when you press NC Start!
End

11.8.2 Input possibilities for self-optimization

Mechanical system measurement

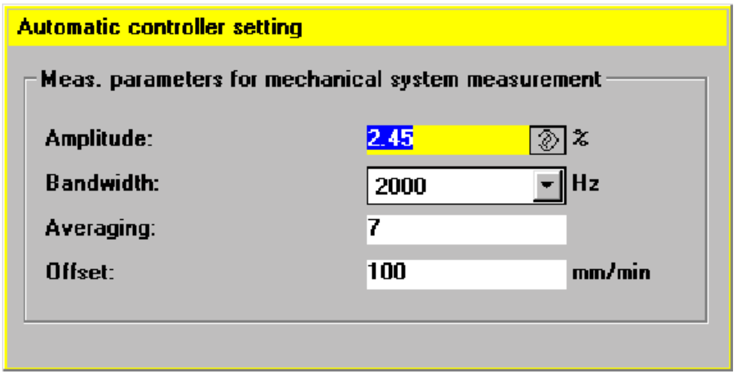


Figure 11-28 Mechanical system measurement

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

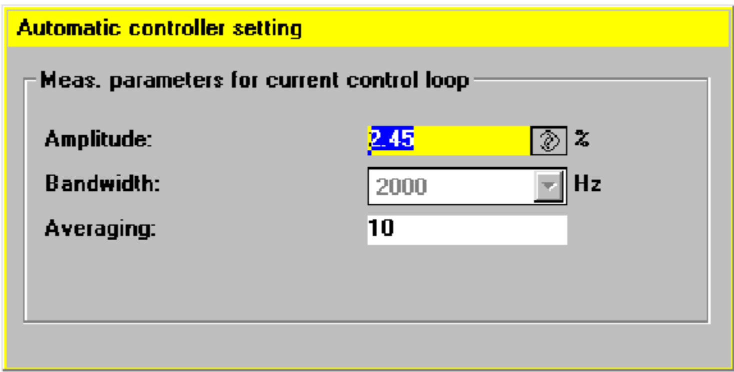


Figure 11-29 Current control loop measurement

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

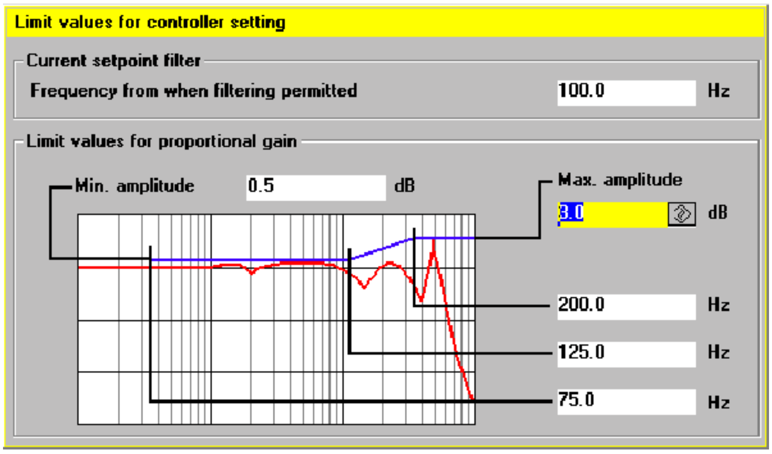


Figure 11-30 Determination of the proportional gain

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 the adaptation range.

Determination of the reset time

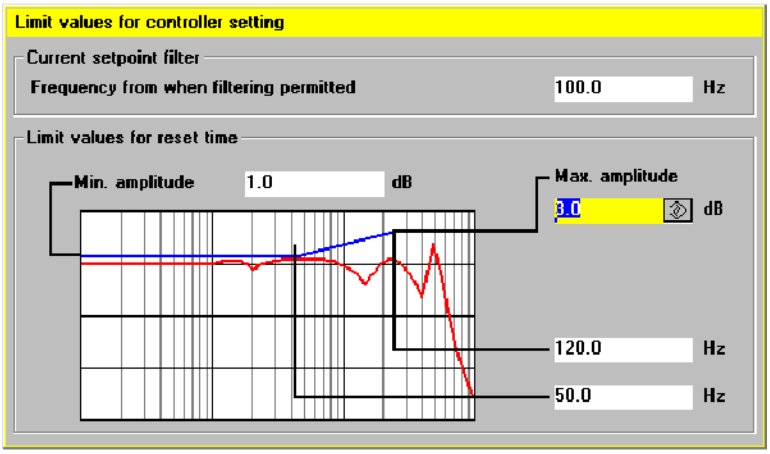


Figure 11-31 Determination of the reset time

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.

11

Speed control loop measurement

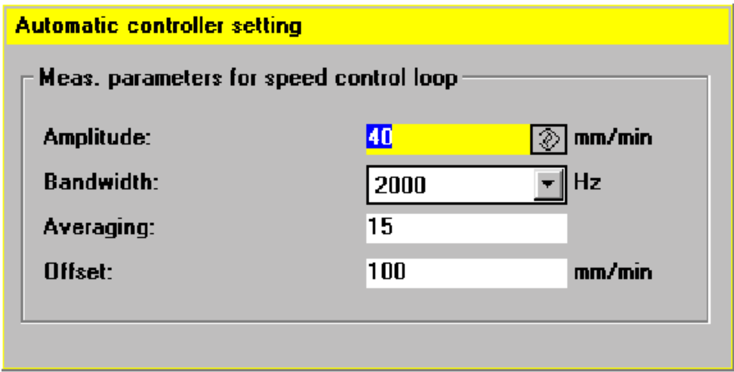


Figure 11-32 Speed control loop measurement

Amplitude:
Input of load velocity 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.

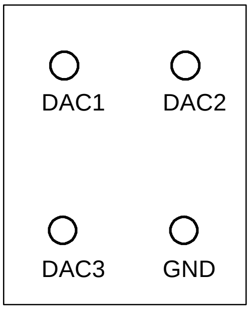
Averaging:
Affects the quality of the measurement.

Offset:
Input of the load velocity in mm/min (should be at least twice the amplitude).

11.9 Analog output (DAC)

Functionality

Special test sockets allow all important control loop signals (setpoints, actual values, control deviations) to be output on external instruments (oscilloscope or signal recorder), e.g. in **automatic** operation. There are three 8-bit DAC channels available on the SINUMERIK 810D. If 611D plug-in units for axis expansion are installed, then the DACs on these modules may also be used. The output voltage of the DAC channels is between 0 and 5 V.



Arrangement of the DAC channels on the CCU3 or external 611D closed-loop control module.

Note

The 3 DAC channels are assigned as standard to the following signals of the drive in slot 1 (module 1):

DAC 1	: Setpoint current	Default settings of shift factor: 4
DAC 2	: Setpoint speed	Default settings of shift factor: 6
DAC 3	: Speed actual value	Default settings of shift factor: 6
GND	: Reference socket (ground)	

These signals can be measured without the PCU 50 or start-up tool.

Activating the analog output

The display for activating and setting the parameters of the DAC outputs is called up from the basic machine display by pressing the **Start-up** / **Drive / Servo** / **Configur. softkeys**.

To activate the configuration, use the **Start** softkey. Active DACs are identified (active/inactive) on the left of the display. The output is ended with **Stop** (active/ inactive).

Note

Before activating the DAC output again with the **Start** softkey, it is necessary to cancel all DAC outputs (slots 1-6) which may be active. This is achieved by activating the **Stop** softkey.

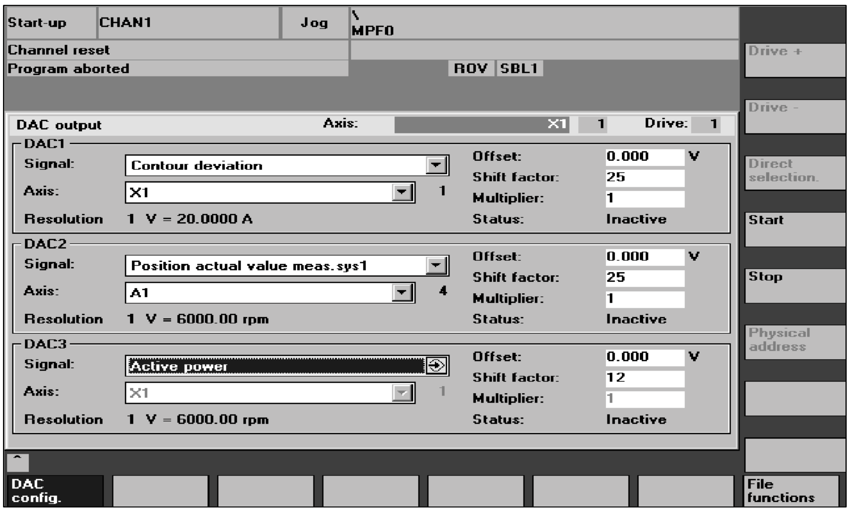


Figure 11-33 Menu for DAC settings

DAC configuration

The assignment of measuring channels and the selection of the signals to be output is made from the DAC configuration display:

- Selection of **Drive No.** of drive module on which signals are to be output via DAC channels.
- Selection of the **Axis name** of the axis/spindle which supplies the signal to be output.
- Specification of a shift factor to adapt the resolution. The shift factor places an 8-bit wide output window over the memory cell to be output (range: –7 ... 31 or 24 with drive signals). When a shift factor of 0 is entered, the output window is always situated on the highest-order byte.
- Selection of signal assignment for every channel used. The signal selection field is called for this purpose and a selection made (marked by cursor or mouse) from the list of available signals (FSD, MSD, servo).

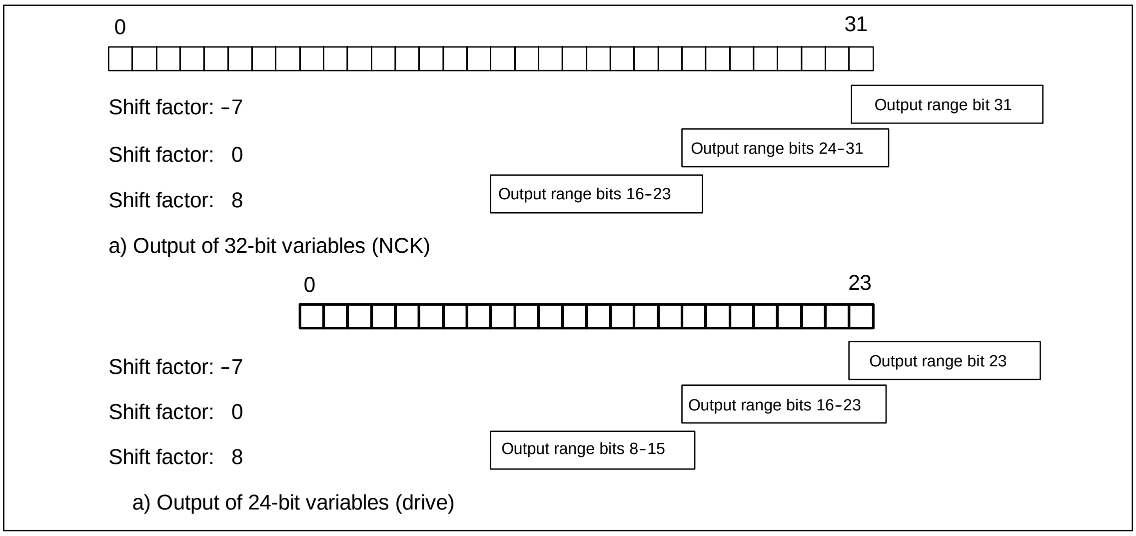


Figure 11-34 Shift factor for analog output of a memory cell

The DAC operates in a 0 V to +5 V voltage range. 2.5 V output voltage corresponds to the zero value of the represented signal. The two's-complement is used for digital to analog conversion, see Fig. 11-17.

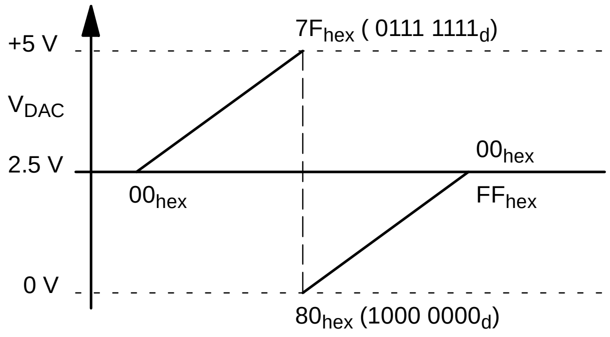


Figure 11-35 Analog output voltage range

Additional information

611D drive signals can only be output on the channels of the associated drive.

The input field **Axis name** has no effect on drive signals.

DAC selection list

No.	Designation	Unit
1	Current i(R)	A
2	Current i(S)	A
3	Current i(d)	A
4	Current i(q)	A
5	Setpoint current I(q) (limited acc. to filter)	A
6	Setpoint current I(q) (before filter)	A
7	Speed actual value motor	rpm
8	Setpoint speed	rpm
9	Speed setpoint reference model	rpm
10	Setpoint torque (limited)	Nm
11	Load (m_set/m_set, limit)	%
12	Active power	kW
13	Rotor flux setpoint	μVs
14	Rotor flux actual value	μVs
15	Cross voltage V(q)	
16	Direct-axis voltage V(d)	
17	Setpoint current I(d)	A
18	Motor temperature	°C
19	DC link voltage	V
20	Zero mark signal, motor measuring system	
21	BERO signal	
22	Speed actual value	rpm
23	Slip frequency setpoint	
24	Rotor position (electrical)	
25	Torque setpoint (speed controller output)	Nm
26	Feedforward control torque	Nm
27	Physical address (drive)	
28	Slip frequency setpoint	
29	Command voltage Q feedforward control	V
30	Command voltage D feedforward control	V
31	Rotor position in $10 000 format with extrapolation	Degrees
32	Voltage setpoint value	V
33	Current actual value	A

Table 11-6 DAC selection list

11.10 File functions

Explanation

The start-up tool offers simple file functions for storing the measurement and function parameters as well as measurement results on the hard disk of the PG or PC.

In addition, for the sake of simplifying initial start-up, NC and drive machine data can also be loaded/saved axis by axis or area by area or transferred to another axis or control. Before an existing file is overwritten, a system request for confirmation of the overwrite command is always output.

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.

■

Data Backup 12

12.1 General information

When to save data:

You should backup your data

- after start-up,
- after changing machine-specific settings,
- during servicing (e.g. after replacing hardware, upgrading software) so that you can put the system back into operation as soon as possible, and
- 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 backup routine for SINUMERIK 810D is subdivided into the following:

1. Data backup for NCK, drive and operating panel settings
2. Data backup for PLC
3. With the PCU 50, data backup for HMI.

Series start-up/ archiving individual areas

There are two basic types of data backup, each for a different purpose.

1. Series start-up
   Provision is made for the generation of so-called series start-up files. These allow easy and complete transfer of a specific configuration to other controls with the same SW version that are, for example, operating on the same machine type. This type of file cannot be modified externally using an ASCII editor. Series start-up files contain all relevant settings (except for compensation data). Series start-up files need to be created for the NCK and PLC and, with the PCU 50, for the HMI as well.
2. Series start-up with compensation data
3. Software upgrade.

Required accessories

You will require the following accessories in order to save data:

- PCIN data transmission program for PG/PC
- RS-232 cable 6FX2002-1AA01-0BF0
  References: /Z/, Catalog NC Z (Accessories)
- PG 740 (or higher) or PC (DOS).

Structure of the file name

_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 defines the data type. During data backup, the file names are generated automatically and output along with the data.

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 data of 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: Settable Work offset, rotations, etc.
EEC	Measuring system error compensation
CEC	Sag/angularity compensation
QEC	Quadrant error compensation
PRO	Protection areas
RPA	R parameter
GUD	Global user data
INI	General initialization program (all data in the active file 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 global user data for channel 1
_N_INITIAL_INI	Archiving of all data in the active file system

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12.2 Data backup via PCU 20

Via RS-232

The following data can be backed up via the RS-232 interface:

- **Series start-up**: with selection option for areas
  - NCK (complete)
  - PLC (complete)
  - HMI (with option of saving only partial areas of the HMI data)
- **Area-specific archiving**: Backup or reimport of individual data areas (softkeys “Data In”, “Data Out” and “Data Selection”).

Error, operating message texts and cycle alarm texts

These texts are part of the 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 backup)

1. Connect the PG/PC to interface X6 on the HMI
2. In the “Services” operating area on the HMI,
3. select “RS-232 PG/PC” interface (vertical softkey).
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:	None
Data bits:	8
Stop bits:	1
Character for XON:	11H(ex)
Character for XOFF:	3H(3x)
Text end character:	1AH(ex)
Format:	– Tape format **disabled** for series machine start-ups or for saving area-specific drive data (boot files). – Tape format **selected** for area-specific saving of all other data.

Saving changed values MD 11210

Via MD 11210: UPLOAD_MD_CHANGES_ONLY you can define whether all data or only those data which deviate from the defaults are to be output via the RS-232 interface.

11210 MD Number	**UPLOAD_MD_CHANGES_ONLY** MD backup of changed MD only		
Default presets: 0	min. input limit: 0	max. input limit: 1	
Change effective: immediately	Protection level: 2/4	Unit: –	
Data type BYTE	valid as of SW release: 1 or 4		
Meaning:	Selects a differential MD upload: Bit 0 (LSB) Effectiveness of differential upload on TEA files **0**: All data are output **1**: Only MDs which contain different values to the compiled values are output Bit 1 Effectiveness of differential upload on INI files **0**: All data are output **1**: Only MDs which contain different values to the compiled values are output Bit 2 Changes of a field element **0**: Complete array is output **1**: Only the changed field elements of an array are output Bit 3 R parameters (only for INITIAL_INI) **0**: All R parameters are output **1**: Only R parameters not equal to zero are output Bit 4 Frames (only for INITIAL_INI) **0**: All frames are output **1**: Only frames not equal to zero are output Bit 5 Tool data, cutting edge parameters (only for INITIAL_INI) **0**: All tool data are output **1**: Only tool data not equal to zero are output Bit 6 Buffered system variables ($AC_MARKER[ ], $AC_PARAM[ ] for INITIAL_INI only) **0**: All system variables are output **1**: Only system variables not equal to zero are output		
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.

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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 of advantage with respect to future SW upgrades.

Continue with "**Series start-up**" or "**Area-specific archiving**".

Series start-up (data backup)

5. HMI interface configuration (see above, tape format deselected).
6. Start PCIN data transmission program ("Data In") on PC/PG.
7. Select "Start-up data" on HMI (HMI "Services" operating area, data output "Data Out"); NCK and PLC areas are displayed after selection of the **Input** key.
8. First select **NCK** and start the read-out process (**Start** softkey). Follow exactly the same procedure for the "PLC" data set.

Area-specific archiving

5. HMI interface configuration (see above, select tape format for all data except for drive data).
6. Start PCIN data transmission program ("Data In") on PC/PG, specify file name.
7. Select data area to be output on HMI (HMI "Services" operating area, data output "Data Out").
8. Select the heading "Data" and then select the following areas in the order given from the list that is then displayed:
   - 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 the read-out process (**Start** softkey) and acknowledge any related input requests on the operator panel.

Note

For the PLC, data backup can be executed with the SIMATIC tools HiGraph.
Note filter setting for SDBs!
References: /S7HT/ Manual, Application of Tools

These tools are useful in ensuring portability of the PLC programs.

Loading archiving data

If you wish to read in a complete configuration, you must execute a general reset on the control.

1. Set the protection level to “user” (password CUSTOMER)
2. Connect the PG/PC to interface X6 on the HMI
3. Select the “Services” operating area on the HMI. Continue with steps listed under “Reading in series start-up” or “Reading in area-specific archive data”.

Retrieving series start-up files

4. Select the HMI interface configuration “RS-232-PG/PC” as above (punched-tape format deselected).
5. Start the PCIN data transmission program on the PG/PC. Select the NCK series start-up file to be read into control under “Data Out” for transmission. Go to the “Services”, “Data In” area on the HMI and start the import process (**Start** softkey). Acknowledge any input requests displayed on the HMI.
6. Follow the same procedure for the PLC series start-up file after executing an NCK reset and a PLC general reset.
7. After another NCK reset, the control powers up with the imported data sets.

Note

The NCK series start-up file must always be imported before the PLC series start-up file.

Retrieving individual archive files

4. Select the HMI interface configuration “RS-232 PG/PC” as above and set “tape format” (except 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.
   - Select the “Services”, “Data In” area in the HMI and initiate the reading-in process (**Start** softkey). The file is automatically detected and loaded accordingly.
5. Read in option data and then initiate NCK reset.

6. Load the machine data file (COMPLETE_TEA_INI) and actuate “NCK reset”. If you then receive messages about a reconfiguration of the memory or re-standardization of machine data, then you must read in the machine data file again and press “NCK Reset”. Generally speaking, this process must be carried out two to three times because the first time the file is loaded the memory allocation is changed or a rotary axis is defined.
7. If global user data must be activated, then the so-called “%_N_INITIAL_INI” file (Table 12-1) must be read out. 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. Read the save “%_N_INITIAL_INI” file back in 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 softkey “Back up boot file” in the drive data menu until you have reset the control once after loading the drive archive data.

Note

Check/correct the interface settings after display of a message regarding memory reconfiguration.

Error during transmission

If transmission is aborted with an error, check the following:

- Is the password at the correct protection level?
- Are the interface parameters (RS-232 PG/PC) correct?
- that while the LEC data are being read in, MD 32700, ENC_COMP _ENABLE is initially set to 0. This also applies to CEC and QEC data.
  CEC: MD 32710 CEC_ENABLE set to 0
  QEC: MD32500 FRICT_COMP_ENABLE set to 0
- Has MD11220 INI_FILE_MODE been set to 1 or 2 (abortion of MD import). (see Subsection 12.4.3.).

Table 12-1 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	• Drive machine data, boot files • Compensation data – Leadscrew error compensation – Quadrant error compensation – Sag compensation • Display machine data • Workpieces • Part programs • Subroutines • User cycles • Standard cycles • Definitions and macros

12.3 Data backup via PCU 50

Via RS-232

To archive or read in data via the RS-232 interface, proceed in exactly the same way described in Section 12.2:

- **Series start-up** with selection possibility for areas
  - NCK (complete)
  - PLC (complete)
  - HMI (with option of saving only partial areas of the HMI data)
- **Archiving** individual data, backup or reading individual data areas back in again (“Data In”, “Data Out” and “Data selection” softkeys).

Via HMI hard disk

You can redirect the data backup to archive files on the PCU 50 hard disk.

Via disk

When a disk drive is connected to the HMI, it is possible to save or reimport data using disks.

Via NC card

You can save data also on the NC card, see Operator’s Guide, “Services” operating area.

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Data are saved via the “Services” operating area.
References: /BA/, Operator’s Guide

12.3.1 Data backup via RS-232 on the PCU 50

Hardware and software requirements

- PG740, PC
- RS-232 cable
- PCIN (V4.2)

System overview

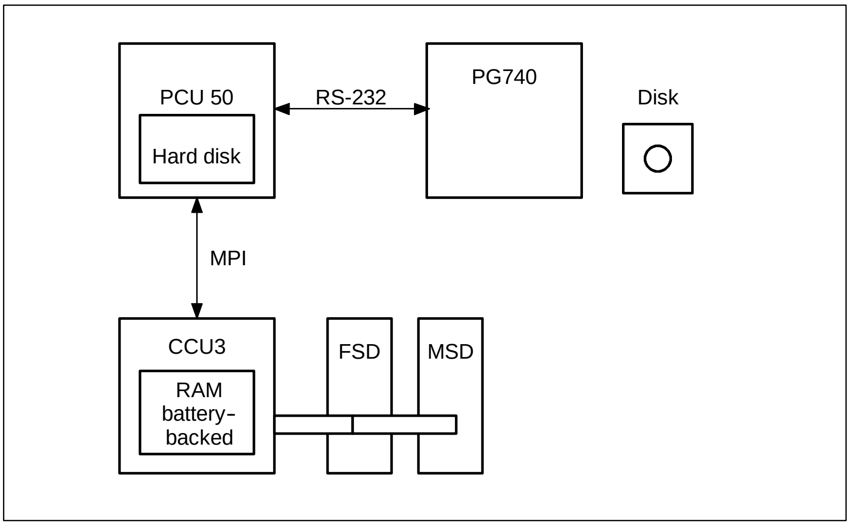

Figure 12-1 System overview

What data does the system contain?

Drive data	NC data	PLC data	HMI data

Where are the data stored?

The data are usually stored in the battery-backed RAM of the NC, PLC or in the PCU 50. The data can also be stored in specific directories on the hard disk of the PCU 50.

Settings for the RS-232 interface

When reading out data via the RS-232 interface some of the data have to be in the archive format. This applies to data with the extension ARC and FSD and MSD boot files.
If remote diagnostics is active, another RS-232 interface must be used for reading out the data.

Selecting the Services area

In the operating area "Services" you will find an overview of all the programs or data to be found in the NC, PLC, drive and on the hard disk. To view all the directories you must first call the display **File selection** and set the display accordingly. Only then are the required data displayed to you.

Example of Services basic display

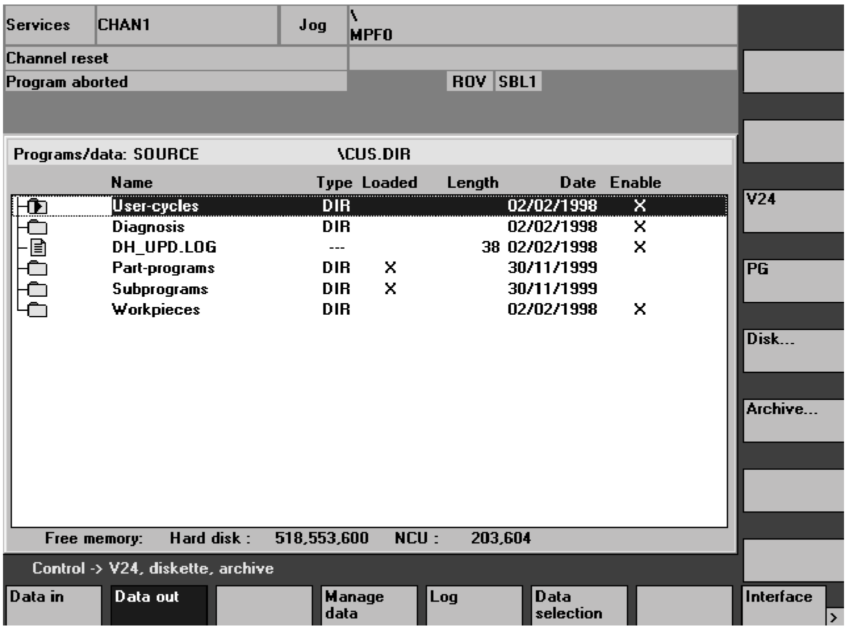

Figure 12-2 Basic display "Services" of operating area

Procedure for reading out data

The operating sequence for reading out data via the RS-232 interface applies to all data. Proceed as follows:

1. Place cursor on the relevant data
2. Press **Data Out** softkey
3. Press **RS-232 or PG** softkey
4. Press **OK** softkey
5. Follow protocol (only if error occurs).

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 backup of all data.

12.3.2 Drive data output via RS-232 on the PCU 50

Drive data

Drive data consist of:

- Boot files (MSD.BOT)
- Boot files (FSD.BOT)
- Drive machine data (*.TEA)

Data	Directory	Name	Meaning
Boot file	Diagnosis\FSD data	VS1.BOT	Boot file 1st axis
Boot file	Diagnosis\MSD data	HS1.BOT	Boot file 1st spindle
Drive MD FSD	DIAGNOSIS\MachDat/FSD	*.TEA	Drive machine data file for FSD 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 FSD data and MSD data.

- FSD.data
  - VS1.BOT
  - VS2.BOT
- MSD data (HS1.BOT)

Note

The boot files can only be output as binary files with the RS-232 setting **Archive format**. The boot files must be backed up before they are output (softkey Save boot files). The backed up boot files (in binary format) can only be restored to the same software version.

Drive MD

The drive machine data must first be backed up in area Start-up\Machine data\File functions before these files can be read out via RS-232.

- DIAGNOSIS
  - MachDat/FSD
  - MachDat/MSD

12.3.3 NC data output via RS-232 on the PCU 50

NC data

By NC data we mean all data that are located in the SRAM of the NC (without part programs and cycles).

The following data are stored in directory **NC active data**:

- 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 compensation (EEC)
  - Beam sag/angular compensation (CEC)
  - Quadrant error compensation (QEC)

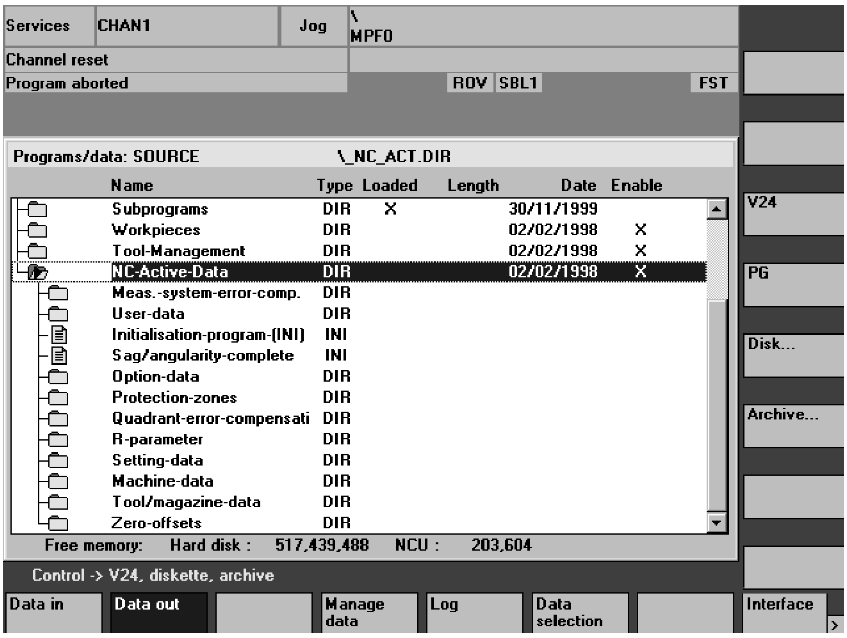

Figure 12-3 NC active data

Structure of the file header

The file header starts with **"%_N"** and ends with **"_INI"**. If you read out the global user data in their entirety, the file header looks like this: **%_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

Output of the measuring system error compensation 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.

Measuring system error compensation
- Measuring system error compensation axis 1
- Measuring system error compensation axis 2
- Measuring system error compensation axis 3
- Measuring system error compensation axis 4
- :
- :
- Measuring system error compensation all

If you wish to read out all data, place the cursor on **Measuring system error compensation all**, otherwise on the relevant axis.
The file header then looks like this:

Measuring system error compensation all:	%_N_AX_EEC_INI
Measuring system error compensation axis 1:	%_N_AX_EEC_INI

Example 2

Output of global user data (GUD). The file header that is sent together with the data output is shown here, too.

- NC active data
  - Global user data (%_N_COMPLETE_GUD_INI)
    - Channel user data (%_N_CH_GUD_INI)
      - User data channel 1 (%_N_CH1_GUD_INI)
        - User data 1 channel 1 (%_N_CH1_GD1_GUD_INI)
        - User data 2 channel 1 (%_N_CH1_GD2_GUD_INI)
        - :
        - User data 9 channel 1 (%_N_CH1_GD9_GUD_INI)
        - User data complete channel 1 (%_N_CH1_GUD_INI)
      - Channel user data all (%_N_CH_GUD_INI)
    - User data all (%_N_COMPLETE_GUD_INI)
    - NC user data all (%_N_NC_GUD_INI)
      - NC user data 1 channel 1 (%_N_NC_GD1_GUD_INI)
      - NC user data 2 channel 1 (%_N_NC_GD2_GUD_INI)
      - :
      - NC user data 9 channel 1 (%_N_NC_GD9_GUD_INI)
      - NC user data all (%_N_NC_GUD_INI)

The central section of the file header which is sent with the output file is shown at the top of the display next to Programs/data: __NC_ACT\GUD.DIR.

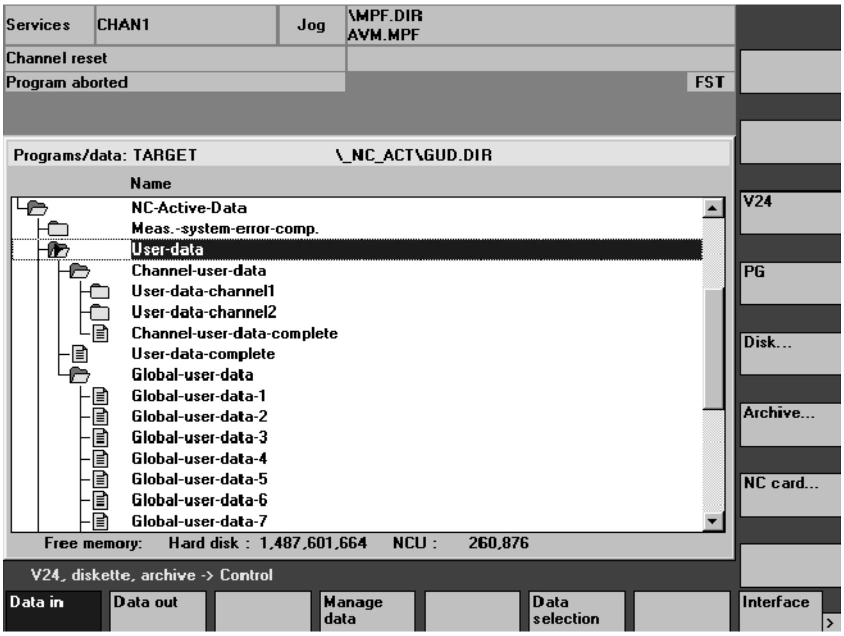

Figure 12-4 Example of global user data

Output of the initialization program (INI)

Position the cursor on the **Initialization program (INI)** directory. Press softkey **RS-232**. 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 trigger data output via RS-232, an initialization program **%_N_INITIAL_INI** is also output, but with all the data located in the directory **NC active data**, i.e. with compensations.

12.3.4 PLC data output via RS-232 on the PCU 50

PLC data

The PLC data must first be backed up as an archive file before they are output via the RS-232 interface.

Procedure

1. Press the **Series start-up** softkey.
2. Only select **PLC**.
3. Press the **Archive** softkey.
4. The display is changed and the job log displayed. The file **PLC.ARC** is created.
5. If the message “**Job complete**” is displayed, then press the **Data out** softkey.
6. Select the directory **Archive\PLC.ARC** and press the **Interface** softkey.
7. RS-232 setting for archive format: Set binary format (PC format) and conclude with OK.
8. Press softkey **RS-232** and confirm with **OK**, the PLC data are then output.

12.3.5 HMI data output via RS-232 on the PCU 50

Display MD

The display machine data on the HMI (MD 9000, ...) must be backed up via file functions (Start-up). These MD are located in the RAM of the PCU 50. The data are stored in directory **Diagnosis\MachDat\OperatorPanel.** The file name assigned when the data were being stored is displayed in the directory.
To read out the display machine data place the cursor on the relevant file and then activate the **RS-232** and **OK** softkeys. The display MD can be output in punched tape format.

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Definitions

The Definitions directory contains the definitions for the macros and the 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 read out via RS-232.

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 tool management data for the PCU 50 are located in the **Tool management** directory. This directory has three subdirectories:

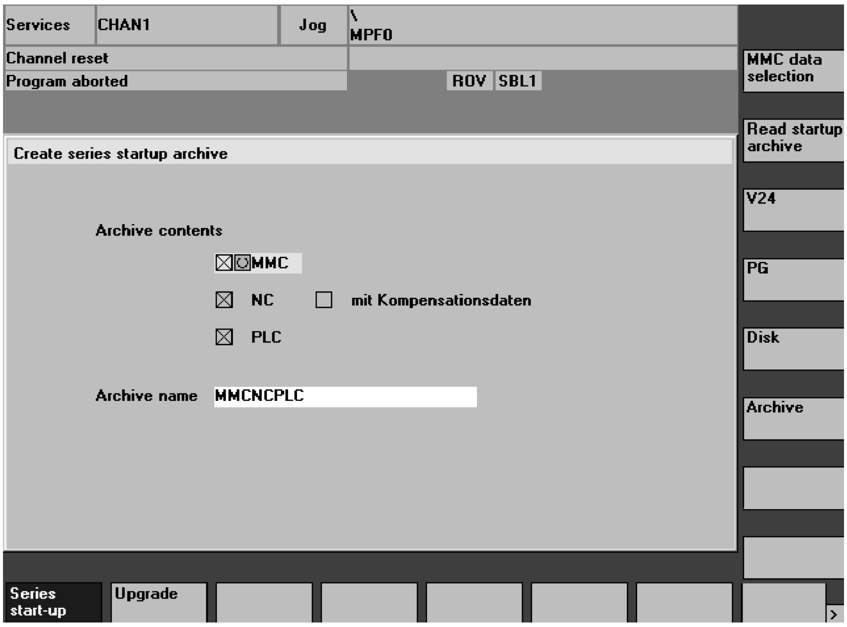
- Magazine configuration (BEISPIEL_DOKU.INI)
- Tool management configuration (TT110.WMF,....)
- Tool management data (WZACCESS.MDB,....).

The PARAMTM.INI file for configuring the displays and access levels is located in directory **Diagnosis\HMI Initialization\...**

12.3.6 Output of the series start-up file via RS-232 on the PCU 50

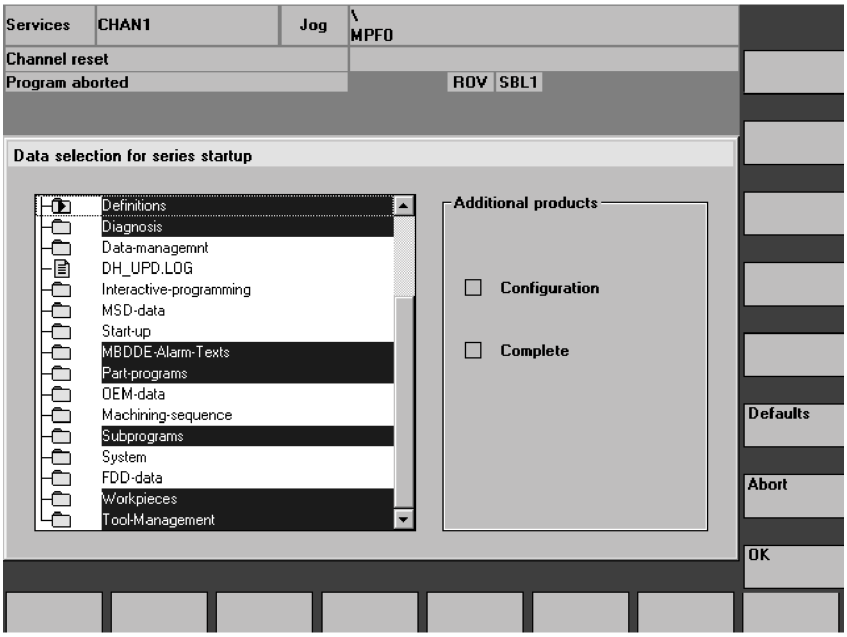
Preparations for series start-up

To create a series start-up file the data selection for series start-up must first be defined. Press the softkey **Series start-up** and define which data (HMI, NC, PLC) you wish to back up.



Setting data selection

Now activate the vertical softkey **HMI data selection.** In this display you define which directories are to be contained in the series start-up file.



Create archive file

Once you have selected the data, press the softkey **OK**. The display changes, and you can start up the creation of the archive file **MMCNCPLC.ARC** by using softkey Archive. On receipt of the message "Job done", the file **MMCNCPLC.ARC** can be output via RS-232 in the archives directory. For this, you have to adjust the RS-232 to PC format.

You can also create and output the areas HMI, PLC, NC separately in the form of series startup files. The file name then is as follows:
HMI: MMC.ARC
NC: NC.ARC
PLC: PLC.ARC

Note

The compensation data EEC, QEC, CEC are not contained in the series setup file. Reason: Each machine has its own compensation data.

12.4 Backing up the hard disk with Norton Ghost

12.4.1 Hard disk backup/restore

Functions

- Simple local backup/restore of PCU 50 hard disks.
  System software, add-on software and user-specific data blocks are completely 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 backup program is installed on each PCU 50.

Norton Ghost

The “Norton Ghost” software can be used to save the complete contents of a PCU 50 hard disk as a “disk image”. This disk image can be stored on various data carriers for a later restoration of the hard disk. The Norton Ghost® program is pre-installed on each PCU 50 module.
For further information please see Internet under web site “www.ghost.com”.

PCU 50

Below is a description of how to back up the complete hard disk of a PCU 50 in order to ensure the integrity of user data and system data in the event of servicing operations:

- **Back up hard disk**
- **Back up user data**
- **Copy data to hard disk.**

Operating instructions

during program operations 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).
To enter HMI BIOS up to BIOS version 2.14 simply press keys CTRL-ALT-ESC, as from BIOS 3.04 using key DEL while the HMI is booting. By loading the
“BIOS setup defaults”
BIOS settings can be reverted.

PCU 50

PCU 50 with BIOS Version 2.12 should be operated with the parallel port setting “378H IRQ7 Bidirectional” (BIOS setup).

Memory capacity required on PC/PG

for backup image file
Free memory capacity on the PC/PG hard disk must be available for the image file.
Thumb rule: Approx. 70% of used HMI hard disk memory capacity.

PG 740/ and others

When the PG is supplied, the parallel interface in the BIOS is set to "output only". Please switch over to EPP. Plug in parallel cable on lower plug (LPT1) on the left-hand side of the PG 740. Careful: Can be mixed up with the COM/ RS-232/AG connection!

Booting from disk

If the backup/restore is to be run from the boot disk, the booting sequence of the PCU 50 should be changed from C,A to A,C in the BIOS.

Backup/Restore via parallel cable

on the PG/PC

- PC/PG with bidirectional interface, EPP setting
  with PG 740 Internal LPT1: <Adresse>
- LapLink Siemens parallel cable (Order No. 6FX2002-1AA02-1AD03) or conventional LapLink cable.
- Disk drive when Backup/Restore is to be executed with Ghost on a PCU 50 with a software version prior to V4.4.
- With PCU 50, set parallel interface to EPP (BIOS). This increases the transmission speed of the parallel interface by approx. 10%.

Backup/Restore with external drive

fitted directly to the PCU 50
Parallel interface, e.g. ZIP, JAZ, CD ROM or network path: The necessary device driver in "autoexec.bat" and/or "config.sys" must be entered on the boot disk by the user.

!

Important

1. Drivers for the above I/O devices are not supported by Siemens.
2. When specifying path or file names with the NortonGhost software, please use the DOS 8-character convention (length of file names: max. of 8 characters).

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Supplementary conditions

1. Backup/restore operations at file level are run from the Services area of the HMI, e.g. in order to save specific setup data, machine date etc. (via disk, RS-232, PC card).
2. Installation/post-installation of individual software components can be achieved either via disk or parallel interface (Interlnk/InterSrv).
   Please take note of the BIOS updating problems.
3. When using the PCU 50 with BIOS version 2.12, the error “Exception error (13)” may occur after a successful restore.
   Remedy: Switch the PCU 50 off and on again.
4. With Backup/Restore via parallel interface or network, the power saving switch-off of the external PC/PG must be switched off.
5. Once you have finished the Backup/Restore with Ghost, please remove the parallel cable in order to avoid unexpected HMI operating states.
6. 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 processors (HMI and PC) are to be operated with the LPT BIOS setting “ECP”.
7. 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 image file from CD to PG hard disk.

Functionality of **Norton Ghost®**

- Saving of complete hard disks in an image file
- Restoring hard disks from an image file
- Compressing of image files
- Integrated master/slave link via LPT port, e.g. from PCU 50 with PG (without Interlnk/Intersrv)
- Support of various PCU 50 operating systems with software versions 3.x and 4.x:
  - Windows 3. x
  - Windows 95
- 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.

12.4.2 Saving user data

In the “Services” operating area of the HMI, you can save PLC, NC and HMI data via the “Series setup” function.
References: /BA/ Operators Guide, Chapter 7, Section “Setup functions”

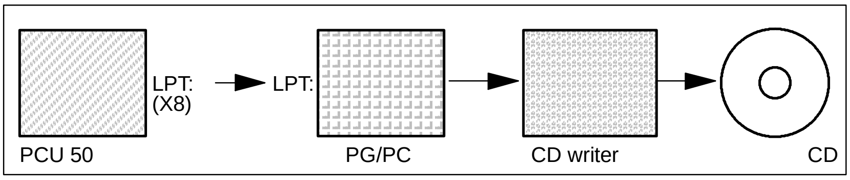
Precondition: Set a password

1. Select operating area “Services”
2. Press softkey “Series setup”
3. Press softkey “HMI data selection”
4. Select the data to be archived
5. Select the “Archive” (hard disk) as target. The series setup archive is generated.

12.4.3 Backing up the hard disk

Precondition:

- Directory where the image file is to be stored exists on PG/PC.
- Sufficient free space is available on PG/PC (see Section “Operating conditions” below)
- One of the operating systems MS-DOS 6.X, Windows 3.x or Windows 95 is present on the PG/PC.
- Ghost program is installed on the PCU 50 and on the PG/PC.
- Connect the PCU 50 and PG/PC using the parallel cable (6FX2002-1AA02-1AD0).



1. Switch off and on control and select setup mode (press key 6 if DOS window appears)
2. Choose item “7: Backup/Restore”

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3. Enter the password
4. Select menu “1 hard disk backup/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 (preset)
       <2> LOCAL
       select the relevant number and confirm
     * Change path:
       <3> Change backup image file name (create directory
       for backup file on PG,
       e.g. C:\SINUBACK\MMC103\)
       <4> Change restore Image filename (create full path name
       for restore file “MMC.GHO” on HMI,
       e.g. D:\SINUBACK\MMC103\MMC.GHO)
       Select the corresponding item, enter the path and confirm
   - Query: save GHOST parameters? answer “Yes”.

     <5> Back to previous menu
     Returns you to the main menu

6. **Execute hard disk backup**
   - **< 2 > Hard disk backup** to <pathname>, PARALLEL mode
     * When this menu is chosen, a message box appears in which you are requested to check whether the connection between HMI and PG/PC has been established.
       The target path for the HMI image directory from which the backup is to be created is displayed.
     * PG/PC:
       Start the Ghost program in a DOS window or at DOS level with the command **ghost -lps**.

* HMI:
  Type “Y” in the message box to confirm and start the backup.
* HMI:
  The SW Norton Ghost message box appears with a:
  display of the transfer progress
  display of the paths used
  details of the data volume to be transferred
* Abort transfer
  PG/PC: Press “Control” + “C”
  When you confirm the query,
  you are returned to the main menu of the Norton Ghost software and Ghost is terminated.

7. **HMI**
   When you abort a Backup/Restore, you are asked:
   Do you want to try to backup again [Y,N]?
   Enter “N” to return to the main menu.
   If you enter “Y”, continue with 6.

   – **< 4 > Back** to previous menu
     Returns you to the main menu

8. PG/PC: Create disk image file on CD
9. PG/PC: Archive the CD at the machine

Duration: approx. 15–20 mins.
to create a compressed disk image = 130 MB of a 540 MB hard disk via LPT.

12.4.4 Copy data to hard disk

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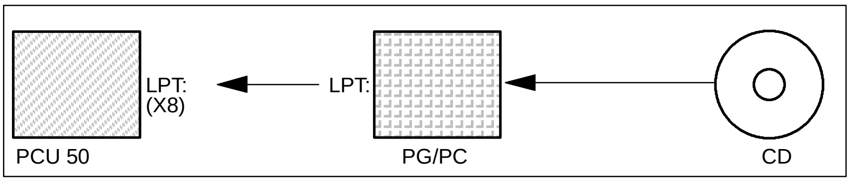
- Ghost program is installed on the PCU 50 and on the PG.
- Connect the PCU 50 to the PC/PG using the parallel cable.
- One of the operating systems Windows 3.x, Windows 95 and a CD drive is available on the PC/PG.



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. Choose item “7: Backup/Restore”
4. Enter the password
5. Select menu “1 hard disk backup/restore with ghost”
6. Set the parameters for the Norton Ghost program:

- **< 1 > configure ghost parameters**:

  see above

7. Restore contents of hard disk

- **<3> Hard disk restore** from <pathname>, PARALLEL mode

  * When this menu is chosen, a message box appears in which:
    you are requested to check whether the connection
    between the HMI and PG/PC has been established.
    The image file name from which the restore
    is to be performed is displayed.
    Image file is available on the PG/PC

  * PG/PC:
    Start the Norton Ghost program in a DOS window or
    at DOS level with the command **ghost -lps**.

  * HMI: “Y”
    Start Restore by acknowledging the message window.

  * HMI:
    The SW Norton Ghost message box appears with a:
    display of the transfer progress
    display of the paths used
    details of the data volume to be transferred

    PC: Press “Control” + “C”
    HMI boots. A boot disk is required to
    boot the HMI.

- **< 4 > Back** to previous menu
  Returns you to the main menu

8. The system boots automatically after a successful restore operation.

Duration: approx. 15–20 mins.
to create a compressed disk image = 130 MB of a 540 MB hard disk via LPT.

Note

Backup of user data, machine data and startup 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.

12.4.5 More than one software version on a PCU 50 (software version 5.2 and later)

Back up a SW version

To make an image of a SW version, proceed as follows:
Precondition:
The Ghost program is installed on the PCU 50.

1. Switch off and on control and select setup mode (press key 6 if DOS window appears).
2. Choose item “7: Backup/Restore”
3. Enter the password
4. Choose item “4: Select Backup/Restore” partitions.
5. Change the maximum number of available displays if applicable:
   Menu “1: Configure ghost parameter”
   Here you can define in menu “1: Change Maximum Backup Images” and how many images you wish to accept. A max. of 7 images are possible.
   Default setting: 1.
6. To back up the current SW version, select menu option “2: Partitions Backup”.
7. The system boots automatically after a successful restore operation. The stored SW version is saved under directory “Images” and is also listed when selecting menu “3 Backup/Restore”.

Restore a SW version

To utilize the image of a SW version, proceed as follows:
Precondition:
The Ghost program is installed on the PCU 50.

1. Switch off and on control and select setup mode (press key 6 if DOS window appears).
2. Choose item “7: Backup/Restore”
3. Enter the password
4. Choose item “4: Select Backup/Restore” partitions.
5. Change the maximum number of available displays if applicable:
   Menu “1: Configure ghost parameter”
   Here you can define in menu “1: Change Maximum Backup Images” and how many images you wish to accept. A max. of 7 images are possible.
   Default setting: 1.
6. To restore the image again, select menu option “3: Partitions Restore”.
7. Choose a SW version from the list of available versions.
8. The system boots automatically after a successful restore operation.

Delete SW version from “Images” directory

To delete an image of a SW version from the “Images” directory, proceed as follows:
Precondition:
The Ghost program is installed on the PCU 50.

1. Switch off and on control and select setup mode (press key 6 if DOS window appears).
2. Choose item “7: Backup/Restore”
3. Enter the password
4. Choose item “4: Select Backup/Restore” partitions.
5. Change the maximum number of available displays if applicable:
   Menu “1: Configure ghost parameter”
   Here you can define in menu “1: Change Maximum Backup Images” and how many images you wish to accept. A max. of 7 images are possible.
   Default setting: 1.
6. To delete an image of a SW version, select menu option “4: Delete Image”.
7. Choose a SW version from the list of available versions.
8. The system boots automatically after a successful delete operation. The desired SW version is removed from the directory “Images” and is thus no longer listed after selecting menu “3 Backup/Restore”.

12.5 Installing a replacement hard disk

PCU 50

Instructions on how to restore the data backup of a complete PCU 50 hard disk are given below. Complete backups ensure the integrity of user and system data for servicing purposes.

Norton Ghost

The “Norton Ghost” software can be used to save the complete contents of a PCU 50 hard disk as a “disk image file”. This disk image file can be stored on various data carriers for later restoration of the hard disk.
The Norton Ghost program is pre-installed on each PCU 50 module and on replacement hard disks.
For further information please see web site “www.ghost.com” or the previous chapter.

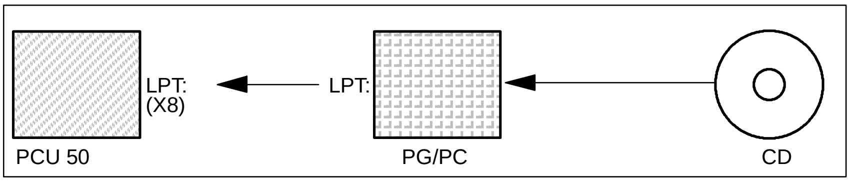
Note

Recommendation:
Archive hard disk backup (hard disk image) including “Norton Ghost” program on CD.

Restore backup copy of hard disk

Precondition:

- Ghost program is installed on the PG.
- A new replacement hard disk is installed.
- Connect the PCU 50 to the PC/PG using the parallel cable.
- One of the operating systems Windows 3.x, Windows 95 and a CD drive is available on the PC/PG.



1. Install a new replacement hard disk on the PCU 50 or a new HMI (see attached instructions)
   - Place hard disk onto hinges
   - Insert the hard disk/HMI connecting cable
   - Mount hard disk using the 4 knurled screws
   - Undo transport lock: 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. Choose item “4: Backup/Restore”
5. Enter the password
6. Select menu option 1 “Hard disk backup/restore with ghost”
7. Set the parameters for the Norton Ghost program:
   - **< 1 > configure ghost parameters**:

     see above
   - **<3> Hard disk restore** from <pathname>, PARALLEL mode
     * When this menu is chosen, a message box appears in which:
       you are requested to check whether the connection
       between the HMI and PG/PC has been established.
       Image file of HMI to which data must be restored
       is to be performed is displayed.
     * PG/PC:
       Start the Norton Ghost program in a DOS window or
       at DOS level with the command **ghost -lps**.
     * HMI: * MMC:
     * HMI:
       The SW Norton Ghost message box appears with a:
       display of the transfer progress
       display of the paths used
       details of the data volume to be transferred

Note

If the data transfer is interrupted during the restore operation, the system on the hard disk is incomplete. You therefore need an HMI boot disk containing MS-DOS $\geq$ 6.X-Boot and the Norton Ghost software.

   - **< 4 > Back** to previous menu
     Returns you to the main menu

8. After a successful restore. The HMI is booted automatically.

Duration: approx. 15–20 mins.
to create a compressed disk image = 130 MB of a 540 MB hard disk via LPT.

12.6 Data backup with the VALITEK streamer on the PCU 50

What can you back up?

Using the VALITEK streamer you can

- back up all data on hard disk C (Backup all)
- back up the user data (archive format) in directory C:\DH\ARC.DIR (Backup User Data)
- restore the data backup (Restore from Tape)

Streamer connection

Connect the VALITEK streamer to the parallel interface X8 (25-pin) on the PCU 50 using SIEMENS cable 6FC9 344–4x☐. No other data backup 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 key **6** on the operator panel keyboard once.

The following menu is displayed:

```
PLEASE SELECT:

1 Install/Update HMI System
2 HMI Configuration Tool
3 DOS Shell
4 Start Windows (Service Mode)
5 HMI System Check
6 Reboot System (Warmboot)
7 Backup / Restore with VALITEK Streamer
8 Start PC Link
9 End (Load HMI)

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 Backup System
4 Backup User Data
5 Restore from Tape
6 Uninstall MMC 102 (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 Backup System
4 Backup User Data
5 Restore from Tape
6 Uninstall MMC 102 (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 backup of all system data. To do this, select 3, Backup System means hard disk C.

```
                  PLEASE SELECT:

                  1 Select VALITEK Streamer Type
                  2 Test Connection to Streamer
                  3 Backup System
                  4 Backup User Data
                  5 Restore from Tape
                  6 Uninstall MMC 102 (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 backup by pressing Y.

8. By pressing key **4**, Backup User Data, you opt to create a backup 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 Backup System
                  4 Backup User Data
                  5 Restore from Tape
                  6 Uninstall MMC 102 (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

[ ...You can specify the directories to be backed up here, 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 backup 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 Backup System
                    4 Backup User Data
                    5 Restore from Tape
                    6 Uninstall MMC 102 (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 backup data from tape by selecting Y.

10. By selecting key **6** you can uninstall the MMC 102/103 system including its data management

```
PLEASE SELECT:

1 Select VALITEK Streamer Type
2 Test Connection to Streamer
3 Backup System
4 Backup User Data
5 Restore from Tape
6 Uninstall MMC 102 (Delete Files)
7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?6
```

```
Do You REALLY want to delete your MMC 102 system?
Your Choice: [Y,N]?Y
```

If you select Y, all data in directories C:\MMC2*.* and C:\DH*.* will be deleted. MS-DOS and WINDOWS operating systems are not deleted.

12

12.7 Line checksums and MD numbers in MD files

Line check sums

Introducing line check sums as you generate backup files for machine data (INI and TEA files) provides an error-checking function. By protecting the files themselves, you can dispense with the “Manufacturer” write authorization when you read them back in again.

MD numbers

Introducing machine data numbers (MD numbers) to the backup files facilitates communication via machine data values for servicing purposes and may ease automatic processing of MD backup files.

The two subsections below give detailed information about line checksums and machine data numbers.

12.7.1 Line checksums (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 generated only by the control system as it is creating an MD backup file, not by external editors on 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.

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

Write permission is not required in order to read in machine data files with valid line checksums.

If you want to load

- machine data without a line checksum,
- modified MD values with deleted line checksum or
- MD files from SW version 1 or 2,

you will need the “Manufacturer” password to read them in.

When loading machine data files, you can choose how the system must react to errors in the machine data file. See Abort procedure Subsection 12.7.3.

If the file contains errored values, then the current values are never overwritten.

12.7.2 Machine data numbers

Archive files

- Machine data numbers are formally positioned as block numbers (e.g. N20070) in front of an MD assignment line.
- A blank is inserted between the machine data number and the MD assignment.
- The MD number refers to the machine data as a whole. Any existing field values have no influence on the MD number.
- You can select generation of MD numbers in front of MD assignment lines in INI and TEA files.
  – MD 11230 MD_FILE_STYLE, Bit 1 = 1 Generate an MD number
  – MD 11230 MD_FILE_STYLE, Bit 1 = 0 Do not generate an MD number

Evaluating MD numbers

When re-importing machine data files, the control evaluates the MD numbers as follows:

- If errors are detected in MD files as they are being imported, the MD number is displayed as a **block number** with the appropriate alarm.

12.7.3 Abort behavior during MD read-in

Abort behavior

If 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. You can select the following control responses in machine data MD 11220: INI_FILE_MODE:

MD 11220 value	Response to errors
0	Output of an alarm, abort on detection of 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, if there is at least one error in the MD file, the name of the affected file is output by a first alarm (alarm 15180).

Further reactions:

- Errored MD do not overwrite current MD.
- Current MD are not overwritten if an attempt is made to load MD without line checksums without appropriate authorization.
- CHANDATA instructions for non-existent channels (MD not set for multi-channel capability) abort the import operation.
- 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 during read-in.
- % character stands for 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.

MD 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

12.8 Machine/setting data

The machine/setting data are listed in
References: /LIS/ Lists

12.9 Back up PLC data

Original image of project

The consistency of the PLC data backup 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 can give rise to data inconsistencies which will cause the user program to stop the PLC.

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SW/HW Replacement 13

13.1 Software update

Note

Sequence for updating software during start-up or software replacement

1. Upgrade HMI
2. Upgrade NCK software.

Please note instructions and advice given in readme file supplied with Tool Box.

13.2 NC upgrade

13.2.1 Standard upgrade

Operating sequence

SINUMERIK 810D contains a firmware flash EPROM for the entire system SW. It is possible to update the software via the PCMCIA slot at the front, without opening the device (**applies to CCU3 export version only**).

- Please save all control and user data before commencing with the upgrade (see Chapter 12, "Data Backup").
- Switch off the control,
- insert the memory card with the new firmware into the PCMCIA slot

and execute the following steps:

1. Set switch S1 to 2
2. Switch on power
3. During booting, the firmware is transferred from the memory card to the device
4. Wait until the digit "6" appears on the display (about 2 minutes)
5. Set switch S3 to 0
6. PLC general reset: Set switch S4 to "2", then to position "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/Ramp-up).
7. Then proceed as described in Section 12.2 (Series start-up) to import the saved data again. Please take note of any manufacturer's instructions regarding the new SW version.

Note

If the digit "6" is not displayed, then an error has occurred:

– Invalid card?

– Memory card or hardware defective?

For CCU3 software (not the export version), the NC card must remain in the slot during operation.

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13.2.2 Series machine 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 transferred to the NC card using SINUCOPY-FFS (on an external PG/PC):

Possible applications:

1. Following replacement of the NC module (or after data loss), the user can restore the original status delivered by the manufacturer from an archive to the NC card or
2. the machine manufacturers can supply their cycles and data on the NC card on delivery of the machine or a software upgrade.

Sequence of operations

A) Creating a start-up file on the NC card

Precondition:
The SINUCOPY_FFS SW is 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 IBN file can be saved directly on the NC card as from SW 5.2.

B) Loading the start-up file from the NC card

Precondition:
The start-up archive with the name _N_ORIGINAL_ARC is located on the NC card (in the directory _N_NC_CARD_DIR_N_ARC_DIR).

1. Insert the NC card in the NCU module
   START UP switch=2 (NCK initialization);
   wait approx. 3 minutes until the digit “9” appears in the 7 segment display

   START-UP switch=1 (reset NCK);
   Press NCK reset and wait until the digit “6” appears in the 7-segment display

   START-UP switch=0 (NCK reset);
   when “6” appears, you can turn the START-UP switch back to the basic setting “0”
2. Set a password
3. Press the “ETC key” in Services basic display and press the “Original status” softkey.
   This softkey 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 you press the softkey, the protocol window appears with the query: “Series start-up archive: Perform series start-up?”; if you confirm, the data is transferred.

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.

13.2.3 SINUCOPY-FFS

The SINUCOPY-FFS program can be used to read and write NC cards of the CCU to a PC that has an active PCMCIA slot, using both the SINUMERIK system software (NC) and a flash file system (FFS).

FFS: flash file system

A flash file system is like a DOS data medium, e.g. disk. You must format the system before you can save any data. Then, you can create the directory structures and save the data in any required 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.

SW/HW 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.

Expert mode
In expert mode, an FFS image is generated in the PC memory. This can be written to an inserted NC card or saved as a file.
Standard mode
In standard mode, every action (read/write/delete) is executed directly on the NC card.

Independently of the FFS, the NC system can be

- re-written (precondition: 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 operating interface. Help is available for all actions and can be accessed with the help menu.

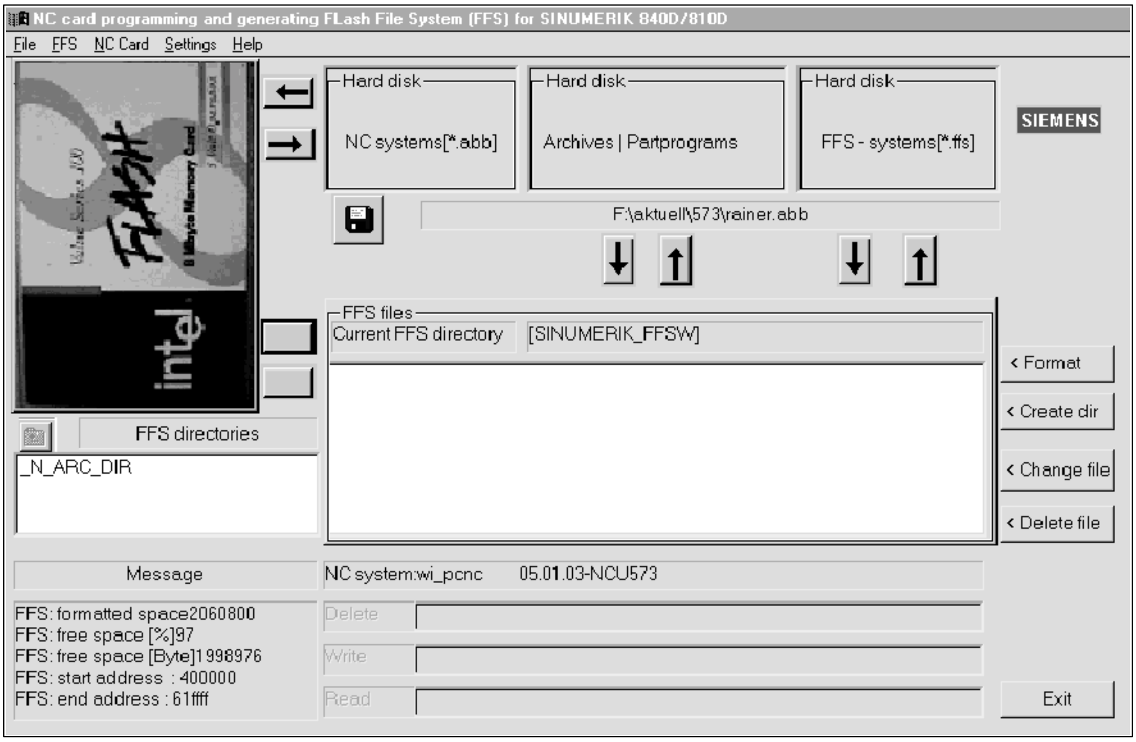

Figure 13-1 SINUCOPY-FFS operator interface

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- Display card contents:
  Click on the NC card image with the **left** mouse button (menu: NC card/version display of NC system.
- Display card information with card and FFS data
  Click the **right** mouse button (as for NC Card/ID Info menu) on a free area (not a button or a figure, e.g. top right).
- 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 fields (Explorer)
  The list fields show the selectable FFS directories on the left and the contents of the selected directory on the right. 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.
- Information field at bottom left
  When you have formatted the FFS system, the information field at the bottom left shows the formatted space, the free space as a percentage and 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 determines 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 unpacking files
4. Dialog: Specify the HW configuration
5. Dialog: Select the components to be installed
6. Dialog: Specify the directory for installation
7. The SW is installed
8. Message: “driver installed”
9. Dialog: “Select the name of the program folder”
10. Dialog: Please read the READ.ME file
11. Dialog: Restart now or later
12. Following restart, you can use the SINUCOPY-FFS function.

Tool: ARCEDIT

This tool is intended for experts.

- Read archive data
- Delete/insert files
- Modify files (if editable).

Tool: SICARD

This tool is intended for experts.

- Read and write NC cards
- Duplicate NC cards.

Note

1. PG with SINUCOPY (predecessor version)
   The installation can fail if the “cisio-s” driver is entered in the “config.sys” file and this is detected during ramp-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. The drive specification for OMNI97 device can be selected freely: Enter the drive letter in the “System control/Device manager/Drives/OMNI97” menu. Windows NT: Enter the drive letter in the “OmniControl/DriveLetter” menu.
3. 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.

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Tool: SINUCOPY

The SINUCOPY program can

- describe, duplicate and read NC cards of the CCU on a PC with active PCMCIA slot using the SINUMERIK system software (NC). The program version identifications can be displayed (according to the version display of the SINUMERIK control).
- NC data can be written onto the NC card; for operating instructions see: /BA/ 840D Operator's Guide, Services operating area.
- Data can be read from and written to the PC cards of the PCU with the SINUMERIK system software (HMI).

Operation

The functions of the program can be called via the menu bar or directly by pressing buttons on the operating interface. Help is available for all actions and can be accessed with the "Help" menu.

Note

NC data can be written onto the NC card; for operating instructions see:
/BA/ 840D Operator's Guide, Services operating area.

13.3 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 CCU3 module can be withdrawn from the CCU box without data being lost since this module is equipped with a backup battery.

References: – /PHC/ Manual Configuring 810D

– /PJU/ Configuring 611A/611D

– /BH/ Operator Components Manual 840D

13.4 Replacing the battery

Replacing the battery

To replace the battery on the SINUMERIK 810D please proceed as follows:

1. Switch off the control.
2. Note instructions regarding handling of ESD-sensitive components!
3. Undo the four fixing screws on the CCU3 module and remove the module.
4. Remove the battery and disconnect the battery connector. The data are buffered in the meantime by a capacitor (approx. 15 minutes).
5. Connect the new battery (watch polarity!) and press it back into the battery holder.
6. Insert the CCU3 module again and tighten the fixing screws.

Order No. 6FC5 247-0AA18-0AA0

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Notes

14 HMI

You will find the contents of this Chapter in
/IAM/ **HMI/MMC Installation & Start-Up Guide**, IM2 and IM4
Order No.: 6FC5 297-6AE20-0BP1
The MMC/HMI Installation & Start-Up Guide is subdivided into 6 books:

AE1	Updates/Extensions
BE1	Expanding the Operator Interface
HE1	Help in the Editor
IM2	Starting up HMI Embedded
IM4	Starting up HMI Advanced
TX1	Creating Foreign Language Texts

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Notes

Miscellaneous 15

15.1 Tool box software package

15.1.1 Contents of the tool box

Contents

Supplied on 3.5” disks with

- Basic PLC program
- NC variable selector
- Standard machine data sets
- SIEMENSd.txt file (Ger.) for the current 810D software version SIEMENSe.txt > English version.

Software requirements

The following software is required for data communication:

- PCIN software
- SIMATIC STEP 7 HiGraph for the PLC programs.

Hardware requirements

Programming device and cable

- Programming device, e.g. PG740 or a PC
- Cable for RS-232 PG/PC NC: 6FX2 002-1AA01-0BF0
- Cable for MPI bus: 6ES7 901-0BF00-0AA0.

15.1.2 Application of the Tool box

Standard MD sets

Various sample standard machine data sets are contained in the software.

- Turning technology (2 axes, 1 spindle)
- Milling technology (3 linear axes, 1 spindle, 1 rotary axis)

Application

Use the data sets as a configuration example. You can alter the data sets to match your application using the DOS editor.

Basic PLC program

See Section 6.6

NC variable selector

You need e the NC variable selector in order to read and write NCK variables.

References: /FB1/, P3, Basic PLC Program
/LIS/ Lists, "Variables" section

15.2 Machine data access via part program

Data identifiers

The names of the machine data are displayed on the HMI. The internal data designation requires further identifiers. These identifiers must be specified if machine data is changed through programming or if data is imported via the serial interface.

Data areas

$MM_	Operator 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

Identifier meanings:	$	System variable
	M	Machine data
	S	Setting data
	M, N, C, A, D	Sub-area (second letter)

Axis data are addressed via the axis name. The internal axis designation (AX1, AX2 ... AX5) or the designation specified via MD10000: AX_CONF_NAME_TAB can be used as the axis name,
e.g.: $MA_JOG_VELO[Y1]=2000
The JOG velocity of axis Y1 is 2000 mm/min.

If a machine data contains a STRING (e.g. X1) or a hexadecimal value (e.g. H41), then the string or hex value must be inserted in apostrophes (e.g. ’X1’ or ’H41’).
e.g.: $MN_DRIVE_INVERTER_CODE[0]=‘H14‘
FSD module 9/18 A in 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
1st fixed point position of axis X1 is 500
(0=1st, 1=2nd, 2=3rd, etc).

Beispiele

$MN_AUXFU_GROUP_SPEC[2]=‘H41‘
Time of output of auxiliary functions in 3rd auxiliary function group

$MN_AXCONF_MACHAX_NAME_TAB[0]=‘X1‘
Name of 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 channel 1
$MC_CHAN_NAME=‘CHAN1‘	Channel name for channel 1
$MC_AXCONF_GEOAX_NAME_TAB[1]=‘Y‘	Name of 2nd geometry axis in channel 1 is Y
...	
R10 = 33.75	R10 from channel 1
...	

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Notes

Abbreviations

A

ASCII	American Standard Code for Information Interchange
ASUB	Asynchronous subroutine
BAG	Mode group
BB	Ready
BCD	Binary Coded Decimals: In binary code coded decimals
BOOTFILE	Boot Files for SIMODRIVE 611D
BP	Basic Program
C 1	Channel 1
CC	Compiler Cycles
CCU	Compact Control Unit
COM	Communication
CPU	Central Processing Unit
CRC	Cutter Radius Compensation
CTS	Clear To Send: Clear to send message in serialdata interfaces
DAC	Digital-to-Analog Converter
DB	Data Block
DBB	Data Block Byte
DBX	Data Block Bit
DCE	Data Communications Equipment

DPR	Dual Port RAM
DRAM	Dynamic Random Access Memory (unbuffered)
DRF	Differential Resolver Function
DRY	Dry Run
DSR	Data Send Ready (message from serial data interfaces)
DTE	Data Terminal Equipment
DW	Data Word
EFP	Single I/O Module (PLC I/O module)
EPROM	Erasable Programmable Read-Only Memory
ETC	ETC key > extension of soft key bar in the same menu
FC	Function Call on the PLC
FSD	Feed Spindle Drive
FEPROM	Flash EPROM Readable and writable memory
FIFO	First in First Out: Memory which works without address specification and whose data are read in the same order in which they were stored.
FIPO	Fine Interpolator
FST	Feed Stop (= feed hold)
GEO	Geometry
GND	Signal Ground (reference point)
HHU	Handheld Unit
HEX	Hexadecimal Number
HMI	Human Machine Interface: Operator function of SINUMERIK for operation, programming and simulation. The meaning of HMI is identical with MMC.
HW limit switch	Hardware limit switch
INC	Increment
INI	Initializing Data

INTM	Internal Multiplication
IS	Interface Signal
ISO code	Special punchtape code, number of punched holes per character always even
JOG	Jog mode
K_V	Servo gain factor
$K_Ü$	Speed ratio
K BUS	Communication bus
LEC	Leadscrew Error Compensation
LED	Light Emitting Diode
LPFC	Low Priority Frequency Channel
MCP	Machine Control Panel
MD	Machine Data
MDA	Manual Data Automatic
MMC	Human Machine Communication: Operator function of SINUMERIK 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
MSD	Main Spindle Drive
NC	Numerical Control
NCK	Numerical Control Kernel
NCU	Numerical Control Unit
OB	Organisation Block on PLC
OPI	Operator Panel Interface
P BUS	I/O Bus
PCMCIA	Personal Computer Memory Card International Association

A

PG	Programming Device
PLC	Programmable Logic Controller
PMS1	Position Measuring System 1
PMS2	Position Measuring System 2
PRT	Program Test
RAM	Random Access Memory in which data can be read and written
ROV	Rapid Override
RPA	R Parameter Active
RS-232	Serial Interface (definition of interchange line between DTE and DCE)
RTS	Request To Send: Switching on signalling unit, control signal on serial data
SBL	Single Block
SD	Setting Data
SEA	Setting Data Active
SK	Soft Key
SKP	Skip Block
SPF	Subprogram File: Subroutine
SRAM	Static RAM
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
TC	Tool Change/Compensation
Tool	Tool
TRC	Tool Radius Compensation
WO	Work Offset (Zero Offset)

ZO Zero Offset (Work Offset)

ZOA Zero Offset Active: Identification for work offset

μC Micro Controller

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A

Notes

References

B

General documentation

/BU/
SINUMERIK 840D/840Di/810D/802S, C, D
Ordering Information
Catalog NC 60
Order No.: E86060-K4460-A101-A9-7600

/IKPI/
Catalog IK PI 2000
Industrial Communication and Field Devices
Oder number of bound edition: E86060-K6710-A101-A9
Order number of single-sheet edition: E86060-K6710-A100-A9

/ST7/
SIMATIC
SIMATIC S7 Programmable Logic Controllers
Catalog ST 70
Order No.: E86 060-K4670-A111-A3

/Z/
SINUMERIK, SIROTEC, SIMODRIVE
Cables & Connections & System Components
Catalog NC Z
Order No.: E86060-K4490-A001-A8-7600

Electronic Documentation

/CD1/
The SINUMERIK System (11.02 Edition)
DOC ON CD
(with all the SINUMERIK 840D/840Di/810D/802 and SIMODRIVE publications)
Order No.: 6FC5 298-6CA00-0BG3

User documentation

/AUK/ SINUMERIK 840D/810D
Short Guide AutoTurn Operation (09.99 Edition)
Order No.: 6FC5 298-4AA30-0BP2

/AUP/ SINUMERIK 840D/810D
AutoTurn Graphic Programming System (02.02 Edition)
Programming/Setup
Order No.: 6FC5 298-4AA40-0BP3

/BA/ SINUMERIK 840D/810D
Operator's Guide MMC (10.00 Edition)
Order No.: 6FC5 298-6AA00-0BP0

/BAD/ SINUMERIK 840D/840Di/810D
Operator's Guide HMI Advanced (11.02 Edition)
Order No.: 6FC5 298-6AF00-0BP2

/BEM/ SINUMERIK 840D/810D
Operator's Guide HMI Embedded (11.02 Edition)
Order No.: 6FC5 298-6AC00-0BP2

/BAH/ SINUMERIK 840D/840Di/810D
Operator's Guide HT 6 (06.02 Edition)
Order No.: 6FC5 298-0AD60-0BP2

/BAK/ SINUMERIK 840D/840Di/810D
Short Guide Operation (02.01 Edition)
Order No.: 6FC5 298-6AA10-0BP0

/BAM/ SINUMERIK 840D/810D
Operator's Guide ManualTurn (08.02 Edition)
Order No.: 6FC5 298-6AD00-0BP0

/BAS/ SINUMERIK 840D/840Di/810D
Operator's Guide ShopMill (11.02 Edition)
Order No.: 6FC5 298-6AD10-0BP1

/BAT/ SINUMERIK 840D/810D
Operator's Guide ShopTurn (03.03 Edition)
Order No.: 6FC5 298-6AD50-0BP2

/BNM/	SINUMERIK 840D/840Di/810D **User's Guide Measuring Cycles** Order No.: 6FC5 298-6AA70-0BP2	(11.02 Edition)
/CAD/	SINUMERIK 840D/840Di/810D **Operator's Guide CAD Reader** Order No.: (included in online help)	(03.02 Edition)
/DA/	SINUMERIK 840D/840Di/810D **Diagnostics Guide** Order No.: 6FC5 298-6AA20-0BP3	(11.02 Edition)
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Manufacturer/Service Documentation

a) Lists

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D2 Interactive Programming
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From Name Company/Dept. Address: Phone: / Fax: /	Installation and Start-Up Guide Order No: 6FC5 297-6AD20-0BP1 Edition: 11.02 Should you come across any printing errors when reading this publication, please notify us on this sheet. Suggestions for improvement are also welcome.

Suggestions and/or corrections

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General Documentation

- *SINUMERIK* 840D/810D — Brochure
- *SINUMERIK* 840D/840Di/810D/ — Catalog Ordering Info. NC 60 ***)**
- *SINUMERIK SIROTEC SIMODRIVE* Accessories — Catalog Accessories NC-Z

User Documentation

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- *SINUMERIK SIMODRIVE* — Description of Functions SINUMERIK **Safety Integrated**
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Siemens AG

Automation and Drives

Motion Control Systems

Postfach 3180, D-91050 Erlangen

Germany

www.ad.siemens.de

Ref.: 6FC5297-6AD20-0BP1

Printed in Germany