Installation and Start-Up Guide 11/2002 Edition

sinumerik
& simodrive

SINUMERIK 840D
SIMODRIVE 611 digital

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SINUMERIK 840D
SIMODRIVE 611 digital

Installation and Start-Up Guide

Valid for

Control	Software version
SINUMERIK 840D	6
SINUMERIK 840DE (export version)	6
SINUMERIK 840D powerline	6
SINUMERIK 840DE powerline	6

Drive
SINUMERIK 611 digital   6

11.2002 Edition

SINUMERIK® Documentation

Printing history

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

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

Status code in the "Remarks" column:

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

Edition	Order No.	Remarks
06.94	6FC5 297-0AB10-0BP0	**A**
08.94	6FC5 297-0AB10-0BP1	**C**
02.95	6FC5 297-2AB10-0BP0	**C**
04.95	6FC5 297-2AB10-0BP1	**C**
09.95	6FC5 297-3AB10-0BP0	**C**
03.96	6FC5 297-3AB10-0BP1	**C**
08.97	6FC5 297-4AB10-0BP0	**C**
12.97	6FC5 297-4AB10-0BP1	**C**
12.98	6FC5 297-5AB10-0BP0	**C**
08.99	6FC5 297-5AB10-0BP1	**C**
04.00	6FC5 297-5AB10-0BP2	**C**
10.00	6FC5 297-6AB10-0BP0	**C**
09.01	6FC5 297-6AB10-0BP1	**C**
11.02	6FC5 297-6AB10-0BP2	**C**

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

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

Trademarks
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Other functions not described in this documentation might be executable in the control. However, no claim can be made regarding the availability of these functions when the equipment is first supplied or for service cases.

We have checked that the contents of this document correspond to the hardware and software described. Nonetheless, differences might exist and therefore we cannot guarantee that they are completely identical. The information contained in this document is, however, reviewed regularly and any necessary changes will be included in the next edition. We welcome suggestions for improvement.

Subject to changes without prior notice

PREFACE

Organization of the documentation

The SINUMERIK documentation is organized on three separate levels:

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

Target group

This document is intended for manufacturers of machine tools incorporating SINUMERIK 840D and SIMODRIVE 611D.

Hotline

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

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

Please send any questions about the documentation (suggestions for improvement, corrections) to the following fax number or email address:
                                    Fax: ++49-9131-98-2176
                                    Email: motioncontrol.docu@erlf.siemens.de

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

Internet address SINUMERIK

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

SINUMERIK 840D powerline

Improved performance variants

- SINUMERIK 840D powerline and
- SINUMERIK 840DE powerline

will be available from 09.2001 onwards. For a list of available **powerline** modules, please refer to Section 1.1 of the Hardware Description /PHD/.

SINUMERIK 810D powerline

Improved performance variants

- SINUMERIK 810D powerline and
- SINUMERIK 810DE powerline

will be available from 12.2001 onwards. For a list of available **powerline** modules, please refer to Section 1.1 of the Hardware Description /PHC/.

Objective   The installation and start-up guide provides the information required for start-up
                         and servicing.

Standard scope   The Guide explains the control system design and the interfaces of the
                         individual components. It describes the procedures required to start up
                         SINUMERIK 840D with SIMODRIVE 611D, and lists all data, signals and PLC
                         modules.

                         Informationen on individual functions, function assignments, performance data
                         of the individual components can be found in special separate documents (such
                         as manuals, descriptions of functions).

                         Separate Reference Manuals are available for user-oriented activities such as
                         creating parts programs and operating the control system.

                         There are finally separate Reference Manuals describing how the machine
                         manufacturer is to perform certain procedures, such as configure, install and
                         program the PLC.

**Finding   To help you access the information you need, this publication includes a table of
information**   contens and list of figures and tables, but also provides you with the following
                         additional information available in the appendix:

                         1. List of Abbreviations

                         2. List of References

                         3. Index.

                         For a list and description of alarms used in SINUMERIK 840D please see the

                         References: /DA/, Diagnostics Guide

                         Further information for installation and start-up and troubleshooting is provided
                         in the

                         References: /FB/, D1, "Diagnostics Tools"

Note   The following notes appear in this document to draw your attention to informa-
                         tion relevant to the subject in hand:

                         _____

                         Note

                         This symbol always appears in this documentation when important information
                         is being conveyed.

                         _____

                         _____

            !   **Important**

                         This symbol always appears in this documentation when important information
                         is being conveyed.

                         _____

Order data option

This symbol appears in the documentation to draw your attention to an ordering data option. The described function will be performed only if the control contains the mentioned option.

Warnings

The following warnings with varying degrees of severity appear in this document.

Danger

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

Caution

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

Warning

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

Caution

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

Notice

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

Technical Information

Trademarks

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Notations

The following notations and abbreviations appear 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 "Feed/spindle override" (DB31–48, DBB0) i.e. the signals are stored per axis / per spindle in data blocks 31 to 48, data block byte 0.

- Machine data –> MD: MD_NAME (German name)

- Setting data –> SD: SD_NAME (German name)

- The symbol "≐" means "corresponds to".

Effectiveness of changes

Whenever you change data (e.g. machine data), please also note their activation (e.g. after power ON or immediately). The time of activation is therefore always indicated.

Contents

Notes

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General Preparations

1.1 Preconditions

Introduction

This Installation and Start-Up Guide describes the procedure for starting up the basic control functions including drive-related functions. More detailed information about special NCK, MMC, PLC or drive functions can be found in the Descriptions of Functions/Manuals (see "Documentation requirements").

Software requirements

You will need the following software to start up the SINUMERIK 840D:

1. PCIN 4.4 for transmission of data to/from MMC
   Order no.: 6FX2 060-4AA00-2XB0 (English, French, German), order from: WK Fürth

2. Start-up tool for digital SIMODRIVE 611 (applies to MMC 100 only)
   Order No. 6FC5 255-☐AX00-0AB0, supplied on 3.5" floppies

3. SIMATIC STEP7 HiGraph

4. Toolbox for SINUMERIK 840D
   Order No. 6FC5 252-☐AX21-0AB0
   Supplied on 3.5" floppies:

   – Basic PLC program

   – Standard machine data blocks

   – NC variable selector

5. Applies only to MMC 100: Software for creating PLC alarm texts and for transmission to MMC 100 (integrated in MMC 100 system software).

Equipment and accessory requirements

You will need the following equipment and accessories to start up the SINUMERIK 840D:

1. Programming device with MPI interface (PG740)

2. MPI cable for PG740

3. RS-232 cable with 9-way connector (female).

Documentation   You will need the following documentation to start up the SINUMERIK 840D:
requirements
                           1. Catalog NC 60.1, Ordering Information /BU/
                              Order no.: E86060-K4460-A101-A6

                           2. Manual /PHD/
                              Order no.: 6FC5 297-5AC10-0BP2

                           3. Operator Components Manual /BH/
                              Order no.: 6FC5 297-5AA50-0BP2

                           4. Description of Functions, Basic Machine (Part 1) /FB/
                              Order no.: 6FC5 297-5AC20-0BP2

                           5. Description of Functions, Drive Functions /FBA/
                              Order no.: 6SN1 197-0AA80-0BP5

                           6. Lists /LIS/
                              Order no.: 6FC5 297-5AB70-0BP2

                           7. Description PCIN 4.4 /PI/
                              Order no.: 6FX2 060-4AA00-4XB0

                           8. Diagnostics Guide /DA/
                              Order no.: 6FC5 297-5AA20-0BP2.

1.2   Standard/export version

Export approval   On account of the approval required for certain control functions as stipulated in
                           the German Export List, two configuration variants are available for the
                           SINUMERIK 840D.

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

                           In the **export** version (840**DE**) the following options are not available:

                           • Interpolation with more than 4 axes

                           • 5-axis milling package

                           • Helical interpolation 2D + n (n greater than 2)

                           • OEM package.

                           The following restrictions apply to options that can be used:

                           • Sag compensation is restricted to the traversing of a path of up to 10 mm.

                           • Adaptive control.

                           The corresponding option bits can be set but they have no effect (alarm when
                           programming the functions). The export version requires no export approval
                           with respect to its **type**.

                           Up-to-date information about types and scope of options can be found in
                           References: /BU/ Catalog NC 60.1.

                           (If a requirement exists for export approval with respect to the **intended use** this
                           is not affected and might even exist in addition.)

1

The specific nature of the control is determined by the system software that is available in two versions (standard and export). In other words, the requirements for approval of the system software (refer also to the delivery notes or invoice for information in this respect) is handed down to the control system with the installation. This point must be observed in particular when converting or upgrading the system software because the requirements for export approval for the control can change accordingly.

Identification of the control

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

Note

The adhesive labels supplied additionally in the packaging are intended to identify the control after installation and start-up and must be pasted into the control logbook. In the case of license orders, a corresponding number of labels is provided and the same applies to these.

When the control has been booted, the export versions can be identified by the additional character 'E' in the Service screen (NC information). The identification of the control variants obtained by these measures is important for service personnel and can also be helpful in providing evidence of conformance for exports, in particular when making use of the negative certificates that are provided for the export version.

■

Notes

Configuration

2

2.1   Mechanical configuration

2.1.1   Overview

Operator panel
front

Machine control panel

QWERTY keyboard

PS   AM   SMs

SIMATIC STEP 7-300 I/O devices

NCU terminal block

SIMODRIVE 611D

SINUMERIK 840D

MS (I/RF, OI)   NCU   MSD   FDD
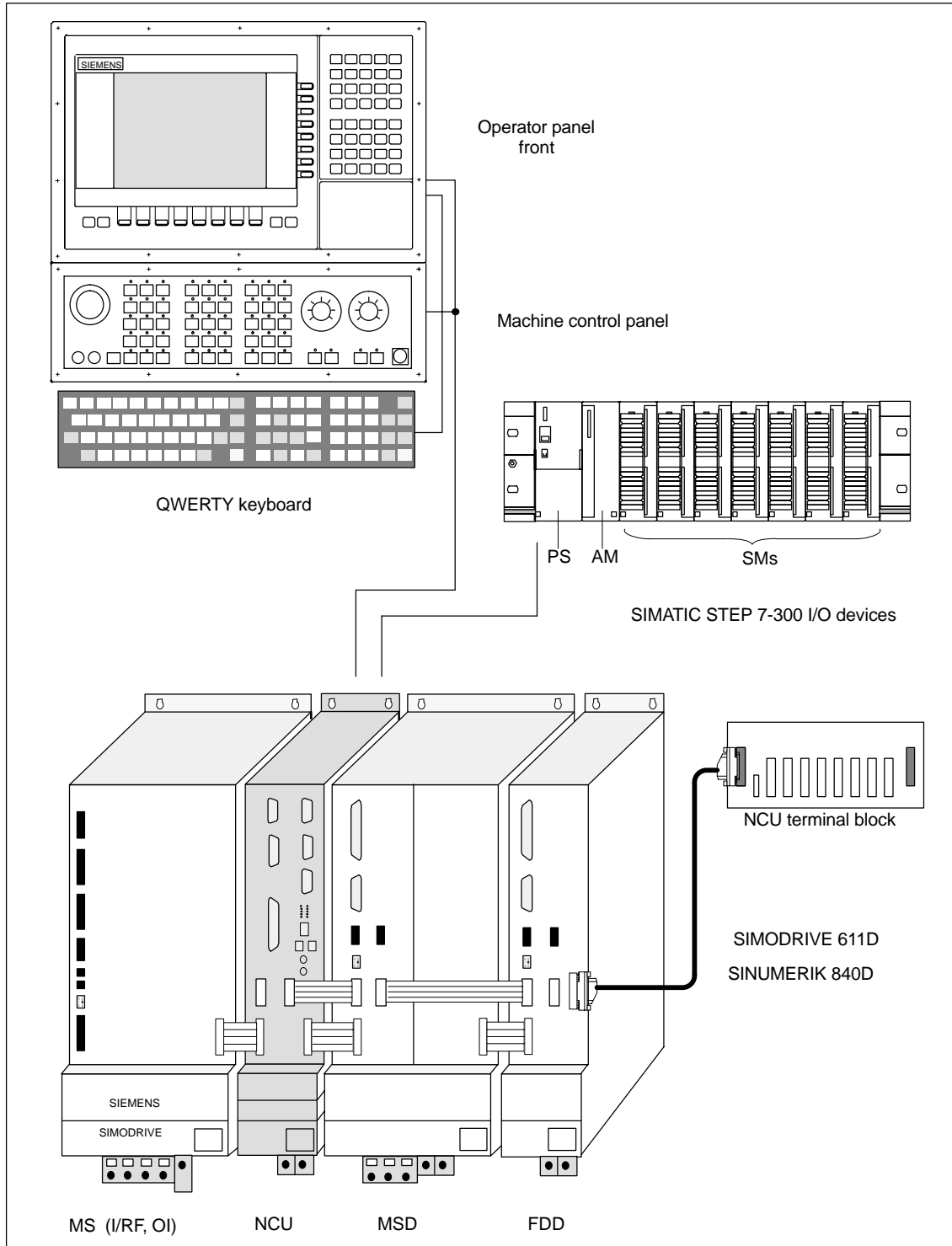
Fig. 2-1   System overview of SINUMERIK 840 with SIMODRIVE 611 (diagrammatic)

2.1.2   Mains infeed module

Mains infeed module

The mains infeed module performs the following tasks:

- Supplies power for the SINUMERIK 840D and axis modules

- Generates the DC link voltage for the motors

- Regenerative feedback (I/RF) or braking resistor (OI) for generator-mode operation.

Open-loop control infeed module OI

If the internal braking resistance is not sufficient, pulsed resistor modules can be installed.

Infeed/regenerative feedback module I/RF

The I/RF module feeds excess DC link energy generated during braking back into the supply system.

Arrangement of mains infeed module

The I/RF or OI module is installed as the first module on the left.

References: PJ1/ Planning Guide for SIMODRIVE 611D

2.1.3 NCU
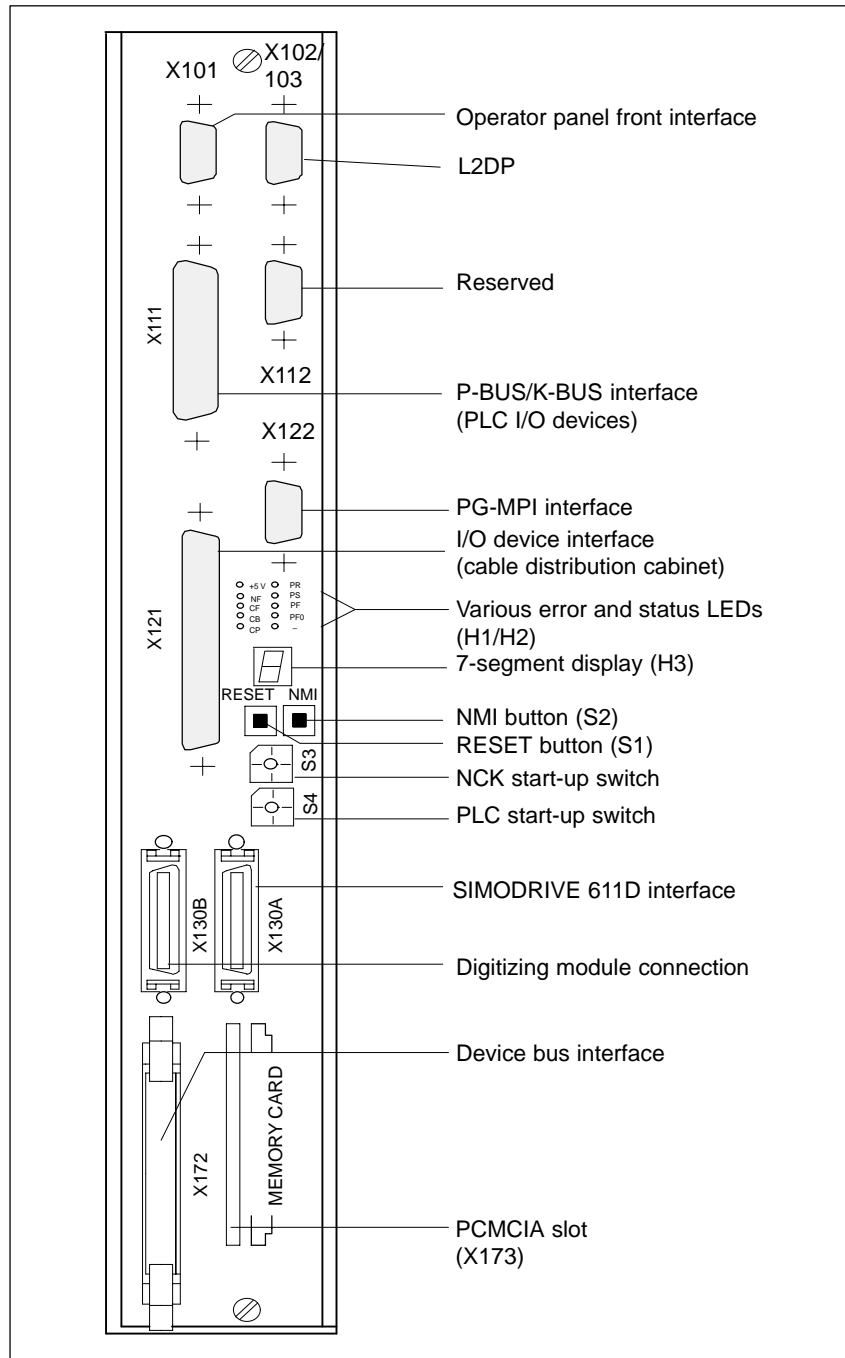
Fig. 2-2   Interfaces, control and display elements of NCU module

2.1.4   General configuration of SINUMERIK 840D
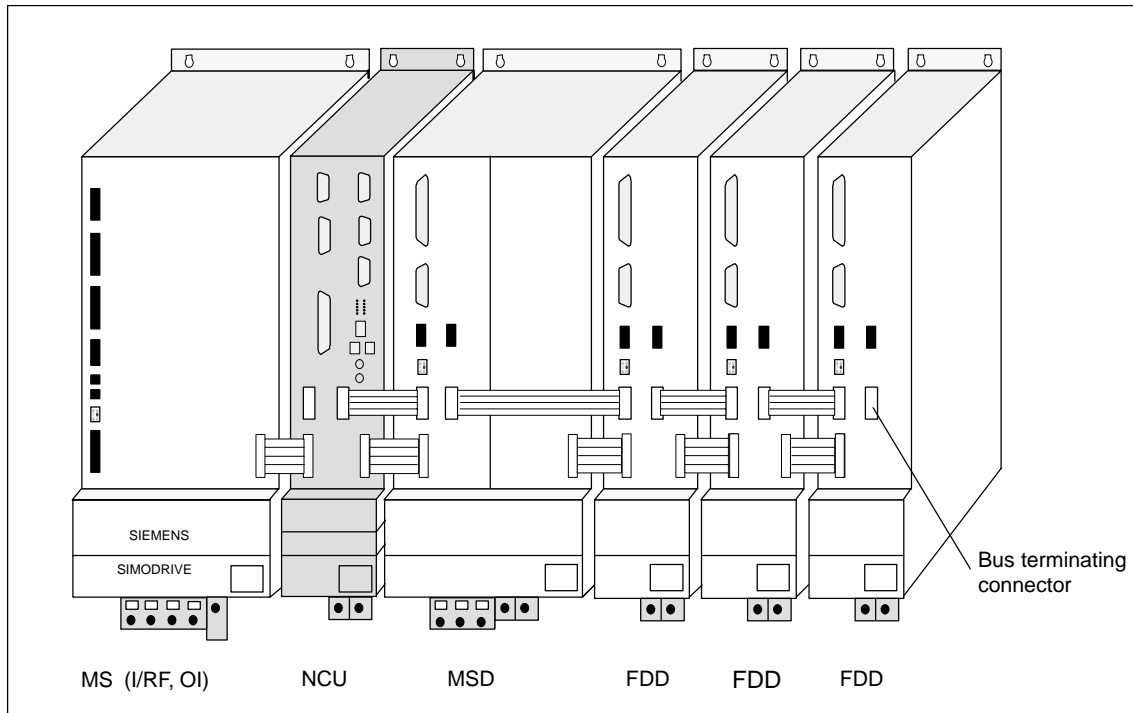
Fig. 2-3   General configuration of SINUMERIK 840D

Please note:

> **Caution**
>
> When installing the drive group, please make sure to keep a space of 100mm for air circulation on top and at the bottom.

2.2   Electrical configuration

2.2.1   Component connections

2.2   Electrical configuration
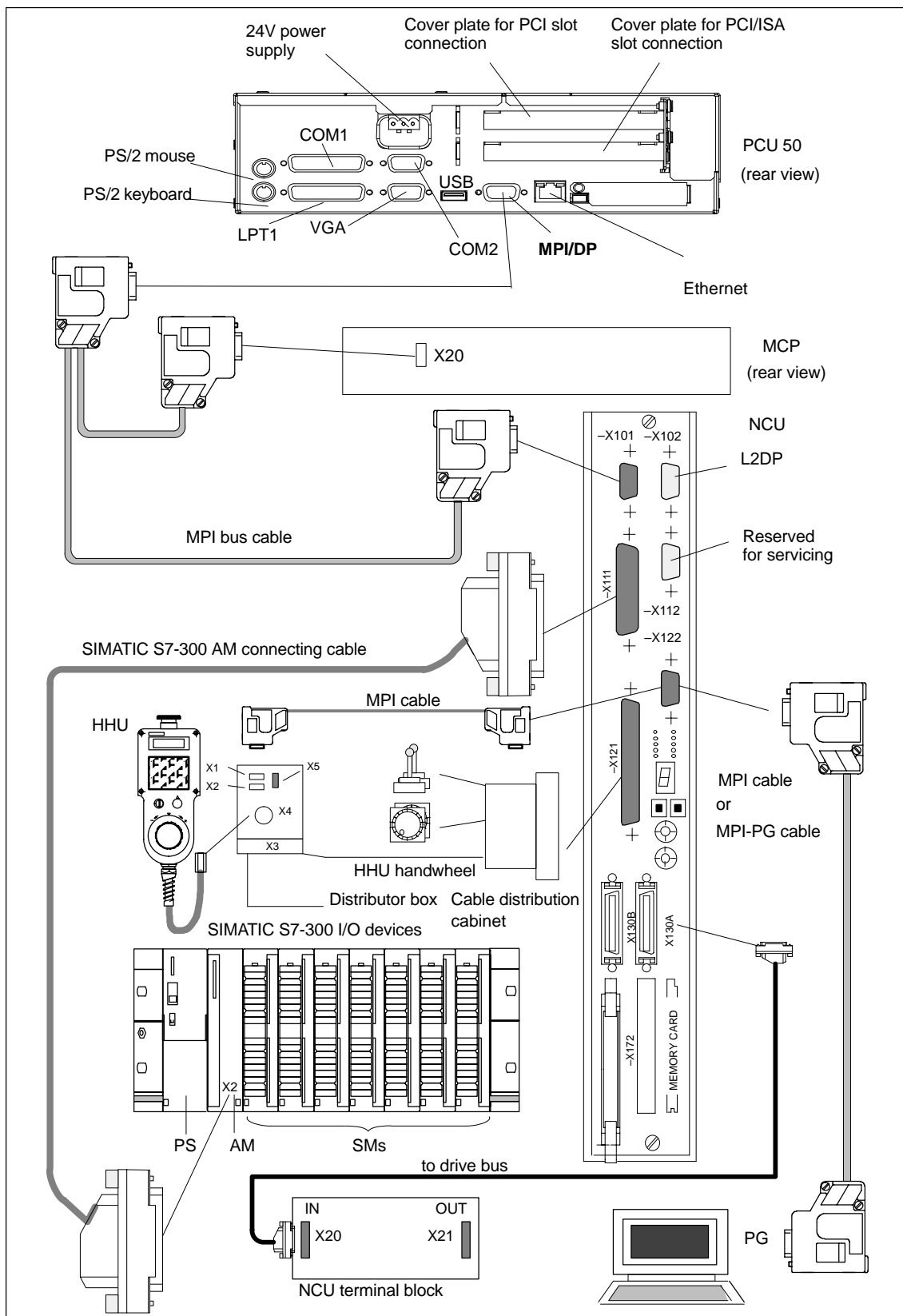
Fig. 2-4   Connection configuration

2

Note

For cables and connectors, see
References: /PHD/, Configuring Manual 840D

2.2.2   Connection of mains infeed module (OI, I/RF)

X111

X121

X141

X161

X171

X172

LED
displays

X181

X351

Device bus

P600

DC link connection

M600

SIEMENS

Power supply

U1 V1 W1 PE1

LED displays

Electronics power supply faulty	Red	Red	5V voltage level faulty
Device is not ready, no enable signal (term. 63, 64 or 48)	Green	Yellow	Device ready (DC link precharged)
Mains fault	Red	Red	DC link over-voltage
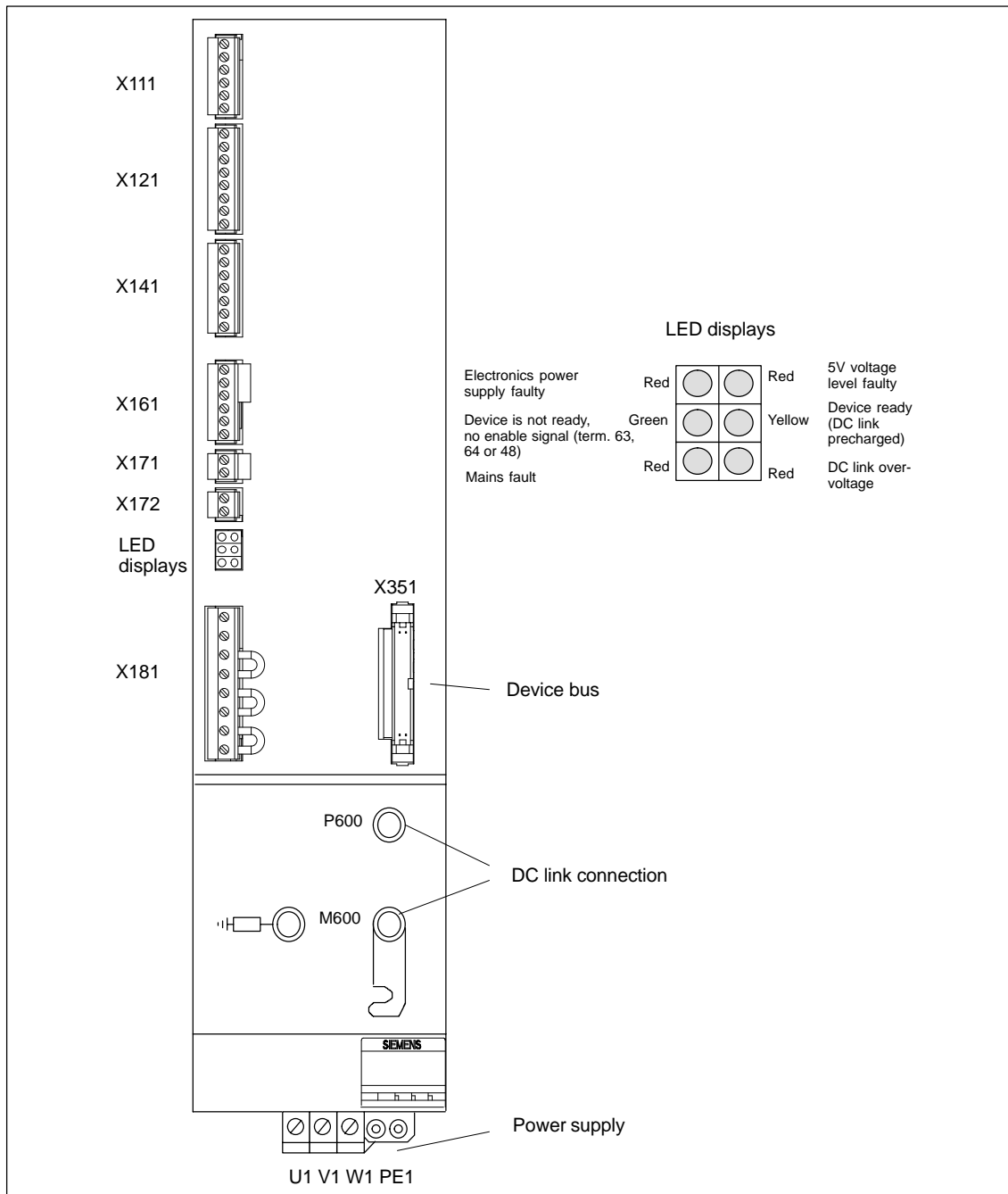
Fig. 2-5   Interfaces for OI and I/RF module 10–55kW

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2.2 Electrical configuration

Label	Terminal	Connector
Relay contact for Ready message — NC contact	74 / 73.2	−X111
NO contact	73.1 / 72	
Relay contact for group message I²t and motor overtemperature	5.3 / 5.2 / 5.1	−X121
Pulse enable	63	
Enable voltage	9	
Enable voltage	9	
Drive enable signal	64	
Reference potential for enable voltage	19	
P24	7	−X141
P15	45	
N15	44	
N24	10	
M	15	
M	15	
RESET (R+term.15)	R	
Enable voltage	9	−X161
Setting-up mode	112	
Contactor energization, start	48	
Signaling contact from mains contactor	111 / 213 / 113	
Enabling signal for internal mains contactor	NS1 / NS2	−X171
Signaling contact for starting lock-out (NC contact)	AS1 / AS2	−X172
LED displays		
DC link power supply for mains buffering	M500 / P500	−X181
External infeed for electronics power supply	2U1 / 1U1	
External infeed for electronics power supply	2V1 / 1V1	
External infeed for electronics power supply	2W1 / 1W1	

Fig. 2-6   Connection terminals on SIMODRIVE 611 mains supply module 10–55 kW

Typical circuit   I/RF module
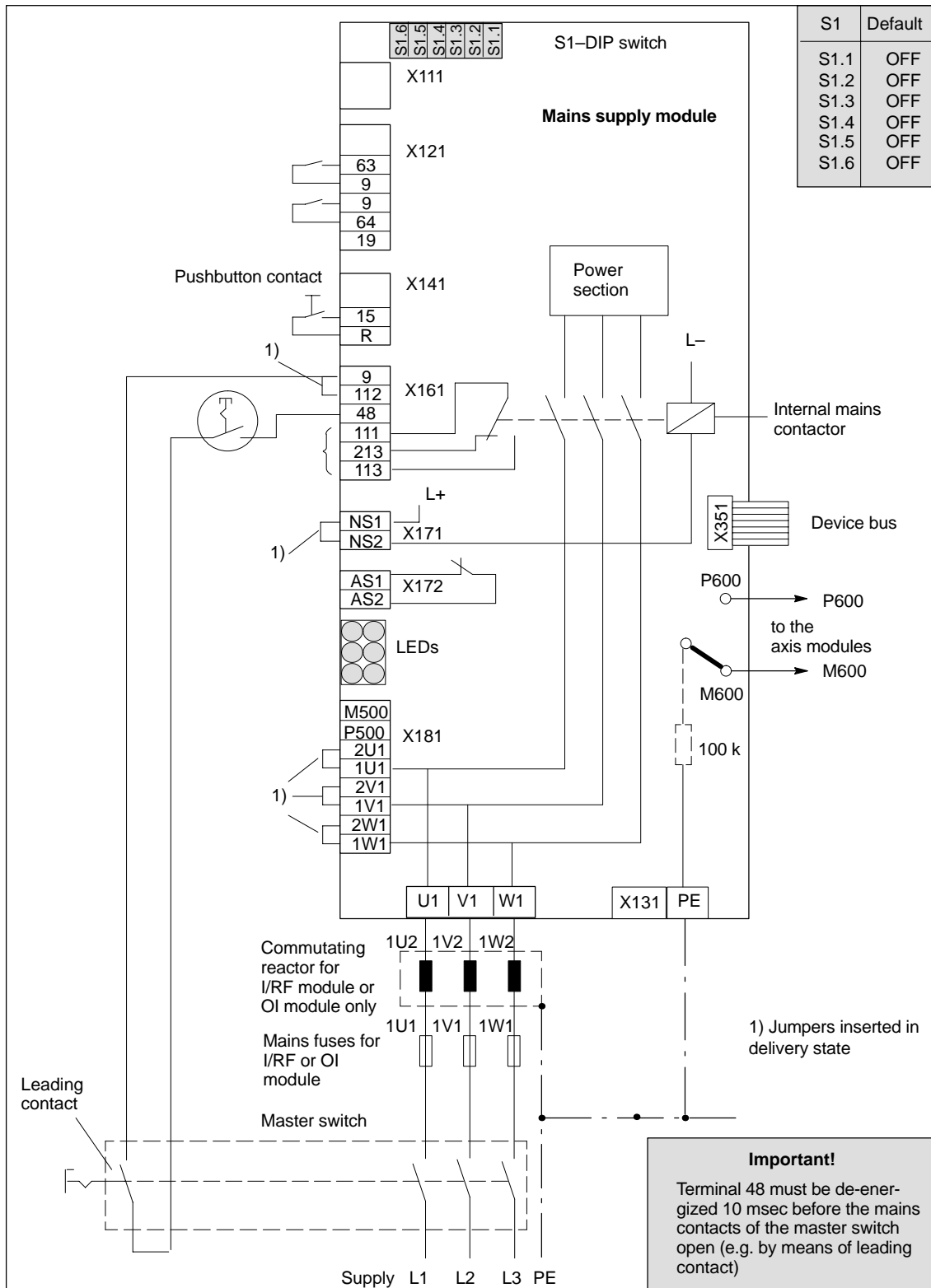
Fig. 2-7   Example of three-conductor connection (standard circuit)

2.2.3   Motor connection
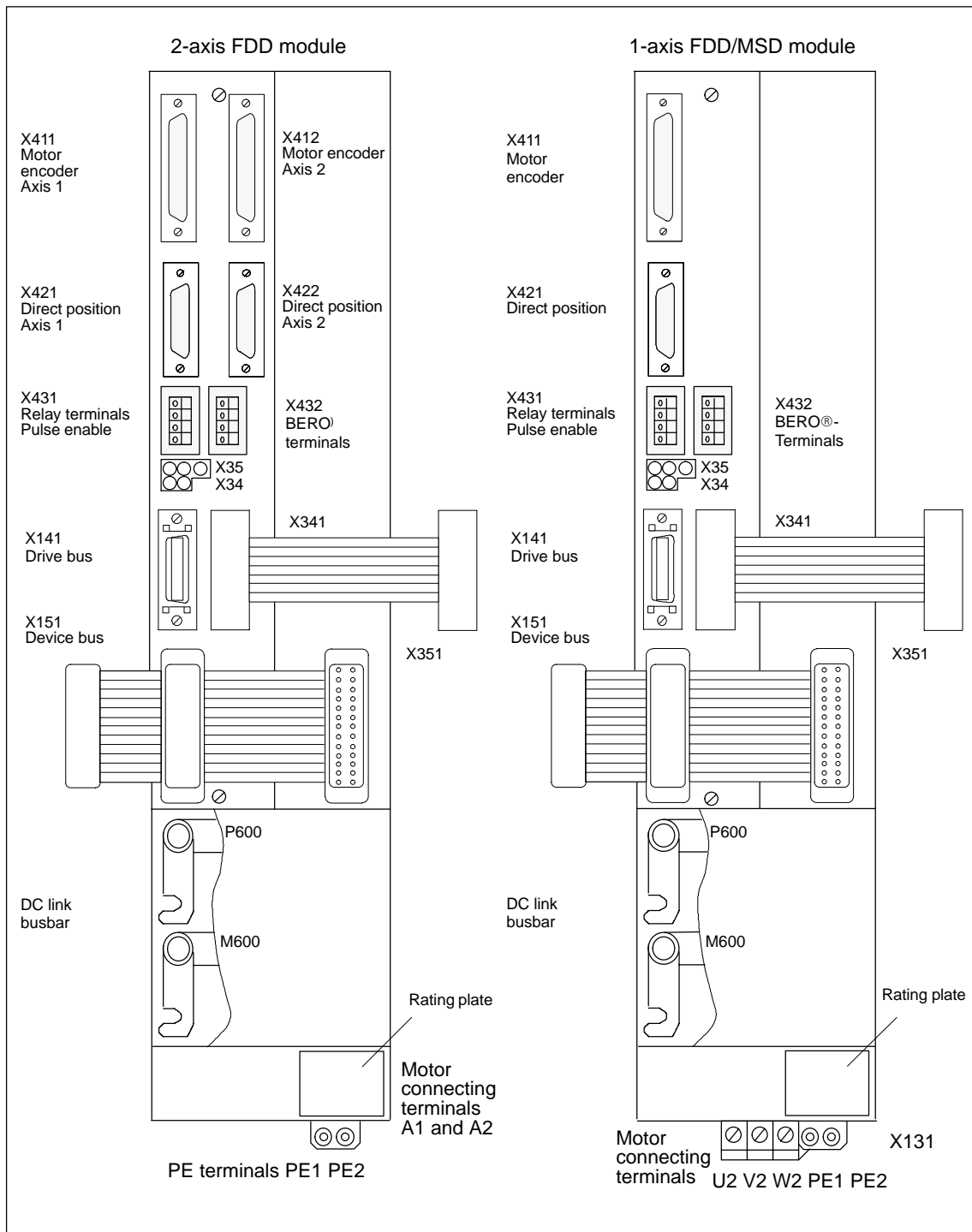
Fig. 2-8   Design of FDD/MSD modules

611D control module Performance 2

Performance 2 control (2-axis)

X411 Motor encoder Axis 1

X412 Motor encoder Axis 2

X421 Direct position Axis 1

X422 Direct position Axis 2

X461 BERO input, axis 1

X462 BERO input, axis 2

X431 Relay terminals Pulse enable

X432 BERO terminals

DAC assignment

DAC 1   DAC 2
DAC 3   Ground

DACs

X141 Drive bus

X151 Device bus
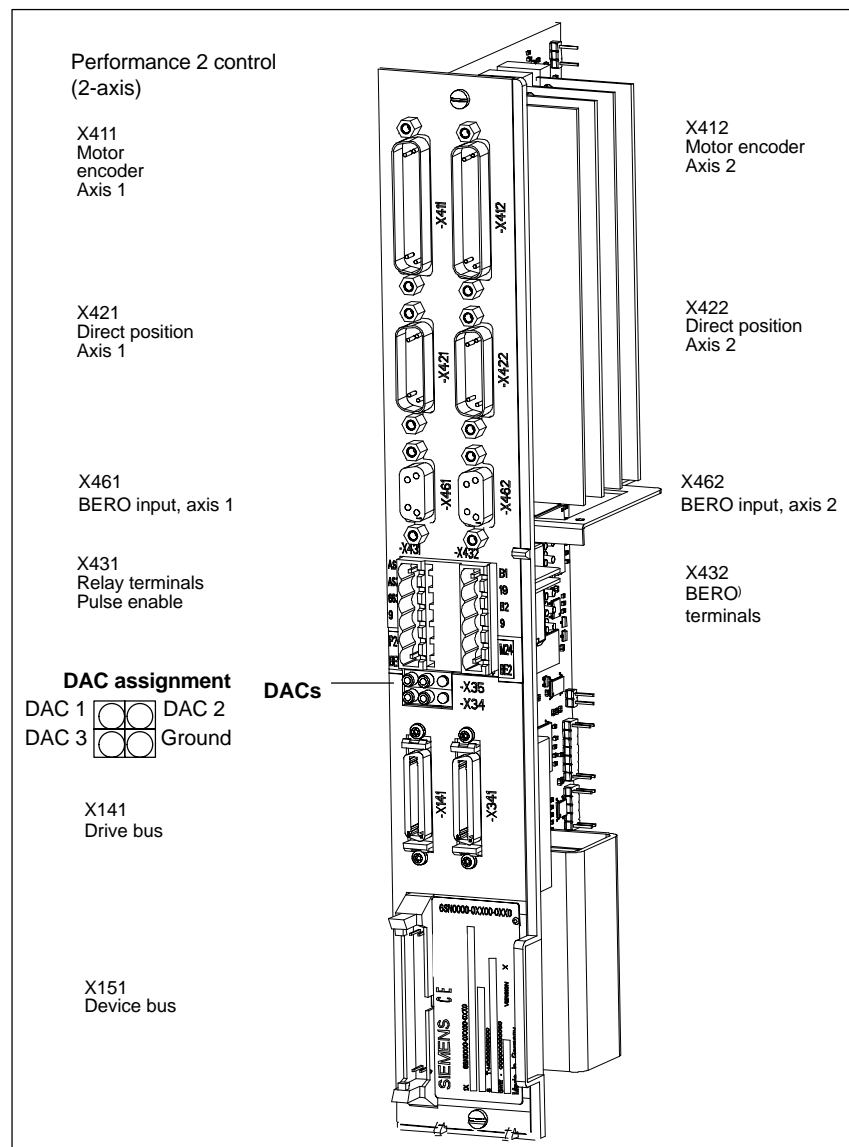
Fig. 2-9   611D control module Performance 2: Position and interface assignment

2.2.4   Encoder connection

Motor measuring system and motor connection

The motor measuring system of the connected motor must always be connected to connector X411 (see Fig. 2-8) of the same module.

2.2.5   PCU 20 and PCU 50 connection

PCU 20
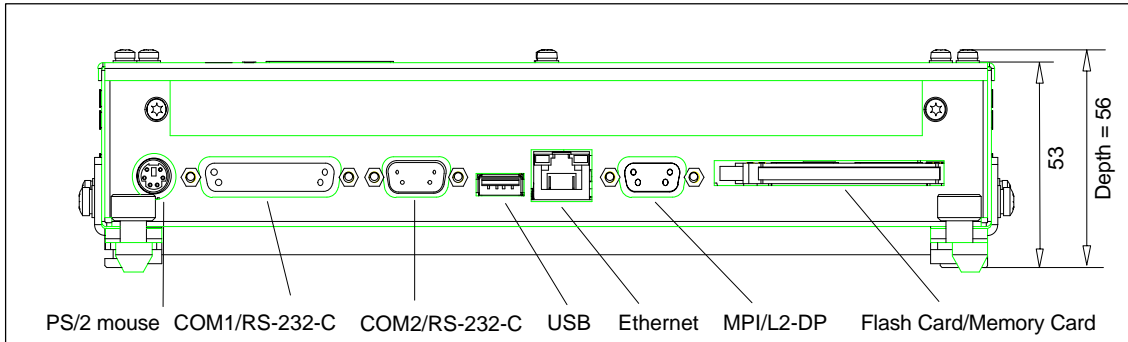
Fig. 2-10   PCU 20 side view from right with interfaces

PCU 50
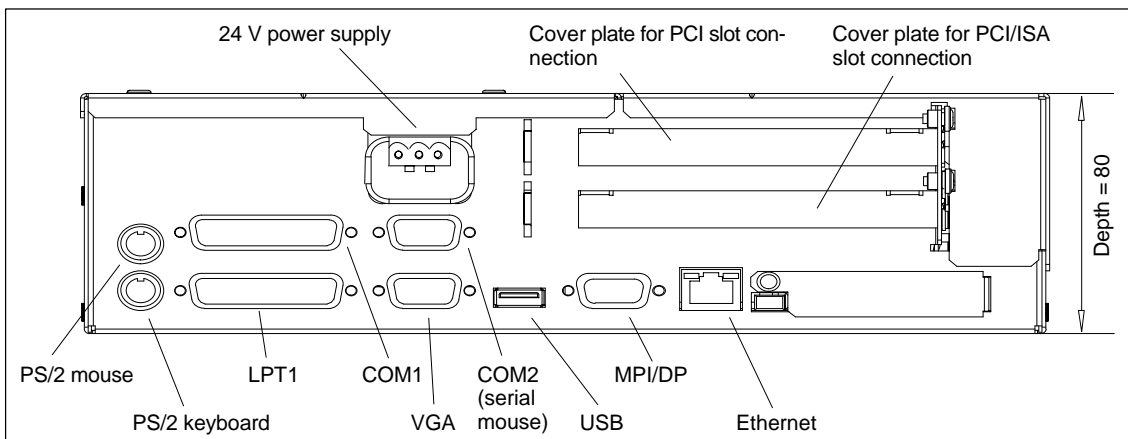
Fig. 2-11   Side view of PCU 50 from right with interfaces

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

References: /BH/, Operator Components Manual

2
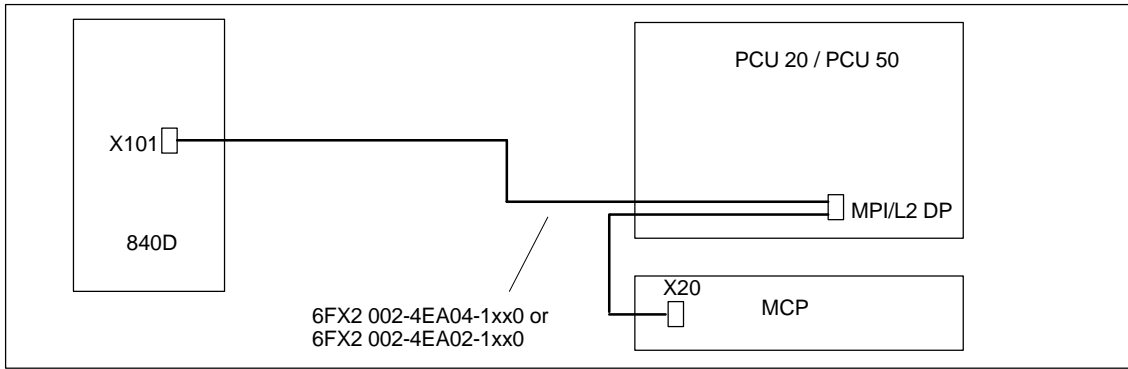
Fig. 2-12   Connection of PCU 20/50 to SINUMERIK 840D

2.2.6 Configuration of components for digitizing
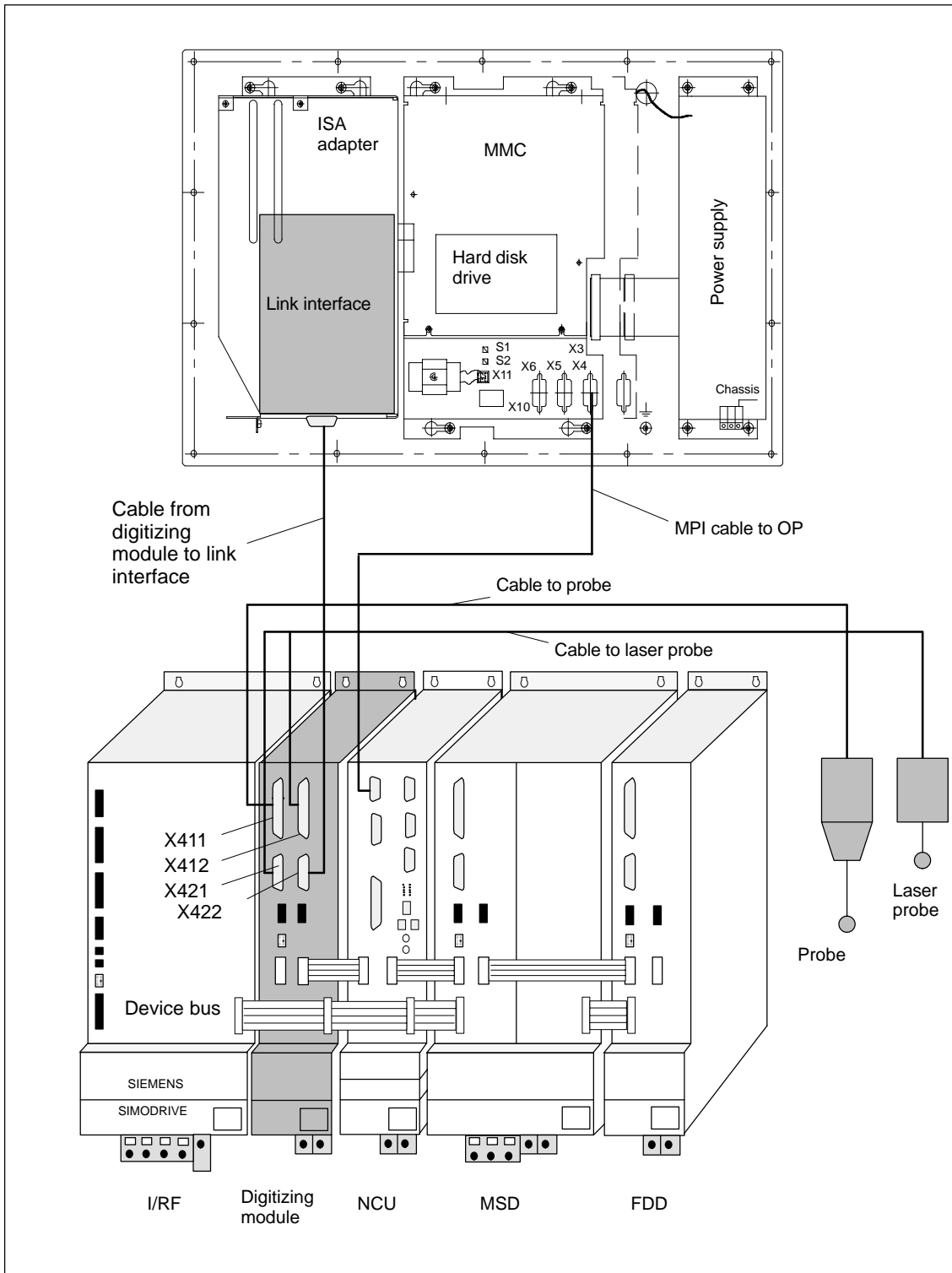
Fig. 2-13 Configuration of components for digitizing

2

Hardware requirements for digitizing

- MMC 101/102

- ISA adapter

- Link interface

- Digitizing module

- NCU 572/573 for digitizing

- Connecting cable from digitizing module to link interface

- Tactile probe (e.g. Renishaw SP2-1) with cable.

For further information, please refer to the following documentation:

References: /FBD/ Description of Functions, Digitizing

■

Notes

Settings, MPI / OPI

3

3.1   MPI/OPI, network rules

The following basic rules must be observed with respect to network installations:

1. The bus line must be terminated at **both ends**. To do so, switch in the terminating resistor in the MPI connector in the first and last nodes. Switch off all other terminating resistors.

Note

- Only two terminating resistors may be activated in the same line at one time.

- The terminating resistors of the bus are **permanently** installed in the HHU/HPU.

---

2. At least 1 terminator must be supplied with 5V voltage.
    This is automatically the case when the MPI connector with activated terminating resistor is connected to an energized unit.

3. Spur lines (feeder cable from bus segment to node) should be as short as possible.

Note

Unused spurs should be removed wherever possible.

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4. Each MPI node must **first** be connected and then activated.
    When disconnecting the MPI node **first** deactivate the connection and then pull out the connector.

5. One HHU and one HPU or two HHUs or two HPUs can be connected to each bus segment. **No** bus terminators may be inserted in the distribution boxes of the HHU or HPU.
    If necessary, more than one HHU/HPU can be connected to a network segment with repeaters.

6. The following cables lengths for MPI or OPI for standard use without repeater must not be exceeded:

    MPI (187.5 kbaud):   max. cable length in total: 10m

    OPI (1.5 Mbaud):   max. cable length in total: 200m

Note

Piggy-back connectors are not recommended for power connections.

Example A
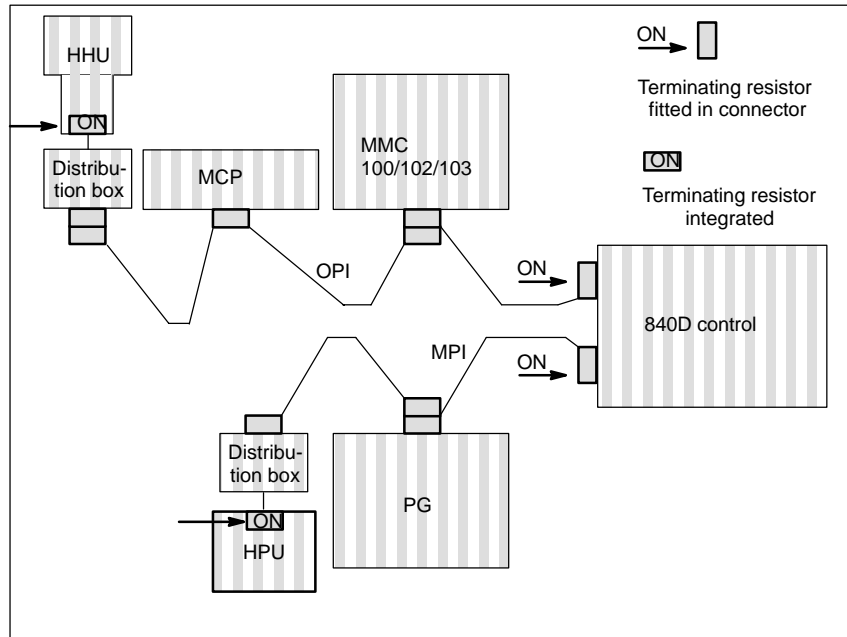
Fig. 3-1   Network installation with two terminating resistors in the
           MPI: HPU, 840D control
           OPI: HHU, 840D control

Example B
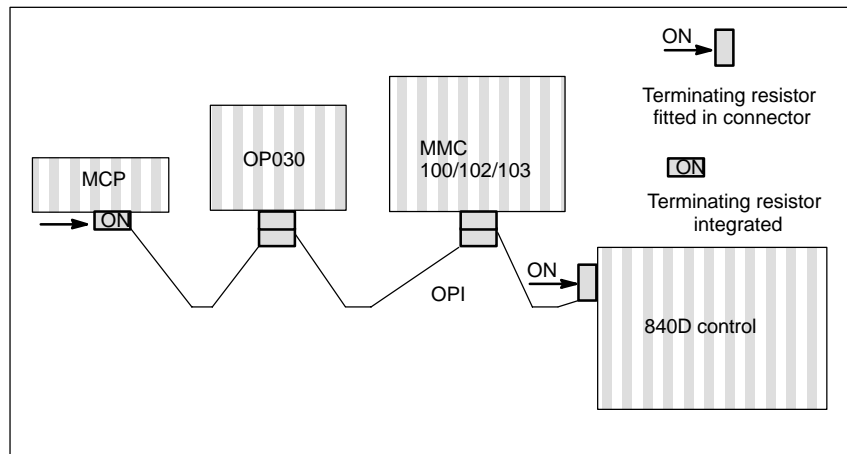
Fig. 3-2   Network installation with two terminating resistors in the
           OPI: MCP, control

3.2   Standard configuration

3.2.1   Standard configuration for SW 3.1 and lower

Standard application   SINUMERIK 840D with MMC 100/102/103 and a machine control panel (MCP) or customer operator panel front on OPI

Hardware requirements   Minimum firmware version V 03_01_01 for

- MCP

- Interface to customer operator panel front / PP031.

STEP7   Version 1.x or higher

Bus addresses   Each node on the MPI/OPI bus must be allocated a bus address (0...31).
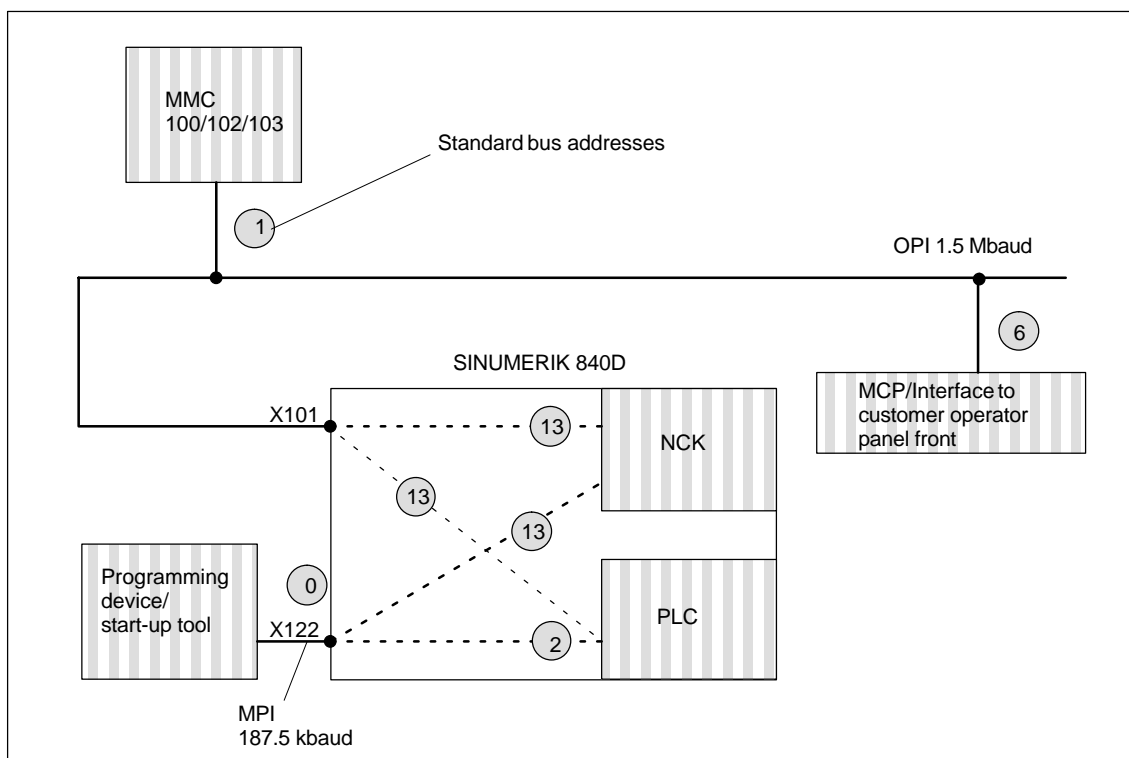
Fig. 3-3   Standard application for SINUMERIK 840D

3

Note

Cable with 3 MPI connectors (Order No.: 6FX2002-4EA04-IAF0 (IBA0))

- This cable is used for connecting a standard machine consisting of MMC, MCP and NCK via OPI/MPI.

- It must not be used for setting up an m:n installation.

- Components must not be connected using internal bus terminators (e.g. HHU, HPU), because the cable is already fitted with bus terminators.

Setting the MCP/interface to customer operator panel front

Table 3-1   Settings on DIP switch S3 for standard application

1	2	3	4	5	6	7	8	Meaning:
ON	OFF	ON	OFF	ON	ON	OFF	OFF	**MCP:** Baud rate: 1.5 Mbaud Cyclical transmit pattern: 100ms Bus address: 6
ON	OFF	ON	OFF	ON	ON	OFF	ON	**Customer operator panel front:** Baud rate: 1.5 Mbaud Cyclical transmit pattern: 100ms Bus address: 6

Assigned inputs/outputs in the PLC CPU

The following bytes in the PLC CPU are assigned for the MCP or interface to the customer operator panel front:

- Input bytes 0–7

- Output bytes 0–7

- Status bytes for error detection, output bytes 8–11, 12–15 (evaluated by basic program).

The parameters on FB1 (basic program) for the MCP are already set to the default values for the standard application.

Communication does not start

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

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

- Cable and connector wiring

- DIP switch S3 (standard application).

3.2.2   Standard configuration for SW 3.2 and higher

Either one or two machine control panels (interface to customer operator panel fronts, HPUs, PP031) and/or HHUs can be connected in SW 3.2 or higher by setting the parameters of the basic PLC program (FB1). In this case, it is no longer necessary to set the parameters with the STEP 7 "Communication Configuration" tool.

SW < 3.2

The procedure used to connect these components using "Communication Configuration", as described in the sections below, no longer has to be followed with SW 3.2 and higher.

References: /FB/ Description of Functions, Basic Machine (Part 3),
                        PLC Basic Program

Standard application

SINUMERIK 840D with MMC 100/102/103 and a machine control panel (MCP) or customer operator panel front on OPI

Hardware requirements

Minimum firmware version V 03_01_01 for

• MCP

• Interface to customer operator panel front / PP031.

Bus addresses

Each node on the MPI/OPI bus must be allocated a bus address (0...31).
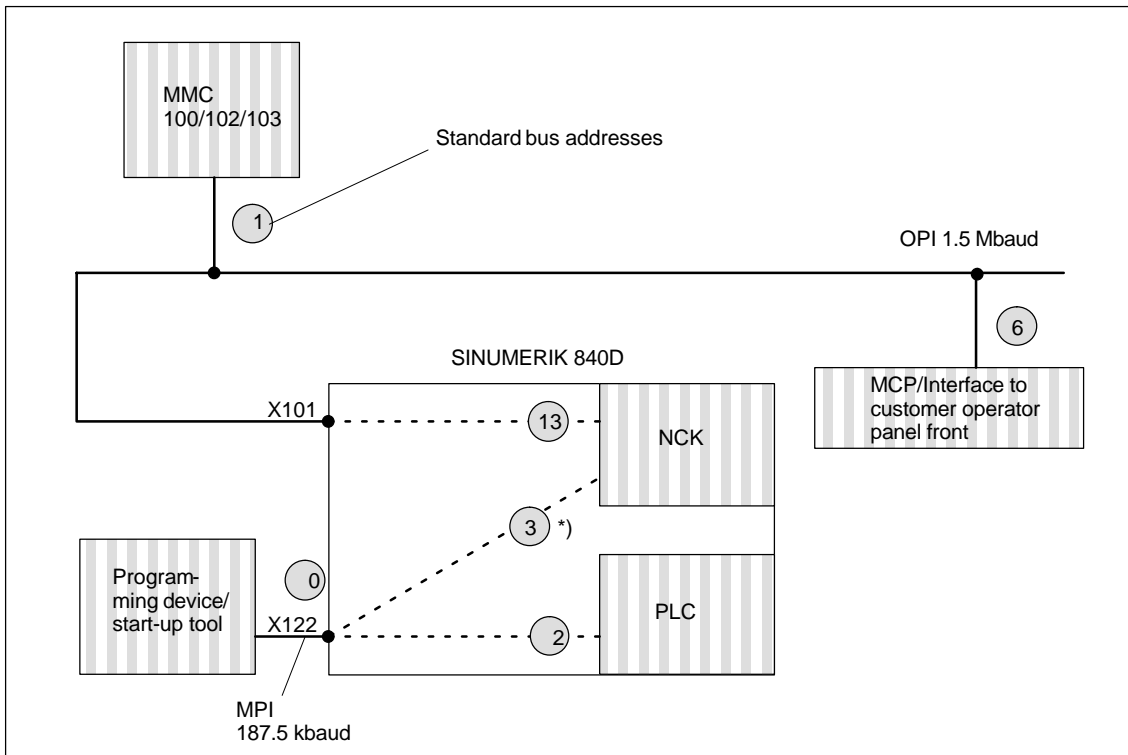
Fig. 3-4   Standard application for SINUMERIK 840D

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*) Address depending on software version:
   Address NCK to MPI = address PLC+1=3
   PLC 314 SW 3.5 and higher

**Bus address and
GD circle**

> **Note**
>
> The logical addressing of components in the PLC basic program is performed
> by means of the bus address parameter setting (for the machine control panel)
> or the GD circle (for the handheld operator unit). The GD circles are always
> used for physical addressing on the OPI/MPI. Each machine control panel,
> customer operator panel front, etc., must be addressed with a separate GD
> circle.

In the control, the conversion of the bus address in the associated GD circle is
performed via the PLC program.
The bus address, and therefore the setting of the associated GD circles, are set
on the machine control panel by means of DIP-FIX switches.

The same GD circles are set, however, with different bus addresses on the MPI
for machine control panel, customer operator panel front, PP031 and handheld
programming unit components. Allowance should be made for this when using
more than one machine control panel, etc.

The table below shows the relationship.

 3.2   Standard configuration

Table 3-2   Relationship between bus address and GD
                   circle

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

Example:
Two machine control panels (MCPs) are to be connected to the MPI of a controller. The first MCP can be connected to bus address 15 (GD circle 1), and the second to bus address 12 (GD circle 2).

MPI interface and GD circle

Note

If, for example PLC-PLC cross-communication is to be configured on the MPI using the STEP 7 "Communication Configuration" tool, and one or more MCPs are connected to the MPI, you should ensure that the allocation of GD circles is unique. The STEP 7 "Communication Configuration" tool allocates GD circles in ascending order starting with GD circle 1. If the MCPs are connected to the operator panel interface, there is no effect on PLC-PLC communication on the MPI.

Example:
"Communication Configuration" allocates GD circles 1 and 2 for PLC-PLC cross-communication. A first MCP on the MPI can then be connected to GD circle 3 (bus address 9 or 10), and a second MCP on the MPI can be connected to GD circle 4 (bus address 7 or 8).

3.3 Connection of a 2nd MCP/customer operator panel front and/or 1 HHU (SW 3.1 and lower)

3

The following configurations are permissible:

- 2 MCPs/customer operator panel fronts/PP031 connected to OPI

- 1 HHU connected to either OPI or MPI.

Machine control panels (MCP), customer operator panel fronts, and handheld units (HHU) are parameterized independently of the bus interface (OPI, MPI) in the basic PLC program.
The parameters for the 1st MCP are preset.

In addition to the parameter settings in the basic PLC program, the MPI also has parameters that must be set by means of the STEP 7 "Communication Configuration" tool.
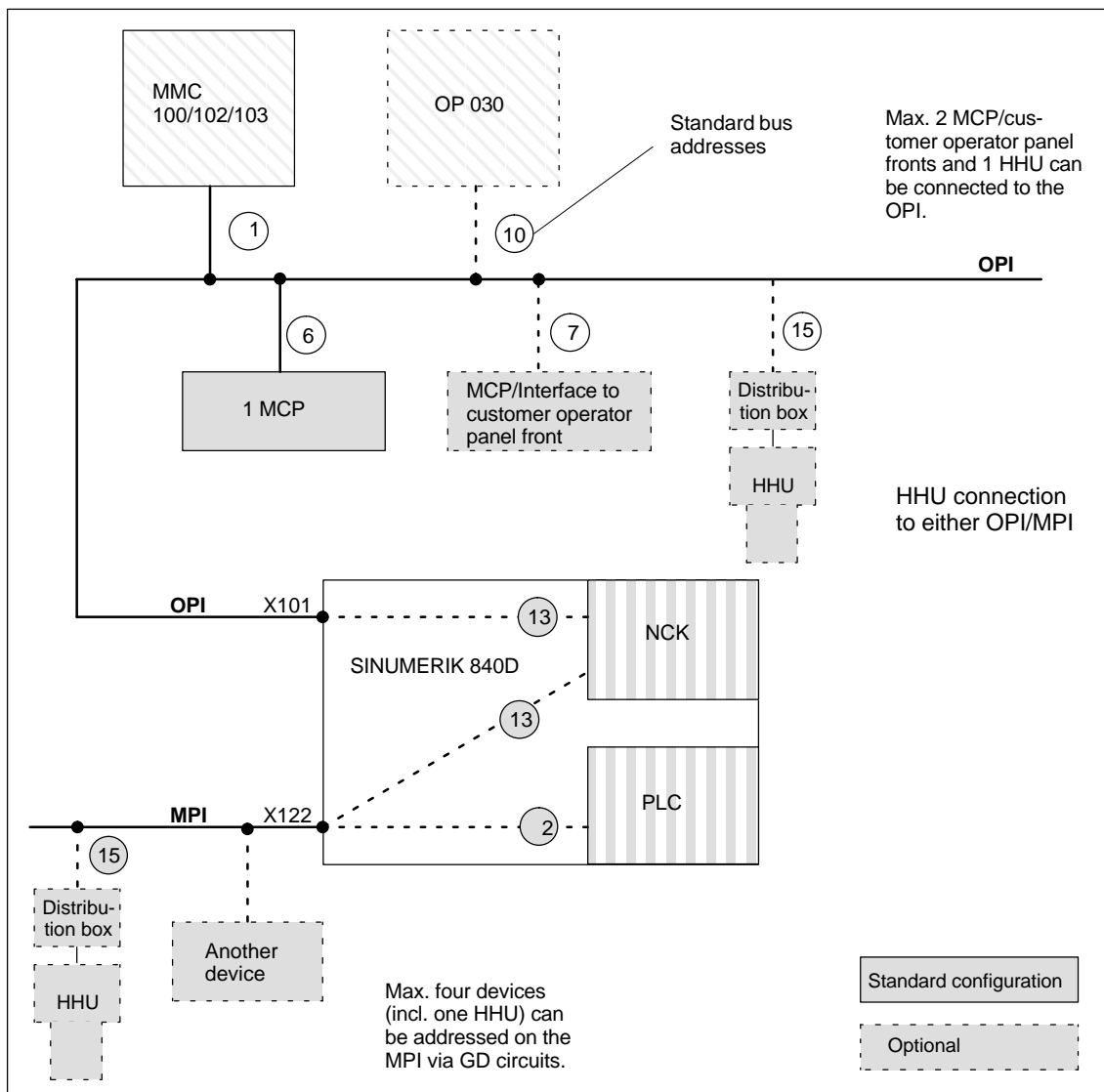
Fig. 3-5   Example: MPI/OPI bus nodes with standard bus addresses

3.3   Connection of a 2nd MCP/customer operator panel front and/or 1 HHU (SW 3.1 and lower)

Connection of
HHU

The handheld unit (HHU) should be connected to the OPI so the user can bene-fit from the following advantages:

- Easier start-up

- Reduction in communication tasks for PLC.

If the HHU is operated on the MPI, it must be parameterized by means of the STEP 7 "Communication Configuration" tool in addition to the parameter set-tings in the basic PLC program. Data exchange between the PLC and HHU is assisted by one of the four possible GD circuits in the PLC.

Documentation
requirements

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

3.3.1   Connection to OPI bus

Example

The following features are examples of deviations from the standard configura-tion:

- Changing the address assignment of the input, output or status bytes for the MCP in the PLC.

- Additional connection of a handheld unit (HHU) to the OPI.

- Connection of a 2nd MCP.

Procedure

You must adjust the communication parameters and possibly the switch settings (addresses) of the bus nodes.

1. Call FB1, DB7 must be parameterized for all operator control components (MCP, HHU) in OB 100 in the basic PLC program.

2. The status pointers (double word) for each operator control component must be configured for each component in FB1 for monitoring purposes.

See example in Subsection 3.3.3.

3.3.2   Connection to MPI bus

Example

The following features are examples of deviations from the standard configuration:

- Additional connection of a handheld unit (HHU).

In this case, you must adjust the communication parameters and possibly the switch settings (addresses) of the bus nodes.

Procedure

You must use the STEP7 "Communication Configuration" tool to input a new configuration. The following description of how to proceed is based on the assumption that you already know how to use this tool.

1. Set up a new project and CPU programs with the STEP7 tool. You must set up a CPU program for each component in the installation (PLC, HHU, etc.) which is linked via the MPI.

2. Network MPI nodes, i.e. network CPU programs with MPI address.

3. Call STEP7 "Communication Configuration" tool and enter the desired configuration.

4. Compile this configuration. A new SDB210 is generated for each CPU program. The SDB210 for the HHU component is meaningless since the GD parameters are set by means of DIP switch or keyboard.

5. Set the cyclical transmit pattern. Once the configuration has been compiled successfully for the first time, the "Reduction ratio" and "Status" can be activated and then input.

6. Compile your configuration again.

7. Transfer the SDB210 (from the CPU program of the PLC) to the PLC.

Note

By default, the STEP7 project manager (S7 TOP) does not display the SDBs. The SDB display is activated in the **View / Set filter** menu "All modules with SDBs".

8. Make the device-specific settings for all nodes:
   You now need to set the GD identifiers from the "Communication Configuration" table for the components (HHU, etc.).

9. Call FB1, DB7 must be parameterized for all operator control components (MCP, HHU) in OB 100 in the basic PLC program.

10. You must configure the status pointer (double word) for the HHU in FB1 for monitoring purposes.

See example in Subsection 3.3.3.

Note

For a description of the "Communication Configuration" tool and its applications, please refer to
References: /S7HT/ SIMATIC STEP7 Manual, Start-Up of MPI Bus Nodes

3.3.3 Example of a configuration of MCP and HHU via OPI

Requirements
- MCP with firmware version V 03_01_01
- HHU with firmware version V 01_01_02
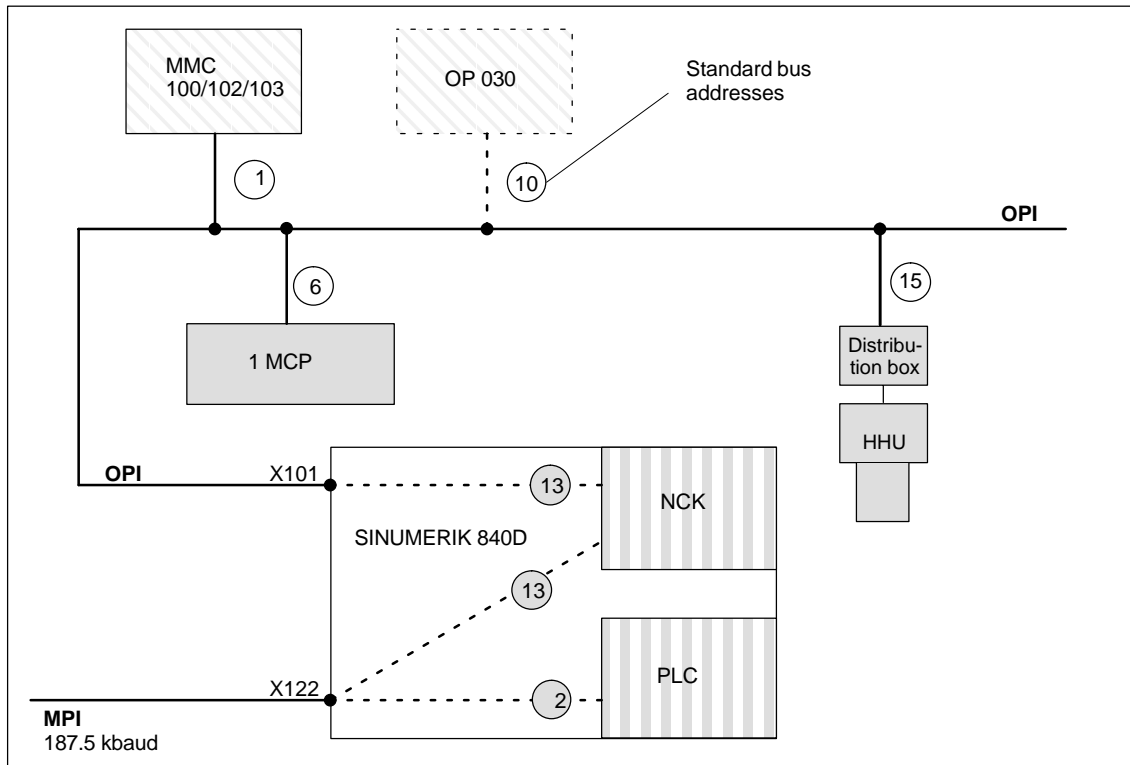
Fig. 3-6 Example of configuration of MCP and HHU via OPI

Parameterization of basic PLC program FB1

The following parameter settings must be made for the MCP and HHU operating components in FB1.

MCPNum:=1	(one MCP)
MCP1In:=P#E0.0	(MCP input signals)
MCP1Out:=P#A0.0	(MCP output signals)
MCP1StatRec:=P#A12.0	(status double word)
MCP1StatSend:=P#A8.0	(status double word)
MPIBusAdr:=6	
BHG:=2	(HHU on OPI)
BHGIn:=P#M20.0	(HHU input signals)
BHGOut:=P#M0.0	(HHU output signals)
BHGStatRec:=P#M26.0	(status double word)
BHGStatSend:=P#M30.0	(status double word)

The other HHU parameters are set to appropriate defaults.
See FB basic program.

Note

Note the DIP switch settings (switches S1 and S2 in the HHU).

3.3.4   Example of a configuration of HHU via MPI

Preconditions   STEP7 version 1.x and HHU with firmware version 01_01_02.
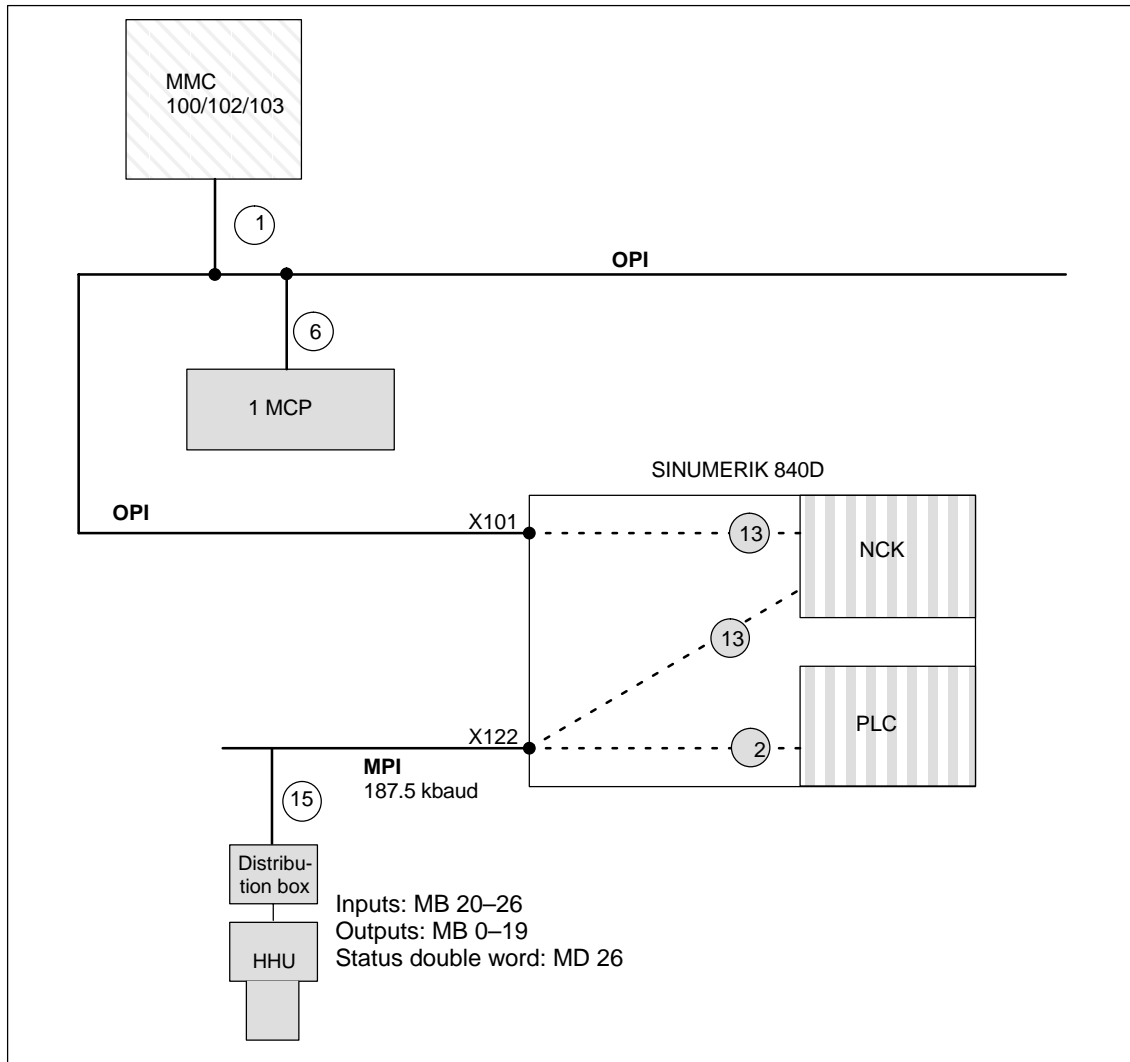
Fig. 3-7   Example of configuration of HHU via MPI

Call STEP7   Set up new project with the name **Sample**.
                           You must set up two CPU programs for the **Sample** project.

- AS314

- HHU

Assignment of   The two CPU programs are assigned as follows:
CPU programs   AS314 is for the PLC CPU, HHU for the handheld unit.

3.3   Connection of a 2nd MCP/customer operator panel front and/or 1 HHU (SW 3.1 and lower)

Networking

A network must be activated via the configuration for every CPU program. Since there is no separate order number for the HHU CPU programs, the standard order number of the AS314 must be used. MPI address 2 is networked for the AS314 CPU program and MPI address 15 for the HHU program. "0" must always be entered as the MPI SUB network number.

"Networking" sequence for each CPU program:

1. Set "Module networked".

2. Set MPI address and enter SUB network no. 0.

3. Confirm with "OK".

4. Save the configuration with "Save".

Call communication configuration

Start the Communication Configuration tool and set up a new file. "**Table 1**" appears.

Table 1

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

1. Using the mouse, click on the field next to GD identifiers (the column is then color-highlighted).

2. Click "**Select CPU module**" under menu item "PLC functions".

3. A window headed "Select CPU" appears. Click on project Example and the 2 CPU programs are displayed: as314, bhg.

4. Select as314.

5. Table 1 appears with entry **as314//CPU1::**

6. Click on empty field to the right of it and repeat steps 2 to 5 above in the order given for CPU program bhg.

7. The result will be Table 1 containing the two CPU programs.

Table 1		
GD identifiers	**as314//CPU1::**	**bhg//CPU1::**
GD		
GD		
GD		
GD		

3.3 Connection of a 2nd MCP/customer operator panel front and/or 1 HHU (SW 3.1 and lower)

3

Enter areas for transmitting and receiving

You can now make the entries for the HHU in **Table 1**.

1. Start in column **as314//CPU1::** by selecting the first field.

2. Enter data area for reception or transmission from Fig. 3-6.

   For **bhg//CPU1::**
   mb0 : 20   is the receive area and
   mb20 : 6   is the entry for the transmit area.
   (mb0 : 20   means that 20 bytes are received starting at mb0 and
   mb20 : 6   means that 6 bytes are transmitted starting at mb20.)

3. Declare the transmit and receive areas to be such. The transmit area is then marked with "»".

4. Table 1 with all its entries then looks like this:

table 1		
GD identifiers	**as314//CPU1::**	**bhg//CPU1::**
GD	»mb0:20	mb0:20
GD	mb20:6	»mb20:6

Note

The order in which inputs are made (transmit, receive) affects the way in which GD identifiers are assigned and should be carefully observed as shown by the above example.

Compilation

You now need to select compilation.
The GD identifiers are generated during compilation. The GD identifiers are displayed in Table 1 as the result of compilation.

Table 1		
GD identifiers	**as314//CPU1::**	**bhg//CPU1::**
GD 1.1.1	»mb0:20	mb0:20
GD 1.2.1	mb20:6	»mb20:6

Setting the reduction ratio

Click the **View / Reduction ratio** menu. Table 1 below appears with the SR parameters.

Table 1		
GD identifiers	**as314//CPU1::**	**bhg//CPU1::**
SR 1.1	8	8
GD 1.1.1	»mb0:20	mb0:20
SR 1.2	8	8
GD 1.2.1	mb20:6	»mb20:6

**Changing the SR
parameters**

The transmission rate for the HHU must be set.
The default setting is one transmission every 8 PLC cycles. With a PLC cycle
time of 25ms, the default then corresponds to a key scan of 200ms. This may
be too slow for some applications. To change the transmission rate, the "Reduc-
tion ratio", i.e. the SR parameters, need to be changed.
You must specify a value of 1, 2, 4 or 8. Only 4 and 8 are allowed for transmis-
sion. The transmission to and from the HHU is then activated at a correspond-
ing frequency (e.g. every 4th PLC cycle). Example of Table 1 with altered SR
parameters:

Table 1		
GD identifiers	**as314//CPU1::**	**bhg//CPU1::**
SR 1.1	**4**	**1**
GD 1.1.1	»mb0:20	mb0:20
SR 1.2	**1**	**4**
GD 1.2.1	mb20:6	»mb20:6

When you have changed the SR parameters, you must compile your configura-
tion again.

Activate status

Click the **View / Status** menu. Table 1 below is then displayed.

Table 1		
GD identifiers	**as314//CPU1::**	**bhg//CPU1::**
GST		
GDS 1.1		
SR 1.1	4	1
GD 1.1.1	»mb0:20	mb0:20
GDS 1.2		
SR 1.2	1	4
GD 1.2.1	mb20:6	»mb20:6

You now need to specify the status double words for GDS1.2.
Extract from Table 1:

Table 1		
GD identifiers	**as314//CPU1::**	**bhg//CPU1::**
GDS 1.2	**md26**	

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

SDB210 The SDB 210s have been generated during compilation. Transfer SDB 210 for CPU program **as314** to the PLC CPU (PLC must be in the STOP state). Procedure:

1. Click on **File/Download to PLC** menu

2. Download window appears. Select **as314//CPU1::** and confirm with OK.

3. Switch PLC into RUN mode (restart).

3

Set HHU The default address 15 can be left unchanged on the HHU, only the GD parameters at 1.1.1–1.2.1 must be set, see Section 3.4.

Parameterization of basic PLC program FB1

The following parameter settings must be added to FB1 for the HHU.
.
.
.
```
HHU:=1               (HHU on MPI bus)
BHGIn:=P#M20.0       (HHU input signals)
BHGOut:=P#M0.0       (HHU output signals)
BHGStatRec:=P#M26.0  (status double word)
```
.
.
.

The other HHU parameters are set to appropriate defaults.

3.4   Handheld unit

Display software   The software version of the HHU appears on the display after ramp-up until
version of HHU   communication between the PLC and the HHU has been established.

Example: Display on the HHU

  Waiting for PLC

  V04.01.01   F

→ Software version of the HHU is V4.11
→ Bus address of the HHU is FH (15)

3.4.1   Settings on the HHU up to 3.x
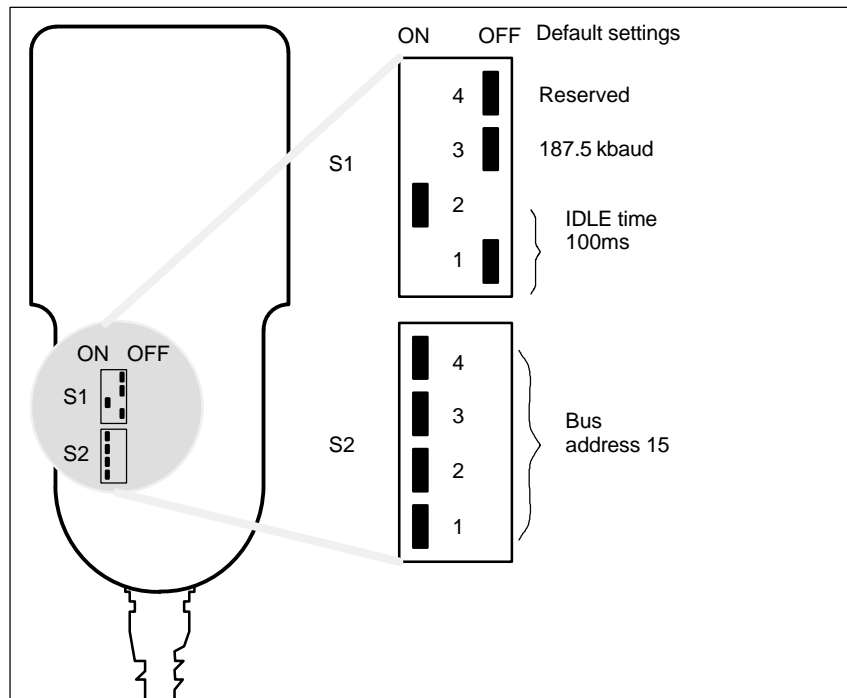
Fig. 3-8   Position of DIP switches in HHU with default setting

DIP switch   The default setting (setting when supplied) should be used for operating the
settings for MPI   HHU on the MPI of the 840D.

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

S1 1	S1 2	S1 3	S1 4	S2 1	S2 2	S2 3	S2 4	Meaning:
OFF	ON	OFF	OFF	ON	ON	ON	ON	Default setting
		OFF						Baud rate: 187.5 kbaud

**DIP switch
settings for OPI**

S1 "3" must be set to "on" when operating the HHU on the OPI.

Table 3-4   Settings on switches S1 and S2 in HHU

S1 1	S1 2	S1 3	S1 4	S2 1	S2 2	S2 3	S2 4	**Meaning:**
OFF	ON	OFF	OFF	ON	ON	ON	ON	Default setting
		ON						Baud rate: 1.5 Mbaud OPI
				ON	ON	ON	ON	Bus address: 15
				ON	ON	ON	OFF	Bus address: 14
				ON	ON	OFF	ON	Bus address: 13
				ON	ON	OFF	OFF	Bus address: 12
				ON	OFF	ON	ON	Bus address: 11
				ON	OFF	ON	OFF	Bus address: 10
				ON	OFF	OFF	ON	Bus address: 9
				ON	OFF	OFF	OFF	Bus address: 8
				OFF	ON	ON	ON	Bus address: 7
				OFF	ON	ON	OFF	Bus address: 6
				OFF	ON	OFF	ON	Bus address: 5
				OFF	ON	OFF	OFF	Bus address: 4
				OFF	OFF	ON	ON	Bus address: 3
				OFF	OFF	ON	OFF	Bus address: 2
				OFF	OFF	OFF	ON	Bus address: 1
				OFF	OFF	OFF	OFF	Bus address: 0

3.4.2   Settings on the HHU for SW 4.x and higher

The settings for "baud rate" and "bus address" parameters made with switches
S1 and S2 on the HHU no longer apply to SW 4.x and higher. These bus pa-
rameters can be reconfigured from this software version (cf. Subsection 3.4.3).

3.4.3   Configuring the HHU, setting interface parameters

The GD parameters must be set before the submodule can communicate via
the MPI interface. The setting can be activated during ramp-up (i.e. while wait-
ing for the first GD message frame from the PLC ("Waiting for PLC" state) via

the HHU interface by means of key combination Jog [icon] (top far left) and T2
(top far right). The individual parameters are then interrogated via the HHU dis-
play and entered via the HHU keyboard. You can change the default values
with the + and – keys within the permitted value range. You can switch to the

next parameter with the Automatic [icon] key. Selection of the next parameter
causes the preceding parameter to be stored in the Flash EPROM. The param-
eters need therefore only be set during start-up and when interfaces are
changed. If the interface parameter settings are not activated after ramp-up, the
stored values are used or the default values (see table) loaded.
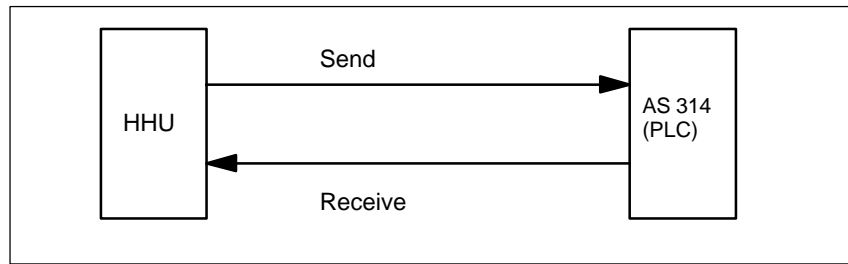
Fig. 3-9   Sending and receiving as seen from the HHU

Meaning of the GD parameters

Separate GD parameters are used for sending and receiving.
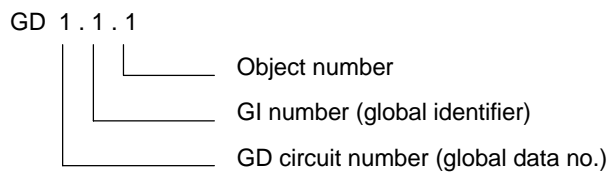
Fig. 3-10   Meaning of the GD parameters

Note

The GD parameters of the HHU and AS314 and PLC block FB1 must agree.

Table 3-5   Value range for GD parameters of the HHU

	Designation	Display	Default value	Value range	PLC FB1 parameters
	Receive GD circuit no.	Rec-GD-No:	2	1–16	HHU Send GD No
	Receive GI no.	Rec-GBZ-No:	1	1–255	HHU Send GBZ No
	Object no. for receive GI	Rec-Obj-No:	1	1–255	HHU Send Obj No
	Send GD circuit no.	Send-GD-No:	2	1–16	HHU Rec GD No
	Send GI no.	Send-GBZ-No:	1	1–255	HHU Rec GBZ No
	Object no. for send GI	Send-Obj-No:	1	1–255	HHU Rec Obj No
SW 4 and higher	Baud rate	Baud rate:	187.5 (kbaud)	187.5 / 1.5M	
	Bus address	Bus address:	15	0–15	

3.4.4   Example: Connecting the HHU to the SINUMERIK 840D

3

1. Make the electrical connections on the distribution box and HHU.
   When the HHU supply is connected, the following message must appear on the display: "Waiting for PLC V04.01.01 F",
   in which F stands for node no. 15 (default setting).

2. Check that the HHU is capable of bus operation:
   "——> BMPI" must be printed on rating plate on rear of unit.

3. Make a permanent bus cable connection at the end of the bus
   (wire up inside connector instead of detachable connection!)
   Note bus settings: OPI   (on NCU at X101)
                          MPI   (on NCU at X122)

4. Deactivate the terminating resistors in the last bus connector
   (terminating resistors are integrated in the HHU).

5. Set the DIP switches in the HHU:
   S 1.3 ON ——>   OPI (1.5 Mbaud)
   S 1.3 OFF ——>   MPI (187.5 kbaud)

6. Parameterize FB 1:
   HHU   0 = No HHU
                         1 = HHU on MPI
                         2 = HHU on OPI
   HHUIn   1st input byte
   HHUOut   1st output byte
                         ——> Byte n+0, bit 7 must be set continually to "1"
                         by the PLC!
   HHUStatSend   Status data word Send
   HHUStatRec   Status data word Receive
   HHUInLen   B#16#6
   HHUOutLen   B#16#14
   HHUTimeout   S5T#700MS
   HHUCycl   S5T#400MS
   HHURecGDNo   2
   HHURecGBZNo   2
   HHURecObjNo   1
   HHUSendGDNo   2
   HHUSendGBZNo   1
   HHUSendObjNo   1

7. Check whether data from FB 1 are included in data view, otherwise update.

8. The Send / Rec data are preset in the HHU. No further parameters need to be set. The data must be set as follows for checking purposes only:
   HHURecGDNo   2
   HHURecGBZNo   1
   HHURecObjNo   1
   HHUSendGDNo   2
   HHUSendGBZNo   2
   HHUSendObjNo   1

9. For the purpose of integration in the PLC, the TOOL box contains a file "HHU.exe" as a programming example.

10. For HHU on MPI (SW 4.x):
    HHU = 2 and
    HHUMPI = TRUE

3.5 Handheld programming unit

The handheld programming unit (HPU) is especially suitable for handling tasks. It is connected to the SINUMERIK 840D via the MPI or OPI interface and can be used either instead of or in addition to an MMC/MCP.

Functions

The HPU includes the operating functions of the MCP.

The state of the operator elements (button pressed/released) is entered in an 8-byte data block and transferred cyclically by global data service to the PLC. The operator elements are evaluated by the PLC.

The following MCP functions can be executed on an HPU with a standard assignment:

- Start and stop programs

- Change operating mode

- Manually traverse five axes in both directions

- Change override

- Switch programs to RESET

- Switch over WCS/MCS for travel commands

- Activate single block

- Select increments (INC1, INC10, ...).

Non-available functions

The following MCP functions are not provided by the HPU and are assigned permanent values:

- Spindle speed override

- Spindle start/stop

- Keyswitch

- Feedrate start/stop.

Display software version of HPU

The software version of the HPU appears in the display after ramp up until communication between the PLC and the HPU has been established.

Example: Display on the HPU

Waiting for PLC

V04.01.01   B

$\rightarrow$ Software version of the HPU is V4.11

$\rightarrow$ Bus address of the HPU is B_{hex} (11)

3.5.1   Interface signals of the HPU

The MCP simulation is available for the HPU. The MCP simulation of the HPU must be parameterized as an MCP in function block FB1 so that the PLC basic program can monitor the failure of the HPU.

Input signals   The parameter setting for the start address n is set in the PLC user program (FB1).

Table 3-6   Interface HPU –> PLC

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IBn	REF	TEACH	AUTO	MDA	JOG	QUIT	RESET	WCS/MCS
IBn+1	Reserved	U4	U3	Shift key	U2	U1	INC	REPOS
			JOG keys positive direction					
IBn+2	Reserved	Reserved	C/6	B/5	A/4	Z/3	Y/2	X/1
			JOG keys negative direction					
IBn+3	Reserved	Reserved	C/6	B/5	A/4	Z/3	Y/2	X/1
IBn+4	Signal	Diagno	Service	System	Param	Correct	Program	Machine
IBn+5	F5	F4	F3	F2	1F	Step	Modify	Insert
IBn+6	Reserved	Reserved	+	–	S2	S1	START	STOP
IBn+7	Reserved							
Note: – Only keys displayed against a gray background are evaluated by the basic PLC program (FC26). – Keys U1 to U4 and F1 to F5 or their inputs may be freely assigned by the PLC user.								

FC 26 also exists and is analogous with PLC functions FC 19 and FC 25. It is described in
Reference: /FB/ P3, Basic PLC Program

Machine data that specify the coding of compensation values must be set as follows:

- MD 12000: OVR_AX_IS_GRAY_CODE = 1

- MD 12020: OVR_FEED_IS_GRAY_CODE = 1

- MD 12040: OVR_RAPID_IS_GRAY_CODE = 1

- MD 12060: OVR_SPIND_IS_GRAY_CODE = 1.

Signals not supported

By default, the following signals are not influenced by the MCP emulation, they are initialized when the control is started up:

- Keyswitch to position 0

- Spindle speed override to 0

- Rapid traverse overlay to 0.

Only "BAGNo" and "ChanNo" parameters are provided for FC 26. For this reason, the user needs to determine the information that is otherwise transferred to the caller via parameters "FeedHold" and "SpindleHold".

3.5.2   Standard configuration of the HPU (without MCP)

The standard configuration comprises a SINUMERIK 840D with MMC 100/102/103 and an HPU.

Parameterizing the PLC basic program FB1

The parameter assignment at FB1 for the HHP operating components correspond to those of the 1st MCP:
MCPNum:=1   (one HPU)
MCPIn:=P#I0.0   (HPU input signals)
MCPOut:=P#Q0.0   (HPU output signals)
MCPStatRec:=P#Q12.0   (status double word)

3

3.5.3   Deviations from the standard HPU configuration (SW 3.1 and lower)

Documentation requirements

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

Example

The following features are examples of deviations from the standard configuration:

- Changes to the address assignment
  of the input, output or status bytes,
  or flag area or data block

- Additional connection of an MCP.

An example is given using the following configuration:

    – PLC CPU AS314

    – MCP

    – HPU.

You must adjust the communication parameters and possibly the switch settings (addresses) of the bus nodes.

Procedure
SIMATIC STEP7,
V2.1

To set a new configuration, first press the **Define global data** soft key. The following description of how to proceed is based on the assumption that you are already familiar with this menu.

1. Set up a new project and CPU programs with the STEP7 tool. You must set up a CPU program for each component of the system (PLC, MCP, HHU, 2nd MCP, HPU...).

2. Network MPI nodes, i.e. network CPU programs with MPI address.

3. Call "Global data" menu (via **File manager / MPI network / Options / Global Data** soft keys) and enter the desired configuration.

4. Compile this configuration. A new SDB is generated for each CPU program.

5. Set the cyclical transmit pattern. Once the configuration has been compiled successfully for the first time, the "Reduction ratio" and "Status" can be activated and then input.

6. Compile your configuration again.

7. Transfer the SDB (from the CPU program of the PLC) to the PLC.

8. Call FB1, DB7 must be parameterized for all operator control components (MPI nodes) in OB 100 in the basic PLC program.

9. The status pointer (double word) must be configured in FB1 for each component for monitoring purposes.

Note
For a description of the "Global data" menu and its applications, please refer to
References: /S7HT/ SIMATIC STEP7 Manual, Start-Up of MPI Bus Nodes

---

Networking

A network must be activated via the configuration for every CPU program. Since there is no separate order number for the MCP/HHU CPU programs, the standard order number of the AS314 must be used.

CPU program	MPI address
AS314	2
MCP	6
HHU	15
HPU	11

"0" must always be entered as the MPI SUB network number.
"Networking" sequence for each CPU program:

1.   Set "Module networked".

2.   Set MPI address and enter SUB network no. 0.

3.   Confirm with **OK** soft key

4.   Save the configuration with **Save** soft key.

SDB

The SDB supplied in the basic PLC program is valid for the first MCP or the HPU and must be reconfigured as required.

3

Calling the "Define global data" menu

Call the "Global data" menu and set up a new file. "**Table 1**" appears.

Table 1

You must call the CPU programs in **Table 1**.

1. Using the mouse, click on the field next to GD identifiers (the column is then color-highlighted).

2. Click "**Select CPU module**" under menu item "PLC functions".

3. A window headed "Select CPU" appears. Click on project Example and the 3 CPU programs are displayed: as314, MCP, HPU.

4. Select as314.

5. **Table 1** appears with entry **as314//CPU1::**

6. Click on the empty field to the right of it and repeat steps 2 to 3 above in the order given for the HPU CPU programs.

7. The result is **Table 1** containing the 3 CPU programs.

Table 1			
GD identifiers	**as314/CPU1**	**MCP/CPU1**	**HPU/CPU1**
GD			
GD			
GD			
GD			

Enter areas for transmitting and receiving

You can now make the entries for the HPU in **Table 1**.

1. Start in column **as314//CPU1::** by selecting the first field.

2. Define and enter data area for receipt and transmission

   For **mstt//CPU1::**
   Receive area: qb0 : 8   Starting from qb0, 8 bytes are sent from the PLC to the MCP.
   Transmit area: ib0 : 8   Starting from ib0, 8 bytes are received by the MCP.

   For **HPU//CPU1::**
   Receive area: qb16 : 8   Starting from qb16, 8 bytes are sent from the PLC to the HPU.
   Transmit area: ib16 : 8   Starting from ib16, 8 bytes are received by the HPU.

3. Declare the transmit and receive areas to be such. The transmit area is then marked with "»".

4. **Table 1** with all its entries then looks like this:

   3.5   *Handheld programming unit*

Table 1			
GD identifiers	**as314/CPU1::**	**MCP/CPU1::**	**HPU/CPU1::**
GD	»qb0:8	qb0:8	
GD	ib0:8	»ib0:8	
GD	»qb16:8		qb16:8
GD	ib16:8		»ib16:8

Note

The order in which inputs are made (transmit, receive) affects the way in which GD identifiers are assigned and should be carefully observed as shown by the above example.

Compiling

Now select compiling.
The GD identifiers are generated during compilation. The GD identifiers are displayed as the result in **Table 1**:

Table 1			
GD identifiers	**as314/CPU1::**	**MCP/CPU1::**	**HPU/CPU1::**
GD 1.1.1	»qb0:8	qb0:8	
GD 1.2.1	ib0:8	»ib0:8	
GD 2.1.1	»qb16:8		qb16:8
GD 2.2.1	ib16:8		»ib16:8

3

**Setting the
reduction ratio**

Click the **View / Reduction ratio** soft keys. The following **Table 1** with the SR parameters appears:

Table 1			
GD identifiers	**as314/CPU1::**	**MCP/CPU1::**	**HPU/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	»qb16:8		qb16:8
SR 2.2	8		8
GD 2.2.1	ib16:8		»ib16:8

**Changing the SR
parameters**

The transmission rate for the HPU must be set.
The default setting is one transmission that takes place every eight PLC cycles. With a PLC cycle time of 25ms, the default then corresponds to a key scan of 200ms. This may be too slow for some applications. To reduce the transmission rate change the "reduction ratio", i.e. the SR parameters.
You must specify a value of 1, 2, 4 or 8. Only 4 and 8 are allowed for transmission. The transmission to and from the HPU is then activated at a corresponding frequency (e.g. every 4th PLC cycle).
Example of **Table 1** with altered SR parameters:

Table 1			
GD identifiers	**as314/CPU1::**	**MCP/CPU1::**	**HPU/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	»qb16:8		qb16:8
SR 2.2	**1**		**4**
GD 2.2.1	ib16:8		»ib16:8

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

3.5 Handheld programming unit

Activate status
Click the **View / Status** soft keys in the menu.
The following **Table 1** appears:

Table 1			
GD identifiers	**as314/CPU1::**	**MCP/CPU1::**	**HPU/CPU1::**
GST			
GDS 1.1			
SR 1.1	**4**	**1**	**1**
GD 1.1.1	»qb0:8	qb0:8	qb0:8
GDS 1.2			
SR 1.2	**1**	**4**	**4**
GD 1.2.1	ib0:8	»ib0:8	»ib0:8
GDS 2.1			
SR 2.1	**4**		**1**
GD 2.1.1	»qb16:8		qb16:8
GDS 2.2			
SR 2.2	**1**		**4**
GD 2.2.1	ib16:8		»ib16:8

Now enter the status double words for GDS1.2 and GDS 2.1.
Extract from **Table 1**:

Table 1			
GD identifiers	**as314/CPU1::**	**MCP/CPU1::**	**HPU/CPU1::**
GDS 1.2	**ad12**		
GDS 2.2	**ad24**		

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

SDB
The SDB has been generated during compilation. Now transfer the SDB for CPU program **as314** to the PLC CPU. (PLC must be in the STOP state).
Procedure:

1. Click on **File/Download to PLC** menu

2. Download window appears. Select **as314//CPU1::** and confirm with **OK** soft-key.

3. Switch PLC into RUN mode (restart).

HPU address
The default setting for the MCP is 6 and the MPI address for the HPU is 14. The address is set in FB1 for each device.
The default addresses are:
MCP: 6
HPU: 11

Parameterization of basic PLC program FB1

The following parameter settings must be made for the MCP and HPU operating components in FB1:

```
MCPNum:=1               (one MCP)
MCP1In:=P#E0.0          (MCP input signals)
MCP1Out:=P#A0.0         (MCP output signals)
MCPStatRec:=P#Q12.0     (status double word)
MPCBusAdr:=             6,

HPU:=1                  (one HPU)
HPUIn:=P#F16.0          (HPU input signals)
HPUOut:=P#F16.0         (HPU output signals)
HPUStatRec:=P#F24.0     (status double word)
HPUBusAdr:=             11,
```

3

3.6   Machine control panel (MCP)

Interfaces, switches and display elements

The following interfaces, switches and display elements are located on the rear of the machine control panel:
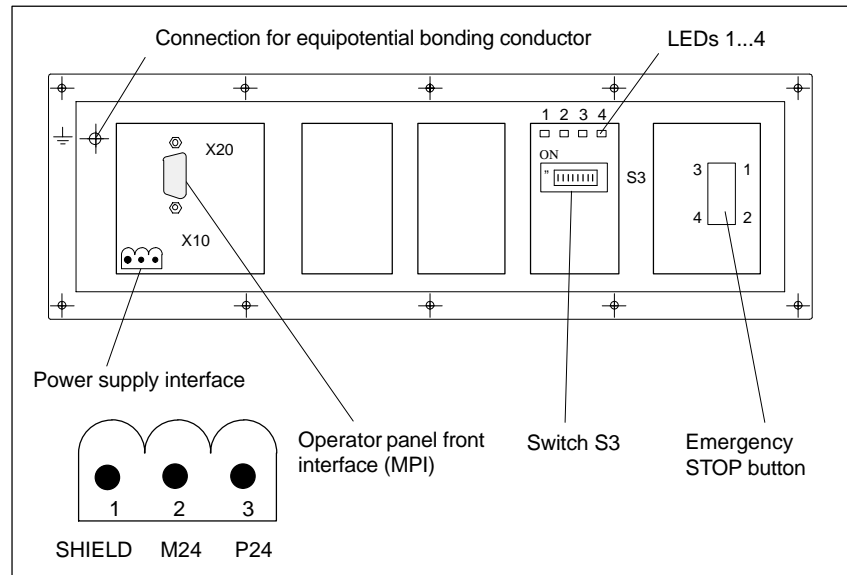
Fig. 3-11   Position of interfaces on rear panel of MCP

Interfaces

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

References: /BH/, Operator Components Manual

LEDs 1...4

Table 3-7   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 state after transmission of data

Display software version of MCP

If the "feed start" and "feed stop" keys are pressed while the MCP is powering up, the software version is displayed in the left-hand, center and right-hand LED blocks.
The module must have firmware version **V 03_01_01** or higher.

Example

After the software version display has been activated, 3/1/1 LEDs light up in the left-hand/center/right-hand LED blocks.
—> SW version v03_01_01 is installed.

3

Switch S3

Table 3-8   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 cycle transmit pattern / 2400ms receive monitoring 100 ms cycle transmit pattern / 1200ms receive monitoring 50ms cycle transmit pattern / 600ms receive monitoring
			ON ON ON ON ON ON ON ON OFF OFF OFF OFF OFF OFF OFF OFF	ON ON ON ON OFF OFF OFF OFF ON ON ON ON OFF OFF OFF OFF	ON ON OFF OFF ON ON OFF OFF ON ON OFF OFF ON ON OFF OFF	ON OFF ON OFF ON OFF ON OFF ON OFF ON OFF ON OFF ON OFF		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	Customer operator panel front
							OFF	MCP
ON	**OFF**	**ON**	**OFF**	**ON**	**ON**	**OFF**	**OFF**	**Default setting**
ON	**OFF**	**ON**	**OFF**	**ON**	**ON**	**OFF**	**OFF**	**Default setting for 840D** Baud rate: 1.5 Mbaud Cyclical transmit pattern: 100ms Bus address: 6

3.7   Customer operator panel front

Interface

A customer operator panel front can be connected via the interface. 64 digital inputs and 64 digital outputs with C-MOS level (5V) are available on the module for this purpose.
The module must have firmware version **V 03_01_01** or higher.

Location of the interfaces
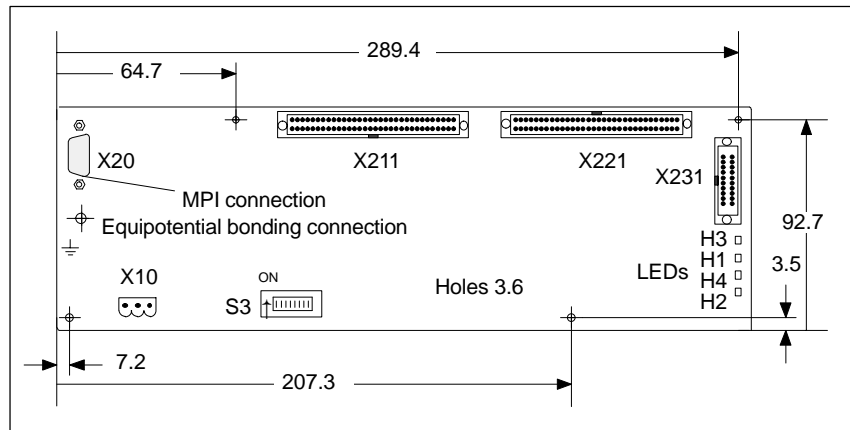
Fig. 3-12   Front view of interface to customer operator panel front

Switch S3, default setting

If only the customer operator panel front is to be connected, then the bus address must be set to 6 as for the MCP (standard application).

Table 3-9   Setting for 840D: Switch S3 on interface for customer operator panel front

1	2	3	4	5	6	7	8	Meaning:
ON	OFF	ON	OFF	ON	ON	OFF	ON	**Baud rate: 1.5Mbaud (OPI)** **Cyclical transmit pattern: 100ms** **Bus address: 6**

Power supply interface

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

Table 3-10   Pin assignment of X10 connector on interface to customer operator panel front

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

3.8   2nd machine control panel

Two machine control panels can be operated with the SINUMERIK 840D. The second MCP must be parameterized in the basic program parameters in FB1.

3

3.9   MMC 100/MMC 103 operator panel front

3.9.1   Settings on the MMC

OPI (default)

The operator panel front (OPI) with a baud rate of 1.5 Mbaud is set as the default on the MMC.

- **MMC 100**
  The MMC 100 is automatically set to the baud rate.

- **MMC 102/103**
  The MMC 102/103 must be set to a baud rate of 1.5 Mbaud in the "Start-up/ MMC/Operator panel front" menu.

Screen

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

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

Language

MD 9003: FIRST_LANGUAGE (foreground language for MMC 100)

- **MMC 100**
  One of two languages can be called in the MMC 100.

- **MMC 102/103**
  The MMC 102/103 is always supplied with a selection of languages. English is the default setting.

Display resolution

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

Screen saver

MD 9006 (for MMC 100):
In this MD you set the time after which the screen saver is to be activated. The screen saver is activated if none of the keys on the operator panel front have been pressed within the specified time.

**Protection levels
for user data**

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

RS-232 interfaces

The settings of the RS-232 interface (V.24) on the MMC for data backup are stored from MD 9300 onwards. The settings for three different devices are made in the "Services" menu via an input display.

3.9.2   Language default

**Language
switchover**

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

1. Select menu bar.

2. Select "Start-up" (3rd horizontal soft key from right).

3. Switch to the highest level with RECALL.

4. Select "Change language" (3rd vertical soft key from top).

MMC 100

One of two languages can be called alternately in the MMC 100. These are defined while the MMC software is being loaded. While the control is in operation, the operator can switch between these two languages only by selecting the soft key "Change language" in the "Start-up" display.

MMC 102/103

On the MMC 102/103 there are several methods of switching over between languages while the control is in operation:

● Switchover between two preset languages.

● Online change of the second language.

**Language
switchover
concept**

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

**Switchover
between two
languages**

The vertical soft key labeled "Change language" in the "Start-up" display is used to switch between two languages. The switchover takes effect immediately. This key can only be used to switch between two predefined languages.

3

Online change of the 2nd language

Different languages are selected in the "Start-up/MMC/Languages" display (provided that languages have been loaded). This display provides the user with a list of the available languages. The user selects one language and confirms the selection with "OK". The user can then change over between the first language and the language just set by selecting the "Change language" soft key in the "Start-up" display. The 2nd language can always be changed in online mode.

Install language packages

The languages installed on the MMC 102/103 on delivery are English and German. The two supplementary packages (1 and 2) are also available.
Supplementary package 1: European languages:

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

Supplementary package 2: Asian languages:

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

Definition of usable languages

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

Default setting without activating logographic languages

Two languages can be configured from the languages listed below:

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.

3.9   MMC 100/MMC 103 operator panel front

**Default setting
with logographic
languages**

2 languages can be configured from the languages listed below:
GR   German (standard)
SP   Spanish
FR   French
UK   English (standard)
IT   Italian
TW   Chinese (Taiwan) pictographic language
CH   Chinese (Mandarin) pictographic language

Example:
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
...

AddOn products

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

Note

When you change the "LanguageList", "FontList", "LBList" and "AddOnProd"
lines, make sure that you only manipulate (shift, delete) the "**;**" character repre-
senting the comment.
When editing file MMC.INI, take care to ensure that you change only the high-
lighted (bold print) texts. Make sure that your entries are spelled correctly.

■

4

EMC / ESD Measures

4.1 Measures to suppress interference

**Shielded
signal leads**

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

Exception:

- If external equipment (such as printers, programming devices, etc.) is connected, standard shielded cables connected at one end may also be used.

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

**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 leads and load leads must be routed at the greatest possible distance from one another.

- Signal cables from and to the NC or PLC must be supplied by SIEMENS.

- Signal leads must not be routed close to strong external magnetic fields (e.g. motors and transformers).

- Pulse-carrying HC/HV leads must always be laid completely separately from all other leads/cables.

- If signal leads cannot be laid at a sufficient distance from other leads, then they must be installed in shielded cable ducts (metal).

- The distance (noise field) between the following leads should be as small as possible:

    – Signal lead and signal lead.

    – Signal lead and associated equipotential bonding lead.

    – Equipotential bonding lead and PE conductor (routed together).

!

Important

For more information about interference suppression measures and connection of shielded cables, please refer to
References: /EMC/, EMC Guidelines

4.2 Measures to protect ESD

Important

Handling of modules at risk from ESD (electrostatic sensitive devices):

- When electrostatic components are handled, it must be ensured that personnel, workstation and packaging are properly grounded.

- As a general principle, electronic modules should only be touched if this is absolutely unavoidable (owing to repair work, etc.). When you are handling PCBs, therefore, make sure that you never touch any submodule pins or conducting paths.

- You may only touch components if
    - you are constantly connected to earth by means of an antistatic chain
    - you are wearing antistatic shoes or antistatic shoes with grounding strips in conjunction with an antistatic floor surface.

- Modules must always be placed on a conductive surface (table with antistatic covering, electrically conductive foam rubber, antistatic packaging materials, antistatic transport container).

- Modules must not be placed near VDUs, monitors or television sets (not closer than 10 cm from screen).

- Modules must not be allowed to come into contact with chargeable, electrically insulating materials such as plastic foil, insulating table tops or clothing made of synthetic fibers.

- Measurements may only be taken on modules if
    - the measuring instrument is grounded (e.g. via PE conductor) or
    - the measuring head on an isolated instrument is discharged briefly (e.g. by being brought into contact with bare metal part of control housing) before the measurement is taken.

4.3 Cooling

Please note:

Caution

When installing the drive group, please make sure to keep a space of 100mm for air circulation on top and at the bottom.

■

Power ON and Booting

5

5.1   Start-up sequence

Start-up sequence   All mechanical and electrical installation work must be complete. Before the system is started up, it is important to ensure that the control and its components boot correctly. It is also essential that the equipment is installed in accordance with the EMC guidelines given in the previous section.
The start-up procedure is detailed below. The order in which the individual steps are taken is not mandatory, but recommended:

1. Check that SINUMERIK 840D boots correctly (Chapter 5)

2. Enter basic settings (Subsection 6.6.1) and memory configuration (Section 6.7)

3. Scaling machine data (Section 6.8)

4. Set axis configuration (Subsection 6.9.1)

5. Configure and parameterize the drives (Subsection 6.9.2)

6. Set axis and spindle-specific machine data

   – Axis velocities (Subsection 6.9.9)

   – Axis monitoring (Subsection 6.9.11)

   – Axis reference point approach (Subsection 6.9.12)

   – Spindle data (Subsection 6.9.13)

   – Spindle encoder matching (Subsection 6.9.15)

   – Spindle velocities (Subsection 6.9.16)

   – Spindle positioning (Subsection 6.9.17)

   – Spindle monitoring (Subsection 6.9.19)

7. Transfer PLC user program and alarm texts (Chapters 7/8)

8. Axis/spindle test run (Chapter 9)

9. Drive optimization (Chapter 10)

   – Frequency response measurements on speed and position control loops (Section 10.5)

   – Analog output (Section 10.8)

10. Data back-up (Chapter 11)

11. Software, hardware replacement (Chapter 12)

12. MMC (Chapter 13).

5.2   Power ON and Booting

Operator control and display elements relevant to booting

Fig. 5-1 below shows the operator control and display elements on the NCU that are relevant for power ON and booting the SINUMERIK 840D:

- Various error and status LEDs

- 7-segment status display

- NMI button

- RESET button

- NC start-up switch

- PLC start-up switch

- PCMCIA slot.
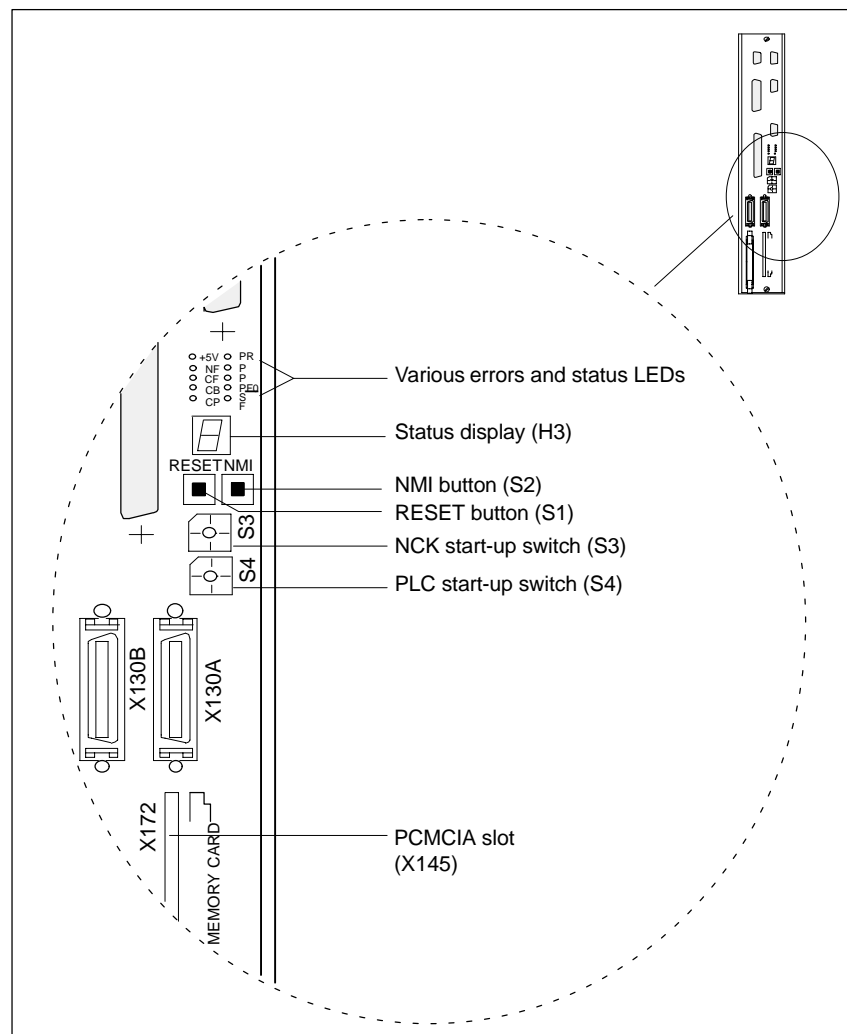
Fig. 5-1   Operator control and display elements of the NCU

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. Please check the supply voltages 230VAC and 24VDC and the shielding and grounding.

Assignments   Please perform and check the assignments of the components MCP, HHU, PLC I/Os as part of the installation procedure.

                         References: /BH/, Operator Components Manual

Power ON   The MCP, HHU and MMC components can be switched on in any desired se-
sequence   quence if they are physically installed.

Power ON   Switch on the power supply on all components and on the mains supply mod-ule. No enabling signals need be present initially on the mains supply module. However, the LEDs on the mains supply module may not indicate any errors/faults in the power supply. There are no enabling signals on the MMC modules, booting starts immediately.

                         Danger

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

5.2.2   Booting

                         When the power is switched on the control boots. The system software is stored on a PCMCIA card on delivery (see Fig. 5-1 for PCMCIA slot, page 5-76).

                         Note

                         Booting takes longer than for a standard configuration if modules via L2-DP and certain FM and CP modules are used.

NC general RESET   To bring the control system into a defined initial state, initialization (NC general RESET) is required when the power is first connected. To execute an NCK RE-SET, place turn start-up switch S3 on the NCU to position 1 and switch on the control. The control then boots, the SRAM memory is erased and the machine data are preset to the default values.

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Table 5-1   Meaning of NC start-up switch S3
                 (see Fig. 5-1, page 5-76)

Setting	Meaning
0	**Normal mode:** The control boots with the set data.
1	**Start-up mode:** The data in the buffered RAM (SRAM) are erased and standard (default) machine data loaded.
2–7	Reserved

**End of
NC booting**

When the NCK has booted correctly, the digit "6" is output on the status display of the NCU. The "+5V" and "SF" (SINUMERIK READY) LEDs light up.
Now switch the NC start-up switch S3 back to the "0" setting.

**Booting via
HMMI/MMC**

NC booting can also be initiated via the soft key "NC RESET" in the Diagnostics operating area (corresponds to position 0 on start-up switch S3). The message "Start-up successful" appears in the status line.

**PLC general
RESET**

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

1. Using the programming device with SIMATIC STEP 7

2. By means of the PLC start-up switch S4 on the NCU module.

Table 5-2   Settings with the PLC start-up switch S4
                 (see Fig. 5-1, page 5-76)

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 device.
2	**PLC STOP:** STOP state.
3	**MRES:** A module RESET (general RESET function) can be executed with the switch in this setting.

Note

On initial start-up, module replacement, battery failure, RESET request by the PLC and PLC operating system upgrade, a general RESET is **mandatory**:

1. Switch PLC start-up switch S4 to position "3".

2. Switch NC start-up switch S3 to position "1" (this resets the DRAM between the NC and PLC).

3. Perform power ON or hardware RESET.

4. Perform a PLC general RESET.

Operation for PLC restart

The following operation initiates a PLC RESTART:

- Turn PLC start-up switch S4 from position "2" (STOP state) to position "1" or "0" (RUN state).

- Perform power ON or hardware RESET.

Operation for PLC general RESET

Perform the following operating steps with PLC start-up switch S4 to generate a general RESET of the PLC:

1. Turn switch to setting "2" (operating state STOP)
   ⇒PS LED lights up.

2. Turn switch to setting "3" (MRES state, request general RESET) and hold in this position (approx. 3 seconds) until PS STOP LED lights up again
   ⇒PS LED goes out and lights up again.

3. Within three seconds, turn switch to settings
   STOP-MRES-STOP ("2"-"3"-"2")
   ⇒PS LED flashes first at a frequency of approx. 2Hz and then displays a continuous light again
   ⇒PF LED lights up.

4. After PS and PF LEDs light up, turn switch S4 to setting "0"
   ⇒PS and PF LEDs go out and LED PR (green) lights up
   ⇒The PLC program memory is now erased, PLC is operating in cyclic mode.

Note

If a hardware RESET or POWER ON is triggered in position "3" on PLC start-up switch S4, the entire SRAM of the PLC is initialized, the diagnostics buffer is not erased. All user data must be loaded again.

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

References: /S7H/, SIMATIC STEP 7-300

5.2.3   Boot PCU 20 / PCU 50

Boot PCU   When the power supply is switched on, the PCU boots automatically. The sys-
                           tem software is installed in the factory and is ready to run. The basic display
                           appears on the screen if the MMC has booted successfully.

Problems with   **PCU 20**
booting   If the PCU 20 cannot make a connection with the NC, the message: "wait for
                           NCU-connection:"x" seconds", "x" = 1 to 60 appears. If a connection has still not
                           been established after this time, then rebooting takes place soon after. Check
                           the following:

- Is the NCU module ready to operate
  (digit "6" on status display)?

- Is the MPI cable inserted, is cable attached properly to connector?

- Are other MPI nodes (MSTT, BHG,...) interfering with MPI communication.
  (open links for testing)

- If the RESET button of the NCU was pressed again during boot (e.g. as per-
  formed during a software upgrade [position 1 / general PLC RESET]), the
  control system must be switched off and on again before the PCU can be
  booted successfully.

PCU 50
If the PCU 50 does not boot (screen remains dark), the 24VDC power supply
must be checked. If the power supply is present at the power unit on the PCU
50 and the seven-segment display on the rear panel does not light up, then the
PCU 50 is defective.

If the PCU 50 boots, but cannot establish a link to the NC, then "Communication
to NC failed" is displayed in the message line at the bottom.In this case, please
check the following:

- Is the NCU module ready to operate (digit "6" on status display)?

- Is the MPI cable inserted, is cable attached properly to connector?

- Is the baud rate in the **Start-up/HMI/operator panel front** menu set cor-
  rectly? It must be set to 187,5 baud (password for protection level 2 re-
  quired).

- Are other MPI nodes (MSTT, BHG,...) interfering with MPI communication.
  (open links for testing).

5.2.4   Boot MMC

MMC 100/102/103 boot

When the power supply is switched on, the MMC boots 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 booted successfully.

Problems with booting

MMC 100

If the MMC 100 does not establish a link with the NC, the message: "wait for NCU-connection:"x" seconds", "x" = 1 to 60 will appear. If a connection has still not been established after this time, then rebooting takes place soon after. Check the following:

- Is the SINUMERIK 840D (NCU module) ready to operate (digit "6" on status display)?

- Is the MPI cable inserted, is cable attached properly to connector?

- If the RESET button of the NCU was pressed again during boot (e.g. as performed during a software upgrade [position 1 / general PLC RESET]), the control system must be switched off and on again before the MMC can be booted successfully.

MMC 103

If the MMC 102/103 does not boot (screen remains dark), the 24VDC power supply must be checked. If the power supply is present at the power unit on the MMC 102/103 and the seven-segment status display on the rear panel does not light up, then the MMC 102/103 module is defective.

If the MMC 102/103 boots, but cannot establish a link to the NC, then "Communication to NC failed" is displayed in the message line at the bottom.In this case, please check the following:

- Is the 840D (NCU module) ready for operation (digit "6" on status display)?

- Is the MPI cable inserted, is cable attached properly to connector?

- Is the baud rate in the **Start-up/MMC/operator panel front** menu set correctly? It must be set to 1.5 Mbaud (password for protection level 2 required).

Note

MMC 103
An 8 is displayed after a successful boot.
The decimal point lights up during hard disk access operations.

5.2.5 Error during control boot (NC)

Status display H3 (7-segment display) Various status messages are output via status display H3 (see Fig. 5-1, page 5-76) during boot. The digit "6" is output when the control has finished booting.

Problems during NC boot If the digit "6" is not output after approximately two minutes, but:

• another number appears,

• the display remains dark,

• the display flashes,

then proceed as follows:

1. Repeat the NC general RESET process.

2. Switch S3 (NCU) must be reset to "0".

3. If the NC general RESET does not work, replace the PCMCIA card.

4. If none of these measures work, the NCU module must be replaced.

PLC status displays The following LEDs are located on the front plate of the NCU module (see Fig. 5-1, Page 5-76). They display the PLC operating states:
PR PLC RUN (green)
PS PLC STOP (red)
PF PLC watchdog (red)
PFO PLC FORCE (yellow)
– PROFIBUS (yellow)

PR and PS LEDs

Table 5-3   Statuses displayed by PR and PS LEDs

PR LED	lights up	OFF	flashes at 0.5Hz	flashes at 2Hz	OFF	OFF
PS LED	OFF	lights up	lights up	lights up	– lights up – off for 3 secs. – lights up	– lights up – flashes at 2Hz (min. 3 secs.) – lights up
Meaning	RUN	STOP	HALT	RE-START	general RESET requested	general RESET in progress

5-82   SINUMERIK 840D Installation and Start-Up Guide (IAD) – 11.02 Edition

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:
"Halts" the PLC user program (initiated by test function).
RESTART:
The control is started (transition from STOP to RUN state). If the start process is aborted, the control switches back to the STOP state.

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

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

PROFIBUS LED   The PROFIBUS LED is the BUSF LED on the SIMATIC CPU 315-DP.
                          For a description, please consult the Hardware and Installation Manual.

Note

If all four LEDs on the status display flash simultaneously after the NCU hardware has been replaced, then another NC boot must be initiated. A PLC general RESET can then be executed if required.

5.2.6   Machine control panel (MCP) boot

SW version   The SW version installed on the MCP can be displayed via the LEDs on the MCP by pressing the "Feed start" and "Feed stop" keys during boot (MCP flashes).

                          The SW version is indicated by three digits:
                          Example: SW V01_02_03
                                        – one LED lights up in the left-hand LED block
                                        – two LEDs light up in the center LED block
                                        – three LEDs light up in the right-hand LED block.

                          This display indicates that the system software on the MCP has booted correctly and is waiting for control messages from the PLC.

5.2.7   Drive system boot

Boot   After an NC general RESET the drives are deactivated. No data records (so-called boot files) are available for the drives. The "SF" LEDs on the NCU module and the 611D closed-loop control module (if installed) light up.

Start-up tool   The drives must be configured and parameterized with the SIMODRIVE 611D start-up tool.

Note

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

5.2.8   MMC 103 BIOS setup

The defaults in the BIOS of the MMC 102/103 can be displayed directly on the screen during boot by selecting key combination

"CTRL+ALT+ESC"

Note

The BIOS setup settings are described in

References: /BH/, Operator Components Manual

■

Parameterization of Control System

6

■

6.1   Machine and setting data

Parameterization   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 front

- 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   For enabling options. The option data are included in the scope of delivery of
                    the option concerned.

Overview of machine and setting data   The machine and setting data are classified as follows:

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 front
from 10000 to 18999	General machine data
from 19000 to 19999	Reserved
from 20000 to 28999	Channel-specific machine data
from 29000 to 29999	Reserved
from 30000 to 38999	Axis-specific machine data
from 39000 to 39999	Reserved
from 41000 to 41999	General setting data
from 42000 to 42999	Channel-specific data
from 43000 to 43999	Axis-specific setting data
from 51000 to 61999	General machine data for compile cycles
from 62000 to 62999	Channel-specific machine data for compile cycles
from 63000 to 63999	Axis-specific machine data for compile cycles

References: **/**LIS/, Lists

**Entering
machine data**

Appropriate displays are provided for the entry of machine data. How to select
displays:
Select "Area switchover" key on the MMC. The menu with the areas Machine,
Parameters, Program, Services, Diagnosis and Start-up is then displayed. Se-
lect "Start-up" and then "Machine data".

Note

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

**Bit editor for HEX
machine data**

A bit editor has been implemented to make it easier to set certain machine data
bits. If the input cursor is positioned on a machine data in HEX format in the MD
list, you can call up the editor by pressing the toggle key.

Note

The bit editor for HEX machine data is available only in conjunction with MMC
102/103 and with SW 4.1 and higher.
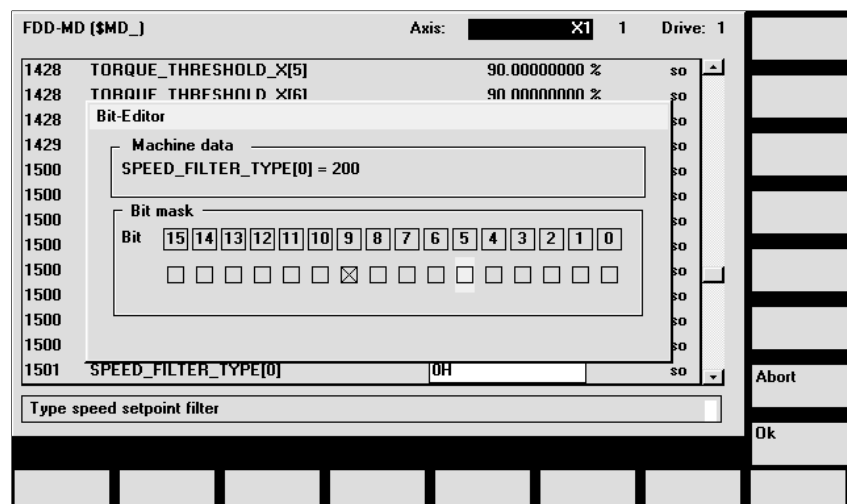
Fig. 6-1   Input screen form of the bit editor for HEX machine data

You can set or reset single bits by clicking them with the mouse or by selecting
them with the cursor keys by pressing the toggle key.

- You can terminate the bit editor and accept the value set with the soft key
  OK.

- With the soft key **Cancel**, you can terminate the bit editor and reject the
  value set. The previous setting is then valid again.

6.2   Handling machine and setting data

Number and identifier

MDs and SDs are addressed by number or by name (identifier). The number and name are displayed on the MMC. The following must also be taken into account:

- Active

- Protection level

- Unit

- Default value

- Value range.

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" soft key on MMC
                    – "RESET" key on MCP
                      Changes at block ends in program mode

- 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:
SCALING_FACTOR_USER_DEF_MASK,
SCALING_FACTOR_USER_DEF and
SCALING_SYSTEM IS METRIC = 1.

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 MMC, the value is limited to ten 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 "∗∗∗".

6.3   Protection level concept

Protection levels

Protection levels for enabling data areas are implemented in the SINUM-
ERIK 840D. There are protection levels 0 to 7;
     0 is the highest and
     7 is the lowest. Protection levels

*   0 to 3 are disabled by means of a password and

*   4 to 7 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 are assigned various protection lev-
els as standard.

Protection level 4 (keyswitch position 3) and higher is required to display ma-
chine 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, refer to
References: **/**BA/ Operator's Guide
                     /FB/ A2, Various Interface Signals

Table 6-2   Protection level concept

Protection level	Locked by	Area
0	Password	Siemens
1	Password: SUNRISE (default)	Machine manufacturer
2	Password: EVENING (default)	Installation engineer, service
3	Password: CUSTOMER (default)	End user
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 ac-
tivation (not recommended). If, for example, the passwords have been forgot-
ten, then the system must be reinitialized (NCK general RESET). This sets all
passwords back to the standard settings of this software version.

The password remains valid until it is reset with the "delete password" soft key.
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 DB10, DBB56.

Table 6-3   Meaning of keyswitch positions

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

**Redefinition of
protection levels**

The user can change the priority of the protection levels. Only protection levels of a lower priority may be assigned to machine data. Levels of a lower or higher priority may be assigned to setting data.

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 2 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 (parts program or PLC).
Example:
MD 10000 is protected by levels 2 / 7, i.e. protection level 2 (password) must be disabled to write it and protection level 7 to read it. Keyswitch position 3 or higher is required to reach the machine data area.

**Undo protection
level chanes**

If you want to undo protection level changes, you will have to write back the original values.
Example:
%_N_UGUD_DEF   File for global variables
;$PATH=/_N_DEF_DIR
REDEF $MA_CTRLOUT_SEGMENT_NR APR 7 APW 2
              (APR ... read authorization)
REDEF $MA_ENC_SEGMENT_NR APR 0 APW 0
              (APW ... write authorization)
REDEF $SN_JOG_CONT_MODE_LEVELTRIGGRD APR 7 APW 7
M30

6

6.4 Machine data masking filter (SW 4.2 and higher)

6.4.1 Function

If you use the masking filter, you can reduce the number of machine data displayed and adapt it to the user's requirements.

All machine data in the areas

- General machine data

- Channel-specific machine data

- Axis-specific machine data

- Drive machine data (FDD/MSD)

are assigned to certain groups.

You can see to which group a machine data belongs in the
machine data list.
References   /LIS/ Lists

- Each area has its own division into groups

- Each machine data in the areas can be assigned to several groups.

6.4.2 Selecting and setting the machine data masking filters

**Selecting the
list displays**

The filters are selected and activated in a list display that is opened with the
Display options vertical soft key in the relevant machine data areas.

Start-up	CHAN1		Jog	\MPF.DIR AVM.MPF		
Channel reset						Select all
Program aborted					FST	
						Deselect all
Display options						
☒☐ MD display filter active			☒ Index from	0		
☐ Expert mode			to	5		
Display groups						
N01 ☐ Configuration / scaling		N09 ☐ Technology functions				
N02 ☐ Memory configuration		N10 ☐ I/O configuration				
N03 ☐ PLC machine data		N11 ☒ Standard machine				
N04 ☐ Drive control		☐ All others				
N05 ☐ Status data / diagnostics						
N06 ☐ Monitoring functions /limits						
N07 ☐ Auxiliary func.						Abort
N08 ☐ Offsets / compensations						
						OK

Fig. 6-2   Display options screen for setting the masking filter

Display criteria

If the user's access rights (password) are insufficient, the machine data is not displayed. If the access rights are fulfilled, the system checks to see if the masking filters are activated.

Note

You can see to which group a machine data belongs from the machine data list.

Table 6-4   Display criteria

Masking filter active	• Inactive: All machine data are displayed • Active: Checking the group filter

Expert mode	• Inactive: The MD is assigned to expert mode
	  => MD not displayed
	• Active: The MD is assigned to expert mode
	   => MD displayed (note index)

Group filter	• Inactive: The MD is assigned to the group
	  => MD not displayed
	• Active: The MD is assigned to the group
	  => MD displayed (note index)

All others	• Inactive: For MDs not assigned to a group
	  => MD not displayed
	• Active: For MDs not assigned to a group
	  => MD displayed (note index)

Index from to	• Inactive: All subparameters of the MD are displayed • Active: Only the specified subparameters of the MD are displayed

Activating the group filter via checkboxes

The checkboxes are selected with the cursor keys and activated and deactivated with the toggle key.

• If a filter is deactivated (not crossed), the corresponding machine data are not displayed.

• If a filter is activated (crossed), the corresponding machine data are displayed. Please also note the "Index from to" filter.

Note

If the "Index from to" filter is active, please note the following:
If the "first" index (0) only is to be displayed, the settings for the override switch, for example, (MD 12000.1: OVR FACTOR_AX_SPEED) are not visible.

Vertical soft keys

- **Select all** soft key
  The checkboxes of the groups are activated.
  The soft key does not affect the checkboxes of:
  – Filter active
  – Expert mode
  – Index from to
  – All others

- **Deselect all** soft key
  The checkboxes of the groups are deactivated.
  The soft key does not affect the checkboxes of:
  – Filter active
  – Expert mode
  – Index from to
  – All others

- **Cancel** soft key
  – Return to the machine data display.
  – The old filter settings are retained.
  – Any changes are lost.

- **OK** soft key
  – Changed filter settings are stored.
  – The machine data display is reconstructed.
  – The input field is positioned on the current MD again. If the MD has
    been masked the field is positioned on the first MD.

Expert mode

The "Expert mode" setting is intended to simplify initial start-up.
Intended procedure:

- Activate all filters (check).

- Activate Mask filters active (check).

- Deactivate expert mode (do not check).

- Only the machine data required for performing the basic functions are dis-
  played (e.g. proportional gain, RESET time, filter).
  Data such as machine data for adaptation, reference model, etc. are not
  displayed.

**Masking all
machine
data**

If all the machine data of an area are masked by the filter setting, the following
message appears when you select this area:
"With the current access rights and the current filter setting no machine data can
be displayed."
After acknowledgment with the OK soft key an empty machine data window
appears.

6.4.3   Saving the filter settings

Saving

The filter settings are saved area-specifically in the file C:\MMC2\IB.INI. This file must be backed up before an MMC software upgrade and restored after upgrading to retain the settings.

For information about data backup see
Reference   /IAD/ Chapter 11, Data Backup

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6.5   Example of a start-up design concept

Objective

1. Simple series start-up during initial start-up

2. Inclusion of machine options (e.g. rotary tables or 2nd spindle)

3. Shortening of the start-up time

4. Simplification of the machine data handling in user displays for mechanics and technicians making measurements

5. Standardized PLC program for the entire machine series.

Basic machine

The following variations, e.g. for a milling machine with one or two rotary tables or spindles are possible.
Starting from a **basic variation**

*   with three axes (X11,Y11,Z11),

*   magazine axis (B11),

*   spindle (C11)

a series start-up file is generated.

In the declaration of the machine data for this basic machine, all axes that might be present as options are declared in the machine axis data.
This applies to one or two rotary tables (A11,A22) and/or a second spindle (C22).

Because all the machine axes that are possible in the series are declared, all the axis data modules are set up in the PLC (DB 31 – 38).
The axis assignment is the same whatever axes the machine has.
This is necessary for a **standardized PLC program**.

Machine data

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

Machine data files are set up for individual machine options that then only contain the changed machine data.

Example file

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

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

Procedure for initial start-up

1. Read in streamer tape with all machine option files

2. Start series start-up for the basic machine in the Services / Archive area

3. Start series start-up file PLC

4. Start machine option file (e.g. for six axes), NCK RESET

5. Set PLC options in the PLC dialog.

6.5   Example of a start-up design concept

After completion of these steps, the machine is fully functional with the basic
data.
Time required: 1 hour

**Size of the tool
magazine**

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

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

**Axis measurement/
compensation
values**

The remaining steps of initial start-up include measurement of the axes and
entry of the corresponding compensation values (e.g. backlash) by the
mechanic or measuring technician.
To simplify operation, you can create user displays in the "Start-up/machine
data" area.
Examples: "MECHANIK" and "QSK" user displays.

Data backup

After completion of the initial start-up, all the data are saved in a series start-up
file. This file is then specific to the machine that was started up and can be used
later on if it is necessary to put the machine back into the condition in which it
was supplied.
The files in the Services / Archive area for the basic machine and the machine
options are no longer required and must therefore be deleted.

The compensation data (e.g. spindle pitch) also have to be backed up
separately from the Services / Active NC data into the archive area.

The last step in the start-up sequence is to back up all MMC 102/103 data onto
a streamer.

6.6   System data

6.6.1   Basic settings

Control cycle times

The control operates according to the cylce 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	NCU 571	NCU 572	NCU 573
MD 10050: SYSCLOCK_CYCLE_TIME	Basic system clock cycle	= 0.0060 s —> 6 msecs.	= 0.0040 s —> 4 msecs.	= 0.0020 s —> 2 msecs.
MD 10060: POSCTRL_SYSCLOCK_TIME_RATIO	Factor for position control clock cycle	= 1 = 1 ∗ 6 msecs. = 6 msecs.	= 1 = 1 ∗ 4 msecs. = 4 msecs.	= 1 = 1 ∗ 2 msecs. = 2 msecs.
MD 10070: IPO_SYSCLOCK_TIME_RATIO	Factor for interpolator clock cycle	= 4 = 4 * 6 msecs. =24 msecs.	= 4 = 4 * 4 msecs. =16 msecs.	= 4 = 4 * 2 msecs. =8 msecs.

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 is switched over from the 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). The existing data are converted to inches after power ON and displayed. After switchover data must be entered in inches.

Setting MD 10260: CONVERT_SCALING_SYSTEM=1 in SW 5 has made it considerably easier to switch the dimension system over.

- Availability of an MMC soft key in the "MACHINE" operating area for dimension system switchover.
- Automatic conversion of NC active data when dimension system is switched over.
- Data back-up with current dimension system identifier.
- Machine data MD 10240: SCALING_SYSTEM_IS_METRIC becomes active on RESET.
- The dimension system for sag compensation is configured in MD 32711:CEC_SCALING_SYSTEM_METRIC.

The basic programming setting (G70, G71, G700, G710) is switched over on a channel-specific basis in MD 20150: GCODE_RESET_VALUES [12]. In the case of soft key toggling via MMC, the value changes between G700 (inches) and G710 (metric).

In SW 5 and higher, feedrates (inch/min or mm/min) are interpreted in the dimension system in addition to length data in response to G700/G710.

Internal physical quantities

The standard units of the physical quantities of the machine data are as follows:

Physical quantity	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/sec^2	1 inch/sec^2
Angular acceleration	1 rev/sec^2	1 rev/sec^2
Linear jerk	1 mm/sec^3	1 inch/sec^3
Angular jerk	1 rev/sec^3	1 rev/sec^3
Timing	1 sec	1 sec
K_V factor (servo gain)	1/sec	1/sec
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 quantities for input and output

The physical quantities for the input/output of machine and setting data (V24, MMC) can be defined system-wide via MD 10220: (activation of scaling factors) and MD 10230: SCALING_FACTORS_USER_DEF (scaling factors of physical quantities).

If the appropriate activation bit is not set in MD 10220 (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.

Index no.	Physical quantity	Input/output	Internal unit	Scaling factor
0	Linear position	1mm	1mm	1
1	Angular position	1 degree	1 degree	1
2	Linear velocity	1 mm/min	1 mm/sec	0.016666667
3	Angular velocity	1 rev/min	1 degree/sec	6
4	Linear acceleration	1 m/sec^2	1 mm/sec^2	1000
5	Angular acceleration	1 rev/sec^2	1 degree/sec^2	360
6	Linear jerk	1 m/sec^3	1 mm/sec^3	1000
7	Angular jerk	1 rev/sec^3	1 degree/sec^3	360
8	Timer	1 sec	1 sec	1
9	K_V factor	1 m/min∗mm	1/sec	16.66666667
10	Feedrate per revolution	1 mm/rev	1 mm/degree	1/360
11	Linear position (compensation value)	1mm	1mm	1
12	Angular position (compensation value)	1 degree	1 degree	1
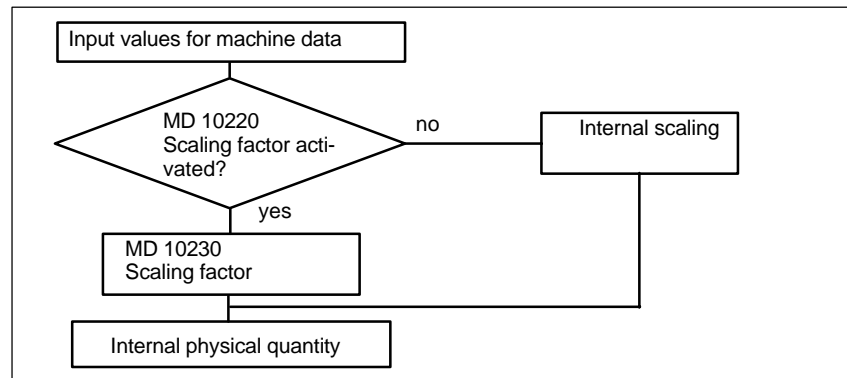
Fig. 6-3   Changing physical quantities

Example

The user wishes to enter the linear velocity in m/min.
The internal physical quantity is mm/s.

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

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 quantities after
input of the new scale and power ON. The new values are displayed on the
MMC and can then be saved.

The unit of the physical quantities for programming in the parts program is
specified in the Programming Guide.

**Internal
calculation
resolutions**

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

The default value for this machine data is "1000". The control thus calculates as
standard in 1/1000 mm or 1/1000 degrees. If greater accuracy is required, only
these two machine data need to be changed. It is useful to enter machine data
in powers of 10 (100, 1000, 10000). If required, rounding (and thus also
falsification) of the internal values can only be achieved with finer 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 front.

**Input and display
limit values**

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

6.7   Memory configuration

Hardware configuration

The following table shows the hardware configuration of the available NC CPUs:

	D-RAM	S-RAM not buffered	S-RAM buffered	FLASH	PCMCIA
NCU 570		1.5MB	0.25MB	2.25MB	
NCU 571	4MB		0.5MB/2.0MB*		4MB
NCU 572	8MB		0.5MB/2.0MB*		4MB
NCU 573	8MB		0.5MB/2.0MB*		4MB
NCU 573.2	8MB		2.0MB		4MB
NCU 573.2	32MB*		2.0MB		4MB

*) available as an option, see Catalog NC 60.1

Memory areas

The memory areas for user data in the NC are preset to suit most user require-ments 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 zones

- Frames.

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

Activation

The MDs for the memory configuration are activated by power ON.

⚠

Caution

Before increasing the DRAM areas (e.g. local user variables, function parameters), check first that there is enough memory available (MD 18050 must be higher than 15000). If more dynamic memory is requested than is available, the SRAM is also erased **without prior warning** the next time the control is powered up and the following user data are lost:
– Drive machine data
– Parts programs
– Memory configuration data
– Configurable memory areas.

References: /FB/, STEP7, Memory Configuration

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6.7.1   Dynamic RAM memory

Set the following machine data:

Table 6-6   MDs for allocating DRAM

MDs for DRAM	Meaning
MD 18242: MM_MAX_SIZE_OF_LUD_VALUE	This data is preset to 8192 bytes for "Cycle 95". It can be reduced to 2048 if Cycle 95 is not in use.
MD 18351: MM_DRAM_FILE_MEM_SIZE	SW 6 and higher: Size of parts program memory in DRAM Also see 12.4.3.
MD 28040: MM_LUD_VALUE_MEM	Memory size for local user variables.You should increase this MD from 25KB (default) to 35–50KB only if you need more than 2048 bytes in MD 18242.

DRAM check   Check the available DRAM memory area in MD 18050. Values of more than 15000 must be displayed. If the value is lower, the memory resources are exhausted and there is a risk that user data will be lost if more DRAM memory space is allocated.

6.7.2   Static RAM memory

Set the following machine data:

Table 6-7   MDs for allocating SRAM

MDs for SRAM	Meaning
MD 18120: MM_NUM_GUD_NAMES_NCK	Number of global user data
MD 18130: MM_NUM_GUD_NAMES_CHAN	Number of channel-specific global user variables
MD 18080: MM_TOOL_MANAGEMENT_MASK	Memory allocation for tool management Set the tool management parameters according to the machine requirements. If you are not using the TM function, set MD 18084 and 18086 to "0". This gives you more parts program memory.
MD 18082: MM_NUM_TOOL	Number of tools according to machine
MD 18100: MM_NUM_CUTTING_EDGES_IN_TOA	Number of tool cuttings edges per TOA module according to requirements of end customer
MD 18160: MM_NUM_USER_MACROS	Number of macros
MD 18190: MM_NUM_PROTECT_AREA MD 28200: MM_NUM_PROTECT_AREA_CHAN MD 28210: MM_NUM_PROTECT_AREA_ACTIV	Number of files for machine-related protection zones Number of files for channel-specific protection zones Number of protection zones simultaneously active in one channel
MD 28050: MM_NUM_R-PARAM	Number of R parameters required
MD 28080: MM_NUM_USER_FRAMES	Number of frames required
MD 38000: MM_ENC_COMP_MAX_POINTS	Number of compensation points required

SRAM with 2MB module   If the NCU 571/572/573 with larger memory is used, the memory must be enabled.

- Enter value 1900 in MD 18230: MM_USER_MEM_BUFFERED.

- Make a copy of the series installation file.

- Perform power ON (the memory is reorganized).

- Reload series installation file in the control.

SRAM check   MD 18060 shows how much user memory is still available.

Recommendation:
Values greater than 15000 should be displayed so that data (e.g. tool offsets) can be imported at any time.

Note

Under normal circumstances do not change any of the other memory settings!

Erasure of 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.

Table 6-8   Machine data for memory configuration

MD number	MD name	Meaning
MD 18020	MM_NUM_GUD_NAMES_NCK	Number of global user variables
MD 18030	MM_NUM_GUD_NAMES_CHAN	Number of global user variables
MD 18080	MM_TOOL_MANAGEMENT_MASK	Memory tool management
MD 18082	MM_NUM_TOOL	Number of tools
MD 18084	MM_NUM_MAGAZINE	Number of magazines
MD 18086	MM_NUM_MAGAZINE_LOCATION	Number of magazine locations
MD 18090	MM_NUM_CC_MAGAZINE_PARAM	Number of magazine data
MD 18092	MM_NUM_CC_MAGLOC_PARAM	Number of magazine location data
MD 18094	MM_NUM_CC_TDA_PARAM	Number of tool-specific data
MD 18096	MM_NUM_CC_TOA_PARAM	Number of TOA data
MD 18098	MM_NUM_CC_MON_PARAM	Number of monitoring data
MD 18100	MM_NUM_CUTTING_EDGES_IN_TOA	Tool offsets per TOA module
MD 18110	MM_NUM_TOA_MODULES	Number of TOA modules
MD 18118	MM_NUM_GUD_MODULES	Number of GUD files
MD 18120	MM_NUM_GUD_NAMES_NCK	Number of global user variables
MD 18130	MM_NUM_GUD_NAMES_CHAN	Number of channel-specific user variables
MD 18140	MM_NUM_GUD_NAMES_AXIS	Number of axis-specific user variables
MD 18150	MM_GUD_VALUES_MEM	Memory location for user variables
MD 18160	MM_NUM_USER_MACROS	Number of MACROS
MD 18190	MM_NUM_PROTECT_AREA_NCKC	Number of protection areas
MD 18230	MM_USER_MEM_BUFFERED	User memory in SRAM
MD 18270	MM_NUM_SUBDIR_PER_DIR	Number of subdirectories
MD 18280	MM_NUM_FILES_PER_DIR	Number of files
MD 18290	MM_FILE_HASH_TABLE_SIZE	Hash table size for files in a directory
MD 18300	MM_DIR_HASH_TABLE_SIZE	Hash table size for subdirectories
MD 18310	MM_NUM_DIR_IN_FILESYSTEM	Number of directories in passive file system
MD 18320	MM_NUM_FILES_IN_FILESYSTEM	Number of files in passive file system
MD 18330	MM_CHAR_LENGTH_OF_BLOCK	Max. length of an NC block
MD 18350	MM_USER_FILE_MEM_MINIMUM	Minimum user memory in SRAM
MD 28050	MM_NUM_R_PARAM	Number of channel-specific R parameters
MD 28080	MM_NUM_USER_FRAMES	Number of settable frames
MD 28085	MM_LINK_TOA_UNIT	Allocation of a TO unit to a channel
MD 28200	MM_NUM_PROTECT_AREA_CHAN	Number of files for protection areas
MD 38000	MM_ENC_COMP_MAX_POINTS [n]	Number of interpol. points with interpol. compensation

6.8   Scaling machine data

Scaling machine data

Machine data also include data which define how machine data are scaled with respect to their physical unit (e.g. velocities).

The following machine data refer to scaling:

- MD 10220: SCALING_USER_DEF_MASK (activation of scaling factors)

- MD 10230: SCALING_FACTORS_USER_DEF (scaling factors of physical quantities)

- MD 10240: SCALING_SYSTEM_IS_METRIC (basic system metric)

- MD 10250: SCALING_VALUE_INCH (conversion factor for switchover to INCH system)

- MD 30300: IS_ROT_AX (rotary axis).

When machine data are loaded (via MMC, RS-232 interface, program), they are scaled according to the physical unit which is currently valid. If this data record 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 MDs 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: axis is defined as a rotary axis and contains the following machine data:
$MA_IS_ROT_AX[A1] = 1 (rotary axis)
$MA_MAX_AX_VELO [A1] = 1000 [rev/min] (maximum axis velocity)

When the MD block 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.

Step-by-step loading of machine data

Either

- Change the relevant machine data by hand via the MMC (MD 10220, 10230, 10240, 10250, 30300) followed by NCK ramp-up. After that, read in the MD set via RS-232-C and start an NCK ramp-up, or

- Create an MD set with the standard machine data (MD 10220, 10230, 10240, 10250, 30300). Load this MD set and initiate an NCK ramp-up. After that read in the complete MD set and start an NCK ramp-up, or

● As an alternative to the options listed above, an MD block can also be
loaded twice (via RS-232-C), with an NCK start-up in each case.

Note

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

Standard data   Standard machine data can be loaded in several ways.

● **Set switch S3 to position 1 on NCU module and** initiate **NCK RESET**.

Note

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

● **MD 11200: INIT_MD** (loading standard MD during "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   **Value "0"**
values in MD11200   The stored machine data MD are loaded during the next ramp-up.
                            Value "1"
                            On the next ramp-up, all machine data (with the exception of the memory con-
                            figuring data) are overwritten with default values.
                            Value "2"
                            On the next ramp-up, all MDs that configure the memory are overwritten with
                            default values.
                            Value "4"
                            reserved.

6.9   Axes and spindles

6.9.1   Description of the axis configuration

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

- NCU 571:   **One channel and five axes**.

- NCU 572/573:   **Two channels and eight axes** with simulated setpoint or actual value channel.

Note

On SINUMERIK 840D the following depend on the hardware/software variant
for each channel   up to 12 axes/spindles permissible
per NCU   up to 31 axes or up to 20 spindles permissible
References: /BU/ "Ordering Information", Catalog NC 60

If you are using DMP compact modules, the number of axes in the axis config-
uration with NCU 573.3 is limited to 31 including DMP modules. For example, if
a DMP compact module is used for 31 axis software, 30 axes will be available.

Number of channels

> Two channels are provided on the SINUMERIK 840D.

Machine axes

Machine axes are all axes existing on the machine. They are defined as geom-
etry 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).

Special axes

In contrast to geometry axes, there is no geometric relationship between special
axes such as:
– Rotary axes
– Turret axes
– Position-controlled spindles.

Axis configuration

The axis configuration is defined on three levels:

1. Machine level

2. Channel level

3. Program level.

1. Machine level

MD 10000: AXCONF_MACHAX_NAME_TAB
An axis name is defined here for each machine axis in
MD 10000: AXCONF_MACHAX_NAME_TAB.

Example:

	Turning machine with X, Z, C axis/spindle		**Milling machine** Four axes + spindle/C axis

MD 10000

X1	Z1	C1		

X1	Y1	Z1	A1	C1

Index

0	1	2	3	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

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2. Channel level

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

Turning machine   **Milling machine**

1	2	3	0	0

1	2	3	4	5

- MD 20080: AXCONF_CHANAX_NAME_TAB[0...7]
  This MD defines the names of the axes in the channel. Enter the names of the geometry and auxiliary axes here.

X	Z	C		

X	Y	Z	A	C

3. Program level

- MD 20060: AXCONF_GEOAX_NAME_TAB[0...2]
  This MD specifies the names to be used in the parts programs for the geometry axes (workpiece axes not specific to machine).

X	Y*	Z		

X	Y	Z		

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

- MD 20050: AXCONF_GEOAX_ASSIGN_TAB[0...2]
  Defines the assignment between the geometry axes and the channel axes (MD20070) **without transformation**. (For assignment with an active transformation, please refer to: References: /FB/, K2).

6.9   *Axes and spindles*

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

| 1 | 0 | 2 | | |

| 1 | 2 | 3 | | |

In a program run, 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, axes A and C).

Machine axis no. for channel 1 2 3 4 5	MD 20070: AXCONF_MACHAX_USED Machine axes used in channel AXCONF_MACHAX_USED[0]=1 AXCONF_MACHAX_USED[1]=2 AXCONF_MACHAX_USED[2]=3 AXCONF_MACHAX_USED[3]=4 AXCONF_MACHAX_USED[4]=5
A C Axis name in channel (addition. axes)	MD 20080: AXCONF_CHANAX_NAME_TAB Name of additional axes in channel (for use in parts program) AXCONF_CHANAX_NAME_TAB [0]= AXCONF_CHANAX_NAME_TAB [1]= AXCONF_CHANAX_NAME_TAB [2]= AXCONF_CHANAX_NAME_TAB [3]=A AXCONF_CHANAX_NAME_TAB [4]=C
Assignment of GEO axes	MD 20050: AXCONF_GEOAX_ASSIGN_TAB Assignment of GEO axes to channel axes. AXCONF_GEOAX_ASSIGN_TAB [0]=1 AXCONF_GEOAX_ASSIGN_TAB [1]=2 AXCONF_GEOAX_ASSIGN_TAB [2]=3 X to X, Y to Y, Z to Z
X Y Z GEO axis / A C Additional axes	

Name of GEO axes
MD 20060: AXCONF_GEO_AX_NAME_TAB[0]=X
MD 20060: AXCONF_GEO_AX_NAME_TAB[0]=Y
MD 20060: AXCONF_GEO_AX_NAME_TAB[0]=Z

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

The names defined in MD 10000: AXCONF_MACHAX_NAME_TAB 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.

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6.9.2   Drive configuration (FDD, SLM, MSD)

Note

The drive configuration and start-up of synchronized linear motors (SLM) is described in the next chapter.

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: AX-CONF_MACHAX_NAME_TAB.
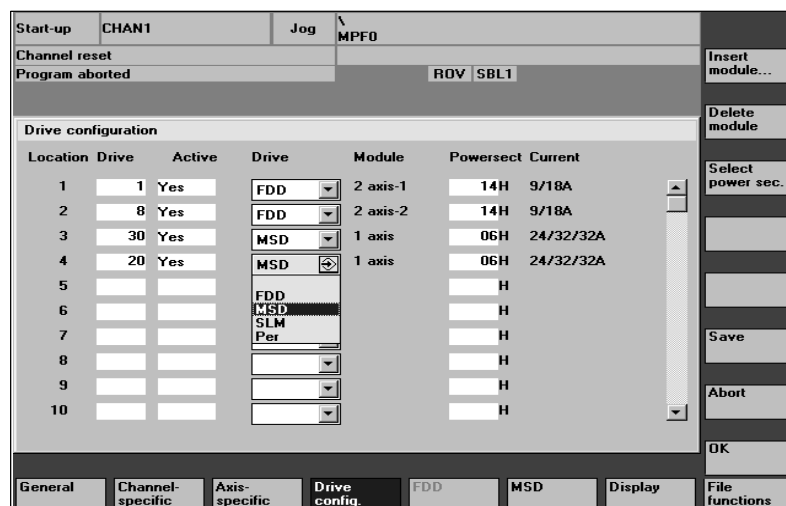
Fig. 6-5   Drive configuration display with MMC 102/103 (SW 4.1 and higher)

Note

The settings made in the display "Drive configuration" are described one by one below.

Setting the drive configuration

The drive configuration settings are entered in the "Drive configuration" display on the operator panel or 611D start-up tool. You can call up this display via the **Machine data** / **Drive configur.** .

• A physical slot number is assigned to each power section.

• If a slot is not used or no power section installed, then it must be coded as passive.

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

Power section selection

Once the drive type has been defined (FDD, SLM, MSD) the corresponding power section is selected by:

– Direct entry of the power section code (e.g. from Table 6-9)

– Selection from the power section list defined for the control (MLFB numbers) with the **Power section selection...** vertical soft key, selection of the power section with the cursor keys, confirmation with the **OK** soft key which then automatically takes you back to the configuration display.

Precondition: The cursor must be positioned in the line of the relevant slot.

Table 6-9   Assignment of drive/power section/power section code

Drive type	Amperage	Power section	Code
MSD	3 / 3 / 3A	8A	01
MSD	5 / 5 / 8A	15A	02
MSD	8 / 10 / 16A	25A	04
MSD	24 / 32 / 32A	50A	06
MSD	30 / 40 / 51A	80A	07
MSD	45 / 60 / 76A	108A	0D
MSD	45 / 60 / 76A	120A	08
MSD	60 / 80 / 102A	160A	09
MSD	85 / 110 / 127A	200A	A0
MSD	120 / 150 / 193A	300A	0B
MSD	200 / 250 / 257A	400A	0C
FDD	3 / 6A	8A	11
FDD	5 / 10A	15A	12
FDD	9 / 18A	25A	14
FDD	18 / 36A	50A	16
FDD	28 / 56A	80A	17
FDD	56 / 112A	160A	19
FDD	70 / 140A	200A	1A
FDD	140 / 210A	400A	1C

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Example 1 of a machine

SINUMERIK 840D with three axes and one spindle
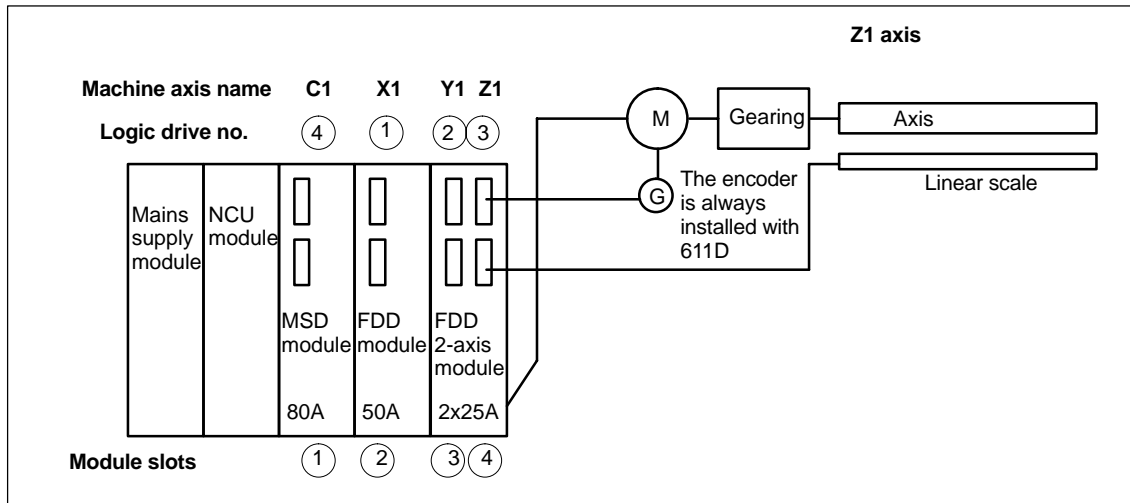
Fig. 6-6   Example 1 of a SINUMERIK 840D with three axes and one spindle

Table 6-10   Data for example shown in diagram above

Slot	Power section module	Drive	Log. drive no.	Direct measuring system	Position measuring system 1	Position measuring system 2
1	80A	MSD	4	no	Motor encoder	no
2	50A	FDD	1	no	Motor encoder	no
3	25A	FDD	2	no	Motor encoder	no
4	25A	FDD	3	yes	Linear scale	no
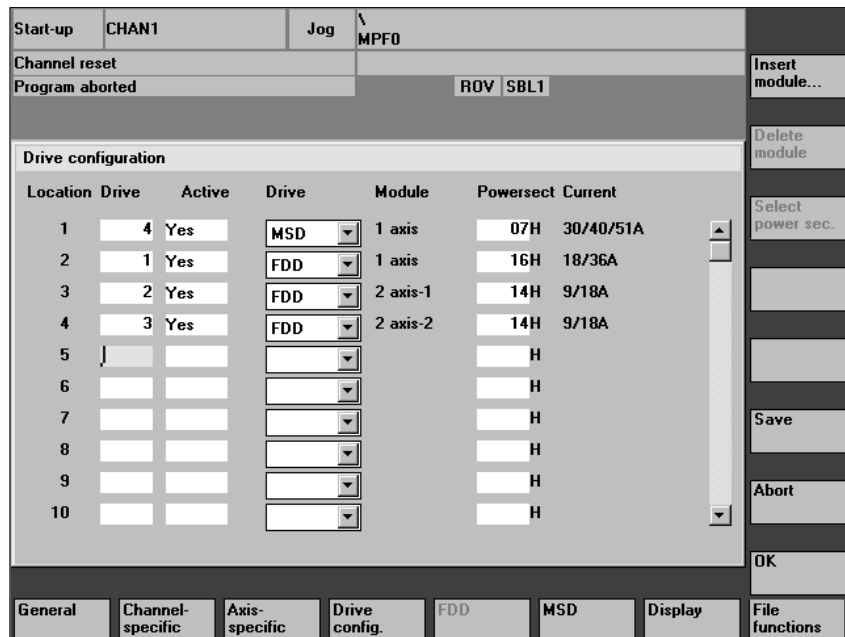
Fig. 6-7   Drive configuration

6.9.3   Setting the axis-specific setpoint/actual value parameters

Assignment of setpoint/actual value channels

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

The motor measuring system (X411) is always used for the speed control function. The table below shows the fixed assignment between the motor connections and motor measuring system connections:
The motor and motor measuring system must always be connected to the same module.

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

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

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Note

Each logical drive number may be entered only once in the configuration dis-
play. All activated slots must be assigned to an axis (setpoint channel).
If axes/spindles must stay temporarily inactive during start-up, MD 30240:
ENC_TYPE and MD 30130 CTRLOUT_TYPE must be set to "0" and the as-
signed power section slot declared as "passive".

The default setting for MD 30100: CTRLOUT_SEGMENT_NR=1, MD 30210:
CTRLOUT_SEGMENT_NR=1 and MD 30210: ENC_SEGMENT_NR =1 must
not be changed.

It is possible to select whether or not the interface signals of a simulation axis
are output at the PLC interface (e.g. during program test if no drive hardware is
installed) via MD 30350: SIMU_AX_VDI_OUTPUT.

Restart

Once the drive configuration and setpoint/actual value assignment have been
entered, an NCK RESET must be executed to initiate a control RESET to make
the set configuration operative.

The message "Start-up required" requesting parameterization of the drive data
is output for all activated drives.

6.9.4   Drive parameterization (FDD, MSD)

**Drive
parameterization**

A motor type must be specified for all drives via the operator panel or SIMO-DRIVE 611 start-up tool in the "Machine data FDD" or "Machine data MSD" menu (see vertical soft key bar). The selection is made by picking the motor MLFB from a list (1FT6☐☐☐–☐☐☐☐, 1FT7☐☐☐–☐☐☐☐, 1PH☐☐☐–☐☐☐☐ see rating plate).

- With FDDs, only the selection of motor 1 is visible.

- For MSD, the selection of motor 1 and motor 2 is visible (e.g. for Y/Δ switchover), with Performance 2 control, 4 motor data sets are offered.
  To avoid incorrect parameterization for MSD, the **OK** soft key remains disabled until a valid motor or unlisted (non-Siemens) motor has been selected for motor 1.

- After you have selected the motor and confirmed with the **OK** soft key, a menu for entering the encoder data is displayed.

- When you select the motor type the most important control data are preset.

Display "Measuring system data" appears when you acknowledge the "Motor selection" display.
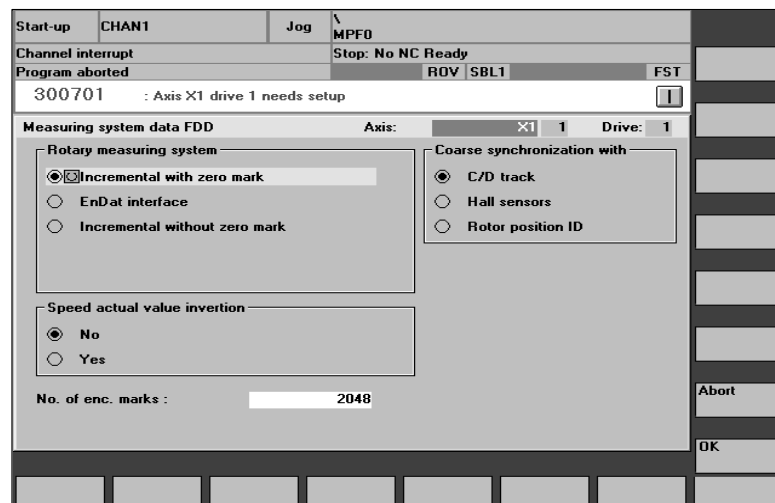
Fig. 6-8   Example of measuring system data for FDD motor selection

The measuring system installed in the motor must be selected in this display, i.e. incremental encoder or absolute encoder with EnDat interface. When you select a measuring system, defaults are automatically assigned to all the other required values. Now acknowledge by pressing "OK".

Example:

- Incremental motor encoder (ERN1387)
  1F□6□□□–□□□□–□A□□
  Incremental with zero mark: You can now accept the display with "OK"
  because the system will correctly preset the other parameters for standard
  motors.

- Absolute motor encoder (EQN1325)
  1F□6□□□–□□□□–□E□□
  EnDat interface: You can now accept the display with "OK" because the sys-
  tem will correctly preset the other parameters for standard motors.

Note

In the case of 1FK6 motors with optical encoders, the torque utilization option is
supported by automatic identification procedures. In this case, traversing mo-
tions < $\pm$5 degrees mechanical are not exceeded. The identification procedure
is performed on every ramp-up.

Non-Siemens motor

If you are using a non-Siemens motor, you must open the menu for entering the
non-Siemens motor data with the **Non-Siemens motor** soft key. After you have
entered the data and returned to the motor selection menu, the entry "Non-
Siemens motor" is automatically displayed in the selection box for motor 1 or
motor 2.

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

After motor selection, the drive data block must be saved for each axis/spindle
by executing "Save boot file". The data block is stored as VSAxx.BOT or
HSAxx.BOT in the user memory (SRAM) of the NC module.

6.9.5   Parameterization of incremental measuring systems

Rotary encoders   The following table lists all the data that you need to enter in order to match a rotary encoder.

Table 6-11   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.

6

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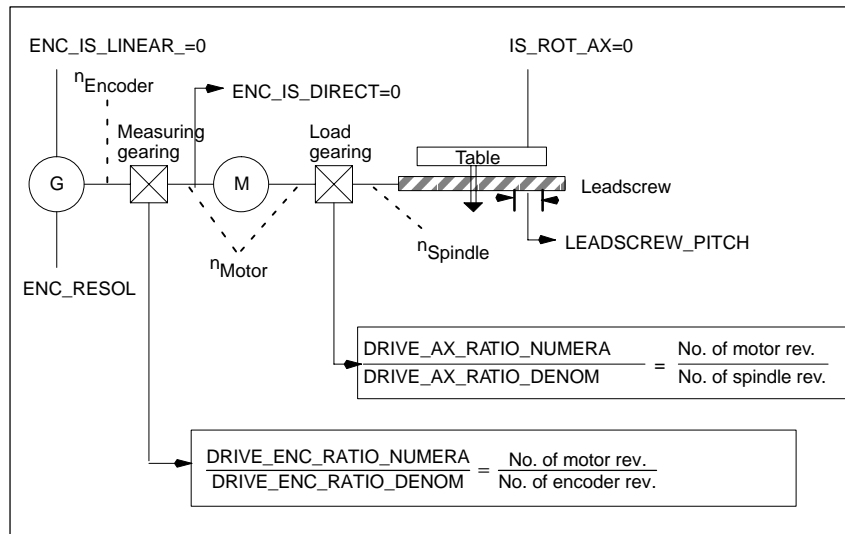
Fig. 6-9   Linear axis with motor-mounted rotary encoder

Linear axis with machine-mounted rotary encoder

$$\frac{\text{DRIVE\_AX\_RATIO\_NUMERA}}{\text{DRIVE\_AX\_RATIO\_DENOM}} = \frac{\text{No. of motor rev.}}{\text{No. of spindle rev.}}$$

ENC_IS_DIRECT=1

IS_ROT_AX=0

Table

Measuring Gearing

ENC_IS_LINEAR_=0

M

Load Gearing

Spindle

ENC_RESOL

LEADSCREW_PITCH

n_{Spindle}

n_{Encoder}

$$\frac{\text{DRIVE\_ENC\_RATIO\_NUMERA}}{\text{DRIVE\_ENC\_RATIO\_DENOM}} = \frac{\text{No. of spindle rev.}}{\text{No. of encoder rev.}}$$
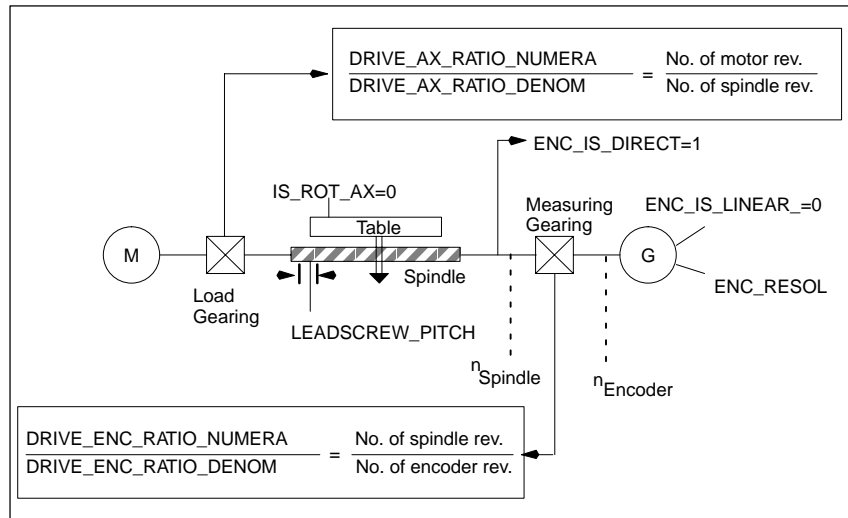
Fig. 6-10   Linear axis with machine-mounted rotary encoder

Rotary axis with motor-mounted rotary encoder

ENC_IS_LINEAR=0

n_{Encoder}

ENC_IS_DIRECT=0

n_{Load}

IS_ROT_AX=1

G

M

L

Rotary table

Measuring Gearing

Load Gearing

ENC_RESOL

n_{Motor}

$$\frac{\text{DRIVE\_AX\_RATIO\_NUMERA}}{\text{DRIVE\_AX\_RATIO\_DENOM}} = \frac{\text{No. of motor rev.}}{\text{No. of load rev.}}$$

$$\frac{\text{DRIVE\_ENC\_RATIO\_NUMERA}}{\text{DRIVE\_ENC\_RATIO\_DENOM}} = \frac{\text{No. of motor revolutions}}{\text{No. of encoder revolutions}}$$
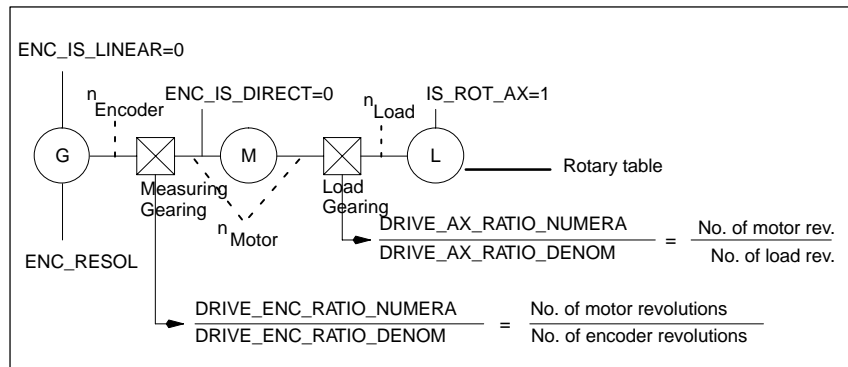
Fig. 6-11   Rotary axis with motor-mounted rotary encoder

Rotary axis with machine-mounted rotary encoder

n_{Load}

Rotary table

ENC_IS_DIRECT=1

n_{Encoder}

ENC_RESOL

ENC_IS_LINEAR_=0

M

L

G

IS_ROT_AX=1

$$\frac{\text{DRIVE\_ENC\_RATIO\_NUMERA}}{\text{DRIVE\_ENC\_RATIO\_DENOM}} = \frac{\text{No. of load rev.}}{\text{No. of encoder rev.}}$$

Load gearing

Measuring gearing

$$\frac{\text{DRIVE\_AX\_RATIO\_NUMERA}}{\text{DRIVE\_AX\_RATIO\_DENOM}} = \frac{\text{No. of motor revolutions}}{\text{No. of load revolutions}}$$
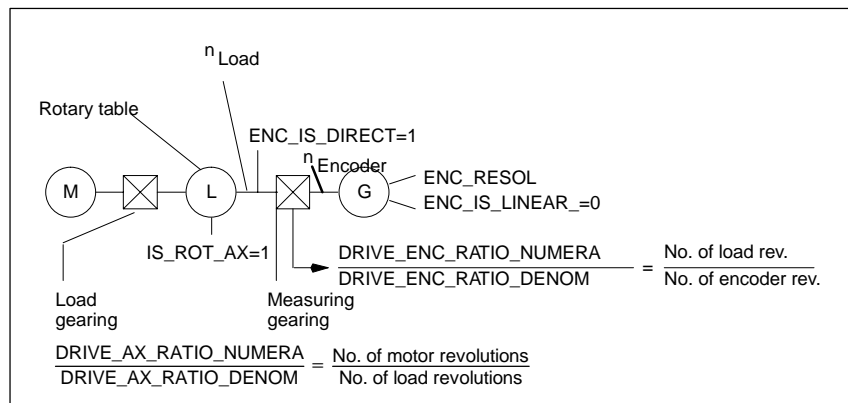
Fig. 6-12   Rotary axis with machine-mounted rotary encoder

Matching encoders with linear measuring systems

The following table lists all the data you need to enter for linear measuring systems.

Table 6-12   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 mounted on motor: 0 Encoder mounted on machine: 1
MD 31010: ENC_GRID_POINT_DIST	Scale graduations
MD 32110: ENC_FEEDBACK_POL	Actual value sign (feedback polarity) [1; -1]
MD 31060: DRIVE_AX_RATIO_NUMERA	Motor revolution
MD 31050: DRIVE_AX_RATIO_DENOM	Spindle revolution

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Linear axis with linear scale
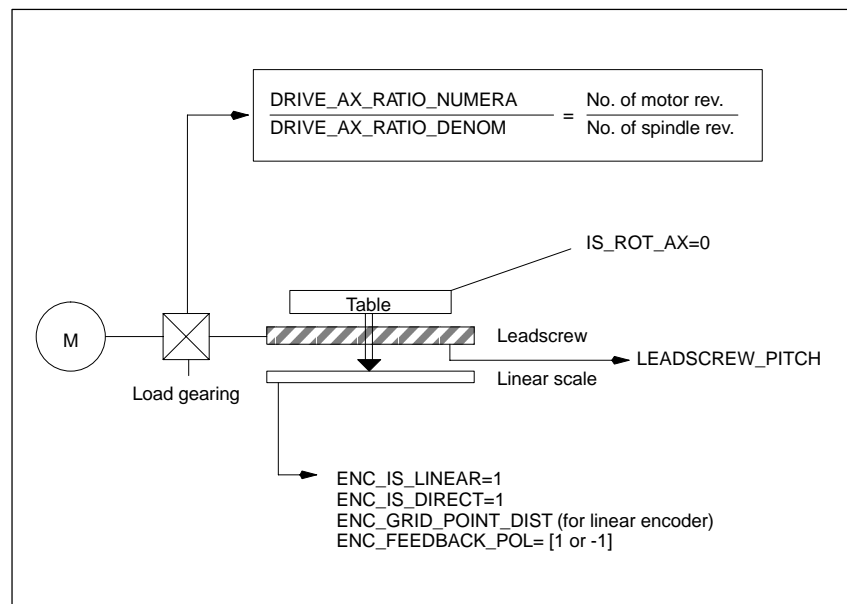
Fig. 6-13   Linear axis with linear scale

6.9.6   Parameterization of absolute measuring systems (EnDat interface)

Precondition   In order to adapt the absolute encoder to the real data of the machine, the encoder must be matched in a similar fashion to a rotary or linear incremental encoder.

The following additional axis machine data must be noted with respect to absolute encoders:

Table 6-13   Axis machine data for absolute encoders

	Rotary absolute encoder		Linear absolute encoder
MD	**Mounted on motor**	**Mounted on machine**	**Mounted on machine**
1005: ENC_RESOL_MOTOR	Marks/rev. (2048 on standard motor)[*]	–	–
1007: ENC_RESOL_DIRECT	–	Marks/rev.	Scale graduations in [nm]
1011: ACTUAL_VALUE_CONFIG	Bit 3 [*]	–	–
1030: ACTUAL_VALUE_CON-FIG_DIRECT	–	Bit 3	Bit 3 + Bit 4
34200: ENC_REEP_MODE [n]: 0...max. no. encoders -1	0	0	0
34220: ENC_ABS_TURNS_MO-DULO [n]: 0...max. no. encoders -1	Multiturn resolution (4096 on standard motor)	Multiturn resolution	–

---

[*] Measuring system parameter has been set automatically after motor selection.

Setting up the absolute encoder   To set up the encoder, the offset between the machine zero and the absolute encoder zero 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: /FB/, R1, "Reference Point Approach"

Readjusting   It is necessary to set 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: If the mechanical connection between the encoder and the load has been separated and an unacceptable deviation remains when the two are joined together again, or

- if data are lost in the NC SRAM, battery voltage failure, PRESET,

- after gear stage changeover between load and absolute encoder the setting in MD 34210: ENC_REFP_STATE is deleted.

Note

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

In the case of "Position back-up after power OFF", setting REFP_STATE=1
merely causes the setting to change to "2" if referencing has already taken
place.

To end this mode, REFP_STATE must be set to 0. This Referenced/Adjusted
state will otherwise remain valid forever, even after REFP_MODE has been
changed and power OFF.

Readjustment of absolute encoder

The following MDs must be noted before the encoder is adjusted:
MD 34200: ENC_REFP_MODE=0 (with absolute encoder: Transfer of
REFP_SET_POS)
MD 34220: ENC_ABS_TURNS_MODULO (required only for rotary axes)

Sequence of operations

1. Set MD 30240: ENC_TYPE=4.

2. Set MD 34200: ENC_REFP_MODE=0.

3. Execute NCK RESET.

4. Move axis to reference position, 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. Set MD 34100: REFP_SET_POS to the actual value of the reference posi-
   tion.

6. Set MD 34210: ENC_REFP_STATE to 1 to activate the adjusted settings.

7. Select the adjusted axis on the MCP and press RESET button on MCP.

8. Select JOG/REF mode, issue feed enabling command for axis.

9. The adjustment process must be initiated with traversing key "+" or "–" ac-
   cording to MD 34010: REFP_CAM_DIR_IS_MINUS and the direction of ap-
   proach 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 neg-
   ative direction. In this case, the "–" key on the MCP must also be pressed.

Rotary absolute encoder with wide traversing range

EQN 1325 type encoders 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 linear axis with an effective spindle lead of 10mm, a traversing range of 40.96m is covered.

Note

In SW 4 and higher the traversing range is identical with that of incremental encoders.

The user must ensure that when the encoder is switched off (power OFF/ON, parking), the axis is moved by less than half the clearly representable absolute encoder number range.

In this case, the software can reconstruct the new position by shortest-path detection.

Otherwise position movements when the encoder is active is possible across the whole traversing range without any limitations.

Limitations with rotary axes

The following limitations apply to endlessly turning rotary axes with absolute encoders:

- When the encoder is installed on the load, the load-sided actual value can be processed only as modulo 1, 2, 4, 8, 16, ..., 4096 revolutions (only powers of 2 are allowed).

- When the encoder is installed on the motor, the gearbox ratio with respect to the load must be n:1 (n motor revolutions to 1 load revolution). For n also, only powers of 2 are allowed.

For normal applications (encoder 1:1 on the load) there are no limitations for endlessly turning rotary axes.

Note

The limitations described above are eliminated in SW 4 and higher.

Any transmission ratios are permitted, the numerator and denominator must be integers; the overrun compensation required for this is performed by the software.

NC RESET

After you have entered and stored all drive data sets, you must perform an NCK RESET. The SF LED then goes out and the drives can be traversed after PLC start-up (presetting of speed controller).

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

6.9.7   Overview of drive optimization parameters

Use the following parameters to optimize the drive (see also Chapter 10):

Table 6-14   Speed controller settings

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

Table 6-15   Field weakening with MSD

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

Table 6-16   Current setpoint filter

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

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6.9 Axes and spindles

Table 6-17 Speed setpoint filter

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

Table 6-18 Major 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	FDD/MSD
1239	TORQUE_LIMIT_FOR_SETUP[DRx]	Torque limit for setup mode	FDD/MSD
1235	POWER_LIMIT_1[0...7,DRx]	1st power limit value	FDD/MSD
1237	POWER_LIMIT_GENERATOR[DRx]	Maximum generator output	FDD/MSD
1105	MOTOR_MAX_CURRENT_REDUCTION[DRx]	Reduction in max. motor current	FDD
1238	CURRENT_LIMIT[DRx]	Current limit value	MSD
1605	SPEEDCTRL_LIMIT_TIME[DRx]	Timer n controller at limit	FDD/MSD
1606	SPEEDCTRL_LIMIT_THRESHOLD[DRx]	Threshold n controller at limit	FDD/MSD
1405	MOTOR_SPEED_LIMIT[0...7,DRx]	Motor monitoring speed	FDD/MSD
1420	MOTOR_MAX_SPEED_SETUP[DRx]	Max. motor speed setting-up mode	FDD/MSD
1147	SPEED_LIMIT[DRx]	Speed limitation	FDD/MSD

Table 6-19 The most important messages

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

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Speed control loop

Function generator
for FFT analysis

n_set

PT1:
1500 NUM_SPEED_FILTERS
1502 SPEED_FILTER_1_TIME

**Speed
setpoint filter**   611D /CCU3: 2 items

1503 SPEED_FILTER_2_TIME

**611D /CCU3
2nd speed setpoint filter
with low-pass and bandstop filter**

611D / CCU3:
Speed setpoint feedforward

1405 MOTOR_SPEED_LIMIT

**Speed setpoint
limitation**

Actual speed monitoring
nact > MD 1147 SPEED_LIMIT
=> Torque setpoint limitation = 0

Setup mode
1420 MOTOR_MAX_SPEED_SETUP

**Speed controller
RESET time**

1409 SPEEDCTRL_INTEGRATOR_TIME_1
1413 SPEEDCTRL_ADAPT_ENABLE
1410 SPEEDCTRL_INTEGRATOR_TIME_2
1411 SPEEDCTRL_ADAPT_SPEED_1
1412 SPEEDCTRL_ADAPT_SPEED_2

**Speed controller
P gain**

1407 SPEEDCTRL_GAIN 1[n]
1413 SPEEDCTRL_ADAPT_ENABLE
1408 SPEEDCTRL_GAIN_2[n]
1411 SPEEDCTRL_ADAPT_SPEED_1
1412 SPEEDCTRL_ADAPT_SPEED_2

Integrator feedback
1421 SPEEDCTRL_INTEGRATOR_FEEDBK [n]

**611D:
Counterweight/feedforward control
torque**

1725 MAXIMAL_TORQUE_FROM_NC
1230 TORQUE_LIMIT_1
1233 TORQUE_LIMIT_GENERATOR
1235 POWER_LIMIT_1
1237 POWER_LIMIT_GENERATOR
1145 STALL_TORQUE_REDUCTION (MSD)

Torque setpoint limitation

Setup mode
1239 TORQUE_LIMIT_FOR_SETUP

**Torque setpoint
monitoring**

Torque conversion
to cross current

1605 SPEEDCTRL_LIMIT_TIME
n_act <1606 SPEEDCTRL_
              LIMIT_THRESHOLD

PT2:
1208 CURRENT_FILTER_4_FREQUENCY
1209 CURRENT_FILTER_4_DAMPING
Band-stop filter
1219 CURRENT_FILTER_4_SUPPR_FREQ
1220 CURRENT_FILTER_4_BANDWIDTH
1221 CURRENT_FILTER_4_BW_NUM

Filter 4

ALARM: 300608 axis %1, drive %2
speed controller output limited

Current setpoint filter

1200 NUM_CURRENT_FILTERS
1201 CURRENT_FILTER_CONFIG

PT2:
1206 CURRENT_FILTER_3_FREQUENCY
1207 CURRENT_FILTER_3_DAMPING
Band-stop filter
1216 CURRENT_FILTER_3_SUPPR_FREQ
1217 CURRENT_FILTER_3_BANDWIDTH
1218 CURRENT_FILTER_3_BW_NUM

Filter 3

Filter	4 3 2 1	0:= Low pass
Bit	3 2 1 0	1:= Band-stop

PT2:
1204 CURRENT_FILTER_2_FREQUENCY
1205 CURRENT_FILTER_2_DAMPING
Band-stop filter
1213 CURRENT_FILTER_2_SUPPR_FREQ
1214 CURRENT_FILTER_2_BANDWIDTH
1215 CURRENT_FILTER_2_BW_NUM

Filter 2

611D / CCU3:
Filters1–4 in the current
controller

Speed actual value filter PT1:
1522 ACT_SPEED_FILTER_TIME

n_act

iq_set

Fig. 6-14   Speed controller with the most important properties

References: /FBA/ DD2, Speed Control Loop

Note

For details about signals and alarms, please refer to
References: /FBA/ DÜ1, Diagnosis and Monitoring Functions

Note

Changes to the FDD or MSD MD will be retained beyond by an NCK RESET if
"Save boot file(s)" is not performed beforehand.

6.9.8   Axis data

With the SINUMERIK 840D, eight linear axes are active by default (five with the
NCU 571). These are assigned to channel 1 (or 2). The rotary axis and spindle
must be assigned during start-up.

Difference 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 axes MD 30300:
IS_ROT_AX = 0
After conversion to rotary axis, the value 27.77777778 is entered in this MD and
the unit is now rpm.

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.

Concurrent positioning axis

The axis can be defined as a "Concurrent positioning axis" in MD 30450:
IS_CONCURRENT_POS_AX.

References: /FB/ P2, "Positioning Axes"

Parameter sets

In the case of the machine data with the "Control parameter set no." field parameter, 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 Subsection 6.9.2.

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	Default	Spindle in axis mode	As specified by manufacturer
1	Axis interpolates with spindle (G33)	Spindle mode	1st
2	Axis interpolates with spindle (G33)	Spindle mode	2nd
3	Axis interpolates with spindle (G33)	Spindle mode	3rd
4	Axis interpolates with spindle (G33)	Spindle mode	4th
5	Axis interpolates with spindle (G33)	Spindle mode	5th

Fig. 6-15   Validity of parameter sets in axis and spindle modes

MD 31050: DRIVE_AX_RATIO_DENOM (denominator load gearing)
MD 31060: DRIVE_AX_RATIO_NUMERA (numerator load gearing)
MD 32200: POSCTRL_GAIN (K_V factor)
MD 32800: EQUIV_CURRCTRL_TIME (substitute time constant, current control
            loop forfeedforward control)
MD 32810: EQUIV_SPEEDCTRL_TIME (substitute time constant, speed
            control loop for feedforward control)
MD 32910: DYN_MATCH_TIME (dynamic response matching time constant)
MD 36200: AX_VELO_LIMIT (threshold value for speed 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)
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 guarantee that the control boots up reliably, all activated axes are
declared as simulation axes (without hardware) during initialization.
MD 30130: CTRLOUT_TYPE = 0
MD 30240: ENC_TYPE = 0
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 whether the inter-
face 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

The measuring system which is active for the position control is selected via
interface signals.
IS "Position measuring system 1 selected" (DB31, DBX1.5)
IS "Position measuring system 2 selected" (DB31, DBX1.6)
If both signals are set, then the position measuring system 1 is active.

References: /FB/, A2, "Various Interface Signals"

6.9.9   Velocity matching (axis)

Machine data for
velocity matching

The following machine data must be defined:
MD 32000: MAX_AX_VELO (maximum axis velocity)
MD 32010: JOG_VELO_RAPID (conventional rapid traverse)
MD 32020: JOG_VELO (conventional 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 approach velocity)

Note

When new velocity/speed values are entered, the velocity/speed monitor
(MD 36200: AX_VELO_LIMIT) must be matched accordingly.

The motor speed for the axis drives which results in velocity MAX_AX_VELO
(MD 32000) must be entered in MD 1401.

In order to ensure correct setpoint scaling, it is essential to enter the correct load
gearbox data!
MD 31060: DRIVE_AX_RATIO_NUMERA
MD 31050: DRIVE_AX_RATIO_DENOM

6.9.10   Position controller data (axis)

Control loops   The closed-loop control of an axis consists of the speed control loop, the current control loop and a higher level position control loop.
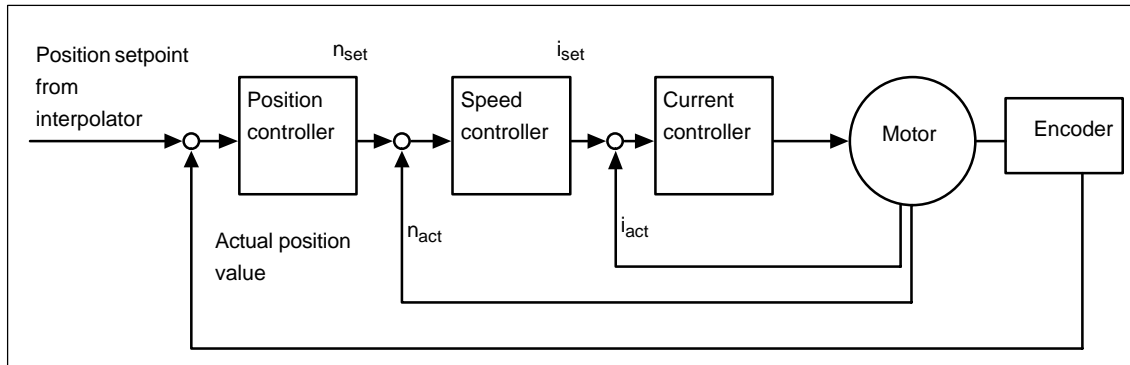
Fig. 6-16   Control loops

Traversing direction   If the axis does not traverse in the desired direction, then an adjustment can be made 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 (K_V factor) of the position controller must be large. However, an excessively high K_V factor causes overshoot, instability and impermissibly high machine loads. The maximum permissible K_V factor is dependent on the design and dynamic response of the drive and the mechanical quality of the machine.

Definition of K_V factor

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

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

The correct scaling of the K_V factor (servo gain) is activated automatically by machine data MD 10220: SCALING_USER_DEF_MASK and the correct physical size considered with MD 10230: SCALING_FACTORS_USER_DE. The loop gain is converted using the formula below:

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

Checking the loop gain

If a K_V factor is already known for the 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.

The K_V factor must also be checked for high speeds of the rotary axis and spindle (e.g. for spindle positioning, tapping).

The servo gain should always be checked.
If it deviates, enter the correct K_V factor, e.g. 16.667, in MD 32200 POSCTRL_GAIN.

Static checking of the K_V factor is performed with the "Service Axis" soft key in the "Service display" menu. The real K_V factor must precisely match that set because monitoring functions are derived from the K_V factor that would otherwise respond (e.g. contour monitoring).

For continuous path control, all axes included in the interpolation must have the same dynamic response.

Note

Axes which interpolate with one another must have the same following error at a given velocity. This can be achieved by setting the same K_V factor or through dynamic response matching via
MD 32900: DYN_MATCH_ENABLE and
MD 32910: DYN_MATCH_TIME.

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

Checking the approach behavior

The approach behavior at various speeds can be checked by means of a storage oscilloscope or the SIMODRIVE 611D/ Start-Up/Drives/Servo/ Servo–Trace. The speed setpoint is recorded for this purpose.
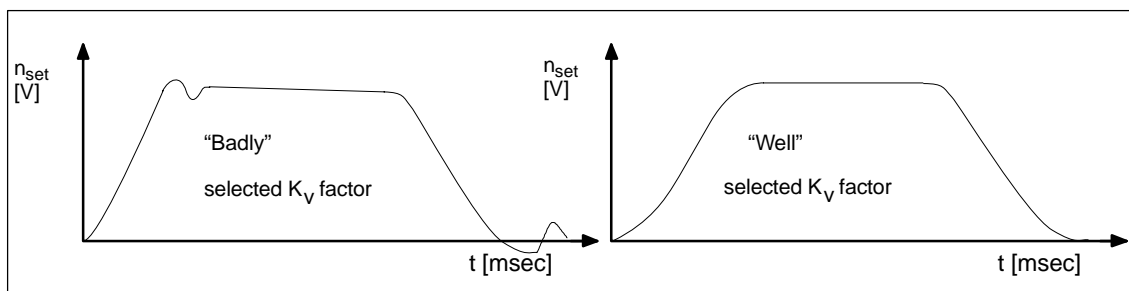
Fig. 6-17   Speed setpoint characteristic

No overshoots may occur while the drive is approaching the static statuses; 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 loop	• Acceleration too high (current limit is reached)
	• Error in speed controller (re-optimization necessary)
	• Mechanical backlash
	• Mechanical components canted.
	For safety reasons set the K_V factor to a little less than the maximum possible value.

6

Acceleration

The axes are accelerated and braked at the acceleration value 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 0.5m/sec^2 to 2m/sec^2 range.

Checking and calculating acceleration values

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

Setting

MD 32300: MAX_AX_ACCEL

Identification

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

Measurement

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

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

Slight load changes during machining must not cause the current limit to be reached. Excessive current during machining causes falsification of the contour. It is therefore advisable in this case as well to enter a slightly lower acceleration value in the MD than the maximum permissible value. Axes can be assigned different acceleration values even if they do interpolate with one another.
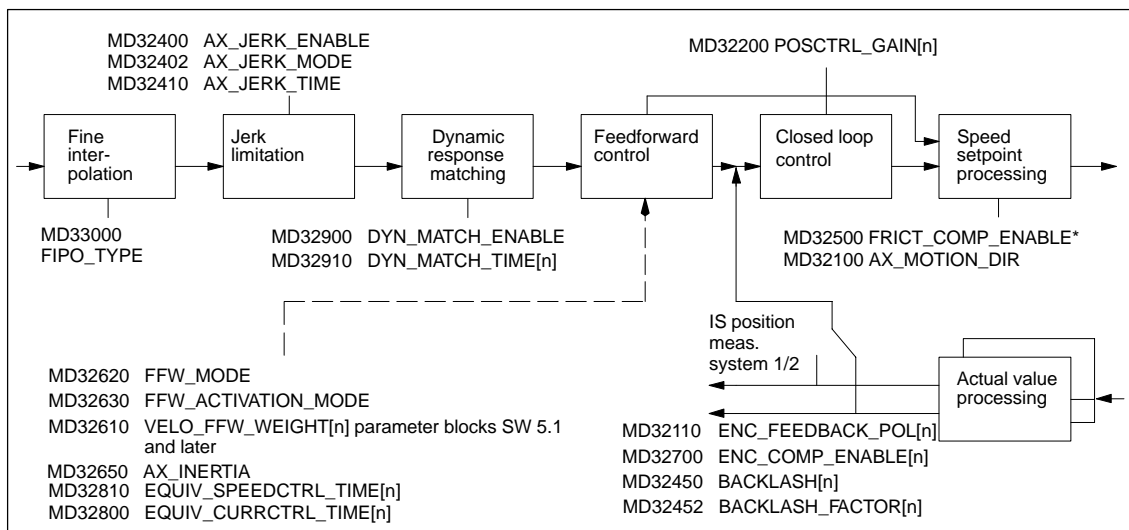
Fig. 6-18   Additional parameters for position control

*Further machine data for friction compensation FRICT... are provided in:
References: /FB/, K3, "Compensation"

SW 5.1 and higher

Control optimization SW 5.0 and higher

The control of an axis can be optimized with respect to the speed control loop, the current control loop and the overlaid position control loop as follows:

Positional deviation control

Positional deviation is controlled on NC side in the position control cycle and shall improve the stability and positioning response of axes with at least two encoders (load and motor encoder) through active vibration absorption.
- The function is activated using MD 32950: POSCTRL_DAMPING ≠ 0 and is available for all controls that use the SIMODRIVE_611 D drives.

Feedforward control

When feedforward control is active for the speed and torque, the position setpoint is sent via a new balancing filter prior to reaching the actual controller to improve the vibration response of the axis. A higher accuracy is achieved at curved contours at the same time.
- Speed feedforward control is activated with MD 32620: FFW_MODE = 3.
- Torque feedforward control is activated with MD 32620: FFW_MODE = 4.

The settings for MD 32620: FFW_MODE = 1 and = 2 are still available and have the same response as before. Improved axis response can be achieved with the new settings MD 32620 = 3 and MD 32620 = 4.

New jerk filter (Positionsetpoint filter)

To produce less machine vibration, it can be advantageous to smooth the position setpoint curves. A new filter type for filter time constants from approx. 20–40 msecs achieves an extensively symmetric smoothing response through mean value and hardly affects the contour accuracy.
- The new jerk filter is activated with MD 32402: AX_JERK_MODE = 2.

For reasons of compatibility, MD 32402: AX_JERK_MODE = 1 is preset. The new filter MD 32402: = 2 is generally recommended for new machines.

Expansion of the parameter block

The following parameter blocks are available for setting the backlash compensation, feedforward control factor, exact stop limit and standstill windows in SW 5.1 and higher:

MD 32450: BACKLASH (backlash compensation)
MD 32610: VELO_FFW_WEIGHT (feedforward control factor)
MD 36000: STOP_LIMIT_COARSE (exact stop coarse)
MD 36010: STOP_LIMIT_FINE (exact stop fine)
MD 36030: STANDSTILL_POS_TOL (standstill window)

Weighting factor

The following machine data are available with suitable weighting factors for the above-mentioned parameter-block-independent machine data:

MD 32452: BACKLASH_FACTOR[n] (backlash compensation) affects:
• MD 32450: BACKLASH (backlash compensation)

MD 36012: STOP_LIMIT_FACTOR[n] (exact stop limit and standstill window) affect:
• MD 36000: STOP_LIMIT_COARSE (exact stop coarse)
   MD 36010: STOP_LIMIT_FINE (exact stop fine)
   MD 36030: STANDSTILL_POS_TOL (standstill window)

Machine data MD 32452: BACKLASH_FACTOR[n] and MD 36012: STOP_LIMIT_FACTOR[n] are preset to the weighting factor [n] = 1.

Example

Effects of various parameter blocks for backlash compensation

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

In parameter block 1 (Index 0) of the first axis (AX1), a backlash compensation factor without he value 1.0 has the following effect:

1.0 * MD 32450: BACKLASH = 0.01mm (or inches or degrees)
2.0 * MD 32450: BACKLASH = 0.02mm (or inches or degrees).

6.9.11   Monitoring functions (axis)

Position monitoring	**Reference:** /FB/, A3, "Axis Monitoring" /FB/, B1, "Continuous-Path Mode", Exact Stop /FB/, G2, "Control", Control Optimization

During positioning, the axis is monitored to check whether the positioning window has been reached (exact stop). It also monitors whether an axis for which no traverse command is pending leaves a certain tolerance window (zero speed monitoring, clamping tolerance).

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

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

MD 36012   STOP_LIMIT_FACTOR[n] (factor for parameter-block-independent analysis of Exact stop fine/coarse and zero-speed monitoring) **in SW 5.1 and higher**
- The ratio of the following three values always remains identical:
  MD 36000: STOP_LIMIT_COARSE
  MD 36010: STOP_LIMIT_FINE
  MD 36030: STANDSTILL_POS_TOL

MD 36020   POSITIONING_TIME (coarse exact stop delay)
- This MD represents the delay after which the actual value must have reached the "Fine exact stop" tolerance window when the setpoint position at the block end is reached.
- If the value does not reach the fine exact stop window within this time, the alarm "25080 axis [name] positioning monitoring" 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 stationary axis may not leave.
- If the axis leaves the tolerance window, the alarm "25040 axis [name] zero speed control" is output. The control switches to follow-up mode.

MD 36040   STANDSTILL_DELAY_TIME (zero speed monitoring delay)
- 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 reached.
- If the position tolerance is not reached within this time, the alarm "25040 axis [name] zero speed monitoring" is generated.

  The control switches to follow-up mode.

MD 36050   CLAMP_POS_TOL (clamping tolerance)
- Position tolerance while the "clamping active" signal is present at the PLC interface. When the tolerance is exceeded, the alarm "26000 axis [name] clamping monitoring" is generated.
- IS "Clamping active" (DB31, ... DBX2.3)
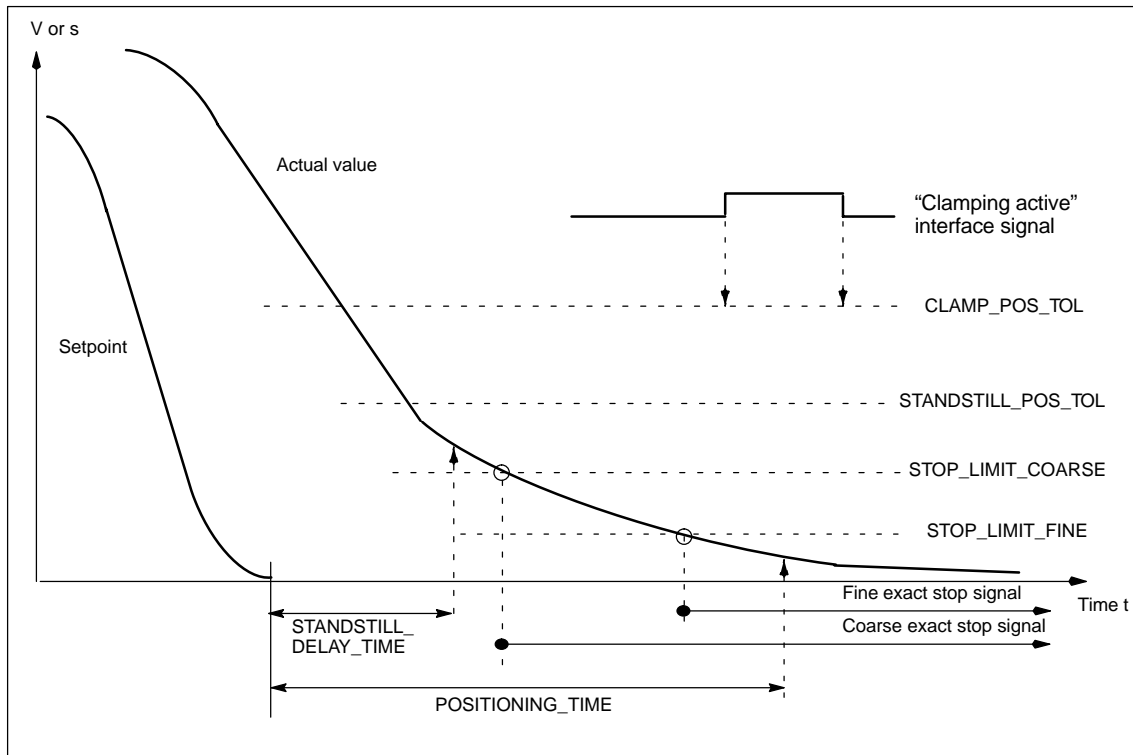
Fig. 6-19   Positioning, zero speed and clamping monitor

Monitoring of positions via hardware limit switch

For each axis, monitoring is possible 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 axes used for interpolation is/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 characteristics are retained)
NST "Hardware limit switch minus" (DB31, ... DBX12.0)
NST "Hardware limit switch plus" (DB31, ... DBX12.1)
Alarm "21614 Kanal [name1] axis [Name2] hardware limit switch plus [+/–]".
The axis must be retracted in the opposite direction in JOG mode.

Monitoring of positions via software limit switch

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

Machine data, interface signals and alarms	MD 36100: POS_LIMIT_MINUS (1st software limit switch minus) MD 36110: POS_LIMIT_PLUS (1st software limit switch plus) MD 36120: POS_LIMIT_MINUS2 (2nd software limit switch minus) MD 36130: POS_LIMIT_PLUS2 (2nd software limit switch plus) 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 limitations	Working area limitations can be specified and activated for geometry axes via setting data or from the parts program (with G25/G26). Monitoring is active after reference point approach.
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 +/–"
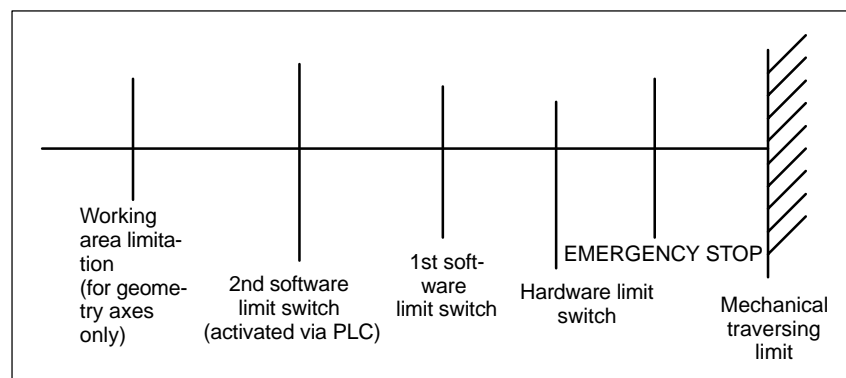
Fig. 6-20   Overview of travel limits

**Dynamic
monitoring**

Velocity limitation

The velocity is adapted internally in the SINUMERIK 840D. The setpoint is limited on a percentage basis in MD 36210: CTRLOUT_LIMIT 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. 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). 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 function is provided to ensure that axes whose velocity is limited in theory owing to the prevailing mechanical conditions (e.g. due to mechanical limit frequency of pulse encoder) traverse correctly. The actual velocity monitoring function is always active if at least one encoder is configured in the axis (MD 30200 NUM_ENCS < > 0) which is lower than 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

The monitoring function is based on the continuous comparison between the measured following error and the following error predicted on the basis of the NC position setpoint. Contour monitoring is always active in position-controlled operation. If the tolerance band is violated, then the "Contour monitoring" alarm 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: ENC_FREQ_LIMIT is monitored. If this is exceeded, the "Encoder frequency exceeded" alarm is output and the axes braked to zero speed. The "Referenced/synchronized" interface signal is reset (DB31, ... DBX60.4, DBX60.5).
Example: Encoder with 2048 pulses mounted directly on motor, limit
frequency 200kHz, $n_{max} = (f_{limit} / pulses) * 60sec = 5900$ 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".

Encoder monitoring (zero mark monitoring)

MD 36310: ENC_ZERO_MONITORING activates the zero mark monitoring function. The value specifies the number of pulses that may be lost.
Special feature:
Value=100, i.e. the HW monitoring for the encoder is also deactivated.

MD 36310: ENC_ZERO_MONITORING (zero mark monitoring)
MD 36610: AX_EMERGENCY_STOP_TIME (braking ramp time in event of faults)
Alarm "25020 axis [name] zero mark monitoring".

Encoder monitoring (encoder switchover tolerance)

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

MD 36500 ENC_CHANGE_TOL (maximum 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".
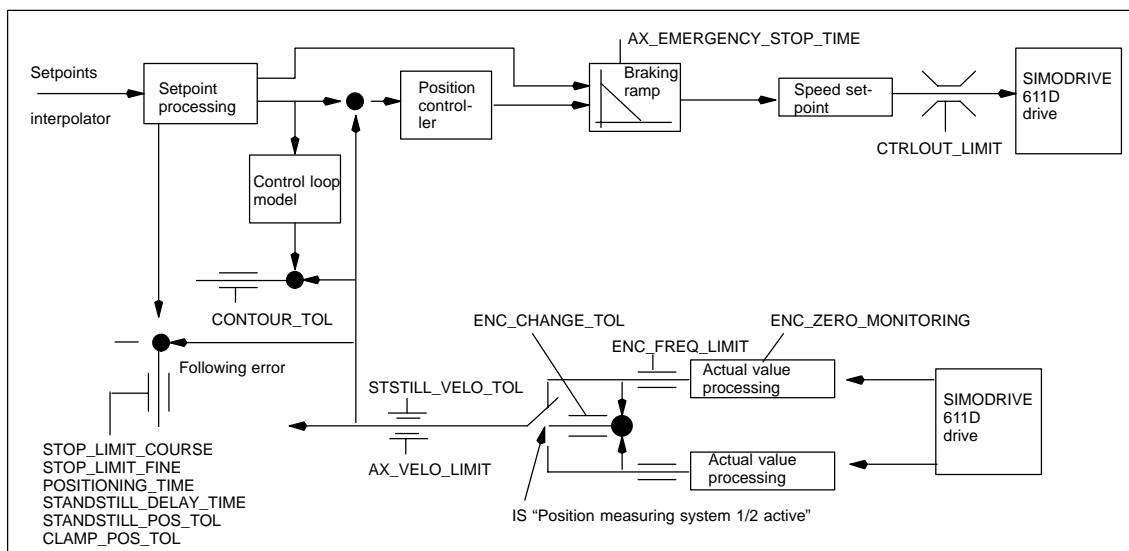
Fig. 6-21   Monitoring with SINUMERIK 840D

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.

6.9.12   Reference point approach (axis)

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 with channel-specific reference point approach) MD 30240: ENC_TYPE (encoder type) MD 34200: ENC_REFP_MODE (referencing mode) IS "Activate referencing" (DB21, ... DBX1.0) IS "Reference active" (DB21, ... DBX33.0)
Reference point approach for incremental measuring systems	The reference point approach for incremental measuring systems is split into three 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 minus direction) MD 34020: REFP_VELO_SEARCH_CAM (reference cam approach velocity) MD 34030: REFP_MAX_CAM_DIST (maximum path to reference cam) IS "Traversing 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 speed) MD 34050: REFP_SEARCH_MARKER_REVERSE (direction reversal to reference cam) MD 34060: REFP_MAX_MARKER_DIST (maximum path from cam to reference mark)
Machine data and interface signals for phase 3	MD 34070: REFP_VELO_POS (reference point approach speed) MD 34080: REFP_MOVE_DIST (reference point distance zero speed) MD 34090: REFP_MOVE_DIST_CORR (additive reference point offset) 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 via power OFF	In SW 4 and higher, it is possible to continue to run a conventional machine tool with the original position information without explicit re-referencing after power ON/OFF. A condition for correct referencing continuation of the axes after power OFF/ON is that the axes concerned have not been moved in the meantime.

When the encoder is switched on, the NC then synchronizes to an internal buffered old absolute value (condition: Set MD 34210: ENC_REFP_STATE=2).

Axis movements are blocked internally until this synchronization is completed. The spindles can continue to turn.

Note

This functionality is permanent linked to the axis signal "Fine exact positioning". Axes or spindles that do not use this signal cannot use this functionality.

Reference point approach with distance-coded reference markers

Referencing of axes with distance-coded reference marks is executed in two phases:
Phase 1:   Synchronize by overriding 2 reference marks
Phase 2:   Traverse to target point

General machine data

MD 34310: ENC_MARKER_INC (differential distance between two reference marks)
MD 34320: ENC_INVERS (inverse measuring system)

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 speed)
MD 34060: REFP_MAX_MARKER_DIST (maximum path between two reference paths)
MD 34300: ENC_REFP_MARKER_DIST (reference mark 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 (target point approach speed)
MD 34090: REFP_MOVE_DIST_CORR (absolute offset)
MD 34330: REFP_STOP_AT_ABS_MARKER (with/without target point)
IS "Referenced/synchronized 1, 2" (DB31, ... DBX60.4, DBX60.5)
MD 34100: REFP_SET_POS (target point), for referencing to target.

Referencing with absolute encoders

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

Note

See Subsection 6.9.6 for details of absolute encoders.

6.9.13   Spindle data

In the SINUMERIK 840D control system, the spindle is a subfunction 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 general RESET.

References: /FB/, S1, "Spindles"

6

Spindle definition

The following machine data are required 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). Entry ofspindle number with which spindle is to be addressed, e.g. "1" means spindle name "S1".

Spindle operating modes

The following spindle operating modes are provided:

- Open-loop control mode (M3, M4, M5)

- Oscillation mode (support for gear changing operations)

- Positioning mode (SPOS, M19 and SPOSA)

- Synchronous mode

- Rigid tapping.

In spindle mode, the feedforward control switches on **as standard (FFW mode = 1)**. Exception: 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 → Parameter set [2]

Axis mode

It is possible to switch directly from spindle mode into axis mode provided that the same drive is used for both modes. The machine data for one axis must be applied in axis operation. In axis mode, the first parameter set (index [0]) is selected irrespective of the current gear 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 spindle initial setting to be defined.
The following are possible:

- Speed control without/with position control

- Positioning mode

- Axis mode.

The time at which the spindle initial setting acts is defined by means of 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

With the following machine data and the field parameter "Gear stage no." and "Control parameter set no." the selected gear stage determines the appropriate field index. The field with **index "0"** is **not** used for the spindle machine data! (See above in this chapter in the "Axis data" section.)

MD 35110: GEAR_STEP_MAX_VELO	(n_{max} for gear stage changeover)
MD 35120: GEAR_STEP_MIN_VELO	(n_{min} for gear stage changeover)
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 35210: GEAR_STEP_POSCTRL_ACCEL	(acceleration in position control mode)
MD 31050: DRIVE_AX_RATIO_DENOM	(denominator load gearing)
MD 31060: DRIVE_AX_RATIO_NUMERA	(numerator load gearing)
MD 32200: POSCTRL_GAIN (K_V factor)	
MD 36200: AX_VELO_LIMIT	(threshold value for speed 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)

6.9.14   Spindle configuration

Machine data for setpoints and actual values

Setpoints: MD 30100: CTRLOUT_SEGMENT_NR
                 MD 30110: CTRLOUT_MODULE_NR
                 MD 30120: CTRLOUT_NR
                 MD 30130: CTROUT_TYPE
Actual values: MD 30210: ENC_SEGMENT_NR
                 MD 30220: ENC_MODULE_NR
                 MD 30230: ENC_INPUT_NR
                 MD 30240: ENC_TYPE

Note

For further information about spindle configuration, see above in this chapter in the "Drive configuration" section.

6

6.9.15   Encoder matching (spindle)

Encoder matching via machine data

For the purpose of matching the spindle encoder, the same machine data apply as for the axis. MD 30300: IS_ROT_AX and MD 30310: IS_ROT_MODULO must always be set for the spindle so that the encoder is always matched to one revolution. IS_ROT_AX and MD 30310: ROT_IS_MODULO 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 referring to 360 degrees, MD 30320: DISPLAY_IS_MODULO must be set. If the motor encoder of the 611D system 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 lines. This multiple is 2048.

Table 6-20   Machine data for encoder matching

Machine data		Spindle	
		Encoder on motor	Encoder on spindle
30300:	IS_ROT_AX	1	1
31000:	ENC_IS_LINEAR	0	0
31040:	ENC_IS_DIRECT	0	1
31020:	ENC_RESOL	Lines/rev.	Lines/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 setpoint calculation. The load revolutions are entered in MD 31050: DRIVE_AX_RATIO_DENOM and the motor revolutions in MD 31060: DRIVE_AX_RATIO_NUMERA.

Example A of encoder matching

Spindle with signal generator (500 pulses) mounted directly on spindle. Internal multiple = 2048. Internal calculation resolution = 1000 increments per degree.

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

$$\text{Internal resolution} = \frac{360 * 1 * 1000}{500 * 2048 * 1} \quad 0.3515$$

The encoder increment corresponds to 0.3515 internal increments. An encoder increment corresponds to 0.003515 degrees (highest possible positioning resolution).

Example B of encoder matching

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

Gear stage 1

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

$$\text{Internal resolution} = \frac{360 \text{ degrees}}{2048 * 2048 \text{ pulses}} * \frac{1}{1} * \frac{1}{2.5} * 1000 \text{ pulses/degree} = 0.034332$$

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

Gear stage 2

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

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

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

6.9.16   Speeds and setpoint adjustment for spindle

Speeds, gear stages

The spindle speed output is implemented in the NC with the SINUMERIK 840D. 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 spindle speeds for conventional operation are entered in 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 adjustment

The speeds for drive control must be transferred to the drive as scaled values. 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 35500:   SPIND_ON_SPEED_AT_IPO_START
            (feedrate enable for spindle in setpoint range)
MD 35450:   SPIND_OSCILL_TIME_CCW (oscillation time for direction M4)
MD 35440:   SPIND_OSCILL_TIME_CW (oscillation time for direction M3)
MD 35430:   SPIND_OSCILL_START_DIR (start direction in oscillation mode)
MD 35410:   SPIND_OSCILL_ACCEL (acceleration in oscillation mode)
MD 35400:   SPIND_OSCILL_DES_VELO (oscillation speed)
MD 35230:   ACCEL_REDUCTION_FACTOR
            (reduced acceleration)
MD 35220:   ACCEL_REDUCTION_SPEED_POINT
            (speed for reduced acceleration)
MD 35200:   GEAR_STEP_SPEEDCTRL_ACCEL
            (acceleration in speed control mode)
MD 35140:   GEAR_STEP_MIN_VELO_LIMIT
            (gear stage minimum speed)
MD 35130:   GEAR_STEP_MAX_VELO_LIMIT
            (gear stage maximum speed)
MD 35120:   GEAR_STEP_MIN_VELO
            (minimum speed for gear stage changeover)
MD 35110:   GEAR_STEP_MAX_VELO
            (maximum speed for gear stage changeover)

MD 32020:   JOG_VELO (conventional axis velocity)
MD 32010:   JOG_VELO_RAPID (conventional rapid traverse)

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

IS "Control mode"   (DB31, ... DBX84.7)
IS "Oscillation mode"   (DB31, ... DBX84.6)
IS "Spindle in setpoint range"   (DB31, ... DBX83.5)
IS "Change over gear"   (DB31, ... DBX82.3)
IS "Setpoint gear stage A to C"   (DB31, ... DBX82.0 to DBX82.2)
IS "Spindle stop"   (DB31, ... DBX61.4)
IS "Setpoint direction of rotation left"   (DB31, ... DBX18.7)
IS "Setpoint direction of rotation right" (DB31, ... DBX18.6)
IS "Oscillation speed"   (DB31, ... DBX18.5)
IS "Oscillation via PLC"   (DB31, ... DBX18.4)
IS "No speed monitoring for gear changeover"
                                      (DB31, DBX16.6)
IS "Gear stage changed over"   (DB31, ... DBX16.3)
IS "Actual gear stage A to C"   (DB31, ... DBX16.0 to DBX16.2)

IS "Plus traversing key"   (DB31, ... DBX4.7)
IS "Minus traversing key"   (DB31, ... DBX4.6)
IS "Spindle stop"   (DB31, ... DBX4.3)
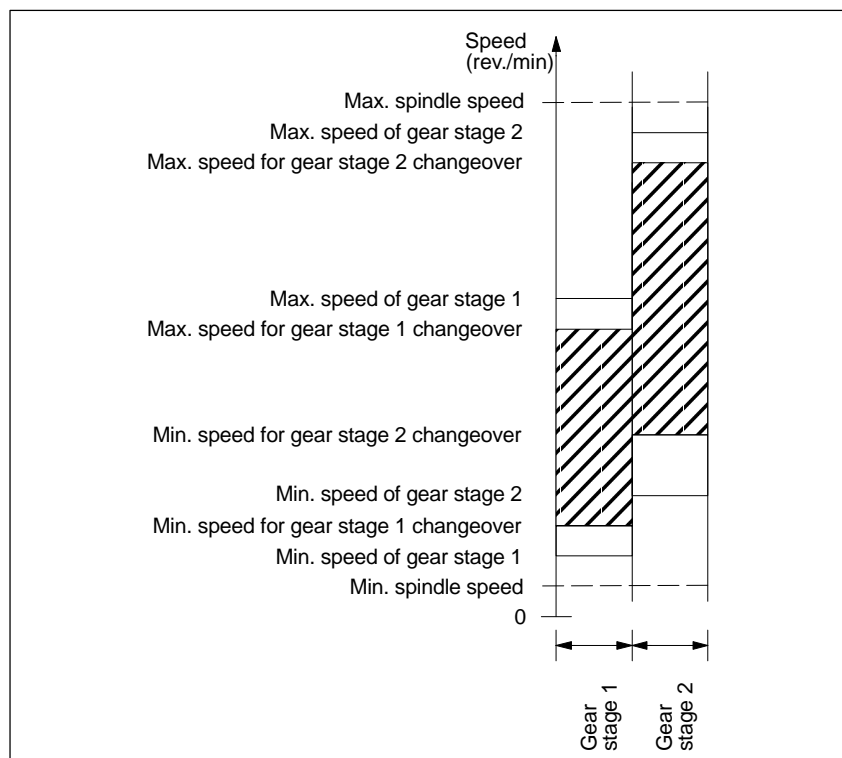
Fig. 6-22   Example of speed ranges with automatic gear stage selection (M40)

6.9.17   Spindle positioning

The control provides an "oriented spindle stop" function with which the spindle can be moved into a certain position and held there (e.g. for tool changing purposes). Several programming commands are available for this function which define the approach and program processing.

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

Machine data and interface signals

MD 36400:	CONTOUR_TOL	(contour monitoring)
MD 36050:	CLAMP_POS_TOL	(clamping tolerance)
MD 36030:	STANDSTILL_POS_TOL	(standstill tolerance)
MD 36020:	POSITIONING_TIME	(effective dead time accuracy fine)
MD 36010:	STOP_LIMIT_FINE	(fine exact stop)
MD 36000:	STOP_LIMIT_COARSE	(coarse exact stop)
MD 35350:	SPIND_POSITIONING_DIR	
	(direction of rotation on positioning from zero speed)	
MD 35300:	SPIND_POSCTRL_VELO	(creep speed)
MD 35210:	GEAR_STEP_POSCTRL_ACCEL	
	(acceleration in position control mode)	
MD 35012:	GEAR_STEP_CHANGE_POSITION	
	(gear step change position from SW 5.3)	
MD 35010:	GEAR_STEP_CHANGE_ENABLE	
	(gear step change options from SW 5.3 to fixed position)	
MD 32200:	POSCTRL_GAIN	(K_V factor)
MD 20850:	SPOS_TO_VDI	
	(output of "M19" to VDI interface as of SW 5.3)	

IS "Positioning mode"   (DB31, ... DBX84.5)
IS "Position reached with exact stop fine/coarse" (DB31, ... DBX60.6/60.7)
IS "Spindle re-synchronized for positioning"   (DB31, ... DBX17.4/17.5)
IS "Clamping in progress"   (DB31, ... DBX2.3)

Parameter blocks for exact stop limit

In SW 5.1 and higher the exact stop limits Coarse and Fine can be set independently of the parameter block using MD 36012: STOP_LIMIT_FACTOR[n] not equal to [1.0].

6.9.18   Spindle synchronization

The spindle must match its position with the measuring system. This operation is called "synchronization". Synchronization always follows the zero mark of the encoder or a BERO signal that is connected with the drive module of the SIMODRIVE 611D. In MD 34200 ENC_REFP_MODE you set via which signal synchronization is to be performed (zero mark (0) or BERO (1))

When is synchronization necessary?

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

To synchronize the spindle, it must always be rotary 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 "Resynchronize spindle 1, 2" (DB31, ... DBX16.4 or 16.5)
IS "Referenced/synchronized 1, 2" (DB31, ... DBX60.4 or 60.5)
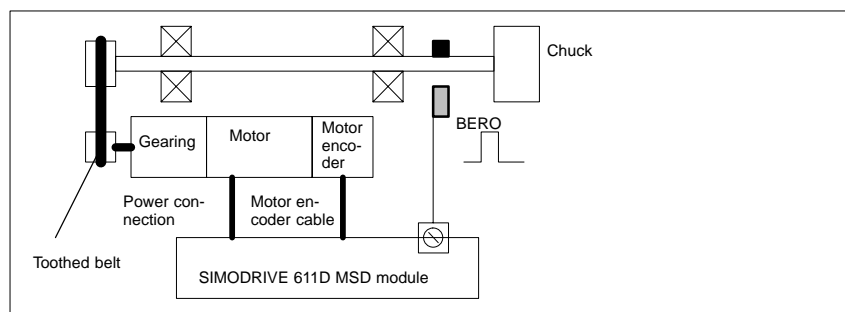
Fig. 6-23   Synchronization via an external reference signal (BERO)

Note

If the spindle encoder is not mounted directly on the spindle and there are speed-transforming gears between the encoder and spindle (e.g. encoder mounted on motor), then a BERO signal connected to the drive module must be used for synchronization. The control then automatically 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 must be set to 2.

6.9.19   Spindle monitoring

Axis/spindle standstill

If the velocity falls below the value entered in MD 36060: STAND-STILL_VELO_TOL, then the interface signal "Axis/spindle stationary" is output. The path feed is then enabled if MD 35500: SPIND_STOPPED_AT_IPO_START is set.

Spindle in set range

If the spindle reaches the tolerance range specified in MD 35150: SPIND_DES_VELO_TOL, then the signal "Spindle in setpoint range" is output. The path feed is then enabled if MD 35510: SPIND_STOPPED_AT_IPO_START 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 and 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).

Gear stage speed min. / max.

The maximum gear stage speed 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 limitations

The function G25 S... permits a minimum spindle speed to be programmed and function G26 S... a maximum spindle speed limitation. 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.

Max. 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 resynchronized as soon as the encoder frequency drops below the value in MD36302: ENC_FREQ_LIMIT_LOW. The encoder limit frequency value must be such that the mechanical encoder speed limit is not exceeded or else the synchronization from high speeds will be incorrect.
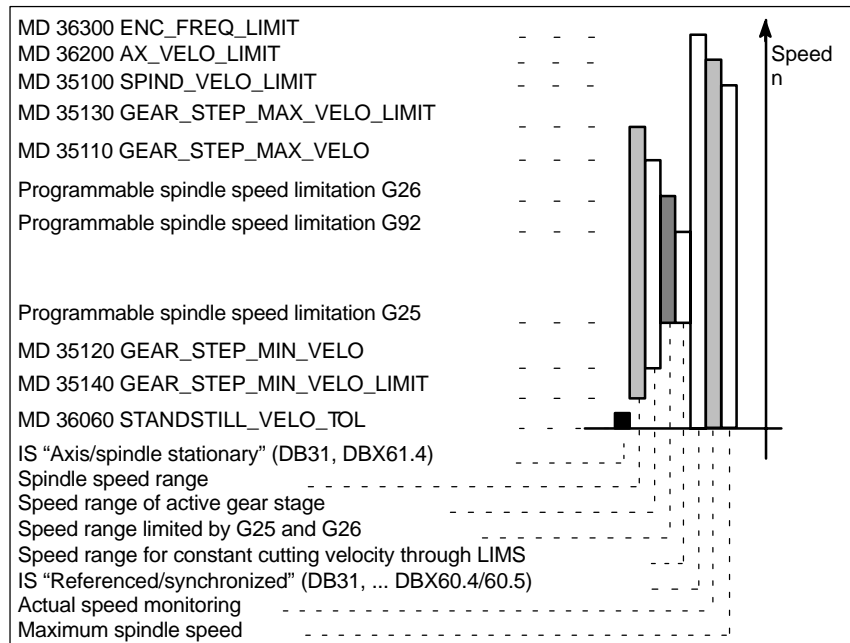
Fig. 6-24   Ranges of spindle monitoring

6.9.20   Example: Start-up of NCK I/O devices

Table 6-21   Start-up of NCK I/O devices, drive no.: 4

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

1. Assign the logical drive number: 4,
   select the module type: DMP-C.

2. Perform an NCK RESET to set up the bus.

3. Set the number of analog inputs and outputs:
   Analog inputs: MD10300 = 2, analog outputs: MD 10310 = 1.

   Set the number of digital input and output bytes:
   Three bytes for dig. inputs, two of these bytes external and one internal:
   MD10350 = 3,
   Four bytes for dig. outputs, three of these bytes external and one internal:
   MD10360 = 4.

4. Assign the analog inputs to the hardware:

   MD 10362 [0] = 01040201
                      ────── 1st input byte
                      ────── Slot on terminal block
                      ────── Logical drive number
                      ────── Always = 01 on 840D
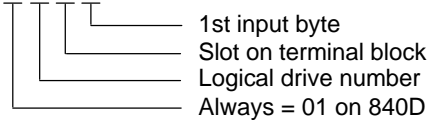
   MD 10362 [1] = 01040301

5. Assign the analog outputs to the hardware:
   MD 10364 [0] = 01040101

6. Assign the digital inputs to the hardware:

   MD 10366 [0] = 01040602
                      ────── 2nd input byte
                      ────── Slot on terminal block
                      ────── Logical drive number
                      ────── Always = 01 on 840D
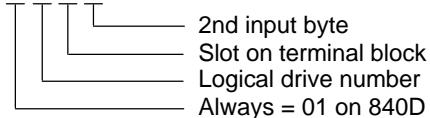
7. Assign the digital outputs to the hardware:
   MD 10368 [0] = 01040401
   MD 10368 [1] = 01040502

8. Set the weighting factors for the analog inputs/outputs:
   MD 10320 = 10000
   MD 10330 = 10000

9. Set the option: Programmed analog output

10. Program the following:

$A_OUTA [1] = 5000
    (preset analog output 1 to 5000mV)

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

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

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

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

6.10   Linear motors (1FN1 and 1FN3 motors)

6.10.1   General information about starting up linear motors

Reader's Note

For detailed information about linear motors, encoder and power con-
nections and configuring and assembly, please refer to:

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

6

**Checks in
the de-energized
state**

The following checks must be made:

1. Linear motor in general

   – Which linear motor is being used?

   – Is the motor listed?

      If yes   Type: 1FN_ _ _ _ –_ _ _ _ _ –_ _ _ _

      If no   Find out the manufacturer's data for the "unlisted" linear
                    motor and enter

   – Is the cooling circuit operational and is the coolant mixture correct? (Rec-
     ommended mix: 75% water, 25% Tyfocor).

2. Mechanical components

   – Can the axis move freely over the entire traversing range?

   – Do the mounting dimensions of the motor and the air gap between the
     primary and secondary parts comply with the manufacturer's specifica-
     tions?

   – Vertical axis:
     If the axis has weight compensation, is this functional?

   – Brake:
     If a brake is fitted, is it being applied and released correctly?

   – Traversing range limitation:
     Are mechanical limit stops installed on both sides 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:

        – Graduations   _ _ _ _ _ _ μm

        – Number of zero markers _ _ _ _ _ _

    b) Absolute measuring system:

        – Graduations   _ _ _ _ _ _ μm

    Determine the positive drive direction:

        Where is the positive count direction of the measuring system? (see
        Subsection 6.10.6)
        —> invert the actual velocity value?   ☐ yes   ☐ no

4. Wiring

    –   Power section (connection with phase sequence UVW, CW rotating field)

    –   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 con-
        nected 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 con-
        nector –X411 or to the adapter on the temperature sensor coupling lead.
        (See also PJLM/CON/Connections: Section "Encoder connection").

6.10.2   Start-up: Linear motor with one primary part

Start-up procedure   Linear motors with one primary part (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 plug-in
unit (term. 663) must be switched off initially before the drive is switched on.

1. Configure the drive:

    –   Select drive type: "SLM" (Synchronous Linear Motor) —> Insert module

    –   Select the power section.

6
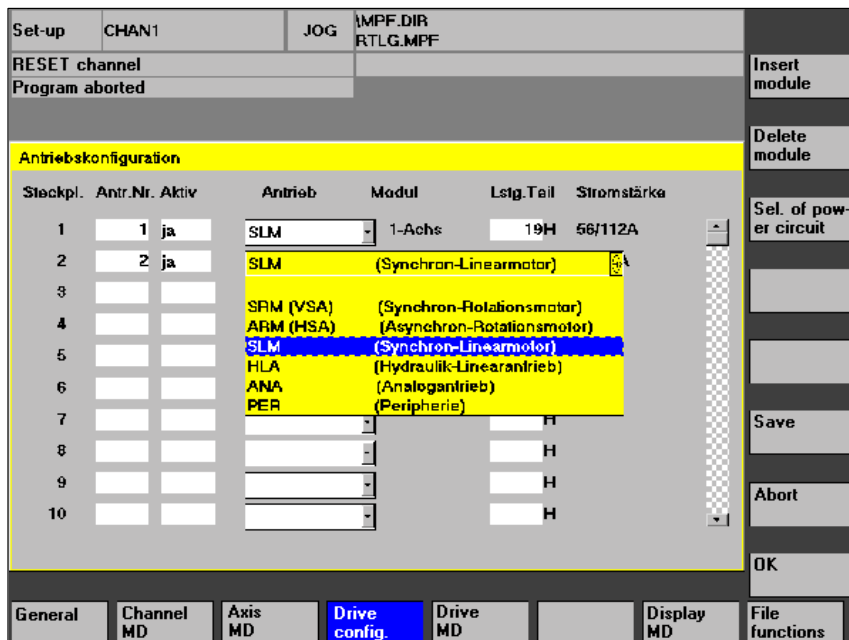
Fig. 6-25   Drive configuration for synchronous linear motor

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

Set-up	CHAN1	JOG	\MPF.DIR RTLG.MPF			

			Axis with drive +

RESET channel	
Program aborted	

Anwendersicht   ACHS_MD_LIMO   Y1 2

30200	NUM_ENCS	1	po AX *Y1
30240	ENC_TYPE[0]	1	po AX *Y1
31000	ENC_IS_LINEAR[0]	1	po AX *Y1
31010	ENC_GRID_POINT_DIST[0]	0.01500000 mm	po AX *Y1
32000	MAX_AX_VELO	120000.00000000 mm/min	cf AX *Y1
32100	AX_MOTION_DIR	1	po AX *Y1
32110	ENC_FEEDBACK_POL[0]	-1	po AX *Y1
32200	POSCTRL_GAIN[0]	1.00000000 userdef	cf AX *Y1
32300	MAX_AX_ACCEL	1.00000000 m/s²	cf AX *Y1
32640	STIFFNESS_CONTROL_ENABLE[0	0	cf AX *Y1
34200	ENC_REFP_MODE[0]	1	po AX *Y1
34210	ENC_REFP_STATE[0]	0	so AX *Y1
36200	AX_VELO_LIMIT[0]	130000.00000000 mm/min	cf AX *Y1

Vorzeichen Istwert (Regelsinn)

 Data have been loaded   i

RTLGID	ACHS_MD_ LIMO					Edit view	Manage views

Side buttons: Axis with drive +, Axis with drive -, Direct selection, Enable MD, NCK reset, Find, Find next

Fig. 6-26   Minimum selection of axis machine data for linear motor

Please observe the following safety instructions:

Note

The following checks must be made before the pulse and controller enabling
signals are set:

*   Make sure that the encoder is correctly parameterized particularly if the
    speed or velocity actual value needs to be inverted.

    Move the motor manually to check whether the sign of the actual speed or
    velocity value is correct and that the actual position value is being increm-
    ented or decremented accordingly.

    Remember that the speed inversion must also be parameterized at the NC
    end (axis-specific data, MD 32110 – ENC_FEEDBACK_POL[0] = –1).

*   For safety reasons, set a current reduction, e.g. to 10% (MD 1105 = 10%)
    for the first tests with the motion-based rotor position identification proce-
    dure. The reduction in current does not affect the identification process, but
    only becomes operative once the rotor position has been identified.

---

3. Select the motor

    Before the motor is selected, message 300701: "Start-up required" must be displayed. (Fig. 6–27)

    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. ...)
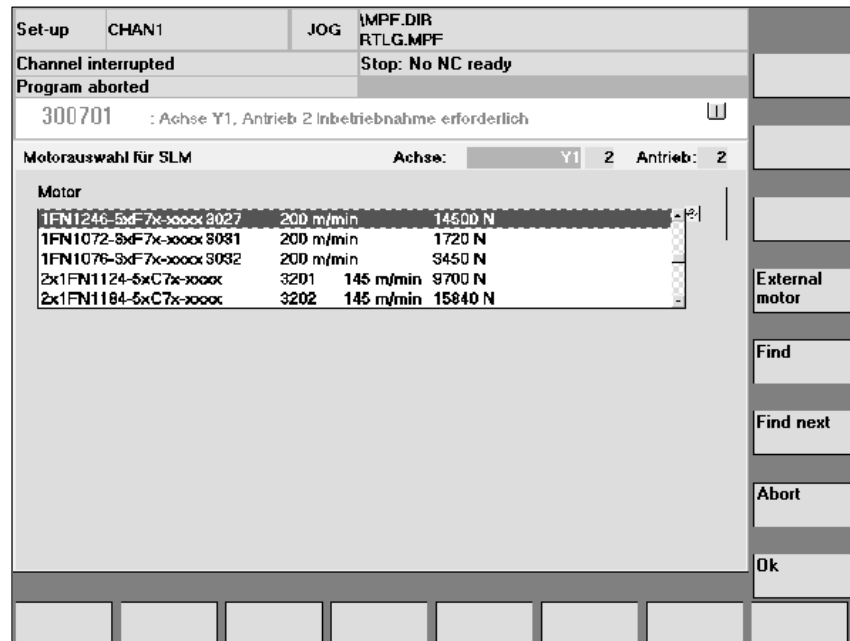
Fig. 6-27   Selecting a motor for which the data are already listed

b) The linear motor is not included in the linear motor
    list? —> **unlisted motor**

    "Motor" field —> enter data

Note

If a lower identification current is required (<40%), alarm 300753 must be con-
cealed with bit 5 in MD 1012.

Set-up	CHAN1		JOG	\MPF.DIR RTLG.MPF	
Channel interrupted				Stop: No NC ready	
Program aborted					

300701   : Achse Y1, Antrieb 2 Inbetriebnahme erforderlich

Fremdmotordaten SLM   Achse: Y1   2   SLM: 2

1103	MOTOR_NOMINAL_CURRENT	0.00000000	A	po
1104	MOTOR_MAX_CURRENT	0.00000000	A	po
1113	FORCE_CURRENT_RATIO	0.00000000	N/A	po
1114	EMF_VOLTAGE	0.00000000	Vs/m	po
1115	ARMATURE_RESISTANCE	0.00000000	Ohm	po
1116	ARMATURE_INDUCTANCE	0.00000000	mH	po
1117	MOTOR_MASS	0.00000000	kg	so
1118	MOTOR_STANDSTILL_CURRENT	0.00000000	A	po
1146	MOTOR_MAX_ALLOWED_SPEED	0.00000000	m/min	po
1170	POLE_PAIR_PITCH	0.00000000	mm	po
1400	MOTOR_RATED_SPEED	0.00000000	m/min	po

Motornennstrom

Pre-assignment

Abort

Ok

i

Fig. 6-28   Entering a motor without listed data

Enter the motor data:

Set-up	CHAN1		JOG	\MPF.DIR RTLG.MPF	
Channel interrupted				Stop: No NC ready	
Program aborted					

300701   : Achse Y1, Antrieb 2 Inbetriebnahme erforderlich

Fremdmotordaten SLM   Achse: Y1   2   SLM: 2

1103	MOTOR_NOMINAL_CURRENT	12.60000000	A	po
1104	MOTOR_MAX_CURRENT	39.20000000	A	po
1113	FORCE_CURRENT_RATIO	97.00000000	N/A	po
1114	EMF_VOLTAGE	56.00000000	Vs/m	po
1115	ARMATURE_RESISTANCE	2.10000000	Ohm	po
1116	ARMATURE_INDUCTANCE	23.60000000	mH	po
1117	MOTOR_MASS	12.10000000	kg	so
1118	MOTOR_STANDSTILL_CURRENT	12.60000000	A	po
1146	MOTOR_MAX_ALLOWED_SPEED	297.00000000	m/min	po
1170	POLE_PAIR_PITCH	46.00000000	mm	po
1400	MOTOR_RATED_SPEED	125.00000000	m/min	po

Motornenngeschwindigkeit

Pre-assignment

Abort

Ok

i

Fig. 6-29   Entered motor data for "unlisted motor"

4. "Measuring system / encoder" dialog

Selection of motor measuring system and entry of encoder data

a) Incremental encoder
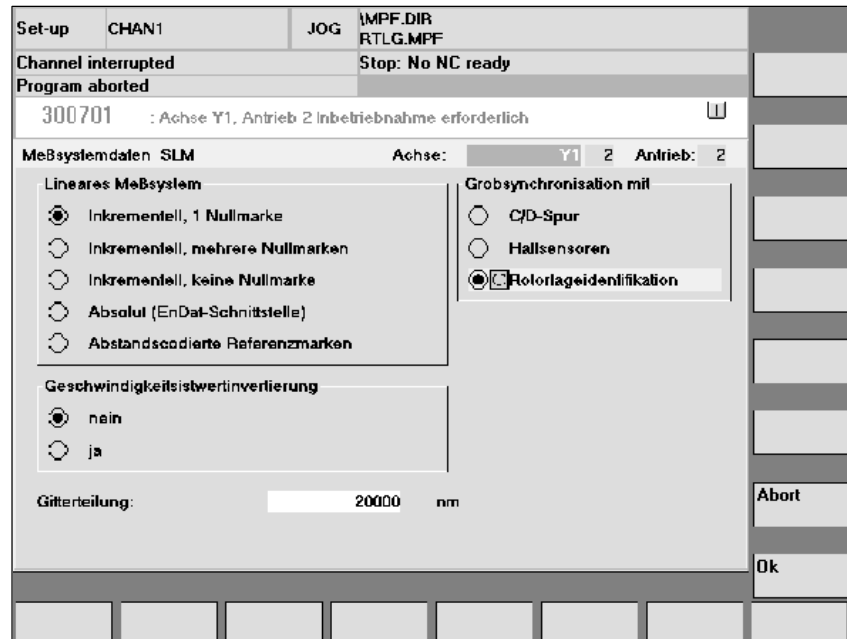
Fig. 6-30   Input for incremental measuring system with rotor position identification

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 area.

–   Incremental – several zero markers
An incremental measuring system with several zero markers is installed in the traversing area.

–   Incremental no zero marker
An incremental measuring system without a zero marker is installed in the traversing area.

"Invert actual velocity value": Yes/no (Subsection 6.10.6)

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 value encoder (EnDat)

An absolute measuring system (EnDat interface) is installed.
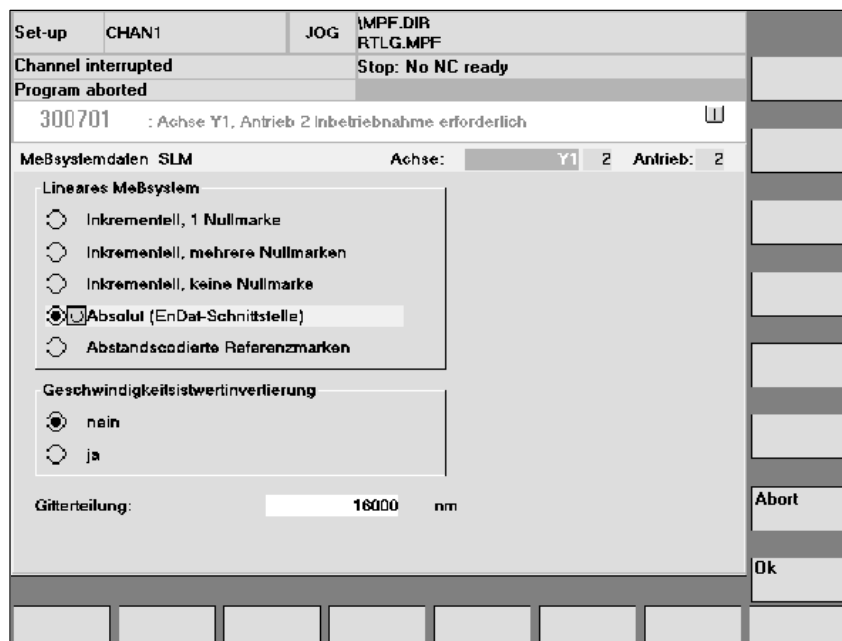
Fig. 6-31   Input for absolute measuring system, e.g. LC181

The following inputs must be made:

– In "Linear measuring system" field: Select absolute (EnDat interface)

– "Invert the actual velocity value" (Subsection 6.10.6)

– Enter "Graduations" of measuring system

Confirm acceptance of data with OK —> "Save bootfile" and select "NCK RESET".

5. Fixed temperature?

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

– MD 1608   e.g. 80°   Monitor OFF

– MD 1608   e.g. 0°   Monitor ON

6. Reduce maximum motor current for safety reasons

– MD1105 (maximum motor current) = e.g. enter 20%

Danger

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

The traversing area 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 calculated as follows:

    a) Select identification process in MD 1075. Adjust other
        machine data for rotor position identification if necessary.

    b) Save bootfiles and perform an NCK RESET.

    c) Continue as follows depending on the measuring system used:

Incremental   With an incremental measuring system:
measuring system


```
                              ┌──────────────┐
                              │    START     │
                              └──────────────┘
                                     │
                                     ▼
   Yes, Hall sensor boxes    ╱ Hall sensor boxes ╲    No, Hall sensor boxes not
   installed        ◄────────   installed?        ────────►   installed
                              ╲                  ╱
            │                                                      │
            ▼                                                      ▼
   ┌─────────────────────┐                    ┌──────────────────────────────┐
   │ Coarse synchroniza- │                    │ A rotor position identifica- │
   │ tion is achieved    │                    │ tion run is executed         │
   │ from the Hall sensor│                    │ immediately if enable        │
   │ signals (C/D track) │                    │ signals are present. An      │
   │ on power ON         │                    │ appropriate alarm is output  │
   │                     │                    │ if the rotor position        │
   └─────────────────────┘                    │ identification run is not    │
                                              │ executed. Once the error     │
                                              │ has been eliminated and the  │
                                              │ error message acknowledged,  │
                                              │ another attempt is made to   │
                                              │ identify the rotor position  │
                                              └──────────────────────────────┘
```

Zero markers?   Set one zero marker

No zero marker,
several zero markers
or distance-coded
reference markers

MD1017 ("startup help")
to 1

Move axis over the zero marker,
"JOG" mode

When the axis crosses the
zero marker, the commutation
angle offset is entered auto–
matically in MD1016

The zero marker is not
selected and the commutation
angle offset is not
transferred

Alarm 300799 is generated
("Save bootfiles and perform an
NCK RESET")

Save bootfiles and perform an
NCK RESET

END
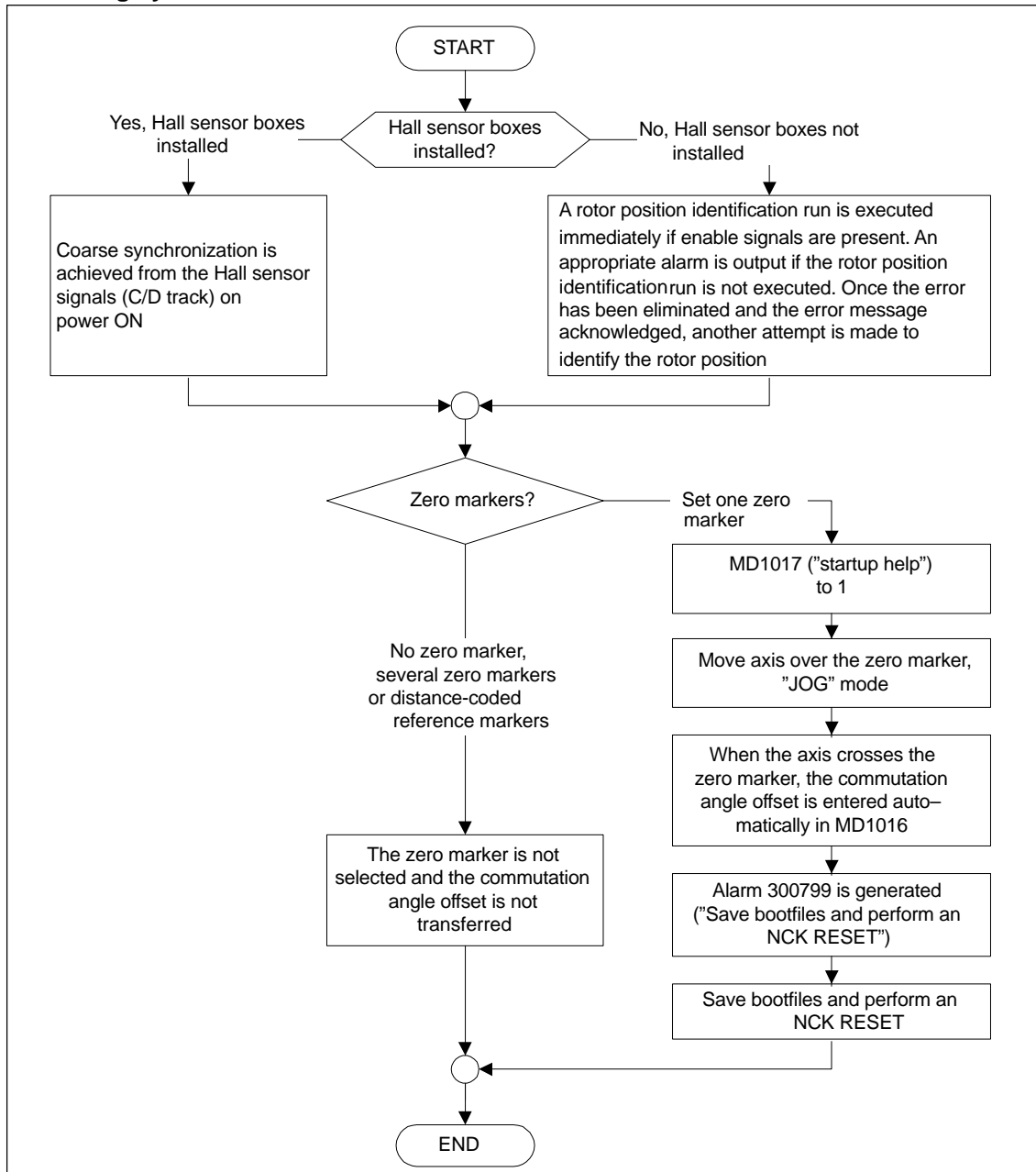
6

Fig. 6-32   Incremental measuring system

6.10   Linear motors (1FN1 and 1FN3 motors)

**Absolute
measuring system**   With an absolute measuring system:
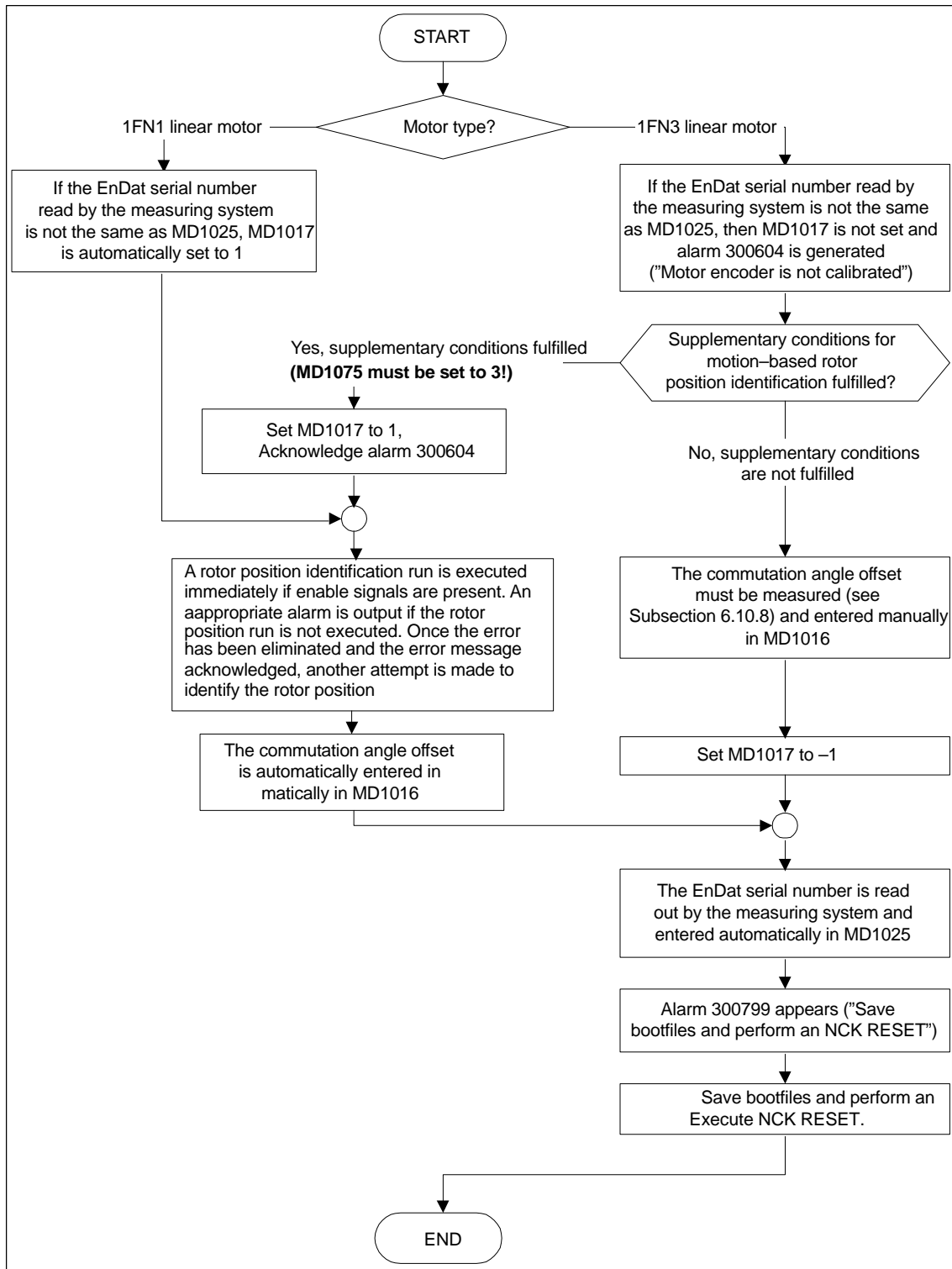

Fig. 6-33   Absolute measuring system

Distance-coded measuring system

This measuring system is not supported by the SIMODRIVE 611D.
Several zero markers must be selected incrementally. (see Fig. 6–30)

Note

The rotor position identification process for determining the commutation angle offset cannot be performed on non-Siemens motors. Depending on the motor design, it might be possible to use the following methods for both measuring systems:

- The saturation-based procedure,

- The motion-based procedure,

- With an absolute measuring system: Measurement of the commutation angle offset (see Subsection 6.10.8).

On completion of start-up, it is absolutely essential to perform a check measurement on the commutation angle offset!

---

8. Check and set rotor position identification if a Hall sensor is not installed

---

Note

If a Hall sensor is being used, a check measurement will suffice (see Subsection 6.10.8).

To check the rotor position identification routine, a test function can be used to determine the deviation between the calculated rotor position angle and the angle currently applied by the closed-loop control. The test sequence is as follows:

– Start the test function several times and evaluate the deviation

    Set   MD 1736 (test rotor position identification) = 1

    Deviation   MD 1737 (rotor position identification deviation)

    = _ _ _ _ , _ _ _ _ , _ _ _ _ , _ _ _ _ , _ _ _ _

– Is the variation in the measured values less than 10 degrees electrical?

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

If result is OK after repeat, then calculate the <u>commutation angle offset</u> again as described below:

– With an incremental measuring system:

    a) Incremental – one zero marker
       see point 7. (Determine the commutation angle offset)

    b) Incremental – none or several zero markers
       Select "Save bootfile" and then "NCK RESET"

– With an absolute measuring system:

    Switch off drive (NCK RESET)
    Switch on drive, set MD 1017 = 1 with pulse or controller enabling signal inhibited

Switch on pulse and controller enabling signals
—> The angle offset is automatically entered in MD1016
—> Alarm 300799 appears

—> Save bootfile and then NCK RESET

Example of rotor position identification (see screenshot below):

Set-up	CHAN1		JOG	\MPF.DIR RTLG.MPF			
Channel interrupted			Stop: No NC ready				Drive +
Program aborted				ROV		FST	
300799 ↓	: Achse Y1, Antrieb 2 Sichern und Boot erforderlich						
							Drive -
SLM (Synchron-Linearmotor) ($MD_)			Achse: Y1		2	SLM: 2	
1011	ACTUAL_VALUE_CONFIG				19H	po	
1012	FUNC_SWITCH				4H	so	Direct selection
1014	UF_MODE_ENABLE				0	po	
1016	COMMUTATION_ANGLE_OFFSET			-168.01434826	Grad	po	Delete bootfile
1017	STARTUP_ASSISTANCE				0H	so	
1019	CURRENT_ROTORPOS_IDENT			45.00000000 %		so	
1020	MAX_MOVE_ROTORPOS_IDENT			20.00000000 mm		so	Save bootfile
1021	ENC_ABS_TURNS_MOTOR				0	po	
1022	ENC_ABS_RESOL_MOTOR				100	po	
1023	ENC_ABS_DIAGNOSIS_MOTOR				0H	so	NCK reset
1024	DIVISION_LIN_SCALE			16000 nm		po	
1025	SERIAL_NO_ENCODER			6465508		po	
1029	DELAY_ROTORPOS_IDENT			0.00000000 ms		so	
Kommutierungswinkeloffset							
▼ Further data are available via display options						i	<<
General -	Channel MD	Axis MD	Drive config.	Drive MD		Display MD	File functions

Fig. 6-34   Result of rotor position identification run with absolute measuring system

9. Traverse axis and perform function check

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

    –   No   Change MD 32100 (travel direction)

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

10. Set and perform referencing/adjustment

    –   Incremental measuring system:
         Referencing (see Subsection 6.9.12)

    –   Absolute measuring system:
         Adjustment (see Subsection 6.9.6)

11. Set software limit switches (see Subsection 6.9.11 under subheading
    "Monitoring of positions via software limit switches")

12. Optimization of axis controller settings

    Note:
    The automatic controller setting run 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 Chapter10)

    –   Position controller (see Chapter 10).

6

6.10.3   Start-up: Linear motors with two identical primary parts

General

If it is certain that the EMFs of both motors have the same phase relation, then the motors can be operated on one drive if they have 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 or measured (see Subsection 6.10.8) and noted.

Motor 2 is then connected in place of motor 1 and operated as a single motor. The commutation angle offset is automatically calculated or measured (see Subsection 6.10.8) and noted for this motor as well.

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 two 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 motor 1 only to the power section.

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

   —>   Note information in Subsection 6.10.1

   —>   Start up the linear motor as described in Subsection 6.10.2 (up to and including point 7.)

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

3. Traverse axis and perform function check

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

   Caution:
   In the case of a Janus configuration (see Subsection 6.10.7), 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 6.10.2, point 7.: "Determine the commutation angle off-
     set")

   – With an absolute measuring system:
     Switch off the drive (NCK RESET)
     (see Subsection 6.10.2, point 7.: "Determine the commutation angle off-
     set")

9. Traverse axis and perform function check.
   (Subsection 6.10.2, point 9.)

10. Note the commutation angle offset of motor 2

    – MD 1016 (motor 2) = _ _ _ _ _ _ _ _ degrees electrical

11. Deviation between point 4. (motor 1) and point 10. (motor 2)

    if ≤ 10 degrees —>   OK

    if > 10 degrees —>   Check and correct mechanical assembly
                          (see Subsections 6.10.4 and 6.10.7)
    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 two linear motors again

    Connect both motors to the power section again.

14. Switch on motors with pulse and controller enabling signals inhibited

15. Start-up of paralleled linear motors

    – Carry out the complete start-up procedure described in Subsection
      6.10.2

    – Select the paralleled motor (2x1FN...) in the "Motor selection" dialog
      or:
      enter the data for the paralleled unlisted motor (as described under sub-
      heading "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 6.10.2, point 7. (Determine the commutation angle
      offset).

6

6.10.4   Mechanical components

**Check of
mounting
dimension
and
air gap**

Mounting dimension e_1 or e_2 can be checked by means, for example, 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 for 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.
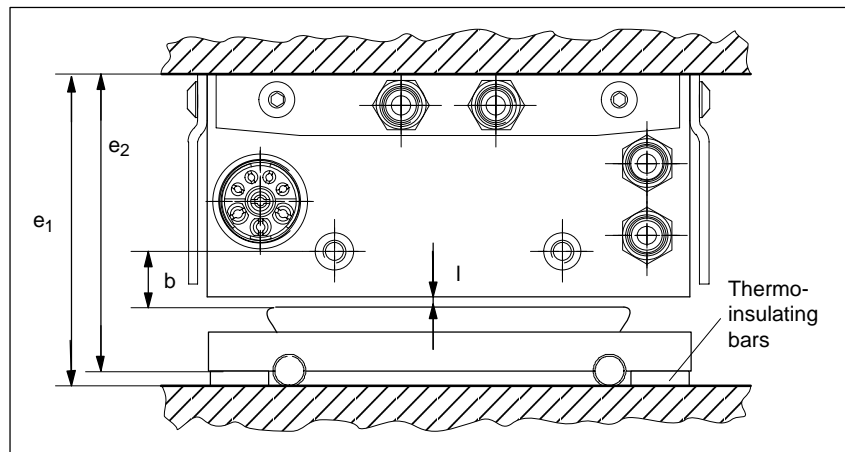

Fig. 6-35   Check dimensions for motor installation illustrated by a 1FN1 motor

Table 6-22   Check dimensions for mounting dimension and air gap for a 1FN1 linear motor

Linear motors	1FN1 ...	
Check dimensions	**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}.

6.10.5   Temperature sensors for 1FN1 and 1FN3 motors

Description of 1FN1

The following temperature sensing system is integrated in the primary part 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 is 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 of 1FN3

The following temperature sensing system is integrated in the primary part 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 for Linear Motor

6.10   Linear motors (1FN1 and 1FN3 motors)

How are the temperature sensors evaluated?

The signal leads for motor temperature monitoring on 1FN motors are not installed 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).

Case a)

The temperature is monitored via the drive.

Case b)

The temperature is monitored via the drive and an external device.

- Temperature sensor via drive

- External temperature switch on 1FN1

- On 1FN3 with PTC resistors via control unit

Case c)

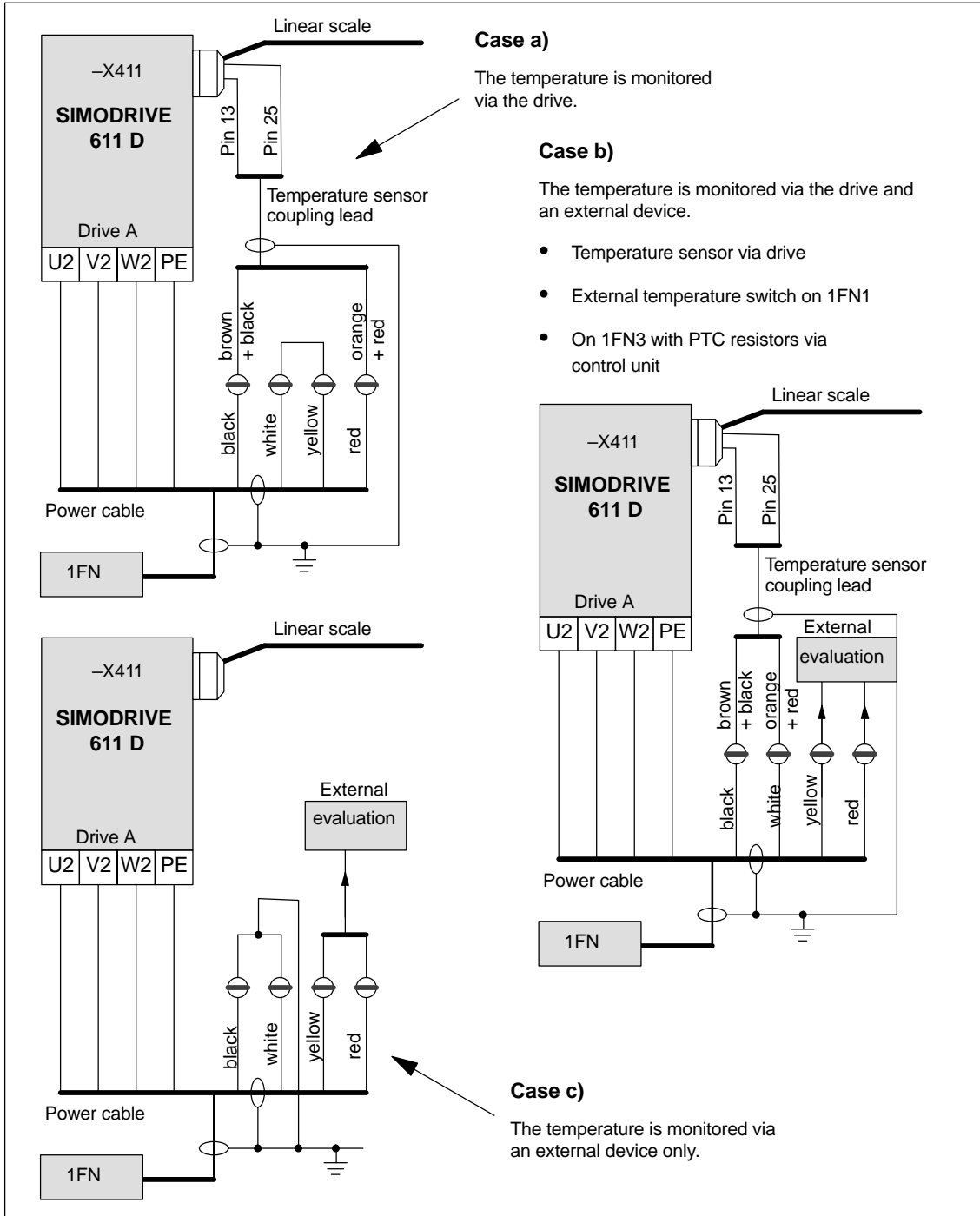The temperature is monitored via an external device only.

Fig. 6-36   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 two-dimensionally to 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 6-23   Assignments of temperature sensor coupling lead

Signal	Power cable	Temperature sensor coupling lead (dongle)	–X411 on drive
Temperature sensor +	Black core	Brown + black cores	Pin 13
Temperature sensor –	White core	Orange + red cores	Pin 25
Temperature switch/PTC	Yellow core	–	–
Temperature switch/PTC	Red core	–	–

6.10.6   Measuring system

Determine 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 (MD 32110) in the "Measuring system/Encoder" dialog during start-up.

It is also possible to check the control direction by parameterizing the drive first and then moving it manually with the enabling signals inhibited.
If the axis is moved in a positive direction (see definition in Fig. 6-37), then the actual velocity value must be counted positively.

Determine the drive direction

The direction of the drive is positive if the primary part moves in the opposite direction to the outgoing cable in relation to the secondary part.
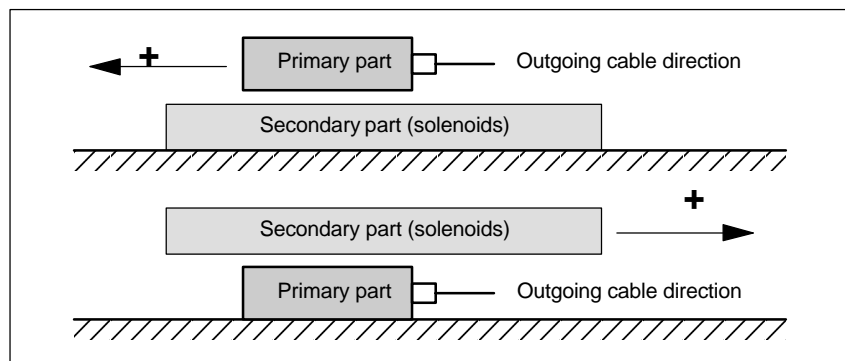

Fig. 6-37   Determining the positive direction of the drive

Calculate 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 rating plate increases (see Fig. 6-38)
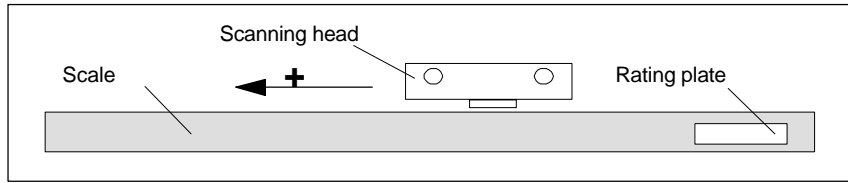

Fig. 6-38   Calculating the count direction of Heidenhain measuring systems

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

The Renishaw RGH22B measuring system (graduations = 20µm) 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 6-24   Signal and pin assignments, routing on 1FN linear motor

Signal	Cable color	Circular connector 12-pin	Connected to	
			+5V	0V
BID	black	Pin 9	Reference marker in both directions	Reference marker in one direction
DIR	orange	Pin 7	Positive directions	Negative direction
+5V	brown	Pin 12		
0V	white	Pin 10		

The count direction of the measuring system is positive if the scanning head moves in the direction of the outgoing cable in relation to the gold strip.
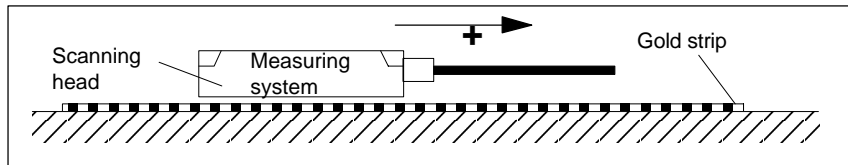

Fig. 6-39   Calculating the count direction of Renishaw measuring systems

Note

If the scanning head is mechanically coupled to the primary part, the outgoing cable direction must be different. Otherwise invert the actual value!

6.10   Linear motors (1FN1 and 1FN3 motors)

**Temperature
sensor coupling
lead (= dongle)**

This connection variant has proved to extremely interference-immune and
should always be employed.

If an incremental measuring system is used, the drive is roughly synchronized
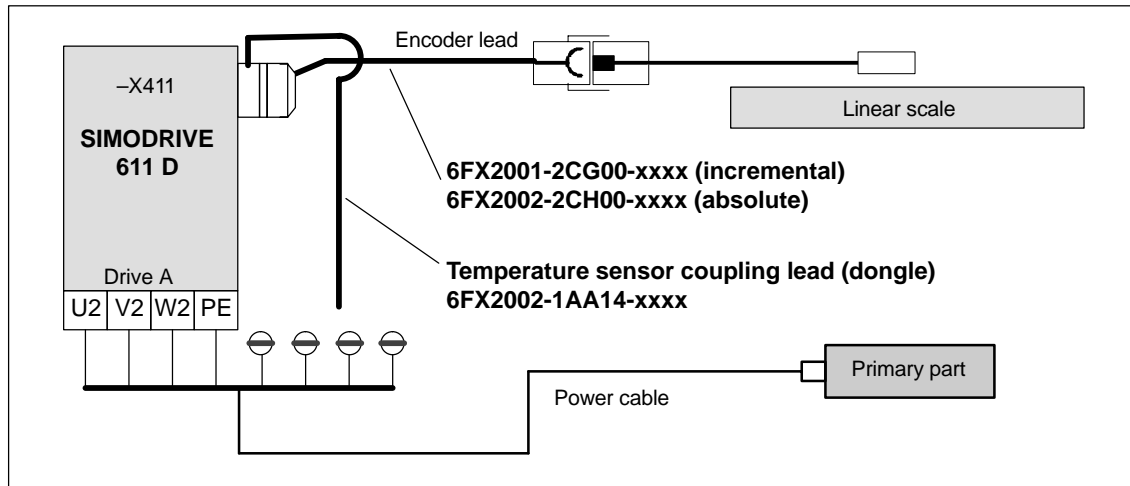using the rotor position identification routine.

Fig. 6-40   Temperature sensor coupling lead (recommended standard connection)

6.10.7   Parallel connection of linear motors

Mechanical construction

The distances between the motor primary parts must ensure an identical phase relation of the motor EMFs.
All primary parts are therefore connected cophasally in parallel to the converter.
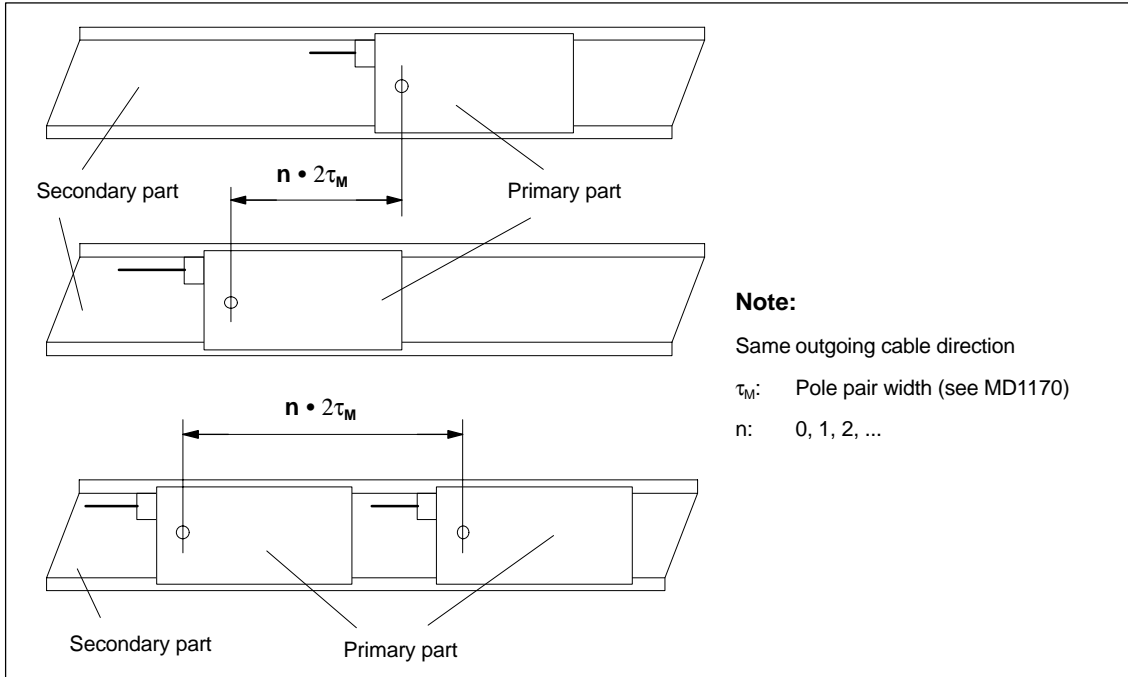

Fig. 6-41   Parallel connection of linear motors (standard configurations)

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.
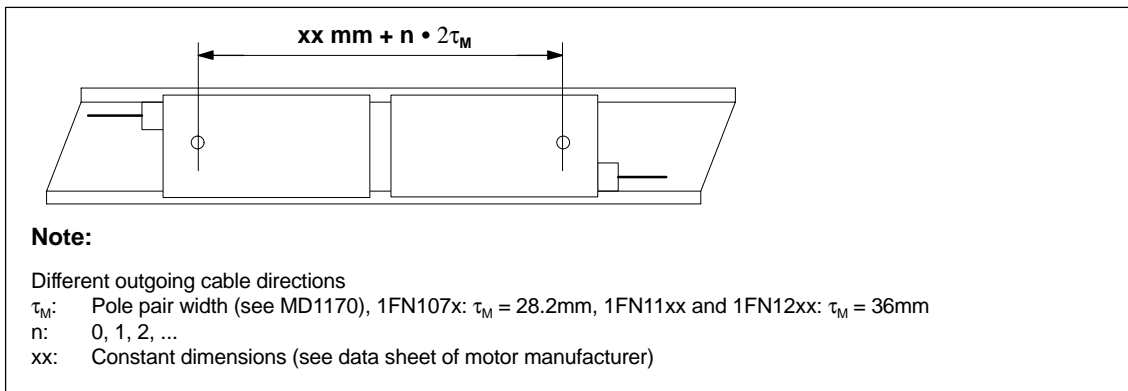
Fig. 6-42   Parallel connection of linear motors (Janus configuration, special type)

Temperature sensor and electrical wiring (see Subsection 6.10.5)

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

- Temperature sensor

  – Motor 1:   Evaluation via the drive

  – Motor 2:   Not connected
                          (shorted-circuited or connected to PE)

- Temperature switch or PTC

  – Motors 1 and 2:   External evaluation

Fig. 6-43   Wiring of parallel-connected linear motors

6.10.8   Test measurements on linear motor

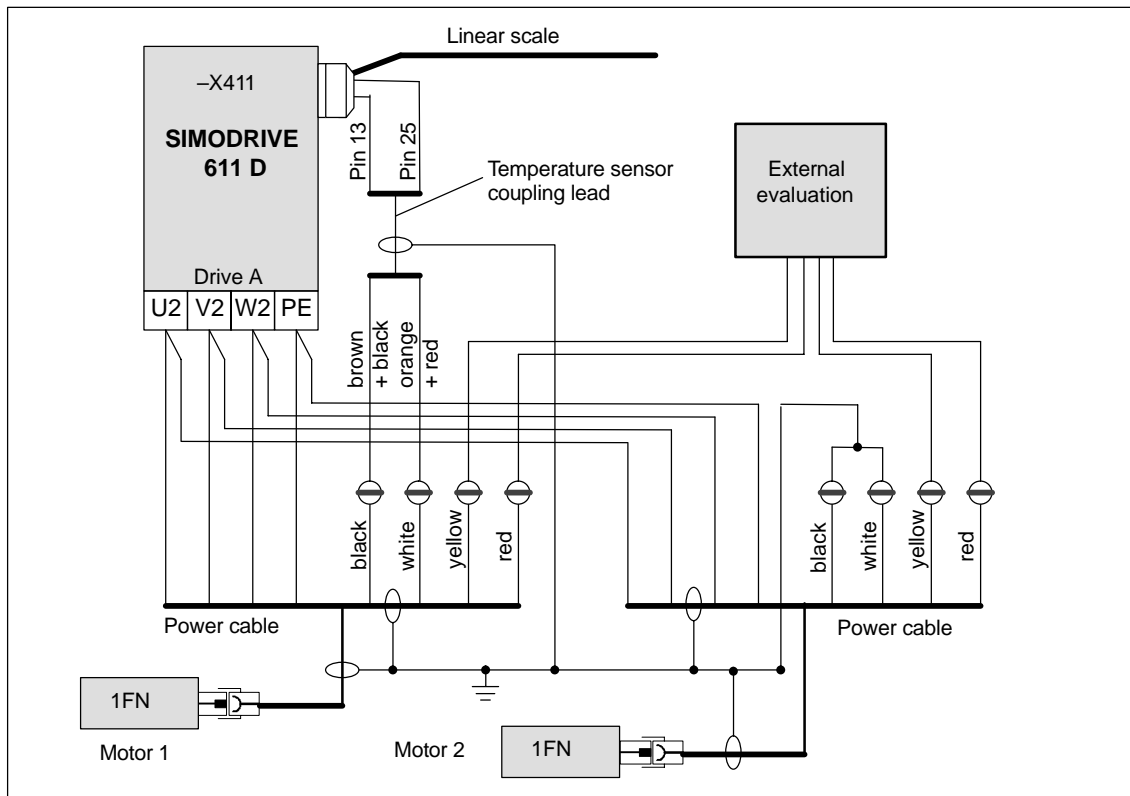**Why measure?**   If the linear motor has been started up in accordance with instructions, but inex-plicable error messages still appear, it will be necessary to test all signals by means of an oscilloscope.

Check phase sequence U-V-W   When the primary parts 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 plug-in unit.

• Caution: Wait for DC link to fully discharge!

• Disconnect power cable from drive.
Separate any parallel connection of primary parts.

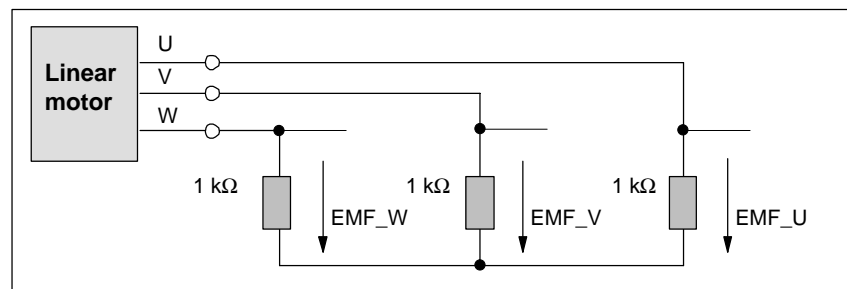• Create an artificial neutral point using 1 kohm resistors.

Fig. 6-44   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 part moves in the opposite direction to the outgoing cable in relation to the secondary part.
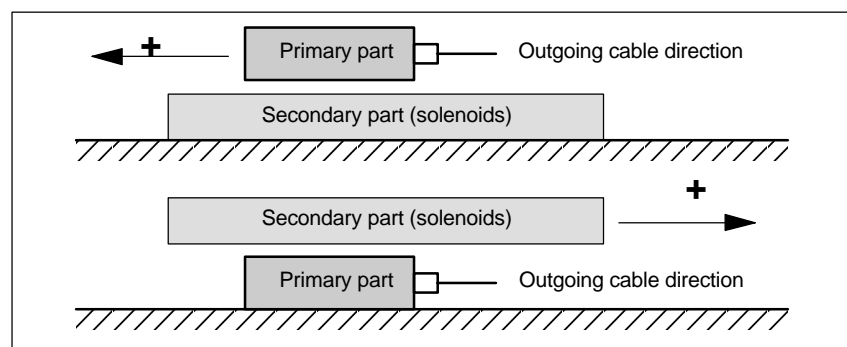
Fig. 6-45   Determining the positive direction of the drive (CW rotating field)

Calculation of commutation angle

After the oscilloscope has been connected, the drive must be moved over the zero marker to synchronize it.
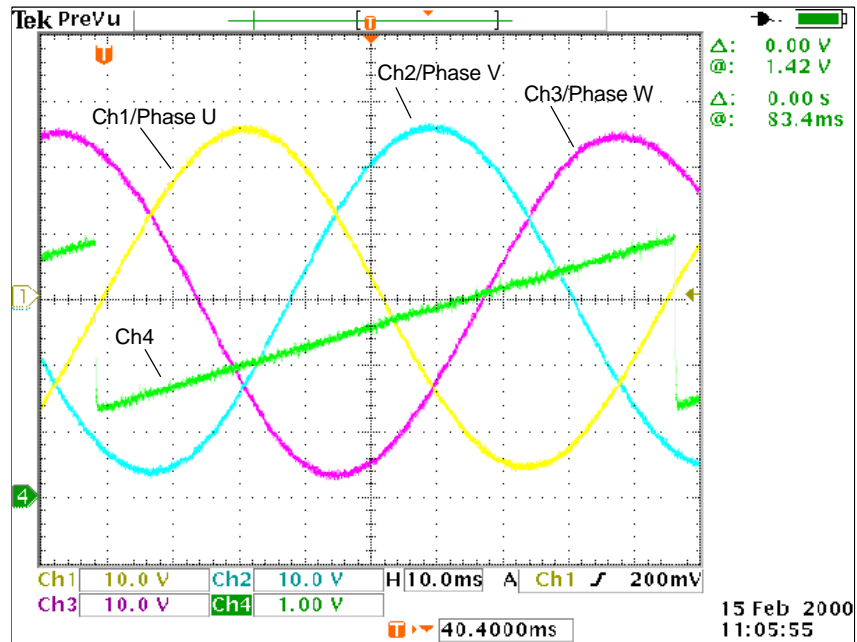
Fig. 6-46   Determining the commutation angle offset by measuring the EMF and normalized electrical rotor position via DAC in a positive drive direction.

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 the measuring signal "Normalized, electrical rotor position" is selected, the SHIFT factor must be changed from 7 to 8 and the offset value from –1.25V to –2.5V.

With a synchronized drive, the difference between EMF/phase U and the electrical rotor position must not exceed $\pm 10°$.

If the difference is greater, the position of the zero marker must be moved in the software in MD 1016 "COMMUTATION_ANGLE_OFFSET".

6.11   AM / V/F function

Note

The AM / V/F function is described in
References: /FBA/, DE1, Extended Drive Functions

6

6.12   System settings for boot, RESET and parts program start

Concept

The behavior of the control after

- Boot (power ON),

- RESET/parts program end

- Parts program start

can be changed with the machine data
MD 20110: RESET_MODE_MASK (definition of the control initial setting
               after boot and RESET) and
MD 20112: START_MODE_MASK (definition of the control initial setting
               after parts program start).

Table 6-25   Change system setting with MD

State	Variable with MD
Boot (power ON)	RESET_MODE_MASK
RESET/parts program end	RESET_MODE_MASK
Parts program start	START_MODE_MASK and RESET_MODE_MASK

Procedure

Select the required system behavior.

- After boot (power ON)
  MD 20110: RESET_MODE_MASK, bit 0 =   0 or 1
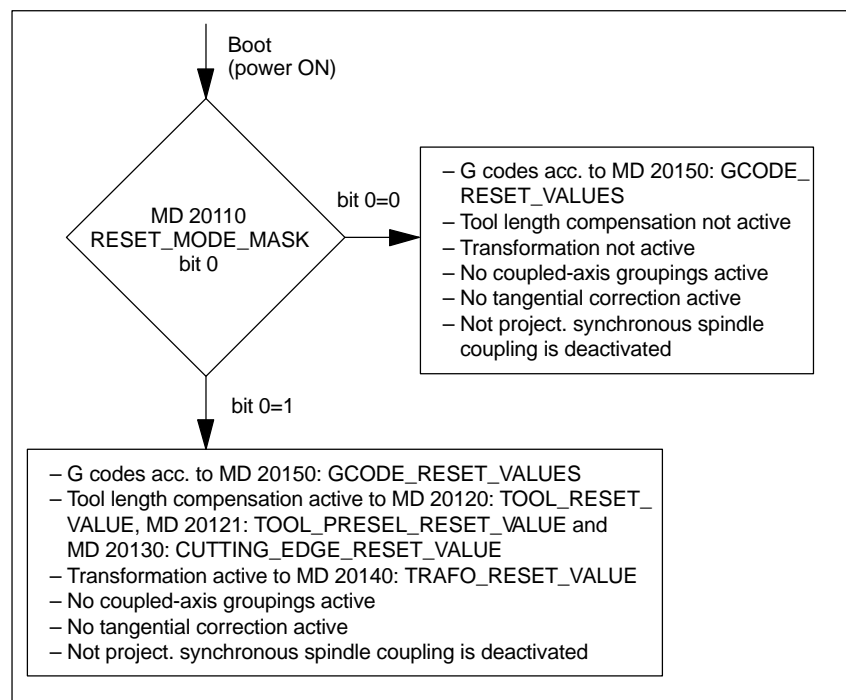
Fig. 6-47   System settings after ramp-up

- After RESET / parts program end
  MD 20110: RESET_MODE_MASK, bit 4–10 =   0 or 1

  Bits 4 to 10 can be combined in any way.
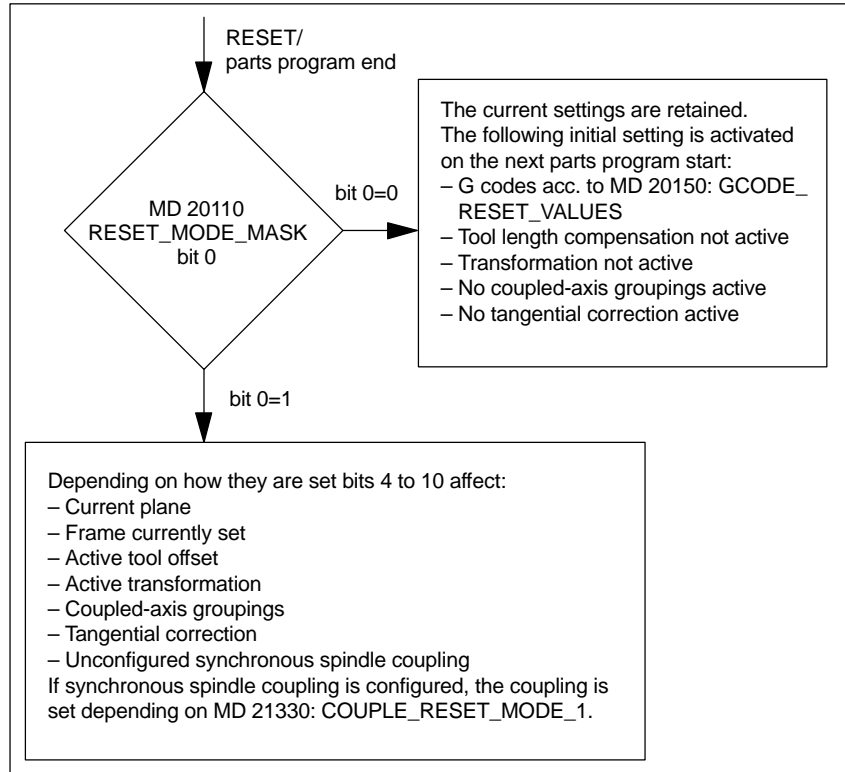
Fig. 6-48   System settings after RESET/parts program end

6

• After parts program start
  MD 20112: START_MODE_MASK, bit 4–10 =   0 or 1

Bits 4 to 10 can be combined in any way.

Parts program start

MD 20112
START_MODE_MASK
bits 4 – 10

bits 4–10 = 0

The current settings are retained with respect to
– Current plane
– Currently settable frame
– Active tool offset
– Active transformation
– Coupled-axis groupings
– Tangential correction
– Unconfigured synchronous spindle coupling

bits 4–10= 1

The current settings are reset with respect to:
– Current plane
– Currently settable frame
– Active tool offset
– Active transformation
– Coupled-axis groupings
– Tangential correction
– Unconfigured synchronous spindle coupling

Fig. 6-49   System settings after parts program start

References: /FB/ "K2", Coordinate Systems:
                Workpiece-Related Actual-Value System

■

PLC Start-Up

7

7.1   PLC start-up

PLC module

The PLC in the 840D is compatible with the SIMATIC S7-300 CPU 314.
The basic model has a memory configuration of 64KB that can be extended by
32KB to a total of 96KB (option).

Basic program, user program

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

7

7.1   PLC start-up
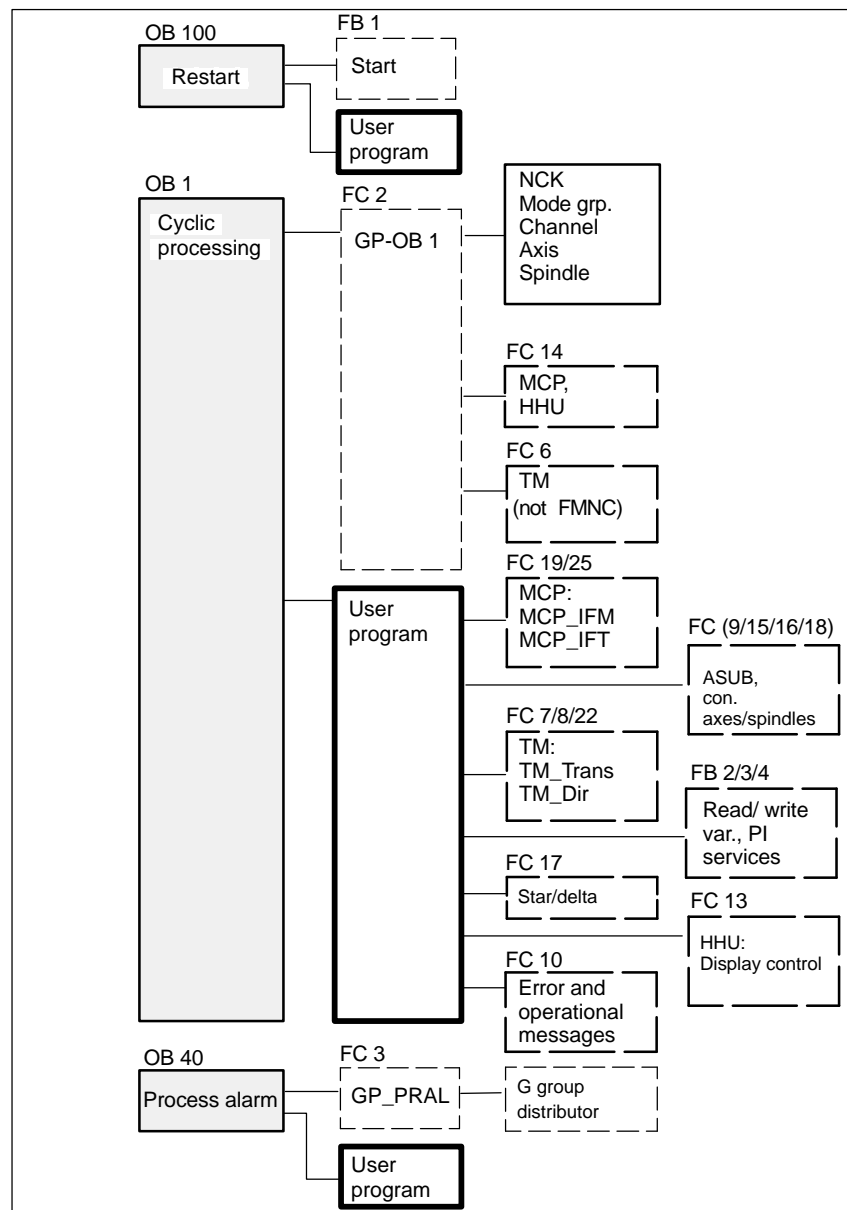
Fig. 7-1   Structure of the basic program

Tool box

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

PLC memory

Set the "PLC memory" option if necessary.

Loading PLC program

There are two ways in which the completed PLC program can be loaded:

1. Load, test and edit the PLC program using SIMATIC STEP 7 HiGraph (see also Readme file on the basic program floppy).

2. Load an archived PLC program with PCIN or via MMC 101/102

Note

By default, the STEP7 project manager (S7 TOP) does not display the SDBs. The SDB display is activated in the **View / Set filter** menu "All modules with SDBs".

PLC status

The PLC status is displayed under the "Diagnosis" menu to permit control and monitoring of PLC inputs, outputs, flags etc.

Start-up behavior of the PLC

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. It does **not return** to the point of interruption (e.g. on a power failure).

RESTART

Bit memories, timers and counters are stored in modal and non-modal memory 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 (backup 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 (PIO)

- Reject process and diagnostic alarms

- Update system status list

- Evaluate parameterization objects of modules (from SD100 onwards) or output defaults parameters to all modules in single-processor mode

- Process restart OB (OB100)

- Read in process image of inputs (PII)

- Cancel command output disable (OD).

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 ramp-up and the first OB1 cycle have been completed. When the PLC fails, alarm "2000 sign of life monitoring PLC" is displayed.

References: /FB/, P3, "Basic PLC Program"
/S7H/, SIMATIC S7-300

Parameters of FB1   FB1 (ramp-up block of basic PLC program) must be supplied with variables.

For an exact description of the variables and the ways in which parameter settings can be altered, please refer to

References: /FB/, P3, "Basic PLC Program"

Note

Timers T0 to T9 are used by the basic program.

7.2   Overview of organization blocks, function blocks and DBs

References: /FB/, P3, "Basic PLC Program"

■

Alarm and Message Texts

8

8

8.1   Alarm and message texts

8.1.1   Alarm text files for MMC 100

Description   The installation routine stored on the MMC 100 application diskette (see Chapter 12) transfers

- configuration settings,

- texts,

- the configured interface and

- the user software

from the update directory on your PC/PG to the MMC 100 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 MMC 100 (X6) and the COM1 or COM2 interface of your PC

- Approx. 3MB free space on hard disk

- The following description is based on the assumption that you have already transferred the software from the supplied MMC 100 application diskette (no. 2) of the hard disk of your PC/PG as described in Chapter 12.

Alarm texts/   The **texts** are stored with the Siemens standard entries in the hard disk drive
message texts   you have selected on your PC. 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 Subsection 8.1.4 for the applicable syntax rules.

More than one language

MMC 100 can be assigned two languages in online mode. These are referred to as **foreground** and **background languages**.
It is possible to exchange the foreground and background languages of the MMC system using the application diskette as described in Chapter 12 Hardware/Software Replacement.

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

Master language

By definition, the master language is German. It defines the number and order of the alarm/message texts for the languages selected by the user.

The number and order of the alarm/message texts in the selected languages must be identical to those of the master language.

8

Conversion and transmission

After the text contents have been modified, the text files must be converted and transferred to the MMC (Chapter 12).

Note

128KB are available to the user for additional text files.

8.1.2   Alarm text files for MMC 102/103

**Storage of
text files**

Files containing error texts are stored in directory C:\dh\mb.dir\.. The error text files to be used are activated in file **c:\mmc2\mbdde.ini**.

**Structure of
mbdde.ini**

Extract from mbdde.ini, relevant for the configuration of alarm text files:

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

Standard files

The standard texts in ASCII format are stored in the following files on the hard disk of the MMC 101/102/103:

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 incorporate error texts. If these files are replaced when new MMC 101/102/103 software is installed, user-specific alarms incorporated or modified by the user will be lost. Users should store their own alarm texts in user files.

User files

Users can replace the error text stored in the standard files by their own texts or add new ones to them. To do so, load additional files in directory **c:\dh\mb.dir** (MBDDE alarm texts) via the "Services" operating area. The names of the text files are set in file **c:\mmc2\mbdde.ini**. An editor is available for this in area **Diagnostics\Start-up\MMC**.

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

An **ASCII editor** must be used to edit the files (e.g. the DOS editor **edit**).

Alarm text languages

A language is assigned to the user alarm texts by means of the text file name. 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 MMC 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 of MMC 102/103

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.

8.1.3   Alarm text files for HPU

The alarm text files for the NC and PLC are created and incorporated in the same manner as for the MMC 100.

Description

The installation routine "HPUSETUP" on the HPU system diskette transfers

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

from the update directory on your PC/PG to the HPU 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 HPU and the COM1 or COM2 interface of your PC
- Approx. 3MB free space on hard disk
- The following description is based on the assumption that you have already transferred the software from the supplied system diskette to the hard disk of your PC/PG as described in ReadMe file supplied.

Procedure

1. Call HPUSETUP
2. Once you have copied the software to the hard disk, exit the installation procedure ("NO").
3. Modify the alarm text files in
   <INSTALLATION DIRECTORY>\proj_hpu\text\al\...
4. After the text contents have been modified, the text files must be converted ("Mkalarm") and transferred to the HPU.
5. Call INSTALL in the <INSTALLATION DIRECTORY>.

Alarm texts/ message texts

The **texts** are stored with the Siemens standard entries in the hard disk drive you have selected on your PC. 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

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 con-
                             tained 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 next Section for the applicable syntax rules.

More than one   The HPU can be assigned two languages in online mode. These are referred to
language   as **foreground** and **background languages**.
                             It is possible to exchange the foreground and background languages of the
                             MMC system using the system diskette.

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

Master language   By definition, the master language is German. It defines the number and order
                             of the alarm/message texts for the languages selected by the user.

                             The number and order of the alarm/message texts in the selected languages
                             must be identical to those of the master language.

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

8

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8.1.4   Syntax for alarm text files

Alarm numbers   The following alarm numbers are available for alarms relating to cycles, compile
                           cycles and the PLC:

Table 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 sequential controllers/graphs		

Text file   The number range in the list is not available with every number
format for   (see **References**: /FB/ P3, "PLC basic program", Lists)
cycle alarm texts   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 programmed"
60101	1	0	60100
...	...	...	...
65202	0	1	"Axis %2 in channel %1 is still moving"
// Alarm text file for cycles in German			

Alarm number   Alarm number list

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

Help ID	MMC 101/102/103 only (with hard disk): The default "0" means: The WinHelp file supplied by Siemens provides a detailed description of the alarm. A value between 1 and 9 uses an assignment entry in the MBDDE.INI file to refer to a WinHelp file created by the user. See also Subsection 8.1.5, HelpContext.

Text or alarm number   The associated text is given in inverted commas with the position parameters.

- The characters " and # must not be used in alarm texts.
  The character % is reserved for displaying parameters.

- If the user wishes to use an existing text, a reference to the appropriate alarm text can be inserted. 5-digit alarm number instead of "text".

- The alarm text file may contain comment lines which must start with "//". The maximum length of the alarm text is 110 characters for a 2-line display. If the text is too long, it is cut off and the symbol "*" added to indicate missing text.

- Parameter "%1": Channel number
  Parameter "%2": Block number.

8

Format of the text file for PLC alarm texts

The ASCII file for PLC alarm texts is structured as follows:

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

Alarm no.	Display	Help ID	Text	Text on MMC
510000	1	0	"Channel %K FDDIS all"	Channel 1 FDDIS all
600124	1	0	"Feed disable axis %A"	Feed disable axis 1
600224	1	0	600124	Feed disable axis 2
600324	1	0	600224	Feed disable axis 3
703210	1	1	"User text"	User text
...				
703211	1	1	"User text%A ..."	User text Axis 1 ...
// Alarm text file for PLC alarms				

References: /FB/, P3, "Basic PLC Program"

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

Help ID	MMC 101/102/103 only (with hard disk): The default "0" means: The WinHelp file supplied by Siemens provides a detailed description of the alarm. A value between 1 and 9 uses an assignment entry in the MBDDE.INI file to refer to a WinHelp file created by the user. See also Subsection 8.1.5, HelpContext.

   8.1   Alarm and message texts

Text or alarm number   The associated text is given in inverted commas with the position parameters.

- The characters " and # must not be used in alarm texts.
  The character % is reserved for displaying parameters.

- If the user wishes to use an existing text, a reference to the appropriate
  alarm text can be inserted. 6-digit alarm number instead of "text".

- The alarm text file may contain comment lines which must start with "//". The
  maximum length of the alarm text is 110 characters for a 2-line display. If the
  text is too long, it is cut off and the symbol "*" added to indicate missing text.

- Parameter "%K": Channel number (2nd digit of alarm number)
  Parameter "%A": The parameter is replaced by the signal group no. (e.g.
  axis no., user area no., sequential controller no.)
  Parameter "%N": Signal number
  Parameter "%Z": Status number.

8.1.5   Properties of alarm list

The properties of the alarm list can be changed 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/data format of the messages)
TextFiles	Path/file setting of the text lists for the alarms (e.g. MMC=..\dh\mb.dir\alm_ <signalling module in dir. mb>)
HelpContext	Names and paths of the help files (e.g. File0=hlp\alarm_)
DEFAULTPRIO	Priorities of the various alarm types (e.g. POWERON=100)
PROTOCOL	Properties of the log (e.g. File=.\proto.txt <name and path of the logfile>)
KEYS	Information about keys with which alarms can be cleared (e.g. Cancel=+F10 <clears alarms with key combination Shift+F10>)

You will find further details of file entries in:
References: /BN/, User's Guide: OEM package for MMC

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

- TimeFormat
  The format that is to be used for output of the date and time is entered here.
  It is the same as the CTime::Format of the Microsoft Foundation Classes.

- MaxNr
  Defines the maximum size of the alarm list.

- ORDER
  Defines the sequence in which the alarms are sorted in the alarm list:

        FIRST puts more recent alarms at the head of the list,
        LAST puts new alarms at the foot of the list.

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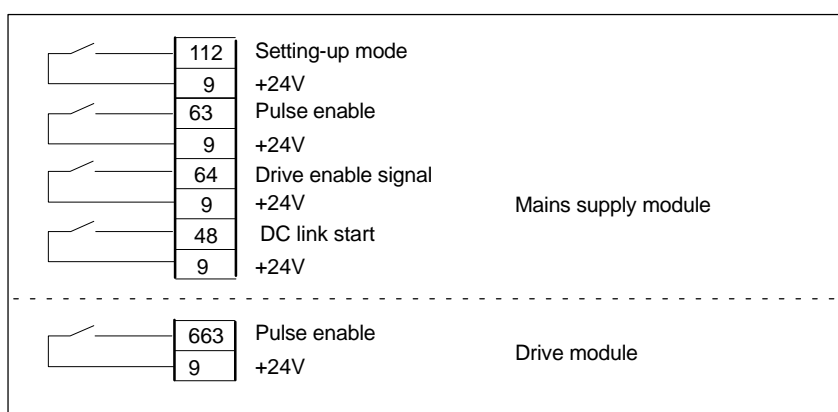[alarms]
TimeFormat=%d.%m.%y %H:%M:%S
MaxNr=50
ORDER=LAST

■

Notes

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Axis and Spindle Dry Run

9

9.1 Preconditions

Axis enabling

To allow an axis to be traversed from the control system, it is necessary to supply enabling terminals on the drive and to set enabling bits on the interface.

Enables on the drive

112	Setting-up mode	
9	+24V	
63	Pulse enable	
9	+24V	
64	Drive enable signal	
9	+24V	Mains supply module
48	DC link start	
9	+24V	
663	Pulse enable	
9	+24V	Drive module

References: /PJ/, Planning Guide for SIMODRIVE 611-A/611-D

⚠ 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"   (DB31–61, DBX2.1)
NST "Pulse enable"   (DB31–61, DBX21.7)
NST "Position measuring system 1 or 2"   (DB31–61, DBX1.5, DBX 1.6)

The following signals on the interface must **not** be set or else the axis/spindle motion will be disabled:
NST "Feed switch / spindle speed override switch" (DB31–61, DBB0) not 0%
NST "Axis disable / spindle disable"   (DB31–61, DBX1.3)
NST "Follow-up mode"   (DB31–61, DBX1.4)
NST "Distance to go / spindle RESET"   (DB31–61, DBX2.2)
NST "Feed stop / spindle stop"   (DB31–61, DBX4.3)
NST "Traversing key disable"   (DB31–61, DBX4.4)
NST "Ramp-function generator disable"   (DB31–61, DBX20.1)

References: /FB/, A2, "Various Interface Signals and Functions"
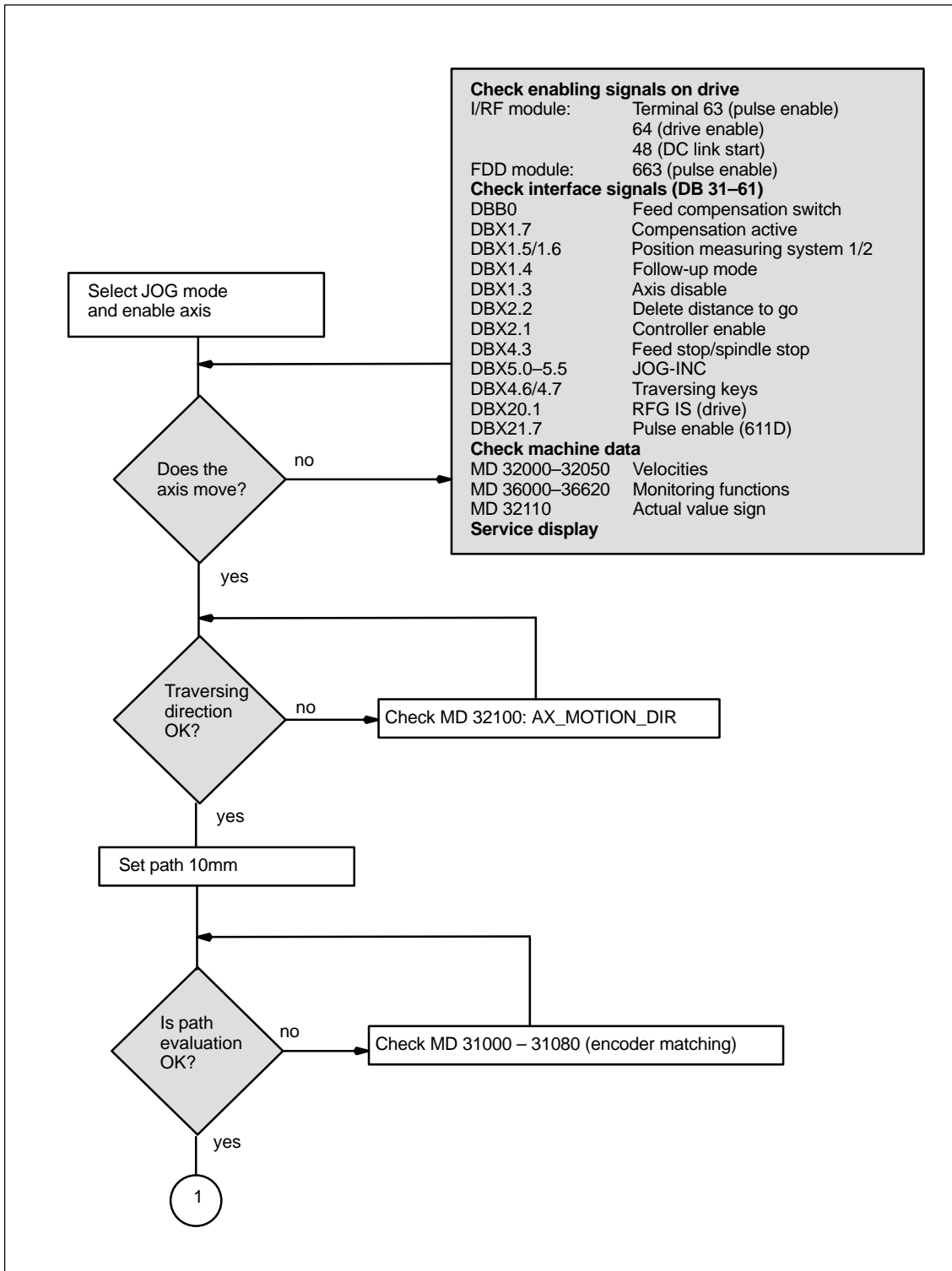   Interface signals from and to axis/spindle

Limit switches   Setting of hardware limit switches and interface signal check:

- Hardware limit switch PLUSDB31–61.DBX12.1

- Hardware limit switch MINUSDB31–61.DBX12.0

References: /FB/, A3, "Axis Monitoring, Protection Zones"
                       Monitoring static limitations

9.2   Axis test run

Check enabling signals on drive
I/RF module: Terminal 63 (pulse enable)
                64 (drive enable)
                48 (DC link start)
FDD module: 663 (pulse enable)

Check interface signals (DB 31–61)
DBB0   Feed compensation switch
DBX1.7   Compensation active
DBX1.5/1.6   Position measuring system 1/2
DBX1.4   Follow-up mode
DBX1.3   Axis disable
DBX2.2   Delete distance to go
DBX2.1   Controller enable
DBX4.3   Feed stop/spindle stop
DBX5.0–5.5   JOG-INC
DBX4.6/4.7   Traversing keys
DBX20.1   RFG IS (drive)
DBX21.7   Pulse enable (611D)

Check machine data
MD 32000–32050 Velocities
MD 36000–36620 Monitoring functions
MD 32110   Actual value sign

Service display

Select JOG mode and enable axis

Does the axis move? — no

yes

Traversing direction OK? — no → Check MD 32100: AX_MOTION_DIR

yes

Set path 10mm

Is path evaluation OK? — no → Check MD 31000 – 31080 (encoder matching)

yes

(1)

9

9.2   Axis test run

```
                    ( 1 )

        ┌──────────────────────┐   ┌──────────────┐
        │ Traverse with feedrate│   │ Traverse in  │
        │ 1000 mm/min           │   │ rapid mode   │
        └──────────────────────┘   └──────────────┘

              ╱╲
             ╱  ╲      yes      ┌────────────────────────────┐
            ╱Alarm?╲──────────▶│ Interpret alarm and check   │
            ╲      ╱            │ machine data for velocity   │
             ╲  ╱              │ adaptation                  │
              ╲╱               └────────────────────────────┘
              │ no

              ╱╲
             ╱  ╲      no
         ╱Following╲─────────▶┌────────────────────────────────────────────┐
         ╲error OK?╱          │ Check                                      │
          ╲      ╱            │ MD 32200       (K_V factor)                │
           ╲  ╱              │ MD 32410       (time constant for jerk     │
            ╲╱               │                 limitation)                │
            │ yes            │ MD 32910       (dynamic response matching) │
                            │ MD 31050/31060  (load gearing)             │
          ( End )            │ MD 32610       (feedforward control)       │
                            │ MD 1401        (maximum motor operating     │
                            │                 speed)                     │
                            │ MD for velocity adaptation                 │
                            └────────────────────────────────────────────┘
```

Check
MD 32200   (K_V factor)
MD 32410   (time constant for jerk limitation)
MD 32910   (dynamic response matching)
MD 31050/31060   (load gearing)
MD 32610   (feedforward control)
MD 1401   (maximum motor operating speed)
MD for velocity adaptation

9.3 Testing the spindle

Check enabling signals on drive
I/RF module   63 pulse enable
                   64 drive enable
                   48 DC link start
Drive module   663 pulse enable
Check interface signals (DB31–61)
DBB0   Spindle speed override
DBX1.7   Compensation active
DBX1.5/DBX1.6   Position measuring system 1/2
DBX1.3   Axis/spindle disable
DBX2.1   Controller enable
DBX16.7   Delete S value
DBX3.6   Velocity/spindle speed limi-
                   tation and MD 35160
DBX4.3   Feed stop/spindle stop
DBX20.1   RFG IS
DBX2.2   Spindle RESET when MD 35050=1
DBX21.7   Pulse enable
Check machine and setting data
MD 35100–35150   Spindle speed limitation
MD 36200   AX_VELO_LIMIT
SD 41200   JOG_SPIND_SET_VELO
SD 43220   SPIND_MAX_VELO_G26
SD 43210   SPIND_MIN_VELO_G25
Service display

Enable spindle
(controller enable NC,
enable on drive)

Define speed

Does the spindle rotate? — no

yes

Rotational direction OK? — no → Change MD 32100 AX_MOTION_DIR

yes

Specified speed 100rpm

Actual speed = setpoint speed? — no → Check MD 31000–31080 (encoder matching)

yes

1

9

Flowchart:

1

NST "Spindle within set range" (DB31–61, DBX83.5)? — no → **Check machine data and interface signals**
MD 35110–35140   Speeds for gear stages
MD 35150   Spindle speed tolerance
NST "Actual gear stage" (DB31–61, DBB16)
NST "Select set of drive parameters" (DB31–61, DBB21)
NST "Gear stage setpoint" (DB31–61, DBB82)
NST "Active set of drive parameters" (DB31–61, DBB93)

Change over gear stage

yes ↓

All gear stages tested? — no → Change over gear stage

yes ↓

Position spindle? — no → End

yes ↓

Position reached from high speed and zero speed? — no → **Check machine data**
MD 36000   Coarse exact stop
MD 36010   Fine exact stop
MD 32200 K_V factor
MD 35210   Acceleration in position control range
MD 35300   Creep speed
MD 36300   Encoder limit frequency
Check encoder matching
Check spindle synchronization (MD 34200)

Change over gear stage

yes ↓

All gear stages tested? — no → Change over gear stage

yes ↓

End

Drive Optimization with Start-Up Tool 10

10

10.1   Instructions for use

Scope of application

The start-up software "Start-up tool" is used to configure and parameterize drive systems on SINUMERIK 810D and 840D.

This tool can be used during initial start-up to enter the drive configuration and assign drive parameters with standard data records 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 make it possible to evaluate the most important speed and position control loop quantities as well as the torque control in the time and frequency range on the screen without any external measuring instruments.

Analog output

All important control loop signals on the position, speed and torque levels can also be output with the DAC configuration on external equipment (e.g. oscilloscope, signal recorder) via test sockets on the 611D drive modules.

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 can 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

Circularity test

A detailed description of the circularity test is given in:

References: /FB2/K3/ Compensations

Saving measurement results

The measurement diagrams can be archived via file functions, allowing machine settings to be documented and facilitating remote diagnostics.

10.1.1   System requirements

Hardware requirements

To be able to use the start-up tool, SW 3.1 and higher, the following hardware conditions must be fulfilled:

- IBM® AT-compatible PG/PC with DX486 microprocessor, e.g. SIMATIC PG 740

- At least 4MB of main memory (ideally 8MB)

- Floppy disk drive (3 1/2" or 5 1/4")

- Hard disk drive for managing data

- Monochrome or color monitor (VGA)

- Keyboard

- MPI interface

- Mouse

- Connecting cable to link PG/PC and NCU module.

Software requirements

Software configuration for start-up tool, software version V3.1x and higher

- MS-DOS operating system®, version 3.1 or later

- WINDOWS™ operator interface, version 3.1 or later.

10.1.2   Installation

Read.me

Please observe the contents of the Read.me 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 floppy disk and start the SETUP.BAT file by means of the WINDOWS™ file manager.

Enter the interface parameter node ID and baud rate (depending on interface used) in file S7CFGPGX.DAT in the MPI driver directory using an ASCII editor.

Input for interface: X101: 3 ($\doteq$ 1.5 Mbaud)

Operator inputs

The installation program requests all further necessary inputs and floppy disk changes in user dialog.

10.1.3   Starting the program

Calling the program

To start the start-up tool on a PG/PC, go to the file manager and double-click on the file REG_CMD.EXE or select a user-defined icon in the Application group. If it is not possible to communicate with the NCK, then the message "No communication with NCK" is output. If communication is interrupted, e.g. through an NCK RESET, then the start-up tool tries to reestablish the link automatically.

10.1.4   Terminating the program

Deselecting the program

The start-up tool is deselected by the following actions:

- Press function key **F10**

- You can terminate the program by activating the **Exit** soft key.

10.2   Measuring functions

Explanation   A range of measuring functions allow the time and/or frequency response of
                         drives and closed-loop controls to be displayed in graphic form on the screen.
                         For this purpose, test signals with an adjustable interval are connected to the
                         drives.

**Measurement/   The test setpoints are adapted to the application in question by means of mea-
signal parameters**   surement or signal parameters, the units of which are determined by the rele-
                         vant measuring function or operating mode. The measurement or signal param-
                         eter units are subject to the following conditions:

Table 10-1   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	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 msecs
Frequency	Specified in Hz

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**Additional   The default setting for all parameters is 0.
information**
                         Functions which initiate a traversing motion are selected via the soft key 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 tra-
                         versing motion being initiated, then the function selection is reset.

                         Once the traversing function has been started, the basic display can be dese-
                         lected without any affect on the traversing motion.

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 such 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** button is within reach.

- there are no obstacles in the traversing path.

Traversing motions can normally be aborted with

- **NC-STOP** key

- **RESET** key

- **STOP** soft key in any basic display.

or by canceling the

- controller enabling command

- drive enable signal

- traverse enabling signal

- feed or spindle enabling command

or with the 0% position on the feedrate override switch or 50% position on the spindle override switch.

NCK or drive alarms (e.g. "Function abort by NC") likewise cause a traversing motion to be aborted. For further details, please refer to Section 10.4 "Aborting measuring functions" or in:
References: /DA/, Diagnostics Guide

Important

NC **JOG** mode must be selected when measuring functions are started, thus ensuring that no axis or spindle can be moved by the parts program.

10.3   Interface signals: Drive test travel request and travel enable

Explanation

Axes with a mechanical brake may need the brake to be activated in some cases. The function **Enable with PLC** in the basic display of the relevant travel function

In the PLC user program, the request signal **Travel request** (NCK→PLC) generated by selecting the measuring function

– DB31–DB61, ... DBX61.0 "Drive test travel request"

and the acknowledgement signal for **Motion enable** (PLC→NCK)

– DB31–DB61, ... DBX1.0 "Drive test travel enable"

can be linked accordingly.

This safety mechanism can be deselected by setting **Enable without PLC**.

References: /FB1/, A2, "Various interface signals and functions"

Deactivate monitoring

For axes with endless traversing range, traversing range monitoring can be deactivated.

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10.4   Aborting measuring functions

- EMERGENCY STOP

- NC stop

- RESET (mode group, channel)

- Feed override = 0

- Spindle override = 50

- No controller enabling command

- Change in operating mode (JOG) or operating mode JOG not selected

- Actuation of traversing keys

- Actuation of handwheel

- No traversing enable signals

- Alarms leading to axis shutdown

- Hardware limit switch reached

- Traversing range limits exceeded

- Selection of parking (in position-controlled operation).

10.5   Frequency response measurement

10.5.1   Measurement of torque control loop

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

1. Set the traversing range monitoring function and enabling logic in the **basic display.**

2. Set the necessary parameters in the **measuring parameter display**

3. Display the results of the measurement on the screen with soft key **Display**

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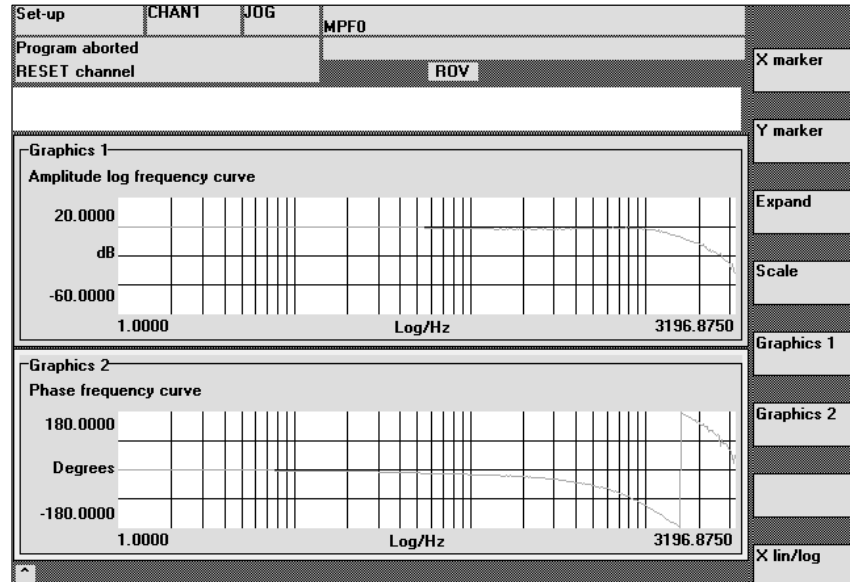
Fig. 10-1   Display diagram: Example of current control loop

Measurement parameter

Amplitude

This parameter determines the magnitude of the test signal amplitude (unit: peak torque specified in %). Values between 1% and 5% are suitable.

Bandwidth
Analyzed frequency range

• 4.0kHz at 840D, double axis module (sampling rate 16.0kHz).

• 0.8kHz on the 840D (sampling rate 16.0kHz).

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 10ms is recommended.

Additional information

The measuring parameters and the results of the measurement (diagrams) can be loaded and saved with soft key **File functions**.

10.5.2   Measurement of speed control loop

Functionality

This measurement function basically analyzes 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**.

1. Set the traversing range monitoring function and enabling logic in the **basic display.**
   Four different types of measurement are available for testing the speed control loop:

• Reference frequency response

• Interference frequency response

• Setpoint step change

• Disturbance step change

2. Set the necessary parameters in the **measuring parameter display**

3. Display the results of the measurement on the screen with soft key **Display**.
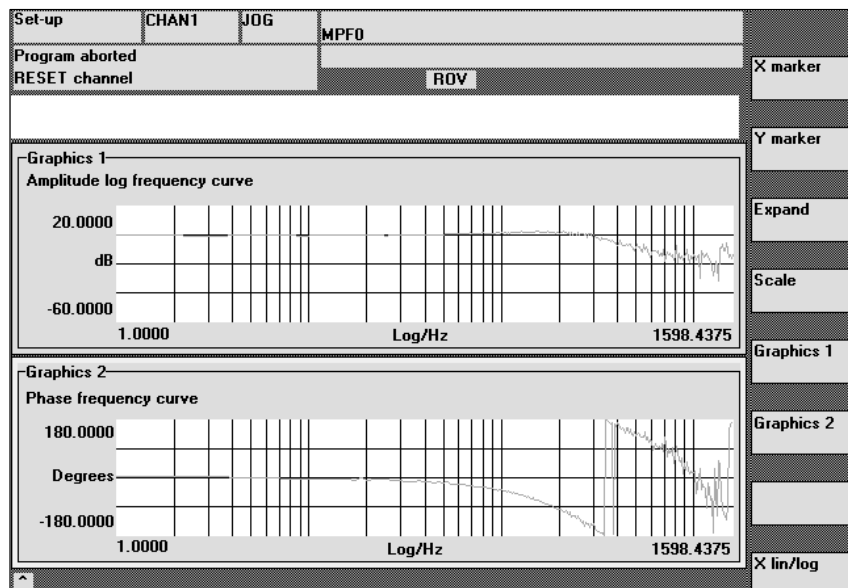
Fig. 10-2   Display diagram: Example of speed control loop

Reference frequency response

The frequency response measurement calculates the response of the speed controller. The response range should be as wide as possible and without resonance. It may be necessary to install stop or low-pass (611D) filters. Particular care must be taken to prevent resonance within the speed controller limit frequency range (stability limit approx. 200–500Hz).

Interference frequency response

Alternatively, the interference frequency response can be recorded in order to assess how well the control suppresses interference.

Measurement 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.

SW 4.1 and higher:

- The **Offset** is run up via an acceleration ramp.

- The acceleration value is defined for one
  axis: check MD 32300: MAX_AX_ACCEL
  spindle: check MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL
              MD 35210: GEAR_STEP_POSCTRL_ACCEL

- The following applies: Acceleration value = 0, no ramp
                           Acceleration value > 0, ramp active

- The actual measuring function is only activated when the offset value is reached.

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Bandwidth
Analyzed frequency range

•   4.0kHz on the 840D (sampling rate 8.0kHz).

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 0.2sec and 1sec is recommended.

Setpoint/ disturbance step changes

The transient response (response to setpoint changes or disturbances) of the speed control in the time range can be assessed with the step stimulation function. The test signal is connected to the speed controller output for recording of the response to disturbances.

Measurement parameters for setpoint/ disturbance step changes

Amplitude
This parameter determines the magnitude of the specified setpoint or disturbance step change.

Measuring time
This parameter determines the recorded time range (maximum 2048 x speed controller cycles).

Offset (SW 4.1 and higher)
You can select a small offset of a few motor rpm to preclude the influence of static friction.

SW 4.1 and higher:

•   The **Offset** is run up via an acceleration ramp.

•   The acceleration value is defined for one
    axis: check MD 32300: MAX_AX_ACCEL
    spindle: check MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL
                MD 35210: GEAR_STEP_POSCTRL_ACCEL

•   The following applies: Acceleration value = 0, no ramp
                                Acceleration value > 0, ramp active

•   The actual measuring function is only activated when the offset value is reached.

Settling time
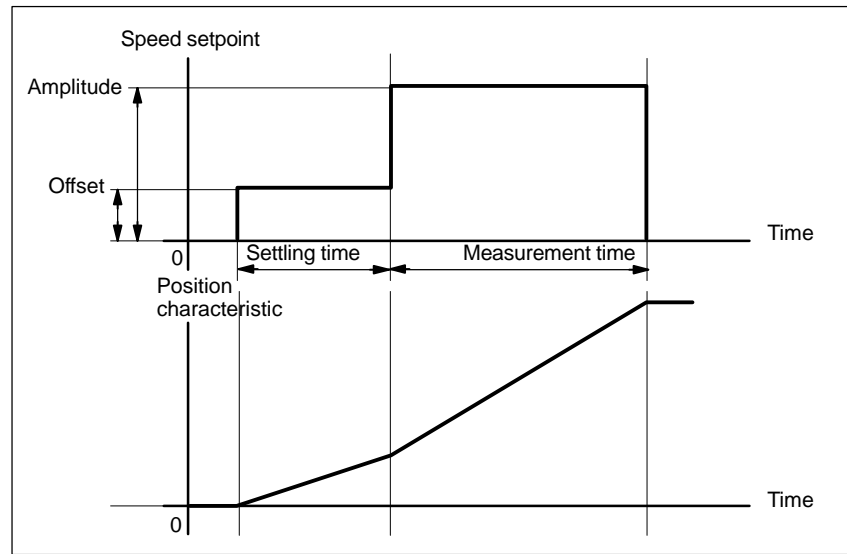This value represents the delay between measured data recording / test setpoint output and the injection of the offset.

Fig. 10-3   Setpoint signal with "Speed control loop step change response" measurement
             function

**Additional
information**

The measuring parameters and the results of the measurement (diagrams) can
be loaded and saved with soft key **File functions**.

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10.5.3   Measurement of position control loop

Functionality

This measurement function basically analyzes the response to the position measuring system. If the function is activated for a spindle without a position measuring system, the NCK generates an error message. Depending on which basic measurement setting has been selected, various measurement parameters lists as described below are made available.

Procedure

1. Set the traversing range monitoring function and enabling logic in the **basic display.**
   One of three different types of measurement can be selected:

- Reference frequency response

- Setpoint step change

- Setpoint ramp

2. Set the necessary parameters in the **measuring parameter display**

3. Display the results of the measurement on the screen with soft key **Display**.
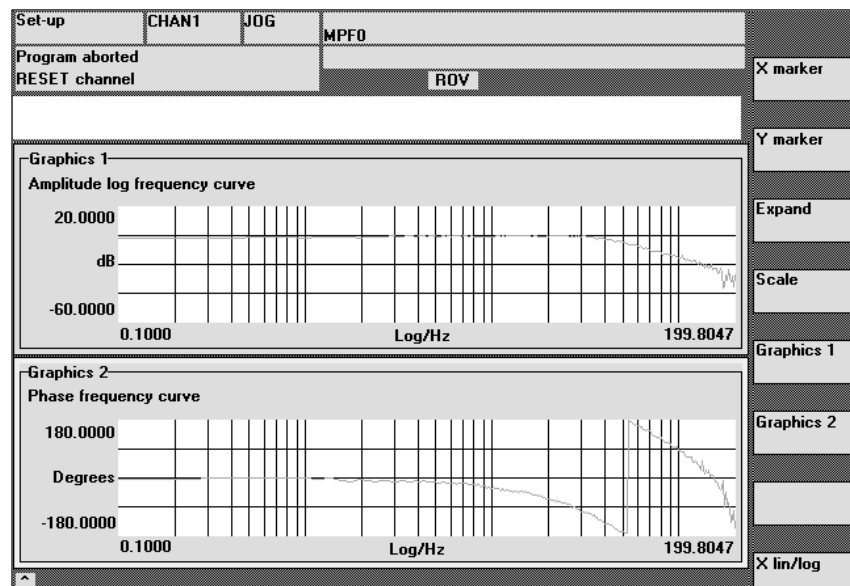
Fig. 10-4   Display diagram: Example of position control loop

Reference frequency response

The reference frequency response measurement determines the response of the position controller in the frequency range (active position measuring system). The setpoint filters, K_v value and feedforward control must be parameterized such that resonance is avoided wherever possible over the entire frequency range. In the case of dips in the frequency response, the setting of the feedforward control balancing filters should be checked. Excessive resonance requires

1. Decrease of the K_v value

2. Decrease of the feedforward control value

3. Use of setpoint filters.

The effects of these measures can also be checked in the time range.

Measurement 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. 0.01mm).

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. 200kHz with position controller sampling time of 2.5 msec).

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 0.2s and 1s 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:

10

- Actual position value (active position measuring system)

- Control deviation (following error)

Measurement 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 duration
In basic setting **Setpoint ramp** the position setpoint is preset according to the set ramp duration. In this case, the acceleration limits which currently apply to the axis or spindle are effective.

A jerking motion can be set with the axis-specific NC MD 32410 AX_JERK_TIME (when NC MD 32400 AX_JERK_ENABLE is set to 1).

The position setpoint and the actual value of the active measuring system are recorded.
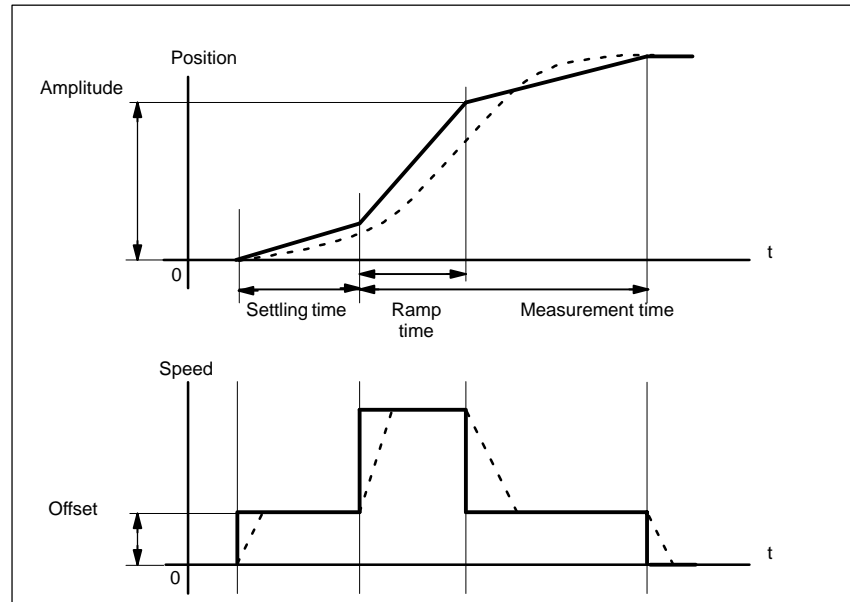

Fig. 10-5   Signal waveform with position setpoint / ramp measuring function

At maximum axis velocity, there is a (virtual) step change in the velocity (continuous line).

The curves represented by the dashed line correspond to a realistic, finite value. The offset component is excluded from the display graphic in order to emphasize the transient processes.

Step height

In order to avoid damage to the machine, the step height for the setpoint step change is limited to the value specified in MD 32000 MAX_AX_VELO. This can prevent the desired step height from being achieved.

The machine data MD 32000 MAX_AX_VELO and MD 32300 MAX_AX_AC-CEL have the same effect in the ramp area.
The MD 32000 MAX_AX_VELO limits the ramp rate of rise (velocity limitation), whereby the drive does not reach the programmed end position (amplitude).
The acceleration limitation caused by MD 32300 MAX_AX_ACCEL "rounds" the transition at the beginning and end of the ramp.

> **Danger**
>
> Changes should not be made to the MD 32000 MAX_AX_VELO and MD 32300 MAX_AX_ACCEL machine data without being knowledgeable, for example just to achieve a specific jump height. These MD have been set to exactly correspond to the machine!

10.6   Graphic display

Explanation   The display is called by pressing the **Graphics** soft key in the basic display of
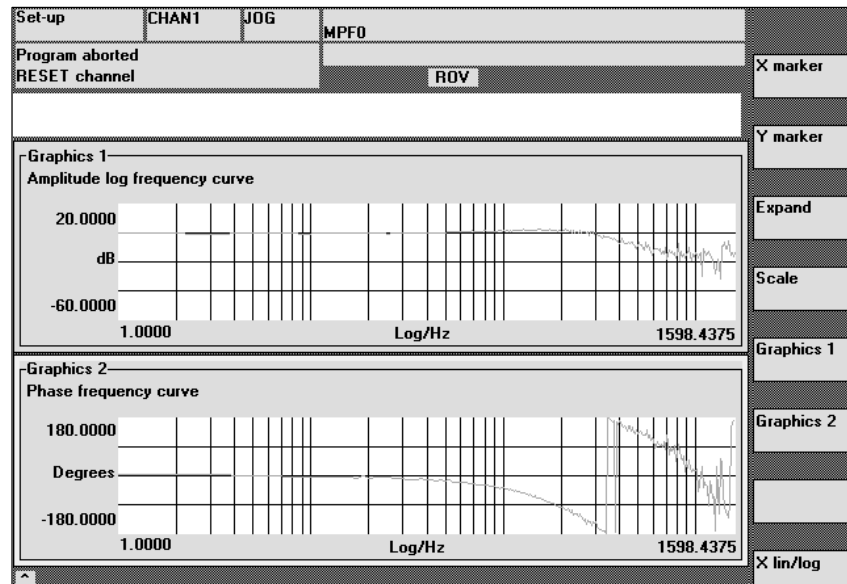   the measuring function.

Fig. 10-6   Display diagrams 1 and 2 of speed control loop

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Soft keys   These soft keys are used to switch backwards and forwards between the two
Graphics 1,   single graphic displays and the screen output with both graphics.
Graphics 2

Soft keys X marker   When these soft keys are selected, a vertical or horizontal line, which marks the
and Y marker   abscissa or ordinate, appears in the selected diagram. The associated coordi-
                                             nates are also output. The **X marker** or **Y marker** soft keys must be selected
                                             again in order to deselect the marker. The markers are moved by means of the
                                             cursor keys.
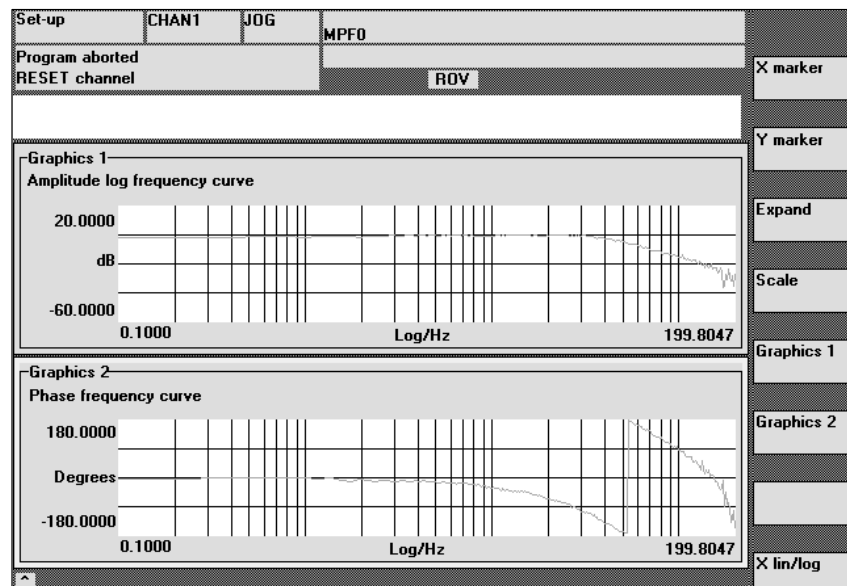
Fig. 10-7   Display diagram: Application of X or Y marker

Soft key Expand

To adapt the time scale, press soft key **Expand** which marks the current X marker position as the beginning of the range to be expanded. Then select soft key **Expand** again to move the X marker to the end of the range to be expanded and once again to display the marked area in full-screen size. Press soft key **Expand** again to return to the normal display. The **Expand** function is active only in the currently selected diagram.

Soft key X Lin/Log

With soft key **X Lin/Log** you can switch between the linear and logarithmic abscissa of the selected diagram.

Y scale

The Y scale is normally processed automatically. You can also define a scale manually with soft key **Scale**.

Note

The function generator and measuring functions must only be activated for the master axis of **GANTRY axes** in software versions up to and including 3.1. The slave axis traverses simultaneously because it is coupled to the actual value of the master axis. If the zero speed monitor on the slave axis responds, the monitoring window must be enlarged temporarily. The system does not reject activation of the function generator and measuring function for the slave axis or for the master/slave axes simultaneously, but such a measure is not recommended and may lead to damage to the machine if handled incorrectly. If it is absolutely essential to activate these functions for the slave axis in order to measure the machine, then the slave axis must be programmed as the master, and vice versa, temporarily.

10.7   Gantry axes (SW 5.1 and higher)

Axis groups were not supported by the previous "Measuring function" and
"Function generator" start-up tools. Software package 5 extends the existing
functionality of the MMC interface.
There is now an option for simple optimization by measuring the axes individu-
ally.

10.7.1   Description

The MMC interface allows the start-up engineer to measure each axis of the
gantry group separately.
The MMC configures the axes so that they execute identical movements.
The user can record the results simultaneously for up to two axes. This corre-
sponds to the previous measuring function for two independent axes.

10.7.2   Conditions

611D: only one function generator or measuring function can be activated on a
multiple module, i.e. the new functionality is only available if the gantry axes are
implemented on different modules.

References: /FB3/ G1, Gantry axes

10

10.8   Trace function (SW 4.2 and higher)

A trace displays monitored values and signals via a time interval. Servo trace provides functions with graphic user interface for checking and monitoring drive/ servo signals and states.

Function overview

Individual functions of the trace function

- Four trace buffers with up to 2048 values each

- Selection of SERVO, Safety Integrated, and 611D signals (in position control cycles)

- Trace/trigger signals can be set with the absolute address and value masking.

- Different trigger conditions to start recording.
  Triggering always on trace 1

- Pretriggering and posttriggering possible

- Measuring signal display

- Fixed Y scaling selectable for every trace or automatic scaling

- Marker function selectable for delimiting detailed areas for each trace. Expand function on the time axis (zoom X).

- Selective loading and saving of the measuring parameters and traces

- Up to ten signal tracks per trace for bit-coded Safety Integrated signals

- Options for displaying and printing traces.

Note

The trace function can be used only with MMC 102/103 or the start-up tool. It is possible to represent bit-coded Safety Integrated signals in ten tracks above the measuring interval for HMI Advanced on SW 6.2 and higher.

10-226   SINUMERIK 840D Installation and Start-Up Guide (IAD) – 11.02 Edition
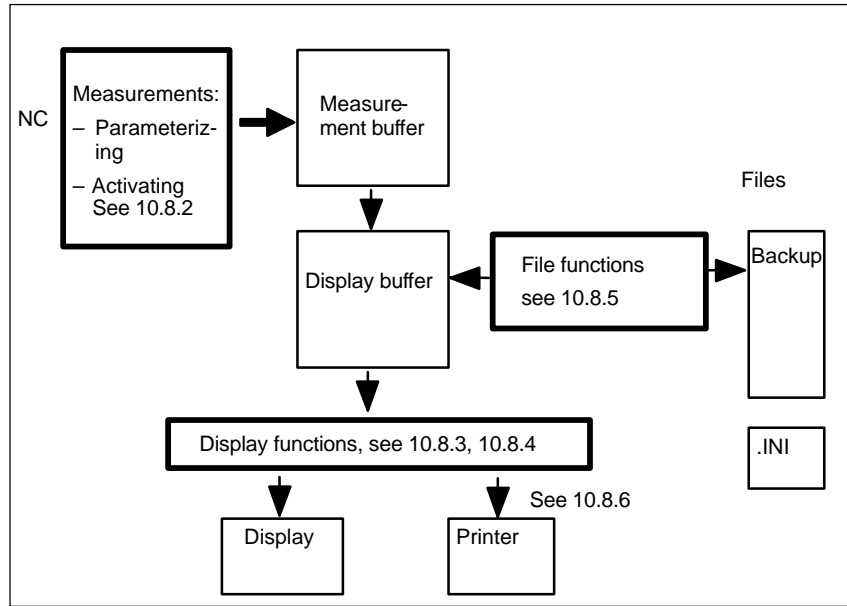
Fig. 10-8   Overview of function groups

You can select measuring signals and set the measuring parameters with soft
keys and dropdown lists. The function is operated using the mouse or key-
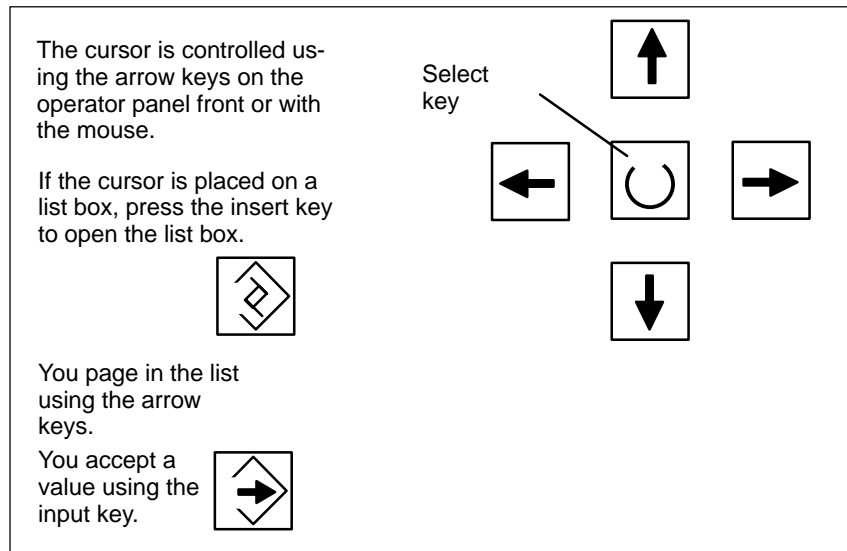board.

Operation

Fig. 10-9   Cursor control

10.8.1   Basic display

**Basic display
Servo trace**

You can access the basic display of the trace function with the soft keys
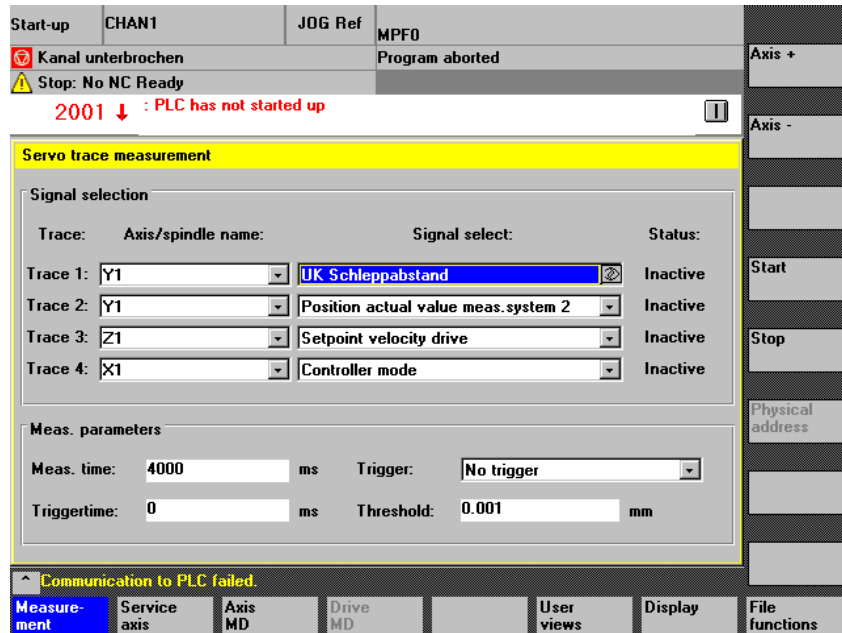**Drives/servo \ Servo trace**.

Fig. 10-10   Basic display of servo trace

10.8.2   Parameterizing and activating measurements

**Parameterizing
in the basic
display**

The following selection is made in the basic display

- The axis/spindle to be measured

- The signal to be measured

- The duration of measurement

- The triggering time

- The type of triggering

- The triggering threshold.

Signal selection

Input field
axis/spindle name

The cursor must be positioned on the "Axis/spindle name" list box of the trace
concerned. You can select it with the soft keys **Axis+** and **Axis–** or by accepting
a value from the dropdown list.

Input field Signal selection	The cursor must be on the "Signal selection" list box of the trace concerned. You can select a value by accepting it from the dropdown list.
	The options that can be selected depend on your configuration and which functions are active.

Measurement parameters

Measuring duration field	The measuring time is written directly into the "Measuring duration" field.
Triggering time field	Direct input of pretriggering and posttriggering. With negative input values (sign minus –) recording starts in advance of the triggering event by the time set.
	With positive input values (without sign) recording starts the time set after the triggering event.
	Condition: Triggering time + measuring duration $\geq$ 0.
Trigger field	The type of triggering is selected from the "Trigger" dropdown list. The trigger always refers to trace 1. Once the triggering conditions are fulfilled traces 2 to 4 are started simultaneously.

Settable triggering conditions:

- No trigger, i.e. measurement starts when you operate the soft key **Start** (all traces are started in synchronism).
- Positive edge
- Negative edge
- Trigger event from the parts program.

Threshold field	Direct input of the triggering threshold.
	The threshold is only active with the types of triggering "Positive edge" and "Negative edge". The unit refers to the signal selected.
Soft keys Axis + Axis –	Selects the axis/spindle when the cursor is positioned on the corresponding "axis/spindle name" list field.
	You can also select the axis/spindle directly in the list box from the dropdown list using the cursor.
Soft keys Start Stop	With the **Start** soft key, trace function recording is started. With the **Stop** or RESET soft key, you can cancel a running measurement.

10

Physical address soft key

The output point is the basic display of the servo trace function.

- The signal type "physical address" must be selected in the trace.

- The cursor in the trace must be in the associated field of the signal selection (to physical address).

If you press the soft key **Physical address** the input screen form is displayed.

Note

This function is only required in exceptional cases, for example, if the information provided by the known signals (see "Signal selection" list field) is not adequate. Please discuss how to proceed after that with the SIMODRIVE hotline.
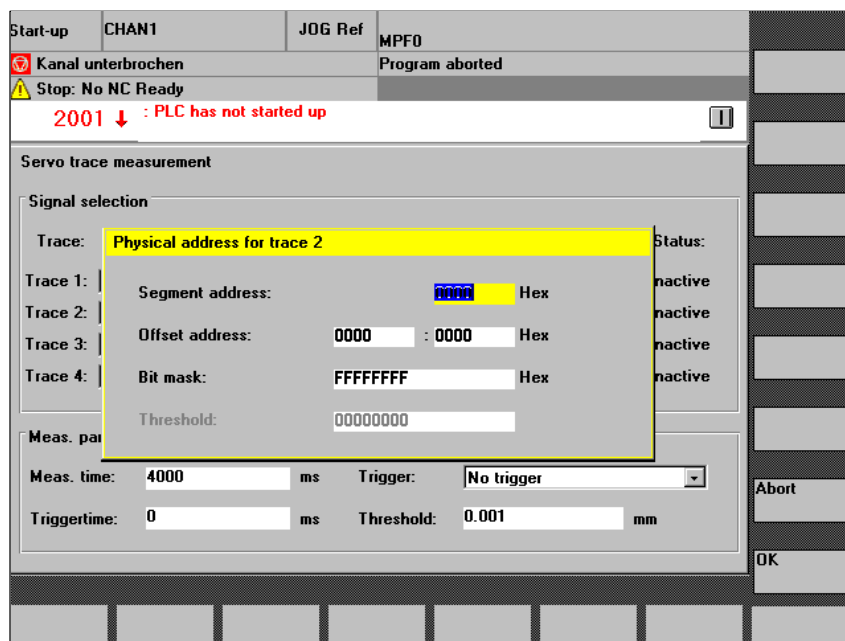
Fig. 10-11   Input screen form for parameterization of the physical address

All parameters are input in hex format.

Segment address field

Direct input of the segment address of the signal to be recorded.

Offset address field

Direct input of the offset address of the signal to be recorded.

Mask field

If you only want certain bits to be displayed you can select them here.

Threshold field

The field labeled "Threshold" is only used to enter the triggering threshold for the physical address of trace 1. If you exit the input screen form with the **OK** soft key, this hex value is then entered in the field "Threshold" of the basic servo trace display.

Start measurement   After parameterization, measurement is started by operating the soft key **Start**. How measuring is performed depends on the conditions defined under measuring parameters/"Trigger" field.

End of measurement   Measurement is terminated after the time set under measuring parameters/input field "Measuring duration" or is stopped when you operate the soft key **Stop**. Results of an interrupted measurement cannot be displayed (soft key display).

The end of measurement is signaled to the user by an appropriate message in a dialog line.

General   If the user has performed measurements with values/signals, they will be stored in the measured value buffer and remain valid until they are replaced by measured value files by the file function or by measured values that are supplied when a measurement is started again.

10

10.8.3   Display function

After measurement, you can display the result in graphical form.
By pressing horizontal soft key **Display** Fig. 10-12 is displayed.
The measured traces are displayed as a diagram.

Graphic1 shows trace 1 (green) and trace 2 (blue), graphic2 trace 3 (green) and trace 4(blue).
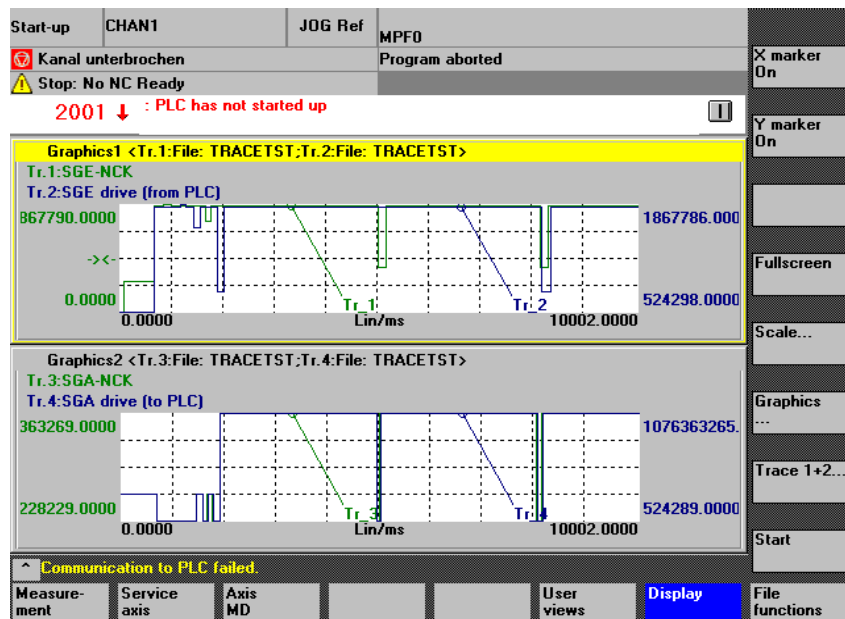

Fig. 10-12   Display of graphic1 and graphic2 with 2 traces each

Soft keys
X marker
Y marker

The X/Y marker is switched on or off in the active graph. The corresponding position value is displayed in the graph. You can move the markers with the cursor keys.

Soft key
Full-size display

After a zoom display (see below), you are taken back to the original display as shown in Fig. 10-12.

Soft key
Scale...

After selection of this soft key, Fig. 10-13, Y axis scaling, appears on the screen. You can scale the relevant traces in this display.
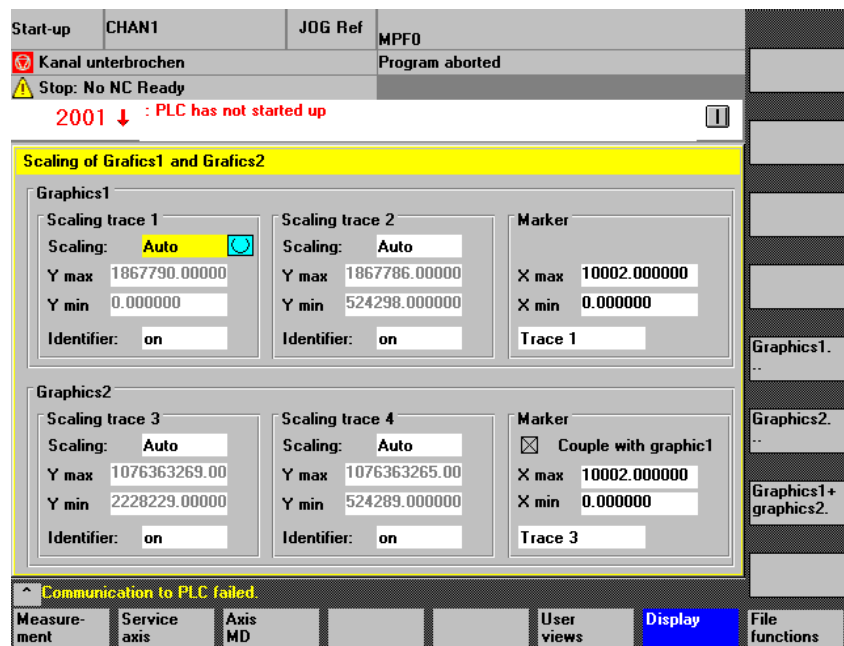
Fig. 10-13   Scaling of Graphics1 and Graphics2

Vert. soft key for scale...

The scaling options include automatic scaling and fixed scaling (select key) of the Y axis for each trace channel:

Auto
The minimum value and the maximum value is automatically calculated from the measured values

Y Min, Y Max fields
show the limit values resulting from the measurement if auto is selected.

Fixed
the user selects the minimum value and the maximum value for the trace channel themselves

Y Min, Y Max input fields
can be assigned user-defined values if fixed is selected.

With "fixed" scaling the inputs are only transferred to the graphics when you exit the display.

For the marker you can define either that movement will occur in both graphics simultaneously ("Link with graphic 1" set for graphic 2) or that each graphic will have a separate marker.

The image can be exited either using the vertical soft keys "Graphic1..." or "Graphic2..." or "Graphic 1+ Graphic 2...".

10

10.8   Trace function (SW 4.2 and higher)

Soft key Graphic ... The vertical soft key graphic ... in Fig. 10-12 takes you to a submenu from which you can select the functions:
– Bit selection, see 10.8.4
– Graphic 1, 2 selection for enlarged display
– Print graphics, see also 10.8.6
– Printer selection (real printer or bitmap file in directory
  dh\dg.dir\bitmap.dir).

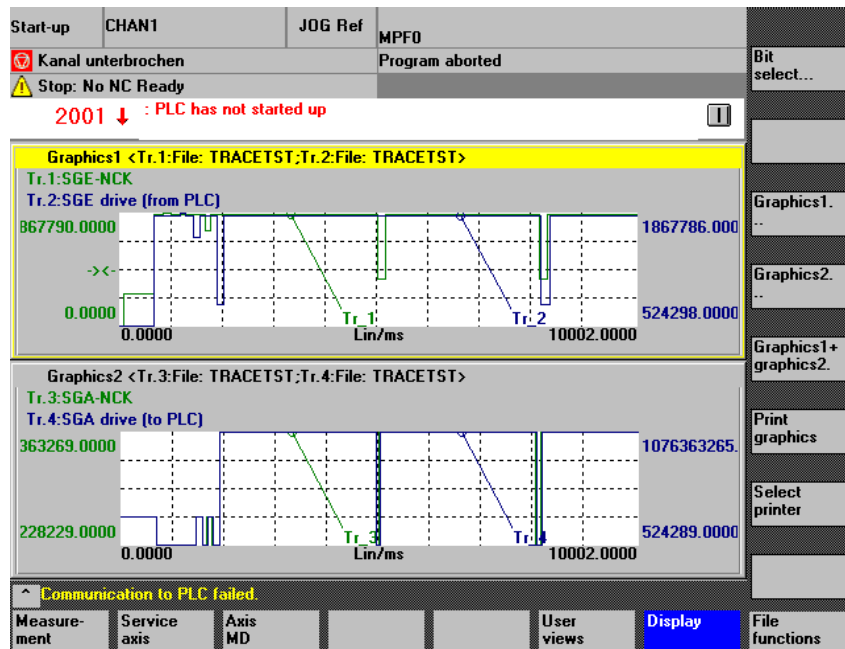The following menu appears:

Fig. 10-14   Menu Graphic ...

**Soft key
Trace 1+2
Trace 3+4**

With the **Trace 1+2 ...** soft key you can select a single trace from the graphic with the focus to view it in more detail.
Pressing once shows trace 1 in graphic 1 (if the focus is on graphic 1).
Pressing a second time shows trace 2 in graphic 1 (if the focus is on graphic 1).
Pressing a third time shows traces 1 + 2 together in graphic 1 (if the focus is on graphic 1).

If the focus is on graphic 2, the soft key is labeled Trace 3+4 ... Its effect is analogous, i.e. trace 3, trace 4, or trace 3+4.

**Switching between
graphics 1 and 2**

The active graphic with 2 traces is highlighted (focus). CTRL TAB lets you activate the other graphic.

Zoom in time axis

The operator actions described above includes setting a marker. After an X marker has been set, the third vertical soft key will allow you to set a 2nd X marker. This defines a time interval from the trace. The third vertical soft key is then labeled "Zoom X".

Pressing this sofkey extends the range between the two X markers across the time axis in such a way that it fills the entire available range on the display. This permits precise observation of signal curves.

Zoom in the zoom
It is possible to set a marker when you are already in the extended display and zoom again by defining a further time interval with 2 X markers.

Shifting measurement curves

If measurement curve displays (trace1, trace 2 or trace 3, trace 4) coincide, making them difficult to evaluate, it is possible to shift the active trace with Cursor Up or Cursor Down.

10

10.8.4   Displaying bit graphics for SI signals

Function

From 10 signal bits from Safety Integrated, 10 tracks can be displayed graphically over the measurement time. Triggering and measurement is described in the previous sections.

Procedure

- Selection of signals

- Assignment of signal bits to tracks

- Display of signals as bit graphics

Requirement

If a bit-coded SI signal is selected with the signal selection, there will be a vertical soft key "Bit selection Trace i" for the trace.
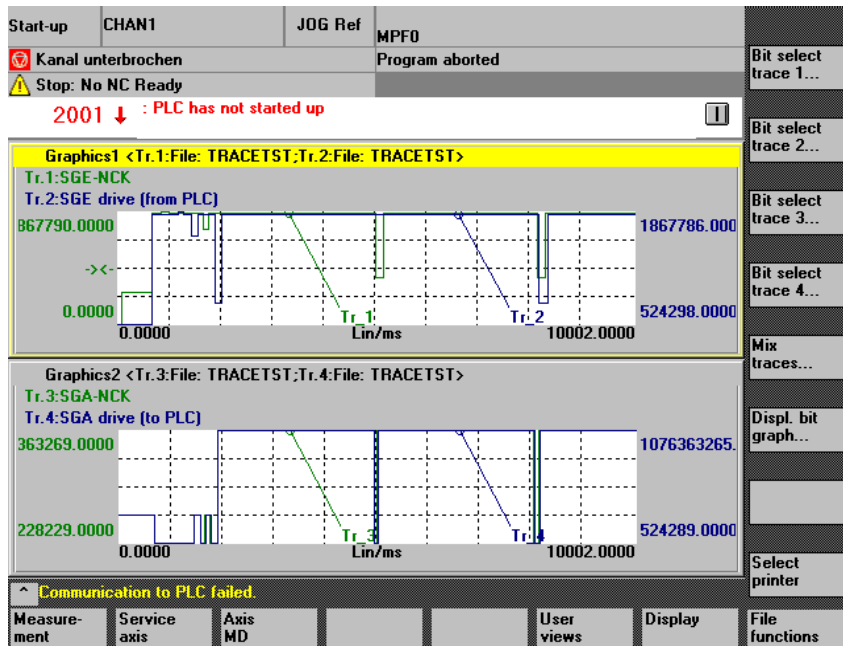

Fig. 10-15   Selected bit-coded SI signals

Bit selection Trace i

If you press this soft key, you will obtain a screen form for assigning individual signal bits to display tracks.
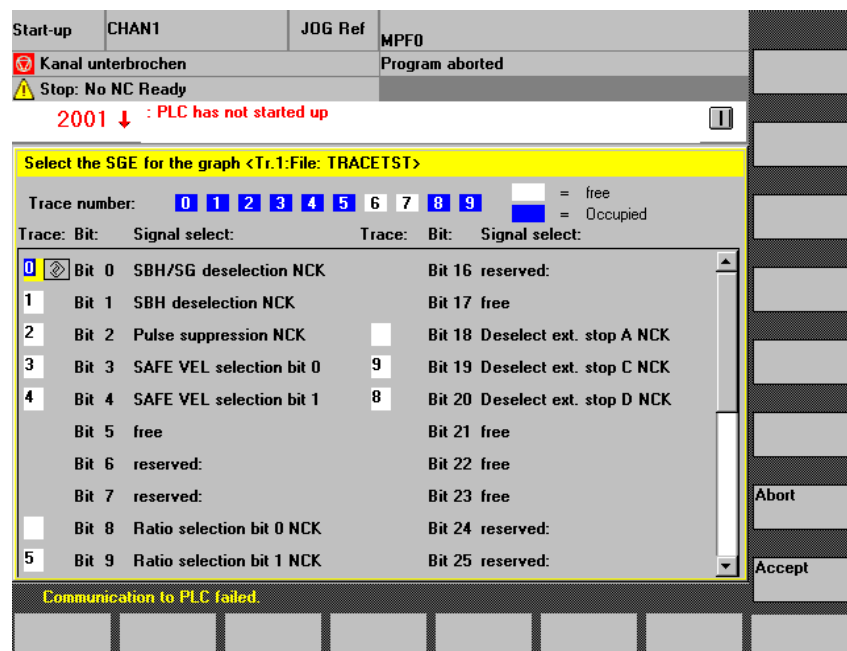
Fig. 10-16   Assigning signals to tracks (example of trace 1)

How to proceed

For each of the not free/reserved bits of the signal, you can enter a track number 0 – 9 corresponding to tracks 0 – 9 in the assigned input field. The "track number" line indicates which of the tracks is already assigned or not free. To visualize bits > 25, you can scroll vertically.

File HMI_ADV\IBSVTSI.INI stores the start values for the assignment. You can change these with the screen form shown in Fig. 10-16.

Soft key Accept

The current assignment is placed in file HMI_ADV\IBSVTSI.INI and will be suggested again the next time the signal is selected.

Soft key Cancel

Exits the screen form without changing file HMI_ADV\IBSVTSI.INI.

Mixing traces

You can select up to 10 tracks from a maximum of 4 traces whose bit tracks you have assigned as described above and display them together in one displayl for purposes of comparison.

When evaluating Traces and Trace Mix always be sure to compare measured values from the same trigger event and over the same measurement period. See also Section 10.8.5.

Soft key Trace Mix

The soft key is accessible from Fig. 10-15. This results in the following display:
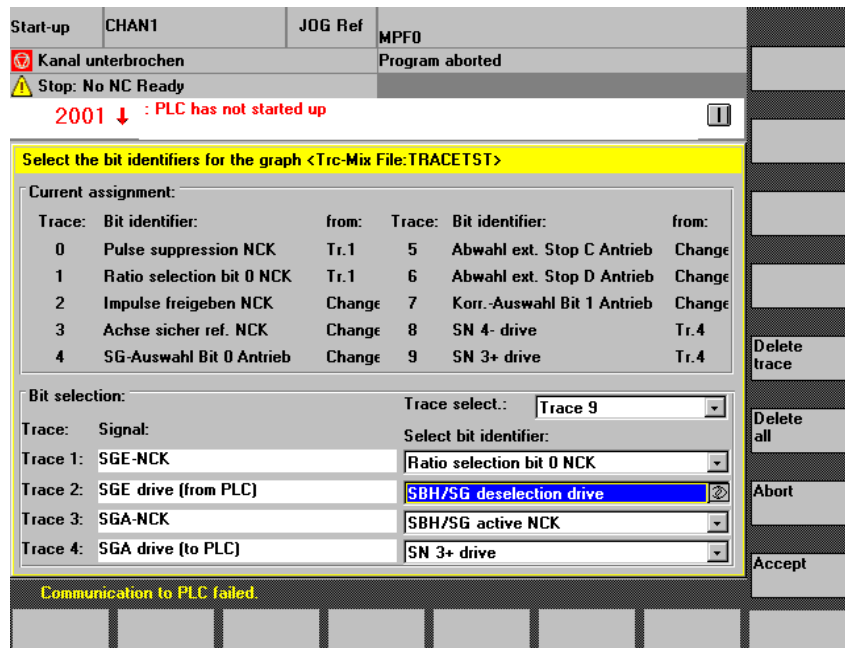
10

Fig. 10-17   Setting up a Trace Mix

The upper portion of the display shows the current assignment of tracks together in a trace mix.

The bit selection portion of the display lets you select the bit identifier for each of the traces from which you want to put signals in the trace mix from a drop-down menu and to enter the required track of the trace mix in input field "Track selection:" or select it from the drop-down menu.

Soft key Delete track

The selected signal is removed from the trace mix.

Soft key Delete all

All signal assignments are removed from the trace mix.

Soft key Cancel

Exits the screen form without changing file HMI_ADV\IBSVTSI.INI.

Soft key Accept

The current assignment is placed in file HMI_ADV\IBSVTSI.INI and will be suggested again the next time the trace mix is selected.

Soft key Display bit graphics ...

The soft key is accessible from Fig. 10-15. This results in the following display:
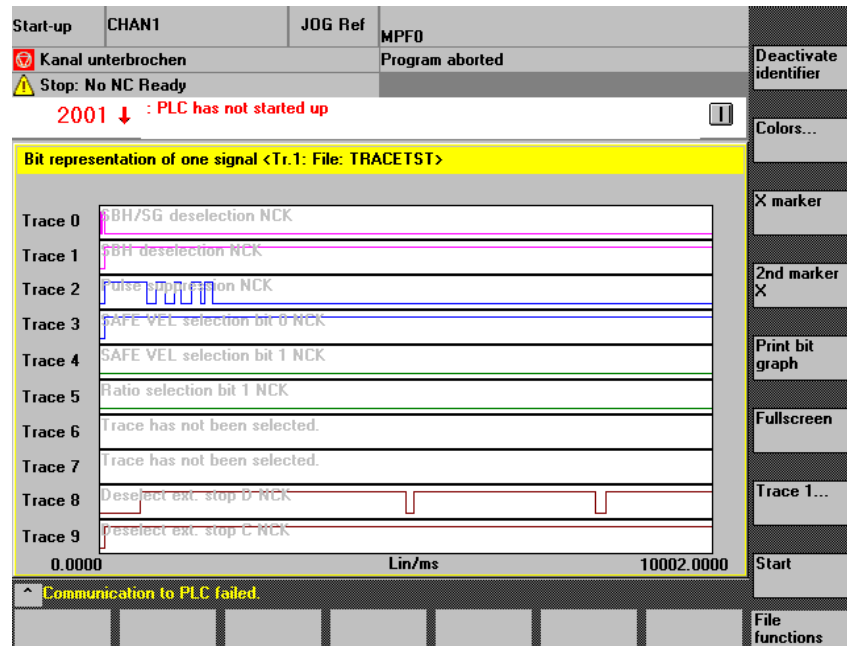

Fig. 10-18   Bit graphics, example trace 1

Up to 10 tracks are displayed over the time of the measuring interval. You can alter the display to meet your requirements or print out the bit graphics with the vertical soft keys.

Soft key Hide identifiers

The signal identifiers for the signal curves are hidden/shown. This function is also available for extended displays. See Soft key "Zoom X".

Soft key Color

Gives you a submenu from which you can select one of the following under "Color scheme":

- User

- VGA

- VGA positive

- Monochrome

- Monochrome positive.

The color palette is then displayed in accordance with the selection you made. You can select one color for each track.

All signal identifiers are displayed in a single color.

How to proceed:

1. Select Track/Word "Identifier" with Cursor Up/Down. The focus is then on the palette.

2. Select color with Cursor Up/Down/Right/Left

3. Accept with Input/Return.

Vertical soft keys under color setting:

Save: The current color settings are accepted and the display
                   is not exited.

Cancel: The display is exited without changing the color
                   settings.

OK   The current color settings are accepted and the display
                   is exited.

After you have returned with Cancel or OK, you will again see the 10 track display as in Fig. 10-18.

Soft key X Marker   A vertical marking is inserted in the bit graphics. You can shift it along the time axis with Cursor Left/Right, e.g. up to the beginning of an interesting portion of the signal. The time associated with the marker position and the measured value interpreted as a number is displayed in the header above track 0.

The soft key is a toggle key between ON and OFF. Pressing X Marker OFF clears the marker.

Soft key 2nd X Marker   A 2nd vertical marker in a different color is inserted in the bit graphics. You can shift it along the time axis with Cursor Left/Right, e.g. up to the end of an interesting portion of the signal. The soft key is a toggle key and switches to the other marker if pressed again.

If a time interval is described with 2 markers, its size is displayed in the footer as delta t: ...ms. The 4th vertical soft key switches to "Zoom X".

Soft key Zoom X   The interval between the markers is extended to the full width of the available display area. The "X Marker ON" soft key is also available in the zoomed display. That allows you to set a marker again in the extended display.

The "Zoom X" soft key is also available for Trace Mix and has the same effect.

Soft key Full-size display   This soft key takes you back to the original signal curve display after zooming.

Soft key Trace 1 ...   You can use the 7th vertical soft key to switch successively from Trace 1 through Trace 4 and Trace Mix.

Soft key Print bit graphics   The function works like the function "Print graphics" for bit graphics. See also 10.8.6.

User
bit names

The following signals whose names can be defined/redefined by the user existed for Safety Integrated in addition to the signals with defined bit names:

Table 10-2   SI signals with changed bit identifiers

SI signal German	Bit	Identifier English
Ext. NCK-SPL interface inputs	0..31	EXT_NCK_SPL_INPUT_0 ... EXT_NCK_SPL_INPUT_31
	32..63	EXT_NCK_SPL_INPUT_32 ... EXT_NCK_SPL_INPUT_63
Ext. NCK-SPL interface outputs	0..31	EXT_NCK_SPL_OUTPUT_0 ... EXT_NCK_SPL_OUTPUT_31
	32..63	EXT_NCK_SPL_OUTPUT_32 ... EXT_NCK_SPL_OUTPUT_63
Int. NCK-SPL interface inputs	0..31	INT_NCK_SPL_INPUT_0 ... INT_NCK_SPL_INPUT_31
	32..63	INT_NCK_SPL_INPUT_32 ... INT_NCK_SPL_INPUT_63
Int. NCK-SPL interface outputs	0..31	INT_NCK_SPL_OUTPUT_0 ... INT_NCK_SPL_OUTPUT_31
	32..63	INT_NCK_SPL_OUTPUT_32 ... INT_NCK_SPL_OUTPUT_63
Ext. PLC-SPL interface inputs	0..31	EXT_PLC_SPL_INPUT_0 ... EXT_PLC_SPL_INPUT_31
	32..63	EXT_PLC_SPL_INPUT_32 ... EXT_PLC_SPL_INPUT_63
Ext. PLC-SPL interface outputs	0..31	EXT_PLC_SPL_OUTPUT_0 ... EXT_PLC_SPL_OUTPUT_31
	32..63	EXT_PLC_SPL_OUTPUT_32 ... EXT_PLC_SPL_OUTPUT_63
Int. PLC-SPL interface inputs	0..31	INT_PLC_SPL_INPUT_0 ... INT_PLC_SPL_INPUT_31
	32..63	INT_PLC_SPL_INPUT_32 ... INT_PLC_SPL_INPUT_63
Int. PLC-SPL interface outputs	0..31	INT_PLC_SPL_OUTPUT_0 ... INT_PLC_SPL_OUTPUT_31
	32..63	INT_PLC_SPL_OUTPUT_32 ... INT_PLC_SPL_OUTPUT_63

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Table 10-2   SI signals with changed bit identifiers

SI signal German	Bit	Identifier English
NCK-SPL markers	0..31	NCK_SPL_MARKER_0 ... NCK_SPL_MARKER_31
	32..63	NCK_SPL_MARKER_0 ... NCK_SPL_MARKER_31
PLC-SPL markers	0..31	PLC_SPL_MARKER_0 ... PLC_SPL_MARKER_31
	32..63	PLC_SPL_MARKER_32 ... PLC_SPL_MARKER_63

Operation

When a trace log is loaded for signals from the above table, you can operate:

Display/Graphics/<Trace i>

A display with the selected signal, its bits and, if necesary, a track assignment is displayed. For example:
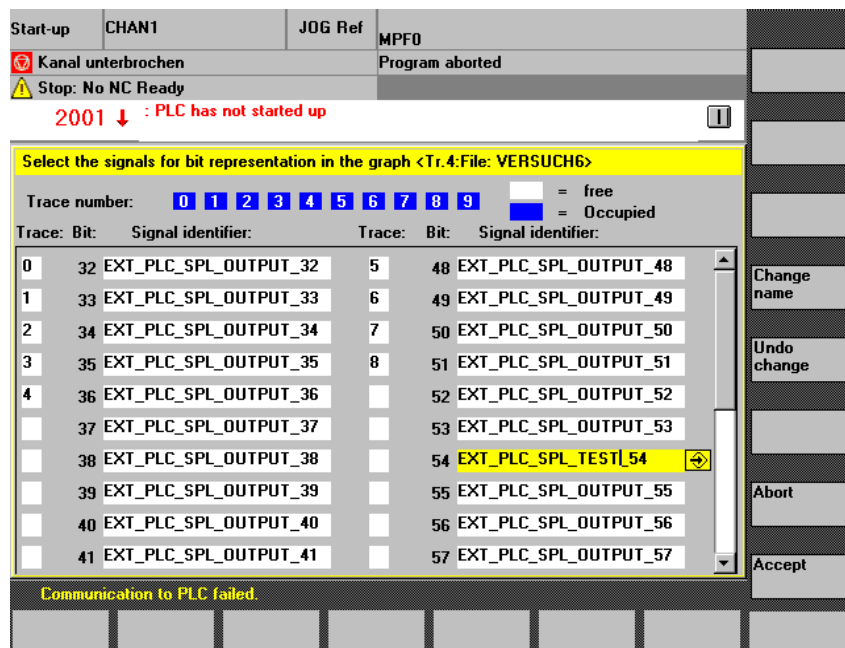
Fig. 10-19   Changed name for bit 54

Vertical soft keys

Change name

Go to the signal identifier you want to change with the cursor keys and enter a new identifier. Confirm with the Input key.

Undo change

The changes to the identifier are undone again.

Accept

The changed identifiers are accepted into file HMI_ADV\IBSVTSI.INI and displayed again in conjunction with this trace.

Cancel

Exits the display without changing the identifiers.

10

10.8.5   File function

Description

Use the **File functions** soft key to switch to the "File functions" display.

Here, you can save/load/delete the measurement settings and the measured values of the trace function.

The file functions are not intended to be a substitute for making a copy of all system and user data, e.g. for archiving or series start-up purposes.
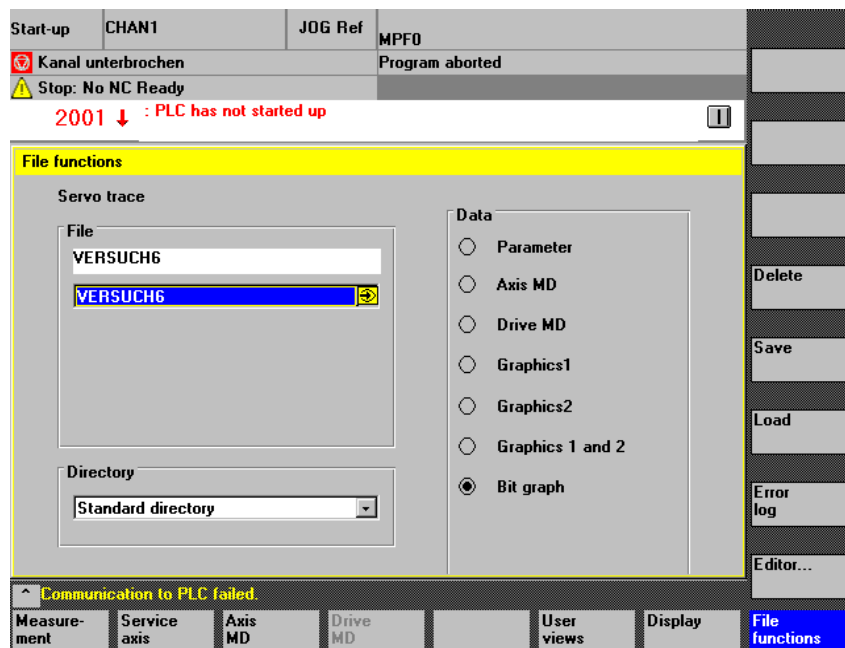

Fig. 10-20   File function servo trace

Assigning file names

In the "File" frame, you can select an existing file from the dropdown list or enter one in the text field underneath.

Selecting the directory

In the "Directory" frame, you can select the directory under which you want to save the file.
This can also be a directory under "Services" or the basic directory of data management (list entry: standard directory).

Selecting the data type

In the "Data" frame, you can select the data to be stored.
You can only select one data type. You select it using the cursor keys and accept it with the toggle key.

Vertical soft keys

Delete
The selected file is deleted with measured values and parameters.

Save
The displayed measured values and the parameters used for the measurement are saved in the set file. With the "Load" function, they are then available again for display, alteration (e.g. zooming), and printing.

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Load
A file that has previously been stored with the "Save" soft key will be placed in the display buffer and displayed when you press the horizontal "Display" soft key.

Traces displayed in the header show the filename, if the display originated from loading a file.

A submenu asks whether the existing display buffer will be replaced.

– "Cancel" prevents loading. That allows you to save the current measurement with the "Save" soft key before loading a new file.

– "Replace" accepts measured values and parameters from the file as current trace data. Measured data from the last measurement are lost if they are not first saved in a file with "Save".

Creating subdirectories

New directories are created in the "Services" area.
You create a new directory in "Data management" mode under the directory "Diagnostics".

See operating area Services.
References: /BA/, Operator's Guide

10

10.8.6 Print graphics

Printer setting

Soft keys **MMC \ Printer Selection** take you to the basic display for printer selection (Fig.10-21).

With the toggle key you can selection whether the graph displayed is to be sent directly to the printer or to a bitmap file when actuating the soft key **Print graphics**.
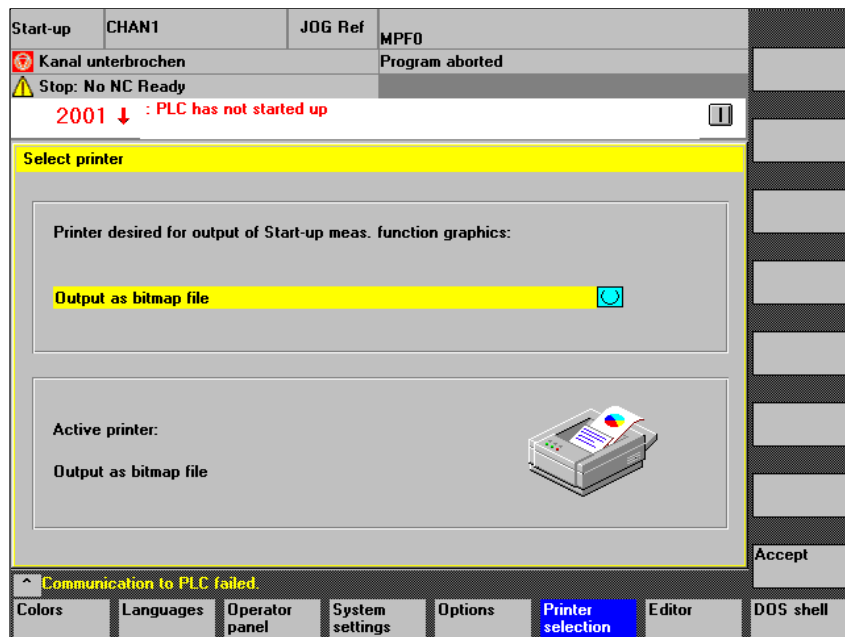
Fig. 10-21 Basic display of the printer selection

Direct output to printer

The printer must be set up under MS-Windows.

Set "Output to printer" in the selection field.
In the display called "Display" you can press the soft key **Print graphics** to output the graph displayed to the connected printer.

Output to bitmap file

You want to save the graph as a bitmap file (*.bmp).

In the selection field for printer setting, set "Output to bitmap file".

After you have pressed the **Print graph** soft key in the display called "Display", the screen form for assigning a file name is displayed (Fig. 10-22). In the drop-down list, you can enter a new file name or an existing file name for overwriting.
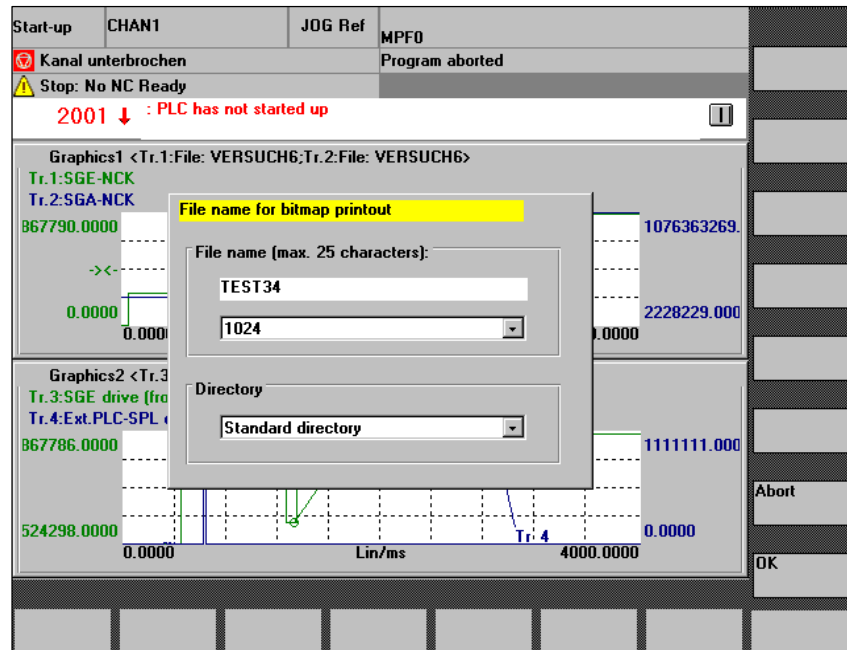
Fig. 10-22   Assigning signals to tracks (example of trace 1)

Assigning
file names

In the "File name" box, you can select an existing file from the dropdown list or
enter one in the text field underneath.

Selecting the
directory

In the "Directory" frame, you can select the directory under which you want to
save the file.
This can also be a directory under "Services" or the basic directory of data man-
agement (list entry: standard directory).

With the soft key **OK**, the file is saved.
With the soft key **Cancel** you can return to the current graphic display.

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10.9   Analog output (DAC)

Note

A description of the DAC function is to be found in
Reference   /FBA/, DD1, Diagnostic Functions

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10.10 Automatic controller adjustment (MMC 103 only, SW 4.3 and higher)

Functionality

Functions of automatic speed controller setting:

- Determination of the gain and RESET time in three different variants.

- Automatic determination of any current setpoint filters required (up to three band-stop filters).

- Display of the measured or calculated frequency response as with the measuring functions.

Note

If the tables natural resonance frequencies are very low (natural resonance frequency < 20Hz), the RESET time should be checked manually.
The setting may be too low.

Procedure

In the "Start-up" user area, select the "Drives/servo" soft key.

a) Normal case

In the extended menu tree, press the "Aut. controller setting" soft key. The "Automatic controller setting" basic display appears.
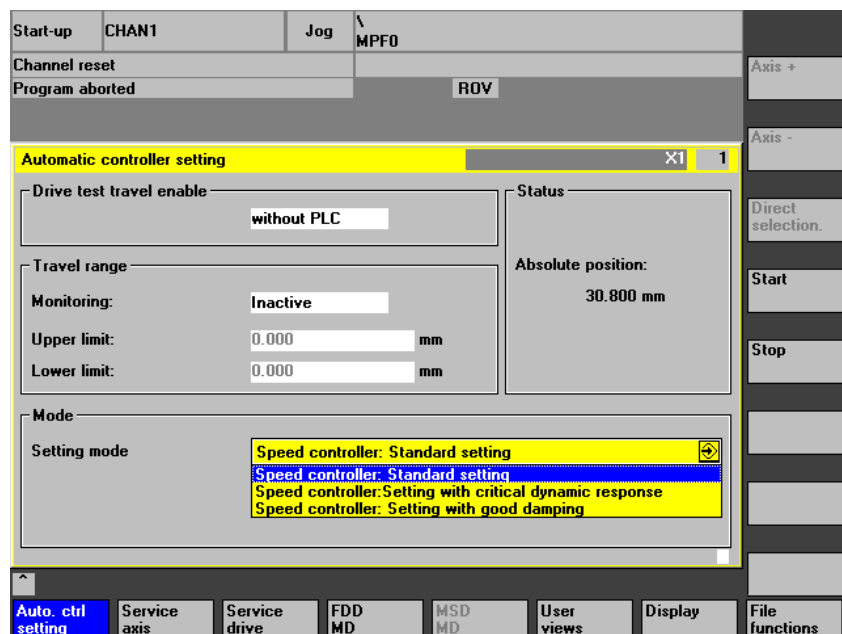
Auto. controller setting

Fig. 10-23 "Automatic controller setting" basic display

10

The entries in the "Drive test travel enable" and "Travel range" sections of the window have the same meaning as for the measuring functions.
The type of adjustment is defined in the "Mode" function area.

1. Select in the "Mode" function area the setting type "**Variant 1**".

2. Press the "Start" soft key.

3. Follow the interactive instructions
    (see flow chart below, boxes shaded gray).

4. When prompted, press the "OK" soft key.

5. When prompted, press the "NC Start" key.
    Caution: When you press NC Start, the axis starts to move!

To optimize further axes, select the axes with the "Axis+" or "Axis–" soft keys and repeat the procedure starting at step 1.

b) Special case: Changing the parameters

The controller setting can be

- parameterized,

- started,

- displayed and

- saved.

The type of adjustment is defined in the "mode" function area. Three different variants are available:

- Variant 1: Standard setting

- Variant 2: Setting with critical dynamic response

- Variant 3: Setting with good damping.

Vertical soft keys

"Axis+" soft key:
Selects the next axis to be optimized.

"Axis" soft key:
Selects the previous axis to be optimized.

"Direct selection" soft key:
Allows direct selection of the axis to be optimized in a dialog window.
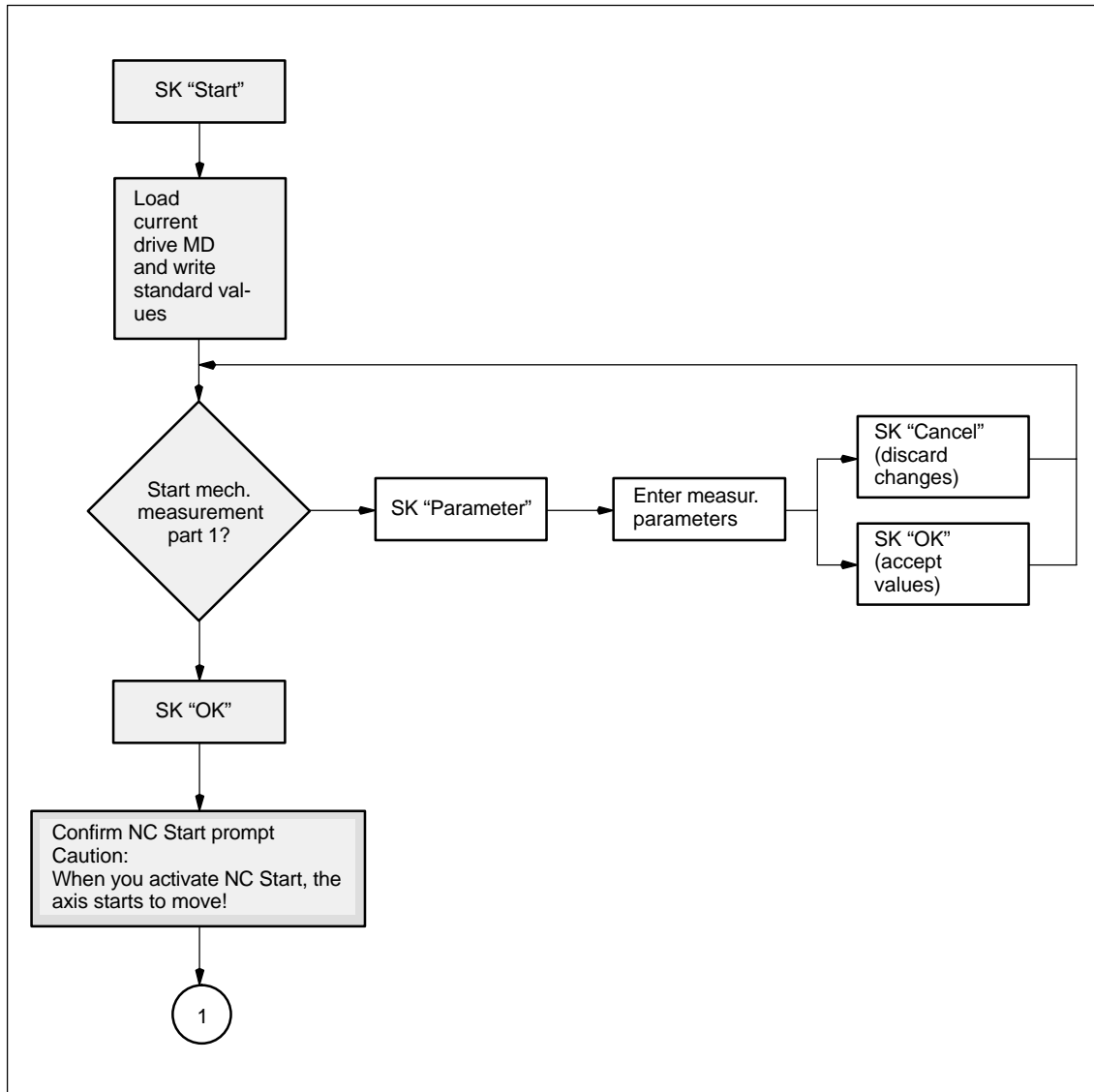
"Start" soft key:
Starts the automatic controller setting for the selected axis.
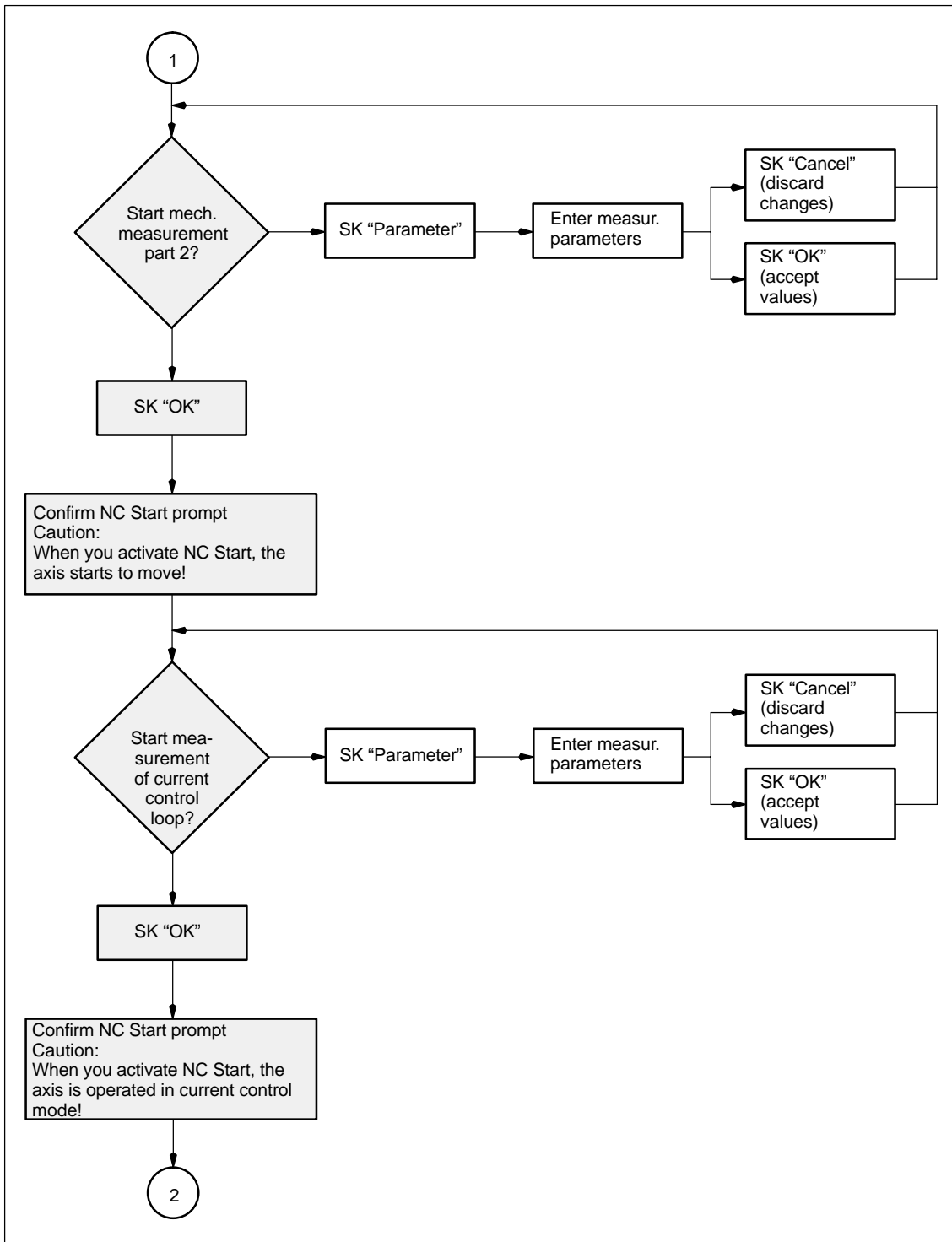
"Stop" soft key:
Stops the automatic controller setting for the selected axis (if a measuring function is active).

10.10.1 Flow chart for self-optimization

Self-optimization can be terminated at any time by pressing the "Cancel" soft key.

10

```
              ( 1 )
                │
                │
                ▼
          ◇ Start mech.          SK "Parameter"      Enter measur.       SK "Cancel"
            measurement  ───────▶                ───▶ parameters    ───▶ (discard
            part 2? ◇                                                     changes)

                                                                         SK "OK"
                                                                         (accept
                                                                         values)
                │
                ▼
           SK "OK"
                │
                ▼
     Confirm NC Start prompt
     Caution:
     When you activate NC Start, the
     axis starts to move!

                │
                ▼
          ◇ Start mea-           SK "Parameter"      Enter measur.       SK "Cancel"
            surement    ───────▶                 ───▶ parameters   ───▶  (discard
            of current                                                    changes)
            control
            loop? ◇                                                       SK "OK"
                                                                         (accept
                                                                          values)
                │
                ▼
           SK "OK"
                │
                ▼
     Confirm NC Start prompt
     Caution:
     When you activate NC Start, the
     axis is operated in current control
     mode!

                │
                ▼
              ( 2 )
```

```
                        ( 3 )
                          │
                          ▼
                     ◇ Do you want to save
                       boot file for drive X and     ┌──────────┐    ┌──────────────┐
                       display modified         ────→│ SK "No"  │───→│ Boot file is │───┐
                       controller data? ◇            └──────────┘    │ not saved    │   │
                          │                                          └──────────────┘   │
                          ▼                                                             │
                   ┌──────────────┐                                                     │
                   │ SK "Yes"     │                                                     │
                   └──────────────┘                                                     │
                          │                                                             │
                          ▼                                                             │
                   ┌──────────────┐                                                     │
                   │ Boot file is │                                                     │
                   │ saved        │                                                     │
                   └──────────────┘                                                     │
                          │←────────────────────────────────────────────────────────────┘
                          ▼
                     ◇ Start mea-
                       surement            ┌──────────────┐    ┌──────────────┐    ┌──────────────┐
                       of speed con-  ────→│ SK "Parameter"│──→│ Enter measur.│──→│ SK "Cancel"  │
                       troller? ◇          └──────────────┘    │ parameters   │   │ (discard     │
                          │                                     └──────────────┘   │ changes)     │
                          ▼                                                         └──────────────┘
                   ┌──────────────┐                                                 ┌──────────────┐
                   │ SK "OK"      │                                                 │ SK "OK"      │
                   └──────────────┘                                                 │ (accept      │
                          │                                                         │ values)      │
                          ▼                                                         └──────────────┘
        ┌─────────────────────────────────┐
        │ Confirm NC Start prompt          │
        │ Caution:                         │
        │ When you activate NC Start, the  │
        │ axis starts to move!             │
        └─────────────────────────────────┘
                          │
                          ▼
                       ( End )
```

10.10.2 Input options for self-optimization

Mechanical system measurement

Fig. 10-24   Mechanical system measurement

Amplitude:
Entered in % of maximum current of power section.

Bandwidth:
The bandwidth should only be changed if the previous optimization runs do not produce satisfactory results (can only be changed in mechanical system part 1).

Averaging:
Should only be reduced if the traversing range of the machine is inadequate.

Offset:
Constant velocity during measurement (changing positive/negative sign for optimum utilization of traversing range).

Current control loop measurement

Fig. 10-25   Current control loop measurement

Amplitude:
Entered in % of maximum current of power section.

Bandwidth:
The bandwidth can only be changed during measurement of mechanical system part 1.

Averaging:
Does not normally need to be changed. Influences the quality of the measurement.

Determination of the proportional gain
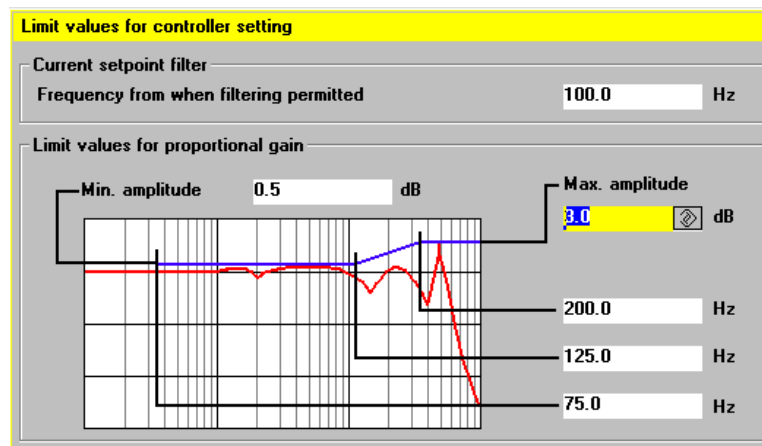
Fig. 10-26   Determination of the proportional gain

Frequency from which filtering can be performed:
A current setpoint filter is not used below this frequency.

Min. amplitude:
This quantity may not be exceeded between the minimum frequency and the average frequency (lower adaptation limit).

Max amplitude:
This quantity may not be exceeded after the upper frequency limit has been reached.

The three frequency entries can be used to influence the start point and the adaptation range.

**Determination of
the RESET time**
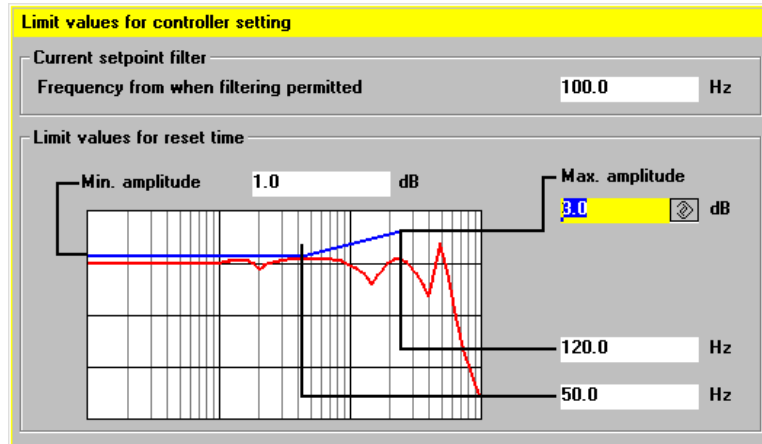
Fig. 10-27   Determination of the RESET time

Frequency from which filtering can be performed:
A current setpoint filter is not used below this frequency.

Min. amplitude:
This quantity may not be exceeded between the minimum frequency and the
lower frequency limit (lower adaptation limit).

Max amplitude:
This quantity may not be exceeded at the upper frequency limit.

The two frequency entries can be used to influence the adaptation range.

**Measurement of
speed control loop**
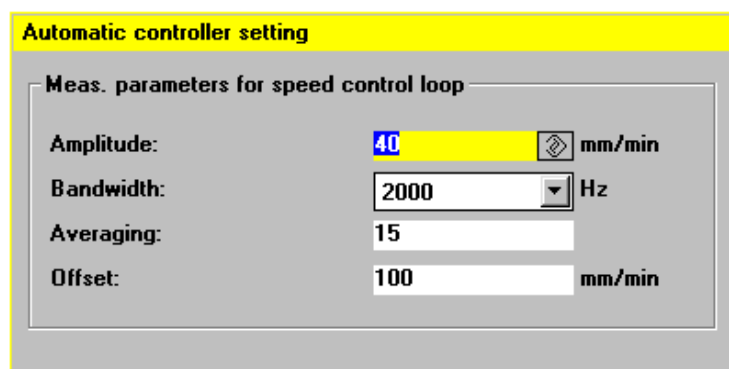
Fig. 10-28   Measurement of speed control loop

Amplitude:
Entered in mm/min of the load speed (should not be more than 50% of the
offset).

Bandwidth:
Any of the available bandwidths can be selected in order to test the automatic controller setting.

Averaging:
Influences the quality of the measurement.

Offset:
Input of load velocity in mm/min (should be greater than the amplitude by a factor of at least 2).

■

Data Backup

11

11.1   General information

When to save data   You should save 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/MMC   There are three types of data to be saved with the SINUMERIK 840D, i.e.

1. Saving data for NCK, drive and operator panel front settings

2. Saving data for PLC

3. Saving data for HMI/MMC.

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**Series start-up/
area-specific
archiving**

The following methods can be used to back up data, each serving a different
purpose.

1. Series start-up
   Provision is made for the generation of series start-up files. These allow a
   specific configuration to be transferred complete to other controls operating
   on the same machine type with the same software version, for example.
   This type of file cannot be modified externally using an ASCII editor. Series
   start-up files contain all relevant settings (except for compensation data).
   They must be created for NCK, PLC and for the MMC if an
   MMC 101/102/103 is installed.

2. Series start-up with compensation data (SW 4 and higher)

3. Software upgrade (SW 4 and higher, without drive data)

4. Area-specific archiving

   – SW 3.x and lower
     To ensure that archived data can be transferred to controls on which
     future software versions are installed or to other controls in the
     810D/840D series, it is advisable to archive data on an area-specific
     basis, i.e. each data area is stored in a separate file which can be edited
     later with an ASCII editor. Drive data should be read out as an ASCII file
     using the start-up tool.

   – SW 4 and higher
     Area-specific archiving is an exception with software versions SW 4 and
     higher, because MD 11210 can be used to specify whether modified
     MDs are to be saved, even for a series start-up.

   Data are read out or read back in again in several steps. Compensation
   data can only be saved in this way (SW 3.x and lower).

   PLC data and HMI/MMC data are not divided up further.

**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)

**Format of the
file name**

_N_	Area	Unit	_	Type

- The data to be saved or imported (general, channel-specific or axis-specific)
  are specified in the Area column.

- The channel, axis or TOA area is specified in the Unit column. The Unit is
  omitted if the whole area has been selected.

- The data type is specified in the Type column. When data are saved, the file
  names are automatically generated and output at the same time.

Areas

NC	General NC-specific data
CH	Channel-specific data (unit corresponds to channel number)
AX	Axis-specific data (The unit is 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 ZO, rotations, etc.
EEC	Measuring system error compensation
CEC	Sag/angularity compensation
QEC	Quadrant error compensation
PRO	Protection zone
RPA	R parameters
GUD	Global user data
INI	General initialization program (all data of 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 machine data for channel 1
_N_CH1_GUD	Archiving of global user data for channel 1
_N_INITIAL_INI	Archiving of all data of active file system

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11.2 Data backup via MMC 100

Note

Start-up (incl. data backup) of the MMC 100 is described in
/IAM/ IM1   Start-up MMC 100.

Via RS-232

You can back up data via the RS-232 interface as follows:

- **Series start-up**: with an option to select the areas

  – NCK (complete)

  – PLC (complete)

  – MMC (with option of saving only partial areas of the MMC data)

- **Area-specific archiving**: Backing up and restoring individual data areas (soft key "Data In", "Data Out" and "Data Selection").

Error, operational message texts and cycle alarm texts

These texts are part of the operator panel front system software. They must be reloaded after hardware component replacement or software upgrading. The messages must be available in the correct format for this purpose (see Section 12.2 Upgrading MMC 100 software). The texts cannot be read back.

Sequence of operations
(data backup)

1. Connect the PG/PC to interface X6 on the MMC.

2. In "Services" operating area on the MMC.

3. Select "RS-232 PG/PC" interface (vertical soft key).

4. Select "Settings" and check or enter the parameter settings of the RS-232 interface (default setting).

Device type:	RTS/CTS
Baud rate:	9600 baud
Parity:	None
Data bits:	8
Stop bits:	1
Character for XON:	11H(ex)
Character for XOFF:	13H(3x)
Text end character:	1AH(ex)
Format:	– Tape format, deselected for series start-up or for saving areas of drive data.
	– Select tape format for saving areas of all other data except for drive data.

**Backing up
changed values
MD 11210**

MD 11210: UPLOAD_MD_CHANGES_ONLY can be set to define whether all data or only those data which deviate from the defaults are to be output via the RS-232 interface.

11210	UPLOAD_MD_CHANGES_ONLY		
MD number	Save only modified MDs		
Default setting: 0	Min. input limit: 0		Max. input limit: 1
Changes effective: immediately		Protection level: 2/4	Unit: –
Data type: BYTE		Applies from SW 1 or 4	

Meaning:	**Up to SW 3.x**
	
	Bit 0 Scope of the differential upload with TEA files
	              (area-specific archiving)
	        0: All data are output
	        1: Only data which deviate from the standard are output
	              (does not apply to INITIAL_INI)
	
	If a value has been changed in a data which is stored as an array, then the complete MD array is always output
	(e.g. MD 10000: AXCONF_MACHAX_NAME_TAB).
	
	SW 4 and higher
	
	Bit 1 Scope of the differential upload with INI files
	        0: All data are output
	        1: Only data which deviate from the standard are output
	              (e.g. INITIAL_INI)
	
	Bit 2 If an array element is changed
	        0: Complete array is output
	        1: Only modified elements of an array are output
	
	Bit 3 R parameters (for INITIAL_INI only)
	        0: All R parameters are output
	        1: Only R parameters not equal to zero are output
	
	Bit 4 Frames (for INITIAL_INI only)
	        0: All frames are output
	        1: Only frames not equal to zero are output
	
	Bit 5 Tool data, cutting edge parameters (for INITIAL_INI only)
	        0: All tool data are output
	        1: Only tool data not equal to zero are output			

Related to			

Note

- It **may** be useful to perform a data backup operation in which only altered machine data are saved prior to upgrading software in cases where the defaults in the new software are not the same as those in the earlier version. This applies particularly to machine data which are assigned SIEMENS protection level 0.

Recommendation

MD 11210 UPLOAD_MD_CHANGES_ONLY or the appropriate bits should be
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 software
upgrades.

Continue with "Series start-up" or "Area-specific archiving".

Series start-up
(data backup)

5. MMC interface configuration (see above, tape format deselected)

6. Start PCIN data transmission program ("Data In") on PC/PG.

7. When you select "Start-up data" on the MMC (MMC operating area "Ser-
    vices", data output "Data out") after pressing the key **Input** areas NCK and
    PLC are offered to you for selection.

8. First select **NCK** ("NCK" is offered as the name of the archive file) and then
    start reading out (soft key **Start**). Follow exactly the same procedure for the
    "PLC" data set.

Area-specific
archiving

5. MMC interface configuration (see above, select tape format for all data ex-
    cept 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 MMC (MMC "Services" operating area, data
    output "Data Out").

8. Select soft key "Data selection" and the areas to be read out. The area "NC active data", for example, contains the following data:

    –   Machine data

    –   Setting data

    –   Option data

    –   Global and local user data

    –   Tool and magazine data

    –   Protection zones

    –   R parameters

    –   Zero offsets

    –   Drive data

    –   Compensation data

    –   Display machine data

    –   Workpieces, global parts programs/subroutines

    –   Standard and user cycles

    –   Definitions and macros.

    When the areas are output, the internal area identifier used in each case appears on the top line of the display.

9. Start reading out (soft key **Start**) and acknowledge any prompts on the operator panel front.

Note

The SIMATIC HiGraph tools can be used to save PLC area data.
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

To read in an entire configuration first perform a general RESET of the control.

1. Set the protection level:

    –   up to SW 3.x to "Manufacturer" (password SUNRISE)

    –   in SW 4 and higher to "User" (password CUSTOMER)

2. Connect the PG/PC to interface X6 on the MMC.

3. Select the "Services" operating area on the MMC. Continue with steps listed under "Reading in series start-up" or "Reading in area-specific archive data".

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Series start-up

4. Select the MMC interface configuration "RS-232 PG/PC" as above (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 the control under "Data Out" for transmission. Select the "Services" area on the MMC, "Data In". Start data import by selecting the **Start** soft key. Acknowledge any input request displayed on the MMC.

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 records.

Note

The NCK series start-up file must always be imported before the PLC series start-up file.

Area-specific archiving

4. Select the MMC 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" area on the MMC, "Data In". Start data import by selecting the **Start** soft key. The file is automatically detected and loaded accordingly.

5. Read in option data, initiate NCK RESET.

6. Load the machine data file and actuate "NCK RESET". If you then receive messages about a reconfiguration of the memory or restandardization of machine data, then you must read in the machine data file again and reset the control. Generally speaking, this process must be carried out two to three times.

7. If global user data must be activated, then the "N_INITIAL_INI" file (Table 11-1) 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.

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-hand side of the screen for interface settings. Do not actuate the "Back up boot file" soft key in the drive data menu until you have reset the control once after loading the drive archive data.

• Check/correct the interface settings after display of a message regarding memory reconfiguration.

Transmission error   If data transmission is aborted with an error message, check the following:

• Is the password at the correct protection level?

• Are the interface parameters (RS-232 PG/PC) correct?

• Has MD 32700, ENC_COMP_ENABLE been set to 0 before importing LEC data?

• MD11220 INI_FILE_MODE is set to 1 or 2 (see this Section, Subsection "Aborting MD import").

Table 11-1   Data in _N_INITIAL_INI file

File _N_INITIAL_INI	**Data not contained in file _N_INITIAL_INI**
• Option data	• Drive machine data
• Machine data	• Compensation data
• Setting data	– Leadscrew error compensation
• Tool offsets	– Quadrant error compensation
• Zero offsets	– Sag compensation
• Global user data	• Display machine data
• Local user data	• Workpieces
• R parameters	• Global parts programs
• Flag in SRAM (SW 6.3)	• Global subroutines
• Parameteriz. of synchr. axes in SRAM (SW 6.3)	• User cycles
	• Standard cycles
	• Definitions and macros

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11.3   Data backup via MMC 103

Note

Start-up (incl. data backup) of the MMC 103 is described in
/IAM/ IM3   Start-up MMC 103.

Via RS-232

To archive or read in data via the RS-232 interface proceed in exactly the same way as described in Section 11.2:

- **Series start-up**: with an option to select the areas

    - NCK (complete)

    - PLC (complete)

    - MMC (with option of saving only partial areas of the MMC data).

- **Area-specific archiving**: Backing up and restoring individual data areas (soft key "Data In", "Data Out" and "Data Selection").

Note

In SW 4.3 and higher, the maximum baud rate is 115,200 baud.

Via MMC hard disk

You can redirect backup data to archive files on the MMC 101/102/103 hard disk.

Via diskette

If a diskette drive is connected to the MMC, it is possible to save or reimport data using diskettes.

Via NC card (SW 5.2 and higher)

You can also back up data on the NC card, see Operator's Guide, Services operating area.

Data are saved via the "Services" operating area.
References: /BA/, Operator's Guide

11.3.1   Data backup via RS-232 on the MMC 103

Hardware and   • PG740, PC
software
requirements   • RS-232 cable

                         • PCIN (V4.2)

System overview
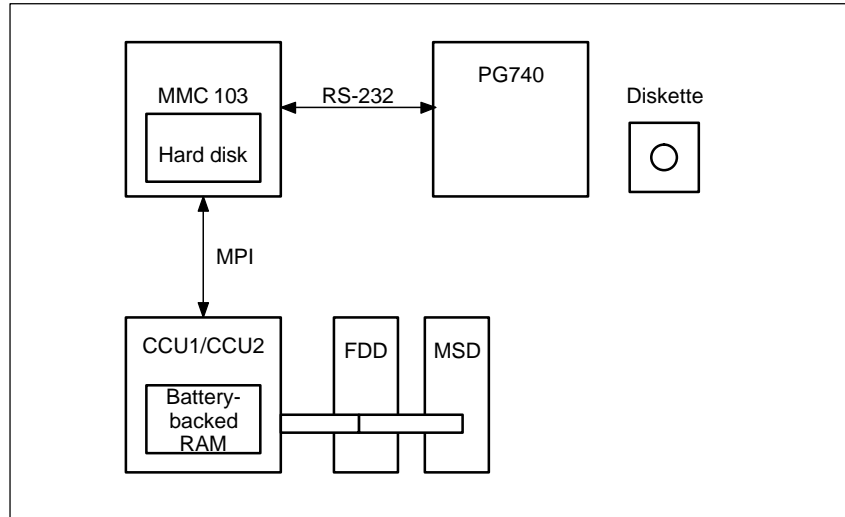
Fig. 11-1   System overview

Data in the system

Drive data	NC data	PLC data	MMC data

Where are the data   The data are normally stored in the battery-backed RAM of the NC or PLC or on
stored?   the MMC 103. You can store all data in specific directories on the hard disk of
                           the MMC 103.

Settings of the   Only the archive format is permitted for certain data during data output via the
RS-232 interface   RS-232 interface. This applies to: data with the ARC extension and data for the
                           boot files of the FDD and MSD.
                           If remote diagnostics is to be activated, a different RS-232 interface must be
                           selected for the data output.

Select the Services area

The "Services" area provides you with an overview of all programs and data stored on the NC, PLC, drive and hard disk. In order to view all of the directories, you must first call up the **Select file** display and then set the display as required. Only then are the required data displayed.

Example for Services basic display

Services	CHAN1	Jog	\ MPF0		
Channel reset					
Program aborted			ROV SBL1		

Programs/data: SOURCE   \CUS.DIR

Name	Type	Loaded	Length	Date	Enable
User-cycles	DIR			02/02/1998	X
Diagnosis	DIR			02/02/1998	X
DH_UPD.LOG	---		38	02/02/1998	X
Part-programs	DIR	X		30/11/1999	
Subprograms	DIR	X		30/11/1999	
Workpieces	DIR			02/02/1998	X

V.24

PG

Disk...

Archive...

Free memory: Hard disk :   518,553,600   NCU :   203,604

Control ->   V.2, diskette, archive

| Data in | Data out | | Manage data | Log | Data selection | | Interface |

Fig. 11-2   Basic display of the Services user area

Output data

The operating sequence for data output via the RS-232 interface applies to all data. Proceed as follows:

1. Position the cursor on the desired data

2. Press SK **Data out**

3. Press SK **V.24 or PG**

4. Press SK **OK**

5. Read the log (only if errors occur)

What do I back up?

It is not practical to back up all directories for a data backup via RS-232. Only the data required from recommissioning are to be output. Use a stream for a full backup of all data.

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11.3.2   Output of drive data via RS-232 on MMC 102/103

Drive data   The following types of drive data are used:

- Boot files (HSA.BOT)

- Boot files (VSA.BOT)

- Drive machine data (*.TEA).

Data	Directory	Name	Meaning
Boot file	Diagnosis\FDD data	VS1.BOT	Boot file for 1st axis
Boot file	Diagnosis\MSD data	HS1.BOT	Boot file for 1st spindle
Drive MD FDD	DIAGNOSIS\MachDat/FDD	*.TEA	Drive machine data file for FDD saved under IBN/MD/Filefunction. A name must be allocated.
Drive MD MSD	DIAGNOSIS\MachDat/MSD	*.TEA	Drive machine data file for MSD saved under IBN/MD/Filefunction. A name must be allocated.

Where are the boot files stored?   The boot files are stored in the FDD data and MSD data directories.

```
├── FDD data
├── VS1.BOT
└── VS2.BOT

├── MSD data (HS1.BOT)
```
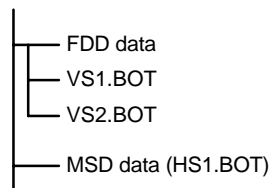
Note

The boot files can only be output as binary files with RS-232 setting **archive format**. The boot files must have been saved before output (Save boot files soft key). The boot file data backup (in binary format) can only be loaded back onto the same software version.

Drive MD   The drive machine data must be saved initially in the Start-up\Machine data\File function area before they can be output via RS-232.

```
├── Diagnosis
    ├── MachDat/FDD
    └── MachDat/MSD
```
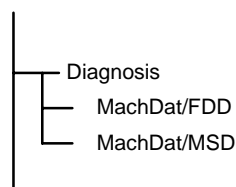
11.3.3 Output of drive data via RS-232 on the MMC 102/103

NC data NC data are all data stored in the SRAM of the NC (excluding the parts program and cycles).

The following data are stored in the **NC active data** area:

- NC machine data (MD11210 UPLOAD_MD_CHANGES_ONLY =1)

- Option data

- Setting data

- Tool/machine data

- ZO

- R parameters

- Global user data

- Protection zones

- Compensation data

    – Measuring system error compensation (LEC=EEC)

    – Sag/angularity compensation (CEC)

    – Quadrant error compensation (QEC).
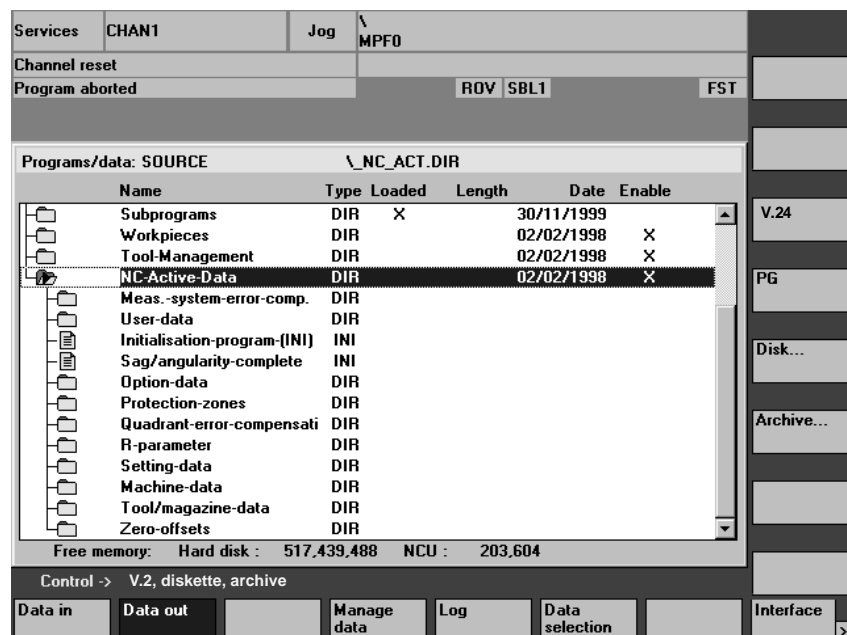
Fig. 11-3 NC active data

**Format of the
file header**
The file header starts with **"%_N"** and ends with **"_INI"**. If you output the com-
plete global user data, the file header is as follows:
  %_N_COMPLETE_GUD_INI.
In the NC active data display, the "middle part" of the file header is displayed
according to the current cursor position. See on the right, next to "program/
data".

Example 1
Output of measuring system error compensation data. There are two ways to
output the EEC compensation data to RS-232:

1. Output complete EEC data (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, complete
```
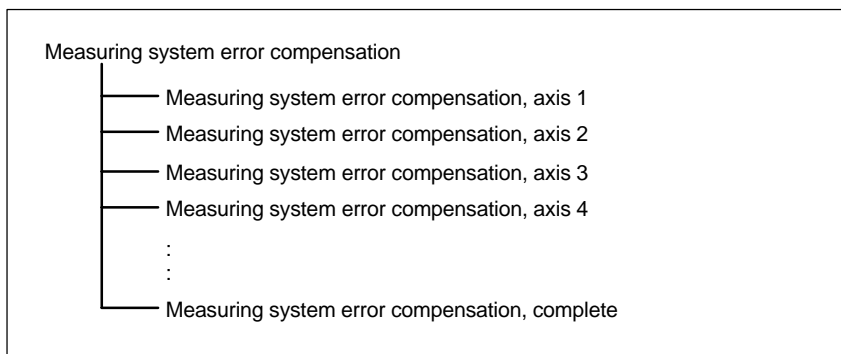
To output all the data, position the cursor on **Measuring system error com-
pensation, complete**, otherwise position the cursor on the desired axis.
The file header is then as follows:

Measuring system error compensation, complete: %_N_AX_EEC_INI

Measuring system error compensation, axis 1:   %_N_AX1_EEC_INI

Example 2
Output of global user data (GUD). The file header transmitted with the data out-
put is listed here once.

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```
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, complete  (%_N_CH_GUD_INI)
          └── User data, complete  (%_N_COMPLETE_GUD_INI)

          └── NC user data  (%_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, complete  (%_N_NC_GUD_INI)
```

The middle part of the file header, which is transmitted with the file output, appears at the top of the display in the program/data area: __NC_ACT\GUD.DIR
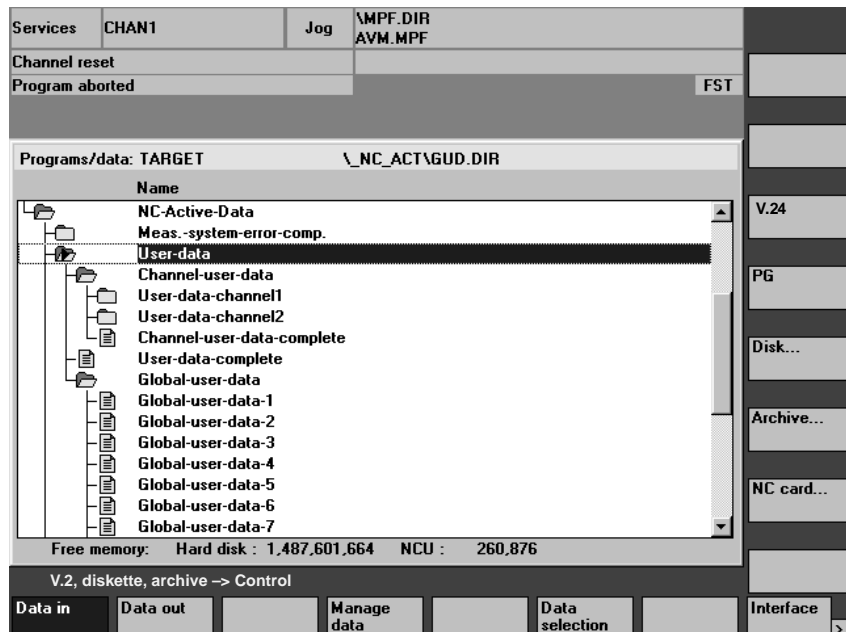
Fig. 11-4   Example for global user data

Output of initialization program (INI)

Position the cursor on the **initialization program (INI)** directory. Press the **RS-232** soft key. The initialization program "**%_N_INITIAL_INI**" is output with the following data:

- Global user data

- Option data

- Protection zones

- R parameters

- Setting data

- Machine data

- Tool/magazine data

- Zero offsets

None

    – Compensation data (EEC, QEC, CEC)

    – Parts programs

    – Definition data and macros

    – Parts programs, workpieces, cycles

    – PLC programs and data

    – Display machine data, drive machine data.

If you position the cursor on **NC active data** and initiate the data output via RS-232, an initialization program **%_N_INITIAL_INI** is also output, but with all data stored in the **NC active data** directory. That is including compensation data.

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11.3.4   PLC data output via RS-232 on MMC 102/103

PLC data

The PLC data must be saved in an archive file before this file can be output via RS-232.

Procedure

1. Press the **Series start-up** soft key

2. Select only **PLC**

3. Press the **Archive** soft key

4. The display changes and the task log appears. The file **PLC.ARC** is created.

5. When the **"task finished"** message appears, press **Data out**.

6. In the directory, select **Archive\PLC.ARC** and press **Interface**.

7. RS-232 setting with archive format: Set binary format (PC format), close with OK.

8. Press **RS-232** soft key and confirm with **OK** soft key; the PLC data are output.

11.3.5   Output of MMC data via RS-232 on MMC 102/103

Display MD

On the MMC, the display machine data (MD 9000, ...) must be saved via the file functions (start-up). These machine data are stored in RAM with the MMC 102/103. The data are stored in the directory **Diagnosis\MachDat/OperatorPanelFront.** The file name specified when the data were saved appears in the directory.
To output the display machine data, position the cursor on the desired file and press the **RS-232** soft key, followed by **OK**. The display machine data can be output in punched-tape format.

Definitions

The definitions directory contains the definitions for the macros and global user data. These include:

- SMAC.DEF   (%_N_SMAC_DEF)

- MMAC.DEF   (%_N_MMAC_DEF)

- UMAC.DEF   (%_N_UMAC_DEF)

- SDUD.DEF   (%_N_SGUD_DEF)

- MGUD.DEF   (%_N_MGUD_DEF)

- UGUD.DEF   (%_N_UGUD_DEF)

The definitions can be output via RS-232.

Example for GUD data:
Define OTTO   as String
Define HANS   as bool
Define NAME   as char

During start-up, the definitions must be read in before the INITIAL_IN file. Only when the definitions are known in the NC can the actual user data be read in.

Tool management data

The data for tool management on the MMC /103 are stored in the **tool manage-ment** directory. There are three subdirectories:

• Magazine configuration (BEISPIEL_DOKU.INI)

• Tool management configuration (TT110.WMF,....)

• Tool data (WZACCESS.MDB,....).

The PARAMTM.INI file for the layout of displays and for access levels is stored in the **Diagnosis\MMCInitialization\..**

11.3.6   Output of the series start-up file via RS-232 on MMC 102/103

Preparations for series start-up

The data selection for series start-up must be defined before the series start-up file can be created. Press the **Series start-up** soft key and define the data (MMC, NC, PLC) you want to save.

Services	CHAN1		Jog	\ MPF0		
Channel reset						MMC data selection
Program aborted				ROV	SBL1	

Create series startup archive

    Archive contents

        ☒◻ MMC

        ☒ NC   ◻ mit Kompensationsdaten

        ☒ PLC

    Archive name **MMCNCPLC**

Soft keys: Read startup archive | V.24 | PG | Disk | Archive

Bottom soft keys: Series start-up | Upgrade

11
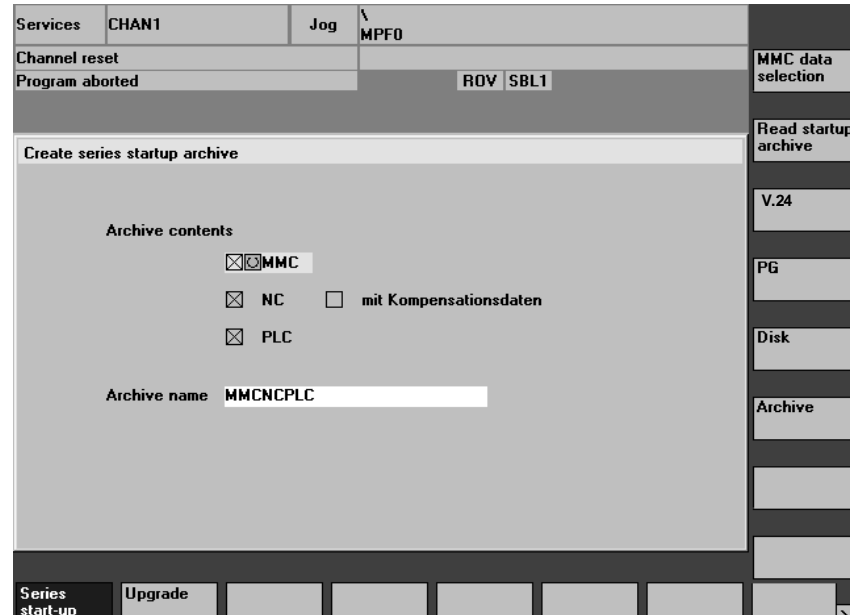
**Set the data
selection**

Press the vertical soft key **MMC data selection.** In this display, you define
which directories are to be included in the series start-up file.

Services	CHAN1	Jog	\MPF0	
Channel reset				
Program aborted			ROV SBL1	

Data selection for series startup

```
┌─▶  Definitions                        ▲    ┌─Additional products──────────
├─🗀  Diagnosis                          │    │
├─🗀  Data-managemnt                     │    │
├─📄  DH_UPD.LOG                         │    │
├─🗀  Interactive-programming            │    │   ☐   Configuration
├─🗀  MSD-data                           │    │
├─🗀  Start-up                           │    │
├─🗀  MBDDE-Alarm-Texts                  │    │   ☐   Complete
├─🗀  Part-programs                      │    │
├─🗀  OEM-data                           │    │
├─🗀  Machining-sequence                 │    │
├─🗀  Subprograms                        │    │
├─🗀  System                             │    │
├─🗀  FDD-data                           │    │
├─🗀  Workpieces                         │    │
└─🗀  Tool-Management                    ▼    │
```

Defaults

Abort

OK
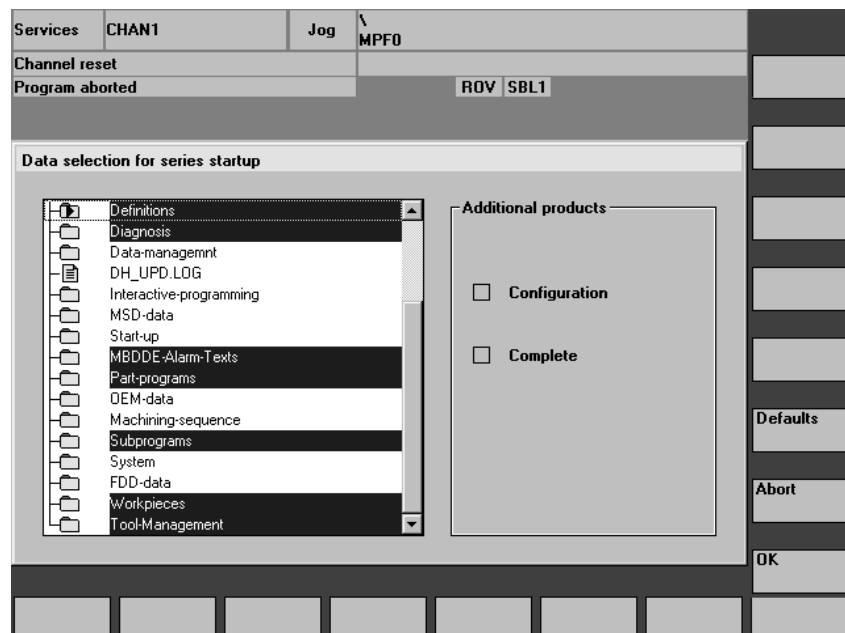
**Create the
archive file**

When you have selected the data, press the **OK** soft key. The display changes
and you can now press the **Archive** soft key to create the archive file
MMCNCPLC.ARC. When the "task finished" message appears, the file
MMCNCPLC.ARC in the archive directory can be output via RS-232. The
RS-232 output should be set to PC format.

You can also create separate series start-up files for the MMC, PLC and NC
areas and output them separately. In this case, the file name is:
MMC: MMC.ARC
NC: NC.ARC
PLC: PLC.ARC

Note

The EEC, QEC and CEC compensation data are not included in the series
start-up file. Reason: Each machine has its own compensation data.

11.4　　Back up hard disk via Norton Ghost® (SW 4.4 and higher)

11.4.1　　Back up hard disk / Import data backup

Functions

- Simple backup and restoration of MMC 102/103 hard disks on site.
  System software, add-on software and user-specific data blocks are backed up completely.

- A hard disk image (saved in a file) can be backed up on a data medium (e.g. CD) for long-term storage and safekeeping.

- Master images (images for series start-up) can be loaded by the machine manufacturer.

- Machine manufacturers can perform upgrades/downgrades (master images) themselves, irrespective of software supplied by Siemens.

- The Norton Ghost backup program® is installed on every MMC 102/103 with SW 4.4 and higher.

Norton Ghost®　　　　The Norton Ghost® software allows the complete contents of an MMC 102/103 hard disk to be saved as a "disk image". This image can be safely stored on various types of data medium for the purpose of restoring the hard disk at a later time. The Norton Ghost program® is supplied as standard with every MMC 102/103 module.
For further information, visit the Internet site at "www.ghost.com".

MMC 103　　　　The procedure for saving a complete MMC 103 hard disk for the purpose of having all user and system data continually available during servicing is described below:

　　　　a) Backing up the hard disk
　　　　b) Backing up the user data
　　　　c) Restoring a backup of the hard disk.

Operating tips　　　　For running the "Norton Ghost®" program

MMC BIOS　　　　You need a keyboard with a PS/2 connector
in order to access and modify the BIOS (a PG keyboard is also suitable).
MMC BIOS versions up to 2.14 are accessed by
pressing CTRL-ALT-ESC; BIOS versions 3.04 and higher
by pressing DEL during MMC ramp-up.
You can undo BIOS settings by loading the
　　　　　　"BIOS Setup Defaults".

MMC 102　　　　With the MMC 102 you must change the BIOS setting to
　　　　　　Virus Warning: Disabled
for a hard disk restore; the setting does not need to be changed for a backup.

11.4   Back up hard disk via Norton Ghost® (SW 4.4 and higher)

MMC 103
The MMC 103 with BIOS version 2.12 should be operated with the parallel port setting "378H IRQ7 Bidirectional" (BIOS setup).

Required memory space on PC/PG
For backup image file
Free memory space on PC/PG hard disk must be available for the image file.
Rule of thumb: approx. 70% of the used MMC hard disk capacity.

PG 740 etc.
When the programming device is supplied, the parallel port is set in the bios to "output only". Please change to EPP.
Plug the parallel cable into the lower connector (LPT1) on the left side of the PG 740. This can be confused with the COM/RS-232/PLC port.

Booting from diskette
If the backup/restore is to be performed from a boot diskette, the boot sequence of the MMC 103 must be changed in the BIOS from C,A to A,C.

Backup/restore via parallel cable
On PG/PC

- PC/PG with bidirectional interface, EPP setting
  for PG 740 internal LPT1: <Address>

- Siemens LapLink parallel cable (order no. 6FX2002-1AA02-1AD0)
  or standard LapLink cable.

- Diskette drive if backup/restore with Ghost is to be performed by an MMC 102/103 with a software version lower than V4.4.

- For MMC 102/103, set parallel interface to EPP (BIOS),
  this increases the transmission rate of the parallel interface
  by approx. 10%.

Backup/restore with external drive
Directly connected to the MMC 102/103
parallel interface, e.g. ZIP, JAZ, CDROM
or network path: The user must enter the necessary device driver in "autoexec.bat" and/or "config.sys" on the boot diskette.

!

Important

1. Drivers for the above I/O devices are not supported by Siemens.

2. When entering paths or file names in connection with the NortonGhost software, please comply with the DOS 8 character convention (length of file names: Max. of 8 characters).

**Supplementary
conditions**

1. A backup/restore at file level is performed on the MMC in the Services area, e.g. by selective backup of start-up or machine data, etc. (via diskette, RS-232, PC card).

2. Individual software components are installed/re-installed either via diskette or parallel interface (Interlnk/ InterSrv).
    Problems associated with the BIOS update must be considered.

3. With MMC 102/3 running BIOS version 2.12 the error "Expection error (13)" can occur after a successful restore".
    Remedy: Switch the MMC 102/103 off and on again.

4. For a backup/restore via parallel port or network the power saving feature of the PC/PG must be deactivated.

5. After completing the backup/restore with Ghost, the parallel cable should be removed again, in order to prevent unexpected MMC operating states.

6. If the external PC is equipped with an AMD K6 processor, problems can arise with the parallel connection at processor clock speeds > 233MHz. In this case, operate both computers (MMC and PC) with LPT BIOS setting "ECP".

7. CD-ROM drive access problems can occur occasionally with certain programming devices. This can lead to a shut-down of the Ghost connection during the direct restore of an image file from CD-ROM.
    Remedy: Copy the image file from the CD onto the hard disk of the programming device.

Functional scope of
Norton Ghost $^{\circledR}$

*   Storage of complete hard disks in an image file

*   Restoration of hard disks from an image file

*   Compression of image files

*   Integrated link via LPT master/slave interface, e.g. from MMC 103 with PG (without Interlnk/ Intersrv)

*   Support for different operating systems of the MMC 102/103 with SW 3.x and SW 4.x:

    –   Windows 3. x

    –   Windows 95

*   Support of long file names

*   Disk integrity and image file integrity check

*   Reloading of image files to unformatted hard disk ("formats on the fly")

*   New destination hard disk can be larger or smaller (provided it is sufficient for data quantity) than the original

11

11.4   Back up hard disk via Norton Ghost $^®$ (SW 4.4 and higher)

- When hard disks with several partitions are copied, the partition sizes can be altered

- Command interface for integration in batch files

- Menu interface for interactive operator inputs.

11.4.2   Saving user data

In the Services operating area of the MMC you can use the "series start-up" function to save PLC, NC and MMC data.

References: /BA/ Operator's Guide, Chapter 7,
                    Section "start-up functions".

Requirement: Set the password

1. Select the "Services" operating area

2. Press the "Series start-up" soft key

3. Press the "Select MMC data" soft key

4. Select the data to be archived

5. Select "Archive" (hard disk) as the destination device; the series start-up archive is created.

11.4.3   Back up hard disk

Requirement:

- The directory exists on the PG/PC on which the image file is to be stored.

- Sufficient storage capacity is available on the PG/PC (see the paragraph entitled "Operating conditions") below.

- One of the operating systems MS-DOS 6.X, Windows 3.x or Windows 95 is installed on the programming device/PC.

- The Ghost program is installed on the MMC 103 and on the programming device/PC.

- The MMC 102/103 and programming device/PC are linked via the parallel cable (6FX2002- 1AA02- 1AD0).
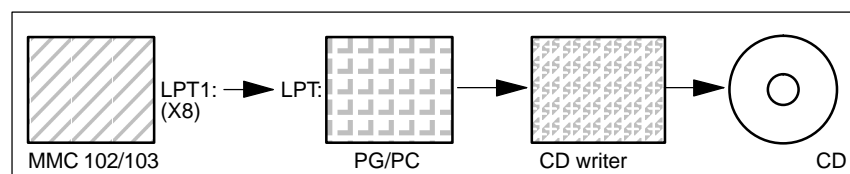
1. Switch the control off and on and select start-up mode (press key 6 when DOS window appears)

2. Select menu "7: Backup/Restore"

3. Enter password

4. Select menu "1 Hard disk Backup/restore with ghost"

5. < only if default not suitable >
    set parameters for Norton Ghost program:

    –   **< 1 > configure ghost parameters**:

        If you want to change the default directory path or the type of interface,
        select menu 1:
        *   Set Connection Mode :
            <1> PARALLEL (default)
            <2> LOCAL
            choose the desired setting and confirm.

        *   Change path:
            <3> Change backup image filename (set up directory
                    for backup file on programming device
                    e.g. C:\SINUBACK\MMC 103\)
            <4> Change restore image filename (set up complete path name
                    for restore file "MMC.GHO" on MMC,
                    e.g. D:\SINUBACK\MMC 103\MMC.GHO)
            choose the appropriate setting, enter the path and confirm.

    –   Enter Yes in response to "Save GHOST parameters?" query save
        GHOST parameters? answer "Yes".

                <5> Back to previous menu
                        Return to main menu

6. **Saving a hard disk**

    –   **< 2 > Harddisk backup** to <pathname>, mode PARALLEL

        *   When you select this menu, a message window appears:
                You are prompted to check whether the connection
                        between MMC and PG/PC has been established.
                The destination path for the MMC image directory is displayed.
                This is the image directory to be backed up.

        *   PG/PC:
                In a DOS window or at DOS level, start the Ghost program with
                the command **ghost –lps**.

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* MMC:
    Start the backup by acknowledging with "Y" in the message
    window.

* MMC:
    The message window of Norton Ghost appears:
        The progress of the data transfer is displayed
        The paths are displayed
        The volume of data to be transferred is displayed

* Cancel the data transfer
    PG/PC: Press "Control" + "C" keys
              After acknowledging the prompt
              you are returned to the main menu of Norton Ghost
              and Ghost is terminated.

7. **MMC**
   After cancelation of a backup/restore, the following prompt appears:
   Do you want to try to backup again [Y,N] ?
   Enter N, the main menu then appears.
   If "Y", continue with 6.

   – **< 4 > Back** to previous menu
                  Return to main menu

8. PG/PC: Write disk image file to CD

9. PG/PC: Store CD in the vicinity of the machine

Time required: approx. 15–20 minutes
for the generation of a compressed disk image =130MB of a 540MB hard disk
via LPT.

11.4.4   Restore data to hard disk

• The Ghost program is installed on the MMC 103 and the programming de-
  vice.

• The MMC 103 is connected to the PC/PG via a parallel cable.

• One of the operating systems Windows 3.x or Windows 95 and a CD-ROM
  drive are installed on the programming device.
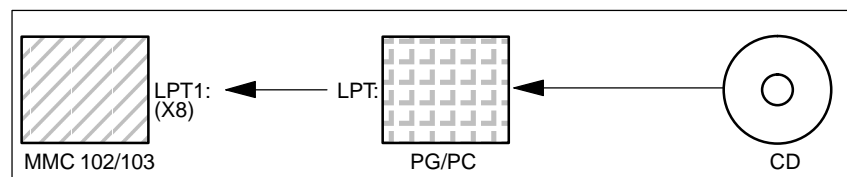
1. Switch on the PG, insert CD in drive.

2. Switch the control off and on and select start-up mode (press key 6 when
   DOS window appears)

3. Select menu "7: Backup/Restore"

4. Enter password

5. Select menu "1 Hard disk Backup/restore with ghost"

6. Set parameters for the Norton Ghost program:

– **< 1 > configure ghost parameters**:

see above

7. Restore the contents of the hard disk

– **< 3 > Harddisk Restore** from <pathname>, mode PARALLEL

*   When you select this menu, a message window appears:
     You are prompted to check whether the connection
          between MMC and PG/PC has been established.
     The name of the image file from which data
          are to be restored is displayed.
     The image file must exist on the programming device/PC.

*   PG/PC:
     In a DOS window or at DOS level, enter
     the command **ghost –lps** to start the
          Norton Ghost program.

*   MMC: "Y"
     Start the restore by acknowledging the message window.

*   MMC:
     The message window of Norton Ghost appears:
          The progress of the data transfer is displayed
          The paths are displayed
          The volume of data to be transferred is displayed

*   Cancel the data transfer
          PC: Press "Control" + "C" keys
                 The MMC boots. A boot diskette is required
                 for the MMC ramp-up.

– **< 4 > Back** to previous menu
                    Return to main menu

11

8. After a successful restore, a reboot is performed automatically.

Time required: approx. 15–20 minutes
for the generation of a compressed disk image =130MB of a 540MB hard disk
via LPT.

___

Note

The backup of user data, machine data and start-up files is an integral function
of the MMC in the Services area.
The File Manager indicates where data to be backed up are located and in
what format, as well as what media can be used to save and re-import them.

___

11.5   Several SW versions on one MMC 103 (SW 5.2 and higher)

With SW 5.2 and higher, several images of software versions are supplied on the hard disk with the current software version.

In addition to the current version, the following versions are also supplied:

- SINUMERIK 840D, SW 3.7

- SINUMERIK 840D, SW 4.4

- SINUMERIK FM-NC, SW 4.4

- SINUMERIK 840D, SW 5.2.

If you wish to load a software version, proceed as described under subheading "Re-import SW version".

Back up SW version

If you wish to create an image of a software version, proceed as follows:

1. Switch on the control and select start-up mode (press key 6 when DOS window appears),

2. Select menu "7: Backup/Restore"

3. Enter password

4. Select menu 4 "Partitions Backup/Restore"

5. Alter the maximum number of available images if necessary:
   Menu "1: Configure Ghost Parameter"
   By selecting menu option "1: Change Maximum Backup Images", you can define your own maximum number of images, a total of 7 can be set. Default setting: 1.

6. To back up the current software version, select menu option "2: Partitions Backup" and enter a descriptive text with which the image will be offered in future for Restore operations.

7. The backup software version will be stored in directory "D:\Images" and included in the list when you select menu option "3: Partitions Restore".

Re-import SW version

If you wish to use the image of a software version, proceed as follows:

1. Switch on the control and select start-up mode (press key 6 when DOS/Windows screen appears),

2. Select menu "7: Backup/Restore"

3. Enter password

4. Select menu 4 "Partitions Backup/Restore"

5. To re-import the image, select menu option "3: Partitions Restore"

6. Select the software version of your choice from the displayed list.

7. After a successful restore, a reboot is performed automatically.

Delete a SW version from the "Images" directory

If you wish to delete the image of a software version from the "Images" directory, proceed as follows:

1. Switch on the control and select start-up mode (press key 6 when DOS/Windows screen appears),

2. Select menu "7: Backup/Restore"

3. Enter password

4. Select menu 4 "Partitions Backup/Restore"

5. In order to delete the image of a software version, select menu option 4: "Delete Image"

6. Select the software version of your choice from the displayed list.

7. The deleted software version is removed from the "Images" directory and therefore no longer listed when you select menu option 3: "Partitions Restore".

SW Norton Ghost

Two versions of the Norton Ghost software are available on the control in software 5.2 and higher:

• Norton Ghost V5.1b (standard)

• Norton Ghost V6.01.

The data format has been changed in Norton Ghost V5.1c and later which means that earlier Norton Ghost versions, i.e. < V5.1c, cannot read the new data format.

If the current version 6.01 is needed (because, for example, a later version is installed on the PG/PC), it can be activated via the Service menu:

1. Switch on the control and select start-up mode (press key 6 when DOS/Windows screen appears),

2. Select menu "7: Backup/Restore"

3. Enter password

4. Select option "Switch to other version of GHOST". The active version of Norton Ghost is displayed at the top of the screen.

Transfer via parallel interface LPT

When the SW is transferred via the parallel interface LPT, it is **not possible to mix** the Norton Ghost software with old (< V5.1c) and new (>V5.1 b) versions. It must be ensured that a compatible data format is transferred via this interface:

• Norton Ghost V5 up to and including V5.1b   or

• Norton Ghost V5.1c up to and including V6.x

11

11.6   Installing a replacement hard disk (SW 4.4 and higher)

MMC 103

The procedure for saving a complete MMC 103 hard disk for the purpose of having all user and system data consistently available during servicing is described below.

Norton Ghost®

The Norton Ghost® software allows the complete contents of an MMC 102/103 hard disk to be saved as a "disk image file". This disk image file can be stored on various types of data medium for the purpose of restoring the hard disk at a later time.

The Norton Ghost program® is supplied as standard with every MMC 103 module and the replacement hard disk.

For further information, please visit the Internet site at "www.ghost.com" or refer to the previous section.

Note

Recommendation:

We recommend you archive the hard disk image backup and the "Norton Ghost" program on CD.

Restoring a backup

Requirements:

- The Ghost program is installed on the programming device.

- A new replacement hard disk is installed.

- The MMC 103 is connected to the PC/PG via a parallel cable

- One of the operating systems Windows 3.x or Windows 95 and a CD-ROM drive are installed on the programming device.
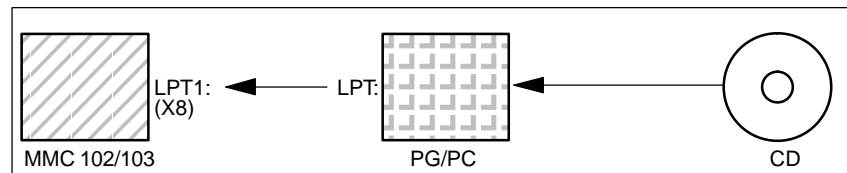
1. Install the new replacement hard disk in the MMC 103 or install a new MMC (see enclosed instructions)

   – Slot the hard disk into the bracket

   – Connect the cable between the hard disk and the MMC

   – Fix the hard disk in place with the 4 knurled screws

   – Release the transport safeguard: turn towards "operating" until it clicks into place.

Note

The replacement hard disk contains neither a Windows operating system nor the MMC system software.

---

2. Switch on the PG, insert CD in drive.

3. Switch the control off and on and select start-up mode (press key 6 when DOS window appears)

4. Select menu "4 Backup/Restore"

5. Enter password

6. Select menu 1 "Hard disk Backup/restore with ghost"

7. Set parameters for the Norton Ghost program:

    –   **< 1 > configure ghost parameters**:

        see above

    –   **< 3 > Harddisk Restore** from <pathname>, mode PARALLEL

        *   When you select this menu, a message window appears:
                You are prompted to check whether the connection
                    between MMC and PG/PC has been established.
                The name of the image file of the MMC
                    are to be restored is displayed.

        *   PG/PC:
                In a DOS window or at DOS level, enter
                the command **ghost –lps** to start the
                    Norton Ghost program.

        *   MMC: "Y"
                Start the restore by acknowledging the message window (Yes).

        *   MMC:
                The message window of Norton Ghost appears:
                    The progress of the data transfer is displayed
                    The paths are displayed
                    The volume of data to be transferred is displayed

---

Note

If the transfer is interrupted during the restore process, the system on the hard

disk is incomplete. An MMC boot diskette with the MS-DOS $\geq$ 6.X boot and Norton Ghost is therefore required.

    –   **< 4 > Back** to previous menu
                    Return to main menu

8. After a successful restore, the MMC is booted automatically.

Time required: approx. 15–20 minutes
for the generation of a compressed disk image =130MB of a 540MB hard disk via LPT.

11.7   Data backup with VALITEK streamer on the MMC 101/102/103 (SW 5.3 and lower)

What can you back up?

With the VALITEK streamer you can:

- Back up all the data on hard disk C (back up 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

The VALITEK streamer is connected to parallel interface X8 (25-pin) on the MMC 101/102/103. Siemens cable 6FC9 344-4x☐ must be used to make the link. You cannot connect any other type of data backup device because the software is adapted especially to the VALITEK streamer.

Operator action

During MMC ramp-up (after control has been switched on) while the message **Starting MS DOS** is displayed:

1.   Press key **6** on the operator panel front keyboard just once and briefly.

The following menu is displayed:

```
              PLEASE SELECT:

              1 Install/Update MMC System
              2 MMC Configuration Tool
              3 DOS Shell
              4 Start Windows (Service Mode)
              5 MMC System Check
              6 Reboot System (Warmboot)
              7 Backup / Restore
              8 Start PC Link
              9 End (Load MMC)


  Your Choice [1,2,3,4,5,6,7,8]?
```

2.   Press key **7**

The system requests you to enter a password with:

```
  passwd:
```

3.   Enter a password for levels 0–2.
              – System
              – Manufacturer
              – Service

The following menu is displayed:

11.7   Data backup with VALITEK streamer on the MMC 101/102/103 (SW 5.3 and lower)

```
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 102/103 (Delete Files)
7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?
```

4. Press key **1**

The following menu is displayed:

```
*** No Streamer configured ***

Please select (new) Streamer type:
1 Valitek PST-160
2 Valitek PST²-M1200
3 Return to previous Menu

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

5. Select a streamer type, e.g. no. 2 Valitek PST^2-M1200. The streamer type is selected and you are taken back 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 102/103 (Delete Files)
7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?
```

6. If the streamer is connected you can check the connection. To do this select menu item **2**
    A message about the streamer type is displayed:

```
*** Current Configuration: Valitek PST²-M1200 ***

Press any key to continue ...
```

The test run then starts.

11.7 Data backup with VALITEK streamer on the MMC 101/102/103 (SW 5.3 and lower)

```
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, perform a full data backup. To do this, select menu item 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 102/103 (Delete Files)
                 7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?
```

The following message appears on the screen:

```
    *** Current Configuration: Valitek PST2-M1200 ***

    Backing up Partition C: ....
     Continue ?

Your Choice: [Y,N]?Y
```

Select Y to start data backup.

8. With key **4,** Backup User Data, you can select data backup of user data, i.e. the batch file C:\TOOLS\BACK_USR.BAT is executed. All the archive files under C:\DH\ARC.DIR are backed up by default. If you want to back up any other files, enter the relevant directories in the 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 102/103 (Delete Files)
                 7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?4
```

11.7   Data backup with VALITEK streamer on the MMC 101/102/103 (SW 5.3 and lower)

BACK_USR.BAT   The file must only be changed at the marked points. File BACK_USR.BAT looks
                        like this:

```
~~C:\
REM Save Archives in DH:\ARC.DIR
>> c:\dh\arc.dir\
*.*
REM Save this file
>> c:\tools\
back_usr.bat

[ ...You can enter 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
```

Select Y to start data backup.

9.   Choose key **5** to restore the data backup.

```
                    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 102/103 (Delete Files)
                    7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?5
```

The following message appears on the screen:

```
    *** Current Configuration: Valitek PST2-M1200 ***

     Restoring from Tape ....
    Continue ?

Your Choice: [Y,N]?Y
```

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11.7   Data backup with VALITEK streamer on the MMC 101/102/103 (SW 5.3 and lower)

Select Y to start the restore procedure of the inserted data backup.

10. With key **6** you can delete the MMC 102/103 system including the data backup.

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 102/103 (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 102/103 System ?
Your Choice: [Y,N]?Y

Selecting Y deletes all the data in directory C:\MMC2*.* and C:\DH*.*. Operating system MS DOS and Windows are not deleted.

11.8 Line checksums and MD numbers in MD files (SW 3.2 and higher)

A check facility has been created through the introduction of line checksums to backup files for machine data (INI and TEA files).

The purpose of introducing machine data numbers (MD numbers) in the backup files is to facilitate the communication of machine data values for servicing purposes and automatic processing of MD backup files in some cases.

By saving the files themselves, it is possible to dispense with the "Manufacturer" write authorization when these backed-up files are read in again.

The following two subsections describe line checksums and machine data numbers in detail.

11.8.1 Line checksums (MD 11230 MD_FILE_STYLE)

Properties of the line checksums

A line checksum

- A line checksum is only generated for lines with machine data assignments.

- The line checksum is positioned immediately after the machine data assignment preceded by a blank space and apostrophe.

- The checksum consists of 4 HEX characters

- The line checksum is only ever generated by the control on creation of an MD backup file and not by external editors on PC or PG.

- Is activated via MD 11230 MD_FILE_STYLE.

- A line checksum can be output together with machine data numbers.

- "; <Comment>" can be added later to lines with checksums without affecting the sum check.

MD 11230 MD_FILE_STYLE

If MD11230 =	Output	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**

Evaluation of line checksums

No write authorization is required to read in machine data files with valid line checksums.

11.8   Line checksums and MD numbers in MD files (SW 3.2 and higher)

To load

- machine data without line checksum,

- modified MD values with deleted line checksum and

- MD files from SW version 1 or 2,

it is necessary to have the "Manufacturer" write authorization.

When loading machine data files, the user can select how the system should respond to errors in the machine data file. See Aborting of MD import 11.8.3.

If the file contains incorrect values, then the current values are never overwritten.

11.8.2   Machine data numbers

Archive files

- Machine data numbers are positioned as block numbers (e.g. N20070) in front of an MD assignment line.

- There is a blank between the machine data number and MD assignment.

- The MD number refers to the machine data in total. Any existing field values are not represented in the MD number.

- It is possible to select/deselect the generation of MD numbers in front of MD assignment lines in INI and TEA files.

  - MD 11230 MD_FILE_STYLE Bit 1 = 1   generate MD number

  - MD 11230 MD_FILE_STYLE Bit 1 = 0   do not generate MD number.

Evaluation of MD numbers

When machine data files are read back in, the control evaluates the MD numbers as follows:

- If errors are detected in the MD files when they are read in, the MD number is displayed as the **block number** with the corresponding alarm.

11.8.3   Aborting MD import

Control reactions

If, during the import of machine data files (INI files) to controls with machine data are read in

- which contain errors

- which do not match the checksum,

then alarms are generated and the import process aborted in some cases. You can use MD 11220 INI_FILE_MODE to select the control behavior as follows:

11.8   Line checksums and MD numbers in MD files (SW 3.2 and higher)

MD 11220 value	Reaction to errors
0	Output of an alarm, abort on detection of 1st error (as for SW version 1 and 2).
1	Output of an alarm, continuation of file import, alarm outputs number of errors at file end.
2	Import process continues to end of file even if errors are detected. Alarm outputs number of errors at file end.

In all cases where at least one error is detected in the MD file, the name of the affected file is output by means of alarm 15180.

Other reactions:

- MD containing errors do not overwrite current MD.

- The current MD are not overwritten when an attempt is made to load MD with no line checksums without adequate write authorization.

- CHANDATA instructions for nonexistent channels (MD for multiple channel configuration are not set) cause import process to be aborted.

- Invalid file end causes import process to be aborted.

MD 11220
INI_FILE_MODE

MD 11220 INI_FILE_MODE must be reset explicitly. An earlier setting is not accepted in the course of series start-up.

Example:

- Import machine data and output alarms generated on import.

- % character stands for file name and number of errors.

- MD 11220 = 1, i.e. output of an alarm for every error, continuation of processing, alarm outputs of errors at end of file.

MD file	Alarms
CHANDATA(1)	
$MC_AXCONF_GEOX_NAME_TAB[0]="X"	
$MC_AXCONF_GEOX_NAME_TAB[1]="Y"	
	15180 Program % cannot be processed as INI file
$MC_AXCONF_GEOX_NAME_TAB[99]="A"	17020 Illegal array index 1
$MC_MM_REORG_LOG_FILE_MEM=1000	17090 Value greater 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

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Extension SW 6.4 and higher

Machine data for unactivated channels are ignored and do not terminate archive read-in.

Channels are activated by configuration in the machine data
MD 10010: ASSIGN_CHAN_TO_MODE_GROUP.

Channel machine data of channels to which a BAG=0 is assigned there, are ignored during read-in.

Alarm options via MD 11220: INI_FILE_MODE are also valid here. However, only data errors read in for the channels to be loaded are handled as errors.

Application:
Series start-up of different machines using a standard archive file created for the largest machine of a class of machines. For the smaller machines, only
MD 10010: ASSIGN_CHAN_TO_MODE_GROUP is set such that only as many channels are activated as the smaller machine can process.

Changing the archive file:
For changes in the archive file to
MD 10010: ASSIGN_CHAN_TO_MODE_GROUP
the SinuCom ARC program is provided. It is part of the start-up SinuCom NC software that is described in

References: /INC/, Start-Up Tool SINUMERIK SinuCOM NC.

Alarm:
If machine data to be ignored are found during archive read-in, warning alarm 15025: "Channel %1 Block %2 CHANDATA: Channel is not active. %3 Data will be ignored" is output.

11.9 Machine/Setting data

The machine/setting data are listed in
References: /LIS/ Lists

11.10 Saving PLC data

Original image of project

The consistency of the PLC data backup can only be guaranteed if the procedure below is followed:

1. Switch PLC to PLCSTOP (PLC switch S4 to position 2)

2. Transfer the PLC data from the programmer to the control

3. Archive the PLC data

4. Switch the PLC to PLCRUN (PLC switch S4 to position 0)

This sequence of operations produces an original image of the project in the data backup.

**Instantaneous
image of PLCCPU**

As an alternative to the above, the PLC can be switched from PLCRUN to
PLCSTOP:

1. Switch PLC to PLCSTOP (PLC switch S4 to position 2)

2. Archive the PLC data

3. Switch the PLC to PLCRUN (PLC switch S4 to position 0)

This sequence of operations produces an instantaneous image of the PLCCPU
contents in the data backup.

Note

If the PLC data backup is performed during cyclic operation of the PLC
(PLCRUN), the data modules are not backed up at the same time. This may
result in a data inconsistency which causes the user program to stop the PLC.

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Notes

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Software and Hardware Replacement 12

12.1 Software update

Note

Sequence for updating software during start-up or software replacement:

1. Upgrade MMC software

2. Upgrade NCK software

Please note instructions and advice given in readme file supplied with tool box.

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12.2   Upgrading the MMC 100/100.2 SW 4.x or lower

Medium supplied   The MMC 100 software is supplied on 2 (3.5") floppy disks. They consist of:

1. System disk(s) (also called installation disk).

   – Boot software

   – System software

   – User software.

2. Application disk(s)

   – Alarm text files

   – Configuration files for MMC 100/100.2 MDs

   – Configuration file for several operator panel fronts

   – User software.

Floppy disk set 1   When you have loaded floppy disk set 1, you have a functionally standard
MMC 100/100.2 system with the first language English and the second lan-
guage German. The alarm text and message files contain only Siemens texts.

Floppy disk set 2   The contents of floppy disk set 2 enable you to do the following:

   – Adapt and expand alarm text files

   – Select one or two languages other than those already loaded from floppy
     disk set 1 (a maximum of 2 languages are loaded on the MMC 100 at
     any given time).

   – Make special MMC 100/100.2 MD settings

   – Adapt configuration parameters for several operator panel fronts/NCUs.

   – Transfer user-defined screen forms for PLC status to MMC 100/100.2

Instructions on how to handle the two diskettes are given below. You will find
rules for adapting files before transfer to MMC 100 in Chapter 11 Data Backup.

For further information see
                     /IAM/ IM1, Start-Up Functions for MMC 100.2

12.3   Upgrade of MMC 103 SW 4.x or lower

This Section describes how to upgrade the software

- on an MMC 103 with Windows 3.11 to SW 2.4 or 3.x or

- on an MMC 103 with Windows 95 to SW 4.x.

A software upgrade on an MMC 103 with <SW 4.x to Windows 95 must be performed by a service engineer (see READ ME for upgrade instructions).
An MMC 102 cannot be upgraded to SW 4.

Principle of operation

Two areas are set up in the control:

- MMC 103
  standard mode which powers up without operator input.

- Windows
  The Windows area (with activation of earlier versions of INI files) is intended for the service engineer who can also use the full Windows functionality to start up the control.

In both areas, you can

- Install add-on software (e.g. additional languages)

- change INI files/hardware configuration (e.g. install drivers)

- upgrade with a network card and/or a mouse.

Each of these must be installed in the MMC2 and/or Windows area if you wish to have the functionality in one or both areas.

Menu overview

For SW 3.1 and higher there are different menus that you can activate on system start-up for installing software and backing up on streamer.
While the MMC 103 is powering up and the message **Starting MS DOS** (SW 3.x and lower) or **Starting Windows 95** is displayed, press key 6.

For further information see
              /IAM/ IM3, Start-Up Functions for MMC 103

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12.4   Upgrading the NC

12.4.1   Standard upgrade

PCMCIA card name convention

The PCMCIA cards used for the NCU and MMC have the same external appearance and are therefore occasionally difficult to distinguish. We will distinguish between them below by referring to the PCMCIA card

- for the NCU as "**NC card**" and

- for the MMC as "**PC card**".

Every SW package is supplied with a read me file in the tool box. This file describes how to upgrade the control software with the new version.

- Save all control and user data before you commence with updating (see Section 11 Data backup).

- Switch off the control.

- Insert the NC card with the new firmware into the PCMCIA slot.

Proceed as follows:

1. Set switch S3 to 1.

2. Switch on power.

3. During ramp-up, the firmware is transferred from the NC card to the device.

4. Wait until the digit "6" appears on the display (this can take up to 2 minutes).

5. Set switch S3 to 0.

6. Perform a PLC general RESET: Switch S4 to "2", then to position "3". Within 3 seconds, turn the switch to positions ("2"-"3"-"2"). When the PS and PF LEDs light up, switch S4 to "0" (see Section 5.2).

7. Then proceed as described in Section 11.2 (series start-up), to restore the back-up data. Please note any manufacturer instructions regarding the new software version.

Note

If the display does not get as far as "6" the possible causes of the error are:

– Software and hardware mismatch (e.g. PC card NC with software for NCU 572.2 is plugged into an NCU 573.2)

– Defective NC card or hardware.

12.4.2   Series start-up via NC card (SW 4.4 and higher)

The free memory on the NC card (PCMCIA card) can be used to store a start-up archive. The archive can be loaded onto the NC card with SINUCOPY-FFS (on an external PG/PC) :

Possible applications:

1. After replacing an NC module (or after the loss of data), the user can restore the original state of the machine with the archive stored on the NC card, or

2. The machine manufacturer can supply cycles and data in an archive on the NC card with the machine or a software upgrade.

SW version 6 and higher provide the option to transfer Siemens cycles and/or machine manufacturer cycles from the Flash File System of the NC card to the DRAM during control ramp-up and execute them from there. For the relevant configurations and the DRAM cycles response see 12.4.3.

Operating sequence

A) Create a start-up file on the NC card

Requirement:
The SINUCOPY_FFS software is loaded

1. Copy the series start-up data of the NC/PLC via RS-232 onto a PG/PC

2. Store the series start-up data as file ORIGINAL.ARC on the PG/PC (e.g. in \tmp)

3. Call up SINUCOPY-FFS on the PG/PC

4. Insert the NC card in the PCMCIA slot

5. Copy the NC software to the PC card

6. Select "Area setting" in NC card menu. Enter 0 under "FFS Startadr" and "FFS Endadr".

7. Select field "Create new FFS", and then the "Calculate automatically" field.

8. Format FFS on NC card.

9. Select field "Create DIR" in the FFS menu and set up and open directory _N_ARC_DIR

10. Call command "Save FFS from hard disk to card [Archives/Parts Programs]" in the FFS menu. The data are loaded onto the NC card.

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Note

The start-up file created can be stored directly on the NC card in SW 5.2 and higher.

B) Load the start-up file from the NC card

Requirement:
The start-up archive with the name _N_ORIGINAL_ARC is stored 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 = 1 (NCK general RESET)
    Press NCK RESET and wait until a "6" appears on the 7-segment display

    Start-up switch = 0 (NCK general RESET executed)
    When the "6" appears, the start-up switch can be set to basic setting "0".

2. Set the password

3. In the Services basic display, press the "Etc key" and then press the "original
    status" soft key.
    This soft key is available only if the NC card contains the above-mentioned
    start-up archive and access level 3 (user) is set on the control system.

4. When you press this soft key, the log window appears with the prompt:
    "Series start-up archive: Perform series start-up?"; when you confirm, the
    data are loaded.

Note

If no PLC program is active, the loading of the data takes longer (since the sys-
tem has to wait for the PLC timeout).

⚠️

Caution

All user-specific NC data (and PLC data if these are contained in the start-up
archive) are deleted and replaced by corresponding data from the start-up ar-
chive.

12.4.3   DRAM for cycle storage and programs (SW 6 and higher)

Cycles

After travel-in, the cycles normally remain unchanged.

Therefore they are suited for processing from the DRAM available in SW 6 and higher. Scarce SRAM memory space can be saved.

Programs

Only ever make use of the option of editing programs from the DRAM if you no longer intend to make changes and saving user memory is a major consideration.

The function "Processing from the DRAM" is available as an option.

Availability

The cycles are available in the Flash File System FFS of the NC card in the directories:

_N_CST_DIR	Siemens cycles
_N_CMA_DIR	Machine manufacturer cycles

As from SW 6.4 also:

_N_CUS_DIR	User cycles
_N_MPF_DIR	Parts programs
_N_SPF_DIR	Subroutines
_N_WKS_DIR	Workpieces

are provided or loaded by the HMI software.

Selection for processing from DRAM

The objects to be processed from the DRAM are indicated in MD 11290: DRAM_FILESYSTEM_MASK If the MD is set to 0, the objects are processed from the SRAM by default.

Bit = 0	The files of the directory are executed from the SRAM
Bit = 1	The files of the directory are executed from the DRAM

Assignment of bits to the directories

Bit 0	Siemens cycles, CST directory
Bit 1	Machine manufacturer cycles, CMA directory
Bit 2	User cycles, CUS directory
Bit 3	Parts programs, MPF directory
BIt 4	Subroutines, SPF directory
BIt 5	Workpieces, WKS directory

Back-up on a background memory

For SW 6.4 and higher, it is possible to select whether the files destined for execution from the DRAM will be saved on the flash file system of the NC card so that they will be available in the DRAM again after NC power ON. Otherwise, you will have to load them from HMI again.

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The saving is set in MD 11291 : DRAM_FILESYST_SAVE_MASK.

Bit = 0   The files of the directory are not saved

Bit = 1   The files of the directory are saved in the flash file system of
                     the NC card

Assignment of bits to the directories

Bit 0   Siemens cycles, CST directory
Bit 1   Machine manufacturer cycles, CMA directory
Bit 2   User cycles, CUS directory
Bit 3   Parts programs, MPF directory
BIt 4   Subroutines, SPF directory
BIt 5   Workpieces, WKS directory

The default is: Save all cycle directories.

DRAM area size

The DRAM memory to be reserved for cycle/program processing within the
DRAM area, must be defined in MD 18351: MM_DRAM_FILE_SIZE.

IIf the DRAM area is too small for the on objects, the objects files which cannot
be stored in the DRAM area, will have to be saved to the SRAM, but treated like
DRAM objects nevertheless. See below.

**Processing the
objects in DRAM**

The directories marked MD 11290: DRAM_FILESYSTEM_MASK are loaded to
the previously deleted DRAM while the control runs up. They become part of
the passive file system.

When an object is loaded by the MMC/HMI software, it is simultaneously stored
in the FFS by the NC, if the bit for that directory is set in MD 11291 : DRAM_FI-
LESYST_SAVE_MASK. That way, the object will be available again in the
DRAM after booting. Please note that writing to the FFS is performed slowly.

**Changing objects
in the DRAM**

During operation the changes are directly transferred to DRAM. The changes
are written to the FFS backup only after closing the editor.

While an FFS backup is performed, the operator panel front displays a sign-of-
life symbol (fan blade). In order not to lose DRAM objects while booting, the NC
must only be switched off after FFS backup is finished.

Deleting SRAM

When deleting the SRAM the NCK automatically deletes all DRAM backup files
in the FFS on the NC card also. Old cycles will therefore not remain while read-
ing in a series start-up file.

12.4.4   SINUCOPYFFS (SW 4.4 and higher)

The SINUCOPYFFS program can be used to read or write either the SINUMERIK system software (NC) or a flash file system (FFS) from or to NC cards of the NCU installed on a PC with an active PCMCIA slot.

**FFS:
flash file system**

A flash file system is similar to a DOS data storage medium, such as a floppy disk. The system must be formatted before data can be stored. Directory structures can then be created and files stored in any format.

The data storage medium is an electrically erasable EPROM. That means that the corresponding area always has to be deleted before data are written. Algorithms adapted in accordance with the block identification are required in order to delete and write data. You can determine the speed of data write transfers to a large extent.

An FFS system can usually be read directly by DOS/WINDOWS. Since the NC system software, which is not saved in FFS format, is also stored on the card, this is only possible with SINUCOPYFFS.

**Software/hardware
requirements**

- The following PCMCIA card drivers/hardware are supported:
    - CSM OMNI97 (external PCMCIA device operated on 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 4MB)
    - CSM PCJB slots (only for cards up to 4MB).
- The program will run under Windows 95. If CSM OMNI97 is used, it will also run under Windows NT.

Functions

SINUCOPYFFS can manipulate the FFS area of the NC card using the following functions, independent of the SINUMERIK system software (NC):

- Read
- Modify
- Rewrite
- Reformat
- Create new directories
- Copy a file into the directories and subdirectories
- Read and write system software
- Write data to the NC card (SW 5.1 and higher).

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Expert mode
An FFS image is generated in the PC memory in expert mode. It can be written onto the inserted NC card or saved as a file.
Normal mode
In normal mode, every action (read/write/delete) is performed directly on the NC card.

Independent of the FFS, the NC system can be:

- Rewritten (condition: the storage capacity above the FFS start address is not used by the NC system).

- Duplicated

- Read out and saved as a file

- NC cards can be duplicated completely (NC + FFS).

The NC system version of the inserted card can be displayed.

The memory capacity of the inserted NC card is automatically detected and displayed. The same applies to the limit memory addresses for the FFS.

Operation   The functions of the program can be called up from the menu bar or by activating buttons in the user interface. Help is available for all actions by activating the "Help" menu.
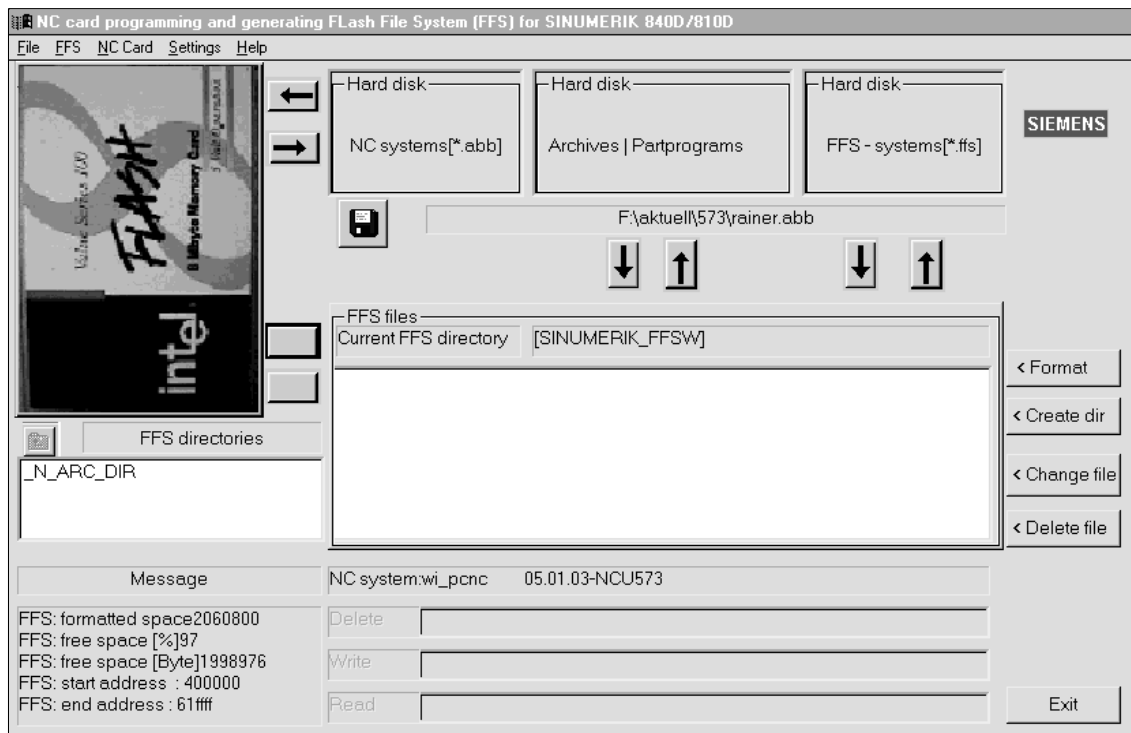
Fig. 12-1   User interface of SINUCOPYFFS

- Display card contents:
  Click the NC card display with the **left** mouse button (menu: NC card/version display of the NC system)

- View card info with card and FFS data
  Click a free location (not a button, not a display, e.g. top right) with the **right** mouse button (same effect as menu NC Card/ID Info menu).

- The arrows are used in the same way as menu commands:

  - Read/write NC system. Below that, read/write FFS system.

  - Copy files from the hard disk to the FFS system.

  - Copy files from the FFS system to the hard disk.

  - Load or save finished FFS systems in RAM image.

- List boxes (Explorer)
  The list boxes show the available FFS directories on the left, and the contents of the selected directory on the right. Double-click the directory names to select the directories. Use the "Back arrow" to move back one level. A file must be selected in the right list field before activating the "Modify file" or "Delete file" key.

- Info field bottom left
  After you format the FFS system, the bottom left info field indicates the formatted memory, and the free capacity as a % number and a byte count.

Note

Nore that the date in the Info field are gross data. Subtract approx. 8% for overhead.

- FFS system detection
  If the program is started when a card is inserted, the program detects whether an FFS system is supported. If no reference data are available for the FFS start and end address on the card, the system suggests these be entered automatically as far as possible.

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Note

A card change is detected automatically. The contents of the card (FFS) are displayed.

Installation

1. Start "sinucopy-ffs.exe" file

2. Enter password

3. Dialog: Specify a temporary directory for extracting the files

4. Dialog: Specify the hardware configuration

5. Dialog: Select the components to be installed

6. Dialog: Specify the directory for the installation

7. The software is installed

8. Message: "driver installed"

9. Dialog: "Select program folder name"

10. Dialog: Please read the READ ME file

11. Dialog: Restart now or later

12. After a restart, the SINUCOPY-FFS function can be used.

Tool: ARCEDIT   This tool is intended for experts.

- Read archive files

- Delete/insert files

- Modify files (if editable).

Tool: SICARD   This tool is intended for experts.

- Read and write data to NC cards

- Duplicate NC cards.

Note

1. Programming device with SINUCOPY (previous version)
    The installation may be unsuccessful if the driver "cisio-s" is entered in the
    "config.sys" file and it is detected during ramp-up: Error message. Remedy:

    – Delete the line "Device ...cisio.exe, cisio.ini".

    – In the "cisio.ini" file, enter a free interrupt number as a hex number in the
      line IRQ=....
      You can determine a free interrupt number from the menu "Properties
      for system"– "Device manager".

2. If an NC card with FFS is duplicated with the previous version SINUCOPY,
    only the NC system (not the FFS part) is duplicated.

3. The drive name for the OMNI97 device can be entered: Enter the drive let-
    ter in the menu "System control/Device manager/Drives/OMNI97".
    Windows NT: Enter the drive letter in the menu "OmniControl/DriveLetter".

Tool: SINUCOPY   The SINUCOPY program can be used to:

- Read, write or duplicate the SINUMERIK system software (NC) on NC cards of the NCU installed on a PC with an active PCMCIA slot. The version identifiers of the programs can be displayed (corresponding to the version display of the SINUMERIK control).

- Read and write the SINUMERIK system software (MMC) on PC cards of the MMC 100.2.

- Write data from the NC onto the NC card.

Operation   The functions of the program can be called up from the menu bar or by activating buttons in the user interface. Help is available for all actions by activating the "Help" menu.

Note

NC data can be written to the NC card (SW 5.1 and later); Operator inputs see: /BA/ 840D Operator's Guide, Services operating area.

12.4.5   SW 6: Supplementary conditions for SW replacement

The following NCs are available for SW 6:

- NCU 571.2

- NCU 572.3

- NCU573.3.

The following points must be observed when upgrading an NC:

1. If an NCU 5xx is to be upgraded from SW 5 from SW 6, the NCU must also be replaced with a current NCU for SW 6.

2. If an NC card is equipped with SW 6 and is inserted in the current HW version (e.g. NCU 572.2), the system does not start-up. The status display flashes in the sequence 0 – 1 – 6.

3. If an NC card is equipped with SW 5 and is inserted in the current HW version (e.g. NCU 572.3), the system does not start-up. The status display flashes in the sequence 0 – 1 – 6.

4. If an NC card of an NCU 573.2 is equipped with SW 5 and is inserted in the current HW version, the system starts up and is functional.

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12.5   Hardware replacement

You can replace all components that are ordered via an MLFB (machine-readable product designation) order number.

Save the data before removing any hardware components.

Note

The CCU module can be withdrawn from the NCU box without data being lost since the data are stored for approx. 15 min. via a backup battery.

References: – /HPU/ Manual Configuring 840D

– /PJ1/ Configuring 611A/611D

– /BH/ Operator Components Manual 840D

12.6   Battery/fan replacement

⚠️ **Caution**

You should never attempt to revitalize dead batteries through heat or any other treatment. The batteries must not be charged because this could cause them to leak or explode.

Failure to observe this warning could lead to physical injury or property damage.

There are battery-backed SRAMs and timers on the NCU box and MMC 103. The NCU buffer voltage is monitored by the control system. Once the monitoring function has responded, the battery must be replaced within 6 weeks. The battery in the NCU box can be changed after the control has been switched off since the data are backed up for a period of 15 minutes.

Lifetime

The battery has a minimum lifetime of three years.

Replacement of battery/fan on NCCPU

The battery/fan drawer is located under the DC link bars (see Fig. 12-2).

1. There is a latch (3) on the bottom of the drawer (see Fig. 12-2). Press the latch (3) up and pull the drawer out towards you at the same time.

2. Remove the battery connector by pressing the retaining jacks slightly outwards.

3. Pull the battery out upwards.

The new battery is inserted in the reverse order.

Make sure that you connect the battery terminals correctly (2).

1) Battery
2) Red cable (+)
3) Latch
4) Fan
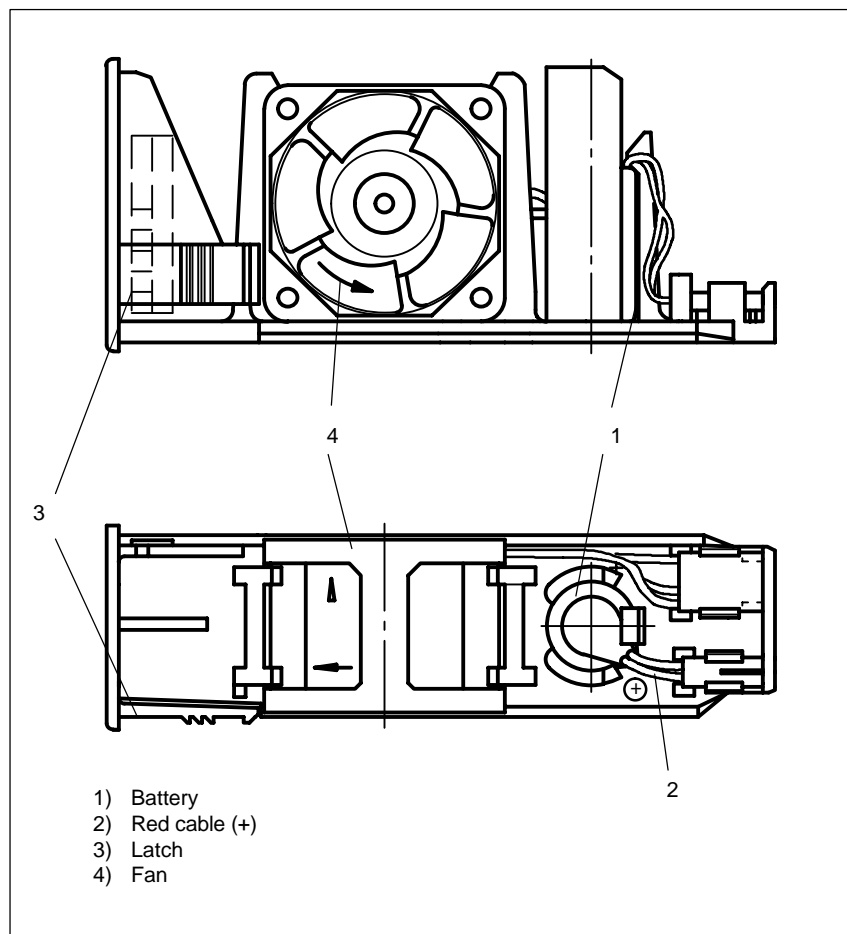
Fig. 12-2   Battery/fan drawer

12

Battery   6FC5 247-0AA18-0AA0

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Notes

HMI/MMC

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SW 5.2 and higher   The contents of this section are provided in
/IAM/ **Start-Up Guide MMC**, IM1 or IM3
Order No.: 6FC5 297-5AE20-0BP1.
The MMC Start-Up Guide is divided into four volumes:

SW 6.1 and higher   The contents of this section are provided in
/IAM/ **Start-Up Guide MMC**, IM2 or IM4
Order No.: 6FC5 297-6AE20-0BP0.
The MMC Start-Up Guide is divided into six volumes:

AE1	Updates/Supplements
BE1	Expanding the Operator Interface
HE1	Online Help
IM2	Starting up HMI Embedded
IM4	Starting up HMI Advanced
TX1	Creating Foreign Language Texts

■

13

Notes

Miscellaneous

14

14.1 Tool box software package

14.1.1 Content of tool box

Content

Supplied on 3.5" diskettes with

- Basic PLC program
- NC variable selector
- Standard machine data blocks
- Read me file about the current 840D software version.

Software requirements

You will need the following software for the data transfer:

- PCIN software program
- SIMATIC STEP7 HiGraph for 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.

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14.1.2 Application of the tool box

Standard MD sets

Various sets of standard machine data are provided as examples.

- "Turning" technology (2 axes, 1 spindle)
- "Milling technology" (3 linear axes, 1 spindle, 1 rotary axis).

Application   Use the data records as a configuration example. You can alter the data records
                           to match your application using the DOS editor.

PLC basic   See Section 6.6.
program

NC variable   You require the NC variable selector in order to read and write the NCK vari-
selector   ables.
                           References: /FB/, P3, Basic PLC Program
                                                  /LIS/ Lists, "Variables" section

14.2   Machine data access via parts program

Data identifiers   The machine data identifiers are displayed on the MMC. The internal designa-
                           tion of the data requires further identifiers which must be specified when a ma-
                           chine data is altered via programming measures or imported via the serial inter-
                           face.

Data areas $MM_   Operator panel front 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   Subarea (second letter)

                           Axis data are addressed via the axis name. The internal axis designation (AX1,
                           AX2 ... AX5) or the designation specified via MD 10000:
                           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 inverted commas
                           (e.g. 'X1' or 'H41').
                           E.g.: $MN_DRIVE_INVERTER_CODE[0]='H14'
                           FDD module 9/18 A at drive slot 1 on the drive bus.

                           To address the various contents of a machine data, identifying data must be
                           specified in square brackets.
                           E.g.: $MA_FIX_POINT_POS[0,X1]=500.000

                             The 1st fixed point position of the ⌐ ⌐ axis X1 is 500
                                 (0=1st, 1=2nd, 2=3rd, etc).

Examples $MN_AUXFU_GROUP_SPEC[2]='H41'
                           Output time for auxiliary functions in 3rd auxiliary function group.

                           $MN_AXCONF_MACHAX_NAME_TAB[0]='X1'
                           The name of the 1st machine axis is X1.

                           $MA_REF_SET_POS[0,X1]=100.00000
                           The 1st reference point value of axis X1 is 100mm.

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 the 2nd geometry axis in channel 1 is Y
...	
R10 = 33.75	R10 from channel 1
...	
CHANDATA(2)	Assignment channel 2
$MC_CHAN_NAME='CHAN2'	Channel name for channel 2
...	
R10 = 96.88	R10 from channel 2
...	

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Abbreviations

<div style="text-align: right; font-size: 2em; font-weight: bold;">A</div>

ASCII	American Standard Code for Information Interchange
ASUB	Asynchronous subprogram (or subroutine)
BA	Operating mode
BAG	Mode group
BCD	Binary Coded Decimals
BOOTFILE	Boot files for SIMODRIVE 611D
BP	Basic Program
CC	Compiler Cycles
CCU	Compact Control Unit
COM	COMmunication
CPU	Central Processing Unit
CRC	Cutter Radius Compensation
CTS	Clear To Send for serial interfaces
DAC	Digital 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
DRF	Differential Resolver Function (handwheel)
DRY	DRY run feedrate
DSR	Data Send Ready: Message from serial data interfaces
DTE	Data Terminal Equipement
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
FDD	FeeD Drive
FEPROM	Flash EPROM: Readable and writable memory
FIFO	First-in-first-out: Memory that operates without addresses where the data are always read out in the same order in which they were stored.
FST	Feed STop (= feed hold)
FIPO	Fine InterPOlator
GEO	GEOmetry
GND	Ground signal
HASH	Software procedure for mapping a large quantity of identifiers onto a finite memory area
HEX	Hexadecimal number
HHU	Handheld Unit
HMI	see MMC
HSA	MSD
HW limit switch	Hardware limit switch
INC	Increment

INI	**INI**tializing data
INTM	INternal Multiplication
IS	Interface
ISO code	Special punchtape code, number of punched holes per character always even
JOG	Jogging: Setting-up mode
K1	Channel 1
K BUS	Communications bus
K$_\ddot{u}$	Transmission ratio
K$_V$	Servo gain factor
LEC	Leadscrew Error Compensation
LED	Light emitting diode
LPFC	Low-Priority Frequency Channel
LSB	Least Significant Bit
MD	Machine Data
MDA	Manual Data Automatic (MDI)
MMC	Human Machine Communication: User interface on SINUMERIK for operator control, programming and simulation.
MPF	Main Program File: NC parts program (main program)
MPI	MultiPoint Interface
MSD	Main Spindle Drive
NC	Numerical Control
NCK	Numerical Control Kernel with block preparation, travel range etc.
NCU	Numerical Control Unit: NC module
OB	Organization Block on PLC
OPI	Operator Panel Interface

A

P BUS	Peripheral Bus
PCMCIA	Personal Computer Memory Card International Association
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: Identifier for R parameters (R variables)
RS-232	Serial interface (V.24)
RTS	Request To Send (control signal on serial data interfaces)
SBL	Single Block
SD	Setting Data
SEA	Setting data active: Identifier for setting data
SK	Soft Key
SKP	SKiP block
SLM	Synchronous Linear Motor
SPF	SubProgram File: Subroutine
SRAM	Static RAM (non-volatile)
SW limit switch	Software limit switch
T	Tool
TC	Tool Change
TEA	Testing data active: Identifier for machine data
TO	Tool Offset

TOA   Tool Offset Active: Tool offset identification

TRC   Tool Radius Compensation

VDI   Interface between PLC and NC

ZO   Zero Offset (WO)

ZOA   Zero Offset Active: ZO identification

μ**C**   Micro Controller

                                                                                                                          ■

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
Order No. of bound edition: E86060-K6710-A101-A9-7600
Order No. of single-sheet edition: E86060-K6710-A100-A9-7600

/ST7/ SIMATIC
SIMATIC S7 Programmable Logic Controllers
Catalog ST 70
Order No.: E86 060-K4670-A111-A3-7600

/Z/ SINUMERIK, SIROTEC, SIMODRIVE
Accessories and Equipment for Special-Purpose Machines
Catalog NC Z
Order No.: E86060-K4490-A001-A8-7600

Electronic Documentation

/CD1/ The SINUMERIK System (11.02 Edition)
DOC ON CD
(includes all SINUMERIK 840D/840Di/810D/802 and SIMODRIVE publications)
Order No.: 6FC5 298-6CA00-0BG3

User Documentation

/AUK/	SINUMERIK 840D/810D **Short Guide AutoTurn Operation** Order No.: 6FC5 298-4AA30-0BP2	(09.99 Edition)
/AUP/	SINUMERIK 840D/810D **AutoTurn Graphic Programming System** Programming/Setup Order No.: 6FC5 298-4AA40-0BP3	(02.02 Edition)
/BA/	SINUMERIK 840D/810D **Operator's Guide MMC** Order No.: 6FC5 298-6AA00-0BP0	(10.00 Edition)
/BAD/	SINUMERIK 840D/840Di/810D **Operator's Guide HMI Advanced** Order No.: 6FC5 298-6AF00-0BP2	(11.02 Edition)
/BEM/	SINUMERIK 840D/810D **Operator's Guide HMI Embedded** Order No.: 6FC5 298-6AC00-0BP2	(11.02 Edition)
/BAH/	SINUMERIK 840D/840Di/810D **Operator's Guide HT 6** Order No.: 6FC5 298-0AD60-0BP2	(06.02 Edition)
/BAK/	SINUMERIK 840D/840Di/810D **Short Guide Operation** Order No.: 6FC5 298-6AA10-0BP0	(02.01 Edition)
/BAM/	SINUMERIK 840D/810D **Operation/Programming ManualTurn** Order No.: 6FC5 298-6AD00-0BP0	(08.02 Edition)
/BAS/	SINUMERIK 840D/810D **Operation/Programming ShopMill** Order No.: 6FC5 298-6AD10-0BP1	(11.02 Edition)
/BAT/	SINUMERIK 840D/810D **Operation/Programming ShopTurn** Order No.: 6FC5 298-6AD50-0BP2	(03.03 Edition)
/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	(11.02 Edition)
	Order No.: 6FC5 298-6AA20-0BP3	

/KAM/	SINUMERIK 840D/810D	
	Short Guide ManualTurn	(04.01 Edition)
	Order No.: 6FC5 298-5AD40-0BP0	

/KAS/	SINUMERIK 840D/810D	
	Short Guide ShopMill	(04.01 Edition)
	Order No.: 6FC5 298-5AD30-0BP0	

/KAT/	SINUMERIK 840D/810D	
	Short Guide ShopTurn	(07.01 Edition)
	Order No.: 6FC5 298-6AF20-0BP0	

/PG/	SINUMERIK 840D/840Di/810D	
	Programming Guide Fundamentals	(11.02 Edition)
	Order No.: 6FC5 298-6AB00-0BP2	

/PGA/	SINUMERIK 840D/840Di/810D	
	Programming Guide Advanced	(11.02 Edition)
	Order No.: 6FC5 298-6AB10-0BP2	

/PGK/	SINUMERIK 840D/840Di/810D	
	Short Guide Programming	(02.01 Edition)
	Order No.: 6FC5 298-6AB30-0BP1	

/PGM/	SINUMERIK 840D/840Di/810D	
	Programming Guide ISO Milling	(11.02 Edition)
	Order No.: 6FC5 298-6AC20-0BP2	

/PGT/	SINUMERIK 840D/840Di/810D	
	Programming Guide ISO Turning	(11.02 Edition)
	Order No.: 6FC5 298-6AC10-0BP2	

/PGZ/	SINUMERIK 840D/840Di/810D	
	Programming Guide Cycles	(11.02 Edition)
	Order No.: 6FC5 298-6AB40-0BP2	

/PI/	**PCIN 4.4**
	Software for Data Transfer to/from MMC Module
	Order No.: 6FX2 060 4AA00-4XB0 (English, French, German)
	Order from: WK Fürth

/SYI/	SINUMERIK 840Di	
	System Overview	(02.01 Edition)
	Order No.: 6FC5 298-6AE40-0BP0	

Manufacturer/Service Documentation

a) Lists

/LIS/	SINUMERIK 840D/840Di/810D SIMODRIVE 611D **Lists** Order No.: 6FC5 297-6AB70-0BP3	(11.02 Edition)

b) Hardware

/BH/	SINUMERIK 840D/840Di/810D **Operator Components Manual** (HW) Order No.: 6FC5 297-6AA50-0BP2	(11.02 Edition)
/BHA/	SIMODRIVE **Sensor** **Absolute Position Sensor with Profibus-DP** User's Guide (HW) Order No.: 6SN1197-0AB10-0YP1	(02.99 Edition)
/EMV/	SINUMERIK, SIROTEC, SIMODRIVE **EMC Installation Guide** Planning Guide (HW) Order No.: 6FC5 297-0AD30-0BP1	(06.99 Edition)
/GHA/	**ADI4 – Analog Drive Interface for Four Axes** Manual Order No.: 6FC5 297-0BA01-0BP0	(09.02 Edition)
/PHC/	SINUMERIK 810D **Configuring Manual** (HW) Order No.: 6FC5 297-6AD10-0BP0	(03.02 Edition)
/PHD/	SINUMERIK 840D **Configuring Manual NCU 561.2-573.4** (HW) Order No.: 6FC5 297-6AC10-0BP2	(10.02 Edition)
/PMH/	SIMODRIVE **Sensor** **Hollow-Shaft Measuring System SIMAG H** Configuring/Installation Guide (HW) Order No.: 6SN1197-0AB30-0BP1	(07.02 Edition)

c) Software

/FB1/	SINUMERIK 840D/840Di/810D **Description of Functions, Basic Machine** (Part 1) (the various sections are listed below) Order No.: 6FC5 297-6AC20-0BP2	(11.02 Edition)

A2	Various Interface Signals
A3	Axis Monitoring, Protection Zones
B1	Continuous Path Mode, Exact Stop and Look Ahead
B2	Acceleration
D1	Diagnostic Tools

D2	Interactive Programming
F1	Travel to Fixed Stop
G2	Velocities, Setpoint/Actual-Value Systems, Closed-Loop Control
H2	Output of Auxiliary Functions to PLC
K1	Mode Group, Channel, Program Operation Mode
K2	Axes, Coordinate Systems, Frames,
	Actual-Value System for Workpiece, External Zero Offset
K4	Communication
N2	EMERGENCY STOP
P1	Transverse Axes
P3	Basic PLC Program
R1	Reference Point Approach
S1	Spindles
V1	Feeds
W1	Tool Offset

/FB2/ SINUMERIK 840D/840Di/810D(CCU2)
Description of Functions, Extended Functions (Part 2) (11.02 Edition)
including FM-NC: Turning, Stepper Motor
(the various sections are listed below)
Order No.: 6FC5 297-6AC30-0BP2

A4	Digital and Analog NCK I/Os
B3	Several Operator Panels and NCUs
B4	Operation via PG/PC
F3	Remote Diagnostics
H1	JOG with/without Handwheel
K3	Compensations
K5	Mode Groups, Channels, Axis Replacement
L1	FM-NC Local Bus
M1	Kinematic Transformation
M5	Measurement
N3	Software Cams, Position Switching Signals
N4	Punching and Nibbling
P2	Positioning Axes
P5	Oscillation
R2	Rotary Axes
S3	Synchronous Spindles
S5	Synchronized Actions (up to and including SW 3)
S6	Stepper Motor Control
S7	Memory Configuration
T1	Indexing Axes
W3	Tool Change
W4	Grinding

/FB3/ SINUMERIK 840D/840Di/810D(CCU2)
Description of Functions, Special Functions (Part 3) (11.02 Edition)
(the various sections are listed below)
Order No.: 6FC5 297-6AC80-0BP2

F2	3-Axis to 5-Axis Transformation
G1	Gantry Axes
G3	Cycle Times
K6	Contour Tunnel Monitoring
M3	Coupled Motion and Leading Value Coupling
S8	Constant Workpiece Speed for Centerless Grinding
T3	Tangential Control
TE0	Installation and Activation of Compile Cycles
TE1	Clearance Control

TE2	Analog Axis
TE3	Master-Slave for Drives
TE4	Transformation Package Handling
TE5	Setpoint Exchange
TE6	MCS Coupling
TE7	Retrace Support
TE8	Path-Synchronous Switch Signal
V2	Preprocessing
W5	3D Tool Radius Compensation

/FBA/　SIMODRIVE 611D/SINUMERIK 840D/810D
Description of Functions **Drive Functions**　(11.02 Edition)
(the various sections are listed below)
Order No.: 6SN1 197-0AA80-0BP9

DB1	Operational Messages/Alarm Reactions
DD1	Diagnostic Functions
DD2	Speed Control Loop
DE1	Extended Drive Functions
DF1	Enable Commands
DG1	Encoder Parameterization
DL1	Linear Motor MD
DM1	Calculation of Motor/Power Section Parameters and Controller Data
DS1	Current Control Loop
DÜ1	Monitors/Limitations

/FBAN/　SINUMERIK 840D/SIMODRIVE 611 digital
Description of Functions
ANA MODULE　(02.00 Edition)
Order No.: 6SN1 197-0AB80-0BP0

/FBD/　SINUMERIK 840D
Description of Functions **Digitizing**　(07.99 Edition)
Order No.: 6FC5 297-4AC50-0BP0

DI1	Start-up
DI2	Scanning with Tactile Sensors (scancad scan)
DI3	Scanning with Lasers (scancad laser)
DI4	Milling Program Generation (scancad mill)

/FBDN/　IT Solutions
**System for NC Data Management and Data
Distribution** (DNC NT-2000)　(01.02 Edition)
Description of Functions
Order No.: 6FC5 297-5AE50-0BP2

/FBDT/　SINUMERIK 840D/840Di/810D
IT Solutions
Sin DNC NC Data Transfer via Network　(09.02 Edition)
Description of Functions
Order No.: 6FC5 297-5AE70-0BP0

/FBFA/　SINUMERIK 840D/840Di/810D
Description of Functions
ISO Dialects for SINUMERIK　(11.02 Edition)
Order No.: 6FC5 297-6AE10-0BP3

/FBFE/   SINUMERIK 840D/840Di/810D
Description of Functions **Remote Diagnosis**   (11.02 Edition)
Order No.: 6FC5 297-0AF00-0BP2

/FBH/   SINUMERIK 840D/840Di/810D
HMI Configuring Package   (11.02 Edition)
Order No.: (supplied with the software)

Part 1   User's Guide
Part 2   Description of Functions

/FBHLA/   SINUMERIK 840D/SIMODRIVE 611 digital
Description of Functions **HLA Module**   (04.00 Edition)
Order No.: 6SN1 197-0AB60-0BP2

/FBMA/   SINUMERIK 840D/810D
Description of Functions **ManualTurn**   (08.02 Edition)
Order No.: 6FC5 297-6AD50-0BP0

/FBO/   SINUMERIK 840D/810D
Configuring OP 030 Operator Interface   (09.01 Edition)
Description of Functions
Order No.: 6FC5 297-6AC40-0BP0

BA   Operator's Guide
EU   Development Environment (Configuring Package)
PS   Online only: Configuring Syntax (Configuring Package)
PSE   Introduction to Configuring of Operator Interface
IK   Screen Kit: Software Update and Configuration

/FBP/   SINUMERIK 840D
Description of Functions **C-PLC Programming**   (03.96 Edition)
Order No.: 6FC5 297-3AB60-0BP0

/FBR/   SINUMERIK 840D/810D
IT Solutions
Description of Functions **Computer Link** (SinCOM)   (09.01 Edition)
Order No.: 6FC5 297-6AD60-0BP0

NFL   Host Computer Interface
NPL   PLC/NCK Interface

/FBSI/   SINUMERIK 840D / SIMODRIVE 611 digital   (09.02 Edition)
Description of Functions **SINUMERIK Safety Integrated**
Order No.: 6FC5 297-6AB80-0BP1

/FBSP/   SINUMERIK 840D/810D
Description of Functions **ShopMill**   (11.02 Edition)
Order No.: 6FC5 297-6AD80-0BP1

/FBST/   SIMATIC   (01.01 Edition)
Description of Functions **FM STEPDRIVE/SIMOSTEP**
Order No.: 6SN1 197-0AA70-0YP4

/FBSY/	SINUMERIK 840D/840Di/810D	
	Description of Functions **Synchronized Actions**	(10.02 Edition)
	Order No.: 6FC5 297-6AD40-0BP2	
/FBT/	SINUMERIK 840D/810D	
	Description of Functions **ShopTurn**	(03.03 Edition)
	Order No.: 6FC5 297-6AD70-0BP2	
/FBTC/	SINUMERIK 840D/810D	
	IT Solutions	
	SINUMERIK Tool Data Communication SinTDC	(01.02 Edition)
	Description of Functions	
	Order No.: 6FC5 297-5AF30-0BP0	
/FBTD/	SINUMERIK 840D/810D	
	IT Solutions	
	Tool Information System (SinTDI) with Online Help	
	Description of Functions	(02.01 Edition)
	Order No.: 6FC5 297-6AE00-0BP0	
/FBU/	**SIMODRIVE 611 universal/universal E**	
	Closed-Loop Control Component for Speed Control and Positioning	
	Description of Functions	(02.02 Edition)
	Order No.: 6SN1 197-0AB20-0BP5	
/FBW/	SINUMERIK 840D/840Di/810D	
	Description of Functions **Tool Management**	(10.02 Edition)
	Order No.: 6FC5 297-6AC60-0BP1	
/FBWI/	SINUMERIK 840D/840Di/810D	
	Description of Functions **WinTPM**	(02.02 Edition)
	Order No.: The document is an integral part of the software	
/HBA/	SINUMERIK 840D/840Di/810D	
	Manual @Event	(03.02 Edition)
	Order No.: 6AU1900-0CL20-0BA0	
/HBI/	SINUMERIK 840Di	
	Manual	(09.02 Edition)
	Order No.: 6FC5 297-6AE60-0BP1	
/INC/	SINUMERIK 840D/840Di/810D	
	Commissioning Tool **SINUMERIK SinuCOM NC**	(02.02 Edition)
	System Description	
	Order No.: (an integral part of the online help for the start-up tool)	
/PAP/	SIMODRIVE **Sensor**	
	Absolute Encoder with Profibus-DP	
	User's Guide	(02.99 Edition)
	Order No.: 6SN1197-0AB10-0YP1	

/PFK/   **SIMODRIVE**
                     Planning Guide **1FT5, 1FT6, 1FK6 Motors**   (12.01 Edition)
                     AC servo motors for feed and main spindle drives
                     Order No.: 6SN1 197-0AC20-0BP0

/PJE/   SINUMERIK 840D/810D
                     Configuring Package HMI Embedded   (08.01 Edition)
                     Description of Functions: Software Update, Configuration Installation
                     Order No.: 6FC5 297-6EA10-0BP0
                     (the document PS Configuring Syntax is supplied with the software
                     and available as a pdf file)

/PJFE/   **SIMODRIVE**
                     Planning Guide **1FE1 Built-In Synchronous Motors**
                     Three-Phase AC Motors for Main Spindle Drives   (09.01 Edition)
                     Order No.: 6SN1 197-0AC00-0BP1

/PJLM/   **SIMODRIVE**
                     Planning Guide **1FN1, 1FN3 Linear Motors**   (11.01 Edition)
                     ALL   General Information about Linear Motors
                     1FN1   1FN1 Three-Phase AC Linear Motor
                     1FN3   1FN3 Three-Phase AC Linear Motor
                     CON   Connections
                     Order No.: 6SN1 197-0AB70-0BP2

/PJM/   **SIMODRIVE**
                     Planning Guide **Motors**   (11.00 Edition)
                     Three-Phase AC Motors for Feed and Main Spindle Drives
                     Order No.: 6SN1 197-0AA20-0BP5

/PJTM/   **SIMODRIVE**
                     Planning Guide **Integrated Torque Motors 1FW6** (08.02 Edition)
                     Order No.: 6SN1 197-0AD00-0BP0

/PJU/   **SIMODRIVE 611**
                     Planning Guide **Inverters**   (05.01 Edition)
                     Order No.: 6SN1 197-0AA00-0BP5

/PMS/   **SIMODRIVE**   (04.02 Edition)
                     Planning Guide **ECO Motor Spindle** for Main Spindle Drives
                     Order No.: 6SN1 197-0AD04-0BP0

/POS1/   **SIMODRIVE POSMO A**   (08.02 Edition)
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