## Overview of SINUMERIK 840D/840Di/810D/FM-NC Documentation (04.00)

### General Documentation
- **SINUMERIK**
  - 840D/810D/840Di/810D/611D FM-NC
  - Brochure
- **SINUMERIK SIMODRIVE**
  - 840D/810D/840Di/810D/611D FM-NC
  - Accessories
- **SINUMERIK SIMODRIVE SIROTEC**
  - Catalog
  - Ordering Info NC 60.1 (*)
  - Technical Info. NC 60.2

### User Documentation
- **SINUMERIK**
  - 840D/810D/840Di/810D/611D FM-NC
  - System Overview
  - Operator’s Guide
    - ManualTurn
    - ShopMill
    - Short Guide
    - Setup (2)
  - AutoTurn
    - Short Guide
    - Programming (1)
  - Operator Panel
    - HPU
    - HT 6
  - Operator’s Guide (*)
  - Diagnostics Guide (*)

### Manufacturer / Service Documentation
- **SINUMERIK**
  - 840D/810D/840Di/810D/611D FM-NC
  - Program. Guide
    - Short Guide
    - Fundamentals (*)
    - Advanced (*)
    - Cycles
    - Measuring Cycles
  - Configuring Kit
    - MMC 100/101
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    - Development Kit
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    - SW Update and Configuration
  - Descri. of Functions
  - Tool Management
  - Configuring
  - Operator Interface OP 030

### Manufacturer / Service Documentation
- **SINUMERIK**
  - 840D/810D/840Di/810D/611D FM-NC
  - Operator Components
    - (HW) (*)
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    - Linear Motor
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    - – Measuring Cycles

### Electronic Documentation
- **SINUMERIK**
  - 840D/810D/840Di/810D/611D FM-NC
  - DOC ON CD (*)
  - The SINUMERIK System
  - EMC Guidelines
  - Manual
    - (HW + Installation and Start-up)

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*) These documents are a minimum requirement for the control
SIEMENS

SINUMERIK 840D
SIMODRIVE 611D

Installation and Start-Up Guide

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04.00 Edition
## 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.

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- **B** . . . . Unrevised reprint with new Order No.
- **C** . . . . Revised edition with new status.

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

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

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

We have checked that the contents of this document correspond to the hardware and software described. Nonetheless, differences might exist. The information contained in this document is, however, reviewed regularly and any necessary changes will be included in the edition. We welcome suggestions for improvement.

Subject to technical changes without prior notice.
PREFACE

Structure of documentation
The SINUMERIK documentation is divided into 3 different levels:
- General documentation
- User Documentation
- Manufacturer/Service Documentation

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

Objective
The Installation and Start-Up Guide provides all the relevant information required for start-up, installation and servicing.

Standard scope
This document provides information about the control system design and the interfaces of the individual components. It also describes the start-up and installation procedure for SINUMERIK 840D with SIMODRIVE 611D including a list of all data, signals and PLC blocks.

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

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

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

Searching aids
In addition to the table of contents and indexes of figures and tables, we have provided the following information in the appendix for your assistance:
1. Index of abbreviations
2. List of references
3. Index

For a complete list and description of SINUMERIK 840D alarms, please refer to

References: /DA/, Diagnostics Guide

For further useful information on start-up and troubleshooting, please refer to

References: /FB/, D1, “Diagnostics Tools”
Symbols

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

Note
This symbol appears in this document to draw your attention to information relevant to the subject in hand.

Important
This symbol appears in this document to draw your attention to an important item of information.

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

Warnings

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

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

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

Warning
This symbol indicates that death, grievous injury or substantial property damage may occur if the appropriate precautions are not taken.
Technical information

Trademarks

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Notation

The following notation and abbreviations are used in this document:

- PLC interface signals → IS “Signal name” (signal data)
  Examples:
  - IS “MMC–CPU1 ready” (DB10, DBX108.2), i.e. the signal is stored in data block 10, data byte 108, bit 2.
  - IS “Feedrate/spindle override” (DB31–48, DBB0), i.e. the signals are stored for specific spindles/axes in data blocks 31 to 48, data block byte 0.

- Machine data → MD: MD_NAME (English designation)

- Setting data → SD: SD_NAME (English designation)

- The character “≡” means “corresponds to”.

Effectiveness of changes

After data (e.g. machine data) have been changed, it must also be noted when the change will become effective (e.g. after power ON or immediately). This information is therefore always provided.
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 (German, English, French), order from:  
   WK Fürth
2. Start-up tool for digital SIMODRIVE 611 (applies only to MMC100)  
   Order No. 6FC5 255–□AX00–0AB0, supplies 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 MMC100: Software for creating PLC alarm texts and for transmission to MMC100 (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. V.24 cable with 9-way connector (female)
You will need the following documentation to start up the SINUMERIK 840D:

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

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 (840DE) 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.)
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.
### Configuration

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2.1 Mechanical configuration

2.1.1 Overview

Fig. 2-1 System overview of SINUMERIK 840 with SIMODRIVE 611 (diagrammatic)
### 2.1.2 Mains infeed module

<table>
<thead>
<tr>
<th><strong>Mains infeed module</strong></th>
<th>The mains infeed module performs the following tasks:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Supplies power for the SINUMERIK 840D and axis modules</td>
</tr>
<tr>
<td></td>
<td>• Generates the DC link voltage for the motors</td>
</tr>
<tr>
<td></td>
<td>• Regenerative feedback (I/RF) or braking resistor (OI) for generator-mode operation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Open-loop-controlled infeed OI</strong></th>
<th>If the internal braking resistance is not sufficient, pulsed resistor modules can be installed.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Infeed/regenerative feedback module I/RF</strong></th>
<th>The I/RF module feeds back into excess DC link energy generated during braking the supply system.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th><strong>Arrangement of mains infeed module</strong></th>
<th>The I/RF or OI module is installed as the first module on the left.</th>
</tr>
</thead>
</table>

**References:** PJ1/ Planning Guide for SIMODRIVE 611D
2.1 Mechanical configuration

2.1.3 NCU

Fig. 2-2 Interfaces, control and display elements of NCU module
2.1.4 General configuration of SINUMERIK 840D system

Fig. 2-3 General configuration of SINUMERIK 840D

2.2 Electrical configuration

2.2.1 Component connections
2.2 Electrical configuration

Fig. 2-4 Connection configuration
2.2.2 Connection of mains infeed module (OI, I/RF)

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

Fig. 2-5 Interfaces for OI and I/RF module 10–55KW
2.2 Electrical configuration

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)

<table>
<thead>
<tr>
<th>S1</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1.1</td>
<td>off</td>
</tr>
<tr>
<td>S1.2</td>
<td>off</td>
</tr>
<tr>
<td>S1.3</td>
<td>off</td>
</tr>
<tr>
<td>S1.4</td>
<td>off*</td>
</tr>
<tr>
<td>S1.5</td>
<td>off</td>
</tr>
<tr>
<td>S1.6</td>
<td>off*</td>
</tr>
</tbody>
</table>

*Do not alter

---

Important!

Terminal 48 must be de-energized 10 ms before the mains contacts of the master switch open (e.g. by means of leading contact).
2.2.3 Motor connection

Fig. 2-8 Design of FDD/MSD modules
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 of the same module.

Fig. 2-9 Connection of encoder cables
2.2.5 Connection of MMC100 and MMC102/103

MMC100

Fig. 2-10 Rear of operator panel with MMC 100

Fig. 2-11 Connection of MMC100/102/103 to SINUMERIK 840D system
2.2 Electrical configuration

Figure 2-12 Location of interfaces and control elements on MMC 101/102/103

Interfaces

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

References: /BH/, Operator Components Manual
2.2.6 Configuration of components for digitizing

![Configuration of components for digitizing](image)

Fig. 2-13 Configuration of components for digitizing
2.2 Electrical configuration

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
2 Configuration

2.2 Electrical configuration

Notes

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____________________________________________________________________
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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 achieved by connecting the MPI connector with a fitted active terminating resistor to a device that is connected to the power supply.

   **Note**
   The NC must be positioned at the end of the line.

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

   **Note**
   Unused spurs should be removed wherever possible.

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: 1000 m
   - OPI (1.5 Mbaud): max. cable length in total: 200 m
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 up to SW 3.1

**Standard application**

SINUMERIK 840D with MMC100/102/103 and a machine control panel (MCP) or customer operator panel interface on OPI

**Hardware requirements**

- Minimum firmware version V 03_01_01 for MCP
- Interface to customer operator panel / PP031

**STEP7**

Version 1.x or higher

**Bus addresses**

Each node on the MPI/OPI bus must be allocated a bus address (0...31).

![Diagram of Standard application for SINUMERIK 840D](image)

Fig. 3-3 Standard application for SINUMERIK 840D
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.

<p>| Setting the MCP/ interface to customer operator panel |
|---------------------------------|-----------------|
| <strong>Table 3-1</strong> Settings on DIP switch S3 for standard application |</p>
<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Meaning:</th>
</tr>
</thead>
<tbody>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td><strong>MCP:</strong>&lt;br&gt;Baud rate: 1.5 Mbaud&lt;br&gt;Cyclical transmit pattern: 100 ms&lt;br&gt;Bus address: 6</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td><strong>Interface to customer operator panel:</strong>&lt;br&gt;Baud rate: 1.5 Mbaud&lt;br&gt;Cyclical transmit pattern: 100 ms&lt;br&gt;Bus address: 6</td>
</tr>
</tbody>
</table>

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:
- 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 must be V03_01_01 or higher
- Cable and connector wiring
- DIP switch S3 (standard application)
3.2.2 Standard configuration as from SW 3.2

Either one or two machine control panels (interface to customer operator panels, 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 software versions SW 3.2 and higher.

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

**Standard application**

SINUMERIK 840D with MMC100/102/103 and a machine control panel (MCP) or customer operator panel interface on OPI

**Hardware requirements**

Minimum firmware version V 03_01_01 for

- MCP
- Interface to customer operator panel / PP031

**Bus addresses**

Each node on the MPI/OPI bus must be allocated a bus address (0...31).
3.2 Standard configuration

Fig. 3-4 Standard application for SINUMERIK 840D

*) 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 interface, 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, 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.
Table 3-2  Relationship between bus address and GD circle

<table>
<thead>
<tr>
<th>Bus addresses on the MPI</th>
<th>GD circle</th>
</tr>
</thead>
<tbody>
<tr>
<td>15, 14, 13</td>
<td>1</td>
</tr>
<tr>
<td>12, 11</td>
<td>2</td>
</tr>
<tr>
<td>10, 9</td>
<td>3</td>
</tr>
<tr>
<td>8, 7</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>5, 4</td>
<td>5</td>
</tr>
</tbody>
</table>

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 OPI and/or 1 HHU (up to SW 3.1)

The following configurations are permissible:

- 2 MCPs/customer operator panel interfaces/PP031 connected to OPI
- 1 HHU connected to either OPI or MPI

Machine control panels (MCP), customer operator panel interfaces and hand-held 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 OPI and/or 1 HHU (up to SW 3.1)

**Connection of HHU**

The handheld unit (HHU) should be connected to the OPI so the user can benefit 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 settings 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:

- `/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 configuration:

- 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 Section 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 Section 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 Connection of a 2nd MCP/customer OPI and/or 1 HHU (up to SW 3.1)

3.3.3 Example of a configuration of MCP and HHU via OPI

Preconditions
- MCP with firmware version V 03_01_01
- HHU with firmware version V 01_01_02

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.

Call STEP 7
Set up new project with the name Example.
You must set up 2 CPU programs for the Sample project.

• AS314
• HHU

Assignment of CPU programs
The 2 CPU programs are assigned as follows:
AS314 is for the PLC–CPU, HHU for the handheld unit.
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 2 CPU programs.

<table>
<thead>
<tr>
<th>table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD identifiers</td>
</tr>
<tr>
<td>GD</td>
</tr>
<tr>
<td>GD</td>
</tr>
<tr>
<td>GD</td>
</tr>
<tr>
<td>GD</td>
</tr>
</tbody>
</table>
3.3 Connection of a 2nd MCP/customer OPI and/or 1 HHU (up to SW 3.1)

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>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314//CPU1::</th>
<th>bhg//CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD</td>
<td>mb0:20</td>
<td>mb0:20</td>
</tr>
<tr>
<td>GD</td>
<td>mb20:6</td>
<td>&gt;mb20:6</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314//CPU1::</th>
<th>bhg//CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD 1.1.1</td>
<td>mb0:20</td>
<td>mb0:20</td>
</tr>
<tr>
<td>GD 1.2.1</td>
<td>mb20:6</td>
<td>&gt;mb20:6</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314//CPU1::</th>
<th>bhg//CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 1.1</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>GD 1.1.1</td>
<td>mb0:20</td>
<td>mb0:20</td>
</tr>
<tr>
<td>SR 1.2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>GD 1.2.1</td>
<td>mb20:6</td>
<td>&gt;mb20:6</td>
</tr>
</tbody>
</table>
### 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 25 ms, the default then corresponds to a key scan of 200 ms. This may be too slow for some applications. To change the transmission rate, the “Reduction 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 transmission. The transmission to and from the HHU is then activated at a corresponding frequency (e.g. every 4th PLC cycle). Example of table 1 with altered SR parameters:

<table>
<thead>
<tr>
<th>SR 1.1</th>
<th>4</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD 1.1.1</td>
<td>»mb0:20</td>
<td>mb0:20</td>
</tr>
<tr>
<td>SR 1.2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>GD 1.2.1</td>
<td>mb20:6</td>
<td>»mb20:6</td>
</tr>
</tbody>
</table>

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

### Activate status

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

<table>
<thead>
<tr>
<th>GST</th>
<th>as314//CPU1::</th>
<th>bhg//CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDS 1.1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>SR 1.1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>GD 1.1.1</td>
<td>»mb0:20</td>
<td>mb0:20</td>
</tr>
<tr>
<td>GDS 1.2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>SR 1.2</td>
<td>mb20:6</td>
<td>»mb20:6</td>
</tr>
</tbody>
</table>

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

| GDS 1.2 | md26 |

Once you have entered the status, you must compile your configuration again.
3.3 Connection of a 2nd MCP/customer OPI and/or 1 HHU (up to SW 3.1)

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).

Set HHU
The default address 15 can be left unchanged on the HHU, only the GD param-
eters 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 version of HHU

The software version of the HHU appears on the display after power up until 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 software version 3.x

**Fig. 3-8** Position of DIP switches in HHU with default setting

DIP switch settings for MPI

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

<table>
<thead>
<tr>
<th>S1 1</th>
<th>S1 2</th>
<th>S1 3</th>
<th>S1 4</th>
<th>S2 1</th>
<th>S2 2</th>
<th>S2 3</th>
<th>S2 4</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>Default setting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Baud rate: 187.5 kbaud</td>
</tr>
</tbody>
</table>
3.4.2 Settings on the HHU for software version 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 software version 4.x and higher. These bus parameters can be reconfigured from this software version (cf. Section 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 power-up (i.e. while waiting for the first GD message frame from the PLC ("Waiting for PLC" state) via the HHU interface by means of key combination Jog (top far left) and T2 (top far right). The individual parameters are then interrogated via the HHU display and entered via the HHU keyboard. 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 key. Selection of the next parameter causes the preceding parameter to be stored in the Flash EPROM. The parameters need therefore only be set during start-up and when interfaces are changed. If the interface parameter settings are not activated after power-up, the stored values are used or the default values (see table) loaded.
3 Settings, MPI / OPI

3.4 Handheld unit

Meaning of the GD parameters

Separate GD parameters are used for sending and receiving.

![Diagram](image)

**Fig. 3-9** Sending and receiving as seen from the HHU

GD 1 . 1 . 1

- Object number
- GI number (global identifier)
- GD circuit number (global data no.)

**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

<table>
<thead>
<tr>
<th>Designation</th>
<th>Display</th>
<th>Default value</th>
<th>Value range</th>
<th>PLC FB1 parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receive GD circuit no.</td>
<td>Rec-GD-No:</td>
<td>2</td>
<td>1–16</td>
<td>HHU Send GD No</td>
</tr>
<tr>
<td>Receive GI no.</td>
<td>Rec-GBZ-No:</td>
<td>1</td>
<td>1–255</td>
<td>HHU Send GBZ No</td>
</tr>
<tr>
<td>Object no. for receive GI</td>
<td>Rec-Obj-No:</td>
<td>1</td>
<td>1–255</td>
<td>HHU Send Obj No</td>
</tr>
<tr>
<td>Send GD circuit no.</td>
<td>Send-GD-No:</td>
<td>2</td>
<td>1–16</td>
<td>HHU Rec GD No</td>
</tr>
<tr>
<td>Send GI no.</td>
<td>Send-GBZ-No:</td>
<td>1</td>
<td>1–255</td>
<td>HHU Rec GBZ No</td>
</tr>
<tr>
<td>Object no. for send GI</td>
<td>Send-Obj-No:</td>
<td>1</td>
<td>1–255</td>
<td>HHU Rec Obj No</td>
</tr>
<tr>
<td>SW 4 and higher Baud rate</td>
<td>Baud rate:</td>
<td>187.5 k (baud)</td>
<td>187.5 / 1.5 M</td>
<td></td>
</tr>
<tr>
<td>Bus address</td>
<td>Bus address:</td>
<td>15</td>
<td>0–15</td>
<td></td>
</tr>
</tbody>
</table>
3.4.4  Example: Connecting the HHU to the SINUMERIK 840D

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 V 04.01.01 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
   BHGIn 1st input byte
   BHGOut 1st output byte
   ——> Byte n+0, bit 7 must be set continually to “1”
   by the PLC!
   BHGStatSend Status data word Send
   BHGStatRec Status data word Receive
   BHGInLen B#16#6
   BHGOutLen B#16#14
   BHGTimeout SST#700MS
   BHCyci SST#400MS
   BHGRecGDNo 2
   BHGRecGBZNo 2
   BHGRecObjNo 1
   BHSendGDNo 2
   BHSendGBZNo 1
   BHSendObjNo 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:
   BHGRecGDNo 2
   BHGRecGBZNo 1
   BHGRecObjNo 1
   BHSendGDNo 2
   BHSendGBZNo 2
   BHSendObjNo 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 (SW4.x): 
    BHG = 2 and
    BHGMPI = 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 5 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 power up until communication between the PLC and the HPU has been established.
Example: Display on the HPU

**Waiting for PLC**

V04.01.01   B

→ Software version of the HPU is V4.11
→ Bus address of the HPU is $B_{\text{hex}}$ (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>
<thead>
<tr>
<th>Byte</th>
<th>Bit 7</th>
<th>Bit 6</th>
<th>Bit 5</th>
<th>Bit 4</th>
<th>Bit 3</th>
<th>Bit 2</th>
<th>Bit 1</th>
<th>Bit 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBn</td>
<td>REF</td>
<td>TEACH</td>
<td>AUTO</td>
<td>MDA</td>
<td>JOG</td>
<td>QUIT</td>
<td>RESET</td>
<td>WCS/MCS</td>
</tr>
<tr>
<td>IBn+1</td>
<td>Reserved</td>
<td>U4</td>
<td>U3</td>
<td>Shift key</td>
<td>U2</td>
<td>U1</td>
<td>INC</td>
<td>REPOS</td>
</tr>
<tr>
<td>IBn+2</td>
<td>Reserved</td>
<td>Reserved</td>
<td>C/6</td>
<td>B/5</td>
<td>A/4</td>
<td>Z/3</td>
<td>Y/2</td>
<td>X/1</td>
</tr>
<tr>
<td>IBn+3</td>
<td>Reserved</td>
<td>Reserved</td>
<td>C/6</td>
<td>B/5</td>
<td>A/4</td>
<td>Z/3</td>
<td>Y/2</td>
<td>X/1</td>
</tr>
<tr>
<td>IBn+4</td>
<td>Signal</td>
<td>Diagno</td>
<td>Service</td>
<td>System</td>
<td>Param</td>
<td>Correct</td>
<td>Program</td>
<td>Machine</td>
</tr>
<tr>
<td>IBn+5</td>
<td>F5</td>
<td>F4</td>
<td>F3</td>
<td>F2</td>
<td>1F</td>
<td>Step</td>
<td>Modify</td>
<td>Insert</td>
</tr>
<tr>
<td>IBn+6</td>
<td>Reserved</td>
<td>Reserved</td>
<td>+</td>
<td>–</td>
<td>S2</td>
<td>S1</td>
<td>START</td>
<td>STOP</td>
</tr>
<tr>
<td>IBn+7</td>
<td>Reserved</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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

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 MMC100/102/103 and an HPU.

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)
3.5.3 Deviations from the standard HPU configuration (up to SW 3.1)

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 S7, Version 2.1

To set a new configuration, first press the Define global data softkey. 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 softkeys) 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.
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.

<table>
<thead>
<tr>
<th>CPU program</th>
<th>MPI address</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS314</td>
<td>2</td>
</tr>
<tr>
<td>MCP</td>
<td>6</td>
</tr>
<tr>
<td>HHU</td>
<td>15</td>
</tr>
<tr>
<td>HPU</td>
<td>11</td>
</tr>
</tbody>
</table>

“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 softkey
4. Save the configuration with Save softkey

SDB

The SDB supplied in the basic PLC program is valid for the first MCP or the HPU and must be reconfigured as required.
**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>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314/CPU1</th>
<th>MCP/CPU1</th>
<th>HPU/CPU1</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GD</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**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:
#### Note

The order in which inputs are made (transmit, receive) affects the way in which GD identifiers are assigned and should be noted carefully 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>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314/CPU1::</th>
<th>MCP/CPU1::</th>
<th>HPU/CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD</td>
<td>qb0:8</td>
<td>qb0:8</td>
<td></td>
</tr>
<tr>
<td>GD</td>
<td>ib0:8</td>
<td></td>
<td>ib0:8</td>
</tr>
<tr>
<td>GD</td>
<td>qb16:8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GD</td>
<td>ib16:8</td>
<td></td>
<td>ib16:8</td>
</tr>
</tbody>
</table>
Setting the reduction ratio

Click the View / Reduction ratio softkeys. The following table 1 with the SR parameters appears:

<table>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314/CPU1::</th>
<th>MCP/CPU1::</th>
<th>HPU/CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 1.1</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>GD 1.1.1</td>
<td>qb0:8</td>
<td>qb0:8</td>
<td></td>
</tr>
<tr>
<td>SR 1.2</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>GD 1.2.1</td>
<td>ib0:8</td>
<td>ib0:8</td>
<td></td>
</tr>
<tr>
<td>SR 2.1</td>
<td>8</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>GD 2.1.1</td>
<td>qb16:8</td>
<td></td>
<td>qb16:8</td>
</tr>
<tr>
<td>SR 2.2</td>
<td>8</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>GD 2.2.1</td>
<td>ib16:8</td>
<td></td>
<td>ib16:8</td>
</tr>
</tbody>
</table>

Changing the SR parameters

The transmission rate for the HPU must be set. The default setting is one transmission that takes place every 8 PLC cycles. With a PLC cycle time of 25 ms, the default then corresponds to a key scan of 200 ms. This may be too slow for some applications. To reduce the transmission rate 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>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314/CPU1::</th>
<th>MCP/CPU1::</th>
<th>HPU/CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR 1.1</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GD 1.1.1</td>
<td>qb0:8</td>
<td>qb0:8</td>
<td></td>
</tr>
<tr>
<td>SR 1.2</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>GD 1.2.1</td>
<td>ib0:8</td>
<td>ib0:8</td>
<td></td>
</tr>
<tr>
<td>SR 2.1</td>
<td>4</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>GD 2.1.1</td>
<td>qb16:8</td>
<td></td>
<td>qb16:8</td>
</tr>
<tr>
<td>SR 2.2</td>
<td>1</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>GD 2.2.1</td>
<td>ib16:8</td>
<td></td>
<td>ib16:8</td>
</tr>
</tbody>
</table>

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

Click the View / Status softkeys in the menu.
The following table 1 appears:

<table>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314/CPU1::</th>
<th>MCP/CPU1::</th>
<th>HPU/CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>GST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDS 1.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR 1.1</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>GD 1.1.1</td>
<td>qb0:8</td>
<td>qb0:8</td>
<td>qb0:8</td>
</tr>
<tr>
<td>GDS 1.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR 1.2</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>GD 1.2.1</td>
<td>ib0:8</td>
<td>»ib0:8</td>
<td>»ib0:8</td>
</tr>
<tr>
<td>GDS 2.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR 2.1</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GD 2.1.1</td>
<td>qb16:8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDS 2.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR 2.2</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>GD 2.2.1</td>
<td>ib16:8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Now enter the status double words for GDS1.2 and GDS 2.1.

Extract from table 1:

<table>
<thead>
<tr>
<th>GD identifiers</th>
<th>as314/CPU1::</th>
<th>MCP/CPU1::</th>
<th>HPU/CPU1::</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDS 1.2</td>
<td>ad12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDS 2.2</td>
<td>ad24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
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,
3.6 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:

![Diagram of machine control panel interfaces](image)

Interface: Connection for equipotential bonding conductor

LEDs 1...4

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

<table>
<thead>
<tr>
<th>Designation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEDs 1 and 2</td>
<td>Reserved</td>
</tr>
<tr>
<td>LED 3</td>
<td>POWER: Lights up when voltage (24 V) is present</td>
</tr>
<tr>
<td>LED 4</td>
<td>SEND: Changes state after transmission of data</td>
</tr>
</tbody>
</table>

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.
### Switch S3

Table 3-8  Meaning of switch S3 for machine control panel

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Meaning:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Baud rate: 1.5 Mbaud</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Baud rate: 187.5 kbaud</td>
</tr>
<tr>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>200ms cycle transmit pattern</td>
</tr>
<tr>
<td>on</td>
<td>on</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>2400 ms receive monitoring</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>100ms cycle transmit pattern</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>1200 ms receive monitoring</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>50 ms cycle transmit pattern</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>600 ms receive monitoring</td>
</tr>
<tr>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>Bus address: 15</td>
</tr>
<tr>
<td>on</td>
<td>on</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 14</td>
</tr>
<tr>
<td>on</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>Bus address: 13</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 12</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 11</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 10</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 9</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>Bus address: 8</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 7</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 6</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>Bus address: 5</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>Bus address: 4</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>Bus address: 3</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>Bus address: 2</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>Bus address: 1</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>off</td>
<td>on</td>
<td>Bus address: 0</td>
</tr>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>on</td>
<td>off</td>
<td>Interface to customer operator panel</td>
</tr>
<tr>
<td>off</td>
<td>MCP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Default setting</td>
</tr>
</tbody>
</table>

- **Default setting for 840D**
- Baud rate: 1.5 Mbaud
- Cyclic transmit pattern: 100 ms
- Bus address: 6
3.7 Customer operator panel interface

Interface
A customer operator panel can be connected via the interface. 64 digital inputs and 64 digital outputs with C-MOS level (5 V) 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

Switch S3, default setting
If only the customer operator panel 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

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Meaning:</th>
</tr>
</thead>
<tbody>
<tr>
<td>on</td>
<td>off</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>on</td>
<td>off</td>
<td>on</td>
<td>Baud rate: 1.5 Mbaud (OPI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cyclical transmit pattern: 100 ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bus address: 6</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>X10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
</tr>
<tr>
<td>-----</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>
3.8 Second 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.

3.9 MMC 100/MMC 102/103 operator panel

3.9.1 Settings on the MMC

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

- MMC 100
  The MMC100 is automatically set to the baud rate.

- MMC102/103
  The MMC102/103 must be set to a baud rate of 1.5 Mbaud in the "Start-up/MMC/Operator panel" menu.

Screen MD 9000: LCD_CONTRAST (contrast)
The contrast setting can be entered directly in the machine data or selected by means of the "LCD brighter" or "LCD darker" softkey 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)

- MMC100
  One of two languages can be called in the MMC 100.

- MMC102/103
  The MMC102/103 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 MMC100):
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 have been pressed within the specified time.
3.9 MMC 100/MMC 102/103 operator panel

Protection levels for user data

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

V.24 interfaces

The settings of the V.24 interface on the MMC for data backup are stored from MD 9300 onwards. The settings for 3 different devices are made in the “Services” menu via an input display.

3.9.2 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 softkey from right).
3. Switch to the highest level with RECALL.
4. Select “Change language” (3rd vertical softkey from top).

MMC 100

One of two languages can be called alternately in the MMC100. 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 softkey “Change language” in the “Start-up” display.

MMC 102/103

On the MMC102/103 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 softkey 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.
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” softkey in the “Start-up” display. The 2nd language can always be changed in online mode.

The languages installed on the MMC102/103 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

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.

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.
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
;LBLList=español, francais, english, italiano

LanguageList=GR, CH, TW, SP, FR, UK, IT
FontList=Europe, China, China, Europe, Europe, Europe, Europe
LBLList=chinese, taiwan, espanol, francais, english, italiano
AddOnProd=c:\cstar20\cstar20.exe
```

**Add-on products**

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

**Note**

When you change the “LanguageList”, “FontList”, “LBLList” and “AddOnProd” lines, make sure that you only manipulate (shift, delete) the “;” character representing the comment.

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

Important
Handling of modules at risk from ESD:

- 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.
## Power On and Power-Up

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
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</tr>
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</tr>
</tbody>
</table>
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 power up 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 powers up correctly (Chapter 5)
2. Enter basic settings (Section 6.6.1) and memory configuration (Section 6.7)
3. Scaling machine data (Section 6.8)
4. Set axis configuration (Section 6.9.1)
5. Configure and parameterize the drives (Section 6.9.2)
6. Set axis and spindle-specific machine data
   - Axis velocities (Section 6.9.9)
   - Axis monitoring (Section 6.9.11)
   - Axis reference point approach (Section 6.9.12)
   - Spindle data (Section 6.9.13)
   - Spindle encoder matching (Section 6.9.15)
   - Spindle velocities (Section 6.9.16)
   - Spindle positioning (Section 6.9.17)
   - Spindle monitoring (Section 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 power-up

Fig. 5-1 below shows the operator control and display elements on the NCU that are relevant for switching on and powering up the SINUMERIK 840D:

- Various error and status LEDs
- 7-segment status display
- NMI button
- RESET button
- NCK start-up switch
- PLC start-up switch
- PCMCIA slot

Fig. 5-1 Operator control and display elements of the NCU
5.2  Power on and power-up

5.2.1  Power on

Visual inspection  The installation should be inspected visually for any obvious faults or defects. Make sure that the mechanical installation of components is correct and that electrical connections are firmly in place (e.g. in the DC link). Make sure that all electrical connections have been made correctly before switching on the power supply. Please check the supply voltages 230V AC and 24V DC 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 sequence  The MCP, HHU and MMC components can be switched on in any desired sequence if they are physically installed.

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

5.2.2  Power-up

When the power is switched on the control powers up. The system software is stored on a PCMCIA card on delivery (see Fig. 5-1 for PCMCIA slot, page 5-77).

Note  Power up takes longer than for a standard configuration if modules via L2–DP and certain FM and CP modules are used.

NCK general reset  To bring the control system into a defined initial state, initialization (NCK general reset) is required when the power is first connected. To execute an NCK reset, place turn start-up switch S3 on the NCU to position 1 and switch on the control. The control then powers up, the SRAM memory is erased and the machine data are preset to the default values.
Table 5-1 Meaning of NCK start-up switch S3
(see Fig. 5-1, page 5-77)

<table>
<thead>
<tr>
<th>Setting</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal mode: The control powers up with the set data.</td>
</tr>
<tr>
<td>1</td>
<td>Start-up mode: The data in the buffered RAM (SRAM) are erased and standard (default) machine data loaded.</td>
</tr>
<tr>
<td>2–7</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

End of NCK power-up

When the NCK has powered up 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 NCK start-up switch S3 back to the “0” setting.

Power-up via MMC

NCK power-up can also be initiated via the softkey “NCK 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. System data blocks and the diagnostics buffer of the PLC are not erased. After the NCK has powered up, the PLC must be set to its initial state by means of a general reset. There are two ways of doing this:

1. By means of the programming device for Step7.
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 5-77)

<table>
<thead>
<tr>
<th>Setting</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>PLC RUN PROGRAMMING: RUN state. It is possible to intervene in the PLC program without activating a password.</td>
</tr>
<tr>
<td>1</td>
<td>PLC RUN: RUN state. The program can only be accessed for reading via the programming device. After activation of the password, it is possible to intervene in (i.e. change) the PLC program.</td>
</tr>
<tr>
<td>2</td>
<td>PLC STOP: STOP state.</td>
</tr>
<tr>
<td>3</td>
<td>MRES: A module reset (general reset function) can be executed with the switch in this setting.</td>
</tr>
</tbody>
</table>

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).
### 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 3 seconds, turn switch to settings STOP–MRES–STOP (“2”–“3”–“2”)
   ⇒ PS LED flashes first at a frequency of approx. 2 Hz 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 reset followed by an acknowledgement is triggered in position “3”, as is the case for GENERAL RESET, the entire SRAM of the PLC is erased, i.e. both the system data blocks and the diagnostics buffer are erased. These data can no longer be accessed. The system data blocks must be loaded again. If setting “3” (MRES) is selected for less than 3 seconds, then no general reset is requested. The STOP LED does not light up if the switch is not changed from STOP to MRES to STOP within 3 seconds after a general reset has been requested.

**References:** /S7H/, SIMATIC STEP7–300

---

### 5.2.3 MMC100 – MMC102/103 power-up

**MMC100/102/103 power-up**

When the power supply is switched on, the MMC powers up automatically. The system software is installed in the factory and is ready to run. The basic display appears on the screen if the MMC has powered up successfully.
**Problems during power-up**

**MMC100**
If the MMC100 cannot establish a link to the NC, the message: “wait for NCU connection: “x” seconds”, “x” = 1 to 60 appears on the screen. 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 power-up (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 powered up successfully.

**MMC102/103**
If the MMC102/103 does not power up (screen remains dark), the 24V DC power supply must be checked. If the power supply is present at the power unit on the MMC102/103 and the seven-segment status display on the rear panel does not light up, then the MMC102/103 module is defective.

If the MMC102/103 powers up, 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 menu set correctly? It must be set to 1.5 Mbaud (password for protection level 2 required).

**Note**

MMC 101/102
The display remains dark after a successful power-up.
The decimal point lights up during hard disk access operations.

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

If the error message “Corrupt SWAP File!” appears under Windows 3.11, a new swap file (20 MB) must be created under the standard Windows user interface.
5.2.4 Error during control power-up (NC)

Status display H3 (7-segment display)  Various status messages are output via status display H3 (see Fig. 5-1, page 5-77) during power up. The digit “6” is output when the control has finished powering up.

Problems during NCK power-up  If the digit “6” is not output after approximately 2 minutes, but:
- another number appears,
- the display remains dark,
- the display flashes,
then proceed as follows:
1. Repeat the NCK general reset process.
2. Switch S3 (NCU) must be reset to “0”.
3. If the NCK general reset does not work, replace the PCMCIA card.
4. If none of these measures work, the NCU module must be replaced.
5 Power On and Power-Up

5.2 Power on and power-up

PLC status displays

The following LEDs are located on the front plane of the NCU module (see Fig. 5-1, Page 5-77). They display the PLC operating states:

- **PR** PLC RUN (green)
- **PS** PLC STOP (red)
- **PF** PLC watchdog (red)
- **PFO** PLC FORCE (yellow)
- **PF** PROFIBUS (yellow)

Table 5-3: Statuses displayed by PR and PS LEDs

<table>
<thead>
<tr>
<th>PR LED</th>
<th>lights up</th>
<th>off</th>
<th>flashes at 0.5 Hz</th>
<th>off</th>
<th>flashes at 2 Hz</th>
<th>off</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS LED</td>
<td>off</td>
<td>lights up</td>
<td>lights up</td>
<td>lights up</td>
<td>– lights up</td>
<td>– lights up</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>– for 3 secs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>– lights up</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>– flashes at 2 Hz (min. 3 secs.)</td>
<td></td>
</tr>
<tr>
<td>Meaning</td>
<td>RUN</td>
<td>STOP</td>
<td>HALT</td>
<td>RE-START</td>
<td>GENERAL RESET requested</td>
<td>GENERAL RESET in progress</td>
</tr>
</tbody>
</table>

**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 4 LEDs on the status display flash simultaneously after the NCU hardware has been replaced, then another NCK power-up must be initiated. A PLC general reset can then be executed if required.
5.2.5 Machine control panel (MCP) power-up

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 power-up (MCP flashes).

The SW version is indicated by three digits:
Example: Software version 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.

5.2.6 Drive system power-up

Power-up
After an NCK 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.

5.2.7 MMC102/103 BIOS setup

The defaults in the BIOS of the MMC102/103 can be displayed directly on the screen during power-up by selecting key combination “CTRL+ALT+ESC”

Note
The BIOS setup settings are described in

References: /BH/, Operator Components Manual
Assigning Parameters to the Control and the PLC Program

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6.12 System settings for power up, RESET and part program start . 6-177
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
- 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

<table>
<thead>
<tr>
<th>Area</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 1000 to 1799</td>
<td>Machine data for drives</td>
</tr>
<tr>
<td>from 1000 to 9999</td>
<td>Machine data for operator panel</td>
</tr>
<tr>
<td>from 10000 to 18999</td>
<td>General machine data</td>
</tr>
<tr>
<td>from 19000 to 19999</td>
<td>Reserved</td>
</tr>
<tr>
<td>from 20000 to 28999</td>
<td>Channel-specific machine data</td>
</tr>
<tr>
<td>from 29000 to 29999</td>
<td>Reserved</td>
</tr>
<tr>
<td>from 30000 to 38999</td>
<td>Axis-specific machine data</td>
</tr>
<tr>
<td>from 39000 to 39999</td>
<td>Reserved</td>
</tr>
<tr>
<td>from 41000 to 41999</td>
<td>General setting data</td>
</tr>
<tr>
<td>from 42000 to 42999</td>
<td>Channel-specific data</td>
</tr>
<tr>
<td>from 43000 to 43999</td>
<td>Axis-specific setting data</td>
</tr>
<tr>
<td>from 51000 to 61999</td>
<td>General machine data for compile cycles</td>
</tr>
<tr>
<td>from 62000 to 62999</td>
<td>Channel-specific machine data for compile cycles</td>
</tr>
<tr>
<td>from 63000 to 63999</td>
<td>Axis-specific machine data for compile cycles</td>
</tr>
</tbody>
</table>

References: /LIS/, Lists
6.1 Machine and setting data

Entering machine data

Appropriate displays are provided for the entry of machine data. How to select displays:
Select “Area switch over” key on the MMC. The menu with the areas Machine, Parameters, Program, Services, Diagnosis and Start-up is then displayed. Select “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 versions 4.1 and higher.

![Input screen form of the bit editor for HEX machine data](image)

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 softkey Ok.
- With the softkey 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

<table>
<thead>
<tr>
<th>Number and identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>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:</td>
<td></td>
</tr>
<tr>
<td>• Active</td>
<td></td>
</tr>
<tr>
<td>• Protection level</td>
<td></td>
</tr>
<tr>
<td>• Unit</td>
<td></td>
</tr>
<tr>
<td>• Default value</td>
<td></td>
</tr>
<tr>
<td>• Value range</td>
<td></td>
</tr>
</tbody>
</table>

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

- POWER ON (po) NCK RESET
- NEW_CONF (cf) – “Set MD active” softkey on 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 (keysweek 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 10 places plus decimal point and sign.

Value range (minimum and maximum)
Specifies the input limits. If no value range is specified, the data type determines the input limits and the field is marked “***”.

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6.3 Protection level concept

Protection levels

Protection levels for enabling data areas are implemented in the SINUMERIK 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 levels as standard.

Protection level 4 (keyswitch position 3) and higher is required to display machine data.
The appropriate protection level must generally be enabled by means of password “EVENING” to start up the system.

Note
For information about changing protection levels, refer to References: /BA/ Operator’s Guide
/FB/ A2, Various Interface Signals

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

Protection levels 0–3

Protection levels 0 to 3 require the input of a password. The password for level 0 provides access to all data areas. The passwords can be changed after activation (not recommended). If, for example, the passwords have been forgotten, then the system must be reinitialized (NCK general reset). This 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

<table>
<thead>
<tr>
<th>Key color</th>
<th>Switch position</th>
<th>Protection level</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (no key used)</td>
<td>0 = Remove key position</td>
<td>7</td>
</tr>
<tr>
<td>Black</td>
<td>0 and 1</td>
<td>6–7</td>
</tr>
<tr>
<td>Green</td>
<td>0 to 2</td>
<td>5–7</td>
</tr>
<tr>
<td>Red</td>
<td>0 to 3</td>
<td>4–7</td>
</tr>
</tbody>
</table>

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 (part 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.
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.

Reference /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 softkey in the relevant machine data areas.

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>
<thead>
<tr>
<th>Table 6-4 Display criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masking filter active</td>
</tr>
<tr>
<td>• Inactive: All machine data are displayed</td>
</tr>
<tr>
<td>• Active: Checking the group filter</td>
</tr>
<tr>
<td>Expert mode</td>
</tr>
<tr>
<td>• Inactive: The MD is assigned to expert mode</td>
</tr>
<tr>
<td>=&gt; MD not displayed</td>
</tr>
<tr>
<td>• Active: The MD is assigned to expert mode</td>
</tr>
<tr>
<td>=&gt; MD displayed (note index)</td>
</tr>
<tr>
<td>Group filter</td>
</tr>
<tr>
<td>• Inactive: The MD is assigned to the group</td>
</tr>
<tr>
<td>=&gt; MD not displayed</td>
</tr>
<tr>
<td>• Active: The MD is assigned to the group</td>
</tr>
<tr>
<td>=&gt; MD displayed (note index)</td>
</tr>
<tr>
<td>All others</td>
</tr>
<tr>
<td>• Inactive: For MDs not assigned to a group</td>
</tr>
<tr>
<td>=&gt; MD not displayed</td>
</tr>
<tr>
<td>• Active: For MDs not assigned to a group</td>
</tr>
<tr>
<td>=&gt; MD displayed (note index)</td>
</tr>
<tr>
<td>Index from to</td>
</tr>
<tr>
<td>• Inactive: All subparameters of the MD are displayed</td>
</tr>
<tr>
<td>• Active: Only the specified subparameters of the MD are displayed</td>
</tr>
</tbody>
</table>

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.
6 Assigning Parameters to the Control and the PLC Program

6.4 Machine data masking filter (SW 4.2 and higher)

Vertical softkeys

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

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

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

- **OK** softkey
  - 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 displayed (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 softkey an empty machine data window appears.
6.4.3 Saving the filter settings

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
6.5 Example of 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[3]="A11"  Rotary table 1
N10000 $MN_AXCONF_MACHAX_NAME_TAB[5]="B11"  Magazine axis
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

```plaintext
%_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[5]=4
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
```

CHANDATA(1)
N20000 $MC_CHAN_NAME="Milling_machine"
N20070 $MC_AXCONF_MACHAX_USED[0]=1
N20070 $MC_AXCONF_MACHAX_USED[1]=2
N20070 $MC_AXCONF_MACHAX_USED[2]=3
N20070 $MC_AXCONF_MACHAX_USED[3]=4
N20070 $MC_AXCONF_MACHAX_USED[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[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 6 axes), NCK reset
5. Set PLC options in the PLC dialog
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 time cycles

The control operates according to time cycles which are defined via machine data. The basic system clock cycle is defined in seconds; the other time cycles are calculated through multiplication with the basic system clock 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

<table>
<thead>
<tr>
<th>Machine data</th>
<th>Name</th>
<th>NCU 571</th>
<th>NCU 572</th>
<th>NCU 573</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 10050: SYSCLOCK_CYCLE_TIME</td>
<td>Basic system clock cycle</td>
<td>= 0.0060 s</td>
<td>= 0.0040 s</td>
<td>= 0.0020 s</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 6 ms</td>
<td>= 4 ms</td>
<td>= 2 ms</td>
</tr>
<tr>
<td>MD 10060: POSCTRL_SYSCLOCK_TIME_RATIO</td>
<td>Factor for position control clock cycle</td>
<td>= 1 = 1 * 6 ms</td>
<td>= 1 = 1 * 4 ms</td>
<td>= 1 = 1 * 2 ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 6 ms</td>
<td>= 4 ms</td>
<td>= 2 ms</td>
</tr>
<tr>
<td>MD 10070: IPO_SYSCLOCK_TIME_RATIO</td>
<td>Factor for interpolator clock cycle</td>
<td>= 4 = 4 * 6 ms</td>
<td>= 4 = 4 * 4 ms</td>
<td>= 4 = 4 * 2 ms</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= 24 ms</td>
<td>= 16 ms</td>
<td>= 8 ms</td>
</tr>
</tbody>
</table>

*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 version 5 has made it considerably easier to switch the dimension system over.

- Availability of an MMC softkey 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 softkey toggling via MMC, the value changes between G700 (inches) and G710 (metric).

In SW version 5 and later, 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:

<table>
<thead>
<tr>
<th>Physical quantity</th>
<th>Metric</th>
<th>Inch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear position</td>
<td>1 mm</td>
<td>1 inch</td>
</tr>
<tr>
<td>Angular position</td>
<td>1 degree</td>
<td>1 degree</td>
</tr>
<tr>
<td>Linear velocity</td>
<td>1 mm/min</td>
<td>1 inch/min</td>
</tr>
<tr>
<td>Angular velocity</td>
<td>1 rev/min</td>
<td>1 rev/min</td>
</tr>
<tr>
<td>Linear acceleration</td>
<td>1 mm/s²</td>
<td>1 inch/s²</td>
</tr>
<tr>
<td>Angular acceleration</td>
<td>1 rev/s²</td>
<td>1 rev/s²</td>
</tr>
<tr>
<td>Linear jerk</td>
<td>1 mm/s³</td>
<td>1 inch/s³</td>
</tr>
<tr>
<td>Angular jerk</td>
<td>1 rev/s³</td>
<td>1 rev/s³</td>
</tr>
<tr>
<td>Timing</td>
<td>1 s</td>
<td>1 s</td>
</tr>
<tr>
<td>( K_V ) factor (servo gain)</td>
<td>1/s</td>
<td>1/s</td>
</tr>
<tr>
<td>Rotational feedrate</td>
<td>1 mm/rev</td>
<td>1 inch/rev</td>
</tr>
<tr>
<td>Linear position (compensation value)</td>
<td>1 mm</td>
<td>1 inch</td>
</tr>
<tr>
<td>Angular position (compensation value)</td>
<td>1 degree</td>
<td>1 degree</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Index no.</th>
<th>Physical quantity</th>
<th>Input/output</th>
<th>Internal unit</th>
<th>Scaling factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Linear position</td>
<td>1 mm</td>
<td>1 mm</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Angular position</td>
<td>1 degree</td>
<td>1 degree</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Linear velocity</td>
<td>1 mm/min</td>
<td>1 mm/s</td>
<td>0.016666667</td>
</tr>
<tr>
<td>3</td>
<td>Angular velocity</td>
<td>1 rev/min</td>
<td>1 degree/s</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>Linear acceleration</td>
<td>1 m/s²</td>
<td>1 mm/s²</td>
<td>1000</td>
</tr>
<tr>
<td>5</td>
<td>Angular acceleration</td>
<td>1 rev/s²</td>
<td>1 degree/s²</td>
<td>360</td>
</tr>
<tr>
<td>6</td>
<td>Linear jerk</td>
<td>1 m/s³</td>
<td>1 mm/s³</td>
<td>1000</td>
</tr>
<tr>
<td>7</td>
<td>Angular jerk</td>
<td>1 rev/s³</td>
<td>1 degree/s³</td>
<td>360</td>
</tr>
<tr>
<td>8</td>
<td>Timer</td>
<td>1 s</td>
<td>1 s</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>( K_V ) factor (servo gain)</td>
<td>1 m/min+mm</td>
<td>1/s</td>
<td>16.6666667</td>
</tr>
<tr>
<td>10</td>
<td>Rotational feedrate</td>
<td>1 mm/rev</td>
<td>1 mm/degree</td>
<td>1/360</td>
</tr>
<tr>
<td>11</td>
<td>Linear position (compensation value)</td>
<td>1 mm</td>
<td>1 mm</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Angular position (compensation value)</td>
<td>1 degree</td>
<td>1 degree</td>
<td></td>
</tr>
</tbody>
</table>
Example

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

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

The machine data must be entered as follows:
MD 10220: SCALING_USER_DEF_MASK = ‘H4’ (activation of new factor) and

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 part 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.

Input and display limit values

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

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

<table>
<thead>
<tr>
<th></th>
<th>D-RAM</th>
<th>S-RAM not buffered</th>
<th>S-RAM buffered</th>
<th>FLASH</th>
<th>PCMCIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCU 570</td>
<td>1.5 MB</td>
<td></td>
<td>0.25 MB</td>
<td>2.25 MB</td>
<td></td>
</tr>
<tr>
<td>NCU 571</td>
<td>4 MB</td>
<td>0.5 MB/2.0 MB*</td>
<td></td>
<td>4 MB</td>
<td></td>
</tr>
<tr>
<td>NCU 572</td>
<td>8 MB</td>
<td>0.5 MB/2.0 MB*</td>
<td></td>
<td>4 MB</td>
<td></td>
</tr>
<tr>
<td>NCU 573</td>
<td>8 MB</td>
<td>0.5 MB/2.0 MB*</td>
<td></td>
<td>4 MB</td>
<td></td>
</tr>
<tr>
<td>NCU 573.2</td>
<td>8 MB</td>
<td>2.0 MB</td>
<td></td>
<td>4 MB</td>
<td></td>
</tr>
<tr>
<td>NCU 573.2</td>
<td>32 MB*</td>
<td>2.0 MB</td>
<td></td>
<td>4 MB</td>
<td></td>
</tr>
</tbody>
</table>

*) available as an option, see Catalog NC 60.1

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

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

The memory must be sectionalized before commencement of the actual start-up process because all buffered user data (e.g. part 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.
6.7 Memory configuration

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
- Part programs
- Memory configuration data
- Configurable memory areas

References: /FBI/, Step7, Memory Configuration

6.7.1 Dynamic RAM memory

Set the following machine data:

Table 6-6 MDs for allocating DRAM

<table>
<thead>
<tr>
<th>MDs for DRAM</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 18242: MM_MAX_SIZE_OF_LUD_VALUE</td>
<td>This data is preset to 8192 bytes for &quot;Cycle 95&quot;. It can be reduced to 2048 if Cycle 95 is not in use.</td>
</tr>
<tr>
<td>MD 28040: MM_LUD_VALUE_MEM</td>
<td>Memory size for local user variables, you should increase this MD from 25 Kbytes (default) to 35 – 50 Kbytes only if you need more than 2048 bytes in MD 18242.</td>
</tr>
</tbody>
</table>

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 Memory configuration

6.7.2 Static RAM memory

Set the following machine data:

Table 6-7 MDs for allocating SRAM

<table>
<thead>
<tr>
<th>MDs for SRAM</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 18120: MM_NUM_GUD_NAMES_NCK</td>
<td>Number of global user data</td>
</tr>
<tr>
<td>MD 18130: MM_NUM_GUD_NAMES_CHAN</td>
<td>Number of channel-specific global user variables</td>
</tr>
<tr>
<td>MD 18080: MM_TOOL_MANAGEMENT_MASK</td>
<td>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 part program memory.</td>
</tr>
<tr>
<td>MD 18082: MM_NUM_TOOL</td>
<td>Number of tools according to machine</td>
</tr>
<tr>
<td>MD 18100: MM_NUM_CUTTING_EDGES_IN_TOA</td>
<td>Number of tool cuttings edges per TOA module according to requirements of end customer</td>
</tr>
<tr>
<td>MD 18160: MM_NUM_USER_MACROS</td>
<td>Number of macros</td>
</tr>
<tr>
<td>MD 18190: MM_NUM_PROTECT_AREA</td>
<td>Number of files for machine-related protection zones</td>
</tr>
<tr>
<td>MD 28200: MM_NUM_PROTECT_AREA_CHAN</td>
<td>Number of files for channel-specific protection zones</td>
</tr>
<tr>
<td>MD 28210: MM_NUM_PROTECT_AREA_ACTIV</td>
<td>Number of protection zones simultaneously active in one channel</td>
</tr>
<tr>
<td>MD 28050: MM_NUM_R–PARAM</td>
<td>Number of R parameters required</td>
</tr>
<tr>
<td>MD 28080: MM_NUM_USER_FRAMES</td>
<td>Number of frames required</td>
</tr>
<tr>
<td>MD 38000: MM_ENC_COMP_MAX_POINTS</td>
<td>Number of compensation points required</td>
</tr>
</tbody>
</table>

SRAM with 2 MB 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

<table>
<thead>
<tr>
<th>MD number</th>
<th>MD name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 18020</td>
<td>MM_NUM_GUD_NAMES_NCK</td>
<td>Number of global user variables</td>
</tr>
<tr>
<td>MD 18030</td>
<td>MM_NUM_GUD_NAMES_CHAN</td>
<td>Number of global user variables</td>
</tr>
<tr>
<td>MD 18060</td>
<td>MM_TOOL_MANAGEMENT_MASK</td>
<td>Memory tool management</td>
</tr>
<tr>
<td>MD 18082</td>
<td>MM_NUM_TOOL</td>
<td>Number of tools</td>
</tr>
<tr>
<td>MD 18084</td>
<td>MM_NUM_MAGAZINE</td>
<td>Number of magazines</td>
</tr>
<tr>
<td>MD 18086</td>
<td>MM_NUM_MAGAZINE_LOCATION</td>
<td>Number of magazine locations</td>
</tr>
<tr>
<td>MD 18090</td>
<td>MM_NUM_CC_MAGAZINE_RPARAM</td>
<td>Number of magazine data</td>
</tr>
<tr>
<td>MD 18092</td>
<td>MM_NUM_CC_MAGLOC_RPARAM</td>
<td>Number of magazine location data</td>
</tr>
<tr>
<td>MD 18094</td>
<td>MM_NUM_CC_TDA_RPARAM</td>
<td>Number of tool-specific data</td>
</tr>
<tr>
<td>MD 18096</td>
<td>MM_NUM_CC_TOA_PARAM</td>
<td>Number of TOA data</td>
</tr>
<tr>
<td>MD 18098</td>
<td>MM_NUM_CC_MON_RPARAM</td>
<td>Number of monitoring data</td>
</tr>
<tr>
<td>MD 18100</td>
<td>MM_NUM_CUTTING_EDGES_IN_TOA</td>
<td>Tool offsets per TOA module</td>
</tr>
<tr>
<td>MD 18110</td>
<td>MM_NUM_TOA_MODULES</td>
<td>Number of TOA modules</td>
</tr>
<tr>
<td>MD 18118</td>
<td>MM_NUM_GUD_MODULES</td>
<td>Number of GUD files</td>
</tr>
<tr>
<td>MD 18120</td>
<td>MM_NUM_GUD_NAMES_NCK</td>
<td>Number of global user variables</td>
</tr>
<tr>
<td>MD 18130</td>
<td>MM_NUM_GUD_NAMES_CHAN</td>
<td>Number of channel-specific user variables</td>
</tr>
<tr>
<td>MD 18140</td>
<td>MM_NUM_GUD_NAMES_AXIS</td>
<td>Number of axis-specific user variables</td>
</tr>
<tr>
<td>MD 18150</td>
<td>MM_GUD_VALUES_MEM</td>
<td>Memory location for user variables</td>
</tr>
<tr>
<td>MD 18160</td>
<td>MM_NUM_USER_MACROS</td>
<td>Number of MACROS</td>
</tr>
<tr>
<td>MD 18190</td>
<td>MM_NUM_PROTECT_AREA_NCKC</td>
<td>Number of protection areas</td>
</tr>
<tr>
<td>MD 18230</td>
<td>MM_USER_MEM_BUFFERED</td>
<td>User memory in SRAM</td>
</tr>
<tr>
<td>MD 18270</td>
<td>MM_NUM_SUBDIR_PER_DIR</td>
<td>Number of subdirectories</td>
</tr>
<tr>
<td>MD 18280</td>
<td>MM_NUM_FILES_PER_DIR</td>
<td>Number of files</td>
</tr>
<tr>
<td>MD 18290</td>
<td>MM_FILE_HASH_TABLE_SIZE</td>
<td>Hash table size for files in a directory</td>
</tr>
<tr>
<td>MD 18300</td>
<td>MM_DIR_HASH_TABLE_SIZE</td>
<td>Hash table size for subdirectories</td>
</tr>
<tr>
<td>MD 18310</td>
<td>MM_NUM_DIR_IN_FILESYSTEM</td>
<td>Number of directories in passive file system</td>
</tr>
<tr>
<td>MD 18320</td>
<td>MM_NUM_FILES_IN_FILESYSTEM</td>
<td>Number of files in passive file system</td>
</tr>
<tr>
<td>MD 18330</td>
<td>MM_CHAR_LENGTH_OF_BLOCK</td>
<td>Max. length of an NC block</td>
</tr>
<tr>
<td>MD 18350</td>
<td>MM_USER_FILE_MEM_MINIMUM</td>
<td>Minimum user memory in SRAM</td>
</tr>
<tr>
<td>MD 28050</td>
<td>MM_NUM_R_PARAM</td>
<td>Number of channel-specific R parameters</td>
</tr>
<tr>
<td>MD 28080</td>
<td>MM_NUM_USER_FRAMES</td>
<td>Number of settable frames</td>
</tr>
<tr>
<td>MD 28085</td>
<td>MM_LINK_TOA_UNIT</td>
<td>Allocation of a TO unit to a channel</td>
</tr>
<tr>
<td>MD 28200</td>
<td>MM_NUM_PROTECT_AREA_CHAN</td>
<td>Number of files for protection areas</td>
</tr>
<tr>
<td>MD 38000</td>
<td>MM_ENC_COMP_MAX_POINTS [n]</td>
<td>Number of interpol. points with interpol. compensation</td>
</tr>
</tbody>
</table>
6.8 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, V.24 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:

$\text{MA_IS_ROT_AX}[A1] = 1$ (rotary axis)
$\text{MA_MAX_AX_VELO}[A1] = 1000$ [rev/min] (maximum axis velocity)

When the MD block is loaded the velocity is interpreted with respect to a linear axis (default setting $\text{MA_IS_ROT_AX}[A1]=0$) 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.

Either

- Change the relevant machine data by hand via the MMC (MD 10220, 10230, 10240, 10250, 30300) followed by NCK power-up. After that, read in the MD set via V.24 and start an NCK power-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 power-up. After that read in the complete MD set and start an NCK power-up, or
• As an alternative to the options listed above, an MD block can also be loaded twice (via V24), 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” power-up)
By entering certain values in MD: INIT_MD, it is possible to load various data areas with default values when the NCK next powers up. The machine data is displayed in HEX format. After MD: INIT_MD has been set, “Power ON” must be executed twice:
• The MD is activated when the power is switched on the first time.
• The function is executed and the MD reset to “0” when the power is switched on the second time.

Meaning of input values in MD11200

Value “0”
The stored machine data MD are loaded during the next power-up.

Value “1”
On the next power-up, all machine data (with the exception of the memory configuring data) are overwritten with default values.

Value “2”
On the next power-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: 1 channel and 5 axes.
- NCU 572/573: 2 channels and 8 axes with simulated setpoint or actual value channel.

Number of channels

> 2 channels are provided on the SINUMERIK 840D.

Machine axes

Machine axes are all axes existing on the machine. They are defined as geometry axes or additional axes.

Geometry axes

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

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 3 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:

<table>
<thead>
<tr>
<th>Turning machine</th>
<th>Milling machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>with X, Z, C axis/spindle</td>
<td>4 axes + spindle/C axis</td>
</tr>
<tr>
<td>MD 10000</td>
<td>MD 10000</td>
</tr>
<tr>
<td>Index</td>
<td>Index</td>
</tr>
<tr>
<td>X1 Z1 C1</td>
<td>X1 Y1 Z1 A1 C1</td>
</tr>
<tr>
<td>0 1 2 3 4</td>
<td>0 1 2 3 4</td>
</tr>
</tbody>
</table>
Example for milling machine: MD 10000
AXCONF_MACHAX_NAME_TAB[0] = X1
AXCONF_MACHAX_NAME_TAB[1] = Y1
AXCONF_MACHAX_NAME_TAB[2] = Z1
AXCONF_MACHAX_NAME_TAB[3] = A1
AXCONF_MACHAX_NAME_TAB[4] = C1

2. Channel level

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

<table>
<thead>
<tr>
<th>Turning machine</th>
<th>Milling machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 0 0</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>

- 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 part 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.)

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

Axis name in channel (addition. axes)
A C

Assignment of GEO axes
X Y Z A C

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

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
6.9.2 Drive configuration (FDD, SLM, MSD)

**Note**
The drive configuration and start-up of synchronous linear motors (SLM) are described in

**References:** /FBLI/ Description of Functions, Linear Motor.

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

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

![Drive configuration display with MMC102/103 (SW 4.1 and higher)](image)

**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 MMC or 611D start-up tool. You can call up this display via the Machine data / Drive config.

- 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.
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 softkey, selection of the power section with the cursor keys, confirmation with the OK softkey 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

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Amperage</th>
<th>Power section</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSD</td>
<td>3 / 3 / 3 A</td>
<td>8 A</td>
<td>01</td>
</tr>
<tr>
<td>MSD</td>
<td>5 / 5 / 8 A</td>
<td>15 A</td>
<td>02</td>
</tr>
<tr>
<td>MSD</td>
<td>8 / 10 / 16 A</td>
<td>25 A</td>
<td>04</td>
</tr>
<tr>
<td>MSD</td>
<td>24 / 32 / 32 A</td>
<td>50 A</td>
<td>06</td>
</tr>
<tr>
<td>MSD</td>
<td>30 / 40 / 51 A</td>
<td>80 A</td>
<td>07</td>
</tr>
<tr>
<td>MSD</td>
<td>45 / 60 / 76 A</td>
<td>108 A</td>
<td>0D</td>
</tr>
<tr>
<td>MSD</td>
<td>45 / 60 / 76 A</td>
<td>120 A</td>
<td>08</td>
</tr>
<tr>
<td>MSD</td>
<td>60 / 80 / 102 A</td>
<td>160 A</td>
<td>09</td>
</tr>
<tr>
<td>MSD</td>
<td>85 / 110 / 127 A</td>
<td>200 A</td>
<td>A0</td>
</tr>
<tr>
<td>MSD</td>
<td>120 / 150 / 193 A</td>
<td>300 A</td>
<td>0B</td>
</tr>
<tr>
<td>MSD</td>
<td>200 / 250 / 257 A</td>
<td>400 A</td>
<td>0C</td>
</tr>
<tr>
<td>FDD</td>
<td>3 / 6 A</td>
<td>8 A</td>
<td>11</td>
</tr>
<tr>
<td>FDD</td>
<td>5 / 10 A</td>
<td>15 A</td>
<td>12</td>
</tr>
<tr>
<td>FDD</td>
<td>9 / 18 A</td>
<td>25 A</td>
<td>14</td>
</tr>
<tr>
<td>FDD</td>
<td>18 / 36 A</td>
<td>50 A</td>
<td>16</td>
</tr>
<tr>
<td>FDD</td>
<td>28 / 56 A</td>
<td>80 A</td>
<td>17</td>
</tr>
<tr>
<td>FDD</td>
<td>56 / 112 A</td>
<td>160 A</td>
<td>19</td>
</tr>
<tr>
<td>FDD</td>
<td>70 / 140 A</td>
<td>200 A</td>
<td>1A</td>
</tr>
<tr>
<td>FDD</td>
<td>140 / 210 A</td>
<td>400 A</td>
<td>C1</td>
</tr>
</tbody>
</table>
Example 1 of a machine

SINUMERIK 840D with 3 axes and one spindle

<table>
<thead>
<tr>
<th>Machine axis name</th>
<th>Logic drive no.</th>
<th>Mains supply module</th>
<th>NCU module</th>
<th>MSD module</th>
<th>FDD module</th>
<th>FDD 2-axis module</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Z1 axis

The encoder is always installed with 611D

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

Table 6-10 Data for example shown in diagram above

<table>
<thead>
<tr>
<th>Slot</th>
<th>Power section module</th>
<th>Drive</th>
<th>Log. drive no.</th>
<th>Direct measuring system</th>
<th>Position measuring system 1</th>
<th>Position measuring system 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>80 A</td>
<td>MSD</td>
<td>4</td>
<td>no</td>
<td>Motor encoder</td>
<td>no</td>
</tr>
<tr>
<td>2</td>
<td>50 A</td>
<td>FDD</td>
<td>1</td>
<td>no</td>
<td>Motor encoder</td>
<td>no</td>
</tr>
<tr>
<td>3</td>
<td>25 A</td>
<td>FDD</td>
<td>2</td>
<td>no</td>
<td>Motor encoder</td>
<td>no</td>
</tr>
<tr>
<td>4</td>
<td>25 A</td>
<td>FDD</td>
<td>3</td>
<td>yes</td>
<td>Linear scale</td>
<td>no</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>MD</th>
<th>Meaning</th>
<th>Input for example 1 (see Fig. 6–6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 30110: CTRLOUT_MODE_NR</td>
<td>Assignment of a logical drive no. to setpoint channel</td>
<td>X1=“1” Slot 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y1=“2” Slot 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z1=“3” Slot 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1=“4” Slot 1</td>
</tr>
<tr>
<td>MD 30130: CTRLOUT_TYPE</td>
<td>Setpoint channel present</td>
<td>“1”</td>
</tr>
</tbody>
</table>

**Actual-value channel assignment (axis-specific)**

<table>
<thead>
<tr>
<th>MD</th>
<th>Meaning</th>
<th>Input for example 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 30200: NUM_ENCS</td>
<td>Number of measuring channels</td>
<td>X1=“1”</td>
</tr>
<tr>
<td></td>
<td>“1” if only one position measuring system is installed</td>
<td>Y1=“1”</td>
</tr>
<tr>
<td></td>
<td>(“2” if two position measuring systems are installed)</td>
<td>Z1=“1”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1=“1”</td>
</tr>
<tr>
<td>MD 30240: ENC_TYPE[0]</td>
<td>Encoder type</td>
<td>X1=“1”</td>
</tr>
<tr>
<td></td>
<td>“1” for incremental encoder (&quot;4&quot; for absolute encoder with EnDat interface)</td>
<td>Y1=“1”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z1=“1”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1=“1”</td>
</tr>
<tr>
<td>MD 30220: ENC_MODULE_NR[0]</td>
<td>Assignment of a logical drive no. to actual-value channel for position measuring system 1</td>
<td>X1=“1” Slot 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Y1=“2” Slot 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Z1=“3” Slot 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1=“4” Slot 1</td>
</tr>
<tr>
<td>MD 30220: ENC_MODULE_NR[1]</td>
<td>Assignment of a logical drive no. to actual-value channel for position measuring system 2</td>
<td>Position measuring system 2 is not in use</td>
</tr>
<tr>
<td>MD 30230: ENC_INPUT_NR[0]</td>
<td>Assignment for position measuring system 1</td>
<td>X1=“1”</td>
</tr>
<tr>
<td></td>
<td>“1” for motor measuring system</td>
<td>Y1=“1”</td>
</tr>
<tr>
<td></td>
<td>“2” for direct measuring system</td>
<td>Z1=“2”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1=“1”</td>
</tr>
<tr>
<td>MD 30230: ENC_INPUT_NR[1]</td>
<td>Assignment position measuring system 2</td>
<td>Position measuring system 2 is not in use</td>
</tr>
<tr>
<td></td>
<td>“1” for motor measuring system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>“2” for direct measuring system</td>
<td></td>
</tr>
</tbody>
</table>
Note

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

The default 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)**

A motor type must be specified for all drives via the MMC102/103 or SIMODRIVE 611 start-up tool in the “Machine data FDD” or “Machine data MSD” menu (see vertical softkey bar). The selection is made from a list via the motor order number (1FT6/C0086/C0086/C0086, 1FT7/C0086/C0086/C0086, 1PH/C0086/C0086 see rating plate).

- With FDDs, only the selection of motor 1 is visible.
- With MSDs, the selection of motors 1 and 2 is visible (e.g. for Y/Δ changeover).
  
  To avoid incorrect parameterization for MSD, the **OK** softkey 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** softkey, 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](image)

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)
  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)
  EnDat interface: You can now accept the display with “OK” because the system 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 motions < ±5 degrees mechanical are not exceeded. The identification procedure is performed on every power-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 softkey. 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

Once you have selected a motor, the drive data block must be saved individually for each axis/spindle with the “Save boot file” command. The data block is stored as a VSAxx.BOT or HSAxx.BOT file in the user memory (SRAM) on 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 |             |             |             |
|-----------------------|-------------|-------------|-------------|
|                       | Encoder on  | Encoder on  | Encoder on  | Encoder on  |
|                       | motor       | machine     | motor       | 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           |
| 31030: LEADSCREW_PITCH| mm/rev.     | mm/rev.     | –           | –           |

Fig. 6-9 Linear axis with motor-mounted rotary encoder
Assigning Parameters to the Control and the PLC Program

6.9 Axes and spindles

Linear axis with machine-mounted rotary encoder

![Diagram of linear axis with machine-mounted rotary encoder]

Rotary axis with motor-mounted rotary encoder

![Diagram of rotary axis with motor-mounted rotary encoder]

Rotary axis with machine-mounted rotary encoder

![Diagram of rotary axis with machine-mounted rotary encoder]

Fig. 6-10 Linear axis with machine-mounted rotary encoder

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

Fig. 6-12 Rotary axis with machine-mounted rotary encoder

\[
\text{DRIVE AX RATIO NUMERA} = \frac{\text{No. of motor rev.}}{\text{No. of spindle rev.}}
\]

\[
\text{ENC IS DIRECT} = 1
\]

\[
\text{ENC IS LINEAR} = 0
\]

\[
\text{ENC RESOL}
\]

\[
\text{DRIVE AX RATIO NUMERA} = \frac{\text{No. of motor rev.}}{\text{No. of load rev.}}
\]

\[
\text{ENC IS DIRECT} = 1
\]

\[
\text{ENC IS LINEAR} = 0
\]

\[
\text{ENC RESOL}
\]

\[
\text{DRIVE AX RATIO NUMERA} = \frac{\text{No. of motor revolutions}}{\text{No. of encoder revolutions}}
\]

\[
\text{ENC IS DIRECT} = 1
\]

\[
\text{ENC IS LINEAR} = 0
\]

\[
\text{ENC RESOL}
\]
6 Assigning Parameters to the Control and the PLC Program

6.9 Axes and spindles

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

<table>
<thead>
<tr>
<th>Machine data</th>
<th>Linear axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 30300: IS_ROT_AX</td>
<td>0</td>
</tr>
<tr>
<td>MD 31000: ENC_IS_LINEAR</td>
<td>0</td>
</tr>
<tr>
<td>MD 31030: LEADSCREW_PITCH</td>
<td>mm/rev</td>
</tr>
<tr>
<td>MD 31040: ENC_IS_DIRECT</td>
<td>Encoder mounted on motor: 0</td>
</tr>
<tr>
<td></td>
<td>Encoder mounted on machine: 1</td>
</tr>
<tr>
<td>MD 31010: ENC_GRID_POINT_DIST</td>
<td>Scale graduations</td>
</tr>
<tr>
<td>MD 32110: ENC_FEEDBACK_POL</td>
<td>Actual value sign (feedback polarity) [1 or -1]</td>
</tr>
<tr>
<td>MD 31060: DRIVE_AX_RATIO_NUMERA</td>
<td>Motor revolution</td>
</tr>
<tr>
<td>MD 31050: DRIVE_AX_RATIO_DENOM</td>
<td>Spindle revolution</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Table 6-13</th>
<th>Axis machine data for absolute encoders</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rotary absolute encoder</strong></td>
<td><strong>Linear absolute encoder</strong></td>
</tr>
<tr>
<td><strong>MD</strong></td>
<td><strong>Mounted on motor</strong></td>
</tr>
<tr>
<td>1005: ENC_RESOL_MOTOR</td>
<td>Marks/rev. (2048 on standard motor)</td>
</tr>
<tr>
<td>1007: ENC_RESOL_DIRECT</td>
<td>–</td>
</tr>
<tr>
<td>1011: ACTUAL_VALUE_CONFIG</td>
<td>Bit 3 *)</td>
</tr>
<tr>
<td>1030: ACTUAL_VALUE_CON-FIG_DIRECT</td>
<td>–</td>
</tr>
<tr>
<td>34200: ENC_REEP_MODE [n]: 0...max. no. encoders -1</td>
<td>0</td>
</tr>
<tr>
<td>34220: ENC_ABS_TURNS_MODULE [n]: 0...max. no. encoders -1</td>
<td>Multiturn resolution (4096 on standard motor)</td>
</tr>
</tbody>
</table>

*) 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”

**Readjustment**

The absolute encoder must be set once the axes are ready to traverse during machine start-up. However, it may also be necessary to re-adjust 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.
Assigning Parameters to the Control and the PLC Program

6.9 Axes and spindles

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**Note**

In all other cases, the user himself/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 34220: 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**

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 position.
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 “-” according to MD 34010: REFP_CAM_DIR_IS_MINUS and the direction of approach towards the reference position. (Backlash has been eliminated.) The axis does not traverse. Instead, the offset between the correct actual value (reference position) and the actual value supplied by the encoder is entered in MD 34090: REFP_MOVE_DIST_CORR. The current actual value appears in the basic display, the axis signals “referenced”. The value “2” is entered in MD 34210 as the result.

**Example:**

MD 34010 = 1 (negative) and reference position has been traversed in negative direction. In this case, the “-” key on the MCP must also be pressed.
**Rotary absolute encoder with 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 10 mm, a traversing range of 40.96 m is covered.

**Note**

As from SW 4 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 software version 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 Section 10):

Table 6-14 Speed controller settings

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

Table 6-15 Field weakening with MSD

<table>
<thead>
<tr>
<th>No.</th>
<th>Identifier</th>
<th>Name</th>
<th>Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1142</td>
<td>FIELD_WEAKENING_SPEED[DRx]</td>
<td>Threshold speed field weakening</td>
<td>MSD</td>
</tr>
<tr>
<td>1143</td>
<td>LH_CURVE_UPPER_SPEED[DRx]</td>
<td>Upper speed Lh characteristic</td>
<td>MSD</td>
</tr>
<tr>
<td>1144</td>
<td>LH_CURVE_GAIN[DRx]</td>
<td>Gain factor Lh characteristic</td>
<td>MSD</td>
</tr>
</tbody>
</table>

Table 6-16 Current setpoint filter

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

**Table 6-17**  
**Speed setpoint filter**

<table>
<thead>
<tr>
<th>No.</th>
<th>Identifier</th>
<th>Name</th>
<th>Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500</td>
<td>NUM_SPEED_FILTERS[0...7,DRx]</td>
<td>Number of speed setpoint filters</td>
<td>FDD/MSD</td>
</tr>
<tr>
<td>1502</td>
<td>SPEED_FILTER_1_TIME[0...7,DRx]</td>
<td>Time constant speed setpoint f. 1</td>
<td>FDD/MSD</td>
</tr>
</tbody>
</table>

**Table 6-18**  
**Major monitoring and limiting functions**

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

**Table 6-19**  
**Important messages**

<table>
<thead>
<tr>
<th>No.</th>
<th>Identifier</th>
<th>Name</th>
<th>Drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1417</td>
<td>SPEED_THRESHOLD_X[0...7,DRx]</td>
<td>nx for 'nact&lt;nx' signal</td>
<td>FDD/MSD</td>
</tr>
<tr>
<td>1418</td>
<td>SPEED_THRESHOLD_MIN[0...7,DRx]</td>
<td>nmin for 'nact&lt;nmin' signal</td>
<td>FDD/MSD</td>
</tr>
<tr>
<td>1426</td>
<td>SPEED_EQ_ACT_TOL[0...7,DRx]</td>
<td>Toler. band for 'nset=nact' signal</td>
<td>FDD/MSD</td>
</tr>
<tr>
<td>1428</td>
<td>TORQUE_THRESHOLD_X[0...7,DRx]</td>
<td>Threshold torque Mdx</td>
<td>FDD/MSD</td>
</tr>
<tr>
<td>1602</td>
<td>MOTOR_TEMP_WARN_LIMIT[DRx]</td>
<td>Motor temp. warning threshold</td>
<td>FDD/MSD</td>
</tr>
</tbody>
</table>
Assigning Parameters to the Control and the PLC Program

Axes and spindles

Fig. 6-14  Speed controller with the most important setting parameters

**Speed controller**

- **Scaling**
  - 1401 MOTOR_MAX_SPEED

- **PT1:**
  - 1500 NUM_SPEED_FILTERS
  - 1902 SPEED_FILTER_1.TIME

- **1405 MOTOR_SPEED_LIMIT**
  - Setup mode
  - 1420 MOTOR_MAX_SPEED_SETUS

- **Actual speed monitoring**
  - n_act > MD 1147 SPEED_LIMIT
  - => Torque setpoint limitation = 0

- **Filter 2**
  - Current setpoint filter

- **Filter 4**
  - Speed setpoint limitation

- **Filter 3**
  - Torque setpoint limitation

- **Setup mode**
  - 1239 TORQUE_LIMIT_FOR_SETUP

- **1725 MAXIMAL_TORQUE_FROM_NC**
  - 1230 TORQUE_LIMIT_1
  - 1235 POWER_LIMIT_1
  - 1145 STALL_TORQUE_REDUCTION (MSD)

- **1239 TORQUE_LIMIT_FOR_SETUP**

- **PT2:**
  - 1208 CURRENT_FILTER_4_FREQUENCY
  - 1209 CURRENT_FILTER_4_DAMPING
  - 1219 CURRENT_FILTER_4_SUPPR_FREQ
  - 1220 CURRENT_FILTER_4_BANDWIDTH
  - 1221 CURRENT_FILTER_4_BW_NUM
  - 1621 CURRENT_FILTER_4_BW_NUM

- **Band-stop filter**
  - 1216 CURRENT_FILTER_3_SUPPR_FREQ
  - 1217 CURRENT_FILTER_3_BANDWIDTH
  - 1218 CURRENT_FILTER_3_BW_NUM

- **PT2:**
  - 1206 CURRENT_FILTER_3_FREQUENCY
  - 1207 CURRENT_FILTER_3_DAMPING
  - 1216 CURRENT_FILTER_3_SUPPR_FREQ
  - 1217 CURRENT_FILTER_3_BANDWIDTH
  - 1218 CURRENT_FILTER_3_BW_NUM

- **Scaling**
  - 1401 MOTOR_MAX_SPEED

- **PT1:**
  - 1500 NUM_SPEED_FILTERS
  - 1902 SPEED_FILTER_1.TIME

- **Integrator feedback**
  - 1421 SPEEDCTRL_INTEGRATOR_FEEDBK [n]

- **1605 SPEEDCTRL_LIMIT_TIME**
  - ALARM: 300608 axis %1, drive %2 speed controller output limited

- **1200 NUM_CURRENT_FILTERS**
  - 1201 CURRENT_FILTER_CONFIG

- **Filter 2**
  - n_act > MD 1147 SPEED_LIMIT

- **Filter 3**
  - q_set

- **Filter 4**
  - iq_set

- **Fig. 6-14** Speed controller with the most important setting parameters
6 Assigning Parameters to the Control and the PLC Program

6.9 Axes and spindles

References: /FBA/ DD2, Speed Control Loop

Note
For details about signals and alarms, please refer to
References: /FBA/ D1, 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, 8 linear axes are active by default (5 with the NCU 571). These are assigned to channel 1 (or 2). The assignment to the rotary axis and spindle must be made on 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 \(\rightarrow\) field index 1). This applies to all machine axes which can be traversed via geometry axes. See Section 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]).

<table>
<thead>
<tr>
<th>Parameter set</th>
<th>Axis</th>
<th>Spindle</th>
<th>Spindle gear stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Default</td>
<td>Spindle in axis mode</td>
<td>As specified by manufacturer</td>
</tr>
<tr>
<td>1</td>
<td>Axis interpolates with spindle (G33)</td>
<td>Spindle mode</td>
<td>1st</td>
</tr>
<tr>
<td>2</td>
<td>Axis interpolates with spindle (G33)</td>
<td>Spindle mode</td>
<td>2nd</td>
</tr>
<tr>
<td>3</td>
<td>Axis interpolates with spindle (G33)</td>
<td>Spindle mode</td>
<td>3rd</td>
</tr>
<tr>
<td>4</td>
<td>Axis interpolates with spindle (G33)</td>
<td>Spindle mode</td>
<td>4th</td>
</tr>
<tr>
<td>5</td>
<td>Axis interpolates with spindle (G33)</td>
<td>Spindle mode</td>
<td>5th</td>
</tr>
</tbody>
</table>

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 for feedforward 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 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 interface signals of a simulation axis are output at the PLC interface (e.g. during program test, if there is no drive hardware).

Interface signals for measuring system switchover
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.

![Control loops diagram](image)

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).

Loop gain

In order to obtain high contour accuracy with an interpolation, the loop 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

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

The $K_V$ factor is entered in MD 32200 POSCTRL_GAIN on the basis of the following conversion formula:

$$K_V(s^{-1}) = K_V \cdot \frac{\text{[m/min]}}{\text{[mm]}} = \frac{m}{\text{min mm}} \cdot \frac{1000 \text{ mm}}{1 \text{ min}} \cdot \frac{1 \text{ m}}{60 \text{ s}} = K_V \cdot 16.66667 \text{ s}^{-1}$$

For the factor $K_V 1 \text{ (m/min)/mm}$, the numerical value must be entered in MD 32200: POSCTRL_GAIN. Allowance for the factor 16.667 is made by MD 10220: SCALING_USER_DEF MASK and MD 10230: SCALING_FACTORS_USER_DEF.

For continuous path control, all axes included in the interpolation must have the same dynamic response. They must all have the same following error at a given velocity.
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 KV factor or through dynamic response matching via MD 32900: DYN_MATCH_ENABLE and MD 32910: DYN_MATCH_TIME.


Checking the loop gain

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

The approach behavior at various speeds can be checked by means of a storage oscilloscope or the SIMODRIVE 611D start-up software. The speed setpoint is recorded for this purpose.

![Fig. 6-17 Speed setpoint characteristic](image)

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 KV factor to a little less than the maximum possible value. Static checking of the KV factor is performed with the “Service Axis” softkey in the “Service Display” menu. The real KV factor must precisely match that set because monitoring functions are derived from the KV factor that would otherwise respond (e.g. contour monitoring).
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 0.5 m/s² to 2 m/s² range.

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 (Section 10) or start-up software for SIMODRIVE 611D

After the acceleration has been entered, the axis is traversed rapidly and the actual current values and current setpoint are recorded. This recording shows whether the drive reaches the current limit. While traversing rapidly, the drive may reach the current limit briefly. However, the current must be well below the current limit before 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**
6.9.11 Monitoring functions (axis)

References: /FB/, A3, “Axis monitoring”

**Monitoring of positioning**

During positioning, a function monitors whether the axis has reached the positioning window (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 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)
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).

- MD 36600: BRAKE_MODE_CHOICE = 1 (rapid braking with setpoint $0$)
- MD 36600: BRAKE_MODE_CHOICE = 0 (braking characteristics are retained)

IS “Hardware limit switch minus” (DB31, ... DBX12.0)
IS “Hardware limit switch plus” (DB31, ... DBX12.1)
Alarm “21614 channel[name1] axis[name2] hardware limit switch [+/-]”

The axis must be retracted in the opposite direction in JOG mode.

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

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 +/-”

Working area limitations can be specified and activated for geometry axes via setting data or from the part program (with G25/G26). Monitoring is active after reference point approach.

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 200 kHz, \( n_{\text{max}} = \left( \frac{f_{\text{limit}}}{\text{pulses}} \right) \times 60 \text{ sec} = 5900 \text{ rev/min} \)
Result: It must be ensured that this speed is not reached at maximum axis velocity (MAX_AX_VELO).

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

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Encoder monitoring (zero mark monitoring)

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”.

---

**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”

<table>
<thead>
<tr>
<th>General machine data and interface signals</th>
<th>Machine data and interface signals for phase 1</th>
<th>Machine data for phase 2</th>
<th>Machine data and interface signals for phase 3</th>
<th>Actual value buffering via Power Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 34000: REFP_CAM_IS_ACTIVE (axis with reference cam)</td>
<td>MD 11300: JOG_INC_MODE_LEVELTRIGGRD (INC/REF in JOG mode)</td>
<td>MD 34040: REFP_VELO_SEARCH_MARKER (creep speed)</td>
<td>MD 34070: REFP_VELO_POS (reference point approach speed)</td>
<td></td>
</tr>
<tr>
<td>MD 34110: REFP_CYCLE_NR (axis sequence with channel-specific reference point approach)</td>
<td>MD 34010: REFP_CAM_DIR_IS_MINUS (approach reference cam in minus direction)</td>
<td>MD 34050: REFP_SEARCH_MARKER_REVERSE (direction reversal to reference cam)</td>
<td>MD 34080: REFP_MOVE_DIST (reference point distance zero speed)</td>
<td></td>
</tr>
<tr>
<td>MD 30240: ENC_TYPE (encoder type)</td>
<td>MD 34020: REFP_VELO_SEARCH_CAM (reference cam approach velocity)</td>
<td>MD 34090: REFP_MOVE_DIST_CORR (additive reference point offset)</td>
<td>MD 34100: REFP_SET_POS (reference point value)</td>
<td></td>
</tr>
<tr>
<td>MD 34200: ENC_REFP_MODE (referencing mode)</td>
<td>MD 34030: REFP_MAX_CAM_DIST (maximum path to reference cam)</td>
<td>IS “Traversing keys plus/minus” (DB31, ..., DBX4.7/DBX4.6)</td>
<td>IS “Reference point approach delay” (DB31, ..., DBX12.7)</td>
<td></td>
</tr>
<tr>
<td>IS “Activate referencing” (DB21, ..., DBX1.0)</td>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>IS “Traversing keys plus/minus” (DB31, ..., DBX4.7/DBX4.6)</td>
<td>IS “Reference point value 1...4” (DB31, ..., DBX2.4, 2.5, 2.6, 2.7)</td>
<td></td>
</tr>
<tr>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>The reference point approach for incremental measuring systems is split into three phases:</td>
<td>IS “Traversing keys plus/minus” (DB31, ..., DBX4.7/DBX4.6)</td>
<td>IS “Reference point value 1...4” (DB31, ..., DBX2.4, 2.5, 2.6, 2.7)</td>
<td></td>
</tr>
<tr>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>Phase 1: Approach reference cam</td>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>IS “Reference point value 1...4” (DB31, ..., DBX2.4, 2.5, 2.6, 2.7)</td>
<td></td>
</tr>
<tr>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>Phase 2: Synchronize with zero mark</td>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>IS “Reference point value 1...4” (DB31, ..., DBX2.4, 2.5, 2.6, 2.7)</td>
<td></td>
</tr>
<tr>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>Phase 3: Approach reference point</td>
<td>IS “Reference active” (DB21, ..., DBX33.0)</td>
<td>IS “Reference point value 1...4” (DB31, ..., DBX2.4, 2.5, 2.6, 2.7)</td>
<td></td>
</tr>
</tbody>
</table>

As from SW 4, 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 2 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 Section 6.9.6 for details of absolute encoders.
6.9 Axes and spindles

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 these MD.

---

**Note**

No spindle is defined after a general reset.

---

**References:** /FB/, S1, “Spindles”

---

### 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 of spindle 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, 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 block [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.

- MD 35110: GEAR_STEP_MAX_VELO \[0,A1\] = 500 (not used for spindle)
- MD 35110: GEAR_STEP_MAX_VELO \[1,A1\] = 500 (n\textsubscript{max} for gear stage change, gear stage 1)
- MD 35110: GEAR_STEP_MAX_VELO \[2,A1\] = 1000 (n\textsubscript{max} for gear stage change, gear stage 2)

### 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 \[0,A1\] = 500 (not used for spindle)
- MD 35110: GEAR_STEP_MAX_VELO \[1,A1\] = 500 (n\textsubscript{max} for gear stage change, gear stage 1)
- MD 35110: GEAR_STEP_MAX_VELO \[2,A1\] = 1000 (n\textsubscript{max} for gear stage change, gear stage 2)

Example

- MD 35110: GEAR_STEP_MAX_VELO \[0,A1\] = 500 (not used for spindle)
- MD 35110: GEAR_STEP_MAX_VELO \[1,A1\] = 500 (n\textsubscript{max} for gear stage change, gear stage 1)
- MD 35110: GEAR_STEP_MAX_VELO \[2,A1\] = 1000 (n\textsubscript{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: CTRLOUT_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.

6.9.15 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

<table>
<thead>
<tr>
<th>Machine data</th>
<th>Spindle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encoder on motor</td>
<td>Encoder on spindle</td>
</tr>
<tr>
<td>30300: IS_ROT_AX</td>
<td>1</td>
</tr>
<tr>
<td>31000: ENC_IS_LINEAR</td>
<td>0</td>
</tr>
<tr>
<td>31040: ENC_IS_DIRECT</td>
<td>0</td>
</tr>
<tr>
<td>31020: ENC_RESOL</td>
<td>Lines/rev.</td>
</tr>
<tr>
<td>31060: DRIVE_AX_RATIO_NUMERA</td>
<td>Motor rev. See following note</td>
</tr>
<tr>
<td>31050: DRIVE_AX_RATIO_DENOM</td>
<td>Load rev. See following note</td>
</tr>
</tbody>
</table>
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.

\[
\text{Internal resolution} = \frac{360 \text{ degrees}}{2048} \cdot \frac{\text{MD 31020} \cdot 2048}{\text{MD 31070}} \cdot 1000
\]

\[
\text{Internal resolution} = \frac{360 \cdot 1 \cdot 1000}{2048 \cdot 2048 \cdot 1} \cdot 0.3515
\]

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, 2 gear stages:
Gear stage 1: Motor/spindle = 2.5/1
Gear stage 2: Motor/spindle = 1/1

Gear stage 1

\[
\text{Internal resolution} = \frac{360 \text{ degrees}}{2048} \cdot \frac{\text{MD 31080} \cdot 1 \cdot 1}{\text{MD 31070} \cdot \text{MD 31060}} \cdot 1000 \text{ incr/degr.}
\]

\[
\text{Internal resolution} = \frac{360 \cdot 2048 \cdot 2048 \cdot 1}{2048 \cdot 2048 \cdot 1} \cdot 1000 \text{ pulses/degree}= 0.034332
\]

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

Gear stage 2

\[
\text{Internal resolution} = \frac{360 \text{ degrees}}{2048} \cdot \frac{\text{MD 31080} \cdot 1 \cdot 1}{\text{MD 31070} \cdot \text{MD 31060}} \cdot 1000 \text{ incr/degr.}
\]

\[
\text{Internal resolution} = \frac{360 \cdot 2048 \cdot 2048 \cdot 1}{2048 \cdot 2048 \cdot 1} \cdot 1000 \text{ pulses/degree}= 0.08583
\]

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 35110: GEAR_STEP_MAX_VELO (maximum speed for gear stage changeover)
- MD 35120: GEAR_STEP_MIN_VELO (minimum speed for gear stage changeover)
- MD 35130: GEAR_STEP_MAX_VELO_LIMIT (gear stage maximum speed)
- MD 35140: GEAR_STEP_MIN_VELO_LIMIT (gear stage minimum speed)
- MD 35200: GEAR_STEP_SPEEDCTRL_ACCEL (acceleration in speed control mode)
- MD 35220: ACCEL_REDUCTION_SPEED_POINT (speed for reduced acceleration)
- MD 35230: ACCEL_REDUCTION_FACTOR (reduced acceleration)
- MD 35400: SPIIND_OSCILL_Des_VELO (oscillation speed)
- MD 35410: SPIIND_OSCILL_ACCEL (acceleration in oscillation mode)
- MD 35430: SPIIND_OSCILL_START_DIR (start direction in oscillation mode)
- MD 35440: SPIIND_OSCILL_TIME_CW (oscillation time for direction M3)
- MD 35450: SPIIND_OSCILL_TIME_CCW (oscillation time for direction M4)
- MD 31060: DRIVE_AX_RATIO_NUMERA (numerator load gearing)
- MD 31050: DRIVE_AX_RATIO_DENOM (denominator load gearing)
- MD 32010: JOG_VELO_RAPID (conventional rapid traverse)
- MD 32020: JOG_VELO (conventional axis velocity)
### 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
6 Assigning Parameters to the Control and the PLC Program

6.9 Axes and spindles

Functionality

- To absolute position (0 – 360 degrees)
- Incremental position (+/- 999999.99 degrees)
- Block change when position reached
- Block change on block end criterion

The control brakes the spindle down to creep speed at the acceleration rate for speed operation. If the creep speed has been reached (INT “Spindle in setpoint range”), the control branches into position control mode and the acceleration rate for position control mode and the KV 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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD 35300</td>
<td>SPIND_POSCTRL_VELO (creep speed)</td>
</tr>
<tr>
<td>MD 35350</td>
<td>SPIND_POSITIONING_DIR (direction of rotation on positioning from zero speed)</td>
</tr>
<tr>
<td>MD 35210</td>
<td>GEAR_STEP_POSCTRL_ACCEL (acceleration in position control mode)</td>
</tr>
<tr>
<td>MD 36000</td>
<td>STOP_LIMIT_COARSE (coarse exact stop)</td>
</tr>
<tr>
<td>MD 36010</td>
<td>STOP_LIMIT_FINE (fine exact stop)</td>
</tr>
<tr>
<td>MD 32200</td>
<td>POSCTRL_GAIN (KV factor)</td>
</tr>
<tr>
<td>MD 36400</td>
<td>CONTOUR_TOL (contour monitoring)</td>
</tr>
</tbody>
</table>

IS “Position reached with fine/coarse exact stop” (DB31, ... DBX60.6/60.7)
IS “Positioning mode” (DB31, ... DBX94.5)

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 synchronization is 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 feed-rate, 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)

![Diagram](image)

**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.
MD 36300 ENC_FREQ_LIMIT
MD 36200 AX_VELO_LIMIT
MD 35100 SPIND_VELO_LIMIT
MD 35130 GEAR_STEP_MAX_VELO_LIMIT
MD 35110 GEAR_STEP_MAX_VELO
Programmable spindle speed limitation G26
Programmable spindle speed limitation G92
Programmable spindle speed limitation G25
MD 35120 GEAR_STEP_MIN_VELO
MD 35140 GEAR_STEP_MIN_VELO_LIMIT
MD 36060 STANDSTILL_VELO_TOL
IS "Axis/spindle stationary" (DB31, DBX61.4)
Spindle speed range
Speed range of active gear stage
Speed range limited by G25 and G26
Speed range for constant cutting velocity through LIMS
IS "Referenced/synchronized" (DB31, ... DBX60.4/60.5)
Actual speed monitoring
Maximum spindle speed

Fig. 6-24 Ranges of spindle monitoring
### 6.9.20 Example: Start-up of NCK I/O devices

<table>
<thead>
<tr>
<th>Analog Out</th>
<th>Analog In</th>
<th>Analog In</th>
<th>8 bits Out</th>
<th>16 bits Out</th>
<th>16 bits In</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUT [17]</td>
<td>OUT [33]</td>
<td>IN [17]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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:
   3 bytes for dig. inputs, 2 of these bytes external and 1 internal: MD10350 = 3,
   4 bytes for dig. outputs, 3 of these bytes external and 1 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:

\[
\text{\$A\_OUTA [1] = 5000} \\
\text{\hspace{1cm} (preset analog output 1 to 5000 mV)}
\]

\[
\text{\$A\_OUTA [1] = 0} \\
\text{\hspace{1cm} (set analog output 1 to 0 mV)}
\]

\[
\text{\$A\_OUT [9] = TRUE} \\
\text{\hspace{1cm} (if analog input 1 > 4000 mV, set output 9)}
\]

\[
\text{\$A\_OUT [9] = FALSE} \\
\text{\hspace{1cm} (reset digital output 9)}
\]

\[
\text{R1 = \$A\_INA [1]} \\
\text{\hspace{1cm} (set value of analog input 1 in R parameter 1)}
\]
6.10 Linear motors (1FN1 and 1FN3 motors)

6.10.1 General information about starting up linear motors

Recommended reading
For detailed information about linear motors, encoder and power connections and configuring and assembly, please refer to:

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

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? (Recommended 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 specifications?
   - 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 \( \_ \_ \_ \_ \_ \_ \_ \mu m \)
   - Number of zero markers \( \_ \_ \_ \_ \_ \_ \_ \)

b) Absolute measuring system:
   - Graduations \( \_ \_ \_ \_ \_ \_ \_ \mu m \)

Determine the positive drive direction:

Where is the positive count direction of the measuring system? (see Section 6.10.6)

\[ \text{invert the actual velocity value? } \checkmark \text{yes} \checkmark \text{no} \]

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 connected between \( \_ \_ \_ \_ \) and the measuring system.
(See also PJLM/CON/Connections: Section “Encoder connection”).

5. Measuring system cable

Check whether the measuring system cable is correctly attached to connector X411 or to the adapter on the temperature sensor coupling lead.
(See also PJLM/CON/Connections: Section “Encoder connection”).
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

![Drive configuration for synchronous linear motor](image-url)
2. Adapt the axis-specific machine data (MD) as for feed drive

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Axis with drive +</th>
<th>Axis with drive -</th>
</tr>
</thead>
<tbody>
<tr>
<td>00200 NUM_ENCODINGS</td>
<td>1</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>00290 ENC_TYPE[0]</td>
<td>1</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>81000 ENC_IS_LINEAR[0]</td>
<td>1</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>97010 ENC_GRID_POINT_DIST[0]</td>
<td>6.01500000000000</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>92000 MAX_AXVELO</td>
<td>1200.00000000000000</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>92100 AX_MOTION_DIR</td>
<td>1</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>92110 ENC_FEEDBACK_POL[0]</td>
<td>1</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>92200 POSITION_GAIN[0]</td>
<td>1.000000000000000000</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>92300 MAX_AXACCEL</td>
<td>1.000000000000000000</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>90340 STFPNESS_CONTROL_ENABLE</td>
<td>0</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>94200 ENC_REP_MODE[0]</td>
<td>1</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>94210 ENC_REP_UP_STATE[0]</td>
<td>0</td>
<td>AX Y1</td>
<td></td>
</tr>
<tr>
<td>98200 AXVELO_LIMIT[0]</td>
<td>300.00000000000000</td>
<td>AX Y1</td>
<td></td>
</tr>
</tbody>
</table>

Fig. 6-26 Minimum selection of axis machine data for linear motor
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. . .)
b) Is the linear motor not included in the list of linear motors?

--- unlisted motor

“Motor” field --> enter data

<table>
<thead>
<tr>
<th>Set-up</th>
<th>CHAN1</th>
<th>JOG</th>
<th>RPM.DIR</th>
<th>RTG.MPF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel interrupted</td>
<td>Step: No NC ready</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program aborted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>030701</td>
<td>Active Y1, Antrieb 2 inbetriebnommen sofortanliegend</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Fig. 6-28 Entering a motor without listed data

Enter the motor data:

<table>
<thead>
<tr>
<th>Set-up</th>
<th>CHAN1</th>
<th>JOG</th>
<th>RPM.DIR</th>
<th>RTG.MPF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel interrupted</td>
<td>Step: No NC ready</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program aborted</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>030701</td>
<td>Active Y1, Antrieb 2 inbetriebnommen sofortanliegend</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 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

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 (Section 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".
6.10 Linear motors (1FN1 and 1FN3 motors)

b) Absolute value encoder (EnDat)

An absolute measuring system (EnDat interface) is installed.

The following inputs must be made:
- In “Linear measuring system” field: Select absolute (EnDat interface)
- “Invert the actual velocity value” (Section 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 Section 6.10.5), the monitoring function must be switched off through input of a fixed temperature > 0.
- MD 1608 e.g. 80°C Monitor off
- MD 1608 e.g. 0°C 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
   a) Incremental measuring system
      - Incremental – one zero marker
        Set MD 1017 = 1
        The pulse and controller enabling signals may only be switched on now!
        Every time the power is switched on and the enabling signals set, an
        audible test current (MD 1019) flows through.
        Traverse axis across zero marker, “JOG” mode
        The angle offset is automatically entered in MD1016
        Alarm 300799 appears
        Accept with OK —> save bootfile —> NCK reset
      - Incremental – none or several zero markers
        The pulse and controller enabling signals may only be switched on now!
        Synchronization takes place at the current position.
      b) Absolute measuring system
        The pulse and controller enabling signals may only be switched on now!
        When the enabling signals are set, an audible test current (MD1019)
        flows through once.
        The angle offset is automatically determined and entered in
        MD 1016
        Alarm 300799 appears
        Accept with OK —> save bootfile —> NCK reset
      c) 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)

8. Check and set rotor position identification
   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
        commutation angle offset 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:

![Image](image-url)
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 = 10 mm --> distance = 10 mm)

10. Set and perform referencing/adjustment
    - Incremental measuring system:
      Referencing (see Section 6.9.12)
    - Absolute measuring system:
      Adjustment (see Section 6.9.6)

11. Set software limit switches (see Section 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 Section 10)
    - Position controller (see Section 10)
### 6.10.3 Start-up: Linear motors with 2 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 and noted during this phase.

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

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

#### Procedure for starting up paralleled linear motors

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

1. **Disconnect the paralleled motors**
   - Connect motor 1 only to the power section.
2. **Start up motor 1 as if it were a single motor**
   - Note information in Section 6.10.1
   - Start up the linear motor as described in Section 6.10.2 (up to and including point 7.)
   - Check and set rotor position identification (see Section 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 Section 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 Section 6.10.2, point 7: “Determine the commutation angle offset”)
   - With an absolute measuring system:
     Switch off the drive (NCK reset)
     Switch on the drive with pulse or controller enabling signals inhibited
     Set MD 1017 = 1
     Activate pulse and controller enabling signals
     —> The angle offset is automatically entered in MD 1016
     —> Alarm 300799 is output
     Save bootfile and then NCK reset

9. Traverse axis and perform function check.
   (Section 6.10.2, point 9.)

10. Note 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 \( \leq \) 10 degrees —> OK
    if > 10 degrees —> Check and correct mechanical assembly
        (see Section 6.10.4 und 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 2 linear motors again
    Connect both motors to the power section again.

14. Switch on motors with pulse and controller enabling signals inhibited

15. Start-up of paralleled linear motors
    - Carry out the complete start-up procedure described in Section 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 Section 6.10.2, point 7. (Determine the commutation angle off-
      set).
6.10.4 Mounting dimensions

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. 6-33 Check dimensions for motor installation illustrated by a 1FN1 motor](image)

Table 6-22 Check dimensions for mounting dimension and air gap for a 1FN1 linear motor

<table>
<thead>
<tr>
<th>Check dimensions</th>
<th>Linear motors</th>
<th>1FN1 07</th>
<th>1FN1 12</th>
<th>1FN1 18</th>
<th>1FN1 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting dimension $e_1$ [mm]</td>
<td></td>
<td>80.7 ± 0.3</td>
<td>106.7 ± 0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting dimension $e_2$ [mm] (without thermo-insulating bars)</td>
<td></td>
<td>76.7 ± 0.3</td>
<td>101.7 ± 0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurable air gap $l$ [mm] (not including mounting dimension tolerance)</td>
<td></td>
<td>1.1 $^{+0.3/-0.45}$</td>
<td>1.1 $^{+0.3/-0.45}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance $b$ [mm] (not including mounting dimension tolerance)</td>
<td></td>
<td>13 ± 1</td>
<td>13 ± 1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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
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. 6-34 Evaluation of KTY temperature sensor (black/white) and switch or PTC (yellow/red) (whether temperature switch or PTC resistor depends on motor type, i.e. 1FN1 or 1FN3)
### Note

The outer and inner shield of the signal leads in the power cable and the shield of the temperature sensor coupling lead must be attached in a 360° connection with the shield connection plate. Failure to connect the shield correctly can result in high touch voltages, malfunctions and sporadic errors or irreparable damage to the closed-loop control module.

<table>
<thead>
<tr>
<th>Signal</th>
<th>Power cable</th>
<th>Temperature sensor coupling lead (dongle)</th>
<th>–X411 on drive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature sensor +</td>
<td>Black core</td>
<td>Brown + black cores</td>
<td>Pin 13</td>
</tr>
<tr>
<td>Temperature sensor –</td>
<td>White core</td>
<td>Orange + red cores</td>
<td>Pin 25</td>
</tr>
<tr>
<td>Temperature switch/PTC</td>
<td>Yellow core</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Temperature switch/PTC</td>
<td>Red core</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
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. 6-35), 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. 6-35 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. 6-36).
2. Renishaw measuring systems (e.g. RGH22B)

The Renishaw RGH22B measuring system (graduations = 20 µm) 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.

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.

Table 6-24  Signal and pin assignments, routing on 1FN linear motor

<table>
<thead>
<tr>
<th>Signal</th>
<th>Cable color</th>
<th>Circular connector 12-pin</th>
<th>Connected to</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>+5 V</td>
</tr>
<tr>
<td>BID</td>
<td>black</td>
<td>Pin 9</td>
<td>Reference marker in both directions</td>
</tr>
<tr>
<td>DIR</td>
<td>orange</td>
<td>Pin 7</td>
<td>Positive directions</td>
</tr>
<tr>
<td>+5 V</td>
<td>brown</td>
<td>Pin 12</td>
<td></td>
</tr>
<tr>
<td>0 V</td>
<td>white</td>
<td>Pin 10</td>
<td></td>
</tr>
</tbody>
</table>

Note

If the scanning head is mechanically coupled to the primary part, the outgoing cable direction must be different. Otherwise invert the actual value!
3. Zeiss measuring systems (e.g. LIE 5)

**Note**
The positive count direction of the Zeiss linear measuring system must be determined in exactly the same way as that of the RGH22B Renishaw system (see Fig. 6-37).

---

**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.

![Diagram](image-url)

Fig. 6-38 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.

![Diagram of parallel connection of linear motors (standard configurations)](image)

**Note:**

Same outgoing cable direction

- $\tau_M$: Pole pair width (see MD1 170)
- $n$: 0, 1, 2, ...

![Diagram of parallel connection of linear motors (Janus configuration, special type)](image)

**Janus configuration (special type of parallel connection)**

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

**Note:**

Different outgoing cable directions

- $\tau_M$: Pole pair width (see MD1 170), 1FN107x: $\tau_M = 28.2$ mm, 1FN11xx and 1FN12xx: $\tau_M = 36$ mm
- $n$: 0, 1, 2, ...
- xx: Constant dimensions (see data sheet of motor manufacturer)
Temperature sensors and electrical wiring (see Section 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. 6-41  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 inexplicable 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 1k ohm resistors.

![Arrangement for test measurements](image)

**Fig. 6-42** Arrangement for test measurements

The phase sequence must be U–V–W with a positive traversing direction. The direction of the drive is positive if the primary part moves in the opposite direction to the outgoing cable in relation to the secondary part.

![Determining the positive direction of the drive](image)

**Fig. 6-43** Determining the positive direction of the drive (CW rotating field)
After the oscilloscope has been connected, the drive must be made to cross the zero marker first in order to synchronize it.

**Fig. 6-44** Determining the commutation angle offset by measuring the EMF and normalized electrical rotor position via DAC in a positive drive direction.

Definition of channels (Ch1 ... Ch4):

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

With a synchronized drive, the difference between EMF/phase U and the electrical rotor position must not exceed \( \pm 10^\circ \).

If the difference is greater, the position of the zero marker must be moved in the software in MD 1016 “COMMUNTATION_ANGLE_OFFSET”.
6.11 AM / U/F function

Note

The AM / U/F function is described in

References: /FBA/, DE1, Extended Drive Functions
### 6.12 System settings for power up, RESET and part program start

#### Concept

The behavior of the control after

- Power up (POWER ON),
- Reset/part program end
- Part program start

can be changed with the machine data MD 20110: RESET_MODE_MASK (definition of the control initial setting after power up and reset) and

MD 20112: START_MODE_MASK (definition of the control initial setting after part program start).

#### Procedure

Select the required system behavior.

- After power up (POWER ON)

MD 20110: RESET_MODE_MASK, bit 0 = 0 or 1

---

<table>
<thead>
<tr>
<th>State</th>
<th>Variable with MD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power up (POWER ON)</td>
<td>RESET_MODE_MASK</td>
</tr>
<tr>
<td>RESET/part program end</td>
<td>RESET_MODE_MASK</td>
</tr>
<tr>
<td>Part program start</td>
<td>START_MODE_MASK and RESET_MODE_MASK</td>
</tr>
</tbody>
</table>

---

Fig. 6-45 System settings after power-up

- G codes acc. to MD 20150: GCODE_RESET_VALUES
- Tool length compensation not active
- Transformation not active
- No coupled-axis groupings active
- No tangential correction active
- Not project. Synchronous spindle coupling is deactivated
6.12 System settings for power up, RESET and part program start

- **RESET / part program end**
  
  MD 20110: RESET_MODE_MASK, bit 4–10 = 0 or 1
  
  Bits 4 to 10 can be combined in any way.

The current settings are retained. The following initial setting is activated on the next part program start:

- G codes acc. to MD 20150: GCODE_RESET_VALUES
- Tool length compensation not active
- Transformation not active
- No coupled-axis groupings active
- No tangential correction active

Depending on how they are set bits 4 to 10 affect:

- Current plane
- Frame currently set
- Active tool offset
- Active transformation
- Coupled-axis groupings
- Tangential correction
- Unconfigured synchronous spindle coupling

If synchronous spindle coupling is configured, the coupling is set depending on MD 21330: COUPLE_RESET_MODE_1.

Fig. 6-46 System settings after RESET/part program end
6 Assigning Parameters to the Control and the PLC Program

6.12 System settings for power up, RESET and part program start

- After part program start
  MD 20112: START_MODE_MASK, bit 4–10 = 0 or 1

  Bits 4 to 10 can be combined in any way.

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

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. 6-47 System settings after part program start

References:
/FB/ “K2”, Coordinate Systems: Workpiece-Related Actual-Value System
Notes
PLC Start-Up

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 64 KB that can be extended by 32 KB to a total of 96 KB (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.
The PLC basic program is an integral component of the SINUMERIK 810D tool box.

Set the "PLC memory" option if necessary.

There are two ways in which the completed PLC program can be loaded:

1. Load, test and edit the PLC program using SIMATIC STEP7 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-reten- tive 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 power-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
7.2 Overview of organization blocks, function blocks and DBs

Parameters of FB1

FB 1 (power-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.
# Alarm and Message Texts

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
<td>Alarm and message texts</td>
<td>8-186</td>
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<td>8.1.1</td>
<td>Alarm text files for MMC 100</td>
<td>8-186</td>
</tr>
<tr>
<td>8.1.2</td>
<td>Alarm text files for MMC 102/103</td>
<td>8-188</td>
</tr>
<tr>
<td>8.1.3</td>
<td>Alarm text files for HPU</td>
<td>8-190</td>
</tr>
<tr>
<td>8.1.4</td>
<td>Syntax for alarm text files</td>
<td>8-192</td>
</tr>
<tr>
<td>8.1.5</td>
<td>Alarm list characteristics</td>
<td>8-195</td>
</tr>
</tbody>
</table>
8.1 Alarm and message texts

8.1.1 Alarm text files for MMC 100

**Description**

The installation routine stored on the MMC100 application diskette (see Section 12) transfers:

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

from the update directory on your PC/PG to the MMC100 hardware. The ways in which the alarm text files can be adapted beforehand are described here.

**Preconditions**

- PC with DOS 6.x
- V.24 cable between the COM1 interface of the MMC100 (X6) and the COM1 or COM2 interface of your PC
- Approx. 3 MB free space on hard disk
- The following description is based on the assumption that you have already transferred the software from the supplied MMC100 application diskette (no. 2) of the hard disk of your PC/PG as described in Section 12.

**Alarm text files**

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:\mmc 100 pj\proj\text\<LANGUAGE DIRECTORY>.
```

Depending on the selected language, one of the following letters stands for `<LANGUAGE DIRECTORY>`:

- **D** for German
- **G** for English
- **F** for French
- **E** for Spanish
- **I** for Italian

**Files**

The alarm file names start with “a” and end in the extension .txt.

- **ALZ.TXT** Cycle alarm texts
- **ALC.TXT** Compile cycle alarm texts
- **ALP.TXT** PLC alarm/message texts
Editor

The DOS editor edit should be used to edit the files. The standard texts contained in the text files can be overwritten by user-specific texts. An ASCII editor, e.g. DOS editor, must be used for this purpose. New entries can be added to alarm text files.

Please refer to Section 8.1.4 for the applicable syntax rules.

More than one language

MMC100 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.

Conversion and transmission

After the text contents have been modified, the text files must be converted and transferred to the MMC (Section 12).

Note

128 KB are available to the user for additional text files.
8.1 Alarm and message texts

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\plc_
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\plc_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 MMC101/102/103 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:

<table>
<thead>
<tr>
<th>Language</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>German</td>
<td>gr</td>
</tr>
<tr>
<td>English</td>
<td>uk</td>
</tr>
<tr>
<td>French</td>
<td>fr</td>
</tr>
<tr>
<td>Italian</td>
<td>it</td>
</tr>
<tr>
<td>Spanish</td>
<td>sp</td>
</tr>
</tbody>
</table>

**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 you generate text files, make sure that the date and time of day on your PC are set correctly or else your texts may not be displayed!

**Example of MMC102/103**

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.

**Preconditions**

- PC with DOS 6.x
- V.24 cable between the COM1 interface of the HPU and the COM1 or COM2 interface of your PC
- Approx. 3 MB free space on hard disk
- The following description is based on the assumption that you have already transferred the software from the supplied system 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
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

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 next Section for the applicable syntax rules.

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

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.

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

<table>
<thead>
<tr>
<th>Number range</th>
<th>Designation</th>
<th>Effect</th>
<th>Clear</th>
</tr>
</thead>
<tbody>
<tr>
<td>60000 – 60999</td>
<td>Cycle alarms (Siemens)</td>
<td>Display, NC start disable</td>
<td>Reset</td>
</tr>
<tr>
<td>61000 – 61999</td>
<td>Display, NC start disable, axis/spindle standstill</td>
<td>Reset</td>
<td></td>
</tr>
<tr>
<td>62000 – 62999</td>
<td>Display</td>
<td>Cancel</td>
<td></td>
</tr>
<tr>
<td>63000 – 64999</td>
<td>Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65000 – 65999</td>
<td>Cycle alarms (user)</td>
<td>Display, NC start disable</td>
<td>Reset</td>
</tr>
<tr>
<td>66000 – 66999</td>
<td>Display, NC start disable, axis/spindle standstill</td>
<td>Reset</td>
<td></td>
</tr>
<tr>
<td>67000 – 67999</td>
<td>Display</td>
<td>Cancel</td>
<td></td>
</tr>
<tr>
<td>68000 – 69000</td>
<td>Reserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70000 – 79999</td>
<td>Compile cycle alarms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400000 – 499999</td>
<td>PLC alarms, general</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500000 – 599999</td>
<td>PLC alarms for channel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>600000 – 699999</td>
<td>PLC alarms for axis and spindle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>700000 – 799999</td>
<td>PLC alarms for user</td>
<td></td>
<td></td>
</tr>
<tr>
<td>800000 – 899999</td>
<td>PLC alarms for sequential controllers/graphs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Text file format for cycle alarm texts

The number range in the list is not available with every number (see References: /FB/ P3, “PLC basic program”, Lists)
The structure of the text file for cycle and compile cycle alarms is as follows:

Table 8-2 Structure of text file for cycle alarm texts

<table>
<thead>
<tr>
<th>Alarm number</th>
<th>Display</th>
<th>Help ID</th>
<th>Text or alarm number</th>
</tr>
</thead>
<tbody>
<tr>
<td>60100</td>
<td>1</td>
<td>0</td>
<td>“No D number %1 programmed”</td>
</tr>
<tr>
<td>60101</td>
<td>1</td>
<td>0</td>
<td>60100</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>65202</td>
<td>0</td>
<td>1</td>
<td>“Axis %2 in channel %1 is still moving”</td>
</tr>
</tbody>
</table>

// Alarm text file for cycles in German

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

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 8.1.5, HelpContext.

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

The ASCII file for PLC alarm texts is structured as follows:

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

<table>
<thead>
<tr>
<th>Alarm no.</th>
<th>Display</th>
<th>Help ID</th>
<th>Text</th>
<th>Text on MMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>510000</td>
<td>1</td>
<td>0</td>
<td>“Channel %K FDDIS all”</td>
<td>Channel 1 FDDIS all</td>
</tr>
<tr>
<td>600124</td>
<td>1</td>
<td>0</td>
<td>“Feed disable axis %A”</td>
<td>Feed disable axis 1</td>
</tr>
<tr>
<td>600224</td>
<td>1</td>
<td>0</td>
<td>600124</td>
<td>Feed disable axis 2</td>
</tr>
<tr>
<td>600324</td>
<td>1</td>
<td>0</td>
<td>600224</td>
<td>Feed disable axis 3</td>
</tr>
<tr>
<td>703210</td>
<td>1</td>
<td>1</td>
<td>“User text”</td>
<td>User text</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>703211</td>
<td>1</td>
<td>1</td>
<td>“User text%A ...”</td>
<td>User text Axis 1 ...</td>
</tr>
</tbody>
</table>

// Alarm text file for PLC alarms

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

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

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 8.1.5, HelpContext.
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>
<thead>
<tr>
<th>Section</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarms</td>
<td>General information about the alarm list (e.g. time/data format of the messages)</td>
</tr>
<tr>
<td>TextFiles</td>
<td>Path/file setting of the text lists for the alarms (e.g. MMC=..\dh\mb.dir\alm_&lt;signalling module in dir. mb&gt;)</td>
</tr>
<tr>
<td>HelpContext</td>
<td>Names and paths of the help files (e.g. File0=hlp\alarm_)</td>
</tr>
<tr>
<td>DEFAULTPRIO</td>
<td>Priorities of the various alarm types (e.g. POWERON=100)</td>
</tr>
<tr>
<td>PROTOCOL</td>
<td>Properties of the log (e.g. File=\proto.txt &lt;name and path of the logfile&gt;)</td>
</tr>
<tr>
<td>KEYS</td>
<td>Information about keys with which alarms can be cleared (e.g. Cancel+=F10 &lt;clears alarms with key combination Shift+F10&gt;)</td>
</tr>
</tbody>
</table>

You will find further details of file entries in:

“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
```
Axis and Spindle Dry Run

9.1 Preconditions

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.

### Axis enabling

Enables on the drive

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>112</td>
<td>setting-up mode</td>
</tr>
<tr>
<td>9</td>
<td>+24 V</td>
</tr>
<tr>
<td>63</td>
<td>Pulse enable</td>
</tr>
<tr>
<td>9</td>
<td>+24 V</td>
</tr>
<tr>
<td>64</td>
<td>drive enable signal</td>
</tr>
<tr>
<td>9</td>
<td>+24 V</td>
</tr>
<tr>
<td>48</td>
<td>DC link start</td>
</tr>
<tr>
<td>9</td>
<td>+24 V</td>
</tr>
</tbody>
</table>

Mains supply module

Drive module

### Enabling via PLC interface

The following signals must be made available at the PLC interface for axis or spindle:

- IS "Controller enable" (DB31–48, DBX2.1)
- IS "Pulse enable" (DB31–48, DBX1.7)
- IS "Position measuring system 1 or 2" (DB31–48, DBX1.5, DBX 1.6)

The following signals on the interface must **not** be set or else the axis/spindle motion will be disabled:

- IS "Feed/spindle override switch" (DB31–48, DBB0) not at 0%
- IS "Axis/spindle disable" (DB31–48, DBX1.3)
- IS "Follow-up mode" (DB31–48, DBX1.4)
- IS "Distance to go/spindle reset" (DB31–48, DBX2.2)
- IS "Feed stop/spindle stop" (DB31–48, DBX4.3)
- IS "Traverse key disable" (DB31–48, DBX4.4)
- IS "Ramp function generator disable" (DB31–48, DBX20.1)

### Limit switches

Setting of hardware limit switches and interface signal check:

- Hardware limit switch PLUS DB31 – 48.DBX12.1
- Hardware limit switch MINUS DB31 – 48.DBX12.0

References:

/PJ/, Planning Guide for SIMODRIVE 611–A/611–D

/FB/, A2, “Axis/Spindle Parking, Follow-Up, Enable Controller”
**9.2   Axis test run**

Select JOG mode and enable axis

Does the axis move?

yes

no

Traversing direction OK?

Check MD 32100: AX_MOTION_DIR

no

yes

Set path 10 mm

Is path evaluation OK?

Check MD 31000 – 31080 (encoder matching)

no

Check MD 31000 – 31080 (encoder matching)

yes

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 – 48)

- 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
1. Traverse with feedrate 1000 mm/min
2. Traverse in rapid mode

- Alarm?
  - yes: Interpret alarm and check machine data for velocity adaptation
  - no: Following error OK?
    - yes: End
    - no: Check
      - MD 32200 (Kv 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

- Alarm?
  - yes: Interpret alarm and check machine data for velocity adaptation
  - no: Traverse in rapid mode
9.3 Testing the spindle

Enable spindle (controller enable NC, enable on drive)

Define speed

Does the spindle rotate?

Rotational direction OK?

Specify speed 100 rpm

Actual speed = setpoint speed?

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 (DB31–48)
- 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 limitation 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?

Rotational direction OK?

Specify speed 100 rpm

Actual speed = setpoint speed?

Check MD 31000–31080 (encoder matching)
9.3 Testing the spindle

1. Change over gear stage
   - IS "Spindle in setpoint range" (DB31–48, DBX83.5)?
     - Yes
     - All gear stages tested?
       - Yes
       - End
       - No
     - No
     - Change over gear stage
     - IS "Position spindle?"
       - Yes
       - Position reached from high speed and zero speed?
         - Yes
         - Check machine data and interface signals
           - MD 35110–35140 Speeds for gear stages
           - MD 35150 Spindle speed tolerance
           - IS "Actual gear stage" (DB31–48, DBB16)
           - IS "Select drive parameter set" (DB31–48, DBB21)
           - IS "Setpoint gear stage" (DB31–48, DBB82)
           - IS "Active drive parameter set" (DB31–48, DBB93)
         - No
         - Check encoder matching
         - Check spindle synchronization (MD 34200)
       - No
       - All gear stages tested?
         - Yes
         - End
         - No

   - No
   - Change over gear stage

   - IS "Position reached from high speed and zero speed?"
     - Yes
     - Check machine data
       - MD 36000 Coarse exact stop
       - MD 36010 Fine exact stop
       - MD 32200 Kᵥ factor
       - MD 35210 Acceleration in position control range
       - MD 35300 Creep speed
       - MD 36300 Encoder limit frequency
     - Change over gear stage
     - IS "All gear stages tested?"
       - Yes
       - End
       - No
9.3 Testing the spindle

Notes

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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, version 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 4 MB of main memory (ideally 8 MB)
- 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 V 3.1x and higher

- Operating system MS–DOS® version 3.1 and higher
- WINDOWS® operator interface, software version 3.1 and higher

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).

Execution
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 baudrate (depending on interface used) in file S7CFGPGX.DAT in the MPI driver directory using an ASCII editor.
Input for interface: X101: 3 (≈ 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** softkey.
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/signal parameters
The test setpoints are adapted to the application in question by means of measurement or signal parameters, the units of which are determined by the relevant measuring function or operating mode. The measurement or signal parameter units are subject to the following conditions:

Table 10-1 Quantity and units for measurement or signal parameters

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Torque</td>
<td>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</td>
</tr>
</tbody>
</table>
| 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 ms                                                     |
| Frequency      | Specified in Hz                                                     |

Additional information
The default setting for all parameters is 0.

Functions which initiate a traversing motion are selected via the softkey menu; they are all actually started by means of the NC START key on the machine control panel. If the basic display for the function is deselected without the traversing motion being initiated, then the function selection is reset.

Once the traversing function has been started, the basic display can be deselected without any affect on the traversing motion.
10 Drive Optimization with Start-Up Tool

10.2 Measuring functions

---

**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 softkey 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 part program.
10.3 Interface signals Traverse request and Motion enable drive test

**Explanation**

Axes with a mechanical brake may need the brake to be activated in some cases. For this, select the option **Enable with PLC** in the basic display of the traverse function being used.

The request signal generated on selection of the measuring function **Traverse request drive test** (DB31.DBX61.0) and acknowledgement signal **Motion enable drive test** (DB31.DBX1.0) can be gated accordingly in the PLC user program.

This safety mechanism can be deselected via the “Enable without PLC” option.

**Additional information**

The traversing range monitoring function can be deactivated for axes with an endless traversing range.
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 softkey Display

Amplitude

This parameter determines the magnitude of the test signal amplitude (unit: peak torque specified in %). Values between 1% and 5% are suitable.
10 Drive Optimization with Start-Up Tool

10.5 Frequency response measurement

Bandwidth
Analyzed frequency range

- 4.0 kHz at 840D, double axis module (sampling rate 16.0 kHz).
- 0.8 kHz on the 840D (sampling rate 16.0 kHz).

Averaging operations
The accuracy of the measurement, but also the measurement time, are increased with this value. A value of 20 is normally suitable.

Settling time
This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of approximately 10 ms is recommended.

Additional information
The measuring parameters and the results of the measurement (diagrams) can be loaded and saved with softkey 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 softkey Display
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).

Alternatively, the interference frequency response can be recorded in order to assess how well the control suppresses interference.

Reference frequency response

Interference frequency response

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.
10.5 Frequency response measurement

**Bandwidth**
Analyzed frequency range
- 4.0 kHz on the 840D (sampling rate 8.0 kHz).

**Averaging operations**
The accuracy of the measurement, but also the measurement time, are increased with this value. A value of 20 is normally suitable.

**Settling time**
This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of between 0.2 s and 1 s 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 (as from SW 4.1)**
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 an
  - 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.
Additional information

The measuring parameters and the results of the measurement (diagrams) can be loaded and saved with softkey **File functions**.
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 softkey **Display**

![Fig. 10-4 Display diagram: Example of position control loop](image)

**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.

<table>
<thead>
<tr>
<th>Measurement parameters for reference frequency response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amplitude</strong></td>
</tr>
<tr>
<td>This parameter determines the magnitude of the test signal amplitude. It should be set to the smallest possible value (e.g. 0.01 mm).</td>
</tr>
<tr>
<td><strong>Offset</strong></td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td><strong>Bandwidth</strong></td>
</tr>
<tr>
<td>Setting of analyzed frequency range (maximum setting = half the position controller sampling frequency). The lower this value, the finer the frequency resolution and the longer the measurement time. The maximum value corresponds to half the position controller sampling rate (e.g. 200 kHz with position controller sampling time of 2.5 ms).</td>
</tr>
<tr>
<td><strong>Averaging operations</strong></td>
</tr>
<tr>
<td>The accuracy of the measurement, but also the measurement time, are increased with this value. A value of 20 is normally suitable.</td>
</tr>
<tr>
<td><strong>Settling time</strong></td>
</tr>
<tr>
<td>This value represents the delay between recording of the measured data and injection of the test setpoint and offset. A value of between 0.2 s and 1 s is recommended. Do not set too low a value for the settling times or the frequency response and phase diagrams will be distorted.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement parameters for setpoint step change and setpoint ramp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Setpoint step change and setpoint ramp</strong></td>
</tr>
<tr>
<td>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:</td>
</tr>
<tr>
<td>• Actual position value (active position measuring system)</td>
</tr>
<tr>
<td>• Control deviation (following error)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement parameters for setpoint step change and setpoint ramp</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amplitude</strong></td>
</tr>
<tr>
<td>This parameter determines the magnitude of the specified setpoint step change or ramp.</td>
</tr>
<tr>
<td><strong>Offset</strong></td>
</tr>
<tr>
<td>The step is stimulated from standstill or starting from the constant traverse speed set in this parameter.</td>
</tr>
<tr>
<td><strong>Measurement time</strong></td>
</tr>
<tr>
<td>This parameter determines the period of time to be recorded (maximum: 2048 position controller cycles).</td>
</tr>
<tr>
<td><strong>Settling time</strong></td>
</tr>
<tr>
<td>This value represents the delay between measured data recording and test setpoint output and the injection of the offset.</td>
</tr>
<tr>
<td><strong>Ramp duration</strong></td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>
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.

![Signal waveform with position setpoint / ramp measuring function](image)

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_ACCEL 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 Display softkey in the basic display of the measuring function.

![Display diagrams 1 and 2 of speed control loop](image)

Fig. 10-6 Display diagrams 1 and 2 of speed control loop

Softkeys
display 1,
display 2

These softkeys are used to switch backwards and forwards between the two single graphic displays and the screen output with both graphics.

Softkeys X marker and Y marker

When these softkeys are selected, a vertical or horizontal line, which marks the abscissa or ordinate, appears in the selected diagram. The associated coordinates are also output. The X marker or Y marker softkeys 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

**Softkey Expand**

To adapt the time scale, press softkey **Expand** which marks the current X marker position as the beginning of the range to be expanded. Then select softkey 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 softkey **Expand** again to return to the normal display. The Expand function is active only in the currently selected diagram.

**Softkey X Lin/Log**

With softkey **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 softkey **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 later)

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 individually.

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 2 axes. This corresponds to the previous measuring function for 2 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
10.8 Trace function (SW 4.2 and higher)

Note
The trace function can be used only with MMC 102/103 or the start-up tool.

10.8.1 Description

Servo trace function with graphic user interface for checking and monitoring drive/servo signals and states. You can select measuring signals and set the measuring parameters with softkeys and dropdown lists. The function is operated using the mouse or keyboard.

Function overview

Individual functions of the trace function

- 4 trace buffers with up to 2048 values each
- Selection of SERVO and 611D signals (in position control cycle)
- 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 each trace.
- Marker function selectable for each trace. Expand function in the time axis.
- Selective loading and saving of the measuring parameters and traces.
10.8.2  Operation, basic display

The cursor is controlled using the arrow keys on the operator panel or with the mouse.

If the cursor is placed on a list box, press the insert key to open the list box.

You page in the list using the arrow keys.

You accept a value using the input key.

Fig. 10-8  Cursor control

Basic display
Servo trace

You can access the basic display of the trace function with the softkeys Drives/servo \ Servo trace.

Fig. 10-9  Basic display of servo trace
10.8.3 Parameterization

In the basic display you can select:

- 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

The cursor must be positioned on the "Axis/spindle name" list box of the trace concerned. You can select it with the softkeys Axis+ and Axis– or by accepting a value from the dropdown list.

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.
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 ≥ 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 softkey Start (all traces are started in synchronism).
- Positive edge
- Negative edge

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.

Softkeys
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.

Softkeys
Start
With the Start softkey, trace function recording is started.

Softkeys
Stop
With the Stop or RESET softkey, you can cancel a running measurement.
Physical address softkey

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 softkey 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.

---

![Input screen form for parameterization of the physical address](image)

Fig. 10-10  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 softkey, this hex value is then entered in the field “Threshold” of the basic servo trace display.
10.8.4 Performing measurement

Start measurement After parameterization, measurement is started by operating the softkey 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 softkey Stop. Interrupted measurement cannot be displayed (softkey display).
### 10.8.5 Display function

After measurement, you can display the result in graphical form. By pressing horizontal softkey Display Fig. 10-11 is displayed. The measured traces are displayed as a diagram.

Graph1 shows trace 1 and trace 2, graph2 shows trace 3 and trace 4.

**Softkeys**

**X 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.

**Y marker**

**Softkey Expand**

Extension function for the X coordinate. The X marker must be activated.

The first time you operate the softkey Expand, a second X marker is displayed. The first X marker remains fixed at the current position. The second marker can be moved using the cursor keys.

If you press the softkey Expand again, the range between the markers is expanded. In that way, you can expand the section.

**Softkey Scale...**

After selection of this softkey, Fig. 10-12, Y axis scaling, appears on the screen. You can scale the relevant traces in this display.
Graph parameterization

Scaling field
On the “Scaling” field, you can select between automatic and manual (fixed) scaling using the toggle key.

Y max
For every trace you can enter the scaling in the input fields Y max and Y min.

Y min
You can only select the input fields if the type of scaling is “fixed”.

Markers field
In the “Markers” field, you can assign the marker to the appropriate traces with the toggle key.

In Graph 1, you can select the marker for trace 1 or trace 2, and in Graph 2, for trace 3 or trace 4.

Softkeys

Graph1...

Graph2...

With the softkeys Graph1 or Graph2, you can display either graphs as a large single display. You can switch back with the vertical softkeys Graph1 + Graph2.

Softkey Print graph
With the softkey Print graph, you can print the displays (Graph1/Graph2 or Single displays) on the printer selected in the printer setup.
10.8.6 File function

**Description**

With the File functions softkeys you can switch to the display “File functions”.

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.

![File function servo trace](image)

**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.

**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
10.8.7 Print graph

**Printer setting**

You can access the basic display for printer selection (Fig. 10-14) with softkeys MMC \ Printer selection.

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 softkey **Print graph**.

![Fig. 10-14 Basic display of the printer selection](image)

**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 softkey **Print graph** 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** softkey in the display called “Display”, the screen form for assigning a file name is displayed (Fig. 10-15). In the drop-down list, you can enter a new file name or an existing file name for overwriting.
In the “File name” box, you can select an existing file from the dropdown list or enter one in the text field underneath.

In the “Directory” box, 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).

With the softkey OK, the file is saved.

With the softkey Cancel you can return to the current graphic display.
10.9  Analog output (DAC)

Note
A description of the DAC function is to be found in
Reference /FBA/, DD1, Diagnostic Functions
10.10 Automatic controller setting (only MMC 103, 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” softkey.

**a) Normal case**

In the extended menu tree, press the “Auto. ctrl setting” softkey. The “Automatic controller adjustment” basic display appears.

![Automatic controller setting basic display](image)

Fig. 10-16  “Automatic controller setting” basic display
10.10 Automatic controller setting (only MMC 103, SW 4.3 and higher)

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” softkey.
3. Follow the interactive instructions (see flow chart below, boxes shaded gray).
4. When prompted, press the “OK” softkey.
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–” softkeys 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 softkeys

“Axis+” softkey:
Selects the next axis to be optimized.

“Axis–” softkey:
Selects the previous axis to be optimized.

“Direct selection” softkey:
Allows direct selection of the axis to be optimized in a dialog window.

“Start” softkey:
Starts the automatic controller setting for the selected axis.

“Stop” softkey:
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.
10.10 Automatic controller setting (only MMC 103, SW 4.3 and higher)

Start mech. measurement part 2?

SK “Parameter” → Enter measur. parameters

SK “OK”

Confirm NC Start prompt
Caution: When you activate NC Start, the axis starts to move!

Start measurement of current control loop?

SK “Parameter” → Enter measur. parameters

SK “OK”

Confirm NC Start prompt
Caution: When you activate NC Start, the axis is operated in current control mode!
2

Start calculation of controller data?

SK "Parameter gain adjustment"

Enter parameters for determination of optimum gain

SK "Cancel" (discard changes)

SK "OK" (accept values)

SK "Parameter T. adjustment"

Enter parameters for determination of optimum reset time

SK "Cancel" (discard changes)

SK "OK" (accept values)

SK "OK"

Please wait.... controller data being calculated.

3
Do you want to save boot file for drive X and display modified controller data?

- **SK “Yes”**
  - Boot file is saved
  - Start measurement of speed controller?
    - **SK “Parameter”**
      - Enter measur. parameters
    - **SK “OK”**
      - Confirm NC Start prompt
        - Caution: When you activate NC Start, the axis starts to move!
      - End
    - **SK “Cancel”**
      - (discard changes)
    - **SK “OK”**
      - (accept values)
- **SK “No”**
  - Boot file is not saved
10.10 Automatic controller setting (only MMC 103, SW 4.3 and higher)

10.10.2 Input options for self-optimization

Mechanical system measurement

![Automatic controller setting](image1)

**Fig. 10-17  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

![Automatic controller setting](image2)

**Fig. 10-18  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

**Limit values for controller setting**

<table>
<thead>
<tr>
<th>Current setpoint filter</th>
<th>Frequency from when filtering permitted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10.0 Hz</td>
</tr>
</tbody>
</table>

**Limit values for proportional gain**

- Min. amplitude: 0.5 dB
- Max. amplitude: 3.0 dB

Fig. 10-19  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

**Limit values for controller setting**

| Current setpoint filter | Frequency from when filtering permitted | 100.0 Hz |

**Limit values for reset time**

<table>
<thead>
<tr>
<th>Min. amplitude</th>
<th>1.0 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. amplitude</td>
<td>120.0 Hz</td>
</tr>
</tbody>
</table>

Fig. 10-20  Determination of the reset time

**Frequency at 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

**Automatic controller setting**

<table>
<thead>
<tr>
<th>Meas. parameters for speed control loop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplitude: 40 mm/min</td>
</tr>
<tr>
<td>Bandwidth: 2000 Hz</td>
</tr>
<tr>
<td>Averaging: 15</td>
</tr>
<tr>
<td>Offset: 100 mm/min</td>
</tr>
</tbody>
</table>

Fig. 10-21  Measurement of speed control loop

**Amplitude:**
Entered in mm/min of the load speed (should not be more than 50% of the offset).
10.10 Automatic controller setting (only MMC 103, SW 4.3 and higher)

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).
Notes
Data Backup

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 settings
2. Saving data for PLC
3. Saving data for MMC when MMC 101/102/103 is installed
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 with the same software version, for example, operating on the same machine type. This type of file cannot be modified externally using an ASCII editor. Series start-up files contain all relevant settings (except for compensation data). 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**
   - **Up to SW 3.x**
     
     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 (up to SW 3.x).

PLC data and – with MMC101/102/103 installed – 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
- V24 cable 6FX2002–1AA01–0BF0

**References:** `/Z/ Catalog NC Z (Accessories)`

- PG 740 (or higher) or PC (DOS)

### Format of the file name

<table>
<thead>
<tr>
<th>N</th>
<th>Area</th>
<th>Unit</th>
<th>Type</th>
</tr>
</thead>
</table>

- 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.
11 Data Backup

11.1 General information

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
11.2 Data backup via MMC 100

You can back up data via the V.24 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 (softkey "Data In", "Data Out" and "Data Selection")

These texts are part of the operator panel system software. They must be re-loaded 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.

1. Connect the PG/PC to interface X6 on the MMC.
2. in “Services” operating area on the MMC.
4. Select “Settings” and check or enter the parameter settings of the V.24 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.

Sequence of operations (data backup)
### 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 V.24 interface.

<table>
<thead>
<tr>
<th>11210</th>
<th>UPLOAD_MD_CHANGES ONLY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MD number</strong></td>
<td>Save only modified MDs</td>
</tr>
<tr>
<td>Default setting: 0</td>
<td>Min. input limit: 0</td>
</tr>
<tr>
<td>Changes effective: immediately</td>
<td>Protection level: 2/4</td>
</tr>
<tr>
<td>Data type: BYTE</td>
<td>Applies from SW version: 1 or 4</td>
</tr>
<tr>
<td><strong>Meaning:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Up to SW 3.x</strong></td>
<td></td>
</tr>
<tr>
<td>Bit 0</td>
<td>Scope of the differential upload with TEA files (area-specific archiving)</td>
</tr>
<tr>
<td>0: All data are output</td>
<td>1: Only data which deviate from the standard are output (does not apply to INITIAL_INI)</td>
</tr>
<tr>
<td>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).</td>
<td></td>
</tr>
<tr>
<td><strong>SW 4 and higher</strong></td>
<td></td>
</tr>
<tr>
<td>Bit 1</td>
<td>Scope of the differential upload with INI files</td>
</tr>
<tr>
<td>0: All data are output</td>
<td>1: Only data which deviate from the standard are output (e.g. INITIAL_INI)</td>
</tr>
<tr>
<td>Bit 2</td>
<td>If an array element is changed</td>
</tr>
<tr>
<td>0: Complete array is output</td>
<td>1: Only modified elements of an array are output</td>
</tr>
<tr>
<td>Bit 3</td>
<td>R parameters (for INITIAL_INI only)</td>
</tr>
<tr>
<td>0: All R parameters are output</td>
<td>1: Only R parameters not equal to zero are output</td>
</tr>
<tr>
<td>Bit 4</td>
<td>Frames (for INITIAL_INI only)</td>
</tr>
<tr>
<td>0: All frames are output</td>
<td>1: Only frames not equal to zero are output</td>
</tr>
<tr>
<td>Bit 5</td>
<td>Tool data, cutting edge parameters (for INITIAL_INI only)</td>
</tr>
<tr>
<td>0: All tool data are output</td>
<td>1: Only tool data not equal to zero are output</td>
</tr>
</tbody>
</table>

#### 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 “Services”, 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 (softkey 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 except for drive data).
6. Start PCIN data transmission program (“Data In”) on PC/PG, specify file name.
7. Select data area to be output on MMC (MMC “Services” operating area, data output “Data Out”).
8. Select softkey “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 part programs/subroutines
- Standard and user cycles
- Definitions and macros

When the areas are output, the internal area identifier used in each case appears on the top line of the display.

9. Start reading out (softkey Start) and acknowledge any prompts on the operator panel.

---

**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”.

---
Series start-up

4. Select the MMC interface configuration “V24 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 softkey. 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 “V24 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 softkey. 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.
11 Data Backup

11.2 Data backup via MMC 100

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” softkey 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 (V24 PG/PC) correct?
- Has MD 32700, ENC_COMP_ENABLE been set to 0 before importing LEC data?
- Is MD11220 INI_FILE_MODE set to 1 or 2 (see Section 11.4.3)?

Table 11-1 Data in _N_INITIAL_INI file

<table>
<thead>
<tr>
<th>File _N_INITIAL_INI</th>
<th>Data not contained in file _N_INITIAL_INI</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Option data</td>
<td>• Drive machine data</td>
</tr>
<tr>
<td>• Machine data</td>
<td>• Compensation data</td>
</tr>
<tr>
<td>• Setting data</td>
<td>– Leadscrew error compensation</td>
</tr>
<tr>
<td>• Tool offsets</td>
<td>– Quadrant error compensation</td>
</tr>
<tr>
<td>• Zero offsets</td>
<td>– Sag compensation</td>
</tr>
<tr>
<td>• Global user data</td>
<td>• Display machine data</td>
</tr>
<tr>
<td>• Local user data</td>
<td>• Workpieces</td>
</tr>
<tr>
<td>• R parameters</td>
<td>• Global part programs</td>
</tr>
<tr>
<td></td>
<td>• Global subroutines</td>
</tr>
<tr>
<td></td>
<td>• User cycles</td>
</tr>
<tr>
<td></td>
<td>• Standard cycles</td>
</tr>
<tr>
<td></td>
<td>• Definitions and macros</td>
</tr>
</tbody>
</table>
11.3 Data backup via MMC 102/103

Via V.24

To archive or read in data via the V.24 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 (softkey “Data In”, “Data Out” and “Data Selection”)

**Note**

In SW 4.3 and higher, the maximum baud rate is 115200 baud.

Via MMC hard disk

You can redirect backup data to archive files on the MMC101/102/103 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 V.24 on the MMC 102/103

Hardware and software requirements
- PG740, PC
- V.24 cable
- PCIN (V4.2)

System overview

![System overview diagram]

Data in the system

<table>
<thead>
<tr>
<th>Drive data</th>
<th>NC data</th>
<th>PLC data</th>
<th>MMC data</th>
</tr>
</thead>
</table>

Where are the data stored?
The data are normally stored in the battery-backed RAM of the NC or PLC or on the MMC 102/103. You can store all data in specific directories on the hard disk of the MMC 102/103.

Settings of the V.24 interface
Only the archive format is permitted for certain data during data output via the V.24 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 V.24 interface must be selected for the data output.
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

![Basic display of the Services user area](image)

Output data

The operating sequence for data output via the V.24 interface applies to all data. Proceed as follows:

1. Position the cursor on the desired data
2. Press SK Data out
3. Press SK V24 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 V.24. You should only output data required for a new start-up. The streamer should be used to create a complete copy of all data.
11.3.2 Output of drive data via V.24 on MMC102/103

Drive data

The following types of drive data are used:

- Boot files (HSA.BOT)
- Boot files (VSA.BOT)
- Drive machine data (*.TEA)

<table>
<thead>
<tr>
<th>data</th>
<th>Directory</th>
<th>Name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boot file</td>
<td>Diagnosis\FDD data</td>
<td>VS1.BOT</td>
<td>Boot file for 1st axis</td>
</tr>
<tr>
<td>Boot file</td>
<td>Diagnosis\MSD data</td>
<td>HS1.BOT</td>
<td>Boot file for 1st spindle</td>
</tr>
<tr>
<td>Drive MD FDD</td>
<td>DIAGNOSIS\MachDat\FDD</td>
<td>*.TEA</td>
<td>Drive machine data file for FDD saved under IBN/MD/Function. A name must be allocated.</td>
</tr>
<tr>
<td>Drive MD MSD</td>
<td>DIAGNOSIS\MachDat\MSD</td>
<td>*.TEA</td>
<td>Drive machine data file for MSD saved under IBN/MD/Function. A name must be allocated.</td>
</tr>
</tbody>
</table>

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 V.24 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 V.24.

- DIAGNOSIS
  - MachDat\FDD
  - MachDat\MSD
11.3.3 Output of drive data via V.24 on the MMC102/103

NC data

NC data are all data stored in the SRAM of the NC (excluding the part 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](image-url)
11 Data Backup

### 11.3 Data backup via MMC 102/103

#### Format of the file header

The file header starts with "%.N" and ends with "_.INI". If you output the complete 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 V.24:

1. Output complete EEC data (all axes).
2. Axis-specific output of EEC data.

![Diagram]

To output all the data, position the cursor on Measuring system error compensation, 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 output is listed here once.
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 V24 softkey. 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)
- Part programs
- Definition data and macros
- Part 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 V.24, 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.
11 Data Backup
11.3 Data backup via MMC 102/103

11.3.4 PLC data output via V.24 on MMC102/103

PLC data

The PLC data must be saved in an archive file before this file can be output via V.24.

Procedure

1. Press the Series start-up softkey
2. Select only PLC
3. Press the Archive softkey
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. V.24 setting with archive format: Set binary format (PC format), close with ok.
8. Press V24 softkey and confirm with OK softkey; the PLC data are output.

11.3.5 Output of MMC data via V.24 on MMC102/103

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 MMC102/103. The data are stored in the directory Diagnosis\MachDat\OperatorPanel. 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 V24 softkey, 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 V.24.
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 102/103 are stored in the tool management 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... directory.

### 11.3.6 Output of the series start-up file via V.24 on MMC102/103

**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** softkey and define the data (MMC, NC, PLC) you want to save.
11.3 Data backup via MMC 102/103

Set the data selection

Press the vertical softkey **MMC data selection**. In this display, you define which directories are to be included in the series start-up file.

Create the archive file

When you have selected the data, press the **OK** softkey. The display changes and you can now press the **Archive** softkey 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 V.24. The V.24 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 MMC102/103 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 MMC102/103 with SW 4.4 and higher.

Norton Ghost®

The Norton Ghost® software allows the complete contents of an MMC102/103 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 MMC102/103 module.

For further information, visit the Internet site at "www.ghost.com".

MMC 102/103

The procedure for saving a complete MMC 102/103 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 power-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 GhostR (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).

Storage capacity requirements on PC/PG

Sufficient storage capacity must be available on the PC/PG hard disk for the backup 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/V.24/PLC port.

Booting from diskette

If the backup/restore is to be performed from a boot diskette, the boot sequence of the MMC 102/103 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 MMC102/103 with a software version lower than V4.4.

- For MMC102/103, 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 MMC102/103 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. 8 characters).
11.4 Back up hard disk via Norton Ghost® (SW 4.4 and higher)

**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, V.24, PC card).

2. Individual software components are installed/re-installed either via diskette or parallel interface (Interlink/ InterSrv). Problems associated with the BIOS update must be considered.

3. With MMC102/3 running BIOS Version 2.12 the error “Exception error (13)” can occur after a successful restore. Remedy: Switch the MMC102/103 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 > 233 MHz. 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.

**Functions of Norton Ghost®**

- 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 Interlink/ Intersrv)
- Support for different operating systems of the MMC102/103 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


11.4 Back up hard disk via Norton GhostR (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 on “start-up functions”.

Requirement: Set the password
1. Select the “Services” operating area
2. Press the “Series start-up” softkey
3. Press the “Select MMC data softkey
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 MMC102/103 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\MMC103)
       <4> Change restore image filename (set up complete path name for restore file “MMC.GHO” on MMC,
          e.g. D:\SINUBACK\MMC103\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.
11 Data Backup

11.4 Back up hard disk via Norton GhostR (SW 4.4 and higher)

* 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 =130 MB of a
540 MB hard disk via LPT.

11.4.4 Restore data to hard disk

- The Ghost program is installed on the MMC 103 and the programming device.
- The MMC103 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 power-up.

   - `<4>` Back to previous menu
       Return to main menu

8. After a successful restore, a reboot is performed automatically.
   Time required: approx. 15–20 minutes
   for the generation of a compressed disk image =130 MB of a
   540 MB 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 software version 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 V 5.2 and higher:

- Norton Ghost Version 5.1b (standard)
- Norton Ghost Version 6.01

The data format has been changed in Norton Ghost version 5.1c and later which means that earlier Norton Ghost versions, i.e. < V 5.1c, 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 software is transferred via the parallel interface LPT, it is not possible to mix the Norton Ghost software with old (< V 5.1c) and new (>V 5.1 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
11.6 Installing a replacement hard disk (SW 4.4 and higher)

MMC 103
The following section describes how to restore a data backup of a complete MMC 103 hard disk for the purpose of having all user and system data continually available during servicing.

Norton Ghost®
The “Norton Ghost®” software allows the complete contents of an MMC102/103 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 MMC103 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 MMC103 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.
11.6 Installing a replacement hard disk (SW 4.4 and higher)

**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 ≥ 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 =130 MB of a 540 MB hard disk via LPT.
11.7 Data backup with VALITEK streamer on the MMC101/102/103 (SW 5.3 and lower)

**What can you backup?**

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 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 power-up (after control has been switched on) while the message *Starting MS DOS is displayed:*

1. Press key 6 on the operator panel 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 MMC101/102/103 (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 MMC102/103 (Delete Files)
7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?

4. Press key 1

The following menu is displayed:

*** No Streamer configured ***

Please select (new) Streamer type:
1 Valitek PST–160
2 Valitek PST–M1200
3 Return to previous Menu

Your Choice [1,2,3]?

5. Select a streamer type, e.g. no. 2 Valitek PST–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 MMC102/103 (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 PST–M1200 ***

Press any key to continue ...

The test run then starts.
7. You can now, for example, perform a full data backup. To do this, select menu item 3, Backup System means hard disk C.

The following message appears on the screen:

```plaintext
*** 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.

The following message appears on the screen:

```plaintext
PLEASE SELECT:
1 Select VALITEK Streamer Type
2 Test Connection to Streamer
3 Backup System
4 Backup Userdata
5 Restore from Tape
6 Uninstall MMC102/103 (Delete Files)
7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]?4
```
The file must only be changed at the marked points. File BACK_USR.BAT looks like this:

```batch
~~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:

```plaintext
*** 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.

```plaintext
PLEASE SELECT:

  1 Select VALITEK Streamer Type
  2 Test Connection to Streamer
  3 Backup System
  4 Backup Userdata
  5 Restore from Tape
  6 Uninstall MMC102/103 (Delete Files)
  7 Return to Main Menu

Your Choice [1,2,3,4,5,6,7]? 5
```

The following message appears on the screen:

```plaintext
*** Current Configuration: Valitek PST2–M1200 ***

  Restoring from Tape ....

Continue?

Your Choice: [Y,N]? Y
```
Select Y to start the restore procedure of the inserted data backup.

10. With key 6 you can delete the MMC102/103 system including the data backup.

<table>
<thead>
<tr>
<th>PLEASE SELECT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Select VALITEK Streamer Type</td>
</tr>
<tr>
<td>2 Test Connection to Streamer</td>
</tr>
<tr>
<td>3 Backup System</td>
</tr>
<tr>
<td>4 Backup Userdata</td>
</tr>
<tr>
<td>5 Restore from Tape</td>
</tr>
<tr>
<td>6 <strong>Uninstall MMC102/103 (Delete Files)</strong></td>
</tr>
<tr>
<td>7 Return to Main Menu</td>
</tr>
</tbody>
</table>

Your Choice [1,2,3,4,5,6,7]?6

<table>
<thead>
<tr>
<th>Do You REALLY want to delete Your MMC102/103 System?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your Choice: [Y,N]?Y</td>
</tr>
</tbody>
</table>

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 (software version 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

<table>
<thead>
<tr>
<th>MD11230</th>
<th>Output</th>
<th>Example:</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>MD name</td>
<td>$MC_AXCONF_MACHAX_USED[0]=1</td>
</tr>
<tr>
<td>1</td>
<td>MD name with line checksum</td>
<td>$MC_AXCONF_MACHAX_USED[0]=1 '2F34</td>
</tr>
<tr>
<td>2</td>
<td>MD name and MD number</td>
<td>N20070$MC_AXCONF_MACHAX_USED[0]=1</td>
</tr>
<tr>
<td>3</td>
<td>MD name, MD number and line checksum</td>
<td>N20070$MC_AXCONF_MACHAX_USED[0]=1 '2F34</td>
</tr>
</tbody>
</table>
No write authorization is required to read in machine data files with valid line checksums.

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 (software version 3.2 and higher)

<table>
<thead>
<tr>
<th>MD 11220 value</th>
<th>Reaction to errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Output of an alarm, abort on detection of 1st error (as for SW version 1 and 2).</td>
</tr>
<tr>
<td>1</td>
<td>Output of an alarm, continuation of file import, alarm outputs number of errors at file end.</td>
</tr>
<tr>
<td>2</td>
<td>Import process continues to end of file even if errors are detected. Alarm outputs number of errors at file end.</td>
</tr>
</tbody>
</table>

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**

Das 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.

<table>
<thead>
<tr>
<th>MD file</th>
<th>Alarms</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHANDATA(1)</td>
<td></td>
</tr>
<tr>
<td>$MC_AXCONF_GEOX_NAME_TAB[0]=&quot;X&quot;</td>
<td></td>
</tr>
<tr>
<td>$MC_AXCONF_GEOX_NAME_TAB[1]=&quot;Y&quot;</td>
<td></td>
</tr>
<tr>
<td>$MC_AXCONF_GEOX_NAME_TAB[99]=&quot;A&quot;</td>
<td>15180 Program % cannot be processed as INI file</td>
</tr>
<tr>
<td>$MC_MM_REORG_LOG_FILE_MEM=1000</td>
<td>17020 Illegal array index 1</td>
</tr>
<tr>
<td>$MC_MM_REORG_LOG_FILE_MEM[1]=100</td>
<td>17090 Value greater than upper limit</td>
</tr>
<tr>
<td>$MC_MM_REORG_LOG_FILE_MEM[1]=&quot;X&quot;</td>
<td>12400 Element does not exist</td>
</tr>
<tr>
<td>$MC_MM_REORG_LOG_FILE_MEM[99]=&quot;A&quot;</td>
<td>12400 Element does not exist</td>
</tr>
<tr>
<td>$MN_UNKNOWN_MD=1</td>
<td>12550 Name % not defined</td>
</tr>
<tr>
<td>M17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15185 % Error detected in INI file</td>
</tr>
</tbody>
</table>
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 PLC–STOP (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 PLC–RUN (PLC switch S4 to position 0)

This sequence of operations produces an original image of the project in the data backup.

Instantaneous image of PLC–CPU

As an alternative to the above, the PLC can be switched from PLC–RUN to PLC–STOP:
1. Switch PLC to PLC–STOP (PLC switch S4 to position 2)
2. Archive the PLC data
3. Switch the PLC to PLC–RUN (PLC switch S4 to position 0)

This sequence of operations produces an instantaneous image of the PLC–CPU contents in the data backup.

Note

If the PLC data backup is performed during cyclic operation of the PLC (PLC–RUN), 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.
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.
12.2 Upgrading the MMC 100/100.2/101 software

Medium supplied

The MMC100/101 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 100/100.2/101 MDs
   - Configuration file for several operator panels
   - User software

Floppy disk set 1

When you have loaded floppy disk set 1, you have a functionally standard
MMC 100/100.2/101 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 MMC100 at any
given time).
- Make special MMC 100/100.2/101 MD settings
- Adapt configuration parameters for several operator panels/NCUs.
- Transfer user-defined screen forms for PLC status to
  MMC100/100.2/101

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 102/103 software version 4.x or earlier

This Section describes how to upgrade the software:

- on an MMC 102/103 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 102/103 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

As from SW Version 3.1 there are different menus that you can activate on system start-up for installing software and backing up on streamer.

While the MMC 101/102/103 is powering up and the message Starting MS DOS (SW 3.x and earlier) or Starting Windows 95 is displayed, press key 6.

For further information see

/IAM/ IM3, Start-Up Functions for MMC 103
### 12.4 Upgrading the NC

#### 12.4.1 Standard upgrade

<table>
<thead>
<tr>
<th>PCMCIA card name convention</th>
</tr>
</thead>
</table>

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 power-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.

**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 V.24 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/Part Programs]” in the FFS menu. The data are loaded onto the NC card.

**Note**
The start-up file created can be stored directly on the NC card in SW version 5.2 and later.
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" softkey.
   This softkey 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 softkey, 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 system 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 archive.
12.4.3 SINUCOPY–FFS (SW 4.4 and higher)

The SINUCOPY–FFS 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 SINUCOPY–FFS.

**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 4 MB)
  - CSM PCJB slots (only for cards up to 4 MB)
- The program will run under Windows 95. If CSM OMNI97 is used, it will also run under Windows NT.

**Functions**

SINUCOPY–FFS can manipulate the FFS area of the NC card using the following functions, independent of the SINUMERIK system software (NC):

- Read
- Modify
- Write new data
- Reformat
- Create new directories
- Copy a file into the directories and subdirectories
- Read and write system software
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 SINUCOPY-FFS
• 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
Please note that the details in the info field are gross figures. Approximately 8% should be subtracted for management 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.

Note
A card change is detected automatically. The contents of the card (FFS) are displayed.
12.4 Upgrading the NC

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 power-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 letter in the menu “System control/Device manager/Drives/OMNI97”.
   Windows NT: Enter the drive letter in the menu “OmniControl/DriveLetter”.

/C0083 Read archive files
/C0083 Delete/insert files
/C0083 Modify files (if editable)
This tool is intended for experts.
/C0083 Read and write data to NC cards
/C0083 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 power-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 letter 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.

**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.
12.5 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 MMC102/103. 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 3 years.

Replacement of battery/fan on NC–CPU
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).
12.6 Battery/fan replacement

Fig. 12-2 Battery/fan drawer

1) Battery
2) Red cable (+)
3) Latch
4) Fan

Battery

6FC5 247–0AA18–0AA0
The contents of this section are provided in
/IAM/ Start-Up Guide MMC, IM1 or IM3
Order No.: 6FC5 297–5AE20–0BP1.
The Start-Up Guide is divided into 5 volumes:

<table>
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<tr>
<th>Volume</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>IM1</td>
<td>Start-up functions for the MMC 100.2</td>
</tr>
<tr>
<td>IM3</td>
<td>Start-up functions for the MMC 103</td>
</tr>
<tr>
<td>HE1</td>
<td>Help in the editor</td>
</tr>
<tr>
<td>BE1</td>
<td>User interface add-ons</td>
</tr>
<tr>
<td>IM4</td>
<td>Start-up of HMI advanced</td>
</tr>
</tbody>
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SW 5.2 (08.99) and higher
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14.1 Tool box software package

14.1.1 Content of tool box

<table>
<thead>
<tr>
<th>Content</th>
<th>Supplied on 3.5&quot; diskettes with</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Basic PLC program</td>
</tr>
<tr>
<td></td>
<td>• NC variable selector</td>
</tr>
<tr>
<td></td>
<td>• Standard machine data blocks</td>
</tr>
<tr>
<td></td>
<td>• Read me file about the current 840D software version</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Software requirements</th>
<th>You will need the following software for the data transfer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• PCIN software program</td>
</tr>
<tr>
<td></td>
<td>• SIMATIC STEP7 HiGraph for PLC programs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hardware requirements</th>
<th>Programming device and cable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Programming device, e.g. PG740 or a PC</td>
</tr>
<tr>
<td></td>
<td>• Cable for V.24 PG/PC NC: 6FX2 002–1AA01–0BF0</td>
</tr>
<tr>
<td></td>
<td>• Cable for MPI bus: 6ES7 901–0BF00–0AA0</td>
</tr>
</tbody>
</table>

14.1.2 Application of the tool box

<table>
<thead>
<tr>
<th>Standard MD sets</th>
<th>Various sets of standard machine data are provided as examples.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• “Turning” technology (2 axes, 1 spindle)</td>
</tr>
<tr>
<td></td>
<td>• “Milling technology” (3 linear axes, 1 spindle, 1 rotary axis)</td>
</tr>
</tbody>
</table>
### 14.2 Machine data access via part program

**Data identifiers**

The machine data identifiers are displayed on the MMC. The internal designation of the data requires further identifiers which must be specified when a machine data is altered via programming measures or imported via the serial interface.

**Data areas**

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$MM_</td>
<td>Operator panel data</td>
</tr>
<tr>
<td>$MN_/SSN_</td>
<td>General machine data/setting data</td>
</tr>
<tr>
<td>$MC_/SSC_</td>
<td>Channel-specific machine data/setting data</td>
</tr>
<tr>
<td>$MA_/SSA_</td>
<td>Axis-specific machine data/setting data</td>
</tr>
<tr>
<td>$MD_</td>
<td>Drive machine data</td>
</tr>
</tbody>
</table>

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 speed 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 to 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 100 mm.
Assignment of channel-specific machine data:
CHANDATA(1)
SMC_CHAN_NAME="CHAN1"
SMC_AXCONF_GEOAX_NAME_TAB[1]="Y"
...
R10 = 33.75
...
CHANDATA(2)
SMC_CHAN_NAME="CHAN2"
...
R10 = 96.88
...
14 Miscellaneous
14.2 Machine data access via part program

Notes

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## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASCII</td>
<td>American standard code for information interchange</td>
</tr>
<tr>
<td>ASUB</td>
<td>Asynchronous subprogram (or subroutine)</td>
</tr>
<tr>
<td>BA</td>
<td>Operating mode</td>
</tr>
<tr>
<td>BAG</td>
<td>Mode group</td>
</tr>
<tr>
<td>BCD</td>
<td>Binary coded decimals</td>
</tr>
<tr>
<td>BOOTFILE</td>
<td>Boot files for SIMODRIVE 611D</td>
</tr>
<tr>
<td>BP</td>
<td>Basic program</td>
</tr>
<tr>
<td>CC</td>
<td>Compiler cycles</td>
</tr>
<tr>
<td>CCU</td>
<td>Compact control unit</td>
</tr>
<tr>
<td>COM</td>
<td>Communication</td>
</tr>
<tr>
<td>CPU</td>
<td>Central processing unit</td>
</tr>
<tr>
<td>CRC</td>
<td>Cutter radius compensation</td>
</tr>
<tr>
<td>CTS</td>
<td>Clear to send for serial interfaces</td>
</tr>
<tr>
<td>DAC</td>
<td>Digital analog converter</td>
</tr>
<tr>
<td>DB</td>
<td>Data module</td>
</tr>
<tr>
<td>DBB</td>
<td>Data block byte</td>
</tr>
<tr>
<td>DBX</td>
<td>Data block bit</td>
</tr>
<tr>
<td>DCE</td>
<td>Data communication equipment</td>
</tr>
<tr>
<td>DPR</td>
<td>Dual port RAM</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>DRAM</td>
<td>Dynamic random access memory</td>
</tr>
<tr>
<td>DRF</td>
<td>Differential resolver function (handwheel)</td>
</tr>
<tr>
<td>DRY</td>
<td>Dry run feedrate</td>
</tr>
<tr>
<td>DSR</td>
<td>Data send ready: message from serial data interfaces</td>
</tr>
<tr>
<td>DTE</td>
<td>Data terminal equipment</td>
</tr>
<tr>
<td>DW</td>
<td>Data word</td>
</tr>
<tr>
<td>EFP</td>
<td>Single I/O module (PLC I/O module)</td>
</tr>
<tr>
<td>EPROM</td>
<td>Fixed-program program memory</td>
</tr>
<tr>
<td>ETC</td>
<td>ETC key &gt; extension of softkey bar in the same menu</td>
</tr>
<tr>
<td>FC</td>
<td>Function call on the PLC</td>
</tr>
<tr>
<td>FDD</td>
<td>Feed drive</td>
</tr>
<tr>
<td>FEPROM</td>
<td>Flash EPROM: Readable and writable memory</td>
</tr>
<tr>
<td>FIFO</td>
<td>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.</td>
</tr>
<tr>
<td>FIPO</td>
<td>Fine interpolator</td>
</tr>
<tr>
<td>FST</td>
<td>Feed Stop (= feed hold)</td>
</tr>
<tr>
<td>GEO</td>
<td>Geometry</td>
</tr>
<tr>
<td>GND</td>
<td>Signal ground</td>
</tr>
<tr>
<td>HASH</td>
<td>Software procedure for mapping a large quantity of identifiers onto a finite memory area</td>
</tr>
<tr>
<td>HEX</td>
<td>Hexadecimal number</td>
</tr>
<tr>
<td>HHU</td>
<td>Hand-held unit</td>
</tr>
<tr>
<td>HW limit switch</td>
<td>Hardware limit switch</td>
</tr>
<tr>
<td>INC</td>
<td>Increment</td>
</tr>
<tr>
<td>INI</td>
<td>Initializing data</td>
</tr>
<tr>
<td>INTM</td>
<td>Internal multiplication</td>
</tr>
</tbody>
</table>
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS</td>
<td>Interface signal</td>
</tr>
<tr>
<td>ISO code</td>
<td>Special punchtape code, number of punched holes per character always even</td>
</tr>
<tr>
<td>JOG</td>
<td>Jogging: Setting-up mode</td>
</tr>
<tr>
<td>K1</td>
<td>Channel 1</td>
</tr>
<tr>
<td>K-BUS</td>
<td>Communications bus</td>
</tr>
<tr>
<td>K_u</td>
<td>Transmission ratio</td>
</tr>
<tr>
<td>K_v</td>
<td>Servo gain factor</td>
</tr>
<tr>
<td>LEC</td>
<td>Leadscrew error compensation</td>
</tr>
<tr>
<td>LED</td>
<td>Light emitting diode</td>
</tr>
<tr>
<td>LPFC</td>
<td>Low priority frequency channel</td>
</tr>
<tr>
<td>LSB</td>
<td>Least significant bit</td>
</tr>
<tr>
<td>MCP</td>
<td>Machine control panel</td>
</tr>
<tr>
<td>MD</td>
<td>Machine data</td>
</tr>
<tr>
<td>MDA</td>
<td>Manual data automatic</td>
</tr>
<tr>
<td>MMC</td>
<td>Human Machine Communication: User interface on SINUMERIK for operator control, programming and simulation.</td>
</tr>
<tr>
<td>MPF</td>
<td>Main program file: NC part program (main program)</td>
</tr>
<tr>
<td>MPI</td>
<td>Multipoint interface</td>
</tr>
<tr>
<td>MSD</td>
<td>Main spindle drive</td>
</tr>
<tr>
<td>NC</td>
<td>Numerical control</td>
</tr>
<tr>
<td>NCK</td>
<td>Numerical control kernel with block preparation, travel range etc.</td>
</tr>
<tr>
<td>NCU</td>
<td>Numerical control unit: NC module</td>
</tr>
<tr>
<td>NPFK</td>
<td>Low-priority frequency channel</td>
</tr>
<tr>
<td>OB</td>
<td>Organization block on PLC</td>
</tr>
<tr>
<td>OPI</td>
<td>Operator panel interface</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>P BUS</td>
<td>Peripheral bus</td>
</tr>
<tr>
<td>PCMCIA</td>
<td>Personal Computer Memory Card International Association</td>
</tr>
<tr>
<td>PG</td>
<td>Programming device</td>
</tr>
<tr>
<td>PLC</td>
<td>Programmable logic controller</td>
</tr>
<tr>
<td>PMS1</td>
<td>Position measuring system 1</td>
</tr>
<tr>
<td>PMS2</td>
<td>Position measuring system 2</td>
</tr>
<tr>
<td>PRT</td>
<td>Program test</td>
</tr>
<tr>
<td>RAM</td>
<td>Random access memory in which data can be read and written</td>
</tr>
<tr>
<td>ROV</td>
<td>Rapid override</td>
</tr>
<tr>
<td>RPA</td>
<td>R parameter active: Identifier for R parameters</td>
</tr>
<tr>
<td>RTS</td>
<td>Request to send (control signal on serial data interfaces)</td>
</tr>
<tr>
<td>SBL</td>
<td>Single block</td>
</tr>
<tr>
<td>SD</td>
<td>Setting data</td>
</tr>
<tr>
<td>SEA</td>
<td>Setting data active: Identifier for setting data</td>
</tr>
<tr>
<td>SK</td>
<td>Softkey</td>
</tr>
<tr>
<td>SKP</td>
<td>Skip block</td>
</tr>
<tr>
<td>SLM</td>
<td>Synchronous linear motor</td>
</tr>
<tr>
<td>SPF</td>
<td>Subprogram file: Subroutine</td>
</tr>
<tr>
<td>SRAM</td>
<td>Static RAM (non-volatile)</td>
</tr>
<tr>
<td>SW limit switch</td>
<td>Software limit switch</td>
</tr>
<tr>
<td>T</td>
<td>Tool</td>
</tr>
<tr>
<td>TC</td>
<td>Tool change</td>
</tr>
<tr>
<td>TEA</td>
<td>Testing data active: Identifier for machine data</td>
</tr>
<tr>
<td>TO</td>
<td>Tool offset</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>TOA</td>
<td>Tool offset active</td>
</tr>
<tr>
<td>TRC</td>
<td>Tool radius compensation</td>
</tr>
<tr>
<td>V24</td>
<td>RS-232-C, defines transmission of serial data between DTE and DCE devices</td>
</tr>
<tr>
<td>VDI</td>
<td>Interface between PLC and NC</td>
</tr>
<tr>
<td>ZO</td>
<td>Zero offset</td>
</tr>
<tr>
<td>ZOA</td>
<td>Zero offset active: Identifier (file type) for zero offset data</td>
</tr>
<tr>
<td>μC</td>
<td>Microcontroller</td>
</tr>
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</table>
References

General Documentation

/BU/
SINUMERIK 840D/810D/FM-NC
Ordering Information
Catalog NC 60.1
Order No.: E86060–K4460–A101–A6–7600

/ST7/
SIMATIC
SIMATIC S7 Programmable Logic Controllers
Catalog ST 70
Order No.: E86 060–K4670–A111–A3

/NS/
SINUMERIK 840D/810D/FM-NC
Technical Information
Catalog NC 60.2
Order No.: E86060–D4460–A201–A4–7600

/NW/
SINUMERIK 840D/810D/FM-NC
Brochure

/IZ/
SINUMERIK, SIROTEC, SIMODRIVE
Accessories and Equipment for Special-Purpose Machines
Catalog NC Z
Order No.: E86060–K4490–A001–A6–7600

Electronic Documentation

/CD6/
The SINUMERIK System
DOC ON CD
(includes all SINUMERIK 840D/810D/FM-NC and SIMODRIVE 611D publications)
Order No.: 6FC5 298–5CA00–0BG2
User Documentation

/AUE/
SINUMERIK 840D/810D/FM-NC
AutoTurn Graphic Programming System
Operator's Guide
Part 2: Setup
Order No.: 6FC5 298–4AA50–0BP2
(07.99 Edition)

/AUK/
SINUMERIK 840D/810D/FM-NC
Short Guide AutoTurn Operation
Order No.: 6FC5 298–4AA30–0BP2
(07.99 Edition)

/AUP/
SINUMERIK 840D/810D/FM-NC
AutoTurn Graphic Programming System
Operator's Guide
Part 1: Programming
Order No.: 6FC5 298–4AA40–0BP2
(07.99 Edition)

/BA/
SINUMERIK 840D/810D/FM-NC
Operator's Guide
Order No.: 6FC5 298–5AA00–0BP2
  – Operator's Guide
  – Operator's Guide Interactive Programming (MMC 102/103)
(04.00 Edition)

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Suggestions for improvement are also welcome.