SIEMENS

SIMODRIVE 611
Single-Axis Positioning Control MCU 172A

Description Edition 03.98

SIEMENS

SIMODRIVE 611

MCU 172A Single-Axis Positioning Control

Manual

Valid for MCU firmware
version 3.x or higher

Compatible to
MCU-PIT version 3.x or higher
SIMODRIVE software version V 3.x
and SIMATIC software V 2.x or higher

Edition: March 1998

SIEMENS

SIMODRIVE 611

Single-Axis Positioning Control MCU 172A

Foreword

Edition March 1998

Note:

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please enquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

1 Foreword

1.1 The Purpose of this Documentation

Range of validity

This Manual is valid for the MCU 172A Single-Axis Positioning Control in conjunction with firmware version V3.x.

Purpose of this Manual

This Manual covers nearly all standard applications of the MCU172A Single-Axis Positioning Control in conjunction with SIMODRIVE and SIMATIC. Information on special applications is to be found in the product-specific documentation on SIMODRIVE and SIMATIC S7.

Target group

This Manual is aimed at:

- the planning engineer when planning the system configuration
- the commissioning engineer when commissioning the system
- the serviceman when eliminating faults on the site.

Required background knowledge

If special knowledge is required for any part of this Documentation, it is mentioned in the beginning of the respective Chapter. The present Documentation on the MCU 172A Single-Axis Positioning Control is fully subjected to the general safety standards, the VDE standards, and the national guidelines and instructions.

1.2 Information Blocks of this Manual

Guide

Section 1.5 *Structure of this Manual* can be considered as a guide through this Manual. This Section will tell you in which chapter of this Manual you will find information on configuring, commissioning, scope of functions, operation & monitoring, and service.

Aids to orientation

The indexes of the individual Chapter, as well as the index of the entire Manual in the Appendix can be used for your orientation. A contents overview in the beginning of each Chapter provides you with information on the topics contained in the respective Chapter. In addition, each main chapter contains a table of contents.

Changes to the last edition

The structure of the Manual has been kept without changes. Compared with the last edition, the contents of the Manual has been added by the function extensions for version 4.x. This concerns the following pages:
Register 5 / pages 1-10
Register 7 / 1-4; 2-3; 3-11; 5-11
Register 8 / 4-13; 4-25; 5-2; 5-12
Register 9 / 5-11; 5-12; 5-15; 5-16; 6-10; 6-11 bis 6- 14; 6-17; 7-33 bis 7-39
Register 10 / 5-5
Register 11 / 4-19
Register 13 / 2-27
Register 14 / 4-8; 4-9; 4-16

1.3 Further Information

SIMODRIVE

For further information on SIMODRIVE refer to the SIMODRIVE-specific manuals. The titles and order numbers are to be found in the Documentation List in the Appendix.

SIMATIC S7

For further information on SIMATIC S7 refer to the SIMATIC S7-specific manuals. The titles and order numbers are to be found in the Documentation List in the Appendix.

Cross-references within the Manual

The cross-references to pages or chapters in this Manual are structured as shown in the following examples:

– 7/3.1 → Register 7, Section 3.1

– 9/5-5 → Register 9, page 5-5

– 4-10 → Page 4-10, in the same Register

Online helps

The Registers 7, 8, 9 and 13 of this Manual are supplied as HLP files with the software MCU-PIT. Fast access to the most important topics of this Manual is thus provided.

1.4 Safety and Danger Notes

Qualified Personnel

All persons engaged with the erection, installation, commissioning or operation of the product must be trained accordingly. In particular, the personnel must be familiar with all safety notes contained in this Manual. Siemens offers training courses providing the required knowledge.

Siemens products shall only be repaired by the SIEMENS Service Organization or workshops/service departments authorized by SIEMENS.

Use as prescribed

The product may only be used for applications prescribed by the Manual. Commissioning and operation of the product must be carried out in accordance with the instructions in this Manual. Any devices or components from other manufacturers may only be connected or installed if recommended or permitted by SIEMENS.

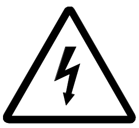
Warning symbols

In this document, important information is specially highlighted.

In order to classify any hazards more clearly, various pictograms have been used in this Manual, which represent different danger categories. The following contains a list of these pictograms with their meaning.

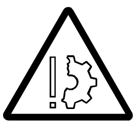
Prevent personal injuries!

This symbol warns you of possible danger to people. Follow the information shown next to the symbol. Inattention might cause personal injuries or loss of life.



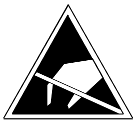
Hazardous electric voltage!

When operating electrical devices, the parts of these devices are necessarily under hazardous voltage. Touching these parts can endanger your life or health. Follow therefore the warning notes provided next to this symbol.



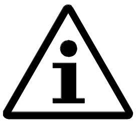
Prevent material damage!

This symbol warns you of possible damage to property or material. The information shown next to the symbol tells you how to avoid damage to your machine or the workpiece being machined..



Electrostatic sensitive device

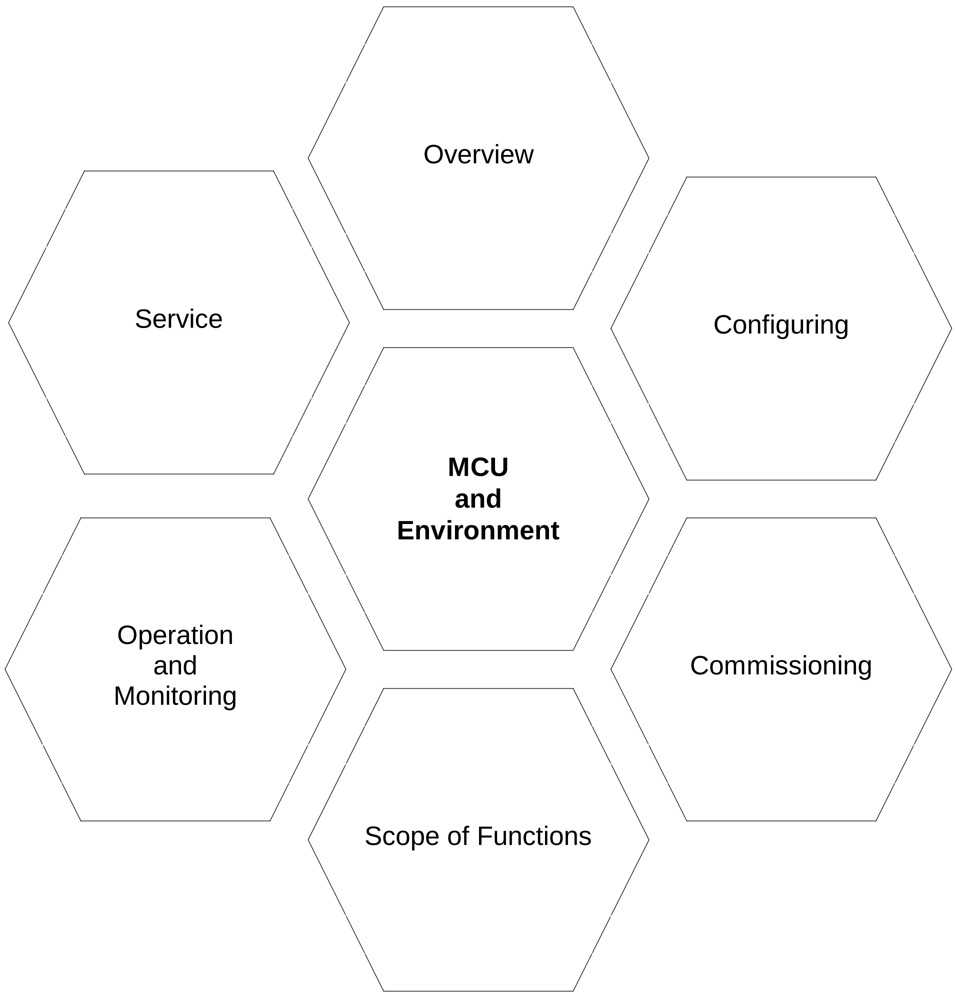
This symbol makes you aware of electronic modules which could be damaged by electrostatic discharging. Provide for equipotential bonding before you touch such a module.



Note:

This symbol draws your attention to an important topic which will help you to avoid any adverse effects to the production process.

1.5 Structure of this Manual



1.5.1 Overview

Register

2 9

General information

General information on:

- MCU modules
- MCU system elements
- Scope of functions, configuration, operation
- Fields of application

System network concept (networking)

Integration of the MCU 172 A via P/K-bus, MPI, PROFIBUS-DP e.g. with:

- SIMATIC S7
- SINUMERIK 810D / 840D
- Elements for operating and monitoring

1.5.2 Configuring

Register

General rules

Mechanical and electrical design 4 90

MCU module

- Firmly assigned inputs/outputs
- Inputs/outputs that can be assigned via the machine data 2 4 7 14
- Addressing 9
  - Module
  - Inputs/outputs
- Mechanical/electrical design
  - Power supply
  - Power dissipation, protective circuits, electrical isolation
- PLC resources, S7 user programs

Encoders

- Selection
  - Incremental encoder (5 V) 2 3
  - Absolute-value encoder
  - Cables

Motors

- 1FT6; 1FK6: three-phase a.c. motors for feed drives
- Cables 4

SIMODRIVE 611

- Power sections, modules 4
- Notes 14

Operating / monitoring / service devices

- PU/PC 10
- Operator panel PP031 11
- SINUMERIK UOP

EMC guidelines

- Mechanical and electrical design 12

Networking / interfaces	• PLC	11
	• MPI-network configuration / interface	10
	• PC user interface (MPI)	
	• Cables PU/PC - MCU (MPI)	
	• Interface modules IM360 / IM361	9
	• Lines MCU - MCU, MCU - S7	
	• Closed-loop control interface	4
Software	• STEP 7 on PU (see Catalog ST 70, User's Guide STEP 7)	
	• Features of the integrated S7 - CPU	9
	• MCU-PIT for :	8
	– Commissioning / optimization	
	– Data archiving	
	– Service (status display, HiGraph diagnosis screens)	
	– System documentation	
	– Editing of traversing programs etc.	
	• MSST	
	• MPI	10
	• SINUMERIK UOP (unit operator panel)	11
Grounding concept	• EMC	4, 12
	• Filter modules	
Catalogs	• MCU, operator panels, SIMODRIVE, cables, encoders	NC 60.1
	• Encoders, cables	NC Z, NC Z1
	• PU	ST 70
	• PROFIBUS-DP	ST 70, IK 10

1.5.3 Commissioning

		Register
Brief overview	Connection, commissioning, operation	2
Commissioning sequence	• Hardware, software • Optimization • System configuration • Communication / data transfer / operation	14
Hardware	• Preconditions • Assembly and connection – Rules, standards, etc. – Installation of pulse converter – Installation/ interfaces – Grounding – Interference elimination	8 4 10 11
Software installation	• Preconditions • STEP 7 • MCU-PIT	8 7
Parameterization / optimization by means of MCU-PIT	• Machine data – System configuration – Encoders – Closed-loop position control – Drive / axis – Interfaces	7 14 5
Data blocks	• to be created by means of MCU-PIT	
Operation and monitoring	• Unit operator panel (UOP) – OP 031 – UOP software	11
EMC guidelines	• Filters • Shielding	12
Error messages	• Positioning control • SIMODRIVE • Intelligent I/O blocks • Unit Operator Panel	13

Register

1.5.4 Scope of Functions

2

Overview

- Axis positioning
- SIMATIC S7

7

Firmware

- User interface
  – Control signals
  – Acknowledgment signals
  – Message signals
- Operating modes 14
- Closed-loop position control / motion functions
- Digital inputs/outputs / PLC functions 9
- SIMATIC S7

8

Software

MCU-PIT

- Start-up (parameterization) 5
  – Motor, encoder
  – SIMODRIVE-power unit / modules
  – Optimization
  – Frequency response
  – Machine data
- Service (status, hints)
- Current operating data
- Editing
  – NC programs
  – NC machine data
  – Tool offsets
- Control functions
  – Machine control panel
  – Drive / axis

1.5.5 Operation and Monitoring

Chapter

Hardware

- PU/PC
- Machine control panel PP 031
- Operator panel OP 031

2
11

Software / operation

- Unit Operator Panel (UOP)
  Ranges:
  – Machine
  – Tool offsets
  – Program
  – Axis selection
  – Alarms / messages
  – System

Software / PU / PC

8

- MS-DOS
- Microsoft Windows
- STEP 7
- Standard function blocks for technology functions (SIMATIC S7)
- MCU-PIT

1.5.6 Service

Register

Resources

- Hardware: PU
  PC
  Machine control panel OP 031
- Software: MS-DOS
  Microsoft Windows
  STEP 7
  MCU-PIT
  UOP (Unit Operator Panel)

8

Start-up

- Commissioning sequence
- LED on MCU

14

Alarm messages

- Displays
  - LEDs on MCU
  - Status displays (data, operator, traversing errors)
  - Encoders
  - SIMODRIVE 611
  - Positioning control
  - CPU
- Alarm code

7 9 8

Error messages

- Positioning control
- SIMODRIVE
- Intelligent I/O blocks
- Unit Operator Panel

13

Machine data

- Encoders
- SIMODRIVE 611
- Motor
- Positioning control
- Interfaces

14 5

Training courses

- Service and configuring course for MCU

2

Suggestion for a New Guideline for the Design of Safety Instructions

cc:

Mr. Brune	AUT E 211	Erl F80
Mr. Engeldinger	AUT 97	Nbg.-M
Mr. Kaiser	AUT 97	Nbg.-M
Mr. Stepper	AUT 97	Nbg.-M
Mr. Vorbeck	AUT GVA KA	Nbg.-M

As far as the design of the safety notes is concerned, I suggest to provide them with new pictograms. By now, only the general attention sign (DIN 30600, No. 1008) had been used. A graduation of the hazards had only been performed in accordance with the American classification (using the signal words CAUTION, WARNING and DANGER).
Using the new pictograms, the reader can immediately differentiate the kind of impending hazard - whether the health or life of persons are in danger or material property. Furthermore, special hazards, such as caused by electric shock, can immediately be recognized.
The aim of the new design is to draw the reader's attention more quickly to important safety notes to ensure that they are followed.

H. Pöppl, AUT 97

How to Design the Safety Notes

Contents

For legal reasons, the text of a safety note must contain the following three pieces of information:

- a note on the kind of the impending hazard
- an explanation on the consequences of the hazard
- an information how to avoid the hazard

Marking

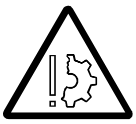
The safety notes are clearly marked both by pictograms and the signal words CAUTION, WARNING, and DANGER so that they can immediately be noticed (conspicuous marking is required according to DIN 8418 and DIN 66055). The pictograms are justified to the right in the marginalia column, and the related text is arranged on the right next to the pictogram. The signal words are bold typed above the text.

Pictograms

The safety notes are graduated by the kind and severity of the impending danger. The pictograms and signal words are selected according to this graduation.

For Europe, the following practical graduation has been proven:

The **Prevent personal damage** pictogram is intended to make you aware of possible hazards for your health and life.
Design acc. to DIN 11042.



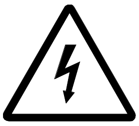
The **Prevent material damage** pictogram is intended to make you aware of the fact that material damage may result.
Design acc. to DIN 11042.

The **Information** pictogram is intended to make you aware of the fact that the normal operation can be affected (design acc. to SN 13390).
If any special notes are required, the warning triangle (acc. to DIN 4844) can contain an appropriate **standardized** symbol instead of the "i".

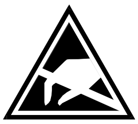
Further information on this graduation are to be found in the Tekom Guideline "Checking and Evaluating Technical Documentation" and in the Document Series "Safety at Work" issued by the Federal Institution for Safety at Work.

If any kind of hazard cannot be assigned unambiguously, the pictogram that warns of the greater hazard will be used. For example, if both material damage and personal injuries may occur, the pictogram "Prevent personal injuries" will be used.

When warning of a special hazard for which a standardized pictogram exists (e.g. acc. to DIN 4844), the standardized pictogram will be used, regardless of the above graduation. The following hazards will occur especially frequently:



The pictogram **Hazardous voltage** warns of components being under voltage.
Symbol acc. to DIN 4844.



The pictogram **Electrostatic sensitive devices** makes you aware of components which are sensitive to electrostatic charging.
Symbol acc. to DIN 30600.

Signal words

Additionally, a graduation as prescribed in the USA will be used:

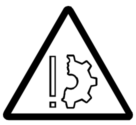
- **Danger**
  means that loss of life, severe personal injury or substantial property damage **will** result if proper precautions are not taken.
- **Warning**
  means that loss of life, severe personal injury or substantial property loss **can** result if proper precautions are not taken.
- **Caution**
  means that minor personal injury or property damage **can** result if proper precautions are not taken.

In accordance with this graduation, the signal word above the safety notes is selected. The signal words are necessary, as the major part of the products is also exported to the USA.

Instead of a signal word, notes will be headlined by the word **Note**.

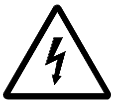
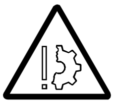
Example

A safety note should have the following appearance:



Warning
Skipping the hardware monitoring functions may result in positioning errors which may damage your machine. For this reason, the hardware monitoring functions should only be skipped for testing purposes.

Selection Table

Signal word / Picto-gram	**Danger**	**Warning**	**Caution**	**Note**
	Loss of life or severe personal injury **will** result if proper precautions are not taken.	Loss of life or severe personal injury **can** result if proper precautions are not taken.	Minor personal injury **can** result if proper precautions are not taken.	–
	Loss of life or severe personal injury **will** result due to **hazardous voltage** if proper precautions are not taken.	Loss of life or severe personal injury **can** result due to **hazardous voltage** if proper precautions are not taken.	Minor personal injury **can** result due to **hazardous voltage** if proper precautions are not taken.	–
	Substantial property damage **will** result if proper precautions are not taken.	Substantial property damage **can** result if proper precautions are not taken.	Minor property damage **can** occur if proper precautions are not taken.	–
	Substantial property loss **will** result due to **electrostatic discharging** if proper precautions are not taken.	Substantial property loss **can** result due to **electrostatic discharging** if proper precautions are not taken.	Minor property damage **can** result due to **electrostatic discharging** if proper precautions are not taken.	–
	–	–	To ensure safe and proper operation, the specified instructions, standards and documents must be followed.	Inattention to the respective note may affect normal operation of the process.

Qualified personnel

Previous documentation normally used the following text on this topic:

Persons who are familiar with the erection, installation, commissioning and operation of the product and have a qualification according to their job, i.e. persons who are

- qualified, instructed or permitted to switch on/off, ground and mark circuits and devices in accordance with the relevant safety standards.
- qualified or instructed in servicing and using appropriate safety equipment in accordance with the relevant safety standards.
- are trained in first aid.

This text is only meant as an example!
The text must absolutely be adapted to the requirements of the particular device. The required qualification must exactly be named and not only outlined by a general formulation.

SIEMENS

SIMODRIVE 611

Single-Axis Positioning Control MCU 172A

Description

Edition January 1997

Note:

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please inquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

BERO, SIMATIC, SIMODRIVE, SINEC, SINUMERIK, STEP are trademarks of Siemens.

The remaining names and designations used in this Documentation may also be trademarks, the use of which by any third parties for their own purposes may violate the rights of the copyright holders.

1 Introduction

Table of Contents

1.1 Structure of the manual

Guide

This description gives you a first insight into the structure and functionality of the MCU (Motion Control Unit). In addition this description will help you to decide how to use the MCU for your application. Please read this description, in order to get an idea of the technology of the MCU, before proceeding to the other chapters of this MCU manual.

The manual is structured by topic and contains all information you need for handling the MCU. You will find the answers to your questions in the respective chapters of this manual.

This description is part of the manual, but is also available as a separate leaflet. For the ordering data of further MCU documentation, please see the survey on the cover page of this leaflet.

Further information

You will find information further to that contained in this leaflet or manual, in the standard documentation on the following Siemens products:

- SIMATIC S7
- SINUMERIK 840D
- PROFIBUS-DP
- SIMATIC HMI
- SIMODRIVE 611
- 1FK6-motors
- 1FT6-motors

A list of the corresponding documentation is to be found in the appendix of this manual.

1.2 What is an MCU?

Single-axis positioning control

MCU ("Motion Control Unit") means "positioning control for one axis". The functionality of the MCU is accommodated in a slide-in module without a case of its own, provided for use in any power module of the SIMODRIVE 611 drive series . Through insertion of the MCU module the power module becomes a single-axis positioning control.

Fig. 1-1 The MCU as a slide-in module for the SIMODRIVE 611 power module

New and yet well proven

The Motion Control Unit is a new digital single-axis positioning control for decentralized applications in connection with SIMATIC S7 technology. Regarding the structures of the MCU, there is no directly comparable product in the SIMATIC S5 world. The MCU was developed using both proven positioning functions and new standards such as SIMATIC S7 and digital drive technology.

Concept

The MCU is innovative in several fields:

- Digital technology instead of analog technology:
  The MCU is a control module in digital technology with all advantages regarding capacity and comfort, such as simple and reproducible parameterization, higher precision and higher dynamics.
- SIMATIC S7 instead of the SIMATIC S5 generation:
  The MCU integrates consistent with the FM modules into the new SIMATIC S7 technology.
- Decentralized instead of central control:
  Thanks to the integration of PLC and positioning control into the drive, you can also install the MCU as a decentralized control, requiring little space.
- PLC S7-300 integrated:
  The Programmable Logic Controller (PLC) is already integrated in the MCU: The MCU contains in addition to the positioning functionality the complete PLC functionality of a SIMATIC S7-300-CPU.
- S7-periphery standard:
  The MCU contains an interface for the SIMATIC S7 periphery, enabling a large extension of the periphery.
- Communication integrated:
  The integrated MPI-interface does not only allow the connection of programming devices and operation and observation devices, but also a data exchange among several MCU's or PLC's via global data .
- Digital drive control integrated:
  The integrated speed and power control offers all advantages of the SIMODRIVE digital drive series, such as easy commissioning, high dynamics or transparent diagnostics, even of the drive.

Three in one

The MCU is the synthesis of three well-known standards in one unit:

- SIMATIC-CPU: functionality of the Programmable Logic Controller with S7-300-CPU
- Positioning functionality: functionality of an S7 peripheral module for closed-loop controlled positioning
- SIMODRIVE 611: digital drive control for standard motors type 1FK6 / 1FT6

Furthermore, the single-axis positioning control can be combined with communication, operation and diagnostics standards. Siemens offers you an innovative, comprehensive system solution.

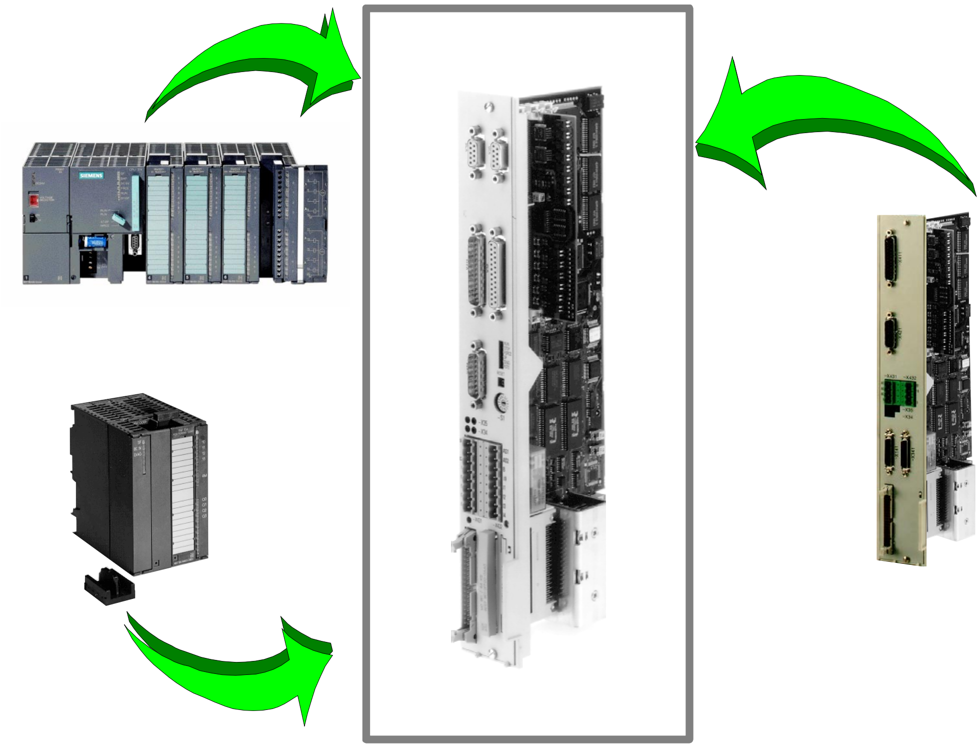


Fig. 1-2 Integration of SIMATIC S7, positioning and SIMODRIVE 611 control in the MCU

MCU in the SIMATIC S7 system world

In the Siemens system world of automation technology, the MCU covers the range of decentralized single-axis positioning applications. Depending on the job and the requirement profile, the solution route shows either a system solution with conventionel technology e. g. S7-300 and FM 354 or
- optically set-off a system solution with MCU and integrated SIMODRIVE technology.

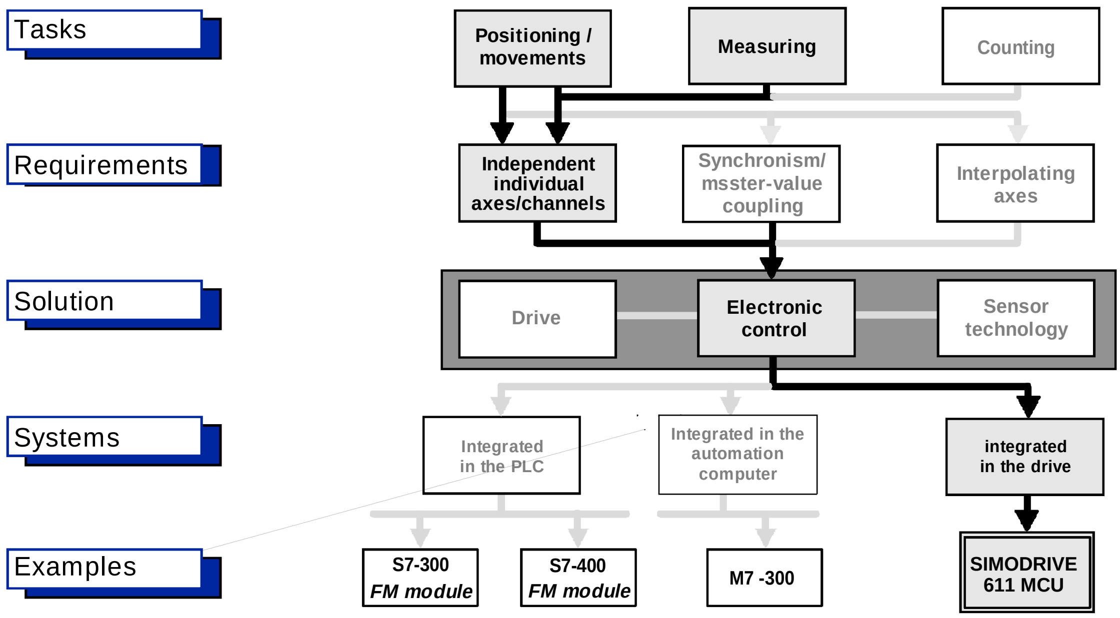


Fig. 1-3 Integration of the MCU in the system of the MCU

MCU in system soltions

In the modular system for transfer lines **Transline 2000,** the MCU is an integral component, together with the SIMATIC S7 and NC technology SINUMERIK 810D and 840D. This overall system Transline 2000 is based on a uniform concept regarding operation and observation, communication, control technique, periphery as well as motors and encoders.

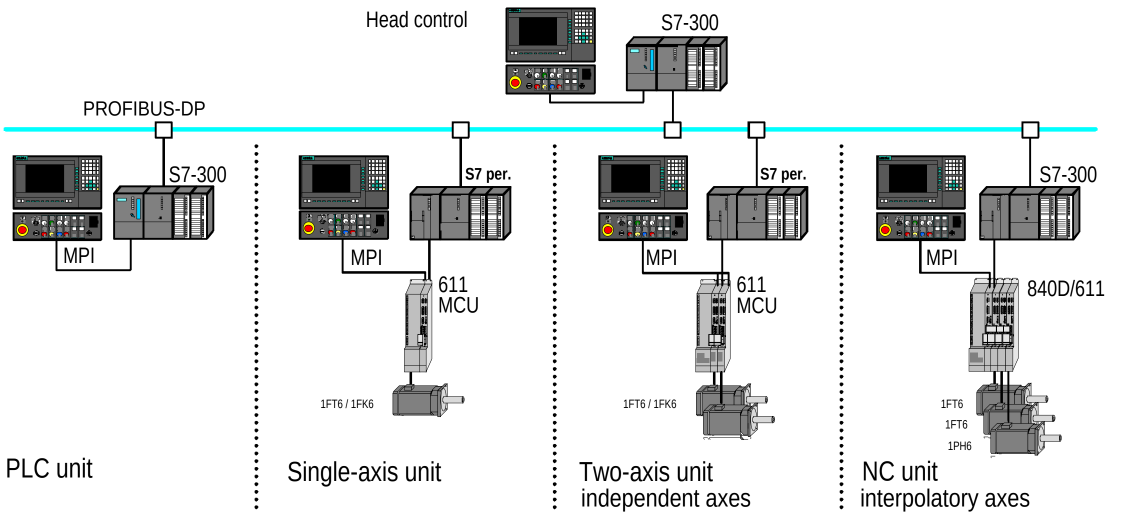


Fig. 1-4 Transline 2000

1.3 Application of the MCU

Decentralized control of individual axes decentralized control

The main field of application of the MCU is the decentralized control of independent individual axes.

The MCU is also well suited for tasks requiring PLC functions, in addition to positioning. The combination of drive and I/O components saves space and costs regarding structure and wiring.

Planning and commissioning of such a solution are simple and inexpensive.

Branch-specific examples of application

Table 1-1 Branch-specific examples of application

Examples of application	**Branch**
Dosing devices	Plastic moulding
Turning arrangements Roll feeds	Presses
Drilling units	Revolving machines
Feed motions	Grinding machines, special machines, welding/cutting, transfer lines, machine tools, rolling mills
Transport	Transfer lines, packaging industry, assembly lines, handling, automobile industry, printing trade, paper industry, rolling mills, special machines
Loading/unloading devices	Packaging industry, handling devices, revolving machines, plastics technology
NC auxiliary axes	Machine tools, wood working machines
Tool changers	Machine tools
Circular tables	Machine tools, revolving machines
Shelf-serving devices	Materials-handling technology

1.4 Advantages of the MCU

It saves costs and space

In addition to the positioning functionality, all instructions of a SIMATIC S7-300 CPU are available, so that no separate PLC and FM 354 positioning module are needed. Of course, the wiring of the functional unit is also reduced.

It minimizes the expenditure of time

With the completely digital concept, the system can be commissioned much more quickly than with analog technology. In addition, safe diagnostics up to the drive are possible, considerably improving the availability.

As exclusively standards are integrated in the MCU, the planning and training expenditure is greatly reduced. Thanks to the integration, interfaces, e.g. between control and drive, are omitted, wich saves planning and wiring expenditure.

It improves the dynamics

The digital technology enables higher accelerations, higher K_V factors, etc.

Through the commissioning functions integrated in MCU-PIT, the dynamics of the entire system can be optimized.

It increases the flexibility

The MCU can be plugged in any power module of the SIMODRIVE 611 series. Mains connection is effected at choice via an open-loop supply module or a controlled supply/re-supply module of the SIMODRIVE 611 device series.

Up to 3 MCU's can be operated on one power supply, per additional monitoring module, another 3 MCU's can be connected.

You can connect peripheral equipment via the S7 periphery bus. The MCU can be extended by 3 racks with 8 peripheral modules each from the S7 series.

It saves training

The available software packages MCU-PIT, STEP 7 and SIMOPRO are in the Windows standard, so that an intuitive and easy operation is offered.

As a SIMATIC S7 CPU is integrated in the MCU and as SIMATIC is very widespread, the operator will quickly be familiar with the system. Communication between the integrated S7-CPU and the positioning part is effected via the standard software "technology functions", which is based on the technology functions for FM modules from the S7-300 series.

The traversing programs are written in the NC language, similar to DIN 66025. This language is known in many branches of technology.

1.5 Terms of MCU

1 Axis

The MCU is a single-axis positioning control.

Operation

The MCU can be operated via visualisation systems, such as OP's with MPI interface. The user can either use standard displays or configure user-specific displays.

Decentralized

The MCU is particularly well suited for decentralized positioning tasks.

Rack

The hardware of the MCU is accommodated on a module which is plugged in any power module of the SIMODRIVE 611 drive series.

Global data

Via the service "Global Data", cyclical data are exchanged. In this way MCU's can easily communicate with each other in a standard manner.

Commissioning

Parameterization and commissioning are effected by means of the Windows tools "STEP 7" and "MCU-PIT". With the commissioning functions, it is possible to optimize the dynamics of the entire system.

Integration

On the MCU, the functionalities of the SIMATIC S7-314, of a positioning control and of the digital drive control of the SIMODRIVE 611 are integrated.

Periphery

The MCU single-axis positioning control possesses an integrated IM 360. to which up to 24 S7 peripheral modules can be connected.

Degree of protection

Alternatively to the structure of the SIMODRIVE components in protection IP20 the structure can also be protected according to IP65. The Protected Power Unit (PPU) contains a power supply module (6.5 kW) and a power module (50 A, 38 Nm) in a housing with protection IP65. In the PPU, both the MCU and the SINUMERIK 840D with corresponding feed control for one axis can be used.

Networking

The MCU possesses an integrated multipoint interface MPI through which it can be networked. The connection to the network with the PROFIBUS-DP is at present effected via the communication processor CP 342-5.

2 How to Use the MCU

Table of Contents

2.1 Required environmental conditions

Degree of protection The MCU can be plugged in all power modules of the SIMODRIVE 611 series. In this case, the structure attains the protection IP20. If you want to use the MCU as a standalone unit and the environmental conditions require an encapsulation of the entire control unit, you can also use the MCU in the Protected Power Unit (PPU)in protection IP65. For further details, please see catalog NC60.

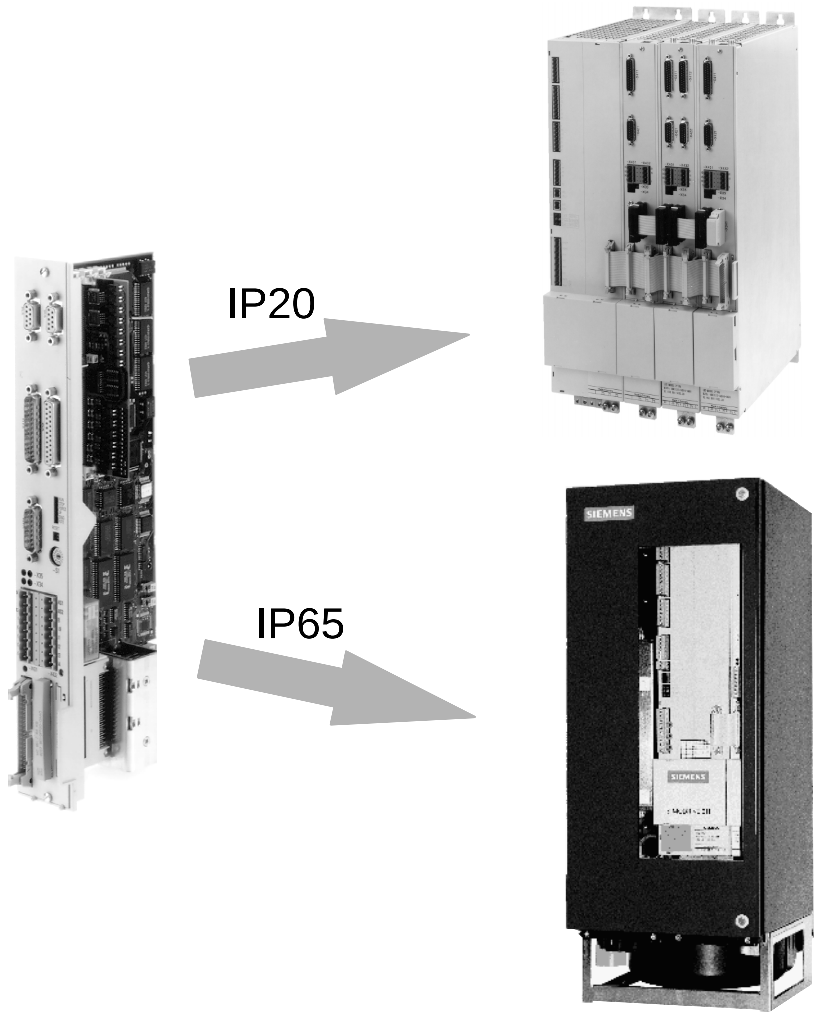


Fig. 2-1 MCU for use in IP20 and IP65

2.2 Necessary components

The following is a schematic representation of the entire system:

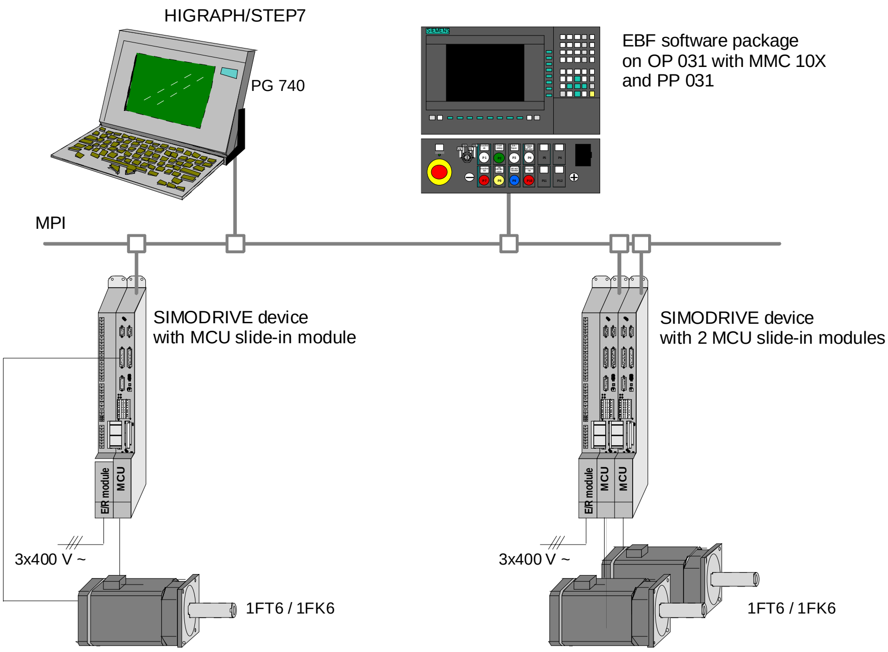


Fig. 2-2 Overall structure for one or two axes without periphery

Mains supply modules

The direct-voltage intermediate circuit is provided by the mains supply modules. These are offered as open-loop supplies for typical MCU applications with low power, or as closed-loop supply/re-supply modules. The latter resupply power into the mains during braking operation. This is useful in case of higher powers because a braking resistance converting kinetic energy into heat would generate much heat. Via the so-called device bus, the mains supply modules also guarantee the electronic power supplies of the MCU modules and the connected encoders.

SIMODRIVEpower module

The power module supplies the connected motor via the power line with closed-loop controlled sinusoidal current. The power module is selected via the MCU module. The range of SIMODRIVE 611 power modules are available graduated according to requirements.

The digital SIMODRIVE 611 drives fulfill high requirements regarding:

- Dynamics
- Speed adjustment range
- Concentricity

Motor

The MCU is designed for the motors of series 1FT6 and 1FK6. The 1FT6 and 1FK6 motors are synchronous motors excited by permanent magnets and distinguish themselves by high dynamics.

Motor encoder

The MCU slide-in module interprets the optical sine/cosine encoder installed in the 1FK6 or 1FT6 motor. The signals generated for rotor position, speed and position actual value are locally processed on the MCU module. The motor encoder, also called indirect encoder, is connected with the MCU via the encoder line.

Direct measuring system

In addition to the encoder, which is integrated in the motor, a second, direct position decoding system can be connected to the MCU. With it, the position actual value can be acquired directly on the mechanics, either incrementally or absolutely.

MPI

Operation is effected via the S7 standard MPI interface. By means of an MPI cable, the MCU is connected with the device for operation and observation and/or with the device for parameterization. One differentiates between devices serving for mere operation and devices with which parameterization and commissioning are also possible. Furthermore, a communication between several S7 CPU's is possible with the help of the MPI service "Global Data."

PG or PC with STEP 7 and MCU-PIT

Commissioning is effected by means of a portable programming device type PG 720 or PG 740. A standard PC, suitable for Windows and equipped with MPI card or MPI adaption cable, can also be used. After installation of the STEP 7 software, the axis can be commissioned by means of the software package "MCU-PIT".

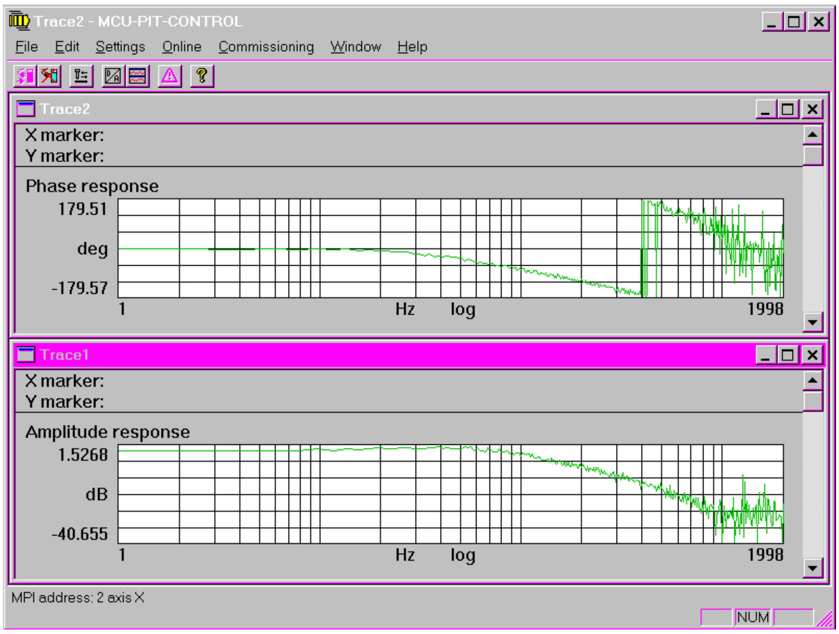


Fig. 2-3 Measuring functions with MCU-PIT

Operator Panels with MMC10x and EBF

Standard masks are available for the operator panels OP 031. The OP 031 is used together with a PC-based MMC100 or MMC102 computer in connection with the software application EBF (unit operator panel).

The EBF software can carry out, in addition to the visualization of an MCU module, other operation and observation tasks, such as:

- Machine operation with plant survey display
- HIGRAPH diagnostics

For the control of the machine, a standard machine control panel PP 031 Push Button Panel, adapted to the OP 031, can be connected via the MPI interface. The operating elements can be modified according to the customer's specific requirements.

OP5 ... OP45

As a SIMATIC S7 with CPU 314 functionality is integrated in the MCU, you can connect all OP's to the MCU for visualization. The OP's to the MCU for visualization. The OP's are configured via ProTool.

Filter modules

Pursuant to the law on EMC according to EN 50081-2, filter modules are available in the SIMODRIVE 611 system. In addition to the use of these filter modules, an essential prerequisite for keeping the limit values is a structure of the switchboard which is in compliance with the EMC rules. Please observe the assembly and connection instructions in the manual "assembly and connection".

2.3 Peripheral modules to be connected

Possible peripheral modules

Thanks to the integrated S7 interface module IM360 up to 24 S7 peripheral modules can be connected to an MCU, for example:

- FM 351 positioning module for rapid-motion/creep-speed drives
- FM 352 electronic cam controller
- SM 321 digital peripherals for inputs from DC 24 V to AC 230 V
- SM 322 digital peripherals for outputs from DC 24 V to AC 230 V
- SM 331 analog peripherals for inputs of e.g. 4 to 20 mA
- SM 332 analog peripherals for outputs of e.g. 0 to 10 V and 4 to 20 mA
- SM 334 analog peripherals for inputs/outputs from 0 to 10 V and 0 to 20 mA
- CP 342-5 communication processor for connection to the PROFIBUS-DP

2.4 How to connect the MCU

Expansion with peripheral units

To explain the connection possibilities, the figure shows the maximum periphery of an MCU:

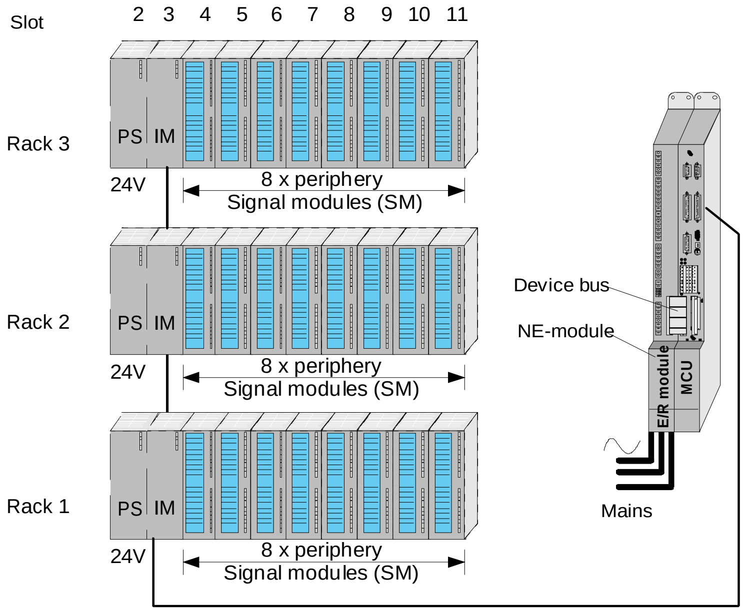


Fig. 2-4 Connection of peripheral units

Three racks with up to eight **S7 peripheral modules** can be connected. The modules are snapped onto the rails and connected with each other on the back by a jumper. This jumper provides for the internal power supply of the modules and for the communication between the CPU and the modules.

Each rack needs a 24 V supply, which is provided, for example, by the PS modules of the S7. The power supply of the MCU and the drive does not supply the peripheral modules.

In addition, each rack contains the IM361 interface module and to the right of it, the peripheral modules required for the individual application.

Front panel with connection possibilities

The following picture of the front panel of the MCU shows the further connection possibilities in detail:

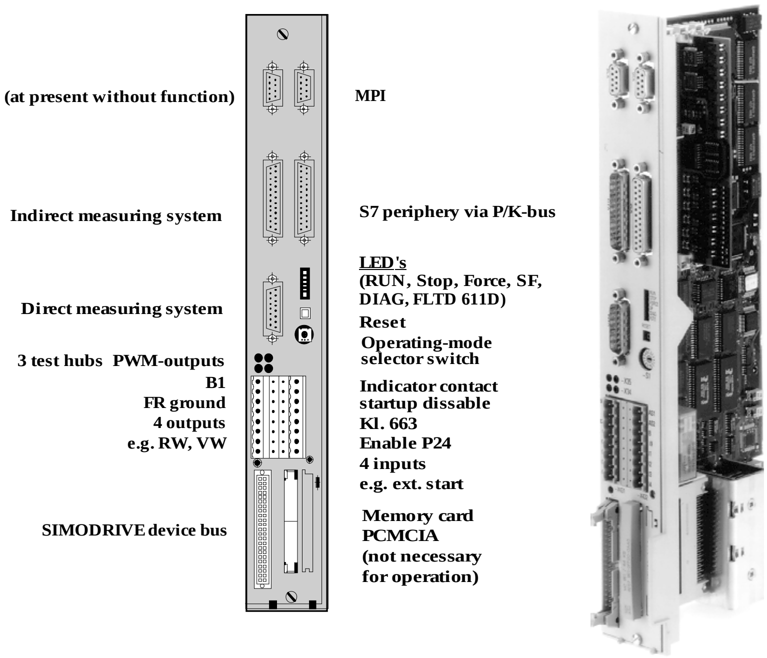


Fig. 2-5 Explanation of the connectors of the MCU

MPI

The MPI interface serves for the communication of the MCU with other users, such as:

- Programming device PG 740
- Operating panel OP 031
- S7-300 or further MCU's

The latter is possible with the MPI service "Global Data". This service enables a simple data exchange between 2 SIMATIC S7 CPU's, each S7 CPU being able to manage up to 4 GD areas.

Measuring system

The indirect measuring system is an encoder integrated in the motor. In addition, a direct encoder for position decoding can be connected.

S7-Periphery via P/K-bus

Connection of the S7 periphery via the integrated IM 360.

LEDs
Reset
Selector switch

The LED's display the status of the integrated S7 CPU, positioning and drive control. With the reset push-button, errors of the positioning control, such as operator , machine and data errors, can be acknowledged. With the mode selector switch you select the operating mode of the CPU, e.g. RUN, STOP. Do not confuse this with the operating modes of the positioning control, e.g. set-up, control.

Test hubs

The test hubs serve for recording measuring values, with which the (inherent) dynamics of the systems can be determined (see MCU function generator and DAU output in the "Description of functions, positioning with MCU").

Terminals

The terminal block serves for connecting enable functions or messages and of the 4 highspeed inputs and outputs, with which the MCU can externally be influenced, for example by an external start signal.

SIMODRIVE device bus

The device bus supplies the electronics with power.

PCMCIA

The PCMCIA memory card serves for updating the module software. The update is effected by means of a PCMCIA card. During operation, no PCMCIA card is needed.

2.5 How to commission the MCU

Required hardware

- Programmer PG720 or PG740 or
- PC suitable for Windows, with MPI card or MPI adaption cable

Required software

- STEP 7 (already installed in the PG)
- MCU-PIT consisting of:
  - PIT-EDIT for data creation and management
  - PIT-CONTROL for direct traversing of the axis via PG/PC
  - Standard function blocks “technology functions“

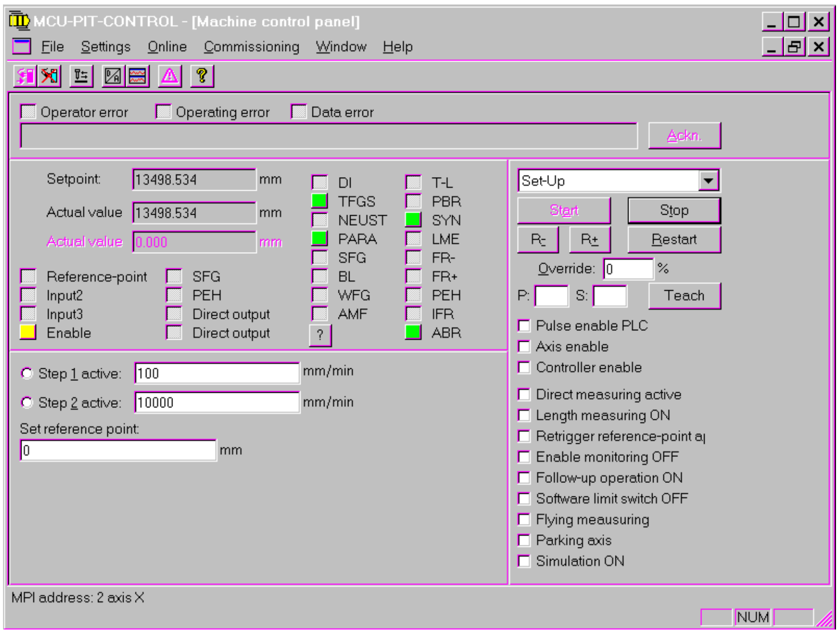


Fig. 2-6 Machine control panel of MCU-PIT

Configuration of the system

With STEP 7, you configure the system, e.g. rack location and MPI user number. In general, the default values can be accepted.

Create and transfer data blocks

With PIT-EDIT, the necessary data blocks can be created. The default values can be used. When inputting the drive machine data, it will normally be sufficient to input motor type and power module number. This can also be effected off-line, i.e. without a direct connection with the MCU via the MPI interface.

When editing in on-line operation, existing data can be read out from the MCU. When the MCU runs up, various data blocks are generated to which corresponding standard values are pre-assigned. Communication with the MCU is established via the MPI user number assigned in STEP 7. The data are transferred to the MCU with the PIT-EDIT software.

Traverse axis

The axis can be traversed directly via PIT-CONTROL, e.g.:

- via an NC program,
- with individual blocks,
- by a certain distance, in the incremental traversing operating mode,
- or in the set-up mode.

Measuring the dynamics of the entire system

It is in addition possible, but not necessary, to measure the dynamics of the entire system by means of the commissioning functions. For this purpose, move the system periodically, e.g. according to a square function, and measure the dynamic reaction of the system, e.g. oscillations or differences between nominal and actual values.

Optimizing controller parameters

The controller parameters can be optimized according to the measurement of the dynamics.

For a detailed description of these functions and the individual operating steps, please refer to the corresponding chapters of the documentation.

Data saving

The data on the MCU can be saved in the on-board FLASH EPROM:

- Data to the SIMATIC S7 with STEP 7 only in CPU stop
- Positioning data with PIT-EDIT
- Drive data with PIT-EDIT

2.6 How to operate the MCU

Once the system is parameterized, there are several possibilities of operation:

- Operation via PG/PC with the MCU-PIT software
- Operation via an operating device and supply of the SIMATIC part by means of the MCU technology block

You can also operate the MCU via an OP. This possibility is recommendable if you operate the MCU without PG/PC of if certain functions of the MCU-PIT software shall not be available to the operator. Corresponding standard masks are offered for OP 031 (EBF) and OP7/OP17.

NC traversing programs can in the standard version be input and loaded by means of PIT-EDIT. Programs are written in a way similar to DIN 66025.

3 Functions of the Positioning Part

Table of Contents

3.1 What does positioning mean?

Definition

Positioning means: Moving a load within a certain time to a defined position, taking into account all acting forces and moments.

Closed-loop controlled positioning means: Moving exactly to the programmed target position, with the correct velocity and acceleration and stopping the axis there, in spite of the influence of disturbance variables.

Survey of the positioning functions

The MCU can position feed and rotary axes. In addition, it offers the following structure/functionality:

- Control and acknowledgment signals
- Operating-mode control
- High-speed digital inputs/outputs
- Settings/functions valid for several operating modes
- Software limit switch
- Diagnostics and error messages

3.2 Control and acknowledgment signals

Communication between the internal S7 CPU and the internal positioning control is effected via the standard software "technology functions". The data interface between the S7 user program and the technology functions is located in the instance DB of the function block FB OP_MCU (see chapter 4.1).

All important control and acknowledgment signals are accessible. Control signals are, for example, start, stop, R+, R-, axis enable, etc. Acknowledgment signals indicate e.g. whether the axis is being traversed, which operating mode is set, etc. Other data, such as actual and nominal values and settings are also stored. Control is effected from the user program through access to these data.

3.3 Operating modes

Survey

Do not confuse the operating modes of the positioning part (set-up, control, ...) with the operating modes of the PLC (run, stop, ...)!
The operating modes of the positioning part, according to which you can traverse the axis, are as follows:

Table 3-1 Description of the operating modes

Operating modes	**Description**
Set-up The axis is in closed-loop position control	Traversing of the axis by means of the direction keys (R+ or R-) with the preset set-up velocity
Control The control loop is open	Traversing of the axis by means of the direction keys (R+ or R-) with the preset speed (in % of maximum speed)
Reference-point approach	Positioning of the axis by means of the direction keys (R+/R-) or the start key in a point defined by the machine data (reference-point coordinate MD16)
Incremental dimension	Traversing of the axis by a selectable amount by means of the direction keys (R+/R-) in the respective direction
Manual Data Input (MDI)	Positioning by means of individual traversing blocks, similar to DIN 66025
Automatic - following block	Positioning by means of individual traversing blocks, similar to DIN 66025
Automatic - individual block	Like automatic - following block, with the difference that each individual block is started
Function generator	Presetting of speed or torque setpoint values during commissioning, in order to adjust and check the dynamics of the control.
Measuring function	Acquire and display step responses or frequency responses, in order to adjust and check the dynamics of the control.

3.4 Digital inputs/outputs

Survey

For fast process signals four digital inputs and 4 digital outputs are available, to which the following functions can be assigned via machine data:

Highspeed inputs

- External start
- Enable input
- External block change
- Flying actual-value setting
- Measuring
- Reference-point switch
- Reversal cam for reference-point approach
- Emergency retraction (self-supporting drive)
- Position-controller blocking

Highspeed outputs

- Position reached, stop
- Axis movement, forwards
- Axis movement, backwards
- Change M97
- Change M98
- Start enable

Highspeed inputs for process signals

Through the concept of highspeed inputs, it is possible to automate machines requiring very short signal or response times. Via machine data, you can assign certain functions to the inputs. The inputs are interrupt inputs, with which a reaction to a process takes place without any delay.

External Start

In installations with positioning processes having a traversing time of, for example, less than 100 ms and positioning processes following each other at very short intervals, it is not possible to start the positioning axes via the SIMATIC input. For these and similar cases, the highspeed inputs of the MCU can be used. The axis is in this case started, as an alternative to the start signal, on the SIMATIC interface (inclusive OR).

External block change

When executing a traversing program, the blocks are processed one by one "on the fly". That means that for a block change, the axis has to perform several checks. These checks are not made at the programmed end point, but earlier, at the braking point.

The braking point depends on the traversing velocity and the braking value stored in the machine data. The braking point will only be changed when these parameters are changed.

It is a technological requirement that the block change point is determined by further parameters.

Example of an external block change

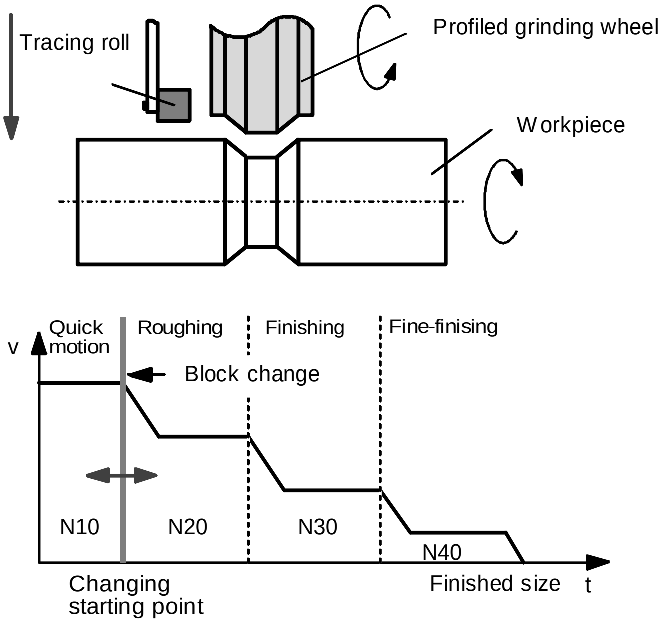


Fig. 3-1 Application for the external block change

On a grinding machine, hardened workpieces are ground by means of a profiled wheel. The grinding wheel effects all operations from roughing to fine-finishing to finished size. Therefore, the wheel must execute a fixed velocity profile. The path positions are defined in the program. As, however, the diameter of the blank varies, the starting position and, therefore, the change from quick motion to grinding speed must permanently be changed. Frequent whetting of the profiled wheel changes the wheel diameter, which means an additional change of the starting position. A tracing roll senses the blank diameter and signals via a switching contact that the starting point for the grinding operation has been reached.

Through the "external block change" function, the axis executes the next block. The actual value is maintained, and the grinding operation starts, adapted to the varying blank diameter. Grinding is effected in optimized time, there are no additional program changes due to the changed diameter of blank or wheel.

Flying actual-value setting

In belt installations, workpieces are identified via light barriers. The following positioning process places the workpiece into working position. The light-barrier pulse causes an external block change with flying actual-value setting. In this way, a backlash or slipping of the conveyor belt can be compensated.

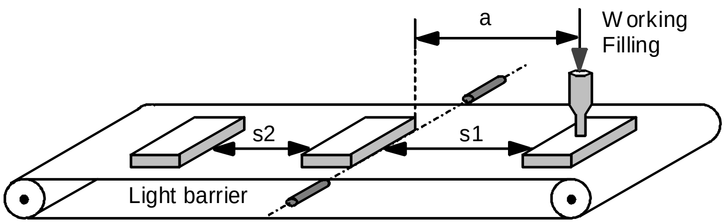


Fig. 3-2 Application for flying actual-value setting

Flying measuring, length measuring

Via the functions "flying measuring" and "length measuring", the axis can carry out measuring tasks.

By mounting a measuring probe on a positioning axis, the depth of a drill-hole or the length of a distance can be determined with high accuracy. In "flying measuring", the probe emits a signal which is transmitted via the interrupt inputs to the MCU. This stops the axis, and the status of the actual-value storage at the switching moment of the probe is stored. This saved actual value indicates the exact depth of the drill-hole, referred to the reference point of the axis and can be read out later.

With the function "length measuring", the distance between the positive and the negative edge of the highspeed "measuring" input is calculated.

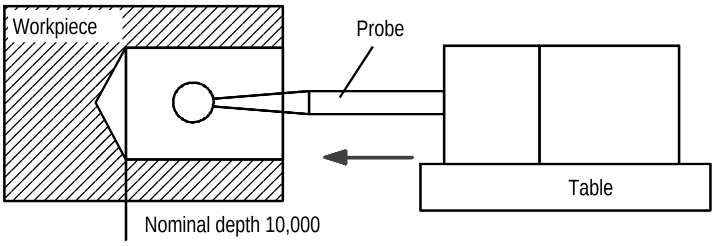


Fig. 3-3 Application for flying measuring or length measuring

Position-controller blocking

Roll feed axes require a fine positioning of the sheet steel for the cutting or pressing operation via positioning pins. For this purpose, the feed roll has to be lifted. When this process is initiated, the control loop of the roll feed axis must stop working. Therefore, the position controller must be blocked. In addition, the pulses of the drive are blocked. As this function has to take place very quickly, a highspeed input of the MCU is used.

3.5 Settings/functions valid for several operating modes

The following is a selection of the most important functions:

Table 3-2 Description of the functions valid for several operating modes

Operating mode	Description
Follow-up mode	In the follow-up mode, the control releases the axis, so that it can be moved by hand. Nevertheless, the MCU records the position, so that the current actual value is always known
Flying measuring	When the signal is recognized on a highspeed input, the current actual value is stored and can be read out, e.g., in the S7 CPU.
Parking axis	Switching the axis inactive (for exchanging the motor or encoder)
Simulation mode	The positioning part simulates a controlled system, all internal functional sequences behave like in normal mode
Automatic block search forwards/backwards	After abortion of a running program, the program can with this function be continued exactly where it was aborted - even if in the meantime, other traversing movements have been carried out
Teach In	With Teach In, the current position is taken over as the preset nominal value in a given block of a given program. That means that you can, for example, move the axis in the desired position in set-up mode and then take over this value in a program.
Actual-value setting	Upon transfer of the position, this value is set as the actual value in the current position.

3.6 Further functions

Backlash compensation

To compensate the mechanical backlash, the control can consider a compensation value. This is of particular importance for indirect measuring systems in connection with, e.g., a ball rolling spindle. The compensation value is taken into account at each reversal of direction.

Jerk limitation

Certain positioning tasks, e.g. transport of oscillatory materials, require a particularly ”smooth” (jerkfree) velocity curve. This will also spare the mechanical system and in general improve the lifetime of your machine.
By means of a jerk filter, you can define both the acceleration and the deceleration as a ramp function.

The jerk filter is parameterized through a time indication (jerk time), which defines how long the jerk shall be active.

Override / time override

By means of the function "override/time override", you can influence the behaviour of the traversing motion. The override is a pure velocity override, i.e. it influences the velocity curve in percent. The function "time override" additionally influences the defined acceleration and deceleration ramps.

Acceleration correction

You can easily adapt the system to changing physical conditions by influencing the acceleration behaviour of the axis in percent.

If a transport system transports very heavy parts or liquids, it may be necessary to reduce the acceleration values. If the transport system moves without the part, it can be accelerated more quickly.

The axis offers the possibility to effect this adaption via the G-functions G30 to G39 in the traversing program. Therefore, the system can even be applied when the mechanical conditions are subject to great variations.

Software limit switches

You can limit the traversing range of the axes by means of software limit switches to avoid collisions. The positions for the software limit switches are stored in machine data. The limit switches are input related to the defined coordinate system and are, therefore, in an absolute relation to the machine actual-value system. Monitoring is effected automatically from the moment synchronism starts.

The system controls these internal software limit switches upon each traversing motion and, if necessary, the motion is interrupted. The axis stops at the software limit switch.

Rotary axis

The MCU offers the possibility to change from feed axes over to rotary-axis operation. The corresponding settings are made via machine data. The distances are programmed in degrees and the traversing motions, in degrees/min.

The actual-value counter of the axis is reset after one revolution of the rotary axis, so that the system allows an absolute as well as an incremental angular-degree programming.

Table of incremental dimensions

In the incremental operating mode, you can effect individual positionings of relative distances. Positioning is in such cases effected at the parameterized set-up speed. Up to 100 nominal values can be stored on the MCU in a table of incremental dimensions.

Remaining-time measuring

To optimize the relative motion between press and roll feed, you can determine the ratio between positioning time and feed-angle time.

Switchover indirect/direct measuring system

Once you have parameterized both measuring systems, you can quickly switch over from one measuring system to the other during standstill of the axis.

3.7 Programming

Survey

- Programming similar to DIN 66025
- 2 subroutine levels, max. number of loops 250
- Up to 199 programs can be addressed
- Up to 255 blocks per program
- Program store of 14.5 kB
- The maximum number of programs and blocks that can be stored on the MCU module, can be calculated according to the following formula:

$$\boxed{14500 = \text{number of programs} \times 110 + \text{number of blocks} \times 20}$$

Example

50 programs are needed on the MCU

$$14500 = 50 \times 110 + \text{Number of blocks} \times 20$$

$$\text{Number of blocks} = \frac{14500 - (50 \times 110)}{20} = 450$$

450 blocks are available for the 50 programs, e.g. 9 blocks per program.

Program structure

A traversing program consists of a number of blocks containing the information for the motion and the velocities of the axis as well as other determinations for processing the traversing blocks.

The block with the lowest block number is automatically the program start, the block with the highest block number is the program end. A program is executed in ascending order of the block numbers.

Block structure

The individual pieces of information of a traversing block are called program words. A program word contains program, geometry or technology information and consists of an address character and a sequence of numbers with or without sign.

/	N	G1	G2	G3	X / t	F	M1	M2	M3	D	P	L

/	Identification of a skip block
N	Block number
G1, G2, G3	G-function of the 1st, 2nd or 3rd function group
X/t	Position/dwell time
F	Velocity
M1, M2, M3	M- function of the 1st, 2nd or 3rd function group
D	Tool offset number
P	Number of subroutine calls
L	Call of a program as a subroutine
%	Identification for program number

G-functions

With the G-functions, the type of movement is determined and offsets are called. The G-functions are divided into G-groups according to their meaning. Each G-group contains a turnon state or a basic position, i.e. this G-function is active without being selected.

The effectiveness of G-functions is either "modal" or "local (block)". G-functions which are effective block by block are only active in the programmed block. Modally effective G-functions remain active until they are replaced by another G-function of the same group

G group	G No.	G function
1	04 s	Dwell time
	87 s	Deselection of measuring-system displacement for flying actual-value setting
	88 s	Continuous motion for (-) for flying actual-value setting
	89 s	Continuous motion for (+) for flying actual-value setting
	90 m	Absolute dimension
	91 m	Incremental dimension
2	**30** m	100 % override of acceleration/deceleration
	31 m	10 % override of acceleration/deceleration
	32 m	20 % override of acceleration/deceleration
	to	to
	39 m	90 % override of acceleration/deceleration
3	43 m	Tool offset (+)
	44 m	Tool offset (-)
	50 s	External block change
	60 m	Block change exact stop
	64 m	Flying block change, continuous-path mode

M-functions

With the additional functions, it is possible to output specific commands causing, e.g. technologically necessary actions, e.g. spindle on/off, chip evacuator, coolant, hydraulics. For real-time applications, separate M-functions are available, which can be output via the highspeed outputs of the MCU.

The M-functions are output via the acknowledgment signals in the instance data block. Machine data determine whether the output takes place time-controlled, reset-controlled, before, during, after the traversing motion or a highspeed output.

M-functions having a direct influence on the program control of the module, e.g. M2 program end, are an exception. Therefore, these M-functions cannot freely be used.

Tool offset

The tool offset provides the possibility to use an existing machining program even after a change of the tool dimensions. Normally, programming refers to the tool zero point. Through wear or exchange of the tool, the position of the tool tip may change. You can compensate this change through the tool offset, without having to change anything in the machining program

The MCU possesses an internal tool offset store in which you can store up to 20 different offset blocks, consisting of absolute/additive length and wear values. Each offset block is addressed with a D-number.

Example of tool offset

During machining, tool wear D_V occurs. This wear is taken into account in comparison with the new tool in absolute terms. Any further occurring wear can be considered additively. It is, however, also possible to consider any additional wear in absolute terms. The tool offset is additively composed of the tool length offset D_L and the tool length wear D_V.

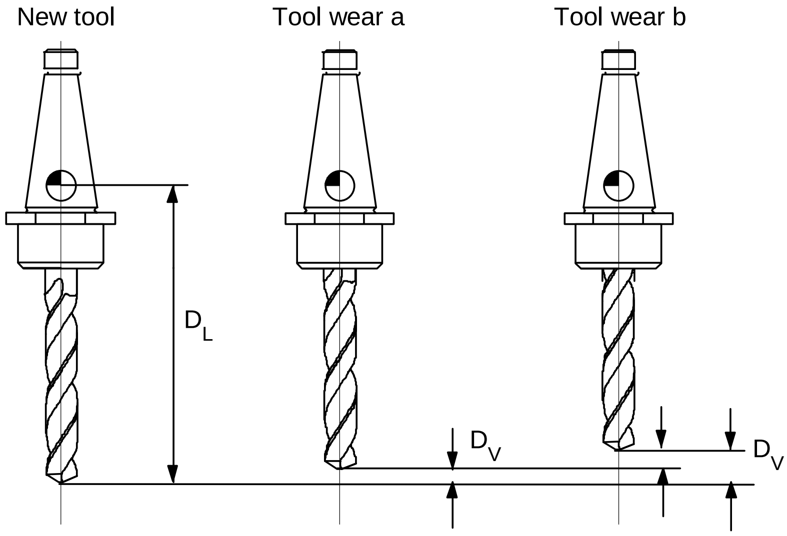


Fig. 3-4 Tool offset with the MCU

3.8 Diagnostics and error messages

Error messages are subdivided into data errors, operator errors and traversing errors. In MCU-PIT, they are displayed with text and time of occurrence. Via the help function you get a detailed description of the error with possible causes and instructions how to eliminate the error.

3.9 Commissioning functions

Survey

With the commissioning functions, the system is traversed periodically, e.g. according to a square function, and the dynamic reaction of the system, e.g. oscillations or differences between nominal and actual values, is measured in the speed and current control loop. In this way, it is possible to measure the dynamics of the entire system and to optimize the controller parameters accordingly.

Two procedures

The commissioning functions include two different procedures:

1. The function generator excites the drive with a periodic signal whose type can be parameterized. Via the DAU output hubs (3 signal hubs and 1 ground hub), external measuring devices, e.g. oscillographs, record the reaction of the system. You can freely parameterize which signals shall be available on the hubs.
2. By means of the measuring functions the two above-mentioned functions - excitation and recording of the dynamic reaction of the system - are carried out by the MCU itself. The measuring results can be graphically viewed and stored or printed.

4 Further Questions

Table of contents

4.1 Which PLC functions does the integrated S7-CPU offer?

Instruction set of the integrated S7-CPU

As **programming language,** STEP 7, a further development of STEP 5, is available.

In addition to AWL, a language similar to assembler with some standard-language components, STEP 7 offers the possibility to program graphically with the contact plan method (KOP), the function plan method (FUP) and, in the status graph, with HIGRAPH. These belong to graphic programming.

The instruction set of STEP 7 includes, for example:

- Elementary operations
- Setting/resetting of bits
- Time operations
- Counting operations
- Arithmetic functions
- Comparing operations
- Data-type conversion
- Jump operations
- Block calls

Call of an FB in FUP representation

```
        +--------------------- FC: RESTART ---------------------+
    ----| EN                                                ENO |----
    ----| INSTANCE_DB                                      TFGS |----
    ----| TFB                                      DISPLAY WORD |----
        +-------------------------------------------------------+
```

Call of an FB in AWL representation

```
CALL  RESTART(
      INSTANCE_DB :=      ,
      TFB     :=      ,
      TFGS    :=      ,
      DISPLAY WORD       :=      );
```

Instance DB

In the SIMATIC S7, each function block is assigned a data block with the same number, e.g. FB1 is assigned the DB1. In the instance DB, all values of the parameters, e.g. control and acknowledgment signals, actual values, error messages, are stored and can be supplied by the user program.

Program structure

STEP 7 has a **program structure** that enables a structured programming. Programming is effected at different levels:

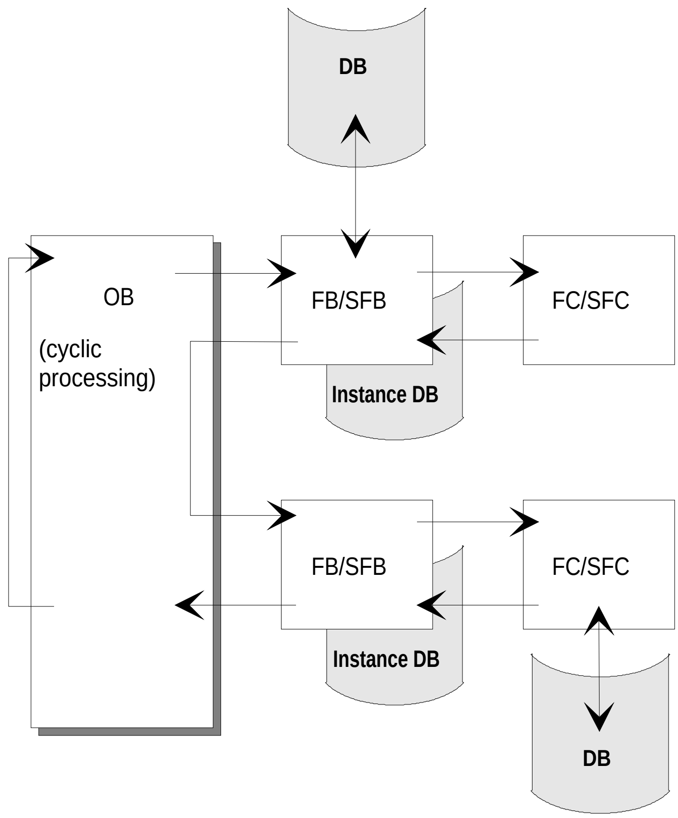


Fig. 4-1 Program structure levels

For a detailed explanation of the philosophy and procedure, please refer to the tutorial von STEP 7.

OB
Organization Blocks

Higher-order transactions are processed in organization blocks. Certain transactions are assigned defined OB numbers, e.g. OB1 for the main program, OB40 for process error elimination, etc., and also certain priorities, e.g. error elimination OB's have a higher priority than the main program. That means that the main program will be interrupted as soon as an error/alarm occurs and that then the corresponding error OB is processed.

FB Function Blocks
FC Function Calls

OB's can call soubroutines: Function Blocks (FB) or Function Calls (FC).

SFB
System Function Blocks /

SFC
System Function Calls

System Function Blocks (SFB) and System Function Calls (SFC) are “pre-fabricated subroutines“. FB's and FC's can, in turn, internally call other FB's/FC's, etc.

Input parameters are given to the subroutine, defining which values shall be utilized, and output parameters, defining where the results shall be written. In our case, the input parameters are the control signals and settings, and the output parameters are the acknowledgment signals and other display data.

This procedure serves for better clarity, but also allows a flexible use of prefabricated functions.

DB Data Blocks/

SDB
System Data Blocks

In addition to the program blocks (OB, FB, FC, SFB, SFC) there are Data Blocks (DB) or System Data Blocks (SDB), containing the relevant data. In our case these are e.g. machine data, nominal-value parameters, tool offsets and traversing programs. The data blocks of the positioning part have numbers over 1000 and can, therefore, neither be read nor written by the user program.

The communication between the S7 part of the MCU and the positioning part is also effected via a data block, namely the instance DB. Here, current actual values are stored, which can be read from the user program. Furthermore, control signals are set in the instance DB, which are transferred to the positioning part of the MCU by means of the below-mentioned FC/FB.

For operation and observation, e.g. with an OP device, actual v alues can be read either from the instance DB or from the system-data block SDB DB1000.

Technology functions of ther MCU

The communication between positioning part and S7 part is programmed by means of the **technology function**, consisting of three standard blocks.

Table 4-1 Technology functions of the MCU

Block number	Block name	Meaning
FB1	OP_MCU	Setting and operating an operating mode and readout of the current operational status
FC1	RESTART	Synchronizing the data exchange between CPU and positioning part after startup of the CPU or the module. Setting the TFB bit for operation via MCU-PIT or S7
FC2	CONTROL	Additional functions MCU: writing setting data into the MCU and reading current actual values from the module
FC3	STATUS	Readout of status information from the MCU in the process-alarm program

Cooperation of the components

The following block diagram will help you to better understand the cooperation of the individual components and the role of the technology blocks in them:

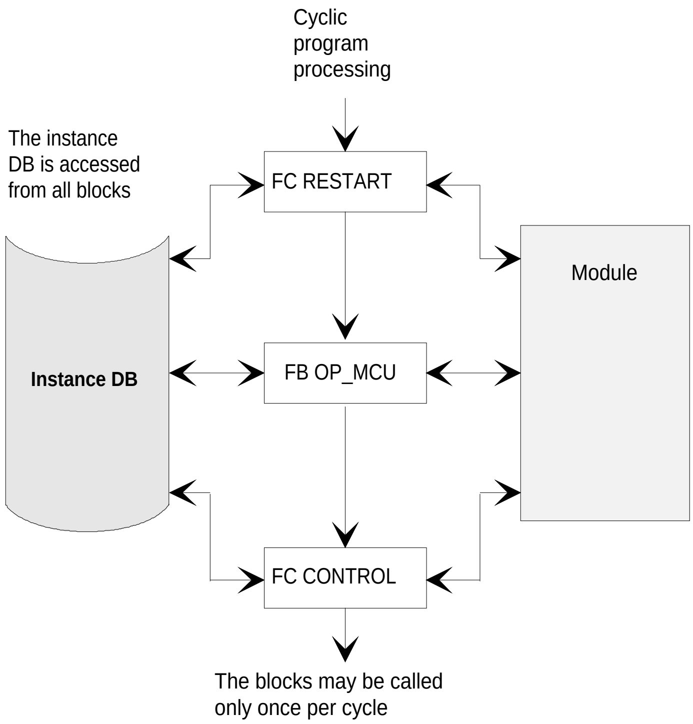


Fig. 4-2 Cooperation of the components

As you see, you can traverse the axis by calling FB OP_MCU and FC CONTROL in the main program (OB1) with the corresponding parameters, above all through NC program selection and start.

Sample programs

The blocks and their parameters are explained in detail in the manual "Description of functions, S7 environment". This manual also contains sample programs.

4.2 In which way are data saved?

FEPROM

A FEPROM is integrated in the MCU for saving user data. All DB's can be saved: NC machine data, drive machine data, nominal-value parameters, tool offsets, traversing programs. The saving of these data can be triggered via MCU-PIT, separately for positioning and drive data. In addition, PLC data, such as OB's, FB's, FC's, and DB's can be saved on this FEPROM via STEP 7.

PCMCIA

Saving of the data on the user module (PCMCIA) is in preparation.

DB

Flags, counters, timers, and DB areas can also be saved in a special data block in case of voltage failure. You can freely parameterize via the STEP 7 software which data shall be saved. Please refer to the corresponding chapter or the SIMATIC S7 manual.

Internal clock

Like the SIMATIC S7, the MCU possesses an integrated internal clock.

4.3 Which networking possibilities does the MCU offer?

PROFIBUS-DP

In addition to the communication with MPI, the MCU can also be networked via PROFIBUS-DP. PROFIBUS-DP is a field bus for decentralized periphery (DP), working according to the process field bus DP standard (DIN E 19 245, part 3). It is applied for fast cyclic communication of small data quantities. PROFIBUS-DP also allows devices of other manufacturers.

Communications module CP 342-5

The MCU is connected to PROFIBUS-DP by means of the communications module CP 342-5 (IM coupling).

With the CP 342-5, the following communication services are possible:

- PROFIBUS-DP as DP-master
- PROFIBUS-DP as DP-slave
- S7 communication (e. g. PG-functions)

The CP 342-5 can be operated alternatively as DP-master or as DP-slave. Each DP-master can reach up to 32 DP-slaves. The size of the DP data areas is up to 24 bytes each for the input/output area. As DP-slave, the CP 342-5 supports up to 86 bytes for input/output. The baud rate for the PROFIBUS-DP can be adjusted with the MCM S7-L2 configuring software between 9600 baud and 1.5 Mbaud.

The following figure illustrates the networking environment:

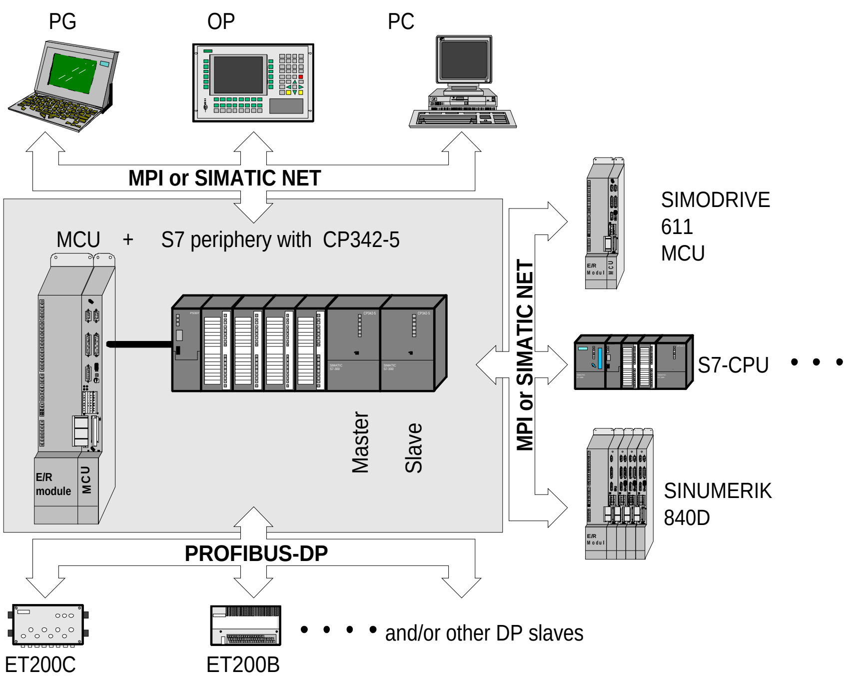


Fig. 4-3 Networking environment

4.4 Which possibilities does the SIMODRIVE 611offer?

Overview

The Siemens SIMODRIVE 611 is a converter system with digital control, with which economic drive systems can be realized, and, if desired, also high requirements concerning dynamics, speed regulating range and radial running accuracy are fulfilled.

Modular design

Thanks to the modular design of the converter system, drive configurations with almost any number of axes or main spindles can flexibly be realized. The modules needed are determined according to the required intermediate-circuit power and the size of the motors.

Central modules

In the SIMODRIVE 611 systems, open-loop supplies, supply/re-supply modules, monitoring modules and pulse impedance modules are used as central modules.

Heat reduction

For the power modules, different types of heat reduction are available, e.g. internal and external heat reduction. For detailed information, please refer to the SIMODRIVE 611 documentation.

4.5 In which way are data exchanged between MCU's by means of "Global Data?"

Global Data (GD)

The Global Data (GD) are a communication mechanism which is effected via MPI and causes the cyclic exchange of up to 22 bytes. Per program cycle, a user can receive up to 4 GD packages, i.e. up to 4 simultaneous GD areas are possible. In each of these areas, senders and receivers can be fixed.

Synchronizing

With the Global Data, it is possible to synchronize two MCU's, e.g. through simultaneous triggering of traversing programs or traversing blocks. A combined or coordinated traversing of the axes is possible. Further functions, such as synchronism and interpolation of several axes can be solved with the SINUMERIK 840D/SIMODRIVE 611 technology.

4.6 What has to be observed when configuring?

Ordering numbers

For ordering numbers for the MCU, please refer to the catalogs of SIMATIC S7 (ST 71) and SINUMERIK (NC 60).

Which supply module do I need?

With smaller motor powers (1 to approx. 14 Nm at 3000 rpm), the open-loop supply module UE 5/10 kW may be used. A module UE 10/25 kW and supply/re-supply modules closed-loop with higher capacities are also available.

Which power modules and motors can I use?

The motor has to be selected according to the power needed for the positioning task. The MCU is designed for core types series 1FT6 and 1FK6. Then, you choose the corresponding power module. In principle, all power module of the SIMODRIVE 611 series can be applied. The supply module depends on the power module to be supplied. The SIMOPRO software enables a simple, user-prompted selection of these components.

Which encoders can I connect?

In principle, the following encoders can be connected:

- Measuring systems integrated in the motor (indirect systems)
  - ERN 1387 (incremental)
  - EQN 1325 (absolute with EnDat interface)
- Additional measuring systems mounted on the machine
  - Linear scales with incremental sine/cosine signals (1 V_{ss}), e.g. LS 486
  - Rotatory add-on encoders with sine/cosine signals (1 V_{ss}), e.g. ROD 486
  - Absolute rotatory add-on encoders with EnDat interface
- Via signal-amplifying electronics, incremental position-measuring systems with current signals (7 bis 16 μA_{ss})

The indirect (motor) measuring system is necessary, a direct one can additionally be used, if needed. Note, however, that when using two measuring systems, only one of them may be absolute.

Which accessories can I use?

Siemens offers a comprehensive choice of accessories. Please refer to the catalogs, e.g. NC-Z, or contact your Siemens agency .

Which clutches can I use?

To avoid oscillation problems, please observe the instructions for the driven clutches in the "Configuring instructions, selection of the 1FT6/1FK6 motors".

4.7 Which training help is available?

Documentation

The overview on the cover page gives you a detailed list of the available documentation.

Training

Service and configuring course for MCU positioning control

Duration:	3 days
Place:	Nürnberg-Moorenbrunn
Designation:	NC-MCUSIP
MLFB-No.:	6ZB1 410-0FW01
ZP-No.:	AD234SN054

Information

Training Center Siemens Automatisierungstechnik

Address:	Gleiwitzer Str 555, 90475 Nürnberg
Postal address:	Postfach 4848, 90327 Nürnberg
Phone:	+911 895-3200
Fax:	+911 895-3252

Description

The training course is meant for programmers, planning engineers and service experts of machine manufacturers and end users. The participants are imparted the necessary know-how for handling and commissioning of the positioning control MCU.

Prerequisites

Knowledge of SIMATIC S7 programming as well as basic knowledge of NC technology and drive technology are required.

Targets/contents of the course

- System overview and structure of the MCU user interfaces
- Parameterization and commissioning of the MCU, consisting of SIMATIC S7, positioning part and drive part
- Parameterization and commissioning with MCU-PIT
- On-line and off-line mode via PG/PC
- Operator environment on OP 031/MMC 101
- Saving data and reading them in again
- Interpretation of error and diagnostic displays
- Commissioning of technology blocks
- Practical commissioning training

Dates and prices

For information on dates and prices:

- contact the training center of Nürnberg-Moorenbrunn
- refer to catalog IT5
- refer to the PRODOK information or user information

5 Technical Data

Parameters of the positioning part

- Traversing range: ±100 m
- Traversing speed: 0.01 mm/min bis 500 m/min
- Acceleration: 1 mm/s^2 bis 100 m/s^2
- Jerk time: 0 to 100 s
- Closed-loop control time: Parameterizable from 2 ms to 10 ms
- Encoder adjustment through machine data
- 2 software limit switches
- Rotary axis reconnectable
- Scaling factor for gear ratio matching
- Backlash compensation
- Tool offsets: Length and wear
- Override: Feed rate and acceleration
- M-functions: Reset/time-controlled or position-controlled
- Zero offset
- Teach In
- Highspeed inputs/outputs, 4 each
  (24 V external, max. 500 mA; 24 V internal, max. 100 mA)

Parameters of the standard control SIMODRIVE 611

- Max. motor speed: 7000 min^{-1}
- Radial run-out: 0.2 µm with 10 mm spindle pitch
- Controller dynamics: – min. current regulator cycle 125 µs
  – min. speed regulator cycle 125 µs
- Startup time of speed regulator: 1.4 ms
- Characteristic frequency of the closed speed regulator: 550 Hz
- Integrated digital drive bus

Drive SIMODRIVE 611

- Open-loop feed 5/10 kW or 10/25 kW
- Closed-loop supply/re-supply 16 to 120 kW
- Power modules with VSA current intensitites from 3/6 A to 70/140 A
- Intermediate circuit voltage 600 V in case of closed-loop supply
- Digital feed control
- Connection voltages
  – 3AC400 V; 3AC415 V
  – 3AC440 V; 3AC480 V; 3AC500 V; 3AC220 V; 3AC230 V via matching transformer in economizing circuit

Motors 1FT6

- Standstill torques from 1 Nm to max. 140 Nm for nominal speeds from 1500 rpm to 6000 rpm
- Protection class IP64 to IP67

Motors 1FK6

- Standstill torques from 1.1 Nm to max. 36 Nm for nominal speeds from 3000 rpm to 6000 rpm
- Degree of protection IP64

Measuring system/ encoder system

- Decoding of speed and rotor position
- Optional position decoding:
  – Direct / indirect
  – Incremental / absolute
  – Rotary / linear
- Input for sinusoidal/cosinusoidal voltage signals (1 V_{SS}) and/or EnDat interface (RS485)
- Encoder limit frequency: 250 kHz

Monitorings

- System program memory, following error
- Voltages, interfaces, encoder line
- Motor temperature, limit switch

Application conditions

- Dimensions of the MCU slide-in module: 304 mm x 114.5 mm x 49 mm (H x D x W)
- Degree of protection depending on the application
  – in modular SIMODRIVE structure: IP20
  – in PPU (Protected Power Unit): IP65
- Up to 3 MCU's on one mains feed, further MCU's via SIMODRIVE monitoring modules

SIMATIC S7

- Programming language STEP 7
- 76 kByte main memory / 128 kByte loader memory
- Maintenance-free buffering 196 bytes of parameterizable counters, timers, flags
- 2048 flags, 128 timers, 64 counters
- Up to 768 digital or 96 analog inputs/outputs
- Up to 24 modules on 3 sub-racks
- Block types: DB, OB, FB, FC, SFC
- Instruction set of the CPU 314 for S7-300
- Initial system start and cyclic operation
- Operating-mode selector switch
- Status and error displays
- Test and information functions
- Data backup on FEPROM

Networking

- MPI-coupling (3 connections per MCU and up to 4 GD areas)
- PROFIBUS-DP connectable via CP342-5

STEP 7 / HIGRAPH / MCU-PIT

- Can run on PG 720 / PG 740 or upgraded PG 730 / PG 770 or industry standard with Microsoft®Windows 95 TM
- Link of PG to MCU via MPI
- Transmission rate: 187.5 kBaud

6 Appendix

Table of Contents

6.1 Abbreviations

A	Output
AC	Alternating current
AD	Drive data
AF	Automatic following block
AG	Automation device
AI	Analog input
AKKU	Accumulator
AO	Analog output
ASCII	American Standard Code for Information Interchange
AWL	Instruction list
AWP	User program
BA	Operating mode
BCD	Binary coded decimals
BD	Operating data
BG	Module
B&B	Operation and observation
EC	European Communities
CP	Communication processor
CPU	Central processing unit
D	Tool offset number
DAU	Digital-analog converter
DB	Data block
DB-SS	Interface data block
DC	Direct current
DIN	Deutsche Industrie-Norm: German industrial standard
DI	Digital input
DO	Digital output
DP	Decentralized periphery
DPR	Dual-port RAM
DS	Data record
E	Input
EBF	Unit operator panel
EEC	Electrostatically endangered components
EMC	Electromagnetic compatibility
EPROM	Erasable programmable read only memory: a memory which can only be erased by UV rays
E/R	Closed-loop supply / re-supply module
F	Feed
FB	Function block
FC	Function call: function block in the PLC
FEPROM	Flash EPROM: a memory which can be read and written

FM	Function module: peripheral module of the SIMATIC S7
FUP	Function plan
G	G-function
GD	Global data
GND	Signal ground: reference point
HEX	Short designation for hexadecimal number
HF	High frequency
HSA	Main spindle drive
HW	Hardware
IEC	International Electrotechnical Commission
IMS / IMR	Interface module: send / receive
IP	Intelligent periphery / degree of protection
K-Bus	Communication bus of the SIMATIC S7
KOP	Contact plan
L	Subroutine number
LCD	Liquid crystal display
LED	Light-emitting diode
LTM	Power module
M1, M2, M3	M-function 1st group, M-function 2nd group, M-function 3rd group
MCU	Motion Control Unit: single-axis positioning control
MD	Machine data
MDI	Manual data input
HMC	Human-machine communication: operator environment for operation, programming and simulation
MPI	Multi-point interface
MSR	Grating of the system of measures
MSST	Machine control panel
N	Block number
NCU	Numeric control unit
NE	Mains feed
NPV	Zero-point offset
OB	Organization block
OP	Operator panel
P	Number of loops
Pa	Parameter
PAA	Process image of the outputs
PAB	Periphery output byte
PAE	Process image of the inputs
P-Bus	Periphery bus of SIMATIC S7
PC	Personal computer
PCMCIA	Personal Computer Memory Card International Association
PEB	Periphery input byte
PG	Programmer

PIT	Parameterization and commissioning tools
PLC	Programmable Logic Controller
PP	Push-button Panel
PPU	Protected Power Unit
PR	Traversing programs
PWM	Pulse-width modulation
PS	Power supply
R	Parameter
RAM	Random-access memory: a program memory which can be read and written
RMS	Acknowledgment signal
ROM	Read-only memory
s	Distance
SDB	System data block
SFB	System function block
SFC	System functions
SM	Signal module/Incremental dimension
SSI	Serial synchronous interface
STS	Control signal (also control block for power module control)
SW	Software
SYSDOK	System-integrated documentation
TF	Technology function
TN-S	TN-S network
TTL	Transistor-transistor logic
UE	Open-loop supply
VDE	Verband Deutscher Elektrotechniker: Association of German Electrotechnical Engineers
VGA	Video graphics adapter
VP	Traversing program
VSA	Feed drives
V24	Serial interface: definition of the exchange lines between data terminal equipment and data communication equipment
WK/WZ/WZK/ WKZ	Tool / tool offset
X	Position/ dwell time

6.2 Alphabetical indexes

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

V

Range of application of the MCU documentation

Your Siemens agency will give you further information on catalogs, leaflets and training. The following list shows you the documentation available for the different tasks:

Documentation \ Tasks	Introduction	Planning	Configuring	Installation and start-up	Process operation	Service
Catalog	recommendable	necessary	recommendable			
Product Brief	necessary	recommendable	recommendable			
Description	necessary	necessary	recommendable	recommendable	recommendable	recommendable
Choice of 1FT6/1FK6 motors		necessary	necessary	recommendable		recommendable
Choice of SIMODRIVE comp.		necessary	necessary	recommendable		recommendable
Assembly and connection		recommendable	necessary	necessary		necessary
Positioning with MCU		necessary	necessary	recommendable		recommendable
MCU-PIT		recommendable	necessary	necessary	recommendable	necessary
S7 environment		recommendable	necessary	recommendable		necessary
Pocket Reference		recommendable	necessary	necessary		necessary

necessary recommendable

Catalogs NC 60.1, ST 70 and ST 71 give you a survey on all SIMODRIVE and SIMATIC S7 products. In the catalogs, you will also find the necessary ordering numbers. The ordering numbers of the documentation are contained in the respective **Docu-Directory** and in the **Info-Pool** system. The data processing procedure Info Pool is permanently being updated, so that you will find there information not yet included in the current leaflet directory.

The training center offers courses for SIMATIC, SINUMERIK and SIMODRIVE. The MCU configuring and service course impart both practical and theoretical knowledge. In **Catalog IT 5**, you find a survey of the courses offered.

Contents of the MCU documentation

Product Brief

This manual, designed in attractive colours, gives you concise information on:

- Application range
- Structure
- Operation
- Entire system
- Handling/planning

Technical data complete this survey on the MCU.

Description

This manual gives you the answers on, e.g., the following questions:

- How do I use the MCU?
- Which functions does the positioning, S7 and drive parts offer?
- Which possibilities of communication and operation does the MCU have?
- How do I parameterize and commission the MCU?

Planning Guide 1FT6/1FK6

This manual informs you in detail about the motors. You select the desired motor and configure your machine with it:

- General
- Description of the motors
- Ordering designations
- Technical data and characteristic curves
- Dimensional drawings

Planning Guide SIMODRIVE 611 Components

This manual helps you to configure the SIMODRIVE 611 components:

- System structure
- Open-loop mains supply
- Power module
- Closed-loop control components

Installation Guide Assembly and Connection

In this manual, you will learn everything about assembly and connection:

- Assembly instructions
- Earthing concept
- Interference elimination
- Hardware interfaces
- Connection survey

Description of Functions Positioning with MCU

In this manual, the integrated position control of the MCU is described:

- Closed-loop position control
- Digital inputs/outputs
- Operating modes
- User interface
- Programming
- Error messages

User's Guide Description of MCU-PIT

This manual describes the scope of functions of the MCU-PIT software:

- Structure and installation
- PIT-EDIT
- PIT-CONTROL
- Menu functions
- Notes on Windows

Description of Functions S7 Environment

This manual describes the integrated S7 CPU of the MCU:

- Mechanical structure
- Addressing of the modules
- Structure of the electrical part
- S7 functionality of the MCU
- Technology functions for MCU
- Communication MPI / SINEC L2-DP

Pocket Reference

Here, you find information on

- Data structure
- Control and acknowledgment signals
- Data blocks
- STEP 7 blocks
- Encoders
- Start-up sequence
- Error messages

MCU documentation directory

Leaflet	Ordering number
Catalog NC 60.1	E86060-K4460-A101-A2-7600
Catalog NC 60.2	E86060-K4460-A201-A2-7600
Catalog ST 70	E86060-K4670-A101-A2-7600
Catalog ST 71	E86060-K4671-A101-A1-7600
Product Brief	6ZB5 440-0WB02-0BA2
Description	6SN1 197-0MA01-1BP0
Complete manual, consisting of:	6SN1 197-0MA01-0BP0
Encoders	in preparation
PJ - Choice of 1FT6/1FK6 motors	6SN1 197-0MA01-2BP0
PJ - Choice of SIMODRIVE 611 components	6SN1 197-0MA01-3BP0
IA - Assembly and connection	6SN1 197-0MA01-4BP0
BS - Positioning with MCU	6SN1 197-0MA01-5BP0
BN - Description of MCU-PIT	6SN1 197-0MA01-6BP0
BS - S7 Environment	6SN1 197-0MA01-7BP0
Pocket Reference	6SN1 197-0MA01-8BP0
Encoders	in preparation
Communication	in preparation
Operation and Observation	in preparation
EMC	in preparation
Appendix	in preparation

SIEMENS

SIMODRIVE 611

MCU 172A
Single-Axis Positioning Control

User Manual
Encoders

Edition January 1997

Note

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please inquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

BERO, SIMATIC, SIMODRIVE, SINEC, SINUMERIK, STEP are trademarks of Siemens.

The remaining names and designations used in this Documentation may also be trademarks, the use of which by any third parties for their own purposes may violate the rights of the copyright holders.

Subject to technical changes within the product.

1 Scope of Functions

Contents

1.1 Introduction

Tasks

Electronic controls require external information regarding the current status of the units to be controlled.
To position and monitor controlled axis drives, the following information (actual values) is required:

- motor speed,
- rotor position, and
- axis position.

Measuring point

Generally, there is a difference between:

- direct measuring and
- indirect measuring.

Definition: Direct measuring

Measuring of the actual value of the rotary movement of rotary axes, or of the translatory movement of linear axes directly at the mechanical unit to be controlled.

Definition: Indirect measuring

Measuring of the actual value of the rotary movement of rotary axes, or of the translatory movement of linear axes indirectly via mechanical intermediate elements, such as ball spindle, gearbox, clutches.

Motor speed/ Rotor position

For the controlling of the motor speed/rotor position, highest dynamic characteristics are required. For this reason, it is absolutely necessary to use a motor encoder (built-in type).

Axis position

For the controlling of the axis position, either direct or indirect position measurement can be used; indirect position measurement of the MCU can be realized by means of the built-in encoder for motor speed/rotor position, or a built-on encoder can be used.

Incremental encoder principle MCU

It is possible to connect incremental encoders for position measurement with sin/cos voltage signals. The difference signals $A - \overline{A}$, $B - \overline{B}$ must provide a peak voltage of 1 V_{ss}, and the zero-pulse track a peak voltage of 0.5 .... 1 V_{ss}.

These signals must be compatible to those of ERN 1387 (see Section 2.2.1).

Absolute-value encoder principle MCU

It is possible to connect EnDat absolute-value encoders with additional sin/cos voltage signals 1 V_{ss} (Incremental track).

1.2 Incremental Encoders

Required signals

The incremental encoders to be used must provide two sinus voltage signals A and B offset by 90 degrees, with their negation and with a zero pulse including its negation. In any case, the commutation signal is provided by the built-in encoder in the 1FT6-/1FK6 motor.

Signal values

Transmission:	Difference signals $A, \overline{A}$; $B, \overline{B}$ and $0, \overline{0}$
Amplitude $A – \overline{A}$	1 Vss ±30 %
Amplitude $B – \overline{B}$	1 Vss ±30 %
Amplitude $0 – \overline{0}$	0.5 Vss...1 Vss
Voltage supply:	5 V±5 % (see also Section 1.4)
Max. supply current:	300 mA
Max. evaluable encoder signal frequency:	350 kHz

Note:

At a frequency of 350 kHz, the signal amplitude must be > 60 % of the nominal amplitude. The phase offset amount shall deviate from the ideal value of 90 ° between the tracks A and B only by < 30 °.

Pay attention to the frequency response of the encoder signals.

Signal characteristic on clockwise rotation

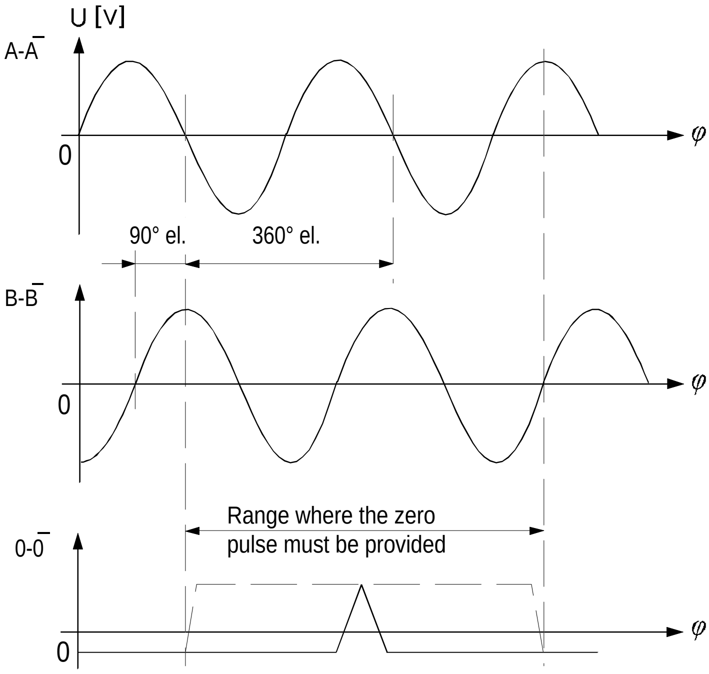


Fig. 1-1 Signal characteristic on clockwise rotation

1.3 EnDat Absolute Value-Encoders

Absolute actual position

In addition to the incremental tracks, EnDat absolute-value encoder systems provide an information on the absolute actual position. This information is read out from the encoder by the MCU after Power ON, thus initializing the actual position. Approaching to the reference point is therefore not necessary.

During operation, the absolute-value encoder works like an incremental measuring system.

EnDat

The <u>En</u>coder <u>Da</u>ta Interface is a bi-directional synchronous-serial interface intended for fast transfer of measured absolute values and further information (parameters).

Required signal values

For the signal values required see 2.2.5. EnDat absolute-value encoders do not require a zero pulse, and this is therefore not transmitted.

1.4 Encoder Supply

The MCU module supplies one encoder each with a +5 V, ± 5 % DC voltage for

- indirect measuring (built-in encoder via X411), and
- direct measuring (built-on encoder via X 421)

The module is operated in the Remote/Sense mode.

Remote/Sense

In all encoders providing 1 V_{ss} signals, the lines

+ 5 V (P encoder) with + 5 V sense
0 V (M encoder) with 0 V sense (internally) are bridged.

The aim is to measure the encoder supply voltage and to feed it back to the voltage regulator of the MCU. This regulator compares the actual-value voltage fed back with the voltage set and regulates the voltage at the controller up to + 5 V DC ± 5 %. In this way, voltage drops along the supply lines up to a line length of 40 m (in case of precut lines as offered in the Siemens Catalog NCZ or NCZ1) are compensated.

Overload protection

The power supply is protected against

- overload > 300 mA and
- short circuit.

It is monitored. In the case of error, respective error messages are displayed (see Error Lists) and/or the axis is stopped.

Data

Control range for Remote/Sense	5.1 V ... 5.3 V
Max. ripple	50 mV_{ss}
Permissible current loading/encoder conn.	300 mA

1.5 Temperature Sensor

1.5.1 Description

The 1FT6/1FK6 motors are equipped with a built-in, thermoresistor-based temperature sensor . The resistance changes proportionally to the temperature change of the winding.

Motor protection

The sensor lines (+temp. -temp.) are lead to the MCU via the encoder line of the built-in encoder (see Sections 3.1.1 and 3.1.3).
The evaluation is carried out in 2 steps:

- prewarning
- shutdown

The MCU responses when the temperature limits set in the machine data are reached.

Additional protection

Due to the thermal coupling time of the sensor, high overloads occurring for a short moment require additional protection measures. If the overload (4 x I_0) lasts longer than 4 sec, an additional protection should be provided.

Warning!

If the user wishes to carry out an additional high-voltage test, the line ends of the temperature sensors must be short-circuited prior to testing. Supplying the test voltage directly to the temperature sensor would destroy the sensor.

CAUTION:

The integrated temperature sensor protects the servomotors from overload up to 4 x $I_{0\ 60\ K}$
Moreover, a protection by the I^2t monitoring of the inverter is provided if $I_{0\ motor} \geq I_{nim\ inverter}$

Overload protection limits

When using servomotors (axis heights 36 and 48), the temperature sensor protects only up to $2 * I_{0\ 60\ K}$.
For thermally critical loads, e. g. high overload on standstill of the motor, no sufficient protection is provided. To provide sufficient protection, a thermal overcurrent relay must be connected.

Specifications of the KTY84

The integrated temperature sensor KTY84 has the following specifications when used in conjunction with 1FT6/1FK6 motors:

Cold resistance at 20° C	approx. 580 ohm
Warm resistance at 100° C	approx. 1,000 ohm
Connection to the motor via	encoder connector
prewarning temp. MD1602	120° C
shutdown temp. MD1607	155° C ± 5° C

1.5.2 Machine Data/Error Messages Regarding the Motor Temperature

Temperature-thresholds

The temperature thresholds are set in the following machine data:

MD	Value/Description	Unit
1602	0 ... 120 Motor temperature warning threshold	°C
1603	0 ... 240 Motor temperature alarm timer	s
1607	0 ... 200 Motor temperature shutdown limit	°C
1608	0 ... 2.. Fixed temperature	°C

MD1602

Input of the thermally permissible stationary motor temperature, or automatic parameterization by MD1102 (motor code number).

MD1003

If the temperature set in MD1602 is exceeded:

- the timer MD1003 is triggered

  If the temperature remains above the value set in MD1602 over the time set in the parameterized timer MD1003, the time elapses until TIME OUT.

  After this:

- The drive is stopped by means of the generator.
- error message 30614

MD1607

The value can be below the value set in MD1602; however, usually, it is higher.
If this temperature limit is reached (for example, before the time set in MD1003 is elapsed), the following happens:

- The drive is stopped by means of the generator.
- error message 30613

MD1608

Entering a value > 0 makes the temperature measurement and thus MD1602, 1603, 1607 ineffective. The entered value imitates the motor temperature. This makes sense if the temperature sensor is defective. The motor control does not work without providing the motor temperature.

Hiding the error message

The following bits can be used to hide error messages:

MD	Value/Description	No. of Hidden Error Message
1601 bit 13	1 $\widehat{=}$ hidden Temperature - motor shutdown directly	30613
1601 bit 14	1 $\widehat{=}$ hidden Timer-controlled temperature shutdown	30614

2 Configuring

Contents

2.1 Selection of the Encoder

Built-in - motor encoder

Generally, speed control and position measurement always require an indirect encoder (built-in encoder).
This is ensured by configuring the 1FT6/1FK6 motors released for work with the MCU.

The encoder integrated in the motor can additionally be used as an actual-value encoder for position control. In this case, no further encoder is required.

Selection of the motor

Configuring Instructions:
see Chapter 4:
Selection of the motors 1FT6/1FK6.

It is possible to configure the 1FT6/1FK6 with:

- a built-in incremental encoder, sin/cos voltage signals 1 V_{ss}
- a built-in EnDat absolute-value encoder and additional incremental tracks / sin/cos voltage signals 1 V_{ss}

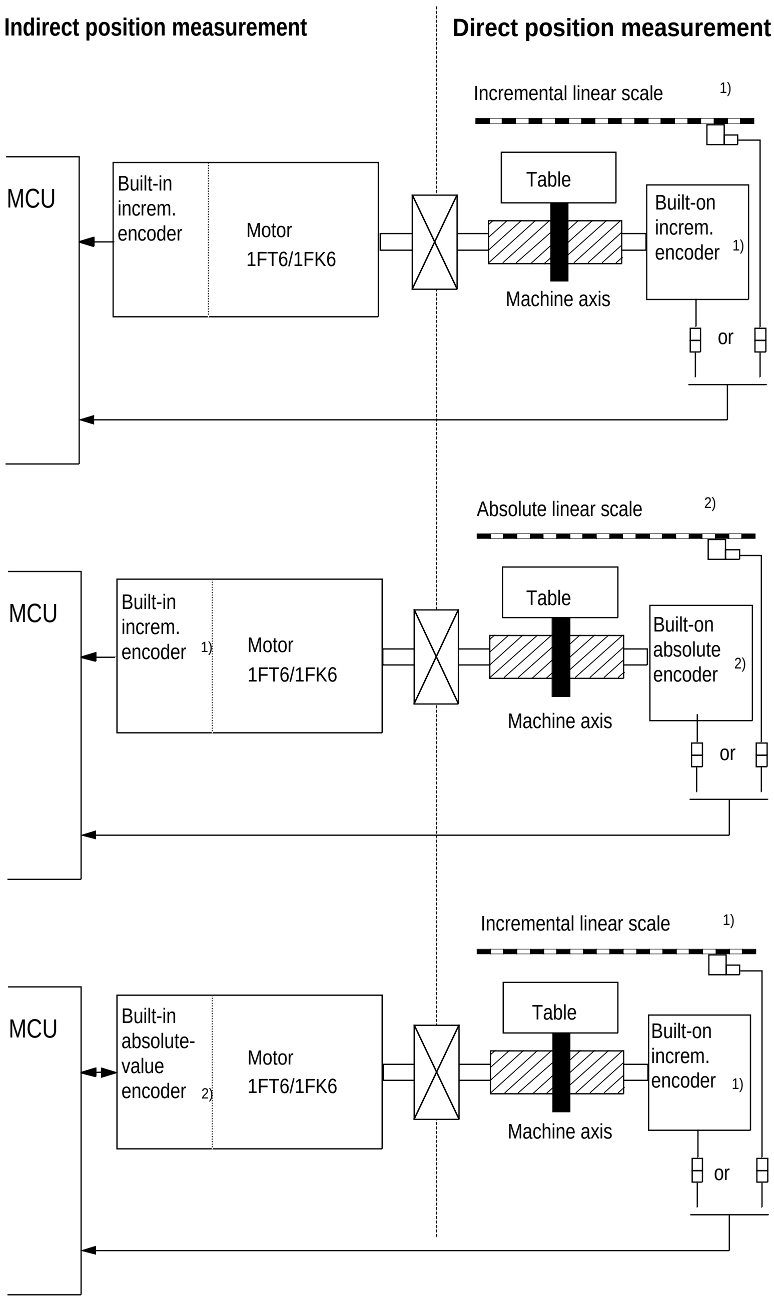
Selection of the direct measuring system

In order to rule out any inaccuracies due to the transmission elements (casing, threaded spindle etc.), a measuring system for acquiring the position directly at the workpiece can be configured. Depending on the number of produced machines, either a rotary or a linear measuring system can be used.

Length of lines

The max. permissible length of the lines between encoder (built-in or build-on encoder) and the MCU amounts to 40m.

Permissible m**otor / encoder combinations**



1) sin/cos voltage signals ~1 V_{SS}

2) EnDat-absolute value encoder and sin/cos voltage signals ~ 1 V_{SS}

2.2 Encoder Data

2.2.1 Incremental Encoder ERN 1381/1387

Incremental encoder ERN 1381/1387

Type: optical encoder system

Coupling: on the operating side (built-in in the motor)

Application:
- tacho for actual speed acquisition
- rotor position encoder for inverter control
- indirect measuring system for position-control loop

Evaluation: incremental

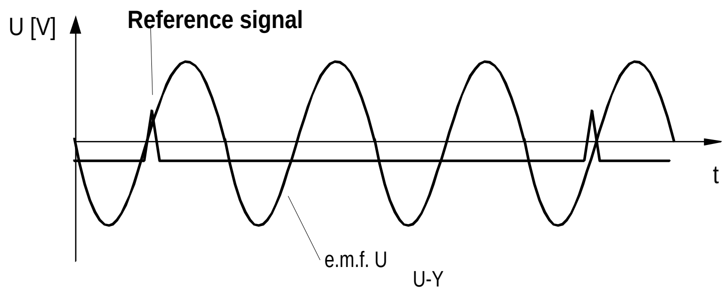
Output signals: sinusoidal

Connection: by plug

Application: 1FT6, 1FK6

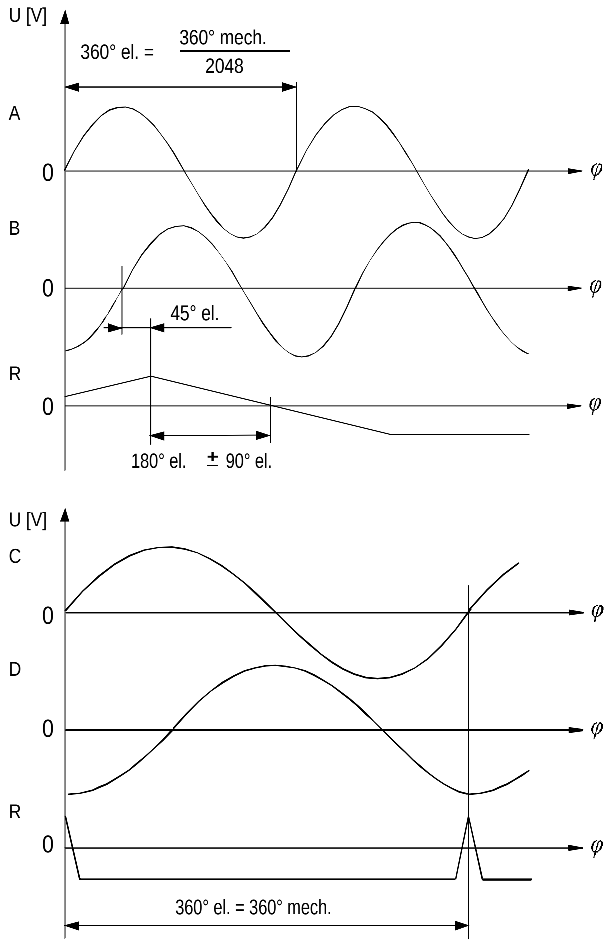
Adjustment:

When adjusting the motor, it is driven in clockwise direction, viewed from the drive side. The encoder is turned such that the passage through zero of the motor e.m.f. $U_{U\text{-}Y}$ ($U_{U\text{-}Y}$: phase voltage of U phase to artificial neutral point) with a rising positive edge coincides with the reference signal of the encoder. After adjusting, a 6-pole motor provides signals having the following characteristic (the reference signal is represented by the wider curve):



Signal sequence

Signal sequence and assignment at positive direction of rotation (clockwise rotation, viewed from the drive side); C-D signals with ERN 1387 only:



Note:

When changing the encoder, the position of the encoder system must be adjusted to the motor e.m.f. (not in case of 1 PH motors).

Technical specifications

Mech. limit speed	12,000 1/min
Operating voltage Current consumption Number of graduation marks Incremental signals Accuracy	5V ±5% max. 150 mA 2,048 1 V_{SS} ±20"
Vibrational strength Vibration (55-2,000 Hz) Shock (10 ms)	 100 m/s^2 to DIN IEC 68-2-6 1000 m/s^2 to DIN IEC 68-2-27
Operating temperature Storage temperature	between -15 °C and +120 °C between -20 °C and +80 °C

2.2.2 Absolute Encoder EQN1325

Absolute encoder EQN1325 EnDat

Type: optical encoder system

Coupling: on the operating side (built-in in the motor)

Application:
- tacho for actual-speed acquisition
- rotor position encoder for inverter control
- indirect measuring system for position-control loop

Evaluation: absolute and incremental

Output signals: sinusoidal and serial interface

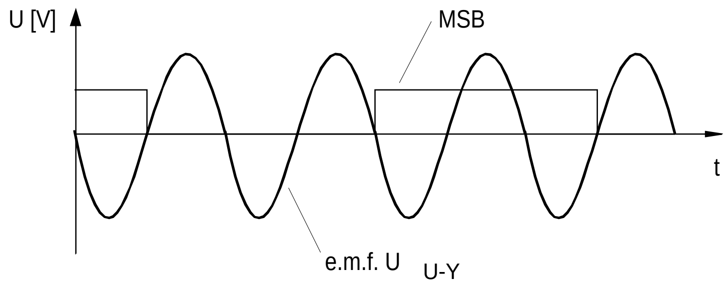
Connection: by plug

Application: 1FT6, 1FK6

Adjustment

One passage through zero of the e.m.f. U_{U-Y} (U phase to neutral point) with a rising positive edge within one revolution must coincide with the falling edge of the MSB (Most Significant Bit) position word.

Signal sequence and assignment at positive direction of rotation (clockwise rotation, viewed from the drive side):



Note:

When changing the encoder, the position of the encoder system must be adjusted to the motor e.m.f.

Technical specifications

Mech. limit speed	12,000 1/min
Operating voltage	5 V ±5%
Current consumption	300 mA
Resolution, incremental	2,048 periods per revolution
Resolution, absolute	4,096 revolutions; coded
Incremental signals	1 V_{SS}
Serial absolute-position interface	RS 486
Accuracy	±20"
Vibrational strength	
Vibration (55-2,000 Hz)	100 m/s^2 to DIN IEC 68-2-6
Shock (6 ms)	1000 m/s^2 to DIN IEC 68-2-27
Operating temperature	between -15 °C and +115 °C
Storage temperature	between -20 °C and +80 °C

Note:

The reduced maximum operating temperature of the EQN 1325 in comparison with the ERN 1387 results in a reduced nominal motor torque (see Technical Specifications of the motors).

2.2.3 Incremental Encoder SIMODRIVE Sensor

Built-on incremental encoder rotary

When using motors of the 1FT6 or 1FK6 series, a built-in encoder is in any case provided so that actual values are available at least for speed control and rotor position measuring. In this case, a built-on encoder has to provide only the actual position values. Installing of a built-on encoder makes only sense for direct position measuring, i.e. without intermediate gear to the encoder.

For direct position measuring, the optoelectronic built-on rotary encoder SIMODRIVE Sensor (1 V_{ss}) can be used.

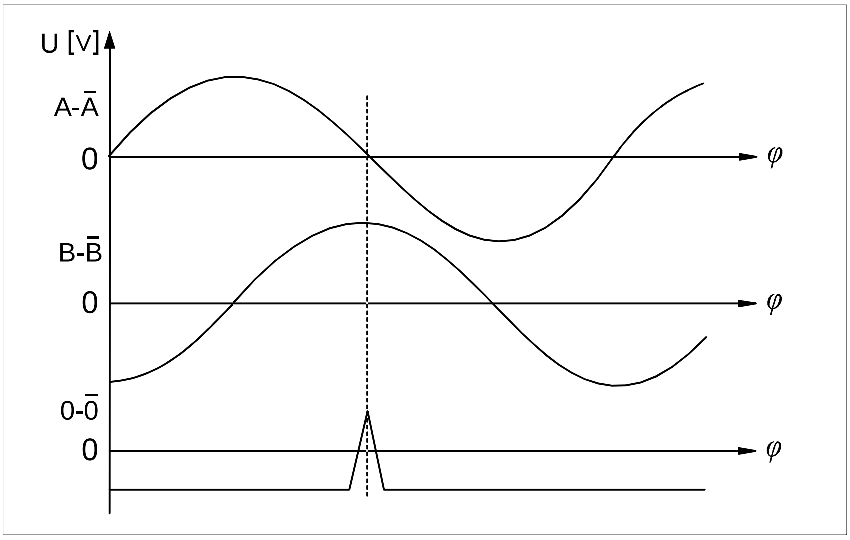
SIMODRIVE Sensor signals (1 V_{ss})

The SIMODRIVE Sensor (1 Vss) provides 3 difference signals:

Signal Name	Sinusoidal	Pulses (Periods) per Revolution	Actual Value for
$A - \overline{A}$ $B - \overline{B}$	x	1,000 1,024 2,500 5,000	position control
$0 - \overline{0}$	no	1	zero pulse

Signal sequence

The Fig. below shows the signal sequence of the SIMODRIVE Sensor at positive direction of rotation (clockwise rotation, viewed from the drive side).



The difference signals listed below have an amplitude of V_{ss} = 1 V:

$A - \overline{A}$
$B - \overline{B}$
$0 - \overline{0}$.

Specifications of the SIMODRIVE Sensor

Incremental signals	Difference signals acc. to the EIA Standard
– Pulses (periods)/revolution	RS 485
– Signal voltages	1,000, 1,024, 2,500, 5,000 [1)]
– Accuracy	≈ 1 V_{ss}
	± 60“ at ≤ 1,000 periods/ revolution
	± 30“ at ≤ 2500 periods/ revolution
Voltage supply	± 15“ at ≤ 5000 periods/ revolution
Limit frequency 3 dB	DC 5 V ± 5 %/ max. 130 mA
Light source	200 kHz
	LED
Max. mechanical speed	
Vibration (10 to 2,000 Hz)	12,000 min^{-1}
Shock (6 ms)	200 m/s^2 to IEC 68-2-6
	2000 m/s^2 to IEC 68-2-29
Weight	
Degree of protection	0.25 kg
– without wave input	
– with wave input	IP65
	IP64
Operating temperature	
Storage temperature	between 0° and + 80° C
	between -25° and + 80° C

1) other resolutions on request

For further specifications see Catalog NC Z.

2.2.4 Linear Scale LS 186

Built-on incremental encoder, translatory

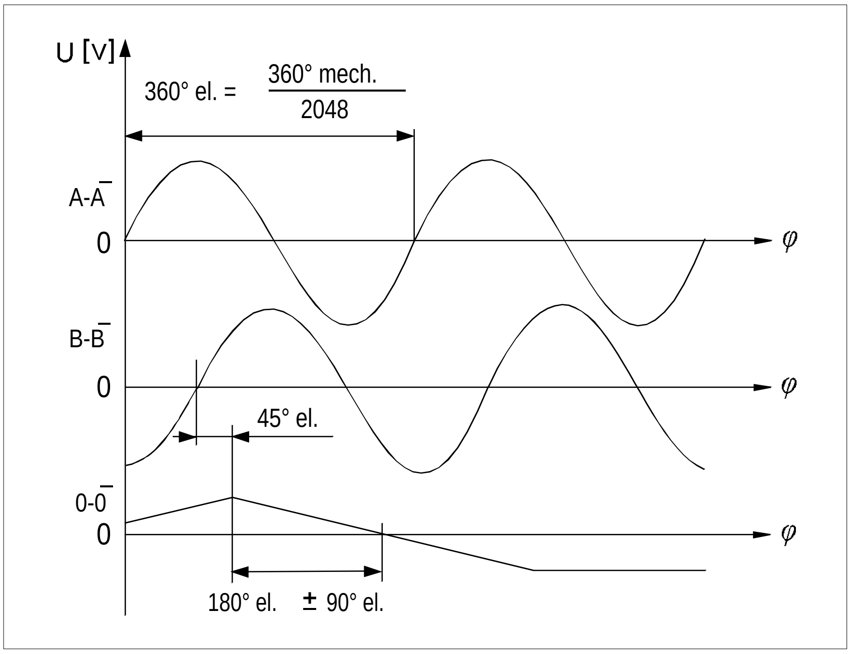
The linear scale LS 186 of Heidenhain Co. can be used for direct translatory position measuring.

LS 186 signals

The linear scale provides 3 difference signals:

Signal Name	Sinus-oidal	Graduation Period/ Distance	Actual Value for
$A - \overline{A}$ $B - \overline{B}$	x	1/20 µm	position control
$0 - \overline{0}$	no	1/50 mm	zero pulse

Signal sequence LS 186



The difference signals $A - \overline{A}$,
$B - \overline{B}$
have an average amplitude of V_{ss} = 1 V.
The useful signal of the zero pulse has an average value of 0.5 V_{ss}.

Specifications of the LS 186

Incremental signals	
– Pulses (periods)	1 per 20 µm
– Signal voltages	≈ 1 V_{ss}
– Accuracy, absolute	± 3 to ± 5µm/m
– Repeating accuracy	between 0.5 and 1µm
Reference marks that can be selected by solenoids; all scale lengths (25 steps)	50 mm min. 140mm, max. 3040 mm
Max. traversing speed	120/ min
Voltage supply	DC 5 V ± 5 %/ < 150 mA
Light source	LED
Vibration (55 to 2,000 Hz)	≤ 200 m/s^2 to DIN IEC 68-2-6
Shock (11ms)	≤ 400 m/s^2 to DIN IEC 68-2-27
Weight	0.2 kg + 2.6 kg/m measuring length
Degree of protection	
– when installed as indicated in the Mounting Instructions	IP63
– if compressed air is supplied	IP64
Operating temperature	between 0° and + 50° C
Storage temperature	between -20° and +70° C

For further specifications see Catalog "NC Length Measuring Systems" of Heidenhain Co.

2.2.5 EnDat Absolute-Value Encoder ROQ 425

Built-on absolute-value encoder, rotary ROQ 425

The optical built-on EnDat absolute-value encoder (multi-turn encoder of Heidenhain Co.) can be configured irrespective of the used 1FT6/1FK6 motors.

Note:

If the encoder built-in in the 1FT6 motor is an absolute-value encoder, only an incremental encoder can be used as external encoder.

The ROQ 425 provides the required position values (signals) for position control. Approaching to the reference point is not necessary.

ROQ 425 signals

Compatible to those of the EQN 1325, see Section 2.2.2

Specifications of the ROQ 425

Absolute-value encoder signals	Difference signals acc. to the EIA Standard
– Measuring range	RS 485
– Accuracy	4,096 revolutions
	± 30 angle seconds
Incremental signals	
– Pulses (periods)/ revolution	Difference signals acc. to the EIA Standard
– Signal voltages	RS 485
– Accuracy, absolute	2,048
	= 1 V_{ss} for $A - \overline{A}$, $B - \overline{B}$
Voltage supply	± 20 angle seconds
Light source	
Max. mechanical speed	DC 5 V ± 5 %/ ≤ 300 mA
Vibration (55 to 2,000 Hz)	LED
Shock (6 ms)	≤ 6,000 min^{-1}
Start-up torque at 20°C	≤ 100 m/s^2 /DIN ICE 68-2-6
Weight	≤ 1,000 m/s^2 /DIN ICE 68-2-27
Degree of protection acc. to DIN 40050	≤ 0.025 Nm
	0.5 kg
– at the wave input	
– without wave input	IP64
Operating temperature	IP67
Storage temperature	between -20° and + 80° C (measuring point - Heidenhain)
	between -30° and +80° C

2.2.6 Other Encoders

If you wish to configure incremental encoders for direct position measuring other than the types described, the signals A – $\overline{A}$, B – $\overline{B}$, 0 – $\overline{0}$ must correspond to those of the ERN 1387. This also applies to EnDat absolute-value encoders. All signals (data protocol, A – $\overline{A}$, B – $\overline{B}$) must be equivalent to those of the EQN 1325.

Note:

If the encoder built-in in the 1FT6/1FK6 motor is an absolute encoder, only an incremental encoder can be used as external encoder.

2.3 Machine Data

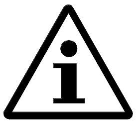
2.3.1 Prior to Commissioning

Prior to commissioning, the machine data must be defined or calculated. The figures provided in the following are examples which are applicable when the machine data (MD) are directly entered into the data blocks DB 1200 (DB-M) and DB 1251 (DB-AM). Any entries made by means of MCU-PIT are correspondingly marked "(MCU-PIT)".

Unit system raster (USR) MD7

Further machine data can only be defined if the unit system raster is set.

MD	Designation	Entry	Value	Unit
7	Unit system for linear and rotary axes	1 2 3 4	10^{-3} mm 10^{-4} inch 10^{-4} degrees 10^{-2} degrees	USR



Note:

The unit system raster (MD7) must match with the indicated unit system raster of the other DBs. If you inadvertently should not have adhered to this note, carry out the following sequence of operations:

1. Delete all data blocks on the MCU which do not correspond to the unit system.
2. Change the unit system in the machine data.
3. Modify the remaining data blocks on the PU.
4. Reload the data blocks to the MCU.

Axis distance to be traversed/ encoder revolutions

Generally, the following applies to rotary encoders with linear and rotary axes:

$$s = \frac{\text{Distance}}{\text{Encoder revolutions}} = \frac{\text{Distance traversed by the linear / rotary axis}}{\text{1 x encoder revolution}}$$

The following applies to linear scales:

$$s = \frac{\text{Distance}}{\text{Graduation cycle}}$$

s is needed to make entries into the machine data.

Graduation cycle: Distance between two zero pulses or
distance per spindle revolution or
distance per motor revolution

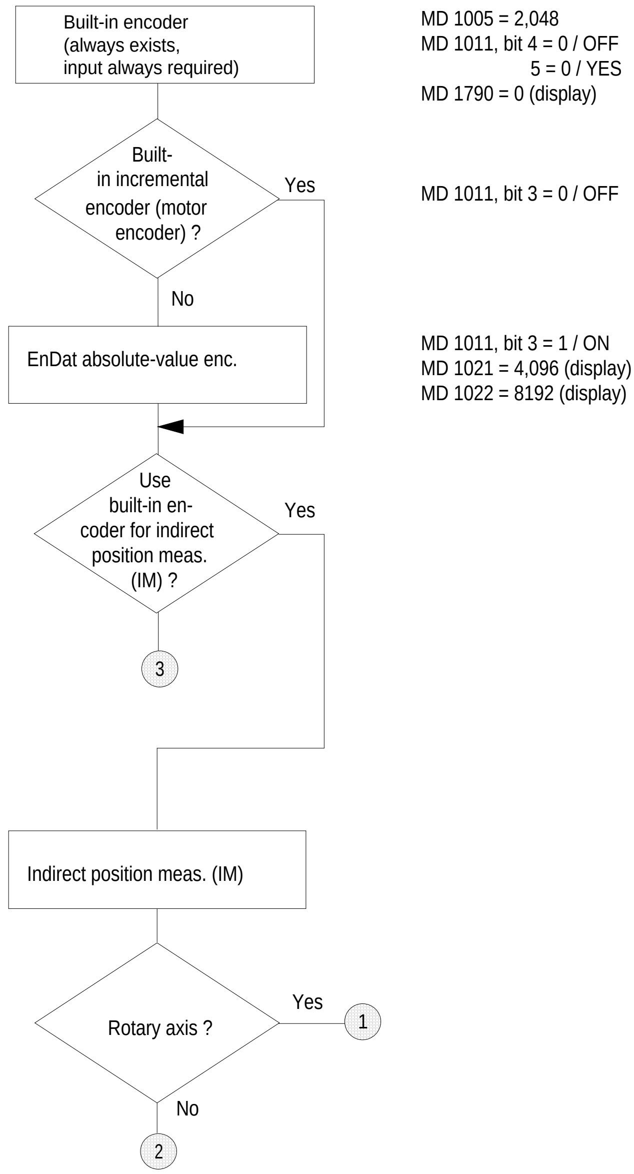
A summary of the machine data to be used for the encoders (with an information on designation, limit value etc.) is to be found in Section 3.3.

The following flow diagrams can be considered either as a sequential unit, but it is also possible to carry out selective jumps:
Flow diagram:

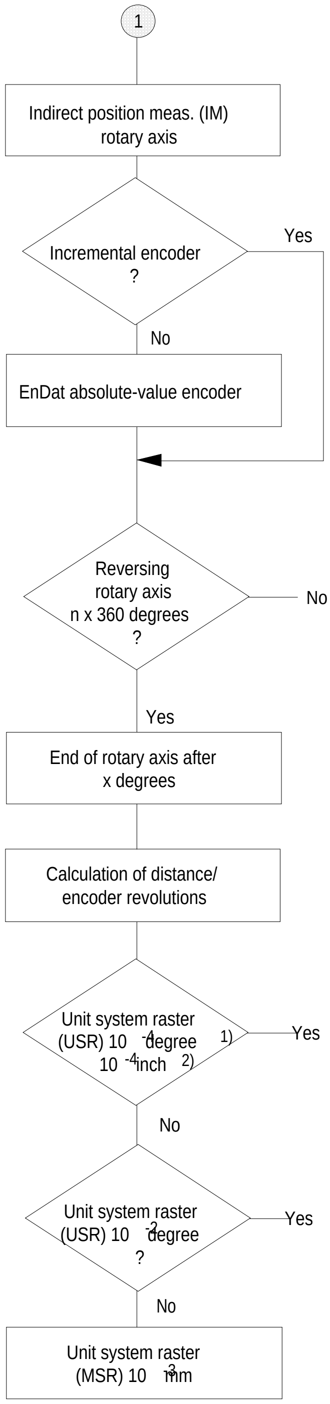
- built-in encoder - MD (must always be processed)
- indirect position measurement (IM), linear axis
- indirect position measurement (IM), rotary axis
- direct position measurement (DM), linear axis with linear scale
- direct position measurement (DM), linear axis with rotary encoder
- direct position measurement, rotary axis

Flow diagrams for encoder machine data which can be configured

Motor encoder



Indirect position measurement, rotary axis



MD8 = 1 / rotary axis
MD60 bit 0 = 1 / yes
bit 1 = 0 / no
MD13 = 2048 = MD1005
MD1790 = 1 (display)

MD10 = 1 / incremental encoder

MD10 = 5 / EnDat encoder
MD14 = 4096
MD 1790=16 (display)

make sense in the following cases:
MD9 = 36000 at USR: 10^{-2} degrees
9 = 3600000 at USR: 10^{-4} degrees
with MCU-PIT:
MD9 = 360.00 at USR: 10^{-2} degrees
MD9 = 360.0000 at USR: 10^{-4} degrees
CAUTION! The number n of revolutions of the rotary axis is only limited when using an EnDat absolute-value encoder.

MD9 = X00 at USR: 10^{-2} degrees
MD9 = X0000 at USR: 10^{-4} degrees
with MCU-PIT:
MD9 = X.00 at USR: 10^{-2} degrees
MD9 = X.0000 at USR: 10^{-4} degrees
The decimale can be unequal to 0.

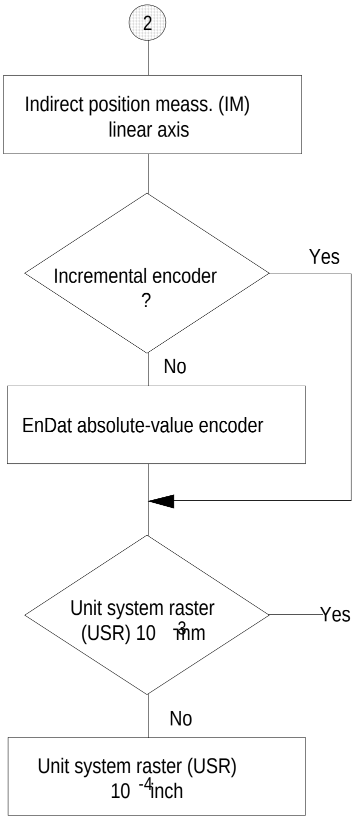
see Section 2.3.1

1) MD7 = 3 / 10^{-4} degree
2) MD7 = 2 / 10^{-4} inch
MD11, 12: see 7/1.2

MD7 = 4 / 10^{-2} degree
MD11, 12 see 7/1.2

MD7 = 1 / 10^{-3} mm
MD11, 12 see 7/1.2

Indirect position measurement, linear axis



MD8 = 0 / linear axis
MD60 bit 0 = 1 / yes
MD60 bit 1 = 0 / no
MD13 = 2048 = MD1005
MD1790 = 0 (display)

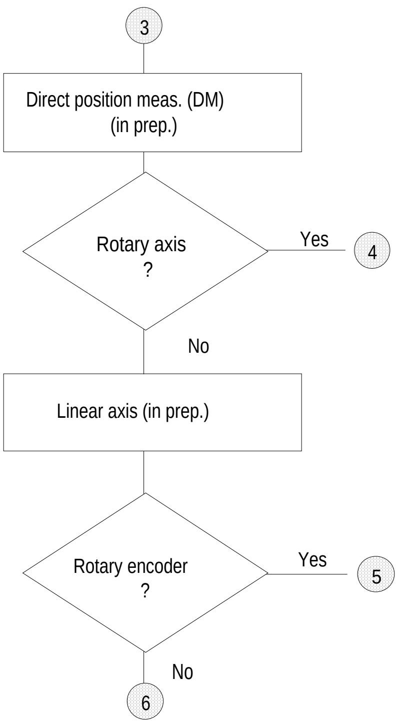
MD10 = 1 / incremental encoder

MD10 = 5 / EnDat encoder
MD14 = 4096

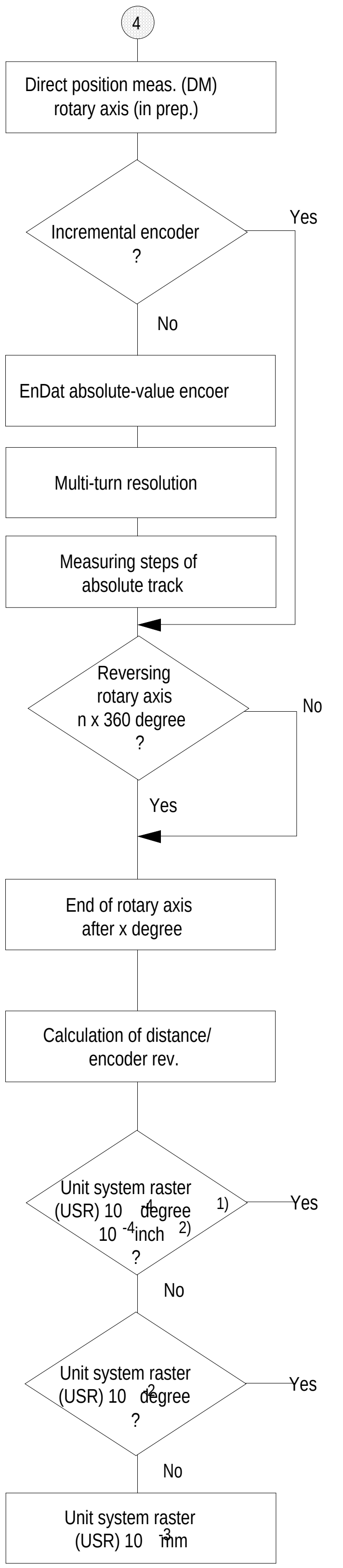
MD7 = 1 / 10^{-3} mm
MD11, 12 see 7/1.2

MD7 = 2 / 10^{-4} inch
MD11, 12 see 7/1.2

Direct position measurement



Direct position measurement, rotary axis



MD60 bit 0 = 0 / no
bit 1 = 1 / yes
MD8 = 1 / rotary axis
MD57 = 2048
MD1007 = 2048
MD1030 bit 4 = 0 / off
MD1791 = 0 (display)

MD54 = 1 / incremental encoder
MD1030 bit 3 = 0 / off

MD54 = 5 / EnDat encoder
MD1030 bit 3 =1 / on
MD1011 bit 3 = 0 / off

MD14 = 4096
MD1031 = entered automatically

MD1032 = entered automatically

makes sense in the following cases:
MD9 = 36000 at USR: 10^{-2} degree
MD9 = 3600000 at USR: 10^{-4} degree
with MCU-PIT:
MD9 = 360.00 at USR: 10^{-2} degree
MD9 = 360.0000 at USR: 10^{-4} degree
CAUTION: The number n of revolutions of the rotary axis is only limited when using an EnDat absolute-value encoder.

MD9 = X00 at USR: 10^{-2} degree
= X0000 at USR: 10^{-4} degree
at MCU-PIT:
MD9 = X.00 at USR: 10^{-2} degree
MD9 = X.0000 at USR: 10^{-4} degree
The decimals can be unequal to 0.

see Section 2.3.1

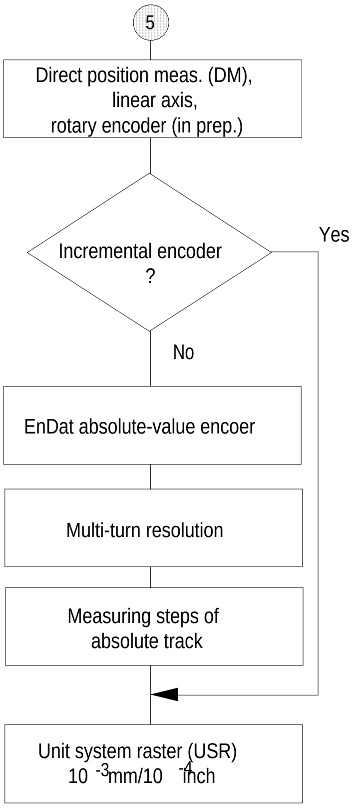
1) MD7 = 3 / 10^{-4} degree
2) MD7 = 2 / 10^{-4} inch

MD55, 56 see 7/1.2
MD1007 = MD57 / 10^{-4} degree

MD7 = 4 / 10^{-2} degree
MD55, 56 see 7/1.2
MD1007 = MD57

MD7 = 1 / 10^{-3} mm
MD55, 56 see 7/1.2
MD1007 = MD57

Direct position measurement, linear axis, rotary encoders



MD60 bit 0 = 0 / no
bit 1 = 1 / yes
MD8 = 0 / linear axis
MD57 = 2048
MD1030 bit 4 = 0 / off
MD1790 = 0 (display)

MD54 = 1 / incremental encoder
MD1007 = MD57
MD1030 bit 3 = 0

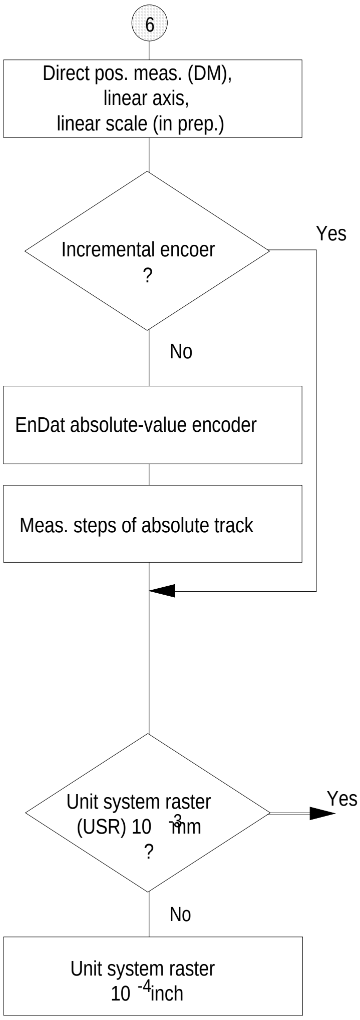
MD54 = 5 / EnDat encoder
MD1011 bit 3 = 0 / aus
MD1030 bit 3 =1
MD 1791=16 (display)

MD14 = 4096
MD1031 = 4096 (display)

MD1032 = 8192 (display)

$\left.\begin{array}{l}\text{MD7}\\ \text{MD55}\\ \text{MD56}\end{array}\right\}$ see 7/1.2

Direct position measurement, linear axis, linear scale



MD60 bit 0 = 0 / no
bit 1 = 1 / yes
MD8 = 0 / linear axis
MD1030 bit 4 = 1 / on
MD1791 = 0 (display)

MD54 = 1 / incremental encoder
MD1030 bit 3 = 0 / off

MD54 = 5 / EnDat encoder
MD1030 bit 3 = 1 / on
MD1791=16 (display)

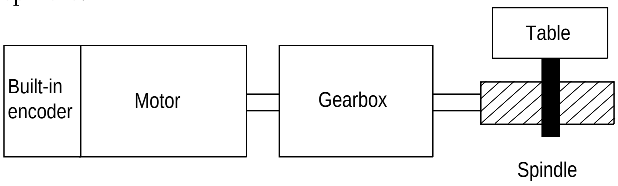
MD1031 = (display)
MD1032 = (display)

MD7 = 1 / 10^{-3} mm
MD55/56 see 7/1.2
MD1007 = MD57

MD7 = 2 / 10^{-4} inch
MD55/56 see 7/1.2
MD1007 = MD57

2.3.2 Parameterizing a Linear Axis by Means of an Indirect Measuring System (IM)

Indirect position measuring (built-in encoder) at a linear axis with gearbox and spindle:



The unit of measurement for the distance can either be 10^{-3} mm or 10^{-4} inch, by option; the selected unit system is indicated in MD7. The following example assumes that USR = 10^{-3} mm.

Given: Gear ratio $\quad ü_{SG} = \dfrac{\text{Spindle revolutions}}{\text{Encoder revolutions}}$

Spindle lead $s_S = \dfrac{\text{Distance}\,[\text{mm}]}{\text{Spindle revolution}}$

Sought: $\quad s = \dfrac{\text{Distance}}{\text{Encoder revolutions}}$

$s = s_s \,.\, ü_{SG}$

Example

Given: $ü_{SG} = \dfrac{1}{136}$, $s_s = \dfrac{20\text{ mm}}{\text{rev.}}$

Sought: $\quad s = \dfrac{20\text{ mm}}{136 \cdot \text{rev.}} \qquad s = 0.1470588235294 \dfrac{\text{mm}}{\text{rev.}}$

Converted to machine data (with refer to the unit system)

MD11 + MD12 $\cdot\, 2^{-32}$ = s $\cdot$ 1/USR

MD11 + MD12 $\cdot\, 2^{-32}$ = 0.1470588235294 $\cdot$ $1/10^{-3}$

MD11 + MD12 $\cdot\, 2^{-32}$ = 147.0588235294

MD11 + MD12 $\cdot\, 2^{-32}$ = 147 + 0.0588235294

⇒ MD11 = 147

⇒ MD12 = 0.0588235294 $\cdot\, 2^{32}$ = 252645135

The machine data are entered by means of **MCU-PIT** in physical units, i.e. the machine-internal unit system is considered internally.

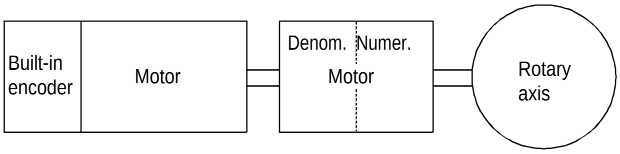
⇒ $MD11_{PIT}$ = 147 $\cdot$ 10^{-3} = 0.147

⇒ $MD12_{PIT}$ = 252645135 $\cdot$ 10^{-3} = 252645.135

From software version MCU-PIT 3.0, the value in the menu "Encoder-related data" can be entered directly: MD11/12=0.1470588235294

2.3.3 Parameterizing a Rotary Axis by Means of an Indirect Measuring System (IM)

Indirect position measuring (built-in encoder) of a rotary axis with gear



$$s = \frac{\text{Distance traversed by the rotary axis}}{\text{Encoder revolutions}}$$

The unit of measurement which can be used for the distance is either 10^{-2} degrees or 10^{-4} degrees, by option also 10^{-3} mm or 10^{-4} inch; the selected unit system is indicated in MD7. The following example assumes that USR = 10^{-4} degrees.

Given: Angle for a full rotary axis revolution

Gear ratio $ü_{SG} = \frac{\text{Rotary axis revolutions}}{\text{Encoder revolutions}}$

Sought: s

$$s = \frac{\text{Angle}}{\text{Rotary axis revolution}} \cdot ü_{SG}$$

Example

Given: 360 degrees
ü = 1 : 136

Sought:

$$s = \frac{360 \text{ degrees}}{136}$$

$$s = 2.647058823529$$

Converted to machine data (with refer to the unit system)

$MD11 + MD12 \cdot 2^{-32} = s \cdot 1/USR$

$MD11 + MD12 \cdot 2^{-32} = 2.647058823529 \cdot 1/10^{-4}$

$MD11 + MD12 \cdot 2^{-32} = 26470.58823529$

$MD11 + MD12 \cdot 2^{-32} = 26470 + 0.58823529$

$\Rightarrow MD11 = 26470$

$\Rightarrow MD12 = 0.58823529 \cdot 2^{32} = 2526451332$

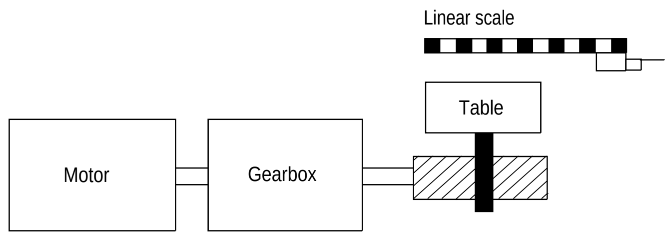
The machine data are entered by means of **MCU-PIT** in physical units, i.e. the machine-internal unit system is considered internally.

$\Rightarrow MD11_{PIT} = 26470 \cdot 10^{-4} = 2.647;$

$\Rightarrow MD12_{PIT} = 2526451332 \cdot 10^{-4} = 252645.133$

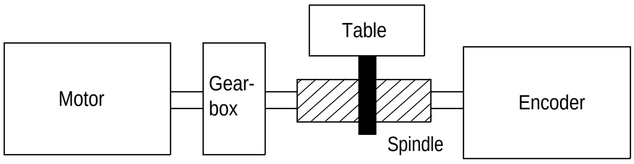
From software version MCU-PIT 3.0, the value in the menu "Encoder-related data" can be entered directly: MD11/12=2.647058823529

2.3.4 Parameterizing a Linear Axis by Means of a Linear Scale (avail. soon)



2.3.5 Parameterizing a Linear Axis by Means of a Rotary Encoder (DM)

Direct position measuring (built-on encoder) at a linear axis with gearbox and spindle



The unit of measurement which can be used for the distance is either 10^{-3} mm or 10^{-4} inch, by option; the selected unit system is indicated in MD7. The following example assumes that USR = 10^{-3} mm.

Given: Spindle lead $s_s = \frac{\text{Distance}\,[\text{mm}]}{\text{Spindle revolutions}} = 20\text{ mm}$

1 spindle revolution = 1 encoder revolution

Sought: $s = \frac{\text{Distance}}{\text{Encoder revolution}}$

Example

$s = s_s$

$\underline{s = 20\text{ mm}}$ (pay attention to the measuring gear (if any) between encoder and spindle)

Converted to machine data (with refer to the unit system)

$MD55 + MD56 \cdot 2^{-32} = s \cdot 1/USR$

$MD55 + MD56 \cdot 2^{-32} = 20 \cdot 1/10^{-3}$

$MD55 + MD56 \cdot 2^{-32} = 20{,}000$

$MD55 + MD56 \cdot 2^{-32} = 20{,}000 + 0$

$\Rightarrow MD55 = 20{,}000$

$\Rightarrow MD56 = 0 \cdot 2^{32} = 0$

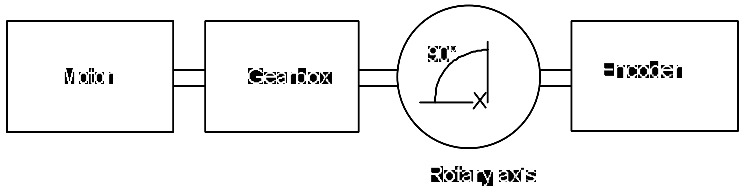
The machine data are entered by means of **MCU-PIT** in physical units, i.e. the machine-internal unit system is considered internally, and the value can be entered directly.

$\Rightarrow MD55_{PIT} = 20{,}000\text{ mm}$

$\Rightarrow MD56_{PIT} = 0.000\text{ mm}$

2.3.6 Parameterizing a Rotary Axis by Means of a Rotary Encoder (DM)

Direct position measurement (built-on encoder) of a rotary axis



The unit of measurement which can be used for the distance is either 10^{-3} mm or 10^{-4} inch, by option; the selected unit system is indicated in MD7. The following example assumes that USR = 10^{-2} mm.

Example

Given: Rotary axis that can be rotated by 90 degrees between the limit switches
Sought: distance per encoder revolution

$$s = \frac{\text{Distance}}{\text{Encoder revolution}}$$

Converted to machine data (with refer to the unit system)

$MD9 = s \cdot 1/USR$

$MD9 = 360 \cdot 10^{-2}$

$\Rightarrow MD9 = 36{,}000$

(The possible angle of rotation, in this case: 90 degrees, has no influence on MD9)

$MD55 + MD56 \cdot 2^{-32} = s \cdot 1/USR$

$MD55 + MD56 \cdot 2^{-32} = 360 \cdot 1/10^{-2}$

$MD55 + MD56 \cdot 2^{-32} = 36{,}000$

$MD55 + MD56 \cdot 2^{-32} = 36{,}000 + 0$

$\Rightarrow MD55 = 36{,}000$

$\Rightarrow MD56 = 0 \cdot 2^{32} = 0$

The machine data are entered by means of **MCU-PIT** in physical units, i.e. the machine-internal unit system is considered internally, and the value can be entered directly.

$\Rightarrow MD9_{PIT}$ = 360.00 degrees

$\Rightarrow MD55_{PIT}$ = 360.00 degrees

$\Rightarrow MD56_{PIT}$ = 0.00 degrees

3 Commissioning

Contents

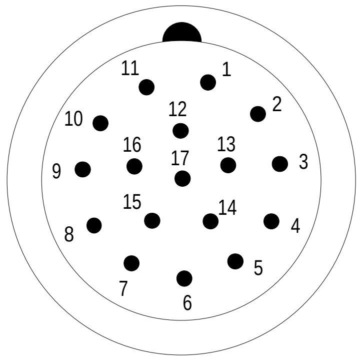
3.1 Plug-In Connectors

In the following, assignment and allocation of the encoder plug-in connectors are illustrated.

3.1.1 Built-In Incremental Encoders

Flange socket at the motor for ERN 1381/1387

Signal Name	PIN
A	1
A	2
Shield	17
B	11
B	12
0	3
0	13
C	5 1)
C	6 1)
D	14
D	4 1)
+Temp	8
-Temp	9
P-Encoder	10
5 V Sens	16
M-Encoder	7
0 V Sens	15



View of the pins on motor 1FT6/1FK6

1) with ERN 1381 "not connected"

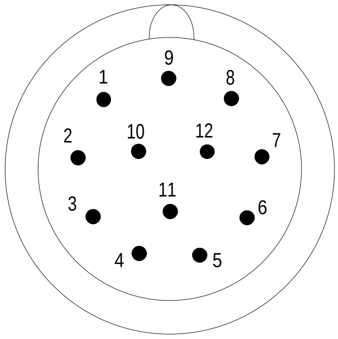
3.1.2 Built-On Incremental Encoders

Cable connector SIMODRIVE Sensor

4 connection variants can be configured:

- flange socket, axial
- flange socket, radial
- 1 m line with connector and axial line output at the encoder
- 1 m line with connector and radial line output at the encoder

Signal	PIN
A	5
$\overline{A}$	6
B	8
$\overline{B}$	1
0	3
$\overline{0}$	4
5 V	12
0 V	10
5 V Sens	2
0 V Sens	11
Shield	Casing

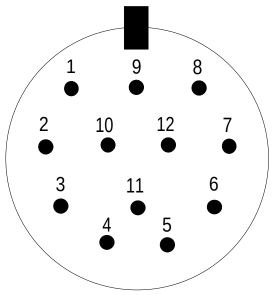


View of plug side of the connector or flange socket

Cable connector LS 186

The linear scale LS 186 is provided with a firmly attached special connector. For connection, a precut line (cable module) of a configurable length must be ordered with Heidenhain Co. Towards the MCU, this cable module has a 12-pole cable connector (see Table/Figure). The line leading further to the MCU must be configured using the Siemens Catalogs NC Z and NC Z1.

Signal	PIN
A	5
$\overline{A}$	6
B	8
$\overline{B}$	1
0	3
$\overline{0}$	4
+5 V	12
0 V	10
+5 V Sens	2
0 V Sens	11
free	9
free	7

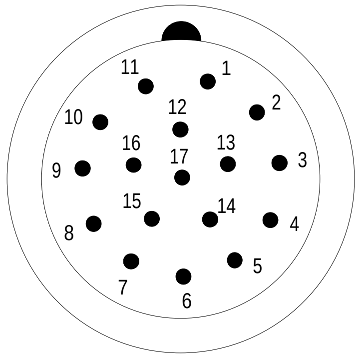


View of the plug side of the cable unit (external thread)

3.1.3 Integrated EnDat Absolute-Value Encoders

Cable connector at the 1FT6 motor for EQN 1325

Signal Name	PIN
A	1
A	2
Shield	17
B	11
B	12
Data	3
Data	13
Cycle	5
Cycle	14
+Temp	8
-Temp	9
P encoder	10
5 V Sens	16
M encoder	7
0 V Sens	15



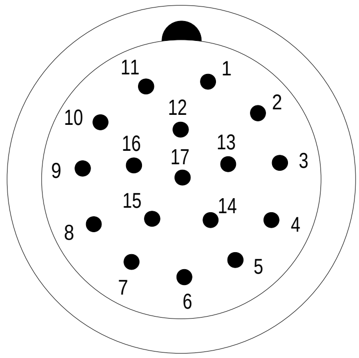
View of plug side
on motor 1FT6

3.1.4 Built-On EnDat Absolute-Value Encoder

Cable connector ROQ 425

The rotary built-on encoder ROQ 425 has a fixed connection line of configurable length (see Catalog of Heidenhain Co.) provided with a 17-pole connector.

Signal Name	PIN
A	15
A	16
Shield, intern.	11
B	12
B	13
Data	14
Data	17
Cycle	8
Cycle	9
+5 V	7
0 V	10
+5 V Sense	1
0 V Sense	4



View of plug side

3.2 Adjusting the Encoder

Integrated encoder

The integrated encoder in the motor is factory-adjusted. In case of repair and when changing the encoder, the motor should be adjusted at an authorized workshop.

EnDat absolute-value encoder

After attaching a motor provided with an EnDat absolute-value encoder or an EnDat absolute-value encoder as direct measuring system, the reference between the absolute value of the encoder and the machine neutral must be preset. This is to be done once by "Set reference point" and then saving the machine data.

3.3 Summary: Machine Data of Encoder

The machine data are entered either by means of MCU-PIT (optional) or into the machine data block during the commissioning. The encoder machine data have been selected, defined or calculated during the configuration (see Section 2.3).

MCU machine data are 2-digit, and drive machine data are 4-digit.

Abbreviations

- IM ⇒ indirect position measurement by means of an integrated encoder
- DM ⇒ direct position measurement by means of a built-on encoder
- A-MD ⇒ drive machine data to be entered analogously

3.3.1 MCU Encoder Machine Data

MD	IM/DM	Designation	Value/Description	Unit	A-MD
7	IM/DM	Unit system raster (USR)	1 = 10^{-3} 2 = 10^{-4} 3 = 10^{-4} 4 = 10^{-2}	mm inch degrees degrees	
8	IM/DM	Axis type	0 = linear axis 1 = rotary axis		
9	IM/DM	End of rotary axis	1 ... 1 000 000 000 • End of rotary axis: value for the ?? of the distance display, no matter whether mm or degrees • integer multiple of (MD11 +2^{-32} x MD12) or (MD55 +2^{-32} x MD56)	USR	
10 54	IM DM	Encoder	0 = does not exist 1 = incremental encoder 5 = EnDat absolute-value encoder		1011 1030
11 55	IM DM	Distance/encoder revolutions (=distance/motor revolutions) For the linear scale also possible: distance between 2 zero marks or distance/spindle revolution	1...1 000 000 000 Establishing the value: • calculating the total distance/encoder revolution (motor revolution) • Representing the result in the USR (measuring system raster) • Entering the integer digits (digits prior to the decimals) in the MD of the DB. (see examples in Chapter 2)	USR	
12 56	IM DM	Distance to go in MD11 Distance to go in MD55	0 ... 2^{32} - 1 Decimals of MD11/MD55 x 2^{32} (Examples see Chapter 2)	2^{-32} USR	
13 57	IM DM	Increments/encoder or motor revolutions Linear scale: increments/distance (MD 55)	2^1... 2^{25} Entry as per encoder type plate Linear scale: $MD57 = \frac{\text{MD55 (digits prior to the dec. and decimals)}}{\text{Graduation period [USR]}}$ Graduation period, e.g. 16 µm for the LC 181 (example see Chapter 2)	incr./rev. or incr./dist. (dist.: mm, inch)	1005 1007
14	IM DM	Number of revolutions EnDat absolute-value encoder	0 or 1 Single-turn encoder 2^1... 2^{12} Multi-turn encoder (only numbers to the power of six permitted)	U	1021 1022 1031 1032
17	IM/DM	Absolute-encoder adjustment	is entered automatically when setting the reference point; cannot be changed by the user. The value can be saved by means of MCU-PIT "Save to FEPROM - FM-POS"		

MD	IM/DM	Designation	Value/Description	Unit	A-MD
60.x	IM/DM	Selection between IM/DM	Bit 0 = 1 IM (indirect measuring system) On Bit 1 = 1 DM (direct measuring system) On From software version 3.0 up, both measuring systems can be active at the same time. The integrated encoder for speed and acquisition of the rotor position is always active, irrespective of MD60.x.		

3.3.2 Encoder Machine Data

MD	IM/DM	Designation	Value/Description	Unit
1005	IM	Number of graduation marks of motor encoder: (increments of incremental track with EnDat absolute-value encoder)	128 ... 8192	Increments (periods) per revolution
1007	DM	Increments/encoder revolution or linear scale: increments per distance MD55 (digits before the decimals and decimals) with EnDat absolute-value encoder, with refer to the incremental track	0 = no DM provided 1 ... 65535 MD1007 = MD57	increments (periods)/revolution or increments/distance (distance: mm, inch)
1011 Bit 3	IM	Configuration of motor encoder	0 = incremental encoder 1 = EnDat absolute-value encoder	
Bit 4			0 = rotary encoder 1 = linear encoder (not available at the moment)	
Bit 5			0 = motor encoder provided 1 = motor encoder not provided	
1021	IM	Motor encoder: Multi-turn resolution of EnDat absolute-value encoder	0 ... 65535 (value only readable is written automatically)	1/min
1022	IM	Motor encoder: Number of measuring steps at the absolute track/revolution	0 ... 65535 (value only readable, is written automatically)	incr./rev.
1030 Bit 3	DM	Encoder type	0 = incremental encoder 1 = EnDat absolute-value encoder	
Bit 4		Design	0 = rotary encoder 1 = linear scale	
1031	DM	Built-on encoder: Multi-turn resolution of EnDat absolute-value encoder	0 ... 65535 (value only readable, is written automatically)	1/min
1032	DM	Built-on encoder: Number of measuring steps at the absolute track / revolution or with linear scale: number of revolutions of absolute track /distance (MD55)	0 ... 65535 (value only readable, is written automatically)	incr./rev. incr./distance (distance: mm, inch)
1790	IM	Type of measuring circuit: indirect measuring system	0 = voltage raw signals 16 = voltage raw signals (EnDat)	
1791	DM	Type of measuring circuit: direct measuring system	0 = sin/cos voltage raw signals -1 = no measuring system provided 1 = current raw signals 16 = voltage raw signals (EnDat)	

3.3.3 Explanations to Selected Machine Data

End of rotary axis MD9

Machine data MD 9 determine the value at which the MCU detects the end of the rotary axis.

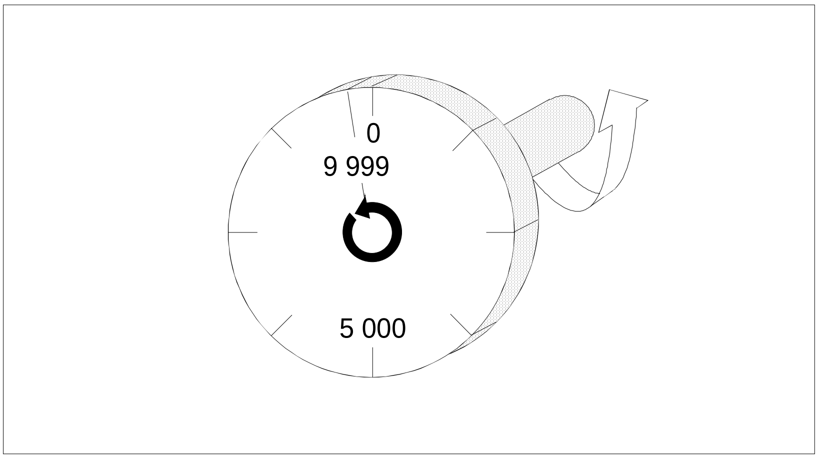
This value is the theoretically highest value that can be reached by the actual value. When this value is reached, the actual-value display switches back to "0".

However, the theoretically highest value is never displayed, as its physical position is the same as that of the beginning of the rotary axis (0).

Example:

The following example makes the situation clear.

You set the value 10 000 for the rotary axis.



The value 10 000 is not displayed. The display always changes from 9 999 to 0.

In the negative direction of rotation, the display changes from 0 to 9 999.
MD 9 only influences the actual-value display.

3.4 Error Messages

3.4.1 Errors in the Encoder Machine Data

The Error Description is to be found in Section 13, Chapter 2.6.

Error No.	MD	Error Description
01287	7	Measuring system raster does not match with the USR of the DBs: NC, SW, WK
01288	8	No linear or rotary axis parameterized
01289	9	End of rotary axis: value beyond the permissible range of values
01290	10	Illegal encoder type (IM)
01291	11	Distance/encoder revolution (spindle revolution or distance between two zero pulses): value beyond the permissible range of values
01293	13	Increments/encoder revolution (distance): value beyond the permissible range of values
01294	14	Number of revolutions of the EnDat absolute-value encoder: value beyond the permissible range of values
01334	54	Illegal encoder type (DM)
01335	55	Distance/encoder revolution (spindle revolution or distance between two zero pulses): value beyond the permissible range of values (DM)
01336	57	Increments/encoder revolution (/distance) (DM): value beyond the permissible range of values

3.4.2 Encoder Faults during Operation

Diagnostic alarms

<table>
<tr><td colspan="2">Diagnostic alarms are identified by setting the respective bits in the diagnosis data record (DS0/1).</td><td colspan="2">Faults that can be Hidden</td></tr>
<tr><th>MD
(MCU-PIT)</th><th>Error Description</th><th>all</th><th>8.2 only</th></tr>
<tr><td>24008.0</td><td>Cable break incremental encoder</td><td rowspan="4">MD
20.5
= 0</td><td rowspan="4">MD 20.5 = 1
MD 20.4 = 0</td></tr>
<tr><td>24008.1</td><td>Transmission error EnDat absolute-value encoder</td></tr>
<tr><td>24008.2</td><td>Zero-mark error</td></tr>
<tr><td>24008.3</td><td>Voltage monitoring of encoder</td></tr>
</table>

Data errors

Error No.	Error Description
01144	Unit system does not match with the USR of the DBs: NC, SW, WK (see also F 01287, Section 3.4.1)

Run-up faults

Error No.	Error Description
24578	Absolute track of EnDat absolute-value encoder defective
24580	Time monitoring of absolute track exceeded
24587	MD 13 $\neq$ MD 1005 or MD 57 $\neq$ MD 1007
24588	MD 10 $\neq$ MD 1011 Bit 3, MD 54 $\neq$ MD 1030 Bit 3
24589	MD 60 invalid coding
24590	MD 11, 13, MD 1401 do not match with MD 23 (maximum speed)

SIMODRIVE error messages

Error No.	Error Description	Monitoring inactive when MD set to "1" ($\triangleq$ OFF)	Errors can occur when
028	Submodule for direct encoder not permitted	-	-
045	Distance-coded reference mark or Bero signal detected during fine synchronization.	1600.4	Power-on
30504	Measuring circuit error: motor encoder	1600.5	Power-on
30507	Synchronization error: rotor position	1600.7	Power-on
30508	Zero-mark error: motor encoder	1600.8	Power-on
30509	Inverter limit frequency exceeded; probable cause:incorrect MD 1005	-	-
30609	Encoder limit frequency exceeded	1601.9	Reset
30725	MD 1005 = 0	-	-
30737	Two EnDat-absolute-value encoders configured (MD 1030 / 1011 bit 3)	-	-

SIMODRIVE error messages provided by means of machine data

MD	Bit No.	Error Description
1023	0	Illumination failure
	1	Faulty signal amplitude
	2	Defective code connection
	3	Overvoltage
	4	Undervoltage
	5	Overcurrent
	6	Battery must be replaced
	7	reserved
	8	reserved
	9	C/D track of encoder defective
	10	Protocol cannot be aborted
	11	SSI level at data line detected
	12	TIMEOUT when reading the measured value
	13	CRC error
	14	reserved
	15	Encoder defective
1033	0	Illumination failure
	1	Signal amplitude too low
	2	Defective code connection
	3	Overvoltage
	4	Undervoltage
	5	Overcurrent
	6	Battery must be replaced
	7	reserved
	8	reserved
	9	reserved
	10	Protocol cannot be aborted
	11	SSI level at data line detected
	12	TIMEOUT when reading the measured value
	13	CRC error
	14	reserved
	15	Encoder defective

4 Index

U

SIMODRIVE 611

MCU 172A
Single-axis positioning control

Planning Guide
Selection, Installation and Connection of

1FK6/1FT6 Motors and SIMODRIVE 611 Components

Edition January 1997

Note

For reasons of transparency, this document doesn't include all of the details on all of the product types. Thus, it does not provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be required or should particular problems arise, which are not covered sufficiently in this document, then the local Siemens sales office should be contacted.

The contents of this Guide shall neither become part of nor modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties nor modify the existing warranty.

BERO, SIMATIC, SIMODRIVE, SINEC, SINUMERIK, STEP are Siemens product names.

The other names in this document could be registered trademarks. It may be illegal that third parties use these names or designations.

Subject to technical changes without prior notice.

1 Engineering motors

Inhalt

1.1 General information

1.1.1 Electrical data

1.1.1.1 Definitions

Characteristics

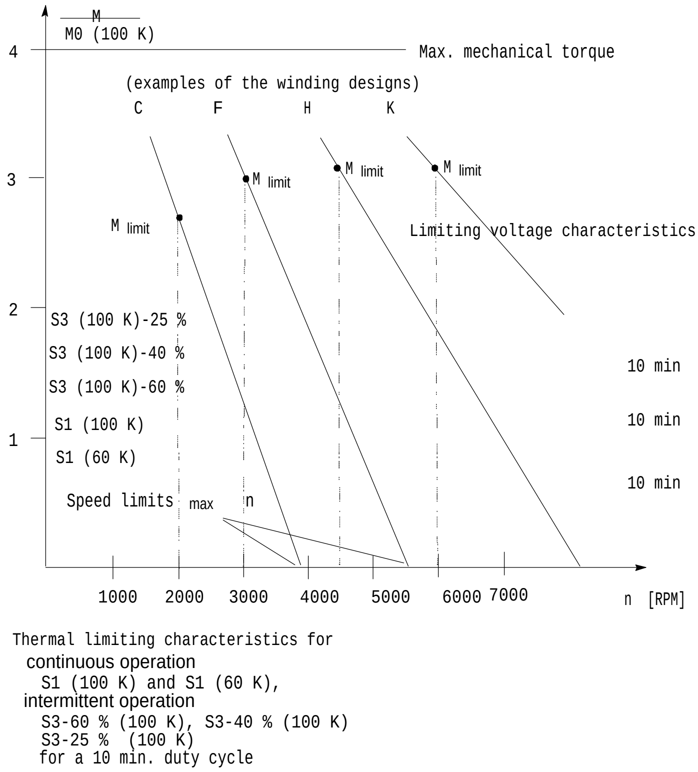


Fig. 1-1 Normalized speed-torque diagram (also refer to Table 1-1)

100 K, 60 K values

100 K or 60 K is the average winding temperature rise.

105 K corresponds to a utilization according to temperature rise class F.

60 K lies within utilization to temperature rise class B. The 60 K utilization should only be used, if

- the housing temperature is below 90 °C for safety reasons
- or if the shaft temperature rise negatively influences the mounted machine.

A permissible ambient temperature or cooling medium temperature of 40 °C is generally valid for all data.

Torque characteristics

Various armature circuit designs are possible within a frame size. The AC servomotors provide a torque characteristic which is constant up to approx. 2000 RPM, and above this, decreases, depending on the motor type. A high overload capability is available over the complete speed control range.

The following limits are valid for all servomotor-drive converter module combinations.

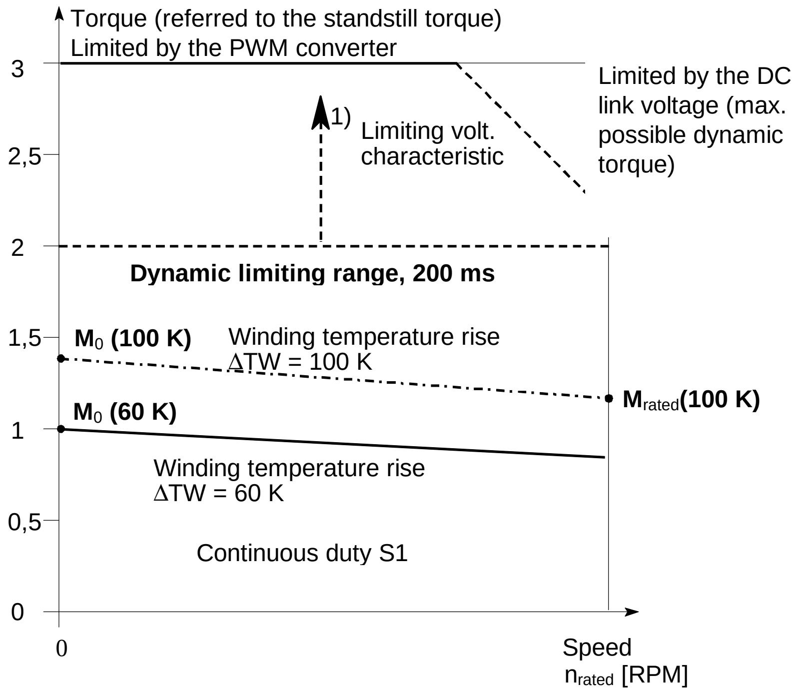


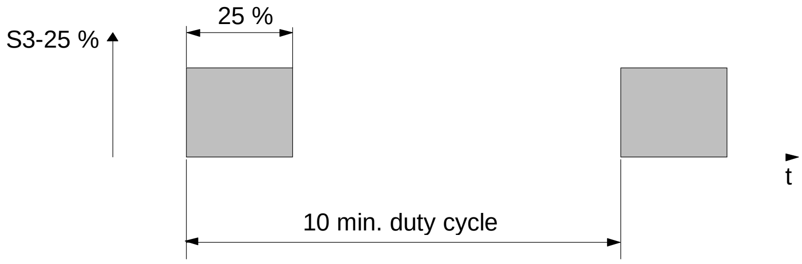
Fig. 1-2 Speed-torque characteristics of AC servomotors

1) Dynamic limiting range 2 * M_0 (60 K) corresponds to the standard drive arrangement. In addition, the drive converter can be configured/engineered according to the particular drive application. If required, an additional motor overload protection should be provided; the mechanical motor limits are 4 * $M_{0100\ K}$.

When the control loop is open, i. e. no closed-loop circuit operation, e. g. an optical encoder is not connected, with the rated voltage data, the motor can accelerate to n_{max} (according to the technical data), and significantly exceed this value for higher supply- or DC link voltages. In this case, only the dynamic torque, limited by the limiting voltage characteristic, can be generated.

Thermal limiting characteristic

Corresponds to the S1 (100 K) characteristic in the diagrams. For intermittent duty, the arithmetic average may not be exceeded.



The switch-on duration is normalized according to VDE 0530 for 15 %, 25 %, 40 %, 60 %.
It is 10 min. if a duty cycle is not specified.

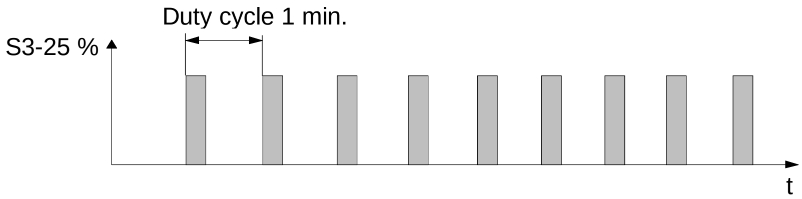
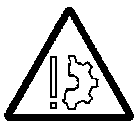


Fig. 1-3 Power-on duration for intermittent duty

Voltage limiting characteristics

The motor counter EMF increases linearly with increasing speed. The difference between the DC link voltage and the increasing motor EMF is available to impress the current. This limits the magnitude of the current which can be impressed at high speeds.



Warning

Continuous operation at the voltage limiting characteristic in the range above the S1 characteristic is thermally inadmissible for the motor.

The voltage limiting characteristic of a motor with a 6000 RPM rated speed lies far above that of the characteristic for the same motor type with a 2000 RPM rated speed. However, this motor requires a far higher current for the same torque. Thus, it is practical to select the rated speed so that this does not lie appreciably above the maximum speed required for the particular application. The converter module rating can thus be minimized (current rating).

Table 1-1 Winding design code

Rated speed [RPM]	Winding design (10th position of the Order No.)
1500	B
2000	C
3000	F
4500	H
6000	K

Shift in the voltage limiting characteristic

In order to identify the motor limits at a lower DC link voltage, the voltage limiting characteristic shown must be shifted to the left for the particular armature circuit. A lower DC link voltage is obtained, e. g. for operation from an uncontrolled supply infeed.

The amount of shift is obtained as follows:

For a DC link voltage of $V_{DC\ link(new)}$ a shift is obtained along the x axis (speed) by a factor of: $\mathbf{V_{DC\ link(new)}/600\ V}$

Example:

If point (P1) of the specified voltage limiting characteristic is at 3000 RPM, then the new voltage limiting characteristic at 490 V for (P2) is:

$$\frac{490\ V}{600\ V} = 0.82$$

3000 RPM * 0.82 = 2460 RPM.

The new voltage limiting characteristic must be drawn in parallel to the existing characteristic at n = 2460 RPM.

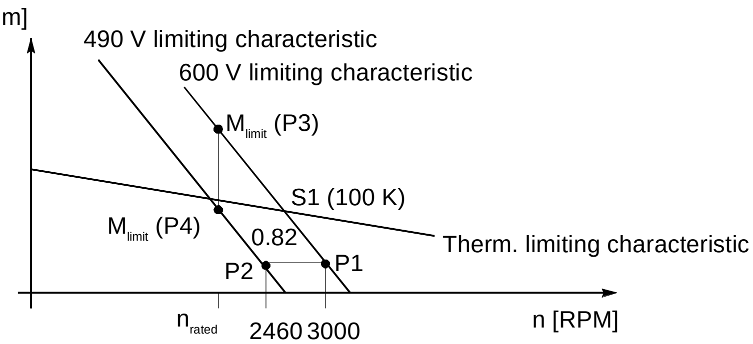


Fig. 1-4 Shift in the voltage limiting characteristic

The new limiting torque with the new limiting characteristic can be calculated according to the following formula:

$$\text{1FT6/1FK6:}\quad M_{limit(new)} = \frac{V_{DC\ link(new)} - \sqrt{2} * k_E * n_{rated} / 1000}{600V - \sqrt{2} * k_E * n_{rated} / 1000} * M_{limit}$$

k_E	= voltage constant from the data sheet
M_{limit}	= limiting torque from the data sheet (P3)
$M_{limit(new)}$	= new limiting torque at n_{rated} (P4)
n_{rated}	= rated speed from the data sheet
Check:	P4 must lie on the new limiting characteristic

Stall torque M_0

Thermal limiting torque when the motor is at a standstill, corresponding to a winding temperature rise of 100 K or 60 K. It is available for an unlimited time at n = 0. M_0 is always greater than the rated torque M_{rated}.

Stall current I_0

RMS motor phase current to generate the stall torque.

1FT6 and 1FK6 motors are supplied with sinusoidal currents.

Rated torque M_{rated}

Thermally permissible continuous torque at the motor rated speed.

Rated current I_{rated}

RMS motor phase current to generate the rated torque.

Rated output P_{rated}

The power which is available at rated speed and rated torque.

Limiting torque M_{limit}

Maximum torque, which is available at rated speed for acceleration.

Limiting current I_{limit}

Motor phase current to generate the limiting torque.

Max. current I_{max}

This current limit is defined by the magnetic circuit. The magnetic material is irreversibly demagnetized if this is even briefly exceeded.

Mechanical limiting speed n_{max}

The maximum permissible operating speed is n_{max}. It is either electrically (voltage limiting characteristic) or mechanically (centrifugal forces, bearing stressing) defined. The lower of the values is specified in the list data.

Maximum torque M_{max}

Torque, which is generated at the maximum permissible current.

The following maximum accelerating torques are briefly available for high-speed dynamic operations:

- $M_{max} = 4 * M_0$ (100 K) for shaft heights 36, 48, 63 (non-ventilated)
- $M_{max} = 4 * M_0$ (60 K) for shaft heights 71, 80, 100, 132 (non-ventilated)
- $M_{max} = 2.5 * M_0$ (100 K) for shaft heights 71, 80, 100, 132 (force-ventilated)

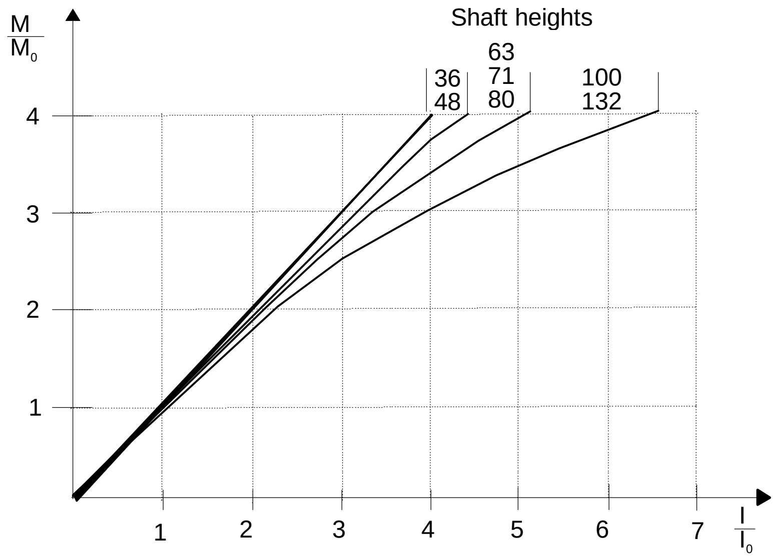


Fig. 1-5 Torque-current characteristic for various shaft heights

The individual characteristics of the 1FT6 and 1FK6 motors are combined in “typical shaft height ranges”. The lefthand characteristic can be considered as the “best case” and the righthand, as “worst case”.

Torque constant k_T

Quotient of the stall torque and stall current. $k_T = M_0/I_0$. The constant is valid up to approx. 2 * M_0.

Note

When configuring the required rated- and accelerating currents this constant is <u>not</u> valid (motor losses!). Further, the steady-state load and the friction torque must also be included in the calculation.

Voltage constant k_E

Induced motor voltage at a speed of 1000 RPM. The phase-to-phase motor terminal voltage is specified.

Winding resistance R_{phase}

The phase resistance is specified at a room temperature of 20 °C. The winding is in a star configuration.

Inductance L_D

The three-phase inductance is specified $L_D = 1.5 * L_{phase}$

Electrical time constant T_{el}

Quotient of the three-phase inductance and winding resistance.
$T_{el} = L_D/R_{phase}$

Mechanical time constant T_{mech}

The mechanical time constant is obtained by the tangent along a theoretical ramp-up function through the origin.

1FT6/1FK6: $T_{mech} = 3 * R_{phase} * J_{mot}/k_T^2$ [s]

J_{mot} = servomotor moment of inertia [kgm^2]
R_{phase} = stator winding resistance [Ohm]
k_T = torque constant [Nm/A]

Thermal time constant T_{th}

Defines the temperature rise of the motor housing when the motor load is suddenly increased (step increase) up to the permissible S1 torque. The motor reaches 63 % of its final temperature after T_{th}.

Thermal resistance R_{th}

Defines the power loss through the motor housing under rated operating conditions.

Braking resistance $R_{a\ opt}$

$R_{a\ opt}$ corresponds to the resistance connected externally in series with the motor winding in each phase for armature short-circuit braking. If this resistance value is specified as zero, then the optimum braking characteristics are achieved without any external resistors, i. e. the terminals are directly short-circuited.

Braking torque $M_{b\ opt}$

$M_{b\ opt}$ corresponds to the average optimum braking torque, which is achieved by adapting the resistance.

Tolerance data

(Data specifications extending beyond these are subject to the measurement accuracy)

Table 1-2 Tolerances of the motor list data

Motor list data		Typ. value	Theoretical value
Stall current	I_0	± 3 %	± 7.5 %
Max. speed	n_{max}	± 3 %	± 7.5 %
Electrical time constant	T_{el}	± 5 %	± 10 %
Torque constant	K_T	± 3 %	± 7.5 %
Voltage constant	K_E	± 3 %	± 7.5 %
Winding resistance	R	± 5 %	± 10 %
Moment of inertia	J_{Mot}	± 2 %	± 10 %

Core types

Core types are a part of the complete motor spectrum. Core types have shorter delivery times, and are, to some extent, available ex-stock. The number of options is restricted. The order designation is modified.

1FK6/1FT6

The motor types essentially differ by the shorter type of construction of the 1FK6 motor with respect to 1FT6 motors

1.1.1.2 Rating plate data

Example from the 1FT6 series:

SIEMENS	Brushless-Servomotor (H)
	1FT6061-1AF71-4AG0
MADE IN GERMANY	
Nr. E 1Q62 7603 01 001	

M_0 = 3.3/4.0 Nm $I_{0(RMS)}$ = 2.25/2.75 A 60/100 K
M_n = 3.50 Nm S1 3000 RPM Vi(RMS) = 282 V Y
(M = 3.75 Nm S1 1500 RPM Vi(RMS) = 141 V Y)
IEC 63 IMB5 IP 64 I.CL.F VDE 0530 PTC Therm.
Encoder nmax. 4200 RPM
Brake EBD ... 24 V/20 W

Typ EBD holding brake
operating voltage, power drain

Encoder (tachometer, encoder, resolver)

Frame size (shaft height), type of construction,

degree of protection, insulating material class,
thermal protection

Rated torque in S1 duty at rated speed,

induced phase-to-phase, RMS motor voltage

2nd line: Additional operating point (for a 230V converter

input voltage)

Stall torque/stall current

for a 60/100 K winding temperature rise

Serial number

16-position motor Order No.

Balancing type, H = half key balancing

(only specified for shafts with keyway)

1.1.2 Mechanical data

1.1.2.1 Definitions

Type of construction (acc. to IEC 34-7)

1FT/1FK motors are supplied in type of construction IMB5. They can be used in IM V1 or IM V3 types of construction without any special order designation.

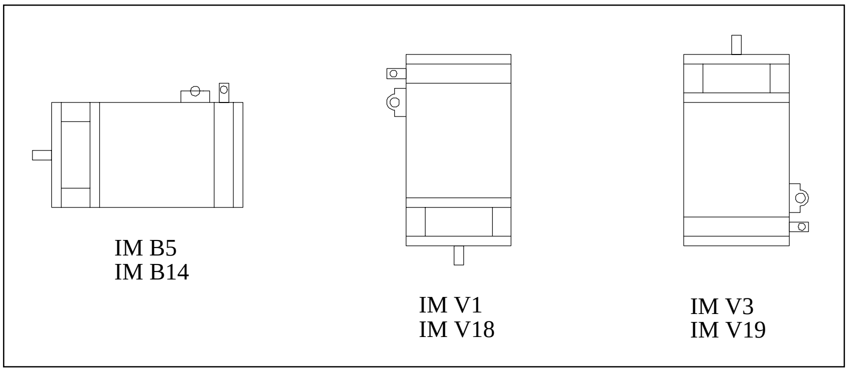


Fig. 1-6 Types of construction

When engineering types of construction IM V3 and IM V19, the permissible axial forces (rotor weight) and especially the required degree of protection must be observed.

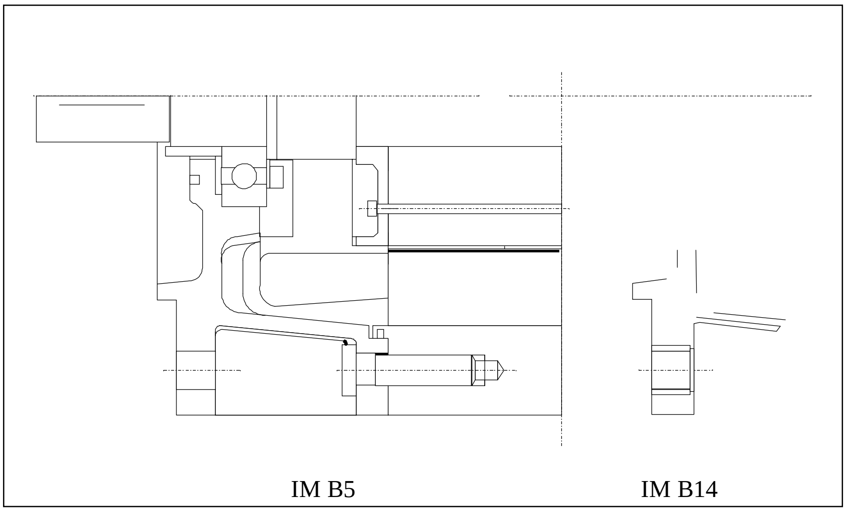


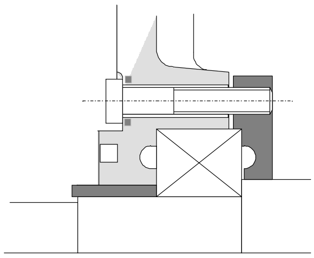
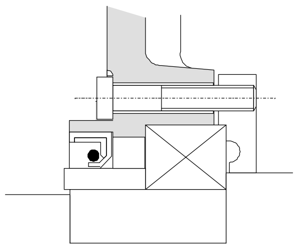
Fig. 1-7 Type of construction IM B5/IM B14 (with threaded gland)

Degree of protection 1FT6 (acc. to EN 60529)

The complete 1FT6 motor is sealed using O rings. This conforms to degree of protection IP 67 for the housing.

The motor shaft sealing principle can be taken from the overview, Table 1-3. All seals are manufactured from fluoride rubber (FPM).

Table 1-3 Overview of the types of protection according to DIN 40050

Degree of protection EN 60529	Shaft sealing using	Application
IP 64	Gland 	Only small amounts of moisture are continuously permitted in the area of the shaft and flange.
IP 67 (only for 1FT5 and 1FT6)	Rotary shaft seal, DIN 3760 	For gearbox mounting (for non-sealed gearboxes) to seal against oil. To guarantee functional reliability, it should be ensured that the sealing lip is adequately cooled and lubricated with gearbox oil. Lifetime, 5000 hours

Selecting the motor degree of protection

Often, protection from water is by itself not adequate, as generally oil-based, penetrating and/or aggressive cooling/lubricating mediums are used.

The following Table is intended to help you select the required degree of protection. In addition to the theoretical DIN specifications, experience values have also been taken into account. If in doubt, then the next higher degree of protection should be selected.

Degree of protection 1FK6

IP64; an oil-tight flange (IP67) is optionally available.

Table 1-4 Selecting the motor degree of protection

Environment	Fluids		
	General shopfloor environment	**Water; oil, general cooling/lubricating medium ($95\%\ H_2O$; 5 % oil)**	**Penetrating oil; petroleum; aggressive cooling/lubricating medium**
Dry	IP 64	-	-
Wet environment	-	IP64 (with oil as cooling/lubricating medium: IP 67)	IP 67
Mist	-	IP 65	IP 67
Spray	-	IP 65	IP 68*
Jet	-	IP 67	IP 68*
Splash; brief immersion, continuous flooding	-	IP 67	IP 68*

*: On request

IP☐☐	1st code (0-6):	Protection against contact and the penetration of foreign bodies
	2nd code (0-8):	Protection against the penetration of water (no protection against oil)

Cooling

Operating temperature range: -15 °C to +40 °C
All catalog data refer to an 40 °C ambient temperature, and a non-insulated thermal design.

Non-ventilated (9th position of the Order No.: A)

The power losses are dissipated through radiation and natural convection. The motor mounting must therefore guarantee sufficient heat dissipation.

Servomotors can have high surface temperatures
(> 100 °C). When required, provide protection against contact.

Forced-ventilation (9th position of the Order No.: S)

Available for selected types (refer to the Catalog)

- for 1FT6 for shaft heights 80, 100 and 132
- for 1FK6, forced-ventilation is not provided

For forced-ventilated motors, it is not permissible that the hot air is drawn-in again.

The following features for non-ventilated motors remain unchanged:

- encoder system
- holding brake
- type of construction, flange dimensions
- vibration- and shock stressing
- oscillation characteristics
- moment of inertias
- natural torsional- and shaft bending frequencies
- bearing design

Degree of protection:

Motors with separately-driven fans fulfill degree of protection IP 64 in accordance with DIN 40 050. The IP 65 or IP 67 options cannot be fulfilled using separately-driven fans.

The motor- and shaft-height specific design and how the separately-driven fan is connected are described in the various motor sections.

Bearing design

The bearings are sealed at both sides and are permanently lubricated. The bearings are designed for a minimum ambient temperature of -15 °C.
The specific designs can be taken from the motor data.

Note

We recommend that the bearings are replaced after approx. 20 000 operating hours, however not later than 5 years.

Motor rotation

It is not permissible to rotate the shaft at the motor non-drive end. If the motor is to be manually rotated, this should be done at the mechanically most accessible position (e. g. ball screw spindle).

Radial eccentricity, concentricity and axial eccentricity (acc. to DIN 42955)

Table 1-5 Radial eccentricity of the shaft end to the housing axis (referred to cylindrical shaft ends)

Shaft height	Standard N	Option R
36	0.035 mm	0.018 mm
63	0.04 mm	0.021 mm
80	0.05 mm	0.025 mm
100	0.05 mm	0.025 mm
132	0.05 mm	0.025 mm

Table 1-6 Coaxiality- and axial eccentricity of the flange surface to the shaft axis (referred to the centering diameter of the mounting flange)

Shaft height	Standard N	Option R
36	0.08 mm	0.04 mm
63	0.1 mm	0.05 mm
80	0.1 mm	0.05 mm
100	0.1 mm	0.05 mm
132	0.125 mm	0.063 mm

Noise (acc. to DIN 45635)

The noise specifications are valid for non-ventilated motors when supplied from a SIMODRIVE 611 PWM inverter, measured at a distance of 1m.

Table 1-7 Noise

Shaft height	Measuring surface sound pressure level under no-load conditions dB (A) 0 to 6000 RPM
36	55
63	65
80	70
100	70
132	70

Vibration severity (acc. to IEC 34-14)

The specified values only refer to the motor itself. The overall system vibration characteristics can increase these values at the motor.

Speeds of 1800 RPM and 3600 RPM and the associated vibration severity limit values are defined according to IEC 34-14. The speeds of 4500 RPM and 6000 RPM and the specified vibration severity limit values are defined by the motor manufacturer.

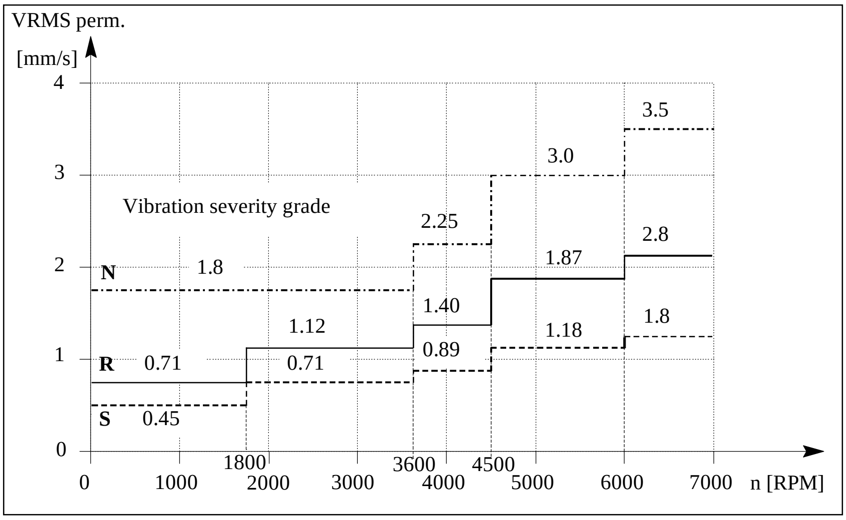


Fig. 1-8 Vibration severity limit value characteristics for shaft heights 36 to 132

Shock stressing (acc. to DIN 40046, T7)

The maximum, briefly permissible radial acceleration values which do not negatively influence the drive, are specified in Table 1-8 (not when the motor is operational; e. g. during transport):

Table 1-8 Shock stressing

Shaft height	Acceleration
36	1000 m/s^2
48	1000 m/s^2
63	500 m/s^2
71	300 m/s^2
80	300 m/s^2
100	200 m/s^2
132	100 m/s^2

Vibration stressing

The maximum permissible limit values where the motors remain fully functional are only valid for motors without brake.

10 m/s^2 axial (20 Hz to 2 kHz)
30 m/s^2 radial (20 Hz to 2 kHz)

Balancing (acc. to DIN ISO 8821)

For motors **with** key:

1FT6/1FK6 motors: Half key balancing

Cantilever force stressing

The permissible cantilever forces are shown in the diagrams for the appropriate motors.

Cantilever forces applied to the shaft end

- at average operating speeds
- for nominal bearing lifetimes of 20 000 hours

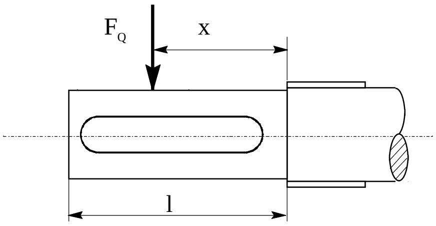


Fig. 1-9 Point of application of cantilever forces at the motor shaft end

Dimension x: Distance between the point of application of force F_Q and the shaft shoulder in mm.

Dimension l: Length of the shaft stump in mm.

Calculating the belt tensioning force:

$F_R = 2 * M_0 * c/d_R$

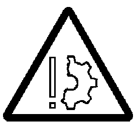
F_R	[N]	Belt tensioning force
M_0	[Nm]	Motor stall torque (starting torque)
d_R	[m]	Effective diameter of the belt pulley
c		Tensioning factor for the accelerating torque Experience values for toothed belts c = 1.5 to 2.2 Experience values for flat belts c = 2.2 to 3.0

For other designs, the actual forces resulting from the torques which have to be transferred must be taken into account.

$F_R \leq F_{qper.}$

Axial force stressing

The permissible axial forces are shown in the diagrams for the appropriate motors.



Caution

Axial forces are not permissible for motors with integrated holding brake!

When using, for example, helical gears as drive element, in addition to the radial force, the motor bearings are also subject to an axial force. For axial forces towards the motor, the bearing contact force can be exceeded, so that the rotor can move according to the bearing axial play (up to 0.2 mm).

The permissible axial force of the 1FT6 drive is calculated, depending on the mounting position, as follows:

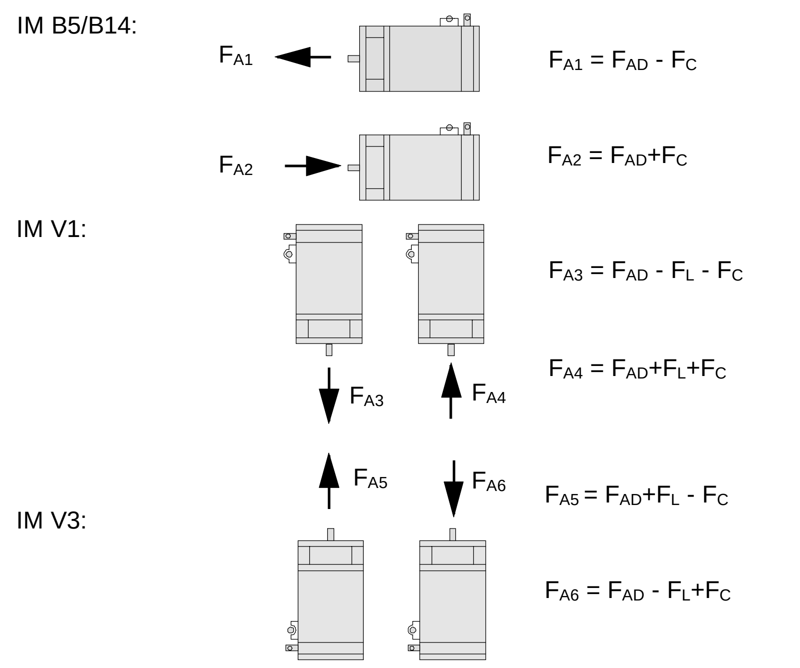


Fig. 1-10 Permissible axial force corresponding to the mounting position for 1FT6 motors

$F_{A1...6}$	axial force permissible on operation
F_{AD}	permissible axial force as a function of the cantilever force F_Q and the average speed
F_C	bearing contact force, refer to Table 1-30, servomotor 1FT6
F_L	rotor weight (force) refer to Table 1-30, servomotor 1FT6

The permissible axial force can be approximately calculated using the following formula:

$$F_A = 0.35 * F_Q$$

More precise information can be taken from the diagrams, taking into account the mounting position.
1FK6 motor data are provided in Catalog NC60.1.

Rotor weight and bearing contact force
The appropriate values are specified in the motor sections.

Paint finish

1FT6: Grey (SN30901-614) two-component epoxy resin paint;
a special paint finish for tropical climates is not required.
1FK6: Primer, no paint finish

1.1.2.2 Mounted/integrated components

Effect of mounted components

By flanging the motor to the mounting surface, some of the motor power losses are dissipated via the motor flange.

- **non-thermally insulated mounting**

  The following mounting conditions are valid for the specified motor data:

Table 1-9 Mounting conditions, non-thermally insulated mounting

Shaft height	**Steel plate width x height x thickness**	**Mounting surface [m²]**
36/48	120 x 100 x 40	0.012
63 to 132	450 x 370 x 30	0.17

  The heat dissipating characteristics are improved for larger mounting surfaces.

- **thermally-insulated mounting without additional mounted components**

  The motor torque must be reduced by between 5 % and 10 %. It is recommended that the drive is engineered with the M_0(60 K) values.

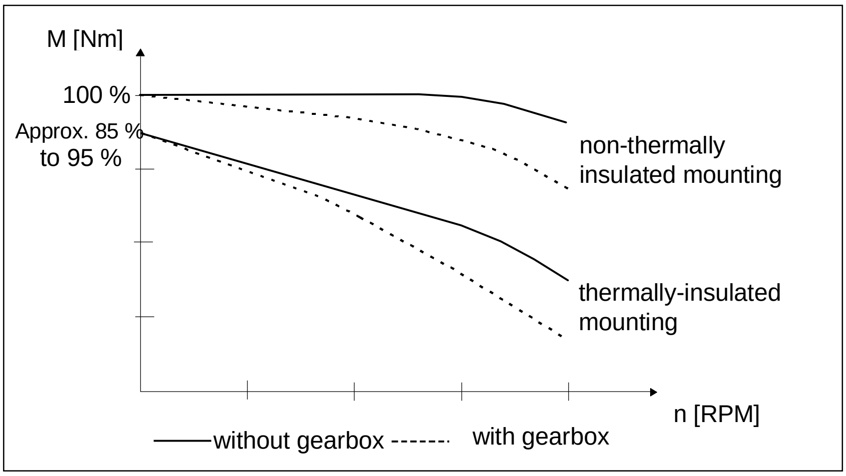


Fig. 1-11 S1 characteristics

- **thermally-insulated mounting with additional mounted components**
  - holding brake (integrated in the motor)
    no additional torque derating required
  - gearbox
    the torque must be derated (refer to the diagram above)

  Information on the rating plate: “reduce rating with gearing”

Dimensioning information/instructions for the required motor size are provided in the following section.

Gearboxes

The following motor options are recommended:

- increased radial eccentricity (R) and flange tolerance
- IP 67 (if gearbox oil is present at the motor flange)

Please refer to the gearbox manufacturers Catalogs for technical data.

Dimensioning the gearbox

1. Selecting the gearbox size

   The following parameters must be taken into account:

   Accelerating torque, continuous torque, cycle number, cycle type, permissible input speed, mounting position, radial- and axial forces and the torsional play

   We recommend that the motor-gearbox assignment is based on the following:

   $M_{max,\ gearbox} \geq M_{0(100\ K)} * f * i$

$M_{max,\ gearbox}$	max. permissible gearbox drive-out torque	
$M_{0(100\ K)}$	motor stall torque	
i	transmission ratio	
f	factor	
S1 duty:	f = 2	factor for gearbox temperature rise
S3 duty:	f = f1 * f2	
	f1 = 2	for motor accelerating torque
	f2 = 1	for ≤ 1000 gearbox switching cycles
	f2 > 1	for > 1000 switching cycles (refer to the gearbox Catalog)

Note

Switching cycles can also be superimposed oscillations!
Factor (f2) is in this case, not sufficient when dimensioning the gearbox, and gearboxes could fail.
The complete system should be optimized, so that superimposed oscillations are minimized.

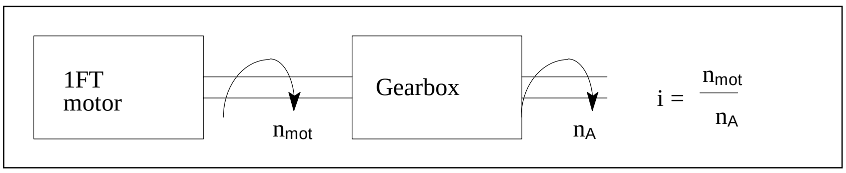


Fig. 1-12 Dimensioning the gearbox

2. Selecting the motor rating

The gearbox output torque and speed and therefore the drive-out rating are defined by the load torque and the required traversing speed.

The required drive power can then be calculated:

$P_{out}\,[W] = P_{mot} * \eta_G = (\pi/30) * M_{mot}\,[Nm] * n_{mot}\,[RPM] * \eta_G$

The gearbox restricts heat dissipation to the motor flange and itself generates frictional heat.

For S1 duty, the torque must be reduced.

- **dimensioning for S1 duty**

  The required motor torque is calculated as follows:

  $$M_{mot} = \sqrt{\left(\frac{M_{out}}{i * \eta_G} + M_v\right)^2 - M_v^{\,2}}$$

  $$\text{with } M_V = a * b * \frac{n_{mot}}{60}\,(1-\eta_G) * \frac{K_T^{\,2}}{R_{phasew}}$$

M_v	calculated “torque loss”
a	$\pi/3$ for motors fed from sinusoidal supplies, 1FT6
b	0.5 weighting factor for gearbox losses (no dimensions)
n_{mot}	motor speed [RPM]
K_T	torque constant [$\frac{Nm}{A}$]
$R_{ph.w}$	motor phase resistance when warm [Ω]=1.4 R_{phase} (Catalog)
M_{out}	gearbox drive-out torque [Nm]
i	gearbox ratio (i>1)
η_G	gearbox efficiency
P_{mot}	motor output [W]
P_{out}	gearbox drive-out rating [W]
M_{mot}	motor torque [Nm]

  Typical efficiencies:

Planetary gearboxes	$\eta \approx 0.94$	single stage
Pinion gears	$\eta \approx 0.95$	
Cyclo gears	$\eta \approx 0.92$	single stage
Harmonic drives	$\eta \approx 0.7$	
Worm drives	$\eta \approx 0.45...0.9$	

- **dimensioning for S3 duty**

  Torque derating is not required.

  $M_{mot} = M_{out} / (i * \eta_G)$

Drive-out couplings

After investigating various drive-out coupling systems for servomotors in conjunction with SIMODRIVE converters, it was identified, that the cause of vibration problems was in many cases due to drive-out couplings.

Thus, we would like to recommend Rotex couplings, which are sold/marketed by KTR, so that optimal drive-out characteristics can be guaranteed.

The advantages of Rotex couplings are:

- 200 to 400 % torsional stiffness of a belt drive
- no teeth (contrary to belt gears)
- low moment of inertia
- excellent control characteristics

As far as mounting is concerned, the clamp connection without key is considered to be adequate up to the specified torques which can actually be transmitted. It should be noted, that the frictional torques, according to their assignment to the actual motor frame sizes, are always adequately dimensioned. The accelerating torque must also be transmitted.

A clamping hub with keyway could be considered as an alternative or the special version with two clamping screws.

The vibration/oscillation characteristics were investigated. The couplings assigned to the motors permit high speed control loop gains and simultaneously result in possibly higher Kv values and uniform motion.

ROTEX GS is available in three different plastic gear pinions with different Shore hardnesses:

	80 Shore A (soft)
Alternatively:	92 Shore A
Alternatively:	98 Shore A (hard)

The possible adaption to existing machine masses and stiffness must be calculated in conjunction with the mounted mechanical system.

KTR can provide technical information, delivery times and prices.
The couplings must be ordered through KTR.

Address: KTR
Kupplungstechnik GmbH
Rodder Damm 170; 48432 Rheine
Postfach 1763; 48407 Rheine
Tel.: 05971/798-465(426)
FAX: -400

The assignment of the drive couplings to the motors is provided in the Planning Guide 6SN1197-OAA20.

Holding brake (option)

Holding brakes are used to hold the axes, without play, at standstill, or in a no-tension condition. The permanent-magnet single-disk brake operates according to the closed-circuit principle and is thus fail-safe.

Note

Axial forces are not permissible for motors equipped with holding brakes!

The holding brake is **not** an operating brake!

Approximately 2000 braking operations can be executed for emergency stops or power failures (for $J_{external} \leq 3 * J_{mot}$), without significantly subjecting the brake armature disks to wear.

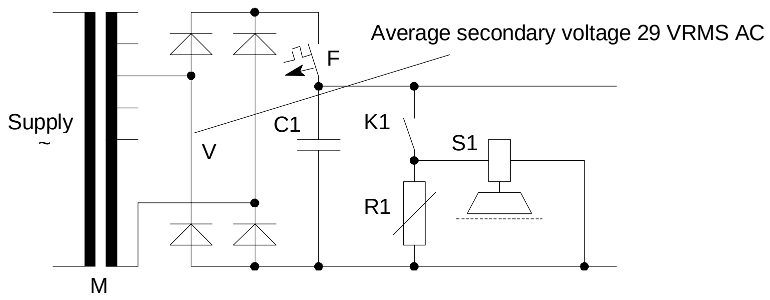
Within any one shaft height slight deviations in the holding torques are possible for motors with low stall torques.

1FT6 motors are longer if they have an integrated holding brake.

Warning

A coating appears on the brake assembly and armature disk if the holding brake hasn't been used for a longer period of time. This can result in a decrease in the holding torque.

Supply voltage: 24 V DC ±10 %
The brake feeder cable must be provided with a free-wheeling diode or a matched varistor to prevent overvoltages occurring when it is switched-off, and to prevent it disturbing the system environment. (preferably a varistor, as a free-wheeling diode extends the closing time)
A Graetz bridge with a 220 µF/60 V capacitor is recommended to prevent noise from the pulsating current after the pull-in point. Depending on the connected load, the capacitor boosts the voltage, so that the transformer secondary voltage can no longer be specified as fixed value. Five taps at the transformer secondary, in 2 V steps, starting from an average secondary voltage of 29 VRMS AC are used to select the correct voltage.



C1 - capacitor F - miniature circuit-breaker
K1 - contactor contact M - single-phase line transformer
S1 - holding brake V - rectifier
R1 - varistor (e. g. Q69-X3022 Siemens type 30 V)

Fig. 1-13 Recommended circuit for the external holding brake power supply

Refer to the appropriate motor sections for technical data.

Note

The brake connecting cable is provided in the power cable. The insulation between the power- and brake connection is designed for the basic insulation (230 V).

Basic insulation must also be provided between the coil and contact of relay K1 to protect the internal logic voltage (PELV; extra-low protective voltage).

The holding brake power supply may not be fed from the PELV supply (refer to the recommended circuit).

Note

It should be guaranteed that the minimum voltage of 24 V -10% is available at the connector on the motor side so that the brake reliably opens.

In this case, the voltage drop along the brake conductors of the power cables must be taken into account. The voltage drop for copper cables can be approximately calculated as follows:

$$dV=0.042*(l/q)*l_{brake}$$

l	=cable length in m
q	=brake conductor cross-section in mm^2
l_{brake}	=brake DC current in A
dV	=voltage drop along the brake cable in V

Example: 1FK6101 with brake EBD 3.8B l_{brake}=0.9A, l=50m, q=1mm^2
dV=0.042*50/1*0.9=1.89
i. e. the voltage on the supply side must be at least
24V*0.9+1.89V=23.5V

1.1.3 Functions - expanded functionality

Armature short-circuit braking

Transistor PWM converters cannot be electrically braked when the DC link voltage is exceeded, or if the electronics fails. If the drive, which is coasting down, represents a danger, the motor can be braked by short-circuiting the armature. Armature short-circuit braking should be initiated in the traversing range of the feed axis, at the latest, by the emergency limit switch.

When determining the coast down travel of the feed axis, the friction of the mechanical system and the contactor switching times must be taken into account. In order to prevent mechanical damage, mechanical shock absorbers should be provided at the end of the absolute traversing range.

For servomotors with integrated holding brake, the holding brake can be simultaneously de-energized, to generate an additional braking torque; however this is applied with delay.

Caution

The drive converter pulses must first be cancelled and this actually implemented, before an armature short-circuit contactor is closed. This prevents the contactor contacts from being eroded and the PWM converter being destroyed.

Warning
Operational braking must always be realized via the setpoint input. For EMERGENCY OFF, braking should be initiated via terminal 64 at the converter.

Brake resistors

The servomotor braking torque in regenerative operation can be optimized by short-circuiting the armature with an adapted external resistor circuit. The external resistors available are listed in the tables with the motors.

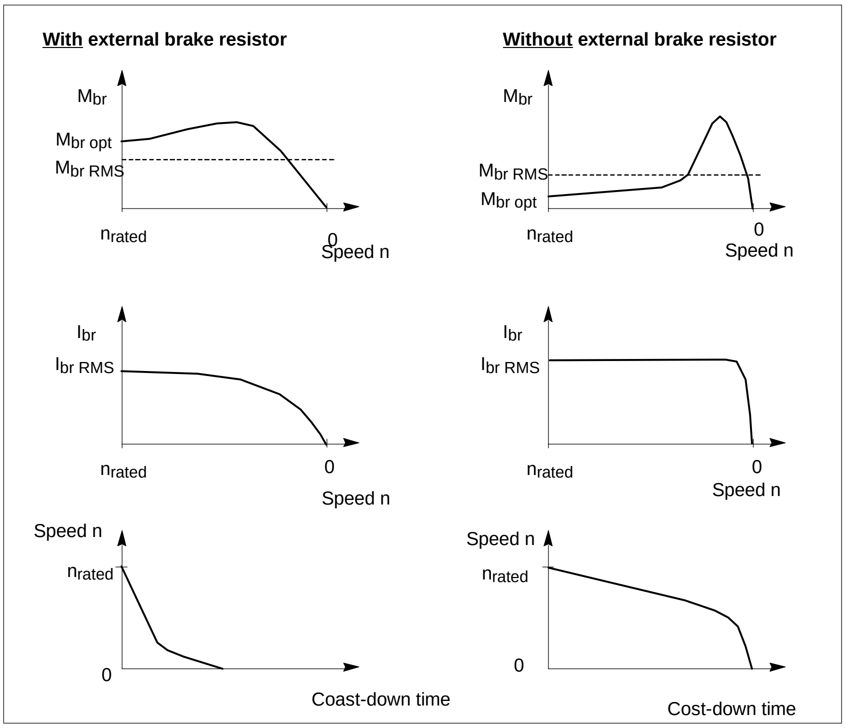


Fig. 1-14 Armature short-circuit braking

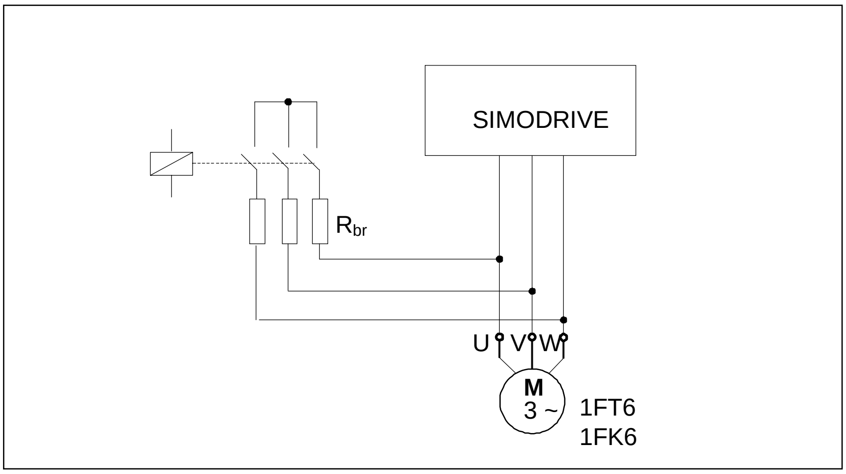


Fig. 1-15 Circuit (principle) for armature short-circuit braking

1.1.4 Connections

Pre-assembled cables reduce installation time and cost and increase the operational reliability.

1.1.4.1 Power cables

Caution

Servomotors are not suitable for direct online operation and must only be operated with the associated SIMODRIVE 611 transistor PWM converters. Please observe the rating plate data and adequately dimension the connecting cables (tables are included in the Guide) and ensure that all of the cables are strain relieved.

For safety-relevant circuits, each individual case should be checked as to whether the internal control devices in the converter are adequate and suitable to electrically isolate the equipment from the line supply.
Any work carried-out must be made with the complete system in a no-voltage condition!

Cross-sections

The permissible current carrying capability according to DIN VDE 0113 Part 1/02.86 “Electrical equipment on industrial machines” for PVC-isolated cables with copper conductors at an ambient temperature of 40° C must be observed.

Note

Siemens cables are designed and manufactured according to VDE 0250, 0298, 0891. The cables are halogen- and silicone-free (according to VDE 0472) and have a lifetime of 5 million bending cycles at 60 m/min. Siemens cables have a PETP conductor insulation and a PUR outer sheath. This means a higher current-loading capability or a lower cross-section with respect to PVC-insulated cables!

Caution

The screening concept must be harmonized with the overall protective grounding concept. Open-circuit conductors, conductors which are not used and electric cables which can be touched, must be connected to protective ground. If the brake conductors in the power cables are not used, then the brake conductors and the brake conductor screens must be connected to protective ground (open-circuit cables conduct capacitive charge currents).

Pre-assembled cables with the necessary cross-sections are available for AC servomotors.

Assignment

The motor - cross-section - power connector assignments are listed in the appropriate motor sections.

1.1.4.2 Cable types

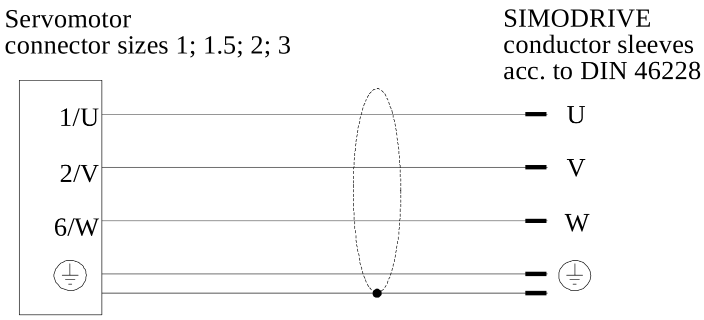
Caution

Observe the motor current requirement for your particular application! Dimension the connecting cables so that they conform to VDE 0100 Part 430, VDE 0113 Part 1, VDE 0298 Part 4.

Pre-assembled power cables

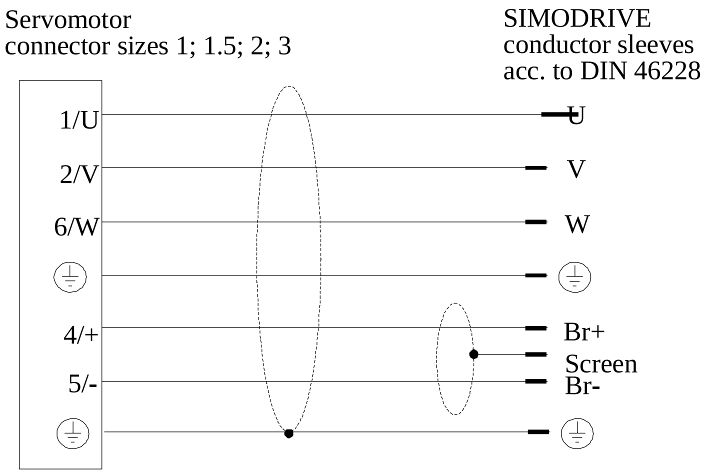
- without braking conductors with overall screen

  Order No.: 6FX2002-5CA❑❑-0❑❑❑
  Smallest bending radius: 12 x D



- with braking conductors, with overall screen

  Order No.: 6FX2002-5DA❑❑-0❑❑❑
  Smallest bending radius: 12 x D



Explanation

6FX2002-❑❑❑❑❑-0❑❑❑

- Length
- Type, cross-section, connector size

Length code

Standard lengths: BF0 = 5 m
CB0 = 10 m
CB5 = 15 m
CB8 = 18 m
CC5 = 25 m

The complete order designation and technical data are provided in Catalog NC Z!

Connector assignment

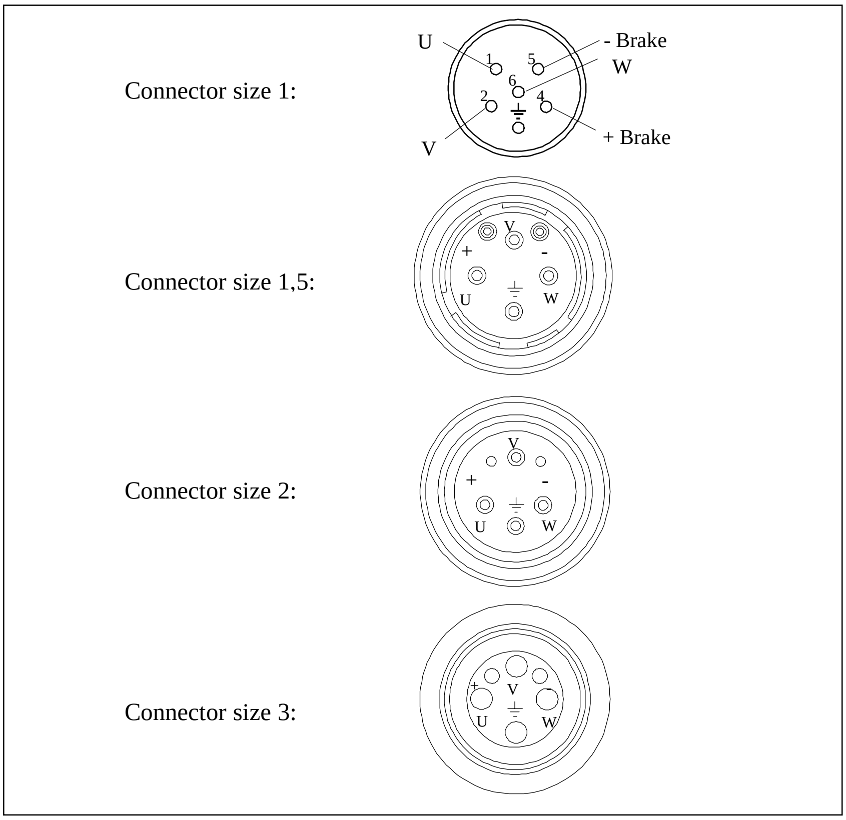


Fig. 1-16 Connector assignment (when viewing the connector side)

Screening

Screened cables are recommended. Unscreened cables can also be used for standard applications (industrial networks). Screened cables must be used if there are higher demands regarding the radio interference suppression level.

The screens must be incorporated in the overall protective grounding concept. Open-circuit conductors, and conductors which are not used/electrical cables which can be touched, must be connected to protective ground. If the brake feeders in the SIEMENS accessory cables are not used, the brake conductors and screens must be connected to the cabinet ground (open-circuit cables conduct capacitive charging currents!).

Note

EMC information is provided in the Section, Installation and connecting-up.

1.1.4.3 Actual value cable

Rotor position-, motor speed- and position data (for indirect position sensing) as well as motor temperature are fed via the actual value cable.

In order that noise is not coupled-in, the actual value cable must be routed separately away from the power cables, and the screen must be grounded at both ends.
Pre-assembled actual value cables should be used to guarantee noise-free operation.

Assignment

The actual value cables used are described for the appropriate encoders/transmitters.

1.2 1FT6 motors

1.2.1 Motor description

1.2.1.1 Characteristics and technical data

Applications

1FT6 motors were developed, in conjunction with the SIMODRIVE drive converter system, for applications on various machine tools, and even special-purpose machines (general machine construction, wood, glass, presses, packing- and transfer lines).

Warning

The motors are not suitable for direct online supply.

Characteristics

Depending on the shaft height, 1FT6 motors have stall torques from 1.0 to 140 Nm at speeds from 1500 to 6000 RPM. They have a high overload capability over the complete speed control range. The motors are optimized to have a low torque ripple.

They can be mounted directly onto feed spindles and gearboxes with toothed wheels or toothed belts.

Standards, regulations

The appropriate standards and regulations are directly assigned to the functional requirements.

Technical features

The motors are designed for operation with a 600 V DC link voltage and impressed sinusoidal currents.

Table 1-10 Standard motors

Features	Design
Motor type	Permanent-magnet synchronous motor AC servomotor
Type of construction	IM B5 (IM V1, IM V3) (according to IEC 34-7)
Degree of protection	IP 64 (according to EN 60529)
Cooling	Non-ventilated (according to IEC 34-6)
Thermal motor protection	PTC thermistor (according to IEC 34-11) in the stator winding
Shaft end	Cylindrical; without keyway and without key (according to DIN 748, Part 3); tolerance zone k6
Rating plate	A second rating plate is provided for all motors
Radial eccentricity, concentricity and axial eccentricity	Tolerance N (according to DIN 42955)
Vibration severity	Grade N (according to IEC 34-14; DIN VDE 0530, Part 14)
Shock stressing (briefly; radial not in operation]	Shaft height 36, shaft height 48: 100g; (according to DIN40046, T7) Shaft height 63: 50g Shaft height 80 30 g Shaft height 100 20 g Shaft height 132 10 g
Vibration severity	1 g axial (20 Hz to 2 kHz) 3 g radial (20 Hz to 2 kHz)
Bearings	Roller bearings with permanent grease lubrication Bearing lifetime > 20000 h Shaft height 36/48: Locating bearing on the non-drive side Shaft height 63 to 132: Locating bearing on the drive side
Winding insulation	Insulating material class F according to DIN VDE 0530 - permits a winding temperature rise of ΔT = 105 K for an ambient temperature of 40 °C.
Magnetic materials	Rare-earth materials
Electrical connection	Connector for power and encoder/sensor signals Connector socket for screened cables Connector outlet direction can be selected
Encoder system	Integrated optical encoder Speed sensing Rotor position sensing Indirect position sensing

Options

Table 1-11 Options

Features	Design
Type of construction	IM B14 (IM V18, IM V19) (according to IEC 34-7/DIN42948)
Degree of protection	IP 65, IP67 (only non-ventilated)
Cooling	Forced ventilation (according to IEC 34-6)
Shaft end	Cylindrical; with keyway and key (according to DIN 6885); tolerance zone k6, half-key balancing according to DIN 8825
Radial eccentricity, concentricity and axial eccentricity	Tolerance R (according to DIN 42955)
Vibration severity	Grade R (according to IEC 34-14; DIN VDE 0530, Part 14)
Integrated/mounted components	Fail-safe holding brake; 24V ±10% supply voltage (according to DIN 0580 7/79) Mounted planetary gear Multi-turn absolute encoder

Technical data

The motors listed here are core types of the 1FT6 series. The Planning Guide SIMODRIVE AC motors for feed- and main spindle drive provides a detailed motor list
Part 1: 6SN1197-0AA20-0APx motors.

100 K values are specified in the table.

Table 1-12 Overview of motors

Rated speed	**M_0**	**M_{rated}** 2)		**Motor type 1FT6...**	**Motor current I_0**	**Rated converter current**	**P_{rated}**	**Connector size**	**Cross section**	**Cable type 6FX2002-**
[RPM]	**[Nm]**	**[Nm]**	**[Nm]**		**[A]**	**[A]**	**[kW]**		**[mm^2]**	
2000	27.0	23.0	23.0	102-❑AC7❑	12.3	18	4.8	1.5	4x1.5	5❑A21-1❑❑0
	50.0	38.0	38.0	105-❑AC7❑	22.2	28	8.0	1.5	4x4	5❑A41-1❑❑0
3000	5.0	4.3	4.1	044-❑AF7❑	3.35	3 2)	1.4	1	4x1.5	5❑A01-1❑❑0
	4.0	3.5	3.3	061-❑AF7❑	2.75	3	1.1	1	4x1.5	5❑A01-1❑❑0
	6.0	4.6	4.4	062-❑AF7❑	4.0	5	1.4	1	4x1.5	5❑A01-1❑❑0
	9.5	7.0	6.7	064-❑AF7❑	6.05	9	2.2	1	4x1.5	5❑A01-1❑❑0
	13.7	10.3	9.8	082-❑AF7❑	10.65	18	3.2	1.5	4x1.5	5❑A21-1❑❑0
	20.0	14.7	14.0	084-❑AF7❑	14.0	18	4.6	1.5	4x2.5	5❑A31-1❑❑0
	27.0	18.5	17.6	086-❑AF7❑	17.3	18	5.8	1.5	4x4	5❑A41-1❑❑0
4500	6.0	3.6	3.2	062-❑AH7❑	5.75	9	1.7	1	4x1.5	5❑A01-1❑❑0
	9.5	4.8	4.3	064-❑AH7❑	9.05	9 1)	2.3	1	4x1.5	5❑A01-1❑❑0
	13	8.5	7.7	082-❑AH7❑	15.3	18	4	1.5	4x2.5	5❑A31-1❑❑0
6000	2.0	1.4	1.2	034-❑AK7❑	2.6	3	0.9	1	4x1.5	5❑A01-1❑❑0

1) With the specified power module, the motor cannot be fully utilized for 100 K winding temperature.
2) With absolute encoder EQN

Power calculation: $P = M * n/9550$ P in kW
M in Nm
n in RPM

1.2.1.2 Functions and options

Armature short-circuit braking

The principle was explained in Section 1.1: General information. The appropriate resistor values are listed here.

Brake resistors

An optimum braking time is achieved by appropriately dimensioning the resistors. The braking torques obtained are listed in the tables. The data is valid for braking from the rated speed. If braking is started at a different speed, the braking time **cannot** be linearly interpolated. However, longer braking times cannot occur.

The resistor rating must be adapted to the actual I^2t load capability.

Table 1-13 Resistor braking for 1FT6 motors, shaft heights 36 and 48

Motor type	External brake resistor R_{opt} [Ω]	Average braking torque $M_{br\ RMS}$ [Nm]	Max. braking torque $M_{br\ max}$ [Nm]	RMS braking current $I_{br\ RMS}$ [A]
1FT6034-1AK71	- 6.5	1.7 2.3	2.9	9.4 8.5
1FT6044-1AF71	- 5.1	5.9 7.4	9.2	11.3 10.2

Table 1-14 Resistor braking for 1FT6 motors, shaft height 63

Motor type	External brake resistor R_{opt} [Ω]	Average braking torque $M_{br\ RMS}$ [Nm]	Max. braking torque $M_{br\ max}$ [Nm]	RMS braking current $I_{br\ RMS}$ [A]
1FT6061-1AF71	- 9	2.6 3.3	4.2	5.4 4.9
1FT6062-1AF71	- 6.4	3.7 5.2	6.6	8.6 7.8
1FT6064-1AF71	- 4.9	5.3 8.5	10.5	13.1 11.8

Table 1-15 Resistor braking for 1FT6 motors, shaft height 80

Motor type	External brake resistor R_{opt} [Ω]	Average braking torque $M_{br\ RMS}$ [Nm]	Max. braking torque $M_{br\ max}$ [Nm]	RMS braking current $I_{br\ RMS}$ [A]
1FT6082-1AF71	- 3.7	4.4 8.2	10.4	15.3 13.7
1FT6084-1AF71	- 2.9	6.3 13.8	17.4	23 21
1FT6086-1AF71	-	8.7	25	31

Motor type	**External brake resistor R_{opt} [Ω]**	**Average braking torque $M_{br\ RMS}$ [Nm]**	**Max. braking torque $M_{br\ max}$ [Nm]**	**RMS braking current $I_{br\ RMS}$ [A]**
	2.4	20		28

Table 1-16 Resistor braking for 1FT6 motors, shaft height 100

Motor type	External brake resistor R_{opt} [Ω]	Average braking torque $M_{br\ RMS}$ [Nm]	Max. braking torque $M_{br\ max}$ [Nm]	RMS braking current $I_{br\ RMS}$ [A]
1FT6102-1AC71	- 2.8	10.7 22	29	15 22
1FT6105-1AC71	- 1.7	16.5 40	50	42 38

Holding brake

Refer to Section 1.1 for a function description: General information.
Holding brakes cannot be retrofitted!

Table 1-17 Technical data for holding brakes used with 1FT6 motors

Motor type	Brake type	Holding torque [Nm]		Dyn. torque [Nm]	DC current [A]	Power [W]	Opening time [ms]	Closing time [ms]	Moment of inertia [10^{-4} kgm^2]
		20 °C	120 °C	120 °C					
1FT603❑	EBD 0.15B	2.5	2.0	1.6	0.35	8.2	30	15	0.08
1FT604❑	EBD 0.4BA	6.5	5.0	3.5	0.8	19.3	30	15	1.06
1FT606❑	EBD 1.5B	22	19	10	0.7	17	130	20	3.6
1FT6081 1FT6082	EBD 1.2B	15	12	8.0	0.83	21	70	35	3.2
1FT6084 1FT6086	EBD 3.5	36.5	26.5	20	1.3	31.5	110	55	16.0
1FT610❑	EBD 4B	100	85	43	1.4	32	180	20	32.0
1FT613❑	EBD 8MF	200	140	70	3.3	78	160	70	75

Gearboxes

Table 1-18 1FT6 motor with planetary gear (alpha company)

Standard motor						1-stage planetary gear											
Type	Dimensions					Type	Dimensions									Dimensions	
	k	k1	l	d	❑F		L13	L14	L15	g6	k6	D4	D9	❑F4	❑F2	K2	K3
			30	14	72	SPG 60-M1	20	28	129	60	16	5.5	68	62	70		
1FT6034	260	280														341	361
1FT6034	260	280				SPG 75-M1	20	36	156	70	22	6.6	85	76	80	360	380
	228	263	40	19	96										90		
1FT6044	278	313														378	413
1FT6044	278	313				SPG 100-M1	30	58	202	90	32	9	120	101	100	392	427
1FT6061	228	258	50	24	116										120	342	372
1FT6062	253	283														367	397
1FT6064	303	333														417	447
			58	32	155	SPG 140-M1	30	82	256	130	40	11	165	141	150		
1FT6082	246	273														390	417
1FT6084	296	342														440	486
1FT6086	346	392														490	536
1FT6086	346	392				SPG 180-M1	30	82	297	160	55	13	215	182	180		
1FT6102	295	341	80	38	192										190	480	526
1FT6105	370	416														555	601
1FT6105	370	416				SP 210-M1	38	105	335	180	75	17	250	212	190	562	608

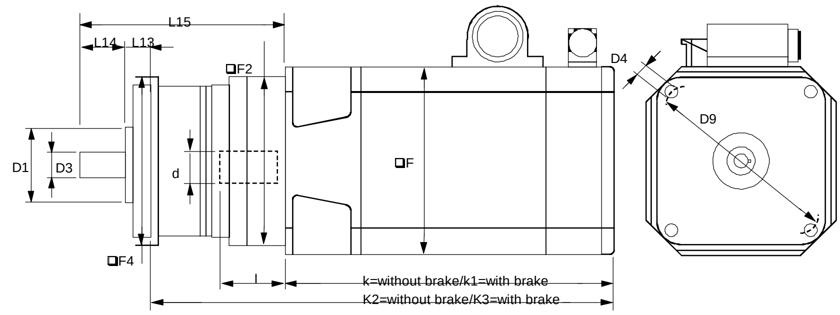


Fig. 1-17 1FT6 motor with planetary gear (alpha company)

Drive coupling

Table 1-19 Assignment of the drive couplings to the motors

Shaft height	**ROTEX GS type**	**Torque which can be transferred with the 98 Sh-A-GS pinion**	
		T_{KN} [Nm]	T_{Kmax} [Nm]
36	14	7.5	15
48	19/24	10	20
63	24/28	35	70
80	28/38	95	190
100	38/45	190	380

Other pinions may have to be used (e. g. Shore hardness 80 Sh-A). The pinion must be optimized in conjunction with the actual mechanical system.

Warning

The accelerating torque may not exceed the clamping torque!

1.2.1.3 Interfaces

Power connection

Various types of pre-assembled cables are available (refer to Technical data).

- Cables and connector assignments are specified in Section 1.1.4: Connections.
- The complete program of accessories is provided in Catalog NC Z.

Note

Assignment of the motor-connector size cable cross-section (refer to Table 1-12).

- The cable cross-section is designed for I_{RMS}=100 K (according to VDE0113).
- 40°C ambient temperature
- For PVC-insulated cables

Actual value cable

The actual value cables used are described for the appropriate encoders/sensors.

1.2.2 Order designations

Order designations core types

1 F T 6 . . . - 1 A . 7 1 - . . . 0

- Electric motor
- Synchronous motor
- AC servomotor
- Series
- Frame size
- Length
- **Core type code**
- Non-ventilated
- Rated speed
  C = 2000 RPM
  F = 3000 RPM
  K = 6000 RPM
- Connector outlet direction
  1 = transverse right for frame sizes 08 and 10
  3 = axial, non-drive end for frame sizes 03, 04 and 06
- A: incremental optical encoder, ERN 1387
  E: absolute optical encoder, EQN 1325
- G = without holding brake
  H = with holding brake
- Vibration severity grade N IP64

1.2.3 Technical data and characteristics

1.2.3.1 Speed-torque diagrams

Table 1-20 Standard 1FT6034 motor

1FT6034			
Technical data	**Code**	**Units**	**-❑AK7**
Engineering data			
Rated speed	n_{rated}	RPM	6000
Rated torque	$M_{rated\ (100\ K)}$	Nm	1.4
Rated current	I_{rated}	A	2.1
Stall torque	$M_{0\ (60\ K)}$	Nm	1.65
Stall torque	$M_{0\ (100\ K)}$	Nm	2.00
Stall current	$I_{0\ (60\ K)}$	A	2.15
Stall current	$I_{0\ (100\ K)}$	A	2.60
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	1.2
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	1.1
Limiting data			
Max. speed	n_{max}	RPM	7000
Max. torque	M_{max}	Nm	8.0
Peak current	I_{max}	A	10.5
Limiting torque	M_{limit}	Nm	3.7
Limiting current	I_{limit}	A	5.2
Physical constants			
Torque constant	k_T	Nm/A	0.77
Voltage constant	k_E	V/1000 RPM	50
Winding resistance	$R_{ph.}$	Ohm	2.6
Three-phase inductance	L_D	mH	14.5
Electrical time constant	T_{el}	ms	5.0
Mechanical time constant	T_{mech}	ms	2.4
Thermal time constant	T_{th}	min	30
Thermal resistance	R_{th}	Ohm	0.20
Weight with brake	m	kg	4.8
Weight without brake	m	kg	4.4

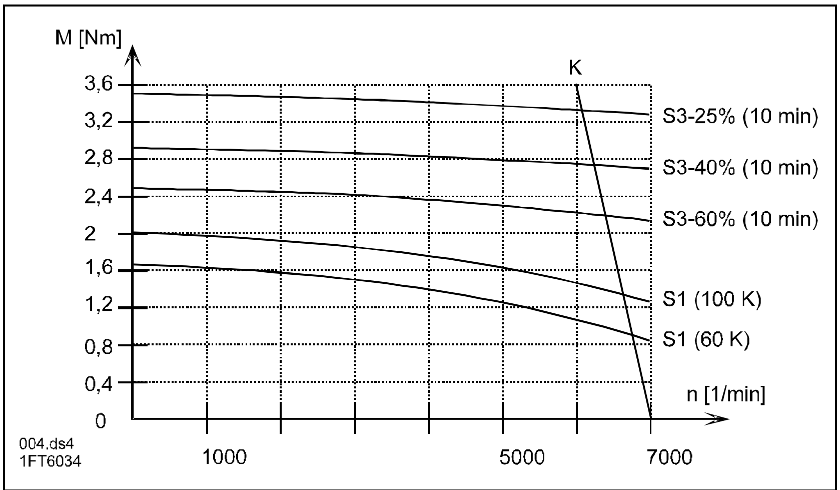


Fig. 1-18 Speed-torque diagram, 1FT6034

Table 1-21 Standard 1FT6044 motor

1FT6044			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	4.30
Rated current	I_{rated}	A	2.9
Stall torque	$M_{0\ (60\ K)}$	Nm	4.15
Stall torque	$M_{0\ (100\ K)}$	Nm	5.00
Stall current	$I_{0\ (60\ K)}$	A	2.50
Stall current	$I_{0\ (100\ K)}$	A	3.00
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	6.2
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	5.1
Limiting data			
Max. speed	n_{max}	RPM	3650
Max. torque	M_{max}	Nm	18.5
Peak current	I_{max}	A	11.0
Limiting torque	M_{limit}	Nm	10.7
Limiting current	I_{limit}	A	6.8
Physical constants			
Torque constant	k_T	Nm/A	1.66
Voltage constant	k_E	V/1000 RPM	108
Winding resistance	$R_{ph.}$	Ohm	3.09
Three-phase inductance	L_D	mH	26
Electrical time constant	T_{el}	ms	8.3
Mechanical time constant	T_{mech}	ms	2.0
Thermal time constant	T_{th}	min	40
Thermal resistance	R_{th}	Ohm	0.18
Weight with brake	m	kg	9.5
Weight without brake	m	kg	8.3

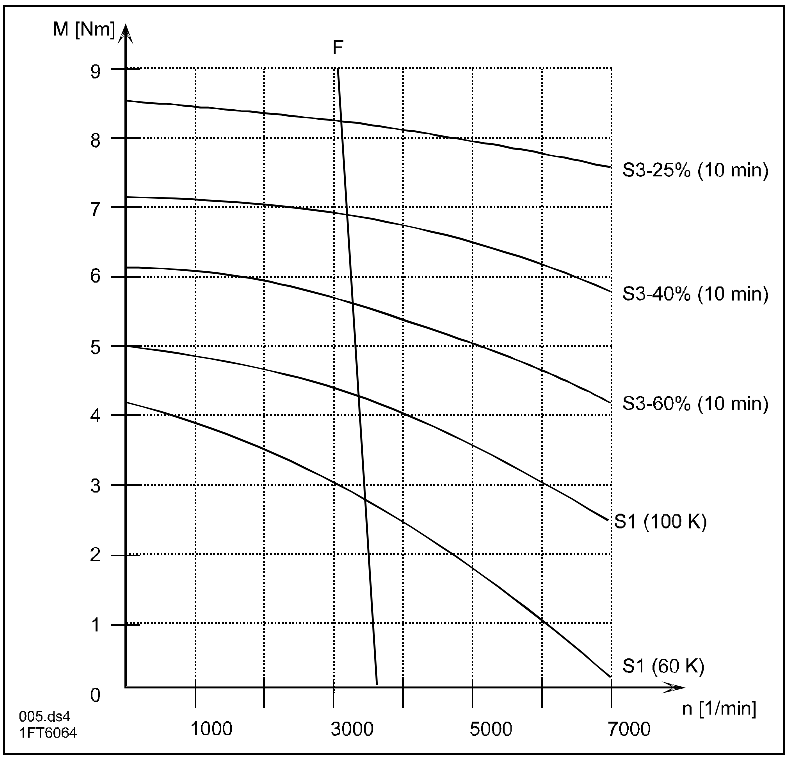


Fig. 1-19 Speed-torque diagram, 1FT6044

Table 1-22 Standard 1FT6061 motor

1FT6061			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	3.50
Rated current	I_{rated}	A	2.6
Stall torque	$M_{0\ (60\ K)}$	Nm	3.3
Stall torque	$M_{0\ (100\ K)}$	Nm	4.0
Stall current	$I_{0\ (60\ K)}$	A	2.25
Stall current	$I_{0\ (100\ K)}$	A	2.75
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	8.0
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	6.0
Limiting data			
Max. speed	n_{max}	RPM	4200
Max. torque	M_{max}	Nm	16
Peak current	I_{max}	A	14.0
Limiting torque	M_{limit}	Nm	6.9
Limiting current	I_{limit}	A	4.8
Physical constants			
Torque constant	k_T	Nm/A	1.46
Voltage constant	k_E	V/1000 RPM	90
Winding resistance	$R_{ph.}$	Ohm	4.8
Three-phase inductance	L_D	mH	30
Electrical time constant	T_{el}	ms	5.6
Mechanical time constant	T_{mech}	ms	4.7
Thermal time constant	T_{th}	min	27
Thermal resistance	R_{th}	Ohm	0.29
Weight with brake	m	kg	9.5
Weight without brake	m	kg	8.0

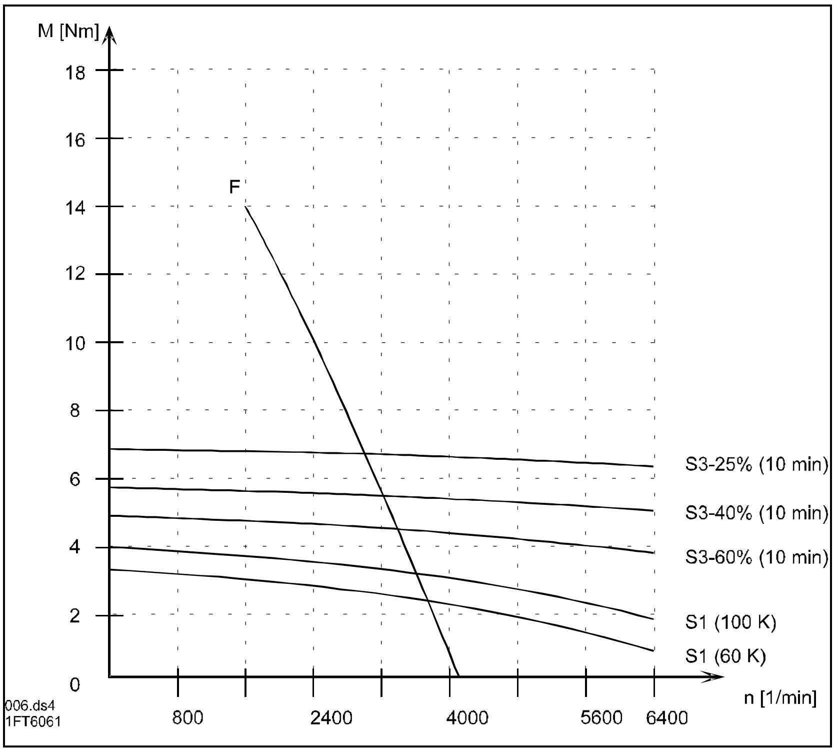


Fig. 1-20 Speed-torque diagram, 1FT6061

Table 1-23 Standard 1FT6062 motor

1FT6062			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	4.60
Rated current	I_{rated}	A	3.4
Stall torque	$M_{0\ (60\ K)}$	Nm	5.00
Stall torque	$M_{0\ (100\ K)}$	Nm	6.00
Stall current	$I_{0\ (60\ K)}$	A	3.40
Stall current	$I_{0\ (100\ K)}$	A	4.00
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	10.5
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	8.5
Limiting data			
Max. speed	n_{max}	RPM	4200
Max. torque	M_{max}	Nm	24
Peak current	I_{max}	A	22.0
Limiting torque	M_{limit}	Nm	11.2
Limiting current	I_{limit}	A	7.9
Physical constants			
Torque constant	k_T	Nm/A	1.46
Voltage constant	k_E	V/1000 RPM	90
Winding resistance	$R_{ph.}$	Ohm	2.6
Three-phase inductance	L_D	mH	19
Electrical time constant	T_{el}	ms	7.1
Mechanical time constant	T_{mech}	ms	3.2
Thermal time constant	T_{th}	min	30
Thermal resistance	R_{th}	Ohm	0.19
Weight with brake	m	kg	11.0
Weight without brake	m	kg	9.5

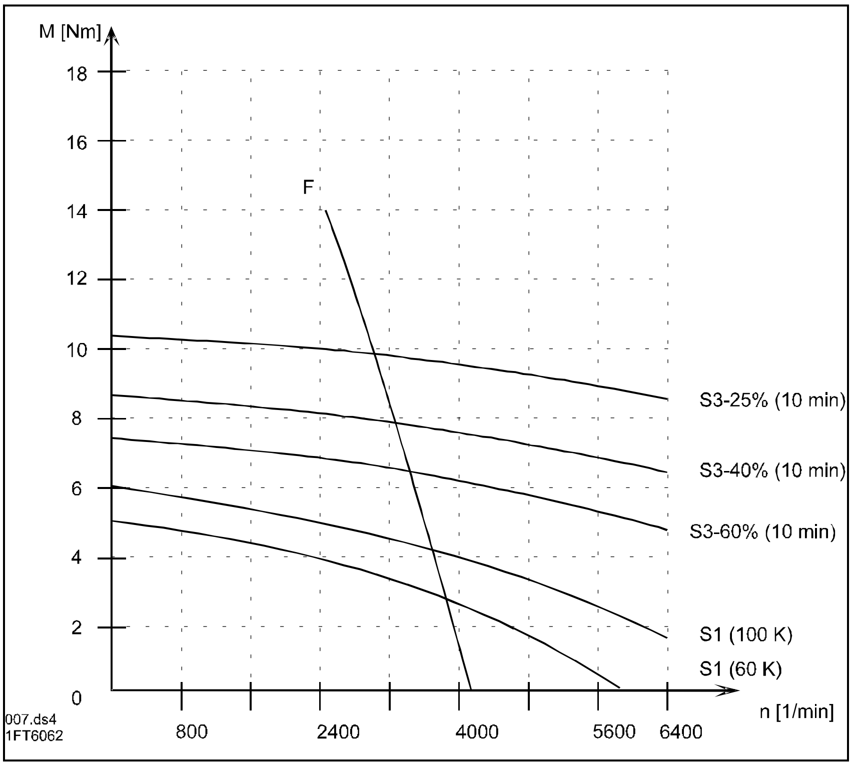


Fig. 1-21 Speed-torque diagram, 1FT6062

Table 1-24 Standard 1FT6064 motor

1FT6064			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	7.00
Rated current	I_{rated}	A	4.9
Stall torque	$M_{0\ (60\ K)}$	Nm	7.90
Stall torque	$M_{0\ (100\ K)}$	Nm	9.50
Stall current	$I_{0\ (60\ K)}$	A	5.00
Stall current	$I_{0\ (100\ K)}$	A	6.05
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	15.5
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	13.0
Limiting data			
Max. speed	n_{max}	RPM	3850
Max. torque	M_{max}	Nm	38
Peak current	I_{max}	A	33.0
Limiting torque	M_{limit}	Nm	16.4
Limiting current	I_{limit}	A	10.6
Physical constants			
Torque constant	k_T	Nm/A	1.57
Voltage constant	k_E	V/1000 RPM	97
Winding resistance	$R_{ph.}$	Ohm	1.42
Three-phase inductance	L_D	mH	13.5
Electrical time constant	T_{el}	ms	9.4
Mechanical time constant	T_{mech}	ms	2.4
Thermal time constant	T_{th}	min	35
Thermal resistance	R_{th}	Ohm	0.11
Weight with brake	m	kg	13.0
Weight without brake	m	kg	12.5

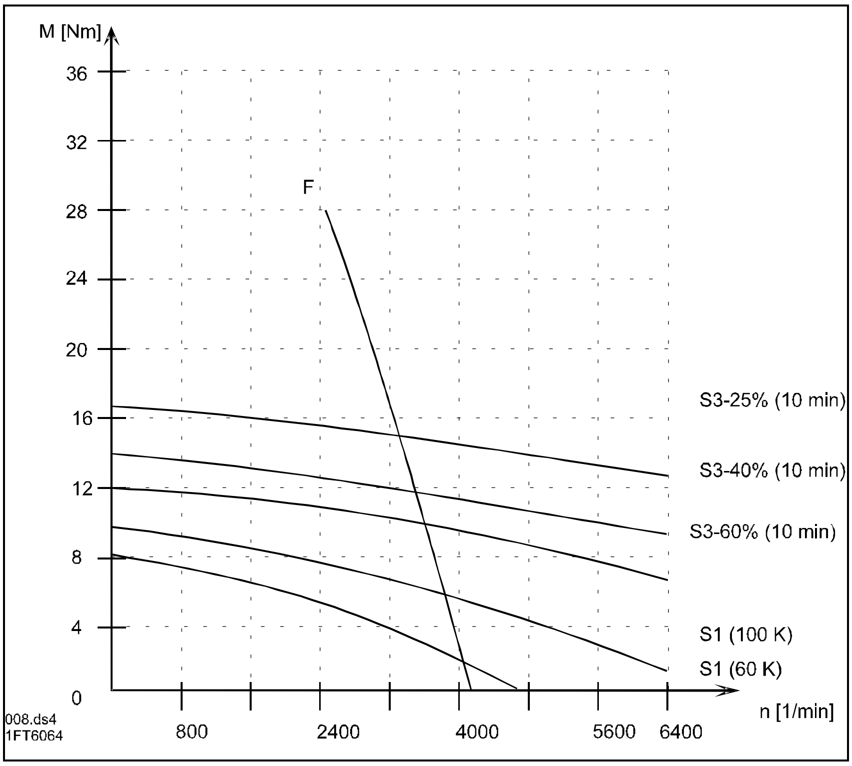


Fig. 1-22 Speed-torque diagram, 1FT6064

Table 1-25 Standard 1FT6082 motor

1FT6082			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	10.30
Rated current	I_{rated}	A	8.7
Stall torque	$M_{0\ (60\ K)}$	Nm	10.40
Stall torque	$M_{0\ (100\ K)}$	Nm	13.00
Stall current	$I_{0\ (60\ K)}$	A	8.20
Stall current	$I_{0\ (100\ K)}$	A	10.65
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	33.5
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	30.0
Limiting data			
Max. speed	n_{max}	RPM	4700
Max. torque	M_{max}	Nm	42
Peak current	I_{max}	A	41.0
Limiting torque	M_{limit}	Nm	22
Limiting current	I_{limit}	A	17.8
Physical constants			
Torque constant	k_T	Nm/A	1.27
Voltage constant	k_E	V/1000 RPM	80.0
Winding resistance	$R_{ph.}$	Ohm	0.73
Three-phase inductance	L_D	mH	7.2
Electrical time constant	T_{el}	ms	8.8
Mechanical time constant	T_{mech}	ms	4.7
Thermal time constant	T_{th}	min	35
Thermal resistance	R_{th}	Ohm	0.15
Weight with brake	m	kg	16.5
Weight without brake	m	kg	15.0

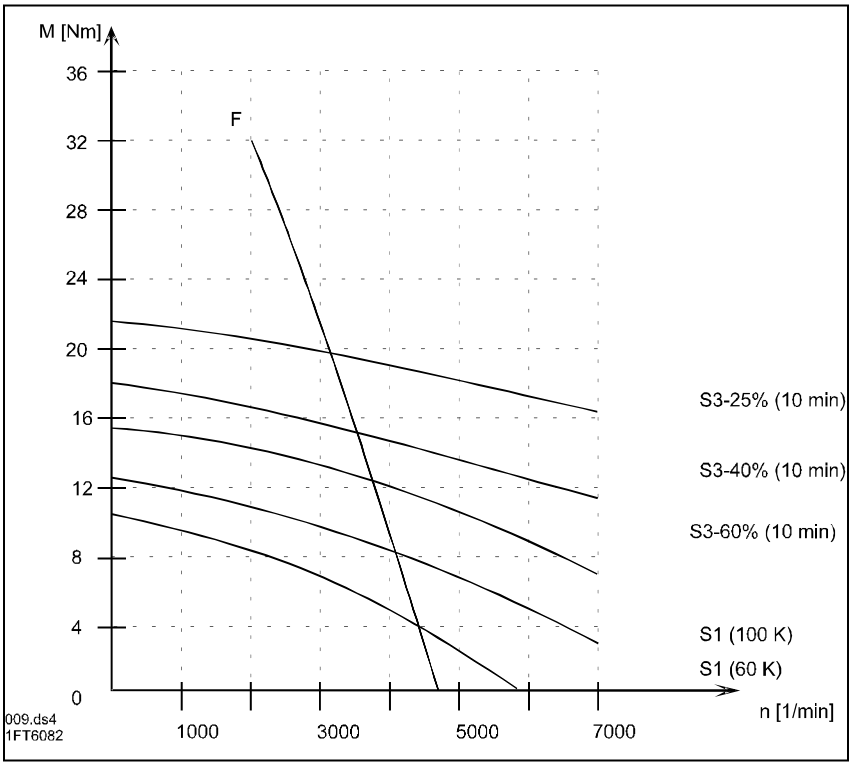


Fig. 1-23 Speed-torque diagram, 1FT6082

Table 1-26 Standard 1FT6084 motor

1FT6084			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	14.70
Rated current	I_{rated}	A	11.0
Stall torque	$M_{0\ (60\ K)}$	Nm	16.20
Stall torque	$M_{0\ (100\ K)}$	Nm	20.00
Stall current	$I_{0\ (60\ K)}$	A	11.30
Stall current	$I_{0\ (100\ K)}$	A	14.00
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	65.0
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	48.0
Limiting data			
Max. speed	n_{max}	RPM	4200
Max. torque	M_{max}	Nm	65
Peak current	I_{max}	A	56
Limiting torque	M_{limit}	Nm	33
Limiting current	I_{gren}	A	24.0
Physical constants			
Torque constant	k_T	Nm/A	1.43
Voltage constant	k_E	V/1000 RPM	90
Winding resistance	$R_{ph.}$	Ohm	0.42
Three-phase inductance	L_D	mH	5.4
Electrical time constant	T_{el}	ms	11.5
Mechanical time constant	T_{mech}	ms	3.5
Thermal time constant	T_{th}	min	42
Thermal resistance	R_{th}	Ohm	0.09
Weight with brake	m	kg	24.0
Weight without brake	m	kg	20.5

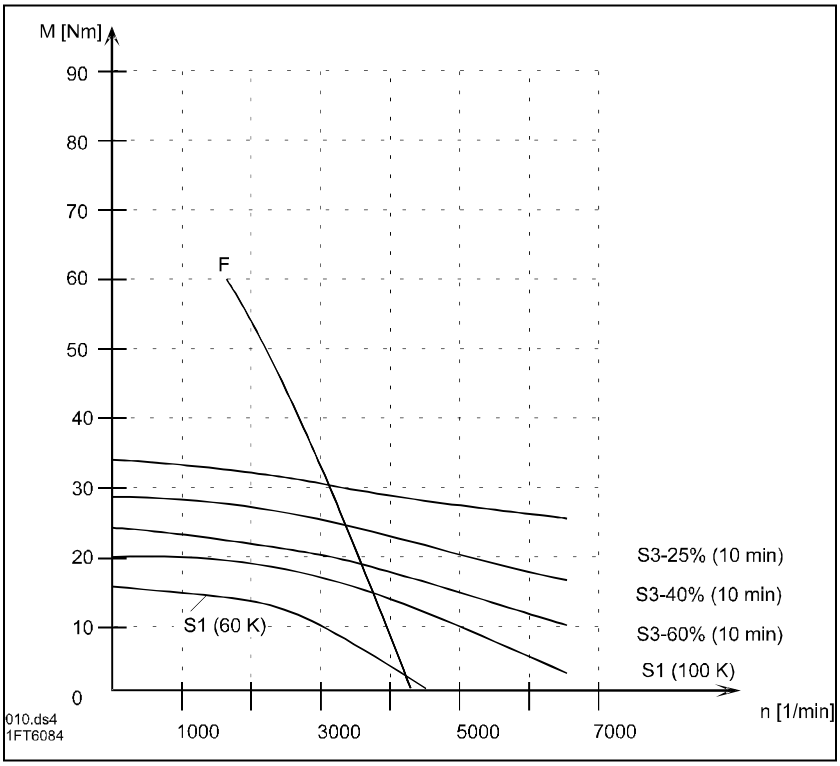


Fig. 1-24 Speed-torque diagram, 1FT6084

Table 1-27 Standard 1FT6086 motor

1FT6086			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	18.50
Rated current	I_{rated}	A	13.0
Stall torque	$M_{0\ (60\ K)}$	Nm	22.40
Stall torque	$M_{0\ (100\ K)}$	Nm	27.00
Stall current	$I_{0\ (60\ K)}$	A	14.40
Stall current	$I_{0\ (100\ K)}$	A	17.30
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	83.0
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	66.5
Limiting data			
Max. speed	n_{max}	RPM	3850
Max. torque	M_{max}	Nm	90
Peak current	I_{max}	A	72.0
Limiting torque	M_{limit}	Nm	40
Limiting current	I_{limit}	A	26.0
Physical constants			
Torque constant	k_T	Nm/A	1.56
Voltage constant	k_E	V/1000 RPM	98
Winding resistance	$R_{ph.}$	Ohm	0.32
Three-phase inductance	L_D	mH	4.4
Electrical time constant	T_{el}	ms	12.6
Mechanical time constant	T_{mech}	ms	3.0
Thermal time constant	T_{th}	min	50
Thermal resistance	R_{th}	Ohm	0.07
Weight with brake	m	kg	29.0
Weight without brake	m	kg	25.5

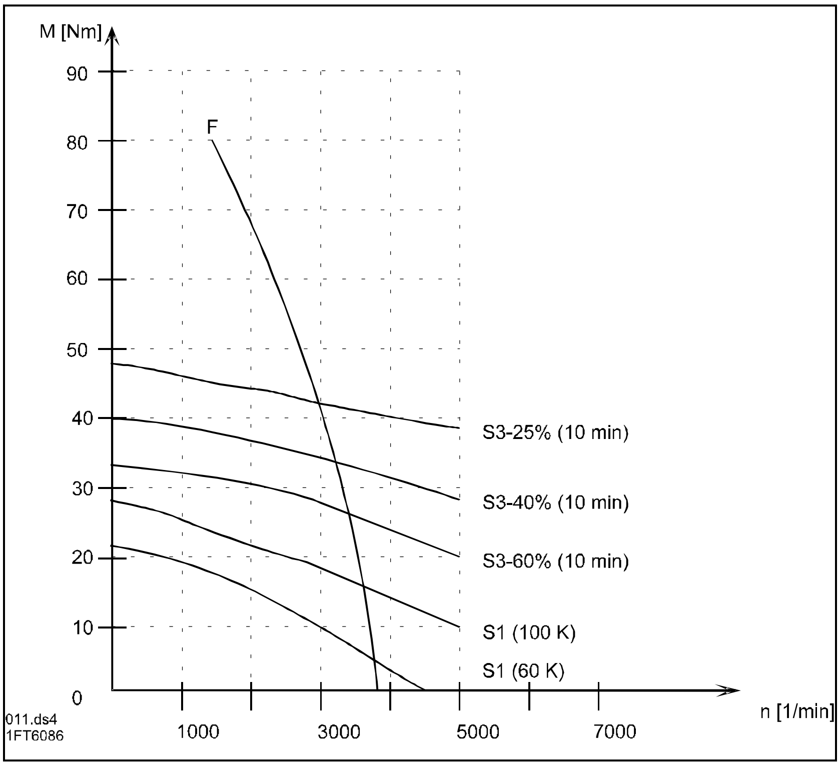


Fig. 1-25 Speed-torque diagram, 1FT6086

Table 1-28 Standard 1FT6102 motor

1FT6102			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	2000
Rated torque	$M_{rated\ (100\ K)}$	Nm	23.00
Rated current	I_{rated}	A	11.0
Stall torque	$M_{0\ (60\ K)}$	Nm	22.40
Stall torque	$M_{0\ (100\ K)}$	Nm	27.00
Stall current	$I_{0\ (60\ K)}$	A	10.20
Stall current	$I_{0\ (100\ K)}$	A	12.30
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	125.0
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	99.0
Limiting data			
Max. speed	n_{max}	RPM	2900
Max. torque	M_{max}	Nm	90
Peak current	I_{max}	A	59.0
Limiting torque	M_{limit}	Nm	45
Limiting current	I_{limit}	A	21.0
Physical constants			
Torque constant	k_T	Nm/A	2.19
Voltage constant	k_E	V/1000 RPM	137
Winding resistance	$R_{ph.}$	Ohm	0.45
Three-phase inductance	L_D	mH	7.7
Electrical time constant	T_{el}	ms	15.7
Mechanical time constant	T_{mech}	ms	3.8
Thermal time constant	T_{th}	min	45
Thermal resistance	R_{th}	Ohm	0.12
Weight with brake	m	kg	32.0
Weight without brake	m	kg	27.5

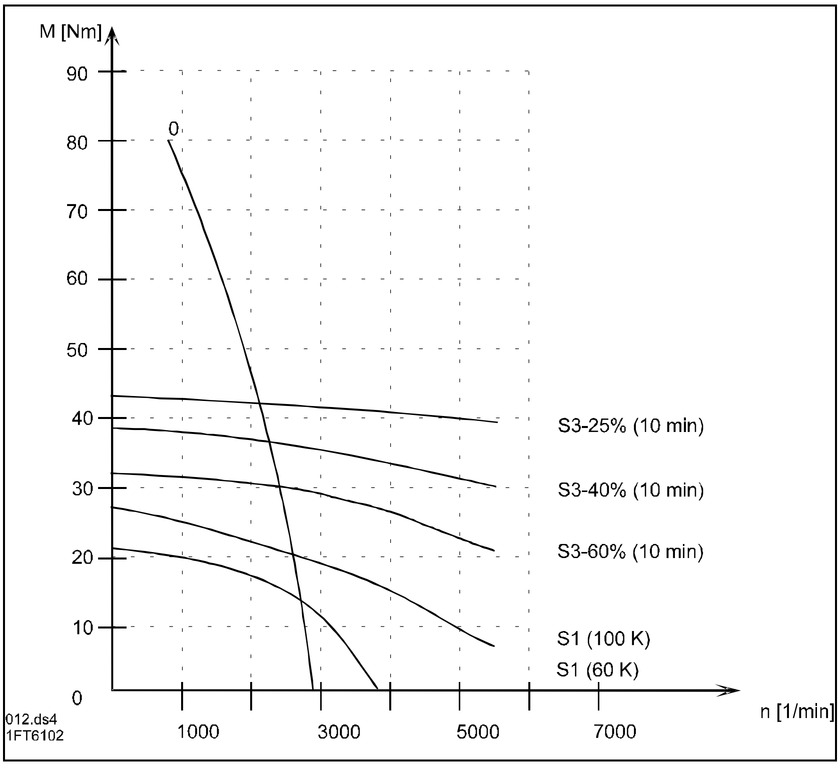


Fig. 1-26 Speed-torque diagram, 1FT6102

Table 1-29 Standard 1FT6105 motor

1FT6105			
Technical data	**Code**	**Units**	**-❑AF7**
Engineering data			
Rated speed	n_{rated}	RPM	2000
Rated torque	$M_{rated\ (100\ K)}$	Nm	38.00
Rated current	I_{rated}	A	17.6
Stall torque	$M_{0\ (60\ K)}$	Nm	41.50
Stall torque	$M_{0\ (100\ K)}$	Nm	50.00
Stall current	$I_{0\ (60\ K)}$	A	18.40
Stall current	$I_{0\ (100\ K)}$	A	22.20
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	194.0
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	168.0
Limiting data			
Max. speed	n_{max}	RPM	2750
Max. torque	M_{max}	Nm	166
Peak current	I_{max}	A	103
Limiting torque	M_{limit}	Nm	74
Limiting current	I_{limit}	A	34.0
Physical constants			
Torque constant	k_T	Nm/A	2.25
Voltage constant	k_E	V/1000 RPM	143
Winding resistance	$R_{ph.}$	Ohm	0.23
Three-phase inductance	L_D	mH	4.7
Electrical time constant	T_{el}	ms	20.3
Mechanical time constant	T_{mech}	ms	2.4
Thermal time constant	T_{th}	min	50
Thermal resistance	R_{th}	Ohm	0.07
Weight with brake	m	kg	44.0
Weight without brake	m	kg	39.5

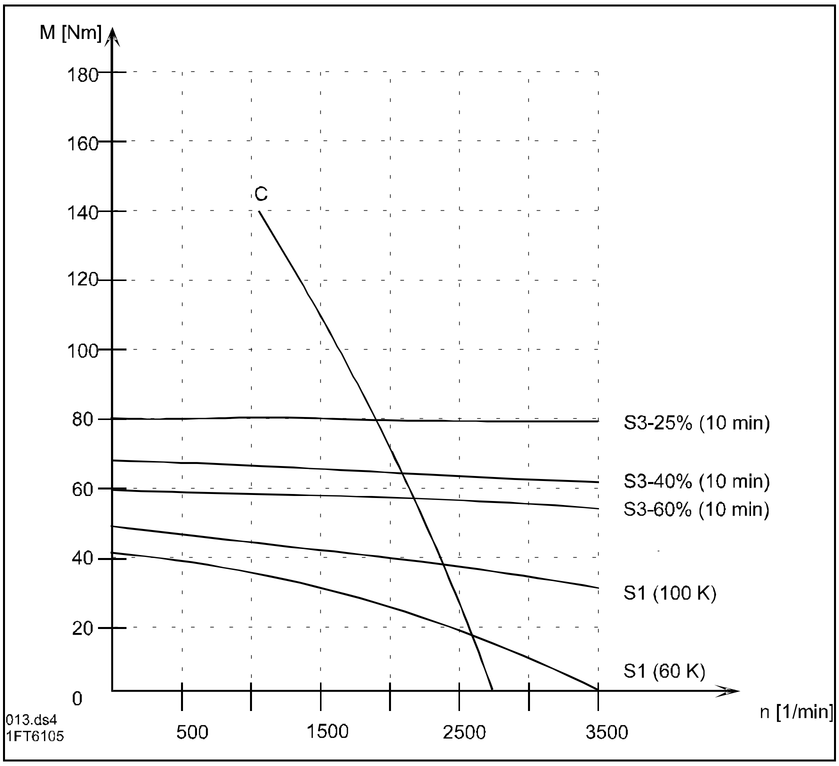


Fig. 1-27 Speed-torque diagram, 1FT6105

1.2.3.2 Cantilever force/axial force diagrams

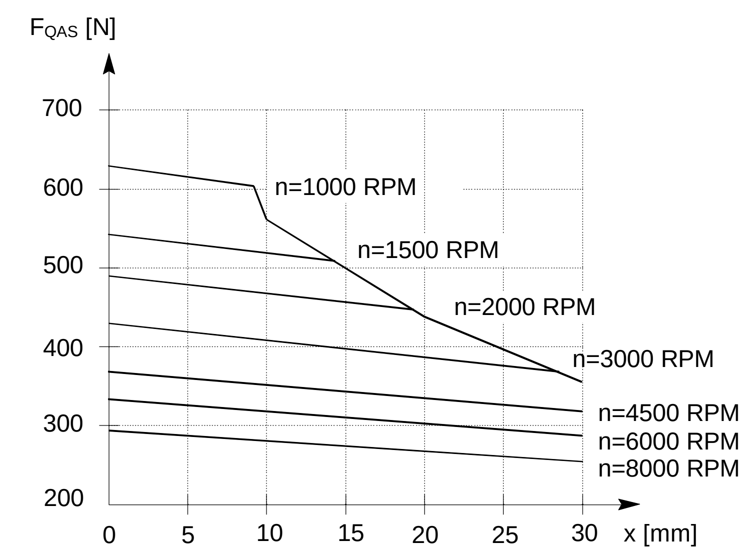
Rotor weight

Table 1-30 Force due to the rotor weight (F_L), bearing contact force (F_C)

Motor type	F_L [N] including brake and encoder system	F_C [N]
1FT6031 1FT6034	10 15	60
1FT6041 1FT6044	20 25	75
1FT6061 1FT6062 1FT6064	25 30 40	95
1FT6081 1FT6082 1FT6084 1FT6086	35 45 75 90	190
1FT6102 1FT6105 1FT6108	100 140 190	260

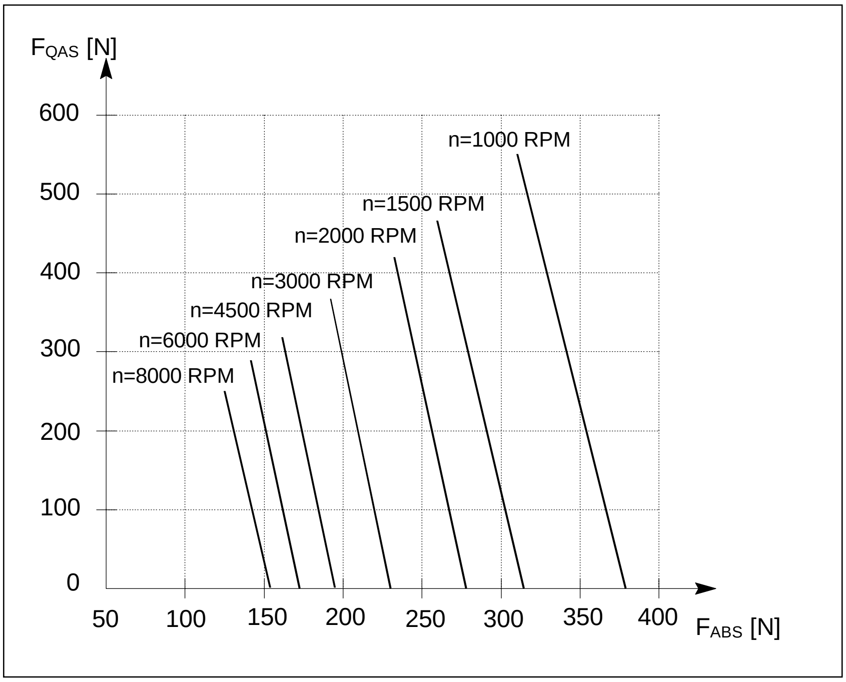
Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

Cantilever force 1FT6034



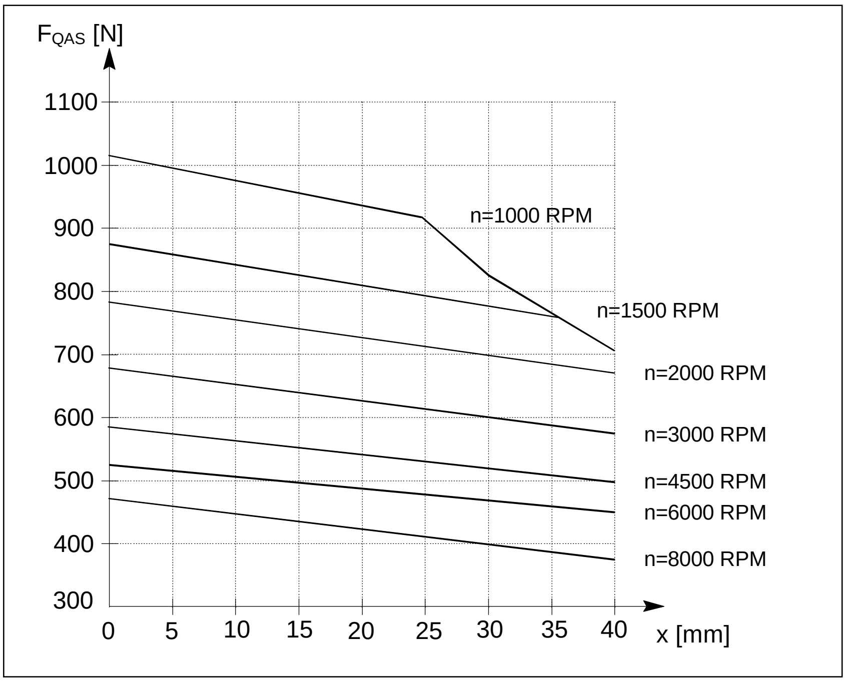
Axial force 1FT6034

Permissible axial force as a function of the cantilever force.

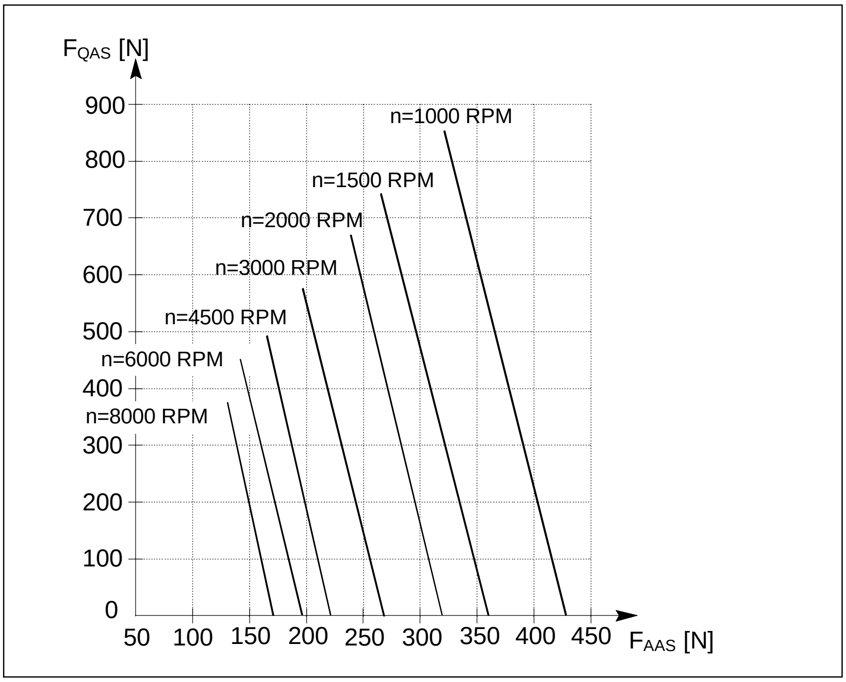


Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

Cantilever force 1FT6044

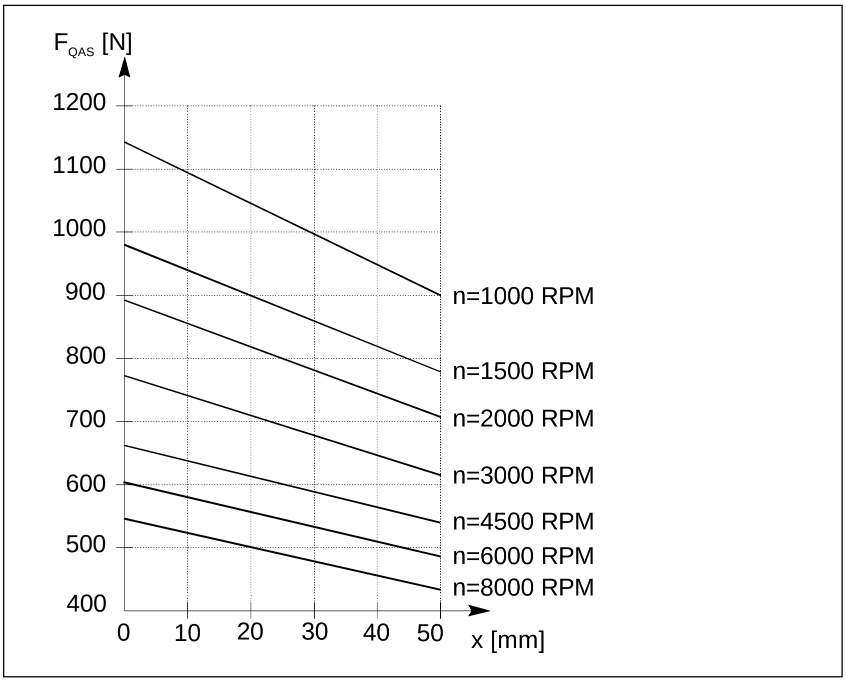


Axial force 1FT6044 Permissible axial force as a function of the cantilever force.



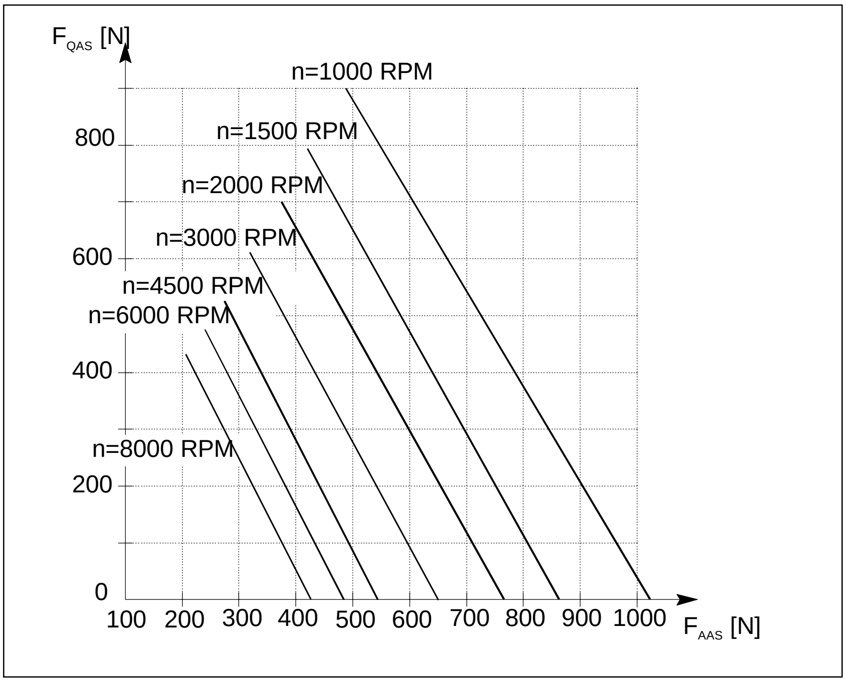
Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

Cantilever force
1FT6061
1FT6062
1FT6064



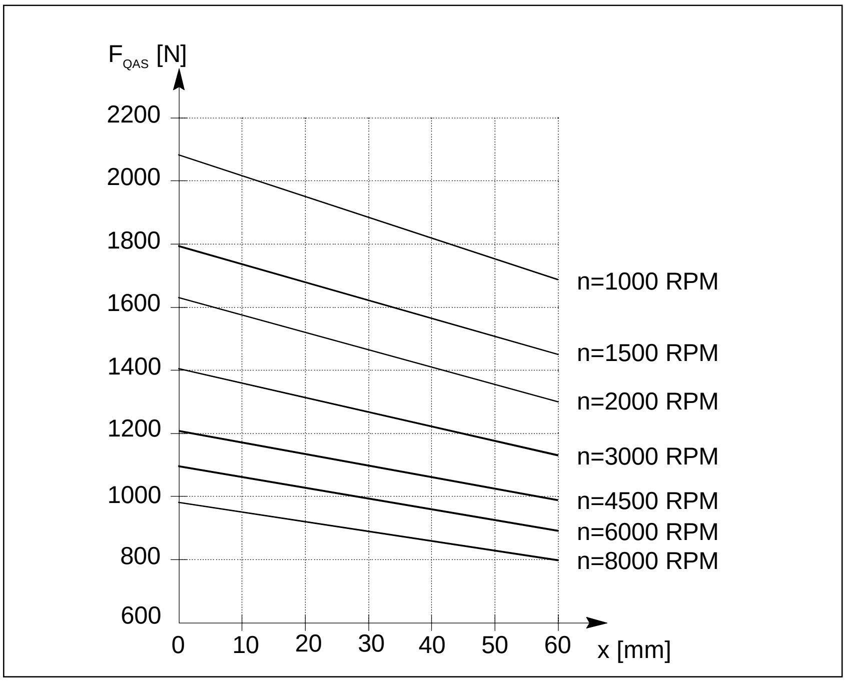
Axial force
1FT6061
1FT6062
1FT6064

Permissible axial force as a function of the cantilever force.



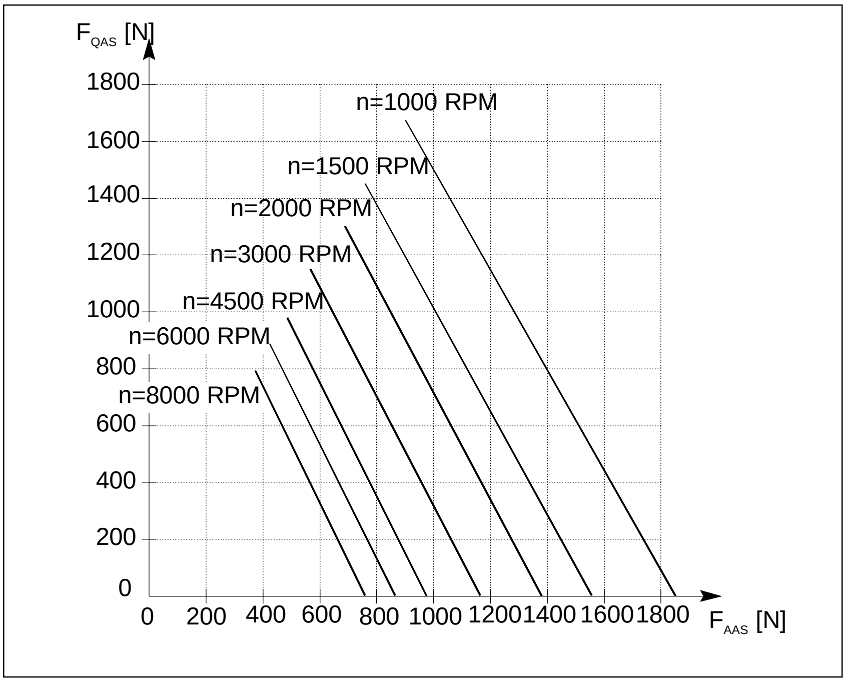
Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 h.

Cantilever force
1FT6082
1FT6084
1FT6086



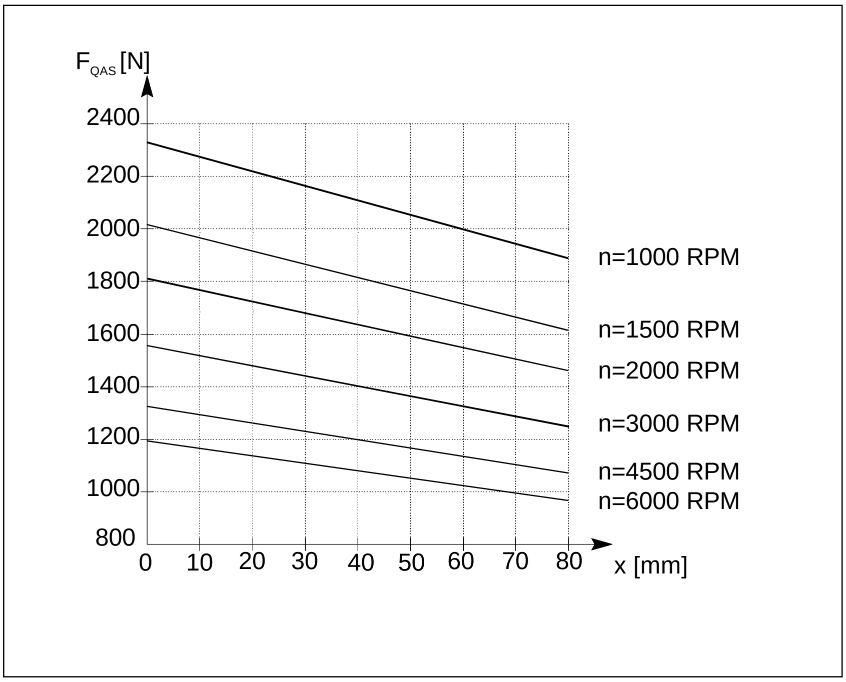
Axial force
1FT6082
1FT6084
1FT6086

Permissible axial force as a function of the cantilever force.



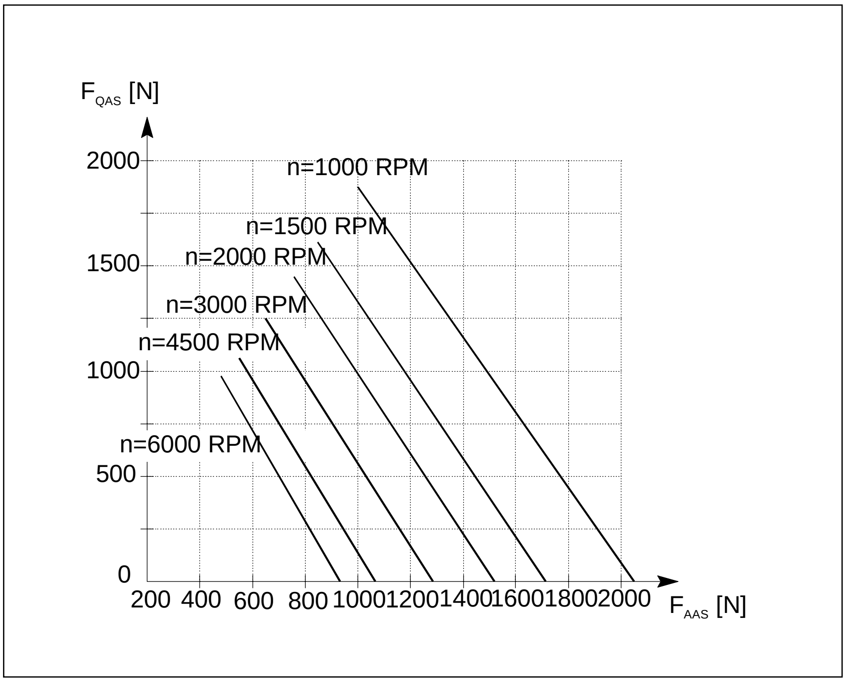
Bearing lifetime of 20 000 h.

Cantilever force
1FT6102
1FT6105



Axial force
1FT6102
1FT6105

Permissible axial force as a function of the cantilever force.



1.2.4 Dimension drawings

Technical data

Additional technical data and dimensions are provided in Catalog NC 60.1 and in the Planning Guide PJ 6SN1197-0AA20.

1.3 1FK6 motors

1.3.1 Motor description

1.3.1.1 Characteristics and technical data

Applications

1FK6 motors were developed for use with the SIMODRIVE 611 drive converter system for machine tools and various types of special-purpose machines.

Warning

The motors are not suitable for direct online supply.

Characteristics

Depending on the shaft height, 1FK6 motors have stall torques from 1.1 to 36 Nm at rated speeds from 3000 to 6000 RPM. They have a high overload capability over the complete speed control range. The motors are flange- and shaft-compatible to 1FT6 motors.

Standards, regulations

The appropriate standards and regulations are directly assigned to the functional requirements.

Features

The motors are designed for operation with a 600 V DC link voltage and impressed sinusoidal currents.

Table 1-31 Standard motors

Features	**Design**
Motor type	Permanent-magnet synchronous motor AC servomotor
Type of construction	IM B5 (IM V1, IM V3) (acc. to IEC 34-7)
Degree of protection	IP 64
Cooling	Non-ventilated (acc. to IEC 34-6)
Thermal motor protection	PTC thermistor (acc. to IEC 34-11) in the stator winding
Shaft end	Cylindrical; without keyway and without key (acc. to DIN 748, Part 3); tolerance zone k6
Rating plate	A second rating plate is provided for all motors
Radial eccentricity, concentricity and axial eccentricity	Tolerance N (according to DIN 42955)
Vibration severity	Grade N (according to IEC 34-14; DIN VDE 0530, Part 14)
Shock stressing (briefly; radial but not an operational condition)	Shaft heights 36, 48: 100 g; (acc. to DIN40046,T7) Shaft heights 80: 30 g Shaft heights 100: 20 g
Balancing	Half-key balancing according to DIN 8821
Vibration stressing	1 g axially (20 Hz to 2 kHz) 3 g radially (20 Hz to 2 kHz)
Bearings	Permanently-lubricated roller bearings (lubricated for their service life - permanently-lubricated) Bearing lifetime > 20000 h Shaft height 36/48: Locating bearing at the non drive end Shaft height 80/100: Locating bearing at the drive end
Winding insulation	Insulating material class F acc. to DIN VDE 0530 permits a winding temperature rise of ΔT = 105 K for an ambient temperature of 40 °C.
Magnetic materials	Rare-earth materials
Electrical connection	Connector for power- and encoder signals Connector socket for screened cables
Encoder system	Integrated optical encoder Speed sensing Rotor position sensing Indirect position sensing

Options

Table 1-32 Standard motors, options

Feature	Design
Degree of protection	Radial sealing ring (oiltight drive end flange)
Radial eccentricity, concentricity and axial eccentricity	Tolerance R (according to DIN 42955)
Integrated/mounted components	Fail-safe holding brake; 24V ±10% supply voltage (according to DIN 0580 7/79)

Note

For 1FK6 motors with optical encoders, optimum torque utilization is supported using an automatic identification routine. Typically, the motor rotates through <+/-5 degrees mechanical. The identification routine is executed after each power-up.

Technical data

Table 1-33 Motor overview (100K values are specified in the table)

Rated speed [RPM]	M0 [Nm]	Mrated [Nm]	Motor type 1FK6-	Motor current I0 [A]	Rated motor current [A]	P_{calc} [kW]	Connector size	Cross section [mm2]	Cable type 6FX2002-
6000	1.1	0.8	032-6AK71	1.7	3	0.5	1	4 x 1.5	5❑A01-1❑❑0
6000	1.6	0.8	040-6AK71	2.8	3	0.5	1	4 x 1.5	5❑A01-1❑❑0
3000	3.2	2.6	042-6AF71	2.7	3	0.8	1	4 x 1.5	5❑A01-1❑❑0
3000	6.0	4.0	060-6AF71	4.3	5	1.3	1	4 x 1.5	5❑A01-1❑❑0
3000	11.0	6.0	063-6AF71	7.9	9	1.9	1	4 x 1.5	5❑A01-1❑❑0
3000	8.0	6.8	080-6AF71	5.4	9	2.1	1	4 x 1.5	5❑A01-1❑❑0
3000	16.0	10.5	083-6AF71	10.6	18	3.3	1	4 x 1.5	5❑A01-1❑❑0
3000	18.0	12.0	100-8AF71	12.2	18	3.8	1	4 x 2.5	5❑A11-1❑❑0
3000	27.0	15.5	101-8AF71	18	18	4.9	1.5	4 x 4	5❑A41-1❑❑0
3000	36.0	16.5	103-8AF71	23.0	28	5.2	1.5	4 x 6	5❑A51-1❑❑0

Without brake cable: without overall screen A
with overall screen C
With brake cable: without overall screen B
with overall screen D

Standard lengths:
5 m - BF0
10 m - CB0
15 m - CB5
18 m - CB8
25 m - CC5

Power calculation: $P = M * n/9550$

P in kW
M in Nm
n in RPM

1.3.1.2 Functions and options

Armature short-circuit braking

The principle was already explained in Section 1.1.3 Functions - expanded functionality.
The appropriate resistor values are now listed.

Braking resistors

An optimum braking time is achieved by appropriately dimensioning the resistors. The braking torques obtained are listed in the tables. The data is valid for braking from the rated speed. If braking is initiated at a different speed, the braking time cannot be linearly interpolated. However the braking time does not increase.

The resistor rating must be adapted to the actual I²t load capability.

Table 1-34 Resistor braking for 1FK6 motors, shaft heights 36 to 100

Motor type	**Ext. braking resistor R_{opt} [Ω]**	**Average braking torque $M_{br\ RMS}$ [Nm]**	**Max. braking torque $M_{br\ max}$ [Nm]**	**RMS braking current $I_{br\ RMS}$ [A]**
1FK6032-❑❑K71	- 6	1.3 1.4	1.8	5.3 4.9
1FK6040-❑❑ K71	- 4.1	2.3 2.4	2.9	4.4 4.2
1FK6042-❑❑F71	- 2.5	4.5 4.9	6.1	9.8 9.1
1FK6080-❑❑F71	- 5.1	4.9 7.9	9.8	12.4 11.2
1FK6083-❑❑F71	- 3.0	7.9 16.1	2.0	24.1 21.6
1FK6100-❑❑F71	- 1.9	12.3 23.0	28.6	36.2 32.0
1FK6101-❑❑F71	- 1.4	16.4 35.4	43.8	52.9 47.4
1FK6103-❑❑F71	- 0.9	25 54	67.1	80.9 72.5

Holding brake

Refer to Section 1.1.2.2 Mounted/integrated components for a function description.

Table 1-35 Technical data of the holding brakes used with 1FK6 motors

Motor type	Brake type	Holding torques [Nm]		Dyn. torque [Nm] *)	DC current [A]	Power [W] ca.	Opening time [ms] *)	Closing time [ms] *)	Moment of inertia [10^{-4} kgm^2]
		20 °C *)	120 °C	120 °C					
1FK6032	EBD 0.13B	1.5	1.1	0.8	0.4	9.6	30	7.5	0.04
1FK604❑	EBD 0.3B	4.5	3.2	2.5	0.6	13.4			0.21
1FK606❑	EBD 0.8B	12	10	6.5	0.7	15.6	55	15	0.6
1FK608❑	EBD 1.4B	23	18	11	0.6	13.5	150	30	2.3
1FK6100	EBD 1.4B	23	18	11	0.6	13.5	150	30	2.3
1FK6101 1FK6103	EBD 3.8B	50	36	25	0.9	22.3	180	25	10.8

*) according to the type test

Forced ventilation

not provided

1.3.1.3 Interfaces

Power connection

Various types of pre-assembled cables are available (refer to technical data).

- You will find cable- and connector assignments in Section 1.1.4: Connections.
- The complete program of accessories is listed in Catalog NC Z.

Note

Motor-connector size-cable cross-section assignment (refer to

Table 1-33 Motor overview (100K values are specified in the table).

- The cable cross-section is dimensioned for I_{RMS}=100 K (in accordance with VDE0113).
- 40°C ambient temperature
- For PVC-insulated cables

Actual value cables

The actual value cables used are described for the appropriate encoders/sensors.

1.3.2 Order designations

Order designation

1	F	K	6	.	.	.	-	.	A	.	7	1	-	3	.	.	.

Electric motor
Synchronous motor
AC servomotor
Series
Frame size
Length

No. of poles
Non-ventilated
Rated speed
F = 3000 RPM
K = 6000 RPM

Connector outlet direction

Optical encoder
A incremental ERN 1387
E reserved

Shaft end1)		Radial eccentricity	Holding brake
G=	b	N	without
H=	b	N	with
K=	b	R	without
L=	b	R	with

Degree of protection
0 = IP 64
2 = Radial shaft sealing ring (oil-tight drive end flange)

1) b = shaft end: smooth shaft, without keyway

1.3.3 Technical data and characteristics

1.3.3.1 Speed-torque diagrams

Table 1-36 Standard 1FK6032 motor

1FK6032			
Technical data	**Codes**	**Units**	**-6AK7**
Engineering data			
Rated speed	n_{rated}	RPM	6000
Rated torque	$M_{rated\ (100\ K)}$	Nm	0.8
Rated current	I_{rated}	A	1.5
Stall torque	$M_{0\ (60\ K)}$	Nm	0.9
Stall torque	$M_{0\ (100\ K)}$	Nm	1.1
Stall current	$I_{0\ (60\ K)}$	A	1.4
Stall current	$I_{0\ (100\ K)}$)	A	1.7
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	0.67
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	0.63
Limiting data			
Max. speed	n_{max}	RPM	9000
Max. torque	M_{max}	Nm	4.1
Peak current	I_{max}	A	6.6
Limiting torque	M_{limit}	Nm	2.5
Limiting current	I_{limit}	A	4.3
Physical constants			
Torque constant	k_T	Nm/A	0.64
Voltage constant	k_E	V/1000 RPM	42
Winding resistance	R_{phase}	Ohm	7
Three-phase inductance	L_D	mH	15
Electrical time constant	T_{el}	ms	2.2
Mechanical time constant	T_{mech}	ms	3.8
Thermal time constant	T_{th}	min	25
Thermal resistance	R_{th}	Ohm	0.1
Weight with brake	m	kg	3.04
Weight without brake	m	kg	2.9

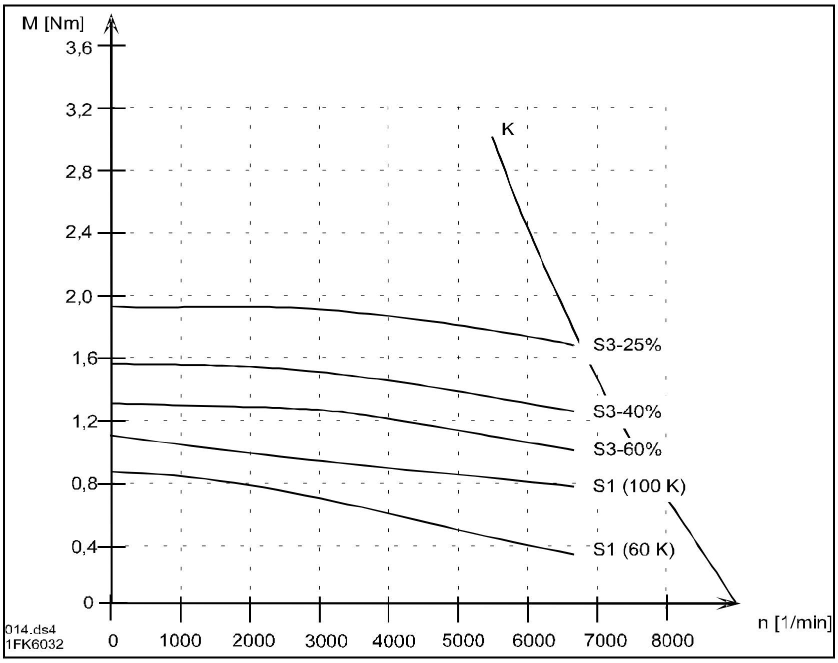


Fig. 1-28 Speed-torque diagram, 1FK6032

Table 1-37 Standard 1FK6040 motor

1FK6040			
Technical data	**Code**	**Units**	**-6AK7**
Engineering data			
Rated speed	n_{rated}	RPM	6000
Rated torque	$M_{rated\ (100\ K)}$	Nm	0.8
Rated current	I_{rated}	A	1.75
Stall torque	$M_{0\ (60\ K)}$	Nm	1.3
Stall torque	$M_{0\ (100\ K)}$	Nm	1.6
Stall current	$I_{0\ (60\ K)}$	A	2.2
Stall current	$I_{0\ (100\ K)}$	A	2.8
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	2.08
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	1.87
Limiting data			
Max. speed	n_{max}	RPM	7500
Max. torque	M_{max}	Nm	5.7
Peak current	I_{max}	A	10
Limiting torque	M_{limit}	Nm	4.9
Limiting current	I_{limit}	A	8.8
Physical constants			
Torque constant	k_T	Nm/A	1.17
Voltage constant	k_E	V/1000 RPM	37.5
Winding resistance	$R_{ph.}$	Ohm	2.65
Three-phase inductance	L_D	mH	7.5
Electrical time constant	T_{el}	ms	3.0
Mechanical time constant	T_{mech}	ms	4.8
Thermal time constant	T_{th}	min	25
Thermal resistance	R_{th}	Ohm	0.3
Weight with brake	m	kg	4.1
Weight without brake	m	kg	3.7

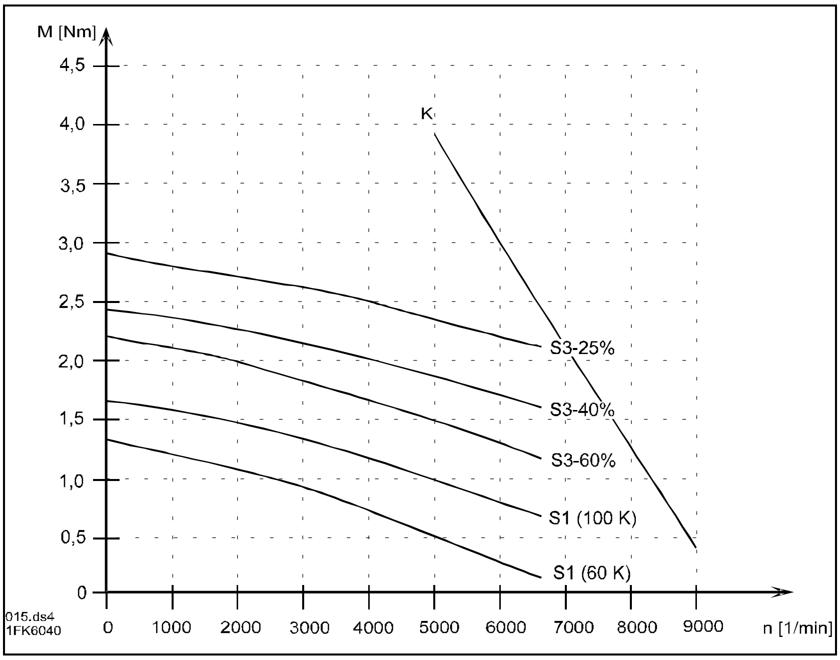


Fig. 1-29 Speed-torque diagram, 1FK6040

Table 1-38 Standard 1FK6042 motor

1FK6042			
Technical data	**Code**	**Units**	**-6AK7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	2.6
Rated current	I_{rated}	A	2.4
Stall torque	$M_{0\ (60\ K)}$	Nm	2.65
Stall torque	$M_{0\ (100\ K)}$	Nm	3.2
Stall current	$I_{0\ (60\ K)}$	A	2.2
Stall current	$I_{0\ (100\ K)}$	A	2.7
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	3.68
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	3.47
Limiting data			
Max. speed	n_{max}	RPM	5200
Max. torque	M_{max}	Nm	11.4
Peak current	I_{max}	A	10.5
Limiting torque	M_{limit}	Nm	10.3
Limiting current	I_{limit}	A	10.2
Physical constants			
Torque constant	k_T	Nm/A	1.18
Voltage constant	k_E	V/1000 RPM	76
Winding resistance	$R_{ph.}$	Ohm	3.6
Three-phase inductance	L_D	mH	13
Electrical time constant	T_{el}	ms	3.6
Mechanical time constant	T_{mech}	ms	3.6
Thermal time constant	T_{th}	min	35
Thermal resistance	R_{th}	Ohm	0.2
Weight with brake	m	kg	5.4
Weight without brake	m	kg	5

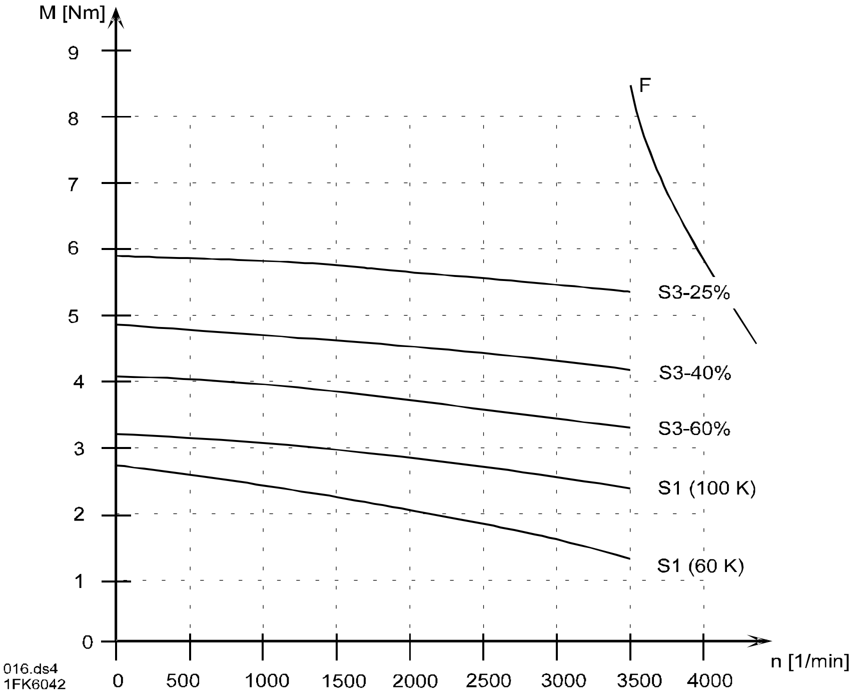


Fig. 1-30 Speed-torque diagram, 1FK6042

Table 1-39 Standard 1FK6060 motor

1FK6060			
Technical data	**Code**	**Units**	**-6AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	4.0
Rated current	I_{rated}	A	3.1
Stall torque	$M_{0\ (60\ K)}$	Nm	5.0
Stall torque	$M_{0\ (100\ K)}$	Nm	6.0
Stall current	$I_{0\ (60\ K)}$	A	3.6
Stall current	$I_{0\ (100\ K)}$	A	4.3
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	9.2
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	8.6
Limiting data			
Max. speed	n_{max}	RPM	4400
Max. torque	M_{max}	Nm	22
Peak current	I_{max}	A	16
Limiting torque	M_{limit}	Nm	12
Limiting current	I_{limit}	A	8.8
Physical constants			
Torque constant	k_T	Nm/A	1.39
Voltage constant	k_E	V/1000 RPM	90
Winding resistance	$R_{ph.}$	Ohm	2.3
Three-phase inductance	L_D	mH	14
Electrical time constant	T_{el}	ms	6.1
Mechanical time constant	T_{mech}	ms	3.1
Thermal time constant	T_{th}	min	30
Thermal resistance	R_{th}	Ohm	0.2
Weight with brake	m	kg	9.6
Weight without brake	m	kg	9

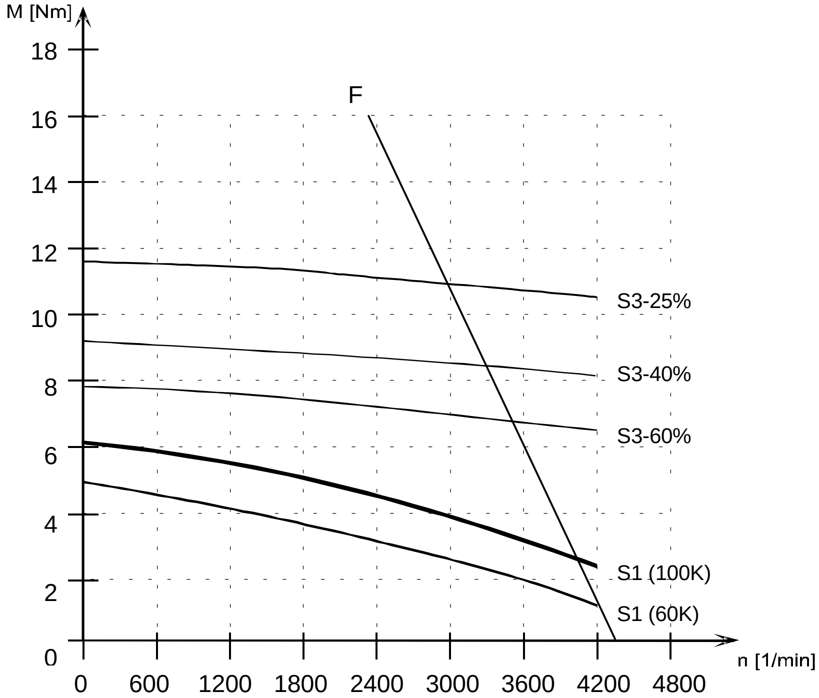


Fig. 1-31 Speed-torque diagram, 1FK6060

Table 1-40 Standard 1FK6063 motor

1FK6063			
Technical data	**Code**	**Units**	**-6AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	6.0
Rated current	I_{rated}	A	4.9
Stall torque	$M_{0\ (60\ K)}$	Nm	9.1
Stall torque	$M_{0\ (100\ K)}$	Nm	11.0
Stall current	$I_{0\ (60\ K)}$	A	6.6
Stall current	$I_{0\ (100\ K)}$	A	7.9
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	16.7
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	16.1
Limiting data			
Max. speed	n_{max}	RPM	4400
Max. torque	M_{max}	Nm	40
Peak current	I_{max}	A	30
Limiting torque	M_{limit}	Nm	30
Limiting current	I_{limit}	A	22
Physical constants			
Torque constant	k_T	Nm/A	1.39
Voltage constant	k_E	V/1000 RPM	90
Winding resistance	$R_{ph.}$	Ohm	0.8
Three-phase inductance	L_D	mH	6
Electrical time constant	T_{el}	ms	7.5
Mechanical time constant	T_{mech}	ms	2
Thermal time constant	T_{th}	min	35
Thermal resistance	R_{th}	Ohm	0.15
Weight with brake	m	kg	13.8
Weight without brake	m	kg	13.2

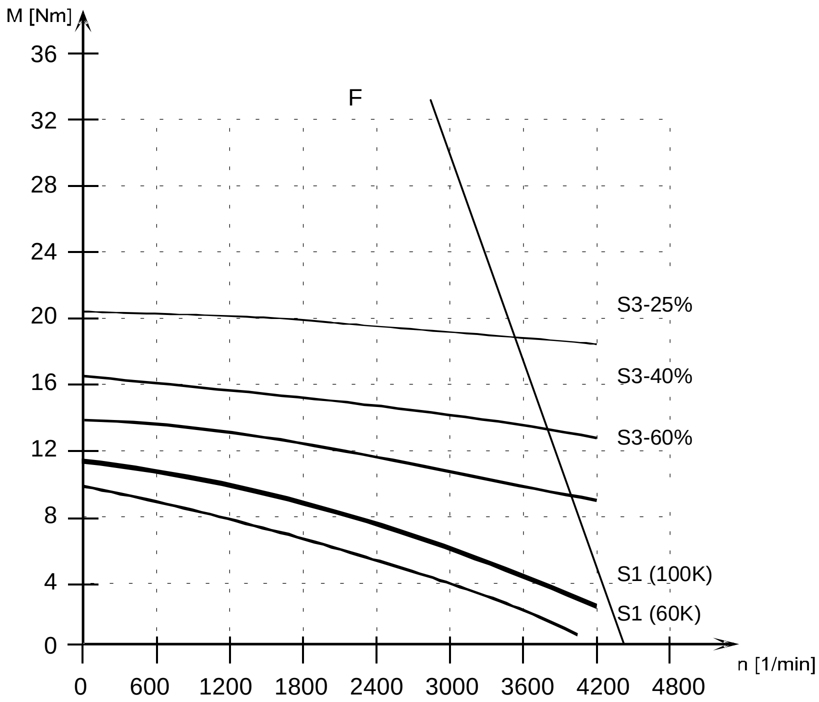


Fig. 1-32 Speed-torque diagram, 1FK6063

Table 1-41 Standard 1FK6080 motor

1FK6080			
Technical data	**Code**	**Units**	**-6AF7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	6.8
Rated current	I_{rated}	A	5.3
Stall torque	$M_{0\ (60\ K)}$	Nm	6.6
Stall torque	$M_{0\ (100\ K)}$	Nm	8.0
Stall current	$I_{0\ (60\ K)}$	A	4.8
Stall current	$I_{0\ (100\ K)}$	A	5.7
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	18.4
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	16.1
Limiting data			
Max. speed	n_{max}	RPM	4200
Max. torque	M_{max}	Nm	27
Peak current	I_{max}	A	21
Limiting torque	M_{limit}	Nm	14
Limiting current	I_{limit}	A	11
Physical constants			
Torque constant	k_T	Nm/A	1.4
Voltage constant	k_E	V/1000 RPM	90
Winding resistance	$R_{ph.}$	Ohm	1.5
Three-phase inductance	L_D	mH	14
Electrical time constant	T_{el}	ms	9.3
Mechanical time constant	T_{mech}	ms	3.7
Thermal time constant	T_{th}	min	30
Thermal resistance	R_{th}	Ohm	0.2
Weight with brake	m	kg	13.7
Weight without brake	m	kg	12.5

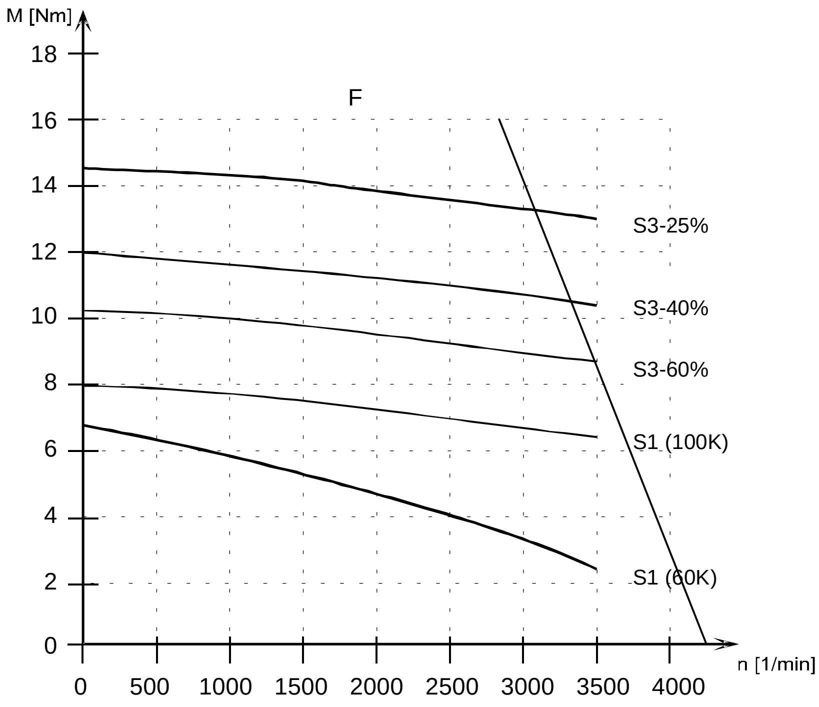


Fig. 1-33 Speed-torque diagram, 1FK6080

Table 1-42 Standard 1FK6083 motor

1FK6083			
Technical data	**Code**	**Units**	**-6AK7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	10.5
Rated current	I_{rated}	A	7.5
Stall torque	$M_{0\ (60\ K)}$	Nm	13.3
Stall torque	$M_{0\ (100\ K)}$	Nm	16.0
Stall current	$I_{0\ (60\ K)}$	A	8.5
Stall current	$I_{0\ (100\ K)}$	A	10.2
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	29.4
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	27.1
Limiting data			
Max. speed	n_{max}	RPM	3850
Max. torque	M_{max}	Nm	54
Peak current	I_{max}	A	40
Limiting torque	M_{limit}	Nm	30
Limiting current	I_{limit}	A	21
Physical constants			
Torque constant	k_T	Nm/A	1.56
Voltage constant	k_E	V/1000 RPM	100
Winding resistance	$R_{ph.}$	Ohm	0.55
Three-phase inductance	L_D	mH	7.6
Electrical time constant	T_{el}	ms	6.7
Mechanical time constant	T_{mech}	ms	3.6
Thermal time constant	T_{th}	min	35
Thermal resistance	R_{th}	Ohm	0.15
Weight with brake	m	kg	18.2
Weight without brake	m	kg	17

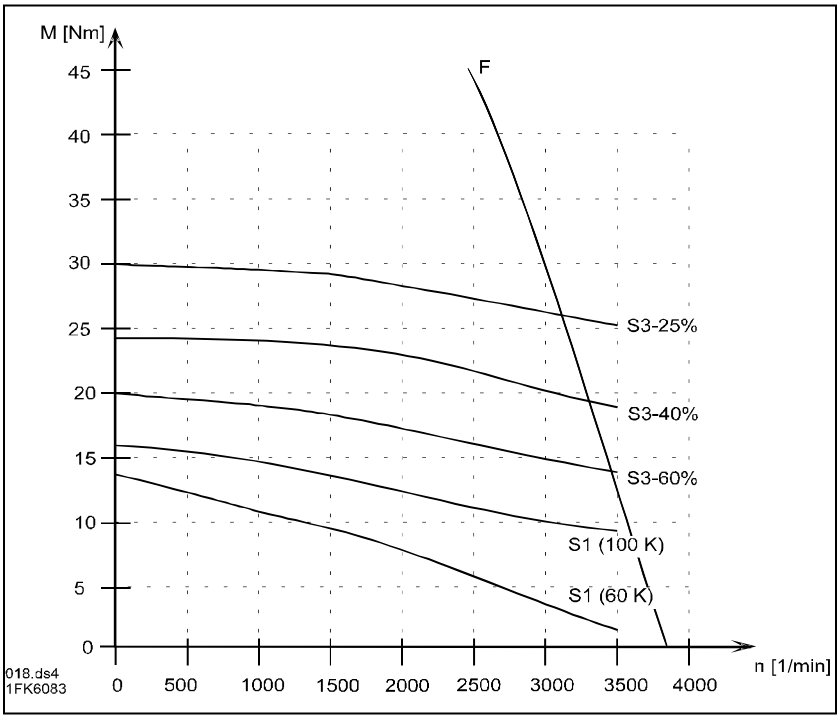


Fig. 1-34 Speed-torque diagram, 1FK6083

Table 1-43 Standard 1FK6100 motor

1FK6100			
Technical data	**Code**	**Units**	**-6AK7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	12.0
Rated current	I_{rated}	A	9
Stall torque	$M_{0\ (60\ K)}$	Nm	15
Stall torque	$M_{0\ (100\ K)}$	Nm	18.0
Stall current	$I_{0\ (60\ K)}$	A	10.2
Stall current	$I_{0\ (100\ K)}$	A	12.2
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	68.3
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	57.5
Limiting data			
Max. speed	n_{max}	RPM	4000
Max. torque	M_{max}	Nm	59
Peak current	I_{max}	A	48
Limiting torque	M_{limit}	Nm	32
Limiting current	I_{limit}	A	24.5
Physical constants			
Torque constant	k_T	Nm/A	1.48
Voltage constant	k_E	V/1000 RPM	95
Winding resistance	$R_{ph.}$	Ohm	0.4
Three-phase inductance	L_D	mH	3.6
Electrical time constant	T_{el}	ms	9
Mechanical time constant	T_{mech}	ms	3.2
Thermal time constant	T_{th}	min	35
Thermal resistance	R_{th}	Ohm	0.12
Weight with brake	m	kg	22.5
Weight without brake	m	kg	21

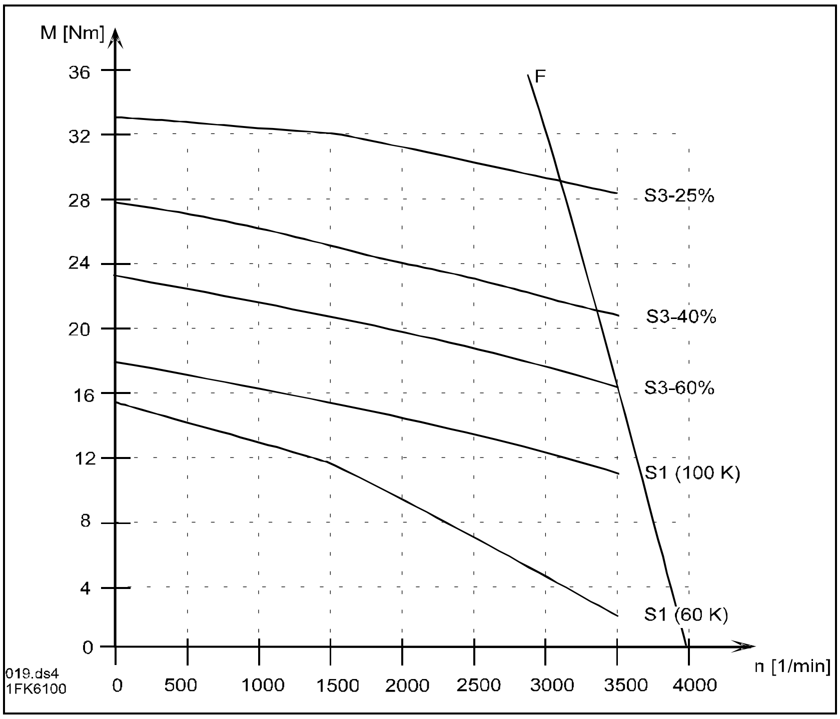


Fig. 1-35 Speed-torque diagram, 1FK6100

Table 1-44 Standard 1FK6101 motor

1FK6101			
Technical data	**Code**	**Units**	**-6AK7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	15.5
Rated current	I_{rated}	A	10.4
Stall torque	$M_{0\ (60\ K)}$	Nm	22.4
Stall torque	$M_{0\ (100\ K)}$	Nm	27.0
Stall current	$I_{0\ (60\ K)}$	A	14.4
Stall current	$I_{0\ (100\ K)}$	A	17.3
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	100.3
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	89.5
Limiting data			
Max. speed	n_{max}	RPM	3850
Max. torque	M_{max}	Nm	88
Peak current	I_{max}	A	67
Limiting torque	M_{limit}	Nm	46
Limiting current	I_{limit}	A	31
Physical constants			
Torque constant	k_T	Nm/A	1.56
Voltage constant	k_E	V/1000 RPM	100
Winding resistance	$R_{ph.}$	Ohm	0.23
Three-phase inductance	L_D	mH	2.6
Electrical time constant	T_{el}	ms	11.3
Mechanical time constant	T_{mech}	ms	2.5
Thermal time constant	T_{th}	min	40
Thermal resistance	R_{th}	Ohm	0.12
Weight with brake	m	kg	28
Weight without brake	m	kg	26

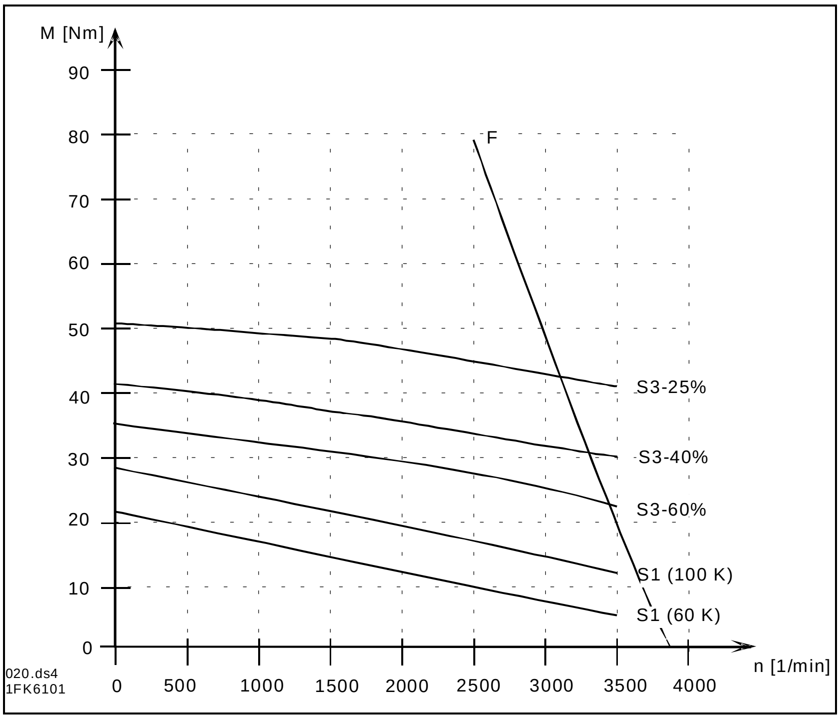


Fig. 1-36 Speed-torque diagram, 1FK6101

Table 1-45 Standard 1FK6103 motor

1FK6103			
Technical data	**Code**	**Units**	**-6AK7**
Engineering data			
Rated speed	n_{rated}	RPM	3000
Rated torque	$M_{rated\ (100\ K)}$	Nm	16.5
Rated current	I_{rated}	A	11.6
Stall torque	$M_{0\ (60\ K)}$	Nm	30
Stall torque	$M_{0\ (100\ K)}$	Nm	36.0
Stall current	$I_{0\ (60\ K)}$	A	19
Stall current	$I_{0\ (100\ K)}$	A	23
Moment of inertia (with brake)	J_{mot}	10^{-4} kgm^2	132.3
Moment of inertia (without brake)	J_{mot}	10^{-4} kgm^2	121.5
Limiting data			
Max. speed	n_{max}	RPM	3850
Max. torque	M_{max}	Nm	118
Peak current	I_{max}	A	90
Limiting torque	M_{limit}	Nm	57
Limiting current	I_{limit}	A	35
Physical constants			
Torque constant	k_T	Nm/A	1.56
Voltage constant	k_E	V/1000 RPM	100
Winding resistance	$R_{ph.}$	Ohm	0.15
Three-phase inductance	L_D	mH	1.7
Electrical time constant	T_{el}	ms	11.3
Mechanical time constant	T_{mech}	ms	2.3
Thermal time constant	T_{th}	min	45
Thermal resistance	R_{th}	Ohm	0.07
Weight with brake	m	kg	32
Weight without brake	m	kg	30

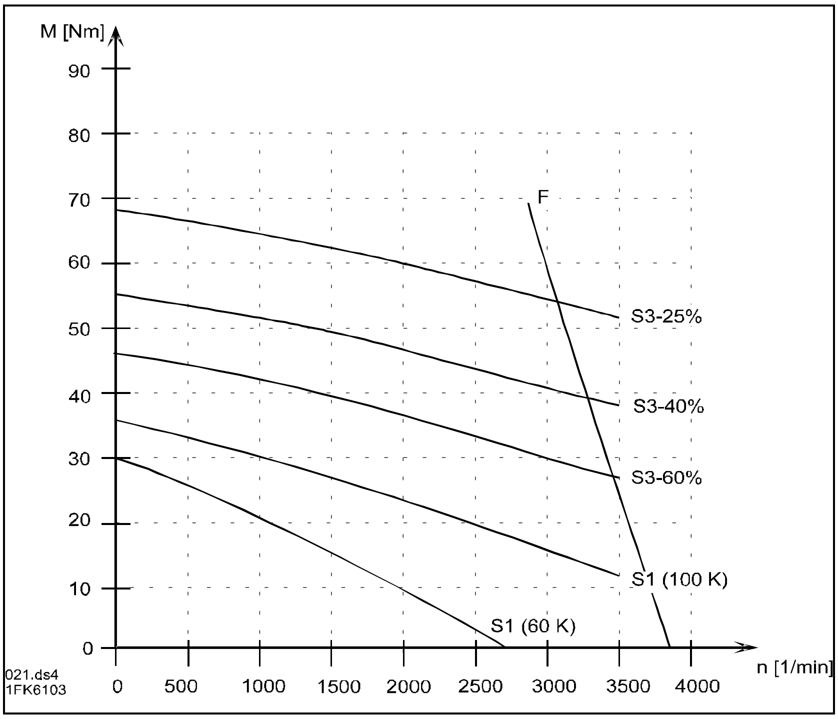
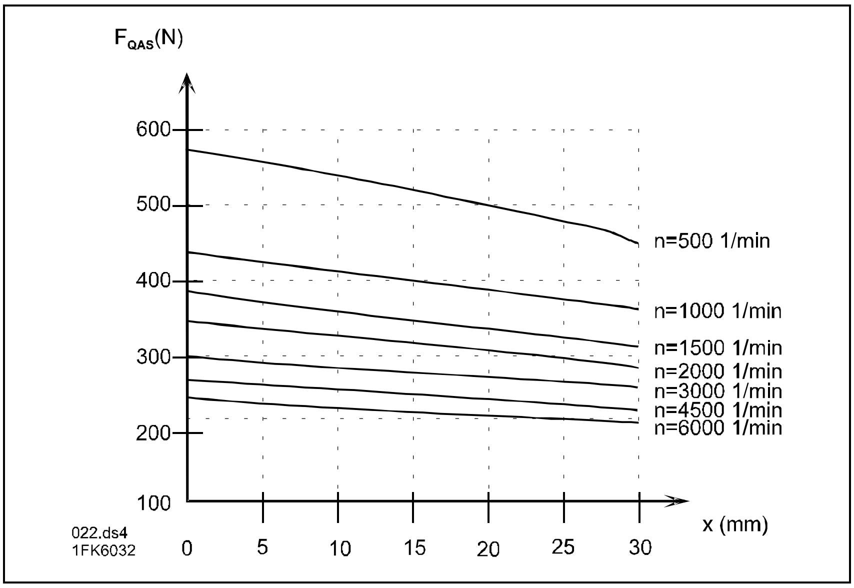


Fig. 1-37 Speed-torque diagram, 1FK6103

1.3.3.2 Cantilever force/axial force diagrams

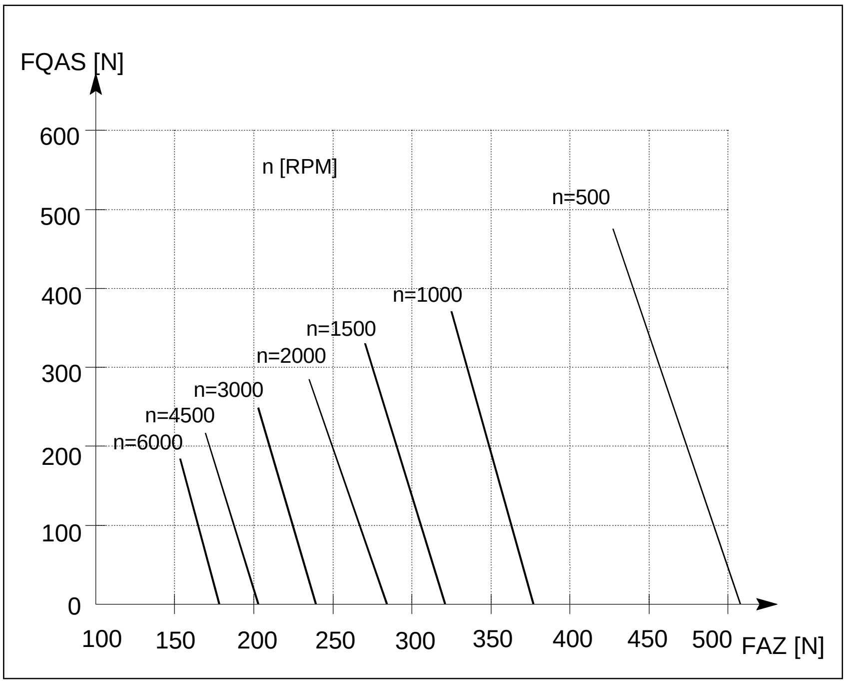
Cantilever force, 1FK6032

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



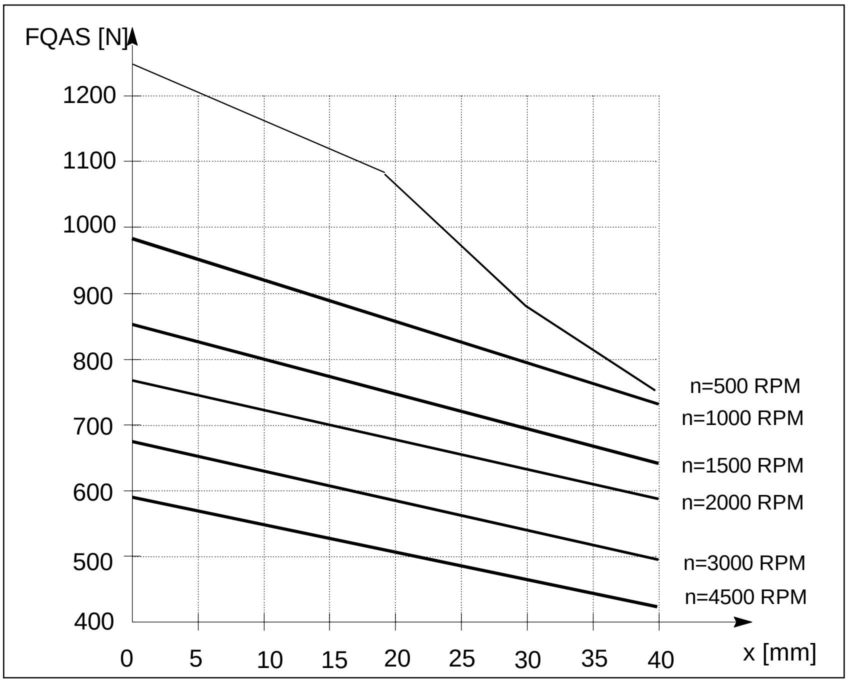
Axial force, 1FK6032

Permissible axial force as a function of the cantilever force



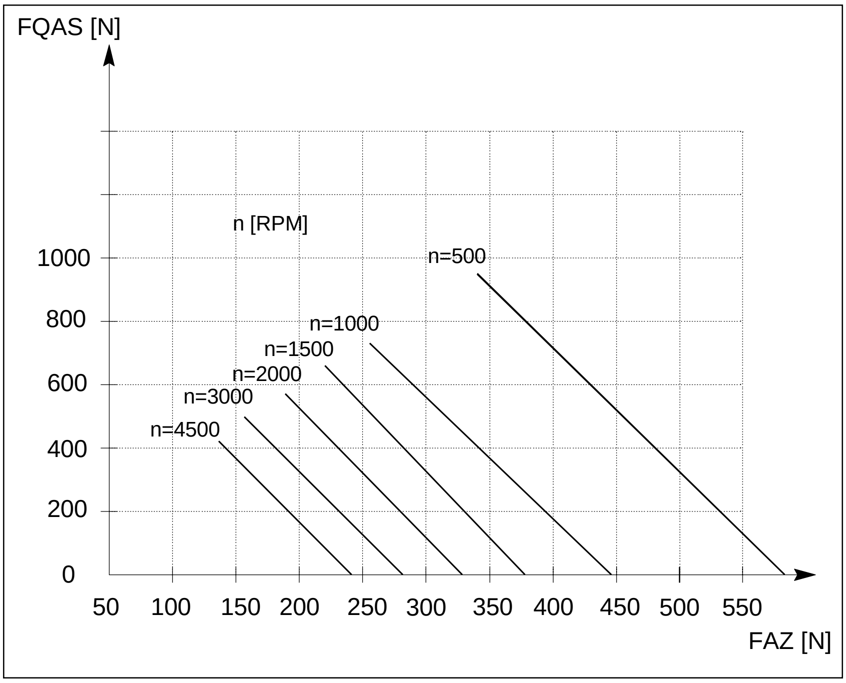
Cantilever force, 1FK6040

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



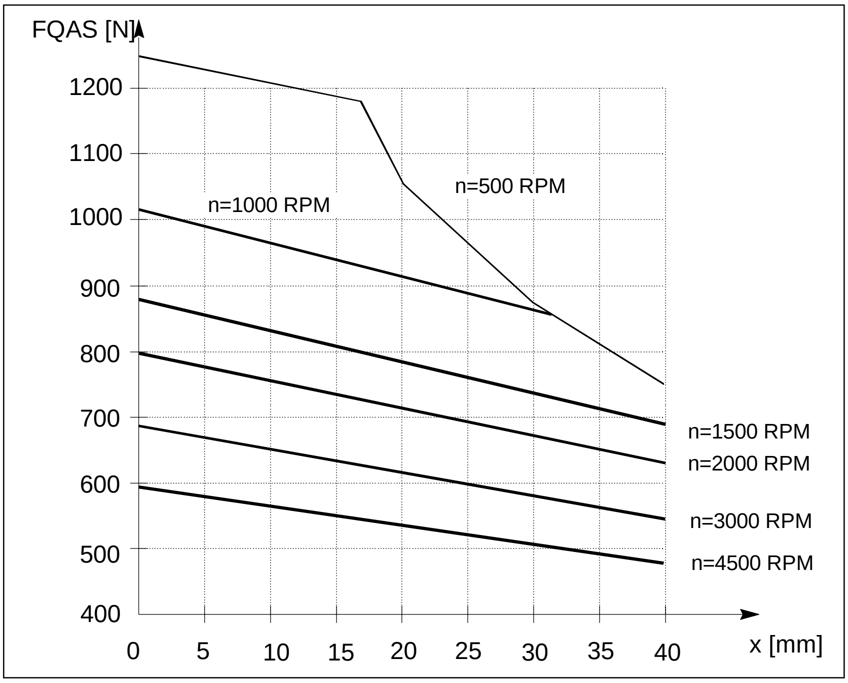
Axial force, 1FK6040

Permissible axial force as a function of the cantilever force



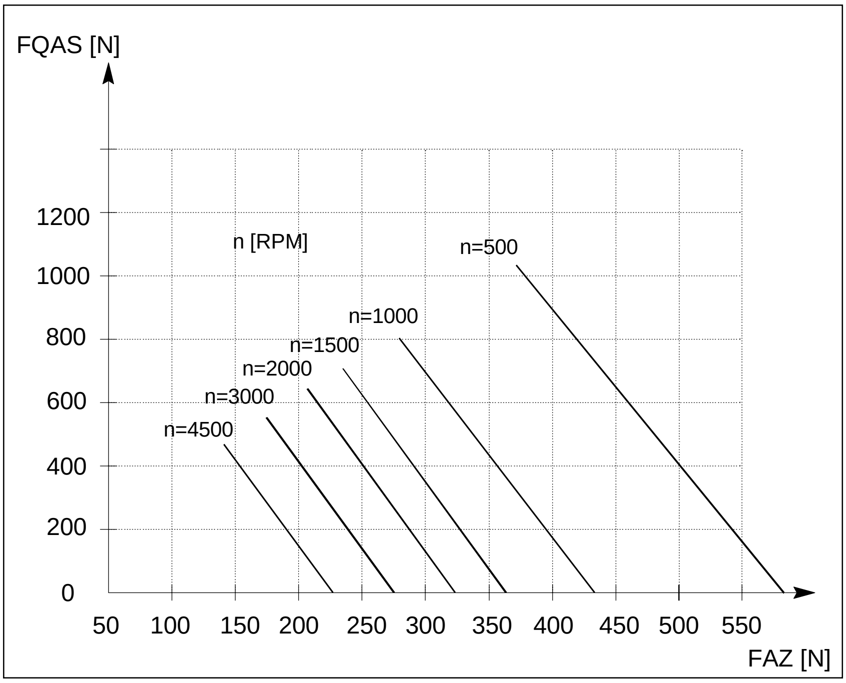
Cantilever force, 1FK6042

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



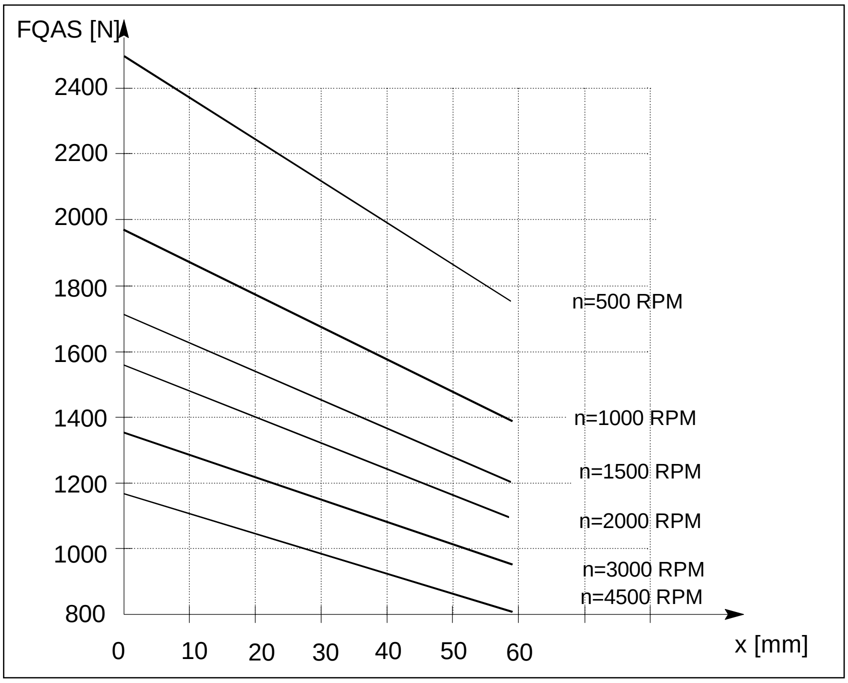
Axial force, 1FK6042

Permissible axial force as a function of the cantilever force



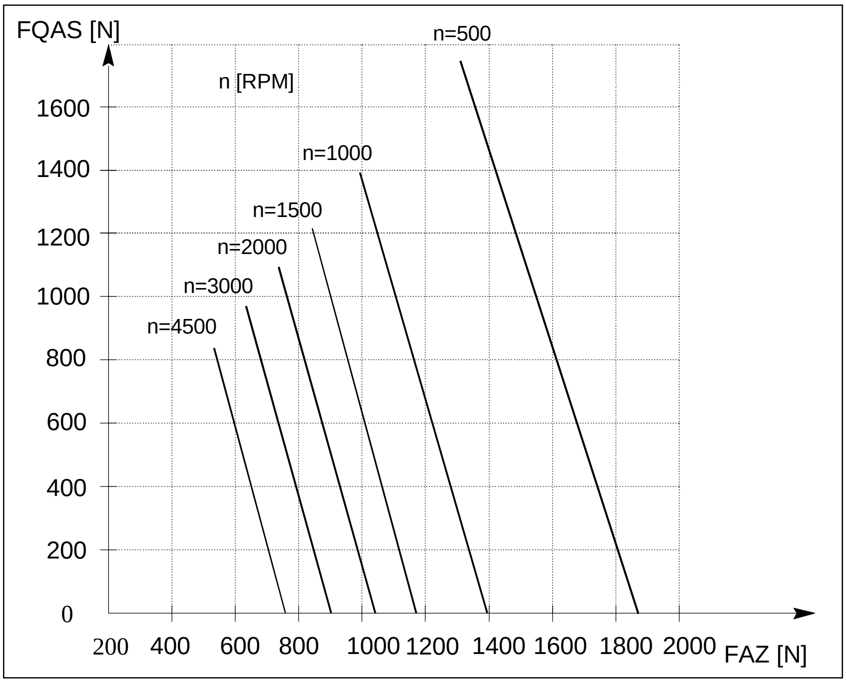
Cantilever force, 1FK6080

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



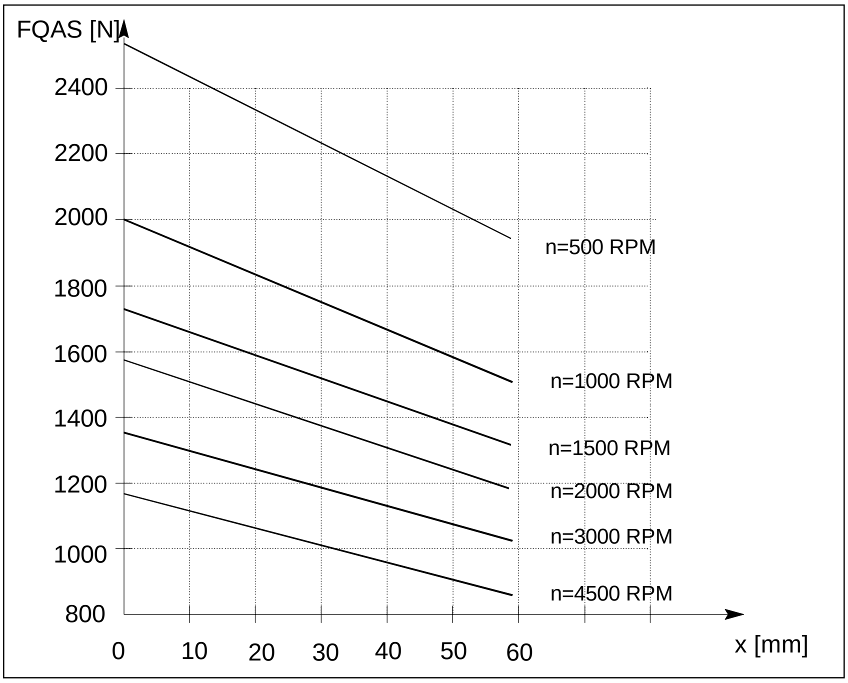
Axial force, 1FK6080

Permissible axial force as a function of the cantilever force



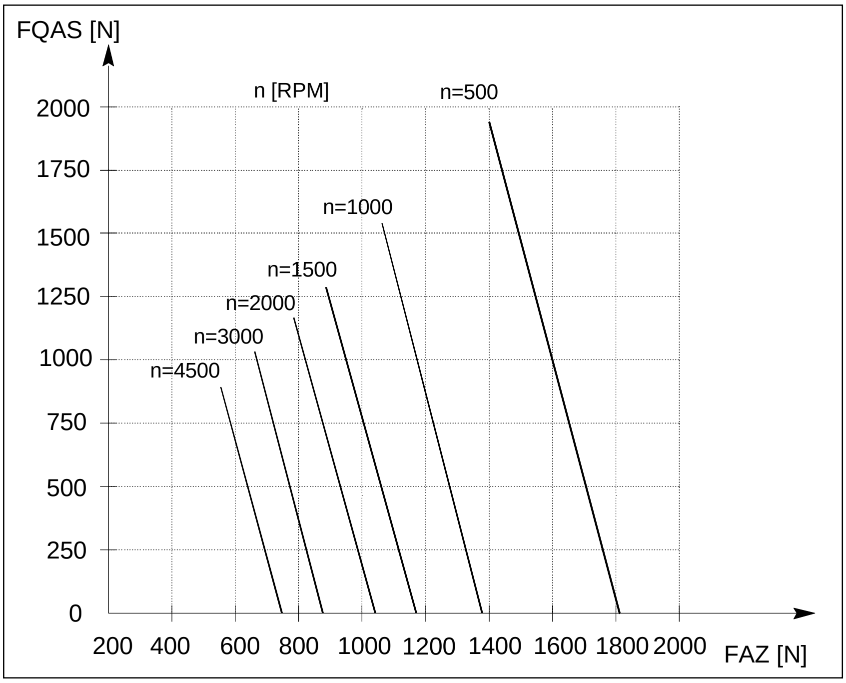
Cantilever force, 1FK6083

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



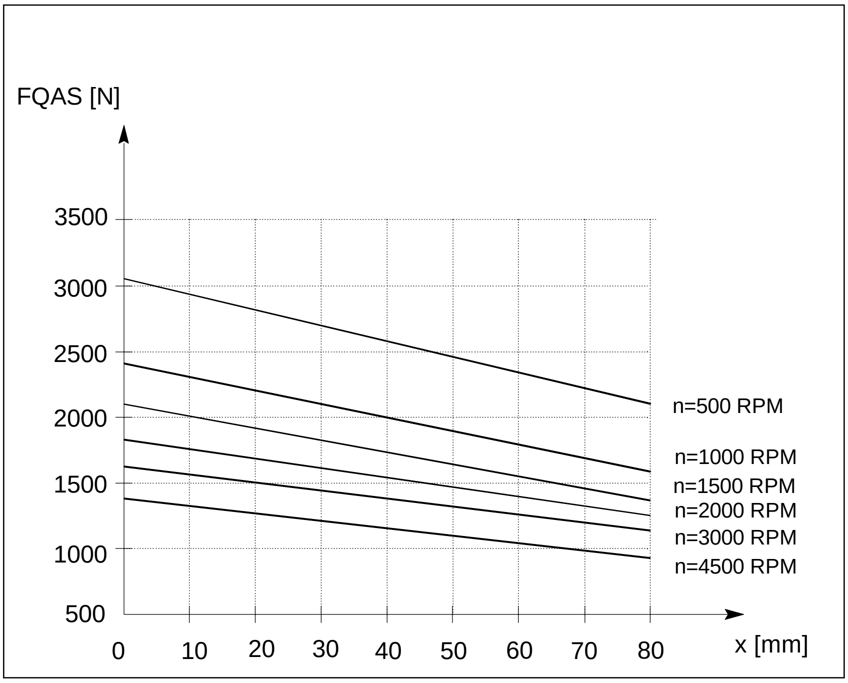
Axial force, 1FK6083

Permissible axial force as a function of the cantilever force



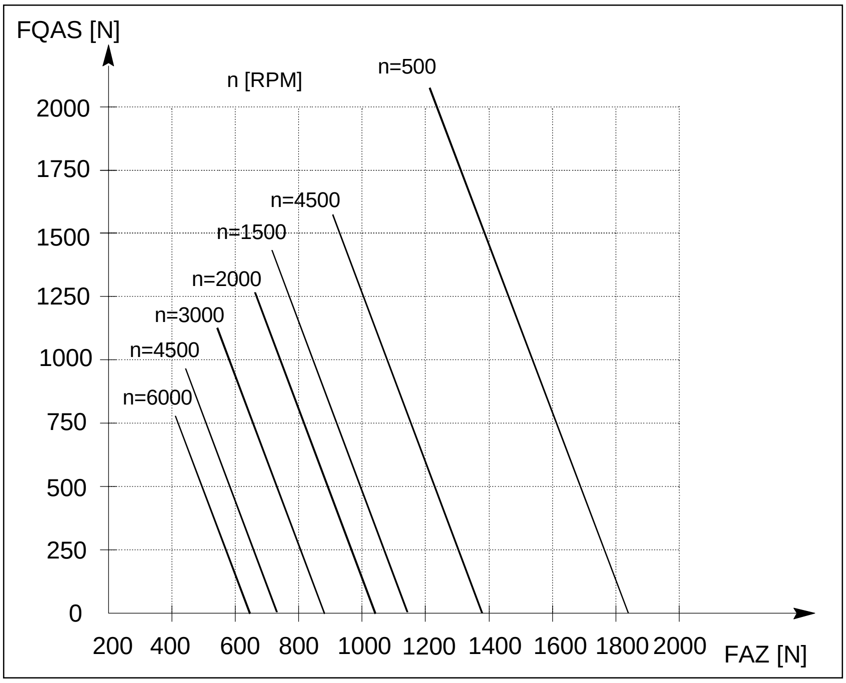
Cantilever force, 1FK6100

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



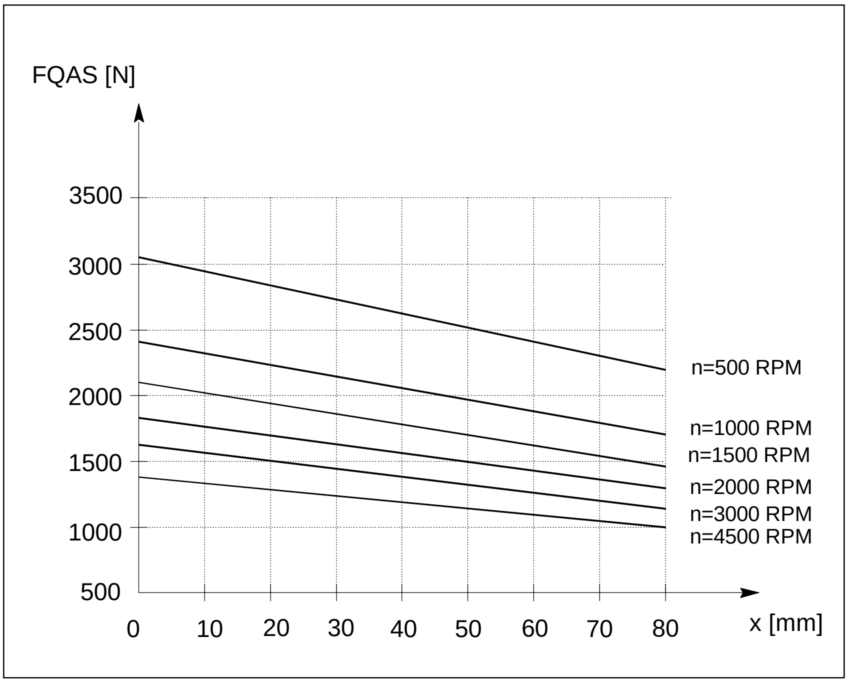
Axial force, 1FK6100

Permissible axial force as a function of the cantilever force



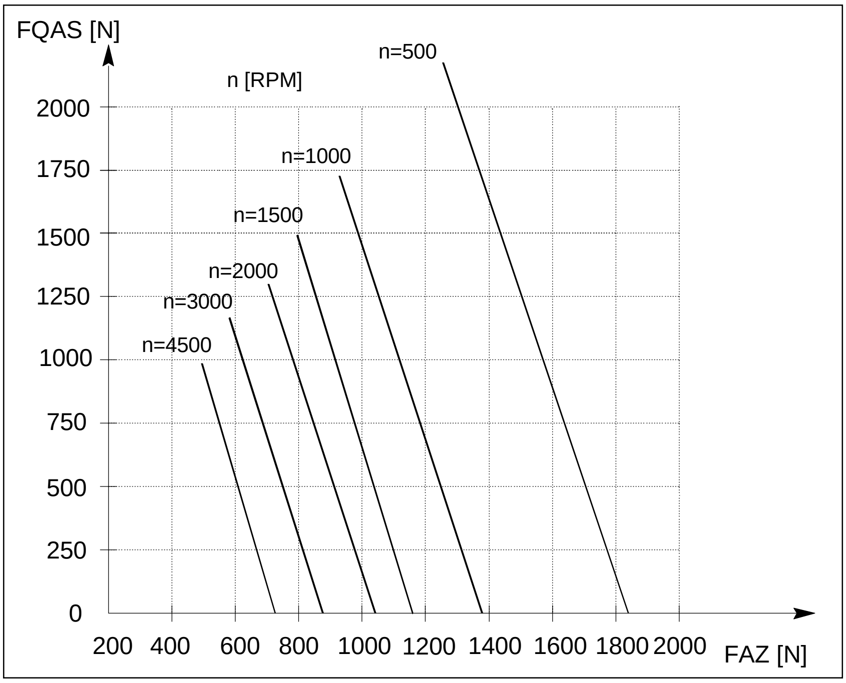
Cantilever force, 1FK6101

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



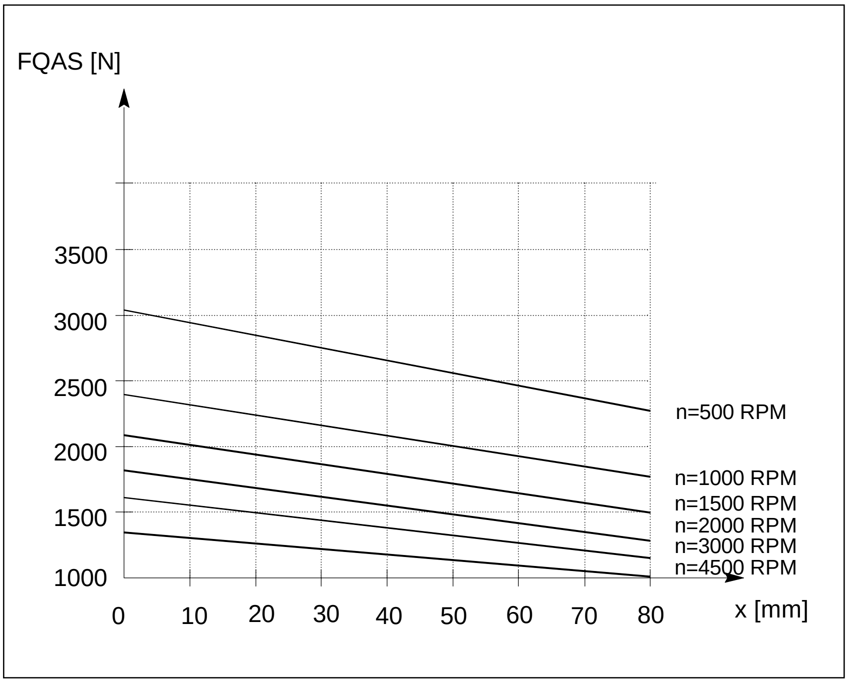
Axial force, 1FK6101

Permissible axial force as a function of the cantilever force



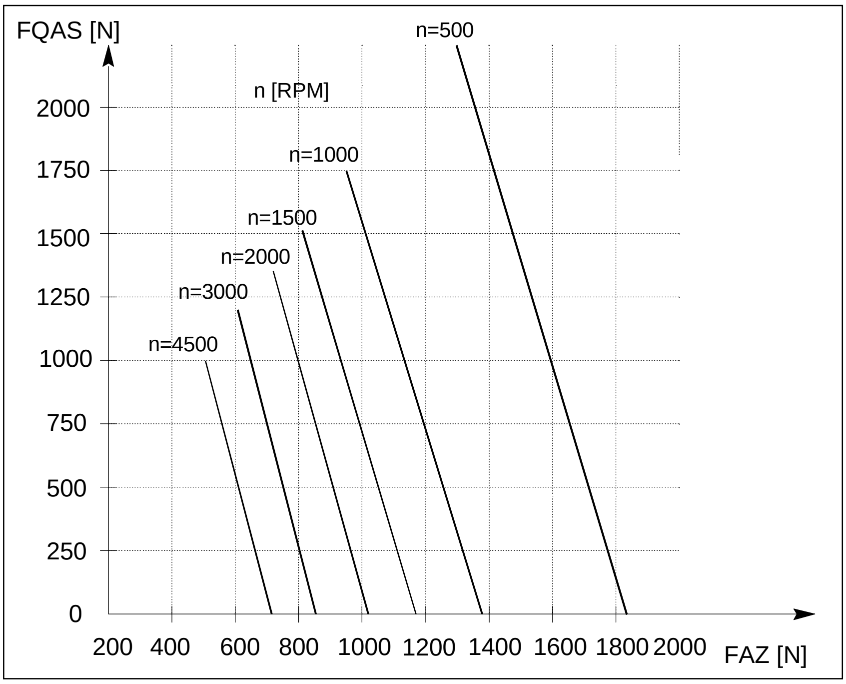
Cantilever force, 1FK6103

Cantilever force F_Q at a distance x from the shaft shoulder for a nominal bearing lifetime of 20 000 hours.



Axial force, 1FK6103

Permissible axial force as a function of the cantilever force



1.3.4 Dimension drawings

Technical data

Additional technical data and dimensions are provided in Catalog NC 60.1 and in the Planning Guide PJ 6SN1197-0AA20.

2 Engineering SIMODRIVE 611

Contents

2.1 Engineering steps

Procedure

The procedure to configure a SIMODRIVE drive group has been sub-divided into simple, basic steps.

- Motor selection
- Selecting the supply infeed
- Selecting the power module (alternatively, the Protected Power Unit)
- EMC measures (when required)

The SIMOPRO PC tool is also available to configure the 6SN series. Please contact your local Siemens office for further information (e. g. Start-up guides, SIMODRIVE 611 and SINUMERIK 840 C/D as well as detailed ordering information).

2.2 System configuration

The single-axis positioning control MCU 172A can be used in various versions depending on the particular positioning task and the application. The configuration can either be modular as a group with the supply infeed (NE), power module and MCU module as well as the monitoring- and pulsed resistor module.

The MCU 172A can be used for distributed positioning tasks in a single-axis module, IP65 degree of protection with the designation PPU (Protected Power Unit).

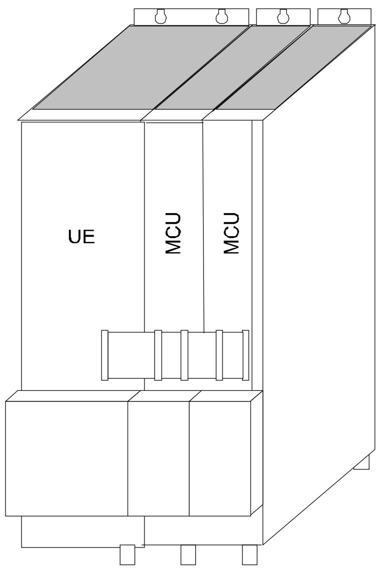


Fig. 2-1 Configuration types

Procedure

In a drive group, the power supply of an NE module can supply a maximum of three MCU axes. A monitoring module must be used for larger drive groups. However, the required DC link power must be supplied from the NE module.

Note

The PPU description is provided in the Planning Guide 6SN1 197-0AA00 from Edition 12.94 onwards.

In this documentation, the description of the supply infeed modules (NE modules) is restricted to the description of the uncontrolled infeed (UE). More detailed information is provided in the Planning Guide 6SN1 197-0AA00.

2.2.1 Specifications

Note

The components are insulated in accordance with DIN VDE 0160 / 05.88 and DIN VDE 0110 / 01.89.
Overvoltage category III
Degree of pollution 2
Installation altitude up to max. 2000 m above sea level
Neutral point of the supply is directly grounded; the module housing is grounded.

2.2.2 Mechanical specifications

Vibration stressing in operation

according to

- DIN IEC 68-2-6
- IEC 65A (Co) 22-I

Severity level according to SN 29010/Part 1

Table 2-1 Vibration stressing in operation

Severity level	Frequency range	Constant deflection	Amplitude of the acceleration	
	[Hz]	[mm]	[m/s]	[g]
Class 12	10 - 58 above 58 - 500	0.075	9.81	1

2.2.3 Electrical specifications

Supply specifications for NE modules

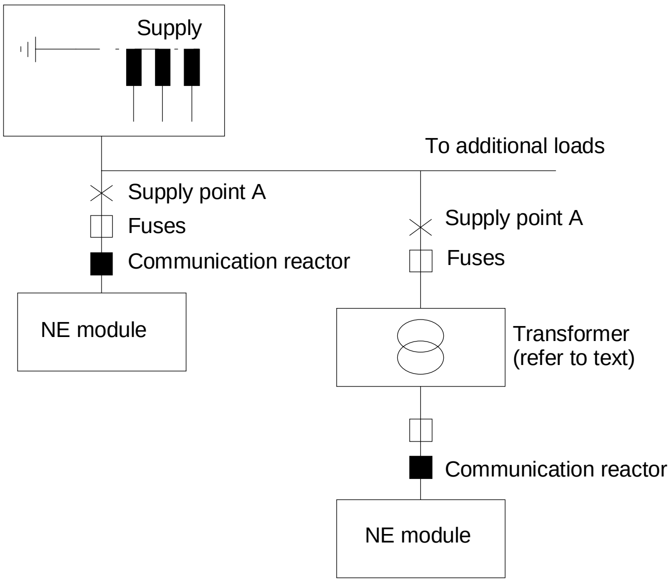


Fig. 2-2 Supply specifications for the NE module

Transformer

If an isolating transformer is used, and this is exclusively used to supply a subsequently connected I/R module, then it can be designed/dimensioned differently than specified in the engineering information for transformers for I/R modules (refer to Section 3.4.3).

The isolating transformer must have the following specifications:

- Short-circuit voltage in %, uk •3%
- Transformer rating:
  S_{rated} must be • 21 kVA for 16/21 kW I/R modules
  S_{rated} must be • 46.5 kVA for 36/47 kW I/R modules
  S_{rated} must be • 70.3 kVA for 55/71 kW I/R modules
  S_{rated} must be • 104 kVA for 80/104 kW I/R modules
  S_{rated} must be • 155 kVA for 120/156 kW I/R modules
- Isolating transformer vector group
  Recommended: YYN0, i. e. the star circuit configuration on the primary side, star circuit configuration on the secondary side with accessible neutral point.

Commutating reactor

External commutating reactors are only required for I/R modules.

Supply point A

In order to ensure perfect system functioning, the system fault level (SK_{supply}) at the supply point must be 100 (30) x greater than the rated output P_n of the connected NE module.
SK_{supply} = 100 x P_n (I/R module) SK_{supply} = 30 x P_n (UE module)

2.2.4 Connecting to the supply through a transformer

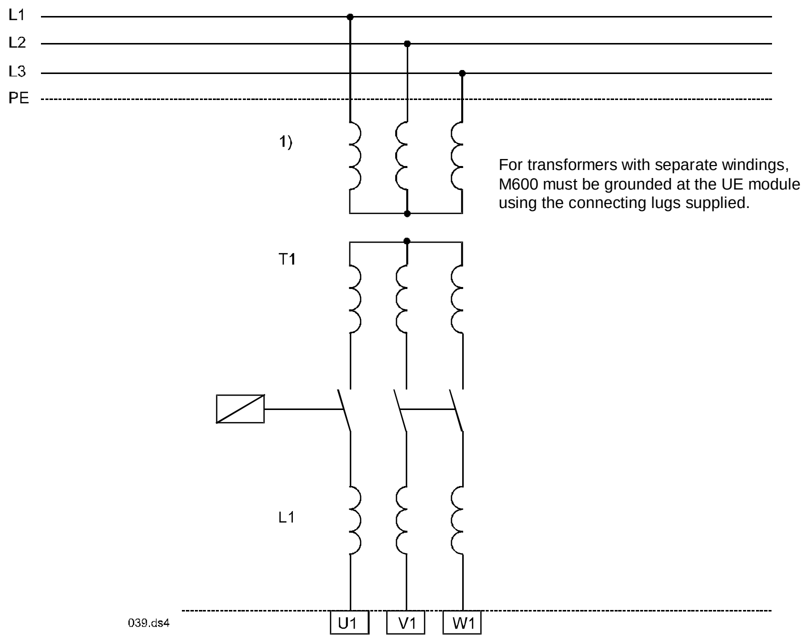


Fig. 2-3 Connecting to the supply through a transformer

A transformer (Catalog type) must be provided if the converter is to be fed from supplies with voltages other than those specified.

When disconnecting the transformer, it must be ensured that the drive converter is first isolated from the transformer using a contactor (due to the induced voltage).

2.2.5 General information

Supply types

The equipment can be connected and operated from various supply types according to VDE 0100 Part 300

1. **Three-phase supplies with grounded neutral point**
   TN supplies (TN-C supplies, TN-S supply, TN-C-S supply)

Possible configurations:

- Directly connected
- Connected through an autotransformer
- Connected through an isolating transformer

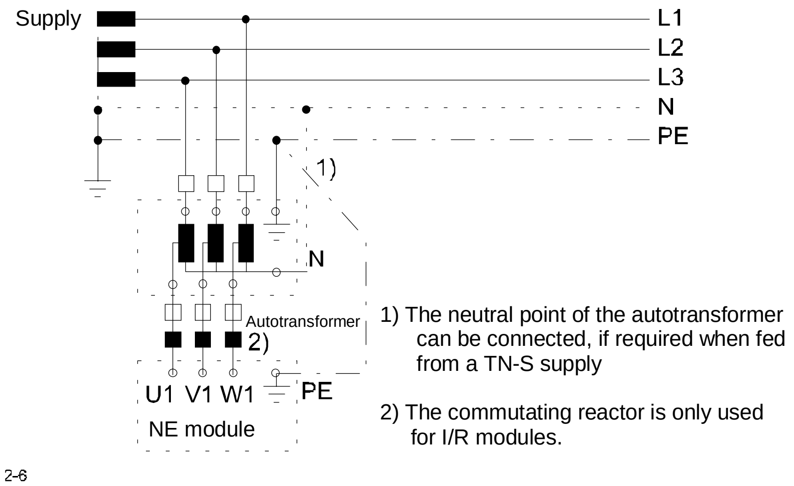


Fig. 2-4 TN-S supply with autotransformer

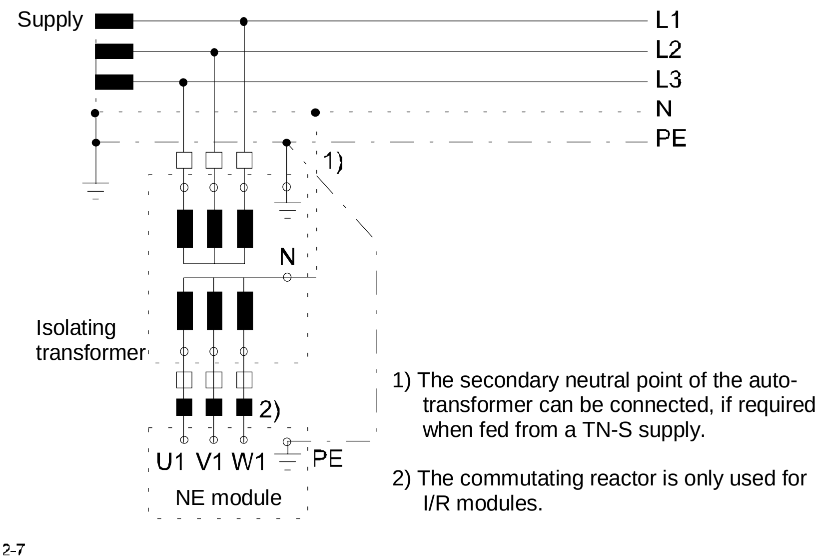


Fig. 2-5 TN-S supply with isolating transformer

2. **Three-phase supplies with ungrounded neutral point**
   e. g. TT supply, IT supply

Possible configurations: Connected via an isolating transformer

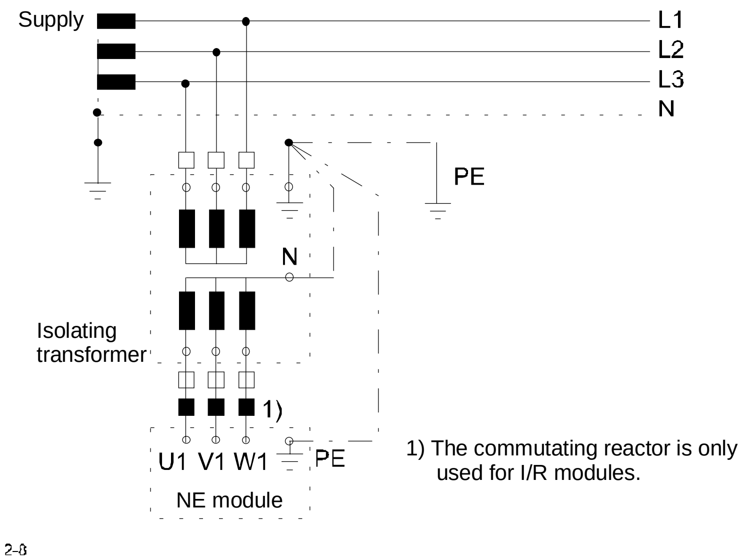


Fig. 2-6 TT supply with grounded neutral point and isolating transformer

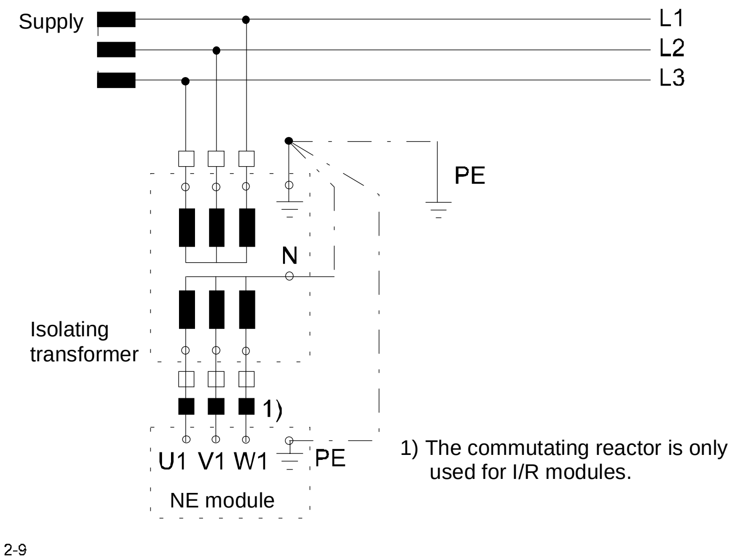


Fig. 2-7 IT supply with isolating transformer

Note

It is not permissible to connect SIMODRIVE equipment to a supply with e.l.c.b.s (this restriction is in accordance with DIN VDE 0160 / 05.88 Section 6.5).

When operational, protection against direct contact is provided in a form to allow the unit to be used in general equipment rooms (DIN VDE 0558 Part 1 / 07.87, Section 5.4.3.2.4).

In compliance with DIN VDE 0160 / 05.88, all SIMODRIVE units are subject to a high-voltage test at the time of routine testing. If the electrical equipment of industrial machines is subject to a high-voltage test, all connections must be disconnected so that sensitive electronic components in the SIMODRIVE unit are not damaged (in accordance with DIN VDE 0113 / 06.93, Part 1, Section 20.4).

2.2.6 Ambient climatic conditions

In operation

according to

- DIN IEC 68-2-1
- DIN IEC 68-2-2
- DIN IEC 68-2-3
- DIN VDE 0160, Section 5.2.1.3
- SN 26556

Temperature range

Upper/lower limiting temperature:	0°C/+55°C
For power modules (100% load):	+40°C
De-rating above +40°C:	2.5%/°C

Dew point temperature t_d, relative air humidity U

Annual average:	U=75% t_d=17°C
On 30 days (24h) per year:	U=95% t_d=24°C

These days should be naturally distributed over the year.

On all other days (<24h):	U=85% t_d=20°C

But still maintaining the annual average.

Temperature change	within one hour:	max. 10 K
	within 3 minutes:	max. 1 K

Moisture condensation

not permissible.

Air pressure [mbar] (kPa)

min. 860 mbar (86 kPa)

max. 1080 mbar (108 kPa).

Damaging gases

according to DIN 40046, Part 36 and Part 37
hydrogen sulfide (H_2S)
sulfur dioxide (SO_2)

Table 2-2 Damaging gases

Gas	Concentration	Temperature	Relative air humidity	Test duration
SO_2	10 cm³/m³ ±0.3 cm³/m³	25°C ±2°C	75% ±5%	4 days
H_2S	1 cm³/m³ ±0.3 cm³/m³	25°C ±2°C	75% ±5%	4 days

Foreign bodies and protection against water

according to

- IEC 529 / EN 60529 / VDE 0470
- DIN VDE 0106, Part 1
- DIN 40050
- DIN 40053, Part 4

Module, internal cooling IP20

Module, external cooling

- Heatsink in the cooling area IP54
- Electronics area IP20

Module with pipe cooling

- Heatsink in the cooling area IP54
- Electronics area IP20

2.3 Supply infeed (NE)

The supply infeed modules (NE) are available as controlled infeed/regenerative feedback modules (I/R module) and as uncontrolled infeed modules (UE). They supply the necessary operating voltages and the power for the particular system in various output stages.

Using the I/R modules, excess DC link power (e. g. during braking) can be fed back into the supply. UE modules dissipate the braking energy in a pulsed resistor.

Note

The supply infeed with infeed/regenerative feedback modules (I/R modules) is described in the Planning Guide 6SN1 197-0AA00.

2.3.1 Uncontrolled supply infeed (NE)

The uncontrolled infeed (UE module) is used to feed power into the DC link. Further, the NE- and monitoring module also provide the power supply for the operating functions of the connected modules.

For UE modules, when the motors brake, the energy of the axes, fed back into the DC link, is converted into heat in the integrated brake resistor and dissipated to the environment. When required, one or several pulsed resistor modules can be used.

The NE module is located as the first module to the left in the drive group. The pulsed resistor module is located in the drive group to the left of the modules to be supplied.

Warning

After all of the voltages have been powered-down, a hazardous voltage level is still present for approx. 4 minutes.

2.3.2 Function overview and settings

NE module settings

Table 2-3 NE module settings

Parameters	**Value range**	**Setting element**
Fault message	Changeover between ready/fault message depending on the operating status, the relay terminal either signals ready or **no** fault	Switch S1.2
Regenerative feedback	Pulsed resistor enabled/inhibited for 5/10 kW NE module	Switch S1.3
Signaling functions via relay/contactor contact	I^2t alarm and motor overtemperature for the NE- and drive module CLOSE internal line contactor start inhibit	
LED displays	Ready, DC link pre-charged, ±15V fault, 5V fault, line supply fault, DC link overvoltage	

2.3.3 Technical data

Table 2-4 Technical data, supply infeed modules, internal cooling (resistor braking)

Designation	**$P_n/P_{s6}/P_{max}$ for supply infeed [kW]**	**$P_n/P_{s6}/P_{max}$ for UE via internal pulsed resistor [kW]**	**Input current [A] for 3-ph. 400 V AC 540 V DC $P_n/P_{s6}/P_{max}$**	**Max. cross-section [2] [mm^2]**	**Module width [mm]**	**Energy of the pulsed resistor for 1 x braking operation**
	Losses [W] P_{Vtotal}		**Output current [A]**		**Weight [kg]**	
Monitoring module	-	-	-	16/10	50	-
	70		-		5	-
Pulsed resistor module	-	0.3/-/25 [1]	-	16/10	50	internal: E_{max}=7.5 kWs
	310		-		5	ext.: E_{max}=180 kWs
NE module 5/10 kW	5/6.5/10	0.2/-/10 [1]	12.5/16.5/25	6/4	50	internal: E_{max}=13.5 kWs
	270		9.3/12/18.6		6.5	-
NE module 10/25 kW	10/13/25	0.3/-/25 [1]	24/32/60	16/10	100	internal: E_{max}=7.5 kWs
	450		18.5/24/46.5		9.5	-

1) The motor braking energy is converted into heat in the integrated pulsed resistor.

2) The 1st number is valid for cable lugs, the 2nd number, for finely-stranded conductors without connector sleeve.

Definition of the powers

P_n, P_{s6}, P_{max}	Data is valid for the total, permitted voltage range of the I/R modules.
P_n	Continuous output of the NE module.
P_{s6}	Output for max. 4 min for an S6 duty cycle.
P_{max}	Peak output.

Refer to the following load duty diagrams for the duty cycle .

$P_{V\ tot}$	Total module power loss.

Supply voltage and frequency

3-ph. 360 to 440 V AC/45 to 65 Hz at 600 V DC:

This is valid for all UE modules up to P_n • 10 kW

UE modules can be connected directly to the line supply.

If an isolating or an autotransformer is used, this can be dimensioned according to the following formula:

P_D transformer • 1.4 x P_n UE module

Cooling type

All UE modules, monitoring modules as well as the pulsed resistor modules, are non-ventilated.

Nominal load duty cycles for NE modules

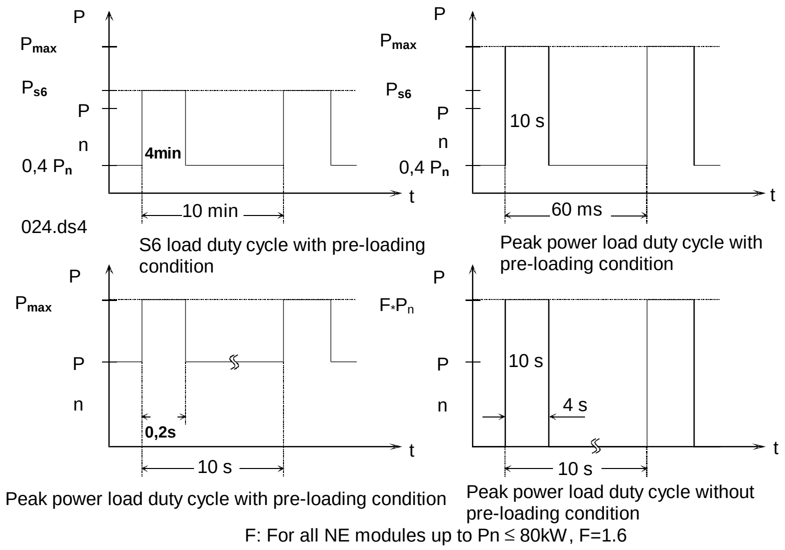


Fig. 2-8 Nominal load duty cycles for NE modules

De-rating dependent on the ambient temperature

All of the technical data are valid for ambient temperatures up to max. 40°C.

For ambient temperatures > 40°C, the outputs must be linearly reduced. For a maximum ambient temperature 55°C: De-rating to 60% of the 40°C value.

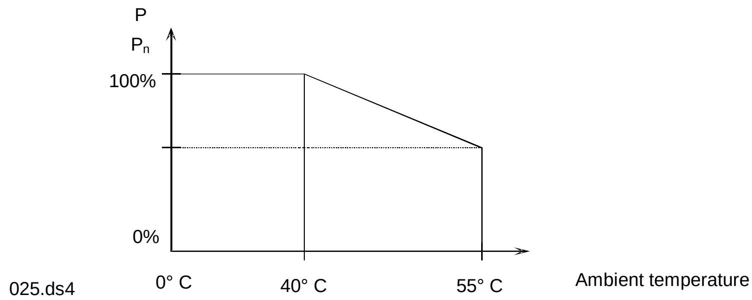


Fig. 2-9 De-rating dependent on the ambient temperature

Current de-rating dependent on the installation altitude

All of the specified load currents are valid up to an installation altitude of 1000 m. For installation altitudes > 1000 m, the load currents must be reduced according to the diagram below.

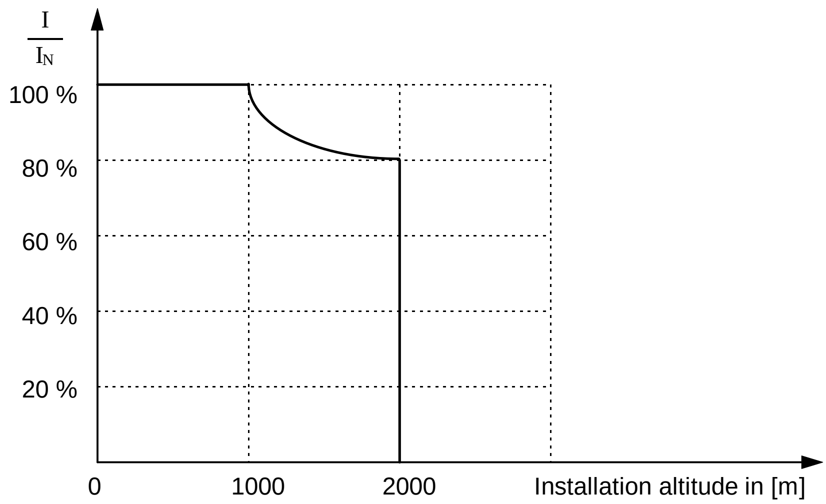


Fig. 2-10 Current de-rating as a function of the installation altitude

Engineering information, pulsed resistor module

Des.	Units	Explanation
E	Ws	Regenerative feedback energy when a motor is braked from n2 to n1 (speed)
f	Hz	Frequency with which braking is repeated
J	kgm²	Axis moment of inertia (including the motor moment of inertia)
M	Nm	Braking torque
n	RPM	Speed

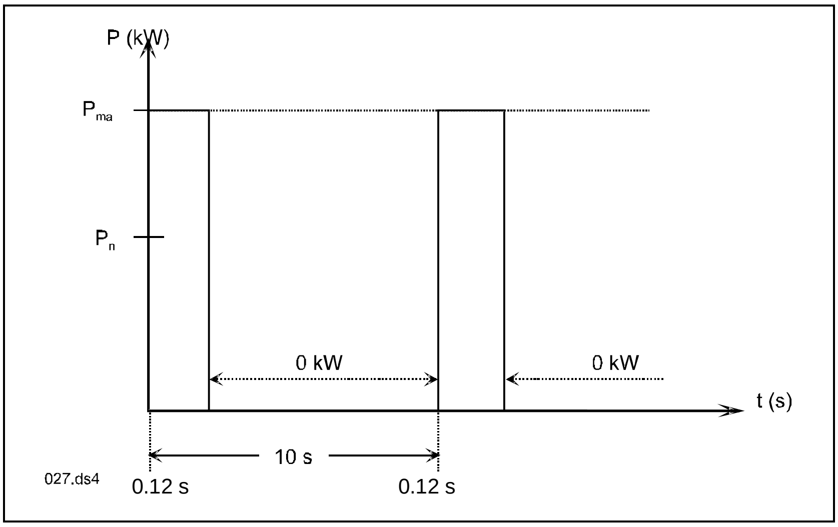


Fig. 2-11 Load duty cycle for a pulsed resistor integrated in the 10 kW UE module and PW module (pulsed-resistor module)

Pulsed-resistor module

$E = J * [2 * \pi * (n2-n1)/60]^2 / 2;$

The following conditions must be fulfilled: P_{max} • $M * 2 * \pi * n/60$

For a single braking operation: E • E_{max} (E_{max} = max. pulsed resistor energy for one braking operation)

For periodic braking operation: P_n • E * f.

Operation with internal pulsed resistor (as supplied), a jumper is located between 1R and 2R.

Operation with external pulsed resistor:

1. Mount the external pulsed resistor with the open side placed downwards on a sheet metal surface (e. g. mounted on the cabinet).
2. Remove the jumper between 1R and 2R.
3. Connect the housing of the external pulsed resistor with PE.
4. Connect the external pulsed resistor via terminals 1R and 3R
   Cable cross-section: 2.5 to 4 mm²
   Length of the connecting cable: < 10 m

Number of pulsed-resistor modules connected to the same DC link, refer to Catalog NC 60.1.

Data of the internal pulsed resistor

Continuous power P_n = 300 W
Peak power P_{max} = 25 kW
For one braking operation: E_{max} = 25 kW for 0.3 s = 7.5 kJ

Data of the external pulsed resistor

Continuous power P_n = 1500 W
Peak power P_{max} = 25 kW
For one braking operation: E_{max} = 25 kW for 7.2 s = 180 kJ

Note

The possible number of pulsed-resistor modules depends on the magnitude of the DC link capacitance. One pulsed-resistor module may be used for each 1.0 mF.

2.3.4 Data of the supplementary components

Table 2-5 Data of the supplementary components

Components	Component Order No.	Comments
Heatsink	6SN1 162-0BA01-0AA0	Required for UE modules when the pulsed resistor is utilized to the maximum (> 200 W) (refer to Catalog NC 60.1 Dimension sheets)

2.3.5 Interface overview, UE module 10/25 kW

A detailed overview of the interfaces is provided in Section 3 “Mounting and connecting-up”.

2.3.6 Interface overview, UE module 5/10 kW

A detailed overview of the interfaces is provided in Section 3 “Mounting and connecting-up”.

2.3.7 Line fuses

The following line fuses can be used: NH, D, DO gL according to VDE 0636, VDE 0641

Table 2-6 Line fuses

	UE module 5/10 kW	**UE module 10/25 kW**
I_{rated} Sich.	= 16 A	= 25 A
I_{fuse} 0.2 s	> 70 A	> 100 A
I_{fuse} 4 s	> 50 A	> 80 A
I_{fuse} 10 s	> 42 A	> 65 A
I_{fuse} 240 s	> 30 A	> 40 A
Recommended fuses		
Nominal voltage 415 V AC	16 A D01 Neoz./B.No. 5SE2116 [1)]	25 A D02 Neoz./B.No. 5SE2125 [1)]
Nominal voltage 500 V AC	16 DA DII Diazed/B.No. 5SB261 [1)]	25 A DII Diazed/B.No. 5SB281 [1)]
Nominal voltage 500 V AC	16 A Gr. 00 NH/B.No. 3NA3805 [1)]	25 A Gr. 00 NH/B.No. 3NA3810 [1)]

1) The Order Nos. are valid for 5 fuses in a package.

The fuses used must fulfill the conditions of the values in the table.

The table values must be compared with the values obtained from the current-time characteristic of the fuse used. If the currents from the current-time characteristic are always greater than the table values at the times specified in the table, then this means that the fuse can be used.

The maximum fuse rating which can be used (I_{rated} fuse), is specified by the maximum conductor cross-section which can be connected at the terminals.

2.4 Power modules

The current rating specified on the power module corresponds to the appropriate rated transistor currents. The output currents can be limited by the plug-in control module. When the MCU 172A single-positioning module is inserted, the mounting screws on the front panel must be tightened-up (electrical connection to the module housing).

Power module, internal cooling

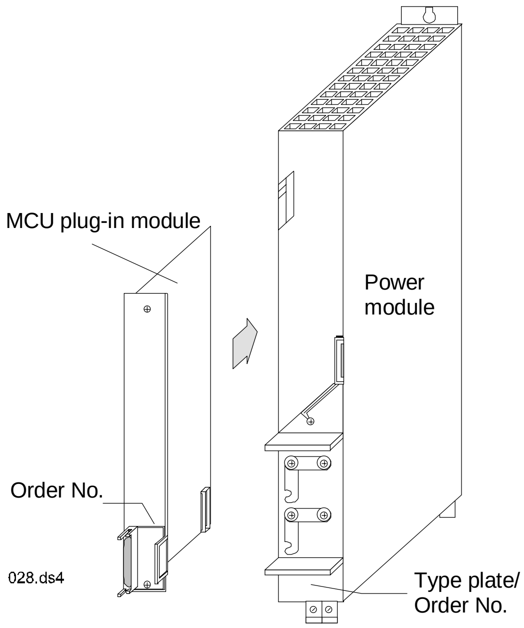


Fig.-2-12 Power module

Warning

After all of the voltages have been powered-down, hazardous voltages are still available for approx. 4 minutes.

2.4.1 Technical data

Current de-rating dependent on the ambient temperature

All of the technical data are valid for ambient temperatures up to max. 40°C.

For ambient temperatures > 40°C, the currents for UE supply infeed must be linearly reduced as for the UE supply infeed. For a maximum ambient temperature of 55°C: Current de-rating to 60% of the 40°C value.

Current de-rating dependent on the installation altitude

All of the specified load currents are valid up to an installation altitude of 1000m. For installation altitudes > 1000 m, the load currents should be reduced according to the diagrams for the UE supply infeed.

Current de-rating dependent on the clock frequency

The current de-rating as a function of the clock frequency is defined in the Planning Guide SIMODRIVE 6SN1 197-0AA00.

Supplementary components

Refer to the Planning Guide SIMODRIVE 6SN1 197-0AA00 for the supplementary components required.

2.4.2 Load duty cycle definitions, drive modules

Nominal load duty cycles, feed drives

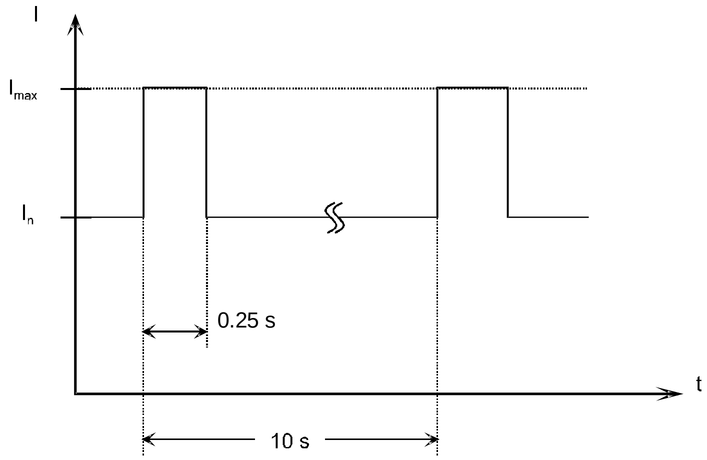


Fig. 2-13 Peak current load duty cycle with pre-load condition

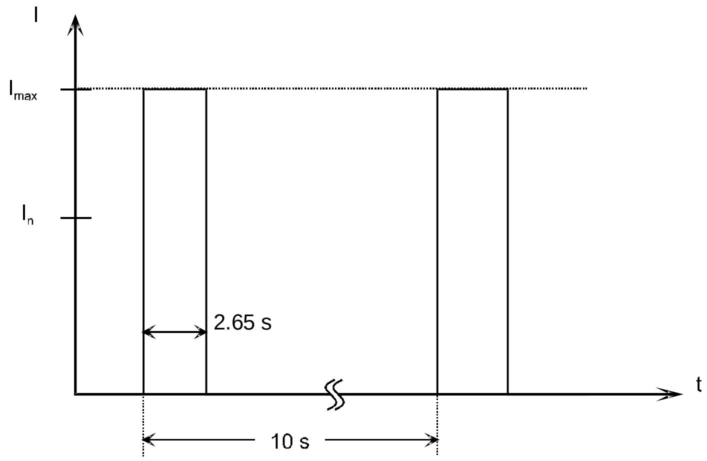


Fig. 2-14 Peak current load duty cycle without pre-load condition

2.4.3 Interface overview, power module

Table 2-7 Interface overview, power module

Terminal No.	Designation	Function	Type [1]	Typ. voltage / limit values	Max. cross-section
U2 V2 W2		Motor connection	O	3-ph. 600 V AC	Refer to Section 4.1 SIMODRIVE 611 Planning Guide 6SN1 197-0AA00
PE1		Protective conductor	I	0 V	Stud
PE2		Protective conductor	I	0 V	Stud
	X151/X351	Equipment bus	I/O	Various	34-core ribbon cable
P600 M600		DC link DC link	I/O I/O	+300 V -300 V	Busbar Busbar

[1] O = Output; I = Input; NC = NC contact (normally closed contact)

Warning

Only motors may be connected to SIMODRIVE 611 power modules, which have safe electrical isolation between the motor winding and the coupled encoder systems (integrated encoder system, temperature sensor). This is implemented for the 1FT and 1FK motor series.

2.4.4 Cable cross-sections of the motor feeder cables

The cable cross-sections required in accordance with VDE 0113 can be taken from Section 1.1.4.

2.5 611 control components

The integrated digital axis control on the MCU board is designed for operation with 1FT6/1FK6 motors.

The MCU board allows an indirect measuring system (motor measuring system), as well as a direct position measuring system with sinusoidal voltage signals to be evaluated (also refer to “Encoder”).

2.5.1 Mode of operation

General information

The integrated SIMODRIVE 611 drive system includes the following function units:

- Speed- and position sensing
- Speed controller
- Current controller
- Filter
- Monitoring functions

The modules are centrally supplied with the electronics power supply via the equipment bus system, whereby the NE unit provides the electronics power supply for the DC link- and central electronics power supply.

Only the following interfaces are involved: Terminal 663, terminal AS1, terminal AS2, terminal 9, BERO, ground, encoder, test sockets.

Closed-loop control

The closed-loop control is completely digital. The closed-loop position- and speed controllers operate as P- or PI controllers. The closed-loop current control is realized in the fixed flux space-vector coordinate system (dq system). The current controller (PI) evaluates the phase current actual values i_R and i_S and calculates three-phase voltage values with the rotor position. This results in pulse-width modulated control signals for the power transistors.

2.5.2 Interface overview of the MCU

A detailed overview of the interfaces is provided in the Section “Mounting and connecting-up”.

2.6 Recommended circuits and EMC measures

Warning

Terminal 63 (pulse enable) and/or terminal 48 (start terminal, contactor control) should be disconnected before the equipment is powered-up or powered-down (shutdown) using the main switch or a line contactor!

If the NE module is used in a 6-conductor connection configuration, the jumpers, which are inserted as standard in connector X181, must be removed.

- The drive group power circuit must be electrically disconnected (isolated) from the supply through terminals NS1, NS2.

The line contactor can be reliably opened by disconnecting the coil circuit when a fault develops, via terminals NS1, NS2.

In operation, the terminal must always be jumpered! The DC link is not pre-charged if the jumper is not inserted when the equipment is powered-up.

The connection between NS1, NS2 may only be interrupted in conjunction with the safe operating stop function (this function is not a safety function in the sense of the Machinery Directive 89/382/EEC), or if the line contactor has dropped-out as terminal 48 was de-energized.

The connection between NS1, NS2 must be established before the enable voltage is connected to terminal 48.

Note

Axis-specific pulse enable, terminal 663 (MCU/X431):

The inverter of the axis is enabled when this terminal is energized. If the terminal is de-energized when the motor is rotating, the inverter is inhibited and the motor coasts-down unbraked.

Start, terminal 48 (UE/X161):

This terminal has the highest priority. A defined power-on or power-down sequence is initiated via terminal 48. If terminal 48 is used, terminal 63 and terminal 64 can be directly connected to terminal 9.

The internal pre-charging sequence is initiated when terminal 48 is energized. After the DC link is charged-up, the pre-charging contactor is opened and the main contactor pulls-in. The internal enable signals are then output. If terminal 48 is de-energized, the internal pulse enable signals are inhibited, and the DC link is electrically isolated from the line supply by opening the internal line contactor.

If terminal 48 is inhibited when charging, this is first completed, and terminal 48 is only inhibited after charging has been completed.

Pulse enable, terminal 63 (UE/X121):

This terminal has the highest priority for pulse inhibit and enable. The power modules for all of the axes are enabled via this terminal. The enable and inhibit functions act instantaneously (without any delay), and simultaneously for all modules. The drives coast-down unbraked when this signal is withdrawn.

Drive enable, terminal 64 (UE/X121):

The drive modules are enabled using terminal 64. The enable signal acts instantaneously and simultaneously for all modules. When the signal is withdrawn, the speed setpoint for all of the axes is set to zero. For the feed modules, all of the controllers and module pulses are inhibited, for each individual axis, after the individually set time stages have expired (these are approximately set to 200 ms when the equipment is shipped).

2.6.1 Timing diagram 6SN11

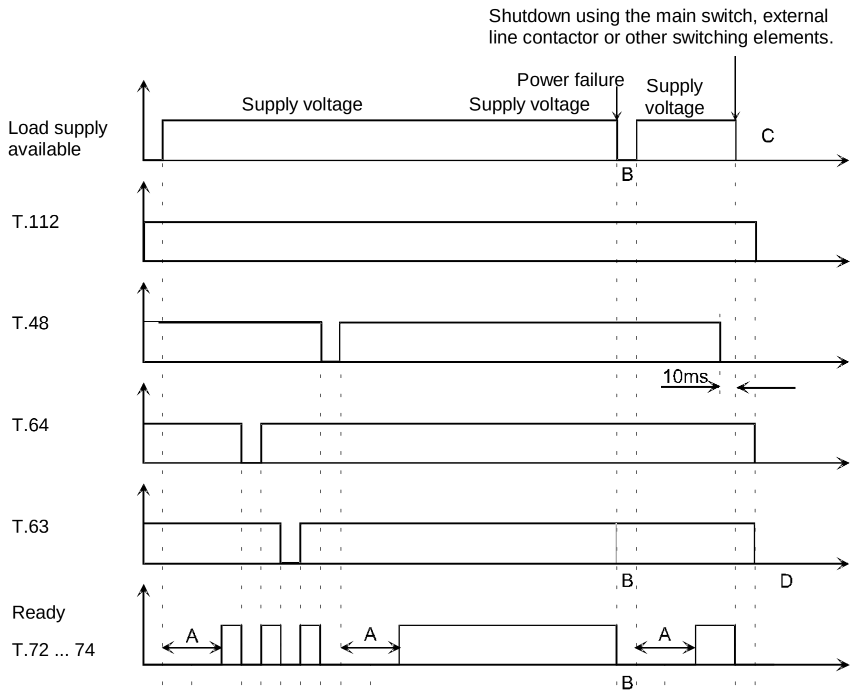


Fig. 2-15 Timing diagram

A) The ready relay can only pull-in if the charging sequence has been completed and the internal line contactor has pulled-in.

B) The axes are not inhibited when the power fails. However, the ready relay drops-out after the power failure identification time, $t_{N\ OFF}$, approx. 30 ms.

2.6.2 Three-conductor connection (standard circuit)

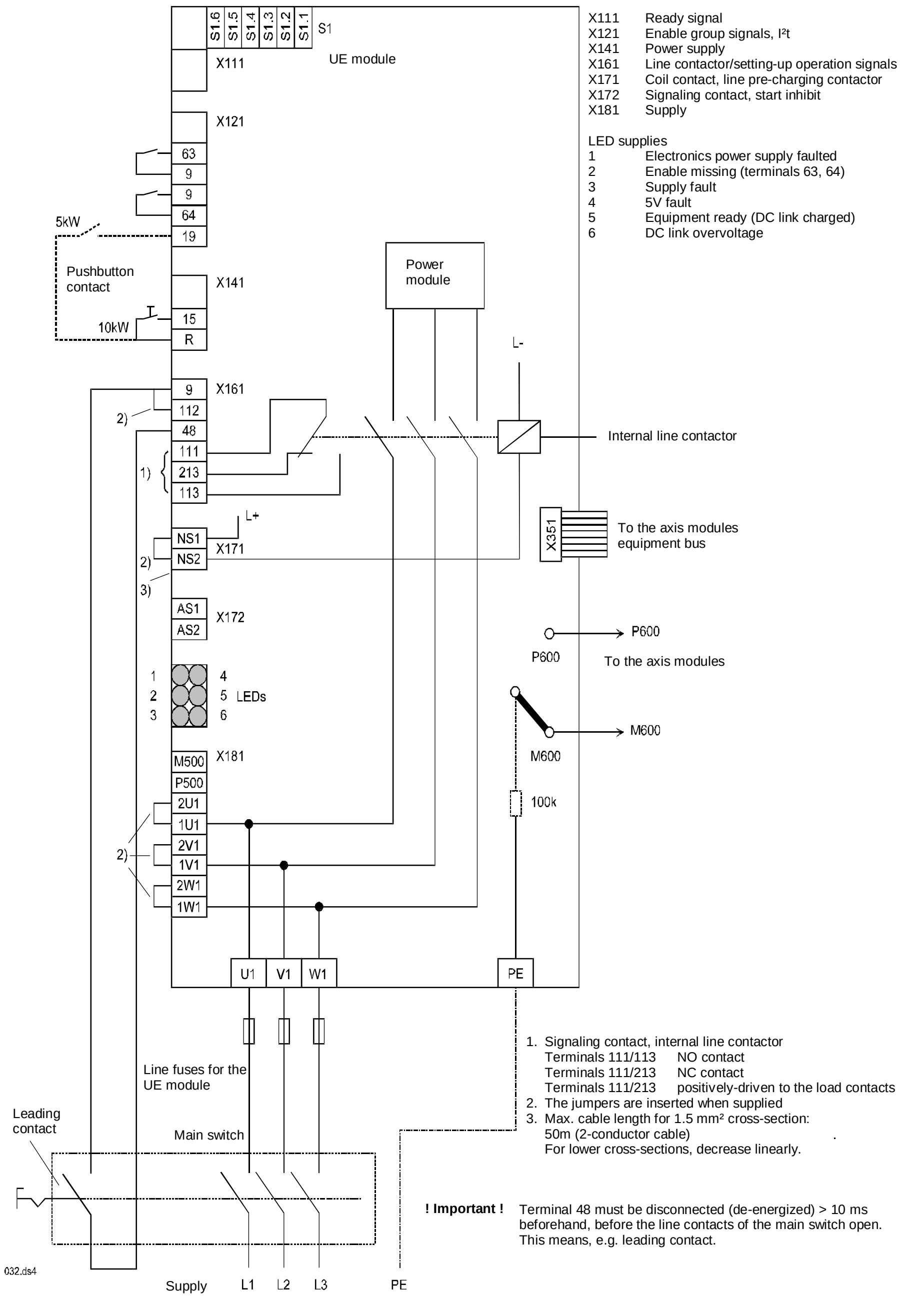


Fig. 2-16 Three-conductor connection

2.6.3 Power failure back-up with the UE module

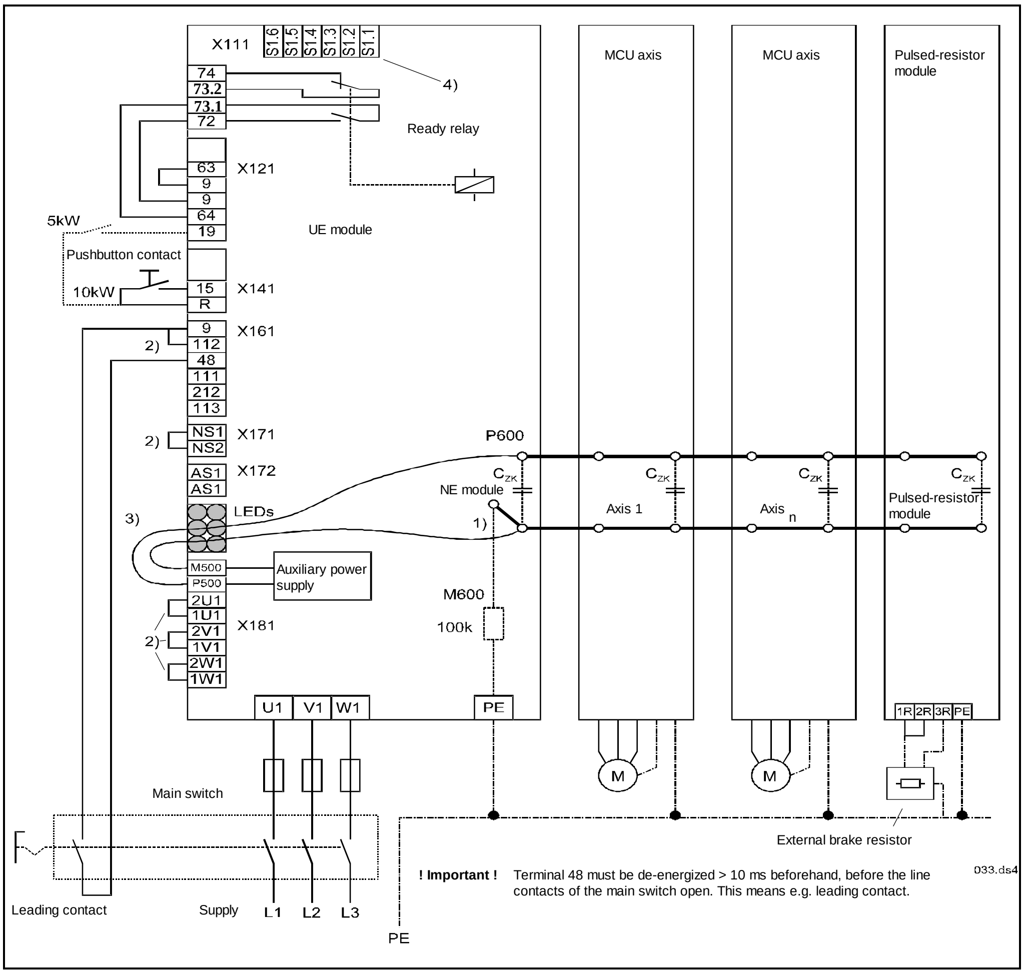


Fig. 2-17 Power failure back-up with the NE module

1. The connection between the DC link and ground via the internal resistance should be inserted.
2. Jumpers inserted as standard
3. Auxiliary power supply connection to the DC link, to maintain the auxiliary power supply even after a power failure.
   The 2x1.5mm² cable must be routed so that it is short-circuit proof.
4. If terminal 72 and terminal 73.1 are looped into terminal 9 and terminal 64, S1.2 must be set to ON = fault signal, and then ready (terminal 72, 73.1, 73.2 and 74) is independent of terminal 63 and terminal 64.

Procedure

Set switch S1.2 in the UE module (if present, also in the monitoring module) to ON = fault signal (the ready relay is then independent of terminal 63 and terminal 64). When the ready relay drops-out during supply failures, a zero setpoint is entered via terminal 64, and the axes can be braked down to standstill. In this case, the auxiliary power supply, terminal P500 and terminal M500 of connector X181 must be connected to the DC link terminals P600 and M600 of the UE module. The electronics power supply for the control is maintained as long as the auxiliary power supply can be maintained.

When a UE module is used, the internal brake resistor can be used and still remains active during power failures. If the internal brake resistor isn't adequate (the braking energy is too high), then an additional pulsed resistor module must also be used here.

Refer to the Section Technical data 2.3.3 when dimensioning and engineering the pulsed-resistor module and the external pulsed resistor.

The energy content of the DC link which can be actually used is limited. At the supply failure instant:

- for UE modules: $E_{DC\ link} = 70\ \Sigma C_{ZK} - 14$

$E_{DC\ link}$ in Ws, $C_{DC\ link}$ in mF,

ΣC_{ZK} = sum of all the DC link capacitances in the system

Refer to Catalog NC 60.1

A supply failure identification time $t_{N\ OFF}$ of approx. 30 ms expires before supply failure is indicated by the ready relay.

The power is down during this 30 ms. However, the drives could be in a load duty cycle by taking power from the DC link. The maximum power drawn during the most unfavorable load duty cycle must be specified for this drawn power.

The following is valid: $P_{max\ drawn}$ [W] * 0.03 s < $E_{DC\ link}$.

If this condition is not fulfilled by the time that it has been identified that the supply has failed, the DC link voltage may have fallen to < 290 V. At this voltage level, the pulse enable for the axis is withdrawn and the drives coast down.

Note

In order that the drive brakes to standstill in a controlled fashion when the power fails, terminals 48 and 63 must be kept energized until the drive comes to a complete standstill.

2.6.4 Start inhibit in the drive modules

Note

The “Start inhibit” and “Setting-up operation” functions are not safety functions in the sense of the Machinery Directive 89/392/EEC. They only support the measures which have to be undertaken by the user himself.

The use of the start inhibit function

The start inhibit function prevents the drive unexpectedly starting from standstill. This circuit macro can be used in the “Safe stop” machine function. However, the machine must have come to a complete standstill and this must be ensured using the external machine control. The start inhibit interrupts the power feed from the drive converter to the motor (motor rotation).

The remaining risk, is in this case, if two errors/faults occur simultaneously in the power section; the motor rotates (jolts) through a small angle (1FT motors: 4 pole 30°, 6 pole 20°, 8 pole 15°).

The start inhibit function neither provides electrical isolation nor does it provide protection against electric shock.

The complete machine must always be electrically isolated from the supply through the main switch during production stops, or when carrying-out maintenance-, repair- or cleaning work on the machine or system (EN 60204/5.3).

The start inhibit function, when correctly used, must be connected to the line contactor circuit or the EMERGENCY OFF circuit with the positively-driven signaling contact AS1/AS2. The drive must be electrically isolated from the supply if the start inhibit relay function is not plausible, when taking into consideration the machine operating mode; e. g. via the line contactor in the infeed module. The start inhibit and the thus associated operating mode may only be used again after the fault has been rectified.

TheMachinery Directive 89/392/EEC and EN 292; pr EN 954; pr EN 1050 specifies that a hazard analysis/risk evaluation must be carried-out; the machine manufacturer must therefore design the safety circuit for the complete machine, taking into account and incorporating all of the integrated components for his machine types and versions; these also include the electric drives.

Mode of operation of the start inhibit

The inverter power section controls the current through the individual motor windings. The motors are fed with sinusoidal current.

A pulse generating logic circuit clocks the power transistors in a rotating field pattern. An optocoupler to provide electrical isolation is located in every transistor branch between the gating logic and the power section gating amplifier.

The start inhibit acts individually for each module. The circuit uses a TÜV-tested relay and acts on the input circuit of the optocoupler. A relay contact interrupts the power supply for the optocoupler input so that it doesn’t transfer any signals. The pulse-generating logic is inhibited through an additional electrically isolated arm. These two circuits are controlled in parallel by the machine control via terminal 663 (motor start inhibit), for the drive modules, or via terminal 112 (step-up controller start inhibit) for the supply infeed modules. The status of the relay contact, located in the pulse power supply circuit, is signaled to the external adaption circuit via a positively-driven NC contact. The signaling contact is accessible at module terminals AS1 and AS2, and the user can interlock it with the safety control. The user must ensure that EMERGENCY OFF is initiated if the start inhibit relay goes into a non-plausible condition.

If the start inhibit circuit is activated, it is no longer possible to control the power transistors. If two power transistors are destroyed in the most unfavorable constellation, this results in the remaining risk, described in Section 2.6.4.

Note

When the start inhibit is activated, the motor can no longer generate a torque. Axes which are <u>not</u> self-locking (e. g. hanging axes) must be locked using a mechanical brake.

Connecting-up the start inhibit

The start inhibit is controlled in the drive modules via terminal 663. The start inhibit relay is controlled using the internal 24 V enable voltage (FR+terminal 9; FR-terminal 19). When the relay has dropped-out (terminal 663 open) the start inhibit relay activates the start inhibit function.

AS1/AS2 closed means that the “Start inhibit is effective”. Terminals AS1 and AS2 signal the start inhibit status (this is a floating signal).

Warning

The start inhibit relay has maximum pull-in and drop-out delay times of. 25 ms. The external wiring connected at terminal AS1/AS2 must short-circuit proof, and have a two-channel configuration.

Application, mode of operation and connecting the line contactor

The infeed modules have a standard line contactor, integrated in the module itself. These contactors are dimensioned to be able to conduct and disconnect (interrupt) the maximum permissible peak current of the infeed module. The line contactors are electronically controlled via terminal 48. For safe, reliable electrical isolation, the coil power supply must be interrupted in the direct line contactor coil circuit, accessible externally (via terminals NS1 and NS2) using electro-mechanical switching elements. Thus, the influence of the electronic control has no effect when the unit is disconnected with electrical isolation. The line contactor must always be de-energized via terminal 48 before the NS1/NS2 connection is interrupted.

Sequence when using the start inhibit function

- The drives must be shutdown before terminal 663 is energized, which initiates the start inhibit. Otherwise, the motor coasts-down unbraked as the drive converter pulses are inhibited. The motor is not able to generate a holding torque, so that mechanical transmission elements which are not self-locking must be locked into position using a brake.
- The speed setpoint input can be externally disconnected and a 0 speed setpoint entered as an additional safety function.
- If a fault condition develops, all of the drives, machine, system, must be shutdown and disconnected.
- In order that the power DC link is reliably isolated from the supply, it should be ensured that all connections in parallel to the power infeed are electrically isolated through switching contacts. In this case, possible user-specific external connection between the electronics power supply and the power DC link must be taken into account. To shutdown the drives in a controlled fashion when the supply fails using the DC link power, there could be a connection, for example, between terminals P500/M500 and P600/M600.
- This connection between the power supply and the power DC link must be safely and reliably isolated and remain isolated, as otherwise the power DC link could be charged-up via the auxiliary DC link power supply. It is not permissible to have a connection between the power supply and the power DC link if the drive is operated with a reduced DC link voltage.
- When using a monitoring module, which is connected to the power DC link via P500/M500, and also to the line supply, when a fault occurs, either the connection between the supply and the monitoring module must be interrupted or the connection between P500/M500 and the power DC link must be reliably and safely isolated.
- If a fault occurs when the start inhibit is activated, then this fault must be removed, before the protective devices of the machine or system are moved aside (i. e. personnel enter the hazardous zone). After the fault has been removed, the start inhibit sequence must be repeated to ensure that it functions correctly.

- Only suitably qualified personnel may operate the drive with a reduced DC link voltage; the safety devices, provided by the machine OEM, must also always be activated. As the protective devices are cancelled in this operating mode, and the axis start inhibits are de-activated, it may only be selected using a lockable mode selector switch. The machining area may only be accessed using a safety switch. Otherwise, all of the drives of the machine and system must, in this case, be automatically isolated from the supply. For hanging axes, it should be ensured that the axis is reliably locked in place so that power cannot be fed into the DC link (regenerative operation).

The relevant regulations must be observed.

- The protective devices for the restricted hazardous zone of the drive can now be moved aside (i. e. personnel can enter the hazardous zone).

  If one of the following faults occurs with the protective devices disabled, then **EMERGENCY OFF must always be immediately initiated**.

  In this case, all of the drives of the machine and system are isolated from the supply through the line contactor.

  The acknowledge contact remains open and the start inhibit is not activated:

  - There is a fault in the external control circuit itself.
  - There is a fault in the signal lines of the acknowledge contact.

  If all of the previous steps have been correctly executed, all of the drives in the restricted working zone are locked-out to prevent them starting accidentally. Personnel can now enter or access the restricted hazardous zone.

Checking the start inhibit

The following checks must always be made when the equipment is first commissioned and when possible must be repeated at certain intervals during the plant lifetime.

- A check should also be made after longer production standstills. In this check, every individual axis drive as well as the NE module must be checked.
- It should be checked that the power module and motor match.
- By removing the voltage at terminal 663, the axis drive pulses must be inhibited. Further, the acknowledge contact of the start inhibit must close. The drive then coasts down.
- Disabling the protective devices, e. g. opening the protective doors while the drive is running. If this represents an inadmissible hazard, a check can be made as follows:
  The signal line to door contact TK is disconnected while the drive is running to investigate what happens. In this case, the line contactor must isolate all of the drives of the machine and system from the supply.
- All possible fault situations which could occur, must be individually simulated in the signal lines between the acknowledge contacts and the external control as well as the signal evaluation functions of this control. The line contactor must isolate all of the drives of the machine and system from the supply in all of these fault situations.
- In the setting-up mode, connect voltage to terminal 112 (terminal 9). The line contactor must then isolate all of the drives of the machine and system from the supply.
- For all of the test points, where the line contactor isolates the drives from the supply, the connection between the power supply and the power DC link must be instantaneously and reliably interrupted.
  This connection is <u>not permissible</u> in the setting-up mode.

Comment

The line contactor in the UE module is used when the drives of the machine and system are to be isolated from the supply when a fault condition occurs. In this case, the power DC link is isolated from the supply. The power supply in the UE module always remains connected to the supply. All externally wired bypass connections from the supply to the power DC link must also be electrically isolated (refer to the text previously: Sequence when using the start inhibit function).

In the setting-up mode, when using an isolating transformer, the isolating transformer secondary **may not** be grounded.

When using an autotransformer in the setting-up mode, the user must monitor the DC link voltage, and if a fault occurs, which results in an increase in the DC link voltage, all of the drives of the machine and system must be isolated from the supply.

In the setting-up mode, when a hanging axis drops, it is possible that the motor can feed power into the DC link, even when the pulses are inhibited, thus increasing the DC link voltage.

When changing-over from standard- to setting-up operation, the DC link first remains at 490 V. The voltage difference between 490 V and the rectified voltage in the setting-up mode, represents a residual amount of energy, which must be taken into account in the particular application. A fault analysis must always be executed before using the start inhibit function.

2.6.5 Application examples

The application examples (Fig.) provided here are exclusively used to explain the “Start inhibit” function, included in the SIMODRIVE 611 product, and the “Setting-up mode” which is possible with some restrictions. The recommended external circuitry used directly with the SIMODRIVE 611 is shown in the following application examples. Machine controls and interlocking functions extending beyond this are not taken into account in the application examples illustrated here. The user must change, adapt or expand the circuit macros explained here to adapt them to his individual machine type.

Note

The machine manufacturer (OEM) must always execute a hazard analysis and risk evaluation for the complete machine and its safety control, according to the EEC Machinery Directive and the Equipment Safety Law. The machine manufacturer (OEM) or the sales/marketing party, resident in the EEC, or their representative must ensure that the complete machine fully conforms to CE.

An excerpt of the circuit macro to protect two separate working zones, which are equipped with one or two drive axes, is illustrated in the following application examples.
The block diagram of the system to be protected is illustrated in the following diagram.

Application examples 1 and 2 show recommended circuits to protect the system with changeover between standard- and setting-up operation.

The following is valid for all circuits:

Only switching contacts may be located between terminals NS1 and NS2. These contacts must be floating.

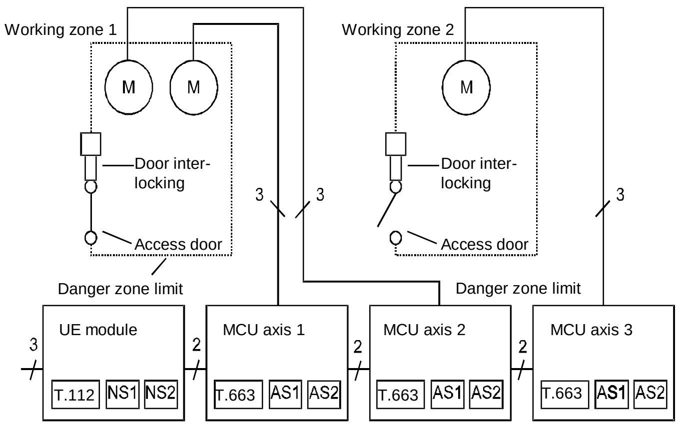


Fig. 2-18 Block diagram of the system to be protected

The following explanations are valid for both application 1 (Fig.) and for application example 2 (Fig.).

Note

1) The safety relay drop-out time is 25 ms.

2) The contactor drop-out time to brake the feed drive can be up to 200 ms.
3) Signals the emergency trip to the PLC.
4) If the machine may only be entered in the setting-up mode, contact S1 (key-actuated switch) must be additionally incorporated.
5) When using the safety switch by itself, it is not permissible that commands may be issued which could initiate or result in a hazardous status (VDI 2854 3.3.6).
6) Key-actuated switch S1 is only required for setting-up operation with reduced DC link voltage.
7) Redundancy according to the machine manufacturers fault analysis. Fault analyses must always be made.
8) The number of times the machine can be powered-up is limited according to the Planning Guide, Section 9.3.1.
9) The individual drives are switched via terminal 663.
10) Can be used to reduce the contactor deadtimes.

All contacts are illustrated in the quiescent setting.

– In this case, the protective barrier is closed, TK1; TK2
– The start inhibit is activated AS1/AS2
– Key-actuated switch S1 has been used to select setting-up operation.

Application example 1

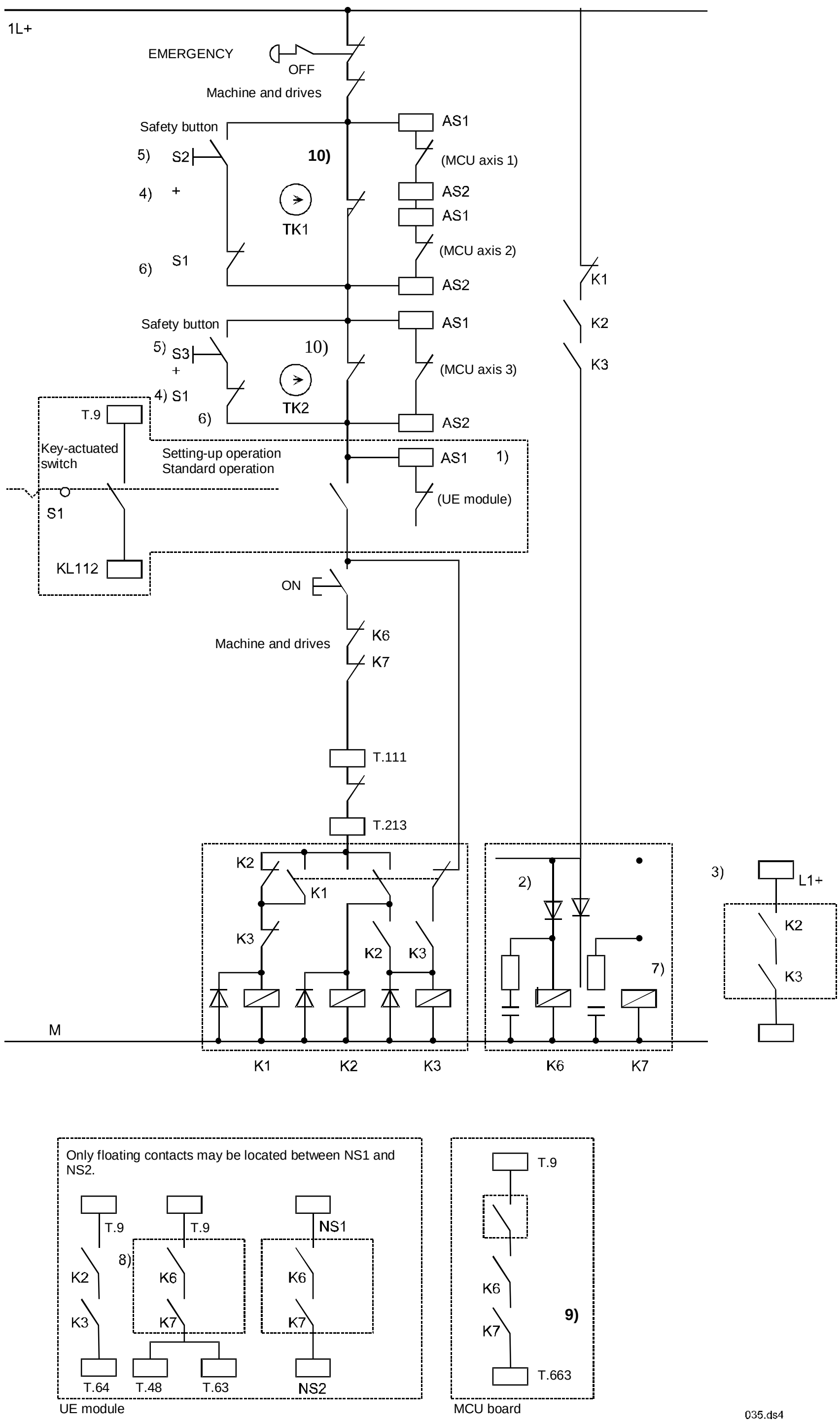


Fig. 2-19 Application example 1

Application example 2

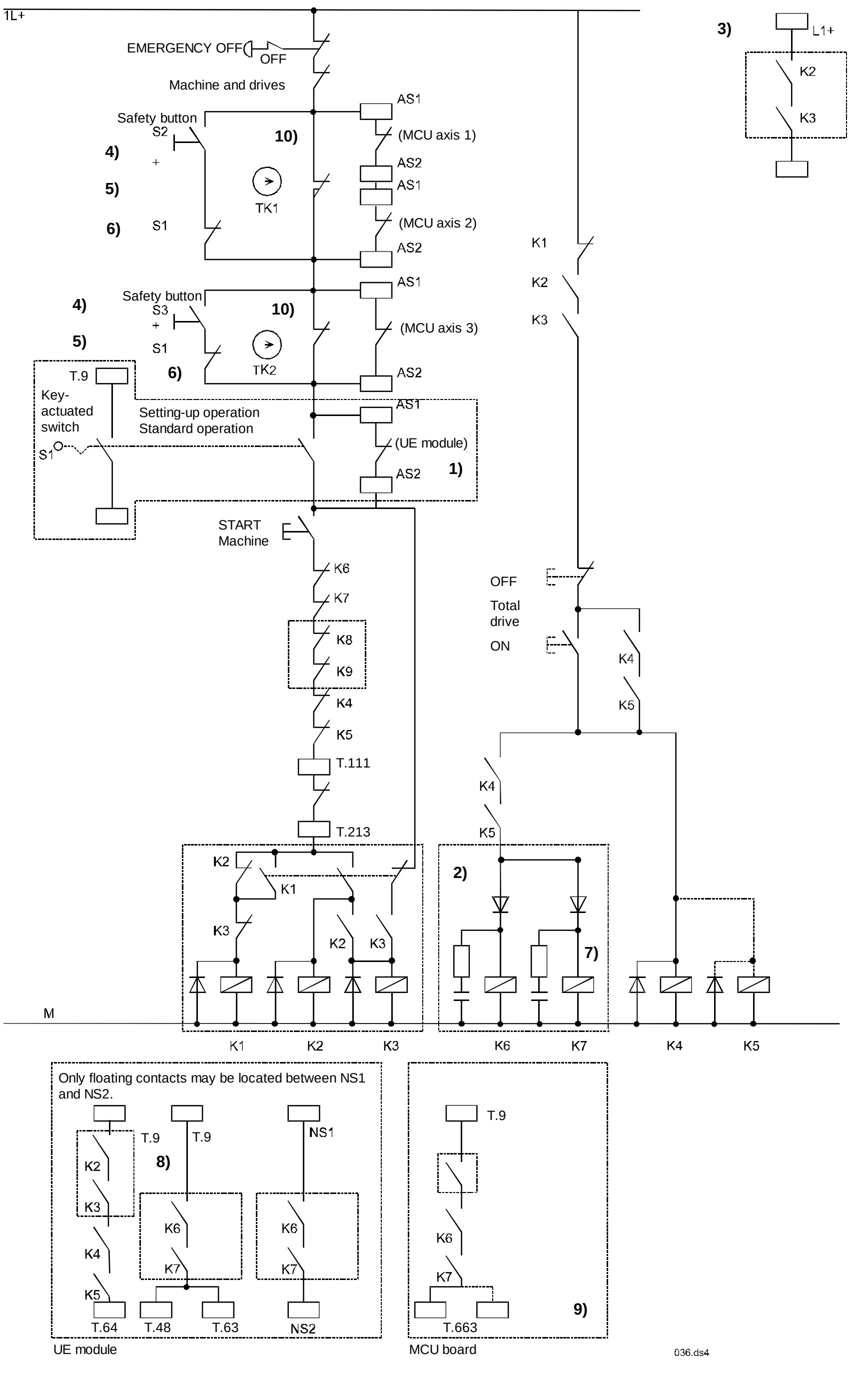


Fig. 2-20 Application example 2

Block diagram 1

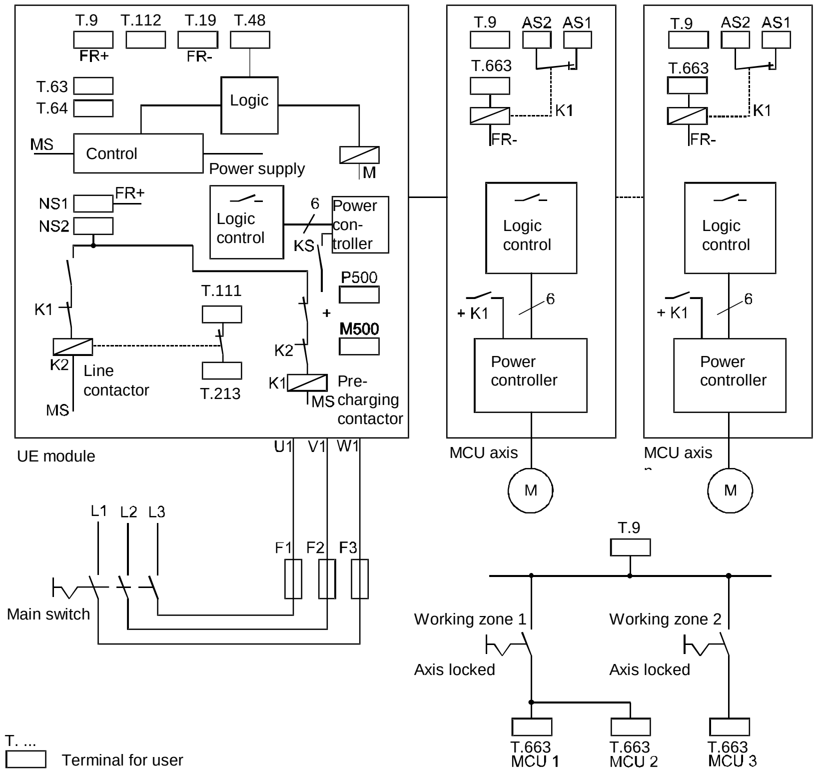


Fig. 2-21 Block diagram 1; valid for **UE modules 5/10 kW to 10/25 kW**

- K1, pre-charging contactor contact, positively-driven
- K2, line contactor contact, positively-driven
- Terminal 111, 213 NC contact, positively-driven to the NO power contacts
- Terminal P500, M500 power supply connecting terminals for the connection to the power DC link.
- Only floating switching contacts may be connected between terminals NS1 and NS2.

2.6.6 EMC measures

Installation

The modules should always be mounted on the bare metal of the rear cabinet panel.

Connecting-up cable screens

The screens of all the screened cables must be connected at the module through the largest possible surface area.
The screens are connected at the top of the module. A screen plate can be screwed to the existing threaded holes.

Connecting-up the screen to the front panel

In order to ensure a good connection between the front panel and the housing, the front panel screws must be correctly tightened-up.

Additional measures

All of the measures described here are only valid for supply networks which are not compatible with VDE! In standard industrial supply networks, it is guaranteed, without having to use any other measures, that the disturbance and noise values remain below the permissible limits, thus ensuring disturbance-free operation.

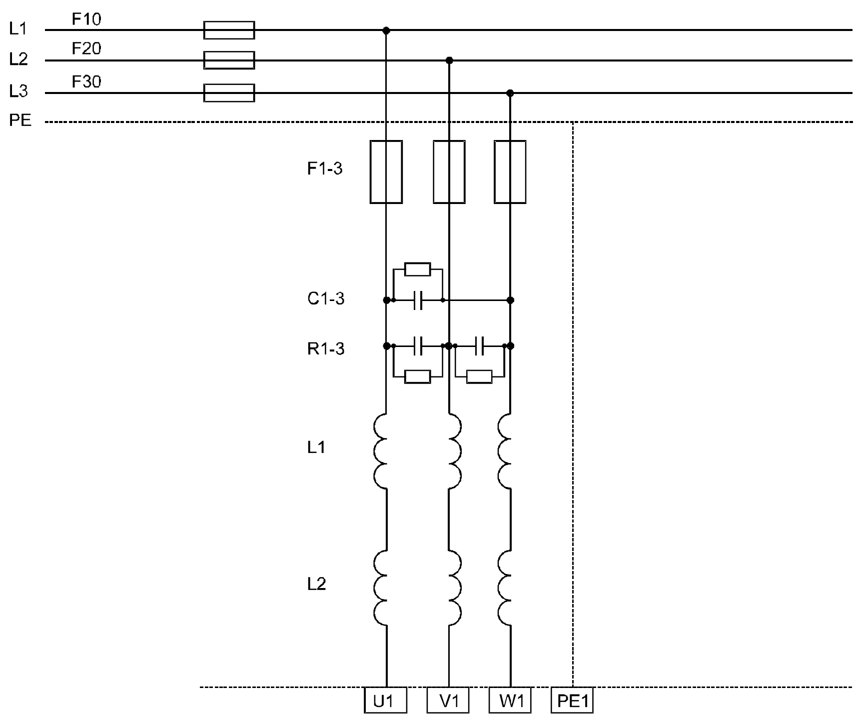


Fig. 2-22 Additional EMC measures

The drive converters are designed for use with industrial supply networks according to VDE 0160. A ratio of PN/PK of 1/100 is assumed. Under this assumption, the series reactor limits the supply voltage dips to permissible values so that loads connected to this supply network can still operate. Further, additional effective measures are included in the unit as standard in order to prevent noise and disturbances influencing other equipment.

However, for unfavorable line supply- or grounding conditions at the actual installation, in exceptional cases, cable-borne disturbances can occur, which are the result of an excessive line supply reactance. In cases such as these, the line commutating reactor must be adapted by connecting a second reactor of the same type in series, thus reducing the voltage dips.

As the dynamic performance of the line supply converter is thus restricted (motor/generator transition time) it may be necessary to use a pulsed resistor module. In order to dimension this, the most unfavorable dynamic operating situation in the system should be selected to check whether the DC link voltage reaches inadmissibly high values (when as many axes as possible brake simultaneously) (fault message $V_{DC\ link}$>>).

If a second reactor is still not sufficient to eliminate the noise, three capacitors (10 µF/450 V MKV) can be connected-up in a delta configuration in front of the reactor. This particular measure can also result in resonance effects which could increase the disturbances and therefore it must be carefully checked on a system to system basis.

Resistors R1 to R3 (G307, 13 W) must have values of 180 kΩ to 330 kΩ to discharge capacitors C1 to C3.

Note

We recommend that pre-assembled encoder cables are used, as correct screening is necessary to establish an EMC-proof connection.
Further, for optimum signal transfer, appropriate cable parameters are required. A guarantee for the correct functioning is only given when the original manufacturers cables are used.

2.6.7 Filter module (FIM)

A filter is available instead of individual components, which provides an effective noise interference suppression. This filter should be mounted close to the infeed.

Technical data

Degree of protection IP20

Line supply

voltage 3-ph. 360 V...456 V AC/45 Hz...66 Hz
3-ph. 480 V and 440V AC, ±10% /60 Hz ±10%
via the adaption transformer according to the power of the supply infeed module.
3-ph. 220 V AC ±10%/60 Hz ±10% via the matching transformer according to the power of the supply infeed module

Power loss 800W

Table 2-8 Filter module terminals

Terminal No.	Function	Type	Typ. voltage	Max. cross-section
Line L1 L2 L3	Direct line supply	Input	3-ph. 400V AC	16 mm², 50 mm²
Load L1 L2 L3	Connection to the UE module	Output	3-ph. 400V AC	16 mm², 50 mm²
PE1	Protective conductor connection	Input	0V	Clamping bar
PE2	Screen connection	Input	0V	Screw

2.7 Dimension drawings

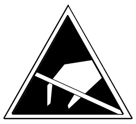
Technical data Additional technical data are included in Catalog NC60.1.

3 Installation and connecting-up

Contents

3.1 Installation instructions

3.1.1 Handling modules and boards



Caution

The boards have components and devices which can be destroyed by electrostatic discharge (ESD). The human body must be electrically discharged before touching or coming into contact with an electronics board. This can be simply done by touching a conductive object immediately beforehand (e. g. bare metal cabinet components, socket protective contact).

The ESD measures in accordance with Section 12 of the Manual must be observed when handling modules and boards.

3.1.2 Installing the PWM drive converters

SIMODRIVE 611 transistor PWM drive converters are designed for cabinet mounting. Please refer to the dimension drawings for the mounting dimensions and the position of the mounting points.

The mounting points of the modules, which can be mounted next to one another, are always in a 50 mm grid pattern.

A minimum clearance of 100 mm must be maintained above and below the PWM drive converter to permit unrestricted air intake and discharge. Please mount the PWM drive converters so that they are protected from conductive dust deposits and vapors.

If several units are mounted one above the other, the hot, discharged air must be kept away from the top transistor PWM converter or the unit should be de-rated.

When mounting the units, it should be observed that the I/R module and the UE module must be always be mounted to the left, and if required, should be followed by one or several power modules with MCU. A monitoring module must be provided after a maximum of 3 MCU modules.

3.1.3 Connecting the PWM drive converter

PWM drive converters are connected to the supply through commutating reactors (for uncontrolled infeeds, the commutating reactor is mounted internally). The infeed modules have, as standard, an inrush current limiting function. The bus link on the infeed module can be closed to connect the M600 DC link to ground potential. However, it must be ensured that the protective ground of all modules is connected to the central protective ground. The motors must also be individually grounded. Protective ground must be connected through the motor feeder cable. Connect-up the PWM drive converters according to the recommended configuration (refer to Fig. 1-2 Grounding concept).

The relevant regulations must be observed when engineering and integrating the drive converter system with motor into the complete machine installation and when connecting it to the supply. In addition to the general regulations in Germany, this involves the following standards.

Generally VDE 0160, VDE 0113/EN 60204, VDE 0100,
VDE 0100 Part 300, VDE 0100 Part 410, DIN 2853, DIN 2854.

It is not permissible to connect the drive converter through an e.l.c.b.

Warning

In accordance with VDE 0160 Sections 5.5 and 6.5, it is not permissible to operate drive converters having a B6 supply configuration from line supplies where the only protection against “indirect contact” is an e.l.c.b.

If a drive converter having a B6 circuit configuration is electrically connected to several other parallel circuits from a common e.l.c.b., when a fault develops, the e.l.c.b. may not respond so that shock protection is not provided.

Another protective measure for “rotection against dangerous currents flowing through the human body” according to VDE 0100 must be provided.

EMC

SIMDORIVE 611 drive converter systems have been designed in accordance with the relevant standards, VDE 0160/05.88; VDE 0558. For operation with industrial supply networks and in industrial environments. When used in mixed environments (industrial and residential), additional external measures may be required to fulfill the relevant EMC level. The EMC Law specifies the requirements. The user is responsible in ensuring that the specified line supply conditions at the point of installation are maintained.

For cabinets and machines, the recommendations, specified in Section 12 of this Manual must be taken into account.

Standards and regulations

The SIMODRIVE 611 drive converter system was designed and manufactured taking into account the following standards (excerpt of the most important):

DIN VDE 0100	Regulations for electrical power equipment with voltages up to 1000 V
DIN VDE 0113/02.86;EN60204	Electrical equipment on industrial machines
DIN VDE 0558	Regulations for semiconductor drive converters
DIN VDE 0106	Protection against dangerous currents flowing through the human body
DIN VDE 0109	Air- and creepage distances
DIN VDE 0110	Insulation classes
DIN VDE 0160/05.88	Electric power systems with electronic equipment
DIN 40050	IP degrees of protection
VBG 4	Accident prevention regulations “Electrical systems and equipment” (German Regulatory Body)

Power connections

The motor outlets at the PWM drive converter can be directly connected at the power modules. The terminals provided allow cable cross-sections according to DIN VDE 0113 to be connected in accordance with the module currents. The cable cross-section must be dimensioned according to the power module used, the motor, the ambient conditions (temperature) and the protective devices (refer to Section 1.1.4).

Note

Cable screens and conductors of power cables which are not used (e. g. braking conductors) must be connected to PE potential in order to dissipate charging effects caused by capacitive coupling.
Hazardous contact voltages could occur if this is not observed.

Encoder cables

Encoder cables must be routed separately away from power cables and contactor cables. Contactor coils without quenching elements can generate electrical noise. Thus, it is recommended that the contactor coils are provided with quenching or damping elements.

S7 connection

Please refer to the S7 documentation for information regarding the installation/mounting and connection of S7 boards as well as the peripheral devices.

Connection diagram

Refer to Section 3.3 for the connection diagram “Connection diagram, NE module and MCU”

3.2 Interfaces of the MCU board

The connections and position of interfaces are provided in Section 3.3 “Connection diagram, NE module and MCU”

3.2.1 Interface overview of the closed-loop control

Table 3-1 Closed-loop control interface

Term. No.	Designa-tion	Function	Type 1)	Typ. voltage/maximum values	Max. cross-section
AS1	X431	Relay, start inhibit (checkback signal, T. 663) 3)	O	250 V $_{AC}$/1A	1.5 mm^2
AS2	X431	Relay, start inhibit (checkback signal, T. 663) 3)	NC	50 V $_{AC}$/ZA	1.5 mm^2
663	X431	Pulse enable 2) The “start inhibit” relay is switched using terminal 663; when the relay opens, the gating pulses are inhibited and the motor is switched into a torque-free condition.	I	+21 V...30V	1.5 mm^2
9	X431	Enable potential 2)	O	+24 V	1.5 mm^2
B1	X432	Input, external zero mark (BERO)	E	+13 V...30 V	1.5 mm^2
19	X432	Reference ground, enable potential	O	0 V+24 V	1.5 mm^2
9	X432	Enable potential 2)	O		1.5 mm^2
1	X35	Test socket DAU1 which can be parameterized	O	±5 V	2mm socket
2	X35	Test socket DAU2 which can be parameterized	O	±5 V	2mm socket
3	X34	Test socket DAU3 which can be parameterized	O	±5 V	2mm socket
M	X34	Reference potential for test socket M	O	0 V	2mm socket

1) I = input; O = output; NC = NC contact; NO = NO contact
2) Terminal 19 is the reference terminal (this is not connected with the general reference ground, terminal 15).
3) It is only permissible to connect circuits which are not associated with the line supply.

3.2.2 Interface overview, measuring systems

Motor measuring system

Indirect measuring system (motor measuring system)

Connector designation:	X411
Connector type	25-pin D sub connector screw locking, UNC thread
Max. cable length	50 m for 0.3 A
Application:	Connecting the position encoder integrated in the motor

Note

We recommend that pre-assembled encoder cables are used as perfect screening is necessary to establish an EMC connection. Further, the cables must have certain characteristics and parameters to permit optimum signal transfer. Correct functioning can only be guaranteed when Siemens original cables are used (ordering data is specified under the Section Product designation).

We recommend that VDW connectors are used to provide a harmonized screen concept for rotary measuring systems. The complete spectrum of pre-assembled cables is available for these connectors. Additional information can be taken from the specific encoder catalogs.

Position measuring system

- **Direct measuring system**

  Connector designation: X421

Connector type	15-pin D sub plug connector screw interlocking, UNC thread
Max. cable length	40 m for 0.3 A

Note

Only insert and withdraw connectors when the equipment is in a no-voltage condition.

Application:	Optional connection of an additional position measuring system

Note

We recommend that pre-assembled encoder cables are used as perfect screening is necessary to establish an EMC connection. Further, the cables must have certain characteristics and parameters to permit optimum signal transfer. Correct functioning can only be guaranteed when Siemens original cables are used (ordering data is specified under the Section Product designation).

3.2.3 Interface overview, communications

MPI interface

- **Multi-point interface**

Connector designation: X20

Connector type 9-pin D sub socket connector

Max. cable length 11 m

Application: Networking the MCU board with operator control- and start-up components (commissioning components)

P/K bus

- **Peripheral/communications bus**

Connector designation: X30

Connector type 25-pin D-sub socket connector

Max. cable length: 10 m

Special features: Non-floating, no protective separation, excludes the use as connector for 12I/8O

Application: Is used to connect the S7-300 periphery via IM361 subrack in the expansion subrack (ER)

3.2.4 Interface overview, inputs/outputs

Integrated I/O

There are 4 digital inputs and 4 digital outputs on the MCU board. The I/O functions are selected with the machine data (refer to the function description "Positioning with MCU")

Connector designation: X431

X432

Connector type Phönix-Contact

Term. No.	Loca-tion	Function	Type 1)	Typ. voltage / max. values	Max. cross-section
E24	X432	24V ext. for digital output	I		1.5 mm²
9	X432	Positive enable voltage	O		1.5 mm²
O 1	X432	Digital output 1	O	Refer to the technical data	1.5 mm²
O 2	X432	Digital output 2	O		1.5 mm²
O 3	X432	Digital output 3	O		1.5 mm²
O 4	X432	Digital output 4	O		1.5 mm²
9	X431	Positive enable voltage	O		1.5 mm²
I 1	X431	Digital input 1	I	Refer to the technical data	1.5 mm²
I 2	X431	Digital input 2	I		1.5 mm²
I 3	X431	Digital input 3	I		1.5 mm²
I 4	X431	Digital input 4	I		1.5 mm²

1) O: Output I: Input

Technical data
Digital outputs X432

No. of outputs **Electrical isolation**	**4 digital outputs** **yes**
Supply voltage ULAST – nominal value – permissible range (ripple included)	 24 V DC 20 V to 30 V
Signal level of the outputs – for “0” signal – for “1” signal	 open circuit ULAST - max. 250 mV
Output load for “I” signal (nominal value) – ohmic load – lamp load – inductive load	dependent on whether 24 V is input internally or externally: external internal 500 mA 100mA 5 W 1 W 500 mA 100 mA
Power loss at 30 V	max. 3,8 W
Short-circuit protection	yes
Switching frequency for – ohmic loads – lamps – inductive load (at the nominal load; higher values are permissible for lower loads)	 100 Hz 11 Hz 2 Hz
Total load capability at 55°C	50%
Delay time for tpLH Delay time for tpHL	tpLH=max. 0.5 ms tpHL=max. 0.5 ms
Max. cable length	25 m

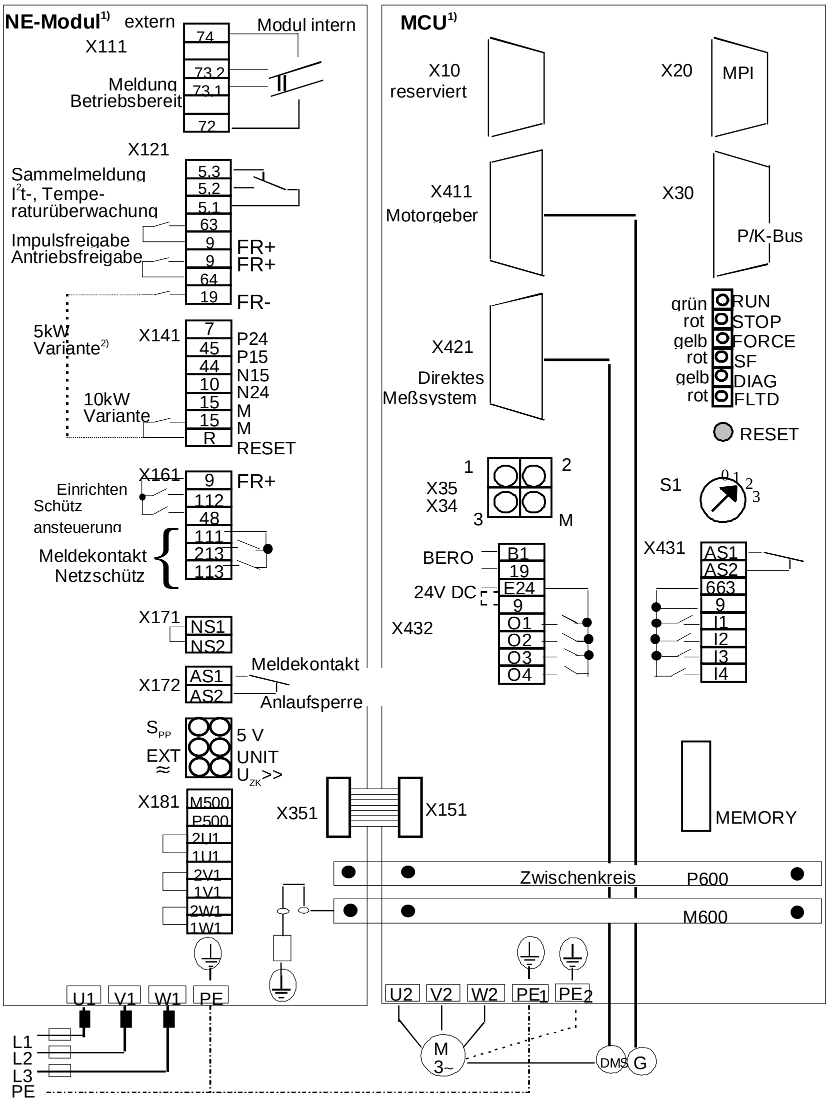
Note

Under fault conditions, initiated by an overcurrent condition or short-circuit, the outputs are re-energized after the fault/error has been removed. When an output is short-circuited, the three additional outputs can also be shutdown. Normally, with currents < 0.7 A, there is no mutual influence. For inductive loads, voltage spikes at switching can be quenched using external quenching diodes.

Technical data
Digital inputs X431

No. of inputs **Electrical isolation**	**4 digital inputs** **yes**
Supply voltage U_{LAST} – nominal value – permissible range (including ripple)	 24 V DC 20 V to 30 V
Input voltage (nominal value)	24 V DC
Short-circuit protection	yes
Input voltage – for “0” signal – for “1” signal	 -3 V to +5V +15V to +30V
Input current for “1” signal	+2 mA to +5 mA
Delay time for tpLH Delay time for tpHL	tp_{LH}=max. 10 ms tp_{HL}=max. 1 ms
Max. cable length	25 m

3.3 Connection diagram, NE module and MCU



1) links der gezeichneten Klemmen-externe Anschlüsse/Elemente
rechts der gezeichneten Klemmen-interne Anschlüsse/Elemente
2) 5kW Variante (gestrichelt)

Note

If a power contactor is used between the motor and MCU module, then it must be ensured that this contactor is only switched in a no-current condition (before de-energizing, the pulses must first be cancelled (terminal 663), and then the contactor can be opened 40 ms later).

---

4 Appendix

A

B

C

D

E

F

G

I

L

M

W

SIEMENS

SIMODRIVE 611

MCU 172A
Single-axis positioning control

Planning Guide
Drive machine data

Edition January 1997

Note

For reasons of transparency, this document doesn't include all of the details on all of the product types. Thus, it does not provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be required or should particular problems arise, which are not covered sufficiently in this document, then the local Siemens sales office should be contacted.

The contents of this Guide shall neither become part of nor modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties nor modify the existing warranty.

BERO, SIMATIC, SIMODRIVE, SINEC, SINUMERIK, STEP are Siemens product names.

The other names in this document could be registered trademarks. It may be illegal that third parties use these names or designations.

Subject to technical changes without prior notice.

1 Motor- and power module data

Contents

In this Section

This Section provides you with an overview of the drive-machine data to be configured.

Classification of the drive-machine data

The drive-machine data are in data block DB-AM (DB 1251) in the number range MD 1000 to MD 1799. They are sub-divided into

- motor- and power module data,
- monitoring- and limiting data,
- message data,
- measuring system data,
- SIMODRIVE controller data and
- status- and diagnostics data.

Generating drive-machine data

Select your SIMODRIVE 611 D power module and your feed motor using the MCU-PIT software package (parameterizing and start-up tool). Using this information, the MCU-PIT calculates the

- machine data for the motor (e. g. rated current, armature resistance and moment of inertia),
- machine data for the power module (rated- and limiting currents) as well as the
- control parameters of the SIMODRIVE section

and assigns the optimum pre-setting for the appropriate machine data.

A detailed description of the parameterizing- and start-up tools are provided in the User Guide *“Description, MCU-PIT“*.

Optimizing drive-machine data

Generally, an optimum configuration is obtained by pre-assigning the machine data standard values. Only a relatively small proportion of the many machine data, relevant for feed drives, must be manually assigned or optimized, to adapt the drive configuration to the specific application and situation (gearbox, external encoder etc.) of the drive system.

Note

Machine data, which are simultaneously assigned to several sections, are highlighted. Example: **MD 1012**[*].

Overview

The following machine data are under the section »*Motor- and power section data*«:

- motor data,
- power section data and
- system data.

Motor data

The following machine data contain the specific characteristic quantities of the AC servomotors:

– MD 1102 (motor code number)
– MD 1103 (rated motor current)
– MD 1104 (maximum motor current)
– MD 1112 (motor pole pair number)
– MD 1113 (torque constant)
– MD 1114 (voltage constant)
– MD 1115 (armature resistance)
– MD 1116 (armature inductance)
– MD 1117 (motor motor of inertia)
– MD 1118 (motor standstill current)
– MD 1146 (maximum motor speed)
– MD 1400 (rated motor speed)
– MD 1401 (speed for the maximum useful motor speed)

For SIMODRIVE 1FT6/1FK6 motors, these machine data are automatically and optimally pre-assigned using the code number, stored in MD 1102, when the motor MLFB is entered (machine readable product designation = Order No.).
It is not practical to subsequently change these standard values.

Power section data

The following machine data contains specific characteristic quantities of the SIMODRIVE 611 D power module:

– MD 1106 (power module code number)
– MD 1107 (transistor limit current)
– MD 1108 (power module limit current)
– MD 1111 (rated power module current)

These machine data are automatically and optimally pre-assigned using the code number stored in MD 1106 when the power module MLFB (Order No.) is entered. It is not necessary to subsequently change these standard values.

System data

These machine data contain system parameters of the SIMODRIVE section:

– MD 1000 (current controller clock cycle)
– MD 1001 (speed controller clock cycle)
– MD 1002 (monitoring clock cycle)
– MD 1100 (frequency, pulse-width modulation)
– MD 1101 (computation deadtime, current control loop)

1.1 Motor data; overview

MD 1102

Motor code number				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**65 535**	**—**	**Power On**

Function:

When the MLFB of the 1FT6-/1FK6 motors is entered, the corresponding motor code number is transferred to the drive. The user does not have to enter any data (also refer to MD 1106). The following motor data are automatically transferred by the motor code number from an internal table:

- rated motor current (MD 1103)
- maximum motor current (MD 1104)
- motor pole pair number (MD 1112)
- torque constant (MD 1113)
- voltage constant (MD 1114)
- armature resistance (MD 1115)
- armature inductance (MD 1116)
- motor moment of inertia (MD 1117)
- motor standstill (stall) current (MD 1118)
- maximum motor speed (MD 1146)
- rated motor speed (MD 1400)
- maximum motor temperature (MD 1602)

MD 1103

Rated motor current				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**500.0**	**A**	**Power On**

Function:

Enter the rated motor current (RMS) when operated at the rated torque and rated speed. Automatic parameterization with MD 1102 (motor code number).

MD 1104

Maximum motor current				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**500.0**	**A**	**Power On**

Function:

Enter the maximum permissible motor current (RMS value).
Automatic parameterization with MD 1102 (motor code number).

Note:

Do not reduce this machine data for reasons of safe monitoring and limiting (refer to MD 1105).

The limiting current is entered when the motor is selected.The limiting current is the current which can be impressed at rated speed. Thus, the drive can operate with constant acceleration over the complete speed range.

If a reduced torque at higher speed is adequate (reduced speed range or jerk limiting), the current can be increased up to the peak current (from the data sheet).

If the maximum motor current is increased, the torque limit
(MD 1230=MD 1104/MD 1118 * 100) and the power limit
(MD 1235=MD 1104/MD 1118 * 100) must be adapted.

This machine data is included in the controller calculation.

MD 1112

Motor pole pair number				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**6**	**—**	**Power On**

Function:

Enter the motor pole pair number. Automatic parameterization with MD 1102 (motor code number).

MD 1113

Torque constant				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**5.0**	**Nm/A**	**Power On**

Function:
Enter the torque constant. Automatic parameterization with MD 1102 (motor code number). The torque constant is the quotion of the rated torque/rated current (RMS) for permanent-magnet synchronous motors.

MD 1114

Voltage constant				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**300.0**	**V**	**Power On**

Function:

Enter the voltage constant. Automatic parameterization with MD 1102 (motor code number). The voltage constant is measured as induced voltage (EMF) under no-load conditions at n = 1000 RPM as RMS value of the motor terminals (phase-to-phase).

MD 1115

Armature resistance				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**20.0**	**Ω**	**Power On**

Function:

Enter the ohmic armature winding resistance (phase value). Automatic parameterization with MD 1102 (motor code number).

MD 1116

Armature inductance				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**100.0**	**mH**	**Power On**

Function:

Enter the armature three-phase inductance. Automatic parameterization with MD 1102 (motor code number).

MD 1117

Motor moment of inertia				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**32.0**	**kgm^2**	**Power On**

Function:

Enter the motor moment of inertia. Automatic parameterization with MD 1102 (motor code number) for motors without holding brake.

MD 1118

Motor stall current				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**500.0**	**A**	**Power On**

Function:

Enter the motor stall current. Automatic parameterization with MD 1102 (motor code number). The machine data corresponds to the thermally permissible continuous current when the motor is a standstill with an overtemperature of 100 Kelvin.

MD 1146

Maximum motor speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**50 000.0**	**RPM**	**Power On**

Function:

Enter the maximum motor speed. Automatic parameterization with MD 1102 (motor code number).

MD 1400

Rated motor speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
1 500.0	**0.0**	**25 000.0**	**RPM**	**Power On**

Function:

Enter the rated motor speed. Automatic parameterization with MD 1102 (motor code number).

MD 1401

Speed for the maximum motor useful speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
1 500.0	**0.0**	**50 000.0**	**RPM**	**Power On**

Function:

This machine data defines the maximum operating speed of the motor. It is used as reference value of the speed setpoint interface and for MD 1405 (motor monitoring speed). The pre-assignment is calculated with the rated motor speed using the **calculate contr. MD**.

Note:

The speed of a feed axis is adapted using the NC machine data 23 (maximum axis velocity). The motor speed, corresponding to this maximum value must be entered in machine data 1401. The spindle leadscrew as well as possible gearbox ratios are entered in the ratio of NC-MD 23 to drive MD 1401.

1.2 Power module data

MD 1106

Power module code number				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Power On**

Function:

When entering the MLFB of the SIMODRIVE power module, at the first start-up, the corresponding power module code number is determined on the MMC side. The user does not have to make an entry (also refer to MD 1102). The following power module data are automatically transferred by the power module code number from an internal table:

- transistor limit current, power module (MD 1107)
- thermal limit current, power module (MD 1108)
- rated power module current (MD 1111)

MD 1107

Transistor limit current				
Standard value	Lower input limit	Upper input limit	Units	Effective
200.0	**1.0**	**500.0**	**A**	**Power On**

Function:

Enter the maximum transistor limit current of the power module (peak value). Automatic parameterization with MD 1106 (power module code number).

Note:

The machine data is used as normalization basis of the current actual value sensing and may not be changed after automatic pre-assignment.

MD 1108

Thermal limit current, power module				
Standard value	Lower input limit	Upper input limit	Units	Effective
200.0	**1.0**	**500.0**	**A**	**Power On**

Function:

Enter the maximum thermally permissible current (RMS current) of the power module. Automatic parameterization with MD 1106 (power module code number).

Note:

The machine data is used as the upper limit of the thermal load and may not be changed after automatic pre-assignment.

MD 1111

Rated power module current				
Standard value	Lower input limit	Upper input limit	Units	Effective
200.0	**1.0**	**500.0**	**A**	**Power On**

Function:

Enter the maximum permissible continuous current (RMS value) of the power module. Automatic parameterization with MD 1106 (power module code number).

Note:
The machine data may no longer be changed after the automatic pre-assignment.

1.3 System data

MD 1000

Current controller clock cycle				
Standard value	Lower input limit	Upper input limit	Units	Effective
4	**2**	**4**	**31,25 µs**	**Power On**

Function:

The basic module clock cycle is derived from the current controller clock cycle of the axis (current controller clock cycle = basic module clock cycle). Possible input values are:

- 2 (for 62.5 µs)
- 4 (for 125.0 µs)

Note:

Intermediate values are not admissible (parameterization error). It is not admissible to exceed the computation time in the level of the current controller clock cycle; this will switch off the drive (system error).

MD 1001

Speed controller clock cycle				
Standard value	Lower input limit	Upper input limit	Units	Effective
4	**2**	**16**	**31,25 µs**	**Power On**

Function:

The speed controller clock cycle is derived from the current controller clock cycle of the axis (current controller clock cycle ≤ speed controller clock cycle). Possible input values are:

- 2 (for 62.5 µs)
- 4 (for 125.0 µs)
- 8 (for 250.0 µs)
- 16 (for 500.0 µs)

Note:

Intermediate values are not admissible (parameterization error). It is not admissible to exceed the computation time in the level of the speed controller clock cycle; this will switch off sthe drive (system error).

MD 1002

Monitoring clock cycle				
Standard value	Lower input limit	Upper input limit	Units	Effective
3 200	**128**	**3 200**	**31,25 µs**	**Power On**

Function:

The interrupt clock cycle is used for high-priority monitoring. When setting the clock cycle it should be observed that the input value must be a integral of 4 ms (parameterizing error): m × 128 × 31,25 µs (m = 1, 2, 3 ... 25).
The standard value 3200 corresponds to 100 ms.

Note:

It is not permissible that the computation time is exceeded at the interrupt level as this would cause the drive to be shutdown.

MD 1100

Frequency, pulse-width modulation				
Standard value	Lower input limit	Upper input limit	Units	Effective
4 000	**2 000**	**8 000**	**Hz**	**Power On**

Function:

Enter the frequency of the sampling signal (ATD) in the PWM inverter. The standard assignment is configured by the drive configuration at start-up.

Note:

For induction motor- and V/f operation, only 4 kHz and 8 kHz are permissible.

MD 1101

Computation deadtime, current control loop				
Standard value	Lower input limit	Upper input limit	Units	Effective
62	**0**	**124**	**µs**	**Power On**

Function:

The computation deadtime is the time between the start of a current controller clock cycle (current setpoint input) and the activation of the actuating voltage setpoints on the gating unit ASIC. The standard pre-assignment is made at the first start-up, and with the **calculate contr. MD** function using the particular configuration by entering MD 1102 (motor code number).

Computation deadtime limits:

MD 1101 < MD 1000 $\times$ 31,25 µs(= current controller clock cycle)

MD 1101 < 1/(MD 1100) (= T_{PBM}, synchro. clock cycle periods)

2 Monitoring- and limiting data

Contents

2.1 Motor monitoring

MD 1105

Reduced maximum motor current				
Standard value	Lower input limit	Upper input limit	Units	Effective
100	**0**	**100**	**%**	**Immediate**

Function:

Enter the reduction factor for the maximum permissible motor current. The maximum motor current (MD 1104) is the reference value for the percentage data.

MD 1147

Speed limiting				
Standard value	Lower input limit	Upper input limit	Units	Effective
7 000.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Function:

Enter the maximum permissible motor speed. Automatic parameterization (initialization) using the **calculate contr. MD** function and the rated motor speed (MD 1400) × 120 %. If the speed actual value exceeds the set limit by more than 2 percent, the motoring torque limit is internally set to zero thus preventing further acceleration. The *"speed controller at limit"* monitoring may respond depending on the setting (response threshold MD 1606 < MD 1147 and response time MD 1605 → short).
The standard pre-assignment is parameterized by the drive configuration at start-up.

Note:

The minimum of the entered value and motor-dependent specified value are the only values which are effective.

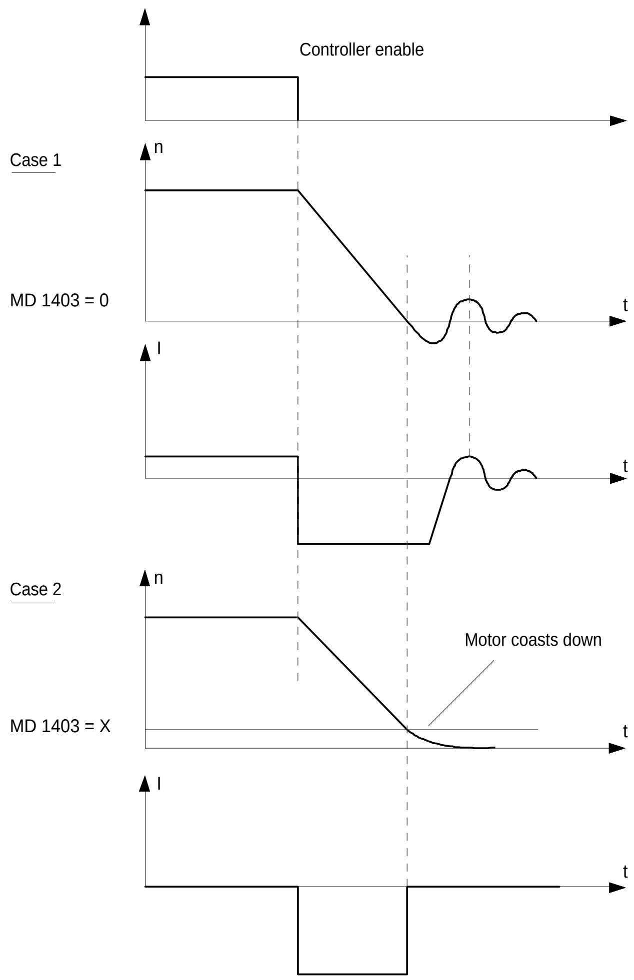
MD 1403

Shutdown speed, pulse cancellation				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**7 200.0**	**RPM**	**Immediate**

Function:

Enter the shutdown speed for pulse cancellation. If the absolute speed actual value falls below the specified speed threshold when the controller enable is withdrawn when powering-down, then the pulses are cancelled per software and the drive is shutdown until it is enabled again using SERVO. The pulses are also cancelled if the controller enable is withdrawn before the time set in MD 1404 (timer stage for pulse cancellation) and the speed threshold has still not been fallen below.

The standard pre-assignment is parameterized at start-up by the drive configuration. A 0 means that the machine data has been de-activated. In this case, the pulses are exclusively cancelled via MD 1404 (timer stage, pulse cancellation).
The functionality of this machine data is required, to suppress overshoot when zero speed is reached after controller enable has been withdrawn, must be suppressed.



MD 1404

Timer stage, pulse cancellation				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**0.0**	**100 000.0**	**ms**	**Immediate**

Function:

Enter the timer stage for pulse cancellation by the drive. Under fault conditions (when braking regeneratively or controller inhibit), the gating pulses of the power module transistors are cancelled by the drive after the selectable timer stage time has expired. The pulses are cancelled earlier, if the speed threshold, set in MD 1403 (shutdown speed, pulse cancellation) was fallen below prior to this.

The standard pre-assignment is parameterized at start-up by the drive configuration.

MD 1405

Motor monitoring speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
110.0	**100.0**	**110.0**	**%**	**Immediate**

Cross-reference: DB1000, DS36, Nr. 23003.11

Function:

Percentage input of the maximum permissible speed setpoint as limit value for the speed setpoint monitoring. MD 1401 is used as the reference value (speed for the maximum useful motor speed). When the monitoring speed is exceeded, a ZK3 message is output. The standard pre-assignment is parameterized using the **calculate contr. MD** function when configuring the drive.

MD 1602

Motor temperature alarm threshold				
Standard value	Lower input limit	Upper input limit	Units	Effective
120	**0**	**200**	**° C**	**Immediate**

Cross-reference: DB1000, DS36, Nr. 23002.14

Function:

Enter the permissible thermal steady-state motor temperature. Automatic parameterization with MD 1102 (motor code number). The motor temperature is sensed using a temperature sensor and is evaluated in the drive. When the alarm limit is reached, a signal is output to the SERVO (also refer to MD 1603 and MD 1607).

MD 1603

Timer stage, motor temperature alarm				
Standard value	Lower input limit	Upper input limit	Units	Effective
240	**0**	**600**	**s**	**Immediate**

Function:

Enter the timer stage for the motor temperature alarm. When MD 1602 is exceeded (motor temperature alarm threshold) a signal is output to the SERVO and a time monitoring function is started. If the timer stage time expires and the motor temperature still has not fallen below the temperature limit, the drive initiates regenerative braking and cancels the transistor gating signals for the individual axes after MD 1404 (timer stage, pulse cancellation) in conjunction with MD 1403 (shutdown speed, pulse cancellation).

Note:

A time monitoring function which has already been started (the counter is already running) is not influenced when the timer stage is changed. It only becomes valid if the motor temperature lies below the alarm limit (MD 1602).

MD 1607

Shutdown limit, motor temperature				
Standard value	Lower input limit	Upper input limit	Units	Effective
155	**0**	**200**	**° C**	**Immediate**

Cross-reference: DB1000, DS36, Nr. 23000.0

Function:

Enter the motor temperature shutdown limit. The motor temperature is sensed using a temperature sensor and evaluated in the drive. When the shutdown limit is reached, the motor is regeneratively braked, and a ZK1 signal is output to the SERVO (also refer to MD 1602 and MD 1603).

Note:

- The temperature monitoring functions (alarm + timer stage and unconditional shutdown) are not subject to any mutual restrictions, i. e. MD 1607 < MD 1602 is permissible. In this case, the drive is shutdown without any prior alarm.
- The temperature sensing accuracy lies in the range from 3...5 %.

MD 1608

Fixed temperature				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**200**	**° C**	**Immediate**

Function:

Enter the fixed temperature. The temperature measurement is no longer effective for a value greater than 0. The fixed temperature is used.

Note:

The motor temperature monitoring functions, set in MD 1602 (motor temperature alarm threshold) and MD 1607 (shutdown limit, motor temperature) are no longer effective.

2.2 Controller monitoring

MD 1604

DC link undervoltage alarm threshold				
Standard value	Lower input limit	Upper input limit	Units	Effective
200	**0**	**680**	**V**	**Immediate**

Cross-reference: DB1000, DS36, Nr. 23002.0

Function:

Enter the DC link undervoltage alarm threshold. When this limit is fallen below, a signal is input to SERVO (*“DC link OFF“*).

MD 1605

Timer stage, speed controller at fixed stop				
Standard value	Lower input limit	Upper input limit	Units	Effective
200.0	**20.0**	**10 000.0**	**ms**	**Immediate**

Function:

Enter the timer stage, speed controller at fixed stop. The speed controller output (= torque setpoint) is monitored. If the output is at its limit for longer than the time in the timer stage, and if the absolute actual speed is lower than the value set in MD 1606 (threshold, speed controller at fixed stop), the ZK1 error signal *“speed controller at fixed stop“* is output and the motor pulses are cancelled.

Note:

With the setting MD 1605 < MD 1404 (timer stage, pulse cancellation) regenerative braking can be interrupted with the fault message *“speed controller at fixed stop“*; the drive then coasts down.

MD 1606

Threshold, speed controller at fixed stop				
Standard value	Lower input limit	Upper input limit	Units	Effective
8 000.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Function:
Enter the speed threshold for the alarm *“speed controller at fixed stop“* (also refer to MD 1605). The standard pre-assignment is parameterized by the drive configuration at start up.

2.3 Limit values

MD 1146

Maximum motor speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**50 000.0**	**RPM**	**Power On**

Function:

Enter the maximum motor speed. Automatic parameterization with MD 1102 (motor code number).

MD 1191

Adaption, servo limit torque				
Standard value	Lower input limit	Upper input limit	Units	Effective
1.0	**0.0**	**100.0**	**—**	**Immediate**

Function:

From drive software 1.00 to 2.00, with the combination of feed drives and main spindle drives, the interface of the torque setpoints has been standardized to 8 x standstill torque. In order to be compatible to earlier feed drive software for a particular application, an adaption factor was inserted into the torque limit value interface. This allows the previous normalization to be kept when upgrading the feed drive software, and is determined as follows:

$$\text{MD 1191} = \frac{\text{MD 1107}}{8 \times \sqrt{2} \times \text{MD 1118}}$$

Note:

Do not change this value for the MCU.

MD 1230

1st torque limit value M_{d1}				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**5.0**	**900.0**	**%**	**Immediate**

Function:

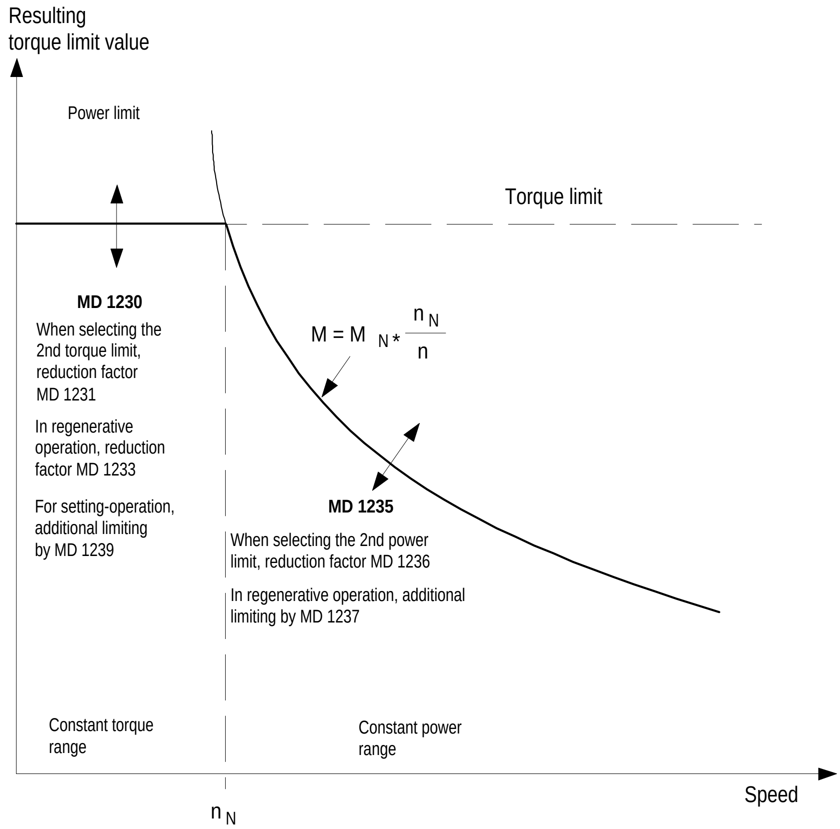
Enter the maximum permissible torque referred to the normalized motor torque. As the power is limited (MD 1235, MD 1236) in the upper speed range, this machine data is only of importance in the lower speed range. The pre-assignment is realized so that the accelerating torque is effective up to the rated speed and then the power limiting function is activated.

The standard pre-assignment is realized using the **calculate contr. MD** function.
The value is obtained as follows:

$$\text{MD 1230} = \frac{\text{MD 1104}}{\text{MD 1118}} \times 100\,\%$$

As the current limit (MD 1104) also limits the maximum torque which can be specified, a higher torque limit can only result in more torque if the current limit can also be increased.

Note:
If the motor is overloaded for a longer period of time, this can result in an inadmissible temperature rise (the drive is shutdown as result of motor overtemperature), and could also destroy the motor. MD 1104 and MD 1231 to MD 1239 are the corresponding machine data.


Resulting
torque limit value
Power limit
Torque limit
MD 1230
When selecting the 2nd torque limit, reduction factor MD 1231
In regenerative operation, reduction factor MD 1233
For setting-operation, additional limiting by MD 1239
$M = M_N * \frac{n_N}{n}$
MD 1235
When selecting the 2nd power limit, reduction factor MD 1236
In regenerative operation, additional limiting by MD 1237
Constant torque range
Constant power range
Speed
n_N

MD 1231

2nd torque limit value M_{d2}				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**5.0**	**100.0**	**%**	**Immediate**

Cross-reference: DB1000, DS8, No. 20200.10

Function:

When entering the 2nd torque limit value, this is a reduction factor referred to the 1st torque limit value (MD 1230). It only becomes effective, if the 2nd torque limit value is selected via the PLC control word (DS8) and the motor speed exceeds the value set in MD 1232 with hysteresis (MD 1234).

MD 1232

Changeover speed from M_{d1} to M_{d2}				
Standard value	Lower input limit	Upper input limit	Units	Effective
6 000.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Function:

Enter the changeover speed above which, it is possible to changeover to the 2nd torque limit value (MD 1231). A selectable hysteresis (MD 1234) is effective at the changeover. The 2nd torque limit value is only effective, if the motor speed exceeds the speed threshold with hysteresis and the 2nd torque limit value was selected via the PLC control word (DS8).

MD 1233

Regenerative limiting				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**5.0**	**100.0**	**%**	**Immediate**

Function:

Enter the torque limit when braking (regenerative torque limiting). It is referred to the maximum torque when motoring. If the 2nd torque limit is active, the reference value comprises machine data MD 1230 and MD 1231, otherwise only MD 1230 (1st torque limit value).

MD 1234

Hysteresis for the changeover speed MD 1232				
Standard value	Lower input limit	Upper input limit	Units	Effective
50.0	**5.0**	**1 000.0**	**RPM**	**Immediate**

Function:

Enter the hysteresis for the changeover speed set in MD 1232 (changeover speed from M_{d1} to M_{d2}).

MD 1235

1st power limit				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**5.0**	**900.0**	**%**	**Immediate**

Function:

Enter the maximum permissible power referred to the normalizing motor power. The pre-assignment is realized for new start-ups or using the **calculate contr. MD** function. The value is obtained as follows:

$$\text{MD 1235} = \frac{\text{MD 1104}}{\text{MD 1118}} \times 100\,\%$$

The pre-assignment is made, so that above the rated speed the following is valid:

$$\frac{\text{Motor\_speed}}{\text{Rated\_speed}} \times \text{accelerating torque} = \text{constant}$$

Note:

If the motor is overloaded for a longer period of time, this can result in an inadmissible temperature rise (the drive is shutdown as result of motor overtemperature), and could also destroy the motor. MD 1104, MD 1145 and MD 1231 to MD 1239 are the corresponding machine data.

MD 1236

2nd power limit				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**5.0**	**100.0**	**%**	**Immediate**

Cross-reference: DB1000, DS8, No. 20200.10

Function:
When entering the 2nd power limit, this is a reduction factor referred to the 1st power limit (MD 1236). It only becomes effective, if the 2nd torque limit is selected via the PLC control word (DS8) and the motor speed exceeds the value set in MD 1232 (changeover speed from M_{d1} to M_{d2}) with hysteresis (MD 1234).

MD 1237

Maximum regenerative power				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**0.3**	**500.0**	**kW**	**Immediate**

Function:
Enter the maximum regenerative power. The machine data allows the power, fed back for the infeed/regenerative feedback module to be limited. Especially when using an uncontrolled rectifier/regenerative feedback unit, an appropriately lower value must be entered here.

2.4 Setting-up operation

MD 1239

Torque limit, setting-up operation				
Standard value	Lower input limit	Upper input limit	Units	Effective
1.0	**0.5**	**100.0**	**%**	**Immediate**

Function:

Enter the torque limit for setting-up operation referred to the rated motor torque. The machine data is not effective under normal operating conditions. In setting-up operation, the maximum from the limit values in normal operation and the value set in this machine data, act as torque limit value. Setting-up operation is selected via terminal 112 of the rectifier/regenerative feedback unit.

MD 1420

Maximum motor speed for setting-up operation				
Standard value	Lower input limit	Upper input limit	Units	Effective
30.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Cross-reference: DB1000, DS36, No. 23003.11

Function:
Enter the maximum motor speed for setting-up operation. For setting-up operation, the absolute speed setpoint is limited to the specified value. If the speed setpoint is limited to MD 1420, a ZK3 signal is additionally output.

2.5 Alarms

MD 1012
Bit 4

Power-on functionality, SIMODRIVE 611 D (function switch: ZK2 parameterizing error)				
Standard value	Lower input limit	Upper input limit	Units	Effective
0004	**0000**	**7FFF**	**Hex**	**Immediate**

Function:

Enter the configuration for the power-on functionality referred to the SIMODRIVE system 611 D. Bit 4 controls the ZK2 parameterizing error:

0 = ZK2 parameterizing errors are not supported (pre-setting).
A fault/error causes the drive to be shutdown (controller inhibit).

1 = ZK2 parameterizing errors are supported.
A fault/error results in an alarm message being displayed on the screen.

MD 1600
Bits 0, 1, 4-9, 15

***»Power On«* alarms which can be suppressed**				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Cross-reference: DB1000, DS1, No. 24008.4

Function:

»Power On« alarms (ZK1 faults) of the SIMODRIVE 611 D system can be suppressed using this machine data. The appropriate monitoring function is active, if the associated bit = 0 (refer to the table).
All 611D monitoring functions are active as standard.

Bit	***»Power On«* alarm**
0	Internal fault/error (cannot be suppressed!)
1	Vector monitoring
4	Measuring circuit, motor measuring system
5	Monitoring, absolute track
6	Not assigned
7	Synchronizing error
8	Zero mark monitoring, motor measuring system
9	AC drive converter frequency too high
15	Temperature monitoring, power module

Note:

- SIMODRIVE 611 D *»Power On«* alarms can only be acknowledged using a hardware reset.
- The power module could be destroyed if the *»Power On«* alarms are suppressed.

- When the *»Power On«* alarm is suppressed, the drive does not transfer the appropriate ZK1 alarm (DB1000, DS1, No. 24008.4), however ZK2 alarms (warnings) are transferred (e. g.: DB1000, DS36, No. 23002.15).

MD 1601
Bits 7, 8, 14

***»Reset«* alarms which can be suppressed**				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

»Reset« alarms of the SIMODRIVE 611 D system can be disabled using this machine data. The appropriate alarm is active, if the associated bit = 0 (refer to the table). All 611D alarms are active as standard.

Bit	***»Reset«* alarm**
6	Flux controller at its limit
7	Current controller at its limit
8	Speed controller at its limit
9	Encoder frequency exceeded
12	Maximum speed = f(UZWK)
13	Temperature, motor trip (temperature)
14	Temperature, motor trip (timer stage)

Note:

- SIMODRIVE 611 D *»Reset«* alarms can be acknowledged using a software reset.
- The power module or motor could be destroyed if the *»Reset«* alarms are suppressed.
- Reset 611D alarms can be changed-over to 611D alarms using MD 1012 bit 4. In this case, suppression has no effect.

MD 1612
Bits 0, 8, 9, 15

Configured shutdown response *»Power On«* alarms				
Standard value	Lower input limit	Upper input limit	Units	Effective
0DBC	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

Input bit field to changeover the particular 611D »Power On« alarm (refer to the table). Either the shutdown response, pulse inhibit (bit = 1) or controller inhibit (bit = 0 → n_{set} = 0 → regenerative braking) can be selected. The controller inhibit is de-activated when pulse inhibit is selected. The standard pre-assignment is parameterized at start-up by the drive configuration.

Note:
The alarms can be disabled or suppressed using MD 1600 (»Power On« alarms which can be suppressed). In this case, the alarms are not active.

The standard values are highlighted in the table.

Bit	*»Power On«* alarm	Value
0	Pulse inhibit for internal error	0 = **off** 1 = on
1, 6, 12-14	Not assigned	—
2-5, 7, 10, 11	Reserved	—
8	Pulse inhibit, zero monitoring	0 = off 1 = **on**
9	Pulse inhibit, drive converter limiting frequency	0 = **off** 1 = on
15	Pulse inhibit, heatsink temperature	0 = **off** 1 = on

MD 1613
Bits 0, 9, 13, 14

Configurable shutdown response »*Reset*« alarm				
Standard value	Lower input limit	Upper input limit	Units	Effective
0100	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

Input bit field to changeover the particular 611D reset alarm (refer to the table). Either the shutdown response, pulse inhibit (bit = 1) or controller inhibit (bit = 0 → n_{set} = 0 → regenerative braking) can be selected. The controller inhibit is activated when the pulse inhibit is selected. The standard pre-assignment is parameterized at start-up by the drive configuration.

Note:

- 611D messages/signals can be changed-over to reset alarms using MD 1012 bit 4 (function switch).
- The alarms can be disabled or suppressed using MD 1601 (reset alarms which can be suppressed). In this case, the alarms are inactive.

The standard values are highlighted in the table.

Bit	Reset alarm	Value
0	Pulse inhibit for a configuration error	0 = **off** 1 = on
1-7, 10-12, 15	Not assigned	—
8	Reserved	—
9	Pulse inhibit for encoder limiting frequency	0 = **off** 1 = on
13	Pulse inhibit, motor encoder temperature	0 = **off** 1 = on
14	Pulse inhibit, for motor temperature alarm	0 = **off** 1 = on

2.6 Emergency retraction

MD 1161

Fixed DC link voltage				
Standard value	Lower input limit	Upper input limit	Units	Effective
600	**0**	**700**	**V**	**Immediate**

Function:

When a fixed DC link voltage is entered which is > 0 V, the DSP-internal DC link measurement is de-activated, i. e. the MD 1701 (DC link voltage display) is inactive (display: *). The voltage reference value is then included in the DC link adaption instead of the measured value.

Note:

Emergency retraction is only possible with active DC link measurement (MD 1161 = 0). Emergency retraction is only possible, if the „emergency retraction enable = ON“ (DB1000, DS8, No. 20200.4).

MD 1630

Response threshold, only DC link monitoring				
Standard value	Lower input limit	Upper input limit	Units	Effective
550	**0**	**680**	**V**	**Immediate**

Function:
Enter the response threshold of the DC link voltage, which, when fallen below, only the DC link voltage is monitored, and no longer the motor temperature. The normal functionality is re-established if the response threshold is exceeded again.

MD 1634

Response threshold, emergency retraction				
Standard value	Lower input limit	Upper input limit	Units	Effective
400	**0**	**660**	**V**	**Immediate**

Cross-reference: DB1000, DS36, No. 23002.1

Function:

Enter the shutdown threshold of the DC link voltage. When this is fallen below, emergency retraction is initiated corresponding to MD 1636.

MD 1636

Emergency retraction, mode 4				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**7**	**—**	**Immediate**

Cross-reference: DB1000, DS36, No. 23002.2

Function:

The emergency retraction mode 4 (immediate emergency retraction with subsequent regenerative braking) is set, when the MCU runs-up by transferring MD 1636, if a terminal (I1 to I4) is assigned the „emergency retraction“ function. This operating mode can be changed in operation via the operator control interface, but data saved in the onboard FEPROM is overwritten the next time the system runs-up.

Under fault conditions, the axis travels at the emergency retraction speed (MD 1639) and maintains this over the emergency retraction time (MD 1638). After this, the axis brakes regeneratively. Under fault conditions, this response is autonomous (without the MCU intervening).

A ZK2 bit is used to indicate that the autonomous emergency retraction function is active (DS 36, status class 2, bit 2: „Emergency retraction/regenerative operation active“).

Note:

The MCU must be reset after an emergency retraction (power-on reset or software reset).

MD 1638

Emergency retraction time				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**10 000**	**ms**	**Immediate**

Function:

Enter the time, where the emergency retraction speed (MD 1639) should be entered as speed setpoint under fault conditions.

MD 1639

Emergency retraction speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
0040 0000	**0040 0000**	**FFC0 0000**	**Hex**	**Immediate**

Function:

Enter the speed, which should be entered as speed setpoint for the emergency retraction time (MD 1638) when a fault/error condition occurs. The hexadecimal value 400 000 corresponds to the maximum operating speed of the motor, specified in MD 1401.

3 Message data

Overview

These machine data are used to output messages:

– MD 1012 (power-on functionality, SIMODRIVE 611 D)
– MD 1417 (threshold speed nx for the »nact < nx« message)
– MD 1418 (threshold speed nmin for the »nact < nmin« message)
– MD 1426 (tolerance bandwidth for the »nset = nact« message)
– MD 1427 (delay time for the »nset = nact« message)
– MD 1428 (threshold torque Mdx)
– MD 1429 (delay time for the »Md < Mdx« message)
– MD 1620 (bits, variable message function)
– MD 1621 (signal number, variable message function)
– MD 1622 (address, variable message function)
– MD 1623 (threshold, variable message function)
– MD 1624 (hysteresis, variable message function)
– MD 1625 (pull-in delay, variable message function)
– MD 1626 (drop-out delay, variable message function)

MD 1012

Power-on functionality, SIMODRIVE 611 D				
Standard value	Lower input limit	Upper input limit	Units	Effective
0004	**0000**	**7FFF**	**Hex**	**Immediate**

Function:

Enter the configuration for power-on functionality referred to the SIMODRIVE system 611 D. The standard values are highlighted in the value column. Value table:

Bit	Function	Value
0	Ramp-function generator tracking	0 (**off**) = not active 1 (on) = active
2	Drive ready, terminal-dependent	0 (off) = drive ready, if there is no ZK1 alarm 1 (**on**) = drive ready, if the following conditions are simultaneously present: – no ZK1 alarm – terminal 63 = 1 (infeed/regenerative feedback module) – terminal 64 = 1 (infeed/regenerative feedback module) – terminal 663 = 1 (drive module)
4	ZK2 parameterizing error	0 (**off**) = ZK2 parameterizing errors are not supported (pre-setting). An error causes the drive to be shutdown (controller inhibit). 1 (on) = ZK2 parameterizing errors are supported. An error results in an alarm message being displayed on the screen.
7	**No effect:** Pre-assignment pre-control speed (IM) when the drive pulses are cancelled and the drive is enabled with the motor still rotating	0 (0) = the drive immediately accelerates the motor to the setpoint speed 1 (**n_{set}**) = the drive brakes the motor towards 0 speed and then accelerates it to the setpoint speed.

MD 1417

Threshold speed n_x for the »$n_{act} < n_x$« message				
Standard value	Lower input limit	Upper input limit	Units	Effective
6 000.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Cross-reference: DB1000, DS36, No. 23003.3

Function:

Enter the threshold speed for monitoring purposes. If the actual speed falls below the absolute speed threshold which has been set, a signal is sent to the SERVO.

MD 1418

Threshold speed n_{min} for the »$n_{act} < n_{min}$« message				
Standard value	Lower input limit	Upper input limit	Units	Effective
5.0	**0.0**	**25 000.0**	**RPM**	**Immediate**

Cross-reference: DB1000, DS36, No. 23003.2

Function:

Enter the threshold speed for monitoring purposes. If the actual speed falls below the absolute speed threshold which has been set, a signal is sent to the SERVO.

MD 1426

Tolerance bandwidth for the »$n_{set} = n_{act}$« message				
Standard value	Lower input limit	Upper input limit	Units	Effective
20.0	**0.0**	**10 000.0**	**RPM**	**Immediate**

Cross-reference: DB1000, DS36, No. 23003.4

Function:

Enter the response value for the tolerance bandwidth of the PLC status messages »$n_{act} = n_{min}$« and »ramp-up completed «. The »$n_{set} = n_{act}$« message becomes active, if the speed actual value enters the tolerance bandwidth which has been set around the speed setpoint, and remains within this bandwidth for at least the delay time (MD 1427). If the tolerance bandwidth is exited, the message immediately becomes inactive. The delay time is only used if the ramp-function generator changes the edge, from active to passive.

The »ramp-up completed « message is simultaneously active with the »$n_{set} = n_{act}$« message; however it is latched in the active setting up until the next setpoint change, even if the speed actual value exits the tolerance bandwidth. The »ramp-up completed « message becomes immediately inactive, if the setpoint changes.

MD 1427

Delay time for the »n_{set} = n_{act}« message				
Standard value	Lower input limit	Upper input limit	Units	Effective
200.0	**0.0**	**500.0**	**ms**	**Immediate**

Function:

Enter the delay time where the »n_{set} = n_{act}« message should respond when it leaves the tolerance bandwidth (MD 1426).

MD 1428

Threshold torque M_{dx}				
Standard value	Lower input limit	Upper input limit	Units	Effective
90.0	**0.0**	**100.0**	**%**	**Immediate**

Cross-reference: DB1000, DS36, No. 23003.1

Function:

Enter the percentage setting for the threshold torque machine data. This machine data defines the torque limit value where the ZK3 message »M_d<M_{dx}« should become inactive. The entered value refers to the actual torque- and power limits.

The »M_d<M_{dx}« message is latched into the active condition as long as the »ramp-up completed « message is not active. If »ramp-up completed « is active, then the delay time (MD 1429) must first expire, and then the »M_d<M_{dx}« message can become inactive.

MD 1429

Delay time for the »M_d < M_{dx}« message				
Standard value	Lower input limit	Upper input limit	Units	Effective
800.0	**0.0**	**1 000.0**	**ms**	**Immediate**

Function:

Enter the delay time which must first expire before the »M_d<M_{dx}« message can become inactive after the »ramp-up completed « message. As long as the »ramp-up completed « is not active, or the delay time has still not expired, the »M_d<M_{dx}« message is latched in the active condition.

MD 1620

Bits, variable message function				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Cross-reference: DB1000, DS36, No. 23003.5

Function:

Input bit field to control the variable message function. Value table:

Bit	Function	Value
0	Variable message function	0 (**off**) = not active 1(on) = active
1	Segment, variable message function	0 (**X:**) = address area X 1 (Y:) = address area Y
2	Comparison, with sign	0 (**off**) = comparison without sign 1 (on) = comparison with sign

Note:

Bit 1 is only effective, if the signal number 0 is selected in MD 1621 (signal number, variable message function).

With the variable message function, a memory location from address area X or address area Y in the data RAM is monitored against a threshold which can be entered. A tolerance bandwidth can be set for this threshold, which is calculated-in when scanning as to whether the threshold has been violated. This message is realized via the operating message ZK3 (status class 3) with bit 5 and can be logically combined with a pull-in delay or drop-out delay. The message function runs in a 4 ms clock cycle.

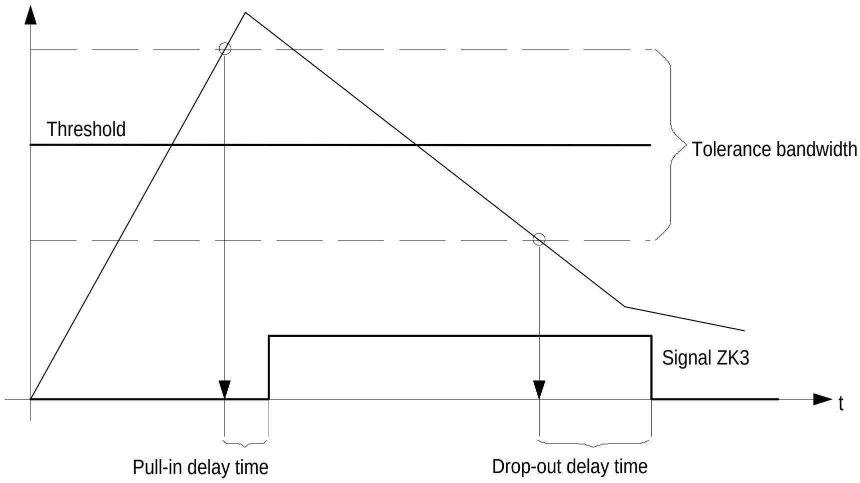
The quantity to be monitored can either be selected by entering a signal number or a physical address, whereby the physical address is only relevant for Siemens service work.

The following are the corresponding machine data:

- MD 1621 (signal number, variable message function)
- MD 1622 (address, variable message function)
- MD 1623 (threshold, variable message function)
- MD 1624 (hysteresis, variable message function)
- MD 1625 (pull-in delay, variable message function)
- MD 1626 (drop-out delay, variable message function)

When input changes are made in the machine data MD 1621 to MD 1624 while the monitoring function is already active (MD 1620, bit 0 = 1), this does not automatically result in the ZK3 message bit 5 being re-initialized, i. e. reset to 0. If this is required, after the machine data has been changed, bit 0 should be switched-out and in again using MD 1620.

Diagram:



MD 1621

Signal number, variable message function				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**100**	**—**	**Immediate**

Function:

Enter the signal number of the memory location which is to be monitored using the variable message function. Value table:

Signal No.	**Signal designation**	**Normalization** (corresponds to the LSB:)
0	Physical address	—
1	—	—
2	Current I_R	MD 1710
3	Current I_S	MD 1710
4	Current I_d	MD 1710
5	Current I_q	MD 1710
6	Current setpoint I_q (limited after the filter)	MD 1710
7	Current setpoint I_q (in front of the filter)	MD 1710
8	Speed actual value, motor	MD 1711
9	Speed setpoint	MD 1711
10	Speed setpoint, reference model	MD 1711
11	Torque setpoint (speed controller output)	MD 1713
12	Torque setpoint limit	MD 1713
13	Utilization ($m_{set}/m_{set,\ limit}$)	8000H = 100 %
14	Active power	0,01 kW
15	Rotor flux setpoint	MD 1712
16	Rotor flux actual value	MD 1712
17	Quadrature-axis voltage U_q	MD 1709
18	Direct-axis voltage U_d	MD 1709
19	Current setpoint I_d	MD 1710
20	Motor temperature	0,1 °C
21	DC link voltage	1 V
22	Zero mark signal, motor measuring system	—
23	Bero signal	—
24	Absolute speed actual value	MD 1711
25	Slip frequency setpoint	$\frac{2000 \times 2\pi}{800000H \times 1s^{-1}}$
26	Rotor position (electrical)	MD 1714
27	Torque setpoint, speed controller	MD 1713
28	Pre-control torque	MD 1713
29	Actuating voltage Q injection	MD 1709
30	Actuating voltage D injection	MD 1709

MD 1622

Address, variable message function				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

Enter the address of the memory location which is to be monitored using the variable **message** function.

Note:

This machine data is only effective if the signal number is set to 0 (refer to MD 1621).

MD 1623

Threshold, variable message function				
Standard value	Lower input limit	Upper input limit	Units	Effective
000000	**000000**	**FFFFFF**	**Hex**	**Immediate**

Function:

Enter the threshold for the address of the memory location, entered in MD 1622 (address, variable **message** function), which is to be monitored via the variable message function. The actual value to be checked is obtained together with MD 1624 (hysteresis, variable message function).

Note:

The numerical value entered in MD 1623 is interpretted as a function of MD 1620 (variable message function bits) without sign (bit 2 = 0) or with sign (bit 2 = 1).

MD 1624

Hysteresis, variable message function				
Standard value	Lower input limit	Upper input limit	Units	Effective
000000	**000000**	**FFFFFF**	**Hex**	**Immediate**

Function:

Enter the hysteresis (tolerance bandwidth) for the address of the memory location entered in MD 1622 (address, variable message function) which is to be monitored using the variable message function. The actual value to be monitored is obtained together with MD 1623 (threshold, variable message function).

Note:

The numerical value entered in MD 1624 is interpretted as a function of MD 1620 (variable message function bits) without sign (bit 2 = 0) or with sign (bit 2 = 1).

MD 1625

Pull-in delay, variable message function				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**10 000**	**ms**	**Immediate**

Function:

Enter the pull-in delay time to set the signal if the threshold is exceeded (with hysteresis).

Note:

A time monitoring function which is already running is influenced when machine data MD 1625 and MD 1626 are changed (drop-out delay, variable message function). The monitoring function is initialized with the newly entered times.

MD 1626

Drop-out delay, variable message function				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**10 000**	**ms**	**Immediate**

Function:

Enter the drop-out delay time to reset the message, if the threshold (with hysteresis) if fallen below.

Note:

An already running time monitoring function is influenced when machine data MD 1625 (pull-in delay, variable message function) and MD 1626 are changed. The monitoring function is initialized with the newly-entered times.

4 Measuring system data

Overview

The following machine data include specific motor encoder parameters:

– MD 1005 (encoder pulse number, motor measuring system)
– MD 1007 (encoder pulse number, direct measuring system)
– MD 1008 (encoder phase error correction)
– MD 1011 (configuration, actual value sensing, motor measuring system)
– MD 1021 (multi-turn resolution, motor absolute value encoder)
– MD 1022 (measuring steps of the motor absolute track)
– MD 1023 (measuring circuit, motor absolute track)
– MD 1030 (configuration, actual value sensing, direct measuring system)
– MD 1031 (multi-turn resolution, absolute value encoder, direct measuring system)
– MD 1032 (measuring steps of the absolute track, direct measuring system)
– MD 1033 (direct measuring circuit, absolute track)
– MD 1790 (measuring circuit type, indirect measuring system)
– MD 1791 (measuring circuit type, direct measuring system)

MD 1005

Encoder pulse number, motor measuring system				
Standard value	Lower input limit	Upper input limit	Units	Effective
2 048	**128**	**8 192**	**Incr/rev**	**Power On**

Function:
Enter the encoder increments per motor revolution of the motor measuring system.

Note:

The indirect measuring system must always be configured.

MD 1007

Encoder pulse number, direct measuring system				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**65 535**	**Incr/rev, Incr/mm**	**Power On**

Function:

Enter the encoder increments per revolution for a linear or a rotary direct measuring system.

Note:

A 0 in the display indicates that a direct measuring system is not available.

MD 1008

Encoding phase error correction				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**-20.0**	**20.0**	**Degree**	**Immediate**

Function:

This machine data is used to compensate phase errors. Phase errors can occur between the A- and B tracks of raw signal encoders (e. g. ERN 1387). They are noticeable as the speed actual value is more noisy, i. e. double the encoder pulse frequency is superimposed on the actual value. Especially for toothed-wheel encoders, phase errors can occur which can even effect the control quality (acoustic).

Note:

This machine data is activated with bit 1 of the MD 1011 (configuration, actual value sensing, motor measuring system).

MD 1011

Configuration, actual value sensing, motor measuring system				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Power On**

Function:

Enter the configuration for actual value functions referred to the SIMODRIVE 611 D system.
Value table:

Bit	Function	Value
0	Actual value inversion (change is not permissible for MCU)	0 (**off**) = not active
1	Phase error correction	0 (**off**) = not active 1 (on) = active
2	Reserved	—
3	Incremental encoder Absolute value encoder with EnDat interface	= (**off**) 0 = (on) 1
4	Rotary measuring system Linear measuring system	= (**off**) 0 = (on) 1
5	Motor measuring system available	0 (**yes**) = yes 1 (no) = no
6-15	Not assigned	—

MD 1021

Multi-turn resolution, motor absolute value encoder				
Standard value	Lower input limit	Upper input limit	Units	Effective
4 096	**0**	**4 096**	**—**	**Power On**

Function:

Number of revolutions of the motor measuring system absolute value encoder which can be displayed. The value can only be read (measuring range).

MD 1022

Measuring steps, motor absolute track				
Standard value	Lower input limit	Upper input limit	Units	Effective
8 192	**512**	**32 768**	**—**	**Power On**

Function:

Number of measuring steps per mechanical revolution when the absolute position value of the motor measuring system is serially transferred. The value can only be read (resolution).

MD 1023

Measuring circuit, motor absolute track				
Standard value	unt. Ausgabegrenze	ob. Ausgabegrenze	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Power On**

Diagnostics, absolute value encoder, motor measuring system.

Bit	Fault	Recommended counter-measure
0	Opto system failed	Replace encoder
1	Signal amplitude too low	Replace encoder
2	Code connection erroneous	Replace encoder
3	Overvoltage	Power-down/power-up, replace encoder
4	Undervoltage	Power-down/power-up, replace encoder
5	Overcurrent	Power-down/power-up, replace encoder
6	Battery change required	Change battery
7, 8, 14	Reserved	—
9	Defective C/D track for ERN 1387 encoders	Power-down/power-up, replace encoder
10	Protocol cannot be interrupted	Power-down/power-up, replace encoder
11	SSI signal level identified at the data line	Check the encoder type, replace the hardware
12	Read TIMEOUT for measured value	Repeat, replace the hardware

13	CRC error	Replace the hardware
15	Defective measuring encoder	Replace the encoder

MD 1030

Configuration, actual value sensing, direct measuring system				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Power On**

Function:

Enter the configuration for the actual value functions referred to the SIMODRIVE 611 D system, direct measuring system.

Bit	Criterium	Value
0-2, 5-15	Not assigned	—
3	Encoder type	0 (**off**) = incremental encoder 1 (on) = absolute encoder with EnDat interface
4	Mechanical design of the measuring system	0 (**off**) = rotary measuring system 1 (on) = linear measuring system

MD 1031

Multi-turn resolution, absolute value encoder, direct measuring system				
Standard value	Lower input limit	Upper input limit	Units	Effective
4 096	**0000**	**4 096**	**—**	**Power On**

Function:

Number of revolutions of the absolute encoder, direct measuring system which can be represented. The value can only be read. (measuring range)

MD 1032

Measuring steps of the absolute track, direct measuring system				
Standard value	unt. Ausgabegrenze	ob. Ausgabegrenze	Units	Effective
8 192	**0**	**8 192**	**—**	**Power On**

Function:

Number of measuring steps per revolution when the absolute position value, direct measuring system is serially transferred. The value can only be read. (resolution)

MD 1033

Direct measuring circuit, absolute track				
Standard value	unt. Ausgabegrenze	ob. Ausgabegrenze	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Power On**

Diagnostics, absolute value encoder, motor measuring system.

Bit	Error/fault	Recommended counter-measure
0	Opto system failed	Replace encoder
1	Signal amplitude too low	Replace encoder
2	Code connection erroneous	Replace encoder
3	Overvoltage	Power-down/power-up, replace encoder
4	Undervoltage	Power-down/power-up, replace encoder
5	Overcurrent	Power-down/power-up, replace encoder
6	Battery change required	Change battery
7, 8, 9, 14	Reserved	—
10	Protocol cannot be interrupted	Power-down/power-up, replace encoder
11	SSI signal level identified at the data line	Check the encoder type, replace the hardware
12	Read TIMEOUT for measured value	Repeat, replace the hardware
13	CRC error	Replace the hardware
15	Defective measuring encoder	Replace the encoder

MD 1790

Measuring circuit type, indirect measuring system				
Standard value	unt. Ausgabegrenze	ob. Ausgabegrenze	Units	Effective
0	**0**	**32 767**	**—**	**Immediate**

Function:

This machine data shows the measuring circuit code number of the indirect measuring system (motor). Value table:

0	Raw voltage signals
1-7	Reserved

MD 1791

Measuring circuit type, direct measuring system				
Standard value	unt. Ausgabegrenze	ob. Ausgabegrenze	Units	Effective
0	**0**	**32 767**	**—**	**Immediate**

Function:

This machine data indicates the measuring circuit code number of the direct measuring system if it is inserted. Value table:

-1	Measuring system not available
0	Raw voltage signals
1	Raw current signals (not for MCU)
2-7	Reserved

5 SIMODRIVE controller data

Contents

5.1 Speed controller

MD 1407

P gain, speed controller				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.3	**0.0**	**100 000.0**	**Nm*s/rad**	**Immediate**

Function:

Enter the P gain of the speed control loop in the lower speed range (n < lower adaption speed MD 1411) or automatic parameterization (initialization via the **calculate contr. MD** function. The gains in the lower speed range (MD 1407) and in the upper speed range (MD 1408) are not mutually restricted.

Note:

- Before entering a P gain of 0, the associated integral component (MD 1409) must be inactivated due to controller stability.
- MD 1407 is active over the complete speed range when speed controller adaption has been cancelled (MD 1413 = 0).

MD 1409

Integral action time, speed controller				
Standard value	Lower input limit	Upper input limit	Units	Effective
10.0	**0.0**	**2 000.0**	**ms**	**Immediate**

Function:

Enter the integral action time of the speed control loop in the lower speed range (n < lower adaption speed- MD 1411) or automatic parameterization (initialized via the **calculate contr. MD** function. The integral action times in the lower speed range (MD 1409) and in the upper speed range (MD 1410) are not mutually restricted.

Note:

- When 0 is entered for the integral action time, the I component for the speed range is disabled (the integral gain and the integrator contents are deleted, i. e. torque jumps cannot be excluded (also refer to the information in MD 1410).
- When the speed controller adaption (MD 1413 = 0) is cancelled, MD 1409 is active over the complete speed range.
- If the adaption is activated, the integral component should not be deactivated for only one speed range (MD 1409 = 0 and MD 1410 ≠ 0 or vice versa) (otherwise a problem could develop due to torque jumps when the integral value is reset at the transition from the adaption- to the constant range).

MD 1421

Time constant, integrator feedback				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**1 000.0**	**ms**	**Immediate**

Function:

The integrator of the speed controller loop is reduced to a low-pass 1st order characteristic with the configured time constant via a weighted feedback.

Effect:

The output of the speed controller integrator is limited to a value proportional to the setpoint-actual value difference (steady-state proportional behavior).

Applications:

- Motion at zero position reference value and dominant stiction can be suppressed (however a position reference value-actual value difference remains).
- Preventing tension for axes or spindles which are rigidly mechanically coupled (synchronous spindle).

Note:

The integrator feedback becomes active above MD 1421 ≥ 1.0.

5.2 Speed setpoint filter

MD 1500

No. of speed setpoint filters				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**2**	**—**	**Immediate**

Cross-reference: DB1000, DS8, No. 20200.11

Function:

Enter the number of speed setpoint filters. Bandstop and low-pass filters (PT2/PT1) can be selected which are set via the machine data type speed setpoint filter (MD 1501).

Selecting the number of filters:

0	No speed setpoint filters active
1	Filter 1 active
2	Filters 1 and 2 active

Note:

- If filter 1 is parameterized as bandstop filter, this can be switched via the user program (control word 1, data set 8).
- Before activating the filter, the filter type as well as the appropriate filter machine data must be assigned.

MD 1501

Speed setpoint filter type				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**0303**	**Hex**	**Immediate**

Function:

Enter the configuration of the 2 speed setpoint filters. Bandstop and low-pass filters can be selected (PT2 or PT1). The filter parameters which can be set are entered in the associated machine data.

Applications:

- The »bandstop« speed setpoint filter type is used to dampen axis-specific resonant frequencies in the position control loop.

  Depending on the particular requirement, the »bandstop« function can be set in three configurations:
  - basic bandstop, MD 1514/MD 1517 and MD 1515/MD 1518
  - bandstop with adjustable damping of the amplitude characteristics, in addition to MD 1516/MD 1519
  - bandstop with adjustable damping of the amplitude characteristic and increase or decrease of the amplitude characteristic after the block frequency, additionally MD 1520/MD 1521
- interpolation with speed setpoint steps - the speed setpoints are output in the position controller clock cycle which can be select far higher than the speed controller clock cycle (low-pass).

Low-pass/bandstop	1st filter, bit 0	0	Low-pass (refer to MD 1502/1506/1507)
		1	Bandstop (refer to MD 1514/1515/1516/1520)
	2nd filter, bit 1	0	Low-pass (refer to MD 1502/1508/1509)
		1	Bandstop (refer to MD 1517/1518/1519/1521)
PT2/PT1 for low-pass	1st filter, bit 8	0	PT2 low-pass (refer to MD 1506/1507)
		1	PT1 low-pass (refer to MD 1502)
	2nd filter, bit 9	0	PT2 low-pass (refer to MD 1508/1509)
		1	PT1 low-pass (refer to MD 1503)

Note:

Before configuring the filter type, the appropriate filter machine data must be assigned.

MD 1502

Time constant, speed setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**500.0**	**ms**	**Immediate**

Function:

Enter the time constant for the speed setpoint filter 1 (PT1 low-pass). The filter is de-activated when a 0 is entered.

MD 1503

Time constant, speed setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**500.0**	**ms**	**Immediate**

Function:
Enter the time constant for the speed setpoint filter 2 (PT1 low-pass). The filter is de-activated when a 0 is entered.

MD 1506

Natural frequency, speed setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
2 000.0	**10.0**	**8 000.0**	**Hz**	**Immediate**

Function:

Enter the natural frequency for the speed setpoint filter 1 (PT2 low-pass). An entry with a value < 10 Hz for the natural frequency of the low-pass filter initializes the filter independently of the associated damping as proportional element with gain 1. The filter is activated via MD 1500 (number of speed setpoint filters) and MD 1501 (speed setpoint filter type).

MD 1507

Damping, speed setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.2**	**5.0**	**—**	**Immediate**

Function:

Enter the damping for speed setpoint filter 1 (PT2 low-pass). The filter is activated via MD 1500 (number of speed setpoint filters) and MD 1501 (speed setpoint filter type).

MD 1508

Natural frequency, speed setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
2 000.0	**10.0**	**8 000.0**	**Hz**	**Immediate**

Function:

Enter the natural frequency for speed setpoint filter 2 (PT2 low-pass). An entry < 10 Hz for the natural frequency of the low-pass filter initializes the filter independently of the associated damping as proportional element with gain 1. The filter is activated via MD 1500 (number of speed setpoint filters) and MD 1501 (speed setpoint filter type).

MD 1509

Damping, speed setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.7	**0.2**	**5.0**	**—**	**Immediate**

Function:

Enter the damping for speed setpoint filter 2 (PT2 low-pass). The filter is activated via MD 1500 (number of speed setpoint filters) and MD 1501 (speed setpoint filter type).

MD 1514

Block frequency, speed setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
3 500.0	**1.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the block frequency for speed setpoint filter 1 and parameterize as basic bandstop filter. The filter is activated via MD 1500 (number of setpoint filters) and MD 1501 (speed setpoint filter type). MD 1516/MD 1519 (bandwidth numerator, speed setpoint filter) and MD 1520/MD 1521 (bandstop natural frequency, speed setpoint filter) keep their standard values.

Formula:

$$H(s) = \frac{1 + s(2\pi f_{bz} / (2\pi \cdot f_z)^2) + s^2 \cdot 1 / (2\pi f_z)^2}{1 + s(2\pi f_{bn} / (2\pi f_n)^2) + s^2 \cdot 1 / (2\pi f_n)^2}$$

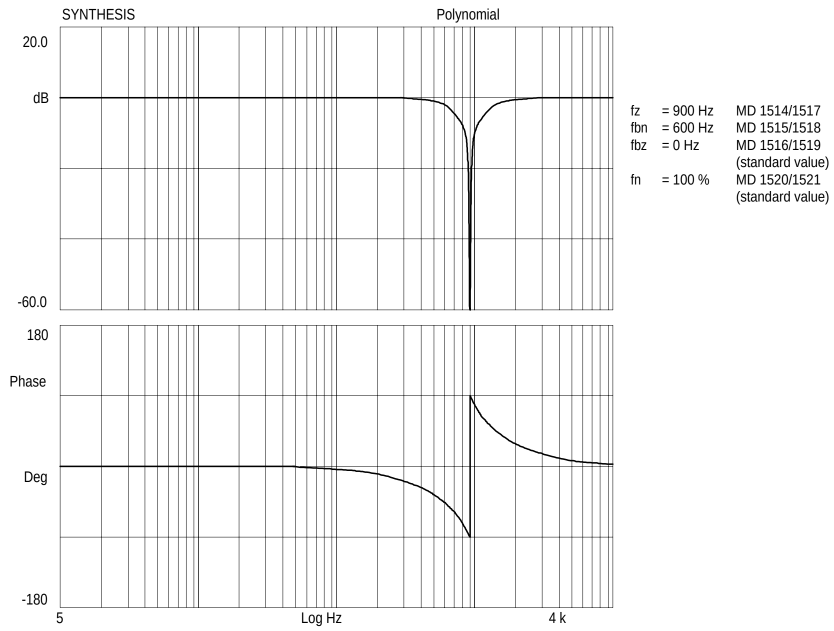
Enter:

f_z = MD 1514/1517	block frequency, speed setpoint 1/speed setpoint 2 [Hz], (resonance position)
f_{bn} = MD 1515/1518	bandwidth denominator, speed setpoint 1/speed setpoint 2 [Hz]
f_{bz} = MD 1516/1519	bandwidth numerator, speed setpoint 1/speed setpoint 2 [Hz]
f_n = MD 1520/1521	bandstop, natural frequency, speed setpoint 1/speed setp. 2 [%] percentage referred to MD 1514 or MD 1517

$$f_n = \frac{\text{MD 1520 (MD 1521)}}{100} \times \text{MD 1514 (MD 1517)} \ [\%]$$

Note:

When entering the block frequency, the upper value is limited due to the sampling frequency of the control (MD 1001) (parameterizing error).



MD 1515

Bandwidth, speed setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
500.0	**5.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the -3dB bandwidth for speed setpoint filter 1 (bandstop). The filter is activated via MD 1500 (number of speed setpoint filters) and MD 1501 (speed setpoint filter type).

Note:

When a 0 is entered for the bandwidth, the filter is parameterized as proportional element with gain 1.

MD 1516

Numerator, bandwidth, speed setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the numerator bandwidth for the damped bandstop filter. The ratio between the bandwidth numerator to the bandwidth denominator defines how significantly the amplitude decreases at the block frequency. For $f_{bz} < f_{bn}$, the amplitude is reduced. It is also conceivable that $f_{bz} > f_{bn}$, in which case the amplitude would be increased. However, this is not realistic, as this would result in a increase in the frequency characteristic and would therefore cause the controller to oscillate.

For $f_{bz} = f_{bn}$, the amplitude remains constant over the complete frequency range.

Formula:

$$\frac{1+s(2\pi f_{bz} / (2\pi \cdot f_z)^2) + s^2 \cdot (1/(2\pi f_z)^2)}{1+s(2\pi f_{bn} / (2\pi f_z)^2) + s^2 (1/(2\pi f_n)^2)} \equiv \frac{1+s(2(D_z/2)\pi f_z) + s^2 \cdot 1/(2\pi f_z)^2}{1+s(2(D_n/2)\pi f_z) + s^2 1/(2\pi f_n)^2}$$

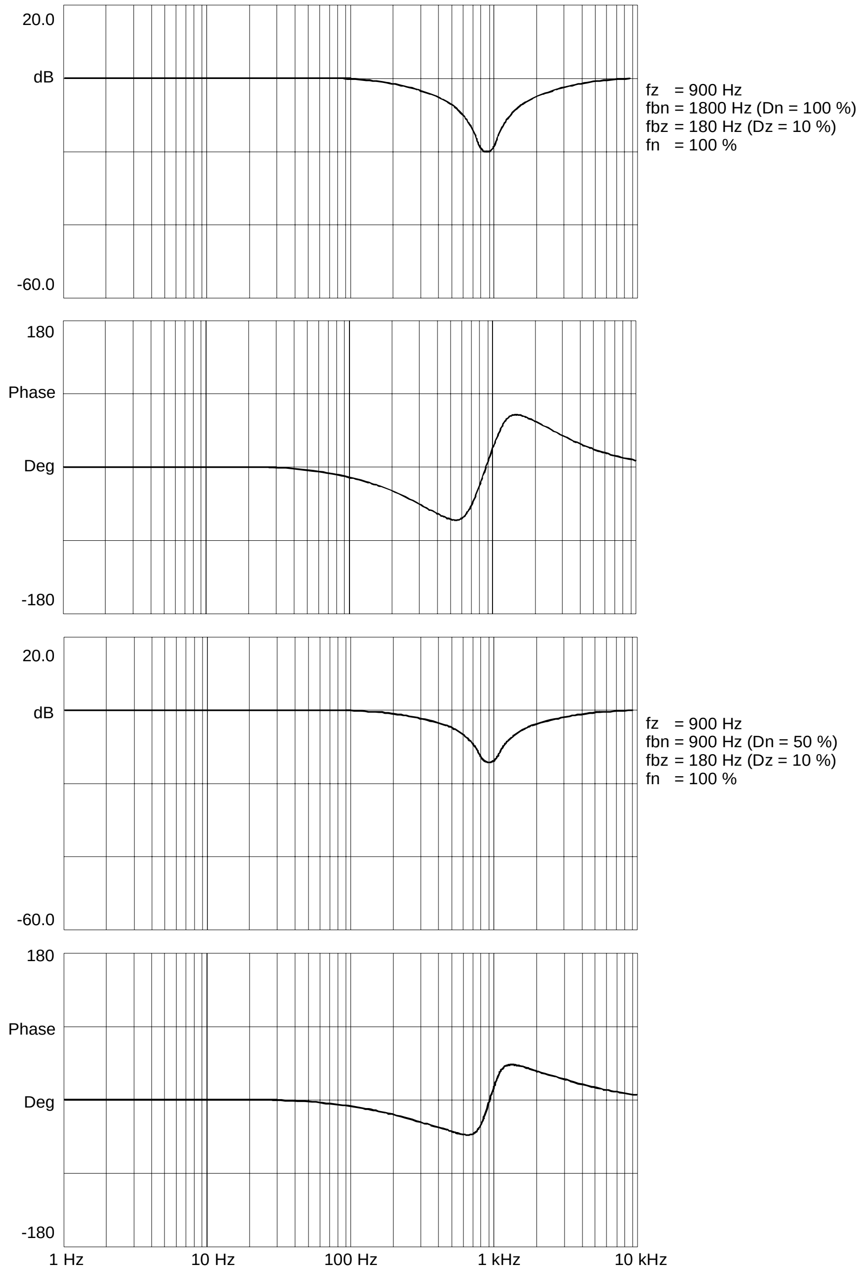
Input:

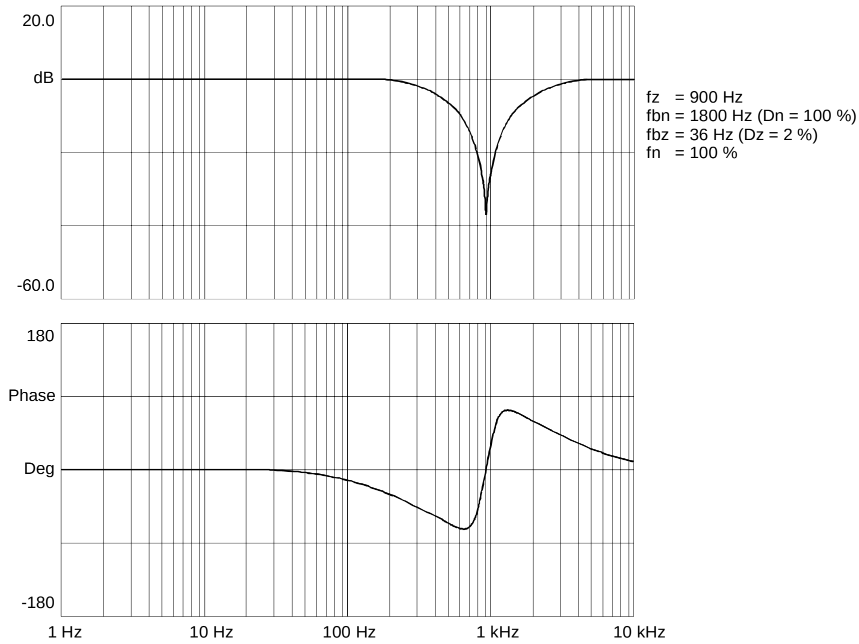
f_z	block frequency	MD 1514/1517
D_z	damping, numerator	
$f_{bz} = 2 \times D_z \times f_z$	bandwidth, numerator	MD 1515/1518
D_n = MD 1520/1521	damping, denominator	
$f_{bz} = 2 \times D_n \times f_n$	bandwidth, denominator	MD 1516/1519
f_n = 100 %	BSP natural frequency	MD 1520/1521 (standard value)

Note:

The value in MD 1516 (bandwidth numerator, speed setpoint filter 1) may only be a maximum of twice that in MD 1515 (bandwidth, speed setpoint filter 1).

Example:


20.0
dB
-60.0
fz = 900 Hz
fbn = 1800 Hz (Dn = 100 %)
fbz = 180 Hz (Dz = 10 %)
fn = 100 %
180
Phase
Deg
-180
20.0
dB
-60.0
fz = 900 Hz
fbn = 900 Hz (Dn = 50 %)
fbz = 180 Hz (Dz = 10 %)
fn = 100 %
180
Phase
Deg
-180
1 Hz
10 Hz
100 Hz
1 kHz
10 kHz



MD 1517

Block frequency, speed setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
3 500.0	**1.0**	**7 999.0**	**Hz**	**Immediate**

Function:

The description of this machine data is identical with that for MD 1514.

MD 1518

Bandwidth, speed setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
500.0	**5.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the 3dB bandwidth for speed setpoint filter 2 (bandstop). The filter is activated via MD 1500 (number of speed setpoint filters) and MD 1501 (speed setpoint filter type).

Note:

If 0 is entered for the bandwidth, the filter is parameterized as proportional element with gain 1.

MD 1519

Numerator, bandwidth, speed setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**7 999.0**	**Hz**	**Immediate**

Function:

The description of this machine data is identical with that of MD 1516.

MD 1520

Bandstop, natural frequency, speed setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
100	**1**	**141**	**%**	**Immediate**

Function:

Enter the bandstop natural frequency to increase or decrease the amplitude characteristic after the block frequency (MD 1514/MD 1517).

MD 1520 and MD 1521 are used to harmonize different axis dynamic characteristics to provide a unified dynamic performance (low-pass). The unified dynamic performance is oriented to the axis with the lowest resonant frequency.

Formula:

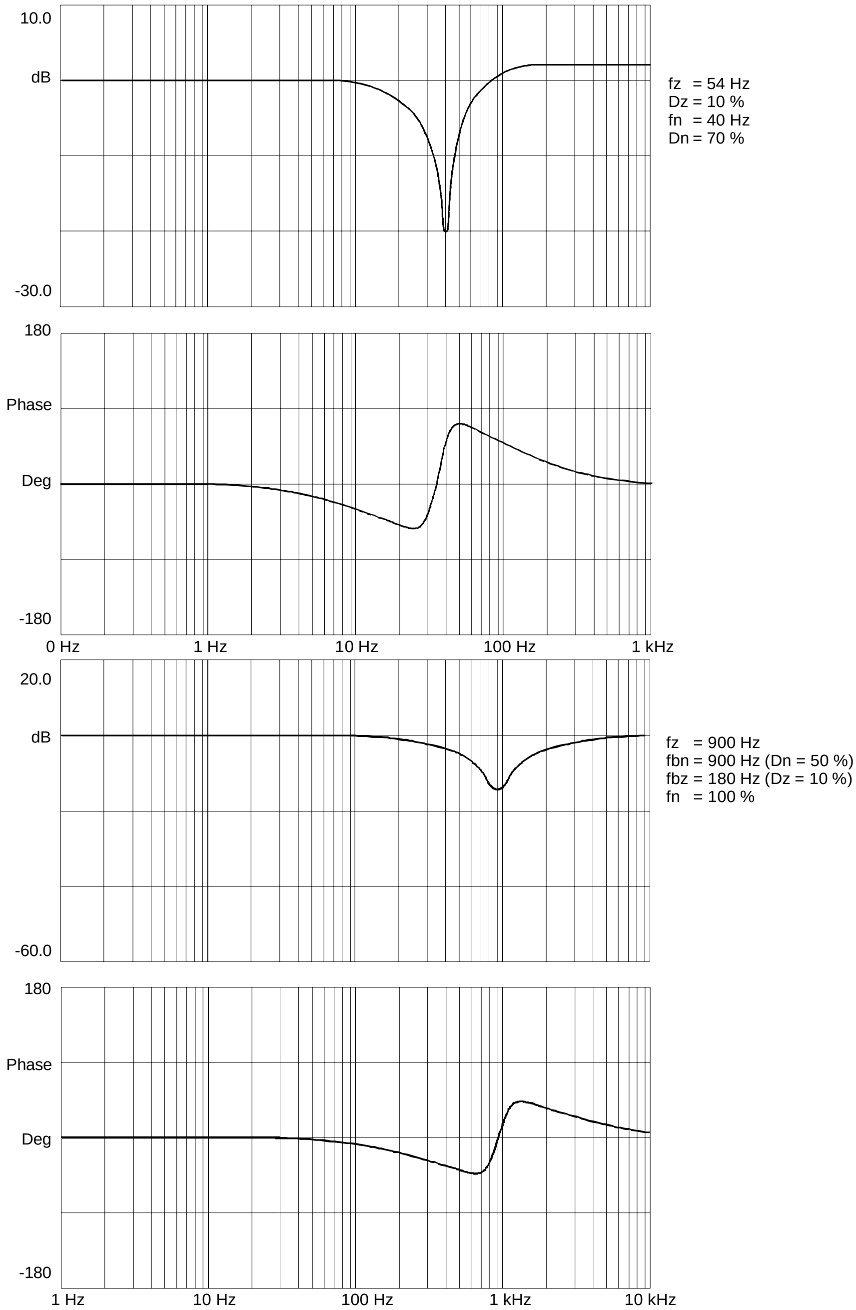
$$\frac{1+s(2\pi f_{bz}/(2\pi \cdot f_z)^2)+s^2\cdot(1/(2\pi f_z)^2)}{1+s(2\pi f_{bn}/(2\pi f_n)^2)+s^2(1/(2\pi f_n)^2)} \equiv \frac{1+s(2(D_z/2)\pi f_z)+s^2\cdot 1/(2\pi f_z)^2}{1+s(2(D_n/2)\pi f_z)+s^2 1/(2\pi f_n)^2}$$

Input:

f_z	block frequency	MD 1514/1517
D_z	damping, numerator	
$f_{bz} = 2 \times D_z \times f_z$	bandwidth, numerator	MD 1515/1518
D_n = MD 1520/1521	damping, denominator	
$f_{bz} = 2 \times D_n \times f_n$	bandwidth, denominator	MD 1516/1519

f_n = MD 1520 [%] $\times$ f_z bandstop natural frequency MD 1520/1521 (standard value)

Example:



MD 1521

Bandstop, natural frequency, speed setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
100	**1**	**141**	**%**	**Immediate**

Function:
The description of this machine data is identical with that of MD 1520.

5.3 Speed controller adaption

MD 1408

P gain, upper adaption speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.3	**0.0**	**100 000.0**	**Nm*s/rad**	**Immediate**

Function:

Enter the P gain of the speed controller loop in the upper speed range (n > upper adaption speed - MD 1412) or automatic parameterization (initialization) using the **calculate contr. MD** function. The gains in the lower speed range (MD 1407) and in the upper speed range (MD 1408) are not mutually restricted.

Note:

- Before entering a P gain of 0, the associated integral component (MD 1410) must be de-activated due to controller stability.
- MD 1408 is not active when speed controller adaption is cancelled (MD 1413 = 0).

MD 1410

Integral action time, upper adaption speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
10.0	**0.0**	**2 000.0**	**ms**	**Immediate**

Function:

Enter the speed control loop integral action time in the upper speed range (n > upper speed threshold MD 1412). The integral action times in the lower speed range (MD 1409) and in the upper speed range (MD 1410) are not subject to any mutual restriction.

Note:

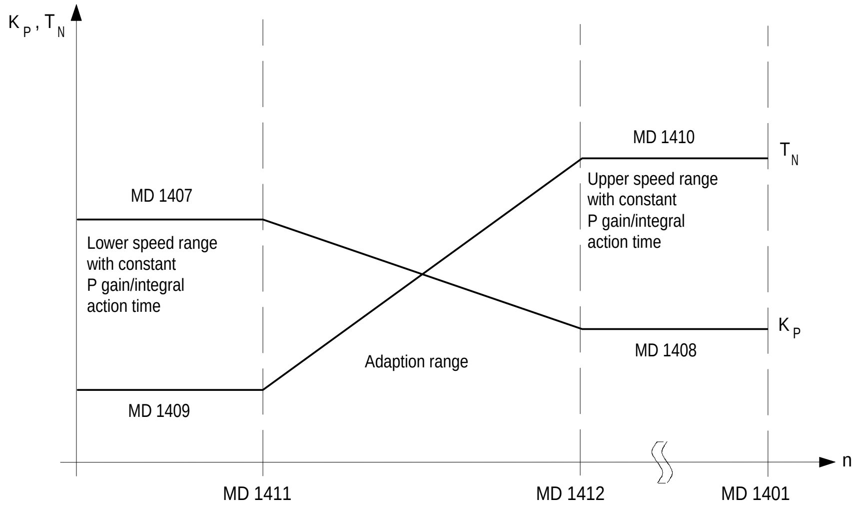
- When an integral action time of 0 is entered, this de-activates the integral component for the range, which is greater than MD 1412 (adaption, upper speed threshold) (also refer to the information in MD 1409).
- MD 1410 is not active when speed adaption is cancelled (MD 1413 = 0).
- When the adaption is active, the integral component should not be de-activated for one speed range (MD 1409 = 0 and MD 1410 ≠ 0 or vice versa) (problem: Torque jumps could occur when resetting the integral value at the transition from the adaption- to the constant range).

MD 1411

Lower adaption speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Function:

Enter the lower speed threshold to adapt the speed controller machine data. When the adaption is active, for speeds n < MD 1411, the controller data MD 1407 and MD 1409 are active. A linear interpolation is made between the two controller data sets in the adaption range MD 1411 < n < MD 1412.



MD 1412

Upper adaption speed				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Function:

Enter the upper speed threshold to adapt the speed controller machine data. When adaption is active, for speeds n > MD 1412, controller data MD 1408 and MD 1410 are active. A linear interpolation is made between the two controller data sets in the center range MD 1411 < n < MD 1412.

MD 1413

Select speed controller adaption				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**1**	**—**	**Immediate**

Function:

This machine data can be used to adapt the speed controller machine data as a function of the speed.

0: Adaption is not active. The settings of controller data MD 1407 and MD 1409 are valid over the complete speed range. Control data MD 1408 and MD 1410 are not taken into account.

1: Adaption is active. For a description refer to machine data MD 1411 and MD 1412.

5.4 Reference model, speed control loop

MD 1414

Natural frequency, speed reference model				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**8 000.0**	**Hz**	**Immediate**

Function:

Enter the natural frequency for the speed control loop reference model. The filter is de-activated when a value < 10 Hz is entered (proportional element with a gain of 1).

MD 1415

Damping, speed reference model				
Standard value	Lower input limit	Upper input limit	Units	Effective
1.0	**0.5**	**5.0**	**—**	**Immediate**

Function:

Enter the damping for the speed control loop reference model. It involves a reference model (PT2) for the speed control loop for a PIR controller type. The damping increases with increasing value (value which is entered).

MD 1416

Balancing, speed reference model				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**1.0**	**—**	**Immediate**

Function:

Enter the balancing possibility for the reference model, speed control loop. This machine data simulates the computation deadtime of the speed control loop. The simulation is in this case calculated as an approximation of an interrupted deadtime. Thus, the characteristics of the reference model can be adapted to the loop characteristics of the P-control speed control loop.

5.5 Current controller

MD 1120

P gain, current controller				
Standard value	Lower input limit	Upper input limit	Units	Effective
10.0	**0.0**	**10 000.0**	**V/A**	**Immediate**

Function:

Enter the proportional gain of the current controller or automatic parameterization (initialization) via **calculate contr. MD**.

MD 1121

Integral action time, current controller				
Standard value	Lower input limit	Upper input limit	Units	Effective
2 000.0	**0.0**	**8 000.0**	**µs**	**Immediate**

Function:

Enter the »current controller integral action time« or automatic parameterization (initialization) via **calculate contr. MD**.

Note:

It is possible to disable the integral component by entering $T_N = 0$.

5.6 Current setpoint filter

MD 1200

Number of current setpoint filters				
Standard value	Lower input limit	Upper input limit	Units	Effective
1	**0**	**4**	**—**	**Immediate**

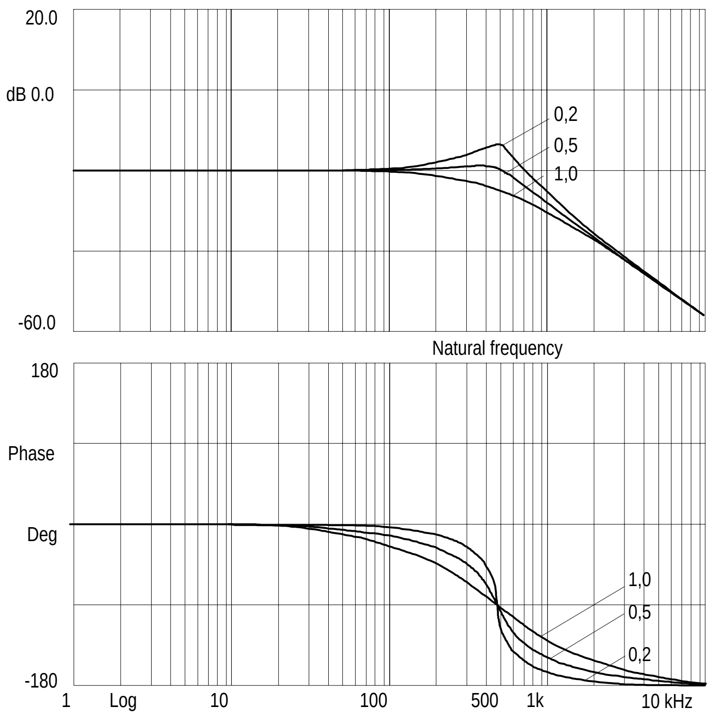
Function:
Enter the number of current setpoint filters. Bandstop and low-pass filters are available which can be set via the machine data MD 1201 (current setpoint filter type). Selecting the number of filters:

0	No current setpoint filter active
1	Filter 1 active
2	Filters 1 and 2 active
3	Filters 1, 2 and 3 active
4	Filters 1, 2, 3 and 4 active

Note:
Before activating the filter, the filter type as well as the appropriate filter machine data must be assigned.

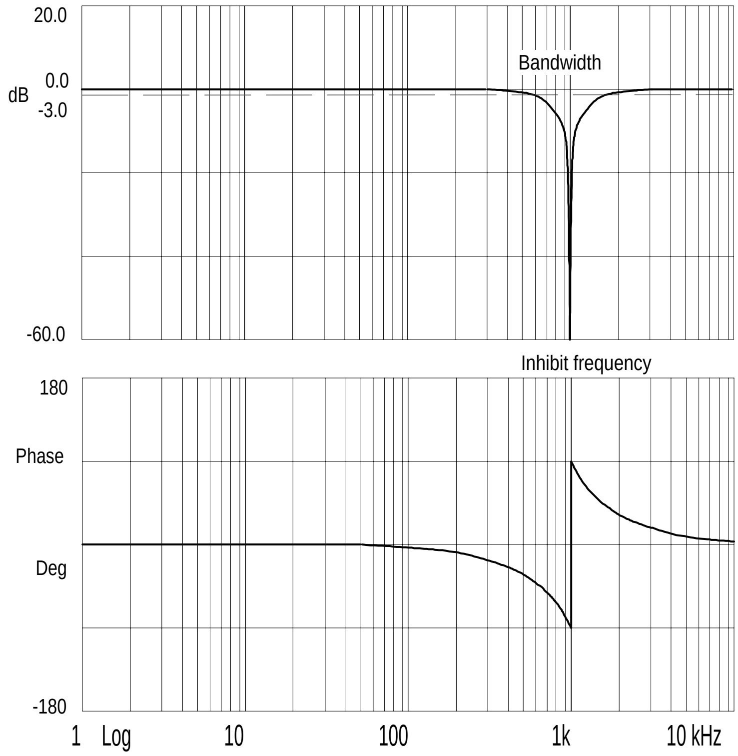
Example, low-pass filter:
Low-pass filters and bandstop filters are used when damping resonance effects above or at the stability limit of the speed control loop.

Input: 500 Hz natural frequency with 20%, 50% and 100% damping.

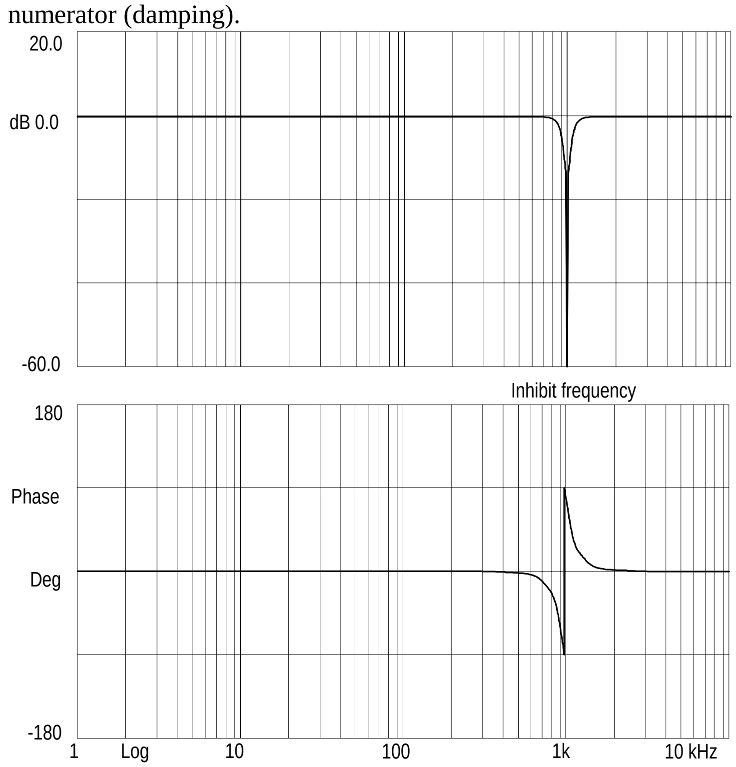


Example, bandstop filter:

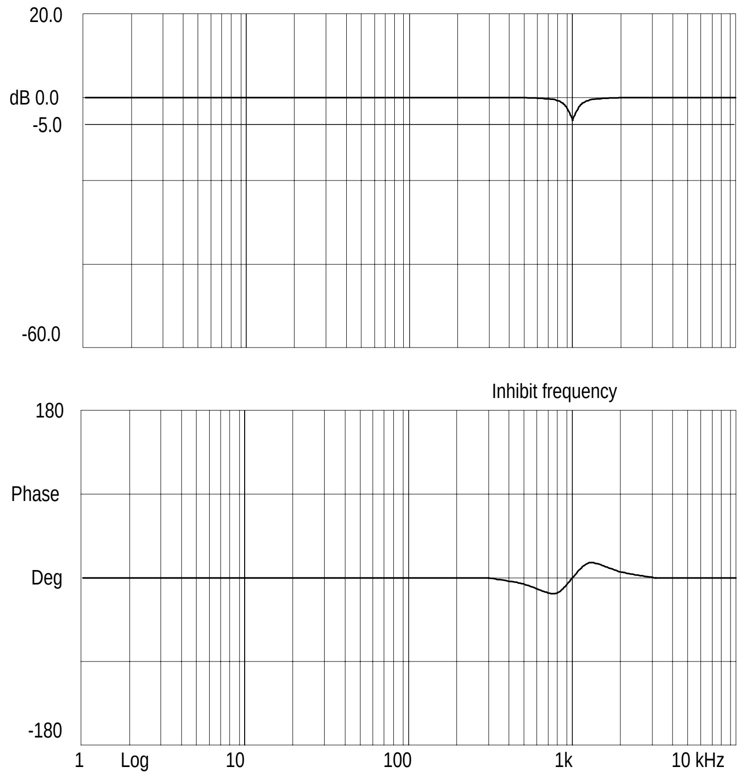
Input: 1 kHz block frequency with 1 kHz bandwidth, 0 Hz bandwidth numerator (damping).



Input: 1 kHz block frequency with 500 Hz bandwidth, 0 Hz bandwidth numerator (damping).



Input: 1 kHz block frequency with 500 Hz bandwidth, 0 Hz bandwidth numerator (damping).



MD 1201

Current setpoint filter type				
Standard value	Lower input limit	Upper input limit	Units	Effective
Low-pass	**Low-pass**	**Bandstop**	**—**	**Immediate**

Function:
Enter the configuration of 4 current setpoint filters. Bandstop- and low-pass filters are available. The filter parameters which can be set are entered in the associated machine data. Value table:

1st filter	Bit 0	0	Low-pass (refer to MD 1202/1203)
		1	Bandstop (refer to MD 1210/1211/1212)
2nd filter	Bit 1	0	Low-pass (refer to MD 1204/1205)
		1	Bandstop (refer to MD 1213/1214/1215)
3rd filter	Bit 2	0	Low-pass (refer to MD 1206/1207)
		1	Bandstop (refer to MD 1216/1217/1218)
4th filter	Bit 3	0	Low-pass (refer to MD 1208/1209)
		1	Bandstop (refer to MD 1219/1220/1221)

Note:
Before configuring the filter type, the appropriate filter machine data must be assigned.

MD 1202

Natural frequency, current setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
2 000.0	**0.0**	**8 000.0**	**Hz**	**Immediate**

Function:

Enter the natural frequency for current setpoint filter 1 (PT2 low-pass filter). If a value < 10 Hz for the natural frequency of the low-pass filter is entered, the filter is initialized independently of the associated damping, as potential equalization element with a gain of 1. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

Current setpoint filter 1 is pre-assigned to dampen the natural encoder torsional frequency for a current controller sampling time MD 1000 = 125 µs. For a current controller sampling time MD 1000 = 62,5 µs, it is recommended that the natural frequency is changed to f_0 = 3000 Hz so that the control dynamic performance can be optimally utilized.

MD 1203

Damping, current setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.7	**0.05**	**5.0**	**—**	**Immediate**

Function:

Enter the damping for current setpoint filter 1 (PT2 low-pass filter). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

0.7 corresponds to 70 %
1.0 corresponds to 100 %

MD 1204

Natural frequency, current setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**8 000.0**	**Hz**	**Immediate**

Function:

Enter the natural frequency for current setpoint filter 2 (PT2 low-pass filter). If a value < 10 Hz for the natural frequency of the low-pass filter, the filter is initialized independently of the associated damping, as proportional equalization element with a gain of 1. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

MD 1205

Damping, current setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
1.0	**0.05**	**5.0**	**—**	**Immediate**

Function:

Enter the damping for current setpoint filter 2 (PT2 low-pass filter). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

MD 1206

Natural frequency, current setpoint filter 3				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**8 000.0**	**Hz**	**Immediate**

Function:

Enter the natural frequency for current setpoint filter 3 (PT2 low-pass filter). If a value < 10 Hz for the natural frequency of the low-pass filter, the filter is initialized independently of the associated damping, as proportional element with a gain of 1. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

MD 1207

Damping, current setpoint filter 3				
Standard value	Lower input limit	Upper input limit	Units	Effective
1.0	**0.05**	**5.0**	**—**	**Immediate**

Function:

Enter the damping for current setpoint filter 3 (PT2 low-pass filter). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

MD 1208

Natural frequency, current setpoint filter 4				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**8 000.0**	**Hz**	**Immediate**

Function:

Enter the natural frequency for current setpoint filter 4 (PT2 low-pass filter). If a value < 10 Hz for the natural frequency of the low-pass filter, the filter is initialized independently of the associated damping, as proportional element with a gain of 1. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

MD 1209

Damping, current setpoint filter 4				
Standard value	Lower input limit	Upper input limit	Units	Effective
1.0	**0.05**	**5.0**	**—**	**Immediate**

Function:

Enter the damping for current setpoint filter 4 (PT2 low-pass filter). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

MD 1210

Block frequency, current setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
3 500.0	**1.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the block frequency for current setpoint filter 1 (bandstop). When entering block frequencies < 10 Hz, the filter is de-activated (proportional element with a gain of 1). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

The maximum block frequency which can be entered is limited by the control sampling time (MD 1000) (parameterizing error).

MD 1211

Bandwidth, current setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
500.0	**5.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the -3dB bandwidth for current setpoint filter 1 (bandstop). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

When 0 is entered for the bandwidth, the filter is parameterized as proportional element with a gain of 1.

MD 1212

Numerator, bandwidth, current setpoint filter 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the numerator bandwidth for the damped bandstop. If 0 is entered, the filter is initialized as non-damped bandstop. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

The value of MD 1212 (bandwidth numerator, current setpoint filter 1) may only be a maximum of twice that of MD 1211 (bandwidth, current setpoint filter 1).

MD 1213

Block frequency, current setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
3 500.0	**1.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the block frequency for current setpoint filter 2 (bandstop). The filter is de-activated when block frequencies < 10 Hz are entered (proportional element with a gain of 1). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:
The maximum block frequency which can be entered is limited due to the control sampling frequency (MD 1000) (parameterizing error).

MD 1214

Bandwidth, current setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
500.0	**5.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the -3dB bandwidth for current setpoint filter 2 (bandstop). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

When a value of 0 is entered for the bandwidth, the filter is parameterized as proportional element with a gain of 1.

MD 1215

Numerator, bandwidth, current setpoint filter 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the numerator bandwidth for the damped bandstop. The filter is initialized as non-damped bandstop filter when a value of 0 is entered. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

The value of MD 1215 (bandwidth numerator, current setpoint filter 2) may be a maximum of twice that of MD 1214 (bandwidth, current setpoint filter 2).

MD 1216

Block frequency, current setpoint filter 3				
Standard value	Lower input limit	Upper input limit	Units	Effective
3 500.0	**1.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the block frequency for current setpoint filter 3 (bandstop). The filter is de-activated when block frequencies < 10 Hz are entered (proportional element with a gain of 1). The filter is activated via the machine data MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:
The maximum block frequency which can be entered is limited by the control sampling frequency (MD 1000) (parameterizing error).

MD 1217

Bandwidth, current setpoint filter 3				
Standard value	Lower input limit	Upper input limit	Units	Effective
500.0	**5.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the -3dB bandwidth for current setpoint filter 3 (bandstop). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

When 0 is entered for the bandwidth, the filter is parameterized as proportional element with a gain of 1.

MD 1218

Numerator, bandwidth, current setpoint filter 3				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the numerator bandwidth for the damped bandstop. When a value of 0 is entered, the filter is initialized as non-damped bandstop filter. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

The maximum value of MD 1218 (bandwidth numerator, current setpoint filter 3) may be twice as large as that of MD 1217 (bandwidth, current setpoint filter 3).

MD 1219

Block frequency, current setpoint filter 4				
Standard value	Lower input limit	Upper input limit	Units	Effective
3 500.0	**1.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the block frequency for current setpoint filter 4 (bandstop). When block frequencies < 10 Hz are entered, the filter is de-activated (proportional element with a gain of 1). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:
The maximum block frequency is limited by the control sampling frequency (MD 1000) (parameterizing error).

MD 1220

Bandwidth, current setpoint filter 4				
Standard value	Lower input limit	Upper input limit	Units	Effective
500.0	**5.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the -3dB bandwidth for current setpoint filter 4 (bandstop). The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

When a value of 0 is entered for the bandwidth, the filter is parameterized as proportional element with a gain of 1.

MD 1221

Numerator, bandwidth, current setpoint filter 4				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**7 999.0**	**Hz**	**Immediate**

Function:

Enter the numerator bandwidth for the damped bandstop. When a value of 0 is entered, the filter is initialized as non-damped bandstop filter. The filter is activated via MD 1200 (number of current setpoint filters) and MD 1201 (current setpoint filter type).

Note:

The maximum value of MD 1221 (bandwidth, numerator, current setpoint filter 4) may be twice as large as that of MD 1220 (bandwidth, current setpoint filter 4).

MD 1245

Threshold, speed-dependent torque setpoint smoothing				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**50 000.0**	**RPM**	**Immediate**

Function:

Enter the speed, above which the torque setpoint smoothing, switched-in with the 2nd order filter (low-pass/banstop filter) MD 1201 (current setpoint filter type) is activated. The user can reduce the speed ripple at higher speeds using this speed-dependent torque setpoint smoothing.

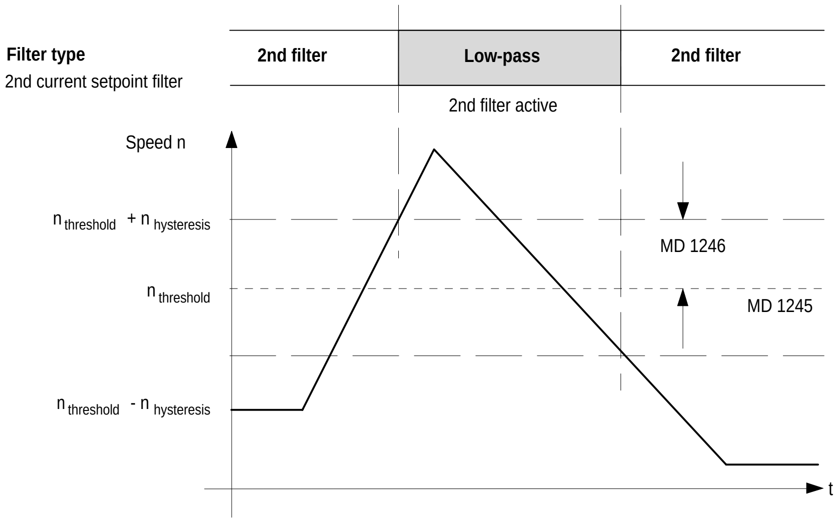
If a threshold value of 0 is entered, the filter remains active as low-pass filter over the complete speed range. If other values are entered, two changeover speeds are calculated from machine data MD 1245 (threshold, speed-dependent torque setpoint smoothing) and MD 1246 (hysteresis, speed-dependent torque setpoint smoothing):

$n_{top} = n_{threshold} + n_{hysteresis}$

$n_{bottom} = n_{threshold} - n_{hysteresis}$

Functionality:

The changeover from straight through to low-pass is realized if the absolute actual speed exceeds n_{top} ($|n_{act}| \geq n_{top}$). Vice versa, the filter changes over from low-pass to straight through if the absolute actual speed is less than n_{bottom} ($|n_{act}| < n_{bottom}$). Both changeover speeds are the same if a hysteresis of zero is selected.



MD 1246

Hysteresis, speed-dependent torque setpoint smoothing				
Standard value	Lower input limit	Upper input limit	Units	Effective
50.0	**0.0**	**1 000.0**	**RPM**	**Immediate**

Function:

Enter the hysteresis for the switched speed, set in MD 1245 (threshold, speed-dependent torque setpoint smoothing).

6 Status- and diagnostic data

Contents

6.1 MIN/MAX memory

MD 1650

Diagnostics control word				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

Select various diagnostic functions.
Value table:

Bit	Function	Value
0	Activate min/max memory	0 (**off**) = not active 1 (on) = active
1	Min/max memory segment	0 (**X:**) = DSP address name X 1 (Y:) = DSP address name Y
2	Comparison, signed	0 (**off**) = unsigned 1 (on) = signed

Information:

Bit 1 is only effective, if the signal number 0 is selected in MD 1651 (signal number, min/max memory).

- Diagnostic function, min/max memory
  This function allows the value range to be determined by moving a specific memory location over a longer period of time. The function runs in the current controller clock cycle (fastest clock cycle) in order to be able to reliably acquire all of the system quantities. The quantity to be monitored can either be selected by entering a signal number or by entering a physical address (refer to MD 1651).

  The value can be compared with the minimum- and the maximum value using either a signed or unsigned bit (bit 2).

  The corresponding machine data are:

  – diagnostics control (MD 1650 bit 0, 1, 2)
  – signal number, min/max memory (MD 1651)
  – memory location, min/max memory (MD 1652)
  – minimum value, min/max memory (MD 1653)
  – maximum value, min/max memory (MD 1654)

- This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1651

Signal number, min/max memory				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**100**	**—**	**Immediate**

Function:

Enter the signal number of the memory location which is to be monitored via the min/max memory function. Value table:

Signal No.	**Signal designation**	**Normalization** (corresponds to LSB:)
0	Physical address	—
1	—	—
2	Current I_R	MD 1710
3	Current I_S	MD 1710
4	Current I_d	MD 1710
5	Current I_q	MD 1710
6	Current setpoint I_q (limited after the filter)	MD 1710
7	Current setpoint I_q (in front of the filter)	MD 1710
8	Speed actual value, motor	MD 1711
9	Speed setpoint	MD 1711
10	Speed setpoint, reference model	MD 1711
11	Torque setpoint (speed controller output)	MD 1713
12	Torque setpoint limit	MD 1713
13	Utilization ($m_{set}/_{mset,\ limit}$) (refer to MD 1621)	8000H = 100 %
14	Active power	0,01 kW
15	Rotor flux setpoint	MD 1712
16	Rotor flux actual value	MD 1712
17	Quadrature-axis voltage U_q	MD 1709
18	Direct-axis voltage U_d	MD 1709
19	Current setpoint I_d	MD 1710
20	Motor temperature	0,1 °C
21	DC link voltage	1 V
22	Zero mark signal, motor measuring system	—
23	Bero signal	—
24	Absolute speed actual value	MD 1711
25	Slip frequency setpoint	$\frac{2000 \times 2\pi}{800000H \times 1s^{-1}}$
26	Rotor position (electrical)	MD 1714
27	Torque setpoint, speed controller	MD 1713
28	Pre-control torque	MD 1713
29	Actuating voltage Q injection	MD 1709
30	Actuating voltage D injection	MD 1709

Note:

This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1652

Memory location, min/max memory				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

Enter the address of the memory location which is to be monitored via the min/max memory function.

Note:

- This machine data is **only** effective if the signal number is set to 0 (refer to MD 1651).
- This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1653

Minimal value, min/max memory				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000 0000	**0000 0000**	**FFFF FFFF**	**Hex**	**Immediate**

Function:

Output the display value of the minimum value, min/max memory.

MD 1654

Maximum value, min/max memory				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000 0000	**0000 0000**	**FFFF FFFF**	**Hex**	**Immediate**

Function:

Output the display value of the maximum value, min/max memory.

6.2 Monitor function

MD 1655

Segment, memory location monitor				
Standard value	Lower input limit	Upper input limit	Units	Effective
0 (X:)	**0 (X:)**	**1 (Y:)**	**—**	**Immediate**

Function:

Using this machine data, the segment for the memory location for the motor function is addressed.

Value table:

Value	Segment
0 (X:)	DSP address space X
1 (Y:)	DSP address space Y

The DSP address is obtained together with the offset address (MD 1656). The contents of the DSP address can be displayed via the machine data, value display monitor (MD 1657).

Note:

This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1656

Address, monitor memory location				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

The offset address of the memory location for the motor function is addressed using this machine data. The DSP address is obtained together with the segment of the memory location (MD 1655). The contents of the DSP address can be displayed via the machine data, monitor value display (MD 1657).

Note:

This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1657

Value display, monitor				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000 0000	**0000 0000**	**FFFF FFFF**	**Hex**	**Immediate**

Function:

Outputs the monitor function display value. This machine data displays the contents of the address which is obtained from the segment (MD 1655) and the offset (MD 1656).

MD 1658

Value input, monitor				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000 0000	**0000 0000**	**FF FFFF**	**Hex**	**Immediate**

Function:

A 24-bit value can be entered in this machine data. The value is written in the monitor function at the address, specified by the segment (MD 1655) and the offset (MD 1656). The value is only written in, if the machine data, value transfer monitor (MD 1659) is set to 1.

Note:

This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1659

Value transfer, monitor				
Standard value	Lower input limit	Upper input limit	Units	Effective
0 (aus)	**0 (aus)**	**1 (ein)**	**—**	**Immediate**

Function:

The value (MD 1658) is written into the addressed memory location (MD 1655, MD 1656) using this machine data if the write operation was initiated with 1. The machine data is automatically set again to 0 after the write operation has been executed.

Note:

This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

6.3 Motor encoder diagnostics

MD 1610

Activate diagnostic functions				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000 (aus)	**0000 (aus)**	**0001 (ein)**	**Hex**	**Power On**

Function:

Diagnostic functions can be activated using this machine data. The function is active if the appropriate bit = 1.
The standard pre-assignment is dependent on the drive type (feed drive (VSA) ≙ 0000).

Value table:

Bit	Function	Value
0	Load test monitoring = dn/dt monitoring	0 (**off**) = not active 1 (on) = active
1	Smooth running monitoring	0 (**off**) = not active 1 (on) = active

Note:

- The 611D diagnostic functions are not active as standard.
- The monitoring function is independent of internal operating modes (pre-control, function generator etc.)
- This machine data is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1611

Response threshold dn/dt				
Standard value	Lower input limit	Upper input limit	Units	Effective
800	**0**	**1 600**	**%**	**Immediate**

Function:

Enter the response threshold of the dn/dt monitoring.

Note:

This machine data is required for the load test, and is **only** relevant for Siemens internal purposes and **may not be changed**.

MD 1721

Diagnostics, speed actual value				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

Displays the monitoring machine data diagnostics, speed actual value. If an excessive speed difference occurs during the run time, then the machine data value is incremented. It is not significant if the function sporadically responds by several increments, as the speed controller is not influenced. If the contents of MD 1721 are continually increased by several increments, then there is an increased fault level.

The causes could be:

- Encoder screen not grounded
- Defective encoder
- The entered motor moment of inertia is too high
- Evaluation electronics

Note:

The function is switched-in with MD 1610 bit 0 and the threshold specified with MD 1611.

6.4 Actual values

MD 1701

DC link voltage				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**32 767**	**V**	**Immediate**

Function:

The machine data is used to display the voltage level of the DC link under normal operating conditions and during setting-up. The DC link voltage $V_{DC\ link}$ is continually measured if MD1161=0.

MD 1702

Motor temperature				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**32 767**	**°C**	**Immediate**

Function:

The machine data is used to display the motor temperature. The motor temperature is measured using a temperature sensor and evaluated in the drive.

MD 1706

Speed setpoint				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**100 000.0**	**RPM**	**Immediate**

Function:

The machine data is used to display the speed setpoint. There is no time-synchronized unlatching (scanning) of machine data MD 1706, MD 1707 and MD 1708. Unlatching is realized by a read request of the non-cyclic communication protocol.

MD 1707

Speed actual value				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**100 000.0**	**RPM**	**Immediate**

Function:

The machine data is used to display the speed actual value. It represents the unfiltered speed actual value. There is no time-synchronized signal unlatching (scanning) of machine data MD 1706, MD 1707 and MD 1708.

MD 1708

Smoothed current actual value				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**100 000.0**	**%**	**Immediate**

Function:

The machine data is used to display the smoothed quadrature-axis current actual value. The torque-generating current actual value is smoothed with the coefficients (MD 1250) using a PT1 element. The smoothed current actual value is displayed as an absolute value in percent. 100 % corresponds to the maximum power module current (e. g. for an 18/36 A power module → 100 % = 36 A RMS).

MD 1722

Utilization				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**100 000.0**	**%**	**Immediate**

Function:

Display machine data for the drive utilization. The ratio between the torque setpoint M_d and the actual torque limit M_{dmax} is displayed. Values less than 100 % indicate the system reserve.

6.5 Status register

MD 1731

Image ZK1 PO register				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

This machine data is used to display the internal ZK1 power on register. The machine data, suppressible interrupts (power ON-MD 1600) is **not** taken into account for this diagnostics data.

Note:

This display value is reset after power-on (hardware reset). Refer to drive MD 1600 for the bit assignment.

MD 1732

Image ZK1 RES register				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:

This machine data is used to display the internal ZK1 reset register. The machine data, suppressible interrupts (reset-MD 1601) is not taken into account for this diagnostics data.

Note:

This display value is only reset by a reset on the NC side (software reset). Refer to drive MD 1601 for the bit assignment.

MD 1733

NPFK diagnostics counter				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**32 767**	**—**	**Immediate**

Function:

This diagnostics machine data provides information as to how often the motor temperature- or DC link measurement through the low-priority frequency channel was erroneous. Thus, the machine data is indirectly a hardware indicator (hardware diagnostics indicator) for the low-priority frequency channel.

Note:

This machine data is always reset when the drive is powered-up.

6.6 Status displays

MD 1700

Status of the binary inputs				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**7FFF**	**Hex**	**Immediate**

Function:
The machine data is used to display the status of the binary inputs.

Value table:

Bit	Status	
0	Gating unit enable (inside the module), including marking according to MD 1003, bit 5	0 = off 1 = on
1	Pulse enable (terminal 663, module-specific pulse cancellation)	
2	Pulse enable (terminal 63/48) of the infeed/regenerative feedback unit (central drive pulse cancellation)	
3	Group signal, hardware pulse enable: – stored hardware group signal – axial pulse enable through the PLC using the 611D control word	
4	Heatsink temperature monitoring responded	
5	Setting-up operation (terminal 112) of the infeed/regenerative feedback unit (signal, setting-up operation)	
6	Drive enable (terminal 64/63) of the infeed/regenerative feedback unit (central drive enable setpoint = 0)	
7	Not assigned	
8	Motor- and power module temperature pre-alarm	

MD 1720

CRC diagnostics parameter				
Standard value	Lower input limit	Upper input limit	Units	Effective
0000	**0000**	**FFFF**	**Hex**	**Immediate**

Function:
The machine data is used to display the identified CRC error (cyclic redundancy check). The 5-bit counter information is updated at every read request (bit 4 ... bit 0 and counter status 0 ... 31).

MD 1797

Data version				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**32 767**	**—**	**Immediate**

Function:

Outputs the actual data version (machine data list).

MD 1798

Firmware data				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**32 767**	**—**	**Immediate**

Function:

Outputs the coded software release. The decimal notation is used. The configuration is as follows: DDMMY, whereby DD = day, MM = month and Y = the last number of the year.

An example: 01.06.1996 corresponds to 01066_{dec}

MD 1799

Firmware release				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**32 767**	**—**	**Immediate**

Function:

Outputs the current software release. The decimal notation is used, e. g. 30012. This corresponds to version 3.00/12.

6.7 Modification control, normalizing 611 actual values

MD 1250

Transition frequency-current actual value smoothing				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**0.0**	**8 000.0**	**Hz**	**Immediate**

Enter the -3dB transition frequency f_o of the quadrature-axis current actual value smoothing (PT1 low-pass filter) for display. The time constant T1 of the PT1 filter is obtained from the formula $T1 = 1/(\pi 2 f_o)$. The display is realized in the machine data, smoothed current actual value (MD 1708). The smoothed quadrature-axis current actual value is also transferred to the PLC data channel. This machine data has no influence on the control.

Note:

The filter is de-activated when values < 1 Hz are entered.

MD 1252

Transition frequency-torque setpoint smoothing				
Standard value	Lower input limit	Upper input limit	Units	Effective
100.0	**0.0**	**8 000.0**	**Hz**	**Immediate**

Enter the -3dB transition frequency f_o of the torque setpoint smoothing (PT1 low-pass filter) for display. The time constant T1 of the PT1 filter is obtained from the formula $T1 = 1/(\pi 2 f_o)$. The smoothed value is transferred to the PLC data channel. This machine data has no effect on the control.

Note:

The filter is de-activated when values < 1 Hz are entered.

MD 1725

Normalization, torque setpoint interface				
Standard value	Lower input limit	Upper input limit	Units	Effective
0.0	**0.0**	**100000.0**	**Nm**	**Immediate**

This machine data contains the reference value of the torque setpoint- and torque limit values transferred from the NC to the drive.

Note:

This machine data is only calculated from power-on data once at run-up.

6.8 V/f operation

MD 1014

Activate V/f operation				
Standard value	Lower input limit	Upper input limit	Units	Effective
0	**0**	**1**	**—**	**Power On**

Function:

Activates V/f operation. The frequency setpoint is entered as speed setpoint via the digital setpoint interface. MD 1400 must be sensibly pre-assigned.

MD 1125

V/f operation: Run-up time 1				
Standard value	Lower input limit	Upper input limit	Units	Effective
5.0	**0.01**	**100.0**	**s**	**Immediate**

Function:

When V/f operation is selected (MD 1014) this is the time in which the speed setpoint should be changed from 0 to the maximum motor speed (MD 1146).

MD 1126

V/f operation: Run-up time 2				
Standard value	Lower input limit	Upper input limit	Units	Effective
5.0	**0.01**	**100.0**	**s**	**Immediate**

Function:

For MCU, run-up time 2 cannot be activated.

Note:

- V/f operation can only be used for service purposes.
- V/f operation cannot be used in the closed-loop controlled operating modes (closed-loop position control). V/f operation can be used in the „open-loop control“ mode. However, in this case, oscillations can occur at the end position due to the activated closed-loop holding control at standstill.
- The speed setpoint is displayed in MD 1707 (speed actual value).

7 Appendix

7.1 Machine data list

SIEMENS

SIMODRIVE 611

Single-Axis Positioning Control MCU 172A

Functional Description
Positioning with the MCU

Valid for: MCU 172A V 3.x or higher

Edition March 1998

Note:

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please inquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

Position Control

Contents

Components of the Position Control

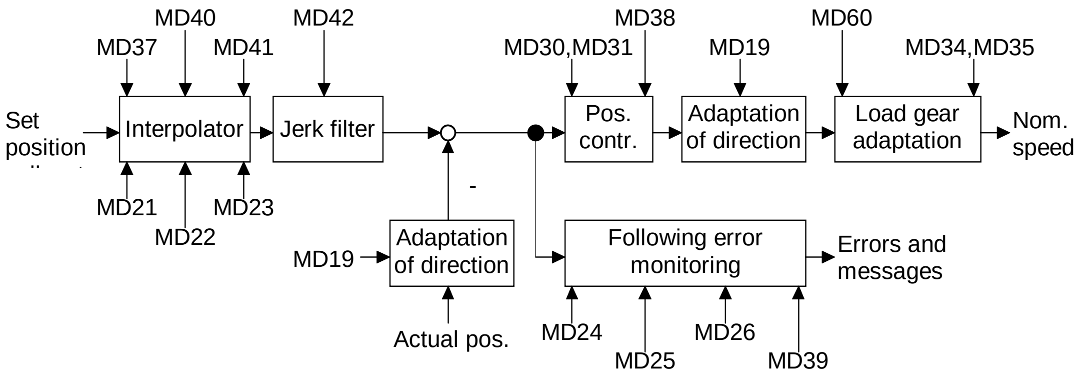
Tasks

The position controller has the following tasks:

- true-to-speed guiding of the drive during the movement
- true-to-target approaching of the axis to the programmed position
- stopping the axis in a certain position in case of interference

Functional units and machine data

The position controller is designed as a P controller. Different functional units arranged in its environment perform special tasks in the complex of motion control. Adaptation to the particular axis conditions is provided by various machine data:



MD19	Adaptation of direction	MD34	Denominator of load gear
MD21	Software limit switch beginning	MD35	Numerator of load gear
MD22	Software limit switch end	MD37	Servo control signal
MD23	Maximum velocity	MD38	Loop-gain coefficient
MD24	Target range (PEH)	MD39	Minimum following error, dynamic
MD25	Monitoring time (PEH)	MD40	Acceleration
MD26	Zero-speed range	MD41	Deceleration
MD30	Backlash compensation	MD42	Jerk time constant
MD31	Direction reference of backlash	MD60	Encoder setting

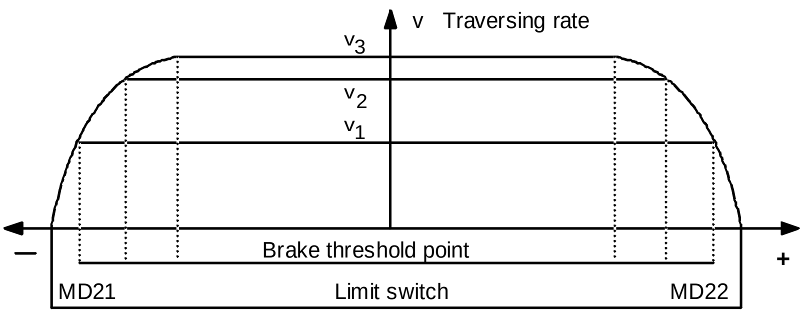
Machine data cross references

MD	Designation	Page
5.X	Process interrupt generation	2-5
6	Axis name	13/1-1, 14/3-25
7	Unit system	3/2-14, 1-15
8	Axis type	5-11
9	End of rotary axis	5-11
10	Encoder type (IM)	1-17, 1-18
11	Path/encoder revolution (IM)	1-17, 1-18
12	Distance to go/encoder revolution (IM)	1-17, 1-18
13	Increments/encoder revolution (IM)	1-17, 1-18
14	Number of revolutions of EnDat encoder	1-18
16	Reference-point coordinate	3-14
17	Absolute-encoder adjustment	3-5
18	Type of reference-point approach	3-14
19.X	Adaptation of direction	1-14
20.X	Hardware monitoring	1-16
21	Software limit switch beginning	1-4
22	Software limit switch end	1-4
23	Maximum speed	1-6
24	Target range (PEH)	1-11
25	Monitoring time (PEH)	1-11
26	Zero-speed range	1-12
27	Reference-point offset	3-14
28	Referencing velocity	3-14
29	Reducing velocity	3-14
30	Backlash compensation	1-14
31	Direction reference of backlash	1-14
32	Output type of M function	5-16
33	Output time of M function	5-16
34	Denominator of load gear	1-13
35	Numerator of load gear	1-13
36.X	Input adaptation	2-2, 3-7
37.X	Servo control signal	1-10
38	Loop-gain coefficient	1-13
39	Min. following error, dynamic	1-12
40	Acceleration	1-6
41	Deceleration	1-6
42	Jerk-time constant	1-7
46.X to 49.X	Digital inputs (I1) to (I4)	2-2, 3-7, 3-14, 3-25
50.X to 53.X	Digital outputs (O1) to (O4)	2-2
54	Encoder type (DM)	1-17, 1-18
55	Path/encoder revolution (DM)	1-17, 1-18
56	Distance to go/encoder revolution (DM)	1-17, 1-18
57	Increments/encoder revolution (DM)	1-17, 1-18
60.X	Encoder setting	1-16
61	Position controller cycle	2-2
63	Drive activation	1-19, 3-6
64	Drive number	1-19
65	Drive power section code	1-19
66	Drive module type	1-19

MD	Designation	Page
67	Drive type	1-19

Software Limit Switches

Software limit switches and brake threshold points



Depending on the traversing rate (v1, v2 or v3), the interpolator calculates the brake threshold point such that the axis is stopped by means of the brake ramp function exactly at the software limit switch.

To limit the working range, beginning and end of the software limit switches are defined by entries in the machine data MD21 and MD22. The value entered in MD21 must always be smaller than the value entered in MD22. These software limit switches become active when the axis is being synchronized. The software limit switches refer to the machine-oriented coordinate system.

If the software limit switches are not needed (for example, with a rotary axis), either values outside the possible working range must be entered into the machine data MD21 and MD22, or the monitoring must be switched off.

Note:

The software limit switches do not replace the hardware limit switches for EMERGENCY STOP reactions.

MD21
MD22

MD	Designation	Value/description	Unit
21	Software limit switch beginning	-1 000 000 000...< MD22 Rotary axis: 0 ... < MD22	[MSR]
22	Software limit switch end	> MD21...+1 000 000 000	[MSR]

The software limit switches are switched off by MD21 = -1 000 000 000 and MD22 = 1 000 000 000.

Note:

When using EnDat encoders, change the machine data for the software limit switches off-line, as an on-line modification may lead to the error message "End of range exceeded".

Special cases

Special cases are listed in the Table below:

Occurrence	Explanation
Controlling mode	If the actual value is outside the limit position, the traversing movement is stopped, and an error is signaled. The limit switch position is overtraveled by the amount of the required brake distance.
Modes "Incremental mode, relative", "MDI", "Automatic"	The axes are already in the stop position or do not start if the set position is outside the working range when reading in the set position. An error message is provided.
Endless traversing (-) for flying actual-value setting	G88 see Chapter *Programming*
Endless traversing (+) for flying actual-value setting	G89 see Chapter *Programming*
Follow-up mode	If the actual value is outside the limit position, an error message is provided.

Response after error

Leaving the limit position or traversing into the working range after error:

1. Acknowledge the error message.
2. Use either the Setting-Up, Controlling, Incremental Dimension or MDI mode to traverse into the working range.

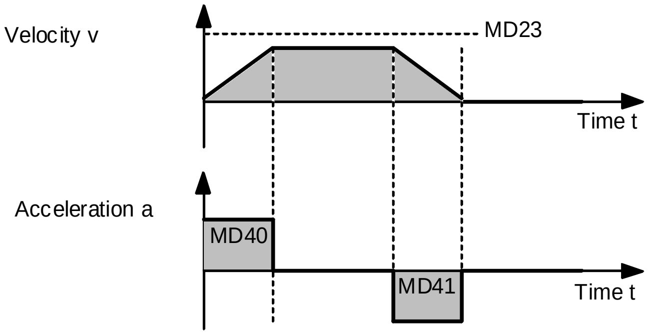
Hints

DS11 can be used to bridge (deactivate) the software limit switches.

Interpolator

Overview

The maximum traversing rate is set by means of machine data MD23. The acceleration and deceleration when starting and stopping the axis is preset in MD40 and MD41.



MD23
MD40
MD41

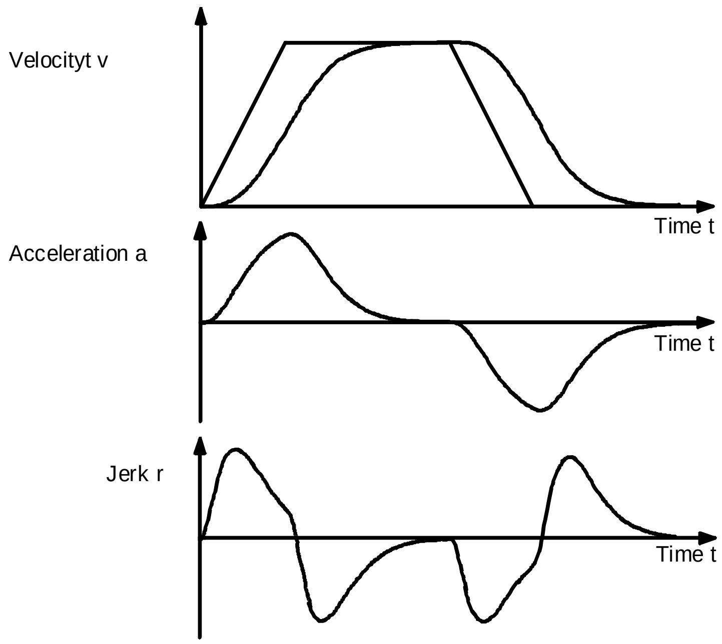
MD	Designation	Value/description	Unit
23	Maximum velocity	10 ... 500 000 000	[MSR]/min
40	Acceleration	0 = without ramp 1...100 000	10^3 [MSR]/s^2
41	Deceleration	0 = without ramp 1...100 000	10^3 [MSR]/s^2

Jerk Filter

Overview

The jerk filter can be used to smooth the ramp speed characteristic both during acceleration and deceleration. This provides a particularly smooth, jerk-free acceleration and braking process when performing special positioning tasks, e.g. when transporting liquids.

The jerk time constant as parameter of the jerk filter can be set in MD42.



MD42

MD	Designation	Value/description	Unit
42	Jerk time constant	0...10 000	ms

Jerk Limiting at Acceleration Limiting

Overview

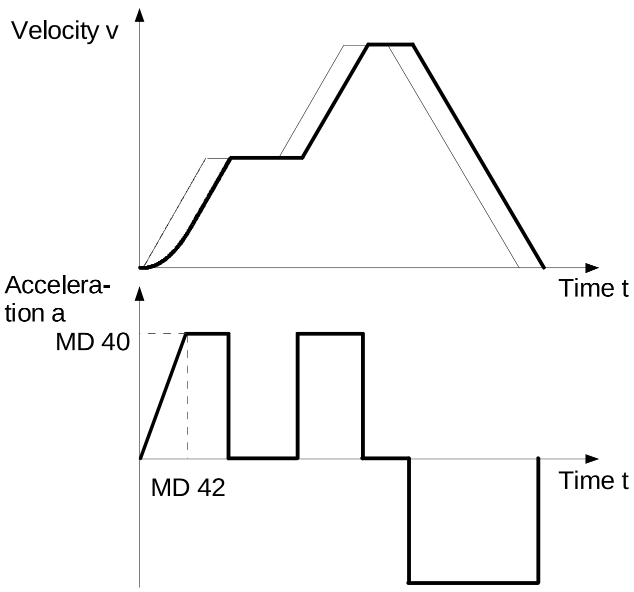
Under certain circumstances, positioning is considerably decelerated by the jerk filter described in Section 0. Alternatively, the jerk can be limited during the start. This function is activated by bit 1 in MD37.

Effects

Any traversing movement is first started with a ramp-type acceleration. The slope of the acceleration ramp (jerk) can be parameterized and adapted by MD42 (jerk time constant). When the acceleration parameterized in MD40 is reached, the axes are constantly accelerated up to the velocity indicated in the traversing block.

Limitations

To ensure an optimized positioning behavior, jerk limiting is active only when starting a traversing movement, not when braking and not when accelerating from a lower to a higher velocity in the Automatic/Subsequent Block mode.



MD37
MD42

MD	Designation	Value/description	Unit
37 .X	Servo control signal	Bit 1=1 jerk limiting at acceleration beginning Bit 7=1 Time override active	–
42	Jerk time constant	0...10 000	ms

Override

Overview

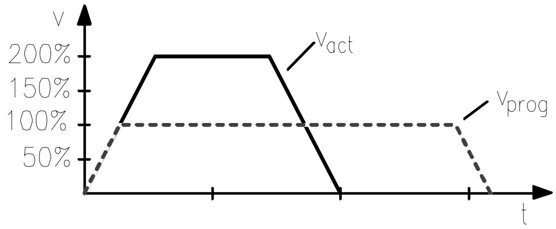
The override influences the behavior of the traversing movement with refer to the axis speed and the duration of the movement. In the Controlling mode, the override is not active.

Velocity override

In the range between 0 and 255 %, the velocity is controlled in percentage.

Example: Velocity override

Doubling of the override from 100 % to 200 %:



Doubling of the velocity v

There is no influence on acceleration and deceleration values.

$$v_{act} = \frac{v_{prog} \times \text{override}}{100}$$

The positioning time is not divided in half.

Time Override

If you activate the Time Override function in MD37, there are two ranges:

- Range from 100 to 255 %: The velocity override is active.
- Range from 0 to 100 %: The time override is active.
  The characteristic of both the velocity and acceleration/deceleration are modified such that the time required for the traversing movement is in direct relation to the override value.

Condition for time override

The time override can only be considered if the following additional condition is met:

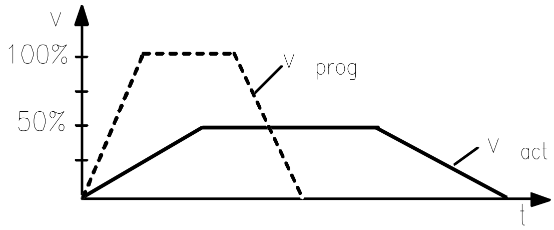
If a traversing movement consists of several positioning blocks with flying block change (the axis is not stopped between the blocks), changing the override value will only have influence on the velocity. The additional influence on acceleration and deceleration is considered only after standstill of the axis (e.g. reversal of direction).

Note:

The time override is active in MDI and Automatic Subsequent/Single Block modes only.

Example: Time override

Dividing of the override from 100 % to 50 %:



- Dividing the velocity v in half
- Dividing velocity and deceleration into four

$$v_{act} = \frac{v_{prog} \times \text{override}}{100} \qquad a_{act} = \frac{a \times \text{override}^2}{100^2} \qquad t_{act} = \frac{t \times 100}{\text{override}}$$

V_{act} ⇒ active velocity

a_{act} ⇒ active acceleration

t_{act} ⇒ active time

The positioning time is doubled if no jerk filter (MD42 = 0) has been parameterized.

MD37

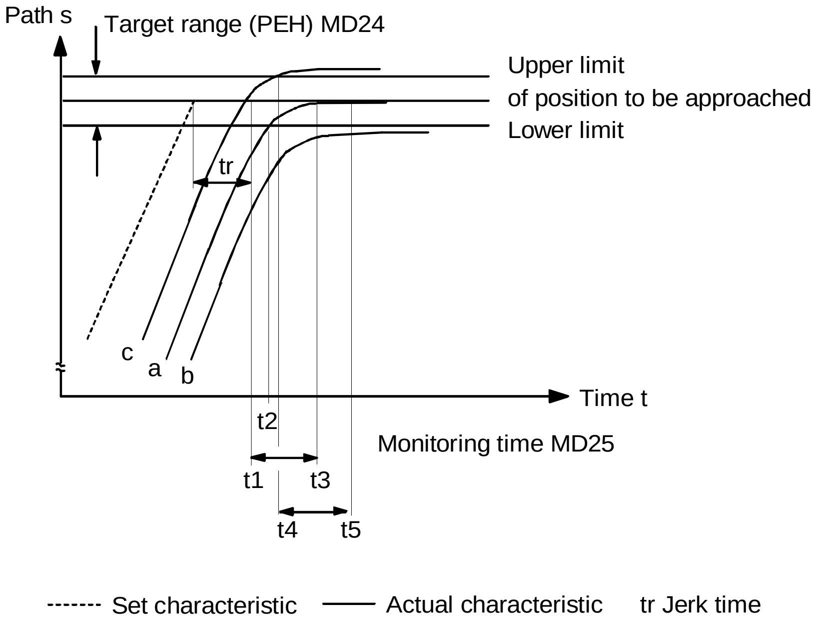
MD	Designation	Value/description	Unit
37.X	Servo control signal	Bit 1=1 Jerk limiting at acceleration beginning Bit 7=1 Time override active	–

Due to the interrelations between acceleration and positioning time which are now no longer linear, it is not possible to indicate an exact factor for the influence of the override.

Positioning

Overview

Positioning is illustrated in the Fig. below:



Actual characteristic

The Table below explains the actual movement characteristic for a, b and c.

By approaching the programmed position, the monitoring time is activated:

Time	Position monitoring
t_1	After the interpolator has reached the target position with delay by the amount of the jerk time constant (MD42, t_r), the monitoring time (MD25) is started.
t_2 (a)	Before the monitoring time is elapsed, the actual position reaches the target range. Positioning is completed, PEH signaled, and the position controller performs exact adjustment.
t_3 (b)	After the monitoring time has elapsed, the actual position is not in the target range (PEH) - error message: 00832 "PEH time monitoring"
t_4 (c)	The axis leaves the target range.
t_5 (c)	The axis remains outside the target range (t > MD25); error message: 00832 "PEH time monitoring"

MD24
MD25

MD	Designation	Value/description	Unit
24	Target range (PEH)	0...10 000	[MSR]

25	Monitoring time (PEH)	1...100 000 0 = no monitoring rounded to multiples of the position controller cycle	ms

Following Error Monitoring

Axis standstill

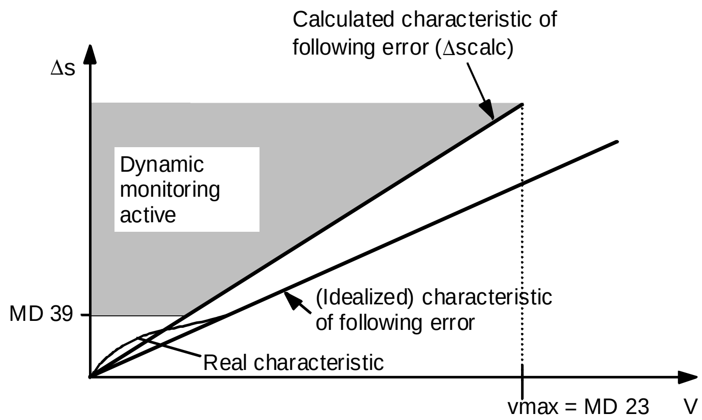
When the axes are on standstill, they remain in their current position, and a respective message is provided when the axis is forced to leave its position by mechanical influences. When the axis control is active, monitoring for the PEH range is carried out, and when the axis control is inactive, monitoring for zero speed is carried out. When exceeding the tolerance window for standstill with the axis control inactive, error message 00268 "Zero speed monitoring" is provided from the MCU.

MD26

MD	Designation	Value/description	Unit
26	Zero speed range	1... 10 000 000	[MSR]

Axis movement

To provide following error monitoring during the movement, the MCU calculates the permissible following error for the current traversing rate from the parameterized closed-loop amplification (MD38). The comparison with the following error actual value is carried out above the parameterized "Minimum following error, dynamic" (MD39).



MD39

MD	Designation	Value/description	Unit
39	Min. following error, dynamic	0...100 000	[MSR]

When the calculated following error is exceeded, the MCU provides error 00834 "Following error too high". The dynamic following error monitoring is switched off by MD39 = 0.

Position Controller

Closed-loop amplification

The closed-loop amplification (Kv factor) defines the following error at a certain traversing rate of the axis:

$$Kv = \frac{\text{traversing rate}}{\text{following error}} = \frac{v\,[m/min]}{\Delta s\,[mm]}$$

Quantity characteristics

The closed-loop amplification (Kv factor) influences the following important quantity characteristics of the axis:

- positioning speed and stop control
- continuity of movement
- positioning time
- deviation from contour

Dependency of the quantity characteristics

The better the design prerequisites of the axes are, the higher will be the Kv factor that can be reached, and the better will be the axis parameters, from the technological point of view. First of all, the value of the Kv factor is influenced by the time constants such as backlash and spring elements of the controlled system.

MD38 is entered with the 10^3fold FUnit in rpm, for example:

$$Kv = 1\,\frac{m/min}{mm} \Rightarrow MD38 = 1000\,\frac{1}{min}$$

MD38

MD	Designation	Value/description	Unit
38	Kv factor	1...10 000	1/min

Load Gear

The load gear (if any) has to be considered in the machine data MD34 (denominator of load gear - number of motor revolutions) and MD35 (numerator of load gear - number of load revolutions) so that the Kv factor entered in MD38 sets.

MD34, MD35

MD	Designation	Value/description	Unit
34	Denominator of load gear	1...1 000	-
35	Numerator of load gear	1...1 000	-

Backlash Compensation

Overview

Generally, mechanical drive elements have a certain backlash (play). MD30 is used to compensate this mechanical backlash.

Direct arrangement

With the position encoder arranged directly at the machine part to be positioned, e.g. slide, the Kv factor is affected by the backlash.

Indirect arrangement

Using an indirect measuring system (position encoder at the motor) provide a high closed-loop amplification (Kv factor). However, during each reversal of direction, first the mechanical backlash comes into effect prior to starting any axis movement. The consequence will be positioning errors.

Compensation

Any backlash value entered in MD30 is corrected by the position controller depending on the current preset traversing direction of the axis. This provides compensation of the backlash value during positioning.

If both measuring systems are parameterized, the backlash compensation has influence on the motor system. If only one measuring system is active, the backlash compensation influences the parameterized measuring system.

"Backlash-free" traversing direction

The "backlash-free" traversing direction of the axis, i.e. the traversing direction corresponding to the measured value, is parameterized in MD31. MD31 = 0 defines the direction of reference-point approach as a backlash-free direction of traversing.

MD30
MD31

MD	Designation	Value/description	Unit
30	Backlash compensation	-10 000...+10 000	[MSR]
31	Reference of backlash direction	0 = as reference-point approach 1 = positive 2 = negative	-

Adaptation of Direction

MD19

MD19 can be used to set the direction assignment of actual position and nominal speed value so that when pressing the + button, the axis moves to the direction defined as the positive direction.

MD	Designation	Value/description	Unit

19 .X	Adaptation of direction	Bit 0 = 1 Bit 1 = 1 Bit 2 = 1	Invert direction of measured value (IM) Invert direction of measured value Direction of measured value (DM)	-

Position Encoder

Note:

For more information on encoders refer to the Documentation *Encoders*.

Overview

Generally, the integrated encoder of the motor (IM = indirect measuring system) is sufficient. This can either be an incremental or an absolute encoder. For the machine data of the incremental encoder, default data are provided. In addition, a position encoder can be connected to the measuring-system interface of the MCU (permissible types see Documentation *Encoders*).

The position resolution of the machine axis which is provided by the encoder is calculated internally in the MCU from the machine data MD11 through MD13 and MD55 through MD57.

Distances and positions are represented either in 10^{-3} mm, 10^{-4} inch or 10^{-4} degrees what can be selected in machine data MD7.

MD7

MD	Designation	Value/description	Unit
7	Unit system raster	1 = 10^{-3} mm 2 = 10^{-4} inch 3 = 10^{-4} degrees 4 = 10^{-2} degrees	-

Changeover direct/indirect measuring system

If both measuring systems are parameterized in MD60, after starting up the MCU, the motor measuring system (indirect measuring system) is active. Changing between direct and indirect measuring system is possible by means of DS11 (bit-coded settings) during axis standstill. Furthermore, it must be made sure that no traversing program is executed when changing over.

MD60

MD	Designation	Value/description	Unit
60.X	Encoder setting Selection between IM/DM	Bit 0 = 1 IM (indirect measuring system) ON Bit 1 = 1 DM (direct measuring system) ON The integral encoder for speed and rotor position acquisition is always active, irrespective of MD60.X.	-

The indirect and/or direct measuring system for the actual-position acquisition is activated by machine data MD60. The direct measuring system on the drive side is **always** activate for the acquisition of rotor position and speed.

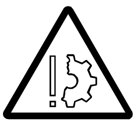
Monitoring functions / error diagnosis

Entering MD20.4 = 1 and MD20.5 = 1activates all monitoring functions for the measuring system needed for positioning. The individual monitoring functions are deactivated either by entering 0 into the respective bit of MD20 or by parameterization in MCU-PIT.

It is also possible to suppress the error messages using the function Parking Axis (see Chapter 2 *Digital Inputs/Outputs*).

MD20

MD	Designation	Value/description	Unit
20.X	Hardware monitoring	Bit 4 =1 zero monitoring (incremental encoder) Bit 5 =1 encoder error (incremental encoder) Entry for the monitoring functions to be activated	-



Prevent material damage!

Decativate the monitoring functions for testing purposes only, as positioning errors may damage the machine.

Exception:
Pulse monitoring for encoders with non-cyclic zero mark.

Incremental Encoders (sin/cos, 1 V_{ss})

Overview

Incremental encoders are used for the acquisition of the actual position; sinus periods are provided which are digitized in the MCU and added to an absolute value. After switching on the MCU, there is an offset between the internal position value and the mechanical position of the axis which cannot be calculated in advance. For this reason, to obtain position reference in a certain axis position, the internal value must be set to a default value stored in the machine data as reference-point coordinate (MD16) (see Chapter 3.4 *Reference-Point Approach Modes*).

Integral encoders

As position encoder, the integral rotary encoder in the motor (IM) can be used. The data of this encoder are default standard values in the machine data.

Additional measuring system

The MCU has an additional measuring system input (DM) for the following applications:

- **rotary incremental encoders at linear axis**
  Encoders that provide one zero mark per revolution can be used. The number of pulses output by the encoder must be an integer multiple of ten or correspond to a power of two.
- **rotary incremental encoders at rotary axis**
  Encoders that provide one zero mark per revolution can be used. The number of pulses output by the encoder must be an integer multiple of ten or correspond to a power of two. It must be guaranteed that the revolution of the rotary axis is divided by the cyclic zero mark by an integer number.

Function parameters

The Table below shows how to adapt the position encoder to the machine:

MD10, MD11, MD12, MD13

MD54, MD55, MD56, MD57

MD (IM)	MD (DM)	Designation	Value/description	Unit
10	54	Encoder type	**1 = i**ncremental encoder	-
11	55	Path/encoder revolution	1...1 000 000 000 (integer component)	[MSR]
12	56	Distance to go/encoder revolution	0...2^{32}-1 (fractional component) decimal places	[2^{-32}]MSR
13	57	Increments/encoder revolution	2^1...2^{25} Entry acc. to encoder type plate	-

The driver machine data 1011.3/4 and 1030.3/4 must correspondingly be parameterized (all bits = 0: incremental encoders selected). The value entered in the machine data MD13 and MD57 must correspond to the respective drive machine data MD1005 and MD1007.

Absolute Encoders (EnDat)

Overview

The MCU can be used to evaluate an absolute encoder. Such an encoder is, by option, either the EnDat encoder integrated in the 1FT6 motor, or a second encoder installed at the machine. Please also refer to the Documentation *Encoders*. The main advantages of EnDat encoders are:

- The transducer need not be synchronized.
- Thanks to the additional incremental tracks, dead times resulting from serial data transfer are eliminated. For the incremental track, multiplying by factor 8 is also applied.

Linear/rotary axes

- Absolute encoders at linear axes

  It must be ensured that the value range of the encoder corresponds at least to the distance to be traversed by the axis.
- Absolute encoders at rotary axes

  It must be ensured that the absolute value acquired by the encoder corresponds exactly to one revolution of the rotary axis.

Function parameters

The Table below shows how to adapt the position encoder to the machine:

MD10, MD11, MD12, MD13, MD14

MD54, MD55, MD56, MD57

MDIM	**MDDM**	**Designation**	**Value/description**	**Unit**
10	54	Encoder type	**5 = absolute encoder EnDat**	-
11	55	Path/encoder revolution	1...1 000 000 000 (integer component)	[MSR]
12	56	Distance to go/encoder revolution	$0...2^{32}-1$ (fractional component) decimal places	[2^{-32}]MSR
13	57	Increments/encoder revolution	$2^1...2^{25}$ Entry acc. to encoder type plate	-
14	14	Number of revolutions of EnDat encoder	0 or 1 Single-Turn encoder $2^1...2^{12}$ Multi-Turn encoder Power of 2 only are permitted.	-

The drive machine data 1011.3/4 and 1030.3/4 must correspondingly be parameterized.

The absolute encoder is adjusted via DS22 (reference-point setting).

The number of revolutions of the absolute encoder (MD14) must correspond to the respective drive machine data MD1021 (IM) or MD1031 (DM).

Drive Machine Data

Overview

MD64, MD66 and MD67 are default, MD65 is assigned automatically.

MD63 can be used to activate/deactivate the drive.

MD63

MD	Designation	Value/description	Unit
63	Drive activation	0 passive 1 active	-

MD63 is active only after Power On. "0" will change the drive to the passive condition. In this way, operation without motor and encoder is possible. The actual values of the encoder are simulated so that traversing programs etc. can be tested. See also Section 3.1.4.

MD64

MD	Designation	Value/description	Unit
64	Drive number	1	-

MD64 cannot be changed by the user. The drive number of the digital drive is a fixed value and set to 1.

MD65

MD	Designation	Value/description	Unit
65	Drive power section code	Drive machine data 1106	-

MD65 is active after Power On only. This value is automatically entered during the commissioning via MCU-Edit (selection of motor/power section). These data should not be changed by the user. This value must always correspond to the drive machine data 1106.

MD66

MD	Designation	Value/description	Unit
66	Drive module type	1 1-axis	-

MD66 is fixed to the value 1, since the MCU supports only the 1-axis module.

MD67

MD	Designation	Value/description	Unit
67	Drive type	1 VSA	-

MD67 is fixed to the value 1 (VSA). The MCU supports only feed drives (VSA), not main spindle drives (HSA).

Digital Inputs/Outputs

Contents

Function Parameters

Overview

Four digital inputs/outputs each of the MCU can be used for particular user applications. They are parameterized the by machine data MD46 to MD53. The signals are processed during the position controller cycle (MD61).

MD46 to MD53

MD46 to MD53 are used to assign the digital inputs/outputs the respective functions. To provide this, the respective bit must be set:

MD	Designation	Value/description	Unit
46.X to 49.X	Digital inputs (I1) to (I4)	Bit 0 = Start, externally Bit 1 = Enable input Bit 2 = External block change Bit 3 = Flying actual-value setting Bit 4 = Measuring Bit 5 = Reference-point switch Bit 6 = Reversal cams for reference-point approach Bit 7 = Emergency retraction (drive-irrespective) Bit 8 = Position controller inhibit	-
50.X to 53.X	Digital outputs (O1) to (O4)	Bit 0 = Position reached, stop Bit 1 = Axis movement, forward Bit 2 = Axis movement, backward Bit 3 = Change M97 Bit 4 = Change M98 Bit 5 = Start enable Bit 7 = Direct output via DS16	-

Note:

Only one function per input/output can be assigned.

Position controller cycle MD61

MD	Designation	Value/description	Unit
61	Position controller cycle	2 ... 10	ms

Level adaptation MD36

MD	Designation	Value/description	Unit
36 .X	Input adaptation	Bit 8= Digital input (I1) inverted Bit 9= Digital input (I2) inverted Bit 10 = Digital input (I3) inverted Bit 11 = Digital input (I4) inverted	-

Function Description of Digital inputs

Standard defaults

In default, the inputs I2 and I3 are not used.

As standard, input I1 is used as "Reference-point switch". Input I4 is generally used as "Enable input".

Status display

The current logic status of the digital inputs is provided in the check-back signals (S_I1, S_I2, S_I3 and S_I4).

Masking of inputs

The machine data for parameterization of the digital inputs (MD46 to MD49) are active only after Power-ON or RESET. By setting the respective bits (bit 10 to bit 13) in DS11, each input can be deactivated separately. In this case, any level change is ineffective even if the input is parameterized.

Limitation:

Masking of the inputs is not active for the functions "Length measuring" and "Flying measuring". These functions can be activated/deactivated by the bits "Length measuring" and "Flying measuring". Masking of the reference-point switch does not make sense and has therefore no effect.

Behaviour with inactive input:

The logical state takes the value FALSE. The checkback signals or the DS 16 still show the state of the input. That means that you cannot recognize whether or not the input is active. If the input is switched, there will be no reaction (and switching functions will not be saved). When the input is selected afterwards, the logical state of the input will take the current value.

Start, Externally

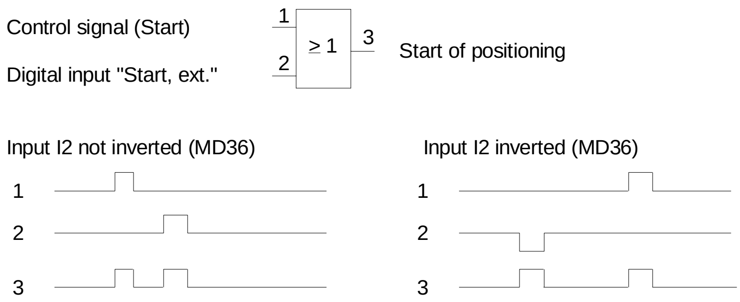
Overview

The control signals of the axes contain the start signal that initiates positioning in the modes Reference-Point Approach, MDI and Automatic Subsequent Block. A logic OR operation is carried out by means of the digital input "Start, externally" and Control Signal (Start).

Response time: max. 2 position controller cycles as set in MD61

Example

Start, ext., is connected to the digital input I2 (MD 47.0 set).


Control signal (Start)
Digital input "Start, ext."
1
2
≥ 1
3
Start of positioning
Input I2 not inverted (MD36)
Input I2 inverted (MD36)
1
2
3
1
2
3

Enable Input

Overview

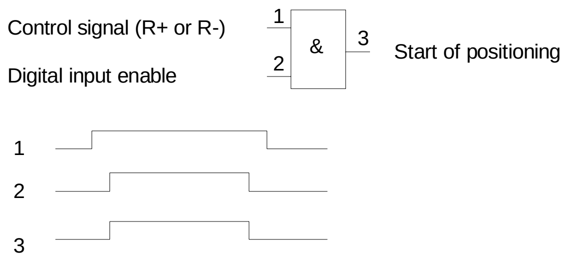
For positioning /movement/output of M functions of the axis, the enable input has to be set if this has been parameterized with MD46 to MD49. Resetting stops the movement.

Setting-up and controlling modes

In the modes Setting-Up and Controlling, the axis is moved as long as the AND operation of the control signal (R+/ R-) and the enable input are active.

Example

The enable input is connected to the digital input I3 (MD 48.1 set).



All modes except for setting-up and controlling

In all operating modes, except for Setting-Up and Controlling, the following has to be observed:

If the enable input is not yet set after a starting edge, this starting edge is internally stored and, in addition to "Waiting for enable", indicated in the check-back signals. By setting the input, the movement starts, and the stored starting edge is deleted (Stop also deletes the stored starting edge).

External Block Change

Only in conjunction with the traversing program

This function can only be used in conjunction with a traversing program (see Chapter *Programming*).

Flying Actual-Value Setting

Only in conjunction with a traversing program

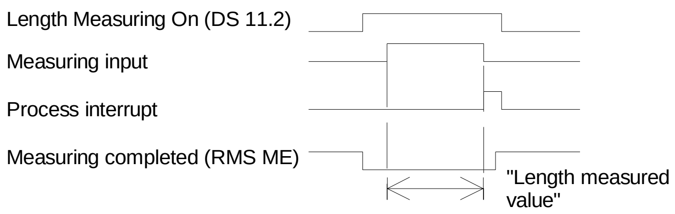
This function can only be used in conjunction with a traversing program (see Chapter *Programming*).

Measuring

Overview

The functions "Length measuring" and "Flying measuring" are mode-independent, can be used optionally, and require the same digital input "Measuring". In contrast to "Length measuring", during "Flying measuring" the movement of the axis is stopped, and the distance to go of the interrupted block deleted, or a flying block change carried out.

Length measuring

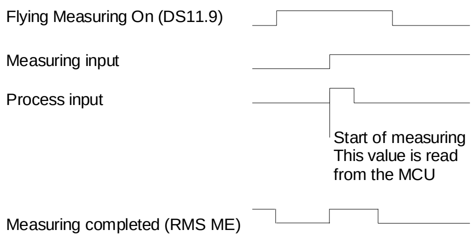


Length measuring is activated by setting bit 1.2 in DS11 (set data with execution instruction). During each edge change at the digital input, the current actual position is entered in DS30 (actual position of front edge / actual position of rear edge). At the end of measuring, i.e. when the rear edge comes, the measured value is calculated and entered in DS30 (measured value) and the check-back signal "End of measuring" [ME] output. In addition, a process interrupt (OB 40) is triggered if parameterized in MD5.

Process interrupt generation MD5

MD	Designation	Value/description	Unit
5.X	Process interrupt generation	Bit 0= 1 Position reached Bit 1= 1 Length measuring completed Bit 3= 1 Flying block change Bit 4= 1 Flying measuring	-

Flying Measuring



The measuring function is activated by setting bit 0.1 in DS11 (set data with execution instruction). During each edge change at the digital input, the current actual value is entered in "Length value, flying measuring" (DS30), and the axis brakes to standstill along its parameterized ramp. At the end of measuring, a process interrupt is generated if this is parameterized in MD5. In addition, the check-back signal "End of measuring" is output.

Note:

Max. two digital inputs can be assigned the Measuring function.

Exception: If a method of reference-point approach using the reference switch (MD18=4, 5, 8 or 9) is parameterized in MD18, only one input can be used for the Measuring function.

Reference-Point Switch

Only in conjunction with reference-point approach

This function can only be used in conjunction with reference-point approach (see Section *Reference-Point Approach*).

Reversal Cams for Reference-Point Approach

Only in conjunction with reference-point approach

This function can only be used in conjunction with reference-point approach (see Section *Reference-Point Approach*).

Emergency Retraction

Overview

This function is described in Section Chapter 3.1.5.

Position Controller Inhibit

Overview

Activating a digital input changes the system to the follow-up mode. In addition, controller enable is deleted so that the axis can be turned by hand. The response time amounts to 1 .. 2 position controller cycles.

Limitation

This function can only be activated with the axis not moving. In the case the axis is moving when activating the input an error message is provided.

Direct Input

DS16 (O/I)

The respective inputs can be read via DS16 (O/I). See also Section 4.1 Data / Signals MCU.

Function Description of Digital Outputs

Signals

The signals of the MCU are described in Chapter. *Interface to the User*.

Standard default

In the standard defaults, the outputs are not used.

Output of PEH, FR+, FR- and SFG

Overview

In addition to the output via the interface, the check-back signals Position R, Stop (PEH), Axis Movement Forward (FR+), Axis Movement Backward (FR-) and Start Enable (SFG) can be output via digital outputs. The parameterization of the output assignment is carried out by means of MD50 to MD53.

Output Alter M97 and M98

Overview

The check-back signal Alter M Function (AMF) for the M functions M97 and M98 is output via a digital output. This ensures that these M functions (switching signals) can be used by the user cycle time without delay.

Direct output

DS16 (O/I)

Writing data into the respective outputs is possible via DS16 (O/I).

See also *Tables Chapter 3 Data*.

Operating Modes

Contents

Overview

The following modes of operation are realized in the MCU:

- Setting-up (ER)
- Controlling (ST)
- Reference-point approach (REF)
- JOG (SM)
- MDI (Manual Data Input)
- Automatic Subsequent Block (AF)
- Automatic Single Block (AE)
- Function generator (FG), measuring functions (MF) only via MCU-PIT

Selecting the operating modes

The operating mode (BA) is transferred from the user program (AWP) via the intelligent I/O module or from MCU-PIT to the MCU.

Check-back signal of operating mode

Provided the preset operating mode is permitted, the MCU signals the preset operating mode back to the user program. If the preset operating mode corresponds to the mode signaled back, the mode will be active.

Changing the operating mode

When changing the operating mode during an active traversing movement, the operating mode is changed only after standstill of the axis. Then, the mode is signaled back.

When changing between the modes Automatic Single Block and Automatic Subsequent Block, the new operating mode is immediately taken over, i.e. without axis standstill.

Functions Applicable in Several Modes of Operation

Overview The individual modes of operation provide the following functions:

Technological Function	Selected by	Activation/ Execution Criterion	Operating Mode [BA]								
			ER	ST	SM	MDI	AF	AE	REF	FG	MF
Direct measuring system	DS11	Write data record, applicable only if BL=0	x	x	x	x	x	x	x	x	x
Follow-up mode	DS11	Write data record, function activated only if BL=0	x	x	x	x	x	x	x	x	x
Software limit position monitoring Off	DS11	Write data record	x	x	x	x	x	x	x	x	x
Parking axis	DS11	Write data record, function activated only if BL=0	x	x	x	x	x	x	x	x	x
Simulation	DS11	after axis standstill, function activated only if BL=0	x	x	x	x	x	x	x	-	-
Flying measuring	DS11	Edge at the input	x	x	x	x	x	x	x	x	x
Length measuring	DS11	Edge at the input	x	x	x	x	x	x	x	x	x
Retrigger reference point	DS11	1st positive edge of zero mark	x	x	x	x	x	x	-	x	x
Delete distance to go	DS12	Write data record and Stop [STP]	-	-	-	x	x	x	-	-	-
Undo actual-value setting	DS12	Write data record and Processing Running [BL]	x	x	x	x	x	x	x	-	-
Zero offset	DS13	Write data record and axis standstill (not when interrupted by Stop [STP])	x	x	x	x	x	x	x	x	x
Actual-value setting	DS14	Write data record and axis standstill	x	x	x	x	x	x	x	x	x
Flying actual-value setting	DS15	Edge at the input and Processing Running [BL]	x	x	x	x	-	-	x	-	-
Flying actual-value setting	G-funct.	Edge at the input	-	-	-	-	x	x	-	-	-
Digital output	DS16	cyclically	x	x	x	x	x	x	x	x	x
Teach In	DS20	Write data record	x	-	x	x	-	-	-	x	x
Automatic block search forward	DS12	Start [ST]	-	-	-	-	x	x	-	-	-
Automatic block search backward	DS12	Start [ST]	-	-	-	-	x	x	-	-	-
Change drive to passive condition	MD63	Power ON	x	x	x	x	x	x	x	x	x
Set reference point	DS22	Write data record with the axis on standstill	x	x	x	x	-	-	x	x	x

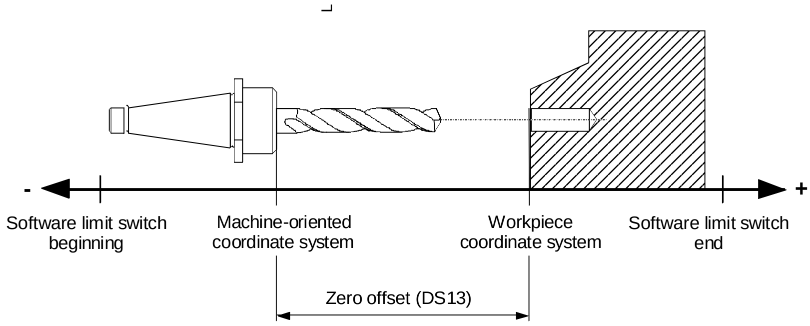
Emergency retraction (drive-independent)	DS8	- Digital input - Sign-of-live failure - Intermediate-circuit low volt.	x	x	x	x	x	x	x	x	x
Measure "relative positioning time"	-	Edge at the input "Start, externally"	-	-	-	x	x	x	-	-	-
Slip monitoring	MD60	Edge at the input "Start externally" or Start if both measuring systems active	-	-	-	x	x	x	-	-	-

Zero Offset

Overview

The zero offset is active only on standstill of the axis. Zero offset will cancel the current offset of the coordinate system (if already active) and the set offset (relative) executed. The actual position is always indicated in the machine-oriented coordinate system and not influenced by the zero offset. All position data indicated in the traversing programs refer to the workpiece coordinate system and are updated in accordance with the respectively active zero offset.

Zero offset - an example



The zero offset is deleted by:

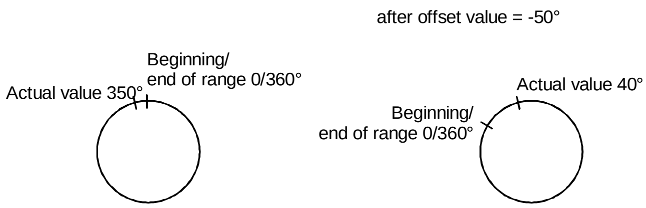
- transferring the offset value = 0
- taking over the reference point in the mode Reference-Point Approach
- Reference-Point Setting (DS22)

Limitation with rotary axis

For rotary axes, the following limitation is applicable:

Zero offset < rotary axis range. The actual value is normalized.

Example: Zero offset for a rotary axis



Range beginning/range end are shifted by -50°.

Exceptions

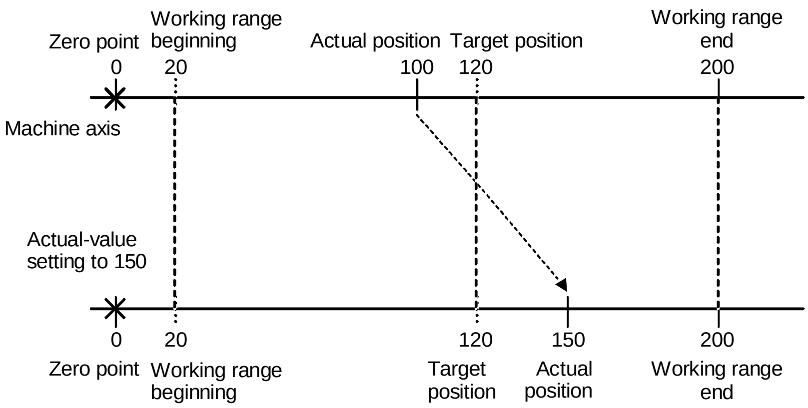
- In the modes Incremental Dimension Relative, MDI and Automatic Subsequent Block/Single Bloc, zero offset is possible only after block execution (PEH).
- Not in the case of interruption by Stop and following axis standstill.

Actual-Value Setting

Overview

By transferring the coordinate, the actual value is set to the desired value if the axis is on standstill (after program selection "Processing running " = 0). The coordinates of the software limit switches remain as they are.

Example



Resetting

Reference-Point Approach and Reset Actual-Value Setting reset the coordinate to its original value.

Reference-Point Setting

Overview

The axis can be synchronized without approaching to the reference point. When doing this, the position value entered in data record DS22 is taken over as actual value in the current position.

For axes with an absolute encoder, the position reference is entered into MD17. The known position value of the unit system is transferred to MCU in a known axis position by Reference-point setting. This value is set as the actual position of the axis. To make this position reference retentive, the NC machine data must be saved by means of MCU-PIT.

Changing the Drive to the Passive Condition

Overview

For testing purposes, it is possible to operate the MCU without motor and encoder. This function is activated by MD63=0.

CAUTION:

- Although the drive runs up, access to the drive machine data, diagnosis data etc. is not possible.
- All hardware monitoring functions are internally switched off.
- Within the system, it is changed to "Simulation".

MD	Designation	Value/description	Unit
63	Drive activation	0 = passive 1 = active	-

Emergency Retraction (Drive-Independent)

Scope of functions

The function "Drive-independent emergency retraction" is intended for separation of workpiece and tool as fast as possible in the following cases:

- signal level at a digital input
- sign-of-life failure on the MCU side
- intermediate-circuit low voltage

The integrated drive is fixed to this emergency retraction mode (immediate retraction with following generator braking). Both the emergency retraction time and the emergency retraction speed are parameterized by means of the drive machine data. Their activation via a digital input is paramaterized by means of MCU-MDs. This function can be switched on/off by an enable in a data record (either by the user program or the operator interface). After any emergency retraction, the MCU has to be reset (Power-On-Reset or SW-Reset).

Overview

The emergency retraction mode 4 (immediate emergency retraction with following generator braking) is fixed during the run-up of the MCU by transferring the drive machine data 1636. Even though this mode can be changed via the operator interface during operation, but any data back-up in the onboard-FEPROM is overwritten during the next run-up of the MCU.

In the case of error, the axis speed is slowed down to the speed n-notr (A-MD 1639) and keeps this speed over the time t-notr (A-MD 1638). Then, the axis brakes by means of the generator. This reaction is carried out by the drive automatically in the case of error (not controlled by the MCU).

A warning that the autonomous emergency retraction is active is provided via an ZK2 bit: DS 36, status class 2, bit 2 "Emergency retraction/generator mode active"

Level adaptation MD36

MD	Designation	Value/description	Unit
36 .X	Input adaptation	Bit 8= Digital input (I1) inverted Bit 9= Digital input (I2) inverted Bit 10 = Digital input (I3) inverted Bit 11 = Digital input (I4) inverted	-

MD46 to MD49

MD46 to MD49 are used to assign the digital inputs the respective functions. To this aim, the respectively indicated bit must be set:

MD	Designation	Value/description	Unit
46 .X to 49 .X	Digital inputs (I1) to (I4)	Bit 0 = Start, externally Bit 1 = Enable input Bit 2 = External block change Bit 3 = Flying actual-value setting Bit 4 = Measuring Bit 5 = Reference-point switch Bit 6 = Reversal cams for reference-point approach **Bit 7 = Emergency retraction (drive-independent)** Bit 8 = Position controller inhibit	-

Note:

Only one function per input can be assigned! When assigning a function twice, error 01314 "MD46... MD49 Inputs allocated twice" is provided.

Drive machine data - emergency retraction

MD	Designation	Description	Value
1161	Intermediate-circuit fixed voltage	Emergency retraction is possible only with intermediate-circuit measuring active (MD1161=0)	0
1630	Response threshold for intermediate-circuit monitoring only	Intermediate-circuit voltage threshold at which, when the actual value is lower the threshold, only the intermediate-circuit voltage and not the motor temperature etc. is monitored	0-600 V
1634	Emergency retraction response threshold	Intermediate-circuit threshold at which, when the actual value is lower the threshold, emergency retraction is initiated	0-580 V
1638	Emergency retraction time	Time for which the emergency retraction speed is preset as nominal speed in case of error	0-10000 ms
1639	Emergency retraction speed	Speed that is preset as nominal speed for the emergency retraction time in case of error (Standardization: 400000H corresponds to A-MD 1401)	FFC00000H-400000H

Emergency retraction enable

The function can be switched on/off by an enable in a data record either by the user program or via the operator interface. This can be used, for example, to lock an automatic traversing movement of the drive in certain ranges (protection from personal injuries ...). DS 8, control word 1, bit 2 "Emergency retraction enable"

General traversing enable

The input "Enable input" (MD46.1 to MD49.1) is active provided it has been parameterized and is not switched off.

Enable efficiency

Both enables are linked by an AND operation, i.e. both enables must be active to enable the emergency retraction; an active emergency retraction can be interrupted by canceling one of the enables.

Release, response

When releasing the emergency retraction, the drive response will be as follows:

- Any external setpoints are ignored, only drive setpoints are generated.
- The external controller enable is ignored, the drive automatically generates its controller enable.
- The pulse blocking remains active (externally or by the internal intermediate-circuit alarms).

Digital input

Emergency retraction is released if a digital input parameterized for emergency retraction responses. After emergency retraction has been initiated by the input, the emergency retraction can no longer be controlled by the input. The response time amounts to max. 2 controller cycles.

Sign-of life failure

Emergency retraction is released if the drive detects sign-of-life failure of the NC. Sign-of-life failure is only monitored if the speed controller enable is set. The response time amounts to max. 2 position controller cycles.

Intermediate-circuit low voltage

Emergency retraction is released if the drive detects that the actual value of the intermediate-circuit voltage is lower than the threshold value. If the function is switched off by canceling the emergency retraction enable, only a warning is output triggered by a ZK2 bit:

DS 36, status class 2, bit 1 "Intermediate-circuit voltage - emergency retraction"

Monitoring of intermediate-circuit voltage

The intermediate-circuit voltage is monitored by a U/f converter using the multiplex principle. To provide low-delay monitoring, it is necessary not to change over the multiplexer any more after the actual value has been lower than the threshold voltage (A-MD 1630) but to monitor only the intermediate-circuit voltage. Monitoring of the motor temperature is switched off for the time of the intermediate-circuit error. Thanks to this measure, the threshold can be detected after max. 1.5 ms.

The response time is:

- with the multiplexer switched off: max. 1.5 ms + 1 position controller cycle
- with the multiplexer not switched off: max. 6.5 ms + 1 position controller cycle

The hardware of the drive is switched off by the supply/energy recovery unit, when the intermediate-circuit voltage is lower than the threshold value and amounts to 280 V, or when the actual value is higher than the intermediate-circuit threshold and amounts to 680 V. Amongst others, the discharging time of the intermediate-circuit depends on the power and/or load and amounts to only a few msec.

Method

- Set drive machine data 1161 to 0.
- Set drive machine data 1634, 1638 and 1639.
- Configure fast input ‘Emergency retraction' MD46-MD49 and MD36.
- Save drive data and machine data on FEPROM.
- Switch the MCU off and then on again.
- The function is released by DS8.

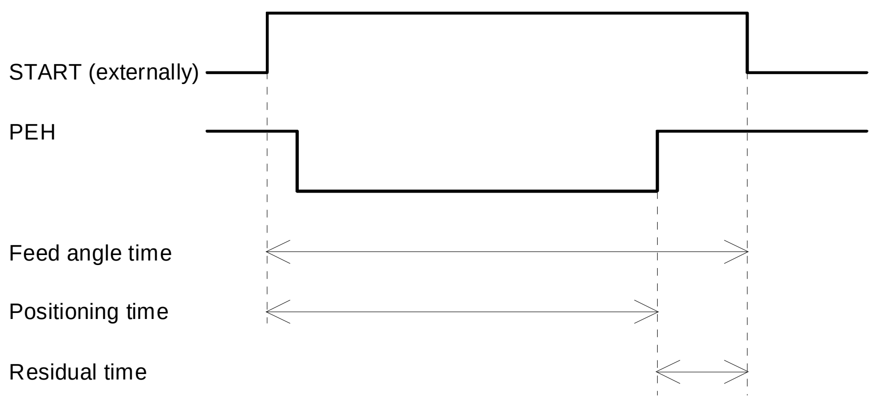
Measuring the "Relative Positioning Time"

Overview

In order to optimize cyclic movement sequences, it is necessary to use the time available for positioning as best as possible. To this aim, in the operating modes MDI and Automatic, the "relative positioning time" is measured. The calculated value is made available in DS26. The "relative positioning time" can also be output via DS19 or DS29 (application data) or via DACs.

Application example

In order to optimize the movement sequence between a press and a roller feed, the "relative positioning time", i.e. the ratio between positioning time and feed angle, is determined.



$$\text{Relative positioning time} = \frac{\text{positioning time}}{\text{feed angle time}} * 100\% * 100$$

Interrupting the positioning process

If a running positioning process is interrupted by STOP, mode change, enable cancellation or error, measuring of the "relative positioning time" is aborted. In this case, 0 is entered in DS26.

Slip Monitoring (Relative Path Difference IM-DM/DM)

Overview

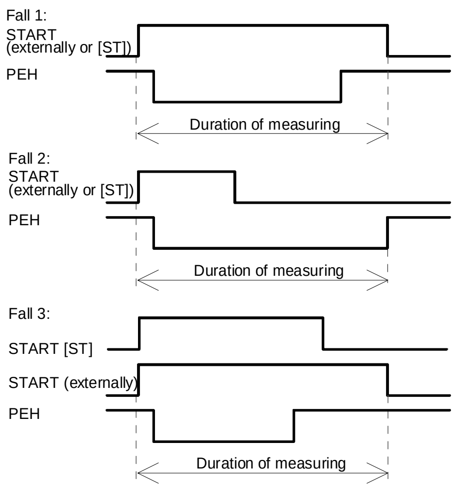
At the end of a traversing movement, the difference of the path traversed between indirect (IM) and direct measuring system (DM) is determined as percentage value with refer to the direct measuring system and made available in DS33. The relative path difference IM-DM/DM can also be output via DS19 or DS29 (application data) or via DACs.

Calculation

The difference of the path traversed is calculated between the positive and the negative edge of the start signal ([ST] or Start, externally). If the [PEH] signal is not yet set when the falling edge comes, the relative path difference is calculated only with the rising edge of [PEH].

$$\text{Relative path difference} = \frac{\text{Path difference IM - path difference DM}}{\text{Path difference DM}} * 100\% * 100$$

Examples



Limitation

The calculation of the relative path difference is only carried out in the operating modes MDI and Automatic if both measuring systems are parameterized.

Special cases

- Traversing block with G91 and path 0:
  As relative path difference, the value 0 is output.
- The DM does not provide actual values:
  No calculation is carried out, the path difference IM is entered in DS33.
- The IM does not provide actual values:
  No calculation is carried out, the path difference DM is entered in DS33.
- The relative distance difference exceeds the maximum value (double word):
  The double word maximum value is output as the relative distance difference.

Interrupting the positioning process

An interruption of a positioning process by operating mode change, canceling an enable or by an error results in abortion of measuring. In this case, the value 0 is entered in DS33. An interruption of a positioning process by STOP does not entail an abortion of measuring.

Setting-Up

Overview

In the Setting-up mode, the traversing movements of the axis are preset by means of the direction keys (R+ or R-) and by the setting-up velocity.

Note:

The Setting-up mode has nothing get to do with terminal 112 at the power supply module.

Setting-up velocity

Before the axis can be moved, first the setting-up velocities have to be transferred to the MCU via data record 2. Two velocities (step 1 and step 2) can be selected via the operating mode parameters (BAP) independently of each other. The values of the velocity steps can be changed during the movement.

Table 3.1 Setting-up velocities in DS2

Designation	Lower input limit	Upper input limit	Unit
Velocity step 1	1	500 000 000	[MSR]/min
Velocity step 2	1	500 000 000	[MSR]/min

The velocity can additionally be influenced via override (see Section 5.2.5 *Override*).

Controlling

Overview

In the Controlling mode, different speeds are preset which are used to realize a controlled movement. The movement direction is determined by the direction keys (R+ or R-).

The actual value of the axis is a follow-up value. (Follow-up mode).

Note:

When the speed is being output, the position control loop is disconnected. After deactivating the direction keys (R+ and R-), the regulation refers to the new actual position and used after standstill of the axis again.

Speed steps

It is possible to choose between two speed values (step 1 and step 2) independent of each other by means of operating mode parameters (BAP). The new value refers to 0.01% of the max. useful motor speed (MD1401), generally, this corresponds to the nominal speed. For example, entering 1,000 means 10% of the nominal speed.

The values of the speed steps can be changed during the movement:

Table 3.2 Speed steps in DS3

Designation	Lower input limit	Upper input limit	Unit
Speed step 1	0	10000	0,01 % x MD1401
Speed step 2	0	10000	0,01 % x MD1401

MD1401 see *Tables Section 3.2.2 SIMODRIVE 611 Machine Data*

Reference-Point Approach

Overview

In the operating mode "Reference-point approach", the axis is positioned to a fixed point preset by the reference-point switch (and, in some cases, by the zero mark of the encoder) either using the direction keys (R+ or R-) or by Start. This is necessary to synchronize the axis. After synchronization, traversing along the reference-point shift (MD27) is carried out. The position reached then is assigned the value of the reference-point coordinate (MD16). The override is limited to max. 100 %. Any active zero offsets or actual-value setting are reset and become not active during reference-point approach.

Reference point

The reference point should be selected such that it can easily and quickly be approached after turning on the control system.

Reducing velocities

If you operate the system manually when approaching the reference point, preselect the velocities such that your reaction time will not have any negative effects in case of error (if necessary vary the preset override values).

Recommendation: Reducing velocity = 150 mm/min

Machine data
MD16
MD18
MD27
MD28
MD29
MD46 to MD49

The Table below lists the machine data which are important for reference-point approach:

MD	Designation	Value/description	Unit
16	Reference-point coordinate	-1 000 000 000...+1 000 000 000	[MSR]
18	Method of reference-point approach	0 = + direction, zero pule, right 1 = + direction, zero pulse, left 2 = - direction, zero pulse, right 3 = - direction, zero pulse, left 4 = + direction, reference-point switch, center 5 = - direction, reference-point switch, center 8 = + direction, reference-point switch, edge 9 = - direction, reference-point switch, edge	-
27	Reference-point shift	-1 000 000 000...+1 000 000 000	[MSR]
28	Referencing velocity	10...v_{max} (MD23)	[MSR]/ min
29	Reducing velocity	10...v_{max} (MD23)	[MSR]/ min
46 .X to 49 .X	Digital inputs (I1) to (I4)	Bit 0 = Start, externally Bit 1 = Enable input Bit 2 = External block change Bit 3 = Flying actual-value setting Bit 4 = Measuring Bit 5 = Reference-point switch Bit 6 = Reversal cams for reference-point switch Bit 7 = Emergency retraction (drive-independent) Bit 8 = Position controller inhibit	-

User handling

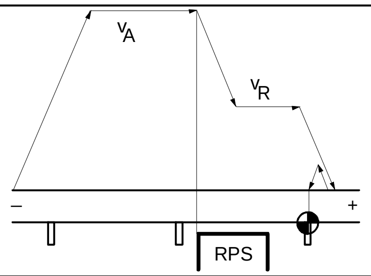
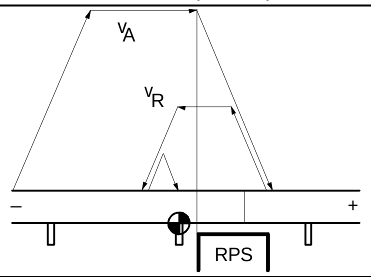
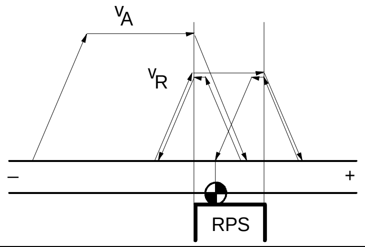
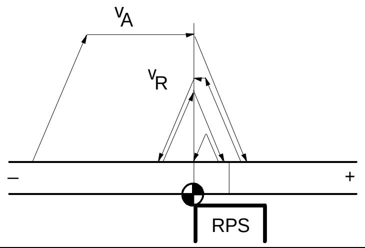
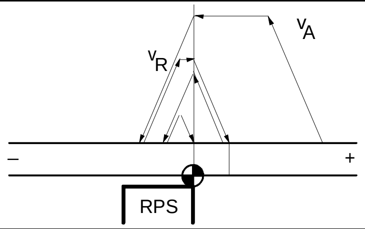
When using an absolute encoder (EnDat), in the operating mode Reference-point Approach, only the reference point of the axis is approached which is defined as fixed point.

When using an incremental encoder, the user has two possibilities to determine the reference point:

- with the reference-point switch (RPS) connected
- with the reference-point switch (RPS) not connected

With reference-point switch (RPS)

To this aim, the reference-point switch must be connected to a digital input and be parameterized via MD46 to MD49.

<table>
<tr><th>Initiation of movement, direction towards synchronization</th><th>Method of reference-point approach</th><th>Sequence of movements (reference-point shift = 0)
VA - referencing velocity
VR - reducing velocity</th></tr>
<tr><td rowspan="4">R +
("edge-controlled")
or Start</td><td>1.
Zero pulse right from RPS</td><td>
</td></tr>
<tr><td>2.
Zero pulse left from RPS</td><td>
</td></tr>
<tr><td>3.
RPS centrally (no zero pulse required)</td><td>
</td></tr>
<tr><td>RPS edge (no zero pulse required)</td><td>
</td></tr>
<tr><td rowspan="4">R -
("edge-controlled")
or Start</td><td colspan="2">see 1) (sequence of movements mirrored)</td></tr>
<tr><td colspan="2">see 2) (sequence of movements mirrored)</td></tr>
<tr><td colspan="2">see 3) (sequence of movements mirrored)</td></tr>
<tr><td>RPS edge (no zero pulse required)</td><td>
</td></tr>
</table>

Without reference-point switch (RPS)

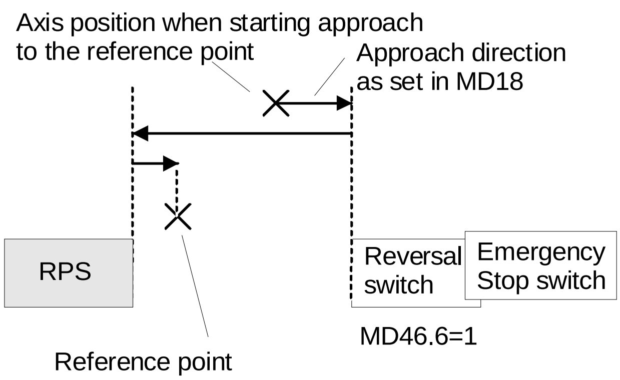
The Table below describes how approaching the reference point is carried out without reference-point switch.

Synchronizing	Sequence of movements
R+, R- ("edge-controlled") or Start	1. The current position is defined as reference point (reference-point coordinate) 2. Traversing along the reference-point shift value

Using a reversal switch

When starting approach to the reference-point and the axis is already behind the reference-point switch, a reversal switch causes the axis to return to the direction of the reference-point switch. The reversal switch is to be installed at the axis end before the emergency limit switch.

Example



Reference-point shift

The reference-point shift is the path difference between synchronization point and reference point.

The reference-point shift serves

- for numerical measuring system adjustment when changing the encoder.
- as path reserve to brake the drive after overtraveling the synchronization point.

Incremental Dimension

Overview

In the operating mode "Incremental Dimension", it is possible to carry out single positioning of relative path amounts in a freely selectable incremental dimension.

The traversing movement is started by pressing the direction keys (R+ and R-).

Position setting

There are the following possibilities for presetting the incremental dimensions:

Start of movement, direction	Selection of incremental dimension	Position, incremental dimension to be traversed
R + or R- "edge-controlled"	BAP = 254	via user program, DS4
	BAP = 1...100	acc. to Incremental Dimension Table

Table 3.3 Incremental dimensions

Designation	Lower input limit	Upper input limit	Unit
Incremental dimension	0	1 000 000 000	[MSR]

As velocity setpoint, velocity step 1 (Setting-up mode, DS2) is used. It can be changed during the movement.

Flying position change for example, changing the position setpoint during the movement, is **not** possible.

MDI (Manual Data Input)

Overview

In the operating mode MDI, it is possible to carry out single positioning via traversing blocks (F values, G functions, M functions). These traversing blocks are made available by the user program.

MDI block (DS7)

The MDI block has the same structure as the traversing-program block (see *Programming*).

The user program provides the MDI block to the MCU where it can then be started for execution. It can be executed several times. The feedrate depends on the override (see Section 5.2.5 *Override*).

The MDI block remains as long as it is overwritten by a new MDI block. Exception: "Flying MDI block".

MDI block information

Table 3.4 MDI block (DS7/DS17)

Designation	**Lower input limit**	**Upper input limit**	**Unit**
Position X/ dwell time t	-1 000 000 000 2	+ 1 000 000 000 100,000	[MSR] ms
Velocity F	1	500 000 000	[MSR]/min
G function group 1	G04 Dwell time G90 Absolute dimension G91 Incremental dimension		-
G function group 2	G30 100% Override: G31 10% Acceleration/ to deceleration G39 90%		-
M function groups 1, 2, 3	M1...17 User M19...96 functions M99 M97,98 Change signal programmed as digital output		-

For a rotary axis n with absolute-value programming, the commands R+ or R- are defined as direction presetting. They must be provided prior to starting positioning; otherwise, the MCU approaches the position on the shortest possible way.

Flying MDI block (DS17)

"Flying MDI block" output by the user program aborts the MDI block which is now being processed. The new block is immediately processed without restarting it. "MDI block, flying" is **not** stored in the MCU.

Block structure

The Table below shows the structure of an MDI block.

X/t Position/dwell time programmed (uses value 1)
G1...G2 G function group 1...2
M1...M3 M function group 1...3
F Velocity programmed (uses value 2)

Byte	Data format	Bit							
		7	6	5	4	3	2	1	0
0	Byte	0 Reserve							
1	Byte	0 Reserve							
2	8 x bit	0	0	0	X/t	0	0	G2	G1
3	8 x bit	0	0	0	0	M3	M2	M1	F
4	Byte	G function 1							
5	Byte	G function 2							
6	Byte	0 Reserve							
7	Byte	0 Reserve							
8	DINT	32-bit value 1							
9									
10									
11									
12	DINT	32-bit value 2							
13									
14									
15									
16	Byte	M function 1							
17	Byte	M function 2							
18	Byte	M function 3							
19	Byte	0 Reserve							

Example: G1=90; X=100 mm; F=1 m/min; M1=35

Byte	Data format	Bit							
		7	6	5	4	3	2	1	0
0	Byte	0							
1	Byte	0							
2	8 x bit	0	0	0	1	0	0	0	1
3	8 x bit	0	0	0	0	0	0	1	1
4	Byte	0	1	0	1	1	0	1	0
5	Byte	0							
6	Byte	0							
7	Byte	0							
8	DINT	1	0	1	0	0	0	0	0
9		1	0	0	0	0	1	1	0
10		0	0	0	0	0	0	0	1
11		0	0	0	0	0	0	0	0
12	DINT	0	1	0	0	0	0	0	0
13		0	1	0	0	0	0	1	0
14		0	0	0	0	1	1	1	1
15		0	0	0	0	0	0	0	0

16	Byte	0	0	1	0	0	0	1	1
17	Byte	0							
18	Byte	0							
19	Byte	0							

Automatic Subsequent Block

Overview

In the operating mode Automatic Subsequent Block, the MCU autonomously executes traversing programs. These programs can be created by means of MCU-PIT and stored as data blocks. The traversing programs contain information about movement sequences and outputs (see *Programming*).

Note:

To obtain identical position values when repeating the program, the 1st block should be programmed in absolute dimensions (G90).

Program selection

Program selection is carried out via the user program by presetting a program number and, as an option, a block number and the direction of processing. Program selection is possible only with a program interrupted or completed (DS18).

A selected program remains active as long as it is deactivated by preselecting program no.=0 or another program is selected.

Note:

The contents of the selected or active program cannot be edited.

Processing forward

Processing always starts at Start with the first block and is carried out by rising block numbers.

When starting processing in any point of the traversing program, the desired block number must be preset. Processing is carried out with Start in the block search mode forward to this block up top the end-of-program command.

Processing backward

Processing always starts at Start with the last block and is carried out by falling block numbers.

When starting processing in any point of the traversing program, the desired block number must be preset. Processing is then carried out with Start in the block search mode backward to the beginning of the program.

Note:

If backward processing is desired to perform the same sequence of movements as the forward movement, the effect of the respective commands have to be observed when programming, for example:

- Any M function outputs in a block should be written separately; it should be paid attention to the type of M output (MD32) and G60/G64.
- Pay attention to changing between G60/G64 and G90/G91.
- Pay attention to beginning and end of the tool offsets.
- M18 is not carried out.
- M02 and M30 at the end of the program are not processed.

Block search forward/backward

The program including tool offsets is prepared up to the end point of the destination block. M commands and dwell times are output, and the traversing movements suppressed.

When running the traversing programs using block search forward/block search backward, there are different special cases:

- Blocks with external block change (G50) are skipped.
- Endless traversing with flying actual-value setting (G88, 89) or cancellation (G87) are not carried out.
- Blocks following after G50, G87, G88, G89 (in processing direction) should include an absolute dimension.

Automatic block search forward / backward

After interrupting an active program in the Automatic mode (by operating mode change), it is possible to continue the program in the respective processing direction from the break point up.

With block search forward, the interrupted program must have been processed in the forward direction prior to the interruption. With block search backward, the interrupted program must have been processed in the backward direction prior to the interruption.

The command for automatic block search forward or block search backward is evaluated when the MCU starts, and block search forward or backward to the breakpoint is initiated. Positioning to the breakpoint is carried out (if positioning has been carried out in another mode of operation), and the interrupted block including the respective output (if any) is executed.

User handling

The Table below lists the parameters to be set in DS18.

Data format	Description	
Byte	Program number	
Byte	Block number	
Byte	Processing direction:	0 = processing direction forward 1 = processing direction backward

Handling when selecting the program

The Table below shows what you have to do when selecting a program.

Initiation of movement	**Program selection**		**Type of movement (acc. to the blocks programmed)**
	Block No.	**Processing direction**	
Start	0	forward	Start at program beginning, processing by rising block no.
	0	backward	Start at program end, processing by falling block no.
	e.g. 30	forward	Block search forward by rising block no., from block no. 30 output of traversing movement
	e.g. 30	backward	Block search backward by falling block no., from block no. 30 output of traversing movement
Start with automatic block search forward		forward	1. automatic block search forward to the breakpoint 2. positioning up to the breakpoint (if a movement has been carried out in any other mode of operation) 3. execution of the interrupted block and continuation of program
Start with automatic block search backward		backward	1. automatic block search backward to the breakpoint 2. positioning to the breakpoint (if a movement has been carried out in any other mode of operation) 3. execution of the interrupted block and continuation of program

Automatic Single Block

Overview

Whereas in the Automatic Subsequent Block mode, the MCU automatically starts the next following block for execution, after a block has been executed, in the Automatic Single Block mode, after each block which contains a distance to be traversed, a dwell time or M commands, the axis waits for a new start signal.

Changing between Automatic Single Block and Automatic Subsequent Block can be carried out at any time and does not result in stopping the movement or canceling the outputs.

Function Generator, Measuring Function

Overview

The functions Function Generator and Measuring Function are mainly used during the commissioning in order to set and check the dynamics of the regulation. Both functions are effective either in the speed or in the current-control loop.

Mode 20 = function generator

The function generator can be used to preset speed and torque setpoints.

Mode 21 = measuring function

The measuring function can be used to record step responses or frequency characteristics and then to display them.

Axis behavior

By selecting mode 20 or 21, the Setting-up mode is selected internally, i. e. first, the axis is in "position control".

With the functions started

When the functions are started, it is changed to follow-up mode internally so that no position control interrupts occur due to autonomous axis movements of the drive. The software limit switches remain active.

The check-back signals FR+, FR- will not be set, as the drive is moving autonomously and the position control is switched off by the follow-up mode. The function status is indicated in data record 36, status word 1, bit 4 and 5.

Bit4	FFT analysis	On
Bit5	Function generator	On

In contrast to other modes of operation, the machine data can be changed, despite of an active traversing movement, in order to optimize the axis without stopping the function.

To start an axis movement, the enable input is used provided it has been parameterized and is not switched off.

MD46 to MD49

MD	Designation	Value/description	Unit
46.X to 49.X	Digital inputs (I1) to (I4)	Bit 0 = Start, externally Bit 1 = Enable input Bit 2 = External block change Bit 3 = Flying actual-value setting Bit 4 = Measuring Bit 5 = Reference-point switch Bit 6 = Reversal cams for reference-point setting Bit 7 = Emergency retraction (drive-independent) Bit 8 = Position controller inhibit	-

Note:

Only one function per input can be assigned!

Start prerequisites

If one of the following start prerequisites is not met, a respective error message is provided to the user interface:

- Error-free parameterization of inputs
- DB interface active (STS: TFB=1)
- No alarm provided (RMS: FS=0, BF=0, DF=0)
- Axis on standstill (RMS: FR+=0, FR-=0)
- Processing not running (RMS: BL=0)
- Axis not parking (DS 11, Bit 14=0)
- Axis enable (AF=1)
- Controller enable (RFG=1)
- Pulse enable (IF=1)
- Follow-up operation (NFB=0)

Cancellation conditions

The following conditions result in canceling the function and in a respective error message displayed at the user interface:

- Changing the DB interface from active to inactive (STS: TFB 1->0)
- Operating mode change (RMS: BAR)
- Canceling the external enable input (I1-I4 see above)
- Canceling the axis enable (STS: AF 1->0)
- Canceling the controller enable (STS: RFG 1->0)
- Canceling the pulse enable (STS: IF 1->0)
- Alarm does not occur (RMS: FS, BF, DF 0->1)
- No check-back signal from drive (DS 36, status word 1, bit4 or bit5)
- Buffer overflow (measuring function only)
- Function generator failure (measuring function only)

Operation display

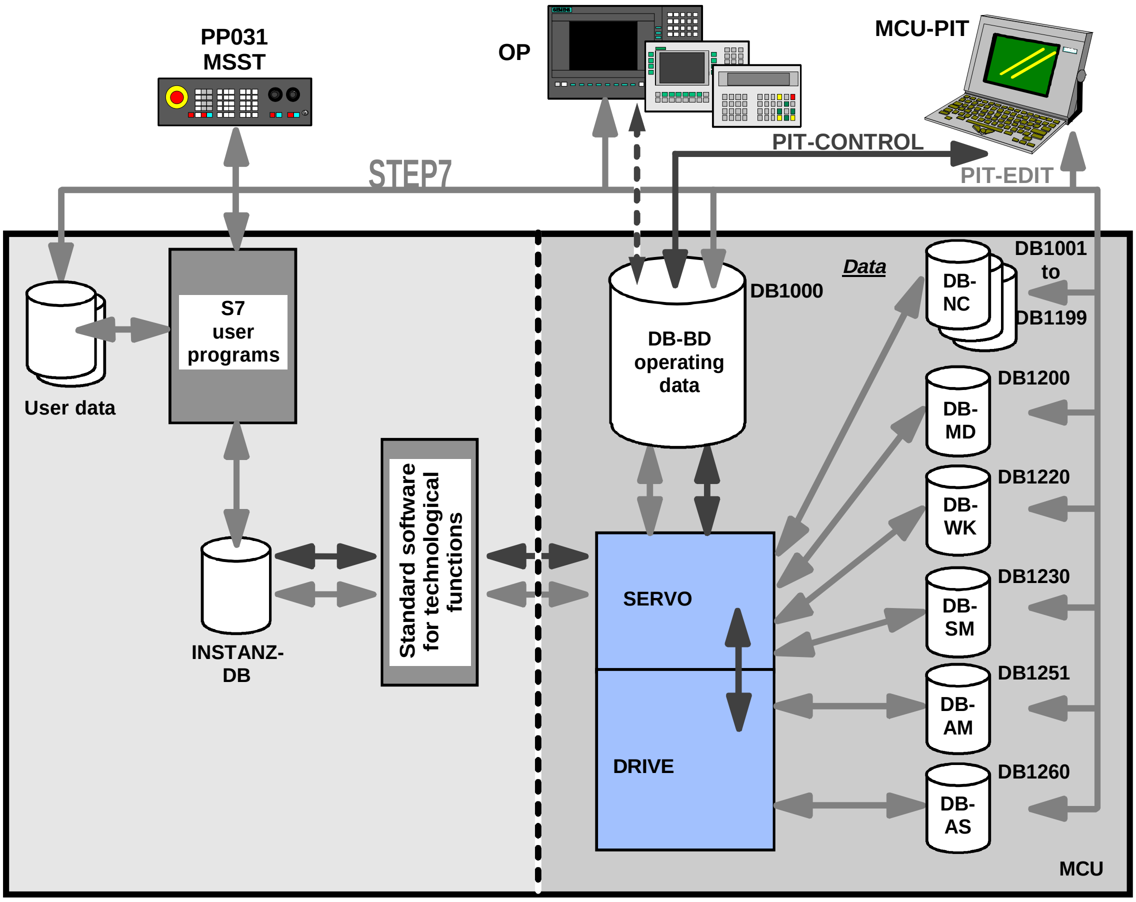
see Operation Guide MCU-PIT; Chapter 5.1.5

Interface to the User

Contents

Overview

This Chapter describes the scheduled data, display data, as well as the control and check-back signals from and to the MCU. For further information, refer to the publications "S7 Environment", "MCU-PIT", and the "Tables".



DB-NC	Traversing programs	DB-SM	Incremental dimension parameters
DB-MD	Machine data of the position control	DB-AM	Drive machine data
DB-WK	Tool offsets	DB-AS	Drive service data

Fig. 4-1 Overview of control signal and data flow

Description of bits

The interrelation between the SIMATIC bits and the PIT-EDIT bits is explained in the following Table. This Documentation uses the same notation as used for the SIMATIC

Bit number

SIMATIC	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.0	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0
PIT-	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0

EDIT	5	4	3	2	1	0										

Example: Bit 9 (PIT-EDIT) corresponds to bit 0.1 (SIMATIC).

Data / Signals to the MCU

Control signals

The operation /control of the axis is provided by means of control signals. Control signals are set either by the user program (AWP) or via the MCU-PIT software according to the desired function.

The Table below describes the control signals and their functions.

Table 4-1 Control signals

Symbol	Name	Value	Function
TFB	Operation via MCU-PIT	0 1	Controlling the MCU via the user program Controlling the MCU via MCU-PIT
BA	Operating mode (BA)	1 2 3 4 6 8 9 20 21	BA "Setting-up" see Section 3.2 BA "Controlling" see Section 3.3 BA "Reference-point approach" see Section 3.4 BA "Incremental dimension" see Section 3.5 BA "MDI" see Section 3.6 BA "Automatic Subsequent Block" see Section 3.7 BA "Automatic Single Block" see Section 3.8 BA "Function generator" see Section 3.9 BA "Measuring function" see Section 3.9
BP	Operating mode parameters	1 or 2 1... 100 254	In the modes Setting-up or Controlling, select velocity or speed steps. In the Incremental Dimension mode, select incremental dimension according to the Table (value = table index). For the incremental dimension refer to DS4.
R +	R Plus	1	Axis movements in positive direction. • In the modes Setting-up and Controlling, move the axis in positive direction (depending on the level). • In the modes "Incremental dimension" and "Reference-point approach", start movement in positive direction (edge-controlled). • In the modes "MDI" and "Automatic Subsequent Block", preset the direction of movement for rotary axes (evaluation at block beginning)
R -	R Minus	1	Axis movements in negative direction. • In the modes Setting-up and Controlling, move the axis in negative direction (depending on the level). • In the modes "Incremental dimension" and "Reference-point approach", start movement in positive direction (edge-controlled). • In the modes "MDI" and "Automatic Subsequent Block", preset the direction of movement for rotary axes (evaluation at block beginning)
ST	Start	0 → 1	Start of movement (edge-controlled, depending on the mode of operation, see Table 4-7).
STP	Stop	0 → 1	Interruption of movement or of program (edge-controlled, depending on the mode of operation, see Table 4-8).
IF	Pulse enable	1 1 → 0	Drive enable. When resetting the signal, the drive coasts.
SA	Skip block	1	In the operating mode "Subsequent Block", the blocks marked in the program are skipped.

Symbol	Name	Value	Function
EFG	Read-in enable	1	Read in the next block in the mode "Automatic Subsequent Block".
QMF	Acknowledge M function	1	M function is acknowledged "acknowledge-controlled" when the M functions are output, and the next block executed.

Symbol	Name	Value	Function
OVERR	Override	0 ... 255	The behavior of the traversing movement is controlled in the range from 0 to 255 %: • Velocity override Range: 0 to 255 % percentage velocity control • Time override If you parameterize the Time Override function in MD37, there are two ranges: - Range 100 to 255 %: The velocity override is active. - Range 0 to 100 %: The time override is active. In the Controlling mode, the override is not active.
FSQ	Acknowledge operator error	0 → 1	When the edge changes from 0 → 1, the error message is reset. Prior to acknowledging the error, the cause must be removed.
BFQ	Acknowledge operator error	0 → 1	When the edge changes from 0 → 1, the error message is reset. Prior to acknowledging the error, the cause must be removed.
AF	Axis enable	1 1 → 0	Movement enable. The movement is quickly decelerated with the parameterized deceleration (MD41). Program execution or movement, resp., is aborted, and the distance to go cleared.
RFG	Controller enable	1 → 0	Braking at the parameterized torque limit.
DIQ	Acknowledge data error	0 → 1	When the edge change from 0 → 1, the error message is reset.
NEUSTQ	Acknowledge restart	1	Acknowledge restart (is automatically acknowledged by FC1 after restart).

Scheduled data

Scheduled data are data/parameters needed for the respective operating modes. The Table below describes the scheduled data and their functions.

Table 4-2 Scheduled data

DS	Name	Value	Function
DS2	Velocity steps 1 and 2	1 ... 500000000	active in Setting-up and Incremental Dimension mode (see Section 3.2 and Section 3.5).
DS3	Speed steps 1 and 2	0 ... 10000	active in the Controlling mode in 0.01% of MD1401 (see Section 3.3).
DS4	Scheduled data for incremental dimension 254	0 ... 1000000000	active in the Incremental Dimension mode (see Section 3.5).
DS7	MDI block	-	active in MDI mode (see Section 3.6).
DS8	Scheduled data 611	-	Preset scheduled data for SIMODRIVE 611 (see Tables Section 3.1).

Scheduled data with execution instruction

Scheduled data with an execution instruction activate settings/functions applicable to several modes of operation. The Table below describes the scheduled data with execution command and their functions.

Table 4-3 Scheduled data with execution instruction

Symbol	Name	Function
DS11: Bit-coded settings		
Bit 0.1	Flying measuring	One of the 4 digital inputs (I1 to I4) can be parameterized as measuring function. Bit 0.1 activates the function (see Section 2.2.5). Flying measuring can be used only as an alternative to length measuring.
Bit 0.2	Digital input (I1) On/Off	By setting bit 0.2, the digital input 1 can be deactivated. By resetting the bit, the input is reactivated.
Bit 0.3	Digital input (I2) On/Off	By setting bit 0.3, the digital input 2 can be deactivated. By resetting the bit, the input is reactivated.
Bit 0.4	Digital input (I3) On/Off	By setting bit 0.4, the digital input 3 can be deactivated. By resetting the bit, the input is reactivated.
Bit 0.5	Digital input (I4) On/Off	By setting bit 0.5, the digital input 4 can be deactivated. By resetting the bit, the input is reactivated.
Bit 0.6	Parking axis	• can be switched on/off during "Processing running" = 0 • deletion of encoder synchronization (SYN = 0) • deletion of existing error messages and no triggering of new error messages (including diagnosis alarms) • encoder cable can be disconnected
Bit 0.7	Simulation	• can be switched on/off if "Processing running " = 0 • To avoid axis movement, PLC Pulse Enable must be Off. • When switching off, an internal restart is initiated. • All digital inputs are evaluated (**CAUTION:** If you wish all processes using such signals to be simulated they must be connected to the inputs of the MCU, for example, for reference-point approach). • Positioning section simulates controlled system, Controller Ready is not necessary for this. • All internal function sequences are carried out as in the normal mode.
Bit 1.1	Direct measuring system (DM) On/Off	Setting bit 1.1 in DS 11 activates the direct measuring system. Resetting the bit activates the indirect measuring system. The machine data MD10 to MD13 (indirect measuring system) and MD54 to MD57 (direct measuring system) must be respectively parameterized for both encoders during the commissioning, and the direct measuring system must be parameterized in MD60. Changing between the two measuring systems is possible only on standstill of the axes and if no program is running. The error message "Change Unit system not permitted" is output if the unit system has not been successfully changed.
Bit 1.2	Length measuring	One of the 4 digital inputs (I1 to I4) can be parameterized as measuring function. Bit 1.2 activates the function (see Section 2.2.5). The length measuring can be used only as an alternative to flying measuring.
Bit 1.3	Retriggering the reference-point	active in all operating modes, except for Reference-Point Approach. Not active in Flying Actual-Value Setting. The axis is synchronized at each first positive edge of the zero mark and after leaving the reducing cam in the direction of the zero mark position. This is carried out only in the parameterized reference-approach direction. Independently of the current velocity, the current actual value is assigned the reference-point coordinate with consideration of an active shift. When retriggering at a velocity higher than the reducing velocity during reference-point approach, a displacement to the position reference made in the Reference-Point Approach can occur. This displacement depends on

		the velocity.

Symb ol	Name	Function
DS11: Bit-coded settings		
Bit 1.4	Enable input Off	One of the 4 digital inputs (I1 to I4) can be parameterized as enable input. Bit 1.4 switches the function of the enable input off (see Section 2.2).
Bit 1.5	Follow-up mode	Controlling of the axis is canceled. • can be switched on/off if "Processing running" = 0 • With external axis movement, the actual value follows. • active only on standstill of the axis.
Bit 1.6	Software limit switch monitoring	Switches software limit switch monitoring off; active in all operating modes (see Section 1.1.1).

Symb ol	Name	Function
DS12: Bit-coded commands		
Bit 1.1	Delete distance to go	• active only in the modes "Incremental dimension", "MDI", "Automatic Subsequent Block" after Stop. • With Start in the MDI mode, the active MDI block is processed from the beginning. • With Start in the modes "Incremental dimension" and "Automatic Subsequent Block", processing is continued with the next block.
Bit 1.2	Automatic block search forward	Activate automatic block search forward (see Section 3.7)
Bit 1.3	Automatic block search backward	Activate automatic block search backward (see Section 3.7)
Bit 1.5	Restart	Resetting of the axis: • Setpoint output and output of controller enable are interrupted over one position controller cycle. • The current status of processing is aborted, and, when using incremental encoders, the synchronization is deleted. • Active compensations are deleted.
Bit 1.6	Undo actual-value setting	The coordinate modified by "Actual-value setting" and "Flying actual-value setting" is reset to its original value (during "Processing running").

Symb ol	Name	Function
DS13	Zero offset	Zero offset is carried out on when the axis is on standstill. Exceptions: • In the modes "Incremental dimension", "MDI" and "Automatic Subsequent Block/Single Block", zero offset is possible only after block execution ("Position reached, Stop" set). • Not in case of interruption by Stop and following axis standstill.
DS14	Actual-value setting	When transferring the coordinate, the actual value is set to this value on standstill of the axis. The coordinates of the software limit switches remain unchanged. (see Section 1.1.1).

Symbol	Name	Function
DS15	Flying actual-value setting	Transferring the coordinate (new actual value) activates "Flying actual-value setting" (not in the Automatic Subsequent Block mode"). However, actual-value setting is initiated only with the edge of the respective digital input if "Processing running" = 1. Repeated "Flying actual-value setting" has to be activated by repeated transferring of "Flying actual-value setting". "Reference-point approach" and "Undo actual-value setting" reset the coordinate to its original value. **Note:** "Flying actual-value setting" in the Automatic Subsequent Block mode by means of G88, G89 (see Section 3.7).
DS16	Digital inputs/outputs	The outputs O1 ... O4 parameterized by "Direct output" using MD50 to MD53 can be controlled by means of the user program. The signal status of the digital inputs I1 ... I4 parameterized by MD46 to MD49 can be read by re-reading.
DS17	MDI block flying	see Section 3.6
DS18	Program selection	see Section 3.7
DS19	Application data request	Selection of max. four display data. The respective data are in DS29 "Application data". Code Table: **Code** **Description** 0 No parameter request 1 Actual position 2 Actual velocity 3 Distance to go 4 Set position 5 Zero offset 6 Speed (rotary axis) 7 Relative positioning time 17 Encoder actual value (motor encoder) 18 Missing pulses 19 K_V factor 20 Following error 21 Following error limit 22 s overshoot amount/switch adjustment value in the Reference-point Approach mode 23 Drive approach time /drive time constant in the Controlling mode 30 Actual position (IM) 31 Actual position (DM) 32 Relative path difference (IM-DM/DM) 40 Capability utilization 41 Active power 42 Nominal torque 43 Smoothed actual current 44 Actual speed 45 Nominal speed
DS20	Teach In	• possible only in the modes Setting-up, Incremental Dimension and MDI • In a program block selected by program and block number, the current actual position is entered as set position (**CAUTION:** absolute-dimension position).
DS22	Reference-point	The axis can be synchronized without reference-point approach

	setting	(see Section 3.1.3).

Data / Signals from the MCU

Check-back signals

The check-back signals indicate the processing status of the axis and signal it back to the user program.

The Table below described the check-back signals and their functions.

Table 4-4 Check-back signals

Symbol	Name	Value	Function
BAR	Active operating mode	1 ... 9	The selected operating mode is signaled back only if it is internally active. For example, when changing the operating mode, any movement must first be stopped before any other operating mode can be activated (not applicable when changing between Automatic Subsequent Block and Automatic Single Block mode).
FR+	Traversing plus	1	The axis moves to the direction of rising actual values or speed setpoint output "+" in the Controlling mode. • As soon as a traversing movement is active, the messages (FR+) or (FR-) are output in accordance with the traversing direction. Only one of the two messages can be provided. • "Traversing plus" or "Traversing minus" is selected already in the beginning of the acceleration phase and remains until standstill of the axis.
FR-	Traversing minus	1	The axis moves to the direction of falling actual-values or speed setpoint output "-" in the Controlling mode.
PEH	Position reached, stop; Exact stop	1	After the target position has been reached, PEH is selected. PEH remains until the next axis movement is started.
SFG	Start enable	1	Start enable signals readiness for positioning and readiness to output O1 to O4. • "Start enable" is set: - if no static stop, operating error, operator error or restart are provided. - if mode presetting and mode check-back coincide (after mode change) - if no axis functions (including M functions, dwell time) are active or after the functions have been completed. **Prerequisite:** Resetting of the signals (ST), (R+) or (R-) that activated the function or movement - to continue a function interrupted by Stop - in the Automatic Subsequent Block mode after program preselection has been carried out (one program active) and after M0, M2, M30 or in Automatic Single Block mode at the end of the block • Without Start Enable, functions that can be activated by Traversing Plus, Traversing Minus or Start are not carried out.
WFG	Waiting for external enable	1	The signal is active only if a digital input has been parameterized by means of MD46 to MD49 (see Section 2.1).

Symbol	Name	Value	Function
BL	Processing running	1	It is indicated that a function has been started by Start or Traversing Plus/Minus and is active. • "Processing running" is set in the following cases: - in the modes "Setting-up", "Controlling" during the movement up to standstill - in the mode "Reference-point approach" during approach up to the synchronization - in the modes "MDI", "Incremental dimension" during positioning or when functions of the MDI block are carried out - in the mode "Automatic Subsequent Block" when running a traversing program up to program end • "Processing running" is deleted: - by operating error, operator error and Restart - by mode change - by canceling axis enable
T-L	Dwell time running	1	active only in the modes "Automatic Subsequent Block" and "MDI". As soon as a traversing block with dwell time is executed, (T-L) is output during the programmed period of time.
PBR	Program execution backward	1	If a program is executed in the reverse direction, in the mode "Automatic Subsequent Block", PBR is set after Start.
AMF	Alter M function	1	• If M functions are programmed in a traversing block, they are signaled when being output by setting "Alter M function". • "Alter M function" remains as long as: - the preset time is elapsed for time-controlled M functions - acknowledgment by the user is carried out for acknowledgment-controlled M functions
MNR	M function No.	0... 99	M command 0...99
TFGS	Acknowledgment TFB	0 1	Controlling by the user program Controlling via MCU-PIT
FS	Operator error	1	Any operator/controlling error of the controlling interface is signaled to the user. The respective error number is to be found is diagnosis block 162.
BF	Operating error	1	Any operator/controlling error of the controlling interface is signaled to the user. The respective error number is to be found is diagnosis block 164.
PARA	Positioning control parameterized	1	The integrated positioning control has valid MDs.
NEUST	Restart	1	Restart has been carried out.
IFR	Pulses enabled	1	Check-back signal of pulse enable.
DF	Data error	1	An error has been detected during the data transfer. The respective error number is to be found in diagnosis block 163.
DI	Data interpretation running	1	A transferred data record is interpreted.
ME	End of measuring	1	Check-back signal "End of measuring" if a digital input (I1 to I4) is parameterized as measuring function.
SYN	Axis synchronized	1	Approach to the reference point of the axis concerned has been carried out (for incremental encoders/absolute encoders always "1").

Symbol	**Name**	**Value**	**Function**
S_I1	Digital input 1	0	Digital input I1 is active.
S_I2	Digital input 2	0	Digital input I2 is active.
S_I3	Digital input 3	0	Digital input I3 is active.
S_I4	Digital input 4	0	Digital input I4 is active.

Display data

Display data are data/parameters that are signaled back from the MCU. The Table below describes the display data and their functions.

Table 4-5 Display data

Symbol	Name	Function/Description
DS26	Operating data	Actual position Actual velocity Distance to go Set position Zero offset Actual speed (rotary axis) Relative positioning time
DS27	Active NC block	see Section 5 or Tables Section 3.1.1 or 3.5
DS28	Next NC block	Structure as active NC block (see Section 5, Tables Section 3.1.1 or 3.5).
DS29	Application data	The display data selected via DS19 "Application data request" are output via DS29.
DS30	Length measuring, flying measuring	Values of length measuring if MD46 ... MD49 are respectively parameterized and the respective enables in DS11 are set. Actual position of front edge (s1) Actual position of rear edge (s2) Measuring value (s = s2 - s1)
DS31	Actual value Block change	With G50, G88 or G89 are programmed, the actual values are output (see Section 5)
DS32	Service data	Nominal speed value Encoder actual value Missing pulses Kv factor Following error Following error limit s overshoot amount/switch adjustment in the reference-point Approach mode Drive approach time /time constant of drive in the Controlling mode
DS33	Service data 1	Actual position (IM) Actual position (DM) Relative path difference (IM-DM/DM)
DS34	Operating data 1	Override Program number Block number Number/counter of subroutine calls Active G90/G91 Active G60/G64 Active G43/G44 Active D number Limiting of max. velocity Limiting of max. nominal speed value Limiting of max. acceleration
DS36	Actual data 611	Output actual values of SIMODRIVE 611 (see Tables Section 3.1.1).
DS162	Error message Operator error	Error number, automatically updated.
DS163	Error message Data error	Error number, automatically updated.
DS16	Error message	Error number, automatically updated.

Symbol	Name	Function/Description
4	Operat./traversing error	
DS235	Information data record	is read by FC RESTART once during running-up.

User Handling

Overview

The Table below provides an overview which data/parameters can be accepted or processed in which operating mode.

Table 4-6 Assignment of system data to the operating modes

DS-No.	Function	Setting-up	Contr.	Reference point approach	Increm. dim.	Manual Data Input	Automatic Subsequent/ Single Block	Function generator	Measur. Function
		ER	ST	REF	SM	MDI	AF/AE	FG	ME
	Scheduled data								
2	Velocity steps	x	-	-	x	-	-	-	-
3	Speed steps in controlling	-	x	-	-	-	-	-	-
4	Setpoint for incremental dimension	-	-	-	x	-	-	-	-
7	MDI block	-	-	-	-	x	-	-	-
8	Scheduled data 611	x	x	x	x	x	x	-	-
	Scheduled data with execution instruction								
11	Bit-coded settings	x	x	x	x	x	x	x	x
12	Bit-coded commands	x	x	x	x	x	x	-	-
13	Zero offset	x	x	-	x	x	x	x	x
14	Actual-value setting	x	x	-	x	x	x	x	x
15	Flying actual-value setting	x	x	-	x	x	-	-	-
16	Digital outputs/inputs	x	x	x	x	x	x	x	x
17	Flying MDI block	-	-	-	-	x	-	-	-
18	Program selection	-	-	-	-	-	x	-	-
19	Application data request	x	x	x	x	x	x	-	-
20	Teach In	x	-	-	x	x	-	-	-
22	Reference-point setting	x	x	x	x	x	-	-	-
	Display data								
26	Operating data	x	x	x	x	x	x	-	-
27	Active NC block	-	-	-	-	-	x	-	-
28	Next NC block	-	-	-	-	-	x	-	-
29	Application data	x	x	x	x	x	x	-	-
30	Length measured value, flying measuring	x	x	-	x	x	x	-	-

31	Actual value - block change	-	-	-	-	-	x	-	-
32	Service data	x	x	x	x	x	x	-	-
33	Service data 1	x	x	x	x	x	x	-	-
34	Operating data 1	x	x	x	x	x	x	-	-
36	Actual data 611	x	x	x	x	x	x	-	-
162	Error message Operator error	x	x	x	x	x	x	-	-
163	Error message Data error	x	x	x	x	x	x	-	-
164	Error message Operating/traversing error	x	x	x	x	x	x	-	-

x Data/parameters essential for the operating mode concerned

- Data/parameters not essential for the operating mode concerned

Notes for the user

In the following, some notes for starting a movement and the behavior of the MCU when the integrated S7-CPU changes its condition are provided:

- First, an operating mode must be set. Then, the data can be transferred. To prevent the axis from uncontrolled traversing, controller enable should not be set.
- Starting a movement is possible only with Start Enable provided (mode active, no Stop, Drive Enable).
- A static Stop signal (STP) will prevent any movement or block execution.
- Edge formation of Start or Direction Plus/Minus:
  These signals should only be reset after deleting Start Enable.
- Before starting any movement in any mode of operation, first the respective scheduled data have to be transferred.
- Behavior of the MCU during the transition of the S7-CPU from the RUN to the STOP condition: as described under "Restart".
- Behavior of the MCU during the transition of the S7-CPU from the STOP to the RUN condition:
  - A restart of the positioning module is carried out internally.
  - Activate the MDs.

Controlling the module

The Table below lists the data/parameters for starting a movement.

Table 4-7 Starting a movement

Mode (BA)	**BA-No.**	**Operating mode parameters (BAP)**	**Command / signal status**	**Activation of movement**
Setting-up	1	Velocity step 1 = Step 1 2 = Step 2	R+, R- / level	R+ or R- with "level" = 1
Controlling	2	Speed step 1 = Step 1 2 = Step 2	R+, R- / level	R+ or R- with "level" = 1
Reference-point approach	3	-	Start, R+, R- / edge	Direction acc. to MD18 R+ or R- = 0 → 1 or Start = 0 → 1 (velocity acc. to MD)
Incremental dimension	4	Setpoint No. 1...100, 254	R+, R- / edge	R+ = 0 → 1 or R- = 0 → 1 (velocity step 1)
MDI	6	-	Start / edge	Start = 0 → 1 (R+, R- only important for rotary axis with preset absolute dimension for direction selection)
Automatic Subsequent Block	8	-	Start / edge	Start = 0 → 1 (after program preselection)
Automatic Single Block	9	-	Start / edge	Start = 0 → 1
Function generator	20	-	Start (via MCU-PIT only)	-
Measuring function	21	-	Start (via MCU-PIT only)	-

The Table below lists the data/parameters for interrupting/completing a movement.

Table 4-8 Interrupting/completing a movement

Mode (BA)	**BA No.**	**Interrupting the movement**	**Continuation of movement**	**Interrupting/completing the movement, Stop**
Setting-up	1	Stop = 1 or enable input[1] = 0	Stop = 0 and Start = 1 or enable input[1] = 1	R+ or R- with "level" = 0 or mode change
Controllin g	2	Stop = 1 or enable input[1] = 0	Stop = 0 and Start = 1 or enable input[1] = 1	R+ or R- with "level" = 0 or mode change
Reference -point approach	3	-	-	Stop = 0 $\rightarrow$ 1 or reference point acquired or mode change or enable input[1] = 0
Increment al dimension	4	Stop = 1 or enable input[1] = 0	Stop = 0 and R+ or R- or enable input[1] = 1, with Start = 0 $\rightarrow$ 1	Position reached or mode change
MDI	6	Stop = 1 or enable input[1] = 0	Stop = 0 and Start = 1 or enable input[1] = 1, with Start = 0 $\rightarrow$ 1	Position reached or "block" executed or mode change
Automatic Subseque nt Block	8	Stop = 1 or enable input[1] = 0	Stop = 0 and Start = 1 or enable input[1] = 1, with Start = 0 $\rightarrow$ 1	Program end or mode change program re-selection at Stop
Automatic Single Block	9	Stop = 1 or enable input[1] = 0	Stop = 0 and Start = 1 or enable input[1] = 1, with Start = 0 $\rightarrow$ 1	Program end or mode change program re-selection at Stop
Function generator	20	Stop (via MCU-PIT only)	Start (via MCU-PIT only)	Stop (via MCU-PIT only)
Measurin g function	21	Stop (via MCU-PIT only)	Start (via MCU-PIT only)	Measuring function carried out or Stop (via MCU-PIT only)
1) **Prerequisite:** digital input parameterized in MD46 ... MD49, see Section 2.1				

Programming

Contents

Fundamentals

Overview

To execute the desired operations of the machine axis (sequence, position, etc.), the MCU requires certain information. This information is programmed by means of MCU-PIT (traversing program development) as a traversing program (oriented to DIN 66025).

Traversing programs

Each traversing program is stored under a program number. A traversing program consists of max. 255 traversing blocks. Program number and traversing blocks are converted into an internal format (*Traversing Blocks*) and transferred to the module where the program is managed. Max. 199 programs (depending on the memory capacity) can be programmed.

Program name

Each program can be assigned a name (optionally). The program name has max. 18 characters and is stored in the program.

Program number

Program numbers from 1 to 199 are possible.

Traversing block

A traversing block contains all data required to execute an operation.

Program structure

A program consists of several blocks. Each program number exists only once. A program is executed in the rising sequence of block numbers.

In the following, an example of program structure:

N5 G90 X500000 F100000 M10	program beginning = lowest block No.
N6 G91 ...	
N7 ...	
N45 ...	
N46 M2	Program end = M2 or M30

Traversing Blocks

Block Structure

Overview

The Figure below provides an overview of the structure of the traversing blocks.

/	N	G1	G2	G3	X / t	F	M1	M2	M3	D	P	L

/	Marking of a skippable block
N	Block number
G1	G function of 1st function group
G2	G function of 2nd function group
G3	G function of 3rd function group
X/t	Position/dwell time
F	Velocity
M1	M function of 1st function group
M2	M function of 2nd function group
M3	M function of 3rd function group
D	Tool offset number
P	Number of subroutine calls
L	Call of a program as subroutine

Skippable blocks"/"

Program blocks not to be executed in each program cycle can be marked as skippable blocks by the symbol "/". During program execution, it can be decided by means of the control signal "Skip block" to sip skippable blocks. The last block may not be skipped.

Block number N

Block numbers N from 1 to 255 are possible. The program is executed in rising sequence of the block numbers or, with backward processing, in falling sequence.

Comments

Comments can be entered in brackets. The comments are not entered in the module but in a file created by and saved under of MCU-PIT. After reading out a traversing program from the MCU, the comments do not exist any more.

G Function Group 1...3

Overview

Only one G function of each G function group can be entered per traversing block, for example:

```
N10  G90  G34  G43  X1000000  F40000  M10
```

G functions

The Table below lists the possible G functions of the individual G function groups:

Table 0-1 G functions

G No.	G Function	G Function Group
04 s	Dwell time	1
87 s	Canceling of measuring-system offset for flying actual-value setting	
88 s	Endless traversing (-) for flying actual-value setting	
89 s	Endless traversing (+) for flying actual-value setting	
90 m	Absolute dimension	
91 m	Incremental dimension	
30 m 31 m 32 m . . . 39 m	100 % override acceleration/deceleration 10 % override acceleration/deceleration 20 % override acceleration/deceleration . . . 90 % override acceleration/deceleration	2
43 m	Tool offset (+)	3
44 m	Tool offset (-)	
50 s	External block change	
60 m	Block change - exact positioning	
64 m	Flying block change, continuous-path control operation	

G30, G90 and G64 are the default settings after starting the program. G functions active block by block are marked with an **s**, and modally active G functions by an **m**.

Note:

The use of the G function numbers partly differs from the current DIN 66025.

Dwell time G04

Except this G function and indication of time, a block with dwell time can only contain M functions. For the dwell time, the following is applicable:

Designation	Lower input limit	Upper input limit	Unit
Dwell time	2	100000	ms

Input values are internally rounded to multiple of the parameterized position controller cycle. Dwell times are active only block by block.

Example: G04 X1000, whereby X is the axis name.

Block change G60, G64 (approach conditions)

With **G60**, the programmed position is exactly approached and the feed motion stopped (block change - exact positioning). **G64** causes the following block to be executed immediately when reaching the brake threshold (flying block change). **G60 and G64** exclude each other and are self-maintained commands. M commands have influence on the **G64** mode (see 0 *Flying Block Change G64*).

External block change (G50) with deletion of distance to go

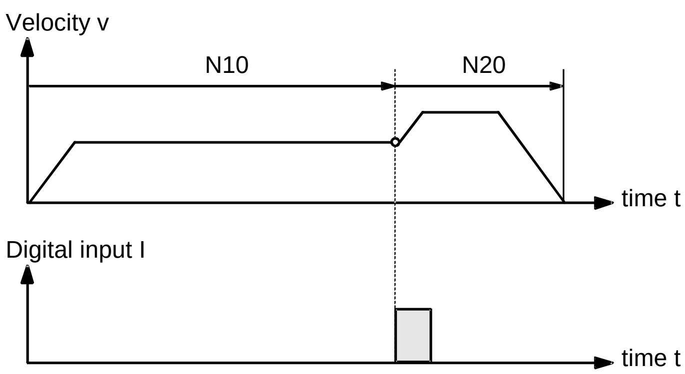
The function "External block change" triggered by a digital input carries out a flying block change. To this aim, the fast input must be parameterized with the function "External block change" via the machine data MD46 (I1) to MD49 (I4).

The function is active only block by block (no influence on G60 and G64).

Example "External block change"

The Figures below illustrate the program structure and the program run of an example for "external block change":

```
N10  G50  X100000
N20  ...
```



Note:

The external block change is also carried out when the read-in enable (EFG=0) is not provided.

Explanations on the example "External block change"

The axis moves as long as a signal change from 0 to 1 is carried out at the digital input. This initiates the following two reactions:

- Flying block change and thus immediate execution of block N20
- Storing of the actual position at the time of abovementioned signal change as "Actual value - block change". This position is also the starting position for any following programming in incremental dimensions.

Depending on the situation, N20 is executed as follows:

- If the block position in N20 is smaller than the actual position at the time when the digital input is provided (reversal of direction), the movement is stopped to approach then position in the opposite direction.
- If no position is programmed in block N20, the movement is stopped, the functions programmed in N20 executed and continued with the next block (except if M0, M2, M30 is provided in the block)
- If the programmed path in N20 is smaller than the braking distance, the programmed position is overtraveled and then positioned by reversal of direction.

If no block change is carried out at the digital input, the target position of N10 is approached with further following behavior:

- On reaching the target position, the error message "Digital input not selected" is output.
- In this case, program execution can be continued from block number N20 by Start after the error has been acknowledged.
- If program execution is desired to start at the beginning, program preselection is to be repeated.

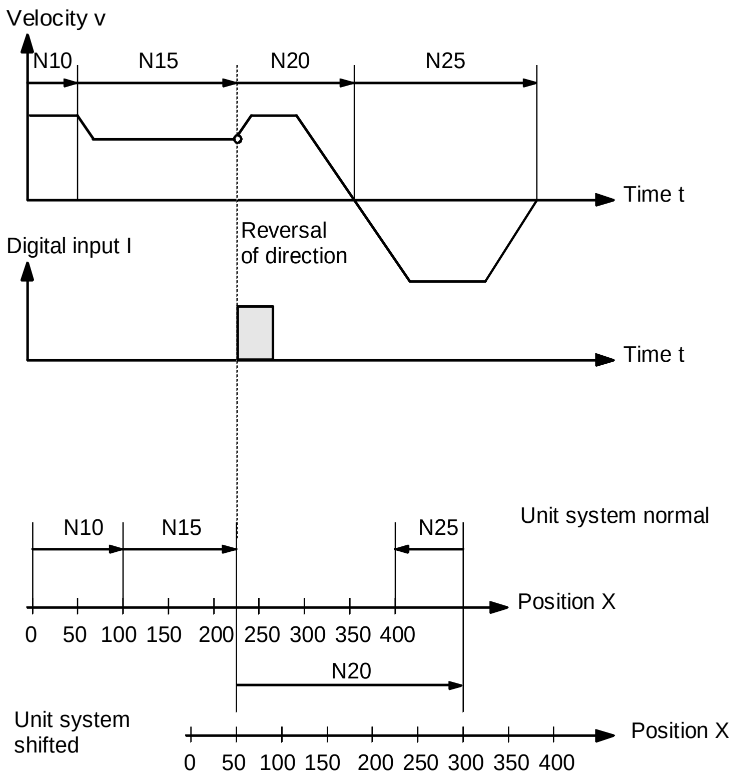
Flying actual-value setting G87, G88, G89

The function "Flying actual-value setting" is programmed and triggered by a digital input; block change is carried out flying, and at the same time the actual value is set to a new dimension (programmed coordinate). The digital input must be parameterized with the function "Flying actual-value setting" via the machine data MD46 (I1) to MD49 (I4).

Example "Flying actual-value setting"

The Figures below show the program structure, program flow and actual-value characteristic of an example for "flying actual-value setting":

```
N10  G90  X100  F400000
N15  G89  (G88)  X50  F200000
N20  G90  X300  F400000
N25  G87  X400  F400000
```



Explanations on the example "Flying actual-value setting"

Flying actual-value setting from **N10 to N15**, with G89 resulting a movement in positive direction, and G88 resulting a movement in negative direction with the velocity programmed in N15. The axis will now move to the preset direction until a **positive edge change** is carried out at the digital input. This will result in the following responses:

- Flying block change and immediate execution of block N20
- Flying actual-value setting to the block position of N15 and thus shifting of the coordinate system
- Saving of the current actual value

The programmed position in block **N20** refers to the shifted coordinate system.

By the block change from **N20 to N25**, G87 cancels the shift of the coordinate system and causes an absolute-dimension programming to the block position of **N25**.

The saved actual value can be read out via "Actual value - block change".

The shift of the coordinate system remains as long as it is canceled either by G87 or by mode change. it is possible to use the existing shift of the coordinate system in different programs. The coordinate system can be shifted without first canceling any existing coordinate system shift.

G88, G89 can be programmed several times. The shift always refers to the original condition. The software limit switches are also shifted together with the coordinate system.

If the signal change of the digital input fails, the axis moves until the limit switches are reached.

Note:

The G functions G87, G88 and G89 are active only block by block and must be reselected if needed.

After a block with G87, G88 or G89, G90 or G91 must be reselected.

Dimensional Notation

Dimensional notation G90, G91

The traversing movement to a certain position can be described by:

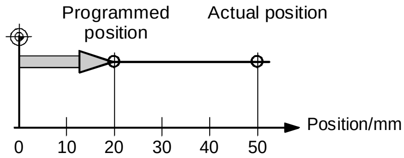
- Absolute dimension input (absolute position data input) G90 or
- Incremental dimension input (relative dimension input) G91

It is possible to change between absolute dimension input and incremental dimension input at the block limits as desired. The condition when the system is switched on is absolute dimension programming G90. G90 and G91 are maintained commands.

Absolute dimension input G90

Absolute dimension inputs are absolute dimensions referring to the coordinate system:

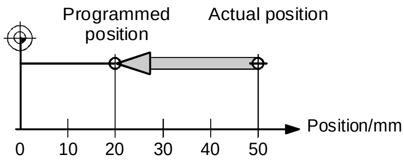
```
N10  G90  X20  F100
```



Incremental dimension input G91

Incremental dimensions refer to the last actual position.

```
N10  G91  X-30  F100
```



Axis as Rotary Axis

Adaptation of measuring system

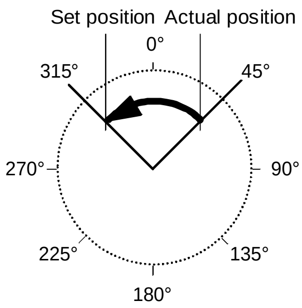
When operating the axis as rotary axis, the measuring system should be adapted such that the dimensional scaling refers to the full circle (e. g. 0° and 360°).

Absolute dimension input G90

With a full circle of 360°, the particularity of absolute dimension programming (G90) is that there are always two possibilities to reach the set position.

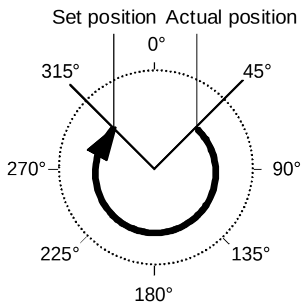
```
N10  G90  X315  F100
```

Possibility 1



Possibility 2

when presetting directionR+



With G90, the axis always automatically selects the shorter way to reach the set position of 45°, via 0° to 315°.

The desired direction of the axis can be enforced by means of the control signals (R+) and (R-). In this example, from 45° via 180° to 315°, (R+) and (R-) must already have been provided when positioning (Start) is activated.

Note:

The direction (R+) or (R-) must be preset in time. It is not possible to enforce the currently active traversing block the traversing direction later.

Incremental dimension input G91

With the incremental dimension programming G91, the direction of rotation of the rotary axis results from the sign of the position setpoint. It is possible to program several revolutions by entering a value larger than 360° as position setpoint.

MD8, MD9
MD21, MD22

MD	Designation	Value/description	Unit
8	Axis type	0 = linear axis 1 = rotary axis	-
9	End of rotary axis	1 ... 1 000 000 000 • End of rotary axis: overflow value of distance indication • integer multiple of (MD11 +2^{-32} x MD12) or (MD55 +2^{-32} x MD56)	[MSR]
21	Software limit switch beginning	-1 000 000 000...<MD22 Rotary axis: 0...<MD22 If you wish to travel across the value of MD9 (end of rotary axis), MD21 and MD22 must be set to the maximum value.	[MSR]
22	Software limit switch end	> MD21...+ 1 000 000 000 If you wish to travel across the value of MD9 (end of rotary axis), MD21 and MD22 must be set to the maximum value.	[MSR]

Note!

From firmware version V3.20 on, MD9 can be entered for the configuration below, regardless of MD11/MD12 or MD55/MD56:

- incremental encoder (see MD10 or MD54)
- referencing by means of the reference-point switch (see MD18)

However, it should be considered that the values in MD9 can only be entered with the accuracy of MD11 and MD55, respectively.

Acceleration Override

Overview

The acceleration override can be used to influence both the acceleration and the deceleration behavior of positioning. The acceleration and deceleration values are set by machine data. G30 to G39 can be used to obtain a percentage reduction of both values in the traversing block. These functions are maintained functions. Changing of the acceleration override in the program prevents flying block change. The consequence is that G60 behavior is enforced in the previous block.

G Function

30 100 % Override acceleration/deceleration

31 10 % Override acceleration/deceleration

to

39 90 % Override acceleration /deceleration

Cancellation

The acceleration override is canceled in the following cases:

- operating mode change
- resetting the axis by the control signal (RST)
- program change and program end

Tool Offset

Overview

The tool offset (WZK) provides the possibility to reuse an existing machining program also after changing the tool dimensions.

G43 and G44
D0...D20

The tool offset is selected by G43 or G44 with indication of the tool offset number D1...D20. The tool offset is canceled by G43 or G44 with indication of the tool offset number D0.

Totally, 20 tool offset memories and tool wear memories are available. The offset values must first be loaded into the module. Any values not agreed have the value 0. The values are loaded into the module via the DB-WK and stored as retentive data. Both with selection, reselection and canceling, the tool offset is considered only during the next following positioning.

Cancellation

Any selected tool offset remains as long as it is either canceled or replaced by a new one. Just as well, a mode change, program change or program end results in canceling of the tool offset.

Variants of tool offset

The tool offset consists of tool length compensation and tool length wear:

- Tool length compensation

  By tool length compensation, the real tool length from the tool zero point to the tool tip is meant.

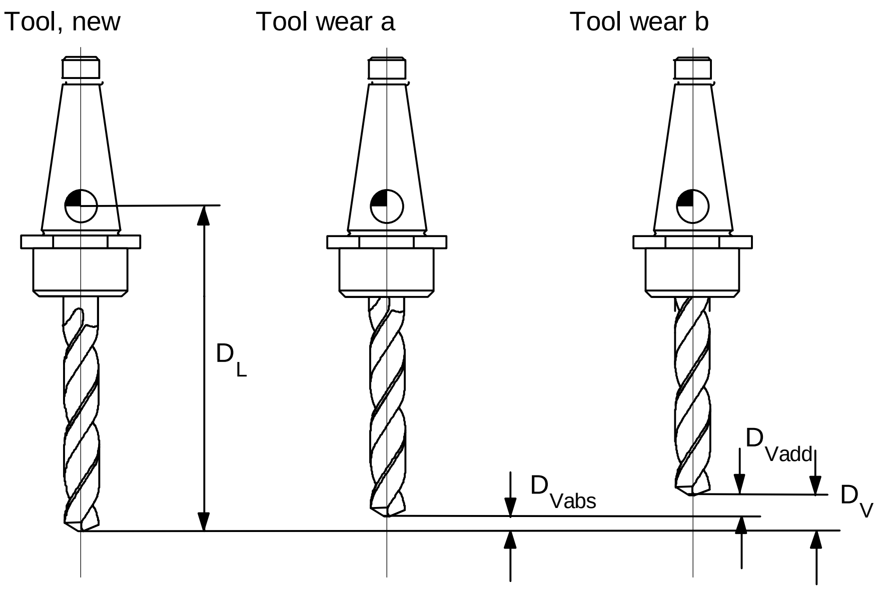
- Tool length wear

  The tool length wear can be used to compensate the tool length change due to wear by using two methods:

  absolute: defining a fixed wear value

  additive: An "offset value" is added to the current contents of the tool length wear.

Tool offset represented as a Figure



$D = D_L - D_V$

$D_V = D_{Vabs} + D_{Vadd}$

D	Tool offset
D_L	Tool length offset (positive or negative)
D_V	Tool length wear (positive or negative)
D_{Vabs}	Wear, absolute (positive or negative)
D_{Vadd}	Wear, additive (absolute amount)

Programming and deleting the tool offset

In order to program a tool offset in a traversing block, as least the tool length offset must be entered. If despite of the selection, no offset is to be calculated, "0" must be preset for tool length offset and tool length wear.

The tool length wear is deleted by absolute entering of 0.

Direction of tool offset

The functions G44 (-) and G43 (+) are used to correct the positional value such that the tool tip reaches the programmed set position.

- **Tool offset negative G44**

  Usually, the tool points in negative direction to the workpiece. When feeding the tool, the positional value is getting smaller.

  Referred to the measuring system, the following position is approached:

  $X_{ms} = X_{set} + (D)$

X_{ms}	Position of measuring system
X_{soll}	Programmed set position
D	Tool offset

- **Tool offset positive G43**

  When feeding the tool, the positional value is getting larger. The positional value is compensated by:

  $X_{ms} = X_{set} - (D)$

Position and Velocity

Position

Positions can be entered either with a negative or a positive sign. When entering positive values, the sign can be omitted.

Designation	Lower input limit	Upper input limit	Unit
Position	- 1 000 000 000	+ 1 000 000 000	[MSR]

Velocity

The entered velocity is included in the calculation with the override. If the velocity value is entered larger than the maximum permissible velocity, the value is limited to the value set in machine data 23. The velocities are maintained and must only be re-entered if any changes have been done.

Designation	Lower input limit	Upper input limit	Unit
Velocity	10	500 000 000	[MSR]/min

M Functions

Overview

Max. three M functions can be programmed in a traversing block whereby M1, M2 and M3 can be used in any way. The output sequence of the M functions is always:
M1⇒M2⇒M3 (explanations on output see Section 5.4).

In the following, an example:

```
N10  G90  G34  G43  X100000  F40000  M10  M11  M12  D1
```

Table 0-2 M functions

M No.	M function	M Function group
0	Stop at block end	1
2, 30	Program end	1
1... 17	User functions	1, 2, 3
18	Endless cycle (jump to program beginning)	1
19.. .96	User functions	1, 2, 3
97, 98	Change signal can be programmed as digital input	1, 2, 3
99	User functions	1, 2, 3

M0, M2, M18 and M30 are always output at the end of the traversing movement. M0, M2, M18 and M30 in a block exclude each other.

Stop at block end M0

If M No. 0 is programmed in a traversing block as M function, execution of the traversing block stops at the end of the block, and M0 is output. The program is only continued when a new START edge is provided.

Program end M2, M30

M2 and M30 have the same function. If M2 or M30 are programmed in the same block, the M function is output with following program stop and jump to the program beginning after positioning. The program can be restarted by the start edge. M2 and M30, respectively, is always the last output in the block.

After the program has been called as subroutine, jump to the main program is carried out. In this case, M2 and M30, resp., are not output.

Endless cycle M18

M18 is always output as the last M function in the block. The following cases are differed:

- M function M18 is output as any other M function. Only after the block has completely been executed (including M18), return to the program beginning is carried out.
- If the M function M18 is programmed alone in the last block of a traversing program, the M function is not output, but an immediate return to the program beginning is carried out (jumping axis).
- M18 in a subroutine is not permitted.

Change signal as digital output M97, M98

If M97 or M98 are programmed in the same block, the M functions are output via the digital outputs according to the entry in the machine data MD50 (O1) to MD53 (O4), analogously to the output at the signal interface.

M functions in blocks with G50, G88 and G89

In a block with G50, G88 or G89, no M functions marked with "after positioning" are output.

If the following block contains M functions marked with "prior to positioning", the movement is stopped to standstill, the M functions output and then the remaining distance positioned.

MD32, MD33

MD32 defines the output type of the M functions:

prior to, during or after positioning, time-controlled or acknowledgment-controlled. With time-controlled output, the output time of the M functions is set by MD33.

MD	Designation	Value/description	Unit
32	Output type of M function	1 = during the positioning, time-controlled 2 = during the positioning, acknowledgment-controlled 3 = prior to positioning, time-controlled 4 = prior to positioning, acknowledgment-controlled 5 = after positioning, time-controlled 6 = after positioning, acknowledgment-controlled	
33	Output time of M function	1 ... 100 000	ms

Subroutine Call

Subroutine call P, L

A block containing a subroutine call (L is the "program number", P is the "Number of calls") may not contain any other information.

In a program, max. 20 different subroutines can be called.

Designation	Lower input limit	Upper input limit
P = Number of subroutine calls	1	250

Flow of Programs and Direction of Processing

Processing forward

Usually, the programs are processed in rising sequence of the block numbers.

Processing backward

When processing programs backward, the effect of the commands must be observed during programming:

- The commands are maintained (G90, G91, G60, G64, G30...G39).
- Active tool offset (G43, G44, D0...D20)
- Change of the coordinate system via G87, G88, G89

For these reasons, forward processing can differ from backward processing both in geometry and in the block transition behavior.

Block Transitions

Overview

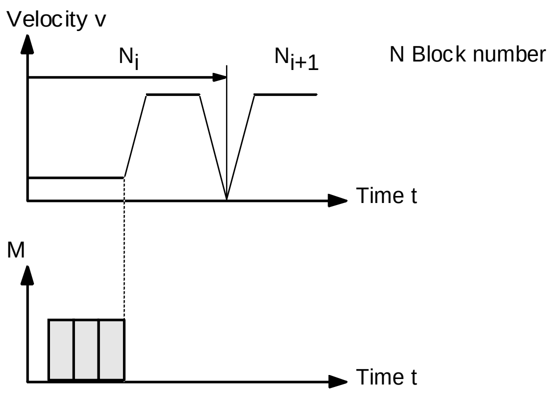
This Chapter describes the influence of certain commands on block transitions.

Exact Positioning G60

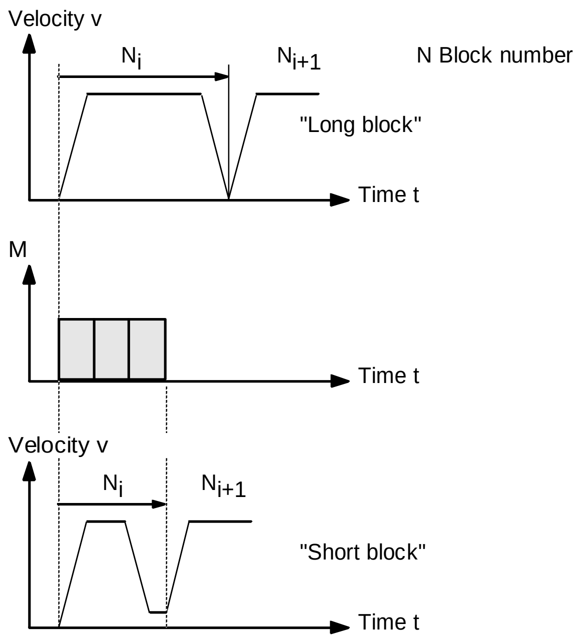
Exact positioning G60

G60 operation is overlaid by G50, G88 to G89 (enforce flying block change). Block changing is carried out when reaching the exact-positioning window. MD32 determines the output type of the M functions: prior to, during, or after positioning, time-controlled or acknowledgment-controlled.

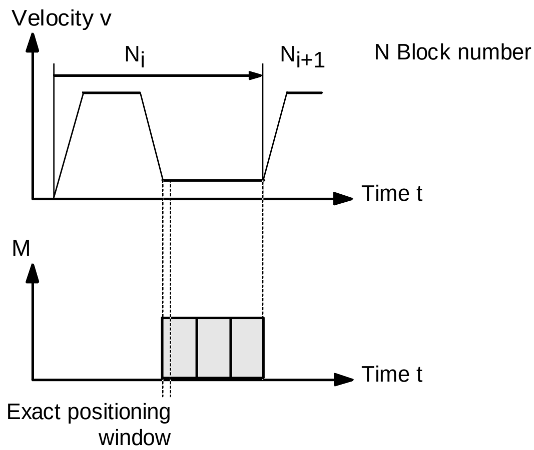
Output of M function prior to positioning



Output of M function during the positioning



Output of M function after positioning



Flying Block Change G64

Overview

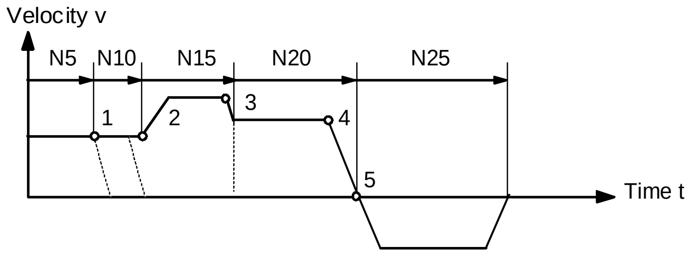
Changing from one traversing block to the next is carried out without stopping the axis. With the G64 function programmed, the acceleration and braking function is calculated for several blocks. 3 blocks are prepared in advance.

Feed change during block change is carried out such that in the path section of a block in no case a higher velocity of an "adjacent block" becomes or remains active. That means any acceleration starts at the starting point of a block whereas a deceleration to a lower velocity of a subsequent block is initiated as with G60. When reaching the velocity of the following block, the distance to go of the active block is traversed with the feed of the following block.

Standard case

The Figure below shows a programming example with program flow for the standard case:

```
N5  G90  G64  X10000  F10000
N10  X20000  M10  M11  M12
N15  X30000  F20000
N20  X40000  F15000
N25  G64  X30000  F10000
```



1 In the brake threshold point of N5, block N10 is started.

2 In the brake threshold point of N10, N15 is started. Once the set position of N10 is reached, acceleration to the higher traversing speed is carried out.

3 In the brake threshold point of N15, N20 is started at a lower traversing speed.

4 When changing the direction of traversing, the axis brakes to standstill and waits as long as the actual value of the position encoder has reached the exact-positioning window.

5 Once the exact-positioning window is reached, acceleration to the opposite direction to the traversing speed of the new block is carried out.

To approach a position correctly, the axis has to calculate the brake threshold point. The parameters required for the calculation are the distance to go, the deceleration value and the current traversing speed.

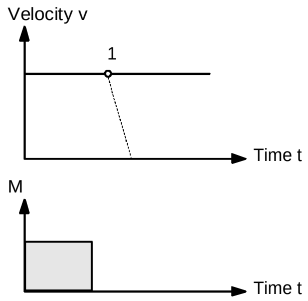
The brake threshold point is at the same time the earliest possible block change moment.

Deceleration

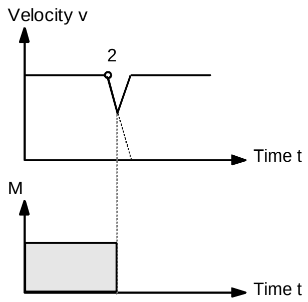
There are different conditions decelerating or preventing the flying block change. in this context, it must be made a difference whether the flying block change is deliberately prevented, or whether the selected function does not permit the flying block change.

- Preventing the flying block change
  - Canceling the control signal "Read-in enable" stops program execution at the end of the current block. To continue the program, it must be re-entered.
  - by outputting the M function prior to or after positioning.
  - by the M function M0 (stop at block end). To continue the program, the control signal START must be re-entered.
  - by a block with dwell time.
  - by program execution in the Automatic Single Block mode. Each block must be activated separately by START.
  - Change of acceleration override

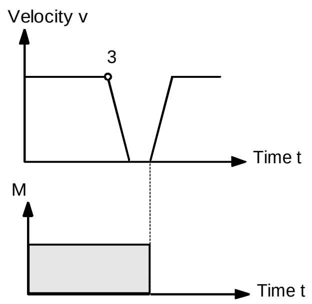
- Functions preventing the flying block change by themselves.
  M functions (during the positioning)



1 Because the M output is completed at the brake threshold point, a flying block change is carried out.



2 At the brake threshold point, the M output is not yet completed. The axis starts braking. At the end of output of the M function, the axis starts (flying transition from the deceleration ramp to the acceleration ramp).



3 The axis comes to full standstill and waits for the end of the M output.

Influence of M Functions on the Flying Change

Influence of M functions on the flying change - machine data

The output time of the M functions can be set by means of machine data:

- M function output prior to or after positioning with block change

  M function output and positioning alternate with each other.

  - M function outputs prior to positioning result in exact positioning behavior in the preceding block.
  - M function outputs after positioning result in exact positioning behavior in the block.

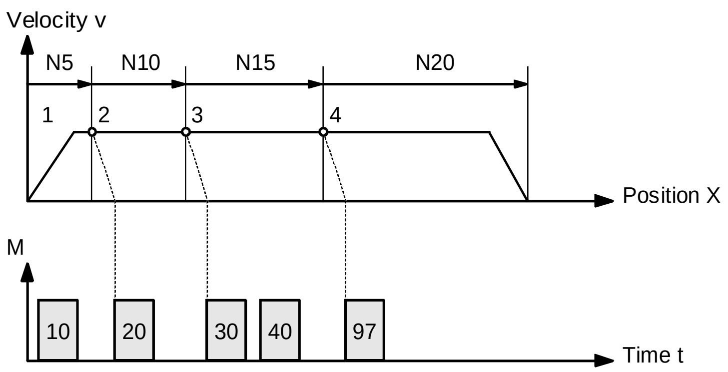
- M function output during the positioning

  M function output and positioning are carried out at the same time.

Program example

The Figure below shows a program example with M function output during the positioning.

```
N5 G90 X10000 F10000 M10
N10 X20000 M20
N15 X30000 F20000 M30 M40
N20 G60 X40000 F15000 M97
```



1 The output of M10 is not path-dependent, as no relevant position exists for the path-dependent M function.

2 The block change from N5 to N10 prepares the output. However, the M function is carried out only after the actual position has reached the programmed position of N5.

3 If two functions are programmed in a traversing block, the first M function is output path-dependent and then the second M function.

4 The change signal for M97 and M98 is output with G64 block transition (digital output) after the actual position has reached the programmed position of the block. The actual position follows the set position (difference = tracking distance).

6 Appendix

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Z

Preface 1

Introduction 2

Set-up and Installation 3

PIT-EDIT 4

PIT-CONTROL 5

Hints on Windows 6

Appendix 7

SIMODRIVE 611

Single-Axis Positioning Control MCU 172A

User's Guide
Description MCU-PIT

Valid for:

MCU-PIT	
PIT-EDIT	V3.x
PIT-CONTROL	V3.x
Technological Functions	V3.x
MCU 172A	V3.x
STEP 7	V2.x

Edition January 1997

Note:

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please enquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

1 Preface

What does MCU-PIT mean?

MCU is the abbreviation for Motion Control Unit.
PIT stands for Parameterizing and Commissioning Tool. In other words, the MCU-PIT software package can be used for the complete parameterizing and commissioning of the single-axis positioning control MCU 172A.

What does this description contain?

This MCU-PIT Documentation describes the installation and the necessary hardware and software conditions. Various screen forms are presented as examples to explain operation.

The scope of application, contents and target group of the overall documentation on the single-axis positioning control MCU 172A are to be found on the cover pages.

For whom is this description intended?

This MCU-PIT Documentation is aimed at software project designers, and commissioning and service technicians. All target personnel must possess the qualifications specified under the definition on page 1-2.

Is previous knowledge necessary?

General safety regulations, VDE regulations and specific local regulations retain their full validity alongside this Description.

Good knowledge in working both with Windows and with the single-axis positioning control MCU 172A are prerequisites for work with the MCU-PIT software package.

Finding your way about

This Documentation is divided into the sections:
- design
- installation
- operation

In addition you will find an overview of functions, hints on working with Windows and lists of the individual functions available in the menus.

Would you like to see any improvements?

Please write and tell us, if there is any part of this Documentation you are not fully happy with. We look forward to receiving your suggestions for improvements and have included a form at the end of this Documentation. We will try to take your proposals into account in future editions.

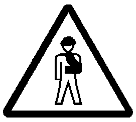
Qualified personnel

Persons who are conversant with the setting up, assembly, commissioning and operation of the product, and who possess qualifications appropriate to their field of work. For example:

- Training, instruction or authorization to switch, to ground and to mark circuits and devices in accordance with recognized standards for safety equipment.
- Training or instruction in the maintenance and use of appropriate safety devices in accordance with recognized standards for safety equipment.
- Knowledge of the functioning of the MCU, especially the positioning functions and their operation via a PLC program or via MCU-PIT.

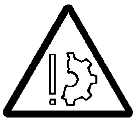
Warning symbols

Your particular attention is drawn to important information in this Documentation. The following warning symbols are used:



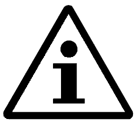
Prevent personal injury!

This symbol warns you of possible dangers for personnel. Pay particular attention to the information given alongside this symbol. Improper actions may endanger life or health.



Prevent material damage!

This symbol warns you of risks of material damage. The information given next to this symbols informs you on how to avoid damage to your machine or workpiece.



Note!

This symbol is used to indicate other particularly important information. This information helps you to prevent disturbances to the proper operating process.

2 Introduction

Scope of application

The MCU-PIT software serves to parameterize and commission the single-axis positioning control MCU 172A from the SIMODRIVE 611 family. It supports the simple programming and planning of data blocks. The software furthermore assists you during commissioning and servicing. MCU-PIT comprises two mutually complementary applications: PIT-EDIT and PIT-CONTROL. The MCU-PIT software also includes an online help system in the form of a paperless documentation SYSDOK-MCU.

PIT-EDIT

The project tool PIT-EDIT offers a simple and fast way to create and save data blocks, which can then be made available rapidly and independently for commissioning or service purposes.

PIT-CONTROL

The functions "Machine control panel" and "Drive commissioning" are available in PIT-CONTROL for the positioning, diagnosis and optimizing of the axes.

Features

The MCU-PIT software offers you the following advantages:

- simple handling through user guidance on the basis of Windows95
- fast and flexible project planning and commissioning through offline planning in the office
- optimum control both with the mouse in the office and without a mouse at the machine
- fast command selection by way of context menus (via the right mouse button)
- simple handling thanks to syntax checks, status lines and info windows
- high degree of reliability in the case of defects in individual modules through central archiving of data on the PG/PC
- simple and fast drive commissioning thanks to special commissioning functions and through selection of the motor type, power unit and encoder settings
- flexible user interface with user-configured displays
- fast standard system start-up through automation with job lists
- flexible project planning through availability of various units of measurement
- effective project planning through open structure with copy-and-paste function
- easy servicing thanks to fast visual comparisons of data on the screen (windows technique)
- optimization of the machine through monitoring of dynamic performance, e.g. frequency response analysis
- clearly readable data blocks with option for user-specific annotations
- complete system documentation
- additional information through the electronic, paperless documentation SYSDOK-MCU

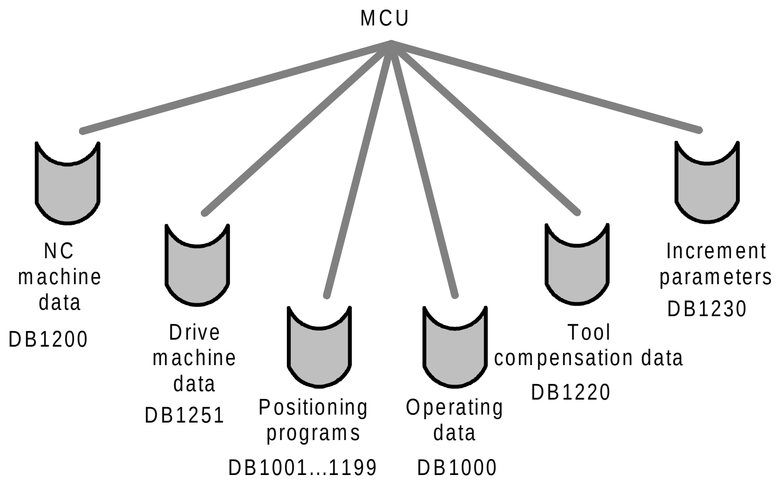
Design and structure

With MCU-PIT you can create and manage various data blocks of the single-axis positioning control MCU 172A. The data blocks of an MCU are best grouped together, for example in a directory. For each data block you can add comments, indicated through special comment fields or enclosed in brackets, and can thus store notes and information specific to the plant or machine.

The data structure of the MCU-PIT software provides for the editing and administration of the data blocks NC and drive machine data, operating data, positioning programs, tool corrections and increment parameters. The standard system start-up can be automated by means of job lists using a simple batch language.

The data blocks can be read out from the MCU 172A single-axis positioning controls, sent to these controls or archived centrally on floppy or hard disk. MCU-PIT provides a clear listing of the existing files in order to simplify file selection (see Chapter 4.1.3).

Overview of positioning and drive data



Handling

Handling of the MCU-PIT software is windows-oriented. The editing windows provide guidance to assist you in your work. You can choose to display or hide the toolbar and status line. You can make use of the toolbar as a shortcut to various recurring functions.

Programming/ project planning

The data blocks are edited using a table editor, while positioning programs can be created using an ASCII-format text editor. Both editors (table and text editor) incorporate a range of text operations such as copy, delete, find and insert. They are able to exchange data with other Windows applications (e.g. Word or Excel) via the clipboard. Syntax errors, e.g. in positioning programs, can be recognized by the function "Edit/Check Data".

The choice of online and offline operation lends flexibility to your project planning. The data blocks can be created offline during the project planning phase and transferred to the MCU module as part of initial commissioning. In this way the commissioning time can be reduced.

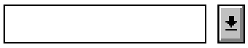
Icons

The icons are used as shortcuts for quicker selection of various recurring functions. If you leave the mouse pointer over an icon for a short time, a small window will appear with a description of the function assigned to the icon. The individual icons have the following meanings:

 New file

 Open file

 Save file

 Search keys

 Search forwards

 Search backwards

 Move selected block to the clipboard

 Copy selected block to the clipboard

 Insert the contents of the clipboard

 Check data

 Start communication

 End communication

 Open alarm window

 Display info dialog

Data views

Data views permit function-oriented structuring of the data necessary for parameterizing the MCU 172A. When a view is activated, you will only be shown the data which are relevant for the parameterizing of a particular function or function group.

User displays

User displays can be used to create your own screens or data lists for the inputting or outputting of data. In this way it is possible, for example, to display machine data and operating data together in a window or list. MCU-PIT can thus be adapted very flexibly to a wide variety of commissioning and operation scenarios.

Job lists

Job lists are used to simplify standard system start-up. All actions which are required for the standard system start-up can be summarized in a job list and then carried out automatically, i.e. without further intervention, by executing the job list.

SYSDOK-MCU

The Electronic Documentation SYSDOK-MCU assists you in your search for specific information. SYSDOK-MCU is the paperless documentation for the MCU.

With SYSDOK-MCU you still have at your disposal the aids usually found in paper-based documentations, such as tables of contents and chapter overviews. An important search tool is a list of key words. When you select the desired key word, SYSDOK-MCU presents a list of the topics dealing with this key word. The required screen can be brought to the display at the press of a button. If, for example, an error occurs, it can be selected in the list of key words, and SYSDOK-MCU will provide you with a detailed description of the error, indicating the cause, the effects and means for elimination.

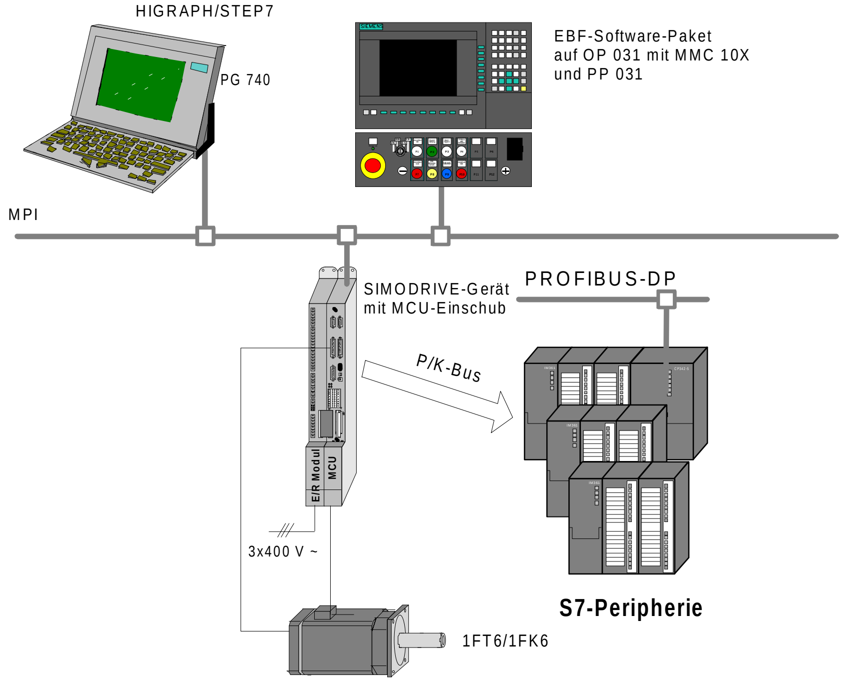
Electronic bookmarks and notes further simplify your work and permit you to add to SYSDOK-MCU in accordance with your personal requirements.

3 Set-up and Installation

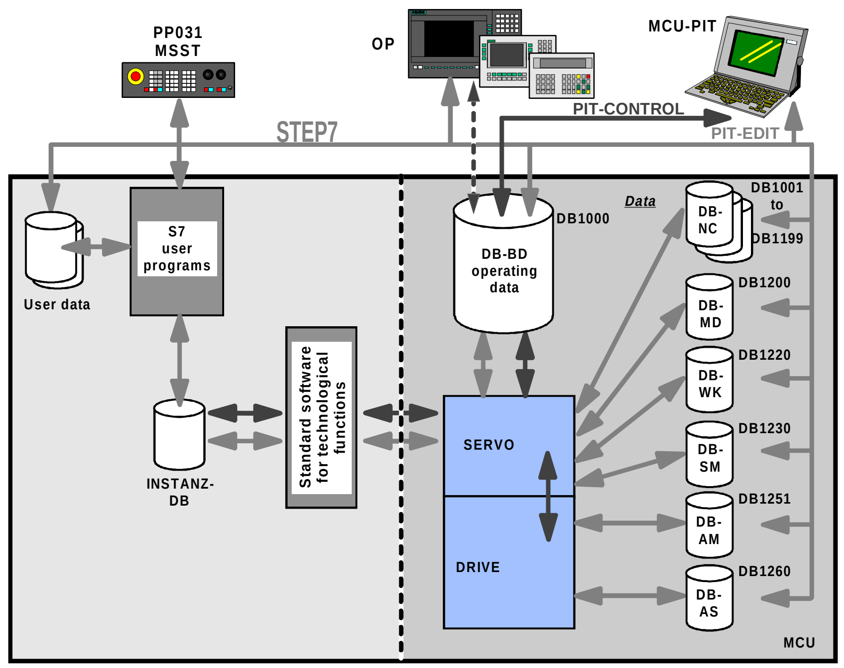
Contents

3.1 System Overview

Hardware (components)



Software



3.2 Hardware and Software Conditions

Hardware configuration

- Programming unit PG720, PG740, PG760 or industry standard PC with Intel 80486 processor (or higher), a recommended RAM memory of at least 8 MB and MPI board;

  Hard disk requirements:
  - approx. 9 MB for MCU-PIT and technical help
  - approx. 30 MB extra, if STEP 7 is not yet installed
- MPI connection cable
- SIMODRIVE components
  - stabilized or non-stabilized supply
  - power unit
  - single-axis positioning control MCU 172A
  - motors 1FT6 or 1FK6
- Optional: printer (see Windows95)

Software configuration

- Operating system Microsoft Windows95
- Firmware MCU 172A v3.x
- Standard software for technological functions (SIMATIC S7) from v3.0

If STEP 7 is already installed on your computer, you can begin with the installation of the MCU-PIT software (see also chapter 3.3), otherwise you must begin by installing STEP 7.

3.3 Installation

Preparation

If the necessary hardware and software conditions have been satisfied, you can install the MCU-PIT software on the hard disk of your PG or PC.

SETUP.EXE

1. Start Windows.
2. Insert the MCU-PIT installation disk (Disk 1) into the disk drive.
3. Start the installation program SETUP.EXE on the MCU-PIT installation disk.

On-screen information will guide you through the installation program.

Note!

Important information on the current software is to be found on the disk in the file "README.WRI".

3.4 Notes on Use

You have acquired the right to use the MCU-PIT software through purchasing:

- a single license,
- a corresponding copy license,
- an UPDATE or
- an UPGRADE.

Note!

Any other use of this software is not permitted and will result in criminal charges.

---

4 PIT-EDIT

Contents

Overview

The MCU-PIT software serves both for the parameterizing and commissioning of the single-axis positioning control MCU 172A. The program PIT-EDIT supports both simple programming and project planning, and the archiving and documenting of files. Assistance during commissioning of the axes and in case of service work is provided by the program PIT-CONTROL.

The program PIT-EDIT permits the comfortable inputting and outputting of drive and NC machine data , operating data, positioning programs, tool compensations and increment parameters. You can use the program PIT-EDIT either in online mode on the MCU 172A or in offline mode, for example in the office.

4.1 General Dialogs

4.1.1 Start Screen

Overview

When you call up the program PIT-EDIT, you see the start screen with a button for the dialog "Safety Information".

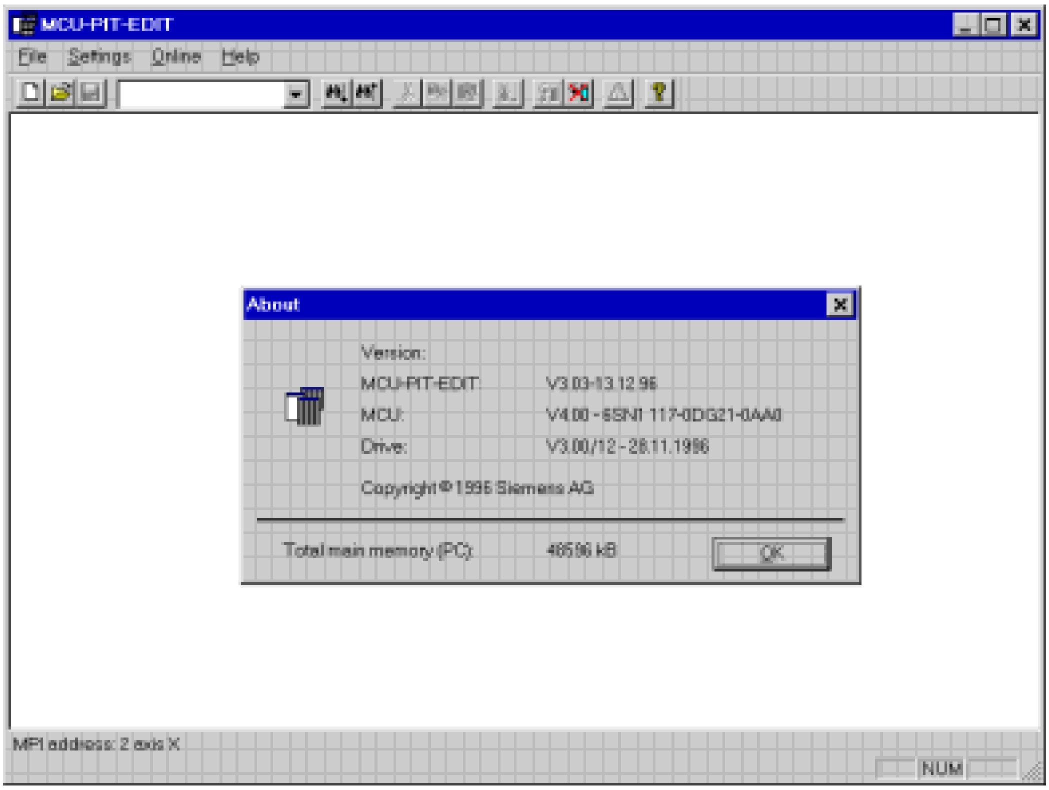


Figure 4-1 PIT-EDIT start screen

Remove/ skip screen

The start-up window is removed by pressing the Return key or by clicking with the mouse on the button <OK>.

Safety information

By activating the button <Safety Information> you can call up information necessary to ensure the safe handling of the PIT-EDIT software.

4.1.2 File/New

Overview

The menu function "File/New" is used to create a new file or a new data block. After selecting the menu function, you will be offered a selection window in which you can define the file type.

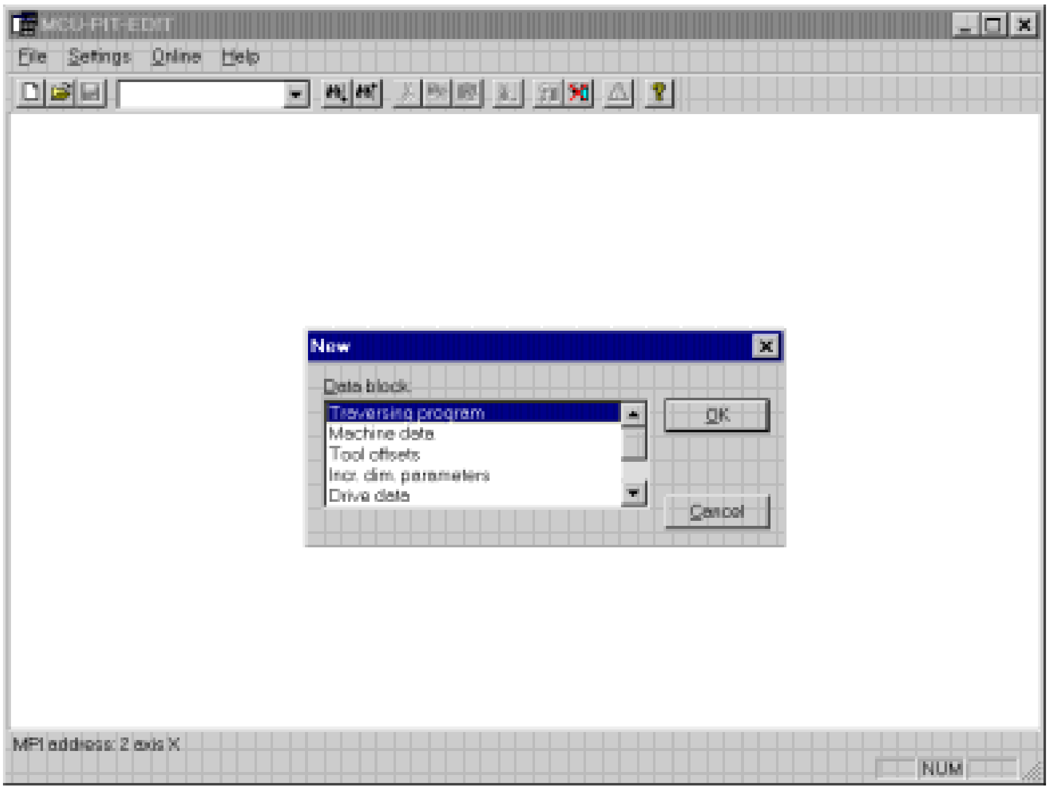


Figure 4-2 Creating a new file

4.1.3 File Selection

Overview

When you select the menu function "File/Open", the "Open" dialog appears with a list of the files available in the current directory.

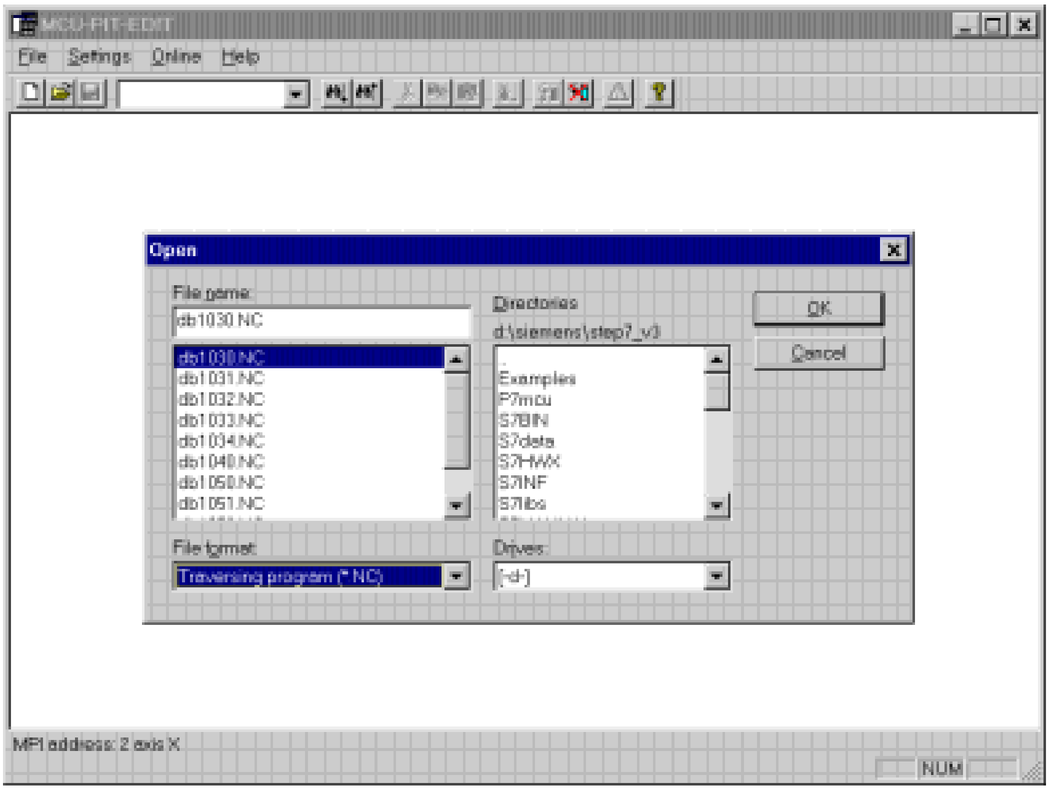


Figure 4-3 Selecting a file

Drives

Select the drive on which the desired directory is to be found.

Directories

Select the desired directory. To open a directory you must double-click on the directory name. The currently open directory is indicated under "Directory".

File format

Select the data type (file type).

File name

Enter the name of the file you would like to open, or select a name from the list of files. The list shows all the files in the current directory with the selected extension. Any file name conforming to the Windows95 conventions can be used as a file name.

4.1.4 Saving Files

Overview

A data block can be saved in a file by means of the menu functions "File/Save" and "File/Save As". You can also reach this dialog via an appropriate information window when closing a new or modified file.

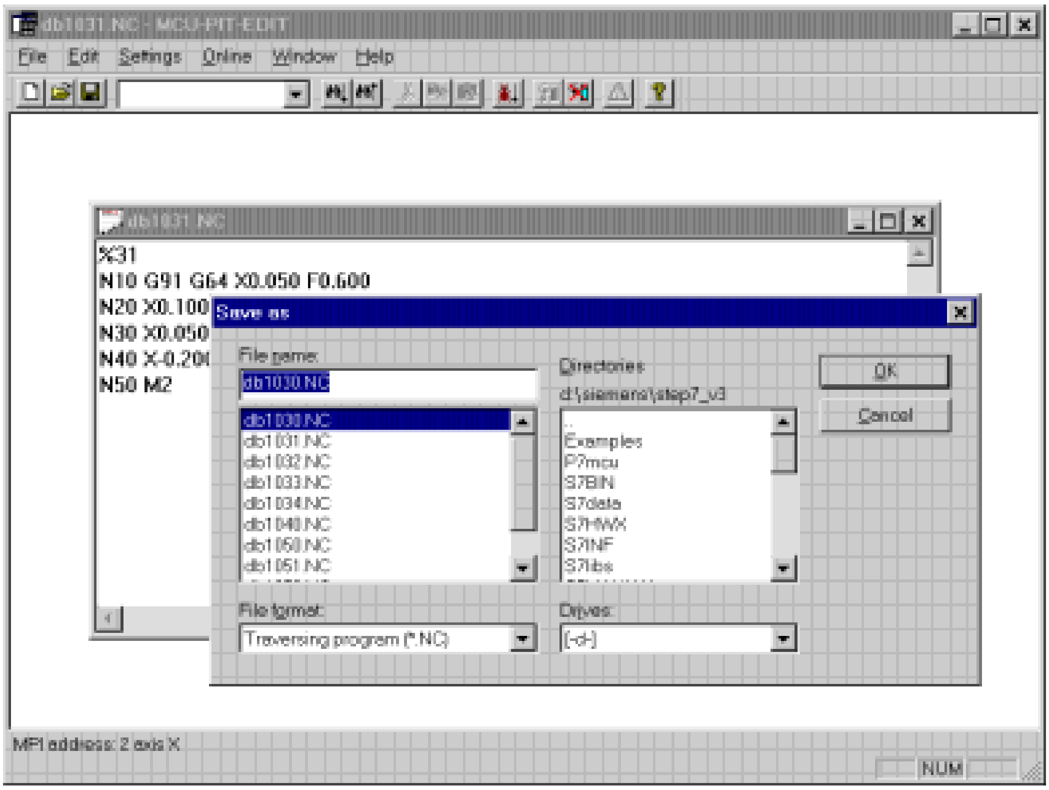


Figure 4-4 Saving a file

Drives

Select the drive on which the desired directory is to be found.

Directories

Select the desired directory. To open a directory you must double-click on the directory name. The currently open directory is indicated under "Directory".

File name

Enter the name of the file you would like to open, or select a name from the list of files. The list shows all the files in the current directory with the selected extension. Any file name conforming to the Windows95 conventions can be used as a file name.

4.2 Communication Dialogs

4.2.1 Communication

Overview

You reach the dialog "Communication" via the menu function "Online/Communication". The dialog enables you to establish or end communication between the MCU module and the programming unit with the MCU-PIT software. A necessary condition for this communication is the proper connection of the user via an appropriate MPI cable. Further information on the MPI interface is to be found in the *SIMATIC S7 Unit Manuals*.

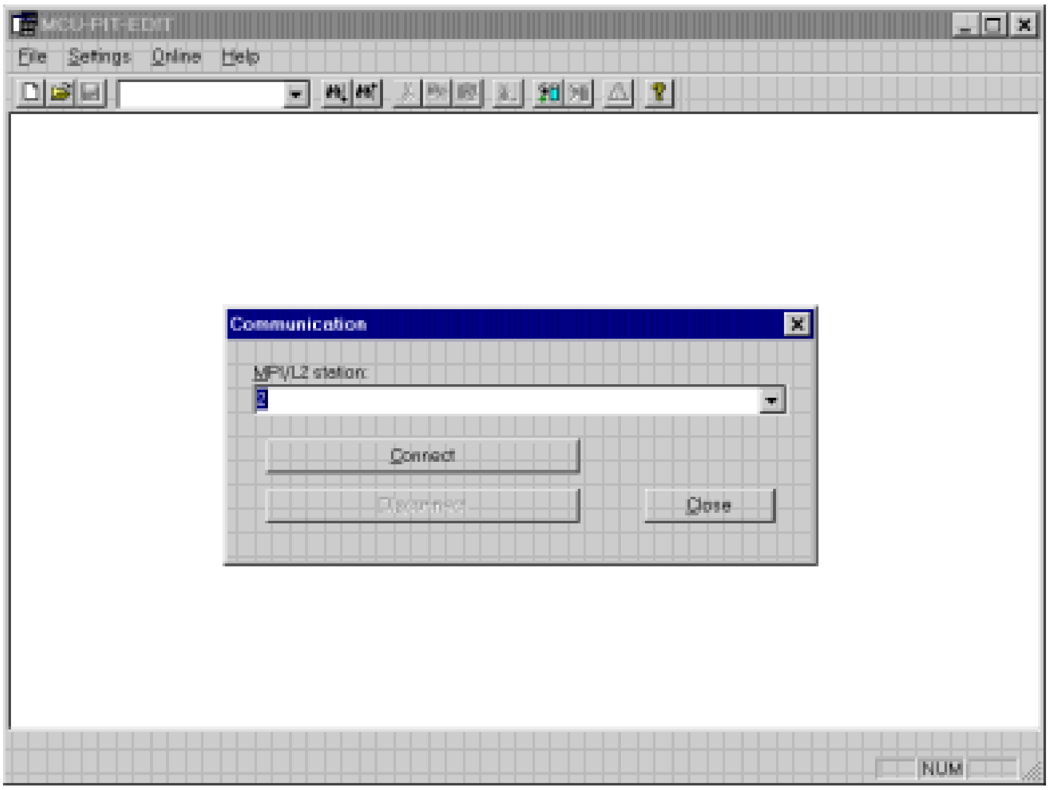


Figure 4-5 Communication

MPI users

Select the MCU with which data communication is to take place by means of the MPI address. Enter "2", for example, if the MCU has been assigned the MPI address 2. The list which can be opened up contains the addresses of all active users on the MPI bus.

Start/end communication

Activating the button <Start Communication> establishes communication between the PG and the corresponding MCU. Disconnection is achieved in a similar manner with the button <End Communication>. The dialog disappears from the screen automatically once the selected action has been executed correctly.

L2 users

If the connection is via L2-DP, it is necessary to enter the CP address, rack number and slot number. For example: "2,0,2", corresponding to "CP address, Rack (MCU always 0), Slot (MCU-CPU always 2)".

4.2.2 Copying Files

Overview

The dialog "Blocks" enables you to copy files in the form of data blocks between the MCU 172A module and the PIT-EDIT software. It is also possible to use the dialog to delete data blocks on the MCU and to compress the memory. This feature is only available via an online connection. You reach the dialog "Blocks" via the menu function "Online/Blocks".

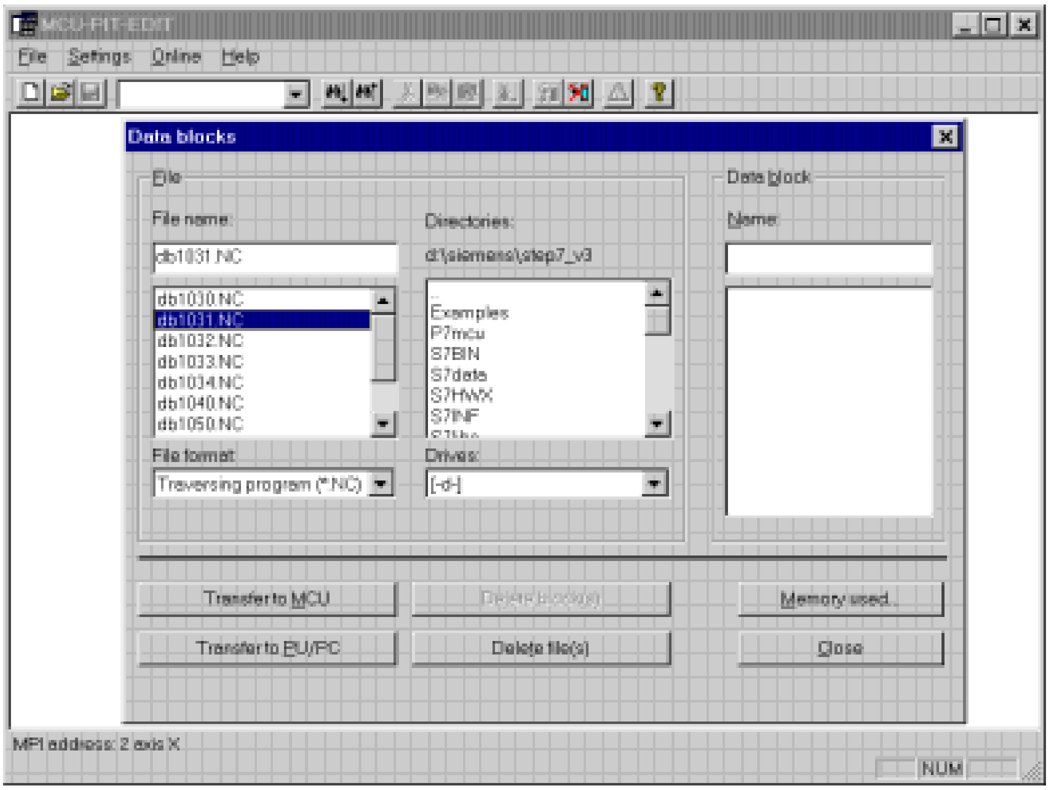


Figure 4-6 Copying data blocks

Drives

Select the drive on which the desired directory is to be found.

Directories

Select the desired directory. To open a directory you must double-click on the directory name. The currently open directory is indicated under "Directory".

File format

Select the data type (file type).

File name

Enter the name of the file you would like to open, or select a name from the list of files. The list shows all the files in the current directory with the selected extension. When copying data from the MCU to the PG/PC you must specify a file name. Any file name conforming to the Windows95 conventions can be used as a file name.

Block name

Specify here which data block is to be copied. When copying data from the PG/PC to the MCU it is not possible to enter a DB number - the DB number is assigned automatically. In positioning programs the DB number is formed from the program number:
DB number = Prog-no. + 1000.
The program number is entered in the first line of the positioning program, for example %100.

Copy to MCU
Copy to PG/PC

Activating these buttons starts the copying of the data blocks. When copying data from the PG to the MCU, the contents of the selected file are first checked and, if found to contain no errors, then copied to the MCU. If the check reveals an error, an appropriate message will be displayed and the copying process will not be initiated.

Delete block

With this button you can delete the selected data block in the memory of the MCU.

Delete file(s)

With this button you can delete the selected file or files from the hard disk/floppy disk.

Memory allocation

The button "Memory Allocation ..." opens a dialog displaying the current EPROM load memory, RAM load memory and user memory. The button "Compress" in the memory allocation dialog activates the function "Memory Compression", which clears the gaps in the block memory of the MCU left behind through the deleting of individual blocks (FM-POS and drive; not STEP 7).

Note!

To achieve optimum utilization of the available memory capacity, you should carry out the function "Memory Compression" at regular intervals and after deleting any blocks.

4.2.3 Saving Data in FLASH-EPROM Memory

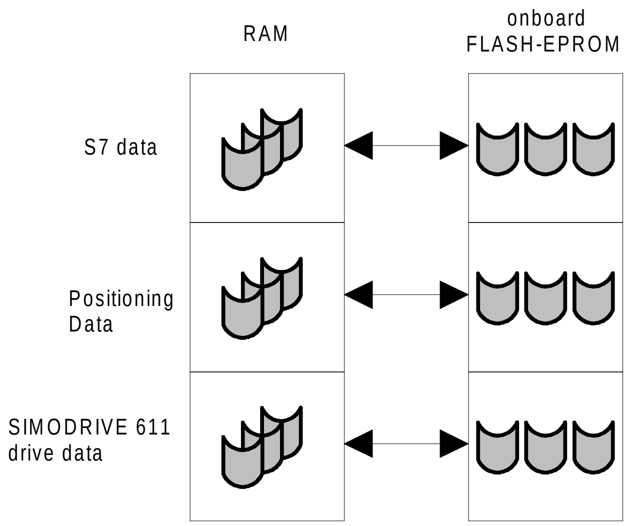
Overview

The MCU provides a flash EPROM memory for the maintenance-free buffering of user data. With the commands "FEPROM Save FM-POS" and "FEPROM Save Drive" you can copy your data from the RAM user memory into the FEPROM memory. When the power supply is restored, the user data are written back from the FEPROM memory to the user memory. You can call the commands "FEPROM Save FM-POS" and "FEPROM Save Drive" via the menu "Online".

Saving SPS data

The SPS data are saved using STEP 7 (copying RAM to ROM).

NC data on FEPROM



4.3 ASCII Editor

Overview

With the ASCII editor you can enter the various positioning programs and job lists in ASCII format. The editor permits free input and syntax checking. After creating your program you can use the function "Check Data" to check the integrity of your entries. You reach this function via the menu "Edit/Check Data".

4.3.1 Positioning Programs

Overview

The ASCII editor for positioning programs is available offline via "File/New" or "File/Open" or in online operation with the MCU via "Online/Positioning Program".

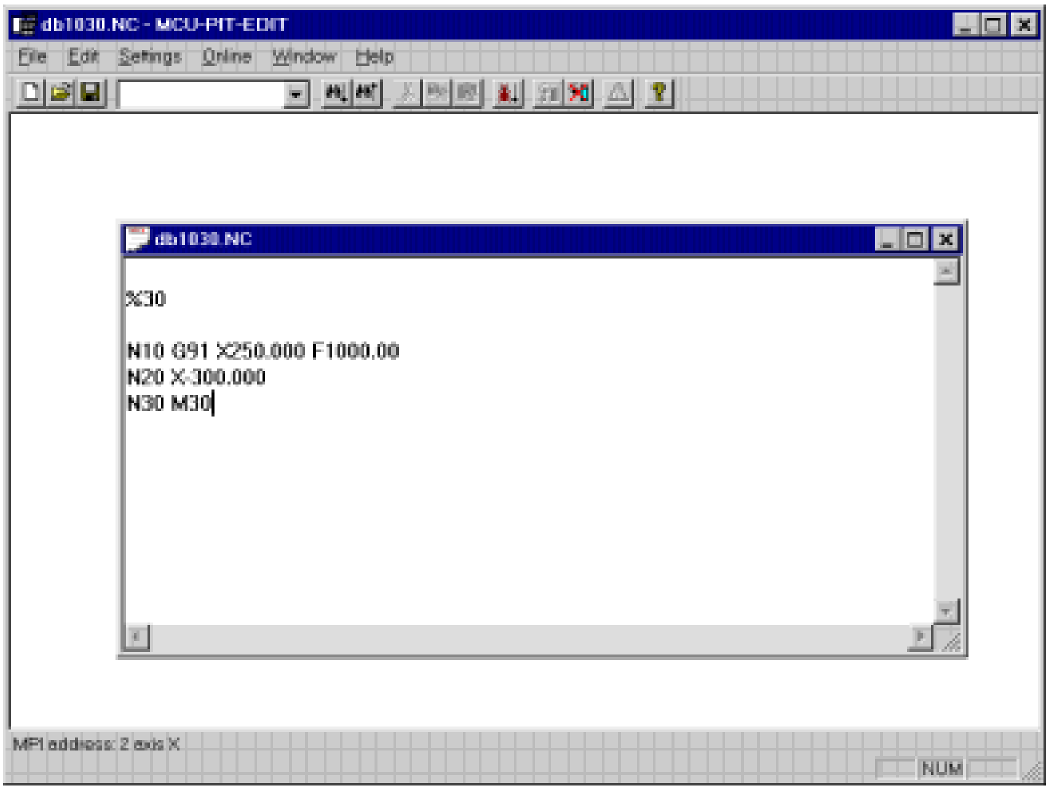


Figure 4-7 Output of positioning programs in ASCII format

Positioning programs

Comments must be enclosed in round brackets. The data must be structured as follows:

%y	Program number
/Ny	Skippable block
Ny	Block number
Gy	G function
Xy	Position X, Y, Z, A, B, C, ... / dwell time
Fy	Speed
Ly	Subprogram number
Py	Loop number for subprograms
My	M function of group 1, 2 or 3
Dy	Tool compensation number

More detailed information on programming can be found in the Function Manual *Positioning With MCU*, the *Booklet of Tables* or the T*echnical Help*.

4.3.2 Job Lists

Overview

The ASCII editor for job lists is available offline via "File/New" or "File/Open".

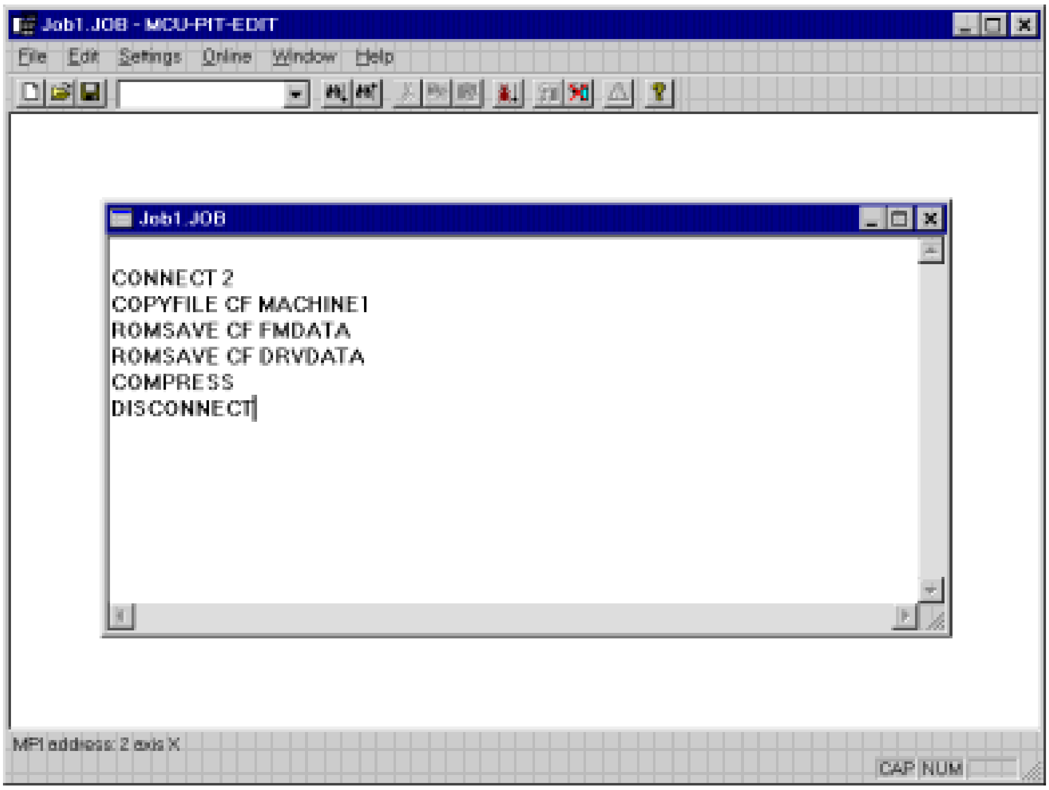


Figure 4-8 Creating job lists

Executing job lists

By selecting the menu function "Edit/Run" you start the execution of a job list. During the execution of a job list the current command is marked with a bar. The successful completion of a job list is reported in a message window. If an error occurs during the execution of a job list, you can choose whether to continue or quit execution.

Comments

Comments are enclosed in round brackets.

Commands

CONNECT <MPI address>
This command establishes the MPI connection to the MCU module with the MPI address <MPI address>.

DISCONNECT
This command terminates an MPI connection established with CONNECT.

COPYFILE [**CF**] <File name>
This command copies the file <File name> to the MCU module. [CF] is an optional command parameter which asks for confirmation by the user before carrying out the copying.

COPYBLOCK [**CF**] <Block name> <File name>
This command copies the data block <File name> (e.g. file name =DB1100) from the MCU module to the PG/PC and saves it under the name <File name> in the current directory. [CF] is an optional command parameter which asks for confirmation by the user before carrying out the copying.

DELETEBLOCK [**CF**] <Block name>
This command deletes the data block <File name>. [CF] is an optional command parameter which asks for confirmation by the user before carrying out the deletion.

COMPRESS
This command compresses the user memory available in the MCU 172A.

ROMSAVE [**CF**] **FMDATA**
This command saves the contents of the data blocks 1200, 1220 and 1230, as well as all available positioning programs (DB1001 to DB1199) in the FEPROM of the MCU module.

ROMSAVE [**CF**] **DRVDATA**
This command saves the drive machine data in the FEPROM of the MCU module.

SKIPCMDERR = ON | OFF
The variable SKIPCMDERR determines the procedure during the execution of a job list. If SKIPCMDERR is set to OFF, the execution of the job list will be stopped should an error occur, indicating the fact with an appropriate error message. If, on the other hand, SKIPCMDERR is set to ON, the command which led to the error will be ignored and the execution continued with the next command. Furthermore, when SKIPCMDERR = ON, a so-called log file will be created with the name <Job list name>.log. All errors which occur during execution of the job list are recorded in this file. The log file is stored in the same directory as the application P7SKEDIX.EXE. The default setting of the variable SKIPCMDERR is OFF.

4.4 Table Editors

Overview

Machine data, tool compensation data and operating data, etc. are entered by means of a table editor. You can use the search facilities of the menu function "Edit/Find" or the toolbar function to search for numbers and texts.

A check is made during input to ensure that only permissible values are entered.

4.4.1 Online Data

Overview

The DBs which are active in the MCU are generally available through the menu "Online". These data are continually read from the MCU when the dialog is open and the updated values displayed.

Note!

During online operation the following convention must be observed: The copying of modified values is initiated either by pressing the Return key or by moving out of the corresponding row of the table.

4.4.2 User Displays

Overview

The user interface for data input and output can be adapted very flexibly to your personal requirements. You can create a customized window to summarize the specific data necessary for the parameterizing of a certain function or in a certain operating situation.

You are allowed to combine data from different data blocks in a single display. The following data blocks are available as data sources:

- Machine data (DB1200)
- Operating data (DB1000)
- Drive machine data (DB1251-DB1258)
- Drive operating data (DB1260)

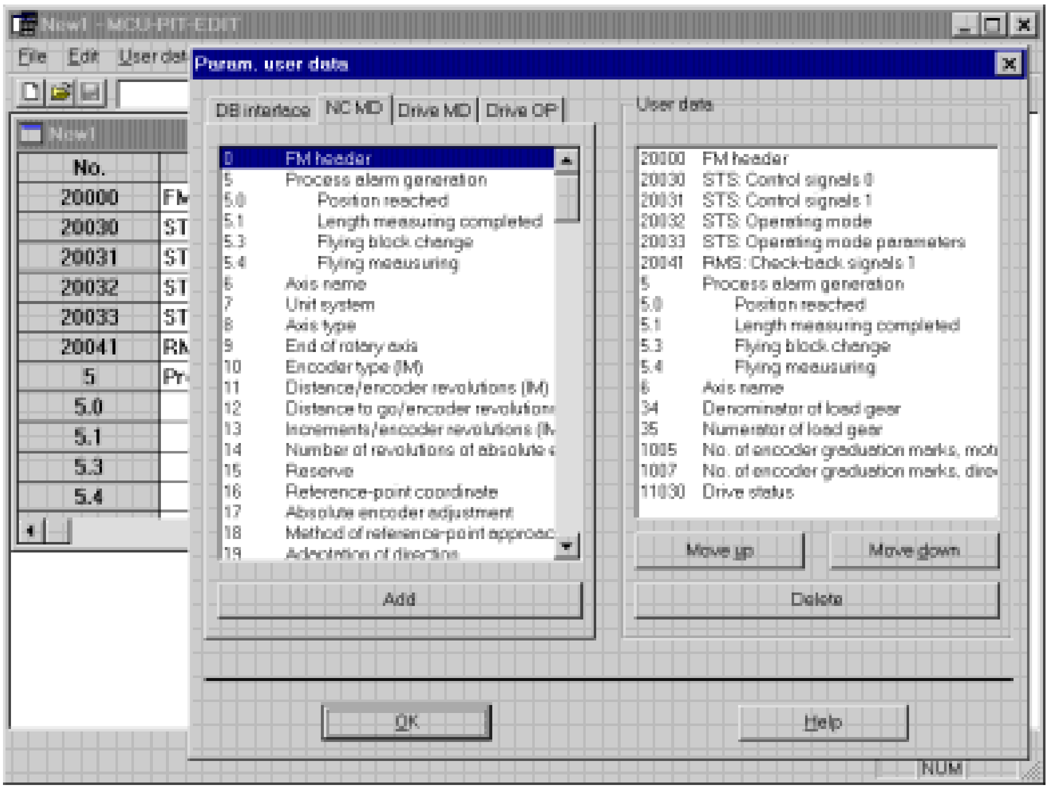


Figure 4-9 Defining a user display

Creating user displays

You can define a new user display with the menu function "File/Create User Display". You enter the user display name and a short form in a dialog. The user display name is limited to alphanumerical characters and the '-' symbol. It may be up to 40 characters long. The short name must be unique and identifies the dialog of the user display. If you enter a valid name and complete the dialog with <OK>, an empty user display will be opened. You can then edit the user display.

Editing user displays

By using the menu function "User Display/Line" you can add new data to a user display. In the dialog you first select the data block from which the data are to be included in the user display, and then the data themselves. Multiple selections are possible, i.e. you can mark several data items at once. When you quit the dialog with <OK>, all the marked data will be accepted into the user display.

The menu function "User Display/Delete Line" is used to delete data/lines from a user display. The data item or line in which the cursor is currently positioned is deleted.

The two menu functions "User Display/Shift Up" and "User Display/Shift Down" permit you to move individual data items/lines up or down by one line in the user display.

Deleting user displays

The menu function "File/Delete User Display" serves to remove user displays currently available on the PC/PG. Multiple selections are possible.

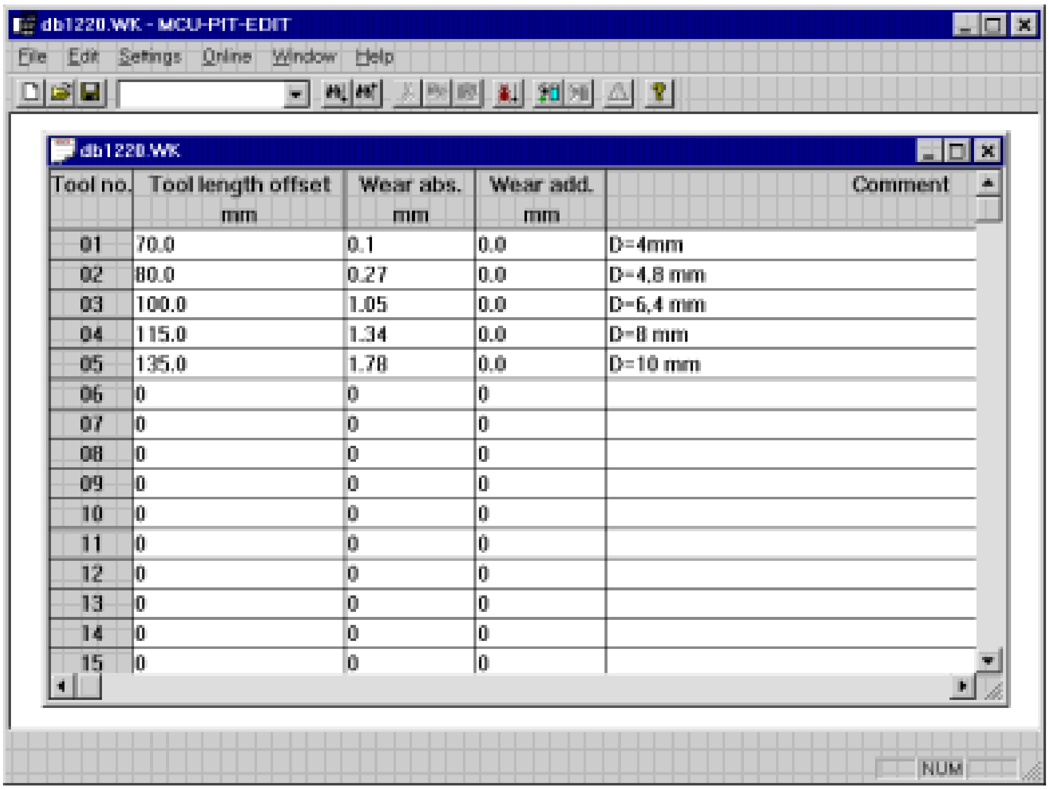
Online user displays

With the menu function "Online/User Displays" you open a dialog showing a selection list containing the names of all available user displays. Select a user display name and confirm your selection to open the corresponding user display in online mode.

4.4.3 Tool Compensation Data

Overview

The table editor for tool compensation data is available offline via "File/New" or "File/ Open", or when working in online mode with the MCU via "Online/Tool Compensation Data".



Tool no.	Tool length offset mm	Wear abs. mm	Wear add. mm	Comment
01	70.0	0.1	0.0	D=4mm
02	80.0	0.27	0.0	D=4,8 mm
03	100.0	1.05	0.0	D=6,4 mm
04	115.0	1.34	0.0	D=8 mm
05	135.0	1.78	0.0	D=10 mm
06	0	0	0	
07	0	0	0	
08	0	0	0	
09	0	0	0	
10	0	0	0	
11	0	0	0	
12	0	0	0	
13	0	0	0	
14	0	0	0	
15	0	0	0	

Figure 4-10 Tool compensation data

WZ No.

This column indicates the tool number.

Tool length comp.

Enter here the value for the tool length compensation.

Wear abs.

Enter here the absolute wear value.

Wear add.

Enter here the additive wear value.

Comment

In this column you can store project-specific remarks for each tool number.

4.4.4 Increment Parameters

Overview

The table editor for increment parameters is available offline via "File/New" or "File/Open", or when working in online mode with the MCU via "Online/Increment Parameters".

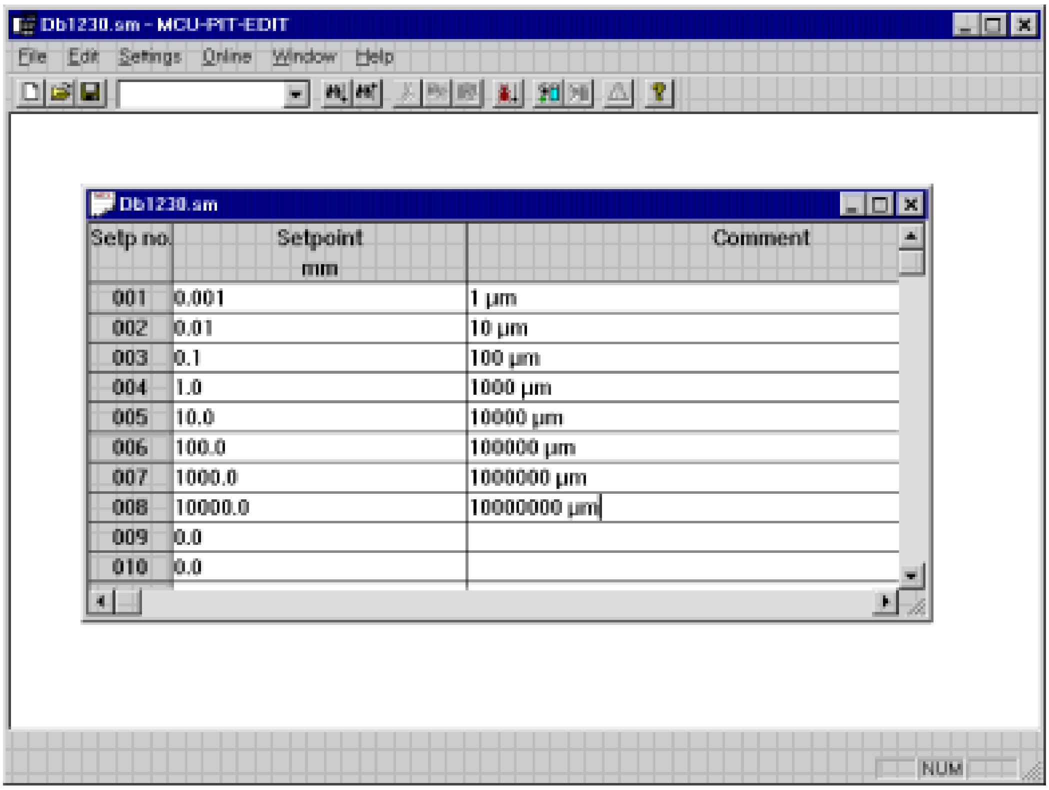


Figure 4-11 Increment parameters

SW No.

This column indicates the parameter (setpoint) number.

Setpoint

Enter here the value for the increment parameter.

Comment

In this column you can store project-specific remarks for each parameter number.

4.4.5 NC Machine Data

Overview

The table editor for NC machine data is available offline via "File/New" or "File/Open", or when working in online mode with the MCU via "Online/Machine Data".

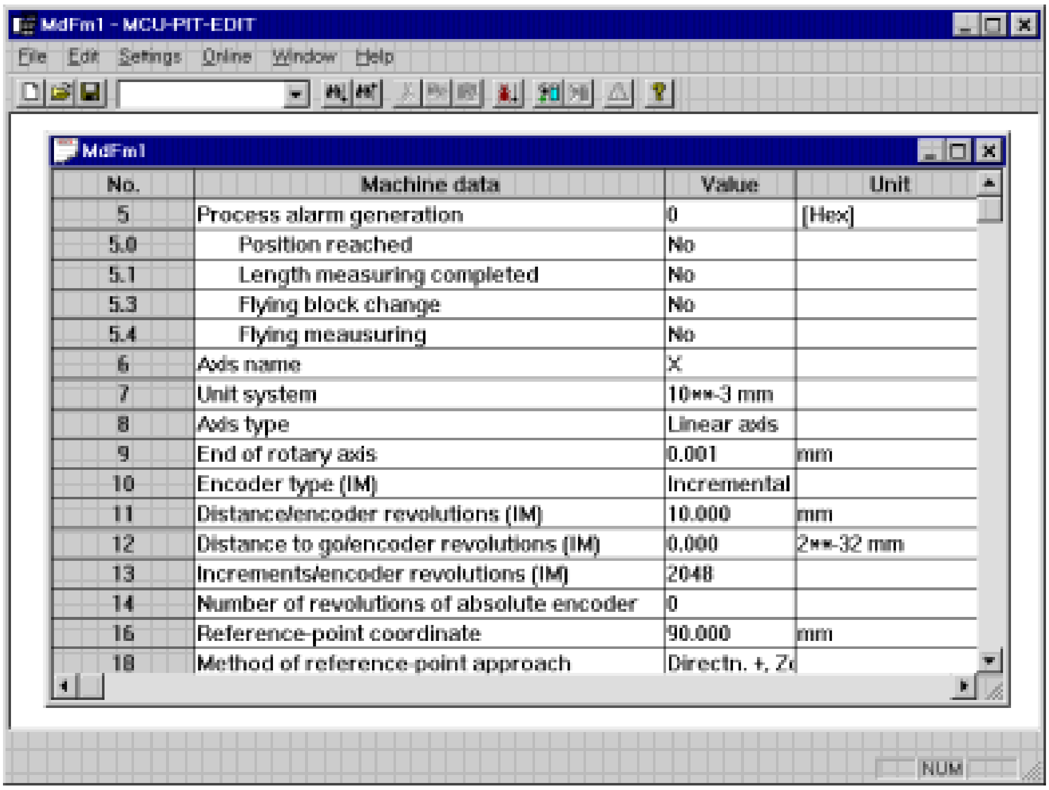


Figure 4-12 Editing of machine data

No.

This column indicates the machine data number.

Machine data

This column shows the identifier of the machine data item.

Value

Enter the value here. For machine data with several possible selections, you can scroll through the possibilities by pressing the space bar or "5" on the numerical keypad.

Unit

This column indicates the appropriate unit of measurement.

Empty/ effectiveness/ standard values/ limits/access rights

The additional columns for the effectiveness of the MDs, standard values of the MDs, upper and lower limits for the MDs and access rights can be activated or deactivated via the menu function "Settings/Use 5th Column".

Comment

In this column you can store project-specific remarks for each machine data item.

Encoder-relevant data When you edit the machine data, you can use the menu function "Edit/Encoder-relevant Data" as a comfortable means to parameterize the machine data for the measuring systems.

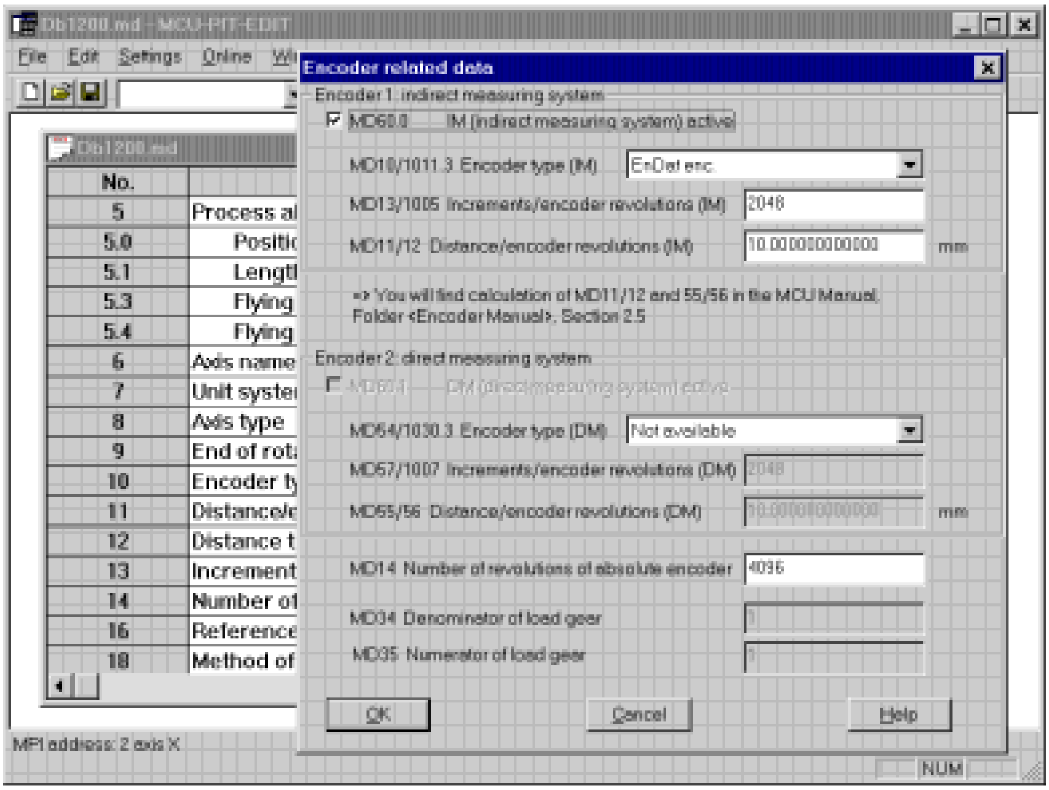
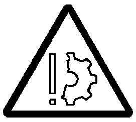


Figure 4-13 Comfortable parameterizing of the measuring systems

4.4.6 Operating Data

Overview

The table editor for operating data is available offline via "File/Open", or when working in online mode with the MCU via "Online/Operating Data FM-POS".



Prevent material damage!

If release signals are set and operation is enabled, the axis can be moved by means of DB-BD. In view of the technological implications of these data, and in particular the control signals, we recommend that the user takes appropriate precautionary measures before making use of this possibility during the project planning or commissioning phases.

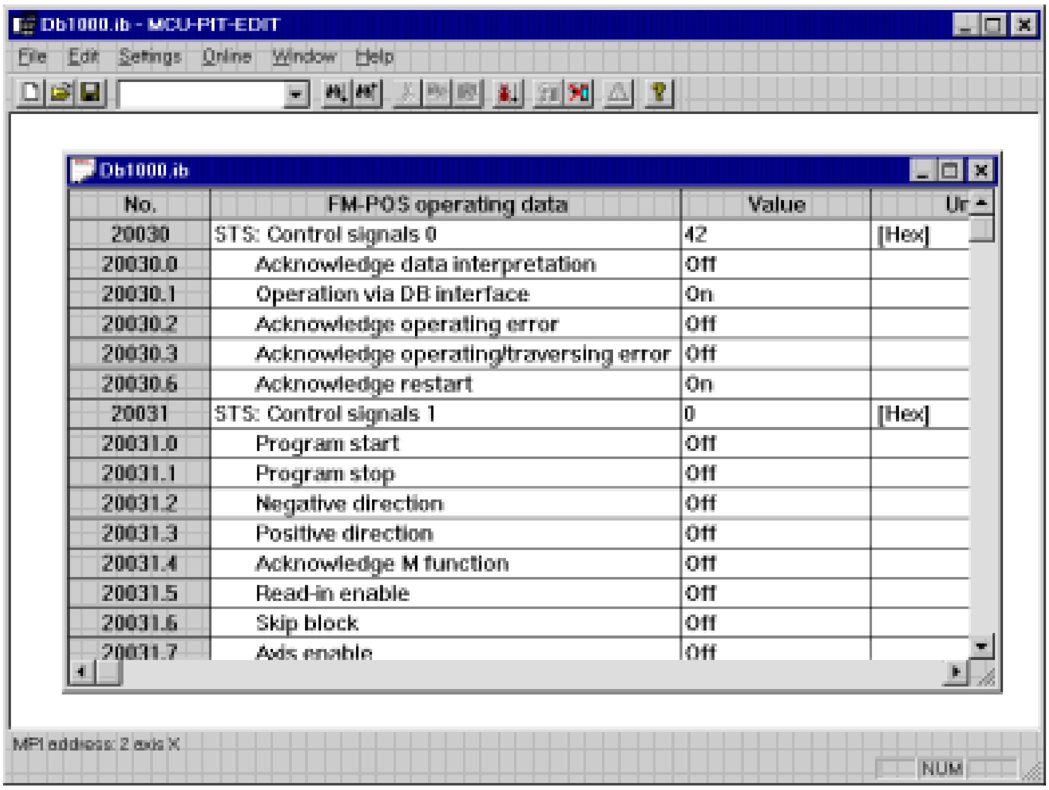


Figure 4-14 Operating data

No. This column indicates the operating data number.

Operating data This column shows the identifier of the operating data item.

Value Enter the value here. For operating data with several possible selections, you can scroll through the possibilities by pressing the space bar or "5" on the numerical keypad.

Unit This column indicates the appropriate unit of measurement.

Empty/ effectiveness/ standard values/ limits/access rights

The additional columns for the effectiveness of the BDs, standard values of the BDs, upper and lower limits for the BDs and access rights can be activated or deactivated via the menu function "Settings/Use 5th Column".

Comment

In this column you can store project-specific remarks for each operating data item.

4.4.7 Machine Data for Drive

Overview

The table editor for drive data is available offline via "File/New" or "File/Open", or when working in online mode with the MCU via "Online/Drive Data".

A fast and simple method to create machine data for the drive is to use the menu "Edit":

1. Set the standard values using the menu "Edit".
2. Select your power unit with the function "Power Unit Selection" (see Figure 4-15).
3. Select your motor with the function "Motor Selection" (see Figure 4-16).
4. The control parameters of the SIMODRIVE unit will be preset in accordance with your selected motor and power unit. Typically you will not need the variety of setting possibilities for the SIMODRIVE unit. If necessary, however, you can further optimize the parameters, for example by adjusting the P amplification of the speed control with MD1407 (see Figure 4-17).

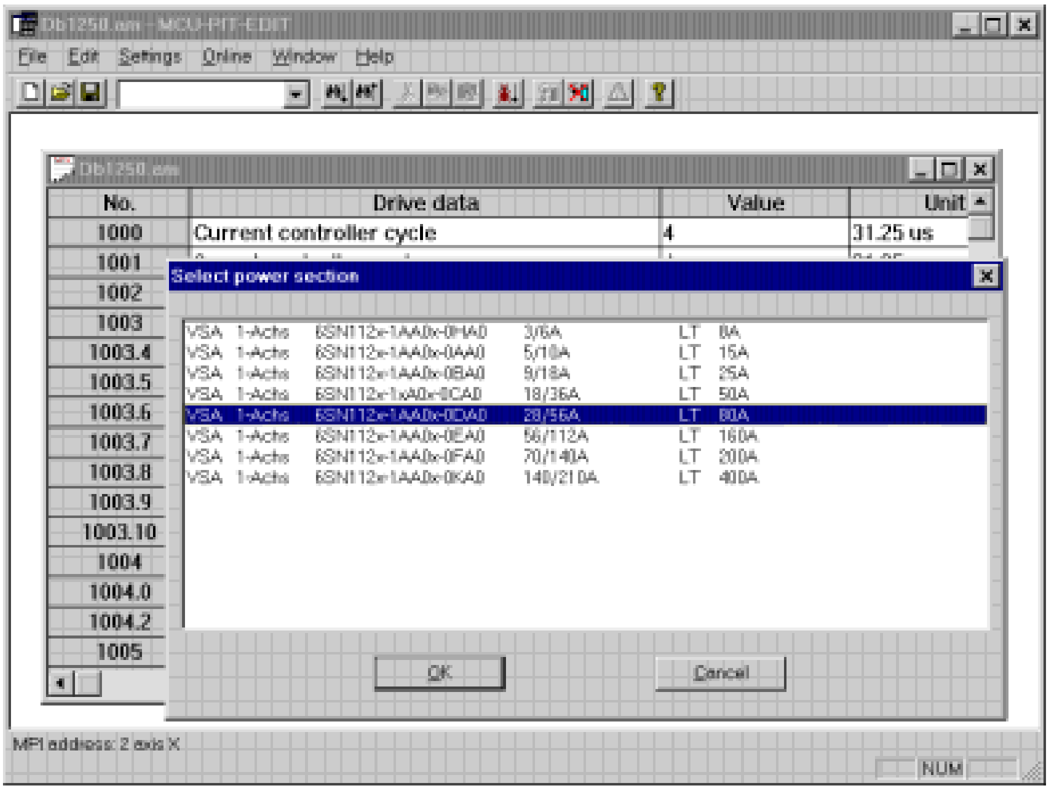


Figure 4-15 Selecting the power unit used

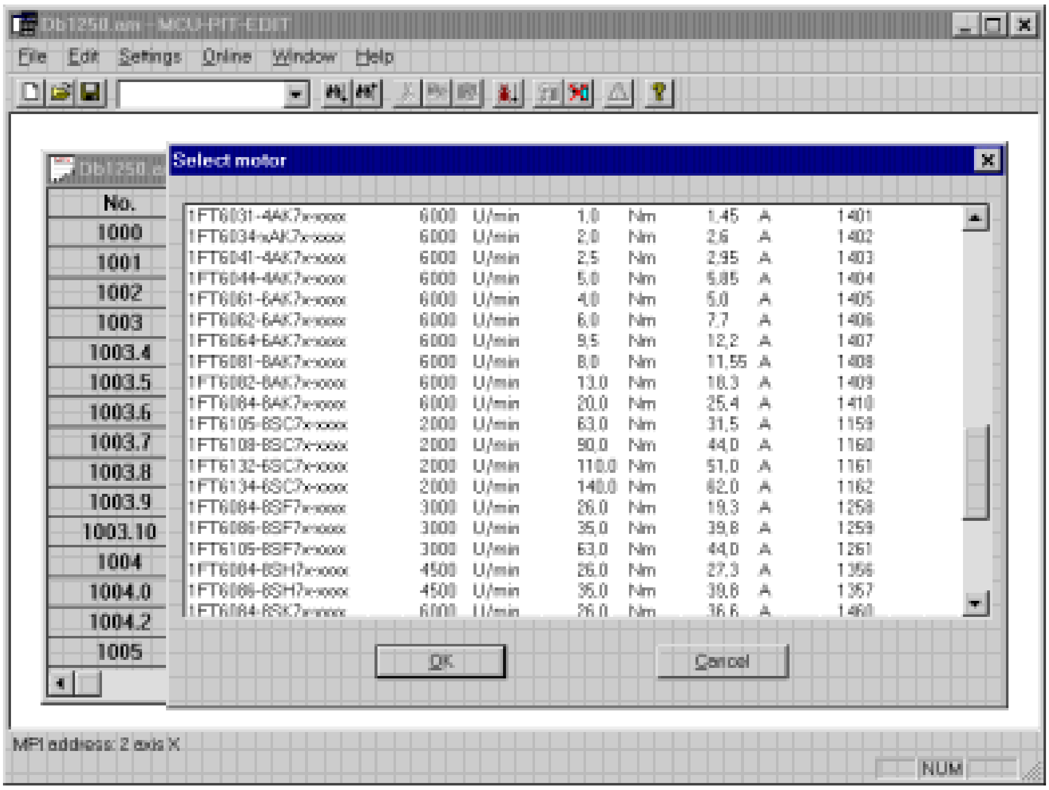


Figure 4-16 Selecting the motor used

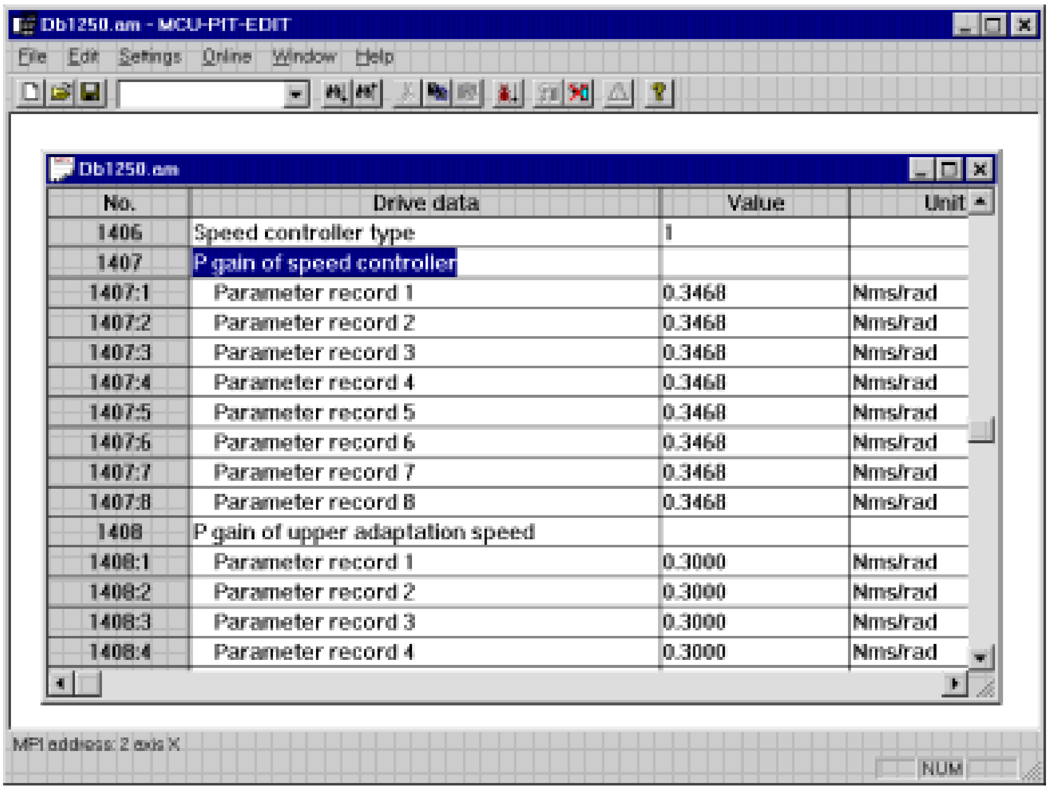


Figure 4-17 Machine data for the drive

No.

This column indicates the drive machine data number.

Drive data

This column shows the identifier of the drive data item.

Value

Enter the value here. For machine data with several possible selections, you can scroll through the possibilities by pressing the space bar or "5" on the numerical keypad.

Unit

This column indicates the appropriate unit of measurement.

Empty/ effectiveness/ standard values/ limits/access rights

The additional columns for the effectiveness of the ADs, standard values of the ADs, upper and lower limits for the ADs and access rights can be activated or deactivated via the menu function "Settings/Use 5th Column".

Comment

In this column you can store project-specific remarks for each drive data item.

Note!

The motor type is selected by marking the motor and activating the button <OK>. The controller data for the selected motor will then be calculated automatically. If, however, you select "Other Motor", you must enter the power unit and motor-dependent data manually and then select the menu function "Edit/Calculate Controller Data".

4.5 Technical Help SYSDOK-MCU

Overview

SYSDOK-MCU is the paperless documentation for the MCU. SYSDOK-MCU can be called up alongside the MCU-PIT software, i.e. you can switch quickly and simply between the two. SYSDOK-MCU, however, can also be used as an electronic reference work without MCU-PIT.

The handling and the functions of SYSDOK-MCU are similar to those of the Windows help system. For further information please refer to the *Online Help* or your *Microsoft-Windows Manual*.

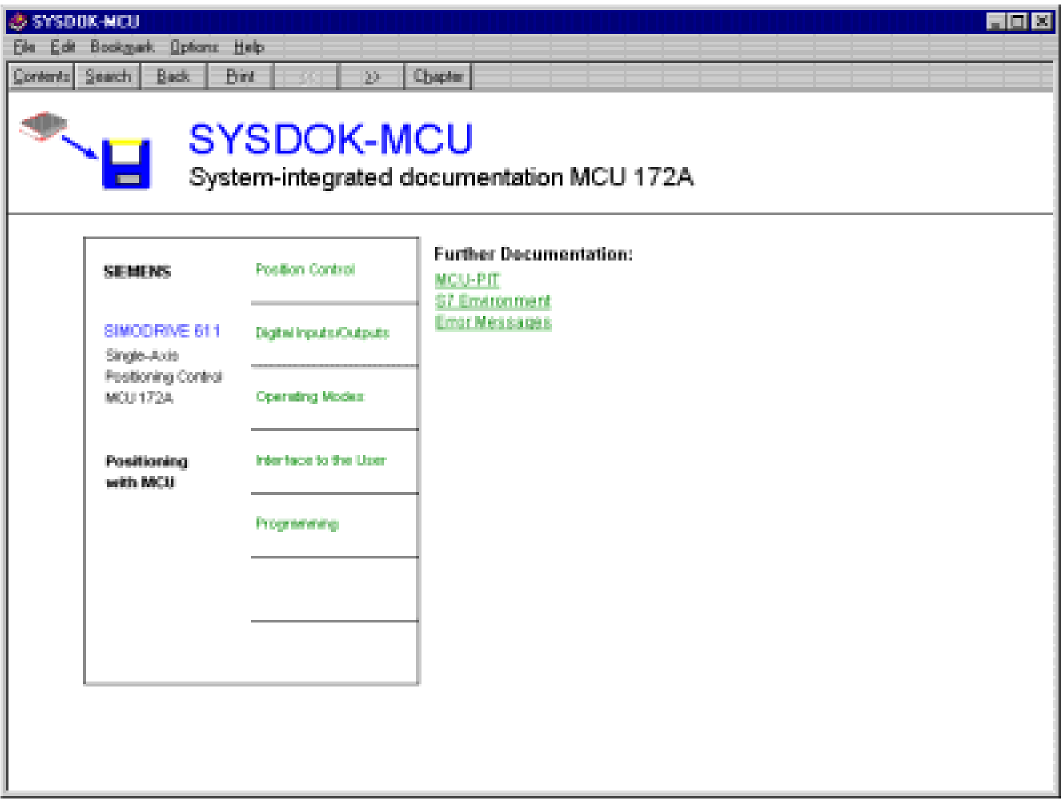


Figure 4-18 Start of the technical help system SYSDOK-MCU

Definitions

Definitions are normally displayed in green and with a dotted underline.

Links

Links are normally displayed in green and with a solid underline.

Search/ notes

With "Search" you can select topics and keywords to jump to the corresponding chapter. With "Edit/Remarks" you can store your own personal notes on each topic. Existing notes are then indicated by means of a green paper clip alongside the topic heading.

4.6 Menu Functions

Overview

In the PIT-EDIT menus the functions displayed in gray (dimmed) are inactive and cannot be selected. The selectable functions may also change in accordance with the data currently being processed.

File	Edit	UserDisplay	Settings	Online	Window	Help

New

Open a new page for input either in ASCII format or table format, depending on the data type. You specify the data type in a dialog box.

Open ...

Load an existing file for editing. A dialog box permits you to select the file type, the file to be opened, the directory and the drive.

Close

Close an open file.

Save

Save the current editor window under the existing file name. The editor window remains open.

Save As ...

Save the current editor window under a new file name. The editor window remains open.

Print ...

Print the contents of the current window.

Print Preview

Display the current window as it will be printed.

Printer Setup

Configure the current printer.

1 to 4

Select one of the last four files to have been edited.

Create User Display

Create a new user display. Enter the user display name in a dialog box.

Delete User Display

Delete an existing user display on the PC/PG.

Quit

Quit the PIT-EDIT program. If data blocks are still currently being edited, a message will be displayed asking whether you would like to save the data before quitting.

File	**Edit**	UserDisplay	Settings	Online	Window	Help

Undo	Cancel the last action to be carried out.
Cut	Delete the selected block from the ASCII editor or the table editor and move it to the clipboard.
Copy	Copy the selected block from the ASCII editor or table editor to the clipboard.
Paste	Insert the block in the clipboard at the current cursor position.
Paste Cells	This function can be used with tables to replace a certain range of cells with cells from the clipboard. When you have marked the cells in the destination document, the software checks whether the range has the correct number of rows and columns; if no cells are marked, the cells will be replaced to the right of and below the current cursor position.
Find	Open a dialog box in which you can enter the search item.
Find Next	Repeat the search for the specified search item.
Standard Value	Preset or define standard values for the open data block.
Power Unit Selection	Open a list box in which you can select the power unit used by means of its order number or designation.
Motor Selection	Open a list box in which you can select the motor type used by means of its order number or designation.
Calculate Controller Data	Calculate the controller data from the specified motor data (third-party suppliers).
Check Data	Check the syntax of the data block in the current window.
Encoder-relevant Data	Parameterize measuring systems (IM and DM).
Run	Start the execution of a job list.

File	Edit	**UserDisplay**	Settings	Online	Window	Help

User Display Parameters	Open the dialog to edit the user displays.
Select Line	Select the line in which the cursor is currently positioned.
Delete Line	Delete the line in which the cursor is currently positioned.
Insert Line	Add new data to a user display. In a dialog you first select the data block from which the data are to be included in the user display and then specify the actual data.
Shift Up	Move the data in the user display up by one line.
Shift Down	Move the data in the user display down by one line.
Save Format	Save the contents (format) of the user display.

File	Edit	UserDisplay	**Settings**	Online	Window	Help

Symbol Bar Show/hide the symbol bar.

Status Line Show/hide the status line.

MPI Connection Display the currently selected MPI connection in the second status line at the bottom of the screen.

MCU Version and Firmware Display and set the versions for the MCU.

PBL Version Display the versions for the parameter base lists.

1st parameter record In the drive machine data offer only the parameters from the first parameter block.

All Parameter Blocks Offer all the parameter blocks in the drive machine data.

mm Input/output values using millimeters as the unit of measurement.

inch Input/output values using inches as the unit of measurement.

degrees Input/output values using degrees as the unit of measurement.

2 Decimal Places Display values with 2 places after the decimal point.

4 Decimal Places Display values with 4 places after the decimal point.

MCU Filter Set the view for the data list. The views available are: General machine data, Basic machine data, Monitoring/limits, Measuring system data, Controller data or All Data.

611D Filter Set the view for the data list. The views available are: Controller data, Monitoring/limits, Status data/diagnosis, Motor/power unit data, Measuring system data or All data.

Use 5th Column Select additional information for each item of machine data, e.g. empty, effectiveness, standard value, limits and access rights.

File	Edit	UserDisplay	Settings	**Online**	Window	Help

Communication	Open the dialog to establish communication.
End Communication	End the existing MPI connection.
Blocks	Open the dialog for copying and deleting data blocks (MCU → PG, PG → MCU), including a facility to display the memory allocation of the MCU.
Machine Data (DB1200)	Read out and display the data block with NC machine data from the MCU.
Tool Compensation Values (DB1220)	Read out and display the data block with tool compensation values from the MCU.
Increment Parameters (DB1230)	Read out and display the data block with increment parameters from the MCU.
Operating Data FM-POS (DB1000)	Read out and display the operating data of the positioning unit from the MCU.
Positioning Program (DB1001-1199)	Read out and display a positioning program from the MCU.
User Displays	Open a dialog box to select the desired user display. The user display is then opened in online mode with the current values.
FEPROM SAVE FM-POS	Save all data of the positioning unit from the user memory (RAM) of the MCU onto the integrated flash EPROM.
Drive Data (DB1250)	Read out and display data blocks for drive machine data online.
Drive Operating Data (DB1260)	Read out and display the operating data of the drive unit from the MCU.
FEPROM Save Drive	Save data blocks of the drive from the user memory (RAM) of the MCU onto the integrated flash EPROM.
Alarms	Display the alarm list.
Load to MCU	Copy the currently open data block into the memory of the MCU.
Reset	Carry out an online reset. This function permits the activation of power-on machine data through the software.
Update Rate	Define the time interval for the screen update of operating data, machine data, drive data and drive operating data (shortest interval 100 ms).

File	Edit	UserDisplay	Settings	Online	**Window**	Help

Cascade Arrange several editor windows as layers.

Vertical Split Arrange several editor windows as columns on the screen.

Horizontal Split Arrange several editor windows below one another on the screen.

Arrange Symbols Arrange the icons at the bottom of the screen.

Close All Windows Close all open windows.

1 to 9 with other windows Select a window which is already open.

File	Edit	UserDisplay	Settings	Online	Window	**Help**

Online Documentation Call up SYSDOK-MCU.

Safety Information Display information on the safe handling of the PIT-EDIT software.

Info Show information such as the version information of MCU-PIT, MCU and drive, and the amount of user memory available.

4.7 Working with PIT-EDIT

Offline operation

1. Select the menu function "File/New".
2. Select the data type (machine data, tool compensation data ...).
3. Carry out editing in the file.
4. Select the menu function "File/Save As".

For information on the dialogs and editors please refer to the corresponding chapters.

Establishing communication with MCU

1. Select the menu function "Online/Communication".
2. In the dialog enter or select the desired path and MPI user number as entered in STEP 7 and activate "Start Communication". The window will disappear automatically once the connection has been established.

Copying a file as DB to MCU, online mode

File is already open:

1. Click on the file window.
2. Select the menu function "Online/Load to MCU".

   If the online DB happens to be open, it will be updated automatically.

File is not open:

1. Select the menu function "Online/Blocks".
2. Select the file in the dialog and copy the block.
3. Save the data in the MCU.

Note!

1. The header of each DB / file contains the unit of measurement defined in MD7 (mm, inch, degrees). The measuring system increment must correspond.
2. It is never possible to copy a DB to the MCU, if it uses a unit other than that currently active in the MCU. The appropriate PBL version (parameter base list) can be set with the menu function "Settings/MCU Version and Firmware").

Saving DB as a file on the hard disk, online mode

Online DB is already open:

1. Click on the file window.
2. Select the menu function "File/Save As".

Online DB is not open:

1. Select menu function "Online/Blocks" to open the dialog.
2. Enter or select the name of the file in the dialog and copy the data block to the file.

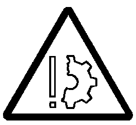
Creating positioning programs

1. Select the menu function "File/New".
2. In the dialog select positioning programs.
3. Create the program in accordance with the DIN standards, e.g.:
   (Program number, permissible from 1 to 199)
   %100
   N1 G90 X499 F500
   N2 X400 F700 M2

   Enter the program as text, whereby PIT-EDIT does not distinguish between upper and lower case characters.
   Use a new line (Return key) to separate blocks.
4. It is recommended to carry out a syntax check after editing: menu function "Edit/Check Data".
5. Save program: select menu function "File/Save As".
6. Copy to the MCU if necessary: select menu function "Online/Load to MCU".

Accessing the DB interface (operating data)

1. Select the menu function "Online/Operating Data".
2. Not all data of the data block interface (DB-BD) can be edited.
3. In order to be able to write control bits and thus control the drive, it is necessary for operation via the DB-BD to be enabled (control bit TFB = 1). This can be provided for by means of a STEP 7 program.



Prevent material damage!

If release signals are set and operation is enabled, the axis can be moved by means of DB-BD. In view of the technological implications of these data, and in particular the control signals, we recommend that the user takes appropriate precautionary measures before making use of this possibility during the project planning or commissioning phases.

Change unit system (MD7)

The standard value 10^{-3} is provided in MD7. When changing this setting to 10^{-2} degrees, for example, the ranges tool offset values, incremental dimension parameters and traversing programs have also to be changed.

Note!

If the error message "Deviating unit system raster" occurs, different unit system are parameterized. Check this in the Settings menu and make sure that the same unit system is set in all four ranges (machine data, tool offset values, incremental dimension parameters, and traversing programs).

Approach:

1. Toggle MD7 to 10^{-2} degress
2. Select "Online/Blocks" from the menu
   – Check the "Tool Offset Value" option in the "Data Format" menu, check then block DB1220 in the "Data Block" option and click the "Delete Blocks" button.
   – Check the "Incremental Dimension Parameters" option in the "File Format" menu, check then block DB1230 in the Data Block menu and click the "Delete Blocks" button.
   – Check the "Traversing Program" option in the "Data Format" menu, check then the blocks DB1001 to DB1199 (if any) and click the "Delete Blocks" button.
3. Select "Online/FEPROM-Save-FMPOS" from the menu in order to save the changes you have made in 1) and 2).
4. Turn the MCU off and on again or select "Online/Reset" from the menu. The blocks DB1220 and DB1230 (tool offset values and incremental dimension parameters) are recreated (empty tables), and the unit system is taken over by MD7. Any traversing programs ((DB1001 to DB1199) do not exist any more.

5 PIT-CONTROL

Contents

Overview

The MCU-PIT software serves both for the parameterizing and commissioning of the single-axis positioning control MCU 172A. The program PIT-EDIT supports both simple programming and project planning, and the archiving and documenting of files.

Assistance during commissioning of the axes and in case of service work is provided by PIT-CONTROL, the program described below.

NOTE!

If PIT-CONTROL is used to traverse the axis (e.g. in the Automatic mode), no axis standstill is provided in case of cable break. The user can change to the PLC interface at any time either by FC-RESTART or directly by resetting the TFB bit. To this aim, safe shutdown must be provided by the user.

5.1 Dialogs

5.1.1 Start Screen

Overview

When you call up the program PIT-CONTROL, you see the start screen with a button for the dialog "Safety Information".

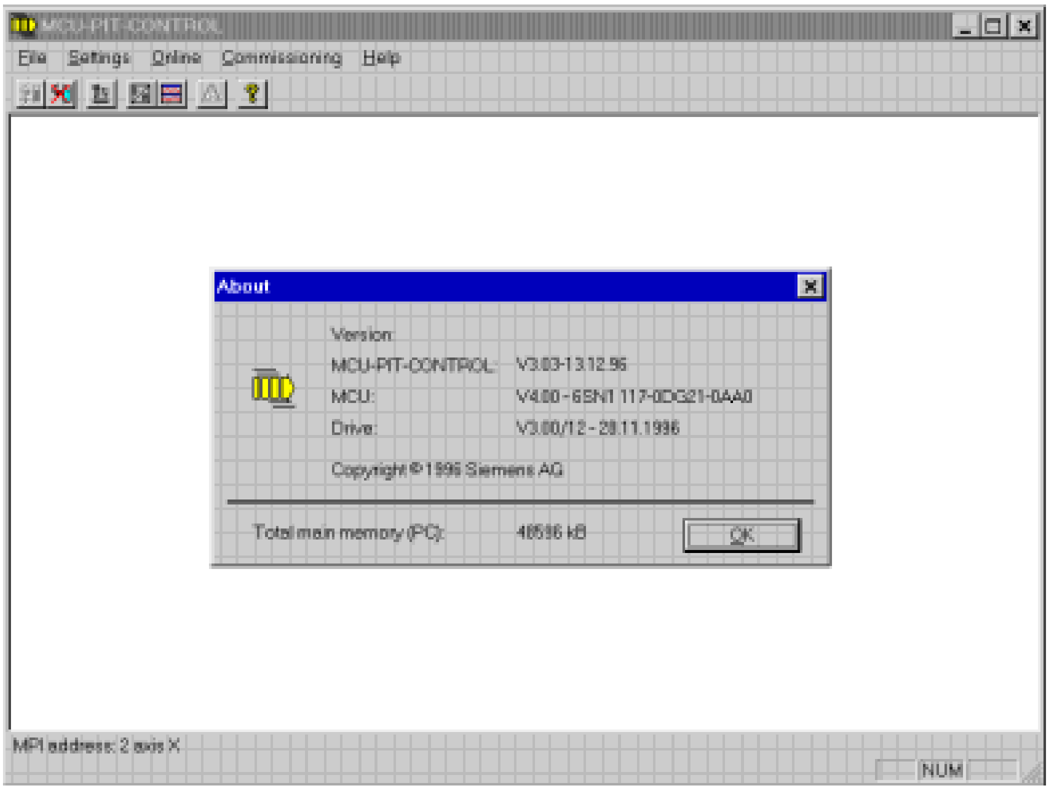


Figure 5-1 PIT-CONTROL start screen

Remove/ skip screen

The start-up window is removed by pressing the Return key or by clicking with the mouse on the button <OK>.

Safety information

By activating the button <Safety Information> you can call up information necessary to ensure the safe handling of the PIT-CONTROL software.

5.1.2 Communication

Overview

You reach the dialog "Communication" via the menu function "Online/Communication ". The dialog "Communication" enables you to establish or end communication between the MCU module and the programming unit with the MCU-PIT software. A necessary condition for this communication is the proper connection of the user via an appropriate MPI cable. Further information on the MPI interface is to be found in the *SIMATIC S7 Unit Manuals.*

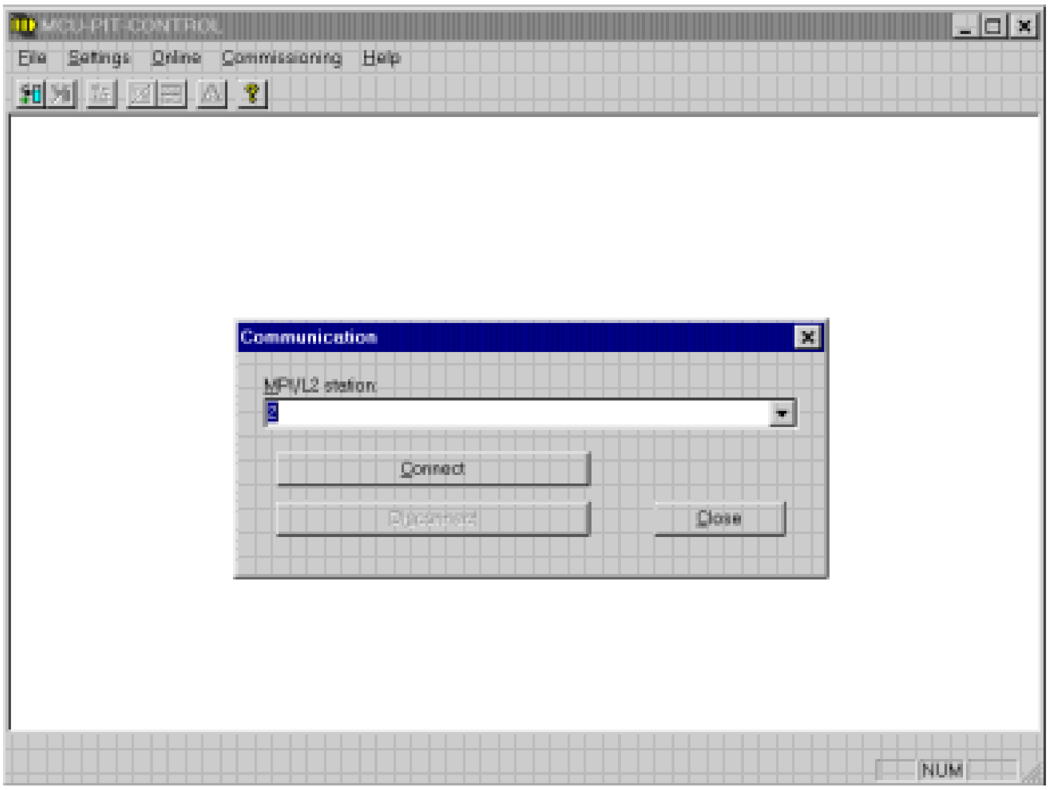


Figure 5-2 Communication

MPI users

Select the MCU with which data communication is to take place by means of the MPI address. Enter "2", for example, if the MCU has been assigned the MPI address 2. The list which can be opened up contains the addresses of all active users on the MPI bus.

Start/end communication

Activating the button <Start Communication> establishes communication between the PG and the corresponding MCU. Disconnection is achieved in a similar manner with the button <End Communication>. The dialog disappears from the screen automatically once the selected action has been executed correctly.

L2 users

If the connection is via L2-DP, it is necessary to enter the CP address, rack number and slot number. For example: "2,0,2", corresponding to "CP address, Rack (MCU always 0), Slot (MCU-CPU always 2)".

5.1.3 Machine Control Panel

Overview

You reach the machine control panel via the menu function "Online/Machine Control Panel". From here you can control positioning travel (condition: "TFB" at FC1) and monitor the current status of the MCU.

Design

The machine control panel can be divided into four sections:

- In the upper part you see a display of the last error to have occurred, and the types of errors still present. Error messages can be acknowledged and canceled with the button <Ack.>.
- On the left is the status display with current values and status signals.
- At the bottom left is a display to enter or indicate the data relevant to the selected operating mode. This section of the window changes in accordance with the operating mode, as soon as mode switching has been successfully completed.
- On the right you find the input fields and buttons available to the operator in all operating modes.

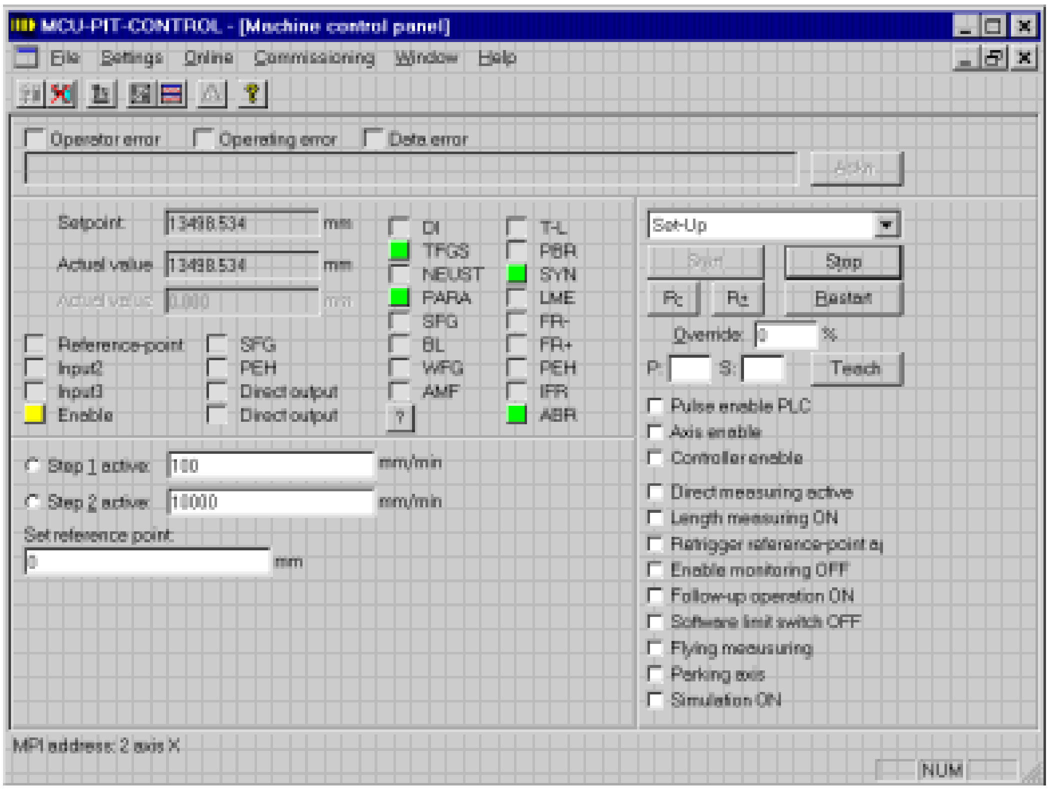


Figure 5-3 Machine control panel

Example

1. Set external enables: terminal 663 (MCU); terminal 48; terminal 63 (UE module)
2. Select operating mode: e.g. Setting up

3. Select traversing speed: e.g. step 1 active, 100 mm/min
4. Set enables: Pulse enable PLC, axis enable, controller enable
5. Enter Override: e.g. 20%
6. Start traversing speed activating either of the buttons R+ or R-

5.1.4 DAU Output

Overview

You obtain this window via the menu function "Commissioning / D/A Converter". Here you define which signals are to be available at the three test sockets of the MCU (output range 0 V to 5 V; the zero line is at 2.5 V).

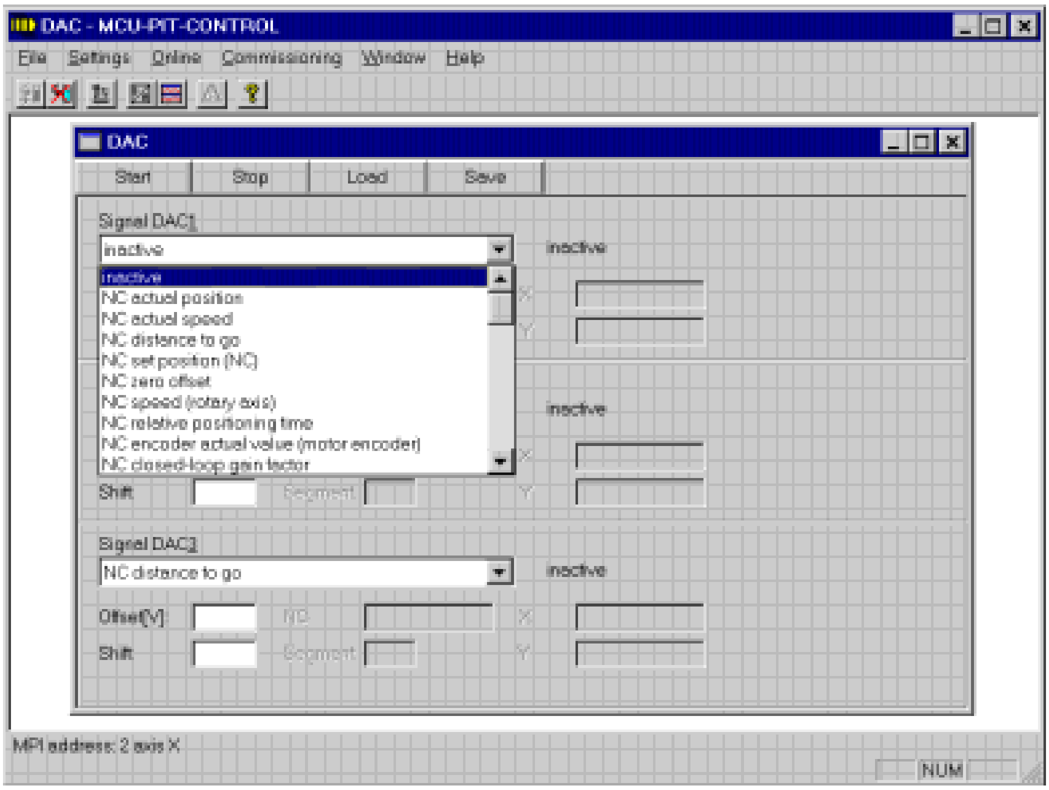


Figure 5-4 DAU output

Start With this button you route the set signals to the test sockets.

Stop With this button you remove the signals from the test sockets.

Load Loads the settings from the memory.

Save Saves the current settings in a file.

Signal Select from this list the signal which is to be available at the test socket. You can also specify that a socket should remain inactive.

Offset [V] Enter the offset in volts by which the signal is to be increased.

Shift factor You can here stretch or compress the measurement along the Y axis. The value entered is interpreted as an exponent in base 2. Entering "2" causes the output to be stretched by the factor 4, while "-2" compresses the output to a quarter.

NC-Adr./X-Adr./Y-Adr. For service purposes only: You can output the status of certain memory addresses of the positioning unit (NC-Adr.) and drive (X-Adr./Y-Adr.) by entering the physical address.

5.1.5 Commissioning Functions

Overview

There are two methods available to determine the dynamic response of the control and carry out optimization:

- The function generator activates the drive with special parameterized test signals. External measuring devices, e.g. oscillographs, can monitor the reaction of the system by means of the signals available at the DAU output sockets (3 signal sockets, 1 ground socket). The signals which are to be available at the sockets are defined in the dialog "DAU Output" (menu function "Commissioning/D/A Converter").
- With the measuring functions the MCU is able to carry out the two above functions - activation and recording of the dynamic response of the system - independently. The results of the measurement can be viewed with the menu functions "Commissioning/Trace1" and "Trace2" and subsequently saved to a file.

These functions can be used to optimize the dynamic response of the axis by modifying the controller parameters.

Figure 5-5 Measuring functions

5.1.5.1 Function Generator

Overview

With the aid of the function generator it is possible to specify torque and speed setpoints. The function generator is used primarily during initial commissioning, in order to adjust and check the dynamics of the axis control.

The function generator mode is selected from the mode selection list of the machine control panel. The operating elements necessary to parameterize the function generator are displayed in the lower section of the machine control panel.

Selection list "Signal"

With this selection list you determine the point of the axis control to which the signal generated by the function generator is to be applied. The choices available are:

- Torque setpoint
- Interference torque
- Speed setpoint

Selection list "Signal type"

With this selection list you define the form of the signal to be generated by the function generator. The following signal forms are available:

- Rectangular signal
- Noise signal

Edit field "Scaling"

In this edit field you can enter a value between 0 and 100% for the scaling of the signal amplitude. Changes to the value are effective after activating the button "Start".

Button "Parameters"

With the button "Parameters" you open the dialog to enter the signal parameters. The parameters available vary according to the selected signal and signal type.

Button "Save"

The current parameter settings of the function generator can be saved. The button "Save" opens a file selection dialog, where you can select the file to store the current parameter settings and then start the saving of the data.

Button "Load"

To simplify the parameterizing of the function generator, you can load parameter settings stored in a file. The button "Load" opens a file selection dialog, where you can select the file with the desired parameters and the start the loading of the data.

Button "Start/Stop"

The two buttons "Start" and "Stop" are used to activate and deactivate the function generator. While the function generator is active, the message "Function generator active" will be displayed in the alarm line.

5.1.5.2 Measuring Functions

Function description

By using the measuring functions it is possible to check the dynamic response of the axis control. By recording step and frequency responses it is possible to observe the dynamics of the torque, current and speed control of the axis over time and frequency ranges.
MCU-PIT treats the measuring functions as an additional operating mode; consequently, the measuring functions are selected via the mode selection list of the machine control panel. The operating elements necessary to parameterize the measuring functions are displayed in the lower section of the machine control panel. The measurements can be evaluated with Trace1/2.

Selection list "Measurement"

With this selection list you select the measurement to be carried out. The following measurements are available:

- Torque step response
- Torque frequency response
- Speed step response
- Speed frequency response
- Speed interference response
- Speed interference frequency response

Button "Parameters"

With the button "Parameters" you open the dialog to enter the measurement parameters. The parameters available vary according to the selected measurement.

Button "Save"

The current parameter settings of the measuring functions can be saved. The button "Save" opens a file selection dialog, where you can select the file to store the current parameter settings and then start the saving of the data.

Button "Load"

To simplify the parameterizing of the measuring functions, you can load parameter settings stored in a file. The button "Load" opens a file selection dialog, where you can select the file with the desired parameters and the start the loading of the data.

Button "Start/Stop"

The two buttons "Start" and "Stop" are used to activate and deactivate the measuring functions. While the measurement is active, the message "Measurement active" will be displayed in the alarm line. When measurement has been successfully completed, the message "Measurement complete" is shown.

5.1.6 Alarms

Overview

You obtain the alarm list via the menu function "Online/Alarms".

This window contains a list of all alarms currently awaiting acknowledgment, with the error number, error message and the time of occurrence.

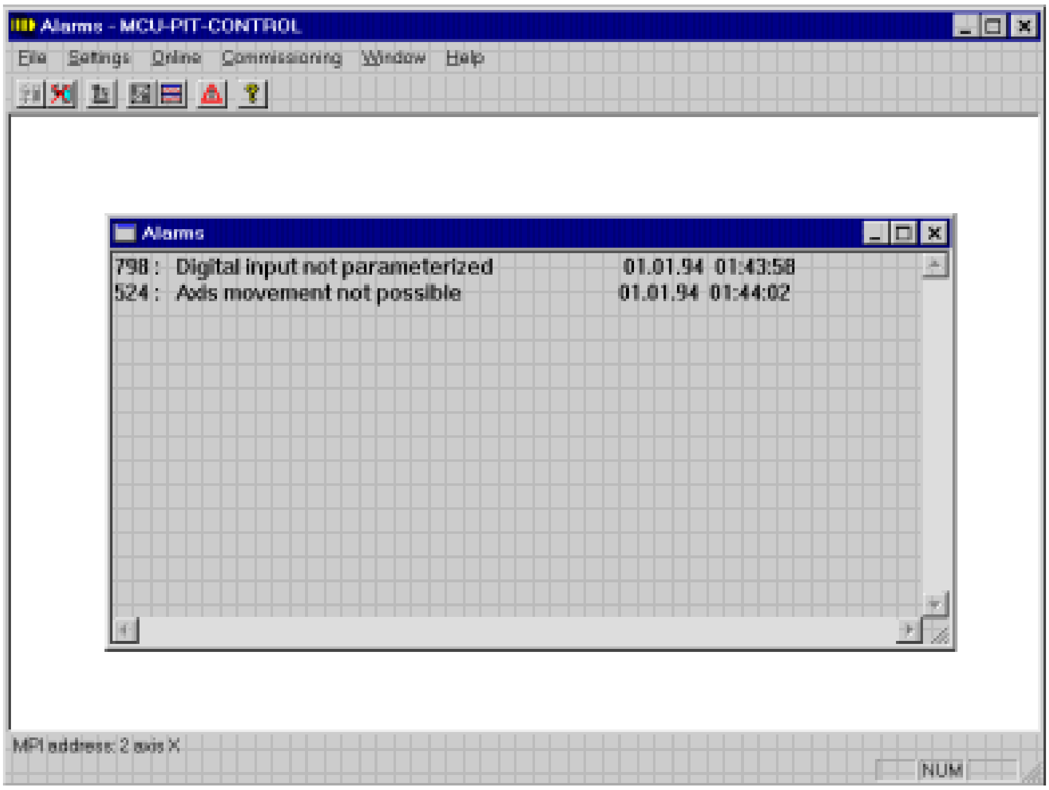


Figure 5-6 Alarms

5.2 Menu Functions

Overview

In the PIT-CONTROL menus the functions displayed in gray (dimmed) are inactive and cannot be selected. Online windows, for example, cannot be opened until communication has been established with the MCU.

File	Edit	Settings	Online	Commissioning	Window	Help

Open

Open a diagram stored in a file.

Save As ...

Save the current diagram window in a file. The diagram window remains open.

Print ...

Print the contents of the current window.

Printer Setup

Configure the current printer.

1 to 4

Select one of the last four files to have been edited.

Quit

Quit the PIT-CONTROL program. If positioning movements are still active, you will receive a message before quitting the program.

File	**Edit**	Settings	Online	Commissioning	Window	Help

X Markers

Activate or deactivate X markers to read certain values of the displayed curve.

Y Markers

Activate or deactivate Y markers to read certain values of the displayed curve.

Zoom

Enlarge sections of the curve.

Scaling

Carry out manual scaling of the Y axis.

File	Edit	**Settings**	Online	Commissioning	Window	Help

Symbol Bar

Show/hide the symbol bar.

Status Line

Show/hide the status line.

MPI Connection

Display the currently selected MPI connection in the second status line at the bottom of the screen.

File	Edit	Settings	**Online**	Commissioning	Window	Help

Communication Open the dialog to establish communication.

End Communication End the existing MPI connection.

Machine Control Panel Open the machine control panel to positioning the axes or carry out diagnosis.

Alarms Display alarm list.

Update Rate Define the time interval for the screen update of the machine control panel.

File	Edit	Settings	Online	**Commissioning**	Window	Help

D/A Converter Parameterize the signal output via the 3 available D/A converters.

Trace 1 Open diagram 1.

Trace 2 Open diagram 2.

Trace 1/2 Open diagrams 1 and 2 and display both diagrams together.

File	Edit	Settings	Online	Commissioning	**Window**	Help

Cascade Arrange several open windows as layers.

Vertical Split Arrange several open windows as columns on the screen.

Horizontal Split Arrange several open windows below one another on the screen.

Arrange Symbols Arrange the icons at the bottom of the screen.

Close All Windows Close all open windows.

1 to 9 with other windows Select a window which is already open.

File	Edit	Settings	Online	Commissioning	Window	**Help**

Online Documentation Call up SYSDOK-MCU.

Safety Information Display information on the safe handling of the PIT-CONTROL software.

Info Show information such as the version information of MCU-PIT, MCU and drive.

5.3 Working with PIT-CONTROL

Establishing communication with MCU

1. Select the menu function "Online/Communication".
2. In the dialog enter or select the desired path and MPI user number and activate "Start Communication". The window will disappear automatically once the connection has been established.

Positioning axes with PIT-CONTROL

Recommendation: You should monitor the positioning range limit switches. Necessary condition: Operation via DB-BD must be enabled (control bit TFB = 1). This can be provided for through the standard software (Technology functions FC-RESTART).

1. Select menu function "Online/Machine Control Panel".
2. Set enable signals: Axis enable, controller enable and PLC pulse enable.
3. Select the desired operating mode, enter appropriate parameters and initiate positioning ("Start" or "R+" / "R-").

There are various ways in which you can position the axes, for example:

- Positioning program:
  Automatic: Select the program and block number and then activate "Start"
- An individual positioning block:
  MDI: Enter the block and then activate "Block on Fly" or "Copy" and "Start"
- By a certain value:
  Increment: Position with R+, R- after defining the increment
- At a certain speed:
  Set-up, Control: Position with R+, R- after defining the speed

See also the Chapter Operating Modes of the MCU in the Function Manual *Positioning with MCU*.

Axis diagnosis with PIT-CONTROL

1. Establish communication with the MCU: Menu function "Online/Communication"
2. Open the machine control panel: Menu function "Online/Machine Control Panel"
3. Carry out the desired operations or diagnosis of the axis status.
4. The last alarm to have occurred is displayed in the alarm line of the machine control panel. A list of all alarms currently awaiting acknowledgment can be accessed via the menu function "Online/Alarms".

Outputting current errors

Menu function "Online/Alarms". The alarms currently awaiting acknowledgment are displayed.

Selecting DAU output signals

1. The menu function "Commissioning/D/A Converter" opens the corresponding dialog.
2. You can now select the desired signal and the output at which it is to be made available.
3. When you activate "Start" at the top of the screen, the desired signals are available at the sockets on the front plate. You can now connect measuring devices to monitor the dynamic response of the system.

Ending DAU output

With the "Stop" button at the top of the DAU window you can remove the signals from the output sockets.

6 Hints on Windows

Contents

Here you will find a list of the Windows commands you need to work with MCU-PIT.

The most important Windows functions

When working with MCU-PIT you need only the following Windows commands :

Function	Key(s) used
Activate menu bar	<ALT>
Confirm	<Return>
Cancel	<ESC>
Move to next button or input/output field	<TAB>
Select item from the current menu	< ↑ > ; < ↓ >
Open system menu	<ALT/Space>
Select help texts	<F1>
Activate or select functions	<Space>
Start menu	<Ctrl/ESC>
Move to next window	<ALT/ESC>

Activating functions

Press the underlined letter in combination with the <ALT> key.

Inactive functions

Inactive functions cannot be selected from the current menu; the menu items are dimmed.

Input

Inputs are always assigned to the currently active window. The active window is normally indicated by a color-highlighted title bar.

Selection

A window is selected by pressing the <Ctrl> and <Tab> keys at the same time or by positioning the mouse pointer and clicking with the left mouse button.

Colors

The currently set colors and many other features can be modified with the aid of Windows functions.

Windows

For further information on Microsoft Windows please refer to your *Windows Manual*.

7 Appendix

Q

R

S

T

U

V

W

SIEMENS

SIMODRIVE 611

Single-Axis Positioning Control MCU 172A

Functional Description
S7 Environment

Valid for: MCU 172A V 3.x or higher

Edition March 1998

Note:

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please enquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

Introduction

Contents

Guide

This Documentation contains information about the integrated SIMATIC S7 functionality of the single-axis motion control unit MCU. It will assist you with the configuration of SIMATIC S7 in connection with the single-axis motion control unit MCU.

Inter alia, you will find detailed information about:

- mechanical assembly
- electrical installation
- addressing
- S7 functionality
- standard function blocks "Technological Functions"

For information about PG/OP connection refer to Chapter 10 *Communication*

Further Information

For further information which would go beyond the scope of this Documentation or this Manual please refer to the respective Standard Documentation for the following Siemens products:

- SIMATIC S7
- 1FT6 motors
- 1FK6 motors
- SIMODRIVE 611
- SINUMERIK 840D
- PROFIBUS-DP

You will find a list of the respective Documentation in the Appendix to the Manual.

Functionality of the MCU With Integrated S7-CPU

Overview

Due to the required combination with the positioning function as a result of the S7-CPU being integrated into the MCU, there are certain differences compared with the similar S7-CPU-314. The principal characteristics are given below.

Features of the Integrated S7-CPU

Rated voltage	5 V / 24 V internally, by means of power supply module SIMODRIVE 611 (UE or E/R)
Weighting factors for internal 24 V supply to the 4 high-speed outputs for external 24 V supply to the 4 high-speed outputs	 EP 3.2 AP 2 EP 2.25 AP 2
Power consumption of the 4 inputs / 4 outputs	 Max. 2 A (24 V externally)
Power consumption of the S7 I/O	Refer to ST 70
External protection	Refer to 611 configuration
Dimensions WxHxD Weight	 50 mm x 316 mm x 115 mm 0.7 kg
Back-up - S7 blocks - S7 runtime data	No back-up battery, data back-up by means of integrated flash EPROM Back-up by means of STEP 7 (Copy from RAM to ROM) Automatic back-up in case of power failure (Configuration by S7 config.)
S7-CPU instruction set Instruction execution times - 1 K bit instructions - 1 K instruction mix Memory - User memory - Load memory (EPROM) - Load memory (RAM) Technological Functions Standard FBs MPI station (PG/OP) MPI station (global data)	Similar to SIMATIC S7-CPU 314 Approx. 0.5 ms Approx. 1.0 ms For 512 KB FEPROM 76 KB 128 KB 128 KB Approx. 8 KB Max. 3 Max. 4
I/Os - On Board - S7 I/Os	 4 inputs / 4 outputs Connection by means of IM361

Planning the Mechanical Assembly

Contents

Product Range

This Chapter

This Chapter will inform you about the most essential components available to set up an MCU with integrated S7-CPU.

The MCU

The MCU with integrated S7-CPU is a complete position control system with integral programmable controller.

Structure of an MCU

The SIMODRIVE compound drive with MCU comprises the following components:

- NE module
- Power module
- MCU with integrated IM 360 (P/K-bus)
- Interconnecting cable 368
- IM 361
- S7 I/O modules (see Table 0-1)
- Motor 1FK6/1FT6 with integral encoder
- Motor line
- Encoder line

Several MCUs can communicate with each other by means of the MPI interconnecting cable.

For programming the integrated S7-CPU you need a programming unit (PG). Link the PG with a PG cable to the MCU.

Components of an MCU With Integrated S7-CPU

For setting up a programmable controller and putting it into operation there is a range of components at your disposal. The following list shows the most essential components with their functions:

- The mounting channel to carry the racks of S7 I/O modules.
- The MCU with integrated S7-CPU executes the user program and communicates by means of the MPI interface with other CPUs or a PG/OP.
- The signal modules match the different process signal levels with the S7-300.
- The optional passive terminal for hard-wiring the signal modules.
- The communication processor CP 342-5 for linking with other components by means of PROFIBUS-DP.

Mounting Dimensions for an MCU System With S7

Mounting Dimensions of Hardware Modules

The following table provides an overview of the mounting dimensions for S7-300 modules.

Table 0-1 Mounting Dimensions for S7-300 Modules

Hardware Modules	Module Width	Module Height	Maximum Depth
Power Supply PS 307, 2 A Power Supply PS 307, 5 A Power Supply PS 307, 10 A	50 mm 80 mm 200 mm	125 mm 125 mm 125 mm	130 mm or 180 mm with open IM 361 front cover
Digital Input Module SM 321 Digital Output Module SM 322 Relay Output Module SM 322 Simulator Module SM 374	40 mm 40 mm 40 mm 40 mm	125 mm 125 mm 125 mm 125 mm	
Analog Input Module SM 331 Analog Output Module SM 332 Analog Input/Output Module SM 334	40 mm 40 mm 40 mm	125 mm (or 185 mm with Shield Bearing Element)	
Interface Module IM 361 Communication Processor CP 342-5 Positioning Module FM 351 for Rapid/Creep Feed Drive Electronic Cam Module FM 352	80 mm 80 mm 80 mm 80 mm	125 mm 125 mm 125 mm 125 mm	

Lengths of Mounting Channels

Depending on your S7-300 configuration, you can use the following mounting channels:

Mounting Channel	Effective Length for Module
160 mm	120 mm
482.6 mm	450 mm
530 mm	480 mm
830 mm	780 mm

Arrangement of Hardware Modules in a System Comprising Several Racks

Introduction

The subsequent section describes the rules to be followed for arranging the hardware modules if you want to install several racks.

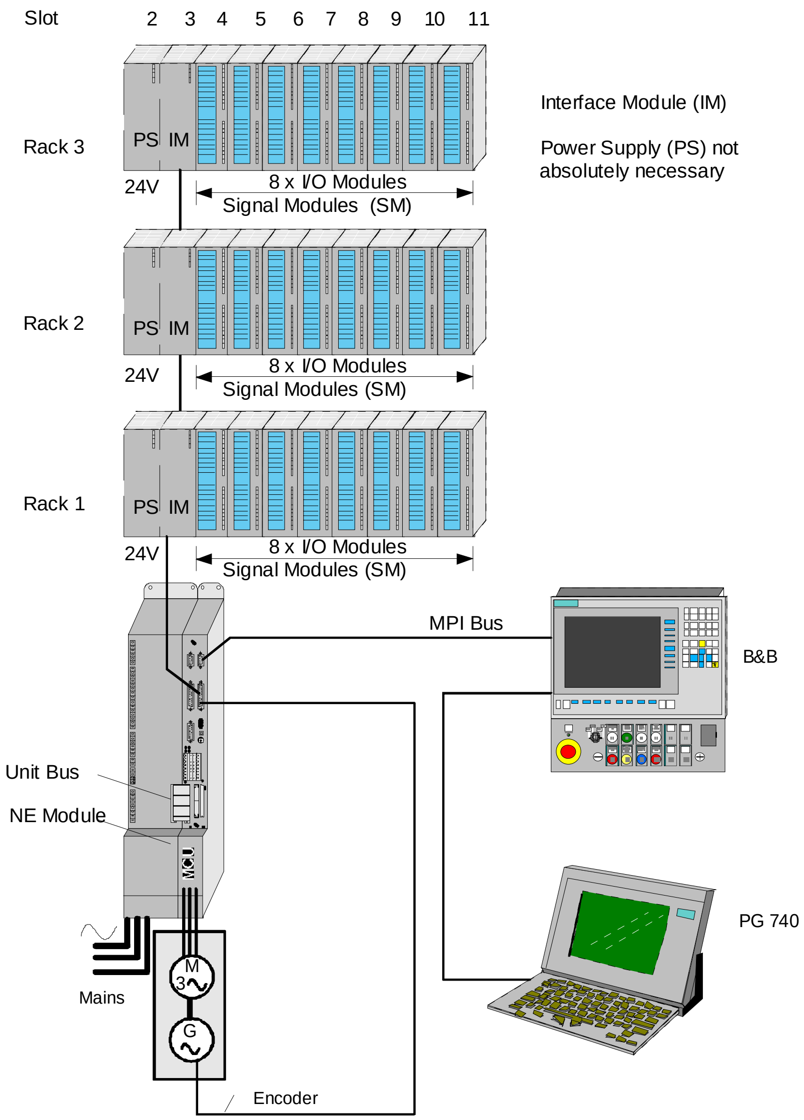


Figure 0-1 Overview of a Hardware Configuration Including one MCU and 3 Racks

Arrangement of Hardware Modules

When arranging the hardware modules, observe the following rules:

- Assign the interface module always to slot 3 and always to the left of the first signal module.
- A maximum of 8 signal modules may be plugged into one rack. The signal modules are always located to the right of the interface modules.
- The number of signal modules possible is limited by the maximum permissible current drawn from the S7-300 backplane bus. The current consumption per rack must not exceed 1.2 A.
(see Table 4-1 or 4-2 and Specifications of Hardware Modules).

Interface Modules for Installation of 1 to 3 Racks

For a system including additional I/O modules you need interface modules. It is the purpose of these interface modules to interconnect the S7-300 backplane bus and the racks.

The following table shows the interface modules for installation of one to three racks.

Table 0-2 Interface Modules IM 360/IM 361 for Installation of Several Racks

Interface Module	Usable for Rack
IM 360	Integrated into MCU (rack 0)
IM 361	Racks 1 to 3

Interconnecting Cable for Interface Module

For connecting the interface modules there are interconnecting cables of 1, 2.5, 5 or 10 m available.

Maximum Configuration

The maximum configuration is shown in the Figure Hardware Configuration. It comprises one MCU and 3 racks with S7-300 modules.

Addressing of Hardware Modules

Contents

Slot-related Address Assignment for Signal Modules

Introduction

The subsequent section describes the interrelation between slot and address assignment. You need this information to determine the module start addresses of the signal modules used.

Slots for Signal Modules

Signal modules may be plugged into slots 4 to 11 of every rack. With reference to the respective slots and rack, every signal module has been assigned its individual module start address. This address cannot be changed.

Maximum Configuration

Figure 0-1 shows a system comprising one MCU with 3 racks and the slots possible.

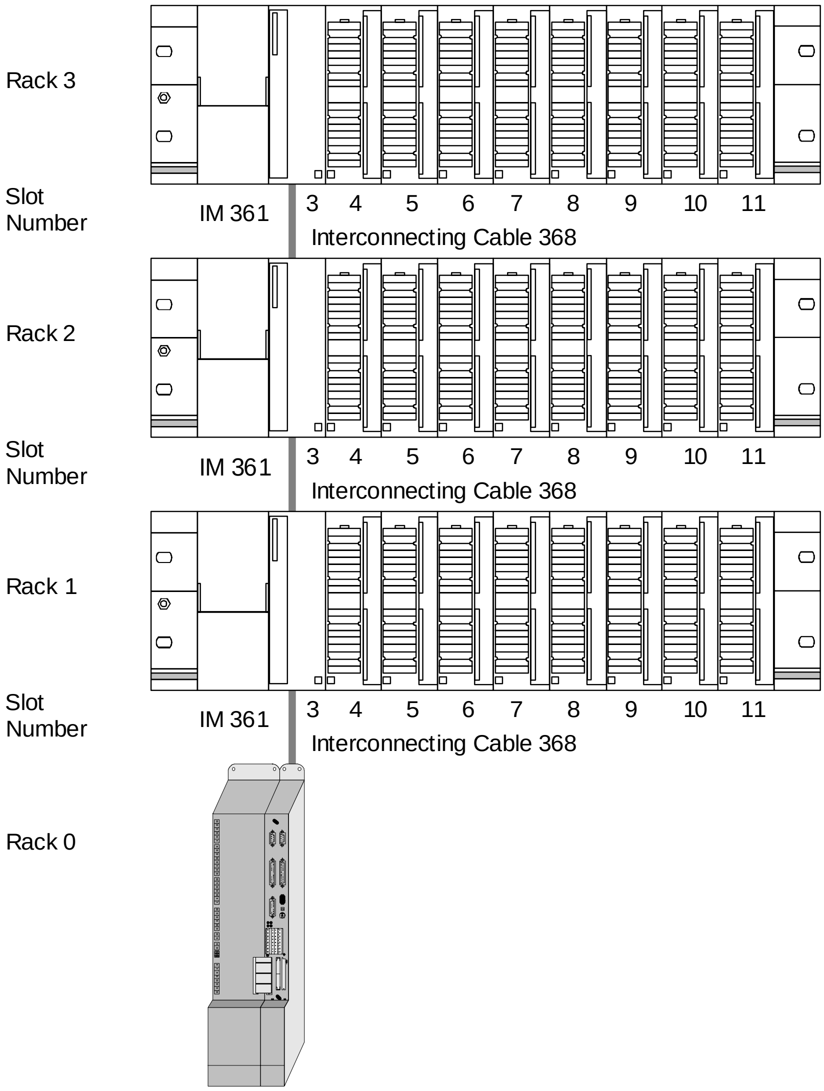


Figure 0-1 Slots of MCU With Integrated IM 360

Address of S7 I/O Modules

The S7 I/O modules are connected with the integrated peripheral bus interface of the MCU by means of IM 361. A maximum installation of 3 racks (1...3) is possible here. Up to 8 I/O modules may be plugged into each rack. Addressing is slot-related as for CPU 314.

Table 0-1 Slot-related Digital Addresses

Rack No.	Slots / Digital Addresses							
	4	5	6	7	8	9	10	11
0	internally assigned							
1	32	36	40	44	48	52	56	60
2	64	68	72	76	80	84	88	92
3	96	100	104	108	112	116	120	124

Table 0-2 Slot-related Analog Addresses

Rack No.	Slots / Analog Addresses							
	4	5	6	7	8	9	10	11
0	**256**	internally assigned						
1	384	400	416	432	448	464	480	496
2	512	528	544	560	576	592	608	624
3	640	656	672	688	704	720	736	752

Rack 0

Rack 0 is utilized for the integrated positioning functionality and is not useable for other S7 I/O modules. The MCU occupies 16 bytes from address 256 in the analog address space.

Warning!

Overwriting of internally occupied memory locations may cause malfunctions of the control system (valid up to and including V2.3 only).

Addressing of Signal Modules

Introduction

The following section describes with various examples how to address the signal modules. You need this information to be able to address the signal module channels in the user program.

Addresses of Inputs and Outputs of Digital Modules

The address of an input or output is composed of byte address and bit address.

e.g.	E32.0		
E	=	Input	
32	=	Byte Address	is related to the respective module start address
0	=	Bit Address	indicated on the respective module

Figure 3-2 illustrates the pattern how to make up the individual channel addresses of the digital modules.

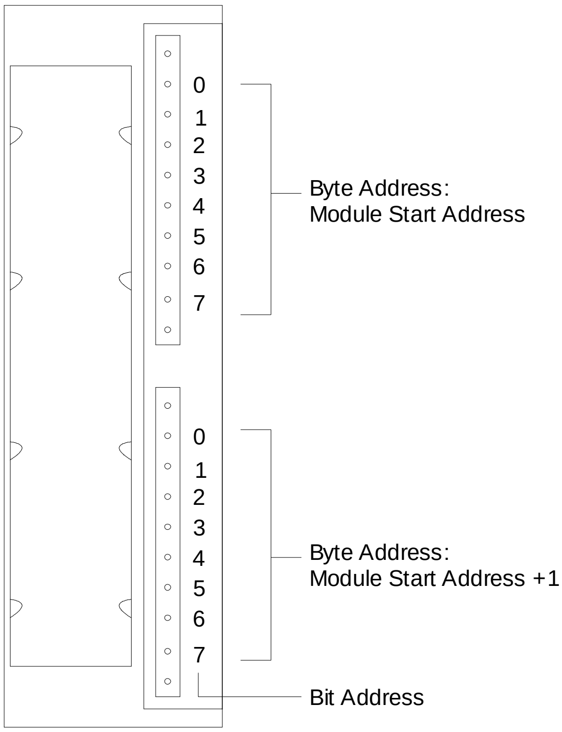
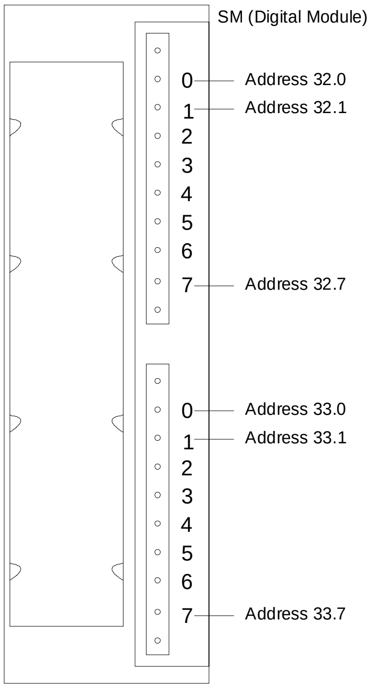


Figure 0-2 Input and Output Addresses of Digital Modules

Example for Digital Modules

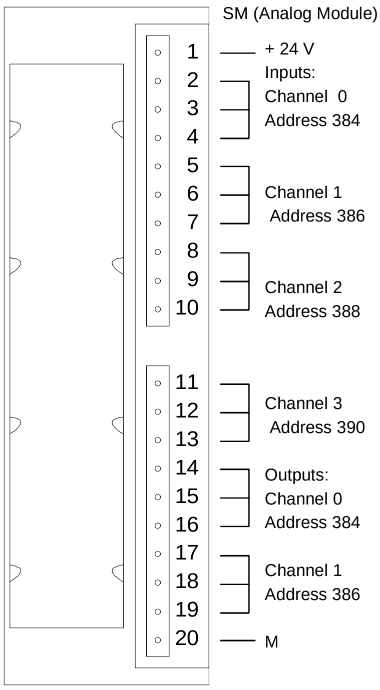


The opposite diagram shows an example for addresses of a digital module plugged in slot 4 of rack 1, which means that the module start address is 32. Slots 1 and 2 are not occupied because it is an expansion rack.

Addresses of Analog Modules

The address of an analog input or output channel is always a word address. The channel address is related to the module start address. If the first analog module is plugged in slot 4 of rack 1, it will have the default start address 384. For the start addresses of the analog modules please refer to Table 0-2.

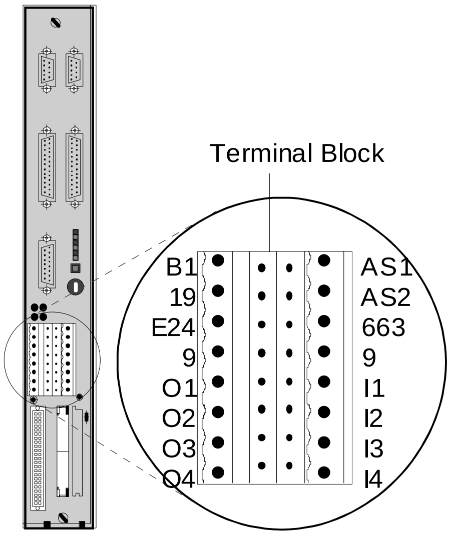
Example for Analog Modules



The opposite diagram shows an example for addresses of an analog module plugged in slot 4. You can see that for an analog input / output module the addressing of both the analog input and output channels starts from the same address, which is the module start address.

Addressing of Onboard Inputs and Outputs of MCU

4 Inputs /
4 Outputs



The MCU provides 4 onboard inputs and 4 onboard outputs. These integrated inputs and outputs can be connected with 8-pin Phönix connectors. The input and output functions are selected by means of the MCU machine data. Direct access on the S7 side of the MCU is not possible if the inputs and outputs are used, because these are only useable for special functions.
(Refer to Function Description: Positioning With MCU).

It is not allowed to set the outputs from the S7, if the outputs O1 to O4 are used for the positioning functionality. Access to the inputs and outputs is possible by means of the technological function FC CONTROL (Data Record 16 „Digital Inputs / Outputs).

Planning the Electrical Installation

Contents

General Rules and Regulations for Operating an S7-300

Introduction

Being an integral part of a plant or system and depending on its particular field of application, the operation of an S7-300 requires special rules or regulations to be observed. This chapter provides an overview of the most essential rules that you have to obey when integrating an S7-300 into a plant or system.

Specific Event

Please observe the safety rules and regulations for the prevention of accidents, such as the machine safety standards, which apply to specific events.

Emergency OFF Devices

Emergency OFF devices according to IEC 204 (corresponding to VDE 113) must remain effective in all operating modes of the plant or system.

Restarting the Plant After Specific Events

The following table shows things you must pay attention to when restarting the plant after specific events.

If ...	make sure that ...
restarting after voltage dip or failure	no dangerous operating conditions occur. Possibly ”Emergency OFF” should be forced!
restarting after resetting of ”Emergency OFF” device	the plant will not start up in an uncontrolled or undefined way.

Mains Voltage

The following table shows things you must observe in connection with the mains voltage.

For ...	make sure that ...
stationary plants or systems without all-pole mains switch	there is a mains switch or circuit breaker included in the building installation.
load power supplies, power supply modules	the adjusted rated voltage range corresponds to the local mains voltage.
all S7-300 circuits	the mains voltage fluctuations/deviations do not exceed the permissible tolerance range for the rated voltage (see Specifications of S7-300 Modules).

DC 24 V Supply

The following table shows things you must pay attention to in connection with the 24-V supply.

For ...	pay attention to ...	
buildings	external lightning protection	Take lightning protection measures (e.g. lightning conductors)
DC 24-V supply lines, signal leads	internal lightning protection	
24-V supply unit	reliable electrical separation of low voltage	

Protection from External Electrical Interferences

The following table shows things you must pay attention to in connection with the protection from electrical interferences or failures.

For ...	make sure that ...
all plants or systems, where an S7-300 has been installed	the plant or system is connected to grounding conductors for diverting electromagnetic interferences!
connecting and signal leads	the wiring arrangement and installation are correct!
signal leads	cases of line or strand breakage will not lead to undefined plant or system states!

Power Consumption and Power Loss of an S7-300

Introduction

The S7-300 hardware modules draw the power required for their operation from the S7-300 backplane bus and from the external load power supply.

Power consumption and power loss of the respective hardware modules are important data for planning the configuration of an S7-300.

This chapter provides a list of the power consumption and power loss data for S7-300 hardware modules. An example will demonstrate to you how to calculate power consumption and power loss for an S7-300 system.

Maximum Power Consumption

The total power consumption of the S7-300 modules from the S7-300 backplane bus must not exceed 1.2 A per phase!

At DC 24-V Load Power Supply

The following table lists the power consumption and power loss values for the S7-300 modules with 24-V load power supply.

Table 0-1 Power Consumption and Power Losses of S7-300 Modules (DC 24-V Load Power Supply)

Hardware Module	**Power Consumption from S7-300 Backplane Bus (Maximum)**	**Power Consumption from 24-V Load Power Supply (At No Load)**	**Power Loss (Nominal Operation)**
Interface Module IM 361	supplies 0.8 A	0.5 A	5 W
Digital Input Module SM 321; DI 16 DC 24 V	25 mA	1 mA	3.5 W
Simulator Module SM 374; 16 Input/Output	80 mA	-	0.35 W
Relay Output Module SM 322; DO 8 AC 230 V	40 mA	75 mA	2.2 W
Digital Output Module SM 322; DO 16 DC 24 V/0.5A	70 mA	100 mA	4.9 W
Digital Output Module SM 322; DO 8 DC 24 V/2 A	40 mA	55 mA	6.8 W
Analog Input Module SM 331; AI 8 12 Bits	60 mA	200 mA	1.3 W
Analog Input Module SM 331; AI 2 12 Bits	60 mA	200 mA	1.3 W
Analog Output Module SM 332; AO 4 12 Bits	60 mA	240 mA	3 W
Analog Output Module SM 332; AO 2 12 Bits	60 mA	240 mA	3 W
Analog Input/Output Module SM 334; AI 4/AO 2 8/8 Bits	40 mA	100 mA	2.6 W
Communication Processor CP 342-5	80 mA	250 mA	
Positioning Module FM 351 for Rapid/Creep-Feed Drives			
Electronic Cam Controller FM 352			

At AC 120/230-V Load Power Supply

The following table lists the power consumption and power loss values for the S7-300 modules with 120/230-V load power supply.

Table 0-2 Power Consumption and Power Losses of S7-300 Modules (AC 120/230-V Load Power Supply)

Hardware Module	**Power Consumption from S7-300 Backplane Bus (Maximum)**	**Power Consumption from AC Load Power Supply (At No Load)**	**Power Loss (Nominal Operation)**
Digital Input Module SM 321; DI 8 AC 120/230 V	22 mA	6.5/11 mA	4.8 W
Digital Input Module SM 321; DI 16 AC 120 V	3 mA	6 mA	4.0 W
Digital Output Module SM 322; DO 8 AC 120/230 V	200 mA	-	9.0 W
Digital Output Module SM 322; DO 16 AC 120 V	200 mA	-	9.0 W

Power Losses of Power Supply Modules

The following table lists the power losses of the power supply modules

Table 0-3 Power Losses of Power Supply Modules

Module	Power Loss (Nominal Operation)
Power Supply Module PS 307; 2 A	10 W
Power Supply Module PS 307; 5 A	18 W
Power Supply Module PS 307; 10 A	30 W

How to Operate an S7-300 With Process Peripherals on Grounded Power Supply

Introduction

This section provides information about the complete configuration of an S7-300 on a grounded power supply unit (TN-S system). The subjects treated herein are:

- Interrupting devices, short-circuit and overload protection according to VDE 0100 and VDE 0113
- Load power supplies and load circuits.

For further information please refer to the *Documentation: Installing and Connecting an MCU*.

Definition: Grounded Power Supply

A grounded power supply includes a grounded neutral conductor of the system. A simple ground fault caused by a live conductor contacting the ground or a grounded part of the plant will activate the safety devices.

Components and Protective Measures

The installation of a complete system requires various mandatory components and protective measures. The type of components and the degree of compulsoriness of the protective measures depend on the VDE standard valid for your system.. The following table refers to Figure 0-1.

Table 0-4 VDE Standards for Installation of a Control System

Refer to ...	VDE 0100	VDE 0113
interrupting device for control system, transducers and actuators	... Part 460: Main Switches	... Part 1: Disconnectors
short circuit and overload protection: in groups for transducers and actuators	... Part 725: Protect one pole of the circuits	... Part 1: **-** if secondary circuit is grounded: protect **one pole** **-** otherwise: protect **all poles**
load power supply for AC load circuits including more than five items of electromagnetic	Electrical isolation by means of transformer	Electrical isolation by means of transformer

equipment	**recommended**	**necessary**

Features of Load Power Supply Units

The load power supply unit feeds the input and output circuits (load circuits), as well as transducers and actuators. Below you will find the features of load power supply units which are required for the particular application.

Features of Load Power Supply Unit	**required for ...**	**Remarks**
Reliable separation	modules to be fed with voltages of ○ DC 60 V or ○ AC 25 V.	The power supply units PS 307 ands the Siemens load power supply units of the 6EP1 series provide this feature.
	DC 24-V load circuits	
Tolerances of output voltage: 20.4 V to 28.8 V 40.8 V to 57.6 V 51 V to 72 V	 DC 24-V load circuits DC 48-V load circuits DC 60-V load circuits	If the tolerances of the output voltage are exceeded it is recommended installing a back-up capacitor. Rating: 200 mF per 1 A of load current (for bridge-connected rectification).

Rule: Ground Load Circuits

Load circuits should be grounded.

The signal common (ground) ensures a high functional reliability. You should provide the load power supply unit (terminal L- or M) or the isolating transformer with a detachable ground terminal (Figure 0-1). This provision will help you to locate more easily ground faults in cases of power distribution trouble.

General Layout of an S7-300

Figure 0-1 shows the general layout of an S7-300 (Load Power Supply and Grounding Concept) fed from a TN-S system.

Note: The arrangement of the supply terminals depicted herein does not reflect their real arrangement; it has been selected for the sake of clarity.

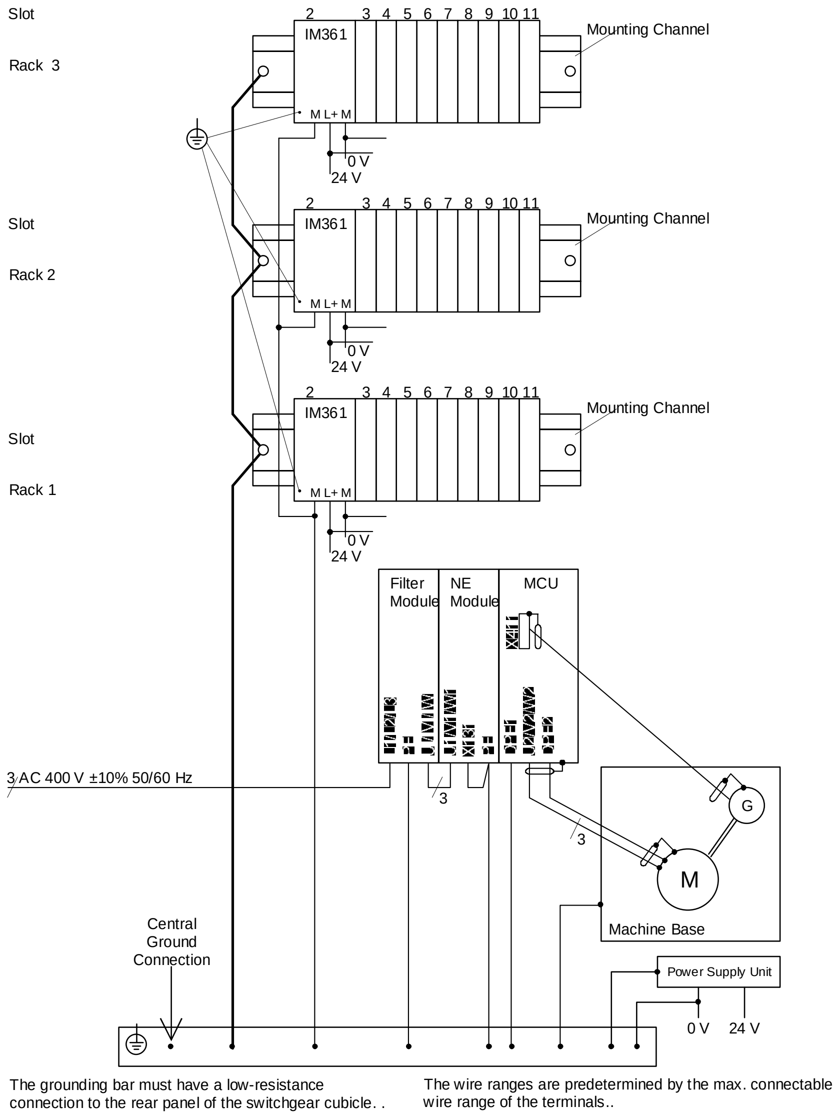


Figure 0-1 Signal Modules Fed from Grounded Power Supply

Installation of an S7-300 With Isolated Modules

Definition

When installing a system including isolated modules, the reference potentials of control circuit (M_{intern}) and load circuit (M_{extern}) will be electrically isolated.

Field of Application

Use isolated modules for:

- all AC load circuits
- DC load circuits with separate reference potentials
  Examples of load circuits with separate reference potentials:
  - DC load circuits with encoders of different reference potentials (e.g. if grounded encoders are installed at long distances from the control system and no equipotential bonding is possible)
  - DC load circuits with grounded plus poles (L +) (battery circuits).

Isolated Modules and Grounding Concept

You can use isolated modules regardless of whether the reference potential of the control system is grounded or not.

Further Information

For further information please refer to *Chapter 13 -EMV Guide to MCU - Chapter 3* and to the *S7-300 Manual*.

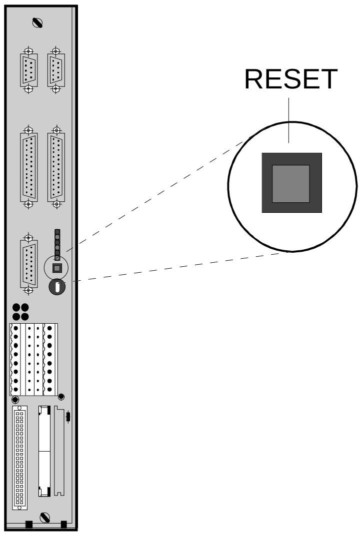
S7 Functionality of the MCU

Contents

Hardware

RESET Button

Overview

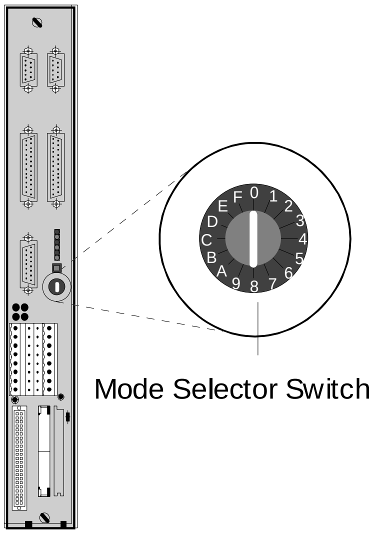


Clear drive alarms by means of the RESET button.

For resetting Power-On alarms, switch respective module OFF/ON or acknowledge alarm by MCU PIT (in menu function ONLINE/RESET).

Mode Selector Switch

Overview



The switch positions of the MCU correspond to those of the S7-CPU-314. The functions are identical with those of the S7-CPU. When the MCU is switched to STOP, the control function is blocked by cancellation of the enables. The other MCU switch positions which are adjustable do not have any function.

Positions of the

Mode Selector Switch and Their Description

Descriptio n	Position of Mode Selector Switch	Explanation
Mode Run Program	Run-P 0	- MCU executes S7 user program; positioning is possible. - Access to full PG functionality. Programs can be transmitted from and to CPU.
Mode RUN	RUN 1	- MCU executes S7 user program; positioning is possible. - Programs can be read out from CPU, but load memory cannot be edited.
Mode STOP	STOP 2	- MCU executes stop loop. The S7 user program is not executed. - PG functions are accessible without restrictions. - Enables are blocked; positioning is not possible.
MRES	3	for special functions
–	4 to F	without function for MCU

Note!

Overall reset cannot be performed on MCU. Switch position 3 leads to an undefined MCU state, which is visible by the flashing of all LEDs. This state can be reset by POWER ON.

Transitions Between Operating Modes

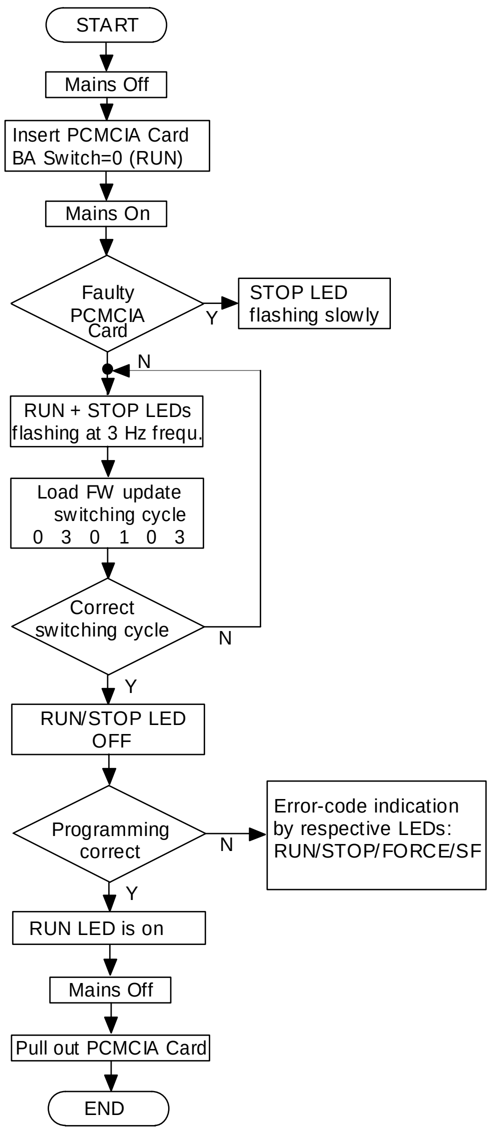
Switching Operations by Mode Selector Switch		Explanations (System Responses)
RUN-P RUN	0 1	none
RUN RUN-P	1 0	none
RUN STOP	1 2	- Interrupts execution of S7 program and inhibits command output. - Cancels enables and axis brakes with max. current. - Entry into diagnostic buffer is made. - Updating of actual values continues.
STOP RUN	2 1	- Exits stop loop after error check. - Erases times and flags and resets counters. - Calls OB100. - MCU resumes cyclic program operation.
STOP MRES	2 3	none
MRES STOP	3 2	none

Erasing of MCU and Loading Standard Data

Switching Operation		Explanation (System Responses)
MRES+POWER ON	3+O N	The MCU erases the S7 program from the RAM and rearranges the data blocks DB1000-1251. All RAM data are erased and the standard data are loaded.

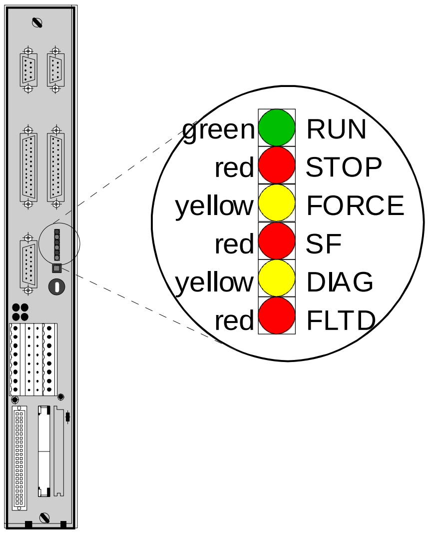
Only
Authorized Staff:
Update
MCU Firmware

Switching Operation		Explanations (System Responses)
	Save all MCU data on PG/PC before. Then switch MCU power OFF and insert update PCMCIA CARD.	
		POWER ON
RUN-P MRES MRES RUN-P RUN-P RUN RUN-P RUN-P MRES	0 1/2 3 3 2/1 0 0 1 0 0 1/2 3	When switching on, the firmware starts being loaded. LED RUN and STOP flashing LED RUN and STOP flashing LED RUN and STOP flashing LED RUN and STOP off After faultless programming, LED RUN lights steadily. In case of error, the error code will be indicated by the LEDs RUN/STOP/FORCE/SF.
		After having loaded the firmware, load data from PG/PC and save in FEPROM.



LED

Overview



The MCU has been provided with several LEDs. As for the MCU various components are incorporated in one module, some indicator functions are combined.

Description

LED	S7-CPU	Positioning Section	611
RUN	-S7 executes cyclically the S7 user program. -The interface services are active (MPI).	- Positioning is possible. - Setpoints are transmitted to controller 611.	- Speed controller is active. - Power will be supplied to motor, if enables are released.
STOP (steady)	-S7 runs in stop loop. -MPI services are executed.	- Positioning is not possible.	- Speed controller is active. - Regulation to $N_{requ} = 0$; if enabled.
STOP (flashing)	Module Failure		
SF	An internal error has occurred. For detailed information refer to S7 diagnostic buffer or MCU-PIT.		
FORCE	Inputs/flags or outputs are permanently controlled.	-	-
DIAG	-	In positioning section or 611 control section have occurred errors: - in running up - reset alarm - info in diagnostic buffer of S7-CPU - DIAG-LED lights in case of POWER ON alarms	

FLTD	-	-	611 control function not possible: - internal and external errors - Info in diagnostic buffer of S7-CPU

Software

Features of the Integrated S7-CPU

Introduction

Table 0-1 shows the main features of the integrated SIMATIC CPU.

Table 0-1 Features of the Integrated S7-CPU

Feature	MCU With Integrated S7-CPU
Load Memory (RAM) with 512 KB FEPROM with 128 KB FEPROM	 128 KB 80 KB
Load Memory (EPROM) with 512 KB FEPROM with 128 KB FEPROM	 128 KB 80 KB
User Memory	76 KB
Speed	Approx. 1 ms for 1 K instructions (mixture of binary and word instructions)
Digital Inputs / Outputs	384
Analog Inputs / Outputs	64
Flag	Retention adjustable (max. 15 flag bytes) Note: From STEP7 stage 2 preset: 16 (0 ... 15) Preset value must be changed for MCU!
Counter	Retention adjustable (max. 4 counters)
Times	Retention adjustable (max. 4 times)
Data Storage Area	Retention adjustable: max. 2 DB of max. 64 bytes (2 x 32 bytes)
Timing Flag	Flags which can be used for clock-pulse generation in the S7 user program. Number: 8 (1 flag byte); can be randomly selected
Local Data	1536 bytes total; 256 bytes per priority class
Area of Process Image	From 32 to 127 Digital Inputs: from E 32.0 to E 127.7 Digital Outputs: from A 32.0 to A 127.7
Nesting Depth	8 per priority class; 4 additionally within a synchronous fault OB
Blocks: OBs FBs FCs DBs SDBs SFCs	 13 128 128 127 9 37

SFBs	-
Clock	Software clock, not backed-up
Run-Time Meter	Cannot be saved

Integral Clock

Overview

The MCU includes a software clock. However, since the MCU has no back-up battery, time is reset during the run-up stage.

Setting the Clock

After running up the system, time and date must be set again. You can set the time in 2 ways:

- By means of SFC 0 "SETCLK" you can set the time of the block. For reading the time in the S7 user program, it can be read out with the help of SFC 1 "READ_CLK" (see Reference Manual *STEP 7 System and Standard Functions*)
- Using the STEP-7 configuration package on a PG or PC, you can set the time by means of the S7 Information.

Run-Time Meter

The MCU includes an integral run-time meter. It can count the elapsed operating hours of the integrated S7-CPU or of an apparatus. The counter can be programmed by means of SFC 2, 3 and 4 SET_RTM, CTRL_RTM and READ_RTM. Upon switching the system off, the counter is reset and must be reprogrammed.

(see Reference Manual *STEP 7 System and Standard Functions*)

The run-time meter cannot be installed to a retentive data storage area.

Blocks of the Integrated S7-CPU

Organization Blocks (OB)

The operating system of the integrated S7-CPU has been designed for an event-controlled S7 user program execution. This chapter tells you upon which event the operating system will automatically call which organization block (OB).

Description of the OBs

For detailed description of the various OBs and their applications please refer to the Manual *STEP 7 Designing User Programs*.

Size of an OB

An OB may have a maximum size of 24 KB.

OBs for Cycle and Start-up

The following table lists OBs determining the MCU action during cycle and start-up.

Cycle and Start-up	OB Called	Preset OB Priority
Cycle	OB 1	Lowest Priority
Start-up (STOP–RUN Transition)	OB 100	-

OBs for Internal and External Interrupts

The following table lists OBs determining the MCU action upon interrupt events.

The OB priority cannot be changed.

Interrupts (Internal and External)	OB Called	OB Priority
Time-of-day Interrupt	OB 10	2 (low)
Time-delay Interrupt Range: 1 ms to 60000 ms (adjustable in steps of 1 ms)	OB 20	3
Time Interrupt Range: 1 ms to 60000 ms (adjustable in steps of1 ms)	OB 35	12
Process Interrupt	OB 40	16
Diagnostics Interrupt	OB 82	26 (high)

Note!

With shorter prompting times (less than 5 ms), a cycle -time monitoring may occur. In this case, the prompting time or the limit for the cycle-time monitoring must be increased.

S7-CPU in STOP

The integrated S7-CPU switches to STOP, if a

- time-of-day interrupt
- time-delay interrupt
- process interrupt
- diagnostics interrupt

occurs, but the respective OB has not been programmed.

S7-CPU not in STOP

The integrated S7-CPU will not switch to STOP if a time interrupt occurs and OB 35 has not been programmed.

OBs for Error Reactions

The following table lists OBs determining the action of the MCU with integrated S7-CPU in the event of an error.

The integrated S7-CPU switches to STOP, if an error occurs and the respective OB has not been programmed (except for OB 81).

Error	OB Called	Preset OB Priority
Time Error (e.g. initiated by the scan time monitor)	OB 80	26
Power Supply Error	OB 81	26
One of the following errors has occurred: • Event (e.g. time-delay interrupt) has occurred, but respective OB cannot be executed • Process image update error (Module not installed or defective)	OB 85	26
Communication Error • Faulty message identifier for reception of global data • Data block for global data status does not exist or is too short	OB 87	26
Programming Error (e.g. addressed timer does not exist)	OB 121	Same priority as the OB, in which the error occurs
Error in direct peripheral access (Module defective or not installed)	OB 122	Same priority as the OB, in which the error occurs

Function Blocks (FB)

Number: 128

Range from 0 to 127

An FB can have a maximum size of 24 KB.

Functions (FC)

Number: 128

Range from 0 to 127

An FC can have a maximum size of 24 KB.

Data Blocks (DB)

Number: 127

Range from 1 to 127; 0 is reserved

A DB can have a maximum size of 16 KB.

System Functions (SFC)

SFCs are system functions integrated into the operating system.

Number: 37

For detailed SFC description please refer to the Reference Manuals *STEP 7 Statement List (AWL) or*. *STEP 7 Ladder Diagram (KOP)* and *STEP 7 System and Standard Functions*.

System Data Blocks (SDB)

The system data blocks contain the parameters of the integrated S7-CPU. Entries are made by means of the STEP 7 Tool ”System Configuration” or ”Define Global Data” (see Manual *STEP 7 Application of the Tools*).

SDB	Contents
SDB 0	Parameters of the integrated S7-CPU
SDB 1	CPU automatically enters the actual configuration of the integrated S7-CPU.
SDB 2	Default parameters of the integrated S7-CPU
SDB 5	Communication parameters for MPI nodes within an MCU system.
SDB 100	none
SDB 101	Parameters for the I/O modules of rack 1
SDB 102	Parameters for the I/O modules of rack 2
SDB 103	Parameters for the I/O modules of rack 3
SDB 210	Parameters for communication by means of global data

Note!

If CPU settings for the system configuration are changed or GD tables compiled, STEP 7 will generate the respective SDBs and store them under SDB in the AP-off area. This SDB container must be loaded to the integrated S7-CPU and saved on FEPROM. The new settings are activated after module start-up.

SFCs in the Integrated S7-CPU

Introduction

The integrated S7-CPU offers you diverse integrated functions, e.g. for program processing or diagnostics. You can select these integrated functions from your S7 user program with the help of the respective SFC or SFB number.

For a detailed description of all integrated functions please refer to the Reference Manual *STEP 7 Standard and System Functions*. There you will find information about how to select the integrated functions and which parameters to be passed on.

Clock Function

The integrated S7-CPU provides the following functions as clock functions.

SFC No.	Name	Description	Execution Time
0	SET_CLK	Setting time of day If the clock to be set is a master clock, time synchronization will simultaneously be initiated. If the clock to be set is a slave clock, only time of day will be set.	120 µs
1	READ_CLK	Reading time of day	190 µs
2	SET_RTM	Setting run-time meter. You can set a run-time meter in the integrated S7-CPU.	65 µs
3	CTRL_RTM	Starting or stopping the run-time meter	55 µs
4	READ_RTM	Reading run-time meter	90 µs
64	TIME_TICK	Reading out system time You can read out the system time with an accuracy of one millisecond.	45 µs

Block Functions

The following table shows integrated functions for copying and presetting variables of a field.

SFC No.	Name	Description	Execution Time
20	BLKMOV	Copying variables of any type (see also Sections 5.2.5 and 5.2.6)	90 µs + 2 µs/byte
21	FILL	Presetting a field (see also Sections 5.2.5 and 5.2.6)	90 µs + 3.2 µs/byte

Generating a Data Block

With the help of SFC 22 ”CREAT_DB” you can generate a data block.

SFC No.	Name	Description	Execution Time
22	CREAT_DB	Generating a data block of a predetermined length within a defined area (see also Sections 5.2.5 and 5.2.6).	110 µs + 3.5 µs per DB within defined area.

Time-of-day Interrupt Functions

You can use the time-of-day interrupts for program processing controlled by the internal MCU clock.

SFC No.	Name	Description	Execution Time
28	SET_TINT	Setting time for time-of-day interrupt	115 µs
29	CAN_TINT	Canceling time for time-of-day interrupt	50 µs
30	ACT_TINT	Activating a time-of-day interrupt	50 µs
31	QRY_TINT	Querying status of a time-of-day interrupt.	85 µs

Time-delay Interrupts

The operating system starts time-delay interrupts after a certain time has elapsed.

SFC No.	Name	Description	Execution Time
32	SRT_DINT	Starting time-delay interrupt	85 µs
33	CAN_DINT	Canceling time-delay interrupt	50 µs
34	QRY_DINT	Querying time-delay interrupts started	80 µs

Interrupt and Error/Fault Processing

The integrated S7-CPU provides the following functions to react on interrupts and errors/faults.

SFC No.	Name	Description	Execution Time
36	MSK_FLT	Masking synchronous faults	150 µs
37	DMSK_FLT	Demasking synchronous faults	160 µs
38	READ_ERR	Querying and deleting occurred and blocked programming and access errors	160 µs
39	DIS_IRT	Disabling processing of new interrupts	215 µs
40	EN_IRT	Enabling processing of new interrupts	305 µs
41	DIS_AIRT	Delaying processing of interrupts	35 µs
42	EN_AIRT	Enabling processing of interrupts	35 µs
43	RE_TRIGR	Retriggering scan time monitor	30 µs
44	REPL_VAL	Copying default value to AKKU 1 of error-causing level	45 µs

Operating Mode Transitions

With the help of the following integrated functions you can influence the operating mode transitions.

SFC No.	Name	Description	Execution Time
46	STP	Transferring the integrated S7-CPU into the STOP mode	-
47	WAIT	Observing waiting times	200 µs

Diagnostic Functions

You can use the following integrated functions for reading and writing of diagnostic information.

SFC No.	Name	Description	Execution Time
51	RDSYSST	Reading out information from the system status list. SFC 51 will not be subject to interrupts.	280 µs +10 µs/byte per data block
52	WR_USMSG	Writing optional items of diagnostic information into the diagnostic buffer	110 µs

Functions for Module Parameterization

The integrated S7-CPU provides the following functions for reading and writing of module parameters.

SFC No.	Name	Description	Execution Time
55	WR_PARM	Writing of dynamic module parameters	1.6 µs
56	WR_DPARM	Writing of predefined dynamic module parameters	1.75 µs
57	PARM_MOD	Parameterizing a module	2.2 µs
58	WR_REC	Writing a module-specific data record	1.4 µs + 32 µs/byte
59	RD_REC	Reading a module-specific data record	0.50 µs

Extension of the SFC 20 to 22 for the integrated FM

Overview

The following SFC's were extended for the DB number range 1001-1249 of the integrated FM:

- SFC20 „BLKMOV“ Copy variable
- SFC21 „FILL“ Pre-occupy field
- SFC22 „CREATE_DB“ General data block

The extensions are used for changing tool offsets, machine data, traversing programs, etc., initialization of DB's and generaton of the OEM-DB.

The functionality of these SFC's for the DB's 1001-1249 corresponds to the standard functionality (see STEP7, Reference Manual, System and Standard Functions). The DB can also be accessed by symbols (symbol table for DB's > 1000).

The change in DB's can also be saved from the user program in the FEPROM. An entry in the machine data DB header (DB1200.DBD 4 = 100) activates the saving of the DB's 1001-1249 in the FEPROM (see Section 0).

Any DB access errors are signaled as FM data errors, but the SFC is exited with a positive return value (RET_VAL = 0). Upon DB access, the following actions take place:

- before access: -> DB-specific test of write admissibility
  -> FM data error 1151 "Data: writing not possible"
- after access -> DB-specific value test, activation ...
  -> AM data error, e.g. 1320 "MD40 acceleration"

When accessing the DB, note that DB's 1000 to 1249 possess an internal FM header of a length of 24 bytes.

Particularities of the SFC 20

DB1001-1249 as a "non sequence-relevant source" (key word UNLINKED) is not admissible (RET_VAL=8x32).

Particularities of the SFC 22

In this number band, only the following DB's are admitted:

- DB1001-1199 (NC programs)
  Data errors may occur due to missing initialization of the net data.
- DB1245 (OEM data)
  This DB is reserved for the user as an OEM-DB.

Contrary to PLC-DB's 1-127, the DB's can also be saved in the FEPROM. The DB's must have a DB-specific minimum length (FM header ...)

Data Saving

Data saving FM-POS

A write access to the DB-MD (through SFC20 or BUB) activates the function "Data saving FM-POS".

Activation of the function:

DB1200.DBD4 = 100 job

After successful data saving, the value 100 is deleted by the FW:

DB1200.DBD4 = 0 positive acknowledgement

In case of faulty data saving, the firmware returns an error number in the DB:

DBD1200.DBD4 = 100001 saving error
(insufficient storage capacity for FEPROM)

DBD1200.DBD4 = 100002 fatal error (FEPROM defective ...)

Data saving Drive

A write access to the DB-AM (through BUB only) activates the function "Data saving drive". However, this does not save the drive MD's which are effective on-line, but only the binary dump of the drive MD's in DB1250.

DB1250 is only updated in case of the following actions:

- Data saving through operating surfaces (MCU-PIT, EBF, OP17)
- Loading of DB1250 through STEP7

Activation of the function:

DB1250.DBD4 = 100 job

After successful data saving, the value 100 is deleted by the FW:

DB1250.DBD4 = 0 positive acknowledgement

In case of faulty data saving, the firmware returns an error number in the DB:

DBD1250.DBD4 = 100001 saving error (insufficient storage capacity for DB's in the FEPROM)

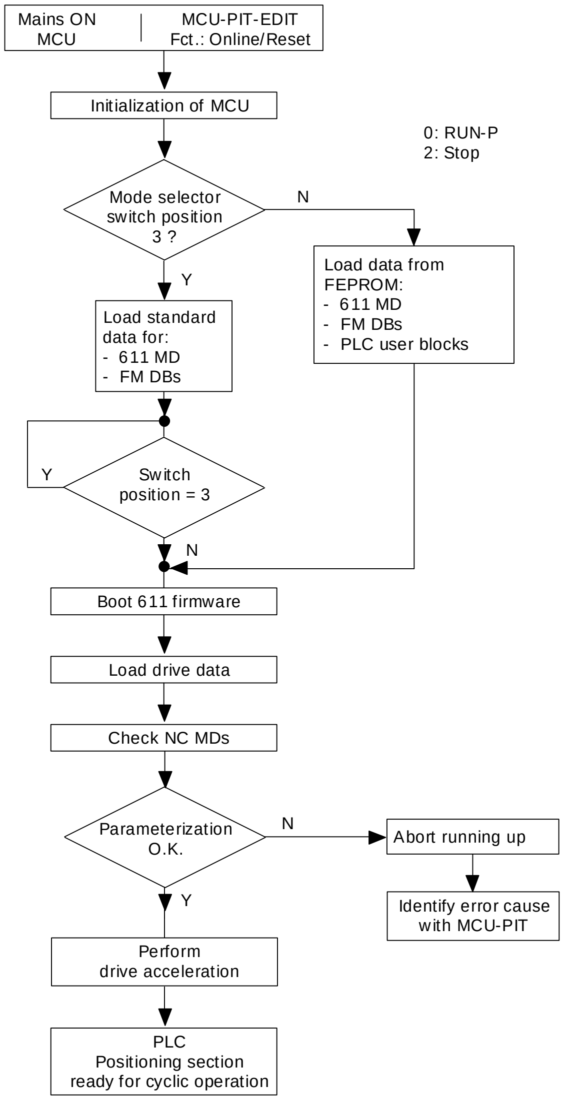
DBD1250.DBD4 = 100002 fatal error (FEPROM defective ...)

Note!

Data saving may only be triggered anew after the value has been deleted (otherwise, the new request will be lost). Write access to data saving must not be made together with other write accesses (otherwise data in the saving might be lost). Data saving must not be triggered cyclically (FEPROM lifetime)

Running up

Overview



Executing the S7 User Program

Overview

When executing the S7 user program with the MCU, time differences compared with the normal S7-300 CPU may arise. Within 5 ms, the S7 processes 15 KB of the S7 user program. Since one processor carries out both the S7 functions and the position control, the S7 user program has to be interrupted by the position control. The time reference of the interruption can be selected in the machine date MD61 (clock pulse setting).

According to this preset time reference, the cyclic program processing will be interrupted and the position control program executed. After completing the position control program, the S7 user program will be resumed from the point of interruption.

Process Interrupts / Time Interrupts

Note!

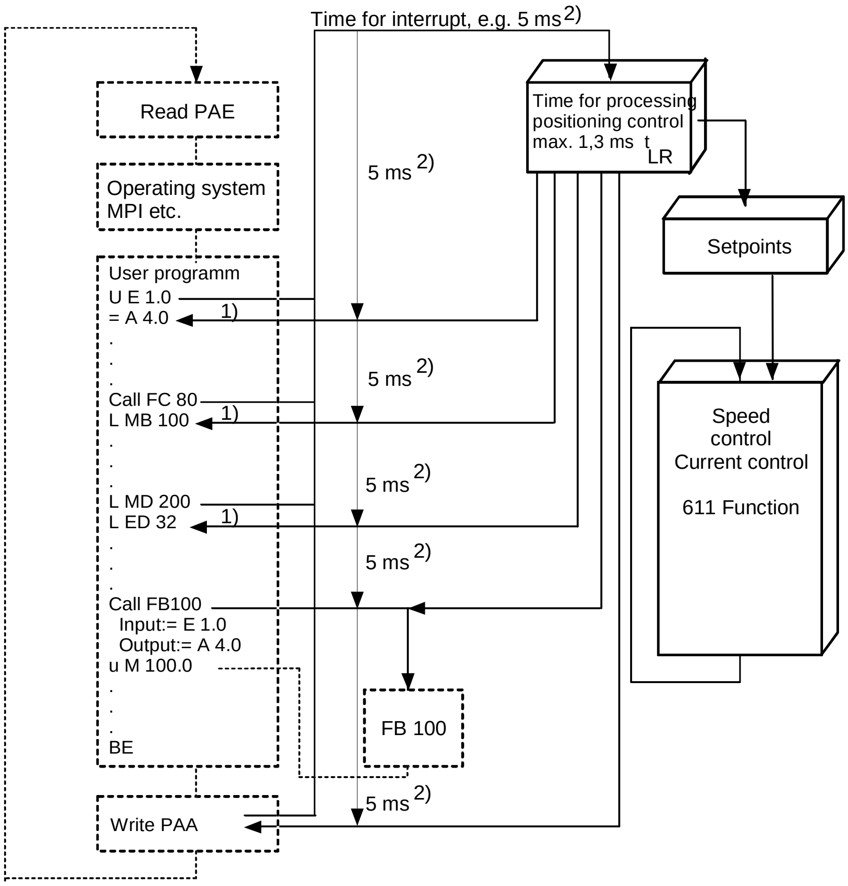
Process interrupts or time interrupts are included in the S7 user program and, therefore, will also be interrupted. It is absolutely necessary to take this into consideration in connection with the configuration and the process interruption response time.

The speed and current control section of the overall control system will not be affected here, because this part of the MCU is processed by its individual processor.

MPI Services

The MPI services increase the processor workload of the MCU. However, they will not be interrupted by the position control section, because this communication service is executed by means of its own ASIC.

Sequence



1) t_{LR} = Time for position control processing

2) $t_{Interrupt}$ = Time for position control interrupt (MD61)

Residual Processing Time $T_R = t_{Interrupt} - t_{LR}$

Response Times

Overview

The response time for the MCU to react on an event is influenced by the scan time and the delay times of the I/O modules. Response times are of decisive importance for the configuration of a system and the structures defined in the S7 user program.

Definition

The scan time is the time that the integrated S7-CPU needs for executing the S7 user program in one cycle.

Scan Time of the Integrated S7-CPU

The scan time of the integrated S7-CPU includes the following components:

- Process Image Transfer Time (PAE and PAA)
- Operating System Run Time
- S7 User Program Processing Time
- MPI Communication Times
- Number of Position Control Steps

Response Time

Since some of the factors influenced by the scan time are not permanently effective (e.g. MPI) and the S7 user program is not constantly processed in the same way, the response time varies. In order to avoid trouble with a system, you should consider the maximum response time possible, e.g. for cut-off functions.

The maximum response time possible is calculated as follows:

Maximum Response Time Possible =	2 x Scan Time Measured + 10% Safety Allowance (at least 1 ms)

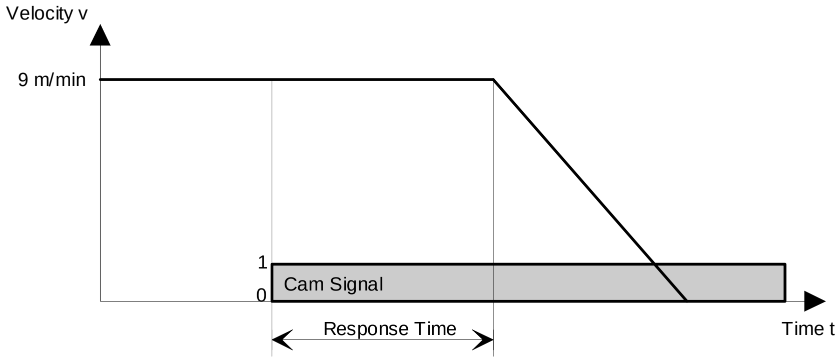
The safety allowance of approx. 10% of the S7 user program scan time - at least 1 ms - is due to the communication load.

For example, in order to determine the lengths of a switch-off cam for stopping a motion, this maximum response time possible must be taken as a basis.

Example

A slide travels at a velocity v of 9 m/min. The motion of the slide shall be stopped at its initial position by a limit switch. The scan time measured is 25 ms.

Response Time $t_{max} = 2 \times 25$ ms + 10 % Safety Allowance = 55 ms



At a maximum response time possible t_{max} of 55 ms, the slide keeps traveling during this time without being slowed down. This equals a travel distance s of:

$s = v \times t_{max}$ = 9 m/min × 55 ms = 8.25 mm

Therefore the cam must be 8.25 mm longer than the deceleration distance of the slide.

Technological Functions for MCU

Contents

Data Interchange by Means of Technological F nction

In addition to the drive control system for 611, a positioning section and an S7-CPU have been integrated into the MCU. In order to interchange data between the positioning section and the integrated S7-CPU, you can make use of so-called technological functions. These are S7 blocks, which must be called in the S7 user program.

These S7 blocks contain parameters. With the help of these parameters you can control the position control system of the MCU by the S7 user program.

Data Interchange Between Integrated S7-CPU and Positioning Section

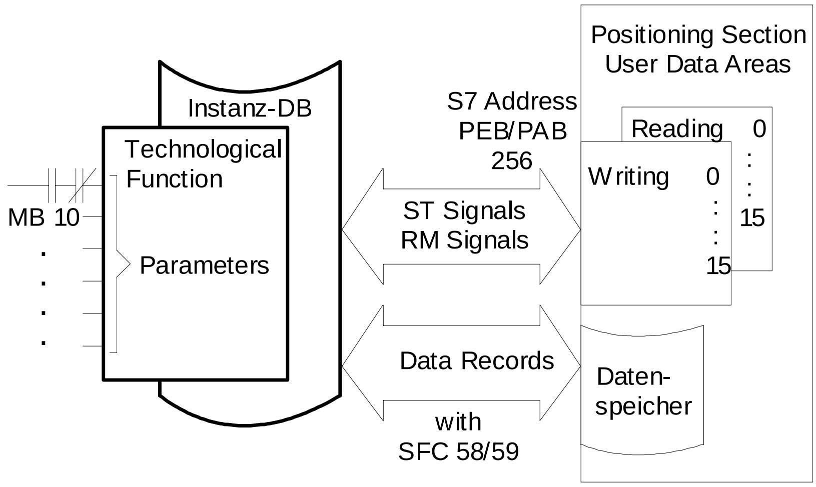


Figure 0-1 Data Interchange With Positioning Section

The data interchange with the positioning section is possible by means of the I/O bus of the integrated S7-CPU. The signal interface occupies for this 16 bytes of peripheral input bytes (PEB) and 16 bytes of peripheral output bytes (PAB). Hence, from the point of view of the integrated S7-CPU, the positioning section acts in the same way as an analog I/O module on address 256.

The technological function (S7 block) transmits data and control signals to this area or reads from this interface data and feedback signals.

Transfer interface for the user are the parameters of the technological functions or the existent instance DB.

Note!

Direct access of the user to the peripheral interface of the positioning section is not allowed.

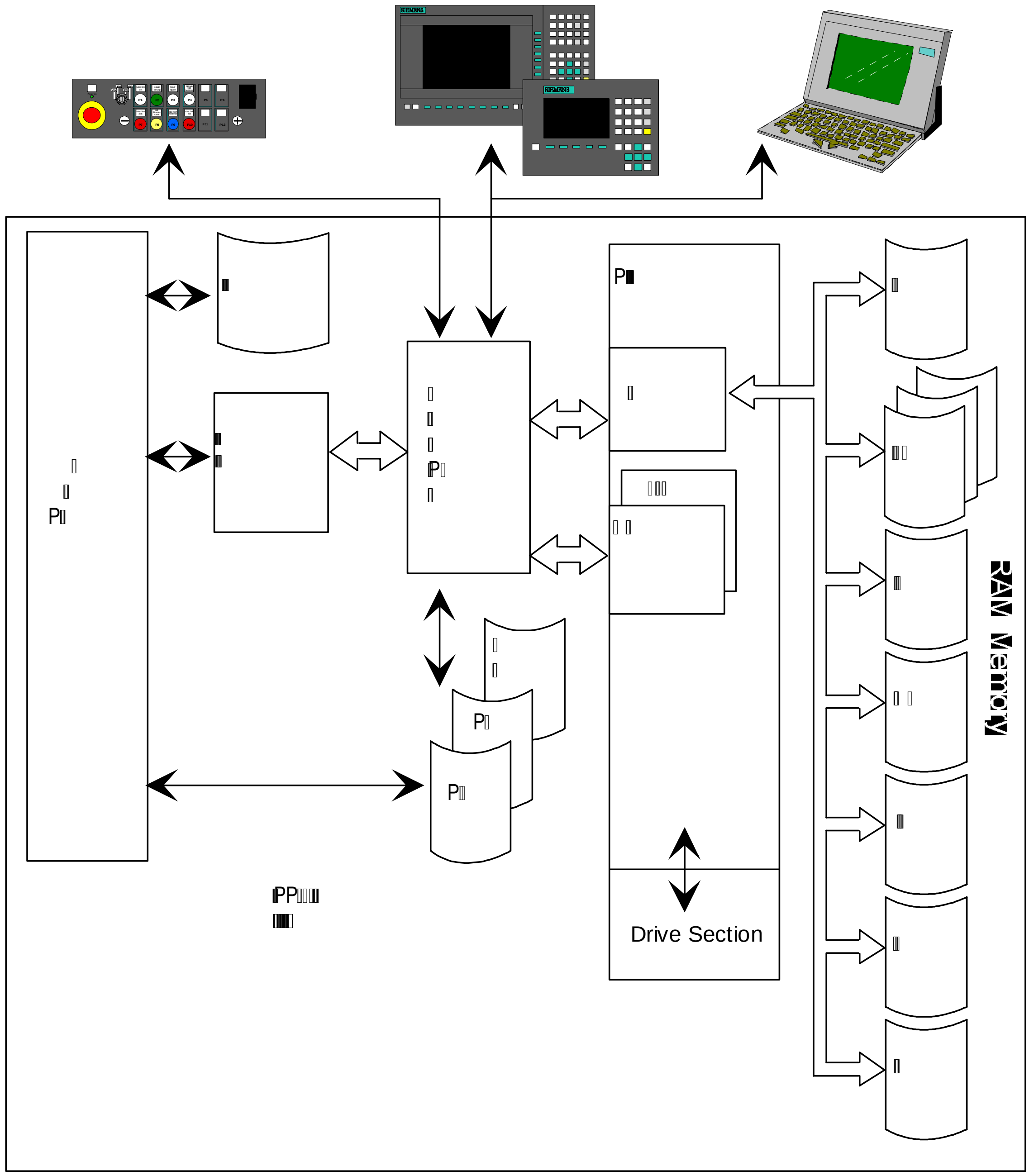


Figure 0-2 Data-Flow Chart

Data Diagram of MCU

The diagram shows the data flows of the MCU in a schematic way. The complete data interchange between integrated S7-CPU and positioning section passes through the data interfaces integrated into the positioning section.

PG with MCU-PIT

The PG loaded with the commissioning software MCU-PIT and connected with the MPI bus is able to read and write the traversing program, tool offsets , operating data and machine data in the positioning section by means of the system services incorporated in the integrated S7-CPU.

Since the complete control signal image is stored in DB-BD, axis and drive can be commissioned with the help of MCU-PIT, even if the user program has not been completely implemented yet. For moving the axis by PIT, the TF bit (parameter of the block RESTART) must be set before.

OPs

As well as the PG, the connected OPs also use the system functions of the MPI services. Therefore all data of the positioning section may also be used by the OPs. Data source and target depend on the OP software configuration.

PP031, MSST

Machine control panels are connected to the MPU bus like the PGs/OPs. However, the user must configure the data storage of these operating devices in the integrated S7-CPU memory by means of the STEP-7 tool *Defining Global Data*. These control signals may be stored in the process image of non-connected I/O modules or in flags or data blocks (see User's Manual *STEP 7 Chapter 9)*.

Technological Functions

Technological functions are those S7 standard function blocks, which execute data interchange and control functions from the integrated S7-CPU to the positioning section. These blocks transfer the control signals and data of the S7 user program to the positioning section or read the feedback signals or required data from the positioning section. Data interface to the positioning section are system functions (SFCs). User interface are instance DB and block parameters.

S7 User Programs

The S7 user program controls all MCU system functions. In the user program, the intelligent I/O blocks are called up and the parameters assigned. The instance DB is utilized for interchanging data. The transfer data are stored in this DB and can be used for system operation. The combination of S7 user program, standard program and functionality of the MCU positioning section makes up the overall function of the system.

Intelligent I/O Blocks of MCU

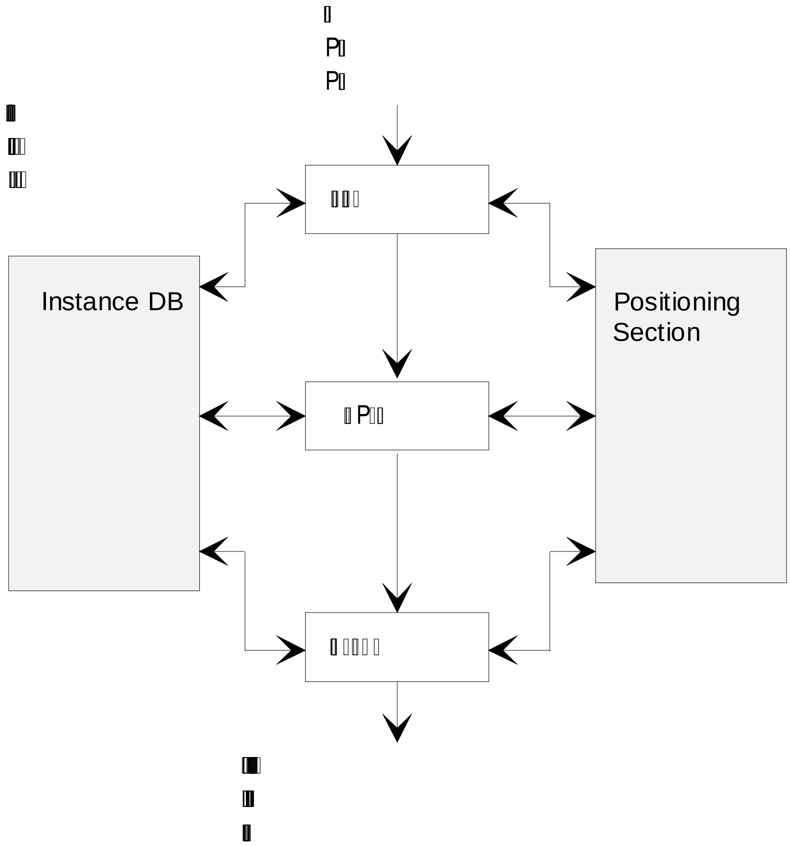


Figure 0-3 Intelligent I/O Blocks

For controlling the positioning section from the S7 user program, the intelligent I/O blocks must be called in the cyclic program section of the S7 user program.

Instance DB

The instance DB of the technological function is the central data memory in the integrated S7-CPU. All intelligent I/O blocks access this DB. The assignment of the DBs is described in the Tables. The instance DB is also of significance to the S7 user program. It stores the data to be transferred to the positioning section and the actual values called up by the S7 user program.

Overviews

For controlling the positioning section from the integrated S7-CPU, 3 standard blocks are required. These blocks must be called up by the S7 user program and linked to the cyclic section.

Table 0-1 Standard Blocks of the Cycle and Their Description

Block Number	**Block Name**	**Description**
FB1	OP_MCU	Executing the entire control functionality and indicating the actual states
FC1	RESTART	Synchronizing the data interchange between CPU and positioning section after CPU or module start-up
FC2	CONTROL	Additional MCU functions: Writing setting data to MCU and reading actual values from the module.

Per S7 cycle the blocks may be called up only once. Calling up an intelligent I/O block several times is not allowed and may cause faulty termination of jobs.

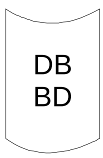
The block STATUS makes it possible to read back status information in the process interrupt program. The information read back is provided at block parameters.

Table 0-2 Standard Blocks in the Process Interrupt Branch and Their Description

Block Number	**Block Name**	**Description**
FC3	STATUS	Reading out status information from the MCU in the process interrupt program.

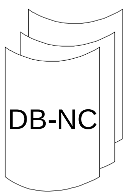
Data Blocks

For storing its working data, the MCU creates data blocks in the work memory (not S7 user memory). The control interfaces and all data are stored in these data blocks. The MCU operates from these data stores. An S7 program does not have direct access to the data blocks with DB numbers > 1000.



DB 1000

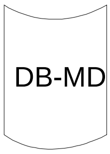
The DB-BD is the control interface and the data store for the actual operating data. The entire functionality of the positioning section is controlled by means of this data block. The DB-BD is served by the technological functions. MCU-PIT has direct access to this data store.



DB 1001-1199

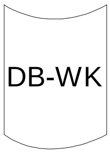
The DB-NC are used for storing the traversing programs, which can be entered with MCU-PIT.

A maximum of 199 DBs is possible.



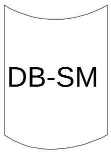
DB 1200

The DB 1200 (DB-MD) stores the machine data of the positioning section. The data are entered with MCU-PIT. When restarting an erased MCU, standard data are loaded to the DB-MD.



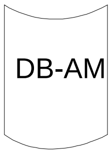
DB 1220

The DB-WK stores tool offset values of the positioning section. This block can be read and written with MCU-PIT.



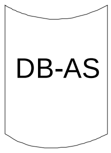
DB 1230

The DB-SM stores the distances for the incremental mode. This block is supplied by MCU-PIT.



DB 1251

The DB-AM stores the drive machine data. These data are determined with MCU-PIT and depend on the installed motor and power section. When restarting an erased MCU, this data store is also supplied with standard data.



DB 1260

The DB-AS stores the actual state of the drive system.

All data blocks are automatically created and fed during the MCU start-up stage. After commissioning with MCU-PIT, the data determined can be saved in a flash-EPROM. (Exceptions: DB-BD and DB-AS are not saved). During every restart, these data are transferred to the created DBs. Saving of the data is initialized with MCU-PIT (drive and positioning sections) and STEP 7 (PLC).

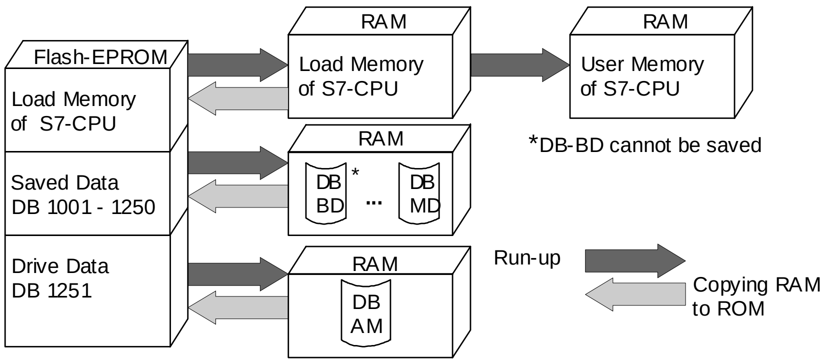


Figure 0-4 Saving Data

Intelligent I/O Block RESTART

Description

The intelligent I/O block RESTART synchronizes the data interchange between integrated S7-CPU and positioning section. When the RESTART function recognizes that a restart was executed, initialization begins. This requires the bit CPU_NEUST be set in the instance DB in OB100. Due to this bit, the other intelligent I/O blocks also set themselves to their initial states.

The input parameter TFB controls the switching of the right to axis travel of the positioning section from P bus to K bus and back. When the TFB has been set (TFB=1), the intelligent I/O block allows testing with MCU-PIT. The testing mode may be canceled with TFB = 0 at any time. During the testing mode communication between technological functions and positioning section is inhibited (Exception: TF bit).

Call

This function must be called up in the cyclic S7 user program. Note that the block RESTART in OB1 of the S7 user program must be called up before the technological functions OP_MCU and CONTROL.

AWL Representation

```
CALL    RESTART(
        INSTANZ_DB          :=      ,
        TFB                 :=      ,
        TFGS                :=      ,
        ANZEIGENWORT        :=      );
```

Parameter Description

Name	**Parameter Type**	**Data Type**	**Description**	**Block will...**
INSTANZ_DB	E	BLOCK_DB	Number of instance DB	scan it
TFB	E	BOOL	1 = Switching to testing mode (PG operation) 0 = Switching to normal mode	scan it
TFGS	A	BOOL	1 = Testing mode activated 0 = Normal mode activated	set / reset it
ANZEIGENWORT	A	WORD	Block status, Error number	enter it

Specifications

Designation	Value
Block Number	FC1
Block Name	RESTART
Version	V3.0
User Memory	728 bytes
Load Memory	940 bytes
Nesting Depth	1 System Functions of the operating system (SFCs) are called up
Data Area Allocation	See Instance DB of FB OP_MCU
Local Data Area Allocation	50 bytes
Flag Area Allocation	-
Blocks Called	SFC58, SFC59

Note!

Before calling the block, enter module address and channel number to the instance DB.

Faulty presetting of data in the instance DB or parameters may lead the stop state of the integrated S7-CPU. Since the block cannot be displayed, accurate parameter assignment is an essential precondition for faultless operation.

Example for parameterizing the MCU address in start-up block OB100:

Instance DB

Variable: BG_ADR_EIN
KA_NR

Example: Instance DB being the MCU-DB

```
L    256                   | | Address 256
T    MCU_DB.BG_ADR_EIN     | | after variable
L    1                     | | channel number
T    MCU_DB.KA_NR          | | after variable
```

Intelligent I/O Block OP_MCU

Description

The technological function OP_MCU controls all functions of the positioning section. By means of the block OP_MCU you can select the operating modes and transfer the control bits necessary for the operating mode to the positioning section. The block reads the actual operating states and makes them available to the user for evaluation at the output parameters.

Call

Call this function in the cyclic S7 user program. Note that the block OP_MCU must be called up after the block RESTART.

AWL Representation

```
CALL    OP_MCU(
        BETRIEBSART                 :=   ,
        BA_PARAMETER                :=   ,
        OVERRIDE                    :=   ,
        R_PLUS                      :=   ,
        R_MINUS                     :=   ,
        START                       :=   ,
        STOPP                       :=   ,
        EINLESEFREIGABE             :=   ,
        SATZ_AUSBLENDEN             :=   ,
        QUITTUNG_M_FUNKTION         :=   ,
        ACHSFREIGABE                :=   ,
        REGLERFREIGABE              :=   ,
        IMPULSFREIGABE_PLC          :=   ,
        AKTIVE_BETRIEBSART          :=   ,
        FAHREN_PLUS                 :=   ,
        FAHREN_MINUS                :=   ,
        STARTFREIGABE               :=   ,
        WARTEN_EXT_FREIGABE         :=   ,
        BEARBEITUNG_LAEUFT          :=   ,
        POSITION_ERREICHT           :=   ,
        VERWEILZEIT_LAEUFT          :=   ,
        PROGRAMM_RUECKWAERTS        :=   ,
        AUSGABE_M_FUNKTION          :=   ,
        M_FUNKTIONSNUMMER           :=   ,
        BEDIENFEHLER                :=   ,
        BETRIEBSFEHLER              :=   ,
        ACHSE_SYNCHRON              :=   ,
        INPULSE_FREIGEBEN           :=   ,
        ANTRIEB_BEREIT              :=   ,
        ANZEIGENWORT                :=   ,
        BEDIENFEHLER_QUITT          :=   ,
        BETRIEBSFEHLER_QUITT        :=   ,
        BETRIEBSDATEN_L             :=   ,
        BEZUGSPUNKT_SETZEN          :=   ,
```

```
SW254_S                         :=      ,
GESCHWINDIGKEITSSTUFEN_S        :=      ,
DREHZAHLSTUFEN_S                :=      );
```

Parameter Description

The E parameters will cyclically be transferred from the intelligent I/O block to the MCU. In the A parameters the MCU resignals its actual status; the entries are made cyclically.

The E/A (I/O) parameters initialize jobs for transferring data to or from the positioning section. Setting of the bit represents the starting edge for the function. Resetting the same bit by the block is the confirmation for the user that the job has been completed. If several jobs are started at the same time, the block will process them in sequence. For description and functions of the individual bits please refer to the "Description: Positioning with MCU".

Name	Parameter Type	Data Type	Description	Block will...
BETRIEBSART	E	BYTE	Select operating mode	transmit it to positioning software
BA_PARAMETER	E	BYTE	Additional operating mode parameter	transmit it to positioning software
OVERRIDE	E	BYTE	Override value	transmit it to positioning software
R_PLUS	E	BOOL	Direction positive	transmit it to positioning software
R_MINUS	E	BOOL	Direction negative	transmit it to positioning software
START	E	BOOL	Start certain operating modes	transmit it to positioning software
STOPP	E	BOOL	Stop certain operating modes	transmit it to positioning software
EINLESEFREIGABE	E	BOOL	Enable input of next block	transmit it to positioning software
SATZ_AUSBLENDEN	E	BOOL	Skip marked blocks	transmit it to positioning software
QUITTUNG_M_FUNKTION	E	BOOL	Acknowledge M function	transmit it to positioning software
ACHSFREIGABE	E	BOOL	Positioning enable	transmit it to positioning software
REGLERFREIGABE	E	BOOL	Closed-loop controller enable	transmit it to positioning software
IMPULSFREIGABE_PLC	E	BOOL	Pulse enable	transmit it to positioning software
AKTIVE_BETRIEBSART	A	BYTE	Feedback active operating mode	enter it
FAHREN_PLUS	A	BOOL	Travel in positive direction	set / reset it
FAHREN_MINUS	A	BOOL	Travel in negative direction	set / reset it
STARTFREIGABE	A	BOOL	Start release	set /reset it
WARTEN_EXT_FREIGABE	A	BOOL	Axis waiting for external release	set /reset it
BEARBEITUNG_LAEUFT	A	BOOL	Machining in progress	set /reset it
POSITION_ERREICHT	A	BOOL	Position reached / Stop	set /reset it

Name	Parameter Type	Data Type	Description	Block will...
VERWEILZEIT_LAEUFT	A	BOOL	Dwell time active (programmed interval)	set /reset it
PROGRAMM_RUECKWAERTS	A	BOOL	Reverse program processing	set /reset it
AUSGABE_M_FUNKTION	A	BOOL	Feedback M function active	set /reset it
M_FUNKTIONSNUMMER	A	BYTE	Number of active M function	enter it
BEDIENFEHLER	A	BOOL	Non-reset operator error	set /reset it
BETRIEBSFEHLER	A	BOOL	Non-reset operating error	set /reset it
ACHSE_SYNCHRON	A	BOOL	Axis has been synchronized	set /reset it
IMPULSE_FREIGEGEBEN	A	BOOL	Pulses have been enabled	set /reset it
ANTRIEB_BEREIT	A	BOOL	Drive is ready	set /reset it
ANZEIGENWORT	A	WORD	Block status, error number	enter it
BEDIENFEHLER_QUITT	E/A	BOOL	Acknowledge operator error	scan it, transmit it to positioning software and reset it
BETRIEBSFEHLER_QUITT	E/A	BOOL	Acknowledge operating/traveling error	scan it, transmit it to positioning software and reset it
BETRIEBSDATEN_L	E/A	BOOL	Read operating data. The data are stored in structure BRT_DAT of instance DB.	scan and reset it
BEZUGSPUNKT_SETZEN	E/A	BOOL	Set reference point. The data are transferred from structure BZPKT_SET of instance DB.	scan and reset it
SW254_S	E/A	BOOL	Transfer setpoint 254 to module. The data are transferred from structure SW254_SM of instance DB.	scan and reset it
GESCHWINDIGKEITSSTUFEN_S	E/A	BOOL	Transfer velocity steps to module. The data are transferred from structure V_1_2 of instance DB.	scan and reset it
DREHZAHLSTUFEN_S	E/A	BOOL	Transfer speed steps to module. The data are transferred from structure U_1_2 of instance DB.	scan and reset it

Specifications

Designation	Value
Block Number	FB1
Block Name	OP_MCU
Version	V3.0
User Memory	2948 bytes
Load Memory	4548 bytes
Nesting Depth	1

	System functions of the operating system (SFCs) are called up
Data Area Allocation	See instance DB
Local Data Area Allocation	50 bytes
Flag Area Allocation	-
Blocks Called	SFC58, SFC59

Instance DB of FB OP_MCU

Designation	Value
Block Number	DB1
User Memory	610 bytes
Load Memory	1892 bytes

Intelligent I/O Block CONTROL

Description

The technological function CONTROL writes selected data blocks to the positioning section or reads actual data requested by the user. The data are stored in the instance DB and can be selected with the help of job numbers at the parameter JOB SELECTION. If several jobs are initiated, they will be processed in sequence.

Call

Call this function in the cyclic S7 user program after FC_RESTART. Calling several times or from any other program processing level than the cyclic level is not allowed.

AWL Representation

```
CALL    CONTROL(
        INSTANZ_DB                      :=    ,
        MESSUNG_ENDE                    :=    ,
        FLIEG_ISTWERTSETZEN_AUSG        :=    ,
        ANZEIGENWORT                    :=    ,
        AUFTRAGSANWAHL                  :=    ,
        BETRIEBSDATEN_ZUS_L             :=    ,
        AKTIVER_NC_SATZ_L               :=    ,
        NAECHSTER_NC_SATZ_L             :=    ,
        APPLIKATIONSDATEN_L             :=    ,
        ISTWERT_SATZWECHSEL_L           :=    ,
        SERVICEDATEN_L                  :=    ,
        SERVODATEN_L                    :=    ,
        ISTDATEN_L                      :=    ,
        DA_DE_L                         :=    );
```

Parameter Description

Name	**Parameter Type**	**Data Type**	**Description**	**Block will...**
INSTANZ_DB	E	BLOCK_DB	Number of instance DB	scan it
MESSUNG_ENDE	A	BOOL	Bit for end of length measurement or flying measurement. The data are stored in the instance DB in structure MESSWERTE.	scan / reset it
FLIEG_ISTWERTSETZEN_AUSG	A	BOOL	Flying setting of actual value executed.	scan / reset it
ANZEIGENWORT	A	WORD	Block status, error number	enter it
AUFTRAGSANWAHL	E/A	INT	Job number for writing job Allowed job numbers are 7, 8, 11-20	scan and delete it

Name	Parameter Type	Data Type	Description	Block will...
BETRIEBSDATEN_ZUS_L	E	BOOL	Triggering bit for reading operating data. The data are stored in the instance DB in structure BTR_DAT1.	scan / reset it
AKTIVER_NC_SATZ_L	E	BOOL	Triggering bit for reading the active NC block. The data are stored in the instance DB in structure NC_SATZ_AKT.	scan / reset it
NAECHSTER_NC_SATZ_L	E	BOOL	Triggering bit for reading the next NC block. The data are stored in the instance DB in structure NC_SATZ_NEXT.	scan / reset it
APPLIKATIONSDATEN_L	E	BOOL	Triggering bit for reading the application data. The data are stored in the instance DB in structure APP_DAT.	scan / reset it
ISTWERT_SATZWECHSEL_L	E	BOOL	Triggering bit for reading the actual-value block change. The data are stored in the instance DB in structure IW_SATZWECHSEL.	scan / reset it
SERVICEDATEN_L	E	BOOL	Triggering bit for reading the service data. The data are stored in the instance DB in structure SERV_DAT.	scan / reset it
SERVODATEN_L	E	BOOL	Triggering bit for reading the servo data. The data are stored in the instance DB in structure SERVO_DAT_AUSL.	scan / reset it
ISTDATEN_L	E	BOOL	Triggering bit for reading the actual drive data. The data are stored in the instance DB in structure ISTDATEN.	scan / reset it
DA_DE_L	E	BOOL	Read digital inputs /outputs	scan / reset it

Description of the Parameter AUFTRAGSANWAHL

No.	Description	Comment Data are transferred from instance DB
7	Transfer MDI block	from structure MDI_SATZ
8	Drive setpoint data	from structure SOLLDATEN
11	Bit-coded settings	from structure BIT_EINST
12	Bit-coded commands	from structure BIT_KOM
13	Zero shift	from double word NULLPKTVER.
14	Setting of actual value	from double word IW_SET
15	Flying setting of actual value	from double word IW_FL_SET
16	Setting of digital inputs / outputs	from structure DA_DE
17	Flying transfer of MDI block	from structure MDI_SATZ_FLG

18	Program selection	from structure PRG_ANWAHL
19	Request application data	from structure ANF_APP_DAT
20	Teach in	from structure TEACH_IN
23	Servo data	from structure SERV_DAT_EINL

When initiating another job number in parameter AUFTRAGSANWAHL, the MCU will indicate an error in ANZEIGENWORT.

Functions

This block allows the user to transfer data by means of the job numbers from the integrated S7-CPU to the positioning section. The user must first store the data in the instance DB of the respective structures. By entering the job number in AUFTRAGSANWAHL, transfer can be started then. When the transfer is completed, the block CONTROL will delete the entry from AUFTRAGSANWAHL. Data which are read from the positioning section are transferred to the structures of the instance DB by the intelligent I/O block CONTROL. This is initiated by setting the corresponding job bits. CONTROL will delete these job bits when the job is finished.

Specifications

Designation	Value
Block Number	FC2
Block Name	CONTROL
Version	V3.0
User Memory	2763 bytes
Load Memory	3266 bytes
Nesting Depth	1 System functions of the operating system (SFCs) are called up.
Data Area Allocation	See instance DB of OP_MCU
Local Data Area Allocation	50 bytes
Flag Area Allocation	-
Blocks Called	SFC58, SFC59

The indicator word is used by the technological functions RESTART, OP_MCU and CONTROL for indicating the status of the technological functions. The errors occurring during data transfer will be displayed in ANZEIGENWORT.

Structure of ANZEIGENWORT

Bit	15							8	7 0
e. g. MW 10	X	X	0	0	X	X	X	X	Error Number
	Status (read only)								Additional Information

X = Bit used

Status Bit	Description
8	Processing of technological functions in progress
9	Processing of technological functions completed
10	Group error
11	Reading error (FC CONTROL)
12	-
13	-
14	Testing mode active
15	Start-up in progress

Description of Error Numbers ANZEIGENWORT

HEX	Description	Remedy
00	No error	
0B	When calling up blocks FC RESTART and FC CONTROL, the data block indicated at parameter INSTANZ_DB does not match the technological function (DB is not the instance DB of FB OP_MCU).	Indicate correct DB
0C	Channel number for MCU invalid	Enter correct channel number in instance DB to word KA_NR (In example via OB100)
0E	Error when calling SFC RD_REC. The return value RET_VAL of the SFC will be indicated in the variable SFCERR_*TFNAME* for the user to evaluate.	See error description of SFC RD_REC
0F	Error when calling SFC WR_REC. The return value RET_VAL of the SFC will be indicated in the variable SFCERR_*TFNAME* for the user to evaluate.	See error description of SFC WR_REC
10	Module not ready for operation or module not parameterized	Parameterize module by means of the tool AS-PARAM.
11	Time-out error. An expected module response is missing. While the TF is waiting for a response, every TF call increases internally the counter by one step. When this counter reaches the value MAX-AUFRUF, this error message will be indicated.	Carry out a restart.
12	Data error. This error is normally recognized by the module and the TF is transferred to be passed on to the user(storage in data block).	Correct data in instance DB
3E	Job number invalid (FC CONTROL)	Enter valid job number

Additional Information

List of additional information (error numbers), which are stored in the data words READERR_CONTROL and LMEERR_CONTROL.

HEX	Description	Remedy
0E	Error when calling SFC RD_REC. The return value RET_VAL of the SFC will be indicated in the variable SFCERR_*TFNAME* for the user to evaluate.	See error description of SFC RD_REC
11	Time-out error. An expected module response is missing. While the TF is waiting for a response, every TF call increases internally the counter by one step. When this counter reaches the value MAX-AUFRUF, this error message will be indicated.	Carry out restart

Intelligent I/O Block STATUS

Description

The technological function "STATUS" is used to read the status information of the digital inputs I1 to I4 from the FM-MCU in the process interrupt program. The read status information is made available by output parameters.

Call

Call this function only in the process interrupt branch (OB40). Module address and channel number must be entered to the instance data block before calling this block.

AWL Representation

```
CALL    STATUS(
        INSTANZ_DB      :=   ,
        S_I1            :=   ,
        S_I2            :=   ,
        S_I3            :=   ,
        S_I4            :=   ,
        ANZEIGENWORT    :=   );
```

Parameter Description

Name	Para-meter Type	Data Type	Description	Block will...
INSTANZ_DB	E	BLOCK_DB	Number of instance DB	scan it
S_I1	A	BOOL	Status information of digital input I1	set / reset it
S_I2	A	BOOL	Status information of digital input I2	set / reset it
S_I3	A	BOOL	Status information of digital input I3	set / reset it
S_I4	A	BOOL	Status information of digital input I4	set / reset it
ANZEIGENWORT	A	WORD	Block status, error number	enter it

Specifications

Designation	Value
Block Number	FC3
Block Name	STATUS
Version	V3.0
Length During Run Time	144 bytes
Length in Memory	260 bytes
Nesting Depth	0

Data Area Allocation	See Instance DB of FB OP_MCU
Local Data Area Allocation	2 bytes
Flag Area Allocation	-

Structure of ANZEIGENWORT

Bit	15							8	7	0
e. g. MW 10	0	0	0	0	0	X	0	0	Error Number	
	Status (read only)								Additional Information	

X = Bit used

Status Bit	Description
8	-
9	-
10	Group Error
11	-
12	-
13	-
14	-
15	-

Additional Information

List of additional information (error numbers) which may be indicated by FC STATUS.

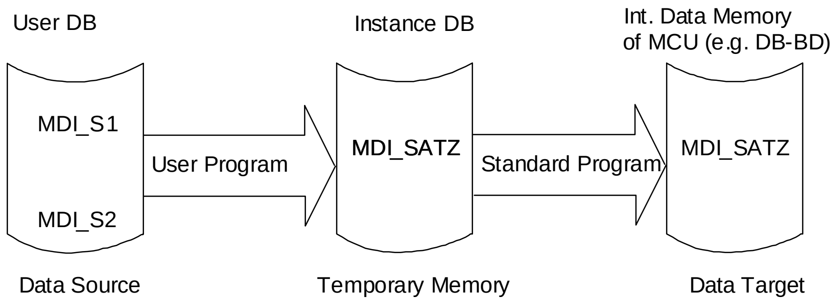
HEX	Description	Remedy
00	No error	-
0B	When calling up block FC STATUS, the data block indicated at parameter INSTANZ_DB does not match the technological function FB OP_MCU (DB is not the instance DB of FB OP_MCU).	Indicate correct DB
0C	Channel number for MCU invalid.	Enter correct channel number in instance DB to word KA_NR

Description of Data Transfer

Contents

General Information About Data Transfer

Schematic Diagram



Instance DB

In order to transfer data to the MCU positioning section, the user program must buffer them in a temporary memory. This temporary memory (instance DB) defines the data formats and the source for the standard program. Data source for the user program may be a user data block or flag, inputs or outputs. Data transmission and scaling are executed by the user program.

Instance DB and Positioning Section

Having stored the data in the instance DB, the user program instructs the standard program to transfer the data from the instance DB to the positioning section. After completion of the transfer, the user program can initialize the respective function for processing the data. The data transfer from the MCU positioning unit works in an analogous way.

Purpose of the User Program

It is the purpose of the user program to:

- read from the data source
- scale the date properly
- store the data in the instance DB correctly
- initialize the transfer
- verify faultless transfer
- trigger data processing
- check for correct processing, if necessary

Variables of Instance DB

In order to facilitate the entry to the instance DB, the transfer areas of the instance DB are combined in data records DS2 to DS235. Every data record contains variables. The variables may be addressed by the S7 program with the help of variable names. The variables of a data record DS are combined in STRUCTs.

Structure STRUCTs

In order to make flexible and easily legible programming possible, the instance DB was subdivided into structures. One structure can combine different variables - the so-called elements - under one collective term. These can be addressed by indication of the STRUCT and element names without knowing the absolute data address. This ensures a system of programming which is essentially easier to understand than the system using absolute data addresses.

A precondition required here is to assign a variable name to the instance DB in the symbol list. For the examples given in this Chapter: MCU_DB.

Selecting Data for Transfer

With the help of parameter AUFTRAGSANWAHL you can select the data to be transferred to the positioning section. The parameter AUFTRAGSANWAHL is of the integer data type (INT). The entry of the data record number to AUFTRAGSANWAHL will start the data transfer to the MCU positioning section. The job data must be entered to the MCU instance DB before. When the data transfer is completed, the technological function CONTROL will delete the value entered in AUFTRAGSANWAHL.

Data Transfer Error

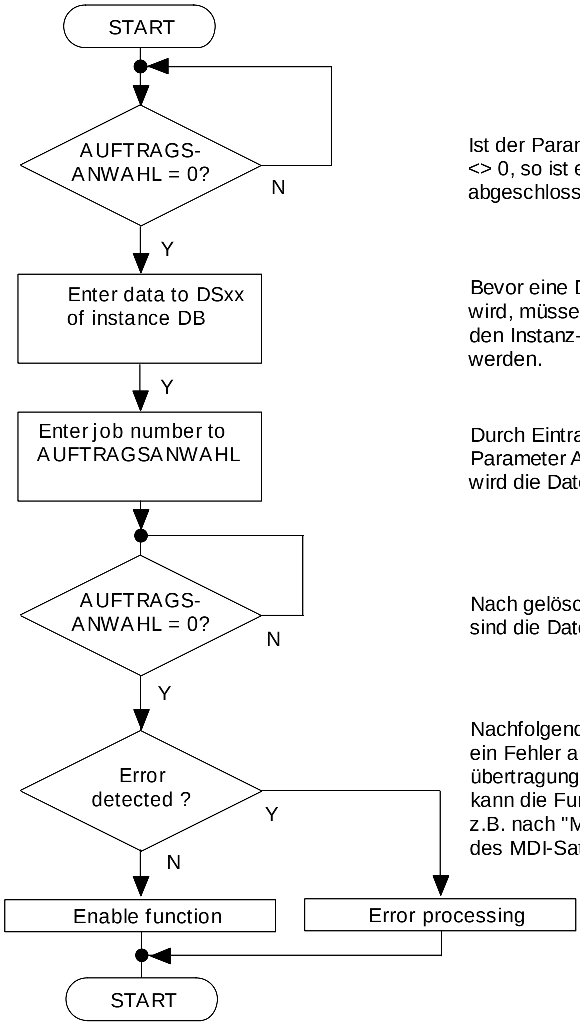
If a data transfer error occurs, an error code will be entered to ANZEIGENWORT.

Res./Reserved

You must not write into the variables labeled **res.** or **reserved.**

Sequence of Data Transfer

Flow Chart



Ist der Parameter AUFTRAGSANWAHL <> 0, so ist eine Übertragung noch nicht abgeschlossen.

Bevor eine Datenübertragung gestartet wird, müssen die zugehörigen Daten in den Instanz-DB der MCU eingetragen werden.

Durch Eintrag der DS-Nummer in Parameter AUFTRAGSANWAHL wird die Datenübertragung gestartet.

Nach gelöschter AUFTRAGSANWAHL sind die Datenübergaben beendet.

Nachfolgend muß geprüft werden, ob ein Fehler aufgetreten ist. Ist die Datenübertragung fehlerfrei beendet worden, kann die Funktion freigegeben werden, z.B. nach "MDI-Satz übertragen" Start des MDI-Satzes.

Conversion into STEP7 Program

The sequence shown in the flow chart has to be converted into a STEP7 program.

Data Records

Instance DB: MCU_DB

It has been assumed that the variable name MCU_DB was assigned to the instance DB in the symbol list for these examples.

Res./Reserved

You must not write into the variables labeled **res.** or **reserved**.

Variable AUFTRAG

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Check AUFTRAGSANWAHL for 0 before (no job running). The indication [MCU_DB] is the absolute address of the MCU_DB - the instance DB of the MCU.

For example DS7:

```
       L      AUFTRAG;          // AUFTRAGSANWAHL
       L      0;                // Check
       <>I;                     // If not zero
       SPB    ENDE;             // Go to ENDE
       [Enter data to STRUCT MDI_SATZ]
       L      7;                // Load DS No. 7
       T      AUFTRAG;          // Load to
AUFTRAGSANWAHL
ENDE:  NOP    0;
```

Note

The variable AUFTRAG corresponds to MW50. MW50 must be declared in the symbol list and must be of the INT data type. Upon calling the FC CONTROL, the variable AUFTRAG is transferred to AUFTRAGSANWAHL. Due to the above-described variable format in the STEP7, you can access the instance DB in any block.

Upon calling the FC CONTROL, it must be parameterized with the variable AUFTRAG to AUFTRAGSANWAHL, in order to ensure that the transfer from AUFTRAGSANWAHL works in the way as described by the example. After completion of the transfer, check whether the value transfer to the positioning section was executed faultlessly.

Example

```
       L      AUFTRAG;          // AUFTRAGSANWAHL
       L      0;                // Check
       <>I;                     // If not zero
       SPB    ENDE;             // go to ENDE

       L      ANZEIGENWORT;     // Load ANZEIGENWORT
       L      W#16#0400;        // Load mask
       UW;                      // Demask group error
       L      0;
       <>I;                     // Has group error been set?
       =      FEHLER;           // Indicate error
```

```
U     FEHLER;                // If error
=     STARTVERRIEGELUNG;     // inhibit start
```

The error occurred has been recorded as error code in ANZEIGENWORT (see Chapter 6.2.3).

P Number DB-BD

P numbers are the parameter numbers of the data records in the operating data DB (DB-BD), which are displayed in MCU-EDIT.

Transfer of DS7 MDI Block

Function

The operating mode MDI (Manual Data Input) allows you to transfer an NC block to the MCU positioning section. The block is initialized with the help of the start signal and executed by the positioning section.

When the execution of the block is finished, you can transfer a new NC block to the positioning section or restart the current block (see Functional Description *Positioning with MCU, Chapter 3.6*).

Before initializing the transfer to the positioning section, enter the MDI block to data record DS7 in the instance DB.

Structure of an MDI Block

The structure of an MDI block corresponds to that of a normal NC block of a process program. Before transfer, make sure that not only the required data have been entered to DS7, but also values which are no longer needed have been deleted.

System Data Interface

<table>
<tr><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th>Address DB Instance</th><th>P Number DB-BD</th></tr>
<tr><td colspan="8">Reserved</td><td>62</td><td rowspan="16">20100</td></tr>
<tr><td colspan="8">Reserved</td><td>63</td></tr>
<tr><td>res.</td><td>Res.</td><td>res.</td><td>X_T</td><td>res.</td><td>res.</td><td>G_2</td><td>G_1</td><td>64</td></tr>
<tr><td>res.</td><td>Res.</td><td>res.</td><td>res.</td><td>M_3</td><td>M_2</td><td>M_1</td><td>F</td><td>65</td></tr>
<tr><td colspan="8">G Function 1</td><td>66</td></tr>
<tr><td colspan="8">G Function 2</td><td>67</td></tr>
<tr><td colspan="8">Reserved</td><td>68</td></tr>
<tr><td colspan="8">Reserved</td><td>69</td></tr>
<tr><td colspan="8" rowspan="4">Value 1 X/T</td><td>70</td></tr>
<tr><td>71</td></tr>
<tr><td>72</td></tr>
<tr><td>73</td></tr>
<tr><td colspan="8" rowspan="4">Value 2 F</td><td>74</td></tr>
<tr><td>75</td></tr>
<tr><td>76</td></tr>
<tr><td>77</td></tr>
</table>

M Function 1	78	
M Function 2	79	
M Function 3	80	
Reserved	81	

Variables of the System Data Interface

Symbol	Name
G_1	G function of group 1
G_2	G function of group 2
X_T	Position/dwell time programmed
F	Velocity programmed
M_1	M function of group 1
M_2	M function of group 2
M_3	M function of group 3

Example With Absolute Data Addresses

The following MDI block shall be stored in the instance DB in DS7:

G1=90 X10.000 F1000.00 M1=4

```
AUF   DI1;                  // Open instance DB
L     W#16#1103;            // Load bits
T     DIW64;                // and set
L     90;                   // G90
T     DIB66;                // Write in 1. G function
L     DW#16#00002710;       // Value 10 000
T     DID70                 // Write in X_T
L     DW#16#000186A0;       // F100 000
T     DID74;                // Write in F
L     4;                    // Write M4
T     DIB78;                // in M1
```

Variables of STRUCT MDI_SATZ

Name	Description	Data Type
G_1	G function group 1 valid	BOOL
G_2	G function group 2 valid	BOOL
X_T	Position/dwell time valid	BOOL
F	F value valid	BOOL
M_1	M1 valid	BOOL
M_2	M2 valid	BOOL
M_3	M3 valid	BOOL
G_FKT1	G function group 1	BYTE
G_FKT2	G function group 2	BYTE
WERT1	Position/dwell time	DWORD
WERT2	F value	DWORD
M_FKT1	M function 1	BYTE
M_FKT2	M function 2	BYTE
M_FKT3	M function 3	BYTE

Example With STRUCTS

The following example shall demonstrate that this method of programming generates a program which is easy to understand. It reduces the amount of additionally necessary documentation.

Example: G1=90 X10.000 F100.000 M1=4

Instance DB is MCU_DB.

```
SET;                                      // Set VKE to "1"
S    MCU_DB.MDI_SATZ.G_1;                 // Set active bits
S    MCU_DB.MDI_SATZ.X_T;
S    MCU_DB.MDI_SATZ.M_1;
S    MCU_DB.MDI_SATZ.F;
CLR;                                      // Clear VKE
R    MCU_DB.MDI_SATZ.G_2;                 // Reset inactive bits
R    MCU_DB.MDI_SATZ.M_2;
R    MCU_DB.MDI_SATZ.M_3;

L    90;                                  // G90
T    MCU_DB.MDI_SATZ.G_FKT1;

L    10000;                               // Position values
T    MCU_DB.MDI_SATZ.WERT1;


L    L#100000;                            // Velocity
T    MCU_DB.MDI_SATZ.WERT2;

L    4;                                   // M4
T    MCU_DB.MDI_SATZ.M_FKT1;

L    7                                    // Transfer DS7
T    AUFTRAG;
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGS-ANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS8 Drive Setpoint Data

Function

With the help of DS8 "Drive Setpoint Data" you can influence the action of the digital drive directly from the STEP7 program. The data record DS8 comprises 2 structures and one single variable: STEU_LOW, STEU_HIGH and MOM_GRENZ. When the data record is transferred to the positioning section, it includes the structures and the variable. Therefore, it is absolutely necessary to ensure that all variables of the structures have been set to the correct values. Disregarding this aspect may lead to undesired actions of the driving system.

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
			Control Word 1						
res.	res.	res.	res.	DZSF1_AKT	MGLG2	HLGSS	res.	82	
HLG_AKT	res.	BIT5	res.	res.	NRZ_FRG	BIT1	ZK1_RESET	83	20200
			Control Word 2						
BIT 15	res.	res.	res.	res.	res.	BIT9	BIT8	84	
BIT7	INT_SPERR	res.	res.	res.	SP_SG_3	SP_SG_2	SP_SG_1	85	20201
Torque Limit								86	
								87	20202
Reserved								88	
								:	20203
								99	

Variables of System Data Interface

The 611D control words 1 and 2 appear in DB-BD, in DB-AS and in the instance DB. Only the bits printed in *italics* are legible.

Symbol	Name
	Control Word 1
ZK1_RESET	ZK1 Reset: Resetting/acknowledging of drive alarms; level 1 must remain active for at least one LR cycle
BIT1	*Parking axis; setpoint matches DS11 bit 14 parking axis - Function internally selected*
NRZ_FRG	Enable bit for emergency retract: 0: Emergency retract locked 1: Emergency retract released
BIT5	*Function generator setpoint: Function generator activation in drive*

Symbol	Name
HLG_AKT	Speed ramp setpoint: 0: Limit signals: |Md| < Mdx active, Nact = Nrequ active 1: Limit signals: |Md| < Mdx = 1, Nact = Nrequ = 0 Acceleration process finished = 0
HLGSS	Speed ramp quick stop setpoint: 0: No effect 1: Drive quick stop nrequ = 0 no pulse suppression after standstill
MGLG2	2. Torque limit setpoint: 0: Torque/power limitation by drive MD1230/1235 1: Torque/power limitation by drive MD1232/1236
DZSF1_AKT	Speed setpoint smoothing setpoint: 0: No speed setpoint smoothing 1: Speed setpoint smoothing active (only effective when low-pass filter has been parameterized by means of drive MDs 1500 etc.)
	Control Word 2
SP_SG_1	Setpoint parameter block
SP_SG_2	Parameter block setting in drive
SP_SG_3	(Switching of speed controller parameterization)
INT_SPERR	Integrator lock setpoint 0: Integral component of speed controller on 1: Integral component of speed controller off
BIT7	*PLC pulse enable setpoint: Pulse enable (by means of S7 user program)*
BIT8	*Current controller enable setpoint: Current Controller Enable*
BIT9	*Speed controller enable setpoint: Speed controller enable*
BIT15	*Signal of life: for service only*

Torque Limit

After balancing with machine-specific limits derived from the motor and power section installed, this value serves for the dynamic limitation of the torque setpoint formed of the speed controller output and the pilot control value. The minimum value formed of motor torque, motor output power section current and limit value is internally effective for the drive. Only positive limit values must be preset which, in addition, have to be limited to 7FFFH.

Unit: [incr]

Format: signed integer

Scaling: 1000H = M_{requ}; MD 1725 = 8 x M_{requ}

M_{limit} [incr]=M_{limit} [Nm] x 8 x 1000H / MD1725 [Nm]

Variables of STRUCT STEU_LOW

Name	Description	Data Type

HLGSS	Speed ramp quick stop	BOOL
MGLG2	2. Torque limit	BOOL
DZSF1_AKT	Speed setpoint smoothing	BOOL
ZK1_REST	ZK1 Reset	BOOL
HLG_AKT	Speed ramp setpoint	BOOL

Variables of STRUCT STEU_HIGH

Name	Description	Data Type
SP_SG_1	Setpoint parameter block bit1	BOOL
SP_SG_2	Setpoint parameter block bit2	BOOL
SP_SG_3	Setpoint parameter block bit3	BOOL
INT_SPERR	Integrator lock	BOOL

Variable MOM_GRENZ

Name	Description	Data Type
MOM_GRENZ	Torque limit	INT

Example

The following example illustrates the transfer to the variables of DS8.

Instance DB is MCU_DB.

```
CLR;                                           // Clear VKE
R    MCU_DB.STEU_LOW.HLGSS;                    // Delete inactive bits
R    MCU_DB.STEU_LOW.ZK1_RESET;
R    MCU_DB.STEU_LOW.HLG_AKT;

SET;                                           // Set VKE to "1"
S    MCU_DB.STEU_HIGH.MGLG2;                   // Set active bits
S    MCU_DB.STEU_HIGH.DZSF1_AKT;
S    MCU_DB.STEU_HIGH.SP_SG_1;

U    E 1.0;                                    // Set integrator lock
=    MCU_DB.STEU_HIGH.INT_SPERR;               // to E1.0

L    80;                                       // Set torque limit
T    MCU_DB.MOM_GRENZ;                         // to 80

L    8;                                        // Transfer DS8
T    AUFTRAG;
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS11 Bit-coded Settings

Function

The "Bit-coded Settings" of DS11 influence directly the positioning section with MCU position control. The bits activate or deactivate several MCU functions. The positioning section will not react until changed DS11 bits have also been transferred.

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
SIM_EIN	PARK_ACHS	I4_INAKT	I3_INAKT	I2_INAKT	I1_INAKT	FLG_MESS	res.	100	20210
res.	SW_END_A	NACH_EIN	FRG_N_AW	REF_TRIG	LAE_MESS	DM_AKT	res.	101	

Variables of STRUCT BIT_EINST

Name	Description	Data Type
SIM_EIN	Simulation ON	BOOL
PARK_ACHS	Parking axis	BOOL
I4_INAKT	Digital input I4 ON/OFF	BOOL
I3_INAKT	Digital input I3 ON/OFF	BOOL
I2_INAKT	Digital input I2 ON/OFF	BOOL
I1_INAKT	Digital input I1 ON/OFF	BOOL
FLG_MESS	Activate flying measurement	BOOL
SW_END_A	Software end position monitoring	BOOL
NACH_EIN	Follow-up mode ON	BOOL
FRG_N_AW	Switch OFF enable input	BOOL
REF_TRIG	Retrigger reference point	BOOL
LAE_MESS	Activate length measurement	BOOL
DM_AKT	Direct measuring system ON/OFF	BOOL

Example

Instance DB is MCU_DB.

```
CLR;                                          // Clear VKE
R     MCU_DB.BIT_EINST.FLG_MESS;              // Delete inactive bits
R     MCU_DB.BIT_EINST.PARK_ACHS;
R     MCU_DB.BIT_EINST.SIM_EIN;
R     MCU_DB.BIT_EINST.REF_TRIG;
```

```
SET;                                    // Set VKE to "1"
S     MCU_DB.BIT_EINST.LAE_MESS;        // Set active bits
S     MCU_DB.BIT_EINST.FRGN_AW;

L     11;                               // Transfer DS11
T     AUFTRAG;
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS12 Bit-coded Commands

Function

Just like the "Bit-coded Settings" (DS11), the "Bit-coded Commands" are also transferred to the MCU positioning section. The "Bit-coded Commands" might by required for the operation of the axis. For making the commands effective, DS12 is to be transferred to the positioning section. The DS12 transfer can always be performed upon any status change.

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
reserved								104	20220
res.	IWS_LOE	RESTART	res.	AUT_SRUCK	AUT_SVORL	RESTW_LOE	res.	105	

Variables of STRUCT BIT_KOMM

Name	Description	Data Type
RESTW_LOE	Delete residual distance	BOOL
AUT_SVORL	Automatic block search forward	BOOL
AUT_SRUCK	Automatic block search reverse	BOOL
RESTART	Restart	BOOL
IWS_LOE	Cancel setpoint setting	BOOL

Example

Instance DB is MCU_DB.

```
U     E 1.1;
=     MCU_DB.BIT_KOMM.RESTW_LOE;
U     E 1.2;
=     MCU_DB.BIT_KOMM.AUT_SVORL;
U     E 1.3;
=     MCU_DB.BIT_KOMM.AUT_SRUCK;
U     E 1.4;
=     MCU_DB.BIT_KOMM.RESTART;
U     E 1.5;
=     MCU_DB.BIT_KOMM.IWS_LOE;
L     ALTSTRUCT;                   // Stored Struct value
L     DB[MCU_DB].DBW104;           // Load STRUCT
XOW;                               // Exclusive OR detects
```

```
L       0;                        // alteration
==I;                              // No ->End
SPB     ENDE;
L       12;                       // Yes ->Transfer data
T       AUFTRAG;
ENDE:
L       DB[MCU_DB].DBW104;
T       ALTSTRUCT;

L       12;
T       AUFTRAG;                  // Transfer DS12
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running. The indication [MCU_DB] is the absolute address of MCU_DB, the instance DB of the MCU.

DS13 Zero Shift

Function

A zero shift can be transferred to the positioning section. The zero shift is activated after transfer. The zero shift can be canceled by the bit command IWS_LOE (DS12).

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
32-bit value Zero Shift								108	20230
								109	
								110	
								111	

Variable

Name	Description	Data Type
NULLPKTVER	Zero shift	DWORD

Example

Instance DB is MCU_DB.

```
L    DW#16#FFFEFFC0;       // Write value -65600
T    MCU_DB.NULLPKTVER;    // in variable

L    13;
T    AUFTRAG;              // Transfer DS13
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS14 Setting of Actual Values

Function

The data record DS14 for the function of "Setting of Actual Values" is to be handled in the same way as "Zero Shift" (DS13). The setting of actual values can be canceled by the bit command IWS_LOE (DS12).

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
32-bit value Setting of Actual Values								112	20240
								113	
								114	
								115	

Variable

Name	Description	Data Type
IW_SET	Value Setting of Actual Values	DWORD

Example

Instance DB is MCU_DB.

```
L    L#123456;        // Write value 123456
T    MCU_DB.IW_SET;   // in variable

L    14;
T    AUFTRAG;         // Transfer DS14
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS15 Flying Setting of Actual Values

Function

The "Flying Setting of Actual Values" is transferred in the same way as "Setting of Actual Values" (DS14). Unlike the "Setting of Actual Values", the "Flying Setting of Actual Values" is only activated by a hardware input of the MCU.

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
32-bit value Flying Setting of Actual Values								116	20250
								117	
								118	
								119	

Variable

Name	Description	Data Type
IW_FL_SET	Flying Setting of Actual Values	DWORD

Example

Instance DB is MCU_DB.

```
L    L#678912;            // Write value 678912
T    MCU_DB.IW_FL_SET;    // in variable

L    15;
T    AUFTRAG;             // Transfer DS15
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS16 Digital Outputs/Inputs

Function

The 4 onboard inputs or outputs, respectively, can be read or set with DS16. Due to the transfer of DS16, the outputs not used for MCU functions (O1...O4) are set to the status of the variables. By setting of the bit DA_DE_L at FC CONTROL, you can read the status of the inputs (I1...I4).

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
res.	res.	res.	res.	D E4	D E3	D E2	D E1	120	20300
res.	res.	res.	res.	D A4	D A3	D A2	D A1	121	

Variables of STRUCT DA_DE

Name	Description	Data Type
DE1	Digital input 1	BOOL
DE2	Digital input 2	BOOL
DE3	Digital input 3	BOOL
DE4	Digital input 4	BOOL
DA1	Digital output 1	BOOL
DA2	Digital output 2	BOOL
DA3	Digital output 3	BOOL
DA4	Digital output 4	BOOL

Example

The outputs O1 and O4 shall be set and O2 and O3 be reset.

Instance DB is MCU_DB.

```
SET;                                // Set VKE to "1"
S     MCU_DB.DA_DE.DA1;             // Set variable
S     MCU_DB.DA_DE.DA4;
CLR;                                // Clear VKE
R     MCU_DB.DA_DE.DA2;             // Reset variable
R     MCU_DB.DA_DE.DA3;

L     16;
T     AUFTRAG;                      // Transfer DS16
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS17 Flying MDI Block

Function

Transferring DS17 "Flying MDI Block" serves the MCU to reject immediately an MDI block that has already been started. The MCU starts immediately processing the flying MDI block. The data of a flying MDI block correspond to those of a normal MDI block (DS7). Transfer of DS17 is performed in the same way as of DS7. The STEP7 programming for entering the data differs only in the indication of the structure name from that of DS7.

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
Reserved								122	21000
Reserved								123	
res.	res.	res.	X_T	res.	res.	G_2	G_1	124	
res.	res.	res.	res.	M_3	M_2	M_1	F	125	
G Function 1								126	
G Function 2								127	
Reserved								128	
Reserved								129	
Value 1 X/T								130	
								131	
								132	
								133	
Value 2 F								134	
								135	
								136	
								137	
M Function 1								138	
M Function 2								139	
M Function 3								140	
Reserved								141	

Variables of STRUCT MDI_SATZ_FLG

Name	Description	Data Type
G_1	1. G function valid	BOOL
G_2	2. G function valid	BOOL
X_T	Position/dwell time valid	BOOL
F	F value valid	BOOL
M_1	1. M function valid	BOOL
M_2	2. M function valid	BOOL

M_3	3. M function valid	BOOL
G_FKT1	1. G function	BYTE
G_FKT2	2. G function	BYTE
WERT_1	Position / dwell time	DWORD
WERT_2	F value	DWORD
M_FKT1	1. M function	BYTE
M_FKT2	2. M function	BYTE
M_FKT3	3. M function	BYTE

Example

The transfer shall be performed in the STEP7 program.

Instance DB is MCU_DB.

```
SET;                                             // Set VKE to "1"
S      MCU_DB.MDI_SATZ_FLG.G_1;                  // Set active bits
S      MCU_DB.MDI_SATZ_FLG.X_T;
CLR;                                             // Clear VKE
R      MCU_DB.MDI_SATZ_FLG.G_2;                  // Reset inactive bits
R      MCU_DB.MDI_SATZ_FLG.F;
R      MCU_DB.MDI_SATZ_FLG.M_1;
R      MCU_DB.MDI_SATZ_FLG.M_2;
R      MCU_DB.MDI_SATZ_FLG.M_3;

L      4;                                        // G04
T      MCU_DB.MDI_SATZ_FLG.G_FKT1;
L      1000;                                     // Dwell time
T      MCU_DB.MDI_SATZ_FLG.WERT1;

L      17;
T      AUFTRAG;                                  // Transfer DS17
```

Please refer also to the example in the Functional Description: Positioning with MCU in Chapter 3.6: Transferring MDI Block.

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS18 Program Selection

Function

The MCU can store traversing programs for the automatic mode. For processing the traversing programs, select the required program number before starting. This is done with data record DS18. If you try to interrupt a program that has already been started by selecting another program number, the MCU will ignore this selection. (*see Functional Description Chapter 3.7*).

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
Program selection (Program No.)								142	21100
Program selection (Block No.)								143	21101
Program selection (Direction)								144	21102
Reserved								145	21103

Variables of STRUCT PRG_ANWAHL

Name	Description	Data Type
PROG_NR	Program number 0...199	BYTE
SATZ_NR	Block number .0...255	BYTE
BEARB	Direction of processing traversing program 0 = forward / 1.=.reverse	BYTE

Example

Instance DB is MCU_DB.

```
L    167;
T    MCU_DB.PRG_ANWAHL.PROG-NR;     // Program number 167
L    0;
T    MCU_DB.PRG_ANWAHL.SATZ-NR;     // Start at beginning
T    MCU_DB.PRG_ANWAHL.BEARB;       // Processing forward

L    18;                            // Transfer DS18
T    AUFTRAG;
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS19 Request Application Data

Function

The "Request Application Data" allows the user to read out information data of the positioning section. The MCU can provide the user with up to 4 different data. The data will be cyclically updated, if the bit APPLIKATIONSDATEN_L is permanently set.

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
Code Application Date 1								146	21200
Code Application Date 2								147	21201
Code Application Date 3								148	21202
Code Application Date 4								149	21203

Variables of STRUCT ANF_APP_DAT

Name	Description	Data Type
CODE_APP1	Code Application Date 1	BYTE
CODE_APP2	Code Application Date 2	BYTE
CODE_APP3	Code Application Date 3	BYTE
CODE_APP4	Code Application Date 3	BYTE

Code Values

For requesting the data, you must enter a code value to the variables.

Code Value	Description

0	No parameter request
1	Actual position
2	Actual velocity
3	Residual distance
4	Required position
5	Zero shift
6	Speed (rotary axis)
7	Relative positioning time
17	Actual encoder value (motor encoder)
18	Slipped cycles
19	Kv factor
20	Following error
21	Following error limit
22	s-Overshoot value / switch adjustment value in BA "Search for Reference"
23	Drive approach time / drive time constant in BA "Controlling"
30	Actual position (IM)
31	Actual position (DM)
32	Relative path difference (IM-DM/DM)
40	Utilization
41	Active power
42	Required torque
43	Smoothed actual current
44	Actual speed
45	Required speed

Variables of STRUCT APP_DAT

The code values are transferred to the positioning section. By setting the bit APPLIKATIONSDATEN_L at FC CONTROL, the data are put out in data record DS29. Just like the STRUCT ANF_APP_DAT, the structure of DS29 includes four variables in which the requested values will be stored.

Name	Description	Data Type
APP1	Value application Date 1	DWORD
APP2	Value application Date 2	DWORD
APP3	Value application Date 3	DWORD
APP4	Value application Date 4	DWORD

For the output of actual position and residual distance, the variable must be initialized as described in the following example.

Example

Instance DB is MCU_DB.

```
L       1;
T       MCU_DB.ANF_APP_DAT.CODE_APP1;
L       3;
T       MCU_DB.ANF_APP_DAT.CODE_APP2;

L       19;
T       AUFTRAG;                        // Transfer DS 19
```

The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

DS20 Teach In

Function

The positions of the traversing programs can be preselected at the MCU with the help of "Teach In". For this you must communicate the program and block numbers to the positioning section.

System Data Interface

7	6	5	4	3	2	1	0	Address DB Instance	P Number DB-BD
Teach In (Program-Number)								150	21300
Teach In (Block Number)								151	21301

Variables of STRUCT TEACH_IN

Name	Description	Data Type
PROG_NR.	Program number	BYTE
SATZ_NR	Block number	BYTE

Example

The actual position shall be transferred to block number 10 of program 132.

Instance DB is MCU_DB.

```
L     132;
T     MCU_DB.TEACH_IN.PROG_NR;
L     10;
T     MCU_DB.TEACH_IN.SATZ_NR;

L     20;
T     AUFTRAG;                         // Transfer DS 20
```

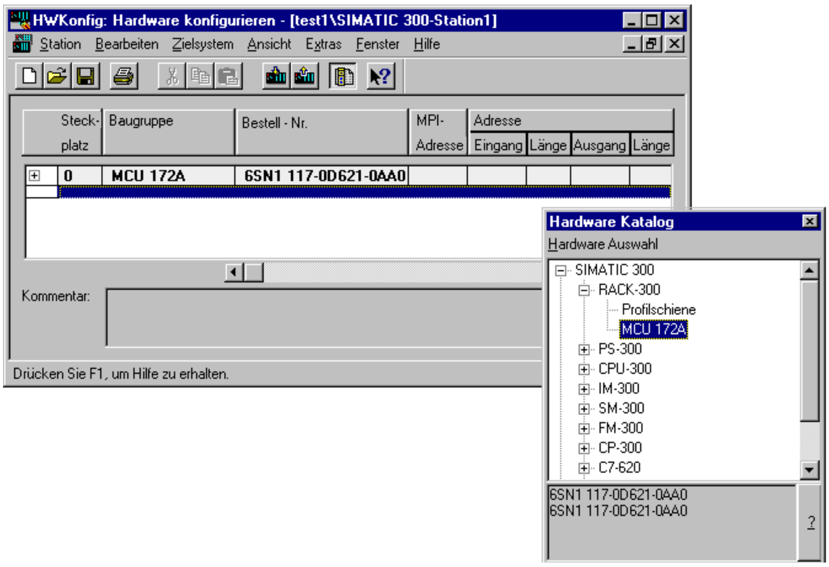
The variable AUFTRAG must be transferred to FC CONTROL in parameter AUFTRAGSANWAHL. Before transferring AUFTRAG in AUFTRAGSANWAHL, make sure that no job is running.

Configuring MCU Projects

Configuring and Parameterizing of the Integrated S7-CPU

Create the project structure: Go to the SIMATIC Manager, click on the **File** menu and select **New → Project** or click on the respective icon on the tool bar. Select the directory in which you want to create your project from the next dialog box and enter a name for your project. Click on **Save** to create the project.

Insert a station into the opened project by clicking on **Insert → Hardware → SIMATIC 300 Station**. Select the SIMATIC-300 Station 1 in the left window. The System Configuration icon will then appear in the right window. Double-click on the icon to open hardware configuration. Click on **View → Catalog** to open the hardware catalog. Select the MCU module from the hardware catalog by clicking on: **SIMATIC 300 → RACK 300 → MCU172A** and drag and drop it into the first line of the configuration table (Precondition: MCU-PIT has been installed).



Open line 0 by clicking on '+' in the configuration table. Select the required interface module from the catalog by clicking on **SIMATIC 300 → IM300 → IM360 IM S** and drag and drop it into slot 3. Now line 0 has been parameterized (slots 5 to 11 are not permitted). If you want to modify the adjustable CPU parameters, double-click on line 2. The CPU configuration table will be displayed.

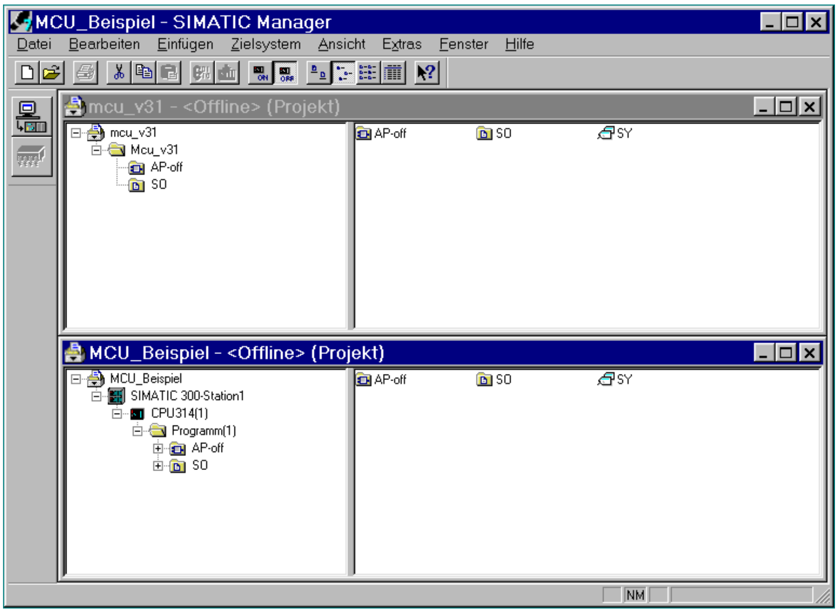
You can enter three more lines if required. Select a rack from the catalog by clicking on **SIMATIC 300 → RACK 300 → Mounting Channel** and arrange it in the lowest (free) line of the configuration table. Open the line (clicking on '+') and enter the required modules with the help of the hardware catalog, e.g. function modules. There must always an interface module be installed to slot 3. Save the overall configuration of the project by clicking on: **File → Save** and load it into the MCU by clicking on: **Target System → Load to AS**, (CPU must be in Stop status).

Copy Intelligent I/O Blocks to the Project Created

Copy intelligent I/O Blocks

The MCU-PIT software comes with a companion diskette with the intelligent I/O blocks. These blocks are contained in the STEP7 program folder. Copy this program folder into the MCU project. To make copying easier, copy the data provided with the companion diskette to a new directory using the Explorer.

Open then the project you have created for the MCU using the S7 manager (**Open File**). Repeat the **Open File** operation but select now the **Search** button. Go to the new directory with the intelligent I/O blocks and press **OK**. Call the **Arrange Window - horizontally** command to see the window arrangement illustrated below.



The data on your companion diskette can now be copied into the CPU314 of your MCU project by drag and drop. Any existing S7 programs will be replaced.

Note!

During this process, any existing S7 blocks will be deleted. In this case, copy the blocks separately from the AP-off folder.

After all data have been copied, start creating your STEP7 program. You can also use the source blocks in the SO container. To assist you in programming, this container provides the following blocks:

- example blocks to select the MCU
- sources for the data blocks
- helps for program development

Sources for the Data Blocks

Sources for the data blocks provides access to the structures by means of icons. This can be helpful in the following cases:

- When projecting an image of an OP using ProTool V3.0, access to the variables can be configured such that icons can be used; ProTool will use the data blocks stored in the project.
- Programming and commissioning under STEP7 by means of icons
- Addressing of the MCU-DBs in DS7 variable tables for Status and Controlling by means of icons

The following name conventions are used when configuring:

- Invocation DB: MCU.SOLLDATEN.STEU_LOW.NRZ_FRG
- DBs without fixed structure: DB_MD.MD_5.MD_5_B1
- DBs with fixed structure: DB_WK.WK_WERT[10].WK_LEN_KOR

Drive machine data must be addressed absolutely in accordance with the following instructions:

- DB number = 1250 + parameter record no. (1-8)
- DB offset = MD no.
- Data typ = see Documentation

Drive machine data may not be mixed with other DBs. It is not possible to address a single bit of the drive machine data.

All data blocks to be addressed by means of icons have to be entered in the icons list, and the related sources from the container have to be translated.

Note!

Any translated DB numbers over 1,000 must not be transferred to the MCU; otherwise, the data on the MCU are set to standard values.

Example for Call of Intelligent I/O Blocks of MCU

Objective

It is the objective of this call example to help you perform the STEP7 block calls required for the MCU in a simple way. This example provides the basic functionality for controlling the positioning section. This example is included in the standard diskette containing the intelligent I/O blocks.

Symbol List

The program contains a symbol list which defines the variables for the call example. Only reference to this symbol list allows a correct compilation of the program. The program parts described in the Documentation can be entered in the STEP7 program editor and compiled. After correct compilation, the programs can be executed in the MCU.

Note!

For the safety-relevant parts of a system, this program will have to be expanded and completed. All effective safety regulations have to be obeyed. This example program does not claim to be complete and reliable for all applications possible.

Rights

This example may be modified, copied and passed on to a third party without license for the purpose of putting a system into operation. However, this does not involve the acquisition of any rights.

Starting up the MCU by Means of OB100

Overview

In order to ensure the appropriate start-up of the MCU, the user must perform some basic settings in the MCU instance DB. These basic data must be entered to the instance DB before calling the intelligent I/O blocks. OB100 is scanned before OB1 during acceleration. The basic settings can be made in this organization block.

Module Address 256 and Channel Number 1

The intelligent I/O blocks require the logical module address 256 and the respective channel number 1. These data are fixed for the MCU.

Restart

With the help of bit CPU_NEUST you must communicate to the intelligent I/O blocks, if a restart has to be performed.

OB100

```
ORGANIZATION_BLOCK OB100
    TITLE = Start-up program
    AUTHOR: Siemens
    FAMILY: MCU
    NAME: Restart
    VERSION: 1.0

VAR_TEMP
    OB100_EV_CLASS      : BYTE ;            //16#13, Event class 1, Entering event state,
                                            Event logged in diagnostic buffer
    OB100_STRTUP        : BYTE ;            //16#81/82/83/84 Method of startup
    OB100_PRIORITY      : BYTE ;            //27 (Priority of 1 is lowest)
    OB100_OB_NUMBR      : BYTE ;            //100 (Organization block 100, OB100)
    OB100_RESERVED_1    : BYTE ;            //Reserved for system
    OB100_RESERVED_2    : BYTE ;            //Reserved for system
    OB100_STOP          : WORD ;            //Event that caused CPU to stop (16#4xxx)
    OB100_STRT_INFO     : DWORD ;           //Information on how system started
    OB100_DATE_TIME     : DATE_AND_TIME ;   //Date and time OB100 started
END_VAR

BEGIN
NETWORK
```

```
TITLE = Set restart bit

    SET
    ;
    S       MCU_DB.CPU_NEUST;

    L       256;                        //Enter module address 256
    T       MCU_DB.BG_ADR_EIN;          //to instance DB

    L       1;                          //Enter channel number 1
    T       MCU_DB.KA_NR;               //to instance DB

END_ORGANIZATION_BLOC
K
```

Instance DB of FB1

Overview

In order to store the basic settings in OB100 during start-up, the instance DB must be set up and loaded to the MCU before starting up the MCU.

For compilation of the program described herein, the STEP7 compiler will create a data block DB1 with the variable structure of FB1 (OP_MCU).This DB must be loaded into the MCU after successful compilation. Additionally, this DB must be assigned FB1 as data type in the symbol list. When this entry in the symbol list is missing, the STEP7 compiler will signal an error when indicating the DB as instance DB.

The DB number 1 was selected as an example, which can be altered at any time.

Instance Data-Block DB1

```
DATA_BLOCK DB 1
FB 1
BEGIN
END_DATA_BLOCK
```

Cyclic Operation in OB1

Overview

Organization block OB1 contains the program organization. In this example, program inputs are loaded to input flags and outputs supplied with output flags. There are often different input and output assignments in different MCUs. By reloading them in OB1, these can very easily be adapted to the call example.

```
ORGANIZATION_BLOCK
OB1
    TITLE = Cyclic program
    AUTHOR: Siemens
    FAMILY: MCU
    NAME: Cycle
    VERSION: 1.0

VAR_TEMP
    OB1_EV_CLASS : byte;        // Bits 0-3 = 1 (Coming event), Bits 4-7 = 1 (Event class 1)
    OB1_SCAN_1 : byte;          // 1 (Cold restart scan 1 of OB 1), 3 (Scan2-n of OB 1)
    OB1_PRIORITY : byte;        // 1 (Priority of 1 is lowest)
    OB1_OB_NUMBR : byte;        // 1 (Organization block 1, OB 1)
    OB1_RESERVED_1 : byte;      // Reserved for system
    OB1_RESERVED_2 : byte;      // Reserved for system
    OB1_PREV_CYCLE : int;       // Cycle time of previous OB1 scan (milliseconds)
    OB1_MIN_CYCLE : int;        // Minimum cycle time of OB1 (milliseconds)
    OB1_MAX_CYCLE : int;        // Maximum cycle time of OB1 (milliseconds)
    OB1_DATE_TIME :             // Date and time OB1 started
    date_and_time;
END_VAR

BEGIN
NETWORK
TITLE = Copying of inputs

    L       EINGANGSBYTE_1;
    T       ABBILD_EB_1;
    L       EINGANGSBYTE_2;
    T       ABBILD_EB_2;
    L       EINGANGSBYTE_3;
    T       ABBILD_EB_3;
    L       EINGANGSBYTE_4;
    T       ABBILD_EB_4;

NETWORK
TITLE = Call of intelligent I/O blocks
    CALL     MCU_BEIS;          // FC MCU_BEISPIEL
```

```
NETWORK
TITLE = Copying of Outputs

    L       ABBILD_AB_1;
    T       AUSGANGSBYTE_1;
    L       ABBILD_AB_2;
    T       AUSGANGSBYTE_2;
    L       ABBILD_AB_3;
    T       AUSGANGSBYTE_3;
    L       ABBILD_AB_4;
    T       AUSGANGSBYTE_4;
END_ORGANIZATION_BLOCK
```

Example for Call in FC100

Overview

FC100 calls the intelligent I/O blocks FC RESTART, FB OP_MCU and FC CONTROL in their correct sequence. In addition, it supplies and verifies some of the I/O variables.

Network 1

In the first network FC1 (FC RESTART) is called. Any errors that might have occurred must be analyzed after the execution. The network provides the framework for adding the appropriate error indicators. In order to perform a test run with MCU-PIT, set the TFB bit before execution of the FC RESTART.

```
FUNCTION FC 100 : VOID
    TITLE = Calling of intelligent I/O blocks
    AUTHOR: Siemens
    FAMILY: MCU
    NAME: MCU_BEIS
    VERSION: 3.03

BEGIN
    NETWORK
    TITLE = Calling of FC RESTART
    CALL    RESTART(
    INSTANZ_DB        :=MCU,
    TFB               :=TFB,
    TFGS              :=TFGS,
    ANZEIGENWORT      :=ANZW_RESTART);

    U       TFGS;                       // If testing mode active,
    SPB     NW1E;                       // then network 1 end

    UN      FC_RES_SAMMELFEHLER;
    SPB     RKFE;                       // No error FC RESTART

    U       FC_RES_SAMMELFEHLER;        // Group error
    S       SF_RESTART;                 // Set error bit

    L       FC_RES_ZUSATZINFO;          // Read additional error information
    T       FNR_FC_RESTART;             //
                                        //
                                        // Other error reaction
                                        //
```

			//
			//
	SPA	NW1E;	// Error analysis end
RKFE:	U	SAMMELFEHLER_LOES;	// Acknowledge error
	SPBN	WEI1;	
	R	SF_RESTART;	// Reset error bit
WEI1:	U	SF_RESTART;	//
	SPB	NW1E;	// Resume normal program execution
			//
NW1E:	NOP 0;		//

Network 2

In the second network FB1-OP_MCU is called. Job processing cycles are checked and edge evaluations for data transfer are set up before the actual call.

```
NETWORK
TITLE = Calling of FB OP_MCU
L     AKTIVE_BETRIEBSART;          // Feedback from module
L     BETRIEBSART;                 // Defined by user
<>I;
O(;
L     BA_FB_MCU;                   // Input parameter FB OP_MCU
<>I;
);
=     BA_AENDERUNG;
U     BA_UEBERNAHME;               // Defined by user
FP    FLANKE_BA_UEBERN;
UN    BETRIEBSDATEN_L_FB_MCU;      //-----------------------------
UN    BEZUGSPUNKT_SETZ_FB_MCU;
UN    SW254_S_FB_MCU;
UN    GESCHW_STUFEN_S_FB_MCU;
UN    DREHZAHLSTUFEN_S_FB_MCU;
U(;                                // No job processing
L     SCHREIBAUFTRAG_FC_CON;
L     W#16#0;
==I;
);
U(;
L     LESEAUFTRAG_FC_CON;
==I;
);                                 //-----------------------------
SPBN  ALBA;                        // Previous operating mode
```

```
        L     BETRIEBSART;                  // Defined by user
        T     BA_FB_MCU;                    // Parameter at FB OP_MCU
        L     BETRIEBSARTEN_PARAMETER;      // Defined by user
        T     BA_PARA_FB_MCU;               // Parameter at FB OP_MCU
ALBA    O     BA_AENDERUNG;                 // In case of change of operating mode or
        O     FB_MCU_BEARB_TF_LAEUFT;       // job execution in progress,
        SPB   C_FB;                         // no job will be transferred to FB OP_MCU.
        U     BETRIEBSDATEN_L;              // Defined by user
        S     BETRIEBSDATEN_L_FB_MCU;       // Parameter at FB OP_MCU

        U     BEZUGSPUNKT_SETZEN;           // Defined by user
        FP    FLANKE_BZP_SETZEN;
        S     BEZUGSPUNKT_SETZ_FB_MCU;      // Parameter at FB OP_MCU

        U     SW254_S;                      // Defined by user
        FP    FLANKE_SW254_S;
        S     SW254_S_FB_MCU;               // Parameter at FB OP_MCU

        U     GESCHWINDIGKEITSSTUFEN_S;     // Defined by user
        FP    FLANKE_GWS_S;
        S     GESCHW_STUFEN_S_FB_MCU;       // Parameter at FB OP_MCU

        U     DREHZAHLSTUFEN_S;             // Defined by user
        FP    FLANKE_DZS_S;
        S     DREHZAHLSTUFEN_S_FB_MCU;      // Parameter at FB OP_MCU
```

Call of FB1

FB1 is called after editing of the parameters. The parameter transfer is performed by means of additional variables. This transfer is also possible by direct entry into the instance DB (*see Example Programs in Chapter Data Transfer).* In this case parameter assignment must be omitted.

```
C_FB:  CALL  OP_MCU,MCU(
       BETRIEBSART                 :=BA_FB_MCU,
       BA_PARAMETER                :=BA_PARA_FB_MCU,
       OVERRIDE                    :=OVERRIDE,
       R_PLUS                      :=R_PLUS,
       R_MINUS                     :=R_MINUS,
       START                       :=START,
       STOPP                       :=STOPP,
       EINLESEFREIGABE             :=EINLESEFREIGABE,
       SATZ_AUSBLENDEN             :=SATZ_AUSBLENDEN,
       QUITTUNG_M_FUNKTION         :=QUITTUNG_M_FUNKTION,
       ACHSFREIGABE                :=ACHSFREIGABE,
       REGLERFREIGABE              :=REGLERFREIGABE,
       IMPULSFREIGABE_PLC          :=IMPULSFREIGABE_PLC,
       AKTIVE_BETRIEBSART          :=AKTIVE_BETRIEBSART,
       FAHREN_PLUS                 :=FAHREN_PLUS,
       FAHREN_MINUS                :=FAHREN_MINUS,
       STARTFREIGABE               :=STARTFREIGABE,
       WARTEN_EXT_FREIGABE         :=WARTEN_EXT_FREIGABE,
       BEARBEITUNG_LAEUFT          :=BEARBEITUNG_LAEUFT,
       POSITION_ERREICHT           :=POSITION_ERREICHT,
       VERWEILZEIT_LAEUFT          :=VERWEILZEIT_LAEUFT,
       PROGRAMM_RUECKWAERTS        :=PROGRAMM_RUECKWAERTS,
       AUSGABE_M_FUNKTION          :=AUSGABE_M_FUNKTION,
       M_FUNKTIONSNUMMER           :=M_FUNKTIONSNUMMER,
       BEDIENFEHLER                :=BEDIENFEHLER,
       BETRIEBSFEHLER              :=BETRIEBSFEHLER,
       ACHSE_SYNCHRON              :=ACHSE_SYNCHRON,
       IMPULSE_FREIGEGEBEN         :=IMPULSE_FREIGEGEBEN,
       ANTRIEB_BEREIT              :=ANTRIEB_BEREIT,
       ANZEIGENWORT                :=ANZW_MCU,
       BEDIENFEHLER_QUITT          :=BEDIENFEHLER_QUIT,
       BETRIEBSFEHLER_QUITT        :=BETRIEBSFEHLER_QUIT,
       BETRIEBSDATEN_L             :=BETRIEBSDATEN_L_FB_MCU,
       BEZUGSPUNKT_SETZEN          :=BEZUGSPUNKT_SETZ_FB_MCU,
       SW254_S                     :=SW254_S_FB_MCU,
       GESCHWINDIGKEITSSTUFEN_S    :=GESCHW_STUFEN_S_FB_MCU,
       DREHZAHLSTUFEN_S            :=DREHZAHLSTUFEN_S_FB_MCU);
```

Error Analysis after Execution of FB OP_MCU

The calling of FB1 OP_MCU must be followed by an error analysis. You can program the evaluation of the signals in the program section for normal program processing. For example decoding of the M functions is often required. This decoding must be executed by the user program.

```
        UN      FB_MCU_SAMMELFEHLER;
        SPB     MKFE;                       // No error FB OP_MCU

        U       FB_MCU_SAMMELFEHLER;
        S       SF_MCU;                     // Set group error indication

        L       FB_MCU_ZUSATZINFO;          // Read additional error information
        T       FNR_FB_MCU;                 //
                                            //
                                            // Other error reaction
                                            //
                                            //
        SPA     NW2E;                       // Error evaluation end

MKFE:   U       SAMMELFEHLER_LOES;          // Acknowledge error
        SPBN    WEI2;                       //
        R       SF_MCU;                     // Reset error bit

WEI2:   U       SF_MCU;                     //
        SPB     NW2E;                       //
                .                           // Continue normal program execution
                                            //
                                            //
NW2E:   NOP 0;                              //
```

Network 3

The third network calls FC CONTROL. Before calling, the input parameters must be edited. Especially when starting a new reading or writing job, you must make sure that the previous job has been processed completely.

```
        NETWORK
        TITLE = Calling of FC CONTROL

        U     BA_AENDERUNG;                // In case of change of operating mode,
        SPB   FCAU;                        // no job will be transferred to FC CONTROL.
        U     SCHREIBAUFTRAG_C;            // Triggering of writing job
        FP    FLANKE_SCHREIBAUFTR_C;
        U(;
        L     B#16#0;                      // No new writing job,
        L     SCHREIBAUFTRAG_FC_CON;       // if the previous one has not yet been processed completely.
        ==I;
        );
        SPBN  LAUF;

        L     AUFTRAGSNR_SCHREIBEN;        // Defined by user
        T     SCHREIBAUFTRAG_FC_CON;       // Parameter at  FC CONTROL

LAUF:   U     ZYKL_LESEN_C;
        FP    FLANKE_ZYKL_LESEN_C;
        U(;
        L     B#16#0;                      // No new reading job block,
        L     LESEAUFTRAG_FC_CON;          // if the previous one has not yet been processed completely.
        ==I;
        );
        SPBN  FCAU;
        L     AUSWAHL_LESEAUFTRAG;         // Defined by user
        T     LESEAUFTRAG_FC_CON;          // Parameter at  FC CONTROL

FCAU:   CALL CONTROL(
        INSTANZ_DB                :=MCU,
```

MESSUNG_ENDE	:=MESSUNG_ENDE,
FLIEG_ISTWERTSETZEN_AUSG	:=FLIEG_IWS_AUSG,
ANZEIGENWORT	:=ANZW_CONTROL,
AUFTRAGSANWAHL	:=SCHREIBAUFTRAG_FC_CON,
BETRIEBSDATEN_ZUS_L	:=BETRIEBSDATEN_ZUS_L,
AKTIVER_NC_SATZ_L	:=AKTIVER_NC_SATZ_L,
NAECHSTER_NC_SATZ_L	:=NAECHSTER_NC_SATZ_L,
APPLIKATIONSDATEN_L	:=APPLIKATIONSDATEN_L,
ISTWERT_SATZWECHSEL_L	:=ISTWERT_SATZWECHSEL_L,
SERVICEDATEN_L	:=SERVICEDATEN_L,
SERVODATEN_L	:=SERVODATEN_L,
ISTDATEN_L	:=ISTDATEN_L,
DA_DE_L	:=DA_DE_L);

Error Analysis after Execution of FC CONTROL

After execution of FC CONTROL you must check whether any error occurred during data transfer. If any error is detected, the user program will have to make sure that the system is brought to a safe operational state. It might be necessary to block motions.

	UN	FC_CON_SCHREIBFEHLER;	// No writing error FC CONTROL
	SPB	LEFE;	// Jump to evaluation of reading errors
	U	FC_CON_SCHREIBFEHLER;	
	S	SF_CONTROL_SCHREIBEN;	// Set writing error indication
	L	FC_CON_ZUSATZINFO;	// Read additional error information
	T	FNR_WRITEERR_CONTROL;	//
			//
			// Other error reaction
			//
			//
			//
	SPA	NW3E;	// Error evaluation end
LEFE:	UN	FC_CON_LESEFEHLER;	// No reading error FC CONTROL
	SPB	CKFE;	// No error FC CONTROL
	U	FC_CON_LESEFEHLER;	
	S	SF_CONTROL_LESEN;	// Set reading error indication
	L	MCU.READERR_CONTROL;	// Additional error information READERR_CONTROL
	T	FNR_READERR_CONTROL;	//
	L	MCU.ME_ERR_CONTROL;	// Additional error information ME_ERR_CONTROL
	T	FNR_ME_ERR_CONTROL;	//
			//
			// Other error reaction
			//
			//
			//
	SPA	NW3E;	// Error evaluation end
CKFE:	U	SAMMELFEHLER_LOES;	// Acknowledge error

	SPB N	WEI3;	//
	R	SF_CONTROL_LESEN;	// Reset error bit
	R	SF_CONTROL_SCHREIBE N;	// Reset error bit
WE I3:	O	SF_CONTROL_LESEN;	//
	O	SF_CONTROL_SCHREIBE N;	//
	SPB	NW3E;	//
			// Continue normal program execution
			//
NW 3E:	NO P 0;		//

Network 4

In the final FC100 network, the diagnostic interrupt is deleted.

```
NETWORK
TITLE = Clearing of diagnostic
interrupt indication
U    DIAGNOSEANZ_LOES;            // Input for clearing
R    DIAGNOSE_ANZ;
BE
;
END_FUNCTION
//*****************************************************************************************************
// The diagnostic indication is set by OB82 upon occurring of an error.
//*****************************************************************************************************
ORGANIZATION_BLOCK OB 82
    TITLE = Diagnostic
    interrupt
    AUTHOR: Siemens
    FAMILY: MCU
    NAME: Diagnosis
    VERSION: 1.0
VAR_TEMP
    OB82_EV_CLASS        : BYTE ;   //16#39, Event class 3, Entering event state, Internal fault event
    OB82_FLT_ID          : BYTE ;   //16#XX, Fault identification code
    OB82_PRIORITY        : BYTE ;   //26/28 (Priority of 1 is lowest)
    OB82_OB_NUMBR        : BYTE ;   //82 (Organization block 82, OB82)
    OB82_RESERVED_1      : BYTE ;   //Reserved for system
    OB82_IO_FLAG         : BYTE ;   //Input (01010100), Output (01010101)
    OB82_MDL_ADDR        : INT ;    //Base address of module with fault
    OB82_MDL_DEFECT      : BOOL ;   //Module defective
    OB82_INT_FAULT       : BOOL ;   //Internal fault
    OB82_EXT_FAULT       : BOOL ;   //External fault
    OB82_PNT_INFO        : BOOL ;   //Point information
    OB82_EXT_VOLTAGE     : BOOL ;   //External voltage low
```

```
    OB82_FLD_CONNCTR        : BOOL ;  //Field wiring connector missing
    OB82_NO_CONFIG          : BOOL ;  //Module has no configuration data
    OB82_CONFIG_ERR         : BOOL ;  //Module has configuration error
    OB82_MDL_TYPE           : BYTE ;  //Type of module
    OB82_SUB_NDL_ERR        : BOOL ;  //Sub-Module is missing or has error
    OB82_COMM_FAULT         : BOOL ;  //Communication fault
    OB82_MDL_STOP           : BOOL ;  //Module is stopped
    OB82_WTCH_DOG_FLT       : BOOL ;  //Watch dog timer stopped module
    OB82_INT_PS_FLT         : BOOL ;  //Internal power supply fault
    OB82_PRIM_BATT_FLT      : BOOL ;  //Primary battery is in fault
    OB82_BCKUP_BATT_FLT     : BOOL ;  //Backup battery is in fault
    OB82_RESERVED_2         : BOOL ;  //Reserved for system
    OB82_RACK_FLT           : BOOL ;  //Rack fault, only for bus interface module
    OB82_PROC_FLT           : BOOL ;  //Processor fault
    OB82_EPROM_FLT          : BOOL ;  //EPROM fault
    OB82_RAM_FLT            : BOOL ;  //RAM fault
    OB82_ADU_FLT            : BOOL ;  //ADU fault
    OB82_FUSE_FLT           : BOOL ;  //Fuse fault
    OB82_HW_INTR_FLT        : BOOL ;  //Hardware interrupt input in fault
    OB82_RESERVED_3         : BOOL ;  //Reserved for system
    OB82_DATE_TIME          : DT ;    //Date and time OB82 started
END_VAR

BEGIN
      SET ;
      S       DIAGNOSE_ANZ;           // Indicate diagnostic interrupt
      BE;                             // Indicate diagnostic interrupt
END_ORGANIZATION_BLOCK
```

SIEMENS

SIMODRIVE 611

MCU 172A
Single-Axis Positioning Control

User Manual
Communication

Valid for: MCU 172A V 3.x or higher

Edition March 1998

Note

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please inquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

1 Installing an MPI Network

Contents

Definition: Multi-point interface MPI

The interface at connector X20 on the MCU is a multi-point interface. Using this MPI interface, several devices have access to the MCU. This multi-point interface allows networking without any additional hardware.

1.1 Fundamentals

Segment

A segment is a bus line between two terminators, which can contain up to 32 stations (nodes). Furthermore, a segment is limited by the permissible line length of 50 m (when using isolated interfaces).

Baud rate

The baud rate in the MPI network is fixed to 187.5 kBaud.

Connectable stations

The following stations (devices) that exchange data with each other can form an MPI network:

- Programming unit (PU/PC)
- Operating and monitoring device (OP)
- MCUs or S7-CPUs
- S7-300 / M7-300
- S7-400 / M7-400

Prevent material damage!

The MPI can be damaged by interference voltages provided to the MPI!

Never link an ungrounded S7-300 with a grounded MCU or a grounded PU through the MPI.

1.2 Rules for Installing a Network

Rules

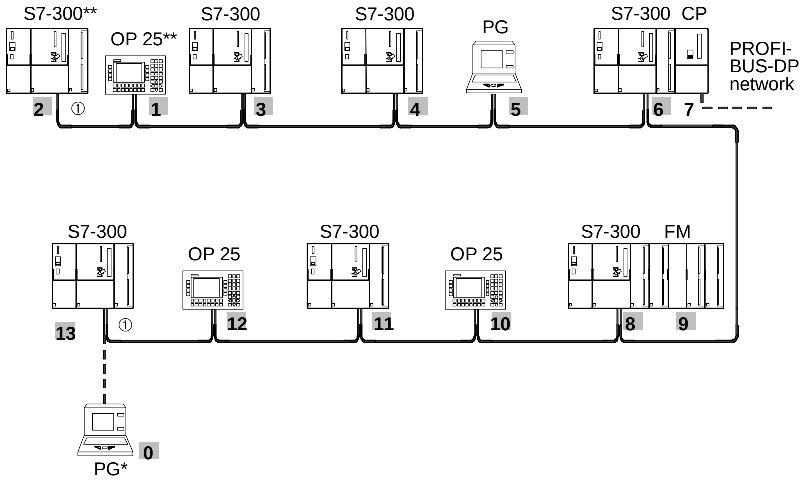
The following rules must be observed for interlinking the network stations:

- **Prior** to interlinking the individual stations of a network, each station must be assigned both an individual MPI address and the highest MPI address. Exception: Stations automatically assigned the MPI address from the MCU when the system is booting, such as CPs, as well as RS 485 repeaters not requiring their own MPI address.

  Hint: The addresses of all network stations should be indicated on the casing so that it is always visible which station is assigned what address.
- All stations of the network should be linked in a row, i.e. the PUs and OPs fixed in place must be integrated in the network directly, and only the PUs/OPs needed for commissioning and maintenance work are attached to the network through connecting cables.
- If more than 32 stations are installed in a network, the bus segments must be coupled by means of RS 485 repeaters.
- Up to 10 segments can be arranged in a row.
- Ungrounded and grounded repeaters are coupled by means of RS 485 repeaters.
- It should be considered that an RS 485 repeater is also included in the total number of stations to be linked and is also counted as a station in the segment even if it has no MPI address of its own.
- **Before** a new station is integrated in the network, the supply voltage of the station concerned must be switched off.
- Individual stations should be linked with each other by bus connectors and by the PROFIBUS bus cable. The stations should be provided with a bus connector having a PU socket to which a PU can be connected if required.
- The segment end of the line must be terminated by its characteristic wave impedance. To this aim, the terminator at the first and last station of a segment (in the connector, bus terminal or repeater) must be turned on.
- Make sure that the stations at which the terminator is turned on are always supplied with voltage both during run-up and operation.

Example of an MPI network

The Fig. below illustrates the schematic design of an MPI network installed acc. to the rules above.



* connected upon commissioning/maintenance work only by connecting cables (with default MPI address)
** later installed firmly in the MPI network (with default MPI address)

0 ... x MPI adresses of the stations
① terminator switched on

2 Network Components

Contents

Application

Network components are needed ...

Application	Components
... to build up a network	PROFIBUS standard line
... to attach stations to the network	Bus connector
... to amplify the signal ... to couple segments ... to galvanically isolate the segments	RS 485 repeater
... to network systems	Bus terminal RS 485
... to attach PUs/OPs to the network	PU connecting cables (taps)

2.1 Bus Connector

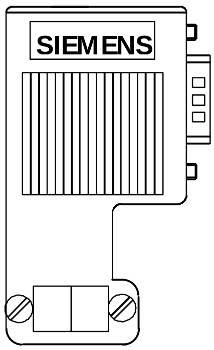
Application of the bus connector

The bus connector is intended to attach the PROFIBUS cable to the MPI. Linking to further stations is carried out as follows:

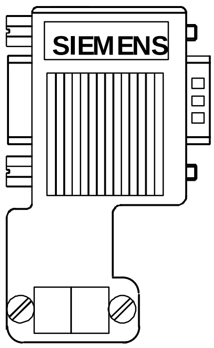
The following bus connectors are used:

- Bus connectors **without** PU socket. This bus connector is intended to attach the PROFIBUS line to the MPI (left Fig.).
- Bus connector **with** PU socket. This PU socket on the bus connector can be used to connect a PU to the networked MCUs (right Fig.).

The Fig. below shows examples of a bus connector:



Bus connector without PU socket



Bus connector with PU socket

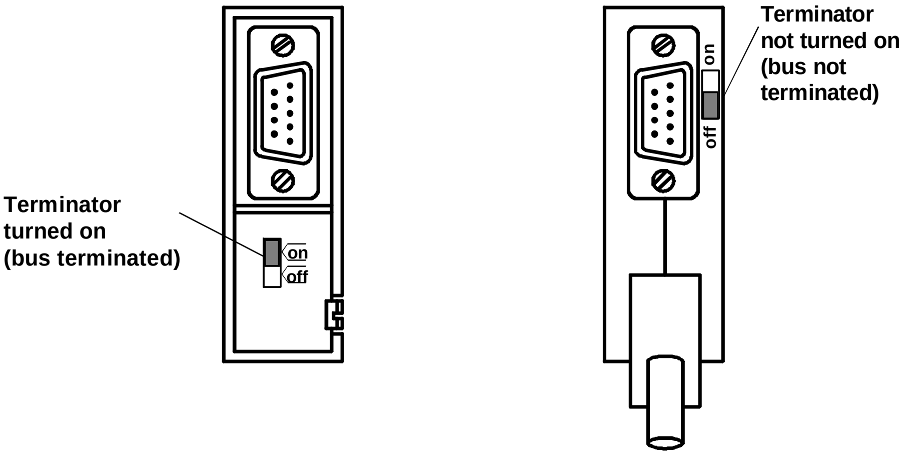
Disconnecting the bus connector

Bus connectors with **bus cable looped through** can be disconnected from the interface at any time without interrupting the data transfer along the bus.

Terminator

The segment end of a line must be terminated by its characteristic wave impedance. If the bus connector is at the beginning or the end of a segment, the terminator must be turned on (switch position ON).

The Figure below shows an example in order to demonstrate how to turn on/turn off the terminator.



Note:

Bus segments must always be terminated at both ends.

Make sure that the stations at which the terminator is turned on are always supplied with voltage.

2.2 RS 485 Bus Terminal RS 485

RS 485 bus terminal RS 485

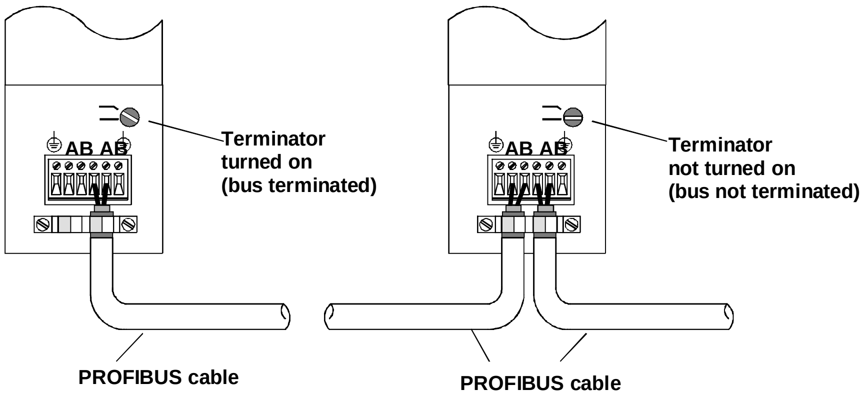
The RS 485 bus terminal can be used to connect an MCU, S7–300 or a PU to the PROFIBUS line. To operate the bus terminal, a 5V supply voltage is required.

To terminate the segment end of a line by its characteristic wave impedance, the terminator at the first and last RS 485 bus terminal each of a segment must be turned on. To this aim, set the switch on the SIMATIC NET bus terminal to "Bus terminated" (see Fig. below).

Detail explanations on the SIMATIC NET bus terminal are provided in the PROFIBUS/*L2FO Network Manual*.

Wiring

The following Figure shows the principle how to connect the PROFIBUS lines to the bus terminal, and where the terminator is turned on.



Why bus terminals?

The RS 485 bus terminal is exclusively intended for use as connector substitute. For certain applications (e.g. for cabinet entries), it is recommended to use an RS 485 bus terminal instead of a bus connector. The cable of the bus terminal is more flexible and can therefore easier be laid than the relatively inflexible bus cable to which the bus terminal is attached.

2.3 RS 485 Repeater

Application of the RS 485 repeater

The RS 485 repeater amplifies data signals on bus lines and couples the bus segments.
An RS 485 repeater is required if:

- a grounded signal is coupled with an ungrounded segment,
- the maximum line length of a segment is exceeded, or
- more than 32 stations are installed in a network.

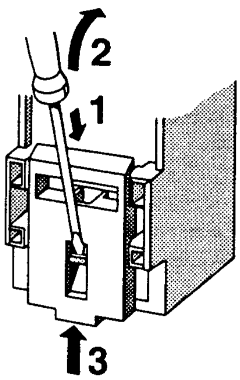
2.3.1 General

Description of the RS 485 repeater

A detailed description, as well as the technical data of the RS 485 repeater are provided in the Reference Manual *Module Data*.

The RS 485 repeater can be installed either at an S7-300 mounting bar or a 35 mm standard top-hat rail.
To install the repeater at an S7-300 mounting bar, the slide on the rear side of the RS 485 repeater must be removed:

The following Figure shows how to remove the slide of the RS 485 repeater.



After removing the slide, the RS 485 repeater can be mounted on the mounting bar as the other S7-300 modules.
To connect the DC 24 V supply line, flexible lines with a cross section between 0.25 mm² and 2.5 mm² (AWG 26 to 14) are used.

DC 24-V supply lines

The DC 24-V supply lines are wired according to the wiring rules provided in the Chapter *Power Supply*.

Connecting lines

The connecting line must be a two-core, twisted and shielded cable. The PROFIBUS lines listed below are used as connecting lines. See also Catalog SIMATIC NET *Industrial Communication Networks Volume IK - PROFIBUS & AS Interface*:

- PROFIBUS line
- PROFIBUS line with PE jacket
- PROFIBUS cable for burial in the ground
- PROFIBUS trailing cable
- PROFIBUS line for festoon installation

Terminal M5.2

Terminal M5.2 may not to be wired, as this connection terminal is used for servicing only. Terminal M5.2 provides the reference potential measuring the voltage curve between the connections A1 and B1.

Baud rate

The baud rate of 187.5 kBaud required for the MCU is set in switch position 4. If you wish to set another baud rate, use the rotary switch on the front side of the RS 485 repeater and set the respective baud rate by means of a screw driver.

2.3.2 Electric Isolation by means of the RS 485 Repeater

Ungrounded operation of the RS 485 repeater

The RS 485 repeater is delivered for ungrounded operation. If the voltage supply of the RS 485 repeater is also ungrounded, it is possible to network a grounded MCU with an ungrounded S7-300.

The electric isolation by the RS 485 repeater is carried out between segment 1 and segment 2. The electric potential for the programming unit is linked with segment 1.

Grounded operation of the RS 485 repeater

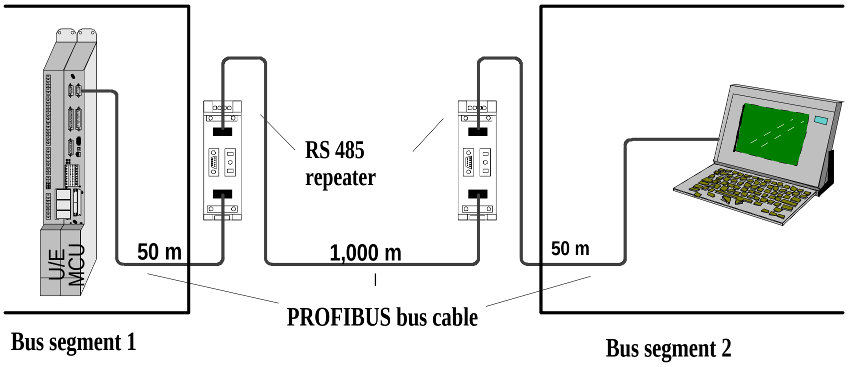
If grounded operation is required, a jumper can be inserted at the upper side of the RS 485 repeater. However, it is better to connect the voltage supply to ground in order to facilitate grounded operation in this way.

2.3.3 Exceeding the Maximum Line Length of a Segment

Larger line lengths

If the maximum line length of a segment is exceeded, the line length can be enlarged by connecting several RS 485 repeaters in series. A maximum of 9 repeaters can be connected in series. For electrically isolated interfaces, the maximum line length between two RS 485 repeaters amounts to 1,000 m. When using this max. line length, **no** further station may connected between the two RS 485 repeaters.

The Fig. below shows the principle of line elongation for the MPI by means of RS 485 repeaters.



Potential conditions

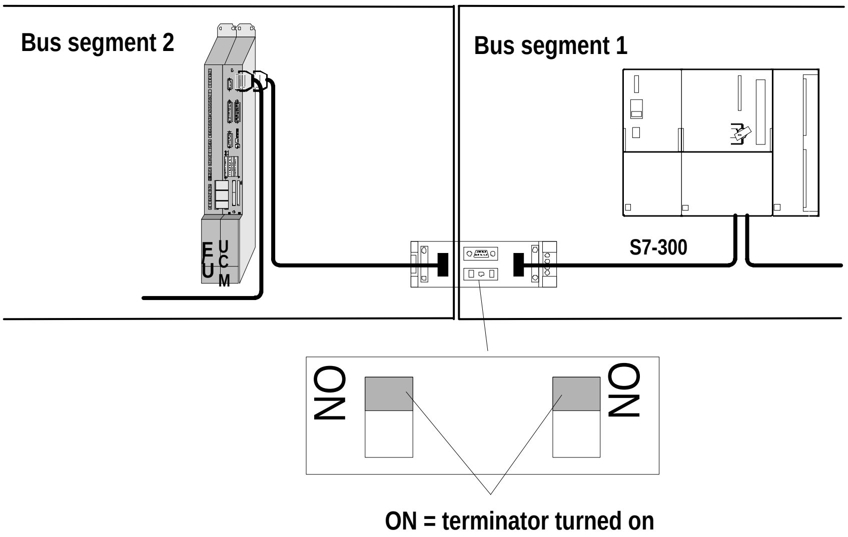
Bus segment 1 and bus segment 2 are electrically isolated. The PU/OP interface is internally linked with the connection for bus segment 1. This means: The bus signals are amplified between the connection for bus segment 1 or the PU/OP interface and the connection for bus segment 2.

2.3.4 Terminator of the RS 485 Repeater

RS 485 repeater at segment end

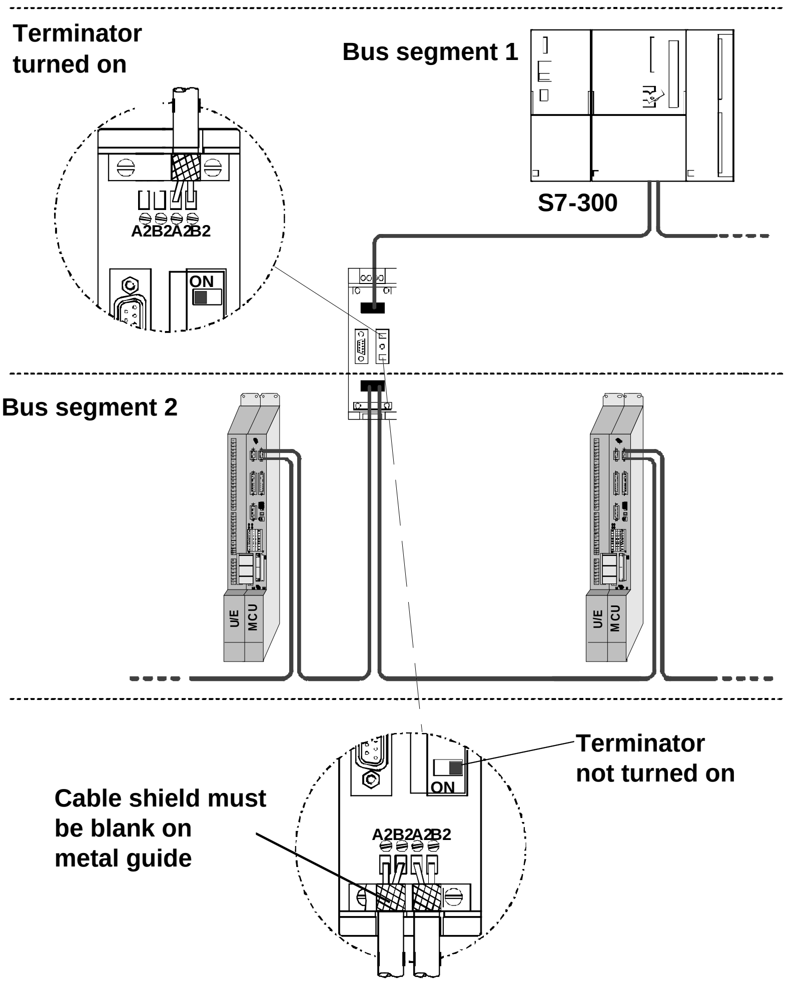
To provide error-free data exchange, the following must be ensured prior to the data exchange: At least one station at which the terminator is turned on must be attached to the network.

The terminator of the respective bus segment must be turned on at the end of the segment. The Fig. below shows the RS 485 repeater at the end of bus segment 2 and at the end of bus segment 1. In the example, the RS 485 repeater is used as amplifier between 2 bus segments. The terminators are turned on.



RS 485 repeater in the bus segment

The terminator within the segment may not be turned on. The following Figure shows the RS 485 repeater within a bus segment. In the example, the RS 485 repeater is used as amplifier between 2 bus segments. The terminator for bus segment 1 is turned on, and that for bus segment 2 not turned on.



Note:

Bus segment 1 is grounded if a PU is connected to the PU/OP socket of the RS 485 repeater. Grounding is provided, because the MPI in the PU is grounded and the PU/OP socket in the RS 485 repeater internally linked with bus segment 1.

2.4 Taps

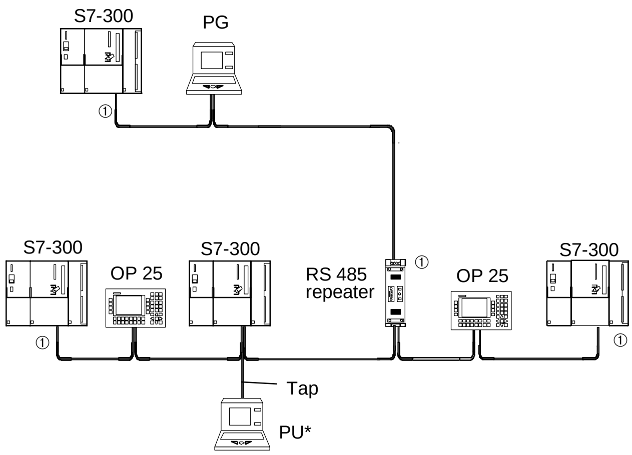
If you do not attach the bus cable directly to the bus connector (e.g. when using an RS 485 bus terminal), consider the maximum possible length of the taps.

The Table below shows the maximum permissible tap length per bus segment:

Baud rate	Total of lengths of tap per segment	Number of stations with a tap length of...	
		1.5 m or 1.6 m	3 m
187.5 kBaud (MPI)	75 m	32	25

Taps and terminators in the MPI network

The Fig. below shows a possible structure of an MPI network in order to demonstrate how to connect a PU by means of a tap, and in which position the terminators must be turned on. The terminators connected at the taps must only be turned on if the tap is at the same time the end of the segment.

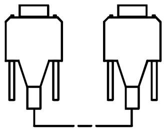
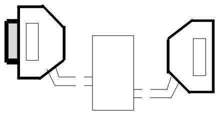
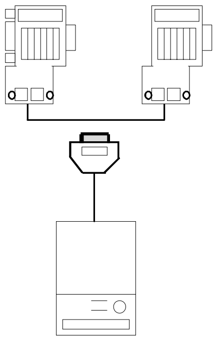
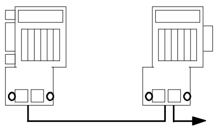


* for for commissioning/maintenance work only connected through taps

① Terminator turned on

2.5 Connection Cables

The following cables can be used to link a PU with the MCU, or from MCU to MCU/S7-300:

Connection cables	Length	Special features	Figure	Link between ...
PU cable, short	5 m	-		MCU ↔PU MCU ↔S7–300 MCU ↔ MCU
PC/MPI cable	5 m	with 24 V for the RS485/RS232C converter		MCU ↔ PC
PROFIBUS line and bus connector and RS 485 bus terminal	-	Line must be made by the user		MCU↔PU MCU↔S7–300 MCU ↔ MCU
MMC cable PP 031 and OP 031 are connected to the MCU by means of an MMC cable	5 m /10 m	Line must be made by the user		MCU↔MMC (PP 031)

3 Linking a PU with the MCU

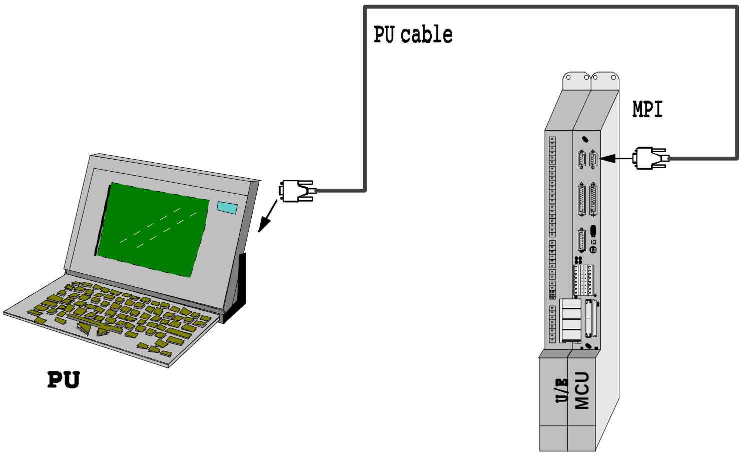
Contents

3.1 Connecting a PU to the MCU

Connecting a PU to the MCU

The PU is linked with the MPI interface of the MCU by means of a connection line.

The Figure below shows the components required to link a PU with the MCU.



Communication

The following conditions must be observed for communication between PU and MCU:

- You need a PU with STEP 7 V2.1 and MCU-PIT
- The MCU can communicate with the PU in the following modes: RUN–P, RUN and STOP

Operation

The operating facilities for the communication between MCU and PU are described in the manuals *STEP 7 Using the Tools* and *STEP 7 Designing User Programs*.

Note:

MCU-PIT can also be used for operation. To use MCU-PIT, STEP 7 must be installed on the PU. In order to build up a link by means of MCU-PIT, STEP 7 must be authorized. Further information is provided in *Chapter 8*.

3.2 Connecting a PU to Several MCUs Networked with each other

Networked MCUs

The MPI can be used for the communication of several MCUs or S7-CPUs having different addresses. To this aim, the MCUs / CPUs must be linked with each other by means of PROFIBUS lines. This Chapter describes how to network the MCUs with each other and with a PU.

Networking possibilities

The PROFIBUS line can be used for networking of the individual MCUs or S7–CPUs. The MCU or CPU can be connected to the MPI network by the following means:

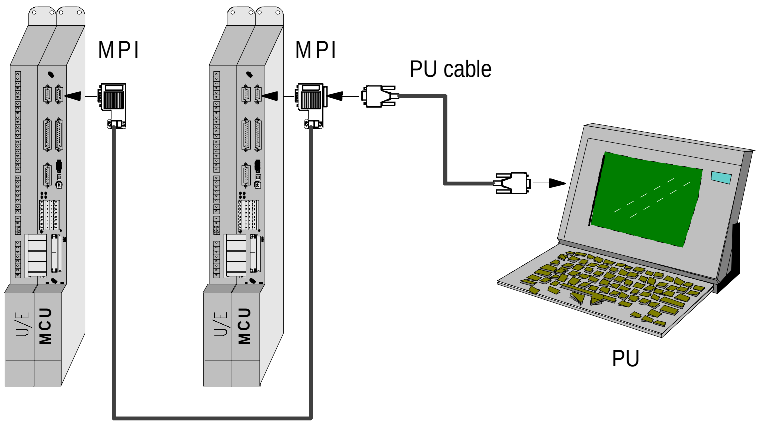
- MPI bus connector
- Bus terminal RS 485

3.2.1 Connecting the PU by means of a Bus Connector

Connecting a PU to the MCU network by means of a bus connector

The following Fig. shows an MCU network consisting of 2 MCUs. The 2 MCUs are linked with each other at the MPI interface by means of bus connectors.

At least one bus connector should have a PU socket. A PU can be connected to this bus connector for communication with the networked MCUs.



3.2.2 Connecting a PU by means of a Bus Terminal

As an alternative to the bus connector, the PU can also be connected to the MCU by means of an RS 485 bus terminal. The bus terminal serves as connector substitute.

4 MPI Addresses

Contents

4.1 Assigning MPI Addresses

General

For communication of the individual stations in the MPI network, they must be assigned both an individual MPI address and the highest MPI address.

If not assigned automatically by the MCU, each individual station must be assigned these MPI addresses separately by means of the PU.
For further information read the *STEP 7 User Manual* or the *ET 200 Manuals.*

Note:

The RS 485 repeater is not assigned an MPI address.

Default MPI addresses

The following Table lists the default MPI addresses of the devices. The permissible MPI address range is between 0 and 126.

Station (device)	Default MPI address	Default highest MPI address
PG	0	15
OP	1	depending on the OP
CPU	2	15

Rules for assigning MPI addresses

Before assigning the MPI addresses, pay attention to the following rules:

- All MPI addresses in a network must be different.
- The highest MPI address must be ≥ the largest real MPI address and therefore the same for all stations. For the highest MPI address, only the values 15, 31, 63 or 126 are permitted.
- If, in addition, any FM or CP modules with communication capabilities are installed in an MCU network, the MCU automatically assigns the MPI addresses for the fixed FM/CP modules during the start-up. Based on the MPI address of the MCU, the MCU assigns the following numbers and stores the MPI parameters. In case of networking or additional extension by FM or CP modules with a K bus, this behavior must be considered when assigning MPI addresses.

Recommendation for MPI addresses

MPI address

– 0 must be reserved for a service PU, and MPI address

– 1 must be reserved for a service OP,

which can be later attached to the MPI network when required. This is the reason why the PUs/OPs in the network must be assigned other MPI addresses.

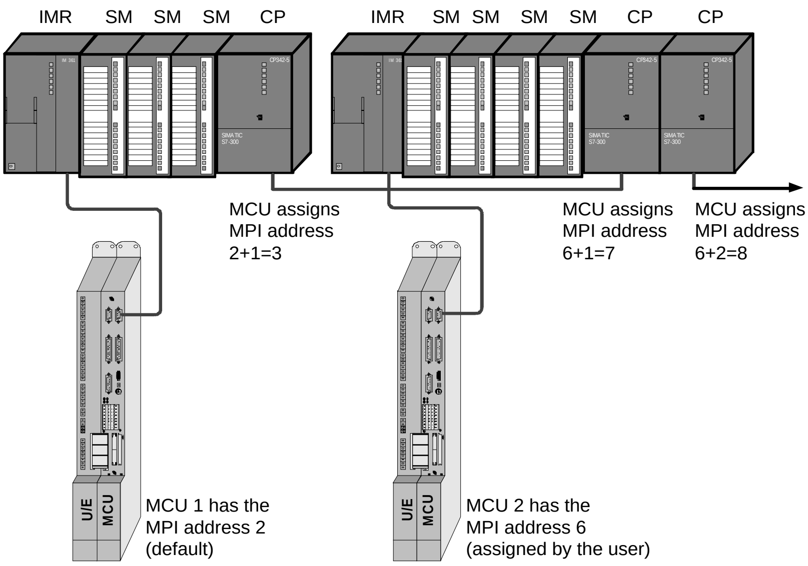
MPI address

– 2 must be reserved for the CPU.

Double MPI addresses after installing a CPU with the default setting in the MPI network (for example, when replacing an MCU) is avoided in this way. For this reason, the CPUs in the network should be assigned MPI addresses larger than 2.

Special features in the conjunction with CPs and FMs

CPs and FMs (with an MPI address of their own) with communication capabilities have one special feature: Their MPI address is automatically determined by the MCU and assigned from the first slot, beginning from rack 1 (MCU address + 1, MCU address + 2, etc.).



Note:

If modules (SM, FM, CP) are removed or plugged during data transfer along the MPI, data can be falsified by interference pulses.

4.2 Modifying the MPI Address of the MCU

Reference

The default MPI address can be modified in the STEP 7 Tool *Hardware Configuration*. See *Step 7 User Manual, Chapter 8.*

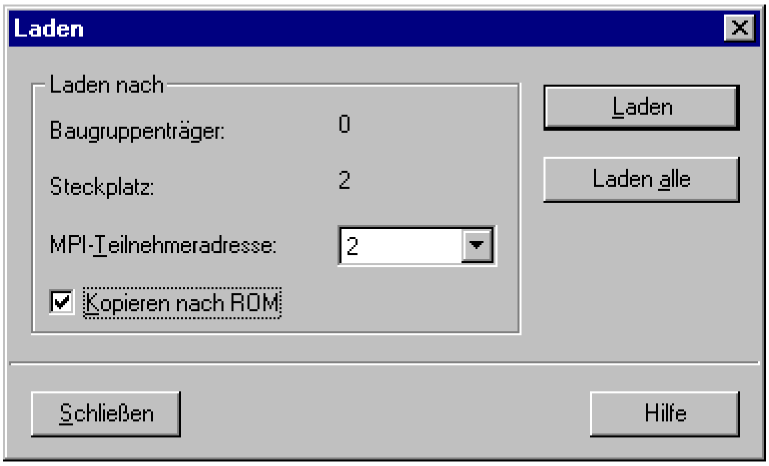
Special features

Because of the FEPROM, modifying the MPI address in the MCU is subject to special conditions. The modified MPI address is active only after "Copy RAM ⇒ ROM".

Approach

- Open the off-line hardware configuration in an existing project.
- Open the CPU parameterizing data (rack 0, slot 2).
- Press the MPI button.
- Enter the new MPI address.
- Load the new hardware configuration to the user interface (in the STOP condition). Make sure that PU and MPI interface of the MCU are linked directly.

  The following screen form appears:



  Before loading, select Copy to ROM.

- The modified configuration must be saved on the PU after loading.
- Turn the CNC off/on. The new MPI address is now active.

5 Communication and Data Exchange

Contents

5.1 Communication

PU/OP - MCU communication

In the communication between MCU and PU or OP, one MCU can establish up to 3 on-line links to one or also several different PUs/OPs. 3 of these links are always reserved for a PU, and one for an OP. This means that one MCU can communicate

- with max. 2 PUs and one OP ,or
- with max. 2 OPs and one PU

MCU - MCU communication via GD

In addition to the PU/OP communication, different MCUs can exchange data packets with each other using the MCU bus. This data exchange of "global data" is carried out via independent global data circuits. Each MCU can be an active station in max. 4 different global data circuits (see also STEP 7 User Manual, Chapter 9).

5.2 Data Exchange

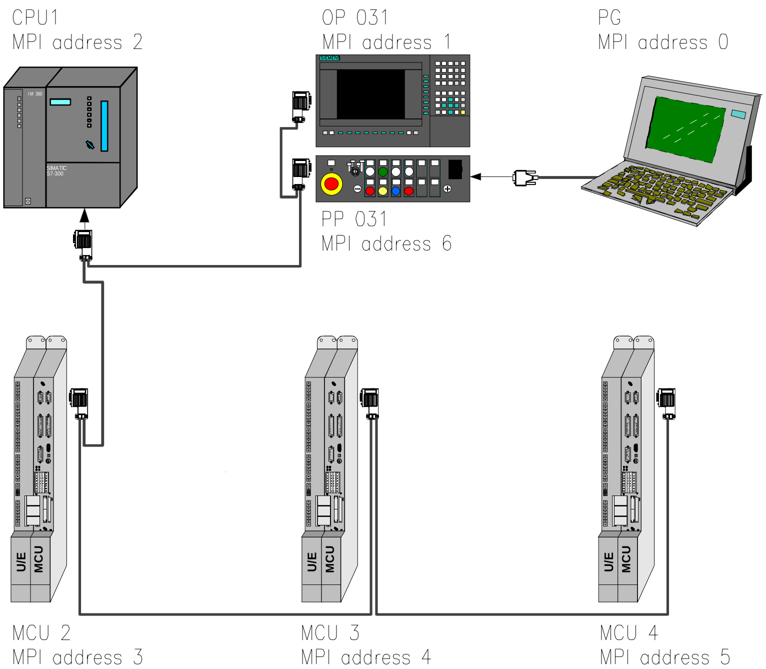
Global data circuit

A global data circuit can be formed as follows:

- 2 MCUs form a global data circuit. In this case, both CPUs are both sender and receiver of the respectively other partner.
- The global data circuit is formed by more than 2 MCUs (max. 5 stations). In this case, only one MCU sends a data packet, and the remaining MCUs/CPUs act as receivers (passive stations).

Number of global data circuits

One MPI network can contain a maximum of 5 global data circuits. The following Figure shows an example how to build up a network with global data.



Data exchange

Global data circuit	CPU 1	MCU 2	MCU 3	MCU 4	PP 031
①	SGD 1.1 →	EGD 1.1			
	EGD 1.2 ←	SGD 1.2			
	SGD 2.1 →		EGD 2.1		
	EGD 2.2 ←		SGD 2.2		
	SGD 3.1 →			EGD 3.1	
	EGD 3.2 ←			SGD 3.2	
		SGD 4.1 →	EGD 4.1		
		EGD 4.2 ←	SGD 4.2		
			SGD 5.1 →	EGD 5.1	
			EGD 5.2 ←	SGD 5.2	
		SGD 6.1 →		EGD 6.1	
		EGD 6.2 ←		SGD 6.2	
	EGD 7.1	EGD 7.1	EGD 7. 1	EGD 7.1 ←	SGD 7.1

E	receiver
S	sender
GD	global data
1.1	GD packet no.

The data circuits shown in the Figure above allow data exchange between all existing stations in the MPI network.

CPU1: CPU1 sends one GD packet each to all MCUs and receives one data packet each from each MCU and from PP031. CPU1 is station in 4 global data circuits:
①, , and

MCU2: MCU2 sends to CPU1, MCU3 and MCU4 and receives a GD packet from these stations. MCU2 is also a station in 4 global data circuits, as the PP031 sends a data packet to all MCUs and to CPU1:
①, , and

MCU3: MCU3 sends to and receives from CPU1, MCU2, MCU4 and PP031. MCU3 is station in 4 GD circuits:
, , and

MCU4: MCU4 is station in the GD circuits with CPU1, MCU2, MCU3 and PP031. As the other MCUs, MCU4 is thus station in 4 GD circuits:
, and

PU: The PU is an MPI station, too, but does not exchange global data with the other stations. The same applies to any OPs connected, such as the OP031. Generally, another OP or max. 2 PUs and 1 OP can be connected to this bus network. A connection facility for a PU should always be provided.

PP031 This push-button panel is intended to operate the axes; it is coupled with all MCUs and with CPU1 through global data. The control key signals can thus be received and evaluated by all control systems.

OP031 This OP is a fixed, active MPI station and logically coupled with CPU1 only. There is no global data link with any station. Furthermore, the possibilities to exchange data with the MPI station depend on the installation and/or configuration of the user interface on OP031.

Since one MCU can be station in max. 4 GD circuits only, the MCUs in this network cannot establish any further GD link.

Send and receive conditions for global data

The communication via global data is bound to the following conditions:

- For the sender of a data packet, the following must be true:
  cycle rate of sender x cycle time of sender $\geq$ 60 ms
- For the receiver of a GD packet, the following must be true:
  cycle rate of receiver x cycle time of receiver < cycle rate of sender x cycle time of sender.

The cycle rate (step-down factor) can be selected when creating the global-data table (see User Manual STEP7).
The following values are possible:

- Receiver: 1 to 255 (default setting 8)
- Sender: 4 to 255 (default setting 8)

Note!

With STEP7 V3.1 and MCU firmware V4.0 or higher, the value 1 to 3 can also be used for the sender. It must be noted, however, that a too low cyle rate is a too big load for the CPU.

Non-compliance with the conditions mentioned above, e.g. due to errors in the determination, may cause a loss of the GD packet.

The loss of a GD packet is indicated in the status double-word of the global-data table. The GD status is defined in the S7 manager "Set-Up GD Table".

Note:

Loss of data packets in the MPI network

If an additional MCU is linked with the MPI network during operation, loss of GD packets and an increase in the cycle time can be the consequence.

Remedy:

1. Make the station to be connected dead.
2. Connect the station to the MPI network.
3. Turn all stations on.

Global data packet size

The max. size of an effective data packet (net data) of a single data block is 22 bytes. This maximum size can be reduced by additional header information regarding data selection and composition. The data can be either bits, bytes, words, double-words, or fields.

Examples for possible data sets in a global-data packet are:

- 22 bytes of a complex range (=field) (F, D, I, O)
- 4 individual double words (F, D, I, O)
- 6 individual double words (F, D, I, O)
- 8 individual bytes (F, D, I, O)
- 8 individual bits (F, D, I, O)

F: flags, D: data, I: inputs, O: outputs

Space requirement

The gross space requirement in a global-data packet is:

- for a field: number of net bytes + 2 bytes (header information)
- for an individual double word: 4 bytes + 2 bytes = 6 bytes
- for an individual word: 2 bytes + 2 bytes = 4 bytes
- for an individual byte: 1 byte + 2 byte = 3 byte
- for an individual bit 1 byte + 2 bytes = 3 bytes

The gross length (=all data blocks in total) of a global-data packet must be ≤ 24 bytes.

Example:

A global-data packet can consist of 5 data blocks, for example:

	1 field of 3 words	6 bytes + 2 bytes =	8 bytes
+	1 individual double word	4 bytes + 2 bytes =	6 bytes
+	1 individual byte	1 byte + 2 bytes =	3 bytes
+	2 individual bits	2 X (1 byte + 2 bytes) =	6 bytes
=	gross length		23 bytes

6 Appendix

R

S

T

SIEMENS

SIMODRIVE 611

MCU 172A
Single-Axis Positioning Control

User Manual
Operating and Monitoring

Edition March 1998

Note

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please inquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

BERO, SIMATIC, SIMODRIVE, SINEC, SINUMERIK, STEP are trademarks of Siemens.

The remaining names and designations used in this Documentation may also be trademarks, the use of which by any third parties for their own purposes may violate the rights of the copyright holders.

1 Overview

About this manual

This Manual is part of the Manual *»Single-Axis Positioning Control for MCU 172A«*. This Manual provides information on:

- the components required for operating and monitoring the SIMODRIVE 611 Digital Drive System by means of the MCU 172A Single-Axis Positioning Control,
- configuring and commissioning the operating and monitoring components,
- the operating and monitoring functions available.

The contents of this Manual is limited to the operation of the MCU by means of the SINUMERIK Unit Operator Panel (further: UOP) consisting of OP031, MMC101/MMC102 and PP031, as well as the related standard MCU user interface.

Further information

For further information going beyond the scope of this Manual see the following Siemens Documentation:

- UOP Configuring Package
- Manual "Operating Components"
- UOP Installation Package and
- Operating Instructions "SINUMERIK Unit Operator Panel"

This Manual contains relevant chapters of the abovementioned MCU manuals.

Target group

This Manual addresses all persons dealing with the planning, configuration, commissioning, operation and service of the SIMODRIVE 611 Drive System equipped with the MCU 172A Single-Axis Positioning Control from the point of view *Operating and Monitoring*.

Previous knowledge

This Manual does not require any special previous knowledge. However, it is helpful for understanding to be familiar with a PU/PC, as well as to have general PLC and NC knowledge.

Hardware and software requirements

A ready-to-operate drive configuration consisting of a SIMODRIVE 611 feed drive module with MCU module and three-phase servomotor 1FT6/1FK6 is required.

SIMATIC HMI Operating and Monitoring Devices

Thanks to the SIMATIC S7 compatibility of the SIMATIC HMI Operator Panels, sophisticated operating and monitoring systems for comfortable process operation and monitoring are provided - from the simple line displays (OP3, OP5, OP15) up to systems with full graphic capabilities (OP25, OP35).

SIMATIC HMI OPs can be connected directly to the MPI of the MCU. When using the PROFIBUS DP, operation and monitoring is possible also over long distances.

To configure the operator panels, the user-friendly software ProTool running under Windows can be used.

OP17 and MCU 172A

The OP17, in conjunction with the extended ProTool Software, provides additional functions tailored to the requirements of the MCU, such as:

- All data modified in the RAM (e.g. machine data, NC programs, S7 DBs) can be saved to the FEPROM of the MCU by pressing one single button.
- It is possible to dynamically change between different MCU control systems in one OP17 user interface, i.e. several control systems can be connected to one OP.
- The integrated STEP7 functionality of ProTool can be used to configure screens with drive data, machine data and tool offsets in an easy manner by means of ready-to-use symbol lists.

Predesigned screens

Predesigned screens on OP17 provide the following functions for the MCU:

- actual-value display
- manual MDI block input
- program selection
- block editor
- machine-data editor

The interface can be embedded by the user into the S7 program.

2 Configuring the Operating & Monitoring Components

About this Chapter

This Chapter provides information on the hardware and software components required for operating and monitoring of the MCU 172A by means of the Unit Operator Panel.

Unit Operator Panel (UOP)

The Unit Operator Panel is intended for use at transfer lines, linked systems and special machines, as well as for the following operating and monitoring tasks:

- MCU operation,
- machine operation and
- HiGraph diagnosis (not part of this Manual).

A configuring package is offered as an option to extend the functionality of the Unit Operator Panel software by user-specific operation dialogs and screens.

Operating & monitoring components

The following components are required for operation and monitoring:

- configured MCU user interface (included in the scope of delivery of the Unit Operator Panel)
- control panel 031 with MMC module,
- PU/PC for configuring the MMC module,
- MPI connection line.

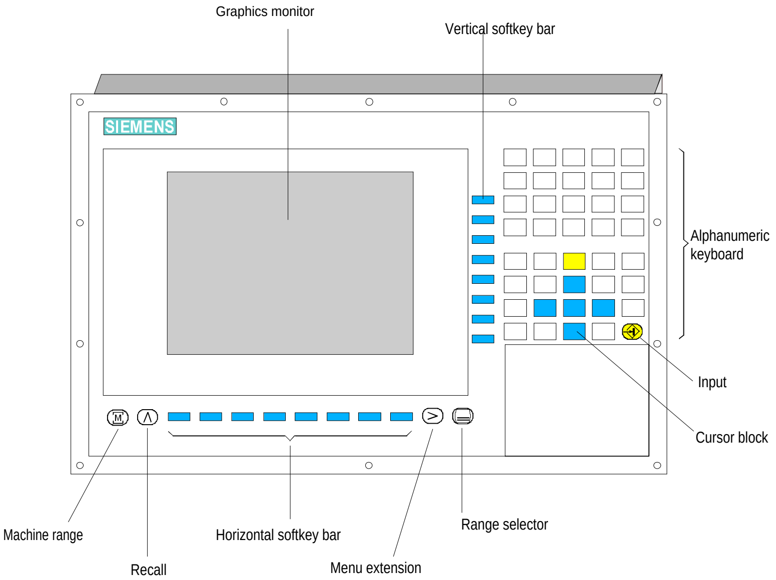
To operate the axes, as well as for the EMERGENCY STOP function, the PP 031 push-button panel can be used in addition.

Operator panel OP 031

The flat operator panel OP 031 is intended to operate and monitor the drive system. To this aim, the input keyboard is provided with 40 alphanumeric keys and 16 softkeys, as well as a flat screen (color or monochrome, by option).

The dimensions of the OP 031 are 483 mm x 307 mm x 60 mm (wxhxd).

The Figure below shows the controls of the operator panel OP 031.



MMC module

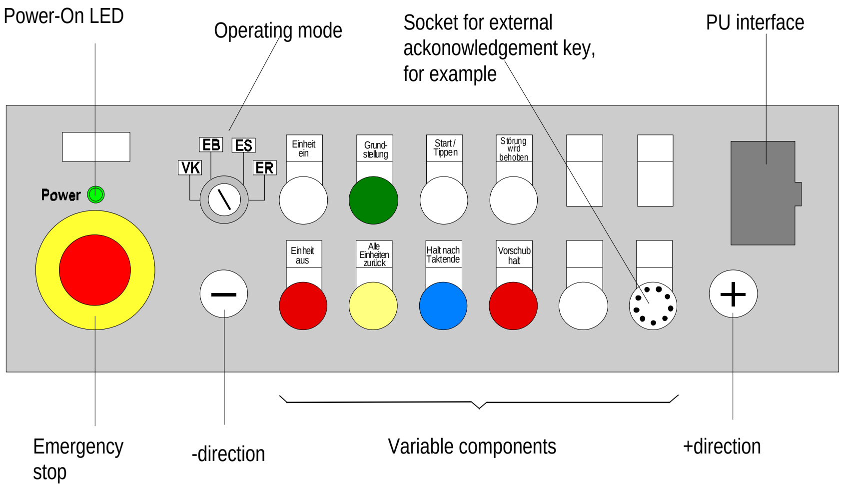
For the communication between operator panel and machine control, an MMC module is required. This module contains the software for comfortable operation of the machine tool. The module must be installed on the rear of the operator panel. MPI interfacing is provided by means of the 9-pole socket connector X4.

Push-button panel PP 031 (optional)

In addition to the operator panel, the PP 031 push-button panel provides straightforward and local operation of the machine tool. Apart from an EMERGENCY STOP switch, it has two direction keys, a selector switch with four switching levels, as well as 12 slots for signaling lamps and push-buttons, which can be equipped with different components, and a socket for an external acknowledgment key. The MPI communication with the machine control is carried out through the 9-pole socket connector X15 (see Manual "Operating Components").

The dimensions of PP 031 are 483 mm x 155 mm x 100 mm (wxhxd).

The Figure below shows the controls of PP 031.

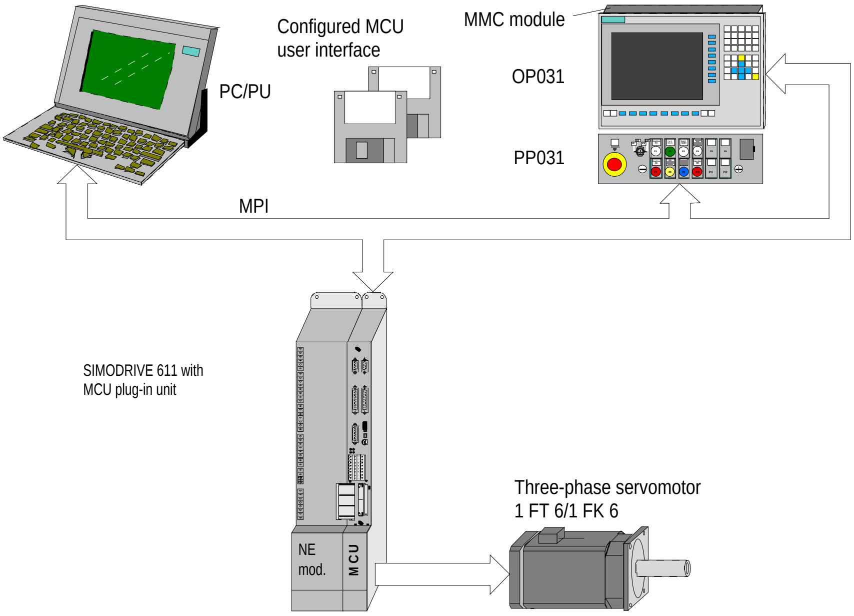


PU/PC

To configure the MMC module and commission the axes, a portable programming unit, type PG 720, 740 or 760, with the STEP 7 software installed is used. Alternatively, it is also possible to use an industrial standard PC equipped with an MPI card or an MPI adapter cable.

System design

The Figure below shows the general design of the system.



3 Commissioning of the Operating & Monitoring Components

Contents

About this Chapter

This Chapter provides information on the installation and configuration of the Unit Operator Panel software and shows how to network and commission the operating & monitoring components.

Prerequisites

Before the OP 031 operator panel can be used to operate and monitor the machine tool, first the software must be loaded to the operator panel MMC module panel.

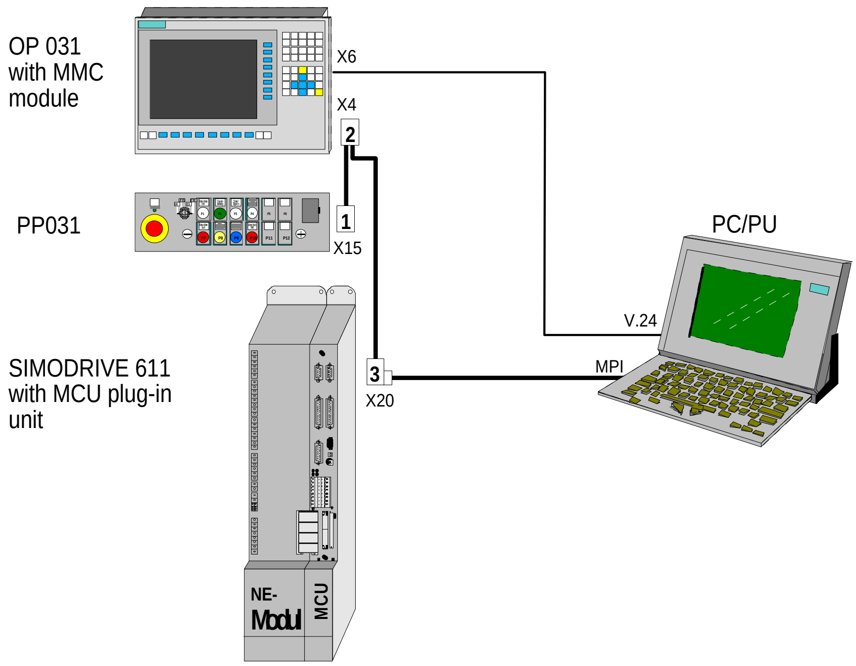
The following is required to install the Unit Operator Panel software:

- MCU standard user interface for MMC 101/MMC 102, consisting of:
  - system master disk
  - application master disk
- PU/PC with
  - floppy disk drive
  - 80386 processor (or higher)
  - V.24 interface
  - MS-DOS 6.x operating system
  - at least 560 KB free working memory
  - at least 6 MB free space on the hard disk,
- V.24 connection line.

Linking the Components

The individual components are linked with each other as shown in the Table below.

from		to		Note
Device/mod.	Conn.	Device/mod.	Conn.	
MPI bus line				
MCU unit..	X20	MMC mod.	X4	Length: max. 25 m
MMC mod.	X4	PP 031	X15	Length: typ. 0.5 m to 1 m
MCU unit	X20	PC/PU	MPI	for commissioning of the axis Length: typ. 5 m included in the scope of delivery of the PU
V.24 line				
MMC mod.	X6	PC/PU	COM1/ COM2	for MMC configuration Length: max. 10 m



MPI bus line

For the MPI line, precut cables of different lengths with connectors are offered. For adaptation to equipment-specific requirements, the bus connectors 1, 2 and 3 (connector 3 with integrated PU connecting socket) are also available separately, and the lines are offered as cut goods. For the respective ordering data, please refer to our Catalog NC 60.1.

MPI addresses

One MCU communicates with a maximum of

- 2 PUs/PCs and 1 OP or
- 2 OPs and 1 PU/PC.

The prerequisite for networking of the stations (nodes) through MPI is that each station is assigned a different MPI address (0...127). The highest MPI address must be the same for each station.

Default MPI addresses:

- PU/PC: 0
- MCU: 2

Further information on MPI networking and cutting the cables to size/attaching connectors to them is provided in Chapter 10 - Extract from the User Manual »*Communication*«.

OP 031

After turning on the 24V supply, the OP 031 operator panel carries out a self-test. After the MPI interface has been initialized successfully, the basic screen defined during the system configuration appears.

PP 031

The data memory of the PP 031 must be configured user-specifically by means of the *Communication Configuration* STEP 7 tool. For further information refer to the *STEP 7 Manual "Using the Tools"*.

In order to provide data exchange of the PP 031 with the control system via the MPI interface, first the interface parameters defined during the configuration must be activated. The interface parameters are:

- bus address,
- baud rate,
- sending rate and
- parameter block.

To enable this, set the DIP switches S16, S17 and S18 on the device rear side as indicated in the Table below.

Switch		Position	Description
S18	4	off	not used
	3	off	parameter block: 2
	2	off	not used
	1	off	hardware reset: OFF
S17	4	off	baud rate: 187.5 kBaud
	3	off	cyclic sending raster: 100 ms
	2	on	
	1	off	MPI bus address: 6
S16	4	on	
	3	on	
	2	off	
	1	on	parameter block: 2

MCU standard user interface

The MCU standard user interface for MMC 101/MMC 102 consists of the following components

- system master disk
- application master disk

System master disk

This diskette can be used to load the user interface (application) to the MMC module without the need of any other tools.

Application master disk

This diskette contains the operating ranges, texts, and system files. Before the application diskette can be used, the system master disk must already have been loaded. The application diskette provides the possibility to modify the software once more (to change over the language, modify the texts etc.).

3.1 Loading Master Disks

3.1.1 Installing the Master Disk

Step 1 Insert the system master disk.

Step 2 Call the SYS_INST.EXE.

The following menu appears:

```
+---------------------------------------------------------------------------+
|   System installation                                                     |
|---------------------------------------------------------------------------|
|   < 1 >     =  Install system disk on hard disk                           |
|   < 2 >     =  Install system disk on hard disk & to hardware             |
|   < 3 >     =  Select MMC100 files to install                             |
|   < ESC >   =  Quit program!                                              |
|                                                                           |
|---------------------------------------------------------------------------|
|   Please make your choice                                | <F1> - Help    |
+---------------------------------------------------------------------------+
```

1 Install the system disk on your hard disk (PC/PU).
This menu item can be used to transfer the system software to several PCs/PUs (with later installation of the system software to the destination hardware = MMC module).

2 Install the system diskette on the hard disk of your PC/PU and transfer the current configuration to the hardware. This menu item can be used to transfer the system software to the hardware of your PC/PU and to install it immediately after this to the destination hardware = MMC module.

3 Updating or modifying the DOS/BIOS software
only necessary if explicitly described in software upgrade instructions; not necessary for normal installation.

ESC cancels the installation and quits the program.

F1 provides help to the currently displayed screen.

Step 3

Modifying the DOS/BIOS software (if necessary).

This step is only necessary if explicitly described in software upgrade instructions; is not necessary for normal installation.

Example:
You install SW 3.3.
The following Table is provided in the upgrade instructions:

System file	Software version by now					
	3.2	3.1	2.3	2.2	2.1	1.1
VGABIO28	-	-	-	-	-	-
SYSBIO31	-	-	+	+	+	+
ROMDOS30	-	-	+	+	+	+
MCIN_27	-	-	-	-	+	+

+ The respective file must be selected for transfer to the MMC module by entering its number.
When entering the number several times, the selection changes between YES and NO.

- It is not necessary to select the respective file for transfer to the MMC module.

The necessity to load one or several files indicated in the Table to the MMC module depends on the software version used until now.

```
+-----------------------------------------------------------------------------+
|   Select Files to Install                                                   |
|                                                                             |
|-----------------------------------------------------------------------------|
|                                                                             |
|   < 1 >     =  VGABIO28.EXE    NO                                           |
|                                                                             |
|   < 2 >     =  SYSBIO31.EXE    NO                                           |
|                                                                             |
|   < 3 >     =  ROMDOS30.BIN    NO                                           |
|                                                                             |
|   < 4 >     =  MMCIN_27.EXE    NO                                           |
|                                                                             |
|   < ESC >   =  Back to main menu!                                           |
|                                                                             |
|                                                                             |
|                                                                             |
|-----------------------------------------------------------------------------|
|   Please make your choice                                                   |
+-----------------------------------------------------------------------------+
```

1 Selection whether to transfer video BIOS

2 Selection whether to transfer system BIOS

3 Selection whether to transfer ROMDOS

4 Selection whether to transfer PCIN

ESC return to the installation menu

Step 4

Select drive:

Select the drive of the PC/PU to which you want to copy the files of the system diskette. All hard disk drives and network drives with write access are possible.

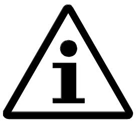
```
Copyright (c) Siemens AG 1996, all Rights reserved
Installation kit version 3.2/03
 Install system disk to hard disk
---------------------------------
                       +--- Select drive for installation --+
                       |               Drive :              |
                       |          ESC        RETURN         |
                       +------------------------------------+
```

Step 5

Select path:

Select the path to which you want to copy the files of the system disk. If the path does not exist, it is created. As default value, \MMC100PJ.SYS is suggested.

```
Copyright (c) Siemens AG 1996, all Rights reserved
Installation kit version 3.2/03
 Install system disk to hard disk
--------------------------------------
                 +--------- Select path for installation ---------+
                 |                      Path :                    |
                 |   e:\MMC100PJ.SYS                              |
                 |                ESC        RETURN               |
                 +------------------------------------------------+
```



Note:

If the directory already exists, it is overwritten!

The files will be copied to your hard disk.
If in the first menu the item "Install system disk to hard disk" has been selected, the installation of the system disk is automatically completed after this, and the initial menu appears again.
From there, it is possible to install the system software on further PCs/PUs (network installation). The system software can then be transferred to the hardware. To this aim, go to the directory where you have installed the system software and call the file SYS_INST.EXE. The System Installation Menu appears.

The transfer of the hardware configuration is continued as follows:

Step 6

Transferring the software to the hardware:

The transfer menu appears. If the port displayed at "Selected COM port:" does not conform to the port which is displayed and to which the cable to the MMC module is connected, press 2. In the following submenu, press the figure which corresponds to the COM interface used. You will return to the transfer menu, and your choice will appear on the display.
Prior to activating transfer by menu item **1**, you must ensure that the MMC module is ready for receive and the cable to it is connected.

```
+--------------------------------------------------------------------------------+
|   Transfer software on hardware                                                |
|   Selected COM port : COM1                                                     |
|--------------------------------------------------------------------------------|
|   < 1 >     =  Install software via serial line                                |
|   < 2 >     =  Select COM port                                                 |
|   < ESC >   =  Quit program                                                    |
|                                                                                |
|                                                                                |
|                                                                                |
|--------------------------------------------------------------------------------|
|   Please make your choice                                        | <F1> Help   |
+--------------------------------------------------------------------------------+
```

Making the MMC module ready for receive:

1. Turn the power supply for the MMC / Unit Operator Panel on or reset the system by pressing push-button S1 on the rear of your hardware.
2. While the system is booting, hold push-button 6 down as long as the input screen of the PCIN transfer software appears.

Activating the transfer:

Press **1** in the transfer menu.
The transfer starts, and the progress of transfer is displayed both at the PC/PU and at the MMC module.
If you have selected YES for VGABIO28, this file is separately transferred to the MMC module first of all the other files. The following note will then appear:

Transfer of VGA-BIOS successfully finished!

Note:

On completion of the transfer of VGABIO28.EXE, the MMC module must be rebooted. In order to make the MMC module ready for receive again, push-button 6 must be hold down during restart. If you should fail to do it for reasons of time, the system can be turned off/on again while pressing push-button 6.

After pressing RETURN, the remaining files are transferred to the MMC module.

Transfer not o.k.:

If the transfer path is not o.k., first the PCIN mask at the PC/PU appears, and after some seconds the note:

WARNING
The program PCIN-Light returned a TIMEOUT error!

Check the cables, the indicated COM port and make sure that the MMC module is ready. Reactivate transfer after removing the error.

Series upgrade:

If the procedure described above is repeated several times for each module to be updated, it is possible to update several MMC modules from the transfer menu. At the end, the transfer menu is left by pressing ESC.

Completion:

When you have completed the transfer to the hard disk or to both the hard disk and the MMC module, quit the installation menu by pressing ESC. You are now in the subdirectory INSTUTIL of your hard disk directory to which the data have been copied from the system disk. From here, the installation menu can be restarted.

Start installation from the hard disk:

When starting SYS_INST.EXE, the installation menu appears again. The menu item "Install system disk on hard disk" (loading from floppy disk to hard disk) is still hidden, since the transfer has already taken place. The remaining items are operated as described above.

3.1.2 Installing the Application Master Disk

Prerequisite

The MMC system software has been loaded from the system disk to the hardware.

Step 1

Call APP_INST.EXE:

Insert the diskette and call the file APP_INST.EXE.

Step 2

Enter drive:

Selection of the drive to which the files on the application disk are to be unpacked. Any hard disk drives and network drives with write access are possible.

```
Copyright (c) Siemens AG 1996, all Rights reserved
Installation kit version 3.2/08
 Install application disk to hard disk
--------------------------------------

                       +--- Select drive for installation --+
                       ¦               Drive :              ¦
                       ¦          ESC        RETURN         ¦
                       +------------------------------------+
```

Step 3

Enter path:

Selection of the path to which the files of the application disk are to be unpacked. If the does not exist, it will be created.
\MMC100PJ.APP is the default path suggested.

The files are copied to the hard disk and unpacked.

When the installation on the hard disk is completed, the following selection menu appears:

```
Copyright (c) Siemens AG 1996, all Rights reserved
Installation kit version 3.2/06
 Install application disk to hard disk
--------------------------------------

                 +--------- Select path for installation ---------+
                 ¦                      Path :                    ¦
                 ¦   e:\MMC100PJ.APP                              ¦
                 ¦                ESC        RETURN               ¦
                 +------------------------------------------------+
```

Step 4

Set configuration:

```
+---------------------------------------------------------------------------------+
¦   Install application to hardware MMC100                                        ¦
¦   First language : English              Second language : German                ¦
¦---------------------------------------------------------------------------------¦
¦   < 1 >     =  Install all modules to hardware                                  ¦
¦   < 2 >     =  Modify configuration                                             ¦
¦   < 3 >     =  Select modules to install                                        ¦
¦   < ESC >   =  Esc to quit!                                                     ¦
¦                                                                                 ¦
¦---------------------------------------------------------------------------------¦
¦   Please make your choice                            | <F1> - Help              ¦
+---------------------------------------------------------------------------------+
```

1 Install the current configuration to the hardware.
If under Item 3 certain modules have been selected for MMC, the following appears under 1 instead of the default setting:
"Install selected modules to hardware",
i.e. only the modules selected under Item 3 are transferred.

2 Alter the language settings and edit selected ASCII files

3 Select the modules for selective installation (**MMC101 only**)

ESC cancels the installation and quits the program.

F1 displays the on-line help for the current screen

Step 4.a

Modify configuration (if necessary):

```
+--------------------------------------------------------------------------------+
|  Install application to hardware MMC100                                        |
|  First language : English              Second language : German                |
|--------------------------------------------------------------------------------|
|  < 1 >     =  Change first language                                            |
|  < 2 >     =  Change second language                                           |
|  < 3 >     =  Edit ASCII files                                                 |
|  < 4 >     =  Edit text files for first language                               |
|  < 5 >     =  Edit text files for second language                              |
|  < ESC >   =  Return to previous menu!                                         |
|                                                                                |
|--------------------------------------------------------------------------------|
|  Please make your choice                           | <F1> - Help               |
+--------------------------------------------------------------------------------+
```

1 Change first language.

2 Change second language.

3 Edit the ASCII files of the system and the applications if these contain ASCII files.

4 Edit the text files for the first language selected.

5 Edit the text files for the second language selected.

ESC Return to the installation menu.

F1 displays the on-line help

Step 4.a.1 **Language selection:**

```
+-----------------------------------------------------------------------------+
|   Change first language (actually : English )                               |
|                                                                             |
|-----------------------------------------------------------------------------|
|                                                                             |
|   < 1 >     =  German                                                       |
|   < 2 >     =  English                                                      |
|   < 3 >     =  French                                                       |
|   < 4 >     =  Spanish                                                      |
|   < 5 >     =  Italian                                                      |
|   < 6 >     =  Russian                                                      |
|   < PgDn >  =  Next languages                                               |
|   < ESC >   =  Return to previous menu!                                     |
|                                                                             |
|-----------------------------------------------------------------------------|
|   Please make your choice                            | <F1> - Help          |
+-----------------------------------------------------------------------------+
```

Item 1..6	assigns the first or second language a new language setting
PgDn	turns to the next page (if more than 7 languages exist)
PgUp	turns to the previous page (if more than 7 languages exist)
ESC	quits the menu (irrespective of the current page) without changing the current language setting.
F1	displays the on-line help

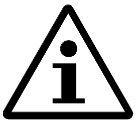
Step 4.a.2 **Editing ASCII files:**

```
+-------------------------------------------------------------------------------+
|  Install application to hardware MMC100                                       |
|  First language : English               Second language : German              |
|-------------------------------------------------------------------------------|
|  < 1 >     =  Edit MPI configuration data                                     |
|  < 2 >     =  Edit Display machine data                                       |
|  < 3 >     =  Edit AUTOEXEC.BAT                                               |
|  < 4 >     =  Edit CONFIG.SYS                                                 |
|  < 5 >     =  Edit OEM.BAT                                                    |
|  < 6 >     =  Edit user specific files                                        |
|  < ESC >   =  Return to previous menu!                                        |
|                                                                               |
|-------------------------------------------------------------------------------|
|  Please make your choice                                  | <F1> - Help       |
+-------------------------------------------------------------------------------+
```

Item 1.6 Starts EDIT.COM to edit the respective files. Some items appear only if the files exist.

ESC quits the menu.

F1 displays the on-line help



Note:

Proper function of the software cannot be guaranteed if any unauthorized modifications to the files AUTOEXEC.BAT and CONFIG.SYS have been made.

Step 5

Transfer the MMC software to the hardware:

```
+---------------------------------------------------------------------------+
|   Transfer software on hardware                                           |
|   Selected COM port : COM1                                                |
|---------------------------------------------------------------------------|
|   < 1 >     =  Install software via serial line                           |
|   < 2 >     =  Select COM port                                            |
|   < ESC >   =  Quit program                                               |
|                                                                           |
|---------------------------------------------------------------------------|
|   Please make your choice                                      | <F1> Help |
+---------------------------------------------------------------------------+
```

The transfer menu appears. If the port displayed at "Selected COM port:" does not conform to the port which is displayed and to which the cable to the MMC module is connected, press 2.
In the following submenu, press the figure corresponding to the COM interface used. You will return to the transfer menu, and your choice will appear on the display.

Prior to activating transfer by menu item **1**, you must ensure that the MMC module is ready for receive and the cable to it is connected.

Activate transfer:

Press **1** in the transfer menu.
The transfer starts, and the progress of the transfer is displayed both at the PC/PU and the MMC module.

Transfer not o.k.:

If the transfer path is not o.k., first the PCIN screen appears at the PC/PU and then, after several seconds, the note:

WARNING
The program PCIN-Light returned a TIMEOUT error!

Check the cables, the indicated COM port, and make sure that the MMC module is ready for receive; reactivate the transfer after removing the error.

Series upgrade:

If the procedure described above is repeated several times for each MMC module to be updated, it is possible to update several MMC modules from the transfer menu. At the end, the transfer module is left by ESC.

Completion:

When you have completed the transfer to the hard disk or to the hard disk and the MMC module, quit the installation menu by pressing ESC. You are now in the subdirectory INSTUTIL of your hard disk directory to which the data have been copied from the system disk. From here, the installation menu can be restarted.

Start installation from the hard disk:

When starting **app_inst.exe**, the configuration menu appears. Drive and path need not be selected, as the transfer from the diskette to the hard disk has already taken place. The remaining items are operated as described above.

3.2 Loading the System

3.2.1 General

Description

The installation procedure transfers

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

from the update directory to your PC/PU or from an installation diskette to the MMC/Unit Operator Panel hardware.

The installation can be performed either from the

- application diskette
- from hard disk, or
- directly from SCK after configuration (not part of this Documentation). The procedure after starting is always the same.

Prerequisites

PC with DOS 6.x or Windows 3.1x (SCK runs under DOS Shell) or Windows 95 (SCK runs under DOS Shell)
Cable between the COM1 interface of the MMC module (X6) and the COM1 or COM2 interface of your PC/PU.
Required memory on the MMC/Unit operator Panel hard disk: approx.. 2 Mbytes (standard configuration).

Note:

It is recommended to exit Windows for installation, as the transfer times reached under DOS are by many times higher.

Installation

Turn the system on and press push-button 6 until the PC IN software appears in the Data In mode.

During these 5 seconds, Item 1 can be selected by entering figure **1** or by means of the cursor key ↑ 1 (Install/Update your Software).

Note:

If push-button 6 is not pressed on time, the hardware starts with the previous software.

When starting from diskette

One of the installation options listed below can be selected by means of the programs APP_INST.EXE or SYS_INST.EXE:

1. Software installation on your PC/PU with following transfer. This makes sense if you wish to load the same software to several Unit Operator Panels.
2. Transfer directly from the diskette (can only be selected in conjunction with SYS_INST).
   This makes sense if you wish to install only one Unit Operator Panel.
   If you configure systems which exceed a capacity of 1 system disk, they can not directly be installed from the diskette to the destination hardware. In this case, the system diskettes must be copied to the hard disk of an installation PC, and the installation must be carried out from there.
3. Transferring the software to your PC/PU.
   This makes sense if the installation on several UOPs is carried out later.

3.2.2 Loading the System Software to the MMC Destination Hardware

At the MMC/UOP

1. Turn the power supply for the MMC / UOP on or press the RESET button S1 on the rear of your hardware.
2. While the system is booting, hold push-button 6 down as long as the input screen of the PCIN transfer software appears.

At the PC/PU

3. Start the update procedure by:
   - SYS_INST.EXE to install the system
   - APP_INST.EXE to install the application
   - HG_INST.EXE to install the HiGraph diagnostic files
4. Entries expected by xxx_INST.EXE:
   - Selection of the software components to be transferred (see above).
   - For text files: selection of first and second language.
   - Selection of configuration file(s) to be edited (if necessary)
   - Selection of serial interface and baud rate for transfer.

Note:

When transferring the files APP_INST and HG_INST:
Make sure that the system and application files are of the same software version.

5. After the respective files have been transferred to the destination hardware, the MMC hardware will start automatically.

3.3 Modifying and Loading Texts

3.3.1 General Approach

- Alarm and user texts can be modified both in the SCK and from the application disk.
- In these environments, the texts can only be modified by means of the DOS editor EDIT. This editor opens automatically in order to edit the display machine data and set the MPI addresses.
- The text files that can be modified are saved in the path
- **...\proj\text***
- and automatically considered by the SCK or the application master disk.
- The installation of the MMC hardware is carried out as described in the Chapter "Loading Master Disks".

Note:

In order to be able to modify texts, you must know the structure and principle of MMC text handling. This is described in the following.

3.3.2 Modifying and Extending Texts

Languages, texts in several languages

The SINUMERIK/UOPs are offered with two languages. These two languages are designated as a first and a second language.
First and second language of the MMC system can be replaced by **other texts or texts in another language** without reassembling the configuration or the basic system.

Note:

The number of texts, as well as their order of translation may not be altered. This limitation is not applicable to alarm texts (all text files starting with an "a": alm, aln, ala, alp, alc, alz).

Master language

The different forms of the binary text files must match with each other. For this reason, **a master language** is always provided for the entire text handling, which defines the number and the order of the texts.
In the MMC/UOP installation package, English (\proj\text\g) is the master language, but it can be changed and later in the Default Options menu during the setup.

Text source files

Configuration text source files are in the path
...\proj\text\d, e, f,... (depending on the language).
Text source files starting with an "a" are alarm text source files (PLC alarm, cycle and compile cycle alarm files).
Text source files always have the extension ***.txt.**

Text accesses General principle

In the **text source files**, a **text** is assigned a **text symbol**.
The text converter uses them to produce

- a **binary text file** for the run-time system, and
- a **text include file** for configuring.

Syntax of the configuration source text files

In the path \proj\text*\, the relevant source text file is stored for each language. A source file (not alarm texts) is structured as follows:

symb_txt_id "text" [// comment]	
symb_txt_id	Symbolic text identification, must begin with a letter; max. length: 45 characters. symb_txt_id must be unambiguous over the entire configuration process (standard and application). For the delivered version of configuration, this requirement is met by the following convention: Text identifiers defined in the XY.TXT file always start with T_XY_ and are therefore unambiguous in the file XY.TXT (to be ensured by searching in the editor). **Recommendation**: Adhere to this convention with text extensions in the application!
text	Text to be displayed, character string included in "". A line feed within the text to be output is indicated by %n.
Comment	possible from the comment identifier // to the end of the line. Usually, the comment contains the max. length of the text which can be represented on the screen.

Alarm text files

The alarm text files *.txt are in

<destination drive> proj\text\<language directory>

As standard, in addition to the user texts, texts for the following alarm ranges can be modified:

alc.txt compile cycle alarms

alp.txt machine-specific PLC alarms

alz.txt cycle alarms

Modifying texts

1. Make sure that all language versions of each text file have the same structure (order of numbers, number of lines etc.) as the respective file of the master language.
2. The standard texts contained in the *.txt files can be overwritten by user-specific texts.
3. Furthermore, the files can be extended by new entries.
4. When adding further lines, they must be inserted in the master language, too, before converting them (see below).

Editor

The *.txt files can only be modified by means of the DOS editor EDIT.

Error in the text conversion

Scan: ERROR line 7: symbol <SYMBOL NAME> not contained in the first language!
Conversion finished
1 error(s)

Remedy: First you must insert the text in the master language and then generate these binary text files, only then you can insert the text in further language text source files.

Scan : Instead of a text, only "???" is displayed.

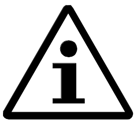
Remedy: You have not generated the texts for the first language. Files *.sp? are missing in the \bin directory.

Scan: ???? "Wrong command line /S1 or S2".**:**

Remedy: The file MMC0_TXV.INI does not exist in the directory \bin.

Alarm number, syntax of alarm texts

For the distribution of the alarm number ranges and the syntax of alarm text files refer to Chapter 8 of the SINUMERIK 840D Commissioning Instructions.



Note:

When modifying the text, pay attention to the following.

1. MMC module: The memory capacity in the flash-file system is limited, and the configuration on the application diskette can therefore not be modified any more. For this reason, when extending the text files make sure that the flash-memory space of 1,280 KBytes which is maximum available for the application is not exceeded.
2. New texts may only be added at the end of a text file.
3. It is not allowed to delete existing texts or to alter their order.
4. It is not allowed to insert empty lines into the text files, even not at the end of the file.
5. The file MMC0_TXV.ini must not be modified.
6. When editing files beyond the installation environment, use an editor that
   - supports the DOS character set,
   - generates CR-LF after each line, and
   - does not insert an end-of-file identifier

3.4 Special Features When Using SIMATIC S7 and SIMODRIVE MCU

Data blocks

When using SIMATIC S7 and SIMODRIVE MCU, the following must be observed:

1. Create the data blocks DB17 (version code) and DB19 (MMC interface).
2. Compile the blocks and load them into the CPU.

3.4.1 Contents of DB17

```
DATA_BLOCK DB 17

TITLE =

VERSION : 2.0

READ_ONLY

STRUCT

    vers: dword;
    gpvers : STRING [54 ] := '@(#)
    ~program_version_id:V32.03.02*12:03:96 18:00:00~';

END_STRUCT ;

BEGIN

    vers:=dw#16#03_32_03_02;
    //Byte 0: 1-FM-NC ;2-810D; 3-840D

END_DATA_BLOCK
```

3.4.2 Contents of DB19

DB19, DBX0.1 *Screen dark*

Function

The screen turns to dark or bright (for screen saving, for example)

- via the keyboard ("automatic screen blanking“)

  If no button is pressed for a certain period set via MMC-MD: DISPLAY_BLACK_TIME (default = 3 minutes), the screen automatically turns to dark (blanks).

  Unblanking is performed when pressing any button on the operator panel (pressing a button for the first time does not activate any operating action)

  Prerequisite for automatic screen blanking:

  – NST "Screen dark" = 0
  – DISPLAY_BLACK_TIME > 0

- from the PLC user program via NST "Screen dark"

  In addition, blanking (1-signal) or unblanking (0-signal) is also possible by the NST "Screen dark" directly from the PLC.
  As soon as the NST "Screen dark" = 1, the following is applicable:

  – Unblanking through the keyboard (see above) is thus not any more possible.
  – Already when pressing any button at the operator panel for the first time, an operating action is carried out.

Note:

If the screen is blanked by means of the NST "Screen dark", the keyboard is to be locked at the same time by the NST "Keyboard locking" = 1 in order to exclude any undesired operating actions.

DB19, DBX0.2 *Key lock*

Function

The NST "Key lock" can be used to lock (1-signal) or enable (0-signal) the keyboard for the operator.

DB19, DBX0.7

Activating the WCS display

Function

For actual-value display, two coordinate systems are differed:

- Machine coordinate system (MCS)

  The machine coordinate system defines the relations of the machine axes. In the MCS, all machine and additional axes are indicated.

- Workpiece coordinate system (WCS)

  The assignment of the workpiece to the machine axes is provided by special transformations (frame definitions, zero offsets). The workpiece is always imaged in a Cartesian coordinate system. In the WCS, all geometry and additional axes are indicated.

Selection of actual-value display

Which coordinate system is displayed can be selected

- either by the operator using the softkeys "MCS actual values" or "WCS actual values"
- or through the PLC by means of the NST "WCS actual-value indication"

If the NST "Activate WCS display" is set to "1" by the PLC, the actual values in the workpiece coordinate system (WCS) are always displayed **when selecting the machine range**. In the machine range, the operator can change over the actual-value display between WCS and MCS as he wants using the softkeys mentioned above.

Actual values in the WCS

When selecting "WCS", the geometry and additional axes, as well as their actual-value positions and distances to go in the workpiece coordinate system are displayed in position window.

Actual values in the MCS

When selecting "MCS", the machine and additional axes, as well as their actual-value positions and distances to go in the machine coordinate system are displayed in the position window.

When connecting one or several SIMODRIVE MCUs, the system files must be adapted (see Section 3.6)

DB19, DBX26.0

MMC software version ≥ 3.2

Function

The NST "MMC software version ≥ 3.2" can be used to indicate the software version of the MMC
1 signal ≥ SW 3.2 or
0 signal < SW 3.2

3.4.3 Setting Up/Checking the Invocation Data Block FB1

The operations of the SIMODRIVE MCU are always written into the invocation data block of the technology function block (FB 1).
In order to carry out these operations, the following items must be observed:

- The operations entered into the range of the input parameters, must be read, checked and taken over into the respective transfer parameter of the FB before calling the technology block.
- In some cases, the operations entered into the local range must be transferred to the MCU by calling FC Control.

The following addresses of the invocation data block are entered by the Unit Operator Panel:

1.	DBB0	BETRIEBSART	transfer parameter
2.	DBB1	BA_PARAMETER	transfer parameter
3.	DBB2	OVERRIDE	transfer parameter
4.	DBX3.5	SATZ_AUSBLENDEN	transfer parameter
5.	DBX14.5	GESCHWINDIGKEITSSTUFEN_S	transfer parameter
6.	DBD42	V_1_2.V_1	local range, transferred internally
7.	DBD46	V_1_2.V_2	local range, transferred internally
8.	DBX100.7	BIT_EINST.SIM_EIN	local range, via FC Control (DS 11)
9.	DBD108	NULLPKTVER	local range, via FC Control (DS 13)
10.	DBD142	PRG_ANWAHL	local range, via FC Control (DS 18)

Program example:

```
UN      BA_UEBERNAHME_GUELTIG        // mode change permitted
SPB     M001
L       DB1.DBB0                     // desired mode
T       PARA_BETRIEBSART             // input parameter mode for FB1
L       DB1.DBB1                     // desired mode parameter
T       PARA_BAPAR                   // input parameter - mode parameter
                                                for FB1
M001:   NOP0

L       DB1.DBB2                     // desired override value
T       PARA_OVERRIDE                // input parameter override for FB1

U       DB1.DBX3.5                   // desired function - skip block
=       PARA_SATZ_AUSBL              // input parameter - skip block for FB1

U       DB1.DBX14.5                  // feed steps changed
=       PARA_GESCHW_S                // input parameter
                                                velocity steps_s for
                                     // FB1
R       DB1.DBX14.5

U       DB1.DBX100.7                 // Simulation ON
UN      MERKE_SIM_EIN                // Write edge formation for DS11
S       MERKE_SIM_EIN
=       SCHREIBE_DS11
UN      DB1.DBX100.7                 // Simulation OFF
U       MERKE_SIM_EIN                // Write edge formation for DS11
R       MERKE_SIM_EIN
=       SCHREIBE_DS11
....
CALL    FB1,DB1                      // Call intelligent I/O module
BETRIEBSART:= PARA_BETRIEBSART
BA_PARAMETER:= PARA_BAPAR
OVERRIDE:= PARA_OVERRIDE
....
UN      SCHREIBE_DS11                // Write job for FC_CONTROL
O       SCHREIBEN_LAEUFT             // Write job being processed
SPB     M002
L       11                           // DS 11, Write bit-coded settings
T       AUFTRAGSNR_FC_CONTROL        // Job number for FC-Control
SU      AUFRUF_FC_CONTROL
M002:   NOP0
....                                 // Enter or check further jobs
                                     // for FC_Control
UN      AUFRUF_FC_CONTROL
SPB     M003
CALL    FC_CONTROL
....
M003:   NOP0
....
```

3.5 Installation Package and Windows 95

You can also use the tools of the installation package in a DOS box under Windows 95. In order to load your software from here to the MMC, the following preparations must be made:

1. Copy the DOS program INTERSRV.EXE to a directory in your search path.
2. Set the MS-DOS mode in "Features" "Program" - "Extended" as follows.
   - Priority: Admit screen saver
   - Idle run activity: Low
   - Cancellation: Warning if still active
   - Further options: To be inserted quickly
   - Access keys: All
3. If you want to use the transfer via V.24 or the parallel interface, you must select the Features menu and there the Other item for the DOS box and set the idle run activity to "Low".

3.6 Example for Connecting Several MCUs

On request, the files can be opened for editing and modified by means of the SCK tool. To this aim, the DOS editor EDIT is activated.

Overview

The following files are used to configure the SINUMERIK Unit Operator Panel:

- NETNAMES.INI
- MCU.INI
- BD.TEA
- AUTOEXEC.BAT
- CONFIG.SYS
- OEM.BAT

NETNAMES.INI

Make the communication settings for the MPI bus partner.

MCU.INI

The SIMODRIVE MCU user interface can also partially be modified. This is carried out by means of the file MCU.INI.

You can alter:

- the number of the axes
- and for each axis:
  - axis type
  - link detection
  - invocation data block number
- the access stage

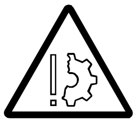
BD.TEA

In the file BD.TEA, it is also possible to configure the V.24 interface, for example. "Display-Machine-Data" means display of machine data; settings of operating modes by $MM_parameters. The file BD.TEA is processed similar to the existing file being displayed.

AUTOEXEC.BAT

The file AUTOEXEC.BAT must not be modified. If any drivers are needed, write a separate OEM-BAT which is automatically called from the existing one.

The developer of the OEM application must make an entry in the respective CFG file.



Warning!

If the files AUTOEXEC.BAT or CONFIG.SYS are modified, proper function of the software cannot be guaranteed.

CONFIG.SYS

The file CONFIG.SYS must not be modified.

OEM.BAT

The file OEM.BAT is supplied by the OEM manufacturer. It must not be modified.

**Example:
1 UOP and
max. 3 MCUs**

The following two files must be adapted according to their configuration and to their MPI addresses of the individual MCUs. A line with the respective axis parameters must be indicated in the file MCU.INI for each existing axis. The number without link identification corresponds to the number behind the conn_parameter from the file NETNAMES.INI.

- File MCU.INI

```
ANZ  = 3        Number of existing axes
A1   = V,1,1    Parameter of the 1st axis
                V =  Type of axis (feed axis)
                1 =  Link connection 1 (conn_1
                     from netname.ini)
                1 =  No. of the invocation data
                     block of the PLC
A2   = V,2,1    Parameter of the 2nd axis
                V =  Type of axis (feed axis)
                2 =  Link identification 2 (conn_2
                     from netname.ini)
                1 =  No. of invocation data block
                     of the PLC
LEV  = 2        Access level
```

- File NETNAME.INI

```
[own]
owner=         MMC_1

; Description of possible connections

[conn MMC_1]
conn_1=        MCU_1
conn_2=        MCU_2

; Description of significant net-parameters

[param network]
bus=           mpi

[param MMC_1]
mmc_address=   1

[param MCU_1]
plc_address=   2
name=          Master MCU

[param MCU_2]
plc_address=   3
name=          Slave MCU 1
```

4 Operating and Monitoring of the MCU by Means of the UOP

Contents

About this Chapter

This Chapter contains an extract from the *SINUMERIK Documentation - Operating Instructions of Unit Operator Panel.* It introduces the MCU-specific operating ranges of the unit operator panel to you and familiarizes you with the operating modes and functions provided in the individual operating ranges.

What can be operated?

For a maximum of three axes, tool offset data and traversing programs can be written into the user data block of the STEP 7 user program via the operator panel and evaluated in the STEP 7 user program.

The UOP software is operated via the horizontal and vertical softkey bar of the OP 031. The assignment of the softkeys is set during the system configuration of the MMC module with specific regard of the user's needs.

What can be monitored?

For a maximum of three axes, messages and data for tool offsets and traversing programs can be read and displayed from the data block for status messages and the respective parameterized data blocks of the MCU module.

Start menu

After turning on the supply voltage, the MMC/UOP module carries out a system test. After the test has been completed successfully, the start menu with the two menu items

1. Software update and
2. Start UOP

appears.
If you fail to decide on one of the two menu items within 5 seconds, UOP is started.

4.1 General

The SINUMERIK UOP in the MCU version MCU is operated in the following operating ranges

- MCU,
- system,
- HiGraph
- in some cases, further customer-specific ranges.

The operating sequences described in the following refer to one axis each.

Note:

The MCU entries are not password-protected.

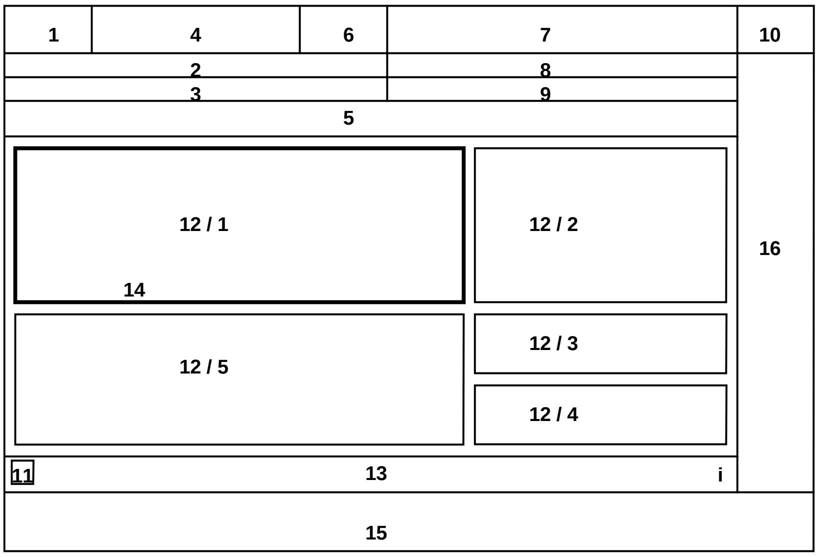
The parameterization of the communication of several MCUs is carried out in the file MCU.INI during the commissioning and is described in Section 3.6.

4.2 Graphical User Interface

Screen division

The graphical user interface of the SIMODRIVE MCU consists of

- a global range (fields 1-4 and 6-10),
- the alarm and dialog line,
- the vertical and horizontal softkey bar, and
- one or several working windows.

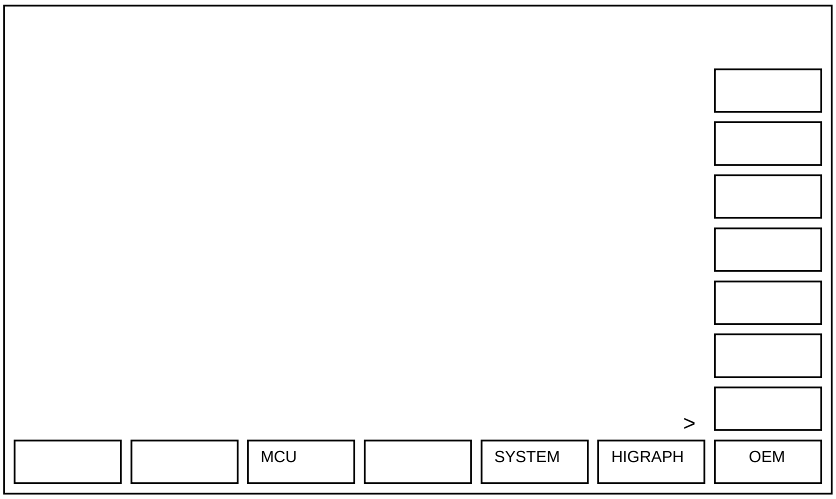


1	Ranges: MCU, System, HiGraph
2	State of selected axis
3	Program state of the active program of the selected axis
4	Name of axis
5	Alarm and message line
6	Mode of selected axis (JOG, AUTO, REFPOS)
7	Program name of the active program of the selected axis
8	Process event signals (operator errors, data errors, operating errors)
9	Status display (SKP, PRT, SBL1 only)
10	Reserved
11	Softkey-bar relevant information and RECALL
12	Working window, activation highlighted by FOCUS
13	Dialog line for operator notes
14	Focus, marking of active working window by stronger frame
15	Horizontal softkey bar with 8 softkeys
16	Vertical softkey bar with 8 softkeys
i	Appears if operating information is provided for the selected function

4.3 Menu Structure

Basic menu

Since the number, position and names of the softkeys can be projected freely, only an example for a basic menu which can be confugured is shown.



Example for a basic menu, MCU variant

4.4 Machine Range

Machine

The machine screen shows the positions of all existing axes in the operating modes possible

- Setting-up (JOG),
- Automatic (AUTO) and
- Reference-point approach (REFPOS).

Entries for override and zero offset are possible in all operating modes. in the JOG mode, the two feedrates can additionally be changed.

Mode selection

When selecting an operating mode by means of the SINUMERIK UOP, the machine basic screen of the machine of the selected mode is displayed.

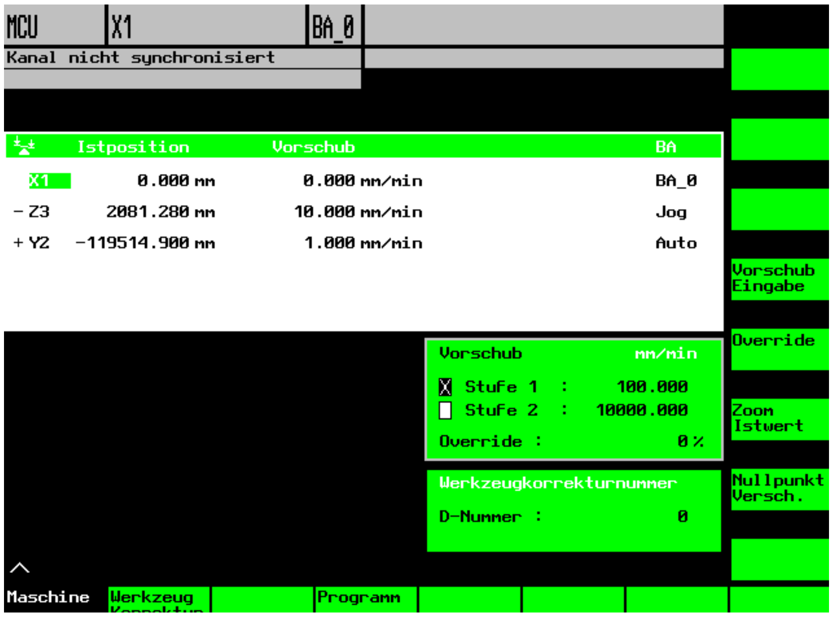
- The machine basic screen contains traversing direction, axis name, actual position, feed, and mode, irrespective of the current operating mode of all existing axes.
- Select an operating mode from the machine basic screen.
- When changing the operating mode, the PLC basic program checks whether a change is admitted.

4.4.1 JOG Mode

In the JOG or Set-up mode, the selected axis is traversed manually by means of the direction keys of the machine control panel or PP031.
To this aim, two fixed speeds can be selected, which can be controlled by the override.

The currently selected speed is marked by the symbol ⊠ in the window.

JOG basic screen



Explanation of the basic screen

Axis	Name of axis
Actual position	Displays the current axis position.
Set position	Displays the set axis position.
Operating mode	Displays the current mode of the axis.
Feed	Displays the current feed.

Modifying the velocity step

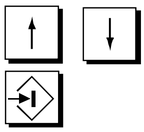
Function:

In the Set-up mode (Jog), 2 velocities can be selected in the feed window.

Modifying the values:

Machine | Jog — The basic menu of Jog mode is selected.

Feed entry — By pressing the **Feed entry** softkey, the values of the 2 velocity steps can be modified. The setpoint indicates the value which you have set, and the actual value indicates the current value of the respective velocity step.

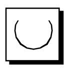


Use the cursor keys to select the desired velocity step, modify the value, and
confirm by pressing the **Input key**.

Use the **RECALL key** to close the window.

Modifying the current velocity step:

Machine | Jog — The basic menu of the Jog mode is selected.



Use the Select key to modify the currently selected step.

Zoom:

See Section AUTOMATIC mode.

4.4.2 Refpos Mode

Function

When using incremental position encoders, after turning on, there is an undefined offset between the internal measuring value and the current mechanical axis position. To provide position reference, the internal measuring value must be synchronized with the axis position.

Operating sequence

Machine

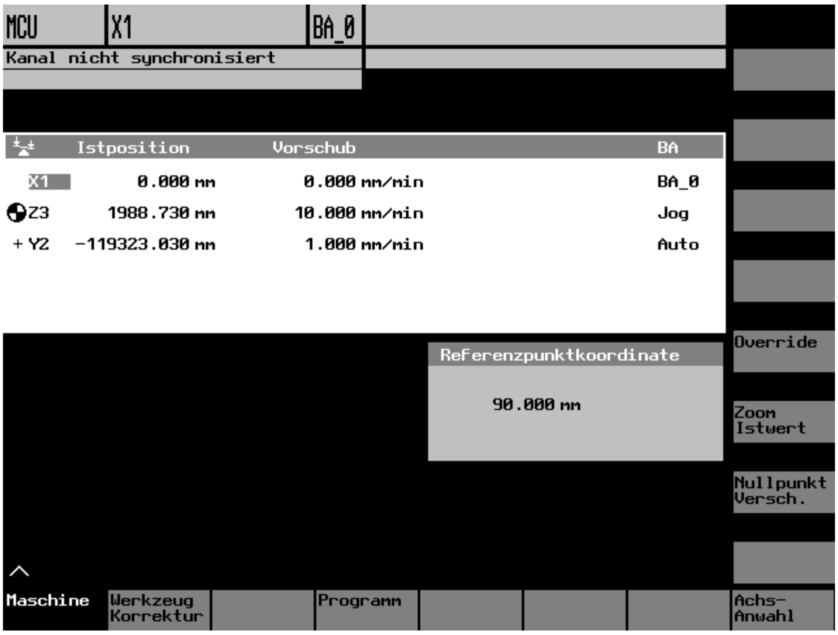
The **Refpos** mode is automatically selected via the PLC.

+X -X

Use the axis traverse keys to traverse the axes.

With Refpos selected, the symbol appears when the reference point is reached.

Refpos basic screen

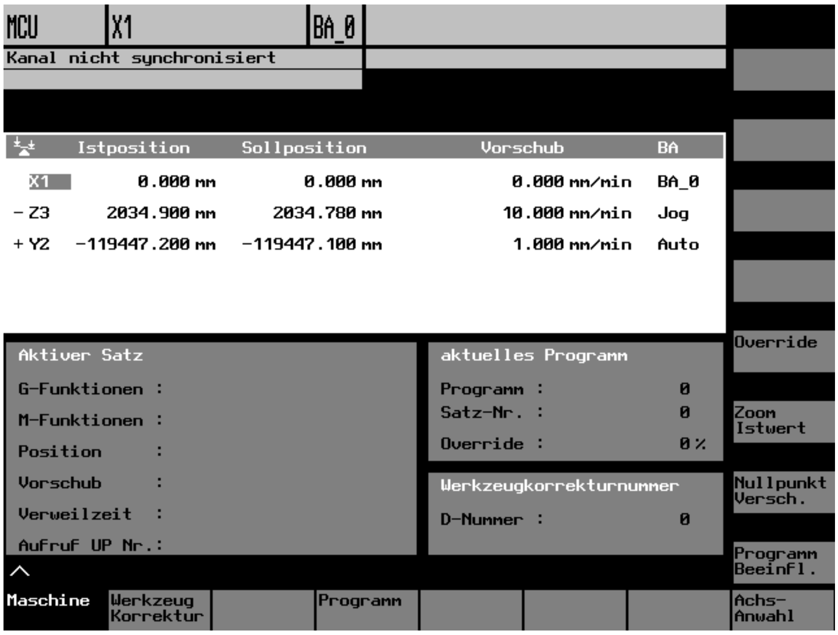


4.4.3 Automatic Mode

Function

In the Automatic mode, individual NC traversing programs are executed; it is not possible to traverse the axes by the direction keys. The NC programs are started and stopped by push-buttons (on the PP031, for example). Program selection is carried out in the program directory.

Automatic basic screen



Explanation of the basic screen

Axis	Name of selected axis
Actual position	Displays the current axis position.
Set position	Displays the set axis position.
Operating mode	Displays the current mode of the axis.
Feed	Displays the current feed.
Active block	The following values and functions of the active block are displayed as a list: • G functions • M functions • feed value • distance to be traversed /set position • possible dwell time • call of subroutine no.
Current program	The window displays program number, block number and override setting of the current program.
Tool	The active tool offset no. is displayed.

ZOOM+

Function:

Zooms out the actual-position window

Operating sequence:

Zoom Act. Value

Pressing the **ZOOM ACT. VALUE** softkey maximizes the working window. The remaining working windows are overlapped.
Press the **Recall button** to reset the zoom.

Program control

Function:

When pressing this softkey, a window appears which lists all possible commands to control an NC traversing program:

SKP	Skip block
PRT	Program test, simulation of the NC traversing program without moving the axes
SBL1	Stop after each machine function block and Automatic Single Block

Operating sequence:

Machine | Automatic

The basic menu of the Automatic mode is selected.

Program Control

Program Control is displayed.

Position the cursor to the desired field.

The desired function is activated/deactivated each time when pressing the **SELECT button**.

Use the **Recall** button to cancel your selection.

Note:

Changeover between Automatic Subsequent Block and Automatic Single Block is carried out by the **Program Control** softkey. This is only possible on standstill of the program.

4.4.4 Modifying the Zero Offset

Function

After approaching the reference point, the actual value display refers to the machine zero point, and the machining program to the workpiece zero point. The part program execution considers this zero offset.
Depending on the kind and clamping of the workpiece, the dimension between machine zero point and workpiece zero point can vary.

Operating sequence

Machine

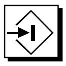
Automatic

Jog Refpos

The basic menu of
Automatic or
Jog or
Refpos mode in the Machine range is selected.

Zero

By pressing the **Zero** softkey, a window is displayed in which a new value for the zero offset can be entered.



Press the **Input key** to confirm the modified value.

Use the **Recall key** to close the window**.**

Note:

The G functions G54 ... G57 that enable the programmable zero offset are not realized in the SIMODRIVE MCU. Only a value exists which is considered in the active tool offset.

4.4.5 Modifying the Override

Function

Use the Override function to modify the feedrate. Both the setpoint and the actual value are displayed. Entries are possible in all operating modes.

Operating sequence

Machine

Automatic

Jog | Refpos

The basic menu of the **Automatic** / **Jog** / **Refpos** mode in the Machine range is selected.

Override

When pressing the **Override** softkey, a window overlapping the tool and the program window is displayed in which the override value can be modified.

Press the **Input key** to confirm the modified value.

Use the RECALL key to cancel your entry and to close the window.

4.5 The Tool Compensation Range

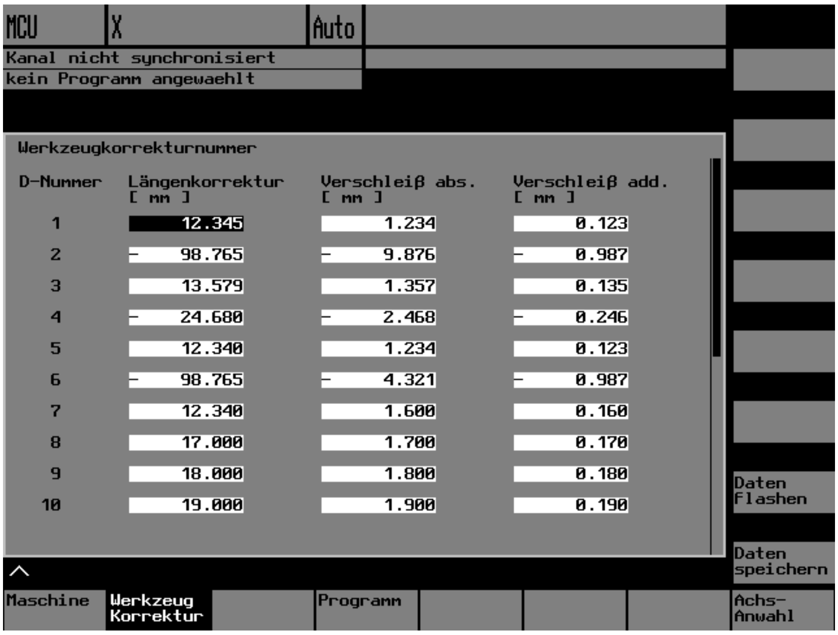
Function

The following is represented for each tool:

- tool length compensation,
- absolute and
- additive wear value for max. 20 tools.

These values can be modified by the operator.

Tool Operating Range basic screen



Operating sequence

Machine / Tool Compens.	The Tool Compensation basic menu is selected.
↑ ↓ ← →	Use the **cursor** and the **page keys** to select
0 ... 9	or change a tool in the Table. Decimals need not be entered.
Flash Data	Use the **Flash Data** softkey to save the modified values in the RAM and store them additionally in the FLASH_EPROM of the SIMODRIVE MCU.
Save Data	Use the **Save Data** softkey to save the modified values in the RAM

Note:

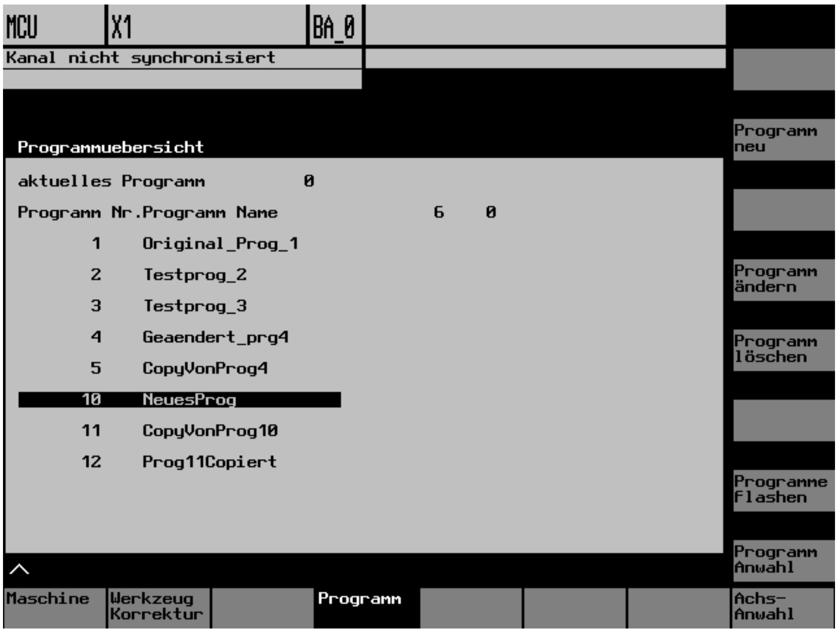
Any changes not saved by Save Data get lost when turning off the control system.

4.6 Program Range

Function

Both all existing and the currently selected traversing program are displayed with their program number and program name.

Program Overview basic screen



Program can only be selected if the axis is in the STOP condition.

Note:

If necessary you can leaf through the displayed program list.

Existing programs can be modified or deleted. This does not apply to the active program.

4.6.1 Selecting a Program

Function

Programs are selected in the Program Overview.

Operating sequence

Machine | Program — The Program basic menu is selected.

↑ ↓ — Programs are selected by means of the **cursor keys** and

Program Selection — the **Program Selection** softkey.

Press the **Program Start** softkey on the machine control panel or on PP031.
The PLC program controls whether a program can be started.

Note:

Programs can be loaded into the control system by means of the commissioning tool (MCU Programming and Commissioning Tool) via the MPI interface.

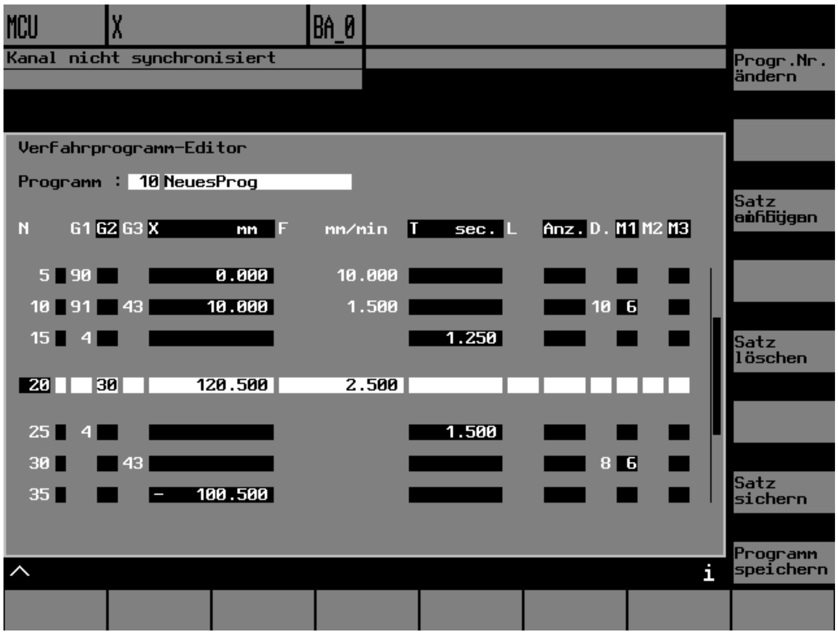
4.6.2 Creating/Modifying Programs

Creating a new program

Function:

The Program Overview can also be used to create a new program by means of the program editor.
Use the **cursor keys** to leaf through the program line by line, and the **page keys** to leaf through the program page by page. The scrollbar shows the position of the block which can be edited.
Any modifications become only active by pressing the **Save Program** softkey. Modifications not taken over by Save Program get lost when the control system is turned off.

Traversing program editor:



Note:

Any modifications can only be carried out in one block; and the modified blocks must then be taken over to the SINUMERIK UOP (not to the MCU) by pressing the **Save Block** softkey.

The active traversing program can only be viewed but not modified.

Operating sequence:

Machine / Program	The Program basic menu is selected.
New Program	Press the **New Program** softkey; the program editor appears.
A 7 ... Z ;	Enter the respective program data block by block, and
Save Block	complete each program block by **Save Block**.
Save Program	When you have entered all blocks, complete the program by pressing **Save Program**.

Note:

If you do not save your entries prior to leaving the program editor, the currently entered data get lost.

Deleting a program

Function:

Use the Program Overview to delete programs.

Operating sequence:

Machine / Program	The Program basic menu is selected.
↑ ↓	Use the **cursor keys** to select a program.
Delete Program	The selected program on the SIMODRIVE MCU is deleted by pressing the **Delete Program** softkey.

Saving a program

Function:

Use the Program Overview to save programs on the FLASH EPROM of the SIMODRIVE MCU. If you fail to perform these functions, the modifications in the programs get lost when turning off the MCU. The contents saved on the FEPROM is recovered when turning on the control system.

Operating sequence:

Machine / Program	The Program basic menu is selected.
Flash Program	Use the cursor keys to select the file which you want to save and press the **Flash Program** softkey.

Note:

I Through saving, not only the programs on the FEPROM are saved, but all data of the integrated FM-POS (DB 1001 to 1249).

Modifying

Function:

Use the Program Overview to view and modify a program.

Operating sequence:

Machine / Program	The Program basic menu is selected.
↑ ↓	Use the **cursor keys** to select a program, and
Modify Program or (Input key)	press then the **Modify Program** softkey or the **Input softkey**; the program editor is selected.
Save Block	Any modifications can only be carried out in one block, and the each modification must be taken over by pressing the **Save Block** softkey.
Save Programs	After all modifications to the program have been made, confirm them by pressing the **Save Programs** softkey.

Note:

Programs can be loaded into the control system by means of the commissioning tool (MCU Programming and Commissioning Tool) via the MPI interface.

Copying a program

Function:

The program displayed can be copied to a new program.
However, existing programs cannot be overwritten.

Operating sequence:

Program Overview	Program	The Modify program submenu is selected.
Modify Progr. No.		Press the **Modify Progr. No.** softkey. The cursor will jump to the Program Number field. This can now be modified.
		Press the **Input key** to confirm your modification.

Note:

If the program number that you have entered already exists, an error message is provided and the previous program number is entered.

Inserting an empty block

Function:

It is possible to insert a line before any block as long as the maximum number of traversing blocks is not reached and the difference of the two block numbers is > 1.

Operating sequence:

Program	Modify Program	The Modify Program submenu is selected.
Insert Block		Press the **Insert Block** softkey. A new empty block is inserted. The block number is already preset, but you can modify it.

Adding a block

Function:

After any block which can be modified a line can be added provided

- the maximum number of traversing blocks is not yet reached,
- the difference of the two block numbers is larger than 1, and
- the block number of the active block is smaller than 255.

If the block that can be modified contains an M30 (program end) or M18 command (program loop) and the block is not a block to be skipped, no more blocks can be added.

Operating sequence:

Program Overview	Modify Program	The Modify Program submenu is selected.
Add Block		Press the Add Block softkey. A new block is displayed in the range which can be edited; the block number is already preset but can be modified.

Deleting a block

Function:

The selected block is deleted without asking the question whether you are sure to delete the block.

Operating sequence:

Program	Modify Program	The Modify Program submenu is selected.
Delete Block		Press the **Delete Block** softkey. The selected block is deleted. The following block is displayed in the range which can be edited, and the cursor is set to this block number.

Saving a block

Function:

Any modifications that you have made in a block which can be edited must be saved before leafing through the program display.

Operating sequence:

Program | Modify Program — The Modify Program submenu is selected.

Save Block — After modifying a program block, press the **Save Block** softkey.
The modifications are saved in the SINUMERIK UOP (not in the MCU), and the cursor is positioned to the block number.

4.6.3 Saving a Program

Function

Modifications in program blocks become only active if they are saved as a block and stored as a program. The program that you have modified is transferred ??? (Reimann) to the SIMODRIVE

Operating sequence

Program | Modify Program — The Modify Program submenu is selected.

Save Block — Active traversing programs can only be viewed.
Enter the respective modifications into the program block by block and save each of them separately by **Save Block** .

Save Program — After all modifications in the program have been done, confirm them by pressing the **Save Program** softkey.
Quit the program editor by pressing **RECALL**

4.6.4 Displaying the Permissible G Functions

Function

In the Modify Program menu, it is possible to call all permissible G functions on the screen.

Operating sequence

| Program | Modify Program | The Modify Program submenu is selected. |

Press the Info key. A list of all permissible G functions appears.

Close the window by pressing the **RECALL** key.

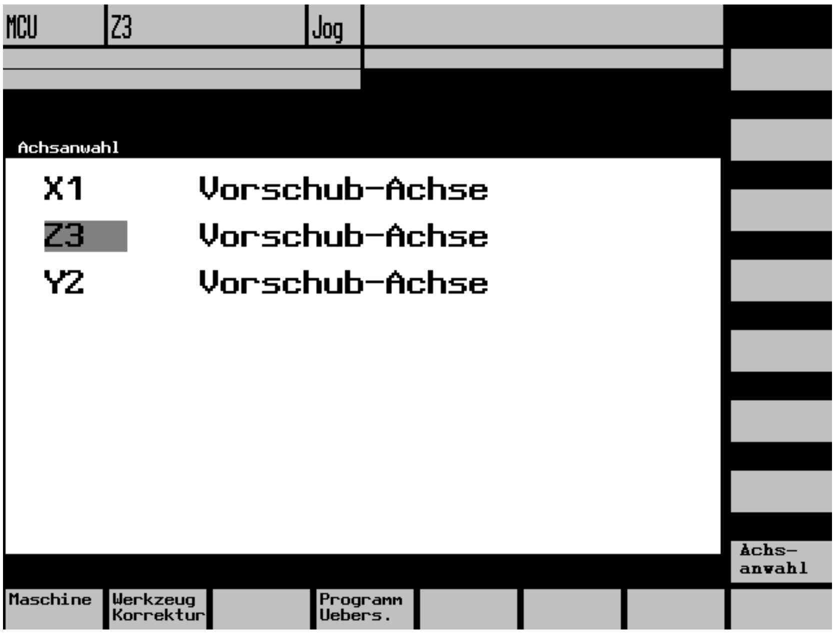
Note:

1. The program editor can only be left by pressing the RECALL key or the Range selector.
   The modifications are only stored if the program has been saved by pressing the Save Program softkey.
2. When leafing through the program without saving the modified block, your modifications get lost.
3. When saving a program, the editor is not left, and you can go on editing the program.

4.7 Axis Selection Range

Function

The operation can be changed over between the existing axes.
The currently selected axis is represented inversely.



The Axis Selection range can only be selected if at least 2 axes exist.

Operating sequence

Machine | Axis Selection — The Axis Selection submenu is selected.

Select an axis using the **cursor keys** and

Axis Selection — the **Axis Selection** softkeyor the **Input key**.

Press **RECALL** to close the window.

4.7.1 Parameterization of User Interface

Function

The SIMODRIVE MCU user interface can be partially modified. This is carried out in the file MCU.INI.

In the first step, you can modify

- the number of axes
- and for each axis:
  - axis type
  - link detection
  - invocation block number
- the access stage

4.8 Alarms/Messages

Function

Any alarms / messages occurred are displayed.
The numbers of the MCU alarms are in the range from 200000 to 299000.
The MCU alarms are described in Chapter 13 *Error Messages*.

Note:

In conjunction with the alarm description, the following must be observed:
The alarm numbers do not correspond to the numbers which are indicated in the MCU manual, for example, alarm **200517** is described in the MCU manual under **517**.

4.9 System Range

4.9.1 General

In addition to the functions described in the following (alarms/messages, password, PLC status, version), in the System Range you can change over

Sprachum-
schaltung

the language using the **Change Language** softkey**,**.

LCD
brighter

LCD
darker

or set the screen using the softkeys **LCD brighter** or **LCD darker**).

Note:

With the MMC module and a SIMATIC S7-300 or SIMODRIVE MCU connected, the brightness setting is not saved after PowerOn.

4.9.2 Alarms/Messages

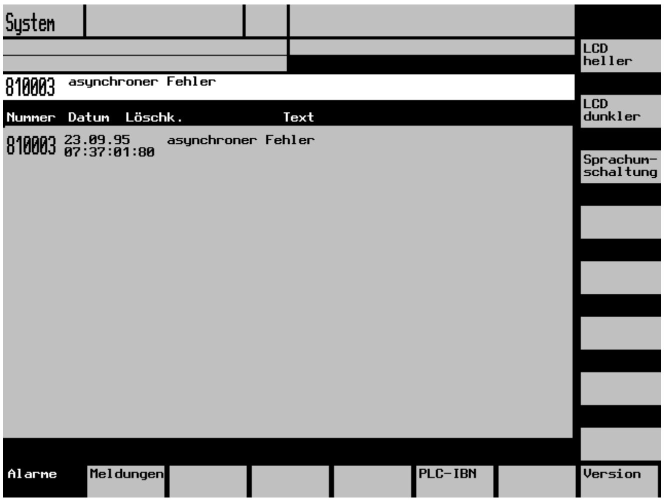
Function

MCU:Any alarms/messages occurred are displayed.

The numbers of the MCU alarms are in the range from 200000 to 299000.
In conjunction with the alarm description, the following must be observed: The alarm numbers do not correspond to the numbers which are indicated in the MCU Manual, e.g. alarm **200517** is described in the MCU Manual under **517.**

The MCU alarms are described in Chapter 13 *Error Messages*.

Any alarms/messages occurred are displayed.



Alarm basic screen

Operating sequence

System	After selecting the System Range, the screen Alarms/Messages with alarm number, time, deletion criteria, and alarm text appears.
Messages	Press the Messages softkey to view any messages occurred.

4.9.3 PLC Status

Function

The PLC status can be displayed by pressing the **PLC Status** softkey.

Operating sequence

System	After selecting the System Range and
PLC Status	pressing the PLC Status softkey, the PLC Status screen appears.

4.9.4 MMC Version

Function

The currently installed software in the control system can be displayed by pressing the **Version** softkey.

Operating sequence

System	After selecting System Range and
Version	pressing the Version softkey, the MMC Version screen appears.

All files of the existing operating ranges are listed with their names, version, output time, and size.

5 Appendix

SIEMENS

SIMODRIVE 611

MCU 172A
Single-Axis Positioning Control

EMC Installation Guideline for MCU

Valid for: MCU 172A V 3.x

Edition January 1997

Note

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please inquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

The remaining names and designations used in this Documentation may also be trademarks, the use of which by any third parties for their own purposes may violate the rights of the copyright holders.

1 Preface

1.1 General

What does EMC mean?

EMC is the abbreviation for **e**lectro**m**agnetic **c**ompatibility. EMC is defined as the ability of a device, unit of equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

What does this Installation Guideline contain?

This Installation Guideline will provide answers to the following questions:

- Why is it necessary to have EMC installation guidelines?
- What type of EMI (electromagnetic interference) emitted by external equipment affects the control ("victim")?
- How can EMC-related malfunctions be prevented?
- What practical design examples of interference-immune installations are available?
- What are the important points to remember when handling ESD-sensitive modules?
- How can malfunctions caused by inadequate EMC be eliminated?

Who should read this document?

This document is provided to assist the following staff:

- Configuring engineer (in planning the NC and drive system configuration)
- Installation engineer (in installing connecting cables)
- Service engineer (in trouble-shooting and fault elimination)

What is the objective of this Installation Guideline?

This Guideline should not be regarded as a textbook on the subject of EMC. Its purpose is to provide information and instructions to those dealing with the practical aspects of implementing electromagnetic compatibility in electrical installations.
It is necessary to follow the instructions in this Guideline in order to

- achieve a minimum degree of interference immunity in equipment so as to ensure that it functions properly in a rough industrial environment and
- protect the operating environment against intolerably high levels of emitted interference.

This Installation Guideline also describes the measures stipulated in the EC Declaration of Conformity Appendix A (see Section 11) to achieve compliance with EC EMC legislation or the EC EMC Directive. On installation sites that are severely polluted with EMI, EMC-related malfunctions may still occur even when all the recommendations in this Guideline have been implemented. Such cases are, however, extremely rare.

What previous knowledge is required?

In addition to this Guideline, all general safety regulations, VDE specifications and nationally applicable codes of practice remain fully valid.

An in-depth knowledge of VDE and EC specifications is required to ensure that safety standards are not undermined when the Guideline is implemented. The measures described in the Guideline must be implemented by appropriately qualified personnel.

Qualified person

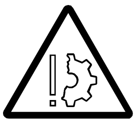
The term "qualified person" refers to all staff who are charged with erecting, installing, starting up and operating the product and who have the appropriate qualifications to perform such tasks.
The term "qualified" refers particularly to the authorization to connect, earth and start up circuits and devices according to recognized electrical engineering standards.

Warning symbols

Important information is especially highlighted in this publication. The following warning symbols are used for this purpose:

Protect personnel against injury!

This symbol warns you about a potential threat to personnel safety. Read the notes printed next to the symbol. Failure to follow the proper procedure could endanger the life or health of personnel.



Protect machine against damage!

This symbol warns you about potential damage to machinery or materials. The notes next to the symbol tell you how to avoid damage to your machine or to the workpiece on the machine.

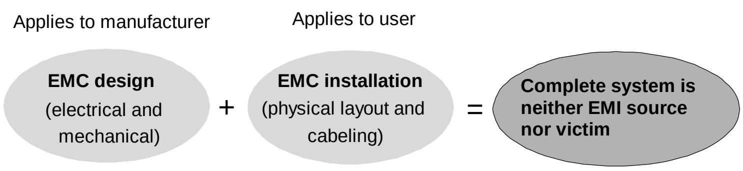
Note

This symbol draws your attention to an important item of information. Notes of this type help you to avoid disruptions to operation.

1.2 Introduction

EMC in installations

EMC measures must be implemented by both the control system manufacturer and the user (including machine tool manufacturer) if a complete system (control system and drive machinery) is to comply with requirements defined in the EC EMC Directive.



Read Planning Guides

To ensure satisfactory EMC, you should

- observe the product-specific EMC measures described in the Planning Guides for SIMODRIVE, SINUMERIK and SIROTEC,
- operate only permissible equipment combinations and
- always use accessories (e.g. preassembled cables) listed in the product documentation or accessories of corresponding functionality and quality.

2 Brief Summary of Basic EMC Rules

Earthing of metal parts

- All metal parts of the control cubicle must be connected to one another conductively over a large surface area.
- The cubicle door must be connected to the cubicle transom by means of short earthing strips (top, centre, bottom).
- The shielding bus and equipotential bonding strip must be connected over a large area with the cubicle housing.
- Connections between metal parts must be permanent. Screw connections on painted and anodized metal parts must either be made by means of special contact washers or, alternatively, the insulating layer between the parts must first be removed.
- The use of aluminium parts should be avoided where possible (risk of oxidation).

Filters

- Filters must normally be mounted at the point at which the cable to be filtered enters the cubicle.
- Specific filters such as the SIMODRIVE filter module or the STEPDRIVE filter must be positioned, mounted and wired up as specified in the documentation supplied by the manufacturer.
- Filters must be mounted such that they are effectively, permanently and conductively bonded over a large surface area with the cubicle housing (mounting plate).
- The filter supply cables must be separated from the filter return cables. Filtered cables must be routed separately from unfiltered cables.

Cable routing

- Signal cables / data cables must be routed separately from power cables and power supply cables (to prevent coupling paths). Minimum separating distance in control cubicle: 20cm. Use earthed partition if necessary.
- Unscreened cables belonging to the same circuit (supply and return conductors) must be twisted where possible or the distance between the supply and return conductors kept to a minimum.
- Cables must be routed as close as possible to metal housing parts (e.g. mounting plate, transoms, metal bars).
- Signal cables and their associated equipotential bonding lead must be routed as close as possible to one another.
- Signal cables must never be routed past equipment that generates powerful magnetic fields (e.g. motors, transformers).
- Wherever possible, signal cables / data cables should enter the cubicle at only one level (e.g. only from bottom of cubicle).
- Superfluous lengths of cable (including spares) must be avoided.
- Signal cables, particularly setpoint and actual value cables, should be routed without interruptions. A continuous screen connection must be provided at separation points.

Attachment of cable screens

- The screens of data cables, analog signal cables and SIMODRIVE motor cables must be connected to ground at both ends. The connection must be effectively conductive and with a 360° contact surface.
- Cable screens must be attached to a shielding bus immediately after the cubicle entry point and taken on to the appropriate module. The product-specific, preassembled cables are designed such that the screen is effectively contacted once the connector is screwed onto the component housing.
- Only metallic or metallized connector housings may be used for screened cables.

Elimination of possible interference sources

- Contactor coils, relays, solenoid valves and other inductances in the cubicle and, where applicable, in the vicinity of the cubicle, must be equipped with suppression elements. The suppression circuit can be constructed, for example, of RC elements, varistors, etc. directly on the appropriate coil.
- Filament lamps should be used to light cubicles where possible. Fluorescent lamps must not be used.

Uniform system reference potential

- If components of the SINUMERIK or SIMODRIVE system are installed in different housings (cubicles), then these must be connected, for example, by means of equipotential bonding leads.
- Adequately dimensioned equipotential bonding leads must be used to compensate potential differences between different system sections.

Protection against lightening strikes

To protect electronic equipment against surge voltages caused by lightening strikes, measures must be implemented on buildings, operating areas and electrical equipment. In this respect, we would advise you to contact your local Siemens sales office or appropriately qualified technical consultant.

Handling of ESD-sensitive modules

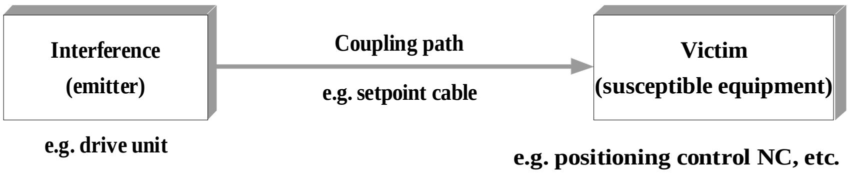
- Put on an anti-static wristband before you start work on modules that are sensitive to ESD.
- Use surfaces and packaging made of anti-static material or plain cardbord.
- Protect the module from contact with chargeable and highly isloated materials, such as plastic foils or clothing made of synthetic fiber.

3 EMI Coupling

Conditions for EMC-related problems

Electromagnetic interference can effect a control system or installation only on condition that it has the following three complementary aspects:

- Interference source
- Coupling path
- Victim equipment



3.1 Interference sources

Interference sources Equipment/devices that cause interference are referred to as interference sources. Appropriate measures must be taken to eliminate or at least dampen the interference emitted by such sources and its effects on other equipment.

Typical interference sources	**Interference generated by**	**Affects victim due to**
Switched inductances, e.g. contactors, relays, electronic valves	– Contacts Coils	– Mains-borne interference Electromagnetic field – Magnetic field
Electric motor	– Collector Winding	– Electromagnetic field – Magnetic field
Spark-generating machines, e.g. electric welding equipment, erosion machines	– Contacts Transformer	– Electromagnetic field – Mains-borne interference – Transient currents – Magnetic field
Power pack	– Circuitry – Switching components	– Electromagnetic field Mains-borne interference
HF equipment	– Circuitry	– Electromagnetic field
Radio transmitters	– Antenna	– Electromagnetic field
Earth or reference potential difference	– Voltage difference	– Transient currents
Operator	– Electrostatic discharge	– Electrical discharge currents – Electromagnetic field
Power cables	– Current flow – Blown fuse	– Mains voltage dips and surges – Electrical and magnetic fields
HV cables	– Voltage difference – Corona discharge	– Electromagnetic field – Electrical field
Converter, power electronics circuitry	– Circuitry	– Overvoltage/undervoltage – Mains harmonics
Atmospheric discharge	– Potential boost, – Current flow	– Overvoltage – Transient currents

3.2 Victims

Victims

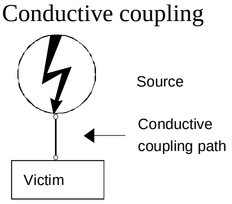
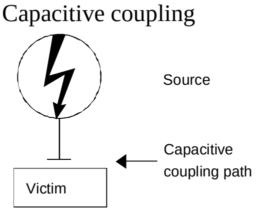
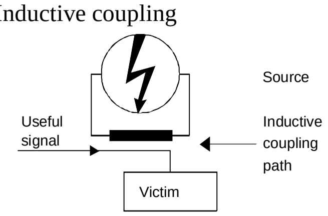
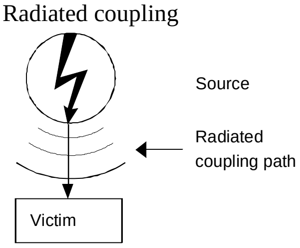
The term "Victim" refers to any device or installation that may malfunction as the result of the effects of interference.

Typical victims	**Very sensitive to**	**Reaction**
Microprocessor-controlled systems, bus systems	Pulse-shaped interference (e.g. switching operations), electromagnetic fields	Sporadic processor crashes, transmission errors
Analog circuits	Low-frequency interference (e.g. potential differences)	Superposition of interference on useful signal (e.g. 50 Hz hum on setpoint)
CRT monitors	Low-frequency magnetic fields (>1.5 A/m)	"Shaky" screen characters or display screen, incorrect screen colour shading
Telephones	Mains harmonics	Audible whistling noise
Fax machines, power packs	Mains harmonics	Fuse trip or defect in power pack, audible whistling noise

3.3 Coupling paths

Coupling paths

The coupling path is the route via which interference from an interference source is transmitted. Such paths allow EMI to spread from the source to victim equipment. There are various mechanisms by which interference is coupled into victim equipment:

Coupling mechanism		**Typical interference sources**
Conductive coupling 	Conductive or metallic coupling always occurs in cases where two circuits have a common impedance (e.g. common grounding cable).	• Switched-mode devices (phase effects on system caused by converter or external power packs) • Motors during starting • Difference in potential between component housings with com mon power supply
Capacitive coupling 	Capacitive or electrical coupling occurs between mutually insulated conductors that are at different po-tentials.	• Interference caused by cable routed in parallel • Electrostatic discharge from operator • Contactors
Inductive coupling 	Inductive or magnetic coupling oc-curs between conductor loops when current is flowing through at least one of them. The magnetic flux generated by the current causes the induction of interference voltage in the other conductor.	• Transformers, motors, electric welding equipment • Mains cable routed in parallel • Cable that carries switched currents • High-frequency signal cable Coils without suppressors
Radiated coupling 	Radiated coupling occurs when a propagated electromagnetic wave comes into contact with cables. The wave induces currents and voltages in the cables.	• Nearby transmitters (radio tele phones) • Spark gaps (spark plugs, collec tors of electric motors, welding equipment)

Examples of coupling paths

Coupling path	**Cause**
Cables	– Incorrect or unsuitable cable installation – Shield is missing or incorrectly connected – Unsuitable routing of cables (incl. equipotential bonding lead) – Unsuitable cables
Control cubicle or control system housing	– Compensating cable is missing or incorrectly connected – Ground connection is missing or incorrect – Unsuitable physical layout – Modules are not fixed in mounting positions – Unsuitable cubicle construction

4 Equipotential Bonding

Note
Equipotential bonding must not be confused with protective earthing. The protective earth must be implemented in accordance with relevant standard and guidelines. It is not dealt with in this EMC Guideline.

Any grounding systems must comply with VDE 0100 and VDE 0141 and be dimensioned such that the permissilbe grounding voltages, touch voltages and resistances to ground are not exceeded.

Why is equipotential bonding needed

Control components that are linked by signal connections referred to a potential require equipotential bonding. Component malfunctions are prevented by providing equipotential bonding between electrical components and between such components and earth.

Where must equipotential bonding be installed?

- Between all control components that are interconnected by signal links and the signals refer to a potential

  and

- between control components and the central earthing bar

  (The central earthing bar is a busbar for all the grounding, equipotential bonding and PE conductors in a control cubicle. It is also connected to the external PE conductor or building earthing system.)

Where is equipotential bonding not necessary?

Control compoents with potential-free signal transmission (e.g. via optical fiber cables) do not require equipotential bonding and, in many cases, it is even not admitted - see also the product-specific documentation.

Which method is used to provide equipotential bonding?

Equipotential bonding is generally provided by the galvanic link of the parts with each other. Either the parts are mounted such that well conductive, large-surface and permanent contact with the reference potential is ensured, or they are linked with each other or with the related reference potential by means of bonding conductors.

The efficiency of equipotential bonding will be as larger as lower the transition resistance (Z) between the parts whose potential difference is to be eliminated is.

4.1 Equipotential bonding of components inside cubicle

Equipotential bonding by interconnection

Equipotential bonding between the individual control components with respect to one another and the central earthing bar within a metallic housing (cubicle) should be provided by means of the "interconnection" method wherever possible.
"Interconnection" means the creation of a conductive connection between several components with a direct conductive connection provided between all components (see Section 4.2, Fig. A).

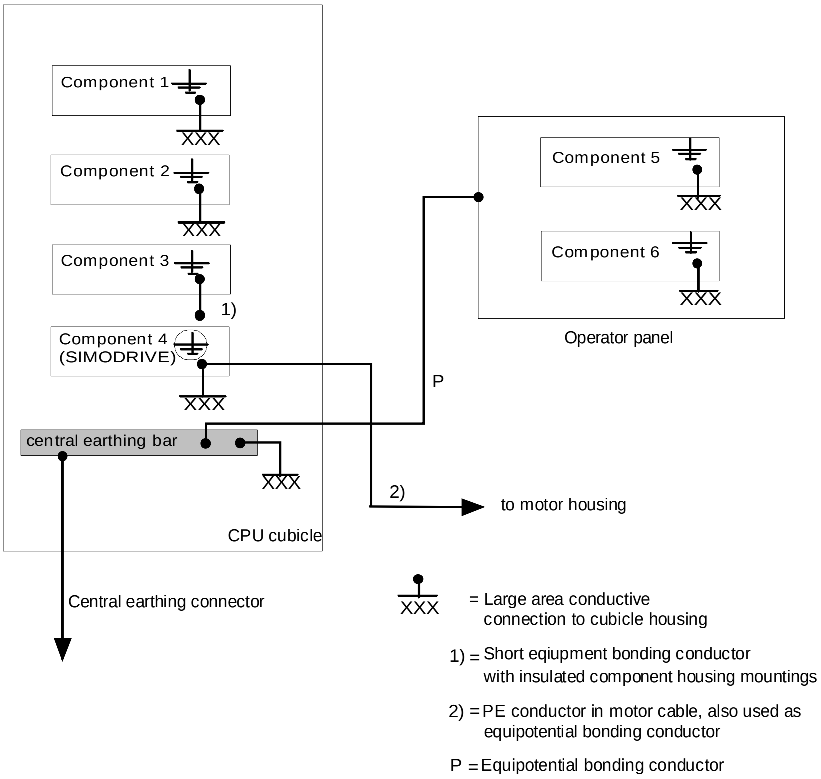
Please note

- Components with metal housings must be bolted to the cubicle housing (mounting plate). The conductive connection must be made over a large surface area. (see also next Section "Reservations")
- The connection between the central earthing bar and the cubicle housing must be low-resistance, short and over a large area.
- All contact surfaces for ground connections must be bare metal. Oxide and paint must be permanently removed.
- The ground connections must be resistant to corrosion, especially with respect to contact corrosion and resistance to external influences.

Reservations

It is possible to make this direct conductive connection between the metal housing and the cubicle rear panel using the component fixing screws only if the equipotential bonding conductor terminal for the control component (marked: ⏚ or ⊥) is designed such that it is conductively connected over a large area to the component mounting surface.
In the case of control components with insulated housing mountings or with a mounting surface made of metallized (galvanized) plastic, the connection between the equipotential bonding terminal of the component and the control cubicle housing must be made by means of a short equipotential bonding conductor of ≥ 10mm^2 (see Figure below, component 3).

Equipotential bonding by interconnection via cubicle rear panel



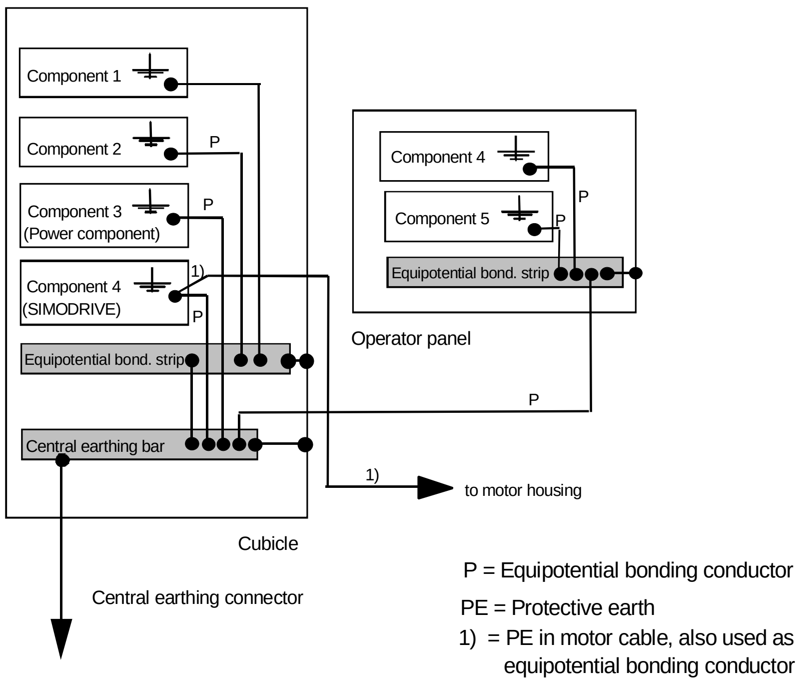
Equipotential bonding, point-to-point (as exception)

If it is not possible to interconnect the control components with one another and with the central earthing bar via the cubicle housing (e.g. because control cubicle has an insulated rear panel), equipotential bonding can be provided by means of bonding conductors between the components and the central earthing bar (see Fig. below).

Please note

- Equipotential bonding systems must be star-connected. The neutral point of the bonding leads can be one of the following:
  - * Central earthing bar or
  - * separate equipotential bonding strip (see Section 4.2, Fig. B)
- Equipotential bonding conductors on power components such as drives, machines, load power supply units, relay adapters, etc. are always connected to the central earthing bar. It is not permissible to use a common equipotential bonding lead for power and signal-circuit components.
- Keep the equipotential bonding conductor lengths as short as possible.
- Cross-section of equipotential bonding conductors ≥ 10mm^2

Equipotential bonding by means of bonding conductors



P = Equipotential bonding conductor

PE = Protective earth

1) = PE in motor cable, also used as equipotential bonding conductor

4.2 Equipotential bonding of external components

Control components in different cubicles

If the control components (e.g. operator panel, DMP modules) are not located in the same cubicle as the associated CPU, then it is necessary to connect the potentials of the cubicles or of the appropriate central earthing bars to one another, i.e.

- by bolting the cubicle housings together, ensuring an effectively conductive connection

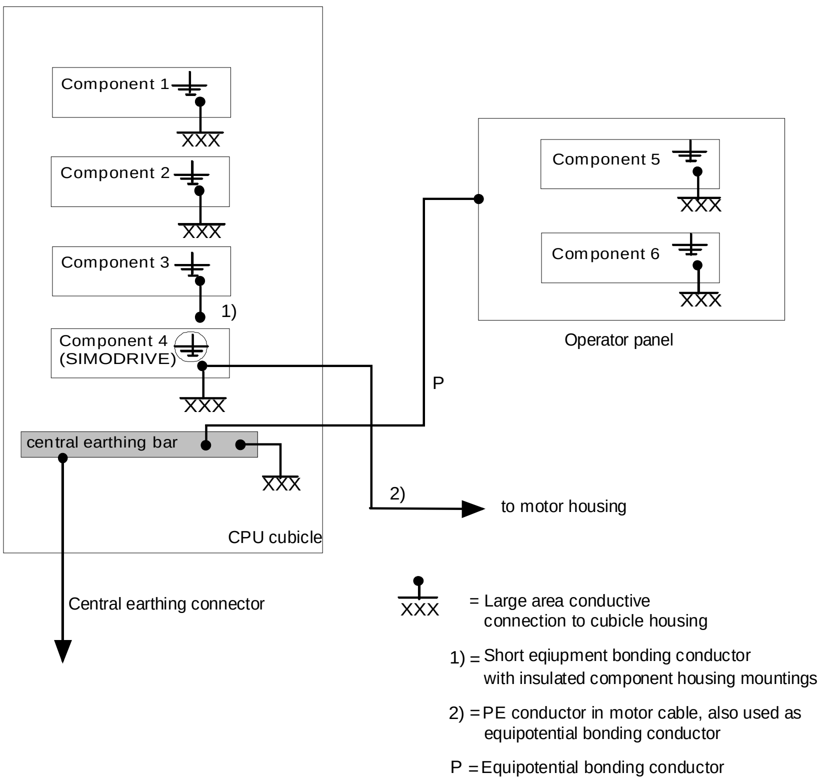
  or, if this method is not feasible,

- by connecting the relevant central earthing bars by means of equipotential bonding conductors.

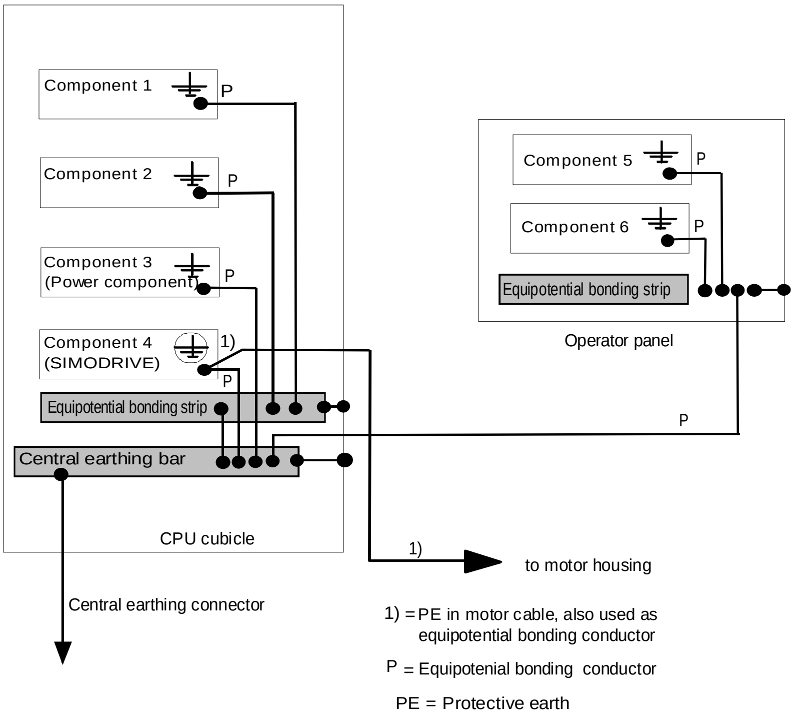
Please note

- Cross-section of equipotential bonding conductors $\geq 10mm^2$
- The equipotential bonding conductor and signal leads must be routed as close to one another as possible (bundle leads if possible).

Equipotential bonding by means of bonding onductors



Equipotential bonding by means of bonding conductors



Layout

The distance between signal cables (supply and return conductors) or between signal cables and the associated equipotential bonding conductors must be minimized (bundle cables!) so as to reduce the interference area between the cables as much as possible.

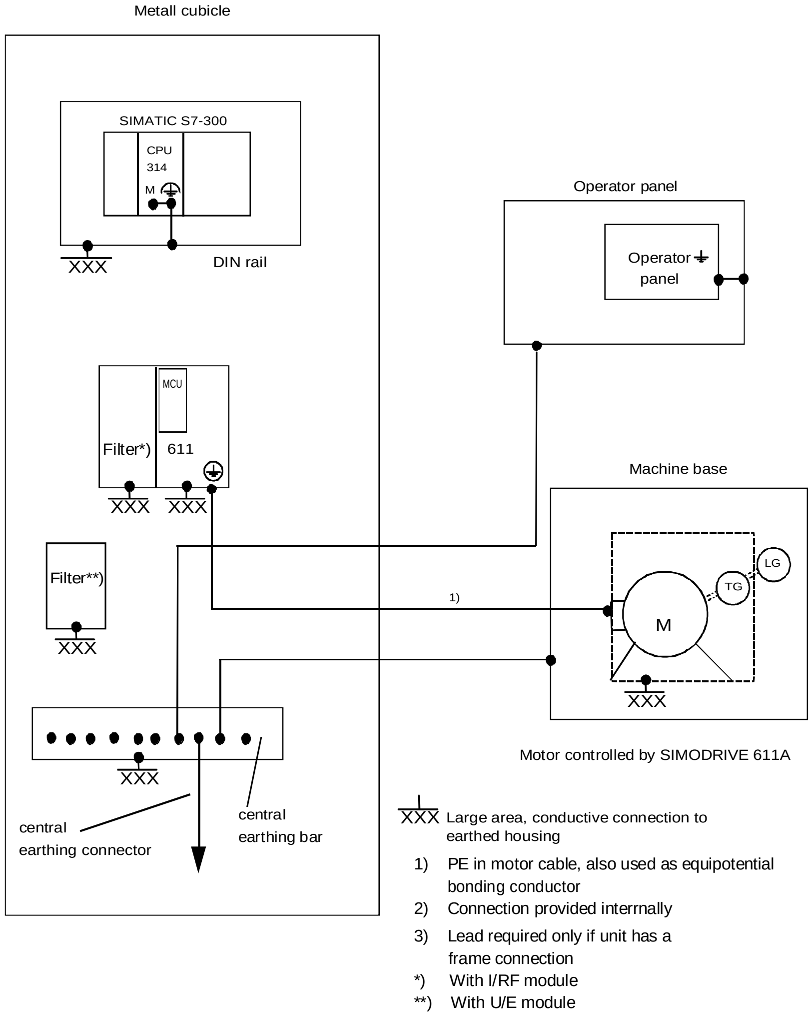
Cross-section

Cross-section of equipotential bonding conductors ≥ 10mm^2

NOTE:

The cross-section of the equipotential bonding conductors must be dimensioned for the max. output current and also be matched with the conductor length.

Examples of equipotential bonding



Example 1: Equipotential bonding on SINUMERIK FM NC with SIMODRIVE 611

5 Control Cubicle Design

5.1 Design and installation of cubicle

5.1.1 Grounding of control cubicle components

The following measures improve the shielding effect of a control cubicle:

- All metal parts of the cubicle must be connected to one another conductively over a large surface area.
- Cubicle covers such as panels on the sides, rear, top and base must be contacted with one another at an adequate distance.
- Side, rear, mounting and roof panels must be bonded over a large surface area with the cubicle frame.
- The support brackets for subracks must have a metal-to-metal connection over a large surface area with the cubicle frame.
- All screw connections on painted or anodized metal parts must be made by means of special contact washers. Alternatively, the insulating protective layer between the parts must be removed before the connection is assembled.
- If large areas of protective layering must be removed to obtain a good metal-to-metal contact, long-term corrosion protection (e.g. contact grease) must be provided by additional measures.
- The parts to be connected including the connecting elements (e.g. screws, serrated lock washers, rivets, etc.) must be made of materials that are closely related according to the electro-chemical series.

5.1.2 Penetrations in cubicle panelling

The shielding effect of the cubicle is impaired when ventilation holes, inspection windows, operator elements, etc. are made or mounted in the cubicle body.

Note
If the opening in the cubicle panel reaches the size of half the wavelength of the interference signal, then the cubicle loses virtually all its shielding effect because the penetration can act as an antenna.

Example: When EMI signal = 500MHz : 1/2wavelength = 30 cm
When EMI signal = 1000MHz : 1/2wavelength = 15 cm

To maintain the shielding effect of the entire unit, the required opening must either be small in comparison with the wave length to be shielded, or the breakthrough must be sealed against HF radiation by additional measures, such as honeycomb windows or meshed grids.

Ventilation slots

If ventilation openings must be made in the control cubicle, then staggered hole patterns or HF mesh are always more effective shields than slots which conduct high-frequency signals into the interior of the cubicle.
A large number of small holes are better than a few large ones.

Operator elements

When operator elements and panels are fitted in the cubicle, it must be ensured that the metal mounting frames are contacted properly all the way round (tighten fixing screws with the torque specified in the product documentation).

Cable entry points

Cable entry points that ensure a good 360°, HF-proof contact between the shield and the housing (cubicle panel) are the best method of grounding shields without weakening the shielding effect of the overall system.
Where cubicle housings are coated (e.g. painted or powder coated), the insulating protective layer around the penetration must be removed to ensure that the cable entry can be perfectly contacted. Contact corrosion can be avoided by selecting suitable metal materials.
The shield braid must be connected to the cable gland and/or the connector according to the mounting guidelines supplied by the gland or connector manufacturer. Proper connection of the shield plays an important role in assuring the EMC quality of the whole system.

EMC cubicles made by Siemens

The Siemens Drives and Standard Products Group (ASI) can supply EMC models of control cubicles. These *8MC cubicles* have a shielding efficiency of approximately 60 dB over a frequency range of 10 kHz to 1 GHz.
Please refer to *Catalog NV 21* for more information about EMC cubicles.

Note

We wish to expressly emphasize at this point that it is far more expensive to upgrade the shielding effect of an existing cubicle than to purchase a new cubicle with specially integrated EMC.

5.2 Mounting components in control cubicle

The following basic rule applies:

- The effects of EMI are reduced as the distance between the source and victim increases.
- A further reduction in interference can be achieved through the installation of shielding plates.
- All components must be connected conductively (HF-proof) to one another over a large surface area.

Modules

When components are mounted (modules, submodules, plug-in cards, etc.), it must be ensured that they are properly secured to the support rail (subrack, etc.) so that they will operate correctly. The recommended tightening torque for the fixing screws must be observed.

Operator panels with monitors

It must be ensured that no lines or devices with coils which produce heavy magnetic fields are arranged in the vicinity of monitors , such as power lines, contactors, relays, solenoid valves, transformers etc.

Power and control components

Power components (transformers, drive units, load power supply units, etc.) must always be installed separately from control components (relay control sections, numerical controls, PLCs such as SIMATIC etc.). However, this does not apply to power components that have been designed specially for use in combination with control components by the manufacturer (e.g. SIMODRIVE 611 and SINUMERIK 840D).

The metal enclosures of all components, especially those of converters and the associated filter modules, must be bonded in a low-resistance connection with the cubicle for high-frequency transient currents. Ideally, the modules should be mounted on a conductive, blank metal plate and bonded with it over a large surface area. Painted cubicle panels, DIN rails or other mounting equipment with a small support surface do not fulfil these requirements.

SINUMERIK FM components are attached to the mounting rail of the SIMATIC system S700. This rail must be contacted with the cubicle in a conductive, large surface area connection.

Filter modules for converters

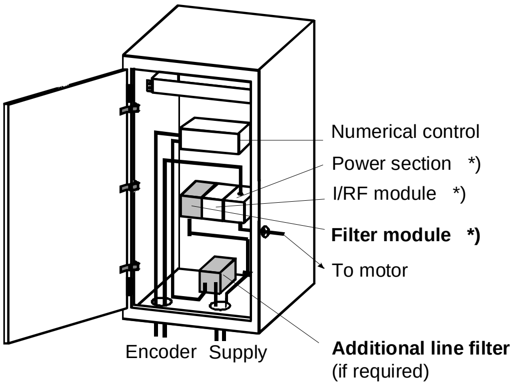
Filter modules of SIMODRIVE or STEPDRIVE are needed to be able to observe the limit values stipulated by the EC EMC Directive. They prevent internal converter interference from coupling onto the mains supply cable. For practical purposes, they are installed directly next to the infeed/regenerative feedback module (see diagram below). As an alternative, they can also be installed directly next to the cubicle mains supply infeed.
SIMODRIVE filter modules are designed specially for RI suppression in SIMODRIVE 611 converters and may not be used on other systems.

Additional line filter

If it is necessary to install an additional line filter for other loads in the control cubicle (see SIMODRIVE Planning Guide), the following points must be noted:

- Line filter must be mounted near the cubicle mains supply infeed.
- Line filter must be conductively bonded over large surface area with cubicle housing.

Mounting example for filter module and line filter (diagrammatic sketch)

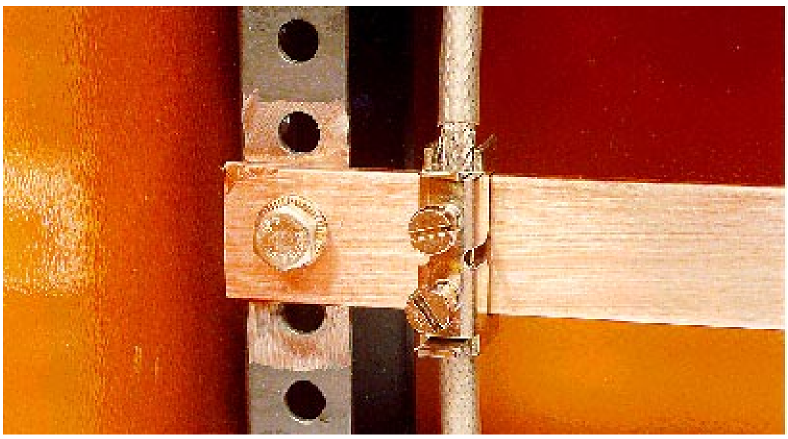


*) = SIMODRIVE components

Shielding buses

The shielding bus to which cable shields are attached must be connected (metal-to-metal) over a large surface area with the transoms.

Example: Mounting of shielding bus



Central earthing bars /PE conductor bar

The central earthing bar or PE conductor bar must be connected (metal-to-metal) over a large surface to the transoms. It must be located in the direct vicinity of the cable gland. Furthermore, the central earthing bar must be connected via a lead to the PE conductor system (earth). Only in this way can fault and transient currents be safely discharged.

Prevent personal injuries!

Dimensioning and installation of the PE conductor system must be carried out by a specialist according to the relevant VDE and EU guidelines.

5.3 Cable routing, shielding and grounding

Cable routing in groups

Power and signal cables must always be routed separately. For this purpose, the different types of cable are divided into groups. Cables in the same group can be bundled together. The different groups are then routed at the appropriate distance from one another (see Section 7, *Installation of Cables*).

Basic rules for routing cables

Power cables and signal cables (24 V control signals, data leads and analog signals) must enter the cubicle on opposite sides. Power cables must be routed separately from signal cables in metal ducts.

- Install control circuits for contactors (AC 230 V) separately from signal cables wherever possible.
- Route cables as close as possible to the cubicle body.
- Cables belonging to the same circuit (supply and return conductors) must be routed closely together inside the cubicle.
- For further information, see Section 7 *Installation of Cables*.

Basic rules for shielding

- The shield must be contacted immediately at the point the cable enters the cubicle unless the product-specific documentation specifies some other bonding method.
- Special shielding buses should be provided for low-impedance shield bonding.
- The cable clamp must contact the full circumference of the shield braid so as to ensure an effectively conductive connection between the shield and the cubicle ground.
- Do not interrupt shields.
- For further information, please see Section 6, *EMC Wiring, Shielding and Shield Bonding.*

6 EMC Wiring, Shielding and Shield Bonding

What is the purpose of shielding?

The term "Shielding" refers to any measures taken to decouple critical circuits and conductors from nearby potential interference sources that may couple into them. Such measures must take account of the shielding effect of cubicles, metal cable ducts, connector housing and the cable braided shield. Shielding is therefore a complementary practice to filtering and is applied to eliminate EMI-related performance degradation in electrical installations.

What additional measures are required?

Optimum shielding is dependent on the provision of conductive bonding between the shield ends and the cubicle frame or shielding bus.

What is the simplest measure?

It is always advisable to use the product-specific, standard original cabling since this has been verified as complying with EMC legislation and the EC EMC Directive. Connector types other than those specified in the product documentation must not be used.
As a general rule, standard cables as well as cables connected to product components are provided with the required shield termination. The bond between the shield and the enclosure is implemented at both ends by means of the connector except in a few cases. The best shielding effect is achieved by connecting the shield to ground at both ends. Special additional measures are described in Section 11 "EC Declaration of Conformity" or in the product-specific documentation.

When is single shielding sufficient?

Cabling with a single shield layer is normally sufficient for EMC purposes in most industrial plants. Connecting both ends of the cable shield to ground is the most effective shielding measure for such cabling.

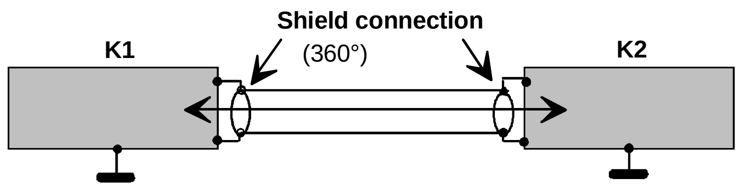
When is double shielding required?

This type of shielding can be of advantage for protecting signal transmission cables in particulary highly EMI-polluted environments.

6.1 Rules of thumb for bonding shields of cables with single shield layer

Shield termination at both ends

As a general rule, the cable shield must be connected at both ends in a 360°, conductive contact with the enclosure to ensure that the cable is immune to HF interference.
If external equipment (e.g. printers, programming devices, PCs, etc.) is connected to the controls during servicing or start-up, the shields on the connecting cables must also be connected to ground at both ends. Interference will probably couple onto the cables if the shield is connected at one end only.

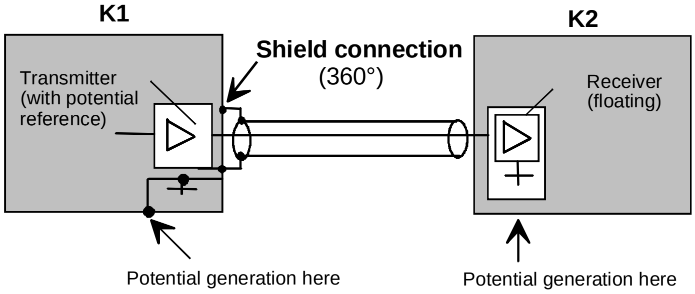


Shield termination at one end (special case)

In very exceptional cases, the shield may be terminated at one end only (e.g. purely analog systems with no digital components):
Cable shields terminated at one end provide only electrostatic protection against low-frequency, capacitive coupled interference and emission.
In the case of interference caused by external earth potential differences, it may be necessary in individual cases to bond only one end of the shield with the enclosure ground even when equipotential bonding is provided between the components to be connected. To increase the effect of the shield, the open shield end can be connected capacitively with the enclosure ground.

Shield bonding with termination at one end

The shield must be bonded at the end at which the electronics reference ground is connected to the enclosure.
If both devices (source and receiver) are floating, then the shield must be connected at the receiver end.
If the source and receiver are both connected to ground, then the shield must be connected at both ends.



Shield connected at one end with transmitter referred to potential

6.2 Supplementary shielding measures

6.2.1 Measures for power cables (on converters)

Shield connection at control end

All cable shields must be connected in a 360° contact that is as close as possible to the terminal in the control unit. On components that have no special shield termination, the contact must be made by means of conduit clips or serrated bar on the bare-metal cubicle mounting panel. Whatever method is chosen, it is absolutely essential to keep the cable between the shield bonding point and the terminal as short as possible.
Shielded backshells with preassembled clamp contacts and mounting points for brake terminals are generally available for contacting the shields on shielded cables.

Shield connection at motor end

If the motor has a brake, the shield of the brake supply cable must be connected at both ends together with the power supply cable shield.
If no proper shield termination is provided at the motor end, then a screwed connection that allows a large-area shield-motor bond to be made must be provided in the terminal box.

Version with comprehensive shielding

A metal duct with a large-area contact cover can be used to shield motor power supply and mains supply cables. The shield/cable duct must be bonded to the appropriate components (converter module, motor) over a large area at both ends.

Protect personnel against injury!

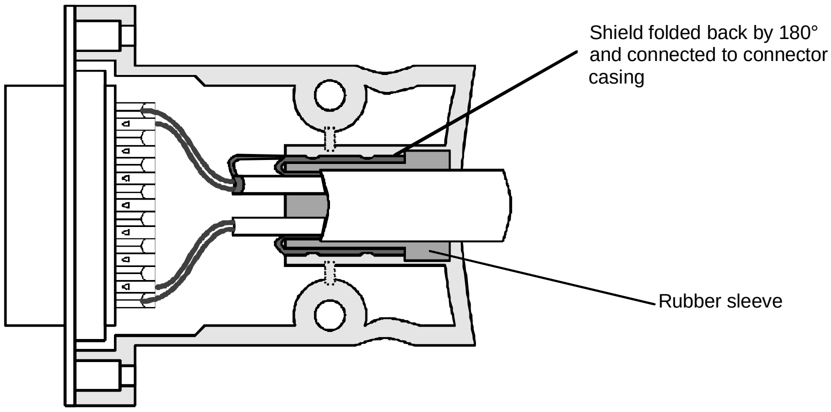
Unused cores of power cables (e.g. brake conductors) and their shields must be connected to earthed enclosure potential at one end at least to ensure discharge of potential caused by capacitive overcoupling.

Failure to implement this precaution might result in potentially lethal shock voltages on unearthed shields and conductors.

6.2.2 Interruption in cable shield

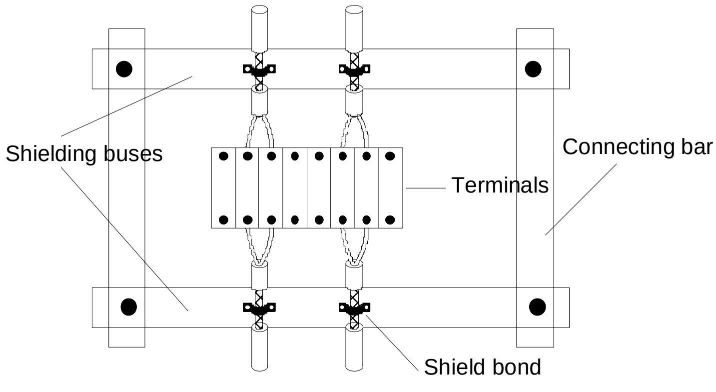
Intermediate connectors

If it is necessary to interrupt shielded cables, the shield must be continued by the connector housing at the interruption point. Only suitable connectors (HF-proof type with good shield bonding) may be used for this purpose.



Terminals

Normally speaking, only specially designed connectors and connector housings may be used to continue the shield at points where it is interrupted. However, in exceptional cases where it is absolutely essential to interrupt the shield and untwist the cable conductors, the cable must be screwed in a 360° contact to a shielding bus before and after the connector (terminal).
The following diagram shows the basic layout of a terminal junction point.



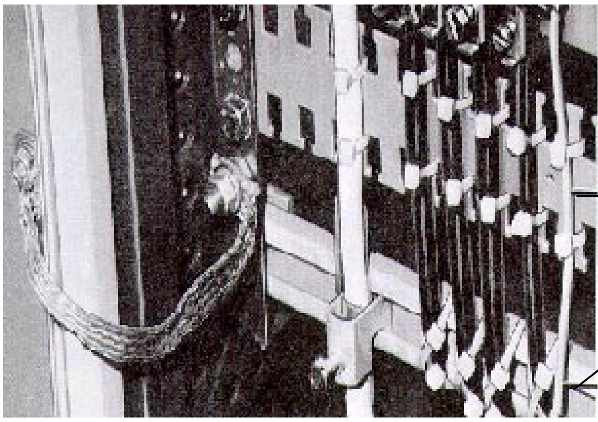
6.3 General information

Shielding bus

The earthing bar or the equipotential bonding bar (if additionally installed) can be used as the shielding bus. The earthing bar is the protective earth, the equipotential bonding bar the functional earth. It is also permissible to provide just one earthing bar which then doubles as the equipotential bonding bar.

Cable clamping rail

The cable clamping rail provides cable strain relief. Two methods of strain relief are shown in the following diagram.



Shield bonding

The shield should be connected to a shielding bus immediately after the cable enters the cubicle and then taken onto the module. The product-specific pre-assembled cables are designed such that effective shield bonding is provided when the connector is screwed to the component housing.

Attachment of shield braid

Metal cable clamps should be used to connect the shield braid to the cubicle enclosure wherever possible. The clamps must hold the shield in a 360°, conductive contact.

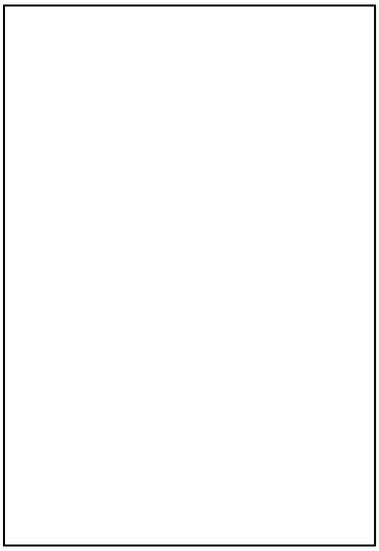
6.3.1 Examples of shield bonding methods

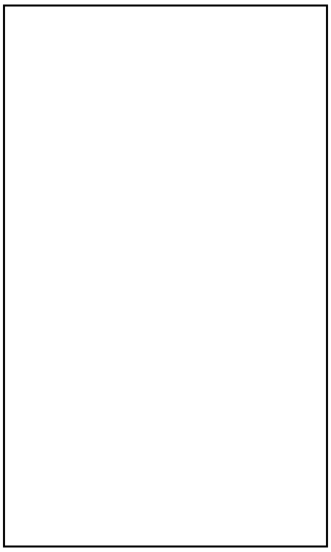
Optimum shield bond

The two photographs below show the shield directly bonded to the equipotential bonding bar.

The picture shows terminals on a copper bar. The maximum cable diameter is 15 mm
Order No. 8US1921-2AC00 (5 mm)
8US1921-2BC00 (10 mm)

The picture shows bar-mounting terminals on a copper bar. The maximum cable diameter is 10 mm.
Order No. 8HS7104, 8HS7174,
8HS7164





Note
Take care not to squash cables by tightening the terminal screws too tightly (Order No. 8US1921-2AC00 and 8US1921-2BC00).

Good shield bond

If the cable cannot be connected directly to the equipotential bonding bar, good shield bonding can also be achieved by connecting the cable shields with a cable clamping rail.

Connection of cable via U clamp.

Clamp and metal counterpart on a cable clamping rail.
Order Nos. 5VC5540... and 5VC7641...

SIMODRIVE 611 A/D motor power supply cable

SIMODRIVE 611 A/D motor power supply cable:
Shield contacting by means of shield bonding clamp on shielded backshell

7 Installation of Cables

7.1 Cable routing

Basic principle

Signal and power leads must be routed at the greatest possible distance from one another. If it is not possible to adequately segregate the cables, then shielded cables in shielding, earthed cable ducts (made of metal) must be used.

Cable installation

All cables in the control cubicle must always be routed as close as possible to mechanical housing components (e.g. control cubicle panels, mounting plates, transoms, metal rails). Interference may couple onto long sections of cable routed through free space (antenna effect).

- Signal and power cables may cross one another if unavoidable, but must never be routed in parallel.
- Signal and data cables must be routed separately from heavy-current and power supply cables (to avoid coupling paths). Minimum separating distance in cubicle: 20 cm. Use earthed partition if necessary.
- Unscreened cables in the same circuit (supply and return conductors) must be twisted if possible. If they cannot be twisted, the conductors must be routed as closely as possible to one another.
- Signal cables and their equipotential bonding conductor must be routed as closely as possible to one another.
- Signal cables must never be routed passed equipment that generates strong magnetic fields (e.g. motors, transformers).
- Wherever possible, all signal/data cables should enter the cubicle at the same level (e.g. at bottom of cubicle only).
- Never install extra lengths of cable that are not required (including spares).
- Signal cables - particularly those carrying setpoint and actual value data - must be installed without interruption. At unavoidable points of separation, it must be ensured that the shield remains intact.
- Continuous shield bonding must be provided at interruption points in shielded cables.
- High-current/high-voltage cables that are subject to clocked pulse phenomena must always be routed completely separately from all other cables.
- Always support cables on metal cable bearers.
- Ensure that cable bearers are conductively bonded at points at which they contact.
- Earth cable bearers.

Provide lightening protection (internal and external) as well as earth protection inasmuch as they apply to the particular application.

Cable length

- Do not install any unnecessary extra lengths of cable. This will help to minimize coupling capacitance and inductance.
- Keep spare cabling as short as possible.
- Connect at least one end of cores of spare cables to a potential, connect them to earth where possible.

7.2 Termination conditions

Use original cables

The pre-assembled original cables recommended by the manufacturer must be used. Do not exceed the maximum permissible cable length specified for the application in question. You will find information about cable lengths in the product catalog or in the product-specific documentation. These lengths refer to original cabling supplied by the manufacturer.

Protect cables

- Protect cables and connectors against mechanical damage, e.g. by means of cable ducts or covers
- Take measures to prevent oil, coolant or chippings from penetrating connector casings.

Contact connectors properly

Attach connectors securely to modules.

Use special cables

Special-purpose cables must be used for trailing-cable applications.

8 Filtering

The purpose of filtering is to attenuate interference that is conducted along connecting cables. For this purpose, filters are inserted in the EMI transmission path between the emission source and the victim. Filters reduce the conducted EMI emitted by the source and increase the immunity of potential victims without having an adverse effect on useful signals.

Filtering and shielding are complementary EMC measures.

8.1 Suppression of inductive loads

Suppression measures

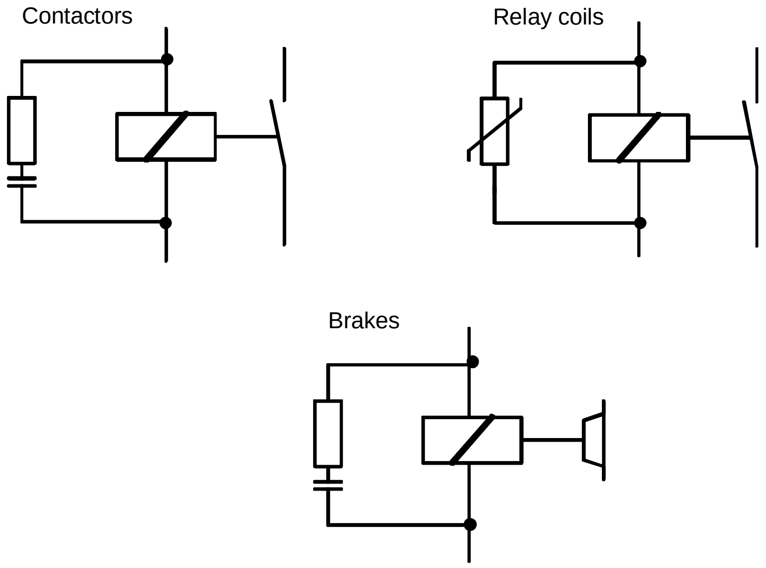
Relays, contactors, valves, motor brakes and basically all types of coil (inductances) generate induction voltages when the current through them is interrupted and must therefore be equipped with suppression elements. 24 V coils, for example, generate transient voltages of 800 V while several 1000 V may be present at the switch when the current through a 230 V coil is interrupted.

RC suppression circuits are effective in attentuating the very high transient voltages that switched coils can generate. The suppression circuit sharply reduces the transient voltage, thus preventing the interference from coupling onto cables running in parallel to the coil cable.

Note

Free-wheeling diodes on modules are suitable only for suppressing cable inductance. They cannot replace direct coil suppression equipment.
Coil suppression equipment must be fitted directly to the coil.

Interference suppression measures

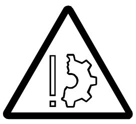

Contactors
Relay coils
Brakes

8.2 Filters on SIMODRIVE

In order to maintain emitted interference to within the limits specified in basic technical standard EN50081-2, filter modules must be installed on the SIMODRIVE drive control system. These modules are specifically designed to filter out the interference generated by the converter. They may not therefore be used as interference filters for other loads in the installation.
In addition to reducing radio interference voltage to within the 150kHz to 30Mhz range specified in EN50081-2, these filter modules for closed-loop-controlled mains supplies also attenuate conducted interference in the frequency range below 150 kHz (thereby reducing phase effects on supply system).

Filter installation in control cubicle

- System-specific filters such as SIMODRIVE filter modules must be installed as required by the system design in accordance with the installation instructions in the manufacturer's documentation.
- The filters should be mounted so that a conductive contact over a large area is provided. Painted cubicle panels, DIN rails or similar mounting equipment with a small support surface and inadequate potential bonding are not suitable as mounting surfaces for converters and filters.



Prevent material damage!

Usually, SIMODRIVE filters heat up heavily in the vicinity of the internal resistors. To protect the adjacent components (distance < 400 mm), it can be necessary to install a heat conducting spacer.

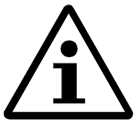
Wiring

Filter supply and return cables must be routed separately.
Power and signal cables must always be routed separately. The practical solution in this case is to route the power cables of the converter module downwards and the encoder cables upwards in order to separate them by the greatest possible distance - see also Section 5.3, *Cable routing, shielding and grounding*.

To maintain emitted interference to within the limits specified in EN50081-2 all motor and supply cables must be shielded. An earthed metal duct with large-area, conductive contact cover can be used as an alternative. 360° bonding of the shield to the appropriate components (motor, converter) must always be provided.

Functional earthing Functional earthing is implemented by installing the filter in the cubicle such that it is conductively contacted over a large area. If it can only be mounted such that it is more or less insulated, then functional earthing must be provided by means of an equipotential bonding conductor.

Protective earthing The existing specifications for protective earthing apply. However, additional measures are required owing to the high leakage currents caused by converter equipment.



Note
VDE stipulates that a PE conductor may only carry currents of a few mA.
Since the interference currents occurring with converter filters are generally higher than permitted, measures defined in pr EN 50178/94 part 5.3.2.1 must be implemented, e.g.
Install a second conductor via separate terminals in parallel to the PE conductor. This equipotential bonding conductor must also fulfil the requirements of PE conductors specified in IEC 364-5-543,
Use a PE conductor with a cross-section of $\geq 10mm^2$

Protect personnel against injury!
Cable shields and unused cores of power cables (e.g. brake wires) must be connected to PE potential at one end at least to ensure discharge of potential caused by capacitive overcoupling. Failure to implement this precaution might result in potentially lethal shock voltages on unearthed shields and conductors.

9 Elimination of EMI-Induced Malfunctions

9.1 Trouble-shooting

Trouble-shooting is greatly facilitated if malfunctions caused by interference are monitored and recorded precisely. The more exact the description of the malfunction, the more targeted and effective the fault correction measures. Make sure that the description you give is not misleading.

Interference source

Localization of interference source

- Is the malfunction continuous or occasional?
- Is there a connection between the occurrence and frequency of malfunctions with the operation of other equipment? Do the malfunctions occur in certain operating modes?
- Is it possible to identify the interference source by switching off devices within the system one at a time?
- Check the system supply voltages.

Victim

Localization of victim equipment

- Is it absolutely certain that the malfunction is not being caused by a hardware or software error?
- Does the system include devices or plant components that are not operating correctly, but which malfunction in such a way that they can effect the whole system (e.g. encoder) without the source of the disturbance being directly identifiable?
- Use the diagnostic tools (LEDs, error indicators, error counters, ...) provided by the systems to determine which device is malfunctioning.
- To narrow down the search for the affected device, it is helpful to switch off / disconnect / replace parts of the system.

Switch off parts, for example, by

– changing the operating mode

– deactivating functions

Coupling paths

Reduction of interference coupling
Once the interference source and victim have been localized, the coupling paths (see Section 3) must be eliminated in accordance with basic EMC rules.

9.2 Elimination of EMI-induced malfunctions

There are three possible approaches to eliminating the malfunctions caused by inadequate EMC:

- Eliminate or reduce the interference emitted by the interference source (coil suppression elements, filters, shields,...).
- Increase the interference immunity of the victim device (filter, shielded enclosure, ...).
- Eliminate coupling paths to remove routes by which interference can be conducted from the source to the victim (e.g. increase distance between power and signal cables, install shielded cables, route cables along metal components, etc.).
- Make sure that you have implemented the measures described in this Installation Guideline and the product-specific documentation.

Nature of malfunction	Possible cause	Elimination of malfunction
Sporadic failure	No suppression equipment on coils of contactors, valves, horns, ...	Install coil suppression equipment.
	Spark-generating machines (welding equipment) near victim	Reroute cables of control system (increase distance to emission source).
	Radio transmitter, ripple control system	Additional shielding
	Cables with incorrectly terminated shield, incorrectly twisted cables or with unsuitable characteristics	Use original cables, check conductor assignments.
	Interruption in cable shield (e.g. where cable junction box is inserted)	Connect cable shields, provide shielding on interruption point (e.g. on junction box).
	Incorrectly installed equipotential bonding lead	Install bonding lead again (see Section 4).
	Clogging/dirt deposits on control components	Clean control components/modules, make sure inlet air is clean.
Permanent axis offset	For possible causes, see "Sporadic failure"	See "Sporadic failure" for elimination measures. The actual value lead is likely to be the victim. Install equipotential bonding lead between encoder casing and control housing or improve equipotential bonding system.
Rough, uneven machining surface	Inadequate equipotential bond between position encoder and control system	Provide effective, large-area, bare-metal, corrosion-protected ground connection between control and position encoder. (Where bonding lead is used: Increase cross-section, make direct connection).
	High compensating current on setpoint cable shields (analog setpoint)	Disconnect shield at control system end.
	Where drive control is supplied by other manufacturer: Setpoint input on drive control is not compatible with Siemens EMC strategy	Modify input circuit on drive control (to match circuitry of Siemens drive controls)

Nature of malfunction	Possible cause	Elimination of malfunction
"Shaky" screen characters or screen display	Monitor is installed near device that generates magnetic field (e.g. transformer, electric motor) or current-conducting cable.	Increase distance between screen and interference source, shield screen or source with MUMETALL in extreme cases.
Areas of incorrect colour shading of screen information and background	Magnetic field of a nearby permanent magnet	Eliminate interference source, shield source with MUMETALL Note: Display disturbance does not disappear for several days after elimination of cause if no demagnetization measures are taken.
Encoder error	Encoder cable shield interrupted, cables with inadequate shielding, encoder cable shield bonded via separate wire/conductor.	Use original cables (for specific product), connect shield at both ends.
Telephones, fax machines, copiers make "whistling" noises	Short-circuit power of supply system too low	Increase short-circuit power of supply system drastically, connect victim devices to another supply, install SIMODRIVE filter module.
Blown fuses on small power packs	Short-circuit power of supply system too low	Increase short-circuit power of supply system drastically, connect victim devices to another supply, install SIMODRIVE filter module.

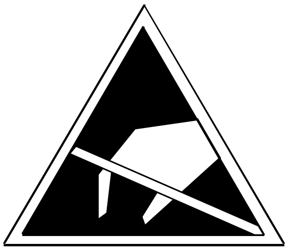
10 Handling of ESD-Sensitive Modules (ESD)

10.1 What does ESD mean?

Definition: ESD/ESD-sensitive components

As a result of the technologies employed on electrical and electronic modules, these components are extremely sensitive to overvoltages and thus to any electrostatic discharge.
Electro**s**tatic **d**ischarge is frequently referred to by the abbreviation **ESD**.
ESD-sensitive devices are labelled with the following symbol:

Symbol



Caution
ESD-sensitive modules can be destroyed by voltages that are well below the limit of voltage that is perceptible to human beings. If you do not discharge your body electrically before touching an ESD-sensitive component, you might be carrying a voltage that will destroy the device. The damage caused to a module as a result of overvoltage cannot be detected immediately in most cases, but only becomes evident after it has been in operation for a considerable period.

10.2 Electrostatic charging of people and objects

Charging

People and objects that have no conductive connection to the electric potential of their surroundings may be electrostatically charged.
The following are examples of such charges:

- Plastic covers or insulating foil up to 5 000 V
- Plastic-coated books/notebooks up to 8 000 V
- Person when
  walking on plastic flooring up to 12 000 V
  sitting on padded chair up to 15 000 V
  walking on synthetic carpet up to 15 000 V

Discharge current/energy

If, for example, a voltage of 10 000 V is discharged because its carrier (person/object) comes into contact with a component, then a discharge current of 15 A can flow briefly. The electrical energy that the component concerned must absorb in this case is about 10^{-3} Ws. This is sufficient energy to destroy, or at least damage, semiconductors such as integrated circuits, rectifiers and signal diodes.
Carefully note and apply the protective measures described below to protect and prolong the life of your modules and components.

10.3 Packaging and shipment of ESD-sensitive modules

Use conductive packaging

Use original conductive packaging where possible for single components and modules that have no enclosure. You can also use metallized plastic boxes or plain cardboard. Always store ESD-sensitive modules in their high-resistance, conductive original packaging.

10.4 Basic protective measures against electrostatic discharge

Prevent electrostatic charges

The best possible protection against the effects of electrostatic discharge is to take measures to prevent the development of electrostatic electricity in the vicinity of sensitive devices.

Take care when handling plastics

Take particular care to prevent plastics coming into contact with sensitive modules since most types of plastic are easy to charge statically.

Provide effective, reliable earthing

When you are handling ESD-sensitive modules, make sure that you, your workstation and the device packaging are earthed across a high resistance (200kΩ to 1GΩ).

Avoid direct contact

Do not touch ESD-sensitive modules unless it is absolutely essential. If you must handle them (e.g. to repair them), make sure that you do not touch component pins or printed conductors. In this way, it is possible to prevent discharge energy from reaching and damaging sensitive module components.

Avoid "hard" discharges

If it is fundamentally impossible to prevent electrostatic charges, a means by which these can be discharged "softly, e.g. via a high resistance of R>200 kΩ, should be provided.

Always use earthed equipment/ instruments

Measurements or soldering jobs may be carried out on ESD-sensitive modules only if

- the instrument/tool is earthed (e.g. via PE conductor) or
- the probe on isolated measuring instruments is discharged before the measurements are taken (e.g. by holding it briefly in contact with earthed metal parts)

Special care with respect to ESD-sensitive modules

Note the following measures in respect to modules with ESD-sensitive components that are not protected by an enclosure and are labelled accordingly (see label at the beginning of this section):

- Do not touch ESD-sensitive modules unless

– you are earthed via an anti-static wristband or

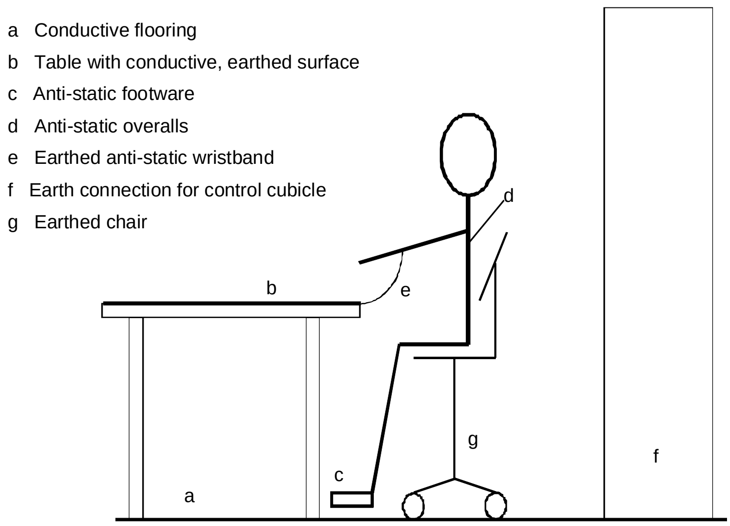
– you are wearing anti-static footwear or earth straps when walking on an anti-static floor

– you have removed all clothing made of synthetic materials or are wearing an anti-static overall.

- Discharge your own body before starting work on the module. To do so, touch an earthed metallic object.
- Safeguard modules against contact with chargeable and highly insulating materials such as plastic foils, insulating table tops or clothing made of synthetic materials.
- Place sensitive modules only on high-resistance, conductive surfaces such as:
  - Table with anti-static surface
  - Conductive anti-static foam or anti-static packaging,
  - Normal, plain cardboard should be used as a provisional material when required.
- Do not bring ESD-sensitive modules into the immediate vicinity of equipment that generates strong electromagnetic fields such as visual display units, monitors or TVs (minimum distance from screen > 10 cm).

Protective measures against ESD

The measures required to protect sensitive components against ESD are illustrated again in the diagram below:



11 EMC Legislation, CE Marking and EC Declaration of Conformity

11.1 Information about EMC legislation

Validity of EMC legislation

EMC legislation pertaining to the electromagnetic compatibility of equipment/installations, which implements Directive 89/336/EEC of the Council dated May 3, 1989, came into force on January 1, 1996. All equipment/installations that can cause electromagnetic interference or which may malfunction as the result of operating in an EMI-polluted environment are subject to this EMC legislation.

Marking

Devices which

- are capable of independent operation or
- are commercially available

require the CE marking and its complementary declaration of conformity. The CE mark is attached to the product itself, or its packaging or included in the covering documentation.
Devices that are merely supplied to system builders as bought-in or spare parts do not require a CE mark or declaration of conformity to comply with EMC legislation. Likewise, no CE mark is required for installations that are assembled at the operating site (e.g. control cubicles).

Conformity of installations

Interference emissions and immunity of installations are dependent both on product-specific properties and on factors such as plant configuration, equipment combinations, cable configuration, cable lengths, etc. To check compliance with the permissible EMC limit values allowing for all these factors and their variations would involve endless testing. EMC of the complete installation is therefore measured on representative configurations within the installation and then verified by the appropriate declaration of conformity.

Note
If the difference between the machine plant configuration and plant configurations that are verified by the declaration of conformity is so great that a degradation in EMC is likely when machinery is operated, it may be necessary to take EMC measurements on site. In this case, please contact your local Siemens Sales Office.

11.2 Information for machine manufacturers

Introduction

The SINUMERIK / SIROTEC control systems and SIMODRIVE drives are not actually machines as defined by the EC Machinery Directive. The electronic controls only constitute machines once they are linked with the units to be controlled. They are not therefore provided with a declaration of conformity in respect of EC Machinery Directive 89/392/EEC.

EC Machinery Directive 89/392/EEC

The EC Machinery Directive 89/392/EEC defines the requirements that a machine must fulfill. A "machine" in this case is an assembly of linked parts or components (see also EN 292-1, para. 3.1).
The Siemens controls form part of the electrical equipment of a machine. The machine manufacturer must therefore include them in the declaration of conformity certification process.

11.3 CE marking / EC declaration of conformity

CE marking

Products that carry the CE mark are certified as fulfilling the requirements of EC Directive 89/336/EEC "Electromagnetic Compatibility" and the relevant harmonized European standards (EN). The CE mark is the visible proof that the product complies with the requirements of the appropriate Directive.
The EC declarations of conformity for these products are kept available to the competent enforcement authorities by the relevant department of the Siemens AG Automation Group in accordance with Article 10 of the above EC Directive.

EC declaration of conformity

A CE mark cannot therefore be obtained without an EC declaration of conformity. In the case of assembled products or complete installations, the declaration of conformity represents the externally attached CE mark.

All products listed in a declaration of conformity fulfill the requirements of EC Directive 89/336/EEC "Electromagnetic Compatibility" and the relevant harmonized European standards (EN) within the specified installation.

The EC declaration of conformity attests to compliance with the required EMC limit values. A copy of the declaration can be found in this Section and in the product-specific documentation (Planning Guide in most cases).

Area of application

The products listed in the declaration of conformity are EMC-designed for industrial applications. They fulfill the following requirements.

Area of application	Products fulfill requirements	
	EMI emission	EMI immunity
Industry	EN 50081–2	EN 50082–2

With an individual test certificate for emission characteristics, these products may also be used in residential areas (residential, commercial and trade areas, small-scale industry). This individual test certificate must be obtained from a competent authority or test house. Such certificates are issued in Germany by the Federal Post and Telecommunications Agency and its branches.

Area of application	Products fulfill requirement	
	EMI emission	EMI immunity
Residential area	Individual test certificate required	EN 50082–2

Observe guidelines

The products fulfill the appropriate EMC requirements if:

1. You install and operate them in accordance with the Installation Guidelines provided in the relevant product documentation,
2. You also follow instructions relating to

– installation of equipment

– working on control cubicles and

– observe information pertaining to individual modules.

3. You always observe the appropriate EMC installation guidelines for the products concerned.

Certificate of Conformity

All components admitted for equipment integration of SIMODRIVE MCU 172A as set forth in the Planning Instructions Part 2, Devices (Order No. 6SN1 197-0AA00-0AP2), in interconnected operation comply with the Guideline 89/336/EWG.

- Conformity to the standards, see Appendix C, Section 11.4
- EU Certificate of Conformity, see last page of this Chapter

11.4 Appendix C to the EU Certificate of Conformity No. 002 V 27/11/96

The compliance of the products with the Guideline of the Council 89/336/EWG has been proved by verification acc. to the Basic Specifications and the Basic Standards listed therein:

Basic Specification: EN 50081-2 as per 8/93
Basic standards:
EN 55011 1)

Basic Specification: EN 50082-2 as per 3/95

Basic standards:	Test item:
ENV 50140 2)	Radio-frequency interference
ENV 50141 3)	HF interference to lines (amplitude-modulated)
ENV 50204	HF interference to lines (pulse-modulated)
EN 61000-4-8	4) Magnetic fields
EN 61000-4-2	5) Static discharge
EN 61000-4-4	6) Fast transients (burst)

Standards that are also complied with:
to 1): VDE 0875 Part 11
to 2): VDE 0847 Part 3
to 3): IEC 801-6
to 4): VDE 0847 Part 4-8
IEC 1000-4-8
to 5): VDE 0847 Part 4-2
EN 60801 Part 2
IEC 801-2
VDE 0843 Part 2
to 6): VDE 0843 Part 4
VDE 0847-Part 4-4
IEC 801-4

SIEMENS

EU Certificate of Conformity

No. E002 V 27/11/96

Manufacturer: SIEMENS AG

Address: SIEMENS AG AUT 2
Frauenauracherstraße 80
91056 Erlangen

Product Designation:	SINUMERIK	850, 805M-P, 805M-TW, 810, 810D, 820, 840C, 840CE, 840D, 840DE, FM NC, FM Lage, FM Schritt, FM Stepdrive
	SIROTEC	RCM1D, RCM1P
	SIMODRIVE	610, 611A, 611D, MCU

The products listed above comply with the standards of the following European guideline:

89/336/EWG Guideline of the Council to match the legal instructions on electromagnetic compatibility in the member states (amended by 91/263/EWG, 92/31/EWG and 93/68/EWG)

The compliance with this guideline requires the products to be installed in the entire equipment according to the relevant EMC guidelines.
For equipment configurations whose compliance with these guidelines has been proven, as well as standard applied to see:

- Appendix A1 - A14 (Equipment Configurations)
- Appendix B1 - B7 (Components)
- Appendix C (Standards)

SIEMENS

Erlangen, Nov 27, 1996

R. Müller Development Dept.	K. Krause Quality Management
Name, Title Signature	Name, Title Signature

The Appendix is integral part of this Certificate.
The Certificate is to certify compliance with the abovementioned guideline but is not a warranty of any characteristics in the sense of product liability.
The safety notes to the supplied products must be followed.

12 Appendix

Contents

12.1 Index

A

C

D

E

F

G

H

V

W

12.2 Abbreviations

Abbreviations	Definition
$\omega=2\pi f$	Angular frequency
AC	Alternating Current
AG	PLC (programmable logical controller)
AUT	Automation Group at the Siemens AG
C	Capacity
CE	Communautès Europèens
CPU	Central Processing Unit
DA	Digital output
DC	Direct Current
DE	Digital input
DIN	German Industrial Standards
E/R	Stabilized power supply/recovery module
EMC	Electromagnetic compatibility
EN	European standard
ESD	Electrostatic Sensitive Device
EU	European Union
EWG	European Economic Community
f	Frequency
FM	Function module
H	Magnetic
HF	High frequency
I	Current
IEC	International Electrotechnical Commission
L	Inductivity
L1, L2, L3	Phases
M	Ground
MCU	Motion Control Unit
MPI	Multi-Point Interface
N	Neutral (conductor)
NC	Numerical Control
NF	Low frequency
P	Equipotential bonding conductor
PE	PE conductor
PG	Programming unit
R	Resistance
SPS	Programmable logic controller
SV	Power supply
U	Voltage
UE	non-stabilized supply module
VDE	Association of German Electrotechnical Engineers
Z	Impedance

SIEMENS

SIMODRIVE 611

Single-Axis Positioning Control MCU 172A

Description
Error Messages

Valid for: MCU 172A V 3.x or higher

Edition March 1998

Note:

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please enquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

General

Invocation DB

With the exception of the diagnostic interrupts, all error messages of the position control caused by the user program are provided by the invocation DB, organized by data error, operator error and operating and traversing error.

Diagnostic buffer of the CPU

All errors, with the exception of the occurring errors, including drive alarms and run-up errors, are entered into the diagnostic buffer of the CPU. The elements of the diagnostic buffer are structured as follows:

Byte 0/1 (module event number)			
Event class EKL	Identifiers KEN	Diagn.-type class DGTK	Group-event no. SEN
(4 Bit)	(4 Bit)	(4 Bit)	(4 Bit)
F Module events	1 Error arrived 0 Error left	Module-type class: 8 (FM)	Class identifier: 1 (positioning)
Byte 2/3 (detailed event number)			
Error number as described in the Error Lists			
Byte 4 (additional information Z4)		**Byte 5 (additional information Z5)**	
Axis number		Axis name (coded)	
Byte 6/7 (additional information Z1)			
Additional parameter 1			
Byte 8/9 (additional information Z2)			
Additional parameter 2			
Byte 10/11 (additional information Z3)			
reserved			
Byte 12-19 (time stamp in S7 format)			
Time stamp (date/time)			

Entry in the diagnostic buffer acc. to MD6

Byte 5 (add. information Z5)	**Value/description**	**Unit**

Axis name (coded)	Bit 0 ... 3 axis letter 0 = X 1 = Y 2 = Z 3 = A 4 = B 5 = C 6 = U 7 = V 8 = W 9 = Q 10 = E Bit 4 to 7 address extension (one-digit) 0 = no address extension 1 = 1 : 9 = 9	-

Indication

In MCU-PIT, errors are indicated with text and time of their occurrence.

Diagnostic interrupts

Diagnostic interrupts are identified by setting the respective bits in the diagnosis data record (DS0/1).

Error class	Group-error message	Coding
Internal errors	Bit 0.1	Bit 3.x
External errors	Bit 0.2	Bit 0.x
Channel errors	Bit 0.3	Bit 8.x

Error processing

Error class	Message/ indication	Internal error response	Error acknowledgment after error removal
Internal errors	Diagnostic interrupt LED SF - On	all OFF	none
External errors	Diagnostic interrupt LED SF - On	all OFF	RESTART
Channel errors	LED DIAG - On		
Operating and traversing errors	Technological functions Diagnostic buffer	Feed STOP or all OFF	Technological functions
Operator errors	Technological functions Diagnostic buffer	Feed STOP	Technological functions
Data errors	Technological functions Diagnostic buffer	WARNING	Technological functions
	Data block		Overwriting with the correct data
Machine-data errors	Diagnostic buffer	Run-up ABORTION	Overwriting with the correct data + Power ON
	Data block	CONTROLLE R INHIBIT	Overwriting with the correct data
Traversing-program errors	Technological function	WARNING	Technological functions
	Diagnostic buffer		Overwriting with the correct data
	Data block		
Run-up errors	Diagnostic buffer	Run-up ABORTION	Power ON

Internal error response

Internal error response	Description

Run-up ABORTION	· blocking of the positioning functionality · no traversing movement possible · drive inactive
all OFF	· immediate stop of traversing · digital outputs are switched off · controller inhibit
Feed STOP	Traversing is decelerated to standstill via a brake ramp
WARNING	· message only · no influence to traversing or controlling of the axes
CONTROLLER INHIBIT	· no traversing movement possible · controller inhibit

Error Messages Provided by the Positioning Control

Contents

Diagnostic Interrupts

Bit 3.6 Process interrupt lost	Bit 0.1 Internal error
Response	all OFF
Acknowledgm.	none
Cause	Process interrupt could not be processed within a the position-controller cycle
Scan	• Axis movement is stopped and/or no axis movement possible • Synchronization is deleted
Remedy	This error should not occur in the normal mode. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

Bit 8.0 Cable break - incremental encoder	Bit 0.3 Channel error
Response	all OFF
Acknowledgm.	RESTART
Cause	• Encoder system cable not plugged or defective • Incorrect terminal assignment • Cable too long • Encoder without inverted track signal (signals $\overline{A}$, $\overline{B}$ missing)
Scan	• Axis movement is stopped and/or no axis movement possible • Synchronization is deleted
Remedy	• Check encoder and encoder cable. • Monitoring can temporarily be deactivated on the user's responsibility by means of MD20.

Bit 8.1 Transmission error - absolute encoder	Bit 0.3 Channel error
Response	all OFF
Acknowledgm.	RESTART
Cause	The telegram exchange between MCU and absolute encoder is faulty or interrupted: • Encoder cable not plugged or defective • Inadmissible encoder type • Encoder provides faulty values • Interference at encoder cable
Scan	Axis movement is stopped and/or no axis movement possible.
Remedy	• Check encoder and encoder cable. • Observe shielding and grounding instructions.

	• Monitoring can temporarily be deactivated on the user's responsibility by means of MD20.

Bit 8.2	Missing pulses - incremental encoder Bit 0.3 Channel error
Response	all OFF
Acknowledgm.	RESTART
Cause	• Missing pulses detected by the encoder monitoring. • No zero mark has been detected within one encoder revolution after leaving the reference-point switch in the operating mode "Reference point approach“. • Defective encoder • Zero mark defective or missing • Pulse length of zero mark less than 1.25 µs • Interference at encoder cable
Scan	• Axis movement is stopped and/or no axis movement possible. • Synchronization is deleted.
Remedy	• Check encoder and encoder cable. • Observe shielding and grounding instructions. • Monitoring can temporarily be deactivated on the user's responsibility by means of MD20.

Bit 8.3	Voltage monitoring - encoder Bit 0.3 Channel error
Response	all OFF
Acknowledgm.	RESTART
Cause	Short-circuit in encoder supply
Scan	• Axis movement is stopped and/or no axis movement possible. • Synchronization is deleted.
Remedy	• Check the connections. • Monitoring can temporarily be deactivated on the user's responsibility by means of MD20.

Bit 8.4	Hardware error - drives Bit 0.3 Channel error
Response	all OFF
Acknowledgm.	Power ON
Cause	• Hardware error signaled by drive (group error) • The number of the error in question is stored in the diagnostic buffer; indication via MCU-PIT
Scan	• Axis movement is stopped and/or no axis movement possible. • Synchronization is deleted.
Remedy	depending on the cause

Operating Errors

00257	Software limit switch beginning overtraveled
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Limit switch overtraveled either in the controlling or in the follow-up mode.
Scan	• Axis movement is stopped. • The limit switch position is overtraveled by the required braking distance. • Actual-value setting (if desired) is not carried out.
Remedy	• After acknowledging the error, traversing into the working range is possible. • Change the value for the software limit switch (MD21). • Switch the limit switch monitoring off. With the limit switches (MD21/22) turned off, the traversing range limits are determined by the maximum admissible values for the limit switches.

00258	Software limit switch end overtraveled
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Limit switch overtraveled either in the controlling or in the follow-up mode
Scan	• Axis movement is stopped. • The limit switch position is overtraveled by the required braking distance. • Actual-value setting (if desired) is not carried out.
Remedy	• After acknowledging the error, traversing into the working range is possible. • Change the value for the software limit switch (MD22). • Switch the limit switch monitoring off. With the limit switches (MD21/22) turned off, the traversing range limits are determined by the maximum admissible values for the limit switches.

00259	Traversing range beginning overtraveled
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	When traversing in the controlling mode and with the software limit switches off, the traversing range beginning has been overtraveled.
Scan	• Axis movement is stopped. • The traversing range limit is overtraveled by the required braking distance. • Synchronization is deleted.
Remedy	• After acknowledging the error, traversing into the working range is possible. • Switch the limit switch monitoring off. With the limit switches (MD21/22) turned off, the traversing range limits are determined by the maximum admissible values for the limit switches.

00260	Traversing range end overtraveled
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	When traversing in the controlling mode and with the software limit switches off, the traversing range end has been overtraveled.
Scan	• Axis movement is stopped. • The traversing range limit is overtraveled by the required braking distance. • Synchronization is deleted.
Remedy	• After acknowledging the error, traversing into the working range is possible. • Switch the limit switch monitoring off. With the limit switches (MD21/22) turned off, the traversing range limits are determined by the maximum admissible values for the limit switches.

00267	Direction of rotation of drive
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Drive rotates in the wrong direction.
Scan	• Axis movement is stopped. • No new traversing instructions possible.
Remedy	• Check drive. • Check MD19 and correct if necessary.

00268	Zero-speed control
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The zero-speed range has been left without traversing instruction provided.
Scan	Measuring-value acquisition is continued.
Remedy	• Check electrical and mechanical drive switching-off (terminals, cables, actuator functions). • Adapt MD26.

00276	RESET alarm drive
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	An error that can be acknowledged occurred at the drive. The number of the error in question is provided both from the diagnostic buffer of the CPU and via MCU-PIT.
Scan	• Axis movement is stopped. • Synchronization is deleted.
Remedy	depending on the drive alarm occurred

00277	Emergency retraction cannot be activated
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Emergency retraction enable (data record 8, control word1, bit2) cannot be set, since the drive machine data (A-MD) 1636 "Emergency Retraction mode" during the run-up could not be transferred without errors. Any emergency retraction mode can only be selected if A-MD 1161 "Fixed voltage of intermediate circuit" = 0 (see also Alarm 30764FEHLER30764, 30765FEHLER30765).
Scan	The Emergency Retraction function cannot be used.
Remedy	Set A-MD 1161 = 0 or do not use the Emergency Retraction function.

00346	System error No. 0
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ

Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00347	System error No. 1
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00348	System error No. 2
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00349	System error No. 3
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00350	System error No. 4
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error

Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00351	System error No. 5
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00352	System error No. 6
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00353	System error No. 7
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00354	System error No. 8
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error

Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

00355	System error No. 9
Response	all OFF
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Internal module error
Scan	Depending on the severity of the error
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

Operator Errors

00513	**Illegal operating mode**
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	The selected operating mode is not permitted.
Scan	Any active traversing movements are stopped. No axis movement is possible, as long as no permissible operating mode is selected.
Remedy	Select a permissible operating mode.

00516	**Invalid operating mode parameters**
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	The selected velocity or voltage step in the operating modes Controlling or Setting-Up is not 1 or 2. The setpoint number in the Jog mode is invalid (1 to 100 and 254 are permitted).
Scan	Axis movement is disabled.
Remedy	Set operating mode parameters to a permissible value.

00517	**Start enable missing**
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	A traversing instruction has been provided with Start Enable missing (Start, Start Externally, R Plus/ Minus).
Scan	Axis movement is disabled and/or stopped.
Remedy	Cancel traversing instruction and wait for Start Enable.

00521	**Axis not synchronized**
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ

Cause	The operating modes JOG, MDI and Automatic require the axis to be synchronized.
Scan	Axis movement is disabled.
Remedy	Carry out reference-point approach or reference-point setting.

00522	No valid MDI block
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	A traversing movement in the MDI mode has been started, with no valid MDI block transferred.
Scan	Axis movement is disabled.
Remedy	Acknowledge error, transfer valid MDI block and restart traversing movement.

00523	Illegal preset direction
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	In the operating modes Setting-up, Controlling or JOG, both the preset direction R Plus/ Minus are active. The preset direction during reference-point approach does not match with the approach direction set in the machine data.
Scan	Axis movement is stopped and/or disabled.
Remedy	Remove cause.

00524	Axis movement not possible
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	A traversing instruction has been provided with a fault not acknowledged, drive enable missing or stop provided.
Scan	Axis movement is disabled.
Remedy	Cancel traversing instruction and acknowledge error and/or deactivate the Stop command or provide Drive Enable.

00525	Incremental dimension does not exist
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	The setpoints set with the operating mode parameters are missing.
Scan	Start not possible.
Remedy	Parameterize and read in setpoint parameters.

00526	Program selection missing
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Program not yet selected during Start.
Scan	Start not possible.
Remedy	First preselect program, then start.

00527	Digital input not selected
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	The programmed set position was reached in a block with external block change (G50).
Scan	Axis movement is stopped.
Remedy	Check programming of MD46 - MD49 and external elements connected to the digital input.

00528	Measuring function not defined
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Both measuring functions Length Measuring AND Flying Measuring are selected.
Scan	No measuring function active
Remedy	Reselect ONE of the two measuring functions.

00533	No valid MD
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	No valid MD-DB at the module.
Scan	No traversing movement possible.
Remedy	Load error-free machine-data DB.

00534	Illegal input of position controller inhibit
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	The digital input „Position Controller Inhibit“ has been activated during an axis movement.
Scan	Axis movement is stopped. No axis movement possible as long as the error is removed.
Remedy	Cancel traversing movement and acknowledge the error. Prior to restarting a traversing movement, make sure that the digital input is not activated during an axis movement.
Note	from version 3.0

00535	Measuring system changeover not permitted
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Measuring system changeover was activated during program execution (RMS.BL = 1) or with direct measuring system not parameterized.
Scan	Axis movement is stopped. No axis movement possible as long as the error is removed.
Remedy	Cancel traversing instruction and acknowledge the error. Only activate measuring system changeover if RMS.BL = 0 and the direct measuring system is parameterized.
Note	from version 3.0

00536	Simulation On/Off not permitted
Response	Feed STOP
Indication	Bit RMS.FS, DS162, diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Simulation has been activated or deactivated during program execution (RMS.BL = 1).
Scan	Traversing movement is stopped. No axis movement possible until error acknowledgment.
Remedy	Cancel traversing instruction and alter activation bit for simulation; acknowledge error.
Note	from version 3.0

Traversing Errors

00769	Software limit switch beginning
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Limit switch approached either in the Setting-up or Automatic mode, with G88/89 not provided with the respective switching signal of the digital input. Actual-value setting causes the axis to leave the software limit switch.
Scan	• Axis movement is stopped at the limit switch position. • Actual-value setting is not carried out.
Remedy	• After removing the error, traversing into the working range is possible. • Change the value for the software limit switch (MD21). • Turn the software limit switch monitoring off. With the limit switches (MD21/22) off, the traversing range limits are determined by the maximum permissible values for the limit switches.

00770	Software limit switch end
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Limit switch approached either in the Setting-up or Automatic mode, with G88/89 not provided with the respective switching signal of the digital input. Actual-value setting causes the axis to leave the software limit switch.
Scan	• Axis movement is stopped at the limit switch position. • Actual-value setting is not carried out.
Remedy	• After removing the error, traversing into the working range is possible. • Change the value for the software limit switch (MD21). • Turn the software limit switch monitoring off. With the limit switches (MD21/22) off, the traversing range limits are determined by the maximum permissible values for the limit switches.

00771	Traversing range beginning approached
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	• The traversing range beginning was approached with the software limit switches off. • Actual-value setting causes the axis to leave the traversing range beginning (traversing range: ± 10^9 or the range covered by the absolute encoder)
Scan	• Axis movement is stopped at the traversing range limit. • Actual-value setting is not carried out.
Remedy	Traversing to the opposite direction.

00772	Traversing range end approached
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	• The traversing range beginning has been approached with the software limit switches off. • Actual-value setting causes the axis to leave the traversing range beginning (traversing range: ± 10^9 or the range covered by the absolute encoder)
Scan	• Axis movement is stopped at the traversing range limit. • Actual-value setting is not carried out.
Remedy	Traversing to the opposite direction.

00773	Set position not within traversing range
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	• The programmed position is outside the working range limited by the software limit switches. • On programming the rotary axis, an absolute dimension not within the positive full circle has been indicated.
Scan	Axis movement is stopped and/or disabled.
Remedy	• Correct the programmed position. • Change the value of the software limit switch (MD21/22) • Turn the limit switch monitoring off. With the limit switches (MD21/22) off, the traversing range limits are determined by the maximum permissible values for the limit switches.

00791	Nominal velocity = 0
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	• Zero entered for the programmed speed. • No feed programmed for positioning.
Scan	Axis movement is disabled.
Remedy	Enter a valid velocity value.

00798	Digital input not parameterized
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	The fast input required for traversing with flying actual-value setting (G88,G89), external block change (G50) or measuring is not parameterized.
Scan	• The functions are not started. • Axis movement is disabled.
Remedy	Parameterization of the fast inputs via MD46 to MD49.

00803	Tool offset value does not exist
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	No tool offset values at the MCU.
Scan	Axis movement is disabled.
Remedy	Parameterize and read in the tool offset values.

00804	Incorrect flying actual-value setting
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Value not within the range $\pm 10^9$.
Scan	Axis movement is canceled.
Remedy	Enter a correct value.

00805	Flying MDI block, incorrect syntax
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Incorrect M or G commands or incorrect block structure
Scan	Axis movement is canceled.
Remedy	Enter a correct MDI block.

00806	Flying MDI block, velocity
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The velocity is not within the range between >0 and the maximum permissible traversing speed (500,000,000 MSR/min).
Scan	Axis movement is canceled.
Remedy	Enter a correct MDI block.

00807	Flying MDI block, position
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Position or dwell time are outside the permissible values. Position: $\pm 10^9$ MSR Dwell time: <100,000 ms
Scan	Axis movement is canceled.
Remedy	Enter a correct MDI block.

00808	Faulty flying MDI block
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Incorrect block syntax
Scan	Axis movement is canceled.
Remedy	Enter a correct MDI block.

00829	Controller enable missing
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Traversing instruction without controller enable
Scan	No axis movement
Remedy	Set controller enable from user program.

00830	Controller not ready
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Axis started without readiness message from controller.
Scan	No axis movement
Remedy	Check drive/cable.

00832	PEH time monitoring
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	The destination range was not reached within the programmed time after the setpoints have been provided to the position controller.
Scan	Position control is continued.
Remedy	• Check drive. • Adapt MD24 and MD25.

00833	No drive motion
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Standstill of axes at max. drive control signal (speed setpoint).
Scan	Axis stop
Remedy	• Check drive. • Check controller enable signal between MCU and drive.

00834	Following error too high
Response	Feed STOP
Indication	Bit RMS.BF, DS164, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.FSQ
Cause	Too high following error during axis movement.
Scan	• Position control is continued. • Axis movement is stopped.
Remedy	• Check drive. • Check MD23.

Data Errors

01025	Data not acceptable in this mode of operation
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	Data not transferred in the mode of operation concerned.
Scan	Data are not accepted.
Remedy	Transfer data in the required mode of operation.

01026	Velocity step 1 incorrect
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The velocity is not in the range between >0 and the max. permissible traversing speed (500,000,000 MSR/min).
Scan	The velocity does not come into effect.
Remedy	Enter a valid velocity value.

01027	Velocity step 2 incorrect
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The velocity is not in the range between >0 and the max. permissible traversing speed (500,000,000 MSR/min).
Scan	The velocity does not come into effect.
Remedy	Enter a valid velocity value.

01028	Speed step 1 incorrect
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The preset speed is not in the range between 0 and 10,000 · 0.01% · MD1401.

Scan	The speed step does not come into effect.
Remedy	Enter a valid speed value.

01029	Speed step 2 incorrect
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The preset speed is not in the range between 0 and 10;000 · 0.01% · MD1401.
Scan	The speed does not come into effect.
Remedy	Enter a valid speed value.

01030	Incremental dimension too high
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The incremental dimension is higher than 10^9 MSR.
Scan	The original incremental dimension remains.
Remedy	Enter a valid incremental dimension.

01031	MDI block, incorrect syntax
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	Incorrect M or G commands or incorrect block structure.
Scan	The original MDI block remains.
Remedy	Enter the correct MDI block.

01032	MDI block, incorrect velocity
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The velocity is not in the range between >0 and the max. permissible traversing speed (500,000,000 MSR/min).
Scan	The original MDI block remains.
Remedy	Enter the correct MDI block.

01033	MDI block, incorrect position or dwell time
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The position or dwell time is across the permissible values: Position: ± 10^9 MSR Dwell time: <100,000 ms
Scan	The original MDI block remains.
Remedy	Enter the correct MDI block.

01034	Zero offset incorrect
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The value is outside the range ± 10^9 MSR.
Scan	The offset does not come into effect.
Remedy	Enter a valid value.

01035	Actual-value setting incorrect
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The actual value is outside the software limits positions or outside the range ± 10^9 MSR.
Scan	Actual-value setting does not come into effect.
Remedy	Enter a valid value.

01036	Reference-point setting incorrect
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The value is outside the range ± 10^9 MSR.
Scan	The reference point does not come into effect.
Remedy	Enter a valid value.

01037	Digital output not possible
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The output is not available for direct output from the user program.
Scan	User program is not executed.
Remedy	• Correct user program. • Correct parameterization of output assignment in MD50 ... MD53 to the desired assignment.

01038	Application data request faulty
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	Incorrect request code.
Scan	User program is not executed.
Remedy	The request code must be in the range 0 ... 6 and 17 ... 23 or 40...45.

01039	Teach In, incorrect program No.
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	Program not parameterized or not read in.
Scan	The function concerned is not executed.
Remedy	Parameterize and read in the program or correct the program number.

01040	Teach In, incorrect program No.
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The block number does not exist in the selected program.
Scan	The function concerned is not executed.
Remedy	Enter the correct block number.

01041	Teach In, no position in block
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	The block number does not exist in the selected program, or a wrong block number was selected.
Scan	The function concerned is not executed.
Remedy	Enter the correct block number.

01042	Teach In, no axis standstill
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	Axis is still moving.
Scan	The function concerned is not executed.
Remedy	Stop axis and repeat traversing instruction.

01051	Illegal bit-coded setting
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	Undefined settings transferred to the MCU.
Scan	The messages do not become active.
Remedy	• Transfer defined settings only. • Correct user program.

01053	Illegal bit-coded command
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	Undefined commands transferred to the MCU.
Scan	The messages do not become active.
Remedy	• Transfer defined commands only. • Correct user program.

01064	Non-relevant data to positioning unit
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	The data record(s) transferred is (are) unknown to the positioning unit.
Scan	The data are not accepted.
Remedy	Correct user program.

01074	Torque limit
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	The torque limit value indicated in DS 8 is not in the legal range between 0000_H and $7FFF_H$
Scan	The data record is not accepted.
Remedy	Correct and restart transmission.

01144	Deviating unit system raster
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	none
Cause	The unit system in the DBs NC, SW, WK does not match with MD7.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01145	Incorrect DB type
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	none
Cause	The wrong DB type was transmitted to the MCU.
Scan	The DB does not come into effect.

Remedy	Delete the DB, correct it and restart transmission.

01146	DB type or DB No. exists already
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	none
Cause	The DB type concerned exists already.
Scan	The DB does not come into effect.
Remedy	Delete the DB concerned prior to the transmission.

01147	NC program No. exists already
Response	WARNING
Acknowledgm.	none
Cause	A DB with a program number that exists already was transmitted to the MCU.
Scan	The DB does not come into effect.
Remedy	Delete DB with program number.

01148	Parameter back-up faulty
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	none
Cause	The coding is not 0 or 1.
Scan	The DB does not come into effect.
Remedy	Correct coding.

01149	DB memory full
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	none
Cause	Memory exhausted.
Scan	The DB does not come into effect.

Remedy	Delete programs (DBs) or compress memory.

01150	Program length exceeded
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	none
Cause	The number of blocks is too high.
Scan	The DB does not come into effect.
Remedy	Correct program and restart transmission.

01151	Data: Writing not possible
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	none
Cause	• It is not possible to write in the selected program (DB 1001 to 1199). • While the axis is moving, machine data cannot be written in the DB 1200. • In the operating modes Automatic Sequence Block and Automatic Single Block, the tool offsets cannot be written in DB 1200. • In the operating mode Incremental Dimension, the associated distances cannot be written in DB 1230.
Scan	Parameters/data do not come into effect.
Remedy	Stop axis.

01152	Module identification incorrect
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	none
Cause	DBs not belonging to the module have been transferred (identification 172 missing).
Scan	The DB does not come into effect.
Remedy	Transfer DBs belonging to the module.

01153	Incremental dimension value error
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledged gm.	none
Cause	The value range is outside ± 10^9
Scan	The incremental dimension does not come into effect.
Remedy	Transfer a valid value.

01154	Tool offset value error
Response	WARNING
Indication	• in the DB concerned • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledged gm.	none
Cause	The value range is outside ± 10^9.
Scan	The tool offset does not come into effect.
Remedy	Transmit a valid value.

Machine-Data Errors

01285	**MD5 Process interrupt generation**
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal value for parameterization of process interrupts indicated.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01286	**MD6 Illegal axis name**
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal value for axis name indicated.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01287	**MD7 Incorrect system of measures**
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The unit system raster (MSR) indicated does not match with the MSR in the remaining DBs of the module.
Scan	The DB does not come into effect.
Remedy	• Check MSR and correct if necessary. • After correct entry and prior to restarting transmission, delete the remaining DBs at the module.

01288	MD8 Incorrect axis type
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	No linear or rotary axis parameterized.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01289	MD9 End of rotary axis
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01290	MD10 Encoder type (IM)
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Invalid encoder type.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01291	MD11 Distance traversed/encoder revolution (IM)
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.

Remedy	Correct and restart transmission.

01293	MD13 Increments/encoder revolution (IM)
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01294	MD14 Number of revolutions of absolute encoder
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01296	MD16 Reference-point coordinate
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01298	MD18 Method of approach to reference point
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal method of reference-point approach
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01299	MD19 Adaptation of direction
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal coding for adaptation of direction
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01300	MD20 Hardware monitoring
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Undefined hardware switching off.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01301	MD21 Software limit switch beginning
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01302	MD22 Software limit switch end
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01303	MD23 Maximum velocity
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01304	MD24 Target range, PEH
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01305	MD25 Monitoring time
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01306	MD26 Standstill range
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01307	MD27 Reference-point offset
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01308	MD28 Referencing velocity
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01309	MD29 Reducing velocity
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01310	MD30 Backlash compensation
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01311	MD31 Direction reference of backlash
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Direction reference of backlash not defined.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01312	MD32 Output type of M function
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Output type of M function not defined.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01313	MD33 Output time of M function
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01314	MD46 ... MD49 Inputs allocated twice
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The same assignment (function) was indicated for several inputs.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01315	MD50 ... MD53 Outputs allocated twice
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The same assignment (function) was indicated for several outputs.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01316	MD36 Input adaptation
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Undefined input voltage.
Scan	The DB does not come into effect.

Remedy	Correct and restart transmission.

01318	MD38 Closed-loop amplification (Kv factor)
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01319	MD39 Minimum following error
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01320	MD40 Acceleration
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01321	MD41 Deceleration
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.

Remedy	Correct and restart transmission.

01322	MD42 Jerk time
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledg m.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01334	MD54 Encoder type (DM)
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledg m.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The encoder type parameterized for the direct measuring system is not permitted.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01335	MD55 Distance traversed/encoder revolution (DM)
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledg m.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01336	MD57 Increments/encoder revolution (DM)
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledg m.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01340	MD67 Drive type
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledg m.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Invalid drive type coding.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01341	MD61 Cycle setting
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledg m.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal position controller cycle.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01343	**MD63 Drive activation**
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal coding for drive activation.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01344	**MD64 Drive number**
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal drive number.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01346	**MD66 Drive module type**
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	Illegal coding of drive module type.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01376	Illegal software limit positions
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	• The software limit positions are parameterized incorrectly (MD21 ≥ MD22). • The software limit positions are not within the rotary axis cycle.
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01377	Limitation of software limit positions of absolute encoder
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The total distance to be traversed and covered by the encoder is smaller than the range limited by the software limit switches (MD21, MD22).
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01378	More than 2 measuring functions with MCU
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	More than 2 digital inputs parameterized as measuring input (MD46 ... MD49).
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.

01379	Illegal actual-value weighting factor
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The actual-value weighting factor X or 1/X exceeds the permissible value 2^{14}. $X = MD11 + MD12 \times 2^{-32} / MD13 \times 8$
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission, save.

01380	MD34 Denominator of load gear
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range (1 ... 1000).
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.
Note	from version 3.0

01381	MD35 Numerator of load gear
Response	Run-up ABORTION or CONTROLLER INHIBIT
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • If occurred after turning on: Save correct DB + Power ON
Cause	The value is outside the permissible value range (1 ... 1000).
Scan	The DB does not come into effect.
Remedy	Correct and restart transmission.
Note	from version 3.0

Traversing Program Errors

02049	Program selection, subroutine No. does not exist
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The subroutine called in the program does not exist in the MCU.
Scan	Program selection is not executed.
Remedy	• Parameterize and read in the program and correct if necessary. • Select another program.

02056	Program selection, program No. does not exist
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	The program was not parameterized or does not exist in the MCU.
Scan	Program selection is not executed.
Remedy	• Parameterize and read in the program and correct if necessary. • Select another program.

02057	Program selection, block No. does not exist
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowledgm.	Bit STS.DIQ
Cause	Block number does not exist in the program selected.
Scan	Program selection is not executed.
Remedy	• Correct program. • Select another block number.

02058	Program selection, block No. illegal
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled	Bit STS.DIQ

gm.	
Cause	Block no. missing or outside the permissible range of numbers.
Scan	Program selection is not executed.
Remedy	Select a valid block number.

02059	Program selection, incorrect indication of direction
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	Wrong preset direction.
Scan	Program selection is not executed.
Remedy	Correct program selection and repeat.

02060	Illegal program selection
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	Another program has been selected during a movement.
Scan	Program selection is not executed.
Remedy	Stop the active program by STOP or repeat program selection at the end of the program.

02061	Program selection, subroutine nesting not permitted
Response	WARNING
Indication	Bit RMS.DF, DS163, diagnostic buffer of the CPU
Acknowled gm.	Bit STS.DIQ
Cause	a) In a subroutine, another subroutine was called. b) In main program, the main program number has been called.
Scan	Program selection is not executed.
Remedy	a) Only use one subroutine level. b) Correct subroutine no.

02068	Error in program No.
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	Incorrect program numbers in the blocks.
Scan	The program is not loaded.

Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02069	No block
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	No block exists in the program.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02070	Error in block No.
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	The value of the block number is not in the permissible range of values.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02071	Incorrect sequence of block numbers
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	The block numbers are not indicated in rising sequence.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02072	G function 1 illegal
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	• The number programmed as G function 1 is not permitted. • The block with the dwell time (G04) contains also other data, except for the M functions.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02073	G function 2 illegal
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	The number programmed as G function 2 is not permitted.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02074	G function 3 illegal
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	• The number programmed as G function 3 is not permitted. • External block change (G50) programmed in a block with continuous traversing for flying actual-value setting (G88/G89). • A tool offset (G43, G44) was programmed without D number. • The direction of the tool offset (G43, G44) was not indicated when selecting a D number.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source.

	• Retry transmission of the DB.

02075	M function illegal
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	• The number programmed as M function is not permitted. • At least two of the M function M0, M02, M18, M30 that exclude each other are in the same block.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02076	Position/dwell time missing
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	• No dwell time indicated in the block with G04. • Set position missing with external block change (G50). • No new actual value programmed for the function Continuous traversing with flying actual-value setting (G88,G89).
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02077	Incorrect D No. (> 20)
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	The number for the tool offset is larger than 20.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02078	**Subroutine, number of calls**
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	The subroutine does not contain any information on the number of calls.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02079	**Velocity missing**
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	No velocity programmed.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02080	**Error in subroutine call**
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowledgm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	Incorrect block syntax in the subroutine call.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02081	**D function illegal**
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	Incorrect block syntax when calling a D function.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

02082	**Too many blocks**
Response	WARNING
Indication	• in the DB • If the error also occurs after turning on the MCU, indication in the diagnostic buffer of the CPU, too.
Acknowled gm.	• none • Any entries in the diagnostic buffer are, however, only deleted after Power ON.
Cause	Max. number of blocks exceeded.
Scan	The program is not loaded.
Remedy	• Correct program depending on the error source. • Retry transmission of the DB.

Run-Up Errors

24577	Sensor with SIDA step 0 not possible
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The hardware does not permit the parameterization of digital inputs as measuring input.
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Correct MD46 ... MD49 (do not select a measuring function) • Save the corrected machine data.

24578	Measuring circuit error: absolute track (EnDat encoder)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	• Defective absolute track of encoder. • Wrong encoder type connected
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Check encoder type connected for reliability. • Check encoder connector and cables. • Replace encoder if necessary.

24579	v_max (MD23) > 1.25 * v_nom (A-MD1401)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The maximum velocity parameterized exceeds the permissible value of 125% of the nominal velocity of the drive.
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.

Remedy	• Adapt MD23 to drive machine data A-MD1401. • Save the corrected machine data.

24580	**Absolute value of encoder during run-up defective**
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON or RESET via MCU-PIT
Cause	Timeout occurred when reading out the absolute encoder, or incorrect measured values.
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Check encoder connection. • Replace encoder if necessary.

24581	**Timeout empty during FIFO request**
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON or RESET via MCU-PIT
Cause	Hardware error
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

24582	**Firmware update**
Response	WARNING
Indication	Diagnostic buffer of the CPU
Acknowled gm.	none
Cause	The firmware was updated.
Scan	The remanent data backed up during last switching off have been deleted.
Remedy	The error is automatically removed when the module is next time switched off.

24583	No NVRAM end-of-block identification exists
Response	WARNING
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON
Cause	The remanent data parameterized in SDB0 could not be saved completely when the module was last switched off.
Scan	The remanent data are deleted.
Remedy	• Turn the module off/on. • Possible remedy: Reduce number of bytes to be saved (SDB0)

24584	New NVRAM block invalid
Response	WARNING
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON
Cause	Hardware error
Scan	The remanent data get lost.
Remedy	• Turn the module off/on. • If the error occurs once more, contact the competent sales department.

24585	NVRAM block not found
Response	WARNING
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON
Cause	It is a brand-new module on which no remanent data have been saved yet.
Scan	No remanent data exist.
Remedy	• Parameterize SDB0. • Turn the module off/on.

24586	Number of revolutions of absolute-value encoder inconsistent (MD14/A-MD1021/A-MD1031)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The machine data MD14 do not match with the related drive machine data A-MD1021 (IM) or A-MD1031 (DM).
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Set machine data MD14 according to drive machine data. • Save the corrected machine data.

24587	Encoder line number inconsistent (MD13/A-MD1005)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The machine data MD13 do not match with the related drive machine data A-MD1005.
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Make sure that MD13 matches with A-MD1005, i.e. set MD13 or A-MD1005 correspondingly. • Save the corrected machine data.

24588	Encoder type selection inconsistent (MD10/A-MD1011)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The encoder type parameterized in machine data MD10 does not match with the related machine data A-MD1011.
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Make sure that MD10 matches with A-MD1011, i.e. set MD10 or A-MD1011 correspondingly. • Save the corrected machine data.

24589	No measuring system parameterized (MD60)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	No measuring system parameterized in machine data MD60.
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Parameterize one or both measuring systems. • Save the corrected machine data.

24590	Velocity overflow (MD11, MD13, A-MD1401 <-> MD23)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The combination of the indicated machine data results in that the maximum speed that can be reached exceeds the permissible range of values for MD23.
Scan	• Initialization of module aborted • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Adapt the machine data. • Possible remedy: Use encoder with smaller number of lines. • Save the corrected machine data.

24591	Encoder line number DM inconsistent (MD57 / A-MD1007)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The machine data MD57 do not match with the related drive machine data A-MD1007.
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Ensure that MD57 matches with A-MD1007, i.e. set MD57 or A-MD1007 correspondingly. • Save the corrected machine data.
Note	from version 3.0

24592	Encoder type selection DM inconsistent (MD54 / A-MD1030)
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The encoder type parameterized in the machine data MD54 does not match with the related drive machine data A-MD1030.
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Ensure that MD54 matches with A-MD1030, i.e. set MD54 or A-MD1030 correspondingly. • Save the corrected machine data.
Note	from version 3.0

24593	Two absolute encoders parameterized
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	In the machine data MD10 and MD54 or in the drive machine data A-MD1011 or A-MD1030, one absolute encoder each was parameterized. However, the MCU has only one absolute-encoder interface.
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Parameterize one of the two encoders as incremental encoder. • Save the corrected machine data.
Note	from version 3.0

24595	FIFO error
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	Hardware error
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.

Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.
Note	from version 3.0

24596	Error during absolute-value reading
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON or RESET via MCU-PIT
Cause	An error occurred when reading out the absolute encoder.
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Check encoder connection. • Possible remedy: Replace encoder.
Note	from version 3.0

24597	EnDat encoder error
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON or RESET via MCU-PIT
Cause	Either the EnDat encoder is defective, or the wrong encoder is connected, e.g. an incremental encoder instead of the parameterized EnDat encoder.
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.
Remedy	• Check encoder connection. • Possible remedy: Replace encoder or correct parameterization.
Note	from version 3.0

24598	No EnDat encoder exists
Response	Run-up ABORTION
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON or RESET via MCU-PIT
Cause	Software error
Scan	• Initialization of module aborted. • Blocking of positioning functionality • No traversing movement possible.
Remedy	This error should not occur in the normal mode of operation. However, should it occur nevertheless, contact your competent sales department and specify the detail circumstances resulting in the error.

Note	from version 3.0

SIMODRIVE Interface Module Error Messages

30000	**System error** [error number/additional information]
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	Defective MCU hardware or system software damaged.
Scan	Stop of program execution
Remedy	Depending on service parameter 1, the following measures have to be taken: • 0102: Make a new boot file. • 0606: Sign-of-life error 611D - replace the hardware • 0638: 611D 1 does not run up - replace the hardware If these remedies should not help: • Reinstall system software. • Replace hardware. • Contact service.

30001	**Configuration error: drive number**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	Invalid drive number indicated.
Scan	611D coupling is not established.
Remedy	Only 1 possible. No parameterization of drive number provided at the moment. If this error occurs, contact service.

30002	**Configuration error Module type**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The projected module type does not match with the real module type.
Scan	611D coupling is not established.
Remedy	Correct 611D module selection (single-axis module). No parameterization of the module type provided at the moment. If this error occurs, contact service.

30003	Configuration error Bus expansion
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The configured bus expansion does not match with the real bus expansion (more real drive exist than configured).
Scan	611D coupling is not established.
Remedy	Correct 611D configuration; check hardware.

30004	Configuration error: measuring-circuit component placement
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The measuring-circuit modules are defective.
Scan	611D coupling is not established.
Remedy	Replace hardware.

30005	Configuration error: drive type
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	The drive type configured does not match with the drive type found.
Scan	611D coupling is not established.
Remedy	Correct configuration.

30006	CRC error: drive coupling
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power ON or RESET via MCU-PIT
Cause	Interference at 611D drive coupling
Scan	Stop of program execution
Remedy	Check control cabinet wiring; observe EMC instructions.

30007	Incorrect number of axes, spindles, drives
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON or RESET via MCU-PIT
Cause	The number of axes is larger than 1.
Scan	Abortion of run-up
Remedy	MCU only single-axis module at the moment. If this error occurs contact service.

30008	VSA software not loaded
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowled gm.	Power ON or RESET via MCU-PIT
Cause	System software faulty
Scan	Abortion of run-up
Remedy	Reload; contact service.

SIMODRIVE Error Messages

30500	**System error: drive**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Severe internal 611D error occurred.
Scan	a) Error occurs during run-up • Run-up stopped • Pulse or controller inhibit • SIMODRIVE_READY and DRIVE_READY canceled b) During cyclic operation With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE _READY canceled • Power On error • Pulse and controller inhibit corresponds to STOP A with Safety Integrated With VSA: • Controller inhibited, motor decelerated. • SIMODRIVE_READY and DRIVE_READY canceled • Power On error • Generator stop (corresponds to STOP B) with Safety Integrated From drive software version SW 2, the response can be configured via MD 1612.0.
Remedy	Make new boot files; replace hardware 611D if necessary
Note	HSA: at the moment not realized with MCU

Error No.	**0xF001**
Add. inform. 1	
Add. inform. 2	Faulty address
Explanation	When testing the program memory during the run-up, it turned out that the written bit pattern could not be read back. Cause: Hardware error at control-loop module. Error only at drive software version V1.x (EPROM version). This error message is replaced in the following download versions by the system errors F034 or F035.
Remedy	Replace control-loop module

Error No.	**0xF002**
Add. inform. 1	
Add. inform. 2	Faulty address
Explanation	When testing the program memory during the run-up, it turned out that the written bit pattern could not be read back. Cause: Hardware error at control-loop module.
Remedy	Replace control-loop module

Error No.	**0xF003**
Add. inform. 1	1 = Bit 0 : time dial, level 3 (UEW) (MD 1300) 2 = Bit 1 : time dial 4 msec 4 = Bit 2 : time dial 1 msec 8 = Bit 3 : time dial LR 10 = Bit 4 : time dial NR (MD 1001) 20 = Bit 5 : time dial IR (MD 1000) 40 = Bit 6 : time dial SI (MD 1300) A0 = Start-up, synchronization B0 = Background calculation-down time
Add. inform. 2	
Explanation	The calculating time of the drive processor is no longer sufficient for the selected functions in the preset cycle times. When using the standard values, this error normally occurs only in conjunction with the commissioning functions (FFT measuring, step response). SINUMERIK Safety Integrated: monitoring cycle too low
Remedy	During the commissioning using the FFT method or measuring the step response: - Switch emergency retraction off (MD 1636) - Switch pilot control off (MD 1004.0) . Switch min./max. memory off (MD 1650.0) - Reduce number of DAC output channels (max. 1 channel) - Switch variable measuring function off (MD 1620.0) - Switch encoder phase compensation off (MD 1011.1) - Select higher position controller cycle of NC - Set the time dial at which the system error occurred to a higher value, or - set the cascaded time dials to a higher value Cancel functions not needed.

Error No.	**0xF004**
Add. inform. 1	
Add. inform. 2	
Explanation	To enable the controller, the NC must update the sign of life in each position controller cycle. If an error occurred, the sign of life failed at least in two position controller cycles following one after another. Causes: NC failure, failure of communication via the drive bus. Hardware error at the drive module or hardware error at the NC CPU if the error occurs sporadically in intervals of several hours. Further causes: ring programming with gear interpolation or Gantry axes.
Remedy	Check plug-in connections, take interference suppression measures (check shielding, grounding). Replace NC hardware, replace control-loop module. Change NC-CPU with VB version, Replace control-loop module.

Error No.	**0xF005**
Add. inform. 1	1A : SZ <> 1 with IZ = 0 2A : SZ <> 1, 2, 3, 4, 5 2B : SZ-IZ <> 0, 1 2C : SZ = 3 at PO parameterizing error 3A : SZ <> 1, 2, 3, 4, 5 3B : SZ-IZ <> 0, 1
Add. inform. 2	
Explanation	The run-up of the drive modules is divided into 5 states (steps). The states are preset one after another from the NC and acknowledged by the drive. In the case of error, an invalid nominal status has been detected. Causes: Fault of communication via the drive bus. Hardware error at the drive module, hardware error at NC
Remedy	Check plug-in connections, take interference suppression measures (check shielding, grounding). Replace control-loop module, NC hardware.

Error No.	**0xF006**
Add. inform. 1	
Add. inform. 2	
Explanation	The cycle for communications processing has been left. Probable cause: hardware error at control-loop module.
Remedy	Replace control-loop module.

Error No.	**0xF007**
Add. inform. 1	
Add. inform. 2	
Explanation	During the cycle synchronization between NC and drive, an illegal status has been read by the hardware. Synchronization could not be carried out.
Remedy	Replace control-loop module.

Error No.	**0xF010**
Add. inform. 1	1 = Hardware underflow 2 = Hardware overflow 3 = Software underflow 4 = Software overflow
Add. inform. 2	
Explanation	Limits of processor-oriented hardware stack or software stack in data memory violated. Probable cause: hardware error at control-loop module.
Remedy	Reload drive software.. Replace control-loop module.

Error No.	**0xF011**
Add. inform. 1	
Add. inform. 2	
Explanation	Watchdog timer at control-loop module elapsed. Probable cause: hardware error in the time basis at the control-loop module.
Remedy	Replace control-loop module.

Error No.	**0xF012**
Add. inform. 1	
Add. inform. 2	
Explanation	Basic cycle generated in the NC and provided to the drive via the drive bus cable failed. Probable causes: NCK reset, EMC interference, hardware error NC, cable break at drive bus, hardware error at control-loop module.
Remedy	Check drive bus cable and plug-in connections, take interference suppression measures (check shielding, grounding). Replace NC hardware, replace control-loop module.

Error No.	**0xF013**
Add. inform. 1	
Add. inform. 2	
Explanation	The basic cycle generated in the NC and provided to the drive via the drive bus cable provided a pulse not matching with the cycle raster. Probable causes: EMC interference at drive bus, hardware error NC, hardware error at control-loop module.
Remedy	Check drive bus cable and plug-in connections, take interference suppression measures (check shielding, grounding). Replace NC hardware, replace control-loop module.

Error No.	**0xF014**
Add. inform. 1	
Add. inform. 2	Faulty address
Explanation	Processor detected illegal command in program memory.
Remedy	Replace control-loop module.

Error No.	**0xF015**
Add. inform. 1	From version 4.0: start address of faulty code - / data range
Add. inform. 2	From version 4.0: segment of faulty code - / data range, with: 0: P:-memory 1: X:-memory 2: Y:-memory
Explanation	During the permanent check of the check sums in the program/data memory, a difference between set and actual check sum has been detected. Probable cause: hardware error at the control-loop module.
Remedy	Replace control-loop module.

Error No.	**0xF016**
Add. inform. 1	
Add. inform. 2	
Explanation	An illegal interrupt of the processor occurred. Probable cause: hardware error at control-loop module.
Remedy	Check drive bus cable and plug-in connections. Replace control-loop module.

Error No.	**0xF017**
Add. inform. 1	
Add. inform. 2	
Explanation	An illegal interrupt of the processor occurred Probable cause: hardware error at control-loop module.
Remedy	Check drive bus cable and plug-in connections. Replace control-loop module.

Error No.	**0xF018**
Add. inform. 1	
Add. inform. 2	
Explanation	An illegal interrupt of the processor occurred Probable cause: hardware error at control-loop module.
Remedy	Check drive bus cable and plug-in connections. Replace control-loop module.

Error No.	**0xF019**
Add. inform. 1	
Add. inform. 2	
Explanation	An illegal interrupt of the processor occurred Probable cause: hardware error at control-loop module.
Remedy	Check drive bus cable and plug-in connections. Replace control-loop module.

Error No.	**0xF01B**
Add. inform. 1	0: Deviations from 0 current 1: Module selection does not match with the existing hardware (from V 2.6)
Add. inform. 2	NC drive number
Explanation	When starting the actual current acquisition or during cyclic operation, with pulse inhibit provided, the current is expected to be 0, since the system ensures that no current can flow. Deviation from 0 current: Possible cause: hardware for actual current acquisition defective. Module selection does not match with the existing hardware: If a single-axis power section was called via the module selection (software parameterization of power section) as twin-axis power section, this system error message is provided from the actual current acquisition, since a current > 0 is measured.
Remedy	Deviation from 0 current: Replace control-loop module. Check plug-in connections. Module selection does not match with the existing hardware: - Change software parameterization of power section (2-axis power section -> 1-axis power section) - Deactivate 2nd axis or use a 2-axis power section

Error No.	**0xF020**
Add. inform. 1	
Add. inform. 2	
Explanation	With a single-axis module, the NC tried to activate the second axis. Possible cause: interference in the communication via the drive bus or control-loop module defective.
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF021**
Add. inform. 1	
Add. inform. 2	
Explanation	With a single-axis module, the NC tried to activate two axes. Probable cause: fault of communications via the drive bus, or control-loop defective.
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF022**
Add. inform. 1	
Add. inform. 2	
Explanation	The motor-measuring system of at least one axis of the drive module is not installed or defective. Since the number of measuring systems is determined by the NC and communicated to the drive, a probable cause could also be interference of the communication via the drive bus.
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF023**
Add. inform. 1	Read K1C register of the relevant PCU-ASICs
Add. inform. 2	NC drive number
Explanation	The motor-measuring system has a motor encoder provided with voltage output. This requires an IPU sub-module with voltage input. However, another module than expected has been detected.
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF024**
Add. inform. 1	
Add. inform. 2	
Explanation	During program execution, an illegal internal axis number has been detected. (for 2-axis modules, only 0 or 1 is permitted). Probable causes: defective control-loop module, EMC interference
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF025**
Add. inform. 1	
Add. inform. 2	
Explanation	During program execution, an illegal internal physical axis number been detected. Probable causes: defective control-loop module, EMC interference
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF026**
Add. inform. 1	
Add. inform. 2	NC drive number
Explanation	The NC tries to log on a VSA module as HSA module. Probable cause: interference in the communication via the drive bus, or control-loop module defective.
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF027**
Add. inform. 1	
Add. inform. 2	NC drive number
Explanation	The NC tries to log on a VSA module as HSA module. Probable cause: interference in the communication via the drive bus, or control-loop module defective.
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF028**
Add. inform. 1	Read K1C register of the relevant PCU-ASICs
Add. inform. 2	NC drive number
Explanation	Only certain sub-modules are permitted for the direct measuring system. An illegal sub-module has been detected.
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF030**
Add. inform. 1	0x01 ;not supported ROSCTR
	0x02 ;illegal ROSCTR
	0x03 ;job management "defective"
	0x04 ;incorrect PDUREF during acknowledgment
	0x05 ;acknowledgment not permitted at this moment
	0x06 ;acknowledgment not supported
	0x07 ;illegal PROTID
	0x08 ;illegal PARLG (odd)
	0x09 ;buffer management "defective"
	0x0A ;illegal PI identifier (internally)
	0x0B ;illegal internal condition of PI recommissioning
	0x0C ;status switchgear in WRITEDATA "defective"
	0x0D ;illegal transfer parameter with REFRESH_PIZUST
Add. inform. 2	NC drive number
Explanation	Either non-removable errors in the communication via the drive bus have been detected, or the drive software does no longer match with the remaining components.
	Probable cause: either a defective drive bus interface or a hardware error at the control-loop module.
Remedy	Check drive bus cable and plug-in connections, take interference suppression measures (check shielding, grounding). Replace control-loop module.

Error No.	**0xF031**
Add. inform. 1	0x40 ;illegal PDU length
	0x41 ;axes have not the same PDU length
	0x42 ;PDU length not a multiple of the word
	0x43 ;axes not of the same NC type
Add. inform. 2	
Explanation	The NC transmitted illegal parameters for communication via the drive bus. Probable cause: interference at the drive bus or a defective control-loop module .
Remedy	Replace control-loop module. Check plug-in connections, take interference suppression measures (check shielding, grounding).

Error No.	**0xF032**
Add. inform. 1	0x20 ;job management "defective"
	0x21 ;illegal condition during RESET_TRANSPO
	0x22 ;check sum test more than 3 times completed with errors
	0x23 ;receive CPU too long
	0x24 ;illegal status 6XX abortion
Add. inform. 2	NC drive number
Explanation	Either non-removable errors in the communication via the drive bus have been detected, or the drive software does no longer match with the remaining components.
	Probable cause: either a defective drive bus interface or a hardware error at the control-loop module .
Remedy	Check drive bus cable and plug-in connections, take interference suppression measures (check shielding, grounding). Replace control-loop module.

Error No.	**0xF033**
Add. inform. 1	0x51 ;wrong data format in the list of elements
	0x52 ;wrong conversion group in the Refresh indicated
Add. inform. 2	
Explanation	The drive software does no longer match with the remaining components. Probable cause: hardware error at the control-loop module.
Remedy	Reload drive software. Replace control-loop module.

Error No.	**0xF034**
Add. inform. 1	0 or incorrect address
Add. inform. 2	0x60 ;illegal behavior of the SERVO during STF handshake
	0x61 ;error during RAM check
	0x62 ;transfer check sum does no longer match with that of the SERVO.
Explanation	Errors detected when loading the drive software. Probable causes: either errors during the transmission at the drive bus, or a defective control-loop module .,
Remedy	Check drive bus cable and plug-in connections, take interference suppression measures (check shielding, grounding), Replace control-loop module

Error No.	**0xF035**
Add. inform. 1	0 or incorrect address
Add. inform. 2	0x60 ;illegal behavior of the SERVO during STF handshake
	0x61 ;error during RAM check
	0x62 ;transport check sum does no longer match with that of the SERVO.
Explanation	Errors detected when loading the drive software. Probable causes: either errors during the transmission at the drive bus, or a defective control-loop module .,
Remedy	Check drive bus cable and plug-in connections, take interference suppression measures (check shielding, grounding), Replace control-loop module

Error No.	**0xF040**
Add. inform. 1	
Add. inform. 2	
Explanation	An illegal number of current-setpoint filters has been entered (> 4).
Remedy	Correct the number of current-setpoint filters (MD 1200).

Error No.	**0xF041**
Add. inform. 1	
Add. inform. 2	
Explanation	An illegal number of speed-setpoint filters (> 2) has been entered.
Remedy	Correct the number of speed-setpoint filters (MD 1500)

Error No.	**0xF044**
Add. inform. 1	
Add. inform. 2	NC DRIVE NUMBER
Explanation	Error during rotor position synchronization (drive software version 2.5 only). The difference between the first part of the rotor position synchronization (rough synchronization) and the second part (fine synchronization to the active encoder zero mark) is larger than 45 electrically. Too high difference are caused by: - incorrect adjustment of encoder - EMC problems with zero mark signal - voltage level of C/D track too high
Remedy	- Check encoder adjustment and/or EMC measures - Restart - Check MODE - Replace motor

Error No.	**0xF045**
Add. inform. 1	
Add. inform. 2	NC DRIVE NUMBER
Explanation	Either an encoder with distance-coded reference marks or a BERO switch has been entered by the NC into the $1D register of the motor-measuring system of the PCU-ASIC. This is not permitted during fine synchronization which is activated by the run-up, zero-monitoring errors or by deselecting the parking axis.
Remedy	Make sure that nor an encoder with distance-coded reference marks, neither a BERO switch is entered by the NC/PLC into the $1D register of the motor-measuring system of the PCU-ASIC after running up, in the case of zero-monitoring errors or after deselecting the parking axis.

30501	Current monitoring
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The smoothed absolute value of the current (smoothing time: MD 1254) is larger than or equal to a current threshold. A severe error occurred during actual-current acquisition. Up to drive software version 2.6: HSA only (in addition to alarm 30502 / alarm 30503) Current threshold = 1.2 * max. permissible power-section current (MD 1107) From drive software version 3.0: VSA and HSA (replaces alarm 30502 / alarm 30503) Current threshold = 1.2 * 1.05 * max. permissible power-section current (MD 1107)
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Check max. power-section current MD 1107, replace 611D hardware if necessary.
Note	HSA: at the moment not realized with MCU

30504	Measuring-circuit error: motor (inc.)
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	• Encoder defective • Motor encoder not connected • Motor encoder cable defective • Module defective
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Remove cause; replace motor / 611D hardware if necessary.
Note	Alarm for MCU from V2.0

30505	Measuring-circuit error: absolute track
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Error at the absolute track or at the measuring-value acquisition of the optical encoder • Absolute-value encoder defective • Motor encoder not connected • Motor encoder cable defective • Module defective Additional information in MD 1023 (IMS) or MD 1033 (DMS)
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Remove cause; replace motor / 611D hardware if necessary.
Note	Alarm for MCU from V2.0

30507	Synchronization error: rotor position
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Difference angle between current rotor position and newly calculated rotor position is larger than 45 degrees electrically. Possible cause: interference at encoder or zero-mark signals.
Scan	With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • From drive software version 2, the response can be configured via MD 1612.7.
Remedy	Cancel reference-point approach using the BERO switch. Check encoder cable, encoder cable connection and grounding, since a probable cause could be EMC problems. Replace motor / 611D hardware if necessary.
Note	Alarm for MCU cannot be configured.

30508	Zero-mark error: motor
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Counted line number of encoder incorrect when passing the zero mark. • Defective encoder • EMC problems • Defective IPU sub-module
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • Power On error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. From drive software version 2, the response can be configured via MD 1612.8.
Remedy	Remove cause; replace motor / 611D hardware if necessary.
Note	HSA: at the moment not realized with MCU

30509	**Converter limit frequency exceeded**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Motor frequency exceeded limit frequency fg (see below). Probable causes: • Encoder line number set in MD 1005 does not match with real encoder line number. • Speed limitation MD 1147 or motor-pole pair number MD 1112 (VSA) or nominal motor frequency MD 1134 and nominal motor speed MD 1400 (HSA) are zero or incorrect. Limit frequency fg: VSA: fg = 1.12 * minimum(1.2*MD 1400, MD 1147) * MD1112 / 60 HSA: fg = 1.12 * minimum(MD 1146, MD 1147) * pole-pair number / 60 Pole-pair number = nominal motor frequency (MD 1134) * 60 / nominal motor speed (MD 1400)
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • Power On error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • Power On error From drive software version 2, the response can be configured via MD 1612.9.
Remedy	Check MD 1005 with real encoder line number. If necessary check MD 1147 (speed limitation), MD 1400 (nominal motor speed) and, in addition, with HSA: MD 1134 (nominal motor frequency) VSA: MD 1112 (motor pole number).
Note	HSA: at the moment, not realized with MCU

30510	**Error during mid-frequency measuring**

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Speed too high during mid-frequency measuring.
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Reduce speed.
Note	Alarm for MCU from V2.0

30511	Measured-value memory active
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Measured-value memory active during run-up.
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Cancel FFT.
Note	Alarm for MCU from V2.0

30515	Heat-sink temperature alarm
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Heat-sink temperature in hot condition and 20 s timer elapsed. • Converter overloaded • Ambient temperature too high • Fan failure • Temperature sensor defective
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • Power On error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • Power On error From drive software version 2, the response can be configured via MD 1612.15.
Remedy	Remove cause
Note	HSA: at the moment, not realized with MCU

30606	**Flow controller at stop**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The preset nominal flow value cannot be realized, even though the maximum current is preset. Causes: • Incorrect motor data (spare wiring diagram data) • Motor data and wiring of motor (star/delta) do not match with each other • Motor pulled out of step, since motor data incorrect • Current limit too low for motor (0,9 * MD 1238 * MD 1103 < MD 1136)
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Remove cause
Note	Alarm for MCU from V2.0

30607	**Current controller at stop**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The preset nominal current cannot be provided to the motor, even though the maximum voltage is preset. Probable causes: • Motor not connected or phase missing
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Check connection line motor - inverter".
Note	Alarm for MCU from V2.0

30608	Speed controller at stop
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	Nominal torque exceeds torque limit value, nominal speed value is smaller than speed threshold MD 1606, and the time set in MD 1603 (VSA) is elapsed. Causes: • Motor encoder not connected • Motor encoder cable defective • Module defective • Encoder defective • Motor ground not connected • Shield of motor encoder cable not connected • Motor not connected or phase missing • Motor blocked
Scan	• Pulse deletion, motor coasts • SIMODRIVE READY and DRIVE_READY canceled. • Power On error
Remedy	Remove cause
Note	Alarm for MCU from V2.0

30609	Encoder limit frequency exceeded

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Actual speed higher than encoder limit frequency: • Wrong encoder • MD 1005 does not match with encoder line number • Encoder defective • Motor encoder cable defective or not correctly attached • Shield of motor encoder cable not connected • Drive module defective
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • Reset error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • Reset error From drive software version 2, the response can be configured via MD1613.9.
Remedy	Remove cause
Note	HSA: at the moment, not realized with MCU

30613	Motor temperature alarm
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Motor temperature threshold MD 1607 exceeded • Motor overloaded • Machine current too high, e.g. due to incorrect motor data • Temperature sensor defective (motor) • Motor fan defective • Module defective • Short-circuit in motor winding
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD1613.9.
Remedy	Remove cause or work at fixed temperature (with HSA) CAUTION: temperate monitoring not active when working at fixed temperature
Note	HSA: at the moment, not realized with MCU

30614	Motor temperature switch-off limit
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Motor temperature threshold MD 1602 exceeded, and timer MD1603 elapsed • Motor overloaded • Machine current too high, e.g. due to incorrect motor data (P-96/P-238) • Temperature sensor defective (motor) • Motor fan defective • Module defective • Short-circuit in motor winding
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD1613.9.
Remedy	Remove cause or work at fixed temperature (with HSA) CAUTION: temperate monitoring not active when working at fixed temperature
Note	HSA: at the moment, not realized with MCU

30701	Commissioning necessary
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	No valid drive parameter record.
Scan	Drive runs up only to run-up condition 2
Remedy	• Load initial data via motor selection or copy TEA3 file • Save BOOT data of drive • Restart
Note	Alarm for MCU from V2.0

30702	Invalid drive basic cycle
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The basic cycle for the drive has been set too high at the NC.
Scan	Drive runs up only to run-up condition 2
Remedy	Change basic cycle at the NC.
Note	Alarm for MCU from V2.0

30703	Invalid current controller cycle
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	A current controller cycle MD 1000 invalid for the drive concerned has been set.
Scan	Drive runs up only to run-up condition 2
Remedy	Change current controller cycle.
Note	Alarm for MCU from V2.0

30704	Invalid speed controller cycle
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Invalid speed controller cycle MD 1001.
Scan	Drive runs up only to run-up condition 2
Remedy	Change speed controller cycle.
Note	Alarm for MCU from V2.0

30705	Invalid position controller cycle
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	An invalid position controller cycle has been set at the NC for the drive.
Scan	Drive runs up only to run-up condition 2
Remedy	Change position controller cycle at the NC.
Note	Alarm for MCU from V2.0

30706	Invalid monitoring cycle
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Invalid monitoring cycle MD 1002.
Scan	Drive runs up only to run-up condition 2
Remedy	Change monitoring cycle.
Note	Alarm for MCU from V2.0

30713	Invalid position controller cycle shift
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The position controller cycle shift preset by the NC is larger than or equal to the position controller cycle.
Scan	Drive runs up only to run-up condition 2
Remedy	NC hotline
Note	Alarm for MCU from V2.0

30714	Invalid power section code
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	• The module MLFB entered into the NC is not permitted for the drive. Additional HSA information (drive software version 1 only): Illegal power section code • The drive has already been loaded with a module MLFB which does not match with the current module MLFB entered in the NC. Additional HSA information (drive software version 1 only): Current power-section code of HSA and current power-section code of the NC
Scan	Drive runs up only to run-up condition 2
Remedy	Reselect module in NC or undo loading of initial data
Note	HSA: at the moment, not realized with MCU

30715	Max. current of power section <= 0
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The value of the max. current of the power section set in MD 1107 is smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Enter a valid value for machine data MD 1107 "Maximum current of power section".
Note	Alarm for MCU from V2.0

30716	Torque constant <= 0
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The value of the torque constant set in MD 1113 is smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Enter a valid value for machine data MD 1113 "Torque constant".
Note	Alarm for MCU from V2.0

30717	Motor moment of inertia <= 0
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The value of the motor moment of inertia set in MD 1117 is smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Enter a valid value for MD 1117 " Motor moment of inertia".
Note	Alarm for MCU from V2.0

30718	Calculating down-time error I controller
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Input error - calculating-down time timer MD 1101
Scan	Drive runs up only to run-up condition 2
Remedy	Remove input error in calculating-down time timer MD 1101.
Note	Alarm for MCU from V2.0

30719	Motor delta not parameterized
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	When the star/delta changeover was activated by drive machine data -MD 1013, the motor delta (motor 2) has not been parameterized.
Scan	Drive runs up only to run-up condition 2
Remedy	Check machine data for motor delta (motor 2) or enter new data.
Note	Alarm for MCU from V2.0

30720	Maximum motor speed too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Value of max. motor speed (MD 1401) or speed controller cycle (MD 1001) too high.
Scan	Drive runs up only to run-up condition 2
Remedy	Reduce maximum motor speed MD 1401 or set lower speed controller cycle MD 1001.
Note	Alarm for MCU from V2.0

30721	I0 of motor > Inom of motor
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The motor no-load current (MD 1136) is larger than the nominal motor current (MD 1103).
Scan	Drive runs up only to run-up condition 2
Remedy	• Change motor data. • Save BOOT files of drive. • Restart
Note	Alarm for MCU from V2.0

30722	I0 of motor > Inom of power section

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledg m.	Power On or RESET via MCU-PIT
Cause	Due to its no-load current (MD 1136), the motor connected is too big for the power section used (permanent current MD 1108)
Scan	Drive runs up only to run-up condition 2
Remedy	Change power section or motor.
Note	Alarm for MCU from V2.0

30724	**Invalid pole-pair number**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	VSA: MD 1112 incorrect. HSA: MD 1134 or MD 1400 incorrect.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the machine data above.
Note	HSA: at the moment, not realized with MCU

30725	**Encoder line number = 0**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The value of the encoder line number set in MD 1005 is zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the encoder line number in MD 1005.
Note	Alarm for MCU from V2.0

30726	**Voltage constant = 0**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The value of the voltage constant set in MD 1114 is smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the voltage constant in MD 1114.
Note	Alarm for MCU from V2.0

30727	**Reactance <= 0**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The stator reactance set in MD 1139 or the rotor reactance set in MD 1140 or the main field reactance set in MD 1141 is smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering MD 1139, MD 1140 or MD 1141.
Note	Alarm for MCU from V2.0

30728	Adaptation factor torque/current too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The adaptation factor (set torque --> cross current) in the speed controller is too high.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the • nominal motor current MD 1103, or the • limit-current transistor MD 1107, or the • torque constant MD 1113.
Note	Alarm for MCU from V2.0

30729	Motor standstill current <= 0
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Motor standstill current (MD 1118) smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove error when entering the motor standstill current in MD 1118.
Note	Alarm for MCU from V2.0

30730	Invalid rotor resistance
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Rotor resistance smaller than or equal to zero, or format overflow.
Scan	Drive runs up only to run-up condition 2
Remedy	The value entered into the following machine data can be incorrect: • speed controller cycle MD 1001, • nominal motor frequency MD 1134, • rotor resistance, cold, MD 1138, • stator leakage reactance MD 1139, • rotor leakage reactance MD 1140.
Note	Alarm for MCU from V2.0

30731	**Nominal power <= 0**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Nominal power (MD 1130) smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the nominal power in MD 1130.
Note	Alarm for MCU from V2.0

30732	**Nominal motor speed <= 0**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Nominal motor speed (MD 1140) smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the nominal motor speed in MD 1140.
Note	Alarm for MCU from V2.0

30733	**Invalid motor no-load voltage**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Motor no-load voltage (MD 1135) is smaller than or equal to zero or larger than the nominal motor voltage (MD 11329 or larger than 450 x MD 1400 / MD 1142. By means of MD 1400: nominal motor speed MD 1142: threshold speed for field weakening.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the • nominal motor voltage MD 1132 or the • motor no-load voltage MD 1135 or the • nominal motor speed MD 1400 or the • threshold speed for field weakening MD 1142.
Note	Alarm for MCU from V2.0

30734	Motor no-load current <= 0
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Motor no-load current (MD 1136) is smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the motor no-load current in MD 1136.
Note	Alarm for MCU from V2.0

30735	Field weakening speed <= 0
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Field weakening speed (MD 1142) is smaller than or equal to zero.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the field weakening speed in MD 1142.
Note	Alarm for MCU from V2.0

30736	Invalid Lh characteristic curve
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Upper speed of Lh characteristic (MD 1143) is smaller than or equal to the field weakening speed (MD 1142), or the amplification of the Lh characteristic curve (MD 1144) is smaller than or equal to 100.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the • upper speed of the Lh characteristic curve (MD 1143), • amplification of the Lh characteristic curve (MD 1144) or the • field weakening speed MD 1142.
Note	Alarm for MCU from V2.0

30737	Two EnDat encoders configured

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	Both an EnDat encoder for the motor-measuring system (MD 1011) and for the direct measuring system (MD 1030) has been configured.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the • configuration of the motor-measuring system MD 1011 or when entering the • configuration of the measuring systems (MD 1030).
Note	Alarm for MCU from V2.0

30741	AM pilot control amplification cannot be represented
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	The calculated AM pilot control amplification cannot be represented in the internal figure format.
Scan	Drive runs up only to run-up condition 2
Remedy	Reduce speed controller cycle MD 1001 or work in the pure AM mode. Reduce the encoder line number (MD 1005) in the AM mode.
Note	HSA: at the moment, not realized with MCU

30742	Converter frequency U/f mode
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	In the U/f mode (selected via MD 1014), only converter frequencies (MD 1100) of 4 kHz or 8 kHz are permitted.
Scan	Drive runs up only to run-up condition 2
Remedy	Remove the error when entering the converter frequency (MD 1100) or by canceling the U/f mode (MD 1014).
Note	Alarm for MCU from V2.0

30743	This function not with this 611D control module
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	SINUMERIK Safety Integrated requires the 611D Performance Control Module (see SINUMERIK Safety Integrated). If this hardware is not installed, this alarm is provided. Further causes: The motors 1PH2/4/6 are connected and no 611D performance control-loop module exists. With motor changeover active (MD1013>0) and the 611D comfort control-loop module connected, MD1100 is not equal to MD2100.
Scan	Run-up process are interrupted, pulses remain blocked.
Remedy	Replace the 611D control-loop module or cancel the function.
Note	HSA: at the moment, not realized with MCU

30750	Speed controller adaptation: n-max < n-min
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The upper adaptation speed (MD 1412) is smaller than the lower adaptation speed (MD 1411).
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software version 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30750 • MD 1012.4 = 1: alarm 30850
Remedy	Enter a larger value for the upper adaptation speed (MD 1412) than for the lower adaptation speed (MD 1411).
Note	HSA: at the moment, not realized with MCU. Message output: at the moment, cannot be configured with MCU.

30751	Speed amplification too high

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The P amplification of the speed controller set in MD 1407 or MD 1408 is too high.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	Enter a smaller value for the P amplification of the speed controller (MD 1407 or MD 1408), or make sure that the motor standstill current (MD 1118) is larger than zero.
Note	HSA: at the moment, not realized with MCU

30752	Invalid cut-off frequency of I-nom filter
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Sampling theorem violated.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	The cut-off frequency (MD 1210, MD 1213, MD 1216, MD 1219) of the current filters concerned must be larger than the reciprocal value of two current controller cycles (MD 1000).
Note	HSA: at the moment, not realized with MCU

30754	Invalid signal number
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Invalid signal number in the variable signaling function or in the min/max memory.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software version 3, the message output can be activated via MD 1012.4. • MD 1012.4 = 0: alarm 30754 • MD 1012.4 = 1: alarm 30854
Remedy	Enter the correct signal number.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30755	u/f operation: motor turning
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	u/f mode: Motor turning during initialization.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30755 • MD 1012.4 = 1: alarm 30855
Remedy	Stop the motor.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30756	Hysteresis of torque nominal-smoothing too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Hysteresis of torque nominal-value smoothing set in MD 1246 is larger than or equal to the threshold of the torque nominal-value smoothing set in MD 1245.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	Remove the error when entering MD 1246 and MD 1245.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30757	Torque adaptation factor too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The torque adaptation factor set in MD 1191 exceeds the format limit.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	Remove the error when entering MD 1191.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30758	Upper generator threshold too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The upper threshold of the 2-position controller is too high in the generator mode, i.e. the total of the values of MD1631 + MD1632 is larger than MD1633.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30758 • MD 1012.4 = 1: alarm 30858
Remedy	Remove the error when entering the data for MD 1631, MD 1632 and MD 1633.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30759	Generator switch-off threshold too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The generator switch-off voltage set in MD 1633 is larger than or equal to the response threshold for the intermediate-circuit monitoring set in MD 1630.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30759 • MD 1012.4 = 1: alarm 30859
Remedy	Remove the error when entering MD 1633 or MD 1630.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30760	Emergency retraction speed too high

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The emergency retraction speed set in MD 1639 is larger than or equal to the maximum speed set in MD 1146.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30760 • MD 1012.4 = 1: alarm 30860
Remedy	Remove the error when entering MD 1639 or MD 1146.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30761	Generator minimum speed too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The minimum speed of the generator axis set in MD 1635 is larger than or equal to the maximum speed set in MD 1146.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30761 • MD 1012.4 = 1: alarm 30861
Remedy	Remove the error when entering MD 1635 or MD 1146.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30762	Emergency retraction / generator active

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Emergency retraction or generator already active.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30762 • MD 1012.4 = 1: alarm 30862
Remedy	Check parameterization / machine data.
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30763	Generator / emergency retraction mode invalid
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The value that is set by means of a G command from the NC must be in the range between 0 and 7.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30763 • MD 1012.4 = 1: alarm 30863
Remedy	Check parameterization (G command in NC).
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30764	No emergency retraction / generator mode possible

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	Emergency retraction/generator mode possible only with the intermediate-circuit measuring active (MD 1161 = 0). With old hardware versions, intermediate-circuit measuring is not possible; for this reason, alarm 30765 is additionally provided in some cases if MD 1161 = 0 is set with an old hardware version.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30764 • MD 1012.4 = 1: alarm 30864
Remedy	Enter zero into machine data MD 1161 or replace the old hardware version by a new one (HW component: Order drive control MLFB 6SN1 118-0Dx1x-0AA0).
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30765	**No intermediate-circuit measuring possible**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	If the fixed voltage MD 1161 = 0 intermediate-circuit measuring is not possible due to a wrong hardware version.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0. From drive software 3, the message output can be activated via MD 1012.4: • MD 1012.4 = 0: alarm 30765 • MD 1012.4 = 1: alarm 30865
Remedy	Enter a value larger than zero into the fixed voltage machine data MD 1161 or order the new hardware version (HW component: drive control MLFB 6SN1 118-0Dx1x-0AA0).
Note	HSA: at the moment, not realized with MCU Message output: at the moment, cannot be configured with MCU.

30766	Stop frequency higher than Shannon frequency
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The band-stop frequency of a current or nominal-speed filter is higher than the Shannon sampling frequency of the sampling theorems.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	The band-stop frequency of a current-setpoint filter must be smaller than the reciprocal value of two current-controller cycles. • Current-setpoint filter 1: MD 1210 < 1 / (2 * MD 1000 * 31.25µsec.) • Current-setpoint filter 2: MD 1213 < 1 / (2 * MD 1000 * 31.25µsec.) • Current-setpoint filter 3: MD 1216 < 1 / (2 * MD 1000 * 31.25µsec.) • Current-setpoint filter 4: MD 1219 < 1 / (2 * MD 1000 * 31.25µsec.) The band-stop frequency of a nominal-speed filter must be smaller than the reciprocal value of two speed controller cycles. • Nominal-speed filter 1: MD 1514 < 1 / (2 * MD 1001 * 31.25µsec.) • Nominal-speed filter 2: MD 1517 < 1 / (2 * MD 1001 * 31.25µsec.)
Note	HSA: at the moment, not realized with MCU

30767	Self-generated frequency higher than Shannon frequency
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The self-generated frequency of a nominal-speed filter is higher than the Shannon sampling frequency of the sampling theorem.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	The self-generated frequency of a nominal-speed filter must be smaller than the reciprocal value of two speed-controller cycles. • Nominal-speed filter 1: MD 1520 * 0.01 * MD 1514 < 1 / (2 * MD 1001 * 31.25µsec.) • Nominal-speed filter 2: MD 1521 * 0.01 * MD 1517 < 1 / (2 * MD 1001 * 31.25µsec.)
Note	HSA: at the moment, not realized with MCU

30768	**Numerator of bandwidth larger than the double of the stop frequency**
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The numerator of the bandwidth of a current or nominal-speed filter is larger than the double of the stop frequency. This error message is provided for the general band stop only if: • Nominal-speed filter 1: MD 1516 > 0.0 or MD 1520 <> 100.0 • Nominal-speed filter 2: MD 1519 > 0.0 or MD 1521 <> 100.0 • Current-setpoint filter 1: MD 1212 > 0.0 • Current-setpoint filter 2: MD 1215 > 0.0 • Current-setpoint filter 3: MD 1218 > 0.0 • Current-setpoint filter 4: MD 1221 > 0.0
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	The numerator of the bandwidth must be smaller than the double of the stop frequency. • Current-setpoint filter 1: MD 1212 <= 2 * MD 1210 • Current-setpoint filter 2: MD 1215 <= 2 * MD 1213 • Current-setpoint filter 3: MD 1218 <= 2 * MD 1216 • Current-setpoint filter 4: MD 1221 <= 2 * MD 1219 • Nominal-speed filter 1: MD 1516 <= 2 * MD 1514 • Nominal-speed filter 2: MD 1519 <= 2 * MD 1517
Note	HSA: at the moment, not realized with MCU

30769	**Denominator of bandwidth larger than the double of the self-generated frequency**

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledg m.	Bit STS.BFQ
Cause	The denominator of the bandwidth of a current-setpoint or nominal-speed filter must be larger than the double of the self-generated frequency. This error message is provided for the general band stop only if: • Nominal-speed filter 1: MD 1516 > 0.0 or MD 1520 <> 100.0 • Nominal-speed filter 2: MD 1519 > 0.0 or MD 1521 <> 100.0 • Current-setpoint filter 1: MD 1212 > 0.0 • Current-setpoint filter 2: MD 1215 > 0.0 • Current-setpoint filter 3: MD 1218 > 0.0 • Current-setpoint filter 4: MD 1221 > 0.0
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	The denominator of the bandwidth of a current-setpoint or nominal-speed filter must be smaller than the double of the self-generated frequency. • Nominal-speed filter 1: MD 1515 <= 2 * MD 1514 * 0.01 * MD 1520 • Nominal-speed filter 2: MD 1518 <= 2 * MD 1517 * 0.01 * MD 1521 • Current-setpoint filter 1: MD 1211 <= 2 * MD 1210 • Current-setpoint filter 2: MD 1214 <= 2 * MD 1213 • Current-setpoint filter 3: MD 1217 <= 2 * MD 1216 • Current-setpoint filter 4: MD 1220 <= 2 * MD 1219
Note	HSA: at the moment, not realized with MCU

30770	Filter coefficient cannot be represented
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The calculated filter coefficients of a bandstop filter cannot be represented in the internal format.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	Change filter setting.
Note	HSA: at the moment, not realized with MCU

30771	Converter frequency AM mode
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	In the AM mode (selected by MD 1465 < MD 1146), only converter frequencies (MD 1100) of 4 kHz and 8 kHz are permitted.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error Response can be configured via MD 1613.0.
Remedy	Remove the error when entering the converter frequency MD 1100 or by canceling the AM mode (MD 1465 > MD1146).
Note	HSA: at the moment, not realized with MCU

30772	Speed controller amplification for AM mode too high
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	The P amplification of the speed controller set in MD 1451 is too high.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error Response can be configured via MD 1613.0.
Remedy	Enter a smaller value for the P amplification of the speed controller (MD 1451) or set MD 1118 > 0.
Note	HSA: at the moment, not realized with MCU

30773	No pilot control structure in AM mode
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	In the AM mode (selected by MD 1465 < MD 1146), no pilot control structure (MD 1004, bit0 = 1) possible.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error Response can be configured via MD 1613.0
Remedy	Remove the error either when entering the pilot control structure (MD 1104) or by canceling the AM mode (MD 1465 > MD1146).
Note	HSA: at the moment, not realized with MCU

30774	Asynchronous mode: Illegal switching speed HSA / AM

Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	In the mixed mode HSA/AM (MD 1465 > 0), only the controlled AM mode is permitted (MD1466 <= MD1465).
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error Response can be configured via MD 1613.0
Remedy	Remove the error either by working in the pure AM mode (MD1465 = 0) or by canceling the AM-controlled mode (MD1466 < MD1465).
Note	HSA: at the moment, not realized with MCU

30776	Measuring circuit monitoring for motor (incr.) active
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Bit STS.BFQ
Cause	With the Safety Integrated function (MD 1301) active, the measuring circuit monitoring of the motor (incr.) must also be active (MD 1600.4).
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. • RESET error From drive software version 2, the response can be configured via MD 1613.0.
Remedy	Activate measuring circuit monitoring for motor (incr.) MD 1600.4 = 0.
Note	HSA: at the moment, not realized with MCU

30799	Save and boot necessary
Response	all OFF
Indication	Diagnostic buffer of the CPU
Acknowledgm.	Power On or RESET via MCU-PIT
Cause	After automatic calculation of the control parameters, saving of the machine data and starting up are necessary.
Scan	With HSA: • Pulse deletion, motor coasts • SIMODRIVE_READY and DRIVE_READY canceled. With VSA: • Controllers inhibited, motor decelerated • SIMODRIVE_READY and DRIVE_READY canceled. From drive software version 2, the response can be configured via MD 1613.0.
Remedy	Carry out the above measures.
Note	Alarm for MCU from V2.0

30850	Speed controller adaptation: n-max < n-min
Response	Alarm indication disappears when removing the alarm cause
Indication	Diagnostic buffer of the CPU
Acknowledgm.	none
Cause	The upper adaptation speed set in MD 1412 is smaller than the lower adaptation speed set in MD 1411.
Scan	Set n-max = n-min. • Error remains statically until correction of machine data. • Message output can be activated via MD 1012.4=1.
Remedy	Enter a larger value for the adaptation speed (MD 1412) than for the lower adaptation speed (MD 1411).
Note	Alarm for MCU from V2.0

Intelligent I/O Modules Error Messages

Structure of Indication Word

- Bit not used

X Bit not used (read only)

15							8	7							Bit 0
X	X	-	-	X	X	X	X								

Status (read only) Additional information (error number)

Description of Status Bit

Status bit	Description
Bit 8	Processing of the technological function running
Bit 9	Processing of the technological function completed
Bit 10	Group error
Bit 11	Read error (FC Control)
Bit 12	-
Bit 13	-
Bit 14	Test mode active
Bit 15	Start-up running

Additional Information ANZW

Listing of the additional information (error numbers) which generate the function blocks by themselves and output them at the parameter ANZW.

HEX	Description	Note
00	No error	
0B	The data block indicated when calling the blocks FC RESTART, FC CONTROL and FC STATUS at the parameter INSTANZ_DB does not match with the technological function (DB is not the invocation DB of FB OP_MCU).	Enter correct DB
0C	Illegal channel number for the MCU	Enter correct channel number in invocation DB in the word KA_NR (in the example via OB100)
0E	Error when calling SFC RD_REC. The return value RET_VAL of the SFC is provided to the user in the variable SFCERR_TFNAME for evaluation.	See Error Description of the SFC RD_REC
0F	Error when calling SFC WR_REC. The return value RET_VAL of the SFC is provided to the user in the variable SFCERR_TFNAME for evaluation.	See Error Description of the SFC WR_REC

10	Module is not ready for operation or not parameterized.	Parameterize module using the AS-PARAM tool
11	Timeout error - an expected module reaction did not come. If the technological function waits for a reaction, an internal counter is increased whenever a technological function is called. If this counter reaches the value MAX-AUFRUF, this error message is provided.	Restart
12	Data error. This error is normally detected by the module and transferred to the technological function for passing to the user (storing in the data block).	Correct data in the invocation DB
3E	Illegal job number (FC CONTROL)	Enter a valid job number

Additional Informat. READERR_CONTROL and ME_ERR_CONTROL

Listing of the additional information (error numbers) which are stored in the data words READERR_CONTROL and ME_ERR_CONTROL.

HEX	Description	Note
0E	Error when calling SFC RD_REC. The return value RET_VAL of the SFC is provided to the user in the variable SFCERR_TFNAME for evaluation.	See Error Description of the SFC RD_REC
11	Timeout error - an expected module reaction did not come. If the technological function waits for a reaction, an internal counter is increased whenever a technological function is called. If this counter reaches the value MAX-AUFRUF, this error message is provided.	Restart

Unit Control Panel Error Messages from the MCU

200001	Power On alarm	Bit 0.3	Channel error
Response	all OFF		
Acknowledgm.	Power ON		
Cause	• Hardware error signalled by drive (group error) • The respective error number is stored in the diagnostic buffer, indication via MCU-PIT		
Scan	• Axis movement is stopped and/or no axis movement possible. • Synchronization is deleted.		
Remedy	depending on the cause		

200002	Voltage monitoring	Bit 0.3	Channel error
Response	all OFF		
Acknowledgm.	RESTART		
Cause	Short-circuit in encoder supply		
Scan	• Hardware error signalled by drive (group error) • The respective error number is stored in the diagnostic buffer, indication via MCU-PIT		
Remedy	• Check connections. • Monitoring can temporarily be turned off by means of MD20 on the user's responsibility.		

200003	Missing pulses from encoder	Bit 0.3	Channel error
Response	all OFF		
Acknowledgm.	RESTART		
Cause	• Encoder monitoring detected missing pulses. • In the operating mode "Reference-point approach", no zero mark has been detected within one encoder revolution after leaving the reference-point switch. • defective encoder • faulty or no zero mark • pulse length of zero mark smaller than 1.25 µs • interferences at measuring cable		
Scan	• Hardware error signalled by drive (group error)		

	• The respective error number is stored in the diagnostic buffer, indication via MCU-PIT
Remedy	• Check encoder and measuring-system cable. • Observe shielding and grounding instructions. • Monitoring can temporarily be turned off by means of MD20 on the user's responsibility.

200004	Error: absolute-value encoder	Bit 0.3	Channel error
Response	all OFF		
Acknowledgm.	RESTART		
Cause	Telegram exchange between MCU and absolute-value encoder faulty or interrupted: • Measuring-system cable not plugged or defective • Illegal encoder type • Encoder provides incorrect values • Interferences at the measuring-system cable		
Scan	Axis movement is stopped and/or no axis movement possible.		
Remedy	• Check encoder and measuring-system cable. • Observe shielding and grounding instructions. • Monitoring can temporarily be turned off by means of MD20 on the user's responsibility.		

200005	Encoder cable break	Bit 0.3	Channel error
Response	all OFF		
Acknowledgm.	RESTART		
Cause	• Measuring-system cable not plugged or defective • Incorrect pin assignment • Cables too long • Encoder without inverted track signals (signals $\overline{A}$, $\overline{B}$ missing)		
Scan	• Axis movement is stopped and/or no axis movement possible. • Synchronization is deleted.		
Remedy	• Check encoder and measuring-system cable • Monitoring can temporarily be turned off by means of MD20 on the user's responsibility.		

Unit Control Panel Error Messages from MMC

No.	Description
810001	Error OB event
810002	Synchronous error
810003	Asynchronous error
810004	Stop/abortion event
810005	BZ process event
810006	Error: communication event
810007	Error: H/F system event
810008	Error: diagnostic data of modules
810009	User -diagnosis-event

SIEMENS

SIMODRIVE 611

MCU 172A
Single-Axis Positioning Control

Tables

Valid for: MCU 172A V 3.x or higher

Edition: March 1998

Note

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please inquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

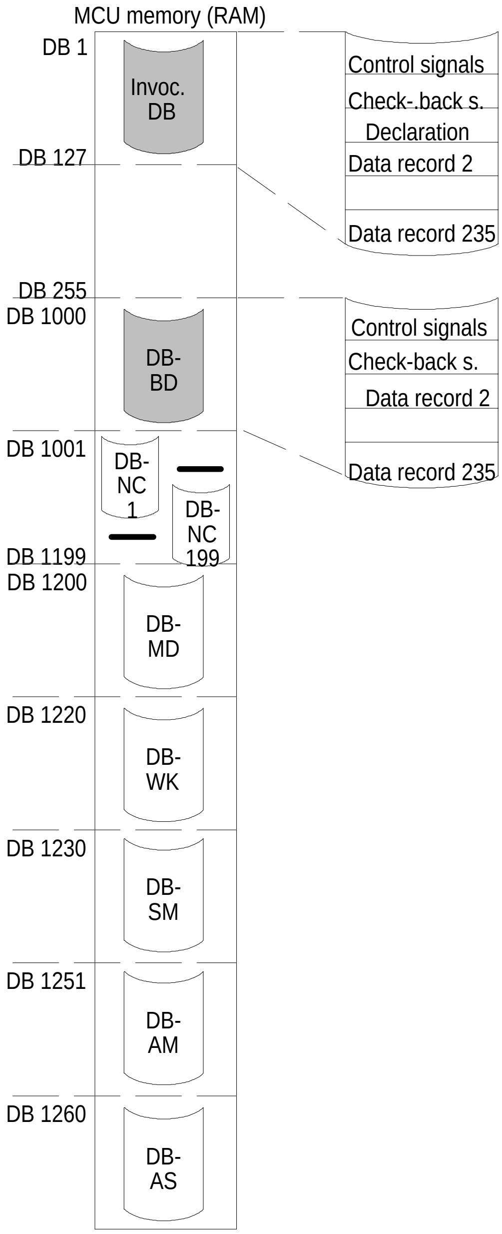
The remaining names and designations used in this Documentation may also be trademarks, the use of which by any third parties for their own purposes may violate the rights of the copyright holders.

Subject to technical changes within the product.

1 Data Structure

Contents

1.1 Invocation DB and OD-DB



Invocation DB (Invocation DB)

The invocation DB is the interface between the S7 user program and the intelligent I/O blocks. The invocation DB can freely be assigned by the user in the range from DB1 to DB127.

Control signals	see Chapter 2
Check-back signals	see Chapter 2
Data records	see Chapter 3.1

Interface DB (DB-BD)

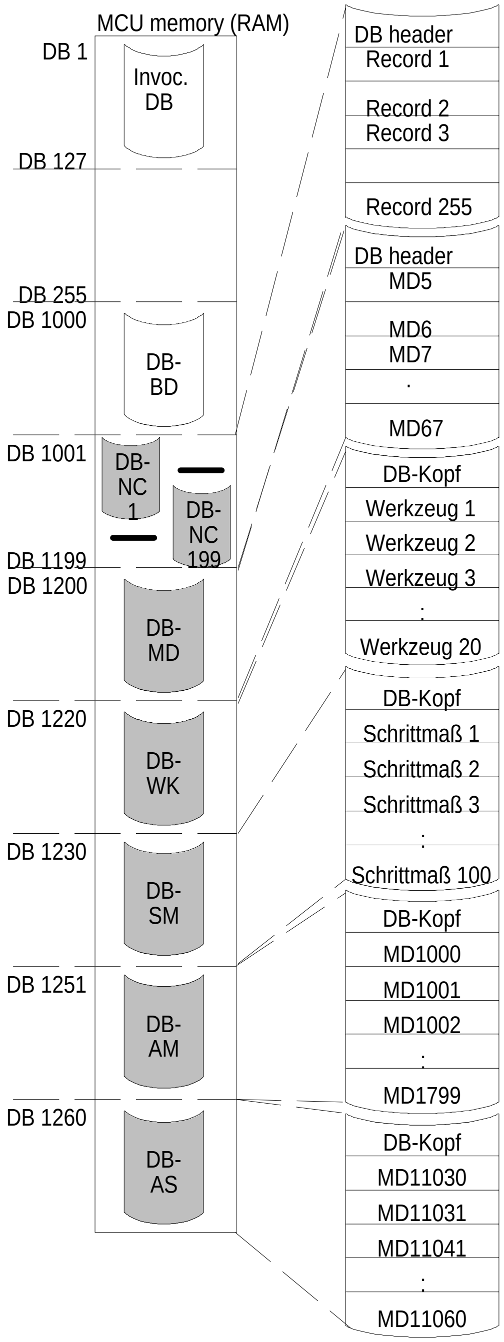
The DB-BD (operating data - the original German abbreviations are used for all data blocks) is the interface between the positioning unit and the monitoring and operating device (OP/PU). This data block contains the control/check-back signals, as well as all MCU data records. With the user program active, i.e. the TFB bit on FC Restart is "0", the data can only be read by the OP/PU. If TFB=1 (test mode active), the user has only write access to the data either by means of MCU-PIT or via his own application on the OP, for example.

Control signals	see Chapter 2
Check-back signals	see Chapter 2
Data records	see Chapter 3.1

1.2 DB-NC, DB-MD, DB-WK, DB-SM, DB-AM and DB-AS

MCU data memory

The MCU data memory (from DB 1001 on) contains the traversing programs, the machine data of the positioning unit, the tool offsets, the incremental dimensions, the machine data, and the operating data of the drive.



Traversing programs DB-NC

Structure of the traversing programs — see Chapter 3.5

Machine data of the position control DB-MD

Machine data of the MCU — see Chapter 3.2.1

Tool offsets DB-WK

Input limits — see Chapter 3.3

Incremental dimension parameters DB-SM

Input limits — see Chapter 3.4

Drive machine data DB-AM

Machine data SIMODRIVE 611 — see Chapter 3.2.2

Service/drive DB-AS

Drive operating data — see Chapter 3.6

2 Control and Check-Back Signals

Control signals in the invocation DB

Bit / Byte	7	6	5	4	3	2	1	0
0	BA Operating mode							
1	BAP Operating-mode parameter							
2	OVER Override							
3	AF	QMF	SA	EFG	STP	ST	R -	R +
4	reserved						IF	RFG
5	reserved							

Check-back signals in the invocation DB

Bit / Byte	7	6	5	4	3	2	1	0
6	BAR Mode check-back signal							
7	PBR	T-L	PEH	BL	WFG	SFG	FR-	FR+
8	reserved							AMF
9	MNR M function number							
10	reserved			ABR	IFR	SYN	BF	FS
11	reserved							
12	Indicator byte							
13	Indicator byte							

Control/check-back signals in the invocation DB

Bit / Byte	7	6	5	4	3	2	1	0
14	res.	N_S	F_S	SW254_S	BZPkt_S	BD_L	BFQ	FSQ
15	reserved							
16	reserved							

Operating modes

Operating mode (BA)	BA No.
Set-up mode	1
Control mode	2
Reference-point approach	3
Incremental dimension	4
MDI	6
Automatic Subsequent Block	8
Automatic Single Block	9
Function generator	20
Measuring function	21

Function of the control signals

Symbol	Name
AF	Axis enable
BFQ	Acknowledge system error
DIQ	Acknowledge data messages
EFG	Read enable
FSQ	Acknowledge operator error
IF	Pulse enable
NEUSTQ	Acknowledge cold start
QMF	Acknowledge M function
RFG	Controller enable
R +	Positive direction
R -	Negative direction
SA	Skip block
ST	Start
STP	Stop
TFB	Operation by means of MCU-PIT (1= operation via DB-BD)

TFB

By setting the interface bit TFB=1 as an alternative to the TFB parameter in the intelligent FC CONTROL I/O block (see Section 4.2.3), the operation and control of the MCU are no longer carried out via the user program/invocation DB but via the data block DB-BD and the software MCU-PIT installed on the programming device.

Function of the check-back signals

Symbol	Name	Symbol	Name
PARA	Positioning control parameterized	FR+	Traversing plus
NEUST	Cold start	FR-	Traversing minus
DF	Data error	ME	End of measuring
BF	Process error	SYN	Axis synchronized
FS	Operator error	AMF	Change of M function
TFGS	TFB Check-back signal	IFR	Pulses enabled
DI	Data interpretation running	FSQ	Acknowledge operator error
PBR	Program execution backwards	BFQ	Acknowledge process error
T-L	Dwell time running	N_S	Set speed steps
WFG	Waiting for external enable	F_S	Set velocity steps
BL	Processing running	SW254_ S	Set incremental dimension (SW254)
SFG	Start enable	BZPkt_S	Set reference point
PEH	Position reached, stop; exact positioning stop	BD_L	Read operating data
ABR	Drive ready		

3 Data

Contents

3.1 Data Records

Overview of data records for channel 1 DS0 to DS235 *

DS No.	Function	Direction E: Reading in S7-CPU→ pos. unit A: Reading out pos. unit→ S7-CPU	Note
	System data interface		
	Scheduled data		
2	Velocity steps	E	1 and 2
3	Speed step of controlling	E	1 and 2
4	Setpoint (No. 254) for incremental dimension	E	Set position
7	MDI block	E	Traversing block
8	Scheduled data 611	E	Set values 611
	Scheduled data with command execution		
11	Bit-coded settings	E	
12	Bit-coded commands	E	
13	Zero offset	E	Value
14	Actual-value setting	E	Set position
15	Flying actual-value setting	E	Set position
16	Digital inputs/outputs	E	
17	Flying MDI block	E	Traversing block
18	Program selection	E	
19	Application data request	E	Display data selection
20	Teach In	E	Changing of set values in the traversing program
22	Reference-point setting	E	during reference-point approach mode
	Display data of positioning control		
26	Operating data	A	
27	Active NC block	A	
28	Next NC block	A	
29	Application data	A	
30	Length measuring value, flying measuring	A	
31	Actual value - block change	A	
32	Service data	A	
33	Service data 1	A	
34	Operating data 1	A	
36	Actual values 611	A	Actual values 611
	Interface diagnosis data		
0	Diagnosis (system)	A	in DB-BD only
1	Diagnosis (channel)	A	in DB-BD only
162	Operator error	A	
163	Data error	A	
164	Traversing/system error	A	
235	Information data block	A	in invocation DB only
	Interface process alarms		
-	Process alarms	A	in DB-BD only

			see MD5

3.1.1 Interface System Data

Data block 2
Velocity steps

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - velocity step 1								42	20060
								43	
								44	
								45	
32-bit value - velocity step 2								46	20061
								47	
								48	
								49	

Data record 3
Speed step of controlling

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - speed step controlling 1								50	20070
								51	
								52	
								53	
32-bit value speed step of controlling 2								54	20071
								55	
								56	
								57	

Data record 4
Setpoint (No. 254) for incremental dimension

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - setpoint for incremental dimension								58	20080
								59	
								60	
								61	

Data record 7
MDI block

7	6	5	4	3	2	1	0	DB Invocation Address	P Number DB-BD
reserved								62	20100
reserved								63	
res.	res.	res.	X_T	res.	res.	G_2	G_1	64	
res.	res.	res.	res.	M_3	M_2	M_1	F	65	
G function 1								66	
G function 2								67	
reserved								68	
reserved								69	
Value 1 X/T								70	
								71	
								72	
								73	
Value 2 F								74	
								75	
								76	
								77	
M function 1								78	
M function 2								79	
M function 3								80	
reserved								81	

Symbol	Name
G_1	G function of group 1
G_2	G function of group 2
X_T	Position/dwell time programmed
F	Velocity programmed
M_1	M function of group 1
M_2	M function of group 2
M_3	M function of group 3

Data record 8
Scheduled data 611

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Control word 1									
res.	res.	res.	res.	DZSF1_AKT	MGLG2	HLGSS	res.	82	20200
HLG_AKT	res.	BIT5	res.	res.	NRZ_FRG	BIT1	ZK1_RESET	83	
Control word 2									
BIT 15	res.	res.	res.	res.	res.	BIT9	BIT8	84	20201
BIT7	INT_SPERR	res.	res.	res.	SP_SG_3	SP_SG_2	SP_SG_1	85	
Torque limit								86	20202
								87	
reserved								88	20203
								:	
								99	

The 611D control words 1 and 2 occur both in DB-BD, DBAS and in the invocation DB. The bits represented in *Italic letters* can only be read.

Symbol	Name
Control word 1	
ZK1_RESET	ZK1 Reset: Reset/acknowledgment of drive alarms; level 1 must be provided for at least one position control cycle
BIT1	*Parking axis setpoint corresponds to DS11, bit 14; parking axis - function selected internally*
BIT5	*Setpoint function generator: Activation of function generator in the drive*
HLG_AKT	Ramp-function generator setpoint: 0: limit-value messages: |Md| < Mdx active, Nact = Nnom active 1: limit-value message: |Md| < Mdx = 1, Nact = Nnom = 0 run-up process completed = 0
HLGSS	Ramp-function generator fast stop setpoint: 0: no effect 1: fast stop of drive nnom = 0 no pulse deletion after standstill
MGLG2	2. Set torque limit: 0: Torque /power limitation by drive MD1230/1235 1: Torque/power limitation by drive MD1232/1236
DZSF1_AKT	Smoothing of speed setpoint: 0: no smoothing of speed setpoint 1: smoothing of speed setpoint active (only active if low-pass filter parameterized via drive MD 1500 and following)
NRZ_FRG	Emergency retraction

	Control word 2
SP_SG_1	Setpoint parameter record
SP_SG_2	Parameter block setting in the drive
SP_SG_3	(changeover of speed controller parameterization)
INT_SPERR	Setpoint integrator inhibit 0: Integral portion of speed controller active 1: Integral portion of speed controller switched off
BIT7	*Setpoint pulse enable PLC: Pulse enable (by S7 user program)*
BIT8	*Setpoint current controller enable: current controller enable*
BIT9	*Setpoint current controller enable: speed controller enable*
BIT15	*Sign of life: for service purposes only*

Torque limit

After accounting it with machine-specific limitations due to the employed motor and power section, this value is used for the dynamic limitation of the set torque formed by the speed controller output and the pilot control value. The minimum of motor torque, motor power, power section current and limit value are active in the drive. As limit values, only positive values can be preset, which, in addition, must be limited to 7FFFH.

Unit: [incr]
Format: signed integer
Standardization: 1000H = M_{nom}; MD 1725 = 8 x M_{nom}
M_{limit} [incr]=M_{limit} [Nm] x 8 x 1000H / MD1725 [Nm]

Data record 11
Bit-coded settings

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
SIM_EIN	PARK_ACHS	I4_INAK	I3_INAK	I2_INAK	I1_INAK	FLG_MESS	res.	100	20210
res.	SW_END_A	NACH_EIN	FRG_N_AW	REF_TRIG	LAE_MESS	DM_AKT	res.	101	

Symbol	Name
SIM_EIN	Simulation
PARK_ACHS	Parking axis
I4_INAK	Digital input (I4) ON/OFF (0=ON)
I3_INAK	Digital input (I3) ON/OFF (0=ON)
I2_INAK	Digital input (I2) ON/OFF (0=ON)
I1_INAK	Digital input (I1) ON/OFF (0=ON)
FLG_MESS	Flying measuring
SW_END_A	Software limit switch monitoring ON/OFF (0=ON)
NACH_EIN	Follow-up operation
FRGN__AW	Enable input OFF
REF_TRIG	Retrigger reference point
LAE_MESS	Length measuring
DM_AKT	Direct measuring system ON/OFF

Data record 12
Bit-coded commands

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
reserved								104	20220
res.	IWS_LOE	RESTART	res.	AUT_SRUCK	AUT_SVORL	RESTW_LOE	res.	105	

Symbol	Name
RESTW_LOE	Delete distance to go
AUT_SVORL	Automatic block search forward
AUT_SRUCK	Automatic block search backward
RESTART	Restart
IWS_LOE	Undo actual-value setting

Data record 13
Zero offset

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - zero offset								108	20230
								109	
								110	
								111	

Data record 14
Actual-value setting

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - actual value setting								112	20240
								113	
								114	
								115	

Data record 15
Flying actual-value setting

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value flying actual-value setting								116	20250
								117	
								118	
								119	

Data record 16
Digital inputs/outputs

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
res.	res.	res.	res.	DE4	DE3	DE2	DE1	120	20300
res.	res.	res.	res.	DA4	DA3	DA2	DA1	121	

Symbol	Name
DE	Digital input
DA	Digital input

Data record 17
Flying MDI block

<table>
<tr><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th>Invocation DB Address</th><th>P Number DB-BD</th></tr>
<tr><td colspan="8">reserved</td><td>122</td><td rowspan="20">21000</td></tr>
<tr><td colspan="8">reserved</td><td>123</td></tr>
<tr><td>res.</td><td>res.</td><td>res.</td><td>X_T</td><td>res.</td><td>res.</td><td>G_2</td><td>G_1</td><td>124</td></tr>
<tr><td>res.</td><td>res.</td><td>res.</td><td>res.</td><td>M_3</td><td>M_2</td><td>M_1</td><td>F</td><td>125</td></tr>
<tr><td colspan="8">G function 1</td><td>126</td></tr>
<tr><td colspan="8">G function 2</td><td>127</td></tr>
<tr><td colspan="8">reserved</td><td>128</td></tr>
<tr><td colspan="8">reserved</td><td>129</td></tr>
<tr><td colspan="8" rowspan="4">Value 1 X/T</td><td>130</td></tr>
<tr><td>131</td></tr>
<tr><td>132</td></tr>
<tr><td>133</td></tr>
<tr><td colspan="8" rowspan="4">Value 2 F</td><td>134</td></tr>
<tr><td>135</td></tr>
<tr><td>136</td></tr>
<tr><td>137</td></tr>
<tr><td colspan="8">M function 1</td><td>138</td></tr>
<tr><td colspan="8">M function 2</td><td>139</td></tr>
<tr><td colspan="8">M function 3</td><td>140</td></tr>
<tr><td colspan="8">reserved</td><td>141</td></tr>
</table>

Symbol	Name
G_1	G function of group 1
G_2	G function of group 2
X_T	Position/dwell time programmed
F	Velocity programmed
M_1	M function of group 1
M_2	M function of group 2
M_3	M function of group 3

Data record 18
Program selection

7 6 5 4 3 2 1 0	Invocation DB Address	P Number DB-BD
Program selection (program number)	142	21100
Program selection (block number)	143	21101
Program selection (direction)	144	21102
reserved	145	21103

Data record 19
Application data request

7 6 5 4 3 2 1 0	Invocation DB Address	P Number DB-BD
Code of application data 1	146	21200
Code of applications data 2	147	21201
Code of application data 3	148	21202
Code of application data 4	149	21203

Data record 20
Teach In

7 6 5 4 3 2 1 0	Invocation DB Address	P Number DB-BD
Teach In (program number)	150	21300
Teach In (block number)	151	21301

Data record 22
Reference-point setting

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - reference-point setting								152	21400
								153	
								154	
								155	

Data record 26
Operating data

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - actual position								172	21600
								173	
								174	
								175	
32-bit value - actual velocity								176	21601
								177	
								178	
								179	
32-bit value - distance to go								180	21602
								181	
								182	
								183	
32-bit value - set position								184	21603
								185	
								186	
								187	
32-bit value - zero offset								188	21604
								189	
								190	
								191	
32-bit value - actual speed (rotary axis)								192	21605
								193	
								194	
								195	
32-bit value - relative positioning time								196	21606
								197	
								198	
								199	
reserved								200	21607
								:	
								203	

Data record 27
active NC block

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
NC program number								212	
NC block number								213	
/	UP	P	X_T	res.	G_3	G_2	G_1	214	
res.	res.	res.	D	M_3	M_2	M_1	F	215	
G function 1								216	
G function 2								217	
G function 3								218	
reserved								219	
Value 1 X/T/UP								220	22000
								221	
								222	
								223	
Value 2 F/P								224	
								225	
								226	
								227	
M function 1								228	
M function 2								229	
M function 3								230	
D function								231	

Symbol	Name
G_1	G function of group 1
G_2	G function of group 2
G_3	G function of group 3
X_T	Position/dwell time programmed
P	Number of subroutine calls programmed
UP	Subroutine call (subroutine number)
/	Skip block
F	Velocity programmed
M_1	M function of group 1
M_2	M function of group 2
M_3	M function of group 3
D	Tool offset value programmed

Data record 28
next NC block

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
NC program number								232	22100
NC block number								233	
/	UP	P	X_T	res.	G_3	G_2	G_1	234	
res.	res.	res.	D	M_3	M_2	M_1	F	235	
G function 1								236	
G function 2								237	
G function 3								238	
reserved								239	
Value 1 X/T/UP								240	
								241	
								242	
								243	
Value 2 F/P								244	
								245	
								246	
								247	
M function 1								248	
M function 2								249	
M function 3								250	
D function								251	

Symbol	Name
G_1	G function of group 1
G_2	G function of group 2
G_3	G function of group 3
X_T	Position/dwell time programmed
P	Number of subroutine calls programmed
UP	Subroutine call (subroutine number)
/	Skip block
F	Velocity programmed
M_1	M function of group 1
M_2	M function of group 2
M_3	M function of group 3
D	Tool offset value programmed

Data record 29
Application data

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - application data 1								252	22200
								253	
								254	
								255	
32-bit value - application data 2								256	22201
								257	
								258	
								259	
32-bit value - application data 3								260	22202
								261	
								262	
								263	
32-bit value - application data 4								264	22203
								265	
								266	
								267	

Data record 30
Length measuring, flying measuring

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - front edge actual position (s1)								268	22300
								269	
								270	
								271	
32-bit value - rear edge actual position (s2)								272	22301
								273	
								274	
								275	
32-bit value - length measuring value								276	22302
								277	
								278	
								279	

Data record 31
Actual value - block change

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - actual value - block change								288	22310
								289	
								290	
								291	

Data record 32
Service data

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - setpoint value of speed								292	22400
								293	
								294	
								295	
32-bit value - encoder actual value								296	22401
								297	
								298	
								299	
32-bit value - missing pulses								300	22402
								301	
								302	
								303	
32-bit value - loop-gain coefficient								304	22403
								305	
								306	
								307	
32-bit value - follow-up error								308	22404
								309	
								310	
								311	
32-bit value - follow-up error limit								312	22405
								313	
								314	
								315	
32-bit value s-overshoot range/ switch adjustment. (in reference-point approach mode only)								316	22406
								317	
								318	
								319	
32-bit value - drive approach time / drive constant (Controlling mode only)								320	22407
								321	
								322	
								323	

Data record 33
Service data

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
32-bit value - actual position (IM)								336	22500
								337	
								338	
								339	
32-bit value - actual position (DM)								340	22501
								341	
								342	
								343	
32-bit value - relative distance difference (IM-DM/DM)								344	22502
								345	
								346	
								347	
reserved								348	
								:	
								367	

Data record 34
Operating data 1

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Override								368	22600
Program number								369	22601
Block number								370	22602
Numerator of number of subroutine calls								371	22603
active G90/91								372	22604
active G60/64								373	22605
active G43/44								374	22606
active D No.								375	22607
res.	res.	res.	res.	BEGR_A_MIN	BEGR_N_SOLL	BEGR_V_MAX	res.	376	22610
reserved								377	22620

Symbol	Name
BEGR_V_MAX	Limitation v_max (MD23)
BEGR_N_SOLL	Limitation n_nom
BEGR_A_MIN	Limitation a_min

Data record 36 Actual values 611

<table>
<tr><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th><th>Invocation DB Address</th><th>P Number DB-BD</th></tr>
<tr><td colspan="10">Status word 1</td></tr>
<tr><td>res.</td><td>res.</td><td>res.</td><td>res.</td><td>DRZSWGL_I</td><td>MG2_I</td><td>HLG_SS_I</td><td>ERB</td><td>382</td><td rowspan="2">23000</td></tr>
<tr><td>res.</td><td>res.</td><td>BIT5</td><td>BIT4</td><td>P_ACHSE</td><td>res.</td><td>ZK2_3_MELD</td><td>ZK1_MELD</td><td>383</td></tr>
<tr><td colspan="10">Status word 2</td></tr>
<tr><td>E_BR_EING</td><td>res.</td><td>res.</td><td>U_F_BETR</td><td>res.</td><td>FGR</td><td>RFG_NR</td><td>RFG_IR</td><td>384</td><td rowspan="2">23001</td></tr>
<tr><td>IFG</td><td>INT_SPERR_I</td><td>ANTR_BER</td><td>res.</td><td>res.</td><td>SP_SG_3</td><td>SP_SG_2</td><td>SP_SG_1</td><td>385</td></tr>
<tr><td colspan="10">Status class 2</td></tr>
<tr><td>KUEHL_WARN</td><td>MOT_WARN</td><td>res.</td><td>res.</td><td>res.</td><td>res.</td><td>res.</td><td>res.</td><td>386</td><td rowspan="2">23002</td></tr>
<tr><td>res.</td><td>res.</td><td>res.</td><td>res.</td><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>ZWI_KREIS</td><td>387</td></tr>
<tr><td colspan="10">Status class 3</td></tr>
<tr><td>res.</td><td>res.</td><td>BIT13</td><td>BIT12</td><td>BIT11</td><td>res.</td><td>BIT9</td><td>BIT8</td><td>388</td><td rowspan="2">23003</td></tr>
<tr><td>BIT7</td><td>BIT6</td><td>BIT5</td><td>BIT4</td><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td><td>389</td></tr>
<tr><td colspan="8" rowspan="2">Capability utilization
Set torque in percent of Mnom_limit
Unit [incr]
Format unsigned integer
Standardization 7FFFH = 100%</td><td>390</td><td rowspan="2">23004</td></tr>
<tr><td>391</td></tr>
<tr><td colspan="8" rowspan="2">Effective power
Unit 0.01[kW]
Format signed integer</td><td>392</td><td rowspan="2">23005</td></tr>
<tr><td>393</td></tr>
<tr><td colspan="8" rowspan="2">Set torque
The set torque is smoothed by a PT1 filter. This filter can be set by means of MD1252. The value specified here is an effective value.
Unit [incr]
Format signed integer
Standard. 4000H[incr] = Mstand[Nm], MD1725</td><td>394</td><td rowspan="2">23006</td></tr>
<tr><td>395</td></tr>
<tr><td colspan="8" rowspan="2">Actual current value (smoothed)
The actual current value is smoothed by means of a PT1 filter. This filter can be set by means of MD1250. The value specified here is a peak value.
Unit [incr]
Format signed integer
Standard. 4000H = imax_LT[A], MD1107</td><td>396</td><td rowspan="2">23007</td></tr>
<tr><td>397</td></tr>
<tr><td colspan="8" rowspan="2">Actual speed value
Unit [incr]
Format signed integer
Standard. 4000H = nmax, motor[rpm],MD1401</td><td>398</td><td rowspan="2">23008</td></tr>
<tr><td>399</td></tr>
<tr><td colspan="8" rowspan="3">reserved</td><td>400</td><td rowspan="3">23009</td></tr>
<tr><td>:</td></tr>
<tr><td>405</td></tr>
</table>

Symbol	Name
	Status word 1
ZK1_MELD	Message ZK1: Drive alarm occurred
ZK2_3_MELD	Message ZK2/3: Event of class ZK2/ZK3 occurred
P_ACHSE	Parking axis - actual value: Axis parking
BIT4	FFT analysis running (for diagnostic purposes only)
BIT5	Function generator running (for diagnostic purposes only)
ERB	Set-up mode - actual value: Set-up mode activated (available soon)
HLG_SS_I	Ramp-function generator fast stop - actual value: Fast stop active
MG2_I	2nd torque limit - actual value: 2nd torque limit active
DRZSWGL_I	Drive MD for smoothing of speed setpoint signal - actual value: MDs for smoothing of speed setpoint value active (MD1500 and following) 0: low-pass filter active and "Smoothing of speed setpoint signal active" (control word 1.11) = 1 1: other (also default value)
	Status word 2
SP_SG_1	Actual parameter record: Actual parameter record of drive
SP_SG_2	
SP_SG_3	
ANTR_BER	Drive ready: Drive ready for traverse
INT_SPERR_I	Integrator inhibit - actual value: Integrator in speed control loop blocked
IFG	Pulse enable - actual value: Pulses enabled
RFG_IR	Current controller enable - actual value: Current controller enabled
RFG_NR	Speed controller enable - actual value: Speed controller enabled
FGR	Reference input variable - actual value: 0: torque-controlled operation 1: speed controlled operation
U_F_BETR	U/f mode: U/f mode active
E_BR_EING	Automatic braking initiated: Drive brakes with max. permissible torque (response after cancellation of controller enable and active pulse enable)
	Status class 2
ZWI_KREIS	Intermediate circuit ("ZWK") 0: Uzwk > MD1604 1: Uzwk < MD1604
BIT1	Emergency retraction intermediate circuit 0: Uzwk > MD1634 (if emergency retraction activated) and default 1: Uzwk < MD1634 (if emergency retraction activated)
BIT2	Emergency retraction/generator mode active 0: default 1: emergency retraction/generator mode active
BIT3	Generator speed < min. speed available soon for the Emergency Retraction function 0: default 1: nact < MD1635 (if emergency retraction activated)
MOT_WARN	Motor temperature warning Motor temperature warning threshold exceeded or temperature sensor broken. When the time set in MD1603 is elapsed, the device is switched off. Remedy: Check load play, check setting in MD1602. Check encoder cable.

Symbol	Name
KUEHL_WARN	Heat sink warning Max. power section temperature exceeded. The device is switched off after 20 sec. Remedy: Check load play.

	Status class 3		
BIT0	Run-up process completed 0: Ramp-function generator active: Limit value messages |Md| < Mdx and Nact = Nnom switched off 1: Ramp-function generator inactive: limit value messages active		
BIT1	/Md/ < Mdx	Mdx Delay time	MD1428 MD1429
BIT2	/nact/ < nmin	Nmin	MD1418
BIT3	/nact/ < nx	Nx	MD1417
BIT4	nnom = nact	Tolerance band Delay time	MD1426 MD1427
BIT5	Variable signaling function Threshold value monitoring of drive signals. Parameterization by MD1620 ... 1626		
BIT6	(nnom - nact) < Delta (-): for service purposes only		
BIT7	(nnom - nact) > Delta (+): for service purposes only		
BIT8	Actuating voltage /u_actuat_g/ > u_max: for service purposes only		
BIT9	Current set value / i_set/ > i_max i _max Minimum of MD1104/MD1105, MD1107, MD1108		
BIT11	Setpoint value of speed /n_nom/ > n_uewa_mot n_uewa_mot MD1405		
BIT12	Actuating voltage /u_actuat_d/ > u_max: for service purposes only		
BIT13	Set torque /mnom/ > mlimit: for service purposes only		

3.1.2 Interface Diagnosis Data

Data record 0
Diagnosis (system)

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Diagnosis 0									
res.	res.	res.	res.	BIT3	BIT2	BIT1	BIT0	-	24000
Diagnosis 1									
res.	res.	res.	res.	res.	BIT2	BIT1	BIT0	-	24001
Diagnosis 2									
res.	res.	res.	res.	res.	res.	res.	res.	-	24002
Diagnosis 3									
res.	BIT6	res.	res.	res.	res.	res.	res.	-	24003

Diagnosis 0	
BIT0	Module error, group error
BIT1	Internal error (see Diagnosis 2,3)
BIT2	External error
BIT3	Channel error (see Diagnosis 8)
Diagnosis 1	
BIT0-2	Type class of module
Diagnosis 2	
reserved	
Diagnosis 3	
BIT6	Process alarm lost

Data record 1
Diagnosis (channel)

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Diagnosis 4 (MCU identification)								-	24004
Diagnosis 5 (length of information)								-	24005
Diagnosis 6 (number of channels)								-	24006
Diagnosis 7 (channel vector)								-	24007
Diagnosis 8									
res.	res.	res.	BIT4	BIT3	BIT2	BIT1	BIT0	-	24008
Diagnosis 9								-	24009
reserved								-	24010

Diagnosis 8	
BIT0	Cable break (incremental encoder)
BIT1	Absolute encoder fault
BIT2	Missing pulses from encoder, zero mark missing
BIT3	Voltage monitoring of encoder
BIT4	ZK1 error (drive POWER-ON alarm)

Data record 162
Operator error

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Operator error (number)								406	24100
								407	
Operator error (source)								408	24101
Operator error (further error numbers)								409	24102

Data record 163
Data error

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Data error (number)								410	24110
								411	
Data error (source)								412	24111
Data error (further error numbers)								413	24112

Data record 164
Traversing/process errors

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Traversing error (number)								414	24120
								415	
Traversing error (source)								416	24121
Traversing error (further error numbers)								417	24122

Data record 235
Information data record

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
Type ID and extension ID								418	-
								419	-
Module ID								420	-
								421	-
Module extension ID								422	-
FW version high byte								423	-
FW version low byte								424	-
Number of channels								425	-
Number of process inputs per channel								426	-
Number of process outputs per channel								427	-
								428	-
reserved								429	-

3.1.3 Interface Process Alarms

MD5
process alarms

7	6	5	4	3	2	1	0	Invocation DB Address	P Number DB-BD
res.	res.	res.	BIT4	BIT3	res.	BIT1	BIT0	-	25000

BIT0	Position reached
BIT1	Length measuring completed
BIT3	Flying block change
BIT4	Flying measuring

3.1.4 Operating Data FM-POS DB 1000

P-No. DB-BD	Bit	Description	Refer to Document.	Invocation DB Address
20030		STS: Control signals 0		-
	0	Acknowledge data interpretation		-
	1	Operation via DB interface		-
	2	Acknowledge operator error (FSQ)	7/4.1	-
	3	Acknowledge system/traversing error (BFQ)	7/4.1	-
	6	Acknowledge cold start (NEUSTQ)	7/4.1	-
20031		STS: Control signals 1	7/4.1	-
	0	Program start (ST)	7/4.1	-
	1	Program stop (STP)	7/4.1	-
	2	Negative direction (R-)	7/4.1	-
	3	Positive direction (R+)	7/4.1	-
	4	Acknowledge M function (QMF)	7/4.1	-
	5	Read-in enable (EFG)	7/4.1	-
	6	Skip block (SA)	7/4.1	-
	7	Axis enable (AF)	7/4.1	-
20032		STS: Operating mode (BA)	7/4.1	-
20033		STS: Operating-mode parameters (BP)	7/4.1	-
20034		STS: Override (OVERR)	7/4.1	-
20035		STS: Control signals 5		-
	0	Pulse enable PLC (IF)	7/4.1	-
	1	Controller enable PLC (RFG)	7/4.1	-
20040		RMS: Check-back signals 0		-
	0	Data interpretation running	7/4.2	-
	1	DB interface active		-
	2	Operator error	7/4.2	-
	3	System/traversing error	7/4.2	-
	4	Data error	7/4.2	-
	6	Cold start	7/4.2	-
	7	FM parameterized		-
20041		RMS: Check-back signals 1		-
	0	Start enable (SFG)	7/4.2	-
	1	Processing running (BL)	7/4.2	-
	2	Wait for release for machining (WFG)	7/4.2	-
	4	Change of M function (AMF)	7/4.2	-
	5	Dwell time running (T_L)	7/4.2	-
	6	Program execution backward (PBR)	7/4.2	-
20042		RMS: Mode check-back signal		-
20043		RMS: Check-back signals 3		-
	0	Channel synchronized		-
	1	End of measuring		-
	2	Negative direction		-
	3	Positive direction		-
	7	Position reached, stop		-

P-No. DB-BD	Bit	Description	Refer to Document.	Invocation DB Address
20044		RMS: M function number		-
20045		RMS: Check-back signals 5		-
	0	Pulses enabled (IFR)	7/4.2	-
	1	Drive ready		-
	2	Status of digital input 1		
	3	Status of digital input 2		
	4	Status of digital input 3		
	5	Status of digital input 4		
20060		DS2: Velocity step 1, Set-Up	7/3-12	42-45
20061		DS2: Velocity step 2, Set-Up	7/3-12	46-49
20070		DS3: Speed step, Controlling 1	7/3-13	50-53
20071		DS3: Speed step, Controlling 2	7/3-13	54-57
20080		DS4: Setpoint for incremental dimension	7/3-18	58-61
20100		DS7: MDI block	7/3-19	62-81
20200		DS8: Control word 1	3-5	82, 83
	0	ZK1 Reset	3-5	83
	2	Emergency retraction enable	3-5	83
	7	Ramp-function generator setpoint	3-5	83
	9	Ramp-function generator fast stop setpoint	3-5	82
	10	2nd torque limit setpoint	3-5	82
	11	Smoothing of speed setpoint	3-5	82
20201		DS8: Control word 2	3-5	84, 85
	0-2	Scheduled parameter block	3-5	85
	6	Integrator inhibit setpoint	3-5	85
20202		DS8: Torque limit	3-5	86, 87
20210		DS11: Bit-coded settings	7/4-5	100, 101
	1	Direct measuring system (DM) ON/OFF	7/1.2	101
	2	Length measuring	7/2-5	101
	3	Retrigger reference point		101
	4	Enable input OFF	7/2-4	101
	5	Follow-up operation		101
	6	Software limit position monitoring		101
	9	Flying measuring	7/2-5	100
	10	Digital input (I1)		100
	11	Digital input (I2)		100
	12	Digital input (I3)		100
	13	Digital input (I4)		100
	14	Parking axis		100
	15	Simulation		100
20220		DS12: Bit-coded commands	7/4-6	104, 105
	1	Cancel distance to go		105
	2	Automatic block search forward		105
	3	Automatic block search backward		105
	5	Restart		105
	6	Undo actual-value setting		105
20230		DS13: Zero offset	7/4-6	108-111

P-No. DB-BD	Bit	Description	Refer to Document.	Invocation DB Address
20240		DS14: Actual-value setting	7/4-6	112-115
20250		DS15: Flying actual-value setting	7/4-7	116-119
20300		DS16: Digital outputs / inputs	7/4-7	120, 121
	0	Digital output 1	7/2.1	121
	1	Digital output 2	7/2.1	121
	2	Digital output 3	7/2.1	121
	3	Digital output 4	7/2.1	121
	8	Digital input 1	7/2.1	120
	9	Digital input 2	7/2.1	120
	10	Digital input 3	7/2.1	120
	11	Digital input 4	7/2.1	120
21000		DS17: Flying MDI block	7/3-9	122-141
21100		DS18: Program selection (program No.)	7/3.7	142
21101		DS18: Program selection (block No.)	7/3.7	143
21102		DS18: Program selection (direction)	7/3.7	144
21200		DS19: Code of application data 1	7/4-7, 9/7-21	146
21201		DS19: Code of application data 2	7/4-7, 9/7-21	147
21202		DS19: Code of application data 3	7/4-7, 9/7-21	148
21203		DS19: Code of application data 4	7/4-7, 9/7-21	149
21300		DS20: Teach-In (program No.)	7/4-7	150
21301		DS20: Teach-In (block No.)	7/4-7	151
21400		DS22: Reference-point setting	7/4-7	152-155
21600		DS26: Actual position	7/4-10	172-175
21601		DS26: Actual velocity	7/4-10	176-179
21602		DS26: Distance to go	7/4-10	180-183
21603		DS26: Set position	7/4-10	184-187
21604		DS26: Active coordinate offset	7/4-10	188-191
21605		DS26: Actual speed (rotary axis)	7/4-10	192-195
21606		DS26: Relative positioning time	7/4-10	196-199
22000		DS27: Active NC block	7/4-10	212-231
22100		DS28: Next NV block	7/4-10	232-251
22200		DS29: Application data 1	7/4-10	252-255
22201		DS29: Application data 2	7/4-10	256-259
22202		DS29: Application data 3	7/4-10	260-263
22203		DS29: Application data 4	7/4-10	264-267
22300		DS30: Front edge actual position (s1)	7/4-10	268-271
22301		DS30: Rear edge actual position (s2)	7/4-10	272-275
22302		DS30: Length measuring value	7/4-10	276-279
22310		DS31: Actual value - block change	7/4-10	288-291
22400		DS32: Setpoint value of speed	7/4-10	292-295
22401		DS32: Encoder actual value	7/4-10	296-299
22402		DS32: Missing pulses	7/4-10	300-303
22403		DS32: Loop-gain coefficient	7/4-10	304-307
22404		DS32: Following error	7/4-10	308-311
22405		DS32: Follow-up error distance limit	7/4-10	312-315
22406		DS32: s-overshoot/switch adjustment	7/4-10	316-319

P-No. DB-BD	Bit	Description	Refer to Document.	Invocation DB Address
22407		DS32: Drive approach time	7/4-10	320-323
22500		DS33: Actual position (IM)	7/4-10	336-339
22501		DS33: Actual position (DM)	7/4-10	340-343
22502		DS33: Relative path difference (IM-DM/DM)	7/4-10	344-347
22600		DS34: Override	7/4-10	368
22601		DS34: Program number	7/4-10	369
22602		DS34: Block number	7/4-10	370
22603		DS34: Numerator of subroutine calls	7/4-10	371
22604		DS34: Active G90/G91	7/4-10	372
22605		DS34: Active G60/G64	7/4-10	373
22606		DS34: Active G43/G44	7/4-10	374
22607		DS34: Active D No.	7/4-10	375
22610		DS34: Status messages	7/4-10	376
	1	Limitation v_max (MD 23)	7/4-10	376
	2	Limitation n_nom	7/4-10	376
	3	Limitation a_min	7/4-10	376
23000		DS36: Status word 1	3.1.1	382, 383
	0	Message ZK1	3.1.1	383
	1	Message ZK2/3	3.1.1	383
	3	Parking axis, actual value	3.1.1	383
	4	FFT analysis, actual value	3.1.1	383
	5	Function generator, actual value	3.1.1	383
	8	Set-up mode, actual value	3.1.1	382
	9	Ramp-function generator fast stop, actual value	3.1.1	382
	10	2nd torque limit, actual value	3.1.1	382
	11	Smoothing of speed setpoint, actual value	3.1.1	382
23001		DS36: Status word 2	3.1.1	384, 385
	0-2	Actual parameter record	3.1.1	385
	5	Drive ready	3.1.1	385
	6	Integrator inhibit, actual value	3.1.1	385
	7	Pulse enable, actual value	3.1.1	385
	8	Current controller, actual value	3.1.1	384
	9	Speed controller enable, actual value	3.1.1	384
	10	Reference input variable, actual value	3.1.1	384
	12	U/f mode	3.1.1	384
	15	Automatic braking initiated	3.1.1	384
23002		DS36: Status class 2	3.1.1	386, 387
	0	Intermediate circuit	3.1.1	387
	1	Intermediate circuit - emergency retraction	3.1.1	387
	2	Emergency retraction/generator mode active	3.1.1	387
	3	Generator speed < min. speed	3.1.1	387
	14	Motor temperature warning	3.1.1	386
	15	Heat sink temperature warning	3.1.1	386
23003		DS36: Status class 3	3.1.1	388, 389
	0	Run-up process completed	3.1.1	389
	1	/Md/ < Mdx	3.1.1	389

P-No. DB-BD	Bit	Description	Refer to Document.	Invocation DB Address
	2	/nact/ < nmin	3.1.1	389
	3	/nact/ < nx	3.1.1	389
	4	nnom = nact	3.1.1	389
	5	Variable signaling function	3.1.1	389
	6	(nnom - nact) < Delta(-)	3.1.1	389
	7	(nnom - nact) > Delta(+)	3.1.1	389
	8	Actuating voltage /u_actuat_q/ > u_max	3.1.1	388
	9	Current set value /i_set/ > i_max	3.1.1	388
	11	Set speed /n_nom/ > n_uewa_mot	3.1.1	388
	12	Actuating voltage /u_actuat_d/ > u_max	3.1.1	388
	13	Set torque /mnom/ > mlimit	3.1.1	388
23004		DS36: Capability utilization (7FFF=stop)	3.1.1	390, 391
23005		DS36: Effective power	3.1.1	392, 393
23006		DS36: Set torque	3.1.1	394, 395
23007		DS36: Actual current value	3.1.1	396, 397
23008		DS36: Actual speed value	3.1.1	398, 399
24000		DS0: Diagnosis 0		-
	0	Module fault, group fault		-
	1	Internal fault (see Diagn. 2,3)		-
	2	External fault		-
	3	Channel fault (see Diagnosis 8)		-
24001		DS0: Diagnosis 1		-
	0-3	Type class of module		-
24003		DS0: Diagnosis 3		-
	6	Process alarm lost		-
24004		DS1: Diagnosis 4 (FM pos. ID)		-
24005		DS1: Diagnosis 5 (length of information)		-
24006		DS1: Diagnosis 6 (number of channels)		-
24007		DS1: Diagnosis 7 (channel vector)		-
24008		DS1: Diagnosis 8		-
	0	Cable break (incremental encoder)		-
	1	Error: absolute-value encoder		-
	2	Missing pulses from encoder, zero mark miss.		-
	3	Voltage monitoring of encoder		-
	4	ZK1 error (drive Power-On alarm)		-
24100		DS162: Operator error (number)		406, 407
24101		DS162: Operator error (source)		408
24102		DS162: Operator error (further error numbers)		409
24110		DS163: Data error (number)		410, 411
24111		DS163: Data error (source)		412
24112		DS163: Data error (further error numbers)		413
24120		DS164: Traversing error (number)		414, 415
24121		DS164: Traversing error (source)		416
24122		DS164: Traversing error (further error numbers)		417
25000		PAL: Process alarms		-
	0	Position reached		-

P-No. DB-BD	Bit	Description	Refer to Document.	Invocation DB Address
	1	Length measuring completed		-
	3	Flying block change		-
	4	Flying block change		-

3.2 Machine Data

3.2.1 Machine Data of MCU

MD	Designation	Value/Description	Unit	Docum.
5.X	Process alarm generation	Bit 0 = 1 Position reached Bit 1 = 1 Length measuring completed Bit 3 = 1 Flying block change Bit 4 = 1 Flying measuring	-	7/2-5
6	Axis name	1st character = initial letter X Y Z A B C U V W Q E 2nd character = address extension 1 2 3 4 5 6 7 8 9	-	13/1-1
7	Measuring system	1 = 10^{-3} mm 2 = 10^{-4} inch 3 = 10^{-4} degrees 4 = 10^{-2} degrees	-	7/1-15
8	Axis type	0 = linear axis 1 = rotary axis	-	7/5-11
9	End of rotary axis	1 ... 1 000 000 000, in integer multiples of (MD11 +2^{-32} x MD12) or (MD55 +2^{-32} x MD56)	-	7/5-11 3/3-6
10	Encoder type (IM)	1 = Incremental encoder 5 = Absolute encoder (EnDat)	-	7/1-17, 7/1-18
11	Distance/encoder revolution (IM)	1...1 000 000 000 (integer component)	[USR]	7/1-17, 7/1-18
12	Distance to go/encoder revolution (IM)	1...2^{32}-1 (fractional component), decimals	2^{-32}[USR]	7/1-17, 7/1-18
13	Increments/encoder revolution (IM)	2^{1}...2^{25} Entry as per encoder type plate	-	7/1-17, 7/1-18
14	Number of revolutions of EnDat encoder	0 or 1 Single-Turn encoder 2^{1}...2^{12} Multi-Turn encoder Only numbers to the power of 2 are permitted	-	7/1-18
15	Reserved	-	-	-

MD	Designation	Value/Description	Unit	Docum.
16	Reference-point coordinate	-1 000 000 000...+1 000 000 000	[USR]	7/3-14
17	Absolute-encoder adjustment	$0...2^{32}-1$ is entered automatically when setting the reference point; cannot be modified by the user and is not displayed in the standard setting.	-	7/3-5
18	Kind of reference-point approach	0 = + direction, zero pulse right 1 = + direction, zero pulse left 2 = - direction, zero pulse right 3 = - direction, zero pulse left 4 = + direction, reference-point switch, middle 5 = - direction, reference-point switch, middle 8 = + direction, reference-point switch, edge 9 = - direction, reference-point switch edge	-	7/3-14
19.X	Adaptation of direction	Bit 0 = 1 Invert direction of measured value (IM) Bit 1 = 1 Invert setpoint Bit 2 = 1 Invert direction of measured value (DM)	-	7/1-14
20.X	Hardware monitoring	Bit 4 =1 Zero monitoring (incremental encoder) Bit 5 =1 Encoder error (incremental encoder) Entry for monitoring functions to be activated!	-	7/1-16
21	Software limit switch beginning	-1 000 000 000...< MD22 Rotary axis: 0 ...< MD22	[USR]	7/1-4
22	Software limit switch end	> MD21...+1 000 000 000	[USR]	7/1-4
23	Max. velocity	10 ... 500 000 000	[USR]/min	7/1-6
24	Target range (PEH)	0...10 000	[USR]	7/1-11
25	Monitoring time (PEH)	1...100 000 0 = no monitoring rounded to a multiple of the position-control cycle	ms	7/1-11
26	Standstill range	1...10 000 000	[USR]	7/1-12
27	Reference-point offset	-1 000 000 000...+1 000 000 000	[USR]	7/3-14
28	Referencing velocity	$10...v_{max}$ (MD23)	[USR]/min	7/3-14
29	Reducing velocity	$10...v_{max}$ (MD23)	[USR]/min	7/3-14
30	Backlash compensation	-10 000...+10 000	[USR]	7/1-14
31	Direction reference of backlash	0 = the same as reference-point approach 1 = positive 2 = negative	-	7/1-14
32	Output type of M function	1 = during positioning, time-controlled 2 = during positioning, acknowl.-controlled 3 = prior to positioning , time-controlled 4 = prior to positioning, acknowl.-controlled 5 = after positioning, time-controlled 6 = after positioning, acknowl.-controlled	-	7/5-16
33	Output time of M function	1 ... 100 000	ms	7/5-16
34	Denominator of load gear	1 ... 1000	-	7/1-13
35	Numerator of load gear	1 ... 1000	-	7/1-13
36.X	Input adaptation	Bit 8 = Digital input (I1), inverted Bit 9 = Digital input (I2), inverted Bit 10 = Digital input (I3), inverted Bit 11 = Digital input (I4), inverted	-	7/2-2, 7/3-7
37.X	Servo control signal	Bit 1=1 Jerk limitation only at acceleration beginning Bit 7=1 Time override active	-	7/1-10
38	Loop-gain coefficient	1...10 000	1/min	7/1-13

MD	Designation	Value/Description	Unit	Docum.
39	Minimum follow-up error, dynamic	0...100 000	[USR]	7/1-12
40	Acceleration	0 = without ramp function 1...100 000	10^3 [USR]/s^2	7/1-6
41	Deceleration	0 = without ramp function 1...100 000	10^3 [USR]/s^2	7/1-6
42	Jerk-time constant	0...10 000	ms	7/1-7
43	Reserved	-		-
44	Reserved	-	-	-
45	Reserved	-	-	-
46.X to 49.X	Digital inputs (I1) to (I4)	Bit 0 = Start, ext Bit 1 = Enable input Bit 2 = External block change Bit 3 = Flying actual-value setting Bit 4 = Measuring Bit 5 = Reference-point switch Bit 6 = Reverse cams for reference-point approach Bit 7 = Emergency retraction (drive-independent) Bit 8 = Position controller inhibit	-	7/2-2, 7/3-7, 7/3-14, 7/3-25
50.X to 53.X	Digital outputs (O1) to (O4)	Bit 0 = Position reached, Stop Bit 1 = Axis movement, forward Bit 2 = Axis movement, backward Bit 3 = Change of M97 Bit 4 = Change of M98 Bit 5 = Start enable Bit 7 = Direct output via DS16	-	7/2-2
54	Encoder type (DM)	0 = not available 1 = Incremental encoder 5 = Absolute encoder (EnDat)	-	7/1-17, 7/1-18
55	Distance/encoder revolution (DM)	1...1 000 000 000 (integer component)	[USR]	7/1-17, 7/1-18
56	Distance to go/encoder revolution (DM)	0...2^{32}-1 (fractional component) decimals	2^{-32}[USR]	7/1-17, 7/1-18
57	Increments/encoder revolution (DM)	2^1...2^{25} Entry as per encoder type plate	-	7/1-17, 7/1-18
58	Reserved	-	-	-
59	Reserved	-	-	-
60.X	Encoder setting	Bit 0 = 1IM (indirect measuring system) ON Bit 1 = 1DM (direct measuring system) ON	-	7/1-16
61	Position controller cycle	2 ... 10	ms	7/2-2
62	Reserved	-	-	-
63	Drive activation	0 = passive 1 = active	-	7/1-19, 7/3-6
64	Drive number	1 (fixed)	-	7/1-19
65	Drive power section code	is automatically entered during the drive commissioning	-	7/1-19
66	Drive module type	1 = single-axis (fixed)	-	7/1-19
67	Drive type	1 = VSA (fixed)	-	7/1-19

3.2.2 Machine Data of SIMODRIVE 611

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1000	Current controller cycle	2	4	4	PO	31.25 µs	WORD	5/1-10
1001	Speed controller cycle	2	4	16	PO	31.25 µs	WORD	5/1-10
1002	Monitoring cycle	128	3200	3200	PO	31.25 µs	WORD	5/1-11
1003	STS configuration	0x0	0x330	0xFFFF	PO	-	WORD	-
1003.4	Super sine	0=OFF	1=ON	1=ON	PO	-		-
1003.5	Pulse deletion masking	0=free	1=masked	1=masked	PO	-		-
1003.6	Time base TBSYN	0=synchron	0=synchron	1=asynchron	PO	-		-
1003.7	Time base ATD	0=synchron	0=synchron	1=asynchron	PO	-		-
1003.8	SYNO synchronization	0=free	1=synchron	1=synchron	PO	-		-
1003.9	Time base EX_TBYN	0=synchron	1=asynchron	1=asynchron	PO	-		-
1003.10	Division ratio STROBE -> XINT	0=1:1	0=1:1	1=2:1	PO	-		-
1004	Structure configuration	0x0	0x0	0x7FFF	PO	-	WORD	-
1004.0	Pilot control structure	0=OFF	0=OFF	1=ON	PO	-		-
1004.2	Higher dynamics (single-axis module)	0=OFF	0=OFF	1=ON	PO	-		-
1005	Encoder line number of motor encoder	128	2048	8192	PO	-	WORD	5/4-1
1007	Encoder line number of direct measuring system	0	0	65535	PO	-	WORD	5/4-1
1008	Encoder phase offset compensation	-20	0	20	immed.	degrees	REAL	5/4-2
1011	Configuration of actual-value acquisition	0x0	0x0	0xFFFF	PO	-	WORD	5/4-2
1011.0	HSA only: inversion of actual value	0=OFF	0=OFF	1=ON	PO	-		5/4-2
1011.1	Phase offset compensation	0=OFF	0=OFF	1=ON	PO	-		5/4-2
1011.2	Speed acquisition with measuring-time register	0=OFF	0=OFF	1=ON	PO	-		5/4-2
1011.3	Absolute encoder (EnDat interface)	0=OFF	0=OFF	1=ON	PO	-		5/4-2
1011.4	Linear measuring system	0=OFF	0=OFF	1=ON	PO	-		5/4-2
1011.5	Motor encoder provided	0=YES	0=YES	1=NO	PO	-		5/4-2
1012	Function switch	0x0	0x0	0x7FFF	immed.	-	WORD	5/3-2
1012.0	Ramp-function generator follow-up	0=OFF	0=OFF	1=ON	immed.	-		5/3-2
1012.2	Drive Ready terminal-dependent	0=OFF	1=ON	1=ON	immed.	-		5/3-2
1012.4	ZK2 - error in parameterization	0=OFF	0=OFF	1=ON	immed.	-		5/2-14 5/3-2
1012.7	HSA only: AM actual speed value after pulse blocking	0=Nnom	0=Nnom	1=0	immed.	-		5/3-2
1014	Activate U/f mode	0=OFF	0=OFF	1=ON	PO	-	WORD	5/6-15
1021	Multiturn resolution of absolute motor encoder	0	4096	65535	PO	-	WORD	5/4-3
1022	Measuring steps of absolute track of motor	0	8192	65535	PO	-	WORD	5/4-3

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1023	Diag. of meas. circuit of absolute track of motor	0	0	65535	immed.	-	WORD	5/4-3
1023.0	Illumination failed	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.1	Signal amplitude too low	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.2	Code connection faulty	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.3	Overvoltage	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.4	Undervoltage	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.5	Overcurrent	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.6	Replace battery	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.9	CD track of ERN1387 encoder defective	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.10	Protocol cannot be canceled	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.11	SSI level at data line detected	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.12	TIMEOUT when reading the measured value	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.13	CRC error	0=NO	0=NO	1=YES	immed.	-		5/4-3
1023.15	Measuring encoder defective	0=NO	0=NO	1=YES	immed.	-		5/4-3
1030	Configuration of actual-value acquisition DM	0x0	0x0	0xFFFF	PO	-	WORD	5/4-4
1030.3	Absolute encoder (EnDat interface)	0=OFF	0=OFF	1=ON	PO	-		5/4-4
1030.4	Linear measuring system	0=OFF	0=OFF	1=ON	PO	-		5/4-4
1031	Multiturn resolution of absolute encoder DM	0	4096	65535	PO	-	WORD	5/4-4
1032	Measuring steps of absolute track DM	0	8192	65535	PO	-	WORD	5/4-4
1033	Diagnosis dir. measuring system of absolute track	0	0	65535	immed.	-	WORD	5/4-5
1033.0	Illumination failed	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.1	Signal amplitude too low	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.2	Code connection faulty	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.3	Overvoltage	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.4	Undervoltage	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.5	Overcurrent	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.6	Replace battery	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.10	Protocol cannot be canceled	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.11	SSI level at data line detected	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.12	TIMEOUT when reading the measured value	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.13	CRC error	0=NO	0=NO	1=YES	immed.	-		5/4-5
1033.15	Measuring encoder defective	0=NO	0=NO	1=YES	immed.	-		5/4-5
1100	Frequency of pulse-width modulation	2000	4000	8000	PO	Hz	REAL	5/1-11
1101	Calculation dead time of current control-loop	0	62	124	PO	µs	INT	5/1-12
1102	Motor code number	0	0	65535	PO	-	WORD	5/1-4
1103	Rated motor current	0	0	500	PO	A	REAL	5/1-4

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1104	Max. motor current	0	0	500	PO	A	REAL	5/1-5
1105	Reduction of max. motor current	0	100	100	immed.	%	INT	5/2-2
1106	Power section code number	0x0	0x0	0xFFFF	PO	-	WORD	5/1-8
1107	Transistor limit current	1	200	500	PO	A	REAL	5/1-8
1108	Power section limit current	1	200	500	PO	A	REAL	5/1-9
1111	Rated current of power section	1	200	500	PO	A	REAL	5/1-9
1112	Pole-pair number of motor	0	0	6	PO	-	WORD	5/1-5
1113	Torque constant	0	0	5	PO	Nm/A	REAL	5/1-5
1114	Voltage constant	0	0	300	PO	V	REAL	5/1-6
1115	Armature resistor	0	0	20	PO	Ohm	REAL	5/1-6
1116	Armature inductivity	0	0	100	PO	mH	REAL	5/1-6
1117	Motor moment of inertia	0	0	32	PO	kgm²	REAL	5/1-6
1118	Motor zero-speed current	0	0	500	PO	A	REAL	5/1-7
1120	P amplification of current controller	0	10	10000	immed.	V/A	REAL	5/5-18
1121	Reset time of current controller	0	2000	8000	immed.	µs	REAL	5/5-18
1124	Balancing of current reference model	0	0.5	1	immed.	-	REAL	-
1125	Start-up time 1 during U/f mode	0.01	5	100	immed.	s	REAL	5/6-15
1126	Start-up time 2 during U/f mode	0.01	5	100	immed.	s	REAL	5/6-15
1146	Max. motor speed	0	0	50000	PO	1/min	REAL	5/2-8 5/1-7
1147	Speed limitation	0	7000	50000	immed.	1/min	REAL	5/2-2
1161	Intermediate circuit fixed voltage	0	600	700	immed.	V	WORD	5/2-19
1190	Evaluation of torque limit value	0	100	10000	immed.	Nm	REAL	-
1191	Adaptation of servo limit torque	0	1	100	immed.	-	REAL	5/2-8
1200:8	Number of current-setpoint filters	0	1	4	immed.	-	WORD	5/5-19
1201:8	Cur.-setpoint filter type	0x0	0x0	0x7FFF	immed.	-	WORD	5/5-21
1201.0	1st filter: low-pass / band-stop filter	0=low pass	0=low pass	1=band stop	immed.	-		5/5-21
1201.1	2nd filter: low-pass / band-stop filter	0=low pass	0=low pass	1=band stop	immed.	-		5/5-21
1201.2	3rd filter: low-pass / band-stop filter	0=low pass	0=low pass	1=band stop	immed.	-		5/5-21
1201.3	4th filter: low-pass / band-stop filter	0=low pass	0=low pass	1=band stop	immed.	-		5/5-21
1202:8	Self-generated frequency of current-setpoint filter	0	2000	8000	immed.	Hz	REAL	5/5-22
1203:8	Damping of current-setpoint filter 1	0.05	0.7	5	immed.	-	REAL	5/5-22
1204:8	Self-gen. frequency of current-setpoint filter 2	0	0	8000	immed.	Hz	REAL	5/5-23

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1205:8	Damping of current-setpoint filter 2	0.05	1	5	immed.	-	REAL	5/5-23
1206:8	Self-gen. frequency of current-setpoint filter 3	0	0	8000	immed.	Hz	REAL	5/5-23
1207:8	Damping of current-setpoint filter 3	0.05	1	5	immed.	-	REAL	5/5-23
1208:8	Self-gen. frequency of current-setpoint filter 4	0	0	8000	immed.	Hz	REAL	5/5-24
1209:8	Damping of current-setpoint filter 4	0.05	1	5	immed.	-	REAL	5/5-24
1210:8	Stop frequency of current-setpoint filter 1	1	3500	7999	immed.	Hz	REAL	5/5-24
1211:8	Bandwidth of current-setpoint filter 1	5	500	7999	immed.	Hz	REAL	5/5-25
1212:8	Numerator of bandwidth of current-setp. filter 1	0	0	7999	immed.	Hz	REAL	5/5-25
1213:8	Stop frequency of current-setpoint filter 2	1	3500	7999	immed.	Hz	REAL	5/5-25
1214:8	Bandwidth of current-setpoint filter 2	5	500	7999	immed.	Hz	REAL	5/5-26
1215:8	Numerator of bandwidth of current setp. filter 2	0	0	7999	immed.	Hz	REAL	5/5-26
1216:8	Stop frequency of current-setpoint filter 3	1	3500	7999	immed.	Hz	REAL	5/5-26
1217:8	Bandwidth of current-setpoint filter 3	5	500	7999	immed.	Hz	REAL	5/5-27
1218:8	Numerator of bandwidth of current-setp. filter. 3	0	0	7999	immed.	Hz	REAL	5/5-27
1219:8	Stop frequency of current-setpoint filter 4	1	3500	7999	immed.	Hz	REAL	5/5-27
1220:8	Bandwidth of current setpoint filter 4	5	500	7999	immed.	Hz	REAL	5/5-28
1221:8	Numerator of bandwidth of current-setp. filter 4	0	0	7999	immed.	Hz	REAL	5/5-28
1230:8	1st torque limit value	5	100	900	immed.	%	REAL	5/2-9
1231	2nd torque limit value	5	100	100	immed.	%	REAL	5/2-10
1232	Switching speed from MD1 to MD2	0	6000	50000	immed.	1/min	REAL	5/2-10
1233:8	Limitation by means of generator	5	100	100	immed.	%	REAL	5/2-10
1234	Hysteresis P:1232	5	50	1000	immed.	1/min	REAL	5/2-11
1235:8	1st power limit value	5	100	900	immed.	%	REAL	5/2-11
1236	2nd power limit value	5	100	100	immed.	%	REAL	5/2-11
1237	Max. power of generator	0.3	100	500	immed.	kW	REAL	5/2-12
1239	Torque limit in set-up mode	0.5	1	100	immed.	%	REAL	5/2-13
1245	Speed-dependent thresh-old, smoothing of Mnom	0	0	50000	immed.	1/min	REAL	5/5-29
1246	Speed-dependent hystere-sis, smoothing of Mnom	0	50	1000	immed.	1/min	REAL	5/5-29
1250	Transition frequency of actual-current smoothing	0	100	8000	immed.	Hz	REAL	5/6-14
1252	Transition frequency of set torque smoothing	0	100	8000	immed.	Hz	REAL	5/6-14

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1254	Time constant of current monitoring	0	0.5	2	immed.	ms	REAL	-
1400	Nominal motor speed	0	0	25000	PO	1/min	REAL	5/1-7
1401:8	Speed for max. useful motor speed	0	0	50000	PO	1/min	REAL	5/1-7
1403	Switch-off speed for pulse deletion	0	0	7200	immed.	1/min	REAL	5/2-3
1404	Pulse deletion timer	0	100	100000	immed.	ms	REAL	5/2-4
1405:8	Motor monitoring speed	100	110	110	immed.	%	REAL	5/2-4
1406	Speed controller type	1	1	1	PO	-	WORD	-
1407:8	P amplification of current controller	0	0.3	100000	immed.	Nms/rad	REAL	5/5-2
1408:8	P amplification of upper adaptation speed	0	0.3	100000	immed.	Nms/rad	REAL	5/5-14
1409:8	Reset time of speed controller	0	10	500	immed.	ms	REAL	5/5-2
1410:8	Reset time of upper adaptation speed	0	10	500	immed.	ms	REAL	5/5-14
1411	Lower adaptation speed	0	0	50000	immed.	1/min	REAL	5/5-15
1412	Upper adaptation speed	0	0	50000	immed.	1/min	REAL	5/5-15
1413	Selection of speed controller adaptation	0=OFF	0=OFF	1=ON	immed.	-	WORD	5/5-16
1414:8	Self-gen. speed of speed reference model	0	0	8000	immed.	Hz	REAL	5/5-17
1415:8	Damping of speed reference model	0.5	1	5	immed.	-	REAL	5/5-17
1416	Balancing of speed reference model	0	0	1	immed.	-	REAL	5/5-17
1417:8	nx for 'nact < nx' message	0	6000	50000	immed.	1/min	REAL	5/3-3
1418:8	nmin for 'nact < nmin' message	0	5	25000	immed.	1/min	REAL	5/3-3
1420	Max. motor speed in Set-up mode	0	30	50000	immed.	1/min	REAL	5/2-13
1421:8	Time constant of integrator feedback	0	0	1000	immed.	ms	REAL	5/5-3
1424	Balancing of speed pilot control channel	0	0	50000	immed.	µs	REAL	-
1425	Balancing of calculating-down time error of current controller	0	0	1	immed.	-	REAL	-
1426:8	Tolerance band for nnom=nact message	0	20	10000	immed.	1/min	REAL	5/3-3
1427	Delay time nnom=nact message	0	200	500	immed.	ms	REAL	5/3-4
1428:8	Threshold torque Mdx	0	90	100	immed.	%	REAL	5/3-4
1429	Delay time 'Md < Mdx' message	0	800	1000	immed.	ms	REAL	5/3-4
1500:8	Number of speed-setpoint filters	0	0	2	immed.	-	WORD	5/5-4
1501:8	Type of speed-setpoint filters	0x0	0x0	0x303	immed.	-	WORD	5/5-4
1501.0	1st filter: low-pass / band-stop filter	0=low pass	0=low pass	1=band stop	immed.	-		5/5-5
1501.1	2nd filter: low-pass / band-stop filter	0=low pass	0=low pass	1=band stop	immed.	-		5/5-5

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1501.8	1nd filter: PT2 / PT1 with low-pass filter	0=PT2	0=PT2	1=PT1	immed.	-		5/5-5
1501.9	2nd filter: PT2 / PT1 with low-pass filter	0=PT2	0=PT2	1=PT1	immed.	-		5/5-5
1502:8	Time constant of speed-setpoint acquisition 1	0	0	500	immed.	ms	REAL	5/5-6
1503:8	Time constant of speed-setpoint acquisition 2	0	0	500	immed.	ms	REAL	5/5-6
1506:8	Self-generated frequency of speed-setpoint acquisition 1	10	2000	8000	immed.	Hz	REAL	5/5-6
1507:8	Damping of speed-setpoint filter 1	0.2	0.7	5	immed.	-	REAL	5/5-7
1508:8	Self-generated frequency of speed-setpoint filter 2	10	2000	8000	immed.	Hz	REAL	5/5-7
1509:8	Damping of speed-setpoint filter 2	0.2	0.7	5	immed.	-	REAL	5/5-7
1514:8	Stop frequency of speed-setpoint filter 1	1	3500	7999	immed.	Hz	REAL	5/5-8
1515:8	Band width of speed-setpoint filter 1	5	500	7999	immed.	Hz	REAL	5/5-9
1516:8	Numerator of band width of speed-setp. filter 1	0	0	7999	immed.	Hz	REAL	5/5-9
1517:8	Stop frequency of speed-setpoint filter 2	1	3500	7999	immed.	Hz	REAL	5/5-11
1518:8	Band width of speed-setpoint filter 2	5	500	7999	immed.	Hz	REAL	5/5-12
1519:8	Numerator of speed-setpoint filter 2	0	0	7999	immed.	Hz	REAL	5/5-12
1520:8	Self-generated frequ. of band-stop filter / speed-setp. filter 1	1	100	141	immed.	%	REAL	5/5-12
1521:8	Self-generated frequ. of band-stop filter / speed-setp. filter 2	1	100	141	immed.	%	REAL	5/5-13
1600	Power-On alarms that can be masked out	0x0	0x0	0xFFFF	immed.	-	WORD	5/2-14
1600.1	Current vector monitoring	0=ON	0=ON	1=OFF	immed.	-		5/2-14
1600.4	Measuring circuit of motor measuring system	0=ON	0=ON	1=OFF	immed.	-		5/2-14
1600.5	Monitoring of absolute track	0=ON	0=ON	1=OFF	immed.	-		5/2-14
1600.7	Synchronization error: rotor position	0=ON	0=ON	1=OFF	immed.	-		5/2-14
1600.8	Zero mark monitoring - motor measuring system	0=ON	0=ON	1=OFF	immed.	-		5/2-14
1600.9	Inverter limit frequency too high	0=ON	0=ON	1=OFF	immed.	-		5/2-14
1600.15	Temperature monitoring of power section	0=ON	0=ON	1=OFF	immed.	-		5/2-14
1601	RESET alarms that can be masked out	0x0	0x0	0xFFFF	immed.	-	WORD	5/2-15
1601.6	Flow controller at stop	0=ON	0=ON	1=OFF	immed.	-		-
1601.7	Current controller at stop	0=ON	0=ON	1=OFF	immed.	-		5/2-15

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1601.8	Speed controller at stop	0=ON	0=ON	1=OFF	immed.	-		5/2-15
1601.9	Encoder limit frequency exceeded	0=ON	0=ON	1=OFF	immed.	-		-
1601.12	Max. speed = f(UZWK)	0=ON	0=ON	1=OFF	immed.	-		-
1601.13	Motor switch-off (temp.)	0=ON	0=ON	1=OFF	immed.	-		-
1601.14	Temp. motor-switch-off (timer)	0=ON	0=ON	1=OFF	immed.	-		5/2-15
1602	Motor temperature warning threshold	0	120	200	immed.	degrees Celsius	WORD	5/2-4
1603	Motor temperature alarm timer	0	240	600	immed.	s	WORD	5/2-5
1604	Intermediate circuit undervoltage warning threshold	0	200	680	immed.	V	WORD	5/2-7
1605	Speed controller timer at stop	20	200	10000	immed.	ms	REAL	5/2-7
1606	Speed controller threshold at stop	0	8000	50000	immed.	1/min	REAL	5/2-7
1607	Motor temperature switch-off limit	0	155	200	immed.	degrees Celsius	WORD	5/2-5
1608	Fixed temperature	0	0	200	immed.	degrees Celsius	WORD	5/2-6
1610	Activate diagnostic functions	0x0	0x0	0x3	PO	-	WORD	5/6-7
1610.0	dn/dt monitoring	0=OFF	0=OFF	1=ON	PO	-		5/6-7
1610.1	Smooth running monitoring	0=OFF	0=OFF	1=ON	PO	-		5/6-7
1611	Response threshold dn/dt	0	800	1600	immed.	%	WORD	5/6-7
1612	Configuration of switch-off response of PO alarms	0x0	0xDBC	0xFFFF	immed.	-	WORD	5/2-16
1612.0	Pulse blocking in case of internal fault	0=OFF	0=OFF	1=ON	immed.	-		5/2-16
1612.8	Pulse blocking - zero monitoring	0=OFF	1=ON	1=ON	immed.	-		5/2-16
1612.9	Pulse blocking - converter limit frequency	0=OFF	0=OFF	1=ON	immed.	-		5/2-16
1612.15	Pulse blocking - heat sink temperature	0=OFF	0=OFF	1=ON	immed.	-		5/2-16
1613	Config. of switch-off re-sponse of RESET alarms	0x0	0x100	0xFFFF	immed.	-	WORD	5/2-17
1613.0	Pulse blocking - configuration error	0=OFF	0=OFF	1=ON	immed.	-		5/2-17
1613.9	Pulse blocking - encoder limit frequency	0=OFF	0=OFF	1=ON	immed.	-		5/2-17
1613.13	Pulse blocking - abs. motor temperature	0=OFF	0=OFF	1=ON	immed.	-		5/2-17
1613.14	Pulse blocking - motor temperature warning	0=OFF	0=OFF	1=ON	immed.	-		5/2-17
1615	Tolerance for smooth running monitoring	0	2	100	immed.	1/min	REAL	-
1620	Bits for variable signaling function	0x0	0x0		immed.	-	WORD	5/3-5
1620.0	Variable signaling function	0=OFF	0=OFF	1=ON	immed.	-		5/3-5

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1620.1	Segment of variable signaling function	0=X	0=X	1=Y	immed.	-		5/3-5
1620.2	Comparison, with sign	0=OFF	0=OFF	1=ON	immed.	-		5/3-5
1621	Signal number of variable signaling function	0	0	100	immed.	-	WORD	5/3-7
1622	Address of variable signaling function	0	0	0xFFFF	immed.	-	WORD	5/3-8
1623	Threshold of variable signaling function	0	0	0xFFFFFF	immed.	-	DWORD	5/3-8
1624	Hysteresis of variable signaling function	0	0	0xFFFFFF	immed.	-	DWORD	5/3-8
1625	Pick-up delay of variable signaling function	0	0	10000	immed.	ms	WORD	5/3-9
1626	Dropout delay of variable signaling function	0	0	10000	immed.	ms	WORD	5/3-9
1630	Response threshold for intermediate-circuit monitoring only	0	550	680	immed.	V	WORD	5/2-18
1631	Response voltage of generator axis	280	450	650	immed.	V	WORD	-
1632	Voltage excursion for generator control	0	30	300	immed.	V	WORD	-
1633	Switch-off threshold in generator mode	0	510	660	immed.	V	WORD	-
1634	Response threshold of emergency retraction	0	400	660	immed.	V	WORD	5/2-18
1635	Min. speed of generator axis	0	0	50000	immed.	1/min	REAL	-
1636	Operating mode of emergency retraction/ generator mode	0	0	7	immed.	-	WORD	5/2-19
1637	Delay time of generated braking	0	0	10000	immed.	ms	WORD	-
1638	Emergency retraction time	0	0	10000	immed.	ms	WORD	5/2-19
1639	Emergency retraction speed	0xFFC00000	0	0x400000	immed.	-	DINT	5/2-19
1650	Diagnosis control	0x0	0x0	0xFFFF	immed.	-	WORD	5/6-2
1650.0	Min./max. memory	0=OFF	0=OFF	1=ON	immed.	-		5/6-2
1650.1	Segment of min./max. memory	0=X	0=X	1=Y	immed.	-		5/6-2
1650.2	Comparison, with sign	0=OFF	0=OFF	1=ON	immed.	-		5/6-2
1651	Signal number of min./max. memory	0	0	100	immed.	-	WORD	5/6-3
1652	Memory cell of min./max. memory	0	0	0xFFFF	immed.	-	WORD	5/6-4
1653	Min. value of min./max. memory	0	0	0xFFFFFF	immed.	-	DWORD	5/6-4
1654	Max. value of min./max. memory	0	0	0xFFFFFF	immed.	-	DWORD	5/6-4
1655	Segment of monitor memory cell	0=X	0=X	1=Y	immed.	-	WORD	5/6-5
1656	Address of monitor memory cell	0	0	0xFFFF	immed.	-	WORD	5/6-5
1657	Value display on monitor	0	0	0xFFFFFF	immed.	-	DWORD	5/6-6

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1658	Value entry on monitor	0	0	0xFFFFFF	immed.	-	DWORD	5/6-6
1659	Monitor value takeover	0=OFF	0=OFF	1=ON	immed.	-	WORD	5/6-6
1665	Run-time factor IPO/ NREG cycle for HLG	0	2	20	immed.	-	REAL	-
1700	Status of binary inputs	0x0	0x0	0x7FFF	immed.	-	WORD	5/6-12
1700.0	Control block enable	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1700.1	Pulse enable (Kl.663)	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1700.2	Pulse enable (Kl.63/48)	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1700.3	Cumulative signal of hardware pulse enable	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1700.4	Temp. monitoring of heat sink responded	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1700.5	Set-up mode (Kl.112)	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1700.6	Drive enable (Kl.64/63)	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1700.8	Motor and power section temperature prewarning	0=OFF	0=OFF	1=ON	immed.	-		5/6-12
1701	Intermediate-circuit voltage	0	0	32767	immed.	V	WORD	5/6-9
1702	Motor temperature	0	0	32767	immed.	degrees Celsius	INT	5/6-9
1703	Set-up time for conv. 'motor-measuring system'	0	0	32767	immed.	µs	WORD	-
1704	Set-up time for conv. 'dir. measuring system'	0	0	32767	immed.	µs	WORD	-
1706	Setpoint value of speed	-100000	0	100000	immed.	1/min	REAL	5/6-9
1707	Actual value of speed	-100000	0	100000	immed.	1/min	REAL	5/6-10
1708	Smoothed actual current value	-100000	0	100000	immed.	%	REAL	5/6-10
1709	Weighting of voltage representation	-100000	0	100000	immed.	-	REAL	-
1710	Weighting of current representation	-100000	0	100000	immed.	µA	REAL	-
1711	Weighting of speed representation	-100000	0	100000	immed.	1/min	REAL	-
1712	Weighting of rotor flow representation	-100000	0	100000	immed.	µVs	REAL	-
1713	Weighting of torque representation	-100000	0	100000	immed.	µNm	REAL	-
1714	Weighting of rotor position representation	-100000	0	100000	immed.	degrees	REAL	-
1720	CRC-diagnosis parameters	0	0	32767	immed.	-	WORD	5/6-12
1721	Actual-speed value diagnostics	0	0	32767	immed.	-	WORD	5/6-8
1722	Capability utilization	-100000	0	100000	immed.	%	REAL	5/6-10
1723	Run-up time diagnosis	0	0	32767	immed.	ms	WORD	-
1724	Smooth-running monitoring diagnostics	0	0	32767	immed.	-	WORD	-
1725	Standardization of torque setp. interface	-100000	0	100000	immed.	Nm	REAL	5/6-14
1730	Indication of operating mode	1=VSA	1=VSA	0x1000= u/f mode	immed.	-	WORD	-
1731	Image of PO register in interm. circuit 1	0	0	32767	immed.	-	WORD	5/6-11

MD	Designation	Min.	Standard	Max.	Eff.	Unit	S7 Data Type	Doc.
1732	Image of RES register of interm. circuit 1	0	0	32767	immed.	-	WORD	5/6-11
1733	NPFK diagnostic counter	0	0	32767	immed.	-	WORD	5/6-11
1790	Measuring-circuit type of indirect measuring system	0	0	32767	immed.	-	INT	5/4-5
1791	Measuring-circuit type of direct measuring system	-1	0	32767	immed.	-	INT	5/4-6
1797	Data version	0	0	32767	immed.	-	WORD	5/6-13
1798	Firmware date	0	0	32767	immed.	-	WORD	5/6-13
1799	Firmware version	0	0	32767	immed.	-	WORD	5/6-13

3.3 Tool Offsets

Input limits and units

Designation	Lower Input Limit	Upper Input Limit	Unit
Tool offset No.	1	20	-
Tool length compensation	-1 000 000 000	+ 1 00 000 000	[USR]
Wear value, absolute	-1 000 000 000	+ 1 00 000 000	[USR]
Wear value, additive	0	+ 1 00 000 000	[USR]

Tool offset D0 is used to cancel the active tool offset No.

3.4 Incremental Dimension

Setting of incremental dimension

Initiation of Movement/Dir.	Selection of Incremental Dimension	Position/Incremental Dimension to be Traversed
R + or R- "edge-controlled"	BAP = 254	via user progr. DS4
	BAP = 1...100	as per Incremental Dimensions Table

Input limits and units DS4

Designation	Lower Input Limit	Upper Input Limit	Unit
Incremental dimension	0	1 000 000 000	[USR]

Velocity steps 1 (DS2) is used as the velocity setpoint. It can be modified during the movement. Changing the position on the fly, e.g. during a movement, is **not** possible.

3.5 Traversing Programs

Overview

/	N	G1	G2	G3	X / t	F	M1	M2	M3	D	P	L

/	Skip block identifier
N	Block number
G1	G function of 1st function group
G2	G function of 2nd function group
G3	G function of 3rd function group
X/t	Position/dwell time
F	Velocity
M1	M function of 1st function group
M2	M function of 2nd function group
M3	M function of 3rd function group
D	Tool offset number
P	Number of subroutine calls
L	Calling a program as subroutine
%	Program number identifier

Note:

The program number of the traversing program is set by entering %100, for example.
To run a program, this number must be specified during the program selection.
The traversing program is stored under the DB No. Program No. +1000.

Program number

Designation	Lower Input Limit	Upper Input Limit	Unit
Program number	%1	%199	-

Skip block

Designation	Input	Unit
Skip block	/ Activation via control bit (SA)	-

Block number

Designation	Lower Input Limit	Upper Input limit	Unit
Block number	N1	N255	-

G function

In the initial position, active G functions are represented in **bold** type.
G functions that are active block by block are marked with an **s**, and modal G functions are marked with an **m.**

G Function Group	G-No.	G Function
1	04 s	Dwell time
	87 s	Cancellation of measuring system offset for flying actual-value setting
	88 s	Endless traversing (-) for flying actual-value setting
	89 s	Endless traversing (+) for flying actual value setting
	90 m	Absolute dimension
	91 m	Incremental dimension
2	**30** m	Acceleration/deceleration override 100 %
	31 m	Acceleration/deceleration override 10 %
	32 m	Acceleration/deceleration override 20 %
	33 m	Acceleration/deceleration override 30 %
	34 m	Acceleration/deceleration override 40 %
	35 m	Acceleration/deceleration override 50 %
	36 m	Acceleration/deceleration override 60 %
	37 m	Acceleration/deceleration override 70 %
	38 m	Acceleration/deceleration override 80 %
	39 m	Acceleration/deceleration override 90 %
3	43 m	Tool offset (+)
	44 m	Tool offset (-)
	50 s	External block change
	60 m	Block change - exact positioning stop
	64 m	Flying block change - continuous-path control mode

Position/dwell time

Designation	Lower Input Limit	Upper Input Limit	Unit
Position	X- 1 000 000 000	X1 000 000 000	USR as per MD7
Dwell time with G04	X2	X100 000	ms is rounded to integer multiples of MD61 (position-controller cycle)

Velocity

Designation	Lower Input Limit	Upper Input Limit	Unit
Velocity	F10	F500 000 000	USR as per MD7/min

M function

M Function Group	M No.	M function
1. 2. 3	0	Stop at block end
	2. 30	Program end
	1...17	User functions
	18	Endless loop (jump to program beginning)
	19...96	User functions
	97. 98	Alteration signal can be programmed as digital input
	99	User functions

Tool offset No.

Designation	Input		Unit
Tool offset No.	D0	Cancellation of tool offset No.	-
	D1 to D20	Selection of tool offset memory	

Subroutine calls

Designation	Lower Input Limit	Upper Input Limit	Unit
Number of subroutine calls	P1	P250	-
Program number	L1	L199	-

3.6 Drive Operating Data

P-No. DB-AS	Bit	Description	Unit	Doc.	P-No. DB-BD	MD
11030		Drive condition The drive condition parameter describes the run-up and operating conditions of the digital drive. 0 = OFF Drive OFF 1 = ON Drive bus initialized without TIMEOUT 2 = online Drive ready to establish communication 3 = bootstrap loading initial drive data have to be loaded (commissioning required) 4 = connected Drive run up completely to condition 5 5 = ready Drive ready for control. No error. Power connected				
11031		Run-up condition (set/act.) The parameter "Run-up condition (set./act.)" contains the control word for the run-up control of the drive. In the high byte, the setpoint of the run-up condition (0...5) is represented by the servo, and the condition acknowledged by the drive is represented in the low byte (0...5).				
	0...7	Run-up condition, actual value 0 Booting of drive firmware acknowledged 1 Drive configuration acknowledged 2 Downloading of drive machine data acknowledged 3 Drive DPR changeover acknowledged 4 Activation of drive synchronization acknowledged 5 Drive synchronization of cyclic operation acknowledged				
	8...15	Run-up condition, setpoint				
11040		Capability utilization	%	3-15	23004	1722
11041		Effective power	kW	3-15	23005	
11042		Set torque	Nm	3-15	23006	
11043		Actual current value	A	3-15	23007	
11044		Actual speed value	rpm	3-15	23008	
11050		Status word 1		3-15	23000	
	0	Message ZK1				1731
	1	Message ZK2/3				
	3	Parking axis, actual				
	4	FFT analysis, actual				
	5	Function generator, actual				
	8	Set-up mode, actual				
	10	2nd torque limit, actual				1231
	11	Smoothing of speed setpoint, actual				1500

P-No. DB-AS	Bit	Description	Unit	Doc.	P-No. DB-BD	MD
11051		Status word 2		3-15	23001	
	0...2	Actual parameter record				
	5	Drive ready				
	6	Integrator inhibit, actual				
	7	Pulse enable, actual				
	8	Current controller enable, actual				
	9	Speed controller enable, actual				
	10	Reference variable, actual				
	12	U/f mode				
	15	Automatic braking initiated				
11052		Control word 1		3-5	20200	
	0	ZK1 Reset				
	1	Parking axis, setpoint				
	5	Function generator, setpoint				
	7	Ramp-function generator, setpoint				
	9	Ramp-function generator fast stop, setpoint				
	10	2nd torque limit, setpoint				
	11	Smoothing of speed setpoint, setpoint				
11053		Control word 2		3-5	20201	
	0...2	Scheduled parameter record				
	6	Integrator inhibit, setpoint				
	7	Pulse enable PLC, setpoint				
	8	Current controller enable, setpoint				
	9	Current controller enable, setpoint				
	15	Sign of life				
11054		Status class 2		3-15	23002	
	0	Intermediate circuit				1604
	1	Intermediate-circuit voltage - emergency retraction				
	2	Emergency retraction/generator mode active				
	3	Generator speed < min. speed				
	14	Motor temperature warning				1602
	15	Heat sink temperature warning				
11055		Status class 3		3-15	23003	
	0	Run-up process completed				1426
	1	/Md/ < Mdx				1428
	2	/nact/ < nmin				
	3	/nact/ < nx				1417
	4	nnom = nact				1426/27
	5	Variable signaling function				1620/21
	6	(nnom - nact) < Delta(-)				
	7	(nnom - nact) > Delta(+)				
	8	Actuating voltage /u_actuat _q/ > u_max				
	9	Current set value /i_nom/ > i_max				
	11	Setpoint value of speed /n_nom/ >				

P-No. DB-AS	Bit	Description	Unit	Doc.	P-No. DB-BD	MD
		n_uewa_mot				
	12	Actuating voltage /u_actuat_d/ > u_max				
	13	Set torque /mnom/ > mlimit				
11060		CRC error The parameter "CRC error" contains the CRC error counter OFF, the DCM. DCS- and PCU-ASICs. The error counters are deleted during the run-up of the drive coupling.				
	0...3	Error counter PCU(0) - total of CRC errors when writing				
	4...7	Error counter PCU(1) - total of CRC error when writing				
	8...11	Error counter DCS - total of CRC error when writing				
	12... 15	Error counter DCM - total of CRC errors when writing				

4 STEP 7 Blocks

Contents

4.1 Blocks of Integrated S7-CPU

4.1.1 Organization Blocks (OB)

Size

The max. size of an OB is 24 kbytes.

OBs for cycle and start-up

Cycle and Start-Up	Called OB	Preset OB Priority
Cycle	OB 1	lowest priority
Start-up (STOP–RUN transition)	OB 100	-

OBs for internal and external interrupts

The priority of the OBs cannot be modified.

Interrupts (Internal and External)	Called OB	OB Priority
Real-time interrupt	OB 10	2 (low)
Delay interrupt Range: 1 ms to 60,000 ms (adjustable in steps of 1 ms)	OB 20	3
Time interrupt Range: 1 ms to 60,000 ms (adjustable in steps of 1 ms)	OB 35	12
Process interrupt	OB 40	16
Diagnostic interrupt	OB 82	26 (high)

CPU in STOP/ not in STOP

CPU changes to STOP, ...	CPU does not change to STOP, ...
if a real-time interrupt, delay interrupt, process interrupt, or diagnostic interrupt occur, but the respective OB has not been programmed.	if a real-time interrupt occurs and OB 35 has not been programmed.

OBs for error response

The CPU changes to the STOP condition if an error occurs but the respective OB has not been programmed (except OB 81).

Error	Called OB	Preset OB Priority
Timing error (e.g. released by cycle time monitoring)	OB 80	26
Power supply fault	OB 81	26
One of the following faults occurred: • Event (e.g. delay interrupt) is provided but the related OB cannot be executed • Error during process image update (module not available or defective)	OB 85	26
Communication fault • wrong telegram identifier when receiving global data • the data block for the status of the global data is not available or too short	OB 87	26
Programming error (e.g. addressed timer not available)	OB 121	the same priority as the OB, in which the error occurs
Error during direct access to periphery (module defective or not available)	OB 122	the same priority as the OB, in which the error occurs

4.1.2 Function Blocks (FB)

Overview

Number: 128
Range: from 0 to 127. The max. length of an FB is 24 kbytes.

4.1.3 Functions (FC)

Overview

Number: 128
Range: from 0 to 127. The max. length of an FC is 24 kbytes.

4.1.4 Data Blocks (DB)

Overview

Number: 127
Range: from 1 to 127, 0 is reserved. The max. length of a DB is 16 kbytes.
Example: Invocation DB

4.1.5 System Functions (SFC)

Overview

Number: 37
SFCs are system functions integrated in the operating system.

Time-keeping function

SFC No.	Name	Description	Execution Time
0	SET_CLK	Setting of real time If the clock to be set a master clock, real-time synchronization is triggered at the same time. If the clock to be set is a slave clock, only the time is set.	120 µs
1	READ_CLK	Real time reading	190 µs
2	SET_RTM	Setting of the hours meter. In the CPU 314, 1 hours meter can be set.	65 µs
3	CTRL_RTM	Starting/stopping of the hours meter	55 µs
4	READ_RTM	Reading of the hours meter	90 µs
64	TIME_TICK	Reading of the system time The system time can be read exactly to the ms.	45 µs

Block functions

SFC No.	Name	Description	Execution Time
20	BLKMOV	Copying variables of any type	90 µs + 2 µs/byte
21	FILL	Loading the default value of a field	90 µs + 3,2 µs/byte

Creating a data block

SFC No.	Name	Description	Execution Time
22	CREAT_DB	Creating a data block with a given length in a given range	110 µs + 3,5 µs per DB in a given range

Time-interrupt functions

SFC No.	Name	Description	Execution Time
28	SET_TINT	Setting the times for the time interrupts	115 µs
29	CAN_TINT	Deleting the times for a time interrupt	50 µs
30	ACT_TINT	Activating a time interrupt	50 µs
31	QRY_TINT	Requesting the status of a time interrupt	85 µs

Delay interrupts

SFC-No.	Name	Description	Execution Time
32	SRT_DINT	Starting a delay interrupt	85 µs
33	CAN_DINT	Canceling a delay interrupt	50 µs
34	QRY_DINT	Requesting started delay interrupts	80 µs

Interrupt and error processing

SFC No.	Name	Description	Execution Time
36	MSK_FLT	Masking real-time deviation events	150 µs
37	DMSK_FLT	Enabling real-time deviation events	160 µs
38	READ_ERR	Requesting and deleting occurred and blocked programming and access error events	160 µs
39	DIS_IRT	Blocking the processing of new interrupt events	215 µs
40	EN_IRT	Enabling the processing of new interrupt events	305 µs
41	DIS_AIRT	Delaying the processing of interrupt events	35 µs
42	EN_AIRT	Enabling the processing of interrupt events	35 µs
43	RE_TRIGR	Retriggering the cycle time	30 µs
44	REPL_VAL	Copy spare value to AKKU 1 of the level which caused the error	45 µs

Mode transitions

SFC No.	Name	Description	Execution Time
46	STP	Changing the CPU to the STOP condition	-
47	WAIT	Realization of waiting times	200 µs

Diagnostic functions

SFC-No.	Name	Description	Execution Time
51	RDSYSST	Reading out the information from the system status list SFC 51 cannot be interrupted.	280 µs +10 µs/byte of a data record
52	WR_USMSG	Writing selectable diagnostic information to the diagnostic buffer	110 µs

Reading and writing parameters of a block

SFC-No.	Name	Description	Execution Time
55	WR_PARM	Writing dynamic parameters to a block	1.6 µs
56	WR_DPARM	Writing predefined dynamic parameters to a block	1.75 µs
57	PARM_MOD	Parameterization of a block	2.2 µs
58	WR_REC	Writing a block-specific data record	1.4 µs + 32 µs/byte
59	RD_REC	Writing a block-specific data record	0.50 µs

4.1.6 System Data Blocks (SDB)

Overview

The system data blocks contain the parameters of the S7–300. The parameters are loaded with values by the user either by means of the STEP7 tool "System Configuration" or by "Define Global Data".

SDB	Contents
SDB 0	Parameters of the CPU 314
SDB 1	The CPU automatically enters the actual configuration of the S7–300.
SDB 2	Default parameters of the integrated S7-CPU
SDB 5	Communication parameters for MPI stations in a S7–300 configuration.
SDB 100	not available
SDB 101	Parameters for the periphery in rack 1
SDB 102	Parameters for the periphery in rack 2
SDB 103	Parameters for the periphery in rack 3
SDB 210	Parameters for communication via global data

4.2 Intelligent I/O Blocks

Overview

For the communication between the integrated S7-CPU and the positioning unit, the standard software "Intelligent I/O Blocks of MCU" is used.

The following further blocks are available:

FB/FC No.	Designation	Name
FB1	OP_MCU	MCU controlling
FC1	RESTART	Synchronization after CPU or block start
FC2	CONTROL	Additional functions of MCU
FC3	STATUS	Status bits in the process interrupt program

The intelligent I/O blocks can be run in the S7 sequencing control of the MCU.

4.2.1 Function Block OP_MCU

Function

The technological function OP_MCU is intended for mode setting and operation. In addition to the operating mode, process data and control parameters are transferred. Furthermore, the current operating conditions are read and provided to the output parameters of the respective block.

Block number

FB1

Designation

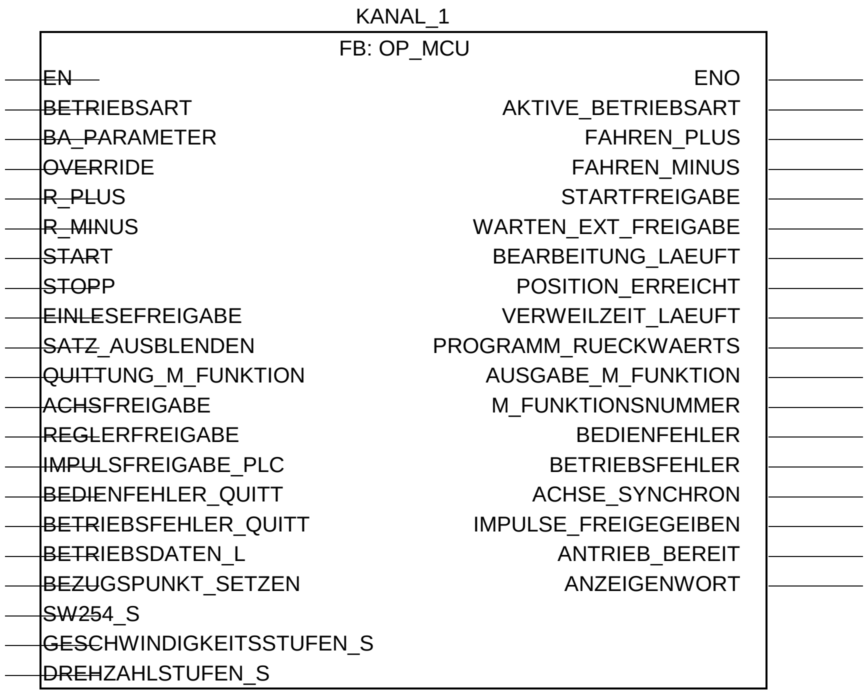
FB1 is intended for the setting and operation of operating modes:

- transfer of control and check-back signals
- reading the error data record in case of operator errors
- reading the error data record in case of data errors
- reading the error data record in case of system/traversing errors
- reading the modes
- reference-point setting and service data reading
- writing of setpoint SW254
- writing of velocity step
- writing of speed step

Calling the block

FB1 (OP_MCU) must be called in the cyclic program after FC1 (RESTART) (CALL).

Function block represented in the form of a ladder diagram: OP_MCU



Parameter function block: OP_MCU

Name	Para-meter Type	Data Type	Description	is...
BETRIEBSART	I	BYTE	Mode selection	transferred by the block to the positioning software
BA_PARAMETER	I	BYTE	Additional mode parameters	transferred by the block to the positioning software
OVERRIDE	I	BYTE	Override-value	transferred by the block to the positioning software
R_PLUS	I	BOOL	Positive direction	transferred by the block to the positioning software
R_MINUS	I	BOOL	Negative direction	transferred by the block to the positioning software
START	I	BOOL	Start of certain operating modes	transferred by the block to the positioning software
STOPP	I	BOOL	Stop of certain operating modes	transferred by the block to the positioning software
EINLESEFREIGABE	I	BOOL	Read enable of the next block	transferred by the block to the positioning software

Name	Para-meter Type	Data Type	Description	is...
SATZ_AUSBLENDEN	I	BOOL	Hide marked blocks	transferred by the block to the positioning software
QUITTUNG_M_FUNKTION	I	BOOL	Acknowledge M function	transferred by the block to the positioning software
ACHSFREIGABE	I	BOOL	Enabling of positioning	transferred by the block to the positioning software
REGLERFREIGABE	I	BOOL	Controller enable	transferred by the block to the positioning software
IMPULSFREIGABE_PLC	I	BOOL	Enable pulses	transferred by the block to the positioning software
BEDIENFEHLER_QUITT	I/O	BOOL	Acknowledge operator error	polled, transferred to the positioning software and reset
BETRIEBSFEHLER_QUITT	I/O	BOOL	Acknowledge system/traversing errors	polled, transferred to the positioning software and reset
BETRIEBSDATEN_L	I/O	BOOL	Reading of operating data. The data are stored in the invocation DB in the structure BRT_DAT.	polled and reset
BEZUGSPUNKT_SETZEN	I/O	BOOL	Reference-point setting. The data are transferred from the structure BZPKT_SET by means of the invocation DB.	polled and reset
SW254_S	I/O	BOOL	Setpoint 254 transferred to the block. The data are transferred from the structure SW254_SM by means of the invocation DB.	polled and reset
GESCHWINDIGKEITSSTUFEN_S	I/O	BOOL	Transfer of the velocity steps to the block. The data are transferred from the structure V_1_2 by means of the invocation DB.	polled and reset
DREHZAHLSTUFEN_S	I/O	BOOL	Transfer of the speed steps to the block. The data are transferred from the structure U_1_2 by means of the invocation DB.	polled and reset
AKTIVE_BETRIEBS-ART	O	BYTE	Check-back signal of active mode	entered
FAHREN_PLUS	O	BOOL	Traversing in positive direction	set /reset
FAHREN_MINUS	O	BOOL	Traversing in negative direction	set/reset
STARTFREIGABE	O	BOOL	Start enable	set /reset
WARTEN_EXT_FREIGABE	O	BOOL	Axis is waiting for external enable	set/reset
BEARBEITUNG_LAEUFT	O	BOOL	Processing running	set/reset
POSITION ERREICHT	O	BOOL	Position reached / Stop	set/reset
VERWEILZEIT_LAEUFT	O	BOOL	Dwell time active (programmed time)	set/reset
PROGRAMM_RUECKWAERTS	O	BOOL	Program execution backward	set/reset
AUSGABE_M_FUNKTION	O	BOOL	Check-back signal "M function active"	set/reset

Name	Para-meter Type	Data Type	Description	is...
M_FUNKTIONSNUMMER	O	BYTE	Number of active M function	entered
BEDIENFEHLER	O	BOOL	Operator error	set/reset
BETRIEBSFEHLER	O	BOOL	Process error	set/reset
ACHSE_SYNCHRON	O	BOOL	Axis synchronized	set/reset
IMPULSE_ FREIGEGEBEN	O	BOOL	Pulses enabled	set/reset
ANTRIEB_BEREIT	O	BOOL	Drive ready	set/reset
ANZEIGENWORT	O	WORD	Block status, error number	entered

Parameter types: I/O = through parameters
I = input parameters
O = output parameters

Technical data

Designation	Value
Block number	FB1
Block name	OP_MCU
Version	V3.0
Work memory	2.948 bytes
Load memory	4.548 bytes
Nesting depth	1 System functions of the operating system are called (SFCs).
Assignment in the data range	see Invocation DB
Assignment in the local data range	50 bytes
Assignment in the flag range	-
Called blocks	SFC58, SFC59

Invocation DB of FB OP_MCU

Designation	Value
Block number	DB1
Work memory	610 bytes
Load memory	1,892 bytes

4.2.2 The RESTART Function Block

Block number

FC1

Function

This block is intended for the synchronization between the CPU and the positioning unit, as well as to changeover between active operation (MCU-PIT) and S7 user program by means of the TFB block parameter. During the active operation, communication from the S7-user program is not possible.

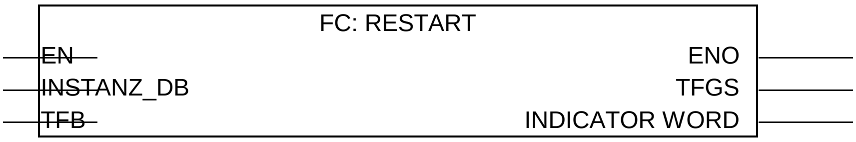
Before calling the block

Before calling FB1, block addresses and channel number must be specified in the invocation data block.
Block address: Invocation DB; $DW24=100_{HEX}$
Channel No.: Invocation DB; DW26=1

Calling the block

FC1 must be called in OB1 prior to OP_MCU and CONTROL.

Function block represented in the form of a ladder diagram: RESTART



Parameter function block: RESTART

Name	**Para-meter Type**	**Data Type**	**Description**	**Is ...**
INSTANZ_DB	I	BLOCK_DB	Number of invocation DB	polled
TFB	I	BOOL	1 = changing to the test mode (PU operation) 0 = changing to normal mode	polled
TFGS	O	BOOL	1 = test mode active 0 = normal mode active	set/reset
ANZEIGENWORT	O	WORD	Block status, error number	entered

Parameter types: I = input parameters
O = output parameters

Technical data

Designation	Value
Block number	FC1
Block name	RESTART
Version	V3.0
Work memory	728 bytes
Load memory	940 bytes
Nesting depth	1 System functions of the operating system are called (SFCs).
Assignment in the data range	see invocation DB of FB OP_MCU
Assignment in the local data range	50 bytes
Assignment in the flag range	-
Called blocks	SFC58, SFC59

4.2.3 The CONTROL Function Block

Block number

FC2

Function

The technological function "CONTROL" can be used to write setting data to the positioning unit and to read current actual values from the module. The data to be transferred are selected by means of input parameters. Data that are to be written to the module must be stored in the invocation DB before calling the function. Data that are to be read are available in the invocation DB after the respective function has been processed.

Calling the block

The block provides the user with various additional functions on the FM module. However, many users do not need these functions. In such cases, the block can completely be omitted. However, if the user wants to use one of these functions, the block must be called absolutely in the cyclic program (CALL). Calling one and the same block in several program execution levels is not permitted.

Function block represented in the form of a ladder diagram: CONTROL

FC: CONTROL	
EN	ENO
INSTANZ_DB	MESSUNG_ENDE
AUFTRAGSANWAHL	FLIEG_ISTWERTSETZEN_AUSG
BETRIEBSDATEN_ZUS_L	ANZEIGENWORT
AKTIVER_NC_SATZ_L	
NAECHSTER_NC_SATZ_L	
APPLIKATIONSDATEN_L	
ISTWERT_SATZWECHSEL_L	
SERVICEDATEN_L	
SERVODATEN_L	
ISTDATEN_L	
DA_DE_L	

Parameter function block: CONTROL

Name	Para-meter Type	Data type	Description	Is...
INSTANZ_DB	I	BLOCK_DB	Number of invocation DB	polled
AUFTRAGSANWAHL	I/O	INT	Job number of write job; job numbers permitted are 7, 8, 11-20	polled and deleted
BETRIEBSDATEN_ZUS_L	I	BOOL	Trigger bit for reading the operating data. The data are stored in the invocation DB in the structure BTR_DAT1.	polled / reset
AKTIVER_NC_SATZ_L	I	BOOL	Triggering bit for reading the active NC block. The data are stored in the invocation DB in the structure NC_SATZ_AKT.	polled / reset
NAECHSTER_NC_SATZ_L	I	BOOL	Triggering bit for reading the next NC block. The data are stored in the invocation DB in the structure NC_SATZ_NEXT.	polled / reset
APPLIKATIONSDA-TEN_L	I	BOOL	Triggering bit for reading the application data. The data are stored in the invocation DB in the structure APP_DAT.	polled / reset
ISTWERT_SATZ-WECHSEL_L	I	BOOL	Triggering bit for reading the block change actual value. The data are stored in the invocation DB in the structure IW_SATZWECHSEL.	reset / reset
SERVICEDATEN_L	I	BOOL	Triggering bit for reading the service data. The data are stored in the invocation DB in the structure SERV_DAT.	polled / reset
SERVODATEN_L	I	BOOL	Triggering bit for reading the servo data. The data are stored in the invocation DB in the structure SERVO_DAT_AUSL.	polled / reset
DA_DE_L	I	BOOL	Reading the digital I/O	polled / reset
ISTDATEN_L	I	BOOL	Triggering bit for reading the actual drive data. The data are stored in the invocation DB in the structure ISTDATEN.	polled / reset
MESSUNG_ENDE	O	BOOL	Bit for the end of length measuring of flying measuring. The data are stored in the invocation DB in the structure MESSWERTE.	set / reset
FLIEG_ISTWERTSE-TZEN_AUSG	O	BOOL	Flying actual-value setting carried out	set / reset
ANZEIGENWORT	O	WORD	Module status, error number	entered

Parameter types:
- I/O = through parameters
- I = input parameters
- O = output parameters

Technical data

Designation	Value
Block number	FC2
Block name	CONTROL
Version	V3.0
Work memory	2,763 bytes
Load memory	3,266 bytes
Nesting depth	1 System functions of the operating system are called (SFCs).
Assignment in the data range	see invocation DB of OP_MCU
Assignment in the local data range	50 bytes
Assignment in the flag range	-
Called blocks	SFC58, SFC59

Write jobs in the PARAMETER "AUFTRAGSANWAHL"

No.	Description	Comment The data are transferred by the invocation DB
7	Transfer of MDI block	from the structure MDI_SATZ
8	Drive setpoint data	from the structure SOLLDATEN
11	Bit-coded settings	from the structure BIT_EINST
12	Bit-coded commands	from the structure BIT_KOM
13	Zero offset	from the double word NULLPKTVER.
14	Actual-value setting	from the double word IW_SET
15	Flying actual-value setting	from the double word IW_FL_SET
16	Setting of the digital I/O	from the structure DA_DE
17	Transfer of flying MDI block	from the structure MDI_SATZ_FLG
18	Program selection	from the structure PRG_ANWAHL
19	Application data request	from the structure ANF_APP_DAT
20	Teach In	from the structure TEACH_IN
23	Servo data	from the structure SERV_DAT_EINL

4.2.4 Intelligent I/O Block STATUS

Function

The intelligent I/O function STATUS is intended to read the status information of the digital inputs I1 to 14 from the FM-MCU in the process interrupt program. The status information read is made available at the output parameters.

Calling the block

The function may only be called in the process alarm branch (OB40). Before calling the block, module address and channel number must be entered in the invocation data block.

Intelligent I/O block represented in the form of a statement list: STATUS

```
              FC: STATUS
EN                              ENO
INSTANZ_DB                     S_I1
                               S_I2
                               S_I3
                               S_I4
                      ANZEIGENWORT
```

Parameters of the intelligent I/O block: STATUS

Name	Para-meter Type	Data Type	Description	Is...
INSTANZ_DB	I	BLOCK_DB	Number of the invocation DB	polled
S_I1	O	BOOL	Status information of digital input I1	set / reset
S_I2	O	BOOL	Status information of digital input I2	set / reset
S_I3	O	BOOL	Status information of digital input I3	set / reset
S_I4	O	BOOL	Status information of digital input I4	set / reset
ANZEIGENWORT	O	WORD	Block status, error number	entered

Technical data

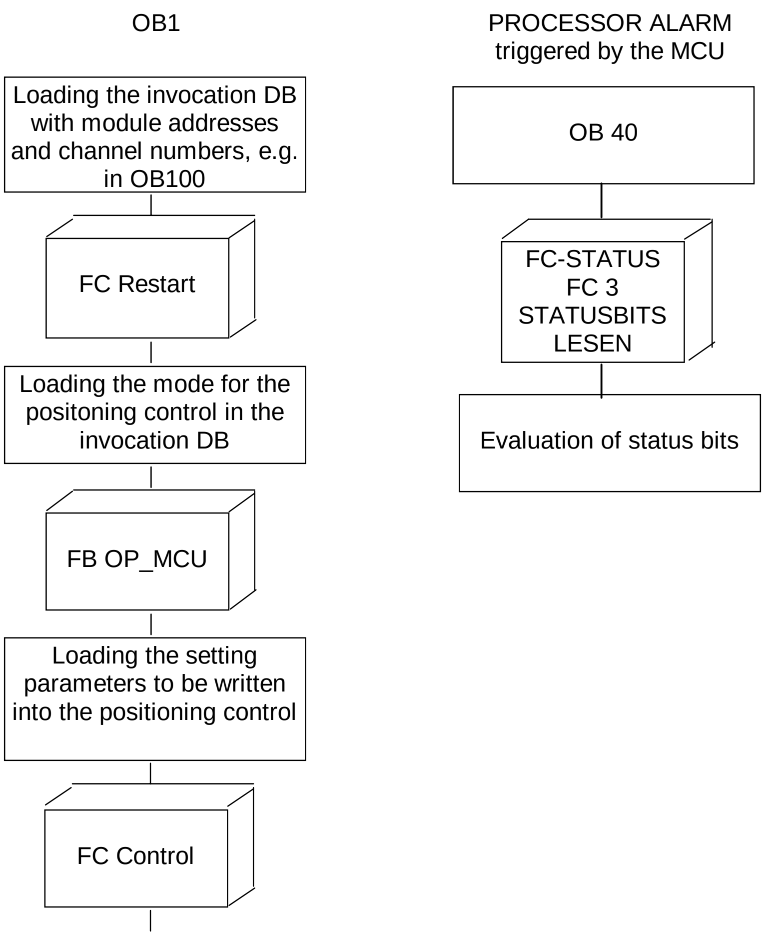
Designation	Value
Block number	FC3
Block name	STATUS
Version	V3.0
Work memory	144 bytes
Load memory	260 bytes
Nesting depth	0
Assignment in the data range	see invocation DB of FB OP_MCU
Assignment in the local data range	2 bytes
Assignment in the flag range	-

4.2.5 Data Blocks

Overview

DB No.	Designation	Name	
1	Invocation DB	Invocation data block	User
1000	DB-BD	Interface data block	internally
1001-1199	DB-NC	NC traversing programs	internally
1200	DB-MD	Machine data of position control	internally
1220	DB-WK	Tool offset	internally
1230	DB-SM	Incremental step parameters	internally
1251	DB-AM	Drive machine data	internally
1260	DB-AS	Drive service data	internally

4.2.6 Example for Calling Intelligent I/O Blocks



5 Encoders

Contents

5.1 ERN 1387

Overview

The incremental position encoder ERN 1387 is integrated in the motors of the 1FT6/1FK6 series as single-encoder system even in the standard version. In addition to the position information, the encoder provides the information on the rotor position and the speed information.

Due to the high accuracy requirements, the ERN 1387 can also be used as an indirect measuring system, i.e. in this case, the position information is provided by this encoder directly attached to the mechanics.

5.1.1 Drive Machine Data

MD	Designation	Unit	Standard	Minimal	Maximal	Data Type	Effect
1005	Encoder line number of motor measuring system	Incr/rev.	2,048	128	8,192	WORD	after Power On
1007	Encoder line number of direct measuring system	Incr/rev.	0	0	65,535	WORD	after Power On
1008	Error correction of encoder phases (IM)	degrees	0.0	-20.0	20.0	FLOAT DWORD	immediately
1011	Configuration of actual-value acquisition (IM)	-	-	-	-	WORD	after Power On
1011b0	Inversion of actual value	-	OFF	OFF	ON	-	after Power On
1011b1	Phase offset compensation	-	OFF	OFF	ON	-	after Power On
1011b2	Speed acquisition with measuring time register	-	OFF	OFF	ON	-	after Power On
1011b3	Absolute encoder (EnDat interface)	-	OFF	OFF	ON	-	after Power On
1011b4	Linear measuring system	-	OFF	OFF	ON	-	after Power On
1011b5	Motor measuring system provided	-	NO	NO	YES	-	after Power On

The encoder parameters of the integrated indirect encoder are set using the data of the selected motor type. The parameters of the direct measuring system must be parameterized by the user.

5.1.2 MCU Machine Data

see Function Description "Positioning with the MCU", Section 1.2.1

Note

The encoder values in the MCU machine data may not deviate from the values in the drive machine data.

The encoder parameters of the integrated encoder are set using the data of the selected motor type. The parameters of the direct measuring systems EQN 1325 must be parameterized by the user.

5.2 EN-DAT Absolute-Value Encoder EQN 1325

Overview

The absolute, rotary position encoder EQN 1325 of Heidenhain Co. can be used both as a single-encoder system in motors of the 1FT6 series and as a direct rotary position encoder.

When used as an integrated encoder, the encoder provides - in addition to the absolute position - the position information, the rotor position and the speed information exactly to the increment after switching on. When used as direct a measuring system, it provides the absolute position information, the rotor position and the speed information.

CAUTION:

It should be considered that absolute EN-DAT encoders shall never be operated at the same time both as indirect and direct measuring system, since this could damage the module.

5.2.1 Drive Machine Data

MD	Designation	Unit	Standard	Minimal	Maximal	Data Type	Effect
1023	Diagnosis of measuring circuit Absolute track of motor encoder	-	NO	NO	YES	WORD	immediately
1023b0	Illumination failed	-	NO	NO	YES	-	immediately
1023b1	Signal amplitude faulty	-	NO	NO	YES	-	immediately
1023b2	Code connection faulty	-	NO	NO	YES	-	immediately
1023b3	Overvoltage	-	NO	NO	YES	-	immediately
1023b4	Undervoltage	-	NO	NO	YES	-	immediately
1023b5	Overcurrent	-	NO	NO	YES	-	immediately
1023b6	Replace battery	-	NO	NO	YES	-	immediately
1023b9	CD track of ERN1387 encoder defective	-	NO	NO	YES	-	immediately
1023b10	Protocol cannot be canceled	-	NO	NO	YES	-	immediately
1023b11	SSI level at data line detected	-	NO	NO	YES	-	immediately
1023b12	TIMEOUT when reading the measured value	-	NO	NO	YES	-	immediately
1023b13	CRC error	-	NO	NO	YES	-	immediately
1023b15	Measuring encoder defective	-	NO	NO	YES	-	immediately
1030	Configuration of actual-value acquisition DM	-	-	-	-	-	after Power On
1030b3	Absolute encoder (EnDat interface)	-	OFF	OFF	ON	-	after Power On
1030b4	Linear measuring system	-	OFF	OFF	ON	-	after Power On

MD	Designation	Unit	Standard	Minimal	Maximal	Data Type	Effect
1031	Multiturn resolution of absolute encoder (DM)	1/min	4096	0000	65535	WORD	after Power On
1032	Measuring steps of absolute track (DM)	incr/rev.	8192	0000	65535	WORD	after Power On
1033	Diagnosis of direct measuring system	-	0000	0000	65535	WORD	immediately
1033b0	Illumination failed	-	NO	NO	YES	-	immediately
1033b1	Signal amplitude too low	-	NO	NO	YES	-	immediately
1033b2	Code connection faulty	-	NO	NO	YES	-	immediately
1033b3	Overvoltage	-	NO	NO	YES	-	immediately
1033b4	Undervoltage	-	NO	NO	YES	-	immediately
1033b5	Overcurrent	-	NO	NO	YES	-	immediately
1033b6	Replace battery	-	NO	NO	YES	-	immediately
1033b10	Protocol cannot be canceled	-	NO	NO	YES	-	immediately
1033b11	SSI level at data line detected	-	NO	NO	YES	-	immediately
1033b12	TIMEOUT when reading the measured value	-	NO	NO	YES	-	immediately
1033b13	CRC error	-	NO	NO	YES	-	immediately
1033b15	Encoder defective	-	NO	NO	YES	-	immediately

5.2.2 MCU Machine Data

see Function Description "Positioning with the MCU", Section 1.2.2

Note

The encoder values in the MCU machine data may not deviate from the values in the drive machine data.

6 Commissioning Schedule

Contents

6.1 Installing MCU-PIT under Windows

Check the software configuration:
- Microsoft Windows 95
- STEP 7 from V 2.1
- Software: Intelligent I/O blocks V 3.0
- MPI card/cables

see Description of MCU-PIT, Section 3.2

Use the EXPLORER of Windows 95 to select the file SETUP.EXE.
Call the file from the supplied program diskette (1/3).
The further steps are menu-assisted.

Notes

a) PLC mode selector switch

0: RUN-P	- The CPU executes the user program. - Blocks can be transferred to the CPU.
1: RUN	- The CPU executes the user program. - Blocks **cannot** be transferred to the CPU.
2: STOP	- The CPU does **not** execute a user program. - Blocks can be transferred to the CPU.
3: MRES	- Bootstrap loading possible by special sequence of operations (function not blocked at the moment). - The Onboard FEPROM is not read when being in this switch position at least 3 sec. during Power-On.

b) Data back-up

Data back-up of the MCU is possible selectively for PLC, FM-POS and drive.

PLC	under STEP 7 / Program Editor / File / Manage Project / Online New / Copy RAM to ROM (in STOP only)
FM-POS	under PIT-EDIT / Online / Save FEPROM FM-POS (also in RUN)
Drive	under PIT-EDIT / Online / Save FEPROM Drive (also in RUN)

If one of the three components (PLC, FM-POS, drive) is not saved to the Onboard-FEPROM during the next start, the old FEPROM data are active after the following Power-On (without switch position 3). This makes a selective commissioning (PLC, FM-POS, drive) possible.

6.2 Commissioning of the MCU (FM-POS, drive)

Before you turn on the equipment:
Check the connections according to Wiring Diagram and configuration.
Disconnect or switch off all enables on the NE module (Kl.63, Kl.64) and on the MCU module (Kl.663).

Call PIT-EDIT:
For example, use the WIN 95 EXPLORER in the STEP7-V2 path in the P7MCU folder.
Call the file "P7SKEDIX.EXE".

Commissioning switch (S1) to position 3, switch the MCU on (Power On) The DBs for FM-MD (standard data) tool offset, incremental dimension, FM operating data, drive MD (standard data) and drive operating data are set up.	**1**	RUN
	0	STOP
	0	FORCE
	0	SF
	1	DIAG
	1	FLDT

Bring the commissioning switch (S1) to 0 position.
STOP-LED goes out, RUN-LED lights.

After the run-up, the LEDs DIAG and FLDT are on. The RUN or STOP-LEDs display an S7 condition which is not relevant for the commissioning of the MDs. See commissioning of the PLC.	**1**	RUN
	0	STOP
	0	FORCE
	0	SF
	1	DIAG
	1	FLDT

MCU-PIT Online: Communication
Enter the MPI-station number,
e.g. "2" ("2" is the default setting)

Establish the link
Online Alarm: com
issioning required

Selection: Online:
Drive data (DB 1250)
Edit: Selection of power section (pulse enable: Kl.663 to X431)

Read power section data out and select them in the selection list
Press OK to confirm.
see Description MCU-PIT, Section 4.4.7

Message: No motor has been selected yet.
Press OK to confirm.

Read out the motor MLFB and use the Select Motor command to select the motor. Press OK to confirm. (controller data are calculated)
see Description MCU-PIT, Section 4.4.7

Message: Already enter encoder data ?

Press OK to confirm.

Online: Machine data (DB 1200)
Edit = encoder-related data
Press OK to confirm.

Enter encoder configuration
Press OK to confirm.

Edit: Check data record
Correct the error accordingly.

Online: Save FEPROM of FM-POS
Online: Save FEPROM of drive

Message: Data back-up succeeded

Switching mains ON/OFF of the MCU in commissioning switch position S1 = 0 or Online = Reset
Power-On or Reset after the commissioning is necessary in order to ensure that
a) the machine and drive data come into effect "after Power On";
b) FM-POS and the drive run up to the cyclic mode

<table>
<tr><td rowspan="6">The LEDs DIAG and FLTD should no longer light after the
run-up.
In case of error (LEDs are still lighting) read the Online alarms out.</td><td>1</td><td>RUN</td></tr>
<tr><td>0</td><td>STOP</td></tr>
<tr><td>0</td><td>FORCE</td></tr>
<tr><td>0</td><td>SF</td></tr>
<tr><td>0</td><td>DIAG</td></tr>
<tr><td>0</td><td>FLDT</td></tr>
</table>

It is essential to observe the order of the commissioning. The drive machine data have to be created first. Then, the FM machine data can be created.

The information of the drive machine data are entered in the FM machine data. If any errors in the order are detected, this is reported as 'inconsistency'. After Mains OFF/ON, online alarms are provided. The LEDs DIAG and FLDT are still lighting.

6.3 Commissioning of the MCU (S7)

Bring the commissioning switch to position 3 to turn the MCU on (E/R module). S1=3 No PLC program active when the switch is in position 3.	0	RUN
	1	STOP
	0	FORCE
	0	SF
	1	DIAG
	1	FLDT

After run-up of the MCU, bring the commissioning switch (S1) to position 0 or 2. S1 = 0 represented on the right	1	RUN
	0	STOP
	0	FORCE
	0	SF
	1	DIAG
	1	FLDT

Copy the S7 blocks from the supplied diskette 3/3 to the S7 user project (intelligent I/O blocks FB 1, FC 1, FC 2, FC3, FC100, OB1, OB100). Copy the S7 blocks from the user project to the PLC.
If the PLC is not in the Stop condition (S1=0),
adhere to the order when copying.

Please note when configuring the MCU hardware: Rack 0 has no mounting channel. Instead of the mounting channel, select "MCU 172A". In addition to CPU 314, an IM 360 IM-S is integrated in the MCU. The MPI address of the MCU is always equal to the MPI address of the CPU!

S7-program test in the RUN mode (S1=0).
Fault localization via respective S7 tools.

In order to make possible traversing by means of PIT-CONTROL, the TFB on
FC1 (RESTART) must be loaded with a logic "1"
(loaded with M 2.6, as per 02.96).
Follow the safety notes !
see Function Description "S7Environment", Section 6.2.1

Use the **SIMATIC-Manager** to save the S7 blocks. Use the function **Copy RAM to ROM** to save the **stations that can be reached**, **MPI=2**, **target system**. **Note:** To this aim, **MPI=2** must be marked, and the PLC be in the Stop condition (S1=2). (default: MPI=2)	0	RUN
	1	STOP
	0	FORCE
	0	SF
		DIAG
		FLDT

Note: The SDBs are only active after Power On.
This is also applicable when the MPI number is modified ('launching').

Mains OFF/ON or
Reset via MCU-PIT-EDIT

6.4 Adapting / Optimizing the FM-POS-Machine Data

Detailed description of the machine data see Function Description "Positioning with the MCU".

MDs that are to be set before moving the axes:

MD7: unit system *see Function Description "Positioning with the MCU", Section 1.2*

MD8 = 0 linear axis MD9 = 1	MD8 = 1 rotary axis MD9 = multiple of MD11 *see Function Description "Positioning with the MCU", Section 5.2.4*

MD23 Max. speed results from MD11 / 55 and the max. motor speed e.g. 3,000 rpm X 10.000µm = 30.000 mm/min *see Function Description "Positioning with the MCU", Section 1.1.2, 1.2.1, 1.2.2*

Denominator / numerator of load gear MD 34/35 if both measuring systems are used see Function Description, Section 1.1.8

MD38 loop-gain coefficient, MD40 Acceleration and MD41 Deceleration result from the mechanical design or the weight conditions. *see Function Description "Positioning with the MCU", Sections 1.1.8, 1.1.2*

MD61 Position Controller Cycle, default setting 4 ms *see Function Description "Positioning with the MCU", Section 2.1*

MD21 and MD22 Software Limit Switches are only active after picking up the reference point. For the commissioning, small traversing ranges are recommended. *see Function Description "Positioning with the MCU", Section 1.1.1*

Further optimization of the machine data makes only sense after traversing the axis.

6.5 Traversing the MCU Axis (PIT-CONTROL)

Make sure that the machine data suit with the mechanical conditions.

Call PIT-CONTROL under Windows 95.
For example, use the EXPLORER to call the file P7SKCTRX.EXE in the path STEP7_V2\P7MCU.
Follow the safety notes !

Set the TFB input on FC 1 to 1-signal to facilitate PIT controlling (S7-user program).
see Function Description "S7 Environment", Section 6.2.1

If TFB is set to 0, the message
"Error when writing a variable" is provided.

PIT Online: Communication
see Description "MCU-PIT", Section 5.1.2

Enter MPI-station number:
e.g. "2" ("2" is the default setting).

Establish link.

MCU-PIT Online: Machine control panel
see Description "MCU-PIT", Section 5.1.3

Preselection:
Set-up mode
Override >< 0
Pulse enable
Axis enable
Controller enable
External pulse enable; connect (Kl.663) to enable voltage
Acknowledge faults (if any)
Select velocity step 1 or 2

Check-back signals:
Set-up mode
Drive ready
Pulses enabled
Start enable

If no Start enable (SFG) provided:
- Stop signal provided when the TFB signal in the PLC was changed
- Errors occurred > **ACKNOWLEDGE**

MD19 Adaptation of Direction - if the axis moves without control or pressing the desired Plus Traversing button on the mechanics results in a negative direction of traversing.
see Function Description "Positioning with the MCU", Section 1.1.10

The unit system is synchronized by Reference-Point Setting. The software limit switches are active provided they have not been switched off via DS11 (S7) or "**SW limit switches OFF"** (PIT-CONTROL). Make sure that the software limit switches are within the mechanical traversing range! **IMPORTANT**: **Reference-point setting moves the unit system!** During the first movements, it is recommended to select a low traversing rate. Reference-point setting for Endat encoders is an encoder adjustment. (Do not forget Data Back-Up / Save FEPROM FM-POS!)

The **R+** and **R-** buttons are of a **self-locking type**. After activating the R buttons by clicking with the mouse on them, the Stop function can be selected by the spacebar provided no new function has been activated by another mouse click. Any axis movement started by pressing one of the R buttons must be stopped by pressing the Stop button.

When traversing the axis by PIT-CONTROL, make sure that an enable button is connected to the input (I4) of the MCU Any axis movements are only enabled after pressing the button! *see Description "MCU-PIT", Section 5.1.3*

Now, the MDs can be optimized accordingly.

When controlling the axis by means of PIT-CONTROL it must be made sure that an enable button is connected to the input (I4) on the MCU. Any axis movements are only enabled after pressing this button. Furthermore, the EMERGENCY STOP button should be arranged in the immediate vicinity of the operator.

6.6 MCU Data Back-Up S7 (V 2.x)

Set the commissioning switch S1 either to 0 or to 2.

Use the SIMATIC Manager, menu item **Selectable Stations**, to determine the MPI number of the MCU-CPU. If several MPI stations exist, the MCU-CPU address can be determined by disconnecting the remaining MPI bus lines or the P/K bus line (of course, in the dead condition only). Use **File > New > Project > File Name**: **XY.S7P > Save** to create a project. An XY (OFFLINE) Project window appears. Use **> Paste > Hardware** to enter a > **2 SIMATIC 300 Station**. Open the hardware configuration in the **SC** icon in the Project window under **SIMATIC 300 Station**. Press F4 in the Hardware directory to select **SIMATIC300/RACK-300/MCU172A** (by double-clicking). Now, in rack 0, a CPU 314 and a MCU are set up. Rack 0 is opened by clicking on "+". Open CPU 314 on slot 2. Check the **MPI...Address** in the Properties window under Stations. If the address is the same as the previously determined address, it is not necessary to alter the address. If not set the correct number in the **MPI ...** box and press O.K. to confirm (if necessary twice). The MPI address of the MCU on slot 4 is automatically adapted by Open and O.K. Close the Hardware Configuration item by **> Station > Save**. The PLC blocks can be displayed using the ONLINE Project window under **SIMATIC 300 Station > CPU 314 > S7-Program >AP-ON**. Save by **> Target System > Load to PU**.

6.7 MCU Data Back-Up FM

Set the commissioning switch S1 either to 0 or 2.

Start **MCU-PIT-EDIT** under Windows 95. Use the EXPLORER, for example, to start the file P7SKEDIX.EXE under Step7_V2/P7MCU. Safety Notes > **OK** **Online > Communication** Connect the **MPI** cable directly to the MCU connector X20. Select the **MPI** number > **Establish the link.** Should several MPI stations exist, determine the CPU-MPI number. See S7 Data Back-Up. **Online > Blocks...** Save all data blocks to the PU (Select All *.*) if possible to an empty folder. MCU data saved. *see Description "MCU-PIT", Section 4.2*

6.8 Replacing MCU Modules

Prerequisite: The saved data must suit with the new firmware / module.

S7 and **MCU** data back-up as described.

Commission the new module as described under **MCU Commissioning** (FM-POS, drive).

Important: If the **MPI address** of the module to be replaced has been altered,
the MPI address of the new module has also to be altered accordingly. (see *Register 10, Section 4.2*).

Transfer the saved data from the PU/PC to the MCU.

Save all data to FEPROM (see MCU-IB FM-POS, drive) and copy "RAM to ROM" in S7.

6.9 Firmware Update

S7 and MCU data back-up as described.

Insert the PCMCIA card when the device is switched off (card stands off). After Power-On, the two bottom LEDs should light. The two uppermost LEDs flash at a cycle of 3 Hz.

Actuating S1 loads the firmware to the MCU.
Switching sequence: 0 > 3 > 0 > 1 > 0 > 3
If the switching sequence is correct, the two uppermost LEDs turn dark.

Updating is completed when the top LED (RUN) lights again.
Remove the PCMCIA card when the device is switched off.

PS: Make sure that no voltage failure occurs during the UPDATE, as in this case, the MCU will not have data to detect the PCMCIA card.

6.10 S7-Update Blocks

The latest intelligent I/O blocks of the S7 (supplied on diskettes) must be transferred to the user project (FB1, FC1, FC2, FC3, DB1). The calls of the blocks FB1, FC1 and FC2, FC3 must be revised in the user program (FC3 only if required) Check the calls in the statement list source code and generate **> Source**. If compiling has been completed without errors, the blocks can be transferred to the MCU!
If no error occurs: ⇒ RAM to ROM

7 Error Messages

Contents

7.1 Positioning Control Error Messages

7.1.1 Diagnostic alarms

Bit	Acknowl.	Explanation	Bit	Explanation
3.6	none	Process alarm got lost	0.1	Internal error
8.0	RESTART	Cable break - incremental encoder	0.3	Channel error
8.1	RESTART	Transmission fault - absolute encoder	0.3	Channel error
8.2	RESTART	Missing pulses - incremental encoder	0.3	Channel error
8.3	RESTART	Encoder voltage monitoring	0.3	Channel error
8.4	Power ON	Drive hardware error	0.3	Channel error

7.1.2 Operating Errors

No.	Ackn. by Bit	Explanation
00257	STS.BFQ	Software limit switch beginning overtraveled
00258	STS.BFQ	Software limit switch end overtraveled
00259	STS.BFQ	Traversing range beginning overtraveled
00260	STS.BFQ	Traversing range end overtraveled
00267	STS.BFQ	Direction of rotation of drive
00268	STS.BFQ	Standstill monitoring
00276	STS.BFQ	RESET alarm of drive
00277	STS.BFQ	Emergency retraction cannot be activated
00346	STS.BFQ	System error No. 0
00347	STS.BFQ	System error No. 1
00348	STS.BFQ	System error No. 2
00349	STS.BFQ	System error No. 3
00350	STS.BFQ	System error No. 4
00351	STS.BFQ	System error No. 5
00352	STS.BFQ	System error No. 6
00353	STS.BFQ	System error No. 7
00354	STS.BFQ	System error No. 8
00355	STS.BFQ	System error No. 9

7.1.3 Operator Errors

No.	Ackn. by Bit	Explanation
00513	STS.FSQ	Illegal operating mode
00516	STS.FSQ	Illegal operating mode parameter
00517	STS.FSQ	Start enable missing
00521	STS.FSQ	Axis not synchronized
00522	STS.FSQ	Illegal MDI block
00523	STS.FSQ	Illegal preset direction
00524	STS.FSQ	Axis motion not possible
00525	STS.FSQ	Incremental dimension does not exist
00526	STS.FSQ	Program selection missing
00527	STS.FSQ	Digital input not selected
00528	STS.FSQ	Measuring function not activated
00533	STS.FSQ	No valid MD
00534	STS.FSQ	Invalid position controller inhibit input
00535	STS.FSQ	Measuring system changeover not permitted
00536	STS.FSQ	Simulation ON/OFF not permitted

7.1.4 Traversing Errors

No.	Ackn. by Bit	Explanation
00769	STS.BFQ	Software limit switch beginning
00770	STS.BFQ	Software limit switch end
00771	STS.BFQ	Traversing range beginning approached
00772	STS.BFQ	Traversing range end approached
00773	STS.BFQ	Set position not in traversing range
00791	STS.FSQ	Set velocity = 0
00798	STS.FSQ	Digital input not parameterized
00803	STS.FSQ	Tool offset value does not exist
00804	STS.FSQ	Incorrect flying actual-value setting
00805	STS.BFQ	Flying MDI block, incorrect syntax
00806	STS.BFQ	Flying MDI block, velocity
00807	STS.BFQ	Flying MDI block, position
00808	STS.FSQ	Faulty flying MDI block
00829	STS.FSQ	Controller enable missing
00830	STS.FSQ	Controller not ready
00832	STS.FSQ	PEH time monitoring
00833	STS.FSQ	No drive motion
00834	STS.FSQ	Follow-up error too high

7.1.5 Data Errors

No.	Ackn. by Bit	Explanation
01025	STS.DIQ	Data not acceptable in this mode of operation
01026	STS.DIQ	Velocity step 1 incorrect
01027	STS.DIQ	Velocity step 2 incorrect
01028	STS.DIQ	Speed step 1 incorrect
01029	STS.DIQ	Speed step 2 incorrect
01030	STS.DIQ	Incremental dimension too high
01031	STS.DIQ	MDI block, incorrect syntax
01032	STS.DIQ	MDI block, incorrect velocity
01033	STS.DIQ	MDI block, incorrect position or dwell time
01034	STS.DIQ	Zero offset incorrect
01035	STS.DIQ	Actual-value setting incorrect
01036	STS.DIQ	Reference-point setting incorrect
01037	STS.DIQ	Digital output not possible
01038	STS.DIQ	Application data request incorrect
01039	STS.DIQ	Teach In, incorrect program No.
01040	STS.DIQ	Teach In, incorrect block No.
01041	STS.DIQ	Teach In, no position in block
01042	STS.DIQ	Teach In, no axis standstill
01051	STS.DIQ	Illegal bit-coded setting
01053	STS.DIQ	Illegal bit-coded command
01064	STS.DIQ	Non-relevant data to positioning unit
01074	STS.DIQ	Torque limit
01144	none	Deviating unit system raster
01145	none	Incorrect DB type
01146	none	DB_type or DB_No. exists already
01147	none	NC program No. exists already
01148	none	Parameter back-up faulty
01149	none	DB memory full
01150	none	Program length exceeded
01151	none	Data: Writing not possible
01152	none	Module identification incorrect
01153	none	Incremental dimension value error
01154	none	Tool offset value error

7.1.6 Machine Data Errors

No.	Acknowl.	Explanation
01285		MD5 Process alarm generation
01286		MD6 Illegal axis name
01287		MD7 Incorrect system of measures
01288		MD8 Incorrect axis type
01289		MD9 End of rotary axis
01290		MD10 Encoder type (IM)
01291		MD11 Distance traversed/encoder revolution (IM)
01293		MD13 Increments/encoder revolution (IM)
01294		MD14 Number of revolutions of absolute encoder
01296		MD16 Reference-point coordinate
01298		MD18 Method of approach to reference point
01299		MD19 Adaptation of direction
01300		MD20 Hardware monitoring
01301		MD21 Illegal software limit switch beginning
01302		MD22 Illegal software limit switch end
01303		MD23 Maximum velocity
01304		MD24 Target range, PEH
01305	none /	MD25 Monitoring time
01306	if	MD26 Standstill range
01307	occurred	MD27 Reference-point offset
01308	after	MD28 Referencing velocity
01309	switching	MD29 Reducing velocity
01310	on:	MD30 Backlash compensation
01311	save	MD31 Direction reference of backlash
01312	correct	MD32 Output type of M function
01313	DB	MD33 Output time of M function
01314	and	MD46...MD49 Inputs allocated twice
01315	Power On	MD50...MD53 Outputs allocated twice
01316		MD36 Input adaptation
01318		MD38 Closed-loop amplification (Kv factor)
01319		MD39 Minimum follow-up error
01320		MD40 Acceleration
01321		MD41 Deceleration
01322		MD42 Jerk time
01334		MD54 Encoder type (DM)
01335		MD55 Distance traversed/encoder revolution (DM)
01336		MD57 Increments/encoder revolution (DM)
01340		MD67 Drive type
01341		MD61 Cycle setting
01343		MD63 Drive activation
01344		MD64 Drive number
01346		MD66 Drive module type
01376		Illegal software limit positions
01377		Limitation of software limit pos. of absolute encoder
01378		More than 2 measuring functions with MCU
01379		Invalid actual-value weighting factor
01380		MD 34 Denominator of load gear
01381		MD 35 Numerator of load gear

7.1.7 Traversing Program Errors

No.	Ackn. by Bit	Explanation
02049	STS.DIQ	Program selection, subroutine No. does not exist
02056	STS.DIQ	Program selection, program No. does not exist
02057	STS.DIQ	Program selection, block No. does not exist
02058	STS.DIQ	Program selection, block No. illegal
02059	STS.DIQ	Program selection, incorrect indication of direction
02060	STS.DIQ	Illegal program selection
02061	STS.DIQ	Program selection, subroutine nesting not permitted
02068	none /	Error in program No.
02069	however,	No block
02070	any	Error in block No.
02071	entries	Incorrect sequence of block numbers
02072	in the	G function 1 illegal
02073	diagnostic	G function 2 illegal
02074	buffer	G function 3 illegal
02075	(if	M function illegal
02076	made)	Position/dwell time missing
02077	will	Incorrect D number (> 20)
02078	only	Subroutine, number of calls
02079	be ON	Velocity missing
02080	deleted	Error in subroutine call
02081	after	D function illegal
02082	Power On	Too many blocks

7.1.8 Run-Up Errors

No.	Acknowl.	Explanation
24577		Sensor with SIDA step 0 not possible
24578	Power On	Meas. circuit error absolute track (EnDat encoder)
24579	or. RESET	v_max (MD23) > 1.25 * v_nom (A-MD1401)
24580	via MCU-PIT	Absolute encoder during run-up defective
24581		Timeout empty during FIFO request
24582	none	FW update
24583	Power ON	No NVRAM end-of-block identification exists
24584	Power ON	New NVRAM block invalid
24585	Power ON	NVRAM block not found
24586		Number of absolute-value encoder revolutions inconsistent (MD14/A-MD1021/A-MD1031)
24587		Encoder line number inconsistent (MD13/A-MD1005)
24588		Emcoder type selection inconsistent (MD10/A-MD1011)
24589	Power ON	No measuring system parameterized (MD60)
24590	or. RESET via MCU-PIT	Velocity overflow (MD11, MD13, A-MD1401 <-> MD23)
24591		Encoder line number DM inconsistent (MD57 / A-MD 1007)
24592		Encoder type selection inconsistent DM (MD54 / A-MD1030
24593		Two absolute encoder parameterized
24595		FIFO error
24596		Error when reading the absolute value
24597		En-Dat encoder error

24598		No En-Dat encoder exists

7.2 SIMODRIVE Interface Error Messages

No.	Acknol.	Explanation
30000	Power ON or RESET via MCU-PIT	System error [error number / additional information]
30001		Configuration error: drive number
30002		Configuration error: module type
30003		Configuration error. bus expansion
30004		Configuration error: measuring-circuit component placement
30005		Configuration error: drive type
30006		CRC error: drive coupling
30007		Incorrect number of axes, spindles, drives
30008		VSA software not loaded
30100		Drive coupling OFF
30300		Drive coupling OFF

7.3 SIMODRIVE Error Messages

No.	Acknowl.	Explanation
30500	Power ON or RESET via MCU-PIT	System error: drive [error number / additional information]
30500		**[Error number/additional information]**
F002		Faulty address
F007		Joker for diagnostic purposes
F01B		NC drive number
F020		Joker for diagnostic purposes
F021		Joker for diagnostic purposes
F022		Joker for diagnostic purposes
F023		NC drive number
F024		Joker for diagnostic purposes
F025		Joker for diagnostic purposes
F026		NC drive number
F027		NC drive number
F028		NC drive number
F031		NC drive number
F033		Error detection
F034		Faulty address
F035		Faulty address
F003		Time disk
F004		Joker for diagnostic purposes
F005		Joker for diagnostic purposes
F006		Joker for diagnostic purposes
F010		1: Hardware underflow, 2: Hardware overflow, 3: Software underflow, 4: Software overflow
F011		Joker for diagnostic purposes
F012		Joker for diagnostic purposes
F013		Joker for diagnostic purposes
F014		Faulty address
F015		Joker for diagnostic purposes
F016		Joker for diagnostic purposes

No.	Acknowl.	Explanation
F017		Joker for diagnostic purposes
F018		Joker for diagnostic purposes
F019		Joker for diagnostic purposes
F030	Power ON or RESET via MCU-PIT	NC drive number
F032		NC drive number
F040		Joker for diagnostic purposes
F041		Joker for diagnostic purposes
F044		NC drive number
F045		NC drive number
30501		Current monitoring
30504		Measuring circuit error: motor (inc.)
30505		Measuring circuit error: absolute track
30507		Synchronization error: rotor position
30508		Zero mark error: motor
30509		Converter limit frequency exceeded
30510		Error during mid-frequency measurement
30511		Measured-value memory active
30515		Heat-sink temperature alarm
30606	Bit STS.BFQ	Flow controller at stop
30607		Current controller at stop
30608		Speed controller at stop
30609		Encoder limit frequency exceeded
30613		Motor temperature alarm
30614		Motor temperature switch-off limit
30701	Power ON or RESET via MCU-PIT	Commissioning necessary
30702		Invalid drive basic cycle
30703		Invalid current controller cycle
30704		Invalid speed controller cycle
30705		Invalid position controller cycle
30706		Invalid monitoring cycle
30713		Invalid position controller cycle shift
30714		Invalid power section code
30715		Max. current of power section <= 0
30716		Torque constant <= 0
30717		Motor moment of inertia <= 0
30718		Calculating-downtime error I controller
30719		Motor triangle not parameterized
30720		Maximum motor speed too high
30721		I0 of motor > Inom of motor
30722		I0 of motor > Inom of power section
30724		Invalid pole pair number
30725		Encoder line number = 0
30726		Voltage constant = 0
30727		Reactance <= 0
30728		Adaptation factor torque/current too high
30729		Motor standstill current <= 0
30730		Invalid rotor resistance
30731		Nominal power <= 0
30732		Rated motor speed <= 0
30733		Invalid motor no-load voltage
30734		Motor no-load current <= 0
30735		Field-weakening speed <= 0
30736		Invalid Lh characteristic curve
30737		Two EnDat encoders configured
30741		AM pilot control amplification cannot be represented

No.	Acknowl.	Explanation
30742		Converter frequency U/f mode
30743		This function not with this 611D control module
30750	Bit STS.BFQ	Speed controller adaptation: n-max < n-min
30751		Speed amplification too high
30752		Incorrect cut-off frequency of I-nom filter
30754	Bit STS.BFQ	Invalid signal number
30755		U/f-operation: motor turning
30756		Hysteresis of torque nominal-value smoothing too high
30757		Torque adaptation factor too high
30758		Upper generator threshold too high
30759		Generator switch-off threshold too high
30760		Emergency retraction speed too high
30761		Generator minimum speed too high
30762		Emergency retraction / generator active
30763		Generator / emergency retraction mode invalid
30764		No emergency retraction / generator mode possible
30765		No intermediate-circuit measuring possible
30766		Stop frequency higher Shannon frequency
30767		Self-generated frequency higher than Shannon frequency
30768		Numerator of bandwidth larger than the double of the stop frequency
30769		Denominator of bandwidth larger than the double of the self-generated frequency
30770		Filter coefficient cannot be represented
30771		Converter frequency AM mode
30772		Speed amplification for AM mode too high
30773		No pilot control structure in AM mode
30774		Asynchronous operation f. switching speed of HSA/AM not permitted
30776		Meas. circuit monitoring for motor (incr.) inactive
30799	Power ON or RESET via MCU-PIT	Save and boot necessary
30850	none	Speed controller adaptation: n-max < n-min

7.4 Intelligent I/O Blocks Error Messages

7.4.1 Indicator Word

15							8	7							0
X	X	-	-	X	X	X	X								
Status (read-only)								Additional information (error number)							

Status Bit	Description
8	Processing of technological function is running
9	Processing of technological function completed
10	Group error
11	Error during reading (FC Control)
14	Test mode active
15	Start-up running

Additional Information		
HEX	Description	Note
00	No error	
0B	The data block specified when calling the blocks FC RESTART, FC CONTROL and FC STATUS on the INSTANZ_DB parameter does not suit with the technological function (DB is not the invocation DB of FB OP_MCU).	Specify the correct DB
0C	Invalid channel number for the MCU	Enter correct channel number in the invocation DB in the word KA_NR (in the example through OB100)
0E	Error when calling SFC RD_REC. The return value RET_VAL of the SFC is made available to the user for evaluation in the variable SFCERR_TFNAME.	See Error Description of SFC RD_REC
0F	Error when calling SFC WR_REC. The return value RET_VAL of the SFC is made available to the user for evaluation in the variable SFCERR_TFNAME.	See Error Description of SFC WR_REC
10	Module is not ready for operation or not parameterized	Parameterize the module by means of the tool AS-PARAM
11	Timeout error. An expected reaction of the module did not come. While the technological function is waiting for a reaction, a counter is internally increased whenever the technological function is called. If this counter reaches the value MAX-AUFRUF, this error message is provided.	Restart
12	Data error. Normally, this error is detected by the module and provided to the technological function to be transferred to the user (stored in the data block).	Correct the data in the invocation DB
3E	Invalid job number (FC CONTROL)	Enter a valid job number

7.4.2 Additional Information READERR_CONTROL and ME_ERR_CONTROL

HEX	Description	Note
0E	Error when calling SFC RD_REC. The return value RET_VAL of the SFC is made available to the user for evaluation in the variable SFCERR_TFNAME.	See Error Description of SFC RD_REC
11	Timeout error. An expected reaction of the module did not come. While the technological function is waiting for a reaction, a counter is internally increased whenever the technological function is called. If this counter reaches the value MAX-AUFRUF, this error message is provided.	Restart

7.5 Unit Control Panel Error Messages from the MCU

No.	Explanation
200001	Power On Alarm
200002	Voltage monitoring
200003	Missing pulses from encoder
200004	Error: absolute-value encoder
200005	Cable break of encoder

7.6 Unit Control Panel Error Messages from the MCU

No.	Explanation
810001	Error: OB event
810002	Synchronous error
810003	Asynchronous error
810004	Stop/abortion event
810005	BZ process event
810006	Error: communication event
810007	Error: H/F system event
810008	Error: diagnostic data of modules
810009	User-diagnosis-event

8 Appendix

A

B

C

D

N

O

P

R

S

T

U

V

Z

SIEMENS

SIMODRIVE 611

Single-Axis
Positioning Control
MCU 172A

Appendix

Edition March 1998

Note:

In order to maintain clarity, this Documentation does not contain all details on all types of the product described herein. It cannot therefore consider all possible cases of erection, operation and repair.

If you require additional information or should any special problems arise, please enquire for further information to your nearest Siemens branch office.

The contents of this Documentation are not part of any earlier or existing agreement, commitment or legal undertaking, nor are they intended as an amendment thereto. All responsibilities on the part of Siemens shall result only from the respective Purchase Contract, which also contains the complete and solely binding warranty regulations. The warranty provisions laid down by the Contract shall neither be extended, nor restricted by this Documentation.

1 Documentation List

Further information

Further information going beyond the scope of this Manual is to be found in the following manuals/documentation:

Topic	Title	MLFB	Edition
SIMODRIVE SINUMERIK	SIMODRIVE 611-A/611-D Configuring Instructions Transistor Pulse Inverters for Three-Phase Feed Drives and Three-Phase Main Spindle Drives	6SN1 197-0AA00-0AP2	11.95
	SIMODRIVE Configuring Instructions Three-Phase Motors for Feed and Main Spindle Drives	6SN1 197-0AA20-0AP1	
	SIMODRIVE 840C SINUMERIK 611-D Commissioning Lists Commissioning Instructions	6FC5 197-5AA60-0AP1	09.95
	SIMODRIVE 840C SINUMERIK 611-D Commissioning Instructions Commissioning Instructions	6FC5 197-5AA50-0AP1	09.95
	SINUMERIK 840D, SINUMERIK FM-NC SIMODRIVE, S7/300, MCU172A Operating Component PP031 Operating Components Manual	6FC5 297-3AA50-0AP0	09.95
	SINUMERIK MMC100 / EBF Function Description Configuring Kit	6FC5 297-3EA00-0AP0	
	SINUMERIK MMC100 / EBF Function Description Installation Kit: Software Update and Configuration	6FC5 297-3EA10-0AP1	
	SINUMERIK EBF Operating Instructions	6FC5 298-3AA60-0AP0	09.95
SIMATIC S7	Automation System S7-300 How to Configure a S7-300 Manual	6ES7 030-0AA01-8AA0	01.96
	Automation System S7-300 Integrated Functions CPU 312 IFM/314 IFM Manual	6ES7 032-0AA00-8AA0	01.96
	Documentation Package STEP 7 Basic Knowledge	6ES7 810-4BA01-8AA0	01.96
	Documentation Package STEP 7 Reference Manuals	6ES7 810-4BA01-8AR0	01.96

2 Index

C

D

I

S

T

U

V

W

Z

3 Abbreviations

$\omega=2\pi f$	Angular frequency
A	Output
AC	Alternating current
AD	Drive data
AF	Automatic Subsequent Block
AG	PLC (programmable logical controller)
AI	Analog input
AKKU	Accumulator
AM	Drive machine data
AMF	Alter M function
AO	Analog output
AR	Working guideline
AS	Drive service
ASCII	American standard code for information interchange
ASIC	Application specific integrated circuit
AT	Advanced Technology
AUT	Automation Group at the Siemens AG
AUTO	Automatic mode
AWL	Statement list (STL)
AWP	User program
B&B	Operation and monitoring
BA	Operating mode
BCD	Binary coded decimals
BD	Operating data
BG	Module
BL	Processing is running
C	Capacity
CE	Communautés européennes
CP	Communication processor
CPU	Central processing unit
D	Tool offset number
DA	Digital output
DAU	Digital analog converter
DB	Data block
DB-SS	Interface data block
DC	Direct current

DE	Digital input
DI	Digital input
DIN	German Industrial Standards
DO	Digital output
DP	Distributed periphery
DPR	Dual-port RAM
DS	Data record
E	Input
E/R	Stabilized power supply/recovery module
EBF	Unit Operator Panel
EGB	Electrostatic sensitive devices /modules
EMV	Electromagnetic compatibility
EN	European standard
EnDat	Encoder Data Interface (bi-directional synchronous-serial interface)
EP	Electronics evaluation factor
EPROM	Erasable programmable read only memory
ESD	Electrostatic Sensitive Device
EU	European Union
EWG	European Economic Community
f	Frequency
F	Speed
FB	Function block
FC	Function
FC	Function call: Function blocks in the PLC
FEPROM	Flash EPROM: read-write memory
FFT	Fast Fourier Transformation
FM	Function module: Periphery module of the SIMATIC S7
FR +/-	Drive +/-
FUP	Sequential Function Chart
G	G function
GD	Global data
GND	Signal ground: reference potential
H	Magnetic
HEX	Abbreviation for hexadecimal number
HF	High frequency
HSA	Main spindle drive
HW	Hardware
I	Current
IEC	International Electrotechnical Commission
IFM	Integrated function modules

IFR	Pulse enable
IMS / IMR	Interface module: send / receive
IP	Intelligent periphery / protection type
JOG	Jogging
K-Bus	Communication bus of SIMATIC S7
KOP	Ladder Diagram
L	Inductivity
L	Subroutine number
L1, L2, L3	Phases
LCD	Liquid crystal display
LED	Light emitting diode
LME	End of measurement
LT	Power section
LTM	Power module
M	Ground
M1, M2, M3	M function of 1st group, M function of 2nd group, M function of 3rd group
MCU	Motion Control Unit: Positioning control for one axis
MCU-PIT	Parameterizing and commissioning tool
MD	Machine data
MDI	Manual Data Input
MMC	Man-machine communication: User interface for operation, programming and simulation
MPI	Multi-point interface
MSR	Unit system raster
MSST	Machine control panel
N	Neutral (conductor)
N	Block number
NC	Numerical Control
NCU	Numeric Control Unit
NE	Mains supply
NE-Module	Power supply module
NEUST	Restart
NF	Low frequency
NPV	Zero offset
OB	Organization block
OEM	Original Equipment Manufacturer
OP	Operator panel
P	Number of loops
P-Bus	Periphery bus of SIMATIC S7
Pa	Parameter

PAA	Process image of outputs
PAB	Periphery output byte
PAE	Process image of inputs
PBL	Parameter basic list
PBR	Program execution backwards
PC	Personal computer
PCMCIA	Personal computer memory card international association: memory card standardization
PE	PE conductor
PEB	Periphery input byte
PEH	Position reached and stop
PG	Programming unit
PIT	Parameterizing and commissioning tools
PLC	Programmable logical controller
PP	Push-button panel
PPU	Protected power unit
PR	Traversing programs
PRT	Program test
PS	Power supply
PW-Module	Pulse resistance module
PWM	Pulse width modulation
R	Resistance
R	Parameter
RAM	Random Access Memory
REFPOS	Reference-point approach
RMS	Check-back signal
ROM	Read Only Memory
s	Path, distance
SCK	System configuration kit
SDB	System data block
SFB	System function block
SFC	System functions
SFG	Start enable
SKP	Skip block
SM	Incremental dimension / signal module
SPS	Programmable logic controller
SSI	Serial synchronous interface
STEP 7	Programming software for SIMATIC S7
STS	Control signal (also control block for triggering LTM)
SV	Power supply

SW	Software
SYSDOK	System-integrated documentation
TB	Intelligent I/O modules
TB	Intelligent I/O modules
TFB	Operation via PIT-Control (control signal)
TFGS	Operation via PIT-Control (check-back signal)
T-L	Dwell time running
TN-S	TN-S network
TTL	Transistor transistor logic
U	Voltage
U/f-Umsetzer	Voltage/frequency converter
UE	non-stabilized supply module
UE-Module	Supply module with non-stabilized intermediate circuit voltage and pulse resistance
ÜW-Module	Monitoring module
V24	Serial interface: Definition of exchange lines between data terminal equipment and data-circuit terminating equipment
VDE	Association of German Electrotechnical Engineers
VGA	Video graphics adapter
VP	Traversing program
VSA	Feed drives
VSA-Module	Feed module
WFG	Waiting for machining enable
WK/WZ/ WZK/WKZ	Tool/tool offset
X	Position/dwell time
XT	Extended Technology
Z	Impedance
ZK, ZWK	Intermediate circuit

Handbuch

MCU 172A

Single-Axis Positioning Control
for SIMODRIVE 611

Version 4.0

Handbuch

MCU 172A

Single-Axis Positioning Control
for SIMODRIVE 611

Version 4.0

6SN1 197-4MA00-0BP0

Handbuch

MCU 172A

Single-Axis Positioning Control
for SIMODRIVE 611

Version 4.0

6SN1 197-4MA00-0BP0