SIEMENS

SIMATIC

M7-300 Programmable Controller Hardware and Installation

Manual

C79000-G7076-C803-02

Safety-related Guidelines

This manual contains notices intended to ensure personal safety, as well as to protect the products and connected equipment against damage. These notices are highlighted by the symbols shown below and graded according to severity by the following texts:

Danger

indicates that death, severe personal injury or substantial property damage **will** result if proper precautions are not taken.

Warning

indicates that death, severe personal injury, or substantial property damage **can** result if proper precautions are not taken.

Caution

indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

contains important information about the product, its operation or a part of the document to which special attention is draw.

Qualified Personnel

A device/system may only be commissioned or operated by **qualified personnel**. Qualified personnel as referred to in safety guidelines in this document are persons authorized to energize, de-energize, clear, ground, and tag circuits, equipment and systems in accordance with established safety practice. For a detailed description of the safety-related guidelines, please refer to the Appendix.

Proper Usage

Please observe the following:

Warning

The equipment/system or the system components may only be used for the applications described in the catalog or the technical description, and only in combination with the equipment, components, and devices of other manufacturers as far as this is recommended or permitted by Siemens.

The product will function correctly and safely only it it is transported, stored, set up, and installed as intended, and operated and maintained with care.

Trademarks

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Third parties using for their own purposes any other names in this document which refer to trademarks might infringe upon the rights of the trademark owners.

Disclaimer of Liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

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Automation Group
Industrial Automation Systems
P.O. Box 4848, D-90327 Nuremberg

Siemens Aktiengesellschaft

Order No. C79000-G7076-C803

Preface

Purpose

The information in this Manual allows you:

- To implement the mechanical and electrical configuration of a SIMATIC® M7-300 automation computer;
- To assemble it;
- To prepare it for operation;
- To look up operator actions, functional descriptions and technical data for specific M7-300 modules.

  The functional descriptions and technical data of the signal modules, power supply modules and interface modules can be found in the Reference Manual: *S7-300 and M7-300 Automation Systems, Module Specifications*.

Audience

The Manual is intended for any user who has the task of

- Implementing the mechanical and electrical configuration of an M7-300 system and addressing it;
  a knowledge of systems for automation-related problems is required;
- Installing an M7-300 system;
  a knowledge of electrical installation is required;
- Preparing an M7-300 system for operation and replacing the battery, modules or interface submodules;
  a knowledge of electrical installation and general EDP is required;
- Operating an M7-300 system;
  general EDP knowledge is required.

Organization of the Manual

This Manual describes the M7-300 hardware. It is organized as follows:

- Chapter 1 provides an overview of available modules, accessories and mounting elements of the M7-300 automation computer.
- Chapters 2 to 9 are arranged according to the activities for assembling an M7-300 automation computer.

- Chapters 10 to 12 contain technical descriptions of the individual M7-300 modules and interface submodules.
- Given in the appendixes are:
  - Dimension drawings of all modules (Appendix A)
  - A guideline for handling electrostatically sensitive modules (Appendix B)
  - Ordering information for modules and submodules, spare parts, accessories and software (Appendix C)
  - A list of documentation needed for the startup and programming of the M7-300 (Appendix D)
  - A list of locations of Siemens offices in the Federal Republic of Germany, as well as all European and Non-European Siemens companies (Appendix E).

Scope of this Manual

This Manual applies to the following CPU:

Product	Order Number	Revision Level
CPU 388-4 (8 Mbyte)	6ES7 388-4BN00-0AC0	01

It contains the descriptions of all the M7 modules valid at the time of publication of the Manual. We reserve the right to supply product information with new modules and modules with a new product release, containing the latest information on the module.

What is new?

In this Manual the errors of the previous edition have been corrected. It is now available as a single manual with the same order number as the former documentation package. The Reference Manual “S7-300, M7-300 Programmable Controllers, Module Specifications”, is no longer part of this documentation package but can be ordered with the order number 6ES7 398-8AA02-8BA0.

Approvals

The following approvals have been obtained for the S7-300/M7-300:

UL-Recognition-Mark
Underwriters Laboratories (UL) to
Standard UL 508, Report E 85972

CSA-Certification-Mark
Canadian Standard Association (CSA) to
Standard C 22.2 No. 142, Report LR 63533

CE Mark

Notes on the CE mark

If a module is marked as follows, it complies with the requirements of EU guidelines:

This product meets the requirements of EU Guideline 89/336/EEC “Electromagnetic Compatibility”.

According to the above EU guideline, Article 10 (1), the EU conformity declaration and corresponding documentation are kept available for the appropriate authority at:

Siemens Aktiengesellschaft
Bereich Automatisierungstechnik
AUT E 147
Postfach 1963
D-92209 Amberg

Field of Application

According to this CE mark, the following field of application is valid for the M7-300 system:

Field of Application	**Requirements for**	
	Requirements for	Noise immunity
Industry	EN 50081–2: 1993	EN 50082–2: 1995

Structure of this Manual

To facilitate rapid access to special information, the Manual contains the following aids:

- Given at the beginning of the manual are a full table of contents and a list of figures and of tables contained in the entire manual.
- In the chapters, each page contains information in the left column which summarizes the contents of the section.
- The annexes are followed by a glossary which defines the important technical terms used in the Manual.
- At the end of the Manual there is a detailed index to enable you to find the desired information quickly.

Hardware Documentation

In addition to this Manual, the following documentation is available for the M7-300 hardware:

Documentation	Contents	Order No.
S7-300, M7-300 Programmable Controllers Module Specifications Reference Manual	Data sheets of all modules usable in the M7-300 from the S7-300 module range Part of the S7-300 documentation package	6ES7 398-8AA02-8BA0
FM 356 Application Module Installation, Hardware and Startup Manual	Describes the use of the FM 356 application function modules of the M7-300 automation system, including expansion modules in the S7-300 system	6ES7 356-0AA00-8BA0

Given in Appendix D is a list of documentation needed for programming and startup of the M7-300.

The whole SIMATIC documentation is also available on CD ROM.

Up–To–Date Information

You can find up–to–date information on SIMATIC products from the following sources:

- On the Internet under http://www.aut.siemens.de/
- Via Fax – Polling number +49–8765–9300 5500

In addition, the SIMATIC Customer Support provides up–to–date information and download facilities for users of SIMATIC products:

- On the Internet under http://www.aut.siemens.de/simatic–cs
- Via SIMATIC Customer Support Mailbox under the following number: +49 (911) 895–7100

For dialing into the mailbox use a modem of up to V. 34 (28. 8 Kbps) and set the following parameters: 8, N, 1, ANSI, or alternatively use ISDN (x. 75, 64 Kbps).

The telephone and fax numbers of the SIMATIC Customer Support service are:
Tel: +49 (911) 895–7000
Fax: +49 (911) 895–7002

You may also ask questions directly using E–mail on the Internet or via the above mentioned mailbox.

Additional Assistance

In the event of queries on the SIMATIC M7-300 programmable controller which are not answered in the Manual, please consult your Siemens contact at a maintenance and repair center or the SIMATIC Hotline.

A list of worldwide Siemens representations is given in Appendix E.

In the event of queries or comments on the Manual itself, please fill in the reply sheet at the end of the Manual. Please also enter your personal assessment of the Manual on the reply sheet.

We offer courses to facilitate entry into the SIMATIC S7 automation system. Please refer to your regional training center or to the Training Center in D-90327 Nuremberg, Tel. ++49 911 895 3154.

Contents

Product Overview

1

Introduction

The SIMATIC M7-300 is a PC-compatible automation computer. It is designed as an enclosed modular system designed for SIMATIC S7 racks; it can be used both in the S7-300 programmable controller and in a standalone arrangement with I/Os from the S7 range.

The M7-300 is capable of solving real-time tasks, such as complex open and closed-loop control algorithms together with visualization and EDP tasks using a single CPU. Software based on RMOS, DOS or Windows will run on it. Furthermore, the standardized PC architecture offers open user-programmable expansion of the S7 automation platform.

Chapter Overview

1.1 Applications and Fields of Application

Applications of the M7-300

The M7-300 automation computer is suitable for the following typical tasks:

- Process data acquisition
- Storage of mass data
- Control of local process I/Os
- Communication
- Closed-loop control, positioning, counting
- Operator interfacing.

It offers the following features:

- Execution of real-time-capable software
- Field programmability
- Event-driven program processing
- Full incorporation in SIMATIC S7-300 systems.

Fields of Application of an M7-300

The fields of application of an M7-300 are in any situations with a need for implementation of special technological requirements, fast closed-loop control or special tasks such as communication, data management, etc. For example:

- Plastics engineering
- Textile industry
- Process engineering
- Packaging systems
- Machine tools.

1.2 What Makes Up an M7-300 Automation Computer?

Minimal Configuration

Depending on the automation task, the M7-300 can be equipped with different modules. In its minimum configuration, it comprises the following components:

- Power supply (PS) from the S7-300 range and
- central processing unit (CPU) with memory card slot.

Suitable Modules and Submodules

The following are available for expansion:

- Expansion modules (EXMs) with card slots for up to three interface submodules
- Mass storage modules (MSMs) with hard disk drive and diskette drive
- Function modules (FMs) from the S7-300 and M7-300 range
- Interface submodules (IFs)
- Signal modules (SMs) from the S7-300 range
- Interface modules (IMs) from the S7-300 range.

Suitable Peripherals

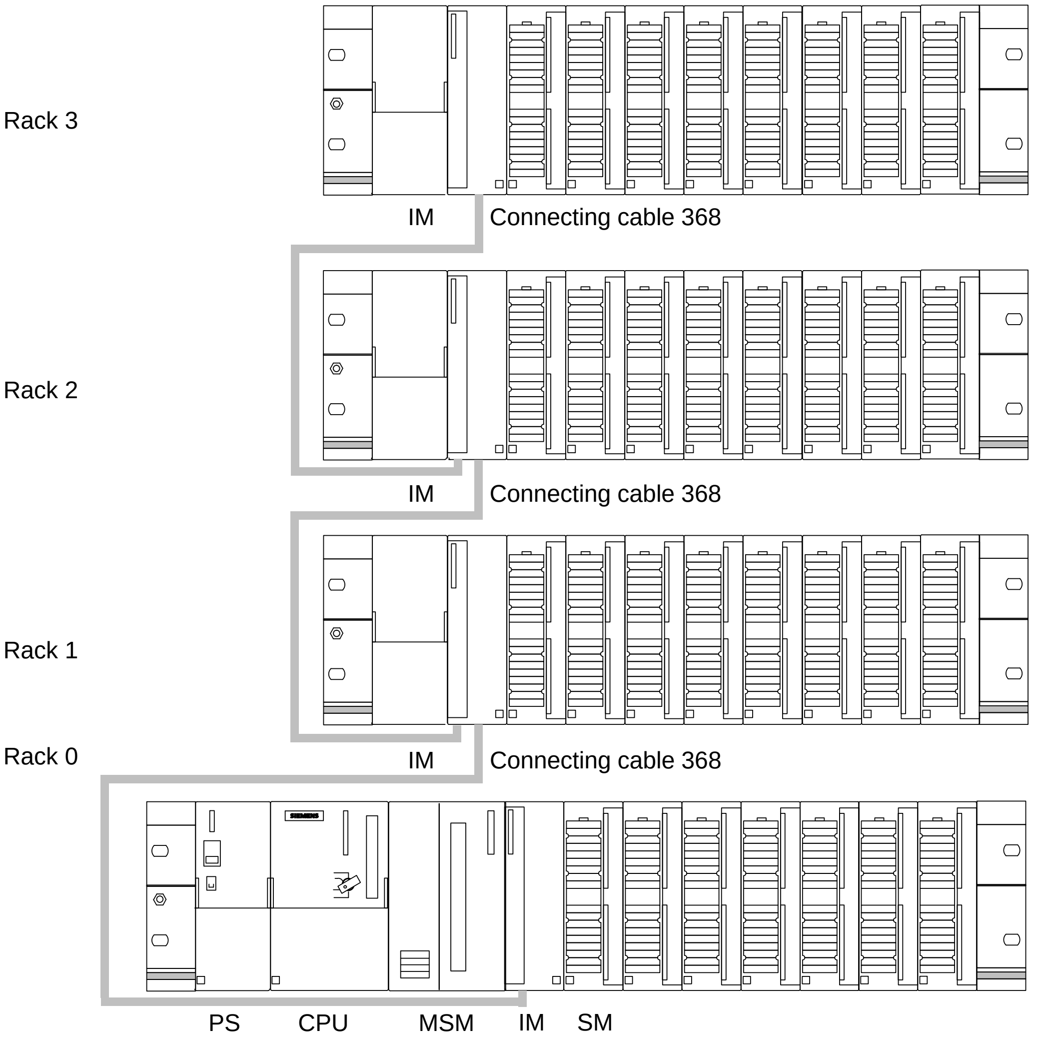
The following peripherals can be connected via an expansion module fitted with the appropriate interface submodules:

- VGA monitor
- Keyboard
- Mouse
- Printer
- Sensors and actuators
- Distributed I/Os.

M7-300 on Two or More Racks

An M7-300 automation computer can be assembled on up to four racks. A rail serves as the rack element. In addition to the power supply module, CPU and interface module, there is space for eight other modules on each rack. The expansions of the CPU or application modules (expansion module and mass storage module) count as one slot each. Interconnection of the individual racks is established via the interface modules and connecting cables.

Shown in Figure 1-1 is an automation computer assembled on four racks.



PS = Power supply module
CPU = Central processing unit
MSM = Mass storage module
IM = Interface module
SM = Signal module

Figure 1-1 M7-300 Assembled on Four Racks

M7-300 ↔ PC/PG Connection

For the remote setup of the M7-300, you can connect a PC or programming device (PG) to the CPU of the M7-300 via a V.24 cable.

A PC/PG cable serves to connect the PC/PG and CPU of the M7-300 via the MPI.

M7-300 ↔ M7-300 Connection

Two or more M7-300s can communicate with each other via the MPI by means of a PROFIBUS cable with bus connector, for example, using the STEP 7 software tools.

Shown in Figure 1-2 is a possible configuration with two M7-300s. Components shown cross-hatched are described in this Manual and elsewhere.

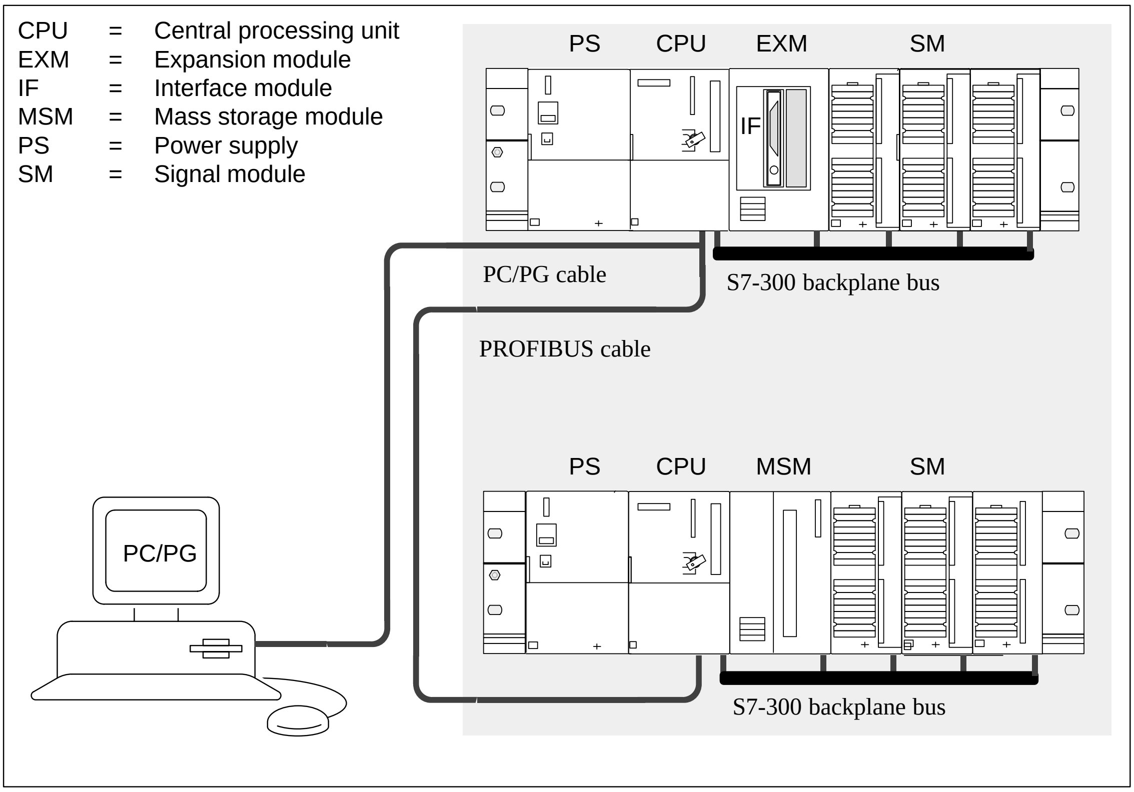


Figure 1-2 Connection Between Two M7-300s and a PC/Programmable Device (PG)

1.3 Components and Their Functions

A range of components is available to you for assembling and starting up an M7-300 automation computer. The major components and their functions are briefly described in Table 1-1:

Table 1-1 Components of an M7-300

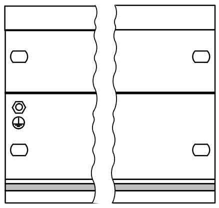
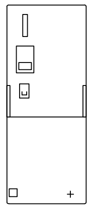
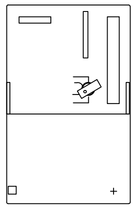
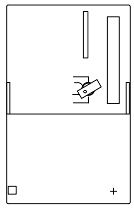
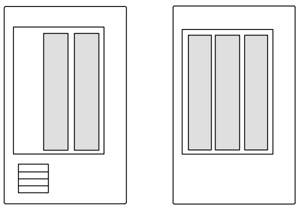
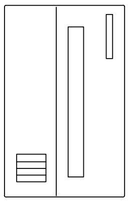
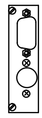
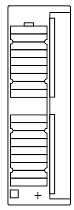
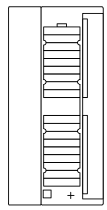
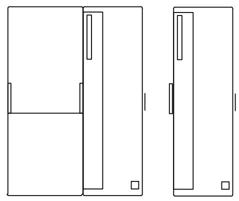
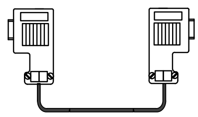
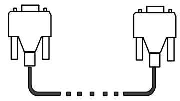
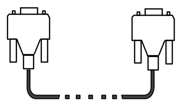
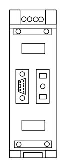
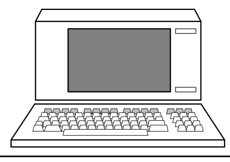
Component	Function	Illustration
Rail	... accommodates the S7-300 modules	
Power supply (PS) from the S7-300 range	... converts the power system voltage (120/230 VAC) into 24 VDC for the M7-300 and load power supply for 24 VDC load circuits	
Central processing unit (CPU) Accessories: Memory card Backup battery	... executes the user program; provides the 5 V supply for the S7-300 backplane bus; communicates with other CPUs or with a programming device via the MPI (multipoint interface)	
Application modules (FMs) Accessories: Memory card Backup battery	... support the CPU as PC-compatible modules, control local segments (described in a separate manual)	
Expansion modules (EXMs)	... accomodate two to three interface submodules (IFs) for interfacing with a VGA monitor, PC/programming device keyboard, printer, sensors and actuators, etc.	
Mass storage module (MSM)	... is used for storing programs and data on hard disk or a 3.5 in. diskette	

Table 1-1 Components of an M7-300, continued

Component	Function	Illustration
Interface Submodules (IFs)	... for connecting I/O devices such as VGA card, mouse, keyboard, printer	
Signal modules (SMs) from the S7-300 range (digital input modules, digital output modules, analog input module analog output module analog input/output module) Accessories: Front connector	... match different process signal levels to the internal signal level of the M7-300.	
Function modules (FMs) from the S7-300 range	... for time-critical and memory- intensive process signal processing tasks, for example, positioning or closed-loop control (described in a separate manual)	
Interface module (IM) from the S7-300 range Accessories: Connecting cables	... interconnects the individual racks of an M7-300	
PROFIBUS cable with bus connector	... interconnects stations on an MPI subnet or PROFIBUS subnet	
Programmer cable	... connects a PG/PC to a CPU via MPI	
V.24 cable	... connects a PG/PC to a CPU for the remote setup or system console functions.	
RS 485 repeater from the S7-300 range	... amplifies signal levels in an MPI or PROFIBUS-DP subnet and interconnects individual segments of an MPI or PROFIBUS-DP subnet.	
Programming device or PC with the STEP 7 software package	... configures, initializes, programs and tests the S7-300	

1.4 Order Number and Revision Level on Modules

Location of Order Number and Revision Level

The order number and revision level are printed on every module of the M7-300. Figure 1-3 shows their locations on the module.

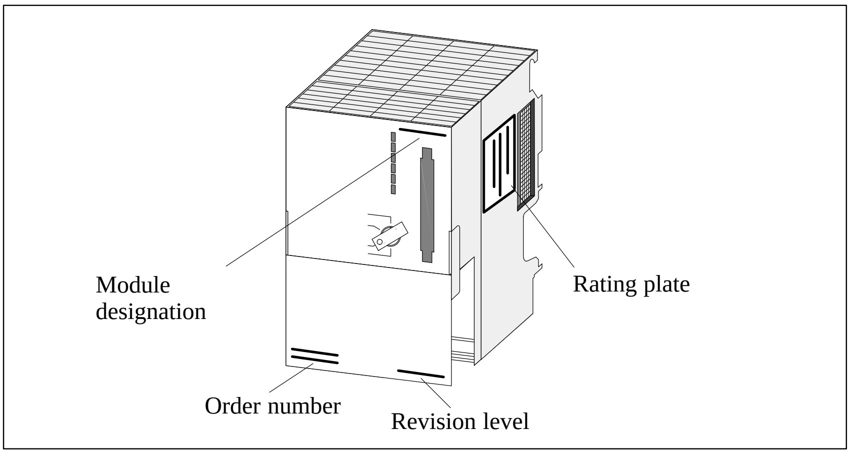


Figure 1-3 Location of Order Number and Product Release

Example of a Rating Plate

Figure 1-4 contains an example of a rating plate with all information.

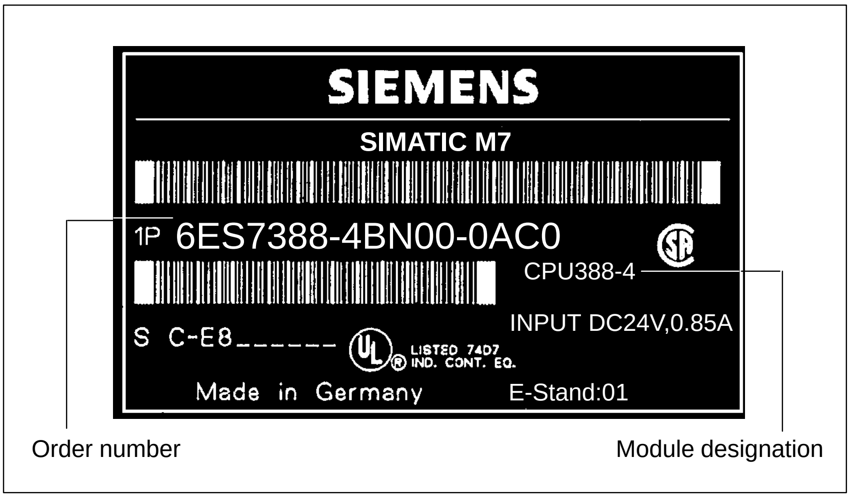


Figure 1-4 Example of a Rating Plate

Mechanical Configuration

2

Introduction

You will need to understand the following when installing an M7-300:

- The mechanical configuration and
- The electrical configuration.

Please therefore also read Chapter 4 “Electrical Configuration”.

Open Components

The modules of an M7-300 are open components. That means you can only install the M7-300 in housings, cabinets or electrical equipment rooms which are only accessible by key or a special tool. Only trained or authorized personnel should have access to the housings, cabinets or electrical equipment rooms.

Chapter Overview

2.1 Horizontal and Vertical Arrangement of an M7-300

Mounting Arrangement

You can mount your SIMATIC M7-300 automation computer in either a horizontal or vertical arrangement.

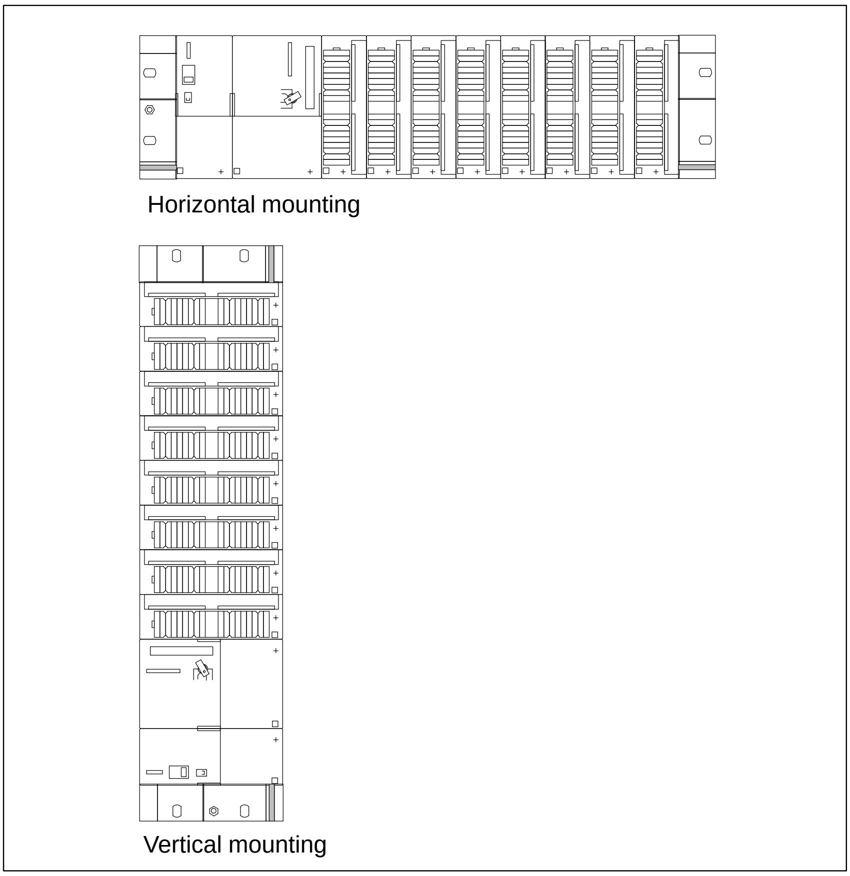


Figure 2-1 Horizontal and Vertical Mounting Arrangements of the M7-300

Location of the CPU on the Rack

For a horizontal arrangement, you must locate the CPU and power supply on the extreme left.

For a vertical arrangement, you must locate the CPU and power supply at the bottom.

Permissible Ambient Temperature

You can take the permissible ambient temperatures for both horizontal and vertical mounting arrangements from Table 2-1:

Table 2-1 Permissible Ambient Temperatures for Horizontal and Vertical Arrangements

Arrangement	Permissible Ambient Temperature
Horizontal	0 to 60°C (32 to 140°F)
Vertical	0 to 40°C (32 to 104°F)

Exception for Mass Storage Module

If you use the MSM 378 mass storage module in your M7-300 system, there are restrictions. Given in Table 2-2 are the ambient temperatures applying to the horizontal and vertical arrangement.

Table 2-2 Permissible Ambient Temperatures for Horizontal and Vertical Arrangement, Using the MSM 378 Mass Storage Module

Arrangement	Permissible Ambient Temperature
Horizontal	0 to 40°C (32 to 104°F)
Vertical	0 to 40°C (32 to 104°F)

2.2 Mounting Dimensions of the M7-300

Introduction

This section describes the various mounting dimensions for an M7-300 on one or more racks.

Clearances for a Configuration on One Rack

Figure 2-2 shows the necessary clearances to adjacent cable ducts, equipment, cabinet walls etc. for standard M7-300 configurations on one rack.

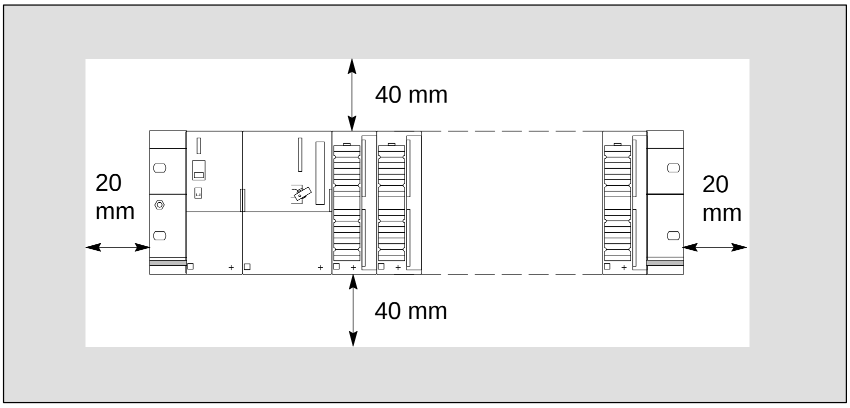


Figure 2-2 Clearances Applying to a Standard M7-300 Configuration on One Rack

If you observe these clearances

- you will guarantee the necessary heat dissipation of the modules,
- you will have adequate space for plugging in and withdrawing the modules, and
- you will have sufficient space for running cables.

Note

If you use a shield connecting element (see Section 6.7), the dimension specifications apply from the bottom edge of the shield connecting element.

Clearances for a Configuration on Several Racks

Figure 2-3 shows the necessary clearances between the individual racks and to the adjacent equipment, cable ducts, cabinet walls etc. for standard M7-300 configurations on several racks.

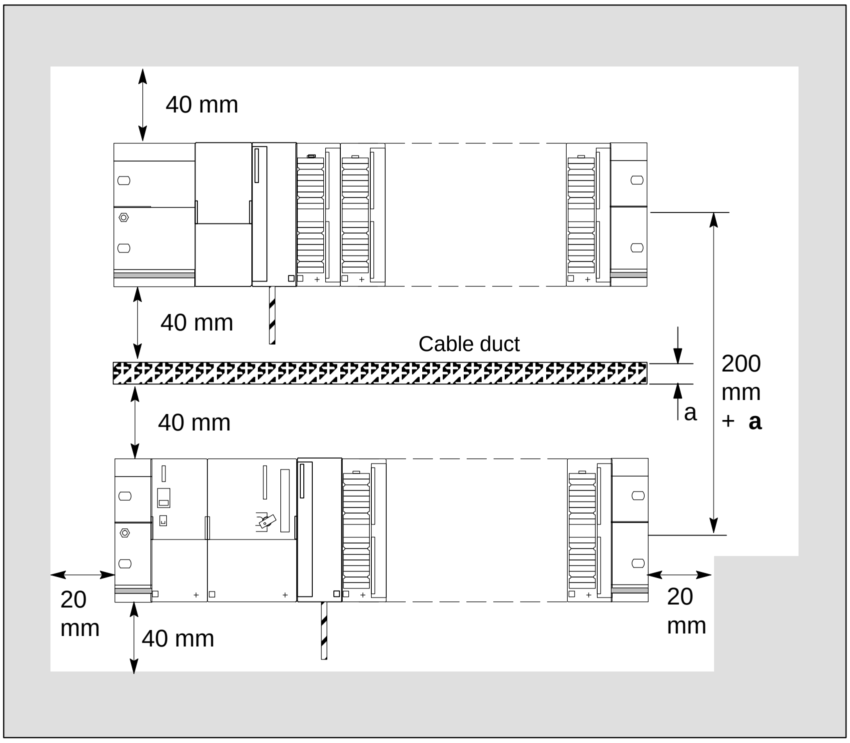


Figure 2-3 Clearances Applying to a Standard M7-300 Configuration on Several Racks

If you observe these clearances

- you will guarantee the necessary heat dissipation of the modules,
- you will have adequate space for plugging in and withdrawing the modules, and
- you will have sufficient space for running cables.

Note

If you use a shield connecting element (see Section 6.7), the dimension specifications apply from the bottom edge of the shield connecting element.

Module Mounting Dimensions

Table 2-3 contains an overview of the mounting dimensions of modules available for the SIMATIC M7-300 automation computer.

Table 2-3 Mounting Dimensions of the M7-300 Modules

Modules	Module Width	Module Height	Max. Mounting Depth
Power supply PS 307, 2 A Power supply PS 307, 5A Power supply PS 307, 10 A	50 mm 80 mm 200 mm	125 mm (4.88 in.) (or 185 mm (7.22 in.) with shield connecting element)	130 mm (5.07 in.) or 180 mm (7.02 in.) with front door open
CPU 388-4	80 mm		
Expansion module EXM 378-2 Expansion module EXM 378-3			117 mm + max. connector height for interface submodules
Mass storage module MSM 378			166 mm
Digital input module SM 321 Digital output module SM 322 Relay output module SM 322 Digital input/output module SM 323 Simulator module SM 374	40 mm		130 mm or 180 mm with front door open
Analog input module SM 331 Analog output module SM 332 Analog input/output module SM 334 Analog input/output module SM 335			
Interface module IM 360 Interface module IM 361 Interface module IM 365	40 mm 80 mm 40 mm		

Rail Lengths

Depending on your M7-300 configuration, you can use the following rails as racks:

Table 2-4 Lengths of Rails

Rail	Usable Length for Module
160 mm (6.24 in.)	120 mm
482.6 mm (18.82 in.)	450 mm
530 mm (20.67 in.)	480 mm
830 mm (32.37 in.)	780 mm
up to 2000 mm (78 in.)	Cut to length required

Special Widths

Special widths are possible with 2 m (6.56 ft.) long rails. You can shorten the 2 m (6.56 ft.) rail to the length you require (see Section 5.2).

2.3 The Module Arrangement for an M7 Configuration on One Rack

Introduction

The following sections explain the rules governing the arrangement of the modules for an M7-300 programmable controller mounted on one rack.

Rules

The following rules apply to the arrangement of the modules on one rack:

- The power supply module always occupies the first slot, and the CPU the second slot on the rack.
- No more than eight modules (expansions, function modules, signal modules) may be mounted to the right of the CPU.
- Expansions (expansion modules, mass storage modules) are always located on the immediate right of the CPU or application module.
  Signal or function modules can be inserted at the slots to the right of the CPU or next to their last expansion.
- The number of modules that can be plugged in is limited by the amount of power they draw from the S7-300's backplane bus (see Tables 4-1 and 4-2, and the technical specifications of the individual modules).

  The total current consumption from the S7-300 backplane bus by all modules mounted on one rail must not exceed 1.2 A.

Maximum Configuration for an M7-300 Mounted on One Rack

Figure 2-4 shows how the modules are arranged on an M7-300 programmable controller with eight signal modules (SMs).

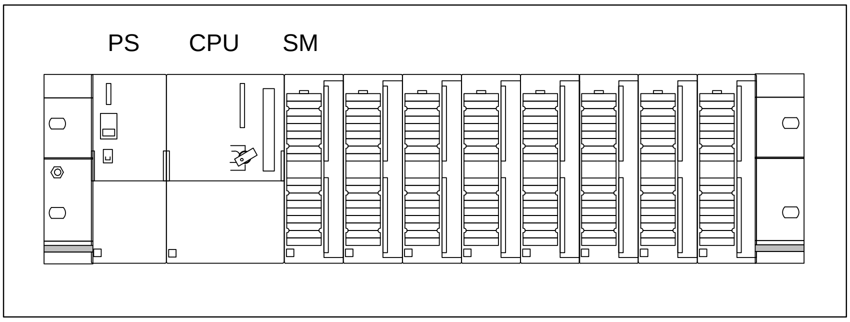


Figure 2-4 Module Arrangement for an M7-300 Mounted on One Rack

2.4 The Module Arrangement for an M7-300 Configuration on Two or More Racks

Introduction

This section explains the rules governing the arrangement of the modules in an M7-300 configuration on two or more racks.

Rules

The following rules apply to the arrangement of the modules:

- The power supply module always occupies the first slot, and the CPU the second slot on rack 0.
- The interface module (IM) occupies the slot to the right of the CPU on rack 0, if the CPU has no expansion; otherwise it is located to the right of the last expansion of the CPU. In any case, it is always to the left of the first signal or application module.
  On racks 1 to 3, the interface module always occupies the third slot.
- Up to eight modules (expansions, application modules, signal modules) may be inserted on the right of the CPU (Rack 0) or on the right of the interface module (racks 1 to 3).
- Expansions (expansion modules, mass storage modules) are always located on the immediate right of the CPU or an application module.
  Signal or function modules can be inserted at the slots to the right of the interface module.
- The number of modules that can be plugged in is limited by the permissible current drawn from the S7-300 backplane bus. The total current consumption must not exceed 1.2 A per rack (see Tables 4-1 and 4-2 and the technical data of the modules).

Requirement: Interface Modules

For mounting on two or more racks, interface modules are required. The task of the interface module is to connect the S7-300 backplane bus from one rack to the next.

Table 2-5 shows an overview of the interface modules for a configuration with two to four racks.

Table 2-5 Interface modules IM360/IM361 for a Configuration on Several Racks

Interface Module	Used for Rack(s)	Order No.
IM 360	Rack 0	6ES7 360-3AA01-0AA0
IM 361	Rack 1 to 3	6ES7 361-3CA01-0AA0

Connecting Cables for Interface Modules

The following cables are available for connecting interface modules:

Table 2-6 Connecting Cables for Interface Modules

Length	Order No. of the Connecting Cable
1 m (3.28 ft.)	6ES7 368-3BB00-0AA0
2.5 m (8.2 ft.)	6ES7 368-3BC50-0AA0
5 m (16.4 ft.)	6ES7 368-3BF00-0AA0
10 m	6ES7 368-3CB00-0AA0

Variant for a Configuration on Two Racks

There is a variant, the IM365, for interfacing the two racks in a two-rack configuration. The two interface modules are permanently connected to each other over a 1 m (3.28 ft.) long connecting cable.

If you use the IM 365 interface modules, then you can use only signal modules on rack 1.

The total current consumption of the signal modules plugged into both racks (including any expansions and application modules) must not exceed 1.2 A; the current consumption from rack 1 is limited to 800 mA.

Table 2-7 shows an overview of the IM 365 interface module for a configuration on 2 racks.

Table 2-7 Interface module IM 365 for a Configuration on Two Racks

Interface Module	Used for Rack	Order No.
IM 365 SEND	Rack 0	6ES5 365-0BA00-0AA0
IM 365 RECEIVE	Rack 1	

Maximum Configuration on Four Racks

Shown as an example in Figure 2-5 is a module arrangement in a four-tier M7-300 configuration.

Rack 0 is equipped with the CPU and interface module, seven signal modules and a mass storage module (MSM 378). Each of the other racks is equipped with one interface module and eight signal modules.

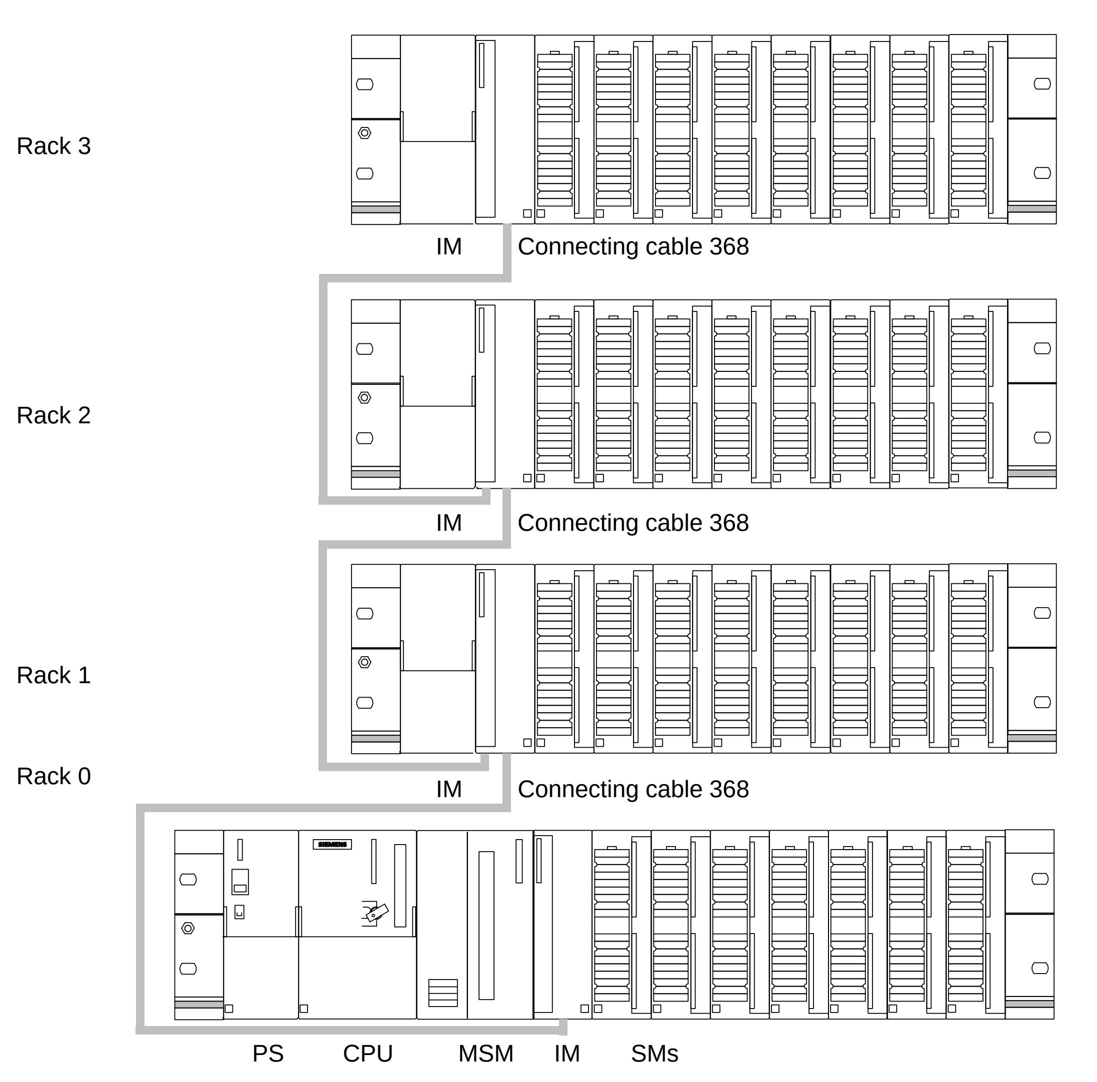


Figure 2-5 M7-300 Configuration on Four Racks

Addressing the M7-300 Modules

3

Introduction

Tere are two possibilites to assign addresses to M7-300 modules:

- Slot-oriented address allocation
  Slot-oriented address assignment is based on default addressing, that is, a defined module start address is allocated to each slot number.
- User-oriented address allocation
  With user-oriented address allocation, in contrast to slot-oriented addressing, you can choose the address of a signal module. You need not know the location or slot number for programming. You use STEP 7 to create the allocation between the location and your chosen address.

Further Information

Please see the STEP 7 user manual for further information on addressing.

Chapter Overview

3.1 Slot-Oriented Addressing for Modules

Introduction

In slot-oriented addressing (default addressing), a module start address is allocated to each slot number. This section shows you which module start address is allocated to which slot number. You need this information to determine the module start addresses on the installed modules.

Module Slots

Shown in Table 3-1 are the possible slots for the modules used in an M7-300.

Table 3-1 Slots Available for Modules

Slots	Available Slots
Power supply module	Slot 1 on each rack
CPU	Slot 2 on rack 0
Function module	Slots 4 to 11 on each rack
Expansion module/ mass storage module	Slots 3 to 5 as CPU expansion on rack 0 Slots 5 to 11 as expansion of an application module on each rack
Interface module	Slots 3 to 6 on rack 0 (Slots 4 to 6 are only used when expansions are plugged in for a CPU) Slot 3 on racks 1 to 3
Signal module	Slots 4 to 11 on each rack

The CPU and its expansions form a unit (module assembly) with a width resulting from the number of individual components. After this module assembly, the interface module is inserted on Rack 0. This slot is reserved even if the interface module is not inserted. In Figure 3-1, slot 5 is reserved for the interface module.

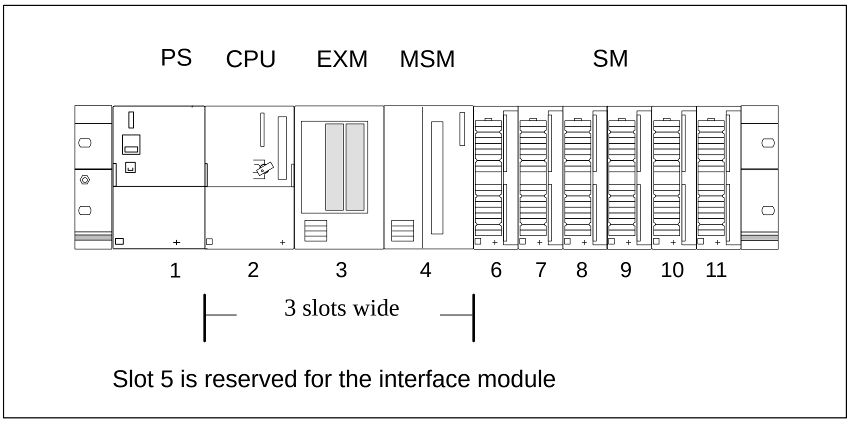


Figure 3-1 Example of Slot Reservation for the Interface Module on Rack 0

Default Addressing

The addressing described in Table 3-2 characterizes default addressing. You can change these settings with the STEP 7 software.

Calculating the Module Start Addresses

The formulae for calculating the module start addresses are given in Table 3-2.

The expansions of CPUs (expansion modules EXM 378, mass storage module MSM 378) do not themselves have a module start address; however, the interface submodules plugged into them do have a start address. The slots for interface submodules in the expansion modules are counted from left to right (from 1 to a maximum of 5 with two expansion modules).

The start addresses of analog and digital modules are calculated with different formulae.

Table 3-2 Formulae to Calculate the Module Start Addresses

Modules	Formula
Expansion modules	Have no start address
Mass storage modules	Have no start address
Signal modules, digital	Start address = rack * 32 + (slot - 4) * 4
Signal modules, analog	Start address = rack * 128 + (slot - 4) * 16 + 256
Interface modules	Start address = rack * 4 +2000
Digital interface submodules	Start address = 128 + (slot - 1) * 4
Analog interface submodules and counters	Start address = 768 + (slot - 1) * 16

Example of a Maximum Configuration

Shown in Figure 3-2 is an example of a maximum configuration of an M7-300 on four racks. The module start addresses for this example are listed in Tables 3-3 to 3-6.

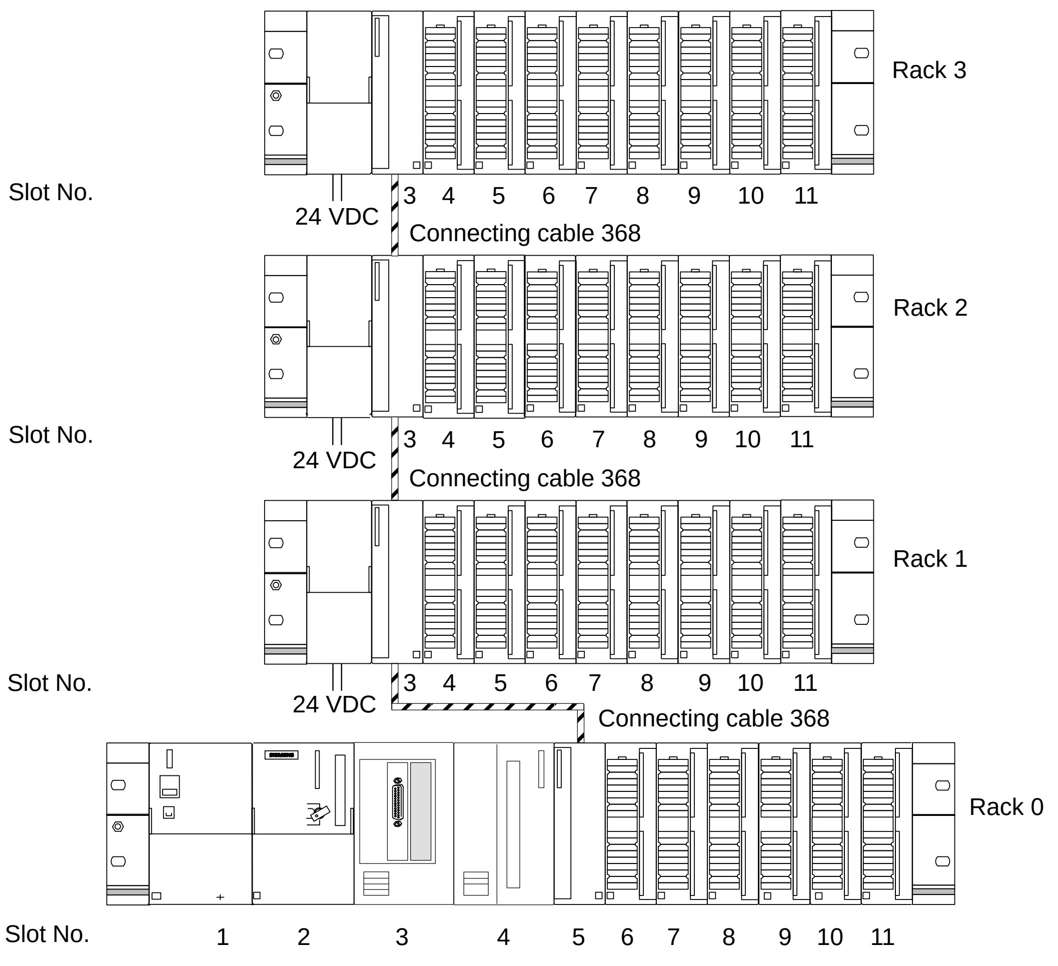


Figure 3-2 Example of a Maximum Configuration for the M7-300

Assignment of Slots to Addresses for Rack 0

Table 3-3 shows the calculated module start addresses on Rack 0 for the example of maximum configuration in Figure 3-2.

Table 3-3 Assignment of Slots to Module Start Addresses

Slot No.	Module	Module Start Address	
		Digital	**Analog**
1	Power supply module (PS)	-	
2	CPU	-	
3	Expansion module (EXM)	-	
	1st card slot	128 *	2048 *
	2nd card slot	Unassigned	
4	Mass storage module (MSM)	-	
5	Interface module (IM)	2000	
6	Signal module	8	288
7	Signal module	12	304
8	Signal module	16	320
9	Signal module	20	336
10	Signal module	24	352
11	Signal module	28	368

* The interface submodule is only accessible locally for the programmable module. Since, however, it is the CPU, access to the interface submodule is comparable to the access to a signal module.

Assignment of Slots to Addresses for Rack 1

Table 3-4 shows the calculated module start addresses on rack 1 of the example of maximum configuration in Figure 3-2.

Table 3-4 Assignment of Slots to Module Start Addresses

Slot No.	Module	Module Start Address	
		Digital	Analog
1	Power supply module (PS)	-	
3	Interface module (IM)	2004	
4	Signal module	32	384
5	Signal module	36	400
6	Signal module	40	416
7	Signal module	44	432
8	Signal module	48	448
9	Signal module	52	464
10	Signal module	56	480
11	Signal module	60	496

Assignment of Slots to Addresses for Rack 2

Table 3-5 shows the module start addresses on rack 2 of the example of maximum configuration Figure 3-2.

Table 3-5 Assignment of Slots to Module Start Addresses

Slot No.	Module	Module Start Address	
		Digital	Analog
1	Power supply module (PS)	-	
3	Interface module (IM)	2008	
4	Signal module	64	512
5	Signal module	68	528
6	Signal module	72	544
7	Signal module	76	560
8	Signal module	80	576
9	Signal module	84	592
10	Signal module	88	608
11	Signal module	92	624

Assignment of Slots to Addresses for Rack 3

Table 3-6 shows the module start addresses on rack 3 of the example of maximum configuration in Figure 3-2.

Table 3-6 Assignment of Slots to Module Start Addresses

Slot No.	Module	Module Start Address	
		Digital	Analog
1	Power supply module (PS)	-	
3	Interface module (IM)	2012	
4	Signal module	96	640
5	Signal module	100	656
6	Signal module	104	672
7	Signal module	108	688
8	Signal module	112	704
9	Signal module	116	720
10	Signal module	120	736
11	Signal module	124	752

3.2 Addressing Signal Modules

Introduction

This section shows you how signal modules are addressed. You need this information in order to be able the address the channels of the signal modules in your user program.

Adressing the Digital Modules

The address of an input or output point consists of a byte part and a bit part.

e.g.. I 1.2

Input Byte address Bit address

The byte address depends on the module start address.

The bit address is the number printed on the module.

Figure 3-3 shows you how the individual channels of a digital module are addressed.

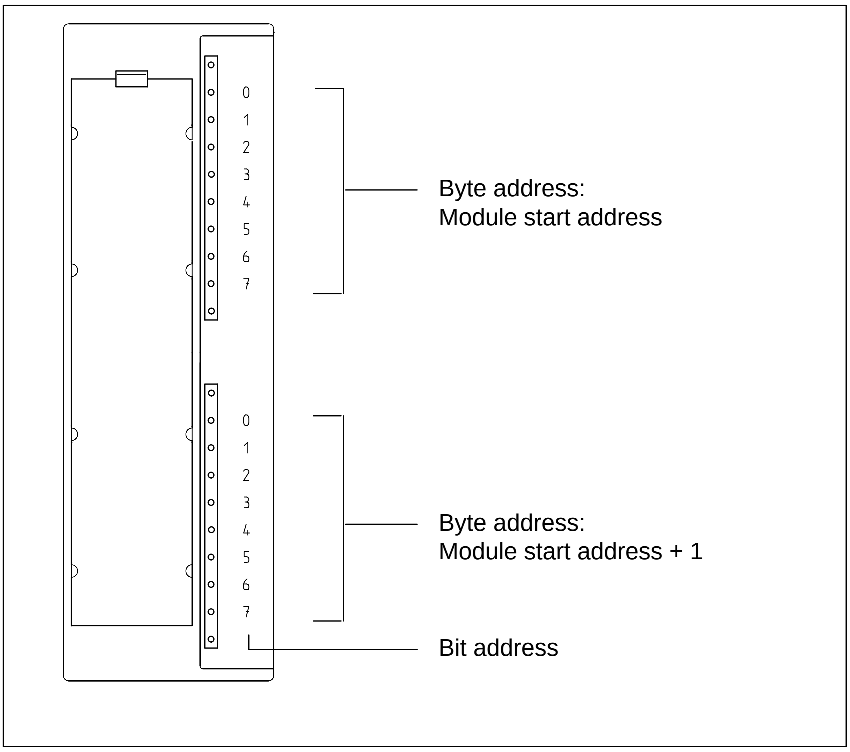


Figure 3-3 Addresses of the Input and Output Points of Digital Modules

Example for Digital Modules

The example in Figure 3-4 shows which default addresses are obtained if a digital module is plugged into slot 4, that is the module start address is 0.

Slot number 3 has not been assigned since there is no interface module in the example.

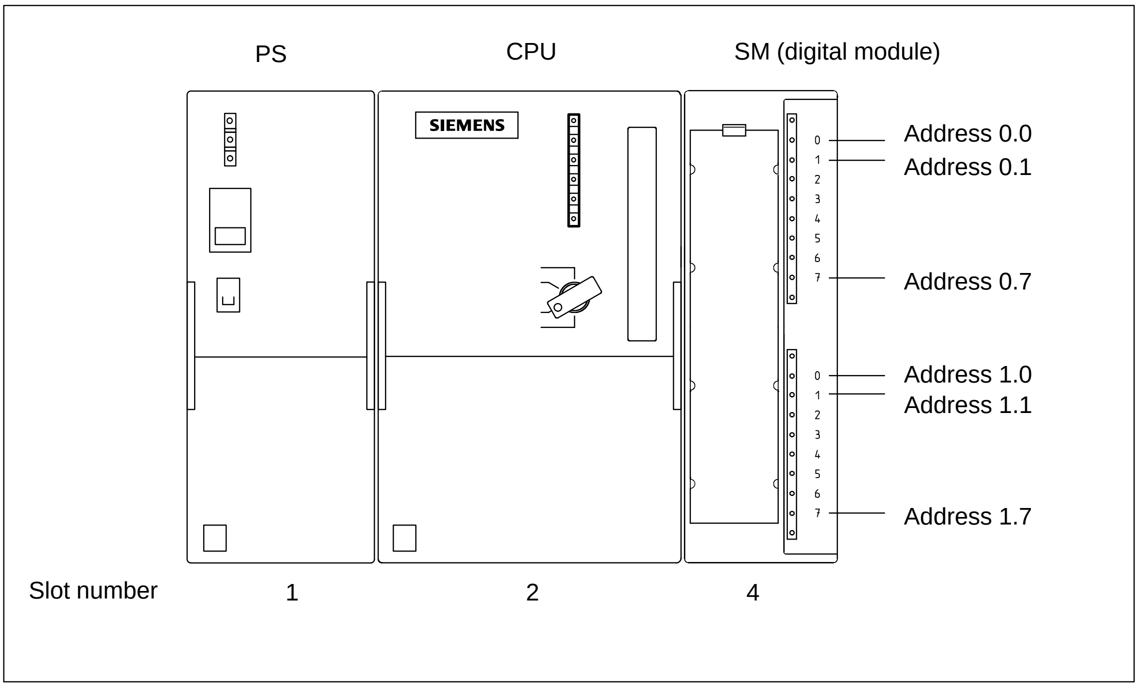


Figure 3-4 Addresses of the Input and Output Points of the Digital Module in Slot 4

Addresses of the Analog Modules

The address of an analog input or output channel is always a word address.

The channel address depends on the module start address.

If the first analog module is plugged into slot 4, it has the default start address 256. The start address of each further analog module increases by 16 per slot (see Figure 3-3).

An analog input/output module has the same start addresses for its input and output channels.

Example for Analog Modules

The example in Figure 3-5 shows you which default channel addresses are obtained for an analog module plugged into slot 4. As you can see, the input and output channels of an analog input/output module are addressed from the same address (the module start address) upwards.

Slot number 3 has not been assigned since there is no interface module in the example.

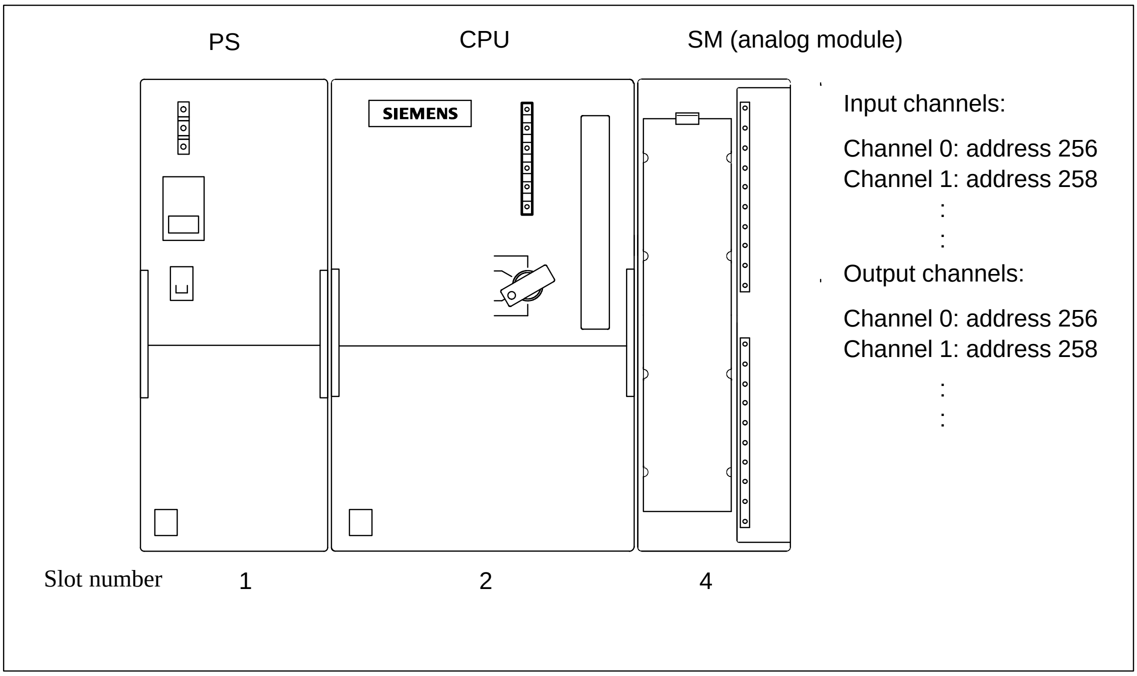


Figure 3-5 Addresses of the Input and Output Points of the Analog Module in Slot 4

Electrical Configuration 4

Introduction

You must take the following into account when assembling an M7-300:

- Planning the mechanical configuration
- Planning the electrical configuration

Please therefore also read Chapter 2 “Mechanical Configuration”.

Basic Rules

In view of the many and varied applications an M7-300 has, this chapter can only describe a few basic rules on its electrical configuration. You must observe at least these basic rules if you want your M7-300 to operate faultlessly and satisfactorily.

Chapter Overview

4.1 General Rules and Guidelines for Operating an M7-300 Automation Computer

Introduction

As part of a plant or system, and depending on its particular area of application, the M7-300 automation computer requires that you observe a number of specific rules and guidelines.

This section outlines the most important rules you must observe when integrating your M7-300 in an existing plant or system.

Specific Application

Observe the safety and accident prevention regulations applying to particular applications or situations, for example the relevant machine protection guidelines.

EMERGENCY OFF Facilities

EMERGENCY OFF facilities to IEC 204 must remain effective in all operating modes of the plant or system.

Plant Restart Following Specific Events

The following table tells you what you have to observe when starting up a plant again following certain events.

Situation ...	What Must Not Happen ...
Restart following power dips or power failure	No dangerous operating states may prevail.
Restart after resetting the emergency OFF facility	Uncontrolled or andefined plant start-up must be avoided.

System Voltage

The following table tells you what to observe in the event of a power system failure.

Equipment	Guidelines
Permanently installed plants or systems without all-pole mains disconnect switches	There must be a mains disconnect switch or a fuse in the building installation system
Load power supplies, power supply modules	The system voltage range set must correspond to the local system voltage
All circuits of the M7-300	Any fluctuations in, or deviations from, the rated system voltage must be within the permissible tolerances (→Technical specifications of the modules available for the M7-300)

24 VDC Power Supply

The following table tells you what you must observe in connection with the 24 VDC power supply.

<table>
<tr><th>Equipment/Location</th><th colspan="2">Measures to Take</th></tr>
<tr><td>Buildings</td><td>External lightning protection</td><td rowspan="2">Take the necessary lightning protection measures (lightning protection unit)
(see Section 4-24).</td></tr>
<tr><td>24 VDC power supply cables, signal cables</td><td>Internal lightning protection</td></tr>
<tr><td>24 V power supply</td><td colspan="2">Reliable electrical isolation of the extra-low voltage</td></tr>
</table>

Protection Against External Electrical Influences

The following table will tell you what you must do to protect your programmable controller against the effects of electrical faults, etc.

Equipment	Measures to Take
All plants and systems in which the M7-300 is installed	Connection of the plant or system to protective groand to discharge interference.
Connection, signal and bus cables	Is the wiring and cable routing in order? (see Sections 4.8 and 4.9).
Signal and bus cables	Cable or wire breaks must not be allowed to result in indefined situations in the plant or system.

4.2 Current Consumption and Power Losses of an M7-300

Introduction

The modules available for an M7-300 automation computer draw the power they need from the M7-300 backplane bus and, if required, from an external load power supply.

The current consumptions and power losses of a module are important when configuring the M7-300.

This chapter lists the current consumptions and power losses of all the M7-300 modules. An example is taken to show you how to calculate the current consumptions and power losses of an M7-300 configuration.

Maximum Current Consumption

The total current drawn by all M7-300 modules from the M7-300 backplane bus must not exceed 1.2 A!

Current Consumption with 24 VDC Load Power Supply

The following tables list the current consumptions and power losses of the modules available for the M7-300. Shown in Table 4-1 are the modules with a 24 V load power supply.

Table 4-1 Current Consumption and Power Losses of the Modules Used in the M7-300 (24 VDC Load Power Supply)

Module	Current Drawn from M7-300 Backplane Bus (Max.)	Current Drawn from 24 V Load Power Supply (No-Load Operation)	Power Losses (Rated Operation)
CPU 388-4	–	870 mA	10.8 W
Expansion module EXM 378-2	3 mA	95 mA	1)
Expansion module EXM 378-3	3 mA	15 mA	0.22 W
Mass storage module MSM 378	3 mA	400 mA	9.6 W
Interface submodule IF 961-AIO	–	30 mA	2.5 W
Interface submodule IF 961-CT1	–	53 mA 2)	1.5 W
Interface submodule IF 961-DIO	–	30 mA 2)	2.4 W
Interface submodule IF 962-COM	–	40 mA	0.5 W
Interface submodule IF 962-LPT	–	40 mA	0.5 W
Interface submodule IF 962-VGA	–	210 mA	2.5 W
Interface submodule IF 964-DP	–	160 mA	2 W

1) Expansion module EXM 378-2 has an internal power supply to power the interface submodules and an EXM 378-3. The power loss is therefore calculated as follows:
$P_{EXM378\text{-}2} = P_1 + 1{,}6 \times P_2 + 0{,}6 \times (P_4 + P_5) + P_3$
$P_{EXM378\text{-}3} = P_4 + P_5 + P_6$
P_1 Power loss of the EXM378-2 (2.28 W)
P_2 Power loss of the interface submodules in EXM378-2
P_3 Power loss of the interface submodules in EXM378-2 from an external supply voltage
P_4 Power loss of the EXM378-3 (0.22W)
P_5 Power loss of the interface submodules in EXM378-3
P_6 Power loss of the interface submodules in EXM378-3 from an external supply voltage
2) The load-dependent current consumption by the digital outputs must be added.

Table 4-1 Current Consumption and Power Losses of the Modules Used in the M7-300 (24 VDC Load Power Supply), continued

Module	Current Drawn from M7-300 Backplane Bus (Max.)	Current Drawn from 24 V Load Power Supply (No-Load Operation)	Power Losses (Rated Operation)
Interface module IM 360	350 mA	–	2 W
Interface module IM 361	Supplies 0.8 A	0.5 A	5 W
Interface module IM 365	Supplies 0.8 A	–	0.5 W
Digital input module SM 321; DI 32 × 24 VDC	25 mA	25 mA	6.5 W
Digital input module SM 321; DI 16 × 24 VDC with process interrupt and diagnostics interrupt	55 mA	40 mA	4 W
Digital input module SM 321; DI 16 × 24 VDC	25 mA	1 mA	3.5 W
Digital output module SM 322; DO 32 × 24 VDC/0.5A	90 mA	200 mA	6.6 W
Digital output module SM 322; DO 16 × 24 VDC/0.5A	80 mA	120 mA	4.9 W
Digital output module SM 322; DO 8 × 24 VDC/0.5A with diagnostics interrupt	70 mA	90 mA	5 W
Digital output module SM 322; DO 8 × 24 VDC/2 A	40 mA	60 mA	6.8 W
Digital input/output module SM 323; DI16/DO16 × 24 VDC	55 mA	100 mA	6.5 W
Digital input/output module SM 323; DI8/DO8 × 24 VDC	40 mA	20 mA	3.5 W
Relay output module SM 322; DO 8 × 230 VAC	40 mA	110 mA	2.2 W
Relay output module SM 322; DO 16 × 120 VAC	100 mA	250 mA	4.5 W
Simulator module SM 374; 16 × Input/Output	80 mA	–	0.35 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	80 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	135 mA	3 W
Analog input/output module SM 334; AI4/AO2 2 × 8/8 bits	55 mA	110 mA	2.6 W

Current Consumption with 120/230 VAC Load Power Supply

Table 4-2 lists all modules with the 120/230 V load power supply and all associated current consumptions and power losses.

Table 4-2 Current Consumption and Power Losses of the M7-300 Modules (120/230 VAC Load Power Supply)

Module	Current Drawn from M7-300 Backplane Bus (Max.)	Current Drawn from 24 V Load Power Supply (No-Load Operation)	Power Losses (Nominal Operation)
Digital input module SM 321; DI 8 × 120/230 VAC	29 mA	–	4.9 W
Digital input module SM 321; DI 16 × 120 VAC	16 mA	–	4.1 W
Digital output module SM 322; DO 8 × 120/230 VAC	184 mA	–	9.0 W
Digital output module SM 322; DO 16 × 120 VAC	100 mA	–	9.0 W

Power Losses of the Power Supply Modules

Table 4-3 lists the power losses of the power supply modules used in the M7-300.

Table 4-3 Power Losses of the Power Supply Modules

Module	Power Losses (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

Example

An M7-300 consists of the following modules:

- 1 power supply module PS 307; 5 A
- 1 CPU 388-4
- 1 expansion module EXM 378-2 with
  - 1 interface submodule IF 962-VGA (VGA monitor interface)
  - 1 interface submodule IF 962-LPT (printer interface)
- 1 mass storage module MSM 378
- 2 digital input modules SM 321; DI 16 × 24 VDC
- 1 relay output module SM 322; DO 8 × 230 VAC
- 1 digital output module SM 322; DO 16 × 24 VDC
- 1 analog input module SM 331; AI 8 × 12 bits
- 1 analog output module SM 332; AO 4 × 12 bits

Current and Power Loss Totals

In Table 4-4 are the current and power loss totals for the above M7-300 configuration, that is, the values are totaled.

Table 4-4 Current and Power Loss Totals

Module	Current Drawn from M7-300 Backplane Bus	Current Drawn from 24 V Load Power Supply	Power Losses
Power supply module PS 307; 5 A	–	–	18 W
CPU 388-4	–	870 mA	10.8 W
Expansion module EXM 378-2 inc. VGA and LPT interface submodule	3 mA	95 mA	7.1 W
Interface submodule IF 962-VGA	–	210 mA	
Interface submodule IF 962-LPT	–	40 mA	$P_{EXM378-2}$ = 2.28 W + 1.6 x (2.5 W+ 0.5 W)
Mass storage module MSM 378	3 mA	400 mA	9.6 W
2 digital input modules SM 321; DI 16 × 24 VDC	(2 × 25 mA) = 50 mA	(2 × 1 mA) = 2 mA	(2 × 3.5 W) = 7 W
1 relay output module SM 322; DO 8 × 230 VAC	40 mA	110 mA	2.2 W
1 digital output module SM 322; DO 16 × 24 VDC	80 mA	120 mA	4.9 W
1 analog input module SM 331; AI 8 × 12 bits	60 mA	200 mA	1.3 W
1 analog output module SM 332; AO 4 × 12 bits	60 mA	240 mA	3 W
Total:	296 mA	2287 mA	63.9 W

Result

The following results are obtained from Table 4-4:

1. Current drawn from the S7-300 backplane bus:

   The total current drawn by the signal modules from the S7-300 backplane bus is 296 mA, and therefore does **not** exceed the 1.2 A the CPU 388-4 supplies to the M7-300 backplane bus.

2. Current drawn from 24 V load power supply:

   The total current drawn by the signal modules from the 24 V load power supply is approximately 2.3 A.
   In addition, you must take into account all other loads connected. Depending thereon, you select the PS 307 power supply.

3. Power losses:

   The total power losses of the M7-300 configuration are 63.9 W.

   The total power losses of all the components installed in a cabinet (including the M7-300 with 63.9 W) must not exceed the maximum power that can be dissipated from the cabinet.

   Tip: Observe the ambient temperature of the cabinet.

4.3 Configuring the M7-300 Process I/O

Introduction

This section contains information concerning the overall configuration of an M7-300 system with grounded incoming supply (TN-S system) ander the following aspects:

- Disconnecting devices, short–circuit and overload protection to VDE 0100 and VDE 0113
- Load power supplies and load circuits.

Definition: Grounded Incoming Supply

In a grounded incoming supply system, the neutral is grounded. A single fault to groand or a grounded part of the plant causes the protective devices to trip.

Components and Protective Measures

A number of components and protective measures are prescribed for a plant. The type of components and the degree of compulsion pertaining to the protective measures will depend on the VDE specification applicable to your particular plant. The following table refers to Figure 4-1 on Page 4-11.

Table 4-5 VDE Specifications for PLC Systems

Compare ...	Ref. to Figure 4-1	VDE 0100	VDE 0113
Disconnecting devices for control systems, sensors and actuators	1	... Part 460: Main switch	... Part 1: Disconnector
Short-circuit and overload protection: In groups for sensors and actuators	2	... Part 725: Single-pole fusing of circuits	... Part 1: • If secondary circuit grounded: **Single-pole** fusing • Otherwise: **All–pole** fusing
Load power supply for AC load circuits with more than five electromagnetic devices	3	Galvanic isolation by transformer **recommended**	Galvanic isolation by transformer **mandatory**

Characteristics of Load Power Supplies

The load power supply powers input and output circuits (load circuits), as well as sensors and actuators. The characteristic features of load power supplies required in specific applications are listed in the following table.

Characteristics of the Load Power Supply	Mandatory for ...	Remarks
Safety isolation	Modules which must be powered with functional extra-low voltage	The PS 307 power supply and the Siemens load power supplies of the 6EP1 series have these characteristics
	24 VDC load circuits	
Output voltage tolerances: 20.4 V to 28.8 V 40.8 V to 57.6 V 51 V to 72 V	 24 VDC load circuits 48 VDC load circuits 60 VDC load circuits	If the output voltage tolerances are not reached by the load power supply, you must fit a back-up capacitor rated at 200 µF per 1 A of load current (with bridge rectification)

Rule: Groand all Load Circuits

Load circuits should be grounded.

The common reference potential (ground) guarantees full functionality. Provide a detachable link to the protective groand conductor on the load power supply (terminal L- or M) or on the isolating transformer (Figure 4-1, $\boxed{4}$). In the event of power distribution faults, this makes it easier to localize groand faults.

Grounding Concept for the M7-300

If you operate the M7-300 with the CPU 388-4 from a grounded supply, you should also groand the reference potential of the M7-300. The reference potential is grounded when the link between the M (0 V) terminal and functional groand terminal on the CPU is in place (factory setting).

M7-300 in the Overall Configuration

Figure 4-1 shows the M7-300 in the overall configuration (load power supply and grounding concept) in a TN-S power system environment.

Note: The arrangement of the power supply terminals does not reflect the actual physical arrangement. This has been done for reasons of clarity.

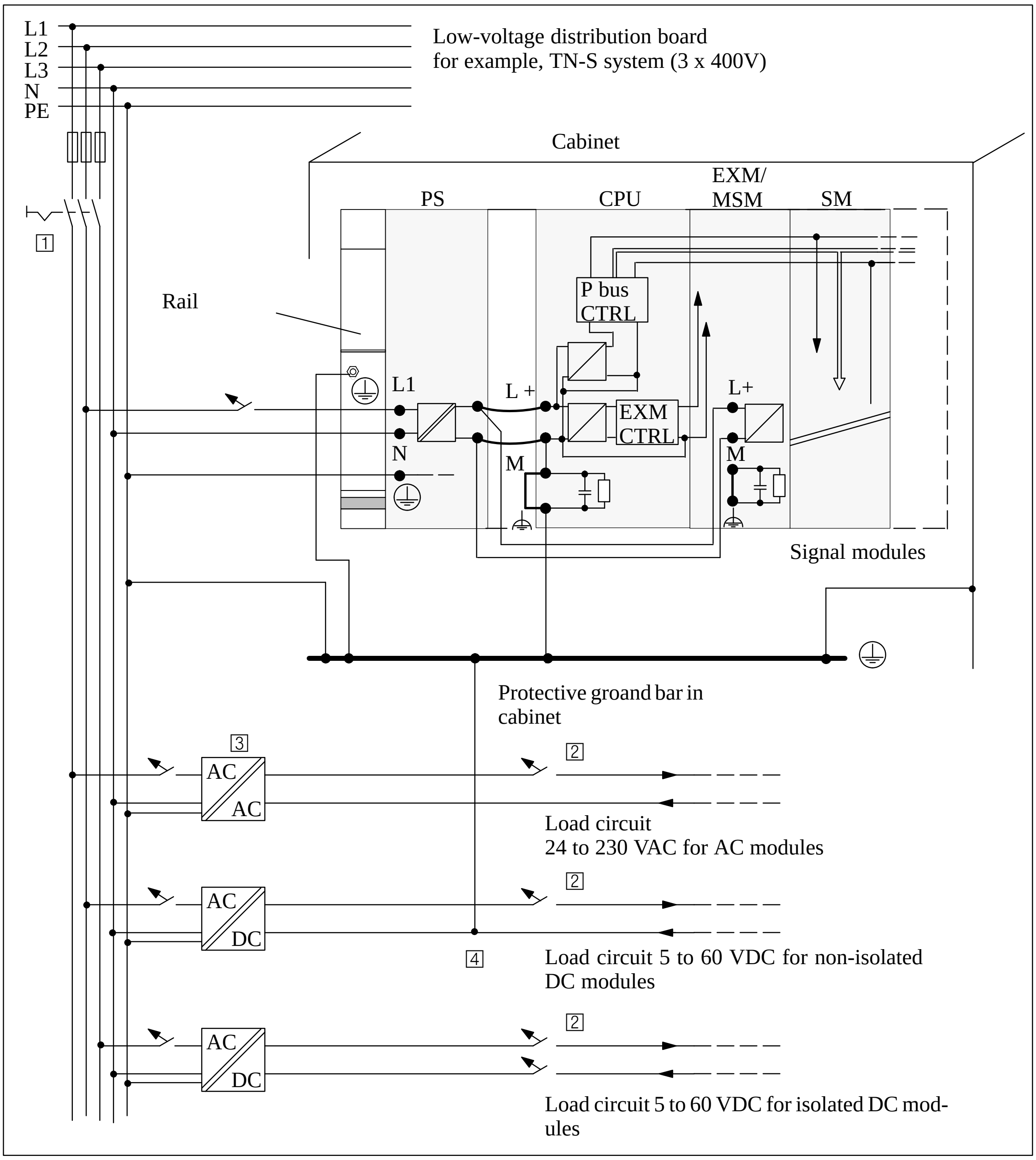


Figure 4-1 Signal Modules Operated on a Grounded Incoming Supply

M7-300 with Load Power Supply from the PS 307

Figure 4-2 shows the M7-300 in the overall configuration (load power supply and grounding concept) in a TN-S power system environment.

Apart from powering the CPU, the PS 307 also supplies the load current for the 24 VDC modules.

Additional note: The arrangement of the power supply terminals as illustrated does not reflect the actual physical arrangement. This has been done for reasons of clarity.

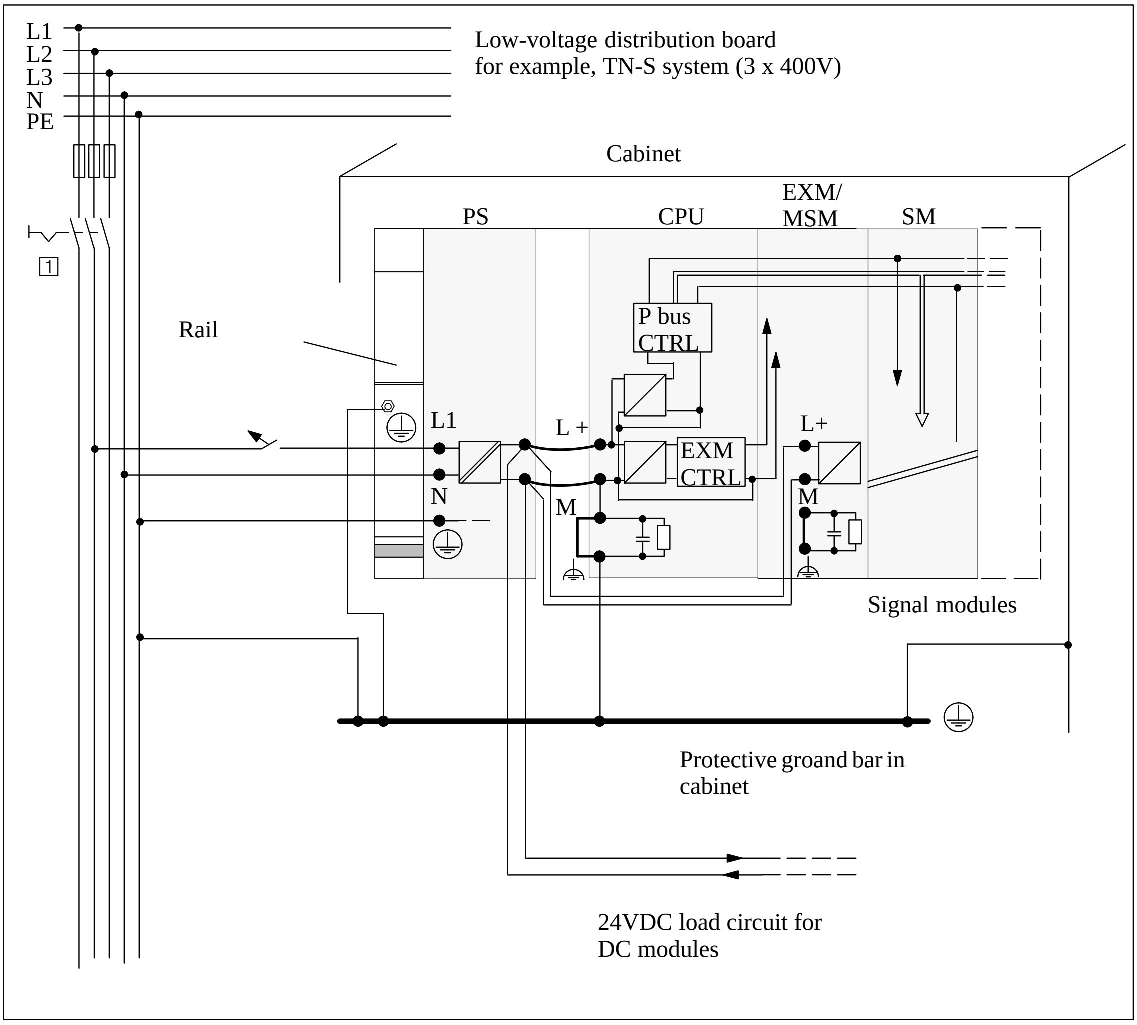


Figure 4-2 Signal Modules Powered from the PS 307

4.4 M7-300 Configuration with Grounded Reference Potential

Application

You use an M7-300 with grounded reference potential in machines or industrial plant.

Interference Discharge

If you install the M7-300 with grounded reference potential, interference currents that might occur are discharged to the protective groand conductor.

With the CPU 388-4, expansion module EXM 378-2 and mass storage module MSM 378, this is achieved via a jumper inserted between terminal M and functional ground. Figure 4-3 shows, as an example, the positioning of the jumper in the screw-terminal front connector of the CPU 388-4. With expansion and mass storage modules, the jumper is situated at the same point in the screw-terminal front connector.

If the CPU is grounded with a jumper, the expansion modules and mass storage modules in the entire M7-300 automation computer must also be grounded with a jumper.

Terminal Connections

Figure 4-3 shows the arrangement of an M7-300 with CPU and grounded reference potential. If you do not wish to groand the reference potential, you must remove the jumper between M terminal and the functional groand from the CPU and from all expansion and mass storage modules.

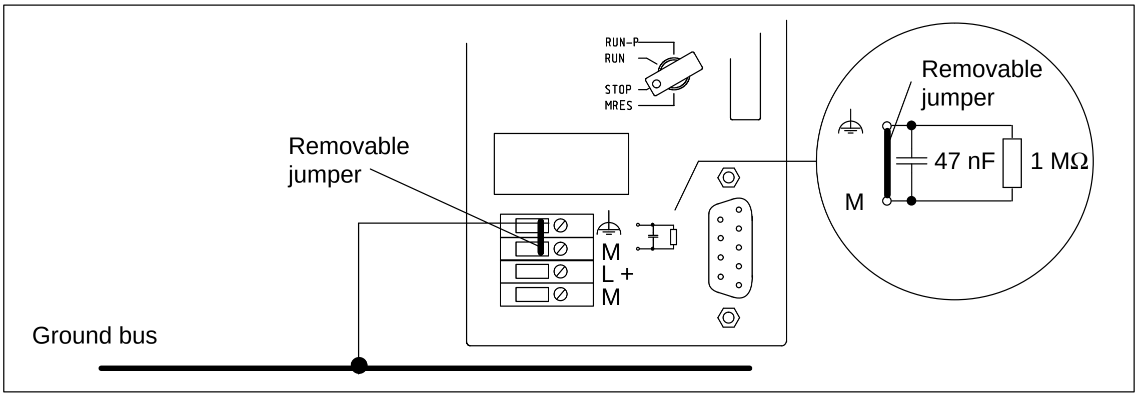


Figure 4-3 Arrangement of an M7-300 with CPU and Grounded Reference Potential

4.5 M7-300 Configuration with Ungrounded Reference Potential

Application

In plants covering large areas, it may be necessary to configure the M7-300 with ungrounded reference potential, for groand fault monitoring purposes, for example.

Interference Discharge

If you install the M7-300 without grounding the reference potential, interference currents that might occur are discharged to the protective groand conductor via an RC network integrated in the CPU (see Figure 4-4).

Terminal Connections

Figure 4-4 shows the schematic of an M7-300 with ungrounded reference potential. If you do not want to groand the reference potential, you must remove the jumper between M terminal and the functional groand from the CPU and from all expansion and mass storage modules of the M7-300. If the jumper is not in place, the M7-300's reference potential is connected internally to the protective groand conductor over an RC network and the rail. This discharges high-frequency parasitic currents and precludes static charges.

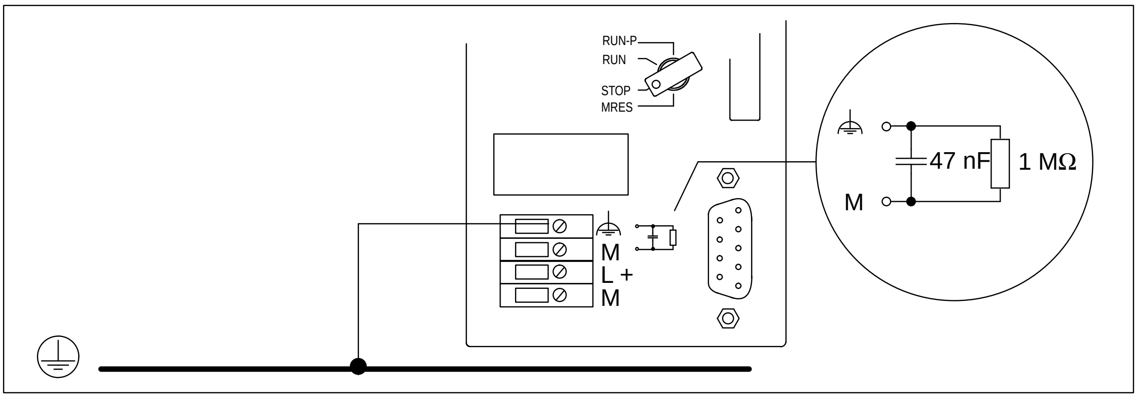


Figure 4-4 Arrangement of an M7-300 with CPU and Ungrounded Reference Potential

Power Supply Units

In the case of power supply units, make sure that the secondary winding has no connection to the protective groand conductor. We recommend the use of the power supply module PS 307.

Filtering of 24 VDC Supply

If you power the programmable modules from a battery in an arrangement with ungrounded reference potential, you must filter the 24 VDC supply. Use an interference suppression device from Siemens, for example, B84102-K40.

Isolation Monitoring

If dangerous plant conditions can arise as a result of double faults, you must provide some form of insulation monitoring.

4.6 M7-300 Configuration with Isolated Modules

Definition

In configurations with isolated modules, the reference potentials of the control circuit (M_{int}) and load circuit (M_{ext}) are galvanically isolated (see Figure 4-5).

Application

You use isolated modules for the following:

- AC load circuits
- DC load circuits with separate reference potential

  Examples of load circuits with separate reference potential:

  – DC load circuits whose sensors have different reference potentials (for example if grounded sensors are located at some considerable distance from the control system and no equipotential bonding is possible)

  – DC load circuits whose positive pole (L+) is grounded (battery circuits).

Isolated Modules and Grounding Concept

You can use isolated modules irrespective of whether the reference potential of the control system is grounded or not.

Configuration with Isolated Modules

Figure 4-5 shows an M7-300 configuration with isolated input and output modules.

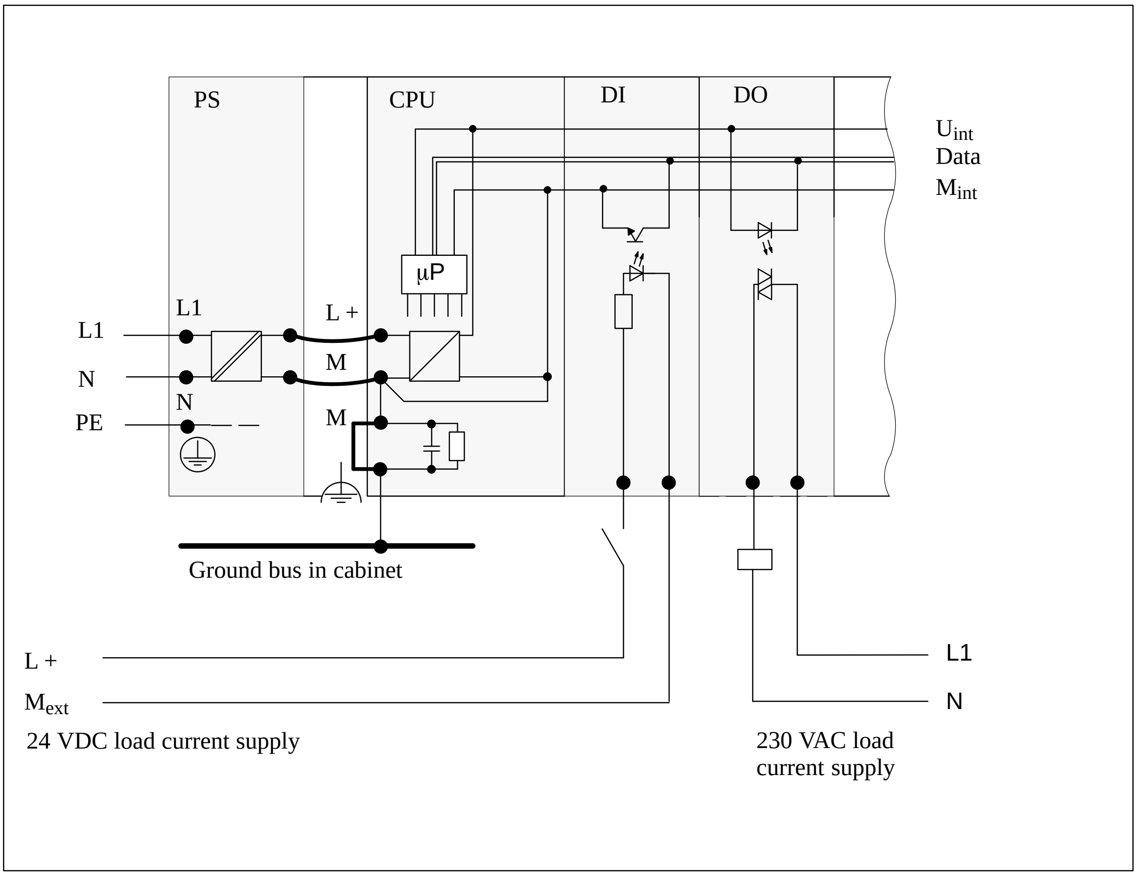


Figure 4-5 Simplified Schematic of a Configuration with Isolated Modules

4.7 Configuration of an M7-300 with Non-Isolated Modules

Configuration with Non-Isolated Modules

Figure 4-6 shows the potential conditions of an M7-300 configuration with grounded reference potential and non-isolated analog input/output module SM 334; AI 4/AO 2 × 8/8 bits.

In an arrangement of the M7-300 with ungrounded reference potential, you must remove the jumper between terminal M and the functional groand on the CPU.

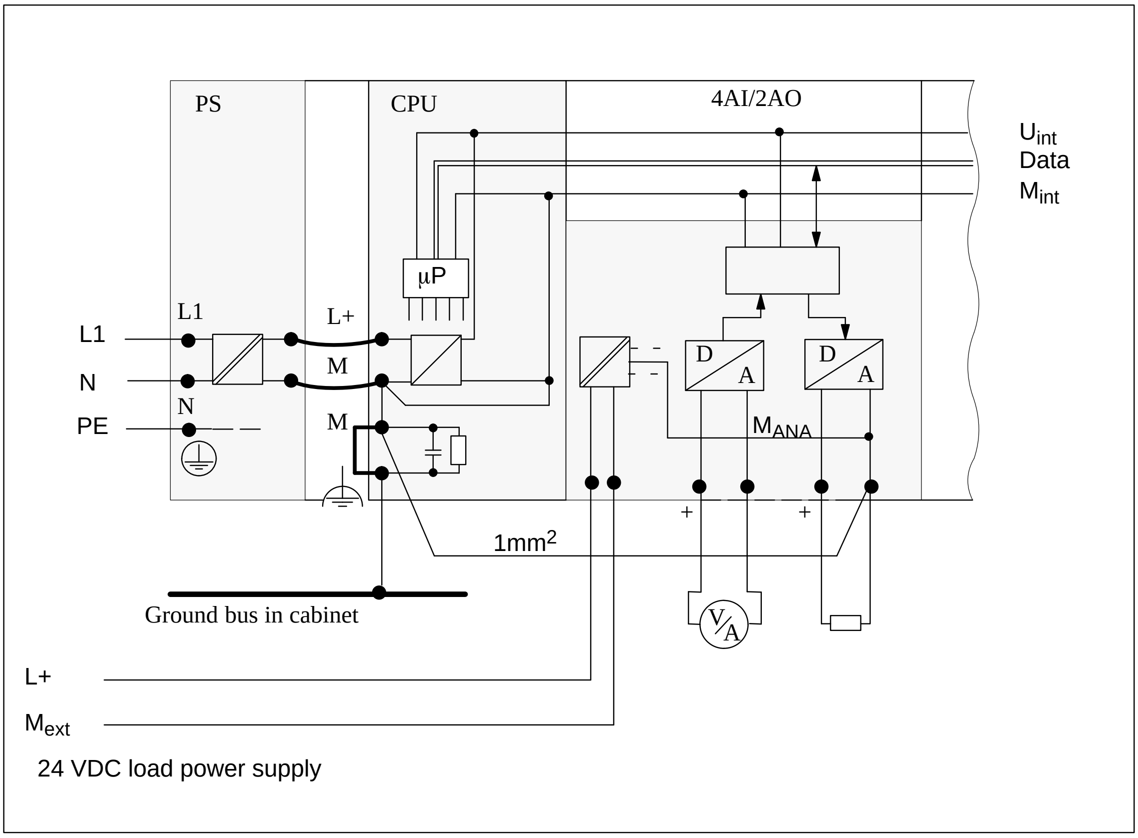


Figure 4-6 Schematic of the Electrical Configuration with the Non-Isolated Analog Input/Output Module SM 334; AI 4/AO 2 × 8/8 Bits

4.8 Cabling Inside Buildings

Introduction

Inside buildings, clearances must be observed between groups of different cables to achieve the necessary electromagnetic compatibility (EMC). Table 4-6 provides you with information on the general rules governing clearances to enable you to choose the right cables.

How to Read the Table

If you want to know how two cables of different types must be run, do the following:

1. Look up the type of the first cable in column 1 (Cables for ...).
2. Look up the type of the second cable in the corresponding field in column 2 (and Cables for ...).
3. Read off the guidelines to be observed from column 3 (Run ...).

Table 4-6 Cabling Inside Buildings

<table>
<tr><th>Cables for ...</th><th>and Cables for ...</th><th>Run ...</th></tr>
<tr><td rowspan="3">Bus signals,shielded
(SINEC L1, PROFIBUS)
Data signals, shielded
(
Analog signals, shielded
DC voltage
(≤ 60 V), unshielded
Process signals
(≤ 25 V), shielded
AC voltage
(≤ 25 V), unshielded
Monitors (coaxial cable)</td><td>Bus signals, shielded
(SINEC L1, PROFIBUS)
Data signals, shielded
(programming devices, operator panels, printers, counter, inputs, etc.)
Analog signals, shielded
DC voltage
(≤ 60 V), unshielded
Process signals
(≤ 25 V), shielded
AC voltage
(≤ 25 V), unshielded
Monitors (coaxial cable)</td><td>in common bundles or cable ducts</td></tr>
<tr><td>DC voltage
(> 60 V and ≤ 400 V), unshielded
AC voltage
(> 25 V and ≤ 400 V), unshielded</td><td>in separate bundles or cable ducts (no minimum clearance necessary)</td></tr>
<tr><td>DC and AC voltage
(> 400 V),
unshielded</td><td>Inside cabinets:
in separate bundles or cable ducts (no minimum clearance necessary)
Outside cabinets:
on separate cable racks with a clearance of at least 10 cm (3.93 in.)</td></tr>
</table>

Table 4-6 Cabling Inside Buildings, continued

Cables for ...	and Cables for ...	Run ...
DC voltage (> 60 V and ≤ 400 V), unshielded AC voltage (> 25 V and ≤ 400 V), unshielded	Bus signals, shielded (SINEC L1, PROFIBUS) Data signals, shielded (programming devices, OPs printers, counter inputs, etc.) Analog signals, shielded DC voltage (≤ 60 V), unshielded Process signals (≤ 25 V), shielded AC voltage (≤ 25 V), unshielded Monitors (coaxial cable)	in separate bundles or cable ducts (no minimum clearance necessary)
	DC voltage (> 60 V and ≤ 400 V), unshielded AC voltage (> 25 V and ≤ 400 V), unshielded	in common bundles or cable ducts
	DC and AC voltage (> 400 V), unshielded	**Inside cabinets:** in separate bundles or cable ducts (no minimum clearance necessary) **Outside cabinets:** on separate cable racks with a clearance of at least 10 cm (3.93 in.)

Table 4-6 Cabling Inside Buildings, continued

Cables for ...	and Cables for ...	Run ...
DC and AC voltage (> 400 V), unshielded	Bus signals, shielded (SINEC L1, PROFIBUS) Data signals, shielded (programming devices, operator panels, printers counter inputs, etc.) Analog signals, shielded DC voltage (≤ 60 V), unshielded Process signals (≤ 25 V), shielded AC voltage (≤ 25 V), unshielded Monitors (coaxial cable) DC voltage (> 60 V and ≤ 400 V), unshielded AC voltage (> 25 V and ≤ 400 V), unshielded	**Inside cabinets:** in separate bundles or cable ducts (no minimum clearance necessary) **Outside cabinets:** on separate cable racks with a clearance of at least 10 cm (3.93 in.)
DC and AC voltage (> 400 V), unshielded	DC and AC voltage (> 400 V), unshielded	in common bundles or cable ducts
SINEC H1	SINEC H1	in common bundles or cable ducts
	Others	in separate bundles or cable ducts with a clearance of at least 50 cm (19.65 in.)

4.9 Cabling Outside Buildings

Rules for EMC

When installing cables outside buildings, the same EMC rules apply as for inside buildings. The following also applies:

- Run cables on metallic cable supports (racks, trays etc.).
- Establish a metallic connection between the joints in the cable supports
- Ground the cable supports
- If necessary, provide adequate equipotential bonding between the various items of equipment connected.
- Take the necessary (internal and external) lightning protection and grounding measures applying to your particular application (see below).

Rules Governing Lightning Protection Outside Buildings

Run your cables either

- in metallic conduit grounded at both ends, or
- in concrete cable ducts with continuous end-to-end armoring

Overvoltage Protection Devices

An individual appraisal of the entire plant is necessary before initiating any lightning protection measures (see Section 4.11).

4.10 Protecting Digital Output Modules Against Induced Overvoltage

Integral Overvoltage Protection

The digital output modules of the M7-300 have integral surge protectors. Surge voltages occur when inductive loads (for example, relay coils and contactors) are switched off.

Supplementary Overvoltage Protection

Inductive loads should only be fitted with supplementary surge protectors,

- if the SIMATIC output circuits can be disconnected by additional contacts (for example, relay contacts for EMERGENCY OFF)
- if the inductive loads are not driven by SIMATIC modules.

Note: Ask the suppliers of your inductive loads how the various surge protectors are rated.

Example

Figure 4-7 shows an output circuit that makes supplementary overvoltage protection necessary.

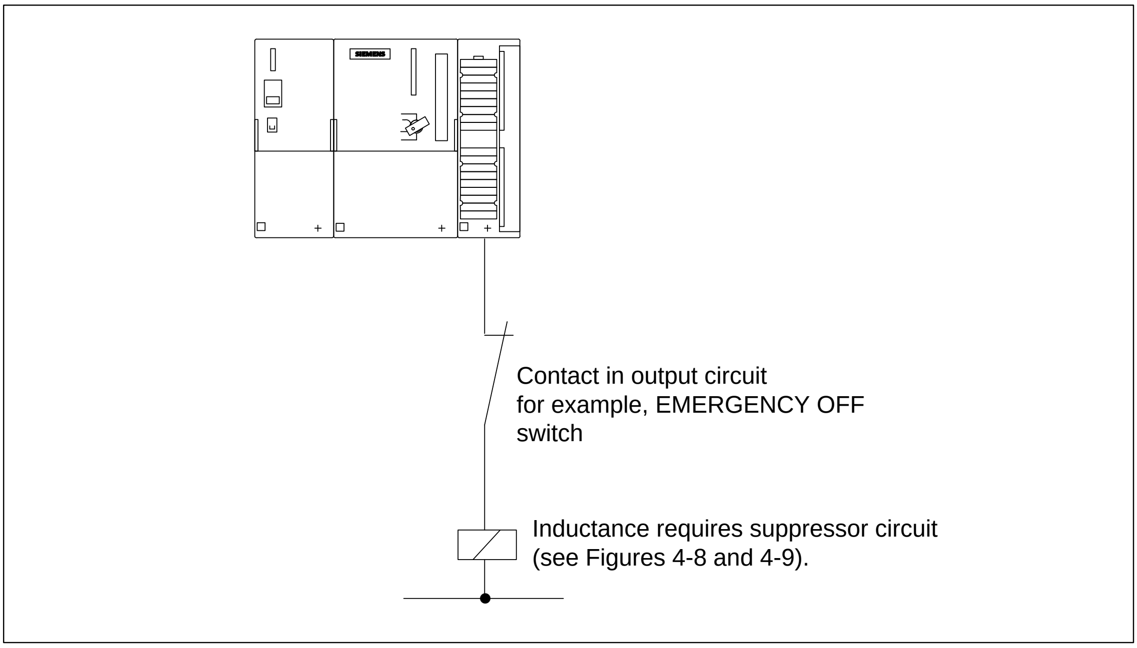


Figure 4-7 Relay EMERGENCY OFF Contact in the Output Circuit

Suppressor Circuits for DC-Operated Coils

DC-operated coils are suppressed by diodes or Zener diodes.

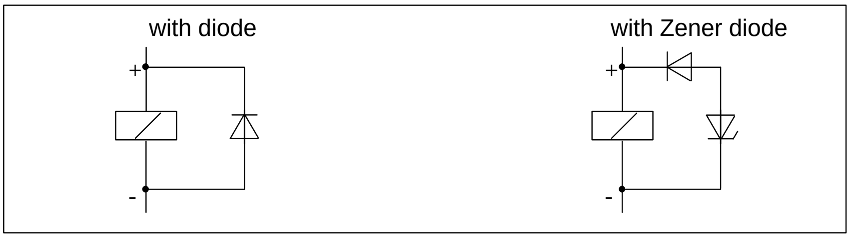


Figure 4-8 Suppressing DC-Operated Coils with Diodes and Zener Diodes

Diode/Zener Diode Circuits

Diode/Zener diode circuits have the following characteristics:

- The overvoltages induced on circuit interruption are completely suppressed/Zener diode has a higher cut-off voltage.
- They have a high time delay (six to nine times higher than without a diode circuit)/Zener diode interrupts faster than diode circuit.

Suppressor Circuits for AC-Operated Coils

AC-operated coils are suppressed by varistors or RC elements.

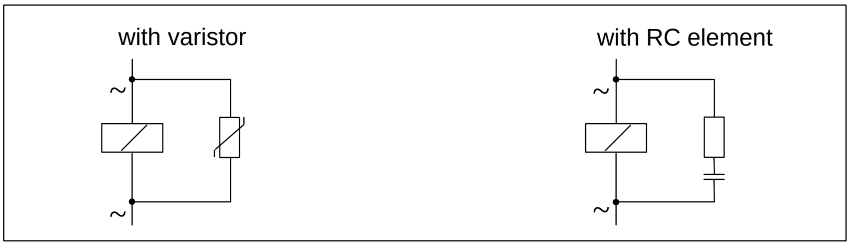


Figure 4-9 Suppressing AC-Operated Coils

Varistors

Suppressor circuits with varistors have the following characteristics:

- The amplitude of the switching overvoltage is limited, but not damped
- The wavefront steepness remains the same
- Very short time delay

RC Elements

Suppressor circuits with RC elements have the following characteristics:

- The amplitude and wavefront steepness of the switching overvoltage are reduced
- Short time delay.

4.11 Lightning Protection

Introduction

The following section shows you possible solutions to protect your M7-300 automation computer against the effects of overvoltages.

Reference Literature

The solutions given are based on the lightning protection zone concept that is described in the IEC 1312-1 “Protection against LEMP”.

Overview

Failures are very often the result of overvoltages caused by:

- Atmospheric discharge or
- Electrostatic discharge.

First of all, we want to introduce you to the lightning protection zone concept, on which the protection against overvoltage is based.

At the end of this section, you will find rules for the transitions between the individual lightning protection zones.

Note

This section can only provide information on the protection of a **programmable controller** against overvoltages.

However, a complete protection against overvoltage is guaranteed only if the whole surrounding building is designed to provide protection against overvoltages. This refers especially to constructional measures for the building already in the planning phase.

If you wish to obtain detailed information on overvoltage protection, we therefore recommend you to address your Siemens contact or a company specialized in lightning protection.

4.11.1 Lightning Protection Zone Concept

Principle of the Lightning Protection Zone Concept

The principle of the lightning protection zone concept states that the volume to be protected, for example, a manufacturing hall, is subdivided into lightning protection zones in accordance with EMC guidelines (see Figure 4-10).

The individual lightning protection zones are constituted by:

The outer lightning protection of the building (field side)	Lightning protection zone0
Shielding	
• Buildings	Lightning protection zone 1
• Rooms and/or	Lightning protection zone 2
• Devices	Lightning protection zone 3

Effects of the Lightning Strike

Direct lightning strikes occur in lightning protection zone 0. The lightning strike creates high-energy electromagnetic fields which can be reduced or removed from one lightning protection zone to the next by suitable lightning protection elements/measures.

Surges

In lightning protection zones 1 and higher, surges can result from switching operations and interference.

Schematic of the Lightning Protection Zones

Figure 4-10 shows a schematic of the lightning protection zone concept for a free-standing building.

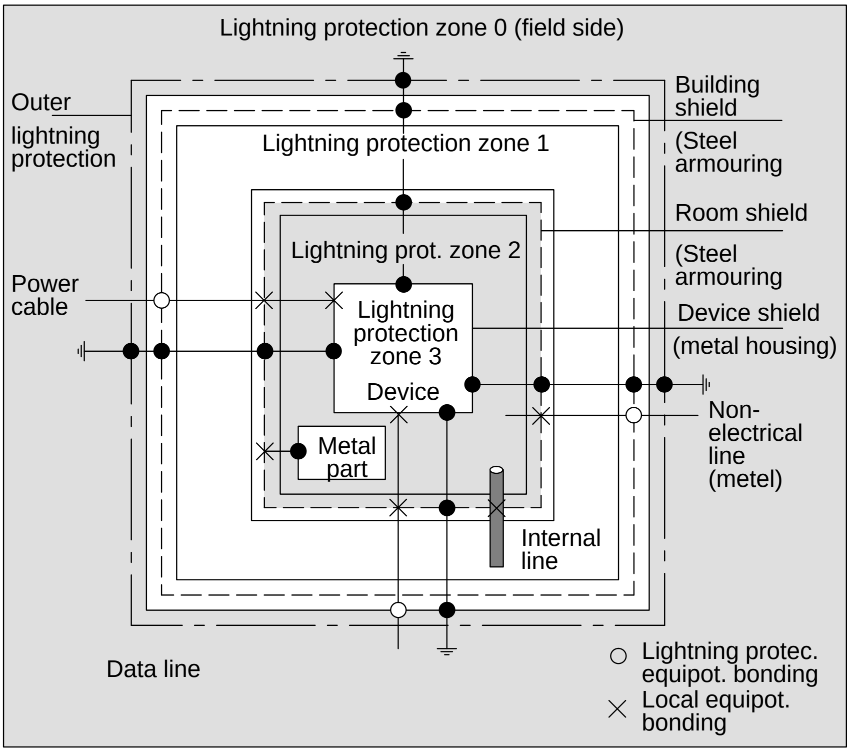


Figure 4-10 Lightning Protection Zones of a Building

Principle of the Transitions between the Lightning Protection Zones

At the transition points between the lightning protection zones, you must take measures to prevent surges being conducted further.

The lightning protection zone concept also states that all lines at the transitions between the lightning protection zones that can carry lightning stroke current (!) must be included in the lightning protection equipotential bonding.

Lines that can carry lightning stroke current include:

- Metal pipelines (for example, water, gas and heat)
- Power cables (for example, line voltage, 24 V supply)

  and
- Data cables (for example, bus cable).

4.11.2 Rules for the Transition between Lightning Protection Zones 0 ↔ 1

Rule for the Transition 0 ↔ 1 (Lightning Protection Equipotential Bonding)

The following measures are suitable for lightning protection equipotential bonding at the transition between lightning protection zone 0 ↔ 1:

- Use grounded, spiralled, current-conducting metal strips or metal braiding, for example, NYCY or A2Y(K)Y, as a cable shield at the start and end,

  and

- lay cable
  - in continuous metal pipes that are grounded at the start and end, or
  - in ducts of armored concrete with continuous armoring or
  - on closed metal cable racks grounded at the start and end,

  or

- use fiber optic cables instead of lightning stroke current-carrying cables.

Additional Measures

If you cannot take the measures listed above, you must install a high-voltage protector at transition 0 ↔ 1 with a relevant lightning conductor. Table 4-7 contains the components you can use for high-voltage protection of your plant.

Table 4-7 High-Voltage Protection of Cables Using Surge Protection Components

No.	Connect Cables for ...	... with the Following at Transition 0 ↔ 1	Order No.
1	• 3-phase TN-C system	3 DEHNport lightning conductors Phase L1/L2/L3 to PEN	5 SD 7 028*
	• 3-phase TN-S and TT system	4 DEHNport lightning conductors Phase L1/L2/L3/N to PE	5 SD 7 028*
	• AC TN-L, TN-S, TT system	2 DEHNport lightning conductors Phase L1 + N to PE	5 SD 7 028*
2	24 VDC power supply	1 KT lightning conductor Type A D 24 V	DSN: 919 253

Table 4-7 High-Voltage Protection of Cables with Surge Protection Components, continued

No.	Connect Cables for ...	... with the Following at Transition 0 ↔ 1	Order No.
3	Bus cable • MPI, RS 485 • RS 232 (V.24)	• up to 500 kbps 1 KT lightning conductor Type ARE 8 V - • over 500 kbps 1 KT lightning conductor Type AHFD 5 V - • per core pair 1 KT lightning conductor Type ARE 15 V -	 DSN: 919 232 DSN: 919 270 DSN: 919 231
4	Inputs/outputs of digital modules and power supply • 24 VDC • 120/230 VAC	 1 KT lightning conductor Type AD 24 V - 2 DEHNguard 150 surge arresters	 DSN: 919 253 900 603*
5	Input/outputs of analog modules • Up to 12 V +/– • Up to 24 V +/– • Up to 48 V +/–	 1 KT lightning conductors Type ALE 15 V - 1 KT lightning conductors Type ALE 48 V - 1 KT lightning conductors Type ALE 60 V -	 DSN: 919 220 DSN: 919 227 DSN: 919 222

* You can order these components direct from DEHN + SÖHNE
GmbH + Co. KG
Elektrotechnische Fabrik
Hans-Dehn-Str. 1
D–92318 Neumarkt
Federal Republic of Germany

4.11.3 Rules for Transition between Lightning Protection Zones 1 ↔ 2 and Greater

Rules for Transitions 1 ↔ 2 and Greater (Local Equipotential Bonding)

The following applies for all lightning protection zone transitions 1 ↔ 2 and greater:

- Set up local equipotential bonding at each subsequent lightning protection zone transition.
- Include all cables (also metal pipelines, for example) in the local equipotential bonding at all subsequent lightning protection zone transitions.
- Include all metal installations located within the lightning protection zone in the local equipotential bonding (for example, metal part within lightning protection zone 2 at transition 1 ↔ 2).

Additional Measures

We recommend low-voltage protection

- for all lightning protection zone transitions 1 ↔ 2 and greater

  and

- for all cables that run within a lightning protection zone and are longer than 100 m.

Lightning Protection Element for 24 VDC Power Supply

You must use only the KT lightning conductor, Type AD 24 V SIMATIC for the 24 VDC power supply of the M7-300. All other surge protection components do not meet the required tolerance range of 20.4 V to 28.8 V of the M7-300's power supply.

Lightning Protection Element for Signal Modules

You can use standard surge protection components for the digital input/output modules. However, please note that these only permit a maximum of $1.15 \times V_{Nom} = 27.6$ V for 24 VDC nominal voltage. If the tolerance of your 24 VDC power supply is higher, use the surge protection components for 48 VDC nominal voltage.

You can also use the KT lightning conductor, Type AD 24 V SIMATIC. However, this can result in the following restrictions:

- Digital inputs: An increased input current can flow in the case of negative input voltages.
- Digital outputs: Dropout time of contactors can increase significantly.

Low-Voltage Protection Elements for 1 ↔ 2

We recommend the surge protection components listed in Table 4-8. You must use these low–voltage protection elements for the M7-300 in order to meet the conditions for the CE mark.

Table 4-8 Low-Voltage Protection for Lightning Protection Zone 1 ↔ 2

No.	Connect Cables for ...	... with the Following at Transition 1 ↔ 2	Order No.
1	• 3-phase TN-C system	3 DEHNguard 275 surge arresters	900 600* 5 SD 7 030
	• 3-phase TN-S and TT system	4 DEHNguard 275 surge arresters	900 600* 5 SD 7 030
	• AC TN-L, TN-S, TT system	2 DEHNguard 275 surge arresters	900 600* 5 SD 7 030
2	24 VDC power supply	1 KT lightning conductor Type A D 24 V	DSN: 919 253
3	Bus cable • MPI, RS 485	• up to 500 kbps 1 KT lightning conductor Type ARE 8 V -	DSN: 919 232
		• over 500 kbps 1 KT lightning conductor Type AHFD 5 V -	DSN: 919 270
	• RS 232 (V.24)	• per core pair 1 KT lightning conductor Type ARE 15 V -	DSN: 919 231
4	Inputs/outputs of digital modules • 24 VDC	1 KT lightning conductor Type AD 24 V -	DSN: 919 253
	• 120/230 VAC	2 DEHNguard 150 surge arresters	900 603*
5	Inputs of analog modules • up to 12 V +/-	1 Terminal block KT ALD 12 V on insulated rail	DSN: 919 216

* You can order these components direct from
DEHN + SÖHNE
GmbH + Co. KG
Elektrotechnische Fabrik
Hans-Dehn-Str. 1
D-92318 Neumarkt
Federal Republic of Germany

Low-Voltage Protection Elements for 2 ↔ 3

We recommend the surge protection components listed in Table 4-9. You must use these low-voltage protection elements for the M7-300 in order to meet the conditions for the CE mark.

Table 4-9 Low-Voltage Protection for Lightning Protection Zone 2 ↔ 3

No.	Connect Cables for ...	... with the Following at Transition 2 ↔ 3	Order No.
1	• 3-phase TN-C system	3 DEHNguard 275 surge arresters	900 600* 5 SD 7 030
	• 3-phase TN-S and TT system	4 DEHNguard 275 surge arresters	900 600* 5 SD 7 030
	• AC TN-L, TN-S, TT system	2 DEHNguard 275 surge arresters	900 600* 5 SD 7 030
2	24 VDC power supply	1 KT lightning conductor Type A D 24 V	DSN: 919 253
3	Bus cable • MPI, RS 485	• up to 50kbps 1 KT lightning conductor Type ARE 8 V -	DSN: 919 232
		• over 500 kbps 1 KT lightning conductor Type AHFD 5 V -	DSN: 919 270
	• RS 232 (V.24)	• per core pair 1 KT lightning conductor Type ARE 15 V -	DSN: 919 231
4	Inputs of digital modules • 24 VDC	1 Terminal block FDK 60 V on insulated rail	DSN: 919 997
	• 120/230 VAC	2 DEHNguard 150 surge arresters	900 603*
5	Outputs of analog modules • up to 12 V +/-	1 Terminal block Type FDK 12 V (on insulated rail connected to M- of the module supply)	DSN: 919 999

* You can order these components direct from DEHN + SÖHNE
GmbH + Co. KG
Elektrotechnische Fabrik
Hans-Dehn-Str. 1
D-92318 Neumarkt
Federal Republic of Germany

4.11.4 Example Circuit for Surge Protection of Networked M7-300s

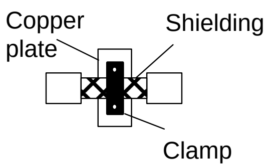
Introduction

This section contains an example circuit for the surge protection of M7-300s networked together.

Numbers in Figure 4-11

Table 4-10 refers to Figure 4-11 and explains the consecutive numbers:

Table 4-10 Example of a Configuration Fulfilling Lightning Protection Requirements (Legend for Figure 4-11)

No. from Figure 4-11	Components	Meaning
1	DEHNport lightning conductors, 2 - 4 depending on mains system Order no.: 900 100*	High-voltage protection against direct lightning strikes and surges from transition 0 ↔ 1
2	2 DEHNguard 275 surge arresters, Order no.: 900 600*	High-voltage surge protection at transition 1 ↔ 2
3	• In the spur line 1 intermediate adapter Type FS 9E-PB Order no.: DSN 924 017 • In the spur line 1 standard rail 35 mm with connecting cable Type ÜSD-9-PB/S-KB Order no.: DSN 924 064	Low-voltage surge protection for RS 485 interfaces at transition 1 ↔ 2
4	Digital modules: KT lightning conductor, Type AD 24 V SIMATIC Analog modules: KT lightning conductor, Type ARE 12 V-	Low-voltage surge protection at inputs and outputs of the signal modules at transition 1 ↔ 2
5	Shielding the bus cable 	-
6	Equipotential bonding cable 16 mm^2	-
7	KT lightning conductor, Type AHFD, for building entry point, Order no.: DSN 919 270	Low-voltage surge protection for RS 485 interfaces at transition 0 ↔ 1

Example Circuit

Figure 4-11 gives an example of how to interconnect two networked M7-300s in order to achieve effective protection against surges:

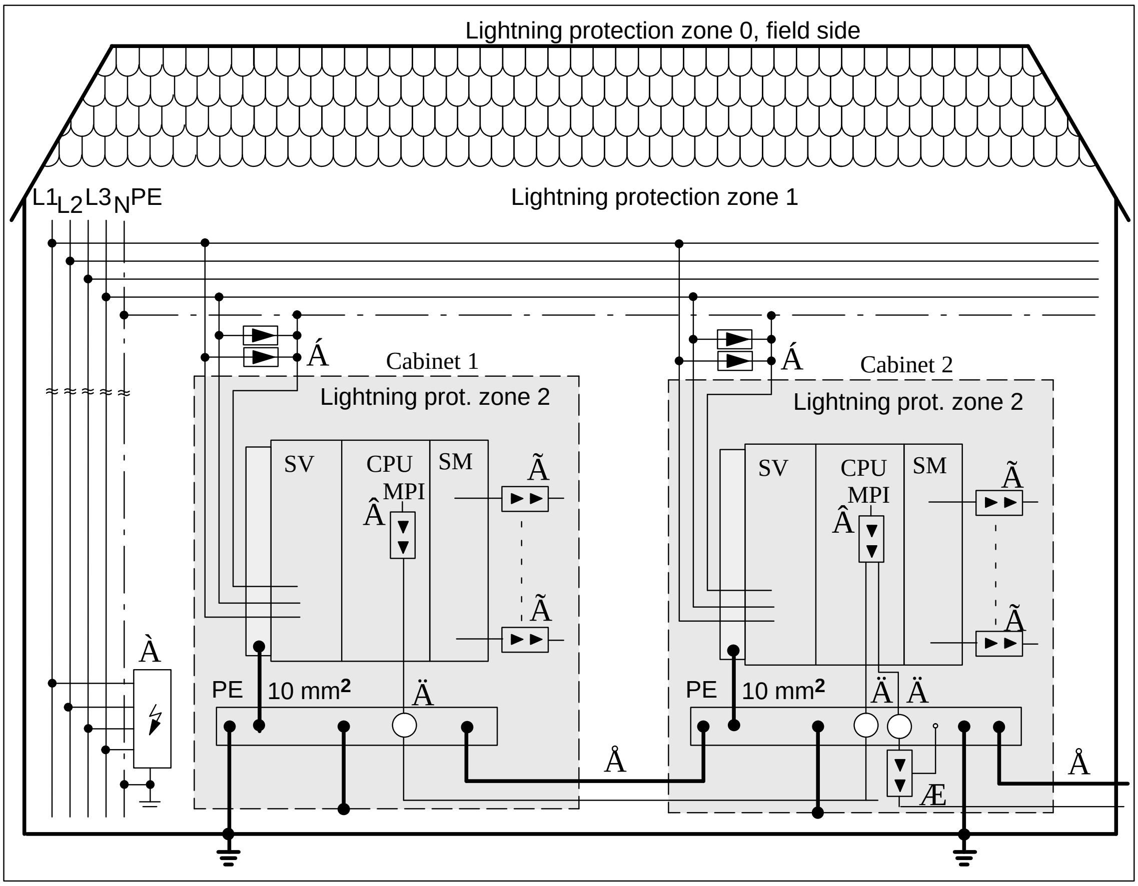


Figure 4-11 Example for Interconnecting Networked M7-300s

Configuring an M7-300

5

Introduction

We assume that you have planned the mechanical and the electrical configuration of your M7-300 (see Chapters 2 and 4).

This chapter explains how to prepare the modules for installation and how to install the modules.

Chapter Overview

5.1 Installing the Rail

Introduction

This section contains information on the fixing dimensions of the rail and describes the procedure to follow when installing the rail.

Dimension Drawing for Fixing Holes

The fixing-hole dimensions for the rail are shown in Figure 5-1.

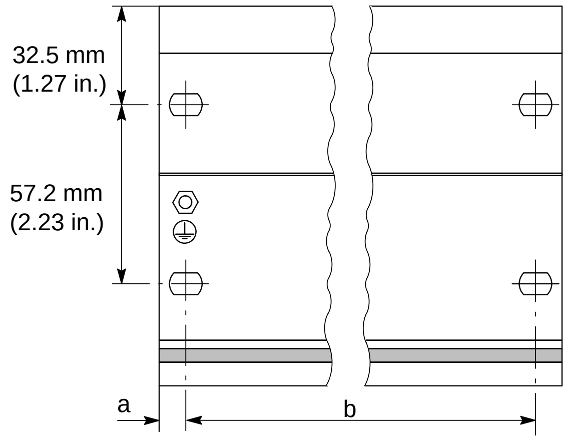


Figure 5-1 Fixing-Hole Dimensions for the Rail

Depending on the particular rail used, the following dimensions apply:

Lenght of Rail	Dimension a	Dimension b
160 mm	10 mm	140 mm
482.6 mm	8.3 mm	466 mm
530 mm	15 mm	500 mm
830 mm	15 mm	800 mm

Fixing Screws

You have a choice of the following screw types for fixing the rail.

Type of Screw	Explanation
M6 fillister-head screw to ISO 1207/ISO 1580 (DIN 84/DIN 85)	Choose the screw length to suit local conditions. You also need 6,4 washers to ISO 7092 (DIN 433)
M6 hexagon-head screw to ISO 4017 (DIN 4017)	

Installing the Rail

To install rails, proceed as follows:

1. Choose a position for the rail that will leave you enough “room” to install it properly and enough “air” to cope with the temperature rise of the modules (that is leave at least 40 mm /1.56 in. free above and below the rail and 20mm/0.8 in. on both sides) (see Section 2.2).
2. Bolt the rail to its mounting surface (bolt size: M6). Is this surface a metallic plate or a grounded supporting plate?

   If the answer to this question is “yes”, make sure that the connection between the rail and this surface has a low resistance. In the case of painted or anodized metals, for instance, use a suitable contacting agent or contact washers.

   If the answer is “no”, you don’t have to take any special measures.
3. Connect the rail to the protective grounding conductor. A screw is provided for this purpose on the rail.

   Minimum cross-sectional area of the conductor used for this connection: 10 mm^2.

Note

Make absolutely sure that your connection to the protective grounding conductor has a low resistance (see Figure 5-2). If the S7-300 is mounted on a hinged rail, you must use a flexible cable to establish the connection to the protective grounding conductor.

Connecting the Protective Ground Conductor

Figure 5-2 shows you how to connect the protective grounding conductor to the rail.

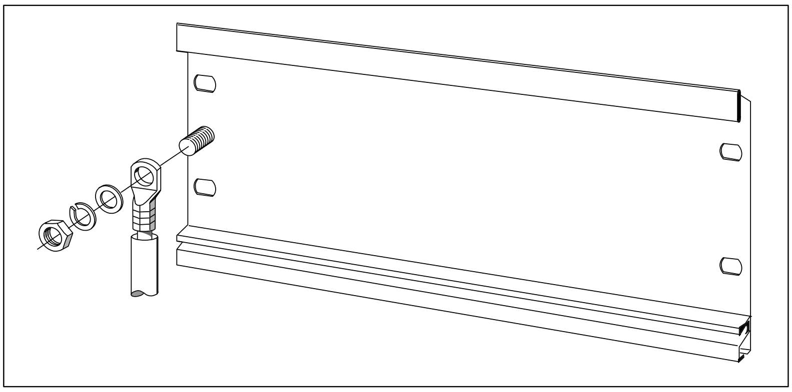


Figure 5-2 Connecting the Protective Grounding Conductor to the Rail

5.2 Preparing and Installing the (2 m/6.56 ft.) Rail

Introduction

You can shorten the 2 m long sectional rail to the length you need. This section will provide you with some information on how to prepare the rail and install it.

Preparing the 2 m Rail

To install standard–width rails, proceed as follows:

1. Shorten the rail to the required length.
2. Mark
   – four holes for fixing screws (dimensions: see Figure 5-4)
   – a hole to take the fixing screw for the protective grounding conductor.
3. Is the rail longer than 830 mm/32.37 in.?

   If it is, you must drill extra holes for fixing screws to stabilize the rail. Mark these holes (at approximately 500 mm/19.5 in. centers) along the groove in the middle section of the rail (see Figure 5-3

   If it isn't, you don't have to take any extra measures.
4. Drill the marked holes to a diameter of $6.5^{+0.2}$ mm for M6 screws.
5. Tighten the screw fixing the protective grounding conductor.

Fixing Holes of the 2 m Rail

Figure 5-3 contains a few details of the 2 m long rail you need to know for preparing it.

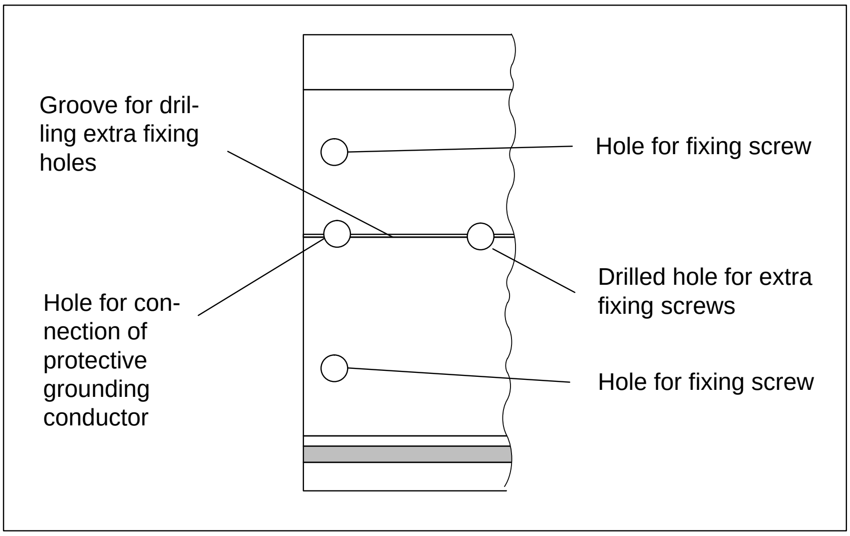


Figure 5-3 Fixing Holes of the 2 m/6.56 ft. Rail

Dimension Drawing for Fixing Holes

The dimensions for positioning the fixing holes are shown in Figure 5-4.

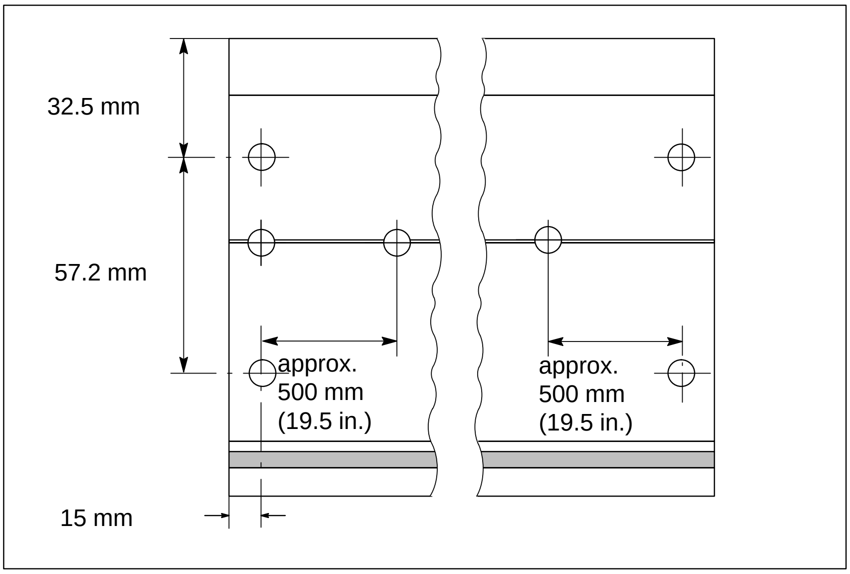


Figure 5-4 Dimensions for Fixing Holes on the 2 m/6.56 ft. Rail

Fixing Screws

You have a choice of the following screw types for preparing the rail.

For	You can use ...	Explanation
Lateral fixing screws	M6 fillister-head screw to ISO 1207/ISO 1580 (DIN 84/DIN 85)	Choose the screw length to suit local conditions. You also need 6,4 washers to ISO 7092 (DIN 433)
	M6 hexagon-head screw to ISO 4017 (DIN 4017)	
Extra fixing screw	M6 fillister-head screw to ISO 1207/ISO 1580 (DIN 84/DIN 85)	

Installing the Rail

To install the prepared rail, proceed in exactly the same way as for the standard-width rail (see Section 5.1).

5.3 Module Accessories

Introduction

This chapter contains information on basic accessories that are supplied with the M7-300 modules or have to be ordered separately.

Module Accessories

The basic accessories you need for installing the modules on the rail are already packed with the modules. But you still have to order a number of accessories separately. The accessories are listed and briefly explained in Table 5-1.

Order numbers for accessories can be found in Appendix C “Spare Parts and Accessories”.

Table 5-1 Module Accessories

Module	Accessories Included	Accessories to be Ordered	Description
Power supply module (PS)	Power connector	–	For wiring the power supply to the CPU
CPU	2 keys	–	The key is used for actuating the CPU’s mode selector
	1 x Labeling strip	–	For marking the modules with slot numbers
	–	1 Backup battery	For backing up the settings of the clock and SRAM
	–	Memory Card	For storing the user program on FEPROM
Expansion module (EXM)	1 Bus connector	–	For the electrical connection between modules
	1 Submodule cover	–	For the EXM 378-2, to cover one unused slot
	2 Submodule covers	–	For the EXM 378-3, to cover unused slots
		12 Submodule covers inc. screws	For the EXM 378-2 and EXM 378-3 to cover unused slots
Mass storage module (MSM)	1 Bus connector	–	For the electrical connection between modules

Table 5-1 Module Accessories, continued

Module	Accessories Included	Accessories to be Ordered	Description
Signal module (SM)	1 Bus connector	–	For establishing the electrical connections between the modules
	1 Labeling strip	–	For labeling the input and output points on the module
	–	Front connector with strain relief	For wiring the signal module
Interface module (IM)	–	Connecting cables	For electrical connection between interface modules
	1 x Slot labels (IM 361 and IM 365 only)	–	For assigning slot numbers on racks 1 to 3

5.4 Expanding a CPU

Introduction

Before installing your M7-300 automation computer on the rail, you must carry out any necessary expansion of the CPU.

This section provides the information needed for the prior expansion of a CPU, for example, with expansion modules EXM 378-2, EXM 378-3 and mass storage module MSM 378.

Installation Sequence

Proceed in the following order:

1. Remove the male and female connector covers from the modules.
2. Place the modules on a level surface and interconnect them.
3. Plug the bus connectors into the modules.
4. Insert interface submodules into expansion modules.

The individual steps for expansion are explained in the following.

Removing the Male and Female Connector Covers

Situated on the right side of the CPU is an 88-pin socket for connecting expansions to the ISA bus (Figure 5-5). This socket is protected by a removable cover.

On expansion modules EXM 378-2 and EXM 378-3, there is also an expansion socket on the right side and the mating connector on the left side (Figure 5-5), which is also protected by a cover.

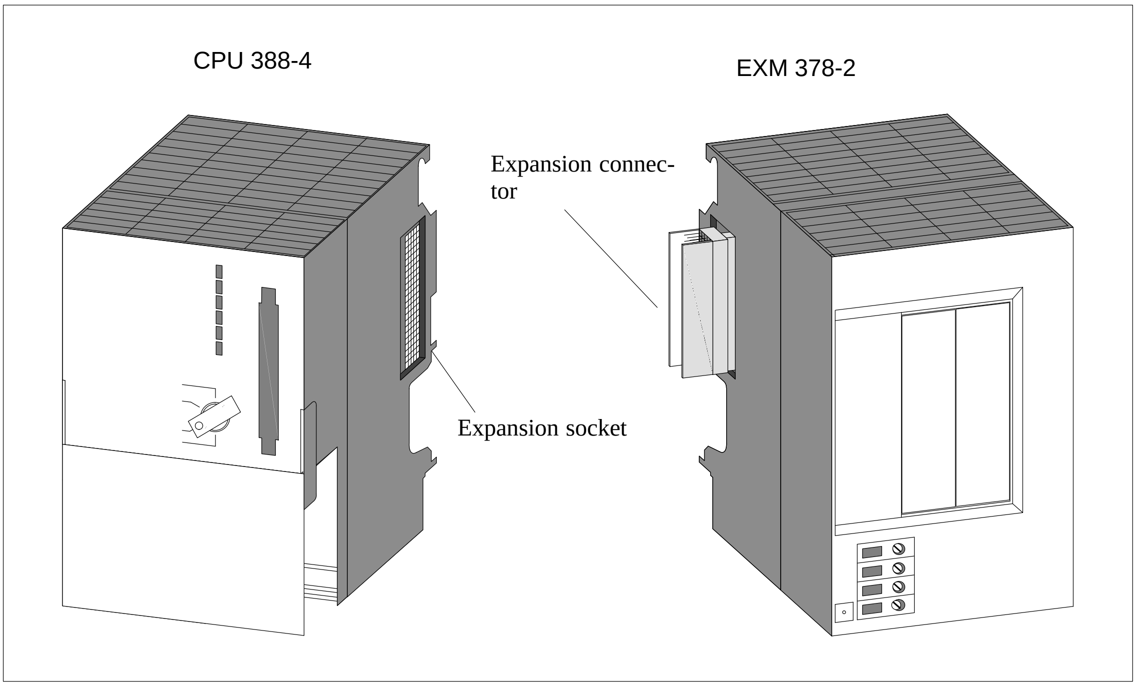


Figure 5-5 Locations of Expansion Socket and Connector

Mass storage module MSM 378 is always the last expansion element. It has only an expansion connector on the left side.

Remove the transportation protection from the expansion connectors and the film from the expansion sockets of the modules into which other expansions will be inserted.

Interconnecting the Modules

Place the modules side by side on a **level** surface, in the order in which you intend to install them (see Figure 5-6). Push the first two modules together carefully so that the connector of the expansion module is precisely inserted into the socket of the CPU with all pins.

Then plug the other modules successively into the assembly. All expansion modules are thus connected to the ISA bus of the CPU.

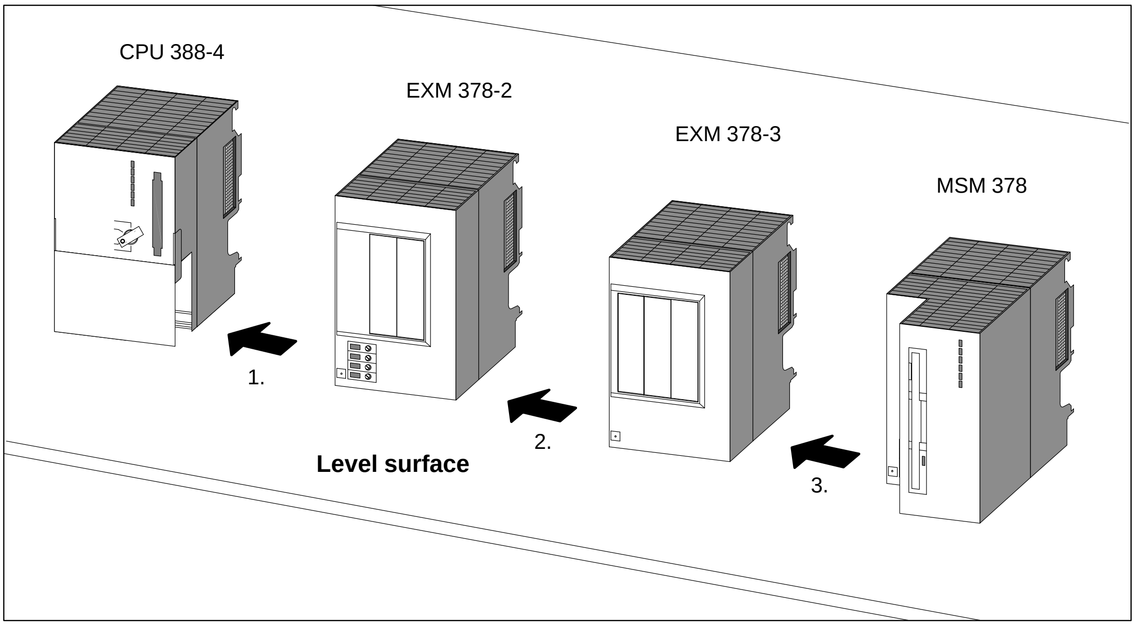


Figure 5-6 Positioning and Interconnecting the Modules

Warning

The connector pins can be damaged.

If you misalign the modules during interconnecting, the connector pins can be damaged.

Interconnect the modules precisely.

Fitting the Bus Connectors

All expansion elements are provided with a bus connector. The CPU is supplied without bus connector.

Start by plugging in the bus connector of the CPU.

Take the bus connector of the next expansion element and use it to connect the CPU to the next expansion element.

Figure 5-7 shows the location for plugging the bus connector into a module.

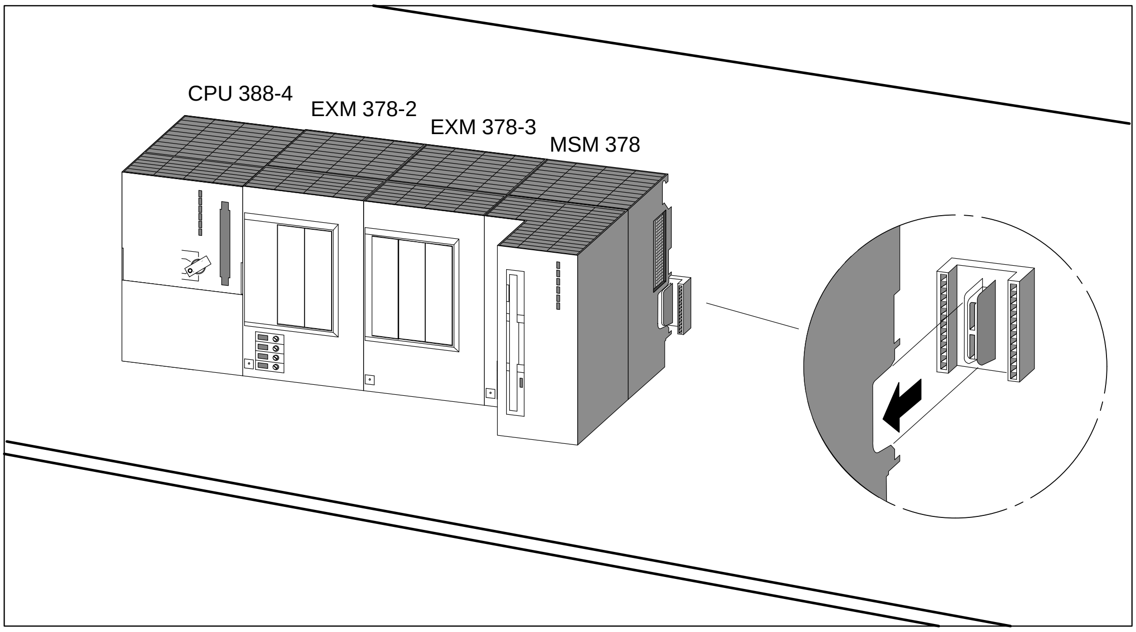


Figure 5-7 Plugging the Bus Connector into a Module

Then connect each of the interconnected modules to the next one with a bus connector. This ensures that the S7-300 backplane bus is looped through all modules.

Inserting Interface Submodules

According to the type, an expansion module has two or three card slots for interface submodules.

Proceed as follows to insert an interface submodule into a card slot of the expansion module:

1. Observe the ESD guidelines (see Annex D) for handling the interface submodule.
2. Hold the interface submodule on the long sides of the front plate.
3. Insert the card end of the interface submodule into the lower and upper guides of the card slot, as shown in Figure 5-8.
4. Slowly slide the interface submodule into the slot until the front plate rests on the frame of the card slot.
5. Secure the front plate to the left frame of the card slot with the two M2.5 x 10 slotted-head screws provided.

Warning

The modules can be damaged.

If the interface submodules are inserted or removed with power applied, the CPU, expansion modules and interface submodules can be damaged.

Never insert or remove the interface submodules with power applied. Always switch off the power supply (PS) before inserting or removing interface submodules.

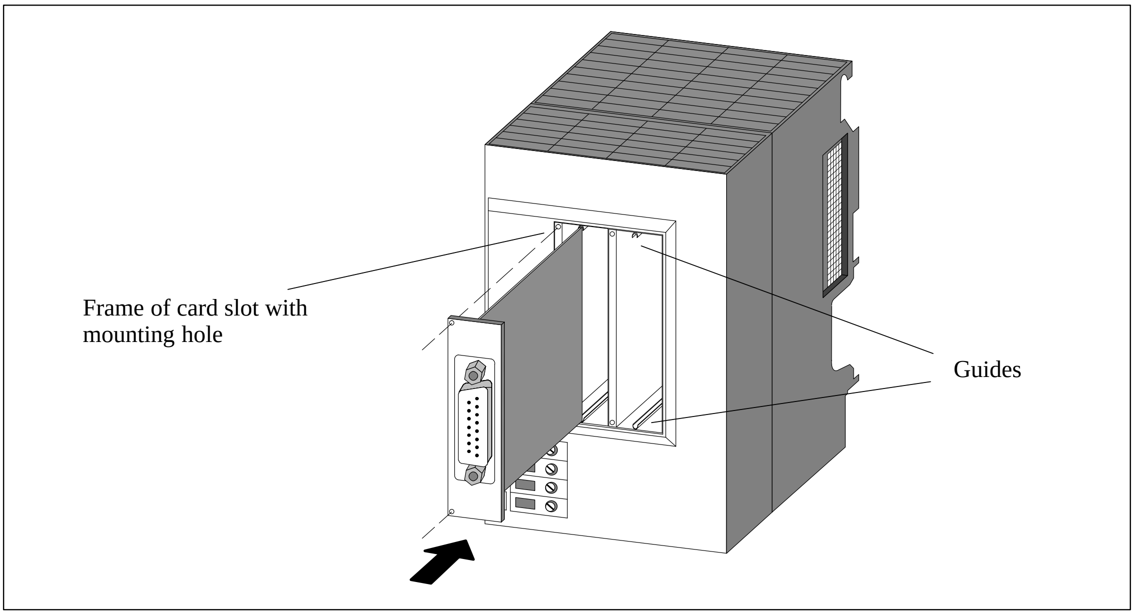


Figure 5-8 Inserting an Interface Submodule in an Expansion Module

Covers of the Empty Card Slots

When the expansion modules are delivered, only the card slot on the extreme left is open. All other slots are closed off with a submodule cover. This is secured to the frame of the card slot with screws.

Slacken the screws and remove the submodule cover to insert more than one interface submodule in an expansion module.

5.5 Installing the Modules on the Rail

Installation Sequence

Proceed as follows to install the modules on the rail:

1. Insert the bus connector into the module or last module of an assembly comprising CPU and expansion element.
2. Hook the module or module assembly onto the rail and swing it downward.
3. Screw on the module or all modules of the assembly.
4. Install the next module according to steps 1 to 3.
5. When you have installed all the modules, insert the key into the CPU.

The individual steps for installing the modules are explained in the following.

Inserting the Bus Connector in a Module

No bus connector is fitted between the power supply module and the CPU.

You have already fitted bus connectors to the CPU and its expansion elements during the expansion procedure.

To fit additional modules to a CPU with expansion elements, insert a bus connector into the last expansion element as shown in Figure 5-9. Use the bus connector of the next module for the purpose.

Proceed similarly to connect a CPU without expansion elements to an additional module and to all subsequent modules.

You must not insert a bus connector into the “last” module of a rack.

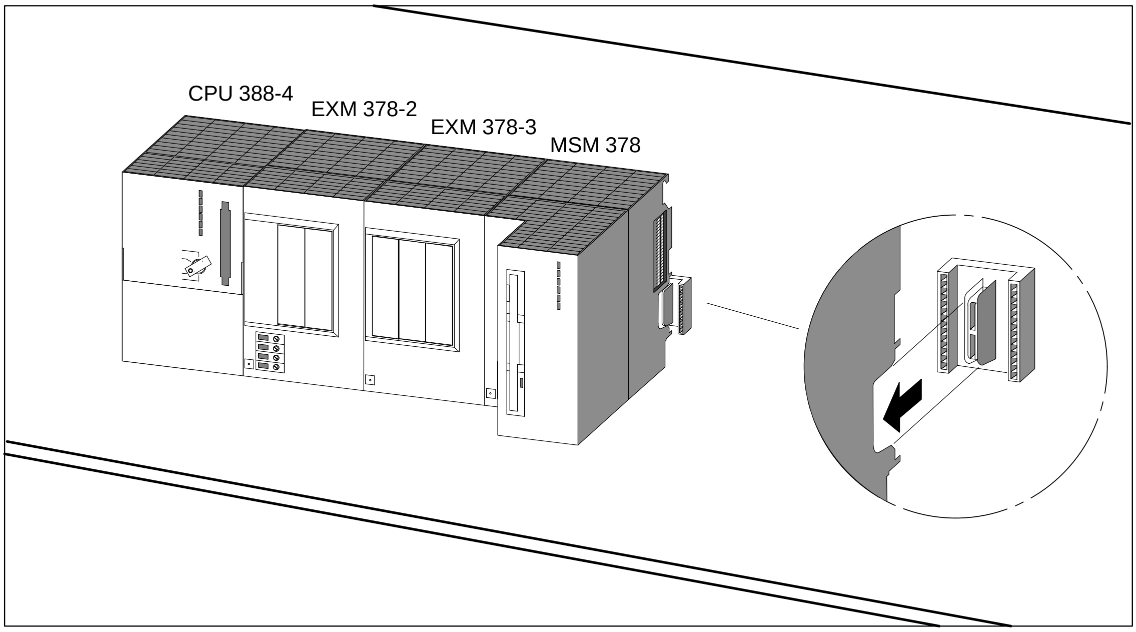


Figure 5-9 Inserting the Bus Connector in a Module

Hooking On the Modules

Hook the modules on successively (1), slide them along as far as the left-hand module (2) and swing them downward until they engage with the bus connector (3).

Sequence for hooking on the modules:

1. Power supply module
2. CPU and expansion elements

   Figure 5-10 shows how to hook a CPU onto the rail and swing it down, if you have not expanded it.

   A module assembly (CPU with expansion elements) is hooked onto the rail in the same way, as one unit, and swung down like a single module.

Caution

Before hooking a module assembly onto the rail and swinging it down, check that all steps for expanding a CPU have been carried out (see Section 5.4, from Page 5-8 onward).

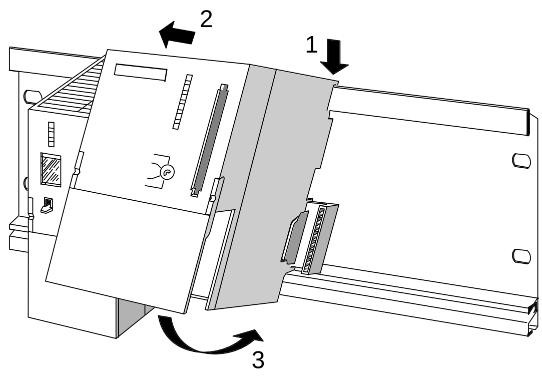


Figure 5-10 Hooking the CPU onto the Rail and Swinging it Down Without Expansion Modules

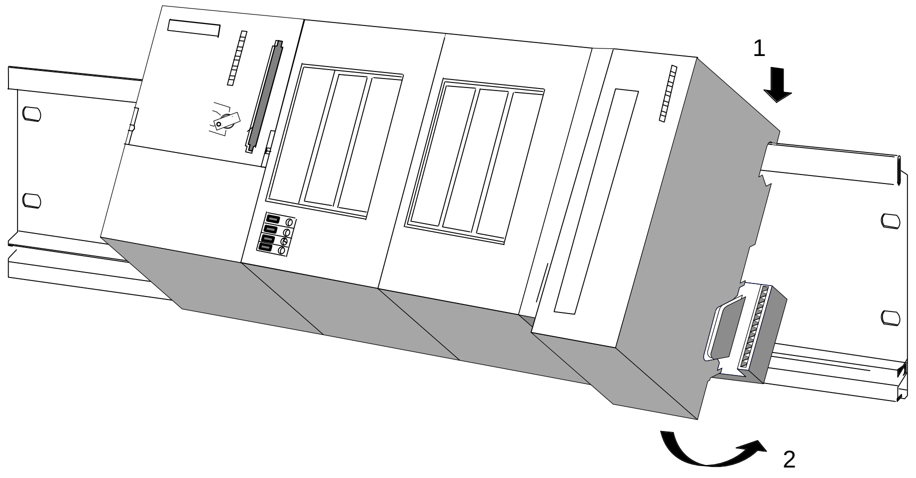


Figure 5-11 Hooking On a Module Assembly Comprising a CPU plus Expansion Modules and Swinging it Down

3. Interface module (only in multi-tier configuration)
4. Signal modules

   Figure 5-12 shows how to hook signal modules onto the rail. Ensure that a bus connector is inserted into the CPU, last expansion element of a module assembly or, with a multi-tier configuration, into the interface module. It must engage with the signal module. This also applies to all subsequent modules.

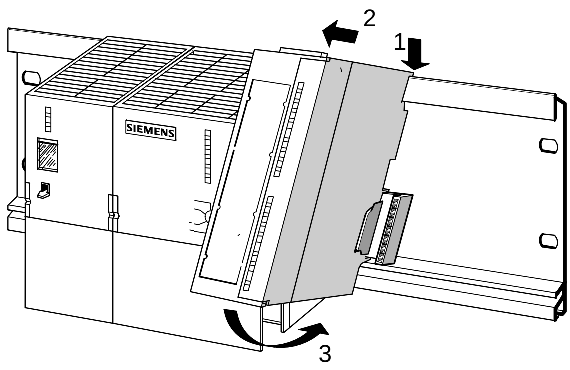


Figure 5-12 Hook the Signal Module onto the Rail and Swing it Down into Place

Bolting the Modules Tight

Bolt the modules tight, applying a torque of between 0.8 and 1.1 Nm (7 to 10 in.-lb.).

Figure 5-13 shows you how to bolt the modules to the rail.

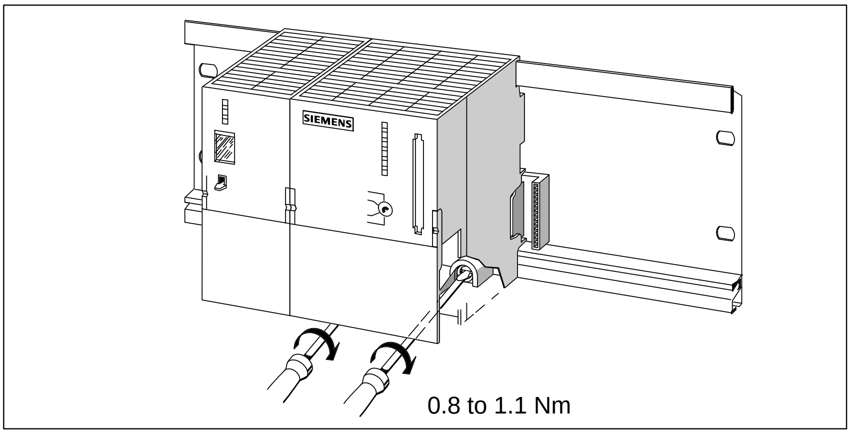


Figure 5-13 Bolting a Module to the Rail

Inserting the Keyswitch

Once you have mounted the CPU on the rail, you can insert the key (see Figure 5-14).

The keyswitch can be inserted in the STOP and RUN switch settings.

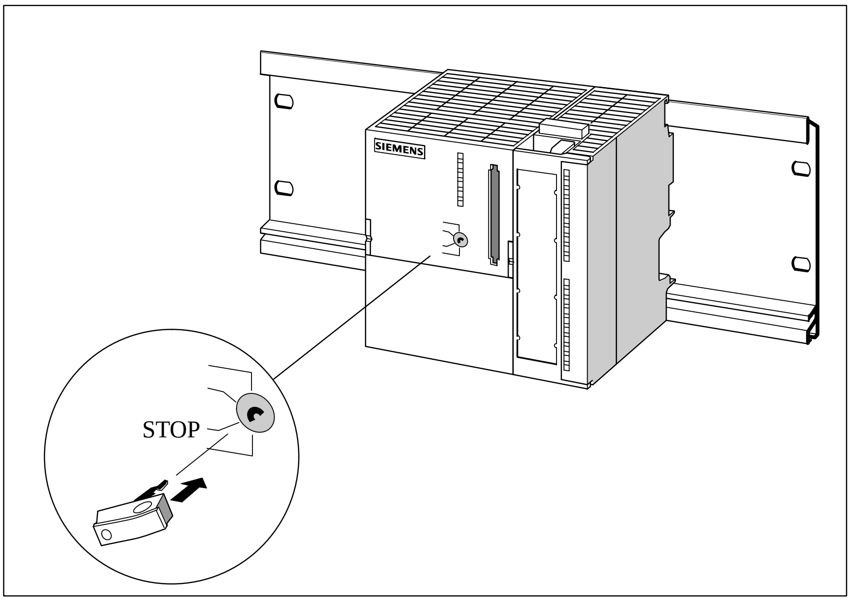


Figure 5-14 Inserting the Keyswitch in the CPU

5.6 Identifying the Modules with Slot Numbers

Assigning Slot Numbers

Once you have mounted the modules on the rail, you can assign a slot number to each individual module. The slot labels you require for this purpose are packed along with the CPU. These slot numbers will make it easier for you to assign the modules to the configuration table in *STEP 7* .

Table 5-2 provides you with the information you need for numbering.

When numbering the modules, proceed as follows:

1. Hold the “number wheel” against the module, lining up the slot number with the mating surface on the module.
2. Press the slot label onto the module with your finger. This breaks the slot label off the “number wheel”.

Attaching Slot Numbers

Figure 5-15 shows you how to attach the slot numbers to the modules.

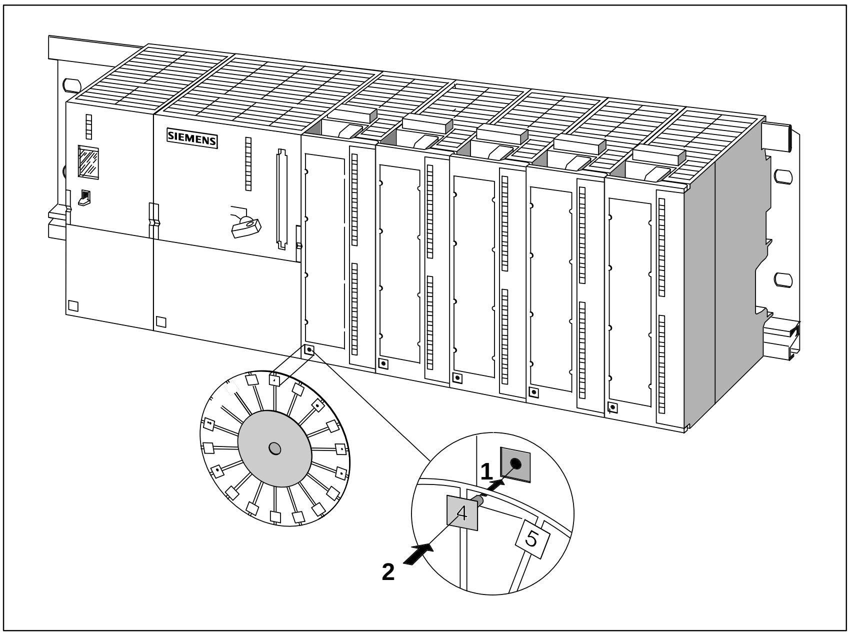


Figure 5-15 Attaching Slot Numbers to the Modules

Numbering Scheme

Table 5-2 shows the numbering scheme for assigning slot numbers to the modules.

The STEP 7 software uses the same numbering scheme.

Table 5-2 Slot Numbers for M7-300 Modules

Slot Number	Module	Remarks
1	Power supply (PS)	Permanently assigned
2	CPU	Permanently assigned
3	CPU expansion elements Interface module (IM)	Priority 1: CPU expansion Priority 2: interface module
4	Function modules (FMs) Signal modules (SMs)	Priority 1: CPU expansion Priority 2: interface module
5	Expansion elements for application modules	Priority 1: CPU expansion Priority 2: interface module
6		Priority 1: interface module
7		–
8		–
9		–
10		–
11		–

The slot for the interface module is considered to be occupied even if no interface module is inserted (see also the section on slot-oriented addressing on Page 3-2).

Wiring an M7-300

6

Introduction

You have installed the M7-300 (see Chapter 5). This chapter describes how to wire the modules.

Chapter Overview

6.1 Wiring Rules

Rules Governing Wiring

The following table tells you what rules you have to observe when wiring the modules.

Rules Governing...	Power Supply and CPU, Expansion Modules	Front Connector of Signal Modules		SIMATIC TOP Connect[1] Front Connecting Module
		20-pin	40-pin	Connection for Potential Supply
Conductor cross-sectional area: Solid conductors Stranded conductors • without end ferrule • with end ferrule	 No 0.25 to 2.5 mm² 0.25 to 1.5 mm²	 No 0.25 to 1.5 mm² 0.25 to 1.5 mm²	 No 0.25 to 0.75 mm² 0.25 to 0.75 mm²	 No 0.25 to 1.5 mm² 0.25 to 1.5 mm²
Number of conductors per connection			One or combination of two conductors up to 0.75mm² (total) in one end ferrule	One or combination of two conductors up to 1.5mm² (total) in one end ferrule
Maximum diameter of conductor insulation	∅ 3.8 mm	∅ 3.1 mm max qty. 20	∅ 2.0 mm max. qty. 40	∅ 3.1 mm max. qty. 4
Length of insulation to be stripped • without insulating collar • with insulating collar	 11 mm 11 mm	 6 mm 6 mm		 6 mm -
End ferrules to DIN 46228 • without insulating collar • with insulating collar	 Version A 10 to 12 mm long Version E up to 12 mm long	 Version A 5 to 7 mm long Version E up to 6 mm long		 Version A 5 to 7 mm long -
Blade width of screwdriver	3.5 mm (cylindrical model)			
Tightening torque for connecting the cables (not with spring-loaded connection)	0.5 to 0.8 Nm		0.4 to 0.7 Nm	

1 see *Module Specifications* Manual

6.2 Wiring the Power Supply Module and CPU

System Cables

Use stranded cables with a conductor cross-sectional area of between 0.25 and 2.5 mm^2 for wiring the power supply.

If you use only one cable per connection, you don't need an end ferrule.

Power Connector

Use the power connector when wiring the PS 307 power supply module to the CPU. The power connector is supplied with the power supply module.

Other 24 V Connections

Above the power connector on the PS 307 power supply there are still a number of free 24 V connections for powering the signal modules.

Using the Power Connector

You will find details on the wiring of the PS 307 power supply module and the CPU in Figure 6-1.

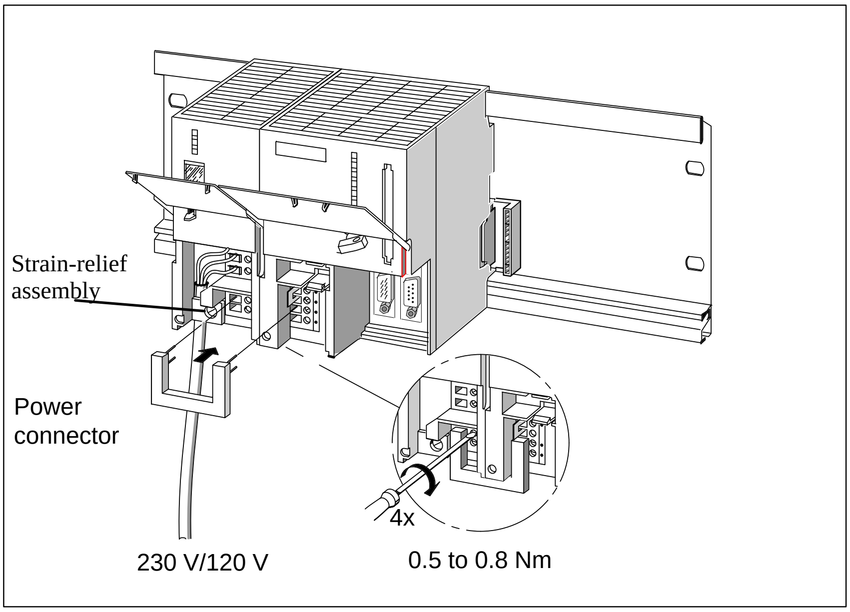


Figure 6-1 Wiring the PS 307 Power Supply Module and the CPU Using a Power Connector

Wiring

Proceed as follows when wiring the power supply module and CPU (see Figure 6-1).

> **Warning**
>
> There is a risk of contact with live conductors if the power supply module and any additional load power supplies are switched on.
>
> Only wire the M7-300 with power removed.

1. Open the front doors of the PS 307 power supply and CPU.
2. Undo the strain-relief assembly on the PS 307.
3. Strip the insulation off the power cable (230V/120V) and connect it to the PS 307.
4. Screw the strain-relief assembly tight.
5. Plug in the power connector and screw it tight.
6. Close the front doors.

Terminal Connection Model

The terminal connection model for a CPU 388-4 is given in the following figure.

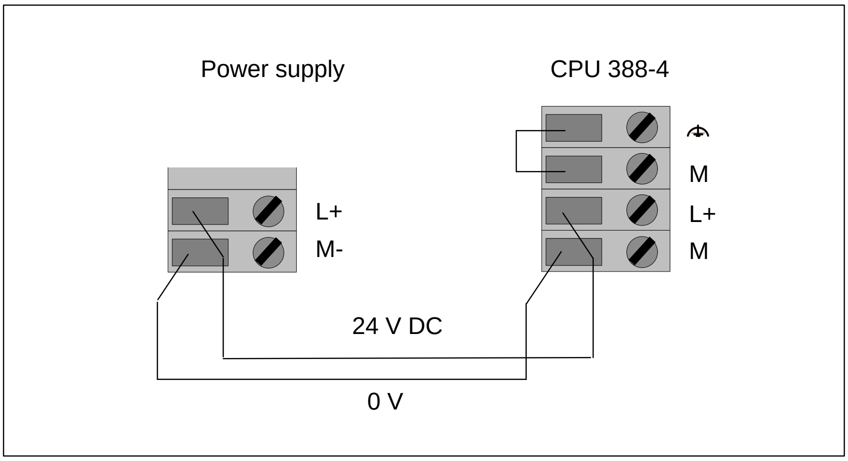


Figure 6-2 Connecting the CPU to the Power Supply

Tightening Torque

Use a torque of between 0.5 and 0.8 Nm when tightening the terminal screws.

6.3 Setting the Power Supply Voltage Selector Switch

Setting the Voltage Selector Switch

Check to see that the voltage selector switch on the power supply module is set to your local system voltage. This switch is always factory-set to 230 V. To select another system voltage, do the following:

1. Pry the cover off with a screwdriver.
2. Set the selector to your system voltage.
3. Replace the cover.

Figure 6-3 shows you how to set the voltage selector switch.

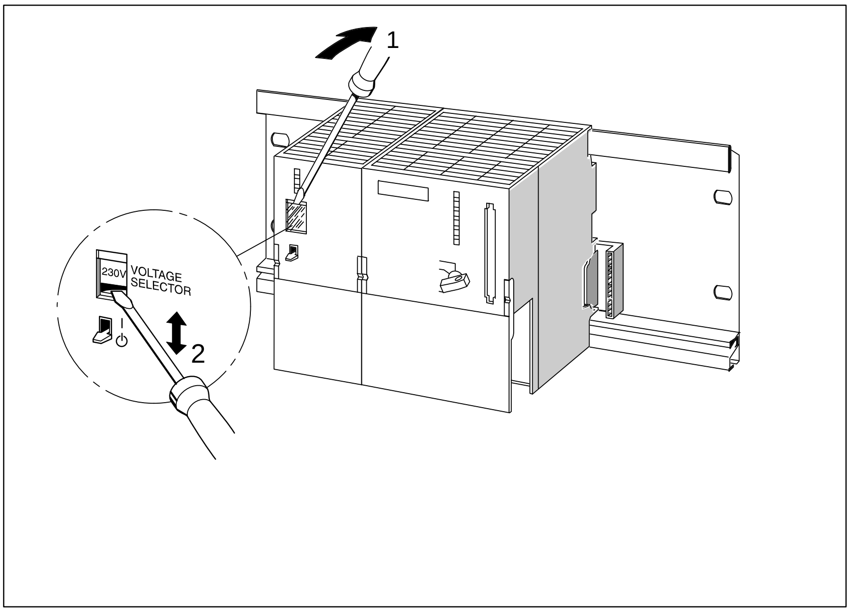


Figure 6-3 Voltage Selector Switch on the PS 307

6.4 Connecting Expansion Elements to the Power Supply

Expansion module EXM 378-2 and mass storage module MSM 378 have a screw-terminal front connector (Figure 6-5). They are wired to the power supply module PS 307 and supplied with +24 V.

Cables

You can use cables with stranded conductors and a cross-section of 1×0.25 to $2.5\ mm^2$.

An end ferrule is not required. If you use end ferrules, only use the ones without insulating collars to DIN 46228, Model A, long version.

Wiring the Front Connector

Proceed as follows to wire the screw-terminal front connector:

1. Prepare the cables
2. Make the connections

These steps are explained in the following.

Preparing the Cables

The following two steps are necessary to prepare the cables for wiring.

Warning

There is a risk of contact with live conductors if the power supply module and any additional load power supplies are switched on.

Only wire the M7-300 with power removed.

---

1. Strip the cables (length of 12 mm).
2. Will you use end ferrules?

   If so: crimp the end ferrules onto the conductors.

Making the Connections

To wire the power supply module to an EXM 378-2 or MSM 378, proceed as follows:

1. Open the front door of power supply module PS 307.
2. Insert one conductor in each of the free terminals L+ and M of the power supply module (Figure 6-4) and tighten them. These terminals can accept two conductors. This means, for example, you can connect an expansion module EXM 378-2 and mass storage module MSM 378 to one pair of screw terminals (M, L+).

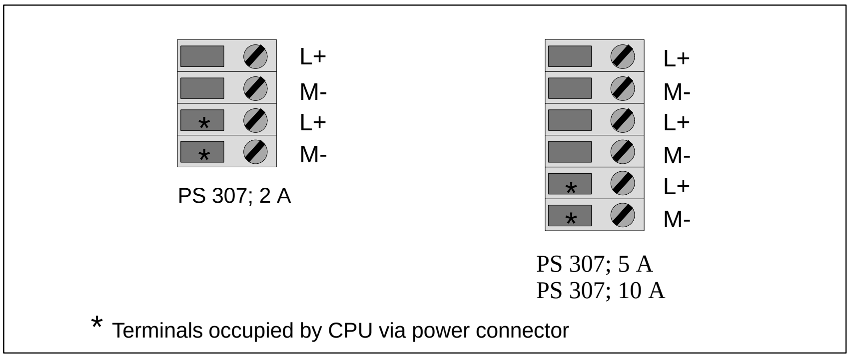


Figure 6-4 Screw-Terminal Front Connector of Power Supply Modules PS 307, 2 A and PS 307, 5 A/PS 307, 10 A

3. Insert the other end of the cable in terminals L+ and M (lower M terminal) of the expansion element (Figure 6-5) and tighten them.

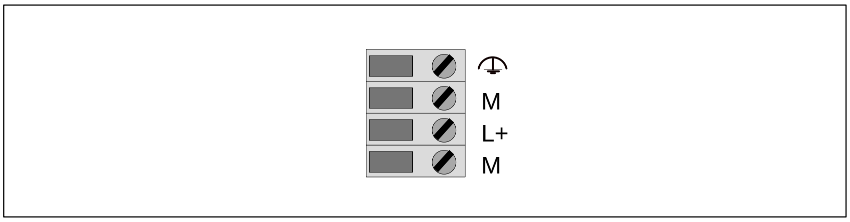


Figure 6-5 Screw-Terminal Front Connector of Expansion Elements

4. Close the front door of the power supply module.

Terminal Connection Model

The terminal connection model for two expansion modules is given in the following figure.

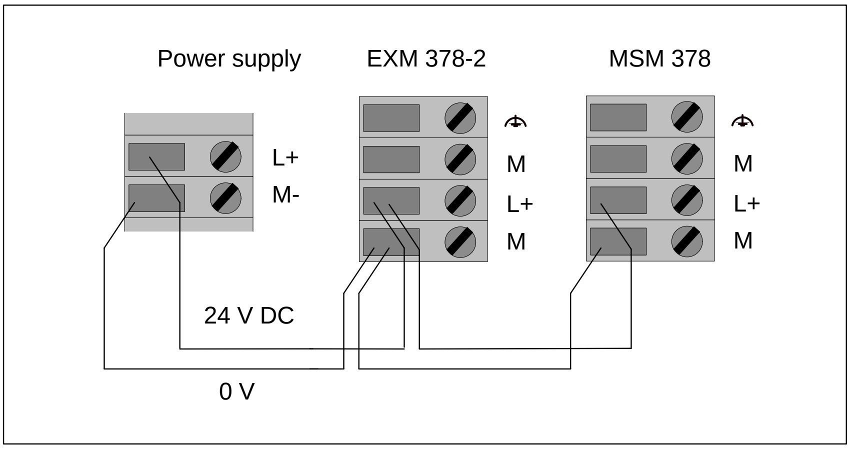


Figure 6-6 Connecting the Modules to the Power Supply

Tightening Torque

Tighten the terminal screws with a torque of 0.5 Ncm to 0.8 Ncm.

6.5 Wiring the Front Connectors of the Interface Submodules

The interface submodules are equipped with sub. D female or male connectors. To be able to connect devices to the interface submodules, you must preassemble cables with the appropriate mating connectors.

Pin assignments of the sub. D female or male connectors can be found in the description of the relevant interface submodule in Chapter 12.

6.6 Wiring the Front Connectors of the Signal Modules

Cables

You can use cables with stranded conductors with a cross-section of 1 x 0.25 mm to 1.5 mm.

You do not need end ferrules. However, if you prefer to use end ferrules, use only ferrules without insulating collar to DIN 46228, Model A, short version.

Wiring the Front Connector

Wire the screw-type front connector as follows:

1. Prepare the connector for wiring.
2. Make the connections.
3. Prepare the module for operation.

These three steps are described on the following pages.

Preparing the Connector for Wiring

Prepare the connector for wiring as follows:

Warning

You may come into contact with live conductors when the power supply module and possible additional load power supplies are switched on.

Make sure the M7-300 is absolutely dead before doing any wiring!

---

1. Open the front door.
2. Place the front connector in the wiring position.

   To do this, push the front connector into the signal module until it snaps into place. The front connector still protrudes from the module in this position.

   Advantage of this wiring position: Wiring is made easier; in the wiring position, a wired front connector is not in contact with the module.

Figure 6-7 shows you how to bring the front connector into the wiring position.

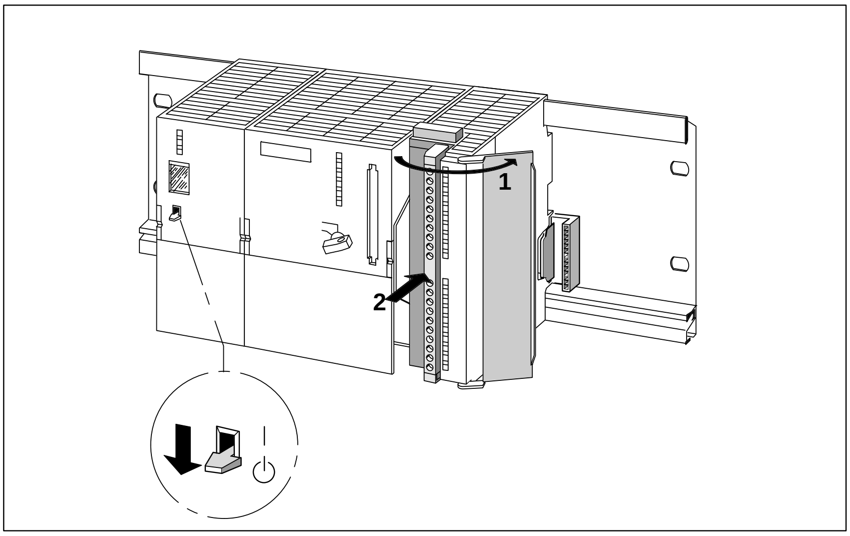


Figure 6-7 Bringing the Front Connector into the Wiring Position

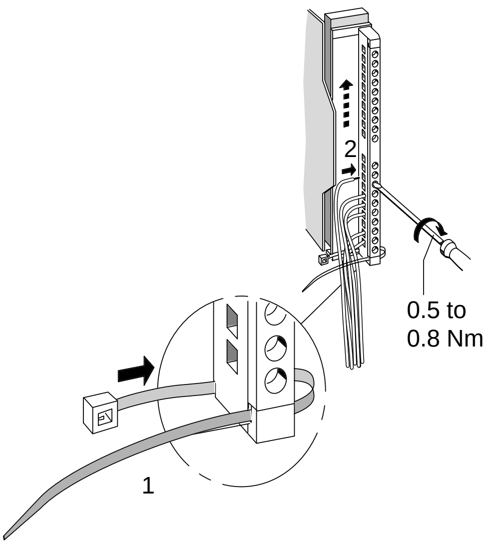
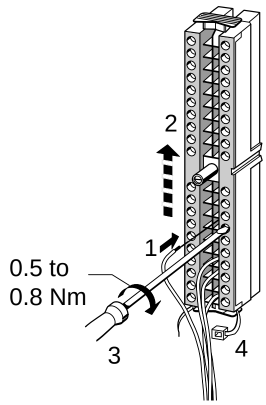
3. Strip the cables (length of 6 mm)
4. Do you want to use end ferrules?

   If your answer is “yes”, crimp the ferrules onto the ends of the conductors.

Making the Connections

Wire the prepared front connector as described in Table 6-1.

Table 6-1 Making the Connections

Step	20-pin front connector	40-pin front connector
1.	Thread the cable strain-relief assembly into the front connector.	-
2.	Do you want to bring the cables out at the bottom of the module? **Yes:**	
	Start with terminal 20, and wire the terminals in the following order: terminal 20, 19, to 1.	Starting at terminal 40 or 20, connect up the terminals in alternating order, that is terminals 39, 19, 38, 18 etc., down to terminals 21 and 1.
	No:	
	Start with terminal 1, and wire the terminals in the following order: terminal 1, 2 to 20.	Starting at terminal 1 or 21, connect up the terminals in alternating order, that is terminals 2, 22, 3, 23 etc., up to terminals 20 and 40.
3.	Also tighten the connection screws of any terminals that are not wired.	
4.	-	Attach the cable strain-relief assembly around the cable and the front connector.
5.	Pull the cable strain-relief assembly tight. Push the retainer on the strain-relief assembly in to the left; this will improve utilization of the available space.	
-		

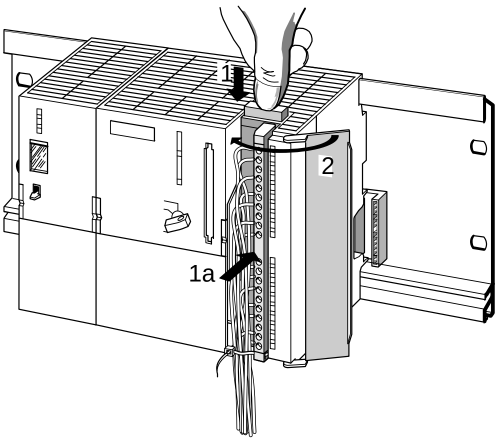
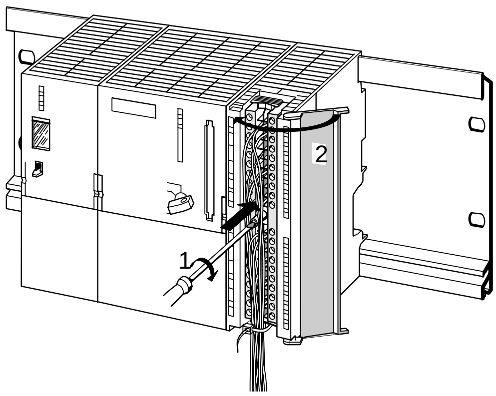
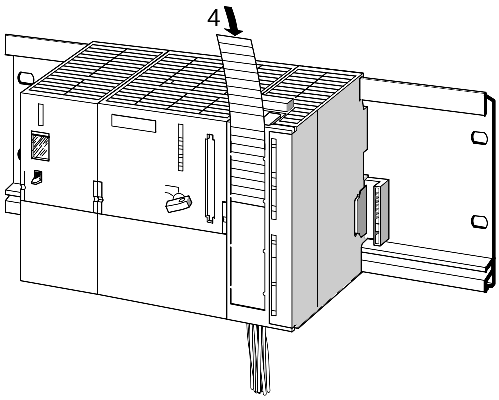
Tightening Torque

Tighten the terminal screws with a torque of 0.5 to 0.8 Nm.

Preparing the Signal Module for Operation

Prepare the signal module for operation as follows:

Table 6-2   Preparing the Signal Module for Operation

<table>
<tr><th>Step</th><th>20-pin front connector</th><th>40-pin front connector</th></tr>
<tr><td>1.</td><td>Press down the unlocking button on the top of the module and, at the same time, push the front connector into its operating position on the module. When the front connector reaches its operating position, the unlocking button will snap back into the locking position.</td><td>Tighten screws to bring front connector to its operating position.</td></tr>
<tr><td></td><td colspan="2">Note: When the front connector is brought into its operating position, a front connector coding key snaps into place. The front connector then only fits this type of module (see Section 9.2).</td></tr>
<tr><td>2.</td><td colspan="2">Close the front door.</td></tr>
<tr><td>3.</td><td colspan="2">Enter the addresses for identifying the individual channels in the labeling strip.</td></tr>
<tr><td>4.</td><td colspan="2">Slide the labeling strip into the guides in the front door.</td></tr>
<tr><td>-</td><td>
</td><td>
</td></tr>
<tr><td>-</td><td colspan="2">
</td></tr>
</table>

6.7 Connecting Shielded Cables Using the Shield Connecting Element

Introduction

This section describes how you connect shielded signal cables to ground, using a shield connecting element. You establish the ground connection by connecting the shield connecting element directly to the mounting rail.

Application

You can easily connect all shielded cables of M7-300 modules to ground using the shield connecting element.

Design of the Shield Connecting Element

The shield connecting element consists of the following parts:

- A fixing bracket with two bolts for attaching the element to the rail (Order No.: 6ES5390-5AA00-0AA0) and
- The terminal elements

Depending on the cable cross-sections used, you must use the following terminal elements:

Table 6-3 Assignment of Cable Cross-Sections and Terminal Elements

Cable with Shield Diameter	Terminal Element Order No.:
2 cables with a shield diameter of 2 to 6 mm (0.08 to 0.23 in.) each	6ES7 390 5AB00-0AA0
1 cable with a shield diameter of 3 to 8 mm (0.12 to 0.31 in.)	6ES7 390 5BA00-0AA0
1 cable with a shield diameter of 4 to 13 mm (0.16 to 0.51 in.)	6ES7 390 5CA00-0AA0

The shield connecting element is 80 mm (3.15 in.) wide. You can therefore connect the cables of one to two modules to one shield connecting element.

Signal Modules with Shield Connecting Element

Figure 6-8 shows two signal modules using one shield connecting element.

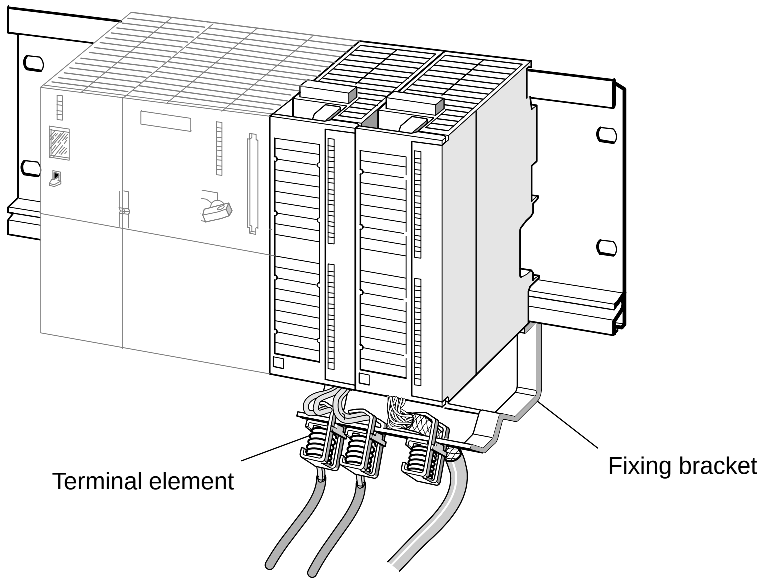


Figure 6-8 Signal Module Assembly with Shield Connecting Element

Installing the Shield Connecting Element

Install the shield connecting element as follows:

1. Push the two bolts of the fixing bracket into the guide on the underside of the rail as far as the modules you are wiring. Position the fixing bracket under the modules to be wired.
2. Bolt the fixing bracket tight to the rail.
3. A slotted web is arranged at the bottom side of the terminal element. Place the terminal element at this position onto edge a of the fixing bracket. Press the terminal elements down and swing them into the desired position.

   You can attach up to four terminal elements on each of the two rows of the shield connecting element.

Attaching the Cables

You can only attach one or two shielded cables per terminal element (see Figure 6-9). The cable is connected by its bare cable shield. The length of bare cable shield must be at least 20 mm (0.78 in.). If you need more than 4 terminal elements, start wiring at the rear row of the shield connecting element.

Note

Provide a sufficiently long cable between the terminal element and the front connector. You can thus remove the front connector without the need to also remove the terminal element.

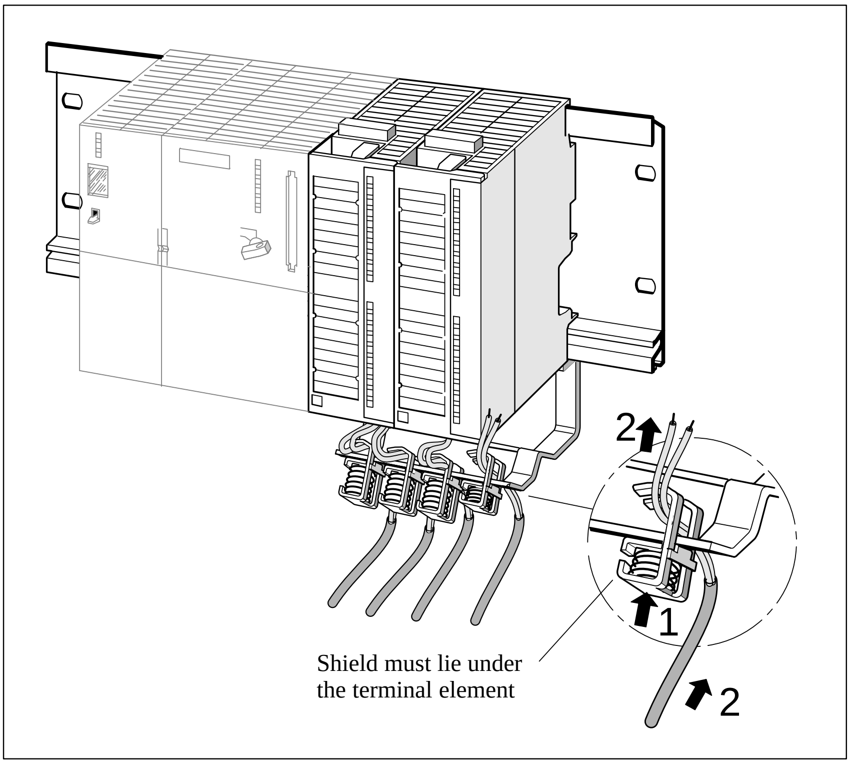


Figure 6-9 Attaching Shielded 2-Wire Cables to a Shield Connecting Element

Configuring an MPI or PROFIBUS Subnet 7

Two Subnets

You can

- integrate the M7-300 in an MPI subnet via the MPI interface or
- set up a PROFIBUS subnet with an M7-300 master.

Same Structure

The structure of an MPI subnet is basically the same as an PROFIBUS subnet. That means the same rules and the same components are used to set up the subnet. The only exception arises if you set a baud rate > 1.5 Mbaud in a PROFIBUS subnet. In this case, you will need other components. Special reference is made to these components where relevant in this documentation.

Since the structure of an MPI subnet does not differ from that of a PROFIBUS subnet, general reference is made in the following sections to configuring a subnet.

Configuring Communication

You must assign MPI or PROFIBUS addresses to the individual nodes of an MPI or PROFIBUS subnet in order to enable them to communicate with each other. How you assign these addresses and what rules you must observe is described in the *STEP 7* User Manual.

Chapter Overview

7.1 Configuring a Subnet

Definition: Multipoint Interface MPI

The interface of the CPU for connecting, for example, programming devices, is called multipoint interface since several devices (that is, from several points) can access the CPU via this interface. In other words: the CPU with the multipoint interface can be networked without additional modules!

Definition: PROFIBUS-DP

Digital, analog and intelligent modules of the programmable controller as well as a wide range of field devices to DIN E 19245 P. 3, such as drivers or valve terminals, are installed in a distributed configuration in the direct vicinity of the process - across distances of up to 23 km (14.375 miles).

The modules and field devices are connected to the programmable controller via the PROFIBUS-DP fieldbus and addressed in the same way as centralized I/Os.

In this Chapter

This chapter describes

- The basic principles for configuring a subnet. It explains
  - what a segment is
  - the baud rates that are possible in a subnet, and
  - special features of the MPI and PROFIBUS node addresses.
- Rules for configuring a subnet. These rules are explained in examples of possible subnet configurations.
- Possible cable lengths in a segment and options for extending the cable lengths.

7.1.1 Basic Principles

Device =Node

Convention: In the following, all devices that you connect in an MPI subnet are called nodes.

Segment

A segment is a bus line between two terminating resistors. A segment can contain up to 32 nodes. A segment is further liwithed by the permissible cable length, which depends on the baud rate (see Section 7.1.3).

Baud Rate

The following table shows the baud rates you can use on the subnet.

MPI	PROFIBUS-DP	
187.5 kbaud; permanent setting	9.6 kbaud	1.5 Mbaud
	19.2 kbaud	3 Mbaud
	93.75 kbaud	6 Mbaud
	187.5 kbaud	12 Mbaud
	500 kbaud	–

Connectable Nodes

Shown in the following table are the nodes with which you can set up

- an MPI subnet with the CPU 388-4;
- an PROFIBUS subnet with the CPU 388-4 + expansion module EXM 378 + interface submodule IF 964-DP as the DP master.

MPI	PROFIBUS-DP
Programming devices (PG/PC)	Programming device (PG/PC)
Operator panels (OP)	DP master (CPU 388-4 or FM 356-4 + EXM 378 + IF 964-DP)
S7-300/M7-300	other DP master
S7-400/M7-400	DP slaves

Number of nodes

You can connect up to 126 (addressable) nodes in a subnet.

MPI/PROFIBUS Addresses

To enable all nodes to communicate, you must allocate an address to them as follows:

- An “MPI address” and a “highest MPI address” in an MPI subnet
- A “PROFIBUS address” and a “highest PROFIBUS address” in a PROFIBUS subnet.

You must allocate this MPI/PROFIBUS address individually to each node, using the programming device (with some PROFIBUS DP slaves a switch must be used on the slave) **before** networking the nodes.

Please refer to the *STEP 7* User Manual or the ET-200 Manuals for more information.

Note

The RS 485 repeater is not allocated an “MPI address” or “PROFIBUS address”.

Table 7-1 contains all the MPI and PROFIBUS addresses permitted for the M7-300.

Table 7-1 Permissible MPI/PROFIBUS Addresses

MPI Addresses	PROFIBUS Addresses
0 to 127	0 to 125
of which are reserved: 0 for PG 1 for OP 2 for CPU	of which are reserved: 0 for PG

Default MPI Addresses

The following table shows the default MPI addresses with which the devices are supplied.

Node (Device)	Default MPI Address	Highest Default MPI Address
PG	0	15
OP	1	depending on OP
CPU	2	15

Rules for the MPI/ PROFIBUS Addresses

Observe the following rules before assigning MPI/PROFIBUS addresses:

- All MPI/PROFIBUS addresses in a subnet must be different.
- The highest possible MPI/PROFIBUS address must be ≥ the largest actual MPI/PROFIBUS address and must be the same for all nodes (Exception: Connecting a programming device to several nodes; see Section 8.6.2).

MPI Addresses of CPs and FMs

CPs and FMs that have own MPI addresses are assigned their MPI address automatically by the CPU. The CPU determines these addresses on the following principle:

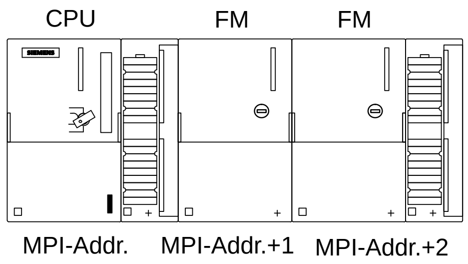


Figure 7-1 Automatic Assignment of MPI Addresses to programmable Modules

Please mind that numbers assigned automatically by the CPU, must not be assigned with STEP 7 to other nodes. If an MPI address is assigned more than once, data transfer on the MPI subnet is affected.

FM Failure

If an FM breaks down in an M7-300, for example due to a local power failure, the CPU recognizes a deviation from the setpoint configuration. It enters the STOP mode and sends no longer parameters to the FM.

This behavior ensures that upon an FM failure, automatically assigned MPI numbers are not shifted within the M7-300.

Programming Devices Connected via PROFIBUS

If an expansion module EXM 378 containing an interface submodule IF 964-DP is attached to the CPU: A programming device can be connected via PROFIBUS interface the same way as via MPI for configuring the CPU and executing monitor and modify functions.

Note

Executing monitor and modify functions via PROFIBUS interface increases the PROFIBUS cycle time.

Plugging in and Removing Modules in the MPI Subnet

You must not plug in or remove any modules or interface submodules of an M7-300 configuration while data are being transmitted via MPI.

Warning

If you remove or plug in M7-300 modules or interface submodules during data transmission via the MPI, the data might be corrupted by disturbing pulses.

You must not plug in or remove modules or interface submodules of the M7-300 configuration during data transmission via the MPI!

Data in the MPI Subnet

Please note the following special characteristics of the MPI subnet:

Warning

Loss of data in the MPI subnet!

Connecting an additional CPU to the MPI subnet during running operation can lead to loss of data and to an increase ...

Remedy:

1. Disconnect the node to be connected from the supply.
2. Connect the node to the MPI subnet.
3. Switch the node on.

7.1.2 Rules for Configuring a Subnet

In this Chapter

This chapter describes how to configure a subnet and provides examples for networking.

Rules

You must observe the following rules when connecting the nodes of a subnet:

- **Before** you interconnect the individual nodes of the subnet you must assign the MPI address and the highest MPI address or the “PROFIBUS address” and the “highest PROFIBUS address” to each node (except for RS 485 repeater).

  Tip: Mark all nodes in a subnet with the address on their housings. In this way, you can always see which node has been assigned which address in your system.

- Connect all nodes in the subnet “in a row”; that is, integrate the stationary programming devices and OPs direct in the subnet.

  Connect only those programming devices/OPs that are required for startup or maintenance via spur lines to the subnet.

Note

Upward of 3 Mbaud, use the bus connecting cable, Order No 6ES7972-0B.**1**0-0XA0 or 6ES7 972-0B.**2**0-0XA0 to connect the nodes (see Chapter 7.2).

Upward of 3 Mbaud, use the PG connecting cable, Order No. 6ES7901-4BD00-0XA0 to connect the PG or PC (see Chapter 7.2).

- If you operate more than 32 nodes on a subnet, or if the maximum permissible cable length is exceeded for a transmission rate (see Table 7-3 on Page 7-14), you must connect the subnet segments via RS 485 repeaters.

  All subnet segments in an PROFIBUS subnet must have at least one DP master and one DP slave between them.

- You connect non-grounded subnet segments and grounded subnet segments via RS 485 repeaters (see the reference manual: *Modules for S7-300/M7-300/ET 200M*).

Rules, Continued

- Each RS 485 repeater that you use reduces the maximum number of nodes on each subnet segment. That means if a RS 485 repeater is installed in one of the subnet segments, only a further 31 nodes can be installed in that segment. The number of RS 485 repeaters has **no** impact on the maximum number of nodes on the subnet, however.

  Up to 10 segments can be installed in a row.
- Switch the terminating resistance on at the first and last node of a segment.
- **Before** you integrate a new node in the subnet, you must switch off its supply voltage.

Recommendations for MPI Addresses

Reserve the MPI address “0” for a service programming device and “1” for a service OP that will be connected temporarily to the MPI if required. This means, that you must assign different addresses to programming devices/OPs that are integrated in the MPI subnet.

Reserve the MPI address “2” for a CPU. You thus avoid that double MPI addresses occur after connection of a CPU with default setting to the MPI subnet (for example, when replacing a CPU). This means that you must assign an MPI address greater than “2” to the CPUs in the MPI subnet.

Recommendation for PROFIBUS Addresses

Reserve the PROFIBUS address “0” for a service programming device that can be connected temporarily to the PROFIBUS subnet if required. Allocate other PROFIBUS addresses to the programming devices integrated in the PROFIBUS subnet.

Components

You connect the individual nodes via bus connectors and the PROFIBUS bus cable (see also Section 7.2). Make sure that the bus connector is provided with a programming device socket so that a programming device can be connected if required.

Use RS 485 repeaters to connect segments or extend the cable.

Terminating Resistance

A cable must be terminated with its surge impedance. To do this, switch on the terminating resistance at the first and last node in a subnet.

The nodes with a terminating resistance switched on must have their power supply switched on during power up and operation.

Terminating Resistance on the Bus Connector

Figure 7-2 shows you how to switch on the terminating resistance on the bus connector.

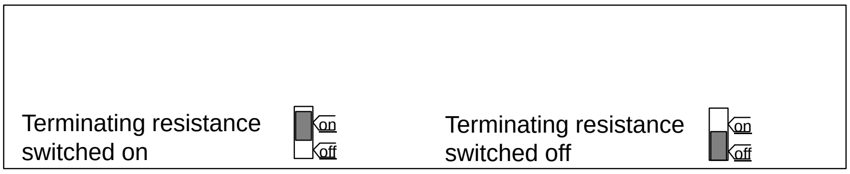


Figure 7-2 Terminating Resistance on the Bus Connector

Terminating Resistance on the RS 485 repeater

Figure 7-3 shows you where to switch on the terminating resistance on the RS 485 repeater.

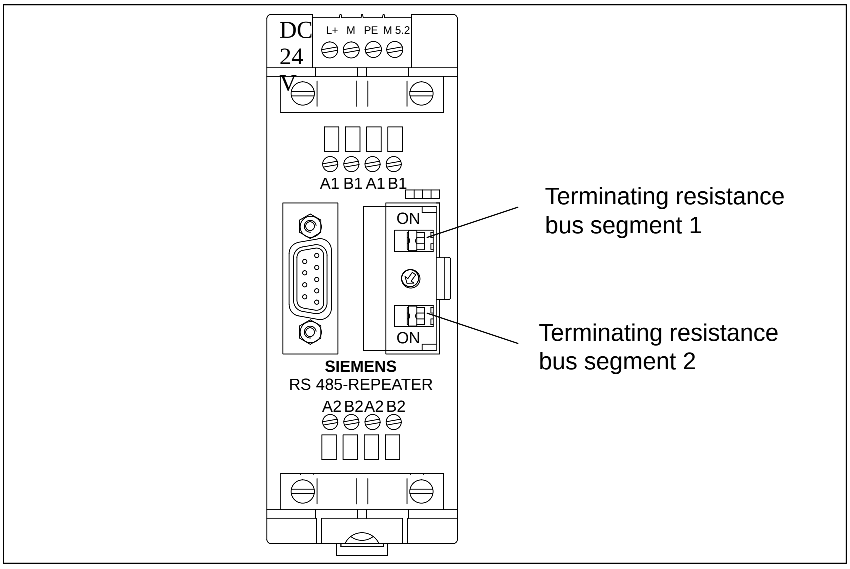
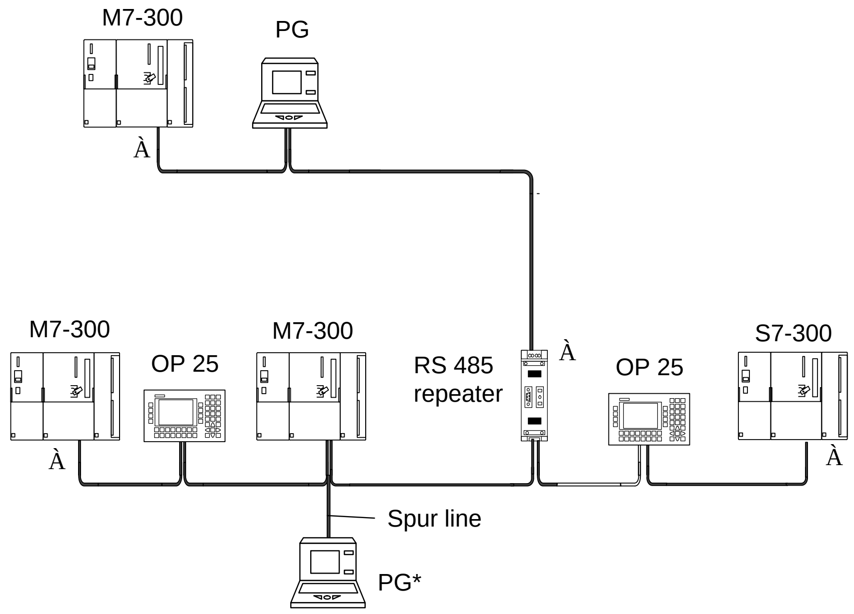


Figure 7-3 Terminating resistance on the RS 485 Repeater

Example: Terminating Resistance in an MPI Subnet

Figure 7-4 shows where you must connect the terminating resistance in a possible MPI subnet configuration.



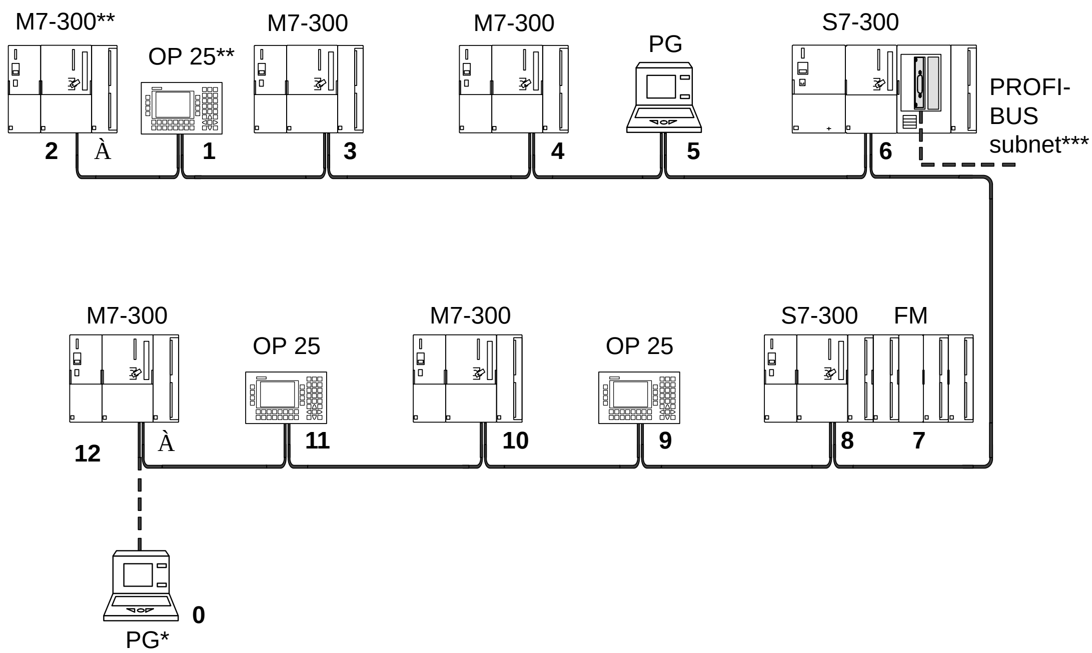
* Connected via spur line for startup/maintenance only

À Terminating resistance switched on

Figure 7-4 Connecting a Terminating Resistance in an MPI Subnet

Example of an MPI Subnet

Figure 7-5 shows an MPI subnet that is configured in accordance with the above rules.

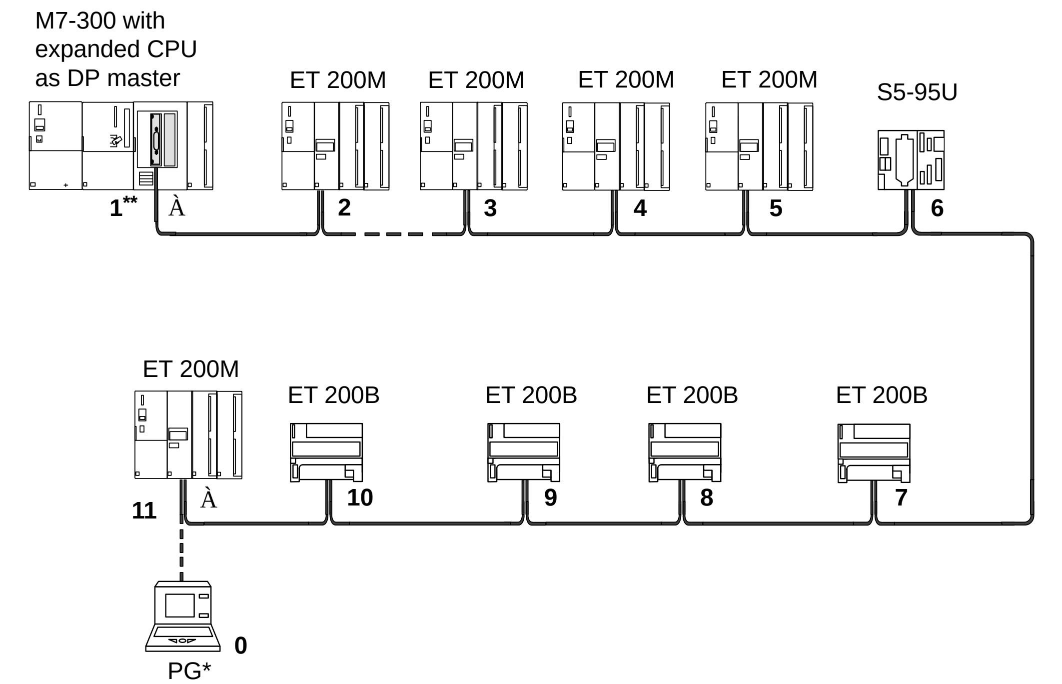


* Connected via spur line for startup/maintenance only (with default MPI address)
** Connected to the MPI subnet later (with default MPI address)
*** The CPU has an PROFIBUS address (e.g. 22) in addition to the MPI address (address 6 here)
0 ... x MPI addresses of the nodes
À Terminating resistance switched on

Figure 7-5 Example of an MPI Subnet

Example of a PROFIBUS Subnet

Figure 7-6 shows a PROFIBUS subnet that is configured in accordance with the above rules.



* Connected via spur line for startup/maintenance only (with PROFIBUS address = 0)

* * 1 = the default PROFIBUS address of the DP master

0 ... x PROFIBUS addresses of the nodes

À Terminating resistance switched on

Figure 7-6 Example of an PROFIBUS Subnet

Example with CPU as DP Master

Figure 7-7 shows an example of a configuration with the CPU 388-4 (including expansion module EXM 378-2 and interface submodule IF 964-DP) integrated in a subnet, operating as DP master in a PROFIBUS subnet.

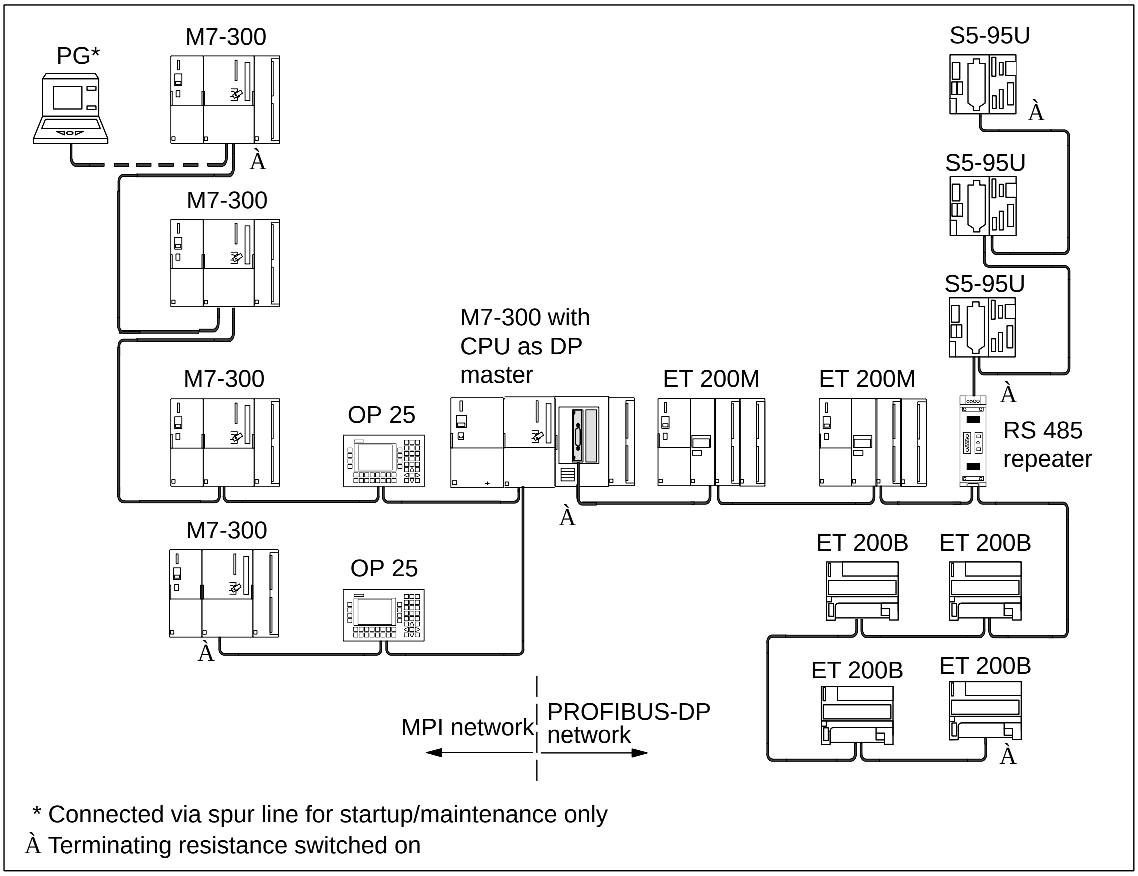


Figure 7-7 Example of a Configuration with the CPU 388-4 in an MPI and PROFIBUS Subnet

7.1.3 Cable Lengths

Segment in the Subnet

You can implement cable lengths of up to 50 m (164 ft.) in an MPI subnet segment. The 164 ft. are measured from the 1st node to the last node of the segment.

Table 7-2 Permissible Cable Lengths in an MPI Subnet Segment

Baud Rate	Max. Cable Length of a Segment (in m)
187.5 kbaud	50

Segment in the PROFIBUS Subnet

The cable length in a segment of a PROFIBUS DP subnet depends on the baud rate (see Table 7-3).

Table 7-3 Permissible Cable Lengths in a PROFIBUS Subnet Depending on the Baud Rate

Baud Rate	Max. Cable Length of a Segment (in m)
9.6 to 187.5 kbaud	1000*
500 kbaud	400
1.5 Mbaud	200
3 to 12 Mbaud	100

*only for isolated interfaces

Larger Cable Lengths

If you want to implement cable lengths above those permitted in a segment, you must use RS 485 repeaters. The maximum cable lengths possible between two RS 485 repeaters correspond to the cable length of a segment (see Table 7-3). Please note that these maximum cable lengths only apply if **no** other node is installed between the two RS 485 repeaters. You can connect up to 9 RS 485 repeaters in series.

When counting the total number of all nodes to be connected, you must observe, that an RS 485 repeater counts as a node of the MPI subnet, even if it is not assigned an MPI/PROFIBUS address.

Figure 7-8 shows how you can increase the maximum cable length for an MPI subnet by means of RS 485 repeaters.

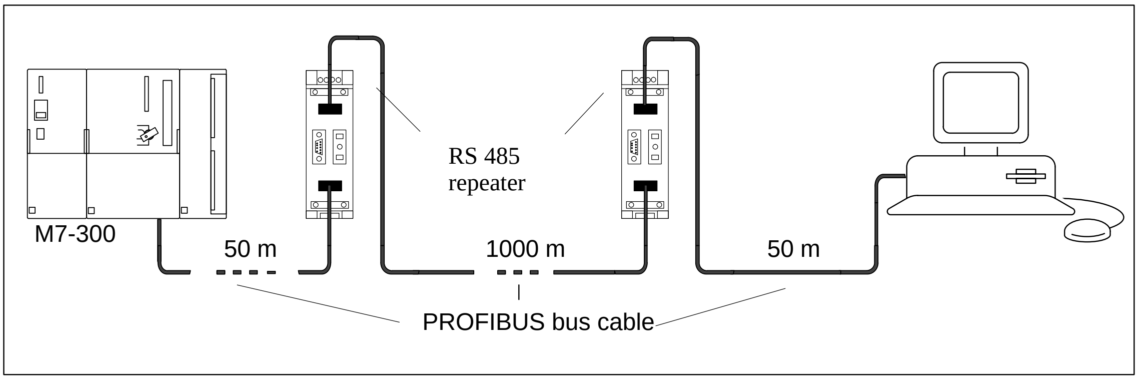


Figure 7-8 Maximum Cable Length between Two RS 485 Repeaters

Length of Spur Lines

Spur lines are the cables used for connecting programming devices or operator panels to a subnet to carry out commissioning and maintenance tasks. They should be kept as short as possible. The use of spur lines is restricted as to their length and number. Their length is determined by the total number of spur lines used in a subnet (see Table 7-4):

Table 7-4 Length of Spur Lines per Segment

Baud Rate	Max. Length of Spur Line per Segment	Number of Nodes with Spur Line Length of ...	
		1.5 m or 1.6 m	3 m
9.6 to 93.75 kbaud	96 m	32	32
187.5 kbaud	75 m	32	25
500 kbaud	30 m	20	10
1.5 Mbaud	10 m	6	3
3 to 12 Mbaud	–	–	–

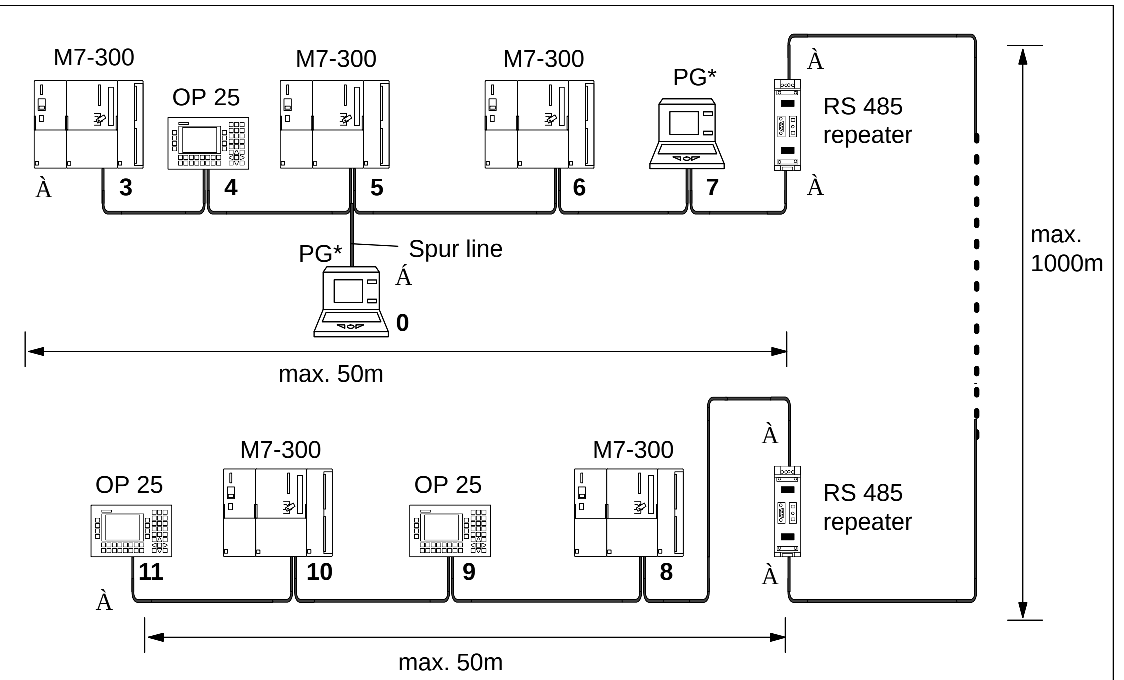
Note

If you don't connect the bus cable directly to the bus connector, for example when using a PROFIBUS bus terminal, then you must also take into account the maximum possible length of the spur line!

Upward of 3 Mbaud, use PG connecting cable, Order No. 6ES7 901-4BD00-0XA0 to connect the PG or PC. You can use two or more PG connecting cables in one configuration. Other spur cables are not permissible.

Example

Figure 7-9 shows you a possible configuration of an MPI subnet. This example illustrates the maximum possible distances in an MPI subnet.



À Terminating resistance switched on

Á Programming device connected for maintenance purposes via spur line

0 ... x MPI addresses of the nodes

Figure 7-9 Cable Lengths in an MPI Subnet

7.2 Network Components

Purpose

You need network components ...

Table 7-5 Network Components

Purpose	Components	Description
... to configure a subnet	PROFIBUS bus cable	Section 7.2.1
... to connect a node to the network	Bus connector	Section 7.2.2
... to amplify the signal ... to connect segments	RS 485 repeater	Section 7.2.6 and Chapter 7 in the Reference Manual
... to convert the signal for a fiber-optic network (for PROFIBUS subnet only)	Optical Link Module	*PROFIBUS / L2FO-Network Components* Manual

In this Section

This section describes the properties of the network components and information for their installation and handling. For a description of the RS 485 repeater, please refer also to Chapter 7 of the Reference Manual *Modules for S7-300/M7-300/ET 200M***.**

7.2.1 PROFIBUS Bus Cable

PROFIBUS Bus Cable

We can provide you with the following PROFIBUS bus cables:

PROFIBUS bus cable	6XV1 830-0AH10
PROFIBUS underground cable	6XV1 830-3AH10
PROFIBUS drum cable	6XV1 830-3BH10
PROFIBUS bus cable with PE sheath (for food and beverages industry)	6XV1 830-0BH10
PROFIBUS bus festooned cable	6XV1 830-3CH10

Properties of the PROFIBUS Bus Cable

PROFIBUS bus cable is a shielded twisted-pair cable with the following properties:

Table 7-6 Properties of PROFIBUS Bus Cable

Properties	**Values**
Line impedance	approx. 135 to 160 Ω (f = 3 to 20 MHz)
Loop resistance	≦ 115 Ω/km
Effective capacitance	30 nF/km
Attenuation	0.9 dB/100 m (f = 200 kHz)
Permissible cross-sectional core area	0.3 mm^2 to 0.5 mm^2
Permissible cable diameter	8 mm ± 0.5 mm

Installation Rules

When installing the PROFIBUS bus cable, you should take care not to:

- Twist the cable
- Stretch the cable
- Compress the cable.

You should also note the following specifications when installing the indoor bus cable (d_A = outer diameter of the cable):

Table 7-7 Specifications for Installation of Indoor Bus Cable

Features	Specifications
Bending radius (one-off)	$\geq$ 80 mm ($10 \times d_A$)
Bending radius (multiple times)	$\geq$ 160 mm ($20 \times d_A$)
Permissible temperature range during installation	– 5 °C to + 50 °C
Storage and stationary operating temperature range	– 30 °C to + 65 °C

7.2.2 Bus Connectors

Purpose of the Bus Connector

The bus connector is used to connect the PROFIBUS cable to the MPI or PROFIBUS interface. You thus make the connections to further nodes.

The following bus connectors are available:

- Up to 12 Mbaud
  - without programming device socket (6ES7 972-0BA10-0XA0)
  - with programming device socket (6ES7 972-0BB10-0XA0)
- Up to 12 Mbaud, optionally for vertical or angular outgoing cable
  - without programming device socket (6ES7 972-0BA20-0XA0)
  - with programming device socket (6ES7 972-0BB20-0XA0)

No Application Area

You do **not** require the bus connector for:

- DP slaves in degree of protection IP 65 (e.g. ET 200C)
- RS 485 repeater

7.2.3 Bus Connector 6ES7 972-0B.20-0XA0

Design

Figure 7-10 shows the bus connectors 6ES7 972-0B.20-0XA0

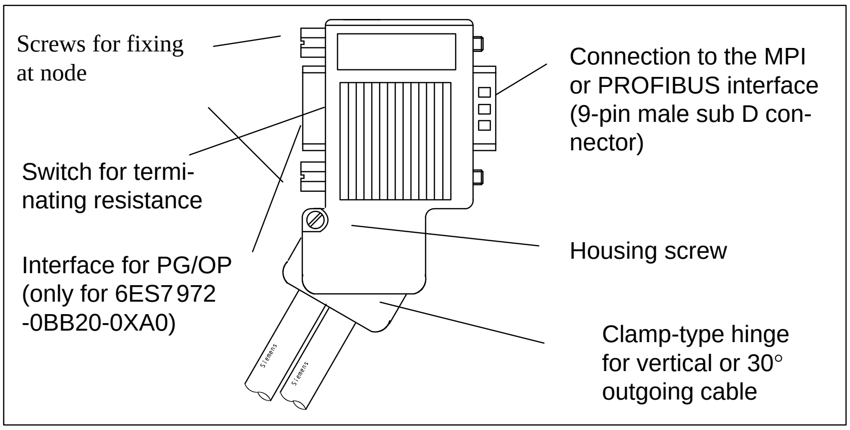


Figure 7-10Bus Connector 6ES7 972-0B.20-0XA0

Fitting the Bus Cable

Connect the bus cable to the bus connector, Order No. 6ES7 9720B.200XA0, as follows:

1. Strip the bus cable as shown in Figure 7-11.

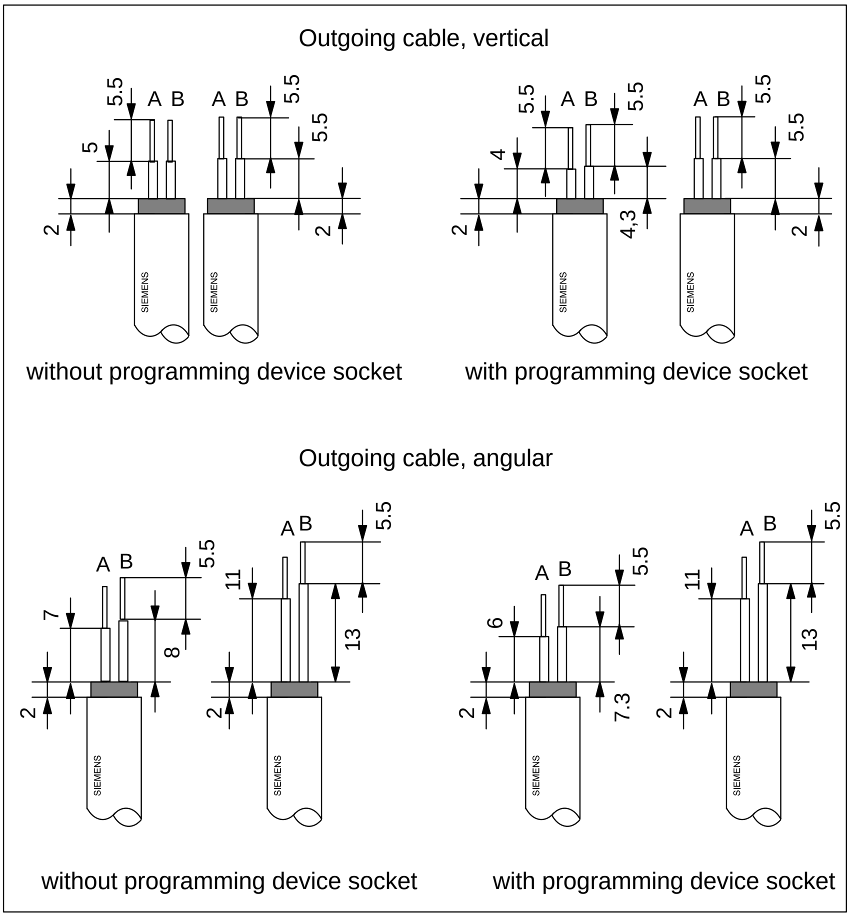


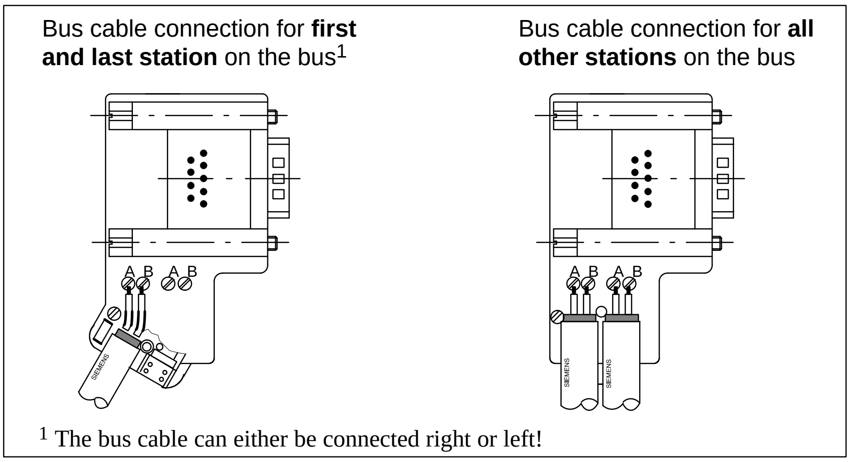
Figure 7-11 Length of Stripped Insulation for the Connection to the Bus Connector (6ES7 972-0B.20 -0XA0)

2. Open the housing of the bus connector by loosening the housing screw and swinging the cover upward.
3. Remove the clamp-type hinge cover.
4. The bus connector 6ES7 972-0B.20-0XA0 is delivered prepared for an angular outgoing cable.

   If a vertical outgoing cable arrangement is required

   – loosen the screw at the left side of the hinge,
   – slightly lift the hinge and
   – turn the hinge inward.
   – For fixing the hinge, tighten the screw on the left.
5. Insert the green and red wires into screw-type terminal block as shown in Figure 7-12.

   Make sure to connect always the same cores to the same connectors (either A or B; for example, connector A always to a green wire and B to a red wire).



[1] The bus cable can either be connected right or left!

Figure 7-12 Connecting the Bus Cable at the Bus Connector (6ES7 972-0B.20 ...)

6. Screw tight the clamp-type hinge cover.

   Make sure that the shielding is bare under the screw-type terminal.

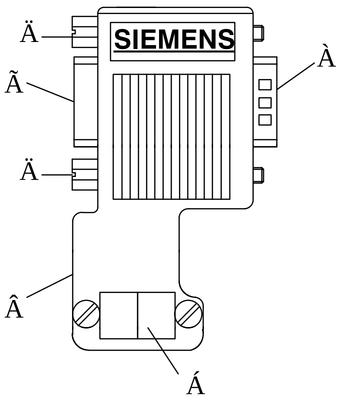
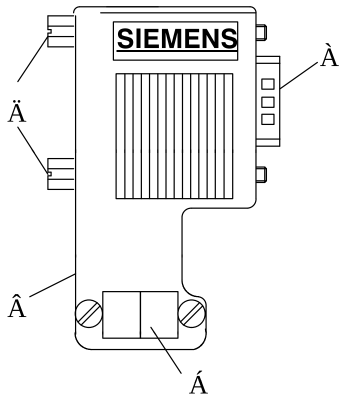
7. Tighten the green and red wires in the screw-type terminal.
8. Close the cover of the bus connector and
9. Screw down the housing.

7.2.4 Bus Connector 6ES7 972-0B.10-0XA0

Design

Table KEIN MERKER shows you the bus connectors 6ES7 972-0B.10-0XA0

Table 7-8 Design and Function of the Bus Connectors 6ES7 972-0B.10-0XA0

Design of the Bus Connectors		No.	Function
with programming device socket 	without programming device socket 	À	Connection to the MPI or PROFIBUS interface (9-pin male sub D connector)
		Á	Connection for the PROFIBUS bus cable
		Â	Terminating resistance
		Ã	PG/OP interface
		Ä	Screws for attachment to node

Preparing the PROFIBUS Bus Cable for the Bus Connector

Proceed as follows to connect the PROFIBUS bus cable to the bus connector 6ES7 972-0B.10-0XA0:

1. Cut the bus cable to the length you require
2. Strip the insulation off the bus cable as shown in Figure 7-13.

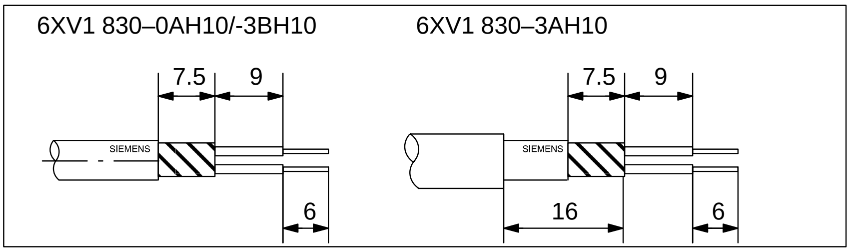


Figure 7-13 Lengths of Stripped Insulation for the Connection to the Bus Connector 6ES7 972-0B.10-0XA0

3. Open the housing of the bus connector by loosening the housing screws and
4. Remove the cover.
5. Insert the green and the red wires into the screw-type terminal block as shown in Figure 7-14.

   Make sure that you always connect the same wires at the same terminal A or B (for example, always connect green wire to terminal A and red wire to terminal B).
6. Press the cable sheaths between the two terminal bars. The cable will thus be fixed.

7. Tighten the green and the red wires in the screw-type terminal.

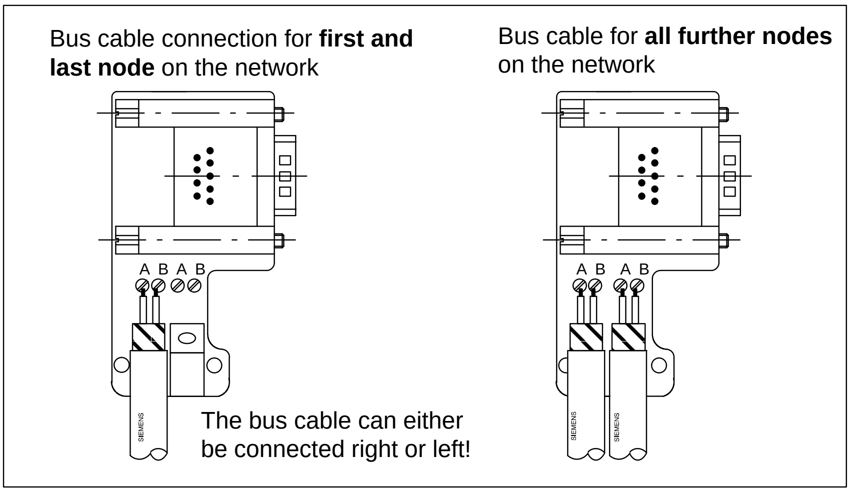


Figure 7-14 Connecting the Bus Cable to the Bus Connector 6ES7 972-0B.10-0XA0

8. Close the housing.

   Make sure that the shielding is bare under the pressure saddle.

7.2.5 Plugging the Bus Connector into Module

Connecting the Bus Connector

Proceed as follows to connect the bus connector:

1. Plug the bus connector into the module.
2. Screw the bus connector tight on the module.
3. If the bus connector 6ES7 972-0B.20-0XA0 is installed at the start or end of a segment, you must activate the terminating resistance (switch setting "ON") (see Figure 7-15).

Please make sure that power is always supplied to the stations where the terminating resistance is fitted during start-up and normal operation.

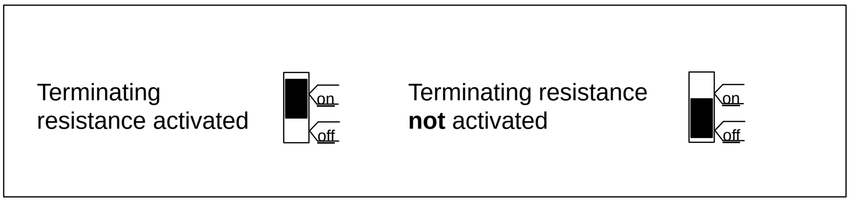


Figure 7-15 Bus Connector: Terminating Resistance Activated and Deactivated

Disconnecting the Bus Connector

With a **looped-through network cable**, you can unplug the bus connector from the PROFIBUS interface at any time, without interrupting data communication on the network.

Warning

A data communication error may occur on the network.

A network segment must always be terminated at both ends with the terminating resistor. This is not the case, for example, if the power supply is not activated on the last slave with a bus connector. Since the bus connector draws power from the station, the terminating resistor has no effect.

Please make sure that power is always supplied to stations on which the terminating resistor is active.

7.2.6 RS 485 Repeater

Purpose of the RS 485 Repeater

The RS 485 repeater amplifies data signals on bus lines and interconnects network segments.

You need an RS 485 repeater if:

- more than 32 nodes are connected to the network
- a grounded segment is to be connected to a non-grounded segment, or
- the maximum cable length of a segment is exceeded (see Table 7-9).

Table 7-9 Maximum Cable Length of a Segment

Baud Rate	Max. Cable Length of a Segment (in m)
9.6 to 187.5 kbaud	1000
500 kbaud	400
1.5 Mbaud	200
3 to 12 Mbaud	100

Rules

If you set up the bus with RS 485 repeaters:

- Not more than nine RS 485 repeaters may be connected in series.
- The maximum cable length between two nodes must not exceed the values in Table 7-10 for the RS 485 repeater, Order No. 6ES7 972-0AA00-0XA0:

Table 7-10 Maximum Cable Length between Two Nodes

Baud Rate	Max. Cable Length Between Two Nodes (in m) with RS 485 Repeater (6ES7 972-0AA00-0XA0)
9.6 to 187.5 kbaud	10000
500 kbaud	4000
1.5 Mbaud	2000
3 to 12 Mbaud	1000

Description of the RS 485 Repeater

You will find a description and the technical specifications of the RS 485 repeater in Chapter 7 of the Reference Manual *Modules for S7-300/M7-300/ET 200M*.

Mounting

You can mount the RS 485 repeater either on the S7-300 rail or on a 35-mm standard rail.

To mount it on the rail, remove the slide at the rear of the RS 485 repeater as follows:

1. Insert a screwdriver under the edge of the latching element and
2. Move the screwdriver towards the rear of the module. Keep this position.
3. Move the slide upwards.

Figure 7-16 shows how the slide of the RS 485 repeater is removed.

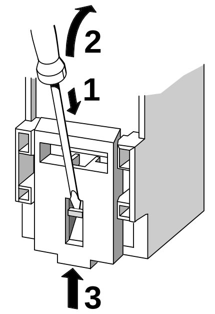


Figure 7-16 Removing the Slide on the RS 485 Repeater

When you have removed the slide, you can mount the RS 485 repeater on the rail as any other M7-300 module (see Section 5.5).

Use flexible cables with a cross-sectional core area of 0.25 mm^2 to 2.5 mm^2 (AWG 26 to 14) to connect the 24 VDC power supply.

Wiring the Power Supply

Proceed as follows to wire the power supply of the RS 485 repeater:

1. Loosen the screws “M” and “PE”.
2. Strip the insulation of the 24 VDC power supply cable.
3. Connect the cable to terminals “L+” and “M” or “PE”.

Terminal “M5.2”

Terminal “M5.2” is a terminal that you do not need to wire, as it is only used for servicing. The terminal “M5.2” supplies the reference potential. You need this reference potential to measure the voltage characteristic between terminals “A1” and “B1”.

Connecting the PROFIBUS Bus Cable

You must connect the PROFIBUS bus cable to the RS 485 repeater as follows:

1. Cut the PROFIBUS bus cable to the length you require.
2. Strip the insulation of the PROFIBUS bus cable as shown in Figure 7-17.

   The shield braiding must be turned up onto the cable. Only thus, the shielding point can later act as a strain relief and a shield support element.

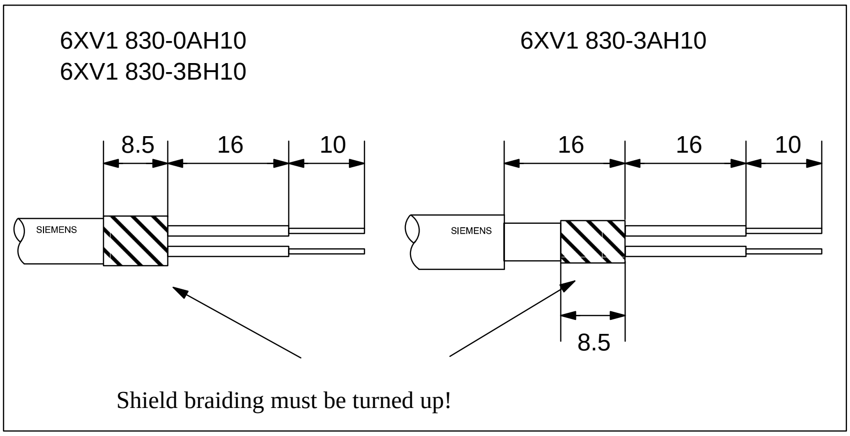


Figure 7-17 Lengths of the Stripped Insulation for Connection to the RS 485 Repeater

3. Connect the PROFIBUS bus cable to the RS 485 repeater:

   Connect similar cores (green/red for PROFIBUS bus cable) to similar terminals A or B (for example, always connect a green wire to terminal A and a red wire to terminal B).
4. Tighten the pressure saddles, so that the shielding is bare under the pressure saddle.

Preparing an M7-300 for Operation and Startup of PROFIBUS-DP

8

Introduction

Explained in this chapter are the steps you must take to prepare the M7-300 automation computer for operation, and start up an PROFIBUS-DP subnet with a CPU 388-4 (including expansion module EXM 378 and interface submodule IF 964-DP) as the DP master.

Chapter Overview

8.1 Checklist

Contents

This section contains information listed in brief form on the steps required for startup (as an overview) and to prepare an M7-300 for operation (in detail).

Steps for Startup

The startup activities can be subdivided into several steps which you take in the following order:

1. Installing and wiring the hardware (see Chapter 5 and 6); preparation for operation, executing BIOS setup if applicable (see Section 10.4),
2. Using STEP 7 software to configure the hardware and assign parameters (see STEP 7 User Manual).
3. Transferring the operating system (see STEP 7 User Manual).
4. Placing an PROFIBUS-DP subnet in operation, if applicable, with a CPU 388-4 (including expansion module EXM 378 and interface submodule IF 964-DP) as the DP master (see Page 8-17),
5. Loading the user software from the programming device/PC into the CPU, testing it and starting it (STEP 7 User Manual).

Given in the following, in the form of a checklist in the required order, are the activities to be carried out to prepare for operation. For the individual points, the checklist contains references for finding detailed information.

Checklist for Preparing for Operation

Please proceed as follows:

1. Insert a backup battery, if required (see Page 8-3).
2. Set the key of the mode switch to RUN.
3. Connect the intended operator panels and peripherals (see Page 8-5).
4. Switch on the peripherals.
5. Switch on the power supply (PS) on the rail.
6. Check that the status and error indicators are correct (see Page 8-16).

8.2 Inserting the Backup Battery

When a Battery is Needed

The CPU of the M7-300 does not normally need a backup battery.

It may be necessary to install a backup battery

- to back up the clock,
- and to back up the SRAM.

Note

You need only use a backup battery when the clock settings must be backed up, as with an AT-compatible PC or SRAM.

Inserting the Backup Battery

Proceed as follows to insert a backup battery in a CPU.

1. Open the front door of the CPU.
2. Insert the battery connector in the corresponding socket in the CPU battery compartment. The marker on the battery connector must point to the left.
3. Insert the backup battery in the CPU battery compartment.
4. Close the front door of the CPU.

How to Insert the Battery

Figure 8-1 shows how to insert a backup battery in a CPU.

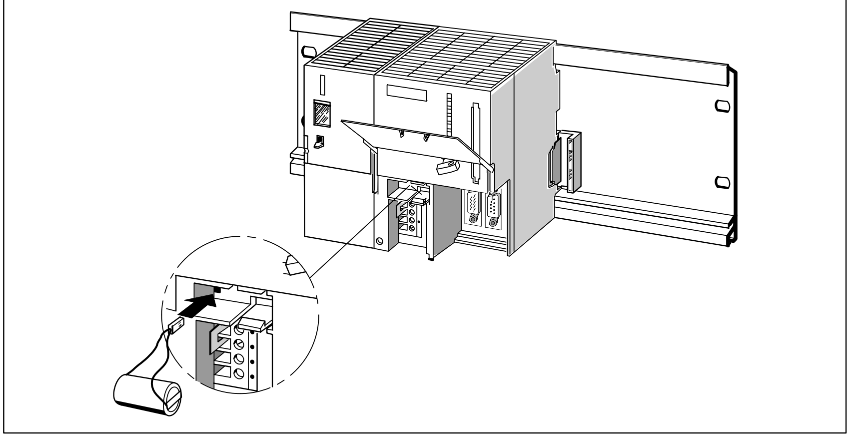


Figure 8-1 Inserting a Backup Battery in the CPU

8.3 Inserting/Removing a Memory Card

Purpose of the Memory Card

By using a memory card, you can

- transport the programs and data stored on the memory card;
- retain the programs and data, even during Power Off.

Caution

Data can be lost.

If the memory card is removed whilst the user program is executing a write operation, data can be lost.

If you are not sure whether write operations onto the memory card are taking place, only change it with power removed.

If possible, avoid switching modules off during a memory card operation.

Inserting/Removing the Memory Card

A memory card should only be inserted or removed when no access to the memory card is taking place, i.e. the “SD” indicator on a CPU must be OFF.

Figure 8-2 shows how to insert a memory card a CPU.

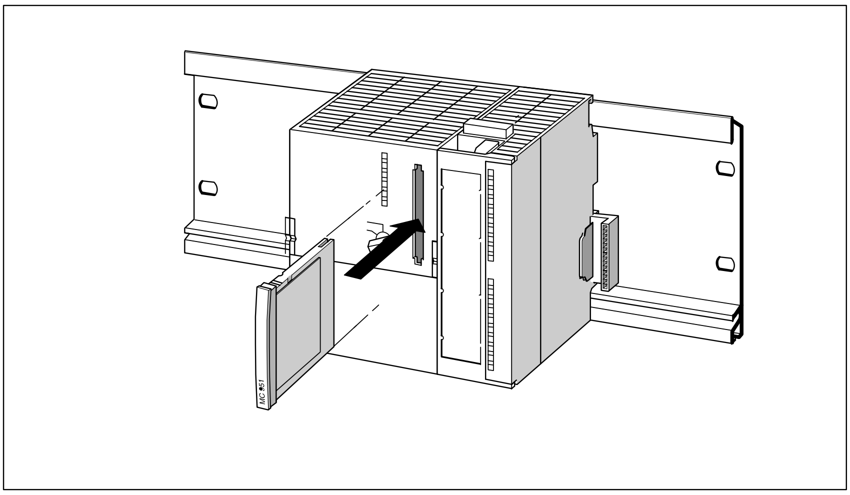


Figure 8-2 Inserting a Memory Card in a CPU

8.4 Connecting the Operator Panels and I/O

Introduction

The operator panels and peripherals which can be connected to your M7-300 depend on its configuration.

Extensive information on all connection options of the M7-300 can be found in the appropriate sections of the technical data.

To prepare for operation, you need either a PC/programming device or the M7-300 configuration with monitor, keyboard, expansion module and mass storage module as well as interface submodules.

For reasons of noise immunity of the entire system, we recommend that you use the standard connecting cables available from Siemens for connecting the peripherals.

Note

When the monitor cable and connecting cables between CPU and keyboard, printer, etc. are routed in parallel with power cables, video interference can be created on the monitor as well as interference in the entire M7-300 system.

The monitor cable and connecting cables between the M7-300 and keyboard, printer, etc. must not be routed in parallel with power cables.

If necessary, install a separate cable rack with a minimum clearance of 50 cm from the power cables.

Connecting a Keyboard

Connect the keyboard to the 6-pin mini DIN circular socket of the IF 962-VGA interface submodule.

Connecting a Local VGA Monitor

To operate a local VGA monitor, connect it to the 15-pin high-density subminiature D female connector of interface submodule IF 962-VGA (up to 2.5 m).

Notes for Setting Up Monitors

Please observe the following notes when setting up monitors:

- Ensure that the clearance between two monitors in asynchronous operation is at least 15 cm, otherwise video interference may occur. Exception: Monitors with a mu-metal shield.
- Provide sufficient space between the monitor and extraneous magnetic sources.
- Do not set up the monitors in steel shelving or on steel benches. Magnetization of the surrounding sheet steel can result in false colors or video shifting.
- Avoid setting up monitors in the vicinity of transformers, radio transmitters, magnets and power cables.
- The effects of extraneous magnetic fields can be attenuated by using a mu-metal shield.

Special Conditions when Using Office Monitors

Additionally, you should observe the following notes when setting up office monitors:

- Office monitors with an internal metallized plastic housing should not be used in an environment subject to electromagnetic interference, because the internal metal surface cannot subsequently be connected to the external ground bus. The required isolation of the electronics ground from the housing ground of the monitors - essential for an environment subject to electromagnetic interference - is not possible with most office monitors.
- You can only use such monitors in conjunction with conventional VGA cables.

Connecting a Printer

You can connect printers with a serial or parallel interface.

- A printer with a parallel interface should be connected with the appropriate connecting cable (see Section C, Ordering Information)
- A printer with a serial interface should be connected with the appropriate connecting cable (see Ordering Information) to a COM interface (for example, interface X1 of the CPU or interface of interface submodule IF 962-COM).

We recommend the use of Siemens printers.

For further information on these printers, such as technical data and order numbers for accessories (printer cables, interfaces, etc.) please refer to Section C (Ordering Information).

Note

Only a connecting cable with the shield grounded at both ends should be used between an M7-400 component and a printer.

Connecting a Mouse

Connect the mouse either to the COM1 interface or to interface submodule IF 962-COM.

Maximum Cable Lengths

The following table specifies the maximum cable lengths of the connecting cables for the individual devices. A prerequisite is a hardware configuration with interference immunity.

Table 8-1 Maximum Cable Lengths for Operator Panels and Peripherals

Device	Maximum Length
Keyboard • via IF 962-VGA	2.5 m
Monitor • via IF 962-VGA	2.5 m
Printer via IF 962-LPT parallel interface	3 m

8.5 Connecting a Programming Device (PG) to the COM Interface

Introduction

To operate your M7-300 without monitor and keyboard, you need a programming device or PC for initial settings in the BIOS setup.

This section explains how to connect a programming device via the COM1 interface to your M7-300. However, it is also possible to connect a programming device via the MPI of the M7-300 CPU. In this case, please refer to Section 8.6.

Connecting an M7-300 to the Programming Device

Connect the 9-pin subminiature D connector of the COM1 interface of your CPU to the connector of a free COM interface of your programming device. The following types of connection are possible:

- Connection using control cables
- Connection without using control cables

Connection with Control Cables

When the interface control cables are used for data traffic via the COM interface, you need a null modem cable. This depends on the programs which control the data traffic on the CPU or programming device/PC.

This may be necessary when, for example, you enter a console redirection in the autoexec.bat of your CPU:

```
:
CTTY COM1
:
```

If the free COM interface of your programming device has a 9-pin subminiature D connector, you can use Table 8-2 below for the pin assignments of the null-modem cable.

This cable can also be procured preassembled (see V.24 cables in Appendix C, Ordering Information).

Table 8-2 Null-Modem Cable for Connecting a CPU to the COM Interface of a PG with 9-pin Sub. D Male Connector

Signal	Pin	Connection	Pin	Signal
E1 / GND	U	connected to	U	E1 / GND
M5 / DCD	1	–	1	M5 / DCD
D2 / RxD	2	connected to	3	D1 / TxD
D1 / TxD	3	connected to	2	D2 / RxD
S1 / DTR	4	connected to	6	M1 / DSR
E2 / GND	5	connected to	5	E2 / GND

Table 8-2 Null-Modem Cable for Connecting a CPU to the COM Interface of a PG with 9-pin Sub. D Male Connector, continued

Signal	Pin	Connection	Pin	Signal
M1 / DSR	6	connected to	4	S1 / DTR
S2 / RTS	7	connected to	8	M2 / CTS
M2 / CTS	8	connected to	7	S2 / RTS
M3 / RI	9	–	9	M3 / RI
9-pin sub. D female conn. (COM1 for CPU)		Pin ”U” = housing (shield) Length: 10 m max.	9-pin sub. D female conn. (COMx for PG)	

If the free COM interface of your programming device has a 25-pin subminiature D female connector, you can use Table 8-3 below for the pin assignments of the null-modem cable.

Table 8-3 Null-Modem Cable for Connecting a CPU to the COM Interface of a PG with 25-pin Sub. D Female Connector

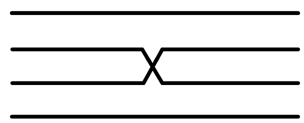
Signal	Pin	Connection	Pin	Signal
E1 / GND	U	connected to	U	E1 / GND
M5 / DCD	1	_	8	M5 / DCD
D2 / RxD	2	connected to	2	D2 / RxD
D1 / TxD	3	connected to	3	D1 / TxD
S1 / DTR	4	connected to	6	M1 / DSR
E2 / GND	5	connected to	7	E2 / GND
M1 / DSR	6	connected to	20	S1 / DTR
S2 / RTS	7	connected to	5	M5 / CTS
M2 / CTS	8	connected to	4	S2 / RTS
M3 / RI	9	_	22	M3 / RI
9-pin sub. D female conn. (COM1 for IF)		Pin ”U” = housing (shield) Length: 10 m max.	25-pin sub. D male conn. (COMx for PG)	

Connection without Control Cables

If the data traffic via the COM interface is to be controlled exclusively via the data lines (depending on the interface software), a connecting cable as described below is sufficient for connecting your CPU to a programming device.

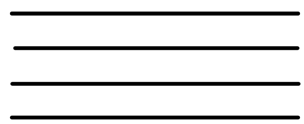
If the free COM interface of your programming device has a 9-pin subminiature D male connector, you can use Table 8-4 below for the pin assignments of the connecting cable.

Table 8-4 Pin Assignments of the Cable for Connecting a CPU to the COM Interface of a PG with 9-pin Sub. D Male Connector

Signal	Pin	Connection	Pin	Signal
E1 / GND	U		U	E1 / GND
D2 / RxD	2		2	D2 / RxD
D1 / TxD	3		3	D1 / TxD
E2 / GND	5		5	E2 / GND
9-pin sub. D female conn. (COM1 for IF)		Pin ”U” = housing (shield) Length: 10 m max.	9-pin sub. D female conn. (COMx for PG)	

If the free COM interface of your programming device has a 25-pin subminiature D female connector, you can use Table 8-5 below for the pin assignments of the connecting cable.

Table 8-5 Pin Assignments of the Cable for Connecting a CPU to the COM Interface of a PG with 25-pin Sub. D Female Connector

Signal	Pin	Connection	Pin	Signal
E1 / GND	U		U	E1 / GND
D2 / RxD	2		2	D1 / TxD
D1 / TxD	3		3	D2 / RxD
E2 / GND	5		7	E2 / GND
9-pin sub. D female conn. (COM1 for IF)		Pin ”U” = housing (shield) Length: 10 m max.	25-pin sub. D male conn. (COMx for PG)	

8.6 Connecting a Programming Device to MPI

Requirements

The programming device must be equipped with either an MPI board or with an integrated MPI interface in order to connect it to an M7-300.

Possible Connections

This chapter explains how to connect the programming device to the MPI:

- Programming Device to an individual M7-300
- Programming Device to two or more nodes in a subnet
- Programming Device to nodes in an ungrounded configuration

Cable Lengths

Information on the possible cable lengths can be found in Section 7.1.3.

8.6.1 Connecting a Programming Device (PG) to an M7-300

Connecting a Programming Device to an M7-300

You can connect the programming device via a preassembled programming device cable to the MPI of the CPU.

Alternatively, you can fabricate the connecting cable with the PROFIBUS cable and bus connectors (see Section 8.6.2).

Shown in Figure 8-3 are the components for connecting a programming device to the M7-300.

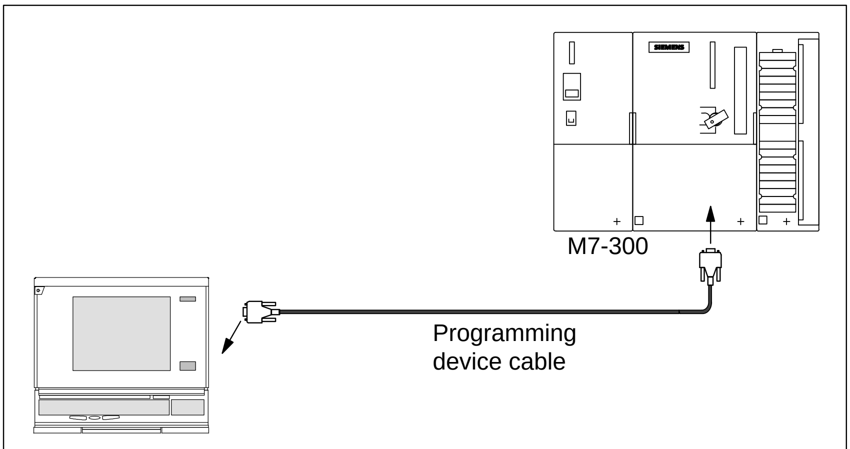


Figure 8-3 Connecting a Programming Device to the M7-300

8.6.2 Connecting a Programming Device to Several Nodes

Two Types of Configuration

When connecting a programming device to several nodes, you must differentiate between two types of configuration:

- Programming device permanently installed in the MPI subnet
- Programming device connected for startup or maintenance purposes.

Depending on these two types, you connect the programming device to the other nodes as follows (see Section 7.1.2).

Type of Configuration	Connection
Programming device permanently installed in the subnet	Integrated directly into the MPI subnet
Programming device installed for startup or maintenance	Programming device connected to a node via a spur line

Stationary Programming Device

You connect the programming device that is permanently installed in the MPI subnet directly to the other nodes in the MPI subnet via bus connectors in accordance with the rules described in Section 7.1.2.

Figure 8-4 shows an M7-300 network with two M7-300s. The two M7-300s are interconnected via bus connectors.

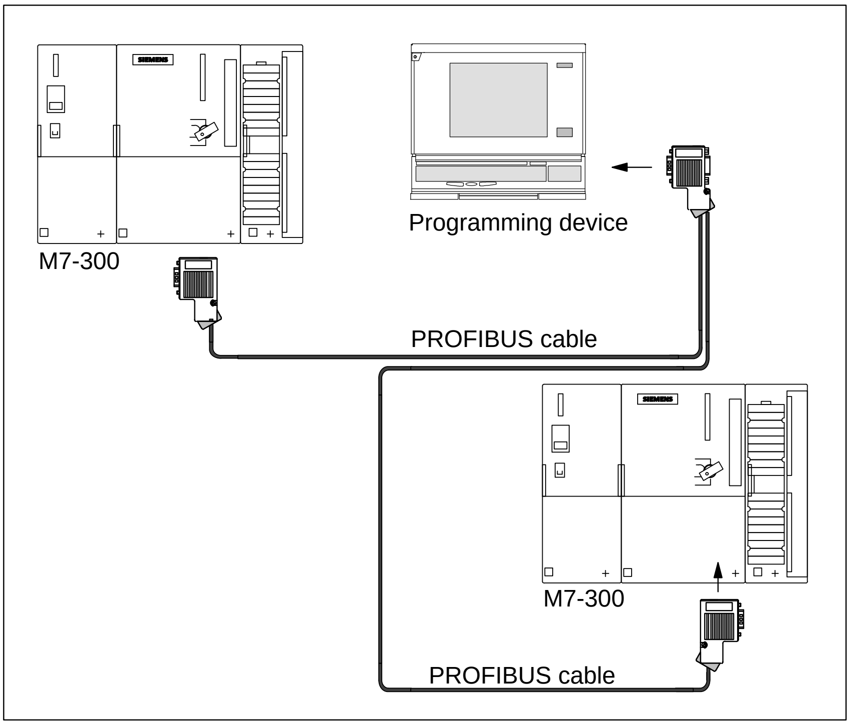


Figure 8-4 Connecting a Programming Device with Several M7-300s

Connecting a Programming Device for Service Purposes

If there is no stationary programming device, we recommend the following:

In order to connect a programming device for service purposes to an MPI subnet with “unknown” nodes addresses, we recommend to set the following address on the service programming device:

- MPI address: 0
- Highest MPI address: 126.

Then use the STEP 7 software to determine the highest MPI address in the MPI subnet and adjust the highest MPI address in the programming device to that of the MPI subnet.

Programming Device for Startup or Maintenance

For startup or maintenance purposes, you connect the programming device via a spur line to a node of the MPI subnet. The bus connector of that node must therefore be provided with a programming device socket (see also Section 4.1).

Figure 8-5 shows the connection of a programming device to two networked M7-300s.

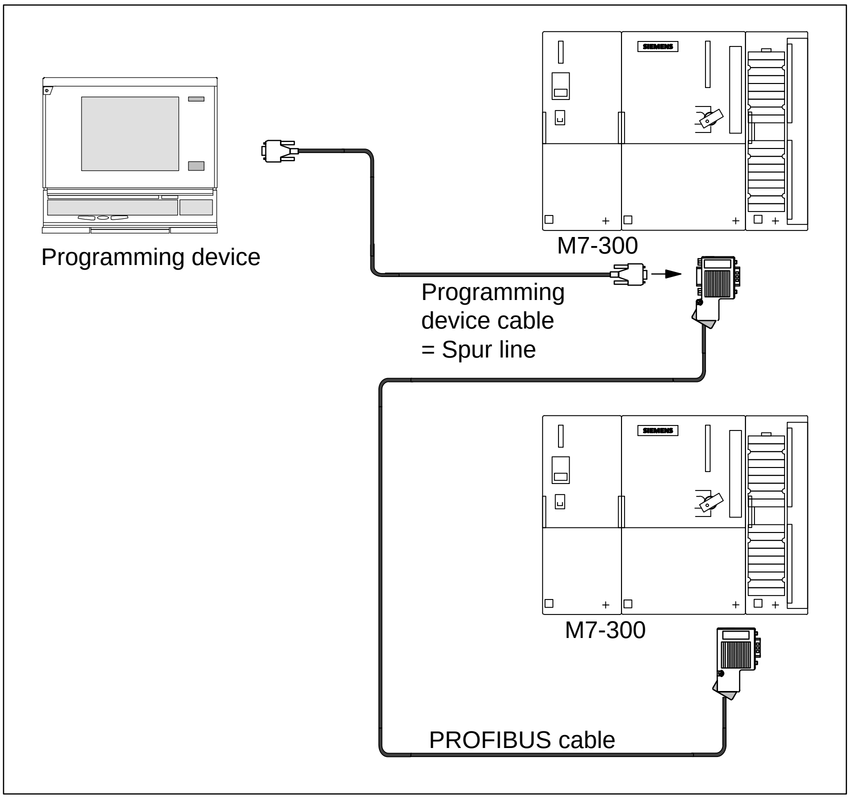


Figure 8-5   Connecting a Programming Device to a Subnet

8.6.3 Connecting a Programming Device to Ungrounded Nodes of an MPI Subnet

Programming Device to Ungrounded Nodes

If you have an ungrounded configuration of nodes in an MPI subnet or an ungrounded M7-300 (see Section 4.4), you may connect only an ungrounded programming device to the MPI subnet or the M7-300.

Grounded Programming Device to MPI

You want to operate the nodes in an ungrounded configuration (see Section 4.4). If the MPI at the programming device is grounded, you must connect an RS 485 repeater between the nodes and the programming device. You must connect the ungrounded nodes to bus segment 2, if you connect the programming device to bus segment 1 (terminals A1 B1) or the programming device/OP interface (see Chapter 7 of the “S7-300, M7-300 Module Specifications” Reference Manual).

Figure 8-6 shows the RS 485 repeater as an interface between a grounded and an ungrounded node in the MPI subnet.

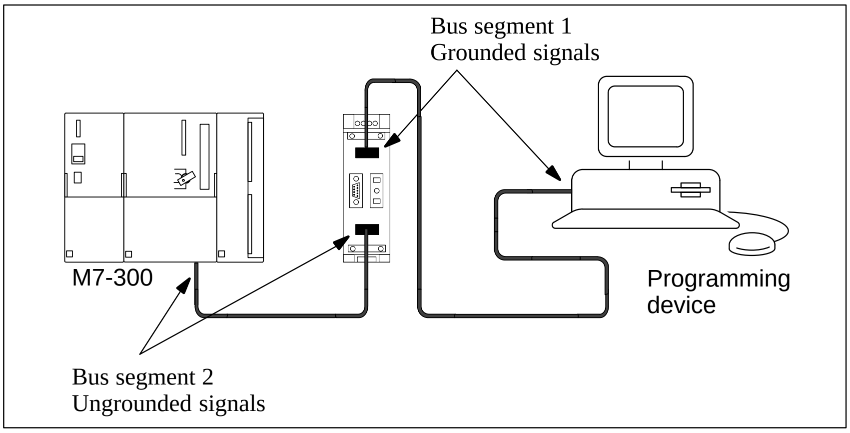


Figure 8-6 Ungrounded Operation of the M7-300 in the Subnet

8.7 Checking the Status and Error Indicators

Switching the M7-300 on for the First Time

When the supply voltage is switched on, all status and error indicators of the CPU of your M7-300 light up briefly. If the mode switch is set to STOP, the STOP status/error indicator lights up after switching on. Otherwise the module boots up. In the event of a fault, the SF indicator lights up.

If this is not the case with your modules, please consult your Siemens contact at a maintenance and repair center or the SIMATIC hotline.

This completes preparations for operation as covered in this Manual.

The remaining stages, such as installing the operating system and the user program, can be found in the M7-SYS User Manual.

8.8 Starting the PROFIBUS-DP

This Section

This section explains how to start up a PROFIBUS-DP subnet with a CPU 388-4 (including EXM 378 and IF 964-DP) as the DP master.

Prerequisites

Before you can start up the PROFIBUS-DP subnet, the following steps must have been taken:

- The PROFIBUS-DP subnet has been set up (see Chapter 5).
- The M7 system software is installed (see M7-SYS User Manual).
- The CPU 388-4 is equipped with an EXM 378 interface module, which is connected to the PROFIBUS-DP subnet.
- With STEP 7, you have configured the PROFIBUS-DP subnet and assigned an PROFIBUS address and the address area to all nodes (see STEP 7 *User Manual*). Note that address switches must also be set on some DP slaves (see the description of the relevant DP slaves).

Startup

Proceed as follows to start up the PROFIBUS-DP subnet:

1. Use the programming device to load the configuration of the PROFIBUS-DP subnet (specified configuration) created with STEP 7 into the CPU 388-4. This procedure is described in the . STEP 7 User Manual.
2. Switch on all DP slaves.
3. Switch the CPU 388-4 from STOP to RUN.

Reactions of the CPU 388-4 During the Start

During the start, the CPU 388-4 compares the setpoint configuration with the actual configuration. You set the duration of the test via STEP 7 with the parameter for module time limits in the “startup” parameter block.

If the setpoint configuration = actual configuration, the CPU goes to RUN.

If the etpoint configuration ≠ actual configuration, the reactions of the CPU depend on the setting of the parameter for starting when setpoint ≠ actual configuration:

Starting when setpoint ≠ actual config. = yes (default)	Starting when setpoint ≠ actual config. = no
CPU 388-4 goes in RUN	CPU 388-4 remains at STOP. In this case, check whether all slaves are switched on or read out the diagnosis buffer (STEP 7 User Manual).

To set the parameters in the “startup” parameter block, see the M7-SYS User Manual, STEP 7 User Manual and the online help of STEP 7.

Replacing a Backup Battery, Module and Fuse

9

Introduction

This chapter explains the following:

- How to replace the backup battery
- What to observe when disposing of the backup battery
- How to replace the modules
- How to replace fuses in digital output modules and which replacement fuses you may use.

Chapter Overview

9.1 Replacing and Disposing of the Buffer Battery

Note

Only replace the battery with POWER ON, otherwise the time and the data in the SRAM will be lost.

Replacing the Buffer Battery

To replace the buffer battery of a CPU, proceed as follows:

1. Open the front door.
2. Pull the buffer battery out of the battery compartment (Figure 9-1) and the battery plug out of the socket with the aid of a screwdriver.
3. Push the battery plug of the new buffer battery into the corresponding socket in the battery compartment. The notch on the battery plug must point to the left (Figure 9-1)!
4. Place the new buffer battery in the battery compartment.
5. Close the front door.

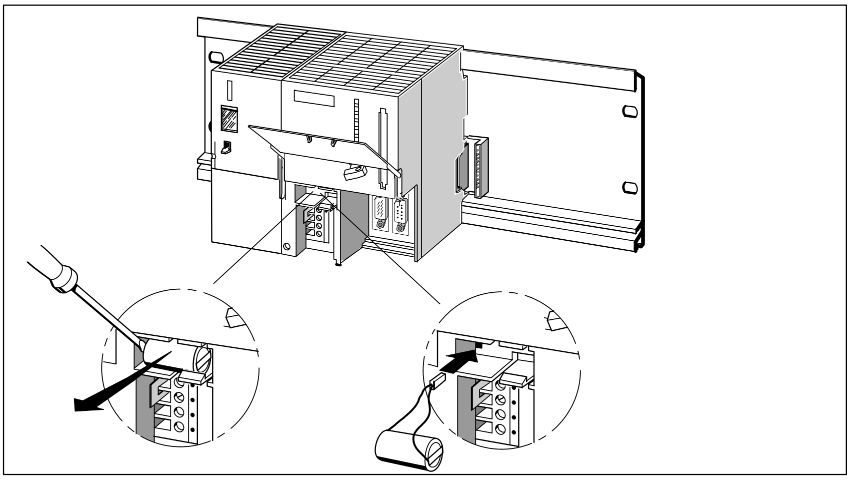


Figure 9-1 Inserting the Backup Battery in the CPU

How Often to Change

We recommend that the buffer battery should be changed after a year.

Disposal

Observe your national regulations/guidelines when disposing of buffer batteries.

Storage of Buffer Batteries

Store buffer batteries in a cool dry place.

Buffer batteries can be stored for 5 years.

Warning

Buffer batteries may catch fire or explode if damaged or exposed to heat and there is a danger of severe burns.

Store buffer batteries in a cool dry place.

Rules for Handling Buffer Batteries

To avoid danger when handling buffer batteries, the following rules must be observed:

Warning

Incorrect handling of buffer batteries may lead to personal injury and property damage.

Incorrect handled buffer batteries may explode and cause severe burns.

- Do not recharge,
- Do not heat,
- Do not burn,
- Do not drill through,
- Do not squash,
- Do not short-circuit.

9.2 Rules for Replacing Modules

Rules for Installation and Wiring

The following table shows you what rules to observe when wiring and when installing or removing M7-300 modules.

Rules for	... Power Supply	... CPU and Expansions	... SM, FM, CP
Width of screwdriver blade	3.5 mm (5/32″)(cylindrical form)		
Tightening torque:			
• Fixing modules to DIN rail	From 0.8 to 1.1 Nm		From 0.8 to 1.1 Nm
• Connecting cables	From 0.5 to 0.8 Nm		–
POWER OFF when replacing the ...	Yes		No
Operating mode of M7-300 when replacing the ...	–		STOP
Load supply OFF when replacing the ...	Yes		

Initial Situation

The module to be replaced is installed and wired. A new module of the same type is to be installed.

Caution

During data traffic via the MPI, you must not replace any modules of the M7-300, otherwise data can be corrupted by interference pulses.

Pull out the connector at the MPI if you are not sure.

9.3 Replacing a Power Supply Module or CPU

Removing a Module

Proceed according to the following sequence to remove a module:

1. Switch the CPU and all function modules in your M7-300 to STOP with the mode switch.
2. Switch off the load voltage for the module.
3. Disconnect the automation computer from the supply.
4. Open the front door of the module.
5. Disconnect the interface connectors (COM 1, MPI) at the CPU.
6. Slacken the screws of the front connector and, on the power supply module, additionally the screw of the strain relief (Figure 9-2).
7. Pull the cables and, on the power supply module and CPU, the link, out of the front connector (Figure 9-2).

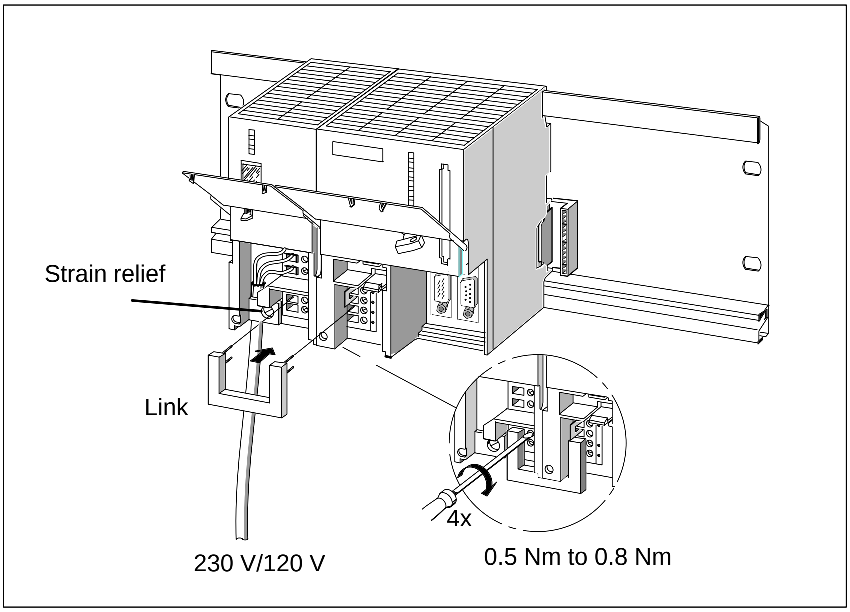


Figure 9-2 Slackening the Front Connector Screws on the Power Supply Module and CPU and Pulling off the Link

8. Slacken the mounting screw(s) of the module (Figure 9-3).

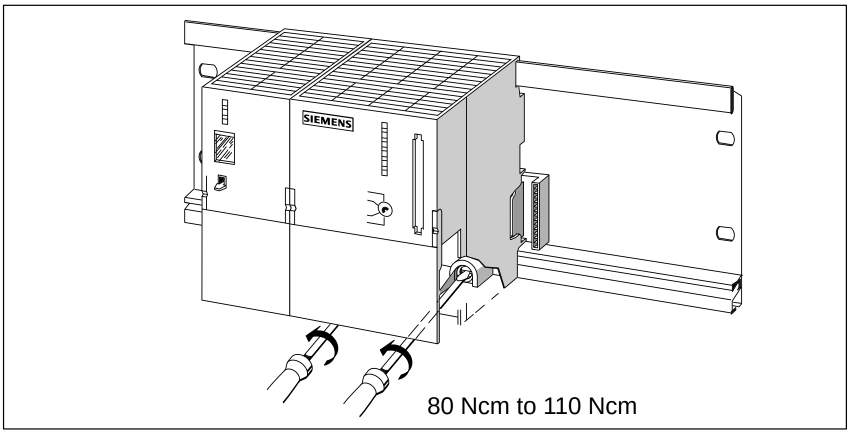


Figure 9-3 Slackening the Screws of the Module

9. Swing the module upward, lift it up and off.

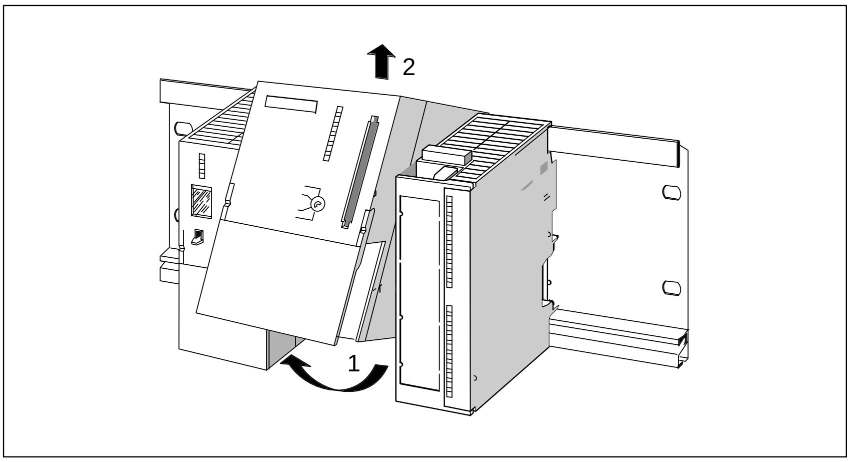


Figure 9-4 Swinging the Module Upward and Removing it

Installing and Wiring a Module

Install and wire the new module in the reverse order. Further details can be found in Section 5.5 “Installing the Modules on the Rail” and in Chapter 6 “Wiring an M7-300”.

Reactions of the M7-300 after Module Replacement

When a module has been replaced, the CPU goes to the RUN state if there are no errors. If the CPU remains in the STOP state, you can display the cause of the error with the STEP 7 software (see STEP 7 User Manual). If the cause of the error is not displayed, check the BIOS setup or install the system software again if necessary.

9.4 Replacing a CPU or Expansion in a Module Assembly

Removing a Module

Proceed according to the following sequence to remove a module from a module assembly:

1. Switch the CPU and all function modules in your M7-300 to STOP with the keyswitch.
2. Switch off the load voltage for the modules.
3. Disconnect the automation computer from the supply.
4. Open the front door of the CPU pertaining to the module assembly.
5. Disconnect the interface connectors at this CPU and, if applicable, at the expansion modules relating to interface submodules.
6. Slacken the screws of the front connectors (Figure 9-2).
7. Pull the cables and, on the CPU, the link out of the front connector (Figure 9-2).
8. Slacken the mounting screws of all modules in the module assembly. Figure 9-3 shows the positions of the mounting screws on a module.
9. Swing the module assembly upward and lift it off (Figure 9-5).

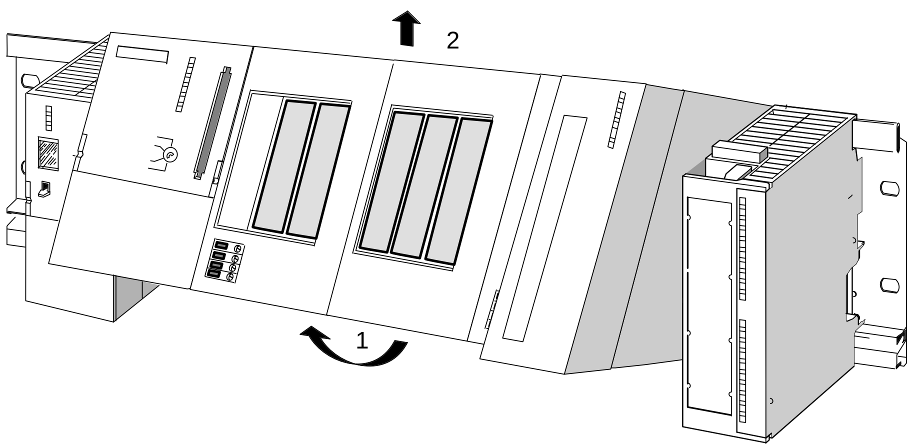


Figure 9-5 Swinging a Module Assembly Comprising CPU and Expansions upward and Lifting it off

10. Place the module assembly on a level surface (Figure 9-6).

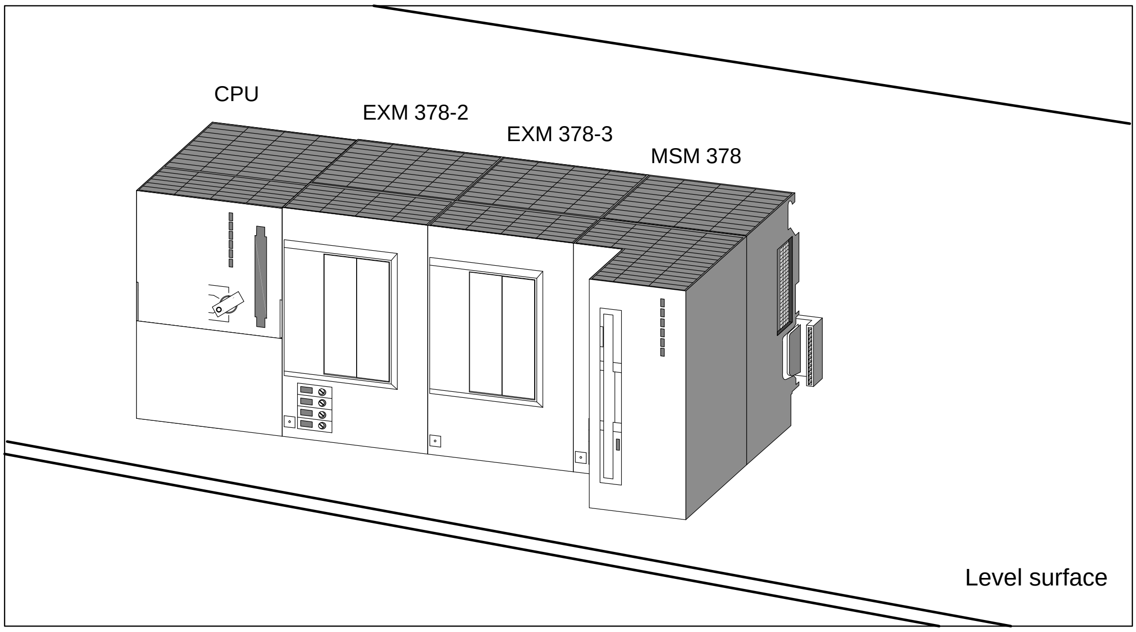


Figure 9-6 Placing the Module Assembly on a Level Surface

11. Disconnect the bus connectors between the module to be replaced and the adjacent modules. Figure 9-7 shows the location of a bus connector on the module.

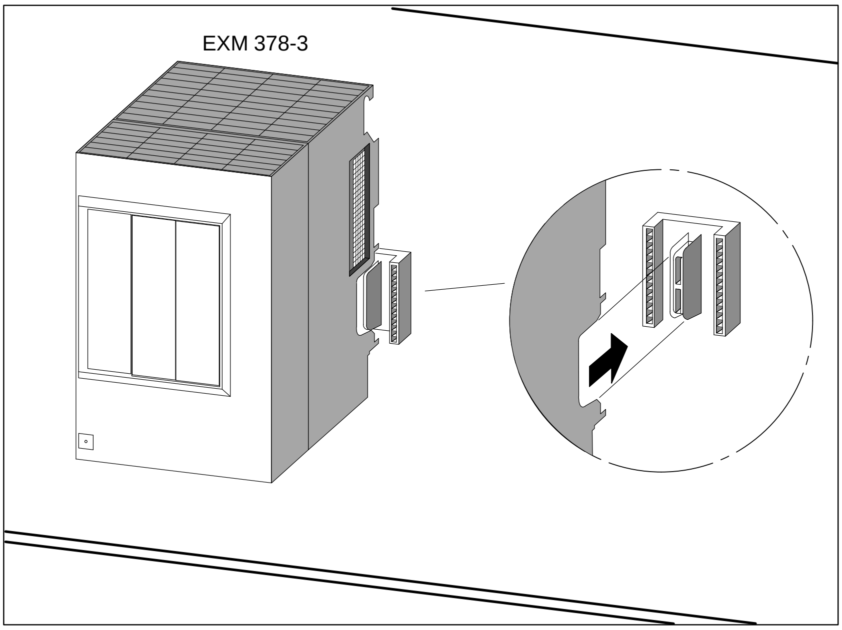


Figure 9-7 Disconnecting the Bus Connector from the Module

12. Pull the adjacent modules carefully away from the module to be replaced, so that the ISA bus connection is detached (Figure 9-8).

Warning

The connector pins can be damaged.

If you misalign the modules while pulling them apart, the connector pins can be damaged.

Pull the modules apart carefully, without misaligning them.

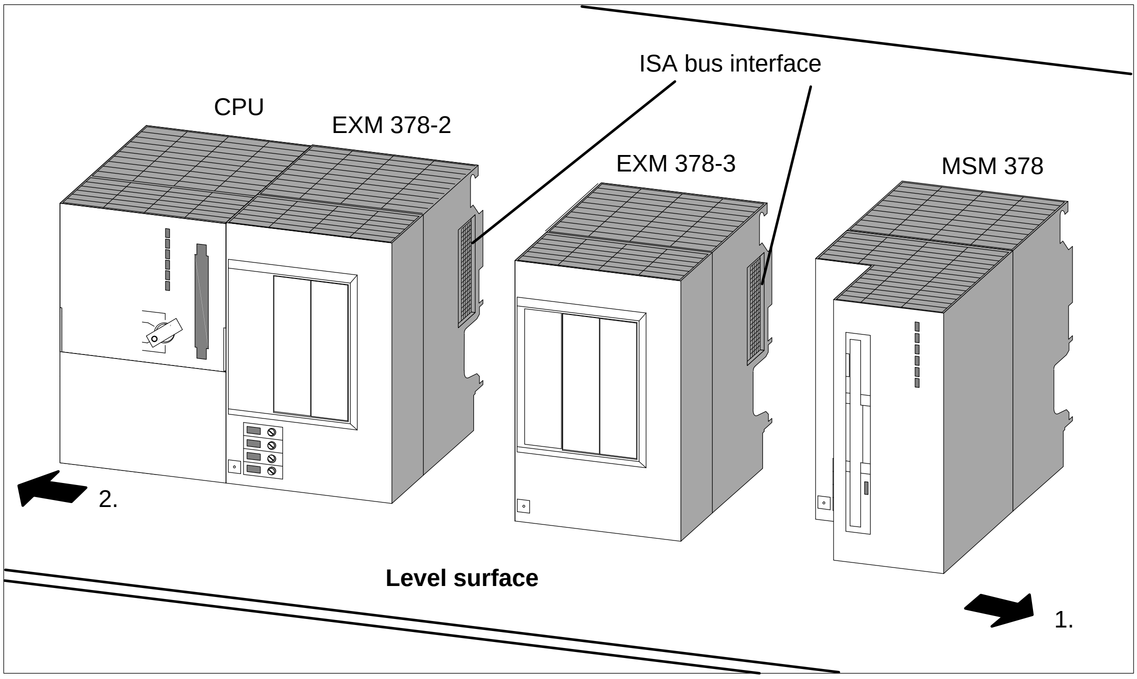


Figure 9-8 Separating a Module Assembly to Allow Replacement of Expansion Module EXM 378-3

13. To remove the interface submodules from an expansion module to be replaced, proceed as follows:
    - Observe the ESD guidelines (see Annex D) for handling the interface submodule.
    - Slacken the two captive slotted-head screws with which the front plate of the interface submodule is secured to the left frame of the card slot.
    - Carefully pull the interface submodule out of the guides of the card slot.

Warning

The modules can be damaged.

If the interface submodules are inserted or removed with power applied, the CPU, expansion modules and interface submodules can be damaged.

Never insert or remove interface submodules with power applied. Always switch off the power supply (PS) before inserting or removing interface submodules.

Avoid interchanging front connectors because this can result in destruction of the interface submodules or connected devices.

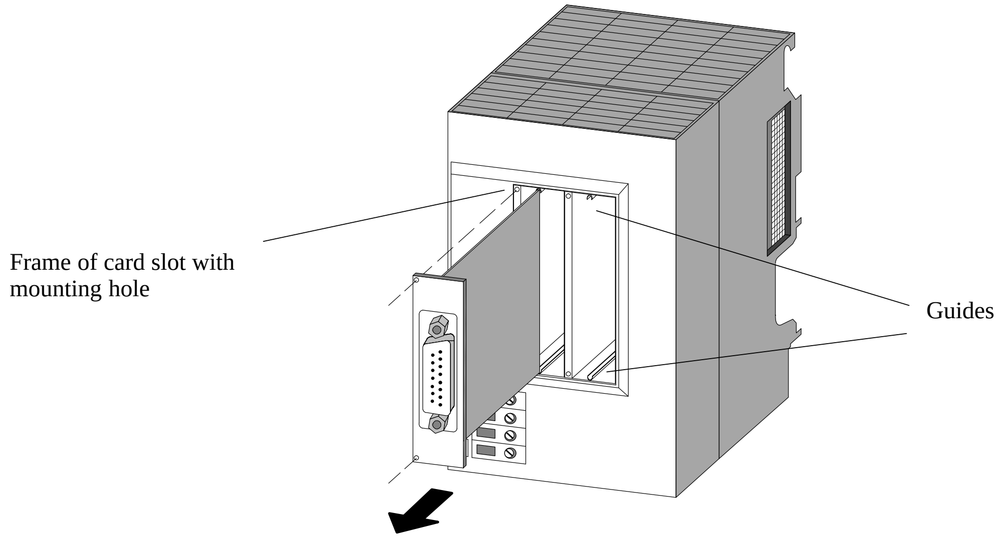


Figure 9-9 Removing an Interface Submodule from the Card Slot of the Expansion Module

Installing and Wiring a Module

Install and wire the new module in the reverse order. Further details can be found in Sections 5.4 “Expanding a CPU” and 5.5 “Installing the Modules on the Rail” as well as in Chapter 6 “Wiring an M7-300”.

Reactions of the M7-300 after Module Replacement

When a module has been replaced, the CPU goes to the RUN state if there are no errors. If the CPU remains in the STOP state, you can display the cause of the error with the STEP 7 software (see STEP 7 User Manual). If the cause of the error is not displayed, check the BIOS setup or install the system software again if necessary.

Note

If data media such as memory card or hard disk are replaced when changing modules, the operating system, user programs etc. will have to be re-installed (see the appropriate sections in the Programming Manual).

When an CPU 388-4 is replaced, it may be necessary to change the settings in the BIOS setup to those of the CPU 388-4 that has been replaced.

9.5 Replacing an SM/FM/CP

Removing the Module

Proceed according to the following sequence to remove a signal module, a function module or a communication processor:

Step	20-pin Front Connector	40-pin Front Connector
1.	Switch the CPU and all function modules in your M7-300 to STOP with the keyswitch.	
2.	Switch off the load voltage for the module.	
3.	Pull the labeling strip out of the module.	
4.	Open the front door.	
5.	Release the front connector and remove it.	
	Use one hand to press the release button (5) and use the other hand to pull the front connector out with the grips (5a).	Slacken the mounting screw in the middle of the front connector. Pull the front connector out with the grips.
6.	Slacken the mounting screw(s) of the module.	
7.	Swing the module out.	

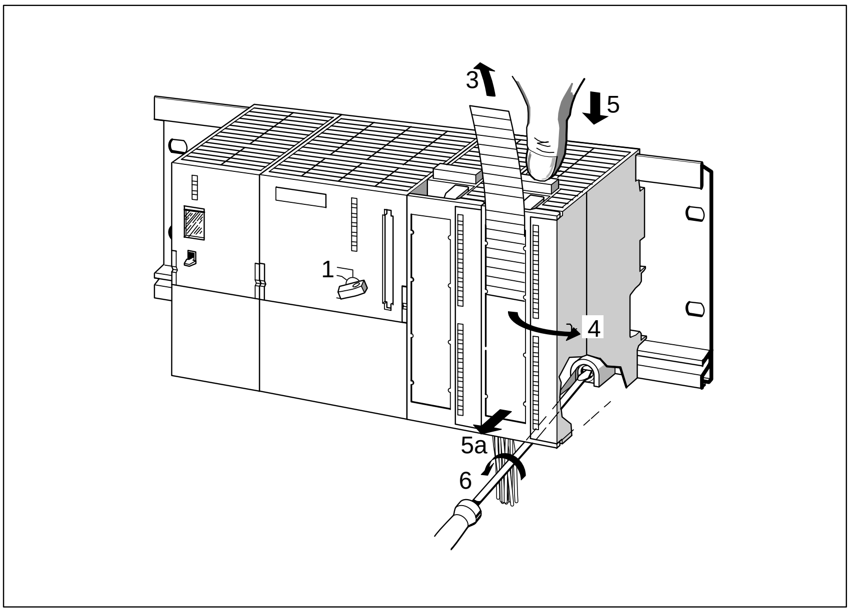


Figure 9-10 Releasing the Front Connector and Removing the Module

Removing the Front Connector Coding Key

Before installing the new module, you must remove the front connector coding key on the module.

Note: You must remove the upper part of the front connector coding key, because it is already inserted in the wired front connector (see Figure 9-11).

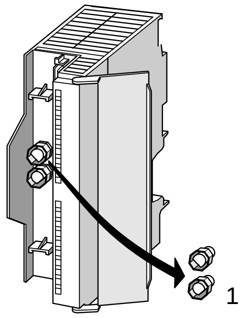


Figure 9-11 Removing the Front Connector Coding Key

Installing the New Module

Proceed as follows to install the new module:

1. Hook on the new module of the same type and swing it downward.
2. Screw the module on.
3. Insert the labeling strip of the removed module into the new installed module.

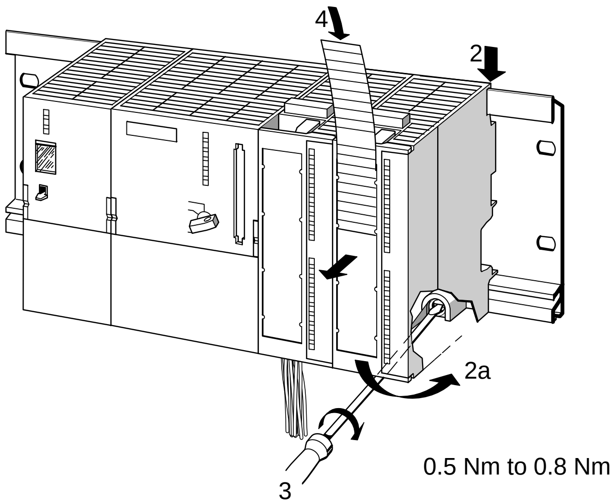


Figure 9-12 Installing the New Module

Removing the Front Connector Coding Key

If you want to rewire an already used front connector for another module, you must remove the front connector coding key from the front connector. Use a screwdriver to press the coding key out of the front connector. You must insert the upper part of this front connector coding key into the front connector of the old module.

Starting up the New Module

Proceed as follows to start up the new module:

1. Open the front door.
2. Place the front connector in its operating position again (see Section 6.6).

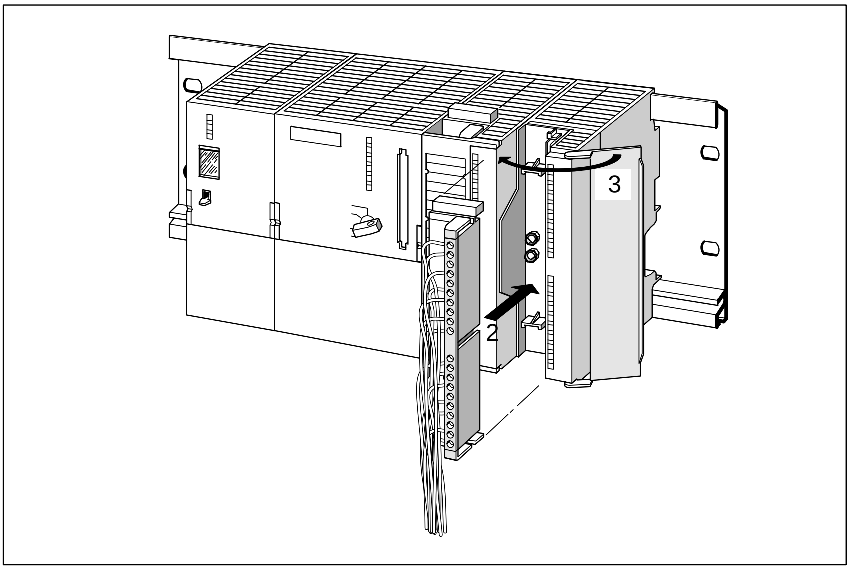


Figure 9-13 Inserting the Front Connector

3. Close the front door.
4. Switch the load voltage on again.
5. Set the CPU in the RUN state again.

Reactions of the M7-300 after Module Replacement

When a module has been replaced, the CPU goes to the RUN state if there are no errors. If the CPU remains in the STOP state, you can display the cause of the error with the STEP 7 software (see STEP 7 User Manual). If the cause of the error is not displayed, check the BIOS setup or install the system software again if necessary.

9.6 Replacing the Fuse on the 120/230 VAC Digital Output Modules

Fuse for Digital Outputs

The digital outputs of the following digital output modules are protected in channel groups with fuses against short-circuits:

- Digital output module SM 322; DO 16 x 120 VAC
- Digital output module SM 322; DO 8 x 120/230 VAC

Replacement Fuses

If you need to replace the fuses, you can use the following fuses, for example:

- Fuse 8 A, 250 V
  - Wickmann 19 194-8 A
  - Schurter SP001.013
  - Littlefuse 217.008
- Fuse holder
  - Wickmann 19 653

Locations of Fuses

The digital output modules have one fuse per channel group. The fuses are situated on the left side of the digital output module. Figure 9-14 shows the locations of the fuses on the digital output modules.

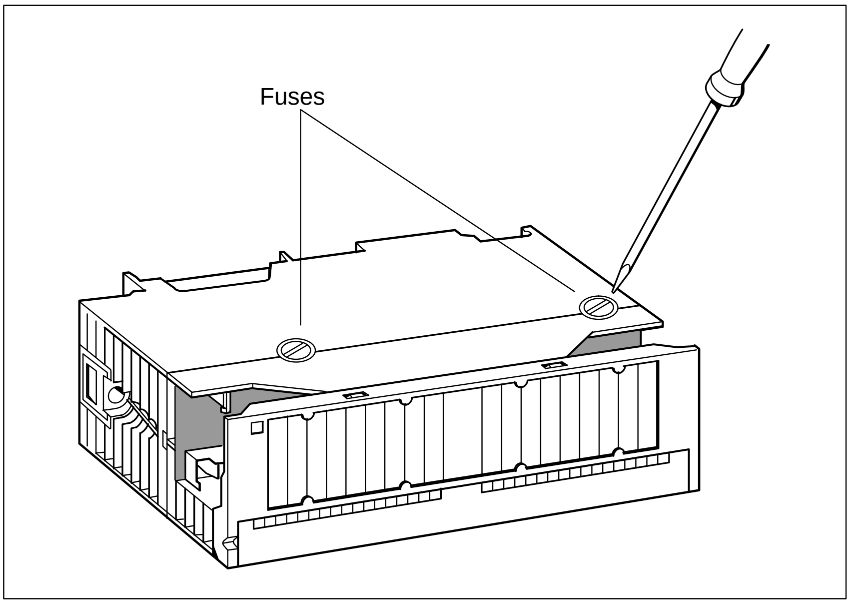


Figure 9-14 Locations of Fuses on Digital Output Modules

Replacing a Fuse

The fuses are situated on the left side of the module. Proceed as follows to replace a fuse:

1. Switch the CPU and all function modules in your M7-300 to STOP with the keyswitch.
2. Switch off the load voltage of the digital output module.
3. Disconnect the front connector from the digital output module.
4. Slacken the mounting screw of the digital output module.
5. Swing out the digital output module.
6. Unscrew the fuse holder from the digital output module.
7. Replace the fuse.
8. Screw the fuse holder back into the digital output module.
9. Fit the digital output module again (see Section 9.2).

CPU 388-4

10

Introduction

This chapter describes the CPU 388-4 of the M7-300 automation computer.

Chapter Overview

10.1 Performance Features

Introduction

The CPU 388-4 is the main component of the M7-300. Table 11-1 contains a summary of its performance features.

Table 10-1 Performance Features of the CPU 388-4

CPU 388-4 Performance Features (6ES7388-4BN00-0AC0)	
Processor	80486DX2/50
Numeric processor	Yes
Watchdog function *	Yes
Main memory	8 Mbyte
COM1 interface 16550-compatible	RS232
Expansion facility via AT bus	Yes
MPI interface	Yes
SRAM (with backup battery)	64 Kbyte
* see also the M7-SYS User Manual	

10.2 Technical Data

Given in the following table are the technical data of the CPU 388-4.

Table 10-2 Technical data of the CPU 388-4

CPU 388-4 Technical Data (6ES7388-4BN00-0AC0)	
Rated voltage	24 V DC (20.4 to 28.8 V DC)
Current consumption	0.87 A
Inrush current	9 A / 4.5 ms
I^2t	0.15 A^2s
Power dissipation	10.8 W
Backup time with backup battery	1 year min. (at 25 °C and uninterrupted backup of the M7-300)
Service life of backup battery	approx. 5 years
Temperature for vertical installation	0 to 40 °C (104 °F)
Temperature for horizontal installation	0 to 60 °C (104 °F)
Weight	650 g
Dimensions W x H x D (mm)	80 x 125 x 130 (180 with door open)

Note

Only an isolated, safety extra-low voltage may be used as the operating voltage.

10.3 Function Elements

Introduction

This section provides you with information about the individual elements of the CPU 388-4. You will need this information to be able to respond to displays, to commission and to use an M7-300 programmable controller and to be able to handle other components (for example, memory cards, expansion modules).

General View

Figure 10-1 shows a general view of an CPU 388-4 without front door. Operator controls and displays/indicators and other important operating elements are shown in their respective positions.

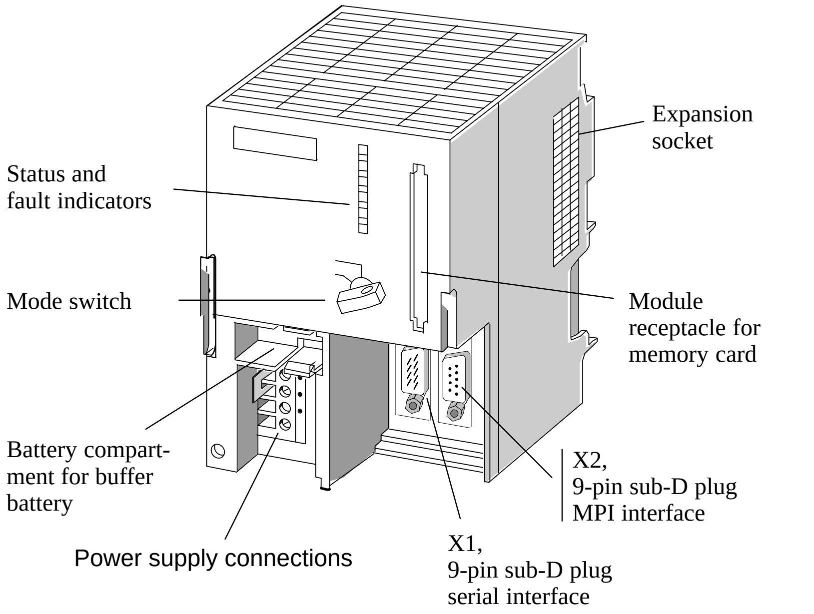


Figure 10-1 General View of a CPU 388-4 without Front Door

Function Elements of the CPU 388-4

The following table shows the function of the individual function elements of a CPU 388-4:

Table 10-3 Function Elements of the CPU 388-4

Element	Function
Status and fault indicators	The status and fault indicators show the operating status of the CPU 388-4. More information can be found on Page 10-6.
Mode switch	The mode selector is in the form of a key switch. More information can be found on Page 10-8.
Battery compartment/ buffer battery	The battery compartment is provided for a buffer battery. The buffer battery is only necessary if the time or the data in the SRAM are to be buffered.
Power supply connections	The operating voltage for the CPU 388-4 is fed via the power supply connections. More information can be found on Page 10-10.
Connector X1 (9-pin Sub-D male connector)	The CPU 388-4 is equipped with a serial interface (COM1). More information about this can be found on Page 10-11.
Socket X2 (9-pin sub. D)	The CPU 388-4 has an MPI. Further details can be found from Page 10-13 onward.
Submodule receptacle/memory card	A long memory card can be inserted in the module receptacle. During start-up, the system and user software can be loaded into working memory from this memory card. More information can be found on Page 10-14.
Expansion socket	Expansion units can be connected via the expansion socket. More information can be found on Page 10-15.

10.3.1 Status and Fault Indicators

Status and Fault Indicators

The CPU 388-4 is provided with the following indicators:

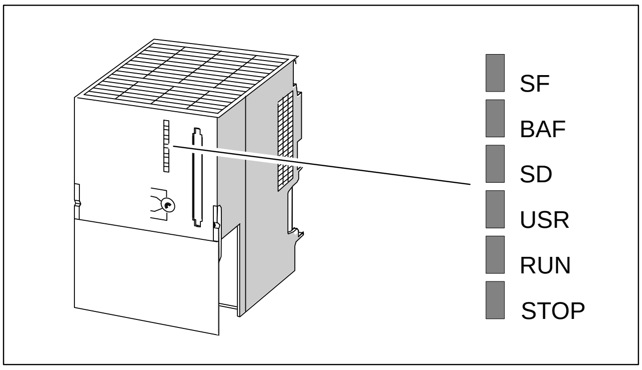


Figure 10-2 Status and Fault Indicators on the CPU 388-4

Meaning of Status and Fault Indicators

The status and fault indicators are explained in Table 10-4 in the order in which they are arranged on the CPU 388-4. The following status and fault indicators (LEDs) are provided:

Table 10-4 Meaning of the Status and Fault Indicators on the CPU 388-4

Indicator	Function	Description
SF (red)	Common alarm	Lights in the event of • Hardware faults • Firmware faults • Programming faults • Parameter assignment faults • Calculation faults • Time faults • Faulty memory card • Peripheral fault Use the PG to determine the exact nature of the fault (read diagnosis buffer).
BAF (red)	Battery failure signal	Lights (after loading the system software) if the battery is not fitted or is no longer supplying the necessary voltage during Power Up.
SD (green)	Access to storage module	Lights when read or write access to the storage module occurs.
USR (yellow)	Special indicator for the user program (**user**)	Can be allocated by the user (see programming manual).
RUN (green)	"**RUN**" status indicator	Lights if the system software is loaded and user programs are running. (I/O access is enabled.)
STOP (yellow)	"**STOP**" status indicator	Lights if the user program on the CPU is not controlling the process (I/O access is disabled) Flashes if a memory reset has been requested or is being executed.
After switching on, all indicators light up briefly (self-test).		

10.3.2 Mode Selector

Mode Selector

The mode selector on the CPU 388-4 is in the form of a key switch.

The following illustration shows the location and positions of the mode selector.

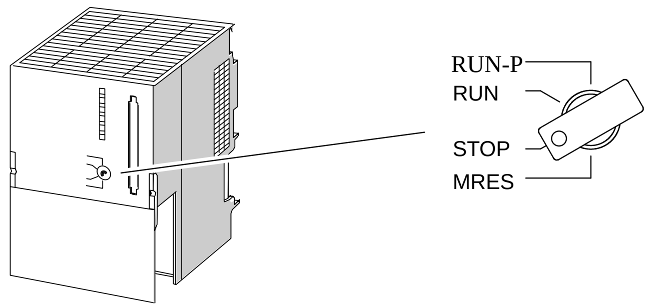


Figure 10-3 Mode Selector

The settings of the mode selector can be examined by software. The significance of the individual switch positions can thus vary depending on the program.

Mode Selector Positions

The positions of the mode selector are explained in Table 10-5 in the order in which they are arranged on the CPU 388-4.

Table 10-5 Mode Selector Positions

Mode switch setting	Description
RUN-P	The CPU processes the user program. The key cannot be removed when in this position.
RUN	The CPU processes the user program. The key can be removed in this position to prevent unauthorized change of mode.
STOP	The user program on the CPU cannot access the I/O modules. The user program cannot control the process. The key can be removed in this position to prevent unauthorized change of mode.
MRES	Spring-return position of the key switch for software-controlled memory reset of the CPU through a hardware reset.

Activating MRES

To effect a hardware reset via MRES, proceed as follows:

1. Turn the mode selector to the STOP position.

   Result:
   The STOP indicator lights up.

2. Turn the mode selector to MRES and hold it in this position.

   Result:
   The STOP indicator switches off/on twice (off for a second, on for a second, off for a second and then it lights up again).

3. Turn the mode switch back to the STOP setting and then within the next 3 seconds again to MRES and back to STOP.

   Result:
   The STOP indicator flashes for about 3 seconds at 2 Hz (the memory reset is being executed) and then lights up again.

4. If the STOP indicator does not flash or other indicators light or flash, steps 2 and 3 must be repeated.

Note

The memory reset of the module by activating MRES is controlled by the system software. If this has not been started, the CPU 388-4 must be reset, if necessary, by switching the power on and off. If a keyboard is connected to the CPU, it is also possible to initiate a cold start via the hotkeys (see Table 10-7 on Page 10-19).

10.3.3 Power Connections and Grounding Concept

Power Connections

The supply voltage for the CPU 388-4 is supplied via the power connections.

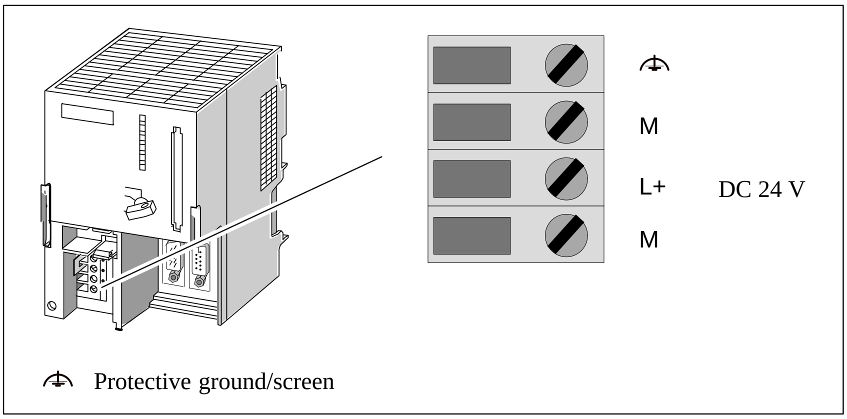


Figure 10-4 Supply Connections on the CPU 388-4

Note

Only a safety separated extra-low voltage may be used as the operating voltage.

Grounding Concept

The following provides an overview of the grounding concept for the CPU 388-4. You will need this information to prevent ground loops when connecting serial interfaces.

The CPU has an internal power supply that provides the necessary voltages. The voltages for the internal supply are non-isolated.

10.3.4 Serial Interface

Introduction

This section provides you with information about the serial interface on the CPU 388-4 and tips on how to use it.

X1 Interface: COM1

The X1 interface corresponds to the COM1 serial interface of an AT compatible PC and is connected via a 9-pin Sub-D connector (see Figure 10-5). The pin-outs are shown in Table 10-6.

The signal levels are defined according to RS232C.

The data transmission for the COM1 interface is compatible with the PC standard. A 16550-compatible module is used.

The Baud rate that can be used depends on the capability of the communication partner, the ambient interference field and the cable length. For a transmission rate of 19.2 kbaud, we recommend a maximum cable length of 10 m (33 ft.).

I/O Addresses: $03F8_H$ - $03FF_H$

Interrupts: 4

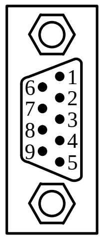


Figure 10-5 9-Pin Sub-D Connector for Connecting the X1 Interface (COM1)

Table 10-6 Pin-Outs for COM1 Interface

Pin	Signal	Function	Direction
1	DCD	Receive signal level	Input
2	RxD	Receive data	Input
3	TxD	Send data	Output
4	DTR	End unit ready	Output
5	Signal GND	Operating ground (GND_{int})	–
6	DSR	Ready to operate	Input
7	RTS	Switch on send section	Output
8	CTS	Ready to send	Input
9	RI	Incoming call	Input

Note

The operating ground (signal GND) on the X1 interface (COM1) is referred to the internal ground (see Section 10.3.3).

If necessary, precautions should be taken on the plant side to prevent ground loops.

What Can Be Connected to the X1 Interface?

Any equipment having an RS232 interface can be connected, for example:

Printer, modem, terminal, PC/PG, etc.

10.3.5 MPI Interface

Interface X2: MPI

Interface X2 of the CPU 388-4 for connecting devices such as PC/PG is a multipoint interface (MPI) and is connected via a 9-pin subminiature D female connector.

Definition: Multipoint Interface MPI

This is known as a multipoint interface because several devices, that is, from several points, can access the CPU via this interface. In other words, the CPU with multipoint interface is network-capable without additional modules.

Connectable Devices

The following can be connected to the MPI:

- Programming devices (PG/PC)
- Operator interfaces (OP)
- Other CPUs

Up to 127 communication partners (PG, OP, CPUs, function modules, etc.) can be connected to the multipoint interface of the CPU 388-4. Up to 44 connections can be established on the CPU 388-4.

K-bus-capable function modules in an M7-300 are automatically incorporated in the MPI subnet by the CPU.

Connectors

Only use bus connectors or PG cables for connecting devices to the multipoint interface (see Section 7.2.2).

10.3.6 Memory Cards

Introduction

The CPU 388-4 provides a facility to use memory cards as a storage medium. This section provides you with information on how to use this facility.

Note

If a power failure occurs during write access to the memory card, the entire content of the memory card may be corrupted under worst case conditions.

Please note that, unlike a diskette, the memory card with flash EPROM is only suitable for a limited number of write operations.

Memory Card

A memory card simulates a diskette drive from which the operating system can be booted. It can also be used for changing user software and data.

Memory cards with flash EPROM are available for the CPU 388-4 function module (see ordering information in Appendix C).

Drive Assignment

The memory card is addressed by the operating system in the same way as a conventional drive.

The drive assignment can be set in the BIOS setup (Section 10.4.9, Page 10-31).

Boot Sequence

The boot sequence can be set in the BIOS setup (Section 10.4.10, Page 10-33).

Formatting

The memory card must also be formatted using the “FTLFORM.exe” formatting program that is part of the M7 SYS system software. Refer to the appropriate section of the “M7-SYS” Manual for more information.

Note

The value given for the storage capacity of the memory card is the actual physical storage capacity (nominal).

Formatting reduces the nominal storage capacity to about 80% (nett), which is then available to the operating system for the storage of data/programs.

UNDELTE:
Files deleted from the memory card cannot be restored using UNDELETE programs.

10.3.7 Expansion Socket

Introduction

The CPU 388-4 is provided with an expansion socket. The ISA bus is looped through via the expansion socket.

Which Expansion Modules Can Be Connected?

An expansion module EXM 378-2 with up to two interface submodules or one mass storage module with diskette drive and hard disk drive can be directly connected to the CPU.

A total of three expansion modules (EXM 378-2, EXM 378-3 for max. 3 interface modules, MSM 378 mass storage module) can be plugged one after another onto the application function module.

10.4 BIOS Setup

Overview

Setup performs the configuring of the corresponding CPU in your M7-300 system. The setup menu displays settings and technical information about the configuration of the application function module. The module already has a default setup that allows a programmable module with a minimum configuration (with memory card drive and COM1 interface) to be powered up via Setup without any programming.

You can change the default settings in the setup menu. This will be necessary, for instance, if you want to connect expansion modules to your CPU (expansion module with interface modules, mass storage module). The operating system must be informed about these modifications.

The following options are available if you want to modify the Setup settings:

- Directly on the appropriate module, if your M7-300 is equipped with an expansion module including interface modules and peripherals such as a monitor and keyboard.
- Remote setup with a terminal program (for instance, “Hyper Terminal” program for Windows 95) on a PG/PC or an ANSI terminal via the COM1 interface (IF 962-COM interface submodule).

Remote Setup

Proceed as follows to setup up the BIOS, if your M7-300 has no IF 962-VGA interface submodule:

1. Connect the programming device to the COM1 interface (see Chapter 8.5).
2. Switch off the power supply of the M7-300.
3. Start “Start > Accessories > Hyper Terminal” under Windows 95 on the programming device.
4. In the Hyper terminal window select “File > New connection”. Assign the connection a name and select the COM1 interface with the following settings: 19000 bits/s, 8 data bits, no parity bit, 1 stop bit, no protocol.
5. Switch on the power supply of the M7-300 and at the same time press the “Q” key during startup until the M7 hardware test is indicated on the hyper terminal (a”U” is displayed).
6. Immediately press the “ESC” key.

   Result: You enter the BIOS Setup.

10.4.1 BIOS Power Up

Power up without Fault Messages

After switch-on or cold starting the CPU, the BIOS (Basic Input Output System) starts a “Power On Self Test” (POST) and outputs the results in the POST window. At the same time, all the LEDs light up briefly and the STOP LED comes on.

```
                  PowerBIOS  Version 1.00
            Copyright (c) 1994 Award Software Intl., Inc.
           Serial No. 092394-PicoPower-Redwood-314Q4080000

              Siemens AG CPU388/FM356-4 M7-BIOS Ax.yy

   CPU Type.................................i486DX2-S 50MHz
   Math CoProcessor................................Internal
   Base Memory.......................................640 Kb
   Extended Memory..................................7168 Kb
   BIOS Shadow RAM..................................Enabled
   Video Shadow RAM.................................Enabled
   Floppy Drives....................................1 Found
   Hard Drives......................................1 Found
   Serial Ports.....................................1 Found
   Parallel Ports...................................0 Found
   Testing Base Memory...............................640 Kb
   Testing Extended Memory..........................7168 Kb

                  Press ESC to enter setup
```

Figure 10-6 POST Window

In the case of a fault, the SF LED lights up additionally.

Power up with Warnings

During power up, warnings are output in the POST window following the “Video Shadow RAM...” line in the following cases:

- Low battery voltage fault,
- Keyboard missing,
- Incorrect CMOS checksum.

The warnings remain on screen for 2 seconds. The first line is then scrolled out of the POST window. If no battery backup is present, the date is reset to the 01.01.1994.

Power up with Fault Messages

If one of the following faults occurs:

- Memory test fault,
- Hard disk configuration fault,
- CMOS fault,

the SF LED remains on as well as the STOP LED. A window with the appropriate error message appears on the screen. The window disappears again after about two seconds and the power up continues.

An erroneous CMOS checksum causes the default settings to be loaded.

Behavior in the Case of Serious Faults

If serious faults occur, the power up is stopped. Serious faults can be:

- More than one IF962-VGA interface module is inserted (SF LED lights).
- An invalid shutdown code is present in CMOS memory location 15 (0xF) during the warm start.

No message can be displayed on the screen in the case of these faults, as the video module is not yet initialized.

Check whether the CPU is equipped more than one IF 962-VGA interface module. If you do not find a fault, the problem is an invalid shutdown code. Reset the CPU in this case.

Warm Start

The following window appears after a warm start of the CPU. This indicates an accelerated system power up (see Section 10.4.2 “BIOS Hotkeys”).

```
               PowerBIOS  Version 1.00
  Copyright (c) 1994 Award Software Intl., Inc.
 Serial No. 092394-PicoPower-Redwood-314Q4080000
    Siemens AG CPU388/FM356-4 M7-BIOS Ax.yy

        Press CTRL-ALT-ESC to enter setup
```

Figure 10-7 Warm Start Window

10.4.2 BIOS Hotkeys

BIOS Hotkeys

After a power up under MS-DOS, the BIOS provides the user with a series of functions that can be carried out using the following key combinations:

Table 10-7 BIOS Hotkeys with German and English Keyboard Layouts

English keyboard	German keyboard	Function
CTRL + Alt + DEL	STRG + Alt + ENTF	Module warm start
CTRL + Alt + HOME	STRG + Alt + POS1	Module cold start (power off/on and initialization of all blocks)
CTRL + Alt + –	STRG + Alt + –	Low CPU speed (DETURBO mode)
CTRL + Alt + +	STRG + Alt + +	Normal CPU speed
CTRL + Alt + ↓	STRG + Alt + ↓	IDE hard disk in standby mode
CTRL + Alt + PGDN	STRG + Alt + Bild↓	Screen saver on (dark screen)
CTRL + Alt + PGUP	STRG + Alt + Bild↑	Screen saver off

Note

These functions can be superseded by other operating systems or user programs (for instance, Windows).

10.4.3 Setup Fields and Key Control

Functions of the Setup Fields

The BIOS setup contains fields where you can make an entry or a selection. These fields have the following functions:

- Edit box:
  [ ] You can enter the required values in this field.
- List box:
  This field [≡] lists, for example, all the menu pages in the setup menu, from which one can be selected and started.
- Check box:
  By selecting a check box [✓] you can activate the associated function; by deselecting the box [ ] the function is deactivated again.
- Radio button:
  Selecting a radio button (✳) chooses one of a number of options; by selecting another radio button, the previous radio button is deselected ( ).

Key Control within the Setup Menu

The following keys are used for control purposes within the setup menu and the associated setup pages (conforms to Windows standard):

ENTER	This key moves the cursor to the first line of a list, edit, check or radio box. If the cursor is on a button (OK, CANCEL, etc.) or on a selected (inverse video) line within a list box, ENTER selects the relevant function. If the cursor is not on any button when ENTER is pressed, the same function will be executed as if you had chosen the OK button: return to setup menu, changes to the setup page are retained.
ESC	This key executes the same function as if you had chosen the CANCEL button: return to setup menu, changes to the setup page are discarded.
TAB	This key moves the cursor from a box to the next box or the next button.
→	Same function as TAB but only in the case of remote setup.
SHIFT TAB	This key combination moves the cursor from a box to the previous box or the previous button.
←	Same function as SHIFT TAB but only in the case of remote setup.

↓ ↑

The cursor keys allow you to move from line to line within a list box. The current line is highlighted by a dark bar.

The cursor keys allow you to scroll within an edit box if there are several values to choose from within the box.

Within a radio box, using the cursor keys to position the cursor on a radio button causes the radio button to be selected.

Ins

Constantly pressing the “INS” key causes certain default BIOS settings to be loaded in order to ensure a secure system startup.

The space bar enables you to confirm the selection of highlighted lines and select check boxes.

10.4.4 Starting and Exiting the BIOS Setup

Starting using a Key Combination

To start the BIOS setup, press the following key combination as the CPU powers up:
CTRL + Alt + ESC or only ESC in the case of remote setup.

The setup menu then appears (Figure 10-8).

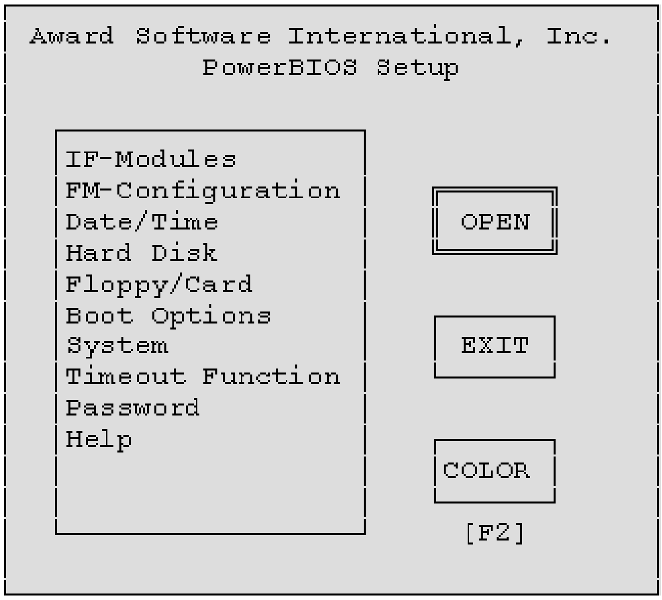


Figure 10-8 Setup Menu

Setup Menu Components

The setup menu consists of

- A list box from which the desired setup page can be selected,
- An OPEN button, which, when chosen, opens the selected setup page,
- An EXIT button, which, when chosen, closes the setup menu after prompting whether the changes are to be saved.
- A COLOR button, which, when chosen, allows the default color or gray scale settings of the setup page to be changed to plain black and white. The COLOR button can also be chosen by pressing the F2 key (not in the case of remote setup).

The setup pages shown in the following sections show the default setup settings.

Exiting the BIOS Setup

To quit the setup menu, choose the EXIT button shown in Figure 10-8 or press ESC. The “Setup Exit” dialog box appears (see Figure 10-9).

Figure 10-9 “Setup Exit” Dialog Box

- Choose the NO button if you do not wish to save your changes.
- To save your settings, choose the YES button. The BIOS setup will be terminated and the settings will be saved.

10.4.5 ”IF Modules” Setup Page

Opening the Setup Page

If you have selected “IF modules” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, the following setup page will appear on the screen (Figure 10-10).

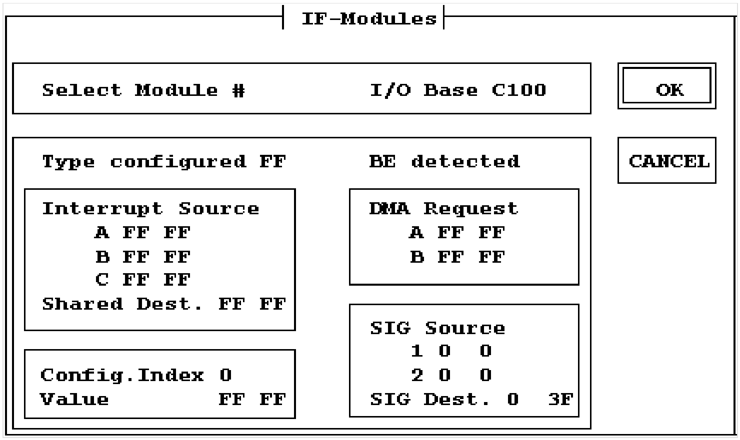


Figure 10-10 “IF Modules” Setup Page

What Does this Setup Page Do?

If you have added expansion modules to your CPU, this setup page enables you to configure the interface submodules they contain. See Chapters 11 and 12 for information on required settings.

Please modify the values only if needed. Default values are usually provided.

Displaying Information

Information cannot be edited. Information on this setup page is represented by dimmed text. Dimmed text is present in all cases except remote setup, where it is replaced by black type.

Accepting Edited Values

The system will only accept those values in the edit boxes for which the corresponding interface module is suitable. If, for example, you enter three values under “interrupt source”, and the interface module only has one interrupt, only the first value will be used.

Modified values are not stored until you confirm them by pressing the Tab key or the Shift Tab key combination. Use the appropriate ← or → keys for this purpose in the case of a remote setup.

Select Module #

Enter here the number of the module receptacle into which the interface module is inserted, or select it using the cursor keys ↓ ↑.

You can enter slot numbers 0 to 5 if you are using both expansion modules. Three module receptacle numbers are used for each slot on the backplane bus. Slot 0 represents the power supply of the EXM378-2. The values "Shared Dest." and "SIG Dest." for the expansion module are all that can be entered here.

The module receptacle number is linked to the other values on this setup page. If you change the module receptacle number, the associated values are displayed if they have already been entered.

I/O Base (dimmed)

Shows the current address of the expansion module (see Chapter "M7-300 Expansion Modules"). The information cannot be edited.

Type Configured + Detected (dimmed)

Under "Type configured", enter the type of interface module that has already been inserted or is to be inserted in this slot.

"Detected" shows the type of interface module that currently occupies this slot (the last time the FM was powered up). The information cannot be edited.

The BIOS carries out a SELECTED/ACTUAL comparison. If the value set under "Type Configured" does not correspond with the type found under "Detected", or the value $0FF_H$ is present under "Type Configured", the BIOS will not configure this interface module.

If there is no interface module in the slot, the value "FF" is displayed.

Interrupt Source

Interrupts A to C for the interface module are set here (see Chapter "Interface Modules"). The values on the left are the setpoint values. These can be edited. The values shown to the right of these as dimmed figures are the present values (as determined at the last power up of the CPU). These cannot be edited.

Shared Dest.

Used to set a shared interrupt for the interface module (see Chapter "Interface Modules"). This value is entered only once per expansion module on the first slot (0 and 3). The value on the left is the setpoint value. This can be edited. The value shown to the right of this as a dimmed figure is the present value (as determined at the last power up of the CPU). This cannot be edited.

DMA Request

Enter the DMA requests A and B for the interface module here (see Chapter "Interface Modules"). The values on the left are the setpoint values. These can be edited. The values shown to the right of these as dimmed figures are the present values (as determined at the last power up of the CPU). These cannot be edited.

Config. Index

The 40_H of configuration space on the interface module can be addressed here (0_H to $3F_H$). The address can be found in Chapter "Interface Modules" in the table "Offset Address for the Configuration Register" for the relevant interface module.

Value (dimmed)

You can now enter the configuration value at the address specified under with "Config. Index". This value and its significance can be found in Chapter "Interface Modules".

The value on the left is the setpoint value. This can be edited. After you have entered a value, confirm it by pressing the Tab key or the Shift Tab key combination. Use the appropriate ← or → keys for this purpose in the case of a remote setup. The value shown to the right of this as a dimmed figure (black type in the case of remote setup) is the present value (as determined at the last power up of the CPU). This cannot be edited.

If there is no interface module in the slot, the value "FF" is displayed.

SIG Source

Enter the signal source, assuming the corresponding interface module is configured accordingly (Chapter "Interface Modules"). The signal source values on the left are the setpoint values. These can be edited. The values shown to the right of this as dimmed figures (black type in the case of remote setup) are the present values (as determined at the last power up of the CPU).

SIG Dest.

Enter the signal destination, assuming the corresponding interface module is configured accordingly (Chapter "Interface Modules"). This value is entered only once per expansion module at the first slot (0 and 3). The destination value on the left is the setpoint value. This can be edited. The value shown to the right of this as a dimmed figure (black type in the case of remote setup) is the present value (as determined at the last power up of the CPU). This cannot be edited.

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page.

Note

The VGA, keyboard, 4 COM and 2 LPT interfaces are automatically configured by BIOS.

10.4.6 ”FM Configuration” Setup Page

Opening the Setup Page

If you have selected “FM configuration” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this setup page will be displayed on the screen (Figure 10-11).

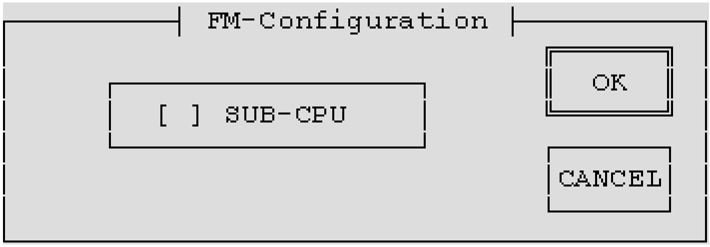


Figure 10-11 “FM Configuration” Setup Page

What Does this Setup Page Do?

This setup page has no function on the CPU.

Note

The SUB–CPU field must not be set!

10.4.7 ”Date/Time” Setup Page

Opening the Setup Page

If you have selected “Date/Time” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-12).

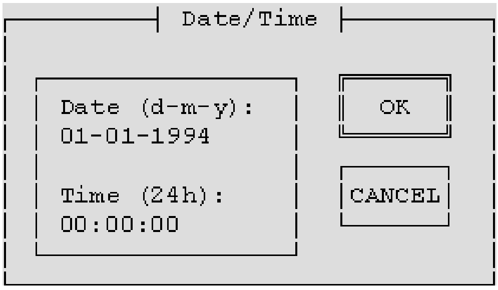


Figure 10-12 “Date/Time” Setup Page (Default)

What Does this Setup Page Do?

The date and time for the CPU is set on this page.

Date

Enter the date in this edit box in the format dd–mm–yyyy (day, month, year).

Time

Enter the time in this edit box in the format hh:mm:ss (hours, minutes, seconds).

The seconds in the setup page are updated continuously and only stop when you select the seconds field. The value then displayed or set can be entered directly by pressing the RETURN key.

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page, except for the time of day.

10.4.8 ”Hard Disk” Setup Page

Opening the Setup Page

If you have selected “Hard Disk” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-13).

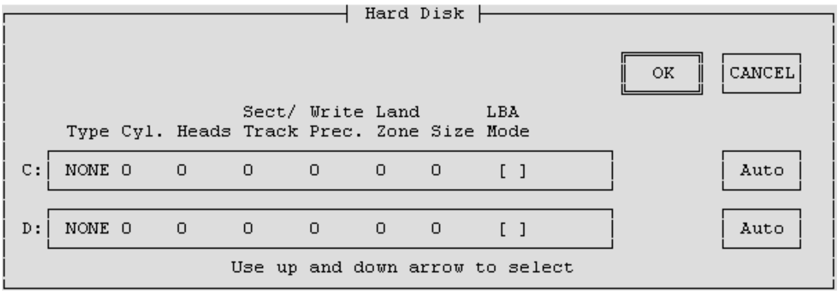


Figure 10-13 ”Hard Disk” Setup Page When There is no Hard Disk

What Does this Setup Page Do?

This setup page is used to transfer the parameters of the hard disk in the mass storage module to the BIOS.

Hard Disk C, Hard Disk D

These edit boxes show the type of hard disk drive fitted.

Only change the standard entries if you install a different hard disk drive that cannot be detected automatically (see Auto function). If an incorrect hard disk type is entered, the operating system will not start.

Possible entries in the “type” edit box are: *1* to *43*, *USR1* and *NONE*.

- 1 to 43
  The parameters for hard disk types 1 to 43 (cylinders, heads, etc.) are preset.
  At present, this entry is not accepted. Choose the AUTO button to interrogate the parameters of your hard disk.
- USR1
  This entry allows you to edit the entries in the other edit boxes (see Auto button).
  At present, this entry is not accepted. Choose the AUTO button to interrogate the parameters of your hard disk.
- NONE (default)
  No hard disk drive is fitted.

Standard entry for *Hard Disk C*:	Depends on the hard disk drive, otherwise *NONE*
Standard entry for *Hard Disk D*:	*NONE*

The second hard disk drive is not supported at present.

LBA Mode

If you have installed a hard disk with a capacity of more than 504 Mbyte, you must set LBA mode (Logical Block Addressing) before pressing the AUTO button. Otherwise, standard mode will be used and it will not be possible to address all the hard disk.

Auto Button

If the AUTO button is chosen, the BIOS setup interrogates the parameters of the associated hard disk. No other entry is necessary. You can, however, edit the displayed hard disk parameters.

Example for an IDE hard disk drive:

Type	Cyl.	Heads	Sect./ Track	Write Precomp	Land Zone	Size*	LBA Mode
USR1	1050	16	63	NONE	1049	516	

* The “size” value is for information only and cannot be changed.

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page.

10.4.9 ”Floppy/Card” Setup Page

Opening the Setup Page

If you have selected “Floppy/Card” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-14).

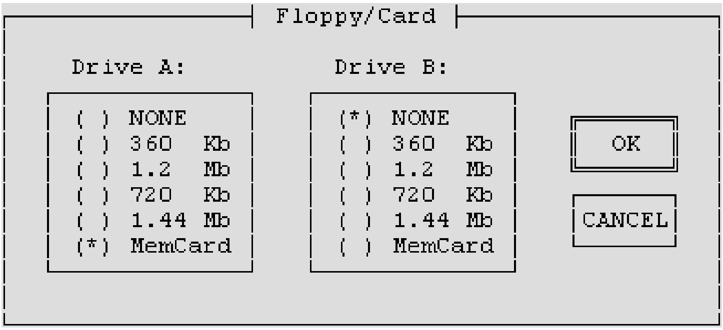


Figure 10-14 Setup-Page ”Floppy/Card”

What Does this Setup Page Do?

This setup page enables you to enter the diskette drive in your mass storage module and the memory card “drive” in your CPU.

Drive A

During the first power-up and when the INS button is pressed during the boot phase, BIOS setup detects whether the CPU has been expanded with a mass storage module and, therefore, whether or not a diskette drive is available.

- If a diskette drive is present, BIOS assigns Drive A to it by activating radio button 1.44 Mb.
- If there is no diskette drive, BIOS assigns Drive A to the memory card drive by activating the memory card radio button.

If you do not want either of the two drives to be entered, activate the NONE radio button.

The other setting options for drive A are currently not assigned any function.

Drive B

Drive B is used to designate the memory card “drive” in the CPU if a diskette drive is specified as drive A.

- Select the “MemCard” radio button if you want to work with a memory card.
- Otherwise select the “NONE” radio button.

The other setting options for drive B have no significance at present.

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page.

10.4.10 ”Boot Options” Setup Page

Opening the Setup Page

If you have selected “Boot Options” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-15).

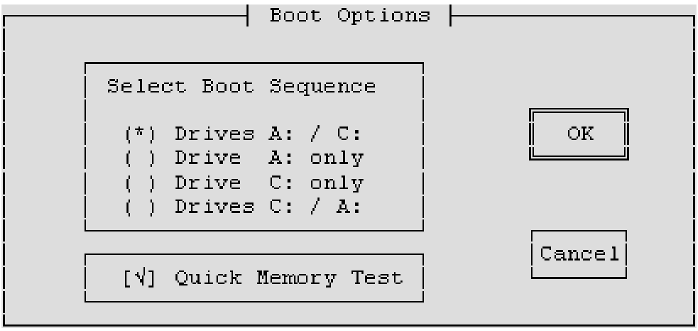


Figure 10-15 “Boot Options” Setup-Page

What Does this Setup Page Do?

This setup page is used to specify the boot drive and the method of main memory test.

Select Boot Sequence

The drive from which the CPU is to be booted on power up is defined here by selecting the corresponding radio button.

- Drive A is the diskette drive or memory card, whichever was specified as drive A on the “Floppy/Card” setup page. If there is no bootable program on the diskette drive, an attempt is then made to boot from the memory card (“Floppy/Card” setup page –> Drive B).
- Drive C is the hard disk drive.

A primary and a secondary drive can be specified. In other words, if there is no boot program available on the primary drive, booting automatically takes place from the secondary drive, assuming this contains a boot program.

If there is no boot program on either drive A or drive C, a message appears on the screen requesting insertion of a bootable medium and confirmation with the RETURN key.

Quick Memory Test

If this check box is selected, only random areas of main memory are checked and the test is thus carried out very quickly.

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page.

10.4.11 ”System” Setup Page

Opening the Setup Page

If you have selected “System” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-16).

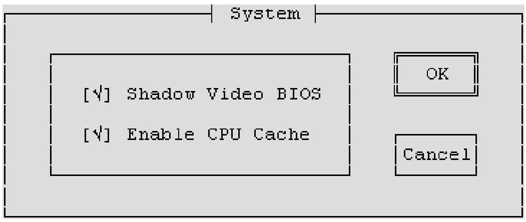


Figure 10-16 “System” Setup Page

What Does this Setup Page Do?

You can activate or deactivate the shadow RAM and processor cache on this Setup page.

Shadow Video BIOS

By selecting this check box, you specify that the video BIOS (32 kByte EPROM) is to be copied into the faster main memory (DRAM) in addition to the system BIOS. If the BIOS is in RAM, the performance of the video output is increased.

Enable CPU Cache

By selecting this check box, you specify that the internal processor cache is to be used. The computing power is considerably increased by using the cache. If the access time is too short for older application programs, the cache must be switched off (do not select).

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page.

10.4.12 ”Timeout Function” Setup Page

Opening the Setup Page

If you have selected “Timeout Function” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-17).

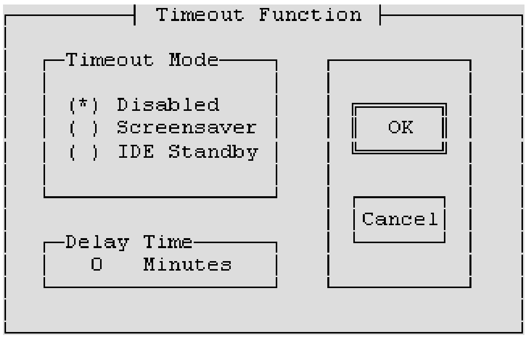


Figure 10-17 “Timeout Function” Setup Page

What Does this Setup Page Do?

This setup page allows you to specify whether the hard disk is to go into standby mode during access intervals and whether the screen is to be protected by the screensaver during breaks in input.

Timeout Mode

Timeout mode provides the following options:

Radio Button Selected	Action
Disabled	Switches off the timeout function.
Screensaver	Specifies that the screen saver is to be activated during breaks in input to prolong its life.
IDE Standby	Specifies that the hard disk is to go into energy-saving standby mode during access intervals.

Delay Time

In this edit box, enter the time in minutes that is to elapse since the last input or the last hard disk access before the timeout function is activated.

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page.

10.4.13 ”Password” Setup Page

Opening the Setup Page

If you have selected “Password” in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-18).

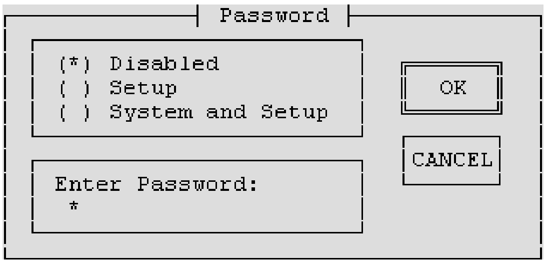


Figure 10-18 “Password” Setup Page

What Does this Setup Page Do?

You can activate or deactivate password protection for the setup and/or the booting of the CPU on this page.

Password

Password provides the following options:

Radio Button Selected	Action
Disabled	Switches off the password protection for the BIOS setup.
Setup	Switches on the password protection for the BIOS setup.
System and Setup	Switches on the password protection for the BIOS setup and the booting of the CPU.

Enter Password

Enter the desired password using a maximum of 8 alphanumeric characters. The password is case-sensitive.
If, after setting a password, you change the American keyboard for, say, a German keyboard, this will affect the password entry. For the password *Jonny_**, you would then have to enter *Jonnz?(* .

Note

Write the password down and keep it in a safe place where you can find it again.
If you cannot remember or find the password you have specified, contact your Siemens representative at your local agency or branch office.

OK Button

Choosing this button returns you to the setup menu. Changes made on the setup page are retained.

CANCEL Button

Choosing this button returns you to the setup menu and discards all the changes you have made since calling up this setup page.

10.4.14 "Help" Setup Page

Opening the Setup Page

If you have selected "Help" in the setup menu (Figure 10-8 on Page 10-22) and chosen the OPEN button, this page will appear on the screen (Figure 10-19).

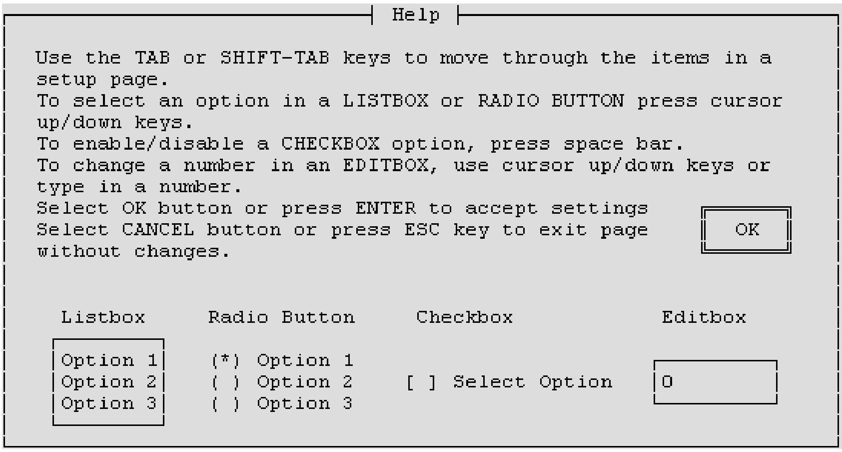


Figure 10-19 "Help" Setup Page

What Does this Setup Page Do?

This setup page contains information to help you use the setup menu.

OK Button

Choosing this button returns you to the setup menu.

10.5 Address, Main Memory and Interrupt Assignments

Introduction

This section contains detailed information in tabular form about I/O address area mapping and the interrupt assignments in the CPU 388-4.

I/O Address Area

Addressing of the AT-compatible input/output components is carried out in the I/O area at addresses from 0000_H to $03FF_H$. The addresses determined by the AT architecture are used. Unlike the original AT, the I/O addresses are fully decoded in the FM 356-4 module, so that addresses above $03FF_H$ can be used for addressing M7-300-specific hardware.

The serial interface COM1 (X1) is addressed according to the AT standard in the range $03F8_H$ to $03FF_H$.

Memory Allocation

The main memory is allocated as follows:

Table 10-8 Memory Allocation of the M7-300

Address	Contents
15 MB to 16 MB	PROFIBUS-DP
1 MB to 8 MB	User area memory
E 5000H to F FFFFH	BIOS
E 0000H to E 4FFFH	Free (20 K)
D 0000H to D FFFFH	Free (64 K)
C F000H to C FFFFH	Free (4 K)
C C000H to C EFFFH	Memory card or free (12 K)
C 8000H to C BFFFH	SRAM (16 KB)
C 0000H to C 7FFFH	Shadow VGA BIOS (32 KB)
A 0000H to B FFFFH	VGA (128 KB)
0 0000H to 9 FFFFH	640 KB system area

Memory areas that are not identified in all cases as being “free” may need to be kept free if a memory manager is used.

SRAM Area:
The size of the battery-backed SRAM is 64 Kbytes (56 Kbytes net capacity for data blocks). If the battery is removed and plugged in again when the power is switched off, the contents of the SRAM are lost. This is indicated by the BAF LED.

Interrupt Assignment

Table 10-9 provides an overview of the interrupt assignments.

Table 10-9 Assignment of Interrupts

Interrupt	Function
NMI	Group interrupt for fault and reset signals
IRQ0	System timer
IRQ1	Reserved for keyboard
IRQ2	Cascading of 2nd interrupt controller
IRQ3	Free – reserved for COM2
IRQ4	COM1
IRQ5	Free – reserved for LPT2
IRQ6	Free – reserved for diskette drive
IRQ7	Free – reserved for LPT1
IRQ8	Real time clock
IRQ9	Software interrupt, routed to IRQ2
IRQ10	Free
IRQ11	Free
IRQ12	Reserved for trackball/mouse
IRQ13	Free – reserved for math co-processor
IRQ14	Free – reserved for hard disk
IRQ15	System interrupt

M7-300 Expansion Modules

11

Introduction

You can add expansion modules for interface modules and/or the mass storage module to your automation computer from the M7-300 range. The interface modules may, for example, be IF 962-COM, IF 962-LPT, etc.

The following expansion modules are available and are described in this chapter:

- EXM 378-2 expansion module to take up to 2 interface modules
- EXM 378-3 expansion module to take up to 3 interface modules
- MSM 378 mass storage module with hard disk and diskette drive

Chapter Overview

11.1 Overview

Expansion Plug

The M7-300 CPU module and application module have an 88-pin socket on the right hand side for connecting expansion modules (only 4 of the 5 rows in the socket are populated). There is a corresponding plug on the left hand side of the EXM 378-2, EXM 378-3 and MSM 378 expansion modules (Figure 11-1).

The EXM 378-2 and EXM 378-3 expansion modules each have an expansion socket on the right hand side so that further expansion modules can be plugged in.

The MSM 378 mass storage module is always the last expansion module that can be connected via the expansion socket. It has an expansion plug on the left hand side only.

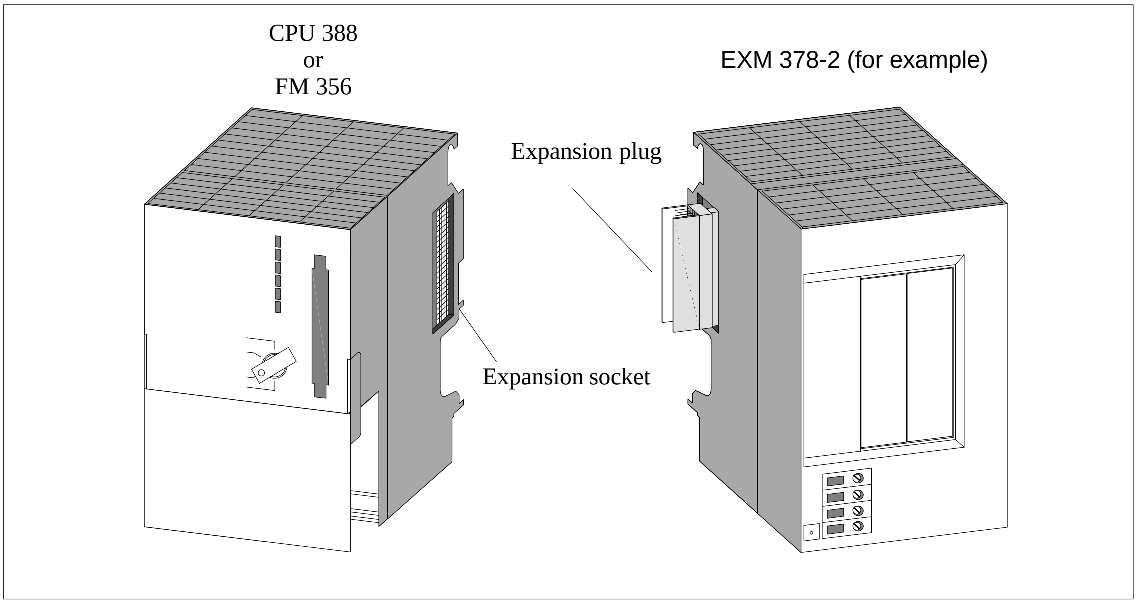


Figure 11-1 Positions of Expansion Socket and Plug

Maximum Configuration

Figure 11-2 shows the maximum configuration of expansion modules for a CPU 388 or FM 356.

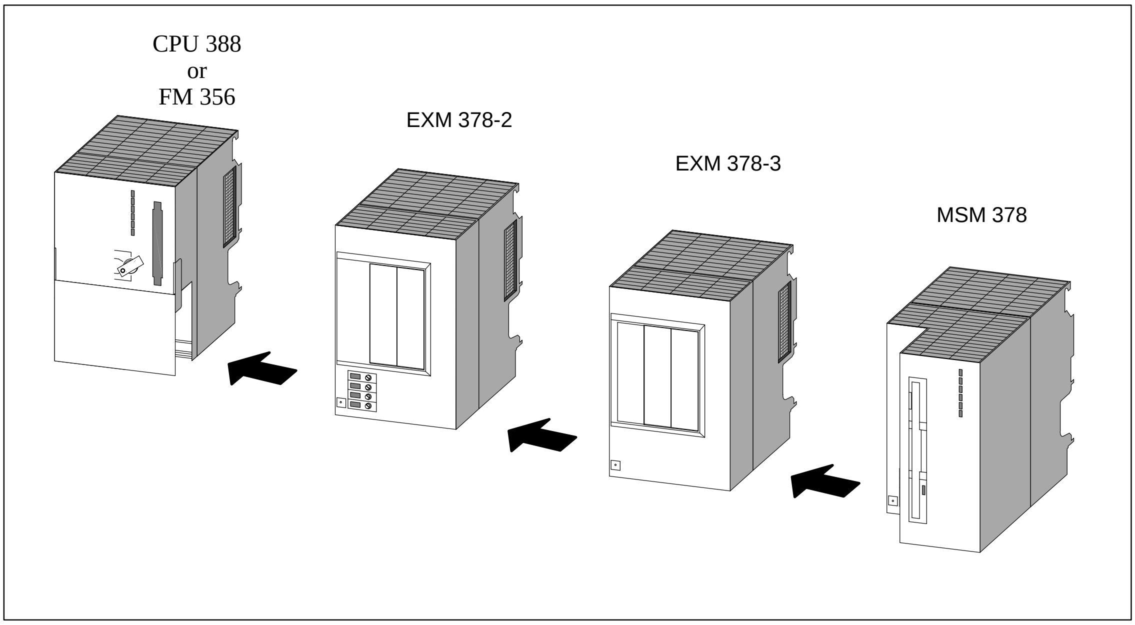


Figure 11-2 Maximum Configuration of Expansion Modules

Power Supply Connections

The EXM 378-2 expansion module and the MSM 378 mass storage module each have an internal power supply that is supplied via the power supply connections. The following illustration shows the arrangement of the power supply connections.

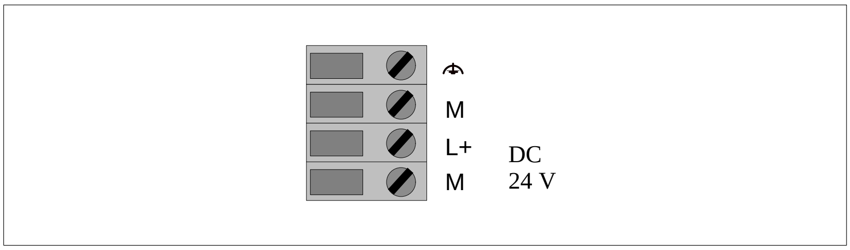


Figure 11-3 Power Supply Connections on EXM 378-2 and MSM 378 Expansion Modules

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Note

Only a safety isolated extra low voltage power supply may be used to supply the modules.

Permissible Combinations

The following table shows which expansion modules can be connected to the programmable M7-300 modules.

Table 11-1 Expansion options for CPU 388 and FM 356

M7-300 Programmable Modules Slot n	Slot n + 1	Slot n + 2	Slot n + 3
FM 356-4, CPU 388-4	EXM 378-2	–	–
	EXM 378-2	EXM 378-3	–
	EXM 378-2	EXM 378-3	MSM 378
	EXM 378-2	MSM 378	–
	MSM 378	–	–

11.2 Addressing on the S7-300 Backplane Bus

Action on the S7-300 Backplane Bus

The S7-300 backplane bus is amplified at every expansion module and fed to the next module. Each expansion module therefore occupies a slot on the backplane bus. There is, however, no access to this module via the backplane bus.

Addressing on the S7-300 Backplane Bus

Even though the EXM 378-2 and EXM 378-3 expansion modules and the MSM 378 mass storage module cannot be adddressd via the backplane bus, they each occupy a slot and must be taken into account with respect to the limit of 8 modules per module rack.

11.3 EXM 378-2 and EXM 378-3 Expansion Modules

Order Numbers

EXM 378-2: 6EM7 378-2AB00-0AC0

EXM 378-3: 6EM7 378-2AC00-0AC0

Features

The EXM 378-2 and EXM 378-3 expansion modules are designed to carry interface submodules. By installing suitable interface submodules such as IF962-VGA and IF962-LPT in these expansion modules, you can connect, for example, a VGA monitor, a keyboard and a printer to your automation computer.

The EXM 378-2 expansion module has a 24 V connection and 2 slots for installing interface submodules. The EXM 378-3 expansion module is supplied with power from the EXM 378-2 expansion module and has 3 slots for fitting interface submodules.

The EXM 378-2 and EXM 378-3 interface submodules have an 88-pin interconnection plug on the left hand side and an 88-pin socket on the right hand side for connecting to a further expansion module or a mass storage module.

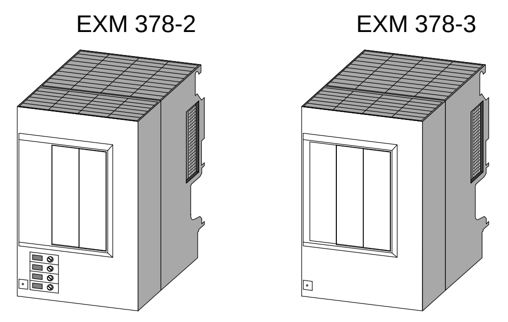


Figure 11-4 EXM 378-2 and EXM 378-3 Expansion Modules

Rules for Fitting Interface Modules

Not all types of interface submodule can be installed in module receptacle 3 of the EXM378-3 (left module receptacle, see Figure 11-5 on Page 11-8). Take note of the section “Rules for Fitting interface submodules” in the chapter “interface submodules”.

11.4 Addressing the EXM 378-2, EXM 378-3 Expansion Modules

Introduction

To be able to program the interface submodules in the EXM 378-2 and EXM 378-3 expansion modules, you need to know their adddresss. The following addressing methods are possible:

- Addressing in the PC compatible I/O address area
- Addressing in the M7-300-specific I/O address area

This section provides information about both methods of addressing the interface submodules.

Addressing in the PC Compatible I/O Address Area

Some of the interface submodules are configured automatically by the BIOS for operation in the PC compatible I/O address area. This automatic configuration is carried out, for example, for:

- The IF 962-VGA interface submodule
- Up to 4 COM interfaces (COM1 to COM4)
- Up to 2 IF 962-LPT interface submodules (LPT1, LPT2)

The configuration of further interfaces is carried out in the BIOS setup. You can find out how to use the BIOS setup in the description of the CPU/FM and the specific setting options can be found in the description of the interface submodules.

You will need to know the module receptacle number of the interface submodule slot to configure it in the BIOS setup. You will find this information in Figure 11-5 further on in this section.

Addressing in the M7-300-Specific I/O Address Area

All interface submodules can be adddressd via M7-300-specific adddresss. How to determine the I/O address of an interface submodule in the “specific address area” is described from Page 11-9 onwards.

You need this information to program an interface submodule that is not adddressd in the PC compatible address area.

Numbering the Interface Submodules

A module receptacle number is assigned to every interface submodule slot. The module receptacle number is shown in Figure 11-5.

You need this module receptacle number when configuring the BIOS setup or to determine the I/O adddresss of an interface submodule.

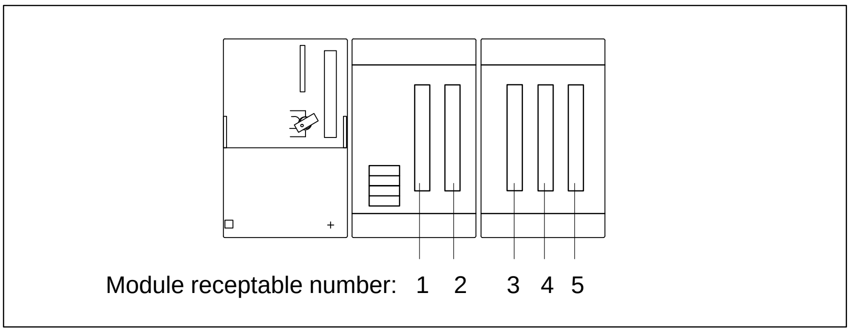


Figure 11-5 Module Receptacle Numbers in EXM 378-2 and EXM 378-3

Address Mapping in the M7-300-Specific I/O Address Area

The EXM 378-2 and EXM 378-3 expansion modules are driven off the PC bus of the automation computer. The I/O address area from $C000_H$ to $C2FF_H$ in the CPU 388 and the FM 356-4 is reserved for this purpose. Each expansion module occupies 256 bytes (100_H) of this area. The mapping of the address area in the CPU/FM is shown in Figure 11-6.

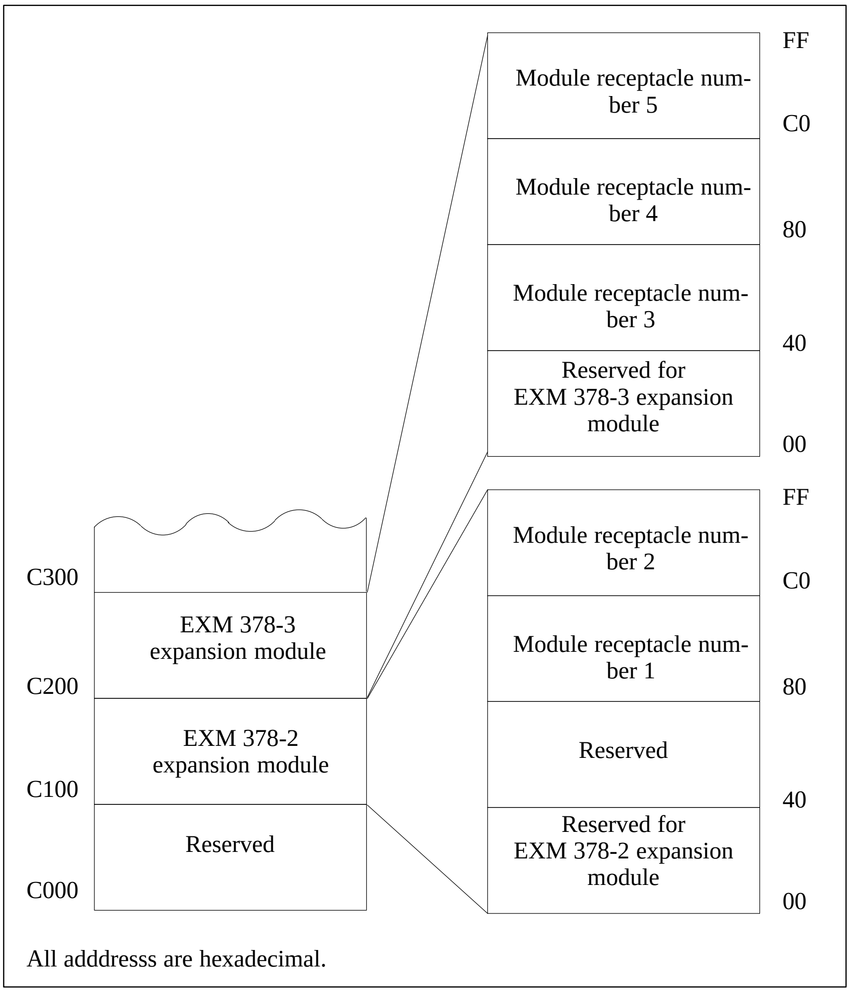


Figure 11-6 Basic Adddresss of Expansion Modules and the Interface Submodules

Addresses within an Expansion Module

Each expansion module occupies 256 bytes (100_H) within the CPU/FM address area. The mapping of the 256 addresses within an expansion module is shown in Table 11-2.

Table 11-2 Address Mapping within an Expansion Module

Address	Function/Slot	Remarks
00_H to $3F_H$	reserviert	The basic settings in the expansion module, such as interrupt assignments, etc. are made in this area by the automation computer BIOS.
40_H to $7F_H$	Interface submodule x	Not used for EXM 378-2
80_H to BF_H	Interface submodule y	
$C0_H$ to FF_H	Interface submodule z	

Basic Addresses of the Interface Submodules

Special properties of the interface submodules are set using the basic addresses, such as the position of the PC compatible I/O addresses (IF 962-COM, IF 962-LPT, etc.), or the interface submodules are addressed exclusively via these basic addresses (IF 961-DIO, IF 961-AIO, etc.).

The basic address for the interface submodules is derived from the sum of the addresses of the expansion module and the interface submodule. The resulting basic address can be seen in Table 11-3:

Table 11-3 Basic Addresses of interface submodules in EXM 378-2 and EXM 378-3 Expansion Modules

Basic Address	Expansion Module	Interface Submodule in Receptacle ...
$C180_H$	EXM 378-2	Number 1
$C1C0_H$		Number 2
$C240_H$	EXM 378-3	Number 3
$C280_H$		Number 4
$C2C0_H$		Number 5

11.5 Interrupt Assignment, Signal Linking with EXM 378-2, EXM 378-3

Introduction

Up to three interrupts per interface submodule are permitted in an EXM 378-2 or EXM 378-3 expansion module. The various interrupt assignment and operation options are described below.

Interrupt Assignment

Up to three interrupts of an interface submodule (IRQa, IRQb, IRQc) can be assigned ISA interrupts as you configure the interface submodule in the BIOS setup. This is done by entering the required ISA interrupt in the appropriate screen.

If you enter the value “$F0_H$” instead of the ISA interrupt, this interrupt will be processed via the group interrupt. Refer to the following section.

Group Interrupt

Since the number of interrupts is limited because of PC compatibility requirements, the EXM 378-2 and EXM 378-3 expansion modules allow several individual interrupts to be assigned to a group interrupt. All interface submodule interrupts within an expansion module for which the interrupt assignment “$F0_H$” has been entered share the group interrupt (shared interrupt).

The assignment of a group interrupt to the ISA interrupt is carried out when the interface submodule is configured in the BIOS setup.

Signal Linking

In an EXM 378-2 or EXM 378-3 expansion module, two signals from an interface submodule can be linked to another one (signal linking). This signal linking is carried out when configuring the interface submodule in the BIOS setup.

The description of the interface submodules tells you whether an interface submodule requires signals from another interface submodule, and thus whether signal linking is necessary.

11.6 MSM 378 Mass Storage Module

Order Number

MSM 378: 6EM7 378-2BA00-0AC0

Features

The MSM 378 mass storage module is used for storing programs and large amounts of data. It has a 24 V connection.

The MSM 378 mass storage module has the following functional units:

- 1 3.5”/1.44 Mbyte diskette drive
- 1 hard disk drive with a capacity of $\geq$ 516 x 10^6 byte

Connection

The mass storage module has an 88-pin interconnection plug on the left hand side.

This can be plugged into the automation computer or into an EXM 378-2 or EXM 378-3 expansion module.

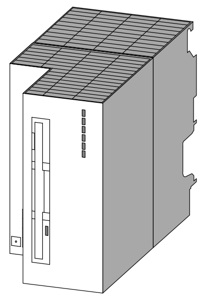


Figure 11-7 MSM 378 Mass Storage Module

System Integration BIOS Setup

To allow the BIOS of your CPU 388 or FM 356 to address the diskette drive and the hard disk correctly, you must implement your CPU/FM settings in the BIOS setup.

The “BIOS setup” section in the module description tells you how to make these settings.

11.7 Technical Data

Technical Data of Expansion Modules

The following tables contain technical data for the MSM 378, EXM 378-2 and EXM 378-3 expansion modules:

Note

The provisions of the “General Technical Data” of the S7-300 and M7-300 programmable logic controllers (see Reference Manual “Module Specifications”) shall apply unless stated otherwise in this section.

Only safety isolated extra low voltage power supplies should be used for the supply to the modules.

MSM 378	
6EM7 378-2BA00-0AC0	
Features	
Diskette drive	8.89 cm (3.5 in.), 1.44 Mbytes
Hard disk drive	516 x 10^6 bytes
Facility to connect expansion modules	–
Technical Data	
Supply voltage	24 V DC
Current consumption from 24-V supply	0.4 A
Inrush current	10 A / 80 ms
I^2t	0.8 A^2s
Power loss	9.6 W
Dimensions B x H x T (mm)	80 x 125 x 166 (3.2″x 4.9″x 6.5″)
Weight	0.8 kg (1.76 lb.)

Ambient Conditions for Operation	
Temperature:	
horizontal installation	0 to 40 °C (32 °F to 104 °F)
vertical installation	0 to 40 °C (32 °F to 104 °F)
Temperature change:	max. 10 K/h (50 °F/h)
Relative humidity:	8% to 80% at 25 °C, No condensation
Height (above sea level)	-50 m to 2.500 m (–164 ft. to 8200 ft.)
Mechanical vibrations (measured on the drive)	
$10 \leq f \leq 58$ Hz	0.035 mm, constant amplitude
$58 \leq f \leq 500$ Hz	0.2 g, constant acceleration
Shock: (measured on the drive)	Half sine wave: 5 g 11 ms
Ambient Conditions for Storage/Transport	
Temperature:	-10 to 60 °C
Temperature change:	max. 20 K/h (50 °F/h)
Relative humidity:	8% to 80% at 25 °C (77 °F), No condensation
Height (above sea level)	Up to 10.000 m (32 800 ft.)
Mechanical vibrations $5 \leq f \leq 9$ Hz $9 \leq f \leq 500$ Hz	3.5 mm amplitude 1 g acceleration
Shock:	Half sine wave: 50 g 11 ms

Note

The ambient conditions specified are limit values determined by the hard disk drive. These values must not be exceeded at the drive.

EXM 378-2	
6EM7 378-2AB00-0AC0	
Features	
Number of plug-in interface submodules	2
Connection of expansion modules	1 EXM 378-3 or 1 MSM 378
Power supply for ...	1 additional EXM 378-3
Technical Data	
Power supply voltage	24 V DC
Current consumption from 24-V supply (without interface submodules)	0.095 A
Inrush current	5,5 A / 2 ms
I^2t	0.8 A^2s
Power loss (base load) (without interface submodules)	2.28 W
Power loss (with interface submodules)	max. 10 W
Dimensions B x H x T (mm)	80 x 125 x 117
Weight	0.5 kg

EXM 378-3	
6EM7 378-2AC00-0AC0	
Features	
Number of plug-in interface submodules	3
Connection of expansion modules	1 MSM 378
Technical Data	
Power supply voltage	Supplied from EXM 378-2
Current consumption from 24-V supply (via EXM378-2, without interface submodules)	0.015 A
Power loss (base load) (without interface submodules)	0.22 W
Power loss (with interface submodules)	max. 10 W
Dimensions B x H x T (mm)	80 x 125 x 117 (3.2″x 4.9″x 4.6″)
Weight	0.45 kg

Calculating the Power Loss

The formulae for calculating the power loss for the EXM378-2 and EXM378-3 expansion modules are given below:

$$P_{EXM378\text{-}2} = P_1 + 1.6 \text{ x } P_2 + 0.6 \text{ x } (P_4 + P_5) + P_3$$

$$P_{EXM378\text{-}3} = P_4 + P_5 + P_6$$

P_1 Power loss of EXM 378-2 (2.28 W)
P_2 Power loss of interface submodules in EXM 378-2
P_3 Power loss of interface submodules in EXM 378-2 from external power supply
P_4 Power loss of EXM 378-3 (0.22W)
P_5 Power loss of interface submodules in EXM 378-3
P_6 Power loss of interface submodules in EXM 378-3 from external power supply

Examples of Power Loss Calculations

A few examples of power loss calculationsg for various configurations of interface submodules in expansion modules are shown below:

1. An EXM 378-2 expansion module is equipped with 2 interface submodules.

   The permissible total power loss of 10 W is not exceeded. This configuration is permissible.

EXM378-2 Module	**Power loss**
EXM 378-2 (P_1)	2.28 W
IF 962-VGA (1.6 x P_2 = 1.6 x 2.5 W)	4 W
IF 962-LPT (1.6 x P_2 = 1.6 x 0.5 W)	0.8 W
Total	7.08 W

2. An EXM 378-2 expansion module is equipped with 2 interface submodules and an EXM 378-3 expansion module is equipped with 3 interface submodules.

   The EXM 378-2 interface submodule exceeds the permissible total power loss of 10 W. This configuration is not permissible.

EXM 378-2 Module	**Power Loss**		**EXM 378-3 Module**	**Power Loss**
EXM 378-2 (P_1)	2.28 W		EXM 378-3 (P_4)	0.22 W
IF 962-VGA (1.6 x P_2 = 1.6 x 2.5 W)	4 W		IF 961-DIO (P_5)	2.4 W
IF 961-AIO (1.6 x P_2 = 1.6 x 2.5 W)	4 W		IF 962-LPT (P_5)	0.5 W
EXM 378-3 1) (0.6 x P_4 = 0.22 W x 0.6)	0.13 W		IF 962-COM (P_5)	0.5 W
IF 961-DIO 1) (0.6 x P_5 = 0.6 x 2.4 W)	1.44 W			
IF 962-LPT 1) (0.6 x P_5 = 0.6 x 0.5 W)	0.3 W			
IF 962-COM 1) (0.6 x P_5 = 0.6 x 0.5 W)	0.3 W			
Total	12.45 W		Total	3.62 W

1) Calculation of the power loss arising in the 24 V DC converter in the EXM378-2
due to supplying the EXM378-3 and its interface submodules.

3. By configuring the interface submodules in the EXM 378-2 and EXM 378-3 expansion modules differently (compared to example 2), the power loss in both expansion modules lies below the maximum permissible power loss of 10 W.

EXM 378-2 Module	**Power Loss**		**EXM 378-3 Module**	**Power Loss**
EXM 378-2 (P_1)	2.28 W		EXM 378-3 (P_4)	0.22 W
IF 962-COM (1.6 x P_2 = 1.6 x 0.5 W)	0.8 W		IF 961-DIO (P_5)	2.4 W
IF 962-LPT (1.6 x P_2 = 1.6 x 0.5 W)	0.8 W		IF 961-AIO (P_5)	2.5 W
EXM 378-3 1) (0.6 x P_4 = 0.6 x 0.22 W)	0.13 W		IF 962-VGA (P_5)	2.5 W
IF 961-DIO 1) (0.6 x P_5 = 0.6 x 2.4 W)	1.44 W			
IF 961-AIO 1) (0.6 x P_5 = 0.6 x 2.5 W)	1.5 W			
IF 962-VGA 1) (0.6 x P_5 = 0.6 x 2.5 W)	1.5 W			
Total	8.45 W		Total	7.62 W
1) Calculation of the power loss arising in the 24 V DC converter in the EXM378-2 due to supplying the EXM378-3 and the interface submodules it contains.				

Interface Submodules 12

Introduction

The interface submodules are intended for use with M7-300 and M7-400 automation computers. They can be used in M7-400 programmable modules and in EXM 378 / EXM 478 expansion modules. The interface submodules are controlled via the ISA bus.

The interface submodules have an identification on the front plate to facilitate identification when installed.

Chapter Overview

12.1 Overview of Interface Submodules

Handling

Insertion and removal of the modules and their front connectors must only take place with the power off. Make sure the modules are connected to the correct front plugs. The interface submodules or the equipment connected to them may be destroyed if the modules are connected to the wrong plugs.

ESD Guidelines

The interface submodules have no cover on the anderside. The ESD guidelines must therefore be rigorously observed when handling these modules.

Slots/Module Receptable Numbers

You need the module receptacle numbers to integrate the interface submodules into your system (for example during BIOS setup). The numbering of the individual receptacles can be foand in the descriptions of the M7-400 programmable modules or the M7-300/400 expansion module.

Addressing in the M7-300/400 Specific I/O Address Area

The I/O address area from $C000_H$ in the M7-300/400 automation computers is reserved for addressing the interface submodules.

The basic addresses of the interface submodules depend on the module receptacle of the M7-400 programmable module or the M7-300/400 expansion module into which the interface submodule is plugged. These basic addresses can be foand in the descriptions of the M7-400 programmable module or the M7-300/400 expansion module.

The registers and their significance and the associated offset addresses for the individual interface submodules are described in the following sections.

The I/O address is the sum of the basic address and the offset address.

Module Identification Code

Every interface submodule has a fixed identification code. This information is needed in the BIOS setup.

Interrupt Assignment

Up to three interrupts of an interface submodule (IRQa, IRQb, IRQc) can be assigned ISA interrupts as you configure the interface submodule in the BIOS setup. This is done by entering the required ISA interrupt in the appropriate screen page.
The format for entering the interrupts is shown in the following table.

Table 12-1 Format for Entering Interrupts in the Interface Submodule BIOS Setup

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	1	1	0	ISA interrupt number			

If you enter the value “$F0_H$” instead of the ISA interrupt (“Ex_H”), this interrupt will be processed via a group interrupt.

Group Interrupt

Since the number of interrupts is limited because of PC compatibility requirements, a facility to allow several individual interface submodule interrupts to be assigned to a group interrupt is provided. All interface submodule interrupts within an expansion module for which the interrupt assignment “$F0_H$” has been entered share the group interrupt.

The assignment of a group interrupt to the ISA interrupt is carried out when the interface submodule is configured in the BIOS setup.

Signal Linking

In an expansion module, up to two signals from an interface submodule can be linked to another interface submodule (signal linking). This signal linking is done when configuring the interface submodules in the BIOS setup.

The description of the interface submodules tells you whether an interface submodule requires signals from another interface submodule, and thus whether signal linking is necessary.

12.2 Module Identification Code and Slot Compatibility

Module Identification Code

The following table shows the module identification codes for the interface submodules.

Table 12-2 Overview of Identification Codes for Interface Submodules

Interface Submodule	Module Identification Code
IF 961-AIO	01_H
IF 961-CT1	03_H
IF 961-DIO	02_H
IF 962-COM	41_H
IF 962-LPT	44_H
IF 962-VGA	81_H
IF 964-DP	$8C_H$

Slot Compatibility

The interface submodules cannot be used in all module receptacles. The following table shows the compatibility of those modules that cannot be used universally:

Table 12-3 Slot Compatibility for Interface Submodules That Are Not Universal

Interface Submodule	Module Receptacle Numbers for Modules ...									
	EXM 378-2		EXM 378-3			FM 456-4		CPU 486-3 CPU 488-3		EXM 478
	1	2	3	4	5	0	1	0	3	all
IF 962-VGA 6ES7 962-1BA00-0AC0	●	●	–	●	●	●	●	●	●	●
IF 964-DP 6ES7 964-2AA00-0AB0	●	●	–	●	●	●	●	●	●*)	●
* Preference receptacle, if only one IF 964-DP is used.										

12.3 IF 962-VGA Interface Submodule

Order Number

6ES7 962-1BA00-0AC0

Features

The IF 962-VGA interface submodule is used to connect a keyboard and a VGA monitor. The interfaces to the keyboard and monitor are PC compatible.

As an alternative to a “normal” keyboard, a keyboard with an integral trackerball (for instance a PG740 keyboard) can be connected.

The IF 962-VGA is only designed for local use; the distance to peripherals should not exceed more than about 2.5 m (8 ft.).

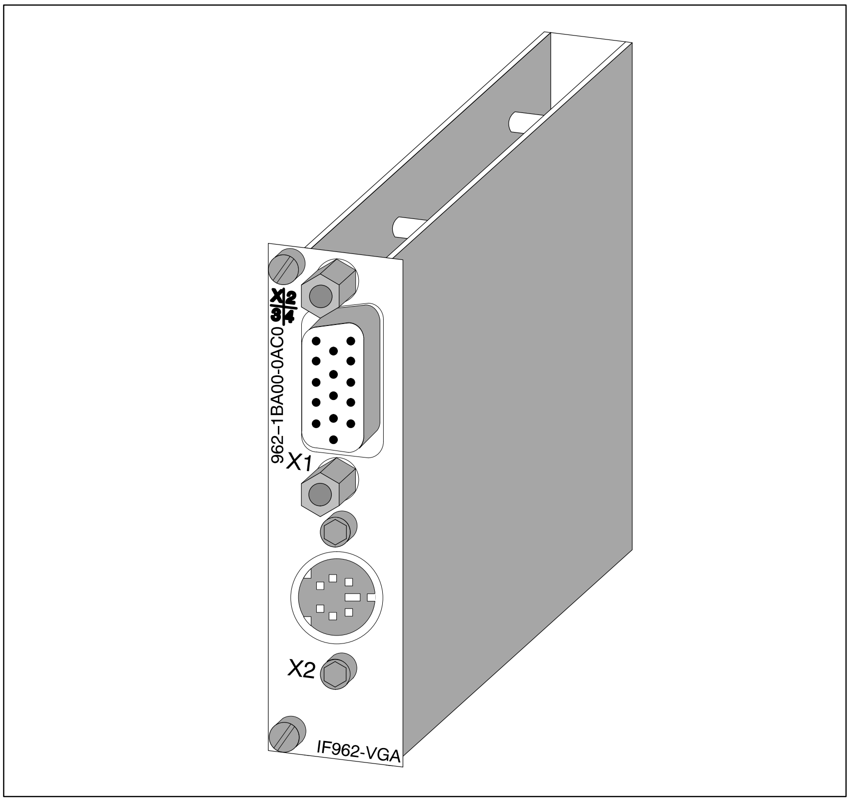


Figure 12-1 IF 962-VGA Interface Submodule

Note

Only one keyboard/graphics module can be used in conjunction with a programmable module (CPU or FM).

12.3.1 Connector Pin Assignment

Table 12-4 Socket X1, VGA Monitor Connection on IF 962-VGA (15-Pin High Density Sub-D Socket)

Socket X1 VGA Monitor Connection

Pin	Signal Definition
1	Red video
2	Green video
3	Blue video
4	
5	Signal GND
6	Red video GND
7	Green video GND
8	Blue video GND
9	
10	Signal GND
11	
12	
13	Horizontal synchronization
14	Vertical synchronization
15	

Table 12-5 Socket X2, Keyboard Plug Connection on IF 962-VGA (6-Pin Mini-DIN Socket)

Socket X2 Keyboard Connection

Pin	Signal Definition	Direction
1	Keyboard data	Input/output
2	Mouse data	Input/output
3	Signal-GND	–
4	5 V DC	–
5	Keyboard clock	Input/output
6	Mouse clock	Input/output

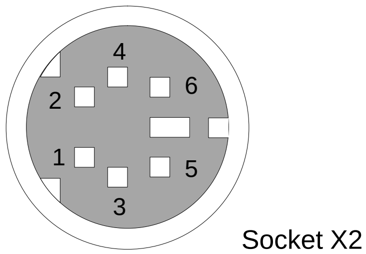


Figure 12-2 Socket X2, Keyboard Plug Connection on IF 962-VGA (6-Pin Mini-DIN Socket)

12.3.2 Addressing, Interrupt and Module Identification Code

Addressing

Addressing conforms to the PC standard.

The following addresses are used by the IF 962-VGA interface submodule
Memory addresses: $A0000_H$ to $C7FFF_H$
I/O addresses: 060_H to $06F_H$, $3B0_H$ to $3BB_H$, $3BF_H$ to $3DF_H$

Interrupt Request

The interface submodule provides the following interrupts:

- IRQ a: Keyboard interrupt
- IRQ b: Mouse interrupt (trackerball)
- IRQ c: VGA interrupt

These interrupts are routed to ISA interrupts by the BIOS in accordance with Table 12-6.

Table 12-6 IF 962-VGA Interface Submodule Interrupt Assignment

Interrupt Source on Interface Submodule		ISA Interrupt
Keyboard	IRQ a	IRQ 1
Mouse (trackerball)	IRQ b	IRQ 12
VGA	IRQ c	Can be defined in BIOS setup

Module Identification Code:

The identification code for the IF 962-VGA interface submodule is $\mathbf{81_H}$.

12.3.3 Technical Data

Technical Data

The IF 962-VGA interface submodule obtains its supply voltage from the M7-400 programmable modules or the M7-300/400 expansion modules. The technical data contains the current consumption so that the power supply can be dimensioned, in other words the current consumption is referred to 24 V for the M7-300 and 5 V for the M7-400.

6ES7 962-1BA00-0AC0	
Technical Data	
Supply voltage	Supplied from the M7-400 programmable modules or the M7-300/400 expansion modules
Current consumption in M7-300 (for dimensioning the 24 V power supply)	0.21 A
Current consumption in M7-400 (for dimensioning the 5 V power supply)	0.6 A
VGA controller	WD90C24
Video memory	1 Mbyte
Module identification	81_H
Power loss	2.5 W
Dimensions W x H x D (mm)	18.2 x 67 x 97 (0.72″x 2.64″x 3.82″)
Weight	0.085 kg (0.19 lb.)

Operating Modes

The WD90C24 VGA controller is used in the IF 962-VGA interface submodule. Table 12-7 shows the video operating modes supported by the BIOS of the IF 962-VGA interface submodule.

Table 12-7 Video-Operating Modes of the IF 962-VGA Interface Submodule

Mode (HEX**)**	**Text / Graphics**	**B&W / Color**	**Resolution** (columns x lines)	**Number of Colors**	**Character Size**	**Horizontal Frequency** (kHz)	**Vertikal Frequency** (Hz)
0, 1	Text	Color	320 x 200	16	8 x 8	31.5	70
0, 1	Text	Color	320 x 350	16	8 x 14	31.5	70
0, 1	Text	Color	360 x 400	16	9 x 16	31.3	70
2, 3	Text	Color	640 x 200	16	8 x 8	31.5	70
2, 3	Text	Color	640 x 350	16	8 x 14	31.5	70
2, 3	Text	Color	720 x 400	16	9 x 16	31.3	70
4, 5	Graphics	Color	320 x 400	4	8 x 8	31.5	70
6	Graphics	B&W	320 x 200	2	8 x 8	31.5	70
7	Text	B&W	720 x 350	2	9 x 14	31.3	70
0D	Graphics	Color	320 x 200	16	8 x 8	31.5	70
0E	Graphics	Color	640 x 200	16	8 x 8	31.5	70
0F	Graphics	B&W	640 x 350	2	8 x 14	31.5	70
10	Graphics	Color	640 x 350	16	8 x 14	31.5	70
11	Graphics	B&W	640 x 480	2	8 x 16	31.5	60
12	Graphics	Color	640 x 480	16	8 x 16	31.5	60
13	Graphics	Color	320 x 200	256	8 x 8	31.5	70
54	Text	Color	1056 x 344	16	9 x 9	31.1	70
55	Text	Color	1056 x 400	16	8 x 16	31.1	70
5F	Graphics	Color	640 x 480	256	8 x 16	31.5	60
58/6A	Graphics	Color	800 x 600	16	8 x 8	35.1	56
58/6A	Graphics	Color	800 x 600	16	8 x 8	37.8	60
58/6A	Graphics	Color	800 x 600	16	8 x 8	47.7	72
5C	Graphics	Color	800 x 600	256	8 x 8	35.1	56
5C	Graphics	Color	800 x 600	256	8 x 8	37.8	60
5C	Graphics	Color	800 x 600	256	8 x 8	47.7	72
5D	Graphics	Color	1024 x 768	16	8 x 16	35.6	87 1)
5D	Graphics	Color	1024 x 768	16	8 x 16	48.4	60
60	Graphics	Color	1024 x 768	256	8 x 16	35.6	87 1)
60	Graphics	Color	1024 x 768	256	8 x 16	48.4	60

1) Interlaced mode

12.4 IF 962-COM Interface Submodule

Order Number

6ES7 962-3AA00-0AC0

Features

The IF 962-COM interface submodule is used to connect equipment that has a serial interface. It contains two PC compatible serial interfaces (COMa, COMb).

A maximum of four COM interfaces can be addressed with standard PC drivers at PC I/O addresses on a programmable module. This includes the COM interfaces that may be located on the programmable module itself or on expansion modules. The IF 962-COM interface submodules can be operated both in the PC compatible address area and, with special drivers, in the address area reserved for M7-300/400.

Connector X1 is for interface COMa, connector X2 for COMb. The signal levels are defined according to RS232C.

The length of cable to the IF 962-COM interface submodule should not exceed about 10 m (33 ft.).

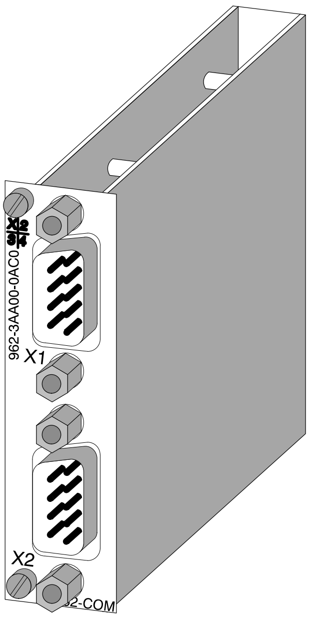


Figure 12-3 IF 962-COM Interface Submodule

What Can Be Connected to the Interfaces?

Any equipment with an RS232 interface can be connected, such as:

printer, modem, terminal, ...

12.4.1 Connector Pin Assignment

Table 12-8 Connectors X1, X2 on the IF 962-COM (9-Pin Sub-D Male Connector)

Connectors X1, X2 COMa, COMb

Pin	Signal	Signal Definition	Direction
1	DCD	Data carrier detect	Input
2	RxD	Receive data	Input
3	TxD	Send data	Output
4	DTR	Data terminal ready	Output
5	Signal GND	Signal groand (GND_{int})	–
6	DSR	Data set ready	Input
7	RTS	Request to send	Output
8	CTS	Clear to send	Input
9	RI	Ring indicator	Input

Note

The signal groand on the COMa and COMb interfaces is referred to the internal groand.

If necessary, suitable measures must be taken on the plant side to prevent groand loops.

12.4.2 Addressing and Interrupt

Addressing

The interface submodule IF 962-COM can be addressed in two ways:

- in the PC Compatible I/O address area
- in the M7-300/400 Reserved I/O address area (starting from $C000_H$)

Addressing in the PC Compatible I/O Address Area

The COM interfaces can be used in the PC-compatible I/O address area. The addresses are defined in the BIOS setup and are shown in the following table.

Table 12-9 Addressing the COM Interfaces in the PC-Compatible Address Area

Name	I/O Address	Remarks
*)	$03F8_H$ to $03FF_H$	Automatically configured by the BIOS and can be set in the BIOS setup.
	$02F8_H$ to $02FF_H$	
	$03E8_H$ to $03EF_H$	
	$02E8_H$ to $02EF_H$	
–	0380_H to 0387_H	
–	0280_H to 0287_H	
*) The BIOS scans the addresses in the order $03F8_H$, $02F8_H$, $03E8_H$ and $02E8_H$ and assigns COM1, COM2, COM3 and COM4 in ascending order. There is no fixed assignment of I/O addresses to COMx. If, for instance, only one COM interface is recognized at address $02E8_H$, this is COM1.		

Example of Defining a PC Compatible I/O Address

In the following example, I/O addresses $03F8_H$ (COM1) for COMa and $02F8_H$ (COM2) for COMb are to be defined in the BIOS setup. To do this, proceed as follows:

1. Select the “IF Modules” page in the BIOS setup.
2. Enter the module receptacle number of the interface submodule under “Select Module #”.
3. Enter the offset address “00_H” for the configuration register of the interface submodule under “Config.Index”.
4. Enter the value “36_H” under “Value”. This value is written to the configuration register (see Table 12-13).
5. Choose the OK button.

Addressing in the M7-300/400 Specific I/O Address Area

The IF 962-COM interface submodule can be be addressed in this reserved address area independently of any possible addressing in the PC-compatible address area.

The basic address depends on which slot the interface submodule occupies in the expansion module or programmable module. The slot-dependent basic address of the interface submodule can be found in the descriptions “M7-300 Expansion Modules”, “M7-400” Expansion Modules” or in the descriptions of the M7-400 programmable modules.

The I/O address is the sum of the basic address and the offset address.

The registers and their significance and the offset addresses are described below.

Table 12-10 Assignment of Offset Addresses for the IF 962-COM Interface Submodule

Offset Address	Function	Remarks
00_H	Configuration register	Read/write
08_H – $0F_H$	UART 16C552 parallel interface	Not used
10_H – 17_H	COMa UART 16C552	Read/write
18_H – $1F_H$	COMb UART 16C552	Read/write

Configuration Register

The configuration register contains the setting, determined by the BIOS setup, that specifies the PC-compatible I/O address area in which the COM interface is to be used, or whether it is only to be used in the reserved I/O address area. Tables 12-11 to 12-13 give an overview of the configuration register setting options.

Table 12-11 Offset Address for the Configuration Register (IF 962-COM)

Offset Address	Function	Remarks
00_H	Configuration register	Read /write

Table 12-12 Significance of the Data Bits in the Configuration Register (IF 962-COM)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	COM b addressing scheme			0	COM a addressing scheme		

Table 12-13 Significance of the Addressing Scheme Bits in the Configuration Register (IF 962-COM)

I/O Address	COM b/a Addressing Scheme		
	Bit 6/2	Bit 5/1	Bit 4/0
Addressing only possible in the reserved I/O address area (from $C000_H$) (default)	0	0	0
280_H	0	0	1
$2E8_H$	0	1	0
$2F8_H$	0	1	1
380_H	1	0	0
$3E8_H$	1	0	1
$3F8_H$	1	1	0
Not used	1	1	1

Note

Each COM interface of a modular PC can **only** have **one** PC-compatible I/O address (this includes modules installed in a programmable module).

COM Interfaces

The COM interfaces (COMa and COMb) of UART 16C552 can be addressed from offset addresses 10_H and 18_H in accordance with the 16C552 module specification.

Data Formats

The following data formats can be defined for the IF 962-COM interface submodule:

Data bits:	5 bits, 6 bits, 7 bits, 8 bits
Parity:	even, odd, disable
Stop bit:	1 bits, 1,5 bits, 2 bits

Transmission Speed

The follwing transmission speeds (baud rates) can be set for the IF 962-COM interface submodule:

PC-compatible transmission speeds and transmission speeds up to 115.2 kbit/s.

Note

Please note that the transmission speed for secure operation depends on, for instance, the cable length, and on the level of interference in the operating environment.

Interrupt Request

The interface submodule issues an interrupt request (IRQa und IRQb) for each serial interface.

The assignment of interrupt requests IRQa and IRQb to the corresponding processor interrupts (for instance IRQ4 and IRQ3) can be specified in the BIOS setup.

Table 12-14 Interrupt Assignment of the IF 962-COM Interface Submodule

Interrupt Source on Interface Submodule		ISA Interrupt
COM a	IRQ a	Can be specified in BIOS setup
COM b	IRQ b	

IRQ4 for COM1 and IRQ3 for COM3 are the default BIOS settings.

Module Identification Code

The identification code for the IF 962-COM interface submodule is $\mathbf{41_H}$.

12.4.3 Technical Data

Technical Data

The IF 962-COM interface submodule obtains its supply voltage from the M7-400 programmable modules or the M7-300/400 expansion modules. The technical data shows the current consumption so that the power supply can be dimensioned, in other words the current consumption is referred to 24 V for the M7-300 and 5 V for the M7-400.

6ES7 962-3AA00-0AC0	
Technical Data	
Supply voltage	Supplied from the M7-400 programmable modules or the M7-300/400 expansion modules
Current consumption in M7-300 (for dimensioning the 24 V power supply)	0.04 A
Current consumption in M7-400 (for dimensioning the 5 V power supply)	0.1 A
Module Identification Code	41_H
Power loss	0.5 W
Dimensions W x H x D (mm)	18.2 x 67 x 97 (0.72″x 2.64″x 3.82″)
Weight	0.080 kg (0.18 lb.).

12.5 IF 962-LPT Interface Submodule

Order Number

6ES7 962-4AA00-0AC0

Features

The IF 962-LPT interface submodule contains a PC-compatible parallel interface (LPT) for connecting a printer with a Centronics interface. The IF 962-LPT can also be used as a bi-directional data interface. A 25-pin Sub-D socket for the connecting cable is located on the front of the module.

A maximum of three LPT interfaces can be addressed with standard PC drivers at PC I/O addresses on a programmable module. This includes the LPT interfaces that may be located on the programmable module itself or on expansion modules. The IF 962-LPT interface submodules can be operated both in the PC compatible address area and, with special drivers, in the address area reserved for M7-300/400.

The length of cable to the IF 962-COM interface submodule should not exceed about 3 m (10 ft.).

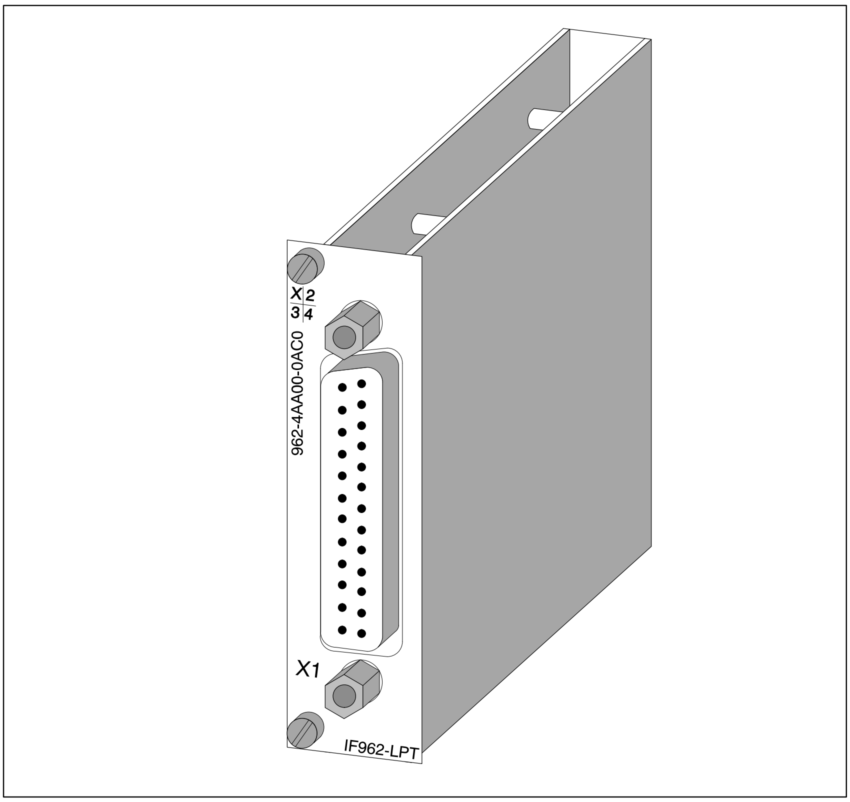


Figure 12-4 IF 962-LPT Interface Submodule

12.5.1 Connector Pin Assignment

Table 12-15 Connector X1 on IF 962-LPT (25-pin Sub-D Female)

Connector X1

Pin	Signal Definition	Direction
1	Strobe	Input/Output
2	Data 0	Input/Output
3	Data 1	Input/Output
4	Data 2	Input/Output
5	Data 3	Input/Output
6	Data 4	Input/Output
7	Data 5	Input/Output
8	Data 6	Input/Output
9	Data 7	Input/Output
10	Acknowledge	Input
11	Busy	Input
12	Paper end	Input
13	Select	Input
14	Auto feed	Output
15	Error	Input
16	Reset	Output
17	Select in	Output
18	GND	–
19	GND	–
:	GND	–
24	GND	–
25	GND	–

Note

The signal ground (GND) on the LPT interface is referred to the internal ground.

If necessary, suitable measures must be taken on the plant side to prevent ground loops.

12.5.2 Addressing and Interrupt

Addressing

The IF 962-LPT interface submodule can be addressed in two ways:

- In the PC compatible I/O address area
- In the M7-300/400-specific I/O address area (from $C000_H$)

Addressing in the PC Compatible I/O Address Area

The LPT interfaces can be used in the PC-compatible I/O address area. The addresses are defined in the BIOS setup and are shown in the following table.

Table 12-16 Addressing the LPT Interfaces

Name	I/O Address	Remarks
*)	$03BC_H$ to $3BE_H$	Automatically configured by the BIOS and can be defined in the BIOS setup
	0378_H to $37F_H$	
	0278_H to $27F_H$	
*) The BIOS scans the addresses in the order $03BC_H$, 0378_H and 0278_H and assigns LPT1, LPT2, and LPT3 in ascending order. There is no fixed assignment of I/O addresses to LPTx. If, for instance, only one LPT interface is recognized at address 0378_H, this is LPT1.		

Note

The LPT interface in the MSM478 expansion module in the M7-400 series always has the I/O address **$03BC_H$**. The I/O address $03BC_H$ can therefore not be set for the IF 962-LPT interface submodule if an MSM478 is used.

Example of Defining a PC Compatible I/O Address

In the following example, I/O address 0278_H is to be defined in the BIOS setup. To do this, proceed as follows:

1. Select the “IF Modules” page in the BIOS setup.
2. Enter the module receptacle number of the interface submodule under “Select Module #”.
3. Enter the offset address “00_H” for the configuration register of the interface submodule under “Config.Index”.
4. Enter the value “FE_H” or “02_H” under “Value”. This value is written to the configuration register (see Table 12-20).
5. Choose the OK button.

Addressing in the M7-300/400 Specific I/O Address Area

The IF 962-LPT interface submodule can be be addressed in this reserved address area independently of any possible addressing in the PC-compatible I/O address area.

The basic address depends on which slot the interface submodule occupies in the expansion module or programmable module. The slot-dependent basic address of the interface submodule can be found in the descriptions “M7-300 Expansion Modules”, “M7-400” Expansion Modules” or in the descriptions of the M7-400 programmable modules.

The I/O address is the sum of the basic address and the offset address.

The registers and their significance and the offset addresses are described below.

Table 12-17 Assignment of Offset Addresses for the IF 962-LPT Interface Submodule

Offset Address	Function	Remarks
00_H	Configuration register	Read/write
10_H – 17_H	UART 16C552 parallel interface	Read/write

Defaulrt Addresses in the BIOS

The following I/O addresses and interrupt numbers are the default BIOS settings for LPT interfaces:

Interface	I/O Addresse	Interrupt Number
M7-400 with MSM 478		
LPT1 (on MSM 478)	03BCH	7
LPT2 (IF 962–LPT)	0378H	5
M7-400 without MSM 478 or M7-300		
LPT1 (IF 962–LPT)	0378H	7
LPT2 (IF 962–LPT)	0278H	5

Configuration Register

The configuration register contains the setting, determined by the BIOS setup, that specifies the PC-compatible I/O address area in which the LPT interface is to be used, or whether it is only to be used in the reserved I/O address area. Tables 12-18 to 12-20 provide an overview of the configuration register setting options.

Table 12-18 Offset Addresses for the Configuration Register (IF 962-LPT)

Offset Address	Function	Remarks
0_H	Configuration register	Read/write

Table 12-19 Significance of the Data Bits in the Configuration Register (IF 962-LPT)

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Write: any (“0” or “1”) Read: always “1”						LPT addressing scheme	

Table 12-20 Significance of the Addressing Scheme Bits in the Configuration Register (IF 962-LPT)

I/O Address	Addressing Scheme	
	Bit 1	Bit 0
Addressing only possible in the reserved I/O address area (from $C000_H$) (default)	0	0
378_H	0	1
278_H	1	0
$3BC_H$	1	1

Note

Each LPT interface of a programmable module can **only** have **one** PC-compatible I/O address.

The LPT interface contained in the M7-400 MSM478 expansion module always has the I/O address **$03BC_H$**. Therefore, when an MSM478 is used, the I/O address $03BC_H$ may not be used for the IF 962-LPT interface submodule.

Parallel Interface

The UART 16C552 parallel interface in the interface submodule can be addressed from offset address 10_H in accordance with the 16C552 module specification.

Interrupt Request

The interface submodule issues an interrupt request (IRQa).

The assignment of the IRQa interrupt request to the corresponding processor interrupt request can be specified in the BIOS setup.

Module Identification Code

The identification code for the IF 962-LPT interface submodule is **44_H**.

12.5.3 Technical Data

Technical Data

The IF 962-LPT interface submodule obtains its supply voltage from the M7-400 programmable modules or the M7-300/400 expansion modules. The technical data gives the current consumption so that the power supply can be dimensioned, in other words the current consumption is referred to 24 V for the M7-300 and 5 V for the M7-400.

6ES7 962-4AA00-0AC0	
Technical Data	
Supply voltage	Supplied from the M7-400 programmable modules or the M7-300/400 expansion modules
Current consumption in M7-300 (for dimensioning the 24 V power supply)	0.04 A
Current consumption in M7-400 (for dimensioning the 5 V power supply)	0.1 A
Module Identification Code	44_H
Power loss	0.5 W
Dimensions W x H x D (mm)	18.2 x 67 x 97 (0.72″x 2.64″x 3.82″)
Weight	0.07 kg (0.15 lb.)

12.6 IF 961-DIO Interface Submodule

Order Number

6ES7 961-1AA00-0AC0

Features

The principal features of the IF 961-DIO interface submodule are as follows:

- 8 inputs, floating in groups of 2

  Input level, 24 V DC; 8.5 mA

  Input interrupt on rising and/or falling pulse edge

  The input delay parameter is set common to all channels: approx. 750 µs or approx. 3 ms
- 8 outputs, floating in groups of 4

  Output level, 24 V DC; 0.1A

  Outputs are short-circuit proof using electronic protection

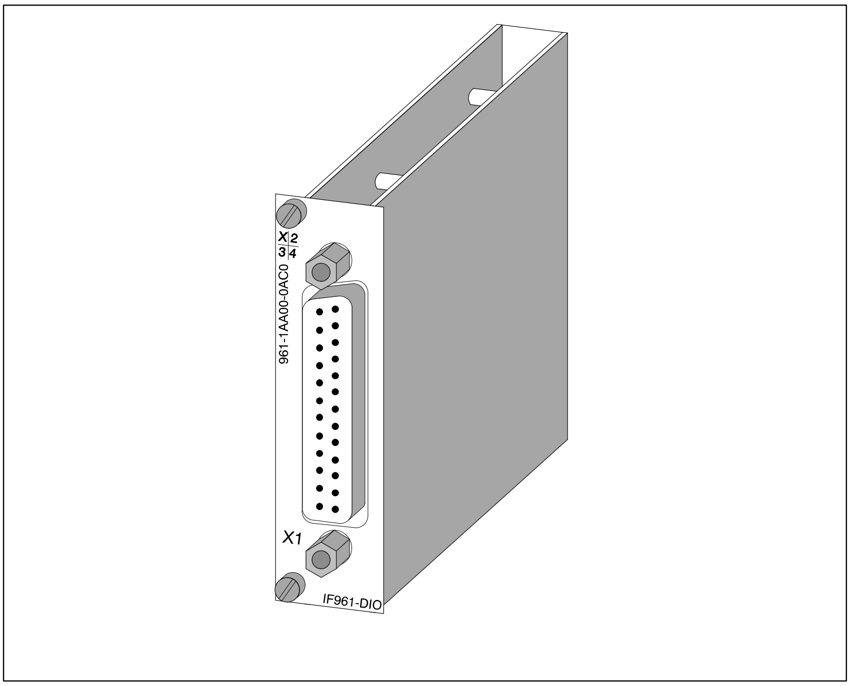


Figure 12-5 IF 961-DIO Interface Submodule

12.6.1 Connector Pin Assignment

Socket X1

A 25-pin Sub-D socket is provided on the front of the module for the connecting cable.

Figure 12-6 shows the pin assignments for this socket.

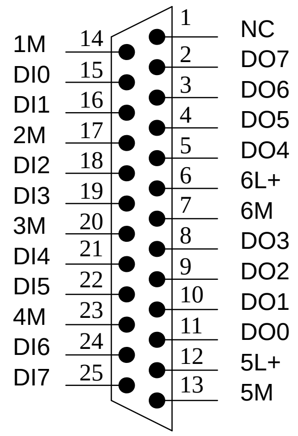


Figure 12-6 Pin Assignment of Connector X1 on IF 961-DIO (25-pin Sub-D Socket)

Figures 12-7 and 12-8 show the block diagrams and connection diagrams for the digital input and output circuits.

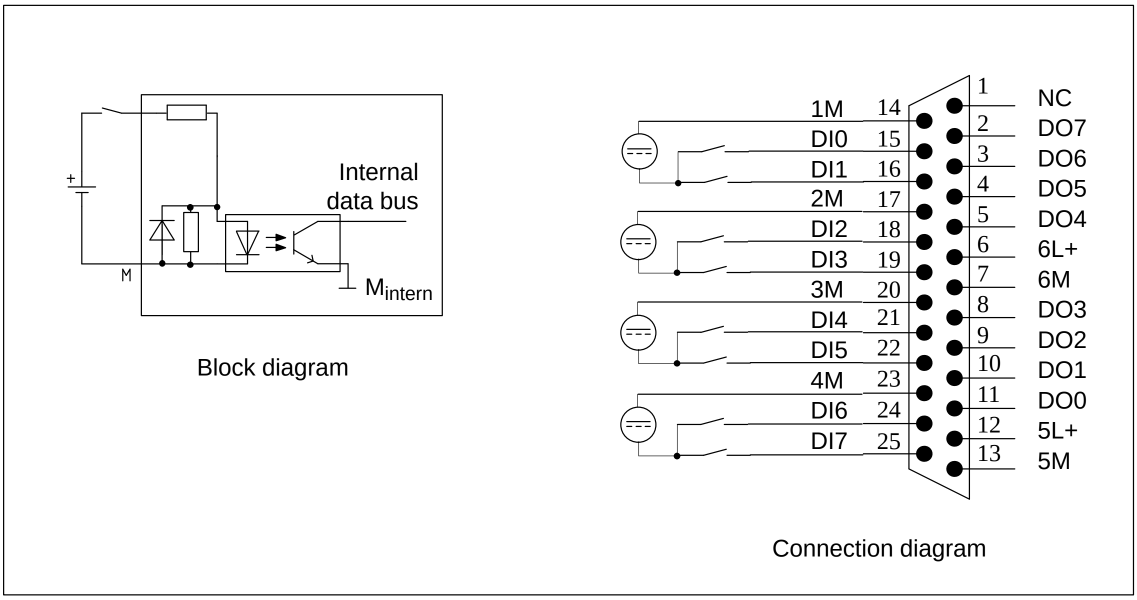


Figure 12-7 Block and Connection Diagram of Digital Input Circuits

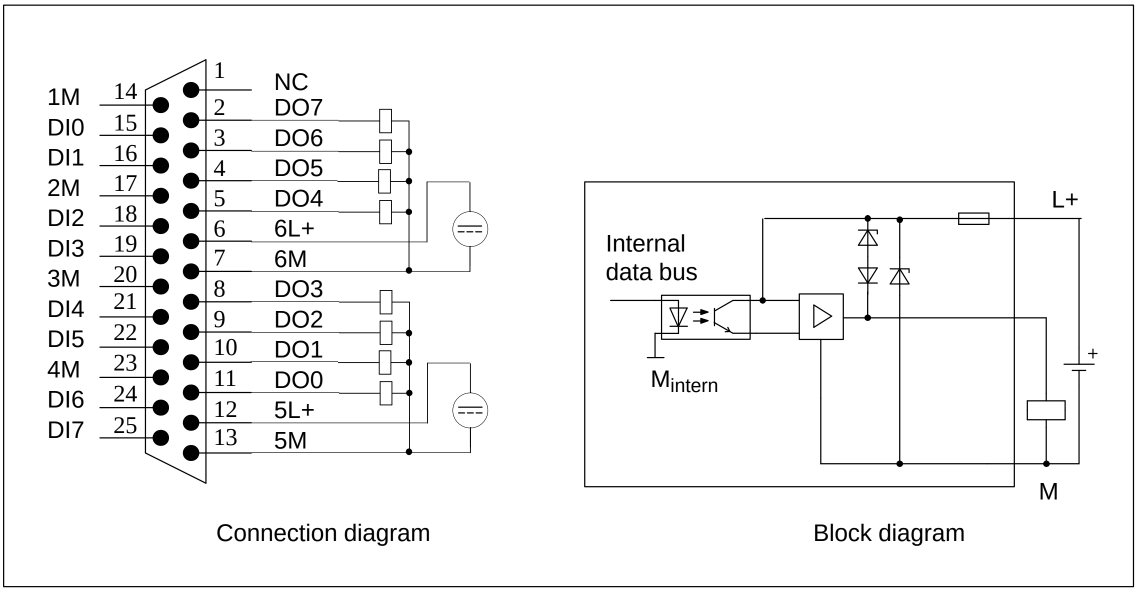


Figure 12-8 Block and Connection Diagram of Digital Output Circuits

12.6.2 Addressing and Interrupt

Addressing in the M7-300/400 Specific I/O Address Area

The basic address depends on which slot the interface submodule occupies in the expansion module or programmable module. The slot-dependent basic address of the interface submodule can be found in the descriptions “M7-300 Expansion Modules”, “M7-400” Expansion Modules” or in the descriptions of the M7-400 programmable modules.

The I/O address is the sum of the basic address and the offset address.

The registers and their significance and the offset addresses are described below.

Table 12-21 Assignment of Offset Addresses for the IF 961-DIO Interface Submodule

Offset Address	Function	Remarks
00_H	Digital input user data	DI0 – DI7 (**D**igital **I**nput)
01_H	Digital output user data	DO0 – DO7 (**D**igital **O**utput)
02_H	Acknowledgement register	Acknowledge interrupt
03_H	Interrupt register	Read interrupt cause
04_H	Interrupt enable register	General interrupt enable
05_H	Rising pulse edge selector register	Interrupt issued on rising pulse edge of digital input
06_H	Falling pulse edge selector register	Interrupt issued on falling pulse edge of digital input
07_H	Mode register	Input delay setting

Digital Input

Tables 12-22 and 12-23 provide an overview of the digital inputs.

Table 12-22 Offset Address for Digital Input (IF 961-DIO)

Offset Address	Function	Remarks
0	Digital input user data	Read only

Table 12-23 Assignment of Digital Input (DI-) Channels to Bits (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	DI channel 0	Range from -30 V to 5 V	Range from 13 V to 30 V
:	:	:	:
2^7	DI channel 7	Range from -30 V to 5 V	Range from 13 V to 30 V

Digital Output

Tables 12-24 and 12-25 provide an overview of the digital outputs.

Table 12-24 Offset Address for Digital Output (IF 961-DIO)

Offset Address	Function	Remarks
1	Digital output user data	Read/write

Table 12-25 Assignment of Digital Output (DO-) Channels to Bits (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	DO channel 0	0 V	+ 24 V
:	:	:	:
2^7	DO channel 7	0 V	+ 24 V

Acknowledgement Register

The interrupt is acknowledged in this register. Tables 12-26 and 12-27 provide an overview of the acknowledgement register.

Table 12-26 Offset Address for Acknowledgement Register (IF 961-DIO

Offset Address	Function	Remarks
2	Acknowlegement register	Write only

Table 12-27 Significance of Bits in Acknowledgement Register (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	Reserved		
:	:		
2^6	Reserved		
2^7	Acknowlege interrupt	No	Yes

Interrupt Register

This register contains the cause of the interrupt. Tables 12-28 and 12-29 provide an overview of the interrupt register.

Table 12-28 Offset Address for Interrupt Register (IF 961-DIO)

Offset Address	Function	Remarks
3	Interrupt register	Read only

Table 12-29 Significance of Bits in Interrupt Register (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	Change of level in DI channel 0	No	Yes
:	:	:	:
2^7	Change of level in DI channel 7	No	Yes

Interrupt Enable Register

Tables 12-30 and 12-31 provide an overview of the interrupt enable register.

Table 12-30 Offset Address for Interrupt Enable Register (IF 961-DIO)

Offset Address	Function	Remarks
4	Interrupt enable register	Read/write

Table 12-31 Significance of Bits in Interrupt Enable Register (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	Reserved		
:	:		
2^6	Reserved		
2^7	Interrupt	Disabled	Enabled

Rising Pulse Edge Selection Register

Tables 12-32 and 12-33 provide an overview of the selection registerer for creation of interrupts on a rising pulse edge of a digital input.

Table 12-32 Offset Address for Rising Pulse Edge Selection Register (IF 961-DIO)

Offset Address	Function	Remarks
5	Rising pulse edge selection register	Read/write

Table 12-33 Significance of Bits in the Rising Pulse Edge Selection Register (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	Creates interrupt on rising pulse edge in digital input channel 0	Disabled	Enabled
:	:	:	:
2^7	Creates interrupt on rising pulse edge in digital input channel 7	Disabled	Enabled

Falling Pulse Edge Selection Register

Tables 12-34 and 12-35 provide an overview of the selection register for the creation of interrupts on the falling pulse edge of a digital input.

Table 12-34 Offset Address for Falling Pulse Edge Selection Register (IF 961-DIO)

Offset Address	Function	Remarks
6	Falling pulse edge selection register	Read/write

Table 12-35 Significance of Bits in the Falling Pulse Edge Selection Register (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	Creates interrupt on falling pulse edge of digital input channel 0	Disabled	Enabled
:	:	:	:
2^7	Creates interrupt on falling pulse edge of digital input channel 7	Disabled	Enabled

Mode Register

Tables 12-36 and 12-37 provide an overview of the mode register.

Table 12-36 Offset Address for the Mode Register (IF 961-DIO)

Offset Address	Function	Remarks
7	Mode register	Read/write

Table 12-37 Significance of Bits in Mode Register (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	Input delay	3 ms	750 µs
2^1	Reserved		
:	:		
2^7	Reserved		

Status After Power Up (Reset Status)

The input delay is set to 3 ms after the interface submodule has been switched on.

Interrupt Request

The interface submodule issues an interrupt request (IRQa).

The assignment of the IRQa interrupt request to the corresponding processor interrupt request can be defined in the BIOS setup.

Module Identification Code

The identification code for the IF 961-DIO interface submodule is $\mathbf{02_H}$.

12.6.3 Technical Data

Technical Data

The IF 961-DIO interface submodule obtains its supply voltage from the M7-400 programmable modules or the M7-300/400 expansion modules. The technical data shows the current consumption so that the power supply can be dimensioned, in other words the current consumption is referred to 24 V for the M7-300 and 5 V for the M7-400.

6ES7 961-1AA00-0AC0	
Dimensions and weight	
Dimensions W x H x D (mm) W x H x D (mm)	18.2 × 67 × 97 (0.72″x 2.64″x 3.82″)
Weight	0.065 kg
Module data	
Module Identification Code	02_H
Number of inputs Number of outputs	8 8
Cable length	
• unscreened	200 m with 750 µs, 600 m with 3 ms delay time
• screened	1000 m
Voltages, currents, potentials	
Rated voltage Load power supply L+	24 V DC
Permissible range of rated voltage for load power supply L+	20.4 V to 28.8 V
Protection against incorrect connection	No (fuse)
Current consumption L+	Depends on load circuits
Number of inputs that can be controlled simultaneously	8
Number of outputs that can be controlled simultaneously	8
Floating	Yes (opto-coupler)
• in groups of	2
Permissible potential differences	
• Between the M connections of the groups	75 V DC 60 V AC
• Between input (M connection) and central ground point	75 V DC 60 V AC
• Insulation tested at	500 V DC
Supply voltage	Supplied from the M7-400 programmable module or the M7-300/400 expansion modules
Current consumption in M7-300 (for dimensioning the 24 V power supply)	0.03 A
Current consumption in M7-400 (for dimensioning the 5 V power supply)	0.085 A
Module power loss	2.4 W

Status, alarms, diagnostics	
Status indication	–
Interrupt	1 group interrupt from up to 8 sources
Diagnostic functions	No
Sensor selection data	
Input voltage	
• Rated value	24 V DC
• For ”1” signal	13 V to 30 V
• For ”0” signal	– 30 V to + 5 V
Input current	
• For ”1” signal	4 mA to 8.5 mA
Input delay time	750 µs or 3 ms
Input characteristic	To IEC 1131, part 2
Type of input to IEC 1131	Type 1
Connection of 2-wire BEROS	Possible under following conditions:
• Permissible quiescent current	$\leq$ 1.5 mA
• Permissible supply voltage	min. 22 V

Actuator selection data	
Output voltage	
• For ”0” signal	max. 3 V
• For ”1” signal	L+ – 1.5 V
Output current	
• For ”1” signal	
Rated value	0.1 A
Permissible range	5 mA to 0.1 A
• For ”0” signal (residual current)	max. 100 µA
Lamp load	max. 2.4 W
Parallel switching of 2 outputs	No
Controlling a digital input	Yes
Max. switching frequency	
• With resistive load/lamp load	500 Hz
• With inductive load	2.0 Hz at 0.1 A
Inductive breaking voltage limitation (internal)	L+ – 39 V
Output short-circuit protection	Yes, electronic

12.7 IF 961-AIO Interface Submodule

Order Number

6ES7 961-2AA00-0AC0

Features

The main features of the IF 961-AIO interface submodule are as follows:

- 4 analog inputs, each as current and voltage input
- 2 analog outputs, each as current and voltage output
- Power supply for the analog circuits from external 24 V DC
- Process and diagnostic interrupts

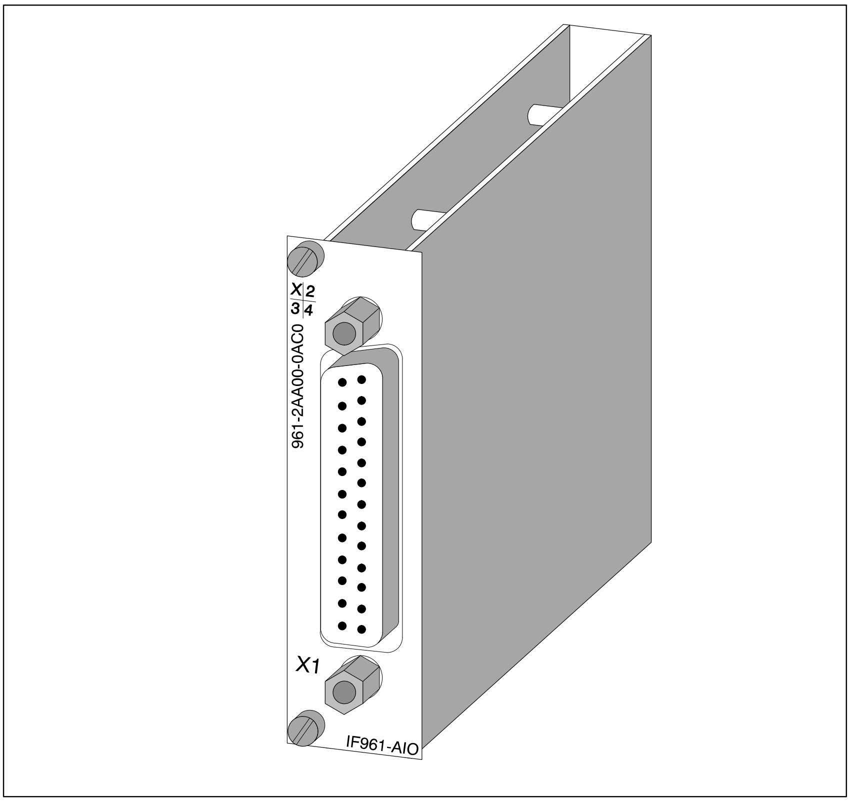


Figure 12-9 IF 961-AIO Interface Submodule

Measuring Range and Output Range Selection Feature

The measurement type (current or voltage measurement) of an input channel is selected by the wiring of the analog inputs (see Figure 12-10). The output type (current or voltage output) is selected by the wiring of the analog outputs (see Figure 12-10).

12.7.1 Connector Pin Assignment and Connection Diagram

Socket X1

A 25-pin Sub-D socket for the connecting cable is situated on the front of the module.

Figure 12-10 shows the pin assignments for connector X1 and the module connection diagram.

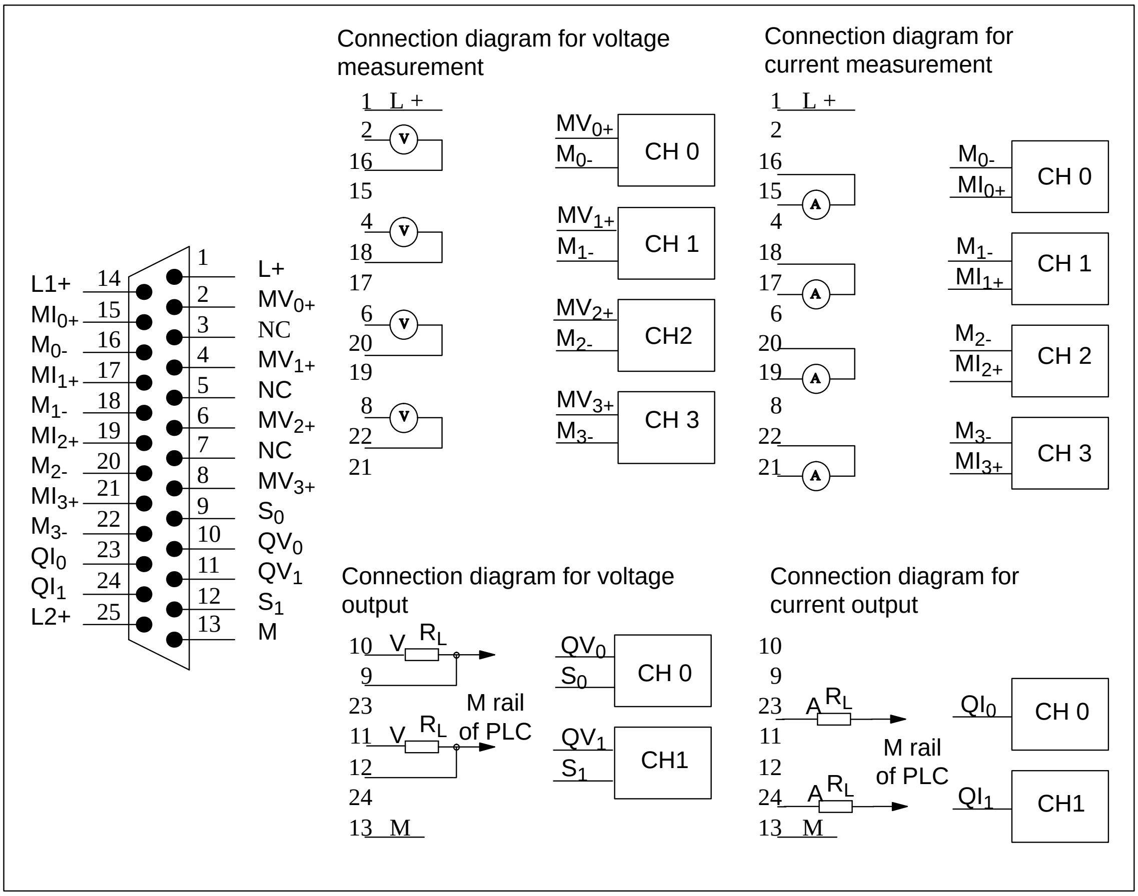


Figure 12-10 Pin Assignments of Connector X1 (25-pin Sub-D Socket) and Connection Diagram – IF 961-AIO

Note

Use screened cables only for the input and output connections.

Signal Definitions

The table below provides a definition of the signals in Figure 12-10.

Table 12-38 Definitions of the Signals on Connector X1 of the IF 961-AIO Interface Submodule

Signal	Definition
MV_{0+} ... MV_{3+}	Analog inputs: input voltage
MI_{0+} ... MI_{3+}	Analog inputs: input current
M_{0-} ... M_{3-}	Reference potential for analog inputs
QV_0, QV_1	Analog outputs: output voltage
QI_0, QI_1	Analog outputs: output current
S_0, S_1	Reference potential for analog outputs
L_+	Power supply input 24 V DC
$L1_+$, $L2_+$	Current supply output for 2-wire transmitters (24 V DC)
M	Ground (0 V)

Block Diagram

Figure 12-11 shows the block diagram for the IF 961-AIO interface submodule.

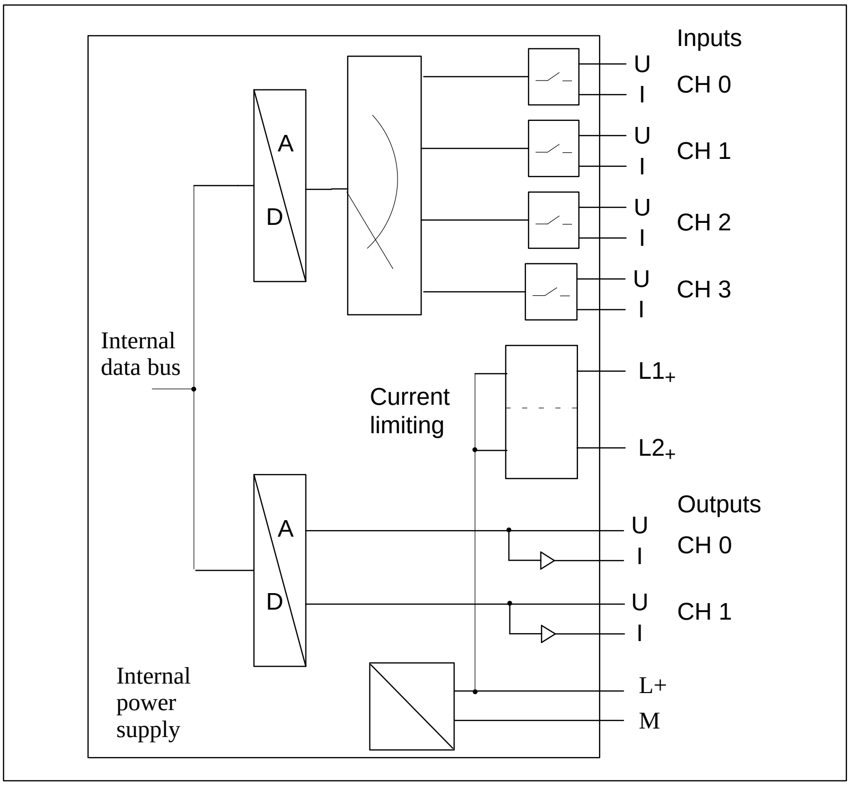


Figure 12-11 Block Diagram of IF 961-AIO Interface Submodule

Grounding of Analog Inputs

If the maintenance of the common-mode range (U_{CM}) cannot be guaranteed, the analog inputs must be grounded directly. The ground conductors of the individual analog inputs (1) and the screen must be routed **separately** to the grounding point. Please see Figure 12-12 for the grounding of analog inputs.

Grounding of Analog Outputs

The ground conductors of the individual analog outputs (2) and the screen must be routed **separately** to the grounding point.

In systems with grounded load current power supply, the ground of the load current power supply must be connected to grounding point (3) with a separate conductor. Please see the illustration below for the grounding of analog outputs.

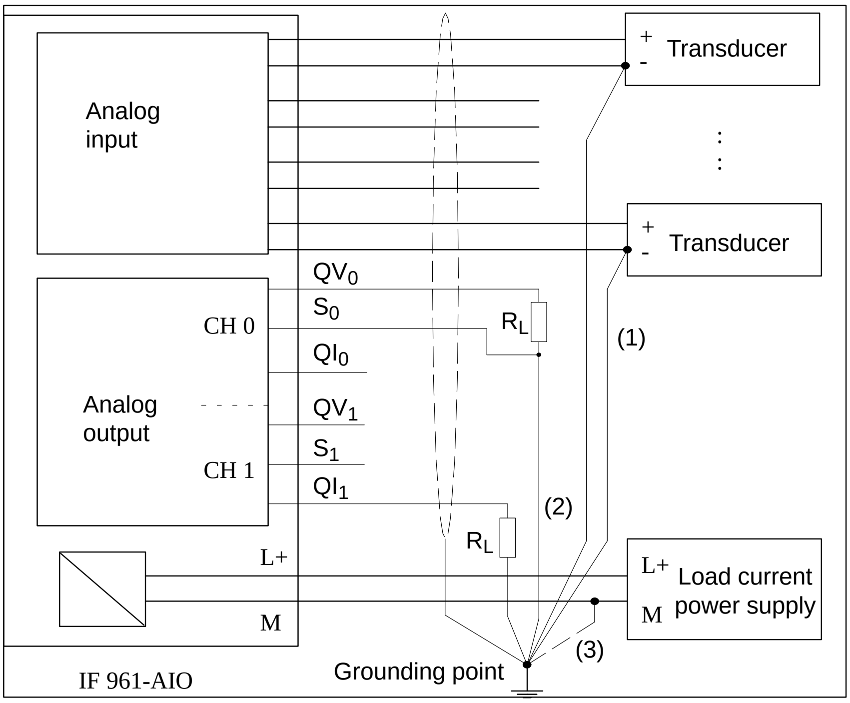


Figure 12-12 Grounding of the Analog Inputs/Outputs of the IF 961-AIO Interface Submodule

12.7.2 Connecting Sensors to Analog Inputs

Introduction

Depending on the type of measurement, various sensors can be connected to the analog inputs:

- Voltage sensor
- Current sensor as
  - 2-wire transmitter
  - 4-wire transmitter
- Resistance

This section describes how to connect the sensors and what to look out for when doing so.

Connecting Sensors to Analog Inputs

The maximum permissible voltage difference (U_{CM} = 8 V AC) between the inputs and the internal ground must not be exceeded.

The choice of measuring range (current/voltage) is made by appropriate wiring of the front connecting plug and by calling up the software driver provided for the measuring range.

Unused Channels

Unused input channels must be short-dircuited and grounded. This ensures optimum interference protection for the analog module.

Floating Sensor

With floating sensors, potential differences can arise between the individual sensors. These can occur due to faults or because of the location of the sensor.

Note

Ensure that U_{CM} (common mode voltage) does not exceed the permitted value. If this happens, measurements will be corrupted.

Figure 12-13 shows the connections for floating sensors.

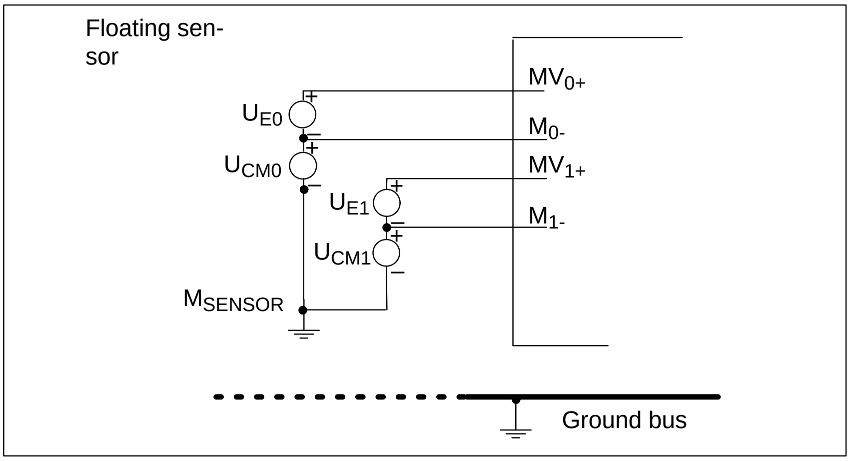


Figure 12-13 Connection of Isolated Sensors

Non-Isolated Sensor

With non-isolated sensors, there must be no potential difference between the sensors. Additional measures must be taken to ensure this if necessary (equipotential bonding conductor).

Figure 12-14 shows the connection of non-isolated sensors.

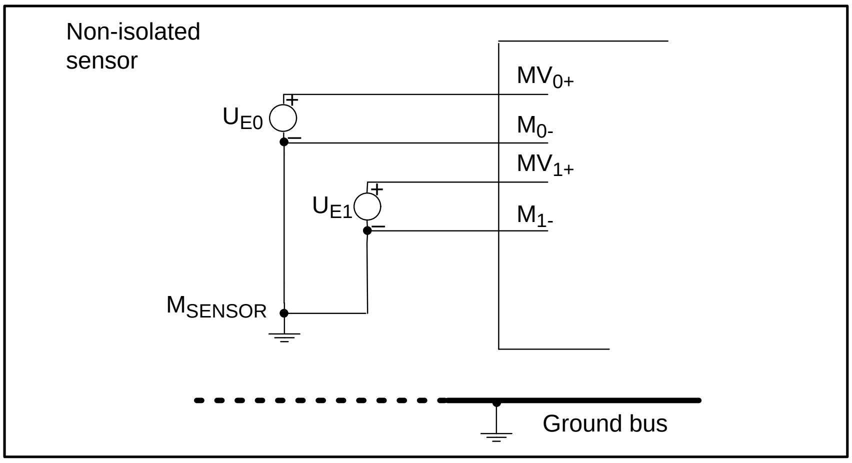


Figure 12-14 Connection of Non-Isolated Sensors

Connecting Voltage Sensors

Figure 12-15 shows the connection of voltage sensors to an analog input module.

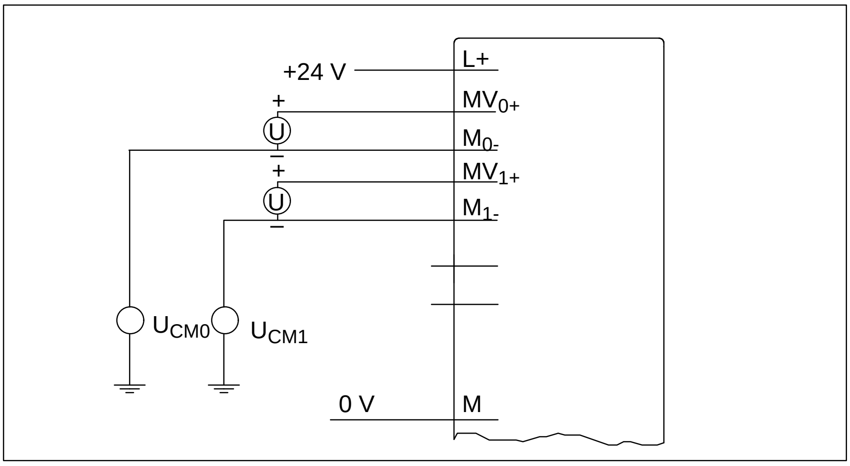


Figure 12-15 Connection of Voltage Sensors

Connecting Current Sensors as 2-Wire and 4-Wire Transmitters

Figures 12-16 and 12-17 show the connection of current sensors to an analog input module as 2-wire and 4-wire transmitters.

The 24 V supply voltage is fed to the 2-wire transmitter via a protected output ($L1_+$, $L2_+$). The 2-wire transmitter converts the measured value into a current of 4 mA to 20 mA. The range 4 mA to 20 mA is converted to the required format by a function in the software driver.

4-wire transmitters have a separate supply voltage.

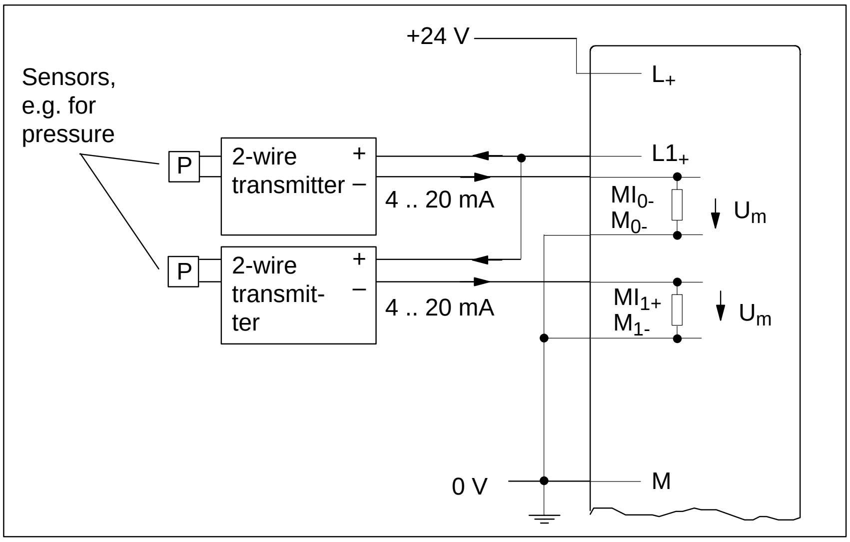


Figure 12-16 Connection of 2-Wire Transmitters

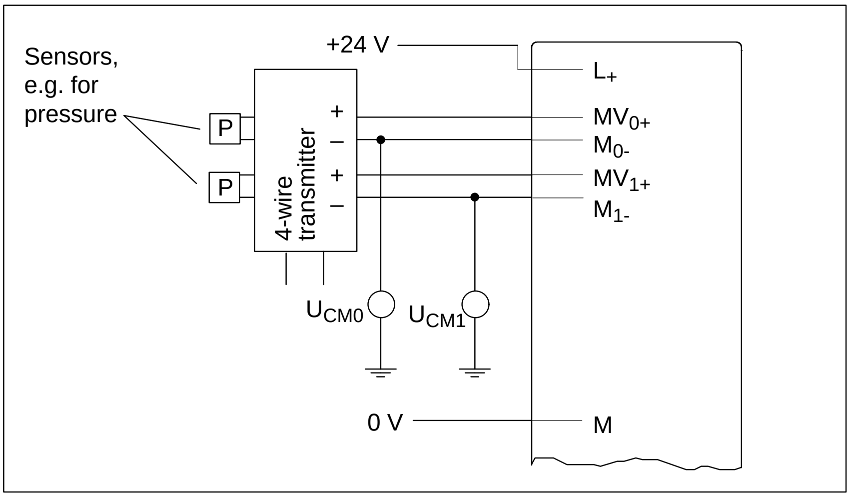


Figure 12-17 Connection of 4-Wire Transmitters

Connecting Resistance Thermometers (such as Pt 100) and Resistors

Resistance thermometers and resistors are measured in a 4-wire circuit. A constant current I_C, whose parameters can be defined, is fed to each of the resistance thermometers/resistors via an analog output QI. The voltage created at the resistance thermometer/resistor is measured via the terminals M_+ und M_- . This produces a very accurate measuring result in the case of a 4-wire connection.

The cables feeding the constant current are laid parallel to the measuring cables and are only connected together at the terminals on the resistor. Voltage drops in the constant current cables do not therefore produce errors in the measurement result.

A 3-wire connection is not possible with the IF 961-AIO interface submodule.

Figure 12-18 shows the connections for resistance thermometers/resistors with current for each provided through an analog output.

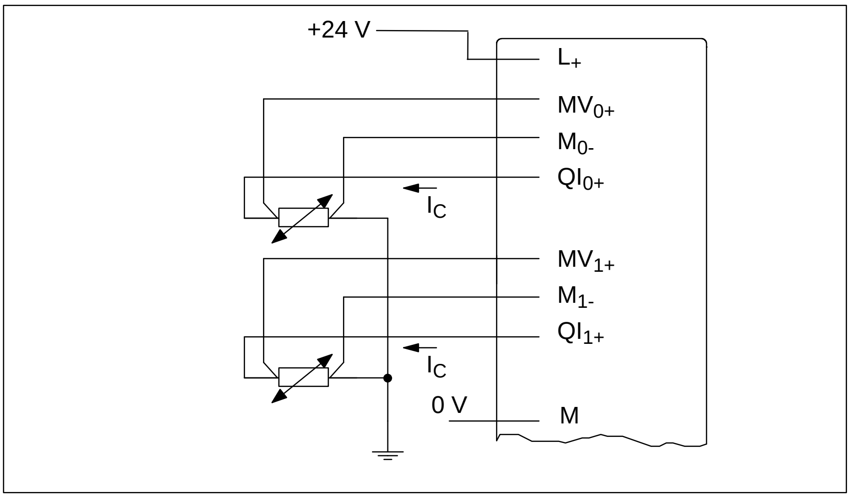


Figure 12-18 4-Wire Connection of Resistance Thermometers/Resistors with Individual Constant Current Sources

Figure 12-19 shows the connection of resistance thermometers/resistors with common current supply from a single analog output. The maximum permitted impedance for analog outputs and the maximum permitted common mode voltage (U_{CM}) must be taken into account.

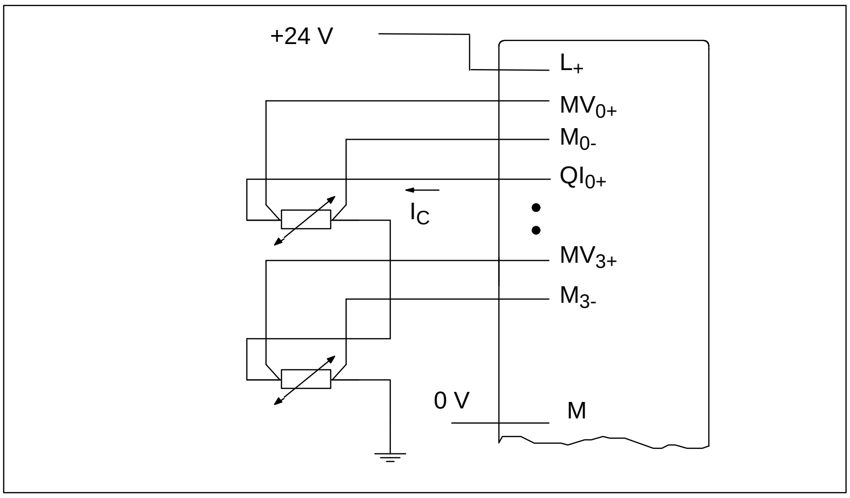


Figure 12-19 4-Wire Connection of Resistance Thermometers/Resistors with Common Constant Current Source

12.7.3 Connecting Loads and Actuators to Analog Outputs

Abbreviations Used

The following abbreviations appear in Figures 12-20 to 12-21:

QI: Analog output current

QV: Analog output voltage

S: Reference potential of analog circuit

R_L: Load resistance

Figures 12-20 and 12-21 show how to connect loads/actuators to the current or voltage outputs of the analog output module.

Connecting Loads to the Current Output

The connection to one channel is shown as an example.

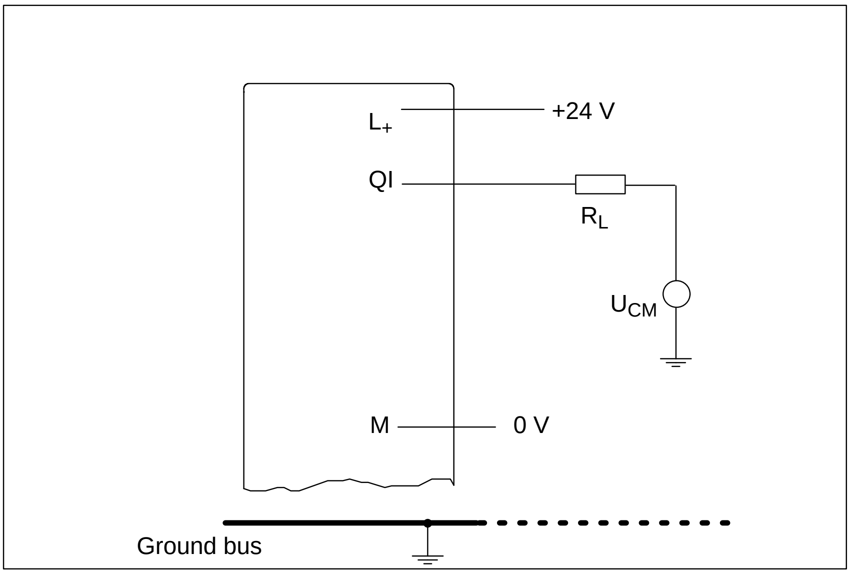


Figure 12-20 Connection of Loads/Actuators to a Current Output in 2-Wire Circuit

Connecting Loads to the Voltage Output

The connection of two channels is shown as an example.

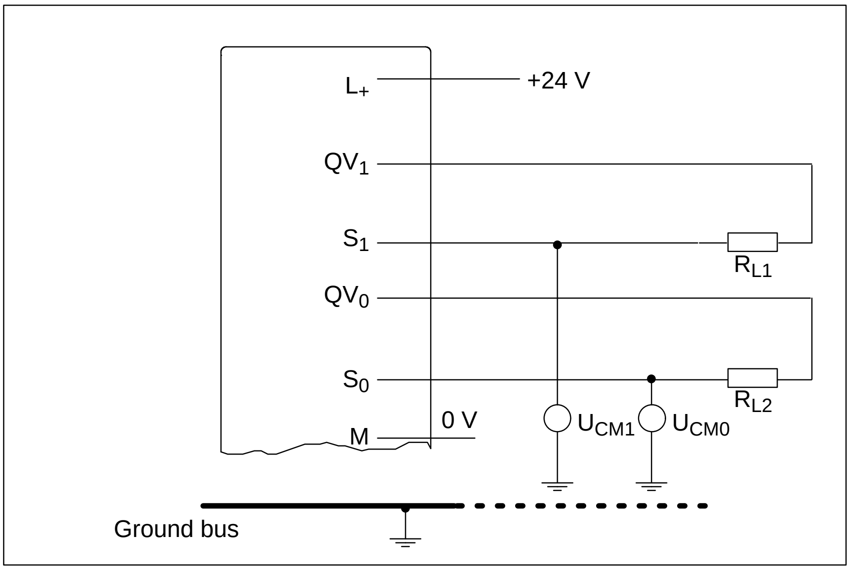


Figure 12-21 Connection of Loads/Actuators to a Voltage Output in 3-Wire Circuit

12.7.4 Conversion Time and Cycle Time of the Analog Input Channels

Introduction

This section contains the definitions and relationships of conversion time and cycle time for analog input modules.

Conversion Time

The conversion time is the sum of the conversion time of the analog/digital converter (ADC) and the settling time of the multiplexer.

Cycle Time

The analog-digital conversion and the transmission of the digitized measured values takes place on demand or as a multiplexed signal (parameter assignment necessary), in other words, the analog input channels are converted consecutively. The cycle time, the time until an analog input value is converted again, is the sum of the conversion times of all the analog input channels in the interface submodule.

Figure 12-22 shows how the cycle time is made up in the case of a 4-channel analog input module.

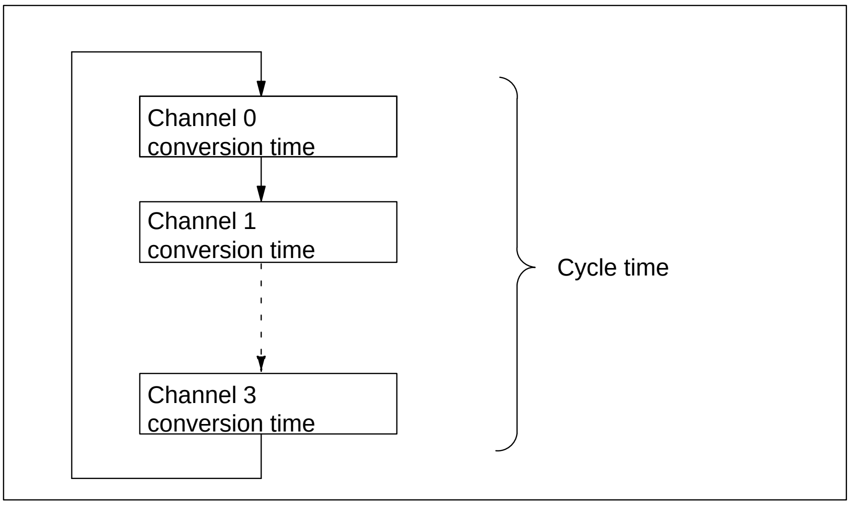


Figure 12-22 Cycle Time of Analog Input Module

12.7.5 Conversion, Cycle, Settling and Response Times of the Analog Output Channels

Introduction

This section contains the definitions and relationships of the relevant times for the analog output modules.

Conversion Time

The conversion time of the analog output channels includes the time taken to transfer the digitized output value from internal memory and the time taken by the digital-analog conversion.

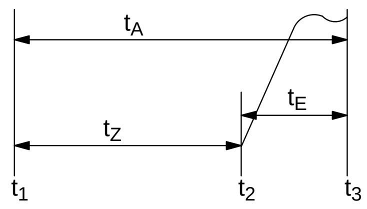
Settling Time

The settling time, in other words, the time that elapses from the arrival of the converted value until the value specified at the analog output is reached, depends on the load. A distinction must be made between resistive, capacitive or inductive load.

Response Time

The response time, in other words, the time that elapses from the arrival of the digital output value in internal memory until the value specified at the analog output is reached, is, in the worst case, the sum of the cycle time and the settling time. The worst case occurs if the analog channel is converted shortly before transmission of a new output value and is not converted again until all the other channels have been converted (cycle time).

Figure 12-23 shows the response time of the analog output channels.



t_A = Respnse time

t_Z = Cycle time = n x conversion time (n = activated channels)

t_E = Settling time

t_1 = Arrival of new digitized value

t_2 = Output value transferred and converted

t_3 = Specified output value reached

Figure 12-23 Response Time of Analog Output Channels

12.7.6 Commissioning the IF 961-AIO Interface Submodules

Electrical Configuration

The ground connection (M and S_0/S_1) of the analog input/ouput module must be connected to the ground connection of the load power supply. Use a 1 mm^2 cable for this purpose.

Unused Channels

Unused input channels must be short-circuited. This ensures optimum immunity to interference for the analog module.

Unused output channels are left open circuit.

12.7.7 Addressing

Addressing

The IF 961-AIO interface submodule is addressed in the area reserved for the M7-300/400 (from $C000_H$).

Addressing in the M7-300/400 Specific I/O Address Area

The basic address depends on which slot the interface submodule occupies in the expansion module or programmable module. The slot-dependent basic address of the interface submodule can be found in the descriptions “M7-300 Expansion Modules”, “M7-400” Expansion Modules” or in the descriptions of the M7-400 programmable modules.

The I/O address is the sum of the basic address and the offset address.

The registers and their significance and the offset addresses are described below.

Table 12-39 Assignment of Offset Addresses for the IF 961-AIO Interface Submodule

Offset Address	Read Function	Write Function
00_H	ADC data channel 0 (2^0 – 2^{15})	DAC data channel 0 (2^0 – 2^{15})
02_H	ADC data channel 1 (2^0 – 2^{15})	DAC data channel 1 (2^0 – 2^{15})
04_H	ADC data channel 2 (2^0 – 2^{15})	Reserved
06_H	ADC data channel 3 (2^0 – 2^{15})	Reserved
08_H	Indicates settings such as automatic conversion, cycle time, interrupt enable	Setting of automatic conversion, cycle time and interrupt enable
$0A_H$	Indicates channel number	Output of channel number
$0C_H$	Indicates end of conversion (EOC) and voltage error	Start analog-digital conversion
$0E_H$	Reserved	Interrupt acknowledgement

12.7.8 Analog Output

Analog Output

The 12-bit digital value to be converted is loaded left-justified into the DAC data register of the corresponding DAC channel. Digital-analog conversion on the selected channel takes place once the value has been loaded into the register.

The table below shows the assignment of addresses to the output channels and the significance of the data bits.

The data format of digital output values is a 2's complement 16-bit value. How the digital output value is represented can be seen in Table 12-44.

Table 12-40 Significance of the Data Bits for the Analog Output (IF 961-AIO)

Offset Ad-dress	D15						Write									D0	Remarks
00_H	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	0	0	0	0	DAC data channel 0
02_H	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	0	0	0	0	DAC data channel 1

Status After Power Up

Both output channels have the value "0".

12.7.9 Analog Input

Analog Input

Tables 12-41 and 12-42 below provide an overview of the write and read registers for the analog input.

The data format of the analog input values is a 2’s complement 16-bit value. How the digitized measured value is represented can be seen in Table 12-43.

Table 12-41 Significance of the Input Bits for the Analog Input (IF 961-AIO)

Offset Address	Read																Remarks
	D15															D0	
00_H	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	ADC data channel 0
02_H	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	ADC data channel 1
04_H	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	ADC data channel 2
06_H	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	ADC data channel 3
08_H	AC	INT	0	0	0	0	0	0	0	0	0	0	0	ta	ta	ta	Control register 1
$0A_H$	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC-channel no.			Control register 2
$0C_H$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	PF	EOC	ADC status register

ta = 000	5.7 ms cycle time of automatic conversion
ta = 001	2.8 ms
ta = 010	1.3 ms
ta = 011	600 µs
ta = 100	185 µs
AC = 1	Automatic conversion of all ADC channels enabled
INT = 1	Create an interrupt after end of cycle
ADC-channel no.	Number of selected ADC channel:
ADC = 001	channel 0
ADC = 010	channel 1
ADC = 011	channel 2
ADC = 100	channel 3
SC = 1	Start of analog-digital conversion (SC = Start of conversion for individual encoding)

Table 12-42 Significance of the Control Bits for the Analog Input (IF 961-AIO)

Offset Address	**D15**							**Write**								**D0**	**Remarks**
08_H	AC	INT	0	0	0	0	0	0	0	0	0	0	0	ta	ta	ta	Control register 1
$0A_H$	0	0	0	0	0	0	0	0	0	0	0	0	0	ADC-channel no.			Control register 2
$0C_H$	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	SC	ADC status register
$0E_H$	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	Acknowledge interrupt x = beliebig

ta = 000	5.7 ms cycle time of automatic conversion
ta = 001	2.8 ms
ta = 010	1.3 ms
ta = 011	600 µs
ta = 100	185 µs
AC = 1	Automatic conversion of all ADC channels enabled
INT = 1	Create an interrupt after end of cycle
ADC-channel no.	Number of selected ADC channel:
ADC = 001	channel 0
ADC = 010	channel 1
ADC = 011	channel 2
ADC = 100	channel 3
SC = 1	Start of analog-digital conversion (SC = Start of conversion for individual encoding)

Status After Power Up

Control register 1: AC = 0, INT = 0, ta = 0 ⇒ 5.7 ms
Control register 2: ADC = 001 ⇒ ADC-channel no. = 0
ADC status register: SC = 0

Starting an Individual ADC Channel

The steps necessary for the individual encoding on an ADC channel are described below:

1. Select the ADC input channel by writing the channel number into control register 2 (offset address “$0A_H$”).
2. Start ADC conversion by setting the SC bit in the ADC status register to “1” (offset address “$0C_H$”).
3. Read the “EOC” bit in the ADC status register at offset address “$0C_H$” and wait until EOC = 1.
4. Read the analog value under the appropriate address (offset addresses “00_H” to “06_H”).

Cyclic Conversion of ADC Channels

The steps necessary for the cyclic conversion of the ADC channels are described below:

1. Set the AC bit in control register 1 to “1” (offset address “08_H”).
2. Wait for interrupt.
3. Read the value under the appropriate address (offset addresses “00_H” to ”06_H”).
4. Acknowledge the interrupt by writing to offset address “$0E_H$”, data bits 0 to 15 are irrelevant in this instance.

12.7.10 Representation of Analog Values for the Analog Input Measuring Ranges

Voltage and Current Range

Table 12-43 shows the representation of the digitized measured value for:

- the ± 10 V voltage range and
- the ± 20 mA current range.

Table 12-43 Representation of the Digitized Measured Value for the Analog Input (Voltage and Current Range)

Range	Measured Value in %	Units		Measuring range ± 10 V	Measuring range ± 20 mA
		Decimal	Hexadecimal		
Overflow	≤118.51	32767	$7FFF_H$	≤11.851 V	≤23.7 mA
Overrange	117.589 : 100.004	32511 : 27649	$7EFF_H$: $6C01_H$	11.7589 V : 10.0004 V	23.515 mA : 20.001 mA
Rated range	100 : 0 : -100	27648 : 0 : -27648	$6C00_H$: 0_H : 9400_H	10 V : 0 V : -10 V	20 mA : 0 mA : -20 mA
Underrange	-100.004 : -117.59	-27649 : -32512	$93FF_H$: 8100_H	-10.0004 V : -11.759 V	-20.001 mA : -23.516 mA
Underflow	≥-118.51	-32768	8000_H	≥-11.851 V	≥-23.7 mA

12.7.11 Analog Value Representation for the Analog Output Ranges

Voltage and Current Output Range

Table 12-44 shows the representation of

- the ± 10 V voltage output range and
- the ± 20 mA current output range.

Table 12-44 Representation of the Analog Output Range (Voltage and Current Output Range)

Range	**Units**		Output range ± 10 V	Output range ± 20 mA
	Decimal	**Hexadecimal**		
Overflow	≥32512	≥7F00$_H$	11.851 V	
Overrange	32496 : 27664	7EF0$_H$: 6C10$_H$	11.7534 V : 10.0005 V	
Rated range	27648 : 0 : –27648	6C00$_H$: 0$_H$: 9400$_H$	10 V : 0 V : –10 V	20 mA : 0 mA : –20 mA
Underrange	–27664 : –32512	93F0$_H$: 8100$_H$	–10.0005 V : –11.759 V	
Underflow	≤–32528	≤80F0$_H$	–11.851 V	

12.7.12 Interrupt and Module Identification Code

Interrupt Request

The interface submodule issues an interrupt request (IRQa).

The assignment of the IRQa interrupt request to the corresponding processor interrupt request can be specified in the BIOS setup.

Process Interrupts and Diagnostic Interrupts

If the IF 961-AIO interface submodule has been configured for cyclic conversion (analog conversion = 1), it is possible to initiate process interrupts at the end of the cycle. It is also possible to initiate a diagnostic interrupt in the event of a lost process interrupt.

Module Identification Code

The identification code for the IF 961-AIO interface submodule is $\mathbf{01_H}$.

12.7.13 Technical Data

Technical Data

The IF 961-AIO interface submodule obtains its supply voltage from the M7-400 programmable modules or the M7-300/400 expansion modules. The technical data shows the current consumption so that the power supply can be dimensioned, in other words the current consumption is referred to 24 V for the M7-300 and 5 V for the M7-400.

6ES7 961-2AA00-0AC0	
Dimensions and weight	
Dimensions W × H × D (mm)	18.2 × 67 × 97 (0.72″x 2.64″x 3.82″
Weight	0.085 kg (0.19 lb.)
Module-specific data	
Module identification	01_H
Number of inputs	4
Number of outputs	2
Length of screened cable	< 200 m
Voltages, currents, potentials	
Rated voltage Load power supply L +	24 V DC
Current consumption L +	150 mA
Protection against incorrect connection	No
Voltage isolation	No
Permissible common mode voltage (U_{CM})	
• Between inputs or inputs to central grounding point	< 8 V AC
• Between voltage outputs or voltage outputs to central grounding point	< 1.5 V DC
• Between current outputs or current outputs to central grounding point	< 2.4 V DC

Voltages, currents, potentials	
Supply voltage	Supplied from the M7-400 programmable module or the M7-300/400 expansion modules
Current consumption in M7-300 (for dimensioning the 24 V power supply)	0.03 A
Current consumption in M7-400 (for dimensioning the 5 V power supply)	0.085 A
Power loss	2.5 W
Formation of input analog value	
Measuring principle	Encoding of instantaneous value
Resolution (incl. overrange)	16 bit, bipolar, 2’s complement
Conversion time / channel	35 µs
Cycle time (all channels) (automatic conversion)	5.7 ms, 2.8 ms, 1.3 ms, 600 µs, 185 µs
Interference Suppression, Fault Limits for the Outputs	
Load-dependent fault on voltage output (R_L in Ohms)	Fault (in %) = 19 x 100 / (19 + R_L)

Interference suppression, error limits for inputs	
Interference voltage suppression for $f = n \times (50/60\ Hz \pm 1\ \%)$ $n = 1, 2, ...$	> 60 dB
• Common mode interference ($U_{SS} < 1\ V$)	0 dB
• Normal mode interference (Peak interference value < rated value of input range)	> 60 dB
Crosstalk between inputs	
Operational limit error (in entire temperature range, referred to input range)	
• Voltage input	± 0.8 %
• Current input	± 0.8 %
Basic error (operational limit error at 25 °C, referred to input range)	
• Voltage input	± 0.7 %
• Current input	± 0.7 %
Linearity error (referred to input range)	± 0.05 %
Repeatability in stable condition at 25 °C, referred to input range)	± 0.2 %
Sensor selection data	
Input ranges (nominal)/input resistance	± 10 V/100 k Ω ± 20 mA/50 Ω
Permissible input voltage (destruction limit) for voltage input	± 18 V
Permissible input current (destruction limit) for current input	± 40 mA
Sensor connection for	
• Voltage measurement	Possible
• Current measurement	
as 2-wire transmitterr	Possible
as 4-wire transmitter	Possible
• Resistance measurement	Possible [1)]

1) Supplied with constant current from an analog output

Formation of output analog value	
Resolution (incl. overrange)	12 bit, bipolar, 2's complement
Cycle time (all channels)	Determined by software
Interference suppression, error limits for outputs	
Crosstalk between outputs	> 60 dB
Operational limit error (in entire temperature range, referred to output range)	
• Voltage output	± 1.0 %
• Current output	± 1.0 %
Basic error (operational limit error at 25 °C, referred to output range)	
• Voltage output	± 0.8 %
• Current output	± 0.8 %
Output ripple (referred to full scale of output range; bandwidth 50 kHz)	± 0.1 %
Actuator selection data	
Output ranges (nominal)	± 10 V ± 20 mA
Load impedance in case of	
• Voltage output	Min. 2 kΩ
• Current output	Max. 500 Ω
• Capacitive load	Max. 1.6 µF
Voltage output	
• Short-circuit protection	Yes
• Short-circuit current	Max. 40 mA
Current output	
• No-load voltage	Max. 13.1 V
Actuator connection	
• for voltage output	
3-wire connection	Possible
4-wire connection (measurement cable)	Not possible
• for current output 2-wire connection	Possible
Interrupts and Diagnosis	
Interrupts	
• end of cycle	yes, parameter assignment
• diagnostic	yes, parameter assignment

12.8 IF 961-CT1 Interface Submodule

Order Number

6ES7 961-3AA00-0AC0

Features

The IF 961-CT1 interface submodule is designed for the connection of incremental sensors. It has the following features:

- Connection with RS422 or 24 V signals
- 4 isolated digital inputs (START, STOP, SET, RESET)
- 2 isolated digital outputs (Q1, Q2)

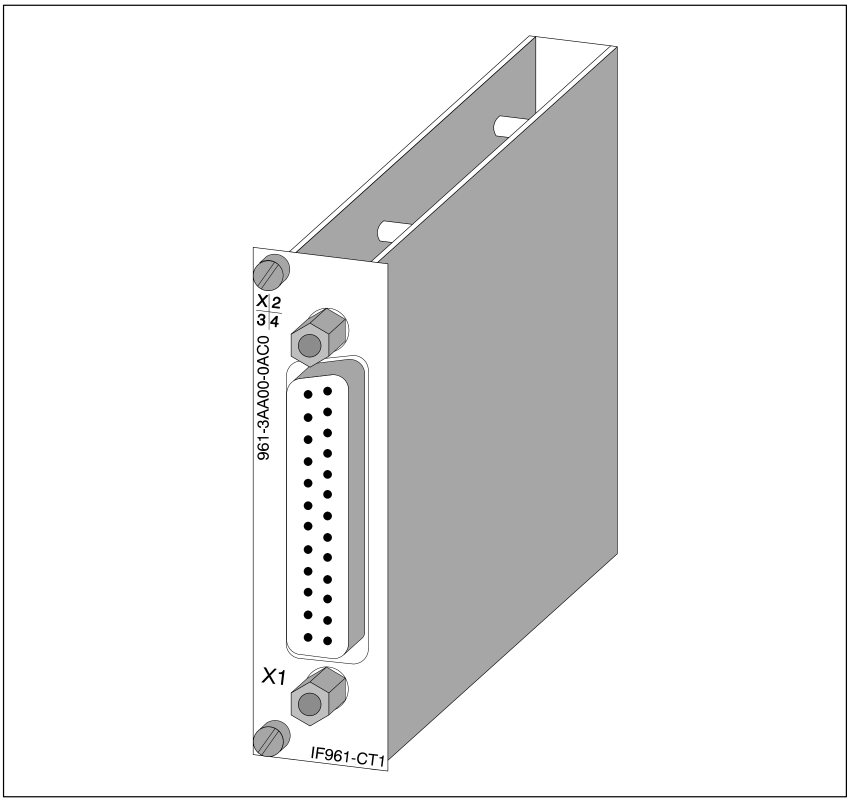


Figure 12-24 IF 961-CT1 Interface Submodule

Software Driver

A driver is available for linking the IF 961-CT1 interface submodule into your user program.

12.8.1 What Can the IF 961-CT1 Interface Submodule Do?

Introduction

This section provides an overview of the functionality of the IF 961-CT1 interface submodule.

What Can the IF 961-CT1 Module Do?

The IF 961-CT1 interface submodule is a fast counter module. The module has a counter that can count through the following ranges:

- 0 to 4 294 967 295 or
- \- 2 147 483 648 to + 2 147 483 647.

The maximum input frequency of the count signal is 500 kHz (5 V) or 200 kHz (24 V).

The IF 961-CT1 interface submodule can be used for the following counting tasks:

- Continuous counting
- Forward/backward counting once
- Periodic forward/backward counting

The counting process can be started and stopped by either the user program or an external signal.

Comparison Values

Two comparison values can be stored in the module. These values are assigned to the two outputs on the module. If the count value reaches one of the comparison values, the associated output can be set to initiate control actions in the process directly.

Start Value

The IF 961-CT1 can be assigned an initial value. The counter is set to the initial value when a signal is present on a 24 V digital input on the module.

Gate Functions

The counting process can be started and stopped depending on other events by the use of gate functions.

The IF 961-CT1 interface submodule has two gate functions:

- A software gate controlled by the program.
- A hardware gate controlled via the digital inputs on the interface submodule.

Interrupts

The IF 961-CT1 can issue an interrupt when the comparison value is reached, on overflow, on underflow and when the counter reaches zero.

Diagnostic Interrupts

The IF 961-CT1 can initiate diagnostic interrupts upon the occurrence of the following events:

- Missing or faulty submodule parameters
- Loss of a process interrupt
- Faulty signal

Which Signals can the IF 961-CT1 Count?

The IF 961-CT1 interface submodule can count signals generated by incremental encoders with 5 V differential signals or 24 V signals.

The IF 961-CT1 can also count 24 V signals from, for instance, a photoelectric barrier.

Further Information

Information on IF 961-CT can be found in the Manual: *IF 961 CT1 Counter Function Module,* Programming and Parameter Assignment .

12.8.2 Addressing and Interrupt

Addressing

The IF 961-CT1 interface submodule is addressed in the I/O address area reserved for the M7-300/400 (from $C000_H$).

Addressing in the M7-300/400 Specific I/O Address Area

The basic address depends on which slot the interface submodule occupies in the expansion module or programmable module. The slot-dependent basic address of the interface submodule can be found in the descriptions “M7-300 Expansion Modules”, “M7-400” Expansion Modules” or in the descriptions of the M7-400 programmable modules.

Interrupt Request

The interface submodule issues an interrupt request (IRQa).

The assignment of the IRQa interrupt request to the corresponding processor interrupt request can be specified in the BIOS setup.

Module Identification Code

The identification code for the IF 961-CT1 interface submodule is $\mathbf{03_H}$.

12.8.3 Technical Data

Technical Data

The IF 961-CT1 interface submodule obtains its supply voltage from the M7-400 programmable modules or the M7-300/400 expansion modules. The technical data shows the current consumption so that the power supply can be dimensioned, in other words the current consumption is referred to 24 V for the M7-300 and 5 V for the M7-400.

6ES7 961-3AA00-0AC0	
Technical Data	
Supply voltage	Supplied from the M7-400 programmable modules or the M7-300/400 expansion modules
Current consumption in M7-300 (for dimensioning the 24 V power supply)	0.053 A
Current consumption in M7-400 (for dimensioning the 5 V power supply)	0.15 A
Rated voltage of load supply 2L+ / 2M	24 V DC
Current consumption 2L+ / 2M	Dependent on the load on the digital outputs
Type identification	03_H
Power loss	1.5 W
Dimensions W x H x D (mm)	18.2 x 67 x 97 (0.72″x 2.64″x 3.82″)
Weight	0.07 kg (0.15 lb.)

5 V counter inputs	
Number of counting channels	1, alternative to 24 V
Signal	To RS422
Terminating resistor	Approx. 220 Ohm
Difference voltage	Min. 0.5 V
Encoder power supply	No
Encoder monitoring	Yes
Counting range	32 bit
Maximum counting frequency	500 kHz
24 V counter inputs	
Number of counting channels	1, alternative to 5 V
Low signal High signal	- 30 V to + 5 V + 11 V to + 30 V
Input resistance	1 kOhm
Input current	Typically 7 mA
Encoder power supply	No
Encoder monitoring	No
Counting range	32 bit
Maximum counting frequency	200 kHz

Digital inputs	
Supply voltage	2L+ / 2M
Number of inputs	4
Low signal High signal	– 30 V to + 5 V + 11 V to + 30 V
Input current	Typically 7 mA
Voltage isolation	Yes, with respect to everything except digital outputs
Input filter (parameters can be assigned)	50 kHz, 200 kHz

Digital outputs	
Supply voltage	2L+ / 2M
Number of outputs	2
Voltage isolation	Yes, with respect to everything except digital inputs
Output voltage – Low signal – High signal	 Maximum 3 V 2 L+ – 1,5 V
Switching current – Rated voltage – Range	 0.3 A 5mA to 0,3 A
Switching time	Maximum 300 μs
Breaking voltage (inductive)	Limited to 2L+ ± 39 V
Short-circuit proof	Yes, using electronic protection

12.9 IF 964-DP Interface Submodule

Order Number 6ES7 964-2AA00-0AB0

Features

The IF 964-DP interface submodule permits the connection of distributed I/Os via PROFIBUS-DP. The module has an isolated RS485 interface. The maximum transmission speed is 12 Mbit/s.

The permissible cable length depends on the transmission speed and the number of nodes. For a point-to-point connection operating at 12 Mbit/s, the cable can be 100 m (330 ft.) long. At 9.6 kbit/s, the length could be 1200 m (1312 yd.).

The system can be expanded up to 125 nodes.

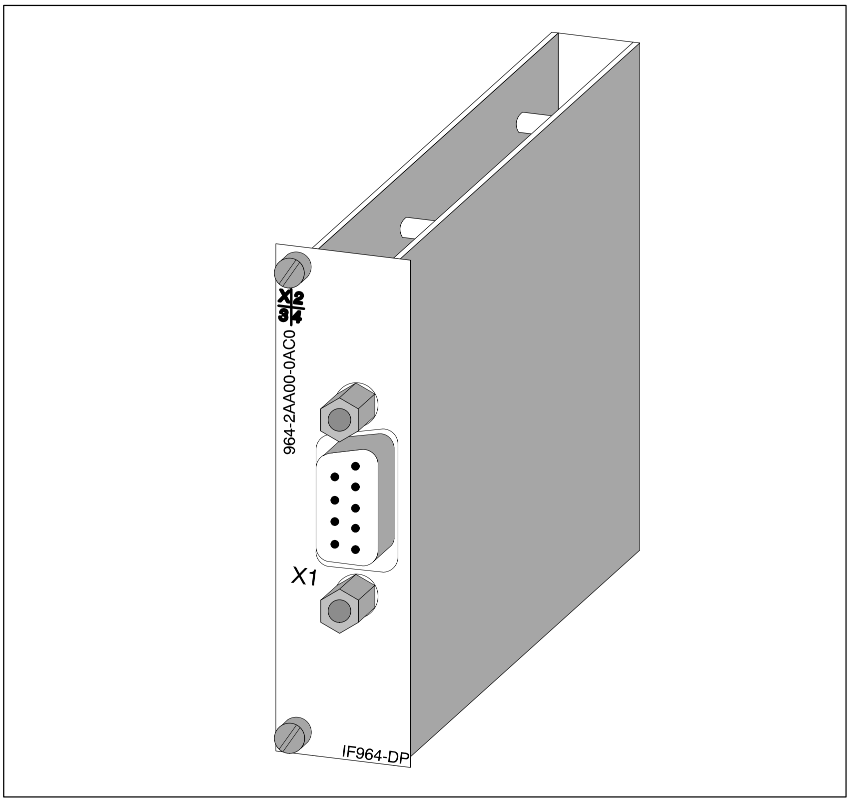


Figure 12-25 IF 964-DP Interface Submodule

Further Information

Information about PROFIBUS-DP can be found in the following brochures and manuals:

- Technical Overview *Distributed I/O in SIMATIC S7 and M7*
- Manuals for the DP masters, for example *S7-300 Programmable Controllers* or *S7-/M7-400 Programmable Controller* for the S7-300 PROFIBUS-DP interface.
- Manuals for the DP slaves, for example *ET 200M Distributed I/O Station* or *ET 200C Distributed I/O Station*
- The manual for the network components, *SINEC L2/L2F Network Manual*, such as bus connector, RS485 repeater
- STEP 7 manuals

12.9.1 Connector Pin Assignment

Connector X1

A 9-pin Sub-D socket is provided on the front of the module for the cable connector. The connector pin assignments are shown in Table 12-45.

Table 12-45 Connector X1 on the IF 964-DP (9-Pin Sub-D Socket)

Pin	Signal	Definition	Direction
1	–		
2	–		
3	LTG_B	Cable B	Input/output
4	RTSAS	Request to send (AS)	Output
5	$M5_{ext}$	Operational ground (floating)	Output
6	$P5_{ext}$	+ 5 V (floating), max. 20 mA (for supply to bus terminator)	Output
7	–		
8	LTG_A	Cable A	Input
9	–		

What Can Be Connected to the Interface Submodule?

Profibus equipment can be connected, such as:

ET 200 M, ET 200 U (B/C) and other equipment conforming to the standard.

12.9.2 Addressing and Interrupts

Addressing in the M7-300/400 Specific I/O Address Area

The basic address depends on which slot the interface submodule occupies in the expansion module or programmable module. The slot-dependent basic address of the interface submodule can be found in the descriptions “M7-300 Expansion Modules”, “M7-400” Expansion Modules” or in the descriptions of the M7-400 programmable modules.

You will need this basic address to assign the driver software parameters.

Buffer

The IF 964-DP interface submodule has a dual-port RAM for storage (buffering) of data. The size of the memory and its address can be specified via the driver parameters:

Protected Mode: 1 of 8 blocks of 512 kbyte in the address area C0 00 00_H to FF FF FF_H.

Real Mode: 1 to 8 pages of 16 kbyte in the address area C 00 00_H to D FF FF_H.

Note

The memory address must not conflict with other system addresses. For instance, the IF961-VGA interface submodule uses the addresses from C 00 00_H to C 7F FF_H.

Interrupt Request

The interface submodule interrupt line is connected to a processor interrupt through software parameters.

Module Identification Code

The identification code for the IF 964-DP interface submodule is **$8C_H$**.

12.9.3 Technical Data

Technical Data

The IF 964-DP interface submodule obtains its supply voltage from the M7-400 programmable modules or the M7-300/400 expansion modules. The technical data shows the current consumption so that the power supply can be dimensioned, in other words the current consumption is referred to 24 V for the M7-300 and 5 V for the M7-400.

6ES7 964-2AA00-0AB0	
Performance features	
Transmission rate	9.6 kbit/s to 12 Mbit/s
Cable length	
• At 9.6 kbit/s	Maximum 1200 m
• At 12 Mbit/s	Maximum 100 m
Number of nodes	≤ 125
Buffer memory (dual port RAM)	256 kbyte
Interface type	RS485
Voltage isolation	Yes
Technical Data	
Supply voltage	Supplied from the M7-400 programmable module or the M7-300/400 expansion modules
Current consumption in M7-300 (for dimensioning the 24 V power supply)	0.16 A
Current consumption in M7-400 (for dimensioning the 5 V power supply)	0.45 A
Permissible load on floating 5 V ($P5_{ext}$)	Maximum 20 mA
Module identification	$8C_H$
Power loss	2 W
Dimensions W x H x D (mm)	18.2 x 67 x 97 (0.72″x 2.64″x 3.82″)
Weight	0.065 kg (0.14 lb.)

Dimension Drawings

A

Introduction

This appendix contains dimension drawings of the M7-300 modules and interface submodules. The modules from the S7-300 range used in the M7-300 automation computer can be found in an annex of the Reference Manual.

Chapter Overview

A.1 CPU and Expansions

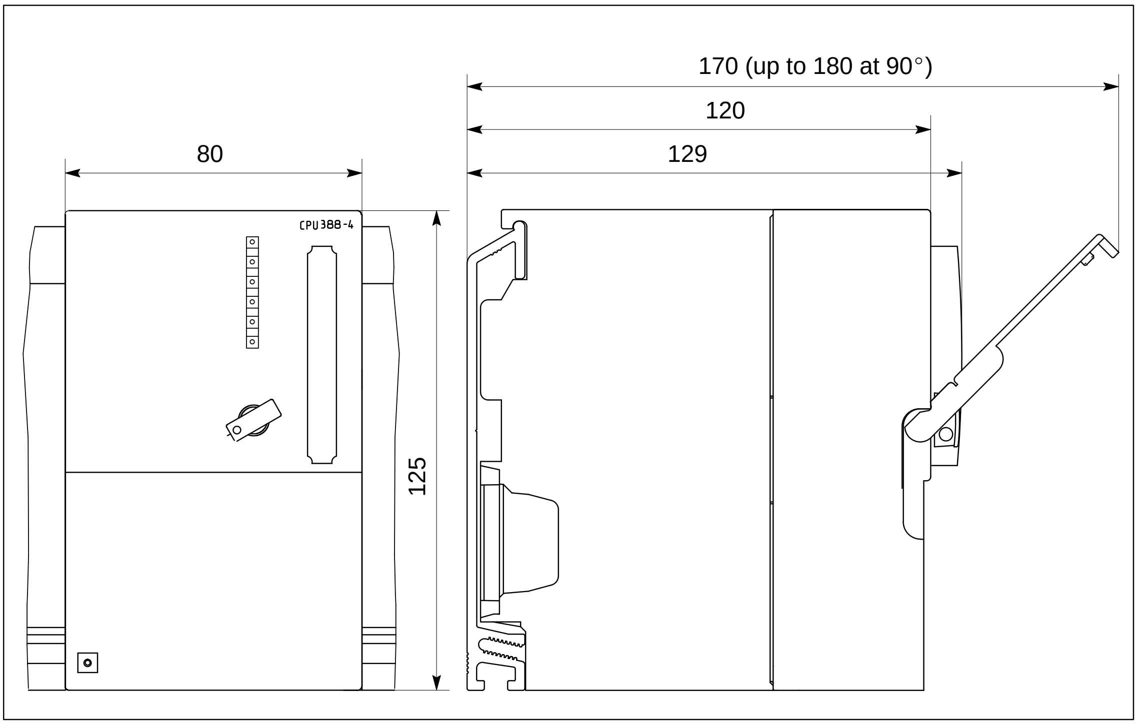


Figure A-1 Dimension Drawing of CPU 388-4

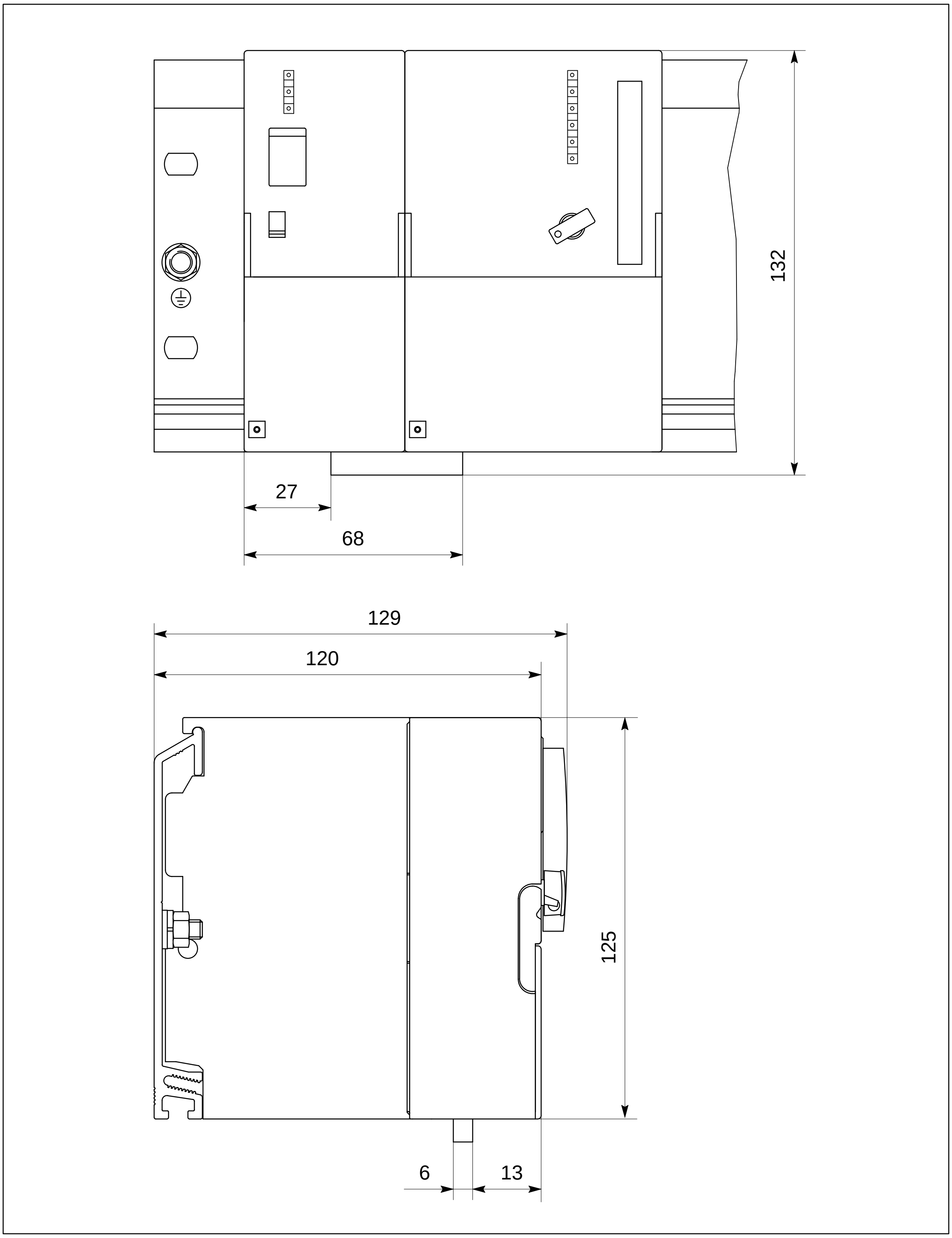


Figure A-2 Dimension Drawing of Power Supply Module PS 307, 5 A with Connecting Terminal and CPU 388-4 with Memory Card Inserted

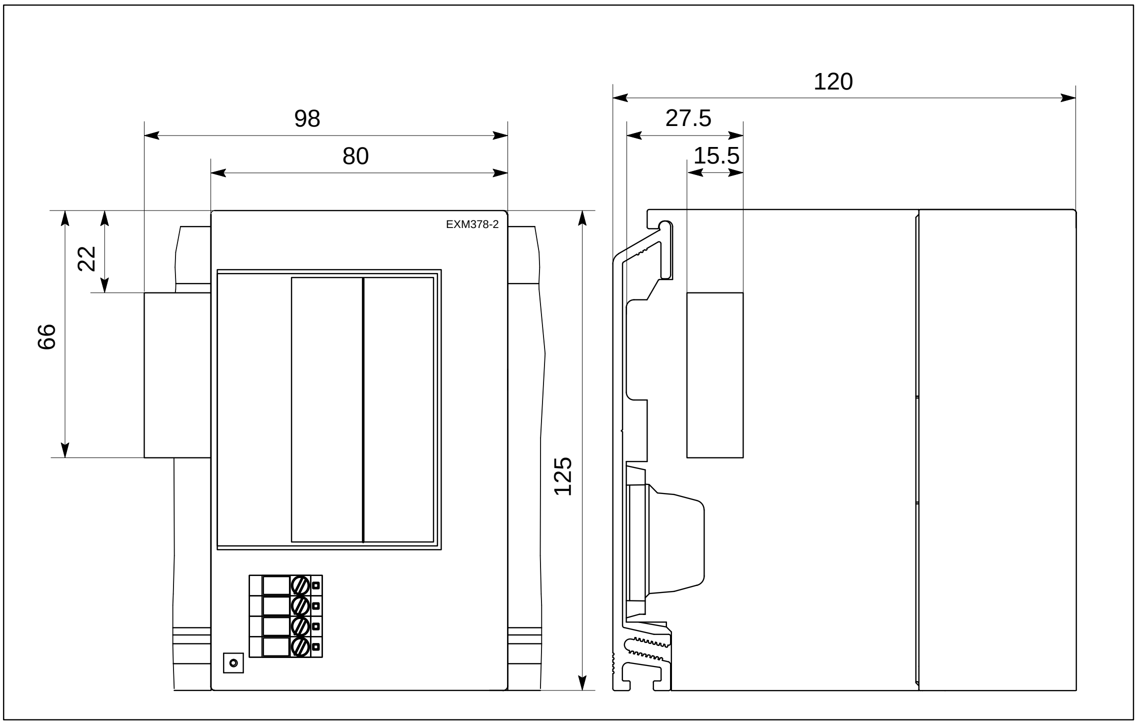


Figure A-3 Dimension Drawing of Expansion Module EXM 378-2

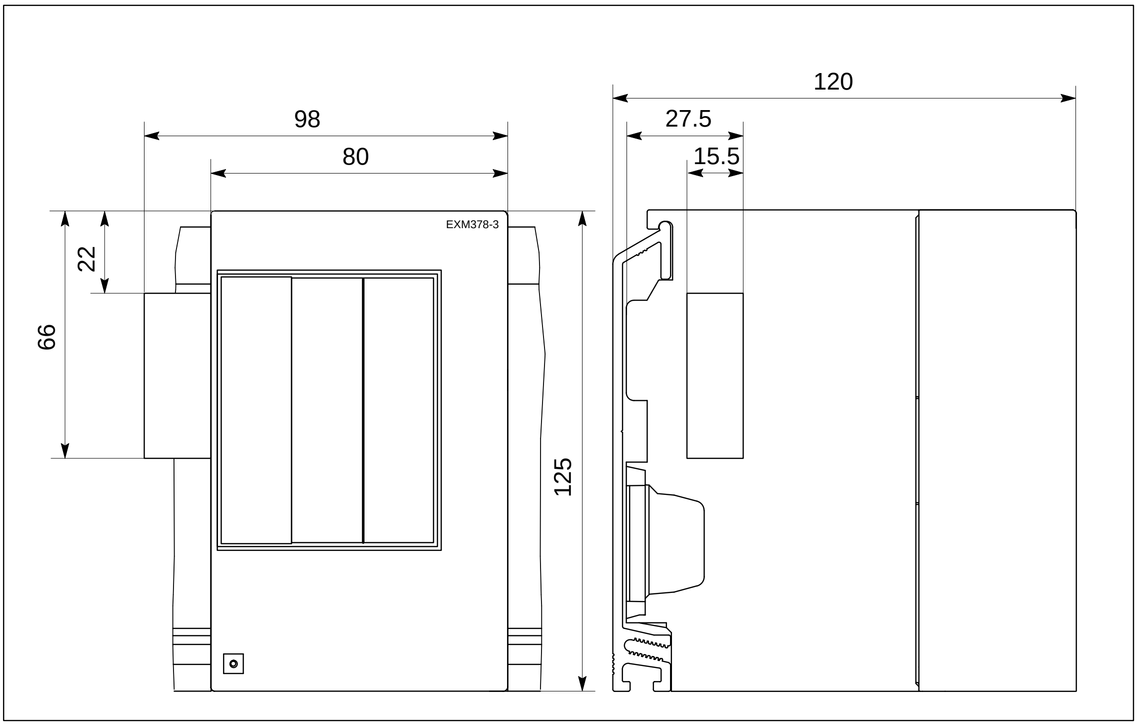


Figure A-4 Dimension Drawing of Expansion Module EXM 378-3

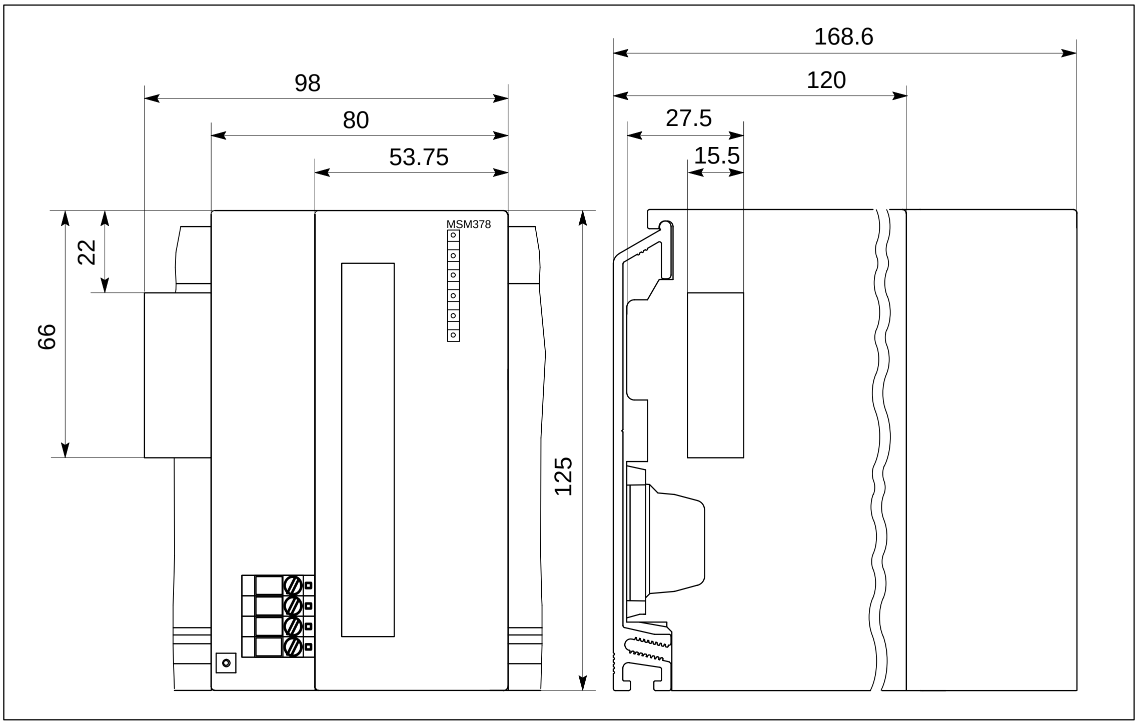


Figure A-5 Dimension Drawing of Expansion Module MSM 378

A.2 Interface Submodules

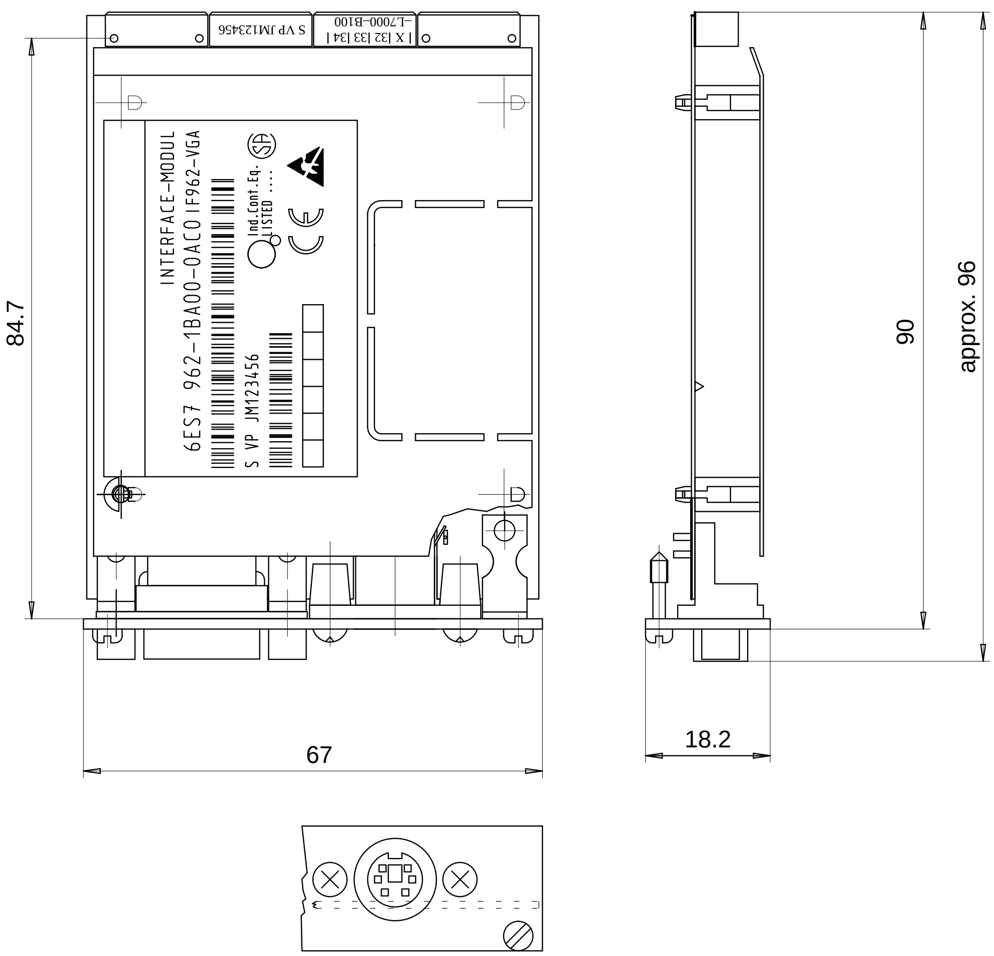


Figure A-6 Dimension Drawing of Interface Submodules with the IF 962-VGA as an Example

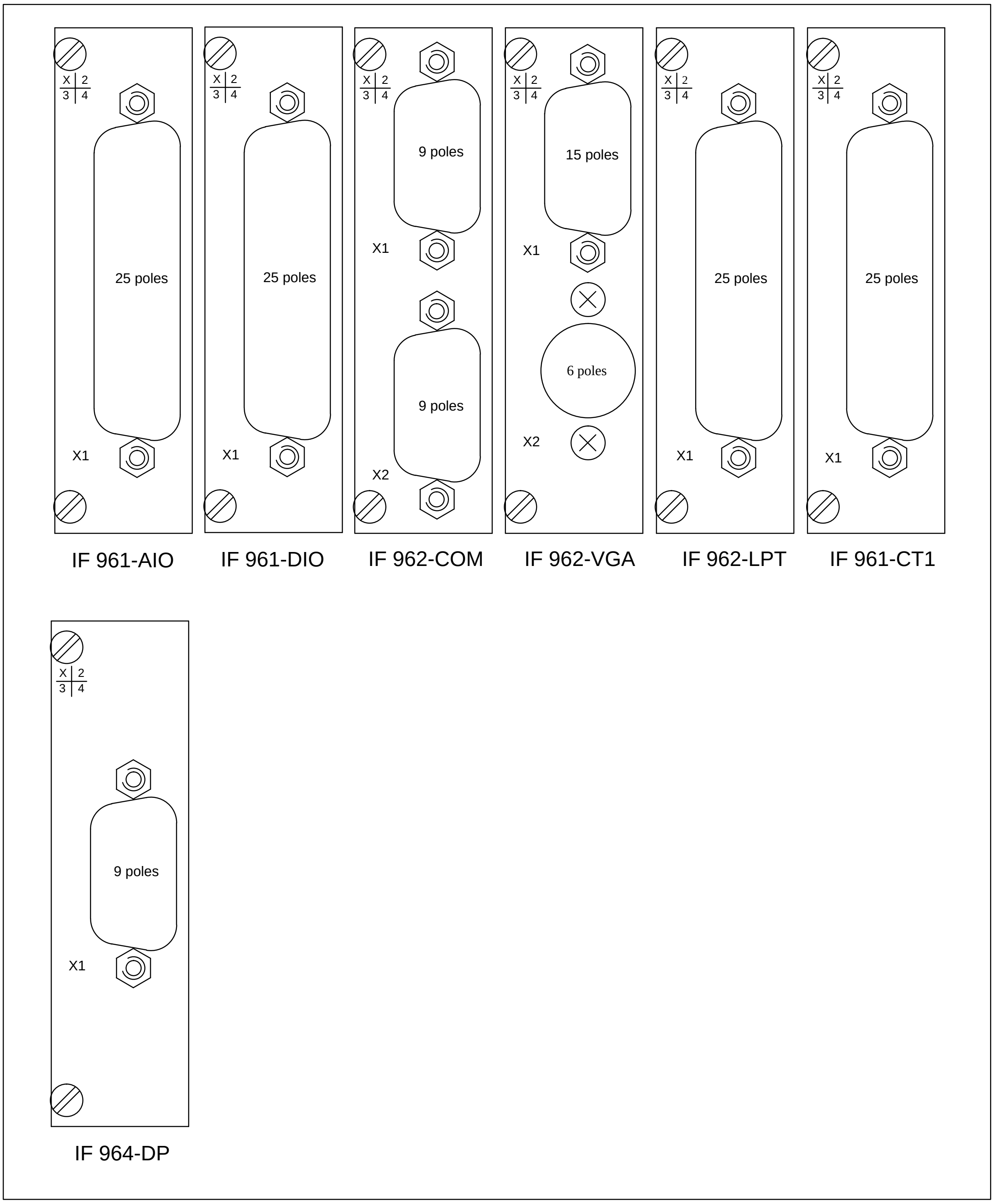


Figure A-7 Front Views of the Interface Submodules

Guidelines for Handling Electrostatic Sensitive Devices (ESD)

B

Chapter Overview

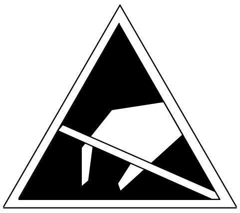
B.1 What is ESD?

Definition

All electronic modules are equipped with large-scale integrated ICs or components. Due to their design, these electronic elements are very sensitive to overvoltages and thus to any electrostatic discharge.

These **E**lectrostatic **S**ensitive **D**evices are commonly referred to by the abbreviation **ESD**.

Electrostatic sensitive devices are labelled with the following symbol:



Caution

Electrostatic sensitive devices are subject to voltages that are far below the voltage values that can still be perceived by human beings. These voltages are present if you touch a component or the electrical connections of a module without previously being electrostatically discharged. In most cases, the damage caused by an overvoltage is not immediately noticeable and results in total damage only after a prolonged period of operation.

B.2 Electrostatic Charging of Persons

Charging

Every person with a non-conductive connection to the electrical potential of its surroundings can be charged electrostatically.

Figure B-1 shows you the maximum values for electrostatic voltages which can build up on a person coming into contact with the materials indicated in the figure. These values are in conformity with the specifications of IEC 801-2.

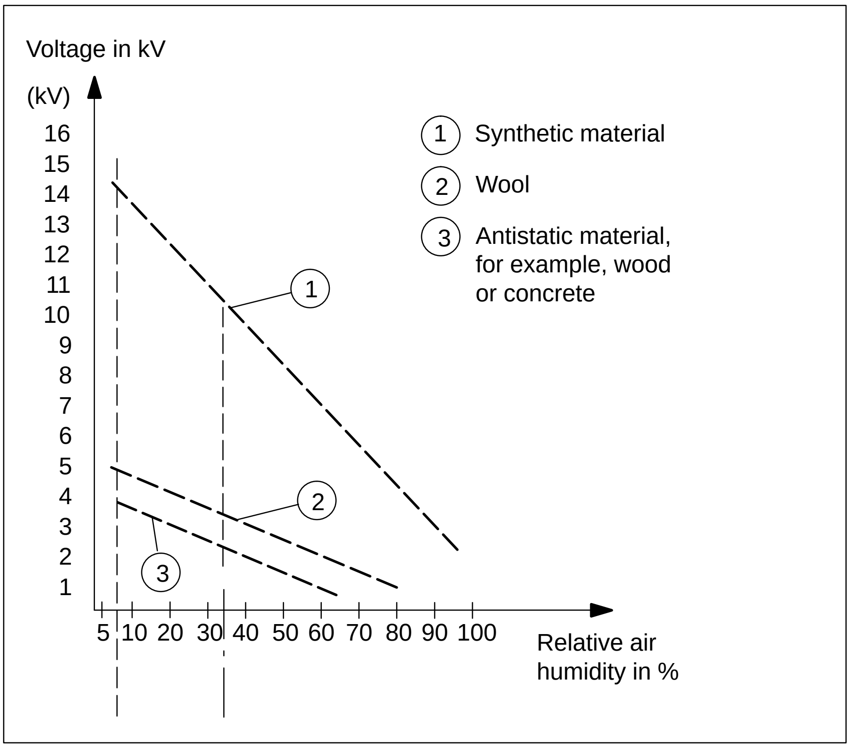


Figure B-1 Electrostatic Voltages which can Build up on a Person

B.3 General Protective Measures Against Electrostatic Discharge Damage

Ensure Sufficient Grounding

Make sure that the personnel, working surfaces and packaging are sufficiently grounded when handling electrostatic sensitive devices.
You thus avoid electrostatic charging.

Avoid Direct Contact

You should touch electrostatic sensitive devices only if it is unavoidable (for example, during maintenance work). Hold modules without touching the pins of components or printed conductors. In this way, the discharged energy cannot affect the sensitive devices.

If you have to carry out measurements on a module, you must discharge your body before you start the measurement by touching grounded metallic parts. Use grounded measuring devices only.

Ordering Information

C

Contents

This Appendix contains the order numbers of spare parts and accessories for the products mentioned or described in this Manual.

Spare Parts and Accessories

Table C-1 Spare Parts and Accessories

Designation	Order No.
Bus connector	6ES7 390-0AA00-0AA0
Power connector	6ES7 390-7BA00-0AA0
Key for CPU (mode selector)	6ES7 911-0AA00-0AA0
Backup battery	6ES7 971-1AA00-0AA0
Memory Cards • Flash-EPROM, 5 V, 1 Mbyte • Flash-EPROM, 5 V, 2 Mbyte • Flash-EPROM, 5 V, 4 Mbyte • Flash-EPROM, 5 V, 8 Mbyte • Flash-EPROM, 5 V, 16 Mbyte	 6ES7 952-1KK00-0AA0 6ES7 952-1KL00-0AA0 6ES7 952-1KM00-0AA0 6ES7 952-1KP00-0AA0 6ES7 952-1KS00-0AA0
Labeling sheet	6ES7 392-2XX00-0AA0
Slot numbering label	6ES7 912-0AA00-0AA0
Screw-on front connector (20-pin)	6ES7 392-1AJ00-0AA0
Front connector for ribbon cable • Screw-type terminals • Spring-type terminals	 6ES7 921-3AB00-0AA0 6ES7 921-3AA00-0AA0
Retaining bracket (with 2 bolts)	6ES7 390-5AA00-0AA0
Shield connection terminals for • 2 cables with a shield diameter of 2 to 6 mm each • 1 cable with a shield diameter of 3 to 8 mm • 1 cable with a shield diameter of 4 to 13 mm	 6ES7 390-5AB00-0AA0 6ES7 390-5BA00-0AA0 6ES7 390-5CA00-0AA0
Connecting cables for printers with • serial interface (COM, 10 m) • parallel interface (Centronics)	 9AB4 173-2BN10-0CA0 6AP1901-0AL00

Table C-1 Spare Parts and Accessories, continued

Designation	Order No.
Connecting cable for interface modules • 1 m • 2.5 m • 5 m • 10 m	 6ES7 368-3BB00-0AA0 6ES7 368-3BC00-0AA0 6ES7 368-3BF00-0AA0 6ES7 368-3CB00-0AA0
V.24 cable (null modem), 10 m 9-pin sub. D female connectors, both ends	9AB4 173-2BN10-0CA0
PG cable, short	6ES7 901-0BF00-0AA0
PG 705 cable	6ES7 705-0AA00-7BA0
PC/MPI cable	6ES7 901-2CB60-0AA0
SINEC L2 bus cable • Indoor cable • Cable for burying in ground	 6XV1 830-0AH10 6XV1 830-3AH10
Bus connector • without PG socket • with PG socket	 6ES7 972-0BA00-0XA0 6ES7 972-0BB00-0XA0
RS 485 repeater	6ES7 972-0AA00-0XA0
Instruction list	6ES7 030-0AN00-8AN0
12 submodule covers for expansion module	6ES7 398-0BA00-0AA0

References for the SIMATIC M7

D

Manuals for Programming and Startup

You will need the manuals listed in Table D-1 to program and start up a SIMATIC M7-300 automation computer.

Table D-1 Manual for Programming and Startup

Title	Describes
Application Module FM 356 Configuring and Startup Manual	Application module from the M7-300 range
System Software for M7-300/400 Program Design Programming Manual	Program package M7-SYS
System Software for M7-300/400 System and Standard Functions Reference Manual	
System Software for M7-300/400 Installation and Operation User Manual	
ProC/C++ Writing C Programs User Manual	Program package M7-ProC/C++
ProC/C++ Debugger for C Programs User Manual	
STEP 7 User Manual	Program package STEP 7
Description of PG Hardware Manual	Programming devices from the S7-300 range

Manuals for PROFIBUS-DP

For the configuration and startup of a PROFIBUS-DP network, you will need the descriptions of the other nodes and network components integrated in the network. For this purpose, you can order the manuals listed in Table D-2.

Table D-2 Manuals for PROFIBUS-DP

Manual
ET 200M Distributed I/O Station
ET 200B Distributed I/O Station
ET 200C Distributed I/O Station
ET 200U Distributed I/O Station
ET 200 Handheld Unit
SINEC L2/L2FO Network Components

Technical Overviews

Table D-3 contains technical overviews that provide you with an overview of the S7-300, STEP 7 and distributed I/Os in the S7/M7.

Table D-3 Technical Overviews

Technical Overviews
Automation System M7-300/M7-400 Programming
Automation System M7-300/M7-400 Configuration and Application
Automation System S7-300/M7-400 Configuration and Application
Automation Systems S7/M7 Distributed Arrangement with PROFIBUS-DP

Siemens Worldwide

E

Chapter Overview

E.1 Siemens Sales Offices in the Federal Republic of Germany

Aachen	Kassel
Augsburg	Kempten/Allg.
Bayreuth	Kiel
Berlin	Laatzen
Bielefeld	Leipzig
Bonn	Lingen
Bremen	Magdeburg
Brunswick	Mainz
Chemnitz	Mannheim
Coblenz	Munich
Constance	Münster/Westf.
Darmstadt	Nuremberg
Dortmund	Osnabrück
Dresden	Regensburg
Duisburg	Rostock
Düsseldorf	Saarbrücken
Erfurt	Siegen
Essen	Stuttgart
Frankfurt am Main	Ulm
Freiburg	Wetzlar
Hamburg	Wilhelmshaven
Heilbronn	Wuppertal
Karlsruhe	Würzburg

E.2 European Companies and Representatives

Austria

Siemens AG Österreich
- Bregenz
- Graz
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Siemens N. V.
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or

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- Edinburgh
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- Athens, Amaroussio
- Thessaloniki

Hungaria

Siemens Kft
- Budapest

Iceland

Smith & Norland H/F
- Reykjavik

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Siemens Ltd.
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- Bari
- Bologna
- Brescia
- Casoria
- Florence
- Genoa
- Milan
- Padua
- Rome
- Turin

Luxemburg

Siemens S.A.

- Luxemburg

Malta

J. R. Darmanin & Co. Ltd.

- Valletta

Netherlands

Siemens Nederland N.V.

- The Hague
- Rijswijk

Norway

Siemens A/S

- Bergen
- Oslo
- Stavanger
- Trondheim

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Siemens GmbH

- Gdansk-Letnica
- Katowice
- Warsaw

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Siemens S.A.

- Albufeira
- Coímbra
- Lisbon, Amadora
- Matosinhos
- Porto

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- Bukarest

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or

Mosmatic

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Siemens AG

- Ekaterinburg

Slovak Republic

Siemens AG

- Bratislava

Slovenia

Siemens d. o. o.

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- Murcia
- Palma de Mallorca
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- Sevilla
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- Valladolid
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	Ukraine Siemens AG • Kiev

E.3 Non-European Companies and Representatives

Africa

The following table lists all Siemens Companies and Representatives of Siemens AG in Africa.

Algeria Siemens Bureau d'Alger • Alger	**Morocco** SETEL Société Electrotechnique et de Télécommunications S.A. • Casablanca
Angola TECNIDATA • Luanda	**Mozambique** Siemens Liaison Office • Maputo
Bophuthatswana Siemens Ltd. • Mafekeng	**Namibia** Siemens (Pty.) Ltd. • Windhoek
Egypt Siemens Technical Office • Cairo-Mohandessin Siemens Technical Office • Alexandria EGEMAC S.A.E. • Cairo-Mattaria	**Nigeria** Electro Technologies Nigeria Ltd. (ELTEC) • Lagos
Ethiopia Addis Electrical Engineering Ltd. • Addis Abeba	**Rwanda** Etablissement Rwandais • Kigali
Ivory Coast Siemens AG • Abidjan	**Sambia** Electrical Maintenance Lusaka Ltd. • Lusaka
Libya Siemens AG, Branch Libya • Tripoli	**Simbabwe** Electro Technologies Corporation (Pvt.) Ltd. (ETC) • Harare

South Africa

Siemens Ltd.

- Cape Town
- Durban
- Johannesburg
- Middelburg
- Newcastle
- Port Elizabeth
- Pretoria

Sudan

National Electrical & Commercial Company (NECC)

- Khartoum

Swaziland

Siemens (Pty.) Ltd.

- Mbabane

Tanzania

Tanzania Electrical Services Ltd.

- Dar-es-Salaam

Tunesia

Sitelec S.A.

- Tunis

Zaire

SOFAMATEL S.P.R.L.

- Kinshasa

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- Buenos Aires
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- Mendoza
- Rosario

Bolivia

Sociedad Comercial é Industrial Hansa Ltda.

- La Paz

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Siemens S.A.

- Belém
- Belo Horizonte
- Brasilia
- Campinas
- Curitiba
- Fortaleza
- Pôrto Alegre
- Recife
- Rio de Janeiro
- Salvador de Bahia
- São Paulo
- Vitória

Canada

Siemens Electric Ltd.

- Montreal, Québec
- Toronto

Chile

INGELSAC

- Santiago de Chile

Colombia

Siemens S.A.

- Barranquilla
- Bogotá
- Cali
- Medellín

Costa Rica

Siemens S.A.

- Panama
- San José

Cuba

Respresentación
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- La Habana

Ecuador

Siemens S.A.

- Quito

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Siemens S.A. • San Salvador	Rieder & Cia. S.A.C.I. • Asunción
Guatemala Siemens S.A. • Ciudad de Guatemala	**Peru** Siemsa • Lima
Honduras Representaciones Electroindustriales S de R.L. - Relectro • Tegucigalpa	**United States of America** Siemens Industrial Automation Inc. Automation Division • Alpharetta, GA Numeric Motion Control • Elk Grove Village, Illinois
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Nicaragua Siemens S.A. • Managua	**Venezuela** Siemens S.A. • Caracas • Valencia

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Bangladesh Siemens Bangladesh Ltd. • Dhaka	**Indonesia** P.T. Siemens Indonesia, P.T. Siemens Dian-Grana Elektrika, Representative Siemens AG • Jakarta
Brunei • Brunei Darussalam	
Hong Kong Siemens Ltd. • Hong Kong	

Iraq Samhiry Bros. Co. Limited or Siemens AG (Iraq Branch) • Baghdad	**People's Republic of China** Siemens AG Representation • Beijing • Guangzhou • Shanghai
Iran Siemens S.S.K. • Teheran	**Philippine Islands** Maschinen & Technik Inc. (MATEC) • Manila
Japan Siemens K.K. • Tokyo	**Qatar** Trags Electrical Engineering and Air Conditioning Co. • Doha
Korea Siemens Ltd. • Changwon • Seoul • Ulsan	**Saudi Arabia** Arabia Electric Ltd. (Equipment) • Al-Khobar • Jeddah • Riyadh
Kuwait National & German Electrical and Electronic Services Co. (NGEECO) • Kuwait, Arabia	**Singapore** Siemens (Pte.) Ltd. • Singapore
Lebanon Ets. F.A. Kettaneh S.A. • Beirut	**Sri Lanka** Dimo Limited • Colombo
Malaysia Siemens Electrical Engineering Sdn. Bhd. • Kuala Lumpur	**Syria** Siemens AG, Branch (A.S.T.E.) • Damascus
Nepal Amatya Enterprises (Pvt.) Ltd. • Kathmandu	**Taiwan** Siemens Ltd., TELEUNION Engineering Ltd. or TAI Engineering Co., Ltd. • Taichung • Taipei
Oman Waleed Associates • Muscat	**Thailand** Berti Jucker Co. Ltd. • Bangkok
Pakistan Siemens Pakistan Engineering Co., Ltd. • Islamabad • Karachi • Lahore • Peshawar • Quetta	

United Arab Emirates	Vietnam
Electro Mechanical Co. or Siemens Resident Engineers • Abu Dhabi Scientechnic or Siemens Resident Engineers • Dubai	OAV Representative Office • Hanoi **Yemen (Arab. Republic)** Tihama Tractors & Engineering Co., Ltd. or Siemens Resident Engineers • Sanaa

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Australia	New Zealand
Siemens Ltd. • Adelaide • Brisbane • Melbourne • Perth • Sydney	Siemens Ltd. • Auckland • Wellington

List of Abbreviations

F

Abbreviation	Description
CP	Communication Processor
CPU	Central Processing Unit
FM	Function Module
IM	Interface Module
LED	Light-emitting Diode
MPI	Multipiont Interface
OP	Operator Pane
PG	Programming device
PS	Power supply
SM	Signal Module

Glossary

A

Address

The address specifies the physical storage location, allowing direct access to the operands stored under this address.

Application Function Module

Application function modules are a subset of → Function modules from the M7 range and are described in a separate manual.

B

Backup Battery

The backup battery ensures that the contents of the SRAM and the clock time are not lost during a power Off.

Baud Rate

Speed of data transmission (bit/s).

BIOS

Basic Input Output System

The BIOS is the part of the software that makes the link between the hardware and the operating system, for instance MS-DOS. The BIOS software is stored in an EPROM.

Important parts of the BIOS are, for instance, the loader for the operating system, the (hardware) SETUP for specifying the hardware configuration and for setting the time.

Mass Storage Module

Expansion module for the FM356 application function module. It is linked to the application function module via an ISA- (AT) bus interface and contains a diskette drive and a hard disk.

Bus Connector

A bus connector is an accessory of the M7-300 system. It is supplied with each → application module, each expansion element, each interface module and each signal module. The bus connector extends the M7-300 bus from the → CPU and from one module to the next.

C

Configuring Configuring is the arranging of individual modules within a programmable controller.

Connecting Cables Connecting cables are prefabricated or need to be preassembled by the user; they are two-wire cables with two connectors. These connecting cables connect the → CPU via the → multipoint interface (MPI) to a PG or other CPUs.

CPU Central processing unit: a programmable module of the M7-300 automation computer with MPI; it controls the automation tasks.

D

Default Setting The default setting is a reasonable basic setting that can always be used if no other value is entered.

DIN Rail The DIN rail is a rail to which the modules of an S7–300 are fitted.

DMA Direct memory access

E

Electromagnetic Compatibility Electromagnetic compatibility is the ability of an electrical device to operate fault-free in a specified environment without causing inadmissible interference in that environment.

EMC → Electromagnetic compatibility

Equipotential Bonding An electrical connection which places the conductive parts of electrical apparatus and extraneous conductive parts at the same or approximately the same potential.

Expansion Module An expansion module is linked to the → CPU via an ISA bus interface and provides space for two or three → interface modules.

F

Functional Ground Grounding, but only for the purpose of ensuring the intended function of the electrical apparatus. Functional grounding causes the short-circuiting of interference voltages which would otherwise interfere with the apparatus.

Function Module Programmable module that, unlike the central processing unit (CPU), has no MPI interface and can only be operated as a slave.

G

Ground The conductive earth whose electrical potential can be considered as zero at any point.

In the region of grounding conductors, the earth may have a potential deviating from zero. In this context, the term “reference ground” is frequently used.

Ground (Internal) Internal or chassis ground is all the inactive parts of the device linked together. These parts must not be able to carry any hazardous voltages, even in the event of a fault.

Ground System The ground system is the entirety of all means and measures used for grounding.

Grounded Supply In a grounded supply, the neutral conductor of the supply is grounded. A single ground fault results in tripping of the protective devices.

Grounding Grounding means connecting an electrically conductive element via a grounding system to the → grounding conductor.

Grounding Conductor One or more conductive elements which make very good contact with earth ground.

H

Hardware Hardware covers all the physical and technical components of a programmable controller.

I

Interface Module Modules that provide the application function module with additional interfaces such as VGA, COM, LPT, etc.

Interrupt Interrupt is the name for the interruption of program execution in the processor by an externally occurring event such as timer expired, data request, etc.

ISA Bus Used in the M-700 for connecting expansions to → CPUs and → application modules.

Isolated (Floating) With isolated input/output modules, the reference potentials of the control and load circuits are isolated, for example by optocouplers, relay contacts or transformers. Input/output circuits can have a common potential.

K

Key Switch The key switch is the → CPU. The keyswitch is operated with a removable key.

L

Lightning Protection Measures to avoid damage in the event of overvoltages caused by lightning.

Load Voltage Load voltage is the supply voltage for function modules, signal modules, actuators and sensors.

M

Main Memory The main memory is a random access memory (RAM) in the programmable modules, in which the processor accesses the software during processing.

Memory Card The memory card is a plug-in memory module. When used in a CPU or function module, part or all of the software of the CPU or function module can be stored, together with static data.

Data and programs are stored on the memory card in a similar manner to a diskette.

Mode Selector

→ Keyswitch

Multipoint Interface

The multipoint interface (MPI) is a 9-pin subminiature D interface. A programmable number of devices can be connected to a multipoint interface and can communicate with each other:

- Programming devices (PGs)
- Operator interfaces
- Other automation computers

N

Network

A network is the connection of two or more M7-300s and other terminals, for example a PG, via → connecting cables. Data are interchanged between the connected devices via the network.

Node Number

The node number is the address of a CPU or PG or of another intelligent I/O module, when they communicate with each other over a → network. The node number is assigned to the CPU or PG with the STEP 7 software.

Non-Isolated

With non-isolated input/output modules, the reference potentials of the control and load circuits are electrically connected.

P

Parameter Assignment

Parameter assignment is the setting of parameters that affect the behavior of a module.

PG

Programming device

PLC

→ Programmable (logic) controller

Process Image

The process image is a special storage area in the automation system. At the start of the cyclic program, the signal states of the input modules are transferred to the process-image input table. At the end of the cyclic program, the process-image output table is transferred to the output modules as the signal states.

Programmable Controller

Programmable controllers (PLC) are electronic controls whose function is stored as a program in the controller. The configuration and wiring are not therefore dependent on the the function of the controller. Programmable controllers are structured like a computer, consisting of a → CPU (central module) with memory, input/output modules and an internal bus system. The I/O modules and the programming language are designed to meet the requirements of control engineering.

R

Reference Ground

→ Ground

Reference Potential

Potential, with respect to which the voltages of associated circuits are considered and/or measured.

Resident Data

Resident data is data that is not lost when the mains power is turned off.

S

Signal Module

Signal modules make the connection between CPU and process.

SRAM

Static RAM. This memory can be backed up.

Supply Voltage

The supply voltage is the voltage needed to operate an automation computer or automation system.

S7-300 System Bus

The S7-300 system bus is a serial data bus, via which the modules communicate with each other and are supplied with the required voltage. The connection between the modules is established by bus connectors.

U

Ungrounded

Without direct connection to → ground

Index

Numbers

A

B

C

I

Q

R

S

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