SIEMENS

SIMATIC

FM 356 Application Function Module, Installation and Startup

Manual

C79000-G7076-C356-01

Safety Guidelines

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:

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

draws your attention to particularly important information on the product, handling the product, or to a particular part of the documentation.

Qualified Personnel

The device/system may only be set up and operated in conjunction with this manual.

Only **qualified personnel** should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground, and to tag circuits, equipment, and systems in accordance with established safety practices and standards.

Correct Usage

Note the following:

Warning

This device and its components may only be used for the applications described in the catalog or the technical description, and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

This product can only function correctly and safely if it is transported, stored, set up, and installed correctly, and operated and maintained as recommended.

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Siemens AG
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Industrial Automation Systems
Postfach 4848, D-90327 Nürnberg

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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.

Siemens Aktiengesellschaft

Order No. 6ES7356-0AA00-8BA0

Preface

Purpose

The information in this manual will enable you to:

- Design a configuration from the M7-300 range and build it into an S7-300 programmable logic control system.
- Look up operating instructions, functional descriptions and technical data for specific modules.

Audience

The manual is intended for the following readers:

- Users who plan and design the scope of a programmable logic controller.
- Users who require detailed technical data.
- Service and maintenance engineers who have to install and maintain programmable logic controllers.

Scope of This Manual

This manual applies to the following M7–300 modules:

Product	Order Number	From Release
FM 356-4 (4 Mbyte)	6ES7 356-4BM00-0AE0	A01
FM 356-4 (8 Mbyte)	6ES7 356-4BN00-0AE0	A01

It contains descriptions of all the modules that are valid at the time of issue of this manual. We reserve the right in the case of new modules and new releases of modules to provide product information sheets containing up-to-date information about those modules.

Note

The structure of the S7-300 and M7-300 systems is described in manuals /1/ and /4/. Familiarity with the content and requirements of these handbooks is a prerequisite for integrating M7-300 application function modules into a S7-300 or M7-300 system.

Other Pertinent Manuals

This manual describes the hardware of the application function modules from the M7-300 range.

You will additionally need the following manuals for programming and starting up M7-300 application function modules:

Manual	Contents	Order Number
Manual: S7-300 programmable logic controller Configuring, CPU data, module data	Planning, installation and preparing for startup	6ES7 030-0AA00-8AA0
Manual: M7-300 programmable logic controller Configuring, CPU data	Planning, installation and preparing for startup	6ES7 038-0AA00-8AA0
Manual: M7-SYS Program design Function library Installation and operation	Designing, creating and testing a C program for M7-CPU/FM modules using the M7 RMOS32 program package, and use of the M7 RMOS32 functions. Detail description of the M7 RMOS32 functions and data structures, listing of message types.	6ES7 881-8AA00-8AA0
User manual Basic software for S7 and M7 STEP 7	Describes the development tools contained in STEP 7 and the general procedure for the creation of applications.	Contained in STEP 7 documentation package

Further Sources of Information

You will find further sources of information in Appendix A.

How to Use This Manual

This manual provides the information you need to install M7-300 application function modules in an S7-300 or M7-300 controller.

Product Overview

Section 1 provides an overview of the M7-300 function modules.

Planning, Addressing

Section 2 contains the information you need to plan a system. Section 3 shows you how to address the M7-300 modules on the S7-300 backplane bus.

Installation, Preparation for Startup

Section 4 shows you how to install the M7-300 modules and prepare them for startup.

Replacing Modules

Section 5 describes how to change a buffer battery and replace M7-300 modules.

Functions, Technical Data

Section 6 provides a detailed description of the FM 356-4 application function module. You will also find the technical data of the FM 356-4 in this section.

M7-300 Expansion Modules

Section 7 contains detailed descriptions of the expansion modules for the application function modules. You will also find the technical data for these modules in this section.

Interface Modules

Section 8 contains detailed descriptions of the application function modules. You will also find the technical data for these modules in this section.

Ordering Information

Section 9 contains ordering information for M7-300 components as well as I/O modules and accessories not described in this manual.

Bibliography

Appendix A contains references to further literature that may be helpful in certain cases.

Glossary, Index

At the end of the manual is a glossary giving definitions of technical terms used in the manual and a comprehensive index to give you quick access to the information you require.

Additional Assistance

If there are questions regarding the use of products described in this manual that are not answered here, please contact your local Siemens office. You will find the addresses in, for example, the “Siemens World-Wide” appendix in the “S7-300 Programmable Logic Controller, Configuring an S7-300” manual.

In the case of questions or comments about the manual itself, please fill in the reply form at the end of the manual and return it to the address given. We would also ask you to give your personal evaluation of the manual in the reply form.

We offer training courses to make the introduction to the SIMATIC S7 Programmable Logic Controller easier for you. Please contact your Regional Training Center or the Training Center in D–90327 Nuremberg, Tel. (+49) 911 895 3154.

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Product Overview

1

In this Chapter

1.1 Overview

Introduction

In this section, you will learn what the FM 356 application function module is and what it has to offer.

What Is an FM 356?

The FM 356 is an application function module from the M7-300 family of automation computers, which is used in the S7/M7-300 programmable logic controller.

FM 356 application function modules are AT compatible computers for mounting on the DIN rail of your S7/M7-300 programmable logic controller.

An FM 356 is a freely programmable module (application function module) that can be expanded or combined to form large configurations:

- programmable 80486DX module that will accept a plug-in memory card.
- EXM 378-2 or EXM 378-3 expansion modules for 2 or 3 interface modules such as IF 962-VGA, IF 962-COM, IF 962-LPT.
- bulk storage modules with diskette drive and hard disk.

Position of an FM 356 in the S7 System

Using the expansion modules, an FM 356 can be expanded to provide full PC functionality within an S7/M7-300 system (including monitor, keyboard and mass memory). Integration into the system is performed by the M7 system software.

A memory card can be inserted through the front plate for loading system and user software. The memory card is addressed in the same way as a diskette drive.

You can use an FM 356 to provide flexibility in meeting specific requirements, such as application technology tasks (controlling, positioning, counting, ...), communications, data storage, etc. This considerably reduces the load on the S7/M7-300 CPU.

Configuration of an S7-300 with FM 356

An FM 356 with or without expansion modules can be fitted in addition to the S7-300 components. Figures 1-1 and 1-2 illustrate sample configurations:

- FM 356 without expansion modules as application function module in the S7-300 system.
- FM 356 with EXM 378-2 expansion module and integrated IF 962-VGA interface module and MSM 378 mass memory module as automation computer in the S7-300 system.

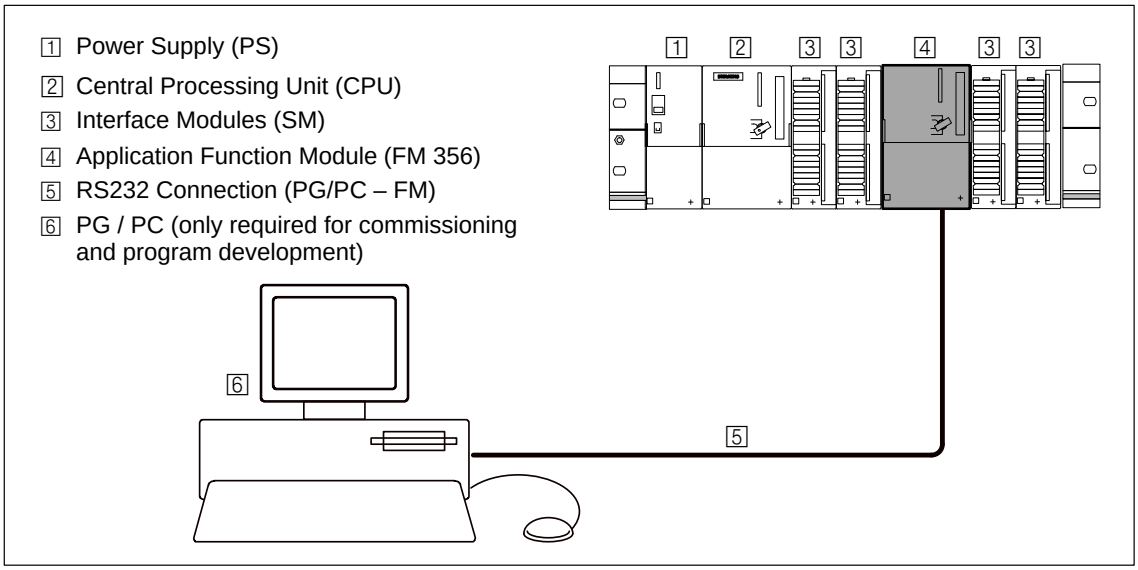


Figure 1-1 FM 356 as Application Function Module in S7-300 System

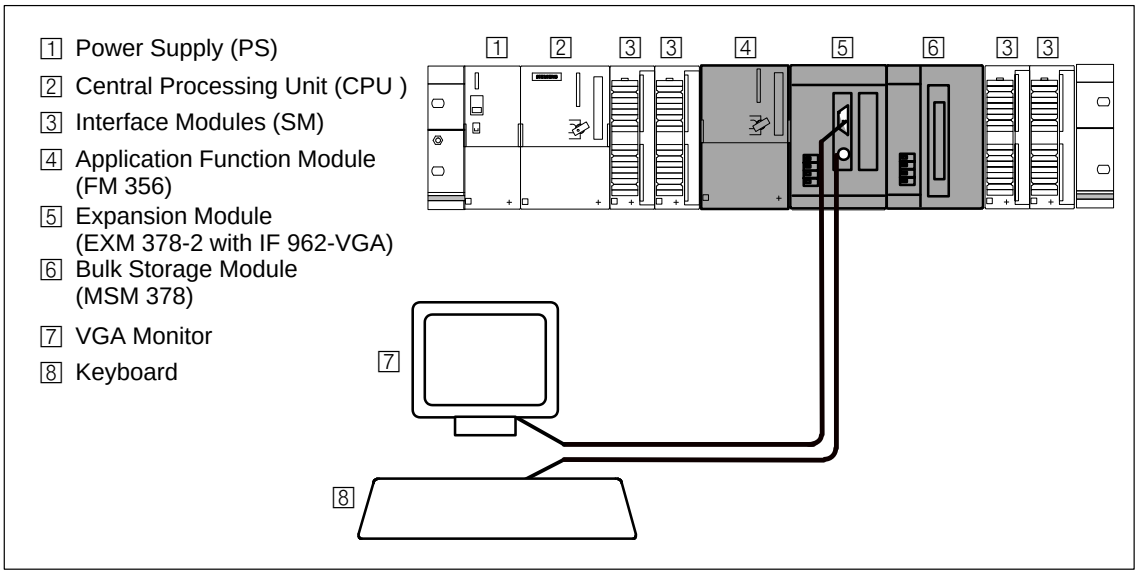
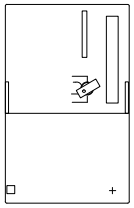
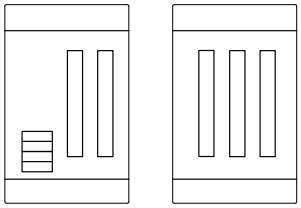
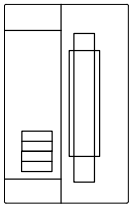
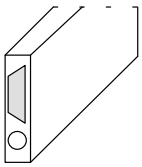


Figure 1-2 FM 356 as Automation Computer in S7-300 System

M7-300 Components

An M7-300 can be equipped or expanded in various ways. The following tables provide an overview of the components in the M7-300 family.

Table 1-1 Components in the M7-300 Automation Computer Family.

Components	Function	Illustration
Application function modules FM 356-4	... are AT-compatible basic modules.	
Expansion modules EXM 378-2 EXM 378-3	... provide space for 2 or 3 interface modules for connecting to, for example, process I/O, VGA monitor, PG/PC keyboard, printer etc.	
Bulk storage module MSM 378	... provides storage for programs and data on a hard disk and3.5″ diskette.	
Interface modules Process modules (IF 961) System modules (IF 962) Point-to-point modules (IF 963) Bus modules (IF 964)	... make the connection from the process or I/Os to the FM 356.	

1.2 Applications

Tasks for an FM 356

An FM 356 is used in an S7/M7-300 programmable logic controller in conjunction with an S7/M7-300 CPU. The following are a few typical tasks or functions for an FM 356:

- Process data acquisition
- Mass memory functions
- Free programming
- Data exchange with the S7/M7 CPU
- Data exchange with PG (operation, monitoring)
- Control of local peripherals
- Event-driven program processing
- Communications
- Controlling, positioning, counting

Areas of Application of an FM 356

The FM 356 can be used in any application where special technical requirements, high-speed control or special tasks such as communications, data storage etc. are to be implemented.

- Plastics technology
- Process systems
- Textile industry
- Machine tools
- Packaging systems

Task Sharing With Local Bus Segment

An FM 356 provides additional computing power in conjunction with your S7-300 CPU to perform your automation task.

Direct communication with the S7/M7-300 CPU via the S7-300 bus provides efficient means of data exchange between an S7/M7-300 CPU and the FM 356.

The (optional) creation of a local bus segment on the S7-300 bus enables an FM 356 to perform autonomous sub-tasks via S7-300 signal modules.

For example, it can process control algorithms that output new setpoints to the I/Os without interfering with the control tasks being performed by the CPU.

User-Defined Functionality

The functionality of an FM 356 is defined by the user. This is achieved through the programming capability of the module. Powerful M-7 system software is available for the implementation of the user's application.

1.3 Module Overview

Application Function Module Type Overview

The following application function modules from the M7-300 family of automation computers are available for use with the S7-300:

Table 1-2 Overview of M7-300 Application Function Modules

Description	Remarks
FM 356-4 application function modules	80486DX2-50, 4 Mbyte RAM, Slot for memory card, 1 serial interface Facility to connect expansion modules
	80486DX2-50, 8 Mbyte RAM, Slot for memory card, 1 serial interface Facility to connect expansion modules

Memory Card Overview

The following memory cards are available for the M7-300 application function modules:

Table 1-3 Overview of Memory Cards for M7-300 Application Function Modules

Description	Remarks
Flash EPROM, 1 Mbyte	Memory cards (5 V) with various storage capacities
Flash EPROM, 2 Mbyte	
Flash EPROM, 4 Mbyte	
Flash EPROM, 8 Mbyte	
Flash EPROM, 16 Mbyte	

Expansion Modules

The following expansion modules are available for the M7-300 application function modules:

Table 1-4 Expansion Modules for M7-300 Application Function Modules

Description	Remarks
EXM 378-2 expansion module	For 2 interface modules
EXM 378-3 expansion module	For 3 interface modules
MSM 378 bulk storage module	3.5″, 1.44 Mbyte diskette drive, ≥ 520 Mbyte hard disk drive

M7-300 Interface Modules

The following interface modules are available for installation in the EXM 378-2 and EXM 378-3 expansion modules:

Table 1-5 Overview of M7-300 Interface Modules

Description	Remarks
IF 961-AIO	Analog input/output
IF 961-CT1	Meter connection
IF 961-DIO	Digital input/output
IF 962-COM	2 serial interfaces
IF 962-LPT	Printer interface
IF 962-VGA	Connection for VGA monitor and keyboard
IF 964-DP	SINEC L2-DP interface (Profibus)

Designing the Mechanical Configuration 2

In this Chapter

2.1 Horizontal and Vertical Configuration of an S7/M7-300

Horizontal and Vertical Configuration

An FM 356 and its expansion modules can be operated in both horizontal and vertical configurations of an S7-300 system.

Permissible Ambient Temperature

The FM 356 application function modules and the EXM 378-2 and EXM 378-3 expansion modules have the same temperature range as the S7-300.

Those modules that have a different temperature range to the S7-300 for horizontal and vertical configurations are listed in Table 2-1.

Table 2-1 Differences in Permissible Ambient Temperature for Horizontal and Vertical Configurations

Components	Configuration	Permissible Ambient Temperature
MSM 378 bulk storage module	Horizontal	0 °C to 40 °C (32 °F to 104 °F)
	Vertical	0 °C to 40 °C (32 °F to 104 °F)

2.2 Installation Dimensions of M7-300 Components

Introduction

This section contains details of the installation dimensions of M7-300 components. You need this data when designing the mechanical configuration of an S7/M7-300 system.

Table 2-2 Installation Dimensions of M7-300 Components

Component Installation Dimensions

Module	Module Width	Module Height	Maximum Mounting Depth
FM 356-4 application function module	80 mm	125 mm	130 mm or 180 mm with front flap open
EXM 378-2 expansion module EXM 378-3 expansion module	80 mm	125 mm	117 mm plus height of plug on cable
MSM 378 bulk storage module	80 mm	125 mm	166 mm

2.3 Current Consumption and Power Loss of M7-300 Components

Introduction

M7-300 components take the current required for their operation from an external load supply and from the the S7-300 backplane bus.

You will need the current consumption details of the M7-300 components from the external load supply and the backplane bus when, for instance, planning how to install an S7/M7-300 into a cubicle.

Detailed information about the calculation of the current consumption and the design of an S7-300 or M7-300 can be found in Manuals /1/ and /4/.

Current Consumption and Power Loss

Table 2-3 gives the current consumptions and power losses of the M7-300 components.

Table 2-3 Current Consumptions and Power Loss of M7-300 Components (24 V DC Supply)

Module	Current Consumption from Backplane Bus (Max.)	Current Consumption from 24 V Load Supply	Power Loss (Rated Operation)
FM 356-4 application function module	80 mA	400 mA	9.6 W
EXM 378-2 expansion module	–	95 mA	1)
EXM 378-3 expansion module	–	15 mA	0.22 W
MSM 378 bulk storage module	–	400 mA	9.6 W
IF 961-AIO interface module	–	30 mA	2.5 W
IF 961-CT1 interface module	–	53 mA 2)	1.5 W
IF 961-DIO interface module	–	30 mA 2)	2.4 W
IF 962-COM interface module	–	40 mA	0.5 W
IF 962-LPT interface module	–	40 mA	0.5 W
IF 962-VGA interface module	–	210 mA	2.5 W
IF 964-DP interface module	–	160 mA	2 W

1) The EXM378-2 expansion module has an internal power supply to power the interface modules and an EXM378-3. The power loss is therefore calculated as follows:
$P_{EXM378-2} = 2.28\ W + 0.6 \times (P_{EXM378-3} + P_{interface\ module})$
2) The load-dependent current consumption due to the digital outputs must be added to the above value.

Example

An S7-300 configuration consists of the following modules:

- 1 PS 307; 5 A power supply module
- 1 CPU 314
- 2 SM 321 digital input modules; DI 16 × 24 V DC
- 1 FM 356-4 application function module
- 1 EXM 378-2 expansion module with
  - 1 IF 962-VGA interface module
  - 1 IF 962-LPT interface module
- 1 MSM 378 bulk storage module
- 1 SM 322 digital output module; DO 16 × 24 V DC
- 1 SM 331 analog input module; AI 8 × 12 Bit
- 1 SM 332 analog output module; AO 4 × 12 Bit

Calculating the Current Consumption and Power Loss Totals

Table 2-4 shows the total current consumption and power loss figures for the above S7-300 configuration.

Table 2-4 Example of Calculation of Power Consumption and Power Loss Totals

Module	Current Consumption from S7-300 Backplane Bus	Current Consumption from 24 V Load Supply	Power Loss
PS 307; 5 A power supply	–	–	18 W
CPU 314	–	1 A	8 W
2 SM 321 digital input modules; DI 16 × 24 V DC	(2 × 25 mA) = 50 mA	(2 × 1 mA) = 2 mA	(2 × 3.5 W) = 7 W
FM 356-4 application function module	50 mA	400 mA	9.6 W
EXM 378-2 expansion module	–	95 mA	2.28 W + 0.6 x (2.5 W + 0.5 W) = 4.1 W
IF 962-VGA interface module	–	210 mA	2.5 W
IF 962-LPT interface module	–	40 mA	0.5 W
MSM 378 bulk storage module	–	400 mA	9.6 W
1 SM 322 digital output module; DO 16 × 24 V DC	70 mA	100 mA	4.9 W
1 SM 331 analog input module; AI 8 × 12 Bit	60 mA	200 mA	1.3 W
1 SM 332 analog output module; AO 4 × 12 Bit	60 mA	240 mA	3 W
Totals:	**290 mA**	**2.687 A**	**68.5 W**

2.4 Layout of M7-300 Components in an S7-300 Configuration

Introduction

The following sections describe the rules governing the layout of M7-300 components in an S7-300 rack configuration.

Module Layout

The following rules apply to the layout of modules on a rack (DIN rail):

- A maximum of 8 signal modules (including FM 356, EXM 378 and MSM 378) can be plugged in to the right of the CPU.
- The number of plug-in signal modules (including FM 356, EXM 378 and MSM 378) is limited by their current consumption from the S7-300 bus (see Table 2-3 for the modules specific to M7-300).

  The total current consumption from the S7-300 bus of all modules (including FM 356, EXM 378 and MSM 378) that are mounted on the DIN rail must not exceed 1.2 A per tier/rack.

FM 356 Operating Modes

An FM 356 can be configured and operated in the following basic modes:

- FM 356 on continuous S7-300 bus
- FM 356 with local bus segment

You should design the configurations according to the requirements and the distribution of computing power.

Both configurations can be operated individually or mixed in a rack. The different configuration options resulting from this are explained in more detail in the following examples.

An FM 356 can be operated in its various modes both in a single tier and a multi-tier S7-300 system (rack 0 to rack 3).

FM 356 in Continuous S7-300 Bus

Figure 2-1 shows the configuration of an FM 356 in a continuous S7-300 bus. The FM 356 can be fitted in **any position** following the CPU. You can operate several FM 356 units on a continuous S7-300 bus.

The modules to the right of the FM 356 are logically allocated to the CPU and are not addressed by the FM 356.

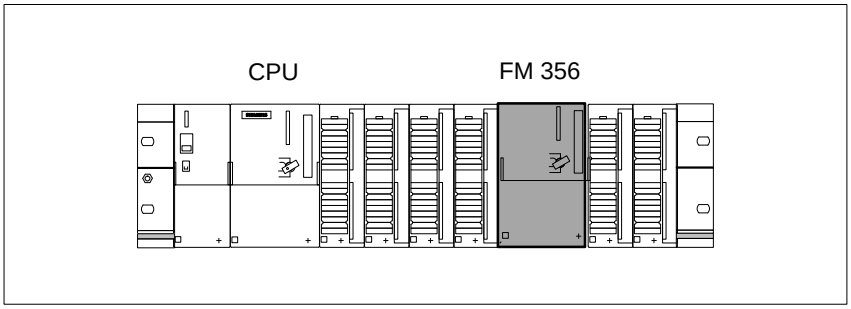


Figure 2-1 Layout of the S7-300 Modules for an FM 356 Configuration on a Continuous S7-300 Bus

FM 356 with Local Bus Segment

Figure 2-2 shows the FM 356 configuration with a local bus segment. Here, the FM 356 controls the (sub-)process independently via (for example) 4 signal modules. In this case, the S7-300 bus is split at the FM 356, so that a local bus segment exists from this point. The logical division of the bus is made by assigning the appropriate parameters to the S7–300 system. The local bus segment ends at the end of the rack.

This configuration relieves the load on the CPU, since the FM 356 processes a task, such as an axis controller, independently.

Note

One local bus segment can be configured in each rack. The position of the FM 356 results from the required number of “local” signal modules.

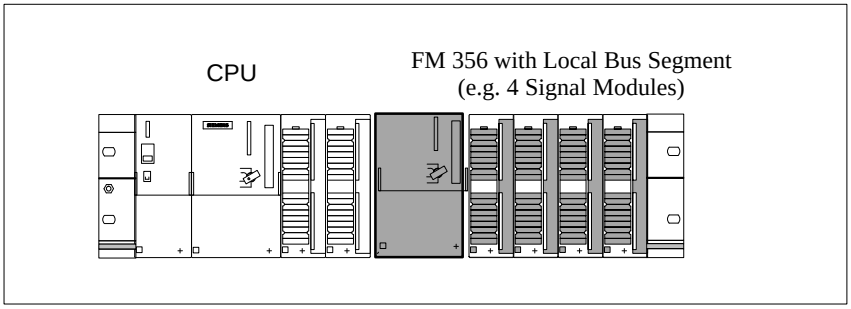


Figure 2-2 Layout of S7-300 Modules in an FM 356 Configuration with Local Bus Segment.

FM 356 in Continuous S7-300 Bus and with Local Bus Segment

Figure 2-3 shows a mixed configuration with an FM 356 on the continuous bus and an FM 356 with a local bus segment. The FM 356 in the local bus segment controls the (sub-)process independently via (for example) 2 signal modules. The continuous backplane bus is split at the second FM 356, so that a local bus segment exists from this point. The logical division of the bus is made by assigning the appropriate parameters in the FM 356.

The same configuration rules apply as for the previous two configurations, as they are both combined in this example.

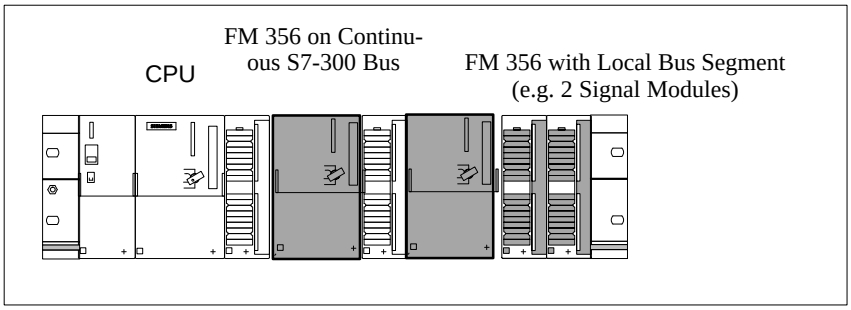


Figure 2-3 Layout of S7 Modules in a Configuration with FM 356 on the Continuous S7-300 Bus and with a Local Bus Segment

FM 356 with Expansion Modules

The examples shown in the preceding pages can also have EXM 378-2, EXM 378-3 and MSM 378 expansion modules.

Figure 2-4 shows an FM 356 configuration with EXM 378-2 and MSM 378 expansion modules.

Note

Even if the EXM 378-2, EXM 378-3 and MSM 378 expansion modules are not addressed via the S7-300 bus, each occupies a slot and count towards the limit of 8 signal modules per rack (including FM 356, EXM 378 and MSM 378).

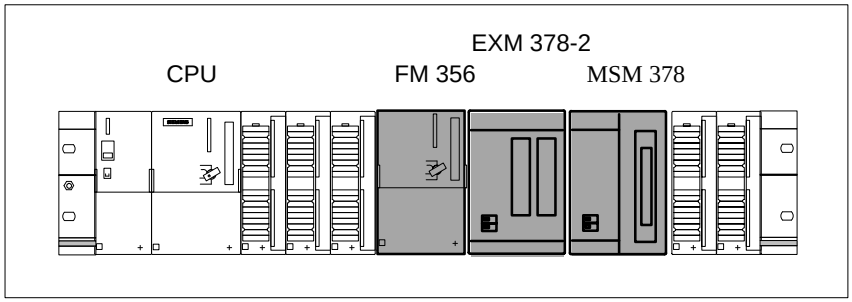


Figure 2-4 FM 356 with Expansion Modules

The unit comprising FM 356 and expansion modules can be fitted and operated in both the continuous bus and the local bus segment.

Addressing the M7-300 Modules

3

In this Chapter

3.1 Slot-Dependent Address Allocation for M7-300 Components

Introduction

The address allocation of M7-300 components is slot-dependent and is performed as described in Manuals /1/ and /4/ . This section tells you which M7-300 components occupy a slot.

Slots for M7-300 Components

Modules in the M7-300 range and their valid expansion modules can be plugged into each tier in slots 4 to 11. For every FM 356 and every expansion module, the module start address depends on the slot and the tier.

The following M7-300 modules each occupy **one** slot within the meaning of Manual /1/.

- FM 356 application function module
- EXM 378-2 expansion module
- EXM 378-3 expansion module
- MSM 378 bulk storage module

Assigning the Addresses to the Slots

The assignment of the addresses to the slots is performed as described in Manuals /1/ and /4/.

3.2 Addressing Interface Modules

Addressing Interface Modules

The module start addresses for IF96x-... interface modules that are operated as a group of modules with an application function module are known locally by the associated application function module.

Direct local access from the CPU to interface modules that are assigned to an application function module is not possible.

It is, however, possible to access the interface modules indirectly via a (user) program on the FM 356.

Calculating the Module Start Address

Table 3-1 shows the formulae for calculating module start addresses.

The expansion modules of FM 356 application function modules have no module start addresses, although the IF961-..., IF962-... etc. interface modules plugged into them do. The module receptacles (slots) of the interface modules in the expansion module are counted from left to right (in the case of two expansion modules from 1 to a maximum of 5).

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

Table 3-1 Formulae for Calculating Module Start Addresses

Module	Calculation Formula
Application function modules	Start address = Rack * 128 + (slot – 4) * 16 + 256
Expansion modules	have no module start address
Bulk storage modules	have no module start address
Digital interface modules	Start address = 128 + (module receptacle no. – 1) * 4
Analog interface modules	Start address = 2048 + (module receptacle no. – 1) * 16

Example

Table 3-2 in section 3.3 shows, among other things, the calculated module start addresses for an interface module in the example in Figure 3-1.

3.3 Local Address Area of an Application Module

Addressing the User Data Interface

The module start address of an application function module from the point of view of CPU is determined as described in Manuals /1/ and /4/. This provides an address area of 16 input bytes and 16 output bytes.

These input and output bytes are available to the application module under the default module start address “240” assigned to it.

Addressing Signal Modules in the Local Bus Segment

An application function module can be operated in an S7/M7-300 system with a local bus segment. In this mode, a parameter assignment splits the S7-300 backplane bus logically at the application function module. There is no difference in this mode to the slot-dependent addressing described in section 3.1.

Example of Addressing with Local Bus Segment

Table 3-2 shows the calculated module start addresses of the local bus segment of an S7/M7-300 configuration for the example in Figure 3-1.

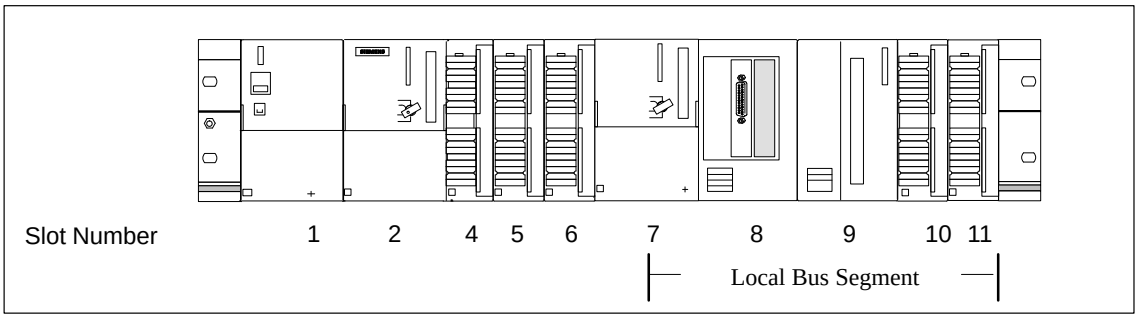


Figure 3-1 Example of an S7-300 Configuration with Local Bus Segment

Table 3-2 Assignment of Slot and Module Start Address from the point of view of the Application Function Module

Slot Number	Module	Module Start Address	
		Digital	Analog
7	Application function module	240	
8	Expansion module	–	
8	Module receptacle No. 1	128	2048
	Module receptacle No.2	not used	
9	Bulk storage module	–	
10	Signal module	8	288
11	Signal module	12	304

Installation and Startup

4

In this Chapter

4.1 Startup Guidelines

Introduction

This section provides you with some brief information about the necessary steps to start up an FM 356.

Startup Steps

The startup activities can be divided into several steps, which should be carried out in the order shown:

1. Installing and switching on the hardware,
2. Load operating system, adapt BIOS setup if necessary,
3. Load user software into the FM 356 from PG/PC, test and commission. Adapt S7/M7 software to the FM 356 functions.

The activities you must carry out in step 1 of the startup process are shown below in the correct order in the form of a checklist. The checklist contains notes on where you can find detailed information on each point.

Refer to Manuals /2/ /3/ for information on activities in steps 2 and 3 of the startup process.

4.2 Installation Checklist and Switch-on Test

Installation Checklist and Switch-On Test

This section explains the procedure for installing and starting up the M7-300 components step by step. Please proceed as described below:

1. Check that the power supply to the DIN rail is correctly dimensioned.

   (Chapter 2 and /1/)

2. If appropriate, assemble the FM 356 with its expansion modules and bus connector into a complete unit before fitting to the DIN rail.

   (Section 4.4)

3. Plug the interface modules into the EXM 378 expansion modules.

   (Section 4.5)

4. Switch off the power supply (PS).

5. Fit the pre-assembled module or module assembly onto the DIN rail and secure with the screws.

   (Section 4.6)

6. Connect the FM 356 and expansion modules to the power supply.

   (Section 4.7)

7. Fit and wire the necessary S7-300 I/O modules.

   (/1/)

8. Fit the buffer battery if this is required.

   (Section 4.9)

9. Insert the key in the operating mode switch.

   (Section 4.6, page 4-13)

10. Connect a PG or a PC if necessary to install the system software.

    (Section 4.12)

11. Connect the necessary operator equipment and peripherals.

    (Section 4.11)

12. Switch on the peripherals.

13. Switch the power supply (PS) on again.

14. Check that the status and fault displays respond correctly.

    (Section 4.13)

4.3 Module Accessories

Introduction

This section provides you with information about the accessories that are supplied with the M7-300 components or that can be ordered.

Module Accessories

The module packaging contains the accessories you need to mount the module on the DIN rail. You may have to order some additional special accessories according to requirements. The accessories are listed and explained in the table below.

Module	Accessories Supplied	Accessories to be Ordered	Explanation
FM 356-4 application function modules	2 keys	–	The key is used in the operating mode switch of the FM 356.
	–	1 buffer battery	To buffer the clock and the SRAM
	–	Memory card	For storing the user program on FEPROM when the FM 356 is in the power off condition
	1 bus connector	–	For the electrical connection between the modules
EXM 378-2 EXM 378-3 expansion modules	1 module cover		Cover for unused module receptacles in the EXM 378-2
	2 module covers		Covers for unused module receptacles in the EXM 378-3
		12 module covers including screws	Covers for unused module receptacles in the EXM 378-2 and EXM 378-3
	1 bus connector		For the electrical connection between the modules
MSM 378 bulk storage module	1 bus connector		For the electrical connection between the modules

4.4 Fitting Expansion Modules to an FM 356

Introduction

Before you fix your FM 356 to the S7/M7-300 system DIN rail, you must pre-assemble the application function module and all the necessary expansion modules.

This section gives you the information you need to pre-assemble an FM 356 application function module and its expansion modules, such as EXM 378-2 and EXM 378-3 expansion modules and the MSM 378 bulk storage module.

The individual steps for fitting the expansion modules are described in the following sections.

Removing the Connector and Socket Cover

On the right hand side of the FM 356 application function module is an 88-pole socket for connecting expansion units to the ISA bus. This socket is protected by a removable foil (Figure 4-1).

The EXM 378-2 and EXM 378-3 expansion modules also have an expansion socket on the right hand side with a corresponding plug on the left hand side. The expansion socket is protected by a removable foil.

The MSM 378 bulk storage module is always the last expansion unit. It just has an expansion plug on the left hand side.

Remove the shipping protection from the expansion plugs and remove the foil from the expansion sockets of those modules to which further expansion units are to be connected.

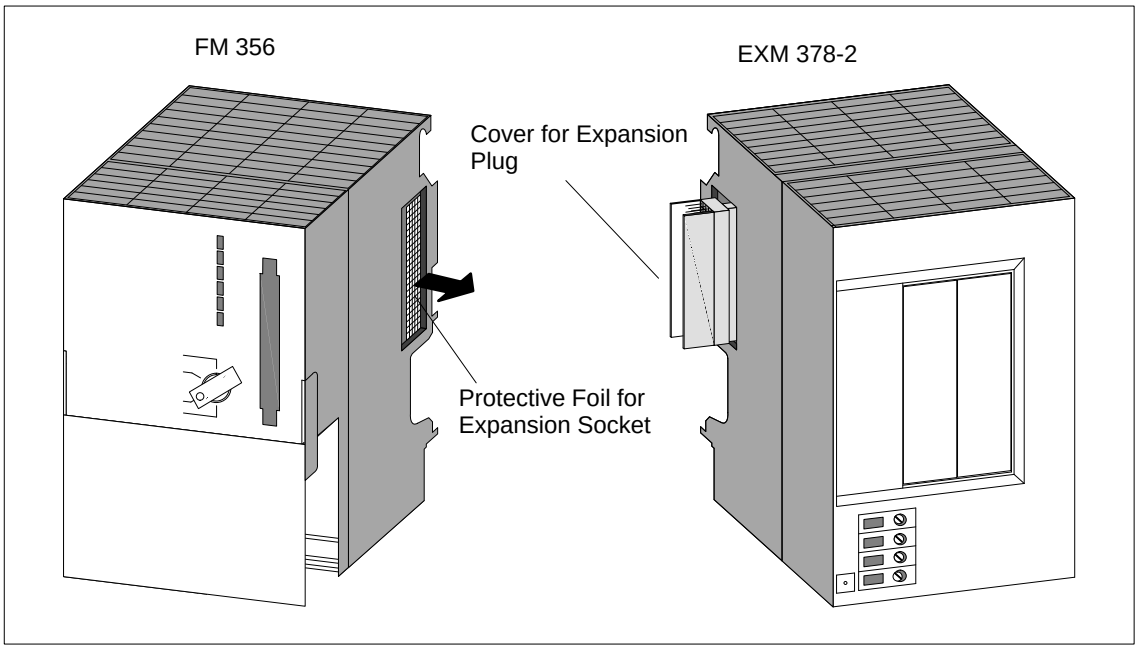


Figure 4-1 Positions of Expansion Sockets and Plugs with Associated Protective Material

Plugging the Modules Together

Place the modules together on a **flat** surface in the order in which you wish to assemble them (see Figure 4-2). Push the first two modules carefully together so that the plug on the expansion module with all its pins fits exactly into the socket on the FM module.

Then plug the other modules one after another into the already assembled units. All the expansion units are then connected to the AT bus of the application function module.

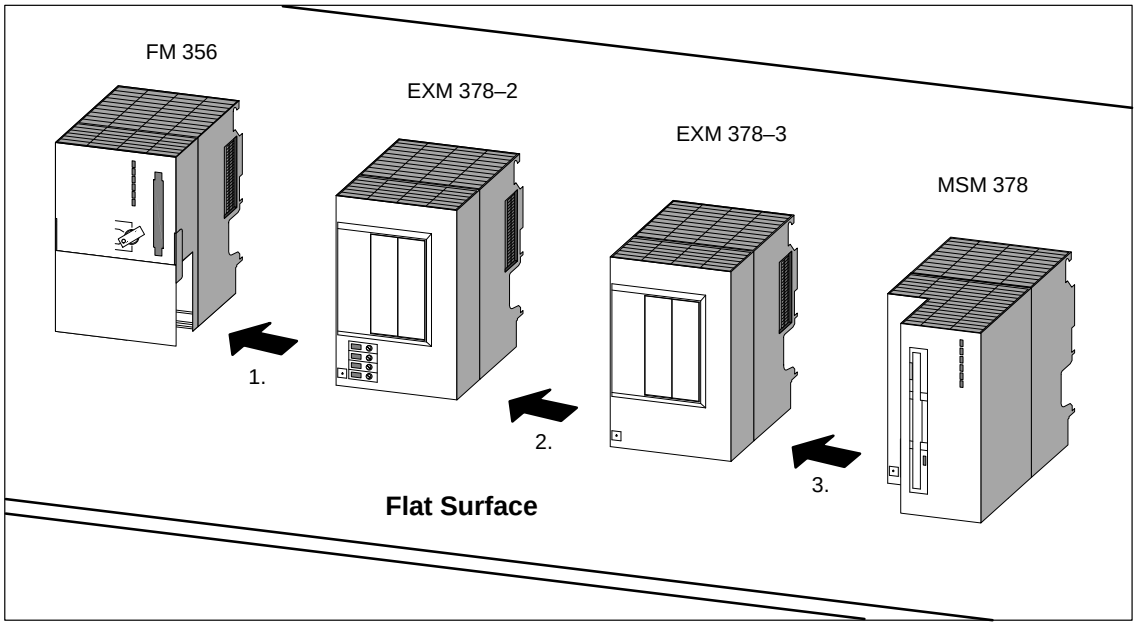


Figure 4-2 Positioning the Modules and Plugging Them Together

Warning

The pins in the expansion unit plugs can become damaged.

The plug pins will be damaged if the modules are plugged together at an angle.

Keep the modules aligned when plugging them together.

Fitting the Bus Connector

A bus connector is provided with every application function module and expansion module. The bus connector of the application module is required for the module to the left of the FM 356 on the DIN rail /1/ and /4/.

Start fitting the bus connectors with the FM 356 application function module.

- Connect each module to the next using a bus connector. This loops the S7-300 bus through to all the modules.
- The last of the modules that are plugged together is connected to the bus connector of the next module on the DIN rail.

Figures 4-3 and 4-4 show you where to plug in the bus connector on a module or a module assembly.

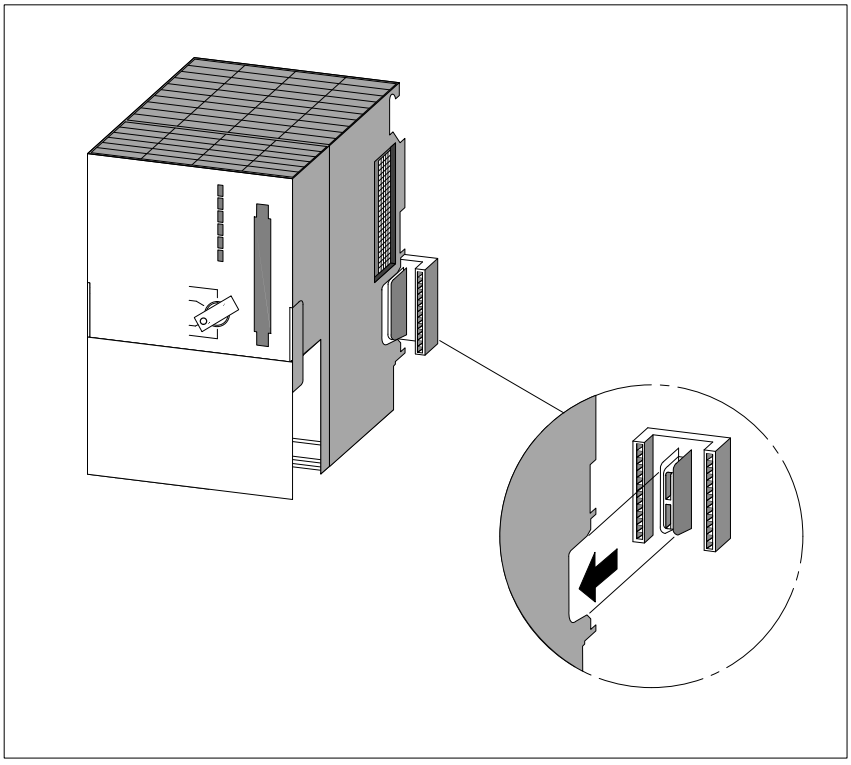


Figure 4-3 Plugging a Bus Connector onto an FM 356

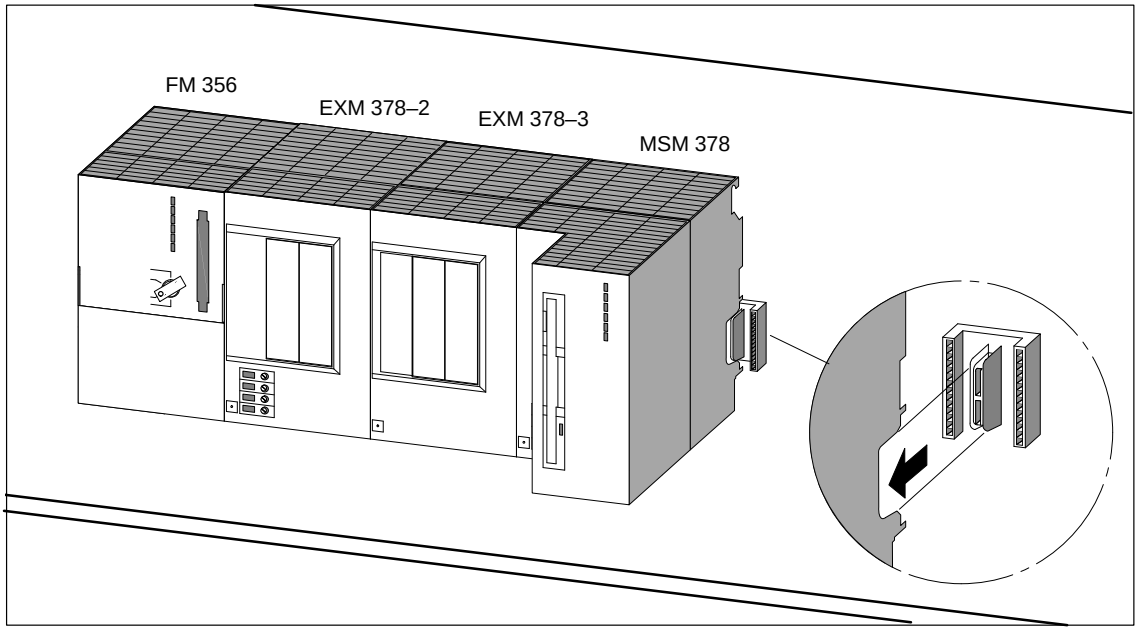


Figure 4-4 Plugging a Bus Connector onto a Module Assembly

4.5 Inserting the Interface Modules

Inserting the Interface Modules

Depending on its type, an expansion module will have 2 or 3 module receptacles (slots) for interface modules.

To insert an interface module into a module receptacle in an expansion module, proceed as follows:

1. Observe the ESD guidelines when handling the interface module (see appendix).
2. Hold the interface module by the long side of the front plate.
3. Insert the end of the interface module PCB into the upper and lower guide rails of the module receptacle.
4. Slide the interface module slowly into the slot until its front plate lies against the module receptacle frame.
5. Fix the front plate to the left hand frame of the module receptacle with the two M2x10 screws provided.

Warning

The modules can become damaged.

If the interface module is inserted or removed with the power on, the FM 356, the expansion module or the interface module may be damaged.

Never insert or remove the interface module with the power on. Always switch off the power supply (PS) before inserting or removing interface modules.

Warning

The interface modules and the connected equipment can become damaged.

The interface modules and the equipment connected to them may be destroyed if the modules are connected to the wrong front plugs.

Make sure the modules are connected to the correct front plugs.

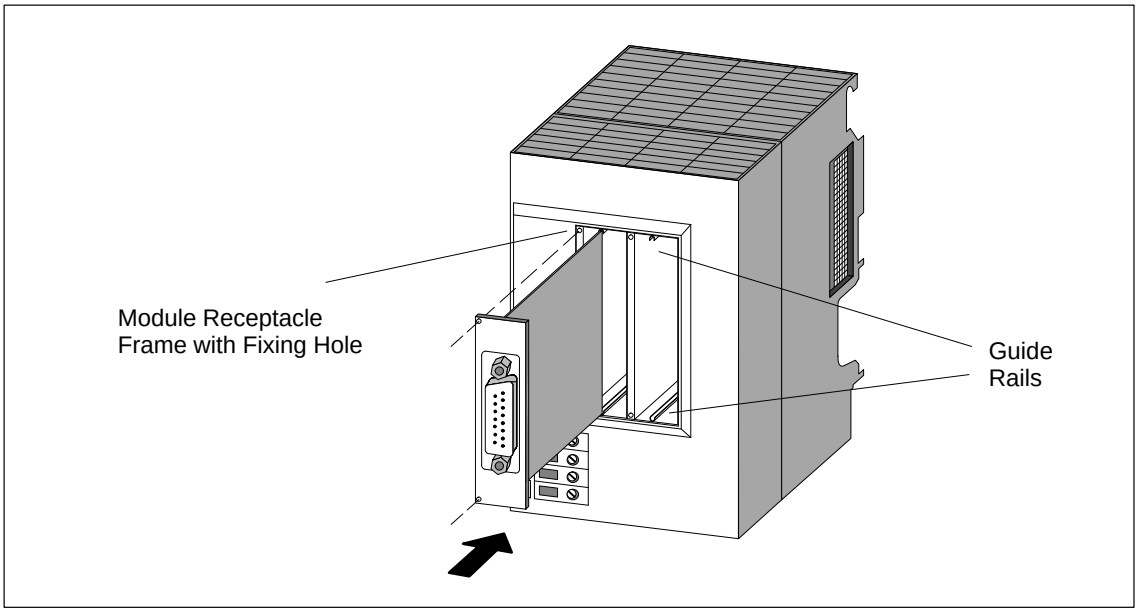


Figure 4-5 Inserting the Interface Module into an Expansion Module

Covering the Empty Slots

As supplied, only the extreme left receptacle of the expansion module is open. All other compartments are covered by cover plates. The cover plates are fixed to the frame of the receptacle by screws.

Slacken the screws and remove the cover plate if you wish to fit more than one interface module in an expansion module.

4.6 Fitting the M7-300 Modules to the DIN Rail

Fitting Sequence

To fit a module to the DIN rail, proceed as follows:

1. Plug the bus connector onto the module.
2. Attach the module or module assembly to the upper edge of the DIN rail and swing downwards.
3. Screw the module or module assembly into place.
4. Fit the next module (for example, a signal module) as described in steps 1 to 3.
5. Plug the key switch into the FM 356 once all modules have been fitted.

The individual steps in fitting the module are described below.

Plugging In the Bus Connectors

A bus connector is supplied with every module.

The bus connector supplied as an accessory is needed for the module installed **before** the FM 356 (or FM 356 module assembly).

Remove the bus connector from the module that follows the FM 356 or the module assembly and plug it into the FM 356 or the last module in the assembly.

Figures 4-3 and 4-4 on Pages 4-7 and 4-8 show you where to plug the bus connector into the module or module assembly.

Fitting the Modules to the DIN Rail

Figures 4-6 and 4-7 below show you how to fit the module or module assembly onto the DIN rail.

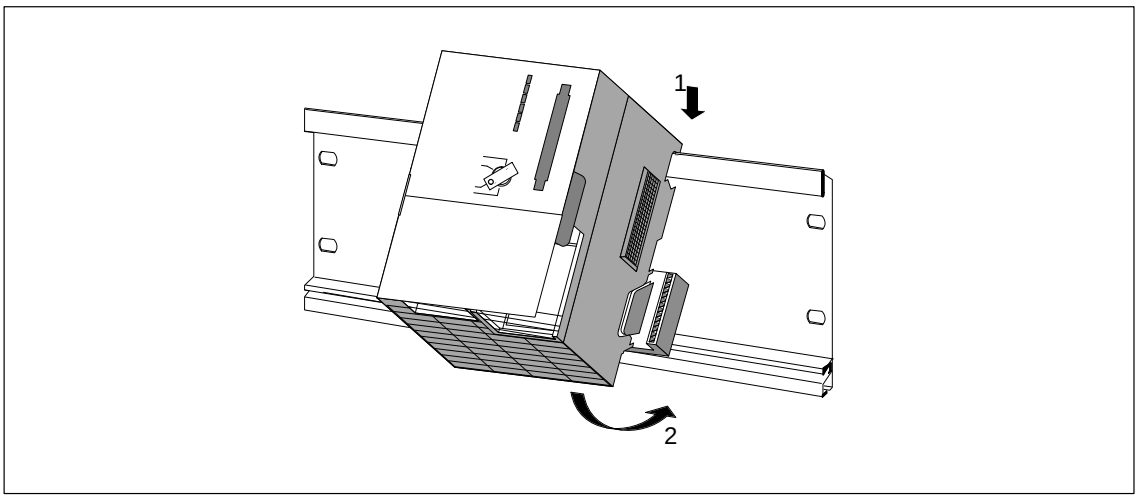


Figure 4-6 Fitting the FM 356 onto the DIN Rail and Swinging into Place

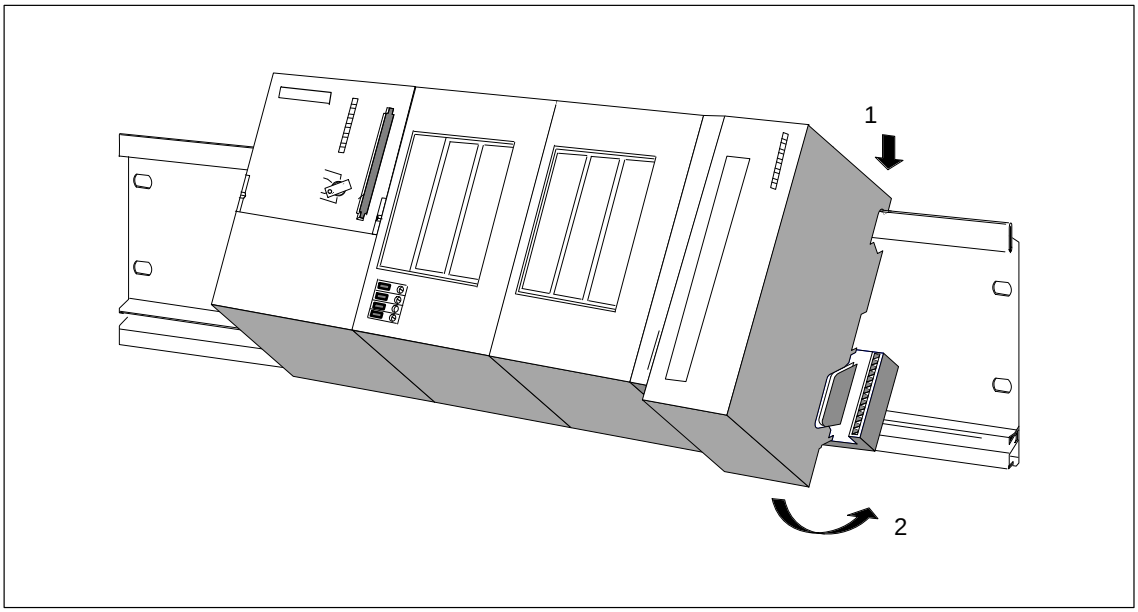


Figure 4-7 Fitting a Module Assembly Comprising FM Module and Expansion Modules onto the DIN Rail and Swinging into Place

Tightening the Module Fixing Screws

Tighten the module fixing screws to a torque of 80 to 110 Ncm.

Figure 4-8 shows how the module fixing screws are tightened.

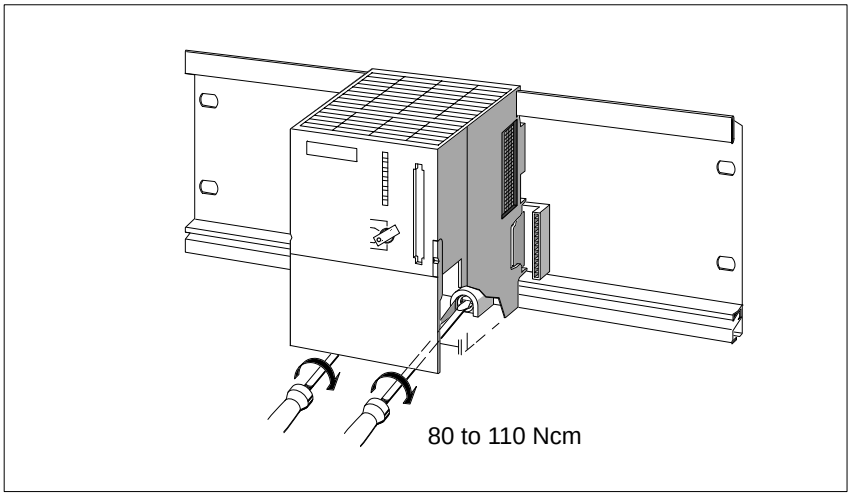


Figure 4-8 Tightening the Module Fixing Screws

Inserting the Key in the Operating Mode Switch

After fitting the FM 356 application function module to the DIN rail, you can insert the key into the operating mode switch (see Figure 4-9).

The key can be inserted in the STOP and RUN positions.

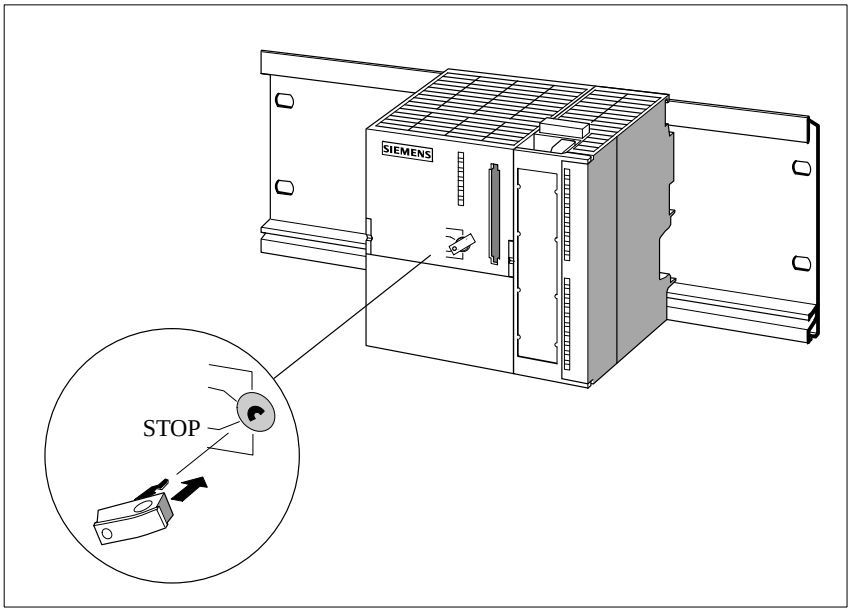


Figure 4-9 Inserting the Key in the Operating Mode Switch on the FM 356

4.7 Connecting the Modules to the Power Supply

Cables

Use flexible cables with a cross-section of 0.25 to 0.75 mm^2 for connecting the power supply.

If you only have one cable per connection, wire ferrules are not necessary.

Warning

The modules can become damaged.

If the modules are connected when the power is on, they may be damaged.

Only connect the modules to the power supply when the power is switched off.

Wiring

To connect the power supply module to an FM 356, EXM 378 or MSM 378 proceed as follows:

1. Open the front doors of the power supply unit and the FM 356.
2. Connect the supply cables from the power supply to M and L+ on the FM 356, EXM 378-2 and MSM 378.
3. Close the front doors.

Note

To prevent ground loops, do not connect the cable screens to the connections on the FM 356, EXM 378-2 and MSM 378.

Tightening Torque

Tighten the connection screws to a torque of 60 to 80 Ncm.

Supply Connections

The following illustrations show the position and significance of the supply connections on the FM 356, EXM 378-2 and MSM 378.

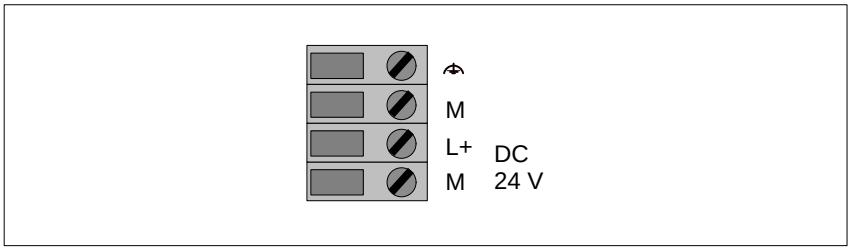


Figure 4-10 Supply Connections on the Application Function Modules and the Expansion Modules

Connection Diagram

The following illustration shows the connection diagram for an FM 356 with expansion modules.

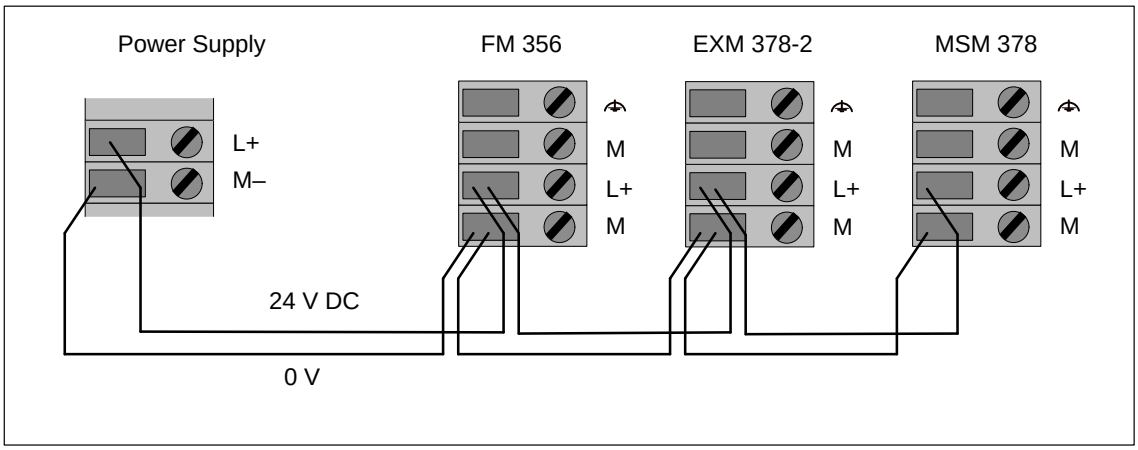


Figure 4-11 Connecting the Modules to the Power Supply

Note

Only safely isolated extra-low voltage power supplies may be used.

4.8 Wiring the Interface Module Front Connectors

The interface modules are equipped with Sub-D sockets or plugs. To connect equipment to the interface modules, cables must be configured with appropriate mating plugs or sockets.

The pin-outs of the Sub-D sockets or plugs can be found in the chapter entitled “Interface Modules”.

4.9 Fitting the Buffer Battery

Necessity for Buffer Battery

An FM 356 normally requires no buffer battery.

The fitting of a buffer battery may be necessary:

- To buffer the clock and
- To buffer an SRAM.

Note

You only need to fit a buffer battery if the clock settings have to be buffered as in an AT-compatible PC or if an SRAM has to be buffered.

Fitting the Buffer Battery

To fit a buffer battery to an FM 356, proceed as follows:

1. Open the front door of the FM 356.
2. Push the battery plug into the appropriate socket in the battery compartment of the FM 356. The notch on the battery plug must point to the left.
3. Place the buffer battery in the FM 356 battery compartment.
4. Close the front door of the FM 356.

How It's Done

Figure 4-12 shows how to fit a buffer battery in an FM 356.

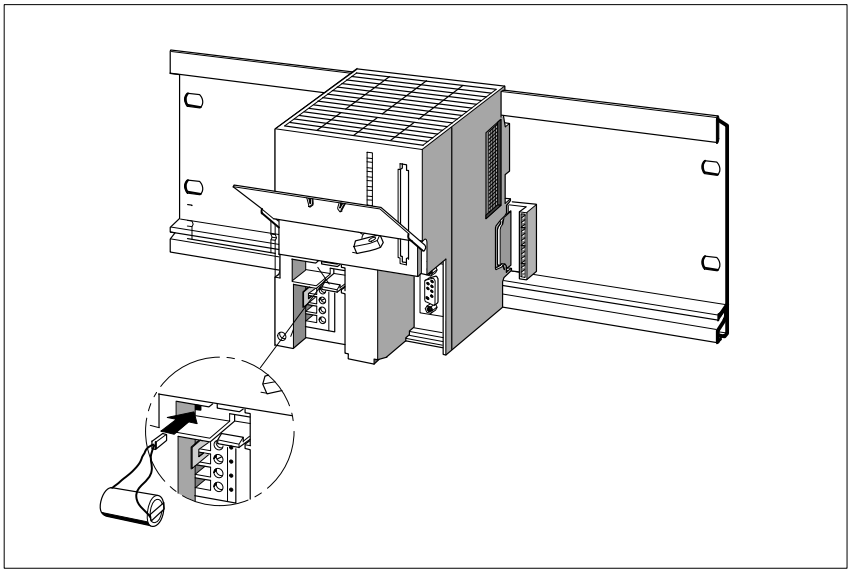


Figure 4-12 Fitting a Buffer Battery in an FM 356

4.10 Inserting/Removing the Memory Card

Purpose of the Memory Card

By using a memory card you can

- Save the operating system, user program and data (in a similar manner as when using a diskette),
- Port the programs and data stored on the memory card to another system,
- Retain programs and data, as with the Onboard Silicon Disk, even with POWER OFF (FM 356-4 has no Onboard Silicon Disk).

Inserting/ Removing the Memory Card

Only insert or remove a memory card when it is not being accessed, that is the operating indicator “SD” on the FM 356 must be OFF.

Caution

Data may be lost when the memory card is inserted or removed.

If write access to the memory card occurs when the memory card is being inserted or removed, data consistency cannot be guaranteed.

If you are not certain whether write access to the memory card is still possible, then remove it only when the power is off.

The switching off of modules during access to the memory card should be avoided as far as possible.

Figure 4-13 shows how to insert a memory card into an FM 356.

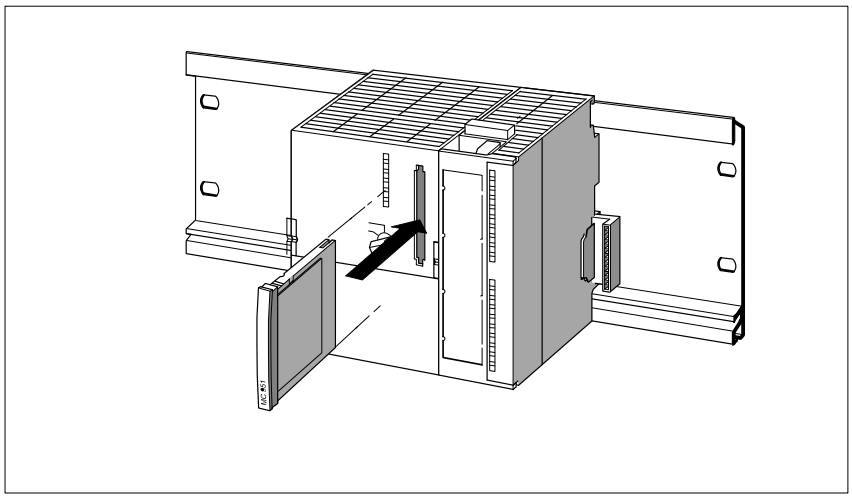


Figure 4-13 Inserting a Memory Card into an FM 356

4.11 Connecting the Operator Equipment and Peripherals

Introduction

Which operator equipment and peripherals can be connected to your FM 356 depends on how your FM 356 is configured.

For commissioning purposes, you need either a PG or a PC (see Section 4.12) or the FM 356 configuration with monitor, keyboard and bulk storage module.

You will find comprehensive information about all the connection options of an FM 356 in the appropriate sections of the technical data.

For reasons of immunity of the complete system against interference, we recommend the peripherals are connected using the standard plug cables available from Siemens.

Note

If the monitor cable and connecting cables between an FM 356 and keyboard, printer etc. are laid parallel to power cables, this can lead to interference in the monitor display and faults in the S7-300 system.

Monitor cables and connecting cables between an FM 356 and keyboard, printer etc. must not be laid parallel to power cables!

If necessary, provide a separate cable channel with a minimum spacing of 50 cm (19.7 inches) from power cables.

Connecting a Keyboard

Connect the keyboard to the 6-pin mini-DIN round socket on the IF 962-VGA interface module.

Connecting a Mouse

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

Connecting a Local VGA Monitor

To drive a local VGA monitor, connect it to the 15-pin high density sub-D socket on the IF 962-VGA interface module.

Notes on Installation of Monitors

Please observe the following points when installing monitors:

- When installing a number of monitors, ensure that there is a gap of at least 15 cm (6 inches) between two monitors operating in asynchronous mode, otherwise picture interference may occur.

  Exception: monitors with mu-metal screening.

- Ensure that there is sufficient space between the monitor and external magnetic sources.
- Do not place the monitors in steel racking or on steel tables. The magnetization of the surrounding steel sheet may lead to incorrect colors or picture displacement.
- Do not install monitors near transformers, radio communication equipment, loudspeaker magnets and power cables.
- The influence of external magnetic fields can be reduced by using a mu-metal screen.

Special Rules for the Use of Monitors in Offices

Please observe the following points when installing monitors in offices:

- Office monitors with internally metallized plastic housings must not be used in environments with EMC requirements, as the internal metal surface cannot be retrospectively connected to the external ground bar. The isolation between the electronic ground and the housing of monitors, which is essential in environments with EMC requirements, is not possible with most office monitors.
- This type of monitor can only be used with standard VGA cables up to a length of 2.5 m (8 ft. 2in.).

Connecting a Printer

Printers can be connected to a serial or parallel interface.

- Connect a printer with a parallel interface to the IF 962-LPT interface module using the appropriate connector cable (see ordering information).
- Connect a printer with a serial interface to a COM interface using the appropriate connector cable (see ordering information).

We recommend the use of Siemens printers.

Note

Only connecting cables with a screen grounded at both ends may be used to connect an M7-300 component to a printer.

Maximum Cable Lengths

The following table shows the maximum lengths of connecting cable for the individual units. The requirement in this respect is an interference-free hardware configuration.

Table 4-1 Maximum Lengths of Cable for Operator Equipment and Peripherals

Unit	Maximum Length
Keyboard	2.5 m (8 ft. 2 in.)
Monitor (connected using VGA cable)	2.5 m (8 ft. 2 in.)
Parallel interface for example: printer	3 m (9 ft. 10 in.)
RS232 interface for example: terminal, printer	10 m (32 ft. 9 in.)

4.12 Connecting a Programming Device or PC

Introduction

If you operate your FM 356 without monitor, keyboard and bulk storage, you need a PG or a PC to install the software. You can find out how to install this software from the appropriate Manuals, for example “M7-SYS”.

Connecting an FM 356 to the PG or to a PC

Connect the 9-pin Sub-D connector of the COM1 port on your FM 356 to the connector of a free COM port on your PG/PC. The following methods of connection may be used:

- Connection using control lines
- Connection without control lines

Connection using Control Lines

If the interface control lines are used for data traffic via the COM port, you will need a “null modem” connector cable. This depends on the programs that control data traffic on the FM and the PG/PC.

This can be necessary, for instance, if you redirect the terminal device in the “autoexec.bat” file of your FM 356 (for example, function testing during commissioning):

```
:
CTTY COM1
:
```

If the free COM port on your PG/PC has a 9-pin Sub-D connector, you can configure the “null modem” connector cable as shown in the following Table 4-2 (see Ordering Information in Chapter 9).

This cable can also be ordered ready made (see V.24 cable in Chapter 9, Ordering Information).

Table 4-2 “Null-modem” Connector Cable for Connecting FM 356 to the COM Port of a PG/PC using a 9-Pin Sub-D Connector

Signal	Pin	Connection	Pin	Signal
E1 / GND	U	Connected to	U	E1 / GND
M5 / DCD	1	_	1	
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
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 socket (COM1 / FM 356)		Pin “U” = housing (screen) Length: maximum 10 m (32′ 9″)		9-pin Sub-D socket (COMx on PG/PC)

If the free COM port on your PG/PC has a 25-pin Sub-D connector, you can configure the “null modem” connector cable as shown in the following Table 4-3.

Table 4-3 “Null-modem”Connector Cable for Connecting FM 356 to the COM Port of a PG/PC using a 25-Pin Sub-D Connector

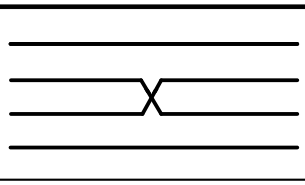
Signal	Pin	Connection	Pin	Signal
E1 / GND	U	Connected to	U	E1 / GND
M5 / DCD	1	_		
D2 / RxD	2	Connected to	2	D1 / TxD
D1 / TxD	3	Connected to	3	D2 / RxD
S1 / DTR	4	Connected to	6	M1 / DSR
E2 / GND	5	Connected to	7	E2 / GND
M1 / DSR	6	Connected to	20	S1 / DTR
S2 / RTS	7	Connected to	5	M5 / CTS
M2 / CTS	8	Connected to	4	S2 / RTS
M3 / RI	9	_	22	M3 / RI
9-pin Sub-D socket (COM1 / FM 356)		Pin “U” = housing (screen) Length: maximum 10 m (32′ 9″)		25-pin Sub-D plug (COMx on PG/PC)

Connection Without Control Lines

If the data traffic via the COM port is controlled exclusively via the data lines (depends on the interface software), a connector cable as described below is sufficient to connect your FM 356 to a PG/PC.

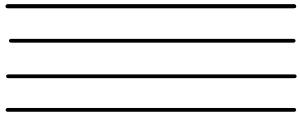
If the free COM port on your PG/PC has a 9-pin Sub-D connector, you can configure the connector cable as shown in the following Table 4-4.

Table 4-4 Configuration of Connector Cable for Connecting FM 356 to the COM Port of a PG/PC with 9-Pin Sub-D 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 socket (COM1 / FM 356)		Pin “U” = housing (screen) Length: maximum 10 m (32′ 9″)		9-pin Sub-D socket (COMx on PG/PC)

If the free COM port on your PG/PC has a 25-pin Sub-D connector, you can configure the connector cable as shown in the following Table 4-5.

Table 4-5 Configuration of Connector Cable for Connecting FM 356 to the COM Port of a PG/PC with 25-Pin Sub-D 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 socket (COM1 / FM 356)		Pin “U” = housing (screen) Length: maximum 10 m (32′ 9″)		25-pin Sub-D plug (COMx on PG/PC)

4.13 Startup

First Switch-On of the FM 356-4

Operating mode switch is in the “STOP” position when switching on:

1. All status and fault indicators light up briefly.
2. The “STOP” indicator remains on.
3. The system is booted if the system software is installed.
4. The system remains in the “STOP” condition.

Operating mode switch is in the “RUN” position when switching on:

1. All status and fault indicators light up briefly.
2. The “STOP” indicator remains on.
3. The system is booted if the system software is installed.
4. The system switches the “RUN” indicator on.

If this does not happen with your module, contact you local Siemens Service Center or the SIMATIC Hotline.

The preparation for operation is now completed within the scope of this Manual.

You will find the further startup steps, for instance installation of the operating system, in the “M7-SYS” Manual .

Replacing the Buffer Battery and Modules 5

In this Chapter

5.1 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 S7/M7-300 modules.

Rules for	FM 356
Width of screwdriver blade	3.5 mm (5/32″)(cylindrical form)
Tightening torque: Fixing modules to DIN rail Connecting cables	 80 to 110 Ncm 60 to 80 Ncm
POWER OFF when replacing the FM 356	Yes
Operating mode of S7-300 when replacing the FM 356	STOP
Load supply OFF when replacing the FM 356	Yes

Initial Situation

The FM 356 to be changed, which may have expansion modules (EXM 378-2, EXM 378-3, MSM 378), is installed and wired. A new FM 356 with the same configuration is to be fitted.

Note

No modules in an S7/M7-300 system may be replaced while data transmission via the MPI interface of the S7/M7-300 CPU is in progress!

Pull out the plug on the MPI interface if you are not sure!

5.2 Replacing an Application Module or an Expansion Module in a Module Assembly

Removing Modules

To remove a module from a module assembly, proceed as follows:

1. Switch the CPU module and all application function modules in your S7/M7-300 system to STOP using the key switch.
2. Switch off the load supply to the FM 356 and expansion modules.
3. Open the front doors of the FM 356.
4. Disconnect the interface connections from the FM 356 and the expansion modules.
5. Remove the power supply cables from the FM 356 and the expansion modules.
6. Unscrew the fixing screws of all the modules in the module assembly. Figure 5-1 shows the position of the fixing screws on a module.
7. Swing the module assembly upwards and lift it off (Figure 5-2).
8. Place the module assembly on a flat surface (Figure 5-3).

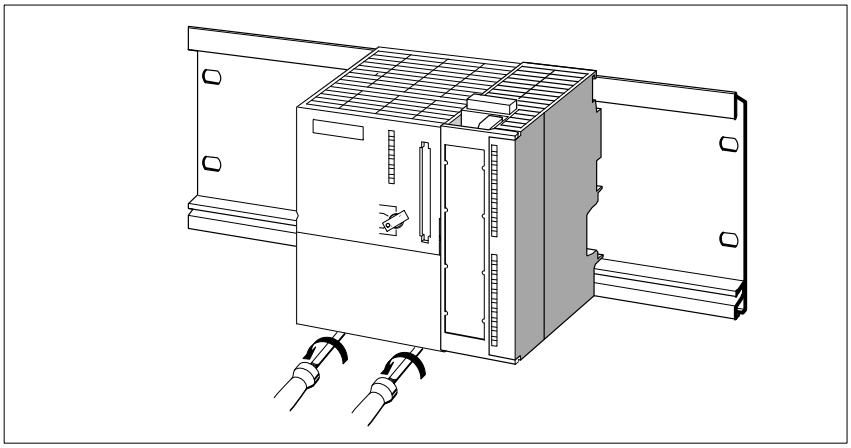


Figure 5-1 Removing the Module Fixing Screws

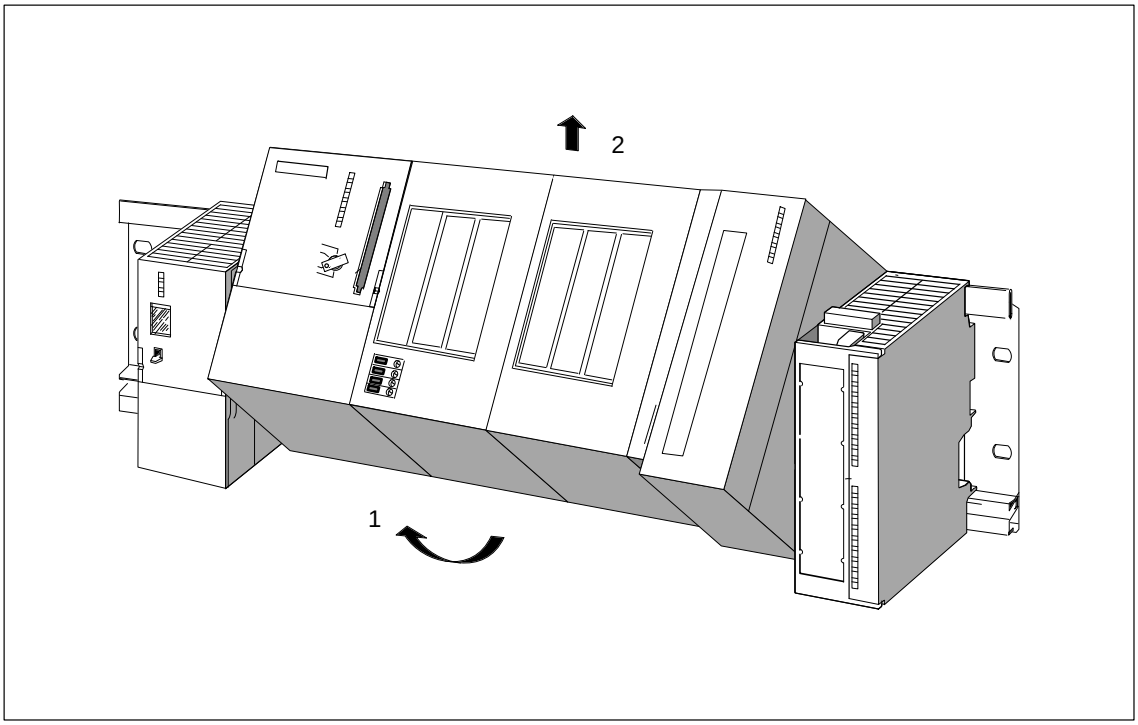


Figure 5-2 Swing the Module Assembly Containing the FM 356 and Expansion Modules Upwards and Lift Off

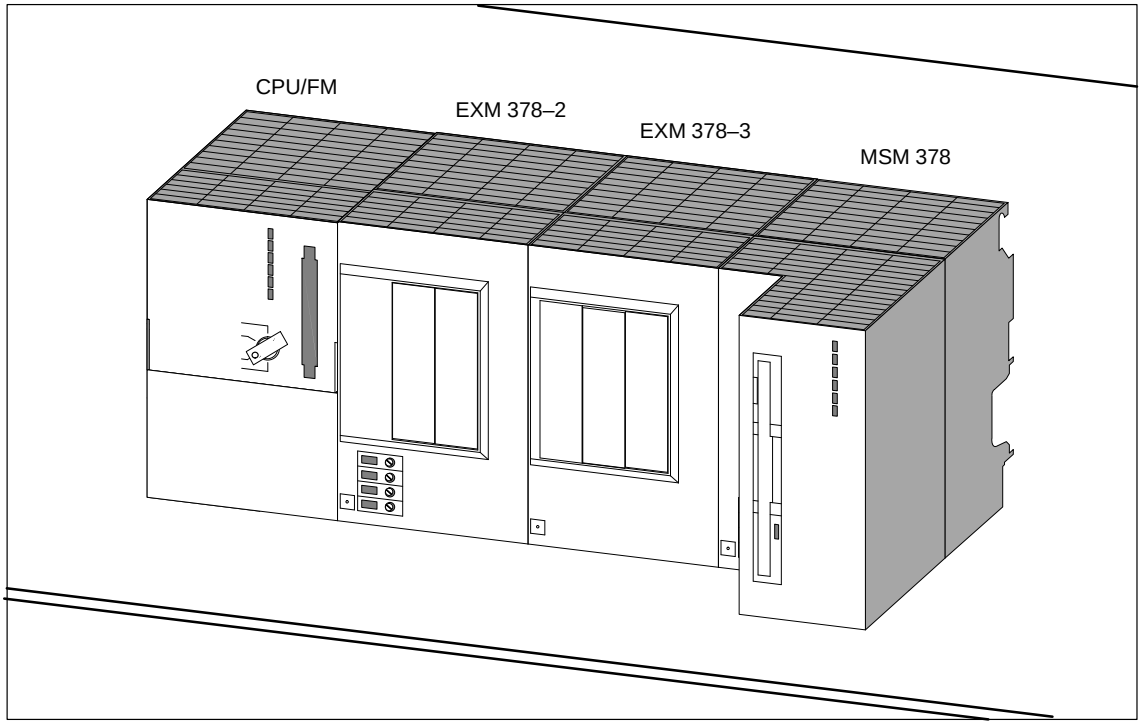


Figure 5-3 Place the Module Assembly on a Flat Surface

9. Remove the bus connectors between the module to be replaced and the adjoining modules. Figure 5-4 shows the position of a bus connector on the module.
10. Pull the adjoining modules carefully away from the module to be replaced, so that the ISA bus connector is disconnected (Figure 5-5).

Warning

The pins in the expansion unit plugs can become damaged.

The plug pins will be damaged if the modules are plugged together at an angle.

Keep the modules aligned when plugging them together.

11. If you wish to replace an EXM 378 expansion module, remove the interface modules as follows (see Figure 5-6):
    - Observe the EMC guidelines when handling the interface module (see Appendix).
    - Remove the two slotted screws that affix the front plate of the interface module to the left hand frame of the receptacle.
    - Grasp the interface module by the long side of the front plate and pull it carefully out of the guide rails in the module receptacle.

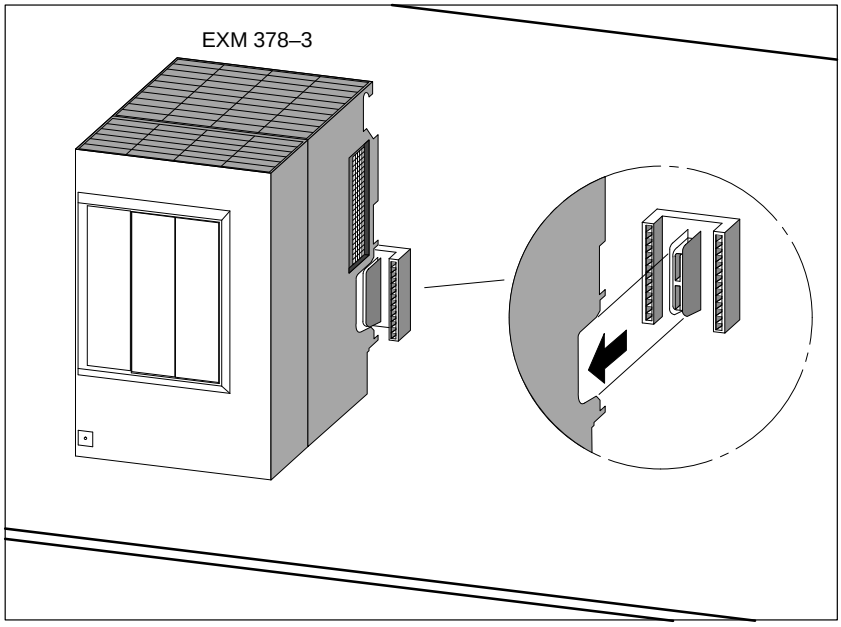


Figure 5-4 Position of a Bus Connector on the Module

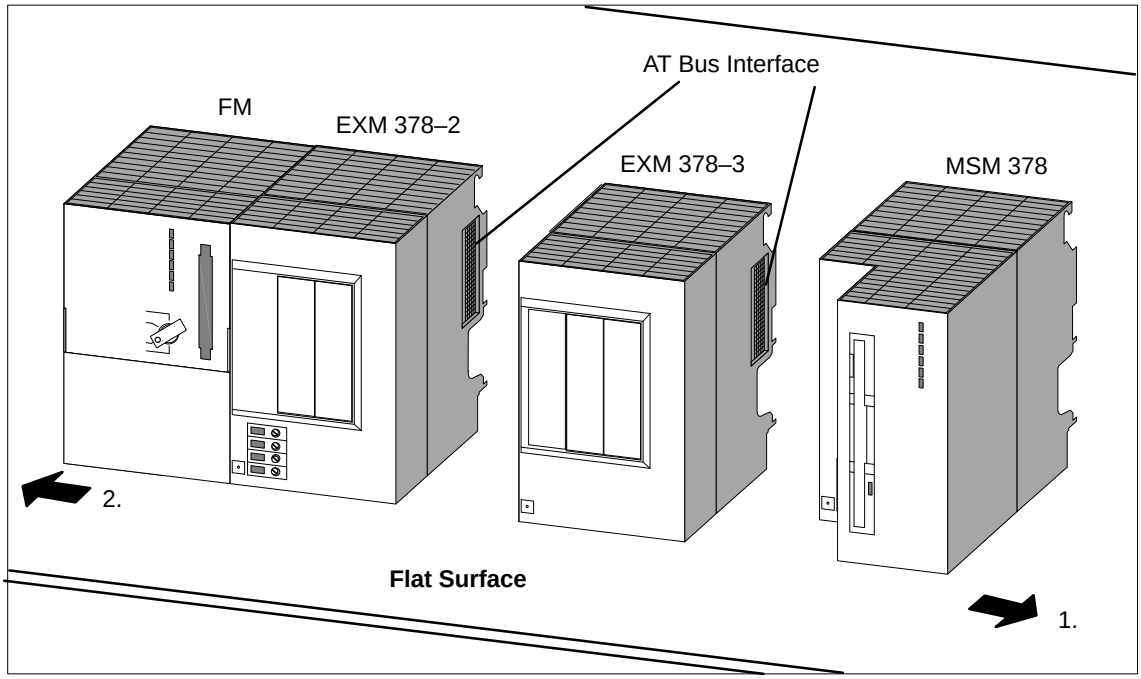


Figure 5-5 Separating a Module Assembly to Enable an EXM 378-3 Interface Module to be Replaced

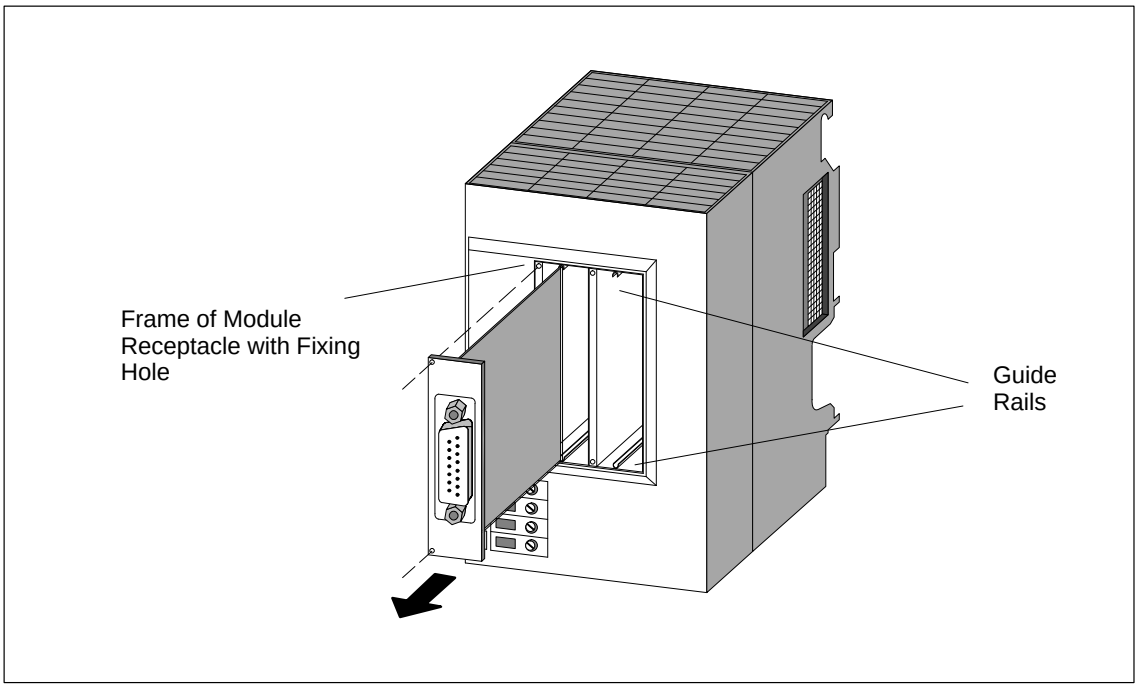


Figure 5-6 Pulling an Interface Module out of an Expansion Module

Installing and Commissioning Modules

Install and wire the new modules in the reverse order. You will find further information in Sections 4.4 “Fitting Expansion Modules to an FM 356”, 4.6 “Fitting the M7–300 Modules to the DIN Rail” and 4.7, “Connecting the Modules to the Power Supply”.

Warning

The interface modules and the connected equipment can become damaged.

The interface modules and the equipment connected to them may be destroyed if the modules are connected to the wrong front plugs.

Make sure the modules are connected to the correct front plugs.

Behavior of S7/M7-300 after Replacing Modules

If the operating mode switch is in the RUN position, the CPU module goes into RUN mode after replacing the modules if there is no fault. If the CPU module remains in the STOP state, the cause of the fault can be displayed using the STEP 7 tool “S7-Info” (see STEP 7 User Manual).

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 FM 356 is replaced, it may be necessary to change the settings in the BIOS setup to those of the FM 356 that has been replaced.

5.3 Replacing and Disposing of the Buffer Battery

Only Replace With POWER ON

The buffer battery must always be replaced with POWER ON. This avoids loss of data while the battery is being changed.

Note

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

Replacing the Buffer Battery in the FM 356

To replace the buffer battery, proceed as follows:

1. Open the front door of the FM 356.
2. Pull the buffer battery out of the battery compartment 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 of the FM 356. The notch on the battery plug must point to the left.
4. Place the new buffer battery in the FM 356 battery compartment.
5. Close the front door of the FM 356.

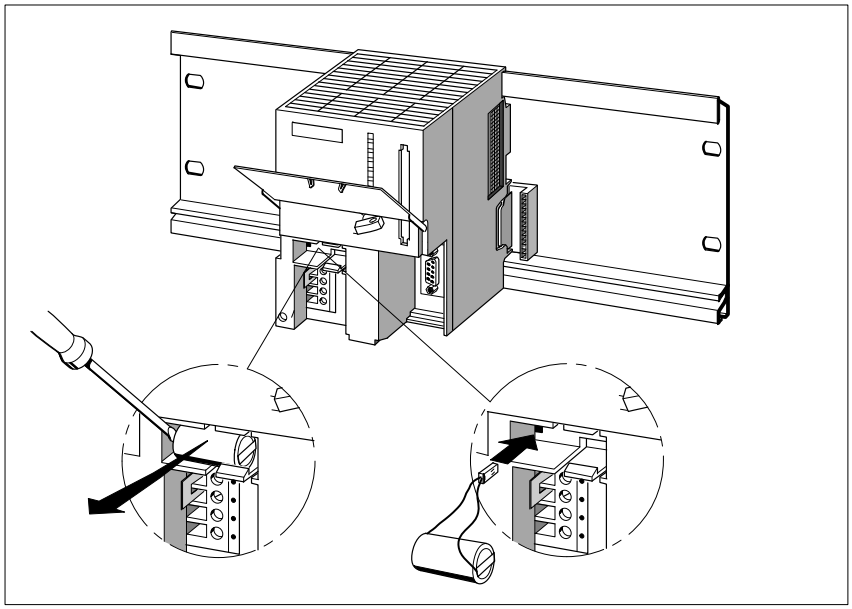


Figure 5-7 Replacing the Buffer Battery

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:

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

FM 356-4 Functions and Technical Data

6

In this Chapter

6.1 Overview of Hardware Elements

Introduction

This section provides you with information about the individual elements of the FM 356-4 application function module. You will need this information to be able to respond to displays, to commission and to use an FM 356-4 and to be able to handle other components (for example, memory cards, expansion modules).

You will also find information on time monitoring, the BIOS setup and the address and interrupt assignments.

There are two versions of the FM 356-4. A comparison of their features can be found in Section 6.11 “Technical Data”.

General View

The following illustration shows a general view of an FM 356-4 application function module without its protective flap. Operator controls and displays/indicators and other important operating elements are shown in their respective positions.

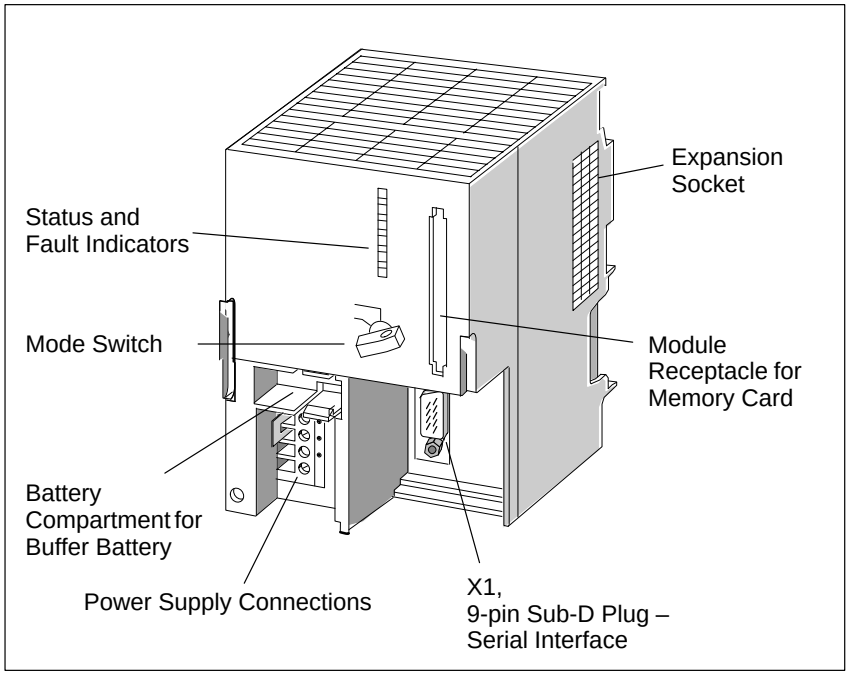


Figure 6-1 General View of FM 356-4 Application Function Module without Protective Flap

FM 356-4 Elements

The following table shows the function of the individual elements of an FM 356-4 application function module.

Table 6-1 Elements of the FM 356-4 Application Function Module

Element	Function
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.
Mode switch	The mode selector is in the form of a key switch. More information can be found on Page 6-4.
Status and fault indicators	The status and fault indicators show the operating status of the FM 356-4. More information can be found on Page 6-6.
Expansion socket	Expansion units can be connected via the expansion socket. More information can be found on Page 6-12.
Module receptacle/ memory card	A full-size S7 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 6-13.
Connector X1 (9-pin Sub-D male connector)	The FM 356-4 application function module is equipped with a serial interface (COM1). More information about this can be found on Page 6-10.
Power supply connections	The operating voltage for the FM 356-4 is fed via the power supply connections. More information can be found on Page 6-8.

6.2 Mode Selector

Mode Selector

The mode selector on the FM 356-4 application function module is in the form of a key switch.

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

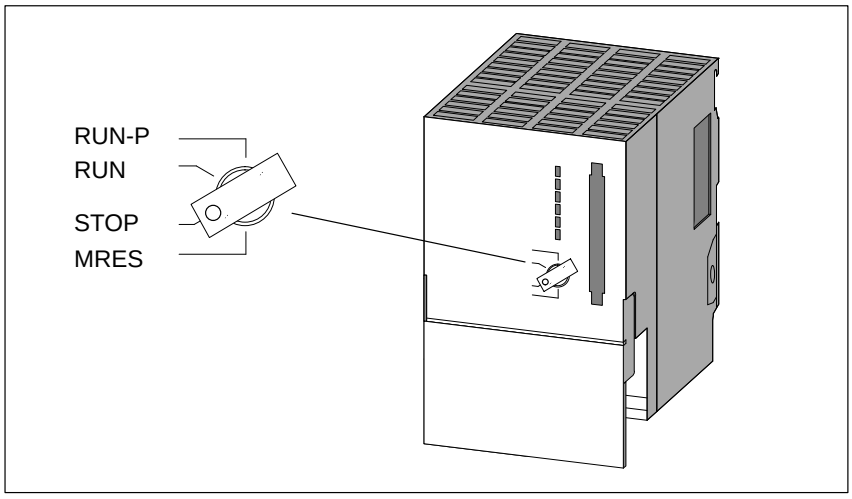


Figure 6-2 Mode Selector on the FM 356-4

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

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 goes out and lights up again after about 3 seconds.

3. Turn the mode selector back to the STOP position, to the MRES position again and back to the STOP position within 3 seconds of the STOP indicator lighting up.

   Result: The STOP indicator flashes for about 3 seconds at 2.5 Hz (fast flash) and then lights up again. The hardware reset has been completed.

4. If the STOP indicator does not flash or other indicators light or flash, steps 2 and 3 must be repeated; in the event of a fault, read the diagnosis buffer using the *S7 Information* Editor Tool program.

Note

The resetting of the module by activating MRES is controlled by the system software. If this has not been started, the FM 356-4 must be reset, if necessary, by switching the power on and off.

Mode Selector Positions

The positions of the mode selector are explained in Table 6-2 in the order in which they are arranged on the FM 356-4 application function module.

Table 6-2 Mode Selector Positions

Mode switch setting	Significance	Explanation
RUN-P	RUN-PROGRAM mode	The application function module processes the user program. The key cannot be removed when in this position.
RUN	RUN mode	The application function module processes the user program. The key can be removed in this position to prevent unauthorized change of mode.
STOP	STOP mode	The user program on the application function module 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	Reset	Spring-return position of the key switch for software-controlled reset of the application function module through a hardware reset.

6.3 Status and Fault Indicators

Status and Fault Indicators

The FM 356-4 application function module is provided with the following indicators:

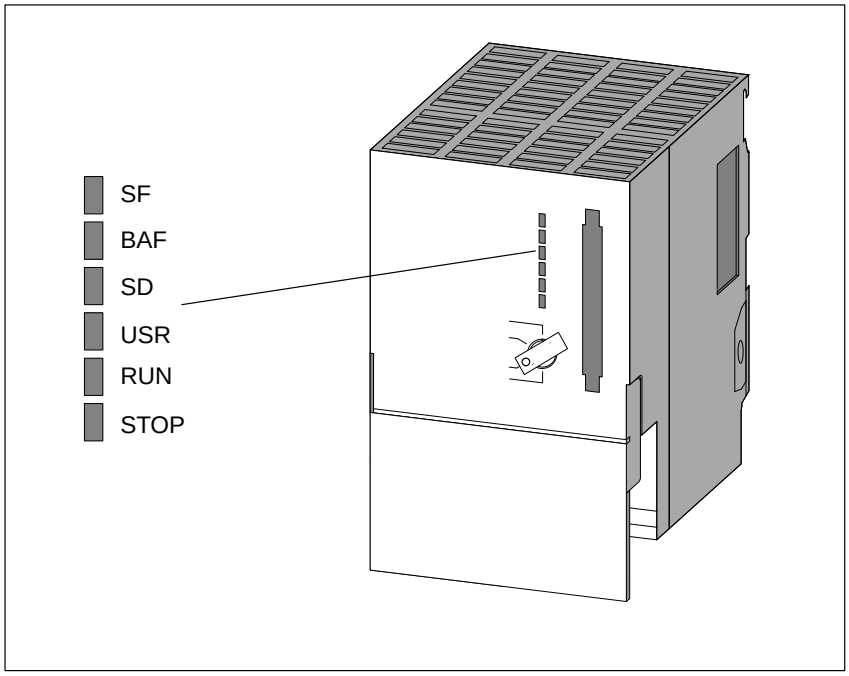


Figure 6-3 Status and Fault Indicators on the FM 356-4 Application Function Module

Meaning of Status and Fault Indicators

The status and fault indicators are explained in Table 6-3 in the order in which they are arranged on the FM 356-4 application function module. The following status and fault indicators are provided:

Table 6-3 Meaning of the Status and Fault Indicators on the FM 356-4 Application Function Module

Indicator	Meaning	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.
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	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 programmable module is not controlling the process (I/O access is disabled)
All indicators light briefly as a self-test following an MRES (see Page 6-4) or switching on of the power supply.		

6.4 Power Connections and Grounding Concept

Power Connections

The supply voltage for the FM 356-4 application function module is supplied via the power connections.

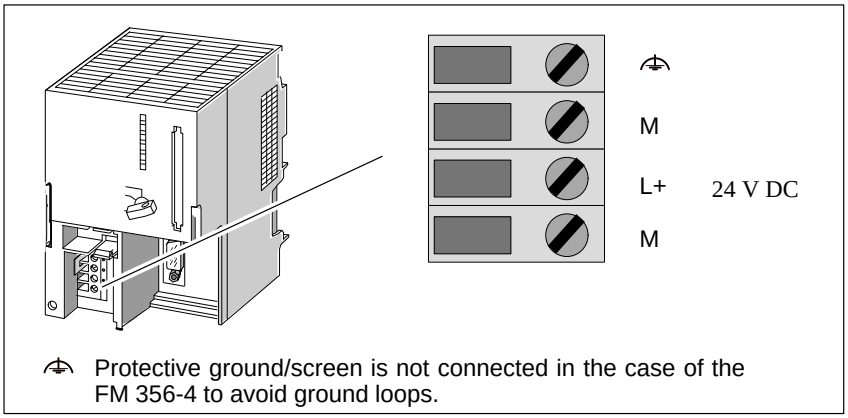


Figure 6-4 Supply Connections on the FM 356-4 Application Function Module

Note

Only safety isolated extra-low voltage power supplies may be used for the operating power supply.

Grounding Concept

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

The programmable modules have an internal power supply that provides the necessary voltages. Depending on the version, these voltages are floating or non-floating with respect to the power input (+24 V):

- The internal supply voltages are floating (V_{int}) or non-floating, depending on the version.

Due to the requirements of the internal power supply, the programmable modules have two grounds:

- Internal ground (signal GND, GND_{int})
- External ground (external GND, GND_{ext})

The following diagram shows the grounding concept for the FM 356-4 application function module.

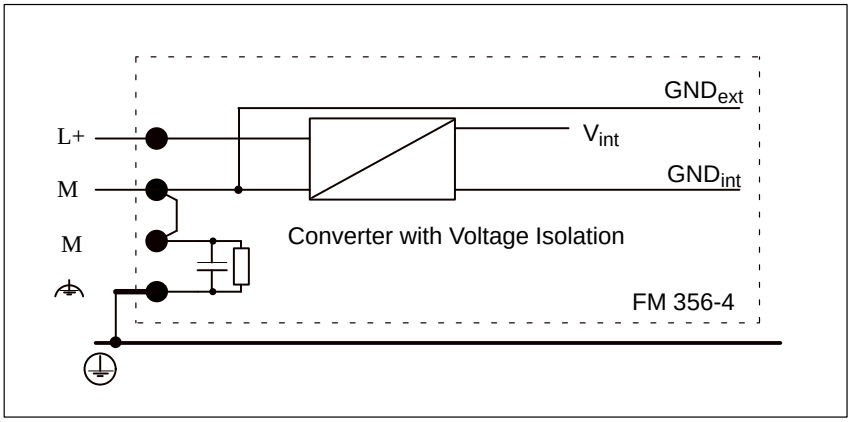


Figure 6-5 Grounding Concept for the FM 356-4 Application Function Module

6.5 Serial Interface

Introduction

This section provides you with information about the serial interface on the FM 356-4 application function module 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 6-6). The pin-outs are shown in Table 6-4.

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

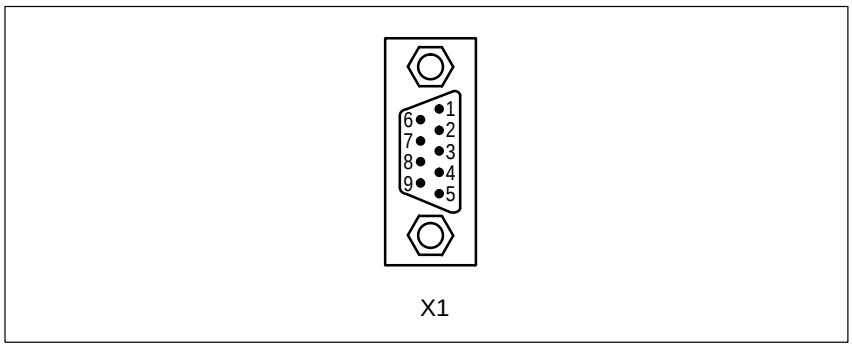


Figure 6-6 9-Pin Sub-D Connector for Connecting the X1 Interface (COM1)

Table 6-4 Pin-Outs for COM1 Interface

Pin	Signal	Meaning	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 6.4).

If necessary, precautions should be taken on the plant side to prevent ground loops.

6

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.

6.6 Expansion Socket

Introduction

The FM 356-4 application function module is provided with an expansion socket. This section tells you which expansion modules you can connect to this socket.

Which Expansion Modules Can Be Connected?

An EXM 378-2 expansion module with a maximum of two interface modules or a bulk storage module with diskette drive and hard disk can be connected directly to the application function module.

A total of three expansion modules (EXM 378-2, EXM 378-3 for max. 3 interface modules, MSM 378 bulk storage module) can be plugged one after another onto the application function module.

6.7 Time Monitoring (Watchdog)

Introduction

The FM 356-4 application function module contains a watchdog for monitoring user programs. This is called on a cyclic basis by the system software. If the cyclic operation fails (for instance, if the software “hangs”), the module is reset after the watchdog period has expired.

6.8 Memory Cards

Introduction

The FM 356-4 application function modules provide a facility to use memory cards in the same way as a diskette. 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 FM 356-4 application function module (see ordering information).

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 6.9.9, Page 6-28).

Boot Sequence

The boot sequence can be set in the BIOS setup (Section 6.9.10, Page 6-30).

Formatting

The memory card must also be formatted in the same way as a conventional drive. Use the “FTLFORM.exe” formatting program for this purpose. You can format a memory card in a PG or an FM 356-4 that has a bulk storage module (MSM 378). 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.

6.9 BIOS Setup

Overview

Setup performs the configuring of the FM 356-4 application function module. 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 application function module (expansion module with interface modules, bulk 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 FM 356-4 application function module is equipped with an expansion module including interface modules and peripherals such as a monitor and keyboard.
- With a terminal program (for instance, Windows terminal.exe) on a PG/PC or an ANSI terminal; in this case you can use the “remote setup” via the COM1 interface after first activating it by pressing the “Q” key during power up.

6.9.1 BIOS Power Up

Power up without Fault Messages

After switch-on or cold starting the application function module, 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.

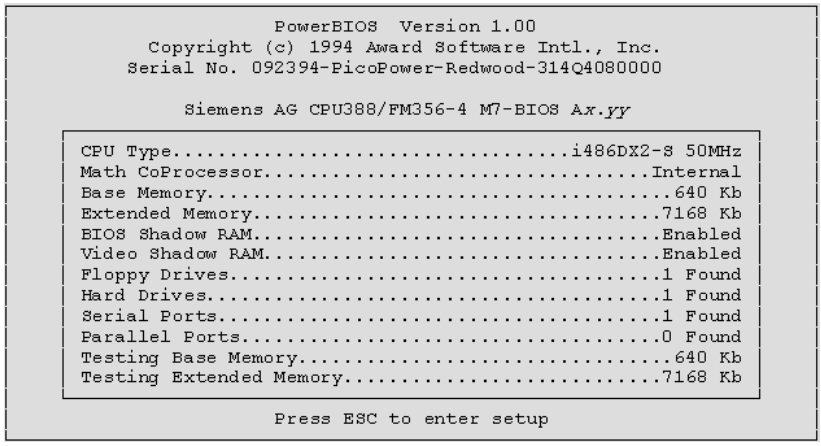


Figure 6-7 POST Window

If a fault occurs, the SF LED also comes on.

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.

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.

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 application function module 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 application function module in this case.

Warm Start

The following window appears after a warm start of the application function module. This indicates an accelerated system power up (see “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 6-8 Warm Start Window

6.9.2 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 6-5 BIOS Hotkeys with German and English Keyboard Layouts

English keyboard	**German keyboard**	Function
CTRL + Alt + DEL	STRG + Alt + ENTF	Module warm start
CTRL + Alt + INS	STRG + Alt + EINFG	Module restart (same as warm start at present)
CTRL + Alt + HOME	STRG + Alt + POS1	Module cold start
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).

6.9.3 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

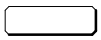
The following keys are used for control purposes within the setup menu and the associated setup pages (conforms to Windows™ standard):

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.



The space bar enables you to confirm the selection of highlighted lines and select check boxes.

You can tell whether a check box or radio button is selected as follows:

Check box deselected	[ ]
Check box selected	[✓]
Radio button deselected	( )
Radio button selected	(⁎)

6.9.4 Starting and Exiting the BIOS Setup

Starting using a Key Combination

To start the BIOS setup, press the following key combination as the application function module powers up:
CTRL + Alt + ESC or CTRL + Alt + ESC with German keyboard, or only ESC in the case of remote setup.

The setup menu then appears (Figure 6-9).

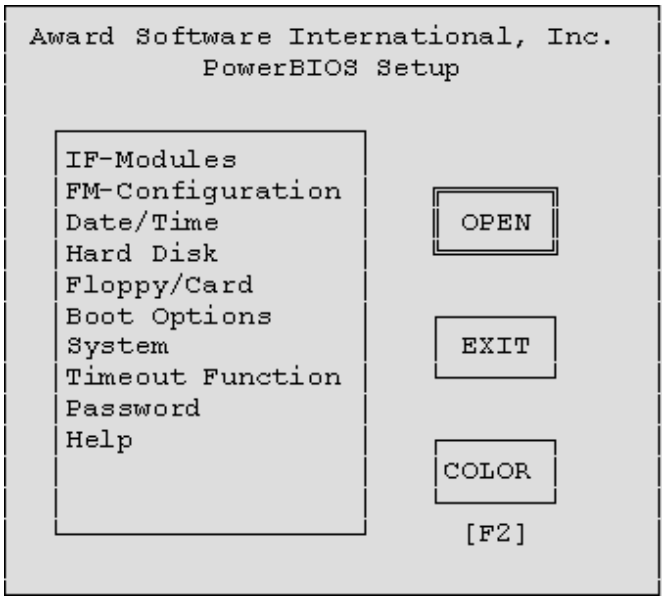


Figure 6-9 Setup Menu

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 6-9 or press ESC. The “Setup Exit” dialog box appears (see Figure 6-10).

Figure 6-10 “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.

6.9.5 “IF Modules” Setup Page

Opening the Setup Page

If you have selected “IF modules” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, the following setup page will appear on the screen (Figure 6-11).

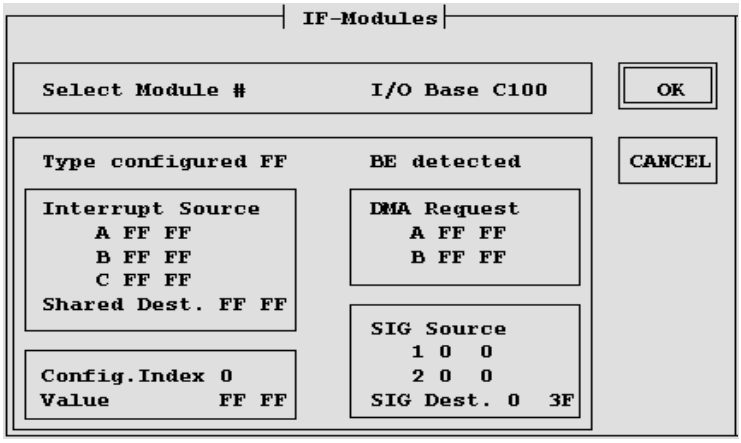


Figure 6-11 “IF Modules” Setup Page

What Does this Setup Page Do?

If you have added expansion modules to your application function module, this setup page enables you to configure the interface modules they contain.

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.

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 7 “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 KEIN MERKER “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 FM). These cannot be edited.

Shared Dest.

Used to set a shared interrupt for the interface module (see Chapter 8 “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 FM). This cannot be edited.

DMA Request

Enter the DMA requests A and B for the interface module here (see Chapter 8 “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 FM). 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 8 “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 8 "Interface Modules" in the table "Mode Bits in the Configuration Register" for the relevant interface module.

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 FM). 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 8 "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 FM).

SIG Dest.

Enter the signal destination, assuming the corresponding interface module is configured accordingly (Chapter 8 "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 FM). 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.

6.9.6 “FM Configuration” Setup Page

Opening the Setup Page

If you have selected “FM configuration” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this setup page will be displayed on the screen (Figure 6-12).

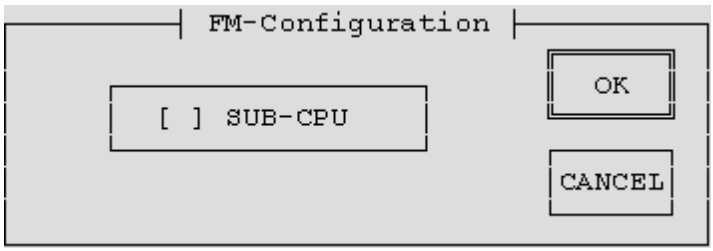


Figure 6-12 “FM Configuration” Setup Page

What Does this Setup Page Do?

This setup page is intended for future expansion modules.

SUB CPU

The “SUB-CPU” check box must not be selected at the moment.

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.

6.9.7 “Date/Time” Setup Page

Opening the Setup Page

If you have selected “Date/Time” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-13).

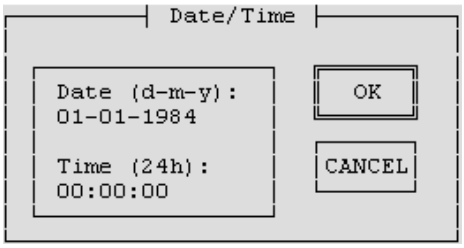


Figure 6-13 “Date/Time” Setup Page

What Does this Setup Page Do?

The date and time for the application function module is set on this page.

Date

Enter the date in this edit box in the format d–m–y (day, month, year).

Time

Enter the time in this edit box in the format h:m:s (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.

6.9.8 “Hard Disk” Setup Page

Opening the Setup Page

If you have selected “Hard Disk” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-14).

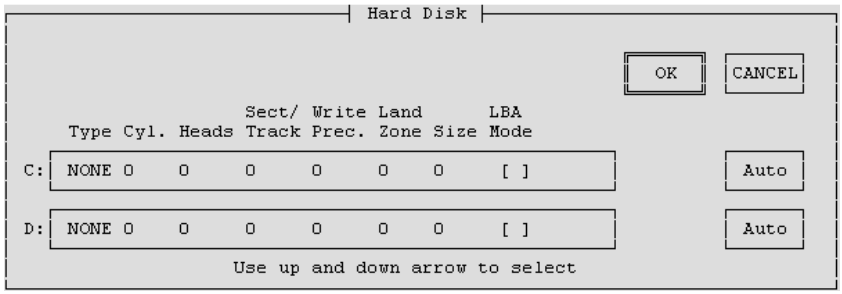


Figure 6-14 “Hard Disk” Setup Page

What Does this Setup Page Do?

This setup page is used to transfer the parameters of the hard disk in the bulk 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
  No hard disk drive is fitted.

Standard entry for *Hard Disk C*: Depends on the hard disk drive when BIOS setup calls “Hard Drives” (Figure 6-7 on Page 6-15) for the first time after the POST, 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 528 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.

Note

LBA mode is not supported at present, therefore only standard mode can be used (do not switch LBA mode on).

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.

6.9.9 “Floppy/Card” Setup Page

Opening the Setup Page

If you have selected “Floppy/Card” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-15).

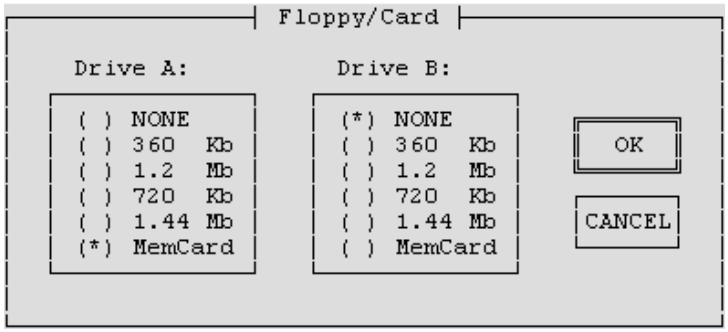


Figure 6-15 Setup-Page ”Floppy/Card”

What Does this Setup Page Do?

This setup page enables you to enter the diskette drive in your bulk storage module and the memory card “drive” in your application function module.

Drive A

The diskette drive in the MSM378 bulk storage module or the memory card “drive” in the application function module can be specified as drive A. If a diskette drive is installed, this must always be specified as drive A.

- Select the “1.44 Mb” radio button if you want to specify the diskette drive of the bulk storage module.
- Select the “MemCard” radio button if there is no diskette drive fitted and you want to specify the memory card “drive” of the application function module.
- If you do not want to specify any A drive, select the “NONE” radio button.

The other options for drive A have no significance at present.

Drive B

Drive B is used to designate the memory card “drive” in the application function module 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.

6.9.10 “Boot Options” Setup Page

Opening the Setup Page

If you have selected “Boot Options” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-16).

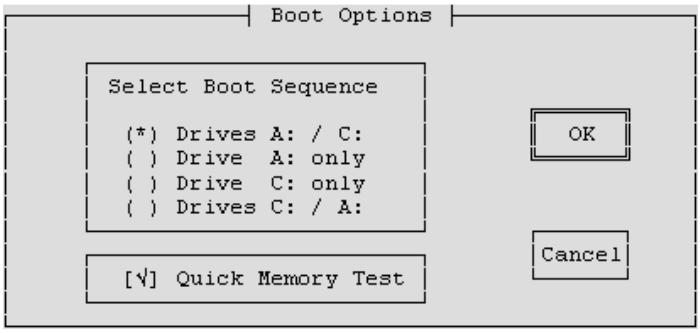


Figure 6-16 “Boot Options” Setup-Page

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 application function module 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.

6.9.11 “System” Setup Page

Opening the Setup Page If you have selected “System” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-17).

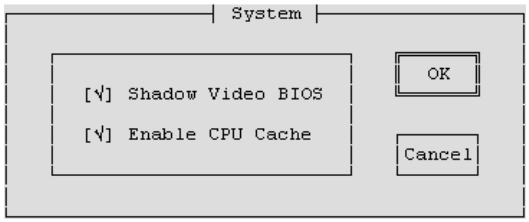


Figure 6-17 “System” Setup Page

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.

6.9.12 “Timeout Function” Setup Page

Opening the Setup Page

If you have selected “Timeout Function” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-18).

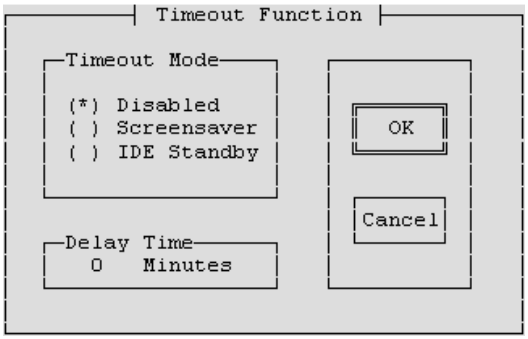


Figure 6-18 “Timeout Function” Setup Page

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.

6.9.13 “Password” Setup Page

Opening the Setup Page

If you have selected “Password” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-19).

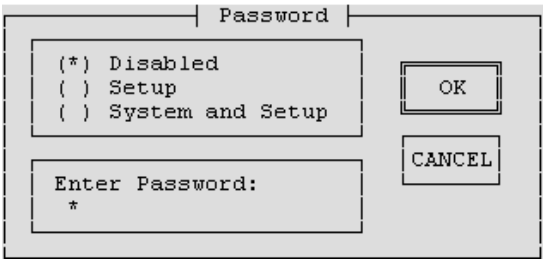


Figure 6-19 “Password” Setup Page

What Does this Setup Page Do?

You can activate or deactivate password protection for the setup and/or the booting of the application function module 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 application function module.

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?(* .

Caution

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.

6.9.14 “Help” Setup Page

Opening the Setup Page

If you have selected “Help” in the setup menu (Figure 6-9 on Page 6-20) and chosen the OPEN button, this page will appear on the screen (Figure 6-20).

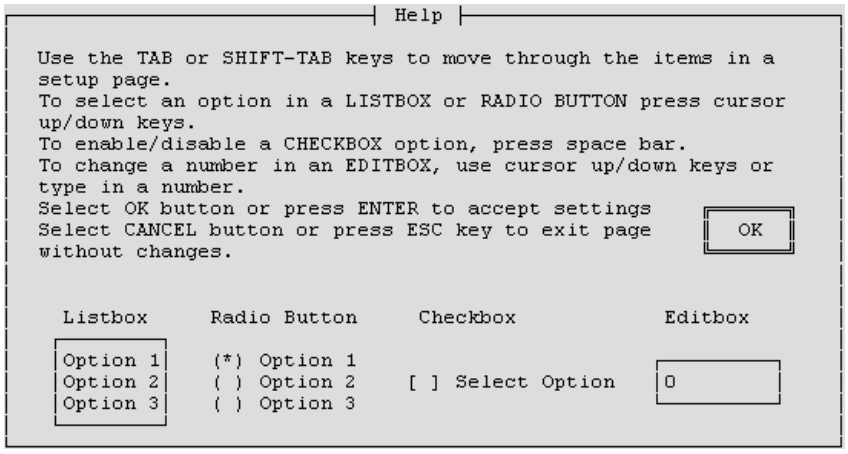


Figure 6-20 ”Help” Setup Page

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.

6.10 Address and Interrupt Assignments

Introduction

This section contains detailed information in tabular form about I/O address area mapping and the interrupt assignments in the FM 356-4 application function module.

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 $03FF_H$.

Interrupt Assignment

Table 6-6 provides an overview of the interrupt assignments.

Table 6-6 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 COM3
IRQ6	Free – reserved for diskette drive
IRQ7	Free – reserved for LPT1
IRQ8	Real time clock
IRQ9	Free
IRQ10	Free
IRQ11	Free
IRQ12	Free
IRQ13	Free – reserved for math co-processor
IRQ14	Free – reserved for hard disk
IRQ15	System interrupt

6.11 Technical Data

Features and Technical Data of the FM 356-4

The following table contains the technical details of the FM 356-4 application function modules.

Note

The “General technical data” of the S7-300 and M7-300 programmable logic controllers applies (see Manuals /1/ and /4/), unless otherwise specified in this section.

Only a safety isolated extra low voltage power supply may be used as the operating supply.

6ES7 356-3BN00-0AE0	
Features	
Processor	80486DX2-50
Main memory	8 Mbyte
COM1 interface 16550-compatible	RS232
Option for connection of expansion modules via AT bus	Yes
Technical Data	
Current consumption from backplane bus	80 mA
Supply voltage	24 V DC
Current consumption from 24 V supply	0.4 A
Inrush current	5.5 A
I^2t	0.1 A^2s
Power loss	9.6 W
Buffer time with buffer battery	Min. 1 year at 25 °C (77 °F) and uninterrupted buffering
Service life of buffer battery	Approx. 5 years
Temperature	
• Vertical installation	0 °C to 40 °C (0 °F to 104 °F)
• Horizontal installation	0 °C to 60 °C (0 °F to 140 °F)
Dimensions W x H x D	80 mm x 125 mm x 130 mm (3.2″x 4.9″x 5.1″)
Weight	0.65 kg (1.43 lb.)

6ES7 356-4BM00-0AE0	
Features	
Processor	80486DX2-50
Main memory	4 Mbyte
COM1 interface 16550-compatible	RS232
Option for connection of expansion modules via AT bus	Yes
Technical Data	
Current consumption from backplane bus	80 mA
Supply voltage	24 V DC
Current consumption from 24 V supply	0.4 A
Inrush current	5.5 A
I^2t	0.1 A^2s
Power loss	9.6 W
Buffer time with buffer battery	Min. 1 year at 25 °C (77 °F) and uninterrupted buffering
Service life of buffer battery	Approx. 5 years
Temperature	
• Vertical installation	0 °C to 40 °C (0 °F to 104 °F)
• Horizontal installation	0 °C to 60 °C (0 °F to 140 °F)
Dimensions W x H x D	80 mm x 125 mm x 130 mm (3.2″x 4.9″x 5.1″)
Weight	0.65 kg (1.43 lb.)

M7-300 Expansion Modules

7

In this Chapter

7.1 Overview

Introduction

You can add expansion modules for interface modules and/or the bulk 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:

- 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 bulk storage module with hard disk and diskette drive

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 7-1).

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 bulk 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.

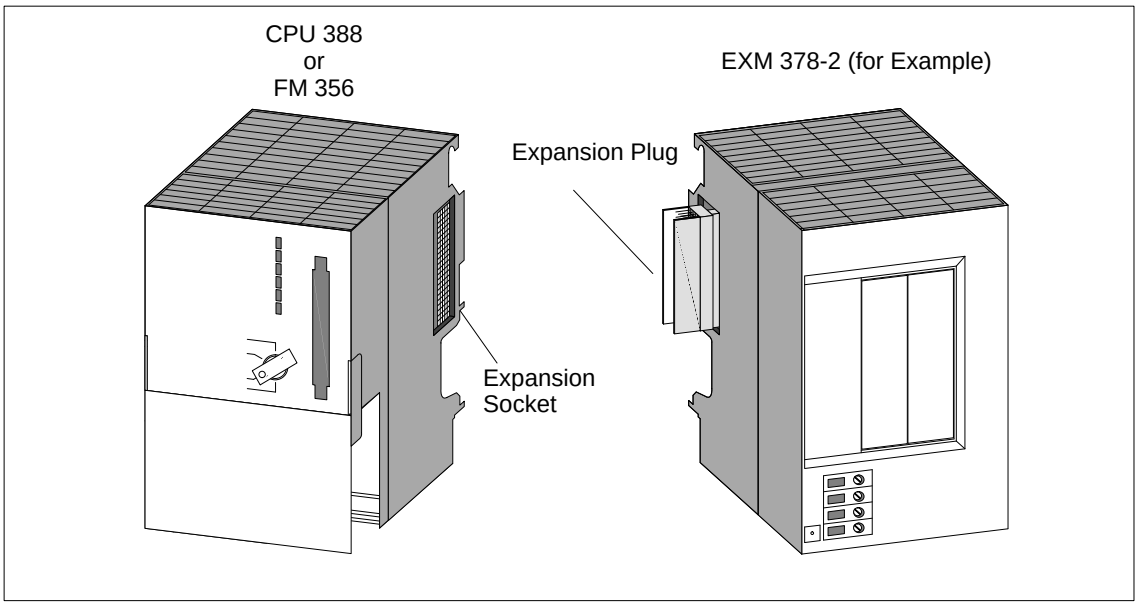


Figure 7-1 Positions of Expansion Socket and Plug

Maximum Configuration

Figure 7-2 shows the maximum configuration of expansion modules for a CPU 388 or FM 356.

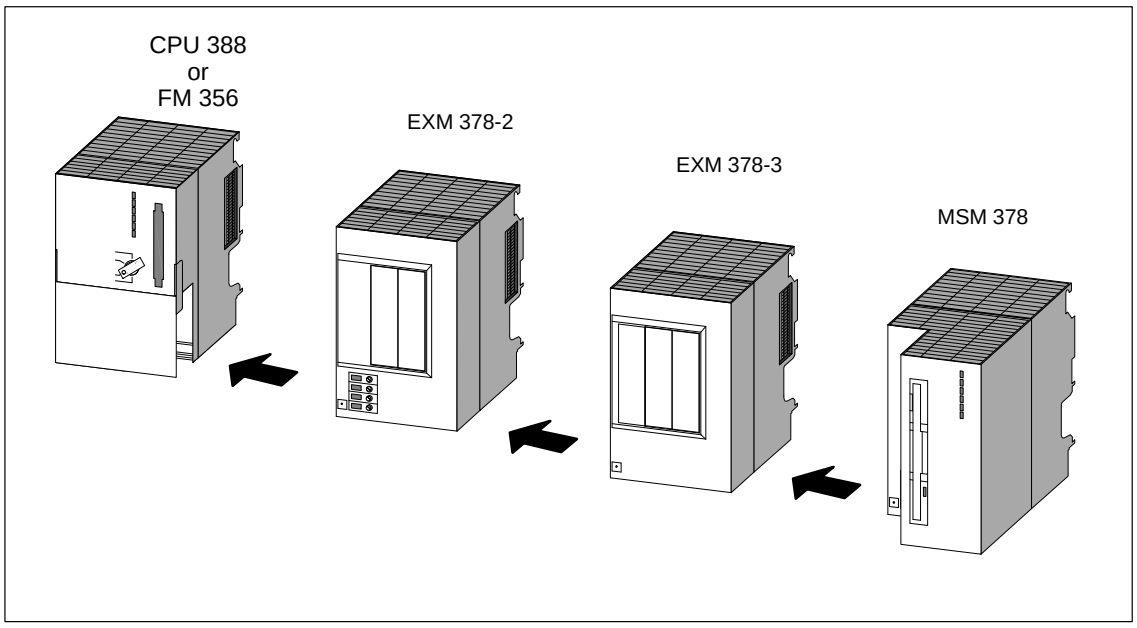


Figure 7-2 Maximum Configuration of Expansion Modules

Power Supply Connections

The EXM 378-2 expansion module and the MSM 378 bulk 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.

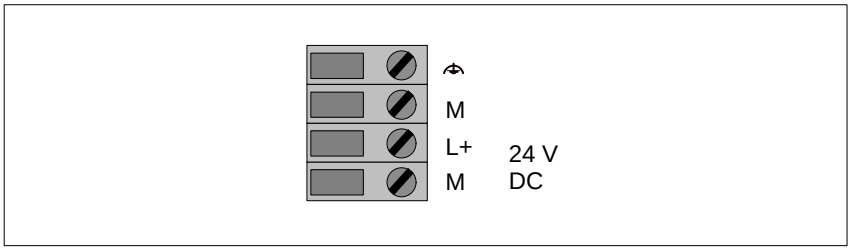


Figure 7-3 Power supply connections on EXM 378-2 and MSM 378 expansion modules

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 7-1 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	–	–

7.2 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 bulk storage module cannot be addressed 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.

7.3 EXM 378-2 and EXM 378-3 Expansion Modules

Order Numbers

EXM 378-2: 6ES7 378-2AB00-0AC0

EXM 378-3: 6ES7 378-2AC00-0AC0

Features

The EXM 378-2 and EXM 378-3 expansion modules are designed to carry interface modules. By installing suitable interface modules 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 modules. The EXM 378-3 expansion module is supplied with power from the EXM 378-2 expansion module and has 3 slots for fitting interface modules.

The EXM 378-2 and EXM 378-3 interface modules 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 bulk storage module.

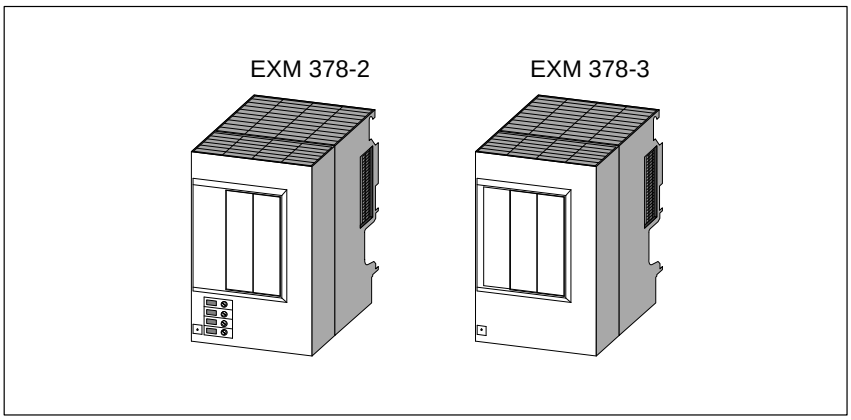


Figure 7-4 EXM 378-2 and EXM 378-3 Expansion Modules

Rules for Fitting Interface Modules

Not all types of interface module can be installed in module receptacle 3 of the EXM378-3 (left module receptacle, see Figure 7-5 on Page 7-7). Take note of the section “Rules for Fitting Interface Modules” in the chapter “Interface Modules”.

7.4 Addressing the EXM 378-2, EXM 378-3 Expansion Modules

Introduction

To be able to program the interface modules in the EXM 378-2 and EXM 378-3 expansion modules, you need to know their addresses. The following addressing methods are possible:

- Addressing in the AT 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 modules.

Addressing in the AT Compatible I/O Address Area

Some of the interface modules are configured automatically by the BIOS for operation in the AT compatible I/O address area. This automatic configuration is carried out, for example, for:

- The IF 962-VGA interface module
- Up to 4 COM interfaces (COM1 to COM4)
- Up to 2 IF 962-LPT interface modules (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 modules.

You will need to know the module receptacle number of the interface module slot to configure it in the BIOS setup. You will find this information in Figure 7-5 further on in this section.

Addressing in the M7-300-Specific I/O Address Area

All interface modules can be addressed via M7-300-specific addresses. How to determine the I/O address of an interface module in the “specific address area” is described from Page 7-8 onwards.

You need this information to program an interface module that is not addressed in the AT compatible address area.

Numbering the Interface Modules

A module receptacle number is assigned to every interface module slot. The module receptacle number is shown in Figure 7-5.

You need this module receptacle number when configuring the BIOS setup or to determine the I/O addresses of an interface module.

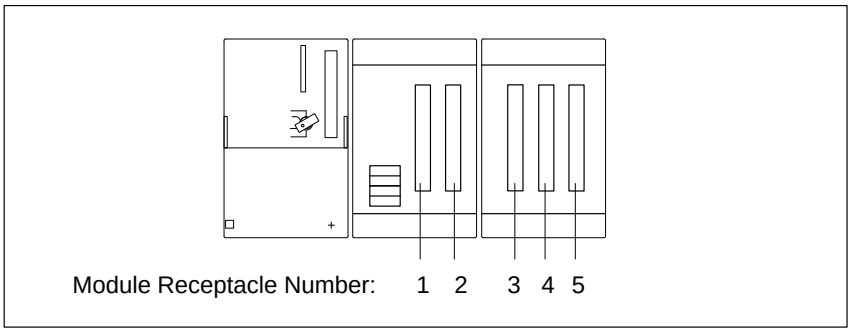


Figure 7-5 Module Receptacle Numbers in EXM 378-2 and EXM 378-3

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 AT bus of the automation computer. The I/O address area from $C000_H$ (to $D2FF_H$) in the CPU 388 and the FM 356 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 7-6.

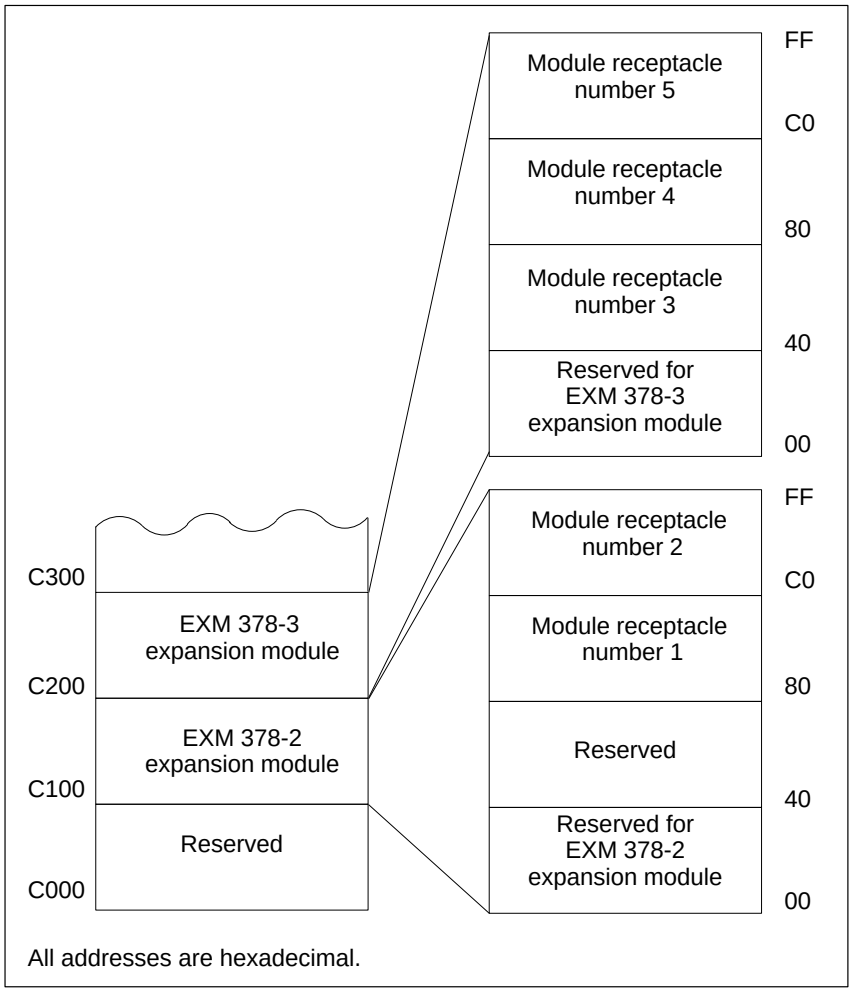


Figure 7-6 Basic Addresses of Expansion Modules and the Interface Module

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 7-2.

Table 7-2 Address Mapping within an Expansion Module

Address	Function/Slot	Remarks
00_H to $3F_H$	Reserved	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 module x	Not used for EXM 378-2
80_H to BF_H	Interface module y	
$C0_H$ to FF_H	Interface module z	

Basic Addresses of the Interface Modules

Special properties of the interface modules are set using the basic addresses, such as the position of the AT compatible I/O addresses (IF 962-COM, IF 962-LPT, etc.), or the interface modules are addressed exclusively via these basic addresses (IF 961-DIO, IF 961-AIO, etc.).

The basic address for the interface modules is derived from the sum of the addresses of the expansion module and the interface module. The resulting basic address can be seen in Table 7-3:

Table 7-3 Basic Addresses of Interface Modules in EXM 378-2 and EXM 378-3 Expansion Modules

Basic Address	Expansion Module	Interface Module 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

7.5 Interrupt Assignment, Signal Linking with EXM 378-2, EXM 378-3

Introduction

Up to three interrupts per interface module 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 module (IRQa, IRQb, IRQc) can be assigned ISA interrupts as you configure the interface module 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 AT 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 module 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 module is configured in the BIOS setup.

Signal Linking

In an EXM 378-2 or EXM 378-3 expansion module, two signals from an interface module can be linked to another one (signal linking). This signal linking is carried out when configuring the interface module in the BIOS setup.

The description of the interface modules tells you whether an interface module requires signals from another interface module, and thus whether signal linking is necessary.

7.6 MSM 378 Bulk Storage Module

Order Number

MSM 378: 6ES7 378-2BA00-0AC0

Features

The MSM 378 bulk storage module is used for storing programs and large amounts of data. It has a 24 V connection.

The MSM 378 bulk storage module has the following functional units:

- 1 3.5”/1.44 Mbyte diskette drive
- 1 hard disk drive with a capacity of ≥ 520 Mbyte

Connection

The bulk 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.

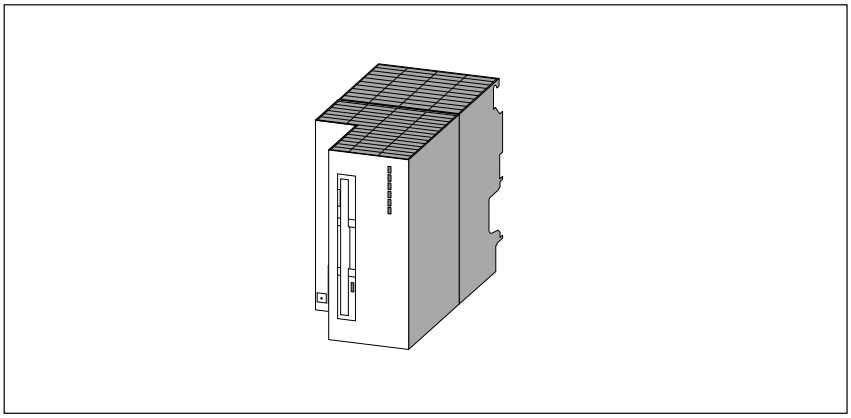


Figure 7-7 MSM 378 Bulk Storage Module

System Integration BIOS Setup

To allow the BIOS of your CPU 388 or FM 356 to address the diskette 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.

7.7 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 Manuals /1/ and /4/) 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	
6ES7 378-2BA00-0AC0	
Features	
Diskette	3.5”, 1.44 Mbyte
Hard disk	≥ 520 Mbyte
Facility to connect expansion modules	–
Technical Data	
Supply voltage	DC 24 V
Current consumption from 24 V supply	0.4 A
Inrush current	6 A
I^2t	0.8 A^2s
Power loss	9.6 W
Dimensions W x H x D	80 mm x 125 mm x 166 mm (3.2″x 4.9″x 6.5″)
Weight	0.8 kg (1.76 lb.)

Ambient Conditions for Operation	
Temperature:	
horizontal installation	0 °C to 40 ºC (32 °F to 104 °F)
vertical installation	0 °C bis 40 ºC (32 °F to 104 °F)
Temperature change:	max. 10 K/h (50 °F/h)
Relative humidity:	8% to 80% at 25 ºC, (77 °F) No condensation
Height (above sea level)	-50 m to 2500 m (–164 ft. to 8200 ft.)
Mechanical vibrations (measured on the drive)	
10 ≤ f ≤ 58 Hz	0.035 mm (0.0014 in.), constant amplitude
58 ≤ f ≤ 500 Hz	0.5 g, constant acceleration
Shock: (measured on the drive)	Half sine wave: 5 g, 11 ms

Ambient Conditions for Storage/Transport	
Temperature:	-10 °C to 60 ºC
Temperature change:	max. 20 K/h (50 °F/h)
Relative humidity:	8% to 80% at 25 ºC, (77 °F), No condensation
Height (above sea level)	Up to 10 000 m (32 800 ft.)
Mechanical vibrations	
5 ≤ f ≤ 9 Hz	3.5 mm (0.14 in.) amplitude
9 ≤ f ≤ 500 Hz	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	
6ES7 378-2AB00-0AC0	
Features	
Number of plug-in interface modules	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	DC 24 V
Current consumption from 24 V supply (without interface modules)	0.095 A
Inrush current	6 A
I^2t	0.8 A^2s
Power loss (base load) (without interface modules)	2.28 W
Power loss (with interface modules)	max. 10 W
Dimensions W x H x D	80 mm x 125mm x 117mm (3.2″x 4.9″x 4.6″)
Weight	0.5 kg (1.1 lb.)

EXM 378-3	
6ES7 378-2AC00-0AC0	
Features	
Number of plug-in interface modules	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 modules)	0.015 A
Power loss (base load) (without interface modules)	0.22 W
Power loss (with interface modules)	max. 10 W
Dimensions W x H x D	80 mm x 125 mm x 117 mm (3.2″x 4.9″x 4.6″)
Weight	0.45 kg (1 lb.)

Calculating the Power Loss

The formulae for calculating the power loss for the EXM378-2 and EXM378-3 expansion modules are given below:

$$P_{EXM378\text{-}2} = P_1 + 1.6 \times P_2 + 0{,}6 \times (P_4 + P_5) + P_3$$

$$P_{EXM378\text{-}3} = P_4 + P_5 + P_6$$

- P_1 Power loss of EXM378-2 (2.28 W)
- P_2 Power loss of interface modules in EXM378-2
- P_3 Power loss of interface modules in EXM378-2 from external power supply
- P_4 Power loss of EXM378-3 (0.22W)
- P_5 Power loss of interface modules in EXM378-3
- P_6 Power loss of interface modules in EXM378-3 from external power supply

Examples of Power Loss Calculations

A few examples of power loss calculationsg for various configurations of interface modules in expansion modules are shown below:

1. An EXM 378-2 expansion module is equipped with 2 interface modules.

   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
IF962-VGA (1.6 x P_2 = 1.6 x 2.5 W)	4 W
IF962-LPT (1.6 x P_2 = 1.6 x 05 W)	0.8 W
Total	**7.08 W**

2. An EXM 378-2 expansion module is equipped with 2 interface modules and an EXM 378-3 expansion module is equipped with 3 interface modules.

   The EXM 378-2 interface module exceeds the permissible total power loss of 10 W. This configuration is not permissible.

EXM378-2 Module	Power Loss		EXM378-3 Module	Power Loss
EXM 378-2 (P_1)	2.28 W		EXM 378-3 (P_4)	0.22 W
IF962-VGA (1.6 x P_2 = 1.6 x 2.5 W)	4 W		IF961-DIO (P_5)	2.4 W
IF961-AIO (1.6 x P_2 = 1.6 x 2.5 W)	4 W		IF962-LPT (P_5)	0.5 W
EXM378-3 1) (0.6 x P_4 = 0.22 W x 0.6)	0.13 W		IF962-COM (P_5)	0.5 W
IF961-DIO 1) (0.6 x P_5 = 0.6 x 2.4 W)	1.44 W			
IF962-LPT 1) (0.6 x P_5 = 0.6 x 0.5 W)	0.3 W			
IF962-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 modules.				

3. By configuring the interface modules 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.

EXM378-2 Module	**Power Loss**		**EXM378-3 Module**	**Power Loss**
EXM 378-2 (P_1)	2.28 W		EXM 378-3 (P_4)	0.22 W
IF962-COM (1.6 x P_2 = 1.6 x 0.5 W)	0.8 W		IF961-DIO (P_5)	2.4 W
IF962-LPT (1.6 x P_2 = 1.6 x 0.5 W)	0.8 W		IF961-AIO (P_5)	2.5 W
EXM378-3 1) (0.6 x P_4 = 0.6 x 0.22 W)	0.13 W		IF962-VGA (P_5)	2.5 W
IF961-DIO 1) (0.6 x P_5 = 0.6 x 2.4 W)	1.44 W			
IF961-AIO 1) (0.6 x P_5 = 0.6 x 2.5 W)	1.5 W			
IF962-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 modules it contains.

Interface Modules

8

In this Chapter

8.1 Overview

Introduction

The interface modules 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 modules are controlled via the ISA bus.

The interface modules have an identification on the front plate to facilitate identification when installed.

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 modules or the equipment connected to them may be destroyed if the modules are connected to the wrong plugs.

ESD Guidelines

The interface modules have no cover on the underside. The ESD guidelines must therefore be rigorously observed when handling these modules.

Slots/Module Receptacle Numbers

You need the module receptacle numbers to integrate the interface modules into your system (for example during BIOS setup). The numbering of the individual receptacles can be found 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 modules.

The basic addresses of the interface modules depend on the module receptacle of the M7-400 programmable module or the M7-300/400 expansion module into which the interface module is plugged. These basic addresses can be found 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 modules 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 module has a fixed identification code. This information is needed in the BIOS setup.

Interrupt Assignment

Up to three interrupts of an interface module (IRQa, IRQb, IRQc) can be assigned ISA interrupts as you configure the interface module 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 8-1 Format for Entering Interrupts in the Interface Module 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 AT compatibility requirements, a facility to allow several individual interface module interrupts to be assigned to a group interrupt is provided. All interface module 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 module is configured in the BIOS setup.

Signal Linking

In an expansion module, up to two signals from an interface module can be linked to another interface module (signal linking). This signal linking is done when configuring the interface modules in the BIOS setup.

The description of the interface modules tells you whether an interface module requires signals from another interface module, and thus whether signal linking is necessary.

8.2 Module Identification Code and Slot Compatibility

Module Identification Code

The following table shows the module identification codes for the interface modules.

Table 8-2 Overview of Identification Codes for Interface Modules

Interface 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 modules cannot be used in all module receptacles. The following table shows the compatibility of those modules that cannot be used universally:

Table 8-3 Slot Compatibility for Interface Modules That Are Not Universal

Interface module	Module Receptacle Numbers for Modules ...												
	EXM 378-2		EXM 378-3			FM 456-4		CPU 488-4			CPU 488-5		EXM 478
	1	2	3	4	5	0	1	0	1	3	0	3	all
IF 962-VGA 6ES7 962-1BA00-0AC0	●	●	–	●	●	●	●	●	●	–	●	–	●
IF 964-DP 6ES7 964-2AA00-0AB0	●	●	–	●	●	●	●	●	●	●	●	●	●

8.3 IF 962-VGA Interface Module

Order Number 6ES7 962-1BA00-0AC0

Features

The IF 962-VGA interface module is used to connect a keyboard and a VGA monitor. The interfaces to the keyboard and monitor are AT 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.).

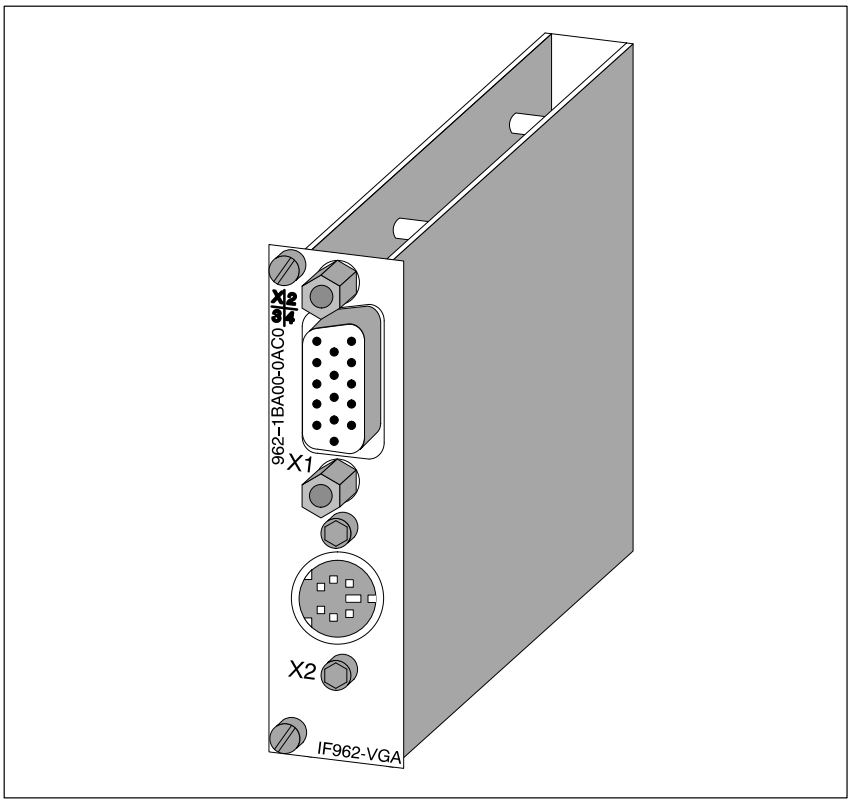


Figure 8-1 IF 962-VGA Interface Module

Note

Only one keyboard/graphics module can be used in conjunction with a programmable module (CPU or FM).

8.3.1 Connector Pin Assignment

Socket X1 VGA Monitor Connection

Table 8-4 Socket X1, VGA Monitor Connection on IF 962-VGA (15-Pin High Density Sub-D Socket)

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	

Socket X2 Keyboard Connection

Table 8-5 Socket X2, Keyboard Plug Connection on IF 962-VGA (6-Pin Mini-DIN Socket)

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

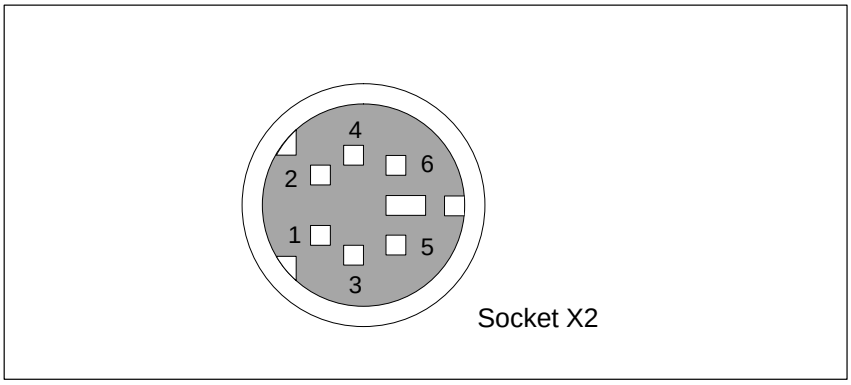


Figure 8-2 Socket X2, Keyboard Plug Connection on IF 962-VGA (6-Pin Mini-DIN Socket)

8.3.2 Addressing, Interrupt and Module Identification Code

Addressing

Addressing conforms to the AT standard.

The following addresses are used by the IF 962-VGA interface module:

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 module 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 8-6.

Table 8-6 IF 962-VGA Interface Module Interrupt Assignment

Interrupt Source on Interface Module		ISA Interrupt
Keyboard	IRQ a	IRQ 1
Mouse (trackerball)	IRQ b	Can be defined in BIOS setup
VGA	IRQ c	

Module Identification Code

The identification code for the IF 962-VGA interface module is **81_H**.

8.3.3 Technical Data

Technical Data

The IF 962-VGA interface module 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	18.2 mm x 67 mm x 97 mm (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 module. Table 8-7 shows the video operating modes supported by the BIOS of the IF 962-VGA interface module.

Table 8-7 Video Operating Modes of the IF 962-VGA Interface Module

Mode (HEX)	**Text / Graphics**	**B&W / Color**	**Resolution** (columns x lines)	**Number of Colors**	**Character Size**	**Horizontal Frequency** (kHz)	**Vertical 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

8.4 IF 962-COM Interface Module

Order Number

6ES7 962-3AA00-0AC0

Features

The IF 962-COM interface module is used to connect equipment that has a serial interface. It contains two AT compatible serial interfaces (COMa, COMb).

A maximum of four COM interfaces can be addressed with standard PC drivers at AT 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 modules can be operated both in the AT 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 module should not exceed about 10 m (33 ft.).

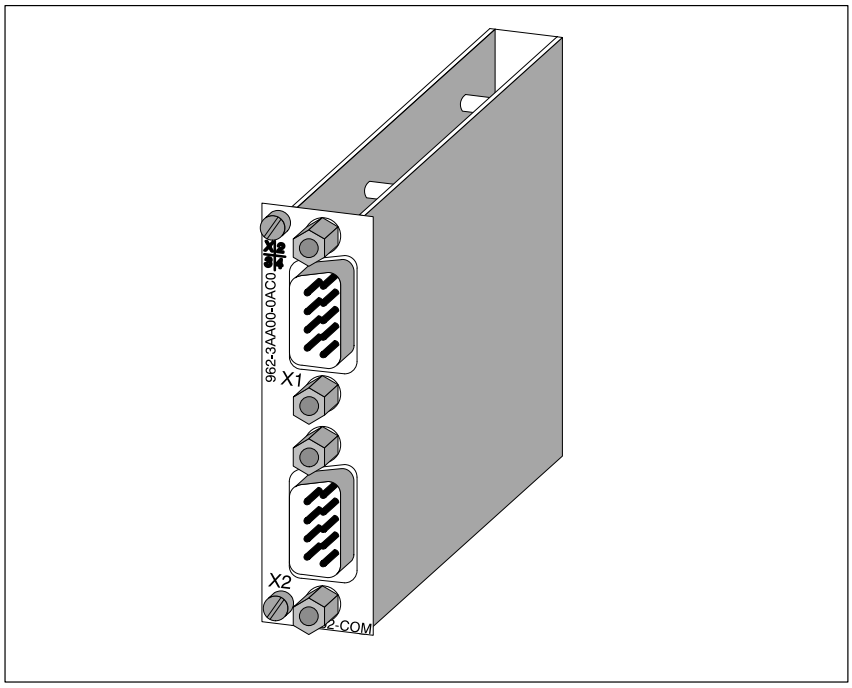


Figure 8-3 IF 962-COM Interface Module

What Can Be Connected to the Interfaces?

Any equipment with an RS232 interface can be connected, such as :

printer, modem, terminal, ...

8.4.1 Connector Pin Assignment

Connectors X1, X2 COMa, COMb

Table 8-8 Connectors X1, X2 on the IF 962-COM (9-Pin Sub-D Male Connector)

Pin	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 ground (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 ground on the COMa and COMb interfaces is referred to the internal ground.

If necessary, suitable measures must be taken on the plant side to prevent ground loops.

8.4.2 Addressing and Interrupts

Addressing

The IF 962-COM interface module can be addressed in two ways:

- In the AT compatible I/O address area
- In the M7-300/400-specific I/O address area (from $C000_H$)

Addressing in the AT Compatible Address Area

The COM interfaces can be used in the AT-compatible I/O address area. The addresses are defined in the BIOS setup and are shown in the following table.

Table 8-9 Addressing the COM Interfaces in the AT-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 an AT 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 module under “Select Module #”.
3. Enter the offset address “00_H” for the configuration register of the interface module under “Config.Index” .
4. Enter the value “36_H” under “Value”. This value is written to the configuration register (see Table 8-13).
5. Choose the OK button.

Addressing in the M7-300/400 Specific I/O Address Area

The IF 962-COM interface module can be be addressed in this reserved address area independently of any possible addressing in the AT-compatible address area.

The basic address depends on which slot the interface module occupies in the expansion module or programmable module. The slot-dependent basic address of the interface module 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 8-10 Assignment of Offset Addresses for the IF 962-COM Interface Module

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 AT-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 8-11 to 8-13 give an overview of the configuration register setting options.

Table 8-11 Offset Address for the Configuration Register (IF 962-COM)

Offset Address	Function	Remarks
00_H	Configuration register	Read /write

Table 8-12 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 8-13 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 $C00_H$) (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** AT-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 module:

Data bits:	5 bits, 6 bits, 7 bits, 8 bits
Parity:	even, odd, disable
Stop bit:	1 bit, 1.5 bits, 2 bits

Transmission Speed

The follwing transmission speeds (baud rates) can be set for the IF 962-COM interface module:

AT-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 module 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 8-14 Interrupt Assignment for IF 962-COM Interface Module

Interrupt Source in Interface Module		ISA Interrupt
COM a	IRQ a	Can be specified in BIOS setup
COM b	IRQ b	

Module Identification Code

The identification code for the IF 962-COM interface module is $\mathbf{41_H}$.

8.4.3 Technical Data

Technical Data

The IF 962-COM interface module 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	41_H
Power loss	0.5 W
Dimensions W x H x D	18.2 mm x 67 mm x 97 mm (0.72″x 2.64″x 3.82″)
Weight	0.080 kg (0.18 lb.).

8.5 IF 962-LPT Interface Module

Order Number 6ES7 962-4AA00-0AC0

Features

The IF 962-LPT interface module contains an AT-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 AT 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 modules can be operated both in the AT 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 module should not exceed about 3 m (10 ft.).

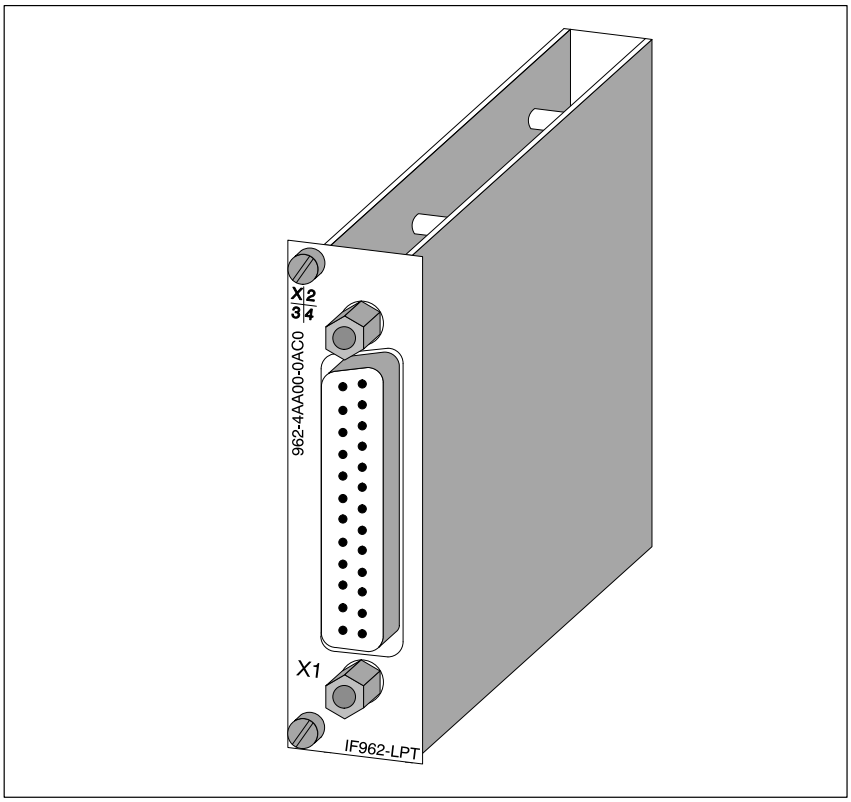


Figure 8-4 IF 962-LPT Interface Module

8.5.1 Connector Pin Assignment

Connector X1

Table 8-15 Connector X1 on IF 962-LPT (25-pin Sub-D Female)

Pin	Signal Definition	Direction
1	Strobe	Input/output
2	Data bit 0	Input/output
3	Data bit 1	Input/output
4	Data bit 2	Input/output
5	Data bit 3	Input/output
6	Data bit 4	Input/output
7	Data bit 5	Input/output
8	Data bit 6	Input/output
9	Data bit 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.

8.5.2 Addressing and Interrupts

Addressing

The IF 962-LPT interface module can be addressed in two ways:

- In the AT compatible I/O address area
- In the M7-300/400-specific I/O address area (from $C000_H$)

Addressing in the AT Compatible Address Area

The LPT interfaces can be used in the AT-compatible I/O address area. The addresses are defined in the BIOS setup and are shown in the following table.

Table 8-16 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 0278_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 module if an MSM478 is used.

Example of Defining an AT 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 module under “Select Module #”.
3. Enter the offset address “00_H” for the configuration register of the interface module under “Config.Index”.
4. Enter the value “FE_H” or “02_H” under “Value”. This value is written to the configuration register (see Table 8-20).
5. Choose the OK button.

Addressing in the M7-300/400 Specific I/O Address Area

The IF 962-LPT interface module can be be addressed in this reserved address area independently of any possible addressing in the AT-compatible I/O address area.

The basic address depends on which slot the interface module occupies in the expansion module or programmable module. The slot-dependent basic address of the interface module 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 8-17 Assignment of Offset Addresses for the IF 962-LPT Interface Module

Offset Address	Function	Remarks
00_H	Configuration register	Read/write
$10_H – 17_H$	UART 16C552 parallel interface	Read/write

Configuration Register

The configuration register contains the setting, determined by the BIOS setup, that specifies the AT-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 8-18 to 8-20 provide an overview of the configuration register setting options.

Table 8-18 Offset Addresses for the Configuration Register (IF 962-LPT)

Offset Address	Function	Remarks
0_H	Configuration register	Read /write

Table 8-19 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 8-20 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** AT-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 module.

Parallel Interface

The UART 16C552 parallel interface in the interface module can be addressed from offset address 10_H in accordance with the 16C552 module specification.

Interrupt Request

The interface module 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 module is **44_H**.

8.5.3 Technical Data

Technical Data

The IF 962-LPT interface module 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	44_H
Power loss	0.5 W
Dimensions W x H x D	18.2 mm x 67 mm x 97 mm (0.72″x 2.64″x 3.82″)
Weight	0.07 kg (0.15 lb.)

8.6 IF 961-DIO Interface Module

Order Number 6ES7 961-1AA00-0AC0

Features The principal features of the IF 961-DIO interface module 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

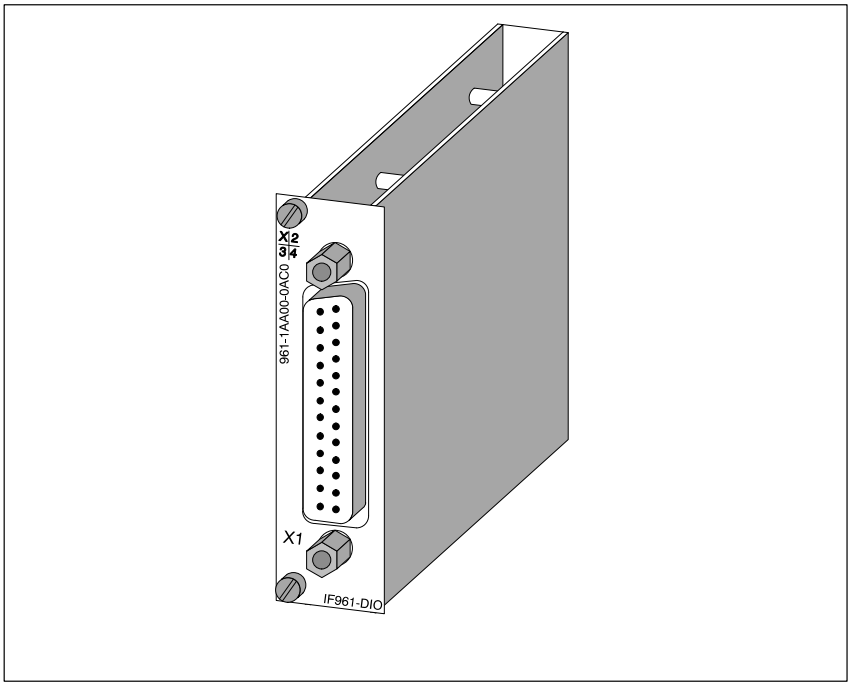


Figure 8-5 IF 961-DIO Interface Module

Software Driver A driver is available to link the IF 961-DIO interface module into your user program. Please see the Programming Manuals for information about this driver.

8.6.1 Connector Pin Assignment

Connector X1

A 25-pin Sub-D socket is provided on the front of the module for the connecting cable.

Figure 8-6 shows the pin assignments for this socket.

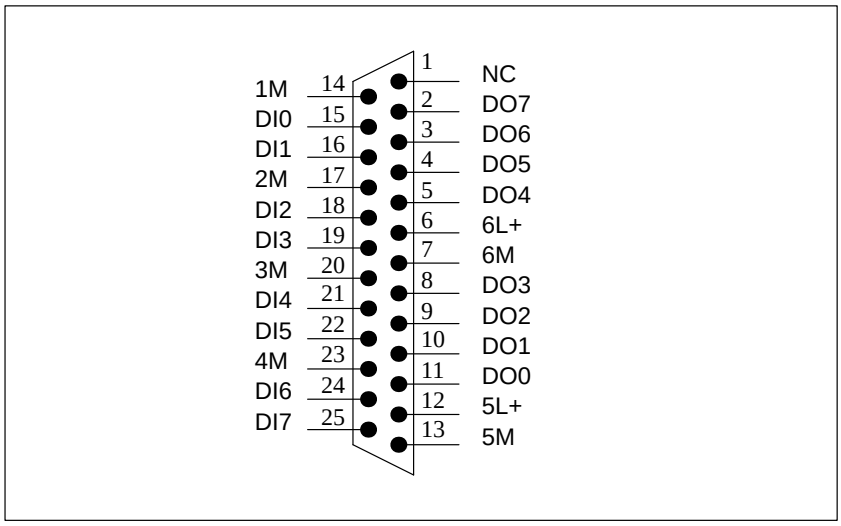


Figure 8-6 Pin Assignment of Connector X1 on IF 961-DIO (25-pin Sub-D Socket)

Figures 8-7 and 8-8 show the block diagrams and connection diagrams for the digital input and output circuits.

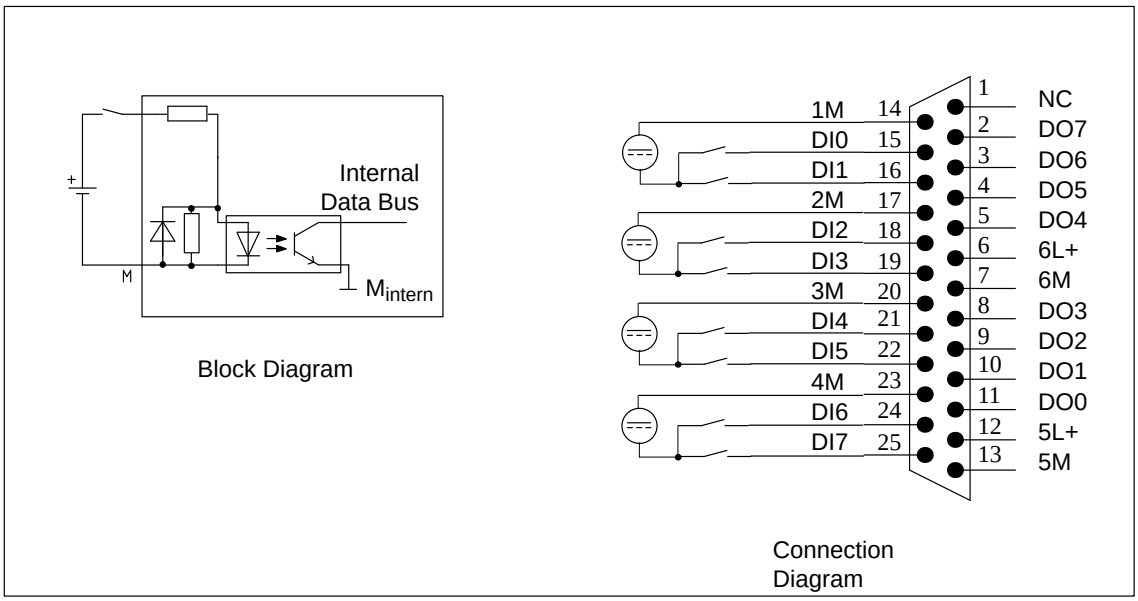


Figure 8-7 Block and Connection Diagram of Digital Input Circuits

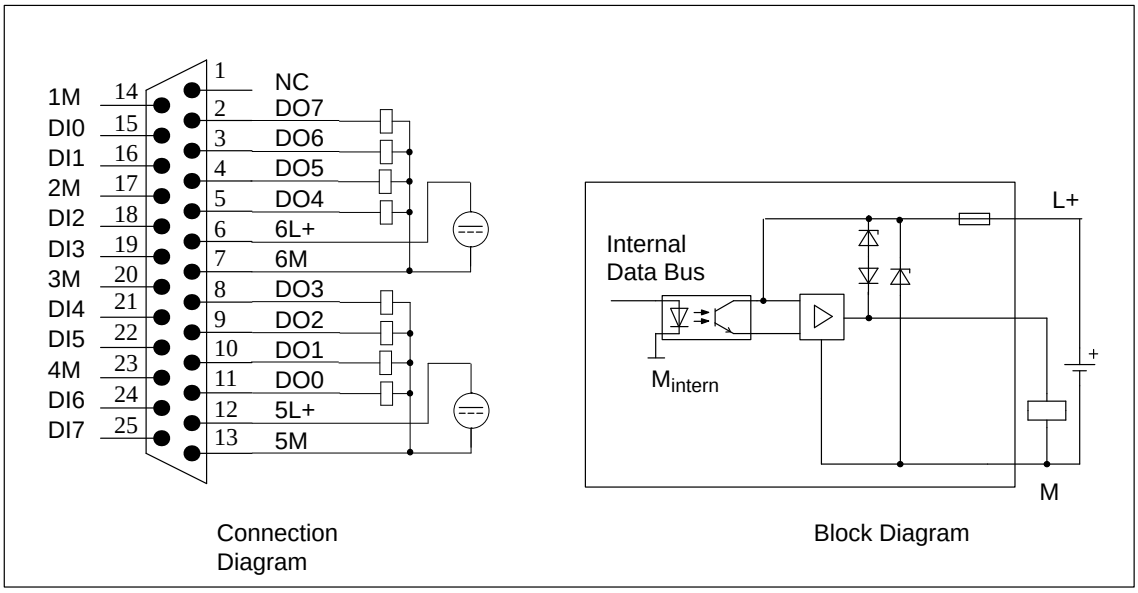


Figure 8-8 Block and Connection Diagram of Digital Output Circuits

8

8.6.2 Addressing and Interrupts

Addressing in the M7-300/400 Specific I/O Address Area

The basic address depends on which slot the interface module occupies in the expansion module or programmable module. The slot-dependent basic address of the interface module 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 8-21 Assignment of Offset Addresses for the IF 961-DIO Interface Module

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 8-22 and 8-23 provide an overview of the digital inputs.

Table 8-22 Offset Address for Digital Input (IF 961-DIO)

Offset Address	Function	Remarks
0	Digital input user data	Read only

Table 8-23 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 8-24 and 8-25 provide an overview of the digital outputs.

Table 8-24 Offset Address for Digital Output (IF 961-DIO)

Offset Address	Function	Remarks
1	Digital output user data	Read / write

Table 8-25 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 8-26 and 8-27 provide an overview of the acknowledgement register.

Table 8-26 Offset Address for Acknowledgement Register (IF 961-DIO)

Offset Address	Function	Remarks
2	Acknowledgement register	Write only

Table 8-27 Significance of Bits in Acknowledgement Register (IF 961-DIO)

Bit	Function	= 0	= 1
2^0	Reserved		
:	:		
2^6	Reserved		
2^7	Acknowledge interrupt	Yes	No

Interrupt Register

This register contains the cause of the interrupt. Tables 8-28 and 8-29 provide an overview of the interrupt register.

Table 8-28 Offset Address for Interrupt Register (IF 961-DIO)

Offset Address	Function	Remarks
3	Interrupt register	Read only

Table 8-29 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 8-30 and 8-31 provide an overview of the interrupt enable register.

Table 8-30 Offset Address for Interrupt Enable Register (IF 961-DIO)

Offset Address	Function	Remarks
4	Interrupt enable register	Read / write

Table 8-31 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 8-32 and 8-33 provide an overview of the selection registerer for creation of interrupts on a rising pulse edge of a digital input.

Table 8-32 Offset Address for Rising Pulse Edge Selection Register (IF 961-DIO)

Offset Address	Function	Remarks
5	Rising pulse edge selection register	Read / write

Table 8-33 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 8-34 and 8-35 provide an overview of the selection register for the creation of interrupts on the falling pulse edge of a digital input.

Table 8-34 Offset Address for Falling Pulse Edge Selection Register (IF 961-DIO)

Offset Address	Function	Remarks
6	Falling pulse edge selection register	Read / write

Table 8-35 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 8-36 and 8-37 provide an overview of the mode register.

Table 8-36 Offset Address for the Mode Register (IF 961-DIO)

Offset Address	Function	Remarks
7	Mode register	Read / write

Table 8-37 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 module has been switched on.

Interrupt Request

The interface module 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 module is $\mathbf{02_H}$.

8.6.3 Technical Data

Technical Data

The IF 961-DIO interface module 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	18.2 mm x 67 mm x 97 mm (0.72″x 2.64″x 3.82″)
Weight	0.065 kg (0.14lb.)
Module data	
Module identification	02_H
Number of inputs	8
Number of outputs	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	
• With “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	
• With “0” signal	Max. 3 V
• With “1” signal	L+ – 1.5 V
Output current	
• With “1” signal Rated value Permissible range	 0.1 A 5 mA to 0.1 A
• With “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

8.7 IF 961-AIO Interface Module

Order Number 6ES7 961-2AA00-0AC0

Features

The main features of the IF 961-AIO interface module 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

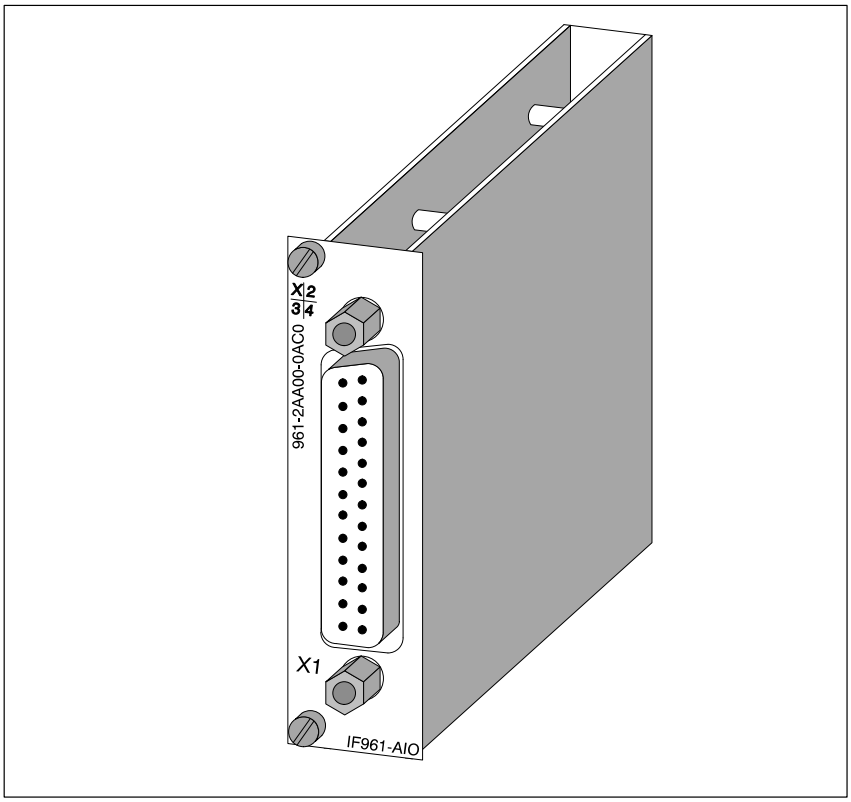


Figure 8-9 IF 961-AIO Interface Module

Software Driver

A driver is available for linking the IF 961-AIO interface module into your user program. Information about this driver can be found in the Programming Manuals.

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 8-10). The output type (current or voltage output) is selected by the wiring of the analog outputs (see Figure 8-10).

8.7.1 Connector Pin Assignment and Connection Diagram

Connector X1

A 25-pin Sub-D socket for the connecting cable is situated on the front of the module.

Figure 8-10 shows the pin assignments for connector X1 and the module connection diagram.

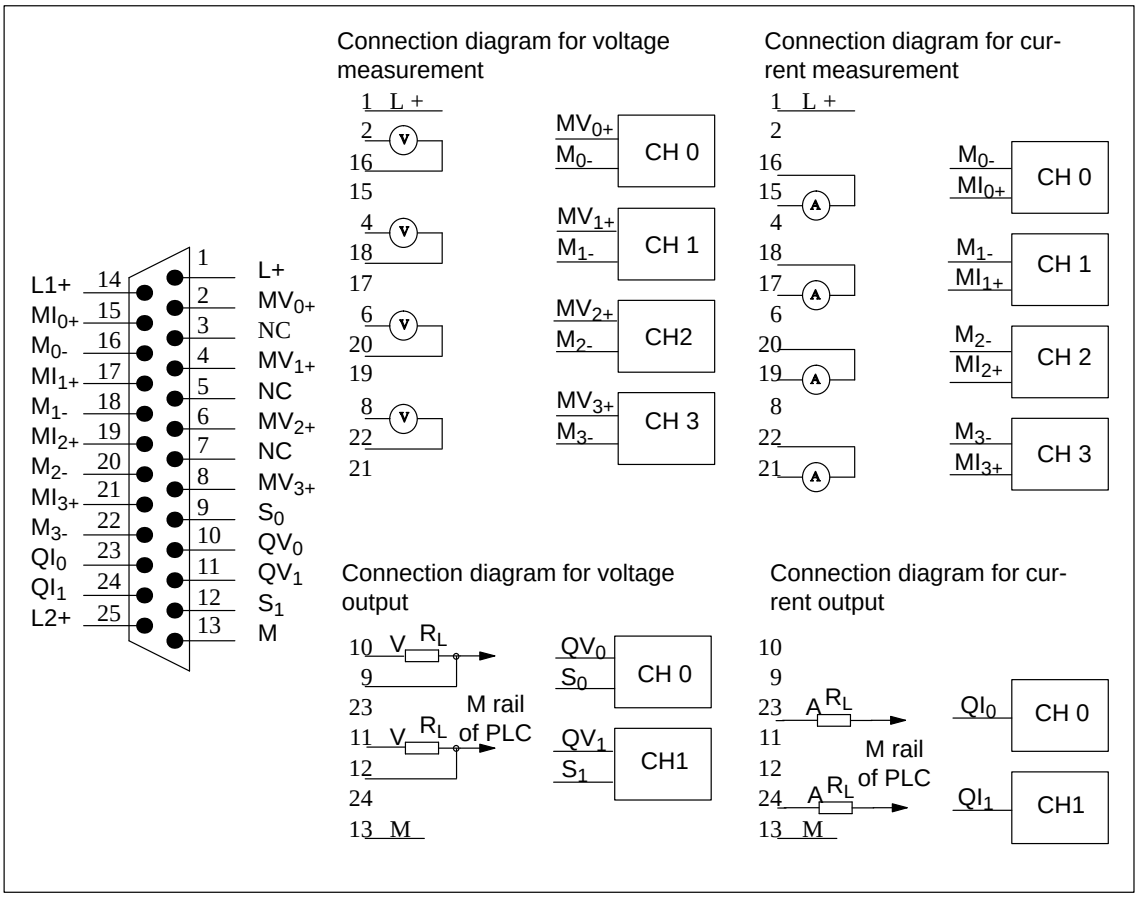


Figure 8-10 Pin Assignments of Connector X1 (25-pin Sub-D Socket) and Connection Diagram – IF 961-AIO

Note

Use screened cables only for the input and output connections.

Signal Definitions

The table below provides a definition of the signals in Figure 8-10.

Table 8-38 Definitions of the Signals on Connector X1 of the IF 961-AIO Interface Module

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 8-11 shows the block diagram for the IF 961-AIO interface module.

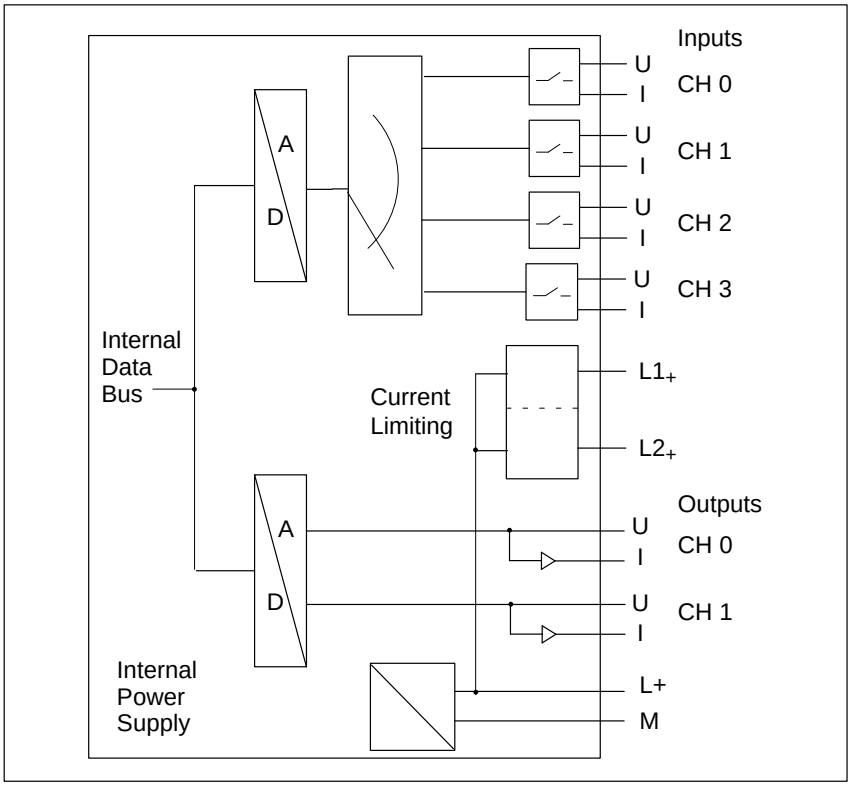


Figure 8-11 Block Diagram of IF 961-AIO Interface Module

8.7.2 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-circuited 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 8-12 shows the connections for floating sensors.

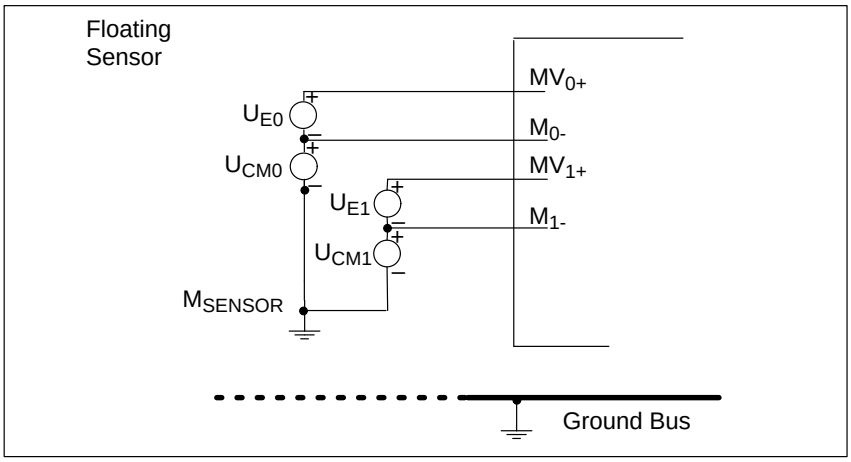


Figure 8-12 Connection of Isolated Sensors

8

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 8-13 shows the connection of non-isolated sensors.

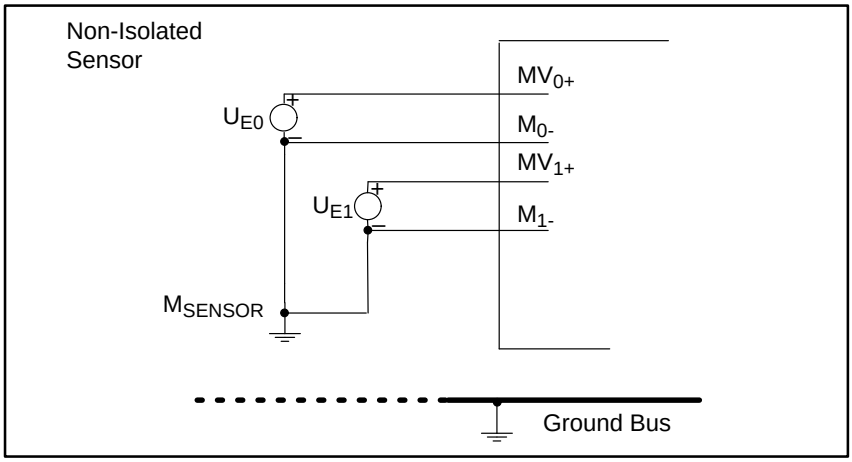


Figure 8-13 Connection of Non-Isolated Sensors

Connecting Voltage Sensors

Figure 8-14 shows the connection of voltage sensors to an analog input module.

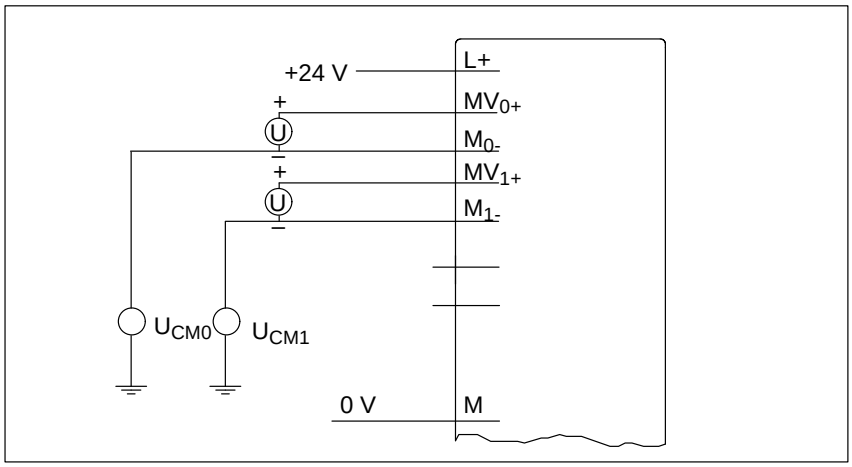


Figure 8-14 Connection of Voltage Sensors

Connecting Current Sensors as 2-Wire and 4-Wire Transmitters

Figures 8-15 and 8-16 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.

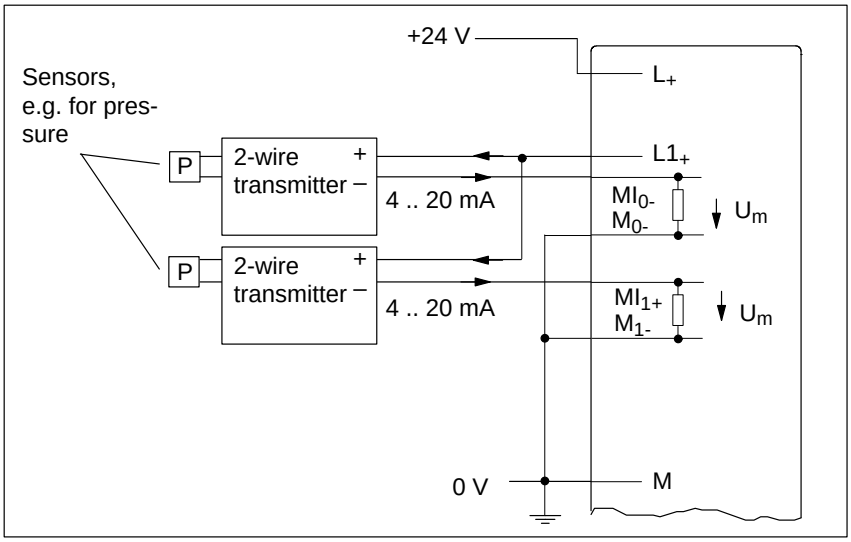


Figure 8-15 Connection of 2-Wire Transmitters

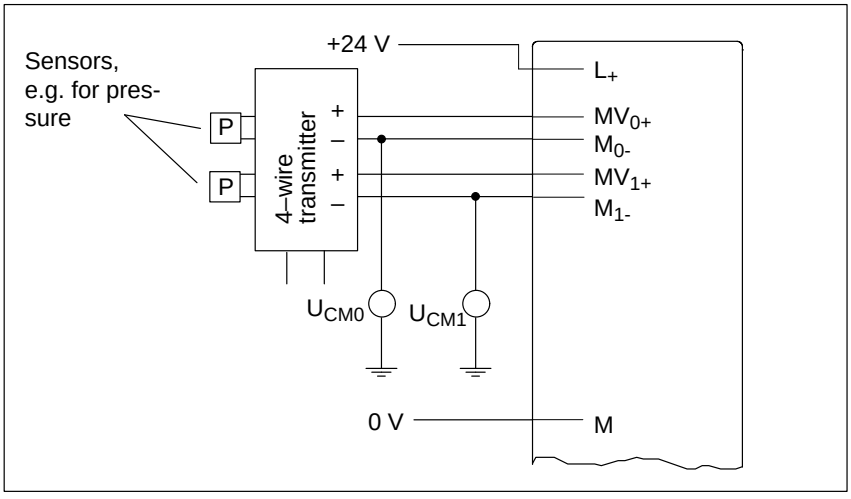


Figure 8-16 Connection of 4-Wire Transmitters

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 module.

Figure 8-17 shows the connections for resistance thermometers/resistors with current for each provided through an analog output.

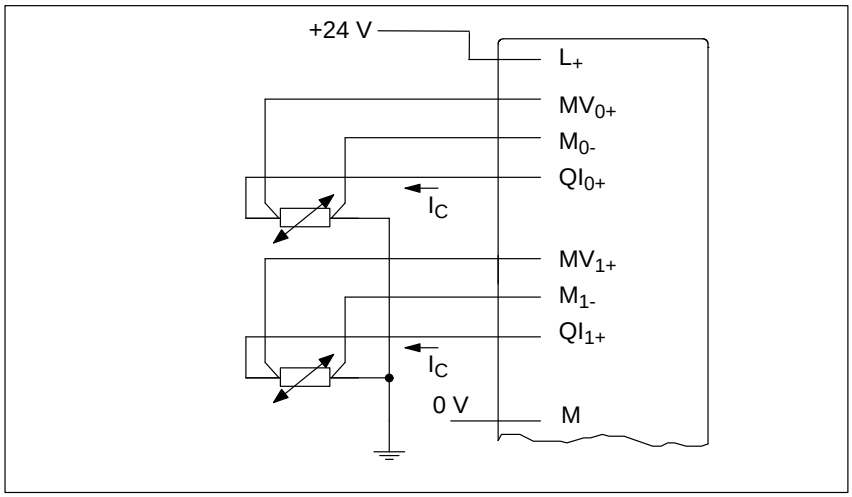


Figure 8-17 4-Wire Connection of Resistance Thermometers/Resistors with Individual Constant Current Sources

Figure 8-18 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.

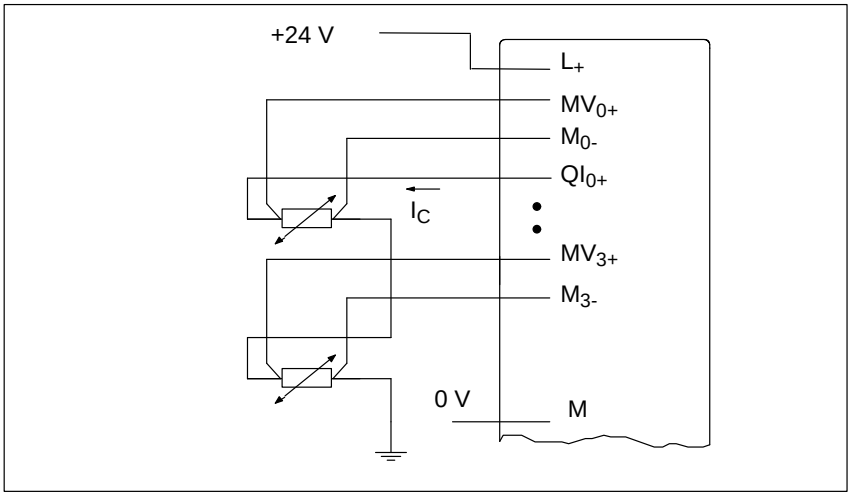


Figure 8-18 4-Wire Connection of Resistance Thermometers/Resistors with Common Constant Current Source

8.7.3 Connecting Loads and Actuators to Analog Outputs

Abbreviations Used

The following abbreviations appear in Figures 8-19 and 8-20:

QI: Analog output current

QV: Analog output voltage

S: Refernce potential of analog circuit

R_L: Load resistance

Figures 8-19 and 8-20 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.

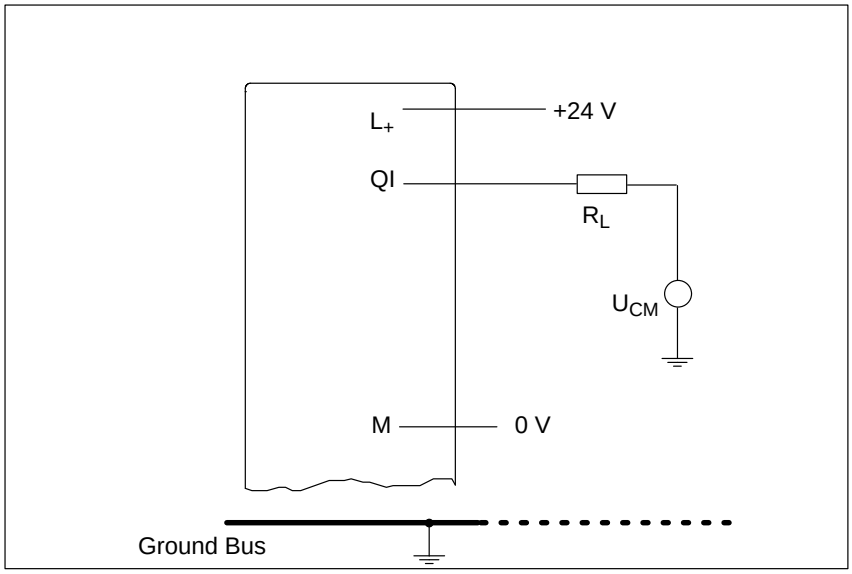


Figure 8-19 Connection of Loads/Actuators to a Current Output in 2-Wire Circuit

Connecting Loads or Actuators to Analog Outputs, Continued

Connecting Loads to the Voltage Output

The connection of two channels is shown as an example.

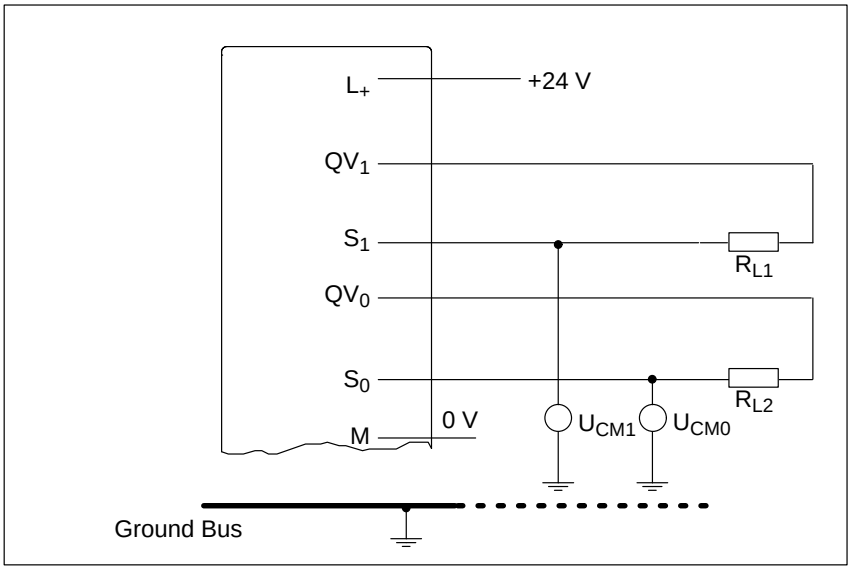


Figure 8-20 Connection of Loads/Actuators to a Voltage Output in 3-Wire Circuit

8.7.4 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 module.

Figure 8-21 shows how the cycle time is made up in the case of a 4-channel analog input module.

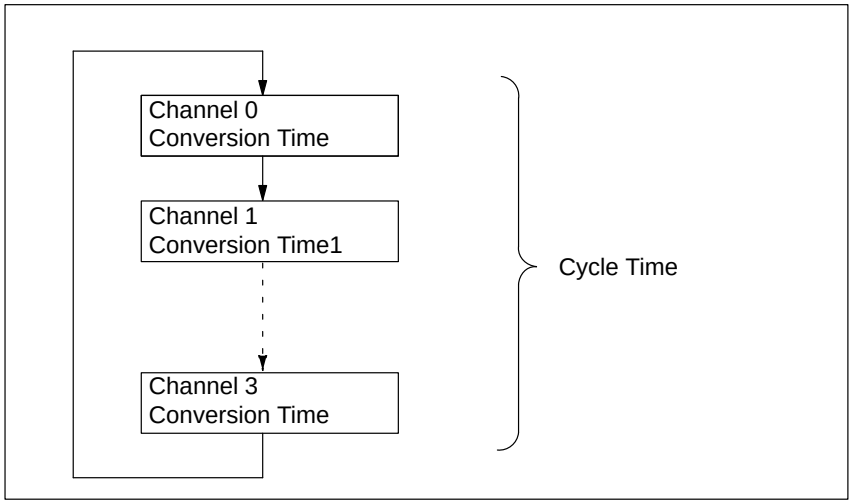


Figure 8-21 Cycle Time of Analog Input Module

8.7.5 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.

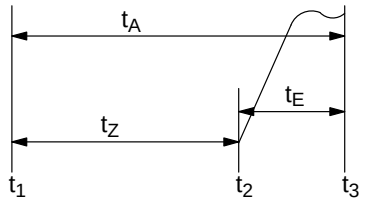
Settling Time

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 8-22 shows the response time of the analog output channels.



t_A = Response 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 8-22 Response Time of Analog Output Channels

8.7.6 Commissioning the IF 961-AIO Interface Modules

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.

8.7.7 Addressing

Addressing

The IF 961-AIO interface module 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 module occupies in the expansion module or programmable module. The slot-dependent basic address of the interface module 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 8-39 Assignment of Offset Addresses for the IF 961-AIO Interface Module

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

8.7.8 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 8-43.

Table 8-40 Significance of the Data Bits for the Analog Output (IF 961-AIO)

Offset Address	Write D15															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".

8

8.7.9 Analog Input

Analog Input

Tables 8-41 and 8-42 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 8-43.

Table 8-41 Significance of the Input Bits for the Analog Input (IF 961-AIO)

Offset Address	Read D15															D0	Remarks
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
	INT	Interrupt enable, INT = 0 = disabled, INT = 1 = enabled
	AC = 1	Automatic conversion of all ADC channels enabled
	ADC channel no.	Number of selected ADC channel (for conversion on demand) (individual encoding)
	ADC = 001	Channel 0
	ADC = 010	Channel 1
	ADC = 011	Channel 2
	ADC = 100	Channel 3
	PF = 1	Power failure, no external voltage available
	EOC = 1	End of conversion, end of analog-digital conversion on the selected channel

Table 8-42 Significance of the Control Bits for the Analog Input (IF 961-AIO)

Offset Address	Write D15															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 = any

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

8.7.10 Representation of Analog Values for the Analog Input Measuring Ranges

Voltage and Current Range

Table 8-43 shows the representation of the digitized measured value for:

- the ± 10 V voltage range and
- the ± 20 mA current range.

Table 8-43 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	32511	$7EFF_H$	11.7589 V	23.515 mA
	:	:	:	:	:
	100.004	27649	$6C01_H$	10.0004 V	20.001 mA
Rated range	100	27648	$6C00_H$	10 V	20 mA
	:	:	:	:	:
	0	0	0_H	0 V	0 mA
	:	:	:	:	:
	-100	-27648	9400_H	-10 V	-20 mA
Underrange	-100.004	-27649	$93FF_H$	-10.0004 V	-20.001 mA
	:	:	:	:	:
	-117.59	-32512	8100_H	-11.759 V	-23.516 mA
Underflow	≥-118.51	-32768	8000_H	≥-11.851 V	≥-23.7 mA

8

8.7.11 Analog Value Representation for the Analog Output Ranges

Voltage and Current Output Range

Table 8-44 shows the representation of

- the ± 10 V voltage output range and
- the ± 20 mA current output range.

Table 8-44 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	

8.7.12 Interrupts and Module Identification Code

Interrupt Request

The interface module 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-AIO interface module is $\mathbf{01_H}$.

8.7.13 Technical Data

Technical Data

The IF 961-AIO interface module 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 x H x D	18.2 mm x 67 mm x 97 mm (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 +	DC 24 V
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

Technical Data, Continuation

Interference suppression, error limits for inputs	
Interference voltage suppression for f = n × (50/60 Hz ± 1 %) n = 1, 2, ...	
• Common mode interference (U_{SS} < 1 V)	> 60 dB
• Normal mode interference (Peak interference value < rated value of input range)	0 dB
Crosstalk between inputs	> 60 dB
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 4-wire connection (measurement cable)	 Possible Not possible
• for current output 2-wire connection	Possible

8.8 IF 961-CT1 Interface Module

Order Number 6ES7 961-3AA00-0AC0

Features

The IF 961-CT1 interface module 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)

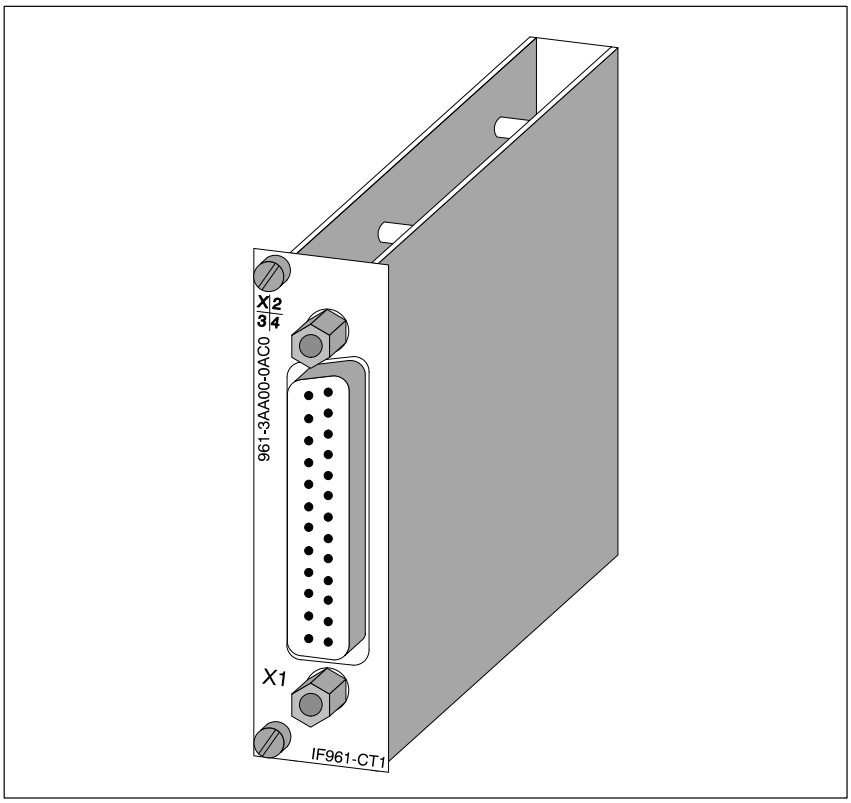


Figure 8-23 IF 961-CT1 Interface Module

Software Driver

A driver is available for linking the IF 961-CT1 interface module into your user program. Information about this driver can be found in the Programming Manuals.

8.8.1 What Can the IF 961-CT1 Interface Module Do?

Introduction

This section provides an overview of the functionality of the IF 961-CT1 interface module.

This functionality is achieved using the associated driver software.

What Can the IF 961-CT1 Module Do?

The IF 961-CT1 interface module 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 module 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 module has two gate functions:

- A software gate controlled by the program.
- A hardware gate controlled via the digital inputs on the interface module.

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.

Delay and Pulse Length

You can specify a delay (dead time) and a minimum pulse length for the digital outputs of the IF 961-CT1.

Which Signals can the IF 961-CT1 Count?

The IF 961-CT1 interface module 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.

8.8.2 Which Encoders Can Be Connected?

Connecting Various Encoders

Various types of encoder that provide the pulses for the counting signals can be connected to the IF 961-CT1 interface module. Table 8-45 provides an overvirew of the various types of encoder and the relevant signals.

Table 8-45 Encoders for the IF 961-CT1 Interface Module

Encoder	Signal
5 V incremental encoder	Differential signals A, $\overline{A}$, B, $\overline{B}$ and N, $\overline{N}$
5 V pulse encoder	A differential signal as count signal A differential signal as direction signal
5 V pulse encoder	A differential signal as count signal No direction signal
24 incremental encoder	A*, B* and N*
24 V pulse encoder	24 V with direction signal
24 V pulse encoder	24 V without direction signal

5 V Incremental Encoder

The 5 V incremental encoder supplies the module with differential signals A, $\overline{A}$, B, $\overline{B}$ and N, $\overline{N}$ to RS 422, signals $\overline{A}$, $\overline{B}$ and $\overline{N}$ being the inverse signals of A, B and N.

Encoders with these six signals are known as symmetrical encoders.

Figure 8-24 shows the profile of these signals against time.

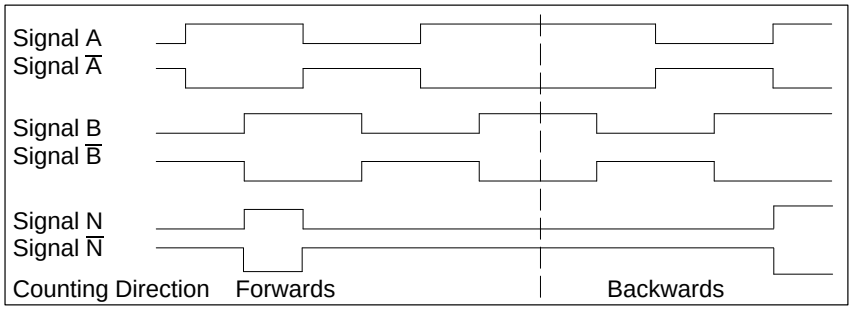


Figure 8-24 Signals from the 5 V Incremental Encoder

The IF 961-CT1 interface module recognizes the counting direction from the ratio of signals A and B. The diagrams in the next section (“Pulse Evaluation”) show which edges of signals A and B are counted forwards or backwards.

Signals B and $\overline{B}$ can be inverted by parameter assignment to change the counting direction without having to change the connections.

5 V Pulse Encoder with/without Direction Signal

The encoder only provides a 5 V differential signal as a count signal. This must be connected to terminals A and $\overline{A}$.

The 5 V differential signal on terminals B and $\overline{B}$ is used as the direction signal.

Table 8-46 shows how the counting direction depends on the signal on terminals B and $\overline{B}$.

Table 8-46 Counting Direction in Relation to the Signal on Connections B and $\overline{B}$

Signal on Connections B and $\overline{B}$	Counting Direction
No signal	Backwards
B positive relative to $\overline{B}$	Backwards
B negative relative to $\overline{B}$	Forwards

When assigning parameters, you must select the “Cycle and Direction” encoder. Analysis of the unconnected signals must be disabled using the appropriate parameter.

The module only counts the positive edge of signal A. A multiple evaluation is not possible.

Inversion of signal B is not possible.

How are the Signals Monitored?

Signals A and B are used for counting in the case of the 5 V incremental encoder. By setting the appropriate parameters, signal N can be used to set the counter to its initial value.

The interface module monitors whether the cables are connected and whether there is a wire break or short-circuit.

You can use parameters to specify which of the three signal pairs are to be monitored. Unused signals do not therefore need to be connected if the analysis of these signal pairs has been disabled by parameter assignment.

If all three signals indicate a fault, either the encoder or the encoder 5V power supply is faulty or no encoder is connected.

24 V Incremental Encoder

The 24 V incremental encoder provides signals A*, B* and N* in the same time relationship as signals A, B and N on the 5 V incremental encoder.

Encoders that provide no inverse signals are known as asymmetrical encoders.

24 V incremental encoders with source switching or with differential mode or ground switching can be connected if wired accordingly Refer to Figures 8-31 and 8-32 on Pages 8-68 and 8-69.

As with the 5 V incremental encoders, the counting direction can be reversed by the “inversion, no inversion” parameter setting.

24 V Pulse Encoder with/without Direction Signal

The encoder, for example a photoelectric barrier, only provides one counting signal, which must be connected to terminal A* on the front plug.

In addition, a signal can be connected to terminal B* as a direction signal.

Figure 8-25 shows the time sequence of the signals from a 24 V pulse encoder with direction signal, and the resulting counting pulse.

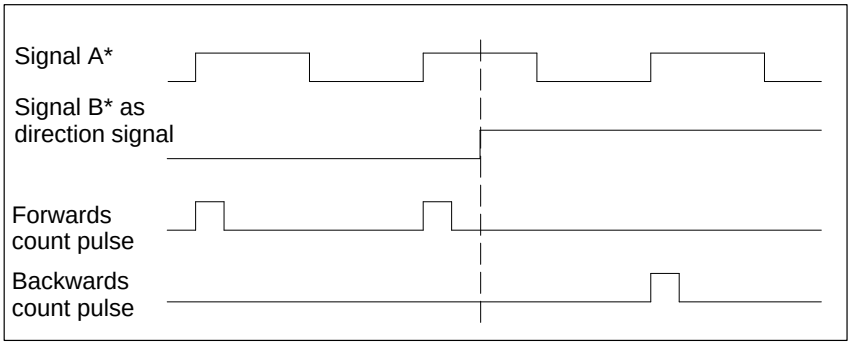


Figure 8-25 Signals from a 24 V Pulse Encoder with Direction Signal

The counting direction depends on the wiring of terminal B*. Table 8-47 shows how the counting direction changes depending on the wiring of terminal B*.

Table 8-47 Counting Direction in Relation to the Wiring of Terminal B*

Terminal B*	Counting direction
No connection	Forwards
24 V connected	Backwards
Short-circuited to ground	Forwards

With these counting signals, reversing the direction by inverting the B* signal is not possible.

Note

With this type of evaluation, the counting signal can “run away” due to the encoder oscillating about the rest position, since all signals are added together.

Filter for 24 V Counter Inputs

To suppress interference, input filters (RC elements) with a uniform filter time can be set for the 24 V inputs A*, B* and N* by parameter assignment. Both input filters are available with a typical input delay of 1.5 µs and 16 µs. Counting signals up to a frequency of 200 kHz or 20 kHz and counting signals with a minimum pulse width of 2.5 µs or 25 µs can be reliably detected. The input filter has a default delay period of 16 µs.

How are the Signals Monitored?

Monitoring is automatically disabled in the case of 24 V counting signals.

8.8.3 Pulse Evaluation

Introduction

The IF 961-CT1 interface module can count not only by evaluating the rectangular pulses, but can also count the positive and negative edges of the signals. This results in multiple evaluation of the rectangular signals and therefore a higher resolution. You can select whether the signals are to be evaluated once, twice or four times.

Multiple evaluation is only possible with 5 V and 24 V incremental encoders with tracks A and B or $\overline{A}$ and $\overline{B}$.

Single Evaluation

Single evaluation means that only one edge of A is evaluated; forward counting pulses are detected when there is a rising edge on A and a low signal level on B, backward counting pulses are detected when there is a falling edge on A and a low signal level on B.

Figure 8-26 shows single signal evaluation.

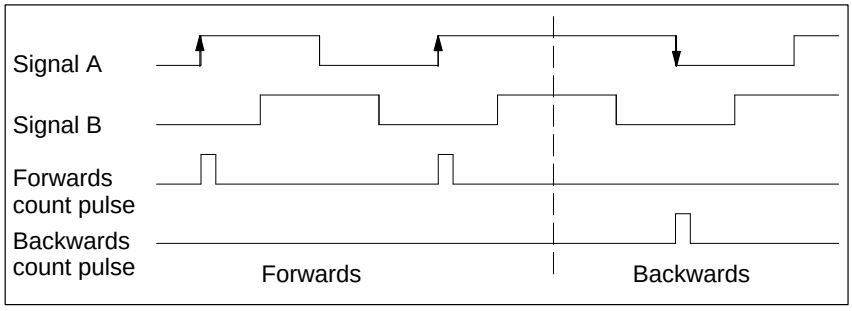


Figure 8-26 Single Evaluation

Double Evaluation

Double evaluation means that the rising and falling edges of signal A are evaluated. The levels of signals A and B determine whether forward or backward counting pulses are produced.

Figure 8-27 shows double signal evaluation.

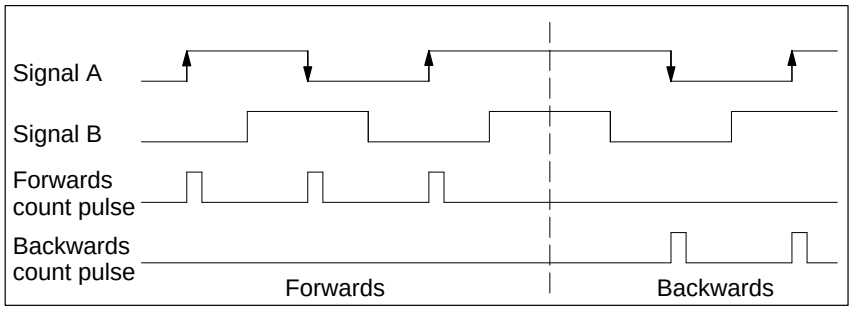


Figure 8-27 Double Evaluation

Fourfold Evaluation

Fourfold evaluation means that the rising and falling edges of A and B are evaluated. The levels of signals A and B determine whether forward or backward counting pulses are produced.

Figure 8-28 shows fourfold signal evaluation.

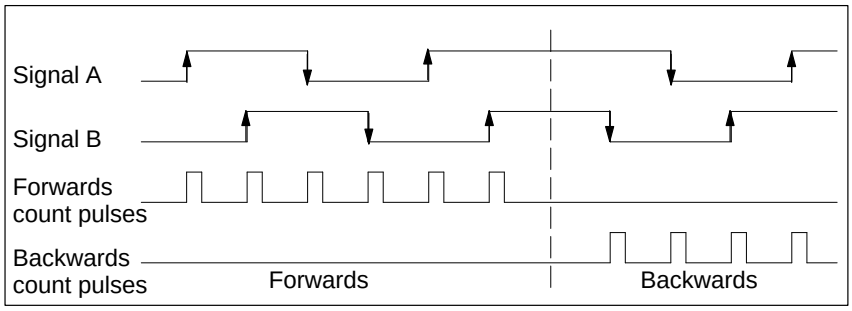


Figure 8-28 Fourfold Evaluation

8.8.4 Status of Interface Module after Power Up

Features

The status of the interface module after switching on the power supply (reset status), if no data has yet been transmitted, is as follows:

- Counter inputs preset for 5 V differential signals, track B not inverted, analysis active for signal pairs A, B, N; single evaluation
- 32 bit counting mode
- Counter set to zero
- Setting of counter with SET input or zero mark disabled
- Input delay for digital inputs START, STOP, SET and RESET: typical 16 µs (maximum frequency: 20 kHz)
- Input delay for 24 V counter inputs: typical 16 µs (maximum frequency: 20 kHz)
- Outputs Q1 and Q2 off
- Pulse duration = 0, delay (dead time) = 0
- No interrupts set
- “Continuous counting” mode set
- Gate function off (gate open)

8.8.5 Connector Pin Assignment and Block Diagram

Connector X1

A 25-pin Sub-D socket for the connecting cable is provided on the front of the module.

Table 8-48 shows the connector pin assignments for this module.

Table 8-48 Pin Assignments on Connector X1, IF 961-CT1 (25-pin Sub-D Socket)

Pin	Signal name	Definition
1	NC	Not used
2	A*	Track A, 24 V signal
3	N*	Zero mark, 24 V signal
4	NC	Not used
5	A	Track A, 5 V signal
6	B	Track B, 5 V signal
7	N	Zero mark, 5 V signal
8	NC	Not used
9	SET	SET digital input
10	RESET	RESET digital input
11	Q1	Digital output Q1
12	NC	Not used
13	2L+	24 V load power voltage for the digital inputs and outputs
14	1M	Ground for 24 V incremental encoder
15	B*	Track B, 24 V signal
16	RE	Termination resistor for 24 V counter input
17	NC	Not used
18	A	Track A negated, 5 V signal
19	B	Track B negated, 5 V signal
20	N	Zero mark negated, 5 V signal
21	NC	Not used
22	START	Start digital input
23	STOP	Stop digital input
24	Q2	Digital output Q2
25	2M	Load voltage ground for digital inputs and outputs

Reference Potential 1M

The 24 V encoder ground is connected to the interface module via terminal 1M (reference potential for 24 V encoder signals).

5 V Encoder Signals A, $\overline{A}$, B, $\overline{B}$, N and $\overline{N}$

Incremental encoders with 5 V differential signals to RS422 can be connected to the front connector.

Three different types of encoder can be connected.

- Incremental encoder with differential signals A, $\overline{A}$, B, $\overline{B}$, N and $\overline{N}$

  Signals A, $\overline{A}$, B, $\overline{B}$, N and $\overline{N}$ are connected via the correspondingly marked terminals.

- Encoder with differential signal without direction signal

  The differential signal is connected to terminals A, $\overline{A}$.

- Encoder with differential signal and direction signal

  The differential signal is connected to terminals A, $\overline{A}$. The differential signal used as the direction signal is connected to terminals B, $\overline{B}$.

The inputs are not isolated.

24 V Encoder Signals A*, B* and N*

24 V signals are identified by the letters A*, B* and N*.

Three different types of encoder can be connected:

- Incremental encoder with 24 V signals

  Signals A*, B* and N* are connected via the correspondingly marked terminals.

- Pulse encoder without direction signal

  The signal is connected to terminal A*.

- Pulse encoder with direction signal

  The counting signal is connected to terminal A*. The direction signal is connected to terminal B*.

The inputs are not isolated.

Digital Inputs START, STOP, SET and RESET

The START and STOP digital inputs can be used for gate control of the counter.

The SET input sets the counter to its initial value.

The RESET input is a spare input and is not used at present.

The inputs operate at a nominal voltage of 24 V.

The digital inputs are isolated from the internal ground and the counting inputs.

Input Filter

To suppress interference, input filters (RC elements) with a uniform filter time can be set for the 24 V inputs START, STOP, SET and RESET by parameter assignment. Both input filters are available with a typical input delay of 1.5 µs and 16 µs. Input signals up to a frequency of 200 kHz or 20 kHz and counting signals with a minimum pulse width of 2.5 µs or 25 µs can be reliably detected. The input filter has a default delay period of 16 µs.

Assignment of parameters for the input filter is carried out in the driver software.

Digital Outputs Q1 and Q2

The IF 961-CT1 interface module has two digital outputs Q1 and Q2 for the direct initiation of control procedures. These outputs are supplied from the load voltage 2L+.

They are isolated from the internal ground and the counting inputs.

The outputs are source switching devices and can be loaded with a current of 0.3 A. They are protected against overload and short circuit. Direct connection of relays and contactors is possible without additional circuitry.

The time characteristic of the outputs can be set by parameter assignment.

Load Voltage 2L+/ 2M

A 24 V load voltage must be supplied to the module via terminals 2L+ and 2M for control of the digital inputs START, STOP, SET and RESET and the digital outputs Q1 and Q2.

The load voltage 2L+ / 2M is not monitored.

Note

If the load voltage polarity is incorrect, the fuse will blow, and the module will have to be returned to the factory for repair.

Block Diagram

Figure 8-29 shows the block diagrams of the individual function units of the IF 961-CT1 interface module.

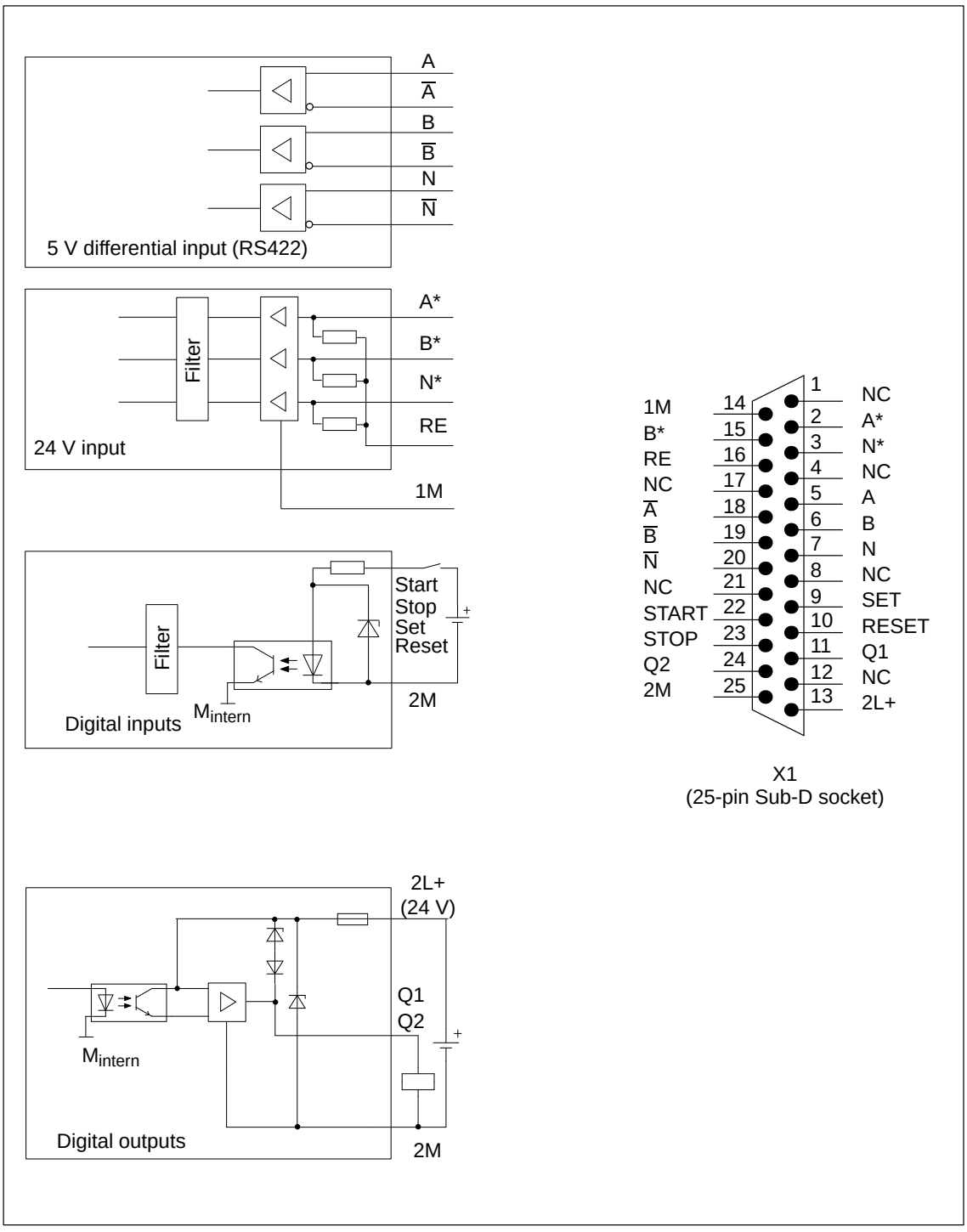


Figure 8-29 Block Diagrams of the Individual Function Units, IF 961-CT1

8.8.6 Connection of Incremental Encoder with 5 V Signals

Connection of 5 V Incremental Encoder

Figure 8-30 shows how to connect a 5 V incremental encoder with RS 422 differential signals to an IF 961-CT1 interface module.

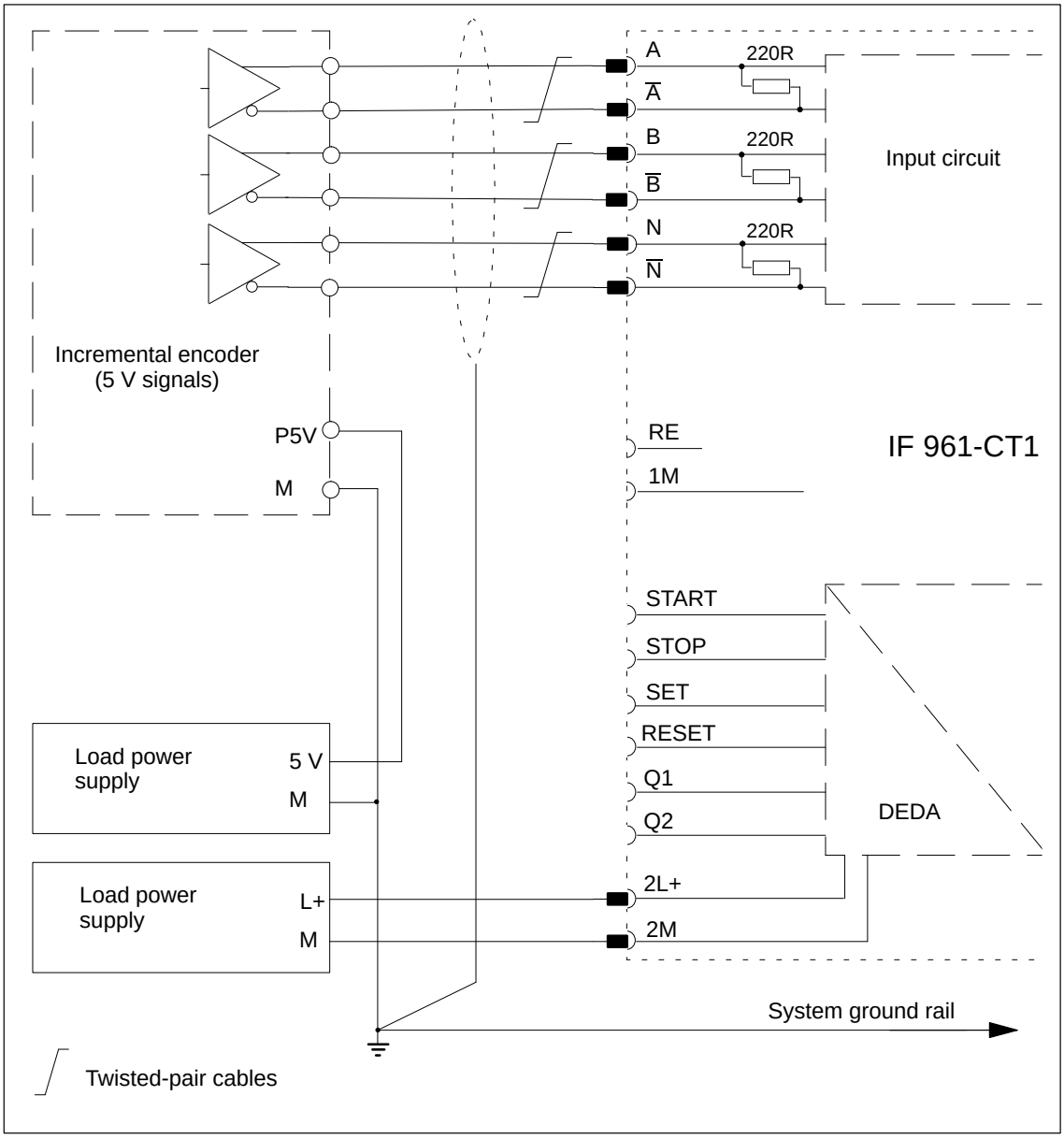


Figure 8-30 Connecting a 5 V Incremental Encoder, IF 961-CT1

8.8.7 Connection of Incremental Encoder with 24 V Signals (Source Switching)

Connection of 24 V Incremental Encoder (Source Switching)

Figure 8-31 shows how to connect a 24 V incremental encoder with source switches (or differential mode switches) to an IF 961-CT1 interface module.

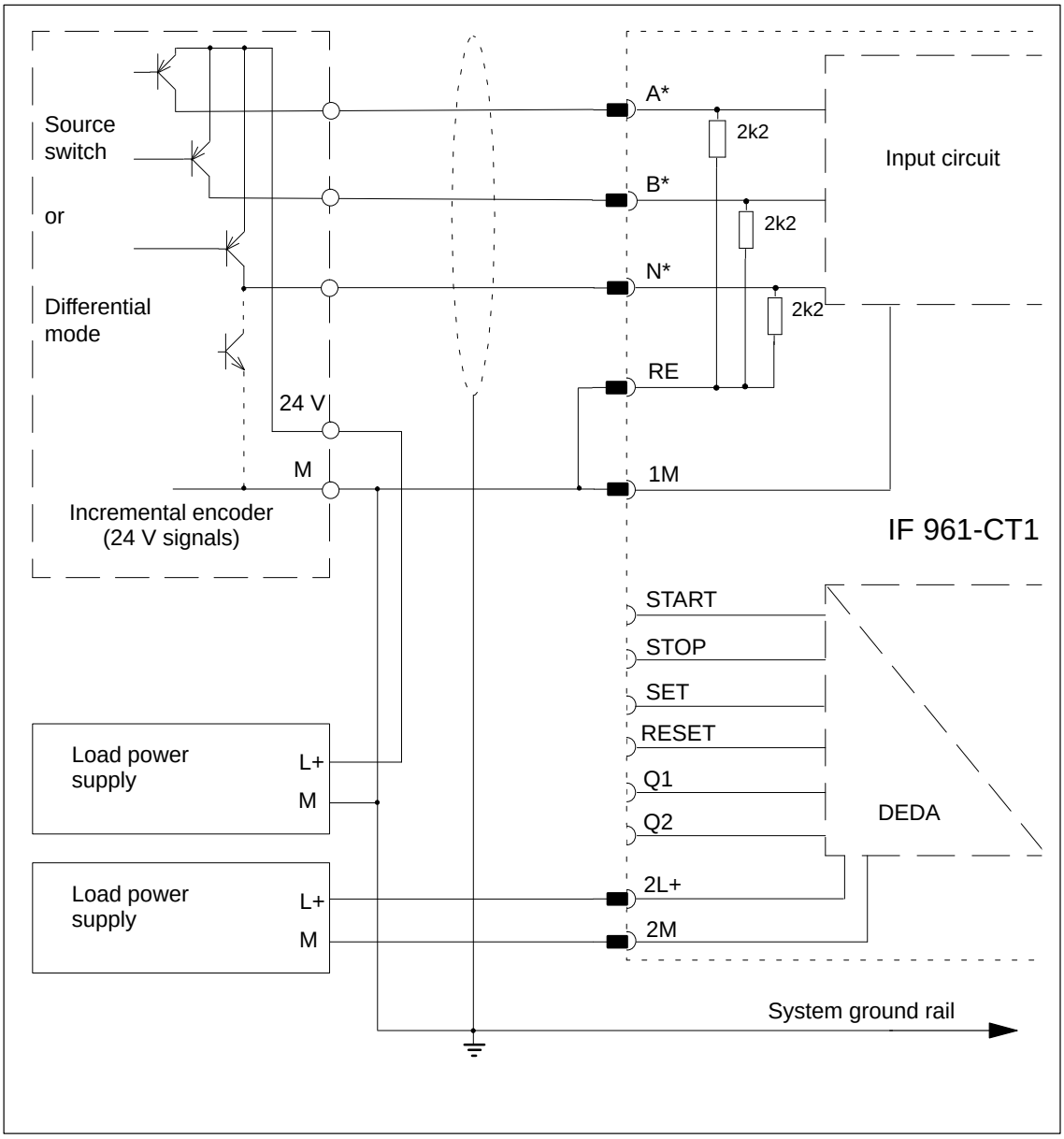


Figure 8-31 Connecting a 24 V Incremental Encoder (Source Switching), IF 961-CT1

8.8.8 24 V Signals (Ground Switching)

Connection of 24 V Incremental Encoder (Ground Switching)

Figure 8-32 shows how to connect a 24 V incremental encoder with ground switches (or differential mode switches) to an IF 961-CT1 interface module.

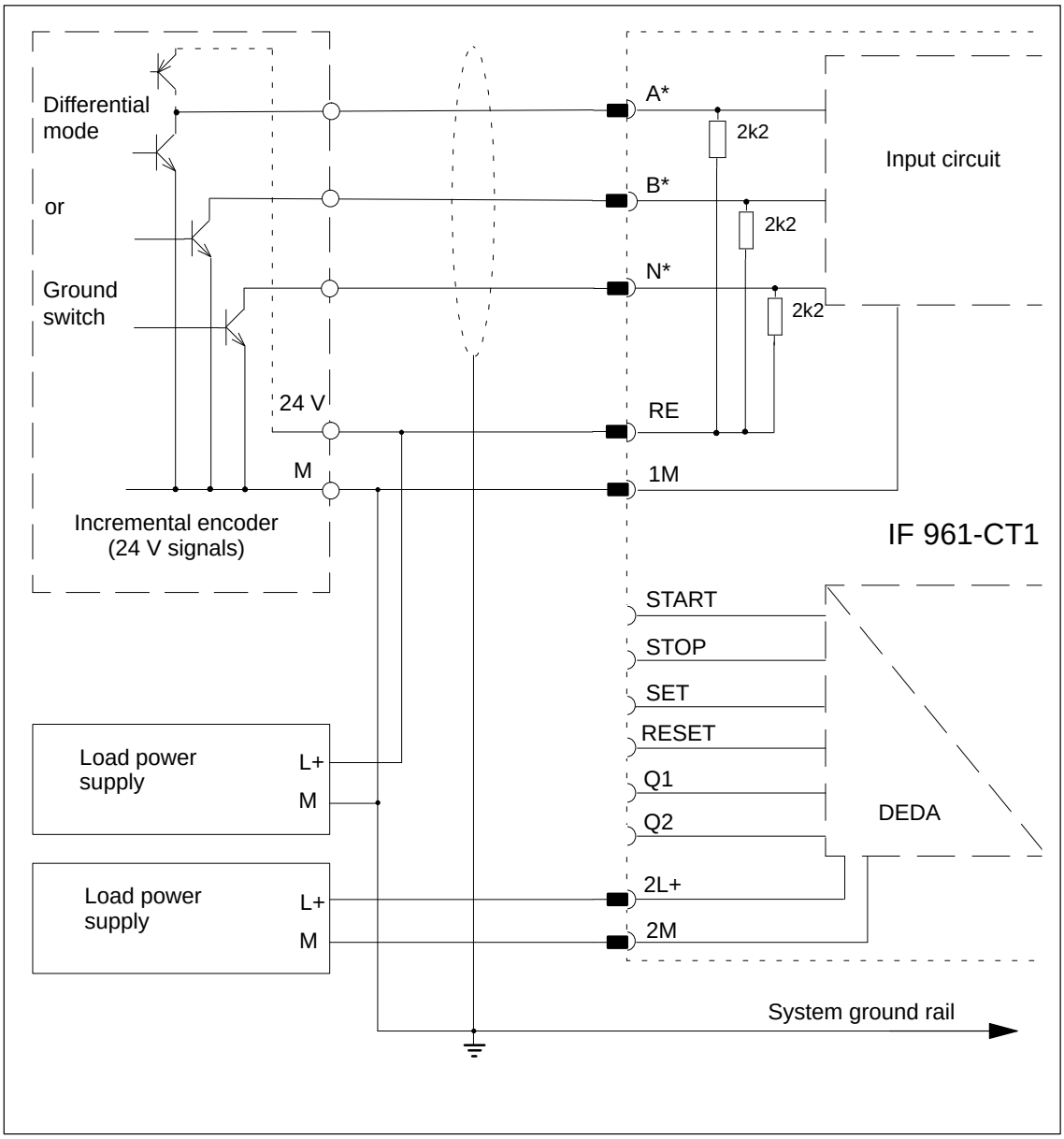


Figure 8-32 Connecting a 24 V Incremental Encoder (Ground Switching), IF 961-CT1

8.8.9 Wiring the Front Plug

Cables

Please observe the following rules when selecting cables:

- The cables for the digital inputs START, STOP, SET and RESET must be screened.
- The cables for the counting pulses must be screened.
- The screens of the counting signal cables must be grounded both to the pulse encoder as well as in the immediate vicinity of the module, for example, via the screen connector.
- Cables A, $\overline{A}$, B, $\overline{B}$ and N, $\overline{N}$ of the 5 V incremental encoder must be twisted together in pairs.
- Use flexible cables with a cross-section of 0.25 to 1.5 mm^2.

Note

To increase resistance to interference, the load cables should be laid separately for lengths > 3 m (10 ft.).

8.8.10 Addressing and Interrupts

Addressing

The IF 961-CT1 interface module 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 module occupies in the expansion module or programmable module. The slot-dependent basic address of the interface module 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 module 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 module is $\mathbf{03_H}$.

8.8.11 Technical Data

Technical Data

The IF 961-CT1 interface module 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	18.2 mm x 67 mm x 97 mm (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)	20 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 value – 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

8.9 IF 964-DP Interface Module

Order Number 6ES7 964-2AA00-0AB0

Features

The IF 964-DP interface module permits the connection of distributed I/Os via “SINEC L2-DP” (Profibus). 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.

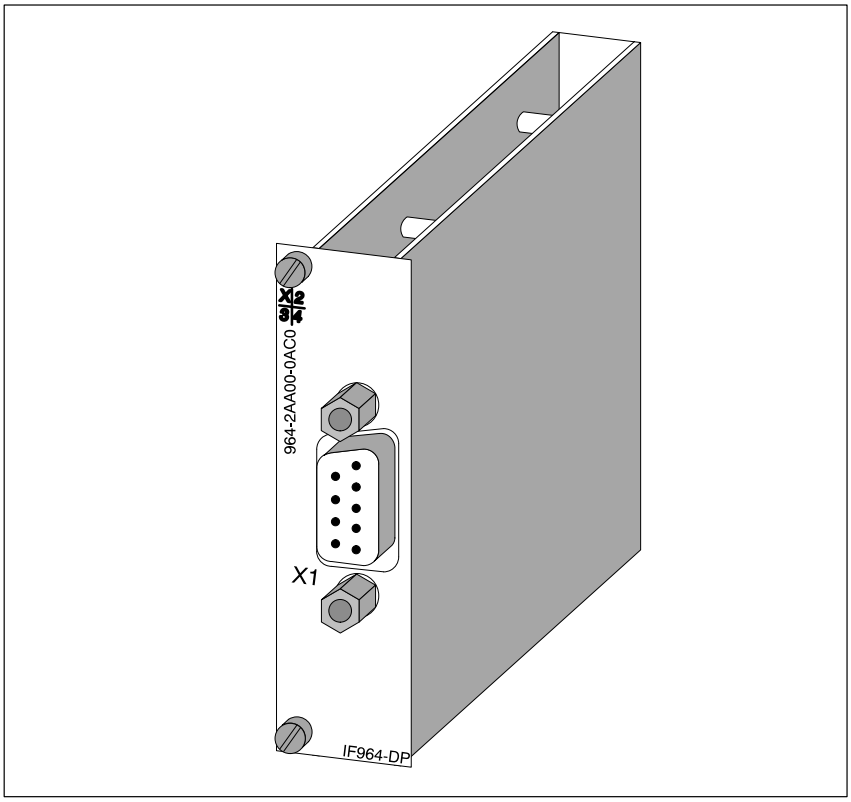


Figure 8-33 IF 964-DP Interface Module

Software Driver

A driver is available for linking the IF 964-DP interface module into your user program. Information about this driver can be found in the Programming Manuals.

Further Information

Information about “SINEC L2-DP” can be found in the following brochures and manuals:

- Brochure *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 SINEC L2-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 connection plug, RS485 repeater
- STEP 7 manuals

8.9.1 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 8-49.

Table 8-49 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 Module?

Profibus equipment can be connected, such as:

ET 200 M, ET 200 U (B/C) and other equipment conforming to the standard.

8.9.2 Addressing and Interrupts

Addressing in the M7-300/400 Specific I/O Address Area

The basic address depends on which slot the interface module occupies in the expansion module or programmable module. The slot-dependent basic address of the interface module 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 module 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 module uses the addresses from C 00 00_H to C 7F FF_H.

Interrupt Request

The interface module interrupt line is connected to a processor interrupt through software parameters.

Module Identification Code

The identification code for the IF 964-DP interface module is **$8C_H$**.

8.9.3 Technical Data

Technical Data

The IF 964-DP interface module 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 (1312 yd.)
• At 12 Mbit/s	Maximum 100 m (330 ft.)
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	18.2 mm x 67 mm x 97 mm (0.72″x 2.64″x 3.82″)
Weight	0.065 kg (0.14 lb.)

Ordering Information

9

In this Chapter

Application Function Modules

Table 9-1 lists all the M7-300 application function modules.

Table 9-1 Order Numbers for M7-300 Application Function Modules

Product	Description	Order Number
FM356-4	FM356 application function module with 80486DX2 50 MHz, 4 Mbyte RAM, Expansion option	6ES7 356-4BM00-0AE0
FM356-4	FM356 application function module with 80486DX2 50 MHz, 8 Mbyte RAM, Expansion option	6ES7 356-4BN00-0AE0

Expansion Modules

Table 9-2 lists all the expansion modules for the M7-300 application function module.

Table 9-2 Order Numbers for M7-300 Expansion Modules

Product	Description	Order Number
EXM378-2	Expansion module for 2 interface modules	6ES7 378-2AB00-0AC0
EXM378-3	Expansion module for 3 interface modules	6ES7 378-2AC00-0AC0
MSM378	Bulk storage module	6ES7 378-2BA00-0AC0

Interface Modules

Table 9-3 lists all the interface modules that can be used with M7-300 application function modules.

Table 9-3 Order Numbers for Interface Modules

Product	Description	Order Number
IF961-AIO	Analog input / analog output	6ES7 961-2AA00-0AC0
IF961-CT1	Incremental encoder connection	6ES7 961-3AA00-0AC0
IF961-DIO	Digital input / digital output	6ES7 961-1AA00-0AC0
IF962-COM	2 serial interfaces	6ES7 962-3AA00-0AC0
IF962-LPT	Printer interface	6ES7 962-4AA00-0AC0
IF962-VGA	Connection for VGA monitor and keyboard	6ES7 962-1BA00-0AC0
IF964-DP	SINEC L2-DP interface (Profibus)	6ES7 964-2AA00-0AB0

Memory Card

Table 9-4 lists all the memory cards that can be used with M7-300 application function modules.

Table 9-4 Order Numbers for Memory Card

Description	Order Number
Memory card, Flash-EPROM, 5 V, 1 Mbyte	6ES7 952-1KK00-0AA0
Memory card, Flash-EPROM, 5 V, 2 Mbyte	6ES7 952-1KL00-0AA0
Memory card, Flash-EPROM, 5 V, 4 Mbyte	6ES7 952-1KM00-0AA0
Memory card, Flash-EPROM, 5 V, 8 Mbyte	6ES7 952-1KP00-0AA0
Memory card, Flash-EPROM, 5 V, 16 Mbyte	6ES7 952-1KS00-0AA0

Connecting Cables

Table 9-5 lists the connecting cables.

Table 9-5 Order Numbers for Connecting Cables

Description	Order Number
V.24 cable (RS232, “Null-Modem”), 10 m (33 ft.) 9-pin Sub-D female connectors at both ends	9AB4 173-2BN10-0CA0
Printer connecting cable for • Serial interface (COM, 10 m (33 ft.)) • Parallel interface (Centronics)	 9AB4 173-2BN10-0CA0 9AP1 901-0AL00

Spare Parts and Accessories

Table 9-6 lists spare parts and accessories.

Table 9-6 Order Numbers for Spare Parts and Accessories

Description	Order Number
Bus connector	6ES7 390-0AA00-0AA0
Key for FM356 (mode switch)	6ES7 911-0AA00-0AA0
Buffer battery for FM356	6ES7 971-1AA00-0AA0
12 module covers for expansion modules	6ES7 398-0BA00-0AA0

Software

Table 9-7 lists all programs that can be ordered for M7-300 application function modules.

Table 9-7 Order Numbers for M7-300 Software

Description	Order Number
System software based on RMOS32 M7-SYS	6ES7 802-0FA00-0AA0
High-level language package M7-PROC/C++	6ES7 812-0BA00-0AA0

Documentation

Table 9-8 lists all the documentation that can be ordered in addition to this manual.

Table 9-8 Order Numbers for Documentation

Description	Language	Order Number
Manual S7-300 programmable controller, configuration, CPU data	German English French	6ES7030-0AA00-8AA0 6ES7030-0AA00-8BA0 6ES7030-0AA00-8CA0
Reference manual S7-300, M7-300 programmable controller module data		
Manual M7-300 programmable controller, configuration, CPU data	German English French	6ES7038-0AA00-8AA0 6ES7038-0AA00-8BA0 6ES7038-0AA00-8CA0
Manual FM 356 application function module, Installation and commissioning	English French	6ES7356-0AA00-8BA0 6ES7356-0AA00-8CA0
Programming manual M7-300/400 system software Program writing	German Englissh	6ES7802-8FA00-8AA0 6ES7802-8FA00-8BA0
Reference manual M7-300/400 system software System and standard functions		
User manual M7-300/400 system software Installation and operation		
User manual S7 and M7 basic software STEP 7	German	Included in STEP 7 documentation package

Bibliography

A

/1/	Manual:	S7-300 Programmable Controller • Installation and Hardware • Module Specifications
/2/	Manual:	Basic Software for S7 and M7 • STEP 7
/3/	Manual:	System Software for M7-300/400 • Program Design • System and Standard Functions • Installation and Operation
/4/	Manual:	M7-300 Programmable Controller • Installation and Hardware

Guidelines for Handling Electrostatically Sensitive Devices (ESD)

B

Introduction

This section explains

- What lies behind the term “electrostatically sensitive devices”
- What precautions must be observed when handling electrostatically sensitive modules.

Contents

You will find the following information about electrostatically sensitive modules in this appendix:

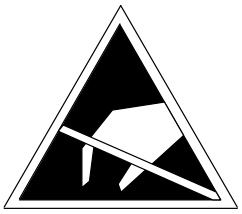
B.1 What Does ESD Mean?

Definition

All electronic modules are equipped with highly integrated devices or components. Because of their technology, these components are very sensitive to overvoltages and therefore to static electrical discharges.

The abbreviation **ESD** is used internationally for these **E**lectrostatically **S**ensitive **D**evices. In Germany these are referred to as EGB (Elektrostatisch Gefährdeten Baugruppen).

Electrostatically sensitive devices are identified with the symbol shown below:



Caution

Electrostatically sensitive devices can be destroyed by voltages well below those that you can normally detect. These voltages occur when you touch a component or the connections of a module without having first ensured that you are electrostatically discharged. The damage that can be caused to a module by overvoltage cannot usually be recognized immediately, but only becomes apparent after a lengthy period of operation.

B.2 Discharging Static Electricity from Persons

Discharging Before Handling

Any person whose electrical potential is not equalized to that in their environment can become electrostatically charged.

Figure B-1 shows the maximum electrostatic voltage with which a person can become charged when coming into contact with the materials shown. These values correspond to the figures in IEC 801-2.

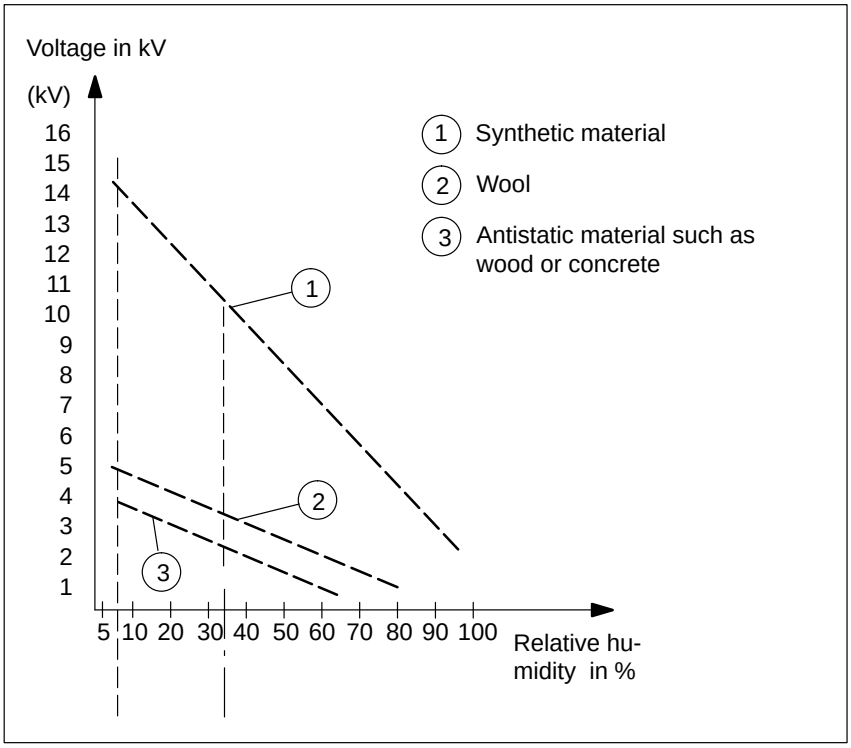


Figure B-1 Electrostatic Voltages with which a Person May Become Charged

B

B.3 Basic Precautions Against Electrostatic Discharge

Ensure a Good Ground

When handling electrostatically sensitive modules, ensure that persons, workplace and packaging are effectively earthed. This will avoid static charging.

Avoid Touching Components Directly

Only touch electrostatically sensitive components if this is unavoidable (for example during maintenance work). Hold the module so that you do not touch either the the module pins or the printed circuit tracks. In this way, the electrical discharge energy will not be able to reach sensitive components and cause damage.

If you have to take measurements on a module, first discharge any static about your body before carrying out the work. This can be done by touching a grounded metallic object. Use only grounded measuring instruments.

Glossary

A

Analog Module

Analog modules are signal converters for analog process signals.

Analog input modules convert analog measured values into digital values.

Analog output modules convert digital values into analog manipulated variables.

Application Function Module

Application function modules are a subset of → Function modules. The FM356-4 is an application function module.

AT Bus

Standard bus system in an AT-compatible PC (AT = Advanced Technology). Used in M7-300 to connect expansion modules to → Application function modules.

B

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.

Buffer Battery

The buffer battery ensures that the settings in the BIOS setup and the time are not lost when the mains power is off.

Bulk 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 S7-300 system accessory and is supplied with every FM356, every expansion module and every I/O module. The bus connector extends the S7-300 from an FM356 to the next adjacent module.

C

Configuring

Configuring is the arranging of individual modules within a programmable controller.

D

Default Setting

The default setting is a reasonable basic setting that can always be used if no other value is entered.

Digital Module

Digital modules are signal converters for binary process signals.

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

Expansion Module

An expansion module for the FM356 application function module is linked to the FM356 via an ISA (AT) bus interface and provides space for two or three → interface modules.

F

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 (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.

H

Hardware

Hardware covers all the physical and technical components of a programmable controller.

I

IEC 1131 Standard

The IEC 1131 standard contains the following:

- IEC 1131-1: Programmable logic controllers
  General information
- IEC 1131-2: Programmable logic controllers
  Equipment requirement and tests
  (Service, storage and transport conditions, methods of testing, information to be provided by the manufacturer)
- IEC 1131-3 Programmable logic controllers
  Programming languages

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 Standard bus system in an AT compatible PC → AT bus.

K

Key Switch The key switch is the → mode selector on the application function module.

L

Load Voltage Load voltage is the supply voltage for application function modules, expansion modules.

Local Bus Segment The standard configuration is a continuous S7-300 backplane bus. This bus can be split following a function module (for example FM356). The section of the backplane bus following the split is the local bus segment.

M

Main Memory The main memory is a read/write (RAM) memory in the FM356. The processor accesses the user program in this memory during processing.

Memory Card The memory card is a plug-in memory module. When used in an FM356, part or all of the software of the FM356 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 The mode selector (key switch) on an FM356 is used to reset and boot the FM356 and to set the operating modes, which are interrogated by the software.

The mode selector is operated by a removable key

Module Modules are plug-in printed circuit boards for programmable logic controllers.

Module Location

A module location is the position on the DIN rail where the individual modules of a PLC are inserted. There are fixed location numbers for these:

- Module location 1 is for the power supply module
- Module location 2 is for the S7-300-CPU
- Module location 3 is for the IM interface module
- Module locations 4 to 11 are for the I/O modules and the FM356 with its expansion modules

MS-DOS

Micro**s**oft **D**isk **O**perating **S**ystem, an operating system from Microsoft

P

Parameter Assignment

Parameter assignment is the setting of parameters that affect the behavior of a module.

PG

Programming device (**P**rogrammier**g**erät)

PLC

→ **P**rogrammable (**l**ogic) **c**ontroller

DIN Rail

The DIN rail is a rail to which the modules of an S7–300 are fitted.

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

Resident Data

Resident data is data that is not lost when the mains power is turned off.

S

S7-300 Backplane Bus

The S7-300 backplane bus is a serial data bus via which the modules communicate with one another and are supplied with some of the necessary voltages. The modules are linked using the bus connector.

A function module (FM356) and the expansion modules (for example EXM378-2, MSM378) are supplied with the necessary voltage by a separate cable because of their higher current requirements.

Signal Module

Signal modules make the connection between the S7-300 CPU and the process. If an FM356 is being used with a local bus segment, signal modules make the connection between the FM356 and the process. Signal modules are:

- → Digital input/output modules
- → Analog input/output modules
- → Simulator modules

Simulator Module

A simulator module is a module with which

- Digital input values can be simulated using operating elements and
- Digital output values can be displayed.

Software

Any or all of the programs that are used in a computer system are known as software. This includes the operating system and the user programs.

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