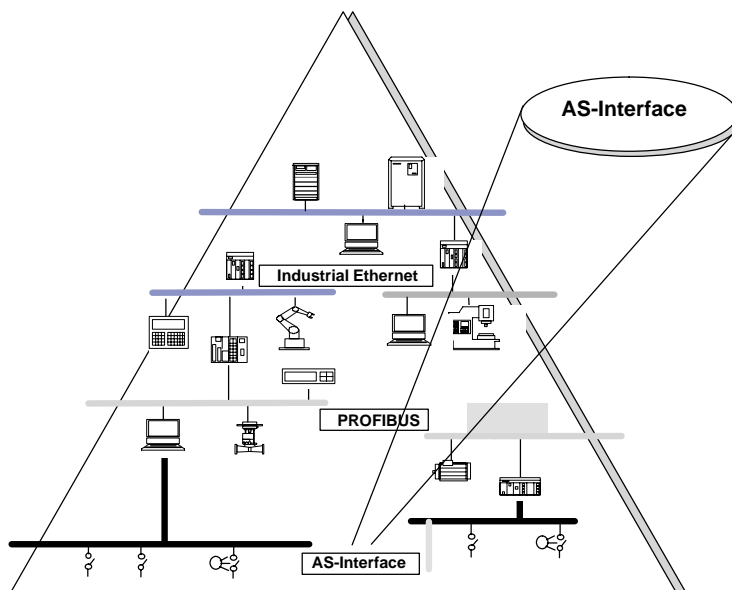


SIMATIC NET

AS-Interface – Introduction and Basic Information

Manual



Preface, Contents

AS-Interface (AS-i)

The AS-i Master

Further AS-i System Components

The Master Mode – Commands, Sequence, Programming

Appendix

References

Glossary

SIMATIC NET – Support and Training

1

2

3

4

A

B

C

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

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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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.

Technical data subject to change.
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Preface

Purpose of the Manual

This manual contains basic information and an introduction to the AS-Interface system concept and the corresponding system components.

You require this manual to understand the manuals that are shipped with the AS-i system components, particularly with the AS-i master.

New in this version



This release of the manual contains supplementary information relating to the expansion of the AS-i master specification and the extended SIMATIC NET product range.

This involves the following aspects:

- The extended addressing mode allows the addressing of up to 62 AS-i slaves.
- Integrated, simple analog value transfer.

The AS-Interface is an open international standard

The AS-Interface is the open international standard EN 50 295. Leading manufacturers of actuators and sensors support the AS-Interface world-wide. The electrical and mechanical specifications are available for interested companies.

Further Support – Who to Contact

If you have technical questions about using the product described here, please contact your local Siemens representative.

You will find further information in the appendix in “Support and Training”.

Other Documentation



You should also read the product information bulletins supplied with the AS-i components from SIMATIC NET and the manuals that can be ordered additionally.

Refer also to the references in the appendix of this manual.



Contents

1	AS-Interface (AS-i)	1-1
1.1	Area of Application	1-2
1.2	Overview of the AS-i System Components	1-4
1.2.1	AS-i Masters	1-5
1.2.2	AS-i Slaves	1-6
1.2.3	Further AS-i System Components	1-8
1.3	System Characteristics and Important Data	1-9
2	The AS-i Masters	2-1
2.1	AS-i Masters for the SIMATIC S7-200	2-2
2.2	AS-i Masters for the SIMATIC S7-300	2-4
2.3	AS-i Master for SIMATIC S5 PLCs in the Higher Performance Range ...	2-6
2.4	AS-i Master for SIMATIC S5 PLCs in the Lower Performance Range ...	2-7
2.5	AS-i Gateways	2-8
2.6	AS-i Master for ET 200X	2-10
2.7	AS-i Master for PC-AT	2-11
3	Further AS-i System Components	3-1
3.1	The AS-i Cable	3-2
3.2	AS-i Modules: Blocks of the AS-i Slaves	3-3
3.3	Installing an AS-i Module	3-5
3.4	AS-Interface Repeater / Extender	3-6
3.5	Addressing Unit	3-9
3.6	SCOPE Diagnostic Software for AS-Interface	3-10
4	The Master Mode – Commands, Sequence, Programming	4-1
4.1	Master-Slave Principle	4-2
4.1.1	Tasks and Functions of the AS-i Master	4-3
4.1.2	How an AS-i Slave Functions	4-4
4.2	Data Transfer	4-5
4.2.1	The Operating Phases	4-7
4.2.2	Interface Functions	4-10
4.2.3	Operating Extended AS-i Slaves with Standard AS-i Masters	4-11

A	References	A-1
B	Glossary	B-1
C	SIMATIC NET – Support and Training	C-1
	Index	



AS-Interface (AS-i)

This chapter deals with the following topics:

- The range of applications that can be covered by the AS-Interface
- Which system components are available on the AS-Interface
- The system properties of the AS-Interface

1.1 Area of Application

AS-i Cable Replaces “Cable Harnesses”

The Actuator/Sensor Interface or AS-Interface, normally abbreviated to **AS-i**, is a connection system for the lowest process level in automation systems. The cable harnesses previously found at this level are replaced by a single electrical cable, the AS-i cable. Using the AS-i cable and the AS-i master, the simplest binary sensors and actuators can be connected to the control devices at the field level via AS-i modules.

AS-Interface in SIMATIC

AS-Interface is the SIMATIC product name for the AS-i technology.

Under the name AS-interface, Siemens produces master interface modules for industrial PCs and programmable controllers. The range of available master interface modules is being permanently extended. Up-to-date information can be obtained from your local Siemens office.

The following diagram illustrates the position of AS-i within the automation system.

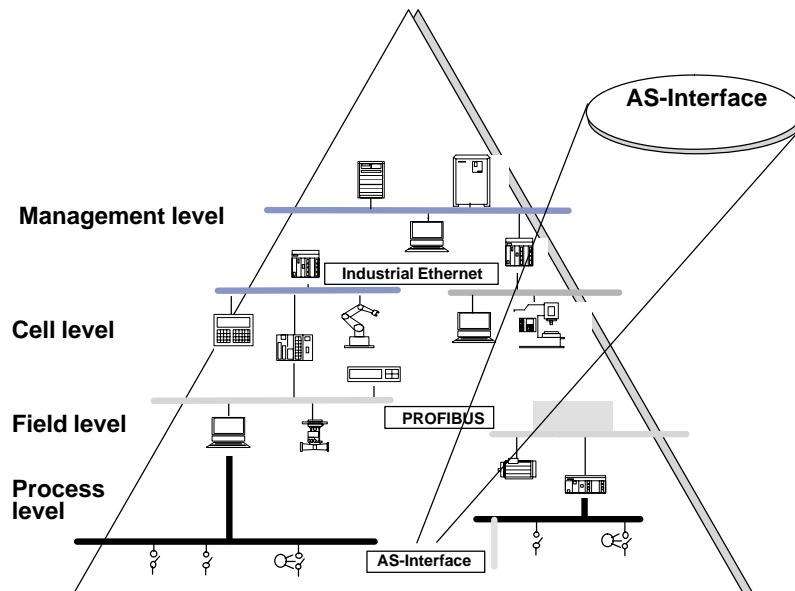


Figure 1-1

The AS-interface is distinguished by several main characteristics:

- AS-interface is optimized for connecting binary sensors and actuators. The AS-i cable is used both for data exchange between the sensors/actuators (AS-i slaves) and the AS-i master as well as for power supply to the sensors / actuators.

- Simple and cost-effective wiring: simple installation with the “penetration” technique, high flexibility with tree-like wiring.
- Fast reaction times: the AS-i master requires a maximum of 5 ms for cyclic data exchange with up to 31 nodes.
- Nodes (AS-i slaves) on the AS-i cable can be either sensors/actuators with an integrated AS-i connector or AS-i modules to which up to four conventional binary sensors/actuators can be connected.
- With standard AS-i modules, up to 124 actuators/sensors can be operated on the AS-i cable.
- If you use AS-i modules with the extended addressing mode, up to 186 actuators and 248 sensors can be operated with one extended master.
- Extended AS-i masters from SIMATIC NET support extremely simple access to analog sensors/actuators or modules operating in compliance with the AS-Interface slave profile 7.3/7.4.

AS-i - Open Standard for Network Systems at the Process Level

The electrical and mechanical specifications for AS-i were compiled by eleven companies active in the field of binary sensors and actuators. The specifications are available for companies with interests in this field. This makes AS-i an open, heterogeneous standard. With AS-interface, Siemens provides a system complying with the AS-i standard.

The “Association for Promoting Interfaces with Bus Capability for Binary Actuators and Sensors” (AS-i Association) is responsible for promoting the application and dissemination of the AS-i system; in particular the specification, standardization, certification and general user information.

1.2 Overview of the AS-i System Components

System Components in the AS-i Network

- AS-i master
- AS-i slaves, distinguished according to their design as follows:
 - AS-i modules
 - Sensors/actuators with an integrated AS-i connection
- AS-i cable
- AS-i power supply unit
- Addressing unit
- SCOPE for AS-Interface

The following diagram illustrates how the described components can be interconnected. The tree structure is particularly clear.

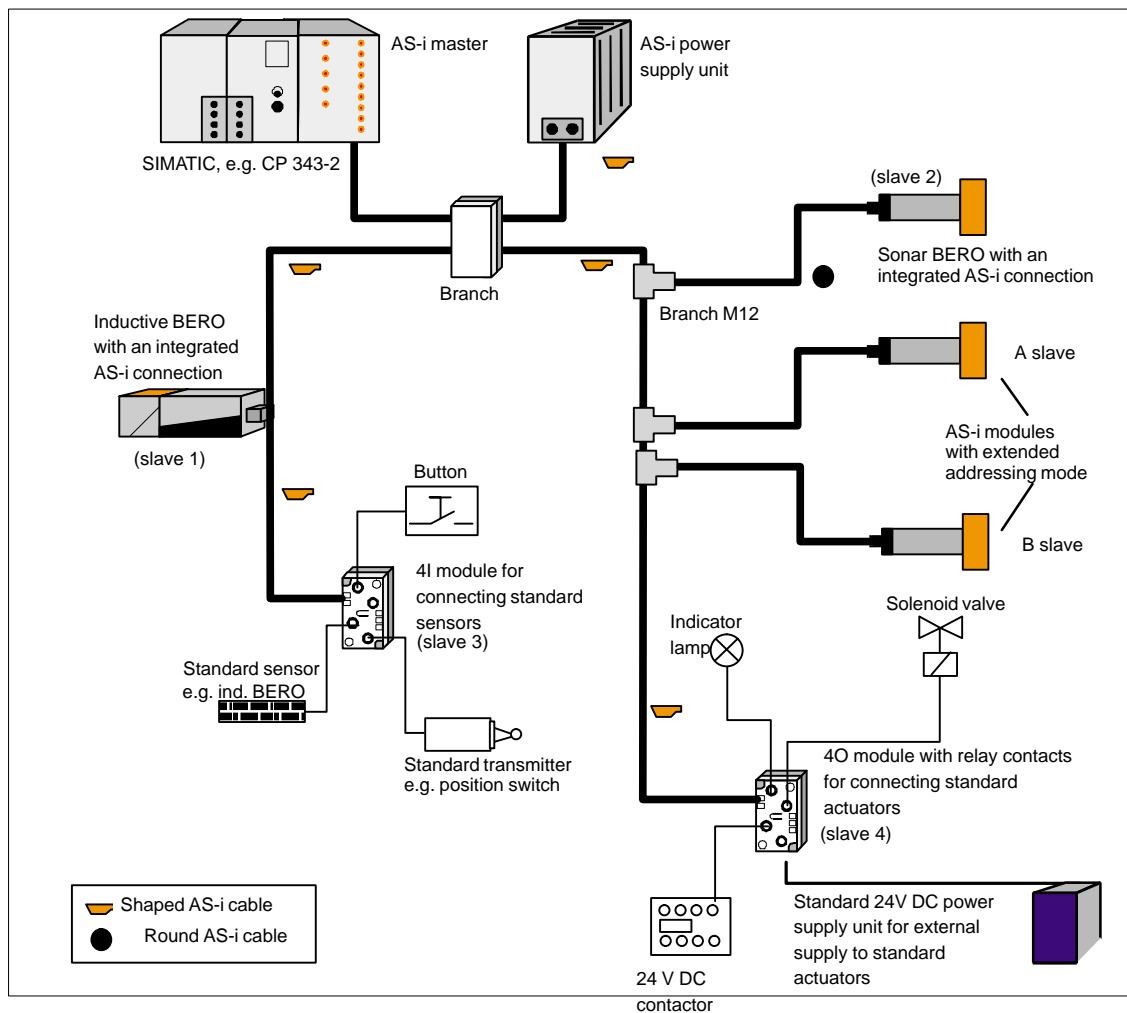


Figure 1-2

1.2.1 AS-i Masters

Siemens currently produces the following AS-i masters:

- **Standard AS-i Master**

Up to 31 standard slaves or slaves with the extended addressing mode (A slaves only) can be attached to standard AS-i masters.

for System	Standard AS-i master
SIMATIC S5 PLC:	CP 2433 for S5-90U, S5-95U, S5-100U, CP 2430 for S5-115U, S5-135U, S5-155U
SIMATIC S7 PLC:	CP 242-2 for S7-200 CP 242-8 for S7-200 CP 342-2 for S7-300
SIMATIC C7:	C7-621 ASi
Distributed I/Os:	DP/AS-Interface Link 20 (type of protection IP 20) CP 242-8 for S7-200 CP 2433 for ET 200U CP 342-2 for ET 200M CP 142-2 for ET 200X DP/AS-Interface Link (type of protection IP 65)
IBM-compatible PCs:	CP 2413 for PC-AT

- **Extended AS-i Masters**

- Addressing mode

The extended AS-i masters support 31 addresses that can be used for standard AS-i slaves or AS-i slaves with the extended addressing mode. AS-i slaves with the extended addressing mode can be connected in pairs (programmed as A or B slaves) to an extended AS-i master and can use the same address. This increases the number of addressable AS-i slaves to a maximum of 62.

Due to the address expansion, the number of binary outputs is reduced to three per AS-i slave on slaves using the extended addressing mode.

- Integrated analog value transfer for AS-i slaves complying with profile 7.3/7.4

The extended AS-i masters of SIMATIC NET support the integrated transfer of AS-Interface analog slaves that operate in compliance with profile 7.3/7.4 of the AS-Interface specification. Analog slaves operating with this profile can be addressed extremely simply by the user program.

for System	Extended AS-i masters
SIMATIC S7 PLC:	CP 243-2 for S7-200 CP 343-2 for S7-300
Distributed I/Os:	DP/AS-Interface Link 20E (type of protection IP 20) CP 343-2 for ET200M

Note

Since the range of available AS-i masters is constantly being extended, consult your Siemens representative about further AS-i masters.

1.2.2 AS-i Slaves

All the nodes that can be addressed by an AS-i master are known as AS-i slaves.

AS-i Slave Assembly System

AS-i slaves with the following assembly systems are available:

- AS-i modules
AS-i modules are AS-i slaves to which up to 4 conventional sensors and up to 4 conventional actuators can be connected.
- Sensors/actuators with an integrated AS-i connection
Sensors/actuators with an integrated AS-i connection can be connected directly to the AS-Interface.

Addressing Mode

AS-i slaves are available with the following addressing modes:

- Standard slaves

Standard slaves each occupy one address on the AS-Interface. Up to 31 standard slaves can be connected to the AS-Interface.

- Slaves with the extended addressing mode (A/B slaves)

Slaves with the extended addressing mode can be operated in pairs at the same address with an extended AS-i master. This doubles the number of addressable AS-i slaves to 62.

One of these AS-i slaves must be programmed as an A slave using the addressing unit and the other as a B slave. Due to the address expansion, the number of binary outputs is reduced to three per AS-i slave.

A slaves can also be operated with a standard AS-i master (see also Section 4.2.3)

For more detailed information about these functions, refer to the AS-i master in the previous section.

Analog Slaves

Analog slaves are special AS-i standard slaves that exchange analog values with the AS-i master. Analog slaves are available with the following profiles:

- Analog slaves complying with profile 7.1/7.2

Analog slaves complying with profile 7.1/7.2 require special program sections in the user program (drivers, function blocks) that execute the sequential transfer of analog data.

- Analog slaves complying with profile 7.3/7.4

Analog slaves complying with profile 7.3/7.4 are intended for operation with extended AS-i masters. The extended AS-i masters handle the exchange of analog data with these slaves automatically. No special drivers or function blocks are required in the user program.

1.2.3 Further AS-i System Components

AS-i Cable

The AS-i cable, designed as an unshielded 2-wire cable, transfers signals and provides the power supply for the sensors and actuators connected using AS-i modules.

Networking is not restricted to one type of cable. If necessary, appropriate modules or “T pieces” can be used to change to a simple 2-wire cable.

Note

If you change to a simple 2-wire cable, keep in mind the technical restrictions such as cable cross section, voltage drop, and cable length as described in the AS-i specification (see /1/ and /2/).

AS-i Power Supply Unit

The AS-i power supply unit supplies power for the AS-i nodes connected to the AS-i cable. For actuators with particularly high power requirements, the connection of an additional load power supply may be necessary (for example using special application modules).

Addressing Unit

The addressing unit allows simple programming of AS-i slave addresses.

SCOPE for AS-Interface

SCOPE AS-interface (previously SCOPE S1) is a monitoring program for WINDOWS which can record and evaluate the data exchange in AS-i networks during the commissioning phase and during operation. SCOPE AS-interface can be operated on a PC under WINDOWS in conjunction with the AS-i master communications processor CP 2413.

1.3 System Characteristics and Important Data

How the AS-Interface Functions

The AS-Interface/AS-i system operates as outlined below:

- **Master-slave access techniques**

The AS-i interface is a “single master system”. This means that there is only one master per AS-i network which controls the data exchange. This polls all AS-i slaves one after the other and waits for a response.

- **Electronic address setting**

The address of an AS-i slave is its identifier. This only occurs once within an AS-Interface system. The setting can either be made using a special addressing unit or by an AS-i master. The address is always stored permanently on the AS-i slave. When they are supplied, the AS-i slaves always have the address “0”.

- **Operating reliability and flexibility**

The transmission technique used (current modulation) guarantees high operating reliability. The master monitors the voltage on the cable and the transferred data. It detects transmission errors and the failure of slaves and sends a message to the PLC. The user can then react to this message.

Replacing or adding AS-i slaves during normal operation does not affect communication with other AS-i slaves.

Physical Characteristics

The most important physical characteristics of the AS-Interface and its components are as follows:

- **2-wire cable for data and power supply**

A simple 2-wire cable with a cross section of $2 \times 1.5 \text{ mm}^2$ can be used. Shielding or twisting is not necessary. Both the data and the power are transferred on this cable. The power available depends on the AS-i power supply unit used.

For optimum wiring, the mechanically coded AS-i cable is available preventing the connections being reversed and making simple contact with the AS-i application modules using the penetration technique.

- **Tree structure network with a cable length up to 100 m**

The “tree structure” of the AS-Interface allows any point on a cable section to be used as the start of a new branch. The total length of all subsections can be up to 100 m.

- **Direct integration**

Practically all the electronics required for a slave have been integrated on a special IC. This allows the AS-i connector to be integrated directly in binary actuators or sensors. All the required components can be installed within a

space of approximately 2 cm³.

- **Increased functionality, more uses for the customer**

Direct integration allows devices to be equipped with a wide range of functions. Four data and four parameter lines are available. The resulting “intelligent” actuators/sensors increase the possibilities, for example, monitoring, parameter assignment, wear or pollution checks etc.

- **Additional power supply for higher power requirements**

An external source of power can be provided for slaves with a higher power requirement (see /1/).

System Limits

- **Cycle time**

- **max. 5 ms with standard AS-i slaves**
- **max. 10 ms with AS-i slaves using the extended addressing mode**

AS-i uses constant message lengths. Complicated procedures for controlling transmission and identifying message lengths or data formats are not required. This makes it possible for a master to poll all connected standard slaves within a maximum of 5 ms and to update the data both on the master and slave.

If only one AS-i slave using the extended addressing mode is located at an address, this slave is polled at least every 5 ms. If two extended slaves (A and B slave) share an address, the maximum polling cycle is 10 ms. (B slaves can only be connected to extended masters.)

- **Number of connectable AS-i slaves**

- **Maximum of 31 standard slaves**
- **Maximum of 62 slaves with the extended addressing mode**

AS-i slaves are the input and output channels of AS-i system. They are only active when called by the AS-i master. They trigger actions or transmit reactions to the master when commanded.

Each AS-i slave is identified by its own address (1 to 31). A maximum of 62 slaves using the extended addressing mode can be connected to an extended master. Pairs of slaves using the extended addressing mode occupy one address; in other words, the addresses 1 to 31 can be assigned to two extended slaves.

If standard slaves are connected to an extended master, these occupy a complete address; in other words, a maximum of up to 31 standard slaves can be connected to an extended master.

- **Number of inputs/outputs**

- **A maximum of 248 binary inputs and outputs with standard modules**
- **A maximum of 248 inputs/186 outputs with modules using the extended addressing mode**

Each standard AS-i slave can receive 4 bits of data and send 4 bits of data.

Special modules allow each of these bits to be used for a binary actuator or a binary sensor. This means that an AS-i cable with standard AS-i slaves can have a maximum of 248 binary attachments (124 inputs and 124 outputs). All typical actuators or sensors can be connected to the AS-interface in this way. The modules are used as distributed inputs/outputs.

If modules with the extended addressing mode are used, a maximum of 3 inputs and 3 outputs is available per module; in other words a maximum of 248 inputs and 186 outputs can be operated with modules using the extended addressing mode.

Range of Functions of the Master Modules

The functions of the AS-i master modules are stipulated in the AS-i master specification (see /1/ and /2/). An overview of these functions can be found in the PICS in the appendix of the master module manual.



The AS-i Masters

AS-Interface is a single-master system. For SIMATIC systems, there are communications processors (CPs) that control the process or field communication as the AS-i masters.

These also include gateways that operate like an AS-i master and allow access to the actuators and sensors, for example, of PROFIBUS DP.

This chapter introduces you to these AS-i system components. For more detailed information on handling, configuring, and programming, refer to the manual of the relevant device.

2.1 AS-i Masters for the SIMATIC S7-200

CP 242-2 (Standard AS-i Master)

The CP 242-2 module allows the connection of an AS-i chain to the S7-200 programmable logic controller. The CP 242-2 provides the complete functionality of the AS-i master specification for standard AS-i masters (profile M1).

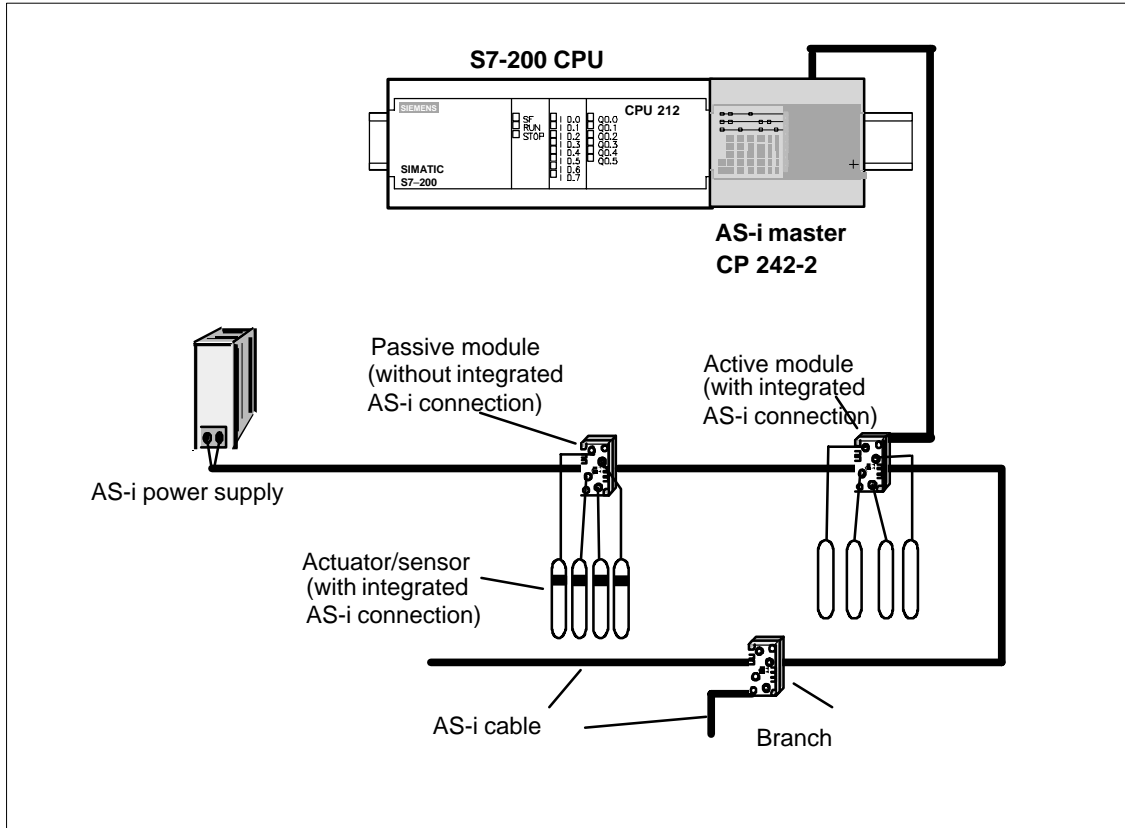


Figure 2-1

CP 243-2 (Extended AS-i Master)

The CP 243-2 module allows connection of an AS-i chain to the new S7-200 series (CPU 222, CPU 224, etc.). The CP 243-2 is an extended master complying with profile M1e; in other words, it covers the complete functionality of the AS-i master specification for extended AS-i masters.

CP 242-8 (Standard AS-i Master)

The CP 242-8 has not only the functions of the CP 242-2 but also a connection to PROFIBUS DP (DP slave). This allows the cost-effective connection of an S7-200 to PROFIBUS DP and the AS-Interface at the same time.

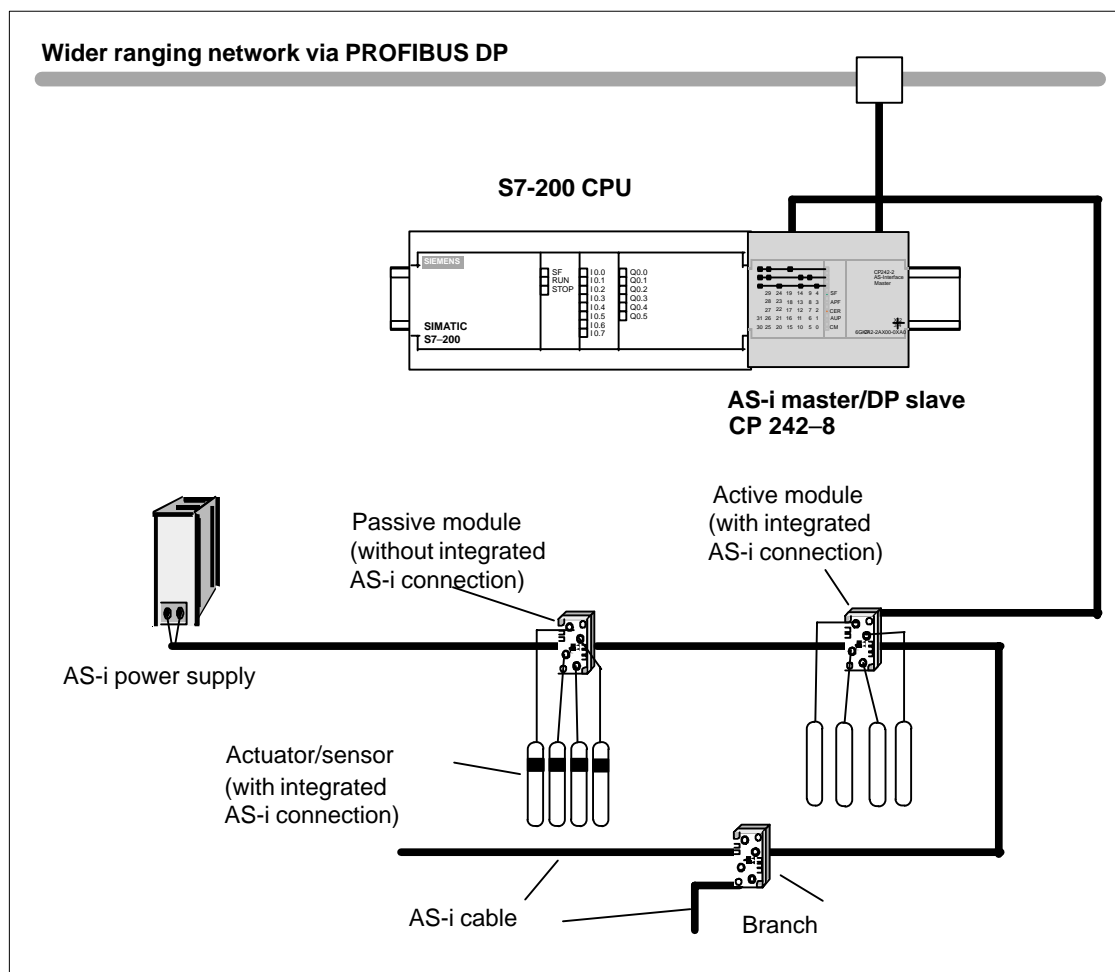


Figure 2-2

2.2 AS-i Masters for the SIMATIC S7-300

CP 342-2 (Standard AS-i Master)

The CP 342-2 is available as the standard AS-i master module for controllers of the S7-300 range and for the ET 200M distributed I/O system.

The CP 342-2 occupies 16 input and 16 output bytes in the analog area of the controller via which the input data of the slaves can be read and the output data of the slaves can be set.

When using an FC, in addition to the I/O data exchange, it is also possible to execute master calls from within the control program. The FC is supplied on a diskette along with the manual for the CP 342-2.

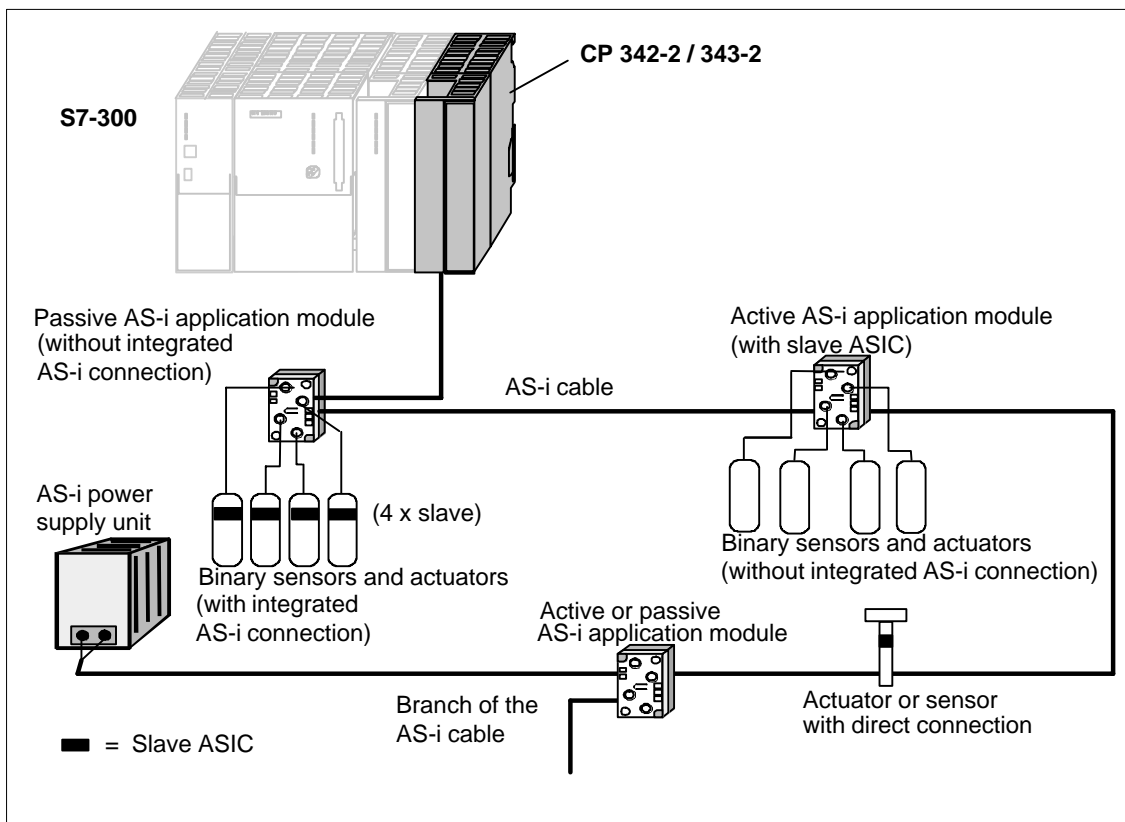


Figure 2-3

CP 343-2 (Extended AS-i Master)

The CP 343-2 is an extended AS-i master for S7-300 series controllers and the ET 200 M distributed I/O system.

The CP 343-2 occupies 16 input and 16 output bytes in the analog area of the controller via which the AS-i standard slaves and AS-i A slaves can be addressed. AS-i B slaves have an additional I/O area that is accessible using SFCs.

When using an FC, in addition to the I/O data exchange, it is also possible to execute master calls from within the control program. The FC is supplied on a diskette along with the manual for the CP 343-2.

2.3 AS-i Master for SIMATIC S5 PLCs in the Higher Performance Range

CP 2430 (Standard AS-i Master)

The CP 2430 is available as a master module (AS-i standard master) for programmable controllers of the S5-115U, S5-135U, S5-155U series.

The CP 2430 is a double master that can operate two independent AS-i networks each with a maximum of 31 slaves.

If required, the AS-i master can be used like an I/O module in the PLC to address the input and output data of the AS-i slaves. In the address area of the PLC, it occupies 16 input and 16 output bytes per AS-i chain, in other words a total of 32 input bytes and 32 output bytes. In terms of programming the PLC, there is no difference between an AS-i master and standard I/O modules. The software only needs a minimum of adaptation.

If handling blocks are used, the full range of functions according to the AS-i master specification is available. As an option, the I/O data can also be transferred to the CP 2430 using handling blocks. In this case, the CP 2430 does not occupy any space in the I/O address area of the controller.

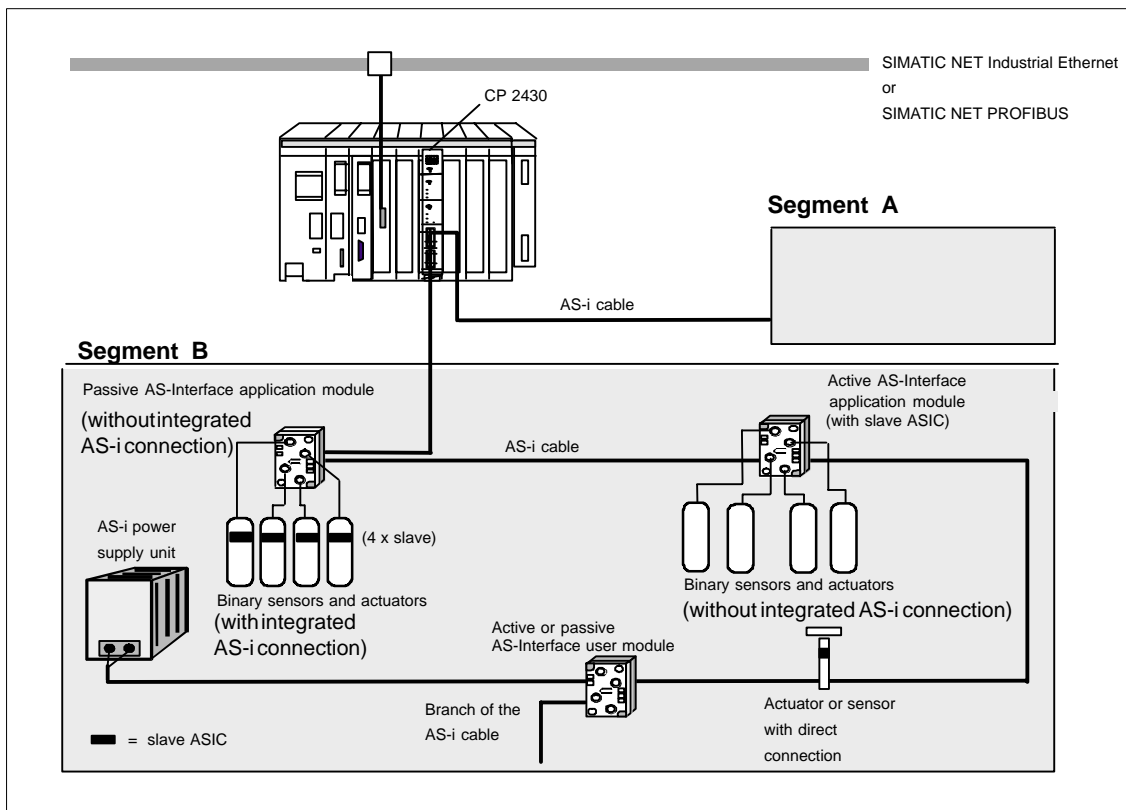


Figure 2-4 Example of a SIMATIC S5 System Configuration with the CP 2430

2.4 AS-i Master for SIMATIC S5 PLCs in the Lower Performance Range

CP 2433 (Standard AS-i Master)

The CP 2433 is available as a master module (AS-i standard master) for programmable controllers of the S5-90U, S5-95U, S5-100U series and the ET 200U distributed I/O system.

The AS-i master is used like an I/O module in the PLC to address the input and output data of the AS-i slaves. In the address area of the PLC, it occupies 16 input bytes and 16 output bytes. When programming the PLC, the user does not see any difference between an AS-i master and standard I/O modules. The software only needs a minimum of adaptation.

If a function block is used, the complete range of functions according to the AS-i master specification is available. This function block is available for the SIMATIC S5-95U and S5-100U / CPU 103 and is supplied on diskette with the manual for the CP 2433.

The CP 2433 occupies a double slot on the bus bar.

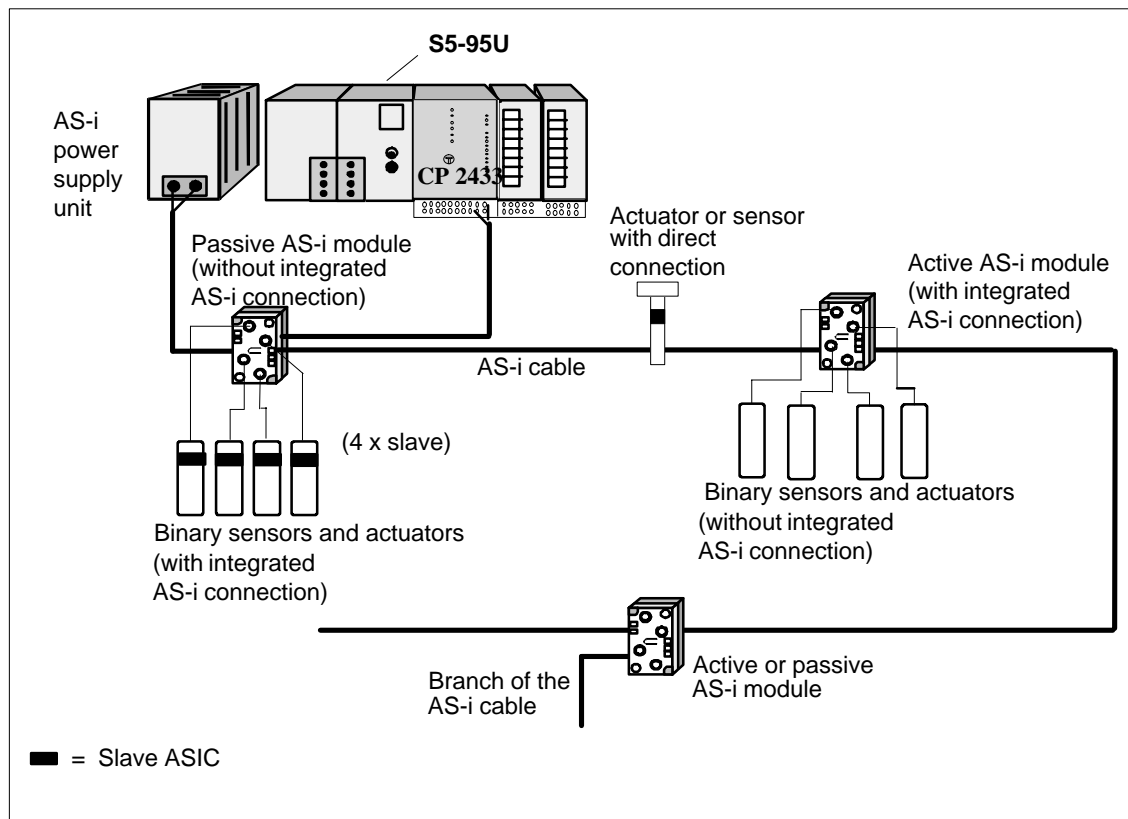


Figure 2-5 Example of a SIMATIC S5 PLC with the CP 2433

2.5 AS-i Gateways

DP / AS-i Gateway

Even when using the PROFIBUS DP distributed I/Os, the use of AS-Interface can have advantages. The networking of the process peripherals can be extended beyond PROFIBUS to include the actuators/sensors.

The following devices can be used as gateways to PROFIBUS:

- DP/AS-Interface Link 20 (a link designed in compliance with IP 20 for interfacing AS-Interface to PROFIBUS DP)
- DP/AS-Interface Link 20E (link designed in compliance with IP 20 with extended AS-i master functionality for interfacing AS-Interface to PROFIBUS-DP)
- CP 242-8 (simultaneous connection of an S7-200 to PROFIBUS DP and AS-Interface)
- CP 142-2 in the ET 200X
- CP 342-2 in the ET 200M
- CP 343-2 in the ET 200M (extended master)
- CP 2433 in the ET 200U
- S5-95U PLC with PROFIBUS interface and CP 2433
- S7-300 / CPU 315-2 DP with CP 342-2 or DP343-2
- DP/AS-Interface Link (link designed in compliance with IP 65 for connecting the AS-Interface to PROFIBUS DP)

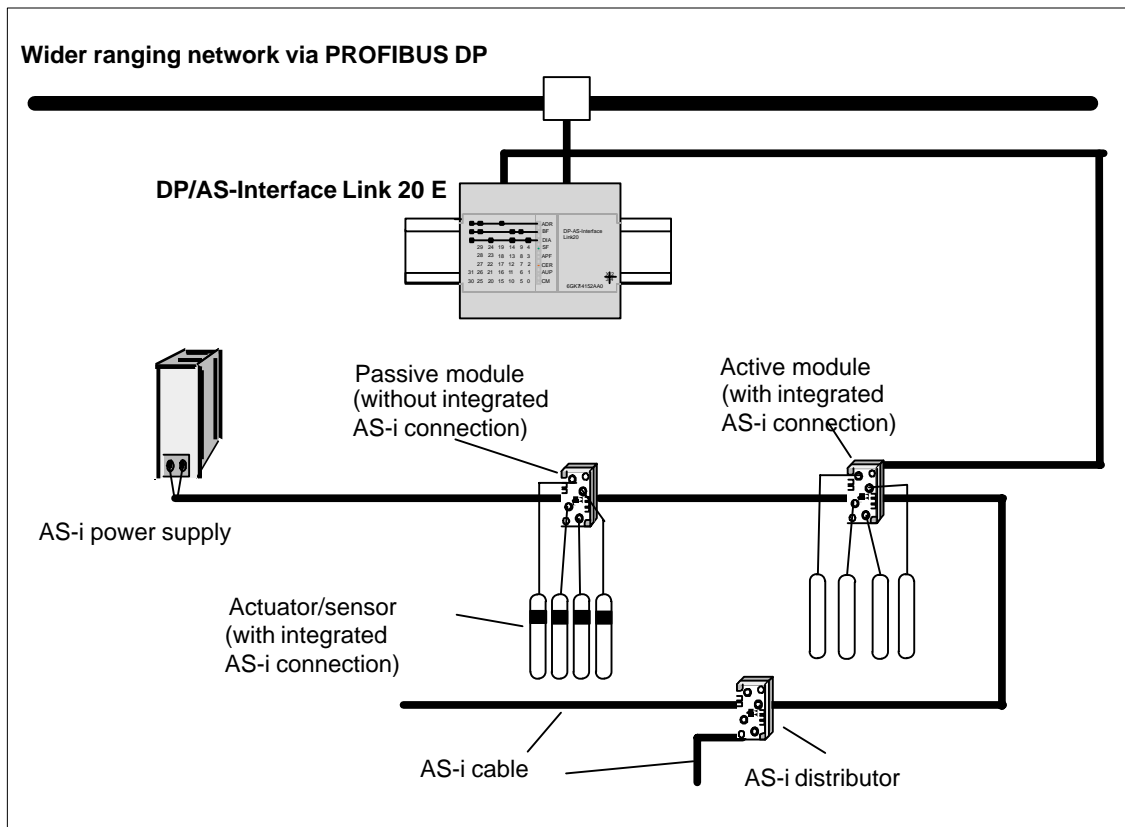


Figure 2-6 Example of a System Configuration with the DP/AS-Interface Link 20

2.6 AS-i Master for ET 200X

CP 142-2 (Standard AS-i Master)

The CP 142-2 module (AS-i standard master) can be operated in the ET 200X distributed I/O system. It allows the connection of an AS-i chain to the I/O device. The special feature of the ET 200X distributed I/O system is its rugged construction complying with IP 65, IP 66 and IP 67.

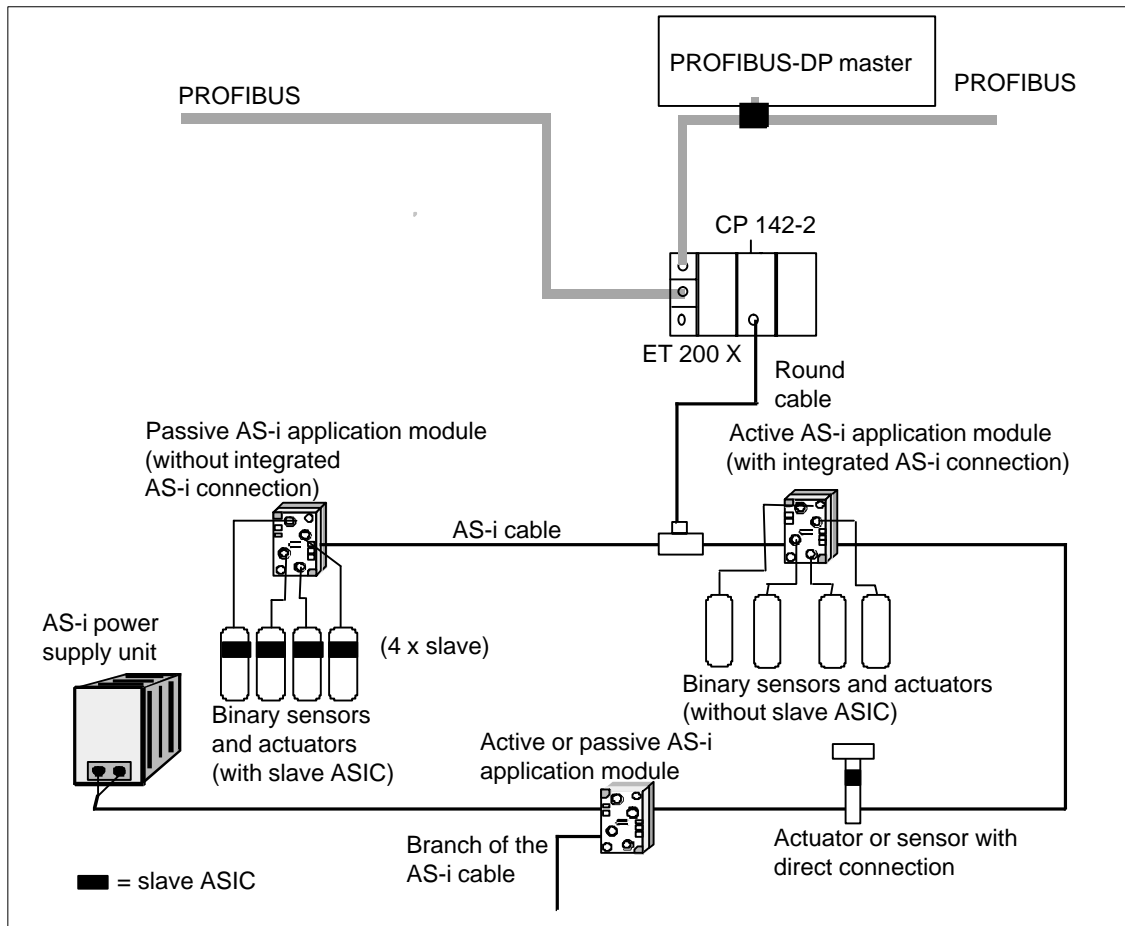


Figure 2-7 Example of an ET 200X with CP 142-2

2.7 AS-i Master for PC-AT

CP 2413 (Standard AS-i Master)

The CP 2413 (AS-i standard master) allows the attachment of AS-Interface to PCs.

The hardware of the AS-i master is implemented as a short PC-AT card. Up to four AS-i master CPs can be operated at the same time in one PC. This means that the Siemens AS-i PC master is also suitable for complex control tasks. The firmware running on the PC master is loaded when the host is started up.

An operating and demonstration program is available which provides the current status of the slaves on the cable and permits simple operation of the slaves. This program can also be used for diagnostic purposes; it also allows the programming of the addresses of AS-i slaves.

Since not only the AS-i master card can be operated in a PC, but also PC interfaces for the Industrial Ethernet and PROFIBUS bus at the same time, the data supplied by the AS-i slaves can also be made available to other stations in the network.

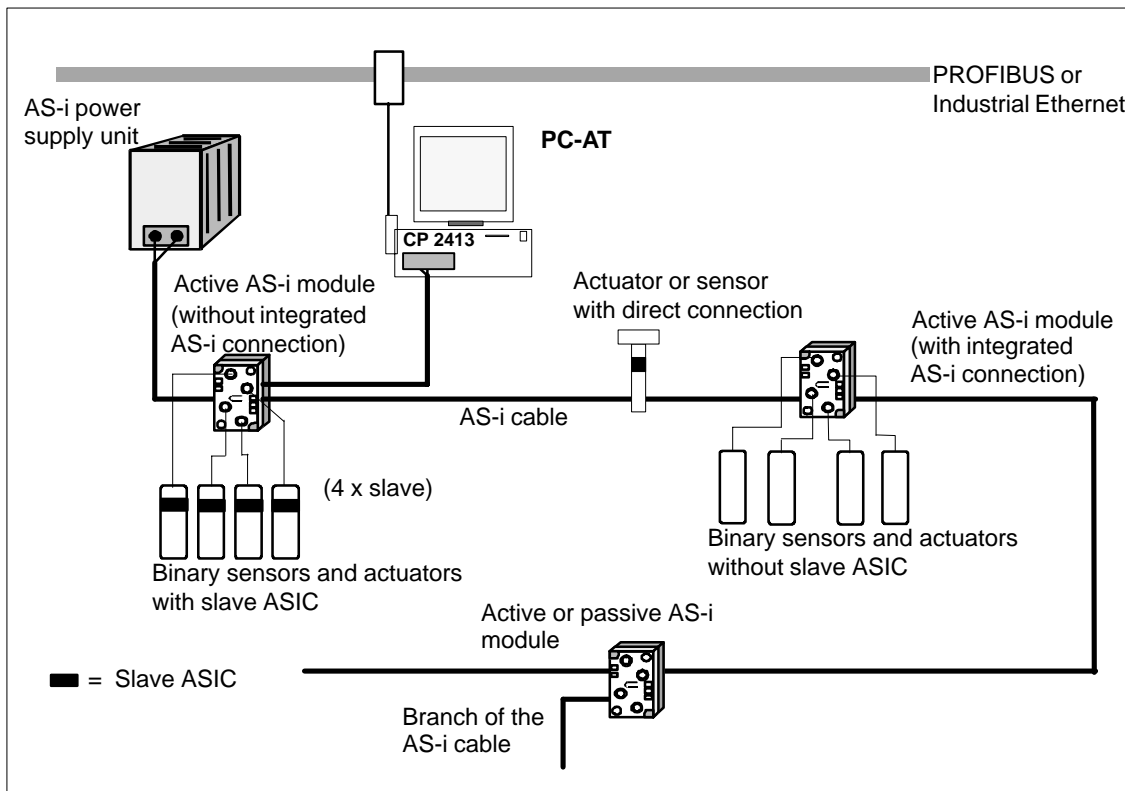


Figure 2-8 Example of a System Configuration with PC-AT and CP 2413

Library for Integrating the AS-i Functions

There are masters and libraries for C and Visual Basic applications for the master under MS-DOS and Windows. These functions are described in the “CP 2413 AS-i Master Module” manual.



Further AS-i System Components

As well as the AS-i masters described in this manual, the components of the AS-i transmission system and the AS-i slaves are also required on the AS-Interface.

The following sections provide an overview of the basic characteristics and interaction of these components.

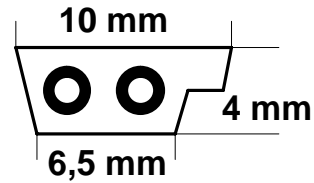
Due to the continuing development of new AS-i system components, a complete presentation of all the currently available components is not possible. Refer to the available system catalogs and ask your Siemens office for more information.

3.1 The AS-i Cable

Design and Advantages

The AS-i cable (shaped cable) allows simple and fast installation of an AS-i system. The AS-i cable is a rubberized 2-wire cable ($2 \times 1.5 \text{ mm}^2$). The profile section prevents stations being connected with incorrect polarity.

The AS-i cable is contacted using the penetration technique. Contact blades penetrate the rubber jacket and make contact with the two wires. This guarantees a low contact resistance and ensures a reliable data connection. The cable does not need to be cut, have its insulation removed or be screwed down. For this type of connection, there are coupling modules designed for the penetration technique.



The jacket of the AS-i cable is rubber. If modules need to be moved after they have been connected to the AS-i cable this is possible without causing any problems. The AS-i cable is “self-healing”. This means that the holes made by the contact blades in the rubber jacket of the cable close themselves and revert to the type of protection IP67. When the cable is installed in an AS-i module, the cable seals the openings. The type of protection IP67 is therefore achieved.

Use of Other 2-Wire Cables

Apart from the special AS-i cable, any 2-wire cable with a cross-section of $2 \times 1.5 \text{ mm}^2$ can be used. Shielding or twisting is not necessary. For the transition from the special AS-i cable to a different cable (e.g. a standard round cable) there is a special module available without integrated electronics (transition from the AS-i cable to four M12 connectors and transition from the AS-i cable to one M12 connector).

3.2 AS-i Modules: Blocks of the AS-i Slaves

Concept

Within the AS-i system, the AS-i modules can be compared with input and output modules. Along with the actuators and sensors they make up the AS-i slaves and connect the slaves to the AS-i master. The actuators/sensors are connected via M12 connectors. The pinout corresponds to DIN IEC 947 5-2. The modules with dimensions of approximately 45 x 45 x 80 mm are used locally on the machine itself. They are connected via the AS-i cable and have the degree of protection IP67.

Active and Passive Modules

The following modules must be distinguished:

- The **active** AS-i module with integrated AS-i chip
Using this, conventional sensors and actuators can be connected. Every normal actuator or sensor can therefore be networked via AS-i.
- The **passive** AS-i module
This does not contain its own electronics and allows the connection of AS-i sensors and actuators with integrated AS-i chips.

In keeping with the concept of the standard AS-i master and the extended AS-i master (see Section 1.2), either AS-i chips with standard functions or with extended functions are used.

The modules are designed so that a uniform electromechanical interface to the AS-i cable can be created. This is achieved with the uniform lower section of the module, which is therefore also known as a coupling module.

Specially constructed upper module sections, also known as application modules are also available. The variations in the module components range from the simple cover for branching the AS-i cable to application modules with integrated AS-i chips for connecting up to four conventional sensors or actuators.

Example:

The following diagram illustrates an active AS-i module for four connections.

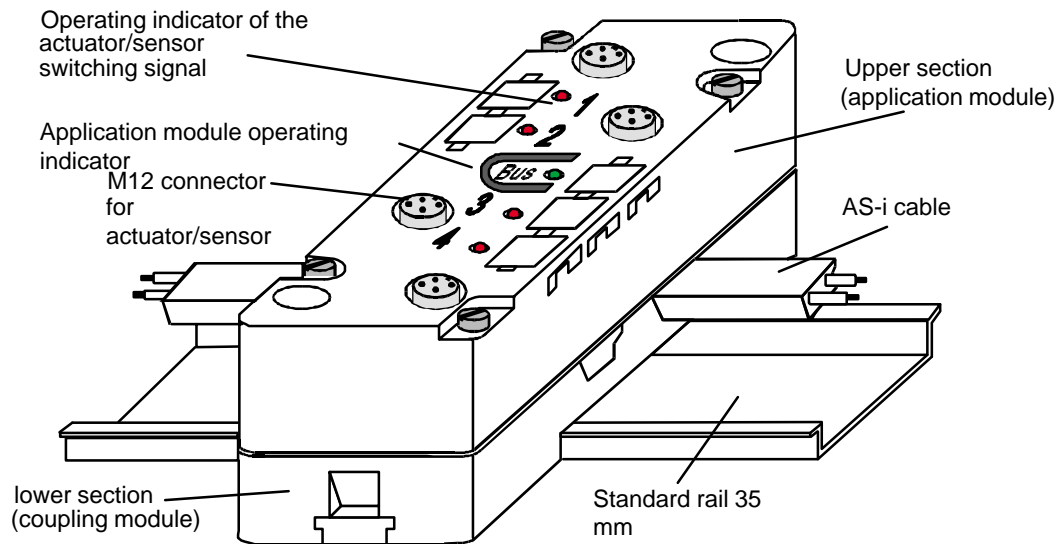


Figure 3-1

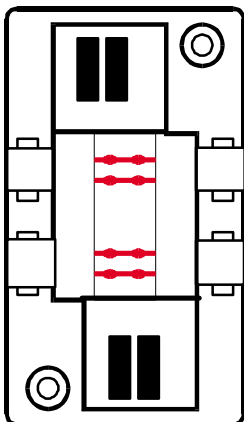
Note

Please ask your local sales office or distributor about other AS-i modules (for example 4I/4O module).

3.3 Installing an AS-i Module

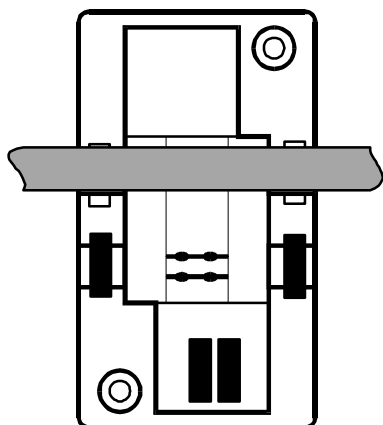
The installation of an AS-i module on the AS-i cable is particularly simple using the connection technique described. This is made clear by the following illustration:

Figure 3-2



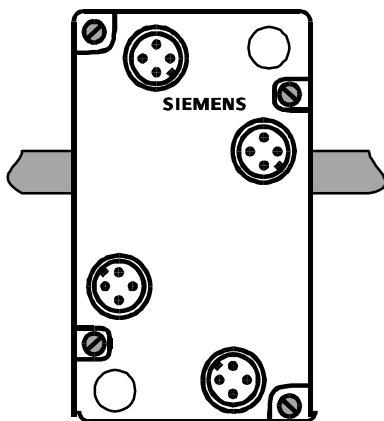
1. The coupling module is screwed or clipped onto a 35 mm standard rail. The coupling module includes four stoppers. These are used to close unused cable openings.

Figure 3-3



2. The AS-i cable is inserted. It locks into a guide above the contact blades and is secured mechanically. No electrical contact is established. Two stoppers are inserted in the unused cable opening.

Figure 3-4



3. By screwing down the application module, the AS-i cable is pressed onto the contact blades. They penetrate the conductors at two points and guarantee a reliable connection. After correct installation, the module has the type of protection IP67.

3.4 AS-Interface Repeater / Extender

Area of Application

The AS interface repeater and extender is intended for use in an actuator-sensor interface environment.

The device is used to extend the maximum possible length of the AS-interface of 100 m. An existing 100 m segment can be extended by a maximum of two further 100 m segments.

Using the Repeater

The AS-interface repeater is used when slaves must be operated on all cable segments. A separate AS-interface power supply unit is then required for each AS-interface segment (before and after the repeater). The repeater has the following features:

- Extends the cable length to a maximum of 300m.
- Slaves can be used on both sides of the repeater.
- A power supply unit is required on both sides of the AS interface.
- Electrical isolation of the two cables.
- Separate indication of the correct voltage for each side.
- Installation in standard application module casing.

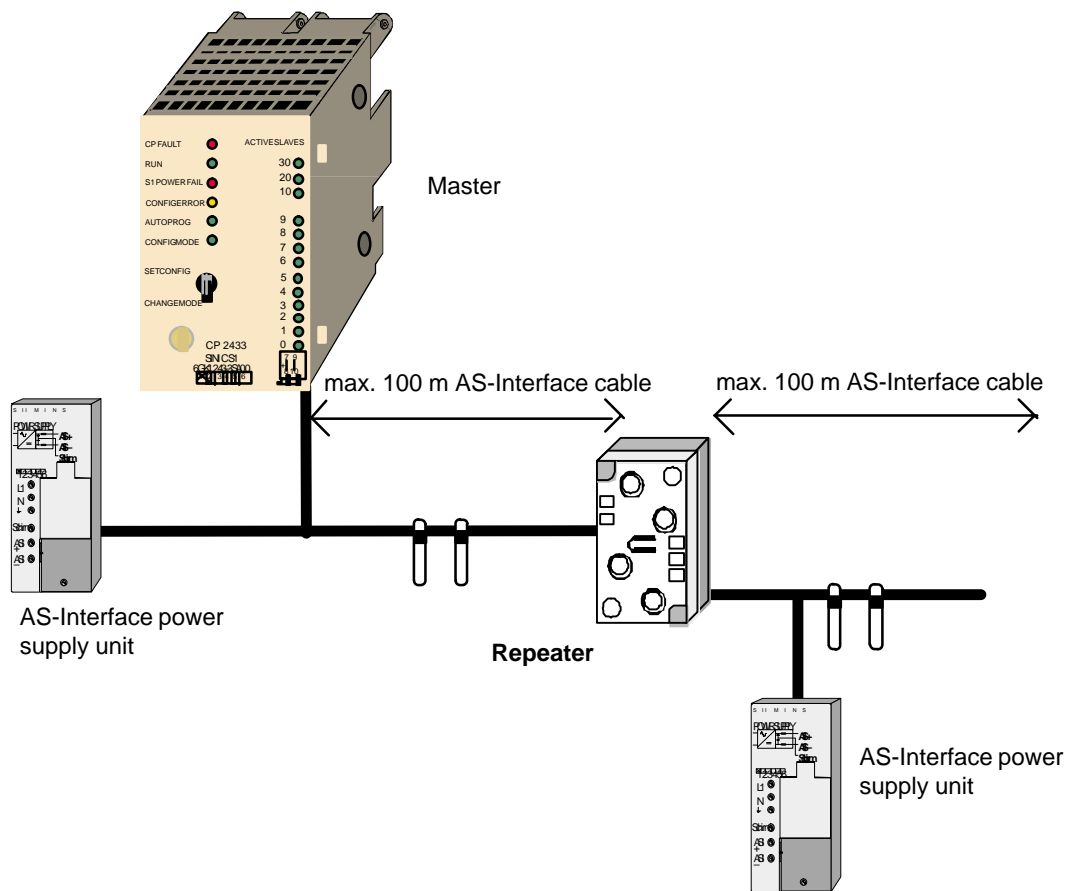


Figure 3-5 Using the Repeater

Using the Extender

The AS-Interface extender is used in applications in which the master is installed at a greater distance from the actual AS-Interface installation:

- Masters can be located up to 100 m from the AS-interface segment.
- Slaves can only be used on the side of the extender away from the master.
- Power supply is only required on the side away from the master.
- No electrical isolation of the two cables.
- Indication of the correct voltage.
- Installed in standard application module casing. The extender is mounted on the FK-E coupling module.

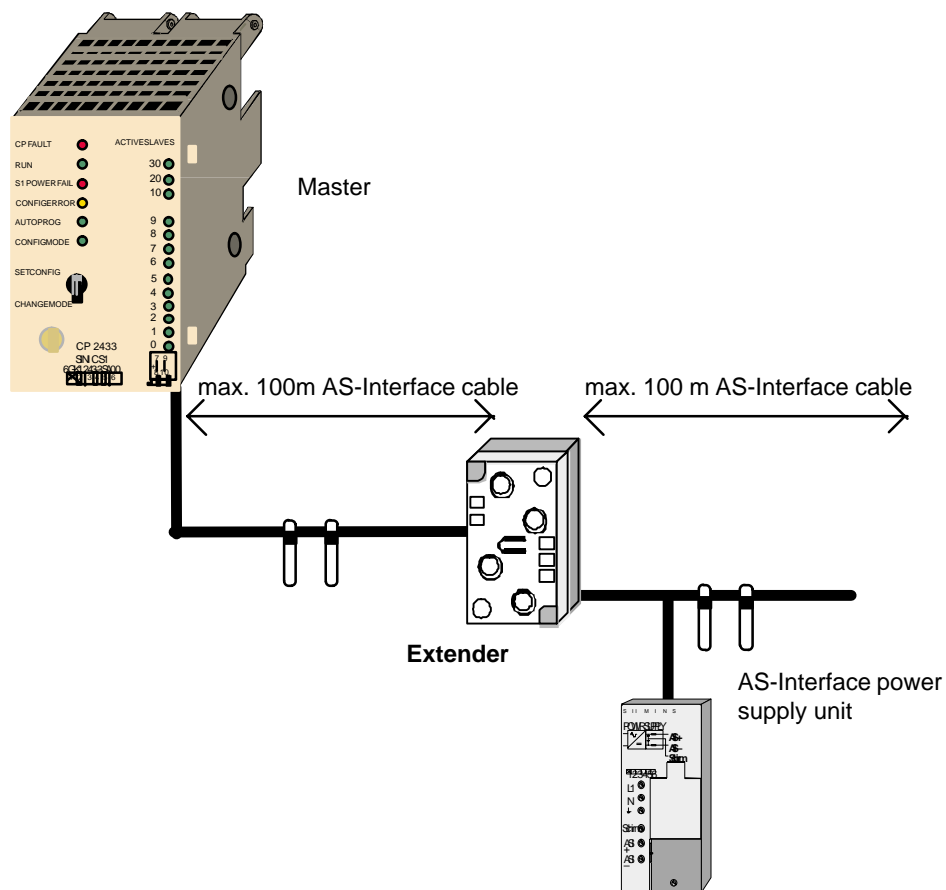


Figure 3-6 Using the Extender

3.5 Addressing Unit

Area of Application

Each slave on the AS-i requires an address. This address is saved on the slave. You can program the address of a slave using the addressing unit.

Handling

To program a module (application module), it is plugged in to the special adapter on the addressing unit. The stored address is displayed on the unit when you press the ADR button. The new address is set using the arrow buttons. After pressing the PRG button, the new address is saved on the application module (slave).

Addressing intelligent sensors/actuators is the same as with application modules. The sensor/actuators are connected to the addressing unit via an M12 connector. The addressing unit has an integrated M12 socket for this purpose.

The addressing unit is supplied by integrated batteries that can be charged using an external power unit. When not in use, the unit switches off automatically after a period of time.

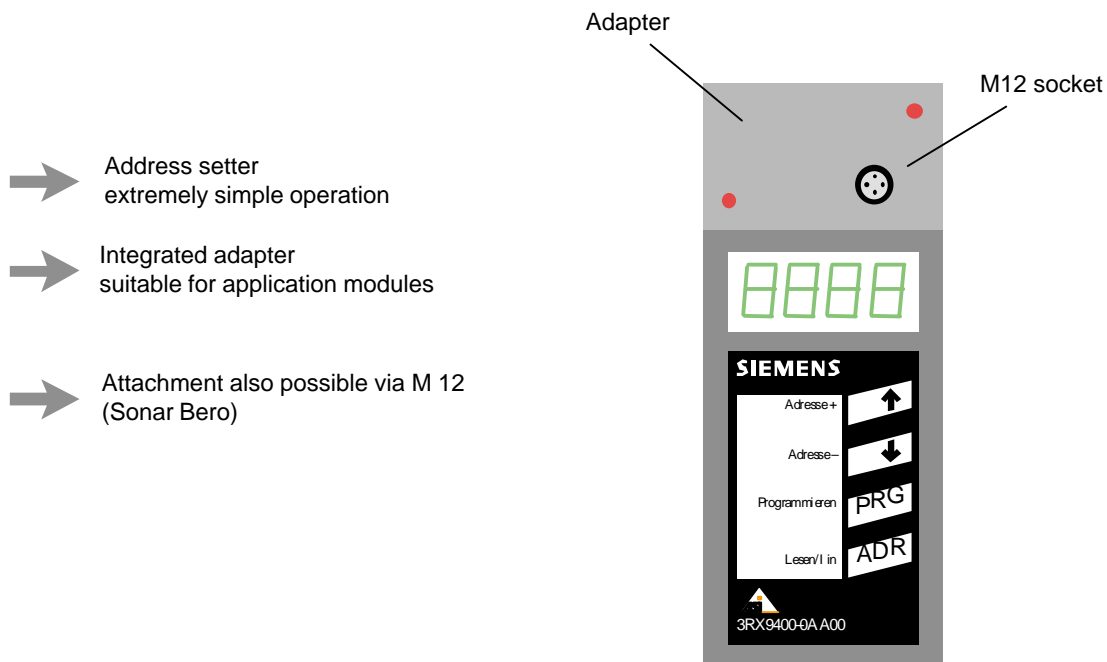


Figure 3-7

3.6 SCOPE Diagnostic Software for AS-Interface

Area of Application

The SCOPE diagnostic software for the AS-Interface is a monitoring program capable of recording and evaluating the data exchange in AS-i networks during installation and operation. SCOPE for AS-interface can be operated on a PC under WINDOWS in conjunction with the AS-i master communications processor CP 2413.

The software is operated using the known WINDOWS conventions. The complete range of functions can be found in the SIMATIC NET catalog /3/ and the product manual.

Functions

SCOPE for AS-interface provides the following functions:

- Online display of all master and slave user data in overview (data monitor);
- Monitoring of slave activities
- Online display of essential statistical values of data exchange on the bus;
- Trigger and filter functions for recording;
- Recording of the entire data exchange in a ring buffer;
- Documentation functions. □

The Master Mode – Commands, Sequence, Programming

4

The tasks and functions of an **AS-i master** are described below.

This section is important for understanding the functions, modes and interfaces available with the AS-i master modules. These functions and interfaces are described in detail in the manuals of the individual CPs.

For further information refer to /1/

4.1 Master-Slave Principle

How the AS-Interface Operates

The AS-Interface operates on the master-slave principle. This means that the AS-i master connected to the AS-i cable controls the data exchange with the slaves via the interface to the AS-i cable.

The following diagram illustrates the two interfaces of the AS-i master CP.

- The process data and parameter assignment commands are transferred via the interface between the master CPU and the master CP.

The user programs have suitable function calls and mechanisms available for reading and writing via this interface.

- Information is exchanged with the AS-i slaves via the interface between the master CP and AS-i cable.

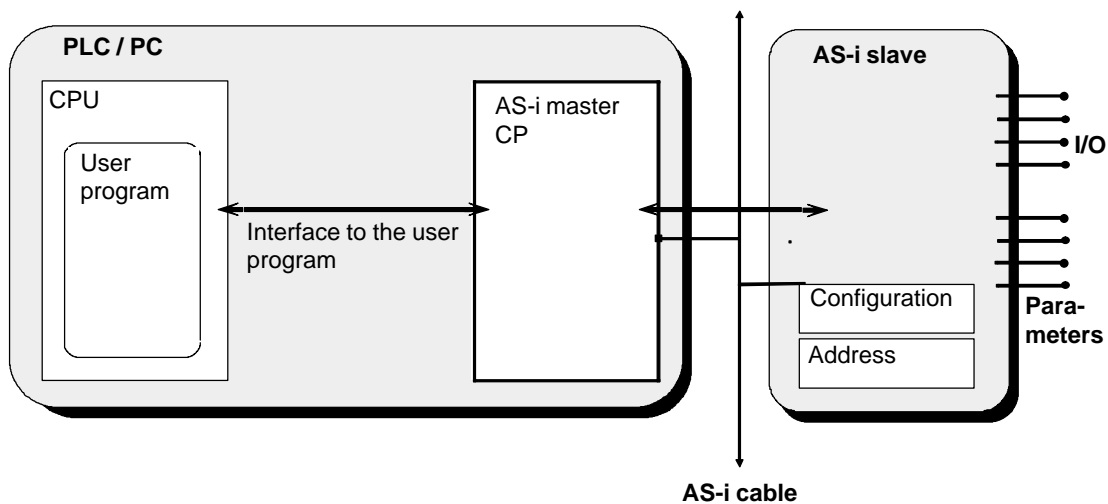


Figure 4-1

4.1.1 Tasks and Functions of the AS-i Master

Graded Range of Performance – Use of Profiles According to the AS-i Specification

The AS-i master specification distinguishes masters with different ranges of functions known as a “profile”.

For standard AS-i masters and extended AS-i masters there are three different master classes (M0, M1, M2 for standard masters, M0e, M1e, M2e for extended masters). The AS-i specification stipulates which functions a master in a particular class must be able to perform (refer also to the PICS in the appendix of the manual for the particular CP).

The profiles have the following practical significance:

- Master profile M0 / M0e:
The AS-i master can exchange I/O data with the individual AS-i slaves. The master is configured by using the station configuration found on the cable known as the “expected configuration”.
- Master profile M1 / M1e :
This profile covers all the functions according to the AS-i master specification.
- Master profile M2 / M2e:
The functionality of this profile corresponds to master profile M0/M0e, but in this profile the AS-i master can also assign parameters to the AS-i slaves.

The essential difference between extended AS-i masters and standard AS-i masters is that they support the attachment of up to 62 AS-i slaves using the extended addressing mode. Extended AS-i masters from SIMATIC NET also provide particularly simple access for AS-Interface analog slaves complying with profile 7.3/7.4.

Note

If you decide to use standard operation (master profile M0), you can skip the remaining sections in this chapter. Continue reading in the manual of your CP to find out the steps required for installation and operating the module.

4.1.2 How an AS-i Slave Functions

Connecting to the AS-i Cable

The AS-i slave has an integrated circuit (AS-i chip; see also Section 3.2) that provides the attachment of an AS-i device (sensor/actuator) to the common bus cable to the AS-i master. The integrated circuit contains the following components:

- 4 configurable data inputs and outputs
- 4 parameter outputs

The operating parameters, configuration data with I/O assignment, identification code, and slave address are stored in additional memory (for example EEPROM).

I/O Data

The useful data for the automation components that were transferred from the AS-i master to the AS-i slave are available at the data outputs. The values at the data inputs are made available to the AS-i master when the AS-i slave is polled.

Parameter

Using the parameter outputs of the AS-i slave, the AS-i master can transfer values that are not interpreted as simple data. These parameter values can be used to control and switch over between internal operating modes of the sensors or actuators. It could, for example, be possible to update a calibration value during various operating phases. This function is possible with slaves with an integrated AS-i connection providing they support the function in question.

Configuration

The input/output configuration (I/O configuration) indicates which data lines of the AS-i slave are used as inputs, outputs or as bidirectional outputs. The I/O configuration (4 bits) can be found in the description of the AS-i slave (an overview of codings can be found in /1/).

In addition to the I/O configuration, the type of the AS-i slave is described by an identification code, and with newer AS-Interface slaves by three identification codes (ID code, ID1 code, ID2 code).

For more detailed information on the ID codes, refer to the manufacturer's description.

4.2 Data Transfer

Information/Data Structure

Before introducing you to the operating phases and the functions during these operating phases, a brief outline of the information structure of the AS-i master/slave system is necessary.

In the following diagram, the data fields and lists of the system are configured in the system structure diagram you saw in the previous section.

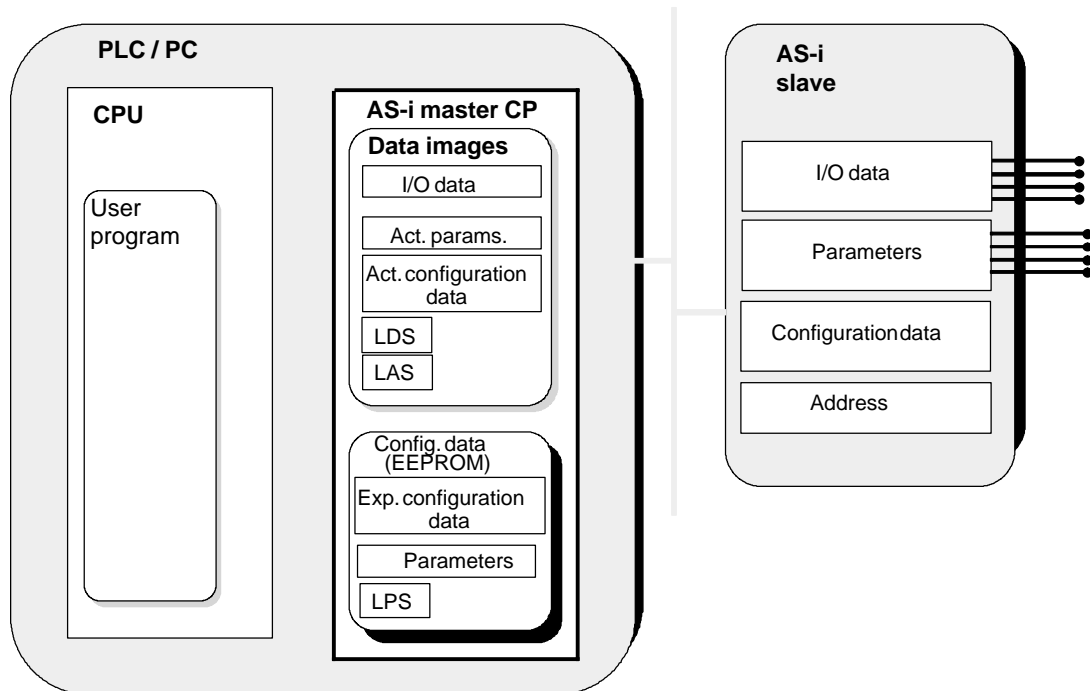


Figure 4-2

The following structures are found on the AS-i master:

- **Data images**

These contain temporarily stored information:

- Actual parameters

The actual parameters are an image of the parameters currently on the AS-i slave.

- Actual configuration data

The actual configuration data field contains the I/O configurations and ID codes of all connected AS-i slaves once these data have been read from the AS-i slaves.

- The list of detected AS-i slaves (LDS)

The LDS specifies which AS-i slaves were detected on the AS-i bus.

- The list of activated AS-i slaves (LAS)
The LAS specifies which AS-i slaves were activated by the AS-i master. I/O data are only exchanged with activated AS-i slaves.
- **I/O data**
The process input and output data.
- **Configuration data**
These are non-volatile data (e.g. stored in an EEPROM), which are available unchanged even following a power failure.
 - Expected configuration data
These are selectable comparison values which allow the configuration data of the detected AS-i slaves to be checked.
 - List of permanent AS-i slaves (LPS)
This list specifies the AS-i slaves expected on the AS-i cable by the AS-i master. The AS-i master checks continuously whether all the AS-i slaves specified in the LPS exist and whether their configuration data match the expected configuration data.

The AS-i slave has the following structures:

- **I/O data**
- **Parameters**
- **Actual configuration data**
The configuration data include the I/O configuration and the ID codes of the AS-i slave.
- **Address**
The AS-i slaves have address “0” when installed. To allow a data exchange, the AS-i slaves must be programmed with addresses other than “0”. The address “0” is reserved for special functions.

4.2.1 The Operating Phases

The following diagram illustrates the individual operating phases.

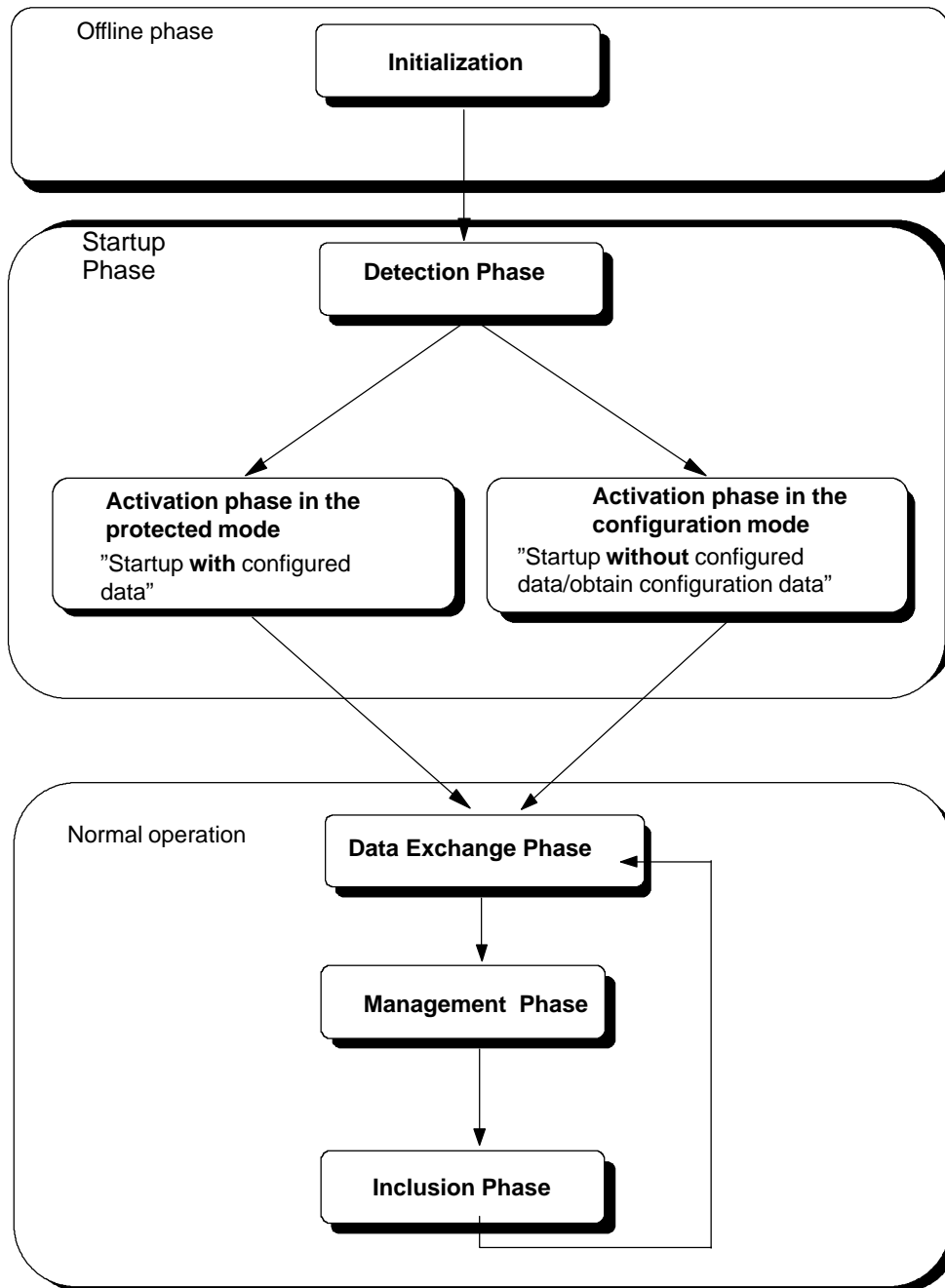


Figure 4-3

Initialization mode

The initialization mode, also known as the offline phase, sets the basic status of the master. The module is initialized after switching on the power supply or following a restart during operation. During the initialization, the images of all the slave inputs and the output data from the point of view of the application are set to the value "0" (inactive).

After switching on the power supply, the configured parameters are copied to the parameters field so that the subsequent activation uses the preset parameters. If the AS-i master is reinitialized during operation, the values from the parameters field which may have changed in the meantime are retained.

Startup Phase

- **Detection phase: Detection of AS-i slaves in the startup phase**

During startup or after a reset, the AS-i master runs through a startup phase during which it detects which AS-i slaves are connected to the AS-i cable and what type these slaves are. The "Type" of the slaves is specified by the configuration data stored permanently on the AS-i slave when it is manufactured and can be queried by the master. Configuration files contain the I/O assignment of an AS-i slave and the slave type (ID codes).

The master enters detected slaves in the list of detected slaves (LDS).

- **Activation phase: Activating AS-i slaves**

After the AS-i slaves are detected, they are activated by the master sending a special call. When activating individual slaves, a distinction is made between two modes on the AS-i master:

- Master in the configuration mode:

All detected stations (with the exception of the slave with address "0") are activated. In this mode, it is possible to read actual values and to store them for a configuration (→ configuration mode).

- Master in the protected mode:

Only the stations corresponding to the expected configuration stored on the AS-i master are activated. If the actual configuration found on the AS-i cable differs from this expected configuration, this is indicated by the AS-i master.

The master enters activated AS-i slaves in the list of activated slaves (LAS).

- **Normal mode**

On completion of the startup phase, the AS-i master switches to the normal mode.

- Data exchange phase

In the normal mode, the master sends cyclic data (output data) to the individual AS-i slaves and receives their acknowledgment messages (input

data). If an error is detected during the transmission, the master repeats the appropriate poll.

- Management phase

During this phase, all existing jobs of the control application are processed and sent. Possible jobs are, for example, as follows:

Parameter transfer:

Four parameter bits (three parameter bits with AS-i slaves with the extended addressing mode) are transferred to a slave and are used, for example, for a threshold value setting.

Changing slave addresses:

This function allows the addresses of AS-i slaves to be changed by the master if the AS-i slave supports this particular function.

- Inclusion phase

In the inclusion phase, newly added AS-i slaves are included in the list of detected AS-i slaves and providing the configuration mode is selected they are also activated (with the exception of slaves with address "0"). If the master is in the protected mode, only the slaves stored in the expected configuration of the AS-i master are activated. With this mechanism, slaves that were temporarily out of service are also included again.

4.2.2 Interface Functions

To control the master/slave interaction from the user program, there are various functions available on the interface. The possibilities are explained based on the illustration below. Here, simply the possible operations and the direction of data flow are illustrated.

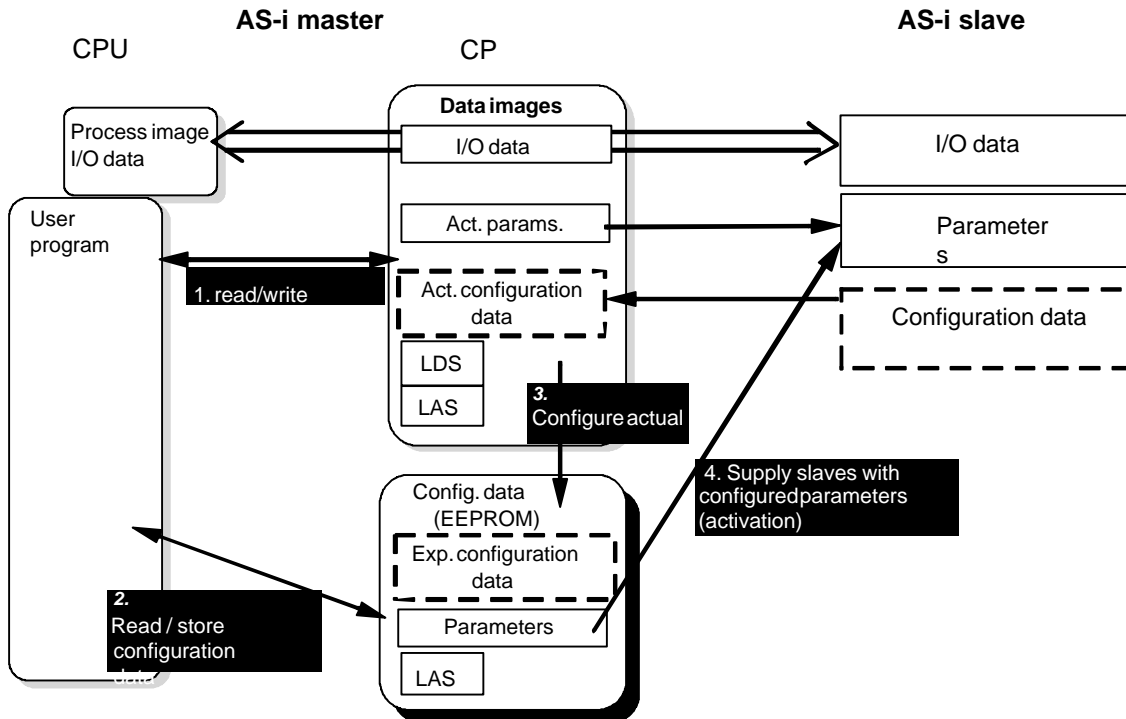


Figure 4-4

1. Read/write

When writing, parameters are transferred to the slave and the parameter images on the CP; when reading, parameters are transferred from the slave or from the CP parameter image to the CPU.

2. Read and store (configured) configuration data

Configured parameters or configuration data are read from the non-volatile memory of the CP.

3. Configure actual

When reading, the parameters and configuration data are read from the slave and stored permanently on the CP. When writing, parameters and configuration data are stored permanently on the CP.

4. Supply slaves with configured parameters

Configured parameters are transferred from the non-volatile area of the CP to the slaves.

4.2.3 Operating Extended AS-i Slaves with Standard AS-i Masters

Note

Please note the following information about operating extended AS-i slaves with standard AS-i masters!

- If A slaves are connected to standard masters, make sure that the most significant slave bit (bit 4) of each A slave is set to “0”. The most significant parameter bit (bit 4) must also be set to “1” (default value).
Without these settings, the A slave cannot be operated with a standard master.
- B slaves must not be connected to standard AS-Interface masters.



References

/1/

AS-Interface Das Aktuator-Sensor-Interface für die Automation
Werner Kriesel, O.W. Madelung, Carl Hanser Verlag München Wien 1994

/2/

AS-Interface Complete Specification
can be ordered from the AS-i Association e.V.
Address:
AS-International Association e.V.
Geschäftsführung: Dr. Otto W. Madelung
Auf den Broich 4A
D – 51519 Odenthal
Germany
Tel.: +49 – 2174 – 40756
Fax.: +49 – 2174 – 41571
(The AS-i technology is promoted by the AS-Interface Association e. V.)
Internet address of the AS-International Association e.V.:
<http://www.as-interface.com>

/3/

SIMATIC NET Industrial Communications Networks
Catalog IK 10
The catalog can be ordered from your local SIEMENS branch office or distributor.

/4/

Profibus & AS-Interface
Components on the Field Bus
Catalog ST PI
The catalog can be ordered from your local SIEMENS branch office or distributor.

/5/

SIMATIC NET
Industrial Communications Networks PROFIBUS Networks
Manual
Siemens AG

/6/

PROFIBUS standard EN 50170

Order numbers

The order numbers of the SIEMENS documentation listed above can be found in the catalogs "SIMATIC NET Industrial Communication, Catalog IK10" and "SIMATIC Programmable Controllers SIMATIC S7 / M7 / C7".

You can order these catalogs and obtain additional information from your local SIEMENS branch or distributor.



Glossary

APF

AS-i Power Fail. Flag or LED display that indicates that the power supply on the AS-i cable is too low or has failed (for example failure of the AS-i power supply unit).

AS-i (AS-Interface)

Actuator-sensor interface. A network system for the lowest field area of the automation range. It is suitable for networking sensors and actuators with control devices. (previously: SINEC S1)

AS-i A/B slave

AS-i A/B slaves use the extended addressing mode. Pairs of A/B slaves can be assigned to one address on the AS-Interface; by organizing addresses in this way, up to 62 AS-i A/B slaves can be attached to the AS-Interface.

AS-i analog slave

AS-i analog slaves are special AS-i standard slaves that exchange analog values with the AS-i master.

AS-i library

Library whose functions allow the user program to communicate with the AS-i driver.

AS-i master

The AS-i master is used to monitor and control the simplest binary actuators and sensors via AS-i modules or AS-i slaves.
A distinction is made between a standard AS-i master and an extended AS-i master.

AS-i module

For the AS-Interface, a module concept has been defined that allows the block-like linking of AS-i slaves – sensors and actuators – via AS-i modules.

The following types of module exist:

The **active** AS-i module with an integrated AS-i chip; using this, up to four conventional sensors and actuators can be connected.

The **passive** AS-i module; this functions as a distributor and provides a connection for up to four sensors and actuators with an integrated AS-i chip.

In keeping with the concept of the standard AS-i master and the extended AS-i master, either AS-i chips with standard functions or with extended functions are used in the AS-i slaves.

AS-i slave

All the nodes that can be addressed by an AS-i master are known as AS-i slaves.

AS-i slaves are distinguished by their design (AS-i modules and sensors or actuators with an integrated AS-i attachment) and their address range (AS-i standard slaves and AS-i A/B slaves with the extended addressing mode).

AS-i standard slave

An AS-i standard slave always occupies one address on the AS-Interface; with this address organization, up to 31 AS-i standard slaves can be attached to the AS-Interface.

Extended AS-i master

An extended AS-i master supports 31 addresses that can be used for standard AS-i slaves or AS-i slaves with the extended addressing mode. This increases the number of addressable AS-i slaves to a maximum of 62.

The extended AS-i masters of SIMATIC NET support the integrated transfer of AS-Interface analog slaves that operate in compliance with Profile 7.3/7.4 of the AS-Interface Specification.

LAS

List of activated slaves.

LDS

List of detected slaves.

LPS

List of permanent slaves.

Nibble

A nibble is a unit of information consisting of four bits.

Standard AS-i master

Up to 31 standard slaves or slaves with the extended addressing mode (A slaves only) can be attached to a standard AS-i master.



SIMATIC NET – Support and Training

C

SIMATIC Training Center

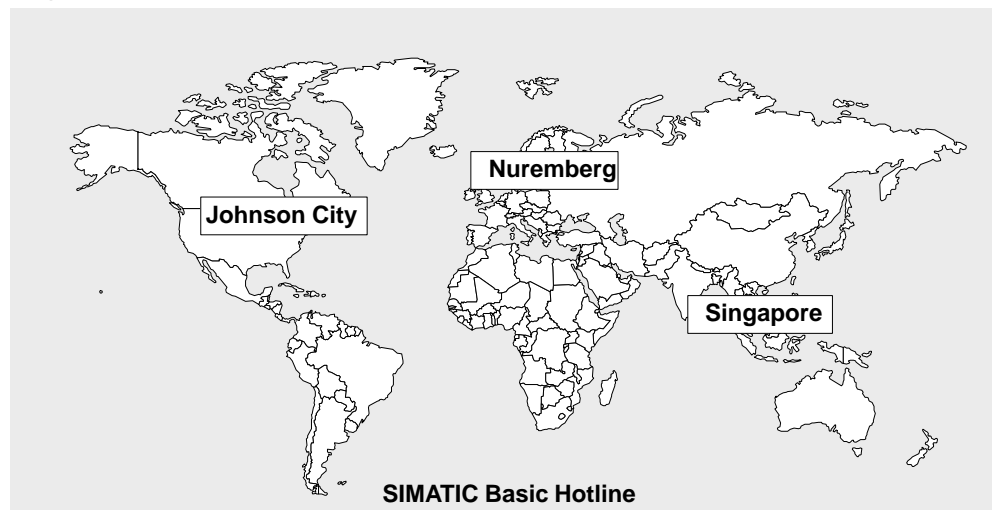
To help you to become familiar with the SIMATIC S7 automation system, we offer a range of courses. Please contact your regional training center or the central training center in D 90327 Nuremberg, Germany. Infoline: Tel. 0180 523 5611 (48 Pfg./min), Fax. 0180 523 5612

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- Current Product Information leaflets and downloads which you may find useful for your product are available:
 - On the Internet at <http://www.ad.siemens.de/csi/net>
 - Via the Bulletin Board System (BBS) in Nuremberg (*SIMATIC Customer Support Mailbox*) under the number +49 (911) 895-7100.

To access the mailbox, use a modem with V.34 (28.8 Kbps) capability with the following settings: 8, N, 1, ANSI, or dial in using ISDN (x.75, 64 Kbps).

Further Support

If you have further questions on SIMATIC NET products, please contact your Siemens representative in your local Siemens office.

The addresses are listed:

- in our catalog IK 10
- on the Internet (<http://www.ad.siemens.de>)



Numbers

2-wire cable, 1-9, 3-2

A

A/B slaves, 1-7
Activation phase, 4-8
 in the configuration mode, 4-7
 in the protected mode, 4-7
Address setting, electronic, 1-9
Addressing mode, 1-5, 1-10
 slaves with extended addressing mode, 1-7
Addressing unit, 1-8, 3-9
Analog value transfer, 1-5
AS-i cable, 1-2, 1-4, 1-8, 3-2
AS-i master, 1-4, 2-2
 extended, 1-5
 Siemens products, 1-5
 standard, 1-5
 tasks and functions, 4-3
AS-i master specification, 1-11
AS-i module, 1-6, 3-5
 meaning and function, 3-3
AS-i power supply unit, 1-4, 1-8
AS-i slave, 1-4, 1-5, 1-6
 addressing mode, 1-7
 analog slaves, 1-5
 configuration, 4-4
 functions, 4-4
 maximum number, 1-10
AS-i slave assembly system, 1-6
AS-Interface , in SIMATIC, 1-2

C

Configuration data, 4-6
CP 142-2 (standard AS-i master), 2-10
CP 142-2 in the ET 200X, 2-8
CP 2413 (standard AS-i master), 2-11
CP 242-2 (standard AS-i master), 2-2
CP 242-8, 2-8
CP 242-8 (standard AS-i master), 2-3
CP 243-2 (extended AS-i master), 2-2
CP 2430 (standard AS-i master), 2-6
CP 2433, 2-8
CP 2433 (standard AS-i master), 2-7
CP 2433 in the ET 200U , 2-8
CP 342-2 (standard AS-i master), 2-4
CP 342-2 in the ET 200M, 2-8
CP 343-2 (extended AS-i master), 2-5

CP 343-2 in the ET 200M (extended master), 2-8
Cycle time, 1-10

D

Data exchange phase, 4-7, 4-8
Detection phase, 4-7, 4-8
Diagnostic software, 3-10
Double master, 2-6
DP / AS-i gateway, 2-8
DP/AS-Interface Link, 2-8
DP/AS-Interface Link 20, 2-8
DP/AS-Interface Link 20 E, 2-8

E

Electrical isolation, 3-6
Extender, 3-6

F

FC, 2-4, 2-5

I

I/O configuration, 4-4
I/O data, 4-4, 4-6
Inclusion phase, 4-7, 4-9
Information/data structure, 4-5
Initialization, 4-7
Initialization mode, 4-8
Interface functions, 4-10

L

List of permanent AS-i slaves (LPS), 4-6
Load current supply, additional, 1-8
LPS, 4-6

M

Management phase, 4-7, 4-9
Master in the configuration mode, 4-8
Master in the protected mode, 4-8
Master profile M0/M0e, 4-3
Master profile M1/M1e, 4-3
Master profile M2 / M2e, 4-3

Master-slave access techniques, 1-9
Master-slave principle, 4-2

N

Normal mode, 4-8

O

Offline phase, 4-8
Operating phases, 4-7
Operating reliability and flexibility, 1-9

P

Parameter lines, 1-10
Physical characteristics, 1-9
Power supply, additional, 1-10
power supply, 1-8
PROFIBUS DP, 2-3
Profiles according to the AS-i specification, 4-3

R

Range of functions, of the master modules,
1-11
Read and store (configured) configuration data,
4-10
Repeater / extender, 3-6

S

SCOPE for AS-Interface, 1-4, 1-8
SCOPE S1, 1-8
Sensors/actuators, with integrated AS-i
connection, 1-6
Slave addresses, changing, 4-9
Standard rail, 3-5
Startup phase, 4-8
System characteristics, 1-9
System components, 1-4
System limits, 1-10

T

Tree structure, 1-9

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