SIEMENS

SIMATIC NET

AS-Interface - Introduction and Basics

Manual
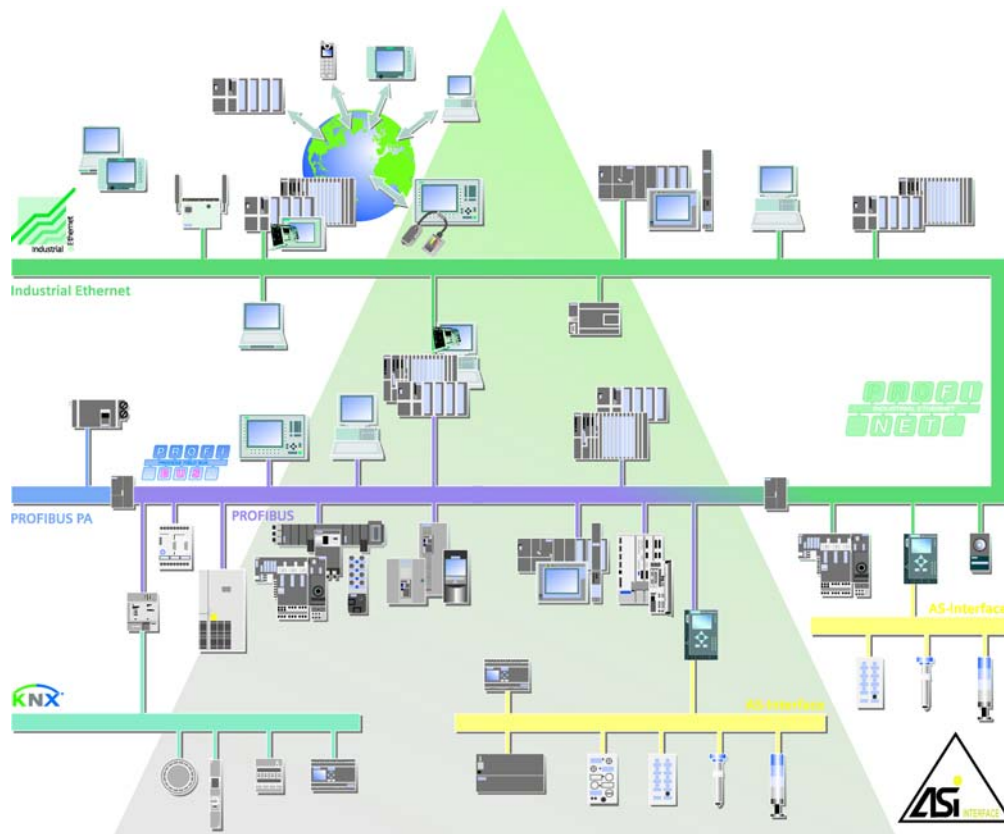
Classification of the Safety‑Related Notices

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 **will** result if proper precautions are not taken.

Warning

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

Caution

with warning triangle indicates that minor personal injury can result if proper pre‑cautions are not taken.

Vorsicht

without warning triangle indicates that damage to property can result if proper pre‑cautions are not taken.

Notice

indicates that an undesirable result or status can occur if the relevant notice is ignored.

Note

highlights important information on the product, using the product, or part of the documentation that is of particular importance and that will be of benefit to the user.

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Safety Instructions Regarding your Product

Before you use the product described here, read the safety instructions below thoroughly.

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 of Hardware Products

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.

Before you use the supplied sample programs or programs you have written yourself, make certain that no injury to persons nor damage to equipment can result in your plant or process.

EC Notice: Commissioning must not be carried out until it has been established that the machine in which this component is to be installed complies with the conditions of directive 89/392/EEC.

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Note the following:

⚠ **Warning**

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

Before you use the supplied sample programs or programs you have written yourself, make certain that no injury to persons nor damage to equipment can result in your plant or process.

Prior to Startup

Before putting the product into operation, note the following:

Vorsicht

Prior to startup you must observe the instructions in the relevant documentation.
For ordering data of the documentation please refer to the catalogs or contact your
local SIEMENS representative.

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 extension of the AS-i master specification and the extended SIMATIC NET product range.

This involves the following aspects:

- With the new concept of "Combined Transactions", slaves with up to 8 binary inputs and eight binary outputs can be connected (496 inputs and 496 outputs per network).

- Simplification of analog data transfer

- Transfer of serial data

- Improved diagnostics

- New cable specification (switching cabinet cabling).

AS-Interface

The AS-Interface is the open international standard EN 50 295. Leading manufacturers of sensors and actuators worldwide support the AS-Interface. 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 information supplied with the AS-i components from SIMATIC NET and the documents on the Internet.

http://www.siemens.com/as-interface

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

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Contents

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1 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

Standardized fieldbus

AS-Interface is the only worldwide standardized bit-oriented fieldbus.

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. Simple command devices, variable speed three-phase motors, light barriers, inductive proximity switches and (over AS-i modules) more complex devices such as process valves are connected over the AS-i cable and the AS-i master to the controllers at the field level.

AS-Interface provides the option of transferring standard data and safety-oriented data on the same cable. This allows, for example, the emergency stop cabling of a machine or system to be implemented over AS-i.

AS-Interface in SIMATIC

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

Under the name AS-Interface, Siemens produces AS-i master interface modules for 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.
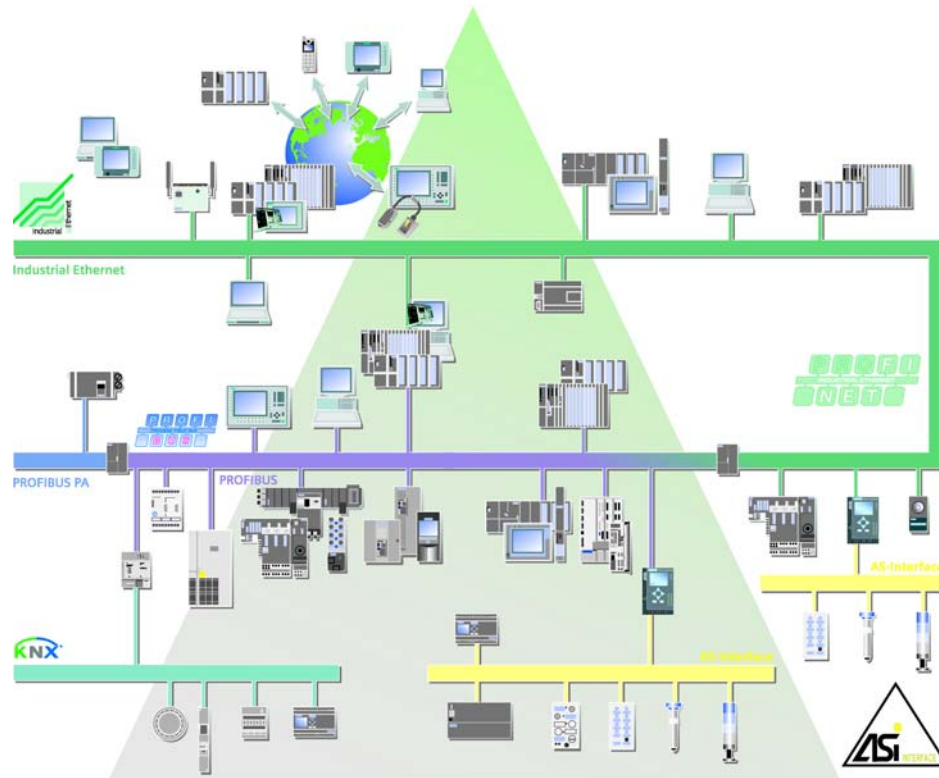
Figure 1-1

The AS-interface is distinguished by several main characteristics:

- AS-interface is optimized for connecting binary and analog 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 (with 62 nodes 10 ms).

- 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 248 actuators and 248 sensors can be operated with one extended master. When using the S-7.A.A profile with 8I/8O, up to 496 actuators and 496 sensors can be operated.

- Extended AS-i masters according to Specification V2.11 support extremely simple access to analog sensors/actuators or modules operating in compliance with the AS-Interface slave profile 7.3/7.4.
  Extended AS-i masters according to Specification V3.0 also support the profiles

  - S-7.5.5 (100 bps bi-directional; 2DI/2DO),

  - S-7.A.5 (50 bps bi-directional; 2DI/2DO),

  - S-B.A.5 (50 bps bi-directional; 20 chars/s),

  - S-7.A.7 (4DI/4DO),

  - S-7.A.A (8I/8O),

  - S-7.A.8 (1 analog channel; 1 DO),

  - S-7.A.9 (2 analog channels),

  - S-6.0 (super fast analog).

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.

Overview of the Various Specifications

Since the introduction of AS‑Interface, three specifications have been published by the AS International Association each with an extended and improved range of functions on the AS‑Interface.

The following table provides an overview:

Table 1‑1   AS‑i Specifications

Version	V2.0	V2.11	V3.0
Year	1994	1998	2004
Master	M0, M1, M2	M3	M4
Slave	all other slaves (all other profiles)	S‑X.A, S‑7.3, S‑7.4	S‑7.5.5, S‑7.A.5, S‑B.A.5, S‑7.A.7, S‑7.A.A, S‑7.A.8, S‑7.A.9, S‑6.0
New features		62 slaves, expanded ID codes, I/O errors, etc.	Synchronization, new communication types etc.
Standards	EN 50295:1998 IEC 62026‑2:2000		IEC 62026‑2:200X

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 (in some cases integrated in the master)
- Diagnostic unit
- Safety monitor
- Repeater
- Extender
- Extension plug

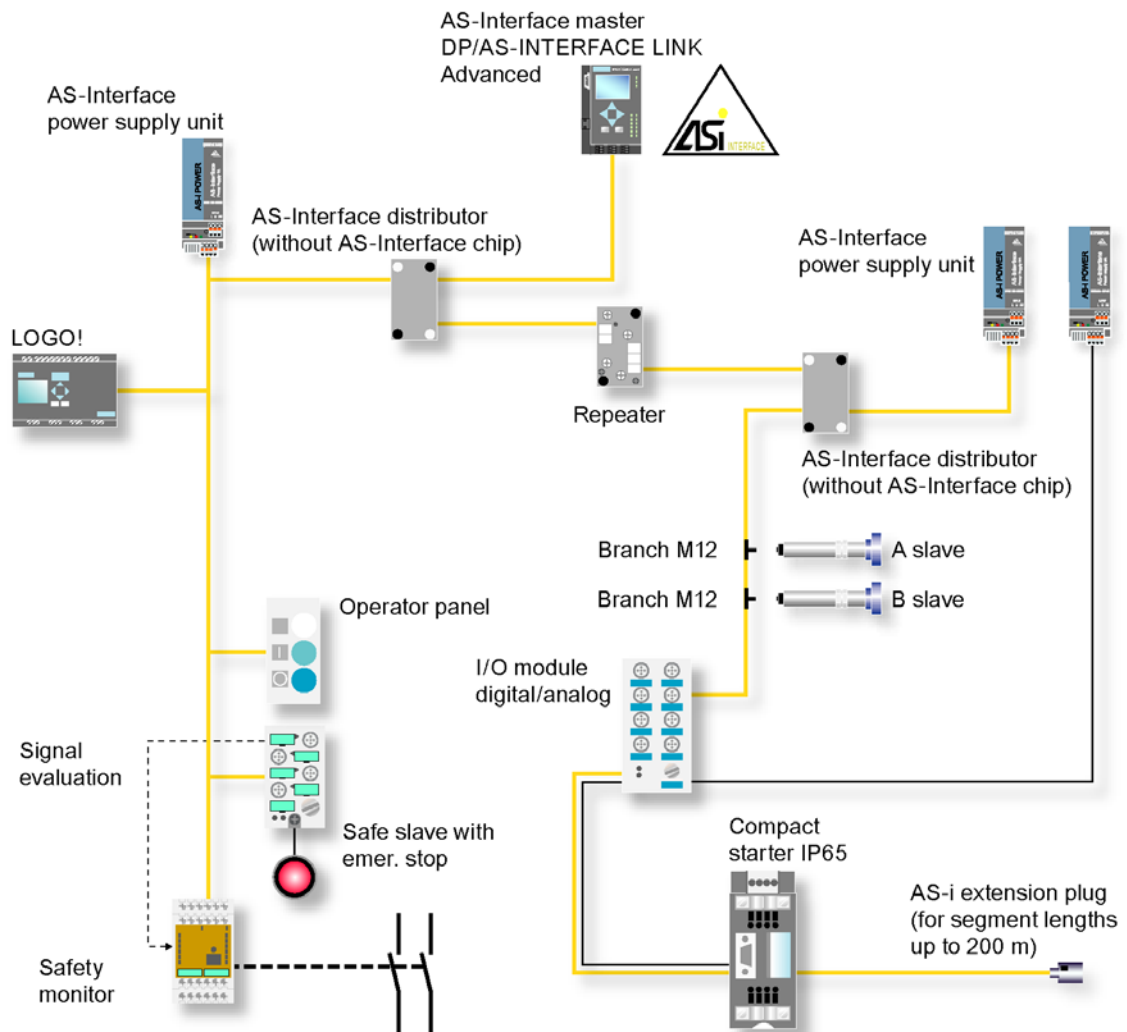The following schematic shows a possible arrangement of AS-i components in a tree structure.

Figure 1-2

Note

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 system catalogs and ask your Siemens office for more information.

1.2.1   AS-i Masters

Siemens currently offers the following AS-i master types:

- **Standard AS-i masters**

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

  Standard AS-i masters are available for connecting to the following systems:

  - SIMATIC S5

  - SIMATIC S7

  - SIMATIC C7

  - Distributed I/O:

  - SIMOTION C

- **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 necessary address extension, the number of binary outputs is reduced for AS-i slaves with extended addressing mode according to Specification V2.11 to 3 per AS-i slave. This restriction does not apply to slaves after Specification V3.0.

    Newer AS-i masters also support the profiles S-7.5.5, S-7.A.5 and S-B.A.5 (serial protocol) as well as S-7.A.7 and S-7.A.A (4I/4O, 8I/8O) according to AS-i Specification V3.0.

- **Analog value transfer for AS‑i slaves**

  The extended masters of SIMATIC NET support the integrated transfer (no special driver required) of AS‑i analog slaves that operate in compliance with profile S‑7.3/7.4 of the AS‑Interface specification. Analog slaves operating with this profile can be addressed extremely simply by the user program.

  The DP/AS‑i LINK Advanced and IE/AS‑i Link also support the profiles S‑7.A.8 and S‑7.A.9 (fast analog) as well as S‑6.0.X (super fast analog) according to AS‑i Specification V3.0 and the AS‑i master profile M4.

  Extended AS‑i masters are available for linking to the following systems:
  - SIMATIC S7
  - Distributed I/O.

Note

The line of available AS‑i masters is constantly being expanded. Refer to the system catalogs and ask your Siemens office for more information.

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 conventional sensors and 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.

  Sensors and actuators are divided into field and cabinet modules according to their use.

Addressing Mode

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

- Standard AS-i slaves

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

- AS-i 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. If there is no addressing unit, the AS-i slaves can also be programmed individually by the master with the user program. Due to the address expansion according to Specification V2.11, the number of binary outputs is reduced to three per AS-i slave.

  If the AS-i slave meets Specification V3.0, the number of binary outputs is not reduced (maximum 8 binary outputs) assuming that a master complying with profile M4 is used.

  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:

- AS-i Analog slaves complying with profile S-7.1/S-7.2

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

- AS-i Analog slaves complying with profile S-7.3/S-7.4

  Analog slaves complying with profile S-7.3/S-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.

- Analog slaves according to profile S-7.A.8/S-7.A.9 and profile S-6.0.X

  Analog slaves according to profile S-7.A.8/S-7.A.9/S-6.0.X are intended for operation with extended AS-i masters. They provide the following options:

  - Fast transfer of analog values with extended addressing mode (1 analog value/cycle)

  - Simultaneous transfer of analog values and binary data

  - Bi-directional transfer of binary data (read inputs / write outputs)

  - Transfer of more than one analog channel in A/B technology

- Combi field devices complying with profile S-7.A.5/S-7.5.5

  Combi field devices according to profile S-7.A.5/S-7.5.5 are slaves that output and/or process both serial and digital data.

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. (in some cases integrated in the AS-i master. This means that a separate addressing unit is not required.)

AS-Interface Analyzer

The AS-Interface analyzer is used to test AS-i networks. Errors during installation, for example bad contacts or EMC problems at extreme load, can be revealed by this device. This makes it possible to evaluate the quality of complete networks. The AS-Interface analyzer also allows documentation for commissioning and service by creating test reports.

Safety Monitor

The safety monitor is heart of Safety at Work (see Chapter 2). You configure a safe application on the PC with the safety monitor. You can choose between several application-specific modes (for example EMERGENCY STOP function, and the selection of stop category 0 or 1).

As an option allowing you to make full use of the diagnostic potential, the monitor can also be operated with an AS-Interface address.

Repeater

A repeater extends the possible uses of the AS-Interface by extending the AS-i segment and providing greater freedom in the planning of the system. Down times and service times can also be reduced because the AS-Interface power supply is displayed for each side (separate power supply).

Further features of the repeater include:

- Slaves can be used on both sides of the repeater.

- Electrical isolation of the two AS-i profile cable lines.

- A maximum of two repeaters can be used in series (max. cable length 300 m).

- Parallel connection of several repeaters is possible (star configuration possible).

Extender

An extender is used to extend the distance between the master and the AS-i segment with the AS-i slaves to a maximum of 100 m. On the master side, however, no extra power supply is required here. An extender expands the possible uses of the AS-Interface in much the same way as a repeater. Here, the slaves can only be used downstream from the extender (from the perspective of the master).

Further features of the extender include:

- With repeaters connected in parallel, a cable length significantly longer than 300 m can be achieved. The maximum span is 500 m.

- A master can be located up to 100 m from the actual AS-i segment.

- No electrical isolation of the two AS-i profile cable lines.

Extension plug

When using the extension plug, the maximum possible cable length in an AS-Interface segment can be doubled from 100 to 200 meters.

The extension plug is a passive component and is connected to the part of the AS-Interface network furthest from the power unit.

Only one power unit is required to power the slaves on the up to 200 m long segment. An undervoltage detection system in the extension plug monitors the AS-i voltage and a diagnostic LED indicates whether the power is adequate up to the end of the bus cable.

1.3   System Characteristics and Important Data

How It Works

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 x 1.5 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.

  For the cabinet-internal wiring (IP20), there is an AS-i cable (profile cable) with a cross-section of 2 x 0.8 mm^2 available.

- **Tree structure network with a cable length up to 100 m (300 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. An existing 100 m segment can be extended by a maximum of two repeaters and therefore to a maximum of 300 m (see 3.5).

- **Direct integration**

  Practically all the electronics required for a slave has 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 cm^3 .

- **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/).

Configuration Limits

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

    AS-Interface/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 (40 ms with 8E/8A according to Specification V3.0).

    B slaves can only be connected to extended masters.

    For time-critical applications, 16-bit input and output data can be transferred in a maximum of 5 ms. To achieve this, the transmission bandwidth normally used by up to four AS-i slaves is used for one slave.

- **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 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 496 inputs and 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 8 inputs and 8 outputs is available per module; in other words a maximum of 496 inputs and 496 outputs can be operated with modules using the extended addressing mode.

Combi Field Devices (Serial Protocol)

Combi field devices use the serial protocol according to Specification V3.0. These devices can output and/or process both serial and digital data. They include, for example,

- Display modules for texts (approx. 20 characters/per second),

- Counter modules (read count, send parameter data, signal limit values),

- Slow analog values when monitoring temperature (read measured temperature value, signal limit value) or

- Pressure sensors (read measured pressure value, signal limit value).

Diagnostics Options

A combi field device according to Specification V3.0 can be configured so that one or two bits of binary data can be exchanged with the master and at the same time a data channel can be made available over which measured value and/or control data can be transferred cyclically or parameter and diagnostic data acyclically. This means that new parameters can be read and/or written during operation and, when necessary, current data can be requested. The amount of data can be selected by the user, it is only limited in practical terms by the relatively low transmission rate (50 bps).

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.

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2 AS-Interface Safety at Work (ASIsafe)

With "AS-Interface Safety at Work", you can connect work-safety components such as emergency stop switches or safety light barriers directly to the AS-Interface network. The main system continues to operate unchanged. The signal and safety sensors are evaluated by a safety monitor. Switching outputs can then bring machines or systems to a safe status.

2.1   ASIsafe - The Safety Concept

With the "Safety at Work" function, AS-Interface provides the option of transferring standard data and safety-oriented data on the same cable. The basis of safe data transfer is a dynamic, safe transfer protocol between the safety slaves and the safety monitor.

ASIsafe is certified by TÜV. By making safety shutdowns possible with only one cable, ASIsafe is not only an extremely economical solution but is also unique on the current market. The great potential savings available with AS-Interface now extend even to safety technology.
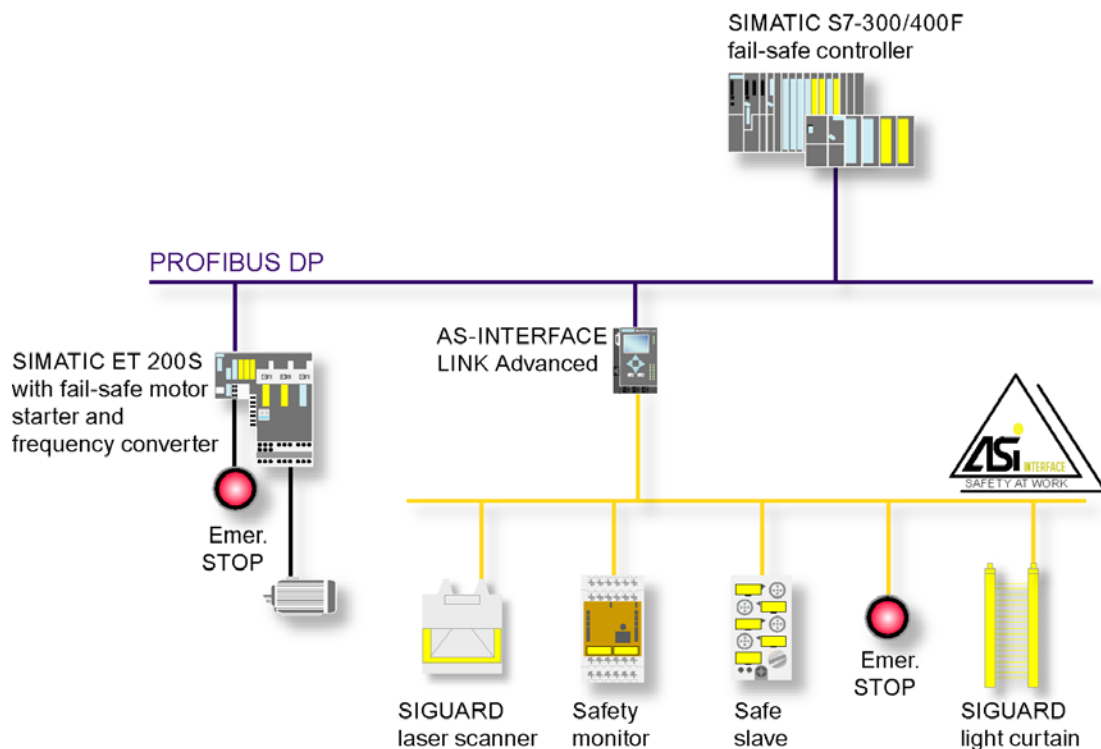

Figure 2-1   Safety at Work

Setup

The extension ASIsafe can be implemented very simply. You require only two extra components to turn AS-Interface into a safety bus:

• A safety monitor

 and

• Safe slaves.

You do not require a fail-safe PLC or any special masters.

The safe AS-i slaves can acquire data from safe inputs. The safety monitor, in turn, monitors the safe inputs, combines them with configurable logic and ensures a safe shutdown over integrated safety relays.

With little effort, emergency stop buttons, light grids, laser scanners and many other I/O modules can be interfaced directly and safely to AS-Interface up to category 4 according to EN 954-1 or SIL3 according to IEC 61508. Even existing applications can be extended simply and quickly by adding safety-oriented functions with ASIsafe.

How It Works

The basis of safe data transfer is a dynamic, safe transfer protocol between the safety AS-i slaves and the safety monitor. In each cycle, the safety monitor expects a specific frame from each slave. This frame changes continually according to a defined algorithm. The shutdown logic of the safety monitor is configured in configuration software.

This allows the safety monitor to react differently to the triggers of specific safety nodes. If the expected frame does not arrive due to a problem or an alarm situation, the safety monitor starts the shutdown procedure over its two-channel circuits safely and quickly after a maximum of 40 ms (worst case).

Grouping Safe Components

ASIsafe allows safe signals to be grouped. This is done by assigning each part of the plant a safety monitor that is responsible for the safe shutdown when necessary. This allows selective shutdown of the safety-oriented application.

Safe slaves are assigned to the safety monitors within an AS-Interface network simply and conveniently using the parameter assignment software of the safety monitor.

Diagnostics

The safety monitor obtains the safety-oriented information from the safe slaves with the master polling technique typical for the AS-Interface.

Advantages: Additional wiring of the safety components for diagnostics is no longer necessary. The evaluation of the safety-relevant events is also possible on an operator control and monitoring system.

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3 AS-i System Components

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 or PROFINET.

The components of the AS-i transmission system, AS-i masters and AS-i slaves are required on the AS-Interface.

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

Note

The line of available AS-i system components is constantly being expanded. Refer to the system catalogs and ask your Siemens office for more information.

You will find AS-i components from Siemens and information on using, configuring and programming them on the SIMATIC NET Manual CD and in the appropriate manuals.

3.1   **AS-i Masters**

The AS-i master is the link to the higher-level control system. It organizes the data traffic on the AS-i cable automatically and, when required, makes the signals of the sensors and actuators available to a higher-level bus system (for example PROFIBUS, PROFINET) over an interface. After polling the signals, the master also transfers the parameter settings to the individual nodes, monitors the network continuously and runs diagnostic checks.

In contrast to more complex bus systems, AS-i is almost completely self-configuring. No settings need to be made (for example, access rights, data rates, frame types etc.). The master automatically executes all functions required for the correct operation of the AS-Interface. It also allows self-diagnostics of the system. It detects problems and automatically assigns the correct address to a slave replaced during maintenance.

The following graphic shows two examples of how AS-i masters can be used in an automation solution.
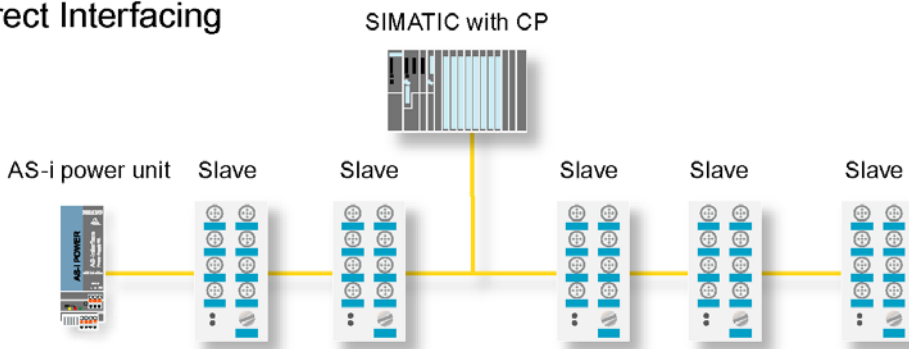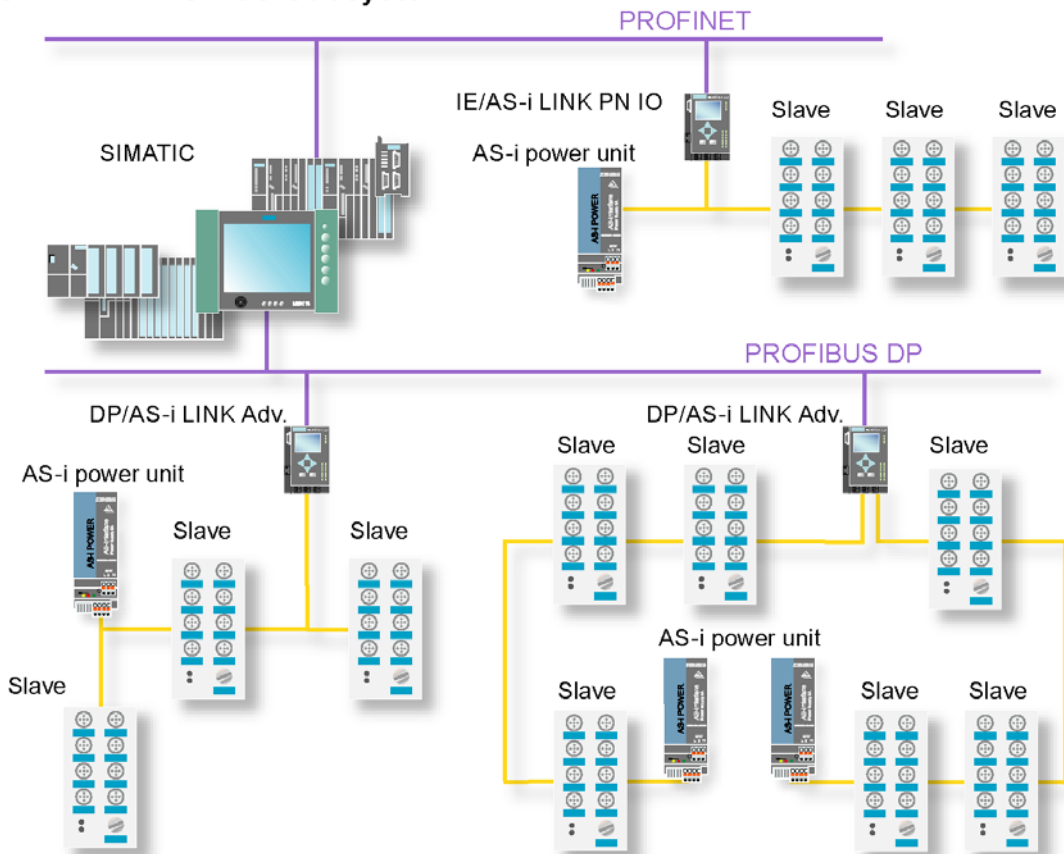

Figure 3-1   Sample Configurations

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 pin assignment corresponds to DIN IEC 947 5-2. The modules (IP67) with dimensions of approximately 45 x 45 x 80 mm are used locally on the machine itself. They are connected over the AS-i cable.

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:

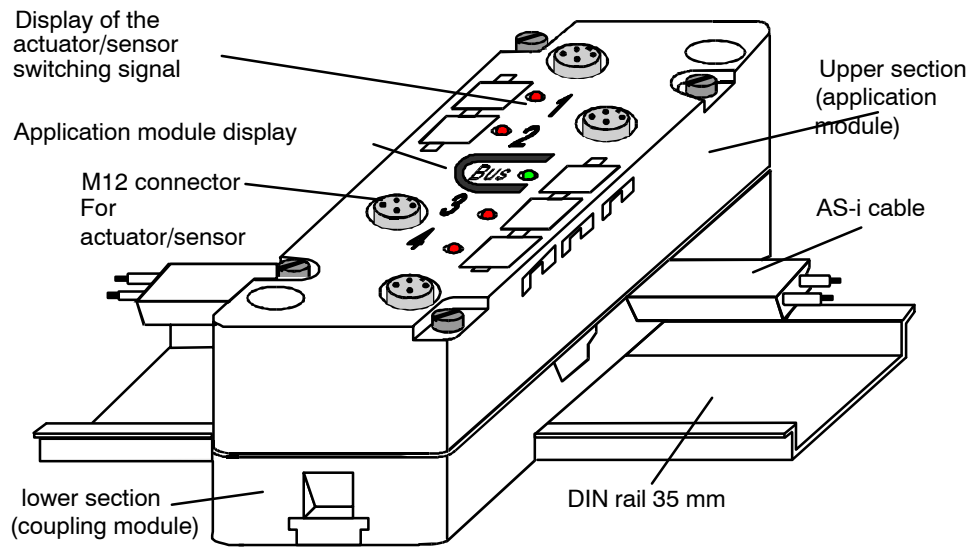The following diagram illustrates an active AS-i module for four connections.

Display of the
actuator/sensor
switching signal

Application module display

M12 connector
For
actuator/sensor

Upper section
(application
module)

AS-i cable

DIN rail 35 mm

lower section
(coupling module)

Figure 3-2

Note

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


3.3   The AS-i Cable

AS-i Profile Cable for Use in the Field

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 x 1.5 mm^2). The profile section prevents stations being connected with incorrect polarity.

The AS-i cable is contacted using insulation displacement connectors (IDC). 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.

10 mm

4 mm

6,5 mm
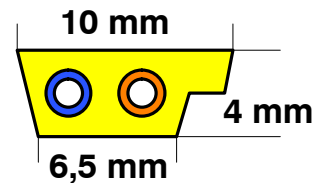
The jacket of the AS-i cable is rubber. If modules need to be moved after they have been connected to the AS-i cable this is possible without causing any problems. The AS-i cable is "self-healing". This means that the holes made by the contact blades in the rubber jacket of the cable close themselves 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.
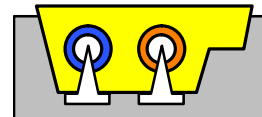
AS-i profile cable for use in a switching cabinet

To wire up AS-i products designed for installation in switching cabinets, there is also a profile cable available with a cross-section of 2 x 0.8 mm^2. The reduced cross-section makes the cable easier to work with, cheaper and optimized for the use of the IDC technique (degree of protection IP20).

2 mm

4 mm
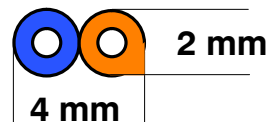
Use of Other 2-Wire Cables

Apart from the special AS-i cable, any 2-wire cable with a cross-section of 2 x 1.5 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).

AS-i profile cables EPDM, TPM, PUR

The various AS-i profile cables differ in their jacket materials:

- EPDM - rubber
    - Applications in protected areas with little chemical influence
- TPE - special PVC compound
    - For applications requiring a higher degree of immunity to chemicals
    - UL/CSA approval
- PUR - polyurethane
    - For applications requiring a higher degree of immunity to chemicals
    - Foodstuffs areas
    - Drag cables and drag chains (little friction)
    - Ship building approval

3.4   Installing an AS-i Module

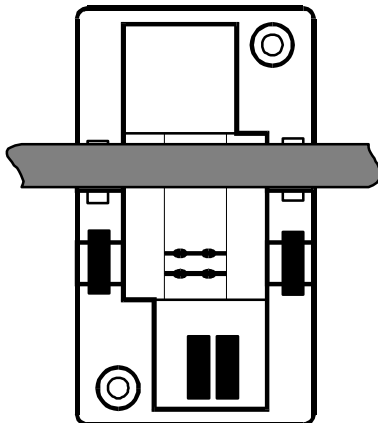The installation of an AS-i module on the AS-i cable is particularly simple using the connection technique described. This is made clear by the following illustration:

Figure 3-3
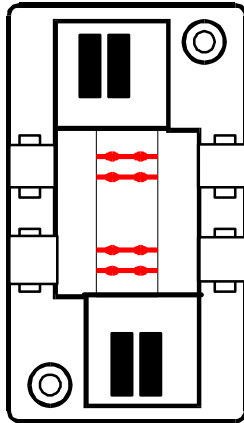
1. The coupling module is screwed or clipped onto a 35 mm DIN rail. The coupling module includes four stoppers. These are used to close unused cable openings.

Figure 3-4

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 3-5
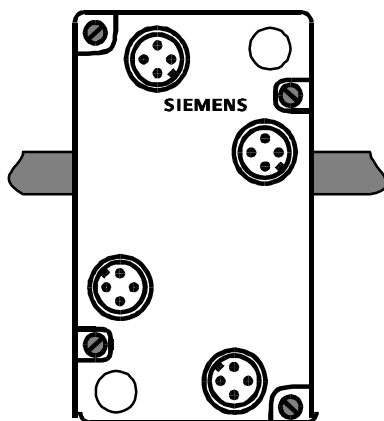
3. By screwing down the application module, the AS-i cable is pressed onto the contact blades. They penetrate the conductors at two points and guarantee a reliable connection. After correct installation, the module has the type of protection IP67.

3.5   AS-Interface Repeaters / Extenders / Extension Plugs

Area of Application

AS-Interface repeaters, extender and extension plugs are used to extend the length restrictions of the AS-Interface of 10 m. An existing 100 m segment can be extended by 2 further 100 m segments (total 300 m).

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:

- Extension of the cable length to a maximum of 300 m is possible (maximum of 2 repeater in series);

- 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 3-6   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.

The extender has the following features:

- 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.
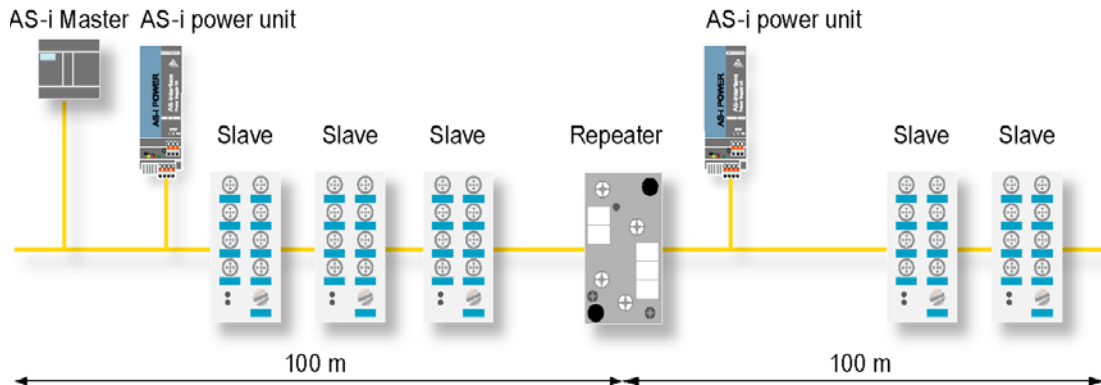
- Installed in standard application module casing. The extender is mounted on the FK-E coupling module.
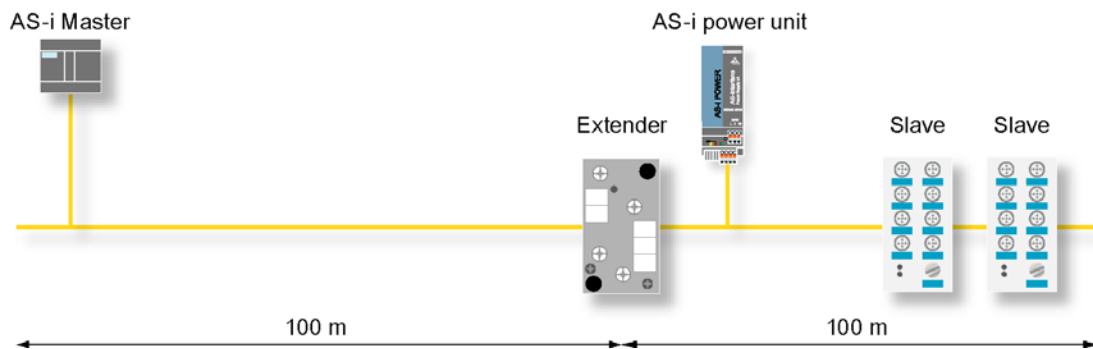
Figure 3-7   Figure 3-8   Using the Extender

Using the Extension Plug

When using the extension plug, the maximum possible cable length in an AS-Interface segment can be doubled from 100 to 200 meters.

The extension plug is a passive component and is connected to the part of the AS-Interface network furthest from the power unit. It has an M12 male connector and can therefore be connected to the AS-Interface M12 branch quickly with degree of protection IP67.

Only one power unit is required to power the slaves on the up to 200 m long segment.

An undervoltage detection system in the extension plug monitors the AS-Interface voltage and a diagnostic LED indicates whether the power is adequate up to the end of the bus cable.

The extension plug has the following features:

- Doubles the cable length per AS-Interface segment from 100 to 200 m

- Expanded applications and greater flexibility when planning systems due to the doubling of the AS-Interface segment

- When combined with repeaters, allows a maximum expansion of the AS-Interface network up to 600 m

- Simple monitoring with integrated overvoltage detection
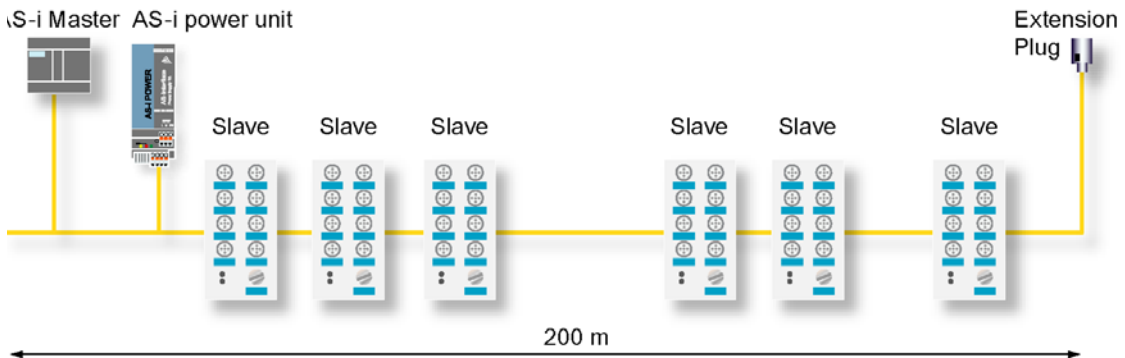
Figure 3-9   Using the Extension Plug

Maximum Network Span with Repeaters and Extension Plugs

if particularly large AS-Interface networks are necessary, the use of repeaters can expand the maximum possible cable length even further.

Note

Note that repeaters are used in conjunction with extension plugs, it is not possible to connect repeaters in series.

This results in a maximum possible distance between a master and a slave of 400 m and an absolute maximum span of 600 m. Parallel connection of repeaters for a star-shaped structure with up to 200 m long segments is possible.
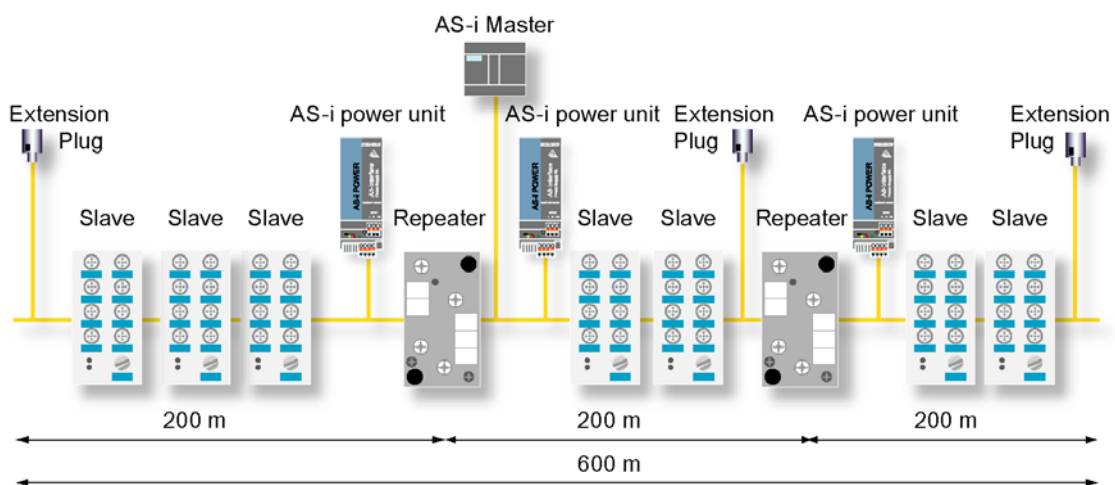
Figure 3-10   Combined Use of Repeaters and Extension Plugs

3.6   Addressing Unit

Area of Application

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

This is done as explained below:

- Offline using an addressing unit

- Online by the master of the AS-Interface system.

The values 1 to 31 (or 1A to 31A and 1B to 31B with the extended specification) are permitted as addresses.

Figure 3-11   Addressing Unit

Functions

- Reading out the slave address 0 to 31, A/B

- Reading out the IO and ID codes of the slave

- Standard and extended ID code1 and ID code2

- Standard and extended addressing mode according to AS-Interface version 2.11

- Programming the ID code 1

- Functional test of the AS-i slaves:
  Read inputs and write outputs of digital or analog slaves.

- AS-Interface test:
  Measurement of voltage (measuring range 0 to 35 V) and
  current consumption (measuring range 0 to 100 mA) of the AS-Interface bus.

- Storage: Entire system configurations can be stored (profiles of all slave,
  including those with extension according to the AS-Interface specification 2.11).

- Detection of the configuration of an entire system

Address Areas

A new slave that has not been assigned an address has address 0. It is then
detected by the master as a new slave without an address assignment and is not
yet included in normal communication.

Any address can be assigned, in other words, it does not matter whether the
slaves begin with address 21 or whether the first slave is actually given the
address 1.

Note

Pure addressing functionality is also available on every AS-i master. The address
can be set on the device itself using the keypad and display or via the integrated
Web server (WBM) or by the user program (STEP 7).

3.7   Diagnostic Device - AS-Interface Analyzer

The AS-Interface analyzer is used to test AS-Interface networks. Troubleshooting is made systematic and permanent monitoring is much easier.

Errors during installation, for example bad contacts or EMC problems at extreme load, can be revealed by this device. This makes it possible to evaluate the quality of complete networks.

The AS-Interface analyzer also allows documentation for commissioning and service by creating test reports.

Detailed diagnostics is made possible for advanced AS-Interface users by trigger functions. As a passive node, the AS-Interface analyzer listens in on the AS-Interface network. At the same time the device is supplied with power from the AS-i cable. This bus monitor interprets the physical signals and records communication.

The data obtained is transferred to a PC over an RS 232 interface where it can be evaluated with the supplied diagnostic software. This mode provides you with a fast overview of the existing AS-Interface system. The configuration of the slaves and the currently transferred data is displayed clearly. The numeric data of the transferred frames can be seen in the advanced statistics.

Figure 3-12   Using the AS-Interface Analyzer
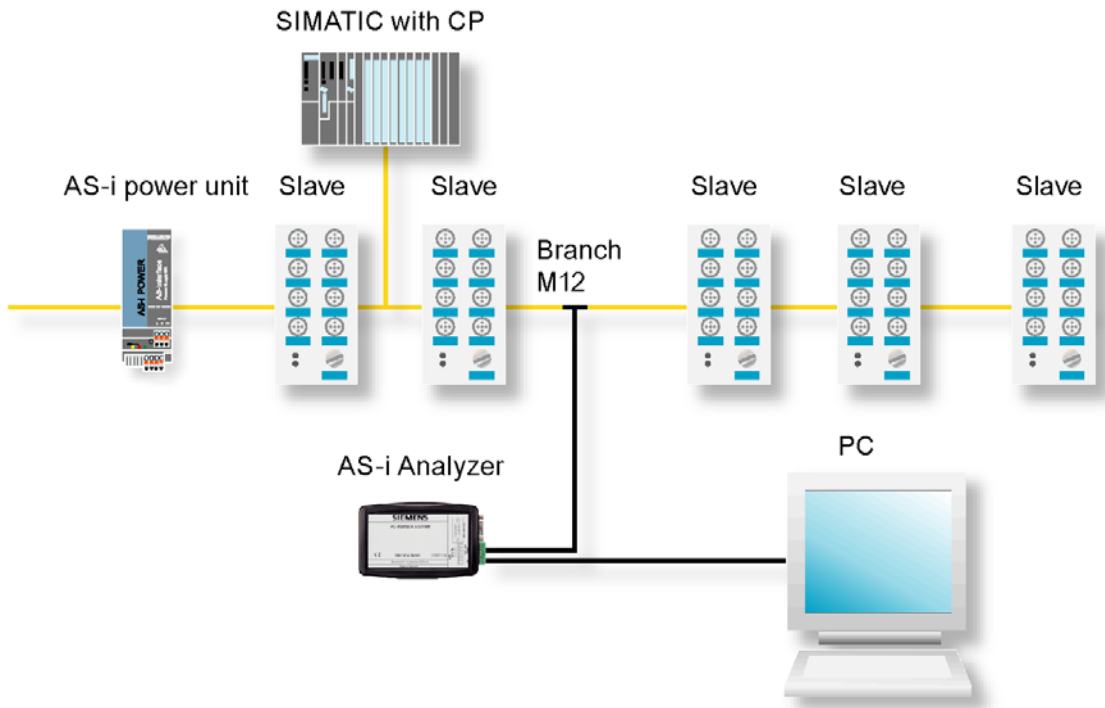
❏

4 The Master Mode - Commands, Sequence, Programming

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 it works:

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.

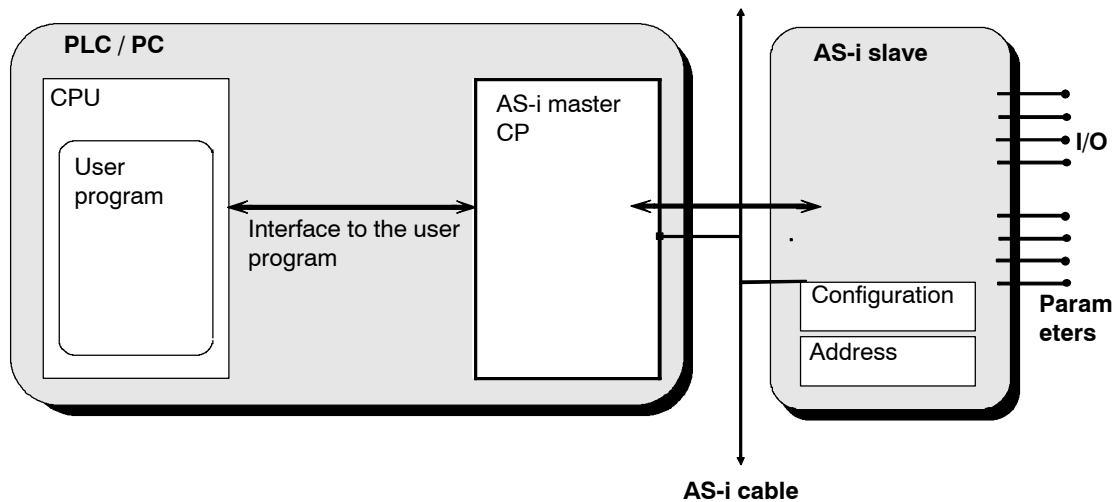- Information is exchanged with the AS-i slaves via the interface between the master CP and AS-i cable.

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".

With the standard AS-i masters and extended AS-i masters, a distinction is made between master classes (M0, M1, M2 for standard masters and M3, M4 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:

  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:

  This profile covers all the functions according to the AS-i master specification.

- Master Profile M2:

  The functionality of this profile corresponds to master profile M0, but in this profile the AS-i master can also assign parameters to the AS-i slaves.

- Master Profile M3:

  The functionality is the same as master profile M2, however here complex slaves can be assigned parameters by the AS-i master and 16-bit inputs or outputs.

- Master Profile M4:

  The functionality is the same as master profile M3, however expanded by the ability of the AS-i master to assign parameters to the combi slaves, transfer of serial data, extended address mode (8 I/O), 16-bit inputs in the extended address mode and fast/super fast analog value transfer.

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.

Expanded masters according to Specification V3.0 provide particularly fast access for analog slaves (including A/B slaves) according to profile S-7.A.8, S-7.A.9, S-6.0.X.

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:

- 8 configurable data inputs and outputs

- 4 parameter outputs

- 2 analog channels (16 bits)

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.

Parameters

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. With the read parameter values function, current diagnostic data can also be requested. The amount of data can be freely selected.

Configuration

The input/output configuration (I/O configuration) indicates which data lines of the AS-i slave are used as inputs, outputs or as bi-directional 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 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.

If you configure with STEP 7 (V5.4 or higher) and use AS-i slaves from Siemens, these settings are unnecessary because they are stored in the system.

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.

The following schematic shows the system components in which the data fields and lists of the system are stored. The data fields and lists are explained after the diagram.
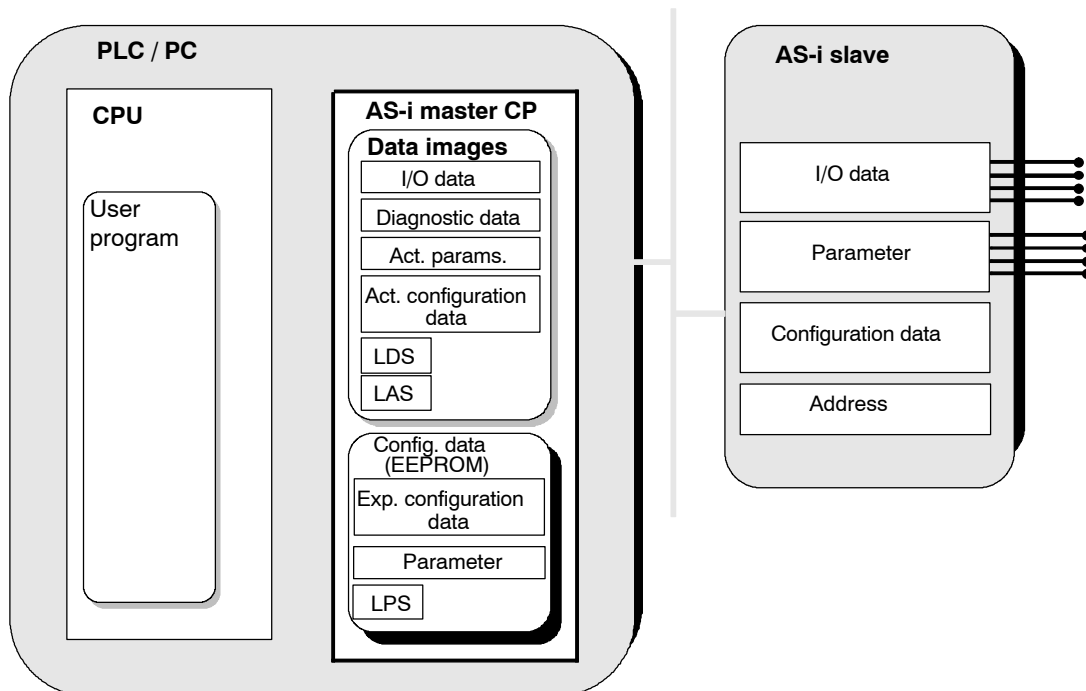

Figure 4-2

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

• **Data images**

These contain temporarily stored information:

- Act. params.

   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.

Offline phase

Initialization

Startup phase

Detection Phase

Activation phase in protected mode

"Startup **with** configured data"

Activation phase in configuration mode

"Startup **without** configured data/obtain configuration data"

Normal operation

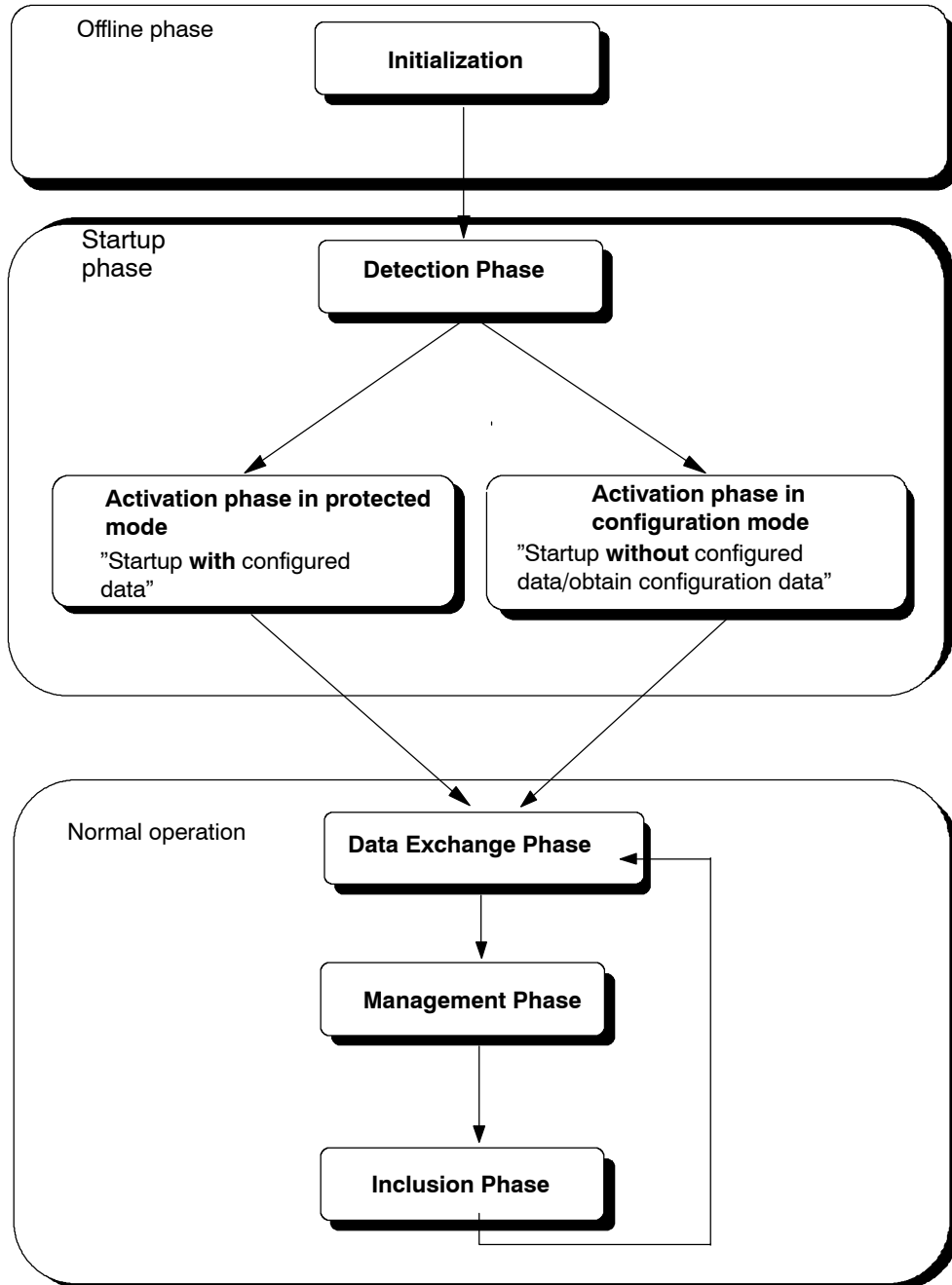**Data Exchange Phase**

Management Phase

Inclusion Phase

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 is with 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 stations, 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 desired configuration stored on the AS-i master are activated. If the actual configuration found on the AS-i cable differs from this desired 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 according to Specification V2.11) are transferred to a slave and are used, for example, for a threshold value setting.

    Measured and control data can be exchanged cyclically or parameters and diagnostic data acyclically over the available data channel (Read parameters function).

    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 slaves that match the expected configuration saved on 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. This shows the possible operations and the associated direction of data flow (applies only to gateways).
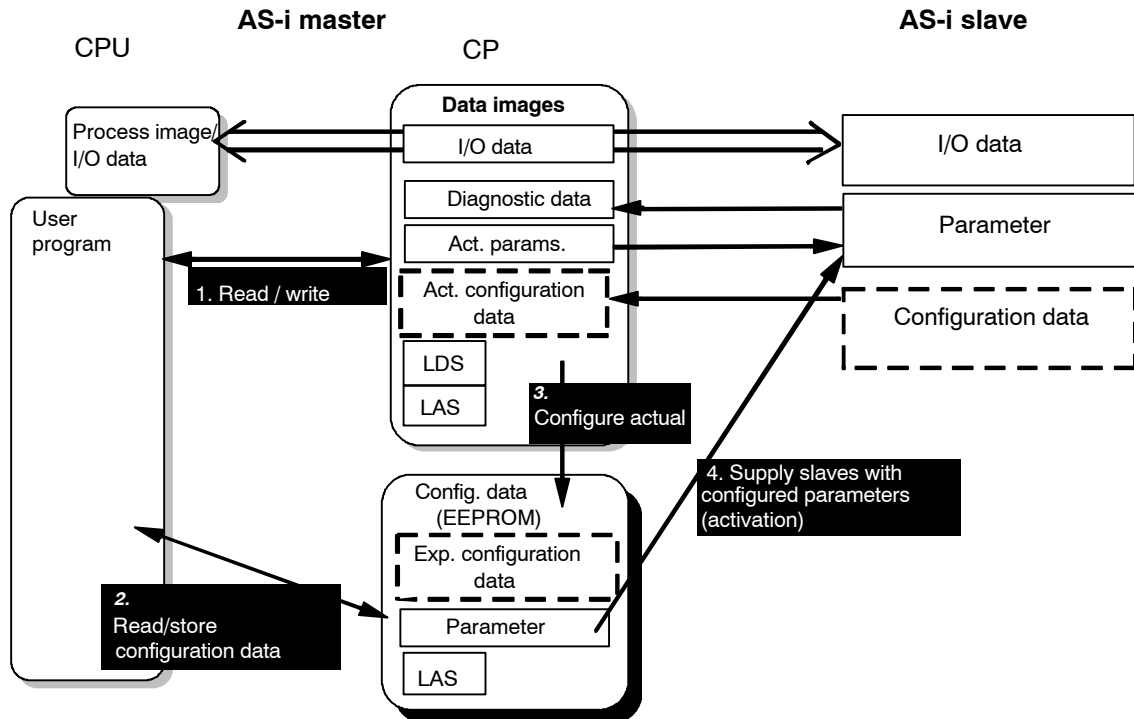

Figure 4-4

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 / read parameters

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

   With diagnostics-compliant slaves, diagnostic data is also read from the slave when parameters are read.

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.

❑

A References

/1/

AS-Interface - The Actuator-Sensor-Interface for 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

Zum Taubengarten 52

63571 Gelnhausen

Germany

Tel: +49 (6051) 4732-12

Fax: +49 (6051) 4732-82

E-mail: info@as-interface.net <mailto:info@as-interface.net>

Web: www.as-interface.net <http://www.as-interface.net>

CEO: Rolf Becker

/3/

Industrial Communication for Automation and Drives

Catalog IK PI

The catalog can be ordered from your local SIEMENS branch office or distributor.

/4/

Low-voltage Controls

SIRIUS-SENTRON-SIVACON Catalog LV1

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 (DIN 19245)
PROFINET Standard IEC 61158 / IEC 61784

Order numbers

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

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

❑

B 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 or A/B) slaves that exchange analog values with the AS-i master.

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 the 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 integrated AS-i chip: Using this, up to four conventional sensors and four conventional 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 extendedAS-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 S-7.3/S-7.4 of the AS-Interface Specification
The extended AS-i masters also support the master profiles M3 and M4 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 AS-i slaves or slaves with the extended addressing mode (A slaves only) can be connected to a standard AS-i master.

WBM

Web‑based Management provides a user interface that allows access to the device (for example AS‑i master) using an Internet browser.

❑

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