SIEMENS

Easy, flexible, efficient

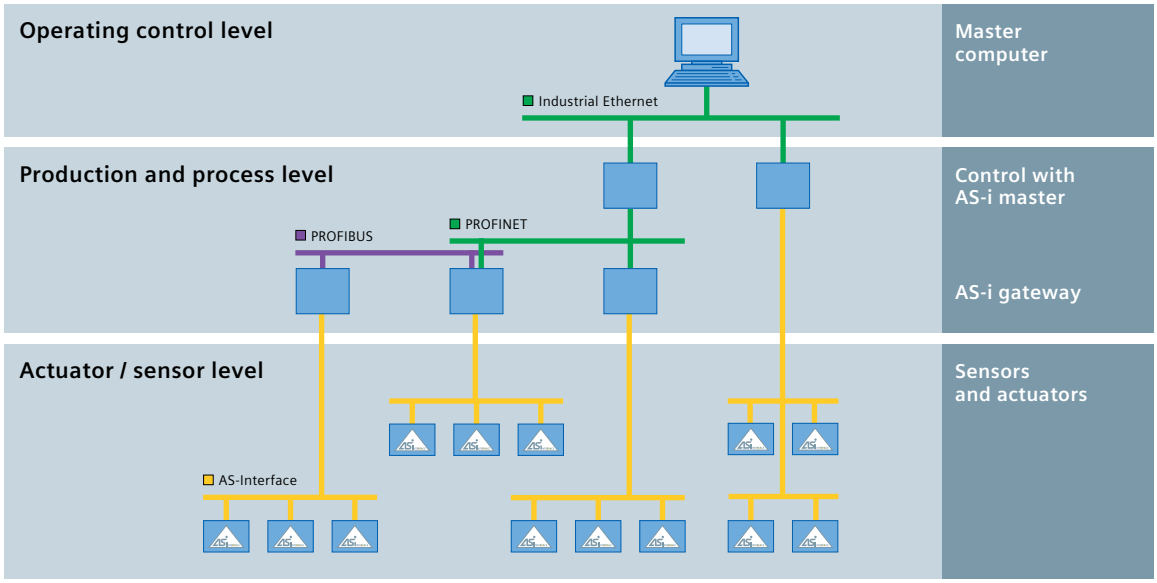
Integrated connection of the field level to the control – revolutionized automation applications with AS-i and benefits

siemens.com/as-interface

Answers for industry.

AS-Interface – the clever standard

Sensors and actuators play an important role in automatic processes. Whether in logistics centers, where the position of parcels on a conveyor belt is checked by light barriers, or in beverage filling systems, where the correct filling level is monitored – sensors and actuators represent the detection and execution organs of the control. AS-Interface provides you with a bus system which connects all sensors and actuators in the field with the superior control with unrivaled ease, safety and integration.



The assembly of a complex automation system is not easily comprehendible at first sight.
Particularly the field level, which features a large number of realtime-capable devices, requires a clear structure.

This is exactly what the AS-i field bus supports: Up to 62 slaves are connected to the AS-i master and simultaneously supplied with energy via a simple two-wire line – the yellow AS-i cable. Rugged data transfer in harsh environments and a high degree of protection come as a standard with AS-Interface.

This brochure explains the operating principle of AS-Interface, the further advantages offered by this bus system and how you can benefit from AS-Interface in combination with our automation technology.

All Arguments speak for AS-i by Siemens

AS-Interface (AS-i) – more specifically the actuator-sensor interface – represents the simple and effective bus system for the field level. As an open, standardized and manufacturer-independent bus system, it facilitates the transmission of process- and machine-level digital and analog signals in realtime. Furthermore, it also acts as a universal communication interface between sensors of all kind as well as a large range of simple and complex actuators and the superior control level.

The clou: The AS-Interface system is characterized by such a high degree of simplicity and effectiveness that it represents the most cost-favorable solution by far compared to other field bus systems. It is therefore not surprising that AS-Interface has established itself as the ultimate standard in the field of industrial automation. It not only offers maximum ease of handling and installation in next to no time, but also supports outstanding flexibility in terms of retrofits and extreme ruggedness even under harshest conditions.

Since its market introduction in 1994, more than 15 million AS-Interface nodes were installed in systems of the most various sectors worldwide. AS-Interface has been standardized as an international industrial standard in accordance with EN 50295 and IEC 62026-2 since 1999.

The AS-International Association, of which Siemens is a founding member, continuously works on the advancement of AS-Interface. Its meanwhile over 300 members – including the most renowned manufacturers of automation technology – ensure that AS-Interface will dominate the market also in the future and that its status as the easiest and most efficient solution is further strengthened.

Today, Siemens offers the most comprehensive portfolio of AS-Interface solutions on the market. This seamless portfolio ranges from hardware (cables, slaves, masters) down to software tools (TIA Portal) and services.

Siemens = full-range AS-i portfolio

- Full-range AS-i product portfolio for bus-based standard and safety technology from a single source
- Consistent integration of AS-i devices by Siemens in the SIMATIC programming and diagnostics concepts and in the TIA Portal engineering framework
- Integration of ASIsafe applications in SIMATIC safety programming (e.g. Distributed Safety)
- Planning, calculation and verification of the entire safety chain on the basis of ASIsafe in the Safety Evaluation Tool (TÜV-tested)
- Integration of subordinate AS-i networks in the PCS 7 process control system
- Global spare parts logistics, consulting and service

AS-i = easy!

- Only *one* cable for data and energy
- Time-saving mounting / installation
- Engineering in TIA Portal
- Comfortable maintenance

AS-i = flexible!

- Flexible topologies
- Open standards
- Expandability
- Safety technology

AS-i = efficient!

- Comfortable addressing
- Rapid device replacement
- Ruggedness and stability
- Device and network diagnostics

AS-i = easy!

AS-i = easy!

- Only *one* cable for data and energy
- Time-saving mounting / installation
- Engineering in TIA Portal
- Comfortable maintenance

Only *one* cable for data and energy

The enormous wiring costs caused by a higher degree of automation and the resulting additional fault sources represented an important reason for the development of AS-Interface. Increasingly complex processes with a multitude of digital and analog measured values had to be centrally bundled and processed in the control. The strategy of AS-i focused on the reduction of cable harnesses while still serving the increasing demand for control and diagnostics data on the control level.

The cost advantages offered by AS-Interface are substantial: According to a survey carried out by the TU Munich, for example more than 25 % of electrical automation costs can be saved when employing AS-Interface with a milling machine. This is owed to the fact that fewer cables not only result in reduced mounting and commissioning times, but also in minimized advance configuration expenditures. As a major advantage for ongoing operation, standstills can be reduced or even completely prevented through eased assembly and additional diagnostics information.

Time-saving mounting / installation

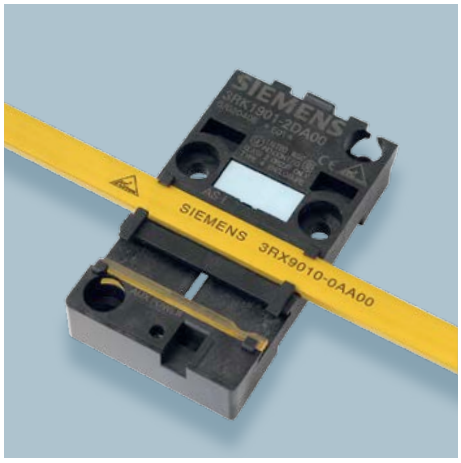
The two-pole AS-i cable is routed throughout the system and connected to the control's AS-i master. It both ensures the sensors' and actuators' data transmission and energy supply – while offering a high degree of protection as all slaves are docked onto the system on the basis of the innovative insulation piercing method.

This is how it works: The modules' contact mandrels pierce the cable's insulation and establish safe contact with the copper conductors – ensuring maintenance of the high degree of protection. When the mandrels are pulled out during removal of a slave, the holes automatically close at the respective position due to the cable's "self-healing power" and thus restore the insulation. A further safety aspect: The cable's geometry ensures reverse polarity protection.

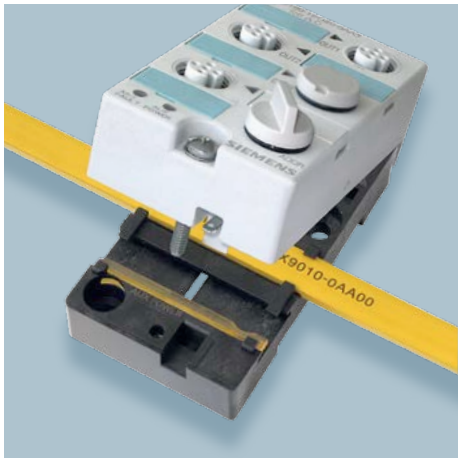
No other bus system can be connected to the control and routed through the system faster while being equipped with I/O modules and AS-i slaves at the relevant positions.

Illustration above:
Cross-section of an AS-Interface shaped cable at a connection point (insulation piercing method)

Illustration right:
Connection of an I/O module – analogous also with pushbuttons and indicator lights



Mounting plate of an I/O module with polarized cable routing



The contact mandrels pierce the two-wire cables through latching of the upper part

Engineering in the Totally Integrated Automation Portal (TIA Portal)

The Totally Integrated Automation Portal represents an innovative engineering framework for all automation tasks. As central component of TIA, the TIA Portal facilitates redefined engineering.

The TIA Portal combines control programming and visualization configuration and integrates the parameterization of drives and networks as well as the programming of fail-safe applications.

The TIA Portal supports very intuitive operation. For instance, configuration can be easily realized via the hardware catalog by means of drag & drop, after which a realistic representation of all network slaves and components is output – right down to the actuator/sensor level.

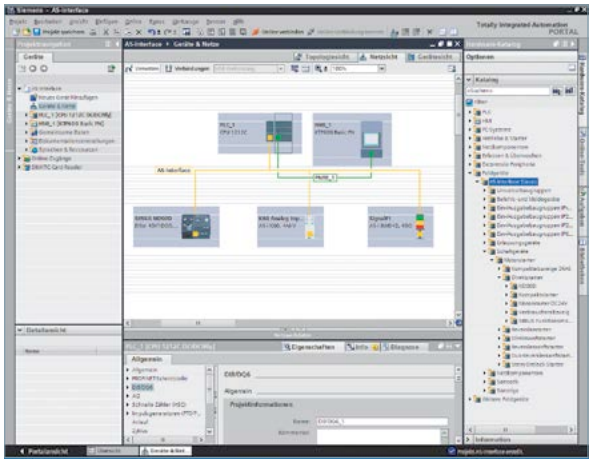
Furthermore, the engineering framework supports easy getting started with safety programming via a library with certified safety functions.

The TIA Portal not only enhances your workflows' efficiency, but also sustainably improves your productivity and competitiveness – no matter in which sector.

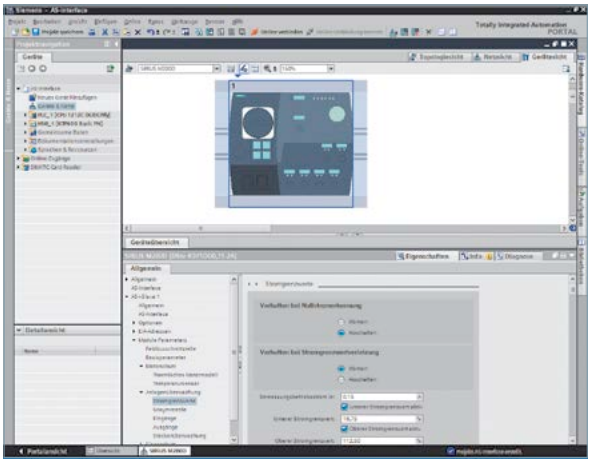
Comfortable maintenance

The online diagnostics in the TIA Portal provides accurately timed information on the slave to be exchanged in plain text. In addition, visual diagnostics information in network and device view and current status messages (operation, fault, maintenance) are provided.

The innovative AS-i insulation piercing method also accelerates device replacement within the scope of maintenance – without interruption of the AS-i bus. Replacement can thus be easily realized even by untrained staff. Moreover, the implementation time for expansions is reduced, allowing for minimized downtimes.



Network view of all communication stations

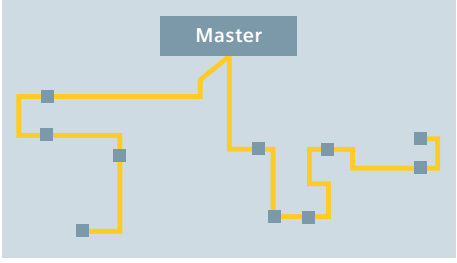


Device view with parameters

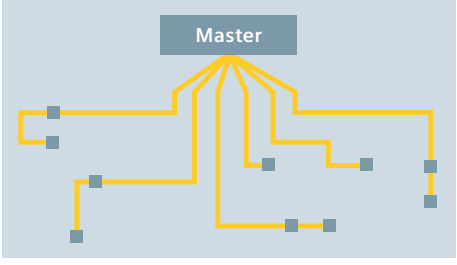
AS-i = flexible!

Flexible topologies

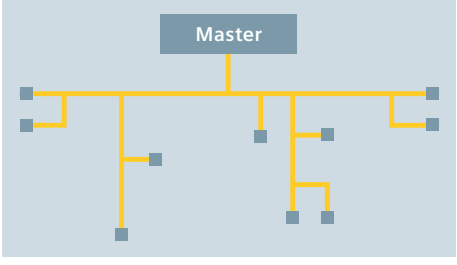
Whether line, star or tree layout – there are no restrictions in terms of structure or network topology thanks to the rugged functional principle. AS-Interface facilitates your installation technology's optimum adjustment to individual systems or machines and supports ample savings in terms of planning, configuration, mounting as well as time. Also expansions can be carried out more easily and rapidly. Where control lines had to be routed before, now only one yellow AS-i cable has to be wired.



"Line" topology



"Star" topology



"Tree" topology

Open standards

AS-Interface is standardized in acc. with EN 50295 and IEC 62026-2. All components by Siemens comply with the AS-i Specification and are correspondingly tested and certified. This ensures the perfect interaction of Siemens products with third-party devices.

Furthermore, a certified standard which supports the application of safety-related components in the AS-Interface network was developed with "AS-i Safety at Work". The "Safety at Work" concept has been certified by the TÜV (German Technical Inspectorate) and by the German social accident insurance's institute for occupational safety.

Expandability

AS-i networks can be easily adjusted to system expansions as AS-Interface is accurately matched to the requirements of the lowest field level: Realtime capability, low data volumes and a large number of connected devices – in addition to the already mentioned benefits of freely selectable topology and innovative insulation piercing method.

An AS-i network can be expanded to up to 62 AS-i slaves. In terms of simple I/O modules, this corresponds to a maximum of 992 I/O points, distributed to a bus length of up to 600 m per AS-i network. Yet, the AS-i network supports further expandability. Also further AS-i networks can be connected to the control and AS-i links immediately or at a later point in time.

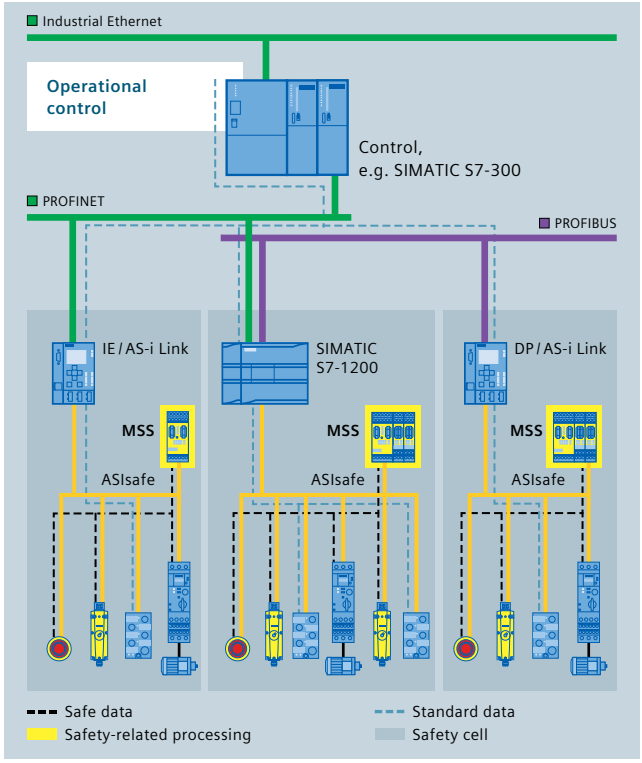
Also analog values, e.g. of analog modules ore measuring transducers, can be integrated just as easily as digital I/Os. The AS-i master automatically organizes the transfer of all data. This way, a small field bus can be effortlessly expanded and flexibly adjusted to machine or system changes.

Safety technology

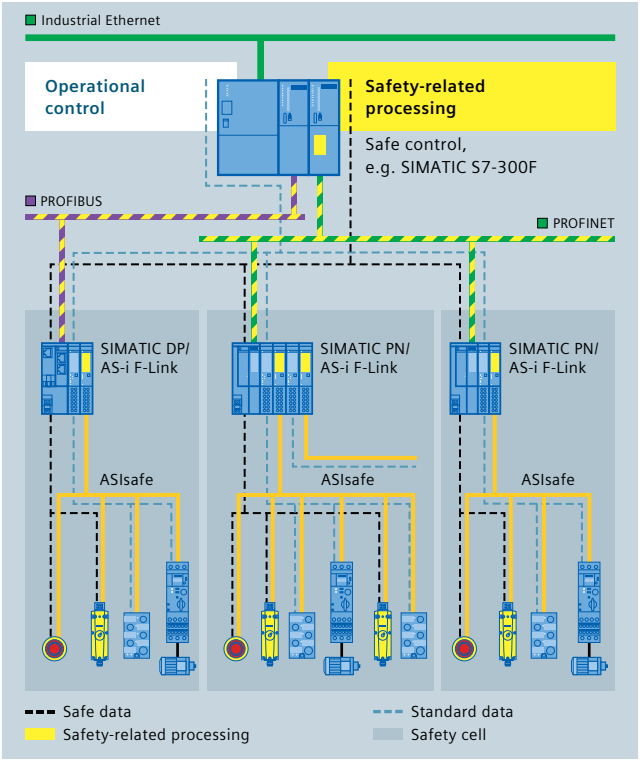
The "ASIsafe" technology already forms part of every AS-i network and can be used by means of corresponding safety-related components right away or in the future. Such components may comprise fail-safe I/O modules, position switches, E-STOP pushbuttons, safety monitors or the 3RK3 modular safety system for safe processing and logics as well as safe AS-i gateways (F-link) for connection to a superior fail-safe control.

Only with Siemens solutions are subordinate safe AS-i networks incorporated in Safety Integrated and thus become part of fail-safe programming via SIMATIC. And only Siemens offers the choice between the "small" **ASIsafe Solution local** with targeted separation of safety technology and control technology and the "large" **ASIsafe Solution PROFIsafe**, i.e. the bundling of standard and safety technology within the control on the basis of Safety Integrated.

Both solutions offer benefits in terms of easy safety function calculation and evaluation via the Safety Evaluation Tool (SET), minimized engineering expenditures and comprehensive diagnostics – for maximum machine and system availability.



ASIsafe Solution local



ASIsafe Solution PROFIsafe

AS-i = efficient!

Comfortable addressing

The mechanical-electrical aspects of wiring were explained on page 6. Yet, how can a specific sensor for evaluation or a specific actuator for switching be selected from a vast pool of slaves? Very easily. In only two steps:

Step 1: Each AS-i slave is assigned to a distinct address via the addressing unit.

Step 2: Network configuration is taken over at the push of a button on the master.

The AS-i master detects all connected AS-i slaves on the basis of their address in next to no time. The control can immediately access the network's AS-i slaves. The AS-i slaves' are automatically assigned to the I/O range of the control. Also address assignment after module replacement is realized automatically. This makes separate configuration or deployment of qualified personnel unnecessary.

Rapid device replacement

The AS-i modules and all other AS-i slaves by Siemens are optimally suited for the assembly of a simple bus. LEDs for status display and signal diagnostics on the AS-i slaves ease commissioning and device replacement.

Depending on the respective version, very high degrees of protection – up to IP69K – are supported. This results in optimum prerequisites for fault-free operation, even under harsh conditions.

A selection of AS-i slaves is available on page 16/17.

Addressing unit

In the field:
e.g. K60 compact module

In the control cabinet:
e.g. 3RA6 compact starter

Ruggedness and stability

The modulation procedure especially developed for AS-Interface ensures extremely stable data transfer and maximum operating availability. An intelligent data protocol protects the entire system and makes it particularly resistant to faults. As a result, additional cable grounding or shielding can be done away with.

The cost-favorable AS-Interface cable, which can be routed just as flexibly and easily as any electrical installation, can thus be used. Special components are neither required for the connection of slaves nor for feeders.

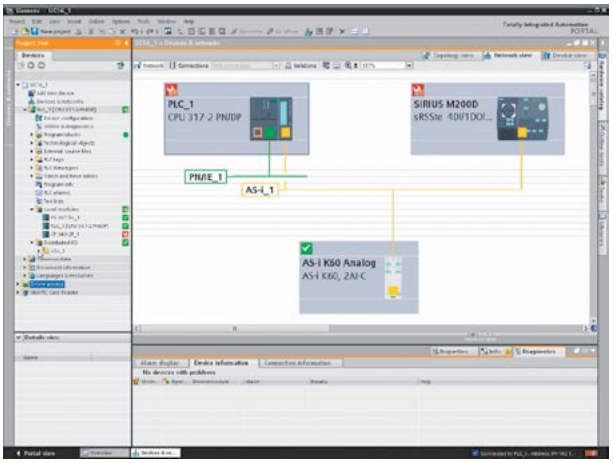
Device and network diagnostics

Redefined engineering with the TIA Portal: Also diagnostics and fault messages can be traced over all bus hierarchies right down to the lowest actuator/sensor level and described in plain text. A realistic representation of the respective bus topology serves as the basis.

The TIA Portal also sets new standards with regard to efficiency. The data of subordinate AS-i networks can be flexibly integrated via drag & drop on the basis of SIMATIC HMI and WinCC flexible. For this purpose, only the signal information of any AS-i slave has to be “dragged” to the operating screen of an HMI Basic Panel.

In addition, integrated web servers and diagnostics on the basis of user-specifically created websites facilitate the data visualization of all connected AS-i networks and their integration in user-specific operating concepts (e.g. website for documentation and operation of a SIMATIC S7-1200).

AS-i is easy, rugged and perfectly suited for demanding applications



Efficient diagnostics in the TIA Portal: Online view of an AS-i network

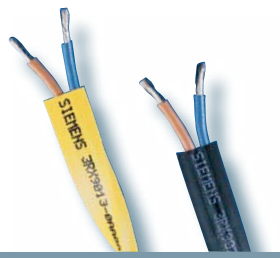
AS-i the modular system

Yellow miracle: the AS-Interface cable

The yellow shaped flat cable is characteristic of AS-Interface. Both the sensors' data transfer and energy supply are realized via this cable.

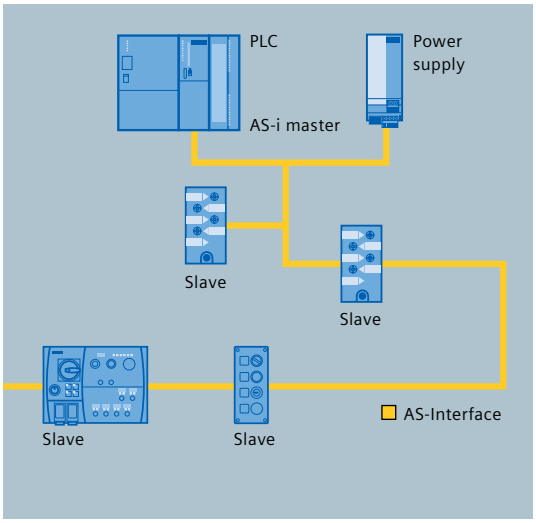
A black shaped cable can be additionally used for a supplementary 24 V supply of powerful actuators.

Both cables employ the contacting technology specifically developed for AS-i which facilitates the connection of slaves with degree of protection IP65/67 to any point of the network – in an easy and polarized manner.



Systematic simplicity: Assembly

An AS-i network consists of a master, a power supply unit and up to 62 stations, the so-called slaves. The AS-Interface master ensures data exchange with the slaves on the basis of cyclic polling and establishes the connection to the superior control. Per each slave, four data bits in input and output direction each are exchanged in every cycle. The power supply unit centrally supplies all connected AS-i slaves with energy via the AS-i cable, on which also the data are transferred. This makes laborious wiring a thing of the past.



Head of the network: AS-i master

The AS-Interface master serves as the link to superior controls. It automatically organizes the data traffic on the AS-i cable. A differentiation is made between AS-i masters for direct installation in a SIMATIC unit (CPs or CMs) and AS-i links which are used as sub-system in PROFINET- or PROFIBUS-based applications. Multiple AS-i networks can be connected to a control or an AS-i link. The F-links represent the safety-related versions of the AS-i links.

Perfect energy feed: Power supply unit

The AS-i bus centrally supplies all connected slaves in the field with the help of a special AS-i power supply unit. The power supply units are offered in various performance classes.

In applications up to a maximum bus length of 50 m (AS-i Power24V), also standard 24 V power supply units (e.g. SITOP) can be used. For this purpose, a separate data decoupling unit has to be employed. This module also facilitates the utilization of one power supply unit for several AS-i networks.

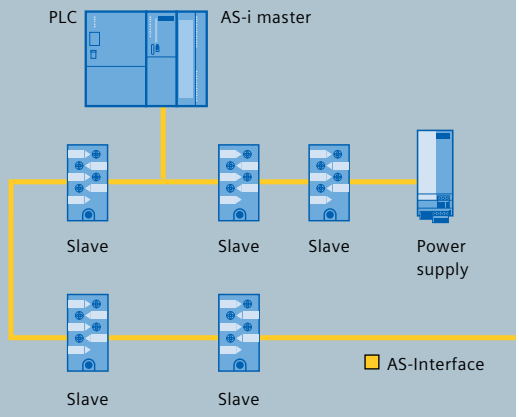
Direct or distributed: Flexible integration options

Whether direct connection via AS-i master or connection as sub-system via AS-i links – we provide an Object Manager, PCS 7 libraries and screens for WinCC for all versions to ensure consistent integration in the automation system as a standard.

AS-Interface with direct connection to the control

AS-Interface networks can be very comfortably directly connected to the SIMATIC control.

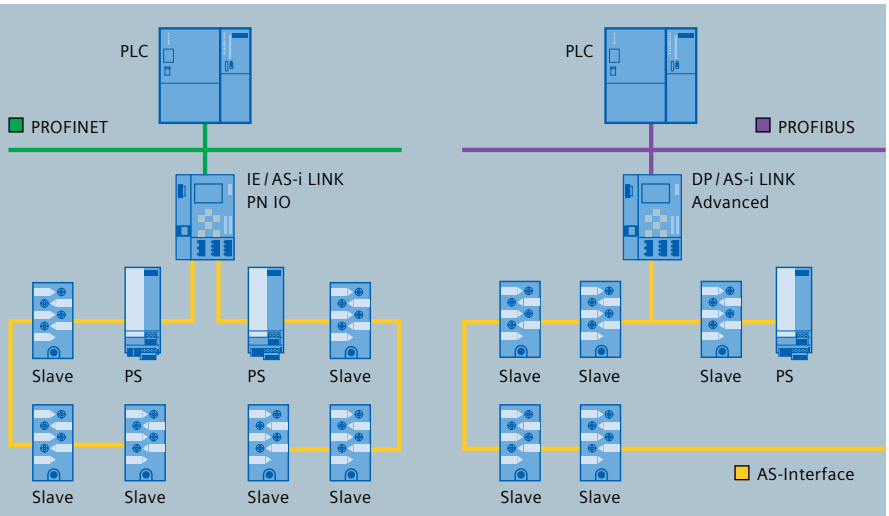
For this purpose, so-called CPs or CMs are available. Integration is just as easy as with other modules of SIMATIC controls by Siemens.



AS-Interface as sub-system

Besides direct integration, AS-Interface can also be employed in a distributed manner as feeder for superior bus systems.

Advantages: The flexible wiring of AS-i can also be utilized in PROFIBUS- and PROFINET-based systems. Subordinate AS-i sub-systems can be completely assembled and commissioned even before the central control is completely programmed. Links to PROFIBUS or PROFINET are used for this purpose.



Large selection: AS-Interface slaves

As the largest system supplier in the field of AS-Interface, Siemens offers a comprehensive product range of AS-i slaves.

The portfolio (see page 16 / 17) ranges from simple and safe I/O modules for the field and the control cabinet to pushbuttons and signaling columns as well as position switches with AS-i connection right down to powerful motor starters and frequency converters.

Key data per AS-i network

Number of slaves	Up to 62
Number of I/Os	Up to 496 inputs and 496 outputs
Topology	Any, combinable, no termination resistors
Medium	Unshielded two-wire line for data and energy
Line length	100 m as a standard, extendable to 600 m with Repeater and Extension Plug
Cycle time	5 ms (typical)
Data transfer	Digital and analog (16 bit)

Simply elegant: AS-i Power24V

Less is more

Particularly in applications with very few I/Os, parallel wiring is frequently still dominant. Even though AS-Interface is perfectly suited for small applications, the additionally required 30 V AS-i power supply unit often represents a cost obstacle. With the expansion of AS-Interface by AS-i Power24V and the resulting possibility of utilizing already available standard 24 V DC power supply units in AS-i networks, AS-Interface also becomes interesting for very tightly calculated applications.

Technical requirements

The expansion of AS-Interface by AS-i Power24V facilitates the utilization of 24 V standard power supply units in AS-i networks. The communication technology of AS-Interface operates with an equally high quality both with 30 V and 24 V operating voltage. With 24 V AS-Interface operation, merely sufficient voltage supply of the slaves and sensors has to be ensured. This is secured by a restriction of the maximum expansion of an AS-i Power24V network to 50 m.

In addition, a data decoupling unit has to be employed. This unit also facilitates the utilization of one power supply unit for several AS-i networks.

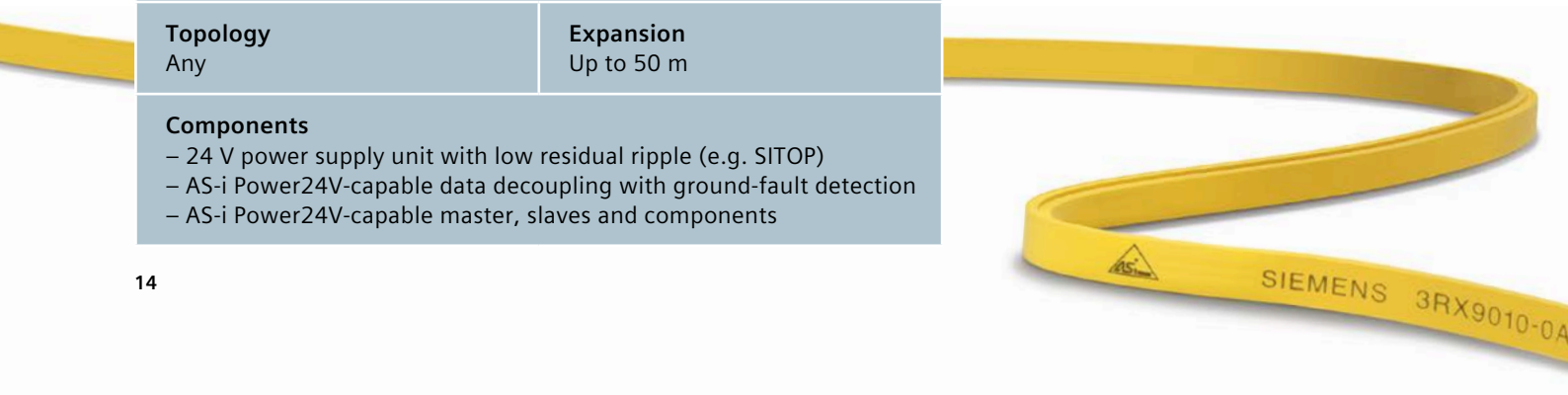
Also small applications benefit from the AS-i technology

Particularly in small applications, the costs for a separate power supply unit account for a disproportionate share of the application's overall costs.

In AS-i Power24V networks, these additional costs no longer accrue thanks to the application of the available 24 V power supply unit. Users benefit from the elimination of this obstacle in multiple ways:

- Cost and space savings thanks to elimination of the 30V AS-i power supply unit
- Efficient utilization of one power supply unit for several AS-i networks
- Increased degree of standardization in small systems
- Reduced getting-started costs for AS-Interface
- Utilization of present AS-i network advantages, e.g. high data quality, extended diagnostics and maintenance information, integrated ASIsafe technology, unlimited number of connectable slaves

Key data per AS-i Power24V network	
Number of slaves Up to 62 standard slaves or up to 31 safe slaves	
Topology Any	**Expansion** Up to 50 m
Components – 24 V power supply unit with low residual ripple (e.g. SITOP) – AS-i Power24V-capable data decoupling with ground-fault detection – AS-i Power24V-capable master, slaves and components	



Integrated safety: ASIsafe

Uncompromising savings with AS-i

This is supported by ASIsafe (AS-i Safety at Work): This safety-related version of AS-Interface facilitates the transmission of standard and safe data on a single bus system.

EMERGENCY-STOP pushbuttons, door tumblers and many further I/Os can be comfortably, safely and directly connected to AS-i – TÜV-certified up to PL e / Cat. 4 or SIL 3.

Also existing applications can be easily and rapidly expanded by safety-relevant functions. For this purpose, Siemens offers ASIsafe from small safety islands (ASIsafe Solution local) to system-wide Safety Integrated architectures (ASIsafe Solution PROFIsafe) with superior safe PLC.

ASIsafe Solution local: 3RK3 modular safety system

The ASIsafe Solution local requires only few components: One MSS and safe slaves. Neither fail-safe PLC nor special masters are required. The MSS monitors safe sensors (e.g. EMERGENCY-STOP), evaluates them in accordance with its parameterized safe logics and ensures their safe disconnection. Disconnection is realized in a distributed manner via ASIsafe in connection with safe AS-i outputs or via safe outputs integrated in the device.

Diagnostics of the MSS is realized via the control. The most important advantage: Additional wiring of the safety components is unnecessary. Furthermore, prefabricated screens for operation and monitoring support the visualization of all safety-relevant events on the available SIMATIC HMI panels.

ASIsafe Solution PROFIsafe: Safe AS-i links for PROFIBUS and PROFINET

With the safety-related AS-i links, the advantages of AS-i can also be utilized in complex safety applications (e.g. fail-safe SIMATIC or SINUMERIK controls). Acting as links in bus-based safety technology, they support the ASIsafe telegrams' transfer to the PROFIsafe protocol. Safe signals are detected in the usual manner via the safe AS-i slaves. Evaluation is carried out by the available F-PLC. Responding is realized on the PROFIsafe level, e.g. via F-DOs / F-ROs in the central rack or with the help of the fail-safe distributed I/O. Furthermore, safe disconnection commands can be transferred back from the PROFIsafe level to the ASIsafe level, where they can effect the disconnection of distributed safe AS-i outputs, e.g. in load feeders.

Safety-related AS-i links represent the best choice for numerous safe slaves and disconnection circuits, for safety-related further processing on superior field bus levels and for complex, interlaced logical interlinks.

The safe AS-i links are configured and parameterized via STEP 7 or TIA Portal, analogous to PROFIsafe slaves. The safe logics are programmed with the "unlimited" possibilities of STEP 7 and TIA Portal in F-LAD or F-FBD. The comprehensive library of TÜV-certified function blocks supports particularly efficient and structured user programs. Also diagnostics is implemented via the system functions provided by STEP 7 or TIA Portal.

Key data per AS-i network (ASIsafe)
Number of safe slaves Up to 31
Safety Integrated level Up to SIL 3 (EN 62061)
Safety category Up to PL e (EN 13849-1)

AS-i product portfolio

Masters for SIMATIC

CP 343-2 (P) for SIMATIC S7-300

CM 1243-2 for SIMATIC S7-1200

CM AS-i master for ET 200SP

AS-i links

DP/AS-i Link 20E

IE/AS-i LINK PN IO or DP/AS-i LINK Advanced

I/O modules

K20 compact modules for the field

K45 compact modules for the field

K60 compact modules for the field

K60 analog modules for the field

SlimLine S22,5 and S45 for the control cabinet

Flat modules for the control cabinet

Motor starters / frequency converters and load feeders

SIRIUS M200D motor starters

SINAMICS G110D frequency converters

SIRIUS MCU motor starters with AS-i

Commanding and signaling devices

SIRIUS pushbuttons / indicator lights

SIRIUS signaling columns

SIRIUS E-STOP

System components /accessories

Extension Plug

Repeater

Addressing unit

Analyzer

SIMATIC PN/AS-i F-Link or
SIMATIC DP/AS-i F-Link

Power supply units & data decoupling units

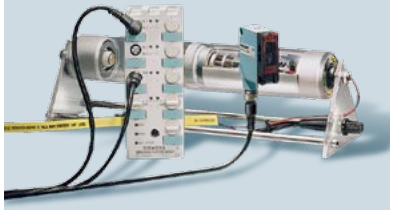
AS-i power supply 30V
with data decoupling

AS-i power supplies 30V
without data decoupling

SITOP power supplies 24V
without data decoupling

S22,5 data
decoupling units

Counter module for
the control cabinet



24 V DC starter
for the field

Safe K45F compact modules
for the field

Safe K22F compact modules
for the field

Safe SlimLine S22,5F
for the control cabinet

SIRIUS load feeders

SIRIUS compact starters

AS-i add-on module

Positions and safety switches

SIRIUS
position switches

SIRIUS position switches
with door tumbler

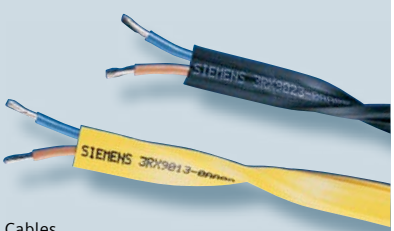
SIRIUS cable-
operated switches

Parameterizable safety relays

SIRIUS 3RK3
modular
safety system

MSS Advanced

MSS ASIsafe



Cables

Compact distributors

M12 feeders

Overvoltage protection

Ground-fault detection

References

Airport Munich, new construction of terminal 2, baggage conveyor system with AS-i

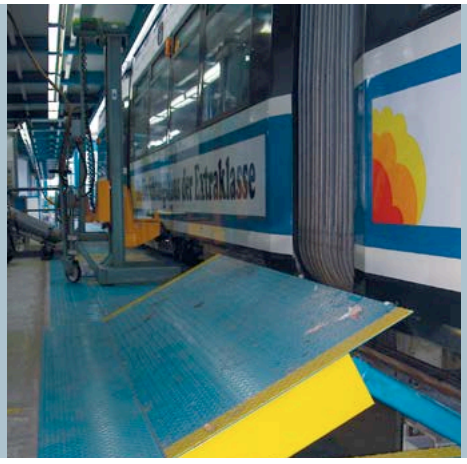
Task

- Planning of a baggage conveyor system's automation with a capacity of 100,000 pieces of baggage per day
- Realization within the 10-month construction period of terminal 2
- Efficient coupling of approx. 27,000 sensors and 20,000 actuators on a space of approx. 260,000 m^2

Solution

- Rapid and accurate baggage localization with a response time of 4 ms
- Extremely fast assembly and easy expandability thanks to "typical concept" with uniform conveyor elements
- Minimized time expenditures for pre-assembly, trial operation and commissioning thanks to easy wiring of AS-Interface
- Reduced complexity regarding control cabinet assembly thanks to a consistently distributed concept
- Extremely short commissioning time and timely transfer of the baggage conveyor system with a length of 40 km

Munich municipal transport services, tram maintenance with ASIsafe



Task

- Safety-related equipment of a maintenance facility for low-floor vehicles, including disassembly of pivoted bogies which is both critical for operating staff and material
- Control of a total of 102 pneumatically controlled flaps of the pit cover spanning a length of 40 m

Solution

- Division of the maintenance facility into individual segments with independently opening and closing flaps
- Optimum protection of flaps through EMERGENCY-STOP pushbuttons on every operator panel
- Easy connection of approx. 500 sensors and actuators despite extremely confined space conditions via only 8 AS-i networks
- Installation of the system during ongoing maintenance operation thanks to the easy assembly of AS-Interface
- Cost minimization through ASIsafe without compromises in terms of safety

Schößwendter Holz, biomass heating plant, fully automatic crane system with AS-i

Task

- Automation of the firing bunker's filling in 24-h continuous operation on the basis of a fully automatic crane system by A+S Schuster (Peiting)
- Hardware configuration in minimum time
- Simple solution with minimum mounting and commissioning times
- Minimization of the control cabinet size

Solution

- Connection of the distributed I/O via AS-Interface
- Connection of up to 7 motor starters to the energy bus
- Standardization of I/O modules, compact starters and control elements
- Minimum wiring expenditures thanks to distributed assembly of I/O functions
- Rapid future localization of cable breakage points and easy expandability by additional sensors

GreCom Dimter Holzoptimierung, finger jointing systems with AS-i

Task

- Collection and networking of sensor and actuator signals required for the finger joints' accurate positioning and precise milling
- Reduced mounting times
- Minimized wiring expenditures

Solution

- Utilization of saving potentials through slave coupling via AS-i
- Distributed motor control via joint energy lines
- Reduction of mounting times by approx. 60 % from 14 to 16 hours

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