

AS-INTERFACE

INSTALLATION GUIDELINES
TIPS AND TRICKS

PEPPERL+FUCHS
SENSING YOUR NEEDS

AS-Interface

Installation Guidelines

Tips and Tricks



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AS-Interface, a Worldwide Standard

Europe EN 50295 (since 2008, EN 62026-2)

Worldwide IEC 62026-2

AS-Interface General Features

- It is important to install only certified products.
- Products that pass the strict evaluation by an authorized agency are identified by the AS-Interface certification symbol (shadow logo).



AS-Interface Key Features

- ❏ Transmission of data and power on the same cable
- ❏ Master / Slave communication process
- ❏ Up to 62 slaves on a single AS-Interface network
- ❏ Cycle time ≤ 5 ms
- ❏ Protection class IP20 to IP69K, depending on housing style
- ❏ Standard and safety communications on the same AS-Interface cable
- ❏ Maximum network length of 100 m without any topology restrictions
  - Up to 500 m using repeaters
  - Optional, manufacturer specific network extension solutions are available. Here it is important to comply with manufacturer's specifications and data sheets.

AS-Interface General Features

- AS-Interface is a potential-free system, symmetrical with respect to ground. Even in industrial environments it offers a high degree of noise immunity without the need for any additional measures such as a shielded cable.
- It is important to not affect the ground symmetry of the system.
- It is possible to use a shielded cable for AS-Interface, but this may have a negative effect on the total network length.

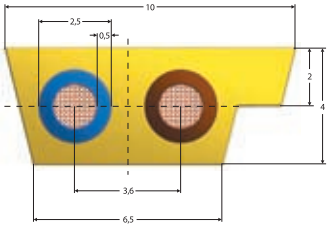
Selecting the Cable

We recommend the use of the yellow flat cable

- ❏ Two-conductor mechanically coded flat cable
  - Not twisted
  - Not shielded
  - Not terminated
- ❏ Data and power over one cable
  - 240W maximum output power (30VDC, 8A)
- ❏ Different cable jacket materials are available
  - PUR
  - TPE
  - EPDM
  - Rubber
- ❏ Different colors for different applications
  - Yellow: AS-Interface
  - Black: Auxiliary power 24V

Selecting the Cable

- Note: The yellow flat cable needs to be protected from UV radiation.
- Mechanically coded cable prevents reverse polarity installation.
- Piercing technology allows simple and fast installation without tools.
- For currents >2A the voltage drop along the cable must be checked.



Dimensions AS-Interface cable

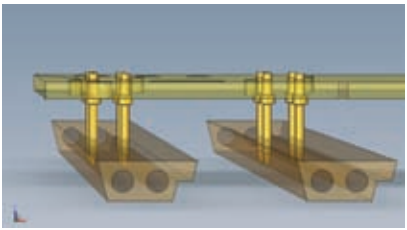


Diagram of piercing technology

Selecting the Cable

If the standard AS-Interface cable cannot be used:

- ❏ Almost any standard round cable can be used.
- ❏ Two-conductor cable with a conductor diameter between 0.5 mm^2 and 2.5 mm^2
- ❏ In this case, the power requirements and the voltage drop must be checked!
- ❏ The attainable network length might be reduced if cables are used that do not conform to the specification.

Cable Routing

- The yellow AS-Interface cable should be used whenever possible.
  - Brown lead for ASI +
  - Blue lead for ASI -
- It is necessary to check for correct polarity at all times.
- Avoid unfavorable non-ground symmetrical cable routing over longer distances.



- Even though communication through the AS-Interface cable is insensitive to electro magnetic interferences, it needs to be routed separately from the power cable – even in a cabinet.

Cable Routing

- We recommend using a separate cable for every AS-Interface network. AS-Interface cables should not be routed together with other AS-Interface cables or other power circuits using a single multi-conductor cable.

- If a single leaded cable is used (for instance in a cabinet) the two separate leads should be routed together and twisted if possible.

Cable Installation, EMC considerations

- EMC protection through protection diodes, varistors, or RC filters must be used for all switched inductive loads, such as master control relays and relay coils, valves, breakers etc., if this is not already integrated in the products.
  Please check the manufacturer's instructions.

- If frequency inverters are installed, the use of network filters, output filters, and shielded motor cables are recommended.
  - Observe installation guidelines in the manufacturer's instructions.
  - Cable shields between filters, frequency inverters, and motors need to be connected directly to the system ground at both ends, using a sufficient cross section (min. 4 mm^2).

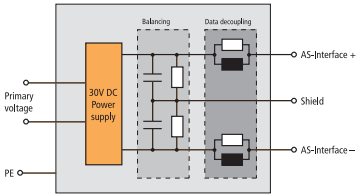
- Keep the distance to potential sources of interferences (i.e. frequency inverters and their cables) as large as possible.

Master

- This recommendation is based on **Specification 3.o Rev.1**.
- All AS-Interface Masters are backward compatible.
- If masters designed according to a specification prior to 3.o are installed, the use of some functions could be limited (for instance diagnostics).
- AS-Interface slaves with the profiles 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 and S-6.0 require a master with profile M4 (first defined in AS-interface Specification 3.o).

Power Supply

- ❏ Use only AS-Interface power supplies (PELV).
  - PELV = Protective Extra Low Voltage
- ❏ The PE-connector on the AS-Interface power supply (protective earth) must be grounded (if available).
- ❏ The ground on the AS-i-network (GND, Ground, Shield) must be connected to the system ground.
- ❏ Neither AS-i - nor AS-i + must be grounded.
- ❏ Output voltage AS-i: 29.5 to 31.6 V DC
- ❏ AS-Interface power supplies deliver up to 8A (model specific).
- ❏ The voltage drop between power supply and network nodes must not exceed 3V. If necessary, the power supply should be installed as close as possible to the largest consumer.



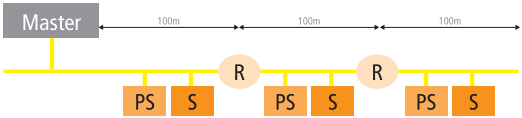
AS-Interface power supply with data decoupling

Network Configuration

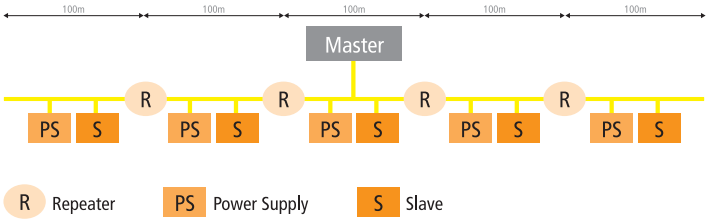
- One AS-Interface segment including all drop lines must not be longer than 100 m.
- For network extension please note the following:
- **Extension using a repeater:**
  - An additional 100 m of AS-i cable can be connected after every repeater. However, no more than 2 repeaters can be installed between a slave and the master (max. 2 repeaters daisy-chained).
  - In each segment, a galvanically separated AS-Interface power supply must be installed.
  - Hence, the maximum possible distance between two slaves in an AS-Interface network is 500 m, if the master is positioned accordingly (see picture on the next page).

Network Configuration

- Extension using a repeater



- Centered grouping: Extension with a repeater up to 500 m



Address Allocation for Slaves

- For AS-Interface 31 slave addresses are available.
- There is a difference between standard address allocation and extended address allocation. The address allocation mode of a slave is set by the manufacturer.
- For standard address allocations, each slave utilizes a full address (1 -31).
- For extended address allocation each address can be used by 2 slaves. (1A - 31A, 1B - 31B)
- Example: Address 3 can be used by:
  - One standard slave with address 3 or
  - One extended slave with address 3A or
  - One extended slave with address 3B or
  - Two extended slaves with addresses 3A and 3B

Address Allocation for Slaves

- Before start-up of the system all slaves must be addressed.
- In general, at the time of delivery, slaves have address 0.
- Each address can only be allocated once.
  - Double address allocation of the slaves is not permitted.
- Address allocation can be conducted electronically or by using an addressing device.

Installation and Connection

- Connecting modules to AS-Interface networks
  - Numerous different module concepts are available from the various manufacturers.
  - It is necessary to follow the manufacture's installation guidelines.

Installation and Connection, I/O Supply

- Whenever possible, sensors and actuators should be supplied directly by the slave's inputs or outputs, respectively.
- This cable should be kept separate from the power cable and as short as possible.
  - Slave modules should be installed as close as possible to sensors and actuators.
- Ground-free sensors/actuators: Grounding of peripheral devices, galvanically connected with AS-i potential, is not permitted according to specification. It must be avoided to maintain a high degree of interference immunity.
- If the sensor/actuator has a ground connection that is **galvanically isolated** from the AS-Interface network, it must be connected to the system ground.

M 12 Connection

❏ Allocation of M12-plug connections on AS-i Slaves (here: bushing).

AS-Interface	Auxiliary energy	AS-Interface and auxiliary energy	Binary input	Binary output (semiconductor)
				
1 - AS-Interface + 2 - 3 - AS-Interface – 4 - 5 -	1 - AUX + 2 - 3 - AUX – 4 - 5 - (Gnd)	1 - AS-Interface + 2 - AUX – 3 - AS-Interface – 4 - AUX + 5 - (Gnd)	1 - U+(24V DC) 2 - Gate input 1 3 - 0V 4 - Gate input 1 5 - (Gnd)	1 - U+(24V DC) 2 - 3 - 0V 4 - Gate output 5 - (Gnd)

Binary double input	Binary output (relay)	Analog input	Input for Pt100 sensor	Analog output
				
1 - U+(24V DC) 2 - Gate input 2 3 - 0V 4 - Gate input 1 5 - (Gnd)	1 - Change over contact 2 - Normally closed contact 3 - 4 - Normally open contact 5 - (Gnd)	1 - U + 2 - In + 3 - 0V 4 - In – 5 - (Gnd)	1 - Iconst + 2 - In + 3 - Iconst – 4 - In – 5 - (Gnd)	1 - Out 2 - 3 - 0V 4 - 5 - (Gnd)

How many inputs and outputs are needed?

- The number of inputs and outputs determines the number of AS-Interface networks.

How much power is required for the peripheral devices?

- The total power demand of the required modules determines the size of the AS-Interface power supply. Since power supplies cannot be wired in parallel, the size of the installed power supply must be chosen according the power consumption. If the AS-Interface network is segmented using repeaters, the power for each segment is supplied separately and the entire network can transmit considerably more power.

Are special cables needed?

- In general, a combination of flat and round cables is possible. Environmental influences must be considered when choosing a suitable cable material.

Project Checklist

Is the address allocation correct?

- To maintain installation clarity it is suggested to maintain a list that clearly identifies each slave with its assigned address.
- In some cases, the master may not recognize double address allocations as error.

Which modules use which addresses?

- It is imperative to carefully mark those modules or slaves that already received an address.

When are modules installed?

- Whenever the above rules have been observed. The cable can be installed arbitrarily.

How to configure the system?

- The configuration is simply read by registering the AS-Interface profile of each slave into the master. In general, this process occurs automatically, but can also be performed manually using the control software.

How will the slaves be recognized?

- First, it is necessary to check if the master recognized all of his slaves. Subsequently, the program can be started in safe mode and in the control system (RUN).

How can the system be tested?

- Input/output tests are performed as usual in the PLC. This means, the sensors are locally activated and verified in the PLC.

How can the system be activated?

- Optionally, the operating software can be programmed as usual or the existing software can be used. If the existing software is to be used, it may be necessary to adjust the symbolic assignment of the addresses.

How to check if ground faults exist on the AS-Interface network?

- By using a ground fault detection device, available as a separate component as well as integrated in the master and/or power supply.
- In general, it is suggested to install a ground fault detection as part of the AS-i networks. The installation of a ground fault detection is mandatory for systems controlling dangerous motion (IEC / EN 60204).

What else can be done to achieve a higher noise immunity?

- The connection "Shield" on the AS-i power supply must be connected directly and with good HF characteristics to the machine ground of the system. This does not present grounding for safety reasons but a functional ground to operate the AS-i cable symmetrically against the ground. If a shielded cable is used, the cable shield must be connected to this point (and only here).
- Good symmetry should also be maintained towards other electrical noise sources (drives, welding equipment, etc.). The cables connecting active I/O modules and sensors or actuators, respectively, should be limited to a maximum of 2m.
- Whenever the possibility for high electrostatic charge exists (for instance polishing machines, die cast machines, or when wrapping/unwrapping plastic foils) it may be necessary to employ additional protective measures, for instance discharge brushes.

Can the AS-i cable be routed parallel to power cables?

- Even if the communication via the AS-Interface is insensitive to noise, it should still be routed separately from power cables – even in a cabinet.
- Maximum possible distances to potential interference sources (such as frequency inverters) should be maintained.
- Each AS-Interface network should have its own cable, i.e. AS-Interface cables should not be routed with other cables using a multi-conductor cable.
- However, if single conductors are needed (for instance in cabinets) conductor pairs must be routed in parallel. Standard single-lead cables must be routed together or twisted.

Considerations when using a 8A-AS-i power supply

If more than the typically normal 2A will be transferred through the AS-i network, the following limitations need to be considered when designing the network:

- The voltage drop along the AS-i network increases. Guideline: If 2A are transmitted using 100 m cable with a diameter of 1.5 mm^2, the resulting voltage drop is about 5V.
- The piercing contacts are designed for certain maximum constant amperage, below 8A. It is very important to refer to the manufacturer's data sheets.

Sign-Off Checklist

- ❑ The installation was done according to the installation guidelines of the different manufacturers.
- ❑ The segment length is equal to or shorter than 100 m. Segment length is the sum of all "drop lines" in a segment.
- ❑ The connection to the slave farthest from the master runs through no more than two repeaters.
- ❑ If network extension is accomplished using manufacturer specific products, the manufacturer's data sheets and information must be observed.
- ❑ A distance of at least 10 to 20 cm has been maintained between AS-i networks or sensor networks and medium interference sources such as controls with inductive loads or low power emission supplies.

Sign-Off Checklist

- ❏ The Ground/PE/Shield connection of the AS-i power supplies is connected to the system ground to maintain symmetry.
- ❏ A distance larger than 50cm has been maintained between AS-i networks or sensor network and strong interferences sources such as: welding robots, switched power supplies and frequency inverters.
- ❏ Wherever possible use the yellow profile AS-Interface cable, otherwise use a twisted two-conductor 2 x 1.5 mm^2 cable.
- ❏ The current carrying capacity of connection T's or terminal connectors has been checked (see manufacturer's data sheet).
- ❏ How to apply the bus configuration to the AS-i master?
  - In the master by pushing a key
  - In the control system through the hardware configuration
  - In the control system through the user application

Sign-Off Checklist

- ❑ How are slaves connected to the network documented (type, address, and identification data)?
  - Drawing of the electrical layout
  - Manually inserted in a table
  - Printed table based on the hardware configuration
  - Printed table with data read by the AS-i master

- ❑ How is the network topology documented?
  The documentation must show the topology such as: line, tree, star, drop lines, etc., and the segmentation with the actually used cable length of AS-i network. AS-i power supplies, slaves with their corresponding address, and repeaters, if used, should be included.
  - Drawing of the electrical layout
  - Graphically
  - Not at all

Sign-Off Checklist

- ❏ Is the maximum power consumption of the AS-i network smaller than the maximum current supplied by the AS-i power supply?
- ❏ If used, the 24V auxiliary power must be checked similarly.
- ❏ Theoretical maximum current load: the current requirement can be calculated by referring to the data sheets of the used components.
- ❏ The value of the AS-i voltage at the end of each segment (the point farthest away from the AS-i power supply) should be determined under full load. The measurement point M must be shown in the network topology. This value must be determined for all segments.
  - The AS-i voltage between AS-i + and AS-i - must be between U+/- = 26.5 and 31.6 V.

Sign-Off Checklist

- ❏ The current load on the AS-i power supply, measured with a clamp meter under full load conditions, must be compared to the maximum permissible current load of the power supply. This value must be determined for all segments. It is recommended that this maximum load does not exceed 90% of the power supply capacity.

- ❏ Using analyzer devices or diagnostic functions in the master, the number of faulty telegrams during operation can be determined. At least 100,000 telegrams need to be evaluated (about 9 minutes for 31 slaves).
  - The three slaves with the largest number of errors should be recorded during system sign-off.
  - According to the AS-Interface specification, the admissible error rate must be below 0.1%.
    Error rate = (faulty telegrams*100)/number of telegrams

- ❏ The diagnostic results must be documented (for instance by reading and interpreting the flags in the AS-i masters).

Further Information: **www.pepperl-fuchs.com**



Notes:
These recommendations were made according to specification 3.0 Rev.1. None of the contributors can be held responsible for the appearance of any inaccurate information or recommendations. Safety technology is not part of these installation recommendations. Data sheets and manufacturer's information must be strictly observed!

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QUICK AND EASY CONNECTIONS – INGENUITY IS OFTEN QUITE SIMPLE





Installed without tools and securely connected with gold-plated pins – the G12 module.

Just what the materials handling industry ordered: a one-piece housing that is quickly installed without any tools. Gold-plated pins guarantee secure long-term contact with the flat AS-i/AUX yellow cable while peripheral errors, such as overload, are displayed directly at the M12 port with an LED. The M12 Speedcon connectors also save time during installation. These features are available only with the G12 As-i module from Pepperl+Fuchs. The G12 module is making AS-Interface even faster!

It´s always an advantage to work with real professionals.

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