TROX GmbH

Heinrich-Trox-Platz
D-47504 Neukirchen-Vluyn
Telephone +49/28 45/2 02-0
Telefax +49/28 45/2 02-2 65
e-mail trox@trox.de
www.troxtechnik.com

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Product Information TROXNETCOM-AS-Interface Appendix

PI/7.1/13/EN/1

The AS-Interface

Appendix; background information; summary

In 1990, in order to render components produced by numerous suppliers compatible within a single system, 11 leading companies in the sensor/actuator industry line formed a consortium whose purpose is to develop a standardized bus system.

AS-Interface-Association

In 1991, as a result of the opening of the system to general industry standards, the Association for the Promotion of Bus-Capable Interfaces for Sensors and Actuators (AS-Interface-Association) was founded.
The AS-Interface-Association has adopted the specifications of the AS-Interface consortium, and has also standardized the system internationally, certified products and is continuing to refine the AS-Interface.
The Association now has over 100 members.
Before any product is authorized to bear the AS-Interface logo, it must be tested and certified.
For further information, contact: www.as-interface.net or AS-International Association, Zum Taubengarten, D-63571 Gelnhausen, Tel.: ++49-(0) 60 51 - 47 32 12, Fax: ++49-(0) 60 51 - 47 32 82, e-mail: as-interface@t-online.de

What does AS stand for?

AS stands for “actuator sensor.”
Thus, the AS-Interface is the “actuator sensor interface.”

Some bAS-ic terminology
Master; slave; bus

The AS-Interface is comprised of master devices and slave devices. The difference between master and slave devices is that masters can become active on their own. In other words, masters can autonomously send messages (telegrams) to other bus slaves. Slaves do not have this ability: they only send telegrams when requested to do so by the master.
Buses are also referred to by the rather awkward expression, “data collection line.” The bus nodes (masters and slaves) communicate over this line.

Description of a system
The master performs management functions

In the AS-Interface, one master per bus line segment is allowed. This master cyclically polls all slaves (e.g., fire protection valves) in the system.
The master’s physical position in the AS-i tree structure is irrelevant in this regard, i.e., the master can be assigned to any position in the AS-i bus system.
Bus operations (i.e., communication with the slaves) are monitored and controlled in the master.
At the same time, information about this interface can be provided to a higher-level controller (e.g., SPS, PC, BMS) or visualized on another display device.

Higher-level controllers (SPS, PC, BMS) are programmed as before, which means that existing programs can still be used. The user is unaware of the fact that it is the AS-Interface rather than the I/O assembly that is providing peripheral signals.
AS-Interfaces can be tied in to higher-level bus systems without any difficulty. Many standardized solutions are available for this purpose.

Tie-ins realized to date:

- Siemens Landis and Staefa Visonic (PRV2) and Desigio (LON)
- Messner technical network master RS 485
- Kieback and Peter DDC SBM54
- Sauter Cumulus Profibus DP
- Siemens S5 and S7 directly or via Profibus DP
- GFR RS 485
- Johnson Controls N2 bus
- ABB technical building systems LON

Number of slaves

Each AS-i master can control up to 31 slaves.

Expandability

All AS-i systems can be expanded to their maximum size of 31 slaves without any difficulty.
If the application requires additional capacity, a second master can be used.
The number of masters used depends solely upon the number of the latter the control or bus system to which the master is connected can administer.
For example: a maximum of 28 masters if the master is connected via the Profibus DP.

Slaves

AS-i slaves are used for peripheral coupling. One of the salient features of the AS-Interface is its modular structure. The user is provided with a comprehensive system of standardized electromechanical modules. The dimensions of the devices have been planned so as to be mutually compatible. Other modules with diverse architectures have also been developed that allow the user to devise a system that is optimally suited to his application.

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Addresses

Addresses serve to identify slaves in an AS-i system. They are allocated by the user.
With parallel wiring, a line is allocated to every signal. This allocation is shown in the diagram of the connecting terminals e.g., upper limit switch position: Terminal 27. If this signal is forwarded to an SPS, a record is made of this event in the allocation list, e.g., upper limit switch position: E4.2. In a bus system, on the other hand, numerous signals are carried by the same cable.
Since capacity must exist for the signal to be allocated to a bus slave, an address is allocated to each slave in the AS-Interface.
The choice of address in the AS-Interface is unrestricted; addresses are stored in non-volatile memory (E^2PROM).

Cabling

Reference is made to bus topology in this regard.
The AS-Interface has a tree structure that allows for flexible adaptation to an extremely wide variety of installations. Bus cables are installed in configurations that closely resemble trees, i.e. trunks, branches and stems. This structure is more flexible than ring or line systems. A feeder line, if adapted to a specific installation, can be realized – or retrofitted – anywhere in the system. This makes AS-Interfaces easy to adapt to modified functional positions.
There are other types of tree structures as well (star, ring, line).
The fact that the choice of topology of an AS-Interface network is virtually unlimited greatly simplifies the planning process. The bus slaves can be distributed evenly along the AS-i line segments, or they can be clustered, in a manner similar to leaves at the ends of the branches of a tree. No end-of-line resistors are needed.

Here are some examples of permissible overall topologies:

- 100 m line with an AS-i slave termination
- 90 m line with a termination consisting of a 31-slave star
- A 31-slave star with the same or differing cable lengths to the master orr
- A line segment with 31 slaves evenly or unevenly distributed along it

What is the maximum allowable cable length?

One point that must be remembered is that cable length is limited to a maximum total of 100 m. This applies to all cable segments, including feeder lines.
Thus, in any setting where longer distances need to be spanned, a repeater must be interposed.
In as much as the master is decentrally positioned in the field, in over 90 percent of cases a cable length of 100 m is sufficient to reach the 31 AS-i slaves.

Bus cables

The AS-i bus cable is an unshielded, two-wire cable that carries both data and energy.
Cabling can be realized with either standard two-wire cable (e.g., H05VV-F2x1,5) or special 2 x 1.5 mm^2 flat cable. The two types of cable can also be combined in an AS-Interface in any configuration desired.

The use of insulation displacement connection technology (insulation-piercing connectors) in conjunction with flat cable reduces installation costs.

Performance characteristics of AS-Interface flat cable technology:

- Cable geometry avoids reversed polarities
- Low-cost installation through the use of insulation displacement technology
- Standardized interfaces to user modules
- High protection class (IP 67) supports on-site installation

Connections

The flat cable is simply placed in the appropriate recesses in the bottom parts of the slave modules. When the upper and lower parts of the module are put together, the contact pins penetrate the insulation. This allows for extremely rapid and simple connection of system components. These connection points can be eAS-ily installed at any location in the installation. The high protection class makes waterproofing unnecessary.

For installations that use standard round cable, modules are available with terminal blocks to which the cable is connected with PG screw connections, thereby ensuring IP 67 protection here as well.
This also allows for realization of transitions from flat to round cable.

Power supplies

Every AS-i line must have its own AS-i-specific power supply. These power supplies contain data decoupling components and provide higher voltages than the usual 24 V.
The AS-i power supplies are designed in such a way that they provide approximately 30 V DC of no-load voltage and up to 8 A of current.
Data is modulated to the frequency of the AS-i network.
If, for example, motor control equipment is powered externally, either a second 24 V DC standard power supply (any type) or a direct 230 V AC or 400 V AC feed must be provided.

Data protection and data transmission

The entire electronics component of the AS-i slave is accommodated in an AS-i IC, which can in turn be accommodated in an intelligent sensor/actuator or in a user module.

The chip contains numerous protective devices that provide the AS-i with a high level of protection against malfunctions:

- Power-on switching for activation
- Current-limiting switch to protect against overload
- Detection of logical errors (e.g., continuous signal transmission)
- Overtemperature monitoring of the chip
- Short-circuit proof

The user will find the AS-i to be an extremely secure, reliable and low-maintenance system. A number of mutually independent hardware-oriented mechanisms in the master device monitor data transmission security:

- Parity bit monitoring
- Manchester coding
- Repeated transmission of distorted telegrams
- Pulse pause time monitoring
- Response time monitoring
- Verifying correctness of slave configuration
- Coded signal transmission with recipient decoding

Data is safeguarded through defined parameters in the hardware and software.
Statistically speaking, an undetected error will occur statistically only after 12 years of operation, which means that virtually all errors in the line will be detected. Continuous signal coding and decoding with error monitoring in each slave enhance data security.

All AS-i telegrams are monitored in the recipient in terms of parity bits as well as other more independent values. This provides an extremely high level of data security when it comes to the detection of single and multiple errors.
A telegram repetition lasts 150µs and remains in the cycle period for 5 ms.
AS-Interfaces can be used without any difficulty in environments with high levels of interference (e.g. welding plants, frequency converters).

In a word:
AS-Interfaces are totally reliable.

Summary
Advantages of using AS-Interfaces

The AS-Interface sets new technological standards compared to previously available bus systems.
The system has tremendous cost advantages for the user in terms of system planning, commissioning and maintenance.

AS-Interfaces cut down on cabling installation work. They also offer an alternative to the use of looms of wires. Cabling costs are substantially reduced, since the need for parallel wiring of each component to the junction box is eliminated. As a result, numerous connectors, SPS input and output cards and cable segments can be dispensed with. The size of junction boxes as well as installation time are significantly reduced. The AS-i requires only a standard 2-wire line that can be looped through the field devices in the installation.

AS-Interfaces: distributed intelligence.
Systems engineers and other practitioners have long since recognized the advantages of decentralized automation. Even as recently as a few years ago, there was still a trend towards increasingly large, high-performance controllers that ran the installation from a central location. But now the trend is towards solutions that rely upon distribution equipment:
important functions are now processed instantaneously on-site in a small, decentralized controller.
Only a minimum of key information is routed to a central processing unit.

The advantages of such solutions are obvious:

- Shorter, easier to understand programs, resulting in simpler commissioning of installation components as well
- Fewer breakdowns – and if they occur at individual stations, the system continues to be fully functional
- Shorter cable connections; data communication between controllers through the bus system
- Easier and faster installation and expansion options.

AS-Interfaces reduce operating costs.
They also drastically reduce time spent on maintenance, retrofitting, localization of errors etc. Errors are localized rapidly and function tests of the installation or of specific system components can be performed centrally.

Expandability

- The AS-i can be expanded at any point in the system.
- Modular structure
- The AS-i is an excellent investment in the future, and is open to innovative technologies.

Key data

Topology	Tree structure (also includes lines etc.)
Bus cables	Non-shielded two-wire cable for data and energy transmission to the slaves (24 V DC, usually up to 200 mA per slave and, e.g., 8 A per bus line).
Cable lengths	100 m, can be extended with repeaters.
Number of slaves	31 per AS-i line segment
Number of AS-i segments	Flexible, depending upon connecting medium (e.g. up to 28 with Profibus DP)
Number of stations	Combinations of up to 31 intelligent or 124 binary stations per bus segment
Access modes	Master-slave, single master mode
Messages	Single-address calling of master with direct response from slave
Address programming	Fixed, unique address in slave. Address programming via master realizable
Cycle time	max. 5 ms
Services of master	Cyclic data communication with all slaves; cyclic data communication with host; acyclic generation of parameters
Management functions	Initialization of AS-i network; identification of bus stations; error diagnosis of the master and error messaging; allocation of new addresses to replacement slaves.