The “eyes and ears” of production

If you want to automate a process, you are going to need sensors and actuators. There’s no way round that. Be it in a logistic centre, where light barriers check the position of a packet on a conveyor belt, in a bottling plant, where the fill level is checked, or in a steel works where beams have to be cut at the correct position: Sensors, the eyes and ears of process control, are everywhere.

The signal encoders and pickups have long been cabled in the same old way: Each individual sensor and actuator was wired directly to the higher level control, giving rise to complex and cluttered cable looms with large associated cabinets. Bus technology – long a standard at the field and control level – entered the world of binary sensors and actuators in the mid nineties with the introduction of AS interface®.

A general standard was agreed, which was robust and flexible enough to fulfil all the requirements of an industrial data bus, but also tailored to the requirements of the “ lowest” control level. With AS interface, the eyes and ears of production finally connected to industrial communication technology.

There has been no serious competition for AS interface to date, and with the backup of a strong international organisation and renowned manufacturers, AS interface will continue to dominate the market in the future.

AS interface is a system with which simple modules close to the process (sensors, actuators, and operator terminals) are combined at the lowest level. It is the least expensive and simplest solution for automation technology.

This brochure is addressed to both prospective buyers and users of AS interface and is intended to provide an insight into the technology of AS interface.
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AS interface -
Just another bus system?

AS interface with which process and local machine, digital and analogue signals can be transmitted in binary form has been around since 1994. AS interface is also the universal interface between the higher control level and simple binary actuators and sensors.

Field bus technology - why “go by bus”?
What made us develop AS interface?
Not so long ago, the pressure to cut costs in automation forced structural changes. This was triggered by the immense cabling costs that had to be invested to connect the field level to automation equipment (usually programmable controllers). Every actuator and every sensor had to be connected to the control and to a power supply, that involved high material costs (wire costs money too) and the astronomical cabling costs already mentioned, whilst at the same time giving rise to a considerable source for errors.

In the past each individual sensor had to be wired to the controller (parallel wiring). Today, the sensors and actuators are simply connected to each other and to the control via one cable – the AS interface cable.
Even as late as 1997, 36% of all machine and plant failures were caused by the installation.

The magic word was (and still is) decentralisation – first in automation technology, later in drive and switching technology, too.

What was meant by that? Well, simply that the conventional, cost-intensive parallel wiring (cable looms) was replaced by a serial field bus, or a two-wire cable with which all automation nodes can be interconnected.

The cost advantages are considerable: For example, according to a study by the Technical University of Munich, you can save more than 25% of the installation costs if AS interface is used on a milling machine. Even if the costs for the AS interface modules are initially higher, savings up to 15% to 30% in total are quite common.

**Industrial communication**

The structure of a complex automation system is pretty opaque even for experts: Numerous control devices are networked on different data networks and with different protocols. It has become customary to divide control levels according to hierarchies. They differ in their time response, degree of protection, type and use of data to be transmitted and many other aspects.

To help you understand the tasks of AS interface and its position in the control
hierarchy in industrial communication, here is a short explanation of the basic properties of the various levels.

**Supervisory level**
At the highest level, the supervisory level, the computers on the management level in a factory, or sometimes even in more than one factory, are inter-networked, or a host computer controls production as a whole using the computers as slaves. The data volume is in the megabyte range and transmission of the data does not need to be in real time. The transmission medium might be Ethernet.
Production or process control level
At the production and process level, PROFIBUS® (process field bus) has become standard. With a transmission rate of up to 12 Mbits/s in its DP version, it is ideal for the high demands of automation technology. PROFIBUS is now available as PROFIBUS-PA for process control, and the extensions added in 1999 for synchronism and peer-to-peer traffic will make it suitable for use in typical motion control applications in the future.

Actuator/ sensor level
The actuator sensor level is the lowest level in the field area. Here, binary actuators and sensors in the field and process area are networked. Many of the devices connected, supply or require binary signals (e.g. BERO®; contactors, motor starter, solenoid valves, pneumatics, valve islands etc.). The necessary data volume is small, but the speed of data transmission is very high. A typical application for AS interface.

AS interface has had an excellent track record in over a million nodes since its introduction and has proven the most low-cost, robust, and best suited solution for the task, almost without competition.
Before the task of developing a bus system, for the lowest field level which was both open and manufacturer independent (just like Ethernet or PROFIBUS) could be undertaken, a simple problem had to be solved: Components supplied by a wide range of different manufacturers which all had to be connected to the same bus system were not necessarily able to communicate smoothly with one another and with the system.

**AS International Association**

In 1990, eleven renowned companies active in the sensor and actuator field formed a consortium to make their components compatible. That AS interface project gave birth to the AS International Association whose main tasks lay in, international standardisation, continued development of the system and certification of products.

The user can recognise tested and certified products by the AS interface “shadow logo” and a test number.

**Requirements of AS interface**

At the lowest control level, sensors, contactors, motor circuit switches, indicator lamps, pushbuttons etc. which transfer volumes of information in the bit range had to learn to communicate. The bus systems already in existence were either over dimensioned or simply could not be used for such a task. They used cables that were either too expensive or unsuitable for a direct link to the process (e.g. fibre-optic cable, shielded and non-flexible cable), and the volumes of data transmitted were simply too high. Either the data protocols were non-deterministic or the control electronics used were much too expensive if each binary sensor was to be a bus node and in an automation network there might be any number of them.

Over and above that, assembly and installation needed to be as simple as possible, without the need for any special training. The costs for each connection should be low and in keeping with the volume of data to be transferred. In short: AS interface had to be able to network binary sensors and actuators and link them to the higher control levels, very simply, inexpensively, and meeting industrial requirements.
The technical result is remarkable. AS interface fulfils all the requirements just about perfectly, in field use (IP65/IP67), in the control cabinet (IP20), and in temperature ranges from -25 °C to +85 °C.

**Single master system**
AS interface was conceived as a single master system with cyclic polling. This means that there is only one control module (master) in the AS interface network which polls the data of the other nodes (slaves) at precisely defined intervals.

With IP67, AS interface is well equipped to deal with dust, humidity, and extreme temperatures.
Small volumes of data
AS interface has been optimised for volumes of data that correspond precisely to the requirements of the lowest field level. The structure and length of the data frame is fixed. Up to four useable Input bits and four useable Output bits are exchanged between a slave and the master in any one cycle.

Real-time requirements
The maximum cycle time, i.e. the time that a master takes until a node is polled again is a maximum of 5 ms for a fully utilised system with up to 31 standard slaves. In a fully utilised AS interface system according to the extended specification 2.1, the maximum cycle time is 10 ms for 62 slaves. In most control systems this time meets the “tough real-time requirements”. Polling procedures are deterministic, i.e. the master “knows” that it can access the current data of each node connected to the AS interface network within a certain time.

Data transmission
Simple two-wire cables without shielding or PE conductor are used to carry both data and the auxiliary power for the sensors simultaneously. The intelligent data protocol is structured in such a way that the entire system is extremely interference resistant. Shielding is therefore not necessary. The yellow profiled AS interface cable has become a characteristic feature of AS interface. Its innovative contacting system (insulation displacement technology) makes it simple and efficient to assemble. An AS interface network can, of course, also be configured with standard circular conductors. For economic reasons, however, the ribbon cable is the preferred option.
The AS interface network can be configured like any conventional electrical installation. Due to the robust functioning principle behind the structure, any network topology can be used. Tree, bus, or star topologies are possible.

A maximum of 31 slaves can be connected to a standard AS interface system, in which each slave can have up to four inputs and four outputs (i.e. a total of 124 inputs and 124 outputs). In an AS interface system expanded according to specification 2.1, up to 62 A/B slaves can be connected. They each have a maximum of 4 inputs and 3 outputs (i.e. up to 248 inputs and 186 outputs in an AS interface system).

Intelligent sensors with integrated AS interface chips each have their own slave address and are interpreted as “normal” slaves by the master.

Bus, star, or tree
AS interface network configurations are possible
Decentralised start-up of a DC motor: No problem with the DC starter module and AS interface

The most important component of the whole AS interface system is so small that would fit comfortably on a fingernail. But without it, AS interface would never have become as important as it is today. We’re talking about the AS interface slave chip.

Slave

Slaves are actually distributed I/O modules of the programmable controller (PLC). AS interface modules recognise the data bits transmitted by the master and returns their own data. Up to 4 binary sensors and actuators can be connected to any one standard AS interface module. An intelligent slave is one where the AS interface chip is integrated into the sensor or actuator. Costs for electronics are minimal. AS interface slaves are available as digital, analogue, and pneumatic modules, and as intelligent nodes, e.g. motor starters, LED columns or membrane keyboards. Single-acting and double-acting pneumatic cylinders can be controlled with pneumatic modules. That means not only savings in cabling, but in tubing, too!

Made possible by the motor starter on AS interface: Motors can be started and protected directly at the machine.
**Master**

The AS interface master provides the link to the higher-level controller. It organises data transmission along the AS interface cable automatically, making the signals of the sensors and actuators available to higher-level bus systems, e.g. PROFIBUS, at an interface. See also gateways.

In addition to polling signals, the master also transfers parameter settings to the individual nodes, continuously monitors the network and performs diagnostics.

Unlike more complex bus systems, AS interface is a self-configuring system. The user does not have to make any settings, e.g. access authorisation, data rates, frame type etc.

The master automatically performs all the functions required for the correct functioning of AS interface. It also performs self-diagnostics functions. It recognises faults and automatically assigns the correct address to a slave removed for maintenance.

**Gateways**

In more complex automation structures, AS interface can also be connected to a higher level field bus, e.g. PROFIBUS. For this, it requires a gateway (e.g. DP/AS-i link) which is used as an AS interface master in the AS interface network but which functions as a slave in the higher level field bus (e.g. PROFIBUS). In such a configuration, AS interface is the supplier of binary signals to any higher level field bus system.

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*Example of an AS interface master: SIMATIC S7-300*

The complete controllers of the SIMATIC S7 range can also be used as AS interface masters.
Cables
The yellow profiled cable has become synonymous with AS interface. It has a geometrically defined cross-section and simultaneously transmits data and auxiliary power to the sensors. Additional auxiliary power is required for the actuators (aux. voltage, e.g. 24 VDC). Different coloured profiled cables have been specified utilising the same installation technology. A black profiled cable is therefore used for 24 VDC auxiliary voltages.

The core insulation usually consists of a rubber mixture (EPDM). For applications where demands are greater, e.g. resistance to chemicals, profiled TPE (thermoplastic elastomer) or PUR (polyurethane) cables are available. However, round two-wire cables without PE conductor can also be used as the transmission cable. The transmission technology obviates the need for cable shielding.
Power supply unit
The power supply of the AS interface network provides a voltage of 29.5 V to 31.6 V DC which must meet the IEC regulations regarding functional extra low voltage with safe isolation (PELV). The safe isolation of PELV circuits is met by a power supply unit designed to IEC 742-1 which also meets the requirements regarding sustained short-circuit resistance and overload withstand capability.

Due to integrated data decoupling in the AS interface power supply unit it is possible to transmit both data and power. This is done by modulating data as pulses onto the flowing DC using alternating pulse modulation (APM). Each AS interface line requires its own power supply unit. Outputs are usually supplied from the black AS interface cable. A standard power supply unit with 24 V DC according to the PELV specification (grounded protective conductor) is required for this. Power supply units are also available from which both the AS interface voltage and the standard direct voltage can be supplied (Combined Power Supplies).
**Additional components for expansion with ...**

AS interface functions without problem up to a range of 300m using repeaters and without repeaters up to 100m.

**... repeaters**

If the system requires more than 100m, the network can be expanded by 100m segments per repeater to a total of 300m. The repeater functions like an amplifier. The slaves can be connected to any AS interface segment. Each segment requires its own power supply unit. The repeater also electrically isolates the two segments from each other, thus increasing selectivity if a short circuit occurs. Use of repeaters does not increase the amount of slaves permissible on an AS interface network.

**... extenders**

The AS interface cable can also be lengthened using extenders, in which case no slaves must be used in the first segment. Extenders are only recommended for covering large distances, say, between the control cabinet and the plant.

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<table>
<thead>
<tr>
<th>Power supply</th>
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<tbody>
<tr>
<td>Master</td>
<td>Extender</td>
<td>Repeater</td>
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<tr>
<td>Slave</td>
<td>Slave</td>
<td>Slave</td>
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<tr>
<td>Segment max. 100 m</td>
<td>Segment max. 100 m</td>
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</table>

The maximum length per AS interface segment is 100 m. The network length can only be extended to maximum 3 segments using extender and/ or repeater modules.

**max. 31 Slaves (or 62 A/B Slaves) together!**
AS interface - Simple connection

Insulation piercing technology
Profiled cables can be connected to the slave interfaces at any location easily and safely. This has been made possible by insulation piercing.
How it’s done: Contact needles pierce through the cable insulation and make secure contact with the copper conductor. When the needles are pulled out again to remove a slave, the cable’s self-healing capability means that the holes close automatically, providing full insulation again (in the case of EPDM cables).
The geometry of the cable means that polarity reversal is practically impossible and there is no shielding to worry about.

Modular technology
Modular technology is a typical element of AS interface technology. Slaves that are made up of two parts are used: A mounting plate forms the lower part, and the module itself, the upper part. The cable is then sandwiched between the two.
The modules contain the AS interface electronics and the connections for the sensors and actuators.
A wide range of different modules are available.

The cables are simply placed on the lower plate of the slave. In this picture, the lower plate of a K45 module.
AS interface has not only become a standard industrial interface for connecting simple binary devices. The claim of “easy entry without special bus know-how” is not exaggerated. On the contrary: The superiority of AS interface lies in its simplicity.

**Beginner’s checklist**
Here is a checklist of 10 points for the beginner, to make entry into the world of AS interface even easier:

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<tbody>
<tr>
<td><strong>1.</strong></td>
<td><strong>How many inputs and outputs are needed?</strong>&lt;br&gt;The number of inputs and outputs tells you how many AS interface networks you need.</td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td><strong>How much power do the I/Os consume?</strong>&lt;br&gt;The total power requirement of the required modules determines which AS interface power supply unit you need. As it is not possible to connect power supply units in parallel, a power supply unit sized to the power requirement must be used.</td>
</tr>
<tr>
<td><strong>3.</strong></td>
<td><strong>Are special cables required?</strong>&lt;br&gt;Any combination of profiled and round cables is possible. External conditions determine whether rubber, TPE or PUR cables have to be used. Repeaters or extenders (See Page 16) have to be used for cable lengths above 100m.</td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td><strong>Is address assignment correct?</strong>&lt;br&gt;For clarity’s sake, a plan should be drawn up, clearly showing which addresses are assigned to which slaves. Double assignments are not necessarily recognised as errors by the master.</td>
</tr>
<tr>
<td><strong>5.</strong></td>
<td><strong>Which modules belong to which addresses?</strong>&lt;br&gt;Modules and slaves that are addressed should be labelled clearly.</td>
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</table>
6. **When are the modules mounted?**
   Only when points 4 and 5 have been dealt with. Cables can be routed in any way.

7. **How is it all configured?**
   The configuration is simply read in by entering the AS interface profile for each slave in the master. This usually happens automatically but can be done manually in the controller software.

8. **Are the slaves detected?**
   First you must check whether the master has recognised all its slaves. Only then can you switch to protected operation and switch the controller to RUN.

9. **How is testing done?**
   Input/output tests are performed by the familiar PLC method, i.e. the sensors are activated locally and then checked in the PLC.

10. **How do you get the whole thing up and running?**
    You can either create your own controller software in the usual way or use existing software. In the latter case, you might have to adapt the symbolic assignment of addresses.
Configuring
As far as AS interface is concerned, configuring means nothing more than drawing up a list of the configured slaves and then storing it in the master. Configuring is usually performed at the master, which means that the master automatically reads in the network configuration. (The user can also make settings for special applications at the PLC).

The slave address and the slave type (ID code), the I/O configuration (I/O code), and the parameters (in the case of intelligent sensors), if they exist, are defined during configuration. The master uses this list to check that the configuration programmed matches the actual configuration. Before this is possible, the slaves must be addressed.

Addressing of the individual nodes
The addresses of all the slave nodes must be programmed before AS interface is put into operation. You can do this offline with an addressing device, online at the master of the AS interface system, or after installation using integrated addressing sockets.

The addresses themselves are the values 1 to 31 (or 1A to 31A and 1B to 31B for an extended specification). A new slave that has not yet been addressed is assigned the address 0. It is then recognised by the master as a new slave that has not yet been addressed, a state in which it is not yet involved in normal communication procedures.

The slaves can be assigned any address – it does not matter whether a slave assigned address 21 is followed by slave 28, or whether the first slave is assigned address 1.
Parameterisation

Usually, slaves are not parameterised. Only intelligent slaves with required options are parameterised. The data sheet of the slave in question defines whether it has to be parameterised and what function the parameters have. Whereas the address of a slave never changes in normal operation, the parameters are very likely to change. We therefore make the distinction between variable and fixed parameters.

Fixed parameters are defined only once during configuration. One example of this is an analogue input module that is set to a current range of 0 to 20mA or 4 to 20mA with a parameter. The parameters themselves are bits, of which four are made available to each module, each of which can be set to 0 or 1. They are transferred to the slaves when the system is started up.

Operation

As soon as the AS interface system is set up, i.e. all the components have been installed, the slaves are addressed and, where necessary, parameterised, and configuration is complete, it’s time to start: The system switches to normal operation, and the master runs in protected mode. Only the slaves that have been configured are activated. Slaves that are not configured – e.g. those that have been added subsequently – merely return an error signal. All you have to do to include such a slave in the communications network is to switch to configuring mode. The function “Configure slaves” sees to that. It’s as easy as that.

The system is constantly monitored, both when it is started up for the first time and during normal operation. The necessary data, such as voltage, mode, incorrect configuration etc., is sent to the higher-level controller by the AS interface master, e.g. in the form of a diagnosis.
Ten valuable tips on assembly
The following 10 tips should be followed to make sure nothing goes wrong during assembly:

**Tip 1 - Power supply unit**
- On no account must AS interface be grounded!
- Never use a normal power supply unit only AS interface power supply units (PELV) with integrated data de-coupling and connect “ground (GND)” with system ground.

**Tip 2 - Network extension**
- Without repeaters or extenders the AS interface cable must be no longer than 100 m – including all feeders to the assembly terminals!
- If you want to expand the network please note the following:
  - Expansion with extenders:
    - The maximum cable length between the extender and the master must be no longer than 100 m
    - Do not connect any slaves or AS interface network power supply unit between the master and the extender.
    - Never confuse the “+” and “-” lines.
  - Expansion with repeaters:
    - Up to two repeaters can be connected in series – this increases the cable length to maximum 300 m (i.e. 3 segments with maximum 100 m)
    - An AS interface power supply unit must be connected at every repeater.
    - Under normal conditions, an extender must not be connected beyond a repeater

**Tip 3 - Slaves**
- Each slave address must only be used once. Only use addresses 1 to 31 or 1A to 31B in A/B technology (Specification 2.1).
- Please note: Modules that contain chip SAP 4.0 (see operating instructions), can be re-addressed 15 times. After that they retain the last address.

**Tip 4 - Additional auxiliary power**
- If slaves are to be given an additional auxiliary power supply
  - A PELV power supply unit and, if necessary, the black profiled auxiliary power cable should be used for 24 V DC and, a red profiled auxiliary cable for 230 V AC
Tip 5 - Routing of the cable
When laying the AS interface cable please note the following:
• Always use the yellow profiled AS interface cable where possible, brown for “+” and blue for “-”.
• Even whilst communication along the AS interface cable offers a high degree of EMC immunity, it should still be routed away from power cables, even in the control cabinet!
• Every AS interface line requires its own cable. AS interface cables must not be laid together with others in a bus cable.
• If individual cores are used (e.g. in the control cabinet), always lay parallel core pairs. In standard stranded wires, lay individual cores together or twist them.

Tip 6 - Ensuring EMC
Connect all inductance’s, e.g. contactor and relay coils, valves, brakes, with suppresser diodes, varistors or RC elements. If frequency converters are used, always use network filters, output filters, and shielded motor cables.

Tip 7 - Sensor and actuator power
Sensors and actuators must be supplied directly from the associated input or output of the slave. The cables should be kept as short as possible and away from energy cables, i.e. the slave modules should be as close as possible to the sensors and actuators.

Tip 8 - Installation of frequency converters
• Always follow the assembly guidelines in the operating instructions.
• Connect the cable shield, e.g. between filter and frequency converter and between the frequency converter and the motor, directly at both ends with a large contact surface, and with a sufficient cross section (at least 4mm²).
• Connect all metal parts to system ground.

Tip 9 - System expansion 2.1
Operation of A/B slaves and “new” analogue slaves is only possible with a master complying with Specification 2.1.

Tip 10 - Status/diagnostics
For speedy diagnostics, the status and diagnostics bits should be analysed in the PLC.
What to do if something goes wrong
Errors can occur even in the best systems.
In AS interface too, there are error patterns that are usually easy to detect and just as easy to eliminate. The only error that AS interface cannot recognise is the failure of a binary sensor or actuator integrated in a module.
A defective slave can simply be replaced by a new slave.

An AS interface cable break will of course result in the failure of slaves. By locating their position it is possible to find the cable break because the slaves located beyond the interruption point from the point of view of the master can then no longer be addressed.
A short circuit can have a disastrous effect on the system. The master therefore recognises a short circuit by the APF bit (AS interface Power Fail) and immediately takes action. All slaves immediately go into the status “not active”. For the actuators that means that power stops flowing.
Three applications have been chosen to show you how flexible AS interface is: Whether empty bottles of different types are distributed to the correct stations, overhead conveyor motors are controlled in a car engine plant, or pneumatic modules are used to control tank or storage containers. Everywhere, AS interface shows just how flexible and efficient it is.
The company Dr. Wiewelhove in Telgte, Westphalia, has designed and built what is now the largest empty bottle sorting plant in Germany for Bier Schneider in Dortmund. The plant which covers a surface of 60 x 30m over three floors identifies and distributes up to 6,000 crates of every possible type every hour to a maximum of 14 stations.

AS interface is used to link the signal I/O of the sorting equipment to four SIMATIC S7-300s. The CP342-2 communication processor is the master and provides the link between the CPU of the controller and the AS interface. More than 100 digital modules each with four digital input signals connect the sensors distributed around the plant with the controllers. For the most part, these are Photo Electric Cells that ensure that there are no jams. Two masters are used for each controller, which means that a total of eight AS interface lines with a maximum cable length of 100 m is sufficient for the entire I/O cabling.

20 pneumatic AS interface compact modules also operate in the plant. By reducing the entire installation to a few cables, such as AS interface, compressed air and emergency stop circuits, considerable areas of the plant could be standardised. One important aspect for H. Pelz, head of electrical design at Dr. Wievelhove, were the huge savings on assembly and installation that AS interface made possible: “AS interface made it possible for us to assemble a plant at low cost on schedule, the reduced configuring phase being an important factor.”
Putting the load feeders, e.g. motor starters, into the field means transferring the advantages of field bus communication to the power side. Switching and protection devices are mounted in close vicinity to the motor, so that the motor cable itself is very short. The distributed motor starters draw the energy they require from a single “power bus”. This is the distributed motor starter concept that Volkswagen AG implemented in their car engine factory in Chemnitz, Saxony. A circular rotating overhead conveyor system which transports approximately 2,200 manufactured engines daily forms the backbone of the entire engine factory. It provides the connection between all the production areas, from the assembly line, through the engine testing bays, to the dispatch areas. The distributed configuration of the I/O functions, such as the connection of the input and output signals, or the drives and their controls is made possible by AS interface. Only a few central control elements, e.g. for in-feed and safety technology, now remain in the control box. Switches controlled by barcode readers are responsible for the controlled passage of the engines through the individual production sections of the circular conveying system.
Stoppers which can uncouple individual engines from the conveyor belt are used to ensure that a defined distance is kept between the individual engines as they move along.

AS interface compact starters control these stoppers. Up to seven stopper motors can be wired up to the energy bus of a starter, making planning, assembly, and installation of the plant considerably easier. Standard I/O modules, compact starters and the SIGNUM® operating equipment of AS interface also meant that the hardware was configured in a very short time.

2,200 engines are checked, conveyed, and stopped daily. The stoppers are controlled by AS interface compact starters.
Bauder, with its headquarters in Stuttgart Weilimdorf, manufactures modern roof sealing, roof insulation, and other insulation materials. Since November 1994, Bauder has been using AS interface in all new areas of production as a low-cost alternative to conventional cabling technology. Process engineering, especially, which is always in a state of flux, is no longer conceivable without AS interface and the opportunities it provides. AS interface not only transmits analogue values but also controls pneumatic valves using pneumatic modules. Additional advantages are the savings in space in the control cabinet and error free wiring.

Complicated circuit diagrams are a thing of the past. Now, cabling lists are produced which are quick and easy to maintain. In day to day operation, simplified fault location and replacement of parts (plug and play technology) are strong arguments in favour of AS interface.

Repairs of plant parts equipped with AS interface have fallen dramatically, and the service personnel do not require specialised knowledge.

For some time now, Bauder has mainly used pneumatic AS interface modules in their extensive tank and storage container controllers.
The good results achieved in this rather demanding area are one reason why Bauder has now decided to implement this technology in machine controls in the form of new pneumatic compact modules. Pneumatic compact modules with integrated 4/2-way modules and a flow rate of 550 l/min replaced the old conventional valve technology which was as much as 13 years old. Conversion did not create any problems and with the 8 mm quick-disconnect fittings, fast, flexible and smooth installation of the pneumatics was possible. As the pneumatic modules are supplied with all accessories “on board”, the usual time consuming and expensive ordering of additional equipment is no longer necessary. No special knowledge was necessary to install the pneumatics modules.

Bauder now uses AS interface in all its equipment. Pneumatic compact modules with integrated 4/2-way valves are also used. The flexible cables and pneumatics connections at the package stacker were reduced by half as a result of the AS interface conversion, which will have a positive effect on the repair bill.
No risks must be taken when it comes to the safety relevant components of manufacturing automation e.g. emergency stop switches, light barriers, protective door contacts, safety light grids etc. Uninterrupted functional reliability of all the sensors and actuators with reliable feedback signals in the millisecond range have top priority when it comes to protecting personnel and equipment from injury and damage. For many years, these demands meant considerable additional investments in automation systems, because the conventional solution for failsafe actuators and sensors has always been parallel circuitry.

Safety at work
With the components “Safety at work”, AS interface fulfils the requirements for a safety bus. Safety related and non safety related digital I/O data can be transmitted along the same AS interface cable.

How does it all work and can it really be safe?
Included in the list of AS interface components already familiar to us (master, slave, power supply unit ...) is the safety monitor and safety related slaves that are operated on the same AS interface network. The master identifies the safety related slaves in the same way as any other slave and integrates it in the network like all conventional slaves.
The transmission protocol and the cable of the standard AS interface are so robust that they can also be used for safety related telegrams. The required safety is achieved by additional signal transmission between the safe slaves and the safety monitor. The safety monitor waits for a four bit telegram from each safety related slave which continuously changes according to a defined algorithm. If the telegram expected from a safety related slave does not arrive or the slave continuously transmits the telegram 0-0-0-0 (e.g. EMERGENCY STOP pressed) because of a fault, the safety monitor switches off the safety related outputs after no longer than 45 ms (= total response time): The plant is shut down safely and an alarm signal is issued to the master. The system operates so reliably that it can be used in applications up to category 4 according to EN 954-1 and has been certified by the German safety bodies TÜV and BIA.
From Siemens you can obtain all the components you require for installation, operation, and maintenance of an AS interface network. The offer is complete and adapted to the user’s requirements: From a simple stand-alone network to a highly specialised solution with AS interface working in conjunction with other bus and control systems in many different ways, all components are offered. Even integration into decentralised drive solutions, e.g. local control of contactors or motor starters is possible. The offer for integration of pneumatics into the AS interface environment is broad and opens up numerous ways of implementing demanding actuator systems for the user. In addition to field devices with degree of protection IP 67, Siemens can also supply AS interface modules with degree of protection IP 20 for installation in control cabinets and special modules for low cost and space saving control configuration.

Siemens consistently supports the AS interface standard and is developing it further to broaden its functionality. Compatibility with AS interface devices of other manufacturers is ensured. One example of this is the development of the new AS interface ASICs SAP 4.1 from Siemens, which noticeably increases the functionality of the AS interface network, e.g. by increasing the number of slaves that can be operated in a network from 31 to 62 and thus enabling even more cost effective operation.

Approval
All AS interface components from Siemens have been approved by international and national standardisation bodies (for example by UL CSA for North America and for marine engineering).

Service and support
As the trend-setter in this technology, Siemens is pursuing technical progress with the power and possibilities only available to a global corporation. A powerful service and support offer provides the user with competent and fast help with all questions to do with the technology and development of custom automation solutions. With the know-how of Siemens, the automation professional, with the superior technology of AS interface, with the quality track record of our products, and with comprehensive service, the user can be certain of solving his automation problem quickly with the best possible result and therefore of being productive within a short time.

You can find us at:
www.siemens.de/as-interface
You can contact us at:
nst.technical-support@Erl7.siemens.de
The range of Siemens AS interface components available is too extensive to be dealt with in this brochure. Full details of all our products together with their technical data is given in our Catalogue “Low-Voltage Controlgear” (NSK) and “Fieldbus Components” (ST PI), available from your Siemens contact. Or you can find the information in the Internet (see Page 34). Only the most important product groups available from Siemens are described below.

**AS interface master**

A whole range of AS interface masters is available for a multitude of applications. The programmable controllers of the SIMATIC® ranges S5, S7-200, S7-300 can be linked to an AS interface via communications processors to implement powerful automation solutions. For example, compact PLCs are available for the stand alone network, and connections via a PC plug-in card, or access via PROFIBUS are also possible.

**Master for SIMATIC S5**

Siemens offers special communications processors via which the SIMATIC S5 and ET 200U can control up to 31 AS interface slaves. Communications processors are also available for the SIMATIC S5 that combine two AS interface masters on one plug-in card in double-height Eurocard format. The result: Control of 2 x 31 AS Interface slaves.

**Master for SIMATIC S7 and ET 200 X**

A communications processor is also available for making an AS interface master of the micro control SIMATIC S7-200. It processes the entire communication volume between the S7-200 and AS interface. A further communications processor is also available for the simultaneous connection of the S7-200 to PROFIBUS-DP and AS interface.

The S7-300 can also be operated with a communications processor as an AS interface system.

The SIMATIC C7-621-AS-i is designed as a low-cost stand alone solution for small automation tasks. A controller, an operator panel, and an AS interface master are integrated in the one device.
The distributed I/O system SIMATIC ET 200 X for PROFIBUS networks can also be connected to AS interface as a master using a special communications processor via a two-pole connector.

Note: To make full use of the new extended functions of AS interface, masters fulfilling the new specifications must be implemented.

PROFIBUS DP/AS interface gateway

An AS interface network can be linked to a PROFIBUS DP network via gateways (DP/AS interface link) available in degree of protection IP 20 and IP 65. In the AS interface network the gateway serves as a master, in the PROFIBUS network, as a slave. In this way, for example, a SIMATIC S7-400 automation system can be connected to an AS interface network.

PC plug-in card

If equipped with the short AT card CP 2413, a PC can also function as an AS interface master. The AS interface profiled conductor is connected directly to the module. Up to four cards can be operated on each PC. Drivers are available for MS-DOS, Microsoft Windows 3.1 and Windows 95/ NT.
AS interface slaves (I/O modules) for use in cabinets

Slimline modules
Compact distributed configurations in a control cabinet are possible with the Slimline model available with degree of protection IP 20. The modules can be clipped onto a DIN rail or screwed to a back plate like any other low-voltage device in a control cabinet.

Load feeder modules
The control circuit of a load feeder module can be fully pre-wired with the AS interface load feeder module. This range has been optimised for applications which include the SIRIUS® 3R load feeder modules sizes S00 and S0. Four different AS interface load feeder modules are available. Direct and reversing starters, as well as double direct starters and starter combinations for pole switchover can be wired with them. The feedback signals from the circuit-breakers and contactor(s) can be scanned at the inputs. The outputs are used for direct control of the contactor coils.

LOGO! minicontrol
The LOGO!® AS interface slave is the first “intelligent” AS interface slave. With it, it is now possible to implement small distributed automation tasks directly at the machine. LOGO! offers a wide range of integrated basic and specialised functions for these tasks; e.g. AND, OR, NAND, NOR, ON/OFF delay, clock generator, counter, time switch, and much more. Distributed automation tasks and plant expansion are much easier to implement as a result. If a fault occurs in the AS interface master or the bus, LOGO! continues to function independently, because it has its own power supply. The combination master and intelligent slave opens up new possibilities for small but widely distributed plant structures.
AS interface slaves (I/O modules) for use in the field

Compact modules
The AS interface compact modules are part of a new generation of AS interface modules available with a high degree of protection. They combine digital, analogue, pneumatic, and 24 V DC motor starter modules in a single family. Two module sizes, the K45 (45 mm wide) and the K60 (60 mm wide) together meet all installation requirements.

An installed module can be addressed via an integrated addressing socket. Degree of protection IP 67 is met by locking the socket with an optional blanking cap. Instant diagnosis is made possible by comprehensive LED displays.

Modules for analogue connections are available from Siemens as a special option. All modules are pre-parameterised for communication with programmable controllers of the SIMATIC S7 range. Each of the analogue modules has two channels and the modules are subdivided into five groups: input modules for current sensors, input modules for voltage sensors, input modules for thermal resistance sensors, output modules for current actuators, and output modules for voltage actuators.

Modules for pneumatic control
In the same way that it is possible for the load feeder to be located directly next to the motor, the valve in the form of an AS interface pneumatic module can now also be placed directly on the cylinder. That means that the valve as a pneumatic output and the position signal from the cylinder in the form of sensor signals are now combined into a single module. Siemens offers two pneumatic model ranges:

• Pneumatic user modules with two integrated 3/2 way valves and pneumatic compact modules with two integrated 4/2 way valves. The pneumatic compact modules are available as mono and bi-stable versions.
**Compact starter**
Our AS interface compact starter is a fully internally pre-wired load feeder with degree of protection IP 65, designed to switch and protect any three-phase current loads up to 5.5 kW at 400/500 V AC – usually three-phase current standard motors in direct or reversing operation. It includes either an Electro-mechanical switchgear assembly or an electronic overload protection and circuit-breaker unit (max. 2.2 kW). The AS interface compact starter can also be addressed when fully wired.

**Motor starter**
The AS interface motor starter is an enclosed direct or reversing starter for load feeders up to 4 kW. Degree of protection IP 65 is achieved with a robust sheet steel enclosure. Integrated in the devices are SIRIUS 3R fuseless load feeders as switchgear. The AS interface data cable and 24 V DC auxiliary power supply are connected with no break in the power and without tools using insulation piercing technology. The AS interface motor starter is mounted using the hole pattern in the sheet steel housing rear wall.

**24 V DC motor starter**
With the K60 AS interface 24 V DC motor starter for the lowest power range up to 70 watts, it is now possible to connect 24 V DC motors and the associated sensors to AS interface directly at the machine. Three different versions are available with the following capabilities. Direct starter (without brake and optional quick stop function), double direct starter (with brake and quick stop function), reversing starter (with brake and optional quick stop function).
**Electronic motor control units**
The SIKOSTART® electronic motor control units are suitable for controlled soft start-up and coasting, for braking and energy saving operation of three-phase induction motors. Possible applications are, for example, machine tools, conveyor belts, fans, compressors, or pumps.

An AS interface control module can be retrofitted in any device. The device can be controlled (starting and stopping) and feedback signals received from the relay contacts via AS interface.

**Proximity switches with an integrated AS interface**
BERO proximity switches can be connected to the actuator sensor interface directly or via modules. Special inductive, optical and ultrasonic BERO proximity switches suitable for direct connection to the actuator sensor interface are also available. They feature an integrated AS interface chip and can supply information (e.g. filling level, coil failure) in addition to that supplied via the switching output. These intelligent BEROs can be parameterised via the AS interface cable.

**Pushbuttons and LEDS**
SIGNUM 3SB3 control devices with AS interface have full communications capability. They can be connected to the AS interface networking system via the integrated AS interface module 4E/4A with minimum wiring. The illuminated command pushbuttons are powered via the AS interface cable. Individual connection of control devices is possible with a special AS interface slave with separate auxiliary supply, making it possible to connect up to 28 NO contacts and 7 signal outputs to each device.

The SIGNUM 3SB4 is a human machine interface with a complete operator communication system with AS interface connection.
Other system components

Addressing unit
On the latest modules, the addressing unit is connected via a special addressing cable which is plugged into the socket on the module provided for that purpose.

Power supply unit, repeaters, extenders
Various power supply units are available in degree of protection IP 20 and IP 67 with the necessary separation of data and supply power. Of course, repeaters and extenders are also available for expanding the actuator sensor interface network.
Cables
The characteristic AS interface cable is available in many different versions for a variety of different applications. AS interface conditions are met by all cable versions with rubber, TPE, or PUR sheathing. A special version is even available that has been approved for shipbuilding by Germanischer Lloyd, the German technical safety bodies for marine engineering.
Naturally, we offer not only the yellow standard cable but also the black version for the 24 V DC supply to actuators.
Contact
If you have any further questions regarding AS interface from Siemens please contact your local Siemens office or Technical Support in Germany who will be glad to answer your questions in either German or English.
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