Your fieldbus connection

AS-interfaceÒ Tutorial

AS-interfaceÒ
Simple,
Robust,
Device-Level,
Bus

Faster, smarter fieldbuses

NOTES:

AS-interface® Tutorial
Revision 1.0

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1. AS-interfaceÒ

AS-i is an acronym for Actuator Sensor Interface. This may be the most high-tech bus of the traditional industrial networks. A huge amount of work has gone into its design to make it the simplest bus to use.

The signal is robust, balanced and has parity redundancy, so cabling is simple. One signal segment can be laid out anyway; star, tree or bus, without drop limitations. The only requirement is that all the cabling in a signal segment must be equal to 100 meters or less in total length. In addition there are no terminating resistors.

The traditional AS-i flat cable is still being used for many applications, but today many users and OEMs are switching to round cable with M12 connectors. The M12 connector is an international specification defined by the EN50 044 Standard. The M12 is also known by names such as euro or micro and is extremely rugged. Some manufacturers have achieved over 40 pounds (18-kg) pullout ratings. It is truly a heavy-duty IP67 connection with the copper wires of the cable being soldered or crimped to gold-plated brass pins and sleeves at the factory.

1.1. v2.0 and v2.1

Bus type	Master-to-slave, single master
Bus topology	Free form, unrestricted branching
Physical distance on a single signal segment	100 meters
Physical distance with 2 repeaters and master in the center	500 meters
Transmission signal	Alternate Pulse Modulation with Manchester II bit encoding impressed upon 24VDC bus power carrier
Speed	167.5 kbps, 5 msec to read/write 31 v2.0 discrete nodes, 10 msec to read/write 62 v2.1 discrete nodes
Bus power	2 amps using the same 2 wires as the data signal
Attendance check per scan	Yes, an attendance list is programmed in the master and checked each scan.
Error detection	Yes, single parity bit check and bit repetition.
Error correction	Yes, master will poll the node again if it doesn't understand. If the node doesn't understand the master it won't respond, then the master will poll the node again after a time-out.
Address setting	Off line via a hand held programmer or online via the master. Some masters are capable of automatically addressing swap-out nodes during replacement.

1.2. v2.0

Total number of nodes	31 slaves and 1 master
Input/Output bits	4/4
Analog capability	Yes, but not standardized
Total discrete input/output points per network	124 In/124 Out

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1.3. v2.1

Total number of nodes	62 slaves and 1 master
Input/Output bits	4/3
Analog capability	Yes, defined
Total discrete input/output points per network	248 In/186 Out
Maximum number of analog points per network	124

2. AS-interfaceÒ v2.1 Highlights

2.1. Version 2.1

Version 2.1 makes the worlds most popular actuator-sensor bus more powerful. More diagnostics, better analog capability and up to 62 field nodes per drop are available without the complexity of the higher-level buses. AS-interface is a simple master-to-slave structure. The master controls all time and network traffic. Protocol is embedded in the hardware. There are no configuration files to maintain.

2.2. Up to 62 nodes

In v2.0 all nodes are “Single Address Slaves”. Version 2.1 specifies “Single Address Slaves” and “A/B Address Slaves”. Single address slaves have a maximum of 4 discrete input bits and 4 discrete output bits. The address range is 1-31, with 0 being reserved for new incoming slaves. “0” is the default address set by manufacturers when a slave leaves the factory. The “A/B-Slaves” are one of the major changes of v2.1. The address ranges are 1A-31A and 1B-31B. A maximum of 4 discrete input bits and 3 discrete output bits are available per “A” or “B” nodes. The new AS-i masters from Bihl+Wiedemann can be used with legacy v2.0 single address slaves, v2.1 single address slaves and v2.1 A/B slaves.

2.3. Analog

Version 2.0 allowed analog I/O, but it was not completely defined. Version 2.1 defines analog data. The master polls the analog station multiple times and assembles the fragmented analog data into complete 16 bit values for delivery to PLCs, Industrial PCs or host buses. Due to AS-i’s low overhead analog values are updated as quick as most applications need.

3. AS-interface in the Modern Industrial Enterprise

The two network level structure is becoming the model for many manufacturers that are trying to tie their ERP systems to the factory or process floor. This is replacing the three level structure that had an “Information Level”, a “Controller Level” and a “Device Level”.

The Information and Controller Levels are being collapsed into one. In most applications the Device Level is not changing. Tying the ERP system to production is the motive behind the change. A truer and more real-time view of production is possible if the ERP system can get down to the controllers that carry out production. In many industries today content data logging, as well as other recorded quality tests, must be documented and archived for years to guard against frivolous litigation.

There are many technologies behind the two network levels. The most crucial are the modern Layer 3 Ethernet Switches and the venerable RFC2323 better know as IP (Internet Protocol). Layer 3 switches combine the features of a router and a Layer 2 managed switch. This allows the building of networks with defined subnets.
[Refer to **Appendix A**]

Therefore, within an enterprise several subnets can exist being defined by some functionality, such as sales, purchasing, etc. and various sub-divisions within manufacturing. IP is the addressing mechanism to get around the subnets.

AS-interface® is at the device level along with many other buses such as DeviceNet, ControlNet, Profibus (DP, PA, FMS), FOUNDATION Fieldbus, Interbus, CANOpen, CC-Link, Modbus and Modbus Plus.

3.1. AS-interface for OEMs

As one OEM claims, "I make the same machines over and over again, but differently each time." What he is saying is that each one of his customers has some slight variation.

The enterprise view [**Appendix A**] shows the versatility of AS-interface. It is supported by more PLC manufacturers than any other bus. It can be a sub bus off almost any other bus. It can be a drop off Industrial PCs and there are Ethernet to AS-interface gateways.

In one way or another AS-interface can be integrated into almost all enterprises. OEMs can create a baseline machine using AS-interface. Version 2.1 provides the power most OEMs need. The gateway or host is all that changes from customer to customer. The benefits are exceedingly significant. The physical machine and the device level control system can be fine-tuned with standard, semi-standard and customized media and I/O. Semi-standard and customized products are where the biggest cost savings and differentiation are achieved from one OEM to another.

3.2. AS-interface for Batch and Continuous Flow Processing

The versatility of AS-interface shown in the enterprise view along with the simplicity of its embedded protocol are reasons that AS-interface is popular with manufacturers of I/O devices for batch and continuous flow processing. Most manufacturers of PLCs and DCSs used in processing have AS-interface card modules that go into their back plane.

Many manufacturers have embedded AS-interface in their discrete products. More analog v2.1 AS-interface products will come in the future. Some popular AS-interface embedded products are:

- Quarter-turn valves (pneumatic and electrical actuation)
- Quarter-turn valve indicators

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- Indicating lights and light towers
- Sensors (inductive, capacitive, and photoelectric)
- Motor control (combination contactor coil and overload device)

The ATO (AS-interface Trade Organization) website, www.as-interface.com, has a very good product-manufacturer search engine. The search categories as of this writing are:

Accessories	Load Feeders
Addressing and Diagnostics Units	Masters
Analog Modules	Other Actuators
Cables	Other Sensors
Capacitive Sensors	Output Modules
Chips	Photoelectric Sensors
Command, Signaling and Monitoring Units	Pneumatic Actuators
Coupling Modules / Mounting Plates	Pneumatic Modules
Earth Fault Monitoring Systems	Power Supply Units
Electric Actuators	Repeaters
Extenders	Safety at Work Products
Gateways	Services
Hydraulic Actuators	Software
Inductive Sensors	Special Products
Input / Output Modules	Ultrasonic Sensors
Input Modules	Valve Position Indicators

What stands out about AS-interface is the number of products that have AS-i embedded into the input or output device.

4. AS-interface Analog Response Times

The original AS-interface consortium was composed of mostly discrete I/O manufacturers. Among them were IFM, TURCK, P&F and FESTO. Analog was not a major priority and discrete favored decisions were made. With v2.1 analog capabilities are very real, but the read-write response time of analog is not as hot as discrete only AS-interface nodes.

To illustrate, we will look at a real application: A user installed a v2.0 network about 3 years ago, which is working fine. The network has 24 discrete nodes and is running faster than the PLC. Two more discrete nodes need to be added, the same as the other 24 nodes, plus 4 channels of analog in and 2 out. The user found the analog I/O nodes he wants - one 4 channel in and another 2 channel out. The questions are: What will be the response time for the discrete and the analog? Does the master need to be changed? Is there a better solution?

4.1. Response time

The discrete response time is pretty easy. A network of 31 nodes and 1 master can do a complete read-write in 5 msec. The actual time per discrete node to use is 0.165 msec. The proposed network of 28 nodes will be 4.62 msec, but only for the discrete I/O. The 4 channel analog node will actually take a little less than 130 msec.

The analog value is actually sent to the master in fragments requiring 7 scans per analog channel. Since there are 4 analog channels the node will require 28 scans at 4.62 msec for a complete read. That is, 28 x 4.62 msec = 139.36 msec.

The 2-channel analog out will be exactly half of that, or 64.68 msec. In reality the analog out will be updated twice as often as the analog in.

In many applications 140 msec is fast. Compared to process buses and older serial communications based on RS-232C or D and proprietary RS-485 that measured level or temperature, this speed is indeed sufficient. However, it is not fast enough for web control or some of the other motion applications.

One way to improve the speed, although it still may not be fast enough for motion control, is to break the 4 analog channels in into 2 nodes of 2 channels. This will add another node for a total of 29, but will improve the analog speed. Following are the calculations:

29 nodes x 0.165 msec = 4.78 msec/scan (read-write response time for all discrete)

7 scans/analog channel x 2 analog channels/node x 4.78 msec/scan = 70.0 msec response time per node (rounded per scientific notation).

Since the channels are updated sequentially, rather than concurrently, this is also the response time per analog channel.

5. Mixing Legacy v2.0 and v2.1 Nodes

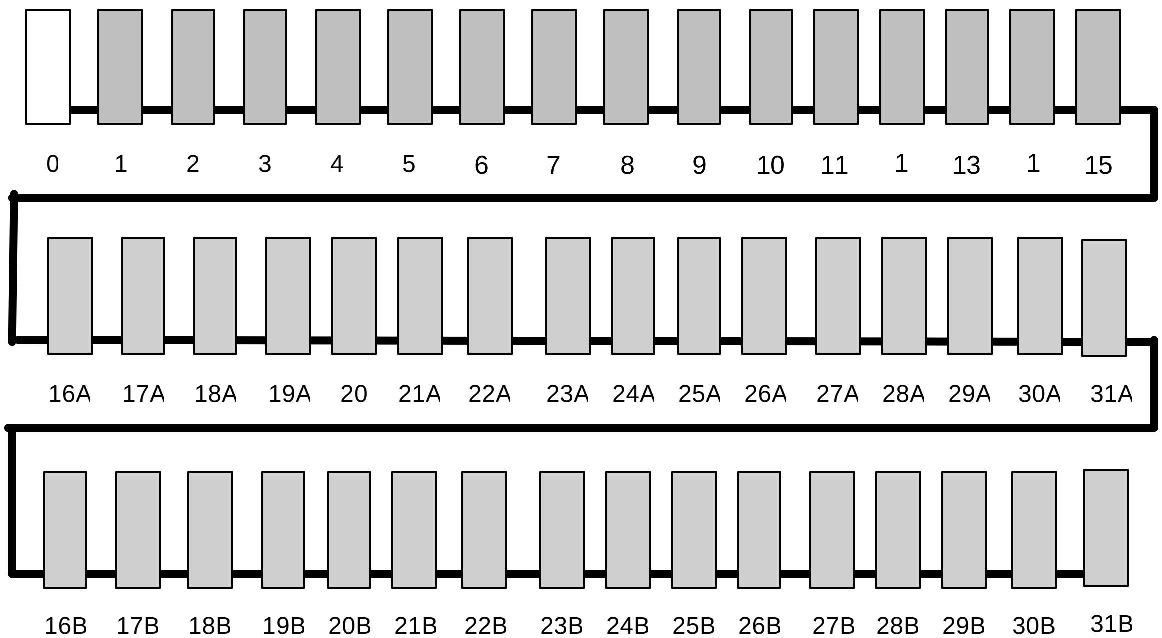

Figure 1

AS-interface does not require any correlation between the physical location and the logical address, but for this example we will create a linear bus topology with consecutive addressing.

There are five types of AS-interface nodes from an addressing standpoint:

Version 2.0 and 2.1 address 0 for incoming nodes
Version 2.0 single slaves address range 1-31 (shown in **Figure 1** as addresses 1-7)
Version 2.1 single slaves address range 1-31 (shown in **Figure 1** as addresses 8-15)
Version 2.1 A slaves address range 1A-31A (shown in **Figure 1** as addresses 16A-31A)
Version 2.1 B slaves address range 1B-31B (shown in **Figure 1** as addresses 16B-31B)

Single slaves, either v2.0 or v2.1, and A/B slaves can be mixed as long as the master is v2.1 compliant.

The v2.1 A/B slaves are subdivided into "A" and "B". Single slave nodes cannot have v2.1 addresses. There cannot be a single slave node address "8" and an "8A" or "8B".

It is not necessary to have complementary "A" and "B" v2.1 integer addresses. There may be a "19B", but no "19A".

Figure 1 shows the natural scan sequence and mapping of single and A/B slaves. A v2.1 master will scan all addresses in two cycles, first the A addresses, then the B addresses.

Since a v2.0 legacy slave technically occupies both A and B addresses for its numeric address, it will be scanned on both cycles and its scan rate will be twice as fast.

It is not necessary to have either v2.0 or v2.1 single addresses at the beginning as shown in **Figure 1.** The addresses of v2.0 nodes can all be at the end or randomly anywhere from 1-31. The beauty of this is that an existing legacy v2.0 system that has unused addresses can be easily upgraded and expanded to a v2.1 system without changing the mapping of the original v2.0 nodes.

6. AS-interface Layout, Power Budget and Physical Media

Since AS-interface is so easy to use, we sometimes forget there are rules. The same power budget rules derived from Ohm's law exist for AS-interface. It is a part of life for anyone that deals with "Electrical" or "Electronic" applications.

The first step in planning any industrial network is to obtain a drawing or make a sketch showing the I/O. Location of the I/O is the most inflexible parameter of the system.

The next step is sizing. In dense I/O systems, such as we find in the semi-conductor industry, sizing is a function of the data capacity of the network. You may need two or more networks to accommodate the I/O and never come close to the physical limits of a particular bus. On the other hand, in a power plant you may need to use two or more networks to encompass the geographical I/O and never come close to the data capacity of the network.

So far in this tutorial we have only looked at the data capacity of AS-interface. Simply put, that is the number of permitted nodes, the input-output bits per node and analog nodes. We will now look at the physical limits of AS-interface.

6.1. Layout

AS-interface is restricted to 100 meters per signal segment. In AS-interface a signal segment is the distance the sine[2] signal wave can travel on an AS-interface specified cable before the strength of the signal is no longer reliable. The capacitance, inductance and resistance of the wire decrease the amplitude and distort the shape of the original signal.

The layout of an AS-interface signal segment is completely free form except for two rules:

1. The total distance of the bus cable cannot exceed 100 meters.
2. The bus cable cannot be laid out with closed loops.

This means that the bus may be a straight line (daisy chain), straight line with drops or a star. There cannot be any topology rings. AS-interface is not designed to have the signal go around in a circle.

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6.2. Repeaters

Although the signal degrades in 100 meters, the timing allowed by AS-interface approved masters allows for two repeaters. Essentially the repeater re-manufactures the signal. The strength and shape are brought back to the original condition so the signal can travel another 100 meters. **Figure 2** shows two topologies if we take AS-interface to the limits with repeaters.

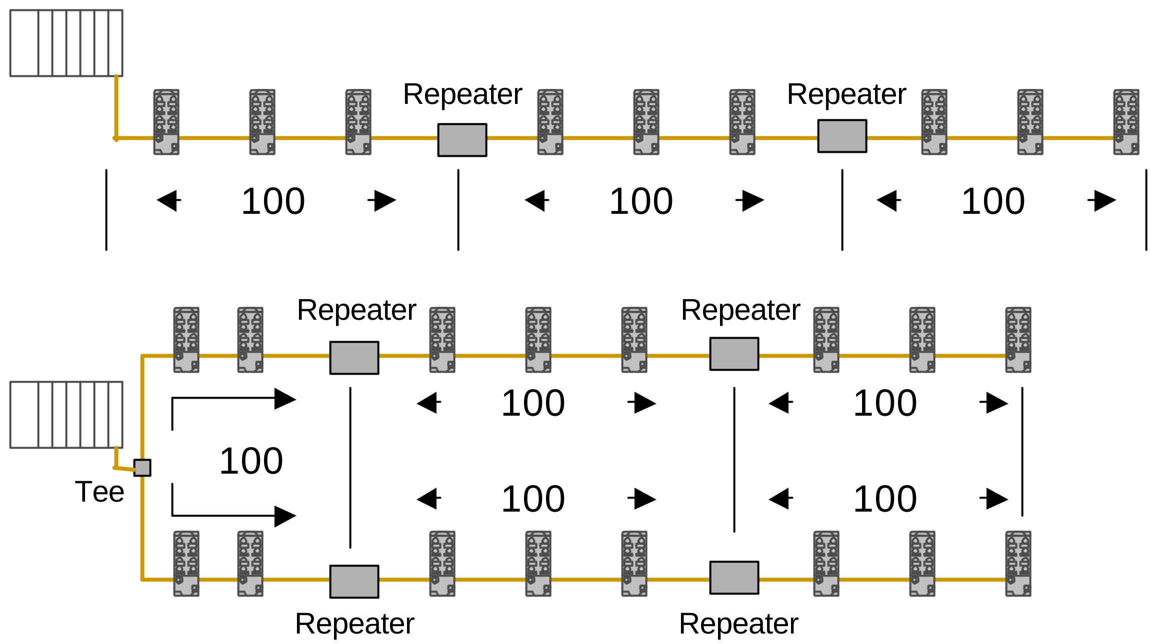


Figure 2

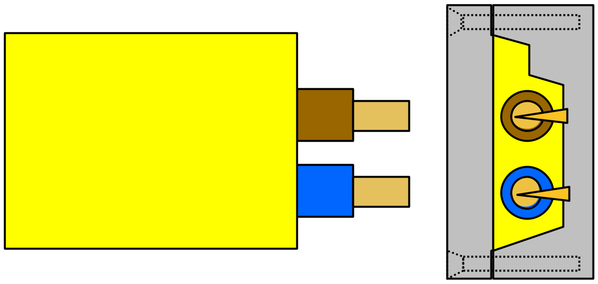
The topology in the upper diagram would permit a total network length of 300 meters from the PLC host or any host to the far end.

The lower diagram, with the host anywhere in the center signal segment, allows for 500 meters end-to-end. This layout is still based upon time. If the host and the last station on the upper leg are communicating, the rules are satisfied because there are only two repeaters between them and no signal segment is looped or longer than 100 meters.

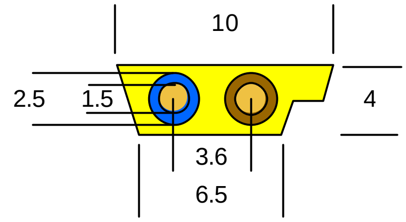
6.3. Physical Media

Before talking about the power budget we need to look at the physical media. The power budget is based upon Ohm's Law with current, voltage and resistance being functions of one another. The physical media specifies the copper cross sectional size of the wire, and therefore a resistance.

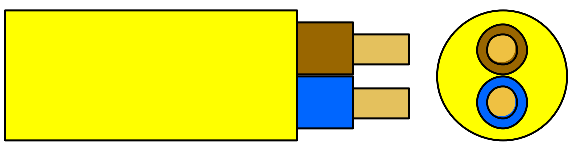
AS-interface is available in both flat cable with IDC (Insulation Displacement Cable) connectors or round cable with industry standard M12 EN50 044 connectors. [Refer to **Figure 3**]



AS-interface Flat Cable
Right figure shown with piercing teeth



2 x 1.5mm^2
2 x 18AWG
2 x 16 AWG



Round AS-interface Cable

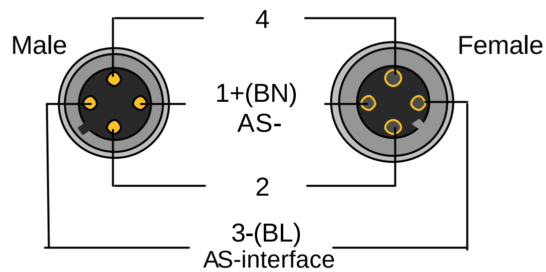


Figure 3

AS-interface wire is specified in international terminology using the cross section of the wire. It is 1.5mm^2. This is equivalent to 18 AWG (American Wire Gauge). Both have a DC resistance of ~ 4.1 Ω/thousand feet. InterlinkBT offers a 16 AWG cable primarily for the North American markets. Resistance and distance are the same all over the planet. The distance may be in different units but there is a conversion constant somewhere. The problem is not in the physics but the interpretation of the physics.

Most countries, or consortia of countries, have electric usage standards, material standards for the jacket and conductor insulation and approval standards. A cable approved in one country may be perfectly suited for the standards of another country, but unless it has appropriate approvals most electrical inspectors will “red-tag” it. Codes require recognized third party approval on most electrical equipment. If the third party approval agency is not recognized an inspector has very little choice but to disallow it.

Therefore, although it may be a true AS-interface certified cable, it still needs the appropriate approvals and must be installed in a manner consistent with jurisdictional codes in the country in which it will be used.

Several European cable suppliers list their cable as suitable for 16 amps. The maximum allowable ampacity per table 400-5a of the National Electric Code in the U.S. for 2-conductor 18 AWG flexible cord is 10 amps. Also, in almost every AS-interface system there are branches via M12 connectors to sensors or actuators. The maximum ampacity of the M12 pins is 4 amps. Therefore the entire signal segment must be based upon a 4 amp maximum.

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The question then is; What is the value of the 1.5mm^2 or 18 AWG or 16AWG when it can only conduct 4 amps? The real value is in reducing the voltage drop over the entire signal segment. The larger the cable, the less voltage drop problems will arise.

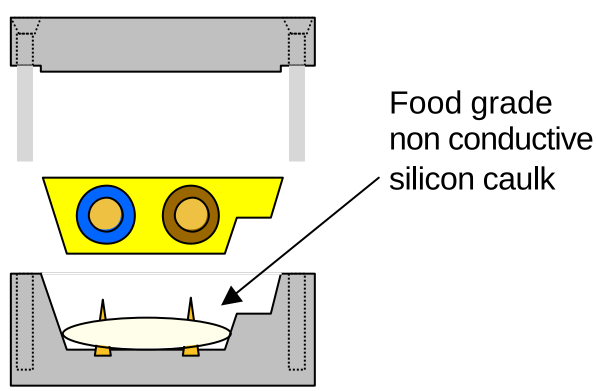
Before leaving the discussion on media we must consider the mechanical merits of the two types of cable. The flat cable and the connector that penetrates the insulation are usually rated IP67. This rating calls for submersion in water of 1-meter depth for 30 minutes measuring the resistance change between conductors. We also typically see an IP65 rating on the flat cable if the IDC connection is removed. IP65 is a spray test. The cable jacket is made of rubber or a synthetic rubber blend compound. Once the teeth have been removed the rubber closes to a large degree.

One problem with the IP test in mirroring real life applications is that the water used can be quite pure. Pure water is fairly non-conductive. It is not until bases, acids or salts are dissolved in the water that the water solution becomes conductive. In North America we use the NEMA 4X test to come closer to real life. NEMA 4X is a water-salt solution spray test. Although this test simulates real life better, it still does not take into account temperature changes.

At InterlinkBT we have an unofficial in-house "dishwasher test". It is the closest thing we have found to simulate real life in many food applications. We set the wash on "hot", the rinse on "cold", and use bases and or salts as the wash soap. The surging spray and splashing in the dishwasher causes anything flexible to wiggle and after 8 hours, if the water solution can defeat seals and gaskets, it will.

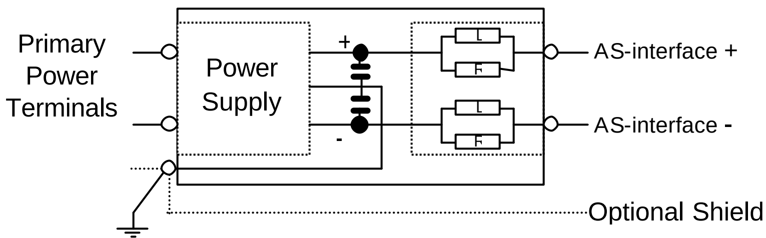
The typical flat IP67 connection will probably not survive an hour in the dishwasher before the resistance drops to an unacceptable level. The problem is in the geometry of the cable. Flat things and round things can be sealed effectively – just think about all the gaskets and seals in an automobile. However, the AS-interface flat cable just has too many angles. If effective compression is made on one surface there is a tendency for adjacent surfaces to buckle, allowing a path for the water solutions to enter.

The M12 connector should be considered in demanding applications, such as food processing. If this is not an option, or if the flat cable has already been installed and is causing a problem, a possible fix is using a nonconductive food grade silicon caulk sealant.



6.4. Power and Grounding

Both data and power are supplied on the two-wire cable. The DC power carries the AS-interface signal. The AS-interface signal and the voltage regulating circuitry of the power supply do not get along and must be separated. The theory of filtering designated frequencies is as old as radio, but there is still some art in the sizing and layout of the components. Filtering is also called decoupling. [Refer to **Figure 4**]



R=39Ω, L=50µH
C= is not specified but must be coordinated with the power supply design.

Figure 4

Different than most industrial buses, the AS-interface negative (-) cannot be grounded. This is because the 2 wires carry both the power and the signal. Grounding the signal lines would result in poor communication, if not completely lost communication.

Typical AS-interface media is not shielded. If an application does arise where shielding is required then the shield would be grounded in only one place, as shown in **Figure 4.**

AS-interface power supplies with integrated signal decoupling are available from 2 to 8 amps. Many gateways also come with the decoupling circuitry so that standard 24VDC power supplies can be used.

The original AS-interface power supply provided voltages in the 30VDC range. The actual specification was 29.5 to 31.6 volts DC. The reason for being higher than the industry standard nominal 24VDC was to compensate for the voltage drop on the line as well as the drop through the AS-interface IC chip. The goal was to be able to supply the end device with 24VDC (+10%/-15%).

The original intentions were good, but none of the other industrial buses went this route. They all stayed with 24VDC nominal power sources. Although the voltage drop through the AS-interface IC can be as high as 3 volts, nodes on other buses also have 1-2 volt drops through protective devices.

One of the more economical ways to use AS-interface is to use 16 AWG cable, a standard 24VDC power supply and a master with a built-in decoupler. The 16 AWG cable handles the voltage drop better and standard 24VDC power supplies are price competitive.

6.5. Auxiliary Power

Most bus systems today have auxiliary power for outputs. Often outputs need to be "killed", as in the case of machine stop or emergency stops. The most reliable way to do

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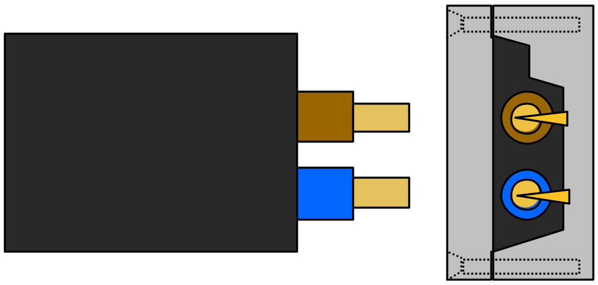
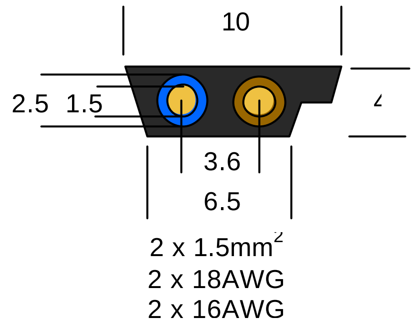
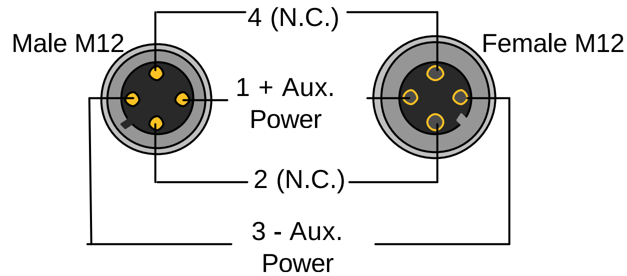
this is to disconnect the output power completely. Another advantage of separating the output power is isolating the line noise caused by inductive devices, such as solenoids and contactors, from the bus power.





AS-interface Auxiliary Power Flat Cable
Right figure shown with piercing teeth



Round AS-interface Auxiliary Power Cable

Figure 5

The same cabling solution for bus power has been adapted for auxiliary power, except the jacket is black. [Refer to **Figure 5**] The pinning convention is the same for the round M12 connection. A second solution is also available which consists of a four-wire round cable with auxiliary power and data in the same cable. Standard pinning for the AS-interface round cable is used, and unconnected pins are used for the auxiliary power connection.

6.6. Power Budget

This topic could also be titled "Voltage Drop". Arriving at the current requirements is straightforward. It is simply an addition of the connected loads.

The best way to calculate the voltage is a Nodal Analysis. This type of analysis involves summing the current at each slave. This could include connected loads such as sensors and the internal load of the node itself. Then sum the currents from the slaves at up stream junctions and tees. [Refer to **Figure 6**]

Next the resistance between the slaves and junction points and other junction points must be found. Resistance for the cable is usually given per 1000 ft or 1000 meters. The resistance for the segment is found by multiplying the distance times the resistance per 1000 units. [Refer to **Figure 6**]

Ohm's Law is then used to find the voltage drop of the segments. Starting at the power source and point of entry to the network, the voltage drop through all junctions and through to the slave is computed. [Refer to **Figure 7**]

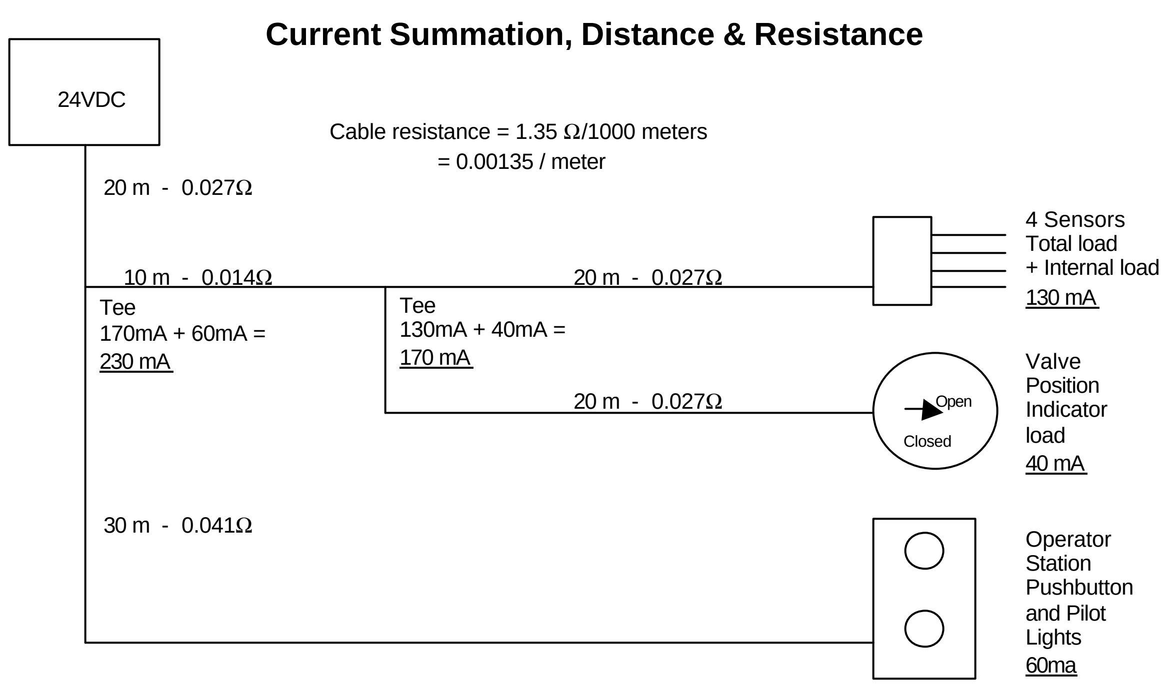


Figure 6

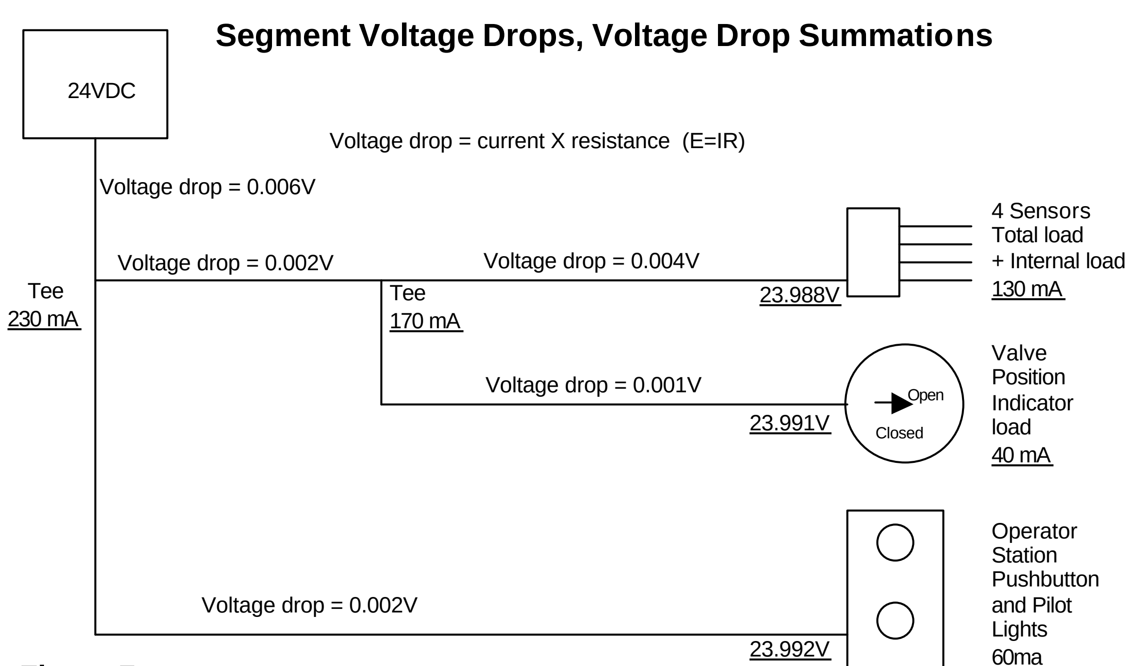


Figure 7

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Assuming a 24VDC source, the voltages at the slaves in **Figure 7** are 23.988, 23.991 and 23.992 top to bottom respectively. Even with a 3-volt drop across the AS-interface chip we still have over 20 volts for any connected device.

For most systems it is not necessary to go through the Nodal Analysis, but with a fully loaded 62-node v2.1 system it is possible to run out of power. When the voltage drop is too great for the connected devices either the network must be broken down into two signal segments connected by a repeater, the voltage at the power supply must be increased (but not above 31.6V), or the wire size of the cable must be increased.

7. Troubleshooting AS-interface

You sometimes hear that AS-interface is difficult to troubleshoot. The reality is that it is, isn't and might be. It really depends on the problem and to which bus AS-interface is being compared.

7.1. Open media

AS-interface is one of the easiest buses to troubleshoot if the media is open. Nodes before the open will report while nodes after the open will not. This is not the case with physical ring buses (unless the ring bus has undamaged redundant media) or if the nodes after the open are "smart" enough to start an error message following a time-out.

AS-interface is also better than buses that use terminating resistors. Without one end being terminated, as in the case of an open, communication is not assured with nodes up-steam of the open. Sometimes you are lucky and sometimes not.

7.2. Shorted data lines

Since AS-interface has data and power on the same wire pair, when they are shorted the entire segment goes down. One way to troubleshoot this problem with AS-interface, or any other bus that uses copper media for that matter, is to go about half way down the segment and open the media. If the up-stream side comes to life, then the short is down stream, if not, it is up-stream. To put it simply, "divide and conquer".

Short circuits can be more of a problem with AS-interface than other networks because of the IDC cable. Once you open the flat cable media you need to repair it. This is one of the reasons many people are going to the M12 connectorized solution.

7.3. Shorted power lines

Troubleshooting shorted power for AS-interface is the same as troubleshooting for shorted data because power and data are on the same pair.

This is almost identical to CANbus based networks because the power pair provides the current and voltage to the transceivers. Once power is down, the network is also down. Again, "divide and conquer" is the most common method to locate the short.

Shorted power is usually easier to handle on ProfibusDP because the power for the nodes is usually from a separate source. If the power does get shorted, groups of nodes go down. Today we are seeing some ProfibusDP networks being run with a power pair and a data pair in the same cable, similar to the CANbus networks.

7.4. Shorted transceiver or shorted transceiver power regulator

This is basically the same as a shorted data pair. The transceiver is actually integrated into the AS-interface chip.

7.5. Open transceiver or open transceiver power regulator

This is fairly easy to troubleshoot because the rest of the network will be live and only the node with the open electronics will fail to report when polled.

7.6. Other transceiver malfunctions

The specific varieties of transceiver transmission malfunctions are nearly endless, but it does come down two troubleshooting scenarios:

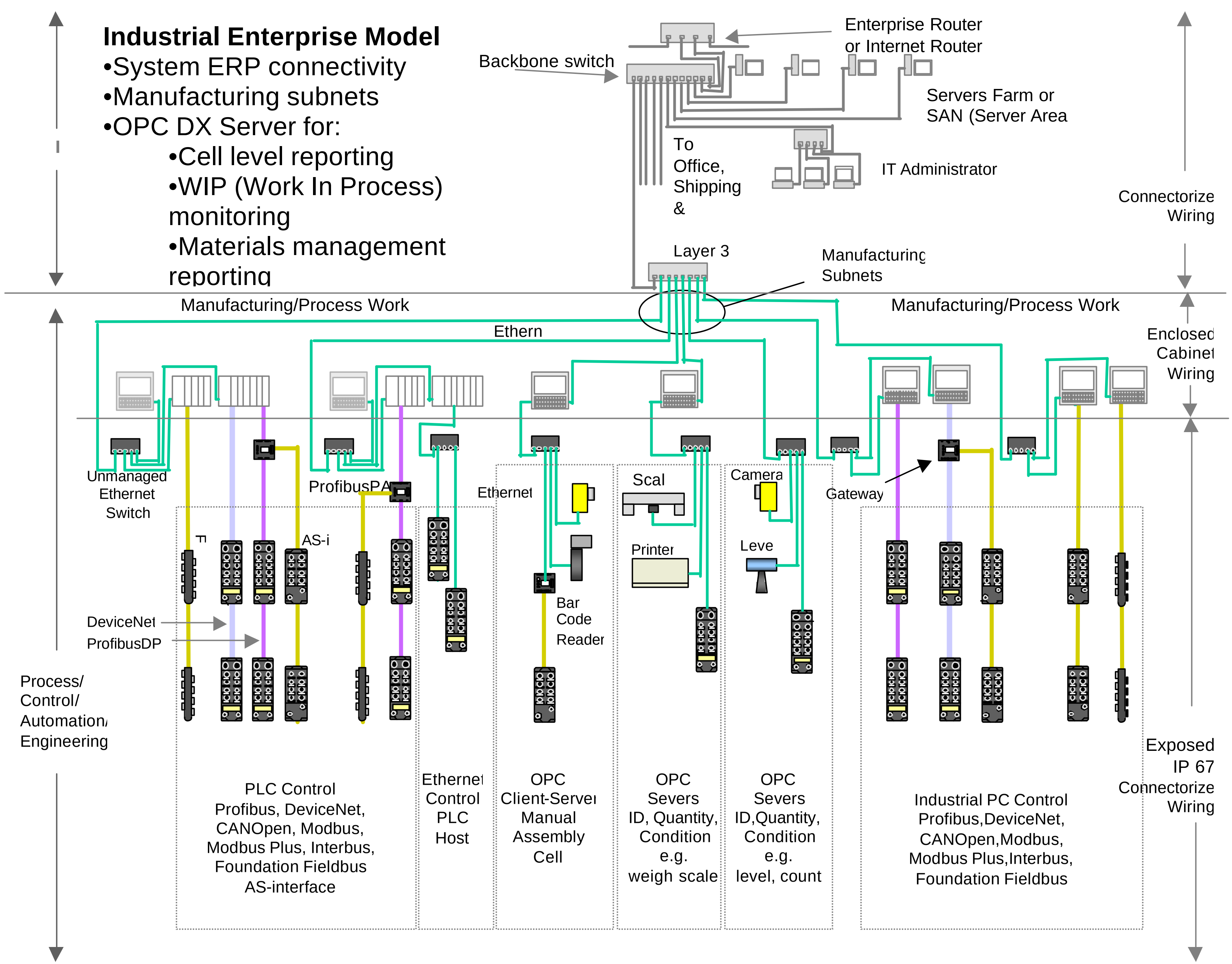
- The transceiver sticks “On” and brings down communications for the whole segment. We can sometimes get help from the communication LED’s on a node and sometimes not. Another “divide and conquer” scenario.

- The transceiver “trash” talks. This is not a very scientific term but is very descriptive. It can be a bad oscillator resulting in bad timing or something else, but in some way it is “talking a foreign language” in a room where no one else understands. When this happens, the node is not understood by the master and, therefore, absent.

8. Summary

AS-interface does not have the glory of Ethernet or the sophistication of DeviceNet, or the speed of ProfibusDP, but it gets the job done for many applications and for less money. AS-interface is supported by most PLC manufacturers and DCS manufactures, and there is a card available for virtually every PC. It may not be every plant’s primary industrial network but should be at least considered as a first alternate.

Appendix A


Industrial Enterprise Model
•System ERP connectivity
•Manufacturing subnets
•OPC DX Server for:
•Cell level reporting
•WIP (Work In Process) monitoring
•Materials management reporting
Backbone switch
Enterprise Router or Internet Router
Servers Farm or SAN (Server Area
To Office, Shipping &
IT Administrator
Connectorize Wiring
Layer 3
Manufacturing Subnets
Manufacturing/Process Work
Manufacturing/Process Work
Ethern
Enclosed Cabinet Wiring
Unmanaged Ethernet Switch
ProfibusPA
Ethernet
Scal
Camera
Gateway
F
AS-i
Printer
Leve
Bar Code Reader
DeviceNet
ProfibusDP
Process/ Control/ Automation/ Engineering
Exposed IP 67 Connectorize Wiring
PLC Control Profibus, DeviceNet, CANOpen, Modbus, Modbus Plus, Interbus, Foundation Fieldbus AS-interface
Ethernet Control PLC Host
OPC Client-Server Manual Assembly Cell
OPC Severs ID, Quantity, Condition e.g. weigh scale
OPC Severs ID,Quantity, Condition e.g. level, count
Industrial PC Control Profibus,DeviceNet, CANOpen,Modbus, Modbus Plus,Interbus, Foundation Fieldbus

AS-interface® Tutorial

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