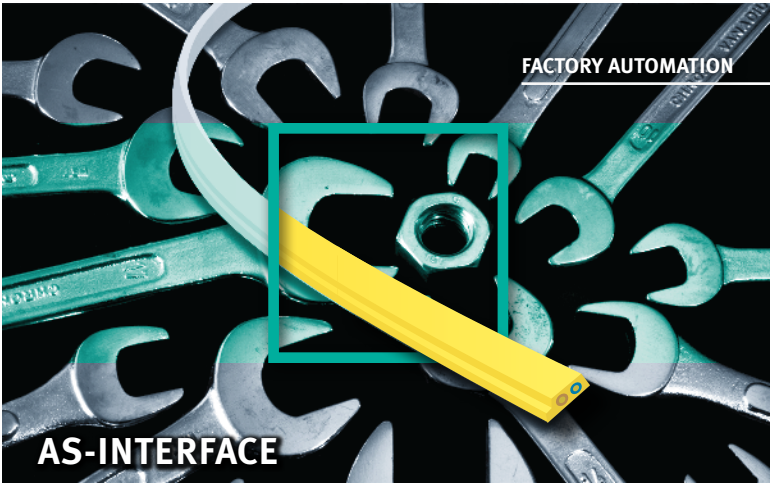


MAINTENANCE AND TROUBLESHOOTING GUIDE

Edition 3.0

PEPPERL+FUCHS
SENSING YOUR NEEDS

Table of Contents

As-Interface Basics

- Use only certified modules, gateways/scanners, and power supplies.
- Total segment cable length is 100 m. This includes the total of all trunk and drop lines.
- One AS-Interface power supply is required per segment. For example, a network with two repeaters requires three power supplies.
- Exactly one gateway/scanner is required per network.
- 31 addresses maximum; extended addressing, 1-31a and 1-31b, is permitted on 2.1 and 3.0 spec. networks for a total of 62 nodes.
- Address 0 (the factory default address) is used for automatic addressing and is not permitted on a running system.
- Modules with extended addressing and 4-in/4-out are permitted only on networks where an M4 (3.0) master is used.
- Update time per module is 150 µs. The formula for scan time is 150 µs x (number of addresses + 2).

  - Single addresses require one scan.
  - Dual addresses (a and b) require two scans.
  - Dual addresses (a and b) 3.0 4-in/4-out require two scans for inputs and 4 scans for outputs.
  - Analog modules (2.1) require seven scans per point.
  - Analog modules (3.0) require three or four scans per point.

- Network cable can be run in any topology.
- No shield or termination is required.
- Specification-compliant flat or round cable must be used.
- Do not ground either AS-i + or – under any circumstances anywhere on the network (ground fault). The network has a differential communication signal.

Addressing Modules

- If only one module has failed:
  - remove failed module,
  - connect new module.

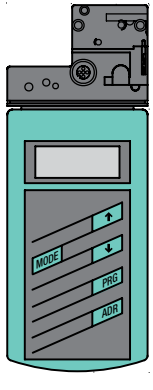
  As long as the new module is identical (i.e., has the same I/O and ID codes and has address 0 before connection), no additional steps are necessary.
- If more than one module has failed:
  - remove all failed modules,
  - use handheld programmer VBP-HH1 to manually assign addresses to all but one replacement module,
  - the last replacement module will receive its address automatically.

  Note: The VAZ-PK-1.5M-V1-G addressing cable is required to work with any module using an addressing jack.

Setting an Address Using Handheld Programmer

1. Connect the module to the handheld using either the addressing cable, M12 receptacle, or direct connection.
2. Press the “ADR” button to display the current address of the module.
3. Use arrow “↑ ↓” buttons to choose new address.
4. Press “PRG” button to set selected address.
5. Press “ADR” button to confirm address.

The diagnostic LEDs on the gateway/scanner indicate a fault when one or more modules are missing or are not properly connected to network.



Handheld Programmer

The handheld programmer is a diagnostic tool that is used to read the inputs or set the outputs on a module. This is often done to isolate and troubleshoot a specific I/O point.

Procedure to Read Inputs and Set Outputs

- Make sure the handheld is in ADDR mode. This allows the address to be read. Press the “MODE” button until the ADDR mode is selected.
- Press “ADR” button and verify address is not zero. (If zero, see previous page to set valid address.)
- Change mode to DATA by pressing the “MODE” button 4x or 7x depending on module type. (Menu will repeat if you go to far.)
- Use arrow “ ↑ ↓” buttons to select output value.
- Press and hold “PRG” button to turn outputs on.
- Press and hold “ADR” button to read inputs.

Note: The chart below shows which inputs or outputs are activated when the hexadecimal digit is displayed.

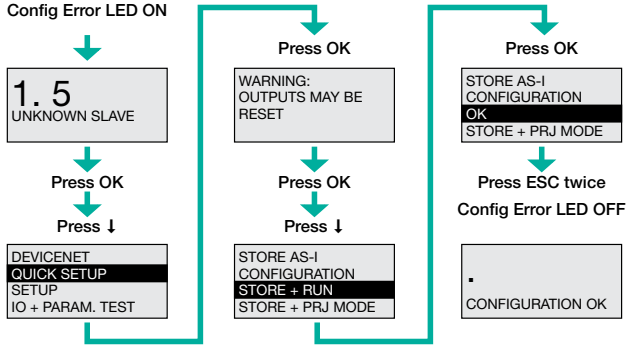
Data Bits	D3	D2	D1	D0
Inputs	I4	I3	I2	I1
Outputs	04	03	02	01

Display	0	1	2	3	4	5	6	7
Inputs	none	I1	I2	I1, I2	I3	I1, I3	I2, I3	I1, I2, I3
Outputs	none	01	02	01, 02	03	01, 03	02, 03	01, 02, 03

Display	8	9	A	b	c	d	E	F
Inputs	I4	I4, I1	I4, I2	I4, I2, I1	I4, I3	I4, I3, I1	I4, I3, I2	I4, I3, I2, I1
Outputs	04	04, 01	04, 02	04, 02, 01	04, 03	04, 03, 01	04, 03, 02	04, 03, 02, 01

Gateway Quick Start

The gateway detects when modules are added or removed from the network and indicates a “Config Error.” For gateways with a graphical display, use the following procedure to make the detected configuration (i.e., all modules found on the network) the active configuration.

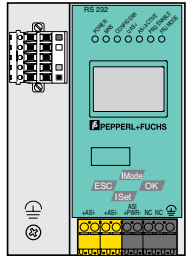


Gateway LED Fuctionality

LED	Indication	Meaning
Power	On (Green)	Power on
Config Error	On (Red)	One slave missing or extra slave on the network
	Flashing (Red)	Peripheral fault on network
U AS-i	On (Green)	AS-i network is sufficiently powered
AS-i Active	On (Green)	AS-i network operating normally in either configuration or protected mode
PRG Enable	On (Green)	Exactly one slave is missing in protected operating mode and automatic addressing is allowed
PRJ Mode	On (Yellow)	AS-i master is in configuration mode

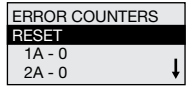
Gateway Advanced Features

Some gateways have advanced diagnostic features that can assist in finding network problems. The built-in fault detector will display new and old network errors. All advanced diagnostics are found on the display by going to ADV. DIAGNOSIS > AS-I CIRCUIT *x* > ...



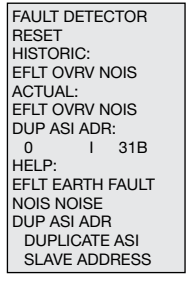
Error Counters

- If a node requires at least two consecutive retries, counts will appear on the display next to that node address. A clean network will have few or no retries. Single retries are automatically handled at the AS-Interface chip level and cannot be detected using the gateway. (Counts always go up by two.)
- If any node has six consecutive retries, it appears in the LCS with an X by the node address. (This node caused a configuration error.)



Fault Detector

The following errors occurred in the past (HISTORIC) or are currently happening (ACTUAL). Duplicate addresses are also displayed on this screen.



EFLT: An earth or ground fault has occurred. Check to make sure that AS-i + or - is not touching machine ground anywhere.

OVRV: A power spike occurred on AS-i such that the AS-i voltage was too high.

NOIS: Noise was detected. Route AS-i cable away from potential noise sources.

Exchanging SafetyNodes

Compared to standard modules, exchanging a SafetyNode requires a few additional steps. See procedure for single and multiple node replacement.

Exchanging a Single Failed SafetyNode

1. Remove SafetyNode.
2. Lightly press the “Service” button on all affected SafetyMonitors. LEDs 1, 2, and 3 will cycle slowly on the SafetyMonitor.
3. Connect replacement SafetyNode. Make sure it receives an AS-i address and its inputs are closed so that full safety-code sequences are received by the SafetyMonitor.
4. Press the “Service” button on all affected SafetyMonitors. If successful, LEDs 1, 2, 3 will turn off and the SafetyMonitor will start normally.

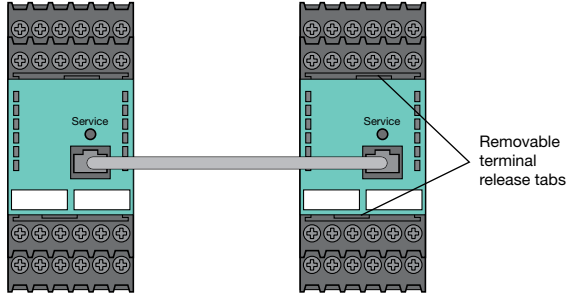
Exchanging Multiple Failed SafetyNodes

1. Remove all defective SafetyNodes.
2. Use handheld programmer VBP-HH1 to manually assign all addresses. (See page 4.) Confirm there is no configuration error on gateway/scanner. (Make sure all e-stops are pressed, all gates are open, and all light curtains are broken such that S1 and S2 safety input LEDs are off on all recently replaced SafetyNodes.)
3. The safety sequence must now be taught by following the procedure in “Exchanging a Single Failed SafetyNode.” Repeat this procedure for every recently replaced SafetyNode on the network.

ATTENTION! After replacing the defective SafetyNodes, make certain to check the new modules for correct functionality.

Exchanging SafetyMonitors

1. Disconnect the failed SafetyMonitor from the 24 V DC power supply. Both L+ and M must be removed!
2. Use the special download cable, VAZ-SIMON-RJ45. Connect the new and old SafetyMonitors together.

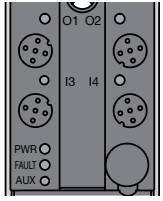


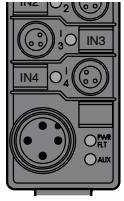
The replacement SafetyMonitor must be new with no configuration or have a configuration that is not validated.

3. Power up replacement SafetyMonitor by connecting both L+ and M.
4. Press the “Service” button on replacement SafetyMonitor.

   On the replacement SafetyMonitor, active transmission is indicated when the yellow READY LED is illuminated. Transfer is complete when the GREEN and YELLOW LEDs are both lit.
5. Disconnect defective SafetyMonitor and move all cables to replacement SafetyMonitor. (Version 2.14 has keyed removable terminals. Press the release tab in at the top of the monitor and pull terminals straight up to remove.)

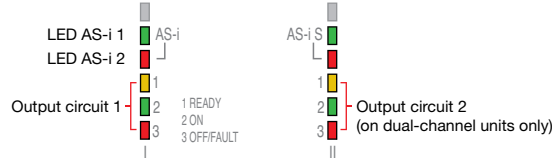
LED Functionality (Modules)





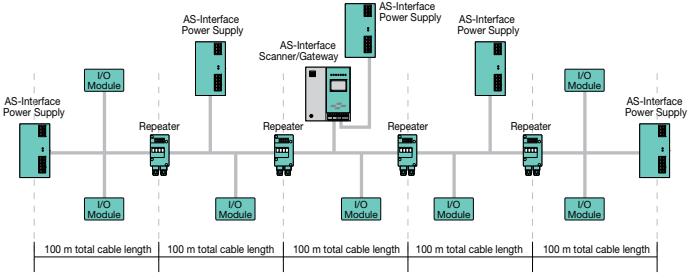
LED	Indication	Meaning
PWR AS-i	Off	No power
	On (Green)	Normal
	Flashing (Green)	Address 0 (FAULT LED on) or peripheral fault (FAULT LED flashing)
FAULT	Off	Normal
	On (Red)	No AS-i communication; check address
	Flashing (Red)	Peripheral fault; check I/O
PWR/FLT	Off	No power
	On (Green)	Normal
	On (Red)	No AS-i communication; check address
	Alternating (Red/Yellow)	Address 0
	Alternating (Red/Green)	Peripheral fault; check I/O
AUX	OFF	No AUX power; check black AS-Interface cable
	ON	Normal
I In	OFF	Input OFF; no AUX power or wire broken
	ON	Input ON
O Out	OFF	Output OFF; no AUX power or output not set by PLC
	ON	Output ON
	ON	Output shorted/overloaded (if supported by module)

LED Functionality (SafetyMonitors)



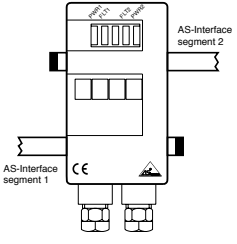
LED	Indication	Meaning
AS-i 1	Off	No 30 V AS-i connection to AS-i+ and AS-i- terminals
	On (Green)	Normal
AS-i 2	Off	Normal operation
	On (Red)	No AS-i communication or monitor address not stored in gateway/scanner
1 READY	On (Yellow)	Waiting for start condition or door unlock condition
	Flashing (Yellow)	Safety module test, local acknowledge required, or diagnostic stop enabled
2 ON	On (Green)	Contacts of the output switching elements closed
	Flashing (Green)	Delay time runs in event of Stop Category 1
3 OFF/FAULT	On (Red)	Contacts of the output switching elements open
	Flashing (Red)	Error on level of the monitored AS-i components
1 READY 2 ON 3 OFF/FAULT	Simultaneously flashing rapidly	Internal device error; power cycle is required
1 READY 2 ON 3 OFF/FAULT	Cycling slowly	Learning safety code sequences
1 READY 2 ON 3 OFF/FAULT	Off	No 24 V supply connected to L+ and M terminals

The communication path between an AS-i module and gateway/scanner must not go through more than two repeaters. This example shows a network with five segments, four repeaters and a total length of 500 m. Note the position of the gateway in the *middle* segment.



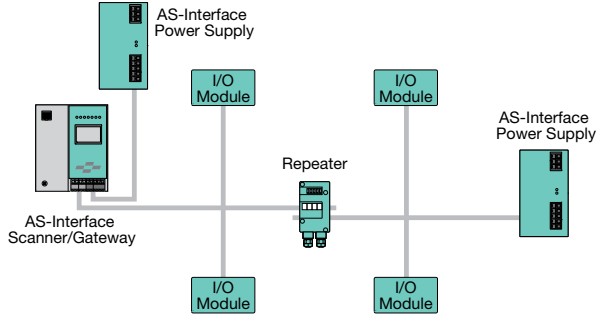
A repeater adds a second galvanically isolated segment to the AS-i network. Because only communication passes through the repeater a second power supply is required. Never put more than one power supply on a segment!

LED	Indication	Meaning
PWR	Off	No power supply connected
	On (Green)	Normal
FAULT	Off	Normal
	On (Red)	No communication

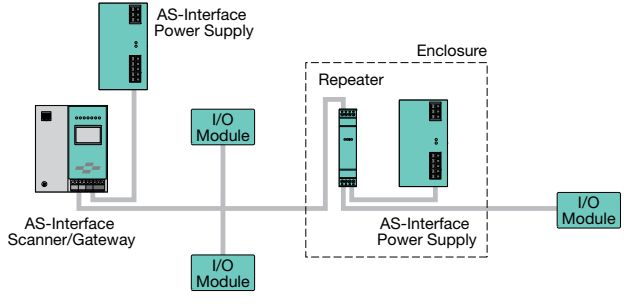


A network that is properly setup will have:

- one gateway/scanner,
- one power supply per segment,
- no segment with more than 100 m total cable length,
- no module separated from the gateway/scanner by more than two repeaters.



Wiring field-mount repeater, VAR-G4F



Wiring enclosure-mount repeaters, VAR-KE3-TERM or VAR-KE2

Analyzer

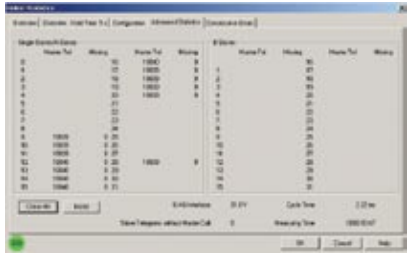
The network analyzer, VAZ-ANALYZER, provides information about network stability and allows detailed analysis of protocol-specific communication detail.

There are two modes of operation. The first is *online statistics* where the overall health of the network is read. The second is *trace mode* where individual AS-i telegrams are recorded, filtered, and viewed for later analysis. This mode is often used to track down specific input, output or timing problems.

Online Statistics

Advance statistics (check for)
- Little or no missing telegrams
- No slave telegrams without master call

Consecutive errors
- Make sure consecutive errors are kept to a minimum. (6x = configuration error)



Network overview
- Check to make sure all connected nodes are green.

I/O data
- Verify that the input and output data is correct.
- Find out if a certain input is flickering or turning on for a short time by running a trace on that input.

Terminator and Tuner

The fixed terminator, VAZ-TERM, extends the network to 200 m, and the tuner, VAZ-TUNER, extends the AS-i network to 300 m. These devices, however, will not correct problems caused by noise or bad AS-i cable.

Requirements for Installation

- The best network to extend is linear. A network that has many drops/branches may not be extendable.
- The power supply must be located at one end of the network segment and the terminator/tuner at the other end.
- If a repeater is to be used, an “Advanced” repeater is required. The advanced repeaters VAR-G4F or VAR-KE3-TERM (with termination switch built in) have a faster response time, which is required to couple long segments together.
- Always use analyzer VAZ-ANALYZER to verify network integrity.

Tuning Procedure

Gateway/scanner:
1. Put in configuration mode by holding “mode” button for 5 seconds.

Tuner:
1. Rotate “mode” switch to 2 (tuning).
2. Press “set” button until LEDs strobe red, yellow, green, red....
4. When strobing stops (this may take several minutes), rotate “mode” switch to 3 (run).

Tuner LED Indication

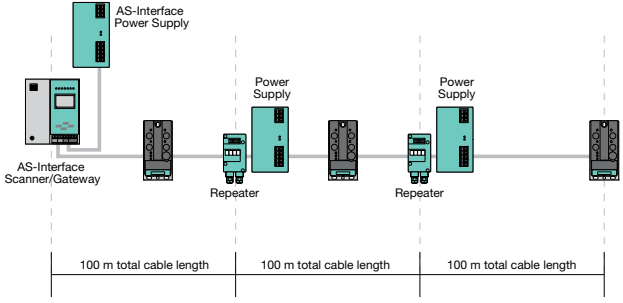
LED	Indication	Meaning
Error	On (Red)	Greater than 5% retries
Warning	On (Yellow)	1% to 5% retries
Green	On (Green)	Less than 1% retries

Terminator LED Indication

Indication	Meaning
Off	No power or voltage below 18.5 V
On (Yellow)	Voltage above 18.5 V
On (Green)	Voltage above 26 V

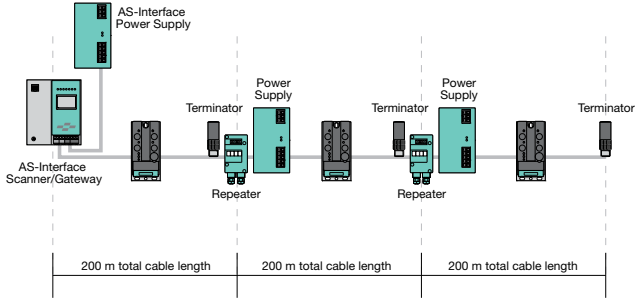
AS-Interface networks are easy to build with only a few guidelines. Communication between a gateway/scanner and module cannot pass through more than two repeaters. Additional network wiring restrictions are necessary if terminators or tuners are used to build even longer networks.

- Terminators and tuners should be located as far away from the power supply as possible within the segment.
- Use only VAR-G4F and VAR-KE3-TERM advanced repeaters when using terminators and tuners to extend the network.
- Use an AS-i analyzer to verify proper terminator and tuner operation.
- See *Terminator and Tuner* section for proper tuning procedure.
- Tune the segments only in configuration mode (PRJ mode LED on).
- Tune segments one at a time starting with segments closest to the gateway/scanner. Disconnect segments that are not already tuned.

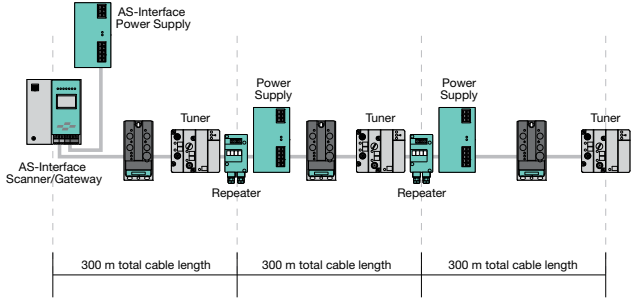


300 m network using repeaters

Building Networks



600 m network using repeaters and terminators

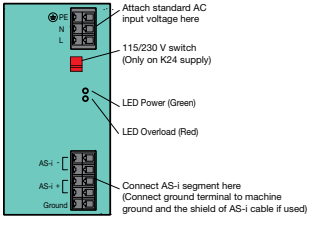


900 m network using repeaters and tuners

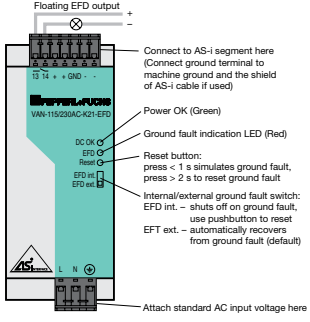
Power supplies used for AS-Interface are specifically designed for this network. No standard DC power supply can be used unless it first goes through a power conditioner. Only a few wiring guidlines are required:

- Exactly one AS-Interface power supply is required for each segment.
- Some gateways have duplicate address detection. To use this feature, the power supply must be connected directly to the dedicated terminal (labeled +PWR-) on the gateway.

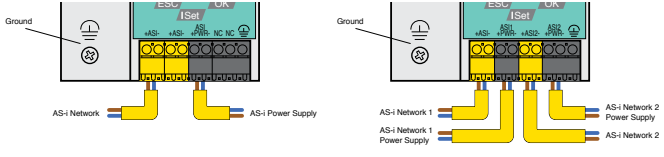
Standard power supply wiring



Power supplies with ground fault detection



Power supply connection for gateways



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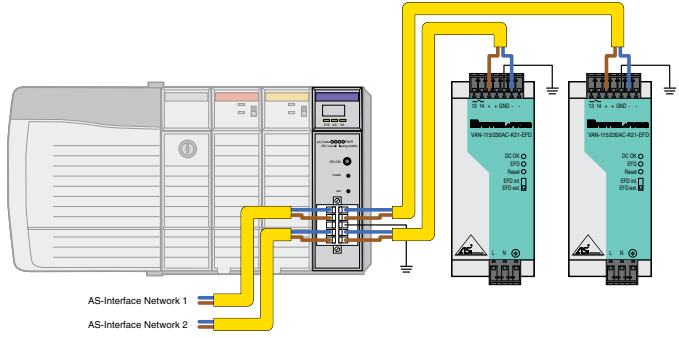
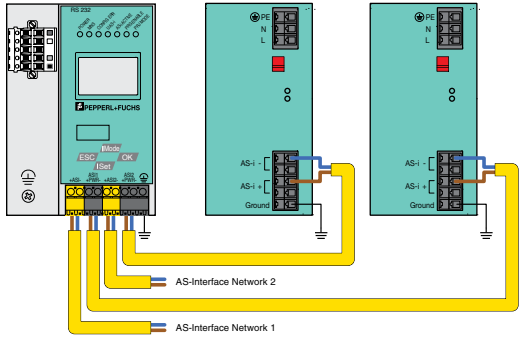


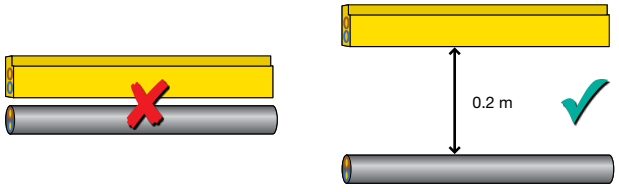
Dual network A-B ControlLogix scanner card connected to two power supplies with ground fault detection



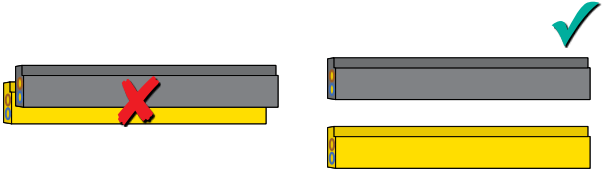
Dual network gateway with duplicate address detection connected to two standard AS-i power supplies

PEPPERL+FUCHS SENSING YOUR NEEDS

DON'T	DO
Don't run AS-i cable parallel to potential noise sources.	Separate AS-i cable and noisy cable by at least 0.2 m.

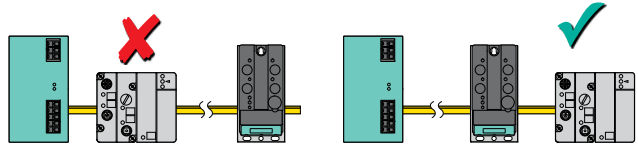


DON'T	DO
Don't fasten yellow AS-i and black auxiliary cable on top of each other.	Separate the black and yellow flat cables. Outputs connected to drives or motors can cause black AUX cable to be noisy.

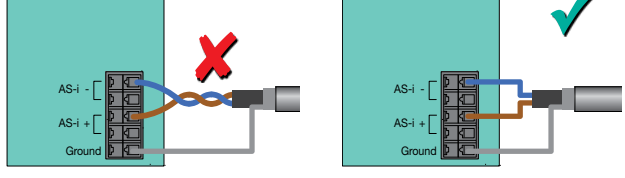


Helpful Wiring Hints

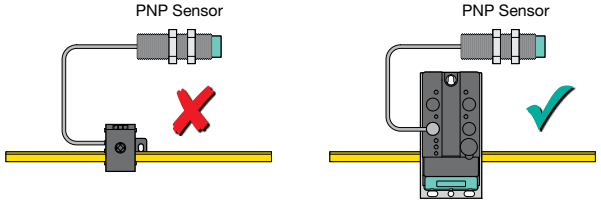
DON'T	DO
Don't locate terminator/tuner next to the AS-i power supply.	Place the AS-i power supply at one end of the network and terminator/tuner at the other end.



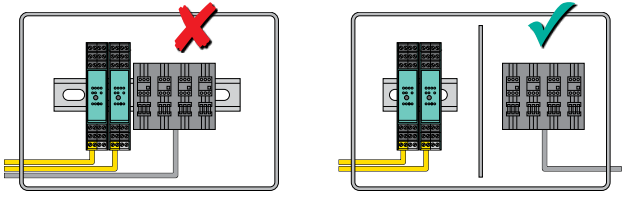
DON'T	DO
Don't use noncompliant or out of specification AS-i cable i.e., twisted, shielded, or, wrong impedance.	Use correct wiring practices when using shielded cable including cable length reduction to 80 m max. and land shield on GND terminal on power supply.



DON'T	DO
Don't power standard devices with AS-i cable.	Power only AS-i certified devices with the AS-i cable. AS-i devices have special filtering components that safely pull power from the network.

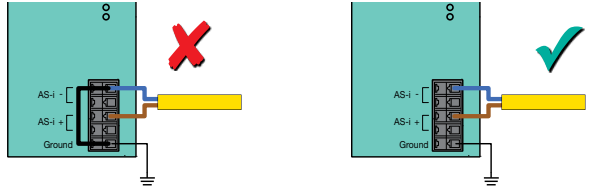


DON'T	DO
Don't place AS-i and noisy components next to each other in a panel.	Keep the AS-i components on one side of panel and high-frequency drive components on the other. Separate them with a metal divider, if possible, and make sure cables do not exit at the same location.



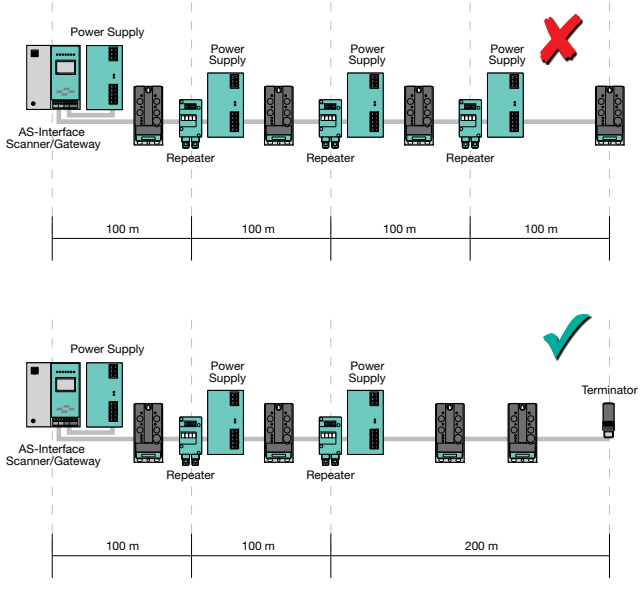
Helpful Wiring Hints

DON'T	DO
Don't ground AS-i anywhere on the network under any circumstances.	Allow the AS-i signal to float properly. AS-i derives much of its noise immunity from this floating signal. Tying one lead to ground will interfere with the AS-i communication.



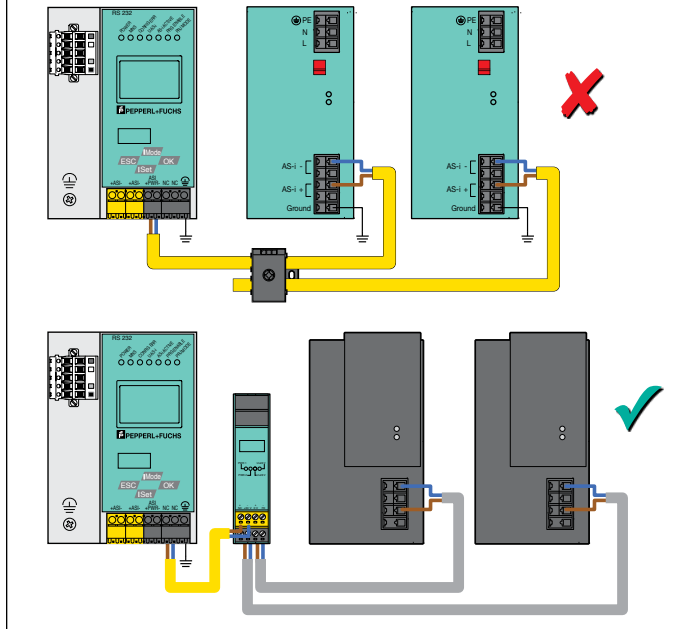
DON'T	DO
Don't neglect to check the number of retries on the AS-i network.	Use the AS-i analyzer to ensure that the network is error free. Capturing the network health during project buyoff can relieve machine builders of future liability if changes are made.

DON'T	DO
Don't use more than two repeaters in a row.	Use repeaters in a star topology around the AS-i scanner/gateway, or use a terminator and tuner to maximize the network length.



Helpful Wiring Hints

DON'T	DO
Don't use more than one AS-i power supply on a network.	For redundancy, use two standard 30 V power supplies connected to a power condintioner.



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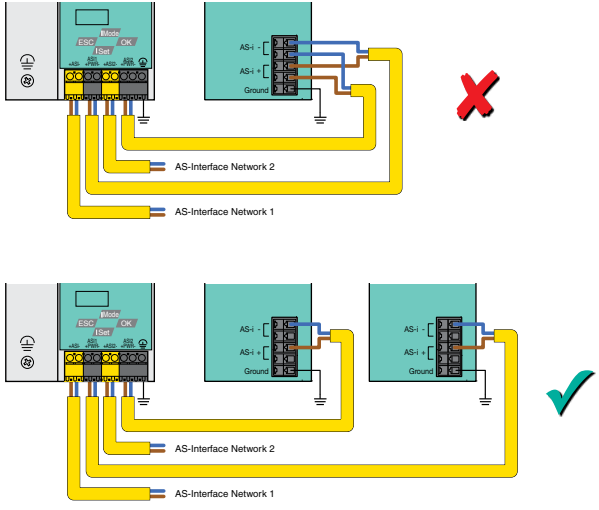
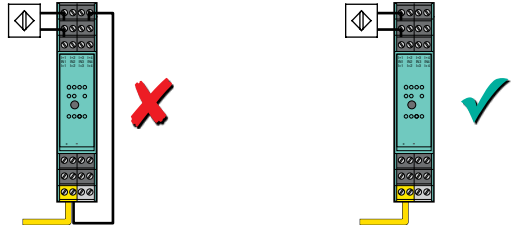
DON'T	DO
Don't use one power supply to power two networks.	Use the dual-channel power conditioner, VAN-KE2-2PE, or use two separate power supplies, one for each network.



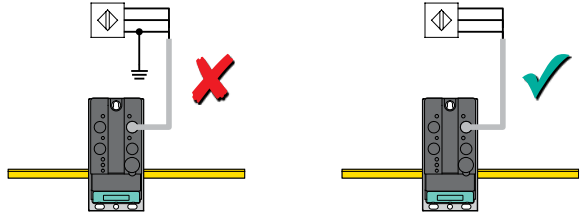
Helpful Wiring Hints

I/O Module Wiring

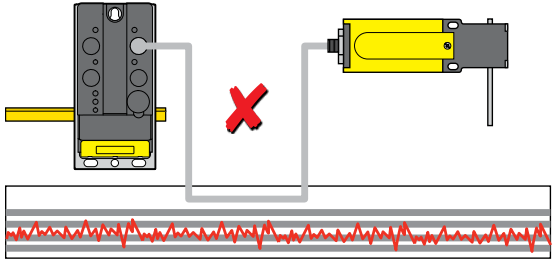
DON'T	DO
Don't use the input power terminals (IN+, IN-) for anything other than what they were designed for; powering sensors.	Use these terminals to provide power to sensors and other input type devices only.



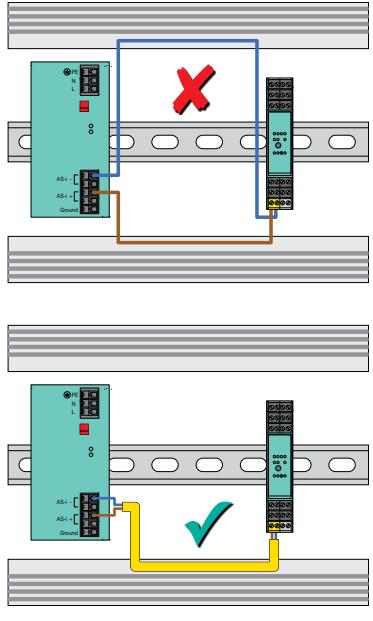
DON'T	DO
Don't ground input signals that are powered by the AS-i network through the I/O modules.	Allow the AS-i module to completely power inputs connected to the module if designed to do so. If the resistance to ground is <10 MΩ inputs should be powered externally.



DON'T	DO
Don't run inputs connected to safety modules with long cables or run inputs close to potential noise sources.	Place AS-i safety modules as close as possible to safe inputs or use Safety at Work components with direct communication to AS-i. The safety sequence runs over safe input lines and any disruption of this sequence can cause nuisance shutdowns.



DON'T	DO
Don't run the AS-i + and AS-i - wires apart in the same enclosure.	Do run the AS-i conductors together preferably in the same jacket. This eliminates current loops and allows proper noise rejection to occur on the network.



The number 41 is on the gateway display. There is no AS-i communication. What do I do?

Check to ensure that exactly one power supply is used for each AS-i segment. This can be checked easily by powering down each of the AS-i power supplies, one at a time. The PWR LEDs on all of the nodes within each segment must go off. The U-AS-i LED on the segment connected to the AS-i gateway/scanner must also go off.

Make sure the AS-i power supply is not being used to power auxiliary devices. Disconnect the auxiliary power supply. Walk around to every AS-i node and make sure that the AUX LED is off.

The node is addressed correctly and connected to the network. The PWR LED is red and the AS-i scanner can't see the node. What do I do?

Check for duplicate addresses. Use gateways or safety monitors with duplicate address detection. If these gateways are wired properly (see pg. 19), problems can be found easily. If this feature is not available, read the LDS (List of Detected Slaves) and check the nodes on the network. These addresses must match exactly. Disconnect duplicate and see if node appears. If so, a node with same address exists somewhere else on the network.

How do I know if my network is running properly by using the LEDs on the scanner/gateway and the LEDs on the nodes?

A properly running AS-i network will have the following LED states:

Gateway/Scanner LEDs

Power/PWR	● On (Green)
Config Error/FAULT	○ Off
U AS-I	● On (Green)
AS-i Active/act	● On (Green)
PRG enable	○ Off
PRJ Mode	○ Off
OK/SYS	● On (Green) (scanner cards only)

Node LEDs

PWR(AS-i)	● On (Green)
FAULT	○ Off
PWR(AS-i)/FAULT	● On (Green)
AUX	● On (Green)

What do the numbers mean on the gateway's 2-digit, 7-segment display?

Gateways/scanners will show AS-i addresses and error codes on the display. While in run mode, (PRJ LED off) the display should be blank. Numbers on the display that range from 1-31 are addresses of the nodes that are faulted; they are not error codes. Numbers greater than 31are gateway error codes. The two most common error codes are 40 and 41.

Common Problems and Solutions

40 – Offline phase: There is no power to the AS-i network causing it to be offline; or the network has been taken offline manually using the keypad or data bits in the PLC/PC. Gateway would say OFF-LINE by host if this was the cause.

41 – Detection phase: Gateway will remain in this phase until at least one node is found. Place nodes on network making sure there are no duplicate addresses. Also check for miswired power supply, two power supplies on one network, one power supply on two networks, or the use of a noncompliant 24 V DC power supply.

My network is unstable. What are possible causes, and how do I fix them?

AS-i cable length could be too long or noncompliant cable was used. AS-i cable length is measured as the sum of the trunk cable and all drops. The AS-i specification, though conservative, is 100 m maximum. Exceeding this length could result in unnecessary retries by the AS-i scanner/gateway. Reduce the segment length by adding a repeater and power supply. Make sure that new segments are under the 100 m limit. **NOTE:** When "over length" network problems occur, the nodes closest to the AS-i master/scanner are often those that are most affected.

I connected a new AS-i module to the network and stored the configuration. It won't communicate. What could be the problem?

Check in the AS-i Reference & Buyer's Guide for the minimum master specification you must have to use this module properly.

- If a node has 4 in/4 out and extended addressing, it can only be used on M4 (3.0) masters
- Nodes with extended addressing that are used on 2.0 (M0, M1, M2) masters must leave parameter bit P3 on and data bit D3 off. These bits, used to toggle between A/B addresses in spec. 2.1, are defined only as data bits in earlier specs. Changing these bits will cause the nodes to go offline.

I am looking at the retry counters on the gateway and notice that the number of retries is significant. What can I do to eliminate them?

Frequently, it is only one AS-interface node that is causing a problem on the AS-i network. This is usually due to miswired components in remote panels. Use the retry counters in the gateways or, even better, use the AS-i analyzer to connect nodes one at a time. When a node is added that starts generating retries anywhere on the network, the cause is probably in the wiring to that node. **NOTE:** A network retry of a node on AS-i does not mean that the problem is with that particular node. The AS-i network is connected to all nodes, so a wiring problem on one node can affect the entire network.

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