

Fieldbus 502

Checkout and troubleshooting

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Overview

How can I make sure the network works as it should?

After installation is complete, the next step toward ensuring a successful startup is checkout and (if necessary) troubleshooting the network. These procedures help eliminate potential network communication problems.

Checkout generally includes testing both the **wiring** and the **communication signal** using standard tools like a multimeter, capacitance meter, and scope meter.

This course provides guidelines for basic checkout procedures, including troubleshooting common problems.

Hint: As you go through the topics in this course, watch for answers to these questions:

- *What are the expected resistance and capacitance values for fieldbus wiring?*
- *Why might you need more than the minimum voltage on a segment?*
- *What's one way to determine the possible cause of a communication error?*

Wiring check

This part of the process involves checking resistance and capacitance for

- Conductor to conductor
- Conductor to shield
- Conductor to ground
- Shield to ground

Before you begin, make sure all the parts of the segment are connected. That includes all wiring, terminators, and field devices — but **DON'T connect the segment power connector** during the wiring check.

With a multimeter, check the following resistance levels.

- + Signal to - signal 50 K ohms
- + Signal to shield >20 M ohms
- - Signal to shield >20 M ohms
- + Signal to instrument ground >20 M ohms
- - Signal to instrument ground >20 M ohms
- Shield to instrument ground >20 M ohms

You should also lift the shield from the ground and check the isolation between the shield and the ground. The value should be greater than 20 M ohms.

Check capacitance wherever you have long wire runs or where fieldbus will be installed on old wiring. Capacitance values should be

- + Signal to - signal ~1 μ F
- + Signal to shield <300 nF
- - Signal to shield <300 nF
- + Signal to instrument ground <300 nF
- - Signal to instrument ground <300 nF
- Shield to instrument ground <300 nF

If everything checks out to be within these limits, then the basic wiring for your segment is good.

Voltage check

After ensuring the segment wiring checks out, next examine the segment power.

Remember that the power connector was disconnected for the wiring check. Re-attach it now for the voltage check.

Check voltage at

- The power supply
- The H1 host interface card
- The individual field devices.

The voltage level between all the positive (+) and negative (-) signal wires must be between 9 and 32 Vdc.

Practical pointer

It's a good idea to make sure the lowest voltage on the segment is at least 1-2 Vdc higher than the minimum 9 Vdc. This gives some buffer for low voltage conditions.

Generally, as the distance increases between devices on the segment and the power supply, the voltage on the bus drops. Any device whose voltage varies significantly from other devices, or any significant voltage drop that is not associated specifically with the distance to the power supply, indicates a possible wiring problem.

If you anticipate a segment extending long distances beyond the current end point, then you should either plan for a higher level of power at the current end point, or make provisions for a powered repeater.

Signal check

Problems can arise when wiring isn't consistently set up according to the rules. For example, a high rate of message retries, especially from a single device, indicates a potential wiring problem.

Fortunately, signal checks can help you easily detect and diagnose situations like this.

Three error conditions account for most of the problems not detected by a resistance, voltage, and capacitance check:

1. Not enough terminators on the segment.

For example, the type of power conditioner used may not have the terminator that's needed for use in a fieldbus installation.

2. Too many terminators on the segment.

A terminator may have been added unnecessarily when one already existed as an optional component in another device, such as a power conditioner. Or a segment may have been extended without moving or removing the existing terminator.

3. Excessive trunk or spur length.

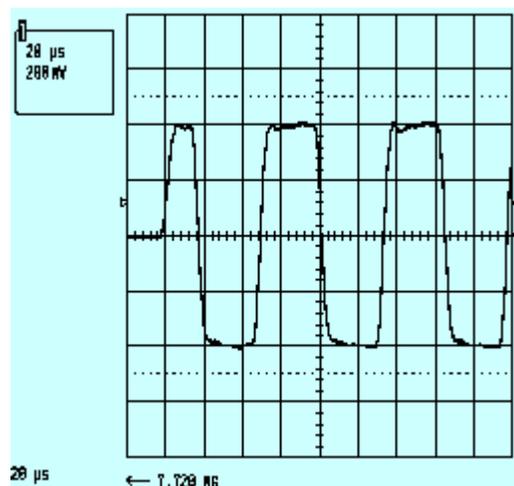
Excessive trunk or spur length can be caused by cable runs that are significantly longer than the line-of-sight distance between the two ends of the segment. This can happen because cable trays tend to follow a vertical / horizontal grid pattern and often change height. This can make the actual length as much as double the perceived length.

Mixing wire types in a segment can also make your segment 'electrically' much longer than you expect.

Some FOUNDATION fieldbus hosts provide communications statistics to help diagnose these errors.

Signal waveforms

Fortunately, signals have easily recognizable signatures — or waveforms — that you can use to quickly identify the signal and any problems associated with it. A normal signature is shown below.



A normal signal will have wave shapes that are well formed and are defined by

- A linear up-slope
- A well-defined wave top
- A linear down-slope
- A well-defined wave bottom

The up- and down-slopes will be symmetrical, and the top and bottom will be relatively flat and free from spikes.

A good waveform will also have a nominal peak-to-peak voltage of 0.8 to 1.2 volts.

The signature in the illustration is well-formed and shows just more than 0.8 volts, so in this case everything is fine.

Recognizing common errors

FOUNDATION fieldbus is very robust. Many segments can operate despite the presence of waveform error conditions, but the overall reliability of the segment will be reduced. These errors will commonly appear as an excess number of message retries.

Many of these errors can be diagnosed by using a scopemeter to check the communication waveforms. Here are some of the errors you may see -- and what our experience has shown to be the most common causes.

Missing terminator. If the waveform shows peak-to-peak signal strength to be twice as large as the normal 0.8 to 1.2 volt, you may be missing a terminator on the segment.

There are two common reasons for missing terminators.

The first is that many fieldbus components such as power conditioners have built-in terminators that can be switched in or out. Often a terminator that is intended to be switched in is in fact switched out. This frequently happens after a repair or maintenance activity where the component with the terminator is replaced.

The other common reason is that a segment is extended beyond its original end point. The terminator at the old end point is removed, but the terminator is not installed at the new end point.

Less common reasons include failing to terminate after an isolating safety barrier, or failing to secure the terminator sufficiently and having it fall out.

Too many terminators. If the waveform peaks are shorter than normal, there may be extra terminators somewhere on the segment.

This problem can occur when a technician doesn't realize that a fieldbus component such as a power conditioner has a terminator in it, and adds another terminator.

It also happens when someone extends a segment, adds a terminator at the new segment end, and forgets to remove the terminator at the old end location.

Excessive spur or segment length. A waveform with rounded peaks — rather than flat, horizontal areas at the top and bottom — may indicate that a spur or segment is too long.

The most common causes of excessive length are

- using conduit and cable tray routes that are much longer than line of sight
- mixing wire types without considering the different maximum length specifications for different wire types
- using wire that is very old and in poor condition.