

The Importance of Isolation for Foundation Fieldbus

Maintaining isolation between the Fieldbus pair and plant ground is critical to the reliability of Foundation Fieldbus systems.

Isolation has been a requirement of Foundation Fieldbus since its inception. It was written into the ISA S50.02 standard and later adopted into the IEC 61158-2 standard. The primary reason for this is to reduce the chance that outside electrical interference will affect the Foundation Fieldbus signals. As we have gained field experience, it has become apparent that there are other issues that can adversely affect a Foundation Fieldbus system when isolation is lost. The following paragraphs will address these different issues.

Noise Immunity

As stated above, the original reason for requiring isolation was to improve noise immunity. By requiring the two Fieldbus wires to be isolated from any other voltage reference (ground for example), they become a differential pair. The DC voltage and the AC signal that exist on the Fieldbus pair only exist differentially. Any electrical interference (noise) that impinges on the wire pair affects them equally - especially when using twisted-pair wire. When you look at the voltage difference between the two wires, this electrical noise is not seen - it cancels. Grounding either wire will eliminate this designed in noise immunity.

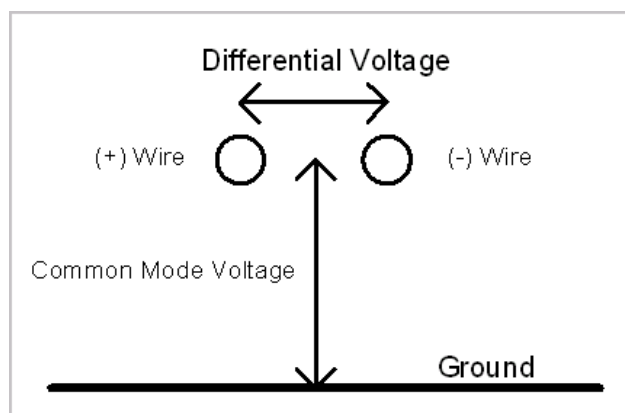


Figure 1: Differential Voltage and Common Mode Voltage

Short Circuit Protection

Galvanic isolation from ground also provides another benefit. Current limiters are often used between the network's trunk and the drop cable to a Fieldbus device to prevent a short circuit on one spur from disabling the entire network segment. If a segment does not have galvanic isolation, current limiter protection can be defeated.

For example, suppose the minus wire is referenced to ground (a fault) at the Fieldbus power supply and the cable shield is also grounded (as it should be). Normally, the current used by a device on the spur cable flows from the (+) wire, through the Fieldbus device and back on the negative wire through the current limiter. If the spur cable's (+) wire is accidentally shorted to the shield, the current no longer flows on the negative wire through the current limiter but on the shield directly to ground. Thus, the current limiter is bypassed and offers no short circuit protection.

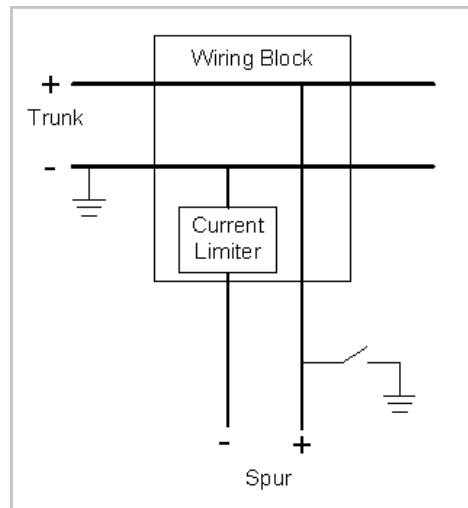


Figure 2: Bypassing the current limiter

A shield short to one of the network wires is a relatively common occurrence. When this happens on a network powered by a galvanically isolated Fieldbus power supply, the network still functions but with reduced noise immunity. Without galvanic isolation there is a possibility that current limiters will not work.

Crosstalk

Fieldbus network segments should be independent from each other. A power conditioner must have equal impedance on both wires of the segment or the segment must be galvanically isolated from all other segments. Without this, there is crosstalk between the two segments. "Crosstalk" means that signals on one segment partially appear on another segment. Crosstalk is caused by capacitive coupling between segment wires and the shield. This is a form of noise and makes network operation unreliable. A properly designed power conditioner along with segment isolation ensures that crosstalk will not occur.

Multiple Wiring Errors

There must be segment independence such that a wiring error or wiring deterioration on one segment does not affect other segments. Consider the case where a galvanically isolated 24 V bulk power supply provides power to two (non-isolated) Fieldbus power conditioners.

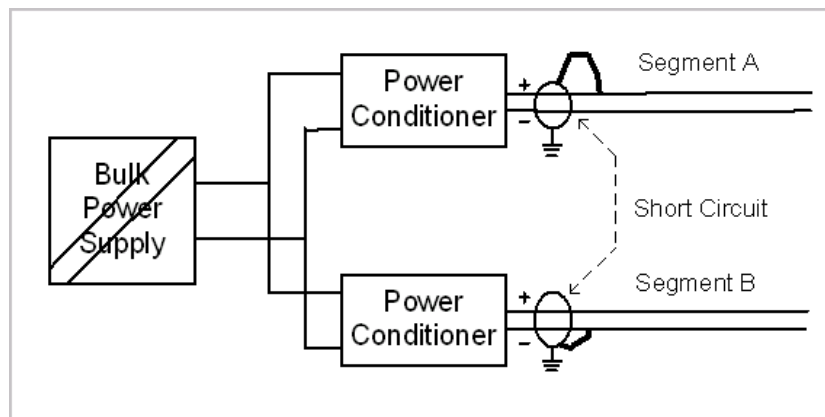


Figure 10.3: Common isolator and two power conditioners

Suppose segment A has its (+) wire shorted to the shield. This is not catastrophic. Segment A will continue to work with reduced noise immunity. Except for higher error rates on segment A, this condition may not be noticed. Now suppose that segment B's (-) wire is shorted to the shield. Now there is a short between the (+) wire of segment A and the (-) wire of segment B. This becomes a short circuit on both segments and disables both segments.

If galvanic isolation is used on each segment (isolated power conditioners), they are completely independent. There is no crosstalk and wiring errors or wiring deterioration on one segment does not affect the other.

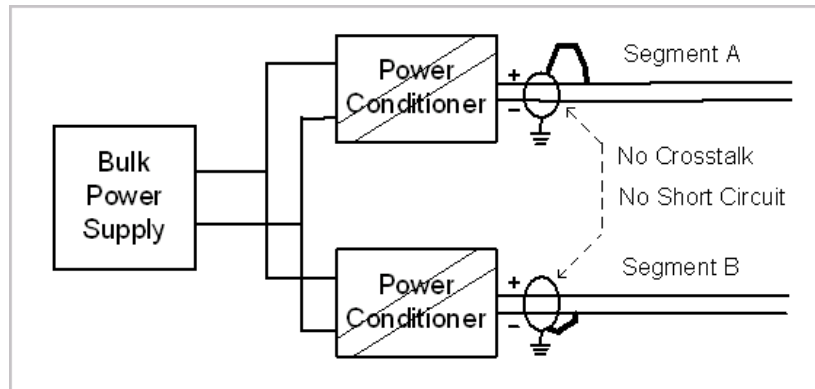


Figure 10.4: Individual isolation

In short, galvanic isolation in each power conditioner provides the required isolation from ground and provides complete segment independence. The result is that a control system that is more reliable and robust.

Summary

We have seen that there are several ways to reduce the reliability of the Foundation Fieldbus segment if isolation is not maintained. This is important enough that it requires attention during design, installation, commissioning, and while the plant is running.