Ground Loops in 4-20 mA Signals
Webinar Organizers

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Objectives & Takeaways

- Learn the basic definition a ground loop
- Gain a basic understanding of the potential detrimental effects of a ground loop in your 4-20 mA current loop
- Learn how to recognize ground loops and what steps you can take to avoid ground loops
Agenda

1. Definitions of a ground loop
2. System and signal problems caused by ground loops
3. Best practices to avoid ground loops
4. Real world examples
Getting to know you

- Where are you located?
- What is your industry?
- What is your level of expertise?
Definition of a Ground Loop
Basics of the Ground Loop

• A ground loop is the result of current flowing from one signal ground in a circuit to another signal ground at a different voltage potential.

• Resolving ground loops is often viewed as some kind of “black magic” or “art.”

• It is much easier to avoid ground loops during installation and project planning than to diagnose and resolve them in the field after installation.

• “Ground loops” are often blamed on issues related to shared signal return (-) pins on multiple input/output devices (PLCs, multi-channel controllers, etc). Though not a true ground loop, we will discuss this.
Ground Loop: Multipoint Ground System

- System is grounded in two locations
  - Often not the same ground
  - Often separated by distance
- Not always just in the 4-20 mA loop
  - Consider non-isolated RS-485 of signal wires
  - Consider non-isolated power/output input power grounds
- The ground potentials are NOT equal
- $R_{\text{GND}}$ caused by multiple factors
  - Noise
  - Resistance of ground path
  - Poor initial power rail installations
- Shielded single wires pick up noise
- Noise induces current on one part of the system caused by:
  - Stray magnetic fields
  - AC power 50/60 Hz noise from power supplies is very common
- Noise not filtered out by the transmitter
- Usually caused because improper pathing and lack of shielded pairs of wire to make installation easier
Shared Commons Ground Loop

- Occurs with multi-loop devices with common nodes for all return signals.
  - All input terminals are a single, non-isolated node.
  - Wiring technique will determine if ‘ground loops’ are present
- This is not a true ground loop, but the term is commonly used in this type of situation.
Problems Created by Ground Loops
What will ground loops do to my system and signals?

- Unpredictable 4-20 mA signal fluctuations
- Adds, detracts, or puts the signal out of range
- Shared commons will often average the process signal, causing errors to the system
- Physical damage to the components
Getting to know you

• What is your primary application?
Questions?

• Please enter your questions in the ‘Questions’ window
Best Practices to Avoid Ground Loops
How do I avoid ground loops before they happen?

- Always use a single point system ground and floating (non-grounded) devices when possible.
- Carry ground throughout the entire system on shielded cable, conduit, etc. Use twisted pairs in shielded cable.
- Isolate signals where possible and within budget, including devices with isolated I/O.
- Be aware of non-isolated multi-loop devices – take extra care in planning.
Real world example: Multiple Grounds in System

- Low cost displays fixed to a ground potential connection
- Multiple grounding points used
- Ground loop from ground 2 to ground 1 cause an influx of current into the sense circuitry of the meters
- Very susceptible to 50/60 Hz noise-like effects
- Meters will react unpredictably, be inaccurate, and potentially be damaged
- Solution: Use Single Point Grounding
Real world example: Non-isolated multi-input PLC

- Improper wiring causes signal averaging
- S1-, S2-, and S3- all one node, with different connection points
- Solution:
  - Use a PLC with isolated inputs
  - Wire through the transmitter first, then through the PLC
Summary

1. Two common definitions of a ground loop
2. System and signal problems caused by ground loops
3. Best practices to avoid ground loops
4. Real world example – before and after installing a 4-20 mA isolator
• How often do you specify digital displays?
• Please enter your questions in the ‘Questions’ window
• Apologies if we do not get to your question today. We’ll contact you offline with a response as soon as possible.
Hazardous area classifications

- This webinar is designed as a basic overview of the what, why and how about hazardous area classifications. The webinar will cover the following topics:
  - Definitions of common terms
  - Classification terms; Division, Area, Class
  - Review of marking and specification

Next Webinar – March 12
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