Precision Digital Presents

# Ground Loops in 4-20 mA Signals

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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

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# 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

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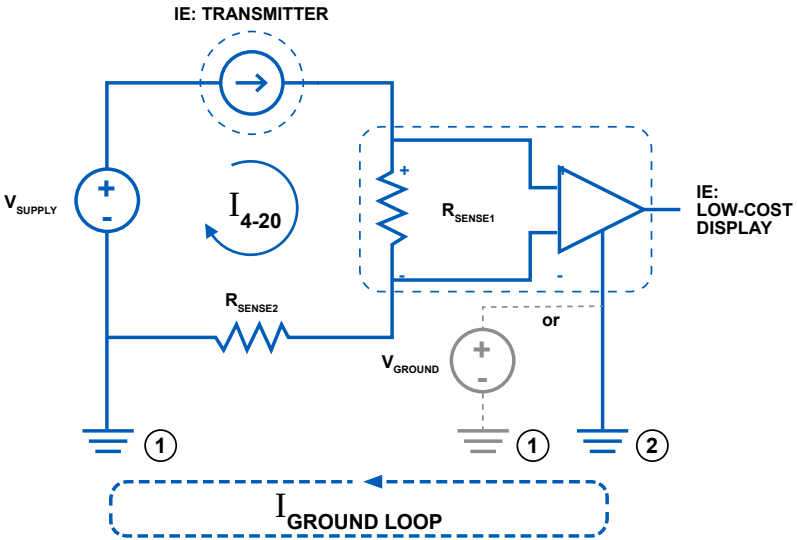
# Basics of the Ground Loop

- 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
- $R_{GND}$ caused by multiple factors
  - Noise
  - Resistance of ground path
  - Poor initial power rail installations



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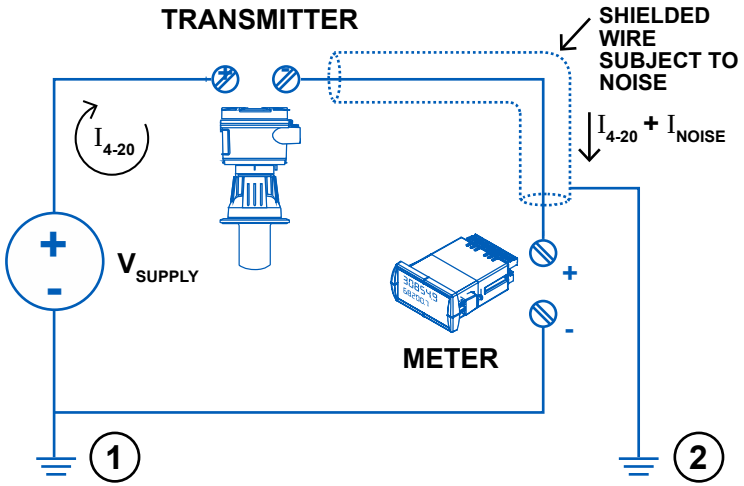
# Ground Loop: Ground-to-Signal Wire Current




- 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

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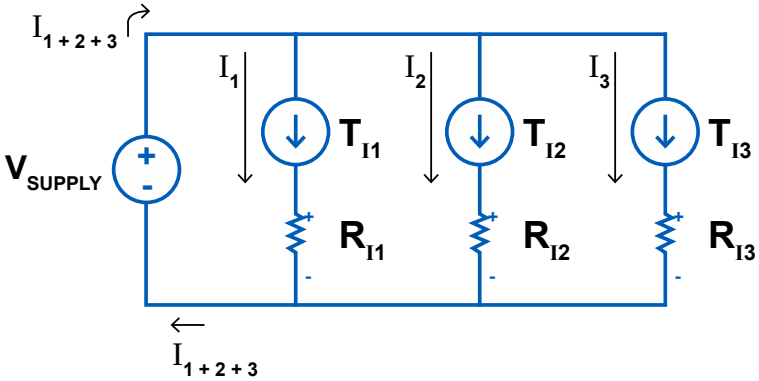
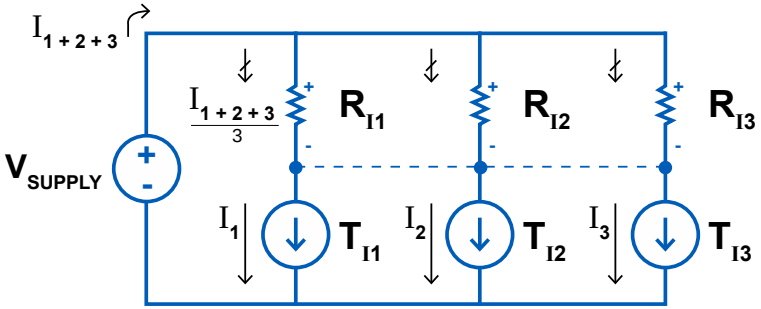
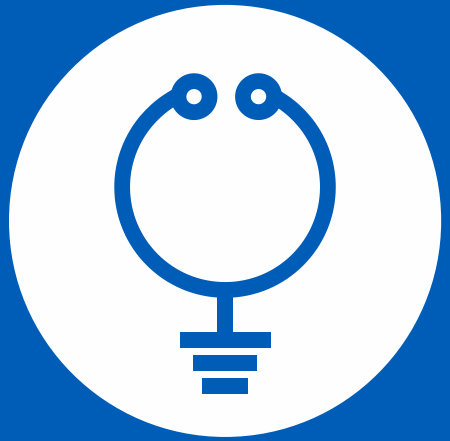
# Shared Commons Ground Loop




- 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

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# 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

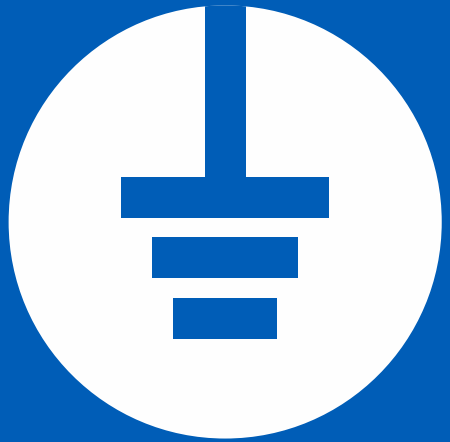
Physical damage to the components

# Getting to know you

- What is your primary application?

# Questions?

- Please enter your questions in the ‘Questions’ window



# Best Practices to Avoid Ground Loops

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# How do I avoid ground loops before they happen?

Always use a single point system ground and floating (non-grounded) devicies 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

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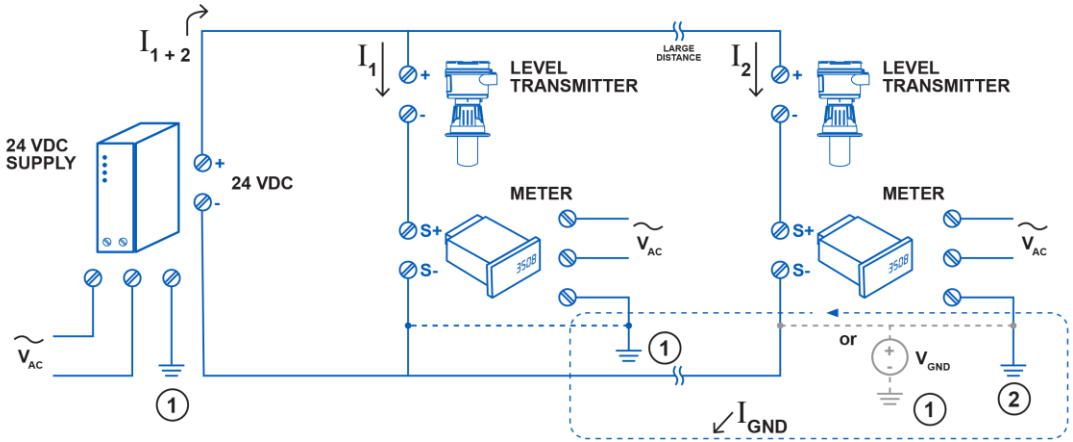
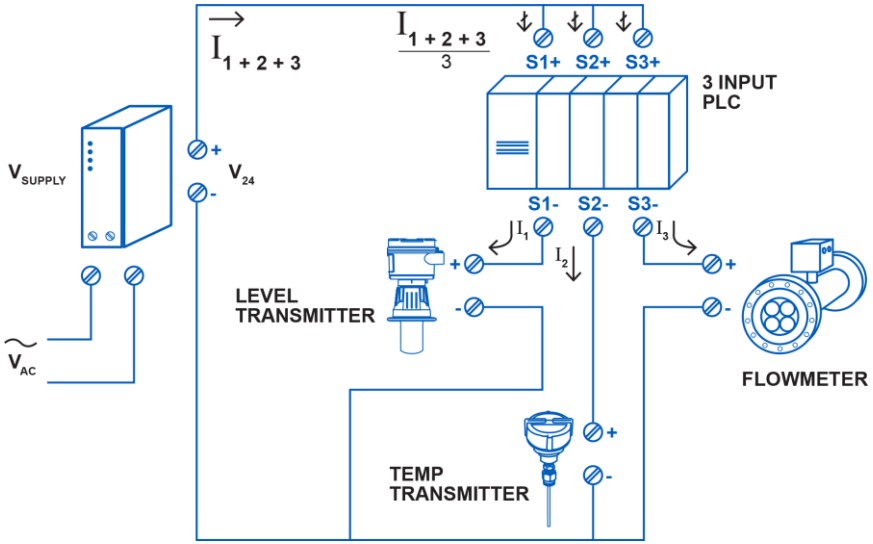
# Real world example: Multiple Grounds in System




- 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



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# 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

# Getting to know you

- How often do you specify digital displays?

# Q & A

- 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.

# Next Webinar – March 12

## 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

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