Decoupler Interaction with CP: Effects to Consider

Mike Tachick
Dairyland Electrical Industries

Appalachian Underground Corrosion Short Course

AGENDA

Decoupler interaction topics

- Capacitance effects on interrupted surveys
- Solutions for accurate readings
- Misapplication and bypasses
- Native measurements and leakage current effects
- Misunderstanding of CP testing with decouplers present

INTERRUPTED SURVEYS

Cathodic Protection

- Analyze per Criteria
- Considers IR Drop
- Reference Half-Cell

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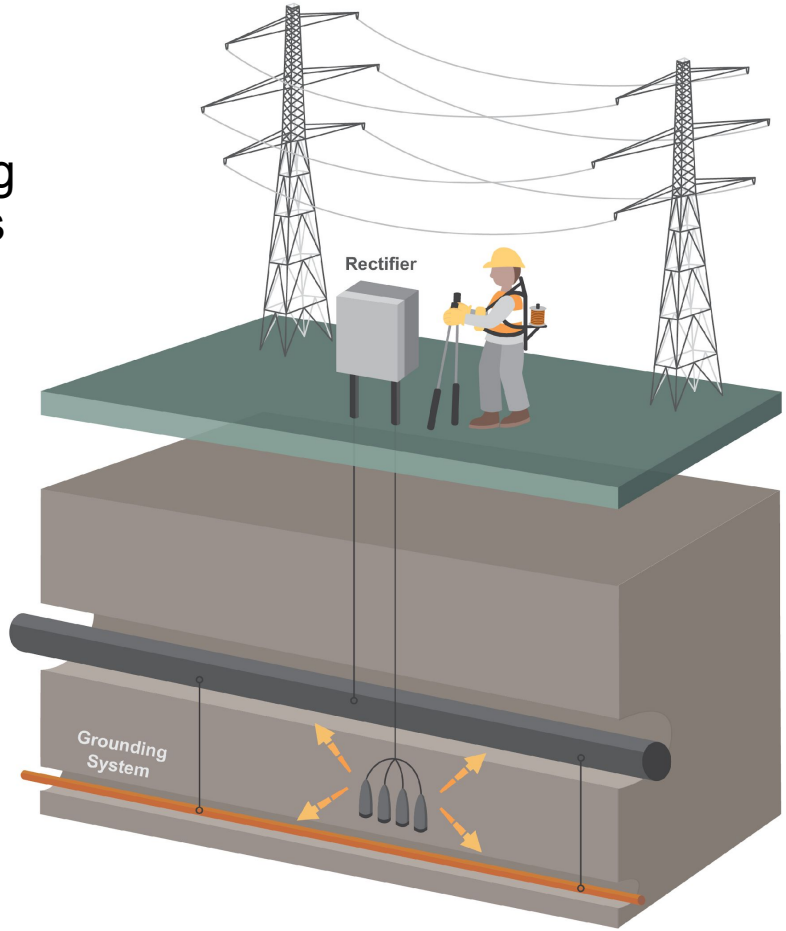
AC MITIGATION

No Decoupler

- Rectifier is protecting everything including AC mitigation grounds
- Inefficient CP



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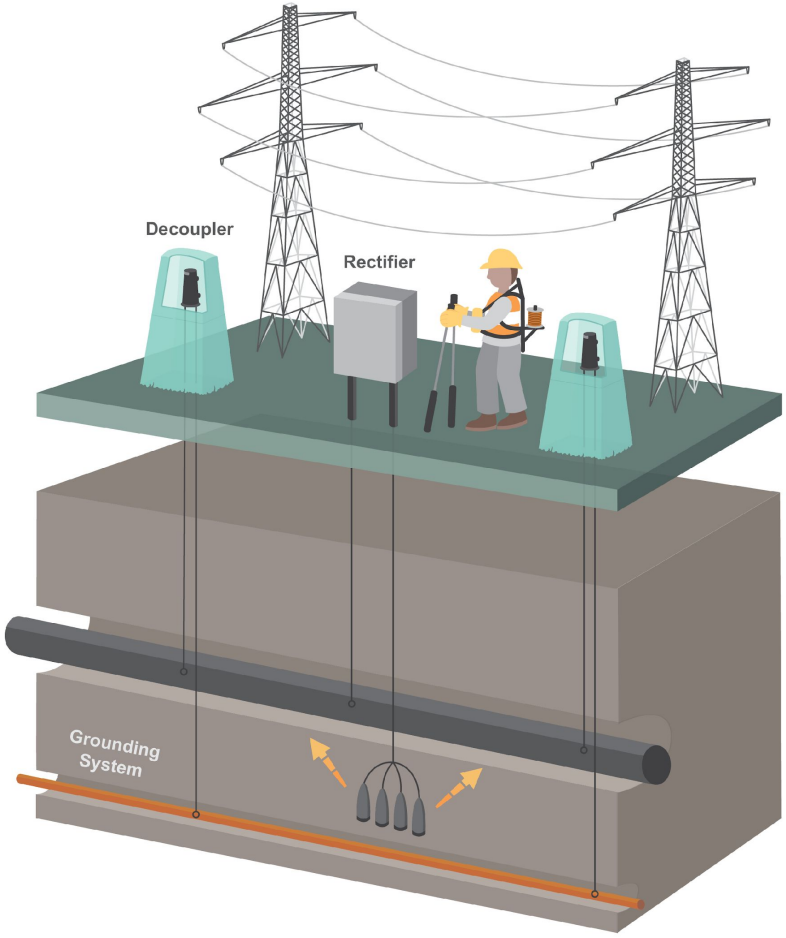
CAPACITANCE - TRADITIONAL SOLUTIONS

Decoupler

- CP isolation from ground
- AC continuity and grounding
- Capacitance introduced



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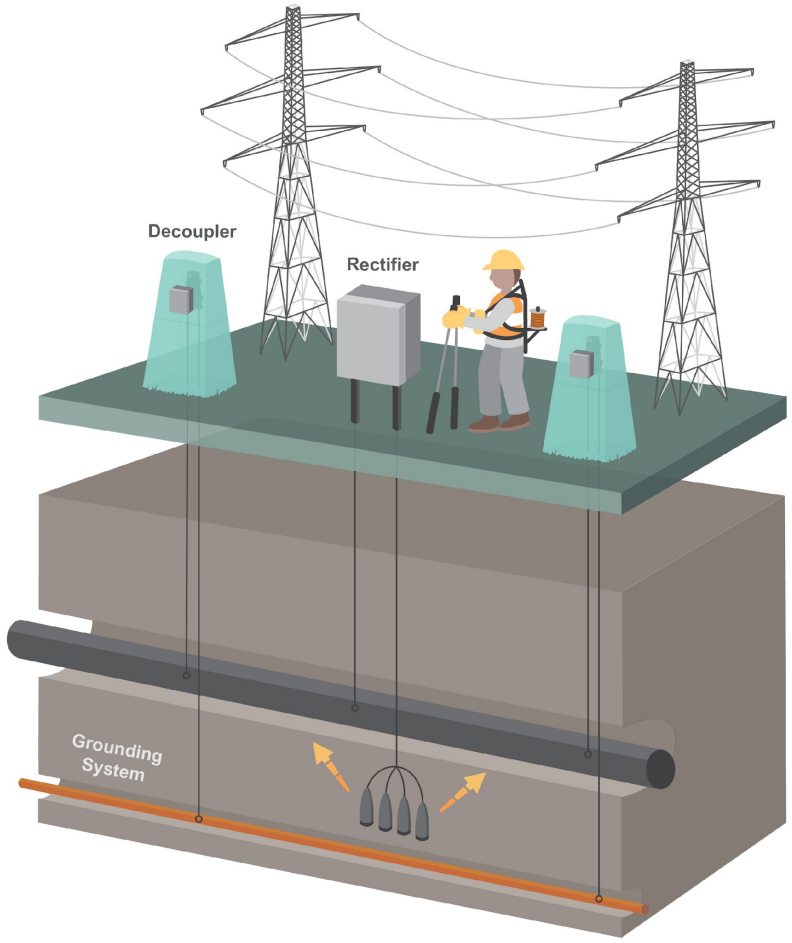
CAPACITANCE - TRADITIONAL SOLUTIONS

Decoupler + Isolation Switch

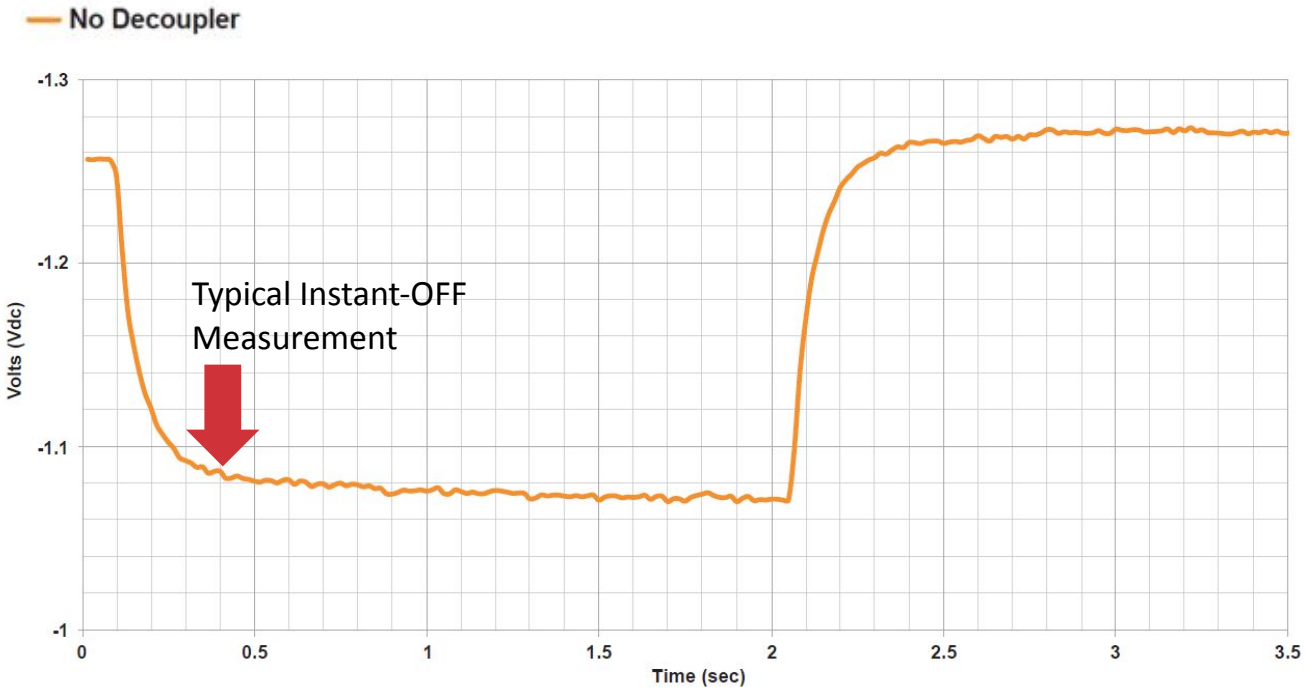
- Switch rated for AC fault and continuous current
- Decoupler disconnection for measurement

Alter cycle or timing

- Capture later in OFF cycle
- Extend OFF cycle



INTERRUPTED SURVEYS



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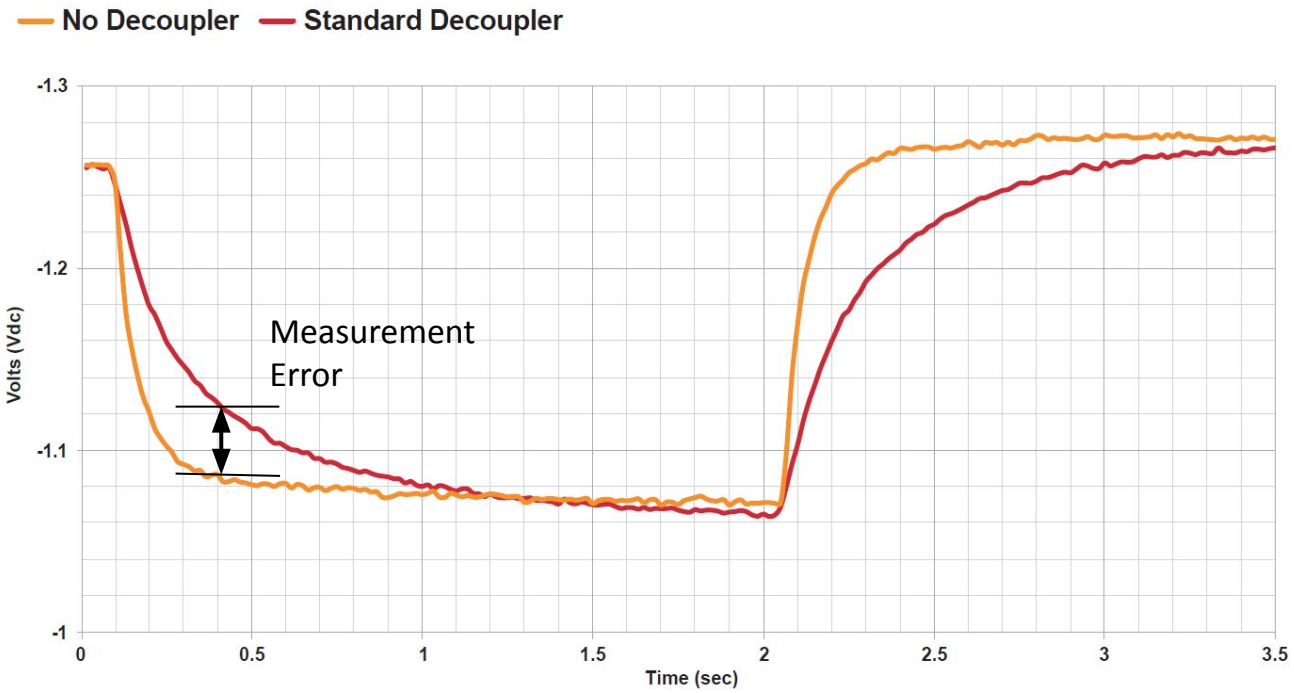
INFLUENCE OF DECOUPLERS



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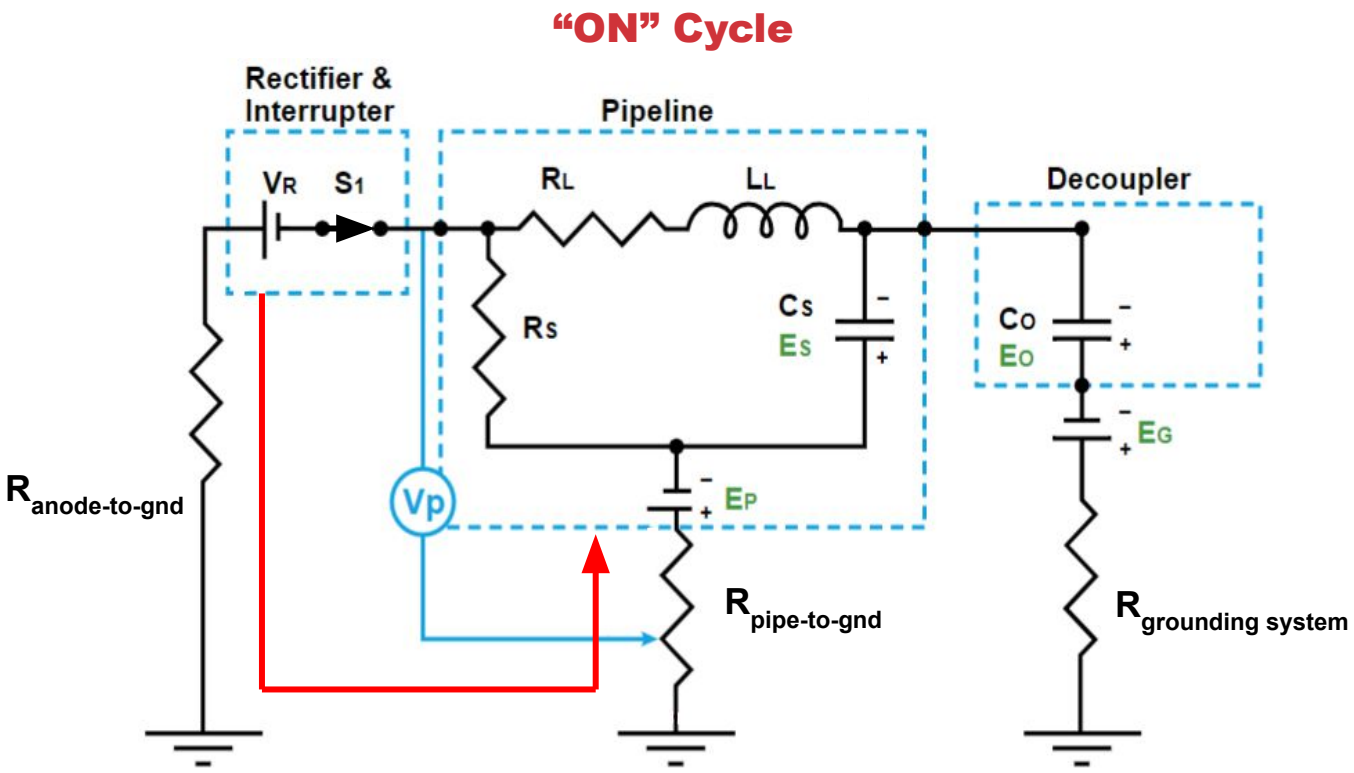
WHY DOES THIS OCCUR?



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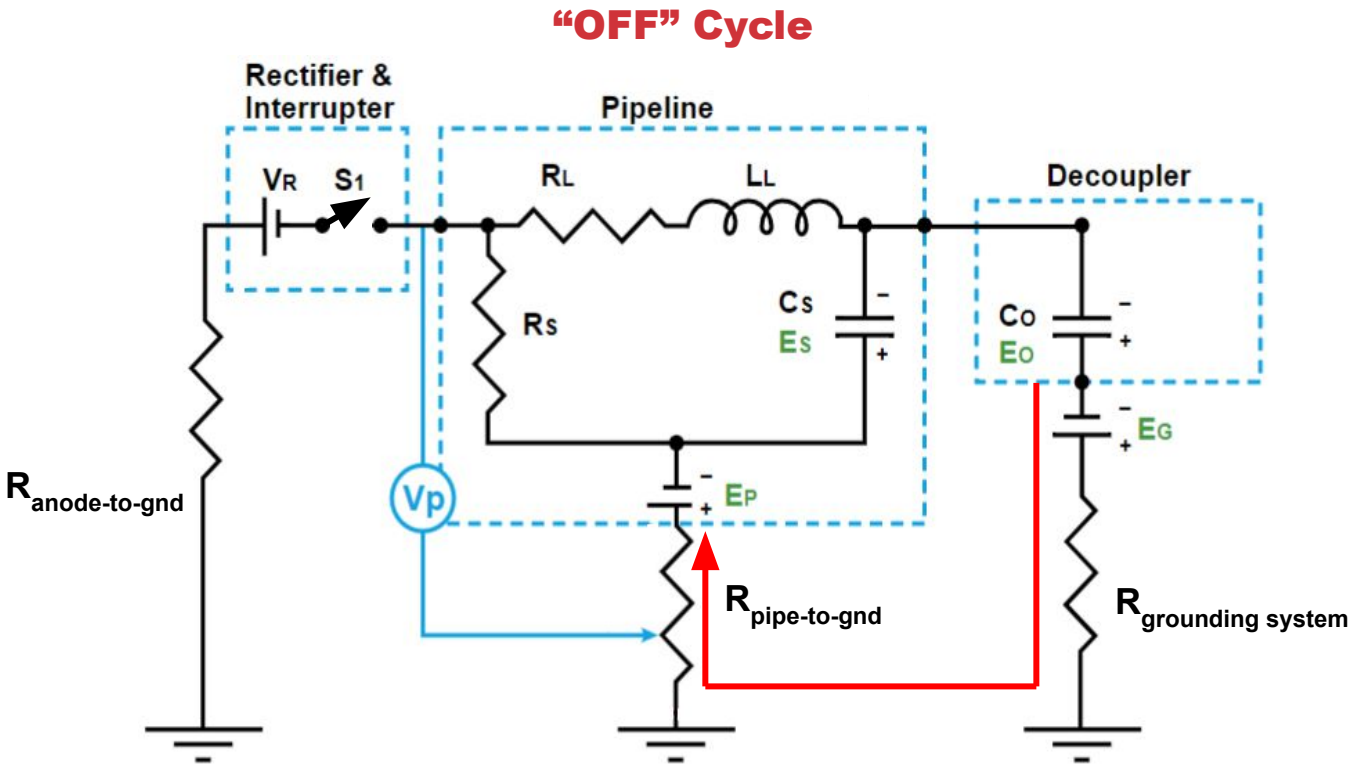

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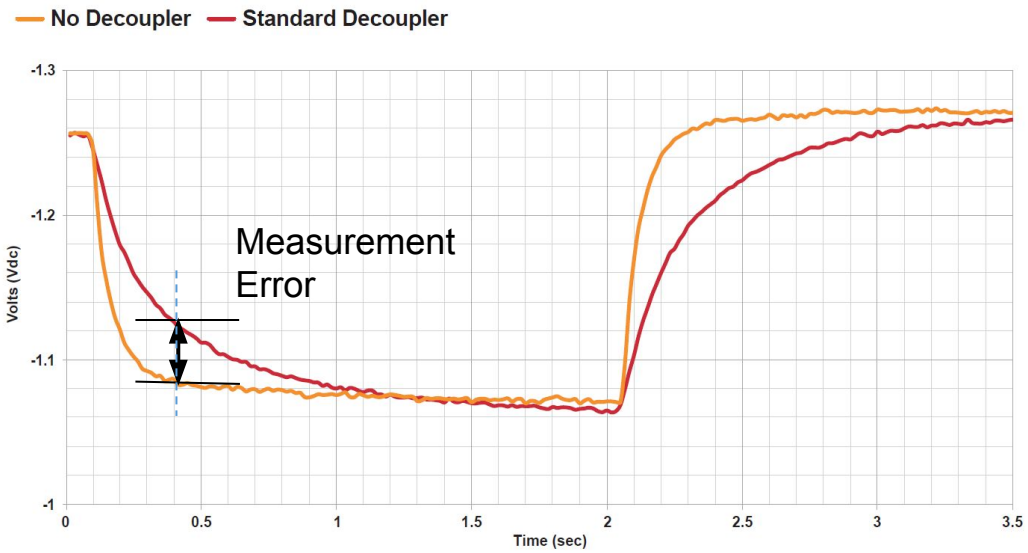
WHY DOES THIS OCCUR?

This effect is most likely observed with …

- High resistivity soils
- High resistance coatings
- Short, small diameter pipe – ie., less surface area
- Many decouplers on the same circuit



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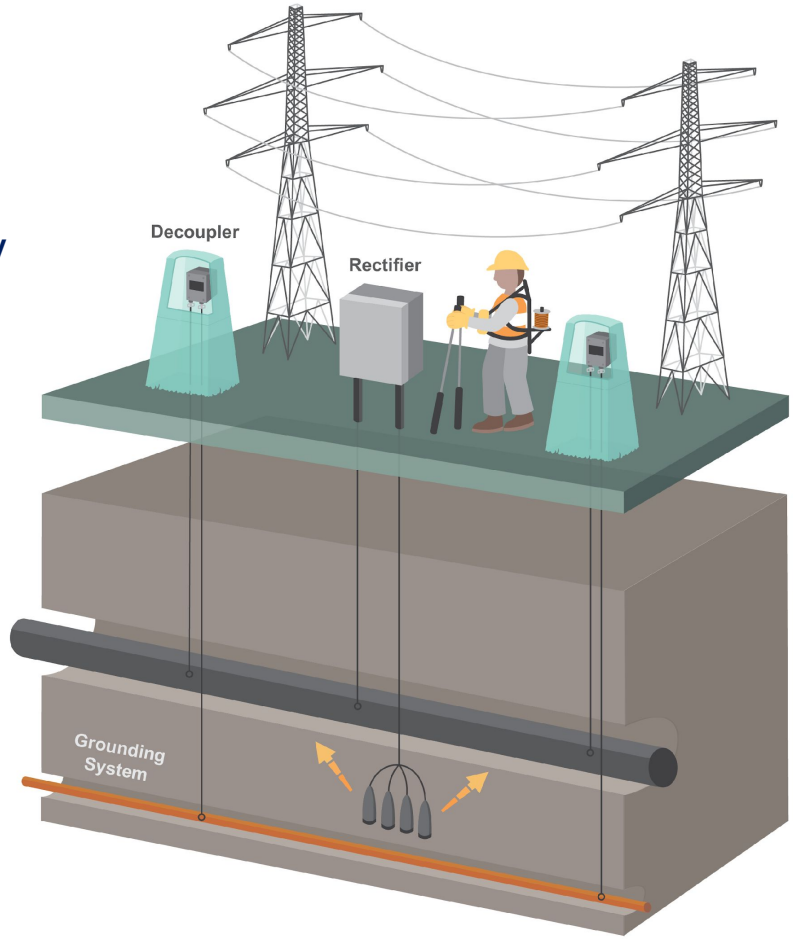
CAPACITANCE - NEW SOLUTION

Next Generation Decoupler

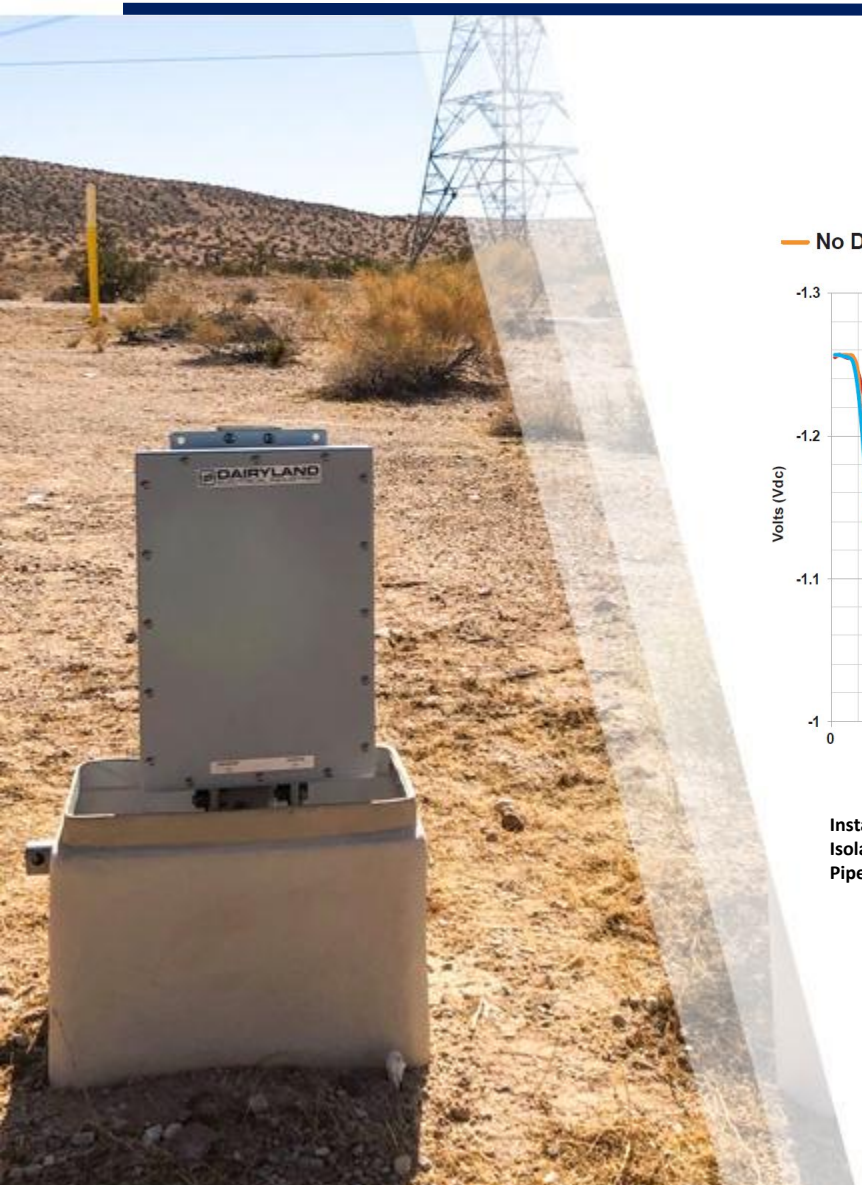
- Camouflages itself from survey
- No disconnecting or reconnecting
- Safety mechanism remains in place
- Faster surveys
- Capacitance is no longer an issue

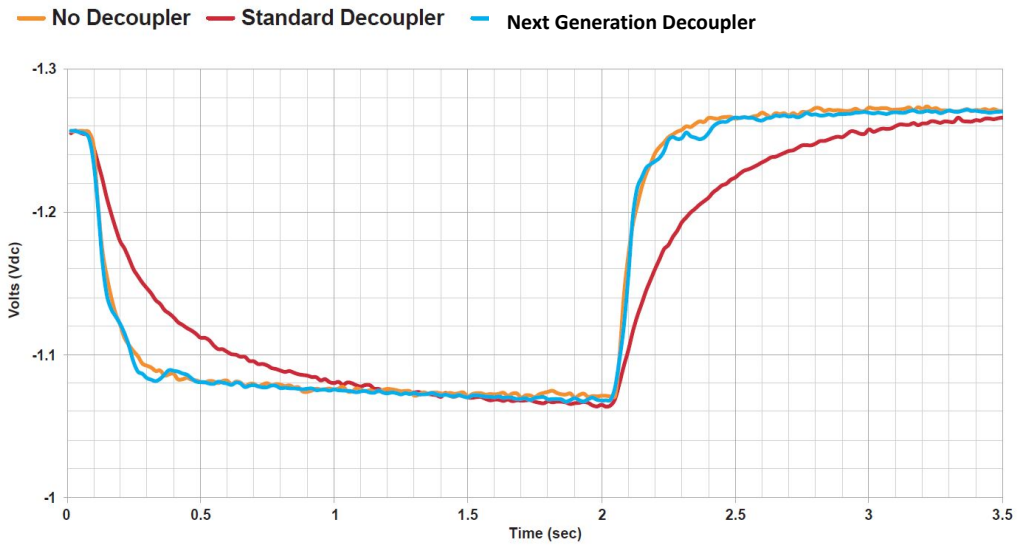


VALIDATION & FIELD TESTING

- AC fault testing
- Lightning impulse testing
- EMC testing
- Environmental testing
- Extensive field testing:
  - Several different pipelines
  - High & low soil resistivity
  - High resistance coatings
  - Units spaced close & far

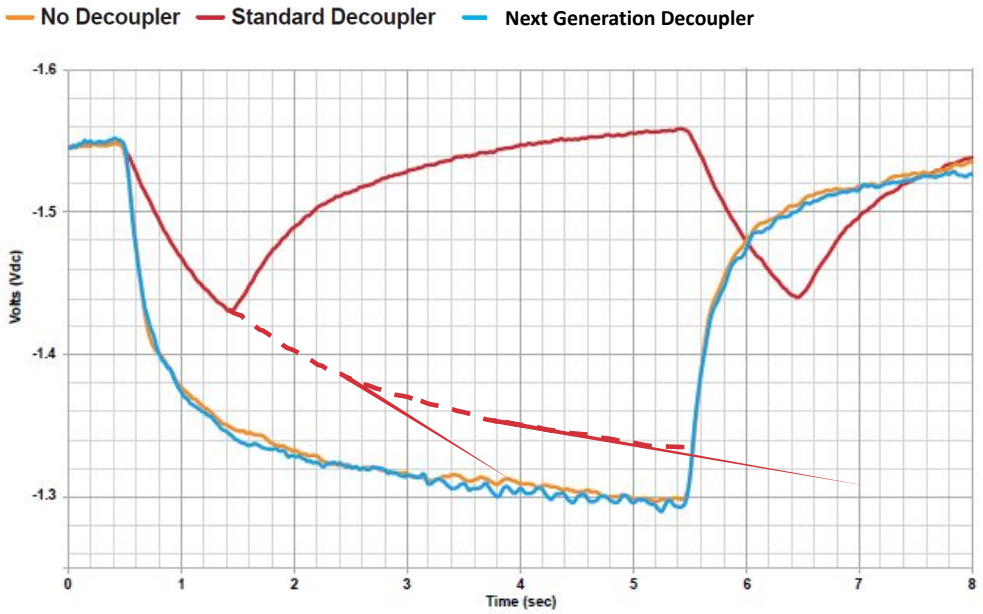
CASE STUDIES





Installation location: Western US **Length of pipeline segment: 3.2 miles**
Isolated 24" diameter pipeline **Soil conditions: Sandy/Dry**
Pipeline coating: FBE **No. of decouplers: 8**

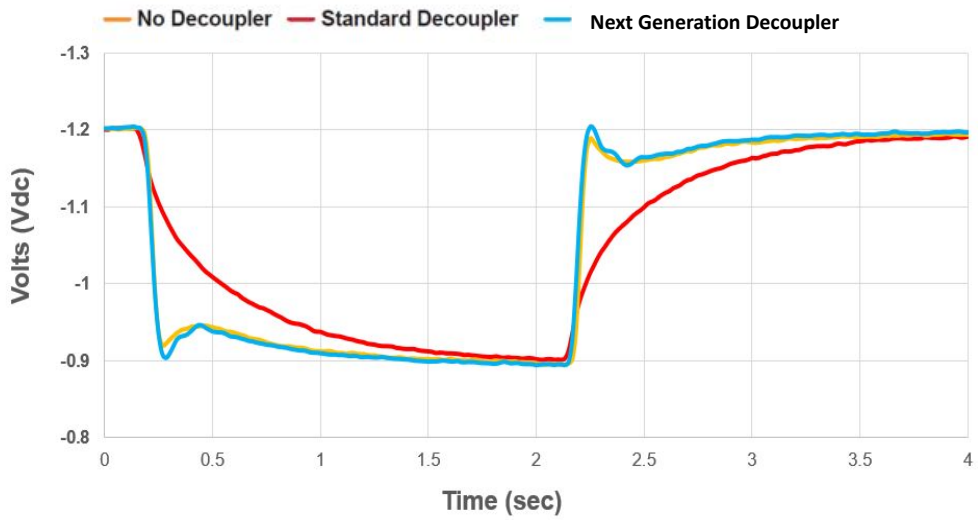
CASE STUDIES



Installation location: Midwestern US **Length of pipeline segment: 2 miles**
Pipeline Diameter: 6 in and 8 in **Soil conditions: Moist farm topsoil**
Pipeline coating: FBE **No. of decouplers: 8**

*** Non-isolated lateral segment**

CASE STUDIES

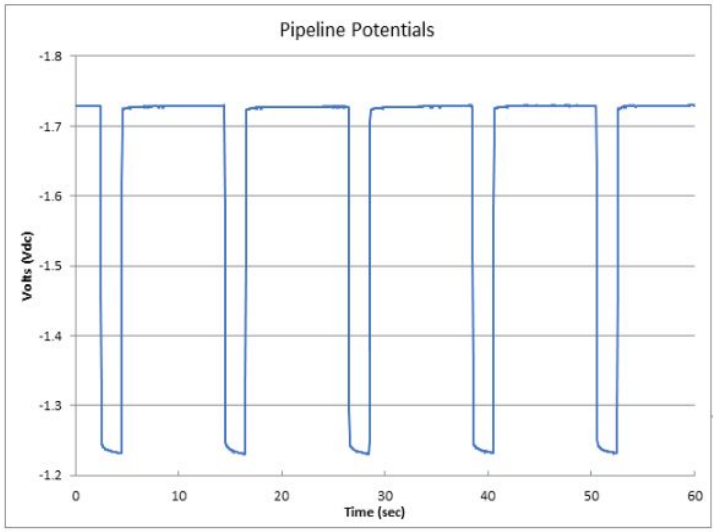


Installation location: Western US **Length of pipeline segments: 11 miles each**
Pipe Diameter: 36" (two pipes) **Soil conditions: Sandy/Dry**
Pipeline coating: FBE **No. of decouplers: 11 and 14**

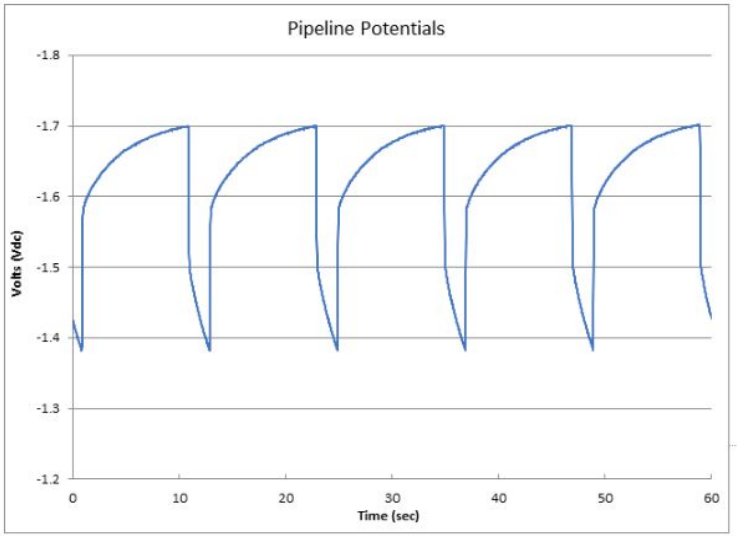
NEXT GENERATION DECOUPLER

Installations with traditional decouplers

Typical Acceptable Response



Typical Unacceptable Response



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NEXT GENERATION DECOUPLER

Benefits Summary

- More Accurate Potential Surveys
- Safer Surveys
- Faster/Lower-Cost Surveys

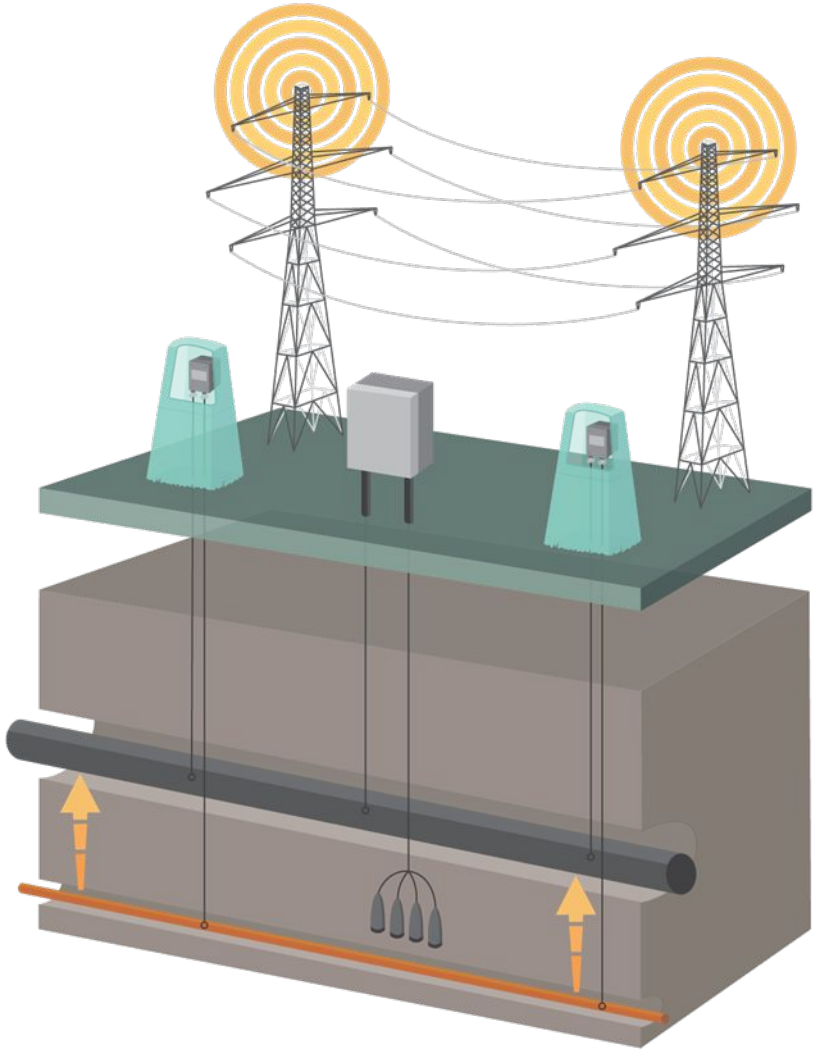
DECOUPLER BYPASS

CP Affected by Electrical Short

- Conduit
- Bonding/grounding wires
- Isolation joint gasket/washers
- Pipe supports
- Gas sampling lines
- …and many more

NATIVE MEASUREMENTS

Small decoupler leakage current may shift potentials



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CAPACITANCE - Testing

Required

- Installed Pipeline
- Installed Grounding System
- Interruptible CP System
- Data Collection Equipment
- Capacitor
  - Traditional Decoupler (SSD or PCR)
  - Capacitive Assessment Device (CAD)

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CAPACITANCE - Testing

CAD-270 -

- Low Cost Option
- Capacitance = PCR/SSD
- Evaluate Waveforms

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CAPACITANCE - Testing

CAD-270 - CAN

- Provide Steady State AC Mitigation with Low Impedance Path to Ground

CAD-270 CANNOT

- Protect against AC Faults or Lightning
- Be used in Hazardous Locations
- Be used Permanently

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CAPACITANCE - Testing

NOTICE

The CAD-270 has no polarity. Either terminal can be connected to the positive or negative connections.

PROTECTION.

The CAD-270 is intended for temporary test purposes only and must be removed from service upon completion of testing. In the event of an over-voltage condition, the CAD-270 will NOT provide protection for personnel or equipment.

user's safety guidelines.

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CAPACITANCE - Testing

System Pre-Evaluation

- All connections to ground
- Isolation joints
- Bonds
- Current Sources
- Groundbed Locations
- Telluric
- Stray Current

CAPACITANCE - Testing

Considerations:

- Utilize CAD-270 at **ALL** planned decoupler locations
- Isolated Pipe Segment
- Track each location separately
- Set a long OFF cycle (4 seconds or more)

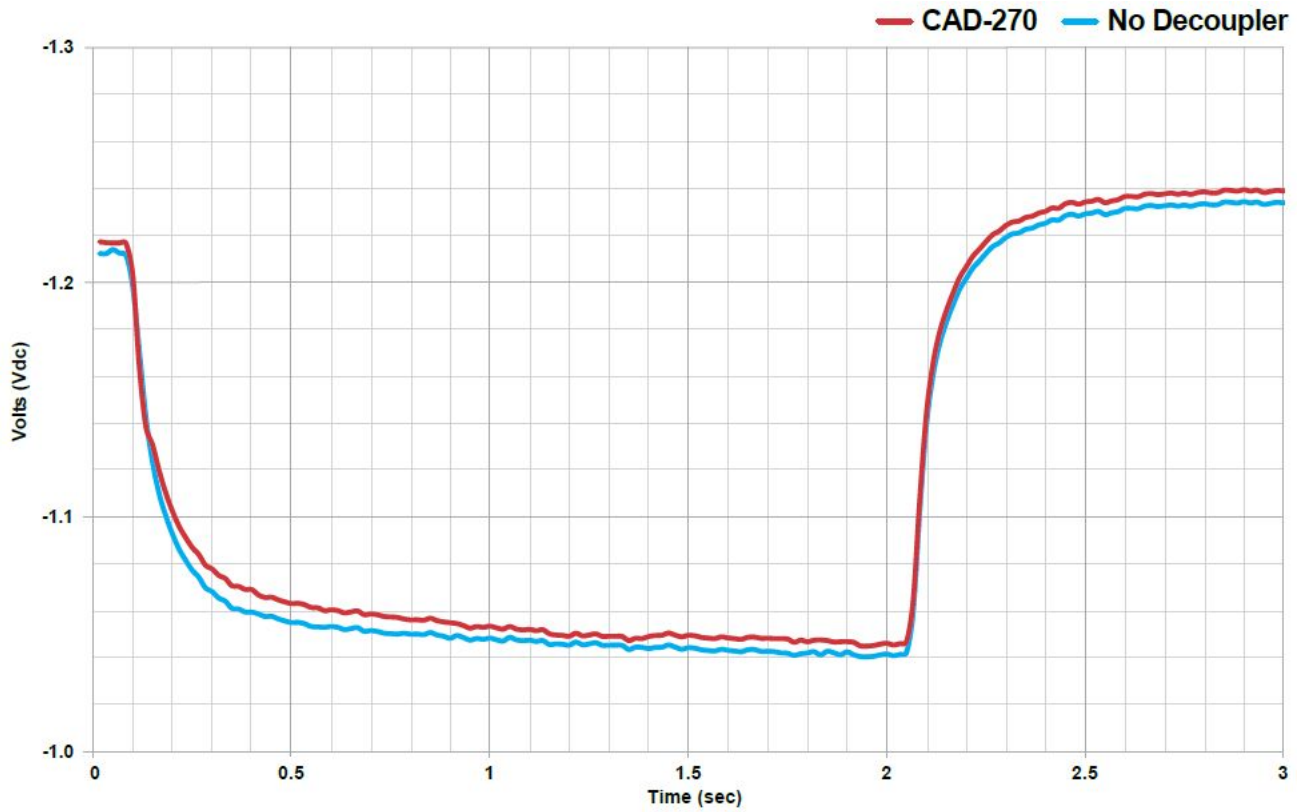
CAPACITANCE - Testing

Procedure:

- Capture waveforms with NO Decouplers Present
  - Analyze for unknown capacitance influence and address
- Capture waveforms at multiple locations along pipe segment
- Install CAD-270 at all locations
- Capture waveforms at same locations along pipe segment
- Analyze waveforms
  - Increase OFF cycle if polarized potential does not flatten out

CAPACITANCE - Testing

Standard Decouplers Acceptable



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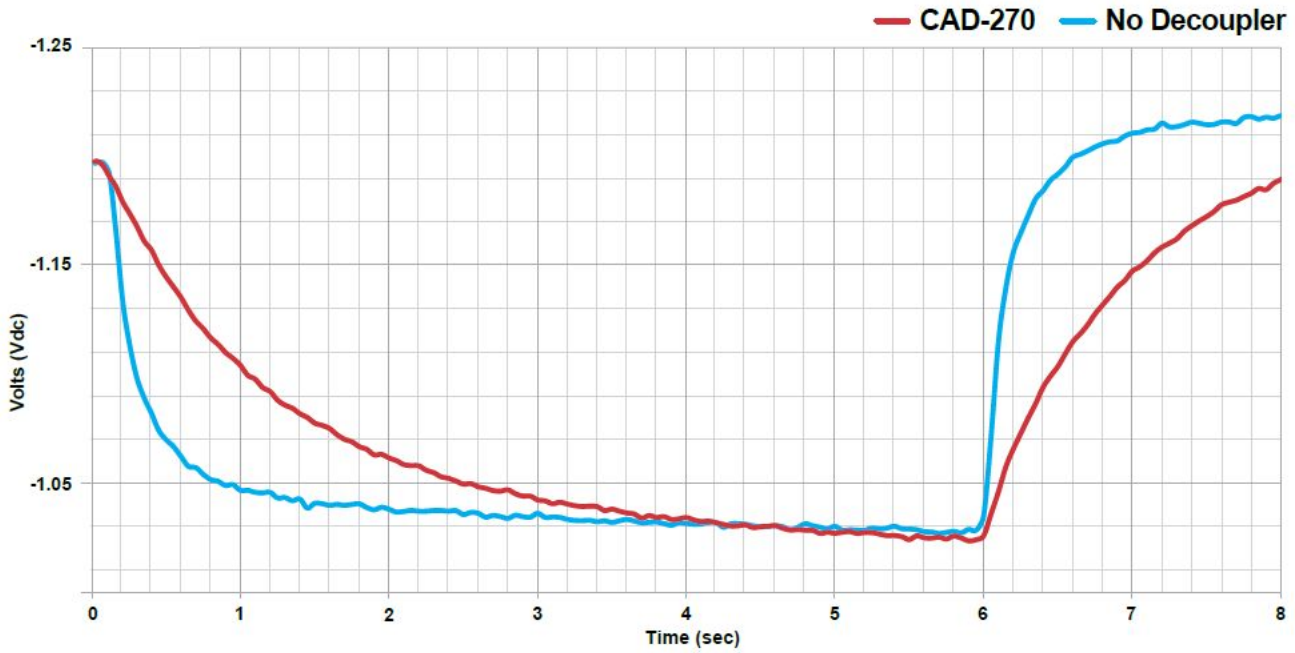
CAPACITANCE - Testing

PCRX Recommended



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CAPACITANCE - Testing

Summary:

- Identify sources of capacitance
- Analyze waveforms
  - With NO decouplers
  - With Decouplers OR CAD-270
- Determine best solution for accurate readings
  - Standard Decouplers (if no capacitance effect)
  - Delayed OFF Reading
  - Isolate Standard Decouplers
  - New Generation Decouplers (PCRX)

FIELD TESTING

Isolation Joint Testing with an RF-IT:

- A decoupler will appear as a short to RF-IT testers
- Test the joint and decoupler separately
- Disconnect the decoupler from the joint, then test the decoupler with the ohm test
- Test the isolation joint using an RF-IT with the decoupler disconnected

Image courtesy of Tinker & Rasor

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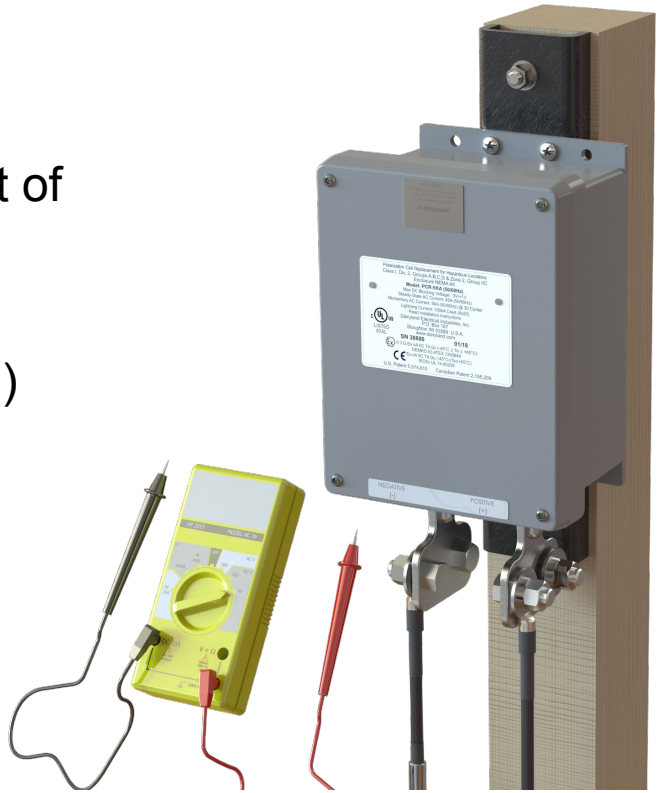
DIRECT DECOUPLER TEST

Resistance check

- Measured between terminals, device out of circuit
- Functional: Value increases from zero
- Non-functional: Fixed, low value (<< 1 Ω)



Keep safety in mind when creating an open-circuit at a decoupler site!

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QUESTIONS?
CONTACT DAIRYLAND

techsupport@dairyland.com

www.dairyland.com

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