DC Power Discovery Algorithm

IEEE P802.3af DTE Power via MDI
Task Force Presentation

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Device Interaction and Safety
Objectives 2, 3, and 10

- Foreseeable Misuse
  - No hazard or damage when connected to other devices with RJ-45 interfaces
  - No hazard or damage when connected to non-Ethernet wiring plans that may include other parallel connections

- Interaction with other RJ-45 devices
  - No damage to devices not intended to be powered
  - Devices may be parallel connected
  - Parallel connected devices may be electrically invisible at some test voltages

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Discovery Requirements

- **Mandatory (Objectives 2 and 3)**
  - Power only devices that are intended to be powered!
  - Devices that should be powered must have well defined signatures
  - Power and Discovery must be on the same pairs

- **Are Important (Objective 10)**
  - Discovery should detect parallel connected devices
  - Parallel connected devices have varying input characteristics

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Implementation Considerations

(Objective 1)

- **Compatible with existing hubs, switches and routers**
  - If existing equipment cannot be used to support new terminals the economic viability is reduced

- **No change to existing device drivers or other firmware**
  - Requiring new drivers would effectively obsolete a lot of existing equipment and reduce the economic viability of a solution

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Implementation Considerations

(Objectives 1 and 2)

- **Isolation Barrier**
  - Control signals crossing the isolation barrier add to complexity and cost
  - Keep discovery and power control on the same side of the isolation barrier

- **Software Controlled Safety?**
  - If power control is considered a safety or liability issue should it be firmware or software controlled?
  - Many systems do use software control as part of the safety implementation but world wide safety approvals may be more complex and costly

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Implementation Considerations

- Practical Design Considerations
  - A low cost single chip solution is desirable. To do this, the discovery mechanism and power control should be integrated in the same low pin count device.
  - It is desirable for discovery mechanism and power control to be on the same side of the isolation barrier
  - For low power applications SELV supply voltages are best. The highest usable voltage (56±4 volts) will provide the best efficiency.

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Safety Considerations

- SELV Circuits

  - An SELV rating reduces the requirements for separation of the user from the circuit. It does not mean that there are no safety requirements for the powered or powering devices.

  - The SELV voltage limit of 60 volts is accepted in most countries. Existing network cabling infrastructures are designed to support higher voltages so non-SELV approvals can be used in the exception countries.

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DC Discovery Algorithm

- One Algorithm supports:
  - Unique signature for powered devices
  - Detection of most parallel devices
  - Discovery on 2 and/or 4 pair power delivery systems
  - More than one power category can be supported
  - Mid-Span insertion via simple power module
  - Discovery and control can be implemented without changes to device drivers or other firmware
  - Low voltage, low current discovery signal won't damage Bob Smith or other terminations

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DC Discovery Implementation

- **Power Consuming Device**
  - Power sink includes a "Discovery Sink"
  - The Discovery Sink is an integral signature that is part of the device power control

- **Power Sourcing Device**
  - Power supply includes a "Discovery Source"
  - The Discovery source is an integral part of the power supply

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Discovery Sink Operation

- Device signature is based on a constant current sink

    - During Discovery, the device to be powered presents a defined constant current (eg 2±0.3 mA) load to the variable output voltage of the discovering power source

    - When the the operating voltage threshold is reached the sink switches to supply mode to power the load

    - If the source current is interrupted (defined current level and time) the Discovery Sink reverts to discovery mode

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Discovery Source Operation

- Signature detection is based on a current limited (under 3 mA) variable output voltage.
  - The sourcing device must see the defined constant load current as the discovery voltage increases from 3 volts to 80% of the maximum output
  - At the operating voltage minus 10% the source switches to power mode
  - Detection of parallel devices is effective from 0 volts to the maximum operating voltage
  - During discovery, a short circuit, open circuits or any parallel devices that affect the DC characteristic, will cause the process to abort and restart
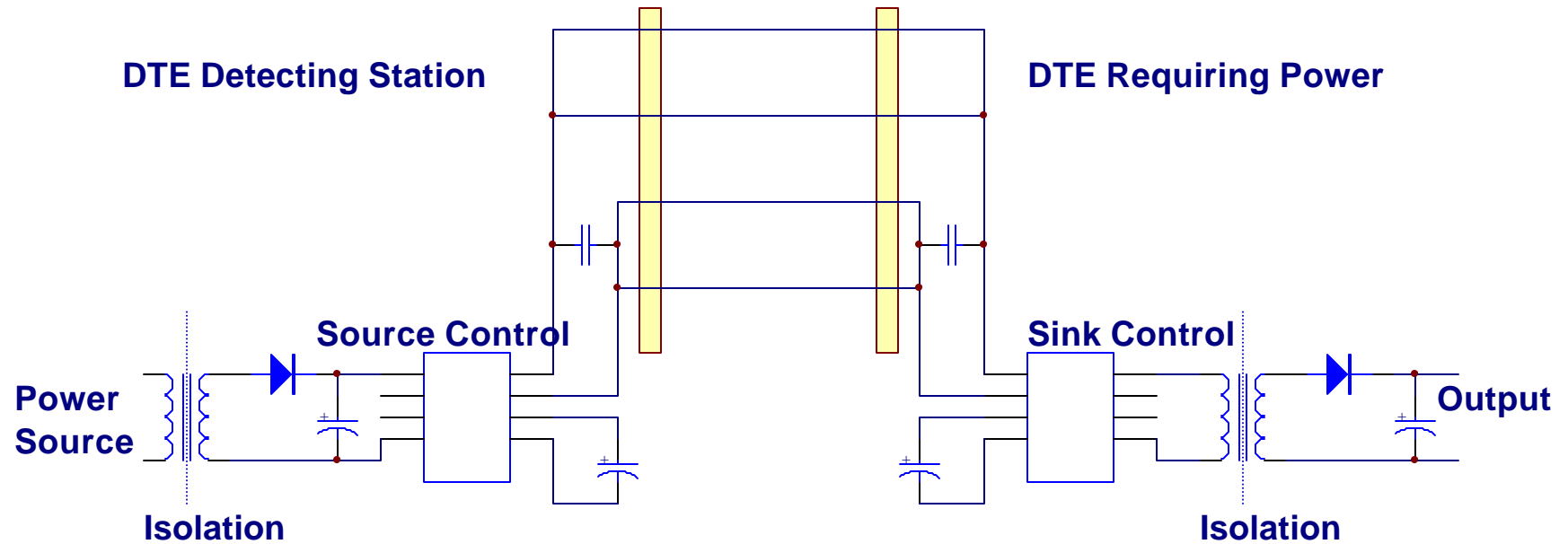
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Interaction with Other Devices

- **Accepted Devices**
  - Only devices that present the correct signature!

- **Rejected Conditions**
  - Open Circuit
  - Short Circuit
  - Source - Source Connection

- **Rejected Devices**
  - Parallel Resistance less than 50K ohms

- Inductors
- Surge protectors (Low Voltage)
- Transformers
- Active devices that draw more than 0.3 mA during discovery
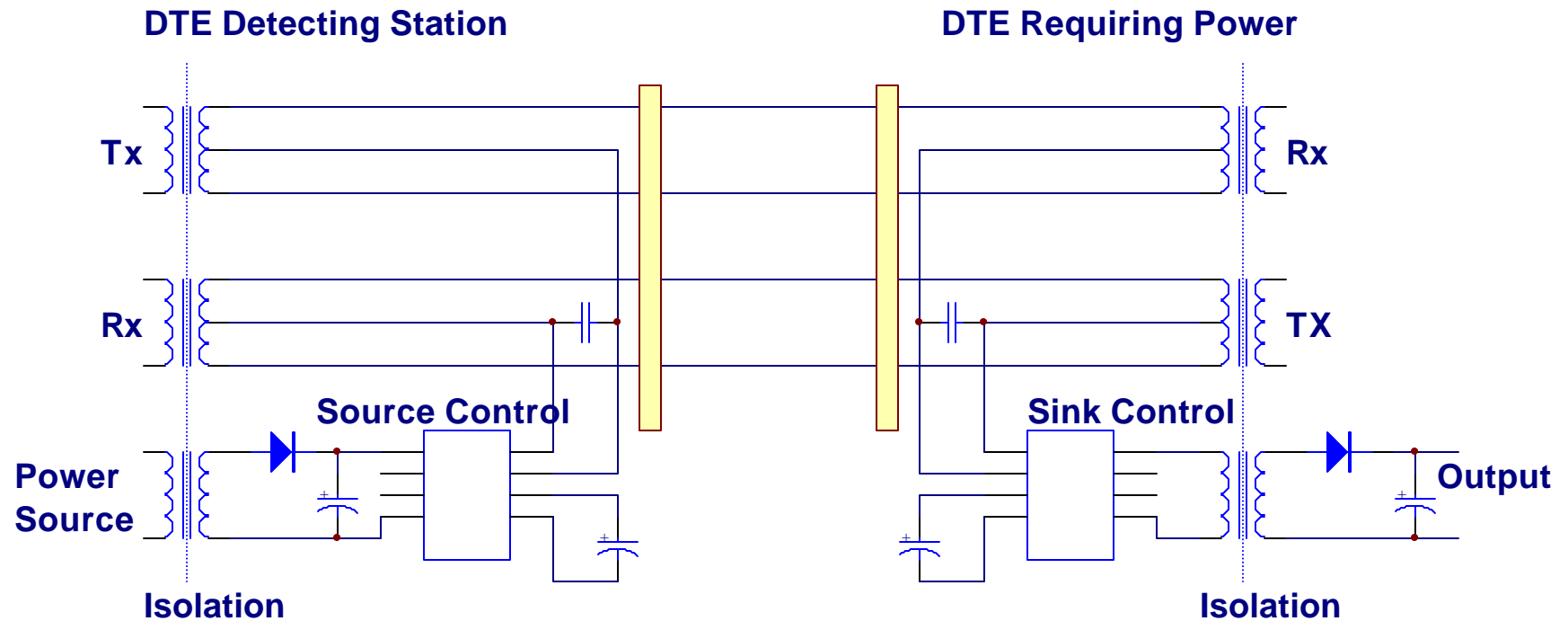- Other power sources

Note:

Rejected devices may be connected in parallel with a device that presents a valid signature and will still be rejected.

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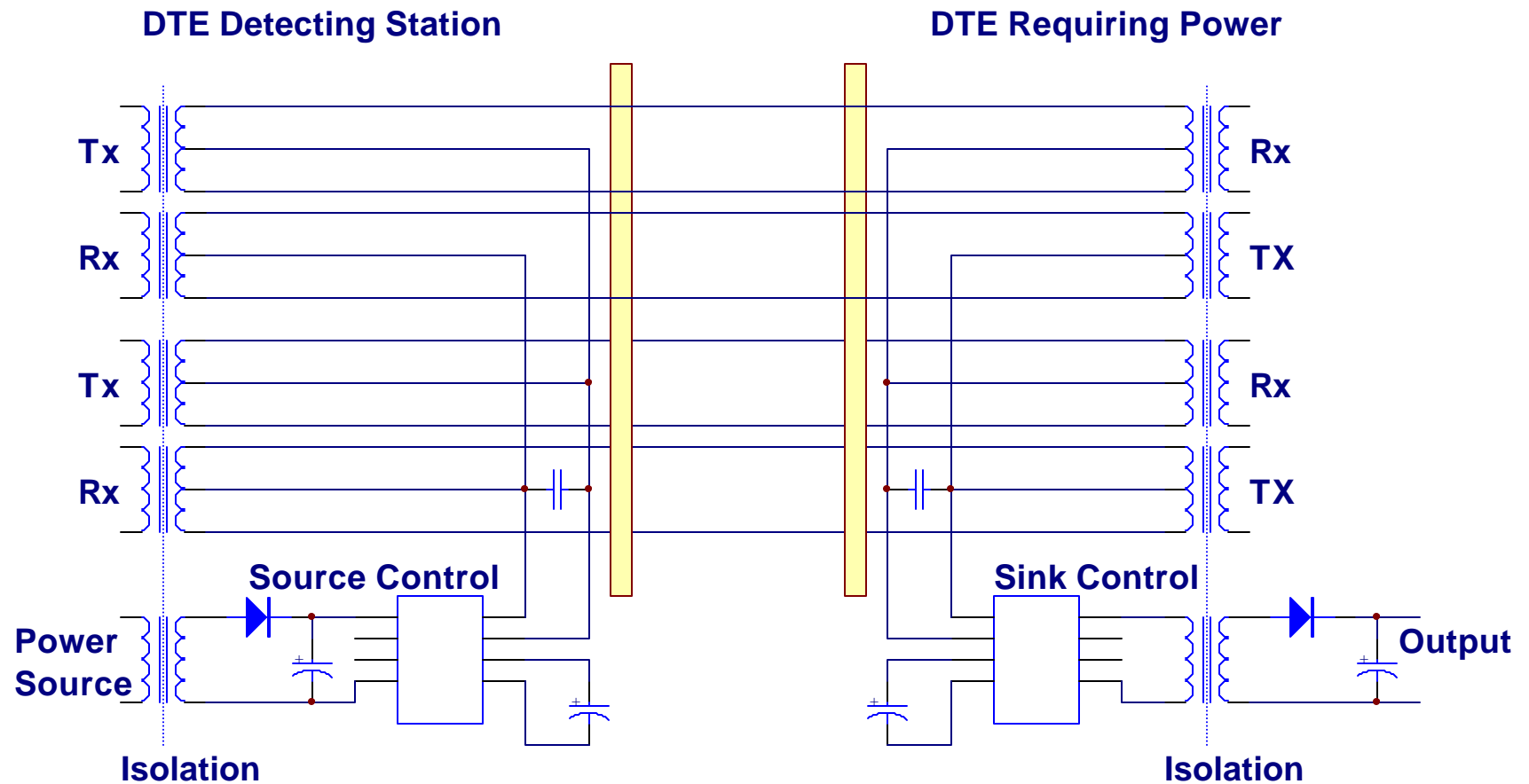# Unused Pairs or Mid-Span Insertion

DTE Detecting Station

DTE Requiring Power

Source Control

Sink Control

Power Source

Output

Isolation

Isolation

Note
AC terminations not shown
but may be required.

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Two Pair Power Configuration

DTE Detecting Station

DTE Requiring Power

Tx

Rx

Rx

TX

Source Control

Sink Control

Power Source

Output

Isolation

Isolation

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Four Pair Power Configuration

DTE Detecting Station

DTE Requiring Power

Tx

Rx

Rx

TX

Tx

Rx

Rx

TX

Source Control

Sink Control

Power Source

Output

Isolation

Isolation

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Future Options

- DC discovery can be used on 2 and 4 pair phantom power implementations.

  - Two pair can be used today and will remain compatible with 4 pair implementations if they are used in the future.

  - Different power categories can be supported buy using different discovery current signatures. The first implementation could be limited a few watts. The same DC discovery mechanism can be used for higher power implementations that may be required in the future.

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Summary

- DC Discovery provides a simple and reliable means of determining if power can be safely applied to a network connection and the combination of devices that may be connected to it.

- DC Discovery provides a simple, low cost solution today while providing a defined migration path to higher power implementations that may be required in the future.

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END

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