DTE Power via MDI

PD - Power Switch & DC/DC Converter
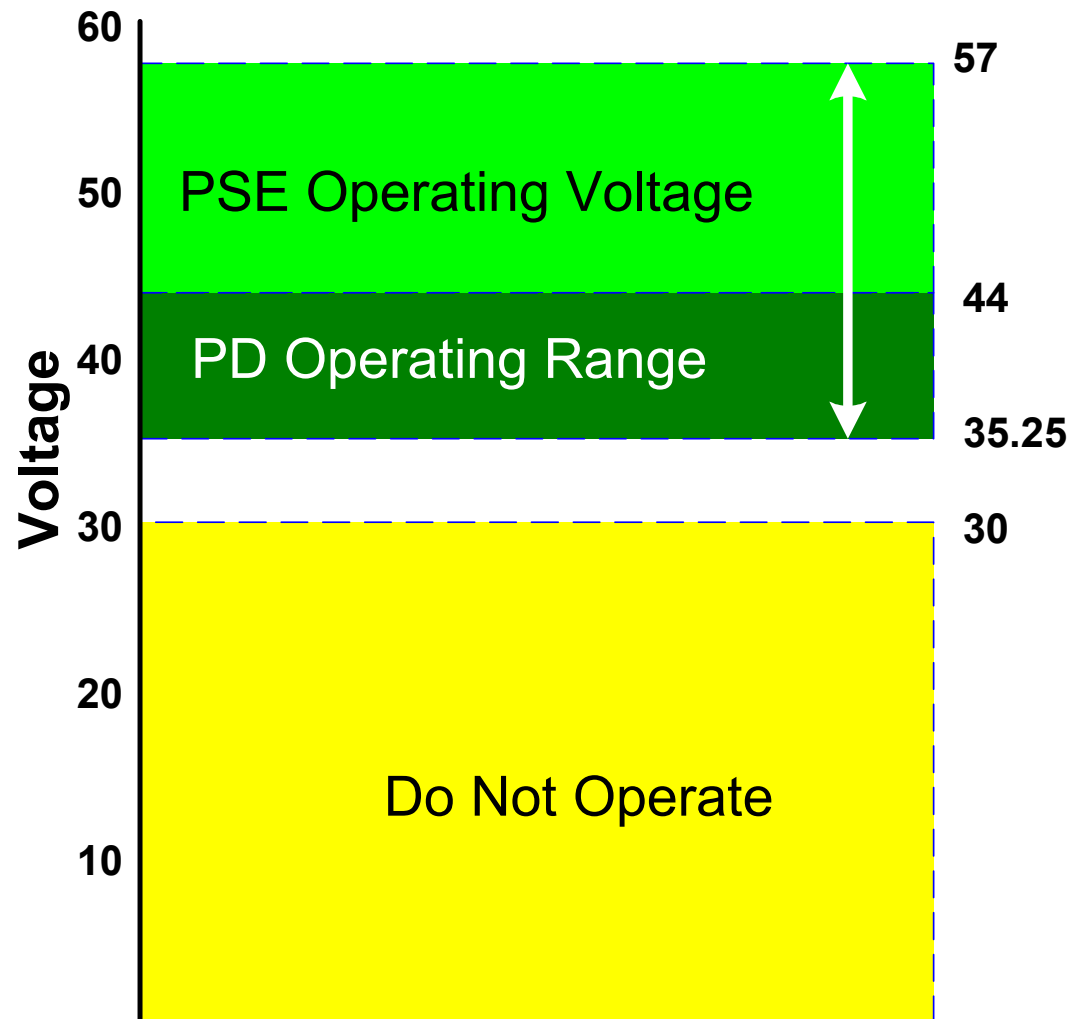## PSE - Integrated Detection, Power Switch & Power Control

January 2001

TEXAS INSTRUMENTS

Powered Devices Considerations

- Input Voltage Range of PD DC/DC Converter (PDDC)

- Maximum Power Delivery

- DC/DC Converter Disconnect

- Overload Protection

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PDDC Voltage Requirements

PSE Operating Voltage 44 -57vdc

PDDC must *start* by 44 vdc

$$350\text{ma} * 25\Omega = 8.75\text{v}$$

Remain on to <35.25 vdc

And *remain disconnected* below 30vdc

Note:
a) 1.5ma max. current requirement only allows 388uA for IC control
b) PD DC/DC Converter (PDDC)

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PDDC Power Limitations

- >35 Volts is available at the connector

$$P1 = 35v * 350ma = 12.2watts$$

- A single Schottky blocking diode drops 0.75 volts

$$P2 = 34.25v * 350ma \cong 12watts$$

- Efficiency will range from 75% to 90%, depending on DC/DC converter output voltage(s)

$$P3 = .75 * 12watts = 9.0watts$$

$$P4 = .9 * 12watts = 10.8watts$$

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PD Considerations

- The input capacitance of the PDDC is significant

    - Hundreds of uF for a 9 to 11 watt DC/DC converter

- Detection requires low capacitance

- A switch is needed to disconnect the DC/DC converter from the source

Voltage Detection

DC/DC Converter

Detection R

Vout

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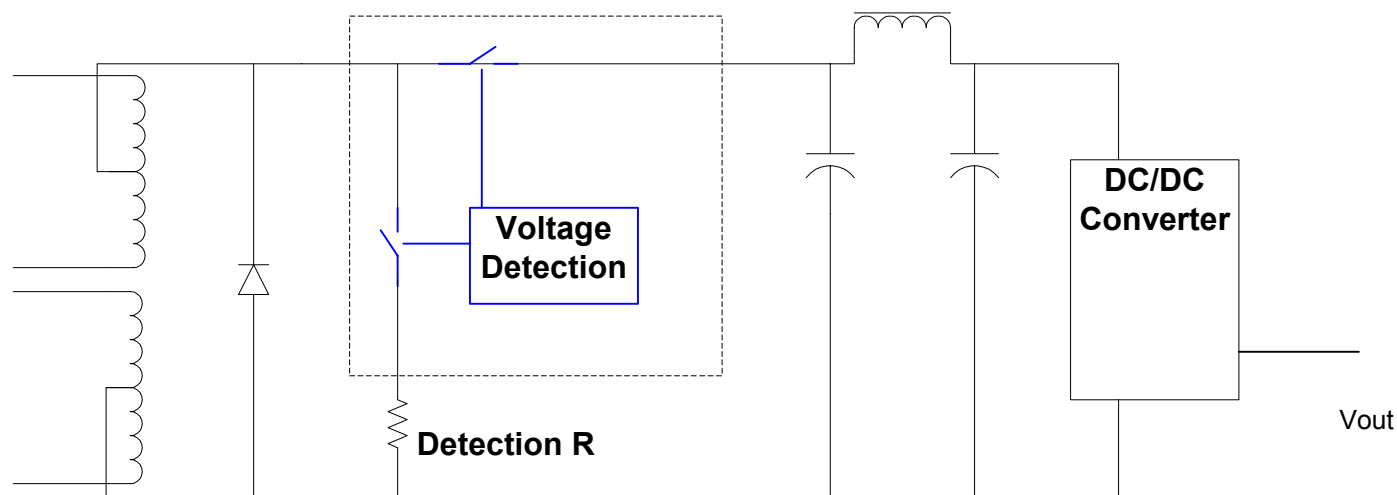
More PD Considerations

- Current limiting (wire protection) should be done at the PSE to protect from wiring/connection faults

- A lower limit (the 500ma for 100ms during start-up) should be provided by the "switch" to prevent excess current during start up

  - Limits maximum Input capacitance in PDDC to 1136uF

  - A power limit may optionally be placed in the converter itself.

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Power Source Element Considerations

- Features of the Implementation

- Network Choice Preference

- PSE Switch

- Discovery Mechanism

- Switching Architecture

- High Side Switch

- Low Side Switch

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Features of the Implementation

- Precision discovery allowing low level signal detection from a resistor in the presence of high level cable noise

- Focus on Safety and Liability

- Design for full **rail** isolation

- Design for UL approval

- Load Isolation fault detection with low side switch disconnect capability.

- Reliable switches with Over/Under current trip, and over-current limit.

- Chip over-temperature protection and input UVLO

- Low power sleep mode

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Network Choice Preference

- Design for compatibility for 1 or 2 Idle-Pair power delivery

- Simple 2 point <25K resistor signature discovery

- Current source based discovery with low noise measurement algorithm

- Wiring polarity reversal detection with parallel diode

- Independent power control and discovery for each Idle Pair

- PD power supply disconnect during discovery topology

- Not compatible with Cross-over cables

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PSE Switch
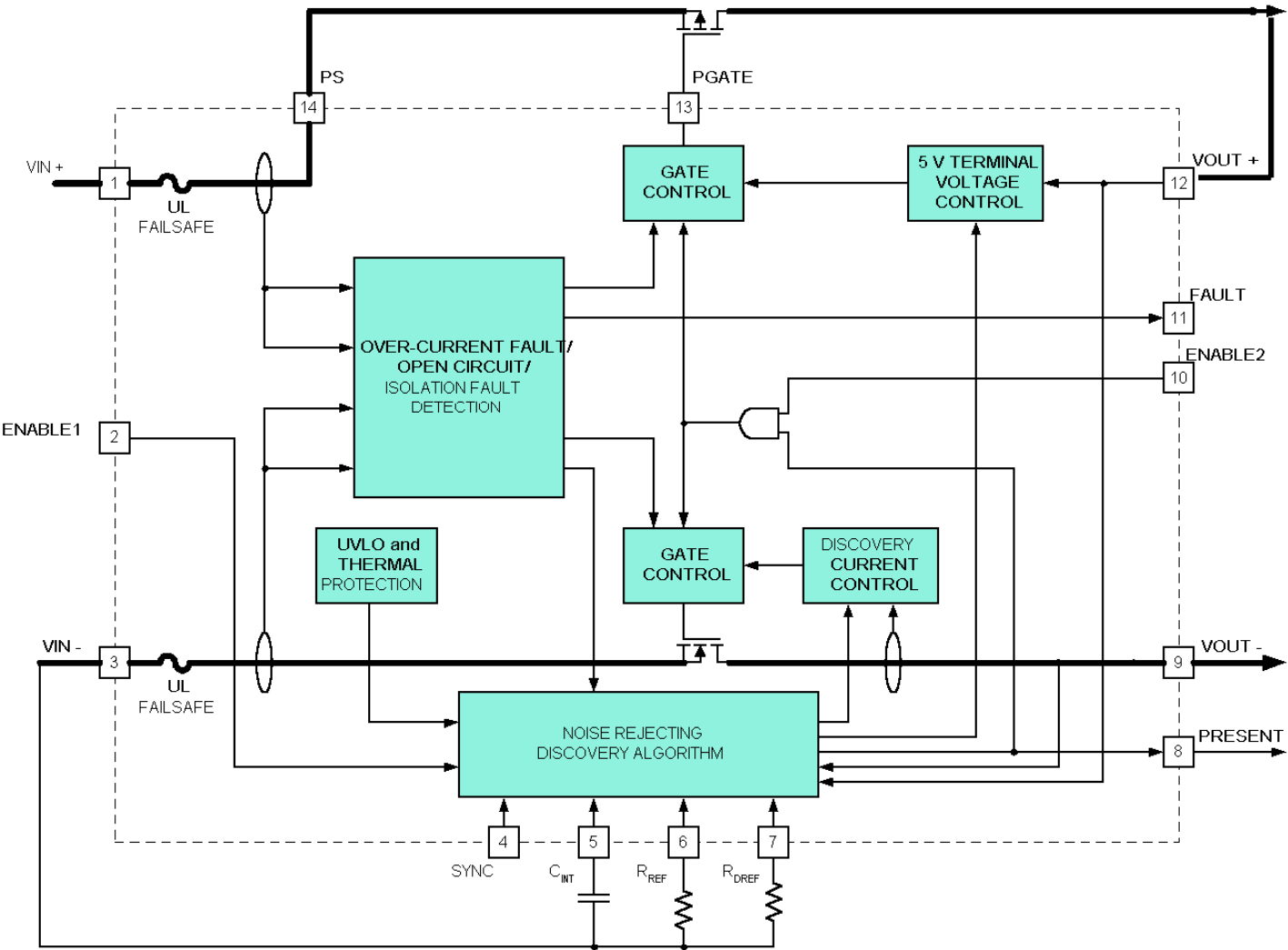
Discovery Mechanism

- Focus on Safety and Liability - Keep the voltage, current and delivered energy low

- Assume that there will be installations out there with **significant** noise issues. Address this now in the silicon implementation.

- Keep discovery simple and keep the silicon flexible to allow for variations in discovery as it becomes reality.

- Low level current delivery and load over-voltage protection to prevent any damage to incompatible load devices.

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Discovery Mechanism

- Low noise algorithm allows low level signal detection in the presence of high level 60hz line noise and adjacent cable data noise

- Externally programmable Network Detection Resistance

- Wrap-able "Present" to "Enable2" for direct switch enable after discovery

- Specifications
  - Consider lower discovery resistor (20K)
  - <350uA detection currents (Cable/Infrastructure leakage errors <3%)
  - 5 or 12V applied open circuit voltage during discovery

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Switching Architecture

- Focus on Safety and Liability

- Consider infrastructure wiring or PD faults which create hazardous conditions in this network

- Consider the cost advantage of a single large power supply or backup battery in the LAN switch with individual small low cost RJ45 power switches that sever **both rails** to maintain isolation

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Switching Architecture

- Consider building the isolation detection feature into the switch.
    - If the current going out the port does not equal the current coming back then …. **There is a problem, shut off the port!**
- Control radiated emissions from the turn-on and off of the switch.
- Protect the switch under all fault conditions
- Provide secondary (backup) power switch fault protection

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PSE Switch

High and Low Side Switch For System Isolation Fault Protection

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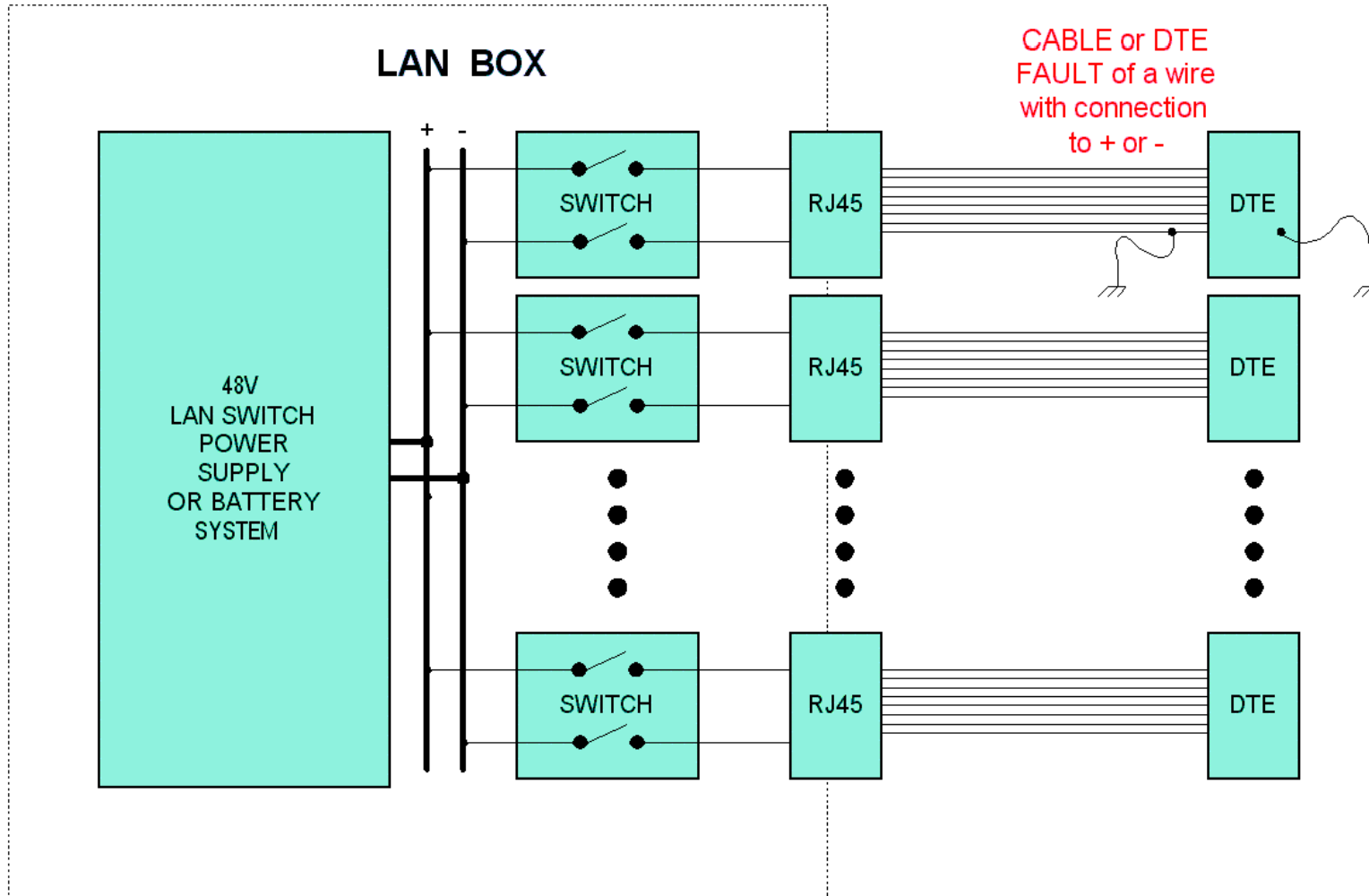
High Side Switch

- Low radiated EMI with dv/dt, di/dt turn-on/off control

- High speed over-current trip during delivery phase

- Under-current trip with programmable delay filter during delivery phase

- Acts as a precision voltage compliance loop (5 or 12V) during discovery

- Failsafe protection with secondary abuse protection element

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Low Side Switch

- Low radiated EMI with dv/dt, di/dt turn-on/off control

- High speed low side over-current trip during delivery phase

- Isolation Fault detector checks

- Built in thermal protection

- Failsafe secondary protection with an abuse disconnect element

- Operated as precision current sink during discovery mode

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