

# Extended Detection Protocol for 4P PSE

Steve Robbins

# Overview

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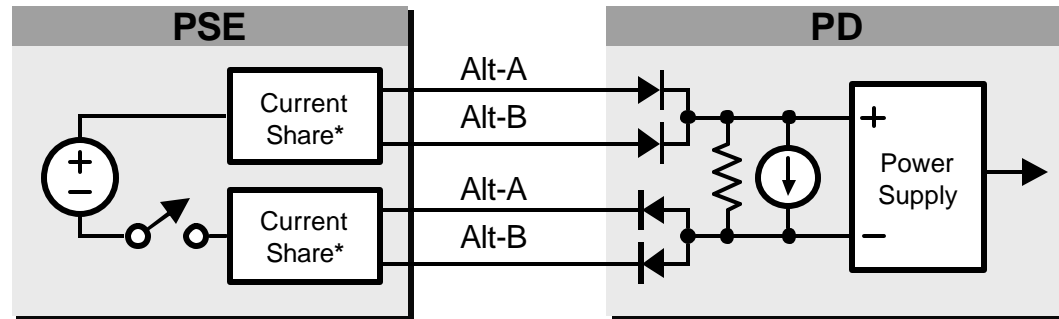
- If a 4P PSE uses a single power source, then there is a potential for putting too much current on some of the wires.
- This paper explains the problem and offers a possible solution, based on a minor extension of the detection protocol.
- This is intended to provide just one piece in the 4P puzzle, and is not in any way a total solution.
- A complete comparison of single-source vs. dual-source topologies is outside the scope of this presentation.

# Quick Review of 4P Topologies

## The Two Major Topology Categories

### Single-Source Topology

\*Could be active or passive.

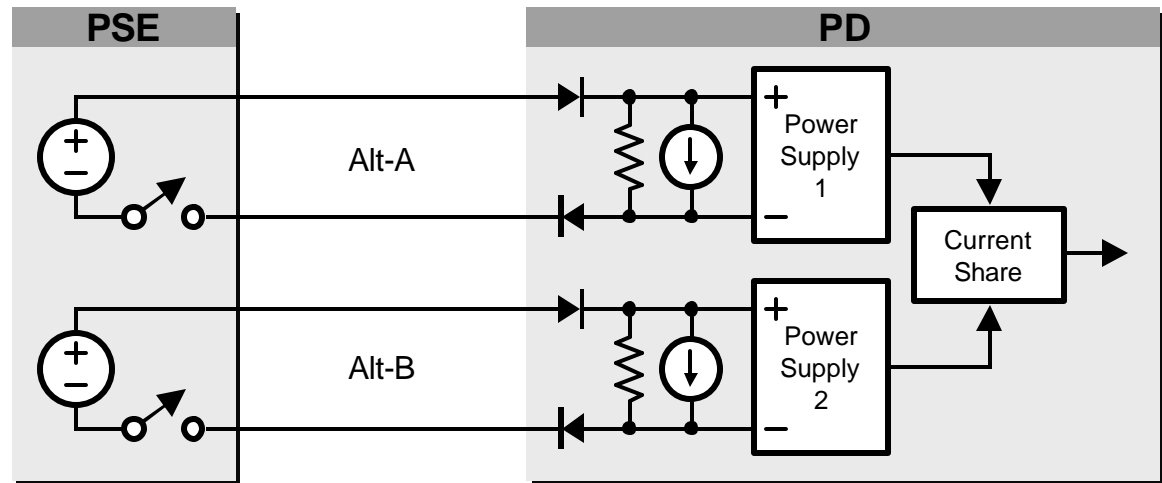


### Dual-Source Topology

#### Symbol Legend

⬇ = Class Signature

⚡ = Detection Signature



# One Key Difference

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- In the case where the PD requires very high power, a Single-Source 4P PSE might put too much current on the wiring, possibly causing overheating.
  - A midspan could block 2 pairs.
  - Some cables might have only 2 pairs.
  - The pairs could be split between two PDs.
- A Dual-Source 4P PSE wouldn't overheat the wiring.
  - Each source would be current-limited to a level that 2P can reliably carry.
  - If only 2 pairs are present in the wiring, then only one supply sources current.

# Fixes For Single-Source

## To Eliminate a Key Advantage of Dual-Source

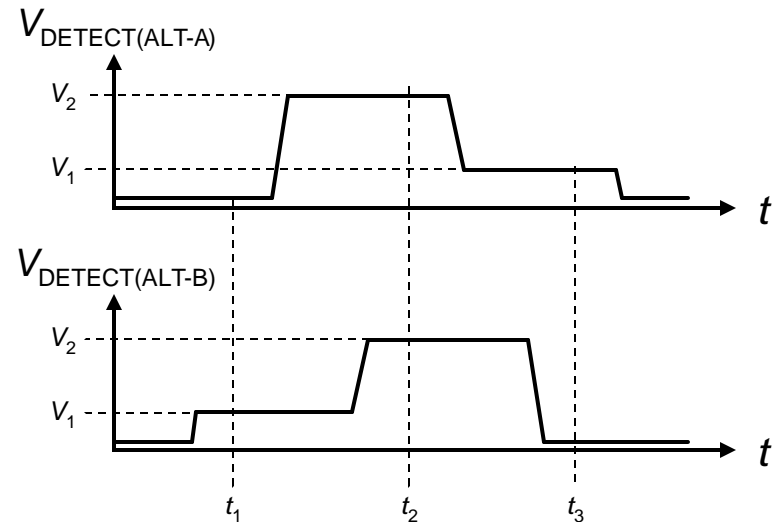
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- One possible solution could be to use the current-sharing circuits as sensors.
  - If a severe imbalance occurs on both top and bottom circuits during classification, then only 2 pairs are present in the wiring.
  - But this method wouldn't tell you if the 4 pairs have been split between two PDs.
- A better solution is to sense the wiring during detection.
  - Several schemes are possible.
  - To show technical feasibility, one scheme is detailed on the next 4 slides. (This is for example only; I'm not suggesting that the standard should define any specific waveforms.)

# Extended Detection Protocol

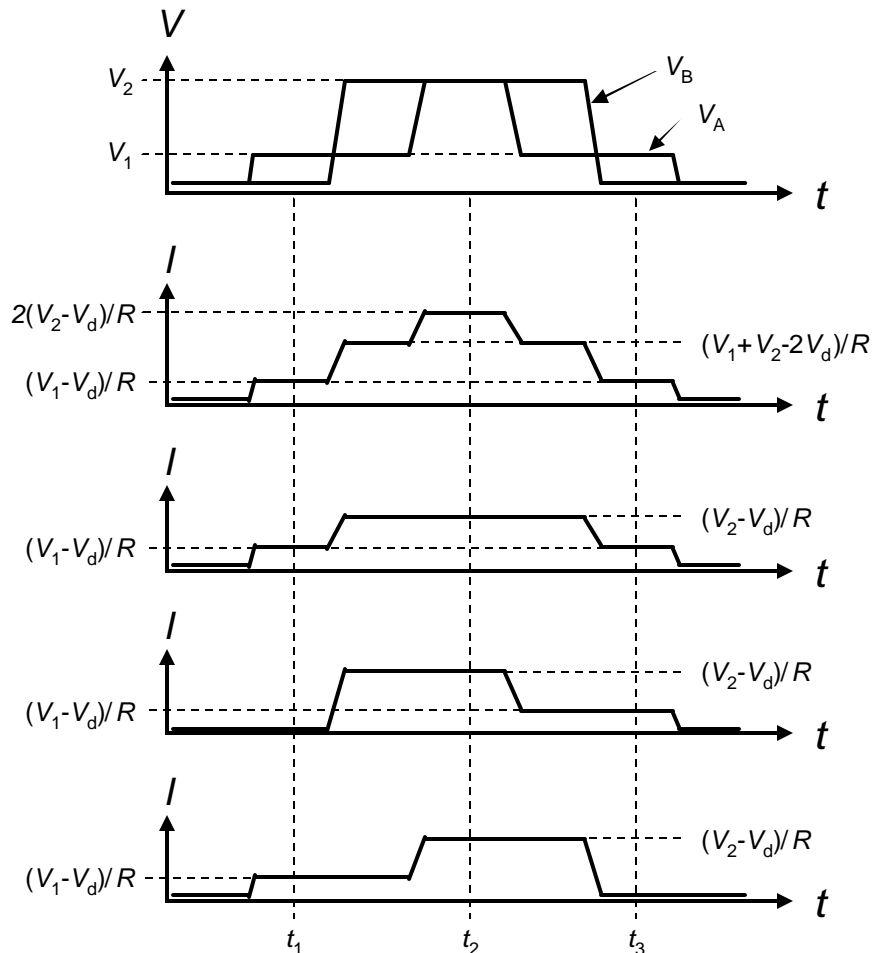
## One Possible Implementation

- A 2P PSE would still follow the original 802.3af protocol.
- But a single-source 4P PSE must look for detection signatures on both Alt-A and Alt-B.
- This example scheme probes Alt-A and Alt-B concurrently, but with one waveform reversed and shifted.
- By looking at the combined return current at only 3 points, all possible scenarios are determined.

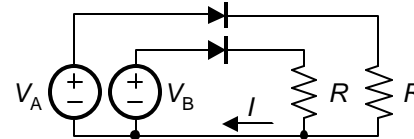


# Extended Detection Protocol

## Example Waveforms

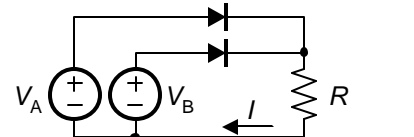


$I$  = The total combined current through both sources.



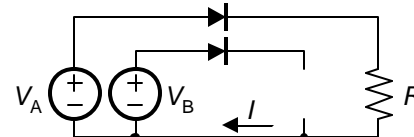
### CASE 1

**Two separate PDs**  
(Don't turn on)



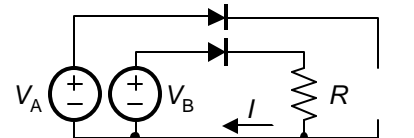
### CASE 2

**PD on all 4 pairs**  
(Turn on, allow full power)



### CASE 3

**PD on Alt-A only**  
(Turn on, allow half power)



### CASE 4

**PD on Alt-B only**  
(Turn on, allow half power)

# Extended Detection Protocol

## Error Analysis

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- The worst-case analysis for cases 2 thru 4 from the previous slide is unchanged from 802.3af.

- But can case 1 be mistaken for case 2? *No.*

- The PSE sees

$$R_{\text{MEASURED}} = \frac{R(V_2 - V_1)}{2(V_2 - V_d) - (V_1 - V_d)}$$

- The worst-case is when  $R_{\text{MEASURED}}$  is maximized

$$R_{\text{MEASURED}} = \frac{26.25\text{k}(10 - 2.8)}{2(10 - 2) - (2.8 - 2)} = 12.43\text{k}$$

- The minimum threshold in the PSE is 15k, so it will reject this signature.



# Extended Detection Protocol

## Calculations and Logic

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### ■ Resistance range tests

- Measurements: Let  $i_1 = I(t_1)$ ,  $i_2 = I(t_2)$ ,  $i_3 = I(t_3)$
- Constants: Let  $\Delta I_{\text{MIN}} = (V_2 - V_1) / R_{\text{MAX}}$  and  $\Delta I_{\text{MAX}} = (V_2 - V_1) / R_{\text{MIN}}$
- Calculations:
  - Let **A** be true if  $\{\Delta I_{\text{MIN}} < i_2 - i_3 < \Delta I_{\text{MAX}}\}$  and false otherwise
  - Let **B** be true if  $\{\Delta I_{\text{MIN}} < i_2 - i_1 < \Delta I_{\text{MAX}}\}$  and false otherwise

### ■ Interpreting the results

<b>A</b>	<b>B</b>	<b>PD Detected</b>	<b>Proceed to Classification</b>	<b>Classification may Grant PD Power Requests up to:</b>
F	F	Two 2P or none	No	N/A
F	T	2P on Alt-B	Yes	Half power
T	F	2P on Alt-A	Yes	Half power
T	T	Single 4P	Yes	Full power

# Summary

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- If a Single-Source topology is used for 4P, then it must be able to sense the wiring in order to avoid potential overheating.
- The maximum power request that can be granted must be a function of how many conductors are actually present.
- The example detection protocol presented here would allow a 4P single-source PSE to:
  - Determine if the wiring has 4 pairs or just 2.
  - Verify all 4 pairs go to the same PD.
- Impact on system cost and complexity is minimal:
  - 2P PSE and PDs are not affected at all.
  - 4P PSE must be able to probe both Alt-A and Alt-B (but that was inevitable).
  - Only 3 data points per detection cycle.
  - None of the timing or voltage parameters in 802.3af need to change.
- This extended protocol would link Detection and Classification.