

# **PSE with Dual Power Channel Solution Impact on PSE and PD**

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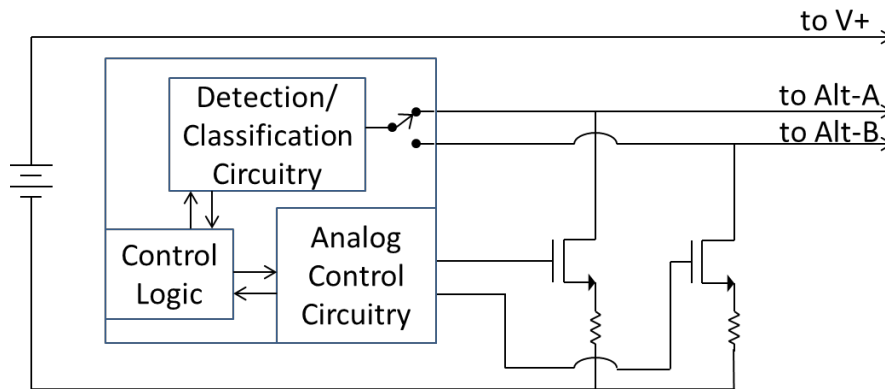
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# Terminologies and Abbreviations

- PSE with Dual Power Channel (or “Dual Switch”):
  - Means that the PSE provides 4P Power using two separate power switches (e.g. MOSFETs, one per 2P), usually both controlled by the same PSE controller.
  - It does not necessarily mean that it is using independent resources to do detect-class from one 2P to next one. Ex: common resources can be multiplexed to perform detection and classification as done for multi-port chips in the current market today. This is implementation choice.



- PSE with Single Power Channel (or “Single Switch”):
  - Means that the PSE provides power to all 4P using one power switch.

# Objective: Reach a Solution that Meets the System Requirements of 4PPoE

- PSE Modularity and Flexibility (“Type 2” vs “4-pair”).
  - Easy configuration of 2P port to 4P port while meeting technical challenges (accuracy, thermal, efficiency,...).
  - Highly cost effective approach system wise.
- Ensures that both four-wire connections are connected to PoE equipment (“Y-cable issue”).
  - Powering a pair set only after a valid detection on the same pair set. See IEEE802.3-2012 clause 33.1 and 33.3.5.
- Lowest PSE noise and current measurement errors.
- Flexible PD Design.
  - 1- or 2- “AT” interface solution possible, allowing more creativity.
  - Easier migration to 4PPOE.
  - Allows faster adoption of the standard.

# Impact on PSE

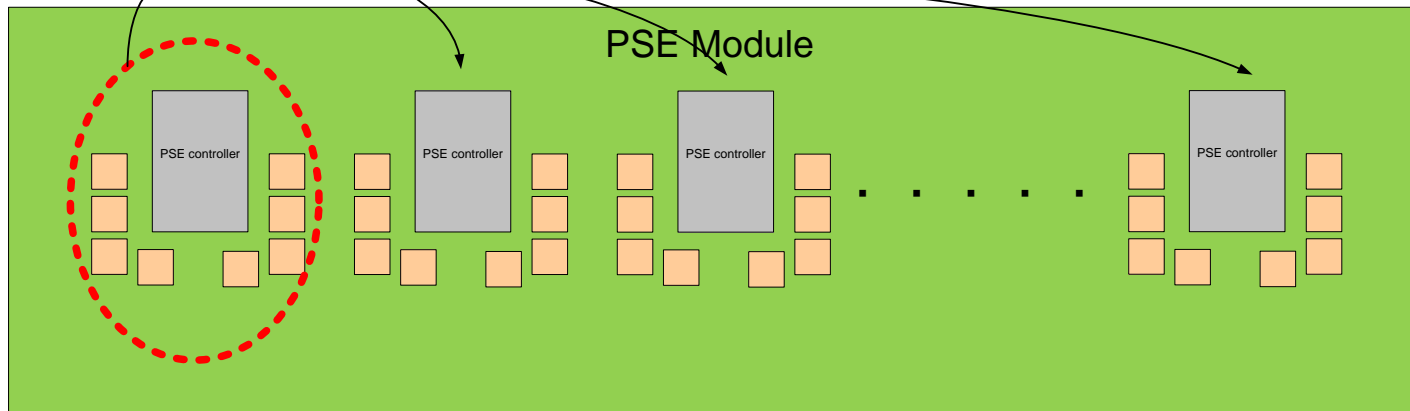
## PSE with Dual Power Channel Solution

# PSE with Dual Power Channel Solution – PSE Advantages

## Modularity, Simpler PCB Routing, Design reuse, Lower System Cost

- PSE equipment manufacturers can use power channels individually as “AT (Type 2)” or collectively (2 channels together) as “4-pair”.
- This means that same configuration across at least all designs up to 60W can be reused.
  - Schematic + BOM + PCB layout (component placement and routing).
  - Same FETs and sense resistors # and package.
  - Symmetrical PCB design
    - Thermal design: the “dissipation” per inch<sup>2</sup> does not change from design to next one.
    - Efficiency.
    - Current sensing : same max current, same sense resistor value, kelvin sensing,...
    - ESD/surge protection, noise,...

Layout Copy-Paste



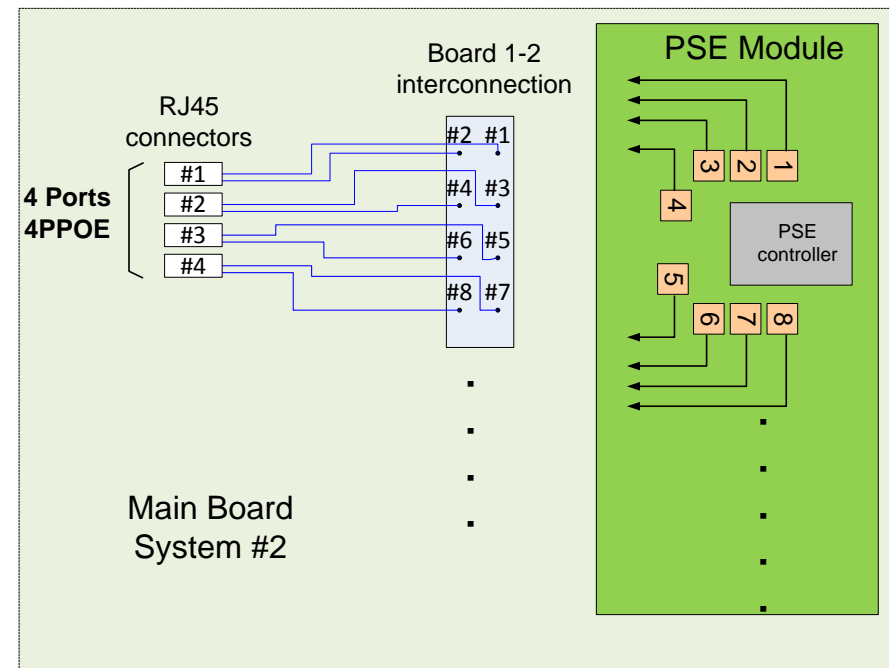
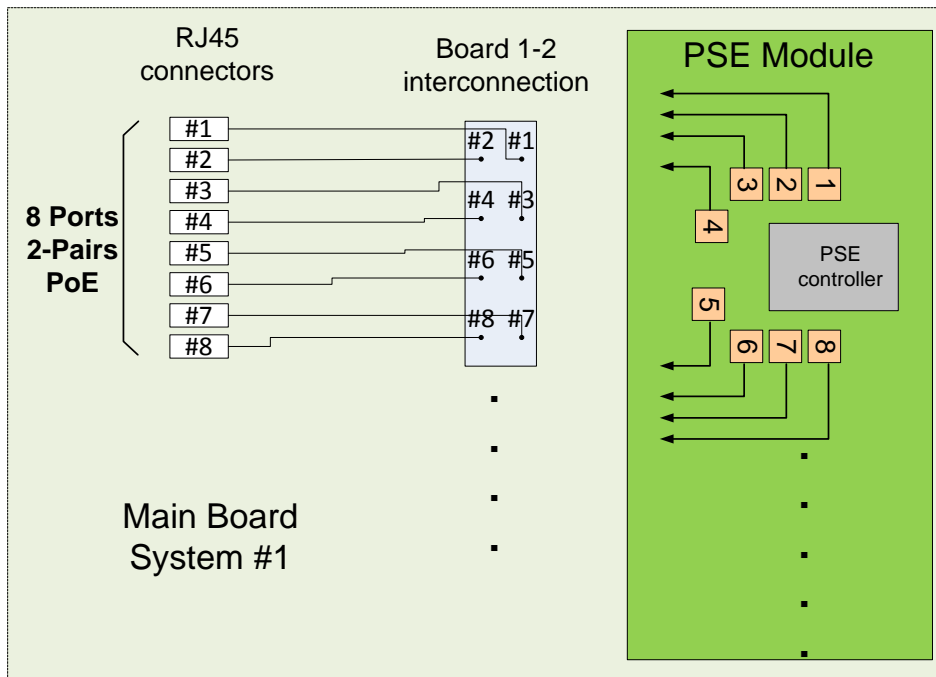
# PSE with Dual Power Channel Solution – Modularity, Design reuse, Lower Cost

- Product development cost: Being able to reuse same configuration across all designs brings the following benefits:
  - Minimize R&D investment, Reduced design risk.
  - For example, thermal analysis and design at system level is very complex, time consuming and costly (thermal engineering, tests, analysis software,...). It involves design risk and costs.
    - Using the “modular approach”, the dissipation per unit of PSE module board area remains the same regardless of the configuration.
    - Simplifies considerably the analysis, shortens design cycles, significant cost savings.
- Components/Board costs:
  - FETs: Reuses same low cost FETs already procured in high volume for the “AT (Type 2)” market.
    - Existing high volume MOSFETs used on AT designs have up to 0.2 ohms.
    - A “single switch” design needs to at least double the MOSFET size. This will increase costs because the larger MOSFET will not be used in volume.
    - Always same part in inventory.
    - Lower cost due to volume, even if 2 FETs are used.
  - PSE modules: same module can be reused, reduced inventory, lower costs.

# PSE with Dual Power Channel Solution – PSE Advantages

## PSE Modularity and Flexibility

- Modularity and flexibility: Easy 2P <-> 4P reconfiguration while always reusing same board design.
- In the example below, the PSE module can be used for any combination of 2P and 4P ports. Both system shown below have a different main board layout and they use same PSE module.





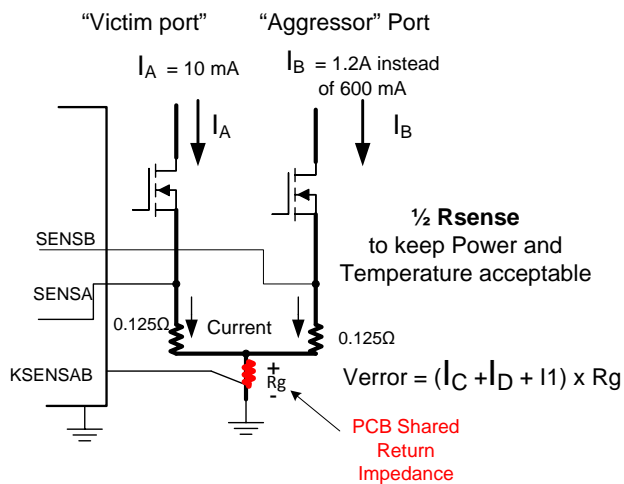
# PSE with Dual Power Channel Solution – System Health

- Ensures that both four-wire connections are connected to PoE equipment.
  - Able to distinguish between a single and dual PD interfaces and prevent damage or safety issues.
- Independent fault protection
  - Each channel can be monitored for current level
  - Provides advanced system-level capabilities.
    - Helps to detect early sign (trends) of PD failures. Ex: active bridge.
    - If there is fault on one of the power channels, the PSE is able to shut off only the faulty channel and allow PD to work if PD was designed for it.
      - Could also help for fault diagnostics.

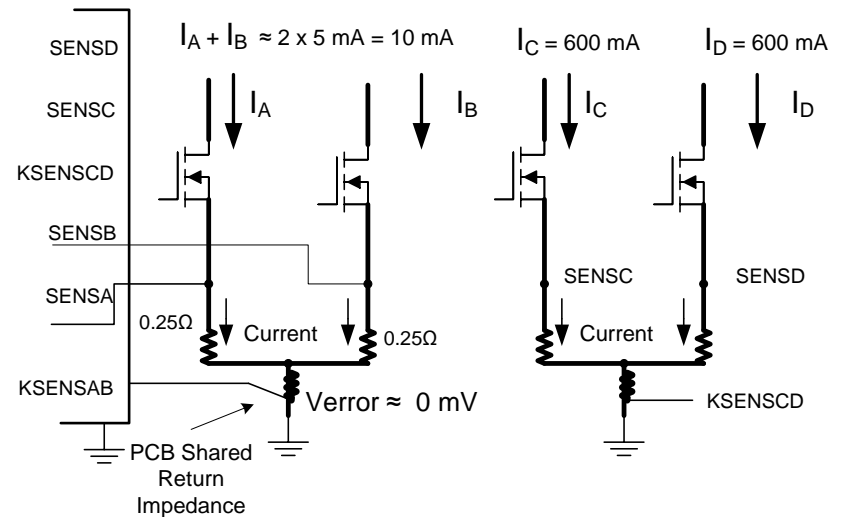
# PSE with Dual Power Channel Solution – PSE Advantages

## Current Sense Accuracy and Layout

- Dual PSE power channel Solution is less sensitive to noise and current measurement errors induced by neighbor channels on PCB.
- Keeps the PCB routing of PSE daughtercard relatively simple, minimizing the needs for Kelvin sensing for current sensing accuracy.
  - The current of the “aggressor” port is divided by 2 if 2-power channel solution.
  - 1 Kelvin sense per 2 power channels with much better result than if single power channel.
- Example if **1-power channel** solution:  $0.125 \text{ ohm} \times 10\text{mA} = 1.25 \text{ mV}$ . If the “victim” port shares same return impedance with **one** 1.2A aggressor port, only 0.52 mohm can result in **+ 0.625mV error**



Single-PSE power channel solution



2-PSE power channel solution

# Disadvantage of a PSE with Single Power Channel solution

- With a single FET you have limited choices of PD implementations
- High power port does not necessarily use same high volume FET used for “AT” ports.
  - Cost will increase considerably for FET (SOA,  $R_{dson}$ ,  $I_{d_{pulse}}$ , ..... ). No economy of scale.
  - Probably not even same package.
- No modularity at all, cannot reuse same board design for different configuration needs, unless tradeoff on costs, accuracy, thermal, size, efficiency,...
- In summary, this solution although interesting in theory, is not practical and its shortcomings undo any economical advantage.
- Issues related to detection over single power feed
  - Cannot verify that both power feeds go to valid PoE equipment
    - We cannot ignore Ethernet cabling infrastructure already implemented today.
    - Both pair sets need to be checked (even if with 4 data transformers), unless it is a new installation or we know for sure that all 4 pairs go to same equipment.
  - Also unable to detect early failures on a particular power feed

# Impact on PD

## PSE with Dual Power Channel Solution

# PSE with Dual Power Channel Solution – PD Advantages Flexibility, Easier (Smoother) Migration to 4PPOE

- Allows flexibility (creativity) at the PD end of the cable (both single and dual PD solutions are allowed).
- Single-chip PD solution may be more cost effective in many situations.
- Solution using 2 “AT” PD chips may be more convenient in others.

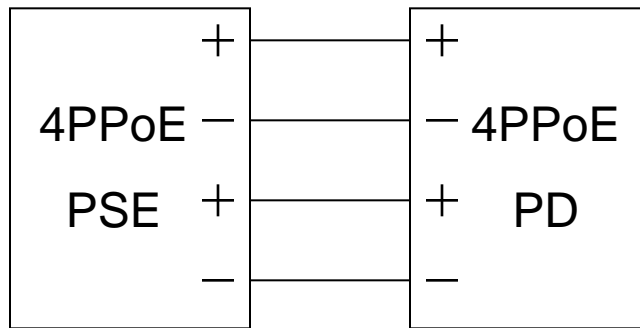
Possible reasons could be:

- Cost for single-chip PD
  - 2x current capability needs larger device.
  - Much lower volume than for “AT” or lower power application. Impact on price negotiations.
- Preference to use an already qualified device, using the same Type 2” PD chips they use today to achieve high power.
- Design re-use to minimize design risk and R&D investment. Particularly if low-volume product.
- All these reasons could be applicable in the short- or longer (ex: cost-reduction phase) term on a case-by-case basis.
- In summary, allowing both 1- and 2-PD interface allows a faster adoption of the standard by PD equipment makers.

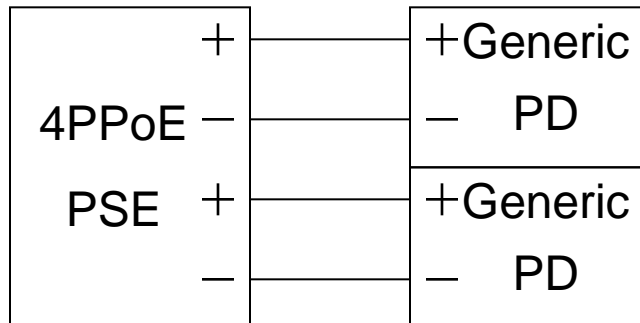
# PSE with Dual Power Channel Solution Both Configurations Below are Allowed

Allows flexibility (creativity) at the PD end of the cable.  
This is implementation choice.

## 4-Pair to 4-Pair (single PD interface)



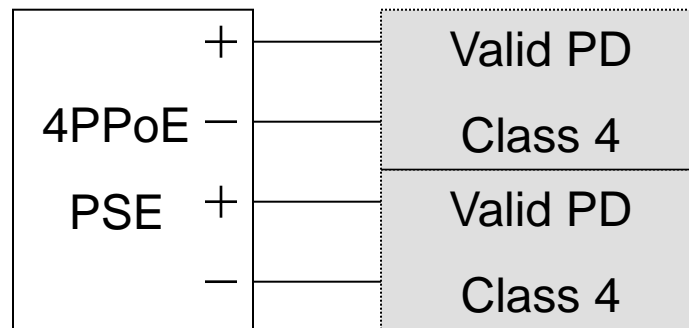
## 4-Pair to 4-Pair (Dual PD interface)



# PSE with Dual Power Channel Solution

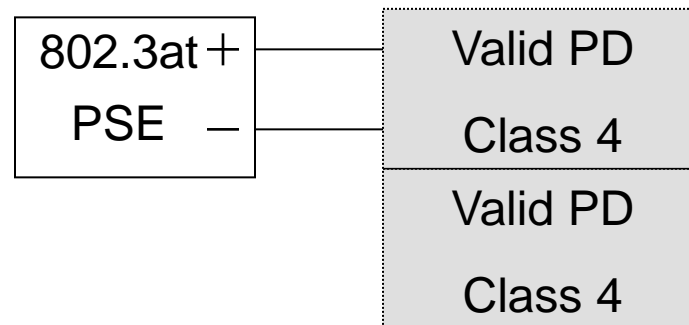
## PD Advantages - Flexibility

- Example: Using 2 “AT” PD interfaces to implement 51W solution.
  - Each PD interface configured as “class 4”
  - PSE does a “connection check <sup>1</sup>” to determine that there are 2 “AT” interfaces at the other end of cable. => 2 x 25.5W = 51W



Using T2P signals to confirm how much power is available, and over 2-pair or 4-pair

- PD equipment could even decide (if acceptable) to operate in reduced power mode (25.5W or 13W) if connected to an older PSE.



T2P indicate there is only af or at power

1. See Abramson, “4PPoE: Maximizing Interoperability with 802.3-2012 Devices” , Dallas, November 2013

# PSE with Dual Power Channel Summary



# PSE with Dual Power Channel Solution – Summary

- Allows lower system cost and higher system performance.
  - Takes advantage of PSE Modularity and Flexibility to provide easy configuration of 2P port to 4P port.
  - Allows design reuse, reduces development costs, reduces board and component inventory to cover both 2P and 4P applications and to meet technical challenges (current sensing accuracy, thermal, efficiency,...),.
  - Lowest PSE noise and current measurement errors.
- Ensures that both four-wire connections are connected to PoE equipment to avoid damage or safety issue.
  - Solves the “Y-cable issue”.
- Independent fault protection. Helps to detect early sign (trends) of PD failures.
- Allows flexibility (creativity) at the PD end of the cable for an easier migration to 4PPOE.
- Allows faster adoption of the standard.

# Straw Poll

- Do you care about damaging network equipment ?
  - Y:
  - N:
  - A: