Bob Smith Terminations and Active Current Balancing for PoE Plus

Steve Robbins

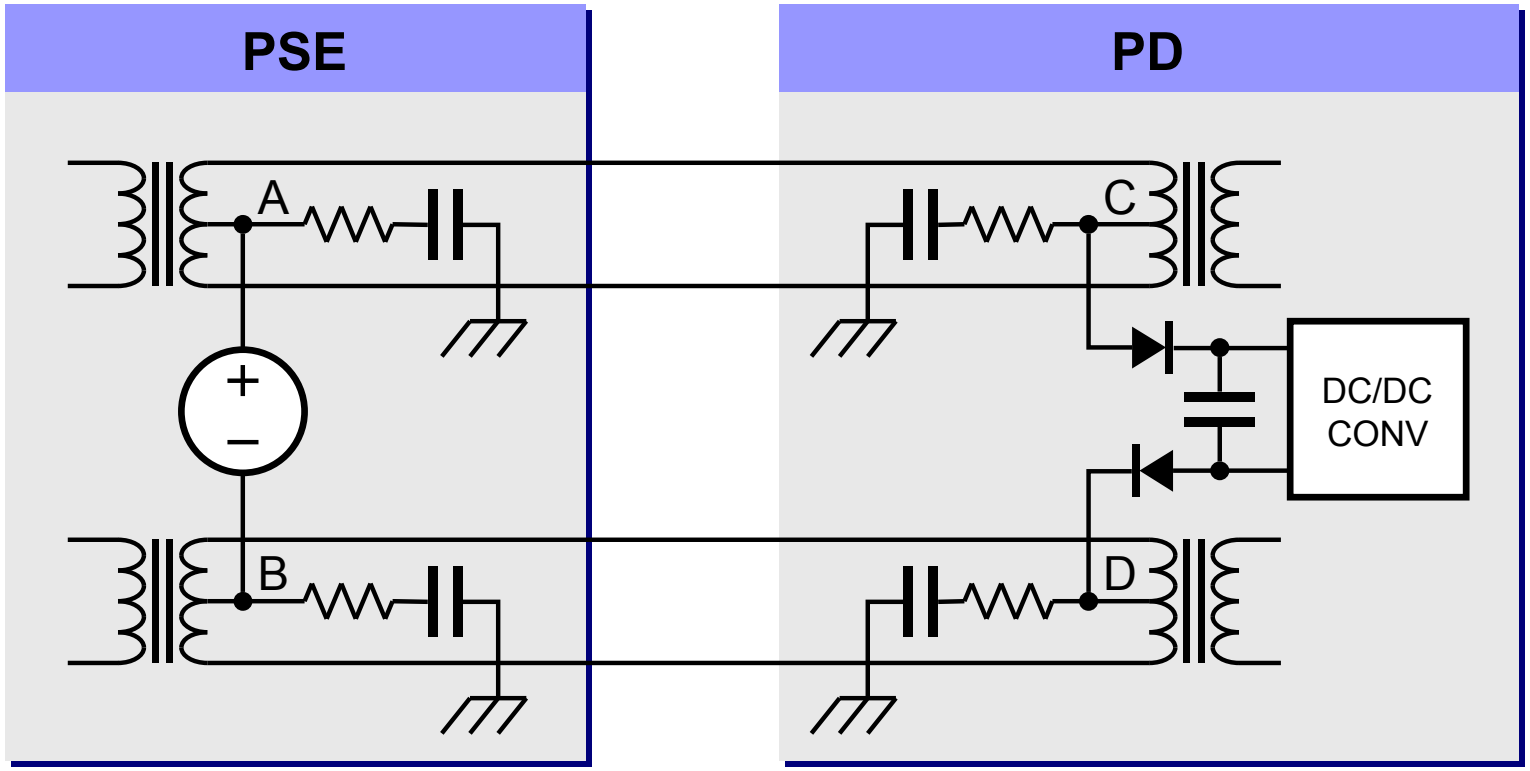
Introduction

- In PoE systems, the Bob Smith Termination (BST) is essentially short-circuited in both the PSE and PD.
- If Active Current Balancing (ACB) were used in PoE Plus, the problem could be partially solved (at one end only) with little additional cost and complexity.

Why BST Doesn't Work in PoE

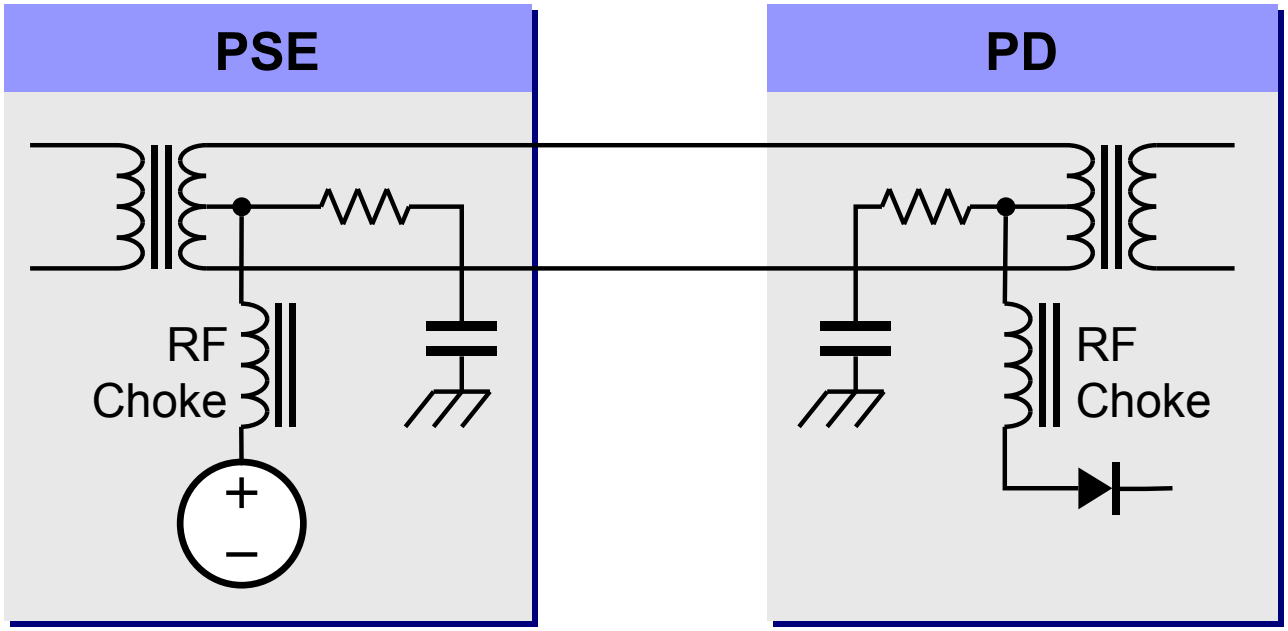
Power supply is an AC-short between nodes A and B.

Diodes and cap form an AC-short between nodes C and D.



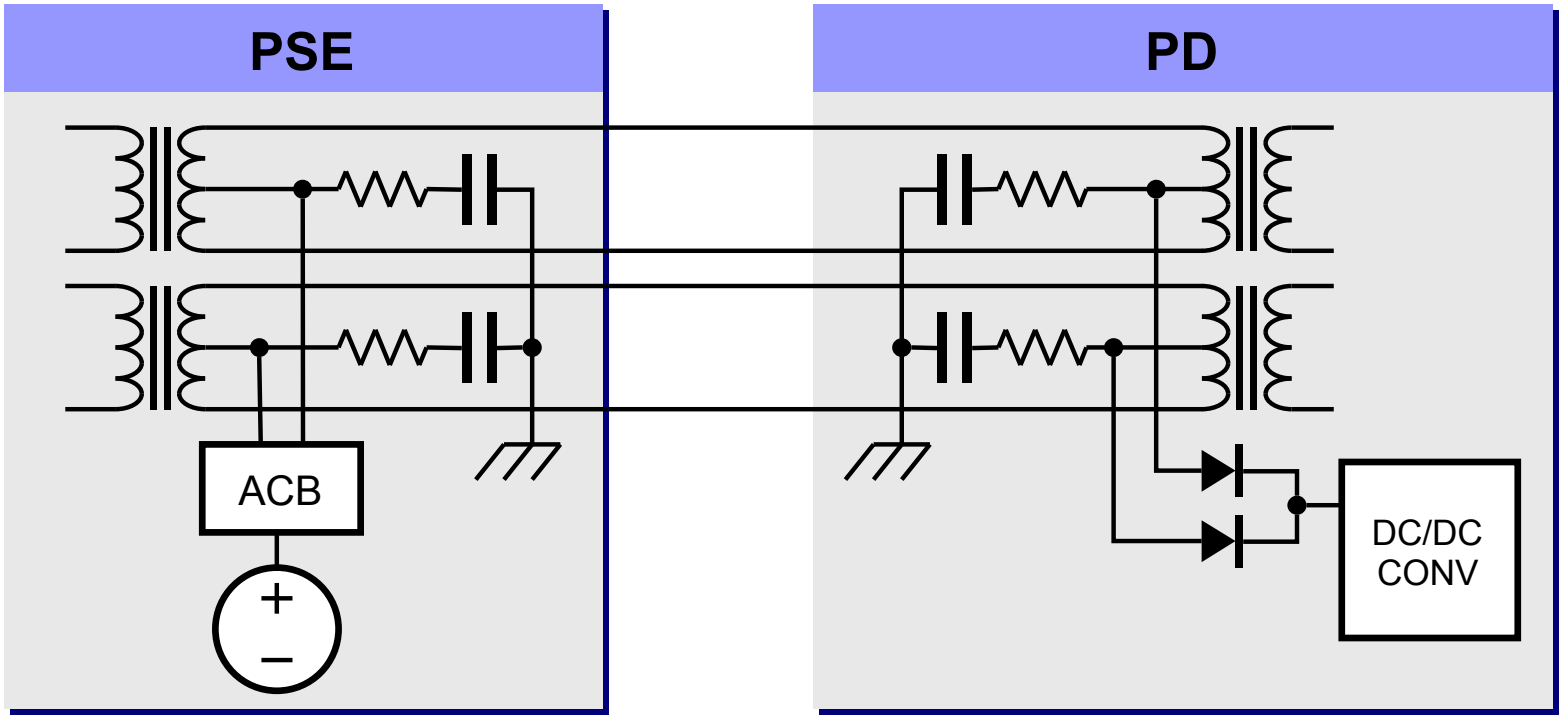
A Simple Choke Won't Work

- PSE source-impedance must be less than 0.3Ω from DC to 100kHz for Source/Load stability per Annex 33D recommendations. (Therefore, L<477nH.)
- Impedance must be much greater than 75Ω above 1MHz to have small affect on BST performance. (Therefore, L>60µH.)
- Contradictory requirements! (A higher-order circuit might work, but would be expensive.)



ACB May Provide A Partial Solution

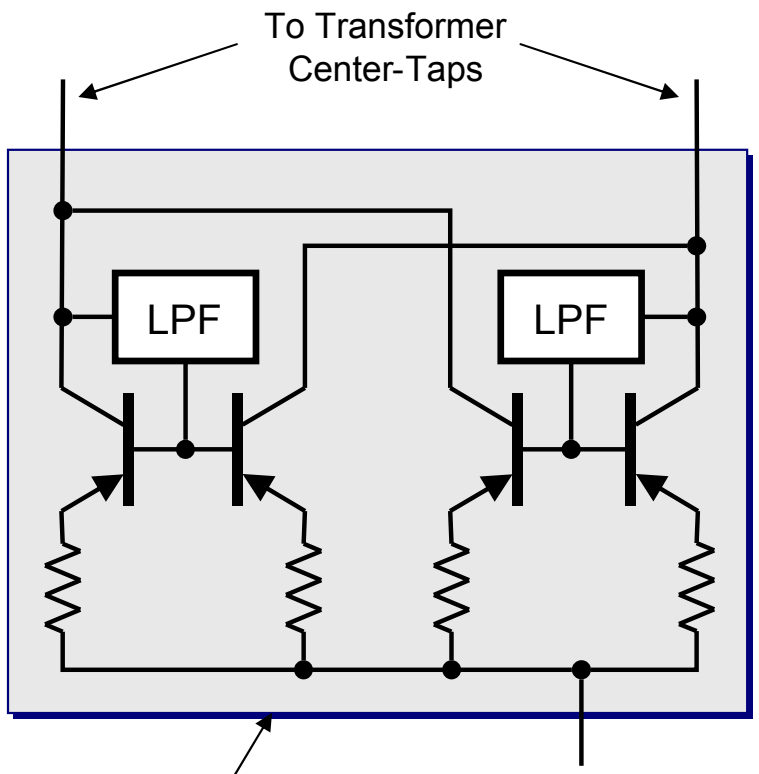
- This example shows half of a 4P system, with pair-to-pair ACB in the PSE.
- Impedance requirements from previous slide still apply, but it's easier to implement the high-order function in silicon than in passives.
- Problem solved at PSE end, but not at PD end of cable.



ACB Circuit: Bipolar vs. CMOS

- To keep the power dissipation in the ACB circuit reasonably low, the voltage drop across it must be less than approximately 250mV.
- A MOSFET would be in the linear region at such low voltage.
  - Drain looks like a low-value voltage-controlled resistance.
  - No way to make it high-Z at high freq with control loop.
- A bipolar with low $V_{CE(SAT)}$ would still be in its active region.
  - Collector looks like a current source. High impedance.
  - Feedback loop would keep impedance low at low freq.

A Possible Implementation



LPF = Low Pass Filter

- This circuit is used only as an example. (A more practical circuit would probably use opamp circuits instead of emitter feedback to balance the DC currents.)
- At low freq, the filter shorts collector to base. This makes two current mirrors that operate back-to-back for symmetry. Collectors appear low-Z.
- At high freq, the bases are AC-grounded. So the collectors appear high-Z.
- The key point is, the frequency-shaping components are not in the high-current branches, so they can be tiny.

Summary

- BST circuits doesn't work with PoE because the power feeding paths short them out.
- Fixing the problem with passives would be difficult and expensive.
- ACB can provide a partial solution (one end of the cable only).
- Bipolar offers a big advantage over CMOS for this application.
- The marginal cost of adding freq compensation to an ACB circuit would probably be small.