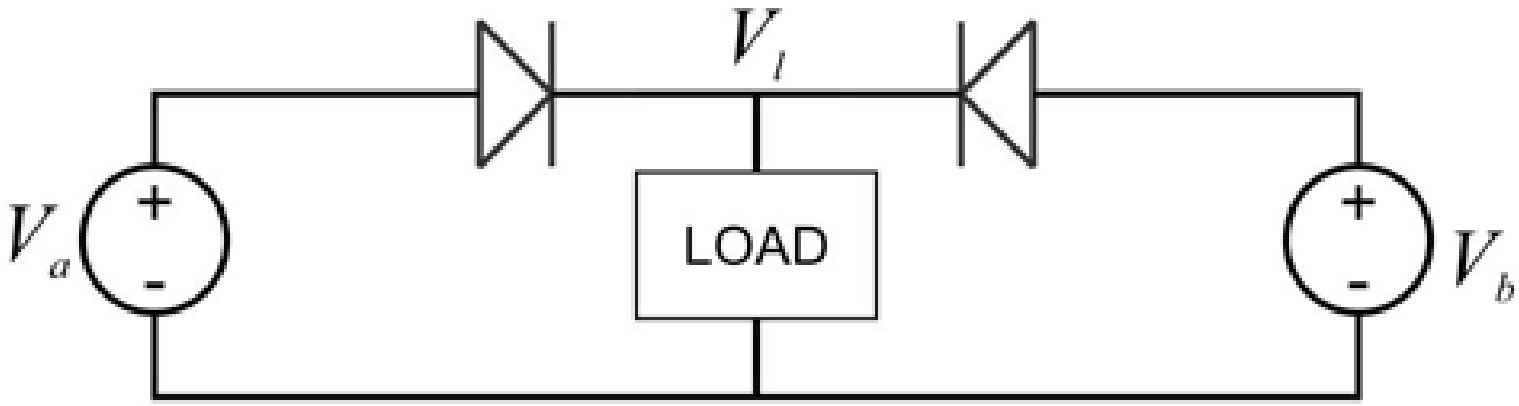
Auctioneering Diodes: Pros and Cons

Norbert Doerry
Naval Sea Systems Command

Robert Ashton
Ashton Consulting LLC

2019 IEEE Electric Ship Technologies Symposium (ESTS 2019)
August 14-16, 2019
Arlington VA

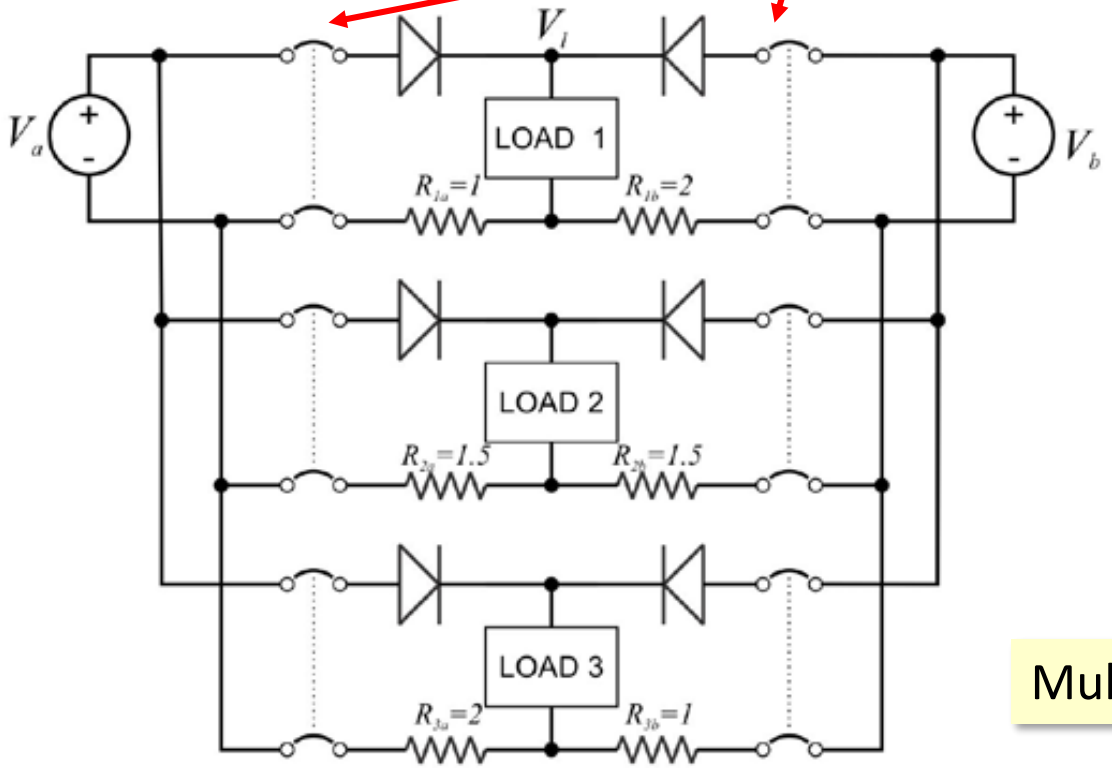
Asymmetric Auctioneering Diodes

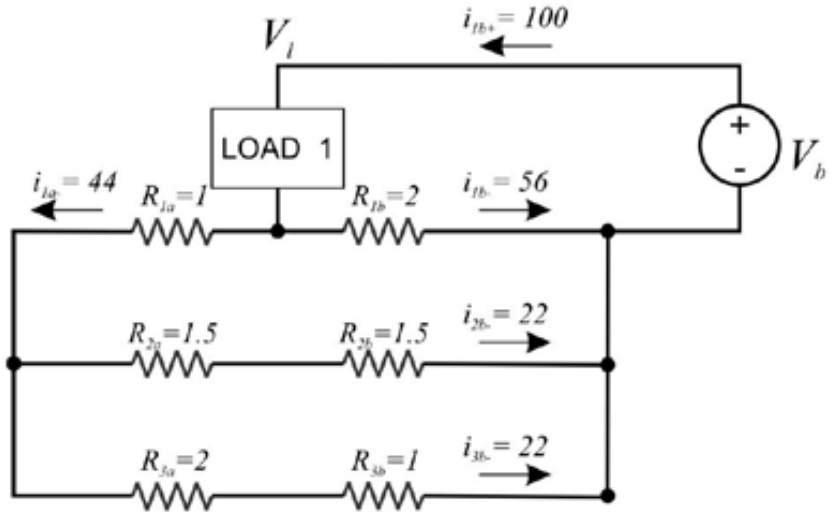


Uninterruptible power to load if either source faults

Asymmetric Auctioneering Diodes: Multiple Loads

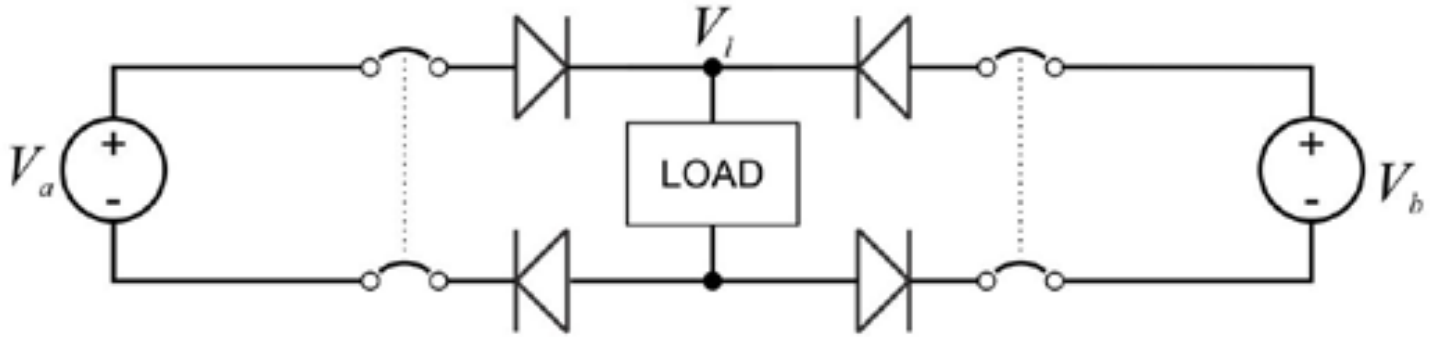
Need circuit protection to avoid single point of failure





Multiple return paths result in common mode currents

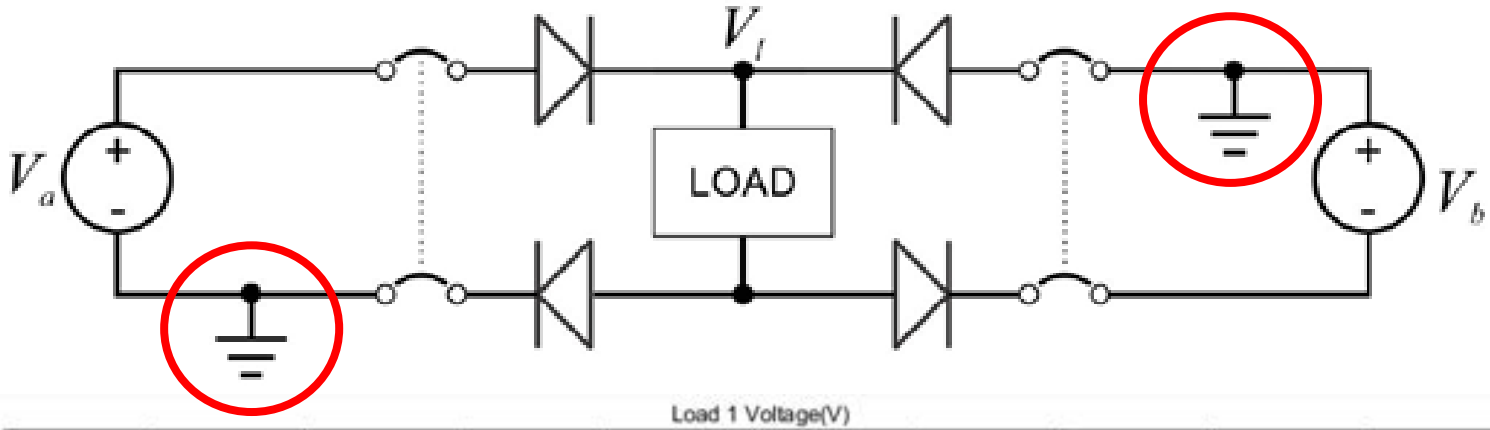
Symmetric Auctioneering Diodes

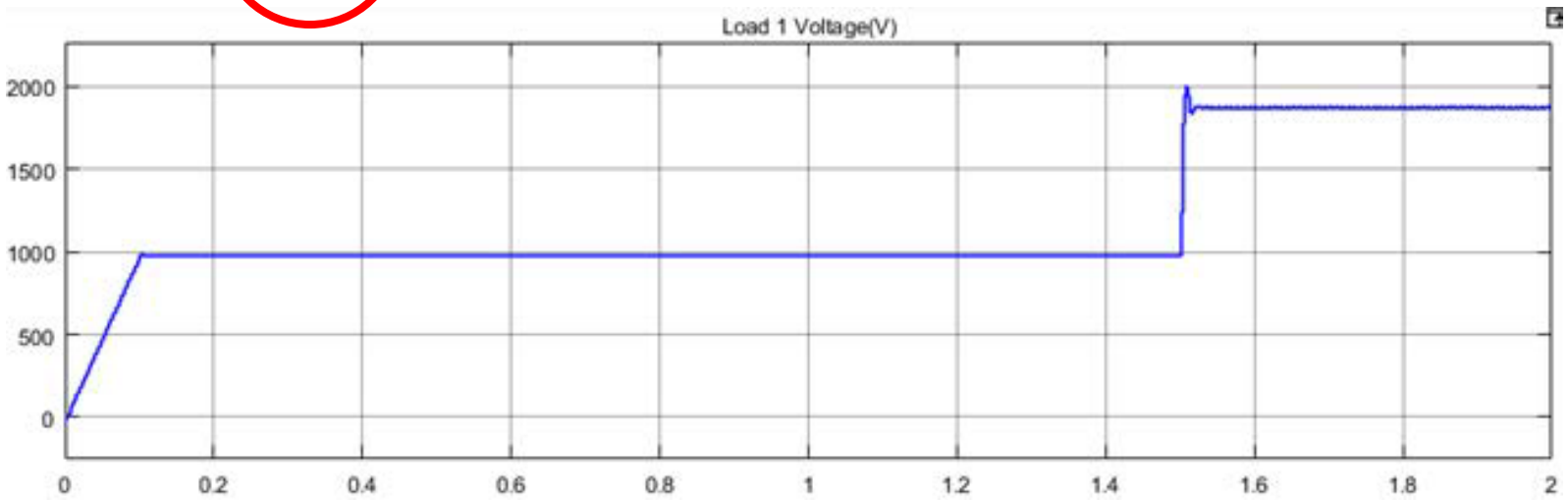


Eliminates multiple return paths and associated common mode currents

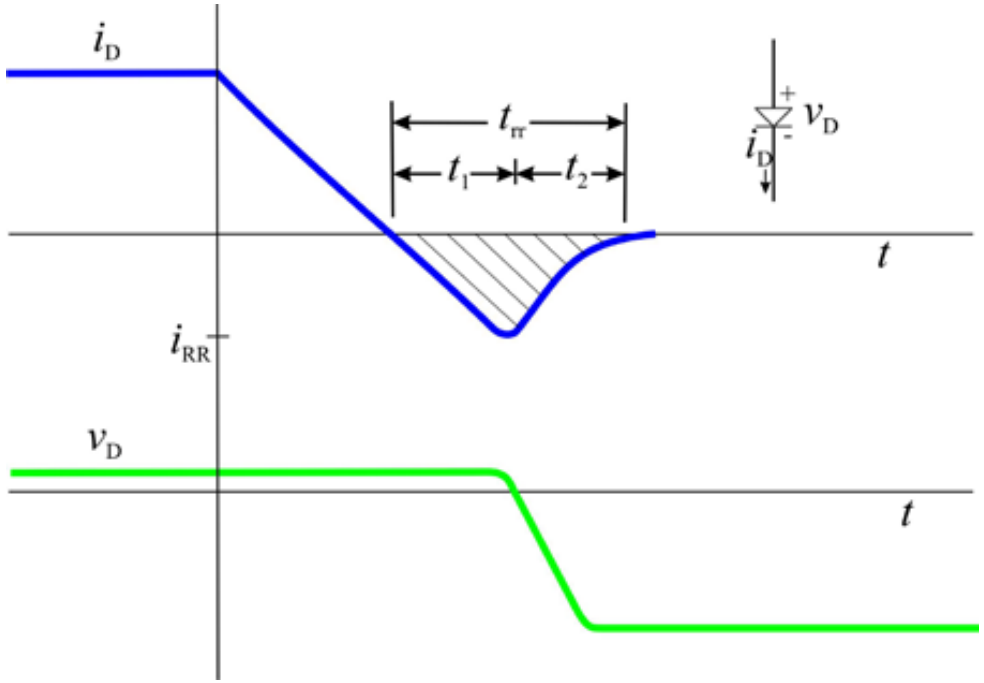
Symmetric Auctioneering Diodes: Double Ground Fault

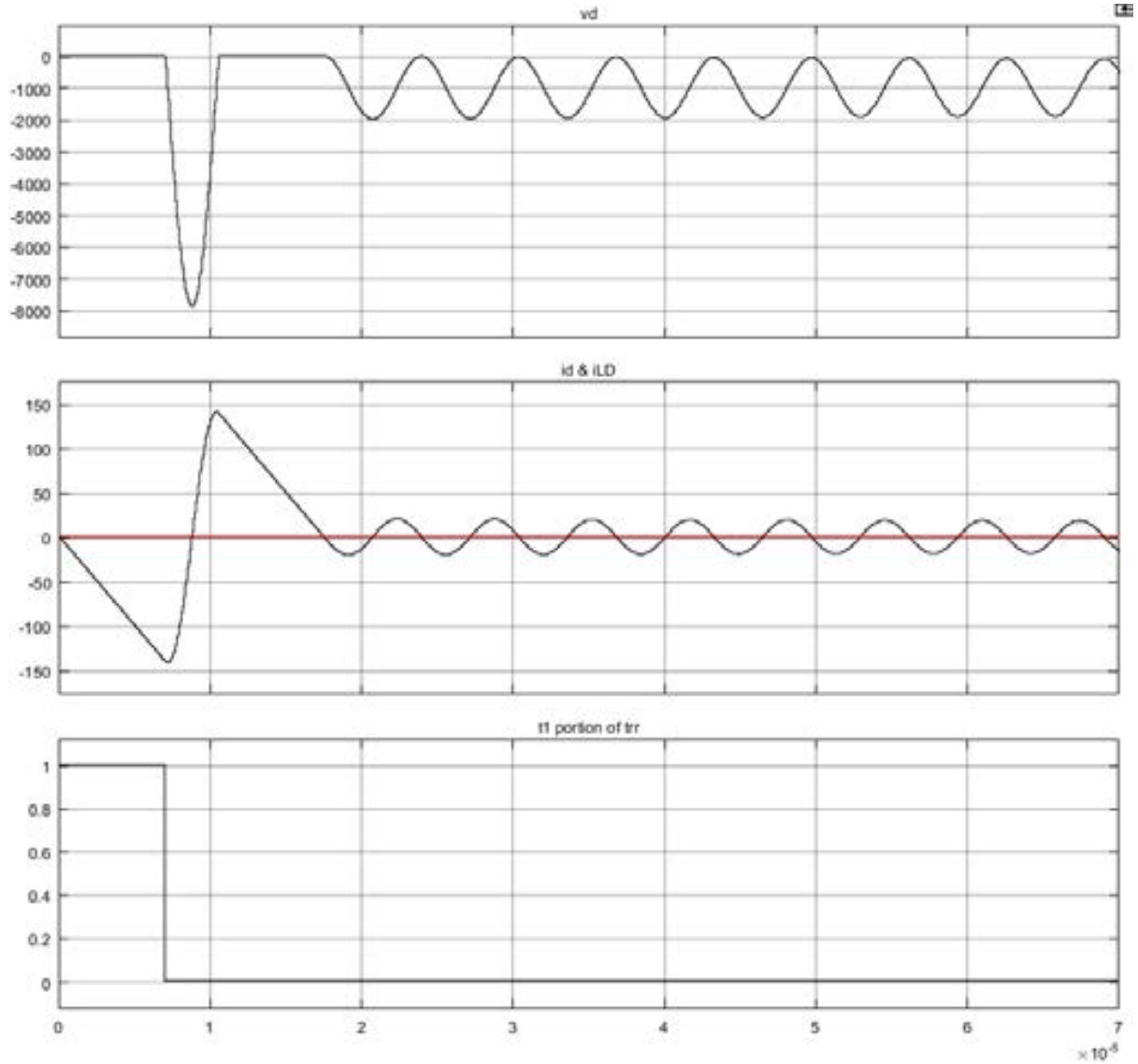
Voltage doubles on double ground fault



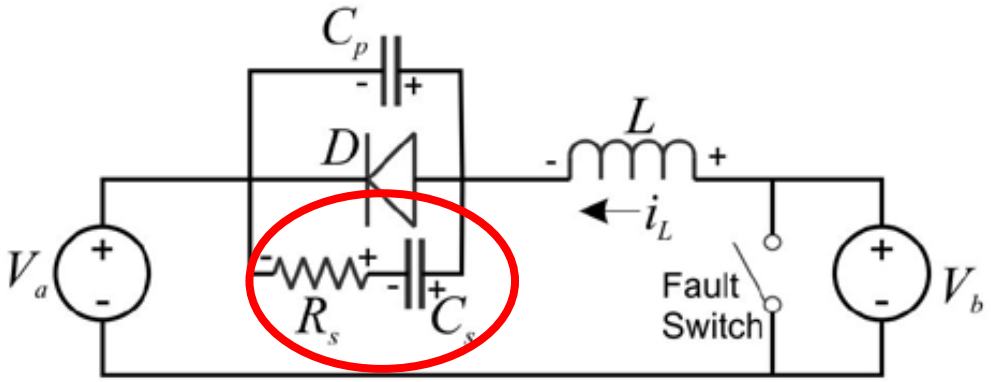


Diode Snubber





Diode Snubber



$$i_L(0) = -i_{RR} \qquad V_{CS}(0) = 0 \qquad (1)$$

$$-V_a = L\frac{di_L}{dt} + R_s i_L + V_{CS} \qquad (2)$$

$$i_L = C_s\frac{dV_{CS}}{dt} \quad \text{or} \quad \frac{di_L}{dt} = C_s\frac{d^2V_{CS}}{dt^2} \qquad (3)$$

Combining (2) and (3) results in (4)

$$-V_a = LC_s\frac{d^2V_{CS}}{dt^2} + R_sC_s\frac{dV_{CS}}{dt} + V_{CS} \qquad (4)$$

Limit initial spike to a value diode can tolerate

$$R_s = \frac{V_a}{i_{RR}}$$

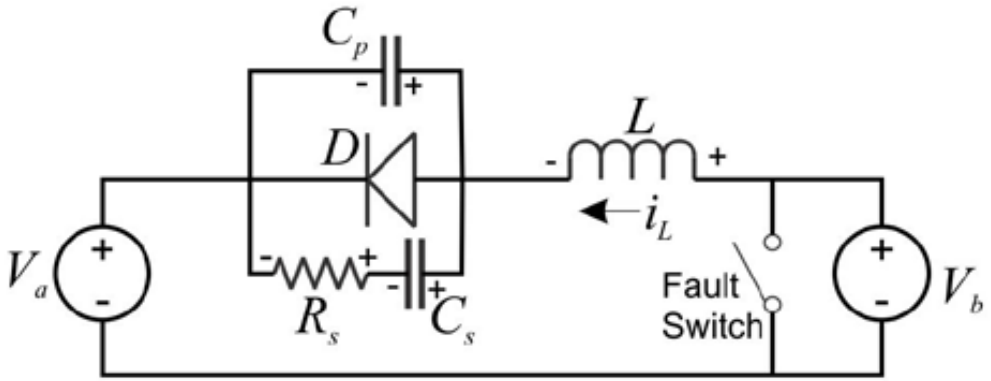
Minimum capacitance (critically damped)

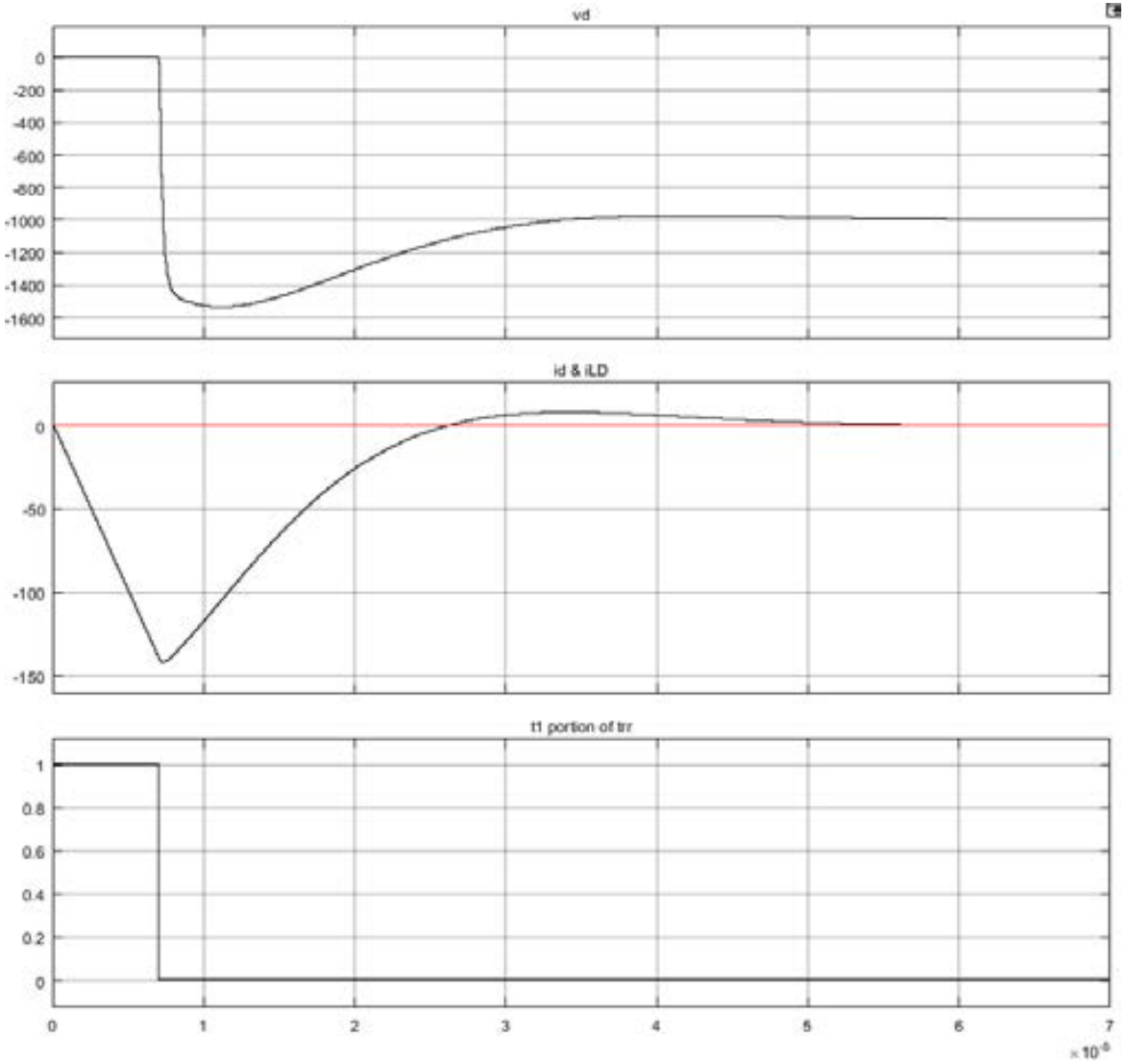
$$C_s = \frac{4L}{R_s^2}$$

Minimum capacitance (Avoid interaction with C_p)

$$C_s > 3C_p$$

Diode Snubber





Summary

- Asymmetric Auctioneering Diodes
  - Great for single loads
  - Issues with multiple loads
    - Requires circuit protection
    - Common mode currents
- Symmetric Auctioneering Diodes
  - Eliminates common mode issue of Asymmetric configuration
  - Still requires circuit protection for multiple loads
  - Voltage doubling issue with double ground faults
- Diode Snubbers
  - May be required due to reverse recovery current of diodes