

How to Design Multi-kW Converters for Electric Vehicles

- Part 1: Electric Vehicle power systems
- Part 2: Introduction to Battery Charging
- Part 3: Power Factor and Harmonic Currents
- Part 4: Power Factor Correction
- Part 5: The Phase Shifted Full Bridge**
- Part 6: How the PSFB works
- Part 7: A High Power On Board Charger Design
- Part 8: MOSFET gate driver considerations and References

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The PSFB in multi-kW power supply systems

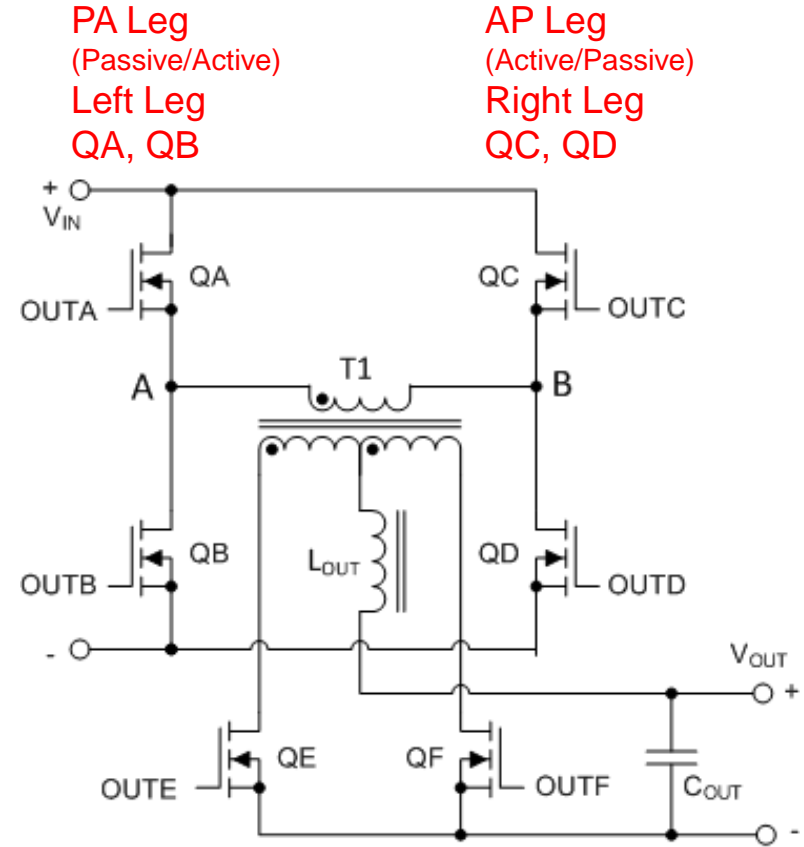
The PSFB is the topology of choice for high input voltage, high power applications because:

- It achieves Zero Voltage Switching (ZVS) which significantly reduces switching losses.
- It uses the full flux swing available from the transformer core so that a smaller transformer is possible.
- The transformer primary is driven with the full input voltage minimising primary currents.
- Efficiencies of greater than 99% can be achieved.
- It works well over a wide input/output conversion ratios

The main disadvantage is that it requires four active switches on the transformer primary.

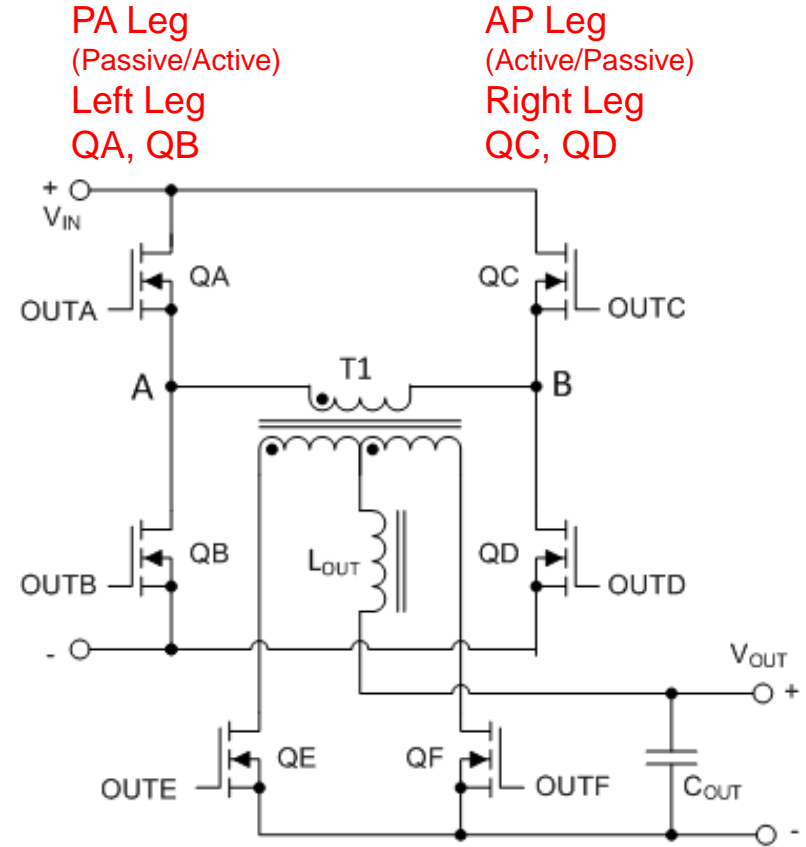
Phase Shifted Full Bridge

- Four switches, transformer, two rectifiers, inductor
 - Double ended topology
- Buck like output stage
 - Two Energy Transfer or Active states
 - Two Passive or Freewheeling states
- Four ZVS transitions per cycle
- Phase between legs controls the conversion ratio
 - Complex control, requires IC
- High power (1kW and upwards)
- Can achieve zero voltage switching
 - Important for high V_{in} applications

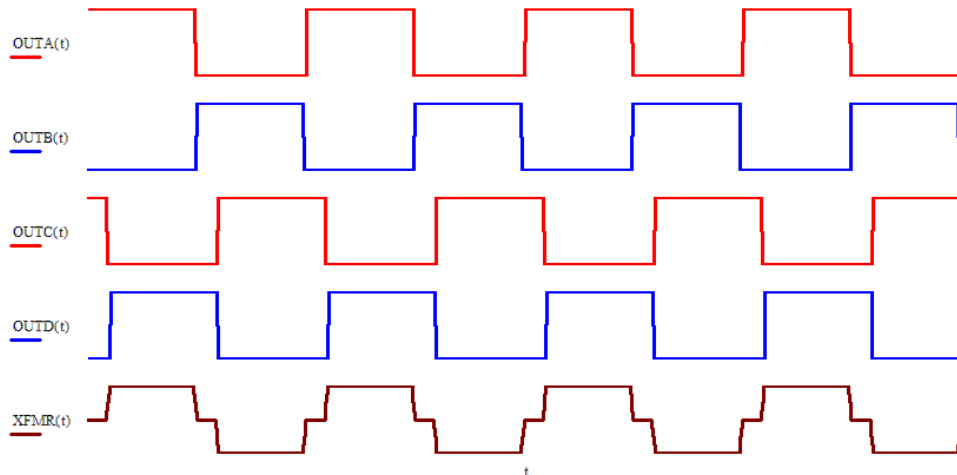


Phase Shifted Full Bridge

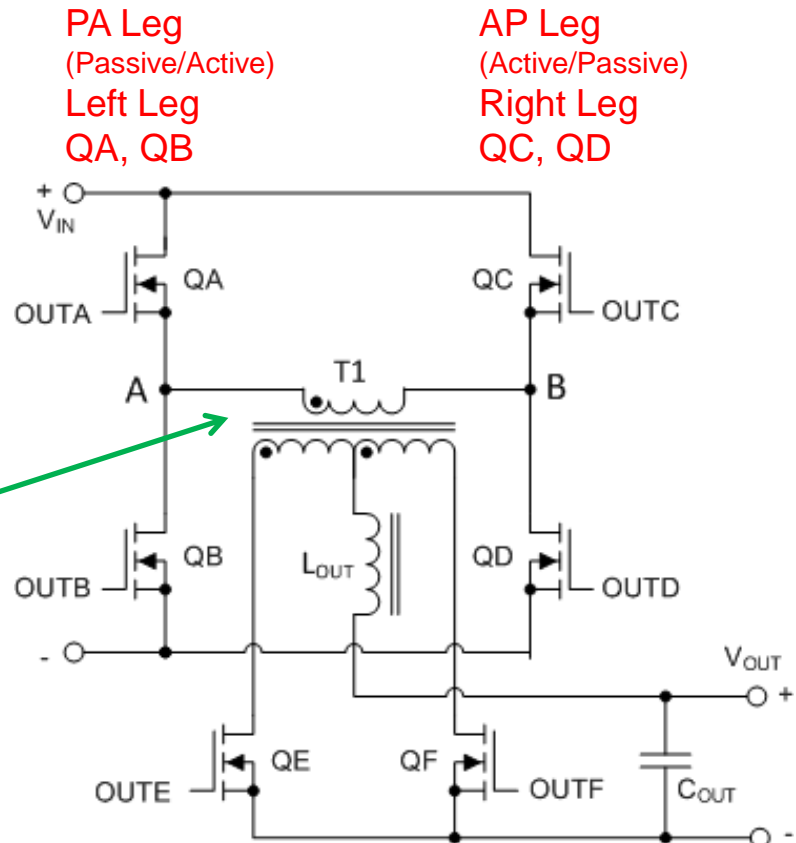
- Can achieve zero voltage switching
- ZVS and reduced cross conduction requires:
 - Delay time between QA OFF and QB ON
 - Delay time between QC OFF and QD ON
- Reduced body diode conduction requires
 - Delay time between QA OFF and QF OFF
 - Delay time between QB OFF and QE OFF



Phase Shifted Full Bridge



Buck Derived topology $\longrightarrow V_{OUT} = D V_{IN} \frac{N_S}{N_P}$
 OUTA, OUTB – reference pair
 D controlled by phase shifting OUTC & OUTD
 QE, QF are SRs, Diode rectification is possible



Mouse over the waveforms to play the animation

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Thank You

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