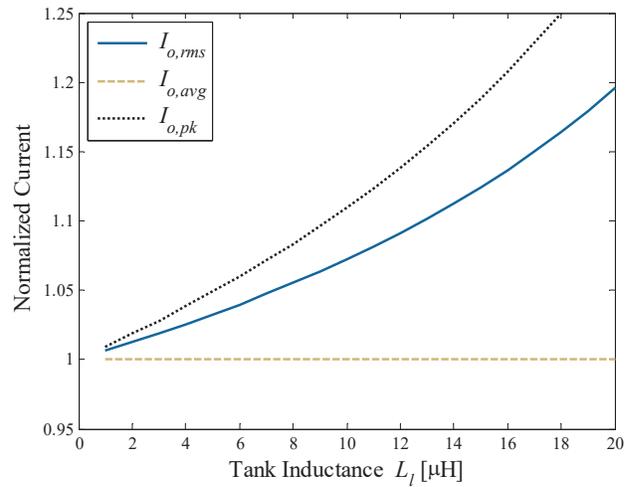
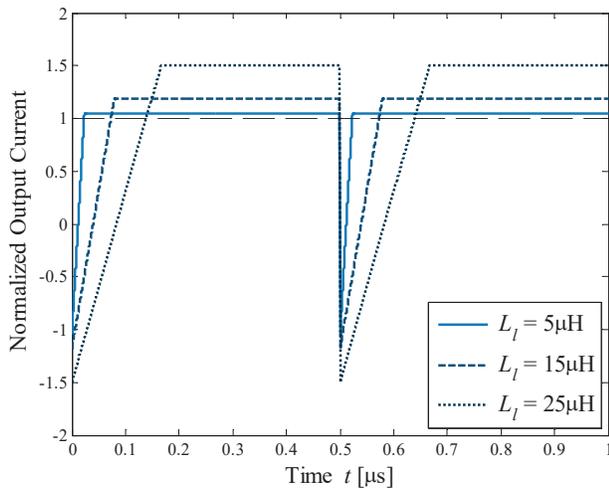
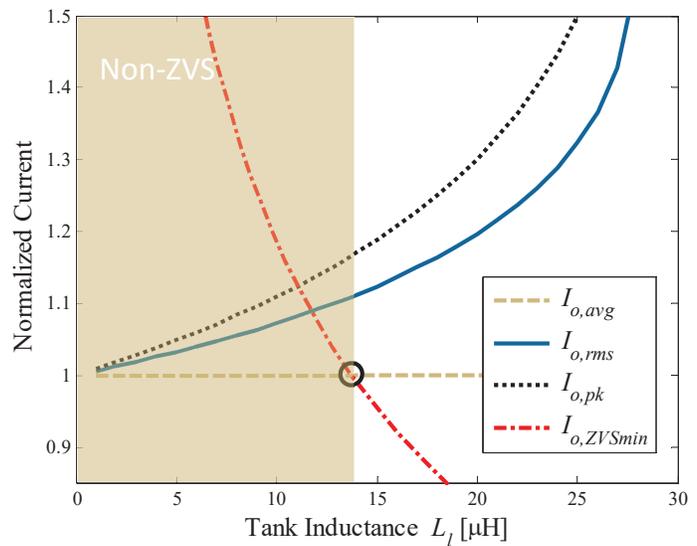


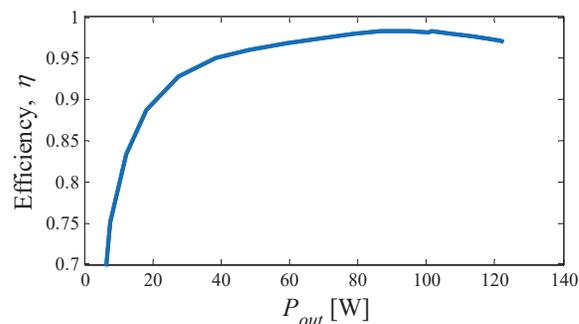
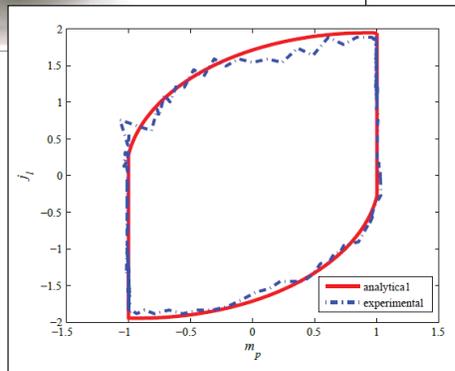
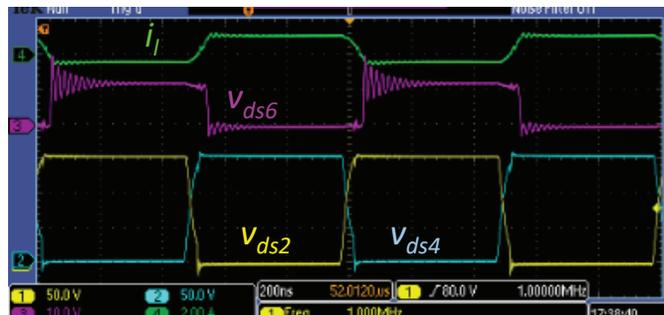
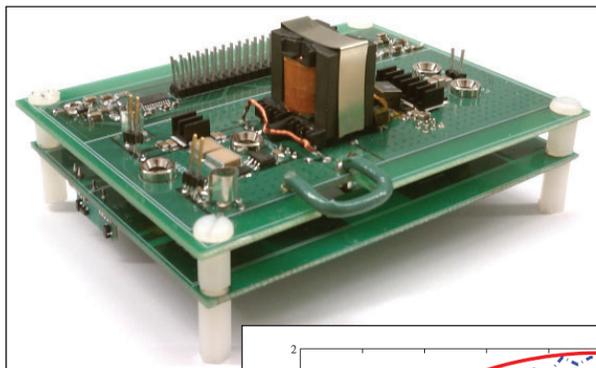
Output Current Vs. Inductance



Constraints on Inductance



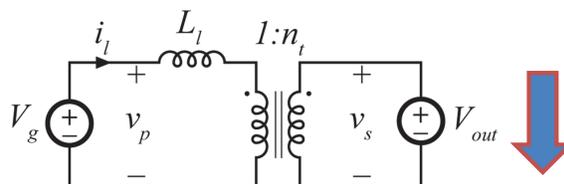
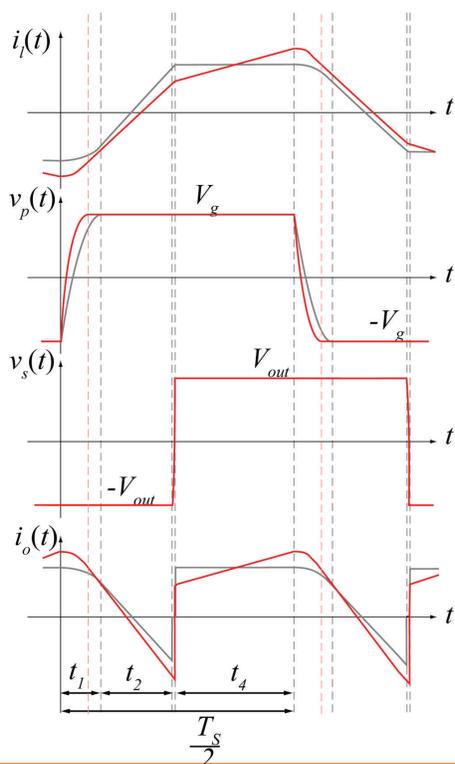
DAB: Experimental Results



D. Costinett, D. Maksimovic, and R. Zane, "Design and control for high efficiency in high step-down dual active bridge converters operating at high switching frequency," IEEE Trans. Power Electron., vol. PP, no. 99, p. 1, 2012.



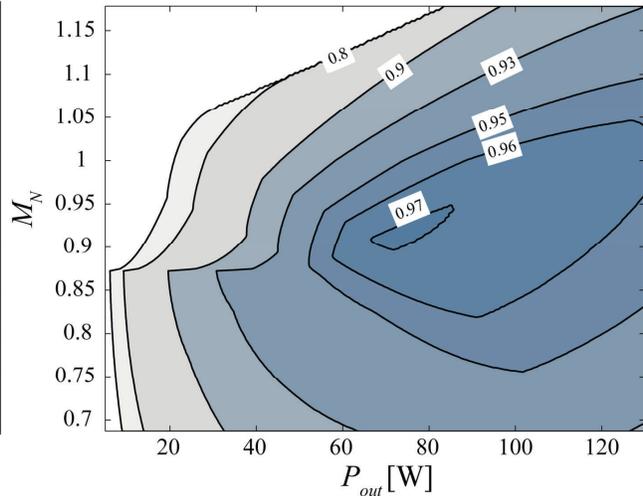
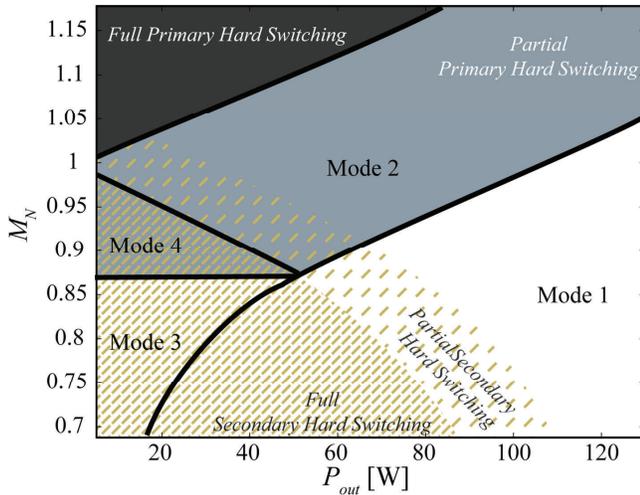
Operation with $V \neq nV_g$



- E.g. Decrease to $M_N < 1$ by decreasing output voltage
- Current now ramping, causing more energy available for primary ZVS, but higher RMS currents
- Can use behavior to extend ZVS range of one bridge



Soft Switching Range with Varying V_{out}



D. Costinett, D. Maksimovic, and R. Zane, "Design and control for high efficiency in high step-down dual active bridge converters operating at high switching frequency," IEEE Trans. Power Electron., vol. PP, no. 99, p. 1, 2012.



Application Example: Automotive

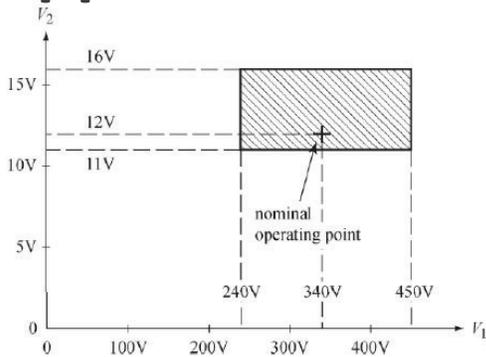


Fig. 1. Converter operating voltage ranges required for automotive application.

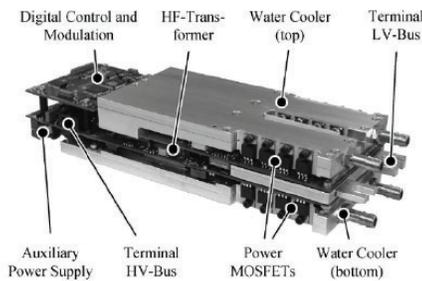
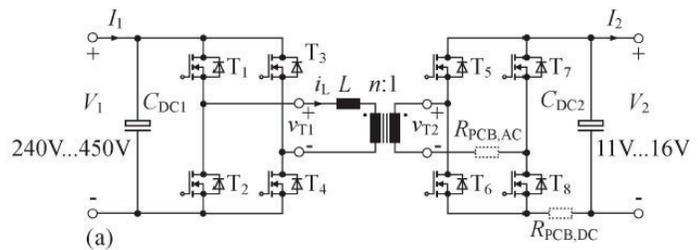


Fig. 3. Automotive DAB converter (273 × 90 × 53 mm).



(a)

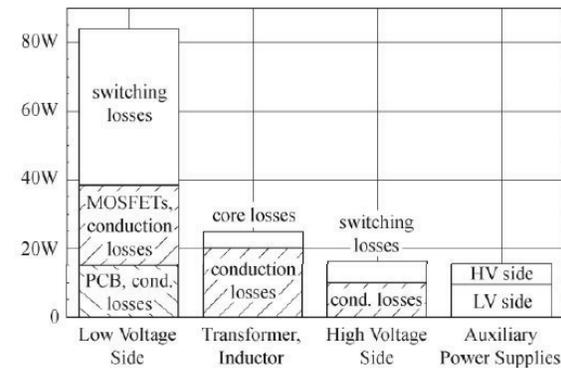
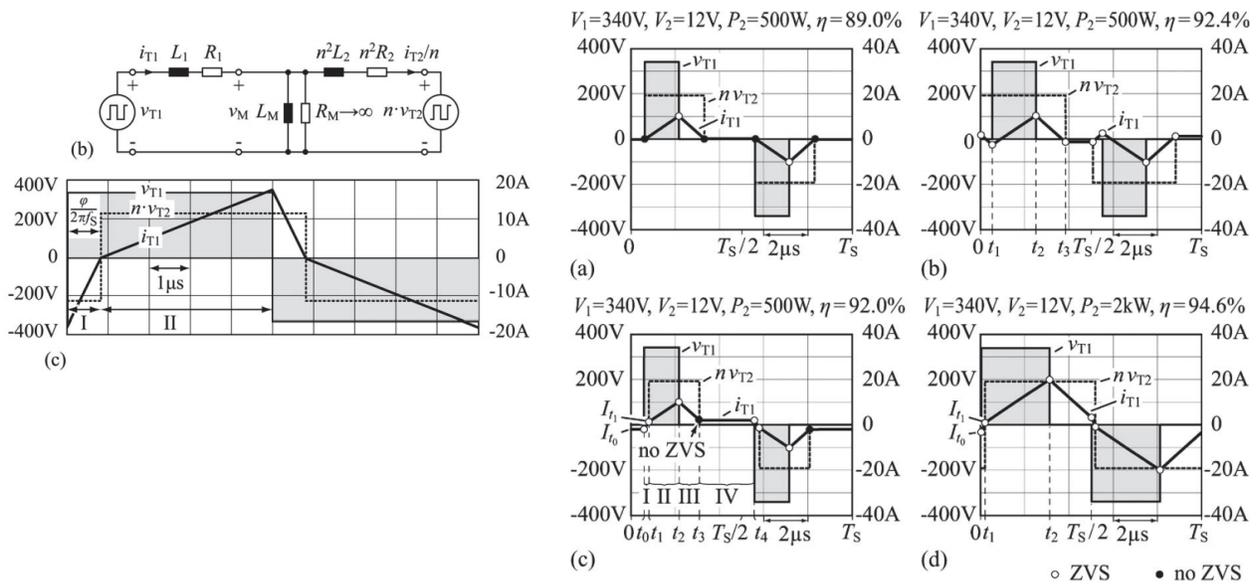


Fig. 13. Calculated distribution of the power losses for operation at $V_1 = 340$ V, $V_2 = 12$ V, and $P_2 = 2$ kW.

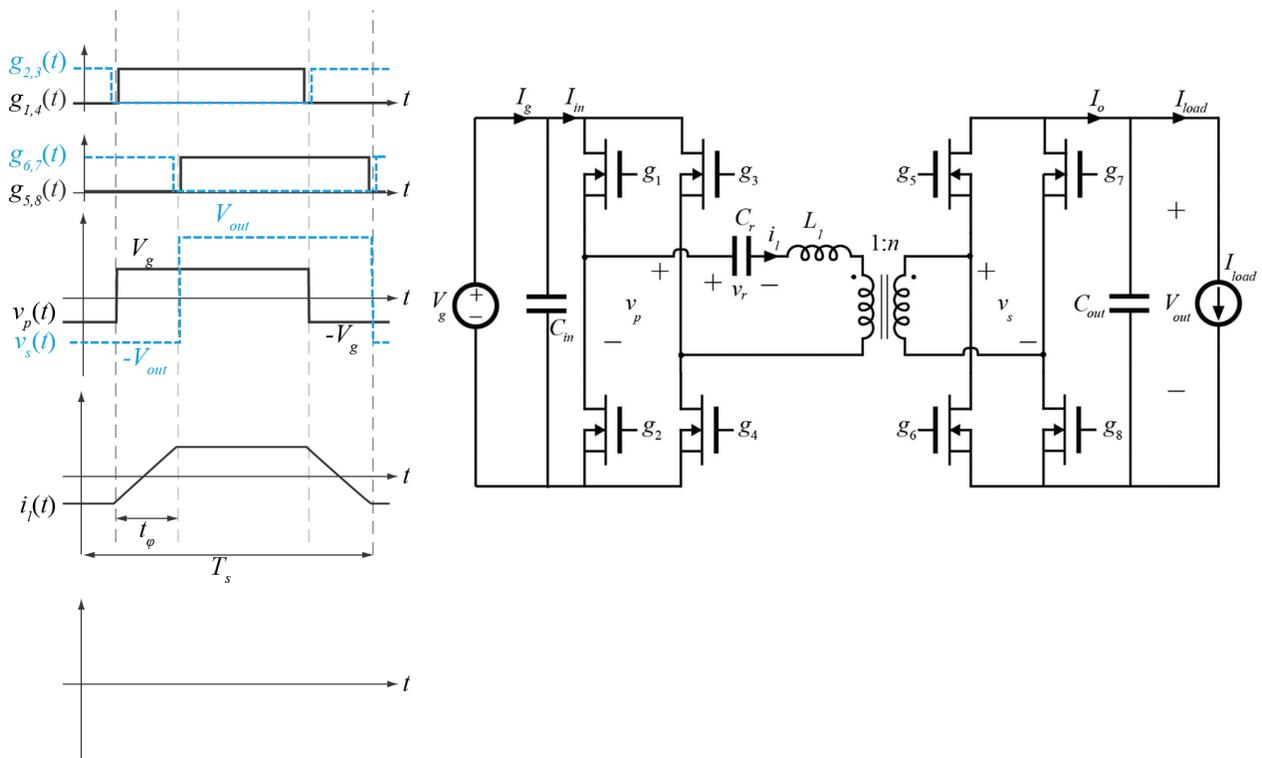
*F. Krismer, J.W.Kolar, "Accurate Power Loss Model Derivation of a High-Current Dual Active Bridge Converter for an Automotive Application, IEEE Trans. On Industrial Electronics, March 2010



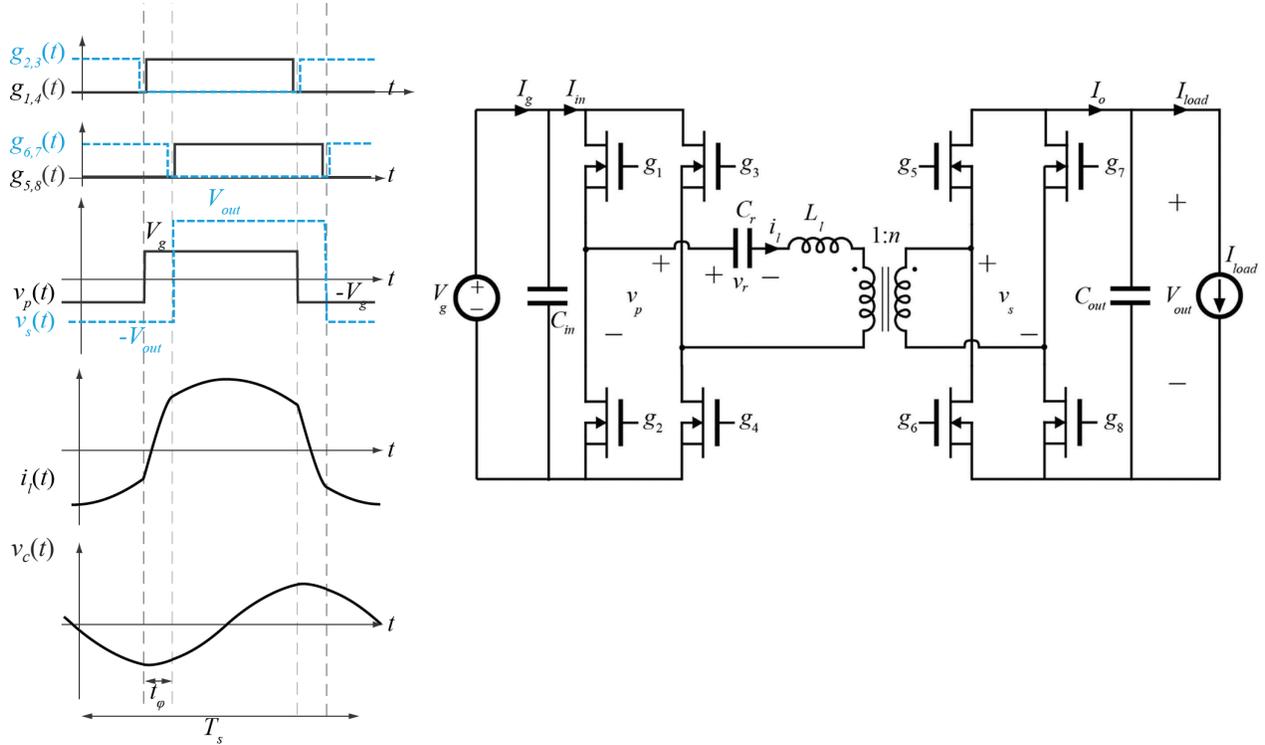
Alternate Modulation Schemes



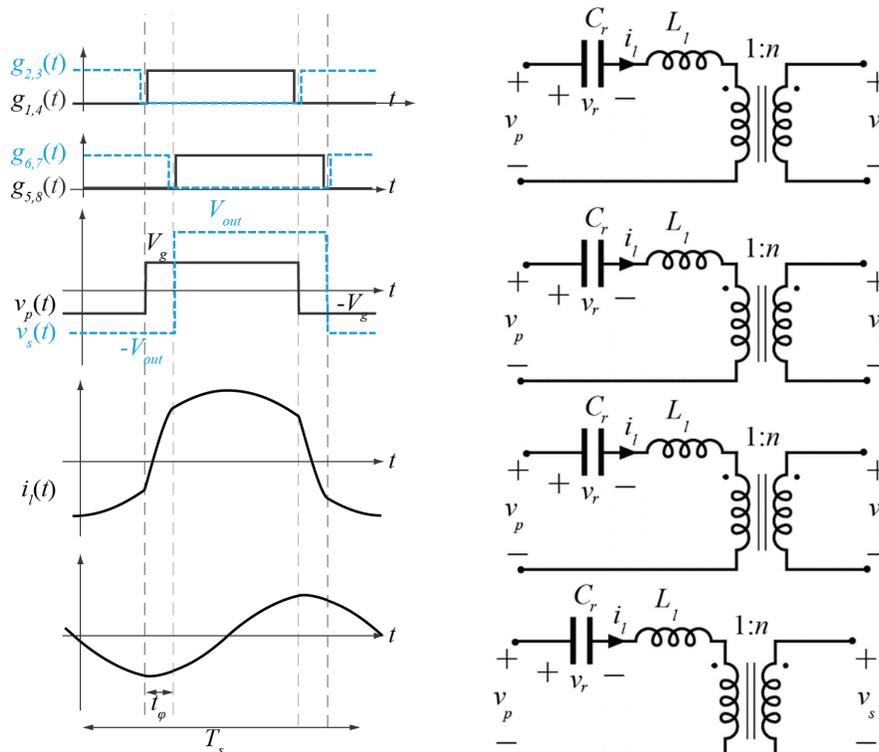
DAB: Transformer Saturation



Series Resonant Converter



Subinterval Equivalent Circuits



Complete State Plane – Phase Shift Modulation

