

Midterm Exam

14. Sep. 21 DCM Converter Examples Recorded Lecture Zetbook: Sections 2.1, 3.2 Lecture 14 handout slides Lecture 14 slides (annotated)	15. Sep. 23 Converter Topologies Isolated Converters Recorded Lecture Zetbook: Section 8.2 Lecture 15 handout slides Lecture 15 slides (annotated)	16. Sep. 25 Isolated Converters: Full Bridge Zetbook: Section 8.3 Lecture 16 handout slides Lecture 16 slides (annotated) <i>Assignment 3 Due</i>
17. Sep. 28 Isolated Converters: Forward Flyback Constant Load: 10 slides Zetbook: Section 8.2	18. Sep. 30 Final Flyback Converter Converter Design Zetbook: Section 8.4	19. Oct. 1 <i>Assignment 4 Due</i> ② Exam Handled out
20. Oct. 7 Handed out	21. Oct. 7	22. Oct. 7 ① In class Exam
23. Oct. 12 Due	24. Oct. 14	Oct. 14 Fall Break
25. Oct. 19	26. Oct. 21	27. Oct. 23 <i>Assignment 5 Due</i>
28. Oct. 26	29. Oct. 28	30. Oct. 30

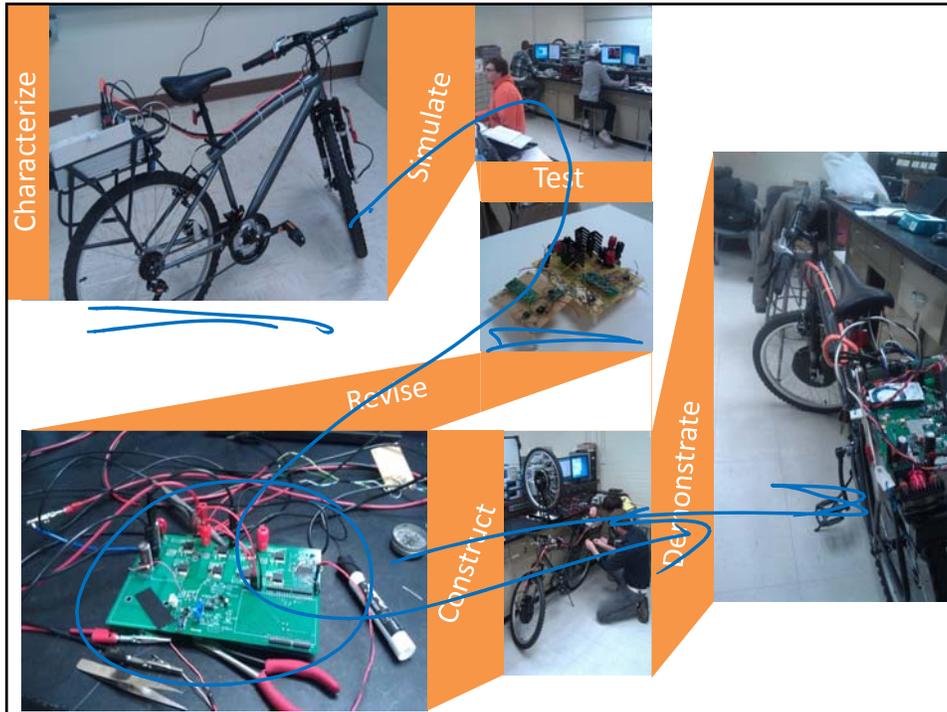
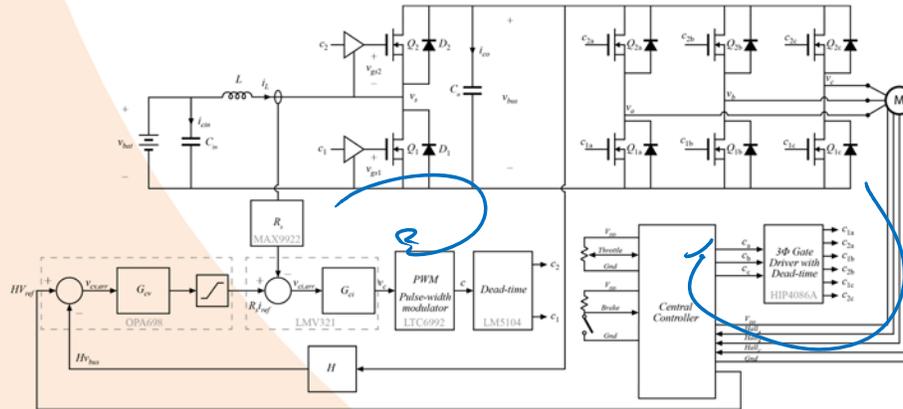


ECE 482: Power Electronic Circuits

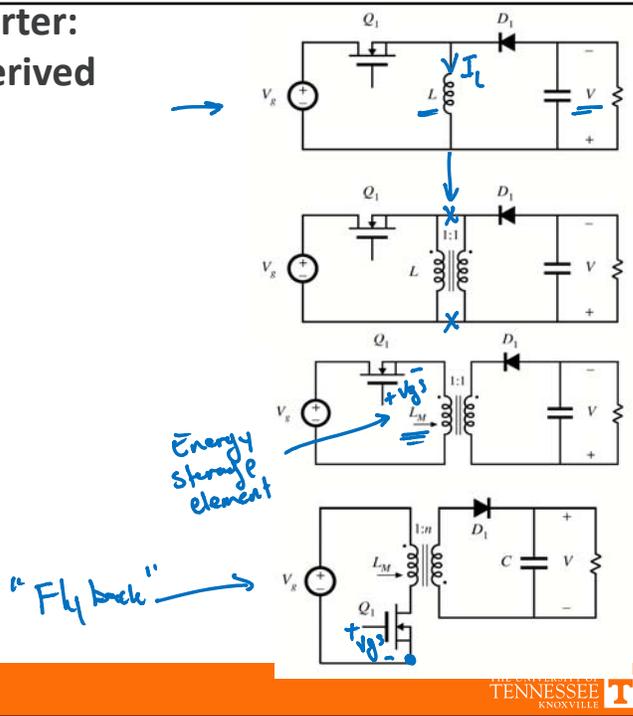
- Hands-on; spend majority of course time on lab work
- Design-oriented introduction to the analysis, modeling, and testing of power electronics
- Fabrication of the multiple switched-mode power converters
 - Analog and digital control systems
 - Realize a functioning, sub-kW electric vehicle
 - Compete to achieve best performance of EV drive train
- For more information, contact:
Prof. Daniel Costinett, daniel.costinett@utk.edu



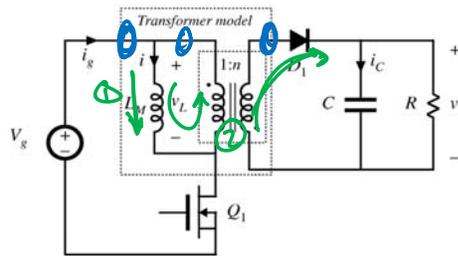
Realize a fully functional electric vehicle drivetrain



Flyback Converter: Buck-Boost Derived



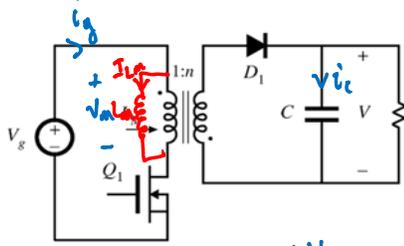
Flyback Transformer



- A two-winding inductor
- Symbol is same as transformer, but function differs significantly from ideal transformer
- Energy is stored in magnetizing inductance
- Magnetizing inductance is relatively small

- Current does not simultaneously flow in primary and secondary windings
- Instantaneous winding voltages follow turns ratio
- Instantaneous (and rms) winding currents do not follow turns ratio
- Model as (small) magnetizing inductance in parallel with ideal transformer

Flyback Waveforms



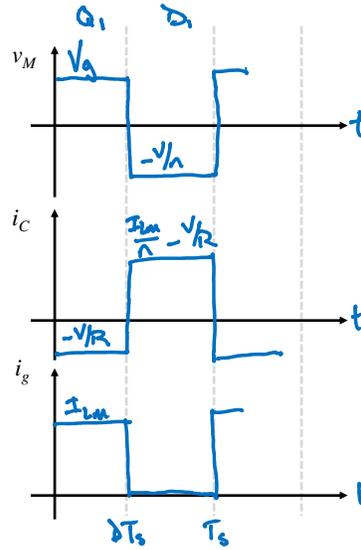
$$\langle v_M \rangle = \phi = D V_g - D' \frac{V}{n}$$

$$M(D) = \frac{V}{V_g} = \frac{D}{D'}$$

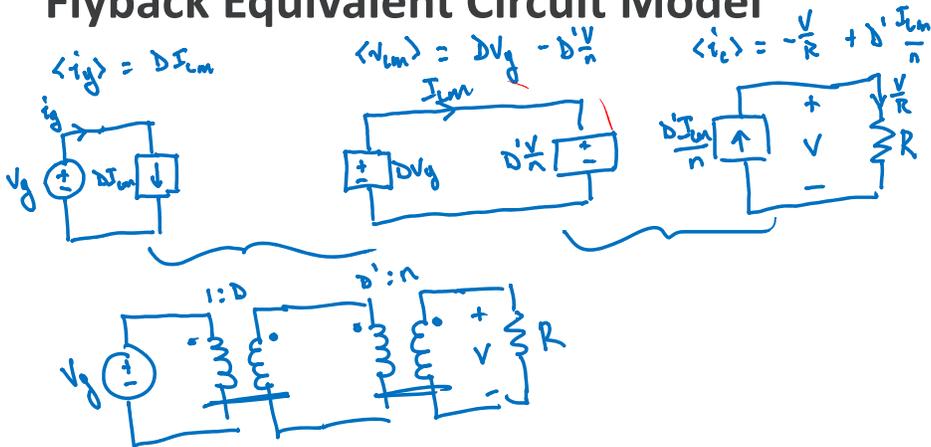
$$\langle i_c \rangle = \phi = -\frac{V}{R} + D' \frac{I_{Lm}}{n}$$

$$I_{Lm} = \frac{nV}{RD}$$

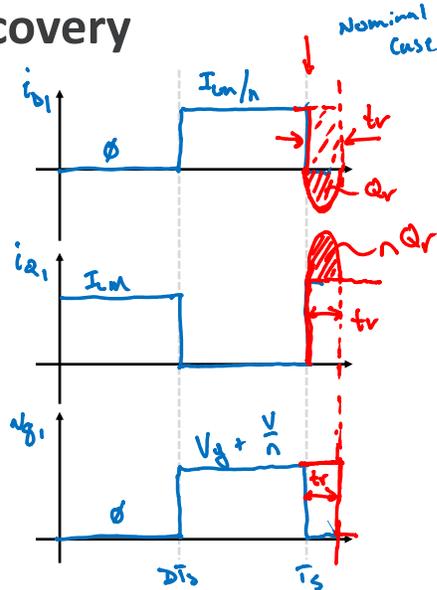
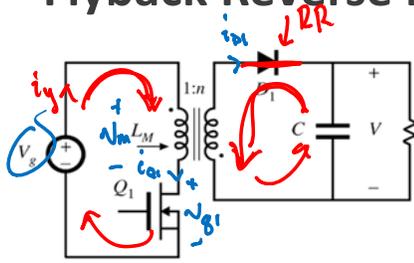
$$\langle i_g \rangle = D I_{Lm}$$



Flyback Equivalent Circuit Model



Flyback Reverse Recovery



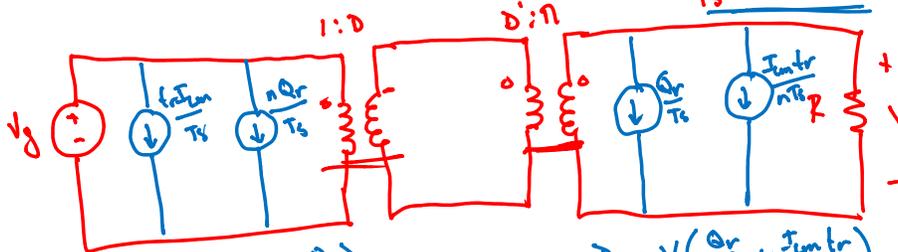
RR MOSFET $E_{loss} = (V_g + \frac{V}{n}) (I_{Mm} tr + nQR)$

Flyback Equivalent Circuit Model

$$\langle i_g \rangle = D I_{Mm} + \frac{tr I_{Mm}}{T_s} + \frac{nQR}{T_s}$$

$\langle I_{Mm} \rangle = (\text{the same})$

$$\langle i_c \rangle = \phi = -\frac{V}{R} + D I_{Mm} \frac{n}{T_s} - \frac{QR}{T_s} - \frac{I_{Mm} tr}{n T_s}$$

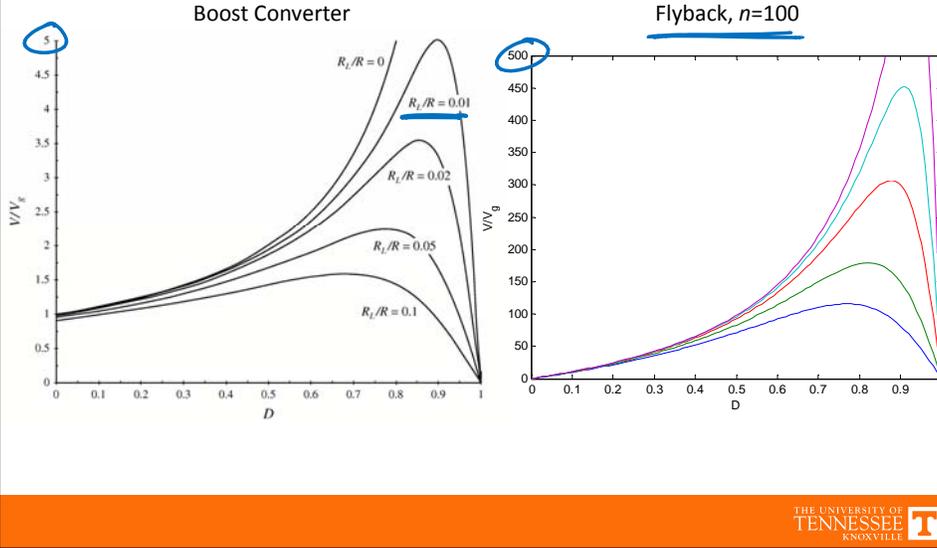


$$P_1 = V_g \left(\frac{tr I_{Mm}}{T_s} + \frac{nQR}{T_s} \right)$$

$$P_2 = V \left(\frac{QR}{T_s} + \frac{I_{Mm} tr}{n T_s} + \frac{n}{R} \left(\frac{nQR}{T_s} + \frac{I_{Mm} tr}{T_s} \right) \right)$$

$$P_1 + P_2 = \frac{1}{T_s} \left(V_g + \frac{V}{n} \right) (nQR + I_{Mm} tr)$$

High Step-Up Conversion Ratios



Switch Ratings

