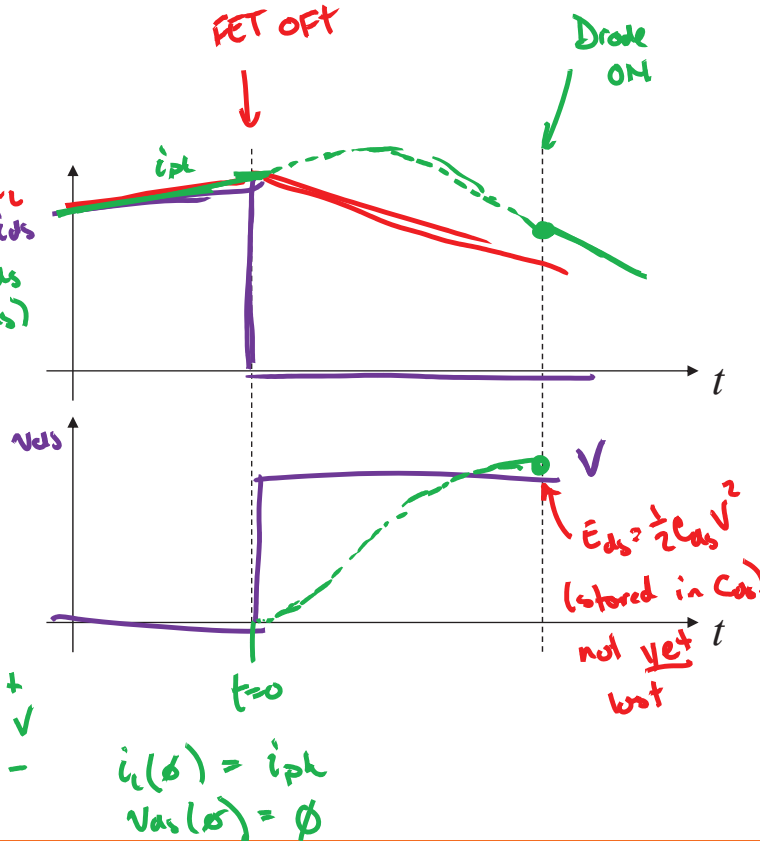
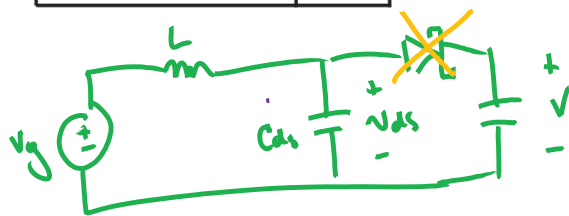
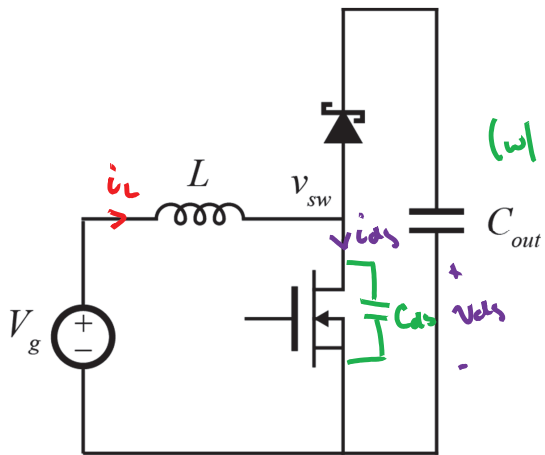
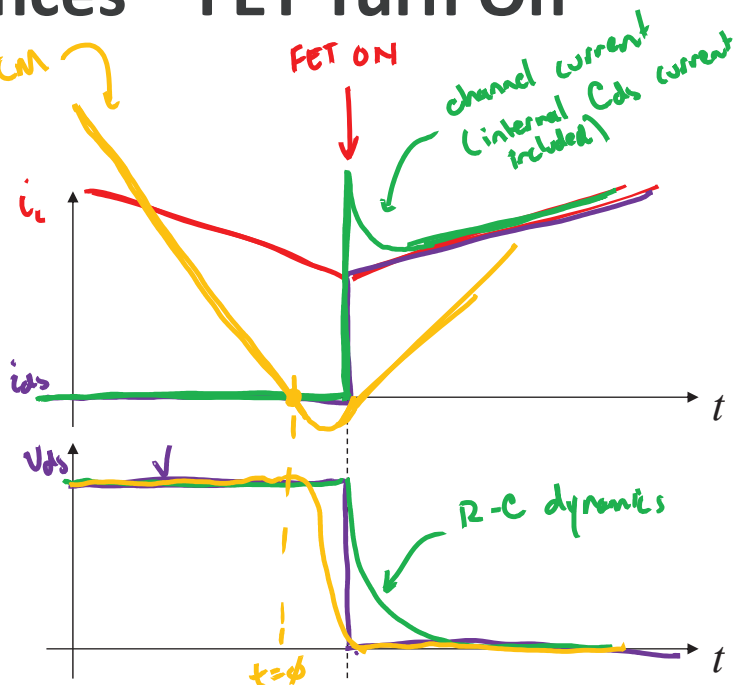
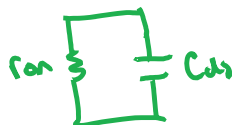
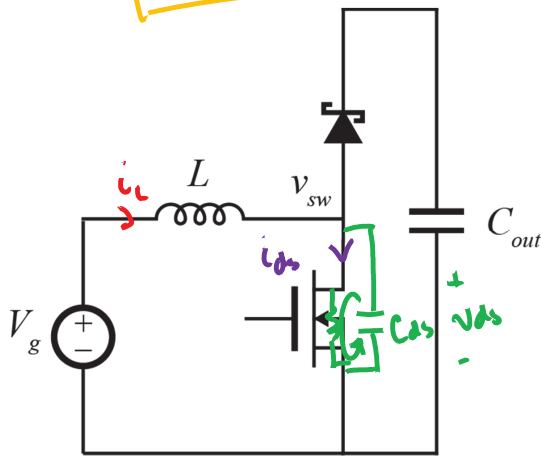
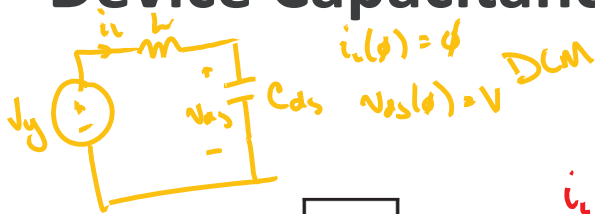


# Device Capacitances – FET Turn Off

ECE 481



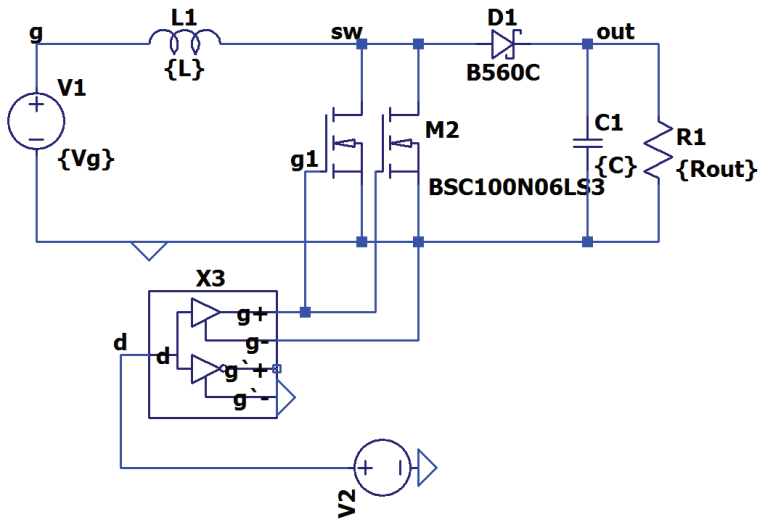
# Device Capacitances – FET Turn On



All  $E_{gs} = \frac{1}{2} C_{gs} V^2$  stored in  $C_{gs}$  dissipated during FET turn-on

# DCM: Soft Switching → zvs

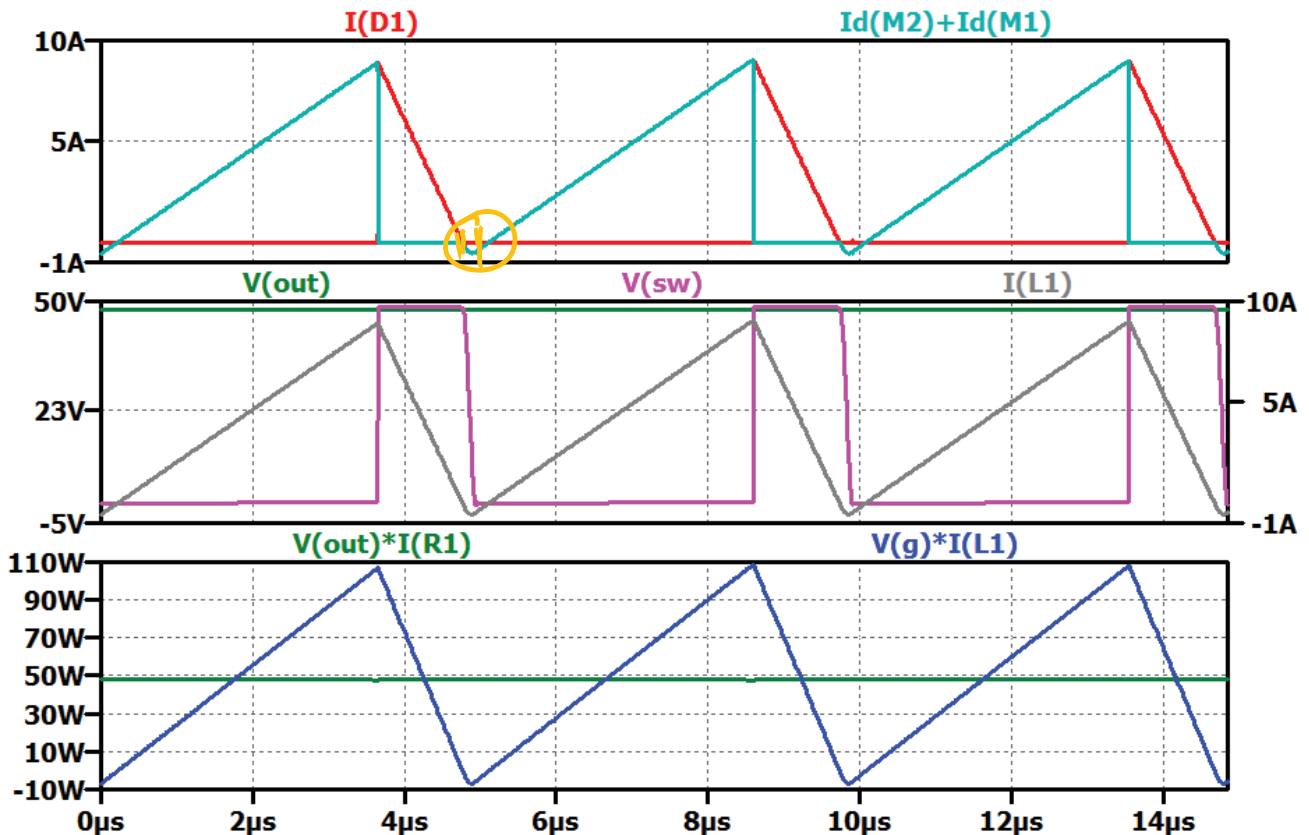
"Zero Voltage Switching"



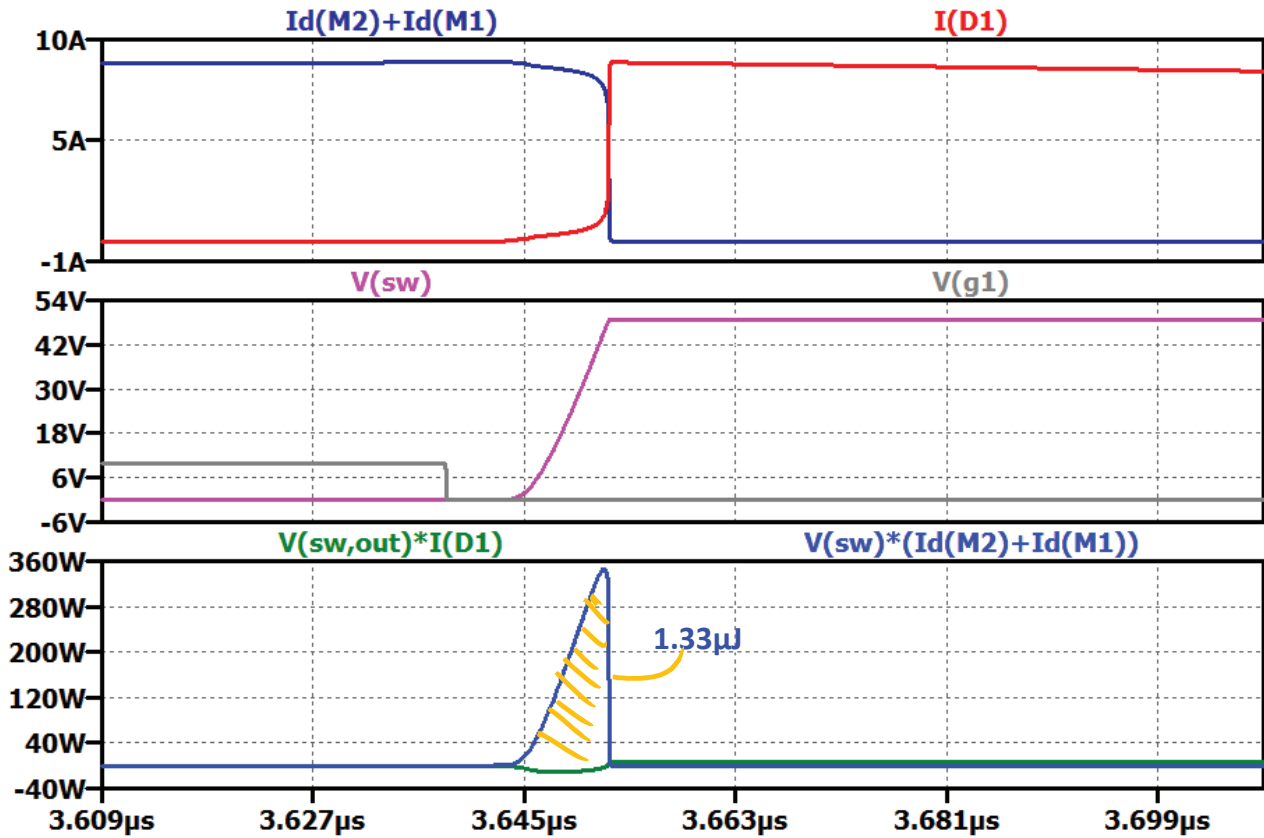
$L$	$C_{out}$	$f_s$	Diode	$\eta$ (Sim)
22uH	22uF	202k	Si (FR)	93.9%
22uH	22uF	202k	Si Schottky	95.8%
4.6uH	22uF	202k	Si Schottky	98.2%

) +20%

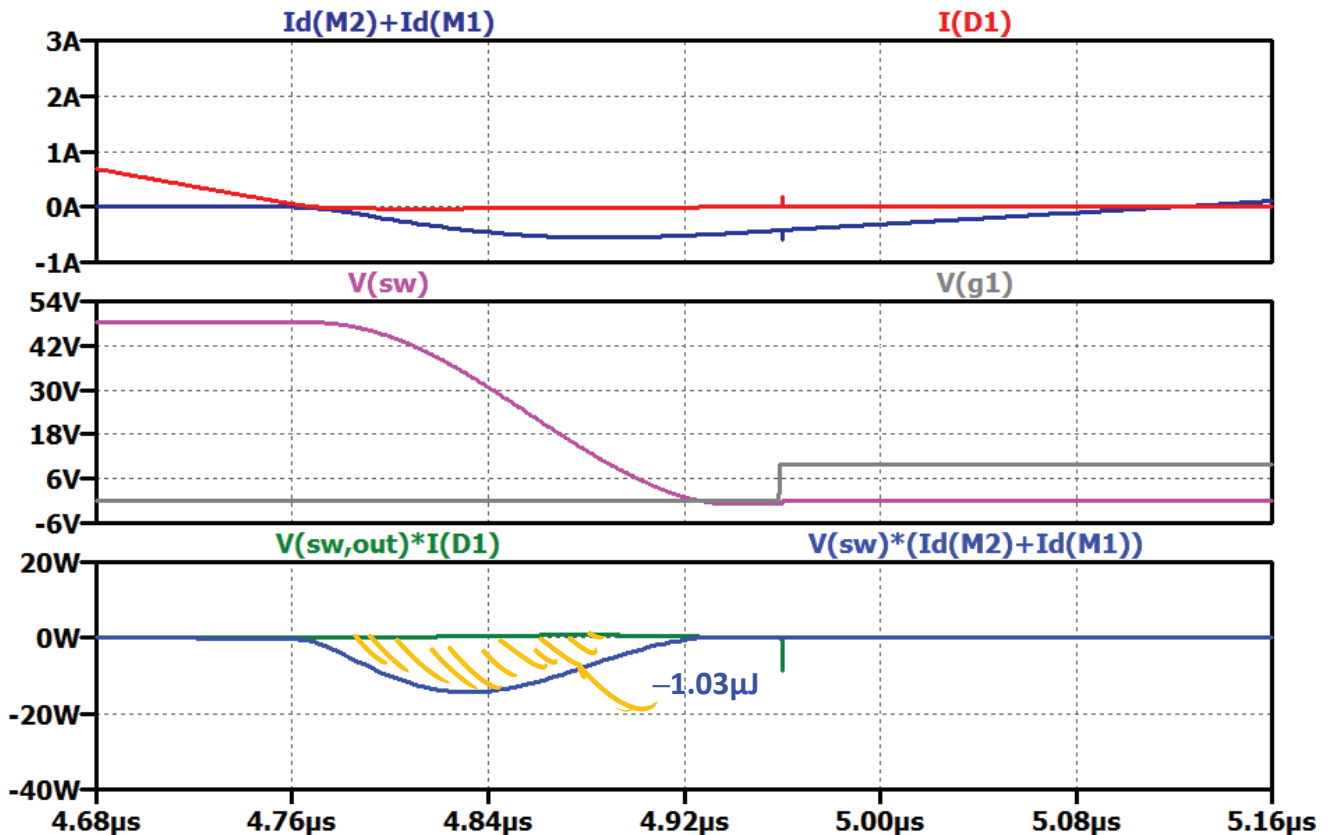
## DCM Simulation



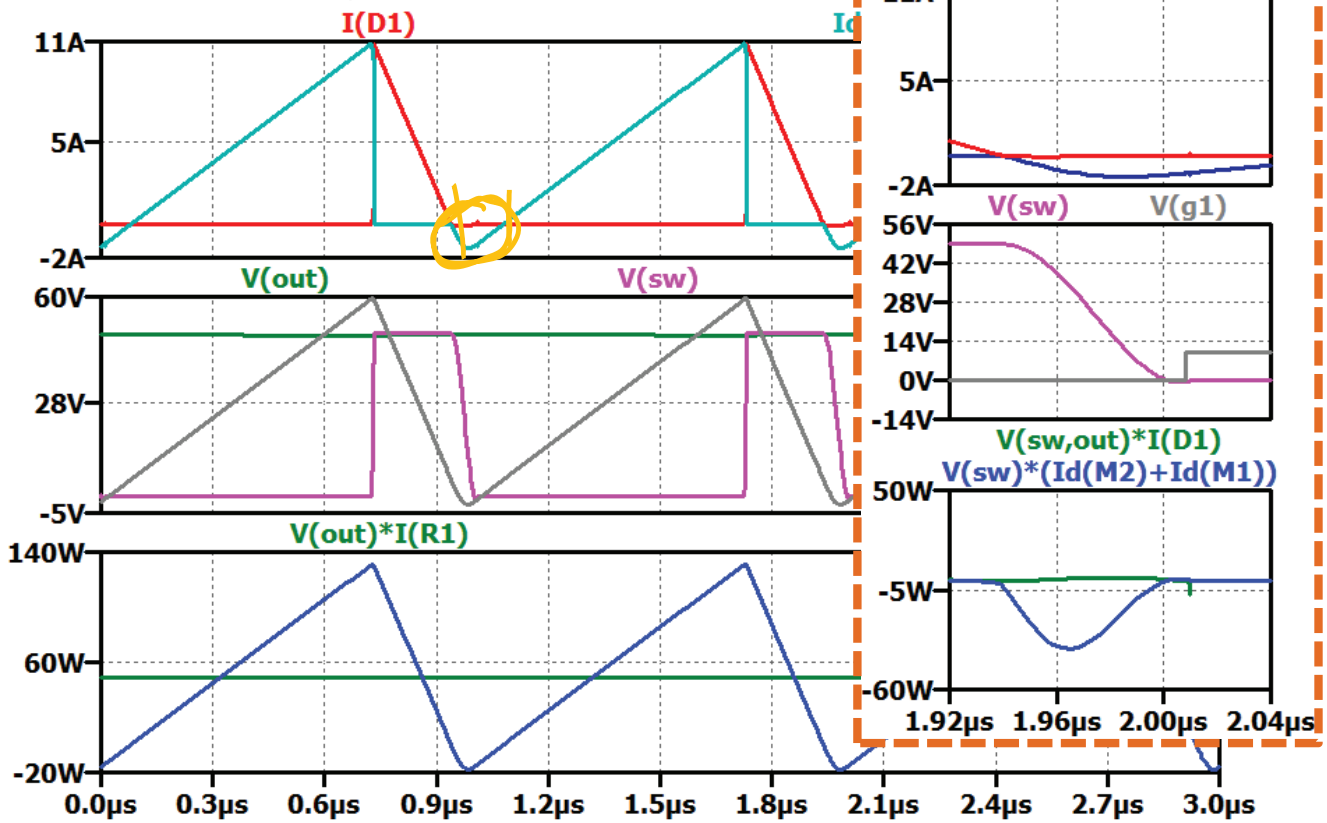
# MOSFET Turn-Off



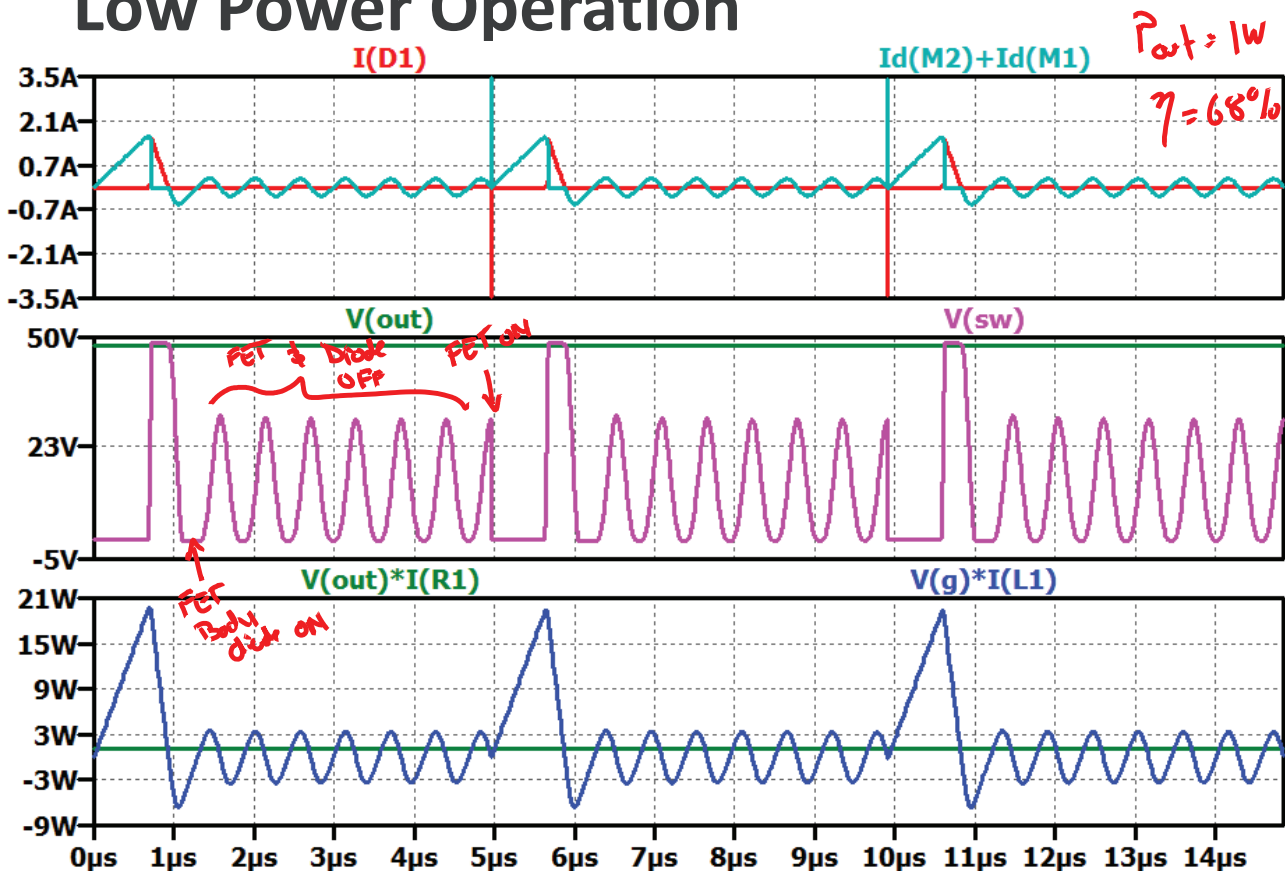
# MOSFET Turn-On



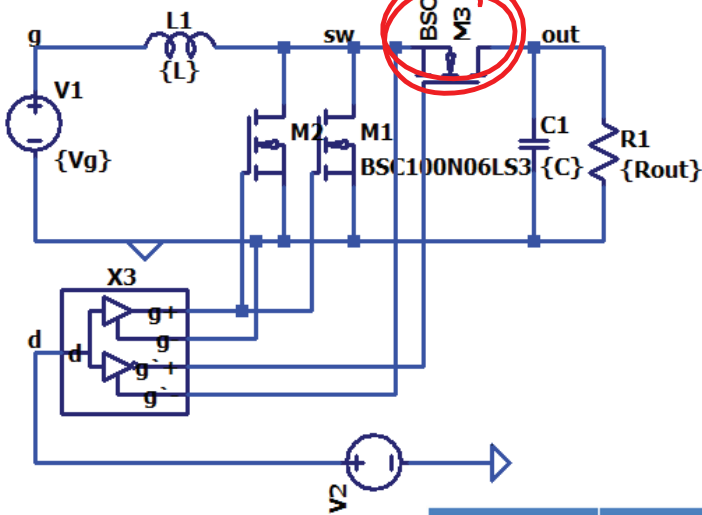
# 1 MHz Operation



# Low Power Operation

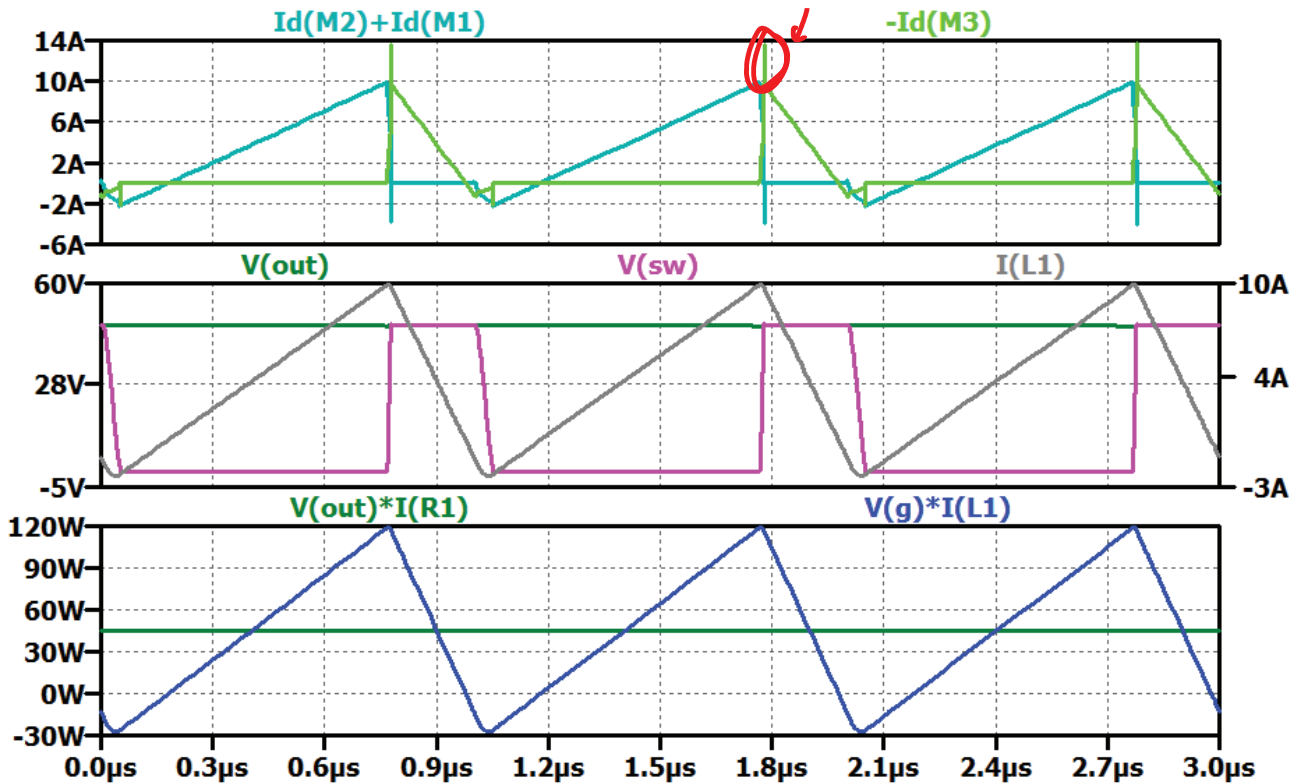


# Synchronous Operation

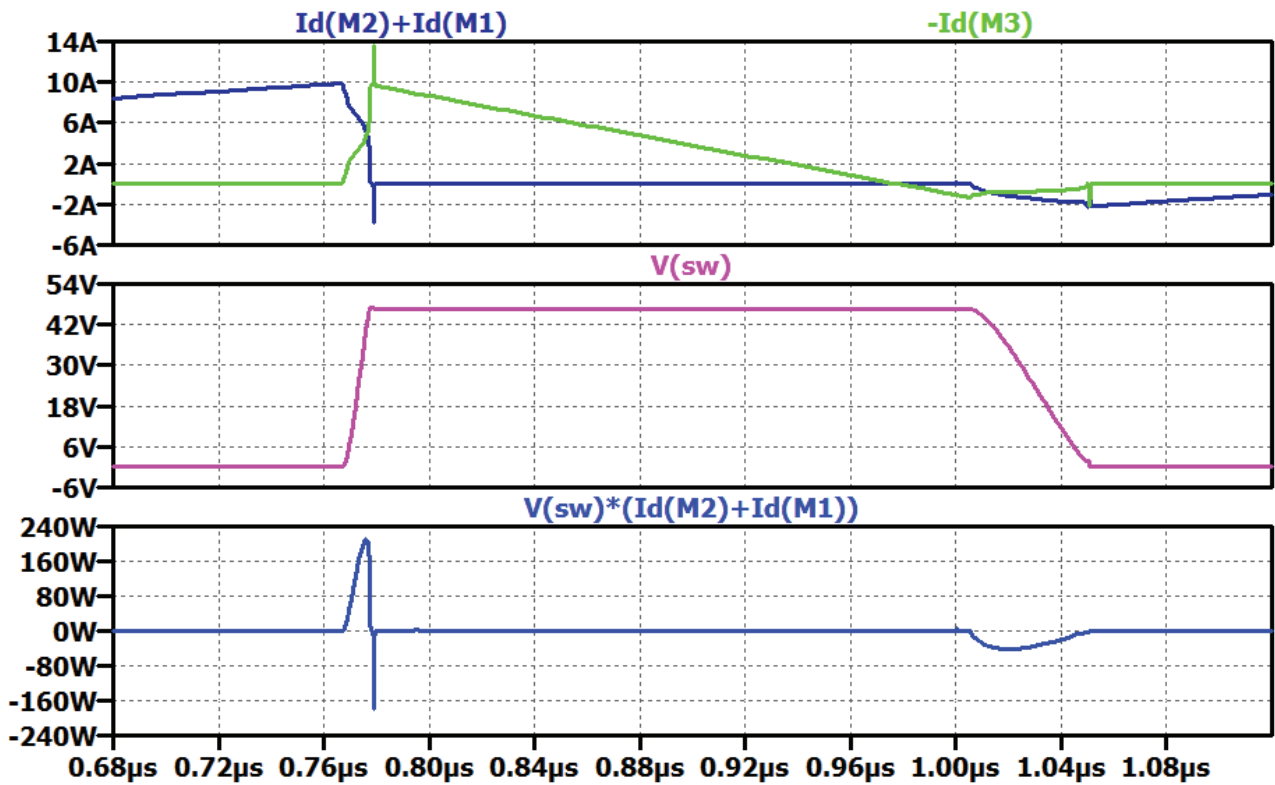


$L$	$C_{out}$	$f_s$	Diode	$\eta$ (Sim)
22uH	22uF	202k	Si (FR)	93.9%
22uH	22uF	202k	Si Schottky	95.8%
4.65uH	22uF	202k	Si Schottky	98.4%
710nH	4.4uF	1 MHz	Si Schottky	98.2%
710nH	4.4uF	1 MHz	MOSFET	99.6%

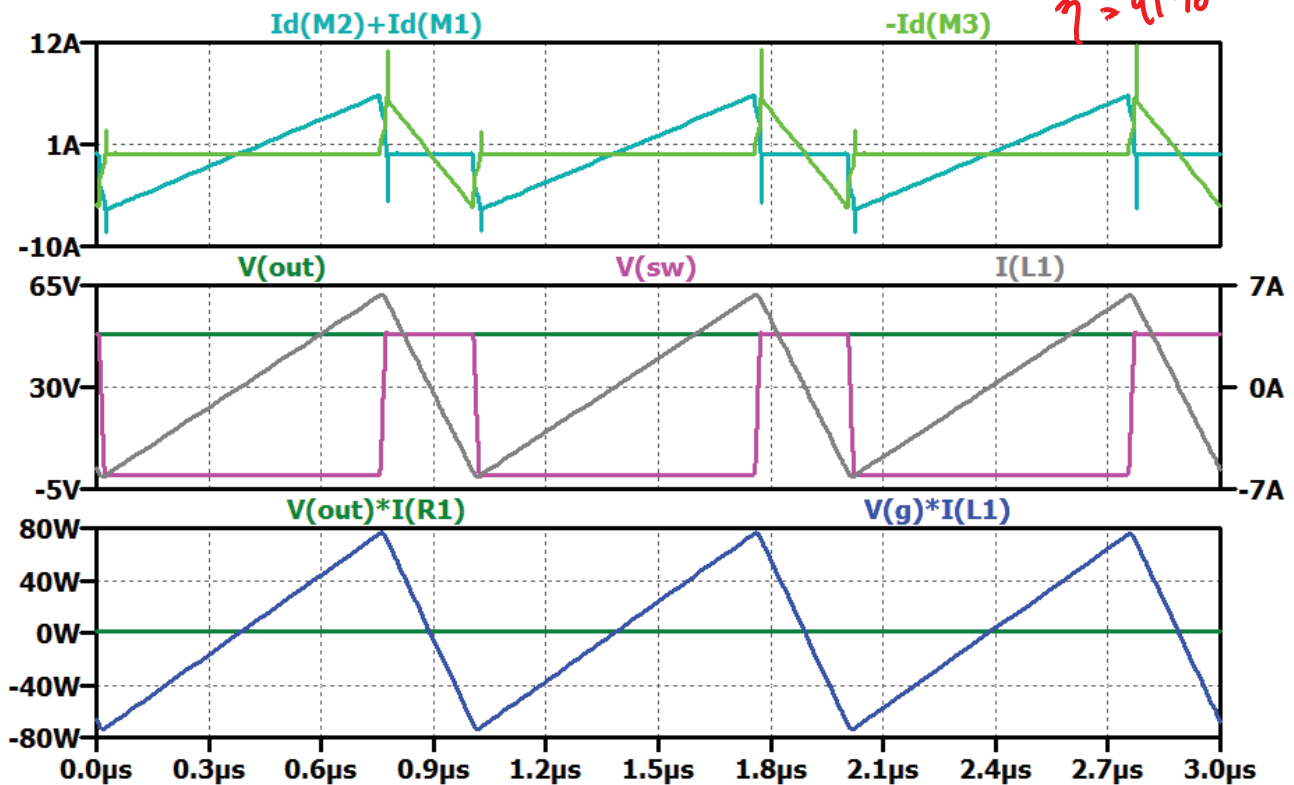
# Synchronous Simulation



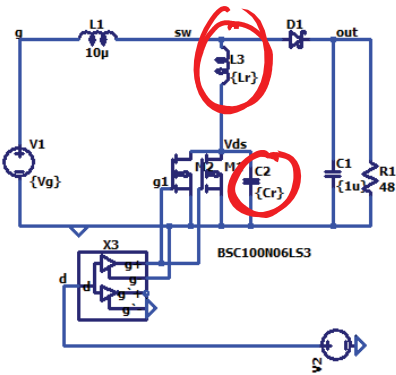
# Switching Transitions



# Low Power Operation



# Resonant Operation

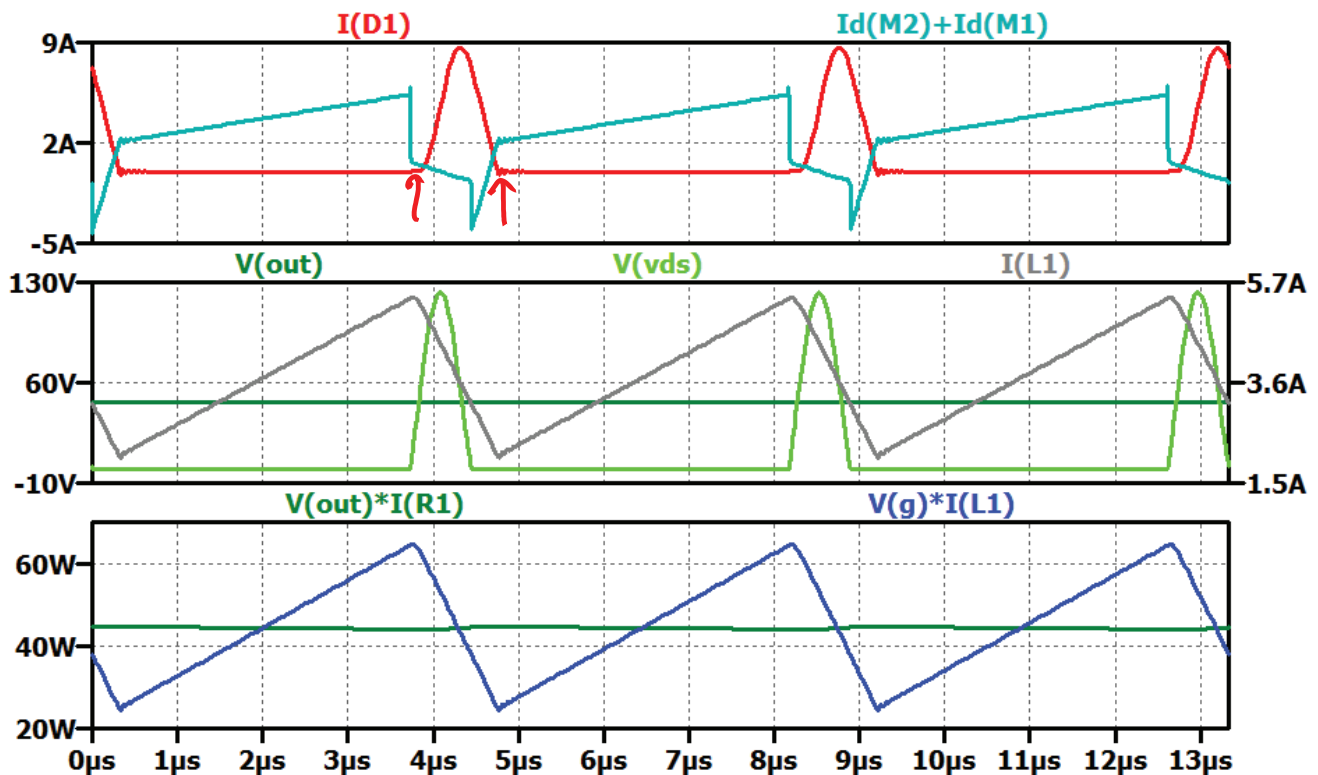


ZVS-QR Boost

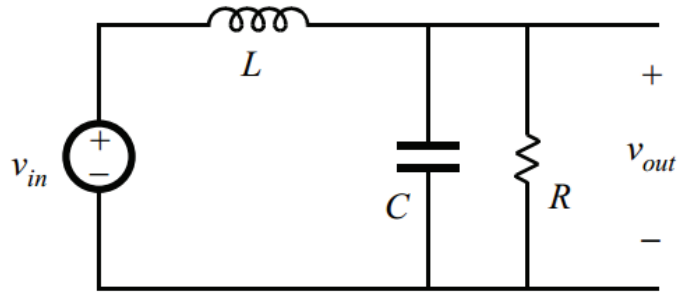
QR → "Quasi-Resonant"

Switching	L	C <sub>out</sub>	f <sub>s</sub>	Diode	η (Sim)
Hard	22µH	22µF	202k	Si (FR)	93.9%
Hard	22µH	22µF	202k	Si Schottky	95.8%
Soft	4.65µH	22µF	202k	Si Schottky	98.4%
Soft	710nH	4.4µF	1 MHz	Si Schottky	98.2%
Soft	710nH	4.4µF	1 MHz	MOSFET	99.6%
Resonant	10µH + 2.4µH	1µF + 10nF	225 kHz	Si Schottky	98.6%
Resonant	10µH + 2.4µH	1µF + 10nF	225 kHz	MOSFET	99.96%

# Resonant Boost Converter



# Resonant Circuits



ECE451

$$i_L \approx I_L$$

$$v_{out} \approx V$$

$$LC \frac{d^2 v_{out}}{dt^2} + \frac{L}{R} \frac{dv_{out}}{dt} + (v_{out} - v_{in}) = 0$$



will develop new techniques