Weekly Report – 07.11.2017

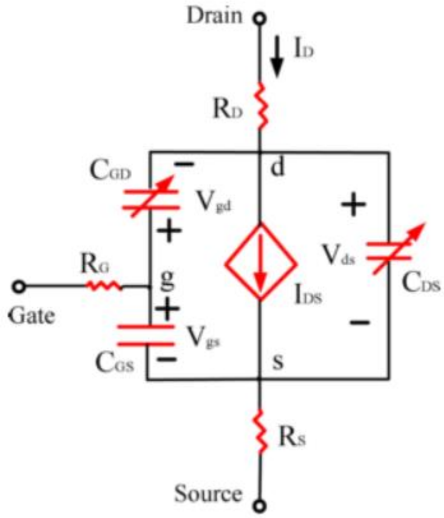


Figure 1: The circuit in GaNFET

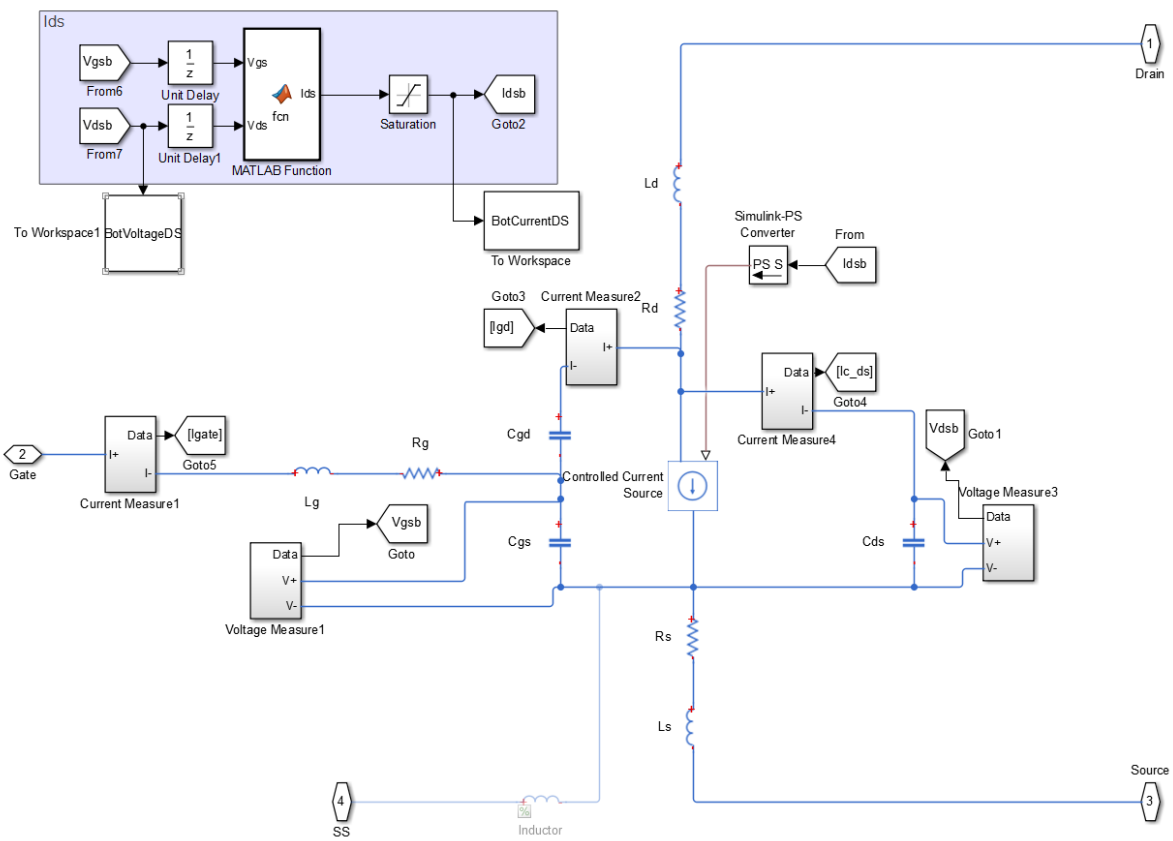


Figure 2: GaN Model

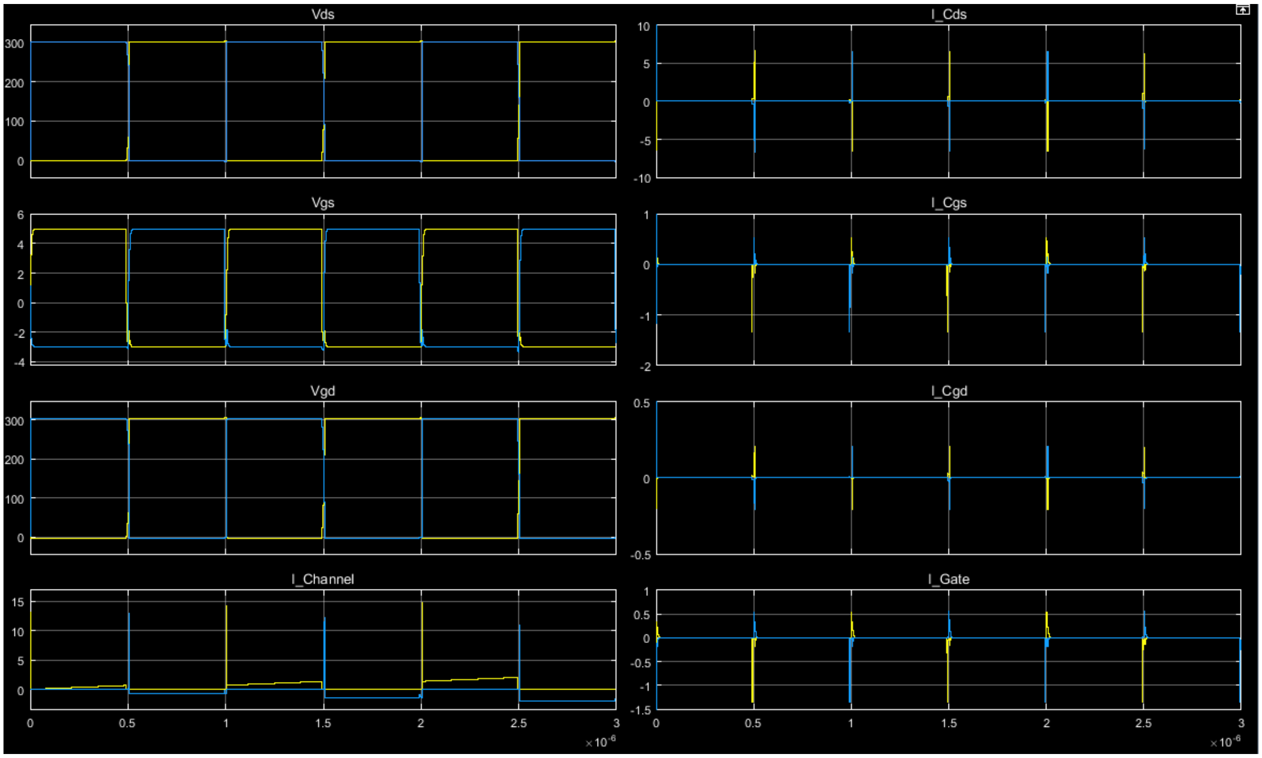


Figure 3: Top and Bottom Switch Characteristics (Yellow-> TOP, Blue-> BOTTOM)

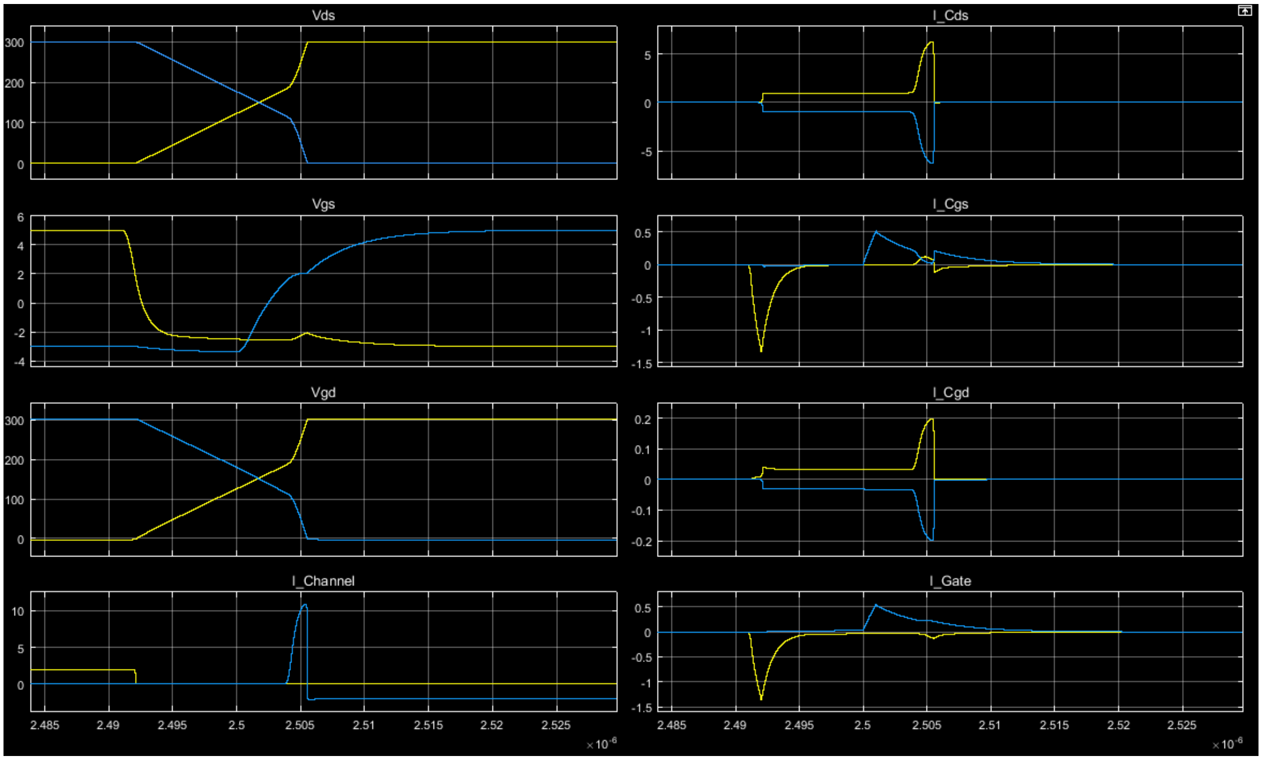


Figure 4: Top Switch Turn OFF, Bottom Switch Turn ON

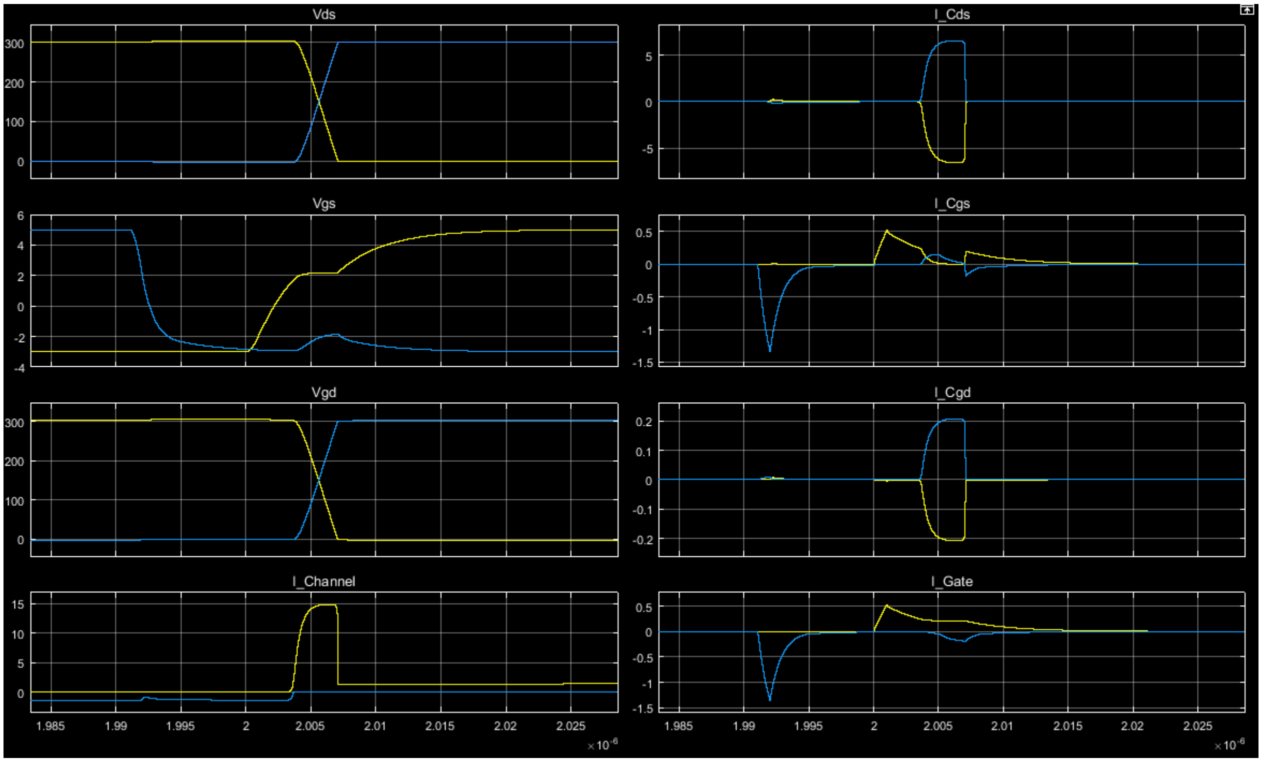


Figure 5: Top Switch Turn ON, Bottom Switch Turn OFF

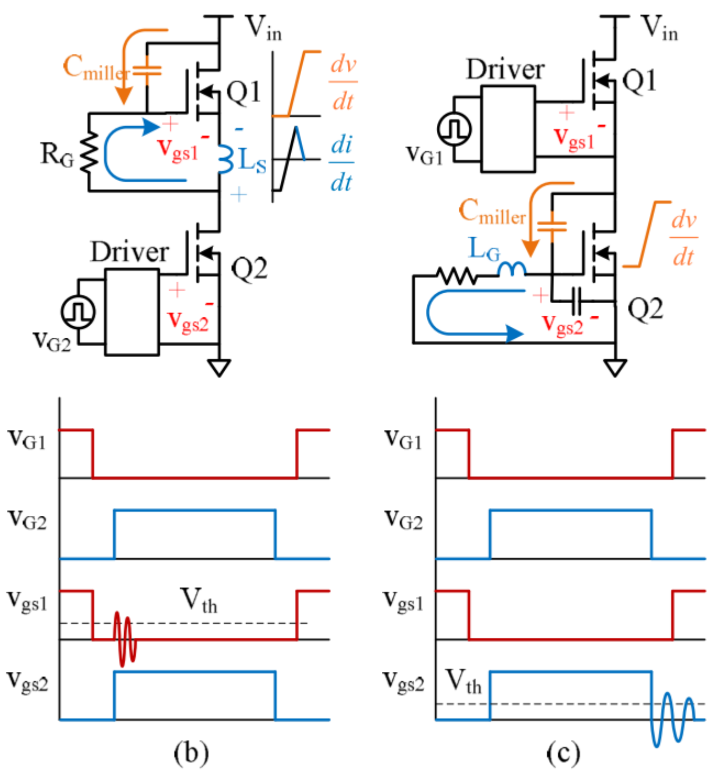


Figure 6: Reasons for Oscillation

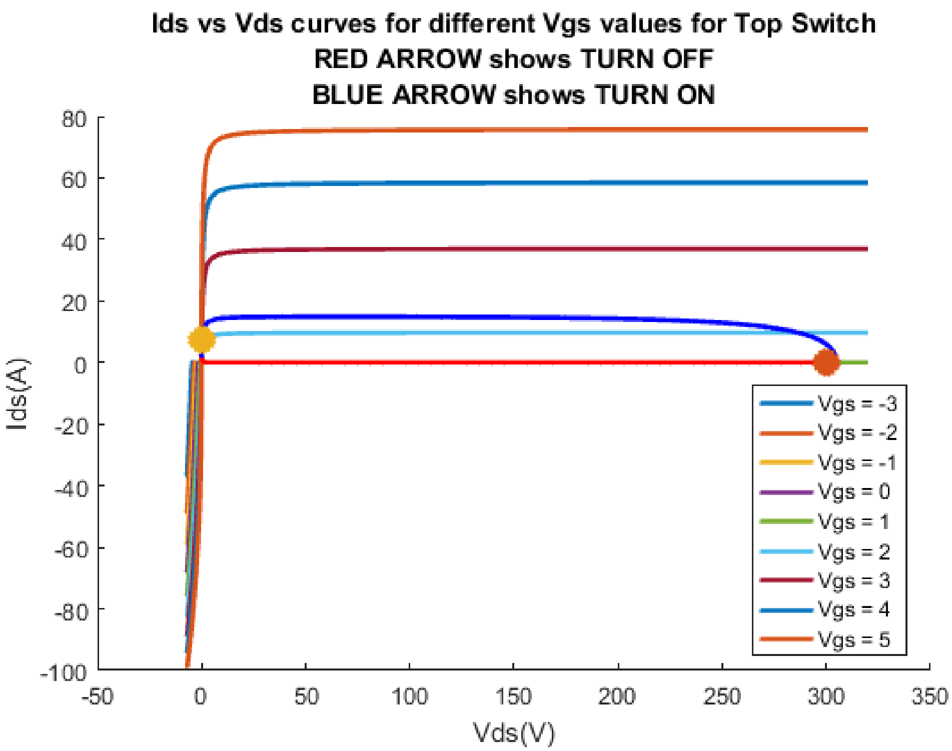


Figure 7: Top Switch Turn ON/OFF Curves

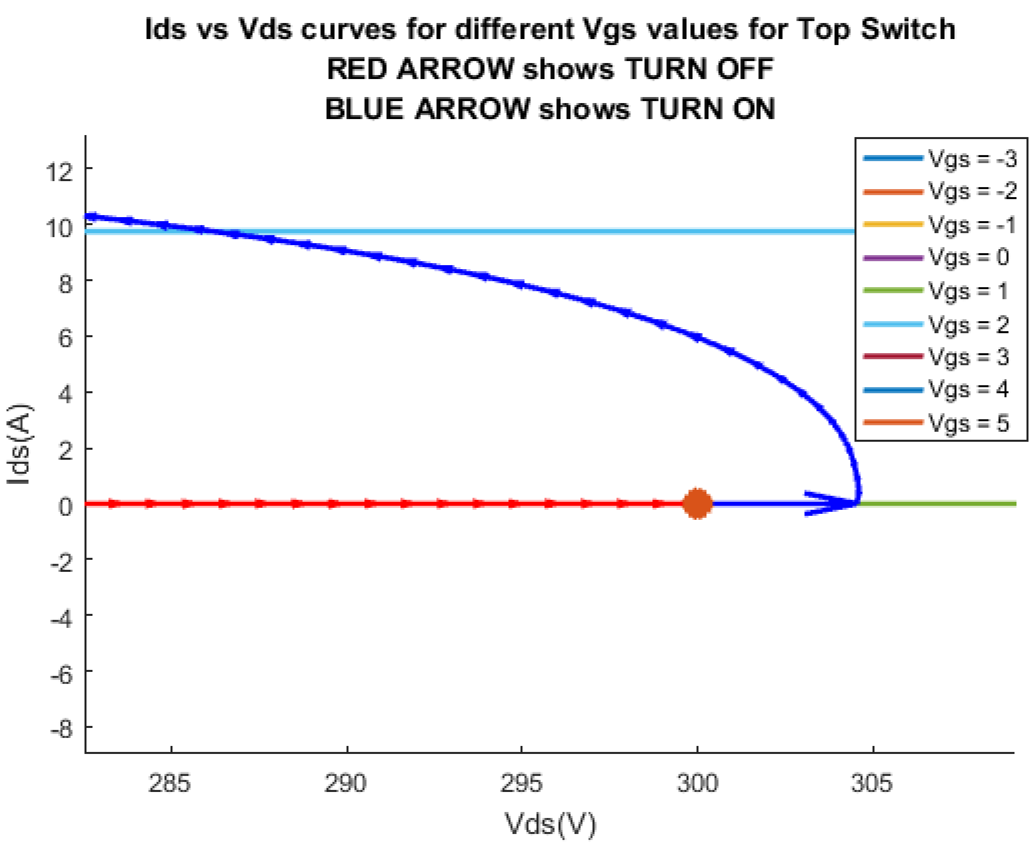


Figure 8: Top Switch Turn ON/OFF

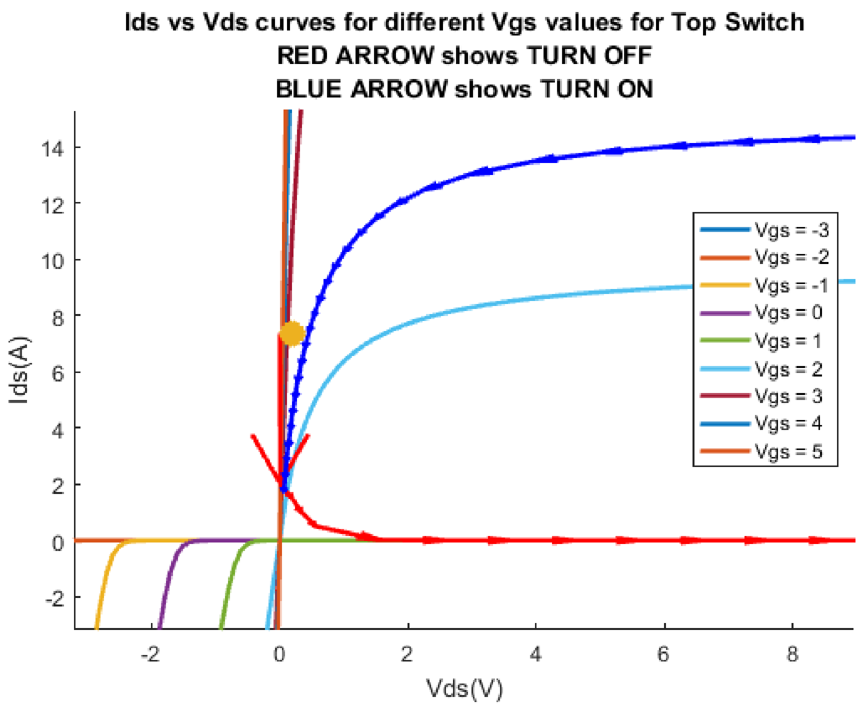


Figure 9: Top Switch Turn ON / OFF

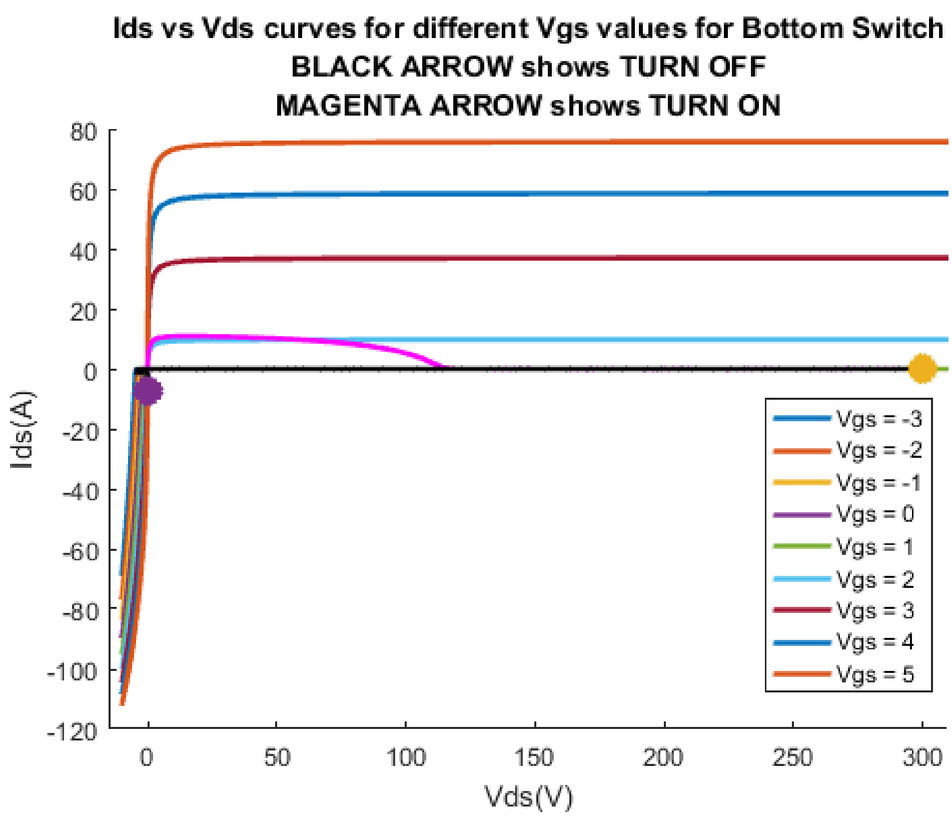


Figure 10: Bottom Switch Turn ON/OFF Curves

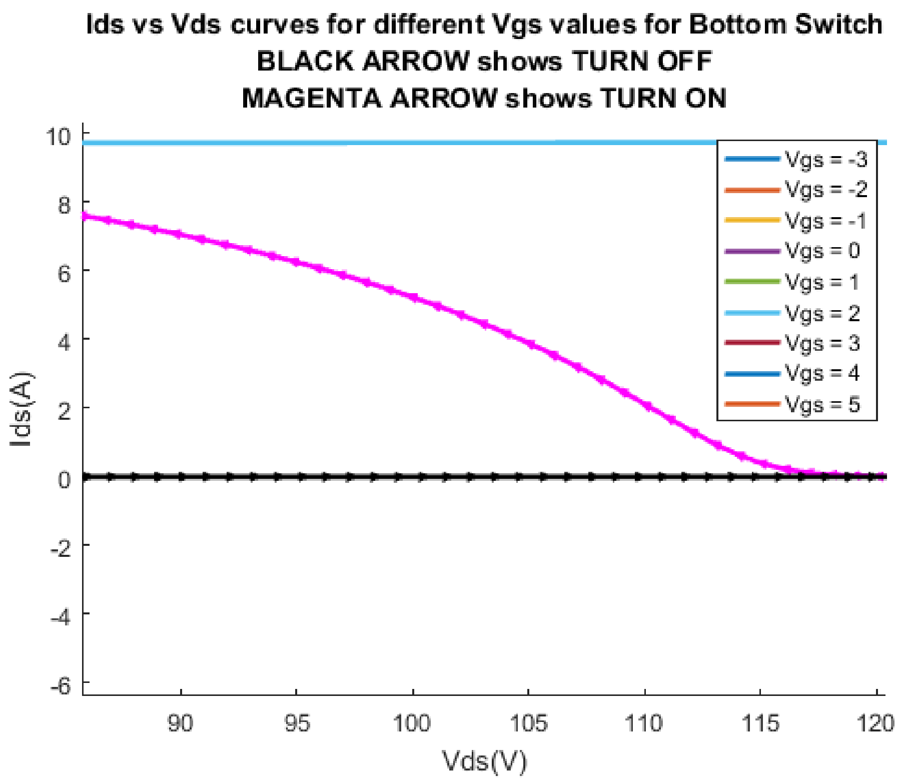


Figure 11: Bottom Switch Turn ON/OFF

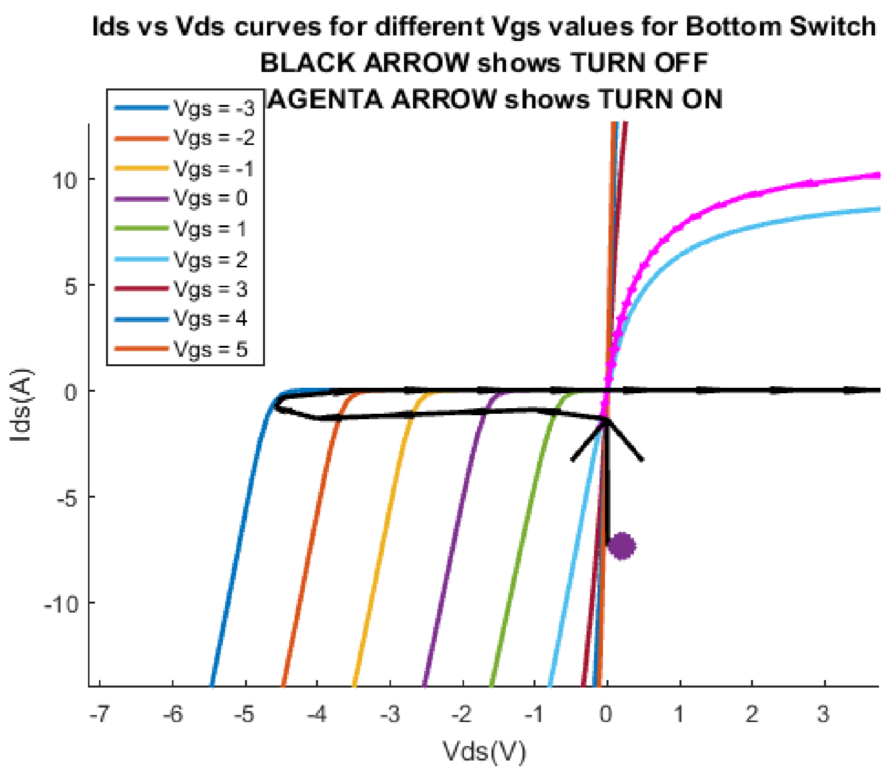


Figure 12: Bottom Switch Turn ON/OFF

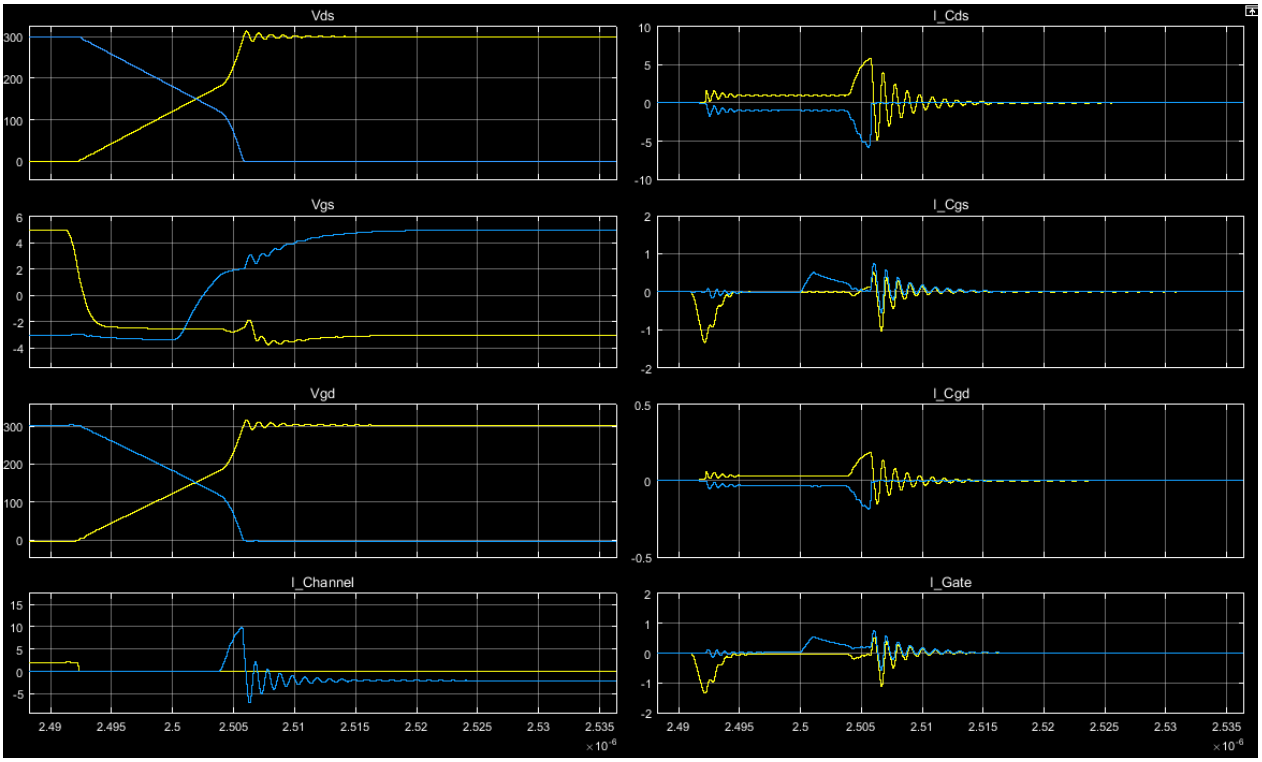


Figure 13: Top Switch Turn OFF, Bottom Switch Turn ON when Ls and Lg are connected

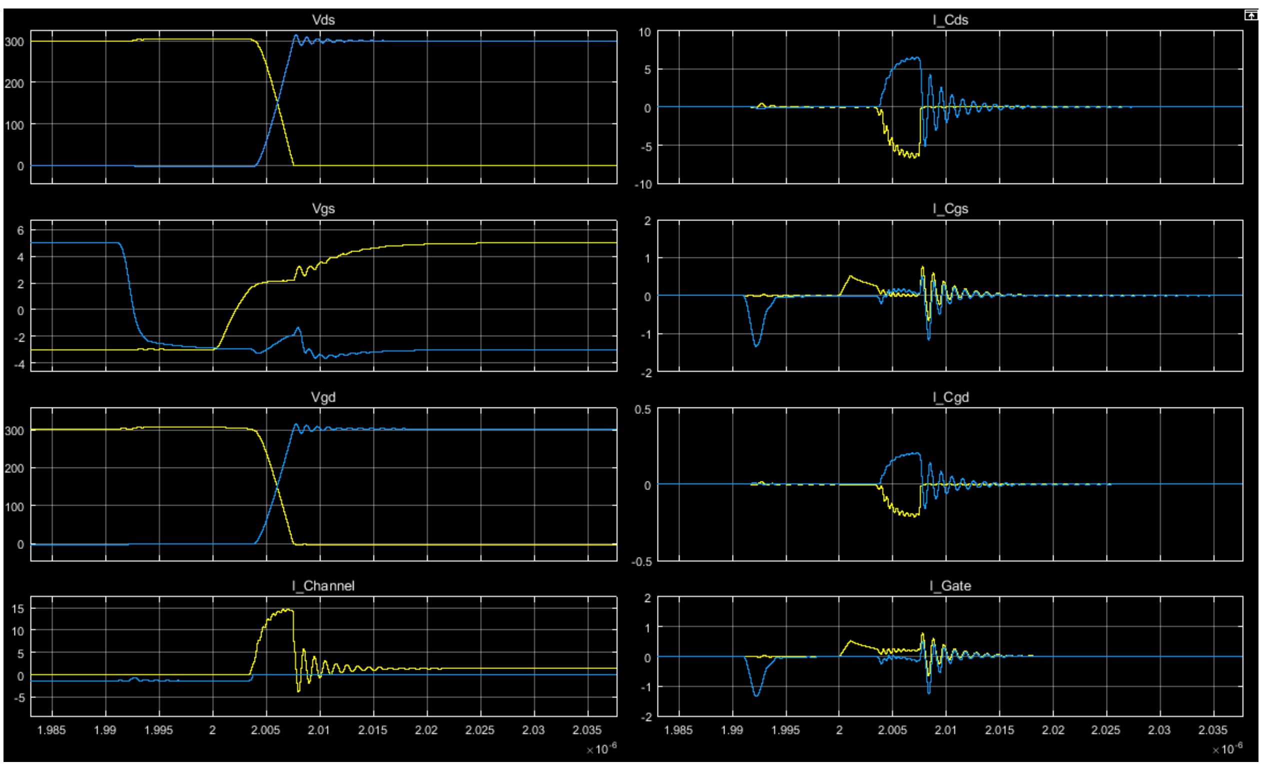


Figure 14: Top Switch Turn ON, Bottom Switch Turn ON when Ls and Lg are connected

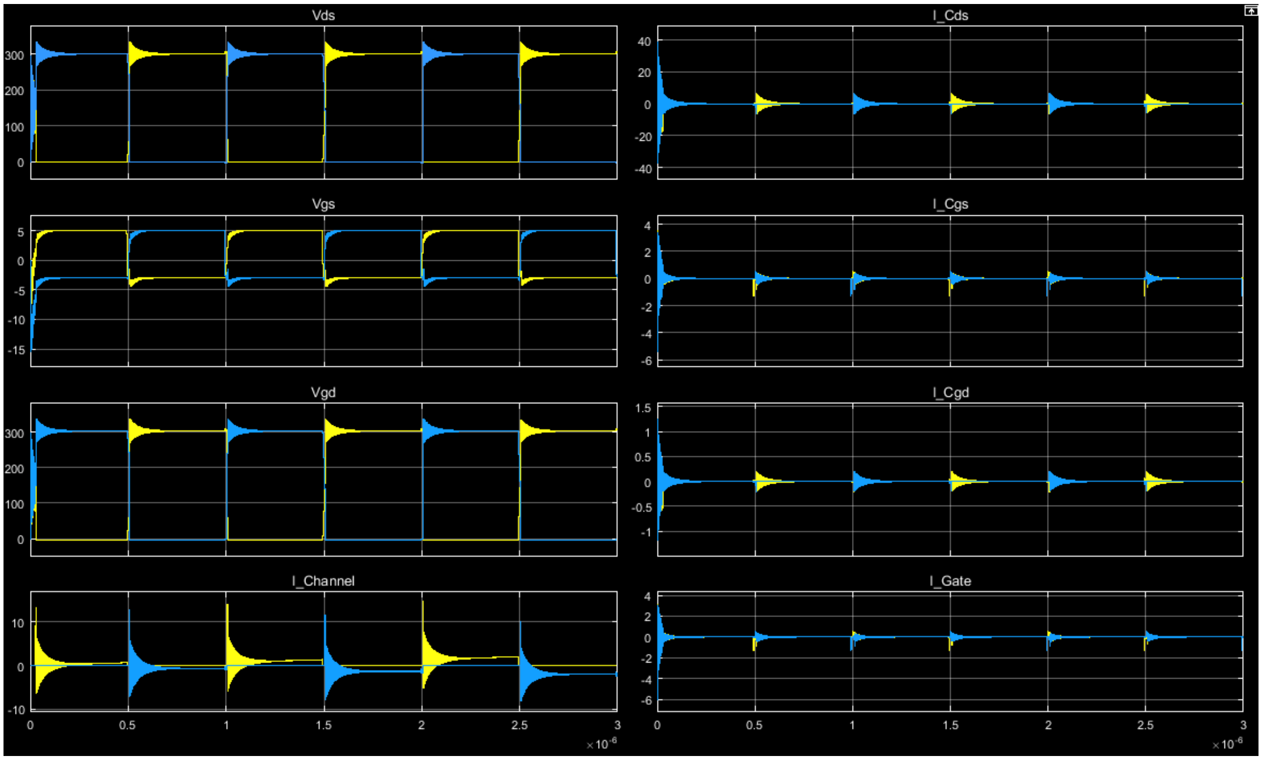


Figure 15: Switch Characteristics when Ld is connected too

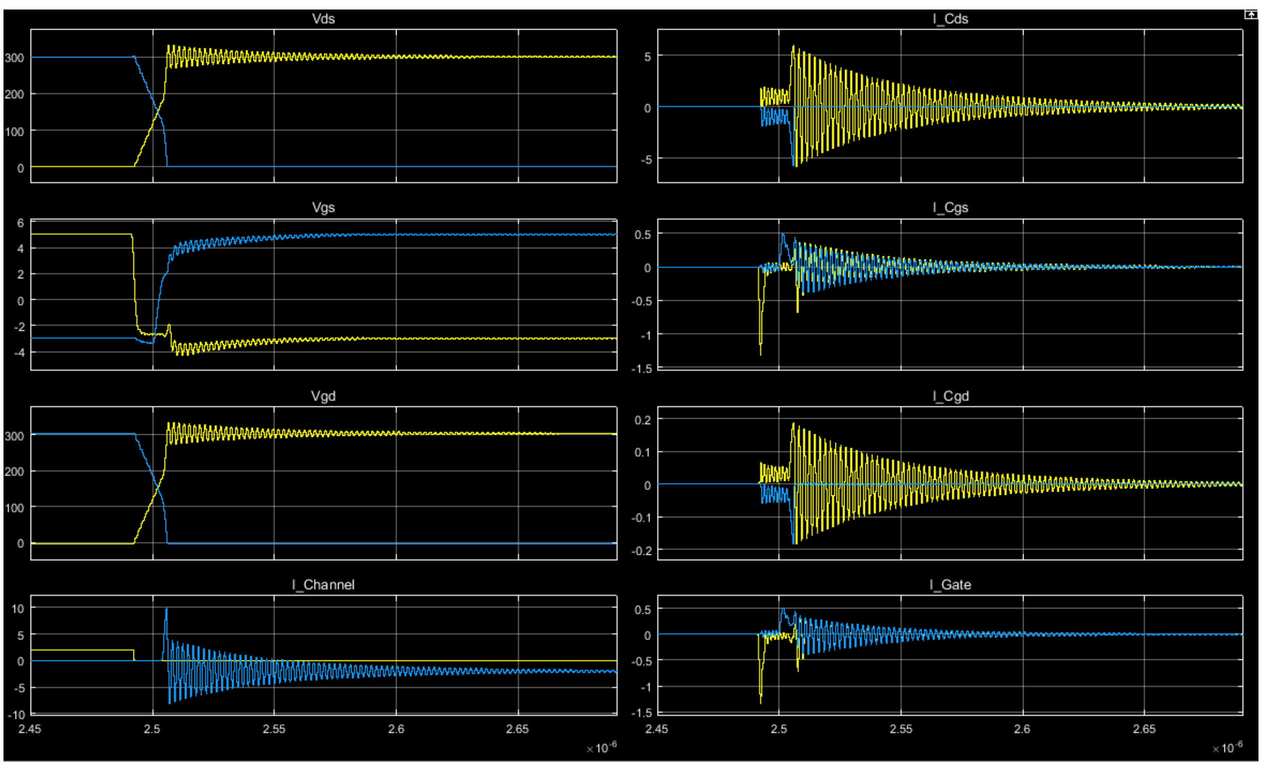


Figure 16: Top Switch Turn OFF, Bottom Switch Turn ON when all parasitic exist

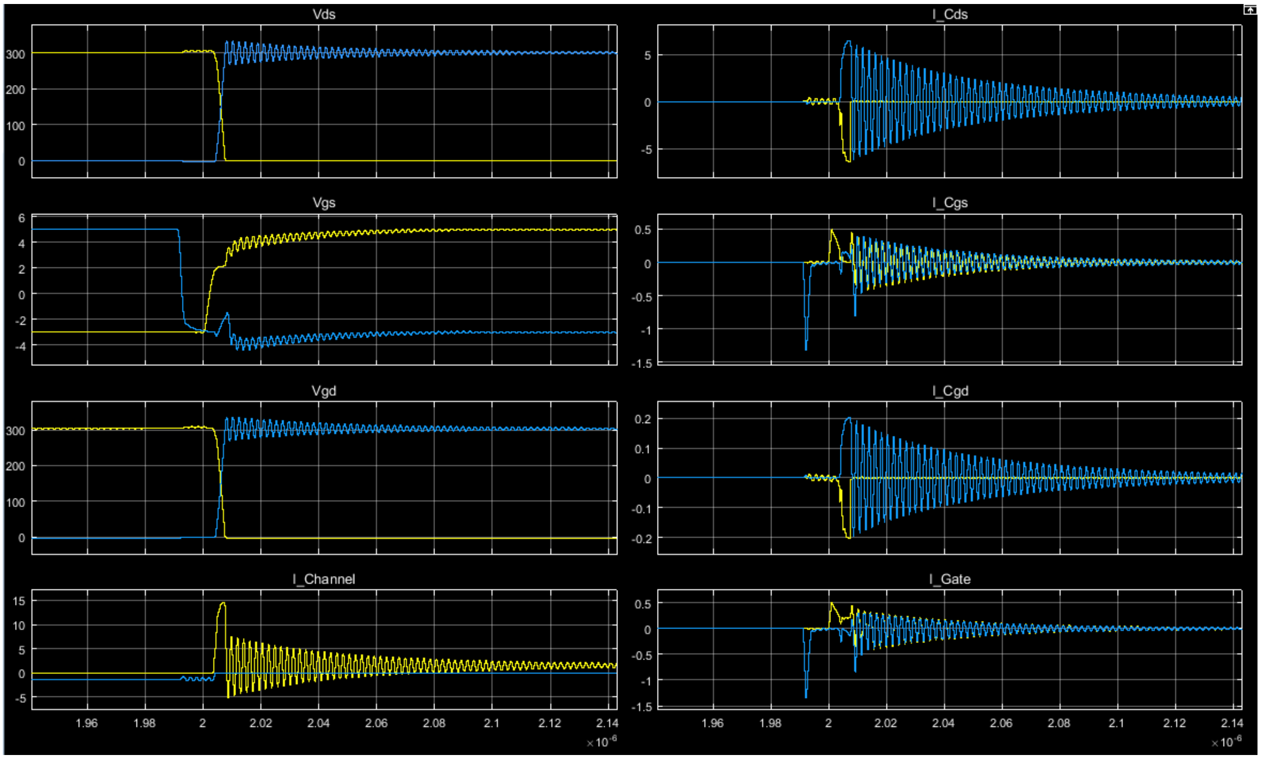


Figure 17: Top Switch Turn ON, Bottom Switch Turn OFF when all parasitic exist

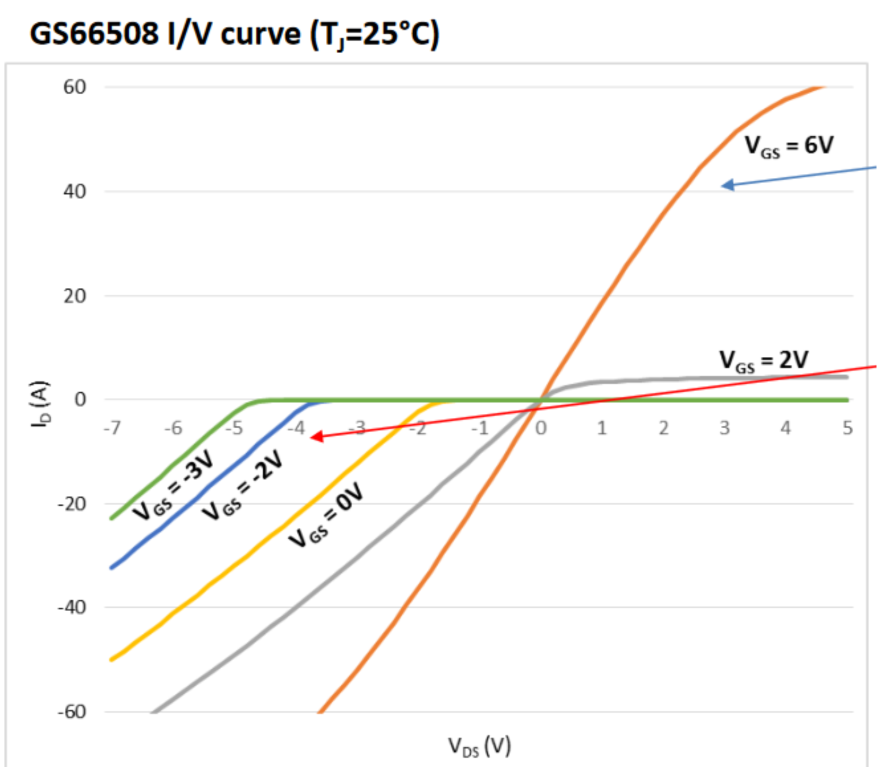


Figure 18: I-V Curve for GaNFET

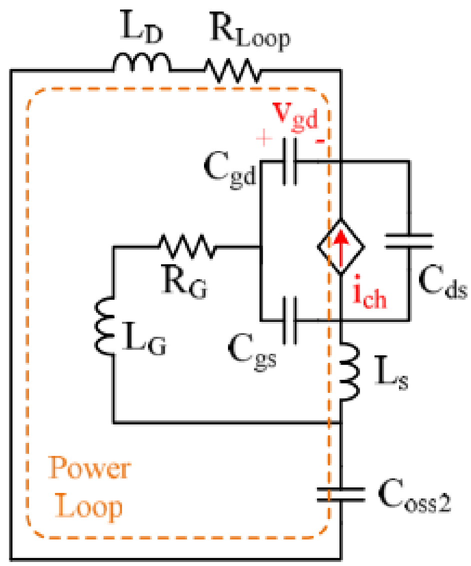


Figure 19: Small Signal Equivalent Circuit for Reverse Conduction

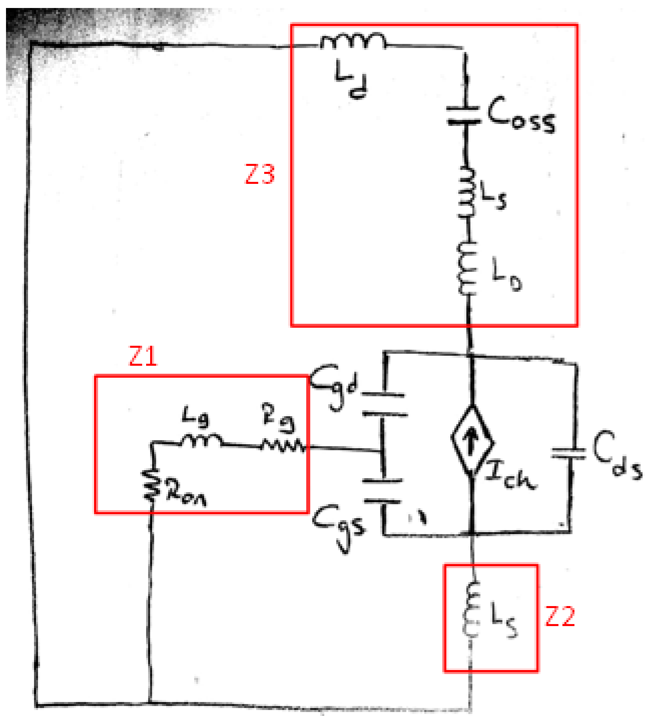


Figure 20: Our Small Signal Circuit for Reverse Conduction

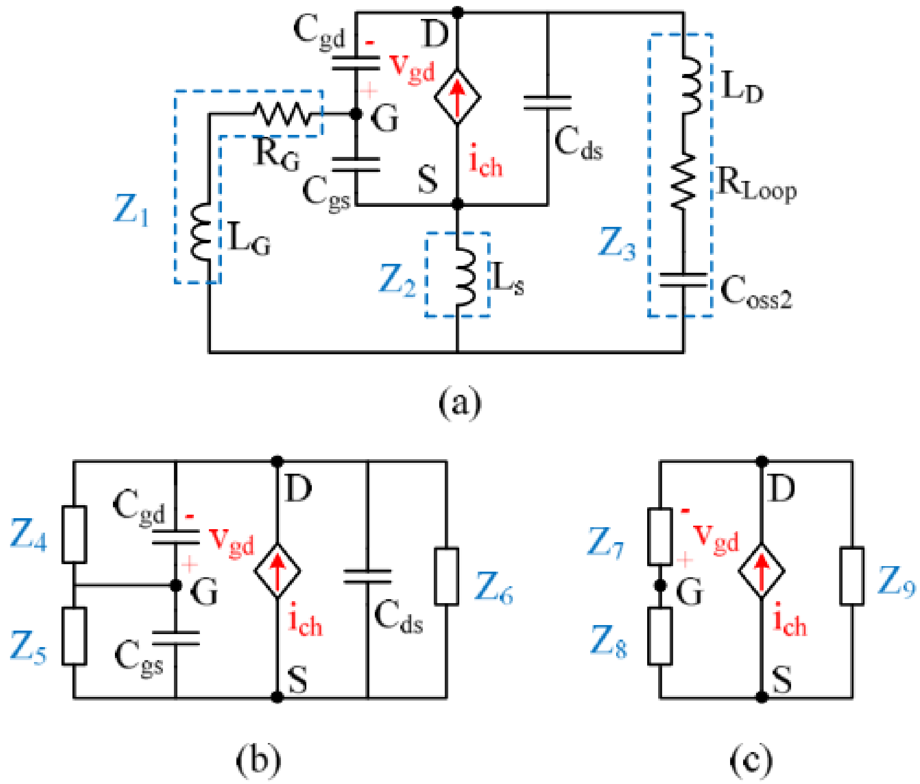


Figure 21: Simplification

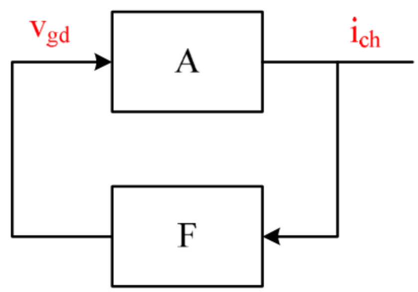


Figure 22: Block Diagram for Reverse Conduction

$$A(s) = \frac{i_{ch}(s)}{v_{gd}(s)} = g_m$$

$$F(s) = \frac{v_{gd}(s)}{i_{ch}(s)} = -\frac{Z_7 * Z_9}{Z_7 + Z_8 + Z_9}$$

$$G(s) = A(s) * F(s)$$

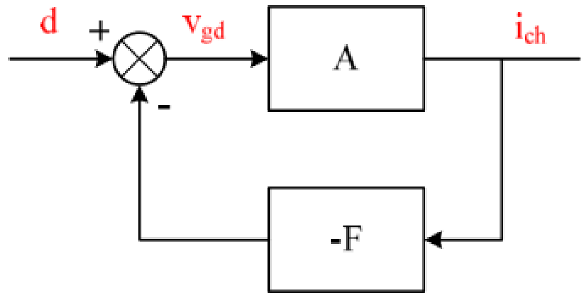


Figure 23: Proper Block Diagram for Reverse Conduction

$$T(s) = \frac{A(s)}{1 - G(s)}$$

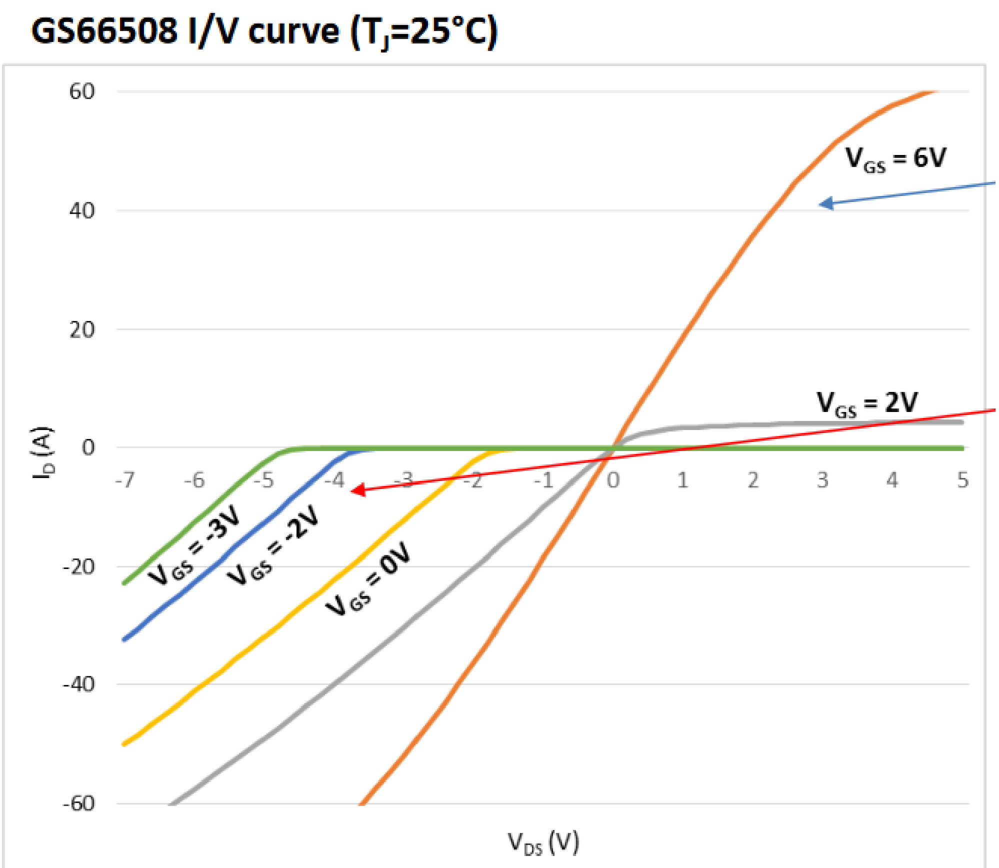


Figure 24: I-V Curve for GaNFET

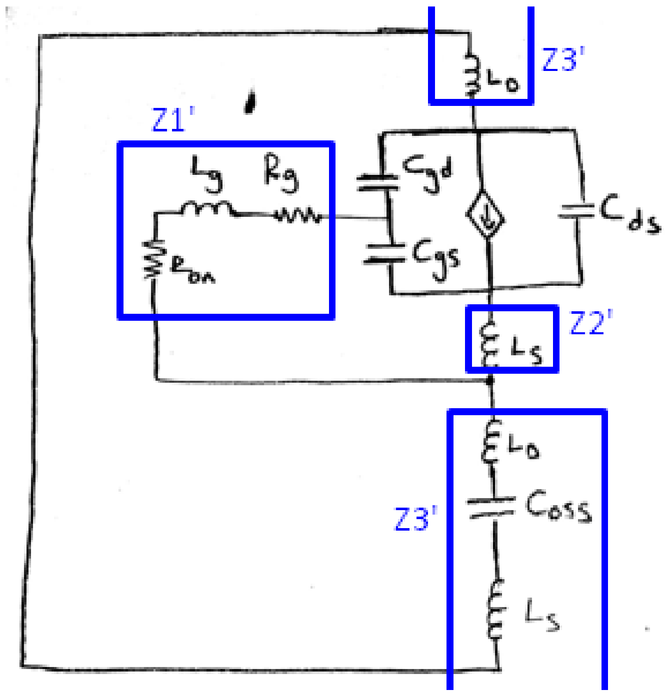


Figure 25: Small Signal Circuit for Forward Conduction

$$Z1 = Z1'$$

$$Z2 = Z2'$$

$$Z3 = Z3'$$

$$A(s) = \frac{i_{ch}(s)}{v_{ds}(s)} = g_m{}'$$

$$F(s) = \frac{v_{ds}(s)}{i_{ch}(s)} = -\frac{(Z_7 + Z_8) * Z_9}{Z_7 + Z_8 + Z_9}$$

Same characteristic equations for open loop transfer functions!

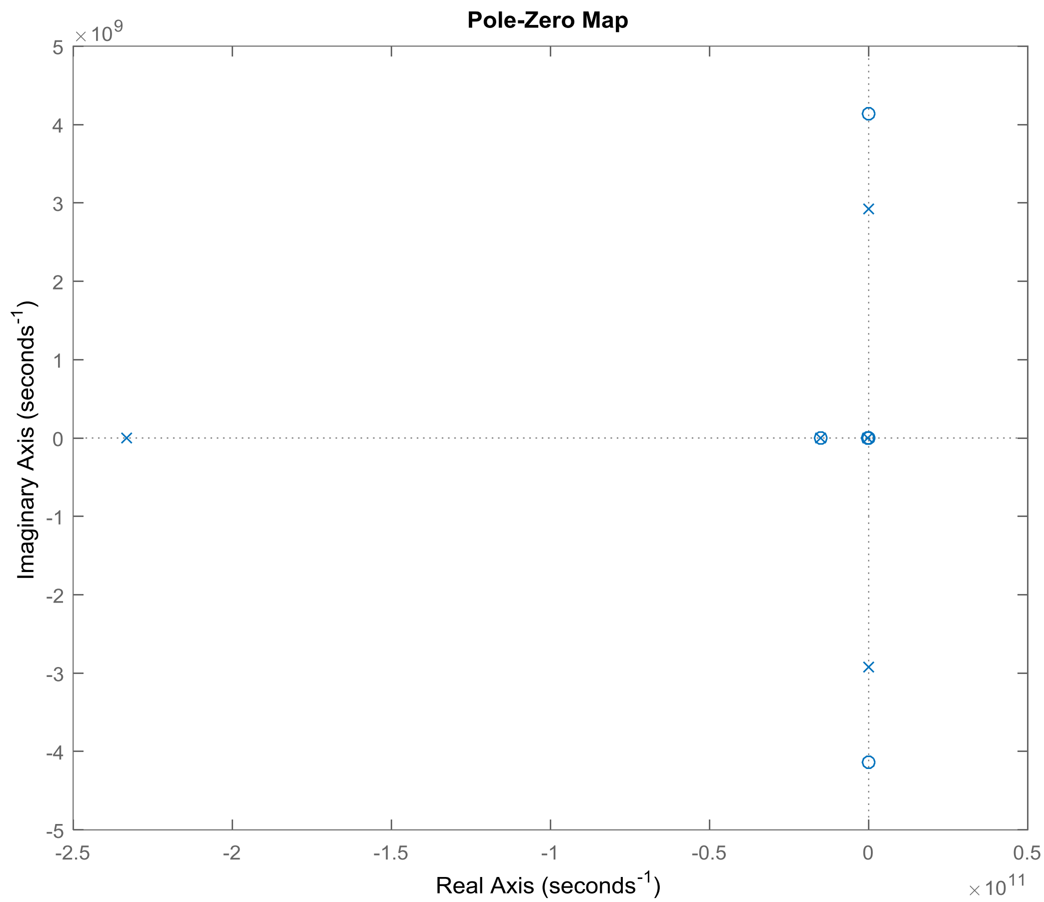


Figure 26: Pole Zero Map for Closed Loop Transfer Function

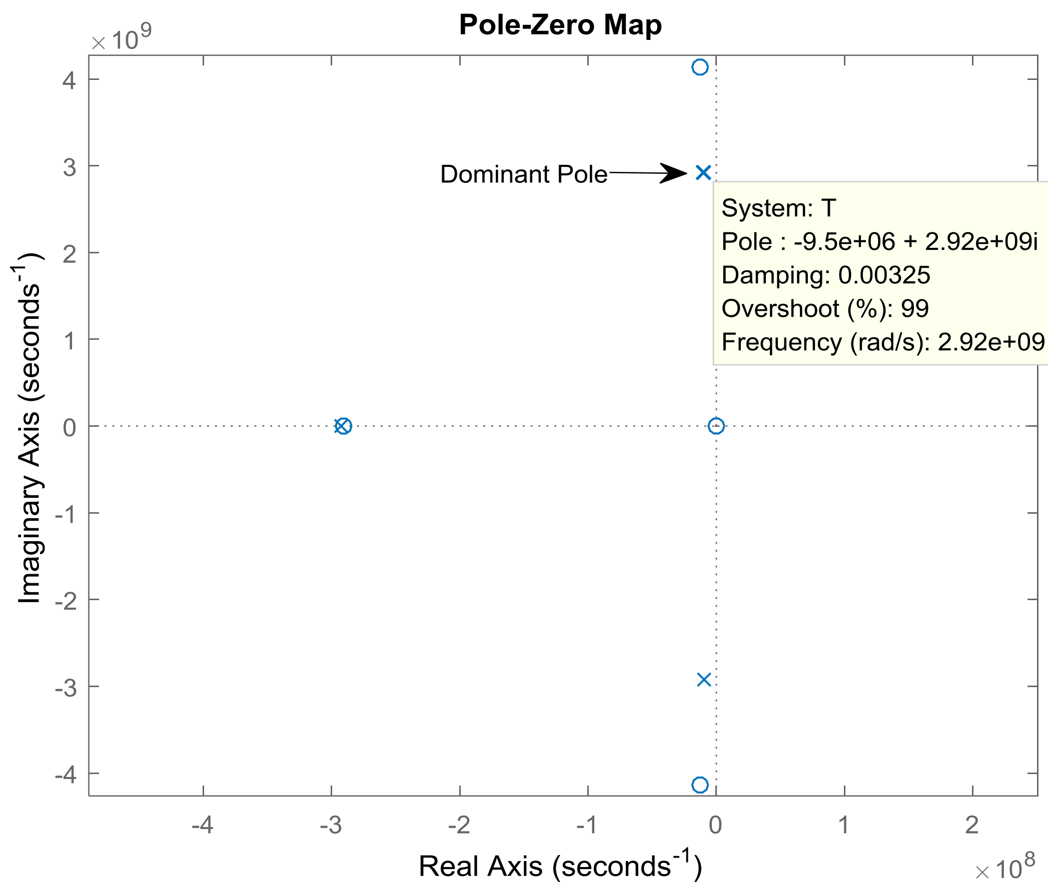


Figure 27: Pole Zero Map - Zoomed

$$\omega = 2 * \pi * f = 2.92 * 10^9 \ rad/s$$

$$f = 464.7 \ MHz$$

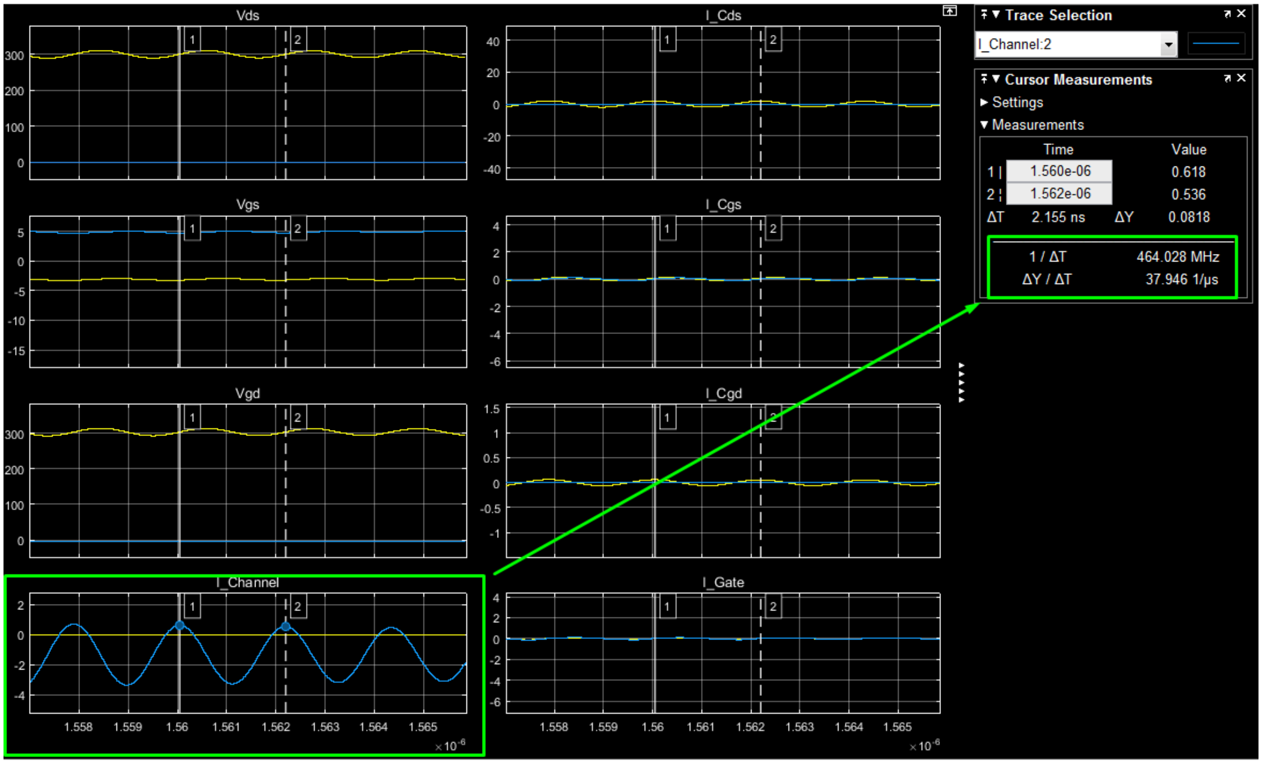


Figure 28: Reverse Conduction Oscillation

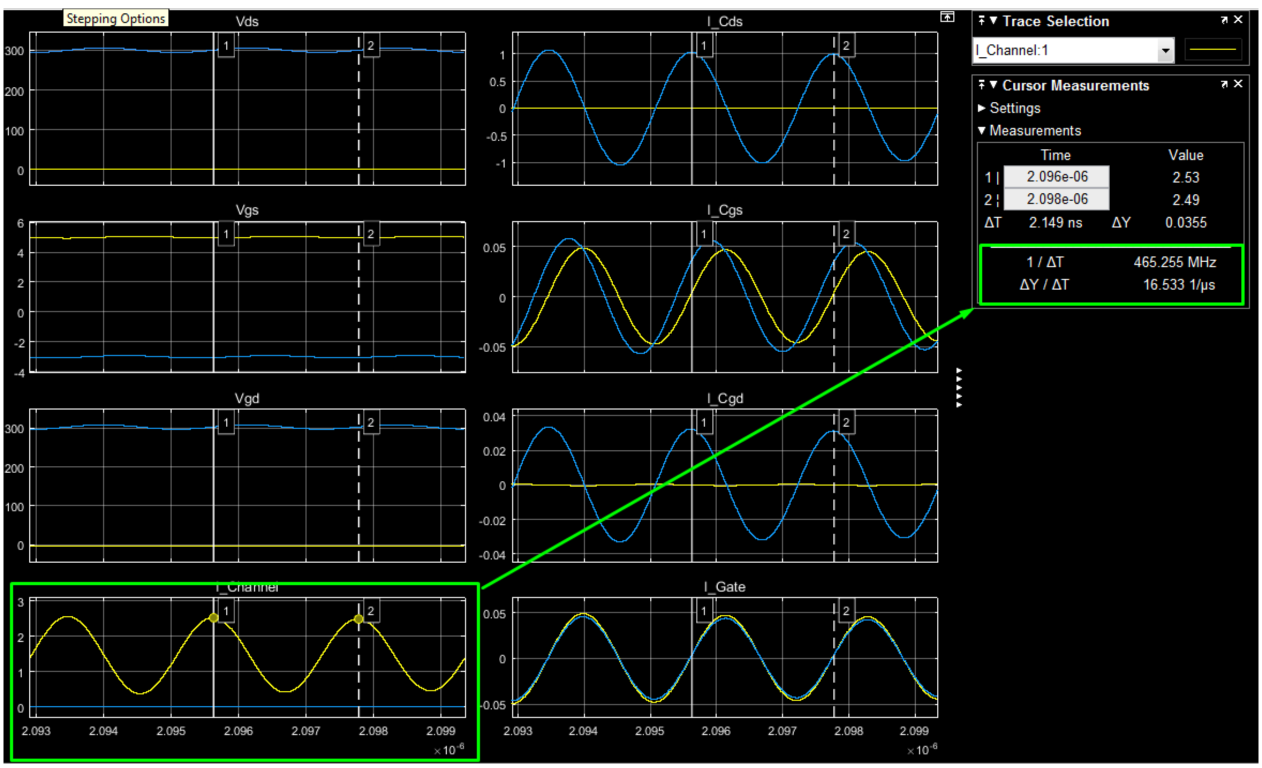


Figure 29: Forward Conduction Oscillation

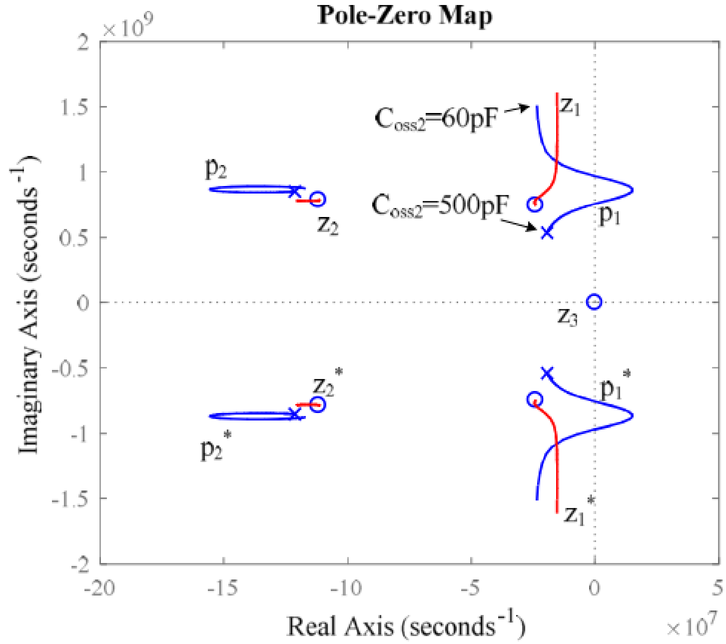


Figure 30: Root-Locus

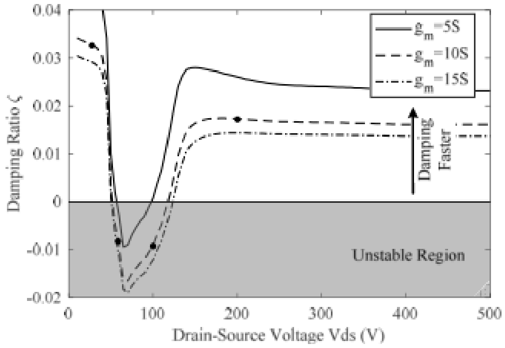


Fig. 12. Damping ratio ζ vs. transconductance g_m.

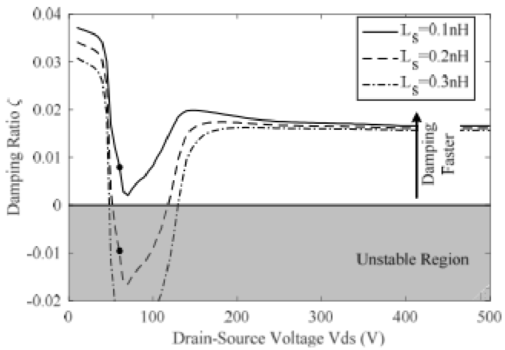
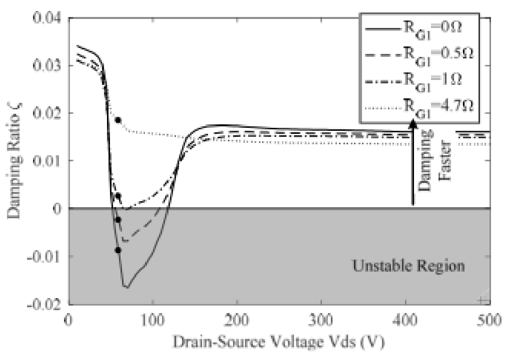


Fig. 13. Damping ratio ζ vs. common-source inductance L_S.



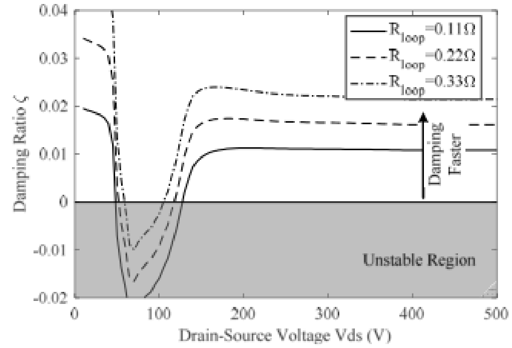


Fig. 15. Damping ratio ζ vs. power loop resistance R_{loop}.

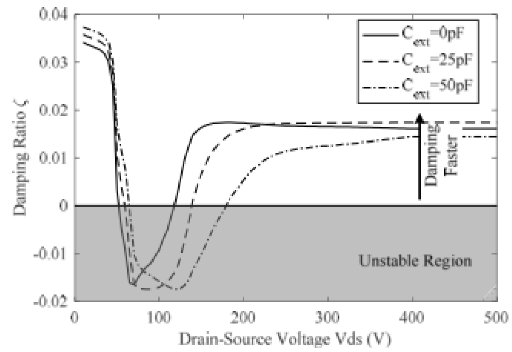


Fig. 16. Damping ratio ζ vs. external capacitance C_{ext} paralleled with C_{oss2}.

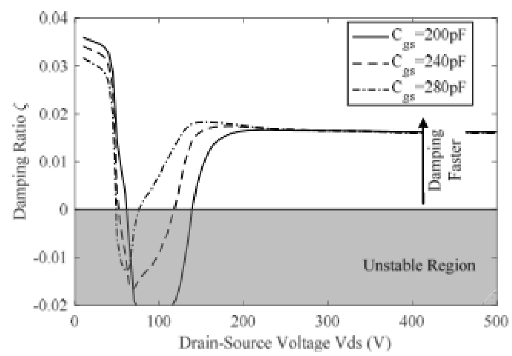


Figure 31: Damping Control

Next Week

- Capacitance Modelling

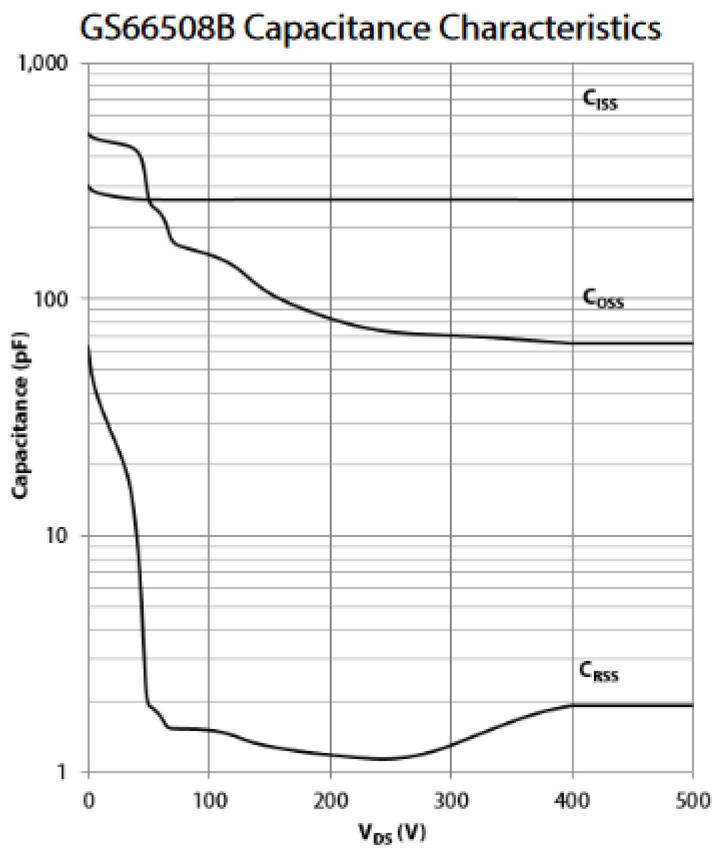


Figure 32: Ciss, Coss, Crss vs Vds Graph

- Loss Analyzation
- Stability Analyzation