TP5 - Gestión de Energía
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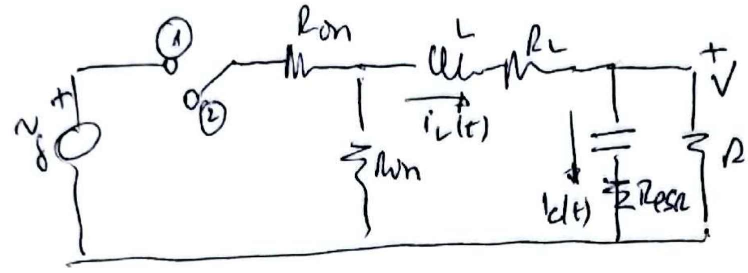


$V = 6v$ $\quad R_{on} = 250 m\Omega$.
$V_g = 12$ $\quad R_L = 50 m\Omega$.
$f = 20 kHz$ $\quad R_{ESR} = 30 m\Omega$.

PARA LOS CÁLCULOS INICIALMENTE NO TOMO EN CUENTA RESR

B V-S (EN SRA)

(1) $V_g = R_{on} I_L + I_L R_L + V + V_L \Rightarrow \left[V_L = V_g - R_{on} I_L - I_L R_L - V \right.$

(2) $-I_L R_{on} = I_L R_L + V + V_L \Rightarrow -I_L R_{on} - I_L R_L - V = V_L \left. \right]$

B.Q.S

$\langle ic \rangle = 0 \to I_L = i_c + I_R \to \frac{V}{R} = I_L$

$\langle v_L \rangle = 0 = V_g . D - R_{on} \cancel{I_L . D} - I_L R_L \cancel{D} - \cancel{VD} - I_L R_{on} - I_L R_L - V$
$+ I_L R_{on} D + I_L R_L D + VD$

$0 = V_g D - V.D - I_L R_{on} - I_L R_L - V$

$-V_g . D = \frac{V}{R} . R_{on} - \frac{V}{R} . R_L - V$

$V_g . D = V . \left[1 + \frac{R_{on}}{R} + \frac{R_L}{R} \right]$

$M = \frac{V}{V_g} = \frac{D}{1 + \frac{R_{on} + R_L}{R}}$; $\frac{V}{I} = R = \frac{6V}{1A} = 6\Omega$.

$\frac{6}{12} = \frac{D}{1 + \frac{250 m\Omega + 50 m\Omega}{6}} \to \left[D = 0,525 \right.$

SI AGREGO $R_{ESR} = 30 m\Omega$.

$\frac{V}{V_g} = \frac{D}{1 + \frac{R_{on} + R_L + R_{ESR}}{R}}$

$D = 0,5275$

Escaneado con CamScanner

PARA EL MODELO EQUIVALENTE Y TRANSFERENCIA

$$C\frac{d\langle v\rangle}{dt} = (I_L+\hat{i}_L)(D+\hat{d}) - \frac{(V+\hat{v})}{R}(D+\hat{d}) + (I_L+\hat{i}_L)\cdot(1-D-\hat{d}) - \frac{(V+\hat{v})}{R}(1-D+\hat{d})$$

AC

$$\langle i_C\rangle = C\frac{d\langle v\rangle}{dt} = I_L\hat{d} + \hat{i}_L\cdot D - \frac{V}{R}\hat{d} - \frac{\hat{v}}{R}\cdot D + \hat{i}_L - \hat{i}_L\cdot D - I_L\hat{d} - \frac{\hat{v}}{R} + \frac{\hat{v}}{R}\cdot D + \frac{V}{R}\hat{d}$$

$$\boxed{\langle i_C\rangle = \hat{i}_L - \frac{\hat{v}}{R}}$$

$$\langle v_L\rangle = L\cdot\frac{d\langle i_L\rangle}{dt} = \left[V_g+\hat{v}_g - \frac{R_{on}}{R}(V+\hat{v}) - \frac{R_L}{R}(V+\hat{v}) - (V+\hat{v})\right]\cdot(D+\hat{d}) - \left[(V+\hat{v})\cdot\frac{R_{on}}{R} + (V+\hat{v})\frac{R_L}{R} + (V+\hat{v})\right]\cdot\left[1-D-\hat{d}\right]$$

AC

$$L\frac{d\langle i_L\rangle}{dt} = \hat{v}_g\cdot D + V_g\cdot\hat{d} - \frac{R_{on}}{R}\cdot V\hat{d} - \frac{R_{on}}{R}\cdot\hat{v}\cdot D - \frac{R_L}{R}V\cdot\hat{d} - \frac{R_L}{R}\hat{v}\cdot D + \frac{VR_{on}}{R}\cdot\hat{d} - \hat{v}\frac{R_{on}}{R} + \hat{v}\cdot\frac{R_{on}}{R}\cdot D + \frac{VR_L}{R}\cdot\hat{d} - \frac{\hat{v}\cdot R_L}{R} + \hat{v}\frac{R_L}{R}\cdot D + V\cdot\hat{d} - \hat{v} + \hat{v}\cdot D$$

$$= \hat{v}_g\cdot D + V_g\cdot\hat{d} - \hat{v}\left(1+\frac{R_{on}}{R}+\frac{R_L}{R}\right)$$

SI AGREGO LOS EFECTOS DE RESR

$$\langle v_L\rangle = L\cdot\frac{d\langle i_L\rangle}{dt} = \hat{v}_g\cdot D + V_g\cdot\hat{d} - \hat{v}\left(1+\frac{R_{on}}{R}+\frac{R_L}{R}+\frac{R_{ESR}}{R}\right)$$

PARA EL CÁLCULO DE L Y C

$$\Delta i_L^+ = \Delta i_L^- = \Delta i_L$$

$$\Delta i_L^+ = \frac{(V_g - I_L \cdot R_L - I_L R_{on} - V) D \cdot T_s}{L}$$

$I_L = 1A$ (max)

$\Delta i_L = 10\% \, I_L = 0{,}1A$

$$L = \frac{(V_g - I_L R_L - I_L R_{on} - V) \cdot D}{\Delta i_L \cdot f_s}$$

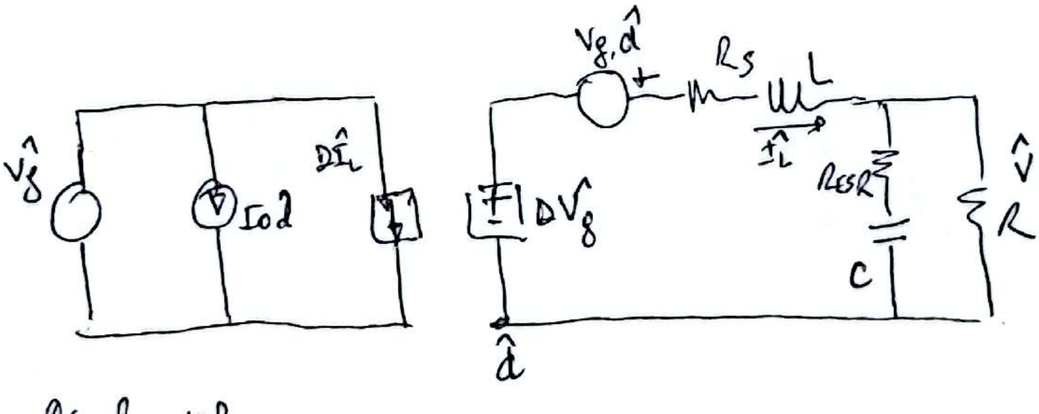
$$\left[L = 150{,}3375 \ \mu Hy \right.$$

$$\Delta v = \frac{\Delta Q}{C} = \frac{1}{C} \cdot \frac{1}{2} \cdot \frac{\Delta i_L}{2} \cdot \frac{T_s}{2} = \frac{\Delta i_L}{8 f_s \cdot C}$$

$$\Delta v = 5\% \cdot V = 0{,}3 \ V$$

$$\left[C = \frac{\Delta i_L}{\Delta v \cdot 8 \cdot f_s} = 208{,}\hat{3} \ mF \right.$$

MODELO EQUIVALENTE BUCK.



$R_S = R_{on} + R_L$

$$G_{vd}(s) = \frac{\hat{v}_o}{\hat{d}} \quad ; \quad G_{vd}(s) = V_g \cdot \frac{1 + \frac{s}{w_{ESR}}}{1 + \frac{1}{Q} \cdot \frac{s}{w_0} + \left(\frac{s}{w_0}\right)^2}$$

$$f_0 = \frac{1}{2\pi \cdot \sqrt{L \cdot C}} = 28{,}439\ \text{kHz}$$

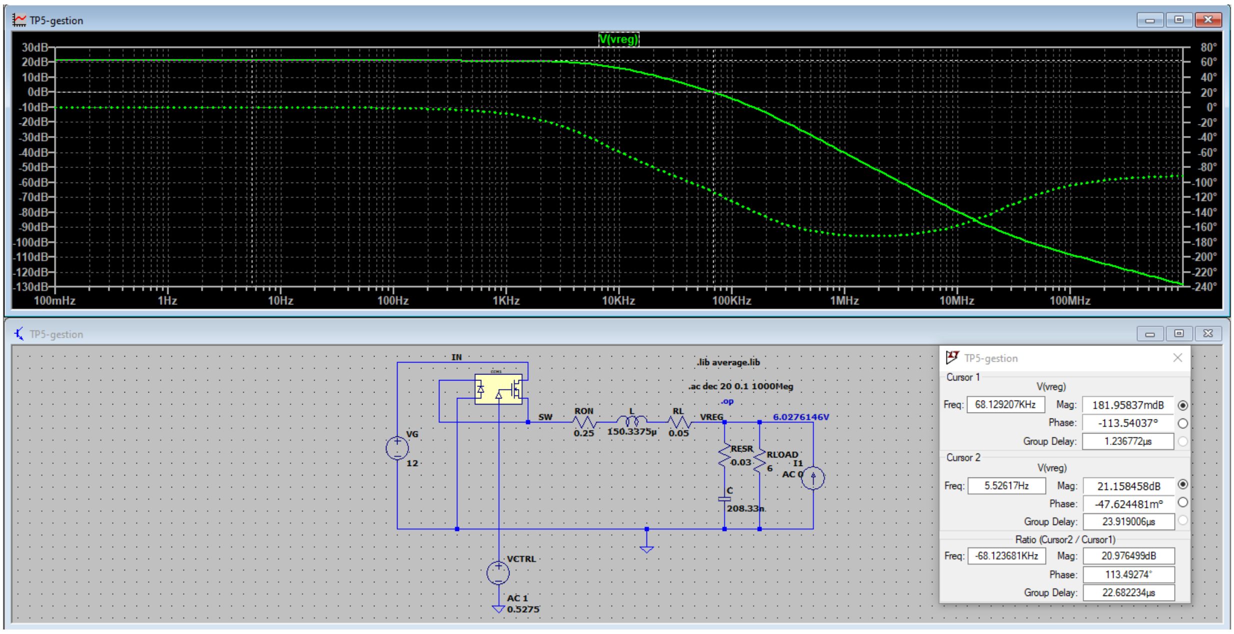
$$Q_{PERD} = \frac{\sqrt{\frac{L}{C}}}{R_{ESR} + R_S} = 81{,}4\ (38{,}21\ \text{dB})$$

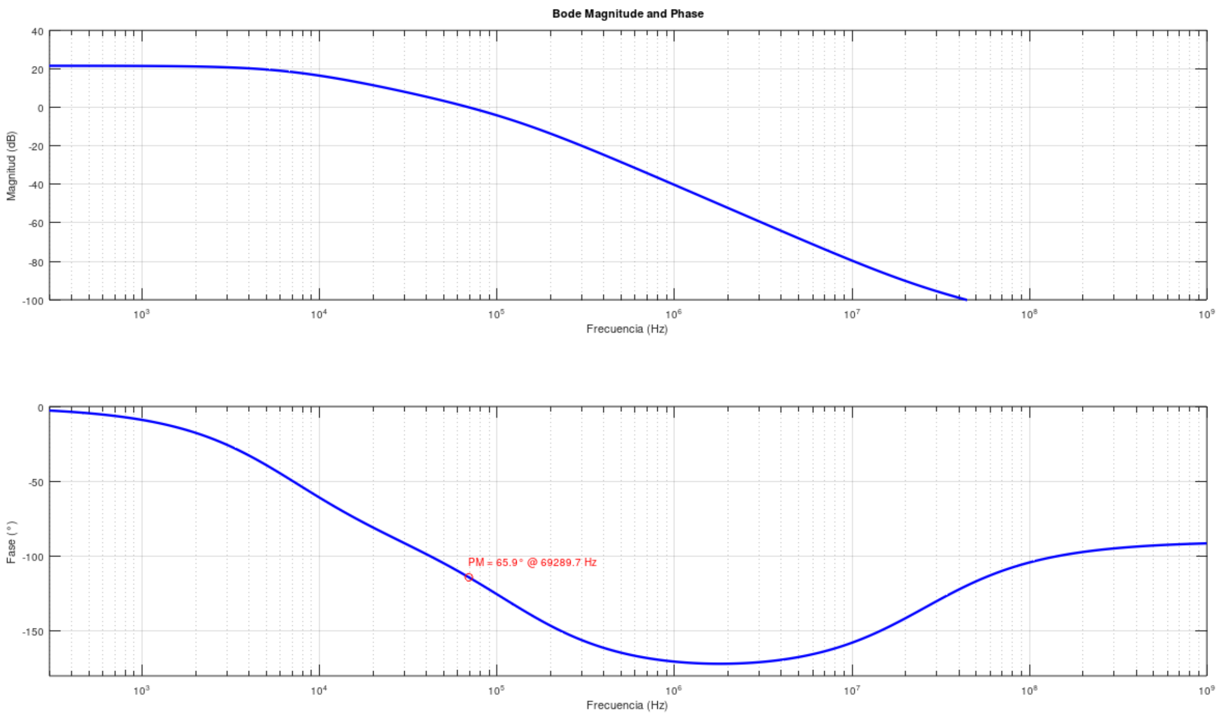
$$Q_{CARGA} = \frac{R}{\sqrt{\frac{L}{C}}} = 0{,}22\ (-13{,}02\ \text{dB})$$

$$Q = Q_{PERD} \parallel Q_{CARGA} = 0{,}219\ (-13{,}175\ \text{dB})$$

$$f_{ESR} = \frac{1}{2\pi \cdot C \cdot R_{ESR}} = 25{,}46\ \text{MHz}$$

$$G_{VDO} = 12 \rightarrow 21{,}58\ \text{dB}$$





Los resultados muestran que, tanto la simulación el LTspice como lo obtenido en Matlab de la transferencia analítica son similares, en magnitud y fase.