Series Resonant Converter

Complete State Plane – Phase Shift Modulation $F \leq 1$
Averaging Step

\[ \omega_0 \frac{T_s}{2} = (\frac{t_{on}}{T_s} + \frac{t_{off}}{T_s}) \omega_0 \]

\[ \alpha + \beta = \frac{\pi}{F} \]

\[ n < i_{out} > = \frac{1}{T_s} \int T_s(t) \, dt = \frac{2}{T_s} \left[ \frac{B_1 + B_2}{2} \right] \]

\[ = \frac{2}{T_s} \left[ C_v (V_{th} + V_{r1}) + C_T (V_{r1} - V_{r0}) \right] \]

\[ \frac{1}{T_{base}} \cdot n < i_{out} > = \frac{2}{T_s} C_v V_{r1} \cdot \frac{F}{V_{base}} \]

\[ J = m_{r1} \frac{2}{\pi} \]

\[ m_{r1} = \frac{\cos \left( \frac{\pi}{F} - \beta \right)}{\cos \left( \frac{\pi}{2F} \right)} - 1 \]

Y. Cheron, “Soft Commutation”

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SRC Simulation

\[ f_s = 2 \mu s, \, \xi = \frac{1}{5} \]

\[ V_{r1} = 100 \, V \]

\[ L = 1 \, \text{mH} \]

\[ C_f = 150 \, \text{nF} \]

\[ F = 1.5 \]
SRC – Light Load

SRC Near Resonance
SRC – Low $V_{out}$

$V_{out} = 0.75 V_{in}$

$n = 2$
Fig. 6: Analytical voltage and current waveforms of DAB (top) and DSRC (bottom) operated at three different p.u. voltage combinations. The plots on left, middle and right result from three different control angle values for rated power operation at base voltages $V_{in}, V_{out} = 1.0, 1.0$, and the according adjustments in series inductance.