Series RLC

\[ f_{RL} = \frac{R}{2\pi L} \]

\[ f_{RC} = \frac{1}{2\pi RC} \]

\[ Z_C \text{ series with } R \]

\[ Z_{RL} \text{ series with } R \]

Finally \( R-L-C \)
Series RLC

\[ Z_{in} = \frac{1}{j \omega C} + \frac{1}{R} + \frac{1}{j \omega L} \]

1. Log Z vs. f

2. Frequency Range

- \[ f_1 = \frac{1}{2\pi RC} \]
- \[ f_2 = \frac{R}{2\pi L} \]
- \[ f_R = \frac{1}{2\pi \sqrt{LC}} \]

3. Phase Angle

\[ \frac{1}{\omega d} = \frac{1}{\omega L} @ \omega R \]

4. Resonance

\[ \omega_R = \sqrt{\frac{1}{LC}} \]

5. Quality Factor

\[ Q = \frac{\omega R}{\omega} \]

6. Characteristics

- \[ Z_C = Z_2 @ \omega R = \sqrt{\frac{L}{C}} \equiv Z_C \]

Above case for \( R > Z_C \)
Case: $R L \sqrt{L C} = \sqrt{\frac{L}{C}}$

Resonance: $Z_L$ canceled by $Z_C$

$Q = \text{Deviation from asymptote}$

$\frac{Z_L}{R} = \frac{Z_C}{R}$

$Q(\omega) = \frac{Z_C(\omega)}{R} - \frac{R(\omega)}{L}$

If $Z_{in}$ "g's" down then $i(t)$?

$i_{in} \rightarrow v_{2}$
Resonant Buck

\[ V_R \quad V_{in} \quad C \quad L \quad f_{sw} \]

\[ f_{sw} = f_R \quad V_R = V_{in} \]

\[ f_{sw} \neq f_R \quad V_R \neq V_{in} \]

\( \frac{f_L}{f_R} : \text{Capacitive} \)

\( \frac{f_R}{f_T} : \text{Inductive} \)

\( ZVS \text{ for } FET \)

\( ZCS \text{ for } FET \)
Fig. 11 - Variable Frequency Continuous Resonance
Figure 8 - Classifying Resonant Converters

1. Series or Parallel Loaded
2. Fixed or Variable Frequency
3. Continuous / Discontinuous Resonance
4. Zero Current or Voltage Switching
5. Half or Full Cycle Conduction
Fig. 1. The classical synchronous buck converter uses two switching MOSFETs: the high-side (control) device, QHS, and the low-side synchronous synchronous rectifier, QLS.
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