Circuit Solution Tips

• Stay symbolic as long as possible
  – Define new equivalent variables as necessary

• Order of analysis
  – Series/parallel equivalents
  – Source transformations
  – Transformer reflection
  – KVL/KCL equations (if you see a path forward)
    ▪ Element Equations
  – Node Voltage / Mesh Current Analysis (otherwise)
Numerical Example

MATLAB Code:

\[ Z_1 = 1j(w L_r + w L_f1 - 1/w C_r); \]
\[ Z_2 = 1j/w/C_f; \]
\[ Z_3 = R_p + 1j(w L_f2 - 1/w C_p); \]
\[ Z_4 = 1j w L_p; \]
\[ Z_5 = 1j w L_k; \]
\[ Z_6 = R_s - 1j/w/C_s; \]

\[ V_a = N^2 VT_X (Z_1 Z_2/(Z_1+Z_2)) / (Z_1 (Z_3+Z_1 Z_2/(Z_1+Z_2))) * 1/(1/Z_4 ... + 1/(Z_3 + Z_1 Z_2/(Z_1+Z_2))); \]
\[ Z_a = N^2*1/(1/(Z_3+Z_1 Z_2/(Z_1+Z_2)) + 1/Z_4); \]
\[ Z_b = Z_5 N^2; \]

\[ V_{R_X} = V_a R_L/(Z_a+Z_b+Z_6+R_L); \]

\[ \text{mag} = \text{abs}(V_{R_X}) \]
\[ \text{phase} = \text{angle}(V_{R_X})/\pi*180 \]

\[ \text{mag} = 28.0892 \]
\[ \text{phase} = -90.0000 \]
Circuit Simulation

.t tran 0 1m 999u

V1
2μ
275.5p
Lr
Cr
Lf1
5μ
Lf2
Rp
.35
Cp
551p
K
Lp
Ls
.2
Cs
110.2p
Rs
.5
rx

SINE(0 100 6.78Meg)

V(tx)

V(rx)

WPTphasor.raw

Cursor 1

V(rx)

Horz: 595.31271ns
Vert: 27.990696V

Cursor 2

Horz: -- N/A--
Vert: -- N/A--

Diff (Cursor2 - Cursor1)

Horz: -- N/A--
Vert: -- N/A--

Freq: -- N/A--
Slope: -- N/A--
\[ \frac{V_{in}}{j213} \]