Voltage Transfer Function[1]

[1] "Introduction to Frequency Domain Analysis (3 Classes)" Slide 46 ff, Signal Integrity ELECT865 @ University of South Carolina
http://www.ee.sc.edu/classes/Spring04/elct865/images/Class7-8-9.ppt

Voltage Transfer Function

- ✓ What is really of most relevance to time domain analysis is the voltage transfer function.
- ✓ It includes the effect of non-perfect loads.
- ✓ We will show how the voltage transfer functions for a 2 port network is given by the following equation.

$$\frac{\frac{s21}{2}\cdot\left(\Gamma_L+1\right)\cdot\left(1-\Gamma_s\right)}{1-s11\cdot\Gamma_s-s22\cdot\Gamma_L-s21\cdot s12\cdot\Gamma_L\cdot\Gamma_s+s11\cdot s22\cdot\Gamma_L\cdot\Gamma_s}$$

- ✓ Notice it is not s21

Example on how to use the transfer function

Simple static example for transfer function impact from channel parameters

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Insertion and return channel loss in dB $dB\_loss := 25$ $ch\_RL := 3$

$s21 := 10^{\frac{-dB\_loss}{20}}$ $s11 := 10^{\frac{-ch\_RL}{20}}$ $\Gamma_s := 0$

Gamma s is the source reflection coef.
Gamma L is the load reflection coef

$s12 := s21$ $s22 := s11$

Use 1/2 source voltage at source resistor instead of at source node

$$\frac{s21\cdot(\Gamma_L + 1)\cdot(1 - \Gamma_s)}{1 - s11\cdot\Gamma_s - s22\cdot\Gamma_L - s21\cdot s12\cdot\Gamma_L\cdot\Gamma_s + s11\cdot s22\cdot\Gamma_L\cdot\Gamma_s}$$ simplifies to--> $$\frac{s21\cdot(\Gamma_L + 1)}{1 - s22\cdot\Gamma_L}$$

$dB\_RL := 10$ $\Gamma_L := -10^{\frac{-dB\_RL}{20}}$ $20\cdot\log\left[\frac{s21\cdot(\Gamma_L + 1)}{1 - s22\cdot\Gamma_L}\right] = -30.056$

$dB\_RL := 12$ $\Gamma_L := -10^{\frac{-dB\_RL}{20}}$ $20\cdot\log\left[\frac{s21\cdot(\Gamma_L + 1)}{1 - s22\cdot\Gamma_L}\right] = -28.934$

10 dB of RL lowers the transfer function by 5 dB
12 dB of RL lowers the transfer function by 3.9 dB

Complete analysis requires complex and frequency dependant parameters