T10/07-267r1

6G SAS Reference TX & RX Termination Networks

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Objective

- Design termination networks to reasonably recreate worst case SDD11, SDD22, SCC11, SCC22, SCD11 & SCD22

But 1st… where is this going?

- Three applications:
  1. Validation of channels
  2. Validation of TX
  3. Validation of RX
- 1st two applications are software, but 3rd application requires hardware implementation of reference TX
- Problem: lab equipment cannot emulate worst case return loss

Proposed Solution

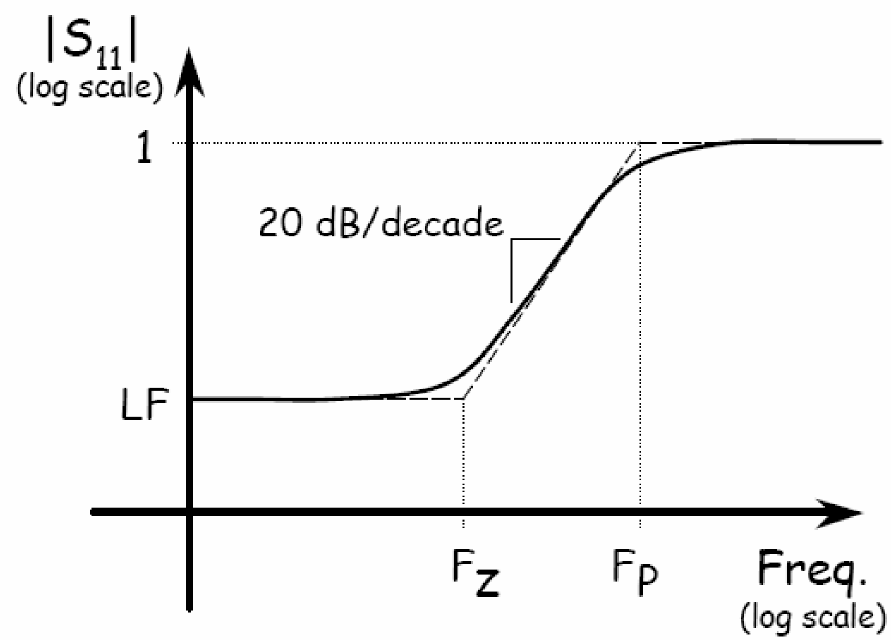
- Since 3rd application (RX validation) always uses 10 meter SAS cable, TX return loss affects far end waveform very little.
- Termination networks should be applied only to software ref. TX & RX

Return Loss Spec Format

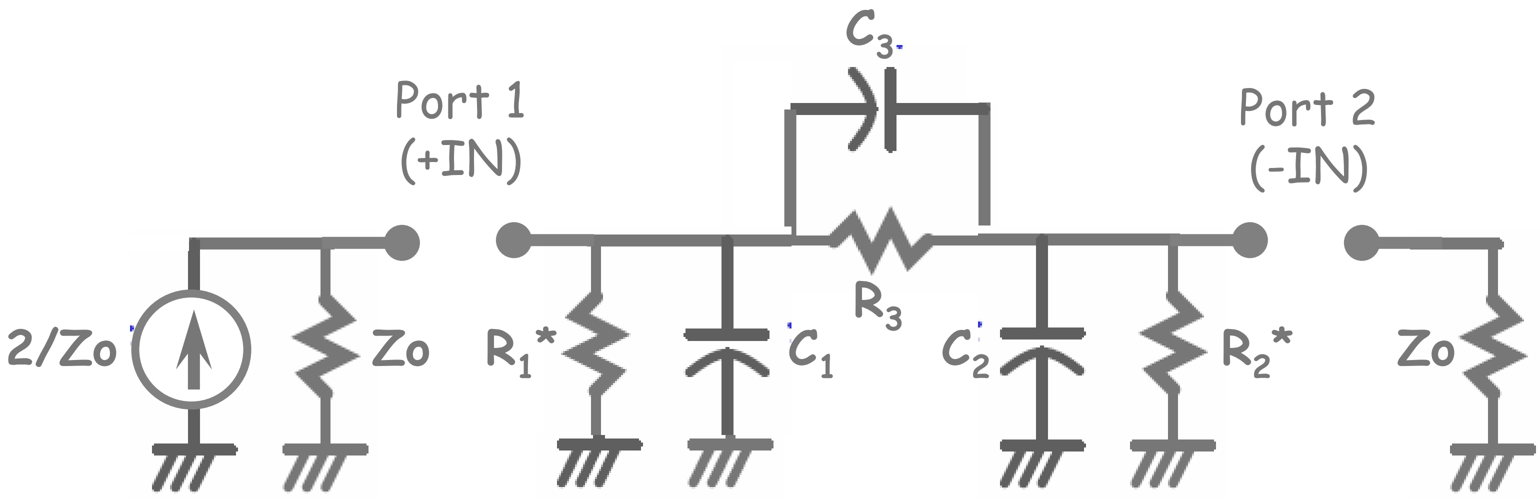
$LF = tol/(2+tol)$
$\sim tol/2$

$F_Z = tol/[2\pi\, R\, C\, (1+tol)]$
$\sim tol/(2\pi\, R\, C)$

$F_P = (2+tol)/[2\pi\, R\, C\, (1+tol)]$
$\sim 1/(\pi\, R\, C)$



Model #1



$R_1 = R_1^* \,||\, Zo$, $R_2 = R_2^* \,||\, Zo$, $R_1 C_1 = R_2 C_2 = R_3 C_3 = \tau$

S_{11} = [(2/Zo) * $(R_1||(R_2+R_3))$ - 1 - sτ] / [1+sτ]

S_{12} = [(2/Zo) * $(R_1R_2 / (R_1+R_2+R_3))$] / [1+sτ]

S_{22} = [(2/Zo) * $(R_2||(R_1+R_3))$ - 1 - sτ] / [1+sτ]

Normalizing resistors to Zo: $r_1 = R_1/Zo$, $r_2 = R_2/Zo$, $r_3 = R_3/Zo$

$$S_{11} = -[(1 - 2(r_1||(r_2+r_3))) + s\tau] / [1+s\tau]$$

$$S_{12} = [2(r_1 r_2 / (r_1+r_2+r_3))] / [1+s\tau]$$

$$S_{22} = -[(1 - 2(r_2||(r_1+r_3))) + s\tau] / [1+s\tau]$$

$$SDDnn = [S_{11} + S_{22} - 2 S_{12}]/2$$

$$= -[(1 - r_3||(r_1+r_2)) + s\tau] / [1+s\tau]$$

$$SCCnn = [S_{11} + S_{22} + 2 S_{12}]/2$$

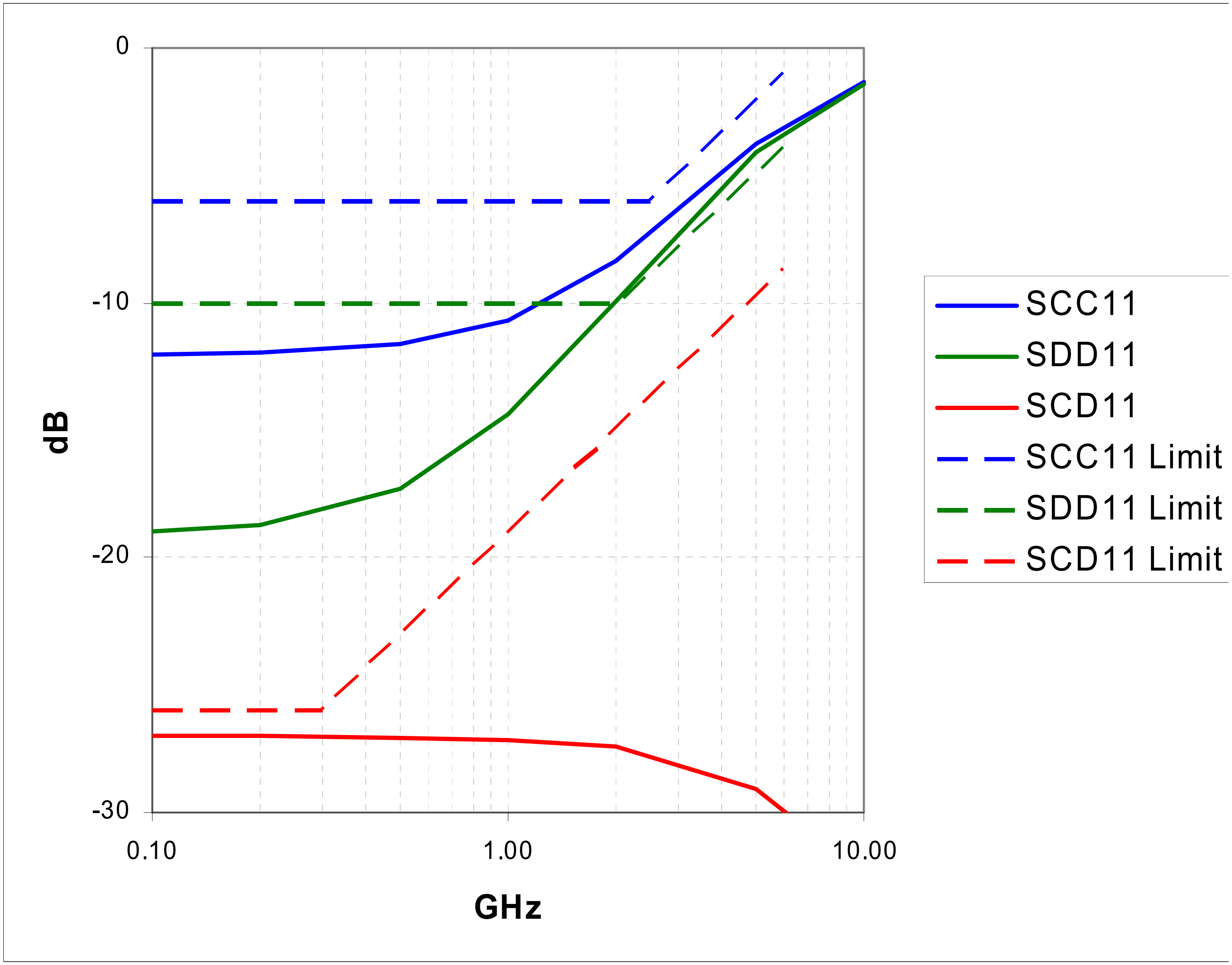
$$= -[(1 - [4r_1 r_2+r_1 r_3+r_2 r_3]/[r_1+r_2+r_3]) + s\tau] / [1+s\tau]$$

$$SCDnn = [S_{11} - S_{22}]/2$$

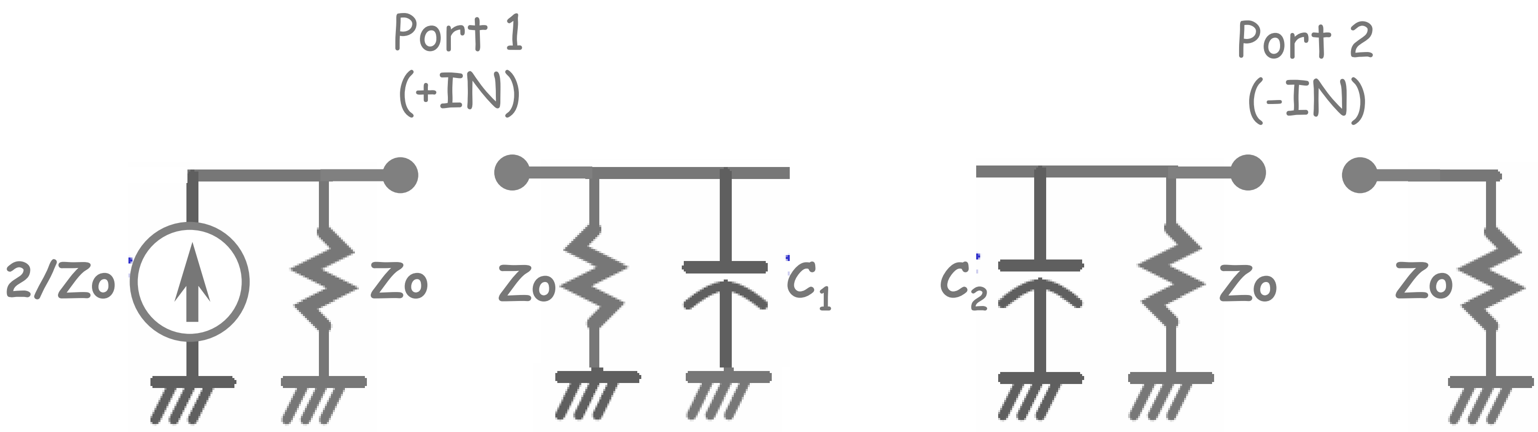
$$= [(r_1-r_2)r_3 / (r_1+r_2+r_3)] / [1+s\tau]$$

Model #1 Values

r1	r2	r3	tau	R1*	R2*	R3	Zo
0.65	0.6	10	25 ps	93 ohms	75 ohms	500 ohms	50 ohms



Model #2



$ZoC_1/2 = \tau_1$ $ZoC_2/2 = \tau_2$

$S_{11} = -s\tau_1 / (1+s\tau_1)$

$S_{12} = 0$

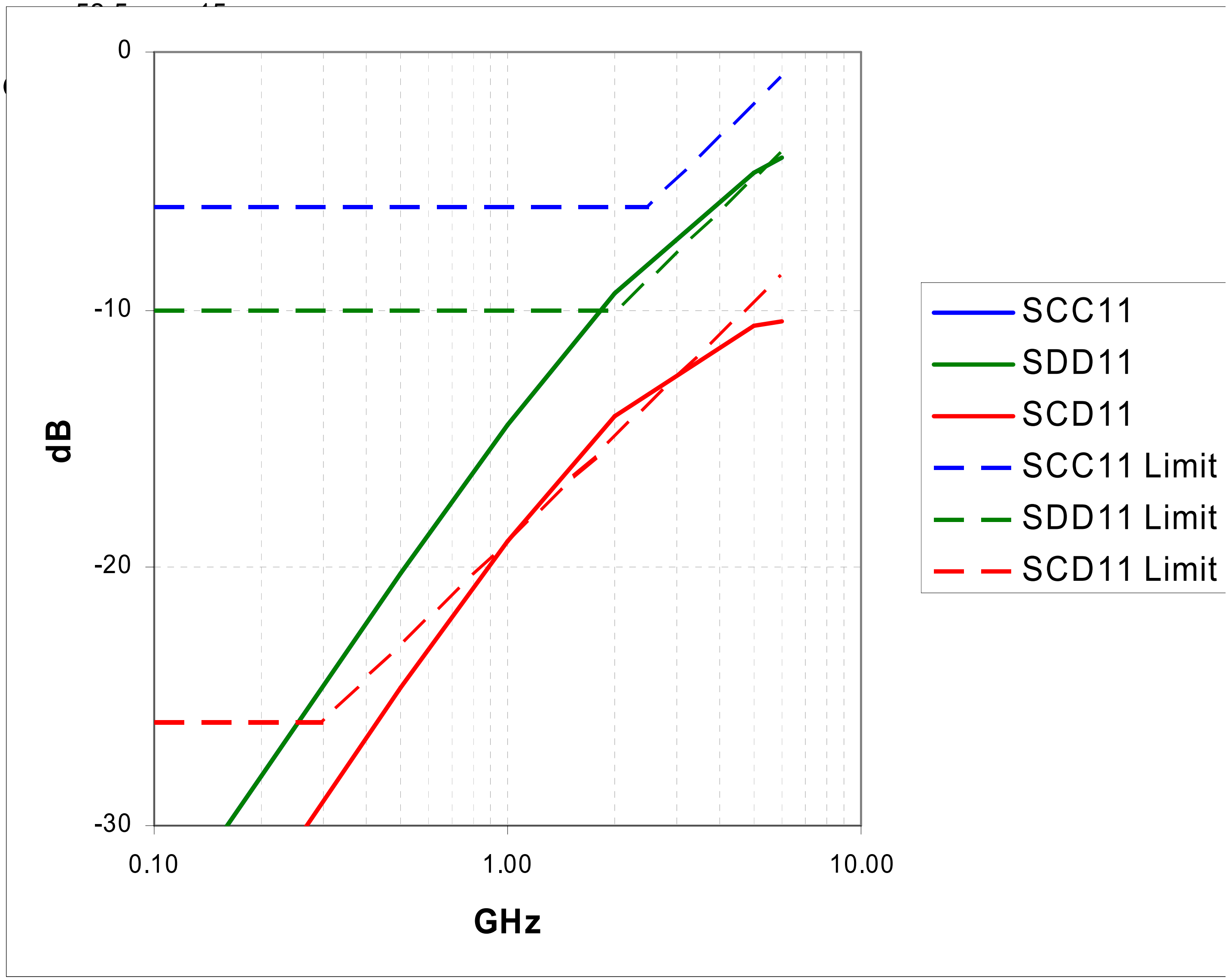
$S_{22} = -s\tau_2 / (1+s\tau_2)$

SDDnn = SCCnn = $[S_{11} + S_{22}]/2$

SCDnn = $[S_{11} - S_{22}]/2$

Model #2 Values

C1	C2	tau1	tau2	Zo
2	0.5	50	12.5	50
pF	pF	ps	ps	ohms



Conclusions

- Since model #2 does a much better job of emulating worst case SCD11, it is chosen as the termination model
- *TxRefTerm.s4p* & *RxRefTerm.s4p* uploaded in *07-267r0.zip* are cascadable 4-port models
    - TxRefTerm: 2pF to GND on ports 1(in) & 2(out) and 0.5pf to GND on ports 3(in) & 4(out)
    - RxRefTerm is identical, but with 2pF and 0.5pF reversed