



Ripple Effects in S21

Gopakumar Parameswaran

Jeff Cain

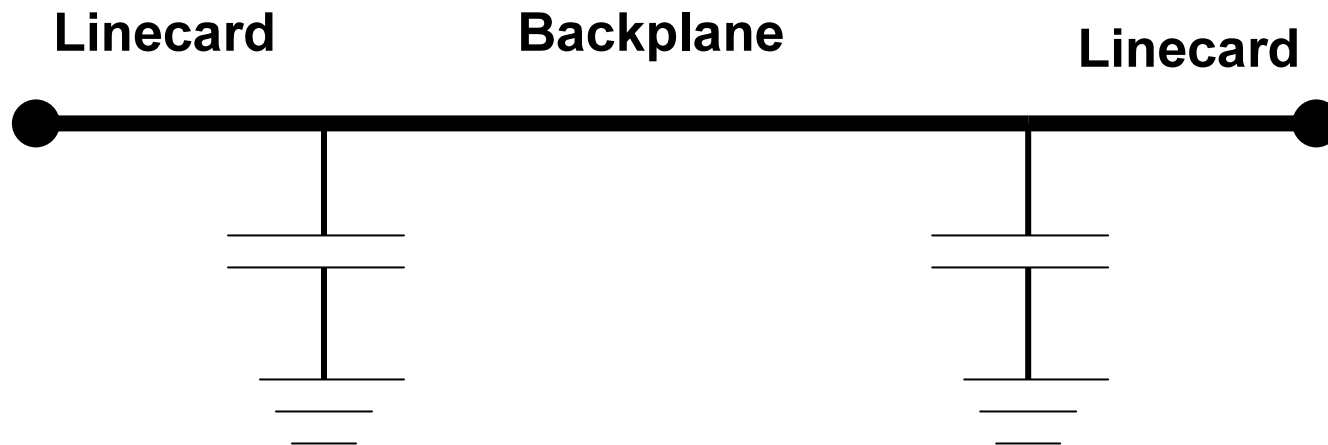
Contents

- **Description of the problem**
- **Ripple effect examples in both frequency and time domain**
- **Ripple recommendations**

Problem

- **The capacitive effects of the backplane connector vias set up reflected waves that cause ripple in the S21**
- **This ripple corresponds directly to time domain issues in the impulse response**
- **This study is a simulation using **ADS** software**

Simplified model



2 main methods for altering ripple:
Change via/connector capacitance
Change loss tangent for BP material

Quick sim results

- By changing loss tangent

Loss tangent	Ripple Amplitude (dB)	Reflection ratio (%)
0	9	17.12
0.001	8.5	16.3
0.005	7	13.5
.01	5.6	10.9
.02	3.8	6.7
.05	2	3.3

Cap=2.7pF Length =**???**

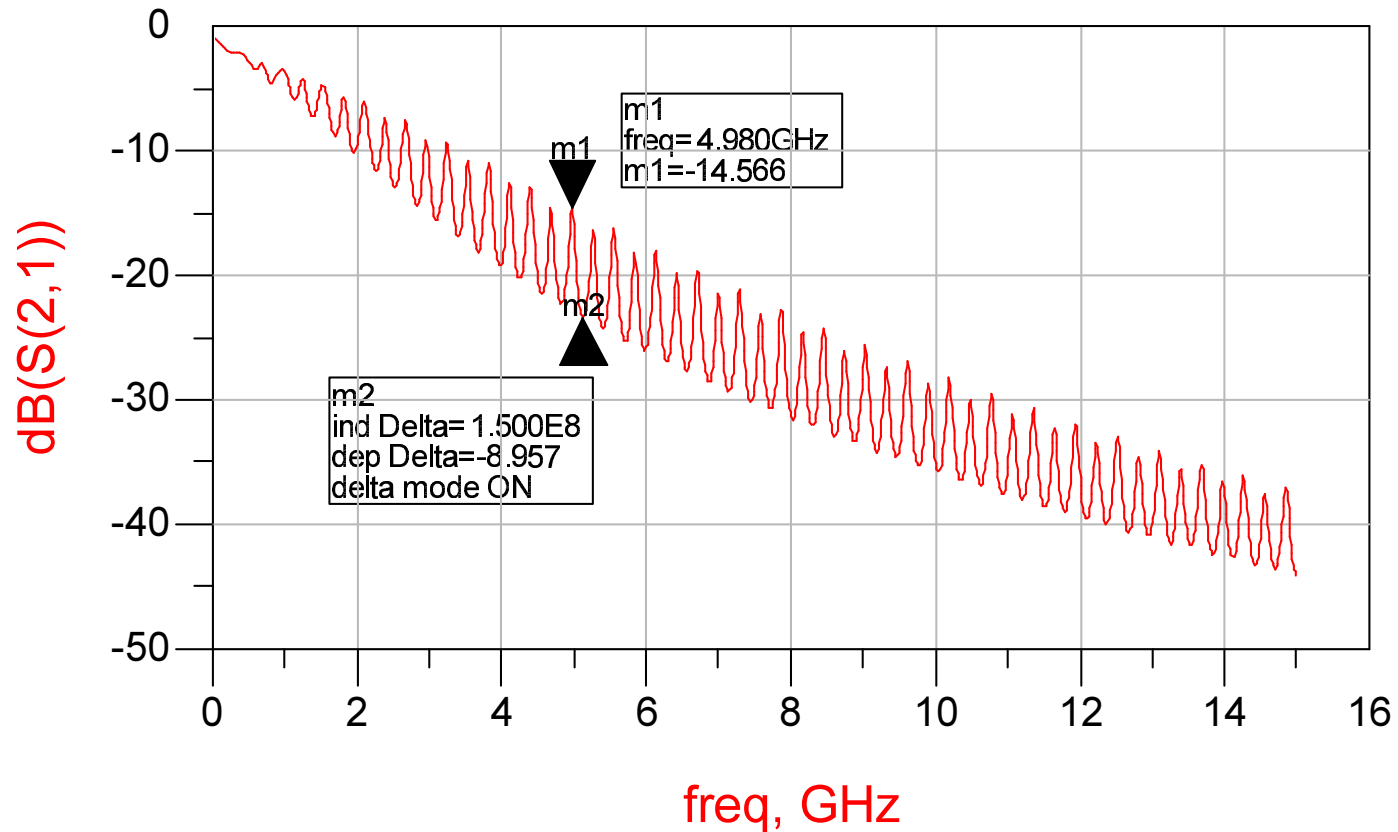
Quick sim results

- Changing capacitance:

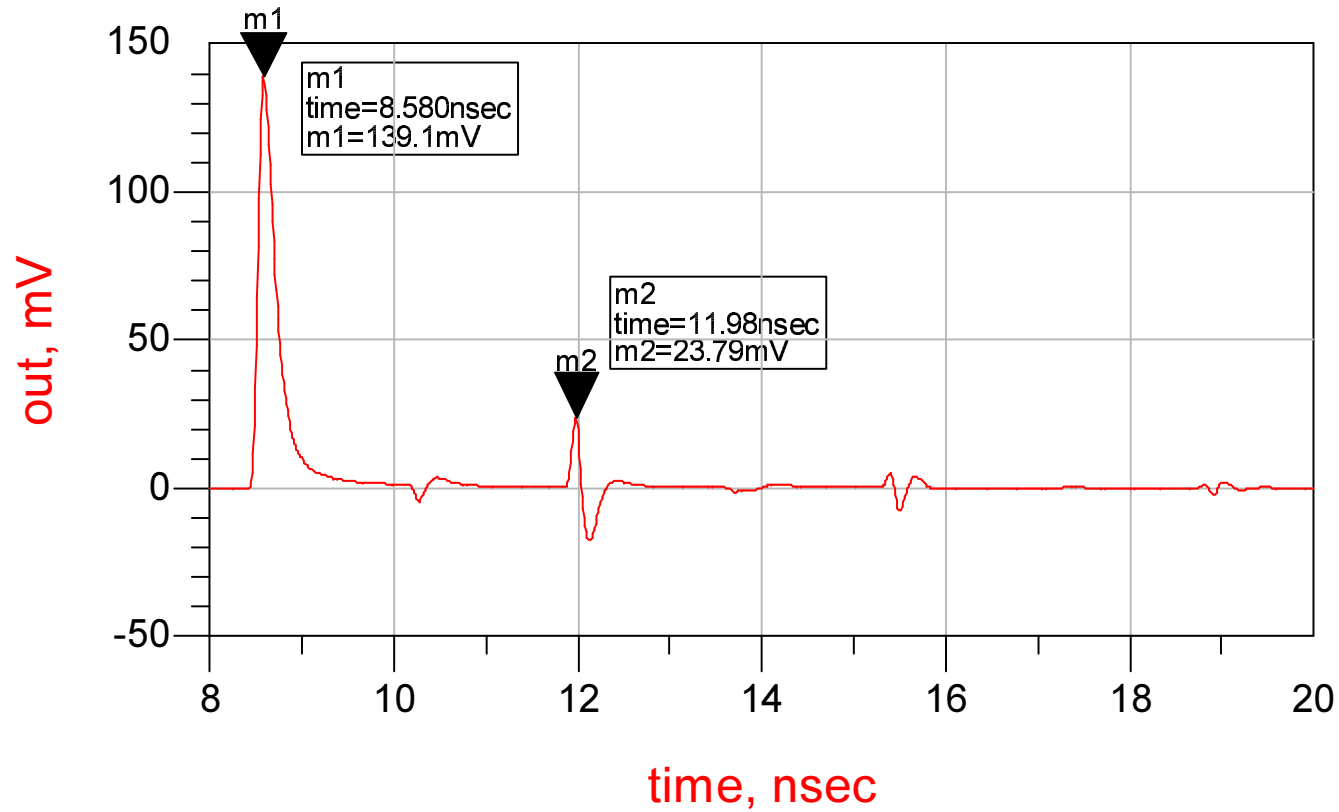
Capacitance (pF)	Ripple Amplitude (dB)	Reflection ratio (%)
0	0	0
0.5	1.4	2.3
1.0	3.7	6.4
1.5	5.7	10.0
2.0	7.2	12.8
2.5	8	15.4

er=0.001 Length =???

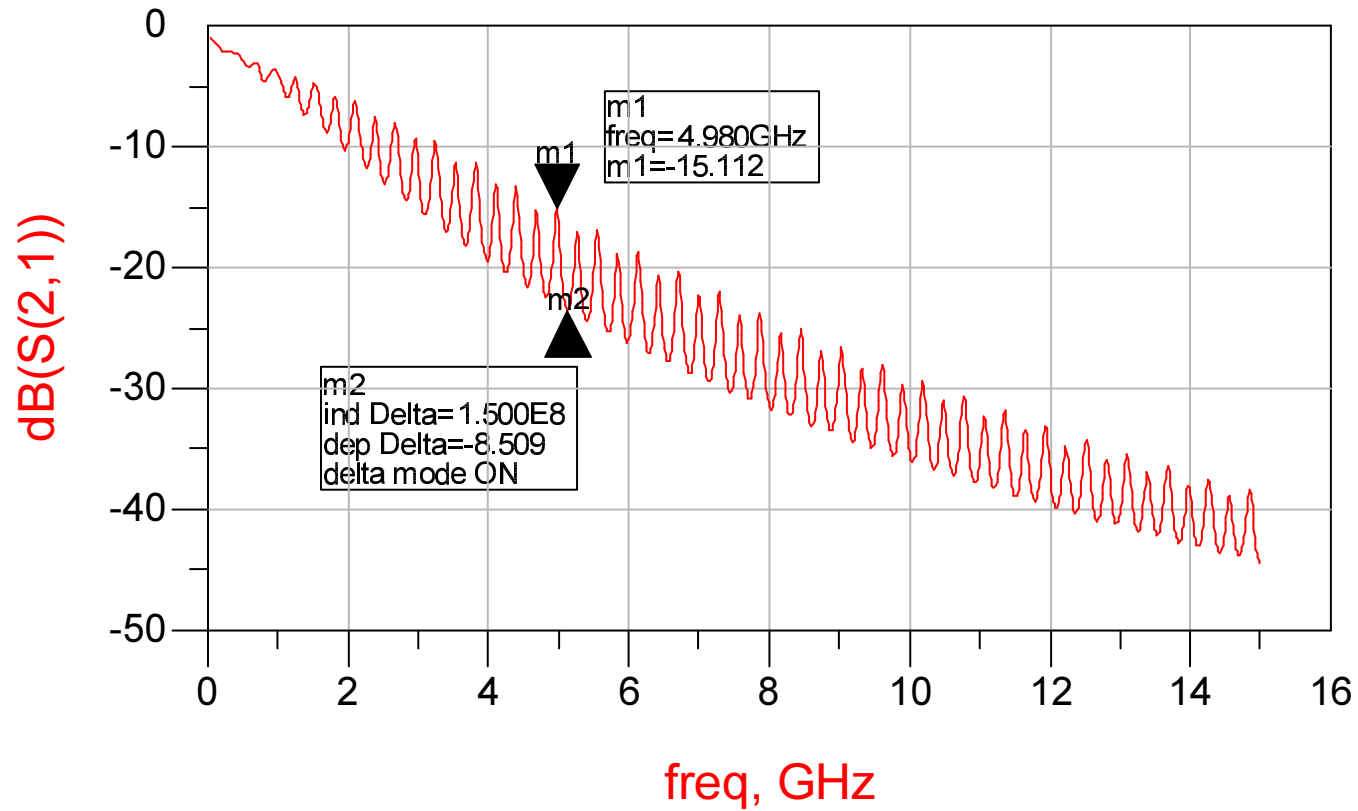
Changing loss tangent



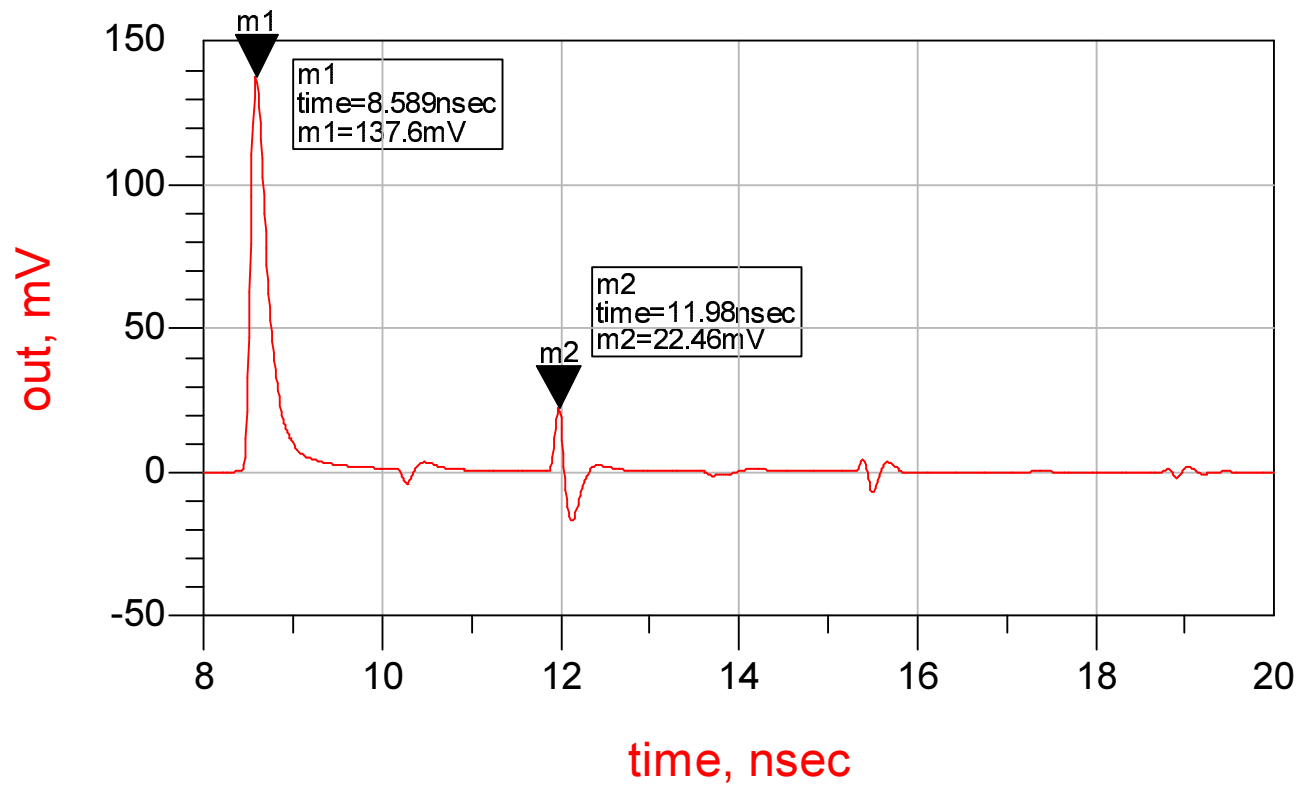
Changing loss tangent



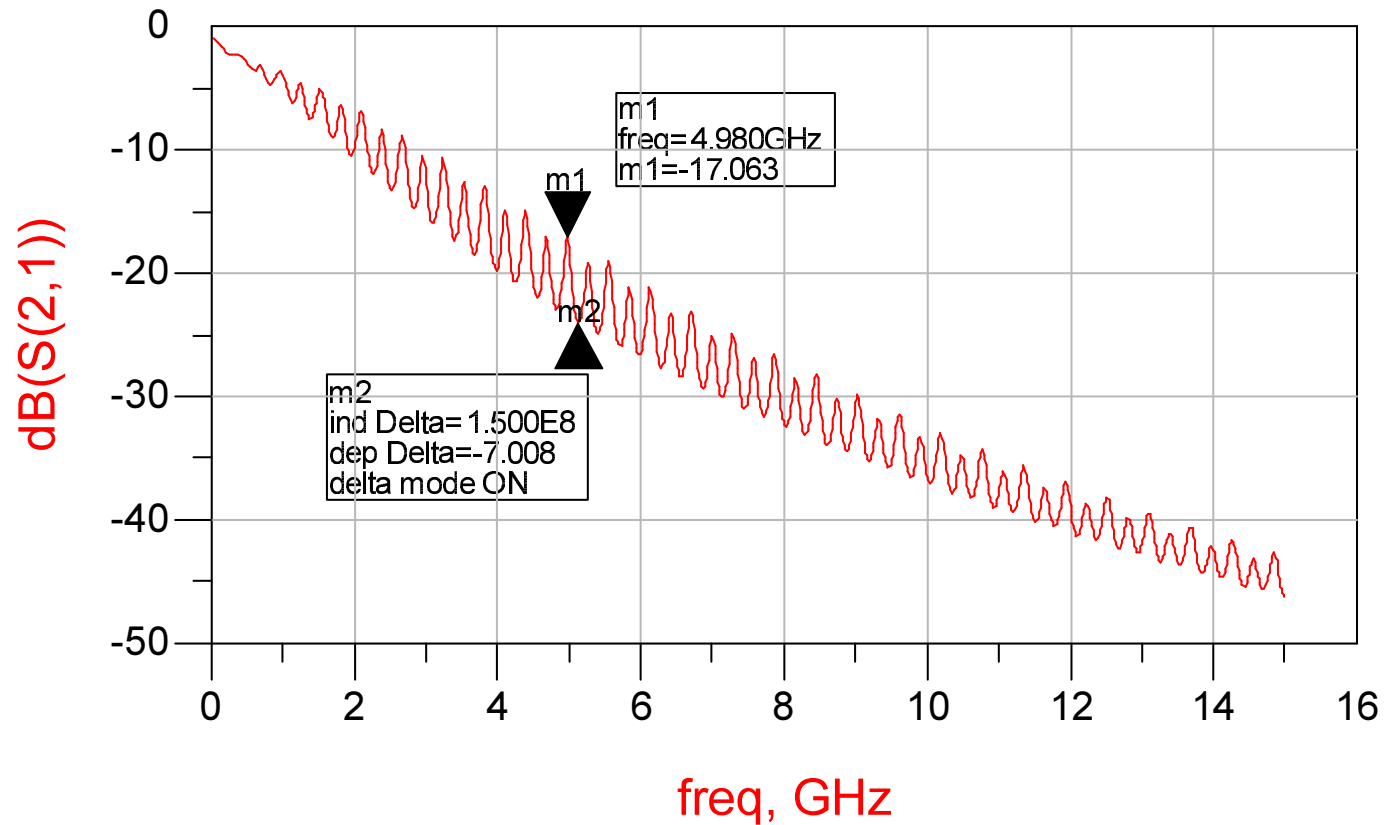
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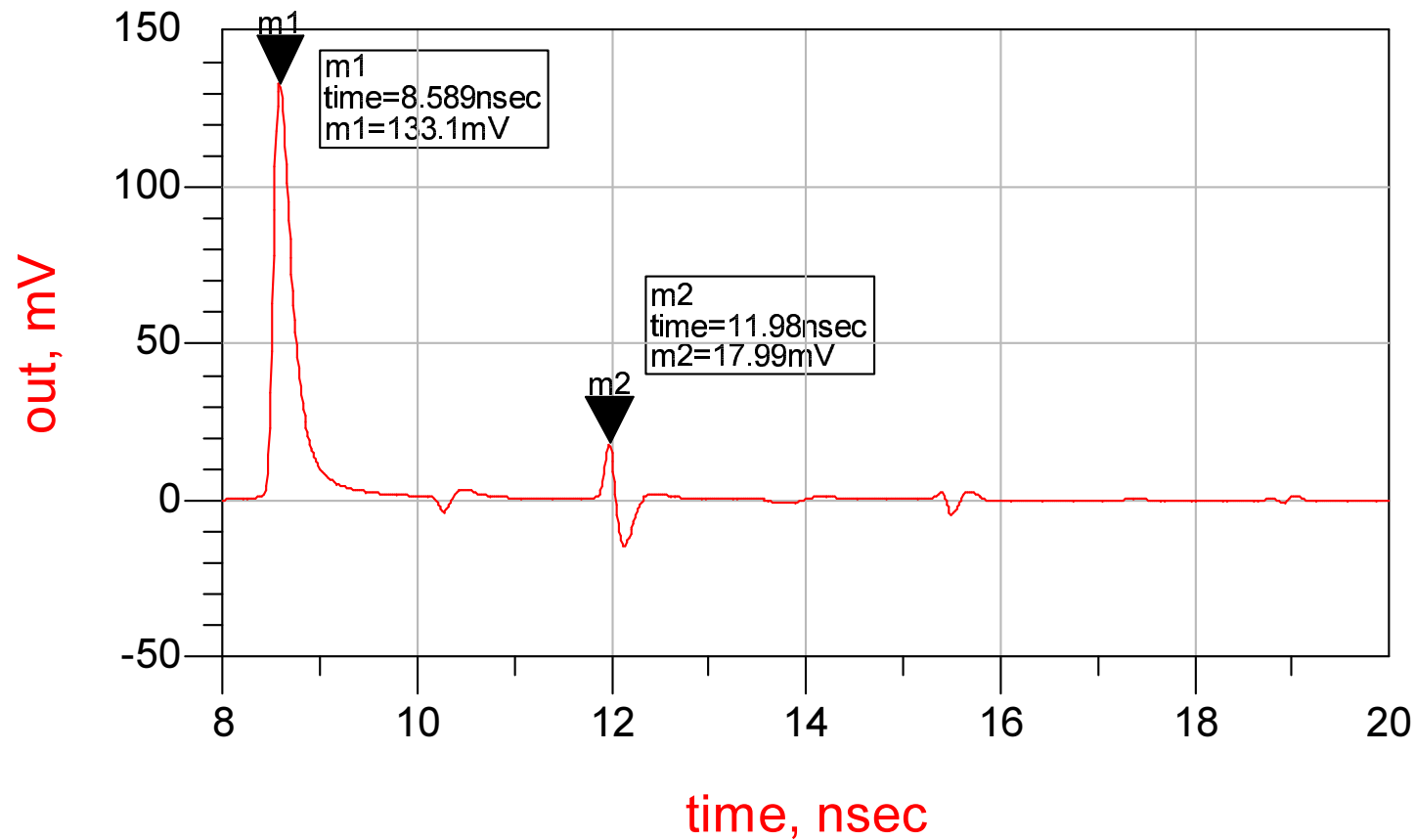
Changing loss tangent



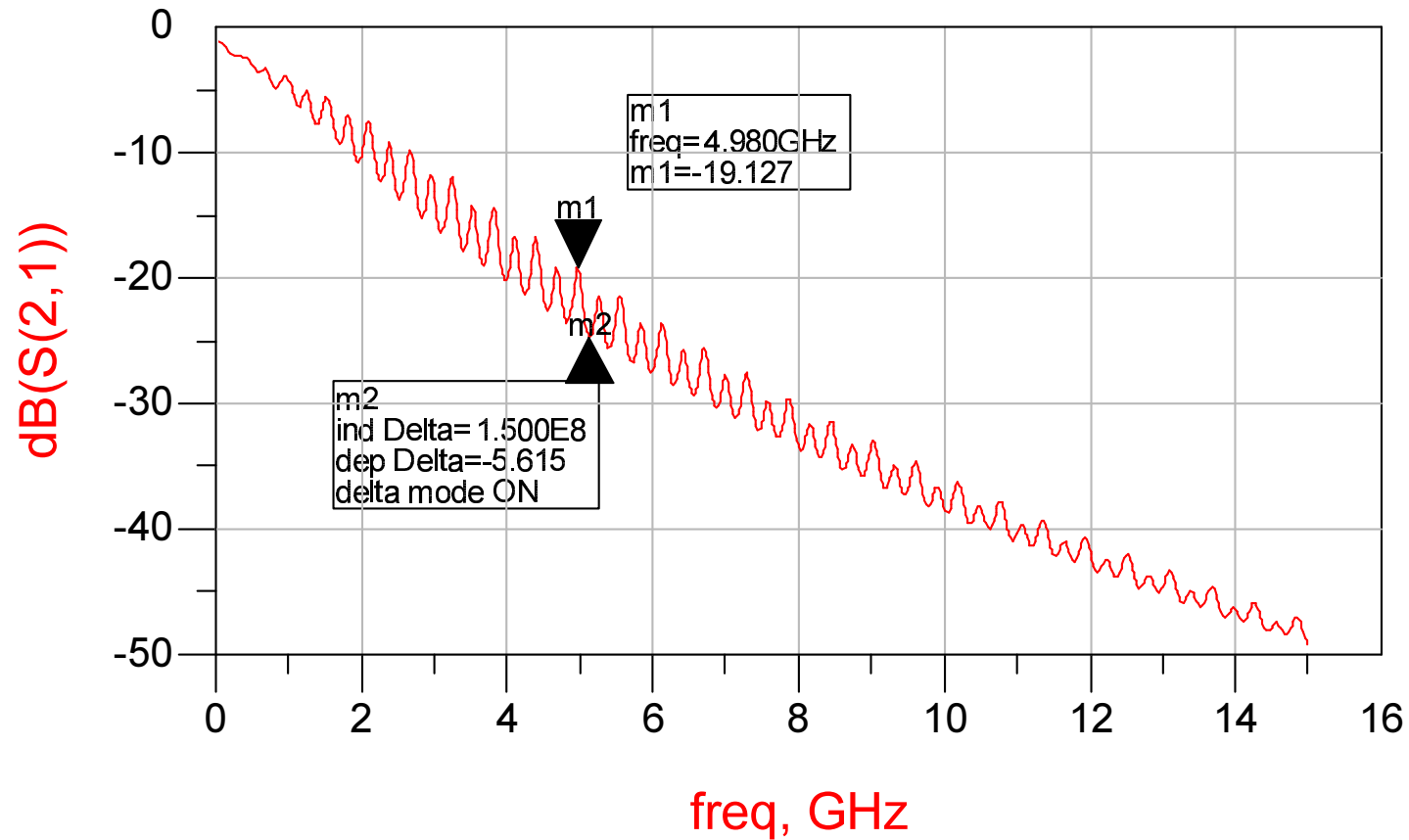
Changing loss tangent



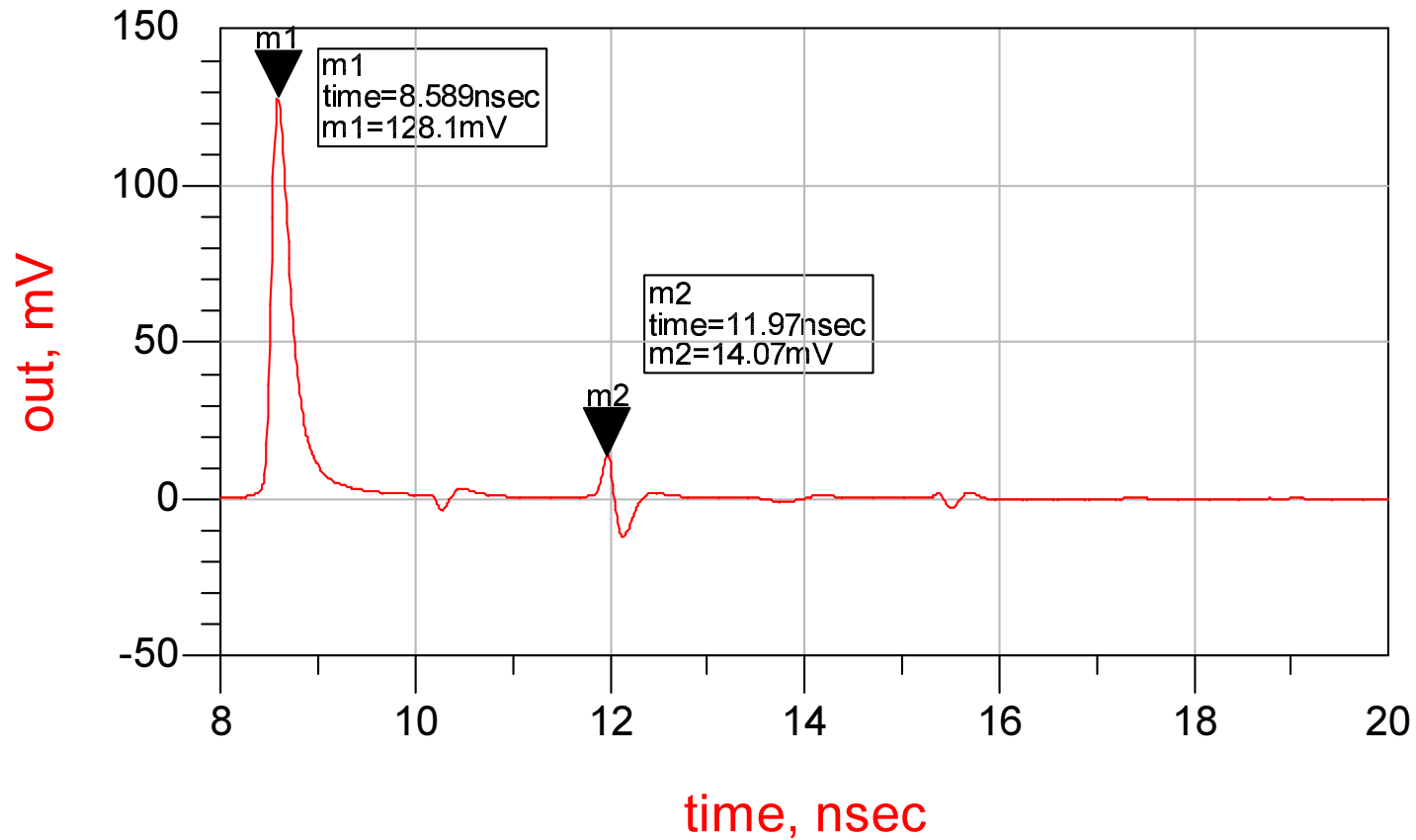
Changing loss tangent



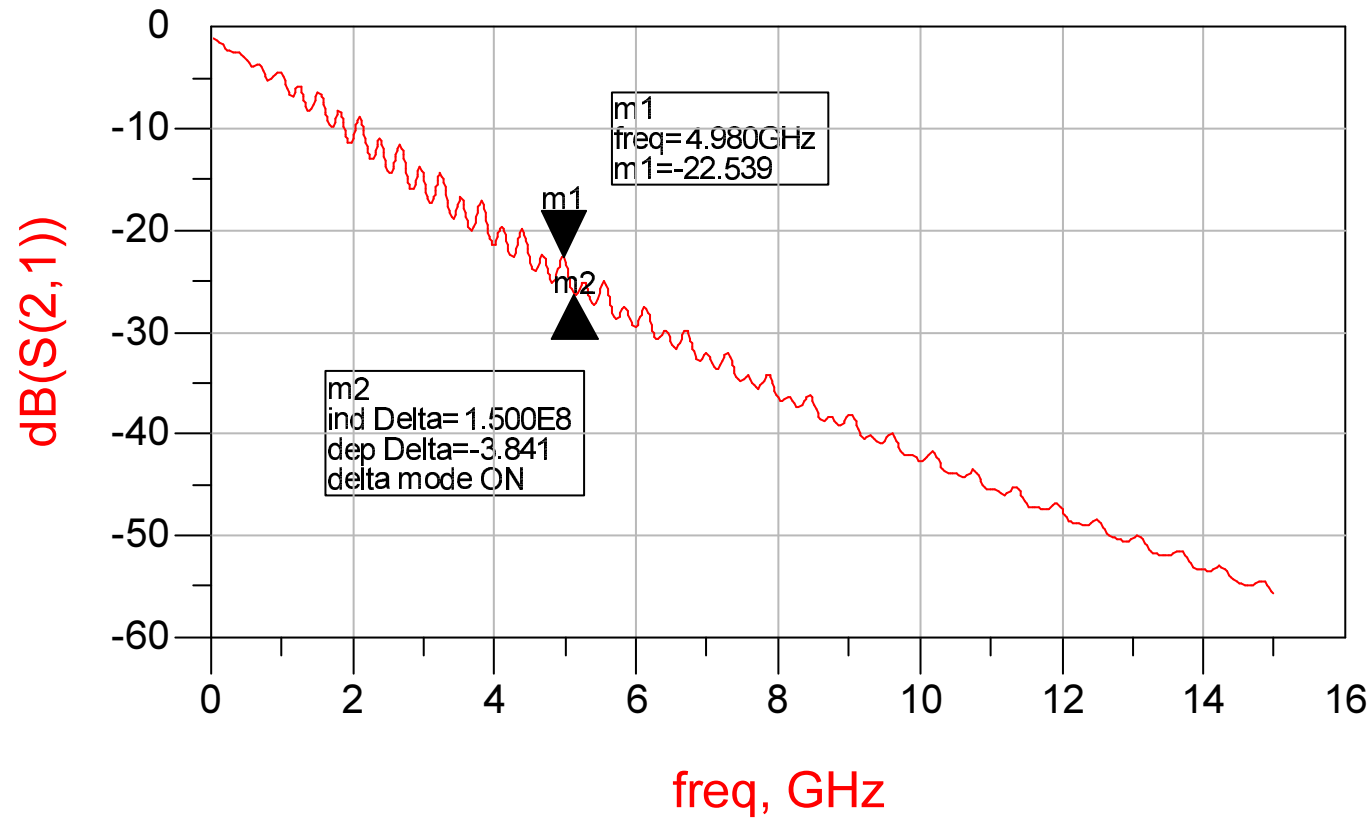
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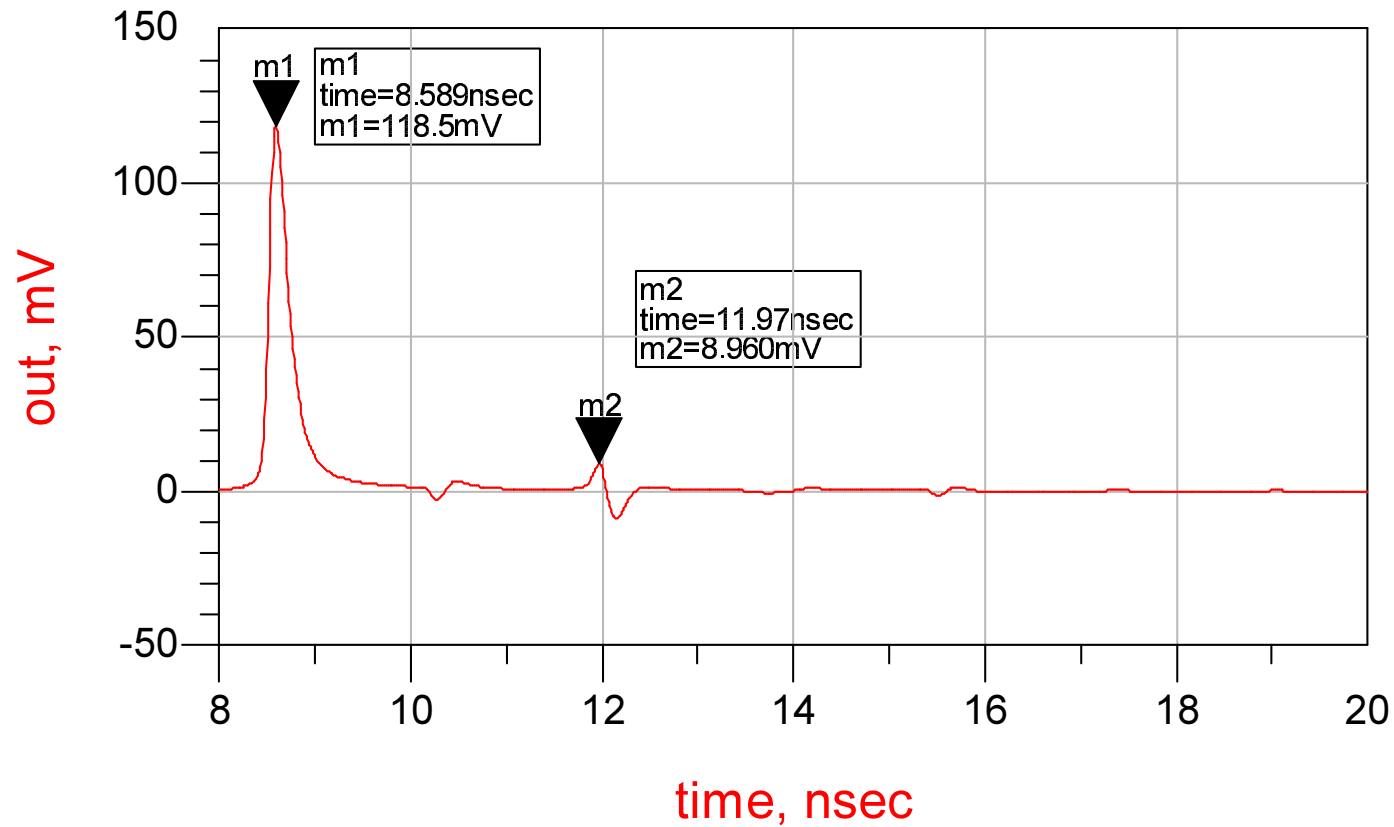
Changing loss tangent



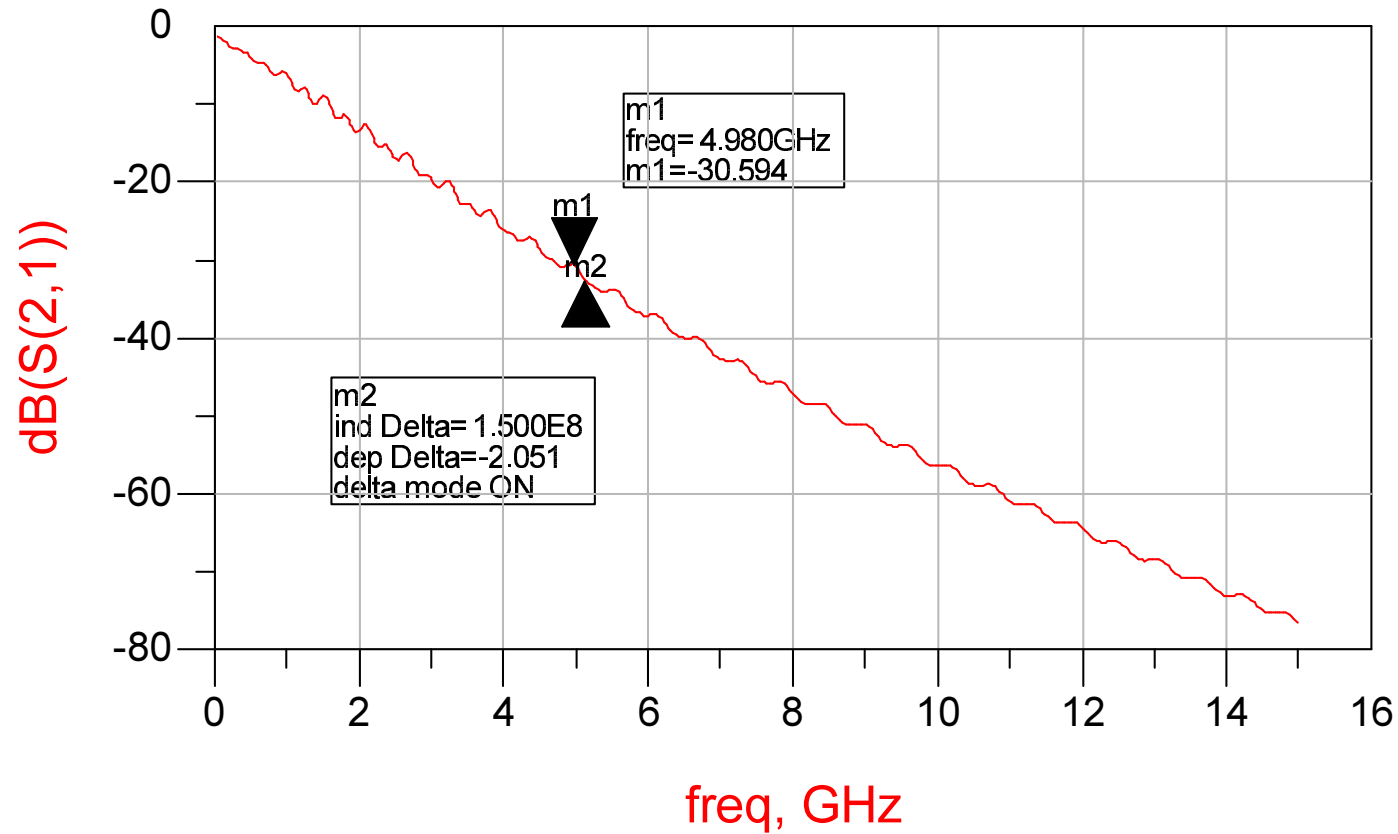
Changing loss tangent



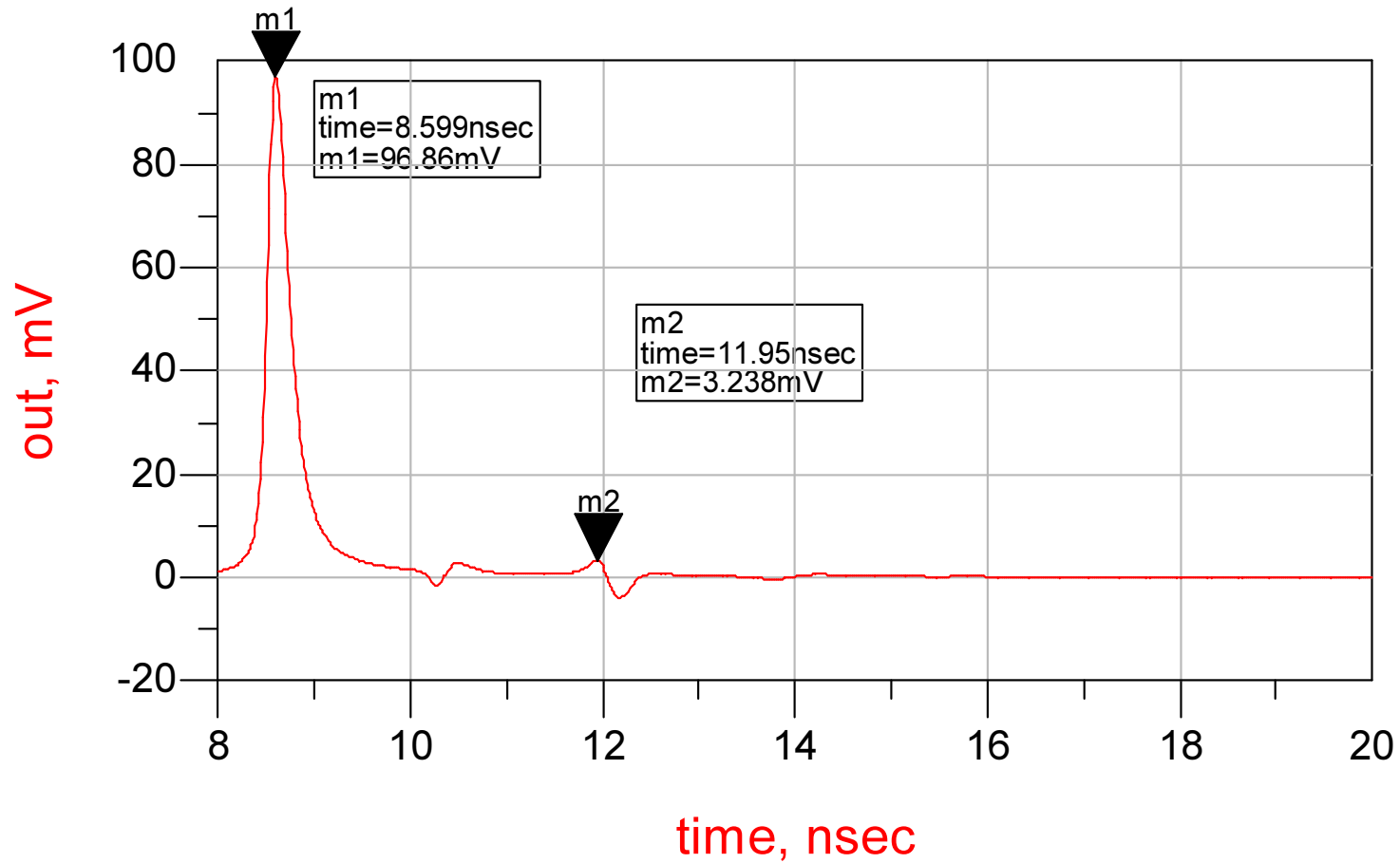
Changing loss tangent



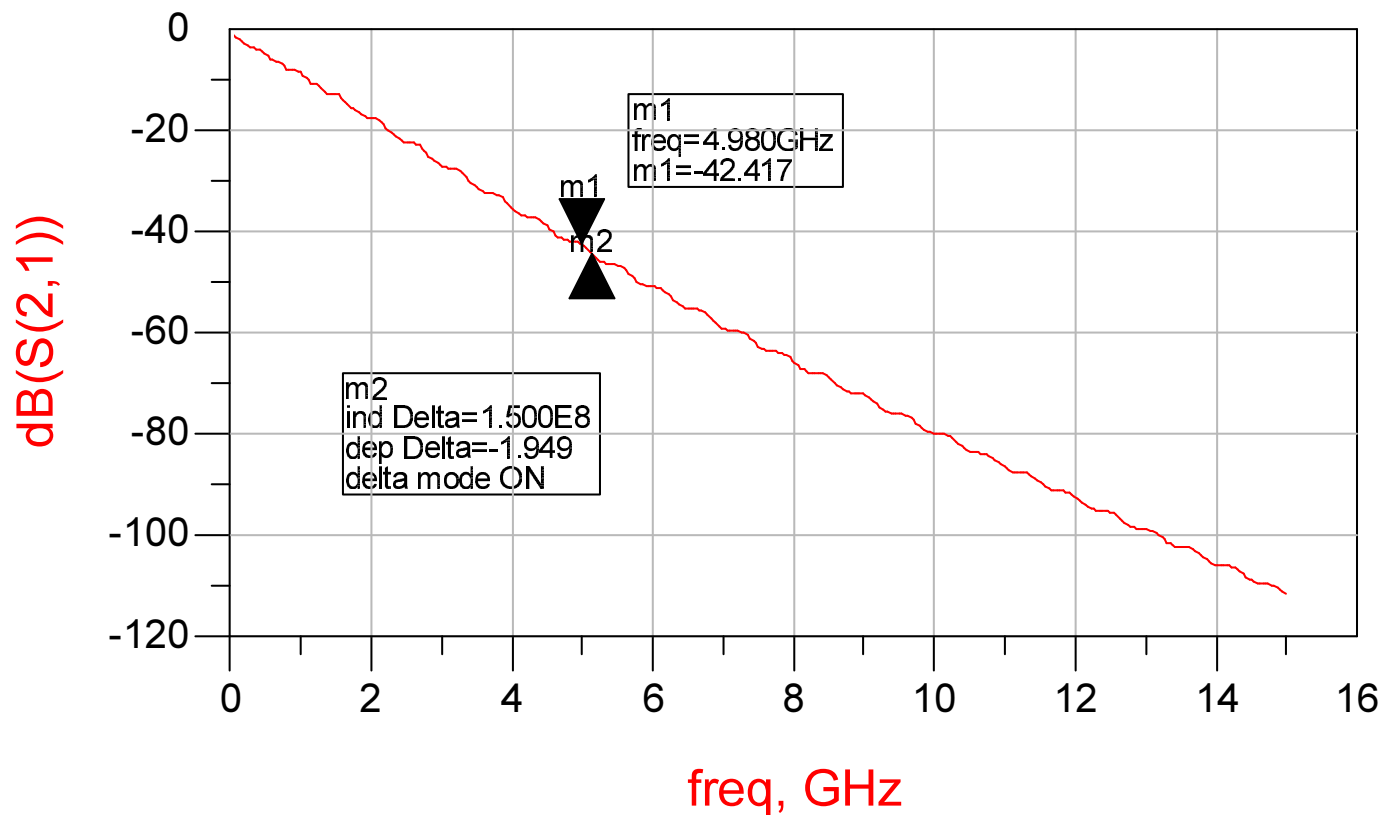
Changing loss tangent



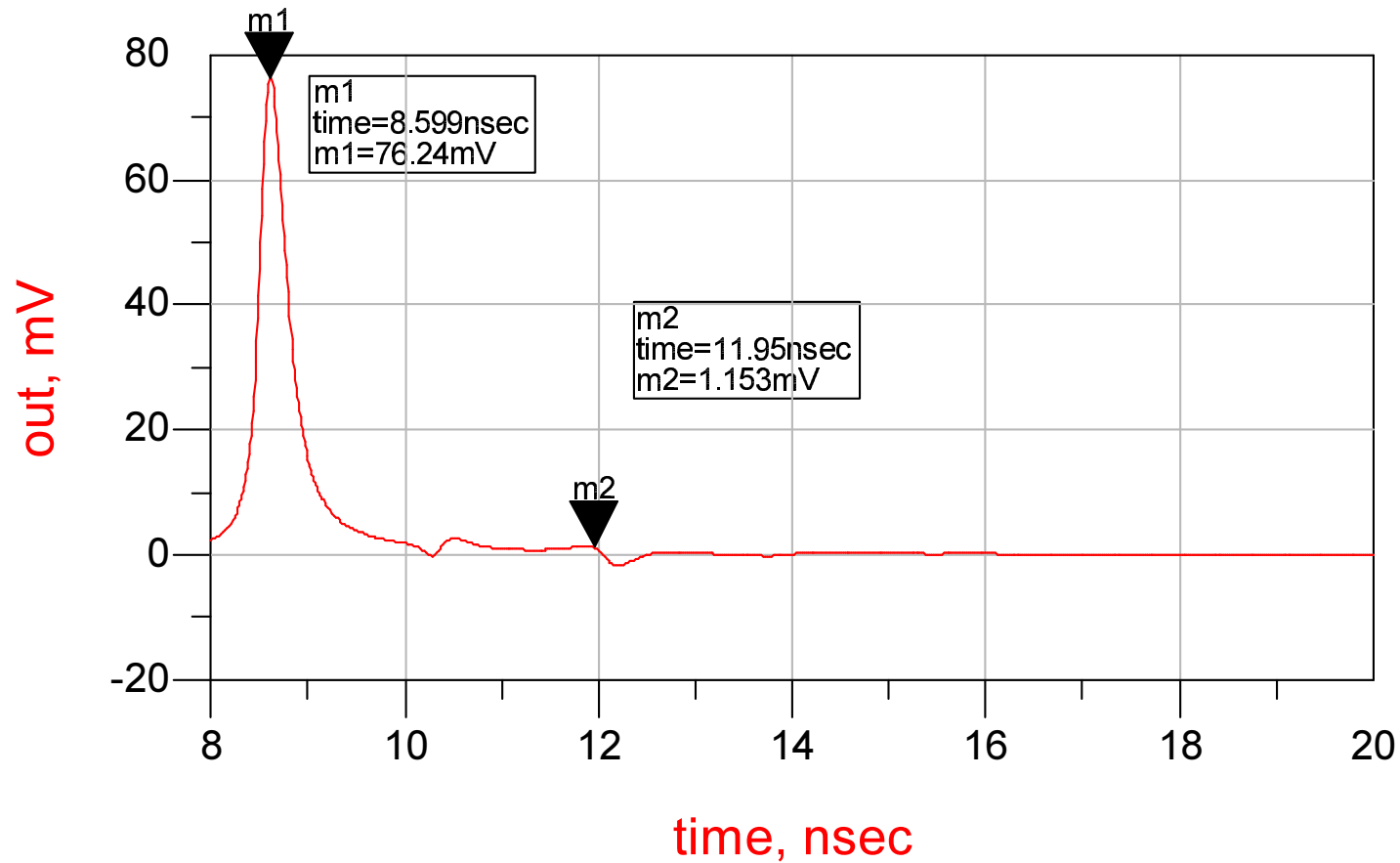
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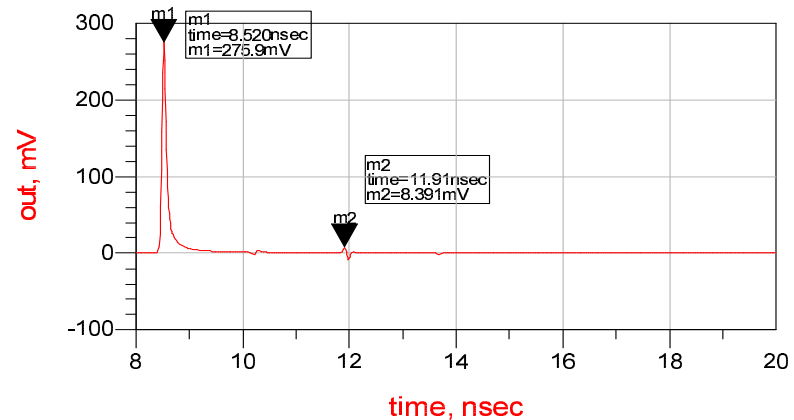
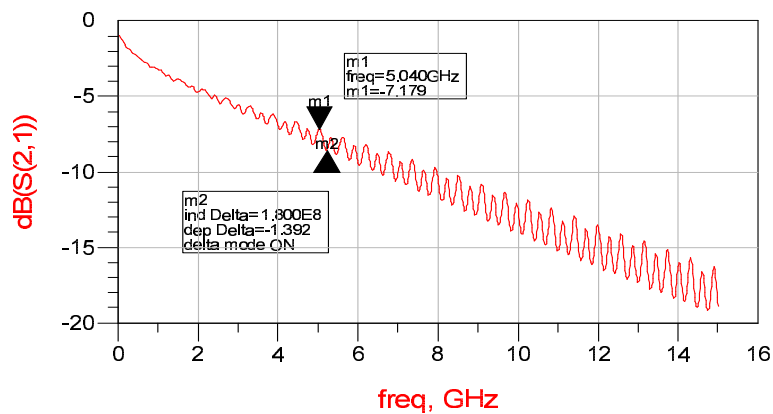
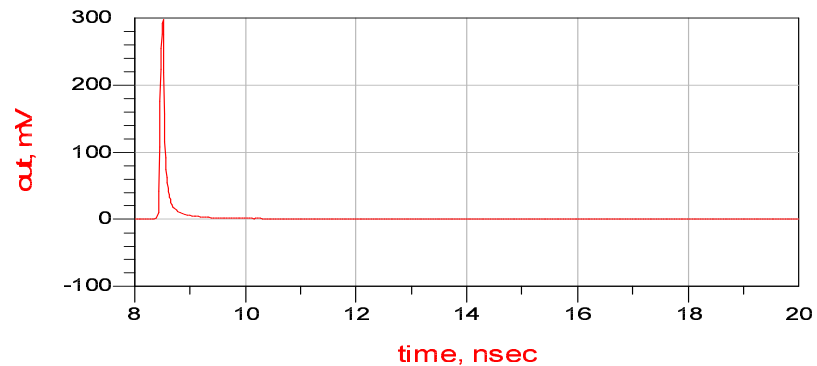
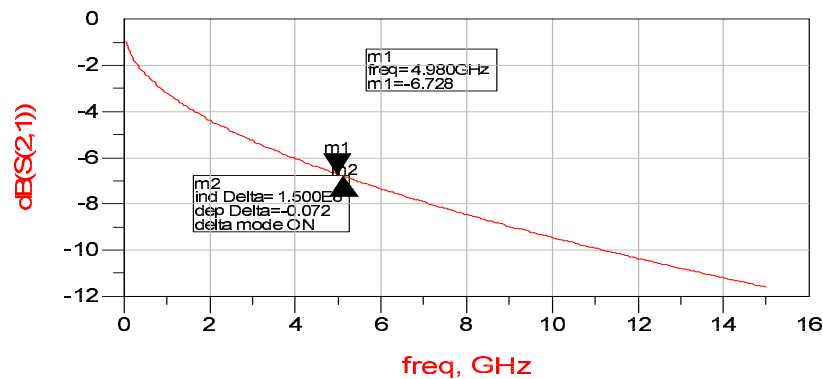
Changing loss tangent



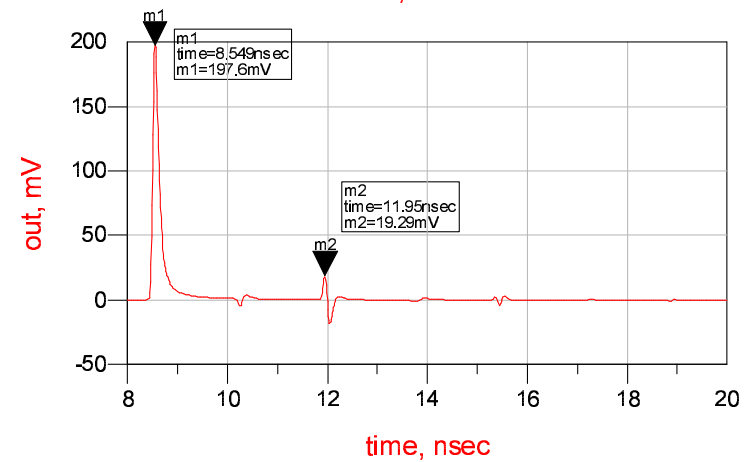
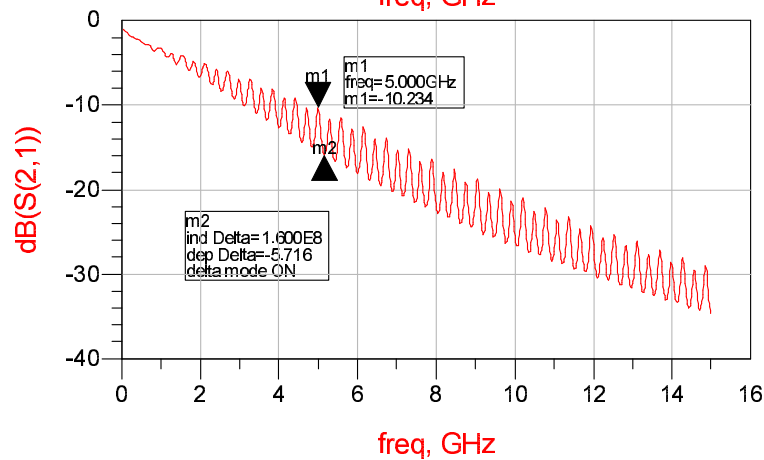
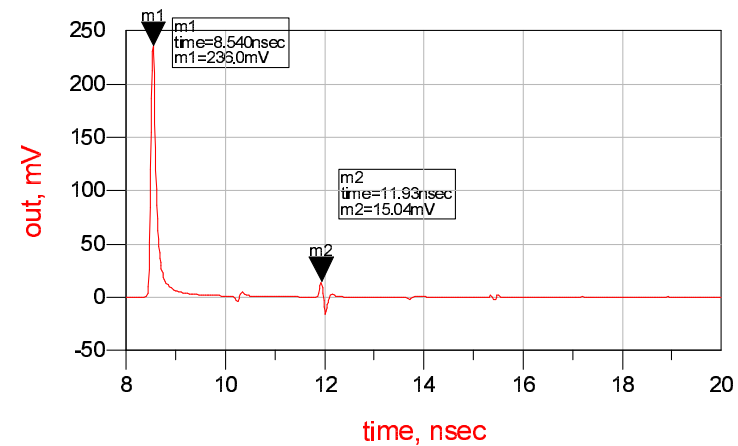
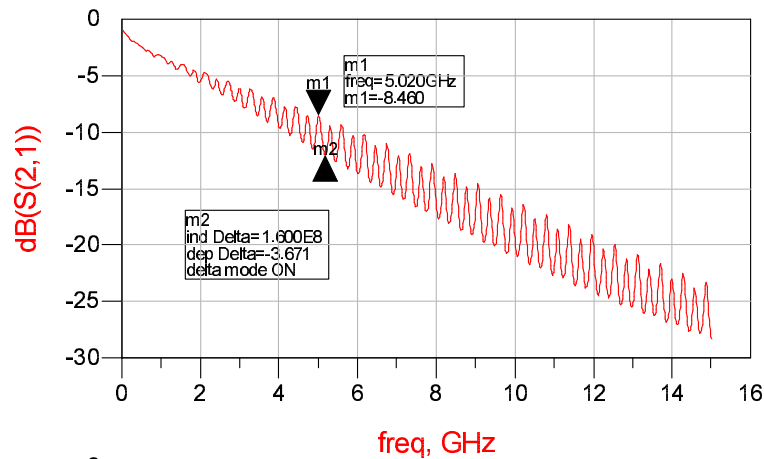
Changing loss tangent



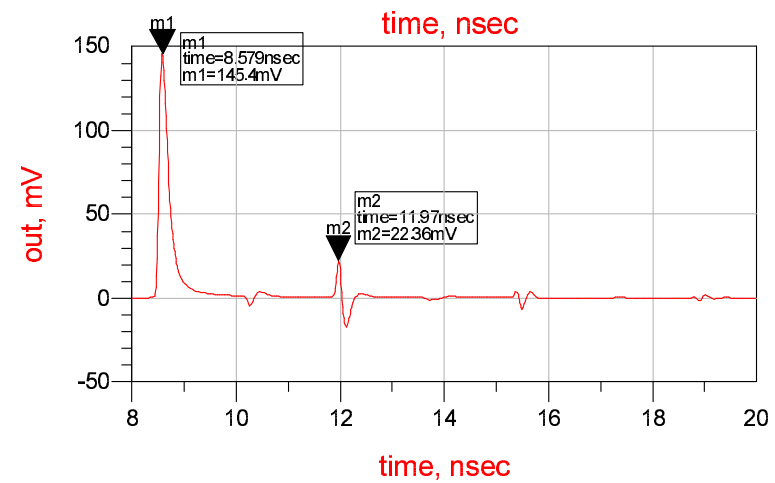
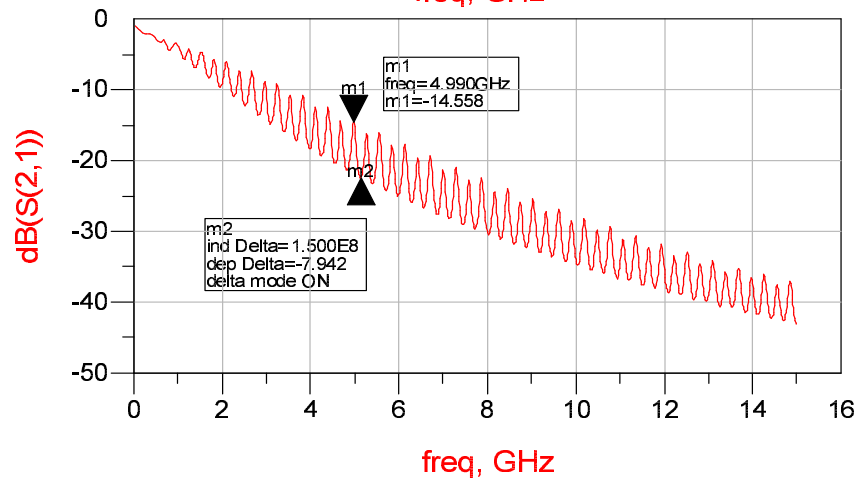
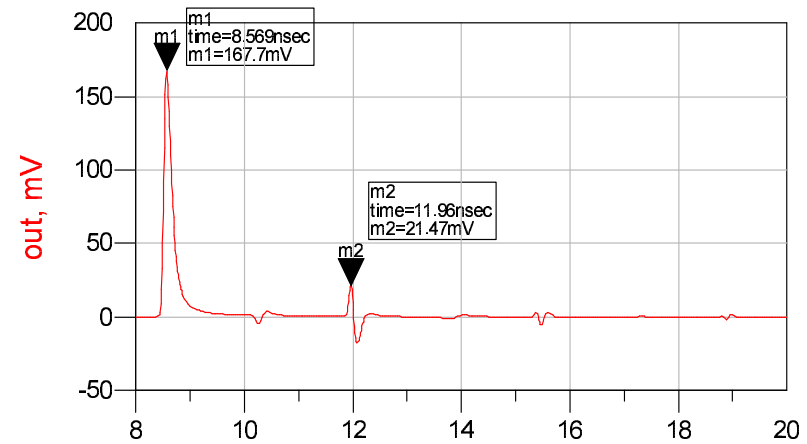
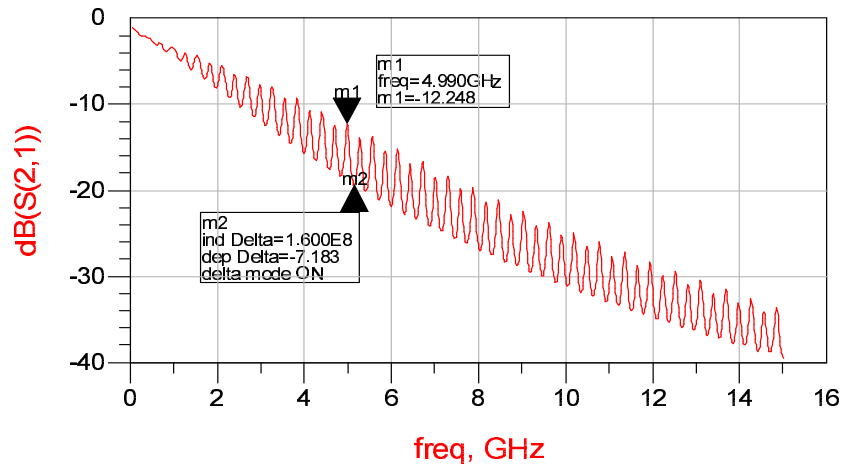
Changing capacitance



Changing capacitance



Changing capacitance



Conclusions

- **Ripple in S21 causes time domain effects that are outside the tap window for this solution**
 - Where this noise occurs is related to the length of the backplane trace**
 - This is true even if you are above the informative S21 limit**
- **Recommendation – consider this ripple as part of the total noise**
 - Ripple + Cross Talk + Jitter**
- **First SWAG - ~5dB of ripple should be accounted**