



Revised rise-time filter for COM interference tolerance calibration

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- **In Clause 93 (100GBASE-KR4) a filter is used in the COM simulations for the Interference Tolerance test calibration to replace the package model “when a test transmitter with a high quality termination” is used. The filter is based on the measured rise-time at TP0a**
- **In Clause 92 (100GBASE-CR4) the same filter is used. TP0a is also the measurement point for the rise-time, but that point isn’t defined in that clause and there is no cross-reference to 93.8.1.1 where it is defined.**
- **802.3by adopted the same methodology and the same filter however for the cable specification (Clause 110) a change was made in Rev 2.2 to measure the rise-time at PGC (equivalent to TP0) without changing the filter. This results in the same filter equation (and resulting rise-time) being used whether the rise-time is measured at TP0a or TP0.**
- **This presentation explores the effect this has and suggests improvements. It is in support of comments i-57 and i-61 against draft 3.0**
- **An earlier version of the presentation was made to the 802.3by Architecture Ad hoc on Dec 2 2015.**

Changes from Dec 2 2015 ad hoc presentation.

- **Based on consensus discussions the proposed revised filter remains a Gaussian Filter and is not changed to a Bessel Thomson filter which was the original proposal. (The concerns with causality were not an issue with any real channel and were solved for simulations at TP0 by including a fixed small delay.)**
- **Significant editorial changes to hopefully make the presentation clearer.**
- **The key slides from the ad-hoc presentation (showing the results with the originally proposed Bessel Thomson filter) are included in a back-up section.**

Changes for Clause 110

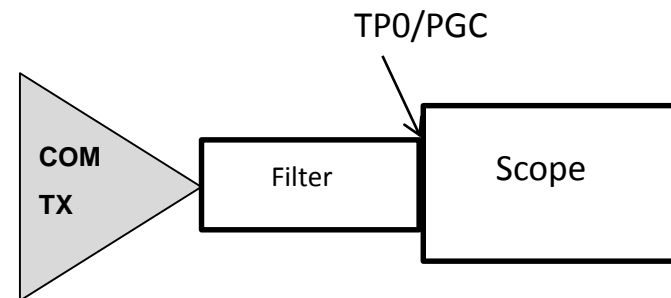
- The existent Gaussian filter defined by (93A-46) is as below.

$$H_t(f) = \exp(-(\pi f T_r / 1.6832)^2) \quad (93A-46)$$

- The proposed revised Gaussian filter is as below.

$$H_t(f) = \exp(-2 * (\pi f T_r / 1.6832)^2)$$

- The resulting rise-time at TP0/PGC is simulated over a range of input rise-times



@TP0

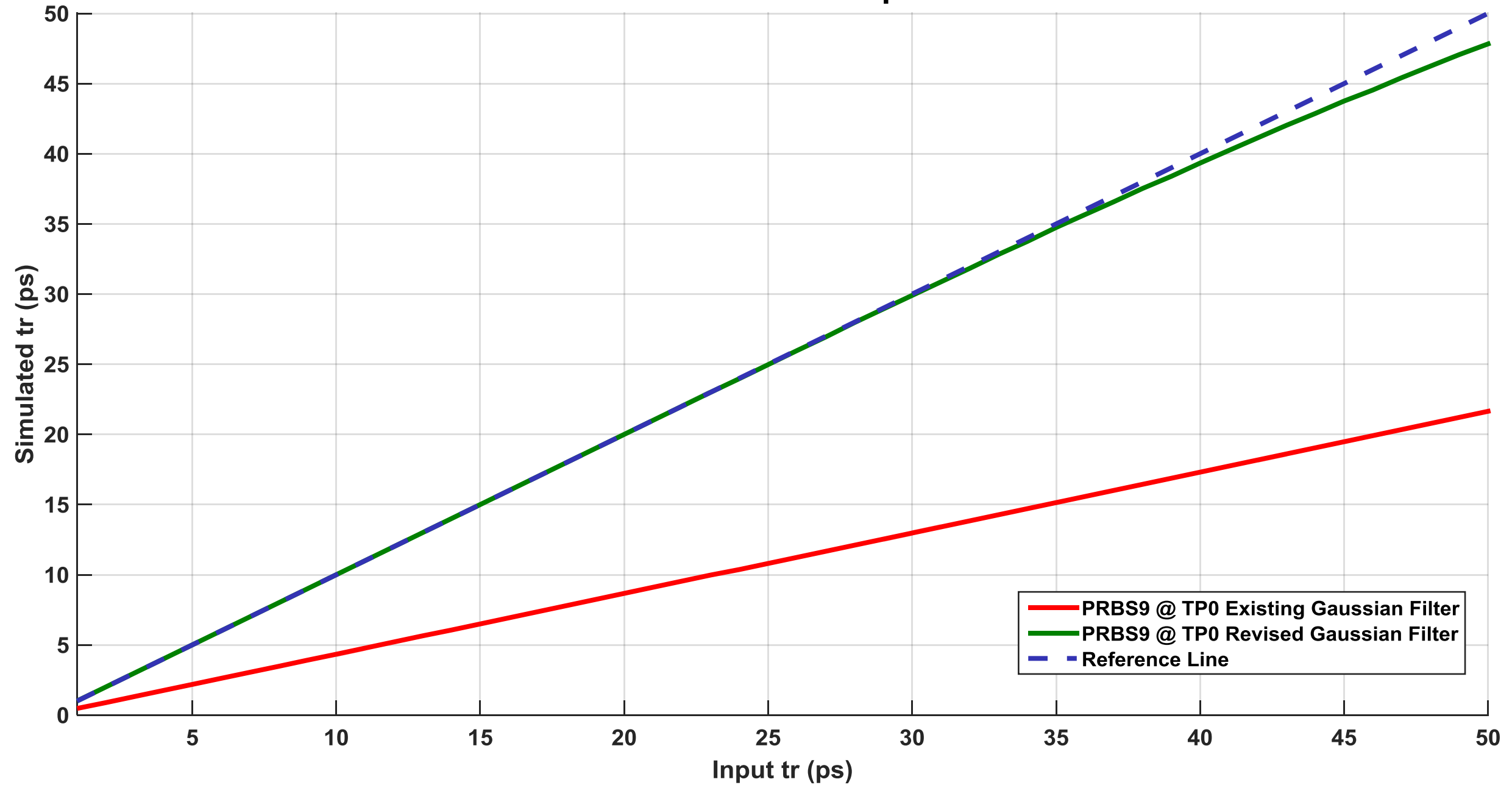
COM PRBS9: PRBS9 * H_t

- In the following slides

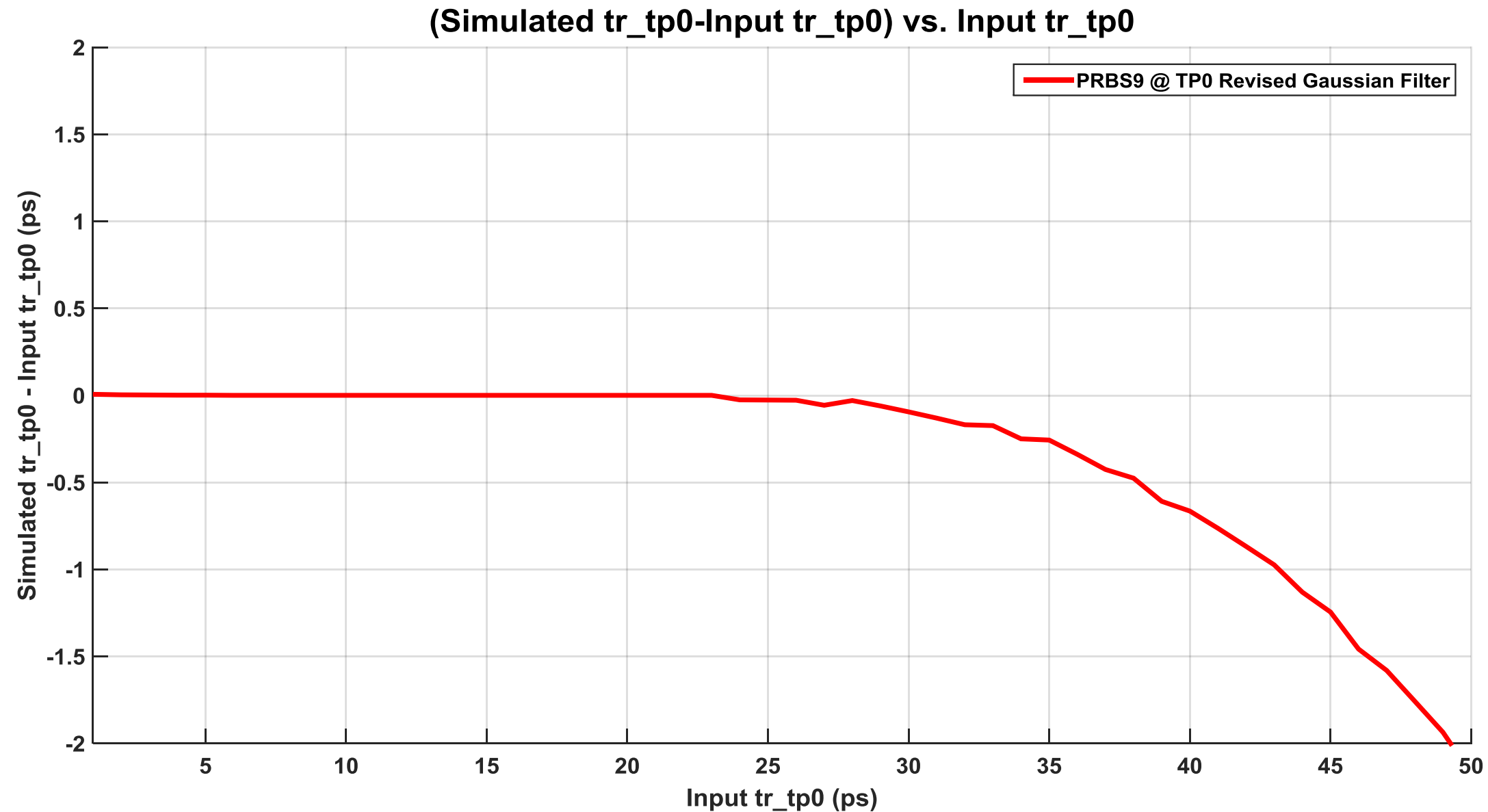
- Input t_r is the T_r used as input to the filter equation. Simulated t_r is the risetime at the defined point extracted from the simulated PRBS9 waveform using the methodology of Annex 86A.5.3.3

For TP0 Simulated tr versus Input tr

Simulated tr vs. Input tr



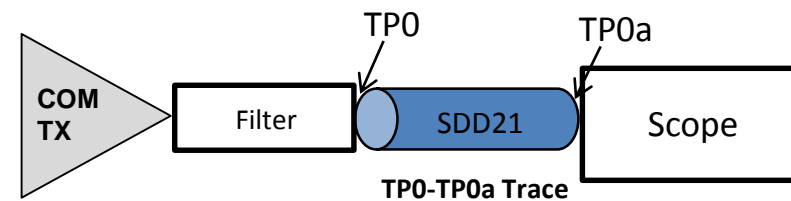
Difference between simulated and input rise-time with Revised Gaussian filter



- It is unlikely that risetimes over 40ps will be used, and if they are it will result in a conservative (ie more noise added result)

Changes for Clause 111.

- The rise-time for the test transmitter is measured at tp0a.
- An allowance therefore needs to be made for the effect of the frequency dependent loss between tp0 and tp0a
- It is proposed to use the same Revised Gaussian filter but modify the Input tr from the value measured at TP0a.



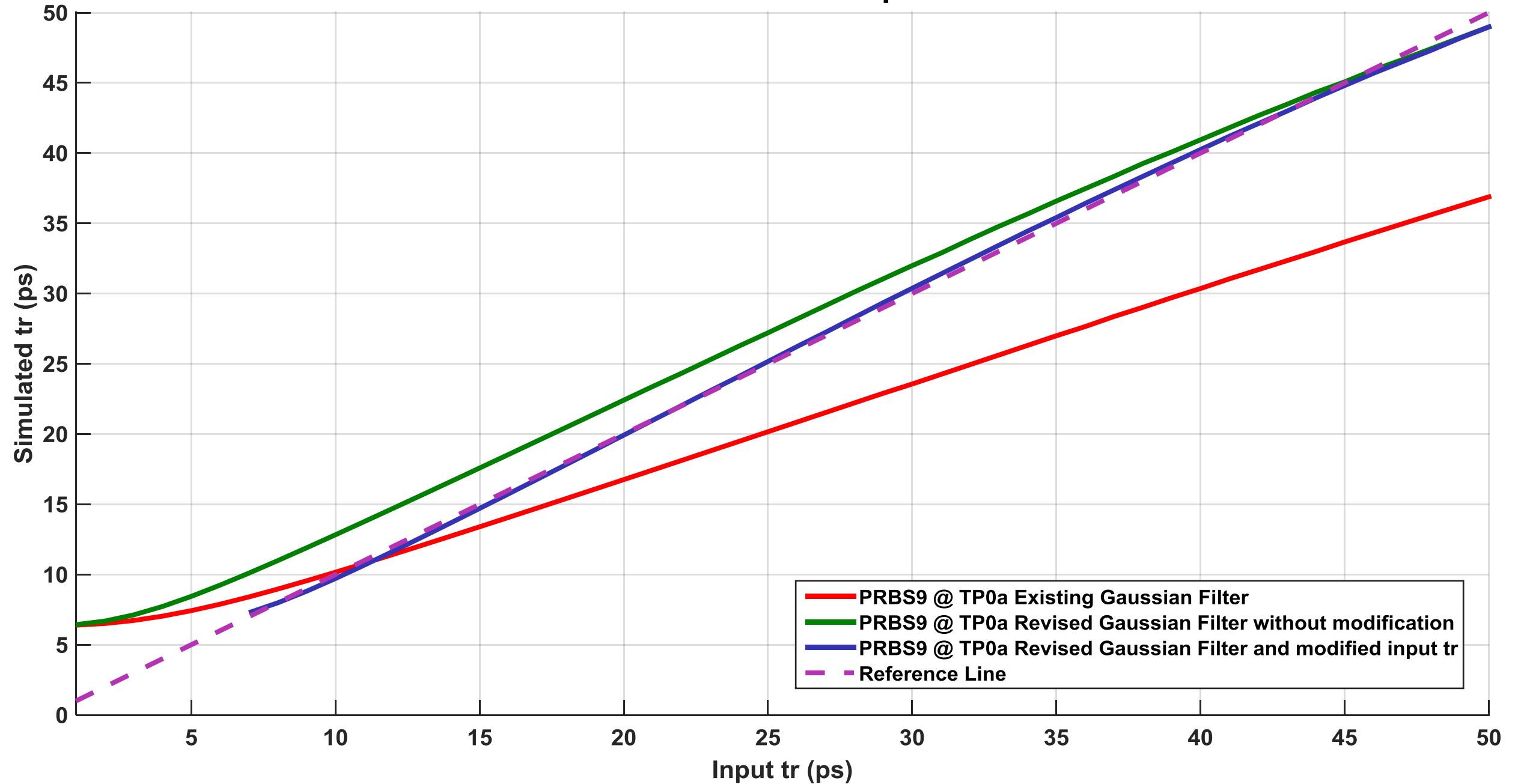
@TP0a

COM PRBS9: PRBS9 *Ht*SDD21

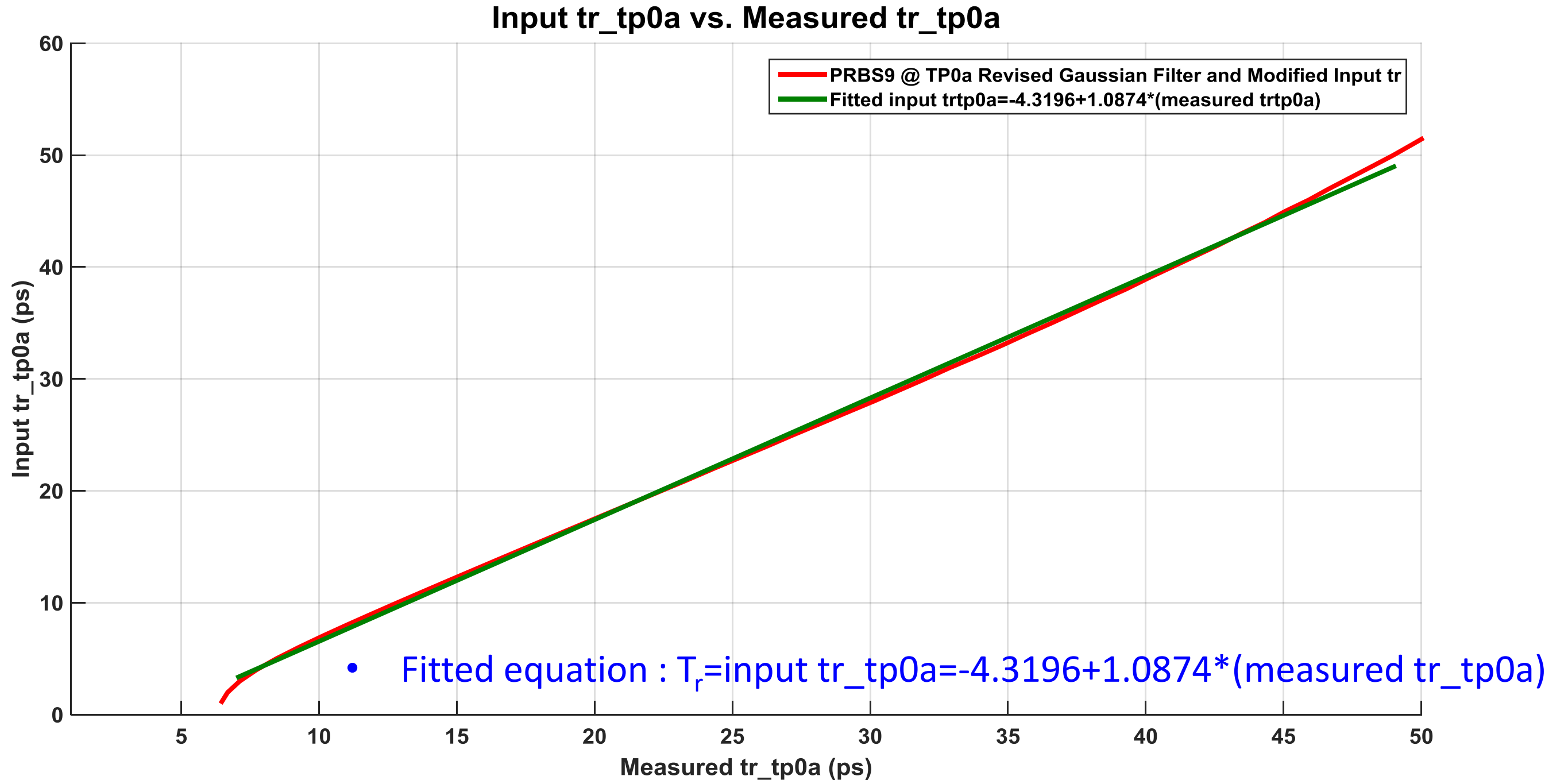
- The rise-time at TP0a is simulated using the Revised Gaussian filter as a function of the input rise-time to the filter and a modification function ($T_r = \mathcal{F}$ (tr_tp0a_measured)) is empirically determined.
- In the following Input tr_tp0a is the Tr used in the filter equation when the test transmitter rise-time is measured at tp0a The rise-time measured at tp0a is measured tr_tp0a

Simulated tr vs Input tr @ TP0a

Simulated tr vs. Input tr



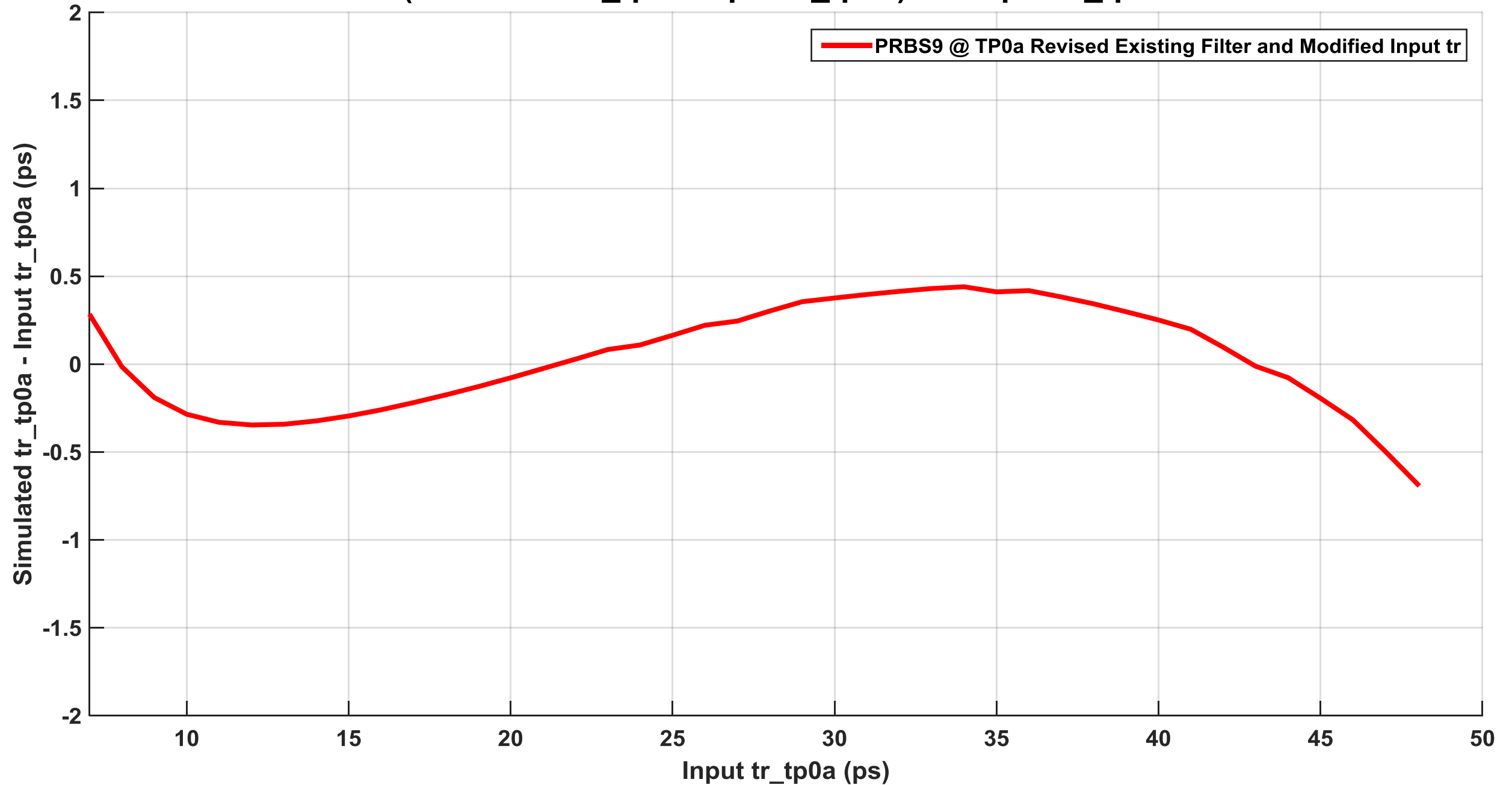
Curve Fitting for Input tr_tp0a vs. Measured tr_tp0a



Simulated tr_tp0a vs. Input tr_tp0a by Revised Gaussian Filter



(Simulated tr_tp0a-Input tr_tp0a) vs. Input tr_tp0a



Simulated Rise-times of Various Patterns

- The PRBS9 and 8180 rise-times are measured with the different methods of determining the “1” and “0” levels as described in 86A.5.3.3

	@TP0		@TP0a	
Input tr (ps)	PRBS9 (ps)	8180 (ps)	PRBS9 (ps)	8180 (ps)
10	9.986	9.986	9.979	10.179
20	19.969	19.969	20.067	20.392
30	29.873	29.936	29.979	30.495
40	40.086	39.816	39.998	40.517
50	49.764	49.545	49.627	50.436

- For best reproducibility it is recommended that we specify the PRBS9 pattern methodology for this calibration. (It is the PRBS9 methodology that has been used in the rest of the presentation).

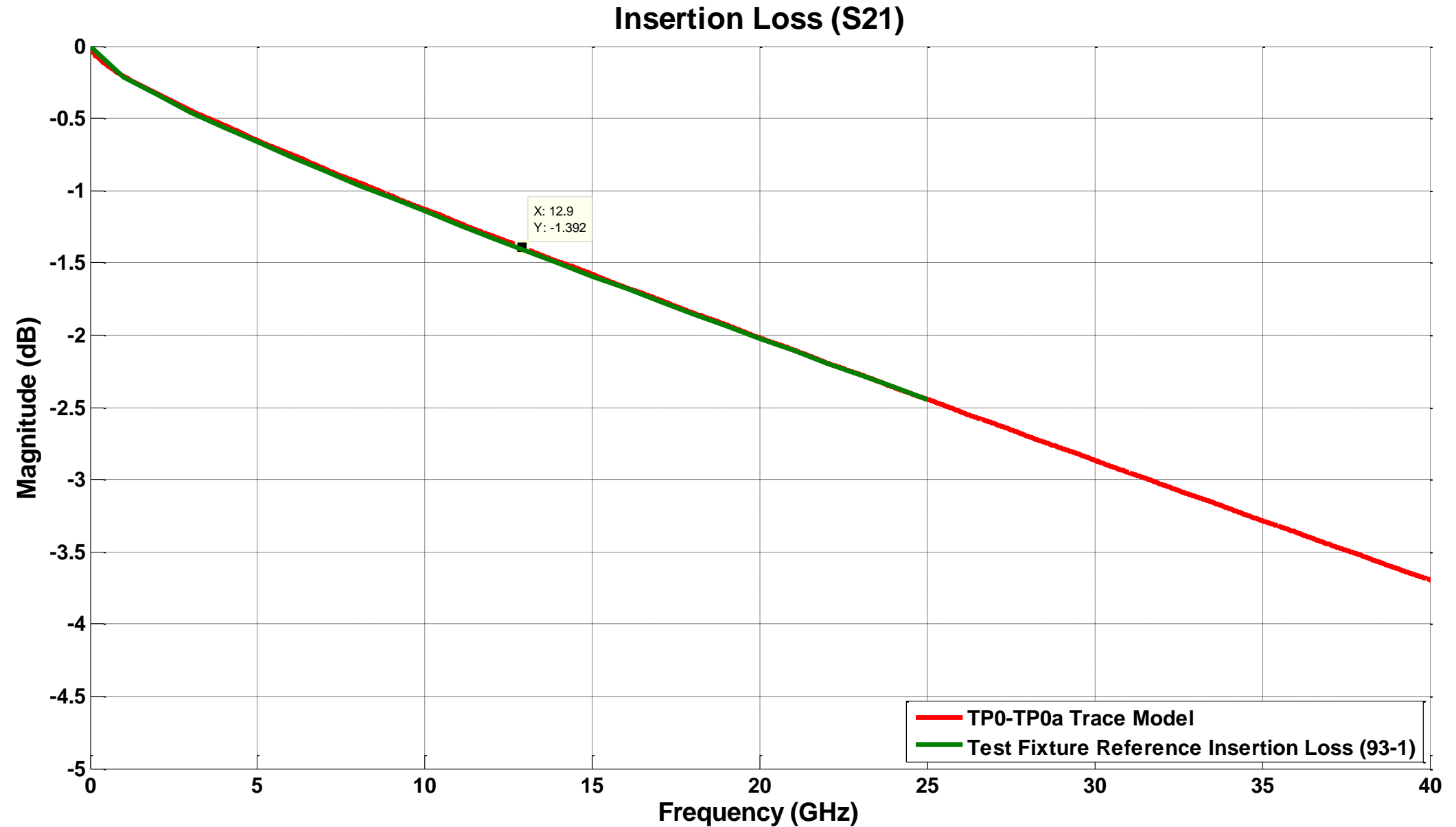
- **The existing specification has a problem in that the risetimes being used in COM to determine how much noise should be added in the Interference Tolerance Test does not match the measured risetime of the test transmitter.**
- **This presentation provides proposed revised equations that solve this issue.**
- **It also points out that for this calibration it would be better to use just one measurement method for the risetime of the test transmitter rather than the two alternatives provided in Annex 86A.5.3.3**



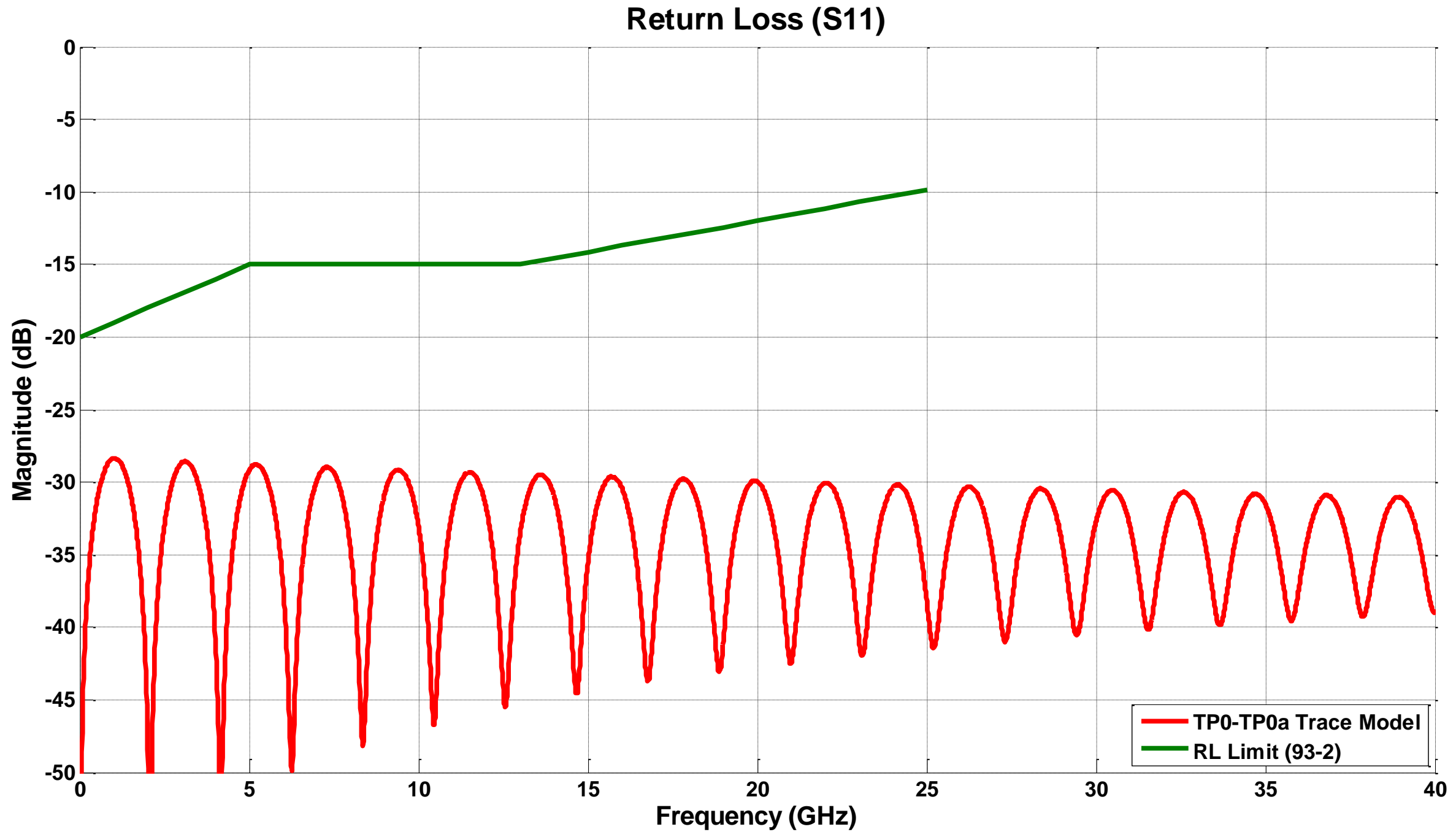
**Back up
TP0-TP0a Trace Model**

TP0-TP0a Insertion Loss

- Trace model is based on the host board model in COM with modified parameters



TP0-TP0a Return Loss

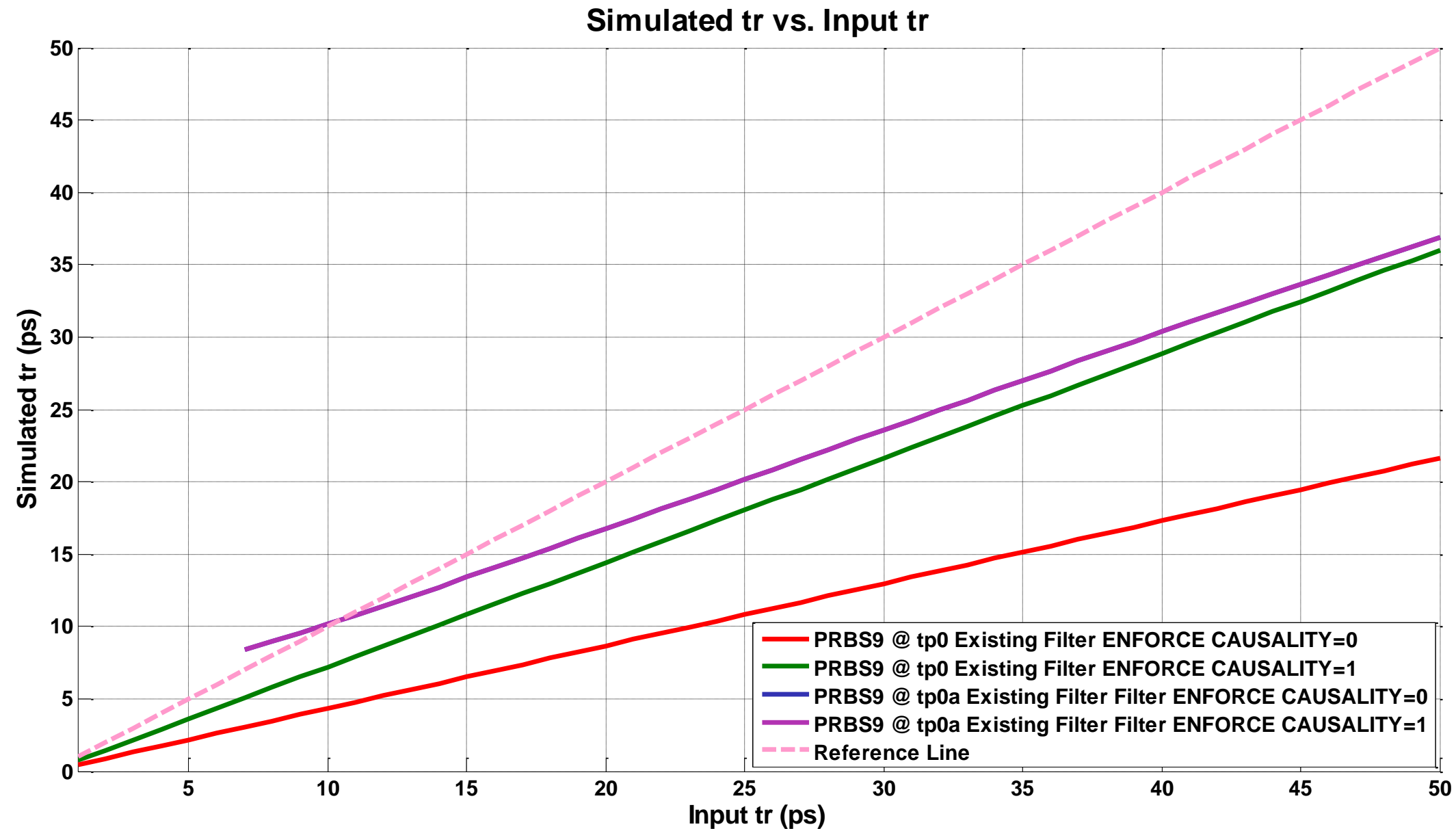




Back Up

Key slides from Dec 2 presentation to the ad-hoc.

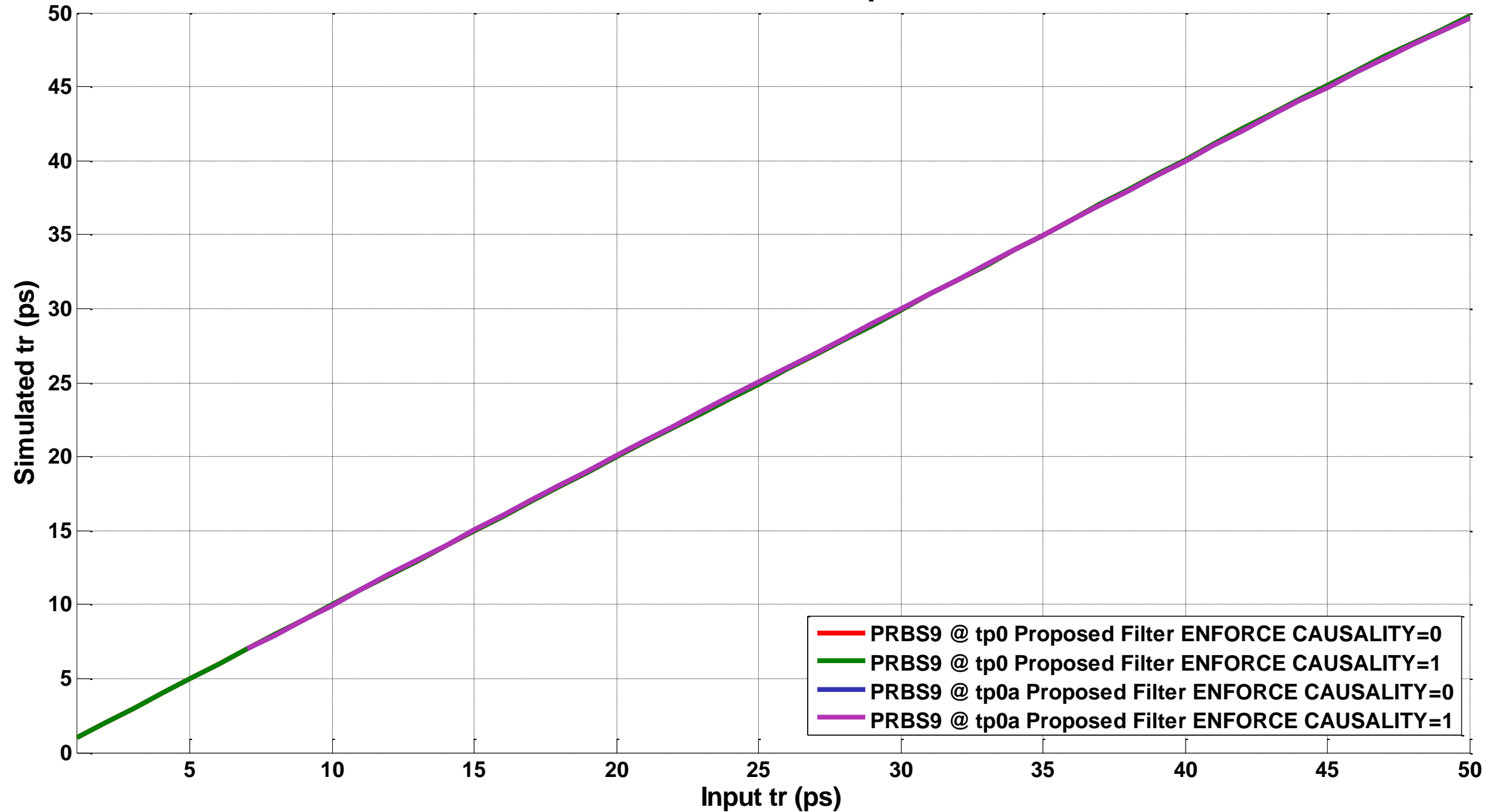
Simulated tr vs Input tr by Existing Filter



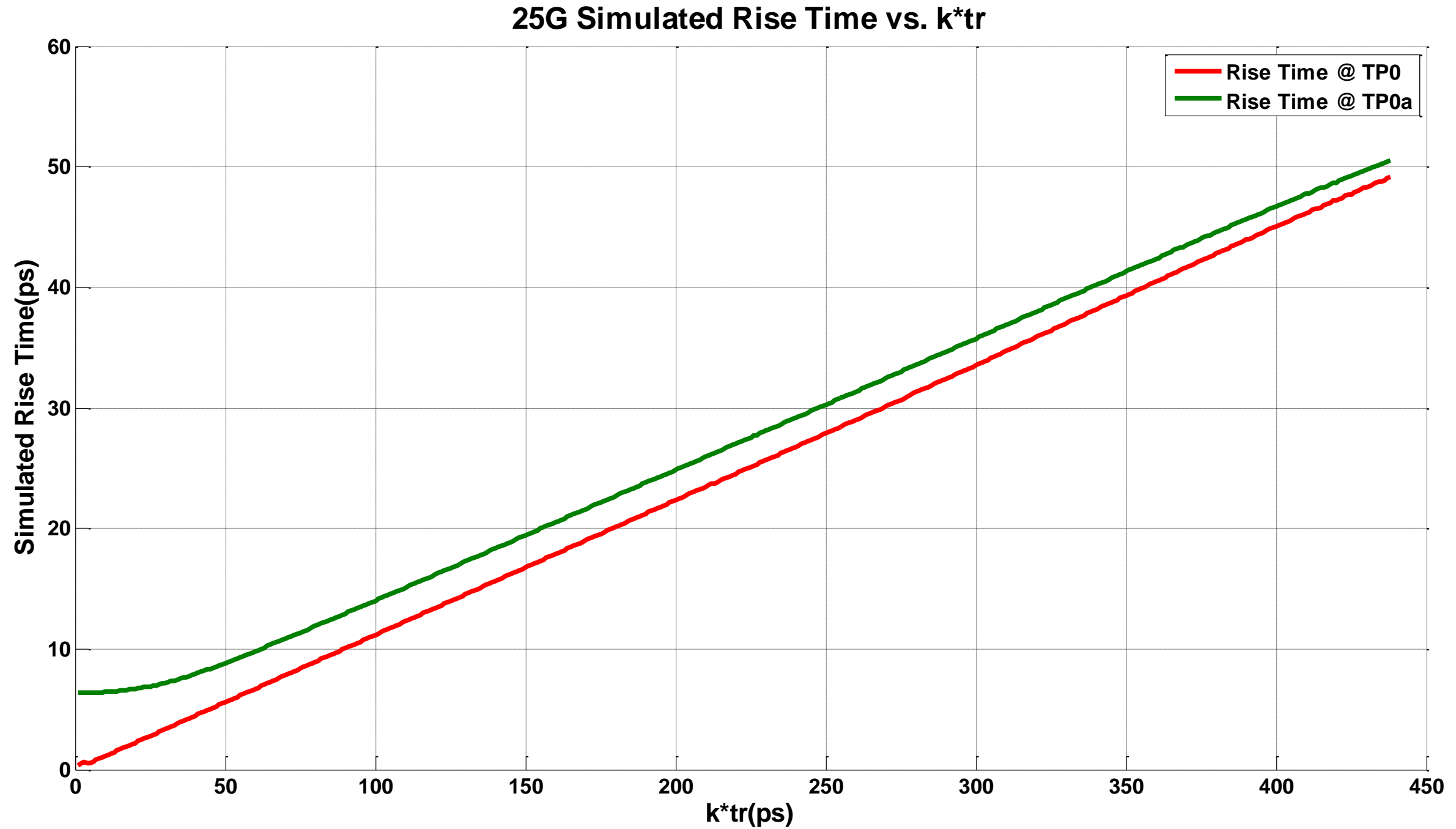
- The existing filter equation is not bad at TP0a with rise-times around 10ps but it has causality problems at TP0 and has significant error over a wider range

Result -Simulated tr vs Input tr by Proposed Filter

Simulated tr vs. Input tr



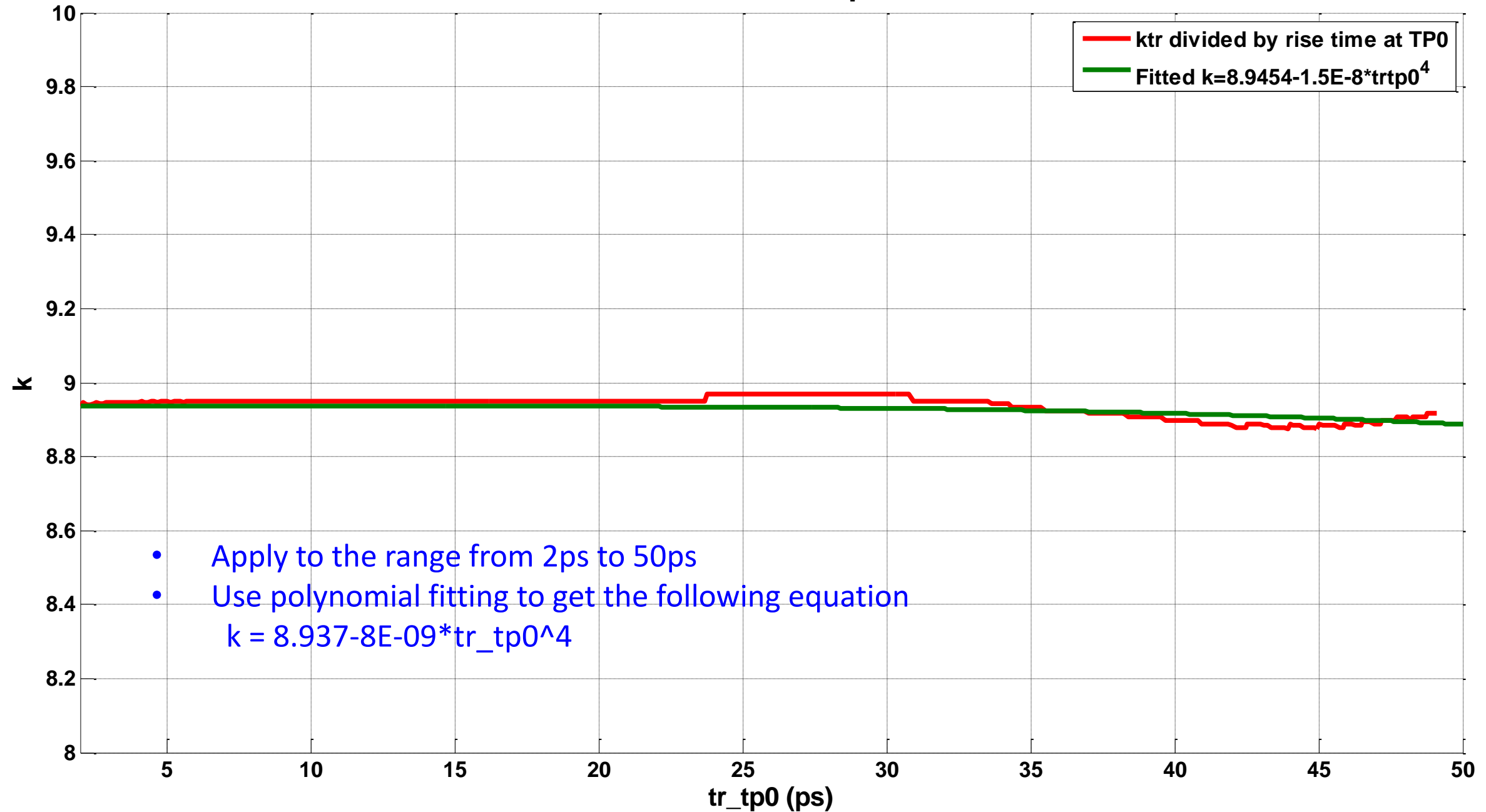
25G Simulated Rise Time vs. $K \cdot Tr$ by Proposed Filter



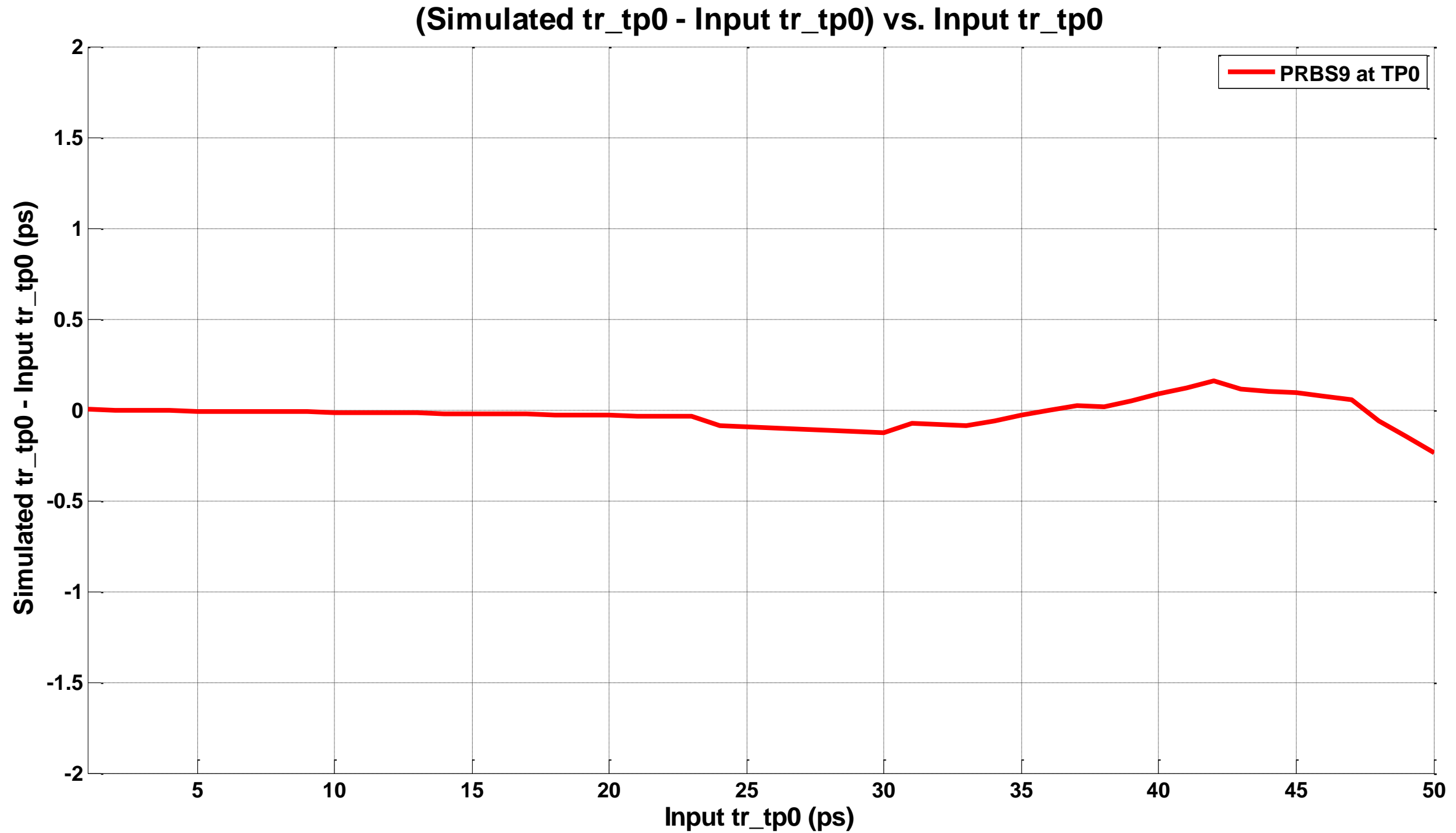
25G Curve Fitting for k vs. tr_tp0 (ie at PGC)



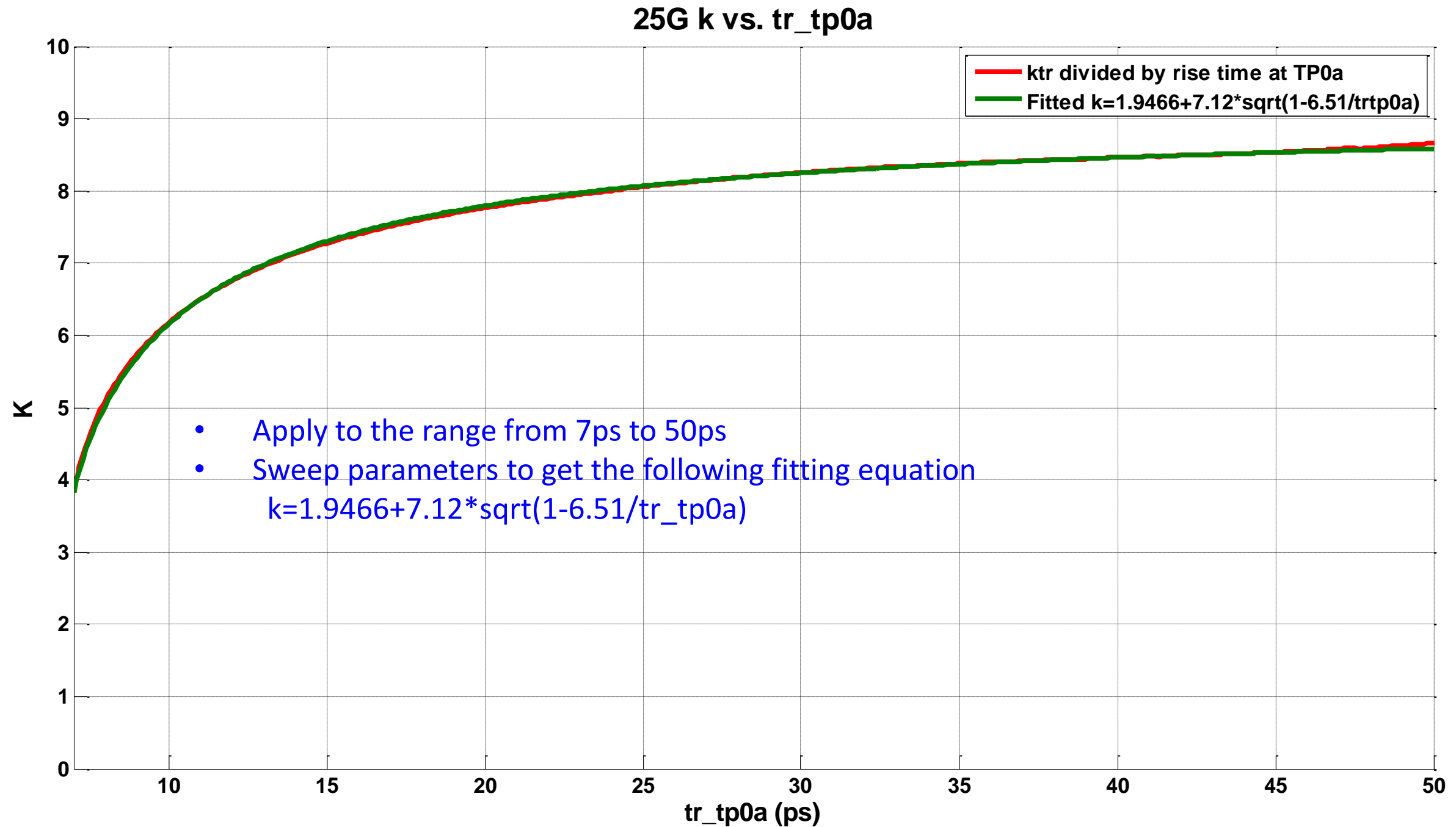
25G k vs. tr_tp0



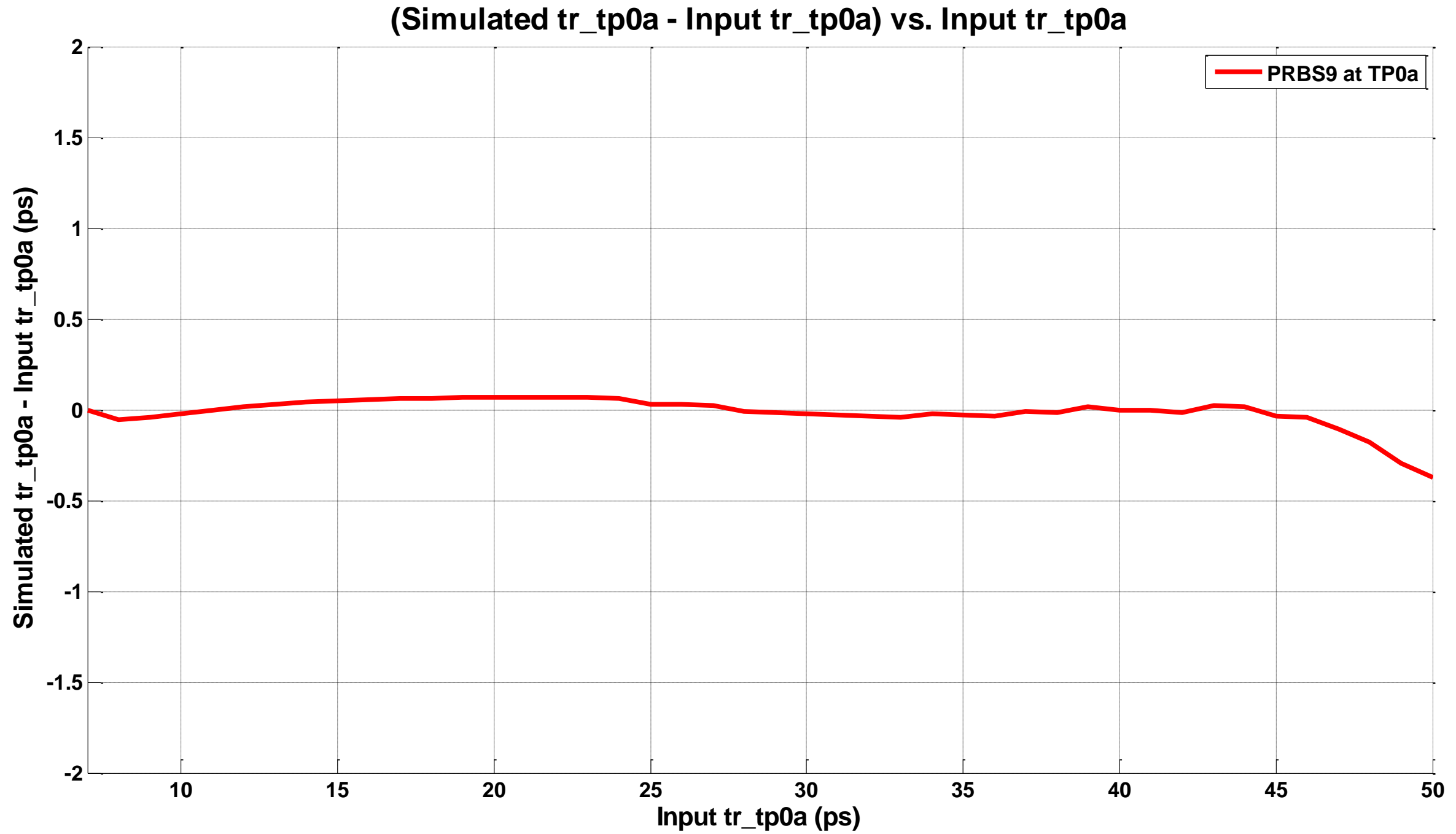
(Simulated tr_tp0 - Input tr_tp0) vs. Input tr_tp0



25G Curve Fitting for k vs. tr_tp0a



(Simulated tr_tp0a - Input tr_tp0a) vs. Input tr_tp0a



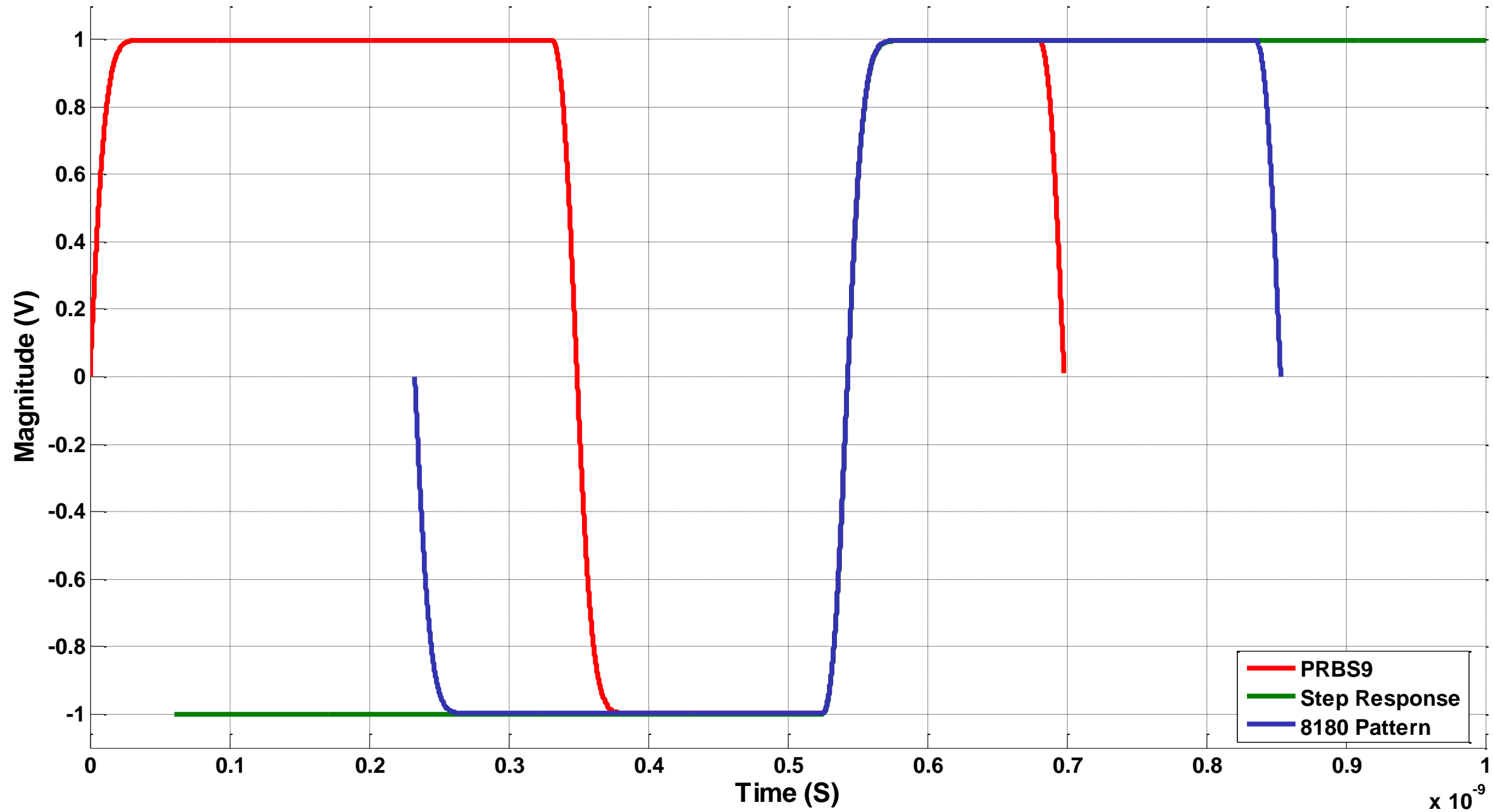


Back Up

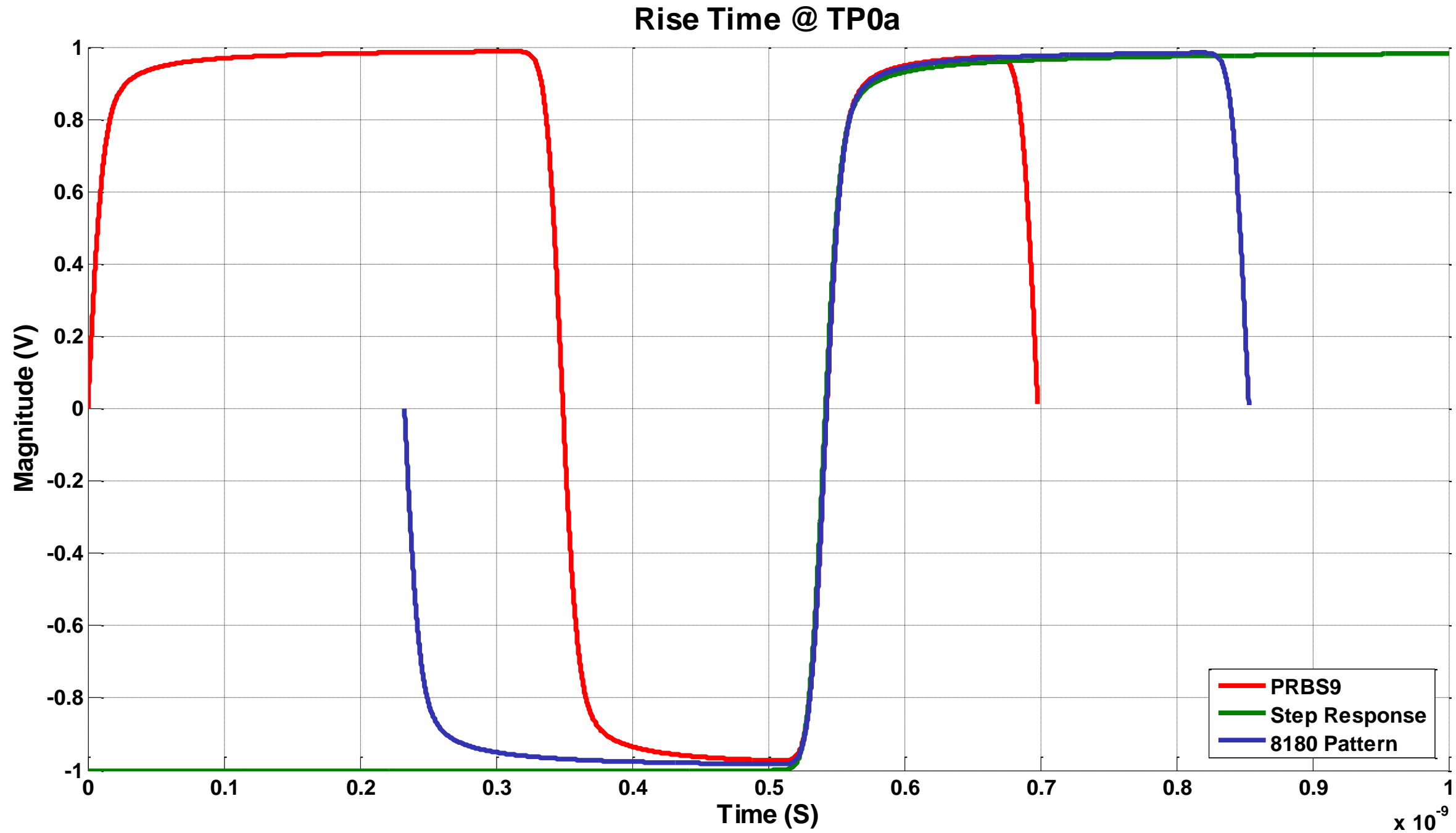
**Waveforms using different patterns with
Proposed BT Filter**

Waveforms at TP0 when $tr_{tp0} = 20\text{pS}$

Rise Time @ TP0

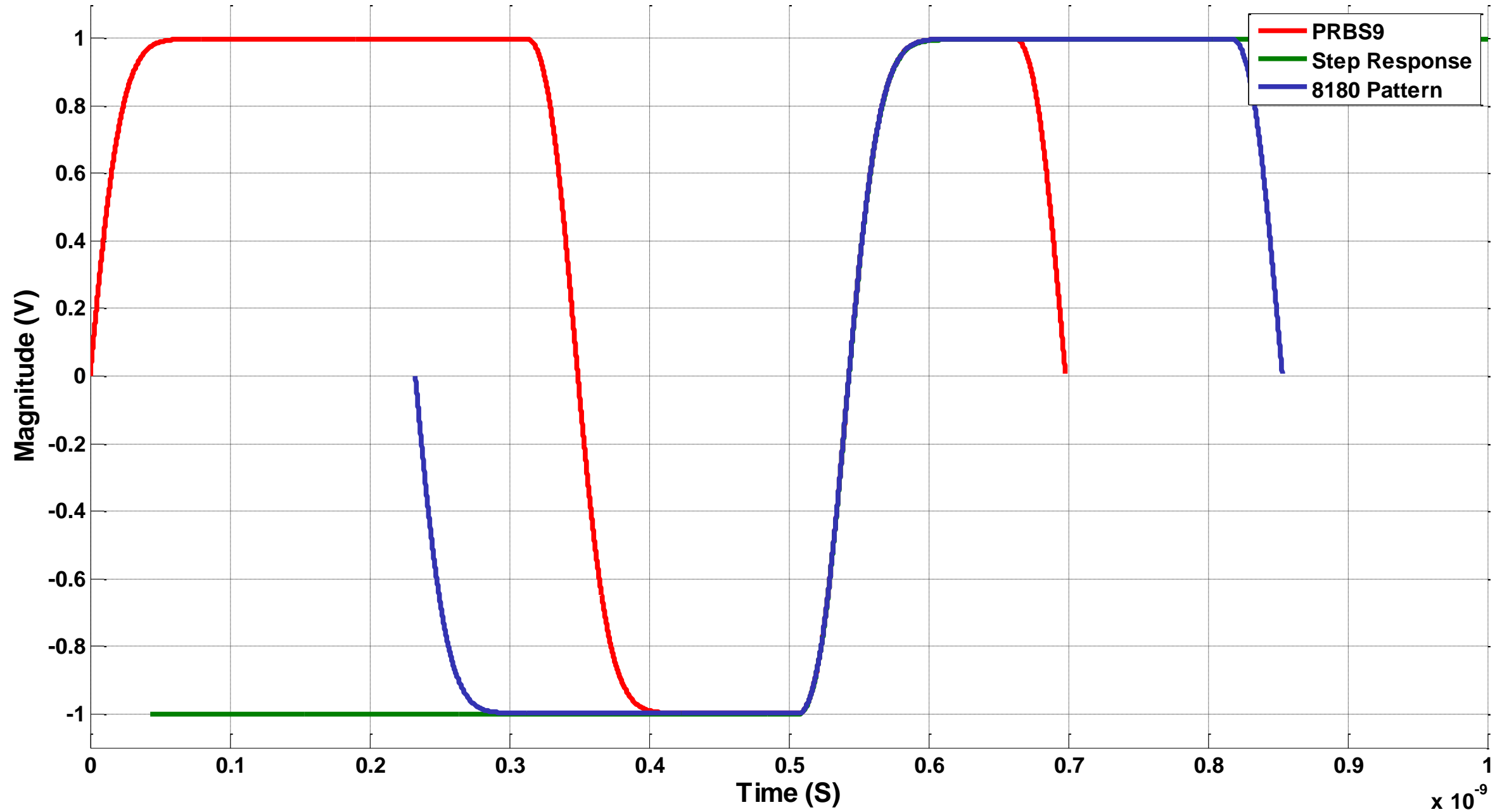


Waveforms at TP0a when $tr_{tp0a} = 20pS$



Waveforms at TP0 when $tr_{tp0} = 40\text{pS}$

Rise Time @ TP0



Waveforms at TP0a when $tr_{tp0a} = 40pS$

