Adjustment of Transition Time for RX Interference Tolerance Test in KR and C2C (Comment #138)

Yasuo Hidaka, Credo

Junqing (Phil) Sun, Credo

IEEE P802.3ck Task Force

May, 2021

Supporters

- Howard Heck, Intel
- Richard Mellitz, Samtec
- Geoff Zhang, Xilinx
- Rick Rabinovich, Keysight
- Upen Reddy Kareti, Cisco
- Ali Ghiasi, Ghiasi Quantum
- Adee Ran, Cisco
- Mike Dudek, Marvell

Comment #138 (overview)

Clause 163.9.3.4 Receiver interference tolerance, P 192

e) In the calculation of COM, if the transmitter is a device with known S-parameters and transition time, these parameters should be used instead of the transmitter package model in 93A.1.2. If a calibrated instrument-grade transmitter is used, the transmitter device package model $S^{(tp)}$ is omitted from Equation (93A–3) in the calculation of COM. The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (93A–19) uses the filter $H_t(f)$ defined by Equation (93A–46), where T_r is calculated as $T_r = 1.09 \times T_{rm} – 4.32$ ps and T_{rm} is the measured 20% to 80% transition time of the signal at TP0v. T_{rm} is measured using the method in 120E.3.1.5. T_{rm} is measured with the transmitter equalizer turned off.

- Equation "$T_r = 1.09 \times T_{rm} - 4.32ps$" is not valid any more.

- When TX is a BERT, we can skip calibration of T_r by omitting test fixture from TP0 to TP0v.

- When TX is not a BERT nor known S-parameters and transition time, T_r at signal source must be calibrated against T_{rm} measured at TP0v through test fixture.

- No change when TX is a device with known S-parameters and transition time.

When TX is a BERT

- In this case, T_r at the COM signal source (=TP0) is directly measurable.
- Omitting TP0 to TP0v (replica) trace (in addition to package model) and skipping calibration of T_r is possible, simpler and more accurate than calibrating T_r at the COM signal source against T_{rm} measured at TP0v.

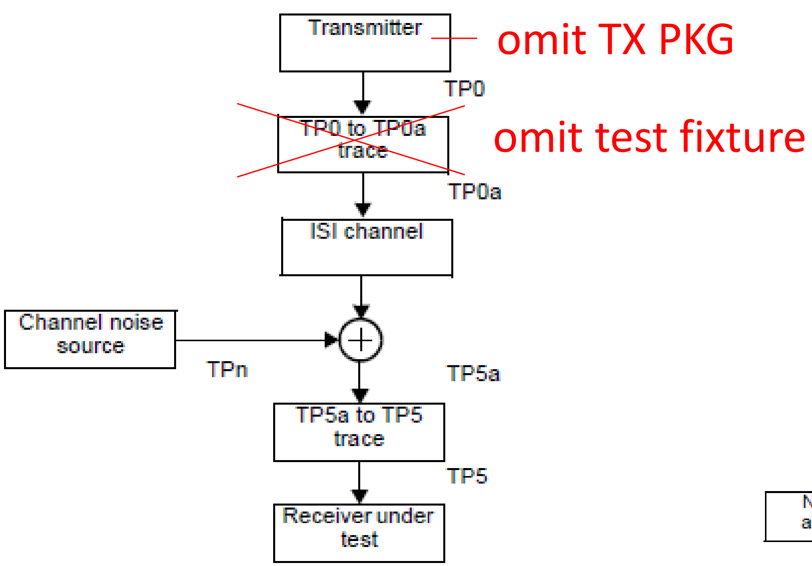


Figure 93C–2—Interference tolerance test setup

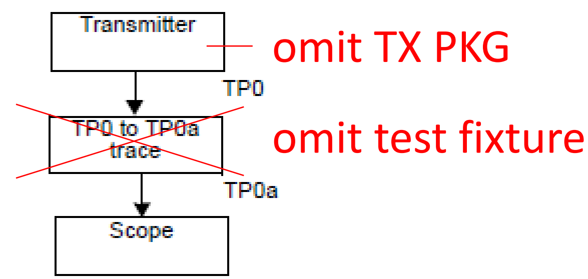


Figure 93C–3—Interference tolerance transmitter test setup

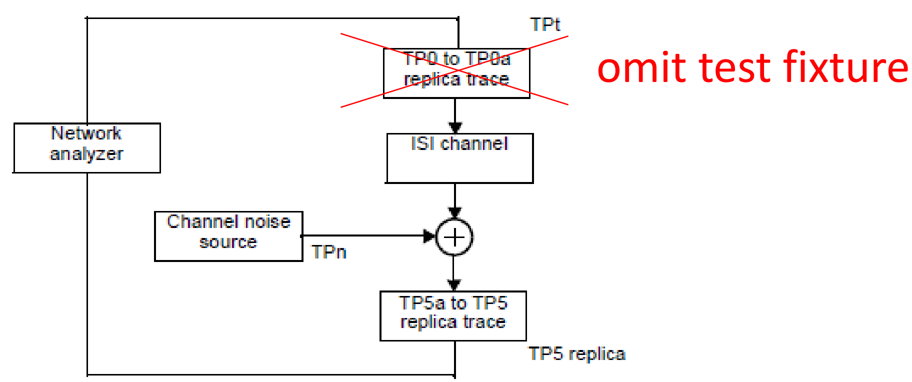
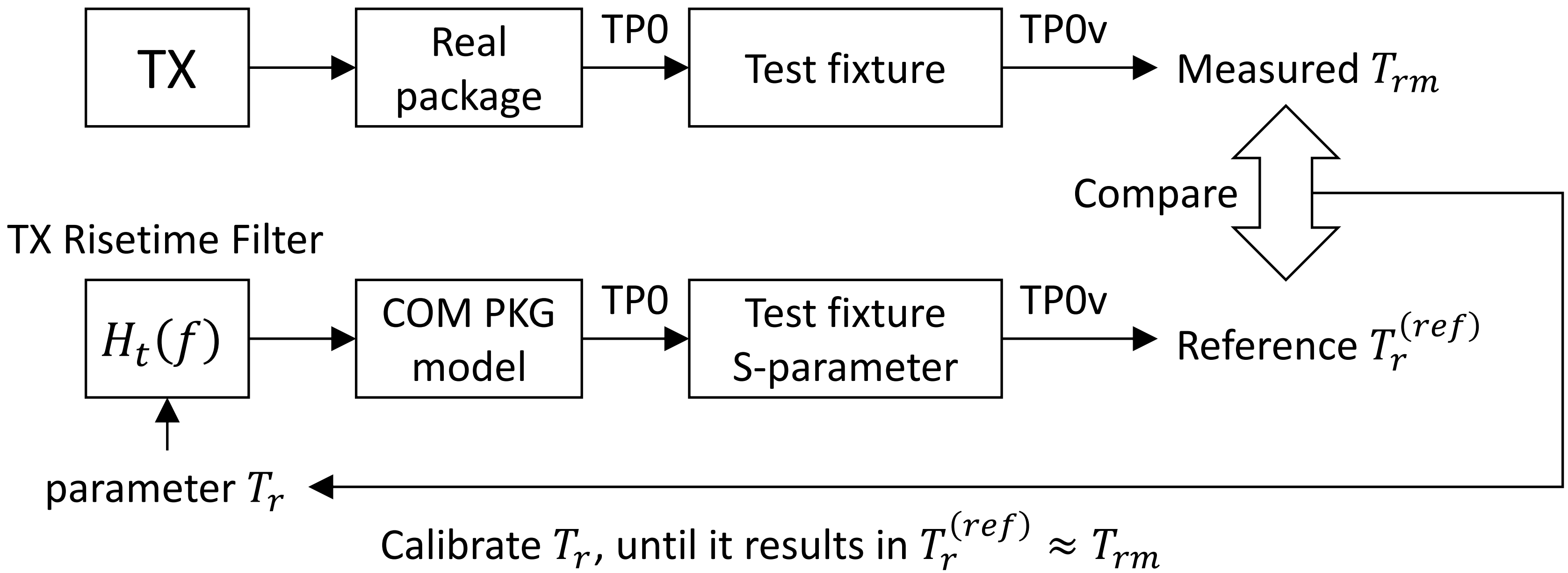


Figure 93C–4—Interference tolerance channel s-parameter test setup

When TX is not a BERT nor known S-parameters and transition time

❖ T_r at the signal source must be calibrated so that reference transition time $T_r^{(ref)}$ at TP0v matches to the measured transition time T_{rm} at TP0v.



Outline of Calibration of Tr in Equation (93A-46)

1. Measure T_{rm} at TP0v using the method in 120E.3.1.5.
2. Calibrate T_r in Equation (93A-46) so that $T_r^{(ref)} \approx T_{rm}$.

   Here, $T_r^{(ref)}$ is the reference transition time at TP0v according to a new subcaluse 163A.3.1.X calculated from the following parameter and functions (see slide 10 for detail):
   - Estimated value of T_r.
   - TX risetime filter $H_t(f)$ (Equation (93A-46)).
   - Reference device and package model $S^{(tp)}(f)$.
   - S-parameter of test fixture $S^{(fixt)}(f)$.

For $S^{(tp)}(f)$, use the longer trace length for consistency with the definition of $v_f^{(ref)}$.
Alternatively, we may calculate $v_f^{(ref)}$ and calibrate T_r for each trace length.

Text change to 163.9.3.4 and 120F.3.2.3

- Change step e in clause 163.9.3.4 as follows:

In the calculation of COM, if the transmitter is a device with known S-parameters and transition time T_r, these parameters should be used instead of the transmitter package model in 93A.1.2. If a calibrated instrument-grade transmitter is used, the transmitter device package model $S^{(tp)}$ is omitted from Equation (93A–3), Figure 163-X replaces Figure 93C-2, Figure 163-Y replaces Figure 93C-3, Figure 163-Z replaces Figure 93C-4, and T_r in Equation (93A-46) is same as the measured transition time T_{rm} of the signal source at TP0 using the test setup in Figure 163-Y. If the transmitter is not a device with known S-parameters and transition time nor a calibrated instrument-grade transmitter, T_r in Equation (93A-46) is calibrated per Figure 163-W so that the reference transition time $T_r^{(ref)}$ calculated according to 163A.3.1.X matches to the measured transition time T_{rm} of the signal at TP0v using the test setup in Figure 93C-3 including TP0 to TP0v trace. ~~in the calculation of COM. The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (93A-19) uses the filter $H_t(f)$ defined by Equation (93A-46), where T_r is calculated as $T_r = 1.09 \times T_{rm} - 4.32$ ps and T_{rm} is the measured 20% to 80% transition time at TP0v.~~ The measured transition time T_{rm} is measured with the transmitter equalizer turned off and using the method in 120E.3.1.5. ~~T_{rm} is measured with the transmitter equalizer turned off.~~

- Apply the same change as above to 120F.3.2.3 step d.

Proposed figures in 163.9.3.4

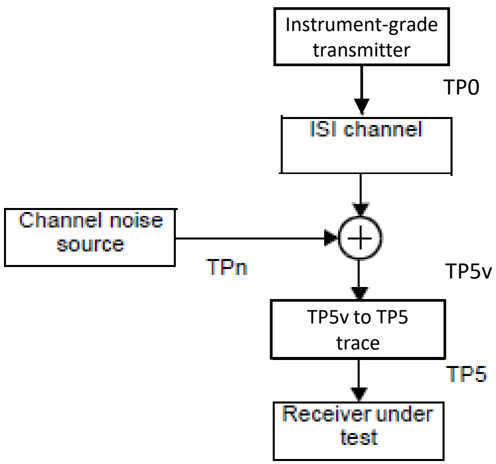


Figure 163-X – Interference tolerance test setup using an instrument-grade transmitter

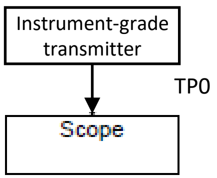


Figure 163-Y – Interference tolerance transmitter test setup for an instrument-grade transmitter

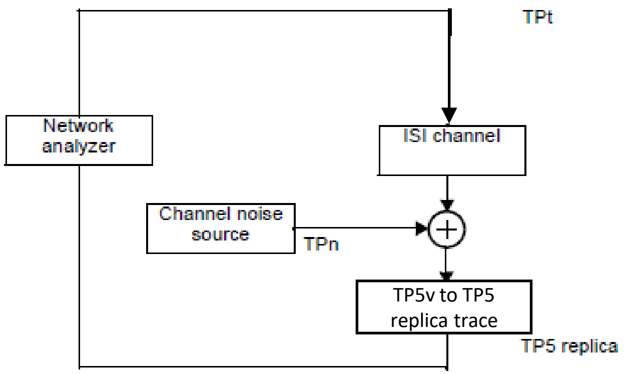


Figure 163-Z – Interference tolerance channel s-parameter test setup for an instrument-grade transmitter

Proposed figures in 163.9.3.4 (continued)

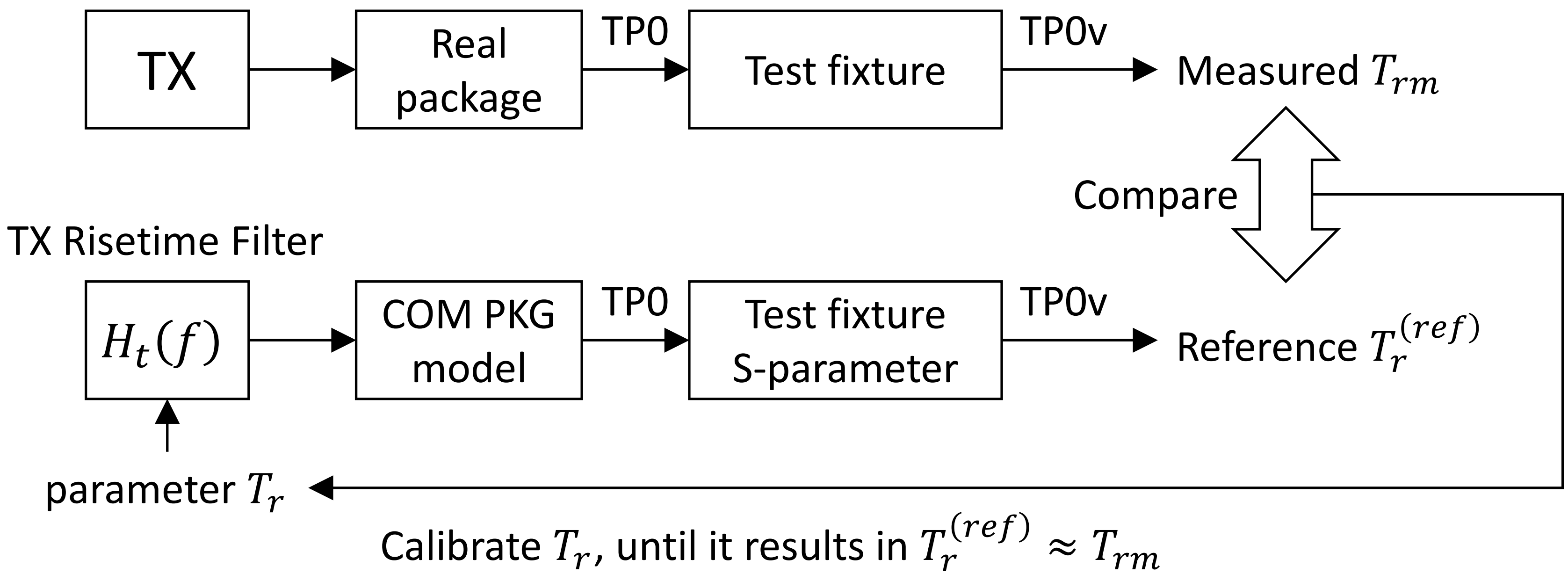


Figure 163-W – Calibration of risetime T_r at signal source against measured transition time T_{rm}

Proposed text of a new sub clause in 163A

163A.3.1.X Transition time reference value

Obtain the output pulse response, $h(t)$, using Equation (93A-23) and Equation (93A-24) with $H^{(0)}(f)$ from Equation (163A-2), where A_t and T_b are specified by the clause that invokes this method.

Obtain the output step response, $u(t)$, using Equation (163A-Y).

From the output step response, find the time to reach 20% and 80% of the reference steady-state voltage $v_f^{(ref)}$ as T_{20} and T_{80}, respectively.

From T_{20} and T_{80}, calculate the reference 20% to 80% transition time $T_r^{(ref)}$ using Equation (163A-X).

$$T_r^{(ref)} = T_{80} - T_{20} \quad \text{(163A-X)}$$

$$u(t) = \sum_{i=0}^{\infty} h(t - i \times T_b) \quad \text{(163A-Y)}$$

T_{80} is a solution of $u(t) = 0.8 \times v_f^{(ref)}$ in terms of t

T_{20} is a solution of $u(t) = 0.2 \times v_f^{(ref)}$ in terms of t

where

$T_r^{(ref)}$	is the reference 20% to 80% transition time
$u(t)$	is the output step response
T_{80}	is the time to reach 80% of the reference steady-state voltage
T_{20}	is the time to reach 20% of the reference steady-state voltage
T_b	is the unit interval in ps
$v_f^{(ref)}$	is the reference steady-state voltage calculated by Equation (163A-3)

If the invoking clause lists more than one set of reference package parameters, the calculation in Equation (163A-Y) is performed with the longer package trace length.