Choosing COM Reference Package Impedance Based On Channel Driving Point Impedance. (Ref: comment# 57)

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The Story

- Monte Carlo methods have been used to determine the worst case package and channel combinations
  - This is way too many COM runs (in the thousands)
- Design of experiments (DoE) has been use to determine the worst case package and channel combinations
  - This is way too many COM runs (in the hundreds)
- Careful selection of package parameter were used to estimate simple worst case set of packages
  - 2 package models
  - Indications are that this is not enough for the 50Gb/s PAM4 effort
- A larger selection of package parameter are proposed
  - A dozen or more to cover all possible channels
  - This appears to be too many COM runs as well
- Another approach is to mathematically select a worst case package model
  - Again limiting the number of COM runs
  - Choose one package for Tx and another for Rx (not done now)
  - Base on driving point impedance at each end

The Process

- ❑ Determine the driving point impedance (ZR11 and ZR22) at tp0 and tp5 of the channel under test
  - Using package line length also to determine ZRxx
- ❑ Determine Zc (package transmission line impedance) at each end by:
  - Choosing the reference Zc with is the farthest distance in ohms from ZRxx
  - E.g. the maximum reflection coefficient
- ❑ Choose transmitter Rd = 55 ohm and receiver Rd=45 ohms
  - Analysis of voltage transfer ratio suggests this

Getting TDR using CL93a

Tb=4*ts
(4 times
the transit delay)
(eq.93A.1.6 b)
Use XR instead of X

Replace H(k) with
s11(f) or s22(f)
from eq. 93A–2
X→XR
h(t)→h11(t) or
h22(t)

93A.1.5 Pulse response

The pulse response of a signal path is defined to be the output of the path following the application of a rectangular pulse one unit interval in duration at its input. First define the function $X(f)$ per Equation (93A–23) where $\mathrm{sinc}(x) = \sin(\pi x)/(\pi x)$ and $T_b = 1/f_b$ is the unit interval.

$$X(f) = A_t T_b \mathrm{sinc}(f T_b) \tag{93A–23}$$

$X(f)$ is a function of A_t, which in turn is based on the path index k. If k=0, i.e., the victim path, then $A_t = A_v$. If k corresponds to a far-end crosstalk path, then $A_t = A_{fe}$. If k corresponds to a near-end crosstalk path, then $A_t = A_{ne}$.

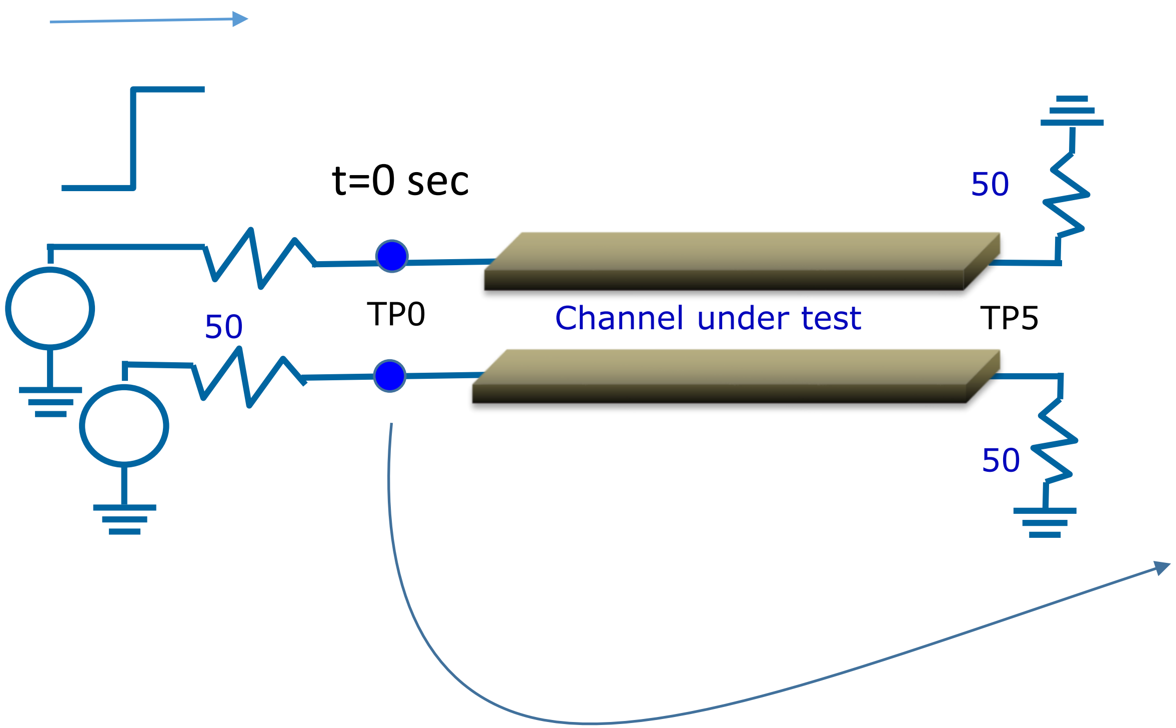
The pulse response $h^{(k)}(t)$ is derived from the voltage transfer function $H^{(k)}(f)$ (see 93A.1.4) using Equation (93A–24).

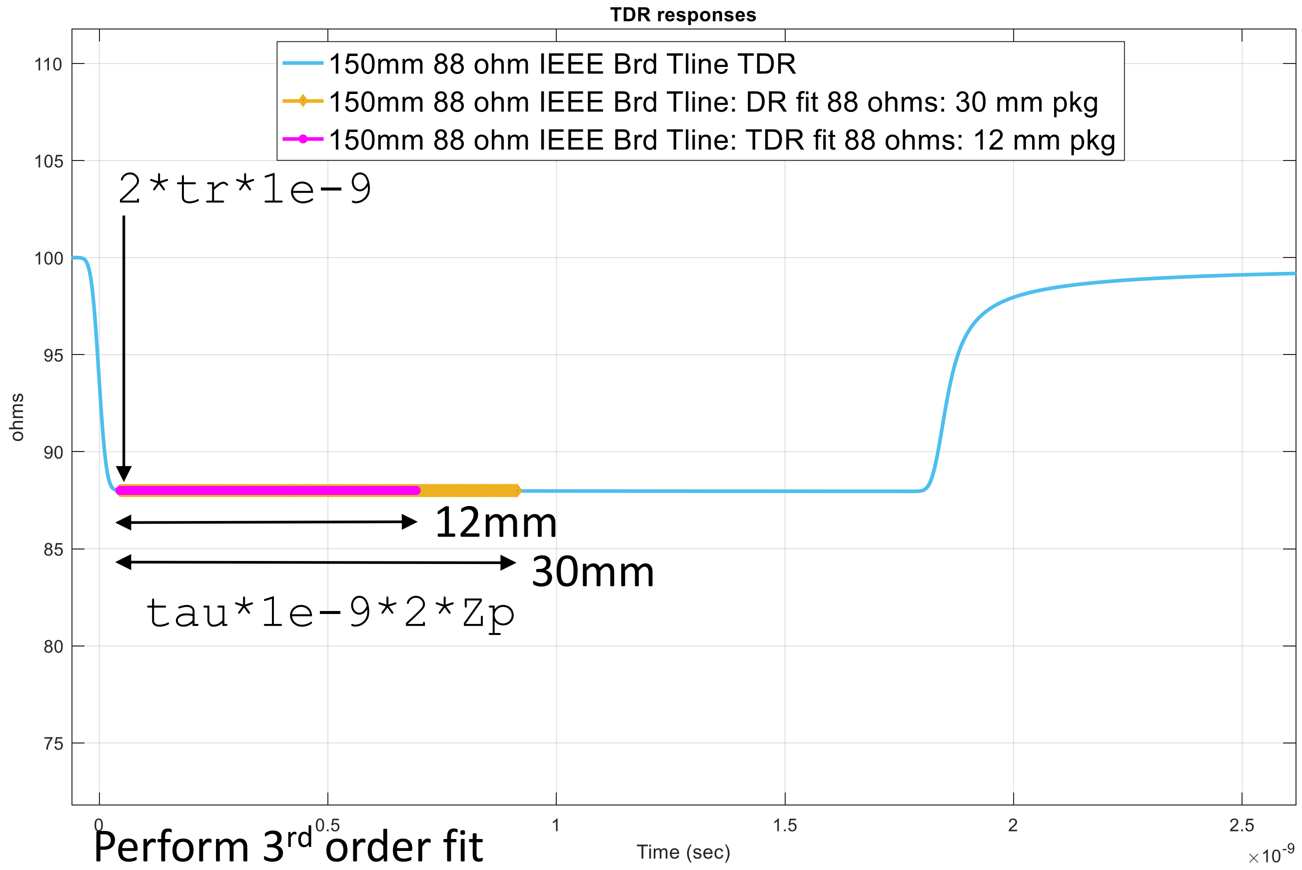
$$h^{(k)}(t) = \int_{-\infty}^{\infty} X(f) H^{(k)}(f) \exp(j2\pi f t) dt \tag{93A–24}$$

$$zrxx(t) = 2 * R_0 \left(\frac{1 + hxx(t)}{1 - hxx(t)}\right)$$

Where x = 1 or 2

Use package length, tau, and TDR Tr=22ps to determine fit region





Perform 3rd order fit

fit(x) = p1*x^3 + p2*x^2 + p3*x + p4

p1 = -9.892e+24

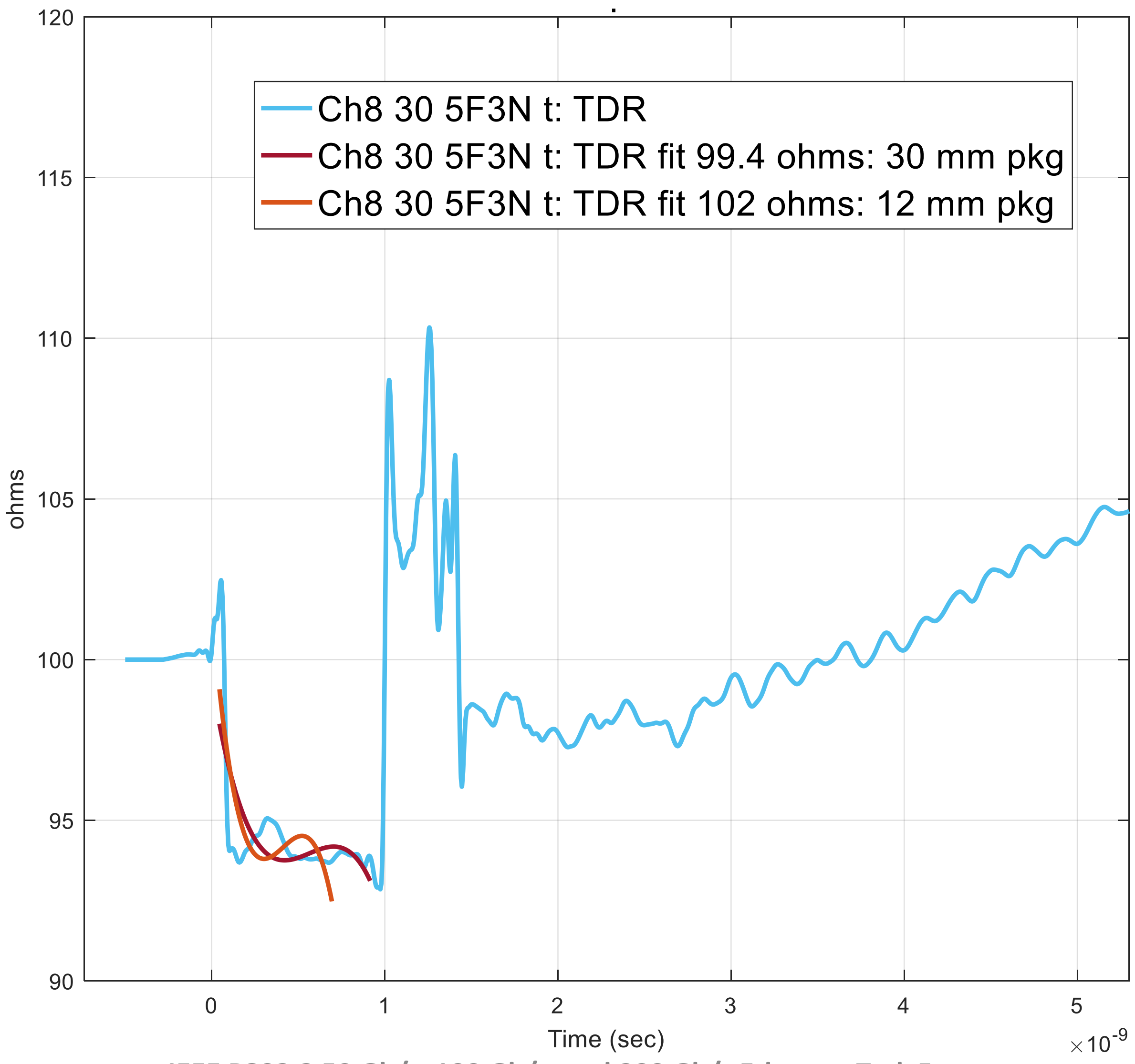
p2 = 1.185e+16

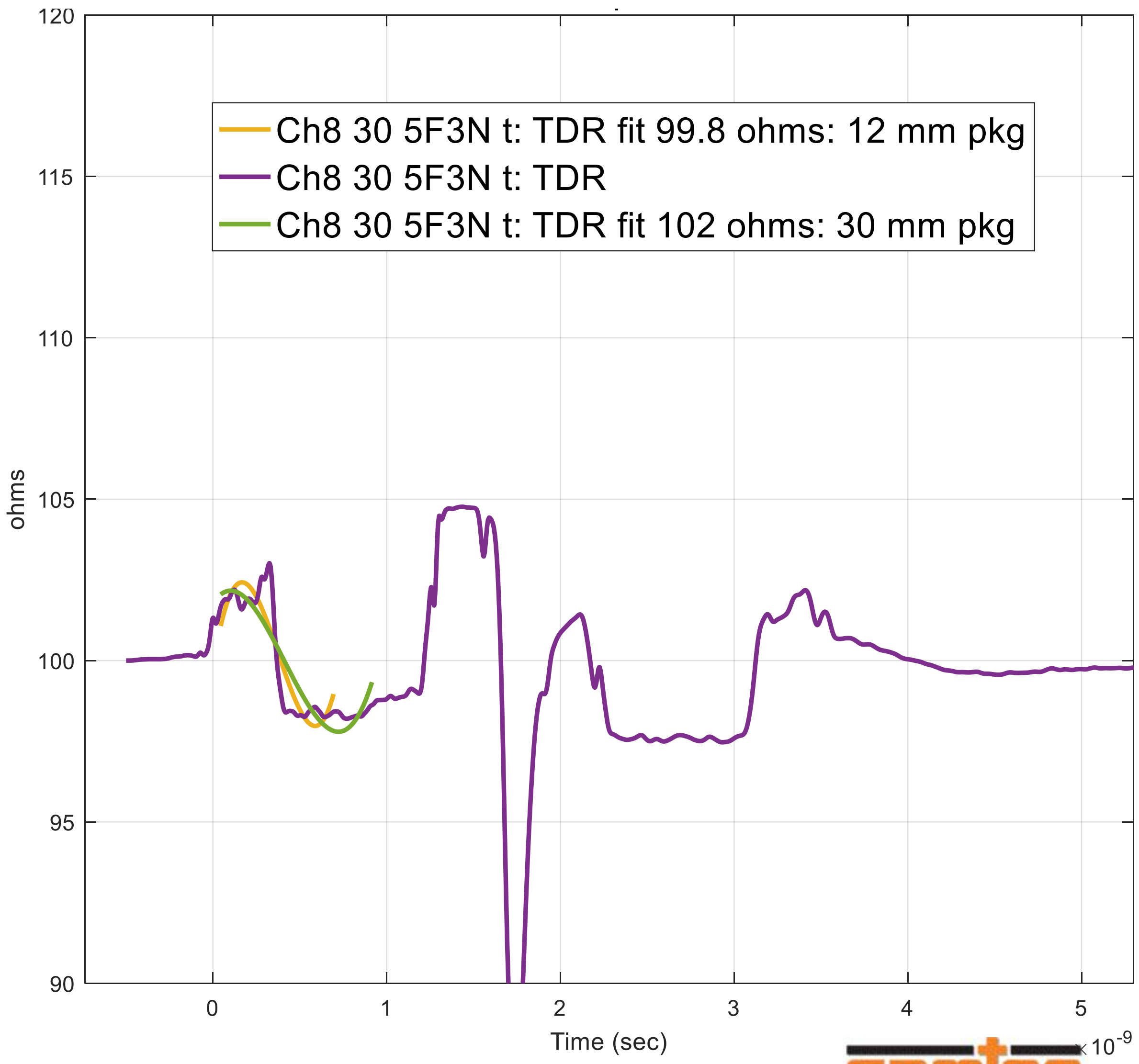
p3 = -2.737e+07

p4 = 88

Use p4 as the driving point impedance, zrxx

Example: fits comprehend vias and mounting





Challenge: What impedance to use for max and min reference Zc?

- ❑ Some designers like the notion of 90 ohms and 110 ohms
- ❑ The package model suggested in IEEE802.3bj specifies a worst case package design about 80 ohm as a low impedance
- ❑ PCIe is targeting 85 ohms
- ❑ Some industry products are suggesting 93 ohms as a compromise
- ❑ The compromise suggests 83.7 ohms and 102.3 ohms would be OK for the two Zc references

Recommendation

- Use separate Tx and Rx termination and package in the COM computation
- Use TDR and package length to determine package impedance
  - Use Zc min = 83.7 ohm and Zc max = 102.3 ohms
- Use Rd= 55 ohms for the Tx termination
- Use Rd= 45 ohms for the Rx termination

Thank YOU!