# C2M Simulation with Short Host Traces

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# Introduction

- sun_3ck_01_0719 analyzed 20 benchmark channels contributed to 802.3ck project and concluded 4-tap DFE or even 3-tap FFE (with different thresholds) can be used as reference receivers for the channels under discussion, which are relatively long C2M channels.

- dudek_3ck_adhoc_01_062619 observed short channels at certain length may result in bad TP1a VEC.

- This contribution is to look at TP1a and host-to-module whole-link simulation for 4 short channels from Jane Lim with 2”, 3”, 4”, 9” host trace lengths.

- Both host and module are with inductor termination model as in sun_3ck_01_0719.

- Reference receiver descriptions are the same as in sun_3ck_01_0719.

- Simulation is performed with COM tool v270.

# Reference Receiver and TP1a Threshold Review

- Reference Receivers (sun_3ck_01_0719):

Higher Performance

| | | | |
|---|---|---|---|
| **DFE-Based** | **A**<br>**4-tap DFE**<br>**(tap 1-4, b1max=0.5)** | **D**<br>**3-tap DFE**<br>**( tap 2 - 4)** | **D2**<br>**1-tap DFE**<br>**(tap 2 only)** |
| **FFE-Based** | **B**<br>**5 tap FFE + 1-tap DFE**<br>**(post 1-4, b1max=0.5)** | **C**<br>**5-tap FFE**<br>**(post 1-4)** | **C2**<br>**3-tap FFE**<br>**(post 1-2)** |

Less Complexity

- Thresholds set in sun_3ck_01_0719:

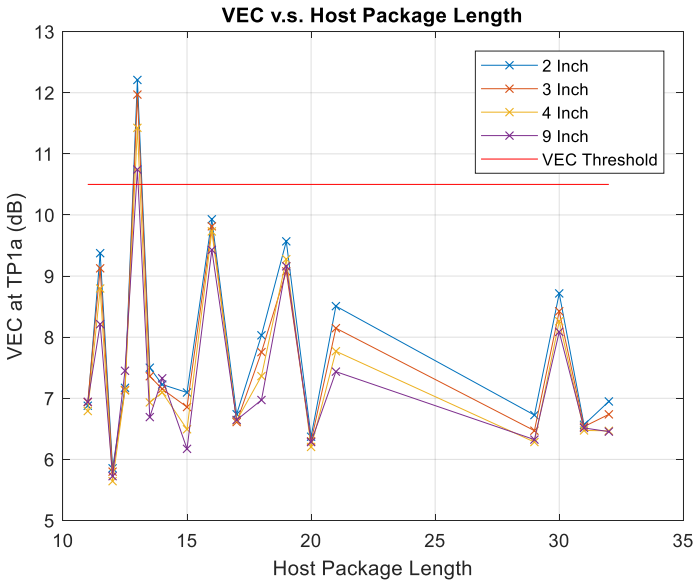
| Reference Receiver | A, B | C, D | C2, D2 |
|---|---|---|---|
| VEC Threshold (dB) | 8 | 9.5 | 10.5 |
| VEO Threshold (mV) | 12.5 | 8 | 8 |

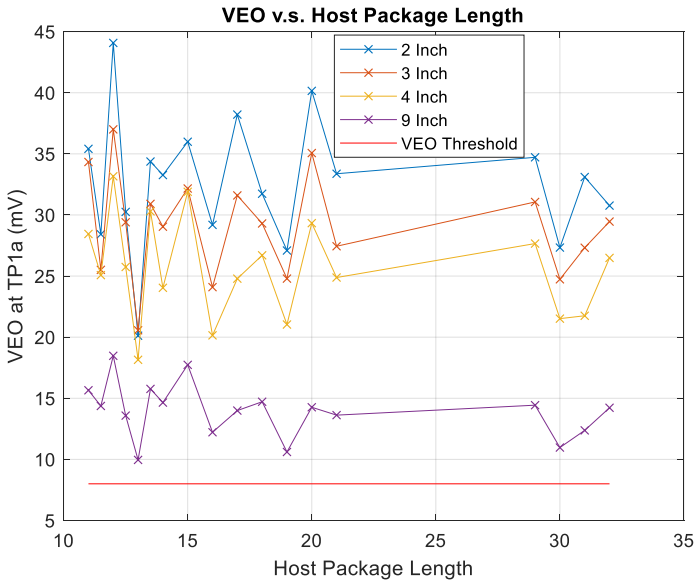
# Channel Overview with Inductor Termination

| ID | Channel Description | IL (dB) | ERL11 (dB) | ERL22 (dB) | ICN (mV) | ILD (dB) |
|---|---|---|---|---|---|---|
| 1 | host PCB trace 2” | 5.67 | 11.93 | 13.01 | 3.52 | 0.16 |
| 2 | host PCB trace 3” | 6.94 | 12.69 | 14.62 | 3.05 | 0.15 |
| 3 | host PCB trace 4” | 8.22 | 13.31 | 16.07 | 2.65 | 0.14 |
| 4 | host PCB trace 9” | 14.55 | 15.17 | 21.20 | 1.34 | 0.13 |

- Parameters highlighted in red are worse than 10.5dB ERL, 2.5mV ICN, or 0.35 dB ILD.
- ERL is reported with Nbx=4. ERL11 is for channel only. ERL22 is at TP1a including TX package.

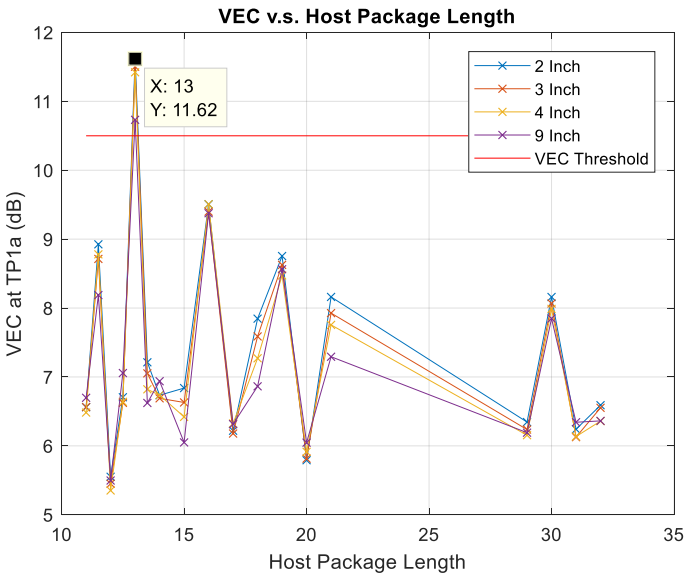
# TP1a VEC with RX C2

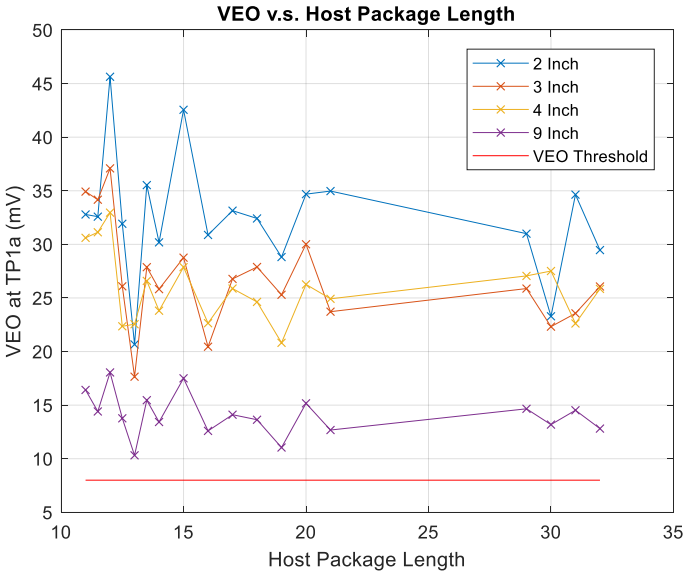



- With Reference receiver C2 – 2 post-tap FFE
- The VEC spike with 13 mm short package is about 2 dB worse than all the other cases.
- With 13 mm package, 2” host trace is worse than the other channels.
- VEO is above the threshold
- Only the pike with 13 mm package fails 10.5 dB VEC threshold. Can this be avoided by adding package/host trace design constraints? E.g. minimum package loss.

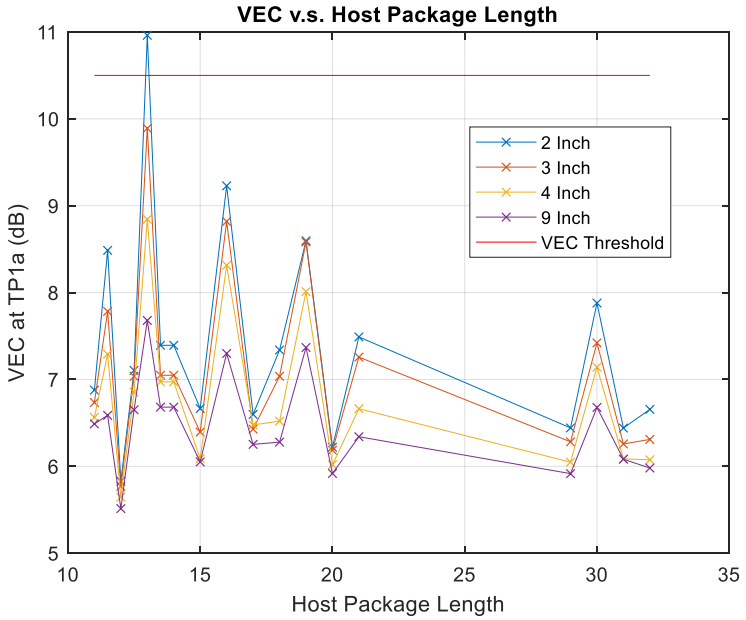
# TP1a VEC with RX C

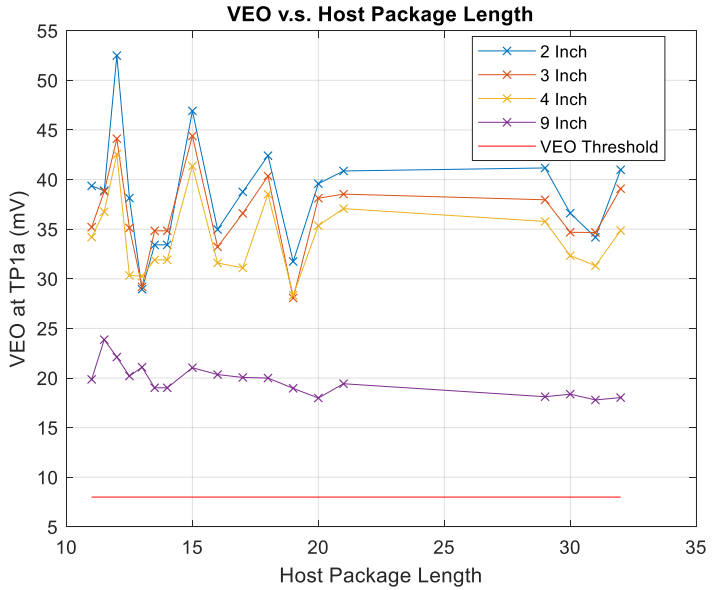



- With Reference receiver C – 4 post-tap FFE
- 13 mm package is much worse than the others.

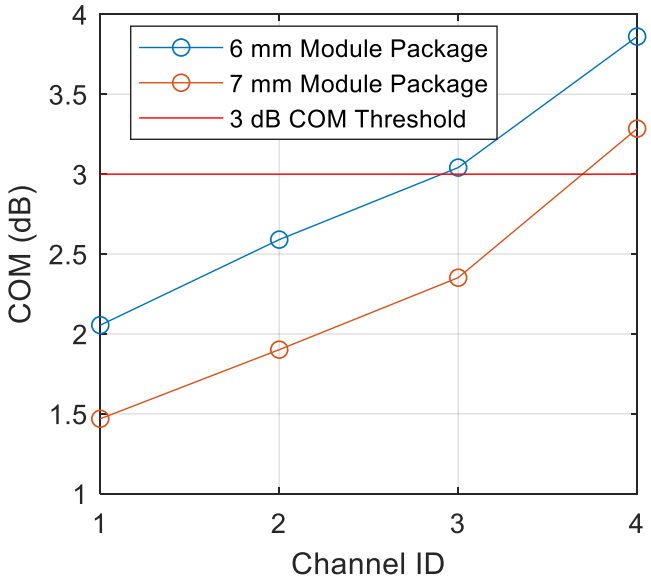
# TP1a VEC with RX A



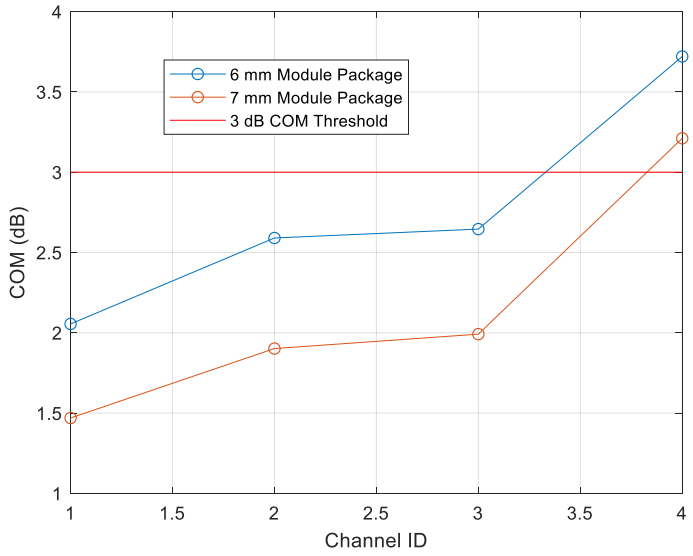




- With Reference receiver A – 4 tap DFE
- 13 mm package is much worse than the others.

# Host-to-module Whole-link Simulation



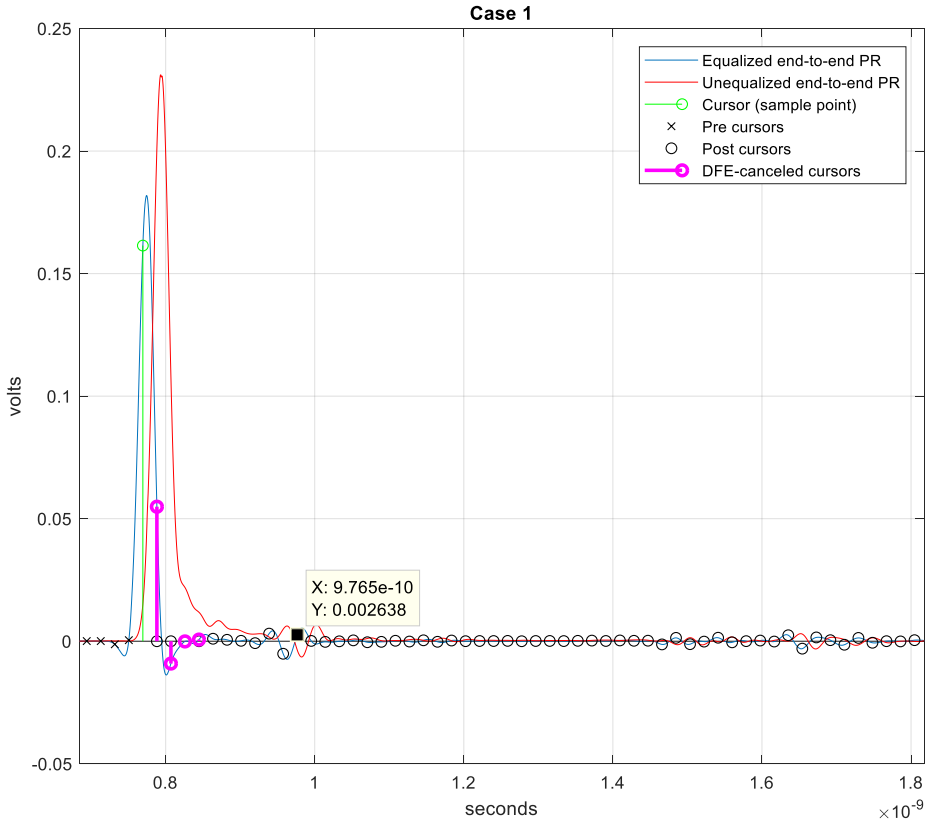

TX FIR is set by TP1a Reference receiver C2




TX FIR is set by TP1a Reference receiver C

- Module RX is assumed to be 5-tap FFE + 1-tap DFE for whole-link simulation.
- TX package length is 13 mm, the worst for TP1a VEC.
- Worst whole-link COM varies with module package length.

# Pulse Response Analysis




- With 13 mm package and 2” host trace, reflections are observed at about postcursor 12.

# Summary

- (Only) when short package is paired with short host trace, TP1a VEC can be dramatically degraded at certain package/host trace length.
- Can this be solved by adding package/board design constraints, e.g., minimum package/host trace loss?
  - There are also discussions about further optimization of host channels and/or on-die termination models.
  - It is preferred if we can avoid increasing module complexity just for these corner cases of short channels.