

# P802.3ck C2M AUI Small Group Update

May 2019 Interim

Kent Lusted, Intel Corporation

# Supporters

- Phil Sun, Credo
- Jane Lim, Cisco
- Mike Dudek, Marvell

# C2M Small Group Participants

- Adam Healey, Broadcom
- Ali Ghiasi, Ghiasi-Quantum
- Phil Sun, Credo
- Jane Lim, Cisco
- Karthik Gopalakrishnan, Inphi
- Mike Dudek, Marvell
- Mike Li, Intel
- Ed Frlan, Semtech
- Matt Brown, MACOM
- Tom Palkert, MACOM
- Piers Dawe, Mellanox
- Mark Kimber, Semtech
- Nathan Tracy, TE
- Matt Schumacher, TE
- Hsinho Wu, Intel
- Masashi Simanouchi, Intel
- Bruce Champion, TE
- Clint Walker, AlphaWave
- Rich Mellitz, Samtec

Please let me know if you want to join the offline consensus calls

# Agenda

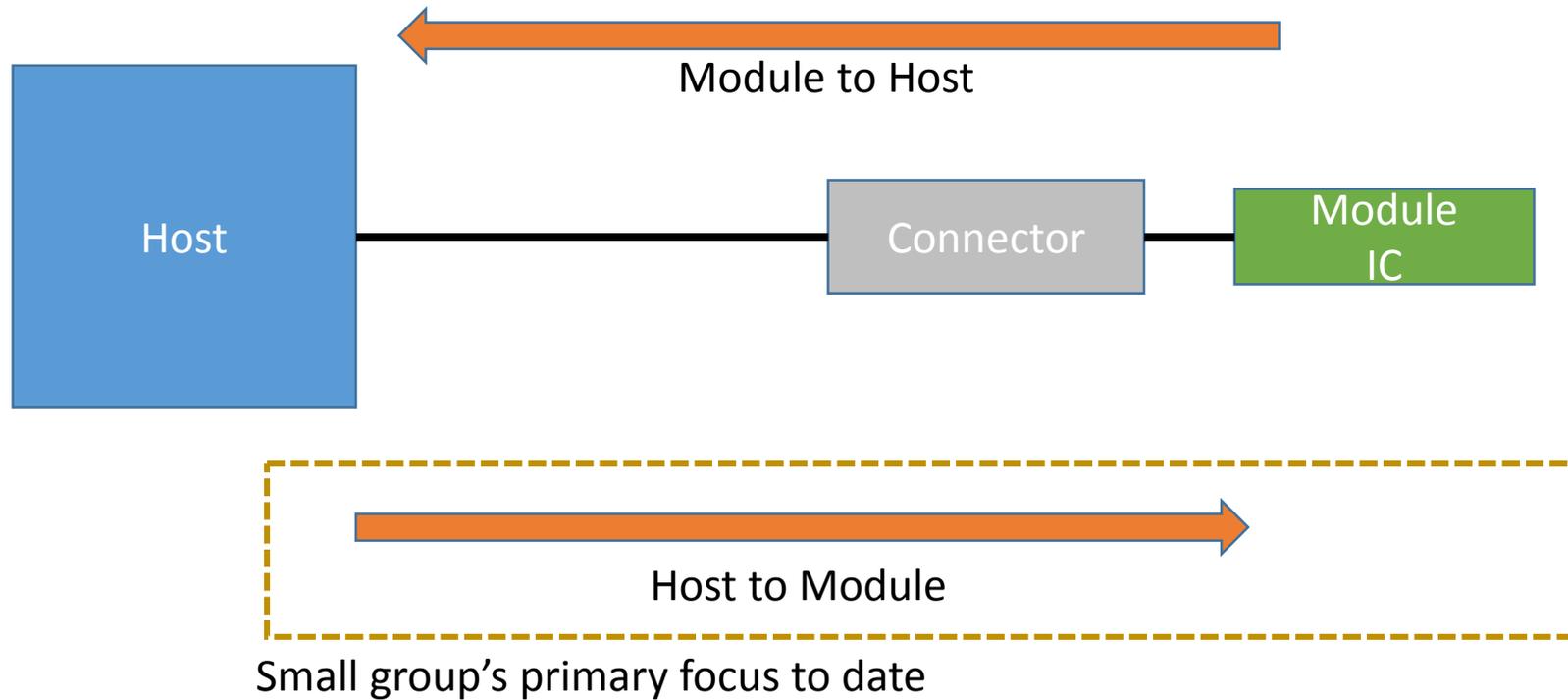
- General observations on C2M
- C2M reference receiver model observations
- Next steps

# May 2019 Goals for C2M AUI

- Primary Goal:
  - Secure direction from the Task Force on which contributed C2M channels should pass versus which should fail
- Secondary Goal:
  - Select the C2M specification parameters, including the reference receiver model

# C2M AUI High Level Block Diagram

- Two directions to consider



# General Observations on C2M AUI

- The contributions to date have been *primarily* focused on 4 reference receiver model candidates:
  - A: 4-tap DFE ( $b_{1\max}=0.5$ )
  - B: 5-tap FFE with 1-tap DFE (FFE4post with DFE  $b_{1\max}=0.5$ )
  - C: 5-tap FFE (FFE4post)
  - D: 4-tap DFE ( $b_{1\max} = 0.0$ . I.e. only three DFE taps.)
  - Note: Some analysis done with other types, such as 12-tap FFE, etc.
- The COM and VEC/VEO results change depending on the channel, Cd, Cp, host and module package trace lengths, reference receiver model architecture & settings, etc.
- 100G/lane C2M is a challenging problem; one that is compelling us to re-examine assumptions and explore different solution techniques than in the past

# Overview of Small Group Work Items

Higher priority

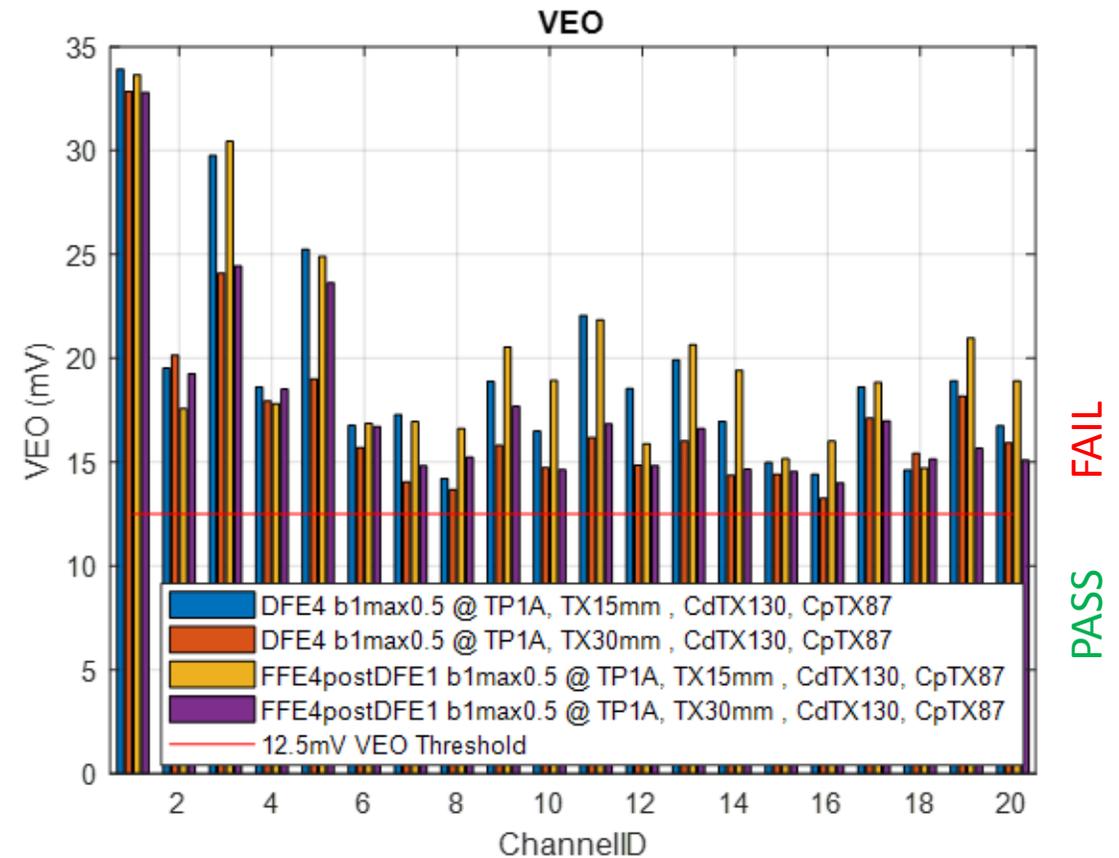
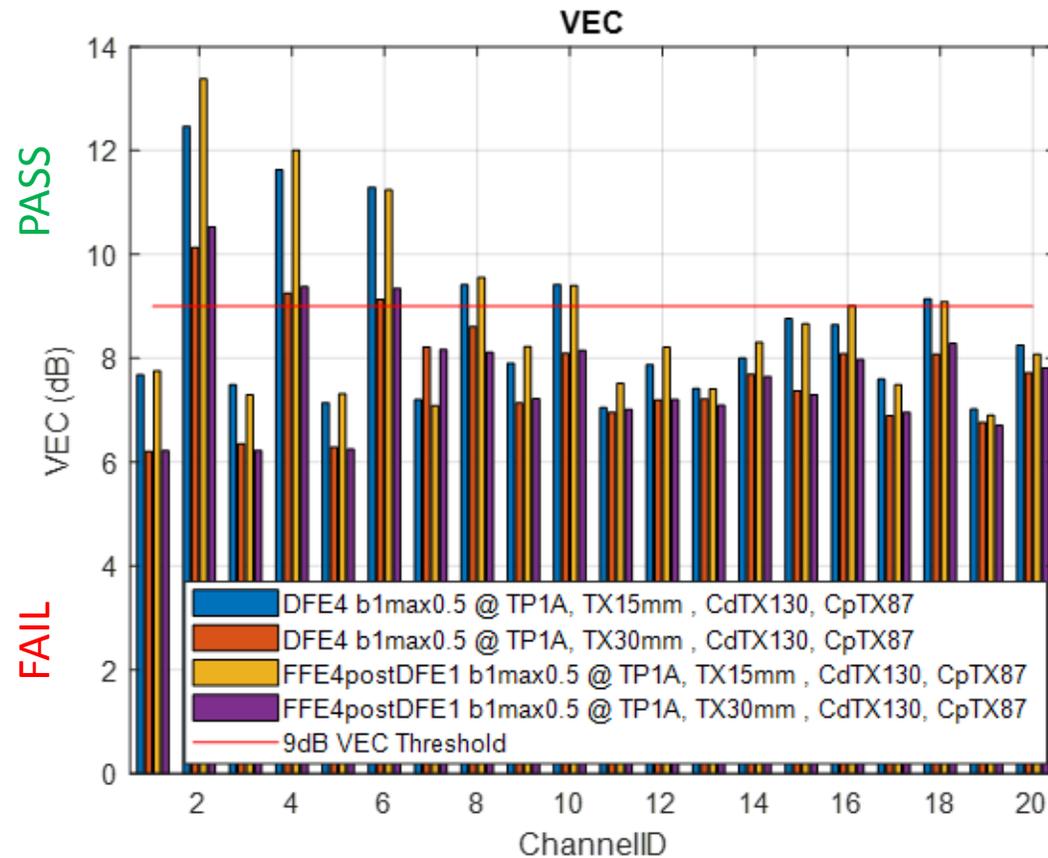
- Channel qualification method and contributed channels to support (pass vs. fail @ TP1a)
  - Module package parameters for informative comparison of channels
- TP1a Ref RX model parameters, including reference equalizer
  - Host TXFIR assumptions are used for informative comparison
- TP1a method and specifications (COM  $\leftrightarrow$  EW & EH mapping contribution)
- Module-side specifications @ TP4.
  - Including how to specify TXFIR settings that work for the MCB and the range of expected hosts
  - Potentially host will need adaptive pre-cursor tap or assumed to be stronger receiver.
- Proposed values for TBD and missing items listed in brown\_3ck\_01\_0519
- Precoding or not

# C2M Ref RX Model Observation #1

- The ref RX models A & B perform “roughly” the same for a given channel/Cd/Cp/pkg/etc.

# TP1A Simulation with Receiver A and B, Host Cd

## 130fF



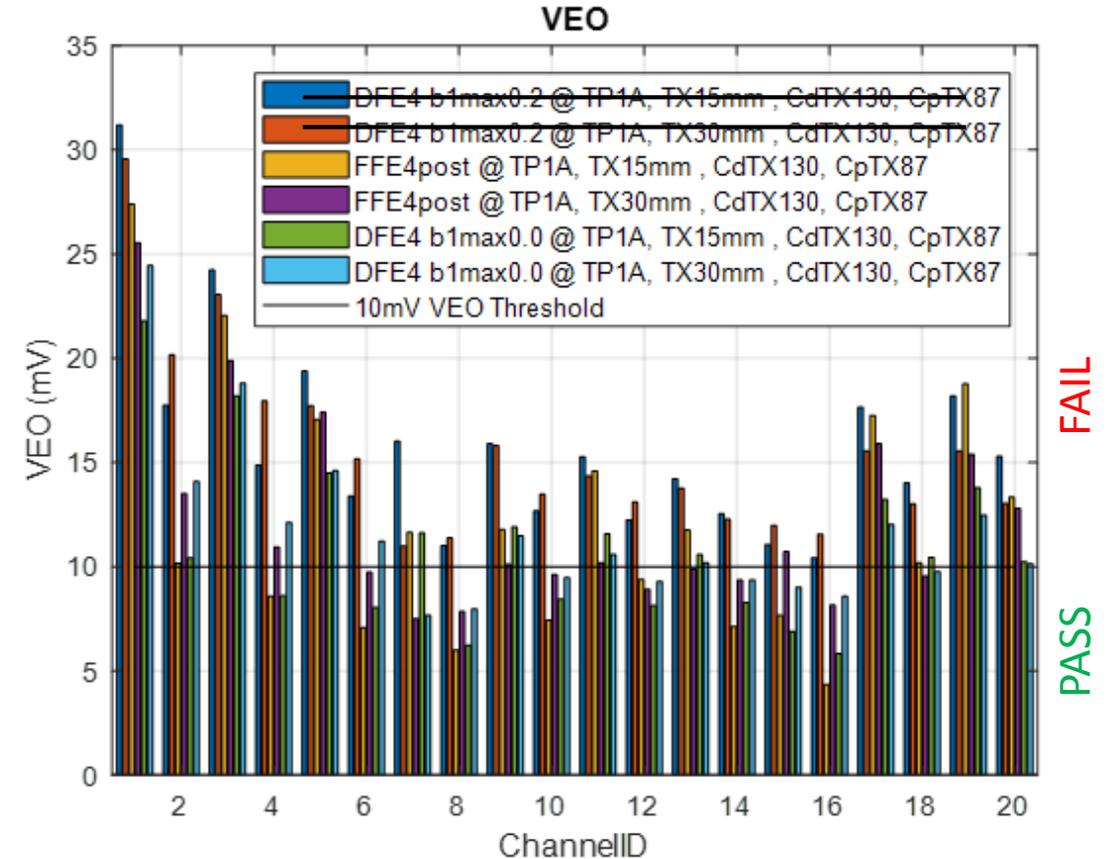
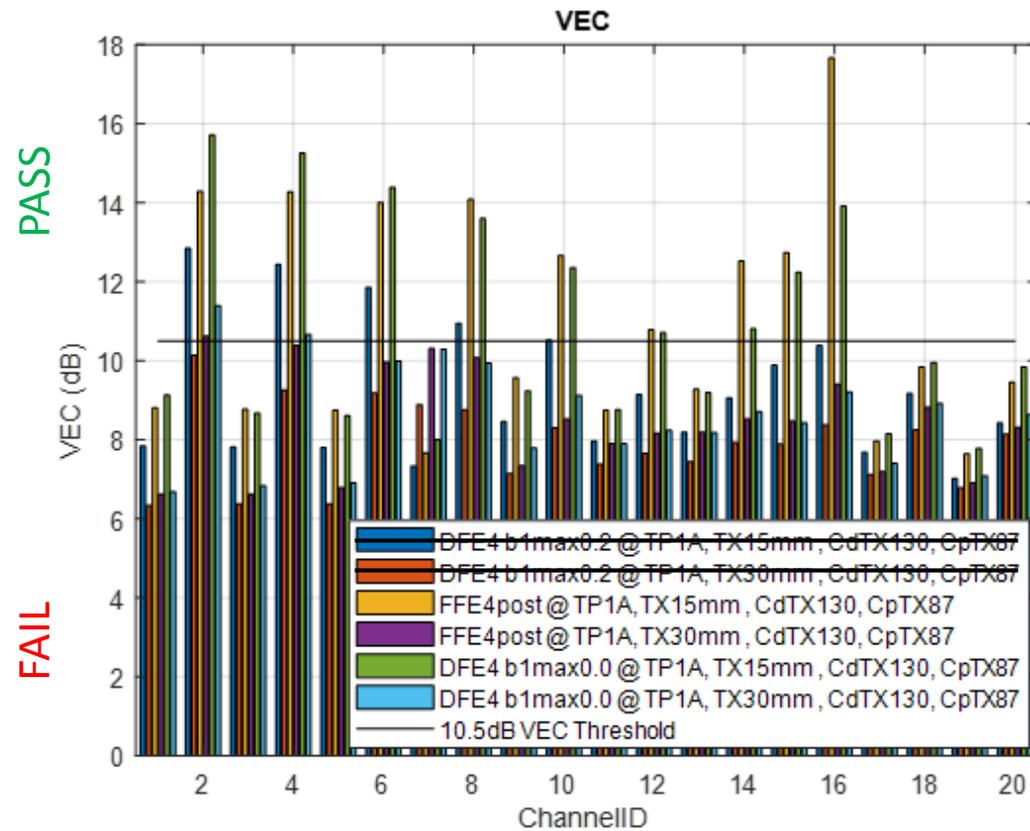
Blue/Yellow “correlate”  
 Red/Purple “correlate”

# C2M Ref RX Model Observation #2

- The ref RX models A & B perform “roughly” the same for a given channel/Cd/Cp/pkg/etc.
- The ref RX models C & D perform “roughly” the same for a given channel/Cd/Cp/pkg/etc.

# TP1A Simulation with Receiver A2, C, D, host Cd

## 130fF



- Yellow/Green “correlate”
- Purple/Light Blue “correlate”

# C2M Ref RX Model Observations #3 & #4

- The ref RX models A & B perform “roughly” the same for a given channel/Cd/Cp/pkg/etc.
- The ref RX models C & D perform “roughly” the same for a given channel/Cd/Cp/pkg/etc.
- None of the investigated reference RX models can pass all of the contributed channels
- Ref RX models A/B support more of the contributed channels than Ref RX models C/D.

# Channel Information

## TP1a Small Group Recommendation

Pass  
Fail  
Pass  
Fail  
Pass  
Fail  
Pass  
Fail  
Pass  
Fail  
Pass  
Pass  
Pass  
Pass  
Pass  
Pass  
Pass  
Fail  
Pass  
Pass

ID	Channel Description	IL (dB)	ERL11 (dB)	ERL22 (dB)	ICN (mV)	FOM ILD	RX Required for TP1a		RX Required for Modules		
							A, B	C, D	A, B	C	FFE12Post
1	mellitz_3ck_01_0518_C2M\9dB	8.95	16.35	12.82	2.28	0.10	Pass	Pass	Pass	Marginal	Pass
2	mellitz_3ck_01_0518_C2M\10dB	9.96	7.79	10.41	4.53	0.48	Fail	Fail	Fail	Fail	Fail
3	mellitz_3ck_01_0518_C2M\11dB	11.16	18.28	14.13	1.93	0.09	Pass	Pass	Pass	Marginal	Pass
4	mellitz_3ck_01_0518_C2M\12dB	12.18	8.39	11.29	3.99	0.46	Fail	Fail	Fail	Fail	Fail
5	mellitz_3ck_01_0518_C2M\13dB	13.12	20.09	14.85	1.68	0.09	Pass	Pass	Pass	Marginal	Pass
6	mellitz_3ck_01_0518_C2M\14dB	13.87	8.73	12.52	3.19	0.47	Fail	Fail	Fail	Fail	Fail
7	tracy_100GEL_02_0118\long_barrel_via\TX5	16.48	14.98	11.58	0.91	0.28	Pass	Fail	Pass	Fail	Marginal
8	tracy_100GEL_02_0118\long_barrel_via\TX6	16.08	14.35	12.61	0.90	0.37	Marginal	Fail	Fail	Fail	Fail
9	tracy_100GEL_06_0118\Microvia\RX6	14.59	15.71	12.50	0.83	0.21	Pass	Pass	Pass	Marginal	Pass
10	tracy_100GEL_06_0118\Microvia\RX5	14.57	16.20	13.45	0.93	0.23	Marginal	Fail	Pass	Marginal	Marginal
11	lim_3ck_01_0319_QDD_new_pad\ch1	14.40	15.83	20.69	0.78	0.20	Pass	Pass	Marginal	Fail	Fail
12	lim_3ck_01_0319_QDD_new_pad\ch2	14.60	14.51	20.20	0.82	0.19	Pass	Marginal	Marginal	Fail	Fail
13	lim_3ck_01_0319_QDD_legacy_pad\ch3	14.69	16.04	15.98	0.77	0.20	Pass	Marginal	Pass	Marginal	Pass
14	llim_3ck_01_0319_QDD_legacy_pad\ch4	14.84	14.77	15.72	0.86	0.18	Pass	Fail	Pass	Marginal	Pass
15	llim_3ck_01_0319_QDD_new_pad\ch5	14.77	14.70	20.57	1.42	0.16	Pass	Fail	Marginal	Fail	Fail
16	llim_3ck_01_0319_QDD_legacy_pad\ch6	15.02	15.01	15.90	1.55	0.17	Pass	Fail	Pass	Fail	Pass
17	ito_3ck_01\QSFP \bottom normal\	15.10	12.79	10.75	1.20	0.18	Pass	Pass	Pass	Marginal	Pass
18	ito_3ck_01\QSFP \bottom worst\	15.58	12.49	10.35	1.14	0.32	Marginal	Marginal	Marginal	Fail	Pass
19	ito_3ck_01\QSFP \top normal\	14.53	12.76	10.85	1.25	0.18	Pass	Pass	Pass	Pass	Pass
20	ito_3ck_01\QSFP \top worst\	14.49	12.43	10.37	1.21	0.31	Pass	Pass	Pass	Fail	Pass

- Parameters highlighted in red are worse than 10.5dB ERL, 2.5mV ICN, or 0.35dB ILD.
- ERL is reported with the settings for reference receiver with 15mm package and 4-tap DFE at TP1a. ERL11 is for channel only. ERL22 is at TP1a including TX package.
- Channel names in red are tough channels for most of the receivers.
- For receiver pass/fail results, 15mm and 30mm host package traces are considered. Marginal means fail but close to the thresholds (violate by less than 0.5 dB).

# C2M Channel Grading Criteria

In sun\_3ck\_01\_0519 (slide 5 and slide 7), for a channel to be graded “pass”, it must have:

- VEC  $\leq$  9 dB (Ref RX type A/B) or VEC  $\leq$  10.5 dB (Ref RX type C/D)
- VEO  $\geq$  12.5 mV (Ref RX type A/B) or VEO  $\geq$  10 mV (Ref RX type C/D)

Additional guidance using:

- ICN better than 2.5 mV
- FOM\_ILD better than 0.35 dB
- ERL better than 10.5 dB

# Proposed Straw Poll

For C2M @ TP1a, I support the pass/fail grading “yellow box” recommended on lusted\_3ck\_01\_0519 slide 13?

Y, N, A

Thanks!

BACKUP

# Channel Information

## Small Group Recommendation

Pass  
Fail  
Pass  
Fail  
Pass  
Fail  
Pass  
Fail  
Pass  
TBD

ID	Channel Description	IL (dB)	ERL11 (dB)	ERL22 (dB)	ICN (mV)	FOM_ILD	TP1a VEC (VEO if only VEO fails)				Whole link COM			
							RX A 15mm TX Pkg	RX A 30mm TX Pkg	RX C 15mm TX Pkg	RX C 30mm TX Pkg	RX A 15mm /8mm	RX A 30mm /8mm	RX C 15mm /8mm	RX C 30mm /8mm
1	mellitz_3ck_01_0518_C2M\9dB	8.95	16.35	12.82	2.28	0.10	7.68	6.21	8.80	6.62	3.89	4.09	3.12	2.83
2	mellitz_3ck_01_0518_C2M\10dB	9.96	7.79	10.41	4.53	0.48	12.47	10.13	14.28	10.62	1.84	2.28	0.96	1.58
3	mellitz_3ck_01_0518_C2M\11dB	11.16	18.28	14.13	1.93	0.09	7.49	6.35	8.77	6.61	3.89	4.08	3.27	2.79
4	mellitz_3ck_01_0518_C2M\12dB	12.18	8.39	11.29	3.99	0.46	11.63	9.25	14.27	10.38	1.99	2.57	1.00	1.79
5	mellitz_3ck_01_0518_C2M\13dB	13.12	20.09	14.85	1.68	0.09	7.14	6.29	8.74	6.78	4.75	4.27	3.32	2.62
6	mellitz_3ck_01_0518_C2M\14dB	13.87	8.73	12.52	3.19	0.47	11.29	9.13	14.00	9.96	2.16	2.83	1.24	2.04
7	tracy_100GEL_02_0118\long_barrel_via\TX5	16.48	14.98	11.58	0.91	0.28	7.20	8.22	7.67	10.31 (7.50)	3.71	3.32	2.84	1.38
8	tracy_100GEL_02_0118\long_barrel_via\TX6	16.08	14.35	12.61	0.90	0.37	9.41	8.61	14.08	10.07	1.95	3.18	0.89	1.79
9	tracy_100GEL_06_0118\Microvia\RX6	14.59	15.71	12.50	0.83	0.21	7.91	7.14	9.56	7.34	3.21	3.85	2.62	2.65
10	tracy_100GEL_06_0118\Microvia\RX5	14.57	16.20	13.45	0.93	0.23	9.42	8.09	12.66	8.52	3.03	3.91	2.55	2.73
11	lim_3ck_01_0319_QDD_new_pad\ch1	14.40	15.83	20.69	0.78	0.20	7.04	6.96	8.74	7.90	4.29	3.00	3.23	1.22
12	lim_3ck_01_0319_QDD_new_pad\ch2	14.60	14.51	20.20	0.82	0.19	7.87	7.19	10.77	8.16	3.93	2.68	2.83	0.74
13	lim_3ck_01_0319_QDD_legacy_pad\ch3	14.69	16.04	15.98	0.77	0.20	7.41	7.22	9.27	8.19 (9.89)	4.23	4.61	2.93	3.75
14	llim_3ck_01_0319_QDD_legacy_pad\ch4	14.84	14.77	15.72	0.86	0.18	8.00	7.69	12.51	8.52	3.68	4.23	2.86	3.24
15	llim_3ck_01_0319_QDD_new_pad\ch5	14.77	14.70	20.57	1.42	0.16	8.76	7.37	12.74	8.47	3.14	2.57	2.84	0.34
16	llim_3ck_01_0319_QDD_legacy_pad\ch6	15.02	15.01	15.90	1.55	0.17	8.65	8.09	17.66	9.41	3.36	3.98	1.98	2.98
17	ito_3ck_01\QSFP \bottom normal\	15.10	12.79	10.75	1.20	0.18	7.60	6.89	7.96	7.19	3.43	3.67	2.84	3.07
18	ito_3ck_01\QSFP \bottom worst\	15.58	12.49	10.35	1.14	0.32	9.15	8.08	9.84	8.82 (9.55)	2.51	2.89	1.71	1.94
19	ito_3ck_01\QSFP \top normal\	14.53	12.76	10.85	1.25	0.18	7.02	6.76	7.64	6.90	4.09	4.20	3.08	3.36
20	ito_3ck_01\QSFP \top worst\	14.49	12.43	10.37	1.21	0.31	8.26	7.72	9.45	8.30	3.11	3.18	1.87	2.21

- Replace pass/fail/marginal information to COM/VEC for some receivers