Baseline Proposal for 100GAUI-1/200GAUI-2/400GAUI-4 C2M Reference Receiver

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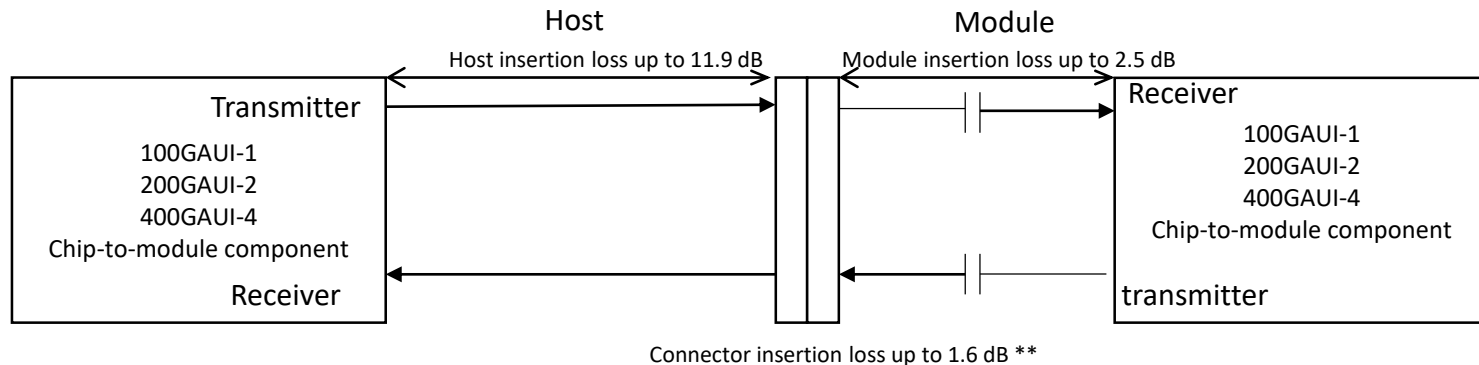
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Introduction

❖ This baseline proposal is to complete open items of the adopted C2M baseline sun_3ck_04b_0319, including the following items:
  ❖ Channel loss allocation
  ❖ Reference receiver and its optimization algorithm
  ❖ EH, ESMW, and VEC thresholds
  ❖ HCB/MCB characteristics
  ❖ Return loss (ERL) parameters for host/module input and output

Channel Insertion Loss Allocation

❖ C2M channel and insertion loss allocation:

Host

Host insertion loss up to 11.9 dB

Module

Module insertion loss up to 2.5 dB

Transmitter

100GAUI-1
200GAUI-2
400GAUI-4
Chip-to-module component

Receiver

Receiver

100GAUI-1
200GAUI-2
400GAUI-4
Chip-to-module component

transmitter

Connector insertion loss up to 1.6 dB **

** The host connector mating interface is allocated 0.3 dB variation allowance, not including via.

Reference Receiver

❖ Reference receiver for both host and module output is CTLE + a 4-tap DFE with
  - b_max(1) limited to 0.5 or lower, and
  - bmax(2,3,4) limited to 0.2.

* Parameters in magenta throughout this presentation need to be confirmed.

CTLE and Noise Filter

CTLE Only Frequency Response
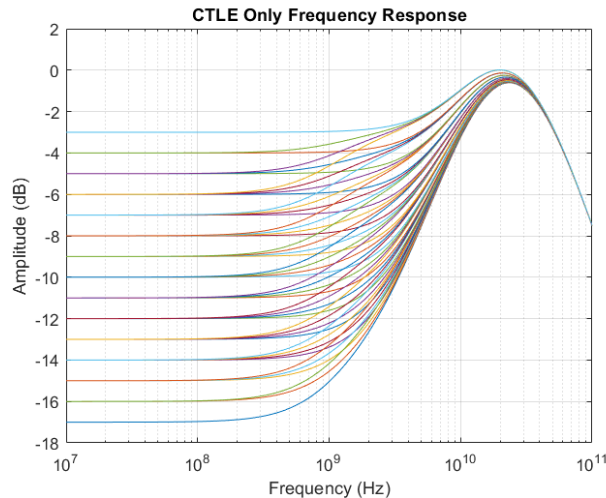
	CTLE	
g_{DC}	[-14:1:-3]	dB
f_z	12.58	GHz
f_{p1}	20	GHz
f_{p2}	28	GHz
g_{DC2}	[-3:1:0]	dB
f_{LF}	fb/40	GHz

- CTLE equation is the same as in Clause 93A:

$$H_{ctf}(f) = \frac{\left(10^{\frac{g_{DC}}{20}} + j\frac{f}{f_z}\right)\left(10^{\frac{g_{DC2}}{20}} + j\frac{f}{f_{LF}}\right)}{\left(1 + j\frac{f}{f_{p1}}\right)\left(1 + j\frac{f}{f_{p2}}\right)\left(1 + j\frac{f}{f_{LF}}\right)}$$

- An additional noise filter is a fourth-order Butter Worth filter with 3dB bandwidth fr=39.8438 GHz:

$$H_r(f) = \frac{1}{1 - 3.414214(f/f_r)^2 + (f/f_r)^4 + j2.613126(f/f_r - (f/f_r)^3)}$$

* CTLE is the same as in sun_3ck_03_0319.

Reference Receiver Adaptation Methodology

❖ Reference equalizer adaptation algorithm is **explicitly specified to achieve measurement consistency**.

- Leverage Clause 85.8.3.3.5 linear fit methodology to extract pulse response. Parameter M is no less than 32, Dp is 3, and Np is 200.
- Leverage Annex 93A for optimal phase and DFE tap weight.
- Apply phase and DFE weight on measured waveforms. Noise and distortion are all kept. Reuse Annex 120E for test point measurement.

Host Output Characteristics (at TP1a)

Parameter	400GAUI-8	100GAUI-1, 200GAUI-2, 400GAUI-4
ESMW (Eye symmetry mask width)	0.22 UI	TBD
Eye height, differential (min)	32 mV	15 mV
Vertical Eye Closure (max)	12 dB	8.5 dB EVEC (Effective Vertical Eye Closure)

EVEC definition:

$$EVEC = \begin{cases} VEC, & if\ EH < 15\ mV \\ VEC - 0.1667 * (EH - 15)\ dB, & if\ EH\ is\ between\ 15\ and\ 30\ mV \\ VEC - 2.5\ dB, & if\ EH > 30\ mV \end{cases}$$

VEC - EH Mask for 8.5 dB EVEC
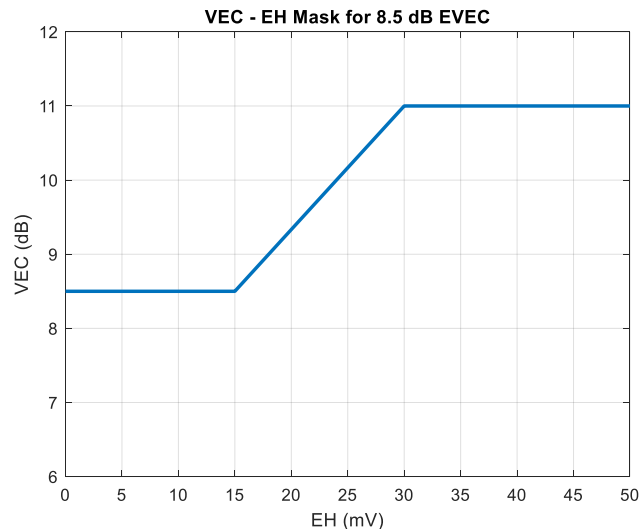
Module Output Characteristics (at TP4)

Parameter	400GAUI-8	100GAUI-1, 200GAUI-2, 400GAUI-4
Near-end Vertical Eye Closure (max)	-	6.5 dB
Near-end Eye height, differential (min)	70 mV	50 mV
Near-end ESMW (Eye symmetry mask width)	0.265 UI	TBD
Far-end Vertical Eye Closure (max)	-	7 dB
Far-end Eye height, differential (min)	30 mV	20 mV
Far-end ESMW (Eye symmetry mask width)	0.2 UI	TBD

Module Output Far-End Reference Channel model

- Host IL (11.9dB) – MCB IL (2.3dB) = PCB model IL budget (9.6dB)
  - 243.84mm PCB model has 9.60dB at 26.56GHz using Table 92-12 parameters shown in config_example_ieee8023_93a=3ck_CR_mellitz_01_100219
    - $\gamma_0 = 0,\ a_1 = 3.8206 \times 10^{-4},\ a_2 = 9.5909 \times 10^{-5},\ \tau = 5.790 \times 10^{-3}$

Far-end Eye   TP4 (Near-end Eye)

| PCB model w/ new parameters | MCB $IL_{CATF}(f)$ | Connector S4P model | Module PCB S4P model | ← TX |

9.60dB   2.30dB

11.90dB
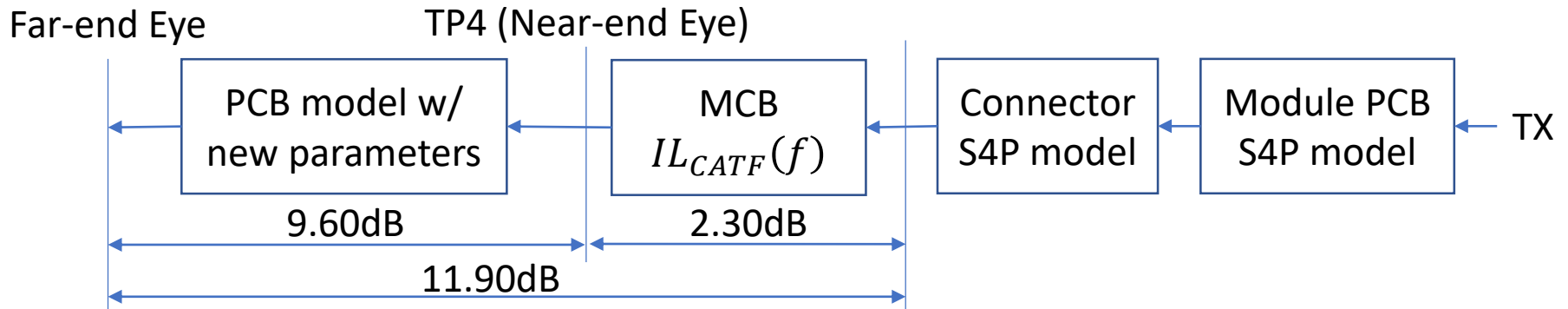
HCB/MCB Characteristics

- HCB characteristics are described in 162B.1.1 where the HCB performs the same equivalent function as the TP2 or TP3 test fixture.

- MCB characteristics are described in 162B.1.2 where the MCB performs the equivalent functionality as the cable assembly test fixture.

- The mated compliance board characteristics are described in 162B.1.3 where the MCB and HCB perform the equivalent functionality as the cable assembly test fixtures.

Host/Module Input / Output Effective Return Loss

Parameter	50GBASE-CR, 100GBASE-CR2, 200GBASE-CR4	100GAUI-1, 200GAUI-2, 400GAUI-4 Host	100GAUI-1, 200GAUI-2, 400GAUI-4 Module
Transition time associated with a pulse (T_r)	0.0189 ns	0.010 ns	0.010 ns
Incremental available signal loss factor (β_x)	1.7 GHz	2.4 GHz	2.4 GHz
Permitted reflection from a transmission line external to the device under test (ρ_x)	0.3	0.3	0.3
Length of the reflection signal (N)	300 UI	600 UI	600 UI
Transmitter steady-state voltage, v_f (min.) Transmitter steady-state voltage, v_f (max.)	0.354 V 0.6 V	0.39 V 0.6 V	0.41 V 0.6 V
Linear fit pulse peak (min.) (P_{max})	0.49 x v_f V	0.28 x v_f V	0.59 x v_f V
Transmitter (Host/Module output) ERL_{min}	EQ 136-6 at TP2	See Equation below, at TP1a	$\geq$ 11 dB at TP4a
Receiver (Host/Module input) ERL_{min}	$\geq$ 10 dB at TP3	$\geq$ 11 dB at TP4a	$\geq$ 11 dB at TP4a
Equalizer length associated with reflection signal (N_{bx})	-	4	4

- See 93A.5 for definition of parameters
- N_p= 200 for fitting. v_f is defined in 93.8.1.5.2 , i.e. 200 UI after the sample point is used for v_f

- Host output ERL_{min} equation:

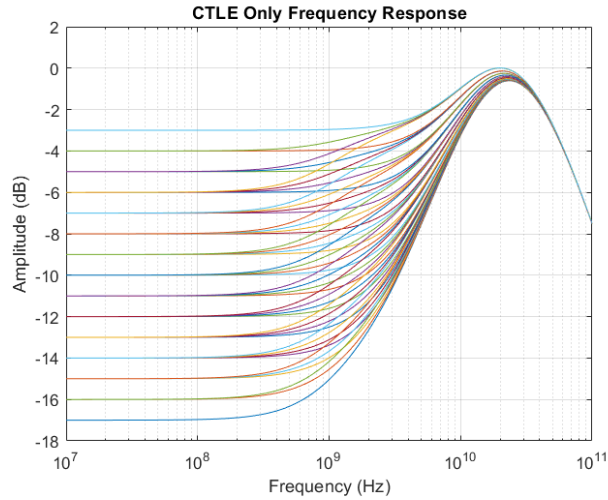$$if \ \frac{\text{Linear fit pulse peak}}{v_f} \geq 0.375 \ ERL_{min} = 11 \ (dB)$$
$$else \ ERL_{min} = 14 \ dB$$

Summary

❖ Propose 802.3ck task force to adopt these baseline proposals on slides 4-12, with a note that VEC, EH, ERL thresholds need to be further confirmed.
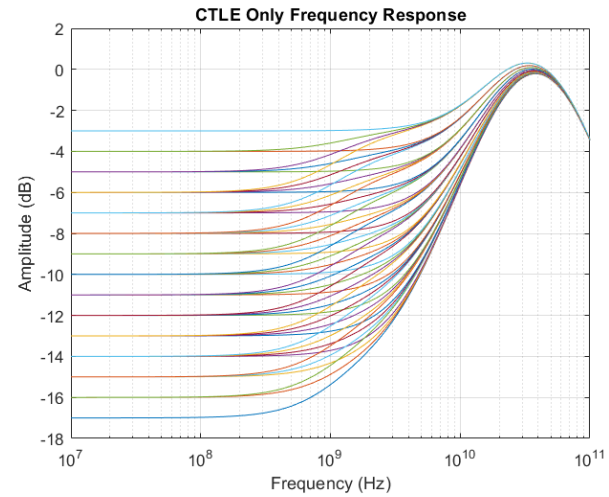
Backup Slides

CTLE

CTLE Only Frequency Response

CTLE and Noise Filter for Receivers A, A2, and B		
g_{DC}	[-14:1:-3]	dB
f_z	12.58	GHz
f_{p1}	20	GHz
f_{p2}	28	GHz
g_{DC2}	[-3:1:0]	dB
f_{LF}	1.328125	GHz

CTLE for b_max(1) > 0

CTLE Only Frequency Response

CTLE and Noise Filter for Receivers C and D		
g_{DC}	[-14:1:-3]	dB
f_z	18.88	GHz
f_{p1}	28	GHz
f_{p2}	53.125	GHz
g_{DC2}	[-3:1:0]	dB
f_{LF}	1.328125	GHz

CTLE for b_max(1) = 0