

25 GE 3m NO FEC Consensus Building

IEEE 802.3by 25Gb/s Ethernet
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We Think There is Consensus that ...

With no changes to specifications, we can not make a 3m no-FEC cable work across solutions smaller than 24awg SFP to SFP with no crosstalk.

Applications need to cover QSFP to QSFP and QSFP to SFP solutions.

Changes to the TX will not make a lot of difference.

The RX specifications, in some form, will need to change. Bottom line ... the receiver has to be more efficient.

What We Could Change is ...

- SNR_{tx} (28.4dB to 31dB, with current baseline at 27dB. Note bj is currently 31dB for pam4, nrz is 27dB.)
- Package C (Cd ~ 200ff, Cp ~ 130ff, base line is 250 and 180.)
- CTLE boost (16dB boost from base line of 12dB.)
- COM margin changes to 2.0dB for CA-N, while COM margin remains 3.0dB for CA-L and CA-S.
- CTLE Pole's/Zero's Change to XX
- Change CA-N Cable spec from 12.98 @ 2m to 16.00 @ 3m.

REPEAT ...

The RX specifications, in some form, will need to change.
Bottom line ... the receiver has to be more efficient.

Running the TE 3m 28ga Pair 1 in COM

- Before any changes were made ...
 - 28AWG (16.48dB cable assembly QSFP-SFP) COM margin is = 1.63dB
- After recommendations ...
 - 28AWG (16.48dB cable assembly QSFP-SFP) COM margin is = 2.698dB

Summary Slide

- We have identified a number of approaches that have strong potential for allowing us to specify 3m no FEC cable operation.

Thank you!

From:

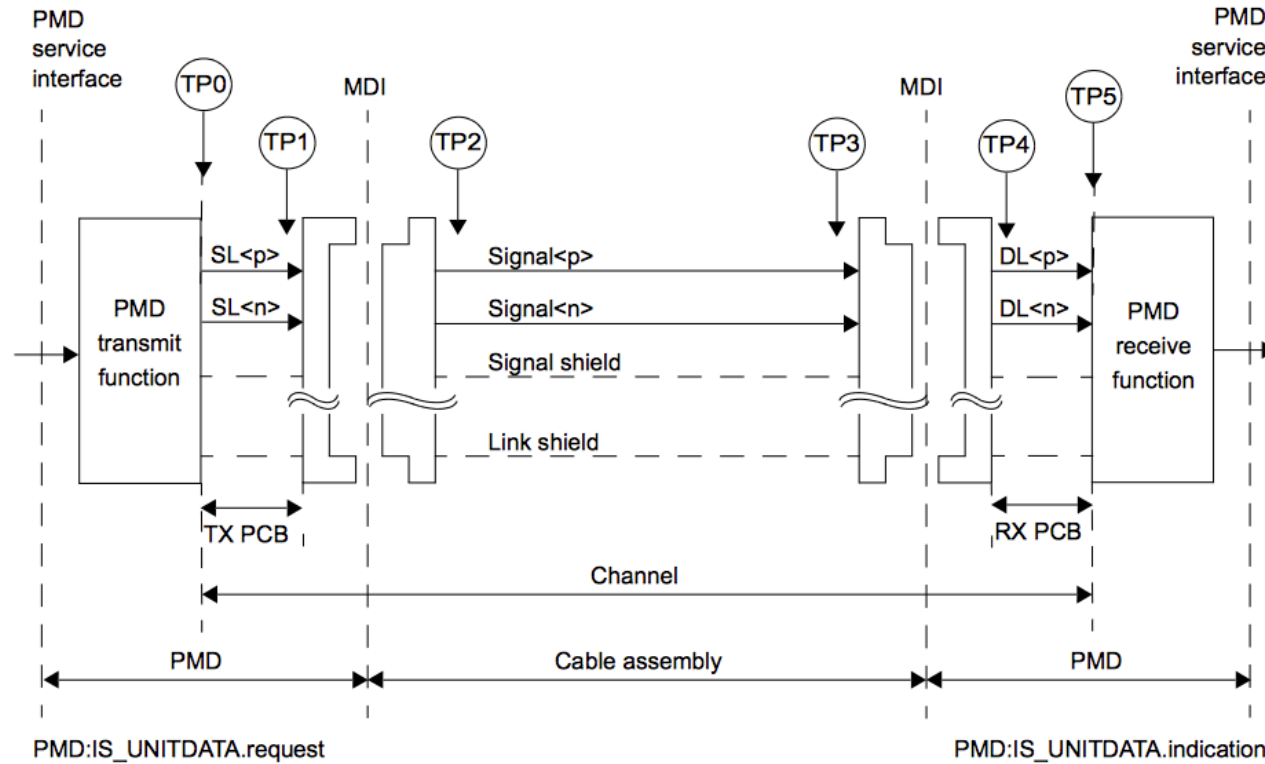


The Following Back-up Slides ...

The following slides are a collection of the parameters we could adjust, more or less.

These parameters come from IEEE802.3by work and are quick pasted for reference

One direction of a 25GBASE-CR or 25GBASE-CR-S link is shown in Figure 110-2.



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Table 92–6— Transmitter characteristics at TP2 summary

Parameter	Subclause reference	Value	Units
Differential peak-to-peak output voltage (max.) with Tx disabled	92.8.3.1	35	mV
DC common-mode voltage (max.)	92.8.3.1	1.9	V
AC common-mode output voltage, v_{cmi} (max., RMS)	92.8.3.1	30	mV
Differential peak-to-peak voltage, v_{di} (max.)	92.8.3.1	1200	mV
Differential output return loss (min.)	92.8.3.2	See Equation (92–1)	dB
Common-mode to differential mode output return loss (min.)	92.8.3.3	See Equation (92–2)	dB
Common-mode to common-mode output return loss (min.)	92.8.3.4	See Equation (92–3)	dB
Transmitter steady-state voltage, v_f (min.) Transmitter steady-state voltage, v_f (max.)	92.8.3.5.2	0.34 0.6	V
Linear fit pulse peak (min.)	92.8.3.5.2	$0.45 \times v_f$	V
Transmitted waveform abs coefficient step size (min.) abs coefficient step size (max.) minimum precursor full-scale ratio minimum post cursor full-scale ratio	92.8.3.5.4 92.8.3.5.4 92.8.3.5.5 92.8.3.5.5	0.0083 0.05 1.54 4	
Signal-to-noise-and-distortion ratio (min.)	92.8.3.7	26	dB
Output jitter (max.) Even-odd jitter, peak-to-peak Effective bounded uncorrelated jitter, peak-to-peak Effective total uncorrelated jitter, peak-to-peak	92.8.3.8.1 92.8.3.8.2 92.8.3.8.2	0.035 0.1 0.18	UI UI UI
Signaling rate, per lane	92.8.3.9	25.78125±100 ppm	GBd
Unit interval nominal	92.8.3.9	38.787879	ps

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Table 92–7—Receiver characteristics at TP3 summary

Parameter	Subclause reference	Value	Units
Receiver input amplitude tolerance	92.8.4.1	1200 mV as measured at TP2	mV
Differential input return loss (min)	92.8.4.2	Equation (92–20)	dB
Differential to common-mode input return loss	92.8.4.3	Equation (92–21)	dB
Interference Tolerance	92.8.4.4	Table 92–8	—
Signaling rate, per lane	92.8.4.6	25.78125 ± 100 ppm	GBd
Unit interval (UI) nominal	92.8.4.6	38.787879	ps

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Table 92–8— 100GBASE-CR4 interference tolerance parameters

Parameter	Test 1 values	Test 2 values	Units
RS-FEC symbol error ratio ^a	10^{-4}	10^{-4}	
Fitted insertion loss coefficients	$a_1 = 1.7$ $a_2 = 0.546$ $a_4 = 0.01$	$a_1 = 4.3$ $a_2 = 0.571$ $a_4 = 0.04$	dB/ $\sqrt{\text{GHz}}$ dB/GHz dB/GHz ²
Applied SJ ^b (peak-to-peak)	0.1	0.1	UI
Applied RJ (RMS)	0.01	0.01	UI
Even-odd jitter	0.035	0.035	UI
COM (max)	3	3	dB

^aThe FEC symbol error ratio is measured in step 11 of the receiver interference tolerance method defined in 93C.2.

^bApplied SJ frequency >100 MHz, specified at TP0.

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Table 110–7—25GBASE-CR and 25GBASE-CR-S interference tolerance parameters, no-FEC mode

Parameter	Test 1 (low loss)	Test 2 (high loss)	Units
Test pattern	Scrambled idle or PRBS31		
Bit error ratio required ^a	$< 10^{-12}$		
Fitted insertion loss coefficients			
a_1	1.7	3	dB/ $\sqrt{\text{GHz}}$
a_2	0.546	0.29	dB/GHz
a_4	0.01	0.02	dB/GHz ²
Approximate fitted loss at 12.89 GHz ^b	14.8	17.57	dB
Applied SJ ^c (peak-to-peak)	0.1		UI
Applied RJ (RMS)	0.01		UI
Even-odd jitter	0.035		UI
COM (max)	3		dB
b_{max} used in COM calculation	0.5		
DER_0 used in COM calculation	10^{-12}		

^aThe bit error ratio is measured using the PCS errored blocks counter (see 49.2.14.2) or the PMA PRBS31 error counter (see 109.4.5.4) as appropriate.

^bFitted insertion loss between the two test reference points (see Figure 92–10).

^cApplied SJ frequency >100 MHz, specified at TP0.

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Table 110–9— Cable assembly characteristics summary

Description	Reference	CA-L	CA-S	CA-N	
Maximum insertion loss at 12.8906 GHz	110.10.2	22.48	16.48	12.98	dB
Minimum insertion loss at 12.8906 GHz	110.10.2	8			dB
Minimum differential return loss at 12.8906 GHz	110.10.3	6			dB
Differential to common-mode return loss	110.10.4	Equation (92–28)			dB
Differential to common-mode conversion loss	110.10.5	Equation (92–29)			dB
Common-mode to common-mode return loss	110.10.6	Equation (92–30)			dB

← Maybe 15.48dB

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Table 110–10—COM parameter values

Parameter	Symbol	CA-N	CA-S	CA-L	Units
Maximum start frequency	f_{min}	0.05	0.05	0.05	GHz
Maximum frequency step	Δf	0.05	0.01	0.01 ^a	GHz
Device package model					
Single-ended device capacitance	C_d		2.5×10^{-4}		nF
Transmission line length, Test 1	z_p		12		mm
Transmission line length, Test 2	z_p		30		mm
Single-ended package capacitance at package-to-board interface	C_p		1.8×10^{-4}		nF
Transmitter differential peak Victim	A_v		0.4		V
Alien far-end aggressor	A_{fe}		0.6		V
Near-end aggressor	A_{ne}		0.6		V
Normalized DFE coefficient magnitude limit, for $n = 1$ to N_b	$b_{max}(n)$	0.5	0.5	1	—
Target detector error ratio	DER_0	10^{-12}	10^{-8}	10^{-5}	—

$A_v \sim .43V / .46V$

$A_{fe} \sim .43 / .645V / .690V$

$A_{ne} \sim .645V / .690V$

^aFor cable lengths greater than 4 m, a frequency step (Δf) no larger than 5 MHz is recommended.

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COM - ran_com_3bj_3bm_01_1114-3

Table 93A-1 parameters

Parameter	Setting	Units	Information
f_b	25.78125	GBd	
f_min	0.05	GHz	
Delta_f	0.005	GHz	
C_d	[2.5e-4 2.5e-4]	nF	
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 30]	mm	[test cases]
z_p (NEXT)	[12 12]	mm	[test cases]
z_p (FEXT)	[12 30]	mm	[test cases]
z_p (RX)	[12 30]	mm	[test cases]
C_p	[1.8e-4 1.8e-4]	nF	
R_0	50	Ohm	
R_d	[55 55]	Ohm	[TX RX]
f_r	0.75	*fb	
c(0)	0.62		min
c(-1)	[-0.18:0.02:0]		[min:step:max]
c(1)	[-0.38:0.02:0]		[min:step:max]
g_DC	[-12:1:0]	dB	
f_z	6.4453125	GHz	
f_p1	6.4453125	GHz	
f_p2	25.78125	GHz	

200ff

130ff

16dB~20dB

A_v	0.4	V	
A_fe	0.4	V	
A_ne	0.6	V	
L	2		
M	32		
N_b	14	UI	
b_max(1)	1		
b_max(2..N_b)	1		
sigma_RJ	0.01	UI	
A_DD	0.05	UI	
eta_0	5.20E-08	V ² /GHz	
SNR_TX	27		
R_LM	1		
DER_0	1.00E-05		
Operational control			
COM Pass threshold	3		
Include PCB	1	logical	

28.4dB~31dB

Maybe 2.5dB

COM - ran_com_3bj_3bm_01_1114-3

I/O control			Table 93A-3 parameters		
DIAGNOSTICS	1	logical	Parameter	Setting	Units
DISPLAY_WINDOW	1	logical	package_tl_gamma0_a1_a2	[0 1.734e-3 1.455e-4]	
Display frequency domain	1	logical	package_tl_tau	6.141E-03	ns/mm
CSV_REPORT	1	logical	package_Z_c	78.2	Ohm
SAVE_FIGURE_to_CSV	0	logical			
RESULT_DIR	.\test_results_C92\		Table 92-12 parameters		
SAVE_FIGURES	0	logical	Parameter	Setting	
Port Order	[1 3 2 4]		board_tl_gamma0_a1_a2	[0 4.114e-4 2.547e-4]	
Receiver testing			board_tl_tau	6.191E-03	ns/mm
RX_CALIBRATION	0	logical	board_Z_c	109.8	Ohm
Sigma BBN step	5.00E-03	V	z_bp (TX)	151	mm
IDEAL_TX_TERM	0	logical	z_bp (NEXT)	72	mm
T_r	8.00E-03	ns	z_bp (FEXT)	72	mm
			z_bp (RX)	151	mm
Non standard control options					
INC_PACKAGE	1	logical			
IDEAL_RX_TERM	0	logical			
INCLUDE_CTLE	1	logical			
INCLUDE_TX_RX_FILTER	1	logical			

85 Ohms