

40GBASE-ER4 PMD Specification Baseline - Working View

Jon Anderson, Opnext

Chris Cole, Finisar

Eddie Tsumura, Sumitomo Electric

Next Gen 40Gb/s & 100Gb/s Optical Ethernet SG

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Introduction

- Following the March, 2012 IEEE 802.3 WG Plenary meeting in Hawaii, the 802 EC officially approved expanding the scope of the Next Generation 100Gb/s Optical Ethernet Study Group to include study of 40GBASE-ER4.
- The following objective was adopted at the March, 2012 IEEE 802.3 WG Plenary Meeting:
Define a 40 Gb/s PHY for operation over at least 40 km of SMF.
- A small group of interested parties has been working to develop a consensus proposal for the 40GBASE-ER4 PMD specification.
- This contribution provides a status of this consensus view. Key parameters are identified that need to be specified in IEEE Std. 802.3ba-2010, Clause 87 Physical Medium Dependent (PMD) sublayer and medium, type 40GBASE-LR4 and 40GBASE-ER4.

Table 87-6: 40GBASE-LR4 and 40GBASE-ER4 operating ranges

PMD Type	Required operating range
40GBASE-LR4	2 m to 10 km
40GBASE-ER4	2 m to 30 km
	2 m to 40 km ^a

^a Links longer than 30 km for the same link power budget are considered engineered links. Attenuation for such links needs to be less than the worst case specified for B1.1, B1.3, or B6_A single-mode fiber.

Table 87-7: 40GBASE-LR4 and 40GBASE-ER4 transmit characteristics

Description	40GBASE-LR4	40GBASE-ER4	Unit
Signaling rate, each lane (range)	10.3125 ± 100 ppm		GBd
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5		nm
Side-mode suppression ratio (SMSR), (min)	30		dB
Total average launch power (max)	8.3	9.8 – 10.5	dBm
Average launch power, each lane (max)	2.3	3.8 – 4.5	dBm
Average launch power, each lane ^a (min)	-7	-1.6 - -0.3	dBm
Optical Modulation Amplitude (OMA), each lane (max)	3.5	4.6 – 7.1	dBm
Optical Modulation Amplitude (OMA), each lane (min) ^b	-4	0.3 – 0.5	dBm
Difference in launch power between any two lanes (OMA) (max)	6.5	4.0 – 5.5	dB
Launch power in OMA minus TDP, each lane (min)	-4.8	-2.1 - -0.5	dBm
Transmitter and dispersion penalty (TDP), each lane (max)	2.6		dB
Average launch power of OFF transmitter, each lane (max)	-30		dBm
Extinction ratio (min)	3.5	5.5 - 6	dB

Table 87-7: 40GBASE-LR4 and 40GBASE-ER4 transmit characteristics (cont.)

Description	40GBASE-LR4	40GBASE-ER4	Unit
RIN ₂₀ OMA (max)	-128		dB/Hz
Optical return loss tolerance (max)	20		dB
Transmitter reflectance ^c (max)	-12		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		

^a Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

^b Even if the TDP < 0.8dB, the OMA (min) must exceed this value.

^c Transmitter reflectance is defined looking into the transmitter.

Table 87-8: 40GBASE-LR4 and 40GBASE-ER4 receive characteristics

Description	40GBASE-LR4	40GBASE-ER4	Unit
Signaling rate, each lane (range)	10.3125 ± 100 ppm		GBd
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5		nm
Damage threshold ^a (min)	3.3	3.8	dBm
Average receive power, each lane (max)	2.3	-2.7 - -1.3	dBm
Average receive power, each lane ^b (min)	-13.7	-20.5 - -20	dBm
Receive power, each lane (OMA) (max)	3.5	-1.0 - -0.5	dBm
Difference in receive power between any two lanes (OMA) (max)	7.5	4.5 – 5.5	dB
Receiver reflectance (max)	-26		dB
Receiver sensitivity (OMA), each lane ^c (max)	-11.5	-18.5	dBm
Receiver 3 db electrical upper cutoff frequency, each lane (max)	12.3		GHz
Stressed receiver sensitivity (OMA), each lane ^d (max)	-9.6	-16.3	dBm
Conditions of stressed receiver sensitivity test:			
Vertical eye closure penalty, ^e each lane	1.9	2.2	dB
Stressed eye J2 Jitter, ^e each lane	0.3		UI
Stressed eye J9 Jitter, ^e each lane	0.47		UI

Table 87-8: 40GBASE-LR4 and 40GBASE-ER4 receive characteristics (cont.)

- ^a The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.
- ^b Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
- ^c Receiver sensitivity (OMA), each lane (max) is informative.
- ^d Measured with conformance test signal at TP3 (see 87.8.11) for BER = 10^{-12} .
- ^e Vertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Table 87-9: 40GBASE-LR4 and 40GBASE-ER4 illustrative link power budgets

Parameter	40GBASE-LR4	40GBASE-ER4		Unit
Power budget (for max TDP)	9.3	19.7 – 20.6		dB
Operating distance	10	30	40	km
Channel insertion loss ^a	6.7	16.0 – 16.1	17 – 18	dB
Maximum discrete reflectance	-26	-26		dB
Allocation for penalties ^b (for max TDP)	2.6	2.6		dB
Additional insertion loss allowed	0	1 - 2	0	dB

^a The channel insertion loss is calculated using the maximum distance specified in Table 87-6 and cabled optical fiber attenuation of 0.47 dB/km at 1264.5 nm plus an allocation for connection and splice loss given in 87.11.2.1.

^b Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

Summary

- A working view of a 40GBASE-ER4 PMD specification consensus proposal has been presented.
- Key parameters are identified that need to be specified in IEEE Std. 802.3ba-2010, Clause 87 Physical Medium Dependent (PMD) sublayer and medium, type 40GBASE-LR4 and 40GBASE-ER4.
- Next step is to reach agreement on open parameter values and prepare 40GBASE-ER4 PMD proposal for future TF meeting.
- Input from other IEEE members is requested.

End of Contribution

Thanks!