

Super-PON PMD (normative)

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Overview

- Revised CD calculations based on the 16-channel plan presented to the IEEE. Previous version used a 20-channel plan.
- Exact changes to PMD tables

Chromatic dispersion calculations

Linear interpolation of CD values (Vince - Corning)

Reference CD values from Corning [ps/nm/km]			
Wavelength [nm]	Min values	midpoint	Max values
1550	16.7	17.05	17.4
1625	21.2	21.6	21.8
Calculations			
m	0.060	0.061	0.059
c	-76.300	-76.983	-73.533
CD for key Super-PON wavelengths (using full 16 channels) [ps/nm/km]			
Wavelength [nm]	Min values	midpoint	Max values
1597.93	19.58	19.96	20.21
1585.54	18.83	19.21	19.49
1561.42	17.39	17.74	18.07
1549.32	16.66	17.01	17.36

Residual CD tolerances

Residual dispersion [ps/nm]				
Distance [km]	C-band min	C-band max	L-band min	L-band max
0	0	0	0	0
25	416.5	451.7	470.8	505.3
30	499.8	542.1	565.0	606.4
50	833.0	903.5	941.6	1010.6

Update DS residual CD tolerance to 910 ps/nm.
Round up slightly to make sure we have coverage.

DCM values

- Using the residual CD values from slide 5, the following table was calculated
- These values assume no slope matching

Propose -590 ps/nm for 0 - 30 km DCM.
Closer to the zero res CD point for 30 km.
0 km expected to have much more margin.

Acceptable DCM values for US assuming -600 to 50 residual CD [ps/nm]				
Distance [km]	Min	Max	midpoint	Range (min-max)
0-30	-556.4	-600	-578.2	43.6
25-50	-960.6	-1070.8	-1015.7	110.2

max dist * max CD -50 min dist * min CD -600

Propose -1020 ps/nm for 25 - 50 km DCM
Slight bias for longer links where margins will be smaller.
Keeps 50 km in negative net CD region.

Resulting min/max residual CD values

Residual CD values			
Distance [km]	DCM value	Min	Max
0-30	-590	-590	16.4
25-50	-1020	-549.2	-9.4

- Proposed DCM values keep residual CD within the proposed bounds
- Allows >5 km overlap between the long and short links. This is important for OSP planning

Normative PMD table updates

Instructions for editor to update draft

- OLT transmit PMD table:
Update table 200-5 with highlighted fields of the table on slide 10
- OLT receive PMD table:
Update table 200-6 with highlighted fields of the table on slide 11
- ONU transmit PMD table:
Update table 200-7 with highlighted fields of the table on slide 12
- ONU receive PMD table (200-8): no changes
- Black link OLT to ONU PMD table:
Update table 200-9 with highlighted fields of the table on slide 13
- Black link ONU to OLT PMD table:
Update table 200-10 with highlighted fields of the table on slide 14

OLT transmit - Table 200-5

Current parameters (current draft)	Current values (in draft)	New parameters (proposal)	New values (proposal)	
Parameter	10GBASE-SP1-Dx 10/2.5GBASE-SP1-Dx	Parameter	10GBASE-SP1-Dx 10/2.5GBASE-SP1-Dx	Unit
Signaling speed (range)	10.3125 ± 100 ppm	Signaling speed (range)	10.3125 ± 100 ppm	GBd
Channel center frequencies	C-band 1 (downstream)	Channel center frequencies	C-band 1 (downstream)	THz
Maximum spectral excursion	± 12.5	Maximum spectral excursion	± 15	GHz
Maximum mean channel output power	1.5	Maximum mean channel output power	1.5	dBm
Minimum mean channel output power	-2.5	Minimum mean channel output power	-2.5	dBm
Minimum side-mode suppression ratio (SMSR)	35	Minimum side-mode suppression ratio (SMSR)	35	dB
Minimum channel extinction ratio	8.2	Minimum channel extinction ratio	8.2	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}	Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}	UI
Transmitter and dispersion penalty (TDP) @ 0 to 1000 ps/nm residual CD	0	Transmitter and dispersion penalty (TDP) 0 to 910 ps/nm residual CD	1.0	dB
RIN ₁₅ OMA (max)	-120	RIN ₁₅ OMA (max)	-120	dB/Hz
Average launch power of OFF transmitter (max)	-39	Average launch power of OFF transmitter (max)	-39	dBm
Optical return loss tolerance (max)	15	Optical return loss tolerance (max)	15	dB

OLT receive - Table 200-6

Parameter	Current draft values		Updated values for next draft		Unit
	10GBASE-SP1-Dx	10/2.5GBASE-SP1-Dx	10GBASE-SP1-Dx	10/2.5GBASE-SP1-Dx	
Signaling speed (range)	10.3125 ± 100 ppm	2.578125 ± 100 ppm	10.3125 ± 100 ppm	2.578125 ± 100 ppm	GBd
Channel frequency range	187.600 to 189.092		187.600 to 189.092		THz
Bit error ratio (max)	10 ⁻²		10 ⁻²		
Maximum mean input power	-6		-6		dBm
Minimum mean input power*	-20.6	-25.1	-21	-25.5	dBm
Minimum OSNR	15	10.5	14	9.5	dB (0.1 nm)
Receiver OSNR tolerance**	12.9	8.4	11.9	8.4	dB (0.1 nm)
Receiver reflectance (max)	-12		-12		dB
Damage Threshold	-5		-5		dBm
Signal detect threshold (min)	-45		-45		dBm
Treceiver_settling (max)	800		800		ns

* Receiver minimum power test to be performed at the minimum required OSNR tolerance with ONU Tx ER of 6.0 dB ER

** Receiver OSNR tolerance to be measured at the minimum mean input power with ONU Tx ER of 6.0 dB ER

ONU transmit - Table 200-7

Current parameters	Current values		New parameters (proposal)	Proposed values		Unit
	10GBASE-SP1-Ux	10/2.5GBASE-SP1-Ux		10GBASE-SP1-Ux	10/2.5GBASE-E-SP1-Ux	
Signaling speed (range)	10.3125 ± 100 ppm	2.578125 ± 100 ppm	Signaling speed (range)	10.3125 ± 100 ppm	2.578125 ± 100 ppm	GBd
Channel center frequencies	L-band 1 (upstream)		Channel center frequencies	L-band 1 (upstream)		THz
Maximum spectral excursion (after turn-on time)	± 15		Maximum spectral excursion (after turn-on time)	± 15		GHz
Maximum mean channel output power	8	4.5	Maximum mean channel output power	8	4.5	dBm
Minimum mean channel output power	see eqn xx	-0.5	Minimum mean channel output power	see eqn xx	-0.5	dBm
Minimum side-mode suppression ratio (SMSR)	38		Minimum side-mode suppression ratio (SMSR)	38		dBm
Minimum channel extinction ratio	see eqn xx	6	Minimum channel extinction ratio	see eqn xx	6	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		UI
Maximum transmitter (residual) dispersion OSNR penalty -400 to +200 ps/nm residual CD -400 to +1000 ps/nm residual CD	2.1	1.1	Maximum transmitter (residual) dispersion OSNR penalty -600 to +50 ps/nm residual CD -600 to +1020 ps/nm residual CD	2.0	1.0	dB
Average launch power of OFF transmitter (max)	-45		Average launch power of OFF transmitter (max)	-45		dBm
RIN ₁₅ OMA (max)	-128		RIN ₁₅ OMA (max)	-128		dB/Hz
Turn-on time (max)	512		Turn-on time (max)	512		ns
Turn-off time (max)	512		Turn-off time (max)	512		ns

Black link: OLT to ONU - Table 200-9

	Current values (in draft)	Proposed values	
Parameter	10 Gb/s	10 Gb/s	Unit
Clear link passband	±15	±15	GHz
Maximum ripple (within the clear link passband)	+2	+2	dB
Maximum (residual) chromatic dispersion	+1000	+910	ps/nm
Minimum (residual) chromatic dispersion	0	0	ps/nm
Minimum optical return loss at transmitter	+20	+20	dB
Maximum discrete reflectance between transmitter and receiver			dB
Maximum differential group delay	+12	+12	ps
Maximum inter-channel crosstalk		0.1	dB
Maximum optical path power penalty	+1	+1	dB
Maximum power excursion			

Black link: ONU to OLT - Table 200-10

Parameter	Current values (in draft)		Proposed values		Unit
	10 Gb/s	2.5 Gb/s	10 Gb/s	2.5 Gb/s	
Clear link passband	±15		±15		GHz
Maximum ripple (within the clear link passband)	+2		+2		dB
Maximum (residual) chromatic dispersion	+200	+1000	+50	+1020	ps/nm
Minimum (residual) chromatic dispersion	-400	-400	-600	-600	ps/nm
Minimum optical return loss at transmitter	+20		+20		dB
Maximum discrete reflectance between transmitter and receiver					dB
Maximum differential group delay	+12		+12		ps
Maximum inter-channel crosstalk			0.1		dB
Maximum optical path OSNR penalty	2	1	2	1	dB
Maximum power excursion			10	10	dB

Open Items

- Normative - reflections on the Tx/Rx and link
- Informative - creation of the informative section in draft for the black link

Thank you