Round OMA or AOP Specs to Closest 0.1dB

- AOP (Average optical power) and OMA are normally measurable parameters which are critical for PMD (or MDI) compliance points (requiring interoperable with multi-vendors).
- AOP is the fundamental measure normally in dBm, std power meters (e.g. from Agilent, ILX etc) typically has accuracy of 0.1dB (with decent ones at 0.05dB).
  - Numerical calculation with precision to two decimal digits doesnot help measure practical parameters with meters in single decimal precision, (otherwise sound laughable)
  - For PMD (or MDI) compliance points, unreasonable precision doesnot help interoperability.
- OMA (=P1-P0) is optical power difference measured for nominal “1” and “0” levels of the optical signal using waveform averaging or histogram means based on square wave pattern. OMA eliminates the ER impact.
  - The precision to measure OMA seldom better than 0.1dB.
  - To define OMA with two decimal digital precision makes no sense.

Round OMA or AOP Specs to Nearest 0.1dB

- There exist too many such examples like 10GbE, SFP+, even 40G/100G etc.
  - Following is for 10GbE LR (e.g. Table 52-12 for TX, Table 52-13 for RX)

Table 52–13—10GBASE-L receive characteristics

Description	10GBASE-L	Unit
Signaling speed (nominal) 10GBASE-LR 10GBASE-LW	 10.3125 9.95328	GBd
Signaling speed variation from nominal (max)	± 100	ppm
Center wavelength (range)	1260 to 1355	nm
Average receive power[a] (max)	0.5	dBm
Average receive power[b] (min)	–14.4	dBm
Receiver sensitivity (max) in OMA[c]	0.055 (-12.6)	mW (dBm)
Receiver Reflectance (max)	–12	dB
Stressed receiver sensitivity (max) in OMA[d, e]	0.093 (–10.3)	mW (dBm)
Vertical eye closure penalty[f] (min)	2.2	dB
Stressed eye jitter[g] (min)	0.3	UI pk-pk
Receive electrical 3 dB upper cutoff frequency (max)	12.3	GHz

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having a power level equal to the Average Receive Power (max) plus at least 1 dB.
[b]Average receive power (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 is informative.
[d]Measured with conformance test signal at TP3 (see 52.9.9.2) for BER = 10^{-12}.
[e]The stressed sensitivity values in the table are for system level BER measurements which include the effects of CDR circuits. It is recommended that at least 0.4 dB additional margin be allocated if component level measurements are made without the effect of CDR circuits.
[f]Vertical eye closure penalty is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.
[g]Stressed eye jitter is a test condition for measuring stressed receiver sensitivity. It is not a required characteristic of the receiver.

AOP and OMA Spec'd Critical Compliance points

- In DS, TP2 and TP3 are critical compliance points for optical modules; while TP6 and TP7 for US.
  - Typical the definition of AOP and OMA numbers should base on distribution of measured values from multi-vendors. (Too risky if all the numbers are based on calculation).

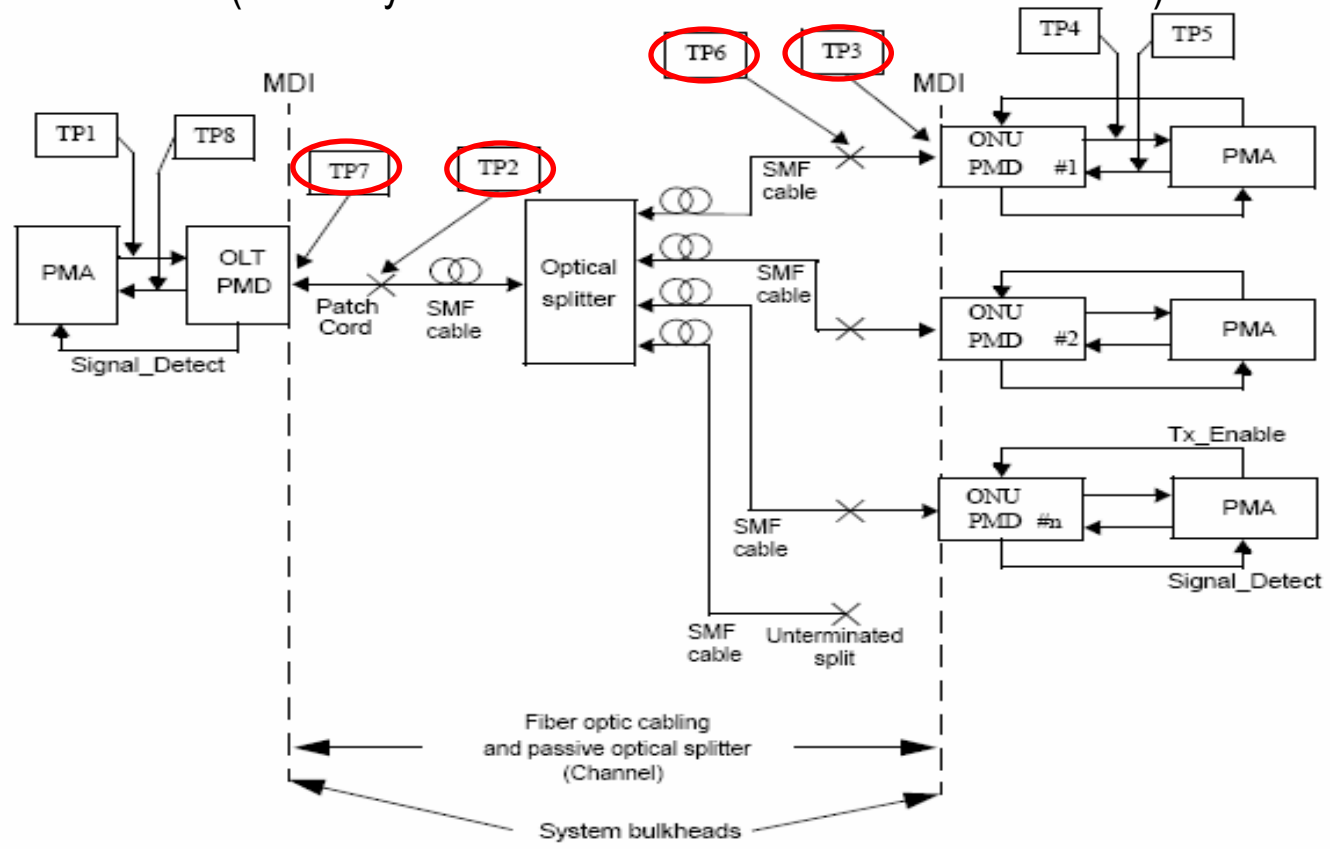

Figure 75–3—10GBASE–PR and 10/1GBASE–PRX block diagram

Comment#2869: Table 75-5

- TX specs in Table 75-5 for 10G DS at TP2

Table 75–5—PR and PRX type OLT PMD transmit characteristics

Description	10GBASE–PR–D1, 10GBASE–PR–D3, 10/1GBASE–PRX–D1 and 10/1GBASE–PRX–D3	10GBASE–PR–D2 and 10/1GBASE–PRX–D2	Unit
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength (range)	1574 to 1580	1574 to 1580	nm
Side Mode Suppression Ratio (min)[a]	30	30	dB
Average launch power (max)	5	9	dBm
Average launch power (min)[b]	2 3.9	5 6.9	dBm
Average launch power of OFF transmitter (max)	–39	–39	dBm
Extinction ratio (min)	6	6	dB
$RIN_{15}OMA$ (max)	–128	–128	dB/Hz
Launch OMA (min)[b]	3.91 (2.46)	6.91 (4.91)	dBm (mW)
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}	UI
Optical return loss tolerance (max)	15	15	dB
Transmitter reflectance (max)	–10	–10	dB
Transmitter and dispersion penalty (max)	1.5	1.5	dB
Decision timing offset for transmitter and dispersion penalty	±0.05	±0.05	UI

[a]Transmitter is a single longitudinal mode device. Chirp is allowed such that the total optical path penalty does not exceed that found in Table 75B–2.
[b]Minimum average launch power and minimum launch OMA are valid for ER = 9 dB (see Figure 75–4 for details)

Comment#2870: Table 75-6

- RX specs in Table 75-6 for 10G US at TP7

Table 75–6—PR type OLT PMD receive characteristics

Description	10GBASE –PR–D1	10GBASE –PR–D2	10GBASE –PR–D3	Unit
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength (range)	1260 to 1280	1260 to 1280	1260 to 1280	nm
Bit error ratio (max)[a]	10^{-3}	10^{-3}	10^{-3}	–
Average receive power (max)	–1	–6	–6	dBm
Damage threshold (max)[b]	0	–5	–5	dBm
Receiver sensitivity (max)	–24	–28	–28	dBm
Receiver sensitivity OMA (max)	–23.22 (4.77)	–27.22 (1.90)	–27.22 (1.90)	dBm (μW)
Signal detect threshold (min)	–45	–45	–45	dBm
Receiver reflectance (max)	–12	–12	–12	dB
Stressed receive sensitivity (max)[c]	–21	–25	–25	dBm
Stressed receive sensitivity OMA (max)	–20.22 (9.51)	–24.22 (3.79)	–24.22 (3.79)	dBm (μW)
Vertical eye–closure penalty[d]	2.99	2.99	2.99	dB
$T_{receiver\_settling}$ (max)[e]	800	800	800	ns
Stressed eye jitter	0.3	0.3	0.3	UI pk to pk
Jitter corner frequency for a sinusoidal jitter	4	4	4	MHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)	(0.05, 0.15)	(0.05, 0.15)	(0.05, 0.15)	UI

-23.2 -27.2 -27.2

-20.2 -24.2 -24.2

[a]The BER of 10^{-12} is achieved by the utilization of FEC as described in 76.3.
[b]Direct ONU–OLT connection may result in damage of the receiver.
[c]The stressed receiver sensitivity is mandatory.
[d]Vertical eye closure penalty and the jitter specifications are test conditions for measuring stressed receiver sensitivity. They are not required characteristics of the receiver.
[e]$T_{receiver\_settling}$ represents an upper bound. Optics with better performance may be used in compliant implementations, since the OLT notifies the ONUs of its requirements in terms of the $T_{receiver\_settling}$ time via the SYNCTIME parameter (see 77.3.3.2).

Comment#2870: Table 75-7

- RX specs in Table 75-7 for 10/1G US at TP7

Table 75–7—PRX type OLT PMD receive characteristics

Description	10/1GBASE –PRX–D1	10/1GBASE –PRX–D2	10/1GBASE –PRX–D3	Unit
Signaling speed (range)	same as 1000BASE-PX10-D receive parameters (see Table 60–5)	same as 1000BASE-PX20-D receive parameters (see Table 60–8)	1.25 ± 100 ppm	GBd
Wavelength (range)			1260 to 1360	nm
Bit error ratio (max)			10^{-12}	
Average receive power (max)			–9.38	dBm
Damage threshold (max)			–5.00	dBm
Receiver sensitivity (max)			–29.78	dBm
Receiver sensitivity OMA (max)			–29.00 (1.26)	dBm (µW)
Signal detect threshold (min)			–45	dBm
Receiver reflectance (max)			–12	dB
Stressed receive sensitivity (max)			–28.38[a]	dBm
Stressed receive sensitivity OMA (max)			–27.60 (1.74)	dBm (µW)
Vertical eye–closure penalty[b]			1.4	dB
$T_{receiver\_settling}$ (max)[c]			400	ns
Stressed eye jitter			0.28	UI pk to pk
Jitter corner frequency for a sinusoidal jitter			637	kHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)			(0.05, 0.15)	UI

-29.0

-27.6

[a]The stressed receiver sensitivity is mandatory.
[b]Vertical eye closure penalty and the jitter specifications are test conditions for measuring stressed receiver sensitivity. They are not required characteristics of the receiver.
[c]$T_{receiver\_settling}$ represents an upper bound. Optics with better performance may be used in compliant implementations, since the OLT notifies the ONUs of its requirements in terms of the $T_{receiver\_settling}$ time via the SYNCTIME parameter (see 77.3.3.2).

Comment#2870: Table 75-8

- TX specs in Table 75-8 for 10G US at TP6

Table 75–8—PR type ONU PMD transmit characteristics

Description	10GBASE –PR–U1	10GBASE –PR–U3	Unit
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength (range)	1260 to 1280	1260 to 1280	nm
Side Mode Suppression Ratio (min)[a]	30	30	dB
Average launch power (max)	4	9	dBm
Average launch power (min)[b]	−1 -0.2	4 -4.8	dBm
Average launch power of OFF transmitter (max)	−45	−45	dBm
Extinction ratio (min)	6	6	dB
$RIN_{15}OMA$ (max)	−128	−128	dB/Hz
Launch OMA (min)[c]	−0.22 (0.95)	4.78 (3.01)	dBm (mW)
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}	{0.25, 0.40, 0.45, 0.25, 0.28, 0.40}	UI
T_{on} (max)	512	512	ns
T_{off} (max)	512	512	ns
Optical return loss tolerance (max)	15	15	dB
Transmitter reflectance (max)	−10	−10	dB
Transmitter and dispersion penalty (max)[c]	3.0	3.0	dB
Decision timing offset for transmitter and dispersion penalty	±0.0625	±0.0625	UI

[a]Transmitter is a single longitudinal mode device. Chirp is allowed such that the total optical path penalty does not exceed that found in Table 75B–2.
[b]Minimum average launch power and minimum launch OMA are valid for ER = 6 dB (see Figure 75–5 for details).
[c]If a transmitter has a lower TDP, the minimum transmitter launch OMA (OMA_{min}) and average minimum launch power (AVP_{min}) may be relaxed by the amount 3.0 dB – TDP.

Comment#2870: Table 75-9

- TX specs in Table 75-9 for 10/1G US at TP6

Table 75–9—PRX type ONU PMD transmit characteristics

Description	10/1GBASE –PRX–U1	10/1GBASE –PRX–U2	10/1GBASE –PRX–U3	Unit
Signaling speed (range)	same as 1000BASE–PX10–U transmit parameters (see Table 60–3)	same as 1000BASE–PX20–U transmit parameters (see Table 60–6)	1.25 ± 100 ppm	GBd
Wavelength[a] (range)			1260 to 1360	nm
RMS spectral width (max)			see [b]	nm
Average launch power (max)			5.62	dBm
Average launch power (min)[c]			0.62	dBm
Average launch power of OFF transmitter (max)			–45	dBm
Extinction ratio (min)			6	dB
$RIN_{15}OMA$ (max)			–115	dB/Hz
Launch OMA (min)[c]			1.40 (1.38)	dBm (mW)
Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}			{0.22, 0.375, 0.20, 0.20, 0.30}	UI
T_{on} (max)			512	ns
T_{off} (max)			512	ns
Optical return loss tolerance (max)			15	dB
Transmitter reflectance (max)			–10	dB
Transmitter and dispersion penalty (max)			1.4	dB
Decision timing offset for transmitter and dispersion penalty			±0.125	UI

5.6

0.6

1.4

[a]This represents the range of center wavelength ±1σ of the rms spectral width.
[b]If the transmitter employs a Fabry–Perot laser, the RMS spectral width shall comply with Table 75–10. If the transmitter employs a DFB laser, the side mode suppression ratio (min) shall be 30 dB.
[c]Minimum average launch power and minimum launch OMA are valid for ER = 6 dB.

Comment#2870: Table 75-11

- RX specs in Table 75-11 for DS at TP3

Table 75–11—PR and PRX type ONU PMD receive characteristics

Description	10GBASE–PR–U1 10/1GBASE–PRX–U1 10/1GBASE–PRX–U2	10GBASE–PR–U3 10/1GBASE–PRX–U3	Unit
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength (range)	1574 to 1580	1574 to 1580	nm
Bit error ratio (max)[a]	10^{-3}	10^{-3}	–
Average receive power (max)	0	–10	dBm
Damage threshold (max)[b]	1	–9	dBm
Receiver sensitivity (max)	–20.50	–28.50	dBm
Receiver sensitivity OMA (max)	–18.59 (13.84)	–26.59 (2.19)	dBm (µW)
Signal detect threshold (min)	–44	–44	dBm
Receiver reflectance (max)	–12	–12	dB
Stressed receive sensitivity (max)[c]	–19	–27	dBm
Stressed receive sensitivity OMA (max)	–17.09 (19.55)	–25.09 (3.10)	dBm (µW)
Vertical eye–closure penalty[d]	1.5	1.5	dB
Stressed eye jitter (min)	0.3	0.3	UI pk to pk
Jitter corner frequency for a sinusoidal jitter	4	4	MHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)	(0.05, 0.15)	(0.05, 0.15)	UI

-20.5
-28.5
-26.6
-18.6
-17.1
-25.1

(Continued in Pg.85)

[a]The BER of 10^{-12} is achieved by the utilization of FEC as described in 76.3.
[b]Direct ONU–OLT connection may result in damage of the receiver.
[c]The stressed receiver sensitivity is mandatory
[d]Vertical eye closure penalty and the jitter specifications are test conditions for measuring stressed receiver sensitivity. They are not required characteristics of the receiver.