OMA Proposal

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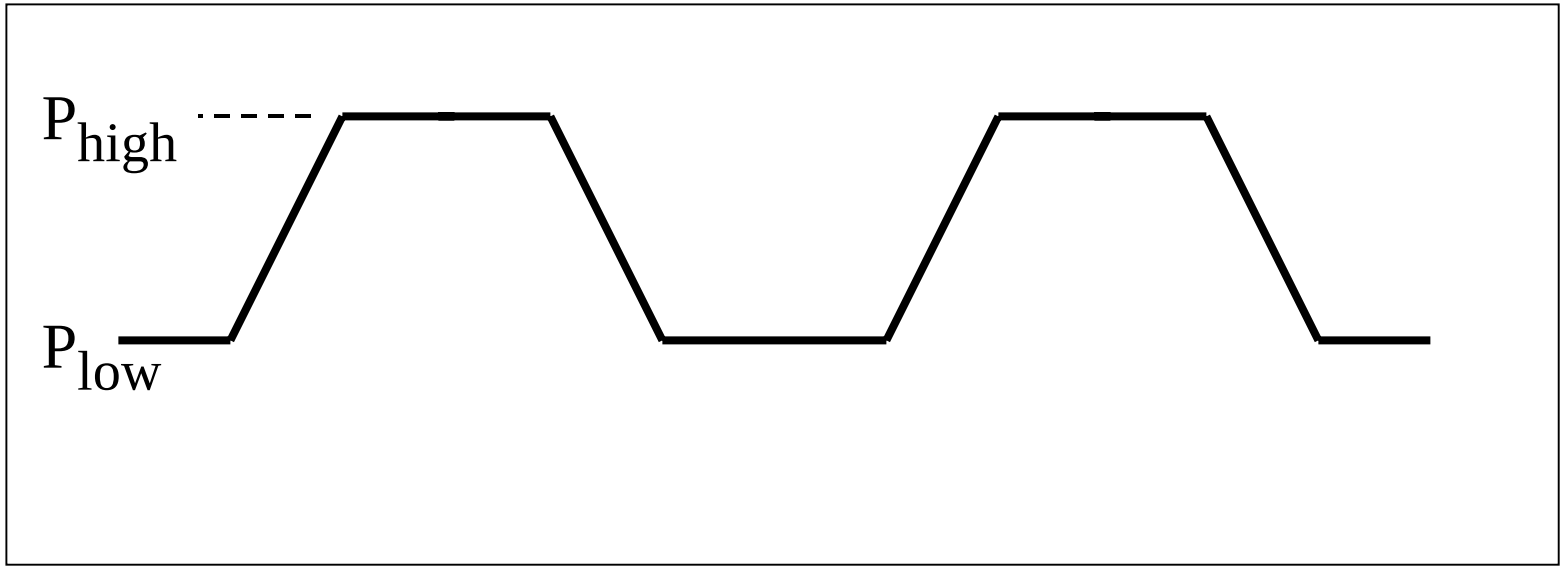
What Is OMA?

- OPTICAL MODULATION AMPLITUDE



- $OMA=P_{high}-P_{low}$

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Why OMA Works

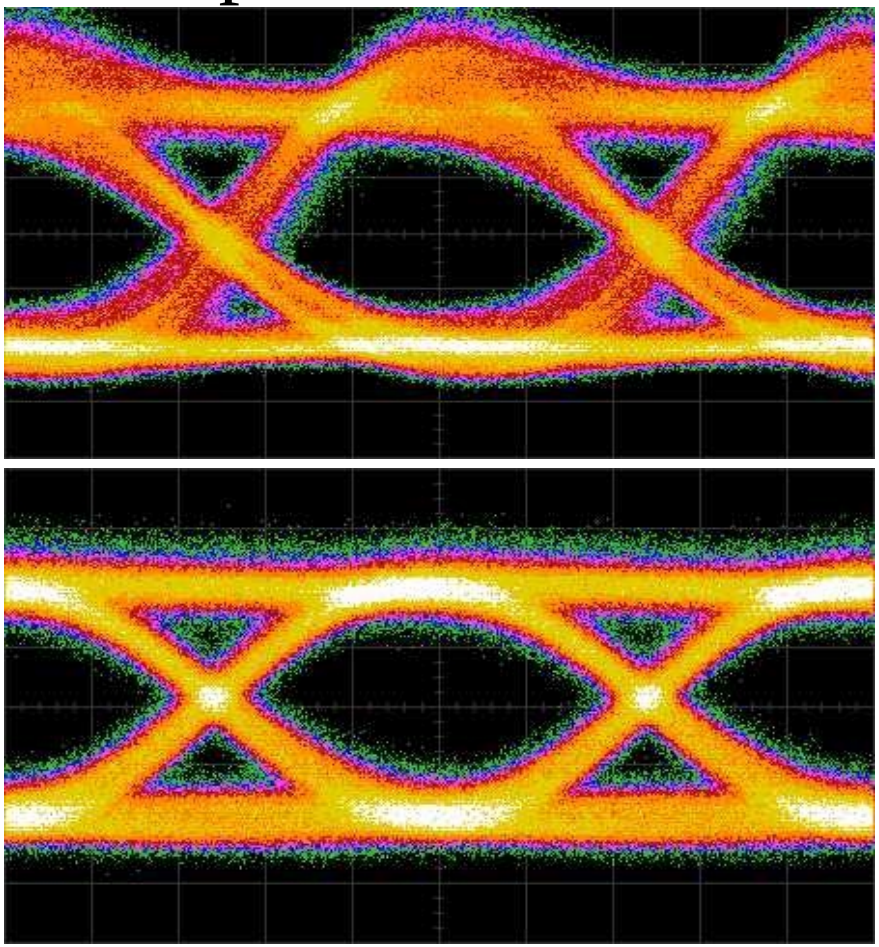
- Rx is AC Coupled, performance is determined by the difference between optical high and optical low
- Pavg only important for EYE Safety and Rx Overload:
  - Pavg < Rx Overload
  - Pavg < Eye Safety

Why Specify OMA

- "More freedom to set bias and modulation currents in transmitter⇨lower cost"
  - Easier to get symmetric eye with an electro-absorption modulator
  - Lower chirp
  - Reduced turn on delay of directly modulated lasers
  - Easier to stay within specification over temperature

Biasing above threshold helps even for fast, low turn on delay lasers

10 Gbps 850nm VCSELs



Biased below threshold

Biased above threshold

IEEE 802.3 High Speed Study Group, September 1999: Courtesy of Gore

Status in Other Standards

- Adopted for latest draft in Fiber Channel

  ftp://ftp.t11.org/t11/pub/fc/pi/00-020v4.pdf

- Adopted by Hippi-6400-Opt
- Being proposed for OIF

Changes to the Specification

- Eliminates ER specification
- Minimum launch power, Rx sensitivity, stressed Rx sensitivity changed to OMA
- Maximum RIN specified relative to OMA power
- All other specification remain the same
  - e.g.
    - Maximum Tx launch power
    - Rx Overload power
- Suggest minimum launch power is NOT specified as average optical power (different from Fiber Channel), since it's not needed.

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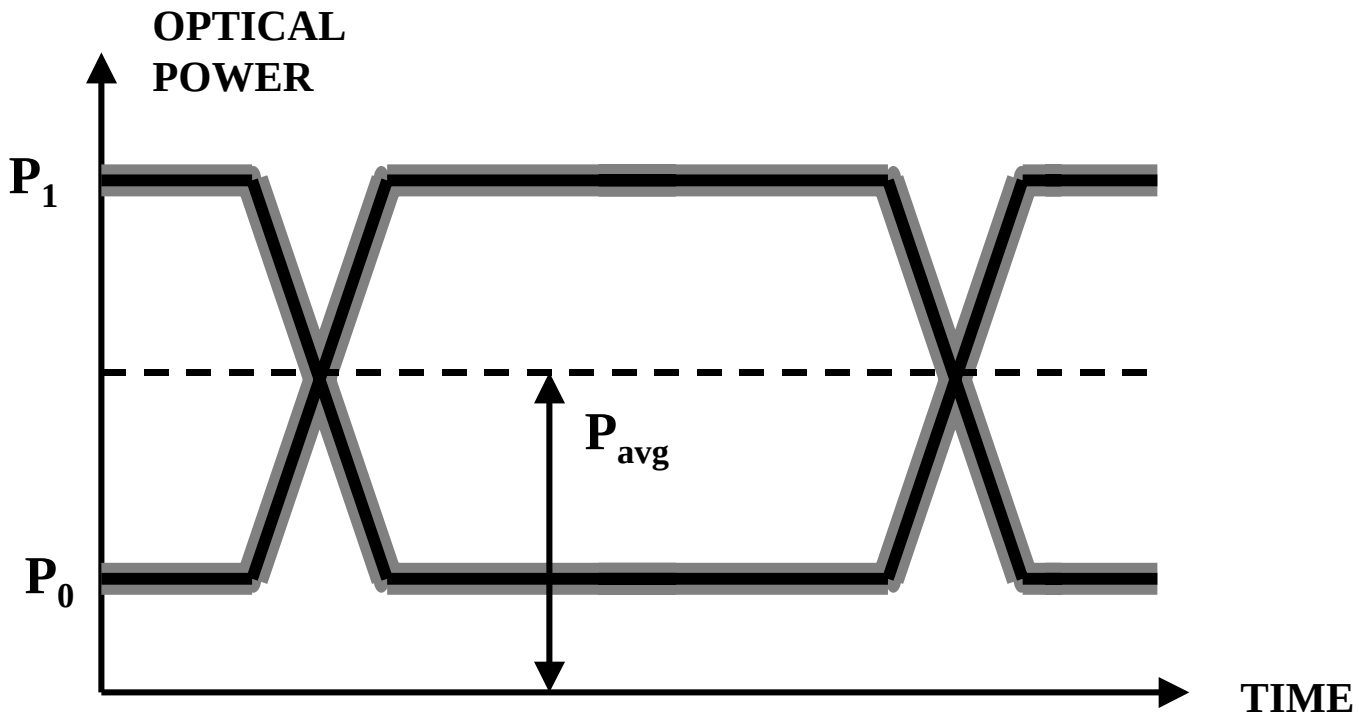
How to Measure: OMA



$OMA(P_1,P_2) = P_1-P_0$

OMA(ER, Pavg)=2*Pavg ((ER-1)/(ER+1))

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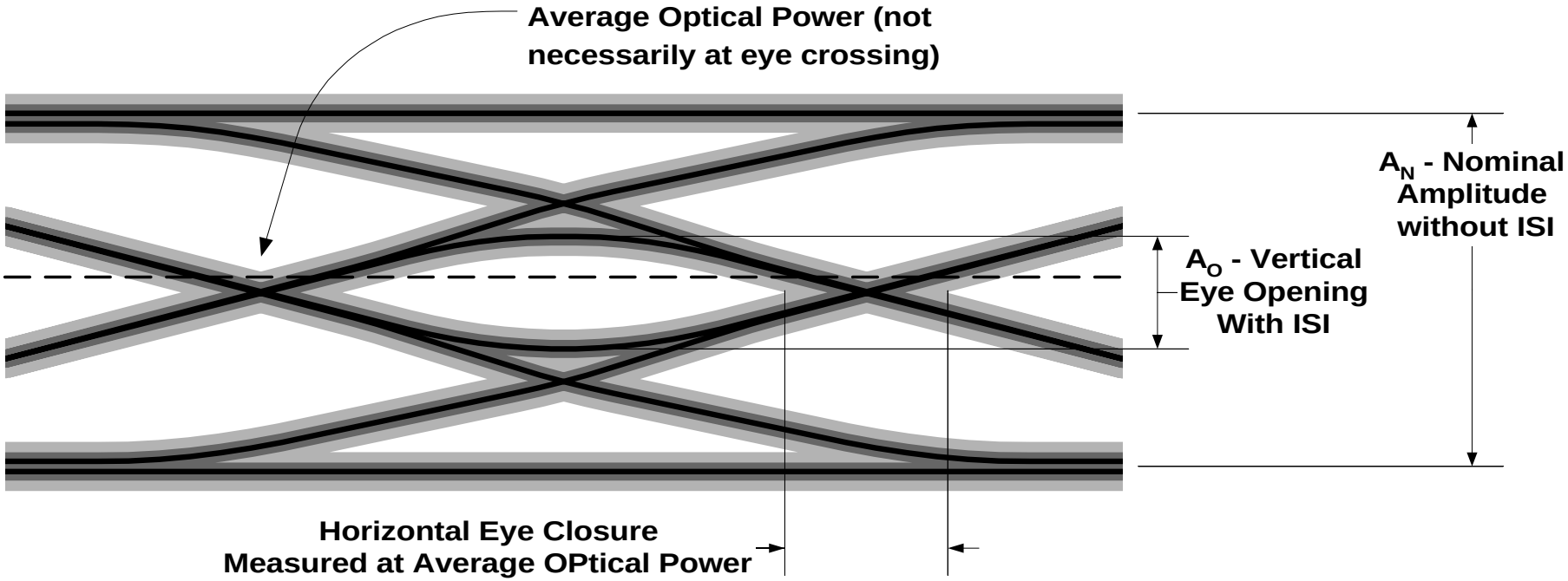
How to Measure: Stressed Receiver OMA



- Stressed receiver sensitivity = A_N
- Vertical eye closure penalty [dB] = $10\log(A_0/A_N)$

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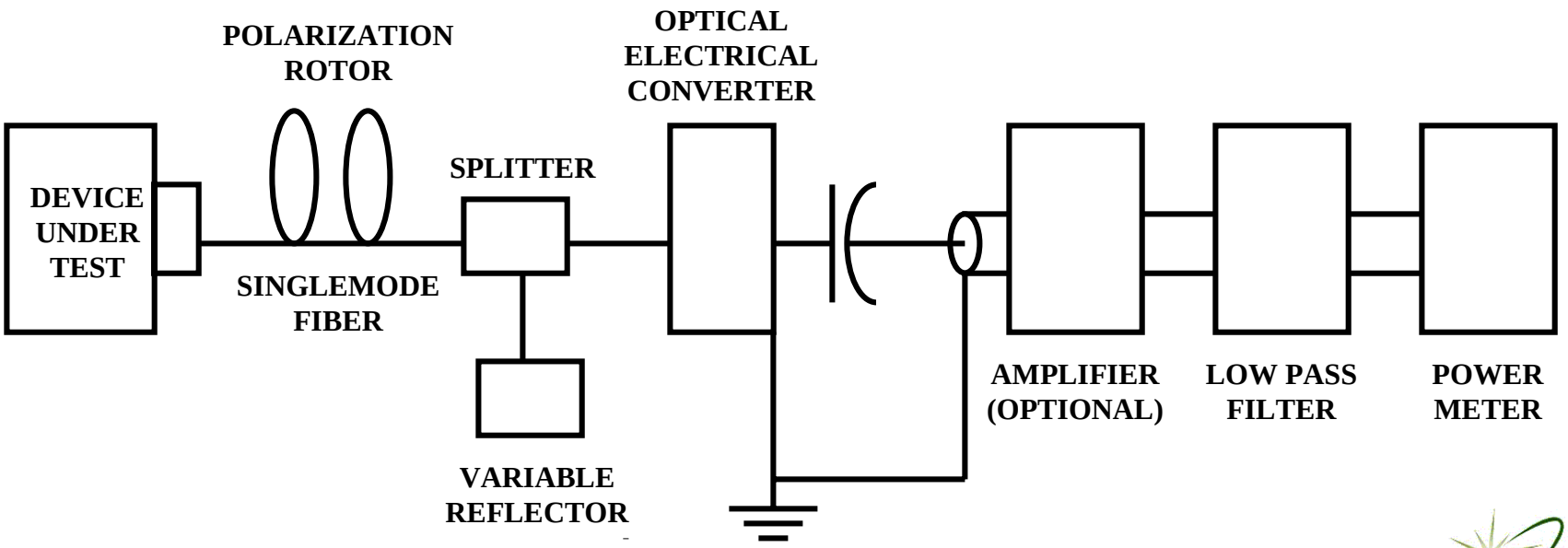
How to Measure: RIN OMA

- RIN(OMA) is the SNR of the transmitter output



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How to Measure: RIN OMA

$$RIN_{12}(OMA) = 10Log[P_N/(BW*P_M)]\ (dB/Hz)$$

$RIN_{12}(OMA)$ = RIN referred to OMA

P_N = Electrical noise power in Watts (modulation off)

P_M = Electrical signal power in Watts (modulation on)

BW = BW(LP filter)-BW(High Pass DC Blocking capacitor) [noise bandwidth of measuring system (Hz)]

Changes 850nm Serial PMD

	Old Spec. (Min ER= 6.5 dB)	Proposed OMA Spec.
$P_{sensitivity}$	-13 dBm	64 µW
$P_{stressed\ Rx\ sensitivity}$ (50 µm MMF)	-8.5 dBm	179 µW
$P_{stressed\ rx\ sensitivity}$ (62.5 µm MMF)	-7.6 dBm	220 µW
$P_{Tx\ min}$	-5.5 dBm	357 µW
RIN	-125 dB/Hz	N/A
RIN(OMA)	N/A	-125 dB/Hz

Changes to 1310nm Serial PMD

	Old Spec. (Min ER= 6 dB)	Proposed OMA Spec.
$P_{sensitivity}$	-14.0 dBm	48 μW
$P_{stressed\ Rx\ sensitivity}$	-11.45 dBm	86 μW
$P_{Tx\ min}$	-4 dBm	477 μW
RIN	-130 dB/Hz	N/A
RIN(OMA)	N/A	-130 dB/Hz

Changes to 1550nm Serial PMD

	Old Spec. (Min ER= 8 dB)	Proposed OMA Spec.
$P_{sensitivity}$	-20 dBm	15 µW
$P_{stressed\ Rx\ sensitivity}$	-14.41 dBm	53 µW
$P_{Tx\ min}$	-2 dBm	917 µW
RIN	-140 dB/Hz	N/A
RINOMA)	N/A	-140 dB/Hz

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Changes to 1310nm WWDM PMD

	Old Spec. (Min ER= 7 dB)	Proposed OMA Spec.
$P_{sensitivity}$	-16.5 dBm	30 μW
$P_{stressed\ Rx\ Sensitivity}$	-15.0 dBm	42 μW
$P_{Tx\ min}$	-7.5 dBm	237 μW
RIN	-120 dB/Hz	N/A
RIN(OMA)	N/A	-120 dB/Hz

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Table 52-8: Transmit Characteristics

Description	10GBASE-LR/LW	Unit
Signaling Speed (range) 10GBASE-LR 10GBASE-LW	 10.3215 ± 100 ppm 9.95328 ± 100 ppm	GBd
Wavelength (range)	1290 to 1330	nm
T_{rise}/T_{fall} (max, 20-80% response time)	33	ps
RMS Spectral width (max)	0.4	nm
Side Mode Suppression Ratio	30	dB
Average launch power (max)	1.0	dB
Optical Modulation Amplitude (min)	477	μW
Average launch power of OFF transmitter (max)	-30	dB
RIN (max)	-130	dB/Hz

Table 52-9: Receiver Characteristics

Description	10GBASE-LR/LW	Unit
Signaling Speed (range) 10GBASE-LR 10GBASE-LW	 10.3215 ± 100 ppm 9.95328 ± 100 ppm	GBd
Wavelength (range)	1290 to 1330	nm
Average receive power (max)	1.0	dBm
Receive OMA sensitivity	48	µW
Return loss (min)	12	dBm
Stressed receive OMA sensitivity	86	µW
Vertical eye closure penalty	1.71	dB
Receive electrical 3 dB upper cutoff frequency (max)		MHz

References:

- Donhowe et al.

  http://www.ieee802.org/3/10G_study/public/sept99/donhowe_1_0999.pdf

- Frojdh et al.

  http://www.ieee802.org/3/ae/public/may00/frojdh_1_0500.pdf

  http://www.ieee802.org/3/ae/public/jul00/frojdh_1_0700.pdf

  http://www.ieee802.org/3/ae/public/sep00/ohlen_1_0900.pdf

PMD Proposal Presentations

850 Serial

http://www.ieee802.org/3/ae/public/sep00/jewell_1_0900.pdf

1310 Serial

http://www.ieee802.org/3/ae/public/may00/hanson_1_0500.pdf

1550 Serial

http://www.ieee802.org/3/ae/public/may00/hanson_1_0500.pdf

WWDM

http://www.ieee802.org/3/ae/public/may00/hanson_1_0500.pdf

References:

- Relevant FC-PI Draft Document: OMA Measurement Techniques

T11/00-020v4 dpANS –

Fibre Channel - Physical Interface, Rev 6.6, Annex A.5

ftp://ftp.t11.org/t11/pub/fc/pi/00-020v4.pdf

END OF PRESENTATION

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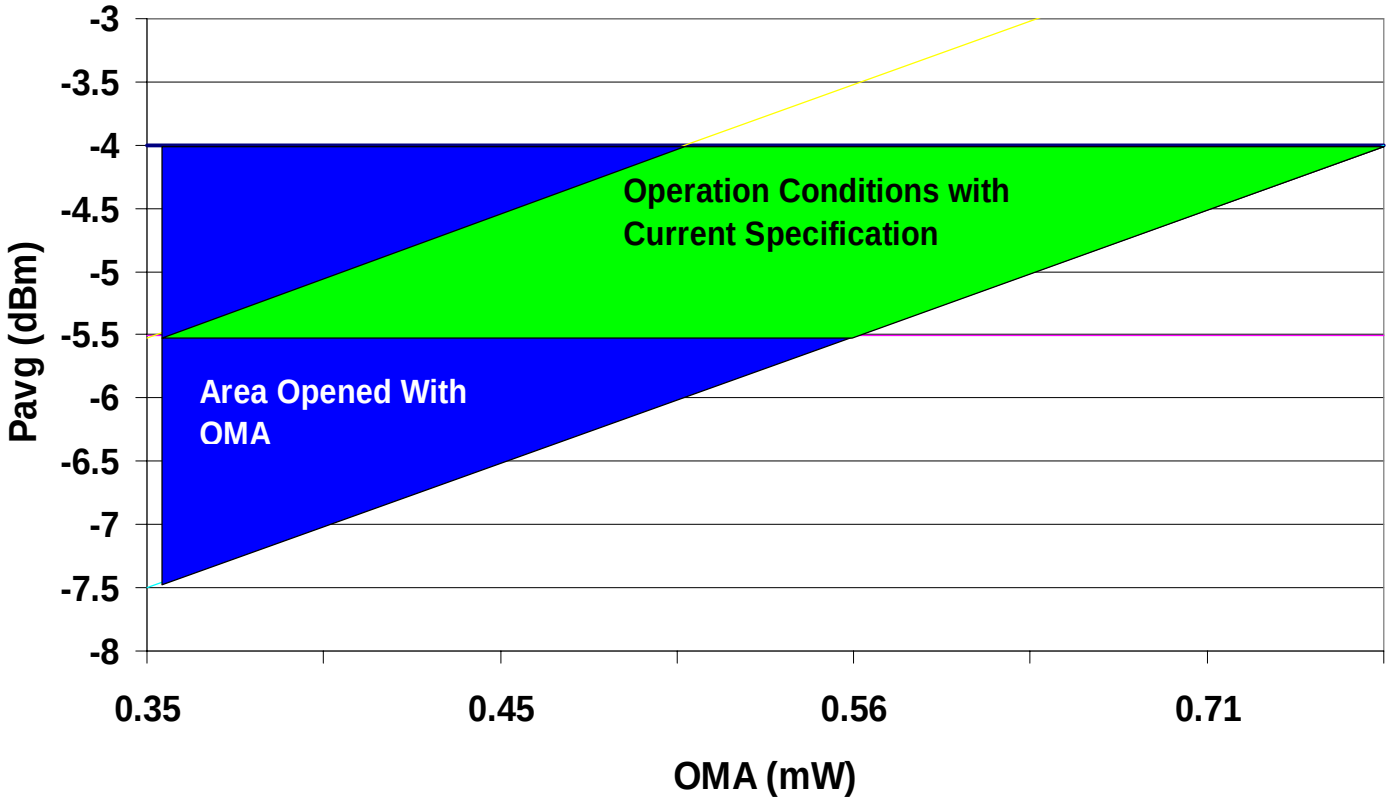
OMA VS Optical Power



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