Populating PR20 PMD Tables

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Supporters

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PR20 PMD Progress

- Consensus was reached at the May 2018 meeting to define power budgets for P802.3ca 25G-EPON PR20 PMDs for downstream and upstream.
  - Based the analysis shown in harstead_3ca_21_0518.pdf.
  - Accepted by the Task Force in May 2018 Motion #9.
  - There is a 0.5dB correction for BOSA loss in the downstream direction (harstead_3ca_1_0718.pdf) which is assumed will be accepted at the July meeting.
- This contribution converts the accepted PR20 power budget to OMA-based PMD tables in the same format as johnson_3ca_1_0518 for the PR30 PMD tables.
  - The PMD tables use the naming convention agreed upon in May 2018 Motion #4, based on kramer_3ca_4a_0518.
  - It is further proposed to make the specs for PR20 50G-EPON the same as for PR20 25G-EPON, based on the same arguments presented for PR30 PMDs in johnson_3ca_2_0518.

May 2018 Motion #9

Motion # 9

Populate these tables from D1.0 as follows:

Table 141-7—OLT PR20 Transmit Characteristics, 25GBASE-PR20-D, Average launch power, each channel (min) = ~~2.5 dBm~~. 2.0 dBm

Table 141-7—OLT PR20 Transmit Characteristics, 25GBASE-PR20-D, Extinction ratio (min) = 8 dB.

Table 141–9—OLT PR20 Receive Characteristics, 25GBASE-PR20-D, Receiver sensitivity (OMA), each channel (max) = -22 dBm

Table 141–11—ONU PR20 Transmit Characteristics, 25GBASE-PR20-U, Average launch power, each channel (min) = 4 dBm

Table 141–11—ONU PR20 Transmit Characteristics, 25GBASE-PR20-U, Extinction ratio (min) = 3.5 dB

Table 141–13—ONU PR20 Receive Characteristics, 25GBASE-PR20-U, Receiver sensitivity (OMA), each channel (max) = ~~-23 dBm~~. −23.5 dBm

Moved: Ed Harstead Second: Ed Walter

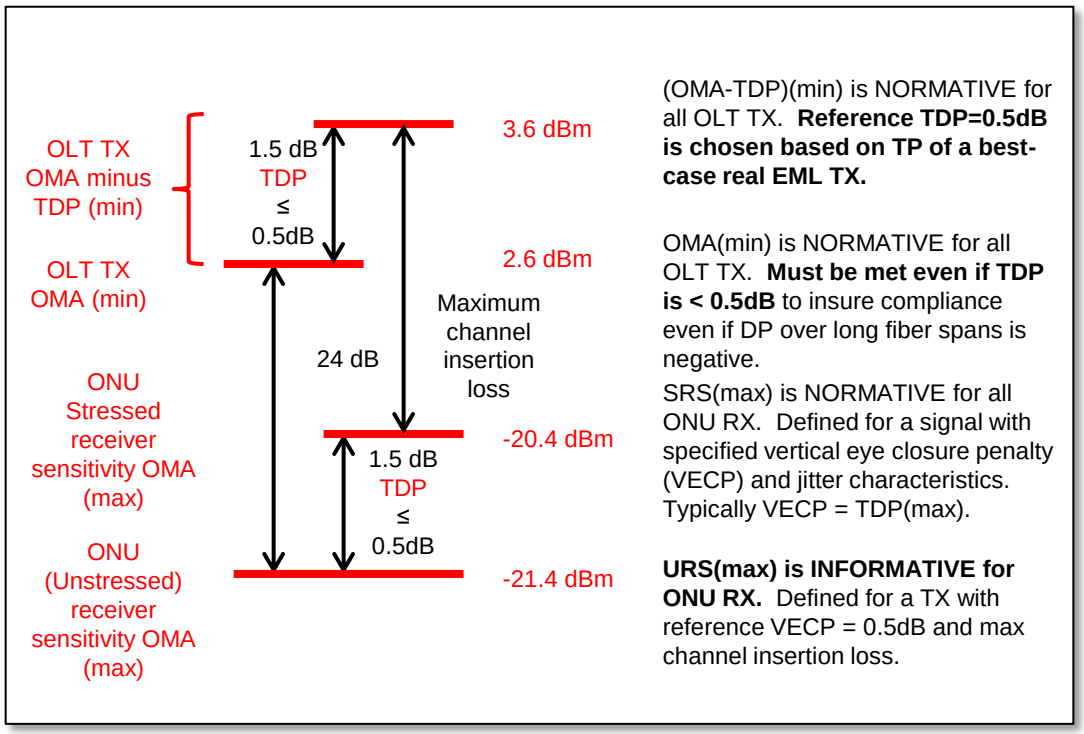
For: 23 Against: 0 Abstain: 0

Technical (≥75%) Motion Passed

Values in red represent the corrections in harstead_3ca_1_0718.pdf.

DS Tx power minus penalties

Power minus penalties spec method, PR20 DS



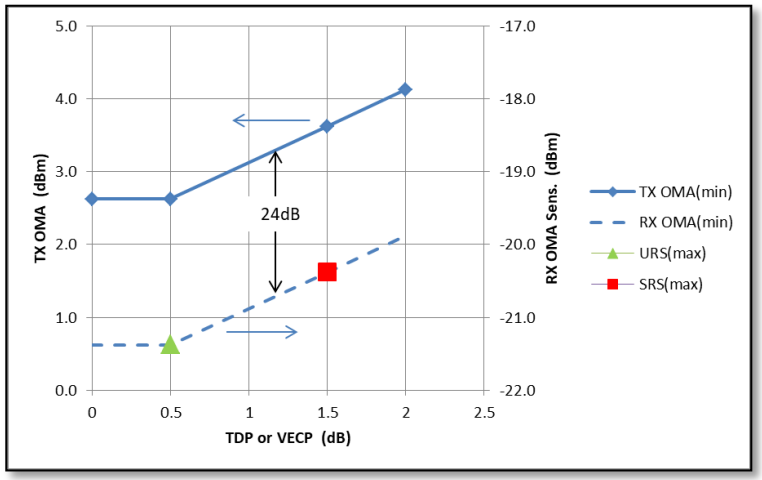
(OMA-TDP)(min) is NORMATIVE for all OLT TX. **Reference TDP=0.5dB is chosen based on TP of a best-case real EML TX.**

OMA(min) is NORMATIVE for all OLT TX. **Must be met even if TDP is < 0.5dB** to insure compliance even if DP over long fiber spans is negative.

SRS(max) is NORMATIVE for all ONU RX. Defined for a signal with specified vertical eye closure penalty (VECP) and jitter characteristics. Typically VECP = TDP(max).

URS(max) is INFORMATIVE for ONU RX. Defined for a TX with reference VECP = 0.5dB and max channel insertion loss.

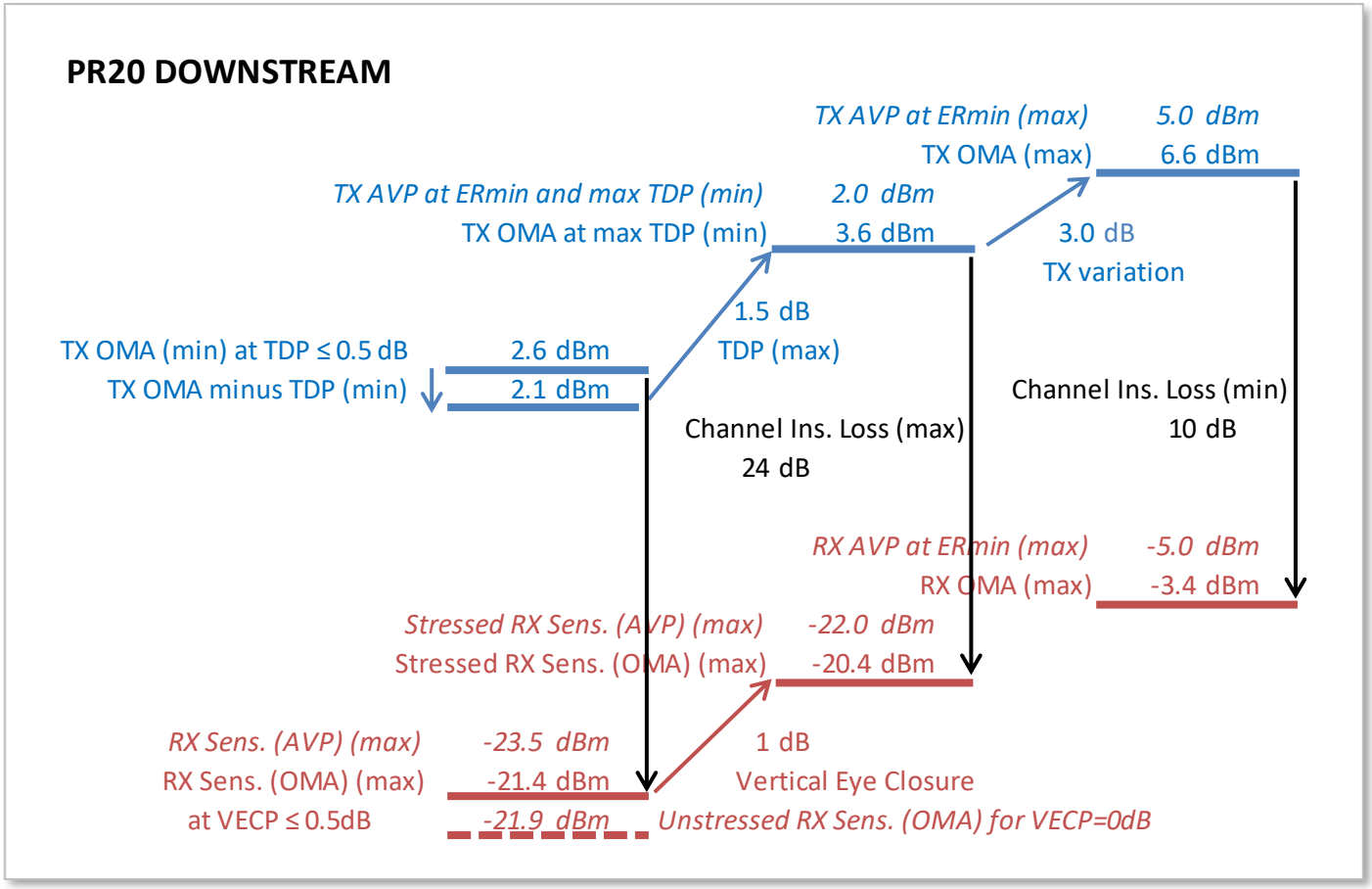
PR20 DS OMA vs. TDP (VECP)



- OLT TX OMA(min) depends on TDP
  - TX with TDP ≤ 0.5dB only needs 2.6dBm
  - Worst case TX (TDP = 1.5dB) must launch 3.6 dBm
- Assumes real-world EML TX have TP ≥ 0.5dB
  - All OLT TX must launch OMA ≥ 2.6dBm
  - URS OMA(max) = -21.4dBm at VECP = 0.5dB
- Stressed ONU receiver sensitivity is defined for worst case TX with VECP = 2dB
  - SRS OMA(max) = -20.4dBm

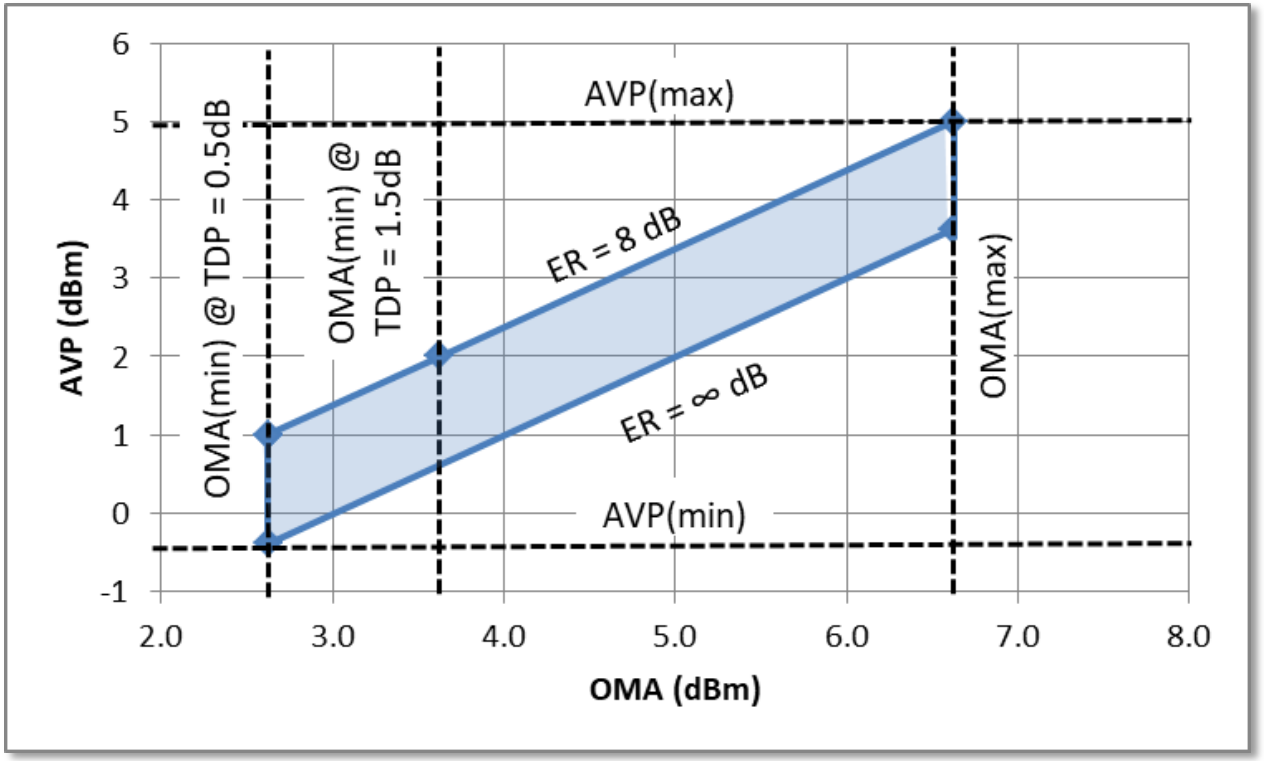
The conversion of the AVP-based PR20 downstream power budget to the OMA minus TDP method is analogous to the analysis shown in johnson_3ca_1a_0318 for PR30 downstream.

PR20 DS power budget - expanded



The values from May Motion #9 as corrected in harstead_3ca_1_0718 are converted to the OMA minus TDP spec method in the same was as was done for PR30 downstream in johnson_3ca_1_0518.

OLT TX AVP, OMA and ER



- The foregoing analysis uses OMA at the minimum extinction ratio ER = 8 dB.
- Maximum Average Power (AVP) is proposed based on ER = 8dB at the value of maximum OMA, giving 5.0 dBm maximum.
- All OLT TX must have both OMA > 2.6 dBm and AVP > 0.5 dBm.

OLT Transmit Characteristics

Table 141-7 — OLT PR20 PMD Transmit Characteristics

Description	25/10GBASE-PQ11G-D2 25/10GBASE-PQ11X-D2 25GBASE-PQ11G-D2 25GBASE-PQ11X-D2	50/10GBASE-PQ21G-D2 50/10GBASE-PQ21X-D2 50/25GBASE-PQ21G-D2 50/25GBASE-PQ21X-D2 50GBASE-PQ22X-D2 50GBASE-PQ22G-D2	Unit
Signaling speed (range)	25.78125 ± 100 ppm		GBd
Channel wavelengths (range)	1356 to 1360	1356 to 1360 1340 to 1344	nm
Side Mode Suppression Ratio (min)	30		dB
Total average launch power (max)	–	8	dBm
Average launch power, each channel (max)	5		dBm
Optical Modulation Amplitude (OMA), each channel (min) [a]	2.6		dBm
Difference in launch power between any two channels (OMA) (max)	–	3	dB
Launch power in OMA minus TDP, each channel (min) [b]	2.1		dBm
Transmitter and dispersion penalty (TDP), each channel (max)	1.5		dB
Average launch power of OFF transmitter, each channel (max)	TBD		dBm
Extinction ratio (min)	8		dB
$RIN_{15}OMA$ (max)	TBD		dB/Hz
Optical return loss tolerance (max)	TBD		dB
Transmitter reflectance [c] (max)	TBD		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	TBD		UI
Decision timing offset for transmitter and dispersion penalty	TBD		UI

[a] Even if the TDP < 0.5 dB, the OMA (min) must exceed this value.

[b] For reference, this implies that the minimum average launch power per channel at minimum extinction ratio and maximum TDP is 2 dBm. This value is informative only.

[c] Transmitter reflectance is defined looking into the transmitter.

ONU Receive Characteristics

Table 141-13 — ONU PR20 PMD Receive Characteristics

Description	25/10GBASE-PQ11G-U2 25/10GBASE-PQ11X-U2 25GBASE-PQ11G-U2 25GBASE-PQ11X-U2	50/10GBASE-PQ21G-U2 50/10GBASE-PQ21X-U2 50/25GBASE-PQ21G-U2 50/25GBASE-PQ21X-U2 50GBASE-PQ22X-U2 50GBASE-PQ22G-U2	Unit
Signaling speed (range)	25.78125 ± 100 ppm		GBd
Channel wavelengths (range)	1356 to 1360	1356 to 1360 1340 to 1344	nm
Bit error ratio (max) [a]	10^{-2}		-
Damage threshold [b]	-4		dBm
Average receive power, each channel (max)	-5		dBm
Receiver reflectance (max)	TBD		dB
Receiver sensitivity (OMA), each channel [c] (max)	-21.4		dBm
Signal detect threshold, each channel (min)	TBD		dBm
Stressed receiver sensitivity (OMA), each channel [d] (max)	-20.4		dBm
Conditions of stressed receiver sensitivity test:			
Vertical eye closure penalty,[e] each channel	1.5		dB
Stressed eye J2 Jitter,e each channel	TBD		UI
Stressed eye J9 Jitter,[e] each channel	TDB		UI

[a] The BER of 10^{-12} is achieved by the utilization of FEC as described in 142.2.3.4.

[b] The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. Direct ONU–OLT connection may result in damage of the receiver.

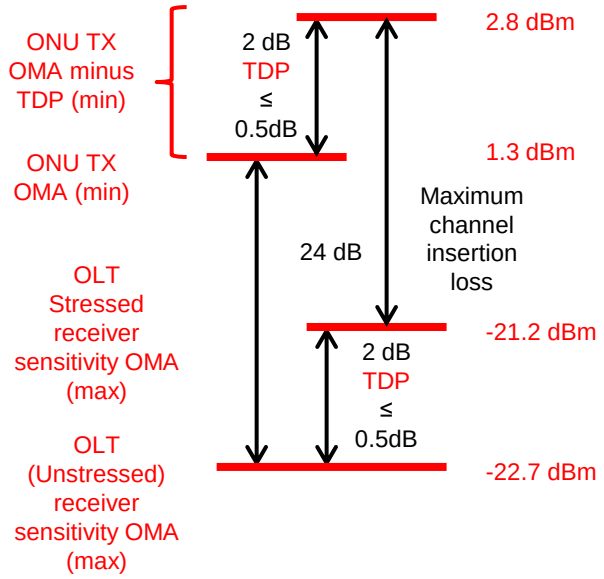
[c] Receiver sensitivity (OMA), each channel (max) is informative and is defined for a transmitter with VECP = 0.5 dB. For reference, this implies that the maximum average power unstressed receiver sensitivity measured with an ideal transmitter signal at minimum extinction ratio is -23.5 dBm. This value is informative only.

[d] Measured with conformance test signal at TP3 (see 141.7.11) for BER = 10^{-2}.

[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.

US Tx power minus penalties

Power minus penalties spec method, PR20 US



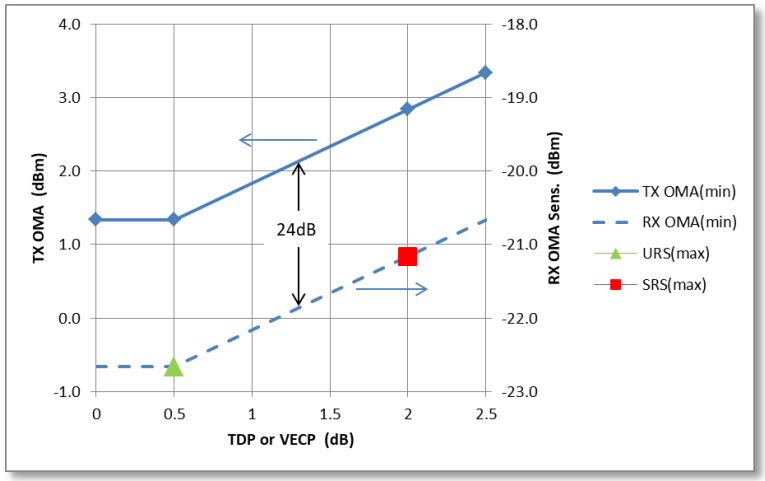
(OMA-TDP)(min) is NORMATIVE for all ONU TX. **Reference TDP=0.5dB is chosen based on TP of a best-case real EML TX.**

OMA(min) is NORMATIVE for all ONU TX. **Must be met even if TDP is < 0.5dB** to insure compliance even if DP over long fiber spans is negative.

SRS(max) is NORMATIVE for all OLT RX. Defined for a signal with specified vertical eye closure penalty (VECP) and jitter characteristics. Typically VECP = TDP(max).

URS(max) is INFORMATIVE for OLT RX. Defined for a TX with reference VECP = 0.5dB and max channel insertion loss.

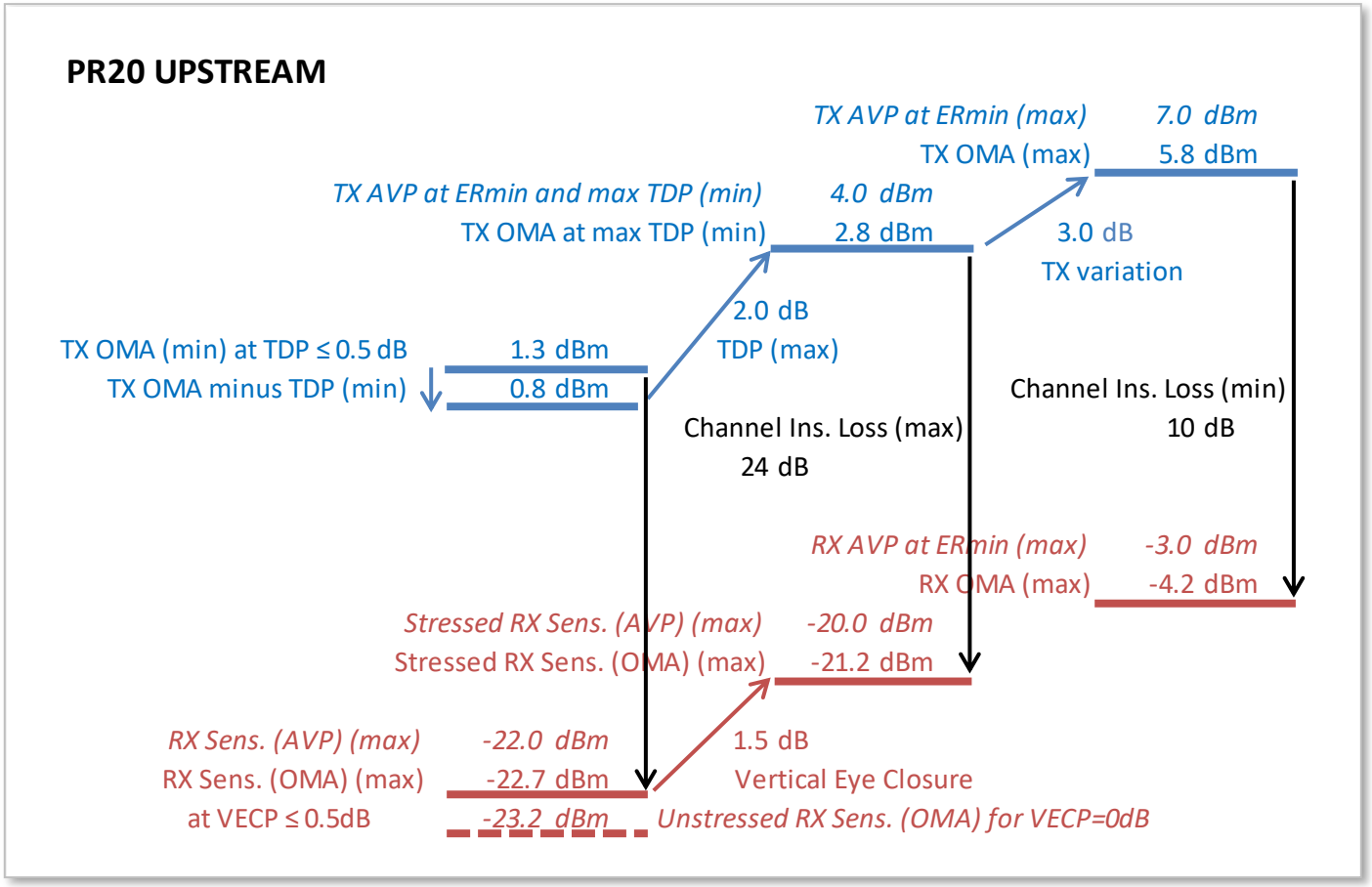
PR20 US OMA vs. TDP (VECP)



- ONU TX OMA(min) depends on TDP
  - TX with TDP ≤ 0.5dB only needs 1.3dBm
  - Worst case TX (TDP = 2dB) must launch 2.8 dBm
- Assumes real-world DML TX have TP ≥ 0.5dB
  - All ONU TX must launch OMA ≥ 1.3dBm
  - URS OMA(max) = -22.7dBm at VECP = 0.5dB
- Stressed OLT receiver sensitivity is defined for worst case TX with VECP = 2dB
  - SRS OMA(max) = -21.2dBm

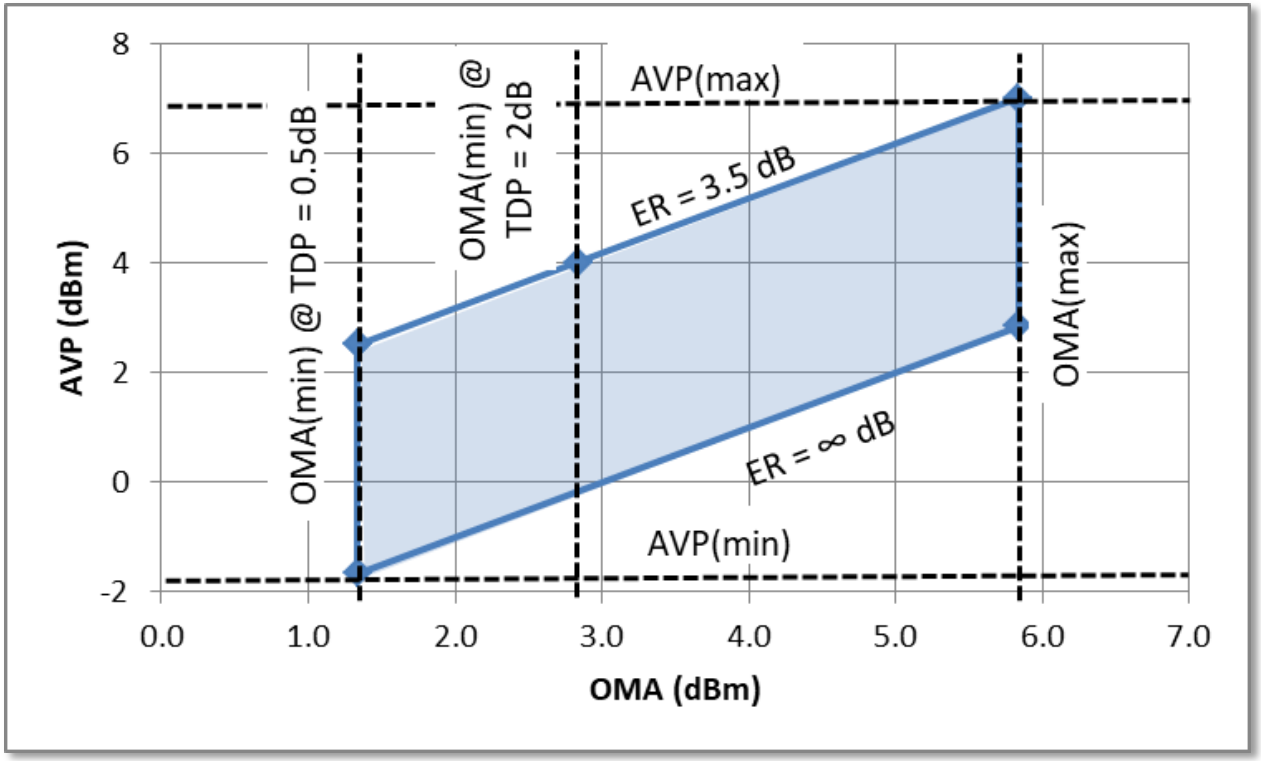
The conversion of the AVP-based PR20 upstream power budget to the OMA minus TDP method is analogous to the analysis shown in johnson_3ca_1a_0318 for PR30 upstream.

PR30 US power budget - expanded



The values from May Motion #9 are converted to the OMA minus TDP spec method in the same was as was done for PR30 upstream in johnson_3ca_1_0518.

ONU TX AVP, OMA and ER



- The foregoing analysis uses OMA at the minimum extinction ratio ER = 3.5 dB.
- Maximum Average Power (AVP) is proposed based on ER = 3.5 dB at the value of maximum OMA, giving 7 dBm maximum.
- All ONU TX must have both OMA > 1.3 dBm and AVP > -0.8 dBm.

ONU Transmit Characteristics

Table 141-11 — ONU PR20 PMD Transmit Characteristics

Description	25GBASE-PQ11G-U2 50/25GBASE-PQ21G-U2	25GBASE-PQ11X-U2 50/25GBASE-PQ21X-U2	50/25GBASE-PQ21G-U2 50GBASE-PQ22G-U2	50/25GBASE-PQ21X-U2 50GBASE-PQ22X-U2	Unit
Signaling speed (range)	25.78125 ± 100 ppm				GBd
Channel wavelengths (range)	1260 to 1280	1290 to 1310	1260 to 1280 1290 to 1310	1290 to 1310 1318 to 1322	nm
Side Mode Suppression Ratio (min)	30				dB
Total average launch power (max)	–		10		dBm
Average launch power, each channel (max)	7				dBm
Optical Modulation Amplitude (OMA), each channel (min) [a]	1.3				dBm
Difference in launch power between any two channels (OMA) (max)	–		3		dB
Launch power in OMA minus TDP, each channel (min) [b]	0.8				dBm
Transmitter and dispersion penalty (TDP), each channel (max)	2				dB
Average launch power of OFF transmitter, each channel (max)	TBD				dBm
Extinction ratio (min)	3.5				dB
$RIN_{15}OMA$ (max)	TBD				dB/Hz
Optical return loss tolerance (max)	TBD				dB
Transmitter reflectance [c] (max)	TBD				dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	TBD				UI
Turn-on time (max)	128				ns
Turn off time (max)	128				ns
Decision timing offset for transmitter and dispersion penalty	TBD				UI

[a] Even if the TDP < 0.5 dB, the OMA (min) must exceed this value.

[b] For reference, this implies that the minimum average launch power per channel at minimum extinction ratio and maximum TDP is 4 dBm. This value is informative only.

[c] Transmitter reflectance is defined looking into the transmitter.

OLT Receive Characteristics

Table 141-9 — OLT PR20 PMD Receive Characteristics

Description	25GBASE-PQ11G-D2 50/25GBASE-PQ21G-D2	25GBASE-PQ11X-D2 50/25GBASE-PQ21X-D2	50/25GBASE-PQ21G-D2 50GBASE-PQ22G-D2	50/25GBASE-PQ21X-D2 50GBASE-PQ22X-D2	Unit
Signaling speed (range)	25.78125 ± 100 ppm				GBd
Channel wavelengths (range)	1260 to 1280	1290 to 1310	1260 to 1280 1290 to 1310	1290 to 1310 1318 to 1322	nm
Bit error ratio (max) [a]	10^{-2}				-
Damage threshold [b]	-2				dBm
Average receive power, each channel (max)	-3				dBm
Receiver reflectance (max)	TBD				dB
Receiver sensitivity (OMA), each channel [c] (max)	-22.7				dBm
Signal detect threshold, each channel (min)	TBD				dBm
Stressed receiver sensitivity (OMA), each channel [d] (max)	-21.2				dBm
Receiver settling time (max)	TBD				ns
Conditions of stressed receiver sensitivity test:					
Vertical eye closure penalty,[e] each channel	2				dB
Stressed eye J2 Jitter,[e] each channel	TBD				UI
Stressed eye J9 Jitter,[e] each channel	TBD				UI

[a] The BER of 10^{-12} is achieved by the utilization of FEC as described in 142.2.3.4.

[b] The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. Direct ONU–OLT connection may result in damage of the receiver.

[c] Receiver sensitivity (OMA), each channel (max) is informative and is defined for a transmitter with VECP = 0.5 dB. For reference, this implies that the maximum average power unstressed receiver sensitivity measured with an ideal transmitter signal at minimum extinction ratio is -22 dBm. This value is informative only.

[d] Measured with conformance test signal at TP3 (see 141.7.11) for BER = 10^{-2}.

[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.

Summary

- Consensus was reached at the May 2018 meeting on the PR20 25G-EPON power budgets for upstream and downstream.
  - The 0.5dB correction for BOSA loss in the downstream power budget described in (harstead_3ca_1_0178) is assumed to be accepted at the July meeting.
- It is further proposed that the same PR20 power budgets be applied to both 25G-EPON and 50G-EPON.
  - The arguments for this are identical to the arguments that were given for PR30 in johnson_3ca_2_0518.
- It is recommended that the PR20 PMD tables and footnotes illustrated in this contribution on slides 8, 9, 13 and 14 be accepted by the Task Force for inclusion in P802.3ca draft D1.2 in support of comments by the author against D1.1.