

Security Level:

# 25G upstream power budget analysis – cooled or uncooled?

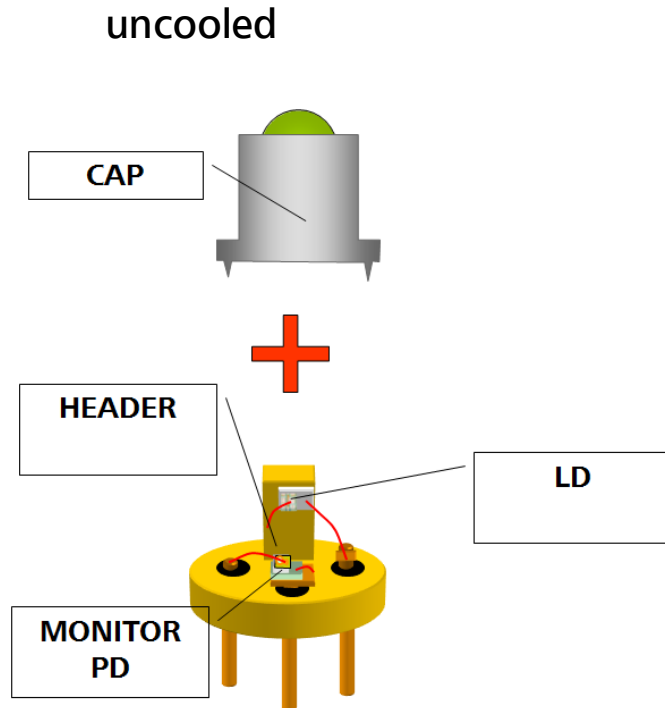
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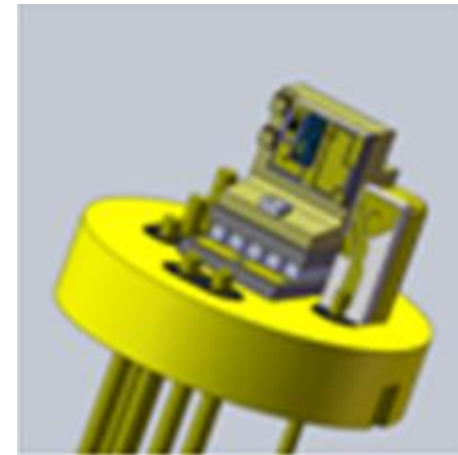
# Background

- 2017 January , -24.2dBm@1E-3 receiver sensitivity based on 25G EML(cooled) &ER=8dB was adopted as the starting point for 25Gb/s PON downstream.
- For 25G PON upstream, the power budget is more challenging due to the burst mode penalty and poorer eye diagram quality of DML laser .
- There is still no agreement if 25G ONU should be cooled or uncooled.
- This contribution analyzes the difference between uncooled/cooled device and the PMD specs for 25G upstream link.

# Uncooled vs cooled transmitter



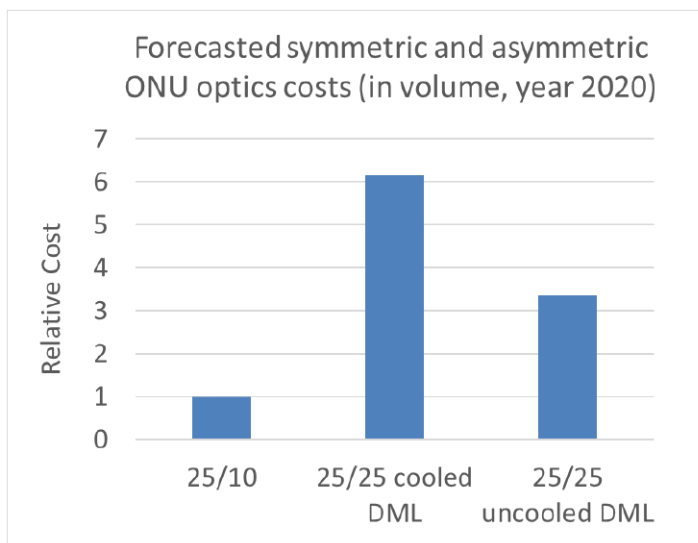
cooled



- Cooled devices need more complicated Header, more complicated package process.
- Besides the BOM cost of TEC, driver, thermistor, the package cost of cooled device is much higher than uncooled device.

# Cooled/uncooled Cost difference

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Type(10G)	DML	Cooled DML, 5nm	Cooled DML, 2nm	EML
Cost	1X	1.5X	2.5X	5.5X



- Cooled 25G DML will increase the cost by at least 50% compared with uncooled DML

# 10G PR30 OLT module sensitivity

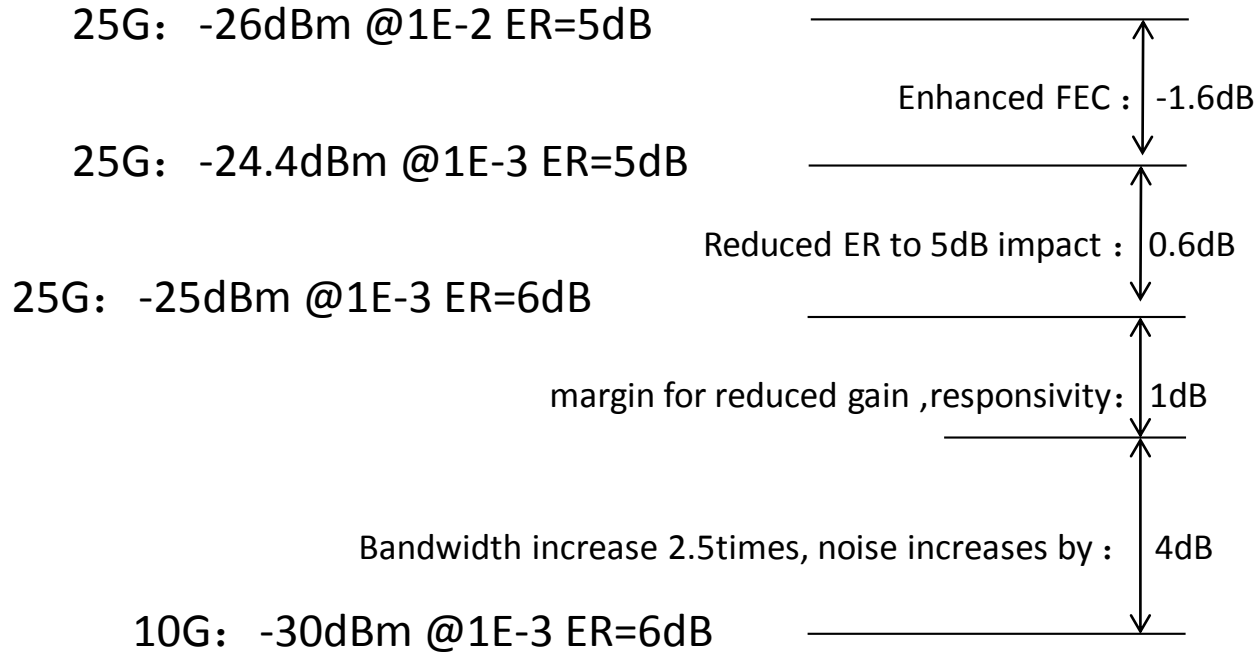
10G EPON OLT module sensitivity based on random example from two vendors

Surounding Temperature	Vendor A		Vendor B	
	10G EPON OLT module SN	Sensitivty@10G based on mutiple ONUs (dBm)	10G EPON OLT module SN	Sensitivty@10G based on mutiple ONUs (dBm)
25°C	XXX038	-31.26	xxx066	-29.61
	XXX028	-31.29	xxx313	-30.16
	XXX042	-31.46	xxx310	-31.03
	XXX054	-31.26	xxx312	-30.32
	XXX040	-30.96	xxx329	-30.10
	XXX003	-31.64	xxx256	-29.48
	XXX004	-32.69	xxx057	-30.35
	XXX001	-30.62		
	XXX002	-31.45		
	XXX005	-31.22		
65°C	XXX038	-30.95	xxx066	-29.32
	XXX028	-30.88	xxx313	-29.87
	XXX042	-31.65	xxx310	-30.34
	XXX054	-30.95	xxx312	-29.53
	XXX040	-30.95	xxx329	-29.51
	XXX003	-31.53	xxx256	-28.79
	XXX004	-32.18	xxx057	-29.66
	XXX001	-30.53		
	XXX002	-31.16		
	XXX005	-31.23		

Note: all the sensitivity are tested based really ONU transmitters without packet loss

- 30dBm@1E-3 at burst mode is feasible for 10G APD based on the test data from several module vendors. Some further improvement in future is still possible.

# 25G OLT sensitivity

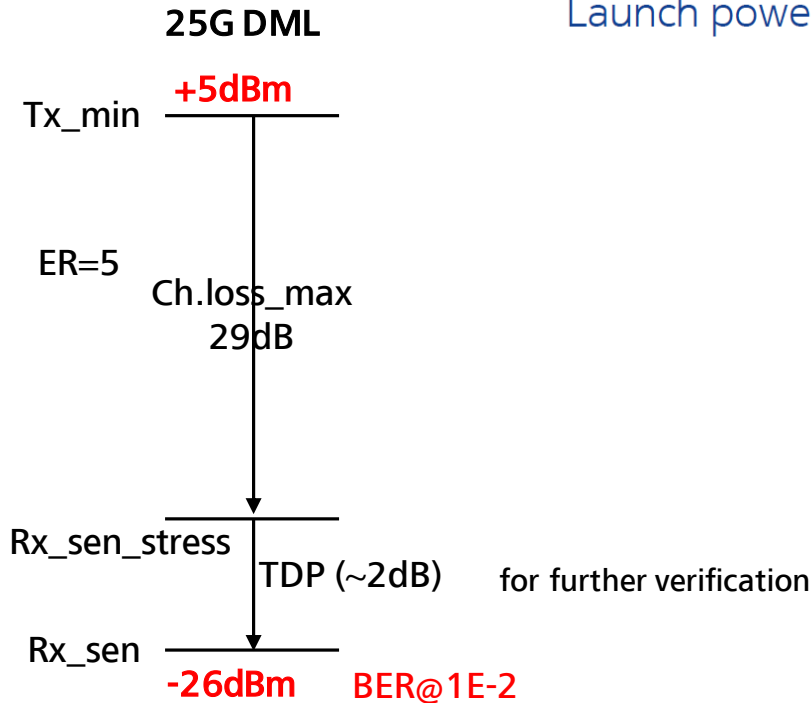


-25dBm@1E-2 based on ER=5dB is feasible for 25G APD based on the iteration from 10G.

# 25G upstream power budget analysis

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Launch power and ER: responses



AVPmin (dBm)	number	mean	$\sigma$
EML	6	4.6	0.7
EML+SOA	3	8.7	2.0
cooled DML	6	6.5	0.5
uncooled DML	5	4.7	1.0

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	25G EML		25G cooled DML		25G uncooled DML	
	Power (dBm)	ER (dB)	Power (dBm)	ER (dB)	Power (dBm)	ER (dB)
vendor 1	3~4	8	7	4.5	5~6	4.5
vendor 2	3	8	5	5	4	4
vendor 3	4	6	4	4	xx	xx
vendor 4	2.5	8	5.8	4	xx	xx
vendor 5	4.3	8	5.5	4.5	4	4
vendor 6	4.5	8	6	5	4	4

5dBm launch power is feasible for both cooled and uncooled DML

# Summary

- The cooled DML has distinct extra cost over uncooled DML.
- Uncooled DML is feasible for 25G upstream to meet the 29dB power budget
- +5dBm is recommended as the launch power for 25G ONU



**Thank you**

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