

# 10GEPON Power Budget Vendor Summary in Japan

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\*Sorted by company name in alphabetic order

- Discussions
  1. Basic Considerations
  2. Additional loss and penalty
  3. PX10 U/S 1G/10G Dual-mode RX
  4. FEC
- Power Budget Table
- Summary

# Basic Considerations

## ITU-T formalism

based on the Tx/Rx specs. on 3av\_0703\_takizawa\_1.pdf

**PIN vs APD (ONU-Rx)** : Vendor opinions **clearly divided**

**EML option (ONU-Tx)** : **No vendor** supports

**Path Penalty (D/S)** : **1dB** suggested with EML up to 20km  
(2dB in ITU-T spec. at C-band, up to 80 km)

**OLT Overload (U/S)** : **-5 to -6dBm** suggested for APD-Rx

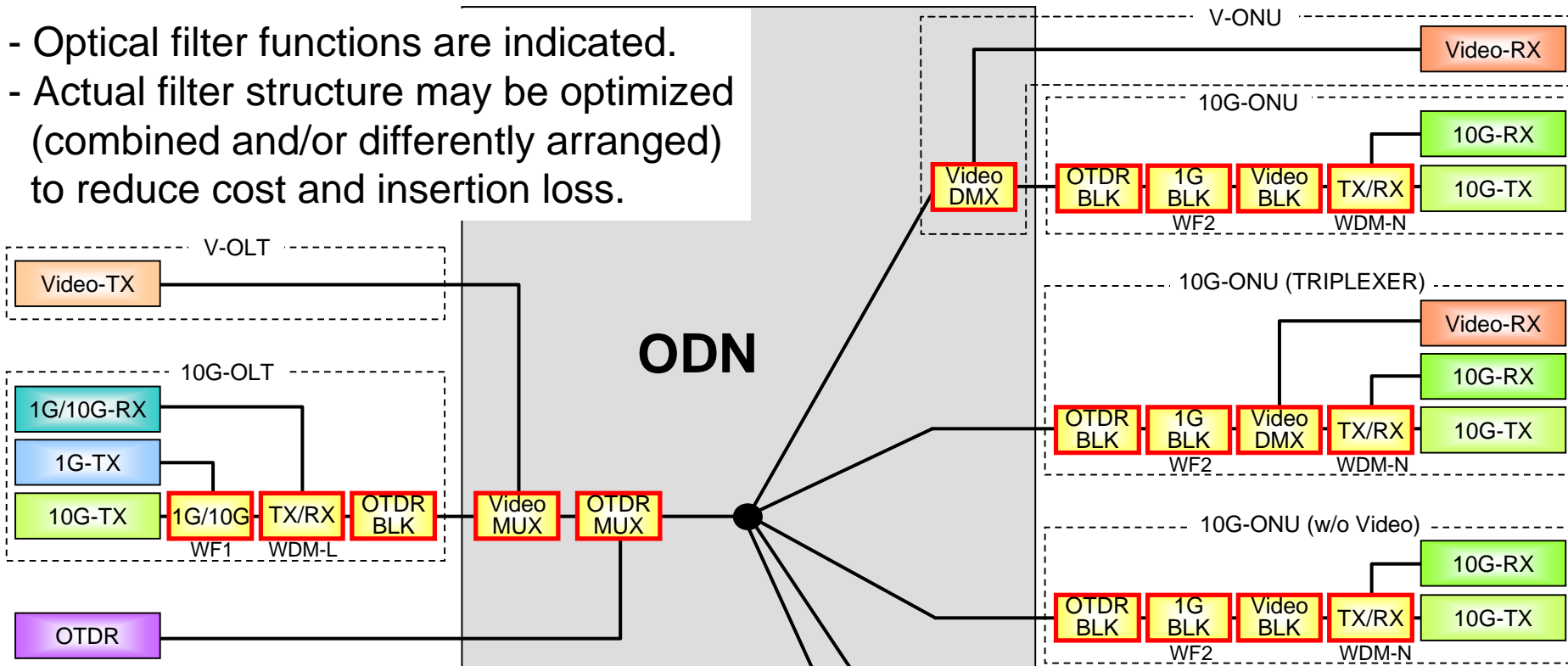
- Burst-mode may degrade APD overload to around -10dBm
- ONU launch stabilization may relax the situation,  
sacrificing the possibility of future uncooled DFB
- Measured data necessary for further discussion

# Additional Loss and Penalty

OLT-Tx	WDM(1G/10G) Filter Loss WDM(U/D) Filter Loss
OLT-Rx	WDM(U/D) Filter Loss WDM Crosstalk Penalty Burst-mode RX Penalty Dual-mode RX Penalty

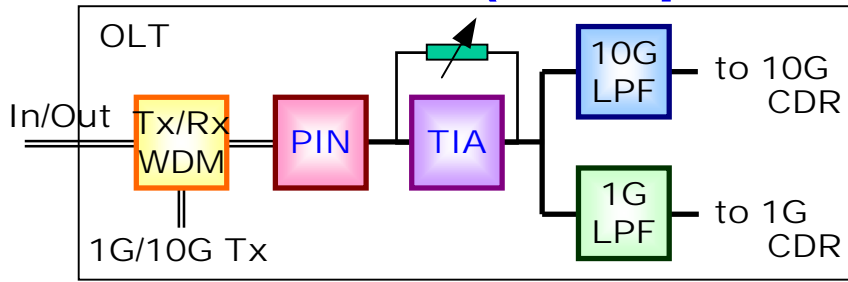
ONU-Tx	WDM(U/D) Filter Loss
ONU-Rx	WDM(U/D) Filter Loss WDM(Video Blocking) Filter Loss WDM Crosstalk Penalty

- Optical filter functions are indicated.
- Actual filter structure may be optimized (combined and/or differently arranged) to reduce cost and insertion loss.



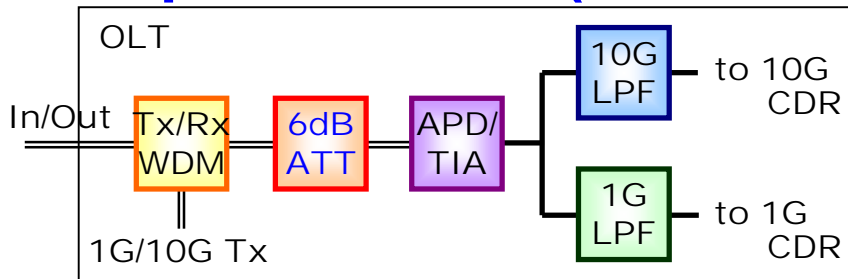
# PX10 U/S 1G/10G Dual-mode RX

## PIN serial PMD (TIA optimized)



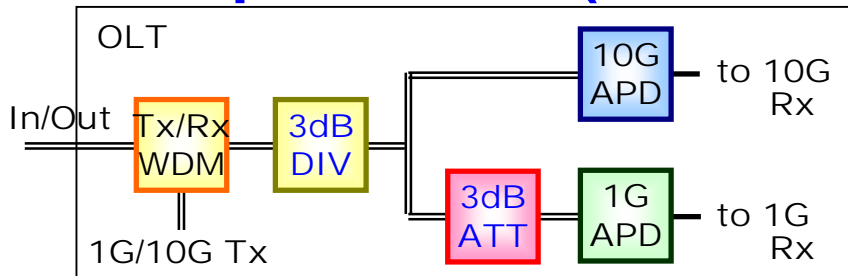
Mean power (dBm)	OLT in	APD in
1G Sensitivity	-24	
1G Overload	-1	
10G Sensitivity	-19	
10G Overload	0	
10G Launch (ONU)	+2	

## APD parallel PMD (ATT inserted)



1G Sensitivity	-24	-30
1G Overload	-1	-7
10G Sensitivity	-20	-26
10G Overload	+1	-5
10G Launch (ONU)	+1	

## APD separate Rx's (DIV inserted)



1G Sensitivity	-24	-30
1G Overload	-1	-7
10G Sensitivity	-23	-26
10G Overload	-2	-5
10G Launch (ONU)	-2	

E-FEC assumed for sensitivities

# FEC

**Standard FEC RS(255,239)** : BER  $10^{-4}$  →  $10^{-12}$

Most vendors assume **3dB** for PIN-Rx  
**4dB** for APD-Rx

**Enhanced FEC** : BER  $10^{-2}$  or  $10^{-3}$  →  $10^{-12}$

To relax the Tx power requirement,  
enhanced FEC hopefully utilized if possible

All the numbers in the budget lists are shifted by **1dB**

## E-FEC issues

- Available E-FEC codes and E-FEC gain
- Latency and Bandwidth efficiency
- Burst-mode CDR locking at the BER of  **$10^{-2}$  -  $10^{-3}$**
- Only option for B++ U/S?, or for all categories?

# 10GEPON D/S Power Budget (PIN@ONU)

$\lambda$  : 157x nm

with E-FEC / with RS(255,239) in ( )

	PX10	PX20	B++	Mean power(dBm)
CH IL (dB)	20	24	29	
Path Penalty (dB)	1	1	1	EML-Tx, <20km
Tx (OLT)	EML	EML+SOA	EML+ SOA/EDFA	
Rx (ONU)	PIN	PIN	PIN	
ER (dB)	9	9	9	
ONU Sensitivity	-20 (-19)	-20 (-19)	-20 (-19)	BER<10 <sup>-2</sup> or 10 <sup>-3</sup> (BER<10 <sup>-4</sup> )
OLT Launch (min)	+1 (+2)	+5 (+6)	+10 (+11)	
OLT Launch (max)	+4 (+5)	+8 (+9)	+13 (+14)	
ONU Overload	-1 (0)	-2 (-1)	-2 (-1)	



# 10GEPON D/S Power Budget (APD@ONU)

$\lambda$  : 157x nm

with E-FEC / with RS(255,239) in ( )

	PX10	PX20	B++	Mean power(dBm)
CH IL (dB)	20	24	29	
Path Penalty (dB)	1	1	1	EML-Tx, <20km
Tx (OLT)	EML	EML	EML	
Rx (ONU)	APD	APD	APD	
ER (dB)	9	9	9	
ONU Sensitivity	-26 (-25)	-26 (-25)	-28 (-27)	BER<10 <sup>-2</sup> or 10 <sup>-3</sup> (BER<10 <sup>-4</sup> )
OLT Launch (min)	-5 (-4)	-1 (0)	+2 (+3)	
OLT Launch (max)	-2 (-1)	+2 (+3)	+5 (+6)	
ONU Overload	-7 (-6)	-8 (-7)	-10 (-9)	

# 10GEPON U/S Power Budget

$\lambda$  : 1310 nm

with E-FEC / with RS(255,239) in ( )

	PX10	PX20	B++	Mean power(dBm)
CH IL (dB)	20	24	29	
Path Penalty (dB)	1	1	1	
Tx (ONU)	DFB	DFB	DFB	
Rx (OLT)	APD <sup>Note</sup>	APD	APD	
ER (dB)	6	6	6	
OLT Sensitivity	-20 (-19)	-26 (-25)	-26 (-25)	BER<10 <sup>-2</sup> or 10 <sup>-3</sup> (BER<10 <sup>-4</sup> )
ONU Launch (min)	+1 (+2)	-1 (0)	+4 (+5)	
ONU Launch (max)	+6 (+7)	+4 (+5)	+9 (+10)	
OLT Overload	+1 (+2)	-6 (-5)	-6 (-5)	

Note : APD parallel PMD (ATT inserted) is assumed for 1G/10G dual-mode Rx

# Summary

**10GEPON Power budget is summarized by Japanese vendors.**

**The most preferable power budget at the moment is listed, based on the current 10G transceiver technology, including all the details discussed and assumed.**

**More information, investigations and measured data are necessary for further discussions or revisions to relax Tx power requirements.**

## Issues

- High-power transmitter feasibility**
- FEC advantage and E-FEC implementation**
- OLT overload**
- Additional loss and penalty details**
- IEEE formalism**