Cost-effective 1310/1550nm Dual-wavelength P2P Gb/s PMD

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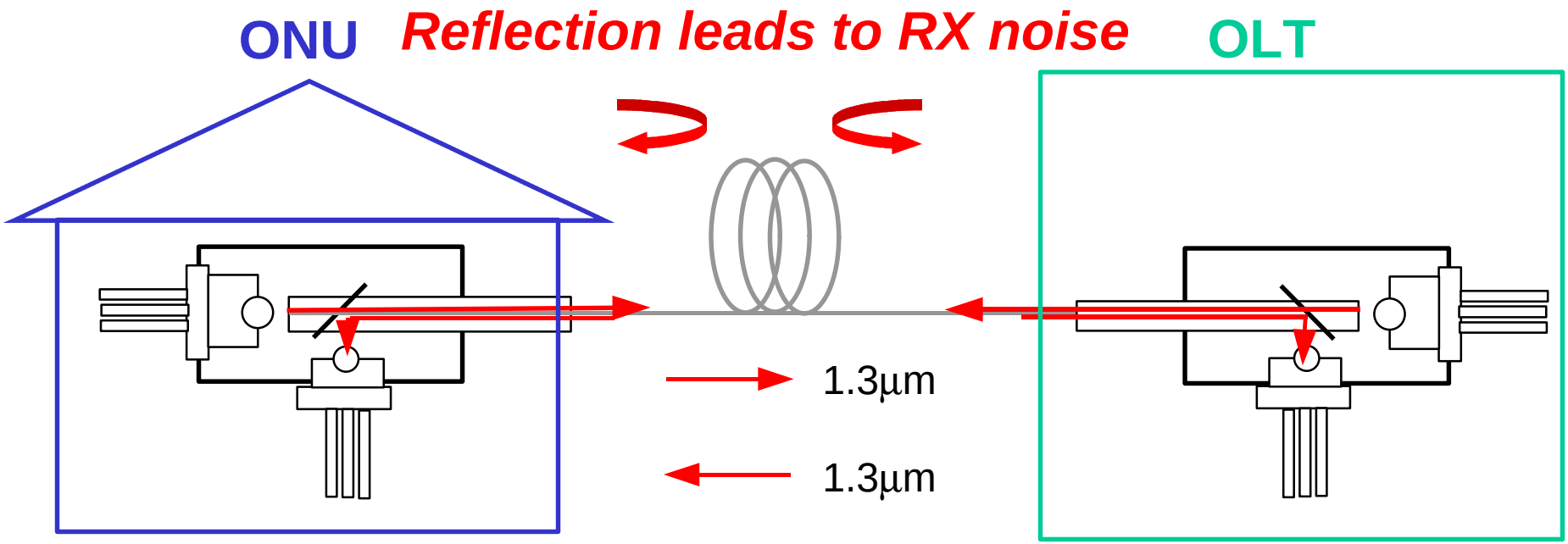
Single-wavelength vs Dual-wavelength

	1310/1310nm Single-wavelength	1310/1550nm Dual-wavelength
1. Source Laser	Uncooled 1310nm FP-LD for both directions	1310nm FP-LD at ONU 1550nm DFB at OLT (uncooled for both)
2. Link budget	Half-mirror loses 3dB or more at both ends, 7dB~ loss as a whole	Proven Thin Film Filter has little excess loss
3. Reflection	Sensitive to reflection	Immune to reflection

1310/1310nm Single-wavelength P2P

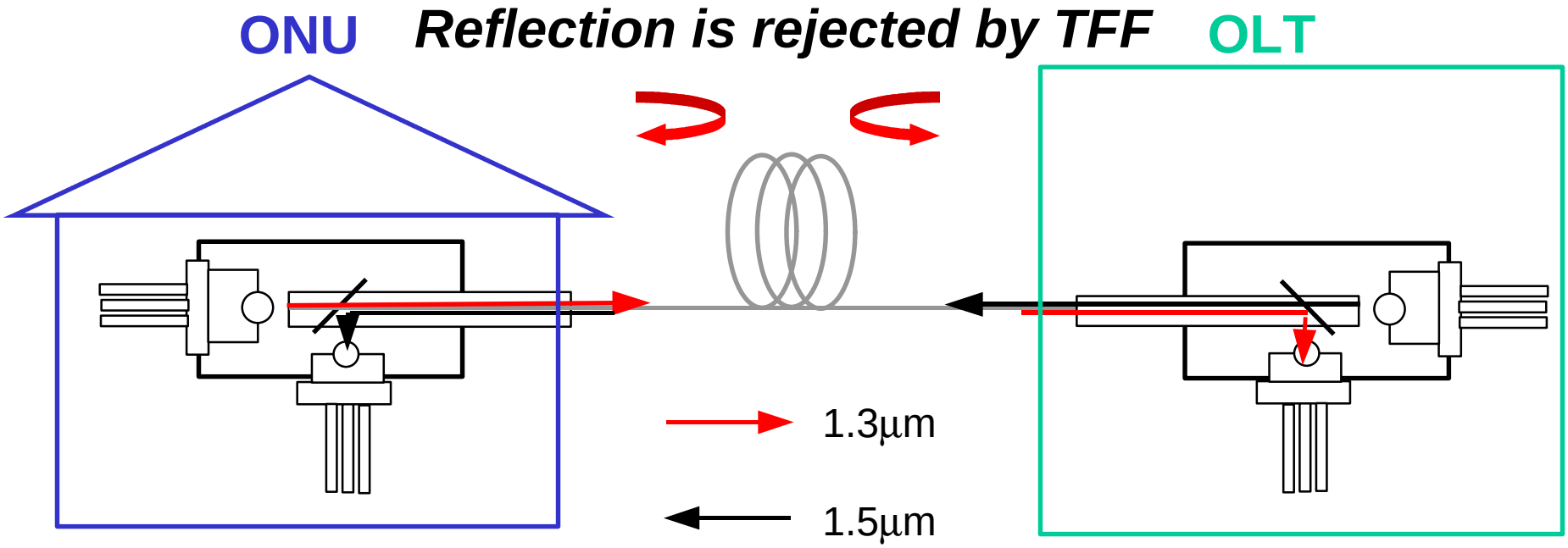


Tx: 1.3μm FP-LD 1.25Gb/s
Rx: 1.25Gb/s pin-preamp
1.3/1.3μm Half-mirror

Tx: 1.3μm FP-LD 1.25Gb/s
Rx: 1.25Gbps pin-preamp
1.3/1.3μm Half-mirror

Loses half the power at both ends

1310/1550nm Dual-wavelength P2P



Tx: 1.3μm FP-LD 1.25Gb/s
Rx: 1.25Gb/s pin-preamplifier
1.3/1.5μm TFF

Tx: 1.5μm FP-LD 1.25Gb/s
Rx: 1.25Gb/s pin-preamplifier
1.5/1.3μm TFF

Source Laser Considerations

1. Cost comparison of 1310 FP and 1550 DFB

1550 DFB is generally more expensive than 1310 FP by several dollars when the isolator is not necessary.

For Gb/s 10km transmission, uncooled FP or DFB without isolator will be good enough.

2. Link budget comparison

7dB~ half-splitting loss requires higher link budget (12dB → 19dB~ virtually) accordingly.

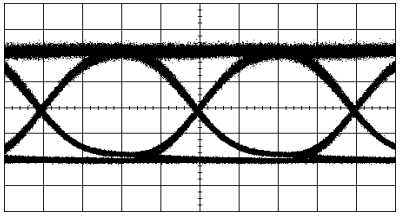
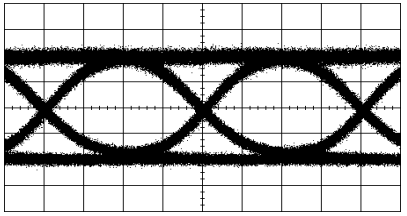
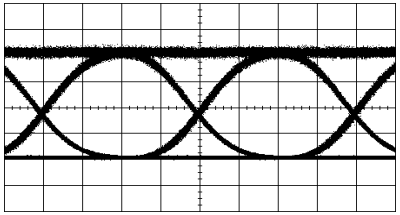
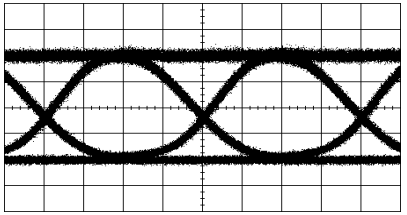
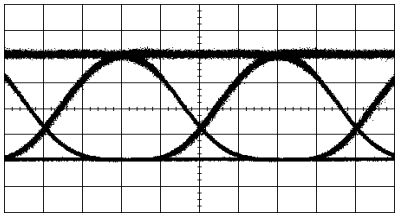
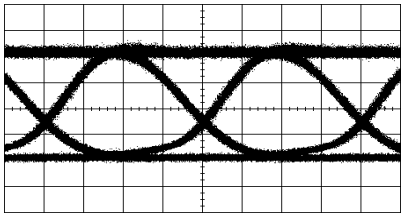
This 7dB~ extra budget leads to more expensive TX and/or RX specifications.

→ As a whole, 1550 DFB will be cheaper.

Waveform of 1.5㎜ TX w/o ISOLATOR

Un-isolated LD output waveform

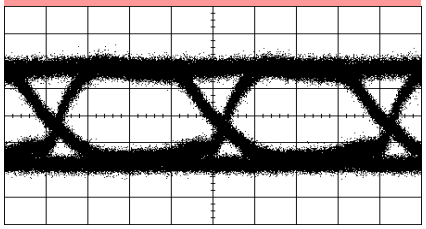
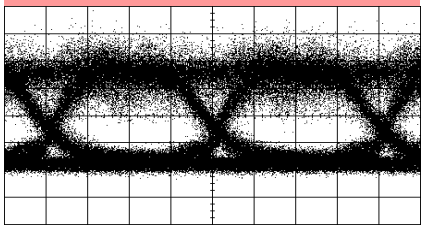
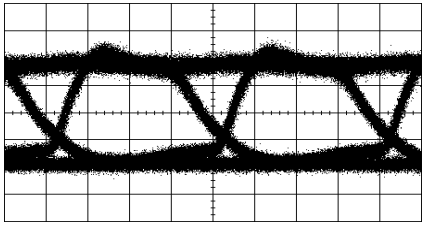
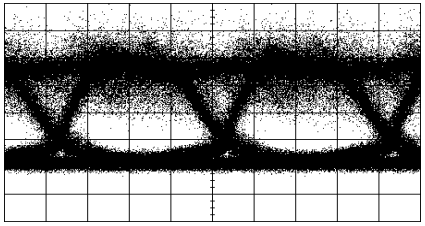
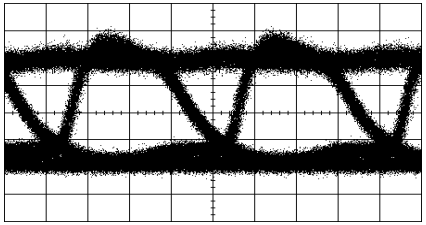
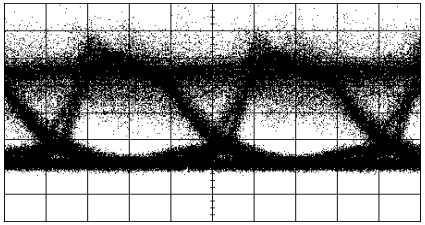
1.25Gb/s, PN7, with 4th B-T Filter

	Back to Back	After 80km Transmission
-10degC		
25degC		
70degC		

Optical Reflection Effect on TX output

w/o B-T Filter
1.25Gb/s
PN7

After 80km Transmission

	-7.7dB reflection	-7.7dB reflection
-10degC		
25degC		
70degC		
	w/ isolator	w/o isolator

Optical Reflection Effect on BER

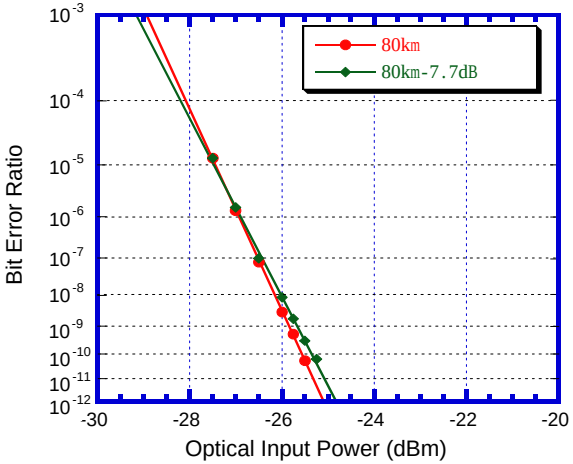
After 80km Transmission

1.25Gb/s

PN7

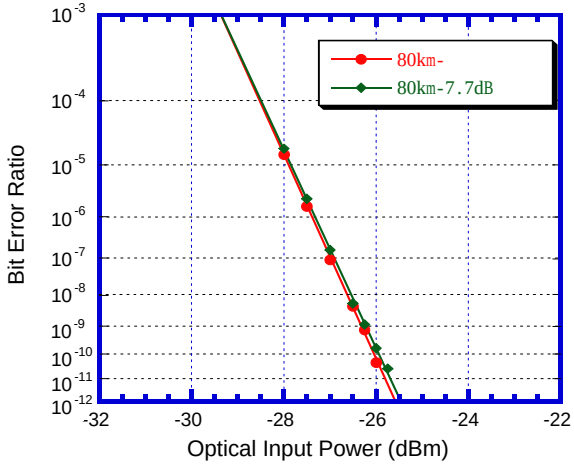
-7.7dB reflection

-10degC



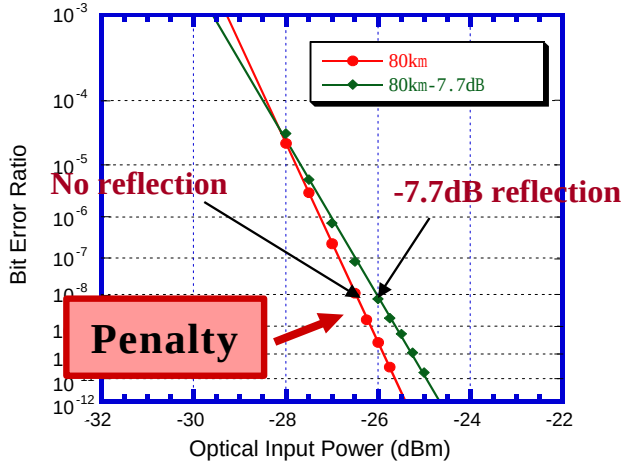
Pmin=0.22dB

25degC



Pmin=0.11dB

70degC



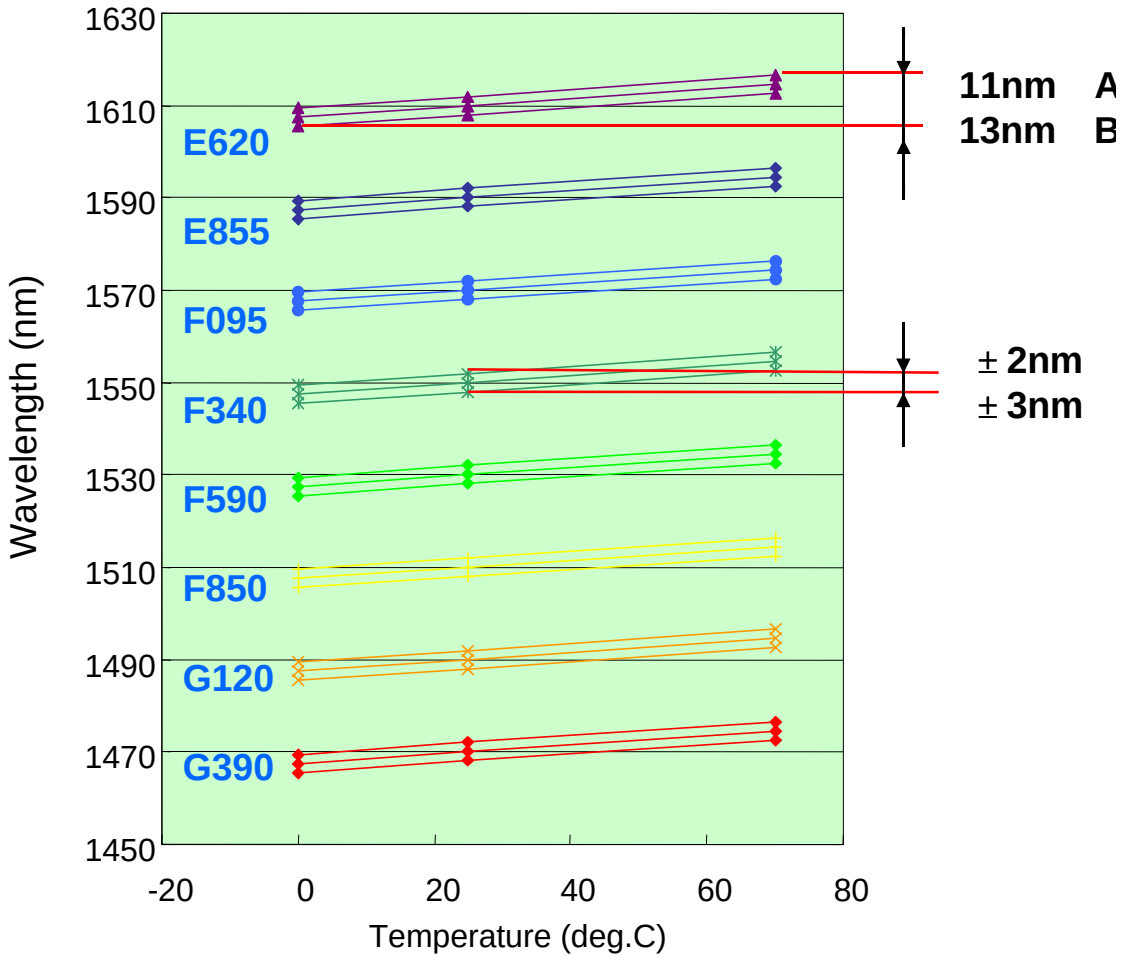
Pmin=0.62dB

Un-isolation penalty is minimal.

CWDM DFB Laser Diodes

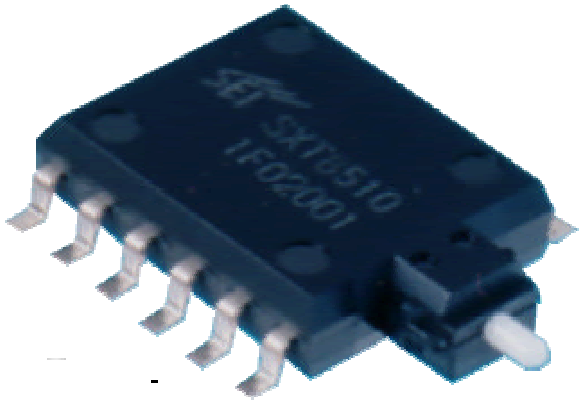
SLT44XX Series Features :

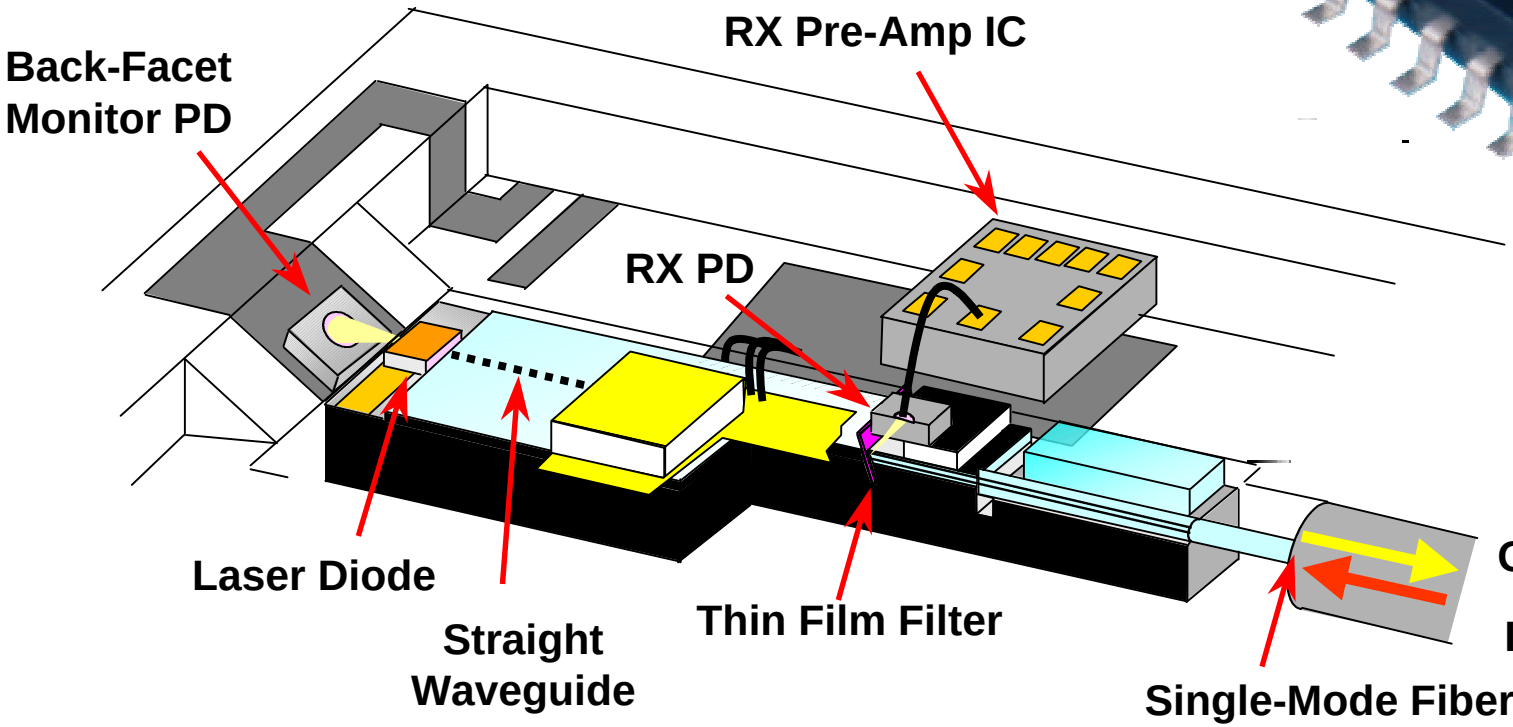
1470 1610nm (8 Colors
2.5Gb/s, LR-2 Applications
TFF MUX/DMUX)



Bi-directional Device (Waveguide-type)

TX: LD, Monitor Photodiode
RX: Photodiode, Pre-amplifier



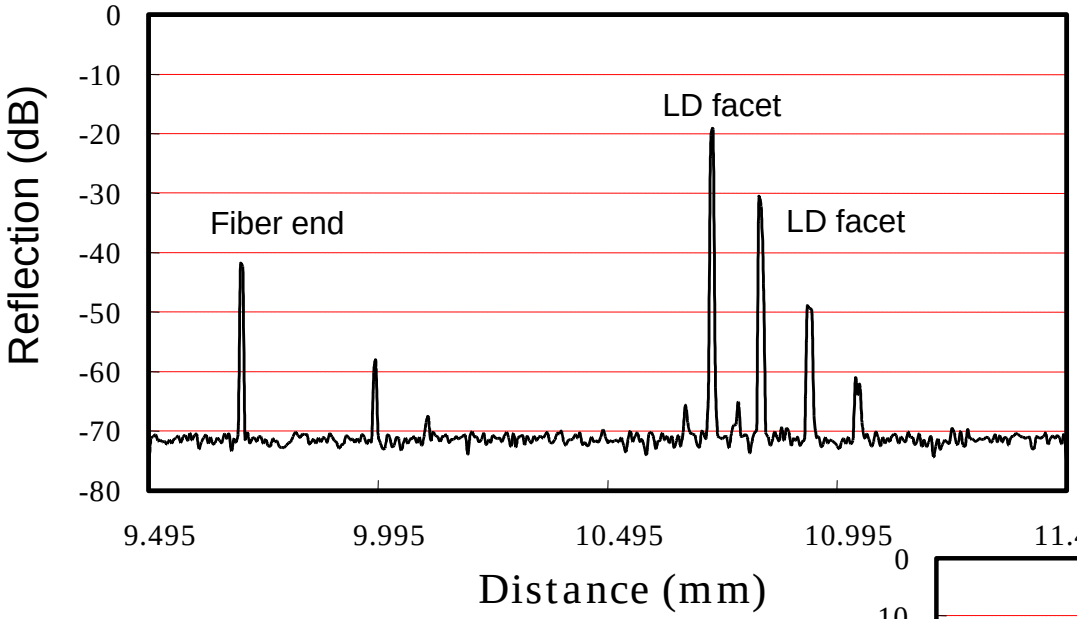


ONU OLT

Out: 1310nm / 1550nm

In: 1550nm / 1310nm

Reflection by Bi-directional device

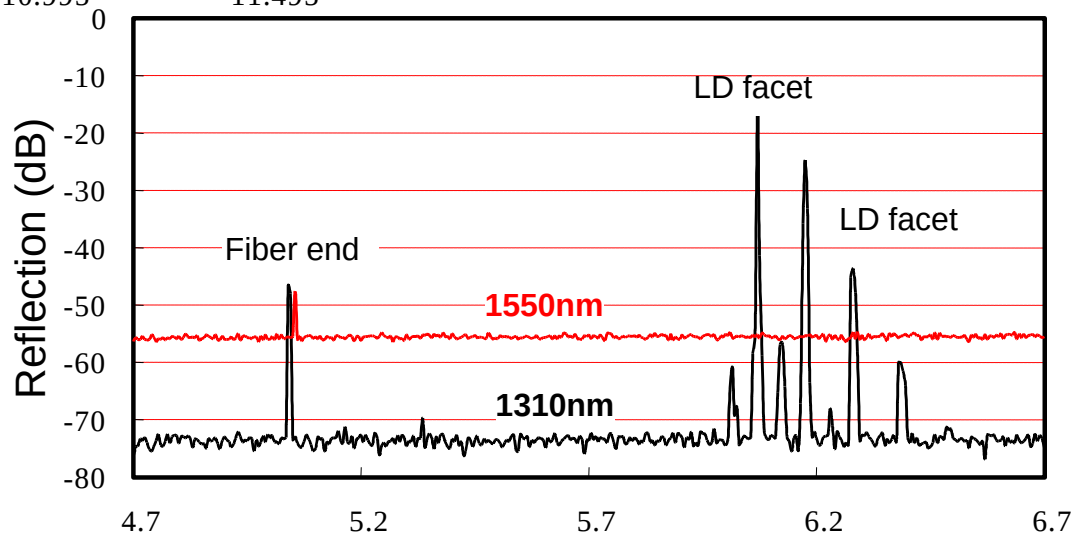


1310/1310nm

Measured at 1310nm

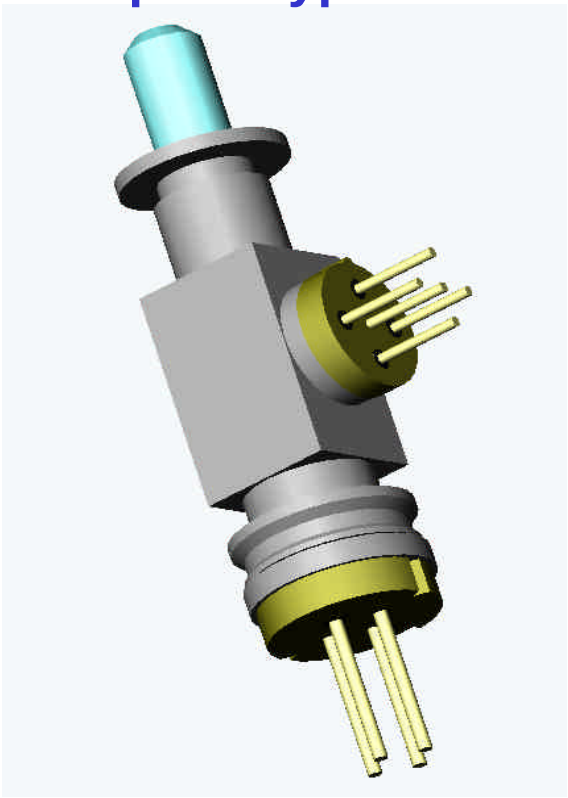
1310/1550nm

Measured at 1310nm & 1550nm



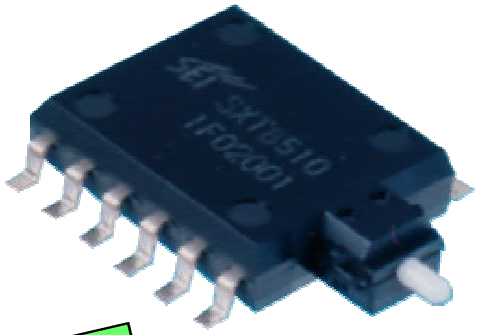
Bi-directional Transceiver module

MicroOptics-type



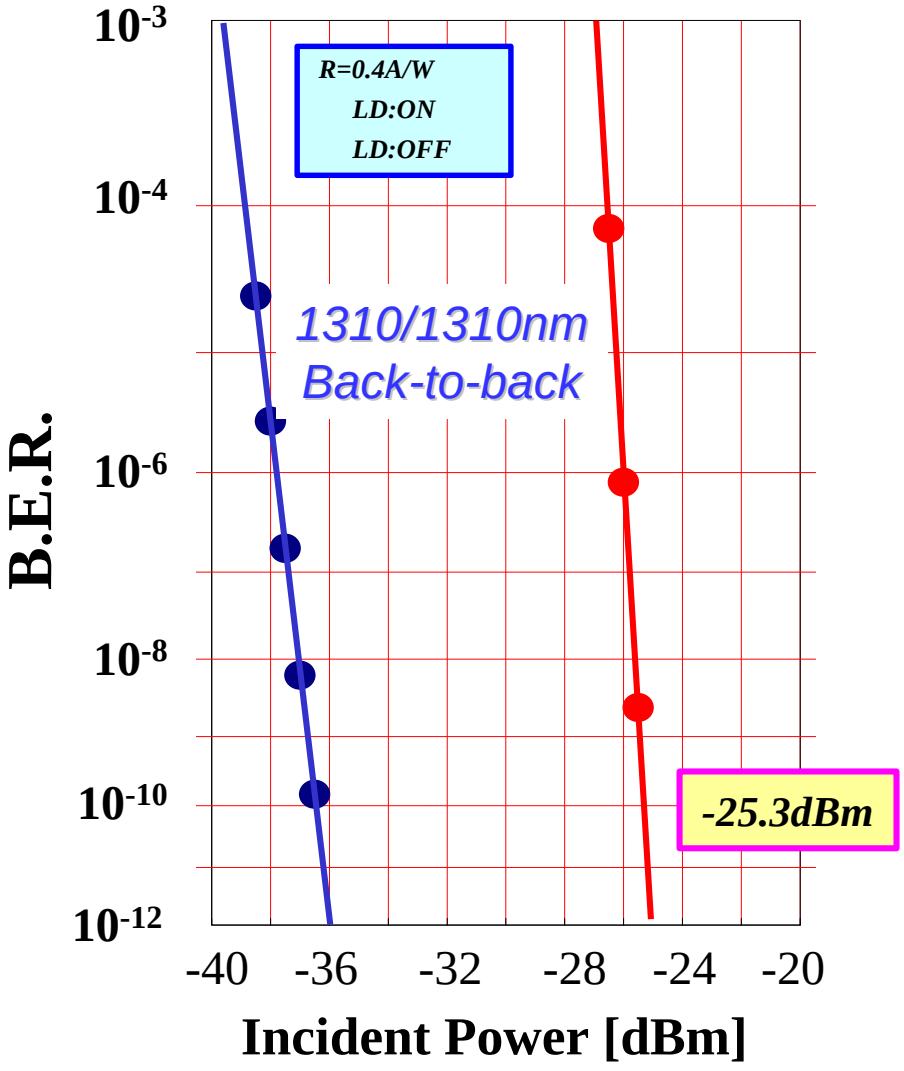
OR

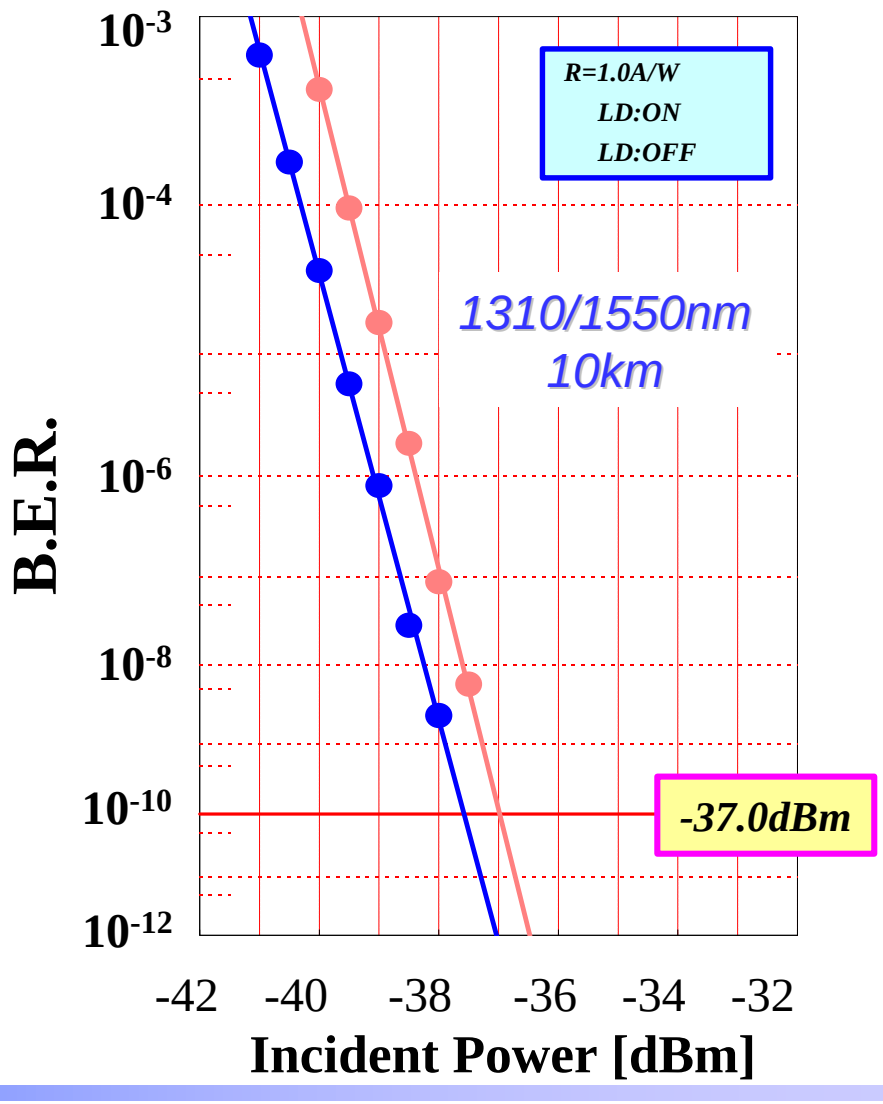
Waveguide-type



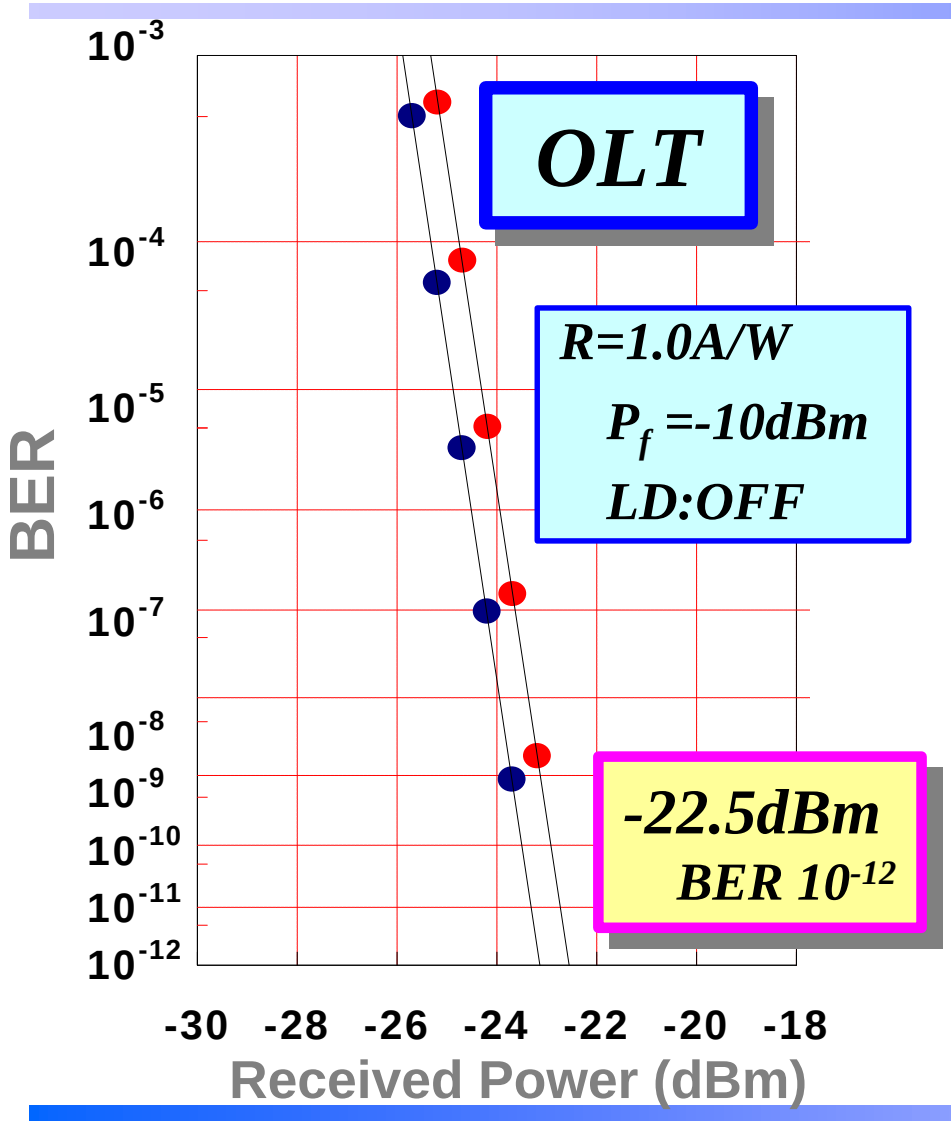
1310Tx/1550Rx for 2x5 SFF with SC
1550Tx/1310Rx for 2x5 SFF with SC

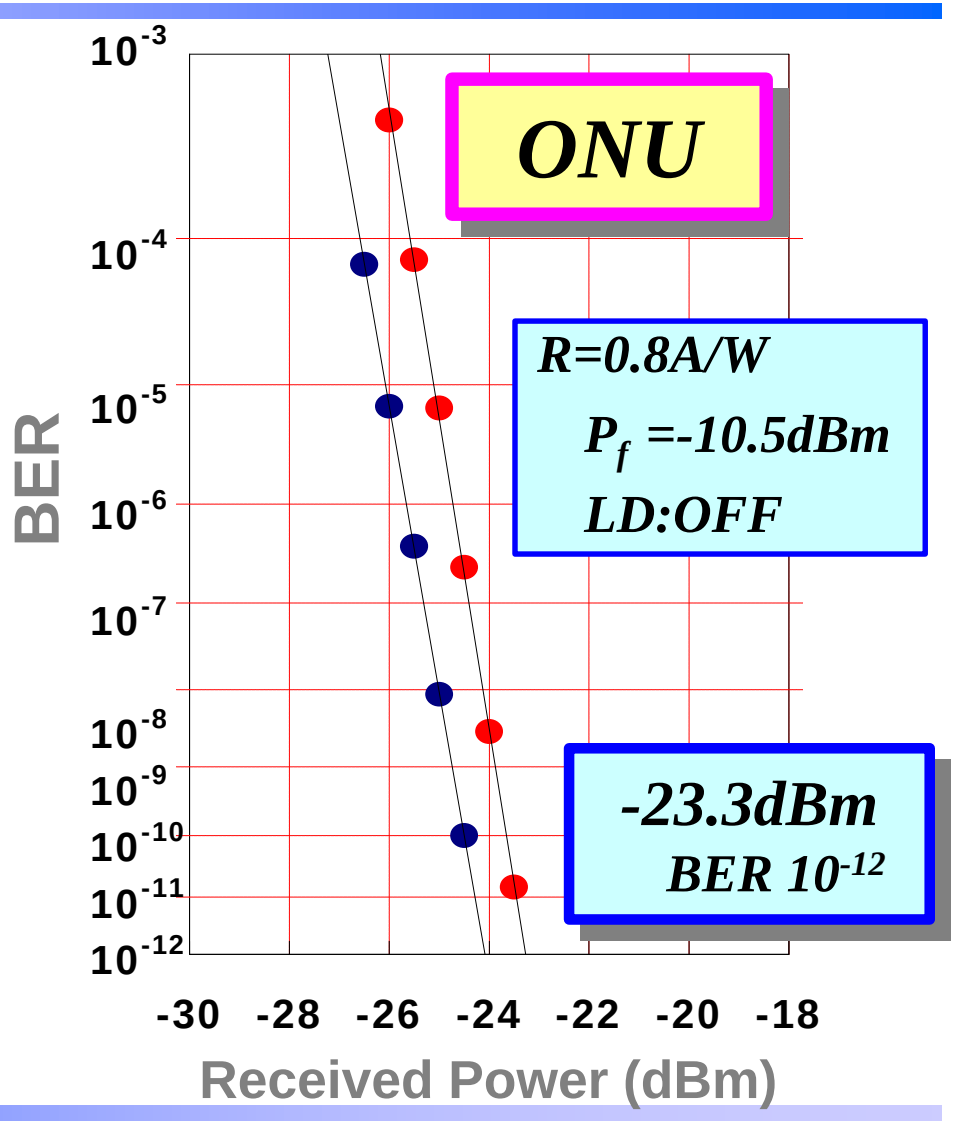
Crosstalk measurement at 156Mbps





2-wave Crosstalk @ 1.25Gbps (b-t-b)



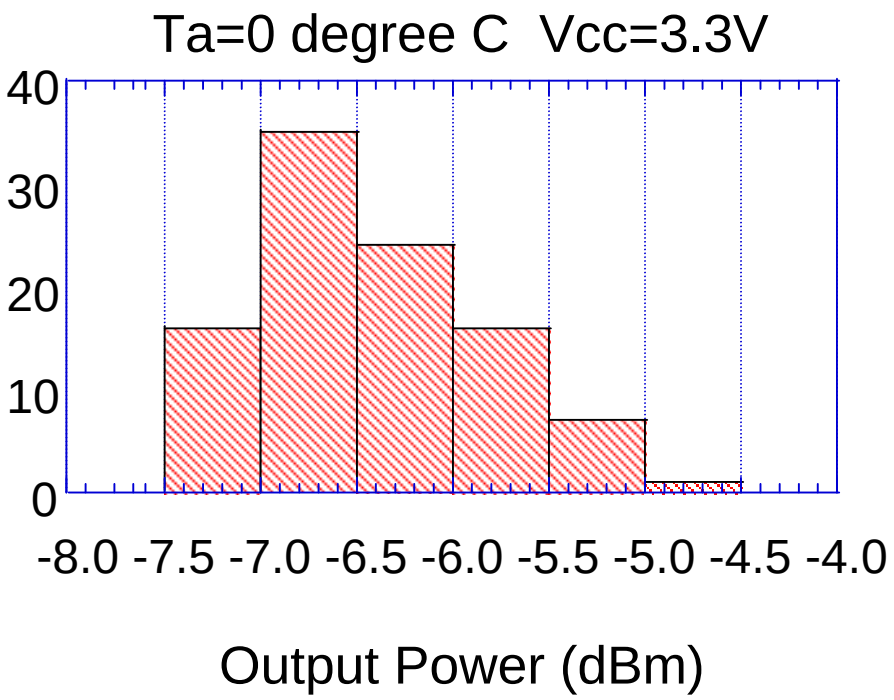


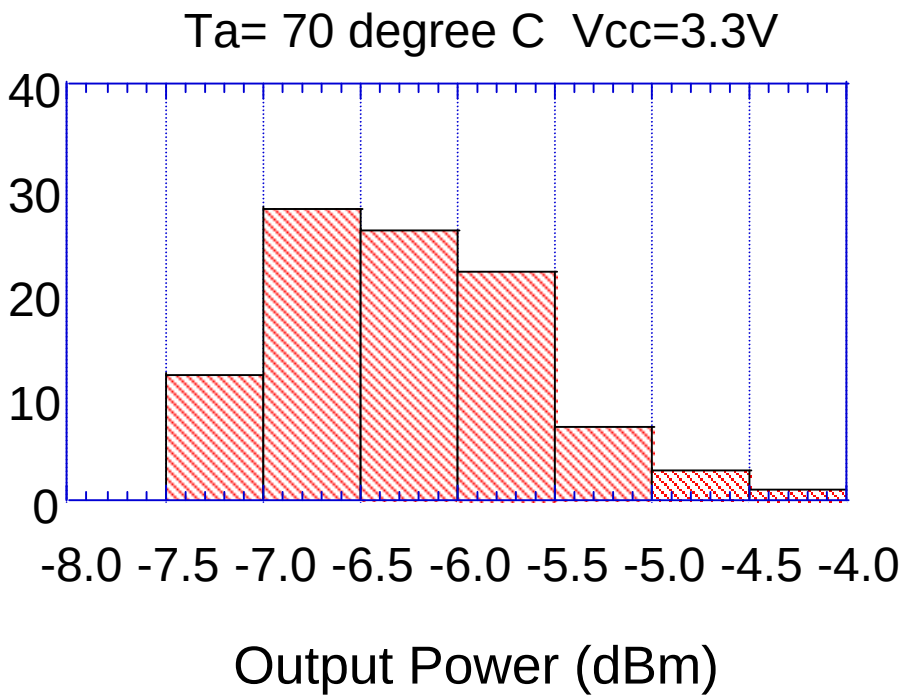
Proposed Link Specifications

Item	*Specification*	
Transmission Speed	1.25Gb/s	
TX wavelength (range, nm)	1270 ~ 1355 upstream	1480 ~ 1580 downstream
RMS spectral width (nm)	<2nm	<1nm
TX output power (average)	-3dBm ~ -9dBm	
TX rise/fall time	<0.26ns	
Extinction Ratio (min)	9dB	
RX Sensitivity (range)	-3dBm ~ -21dBm	

Transmitter Output Characteristics

1.25Gbps, PRBS2^{23}-1, SMF



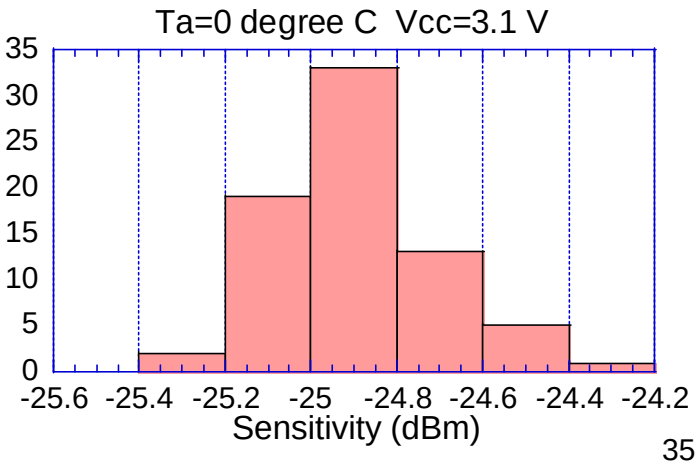


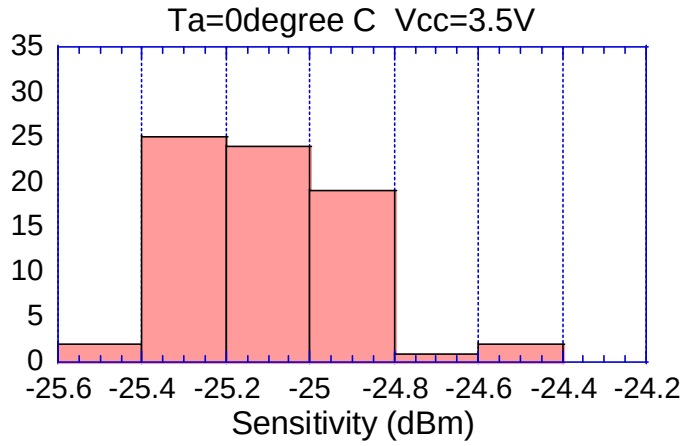
Receiver Sensitivity Characteristics

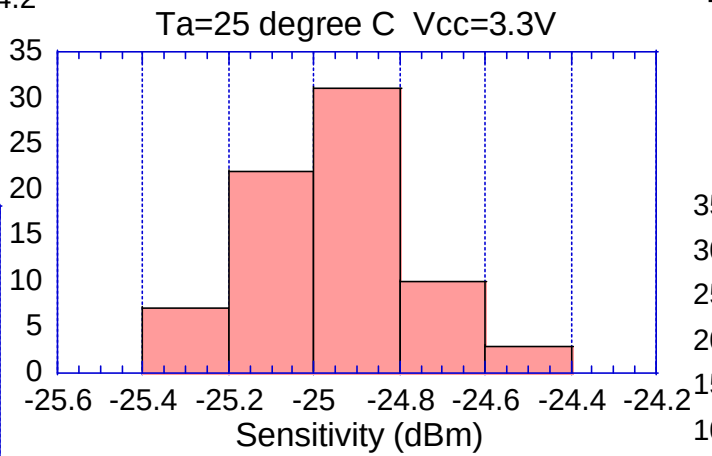
1.25Gbps

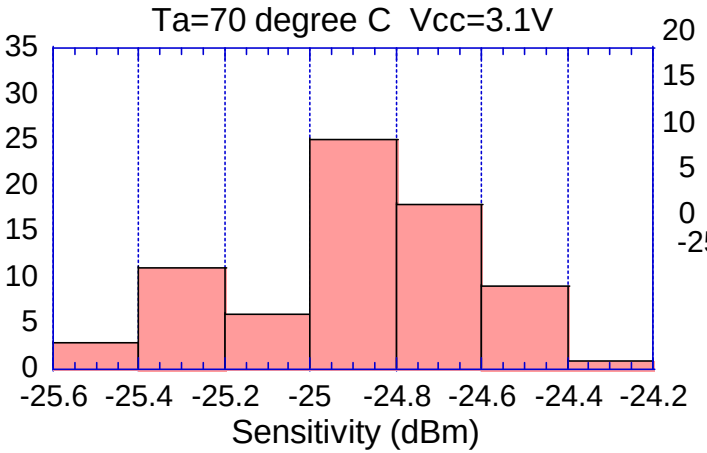
PRBS2^7-1

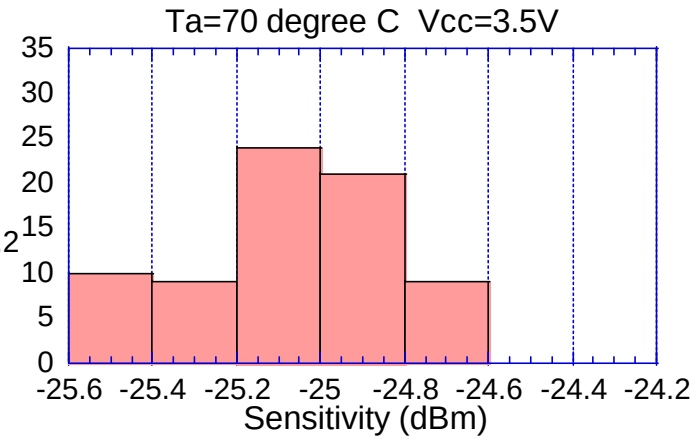
BER=10^{-12}











Summary

1310nm FP/1550nm DFB is …..

- based on mature WDM technology,
- immune to optical reflection,
- allowing largest link budget,
- utilizing inexpensive uncooled lasers,
- implemented with industry-standard Small Form Factor transceiver (SFF TRx), etc.,

therefore, the most proven, cost-effective and practical P2P Gb/s PMD solution.