1300nm / 1500nm Bi-Directional Point-to-Point Specifications

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Target Specifications for Optical PMD Clause (802.3z Clause 38 style)

Figure 38-1

- Almost the same as in 802.3z
- The mode conditioning patch cord does **not** apply
- (802.3z Figure 38-1 shows PMA, PMD, Fiber Optic Cabling (channel) and four test points)

Table 38-2

Operating range for 1000BASE-BX over optical fiber type

Fiber Type	**Modal Bandwidth**	**Minimum Range (km)**
10μm SMF	N/A	10

Table 38-7

1000BASE-BX transmit characteristics[a]

Description	Upstream		Downstream	Unit
Transmitter Type	FP	VCSEL / DFB	VCSEL / DFB	
Signaling speed	1.25 +/- 100 ppm			Gbd
Trise/Tfall (max; 20%-80%)	260			ps
Wavelength (λ, range)	1270-1360	1260-1360	1470-1500	nm
RMS spectral width (max)	3.0	0.4		nm
Average launch power (max)	-3.0			dBm
Average launch power (min)	-9.0	-11.5	-14.0	dBm
Average launch power of OFF	-30.0			dBm
Extinction ratio (min)[b]	6.0			dB
RIN (max)	-120			dB/Hz

a. Measured at TP2

b. A change to Optical Modulation Amplitude (OMA) is suggested.

Table 38-8

1000BASE-BX receive characteristics[a]

Description	Upstream and Downstream	Unit
Signaling speed	1.25 +/- 100 ppm	Gbd
Wavelength (λ, range)	1260-1500	nm
Average receive power (max)	-3.0	dBm
Receive sensitivity[b]	-20.0	dBm
Stressed receive sensitivity[c]	-18.4	dBm
Minimum return loss	12.0	dB

a. Measured at TP3

b. A change to Optical Modulation Amplitude (OMA) is suggested.

c. Most sensitive value for all cases

Table 38-9

Worst case 1000BASE-BX link power budget and penalties[a]

Description	Upstream		Downstream	Unit
Transmitter Type	FP	VCSEL / DFB	VCSEL / DFB	
Modal Bandwidth	N/A			
Link Power Budget	11.0	8.5	6.0	dB
Operating distance	10.0			km
Channel insertion loss[b]	7.19[c]	7.25[d]	4.23[e]	dB
Link power penalties	3.00[c]	0.89[d]	0.98[e]	dB
Unallocated margin in link power budget	0.80[c]	0.36[d]	0.79[e]	dB

a. Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

b. Operating distance used to calculate the channel insertion loss are the maximum values specified in Table 38.6.

c. A wavelength of 1270nm is used to calculate channel insertion loss, link power penalties and unallocated margin.

d. A wavelength of 1260nm is used to calculate channel insertion loss, link power penalties and unallocated margin.

e. A wavelength of 1470nm is used to calculate channel insertion loss, link power penalties and unallocated margin.

Table 38-10

1000BASE-BX link jitter budget

Compliance point	Total jitter		Deterministic jitter	
	UI	ps	UI	ps
TP1	0.24	192	0.100	80
TP1 to TP2	0.284	227	0.100	80
TP2	0.431	345	0.200	160
TP2 to TP3	0.170	136	0.050	40
TP3	0.510	408	0.250	200
TP3 to TP4	0.332	266	0.212	170
TP4	0.749	599	0.462	370

More Spreadsheet Detail – 1

(corresponding to 1270nm FP upstream)

Spreadsheet by Del Hanson, David Cunningham, Piers Dawe, David Dolfi Agilent Technologies

Basics	Input=	**Bold**		Ts(20-80)	**260**	ps	Case:	1310nm serial	**SMF**	
	Q=	**7.04**		Ts(10-90)	395	ps	*Target*	Target reach	**10.0**	km
	Base Rate=	**1250**	MBd	RIN(OMA)	**-120**	dB/Hz	*and*	L_start=	**0.200**	km
Transmitter				RIN at MinER	-127.3	dB/Hz	*graph*	L_inc=	**0.653**	km
	Wavelength Uc	**1270**	nm	RIN_Coef=	**0.70**			Power Budget P=	11.00	dB
	Uw (see notes)	**3.00**	nm	Det.Jitter	**80.0**	ps inc. DCD		Connections C	**2**	dB
	Tx pwr OMA=	**-8.219**	dBm	DCD_DJ=	**80**	ps TP3		Pwr.Bud.-Conn.Loss	9	dB
	Min. Ext Ratio=	6.00	dB	Effect. DJ=	0.00	(UI) ex DCD		C1=	**480**	ns.MH
	"Worst"ave.TxPwr	**-9.0**	dBm	MPN k(OMA)	**0.3**			Reflection Noise factor	**0**	no uni
	Ext. ratio penalty	3.66	dBo	Tx eye height				Effective Rate	1389	MBd
Tx mask	X1=	**0.3**	UI	Refl Tx	**-12**	dB		Tb_eff=	720	ps
	X2=	**0.4**	UI	ModalNoisePen	**0**	dB		Effective Rec Eye	0.22	UI
	Y1=	**0.25**		Tx mask top	0.2	UI				

Rev. 3.2/3	This file	10GEPBud3_1_16a.xls			of	17-Oct-01			
		Model/format rev	3.1.16a		of	31-Oct-01			
Attenuation=	**0.5** dB/km	NomSens OMA	**-19.22**	dBm	Margin	0.00	dB at		
Fiber at	1310 nm	*Receiver* Refl Rx	**-12**	dB	*Answer!*		10 km		
C_att=	0.34	Rec_BW=	**1,000**	MHz	Test Rx BW	**1,000**	MHz		
Attenuation=	0.52 dB/km	c_rx	**329**	ns.MHz					
at	1260 nm	T_rx(10-90)	329.0	ps	Test Source ER=				
sp. min. Uo=	**1324** nm	TP4 Eye	160	ps	*Test Tx*	**6.5**	dB		
Disp. So=	**0.093** ps/nm^2*km	Opening		(=Tx eye)	TestERpen	1.98	dBo		
lzDisp. D1=	-6.42 ps/(nm.km)	RMS Baseline wander SD	**0.025**	fraction of 1/2 eye					
ts					V.E.C.P.	#NUM!	dBo		
MD DGDmax	**10** ps at target 10km								
BWm=	**1.E+06** MHz*km	P_BLW(no ISI)	0.07	dB					
Eff. BWm=	3.3E+05 MHz*km	P_BLW	0.36	dB					

More Spreadsheet Detail – 2

Link Power Budget and Penalties

Description	FP	FP	DFB / VCSEL	DFB / VCSEL	DFB / VCSEL	DFB / VCSEL
Operating Distance (km)	10	10	10	10	10	10
Zero Dispersion Wavelength (nm)	1324	1300	1324	1300	1300	1300
Wavelength Range (nm)	1270	1360	1260	1360	1470	1500
Link Power Budget (dB)	11.0	11.0	8.5	8.5	6.0	6.0
Channel Insertion Loss (dB)	7.19	6.80	7.25	6.80	4.23	4.19
Link Power Penalties (dB)	3.00	2.84	0.89	0.88	0.98	1.03
Unallocated Margin (dB)	0.80	1.36	0.36	0.82	0.79	0.78

Transmit Characteristics

Description	FP	FP	DFB / VCSEL	DFB / VCSEL	DFB / VCSEL	DFB / VCSEL
Signal Speed (Gbaud)	1.250	1.250	1.250	1.250	1.250	1.250
Wavelength (nm)	1270	1360	1260	1360	1470	1500
Trise / Tfall (20%-80%) (ps)	260	260	260	260	260	260
Max RMS Spectral Width (nm)	3.00	3.00	0.40	0.40	0.40	0.40
Max Avg Launch Power (dBm)	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Min Avg Launch Power (dBm)	-9.0	-9.0	-11.5	-11.5	-14.0	-14.0
Min Optical Mod. Amp. (mW)	0.151	0.151	0.085	0.085	0.048	0.048
Min Extinction Ratio (dB)	6.0	6.0	6.0	6.0	6.0	6.0
Max RIN (dB/Hz)	-120	-120	-120	-120	-120	-120

Receive Characteristics

Signal Speed (Gbaud)	1.250	1.250	1.250	1.250	1.250	1.250
Wavelength (nm)	1270	1360	1260	1360	1470	1500
Max Avg Receive Power (dBm)	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0
Receive Sensitivity (dBm)	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0
Min Optical Mod. Amp. (mW)	0.0120	0.0120	0.0120	0.0120	0.0120	0.0120
Min Return Loss (dB)	12.00	12.00	12.00	12.00	12.00	12.00
Stressed Rx Sensitivity (dBm)	-17.39	-17.45	-18.50	-18.51	-18.42	-18.38
Min Stressed Rx OMA (mW)	0.0218	0.0215	0.0169	0.0169	0.0172	0.0174

Notes and Further Work

- Notes
  - Used link model version 3.1.16a (thanks Piers Dawe!)
  - MPN k factor = 0.3 could be too low for FP lasers
  - Suggest moving to OMA specification
  - Triple tradeoff suggested for 1300 band (wavelength, spectral width, rise/fall)
- Further Work
  - Target specifications complete. Refinement work underway.