JDSU

You know us because you depend on our technology every day.

32GFC SMF 10km Optical Proposal

Dave Lewis

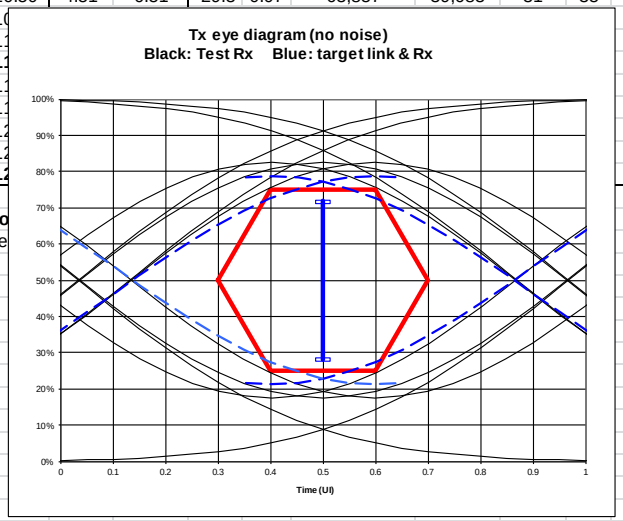
1/3/2013
13-001v0

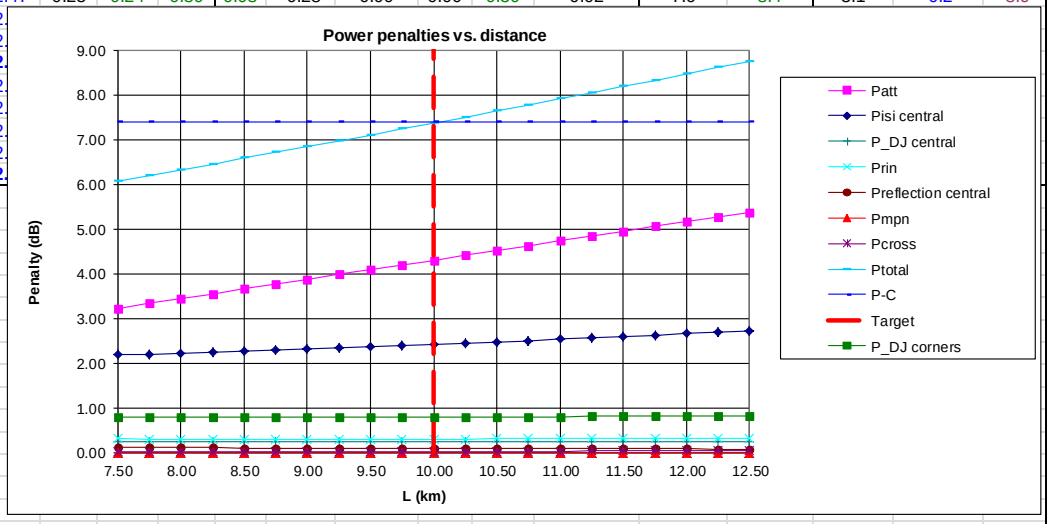
Background and Assumptions

- This presentation updates 12-394v2 to adopt the recommendations of 12-442v0.
- Assumes FEC and is modeled for a 1E-6 BER (Q= 4.7534).
- Rx OMA sensitivity of -11.4 dBm at 1E-6
- Rx min bandwidth of 21.0 GHz
- Rx return loss -26 dB
- Tx OMA min of -2 dBm with 20-80% rise/fall of 18 ps
- RIN(OMA) of -130 dB/Hz
- CDRs in Tx and Rx direction
- DDPWS at TP3 of 0.06 UI (2.3 ps)

Spreadsheet Results

Spreadsheet by Del Hanson, David Cunningham, Piers Dawe, David Dolfi Agilent Technologies													Rev.		This file					of		
Basics	Input=	**Bold**			Ts(20-80)	**18**	ps	Case	1310nm serial		**SMF**		Attenuation=	**0.424**	dB/km		Model/format rev			of		
	Q=	**4.75**			Ts(10-90)	27	ps	*Target*	Target reach	**10.00**	km	*Fiber*	at	1295	nm		NomSens OMA	**-11.40**	dBm	Margin	0.04	dB at
	Base Rate=	**28050**	MBd		RIN(OMA)	**-130**	dB/Hz	*and*	L_start=	**7.5**	km		C_att=	0.29		*Receive*	Refl Rx	**-26**	dB	*Answer!*		10 km
Transmitter					RIN at MinER	-137.3	dB/Hz	*graph*	L_inc=	**0.25**	km		Attenuation=	0.430	dB/km		Rec_BW=	**21,000**	MHz	est Rx BW	**21,000**	MHz
Wavelength Uc		**1295**	nm		RIN_Coef=	**0.70**			Power Budget P=	9.40	dB		at	1295	nm		c_rx	**329**	ns.MHz			
Uw (see notes)		**0.10**	nm		Det.Jitter	**9.312**	ps inc. DCD		Connections C	**2**	dB	Disp. min. Uo=		**1324**	nm		T_rx(10-90)	15.7	ps	Test Source ER=		
Tx pwr OMA=		**-2.00**	dBm		DDPWS=	**2.328**	ps TP3	Pwr.Bud.-Conn.Loss		7.4	dB		Disp. So=	**0.093**	ps/nm^2*km		TP4 Eye	7.13	ps	*Test Tx*	**6**	dB
Min. Ext Ratio=		4.00	dB		Effect. DJ=	0.21	(UI) ex DCD		C1=	**480**	ns.MHz		Disp. D1=	-2.79	ps/(nm.km)		Opening		(=Tx eye)	TestERper	2.23	dBo
Worst"ave.TxPwr		**-1.35**	dBm		MPN k(OMA)	**0**		Reflection Noise factor		**0.6**	no units						RMS Baseline wander SD	**0.013**	fraction of 1/2 eye			
Ext. ratio penalty		3.66	dBo		Tx eye height	39.6%			Effective Rate	30010	MBd	PolMD	DGDmax	**8**	ps at target 10km					V.E.C.P.	2.65	dBo
Tx mask	X1=	**0.3**	UI		Refl Tx	**-12**	dB		Tb_eff=	33.3	ps		BWm=	**1E+06**	MHz*km		P_BLW(no ISI)	0.01	dB			Stressed
	X2=	**0.4**	UI		ModalNoisePen	**0**	dB	Effective Rec Eye		0.21	UI		Eff. BWm=	4.2E+05	MHz*km		P_BLW	0.01	dB			Rx sens
	Y1=	**0.25**			Tx mask top	0.2	UI		Pisi	P Eye	P_DJ	P_DJ	Preflection					Pcross	Ptotal	<Ptotal	LP Pen		OMA
L	Patt	Ch IL	D1.L	D2.L	BWcd	effBWm	Te	Tc	central	corners	central	corners	central	Beta	SDmpn	Pmpn	Prin	central	central	corners	central	Margin	central
(km)	(dB)	(dB)	ps/nm	ps/nm	(MHz)	(MHz)	(ps)	(ps)	J=0, dB	(dB)	(dB)	(dB)	(dB)			(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dBm)
0.002	0.00	2.00	-0.01	0.00	3E+08	2.1E+08	27	31	1.87	0.25	0.24	0.79		-5E-05	0.00	0.00		0.02	2.13	2.93	2.1	5.3	-4.0
7.50	**3.22**	**5.22**	**-20.9**	**0.05**	**89,400**	**55,556**	**29**	**33**	**2.18**	**0.25**	**0.24**	**0.79**	**0.11**	**-0.20**	**0.00**	**0.00**	**0.30**	**0.020**	**6.1**	**6.9**	**2.8**	**1.3**	**-7.7**
7.75	3.33	5.33	-21.6	0.05	86,516	53,763	29	33	2.20	0.25	0.24	0.79	0.11	-0.20	0.00	0.00	0.30	0.020	6.2	7.0	2.9	1.2	-7.8
8.00	3.44	5.44	-22.3	0.05	83,813	52,083	29	33	2.22	0.25	0.24	0.79	0.10	-0.21	0.00	0.00	0.30	0.021	6.3	7.1	2.9	1.1	-7.9
8.25	3.55	5.55	-23.0	0.05	81,273	50,505	30	33	2.24	0.25	0.24	0.79	0.10	-0.22	0.00	0.00	0.30	0.021	6.4	7.3	2.9	1.0	-8.0
8.50	3.65	5.65	-23.7	0.06	78,882	49,020	30	34	2.26	0.25	0.24	0.79	0.10	-0.22	0.00	0.00	0.30	0.021	6.6	7.4	2.9	0.8	-8.1
8.75	**3.76**	**5.76**	**-24.4**	**0.06**	**76,629**	**47,619**	**30**	**34**	**2.28**	**0.25**	**0.24**	**0.80**	**0.10**	**-0.23**	**0.00**	**0.00**	**0.30**	**0.021**	**6.7**	**7.5**	**2.9**	**0.7**	**-8.2**
9.00	3.87	5.87	-25.1	0.06	74,500	46,296	30	34	2.31	0.25	0.24	0.80	0.10	-0.24	0.00	0.00	0.30	0.022	6.8	7.6	3.0	0.6	-8.3
9.25	3.98	5.98	-25.8	0.06	72,487	45,045	30	34	2.33	0.25	0.24	0.80	0.09	-0.24	0.00	0.00	0.30	0.022	7.0	7.8	3.0	0.4	-8.4
9.50	4.08	6.08	-26.5	0.06	70,579	43,860	30	34	2.36	0.25	0.24	0.80	0.09	-0.25	0.00	0.00	0.30	0.022	7.1	7.9	3.0	0.3	-8.5
9.75	4.19	6.19	-27.2	0.06	68,769	42,735	30	34	2.38	0.25	0.24	0.80	0.09	-0.26	0.00	0.00	0.30	0.023	7.2	8.0	3.0	0.2	-8.6
10.00	**4.30**	**6.30**	**-27.9**	**0.07**	**67,050**	**41,667**	**31**	**34**	**2.41**	**0.25**	**0.24**	**0.80**	**0.09**	**-0.26**	**0.00**	**0.00**	**0.30**	**0.023**	**7.4**	**8.2**	**3.06**	**0.04**	**-8.7**
10.25	4.41	6.41	-28.6	0.07	65,415	40,650	31	34	2.44	0.25	0.24	0.80	0.09	-0.27	0.00	0.00	0.30	0.02	7.5	8.3	3.1	-0.1	-8.8
10.50	4.51	6.51	-29.3	0.07	63,857	39,683	31	35	2.47	0.25	0.24	0.80	0.08	-0.28	0.00	0.00	0.30	0.02	7.6	8.4	3.1	-0.2	-8.9





Spreadsheet Results – TDP Calculation

Spreadsheet by Del Hanson, David Cunningham, Piers Dawe, David Dolfi Agilent Technologies														Rev.		This file					
Basics	Input=	**Bold**			Ts(20-80)	**18**	ps	Case	1310nm serial		**SMF**			Attenuation=	**0.45**	dB/km		Model/format rev		
	Q=	**4.75**			Ts(10-90)	27	ps	*Target*	Target reach		**10.00**	km	*Fiber*	at	1310	nm		NomSens OMA	**-11.40**	dBm
Base Rate=		**28050**	MBd		RIN(OMA)	**-130**	dB/Hz	*and*	L_start=		**1.5**	km		C_att=	0.30		*Receive*	Refl Rx	**-26**	dB
Transmitter					RIN at MinER	-137.3	dB/Hz	*graph*	L_inc=		**0.5**	km		Attenuation=	0.456	dB/km		Rec_BW=	**21,038**	MHz
Wavelength Uc		**1295**	nm		RIN_Coef=	**0.70**			Power Budget P=		9.40	dB		at	1295	nm		c_rx	**329**	ns.MHz
Uw (see notes)		**0.10**	nm		Det.Jitter	**4.0**	ps inc. DCD		Connections C		**2**	dB		Disp. min. Uo=	**1324**	nm		T_rx(10-90)	15.6	ps
Tx pwr OMA=		**-2.00**	dBm		DDPWS=	**2.328**	ps TP3		Pwr.Bud.-Conn.Loss		7.4	dB		Disp. So=	**0.093**	ps/nm^2*km		TP4 Eye	7.13	ps
Min. Ext Ratio=		4.00	dB		Effect. DJ=	0.05	(UI) ex DCD			C1=	**480**	ns.MHz		Disp. D1=	-2.79	ps/(nm.km)		Opening		(=Tx eye)
Worst"ave.TxPwr		**-1.35**	dBm		MPN k(OMA)	**0**			Reflection Noise factor		**0.6**	no units						RMS Baseline wander SD	**0.013**	fraction of 1
Ext. ratio penalty		3.66	dBo		Tx eye height	47.9%			Effective Rate		30010	MBd		PolMD DGDmax	**8**	ps at target 10km				
Tx mask	X1=	**0.3**	UI		Refl Tx	**-12**	dB		Tb_eff=		33.3	ps		BWm=	**1E+06**	MHz*km		P_BLW(no ISI)	0.01	dB
	X2=	**0.4**	UI		ModalNoisePen	**0**	dB		Effective Rec Eye		0.21	UI		Eff. BWm=	4.2E+05	MHz*km		P_BLW	0.01	dB
	Y1=	**0.25**			Tx mask top	0.2	UI													

L	Patt	Ch IL	D1.L	D2.L	BWcd	effBWm	Te	Tc	Pisi	P Eye	P_DJ	P_DJ	Preflection					Pcross	Ptotal	<Ptotal
									central	corners	central	corners	central	Beta	SDmpn	Pmpn	Prin	central	central	corners
(km)	(dB)	(dB)	ps/nm	ps/nm	(MHz)	(MHz)	(ps)	(ps)	J=0, dB	(dB)	(dB)	(dB)	(dB)			(dB)	(dB)	(dB)	(dB)	(dB)
10.00	4.56	6.56	-27.9	0.07	67,050	41,667	31	34	2.41	0.25	0.01	0.14	0.08	-0.26	0.00	0.00	0.27	0.02	7.4	7.7
10.50	4.79	6.79	-29.3	0.07	63,857	39,683	31	35	2.46	0.25	0.01	0.14	0.08	-0.28	0.00	0.00	0.27	0.02	7.6	8.0
11.00	5.02	7.02	-30.7	0.07	60,955	37,879	31	35	2.52	0.25	0.01	0.14	0.07	-0.29	0.00	0.00	0.27	0.02	7.9	8.3
11.50	**5.25**	**7.25**	**-32.1**	**0.07**	**58,304**	**36,232**	**31**	**35**	**2.58**	**0.25**	**0.01**	**0.14**	**0.07**	**-0.30**	**0.00**	**0.00**	**0.27**	**0.02**	**8.2**	**8.6**

TDP ~= Pisi+P_DJ+Prin+P_BLW 2.70

Proposed Optical Specifications

Table 7 - Single-mode link classes (OS1, OS2)				
FC-0 (note 1)	**Unit**	**3200-SM-LC-L**		**Note**
Nominal signaling rate	MBd	**28 050**		
Operating distance	m	**0.5 - 10 000**		
Transmitter (gamma-T)				
Type		**Laser**		
Center wavelength, max.	nm	**1325**		
Center wavelength, min.	nm	**1295**		
RMS spectral width, max.	nm	**NA**		
Optical modulation amplitude, min.	mW (dBm)	**0.631 (-2.0)**		
Side-mode suppression	dB	**30**		
-20 dB spectral width	nm	**1**		
Average launched power, max.	dBm			
Average launched power, min.	dBm	**-5.0**		
Rise/Fall time (20% - 80%), max.	ps	**NA**		
$RIN_{12}OMA$, max.	dB/Hz	**-130**		
Extinction Ratio, min.	dB	**4.0**		
Transmitter and dispersion penalty (TDP), max.	dB	**2.7**		
Receiver (gamma-R)				
Average received power, max.	dBm	**+2.0**		
Rx jitter tolerance test, OMA	mW (dBm)	**0.120 (-9.2)**		
Rx jitter tracking test, frequency and pk-pk amplitude	(kHz, UI)	**(1680, 1) (336, 5)**		
Unstressed receiver sensitivity, OMA	mW (dBm)	**0.072 (-11.4)**		
Return loss of receiver, min.	dB	**26**		
Receiver electrical 3 dB upper cutoff frequency, max	GHz	**36**		

Future Work

- Add notes to Table 7
- Provide text for FC-PI-6