Notes on calculating TDP using spreadsheet model

jpk

TDP

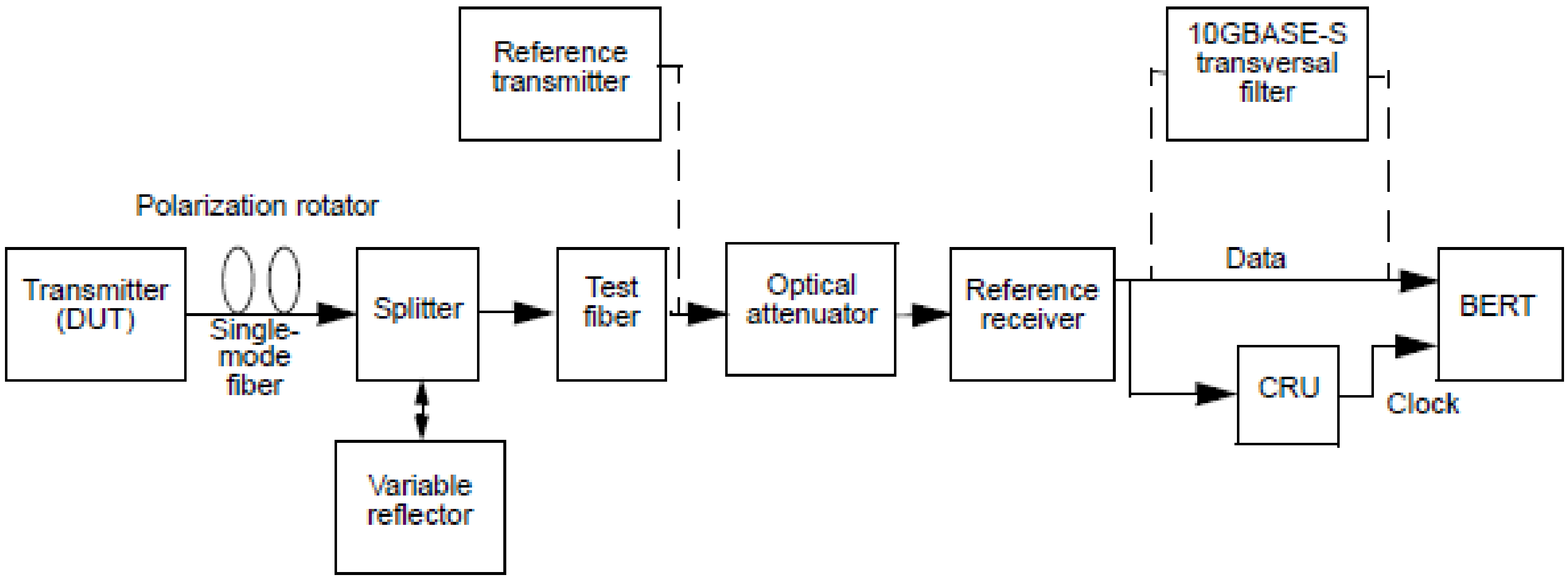


Figure 52–12—Test setup for measurement of transmitter and dispersion penalty

- TDP is difference in sensitivity measured for the two cases:
  - DUT Tx, with worst case path (or equivalent), into reference Rx (P_DUT)
  - Reference Tx, no path penalty, into reference Rx (S)
- TDP is the greater of (P_DUT - S), 0.

- Although the reference Tx is considered ideal, it still has a small penalty which should be accounted for in link modeling when trying to extract a TDP value.

Clause 52 Ref Tx

52.9.10.1 Reference transmitter requirements

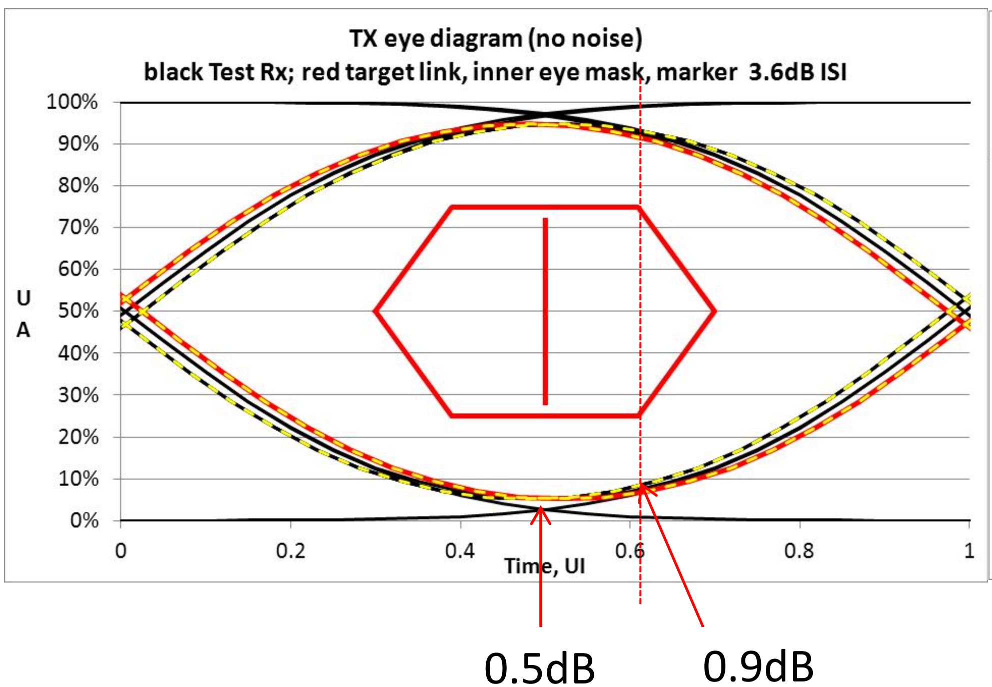
The reference transmitter is a high-quality instrument-grade device, which can be implemented by a CW laser modulated by a high-performance modulator. It should meet the following basic requirements:

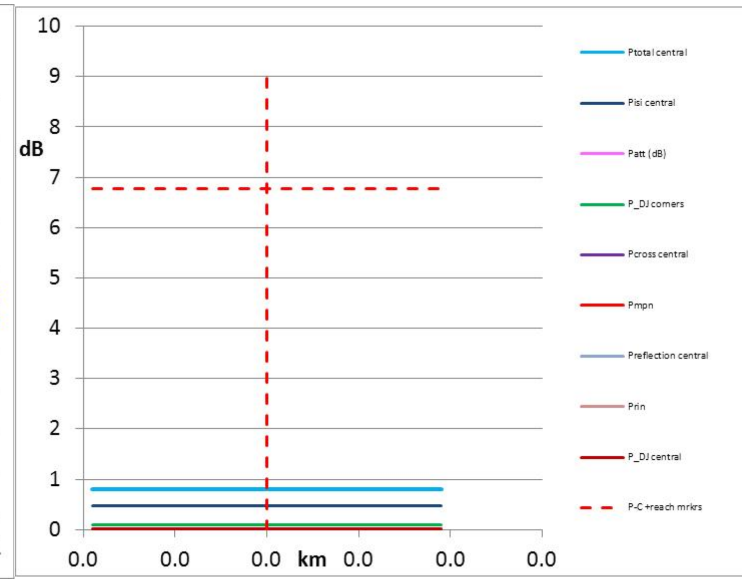
a) The rise/fall times should be less than 30 ps at 20% to 80%.
b) The output optical eye is symmetric and passes the eye mask test of 52.9.7.
c) In the center 20% region of the eye, the worst case vertical eye closure penalty as defined in 52.9.9.3 is less than 0.5 dB.
d) Jitter less than 0.20 UI peak-peak.
e) RIN should be minimized to less than–136 dB/Hz

- When scaled for bit rate from 10.3 to 25.8 Gb/s:
  - 20% to 80% rise fall time < 12 ps
  - ≤0.5dB VECP
  - Jitter < 0.2 UI (7.76 ps)
  - RIN_{OMA} < -140dB/Hz
    - assuming a reference Tx would be expected to have a similarly RIN negligible penalty (in fact with FEC, the RIN penalty is still <<0.1 dB at -136dB/Hz).

Example using a spreadsheet model*

- Using the Tx values which just meet scaled values for a reference Tx, the modeled eye closure penalty for the ref. Tx is 0.8 dB (eye corner) or 0.5 dB (centre eye)





The 'eye corner' in the spreadsheet model is set by the X2 coordinate of the Tx mask. Could be used to represent required TP4 eye opening, for example.

Snapshot

X2 sets eye corner

VECP at 2m
at centre of eye

Spreadsheet by Del Hanson, David Cunningham, Piers Dawe, David Dolfi Agilent Technologies		Rev. 3.2/3	This file	10GEPBud3_1_16a.xls	of 17-Oct-01
Basics Input= **Bold**	Ts(20-80) 12 ps	Case: 850nm serial **newMMF**	Attenuation= **3.5** dB/km	Model/format rev 3.1.16a	of 31-Oct-01
Q= **3.90**	Ts(10-90) 18 ps	*Target* Target reach **0.00** km	*Fiber* at 850 nm	NomSens OMA **-11.10** dBm	Margin 5.02 dB at
Base Rate= **25781** MBd	RIN(OMA) **-140** dB/Hz	*and* L_start= **0.0** km	C_att= 1.00	*Receive* Refl Rx **-12** dB	*Answer!* 0.002 km
Transmitter	RIN at MinER -149.6 dB/Hz	*graph* L_inc= **0.0** km	Attenuation= 3.62 dB/km	Rec_BW= **#####** MHz	est Rx BW **19,336** MHz
Wavelength Uc **840** nm	RIN_Coef= **0.70**	Power Budget P= 7.30 dB	at 840 nm	c_rx **329** ns.MHz	
Uw (see notes) **0.29** nm	Det.Jitter **3.8** ps inc. DCD	Connections C **1.5** dB	Disp. min. Uo= **1320** nm	T_rx(10-90) 17.0 ps	Test Source ER=
Tx pwr OMA= **-3.80** dBm	DCD_DJ= **0** ps TP3	Pwr.Bud.-Conn.Loss 5.8 dB	Disp. So= **0.11** ps/nm^2*km	TP4 Eye 9 ps	*Test Tx* **6.5** dB
Min. Ext Ratio= 3.00 dB	Effect. DJ= 0.10 (UI) ex DCD	C1= **480** ns.MHz	Disp. D1= -117.76 ps/(nm.km)	Opening (=Tx ey	TestERpen 1.98 dBo
"Worst"ave.TxPwr **-2.03** dBm	MPN k(OMA) **0.3**	Reflection Noise factor **0** no units		RMS Baseline wander SD **0.013**	fraction of 1/2 eye
Ext. ratio penalty 4.78 dBo	Tx eye height 78.2%	Effective Rate 25781 MBd	(not in use) **10**		V.E.C.P. 0.46 dBo
Tx mask X1= **0.3** UI	Refl Tx **-12** dB	Tb_eff= 39 ps	BWm= **4400** MHz*km	P_BLW(no ISI) 0.01 dB	Stressed
X2= **0.39** UI	ModalNoisePen **0.3** dB	Effective Rec Eye 0.22 UI	Eff. BWm= ###### MHz*km	P_BLW 0.01 dB	Rx sens
Y1= **0.25**	Tx mask top 0.22 UI				

L (km)	Patt (dB)	Ch IL (dB)	D1.L ps/nm	D2.L ps/nm	BWcd (MHz)	effBWm (MHz)	Te (ps)	Tc (ps)	Pisi central J=0, dB	P Eye corners (dB)	P_DJ central (dB)	P_DJ corners (dB)	Preflection central (dB)	Beta	SDmpn	Pmpn (dB)	Prin (dB)	Pcross central (dB)	Ptotal central (dB)	<Ptotal corners (dB)	LP Pen central (dB)	Margin (dB)	OMA central (dBm)
0.002	0.01	1.51	-0.24	0.00	3E+06	#######	18	25	0.42	0.21	0.04	0.25		-6E-03	0.00	0.00		0.00	0.77	1.19	0.8	5.0	-10.6
0.00	**0.00**	**1.50**	**0.0**	**0.00**	**#####**	**######**	**18**	**25**	**0.42**	**0.21**	**0.04**	**0.25**	**0**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.8**	**1.2**	**0.8**	**5.0**	**-10.6**
0.00	0.00	1.50	0.0	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	0.00	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.00	0.00	1.50	-0.1	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	0.00	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.001	0.00	1.50	-0.1	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	0.00	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.001	0.00	1.50	-0.1	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	0.00	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.001	**0.00**	**1.50**	**-0.1**	**0.00**	**#####**	**######**	**18**	**25**	**0.42**	**0.21**	**0.04**	**0.25**	**0**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.8**	**1.2**	**0.8**	**5.0**	**-10.6**
0.001	0.00	1.50	-0.1	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	0.00	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.001	0.01	1.51	-0.2	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	0.00	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.002	0.01	1.51	-0.2	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	0.00	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.002	0.01	1.51	-0.2	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	-0.01	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.002	**0.01**	**1.51**	**-0.2**	**0.00**	**#####**	**######**	**18**	**25**	**0.42**	**0.21**	**0.04**	**0.25**	**0**	**-0.01**	**0.00**	**0.00**	**0.01**	**0.00**	**0.8**	**1.2**	**0.8**	**5.0**	**-10.6**
0.002	0.01	1.51	-0.3	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	-0.01	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.002	0.01	1.51	-0.3	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	-0.01	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.003	0.01	1.51	-0.3	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	-0.01	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.003	0.01	1.51	-0.3	0.00	#####	#######	18	25	0.42	0.21	0.04	0.25	0	-0.01	0.00	0.00	0.01	0.00	0.8	1.2	0.8	5.0	-10.6
0.003	**0.01**	**1.51**	**-0.3**	**0.00**	**#####**	**######**	**18**	**25**	**0.42**	**0.21**	**0.04**	**0.25**	**0**	**-0.01**	**0.00**	**0.00**	**0.01**	**0.00**	**0.8**	**1.2**	**0.8**	**5.0**	**-10.6**