Photline TECHNOLOGIES

DeliveringModulationSolutions

ModBox 1550 nm 12 Gb/s DPSK

C, L bands ; 12 Gb/s Reference Transmitter & Receiver

ModBox

The ModBox-1550nm-12Gbps-DPSK is an optical modulation unit that generates high performance DPSK optical data streams. The equipment incorporates a modulation stage based on a high data rate $LiNb0_3$ Mach-Zehnder modulator, coupled with a high performance RF driver and an automatic bias control circuitry. It can also receive an internal laser source (DFB, ITLA...), a receiver stage based on a delay line interferometer and balanced detector.

The ModBox-1550nm-12Gbps-DPSK provides R&D and production engineers with state of the art performance and the peace of mind of a turn-key instrument. It can be used as a reference transmitter in optical telecommunications laboratories, or in production test beds.

In addition to the traditional 1550 nm wavelength range, it is also available at 1310 nm.

FEATURES

- Up to 12 Gb/s
- Short rise and fall time
- High stability

APPLICATIONS

- Telecom laboratories
- Transmission system test
- Production test

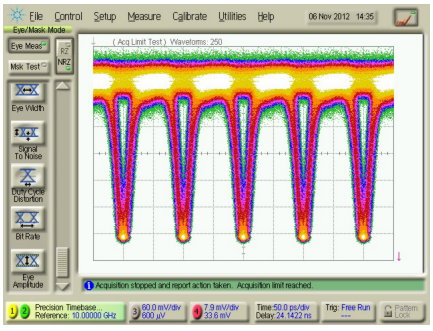
OPTIONS

- DFB or tunable laser(s)
- DPSK encoder
- Receiver stage
- Fixed or tunable FSR optical demodulator
- 28 Gb/s version
- Multi-channel version
- 1300 nm band version
- Multiformat optical transmitter version : NRZ & RZ, NRZ & RZ-DPSK, CS-NRZ-DPSK

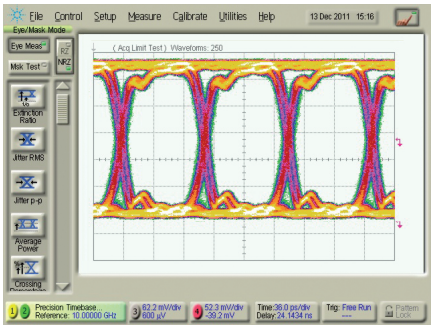
Performance Highlights - Output Modulated & Demodulated Signal

Parameter	Min	Typ	Max	Unit
Optical wavelength range		C, L bands		
Modulation format		DPSK		
Data rate	0.1	10	12	Gb/s
Demodulated signal rise / fall time	-	40	-	ps
Demodulated signal SN	-	15	-	-
Demodulated signal amplitude	-	250	-	mV

Eye diagrams

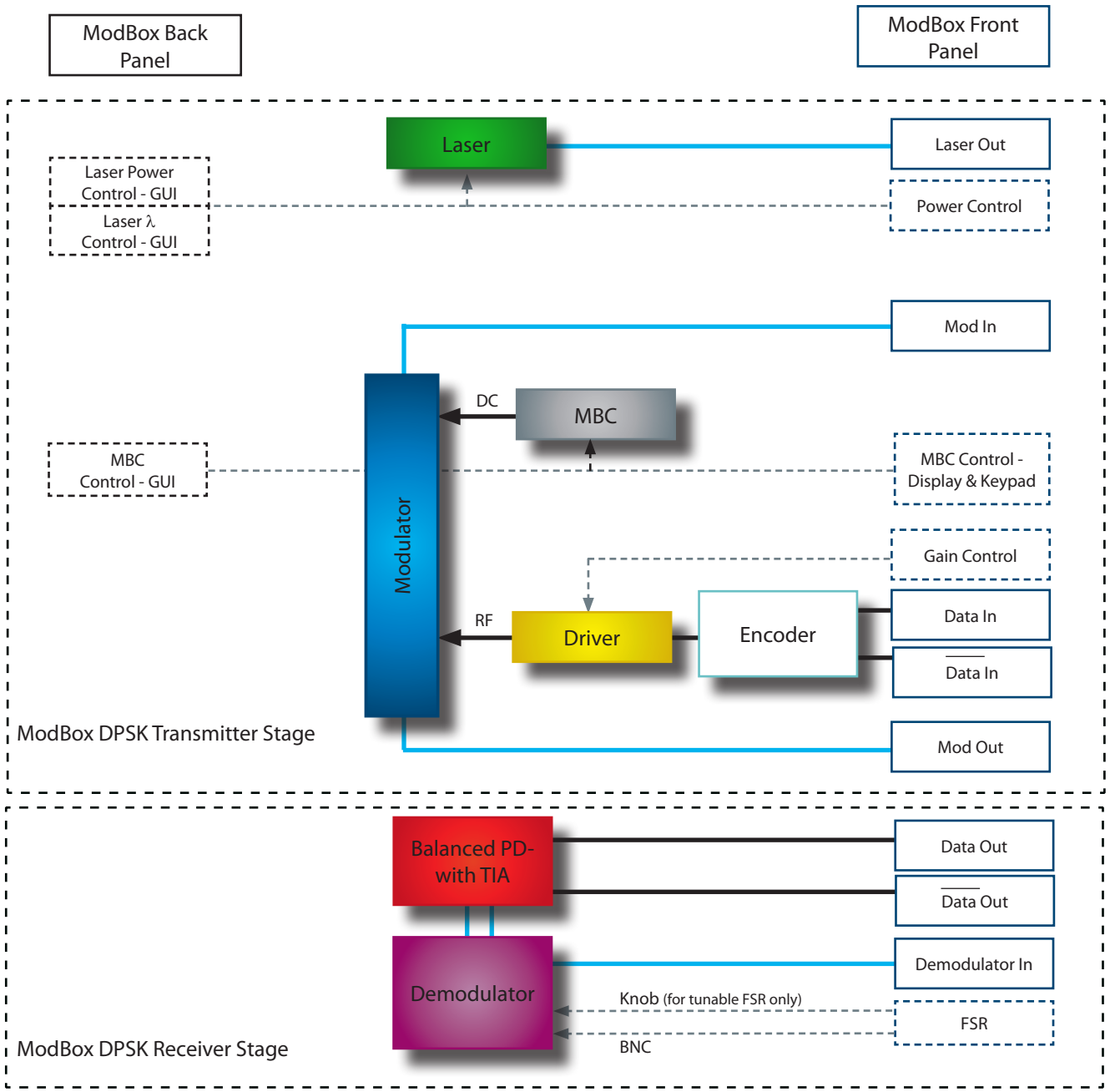


10 Gb/s Optical DPSK Eye Diagram



10 Gb/s Electrical Demodulated Eye Diagram

Functional Block Diagram



The ModBox-1550nm-12Gbps-DPSK integrates :

- a high bandwidth, chirp-free, X-cut $LiNb0_3$ Mach-Zehnder modulator,
- a high bandwidth NRZ RF driver with gain level adjustment for eye diagram optimization,
- a bias control circuit to lock the Mach-Zehnder modulator and ensure a highly stable output optical signal,
- an optional laser source, DFB or tunable type, with its high precision driver that allows control of output power,
- an optional electrical encoder,
- an optional receiver stage composed of one optical demodulator (fixed or tunable FSR) and balanced photodiodes.

Input Electrical Specifications - User supplied, not a ModBox specification

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Input electrical data-rate	-	Single ended	-	-	12	Gb/s
Modulation format	-	Single ended		NRZ		-
Rise / fall time	t_r / t_f	10 % - 90 %	-	40	-	ps
Impedance matching	Z_{IN}	-	-	50	-	Ω
Input signal amplitude	V_{IN}	Single ended	-	0.5	-	V_{pp}

Input Optical Specifications - User supplied, not a ModBox specification

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Laser type	-	CW		DFB or tunable		-
Optical wavelength range *	λ_band	C, L bands version	1527	-	1608	nm
Polarization	-	-		Linear and controlled		-
Power	P_{IN}	CW	1	20	100	mW

* Performance is optimized for one wavelength.

Modulated Output Optical Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Insertion loss	IL	At maximum modulator transmission	-	4	6	dB
DC extinction ratio	ER_{DC}	-	25	-	-	dB
Return loss	ORL	-	-40	-45	-	dB
Chirp	α	-	-0.1	0	0.1	-

Demodulated Output Signal - Measured with ModBox DPSK Transmitter and Receiver Stages

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output data-rate	-	Differential	-	-	12*	Gb/s
Output eye amplitude	-	Single ended	-	250	-	mV
Rise / fall time	t_r / t_f	10 % - 90 %	-	40	-	ps
Added jitter	J_{RMS}	$J_{RMS} = \sqrt{J^2_{RMS\text{-}total} - J^2_{RMS\text{-}source}}$	-	3	-	ps
S/N	SN	-	-	15	-	-
Crossing point	-	-	-	50	-	%
Electrical return loss	S_{11}	-	-	-10	-	dB

* Automatic Bias Control is warranted from 5 Gb/s up to 12 Gb/s.

Absolute Maximum Ratings - ModBox DPSK Transmitter without any options

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Optical input power	OP_{in}	-	20	dBm
RF input power	EP_{in}	-	5	dBm

Optional C-Band DFB Laser Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Wavelength	λ	Other wavelength on request		1550.12 nm - ITU CH 34 *		-
Laser type	-	-		DFB		-
Optical output power	-	CW	-	40*	-	mW
Spectrum linewidth	Δλ	FWHM	-	-	1	MHz
Optical return loss	ORL	-	30	35	-	dB
Side mode suppression ratio	SMSR	-	30	-	-	dB
Optical output power adjustment	P_{CW}	Front & back panels with GUI	20	-	40	mW
Wavelength laser tuning range	-	Back panel with GUI	-	0.8	1	nm

* Other ITU-Channel and power laser on request.

Optional C-Band & L-Band Tunable Laser Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Optical wavelength range	λ_C-band	C-band version	1527.60	-	1565.50	nm
Optical wavelength range	λ_L-band	L-band version	1570.01	-	1608.76	nm
Optical output power	P_{CW}	CW	5	-	35	mW
Frequency fine tune resolution	FTF	-	-	1	-	MHz
Optical output power accuracy	$P_{CW\text{-}acc}$	-	-1	-	1	dB
Wavelength accuracy	$\Delta\lambda_{acc}$	-	-1.5	-	1.5	GHz
Spectrum linewidth	Δλ	FWHM @-3 dB, instantaneous	-	-	100	kHz
Side Mode Suppression Ratio	SMSR	-	40	55	-	dB
RIN	RIN_7	For 5 mW output power	-	-	-140	dB/Hz
	RIN_{13}	For 20 mW output power	-	-	-145	
Optical output power adjustment	ΔP_{CW}	Back panel with GUI	5	-	35	mW

Optional Encoder Specifications

The encoder option is a NRZ differential coder for high data rate application. The device has two high frequency differential inputs (Data & Clock). The encoder can be either used is 50 Ω single ended or 100 Ω differential. The input data stream is synchronized by the clock and electrically coded to a differential format. If a logical zero is present to the input, the output remains unchanged: Qn+1=Qn. If a logical one is present to the data input, the output value is changed at every rising edge of the clock: a constant one to the input gives a continuous series of 01010 to the output.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Data coding type	-	-		DPSK encoding		-
Data & Clock input impedance	Z_{IN}	Single ended	-	50	-	Ω
Data & Clock input amplitude	V_{IN}	Single ended or Differential	2	300	-	mV_{pp}
Output rise and fall times	t_r / t_f	10 % - 90 %	-	15	-	ps

Optional Optical Demodulator with Fixed FSR (Kylia)

The DPSK demodulator is a Delay Line Interferometer performing the interface between the signal and itself 1-bit delayed. It is tunable to perfectly match the carrier frequency.

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Optical wavelength range	λ_C-band	C-band version	1527	1550	1565	nm
Free Spectral Range *	FSR	Fix		5, 10.7, 12		GHz
Decoding data-rate *	-	Fix		5, 10.7, 12		Gb/s
Insertion loss	IL	-	-	2	-	dB
Pol dependant frequency shift	PDFS	-	-	4	-	%FSR
Phase tuning range	-	-	-	-	1.5	FSR
Maximum optical input power	OP_{in}	-	-	-	300	mW

* Only typical values are listed. FSR ranging from 4.5 to 12 GHz can be provided.

Optional Optical Demodulator with Tunable FSR (Kylia)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Optical wavelength range	λ_C-band	C-band version	1527	-	1565	nm
FSR tuning range	ΔFSR	Manual adjustment using knob	4.5	-	10	GHz
Decoding data-rate range	-	-	4.5	-	10	Gb/s
Phase tuning range	-	-	-	-	1.5	FSR
Tuning voltage	-	User supplied, with voltage input -BNC	0	-	4	V
Insertion loss	IL	-	-	3.5	-	dB
Tuning	ΔIL	-	-	0.5	-	dB
Pol dependant frequency shift	PDFS	-	-	4	-	%FSR
Maximum optical input power	OP_{in}	-	-	-	300	mW

Optional Optical Photoreceiver Specifications

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Photodetector type	-	-		Balanced PIN photodiodes with TIA		-
Operating wavelength range	λ	-	1480	-	1620	nm
Maximum bit rate	-	-	-	-	20	Gb/s
PD responsivity	S	Average polarization @1550 nm	0.85	0.92	-	A/W
Conversion gain *	CG	@-10 dBm NRZ input	-	2 100	-	V/W
OSNR sensitivity	-	DPSK system with BER1e-3	-	+13	-	dBm
Maximum optical input power	P_{opt}	Into each PD (average level, NRZ)	-	-	+6	dBm
Maximum output swing	V_{out}	Differential	-	500	600	mV
Output rise and fall times	t_r / t_f	-	-	10	-	ps

* CG = differential output swing / total input swing

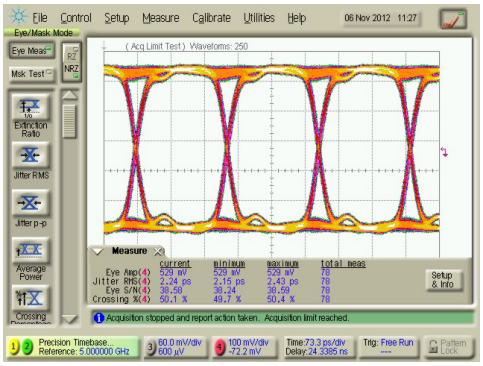
Modulated DPSK Eye Diagrams from ModBox Transmitter

The following equipment was used in obtaining these results :

- Agilent Infinium DCA 86100B
- Anritsu synthesizer MG3694C
- Anritsu Signal Analyzer MP1800A
- Photodiode u²t XPDV2320R

5 Gb/s data rate

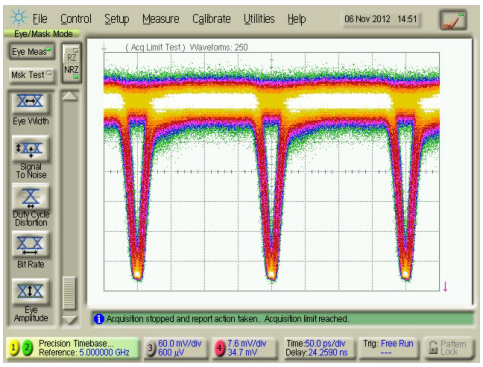
Input electrical signal



Eye Amp = 529 mV
Jitter RMS = 2.2 ps
Eye S/N = 38

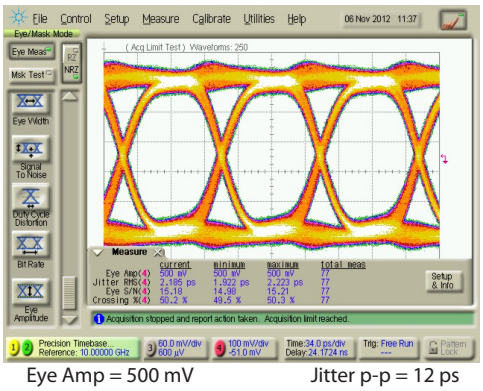
Jitter p-p = 11 ps
Rise time (10/90) = 42 ps
Fall time (10/90) = 44 ps

DPSK Output optical signal



10 Gb/s data rate

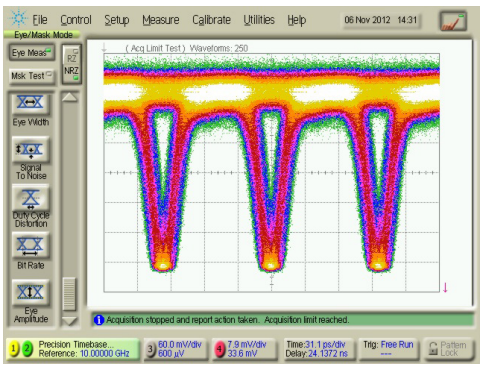
Input electrical signal



Eye Amp = 500 mV
Jitter RMS = 2.18 ps
Eye S/N = 15

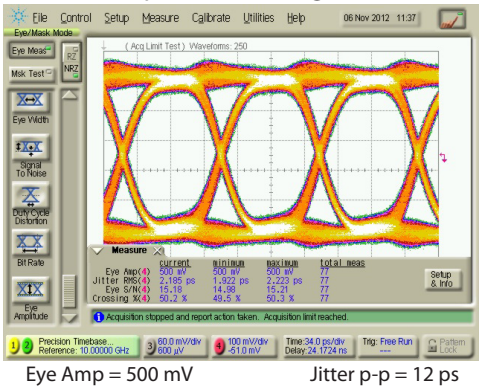
Jitter p-p = 12 ps
Rise time (10/90) = 43 ps
Fall time (10/90) = 38ps

DPSK Output optical signal



12 Gb/s data rate

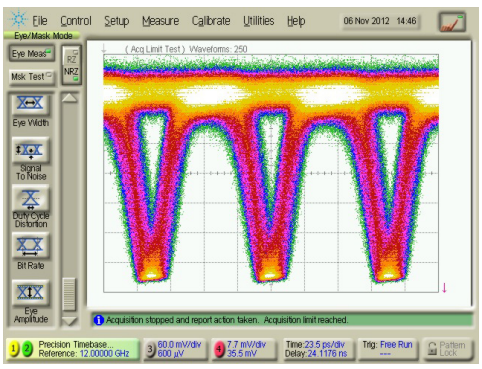
Input electrical signal



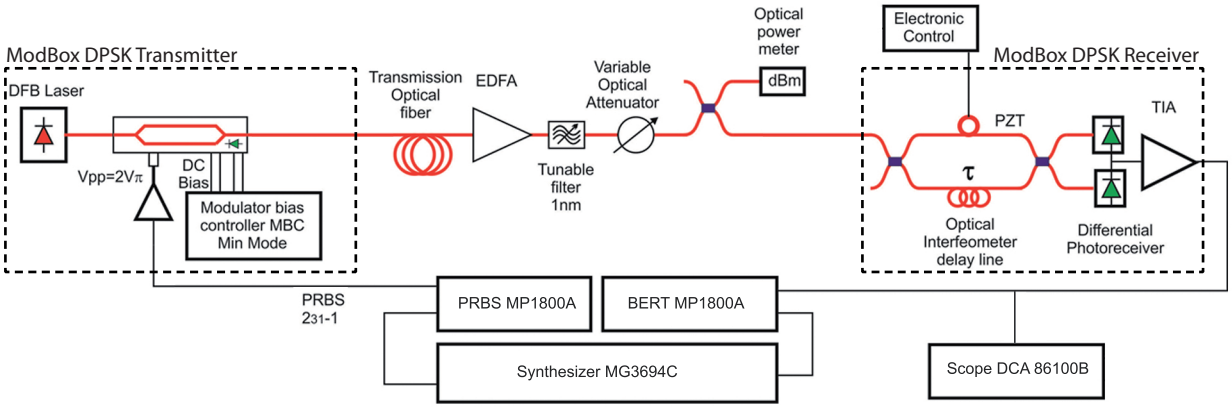
Eye Amp = 500 mV
Jitter RMS = 2.18 ps
Eye S/N = 15

Jitter p-p = 12 ps
Rise time (10/90) = 43 ps
Fall time (10/90) = 38ps

DPSK Output optical signal

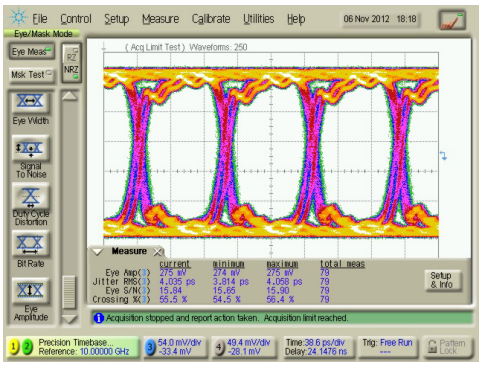


10 Gb/s DPSK Modulation and Demodulation Set-up



10 Gb/s Demodulated Eye Diagrams

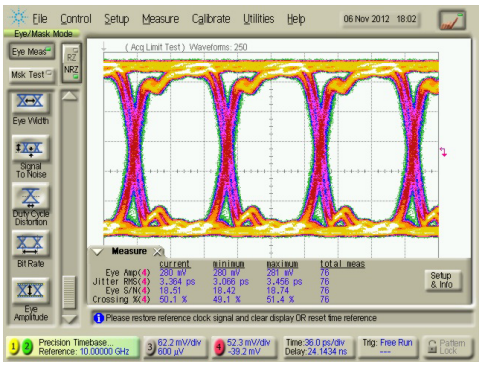
Data +



Eye Amp = 275 mV
Jitter RMS = 4 ps
Eye S/N = 15

Jitter p-p = 17 ps
Rise time (10/90) = 33 ps
Fall time (10/90) = 28 ps

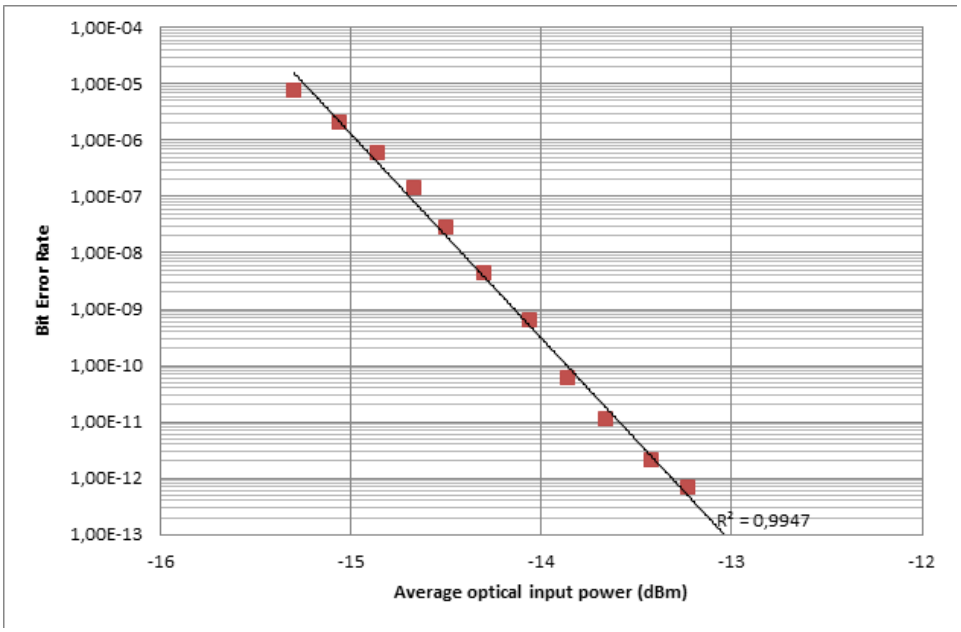
Data -



Eye Amp = 280 mV
Jitter RMS = 3.3 ps
Eye S/N = 18

Jitter p-p = 19 ps
Rise time (10/90) = 36 ps
Fall time (10/90) = 35 ps

10 Gb/s BER



Dimensions - Interfaces - Compliance

Dimensions	
Dimensions	19 inches x 3U
Weight	3 kg - 6.6 pounds
Power supply (rear panel)	100 - 120 V / 220 - 240 V automatic switch, 50 - 60 Hz

Interfaces	
Optical connectors	FC/UPC - FC/APC - SC/UPC
RF connector	50 Ω - SMA female
Modulator fibers	Polarization maintaining fiber, PM1550
Demodulator fiber	SMF-28
Remote type	MBC - Laser - USB type B with Windows GUI

Compliance	
Safety	EN 60625-1
Marking	CE

Ordering Information

ModBox-W-DR-OL-OENC-ORx-ODEC-XX

W = Wavelength range : 1550nm, 1310nm, 1060nm, 850nm
DR = maximum output Data-Rate : 12.5Gbps, 28Gbps
OL = Laser Option, omit if no laser - CHX* : CW ITU Channel - C or L Tunable laser : C-Tun or L-Tun
OENC = Encoder Option, omit if no electrical encoder
ORx = Photodetector Option, omit if no photodetector - Rx : Photodetector
ODEC = Encoder Option, omit if no electrical encoder : Data-rate for a fix FSR or TunFSR
XX = Input / Output connectors, FA : FC/APC - FC : FC/UPC - SC : SC/UPC
* X is the ITU channel number, X = 34 by default

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About us

Photline Technologies is a provider of Fiber Optics Modulation Solutions based on the company $LiNb0_3$ modulators and high-speed electronics modules. Photline Technologies offers high speed and high data rate modulation solutions for the telecommunication industry and the defense, aerospace, instruments and sensors markets. The products offered by the company include : comprehensive range of intensity and phase modulators (800 nm, 1060 nm, 1300 nm, 1550 nm, 2000 nm), RF drivers and modules, transmitters and modulation units.

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