



The ModBox-CBand-28Gb/s-DPSK-NRZ is an optical modulation unit that generates high performance DPSK and NRZ optical data streams up to 28 Gb/s, and analog modulation up to 20 GHz. The equipment incorporates a modulation stage based on a high data rate LiNbO<sub>3</sub> Mach-Zehnder modulator, coupled with a high performance RF driver and an automatic bias control circuitry. It can also receive an internal tunable laser source.

The ModBox-CBand-28Gb/s-DPSK-NRZ 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.

### FEATURES

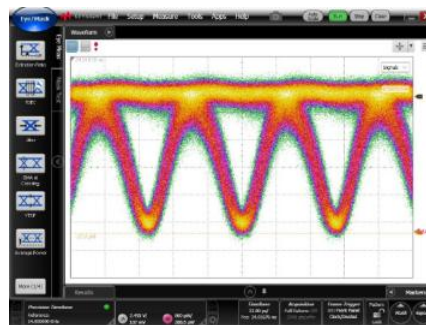
- Full C-Band Reference Transmitter
- Up to 28 Gb/s DPSK, NRZ
- Analog modulation up to 20 GHz
- Reliable & reproducible measurements
- High eye diagram stability

### APPLICATIONS

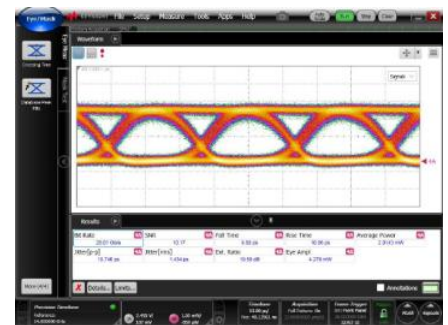
- Transmission system test
- Components characterization
- Production test
- R&D laboratories

### Performance Highlights

Parameter	Min	Typ	Max
Operating wavelength	-	C-Band	-
Modulation format	DPSK and NRZ / Analog		
Modulation bandwidth	28 Gb/s / 20 GHz		

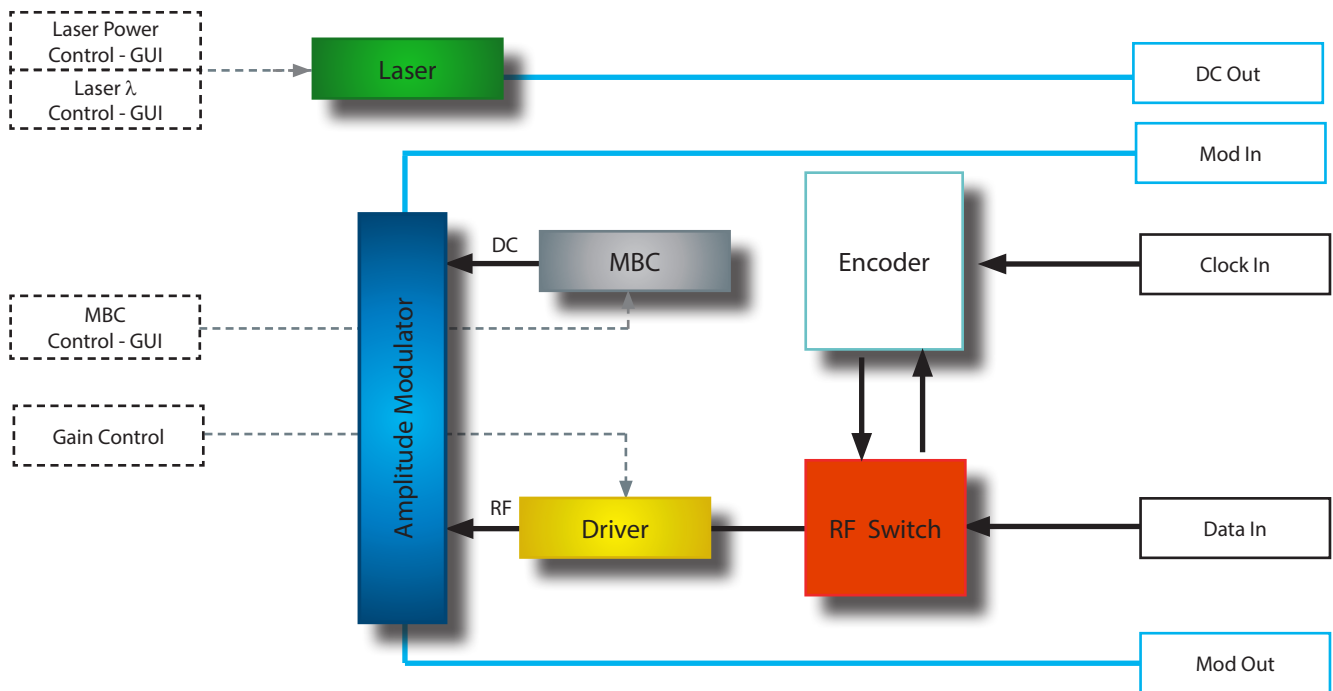


28 Gb/s Optical DPSK Eye Diagram



28 Gb/s Electrical Demodulated Eye Diagram

Functional Block Diagram



The ModBox-CBand-28Gb/s-DPSK-NRZ integrates:

- a laser source, tunable type, with its high precision driver that allows control of the output power and its wavelength,
- a set of modulation composed of a wide bandwidth, chirp-free, LiNbO<sub>3</sub> Mach-Zehnder modulator which is associated to its matching wide bandwidth RF driver (with gain level adjustment for eye diagram optimization) and bias control circuit (MBC, Modulator Bias Controller) to lock the Mach-Zehnder modulator at the desired operating point (Min for DPSK, Quad for NRZ and Analog, and Max for DC modes) and ensure a highly stable output optical signal,
- an electrical encoder for DPSK modulation scheme selected through a RF switch path.

## Input Electrical Specifications User supplied, not a ModBox specification

ID	Parameter	Symbol	Condition	Min	Typ	Max	Unit
0.1	Data-rate	BR	DPSK, NRZ	0.1	-	28	Gb/s
0.3	Frequency range	FBR	Analog	0.1	-	20	GHz
0.5	Data input voltage	Data <sub>IN</sub>	NRZ <sup>(1)</sup>	0.400	0.450	0.500	Vpp
			Analog mode <sup>(1)</sup>	-	0.125	0.150	Vpp
0.6	Jitter	J <sub>RMS</sub>	-	-	1	1.2	ps
0.7	Cross point	%	NRZ input signal	45	50	55	%
0.8	Rise / fall time	t <sub>r</sub> / t <sub>f</sub>	20% - 80 %	-	13	18	ps
0.9	Clock input voltage	Clock <sub>IN</sub>	Analog signal <sup>(1)</sup>	-	0.500	-	Vpp

(1): AC coupled - 50 Ω - Single ended

## Input Optical Specifications User supplied, not a ModBox specification. External laser specifications.

ID	Parameter	Symbol	Condition	Min	Typ	Max	Unit
1.1	Operation	λ	CW	1530	-	1675	nm
1.2	Polarisation	Pol	PM fiber - FC/APC	Linear and controlled			-
1.3	Power	P <sub>IN</sub>	-	10	-	20	dBm
1.4	Side mode sup ratio	SMSR	Intrinsic laser value	30	-	-	dB
1.5	Spectrum linewidth	Δλ	Intrinsic laser value	-	1	20	MHz

## Absolute Maximum Ratings

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
1.6	Data input voltage	Data <sub>IN</sub>	-	1	Vpp
1.7	Clock input voltage	Clock <sub>IN</sub>	-	1	Vpp
1.8	Optical input power	Mod <sub>IN</sub>	-	20	dBm

## Modulated Output Optical Specifications

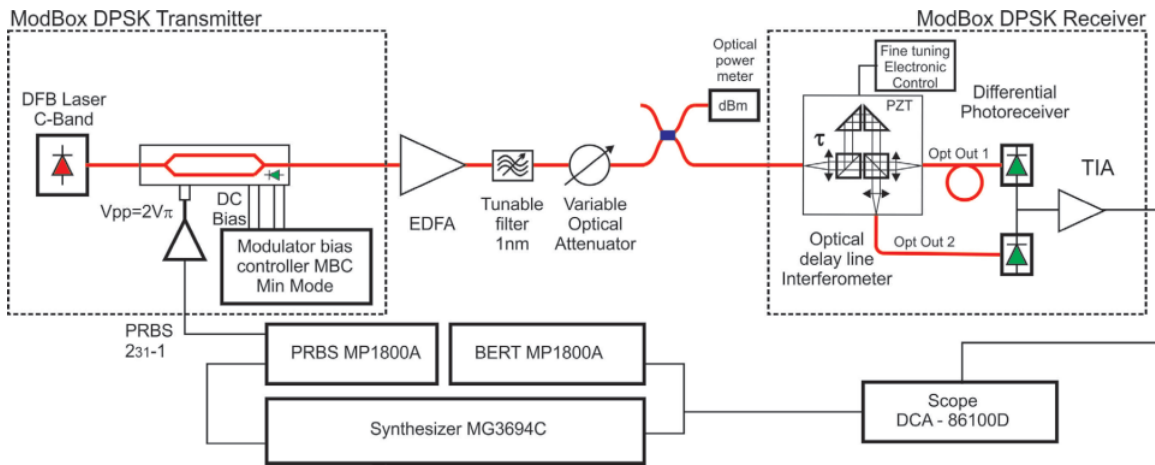
Specifications below are given with embedded tunable laser and supplied PRBS.

	Parameter	Symbol	Condition	Min	Typ	Max	Unit
2.1	Embedded laser type	-	Intrinsic laser value	Tunable			-
2.2	Wavelength	$\lambda$	Intrinsic laser value	1527.60	-	1565.50	nm
2.3	Wavelength accuracy	$\Delta\lambda_{acc}$	Intrinsic laser value	-1.5	-	1.5	GHz
2.4	Spectrum linewidth	$\Delta\lambda$	Intrinsic laser value	-	10	100	kHz
2.5	Side Mode Supression	SMSR	Intrinsic laser value	40	-	-	dB
2.6	Optical Signal to Noise	OSNR	Intrinsic laser value	40	-	-	dB
2.7	Optical output power	Mod Out	Modulation On - @1550 nm	10	-	-	dBm
2.8			Modulation On / Full C-band	7	-	-	dBm
2.9			Modulation Off - @1550 nm	13	-	-	dBm
2.10			Modulation Off / Full C-band	10	-	-	dBm
2.13	Data-rate	BR	DPSK, NRZ	0.1	-	28	Gb/s
2.15	Frequency range	FBR	Analog	0.1	-	20	GHz
2.17	Dynamic Signal to Noise	SNR	NRZ	20	-	-	dB
2.18	Extinction ratio	ER	NRZ	12	15	-	dB
2.19	High extinction ratio	HER	NRZ - Option Opt-HER	15	18	-	dB
2.20	RMS jitter	$J_{RMS}$	NRZ	-	-	2	ps
2.21	Rise / fall time	$t_r / t_f$	20 % - 80 %	-	15	18	ps
2.22	Optical return loss	ORL	Modulated signal	-40	-45	-	dB
2.23	Polarisation extinction	PER	Modulated signal	15	20	-	dB

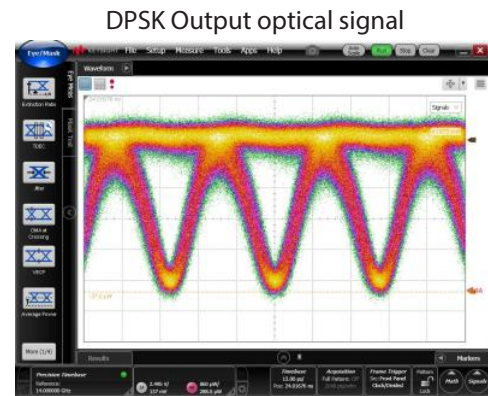
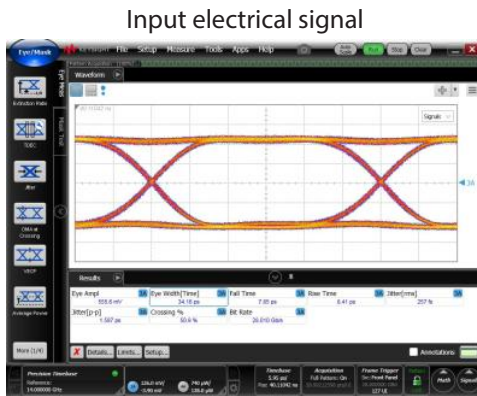
28 Gb/s DPSK Modulation and Demodulation Set-up

The following equipment was used in obtaining these results:

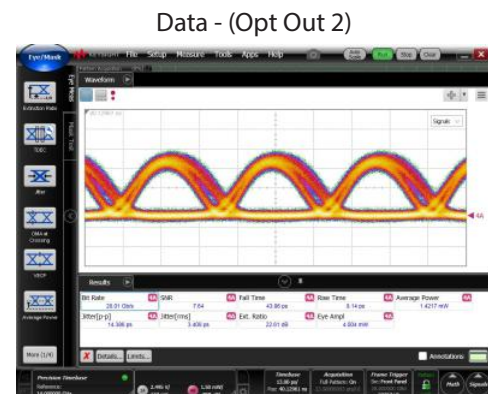
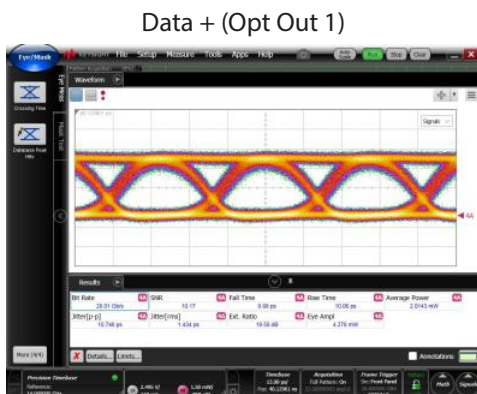
- Keysight Infinium DCA-X 86100D scope with high precision timebase
- Anritsu synthesizer MG3694C
- Anritsu Signal Analyzer MP1800A
- Keysight Receiver 86116-C module for high speed signal detection
- EDFA and filter
- Delay line interferometer with piezoelectric driver



28 Gb/s Modulated Eye Diagrams

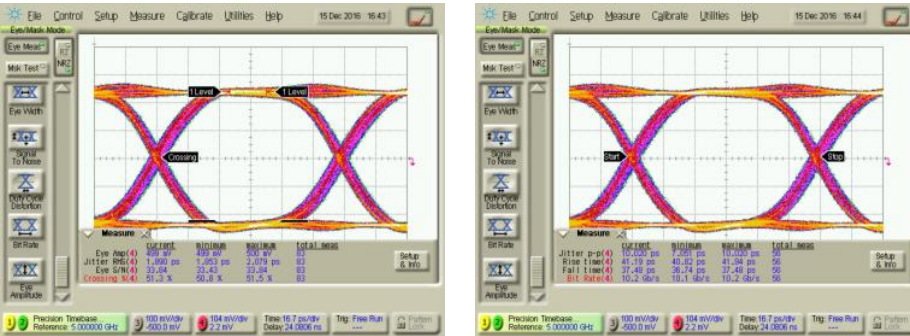


28 Gb/s Demodulated Eye Diagrams (at the photodiode output port, without TIA)

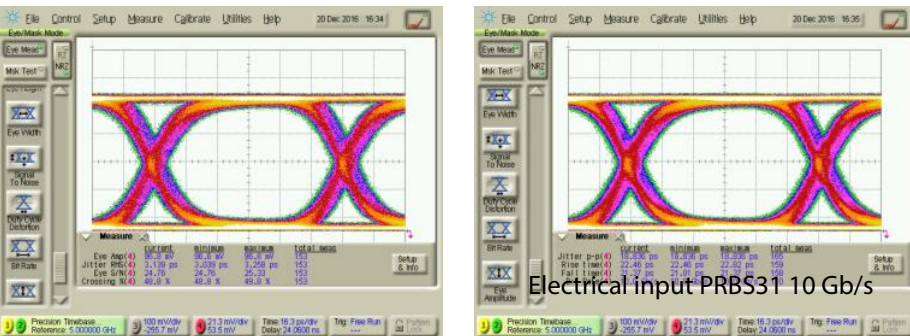


Modulated NRZ Eye Diagrams from ModBox Transmitter

The following equipment was used in obtaining these results: Agilent Infinium DCA 86100D, Anritsu Signal Analyzer MP1800A and Anritsu synthesizer, Photodiode finisar XPDV2320R

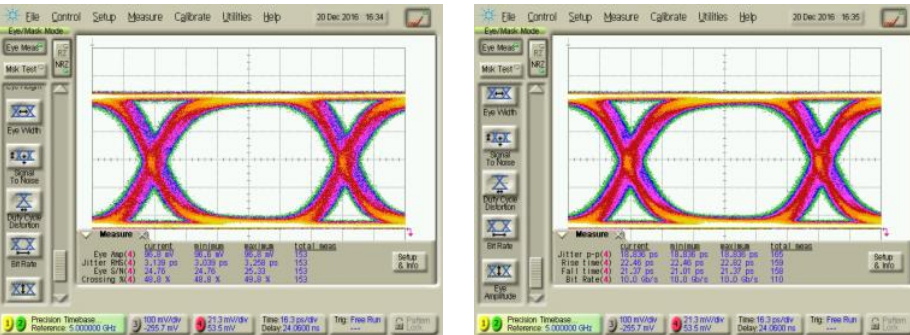


Electrical input PRBS31 10 Gb/s



Electrical input PRBS31 10 Gb/s

Optical output PRBS31 10 Gb/s



Optical output PRBS31 28 Gb/s



## Interfaces, Dimensions and Compliance

ID	Interfaces	
3.1	Optical input and output ports	Polarization maintaining fiber / FC/APC optical connectors, narrow key, slow axis // to the key
3.2	RF input	Single SMA female RF connector - 50 Ω
3.3	Control	Smart Interface (front panel tactile interface), GUI (Ethernet)
3.4	Power supply	100 V-120 V / 220 V - 240 V automatic switch 50 Hz - 60 Hz (Rear panel)
3.5	Dimensions / Weight	Rack 19" x 3U, Depth=495mm / 5 kg
3.6	EMC and optical norms	EN61326-1 Ed. 2006 / NF EN 60825-1 & EN 60825-2 Ed.2014

## About us

iXblue Photonics produces specialty optical fibers and Bragg gratings based fiber optics components and provides optical modulation solutions based on the company lithium niobate (LiNbO<sub>3</sub>) modulators and RF electronic modules.

iXblue Photonics serves a wide range of industries: sensing and instruments, defense, telecommunications, space and fiber lasers as well as research laboratories all over the world.