



## FEATURES

- 1310nm & 1550nm Reference Transmitter
- PAM-4 up to 28 Gbaud
- NRZ up to 28 Gb/s
- 1310nm & 1550nm lasers embedded
- Reliable & reproducible measurements
- High eye diagram stability
- Extinction Ratio Adjustable

## APPLICATIONS

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

## OPTIONS

- Tunable C-band laser
- Multi-Channel
- 850 nm, O-band, C-band

The ModBox-1310nm-1550nm-28Gbaud-PAM4 is a dual wavelength 1310 nm and 1550 nm Linear Reference Transmitter that generates excellent quality optical data streams PAM-4 up to 28 Gbaud and NRZ up to 28 Gb/s. The transmitter produces very clean eye diagrams with high SNR and fast rise and fall times. It also provides the flexibility of adjusting the extinction ratio for vertical eye closure.

The ModBox-1310nm-1550nm-28Gbaud-PAM4 provides R&D and Production engineers with a user friendly turn-key instrument delivering state of the art performance. It is being used in optical telecommunications laboratories and production test beds.

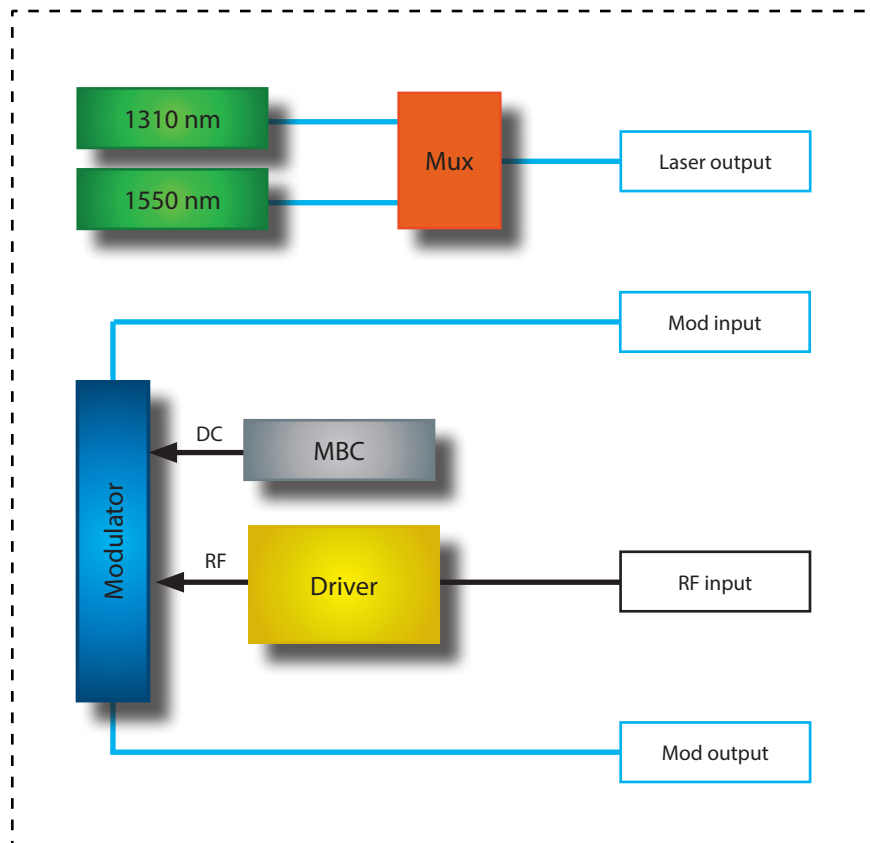
The equipment incorporates a modulation stage based on a chirp-free LiNbO<sub>3</sub> Mach-Zehnder modulator, coupled with a high performance RF driver and an automatic bias control circuitry. The ModBox integrates two DFB lasers centered at 1310 nm and 1550 nm.

In addition to the dual wavelength, ixblue offers reference transmitters in the full O-band, full C-band and at 850 nm.

## Performance Highlights

| Parameter                       | Min                                     | Typ   | Max |
|---------------------------------|---|-------|-----|
| Operating wavelength            | 1310 nm & 1550 nm                       |       |     |
| Modulation format               | PAM-4, NRZ                              |       |     |
| Modulation bandwidth            | PAM-4 up to 28 Gbaud, NRZ up to 28 Gb/s |       |     |
| Modulated output power @1310 nm | 2 dBm                                   | 3 dBm | -   |
| Modulated output power @1550 nm | 5 dBm                                   | 6 dBm | -   |

## Functional Block Diagram



## The ModBox-1310nm-1550nm-28Gbaud-PAM4 features:

- A chirp-free X-cut LiNbO<sub>3</sub> (Lithium Niobate) Mach-Zehnder Intensity modulator. It is selected for its wide optical bandwidth, and its high electro-optic bandwidth and flat, low ripple, electro-optic response curve.
- A high bandwidth and highly linear RF driver.
- A modulator bias controller. The internal LiNbO<sub>3</sub> modulator is a X-cut device with very low drift. However an automatic bias control circuit is provided to lock the operating point of the modulator at the quadrature point whatever the environmental and optical (laser power and wavelength) conditions. The MBC ensures a highly stable optical output signal to provide reliable and reproducible measurements.
- Two 1310 nm and 1550 nm low RIN lasers are integrated by default (C-Band tunable laser in option). For convenience, the two lasers are multiplexed and an external patch cord is delivered to connect the laser output to the modulator input optical port. Wavelength selection (1310 nm or 1550 nm) and laser power are tunable through the front panel controls or the ModBox software interface.

The ModBox-1310nm-1550nm-28Gbaud-PAM4 is controlled from the front panel via the Smart interface with a simple rotary knob and keypad. The Smart manual interface allows for bias control circuit, RF driver and laser settings. It comes also with a simple GUI solution, Windows based and implemented through the USB interface of the user PC.

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

| Parameter        | Symbol      | Condition                                   | Min | Typ   | Max   | Unit  |
|------------------|-------------|---|-----|-------|-------|-------|
| Data-rate        | PRBS        | PAM-4 electrical input signal               | 0.1 | -     | 28    | Gbaud |
|                  |             | NRZ electrical input signal                 | 0.1 | -     | 28    | Gb/s  |
| Input voltage    | $V_{IN}$    | AC coupled - 50 $\Omega$ - Linear operation | -   | 0.200 | 0.300 | Vpp   |
| Jitter           | $J_{RMS}$   | -   | -   | 1     | 1.2   | ps    |
| Rise / fall time | $t_r / t_f$ | 20 % - 80 %                                 | -   | 13    | 18    | ps    |
| Corss-point      | -           | NRZ mode                                    | 45  | 50    | 55    | %     |

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

| Parameter                     | Symbol          | Condition         | Min                   | Typ     | Max  | Unit |
|-------------------------------|-----------------|-------------------|-----------------------|---------|------|------|
| Operation                     | $\lambda$       | CW                | 1310                  | 1550    | 1565 | nm   |
| Polarization                  | -               | -                 | Linear and controlled |         |      | -    |
| Power                         | P               | 1310 nm / 1550 nm | -                     | 10 / 16 | -    | dBm  |
| Side Mode Supression Ratio    | SMSR            | -                 | 30                    | -       | -    | dB   |
| Spectrum linewidth            | $\Delta\lambda$ | FWHM              | -                     | 0.5     | 1    | MHz  |
| Polarization Extinction ratio | PER             | -                 | -                     | 19      | -    | dB   |

## Output Optical Specifications Specifications below are given with embedded 1310 nm and 1550 nm lasers.

| Parameter                        | Symbol          | Condition                          | Min               | Typ | Max | Unit  |
|----------------------------------|-----------------|------------------------------------|-------------------|-----|-----|-------|
| Embedded Laser                   | $\lambda$       | DFB integrated by default          | 1310 nm & 1550 nm |     |     | -     |
| Data format                      | -               | -                                  | PAM-4 & NRZ       |     |     | -     |
| Data-rate                        | -               | PAM-4 electrical input signal      | 0.1               | -   | 28  | Gbaud |
|                                  |                 | NRZ electrical input signal        | 0.1               | -   | 28  | Gb/s  |
| Output modulated power           | $OP_{OUT}$      | With embedded 1310 nm laser        | 2                 | 3   | -   | dBm   |
|                                  |                 | With embedded 1550 nm laser        | 5                 | 6   | -   | dBm   |
| Jitter                           | $J_{RMS}$       | RMS Jitter, NRZ mode               | -                 | 0.8 | -   | ps    |
|                                  | $J_{PP}$        | Peak-to-Peak Jitter, NRZ mode      | -                 | 5   | -   | ps    |
| Minimum dynamic extinction ratio | $DER_{MIN}$     | By NRZ data input level adjustment | 2                 | -   | -   | dB    |
| Maximum dynamic extinction ratio | $DER_{MAX}$     | By NRZ data input level adjustment | -                 | 10  | 13  | dB    |
| Dynamic Signal to Noise Ratio    | SNR             | NRZ mode                           | -                 | 12  | -   | dB    |
| Rise / fall time                 | $t_r / t_f$     | NRZ mode                           | -                 | 15  | -   | ps    |
| Crosspoint                       | -               | NRZ mode                           | 45                | 50  | 55  | %     |
| Optical return loss              | ORL             | -                                  | -40               | -45 | -   | dB    |
| Side Mode Supression Ratio       | SMSR            | -                                  | 30                | -   | -   | dB    |
| Spectrum linewidth               | $\Delta\lambda$ | FWHM                               | -                 | 1   | -   | MHz   |

**1310 nm & 1550 nm DFB Lasers Specifications** The laser 1310 nm & 1550 nm lasers are embedded by default.

| Parameter                       | Symbol          | Condition                       | Min               | Typ | Max | Unit |
|---------------------------------|-----------------|---------------------------------|-------------------|-----|-----|------|
| Lasers type                     | -               | -                               | DFB               |     |     | -    |
| Wavelength                      | $\lambda$       | Embedded by default             | 1310 nm & 1550 nm |     |     | -    |
| Wavelength laser tuning range   | -               | Diode chip temperature control  | -                 | 0.8 | 1   | nm   |
| Optical output power adjustment | -               | Diode Injection current control | 0                 | -   | 100 | %    |
| Spectrum linewidth              | $\Delta\lambda$ | FWHM                            | 1                 | 2   | -   | MHz  |
| Side Mode Suppression Ratio     | SMSR            | -                               | 35                | -   | -   | dB   |
| Optical Return Loss             | ORL             | -                               | 30                | -   | -   | dB   |

**Tunable C-Band Laser Specifications Option**

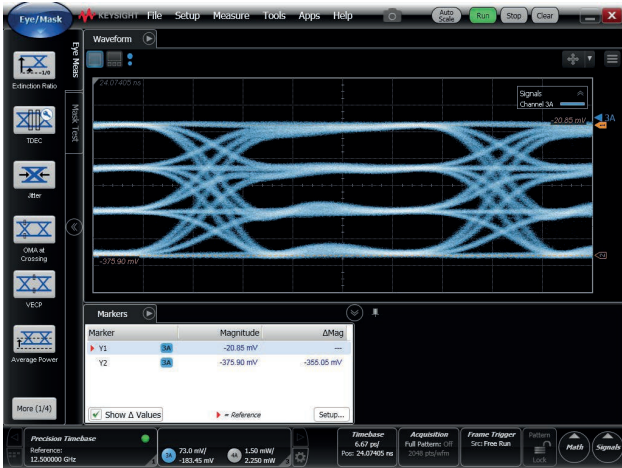
| Parameter                       | Symbol          | Condition                       | Min     | Typ | Max     | Unit |
|---------------------------------|-----------------|---------------------------------|---------|-----|---------|------|
| Wavelengths laser tuning range  | $\lambda$       | -                               | 1527.60 | -   | 1565.50 | nm   |
| Optical output power            | -               | CW                              | -       | 15  | -       | dBm  |
| Optical output power adjustment | -               | Diode Injection current control | 0       | -   | 100     | %    |
| Spectrum linewidth              | $\Delta\lambda$ | FWHM, instantaneous             | -       | 100 | -       | kHz  |
| Side Mode Suppression Ratio     | SMSR            | -                               | 40      | 55  | -       | dB   |
| Optical Return Loss             | ORL             | -                               | 30      | -   | -       | dB   |

**Absolute Maximum Ratings**

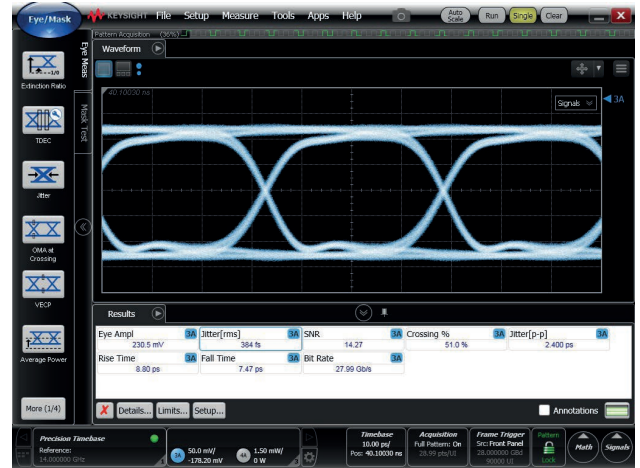
Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute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

| Parameter           | Symbol    | Min | Max | Unit |
|---------------------|-----------|-----|-----|------|
| Input voltage       | $V_{IN}$  | -   | 1   | Vpp  |
| Optical input power | $OP_{in}$ | -   | 20  | dBm  |

Electrical Eye Diagram

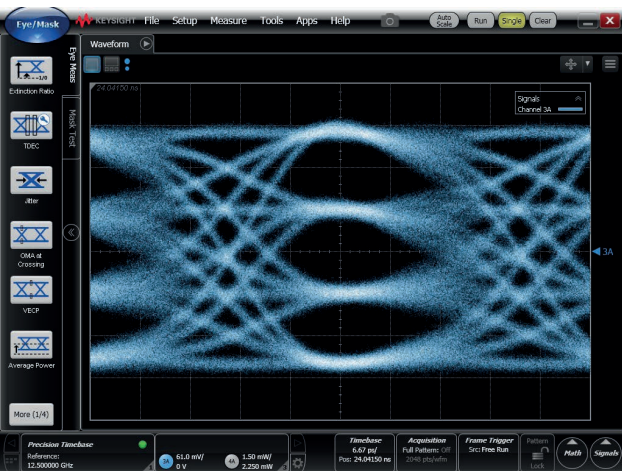


PAM-4 28 Gbaud

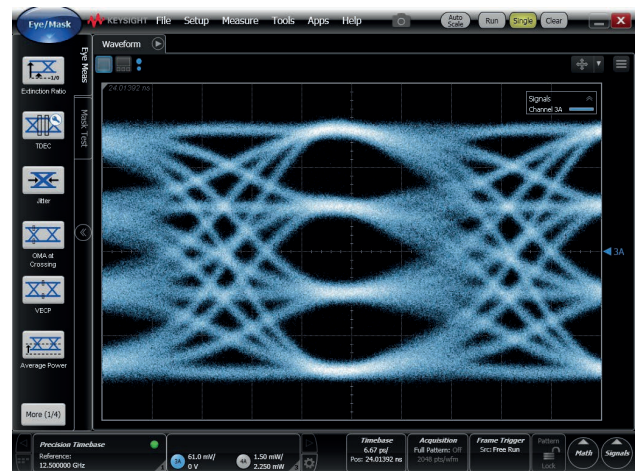


NRZ 28 Gb/s

Eye Diagrams - PAM-4 25 Gbaud From ModBox-1310nm-1550nm-28Gbaud-PAM4

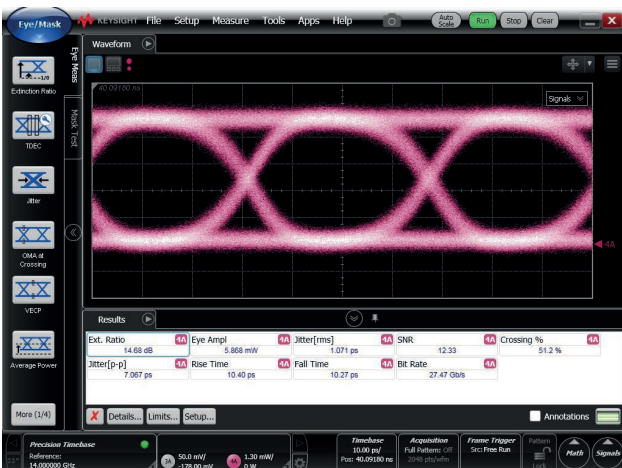


Using internal 1310 nm laser source

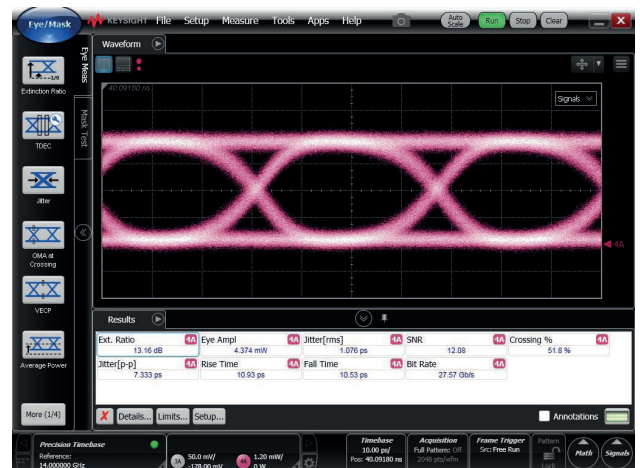


Using internal 1550 nm laser source

Eye Diagrams - PAM-4 25 Gbaud From ModBox-1310nm-1550nm-28Gbaud-PAM4



Using internal 1310 nm laser source



Using internal 1550 nm laser source



Interfaces, Dimensions and Compliance

|                       |  |
|-----------------------|--|
| Interfaces            |  |
| Optical               | Polarization maintaining fiber PM - FC/APC (by default, other connectors type in option) |
| RF input              | Single 1.85 mm female RF connector - 50 Ω  |
| Control               | Smart Interface (front panel), GUI (USB typeB)   |
| Power supply          | 100-120V/220-240 automatic switch 50-60Hz (Rear panel)                                   |
| EMC and optical norms | EN61326-1 Ed. 2006 / NF EN 60825-1 & EN 60825-2 Ed.2014                                  |
| Dimensions / Weight   | Rack 19" x 3U, Depth = 495mm / 3 kg  |



Ordering information

**ModBox-1310nm-1550nm-28Gbaud-PAM4**

1310nm-1550nm = 1310 nm & 1550 nm operation, embedded lasers  
28Gbaud = Data-rate: NRZ up to 28 Gb/s - PAM-4 up to 28 Gbaud

**Opt-TunC**

TunC = Full C-Band Tunable laser  
This laser comes instead of embedded DFB 1550 nm laser

**Opt-YY**

YY = Output connectors, FA : FC/APC - FC : FC/UPC - SA : SC/APC - SC : SC/UPC

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.