

ModBox-CBand-28Gb/s-DPSK

C-Band, 28 Gb/s DPSK Reference Transmitter

ModBox



FEATURES

- Full C-Band Reference Transmitter
- Up to 28 Gb/s
- Reliable & reproducible measurements
- High eye diagram stability

APPLICATIONS

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

OPTIONS

- Tunable Laser source, C-Band, L-Band
- DPSK encoder
- Receiver stage
- Fixed, tunable FSR optical demodulator
- Multi-formats version:
NRZ & RZ, NRZ & RZ-DPSK, CS-NRZ-DPSK

The ModBox-CBand-28Gb/s-DPSK is an optical modulation unit that generates high performance Differential Phase-Shift Keying (DPSK) optical data streams up to 28 Gb/s. The equipment incorporates a modulation stage based on a high bandwidth LiNbO₃ Mach-Zehnder modulator, coupled with a high performance RF driver and an automatic bias control circuitry. A receiver stage based on a delay line interferometer and balanced detector can be implemented to offer a solution for demodulation of DPSK-encoded optical signals and conversion back into electrical data stream. The ModBox can also receive an internal laser source (DFB, ITLA...).

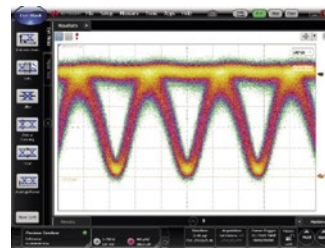
The ModBox is remotely controlled over a standard USB connection using the software package provided and its friendly Smart interface.

The ModBox-CBand-28Gb/s-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.

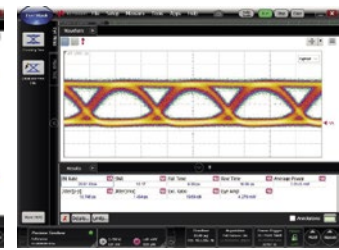
In addition to the traditional C-Band wavelength range, it is also available in the O-Band.

Performance Highlights

| Parameter | Min | Typ | Max |
|----------------------|---------|--------|-----|
| Operating wavelength | - | C-Band | - |
| Modulation format | DPSK | | |
| Modulation bandwidth | 28 Gb/s | | |



28 Gb/s Optical DPSK Eye Diagram



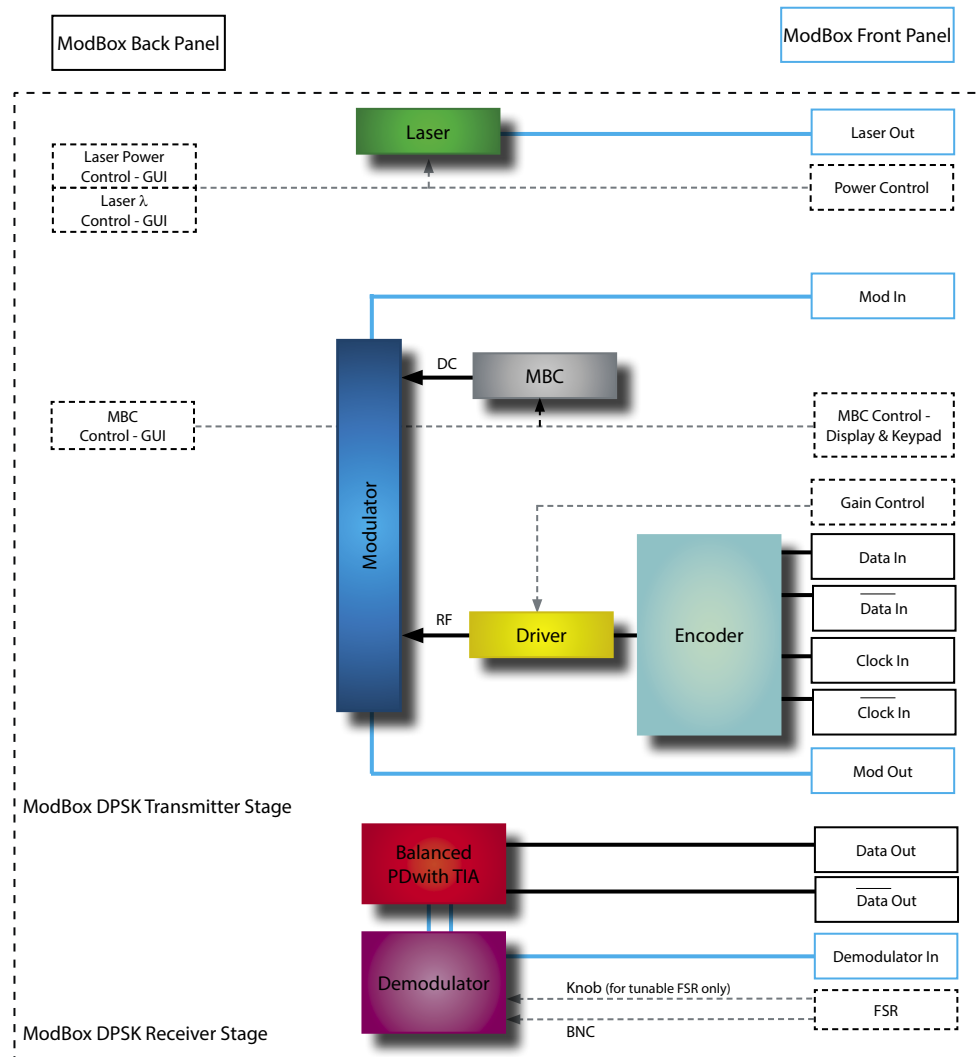
28 Gb/s Electrical Demodulated Eye Diagram

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Functional Block Diagram



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

- a high bandwidth, chirp-free, X-cut LiNb₃ 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 (tunable FSR) and balanced photodiodes.

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Input Electrical Specifications User supplied, not a ModBox specification

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|------------------------------|---------------------------------|--|-----|-----|-----|------|
| Data-rate | PRBS | NRZ | 0.1 | - | 28 | Gb/s |
| Input voltage (Data & Clock) | $V_{IN-Data}$ $V_{IN-Clock}$ | AC coupled - Single ended 50 Ω | - | 300 | - | mVpp |
| | | AC coupled - Differential 100 Ω | - | 600 | - | mVpp |
| Rise / fall time | t_r / t_f | 20 % - 80 % | - | 13 | 18 | ps |
| Cross point | - | - | 45 | 50 | 55 | % |

Input Optical Specifications User supplied, not a ModBox specification

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|-------------------------------|-----------------|-----------|-----------------------|-----|-----|------|
| Operation | λ | CW | C-Band | | | - |
| Polarization | - | - | Linear and controlled | | | - |
| Power | P | - | - | 10 | 16 | dBm |
| Side Mode Supression Ratio | SMSR | - | 30 | - | - | dB |
| Spectrum linewidth | $\Delta\lambda$ | FWHM | - | 1 | - | MHz |
| Polarization extinction ratio | PER | - | - | 19 | - | dB |

Modulated Output Optical Specifications Specifications below are given with embedded 1550 nm

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|-------------------------------|-------------|--------------------------------------|-----|-----|-----|------|
| Data-rate | - | DPSK - Differential encoder embedded | 0.1 | - | 28 | Gb/s |
| Dynamic Signal to Noise Ratio | SNR | - | 13 | 16 | - | dB |
| Rise / fall time | t_r / t_f | 20 % - 80 % | - | 15 | 18 | ps |
| Optical return loss | ORL | - | -40 | -45 | - | dB |
| Insertion loss | IL | At maximum modulator transmission | - | 5 | - | dB |
| Static extinction ratio | SER | - | 20 | - | - | dB |
| Electrical return loss | ERL | - | 10 | - | - | dB |

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: $Q_{n+1}=Q_n$. 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.

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 |
|------------------------------|-----------|------|-----|------|
| Input voltage (Data / Clock) | V_{IN} | -0.5 | 4.6 | V |
| Optical input power | OP_{in} | - | 20 | dBm |

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Demodulated Output Optical Specifications Measured with ModBox DPSK Transmitter and Receiver Stages.

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|-----------------------|--------------|---|--------|-----|-------|------|
| Operation | λ | - | C-Band | | | - |
| Maximum optical power | OP_{IN} | - | - | - | 5 | dBm |
| Data-rate | - | Differential | 6 | - | 28 | Gb/s |
| FSR tuning range | ΔFSR | Manual adjustment knob (front panel) | - | - | 1.5 | - |
| Phase tuning voltage | - | - | 0 | - | 4 | V |
| Optical eye amplitude | - | Differential with TIA - $OP_{IN} = 3.5$ dBm | - | - | 1 800 | mVpp |

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 | $\Delta\lambda$ | 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 |

C-Band Tunable Laser Specifications

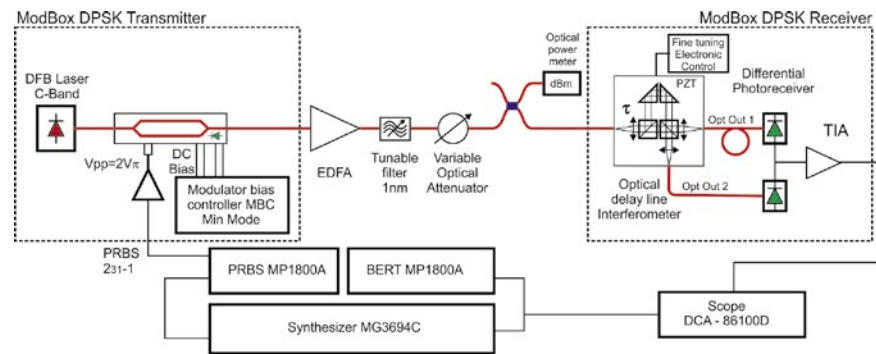
| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---------------------------------|-----------------------|----------------------------|---------|-----|---------|------|
| Laser type | - | - | Tunable | | | - |
| Wavelength | λ | Embedded by default | 1527.60 | - | 1565.50 | nm |
| Wavelength accuracy | $\Delta\lambda_{acc}$ | - | -1.5 | - | 1.5 | GHz |
| Spectrum linewidth | $\Delta\lambda$ | FWHM @-3 dB, instantaneous | - | - | 100 | kHz |
| Optical output power | - | CW | 5 | - | 35 | mW |
| Optical output power adjustment | - | - | 0 | - | 100 | % |
| Optical Return Loss | ORL | - | 30 | - | - | dB |
| Side Mode Suppression Ratio | SMSR | - | 40 | - | - | dB |

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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)



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Interfaces, Dimensions and Compliance

| Interfaces | |
|-------------------------|--|
| Optical | Polarization maintaining fiber, PM1550 / SMF58 (demodulator) |
| RF input (Data & Clock) | Differential SMA female RF connector 100 Ω – Single Ended SMA female RF connector 50 Ω |
| Control | Smart Interface (front panel) & GUI (USB typeB) |
| | MBC, Driver Gain, Laser (power & wavelength), optical demodulator fine adjustment, TIA driver gain |
| Power supply | 100-120V/220-240 automatic switch 50-60Hz (Rear panel) |
| Dimensions / Weight | Rack 19" x 6U, Depth=375mm / 6 kg |

Ordering information

ModBox-CBand-DPSK-XX-Rx

CBand = Full band of operation, embeds laser, C-Band Tunable laser by default
 XX = Data-rate: 12.5Gb/s up to 12 Gb/s- 28Gb/s up to 28 Gb/s
 RX = Receiver option

Opt-XXTun

Tunable laser option
 XX = Optional additional laser band : C : C-Band

Opt-DFB

DFB laser option
 Optional additional laser at 1550.12 nm

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 (LiNbO₃) 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.

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