Fiber Optical Modulator DP-QPSK (I-Q) Dual Polarizations

1530-1610 nm, 30GHz, 128Gbps

DATASHEET

Return to the Webpage

Features

- Low Drive Voltage, RF Vπ Voltage 3.5V@32GBaud
- 128Gbps (32GBaud) Mach-Zehnder Modulator for DP-QPSK Transmission Format
- Separated DC Bias Port for Each Mach-Zehnder Interferometer
- Dual QPSK modulators and Polarization Beam Combiner are Integrated in One Package
- Integrated Monitor Photodiode for Auto Bias Control
- Low Insertion Loss, ≤12dB

Applications

- DP-QPSK 128Gps Optical Transmission System

Note: The specifications provided are for general applications with a cost-effective approach. If you need to narrow or expand the tolerance, coverage, limit, or qualifications, please [click this link]:

RoHS COMPLIANT

ATTENTION
OBSERVE PRECAUTIONS FOR HANDLING ELECTROSTATIC SENSITIVE DEVICES

The DQPSK-series fiber-optic modulator has an analog bandwidth of 30 GHz that supports 128 Gbps digital transmission using the DP-QPSK format, integrating four independently driven Mach–Zehnder interferometers (each offering ~30 GHz bandwidth, a low 3.5 V Vπ, dedicated DC-bias ports, and monitor photodiodes for automatic bias control) in a single package. Two MZI pairs form dual I/Q modulators for the X- and Y-polarization paths, where the two arms correspond to the in-phase (I) and quadrature (Q) electrical inputs, enabling full complex modulation. A single-polarization CW laser is split into two orthogonal polarization channels, modulated independently, and recombined to produce a dual-polarization output. The design achieves 128 Gbps by combining a 30-Gbaud symbol rate with QPSK modulation (2 bits/symbol) and dual polarization, effectively utilizing all four MZIs to quadruple the data rate compared to a single-polarization modulator. The device provides ≤12 dB insertion loss and supports the full C+L band. Matching dual-channel RF amplifiers and an automatic bias controller are also available to simplify system integration.

The device is based on a traveling push-pull waveguide electrode design. We offer mounting the device on an automatic bias control PCB option for convenient application.

Warning: The photodetector pins are highly sensitive to electrostatic discharge (ESD). Extreme caution must be exercised during handling to prevent permanent damage.

Note: Without a bias controller, the device will not function properly.

Note: This component is intended for OEM system integration and is not designed for standalone laboratory use. Units supplied without a protective benchtop enclosure are provided without warranty, as they are susceptible to damage from improper handling, installation, or operation.

Specifications *

Parameter		Min	Typical	Max	Unit
Operating Wavelength		1530		1610	nm
Optical Bandwidth (-3dB Down)		23	28	35	GHz
Insertion Loss (for each polarization)				14	dB
RF Drive Voltage (2Vp @20GHz)				7.5	Vpp
Bias Half Ware Voltage			12	14	V
Monitor PD Responsivity				0.001	A/W
RF Impedance			50		ohm
DC Extinction Ration for Parent MZI [1]		22			dB
DC Extinction Ration for Child MZI [1]		20			dB
Optical Delay (between X and Y)	*1	-6		-1	ps
	*2	13.5		18.5	
Operating Temperature		-5		75	°C
Package Size (L x W x H)		79.4 x 13.2 x 7.0			mm

Notes:
[1]. With bias control

Note: Applying over the maximum RF control voltage or optical power will burn the device. Only the protected benchtop package has warranty.

Rev 07/20/26

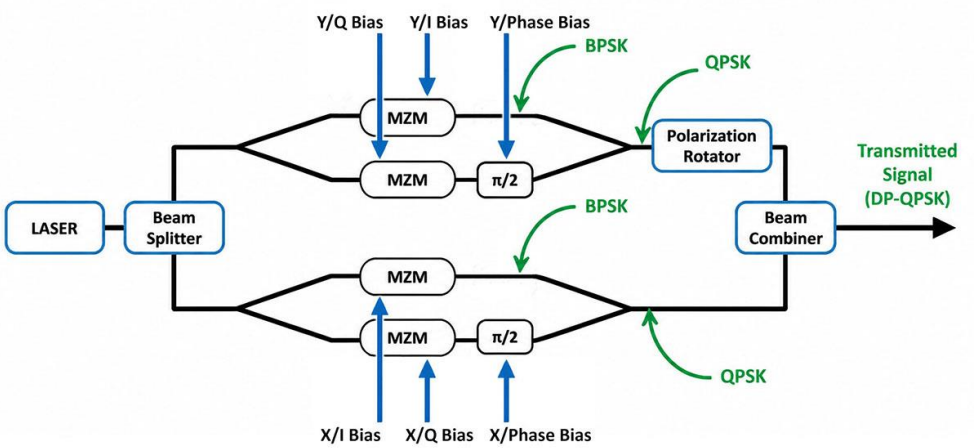
P +1 781-935-1200 E sales@agiltron.com W www.agiltron.com

Fiber Optical Modulator DP-QPSK (I-Q) Dual Polarizations

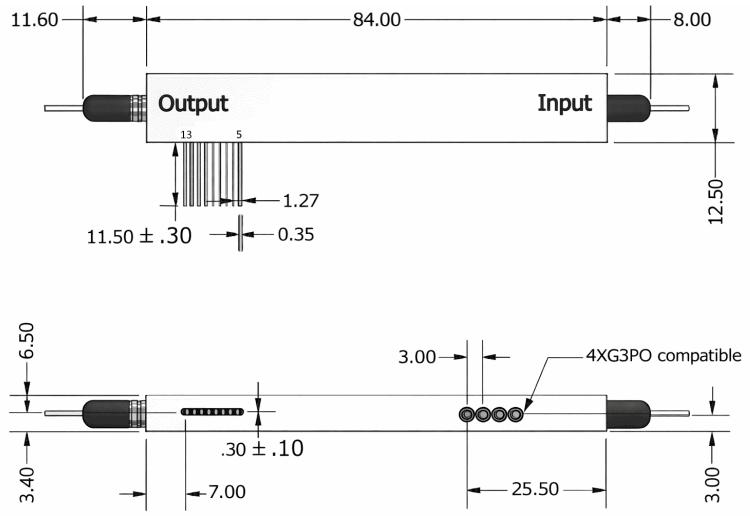
1530-1610 nm, 30GHz, 128Gbps

DATASHEET

Functional Diagram



Mechanical Dimensions (mm)



*Product dimensions may change without notice. This is sometimes required for non-standard specifications.

Pin Definition

Pin No.	Symbol	Function
1	PD1-A	Monitor Photodiode 1 Anode (I-arm)
2	PD1-K	Monitor Photodiode 1 Cathode (Common)
3	GND	Ground
4	MZC2	DC Bias for Parent (Amplitude) MZI
5	MZC1	DC Bias for Parent (Phase) MZI
6	MZA2	DC Bias for Child MZA2
7	MZA1	DC Bias for Child MZA1
8	MZB2	DC Bias for Child MZB2
9	MZB1	DC Bias for Child MZB1

Fiber Optical Modulator DP-QPSK (I-Q) Dual Polarizations

1530-1610 nm, 30GHz, 128Gbps

DATASHEET

Device Mounted On Automatic Bias Controller

Fiber Optical Modulator DP-QPSK (I-Q) Dual Polarizations

1530-1610 nm, 30GHz, 128Gbps

DATASHEET

Ordering Information (Part Number)

	5	☐	☐	☐	5	5	☐	☐
Prefix	**Wavelength**	**Auto Bias Controller**	**Connector [1]**	**RF Amplifier**	**Input Fiber**	**Output Fiber**	**Benchtop [2]**	**RF Connector**
DPSD-	1550 nm = 5	Non = 1 Yes = 2 Special = 0	Non = 1 FC/APC = 2	Non = 1 Yes = 2	PM1550 = 5	PM1550 = 5	None = 1 Yes = 2	GPPO = 1 SMA = 2

[1]. The default connector configuration uses fiber with 0.9 mm buffer protection. The connector cannot be installed directly onto bare fiber because the bare fiber is prone to damage during shipping. However, the connector can be assembled on bare fiber if a 3 cm protective loose tube is added for reinforcement. The customer may remove this protective tube after testing. The optical power handling of a standard connector is less than 0.5 W for SMF-28 fiber and decreases further for smaller-core fibers.

[2]. Turn-key package integrates two differential RF linear amplifiers, auto bias controller, and power supply.

Application Notes

Fiber Optical Modulator DP-QPSK (I-Q) Dual Polarizations

1530-1610 nm, 30GHz, 128Gbps

DATASHEET

Instruction for Comprehensive Characterization Procedure for $LiNbO_3$ Modulator

1. Initial Setup and Inspection

- **Visual inspection**: Check for fiber integrity, waveguide cleanness, electrode contacts.
- **Connector integrity**: Inspect RF and optical connectors for damage or debris.
- **Polish & clean fibers**: Use fiber scope and fiber wipes if necessary.
- **Thermal stabilization**: Place the device on a temperature-controlled stage (if needed).

2. Electrical & RF Interface Check

- Measure **RF return loss (S11)** using a VNA.
- Confirm **50 Ω impedance matching** across the modulator's bandwidth.
- Verify the **bias-T (if present)** does not short or distort the signal.
- Check for **electrode continuity** and isolation between electrodes.

3. Optical Characterization

a. Insertion Loss

- Use a narrow-linewidth laser (e.g., at 1550 nm).
- Launch light into input fiber and measure output power.
- Insertion Loss = 10·log(Pin / Pout)
  (Typical $LiNbO_3$ insertion loss: 3–7 dB)s.

b. Extinction Ratio (for MZIs)

- Apply DC voltage sweep to modulation electrodes.
- Record maximum and minimum output powers.
- ER = 10·log(Pmax / Pmin)
  (Good ER: >20 dB for analog, >30 dB for digital).

c. Vπ Measurement (Half-wave voltage)

- Apply a slowly varying triangular or sinusoidal voltage.
- Measure output optical power vs. voltage.
- Determine Vπ = voltage required to induce a π phase shift (first null).
- Also check **Vπ·L** product (performance metric).

4. Electrical & RF Interface Check

- Connect modulator RF input to a signal generator or VNA (S21 test).
- Bias the MZI at quadrature (linear point of transfer curve).
- Apply RF sweep from 100 kHz to >20 GHz (or device limit).
- Use a fast photodiode and spectrum analyzer or VNA.
- Record **modulation response (S21)**:
  - Bandwidth = −3 dB point from peak response.
  - Watch for peaking or drop-offs due to impedance mismatch or piezoelectric resonances.

5. Linearity Tests (for Analog Applications)

- Use two-tone RF input (e.g., f1 = 10 GHz, f2 = 10.01 GHz).
- Measure intermodulation distortion (IMD3).
- Calculate **Spurious-Free Dynamic Range (SFDR).**

6. Bias Drift / Stability Testing

- Apply DC bias and monitor optical output over time.
- Check for **DC drift**, typically caused by photorefractive or charge trapping effects.
- Test under light-on and light-off conditions.
- Optional: Integrate **auto-bias control loop**.

7. Thermal Response (Optional)

- Vary modulator temperature (e.g., from 20°C to 70°C).
- Track **Vπ, insertion loss, and ER** as a function of temperature.
- Identify thermal sensitivity and hysteresis.
- Important for packaged systems or field deployments.

8. High-Power Handling & Backreflection

- Gradually increase optical input power (with isolator).
- Watch for power-induced drift or photorefractive effects.
- Check backreflections using an **optical return loss meter (ORL).**

9. Data Logging and Reporting

- Capture all test data in a structured format.
- Plot:
  - Optical power vs. voltage (transfer function)
  - S21 vs. frequency
  - Vπ vs. temperature
  - Drift vs. time
- Include tables for:
  - Insertion loss
  - ER
  - Vπ and bandwidth
  - Bias stability
  - RF return loss

Optional Advanced Tests:

- **Jitter analysis** (for digital modulators)
- **Bit Error Rate Testing (BERT)** for NRZ or PAM signals
- **Eye diagram measurements**
- **Pulse response and rise/fall time**
- **Photorefractive damage threshold test**

P +1 781-935-1200 E sales@agiltron.com W www.agiltron.com

Fiber Optical Modulator DP-QPSK (I-Q) Dual Polarizations

1530-1610 nm, 30GHz, 128Gbps

DATASHEET

RF Performance