

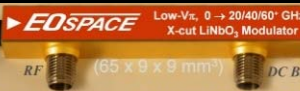
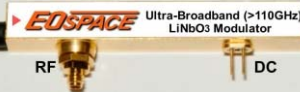
2018

## Advanced Products

$\lambda$  (0.65, 0.78, 0.85, 0.98, 1.06, 1.3, 1.55, 1.7, 2.0<sup>+</sup>  $\mu\text{m}$ )

- **Low- $V_{\pi}$** : 1x1, 1x2, 2x2 X-cut (zero-chirp) 20 & 40 & 60<sup>+</sup> GHz Compact Modulators
- **Low- $V_{\pi}$** : Intensity & Phase Modulators (<4V, <3.5V, <3V, custom <2.5V, ~2V)
- **Low- $V_{\pi}$** : QPSK (I/Q) Dual-Parallel Nested-MZM X-cut Modulators
- 1x1, 1x2 **Dual-Drive Low- $V_{\pi}$**  (<2.5V/side) 10 & 20 & 40<sup>+</sup> GHz Modulators
- Custom: **Extremely-High Extinction-ratio** (>30, >40, >50, >60dB) Modulators
- Custom: **High power-handling** Modulators:  $\lambda$ 1.55 $\mu\text{m}$  (>1W);  $\lambda$ 1.06 $\mu\text{m}$  (>1/2W); 0.8 $\mu\text{m}$  (please call)
- Custom: **Extremely-High temperature-handling** Modulators: -55 $^{\circ}\text{C}$   $\rightarrow$  > +150 $^{\circ}\text{C}$
- Custom: **Ultra-wideband** (DC  $\rightarrow$  60<sup>+</sup>GHz; DC  $\rightarrow$  110<sup>+</sup>GHz) LiNbO<sub>3</sub> Modulators
- Custom: **Y-branch 1x2 Phase** modulator
- Custom: **Ultra-compact** LiNbO<sub>3</sub> modulators
- Custom: Application-specific LiNbO<sub>3</sub> components

65 x 8.9 x 8.9 mm<sup>3</sup>



for High-Dynamic-Range 0  $\rightarrow$  20/40/60<sup>+</sup> GHz RF Fiber Optic Links  
65x9x9mm<sup>3</sup> with 2.9mm connector; thinner 65x5x9mm<sup>3</sup> with GPPO



## Low- $V_{\pi}$ 1x1, 1x2, 2x2 X-cut (0-chirp) Compact Modulators

- 20G version: Low- $V_{\pi}$  ~ 3.5-3.8V@1GHz; >20-25GHz; <4dB (<3dB option)
- 40G version: Large BW ~ 30-40GHz;  $V_{\pi}$  ~ 4.5-4.9V@1GHz; <4dB (<3dB option)
- **Extended frequency** operation versions (to >60<sup>+</sup>GHz) available

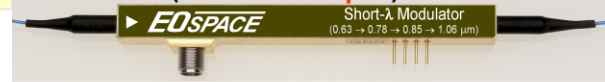
## Low- $V_{\pi}$ QPSK (I/Q) Dual-Parallel MZM (X-cut Single-Drive)

- 25<sup>+</sup> Gbaud version: Low- $V_{\pi}$  ~ 2.9-3.3V@1GHz; >20-25GHz; Excess Loss: <4dB
- 50 Gbaud version: >30-35GHz;  $V_{\pi}$  ~ 3.9-4.3V@1GHz; Excess Loss: <4dB

## Short- $\lambda$ : 0.65 $\rightarrow$ 0.78 $\rightarrow$ 0.85 $\rightarrow$ 0.98 $\rightarrow$ 1.06 $\mu\text{m}$ Phase & Intensity

- 10 & 20 & 40GHz,  $V_{\pi}$ : <4V, <3V & <2V, Insertion loss: <4, <3 & 2dB-custom
- **High-Extinction-Ratio** versions ( $\lambda$ =1.06 $\mu\text{m}$ : 30, 40 & 50dB)

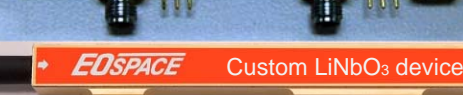
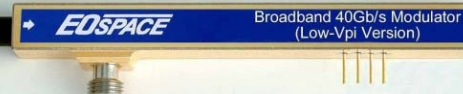
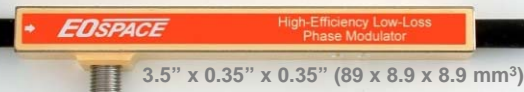
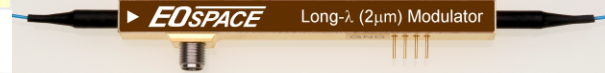
## Short- $\lambda$ (0.63 $\rightarrow$ 1.06 $\mu\text{m}$ ) Modulators



## Long- $\lambda$ : 2 $\mu\text{m}$ Intensity & Phase Modulators (10 & 20 & 40<sup>+</sup>GHz)

- Insertion loss: <4dB, 3dB & (2dB - custom)
- $V_{\pi}$ : Intensity modulator: <7V, (5V-opt.); Phase Modulator:  $V_{\pi}$  <10V, (7V-opt.)

## Long- $\lambda$ (2<sup>+</sup> $\mu\text{m}$ ) Modulator



## 10 & 20 & 40 & 60<sup>+</sup> GHz Phase Modulators

- **Ultra-Low- $V_{\pi}$**  version: ~3V@1GHz, ~20GHz, <4 & <3dB
- **Extra-Bandwidth** version: ~4V@1GHz, ~30GHz, <4 & <3dB
- **Very-Low-Loss** version: <2dB & <3dB, <5V@1GHz, 10&20GHz
- **Extended frequency of operation** option: >50, >60, >65GHz

## 40/60<sup>+</sup> GHz (Z-cut & X-cut) Modulators

- $V_{\pi}$  ~ 4.5V@1GHz, ~30-40GHz, ~4dB (~3dB-opt)
- **Lower- $V_{\pi}$  Options**: ~4.0V & ~3.5V, ~25-35GHz, <4dB, (<3dB-option)
- **Extended frequency of operation**: >50, >60, >65 GHz
- **Low- $V_{\pi}$**  (<2.5V/side) **Dual-Drive** (10/20/40GHz) Modulator

## 10 & 20<sup>+</sup> Gb/s (Z-cut & X-cut) Modulators

- **Z-cut: Pre-chirp**: Low-Loss <3dB, (<2dB option)
  - BW >12.5GHz, (>18GHz version);  $V_{\pi}$  <5V, <4V@1GHz
  - Lower- $V_{\pi}$  versions:  $V_{\pi}$  <3.5V@1GHz; <3V, <2.5V (custom)
- **X-cut: Zero-chirp**: Low-Loss <4dB, (<3dB option)
  - BW >12.5GHz, (>18GHz version);  $V_{\pi}$  <5, <4.5V@1GHz
  - Lower- $V_{\pi}$  versions:  $V_{\pi}$  <4V@1GHz; <3V, <2.5V (custom)

Other available : • 1x2 (& 2x2) Dual-Outputs • Dual- $\lambda$ : 1300/1550nm • Integrated PD • Ultra-High-Power Handling (>1W, >2W) device versions : • High Extinction-Ratio (>30 & >40 & >50 & >60dB) • Extended Temperature Range (-40 $^{\circ}\text{C}$  & -55 $^{\circ}\text{C}$   $\rightarrow$  +100 $^{\circ}\text{C}$ )

## General Polarization Control, Tracking, Scrambling



## High-speed Polarization Controllers

- Low Insertion Loss <3dB, (~2dB option)
- Multiple Integrated Device Stages: 1, 3, 4, 6, 8

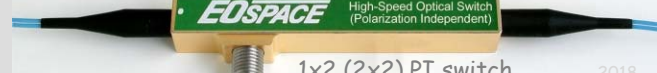
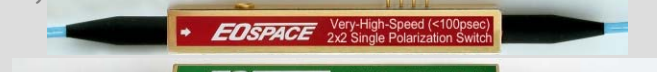
## High-speed 1x2, 2x2, 1xN, NxN Switches

Single-Polarization (SP) or Polarization-Independent (PI)



1x8 SP Switches

1x2 (2x2) SP switch



1x2 (2x2) PI switch