EOspace

Exceptionally-Low-Loss LiNbO₃ **E**lectro-**O**ptical Devices & ICs
Technology Originally Developed for Defense/Aerospace Systems

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2017 Advanced Products

λ (0.65, 0.78, 0.85, 0.98, 1.06, 1.3, 1.55, 1.7, 2.0⁺ μm)

- **Low-Vπ**: 1x1, 1x2, 2x2 **X-cut** (zero-chirp) **20 & 40 & 60⁺ GHz Compact** Modulators
- **Low-Vπ**: Intensity & Phase Modulators (**<4V, <3.5V, <3V**, custom **<2.5V**)
- **Low-Vπ**: **QPSK (I/Q)** Dual-Parallel Nested-MZM **X-cut** Modulators
- 1x1, 1x2 **Dual-Drive Low-Vπ** (<2.5V/side) **10 & 20 & 40⁺ GHz** Modulators
- Custom: **Extremely-High Extinction-ratio** (>30, >40, >50, >60dB) Modulators
- Custom: **High power-handling** Modulators: λ1.55μm(>1W); λ1.06μm(>1/2W); 0.8μm (please call)
- Custom: **Extremely-High temperature-handling** Modulators: -55°C → > +150°C
- Custom: **Ultra-wideband** (DC → 60⁺GHz; DC → 110⁺GHz) LiNbO₃ Modulators
- Custom: **Y-branch 1x2 Phase** modulator
- Custom: **Ultra-compact** LiNbO₃ modulators
- Custom: Electro-optic LiNbO₃ components

65 x 8.9 x 8.9 mm³

Ultra-Broadband (>110GHz) LiNbO3 Modulator — RF — DC

Y-BRANCH DUAL PHASE MODULATOR — EOSPACE Made in USA S/N:
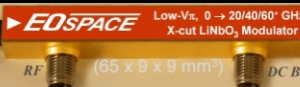
Low-Vπ, 0 → 20/40/60⁺ GHz X-cut LiNbO₃ Modulator — RF — (65 x 9 x 9 mm³) — DC Bias
for **High-Dynamic-Range 0 → 20/40/60⁺ GHz** RF Fiber Optic Links
65x9x9mm³ with 2.9mm connector; thinner 65x5x9mm³ with GPPO

Low-Vπ 1x1, 1x2 , 2x2 X-cut (0-chirp) Compact Modulators
- **20G** version: Low-Vπ ~ 3.5-3.8V@1GHz; >20-25GHz; <4dB (<3dB option)
- **40G** version: Large BW~ 30-40GHz; Vπ ~4.5-4.9V@1GHz; <4dB (<3dB option)
- **Extended frequency** operation versions (to >60/70GHz) available

QPSK Modulator — I — DC-I — Q — DC-Q — phase

## Low-Vπ QPSK (I/Q) Dual-Parallel MZM (X-cut Single-Drive)
- **25⁺ Gbaud** version: Low-Vπ ~2.9-3.3V@1GHz; >20-25GHz; Excess Loss: <4dB
- **50 Gbaud** version: >30-35GHz; Vπ ~3.9-4.3V@1GHz; Excess Loss: <4dB

Short-λ: 0.65→0.78→0.85→0.98→1.06μm Phase & Intensity
- **10 & 20 & 40GHz**, Vπ: <4V,<3V & <2V, Insertion loss:<4, <3 & 2dB-custom
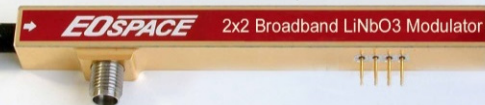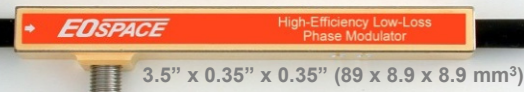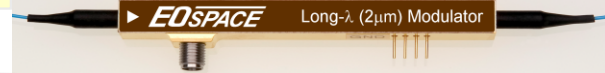- **High-Extinction-Ratio** versions (λ=1.06μm: 30, 40 & 50dB)

Short-λ (0.63 →→1.06 μm) Modulators
Short-λ Modulator (0.63 → 0.78 → 0.85 → 1.06 μm)
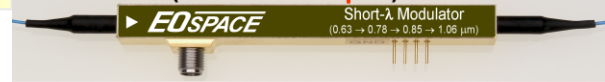
Long-λ: 2μm Intensity & Phase Modulators (10 & 20 & 40⁺GHz)
- Insertion loss: <4dB, 3dB & (2dB – custom)
- Vπ : Intensity modulator: <7V,(5V-opt.); Phase Modulator: Vπ <10V,(7V-opt.)

Long-λ (2⁺ μm) Modulator
Long-λ (2μm) Modulator

High-Efficiency Low-Loss Phase Modulator — 3.5" x 0.35" x 0.35" (89 x 8.9 x 8.9 mm³)

10 & 20 & 40 & 60⁺ GHz Phase Modulators
- **Ultra-Low-Vπ** version: ~3V@1GHz, >20GHz, <4 & <3dB
- **Extra-Bandwidth** version: ~4V@1GHz, >30GHz, <4 & <3dB
- **Ultra-Low-Loss** version: <2dB & <3dB, <5V@1GHz, 10&20GHz

2x2 Broadband LiNbO3 Modulator

40/60⁺ GHz (Z-cut & X-cut) Modulators
- **Z-cut: Pre-chirp**
  - Vπ ~3.5V@1GHz, BW >30-40GHz , <4dB, (<3dB option)
- **X-cut: Zero-chirp**
  - Vπ <4.5V@1GHz, BW >30-40GHz, <5dB,<4dB & (<3dB option)

Broadband 40Gb/s Modulator (Low-Vpi Version)

Low-Vπ (<2.5V/side) Dual-Drive (10/20/40GHz) Modulator

10 & 20⁺ Gb/s (Z-cut & X-cut) Modulators
- **Z-cut: Pre-chirp:** Low-Loss <3dB, (<2dB option)
  - BW >12.5GHz, (>18GHz version); Vπ <5V, <4V@1GHz
  - Lower-Vπ versions: Vπ <3.5V@1GHz; <3V, <2.5V (custom)
- **X-cut: Zero-chirp:** Low-Loss <4dB, (<3dB option)
  - BW >12.5GHz, (>18GHz version); Vπ <5, <4.5V@1GHz
  - Lower-Vπ versions: Vπ <4V@1GHz; <3V, <2.5V (custom)

Low-Loss Dual-Drive 40 Gb/s LiNbO₃ Modulator

Custom LiNbO₃ device

Other available : • 1x2 (& 2x2) Dual-Outputs • Dual-λ:1300/1550nm • Integrated PD • Ultra-High-Power Handling (>1W, >2W)
device versions : • High Extinction-Ratio (>30 & >40 & >50 & >60dB) • Extended Temperature Range (-40° & -55°C → +100°C)

General Polarization Control, Tracking, Scrambling

Polarization Controller

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)**

1x2 (2x2) SP switch

Very-High-Speed (<100psec) 2x2 Single Polarization Switch

High-Speed Optical Switch (Polarization Independent)

High-Speed Optical Switch

1x8 SP Switches

1x2 (2x2) PI switch

2017