

# Nonlinear and Electro-Optical Products

## Product Description

Lithium Niobate is a noncentrosymmetric large band-gap ferroelectric oxide crystal. It has nonlinear optical applications in harmonic generation, optical parametric oscillation and electro-optic modulation. It offers excellent transmission properties coupled with a high extinction ratio and low half-wave voltage. Deltronics Crystal grows large diameter high quality optical crystals from a congruent melt, using the Czochralski method.

## Applications

- Electro-optic Amplitude Modulators
- Electro-optic Phase Modulators
- Electro-optic Q-switches
- BPM Optical Parametric Conversion
- Binary Optics

## Features

- Excellent Transmission Properties
- High Extinction Ratio
- Grown by Czochralski Method

Figure 1. Type I Phase-matching Angle and Effective Second-Order Nonlinear Susceptibility

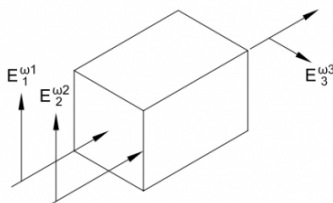


Figure 2. Type II Phase-matching Angle and Effective Second-Order Nonlinear Susceptibility

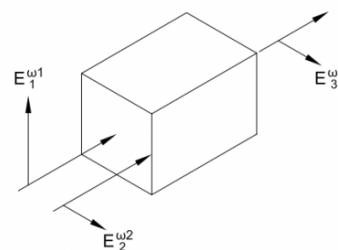
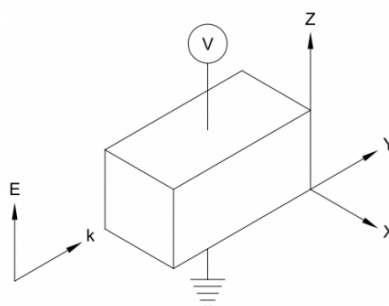


Figure 3. Transverse Electro-optic Modulator



Property at 25°C	Value
Empirical Formula	LiNbO <sub>3</sub>
Congruent Melt Composition	48.6 mole % Li <sub>2</sub> O
Congruent Melting Point (°C)	1253
Crystal Structure	trigonal
Space Group	R3c
Point Group	3m
Curie Temperature (°C)	1143
Density (g-cm <sup>-3</sup> )	4.612
Hardness (moh)	5
Thermal Expansion Coefficient (°C <sup>-1</sup> )	a = 16.7x10 <sup>-6</sup> c = 2.0 x 10 <sup>-6</sup>
Resistivity (ohm-cm)	> 10 <sup>14</sup> at 200°C
Bandgap (eV)	3.7
Lattice Constant (Å)	a = 5.14829 (hex) c = 13.8631 (hex)
Spontaneous Polarization (Coul/m <sup>2</sup> )	0.71
Dielectric Constants	$\hat{a}_{33}^s = 29$ $\hat{a}_{11}^s = 44$ $\hat{a}_{33}^s = 30$ $\hat{a}_{11}^T = 84$
NLO Coefficients at 1064nm (pm/V)	$d_{31} = -1.4$ $d_{33} = -2.1$ $d_{22} = 2.2$
Refractive Index, 1064nm	$n_o = 2.2340$ , $n_e = 2.1554$
Electro-optic Coefficients at 633nm [pm/V] (constant tension)	$r_{13} = 9.6$ $r_{22} = 6.8$ $r_{33} = 30.9$ $r_{51} = 32.6$ $r_c = 21.1$

<b>Crystallographic Orientations, Dimensions, and Tolerances</b>	
Standard Sizes	To customer specifications
Dimension Tolerances	$\pm 0.25\text{mm}$ on polished faces
Orientations	To customer specifications (X-ray oriented to $\pm 0.2$ degrees)
Flatness	$< \lambda/10$ at 633nm
Surface Quality	$< 10/5$ (scratch/dig)
Transmitted Wavefront	$< \lambda/10$ at 633nm
Edges	0.1 to 0.15mm chamfer at $45^\circ$
Dopants	To customer specification
Anti-reflection Coating	Specify wavelength of operation