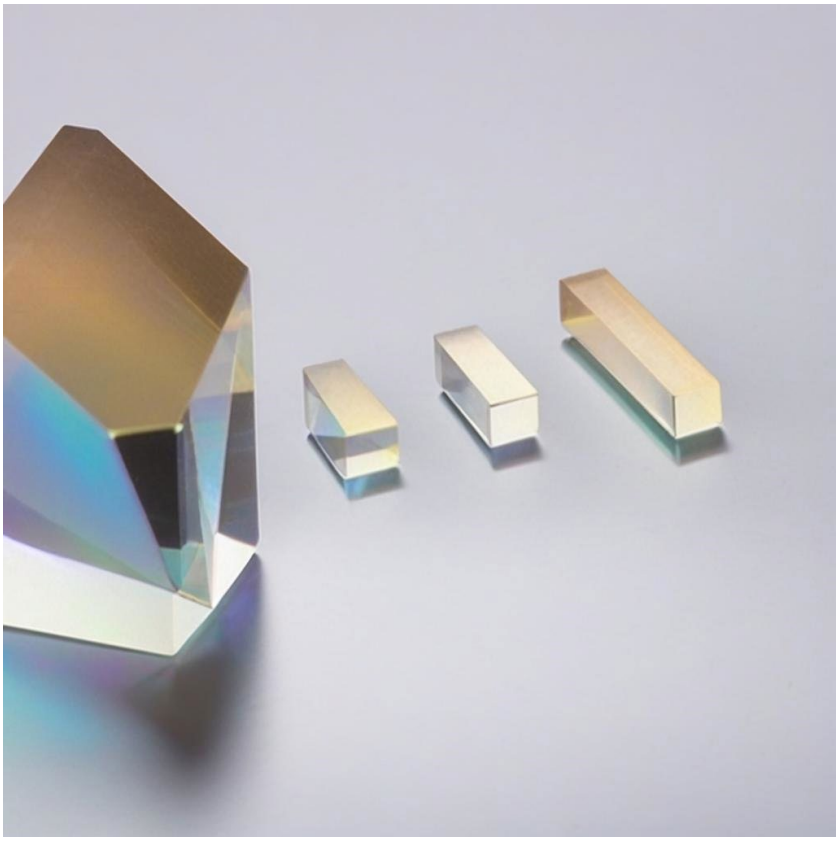
Photonics On Crystals

POC-OC-122408-RTP Crystal Datasheet

1. Main Features (Summary)

- High damage threshold, approximately 1.8 times higher than KTP, ensuring reliability in high-power laser systems.
- Excellent electro-optical properties, with fast response times for signal modulation up to 60 kHz.
- Non-hygroscopic and chemically stable, offering long-term durability in varied environments.
- Wide transmission range from 350 nm to 4500 nm, making it versatile for nonlinear and electro-optical applications.
- High resistivity and piezoelectric-free operation, ensuring stable performance in demanding applications.



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2. Material General Description

Rubidium Titanyl Phosphate (RTP, $RbTiOPO_4$) is an advanced nonlinear and electro-optical crystal widely used for high-performance laser systems and electro-optic applications. As an isomorphic crystal of KTP, RTP inherits many of the desirable properties of its counterpart while providing enhanced features such as a higher damage threshold, high resistivity, and no piezoelectric ringing. These characteristics make RTP ideal for high-repetition-rate and high-energy laser systems.

RTP crystals are non-hygroscopic and chemically stable, eliminating the need for specialized storage and maintenance conditions. With a wide transmission range from 350 nm to 4500 nm and excellent optical clarity, RTP is suitable for a broad range of applications, including frequency doubling, optical parametric oscillation, and electro-optic modulation. Its superior thermal and mechanical properties further enhance its reliability and performance, making RTP a preferred choice for scientific, industrial, and medical applications.

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3. General Applications and Examples

RTP crystals are versatile and widely used in various applications due to their exceptional nonlinear and electro-optical properties. Below are some examples:

1. Frequency Doubling and Mixing:

- RTP crystals are utilized in frequency doubling of Nd:YAG and Nd:YVO_4 lasers to generate visible and UV laser outputs.
- Example: Conversion of 1064 nm laser wavelength to 532 nm (green) or UV wavelengths in laser systems for precision machining and scientific research.

2. Electro-Optic Modulation:

- RTP's high electro-optic coefficients make it ideal for modulating laser signals with high efficiency and fast response times.
- Example: Electro-optic modulators in fiber optic communication systems, offering high-speed signal control without piezoelectric ringing.

3. Optical Parametric Oscillation (OPO):

- RTP is used in OPO systems to produce tunable laser outputs in the visible and infrared ranges.
- Example: Generation of tunable laser outputs between 450 nm and 4500 nm for spectroscopy and imaging applications.

4. Medical and Biomedical Applications:

- RTP is used in laser systems for applications such as ophthalmology, dermatology, and surgical procedures.
- Example: High-repetition-rate lasers for non-invasive medical diagnostics and treatment.

5. High-Power Laser Systems:

- RTP crystals are employed in high-power pulsed and continuous-wave (CW) lasers for industrial applications.
- Example: Lasers for micromachining, welding, and 3D printing, where high damage thresholds and stability are essential.

RTP crystals provide unmatched performance in terms of stability, efficiency, and durability, making them suitable for a wide array of advanced optical and electro-optical systems.

4. Chemical and Structural Properties of RTP Crystals

Property	Specification
Crystal Structure	Orthorhombic
Lattice Parameters	a = 12.96 Å, b = 10.56 Å, c = 6.49 Å
Density	3.6 g/cm³
Melting Point	Approximately 1000 °C
Thermal Expansion Coefficients	$a_1 = 1.01 \times 10^{-5}$/°K, $a_2 = 1.37 \times 10^{-5}$/°K, $a_3 = 4.17 \times 10^{-6}$/°K
Sellmeier Equations (λ in μm)	$n_x^2 = 2.15859 + 0.09307/(\lambda^2 - 0.20994) - 0.01452\lambda^2$ $n_y^2 = 2.23984 + 0.76303/(\lambda^2 - 0.23891) - 0.01585\lambda^2$ $n_z^2 = 2.27722 + 1.11300/(\lambda^2 - 0.23454) - 0.01995\lambda^2$
Thermo-Optic Coefficient	dn/dT = 0.029 nm/°C
Electro-Optic Constants	γ_x = 38.5 pm/V (X-cut), γ_y = 35 pm/V (Y-cut), γ_z = 10.6 pm/V (Z-cut)
Electrical Resistivity	About 10^{10}–10^{11} ohm·cm

5. Optical and Nonlinear Optical Properties of RTP Crystals

Property	Specification
Transparency Range	350–4500 nm
SHG Phase Matching Range	Visible and infrared ranges
Damage Threshold	>1.8 GW/cm²
Refractive Indices	n_x = 1.829, n_y = 1.850, n_z = 1.899
Absorption Coefficients	<0.1% at 1064 nm, <1% at 532 nm
Nonlinear Coefficients	d_{31} = 3.9, d_{32} = 2.5, d_{33} = 7.5 pm/V
Thermal-Optic Coefficients	$dn_x/dT = 1.1 \times 10^{-5}$, $dn_y/dT = 1.3 \times 10^{-5}$, $dn_z/dT = 1.6 \times 10^{-5}$

6. Spectrum Transmission Curves

RTP transmission curves illustrate its excellent optical transparency over a wide wavelength range, minimizing absorption in UV, visible, and infrared regions.

7. Coating Specification

Base Material	AR Coating	Reflectance
RTP	Dual Band AR (1064/532 nm)	R < 0.2% @ 1064 nm, R < 0.5% @ 532 nm
	HR Coating (1064 nm)	R > 99.8% @ 1064 nm
	Broad Band AR (350–4500 nm)	R < 2% over entire range

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8. Standard Fabrication Specifications

Parameter	Specification
Maximum Length	Up to 25 mm
Length Tolerance	±0.5 mm
Surface Quality	20/10 to MIL-PRF-13830B
Flatness	λ/6 @ 633 nm
Parallelism	20 arc seconds
Perpendicularity	<15 arc minutes
Clear Aperture	>90% of the diameter
Extinction Ratio	>20 dB @ 633 nm
Damage Threshold	>1 GW/cm² @ 1064 nm

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9. POC Strength and Capabilities

Photonics On Crystals provides high-quality RTP crystals with advanced manufacturing capabilities, including:

- Custom dimensions and coatings for specific applications.
- High inventory availability for fast delivery.
- Extensive technical support to ensure optimal performance in complex systems.

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10. Standard Products and Customization

Dimensions (mm)	Length (mm)	Coatings	Application	Price (USD)
3 × 3	5	AR@1064/532 nm	SHG of Nd:YAG lasers	400
5 × 5	10	HR@1064 nm	High-power systems	550
7 × 7	15	BBAR (350–4500 nm)	OPO and spectroscopy	800
Custom	Custom	Upon Request	Custom Applications	TBD

For customization options, contact our team for tailored solutions.

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