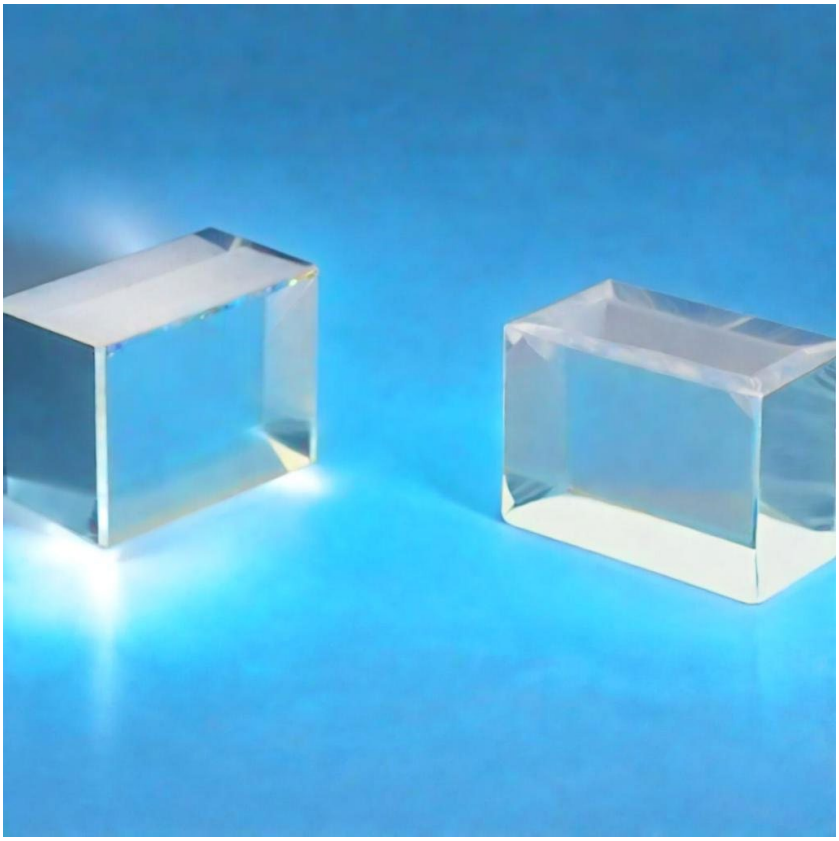
Photonics On Crystals

POC-OC-122479-Quartz Crystal Datasheet

1 Main Features

- High transmission in UV to IR regions, ranging from 0.18 to 3.5 µm and 40 to 100 µm.
- Positive birefringent material, suitable for wave retardation applications.
- Exceptional thermal properties with high melting point (1710°C).
- Hard and insoluble in water, suitable for various optical and thermal applications.
- High optical homogeneity with low absorption losses.



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2. Material General Description

Quartz Crystal (SiO_2) is a naturally occurring mineral, although most modern applications utilize synthetic quartz grown in controlled conditions to produce high-purity, large-sized crystals. Quartz is a positive birefringent material with applications in wave retardation (e.g., quarter-wave plates) and polarizers. Unlike fused quartz, crystalline quartz offers distinct properties such as birefringence and a structured molecular arrangement.

Due to its high mechanical strength and thermal resistance, Quartz Crystal is ideal for applications involving elevated temperatures, although it should not be processed above 490°C to avoid

structural degradation. The material's optical transmission properties make it a versatile choice for UV and IR optical systems, including scientific, industrial, and defense technologies.

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3. General Application Examples

Quartz Crystals are extensively used in both optical and mechanical applications due to their birefringence, optical transparency, and thermal resistance:

- **Optical Retardation Plates:** Utilized in polarizers and wave retarders for precision optical systems in microscopy, spectroscopy, and astronomy.
- **Laser Applications:** Common in laser systems as substrates and waveguides due to their ability to withstand thermal shock and maintain stability under high power.
- **UV and IR Optics:** Widely used for optical windows, prisms, and lenses in spectrometers, thermal imaging, and astronomy.
- **High-Temperature Environments:** Quartz is employed in industrial applications where high temperatures (up to 490°C) and mechanical durability are essential.
- **Electronic Devices:** Used as a resonator material in frequency control applications such as oscillators and filters in RF devices.

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4. Chemical, Physical, and Structural Properties

Property	Value
Density	2.649 g/cm³
Melting Point	1710°C
Thermal Conductivity	10.7 $W \cdot m^{-1} \cdot K^{-1}$ (parallel)
	6.2 $W \cdot m^{-1} \cdot K^{-1}$ (perpendicular)
Thermal Expansion	7.1×10^{-6} K^{-1} (parallel)
	13.2×10^{-6} K^{-1} (perpendicular)
Hardness (Knoop)	741 with 500g indenter
Specific Heat Capacity	710 $J \cdot Kg^{-1} \cdot K^{-1}$
Dielectric Constant	4.34 (parallel)
	4.27 (perpendicular)
Elastic Coefficients	C11=87 GPa, C12=7 GPa
	C44=58 GPa, C33=106 GPa
Molecular Weight	60.06
Structure	Trigonal (hexagonal), P3(2)21

Birefringence (dn/dT)	-5.5×10^{-6} (parallel)
	$-6.5 \times 10^{-6}\ K^{-1}$ (perpendicular)

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5. Optical, Laser, and Nonlinear Optical Properties

Optical Property	Value
Transmission Range	0.18 to 3.5 µm; 40 to 100 µm
Refractive Index (No)	1.54421 at 0.6 µm
Refractive Index (Ne)	1.55333 at 0.6 µm
Reflection Loss (2 surfaces)	8.8% at 0.6 µm
Absorption Coefficient	Negligible
Reststrahlen Peak	Not applicable
Thermo-optic Coefficients	$dn/d\mu = 0$ at 1.3 µm
	$dn/dT = -5.5 \times 10^{-6}\ K^{-1}$ (para)
	$dn/dT = -6.5 \times 10^{-6}\ K^{-1}$ (perp)

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6. Spectrum Transmission Curves

Quartz Crystals exhibit high transmission rates from UV to IR spectra. For example:

- **UV Range (200 nm to 400 nm):** Quartz shows >80% transmission.
- **IR Range (2 µm to 3 µm):** Transmission efficiency remains consistently high (>85%).

Detailed transmission data can be illustrated in a graph showing %T over a range of wavelengths from 0.18 to 3.5 µm.

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7. Coating Specification

Quartz Crystals can be coated for enhanced transmission and reduced reflection in various spectral ranges:

- **UV AR Coatings:** Enhances UV light transmission efficiency up to 95%.
- **Broadband AR Coatings:** Optimized for both UV and IR ranges for multifunctional optical systems.
- **Custom Coatings:** Available upon request for specialized optical systems.

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8. Standard Fabrication Specifications

Specification	Value
Flatness	λ/4 at 632.8 nm
Surface Quality	40-20 scratch-dig
Parallelism	<1 arc minute
Clear Aperture	>90%
Chamfer	<0.25 × 45°
Dimensional Tolerance	±0.1 mm

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9. POC Strength and Capabilities

Photonics On Crystals (POC) excels in producing high-quality Quartz Crystals with customized specifications to meet the most demanding industrial and scientific applications:

- Expertise in high-precision fabrication for optical and thermal systems.
- Advanced coating technologies for optimized performance in UV, visible, and IR ranges.
- A strong focus on research and development to innovate optical crystal applications.
- OEM capabilities to support custom-designed Quartz Crystal solutions.

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10. Standard Products and Customization

Product	Specifications	Price (USD)
Quartz Window	20 mm × 2 mm, AR-coated	$250
Quartz Plate	50 mm × 5 mm, uncoated	$450
Quartz Prism	Custom shape, coated	$650
Custom Specifications	Tailored designs	Contact for pricing