



ENTANGLED PHOTON SOURCE

QEC SERIES



The QEC Series, consists of high-precision, compact, and fully integrated polarization entangled photon source modules that operate in the visible and near-infrared wavelength ranges.

FEATURES

- High Pair Rate
- Customizable Wavelengths
- Fully Integrated Design
- Space-Ready Architecture
- Ultra-Low Power Consumption
- Flexible Output Options
- High Thermal Stability

APPLICATIONS

- Quantum Key Distribution
- Quantum Communication
- Entanglement Distribution
- Quantum Optics Experiments
- Quantum Sensing and Metrology
- Quantum Networking

The QEC Series, consists of high-precision, compact, and fully integrated polarization entangled photon source modules that operate in the visible and near-infrared wavelength ranges. Operating based on Spontaneous Parametric Down-Conversion (SPDC), the series generates entangled photon pairs with customizable signal-idler wavelengths. The source includes a laser current driver. Designed for versatility, the grades are divided into two specialized categories: the C-Grades (Commercial) for high-precision laboratory use and the S-Grades (CubeSat) specifically optimized for spaceborne missions. The space-qualified version features a compact mechanical design (180 mm x 140 mm x 56 mm) and low power consumption (0.5 W), enabling efficient integration into small satellite platforms.

KEY ADVANTAGES

- 🔑 **High Entanglement Efficiency:** Delivers a high pair rate in the tens of Mcounts/s range, ensuring robust quantum correlations for demanding optical applications.
- 🔑 **Compact & Lightweight Design:** The CubeSat-compatible space version features an ultra-lightweight build and small form factor, ideal for integration into small satellite platforms.
- 🔑 **Exceptional Energy Efficiency:** Optimized low-power architecture consumes only 0.5 W, making it suitable for power-constrained spaceborne missions.
- 🔑 **Versatile Wavelength Customization:** Supports a broad spectrum from visible to near-infrared (548 nm to 1550 nm), allowing for seamless integration into various quantum networks.
- 🔑 **High Structural Integrity:** Constructed with a robust mechanical design to maintain performance stability in both terrestrial and space environments.
- 🔑 **Integrated Control System:** Features a built-in laser current driver and USB control interface, eliminating the need for external driver electronics and simplifying laboratory setups.



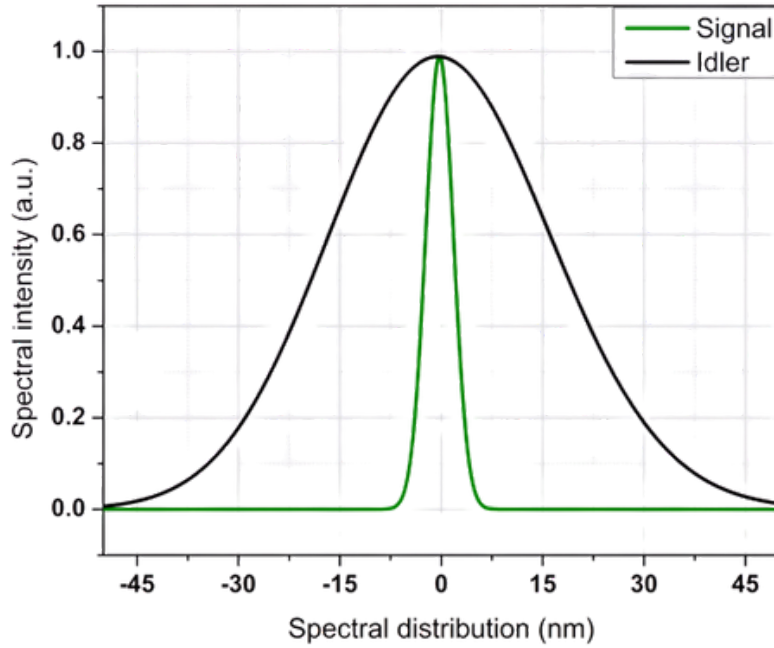


Figure 1: Spectral distribution of signal and idler photons in a BBO-based EPS.

The spectral characterization of the Entangled Photon Source (EPS) reveals the distinct emission profiles of the generated photon pairs. As illustrated in Figure 1, the BBO-based SPDC process produces a broad Idler spectrum (black) and a significantly narrower Signal spectrum (green). The wide spectral distribution of the idler photons—spanning approximately 30 nm FWHM—demonstrates the phase-matching bandwidth of the BBO crystal, while the sharp signal peak indicates high spectral purity. This asymmetric spectral correlation is a key feature for advanced quantum communication tasks, allowing for flexible wavelength de-multiplexing and incorporating into the standard ITU channels for long-haul quantum key distribution (QKD) and entanglement-based networking.

QEC SERIES (ENTANGLED PHOTON SOURCE) TECHNICAL SPECIFICATIONS

Description	Condition		Typical
Wavelengths for Signal-Idler	Customizable		780±25 nm & 842±25 nm
			548±5 nm & 1550±40 nm
Pair Rate (Type-1 BBO)	Free-Space	780±25 nm & 842±25 nm	250 Mcount/s
	Fiber	780±25 nm & 842±25 nm	700 kcount/s
		548±5 nm & 1550±40 nm	100 kcount/s
Pair Rate (Type-0 ppKTP)	Free-Space	780±25 nm & 842±25 nm	900 Mcount/s
	Fiber	780±25 nm & 842±25 nm	2,5 Mcount/s
		548±5 nm & 1550±40 nm	175 kcount/s
Control Interface			USB
Power Consumption		0.5 W	
Photon Bandwidth	Customizable		10 nm
Coherence Time of Signal-Idler			~100 fs
Supply Voltage		6 V	
Coding	Polarization		Linear

The table illustrates that the system supports both standard quantum optics ranges (780 ± 25 nm – 842 ± 25 nm) or broad-spectrum (548 ± 5 nm – 1550 ± 40 nm) wavelengths, with customizable conditions.

Pair rate parameters are categorized by crystal type (Type-1 BBO or Type-0 ppKTP), wavelength, and coupling method (Free-Space or Fiber), highlighting the system's versatility.

It specifies a USB control interface and confirms that the SPDC output can be configured for either Free Space or Fiber-coupled delivery. The table presents key technical standards, including a customizable photon bandwidth (10 nm) and a signal-idler coherence time of approximately 100 fs.

Beyond the standard configurations, the QEC Series offers the flexibility to be tailored for specific wavelength ranges and output requirements to meet unique experimental or network needs.

OPERATING STRUCTURE

- The module requires a stable DC supply of 6 V for optimal performance.
- Incorrect connection or applying reverse voltage may permanently damage the internal electronic and optical components.
- The digital control and output interfaces must be properly terminated according to the user manual to maintain pulse integrity and avoid signal distortion.
- While the system is designed for high-performance photon generation, avoid exposing the internal optical path to intense ambient light or high-intensity pulses to prevent temporary performance degradation or potential damage.
- This module contains highly sensitive electronic components and should only be handled at an ESD-safe workstation.

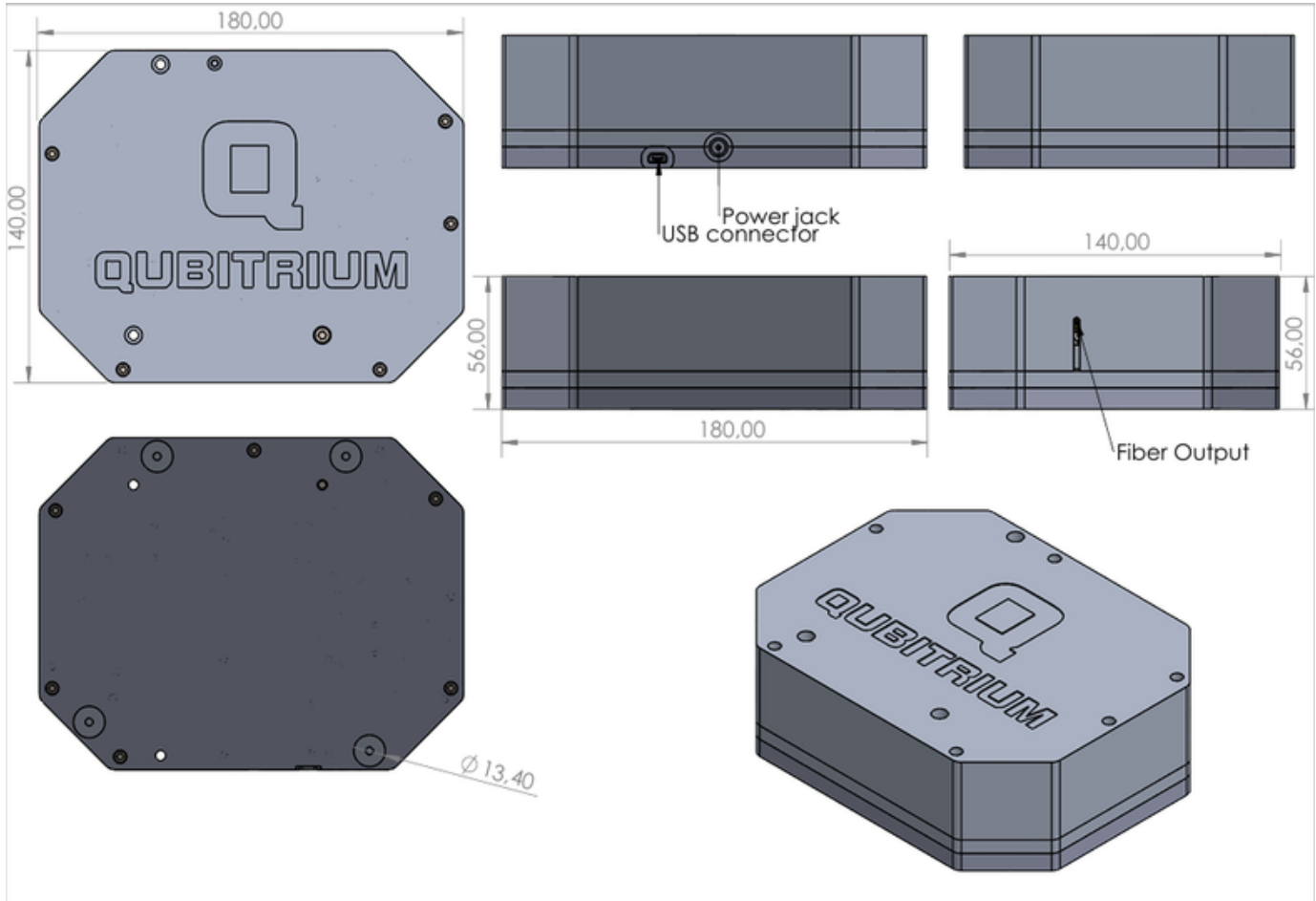
OPERATING CONDITIONS				
Description	Condition	Min	Typical	Max
Operating Temperature			20 ± 5 °C	
Storage Temperature		10°C		40°C
Storage Humidity	Non-condensing	5%		95%
Operating Humidity	Non-condensing	5%		85%

CAUTION: Any attempt to open the sealed enclosure or modify the internal optical and electronic circuitry will void the manufacturer's warranty.

CAUTION: For long-term storage, ensure the protective cap is firmly attached to the optical output (Fiber or Free Space) to prevent dust accumulation on sensitive optical surfaces.

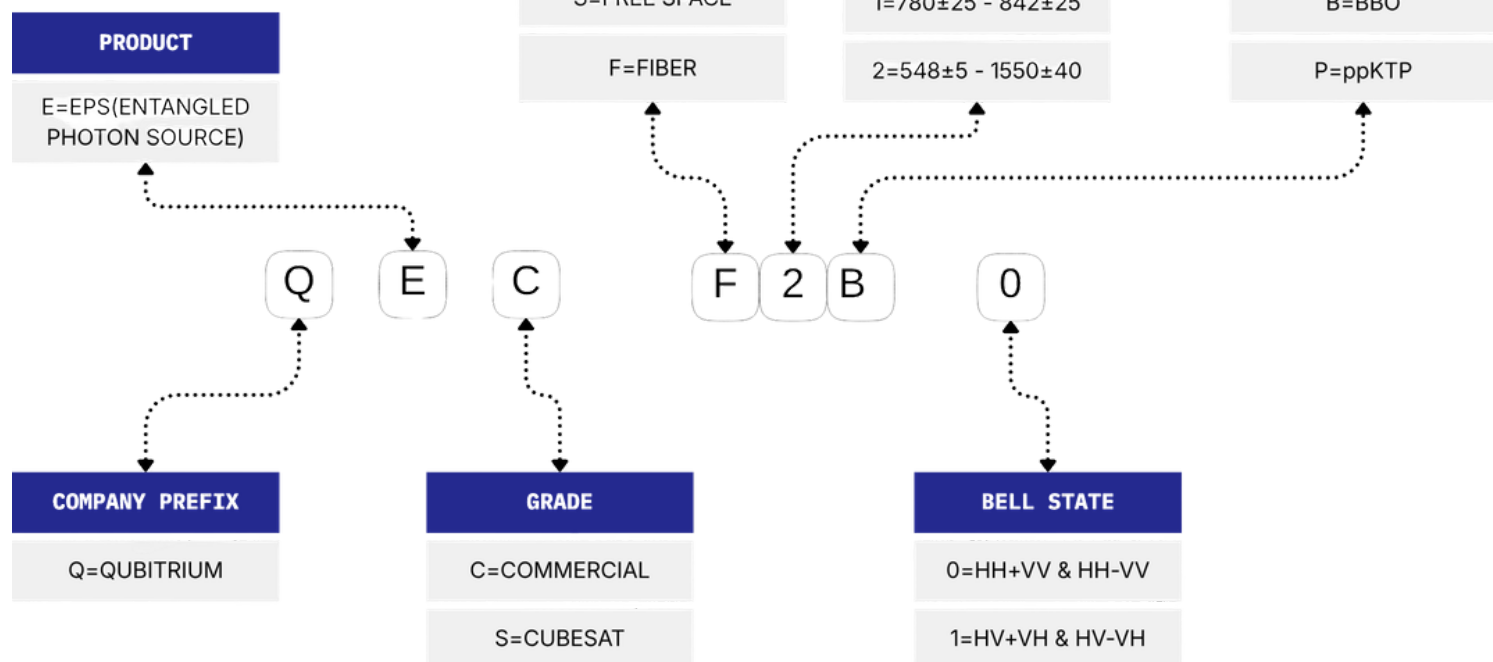


MECHANICAL DRAWINGS



The QEC Series features a robust and precision-engineered aluminum enclosure designed for high thermal stability and structural integrity. The standard commercial module has external dimensions of 180 mm x 140 mm x 56 mm, providing a stable platform for sensitive optical alignments. For seamless integration, the unit is equipped with a USB connector for digital control and a dedicated Power Jack. While the illustrated model features a Fiber Output, the system architecture is fully customizable to support Free Space output based on specific user requirements. Additionally, the baseplate includes precision mounting holes to allow secure fixing onto standard optical breadboards.

ORDERING INFORMATION



The QEC Series product configuration is offered through a modular system to ensure full compatibility with specific application needs. Current options include specialized wavelength ranges of 780±25 nm & 842±25 nm or 548±5 nm & 1550±40 nm, with a choice between BBO or ppKTP crystal types to optimize phase-matching and brightness performance.

A unique feature of this series is the ability to specify the required Bell State such as HH+VV, HH-VV, HV+VH, or HV-VH ensuring the entangled photon pairs are pre-optimized for specific quantum correlations and protocol requirements. Depending on project demands, users can select between Commercial or CubeSat grades and specify the output as either Free Space or Fiber-coupled. Furthermore, customized solutions for different wavelength ranges and tighter tolerances are available upon request beyond these standard configurations.

RELATED PRODUCTS

To complete your quantum optics or timing measurement setup, the following Qubitrium products are fully compatible with the QEC Series:

Qubitrium QTC series Time Tagger: High-performance time-to-digital converters optimized for multi-channel photon arrival time stamping with picosecond resolution



Qubitrium QDC-V series Single Photon Detectors: High-precision, compact detection modules optimized for visible and telecommunications wavelength ranges



Qubitrium QubitCore Integrated QKD Systems: Comprehensive Quantum Key Distribution solutions for secure communication research and network integration.

