QUANTUM COMPUTING INC

LN²-QFC-XX-YYY Series

Low Noise Lithium Niobate Quantum Frequency Conversion Series

User's guide

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LN²-QFC-XX-YYY Series
Frequency conversion

Key element to practical quantum networking and quantum sensing

Quantum Frequency Conversion is essential for a wide range of applications, especially in quantum optical information processing and sensing. QCI's versatile LN²-QFC-XX-YYY module enables the transformation of a C-band photons and an O-band photons into sum frequency photons of visible wavelength via a periodically poled lithium niobate waveguide. With excellent customizability, durability, low noise, and compact design, QCI's module is ideal for use in both academic research and industrial settings.

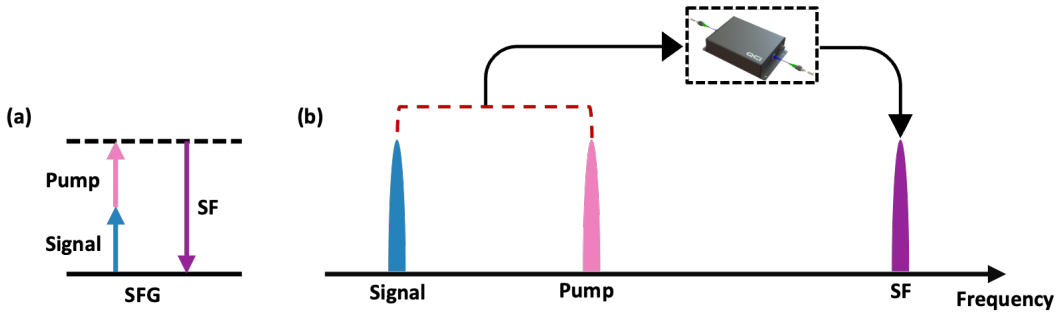

Figure 1(a), illustrates the sum frequency generation (SFG) process, a phenomenon in nonlinear optics wherein a signal photon combines with a pump photon to generate a sum frequency photon. This conversion process adheres to the principles of conservation of energy and momentum. Figure 1(b) presents a conceptual diagram wherein a signal photon and a pump photon (connected by red dashed lines) enter the LN²-QFC-XXX module, resulting in the production of a sum frequency (SF) photon at visible wavelength. The module incorporates additional filters to prevent the emission of any undesired second harmonic and Raman scattering photons from either the signal or pump.

Energy conservation requires that for the photons holds

$$\omega_{signal} + \omega_{pump} = \omega_{SF}$$

LN^2-QFC-XX-YYY Series
Frequency conversion

Optimize communication and sensing with our Quantum Frequency Conversion series, merging low loss optics and high-performance detectors. Enjoy simplicity with our plug-and-play systems.

APPLICATIONS

Quantum Computing
Quantum Remote Sensing
Quantum Metrology
Quantum Networking
Time Synchronization System
Fundamental Physics Research and Development

ADVANTAGES

Our Low-Noise Lithium Niobate Quantum Frequency Converter efficiently transforms communication-band photons to visible wavelengths, to be detected by cost-effective, highly efficient Si APD's. With custom-designed wavelength separation to filter out background noises due to second harmonic generation and Raman scattering, our LN^2-QFC-XX-YYY module ensures high conversion efficiency and low background noise, vital to preserve signal quantum properties for long-distance quantum communication, networking, and sensing.

LN^2-QFC-CC-YYY series support conversion of C-band photons by a C-band pump.

LN^2-QFC-CO-YYY series support conversion of C-band photons by an O-band pump.

LN^2-QFC-OC-YYY series support conversion of O-band photons by a C-band pump.

By using pump pulses, the SF output can be gated. Our rack-mountable, plug-and-play module integrates seamlessly into any system, ensuring efficient operation.

LN^2-QFC-CC-YYY Series
Frequency conversion

Device Specification

General	**Specification**
LN^2-QFC-XX-YYY	LN^2-QFC-CC-YYY
Input Fiber	PM1550 + mode adaptor / FC/APC
Output Fiber	FG050LGA/ FC/APC
Waveguide length	20 mm
Optical	**Specification**
Signal Wavelength	Telecom C band
Pump Wavelength	Telecom C band
Sum Frequency Wavelength	760 nm ~ 880 nm
Overall Efficiency	$\geq$ 80%/W @ low input
Noise Probability	2.05×10^{-5} counts per pulse at 100% conversion efficiency
Temperature Controller	**Specification**
Electrical connector	Hirose HR 10G-10R-10P (73)
Thermoelectric cooler	3.2 V, 4 A maximum, Qc = 6.9 W
NTC Thermistor resistance @ 25 ˚C	10 kΩ
Thermistor B value (B25/85)	3478

LN^2-QFC-OC-YYY Series
Frequency conversion

Device Specification

General	**Specification**
LN^2-QFC-XX-YYY	LN^2-QFC-OC-YYY
Input Fiber	PM1550 + mode adaptor / FC/APC
Output Fiber	FG050LGA/ FC/APC
Waveguide length	20 mm
Optical	**Specification**
Signal Wavelength	Telecom O band
Pump Wavelength	Telecom C band
Sum Frequency Wavelength	760 nm ~ 880 nm
Overall Efficiency	$\geq$ 80%/W @ low input
Noise Probability	2.5×10^{-10} counts per pulse at 100% conversion efficiency
Temperature Controller	**Specification**
Electrical connector	Hirose HR 10G-10R-10P (73)
Thermoelectric cooler	3.2 V, 4 A maximum, Qc = 6.9 W
NTC Thermistor resistance @ 25 ˚C	10 kΩ
Thermistor B value (B25/85)	3478

LN^2-QFC-CO-YYY Series
Frequency conversion

Device Specification

General	**Specification**
LN^2-QFC-XX-YYY	LN^2-QFC-CO-YYY
Input Fiber	PM1550 + mode adaptor / FC/APC
Output Fiber	FG050LGA/ FC/APC
Waveguide length	20 mm
Optical	**Specification**
Signal Wavelength	Telecom C band
Pump Wavelength	Telecom O band
Sum Frequency Wavelength	760 nm ~ 880 nm
Overall Efficiency	$\geq$ 80%/W @ low input
Noise Probability	2.5×10^{-10} counts per pulse at 100% conversion efficiency
Temperature Controller	**Specification**
Electrical connector	Hirose HR 10G-10R-10P (73)
Thermoelectric cooler	3.2 V, 4 A maximum, Qc = 6.9 W
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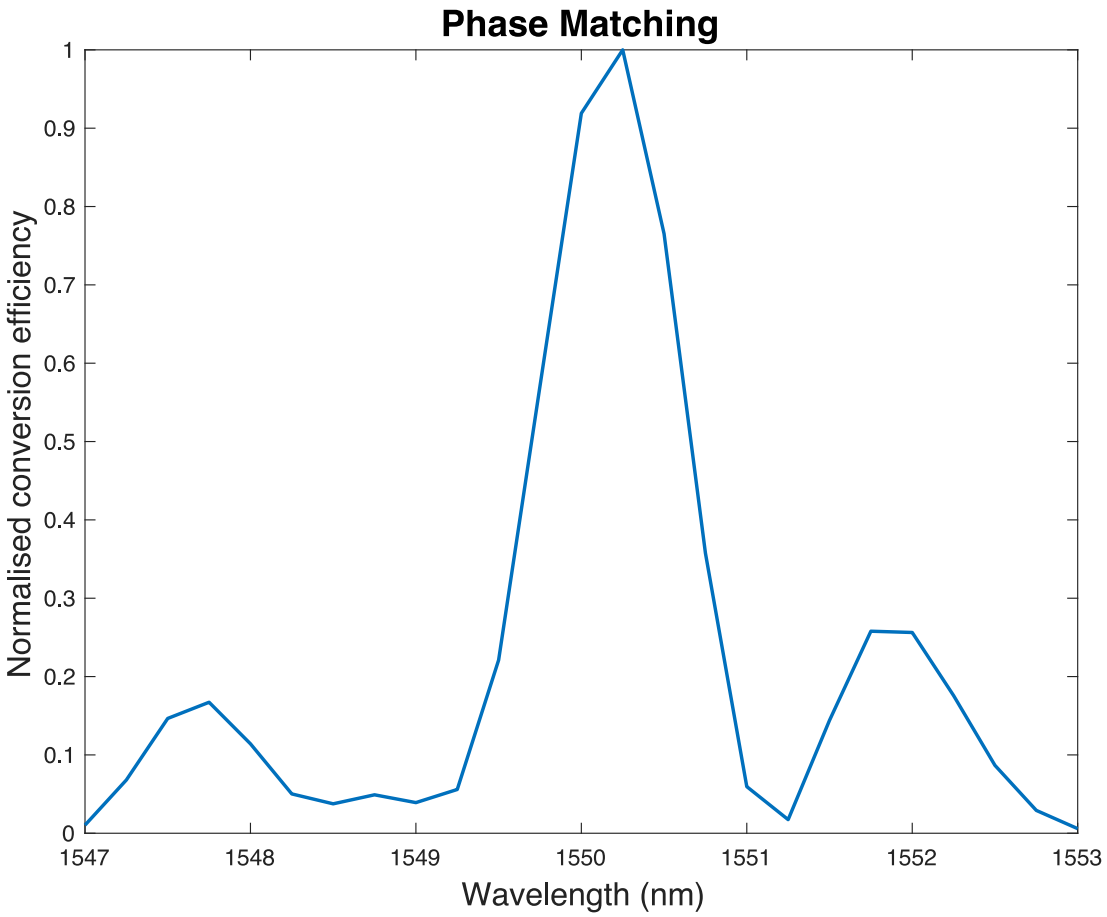
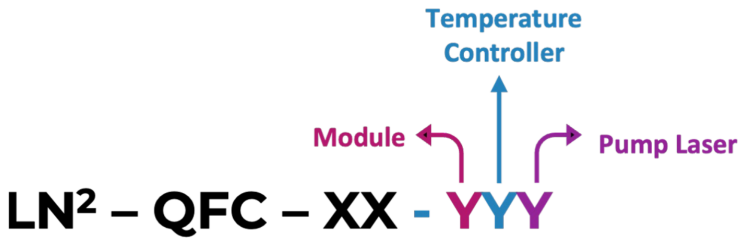
LN²-QFC-XX-YYY Series
Frequency conversion

Measured wavelength tuning curve or Phase Matching curve

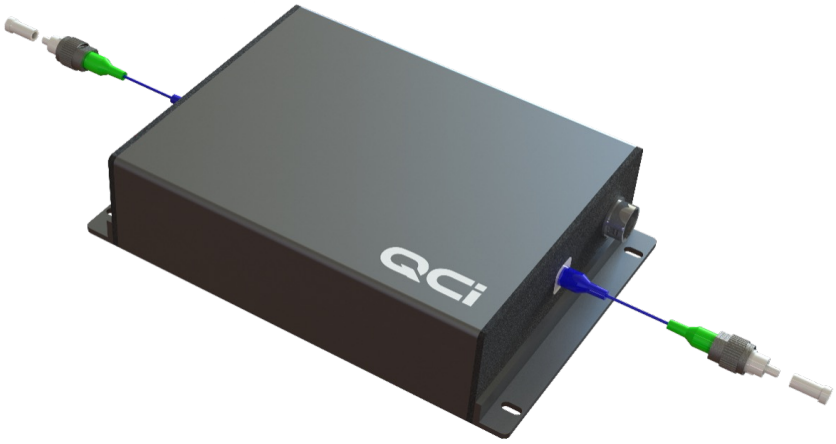
Our rack-mountable quantum frequency conversion module is distinguished by its high efficiency in converting photons from communication band wavelengths, which exhibit minimal loss over long distances of propagation in optic fibers, to visible wavelengths. This conversion facilitates the use of highly efficient and cost-effective single photon detectors while preserving the quantum properties of the photons themselves.



LN²-QFC-XX-YYY Series Product Family



LN²-QFC-XX-YYY	100	Stand Alone Module
	110	Module integrated with Temperature controller
	111	Module integrated with Temperature controller and CW Pump laser
	101	Module integrated with CW Pump laser



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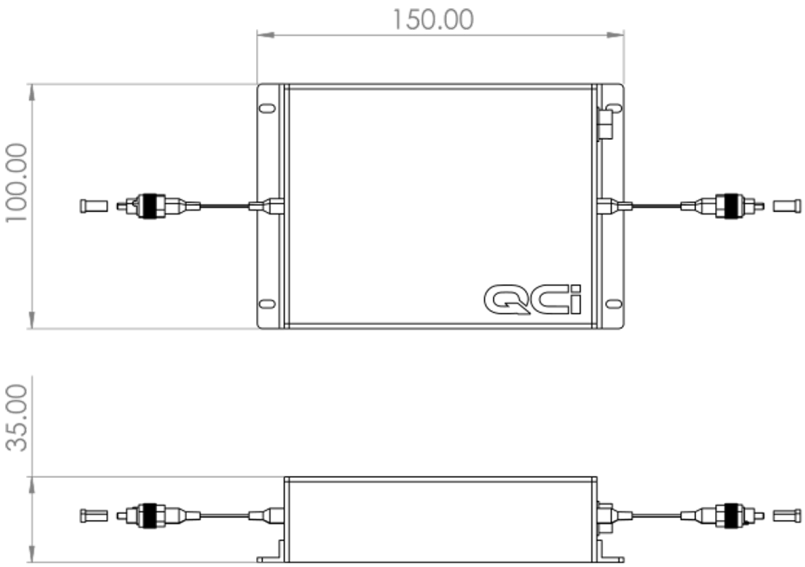
Frequency conversion

MECHANICAL DESIGN – Stand Alone Module



All Dimensions are in mm