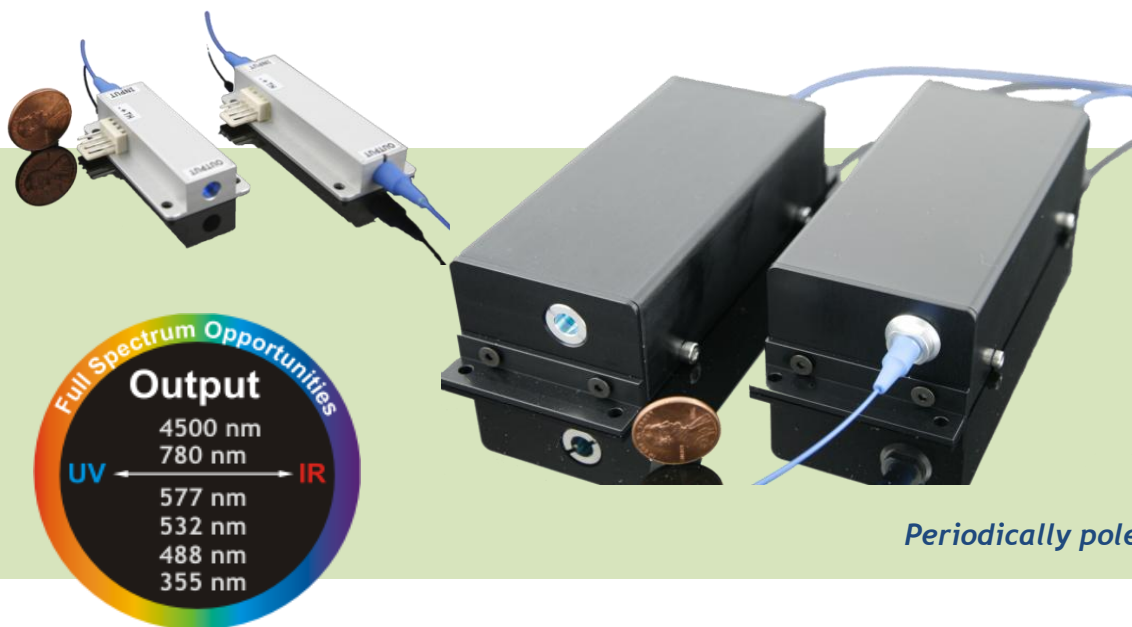


Optical Mixers

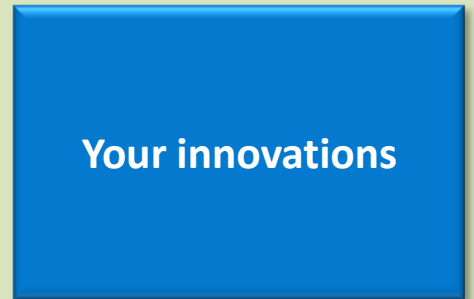


Robust, Compact and Maintenance-free optical frequency converter for full-spectrum applications.

Your trusted value co-creation partner

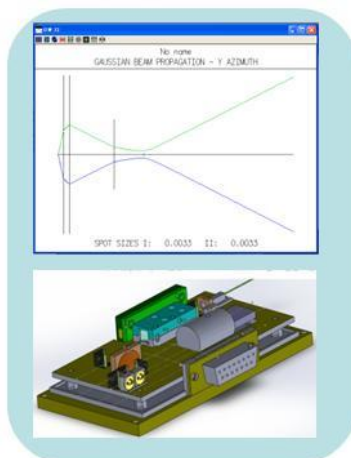


HC Photonics provides a compact, robust and maintenance-free module for the optical wavelength conversion called "Mixer". With the periodically-poled nonlinear crystals (e.g. PPLN bulk or waveguide chips), optics and electronics integrated inside, the mixer provides high conversion efficiency from UV to mid-IR for various applications, such as atomic science, bio-medical engineering and quantum information.

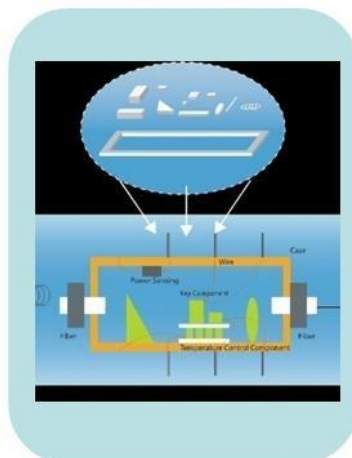


The optical beam path simulation will be performed with the nonlinear crystal for optimal parameters, including the conversion efficiency, beam characteristics...etc. At the design phase, the mixers experience a variety of reliability tests, like thermal/humidity cycling, ingress protection examination, and even vibration/shock verification up to Telecordia standard. Before delivery, environmental qualifications in terms of temperature cycling, drop and vibration test are performed on each mixer to ensure the quality.

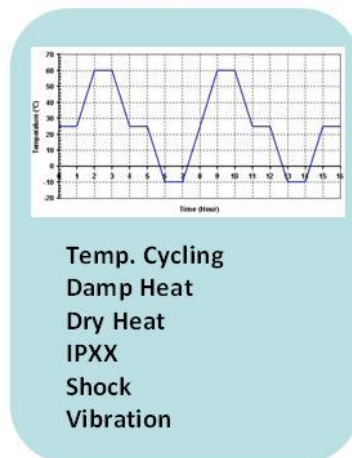
Simulation



Integration



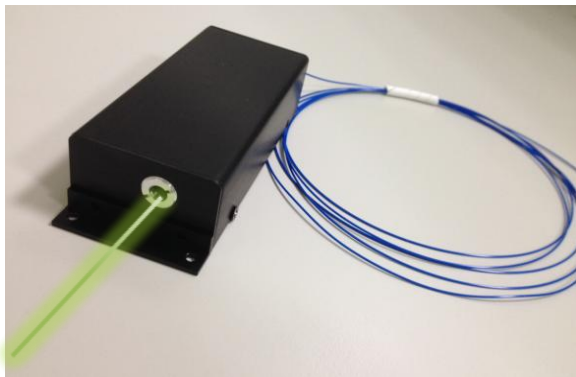
Qualification Test



On the basis of high quality standard, we believe our precision alignment capability and photonics packaging technology could satisfy you with the perfect rapid customization and commercialization.

Bulk Mixer

Standard 1x0 Mixer



- High output power
- Excellent beam quality
- Robust package
- Broad wavelength selection
- Fiber delivery

An optical frequency conversion platform based on **periodically poled bulk chips** for various lasers from continuous wave (CW) to ultrafast pulse input/outputs. Via different nonlinear frequency conversion processes (e.g. SHG, SFG,...etc), the bulk mixer provides the polarization maintained output from UV to mid-IR with output power up to few Watts either in free space or optical fiber.

Best-seller

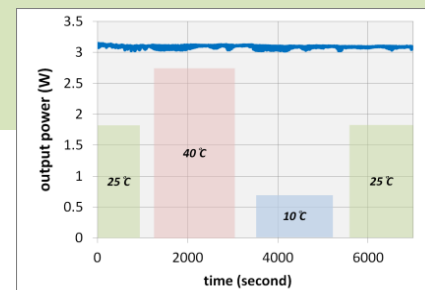
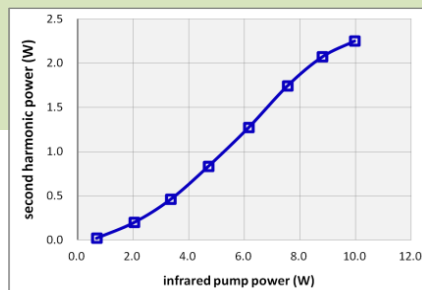
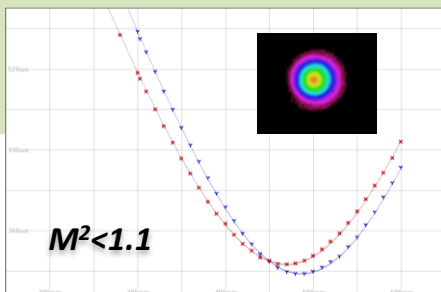
Five color series corresponding to the different wavelength range are our Best-seller selections designed for specific application such as laser microscopy or atom trapping. Detailed specifications are shown below. Alternatively, contact us for your specific wavelength or requirements.

	Bulk Mixer – SHG ^{*1}				
Color	B	G	Y	O	R
Range	450-495	495-560	560-580	580-620	620-800
Best seller, λ ^{*2}	473nm, <u>488nm</u>	515nm, <u>532nm</u> , 543nm	<u>561nm</u>	<u>589nm</u> , 594nm	<u>775nm</u> , <u>780nm</u> , 785nm
Applications	CyPet, GFP, PA-GFP, Dronpa, FITC	YFP, Rhodamine, mOrange, DsRed	mApple, DsRed, TRITC, Cy3	Texas Red, mCherry, mRFP, mKate	NIR Raman spectroscopy, Rb/K cooling,
Power ^{*3} (max)	1W	2W	3W	4W	6W
Pump	Diode	Diode/Yb&Yb+/Raman lasers			Diode/Er laser
Fiber output ^{*4}	Yes, <1W with single mode PM fiber				

1. Second-harmonic generation (SHG)
2. HC Photonics offers the best sellers at these wavelengths within +/- 0.5 nm. Custom wavelengths are available upon request.
3. SHG power is pump dependent. Please contact us for different power requirements with your pump conditions.
4. Typical coupling efficiency is 75% with single mode PM fiber. Please contact us for higher efficiency.

Specifications

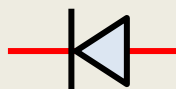
Optics	unit	Spec.		
		Minimum	Typical	Maximum
Beam quality, M^2				≤ 1.2
Diameter of collimated output beam	mm	0.9	1	1.1
Output beam (TEM00) ellipticity	%			≤ 10
Residual IR/output power rejection ratio	dB			-40
Output polarization state		Horizontal, PER>20dB		
Back reflection for IR wavelength	dB		-45	-42
Fiber coupled output	%		75	
Mechanics	unit	Spec.		
		Minimum	Typical	Maximum
Housing dimension (L*W*H)	mm	150x50x35		
Beam height	mm	18.9 ± 0.5		
Statistic beam angle	mrاد	-7.5	0	7.5
Electrics	unit	Spec.		
		Minimum	Typical	Maximum
Electrical connector		Hiroshi HR 10G-10P(73)		
Thermoelectric cooler		3.2V, 4A maximum, $Q_c = 6.9$ W		
Environment	unit	Spec.		
		Minimum	Typical	Maximum
Storage temperature (no humidity)	$^{\circ}C$	-20	-	70
Operating temperature range	$^{\circ}C$	10	25	35
Operating rel. humidity (non condensing)	%RH	10	-	85
Restriction of hazardous substances directive (RoHS)		Declaration of Conformity to 2011/65/EG		



(Left) The typical beam quality of collimated output from the bulk mixer. (Middle) The typical power scaling curve of the second harmonic generation from the bulk mixer-G at 532nm. (Right) The mixer gives nominal output power ($\pm 2\%$ variation) under environmental temperature cycling (10-40 deg. C).

Options:

Power Monitoring



Photodiode for the output power monitoring, giving a voltage signal V_{pd} typically 3V at maximum output power allows to operate auto-power control mode.

Filter Module



The filter module with free space/fiber input/output provides further filtering up to 100dB between residual pump and converted signal.

Control unit



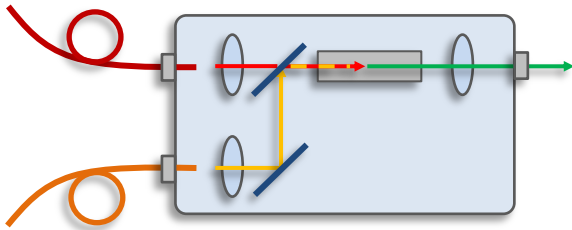
A control unit allows to set/read out the crystal temperature for phase-matching optimization. Photodiode signal can be read-out with power monitoring option.

Customer Inspiration



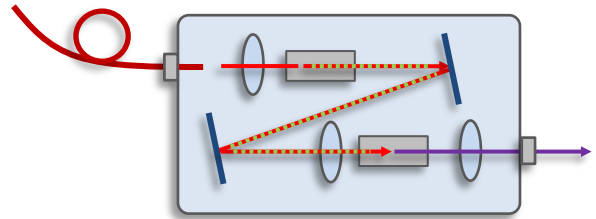
We are open to discuss the possibility of extra components as you desired. Don't hesitate to contact us while coming up with some ideas about our mixers.

2x0/2x1 Mixer



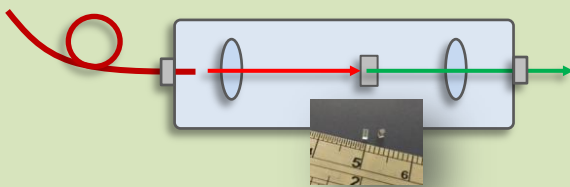
Sum frequency generation (SFG)
Difference frequency generation (DFG)
Optical parametric amplification (OPA)

Cascaded Mixer

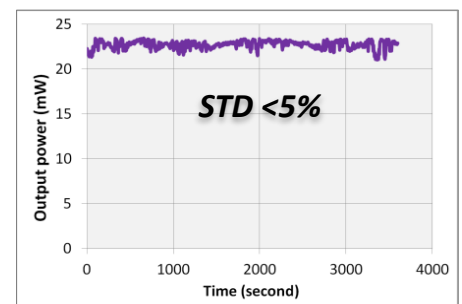
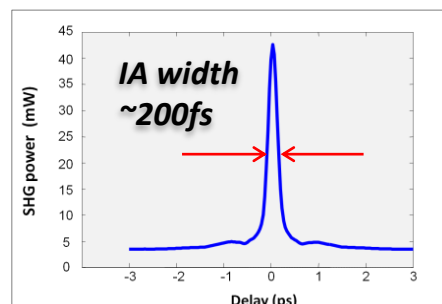
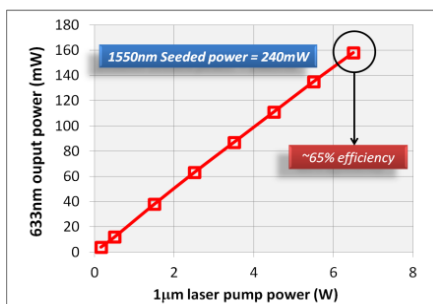


Third-harmonic generation (THG)
Fourth-harmonic generation (FHG)

Ultrafast mixer



(Up left) 2x0/2x1 Mixer configuration is two fiber coupled input, giving a free space converted beam or back couple into the fiber. The free-space optical design inside makes the beam combination without losses. (Up) Cascaded Mixer configuration includes two frequency conversion stages, e.g. one sum-frequency generation (SFG) followed by a SHG, which is equivalent to frequency tripling. (Left) An ultrafast mixer with very tiny crystal inside enables to convert a broad spectrum of ultrafast pulses.



(Left) The 2x0 mixer combined the infrareds at 1550nm and 1064nm that gave 633nm by sum-frequency generation. (Middle) The measured correlation trace of the 780nm ultrashort pulse doubled from an ultrafast erbium-doped fiber laser by the ultrafast mixer (50% efficiency). (Right) The measured power stability of UV (355nm) tripled from 4W infrared by our third harmonic mixer.

How to select YOUR mixer?

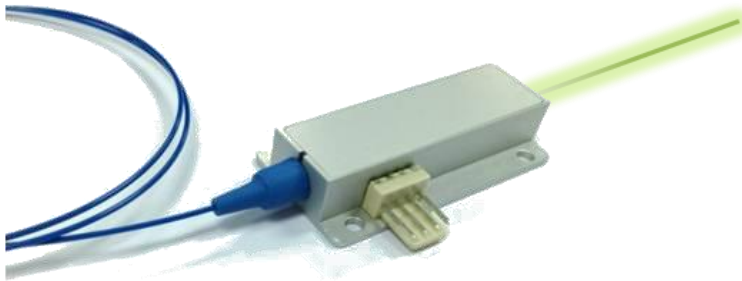
1. Check the nonlinear conversion configuration you would like to proceed (e.g. SHG or SFG...etc), and choose the corresponding mixer type.

2. Select the optional function you would like to add in the mixer

3. Contact HC Photonics directly or the local representative for further information about mixers or some customization.

Waveguide Mixer

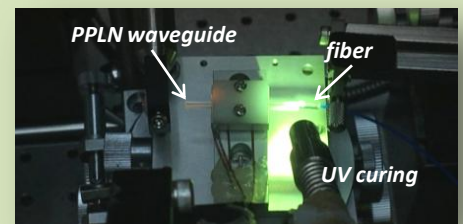
Standard 1x0 Mixer



- High efficiency
- Compact/Robust package
- Wavelength upon request
- Fiber delivery

An optical frequency conversion platform based on **periodically poled waveguide** for various lasers from continuous wave (CW) to ultrafast pulse input/outputs. Via different nonlinear frequency conversion processes (e.g. SHG, SFG,...), the waveguide mixer provides the output wavelength from UV to mid-IR with extreme high conversion efficiency up to sub-Watt.

The waveguide mixers are fabricated with fiber butt-coupling technique, leading to a very robust and reliable coupling between fiber and waveguide. Rather than typical low power handling of butt-coupling, our special fixing method isolates the light path from the epoxy to increase the power handling capability up to Watt level.

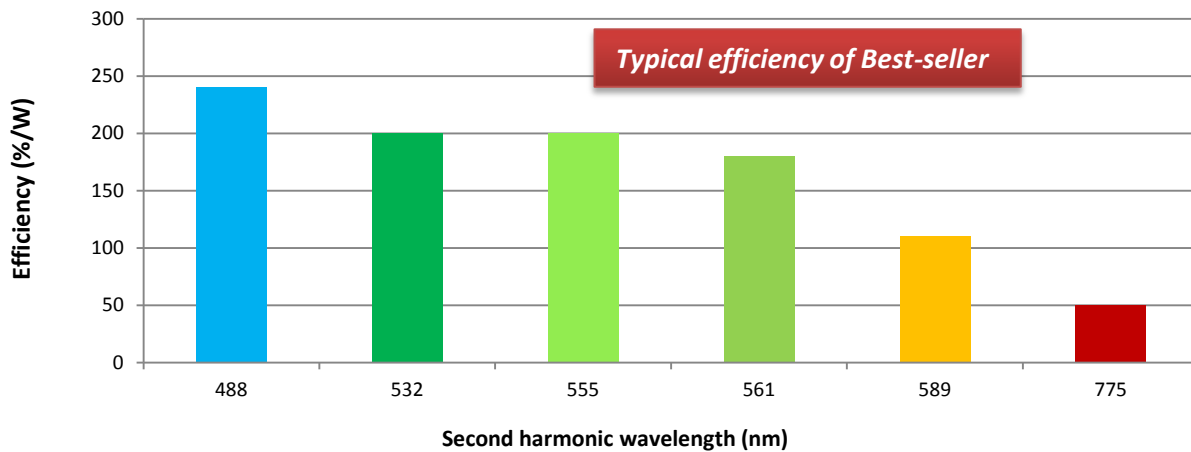


Best-seller

	Waveguide Mixer – SHG				
Color	B	G	Y	O	R
Range	450-495	495-560	560-580	580-620	620-800
Best seller, λ ^{*1}	<u>488nm</u>	<u>532nm</u> , <u>555nm</u>	<u>561nm</u>	<u>589nm</u>	<u>775nm</u>
Applications	CyPet, GFP, PA-GFP, Dronpa, FITC	YFP, Rhodamine, mOrange, DsRed	mApple, DsRed, TRITC, Cy3	Texas Red, mCherry, mRFP, mKate	NIR Raman spectroscopy, Rb/K cooling,
Efficiency ^{*2}	240%/W	200%/W	180%/W	130%/W	50%/W
Pump	Diode	Diode/Yb&Yb+/Raman lasers			Diode/Er laser
Fiber output ^{*3}	Yes, <0.5W with single mode PM fiber				

1. HC Photonics offers the best sellers at these wavelengths within +/- 0.5 nm. Custom wavelengths are available upon request.
2. SHG power is pump dependent. Please contact us for different power requirements with your pump conditions.
3. Typical coupling efficiency is 75% with single mode PM fiber. Please contact us for higher efficiency.

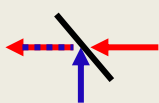
Specifications



Optics	unit	Spec.		
		Minimum	Typical	Maximum
Beam quality, M ²				≤1.2
Output beam (TEM00) ellipticity	%	1.2-2.0, wavelength dependent		
Numerical aperture		Wavelength dependent		
Output polarization state		Horizontal, PER>20dB		
Back reflection for IR wavelength	dB		-40	
Fiber coupled output	%		75	
Mechanics	unit	Spec.		
		Minimum	Typical	Maximum
Housing dimension (LxWxH)	mm	60x25x10.5, 70x25x10.5(fiber-out)		
Beam height	mm	5.25+/-0.5		
Statistic beam angle	mrاد	-7.5	0	7.5
Electrics	unit	Spec.		
		Minimum	Typical	Maximum
Electrical connector		Molex (4P)		
Thermoelectric cooler		3.9V, 1.7A maximum, Qc = 4.9W		
Environment	unit	Spec.		
		Minimum	Typical	Maximum
Storage temperature (no humidity)	°C	-20	-	70
Operating temperature range	°C	10	25	35
Operating rel. humidity (non condensing)	%RH	10	-	85
Restriction of hazardous substances directive (RoHS)		Declaration of Conformity to 2011/65/EG		

Options:

Wavelength Combiner



A free space module combines arbitrary optical wavelengths into waveguide mixer with low insertion loss.

Filter Module



The filter module with free space/fiber input/output provides further filtering up to 100dB between residual pump and converted signal.

Control unit



A control unit allows to set/read out the crystal temperature for phase-matching optimization. Photodiode signal can be read-out with power monitoring option.

Fiber adaptor package



The waveguide mixers could be integrated into a housing that provides FC/APC fiber adaptor interface with collimation optics, enabling a directly plug & play experience.

Distributors



Ver. Jan-18

China

YC Optics
www.ycoptics.com

France

Opton Laser International
www.optonlaser.com

Germany

GWU GmbH
www.gwu-lasertechnik.de

Israel

Bi-Pol electro optics Ltd.
www.bi-pol.com

Japan

Optronscience, Inc.
eng.opt-ron.com

Broadband, Inc.

www.bblaser.com

United Kingdom

Photonic Solutions Ltd.
www.photonicsolutions.co.uk

GWU-Lasertechnik Vertriebsges. mbH

Bonner Ring 9
50374 Ertstadt
Germany

Fon +49 . (0)22 35 . 9 55 22-0
Fax +49 . (0)22 35 . 9 55 22-99

info@gwu-group.de
www.gwu-group.de



HCP
HC PHOTONICS CORP.

HC Photonics Corp.
4F, No.2, Technology Rd. V,
Hsinchu City 30078,
Taiwan

Phone: +886-3-666 2123
Fax: +886-3-666 2124
service@hcphotonics.com
www.hcphotonics.com