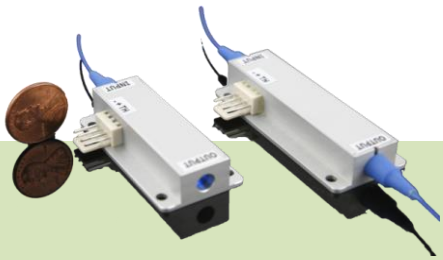
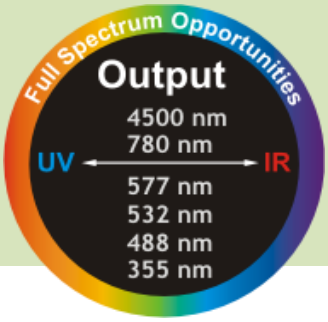
PPLN Optical Mixers





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

Your trusted value co-creation partner

HC PHOTONICS CORP.

GWU-Lasertechnik Vertriebsges. mbH

Bonner Ring 9
50374 Erftstadt
Germany

Fon +49.(0) 22 35.9 55 22-0
Fax +49.(0) 22 35.9 55 22-99

info@gwu-lasertechnik.de

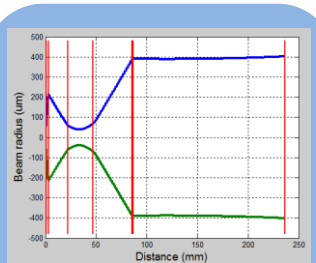
www.gwu-lasertechnik.de

HC Photonics provides a compact, robust and maintenance-free module for optical wavelength conversion called “Mixer”. Integrated with Periodically-Poled nonlinear crystals (e.g. PPLN or PPLT bulk or waveguide chips) as well as optics and electronics, the mixer provides high conversion efficiency from UV to mid-IR. Numerous successful cases are applied in Quantum, Industrial Productivity, Bio & Medicine, Spectroscopy & Environment, Space & Defense, Science & Research, etc.

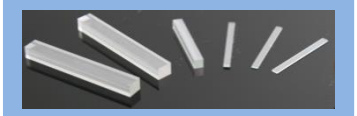
Your innovations

The success of HCP product does not come easy. Every single device is examined microscopically. At design phase, optical beam path simulation is performed with the nonlinear crystal for optimal parameters, including the conversion efficiency and other beam characteristics. Moving forward to engineering development phase, the mixers are set to go through a variety of reliability tests, i.e. thermal/humidity cycling, ingress protection examination, and vibration/shock verification in compliance with Telcordia standard. Among the key tasks is the perfection of final touch before delivery. Environmental qualifications, such as temperature cycling, drop and vibration test are performed on each mixer to ensure the quality.

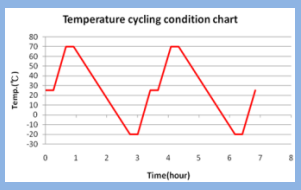
Simulation



Integration



Qualification Test

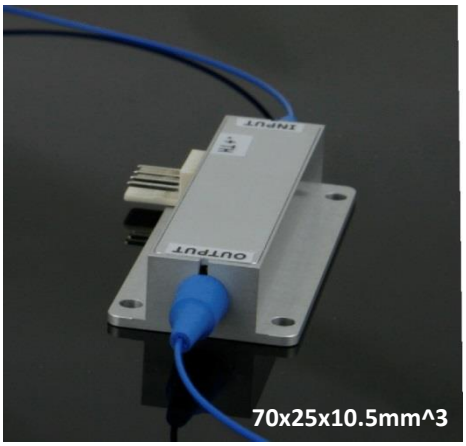


Temperature cycling
Damp Heat
Dry Heat
IPXX
Shock
Vibration

With these strict quality criteria, we believe our precision alignment capability and photonics packaging technology could surely meet all requirements from innovative ideas to volume production.

HCP
HC PHOTONICS CORP.

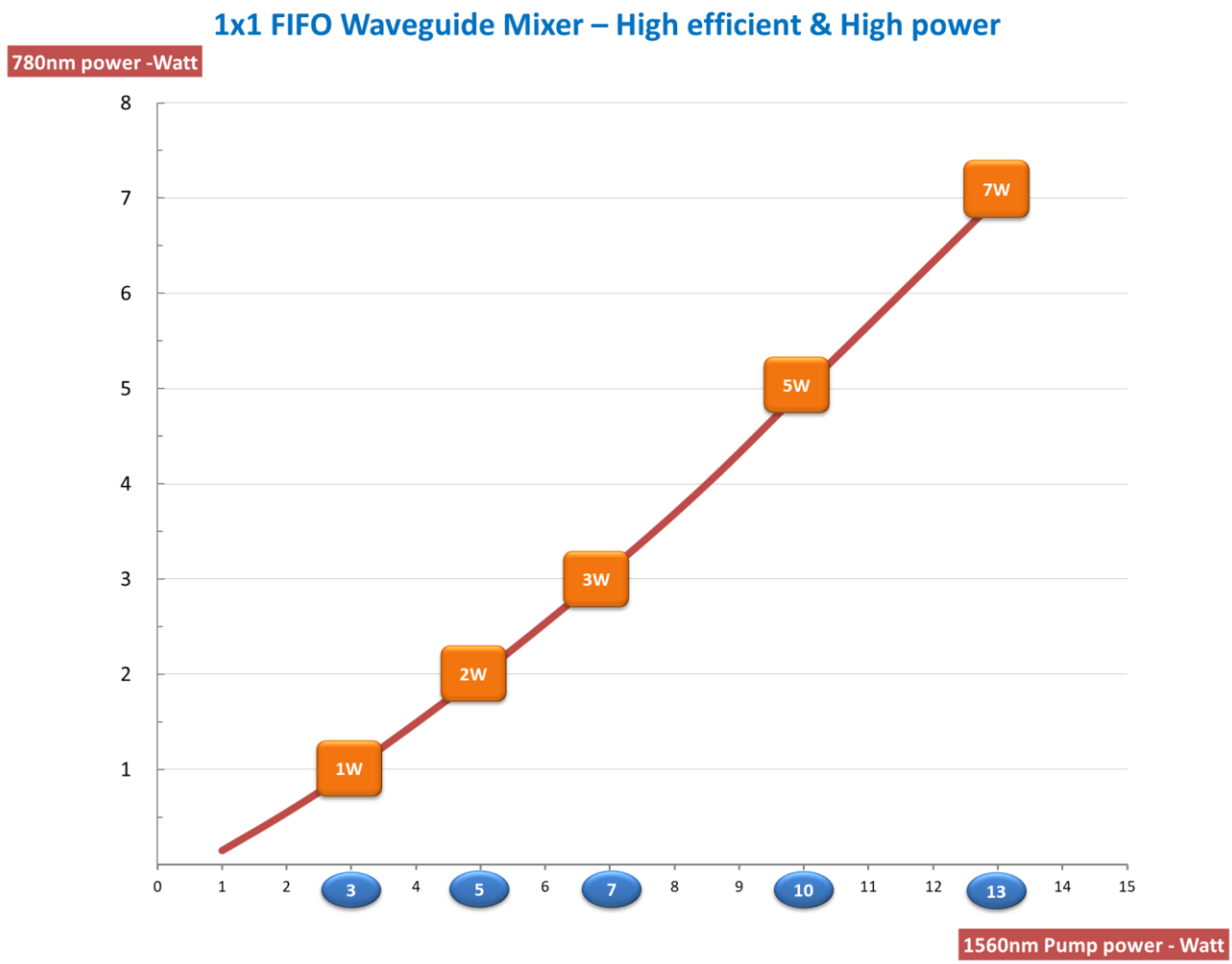
High Power Waveguide Mixer & Tunable Mixer



NEW Telecom band & Quantum

- High efficiency (up to 65%)
- High power (up to **7W/8.5W** out of PM fiber/free-space)
- Compact/Robust package (~18 cc only)
- Wide & Custom Wavelengths
- Fiber & Free-space Delivery
- **Commercial volume available now**

Waveguide solutions with high power endurance in compact footprints remain paramount in our design philosophy. HCP aims to turn the light into something feasible and affordable. Thus countless efforts are merged into the preliminary 7W/8.5W waveguide mixers. This breakthrough not only obscures the line between waveguide and bulk chip solution, but inspires even more in the territory of photonic application!



HCP
HC PHOTONICS CORP.

Full C Band Input Tunable Waveguide Mixer

- **One mixer covers full C band**
- **Watts level output**
- **Wide tunability & high-efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

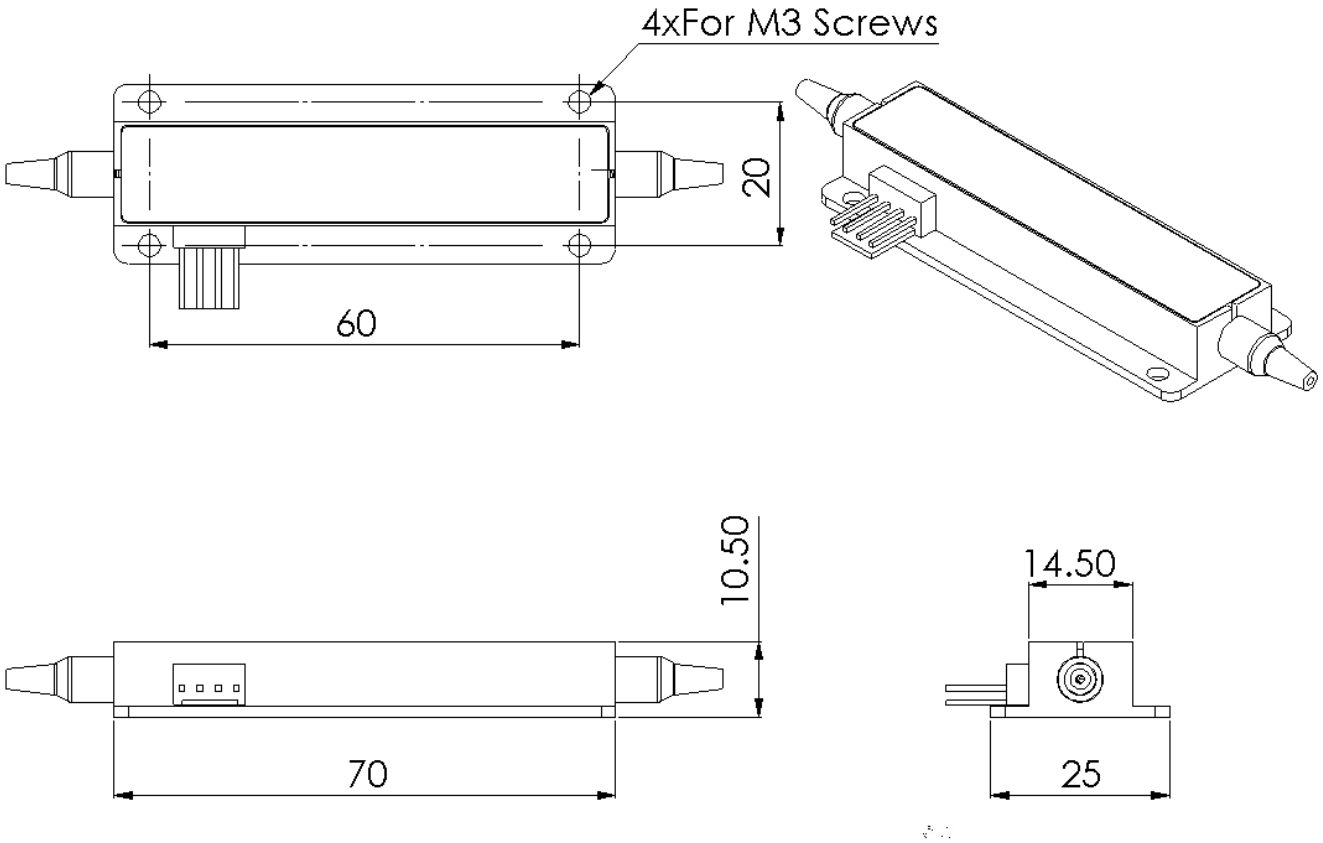
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1528 ~ 1564			[1], [2]
Output Wavelength	nm	764 ~ 782			
Input Fiber, Connector		PM1550 + mode adaptor, None			
Output Fiber, Connector		PM780, None			
Specified pump power	W	4.5			
Pump condition		CW, single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	1	1.1		[3], [4]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Tunable through temperature tuning
[2] Other wavelength region is available upon request
[3] Up to 2W is available upon request
[4] Pump residual arrangements are optional

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

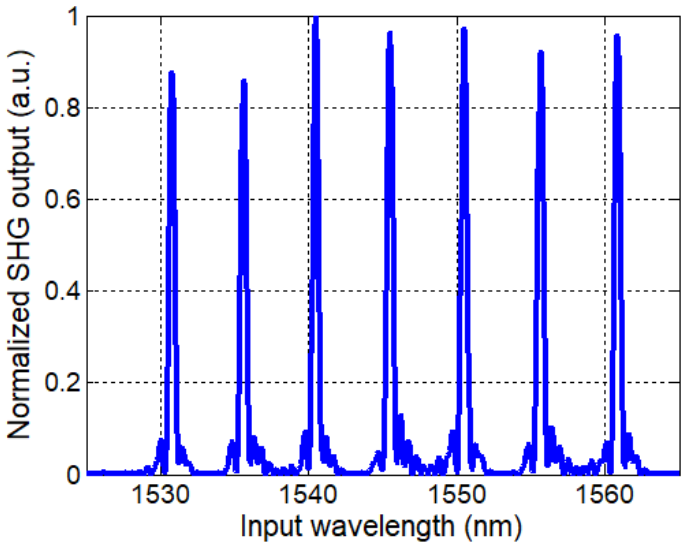
Full C Band Input Tunable Waveguide Mixer

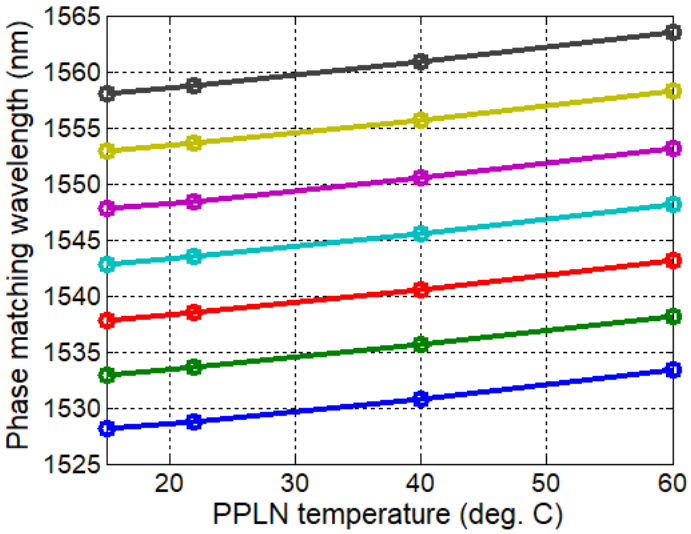
- Mechanical drawing



Unit: mm

- Referenced phase matching spectrum and temperature tuning curve

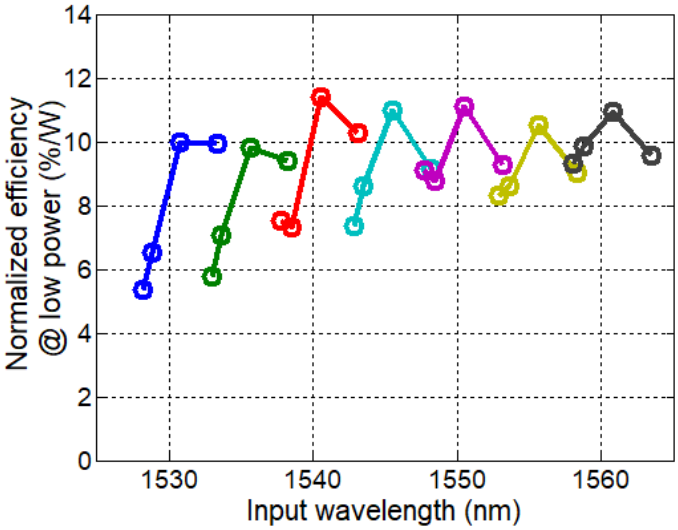


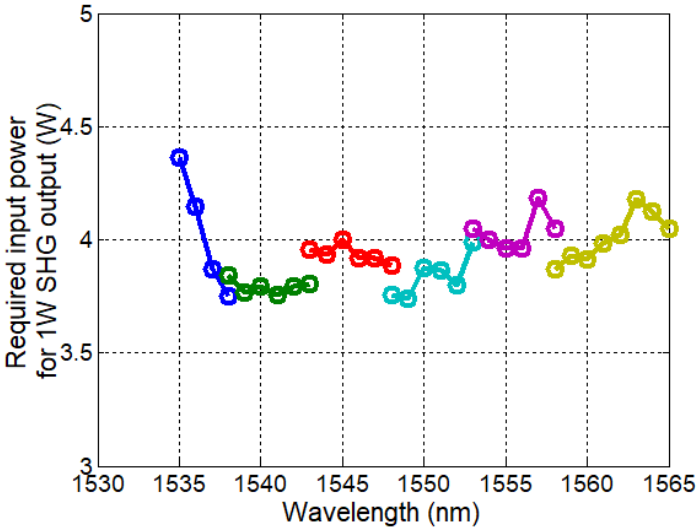


HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

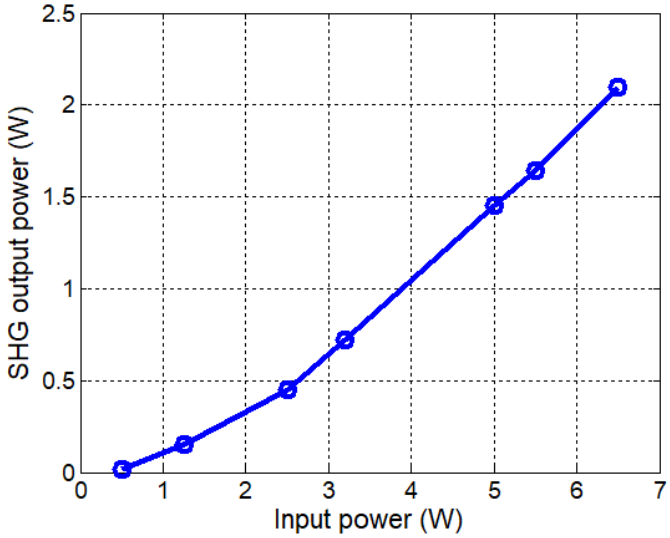
Full C Band Input Tunable Waveguide Mixer

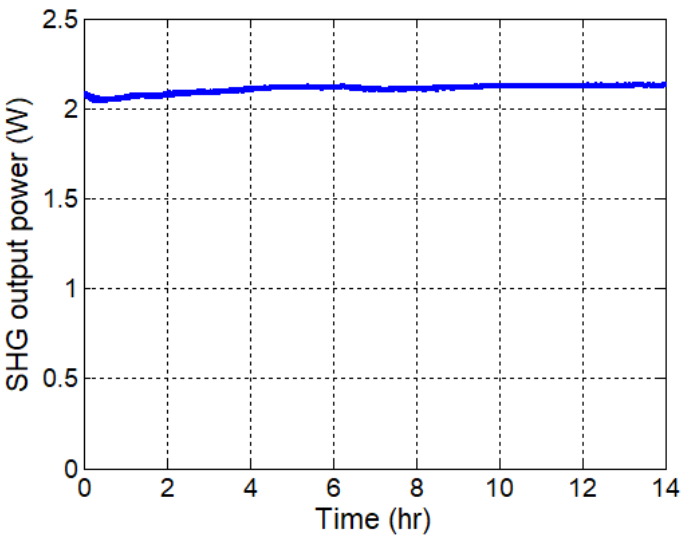
- Reference overall efficiency @ low power condition (Figure left) and required input power for 1 watt output (Figure right)





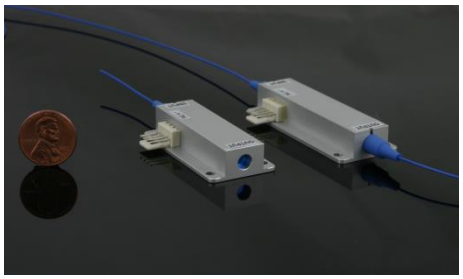
- Reference input / output power relation and long-term operation characteristic





HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x0 8.5W 780nm Waveguide Mixer



Preliminary

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x0			
Input Wavelength	nm	1560			[1]
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550 + mode adaptor, None			
Output Fiber, Connector		Free space, divergence (ellipse shape)			
Specified pump power	W	13			
Pump condition		CW, single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	8.5	8.8		[2]
Output polarization state			linear @ vertical axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	60 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Any wavelength at C band is available with the same spec upon request.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 7W 780nm Waveguide Mixer

Preliminary

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550+mode adaptor			[1]
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	13			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	7	7.2		[2]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25℃	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Additional fiber mode adaptor is included.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

HC PHOTONICS CORP.

EPOPO-TB Mixer

- **CW mid-infrared output at Watt level**
- **Tunable wavelength from 1.44-1.88 micron and 2.5-4.08 micron**
- **NIR /MIR dual outputs**
- **Fiber output for the NIR port optional**

Preliminary

Reference Specification sheet

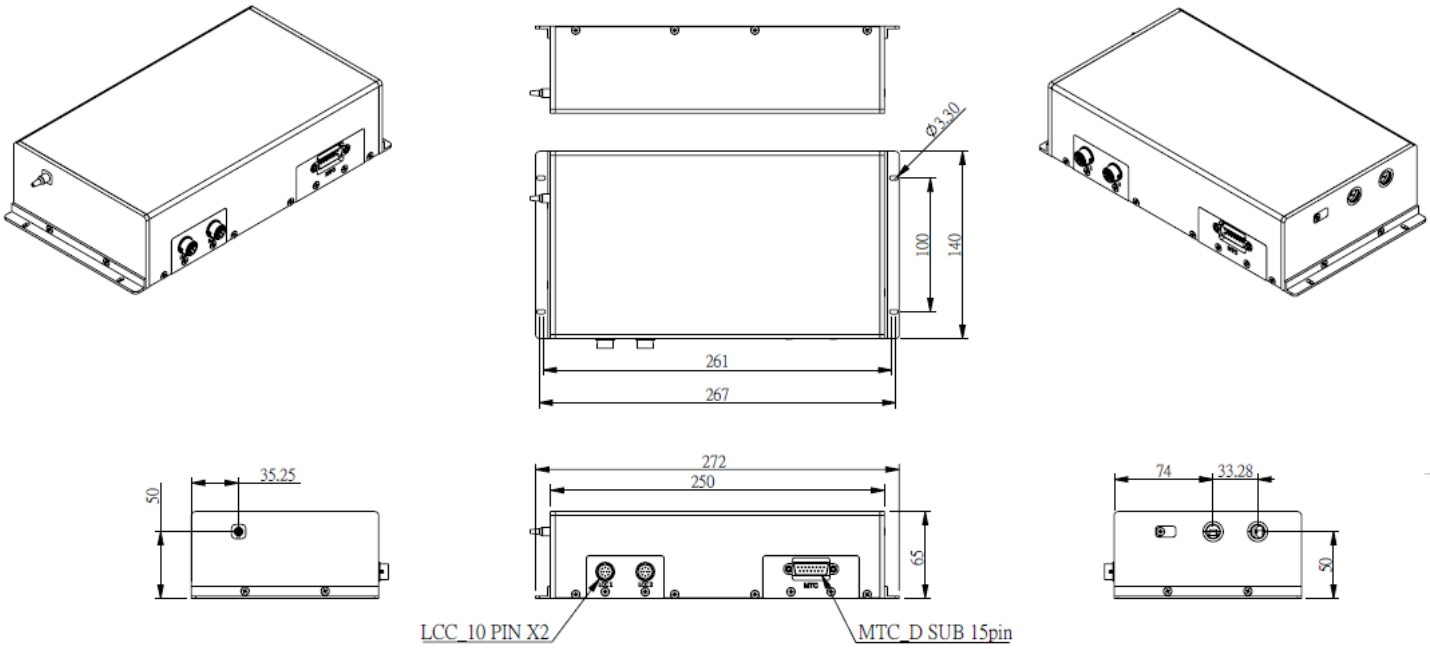
Optics (General)	unit	Specification			Note
Module type		EPOPO-TB			
Mixer Pigtailing Type		1 x (0 + 0)			
Input Wavelength	nm	1064			[1]
Input Fiber, Connector		FUD3460, None			
Pump condition		CW, single frequency, or multimode with <0.1nm linewidth			
Specified pump power	W	10			
Output Wavelength - Signal	nm	α series - 1560 - 1880 β series - 1495 - 1640 γ series - 1440 - 1510			
Output Wavelength - Idler	nm	α series - 2500 - 3300 β series - 3000 - 3700 γ series - 3600 - 4080			
Output power - Signal	W	α series - 3, β series - 2.5, γ series - 2			[2]
Output power - Idler	W	α series - 1.5, β series - 1.5, γ series - 1			[2]
Output type		CW, free space, collimated			[3]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Beam quality, M^2 - Signal			1.1	1.2	
Beam quality, M^2 - Idler			1.2	1.5	
Linewidth	GHz		150	300	
Diameter of collimated output beam (Signal / Idler)	mm	0.8 / 3	1 / 3.5	2 / 4	[4]
Output beam (TEM00) ellipicity	%		10	20	
Residual power rejection ratio at different wavelength	dB	40	45		
Output polarization state		linear @ vertical axis			
Output PER	dB	20	25		
Output beam height	mm	43.5	44	44.5	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (L*W*H)	mm	~ 272 x 140 x 65			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		DTSC-20-s			[5]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	5	-	65	
Operating ambient temperature range	℃	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Other pump wavelength is possible upon request.
[2] Defined by the maximum output in the wavelength region. The real output power may vary by wavelengths. Please refer to the figure for reference .
[3] Fiber output for the signal port is possible upon request. Coupling efficiency is 70% typically.
[4] Defined at the center output wavelength. For the whole output wavelengths, beam diameters may be different but the divergence angle remains similar.

Ver. Jan-24

EPOPO-TB Mixer

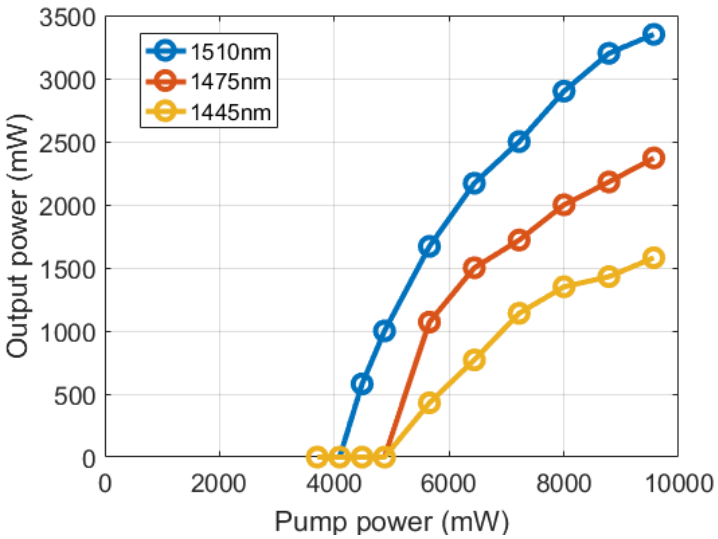
- Mechanical drawing



Unit: mm

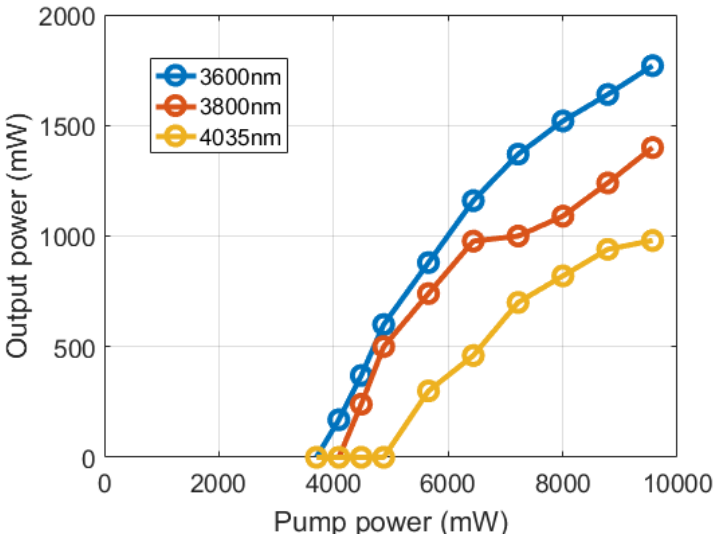
- Reference for output power at different output wavelength

Signal



For signal wavelength longer than 1510nm, the threshold and maximum output power is similar to 1510nm.

Idler



For idler wavelength shorter than 3600nm, the threshold and maximum output power is similar to 3600nm.

Ultrafast OPG series Bulk Mixer

- **Ultrafast OPG module with NIR and MIR outputs**
- **Up to 10% conversion efficiency**
- **Linear polarized**

Reference Specification sheet

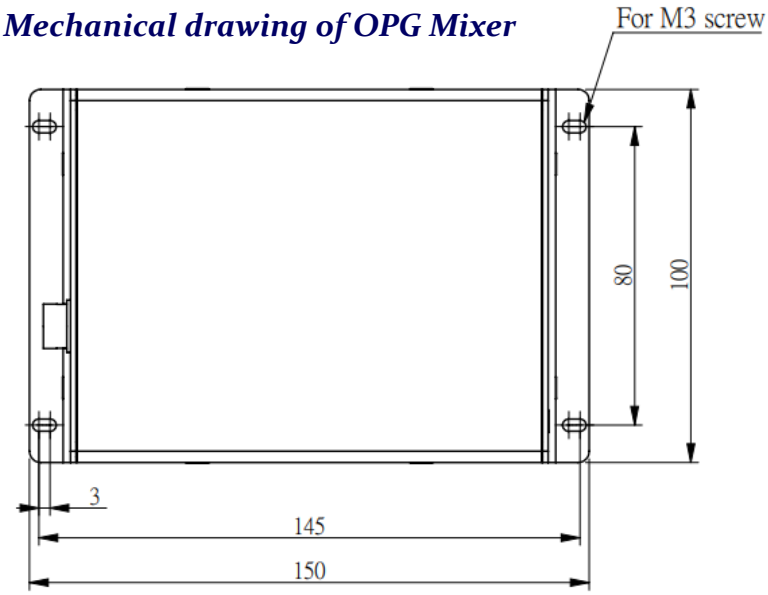
Optics (General)	unit	Specification			Note
Mixer type		Ultrafast OPG Mixer			
Mixer pigtailing type		0 + (0 x 0)			
Input wavelength	nm	1060			
Output signal central wavelength	nm	1570 to 1700			[1]
Output idler central wavelength	nm	2800 to 3400			[1]
Pump condition		>50nJ, >35fs			
Output type		Free space, collimated			
Optics (Output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output conversion efficiency (Signal / Ider)	%	10 / 7		24 / 10	[2]
Output pulse width (Signal / Idler)	fs		150 / 65	200 / 100	
Diameter of collimated output beam (Signal / Idler)	mm	2.5 / 3.5		3.5 / 4.5	[3]
Beam quality, M^2			2	2.5	[3]
Output beam (TEM00) ellipicity	%			15	
Output polarization state		Linear @ vertical axis			
Output PER	dB	20			
Output beam height	mm	25	25.5	26	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	150 x 100 x 42			[4]
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Hirose HR 10G-10R-10P(73)			
Thermoelectric cooler		~3.2V, ~4A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

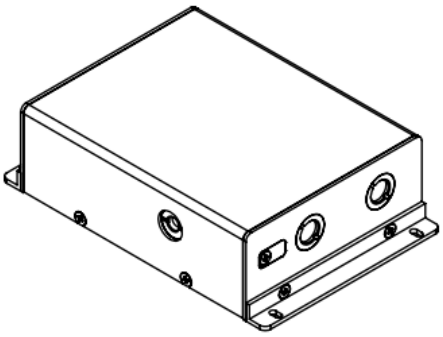
[1] Wavelength in this region can be selected with small tuning range through temperature.
[2] The shorter the signal λs, the higher the conversion efficiency.
[3] Beam diameter is defined by $1/e^2$ definition.
[4] Pump source can be integrated optionally. The housing dimension of integrated version is 496 x 320 x 158.1 mm^3

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

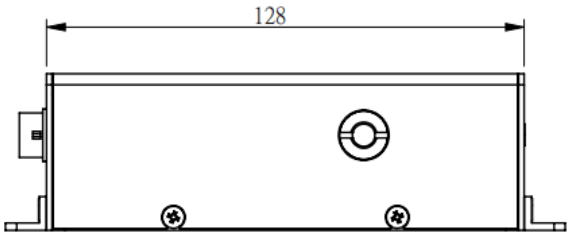
Ultrafast OPG series Bulk Mixer

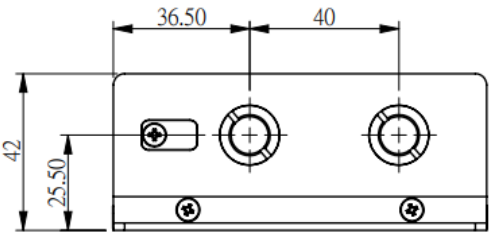
- Mechanical drawing of OPG Mixer



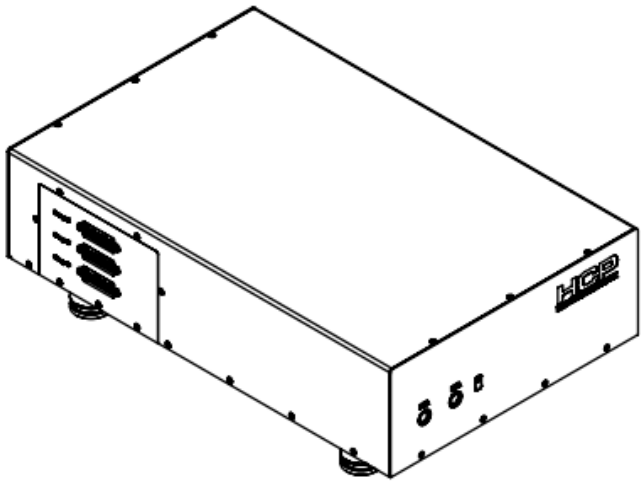


Unit: mm

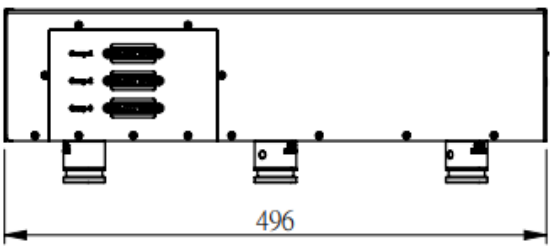


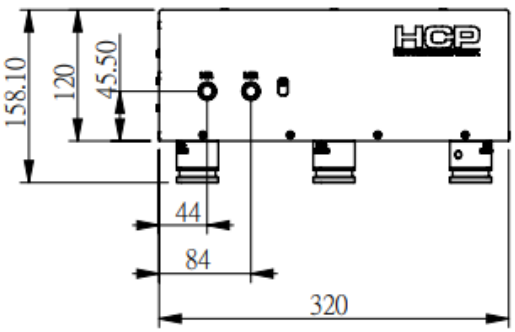


- Mechanical drawing of OPG Mixer with integrated pump



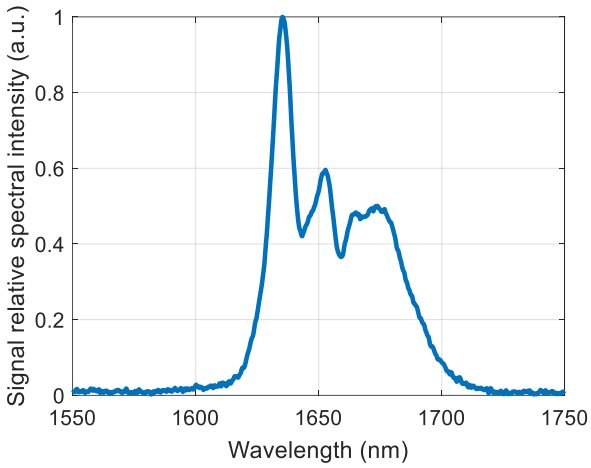
Unit: mm



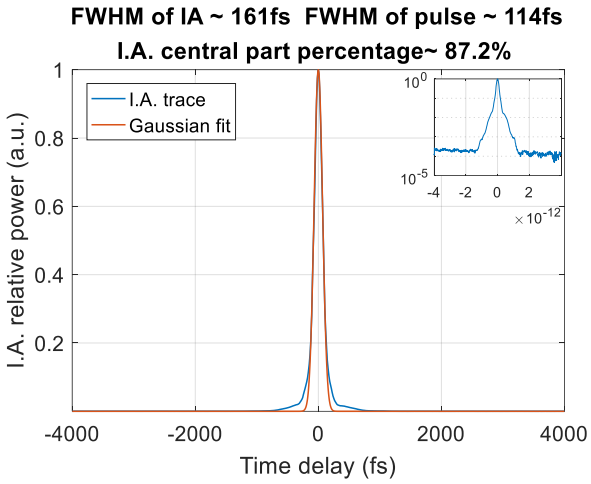


HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

- Reference for output signal spectrum and intensity auto correlation trace (I.A.)

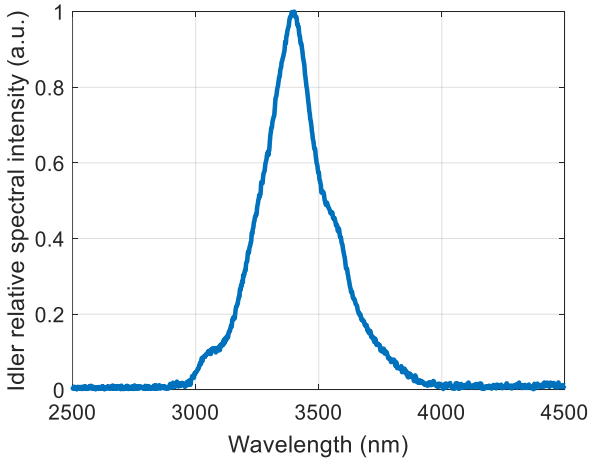


Typical signal output spectrum of the OPG mixer. The pump source is a 40fs, 50nJ femtosecond pulse

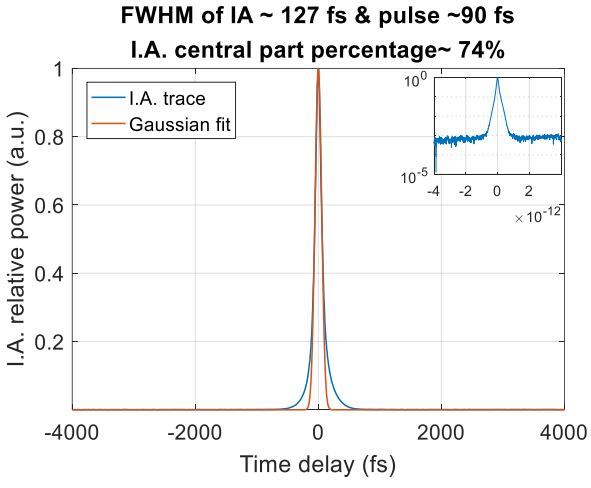


Typical output signal I.A. of the OPG mixer together with a 114fs FWHM Gaussian for comparison. Inset is I.A. scanning result spanning 8 picoseconds in logarithm scale.

- Reference for output idler spectrum and intensity auto correlation trace (I.A.)

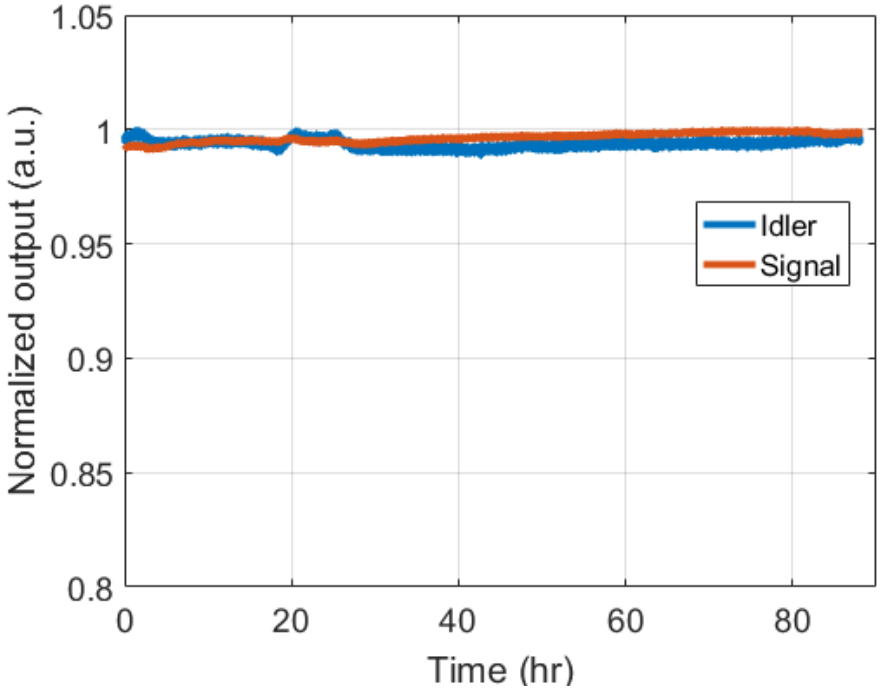


Typical idler output spectrum of the OPG mixer. The pump source is a 40fs, 50nJ femtosecond pulse



Typical output idler I.A. of OPG the mixer together with a 90fs FWHM Gaussian for comparison. Inset is I.A. scanning result spanning 8 picoseconds in logarithm scale.

- Reference for normalized output power stability over 80 hours



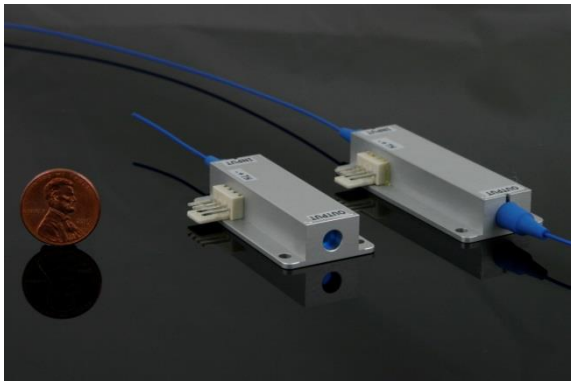
Measured normalized signal and idler output power. The pump source is a 40fs, 50nJ femtosecond pulse

- Reference specsheet for the ultrafast OPG Mixer with integrated femtosecond pump

Ultrafast OPG Mixer with integrated femtosecond pump					
Optics (General)	**unit**	**Specification**			**Note**
Mixer type		Ultrafast OPG Mixer with integrated femtosecond pump			
Output central wavelength (Signal / Idler)	nm	~1650 / ~3400			
Output average power (Signal / Idler)	mW	120 / 50	140 / 70		
Output type		Free space, collimated			
Optics (Output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output pulse width (Signal / Idler)	fs		150 / 65	200 / 100	
Repetition rate	MHz	13	14	15	
Diameter of collimated output beam (Signal / Idler)	mm	2.5 / 3.5		3.5 / 4.5	[2]
Beam quality, M^2			2	2.5	[3]
Output beam (TEM00) ellipicity	%		7	15	
Output polarization state		Linear @ vertical axis			
Output PER	dB	20			
Output beam height	mm	82.6	83.6	84.6	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	496 x 320 x 158.1			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Controller		Included			

Waveguide Mixer

Standard 1x0 & 1x1 Mixer



- High efficiency (up to 65%)
- High power (up to **8.5W** free-space out)
- Compact/Robust package
- Custom Wavelengths(output UV to MIR)
- Fiber & Free-space Delivery
- **Commercial volume available now**

PPLN waveguide mixer is made with **PPLN waveguide chips** for continuous wave (CW) and pulsed laser(fs, ps and ns). Via different nonlinear frequency conversion processes (e.g. SHG, SFG, DFG…), the PPLN waveguide mixer provides the output wavelength from UV to mid-IR with superb conversion efficiency and exceptional high power up to Watts level.

Unlike the conventional technology for low power only, our unique design breaks the confinement of technical barrier and pushes ahead the power handling capability to Watts level while remaining compact and robust. 7W/8.5W out of single mode PM780 fiber/free-space with 13W pump at 1560nm CW is the spotlight you definitely cannot miss!

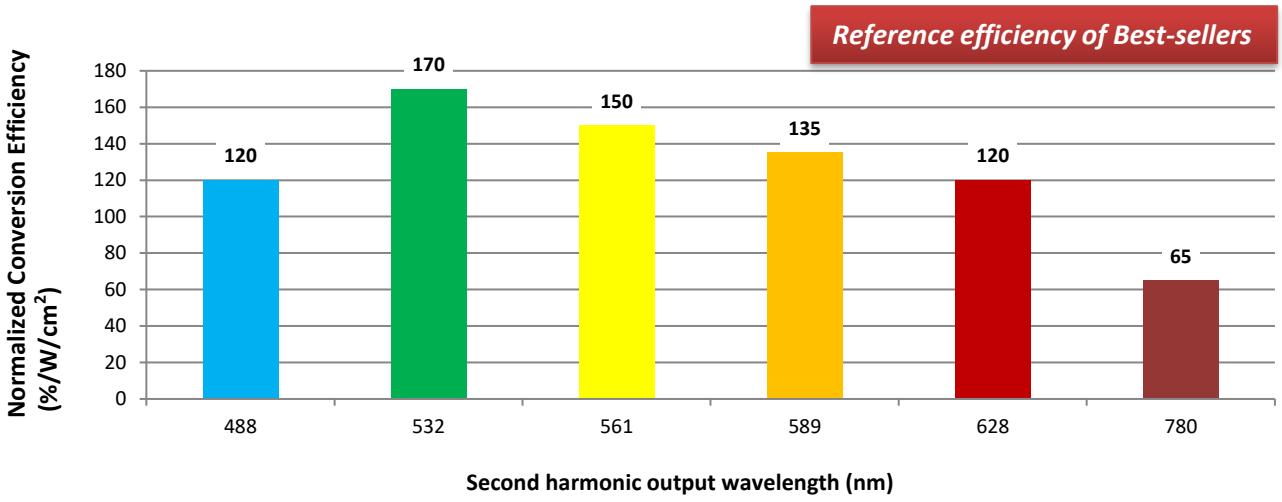
Best-seller

	Waveguide Mixer – SHG					
Series	**B**	**G**	**Y**	**O**	**R**	**T**
Range (nm)	450-495	495-560	560-580	580-620	620-700	700-800
Best seller, λ *1	**488nm**	**532nm** **555nm**	**561nm**	**589nm**	**628nm**	**775nm** **780nm**
Overall Efficiency*2	80%/W	120%/W	105%/W	90%/W	80%/W	50%/W
Fiber output*2	Yes, ~80% coupling efficiency from waveguide to single mode PM fiber					

1. The wavelengths of the best sellers are within +/- 0.5 nm typically. Custom wavelengths are available upon request.
2. The listed overall efficiency is baseline for volume production and reference only at low power regime with single longitudinal mode input. In general, the efficiency could be doubled with multi-longitudinal mode lasers e.g. **180%/W for 1064 nm SHG to 532 nm**. High power versions are also available.

HCP
HC PHOTONICS CORP.

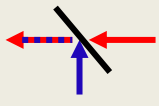
Specifications



Optics	unit	Spec.		
		Minimum	Typical	Maximum
Beam quality, M^2				≤1.2
Output beam (TEM00) ellipticity			1.2-2.0	
Output polarization state			Vertical or Horizontal, PER>20dB	
Back reflection for IR wavelength	dB		-40	
Fiber coupled output	%	75	80	
Mechanics	**unit**	**Spec.**		
		Minimum	**Typical**	**Maximum**
Typical housing dimension (LxWxH)	mm		60x25x10.5, 70x25x10.5(fiber-out)	
Beam height	mm		5.25+/-0.5	
Electrics	**unit**	**Spec.**		
		Minimum	**Typical**	**Maximum**
Electrical connector			Molex (4P)	
Typical thermoelectric cooler			~3.9V, ~1.7A maximum	
Environment	**unit**	**Spec.**		
		Minimum	**Typical**	**Maximum**
Storage temperature (no humidity)	˚C	-20	-	70
Operating ambient 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/EU	

Options:

Wavelength Combiner

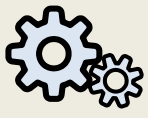


A free space module combines arbitrary optical wavelengths into waveguide mixer with low insertion loss.

Filter Module

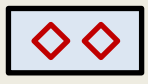
The filter module with free space/fiber input & output removes the undesired wavelengths for up to 100dB between residual pump and converted signal.

Control unit



A control unit allows to set and read the crystal temperature for phase-matching optimization. Photodiode signal can also be viewed at power monitoring option.

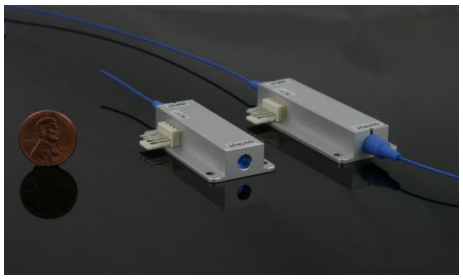
Fiber adaptor package



The waveguide mixers could be integrated into a housing that provides FC/APC fiber adaptor interface with collimation optics. Simply plug & play, life is just that easy!

HCP
HC PHOTONICS CORP.

1x0 6W 780nm Waveguide Mixer



- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**

Reference Specification sheet

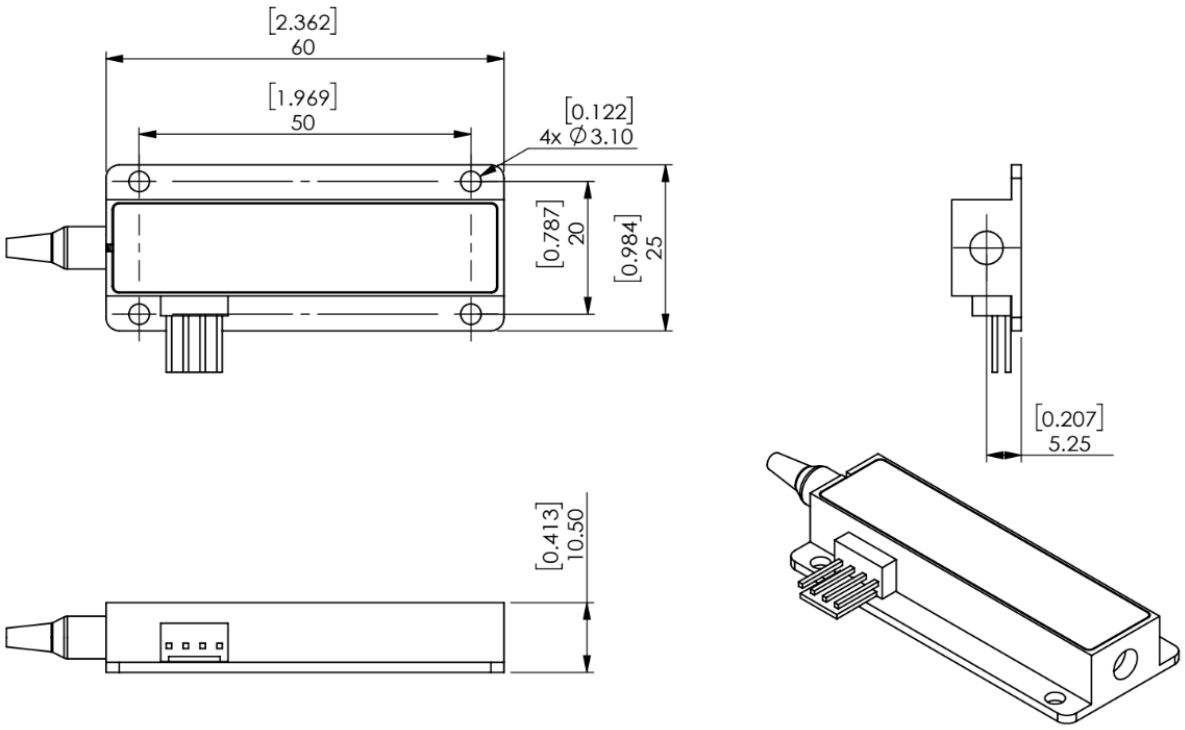
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x0			
Input Wavelength	nm	1560			[1]
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550 + mode adaptor, None			
Output Fiber, Connector		Free space, divergence (ellipse shape)			
Specified pump power	W	10			
Pump condition		CW, single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	6	6.5		[2]
Output polarization state			linear @ vertical axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	60 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Any wavelength in C band is available with the same spec upon request.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

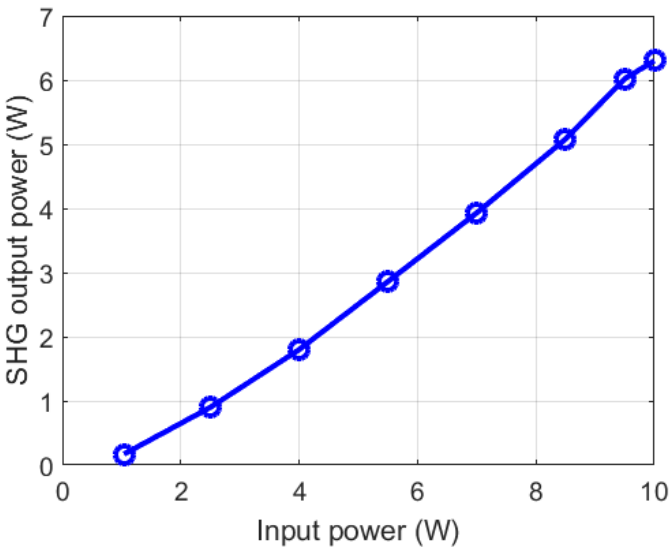
1x0 6W 780nm Waveguide Mixer

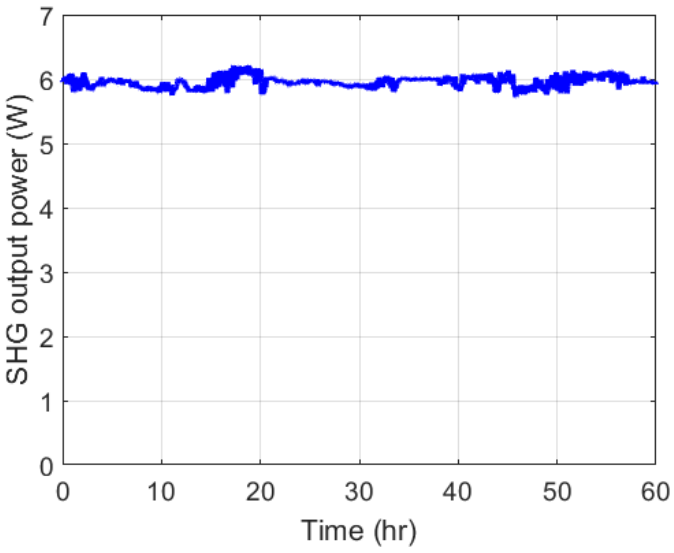
- Mechanical drawing



Unit: mm

- Reference input / output power relation and long-term operation characteristic





1x1 5W 780nm Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550+mode adaptor			[1]
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	10			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	5	5.1		[2]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25℃	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Additional fiber mode adaptor is included.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 4W 780nm Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550+mode adaptor			[1]
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	8.5			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	4	4.2		[2]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Molex 0022112042 (4P)			
Thermoelectric cooler		~3.9V, ~1.7A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Additional fiber mode adaptor is included.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 3W 780nm Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550+mode adaptor			[1]
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	7			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	3	3.2		[2]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Molex 0022112042 (4P)			
Thermoelectric cooler		~3.9V, ~1.7A maximum			
NTC Thermistor resistance@25℃	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Additional fiber mode adaptor is included.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 2W 780nm Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550+mode adaptor			[1]
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	5.2			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	2	2.2		[2]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Molex 0022112042 (4P)			
Thermoelectric cooler		~3.9V, ~1.7A maximum			
NTC Thermistor resistance@25℃	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Additional fiber mode adaptor is included.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 1W 780nm Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550+mode adaptor			[1]
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	3.2			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	1	1.1		[2]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Additional fiber mode adaptor is included.
[2] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 1064nm Waveguide Mixer

- **Plug & play**
- **2μm SHG waveguide for f-2f application**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

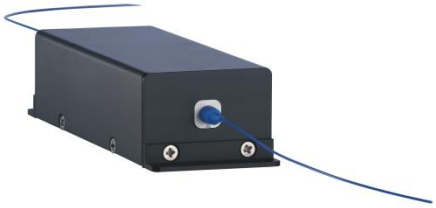
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	2128			[1]
Output Wavelength	nm	1064			
Input Fiber, Connector		PM2000, FC/APC			[2]
Output Fiber, Connector		PM980, FC/APC			[2]
Pump condition		CW, single frequency			[3]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Specified overall efficiency @ low input	%/W	5	5.5		[4]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Any wavelength in 2μm region (up to silica fiber transparent wavelength) is available upon request.
[2] Input / Output fiber can both be changed to PM1550 upon request for application purpose.
[3] Defined in CW efficiency for general definition
[4] Typically the residual input / output power ratio will be < -40dB. Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 1W 780nm Supreme Efficiency Waveguide Mixer

HC PHOTONICS CORP.



Preliminary

- **Plug & play**
- **Supreme efficiency**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

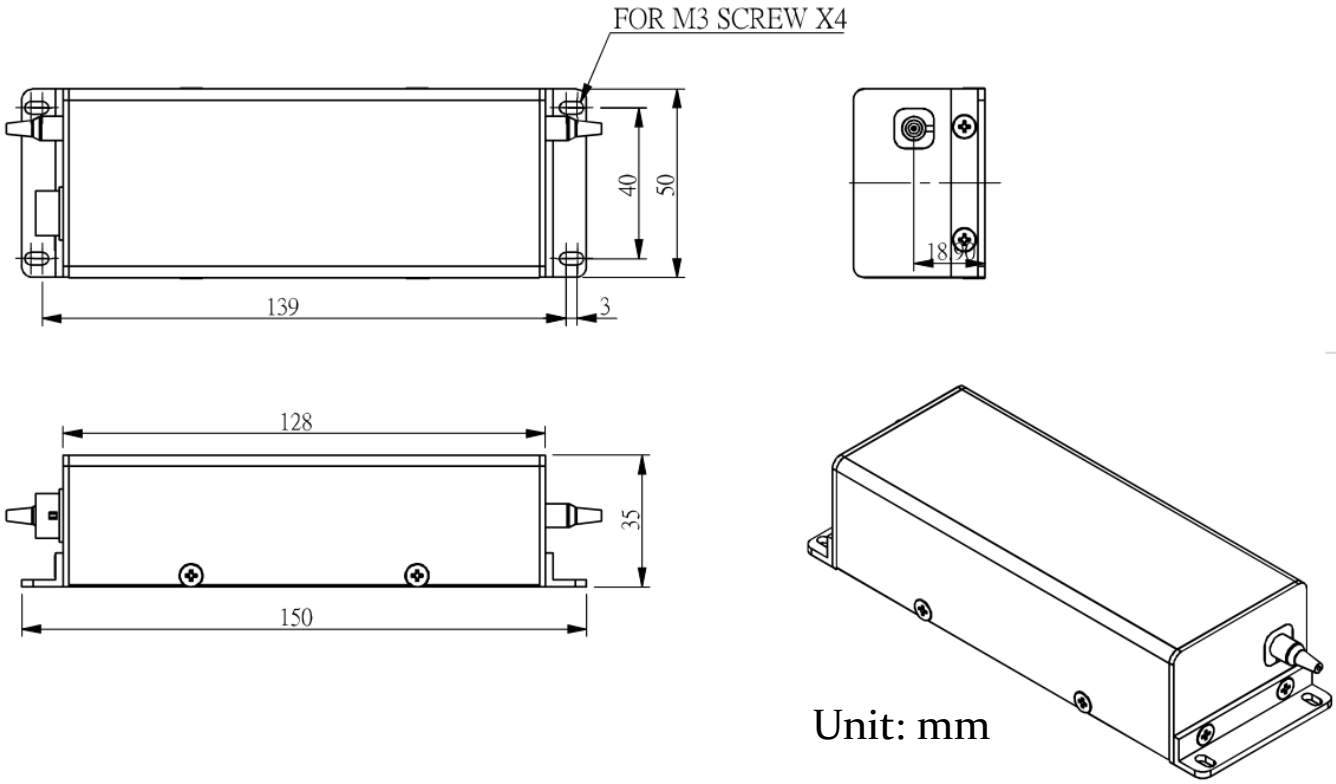
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			[1]
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550, None			
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	2			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	1	1.1		
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	150 x 50 x 35			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Hirose HR 10G-10R-10P(73)		
Thermoelectric cooler			~3.2V, ~4A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Any wavelength at C band is available with the same spec upon request

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

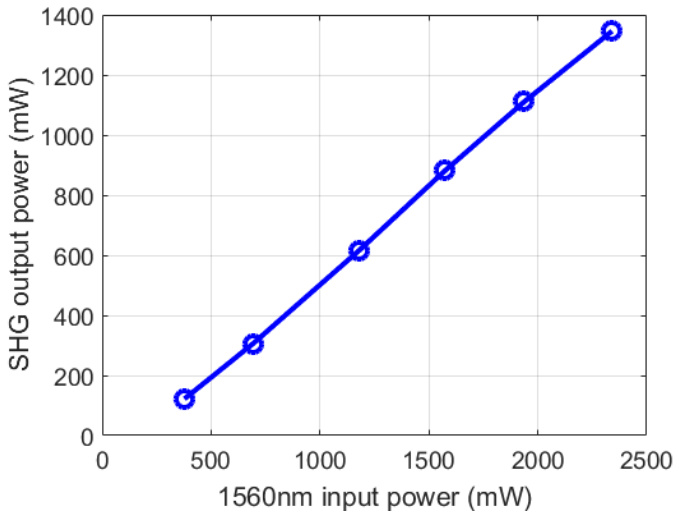
1x1 1W 780nm Supreme Efficiency Waveguide Mixer

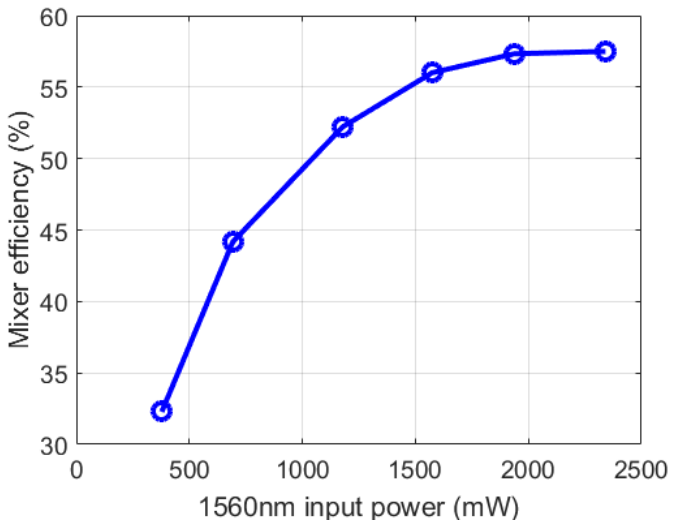
- Mechanical drawing



Unit: mm

- Reference data for input / output power relation and the overall mixer efficiency





1x1 Type0 775/780 SPDC Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Watts-level power handling**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

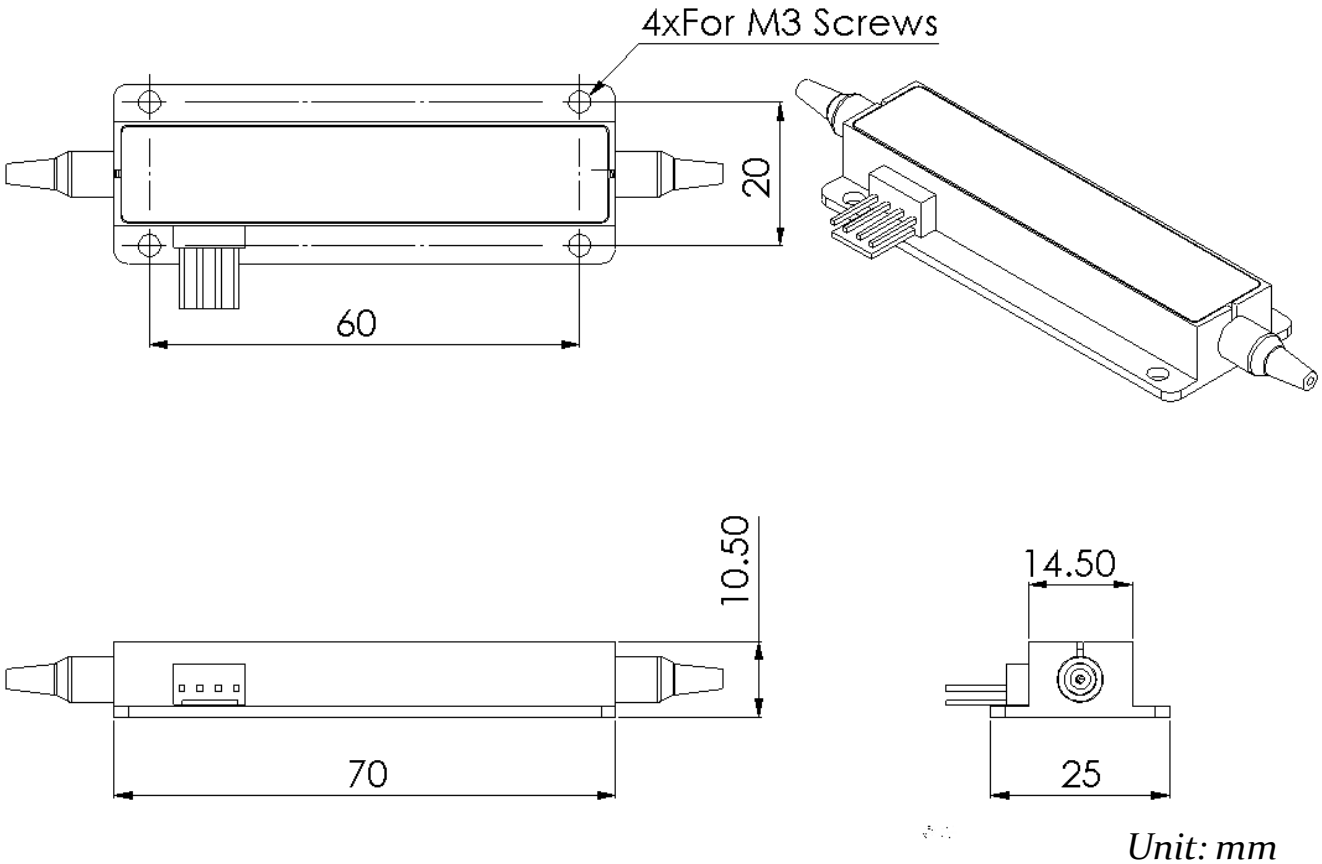
Optics (General)	unit	Specification			Note
Mixer Type		SPDC (Spontaneous Parametric Down-Conversion), Type0			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	775/780			[1]
Output Wavelength	nm	1550/1560			[2]
Input Fiber, Connector		PM780, FC/APC			
Output Fiber, Connector		PM1550+mode adaptor, FC/APC			
Pump condition		CW, single longitudinal mode			[3]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
SPDC output photon rate	Hz/mW	1e9	1e10		[4]
Specified overall efficiency @ low input	%/W	45	50		[5]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Other wavelength available upon request.
[2] Broadband output, in the level of ~100 nm bandwidth, and the residual pump is not filtered, can add HCP 1x1 filter module to eliminate 775/780.
[3] Power handling up to watts-level.
[4] Typically measured in the level of hundreds mW pump.
[5] Defined in reversed equivalent SHG.

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

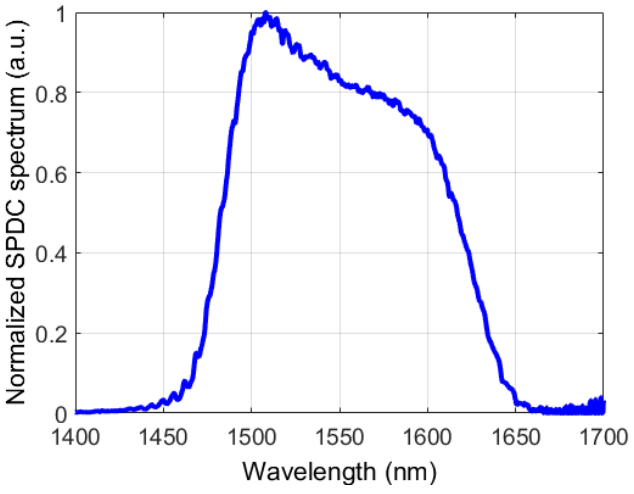
1x1 Type0 775/780 SPDC Waveguide Mixer

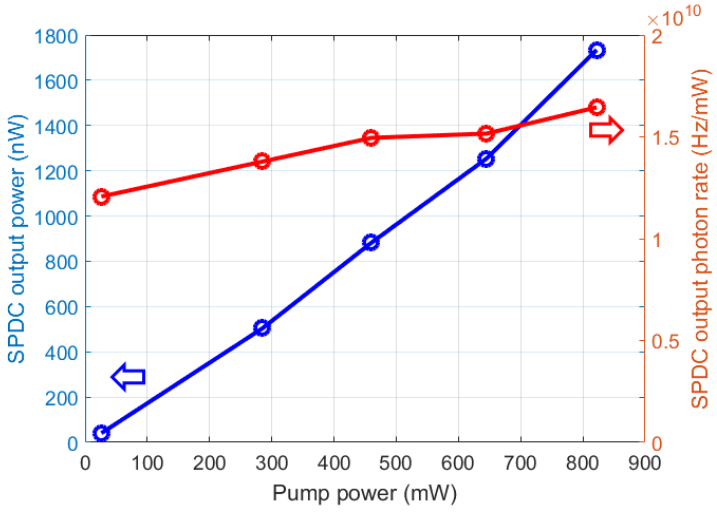
- Mechanical drawing



Unit: mm

- Reference SPDC output spectrum, SPDC output power and output photon rate





1x1 TypeII 775/780 SPDC Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Watts-level power handling**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

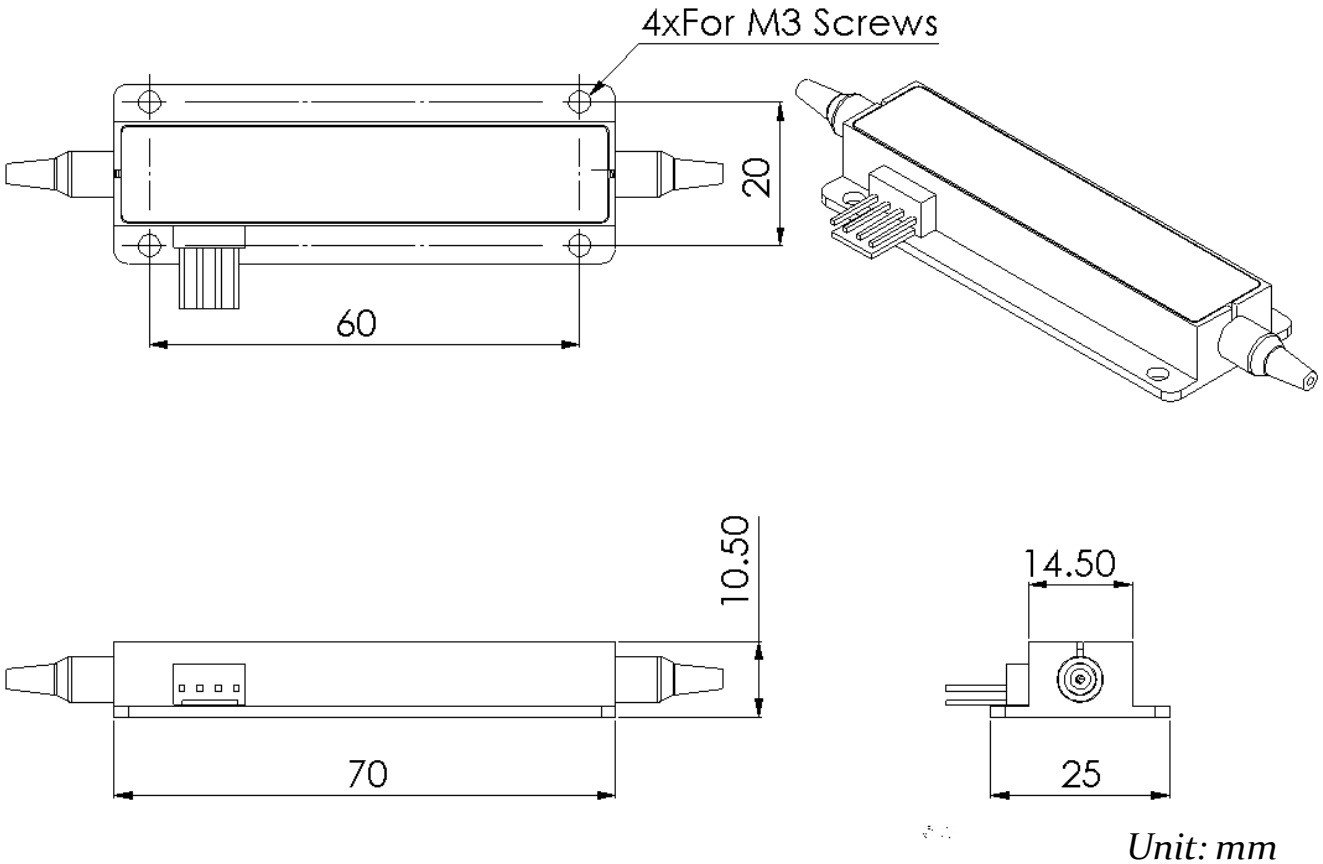
Optics (General)	unit	Specification			Note
Mixer Type		SPDC (Spontaneous Parametric Down-Conversion), TypeII			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	775/780			[1]
Output Wavelength	nm	1550/1560			[2]
Input Fiber, Connector		PM780, FC/APC			
Output Fiber, Connector		PM1550+mode adaptor, FC/APC			
Pump condition		CW, single longitudinal mode			[3]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
SPDC output photon rate	Hz/mW	5e6	1e7		[4]
Specified overall efficiency @ low input	%/W	1.7	2		[5]
Output polarization state		~50/50 @ slow / fast axis			
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Molex 0022112042 (4P)			
Thermoelectric cooler		~3.9V, ~1.7A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Other wavelength available upon request.
[2] Narrowband output, adjustable through temperature tuning, and the residual pump is not filtered, can add HCP 1x1 filter module to eliminate 775/780
[3] Power handling up to watts-level.
[4] Measured through equivalent method
[5] Defined in reversed equivalent SHG.

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

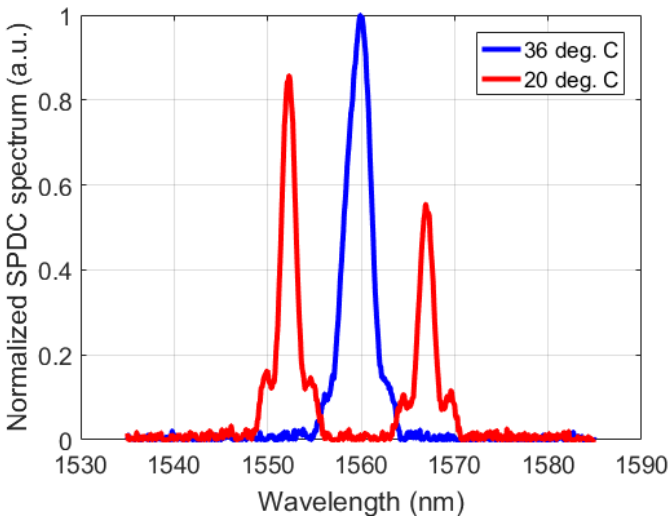
1x1 TypeII 775/780 SPDC Waveguide Mixer

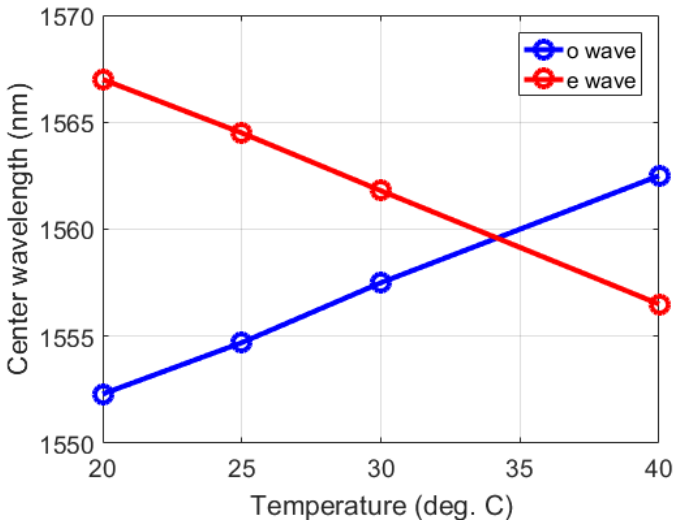
- Mechanical drawing



Unit: mm

- Reference SPDC output spectrum and the temperature tuning behavior





* Center temperature will be different, while the spectrum and the tuning behavior is similar

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 600mW 532nm Waveguide Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

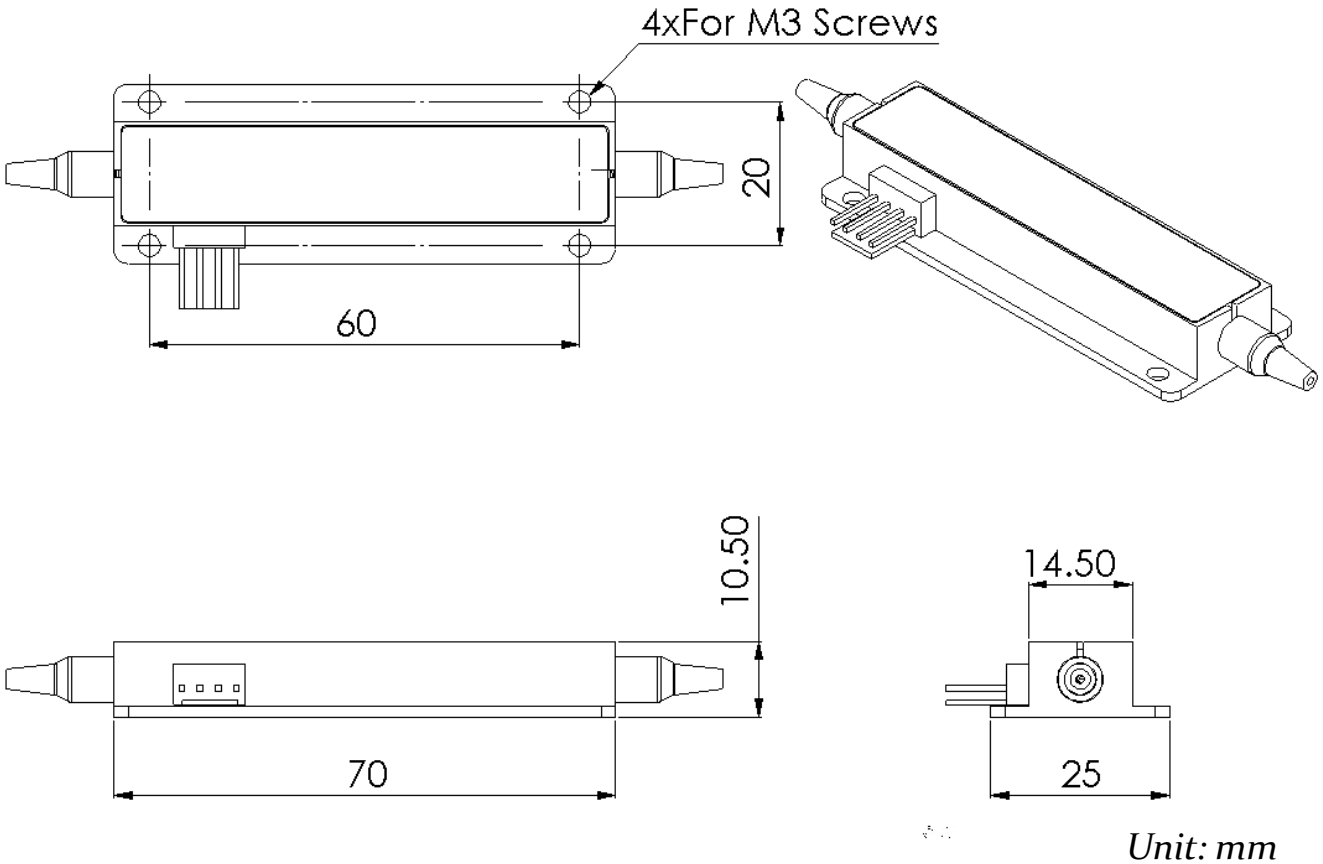
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1064			
Output Wavelength	nm	532			
Input Fiber, Connector		PM980, None			
Output Fiber, Connector		PM480, None			
Specified pump power	W	2.2			
Pump condition		CW, multimode, <0.1nm linewidth			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	0.6	0.63		[1]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Molex 0022112042 (4P)			
Thermoelectric cooler		~3.9V, ~1.7A maximum			
NTC Thermistor resistance@25℃	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Typically the residual input / output power ratio is < -40dB. Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

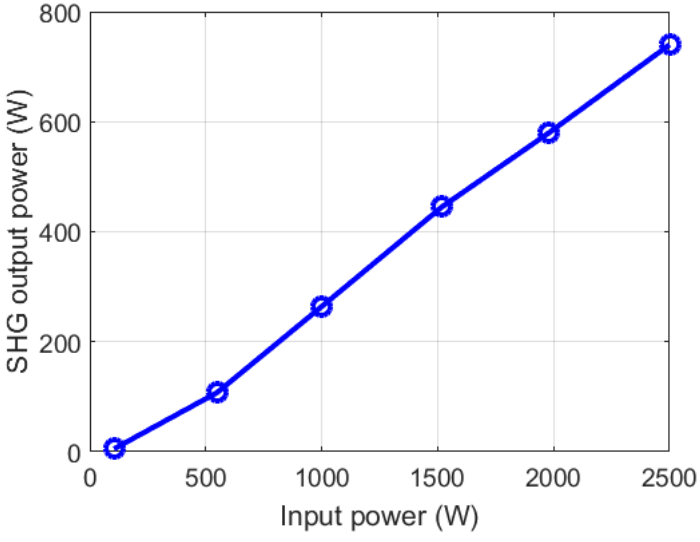
1x1 600mW 532nm Waveguide Mixer

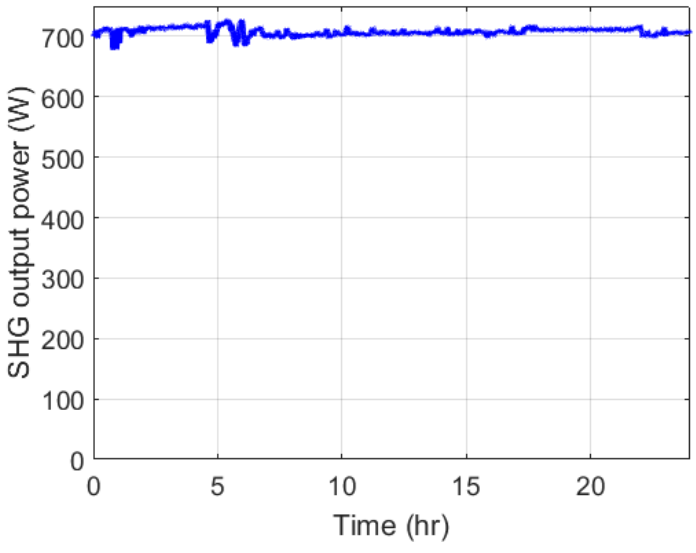
- Mechanical drawing



Unit: mm

- Reference input / output power relation and long-term operation characteristic





1x1 350mW 532nm Waveguide Mixer

- **Plug & play**
- **High-efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

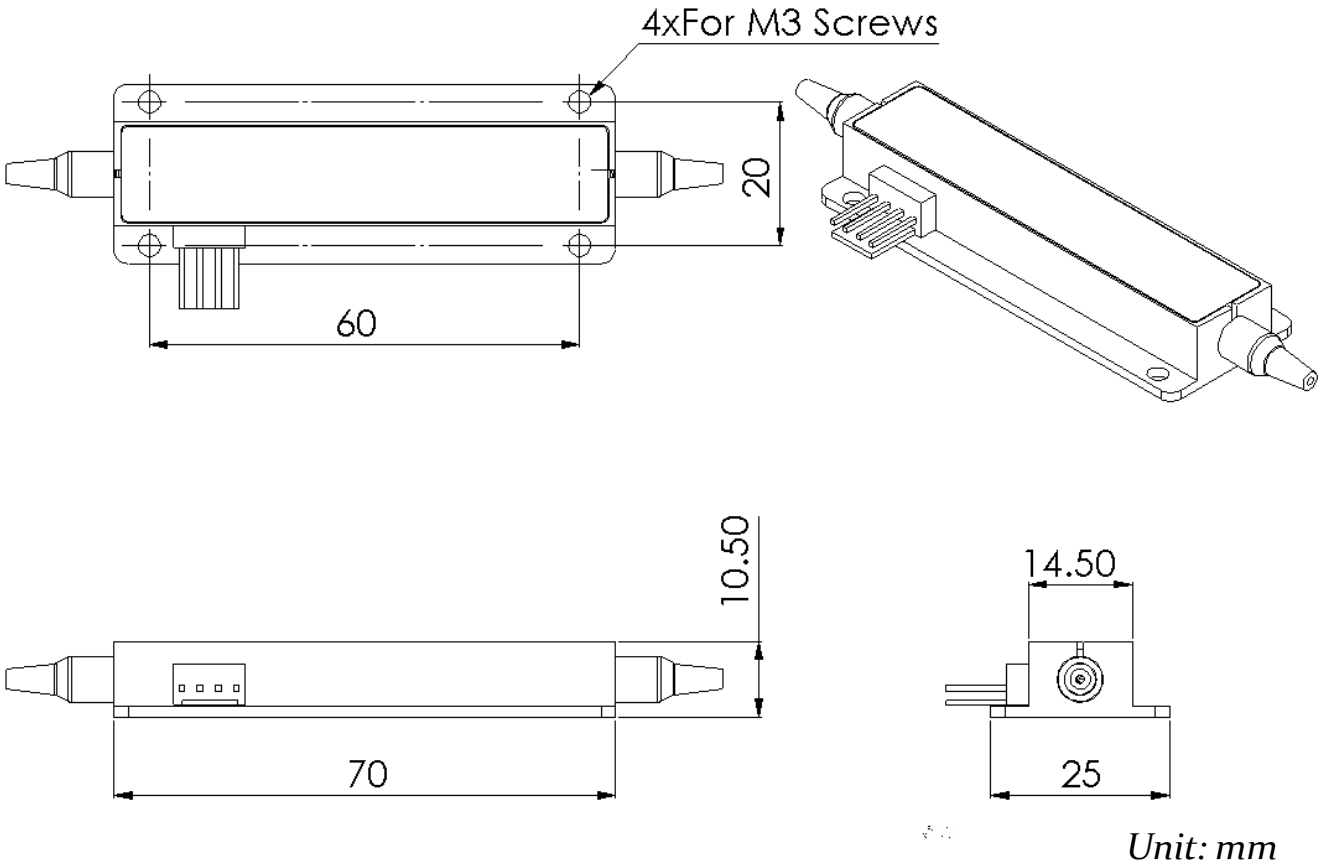
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1064			
Output Wavelength	nm	532			
Input Fiber, Connector		PM980, None			
Output Fiber, Connector		PM480, None			
Specified pump power	W	1.3			
Pump condition		CW, multimode, <0.1nm linewidth			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	0.35	0.36		[1]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Molex 0022112042 (4P)			
Thermoelectric cooler		~3.9V, ~1.7A maximum			
NTC Thermistor resistance@25℃	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Typically the residual input / output power ratio is < -40dB. Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

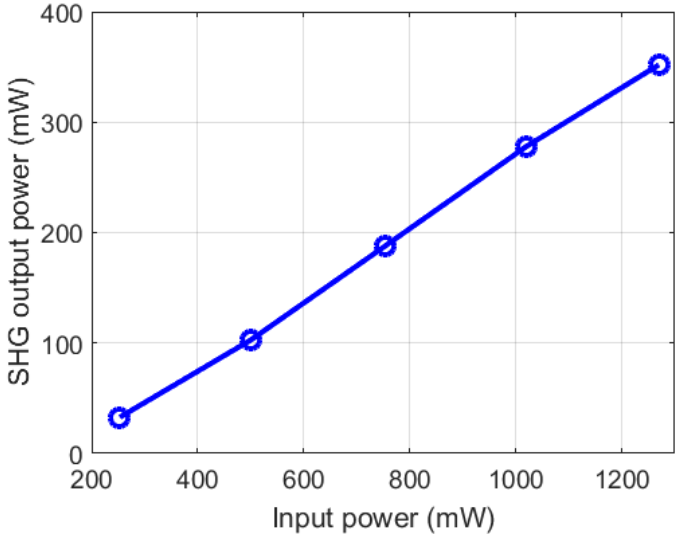
1x1 350mW 532nm Waveguide Mixer

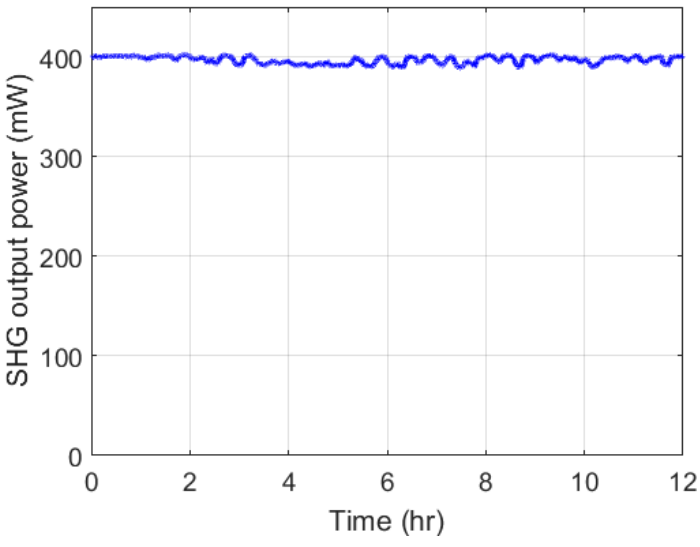
- Mechanical drawing



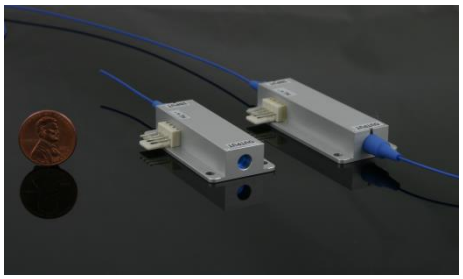
Unit: mm

- Reference input / output power relation and long-term operation characteristic





1x0 250mW 532nm Waveguide Mixer



- **Plug & play**
- **High-efficiency**
- **Compact & robust**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x0			
Input Wavelength	nm	1064			
Output Wavelength	nm	532			
Input Fiber, Connector		PM980, FC/APC			
Output Fiber, Connector		Free space, divergence (ellipse shape)			
Specified pump power	W	1			
Pump condition		CW, multimode, <0.15nm linewidth			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	0.25	0.27		[1]
Output polarization state			linear @ vertical axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	60 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating ambient temperature range	°C	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Input wavelength not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 200mW 532nm Waveguide Mixer

- **Plug & play**
- **High-efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

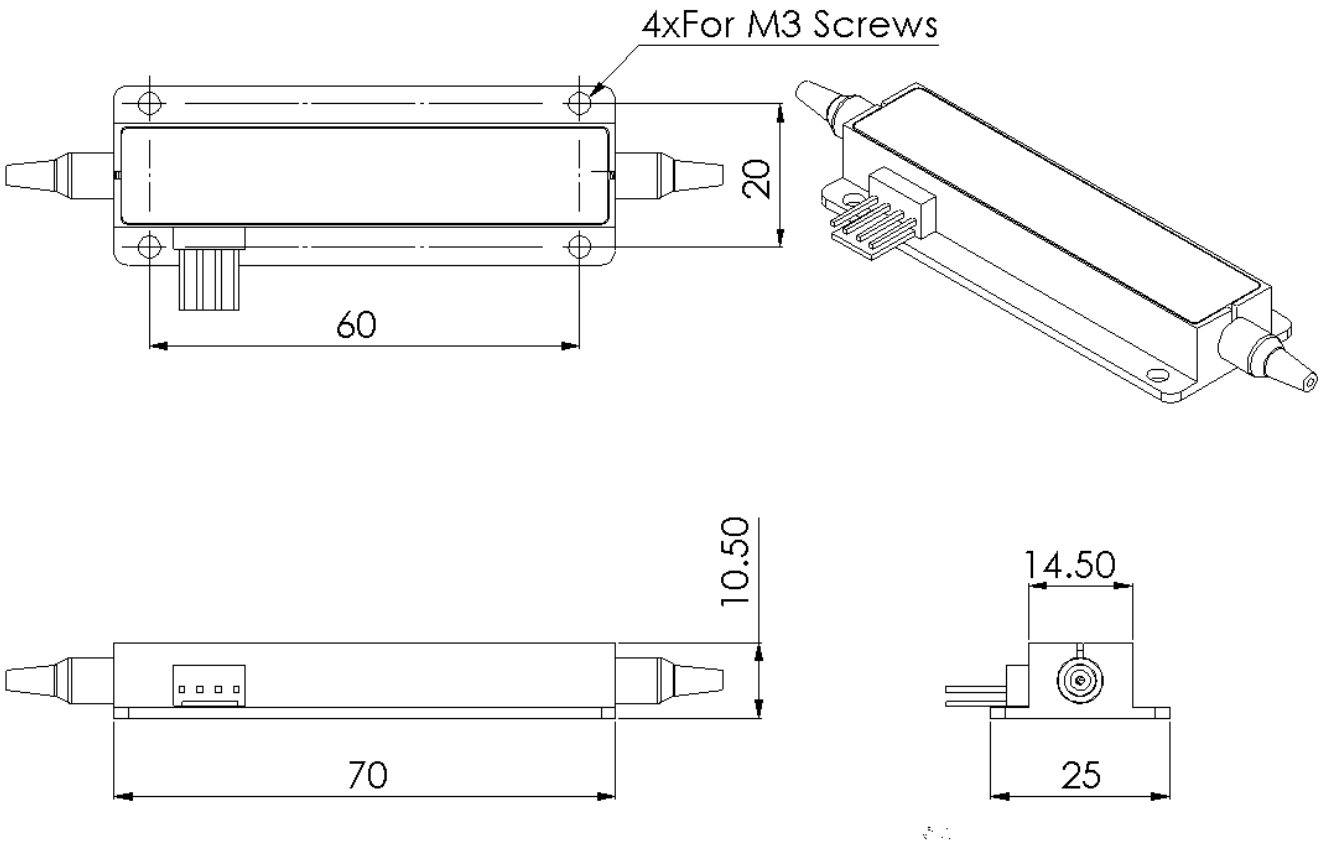
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1064			
Output Wavelength	nm	532			
Input Fiber, Connector		PM980, FC/APC			
Output Fiber, Connector		PM480, FC/APC			
Specified pump power	W	1			
Pump condition		CW, multimode, <0.15nm linewidth			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	0.2	0.21		[1]
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-40	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	70 x 25 x 10.5			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Molex 0022112042 (4P)		
Thermoelectric cooler			~3.9V, ~1.7A maximum		
NTC Thermistor resistance@25℃	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	15	25	30	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Typically the residual input / output power ratio will be < -40dB.] Input wavelength is not filtered. (Filter can be added optionally in different housing.)

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

*(L-70: 70*25*10.5mm^3)Waveguide Mixer*

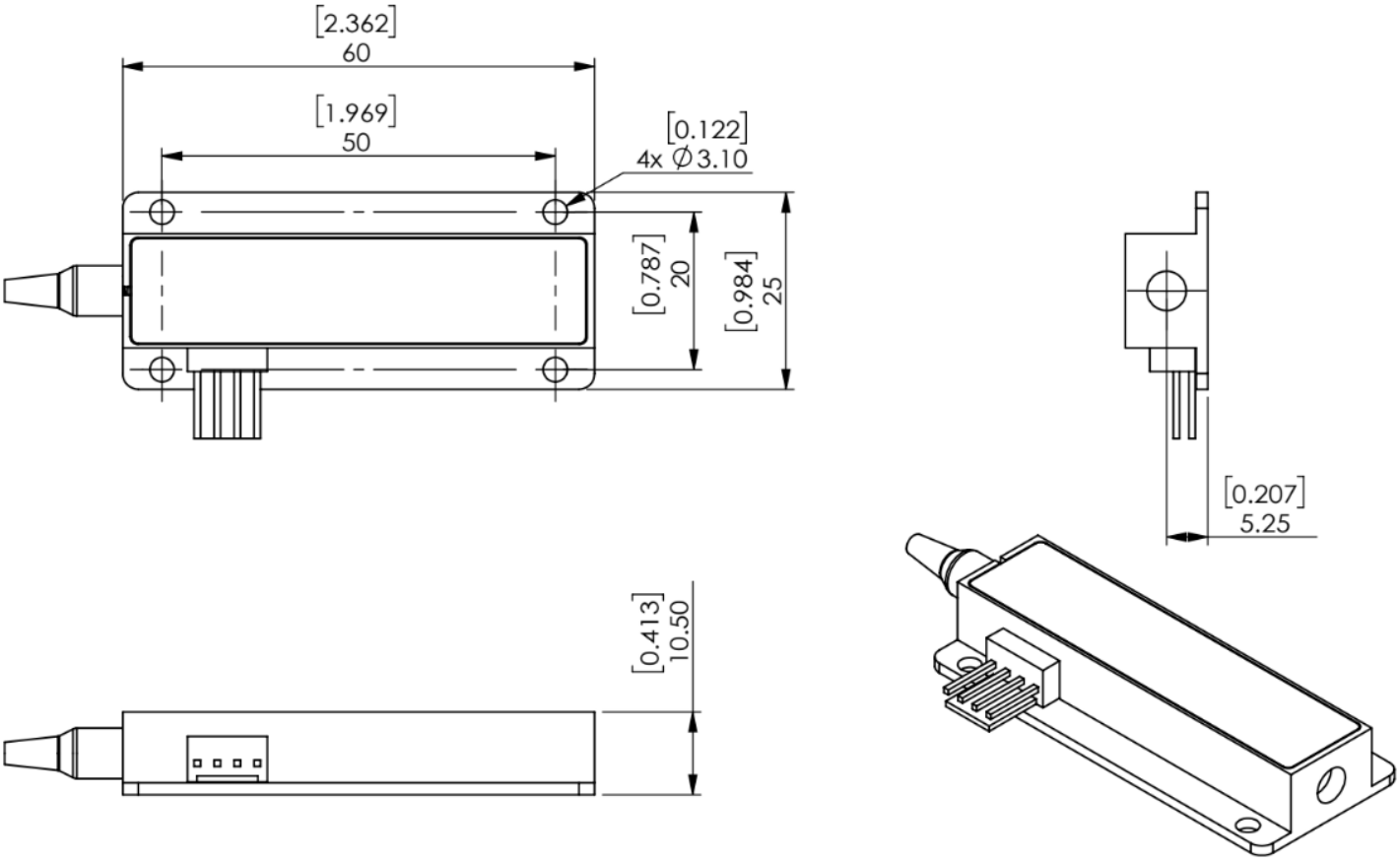
- Mechanical drawing



Unit: mm

(L-60: 60*25*10.5mm^3) Waveguide Mixer

- Mechanical drawing



Unit: mm

Bulk Mixer

Standard 1x0 & 1x1 Mixer

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

PPLN bulk mixer is made with **PPLN bulk chips** for continuous wave (CW) and pulsed lasers(fs, ps, and ns). Via different nonlinear wavelength conversion processes (e.g. SHG, SFG, DFG…etc), the PPLN bulk mixer provides the polarization maintained output from UV to mid-IR with output power up to 10W CW either free-space or fiber output.

Best-seller

Five color series corresponding to the different wavelength range are our Best-sellers. They are designed for specific applications such as laser microscopy or atom trapping. Detailed specifications are shown below. Alternatives are also available upon request.

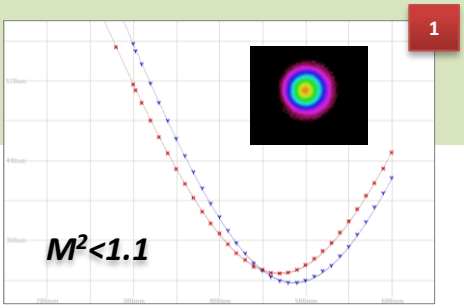
	Bulk Mixer – SHG [*1]				
Color	**B**	**G**	**Y**	**O**	**R**
Range (nm)	450-495	495-560	560-580	580-620	620-800
Best seller, λ [*2]	473nm, **488nm**	515nm, **532nm,** 543nm	**561nm**	**589nm,** 594nm	**775nm, 780nm,** 785nm
Power[*3] (max)	1W	2W	3W	4W	6W
Pump	Diode	Diode/Yb&Yb+/Raman lasers			Diode/Er laser

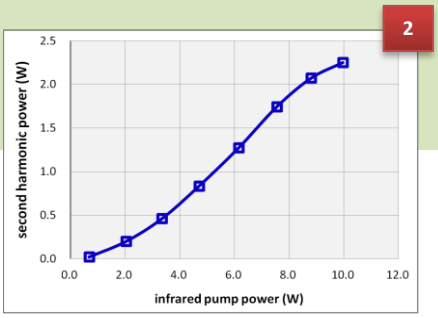
1. Second-Harmonic Generation (SHG)
2. The wavelengths are within +/- 0.5 nm. Other custom wavelengths are open for discussion.
3. SHG power is pump dependent. Typical output coupling efficiency from chip to single mode PM fiber is >80%. Higher efficiency is also achievable. Please contact us with your pump conditions (power, linewidth, pulse width, repetition rate...) for further evaluation.

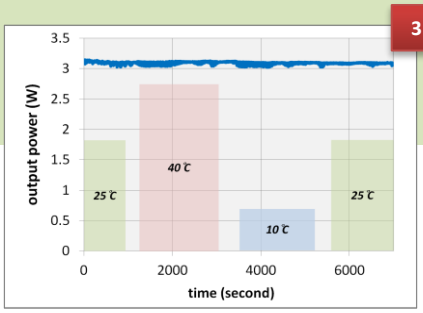
HCP
HC PHOTONICS CORP.

Specifications

Optics	unit	Spec.		
		Minimum	Typical	Maximum
Beam quality, M^2				≤1.2
Reference diameter of collimated output beam	mm	0.9	1	1.1
Output beam (TEM00) ellipicity	%			≤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**
Typical housing dimension (L*W*H)	mm	150x50x35		
Beam height	mm	18.9±0.5		
Statistic beam angle	mrad	-7.5	0	7.5
Electrics	**unit**	**Spec.**		
		Minimum	**Typical**	**Maximum**
Electrical connector		Hirose HR 10G-10R-10P(73)		
Thermoelectric cooler		~3.2V, ~4A maximum		
Environment	**unit**	**Spec.**		
		Minimum	**Typical**	**Maximum**
Storage temperature (no humidity)	°C	-20	-	70
Operating ambient 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/EU		



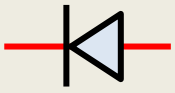




(**1**) The typical beam quality of collimated output from the bulk mixer
(**2**) The typical power scaling curve of the second harmonic generation from the bulk mixer-G at 532nm
(**3**) Temperature cycling(-20-70 ˚C) test before delivery

Options:

Power Monitoring

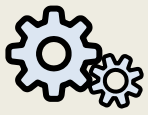


Photodiode for the output power monitoring with a voltage signal Vpd (typically 3V at maximum output power) allows auto-power control (APC) mode operation.

Filter Module

The filter module with free space/fiber input & output removes the undesired wavelengths for up to 100dB between residual pump and converted signal.

Control unit



A controller allows to set and read the crystal temperature for phase-matching optimization. Photodiode signal can also be viewed at power monitoring option.

Customer Inspiration

We are open to discuss the possibility of integrating other components. Don't hesitate to contact us and share your innovative ideas!

HCP
HC PHOTONICS CORP.

1x0 THG UV Bulk Mixer

- **Single-pass & high-efficiency**
- **Compact & robust**
- **Optional 532nm/355nm dual outputs**

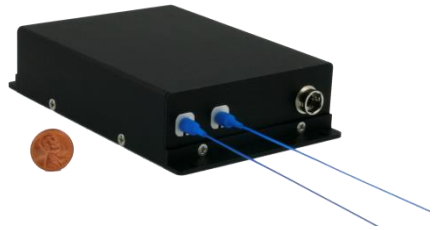
Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Third Harmonic Generation (THG)			
Mixer Pigtailing Type		1x0			
Input Wavelength	nm	1064			[1]
Output Wavelength	nm	355			
Input Fiber, Connector		PM980, None			
Output Fiber, Connector		None			
Specified pump power	W	3.5			
Pump condition		CW, multimode, <0.05nm linewidth			[2]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	0.05	0.055		
Beam quality, M^2			1.1	1.2	[3]
Diameter of collimated output beam	mm	0.5	1	1.5	[3]
Waist location (from the output window)	mm	-500	0	500	[3]
Output beam (TEM00) ellipicity	%		5	10	[3]
Residual IR/output power rejection ratio	dB	40	45		
Output polarization state		linear @ vertical axis			
Output PER	dB	20	25		
Back reflection of IR wavelength	dB		-45	-42	
Output beam height	mm	18.4	18.9	19.4	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	150 x 100 x 35			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		2x Hirose HR 10G-10R-10P(73)			
Thermoelectric cooler		~3.2V, ~4A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
PD response	V/W		NA		[4]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Different wavelength possible upon request
[2] Efficiency will be different for single longitudinal mode pump
[3] Defined at the target output power
[4] PD response allows to read SHG.

Ver. Jan-24

2x0 3W 632 SFG Bulk Mixer



- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**

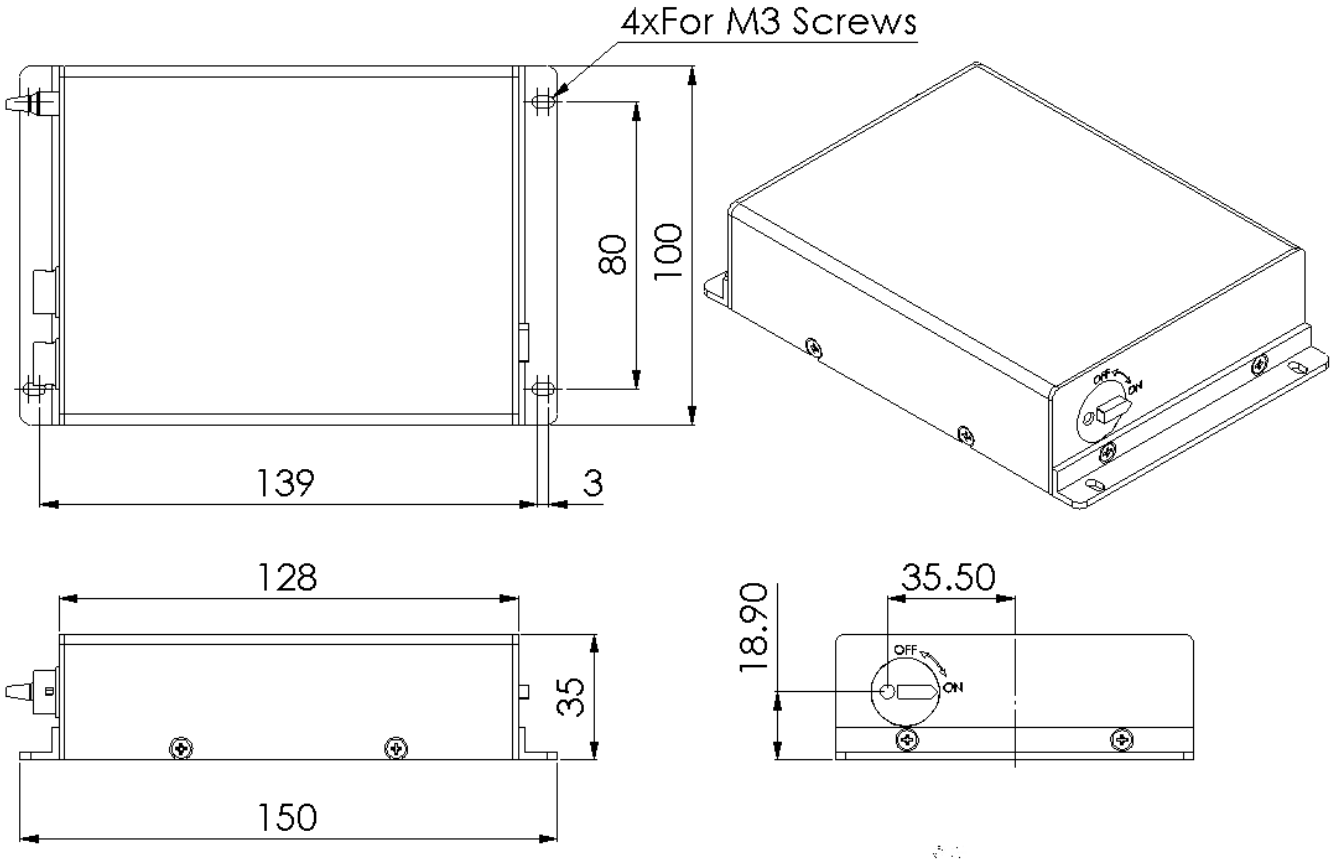
Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Sum Frequency Generation (SFG)			
Mixer Pigtailing Type		2x0			
1st/2nd Input Wavelength	nm	1064/1560			[1]
Output Wavelength	nm	632			
1st/2nd Input Fiber, Connector		PM980, None & PM1550, None			
Output Fiber, Connector		None			
Specified pump power	W	7.5 + 7.5			
Pump condition		CW, multimode, linewidth <0.08nm			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	3	3.2		[2]
Beam quality, M^2			1.1	1.2	
Diameter of collimated output beam	mm	0.8	1	1.2	
Waist location (from the output window)	mm	-300	0	300	
Output beam (TEM00) ellipicity	%		5	10	
Residual IR/output power rejection ratio	dB	40	45		
Output polarization state		linear @ horizontal axis			
Output PER	dB	20	25		
Back reflection of IR wavelength	dB		-45	-42	
Output beam height	mm	18.4	18.9	19.4	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	150 x 100 x 35			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Hirose HR 10G-10R-10P(73)			
Thermoelectric cooler		~3.2V, ~4A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
PD response	V/W	0.36	0.4	0.44	
PD response linearity	%		2	4	[3]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Other wavelength available upon request
[2] Higher output power available upon request
[3] Defined by the range from 20% to full power

Ver. Jan-24

- Mechanical drawing



Unit: mm

1x0 5W 532nm High Power Bulk Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**

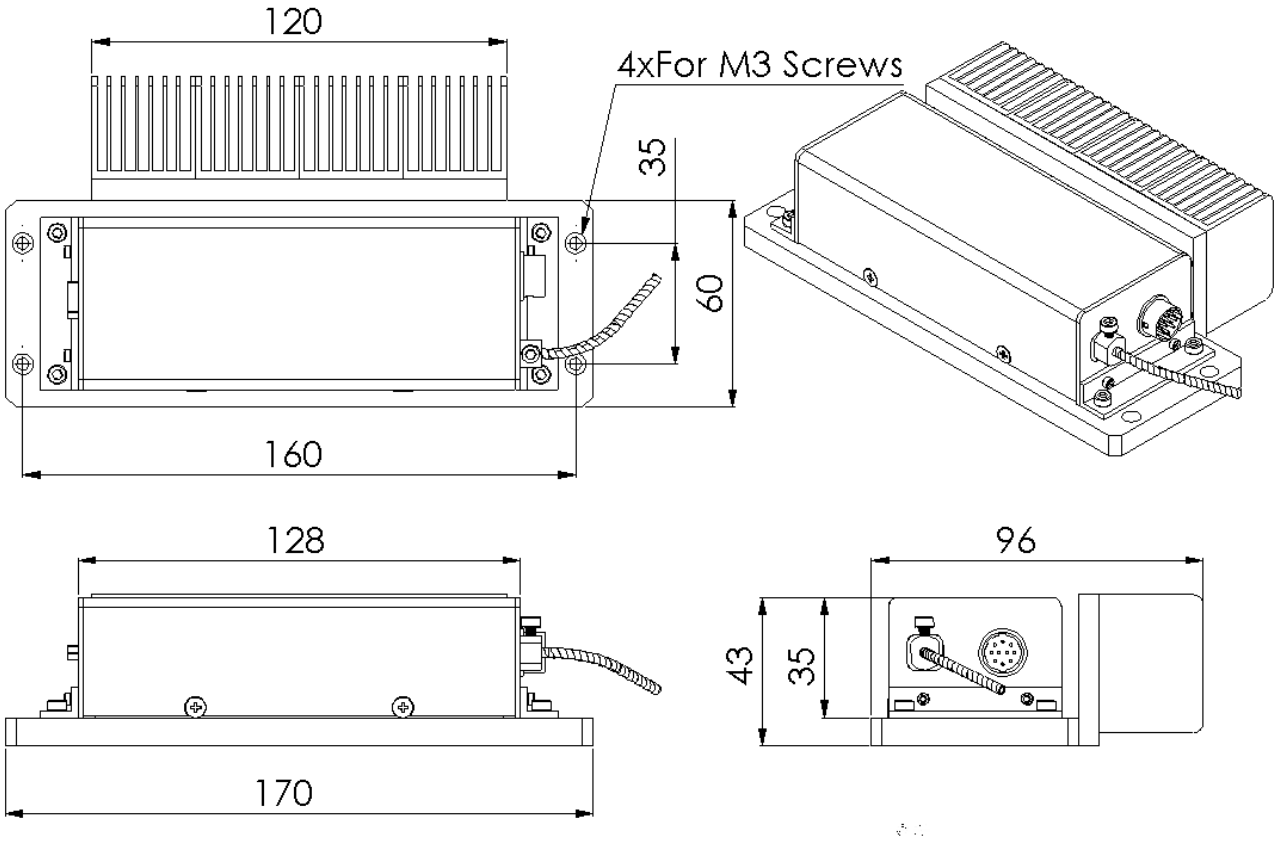
Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x0			
Input Wavelength	nm	1064			
Output Wavelength	nm	532			
Input Fiber, Connector		FUD3460, None			
Output Fiber, Connector		None			
Specified pump power	W	25			
Pump condition		CW, multimode, <0.06nm linewidth			[1]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	5	5.2		
Beam quality, M^2			1.1	1.2	[2]
Diameter of collimated output beam	mm	0.8	1	1.2	[2]
Waist location (from the output window)	mm	-300	0	300	[2]
Output beam (TEM00) ellipicity	%		5	10	[2]
Residual IR/output power rejection ratio	dB	40	45		
Output polarization state		linear @ horizontal axis			
Output PER	dB	20	25		
Back reflection of IR wavelength	dB		-45	-42	
Output beam height	mm	18.4	18.9	19.4	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	170 x 96 x 43			[3]
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Hirose HR 10G-10R-10P(73)			
Thermoelectric cooler		~3.2V, ~4A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
PD response	V/W	0.36	0.4	0.44	
PD response linearity	%		2	5	[4]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Efficiency will be different for single longitudinal mode pump
[2] Defined at the target output power
[3] Including external heatsink, mixer itself is 150x50x35 mm3
[4] Defined by the range from 20% to full power

Ver. Jan-24

- Mechanical drawing



Unit: mm

1x0 2W 532nm Bulk Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**

Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x0			
Input Wavelength	nm	1064			
Output Wavelength	nm	532			
Input Fiber, Connector		PM980, None			
Output Fiber, Connector		None			
Specified pump power	W	10			
Pump condition		CW, multimode, <0.08nm linewidth			[1]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	2	2.2		
Beam quality, M^2			1.1	1.2	[2]
Diameter of collimated output beam	mm	0.8	1	1.2	[2]
Waist location (from the output window)	mm	-300	0	300	[2]
Output beam (TEM00) ellipicity	%		5	10	[2]
Residual IR/output power rejection ratio	dB	40			
Output polarization state		linear @ horizontal axis			
Output PER	dB	20	25		
Back reflection of IR wavelength	dB		-45	-42	
Output beam height	mm	18.4	18.9	19.4	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	150 x 50 x 35			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Hirose HR 10G-10R-10P(73)			
Thermoelectric cooler		~3.2V, ~4A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
PD response	V/W	0.8	1	1.2	
PD response linearity	%		2	4	[3]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Efficiency will be different for single longitudinal mode pump
[2] Defined at the target output power
[3] Defined by the range from 20% to full power

Ver. Jan-24

1x1 3W 532nm Bulk Mixer

- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

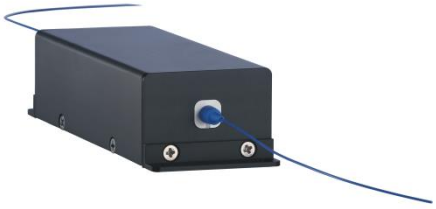
Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1064			
Output Wavelength	nm	532			
Input Fiber, Connector		FUD3460, None			
Output Fiber, Connector		None			
Specified pump power	W	20			
Pump condition		CW, multimode, <0.06nm linewidth			[1]
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	3	3.3		
Residual IR/output power rejection ratio	dB	40	45		
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-42	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	150 x 50 x 35			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Hirose HR 10G-10R-10P(73)			
Thermoelectric cooler		~3.2V, ~4A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
PD response	V/W	0.8	1	1.2	
PD response linearity	%		5	10	[2]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Efficiency will be different for single longitudinal mode pump
[2] Defined by the range from 20% to full power

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 1W 780nm Bulk Mixer



- **Plug & play**
- **High power & high efficiency**
- **Compact & robust**
- **All-fibered (FIFO, fiber input & fiber output)**

Reference Specification sheet

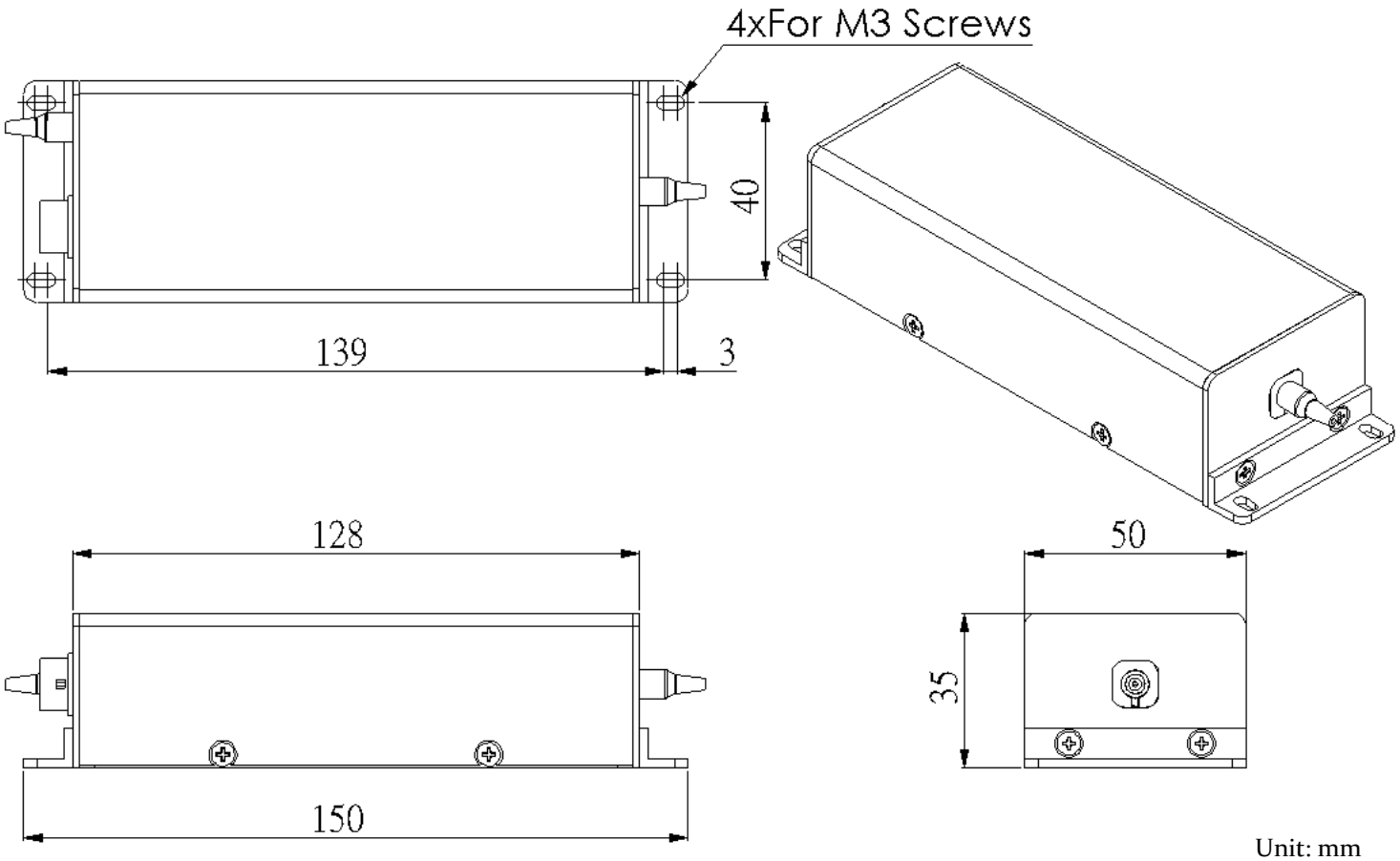
Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1560			[1]
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550, None			
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	10			
Pump condition		CW, single longtudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	1	1.1		
Residual IR/output power rejection ratio	dB	40			
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-42	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	150 x 50 x 35			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector			Hirose HR 10G-10R-10P(73)		
Thermoelectric cooler			~3.2V, ~4A maximum		
NTC Thermistor resistance@25°C	kΩ		10		
Thermistor B vale (B25/85)	K		3478		
PD response	V/W		NA		[2]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

[1] Different wavelength available upon request
[2] Photodiode power monitoring optional

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

(150*50*35mm^3)Bulk Mixer

- Mechanical drawing



Unit: mm

* Location of the fiber output port may be modified without notice

1x0 0.1W 780nm fs Bulk Mixer

- **Plug & play**
- **High-efficiency (≧40%)**
- **Compact & robust**

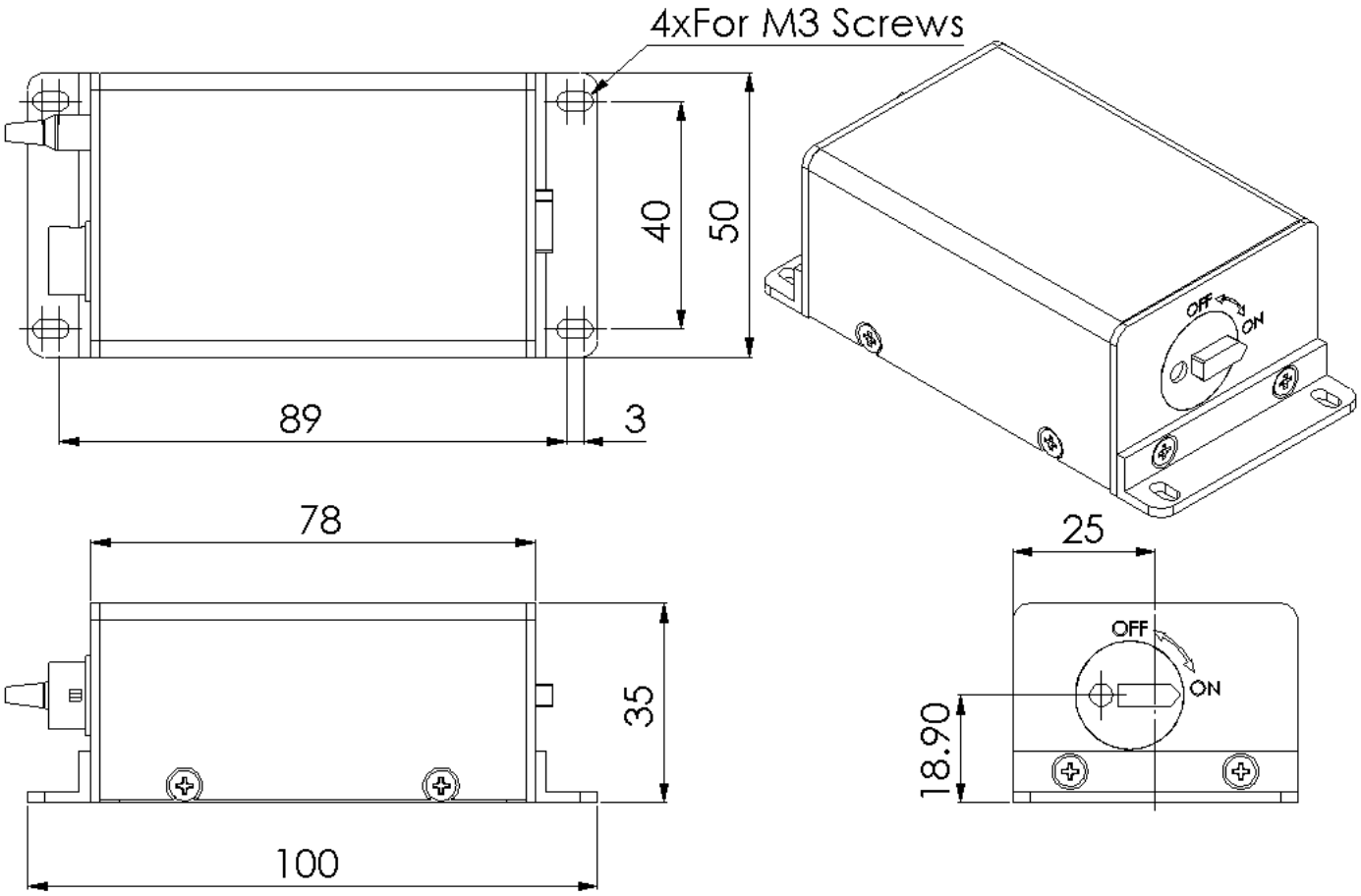
Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Second Harmonic Generation (SHG)			
Mixer Pigtailing Type		1x0			
Input Wavelength	nm	1560			
Output Wavelength	nm	780			
Input Fiber, Connector		PM1550, FC/APC			
Output Fiber, Connector		None			
Specified pump power	W	0.3			
Pump condition		<100fs, 80MHz			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	0.1	0.12		[1], [2]
Beam quality, M^2			1.1	1.2	
Diameter of collimated output beam	mm	0.8	1	1.2	
Waist location (from the output window)	mm	-300	0	300	
Output beam (TEM00) ellipicity	%		5	10	
Residual IR/output power rejection ratio	dB	40			
Output polarization state		linear @ vertical axis			
Output PER	dB	20	25		
Back reflection of IR wavelength	dB		-45	-42	
Output beam height	mm	18.4	18.9	19.4	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	100 x 50 x 35			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Electrical connector		Hirose HR 10G-10R-10P(73)			
Thermoelectric cooler		~3.9V, ~1.7A maximum			
NTC Thermistor resistance@25°C	kΩ	10			
Thermistor B vale (B25/85)	K	3478			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Output power is for reference only, which will be influenced by the input pulse quality
[2] ~100fs pump / SHG walk-off in the PPLN crystal, support ~40nm conversion bandwidth @ 1560nm

Ver. Jan-24

- Mechanical drawing



Unit: mm

1x1 1W ~780nm Tunable Bulk Mixer

- **Plug & play**
- **Continuous wavelength tuning for your selected wavelength bands (e.g. C/L/C+L)**
- **Optional fiber-in/fiber-out (1x1) or fiber-in/free-space-out (1x0)**

Reference Specification sheet

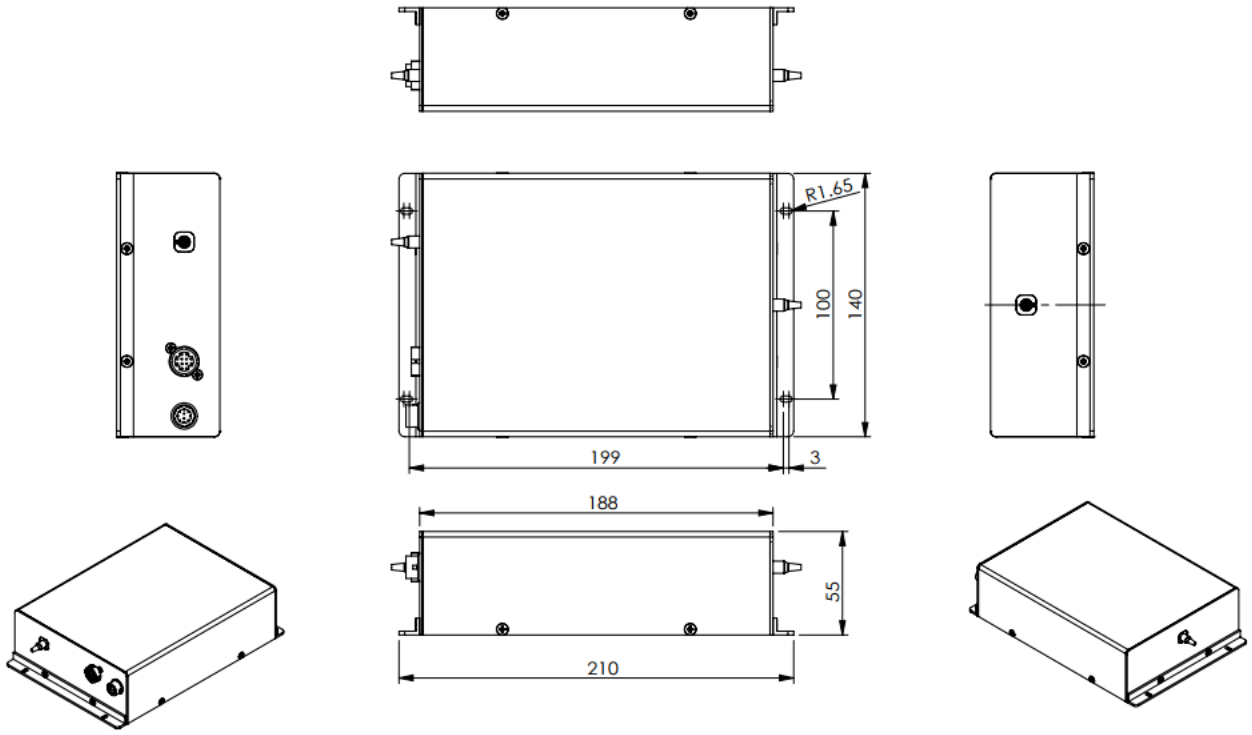
Optics (General)	unit	Specification			Note
Mixer Type		Tunable Second Harmonic Generation (SHG)			[1]
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	1520 ~ 1590			[2]
Output Wavelength	nm	760 ~ 795			[2]
Input Fiber, Connector		PM1550, None			
Output Fiber, Connector		PM780/850, None			
Specified pump power	W	10			
Pump condition		CW, Single longitudinal mode			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Output power @ specified pump	W	1	1.1		[3]
Residual IR/output power rejection ratio	dB	40	45		
Output polarization state			linear @ slow axis		
Output PER	dB	18	20		
Back reflection of IR wavelength	dB		-45	-42	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	210 x 140 x 55			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Controller partname			DTSC-20-S		[4]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Motorized stage tuning
[2] Other wavelength available upon request
[3] Only partial wavelength will be tested up to 1W, others will be tested in low power with similar performance.
[4] Including controller and software

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

1x1 1W ~780nm Tunable Bulk Mixer

- Mechanical drawing



Unit: mm

Cavity Mixer

- Cavity enhanced for higher efficiency
- Wavelength from UV/Visible to NIR/MIR
- Fiber delivery optional
- Wavelength tunable up to few-hundred nm
- Convenient, compact and robust

Cavity configuration is an alternative way to enhance nonlinear frequency conversion. To fit all kinds of applications, HCP develops a versatile cavity mixer platform with a users-friendly interface. This structure seamlessly adapts to various form, including external pump OPO (EP-OPO), Intra-cavity OPO (IC-OPO), Intra-cavity SFG (IC-SFG), Intra-cavity DFG (IC-DFG) etc. They are widely applied for generating NIR signal wavelengths between 1.4-2 um and MIR idler wavelengths between 2.3-4.5 um.

Best-seller

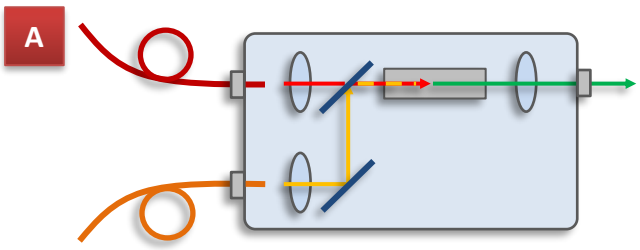
ICOPO-B & ICOPO-TB series are optical parametric oscillator (OPO) mixers, particularly designed for ultra-low input power. The intra-cavity structure utilizes the high circulating power in the cavity so as to reach the threshold efficiently. With accumulation of years-experience, now HCP proudly presents the series of 3 different wavelength ranges together with software and controller!

Parameter	unit	ICOPO-B[1] & ICOPO-TB[2]
Signal/Idler Wavelength	nm	α series: 1560-1880/2500-3300 β series: 1495-1640/3000-3700 γ series: 1440-1510/3600-4080
Signal/Idler Output Power	mW	α series: 250/100 β series: 250/90 γ series: 200/70
Linewidth	GHz	300
Beam Quality		TEM00, Signal M2<1.2, Idler M2<1.5
Polarization		Linear, >20dB

1. ICOPO-B: broad bandwidth (few nm), specific wavelength within α,β,γ range could be designed
2. ICOPO-TB: tunable (few hundred nm)

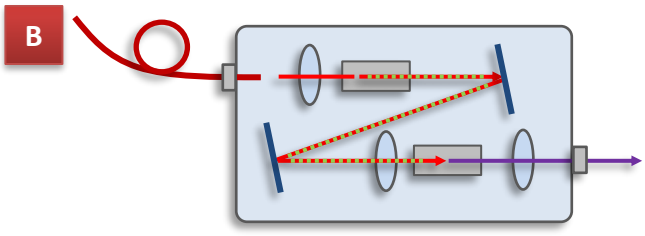
HCP
HC PHOTONICS CORP.

2x0/2x1 Mixer



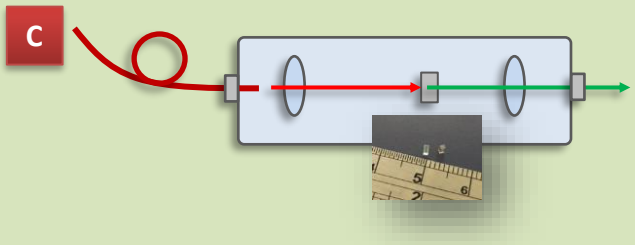
Sum Frequency Generation (SFG)
Difference Frequency Generation (DFG)
Optical Parametric Amplification (OPA)

Cascaded Mixer

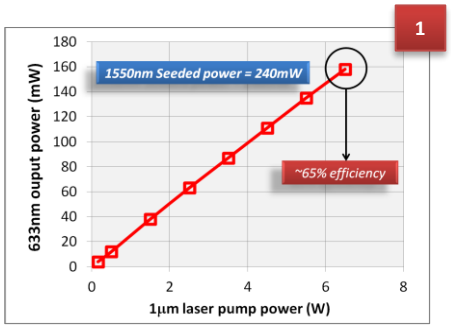


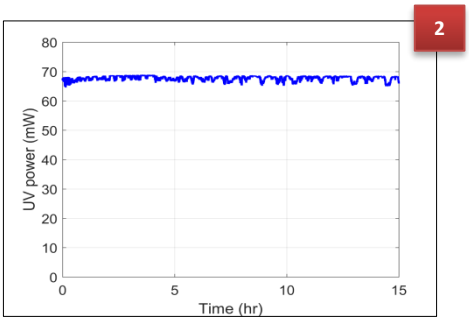
Third-Harmonic Generation (THG)
Fourth-Harmonic Generation (FHG)

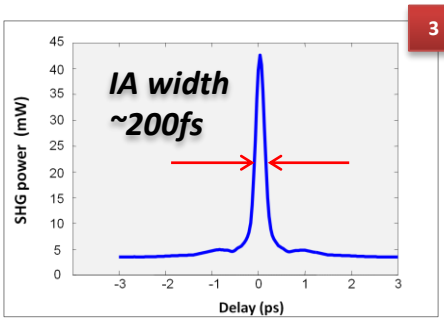
Ultrafast mixer



(**A**) 2x0/2x1 Mixer configuration goes with two fiber-coupled inputs, out with either free-space converted beam or fiber-coupled. The free-spaced optical design inside the module reduces loss of beam combination.
(**B**) 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(THG).
(**C**) An ultrafast mixer with tiny crystal inside can convert a broad spectrum of ultrafast pulses.







(**1**) 1550nm and 1064nm lasers are combined to generate 633nm output by Sum-Frequency Generation (SFG) 2x0 mixer. 633nm output power vs. pump source is shown in depiction (1).
(**2**) UV (355nm) is generated from 3.5W infrared by a Third Harmonic Generation (THG) cascaded mixer. The stability (measured power vs. time)is shown at depiction (2).
(**3**) 780nm ultrashort pulse is generated from an ultrafast erbium-doped fiber laser by a SHG ultrafast mixer with >50% conversion efficiency. Measured correlation trace is shown at depiction (3).

How to select YOUR mixer?

1. Check the nonlinear conversion configuration you would like to proceed (e.g. SHG, SFG, DFG, OPO/OPG, SPDC…etc.)

2. Select the corresponding mixer type as well as the optional parts for specified application.

-1x0: fiber in, free-space out
-1x1: fiber in, fiber out
-2x0: 2 fibers in, free-space out
-2x1: 2 fibers in, 1 fiber out

3. Contact HC Photonics directly or the local representative for further information about mixers with custom options.

HCP
HC PHOTONICS CORP.

HC PHOTONICS CORP.

ICOPO Mixer

- **CW mid-infrared output at tens to hundreds mW**
- **Selected wavelength at 1.44-1.9 micron and 2.4-4.1 micron**
- **NIR /MIR dual outputs**
- **Optional fiber output for the NIR port**

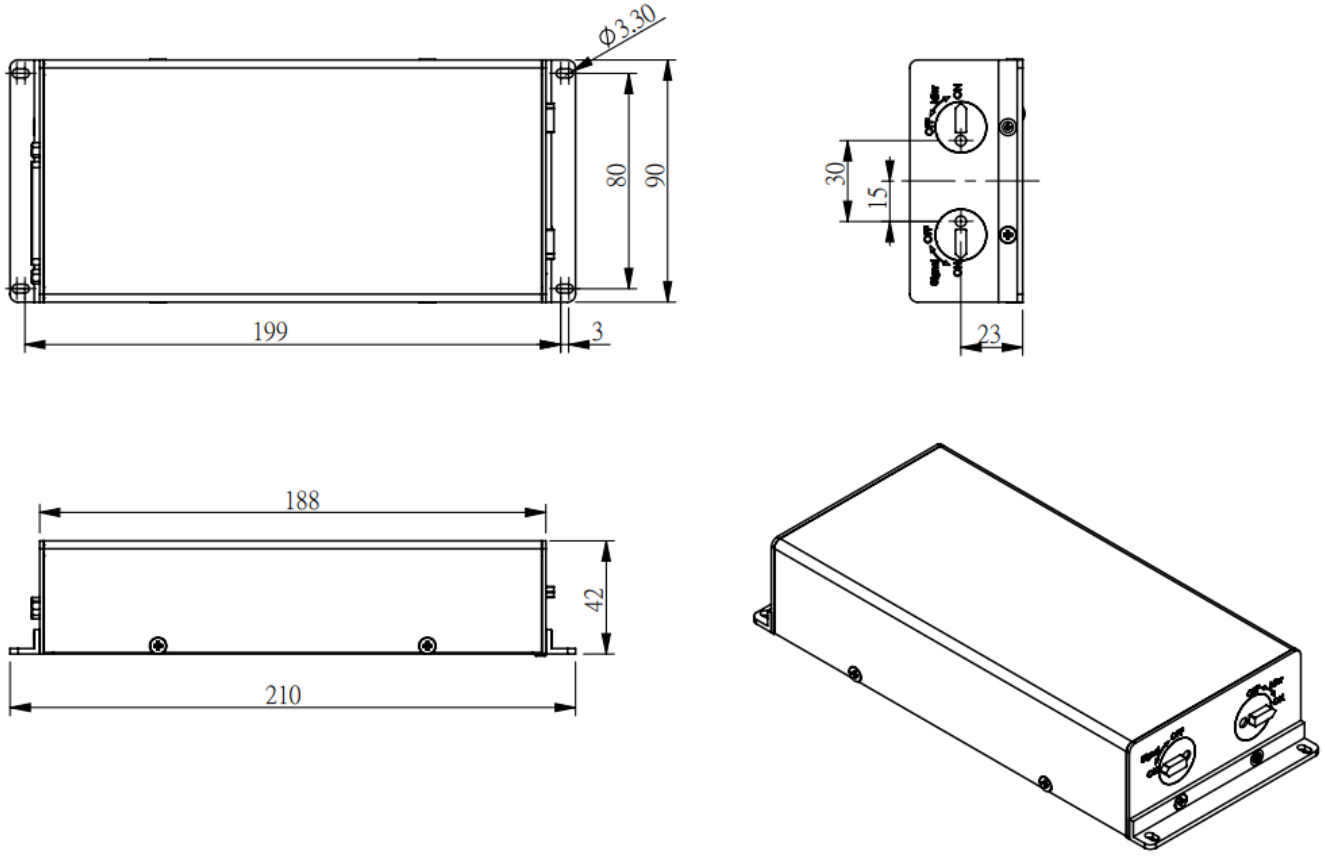
Reference Specification sheet

ICOPO-B series					
Optics (General)	**unit**	**Specification**			**Note**
Module type		ICOPO-B			
Output Wavelength - Signal	nm	Wavelength @ 1440-1900			[1], [2]
Output Wavelength - Idler	nm	Wavelength @ 2400-4100			[1], [2]
Output power - Signal	mW	Wavelength dependent, ranging from 50mW ~ 300mW			[3]
Output power - Idler	mW	Wavelength dependent, ranging from 30mW ~ 150mW			[3]
Output type		CW, free space, collimated			[4]
Optics (Output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Beam quality, M^2 - Signal			1.1	1.2	
Beam quality, M^2 - Idler			1.2	1.5	
Linewidth	GHz		150	300	
Diameter of collimated output beam	mm	0.8	1	2	
Output beam (TEM00) ellipicity	%		10	20	
Residual power rejection ratio at different wavelength	dB	40	45		
Output polarization state		linear @ vertical axis			
Output PER	dB	20	25		
Output beam height	mm	22.5	23	23.5	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	210 x 90 x 42			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Controller		DTSC-42			[5]
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Any single wavelength from 1440~1900 nm to 2400 ~ 4100 nm possible upon request
[2] Typically the mixer can be tuned ~ten nm (signal port) and tens of nm (idler port), but the specific tuning range need to be discussed in advance.
[3] Output power is wavelength dependent, please refer to the figure in next page for reference.
[4] Fiber output for the signal port is possible upon request, coupling efficiency is 70% typically.
[5] One DTSC-42 controller can support two ICOPO-B units.

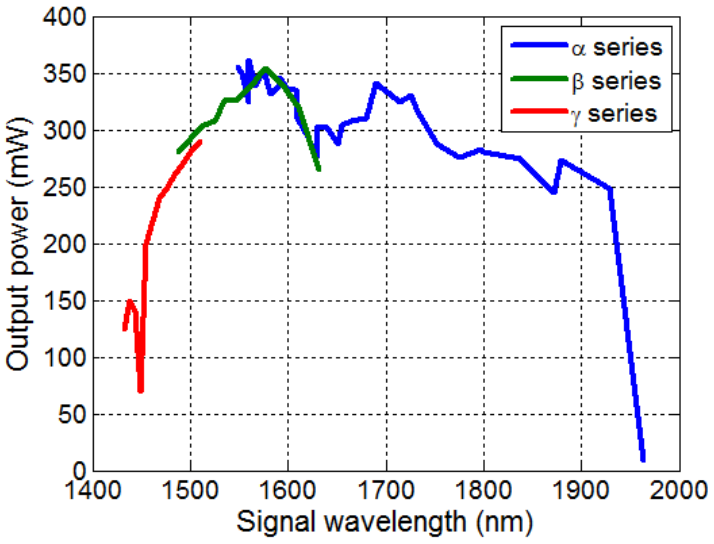
HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

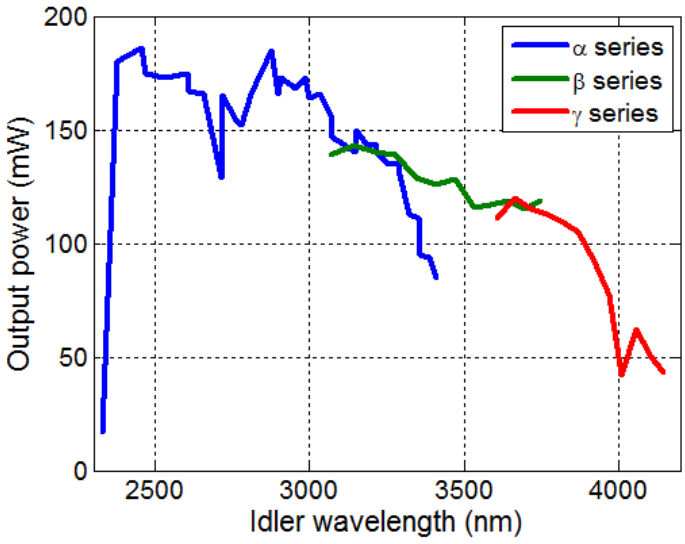
- Mechanical drawing



Unit: mm

- Reference for output power at different output wavelength





* α, β, γ series in the above figure corresponds to the type of ICOPO-TB, for ICOPO-B, the output power at each wavelength is similar to it.

HC PHOTONICS CORP.

Tunable ICOPO Mixer

- **CW mid-infrared output at 10s -100s mW**
- **Tuning for selected λs (1.44-1.9 and 2.5-4.1 micron)**
- **NIR /MIR dual outputs**
- **Optional fiber output for the NIR port**

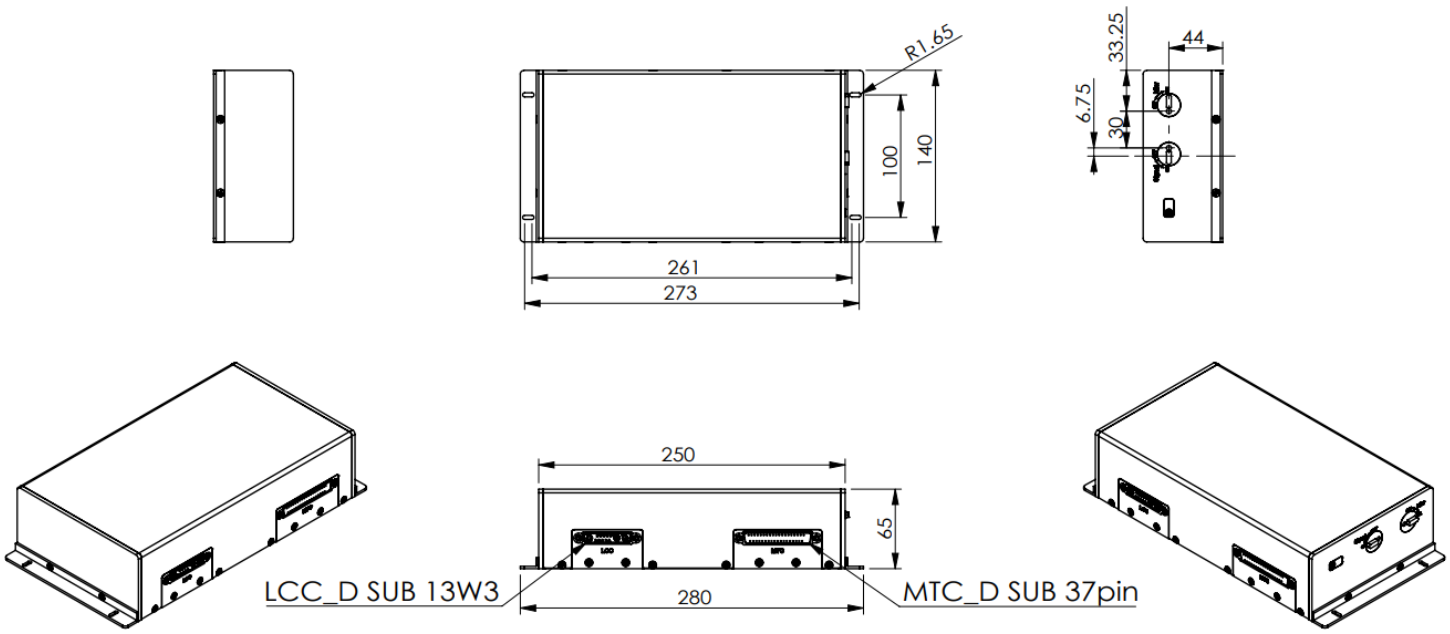
Reference Specification sheet

ICOPO-TB series					
Optics (General)	**unit**	**Specification**			**Note**
Module type		ICOPO - TB			
Output Wavelength - Signal	nm	α series - 1560 - 1880 β series - 1495 - 1640 γ series - 1440 - 1510			
Output Wavelength - Idler	nm	α series - 2500 - 3300 β series - 3000 - 3700 γ series - 3600 - 4080			
Output power - Signal	mW	α series - 250, β series - 250, γ series - 200			[1]
Output power - Idler	mW	α series - 100, β series - 90, γ series - 70			[1]
Output type		CW, free space, collimated			[2]
Optics (Output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Beam quality, M^2 - Signal			1.1	1.2	
Beam quality, M^2 - Idler			1.2	1.5	
Linewidth	GHz		150	300	
Diameter of collimated output beam	mm	0.8	1.2	2	[3]
Output beam (TEM00) ellipicity	%		10	20	
Residual power rejection ratio at different wavelength	dB	40	45		
Output polarization state		linear @ vertical axis			
Output PER	dB	20	25		
Output beam height	mm	43.5	44	44.5	
Output beam angle	mrad	-7.5	0	7.5	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (LxWxH)	mm	280 x 140 x 65			
Electrics	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Controller		DTSC-42-S			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	℃	-20	-	70	
Operating ambient temperature range	℃	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Defined by the maximum output in the wavelength region. The real output power may vary upon wavelengths. Please refer to the figure for reference .
[2] Fiber output for the signal port is possible upon request, coupling efficiency is 70% typically.
[3] Defined at the center output wavelength. For the whole wavelength range, the beam diameter may be different but the divergence angle remains similar.

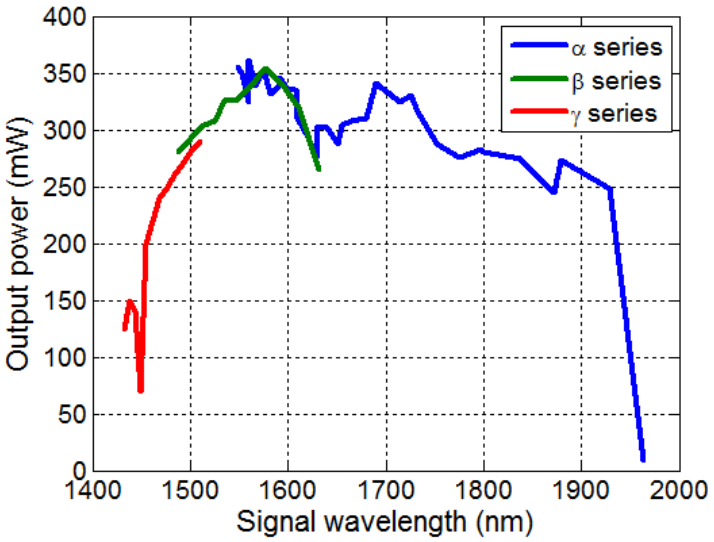
Ver. 1.0

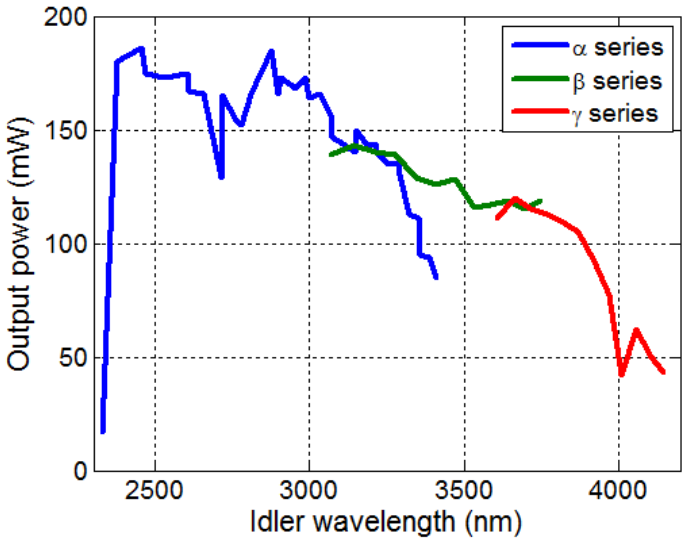
- Mechanical drawing



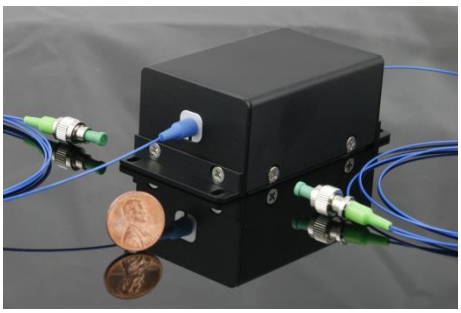
Unit: mm

- Reference for output power at different output wavelength





1x1 Filter Module



- **Custom input/output fiber types and wavelengths**
- **Polarization Maintenance (PM) and High Power (HP)**
- **>80dB filtering ratio available**
- **Wavelength/power management components (e.g. spectrometer/photodiode) optional**

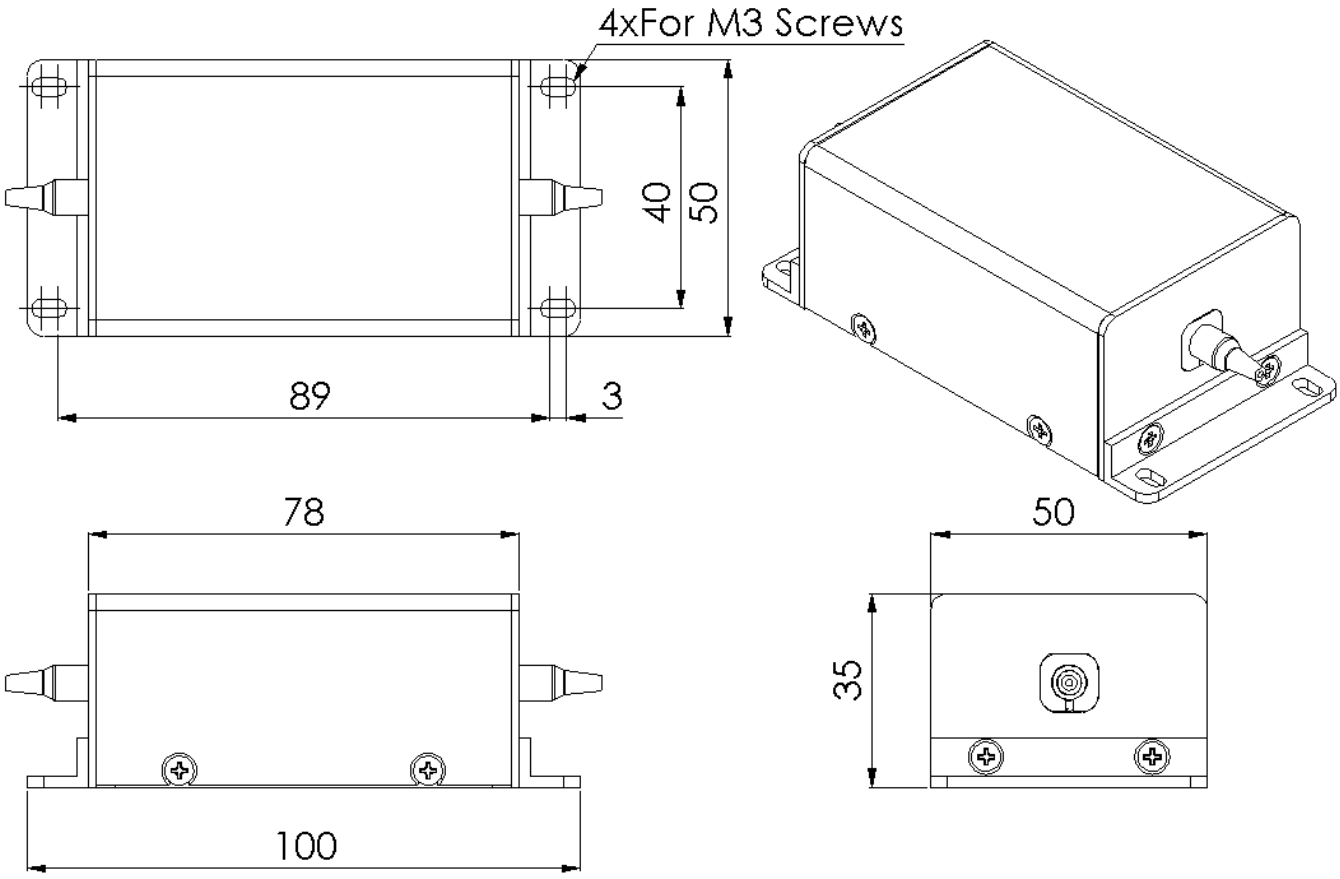
Reference Specification sheet

Optics (General)	unit	Specification			Note
Mixer Type		Filter module			
Mixer Pigtailing Type		1x1			
Input Wavelength	nm	780			[1]
Block Wavelength	nm	1560			[1]
Input Fiber, Connector		PM850, FC/APC			
Output Fiber, Connector		PM850, FC/APC			
Maximum input power	W	2			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Transmittance @ input wavelength	%	75	80		[2]
Rejection ratio @ block wavelength	dB		70		[3]
Output polarization state			Linear @ slow axis		
Output PER	dB	18	20		[4]
Back reflection of input wavelength	dB		-45	-42	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (L*W*H)	mm	100x50x35			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C		10		
Operating relative humidity (no condensing)	%RH	0	-	85	
Vibration / Shock			Refer to ISTA-2A		
Restriction of hazardous substances directive (RoHs)			Declaration of Conformity to 2011/65/EU		

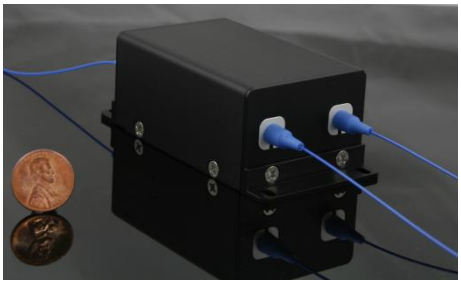
[1] Can be broadband range upon request
[2] Without FC/APC connector loss
[3] >100dB is available upon request
[4] Without FC/APC connector

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

- Mechanical drawing



2x1 Broadband Combiner



- **Custom input/output fiber type and wavelengths**
- **Polarization Maintenance (PM), High Power (HP) and Broadband**
- **Wavelength/power management components (e.g. filter/photodiode) optional**

Reference Specification sheet

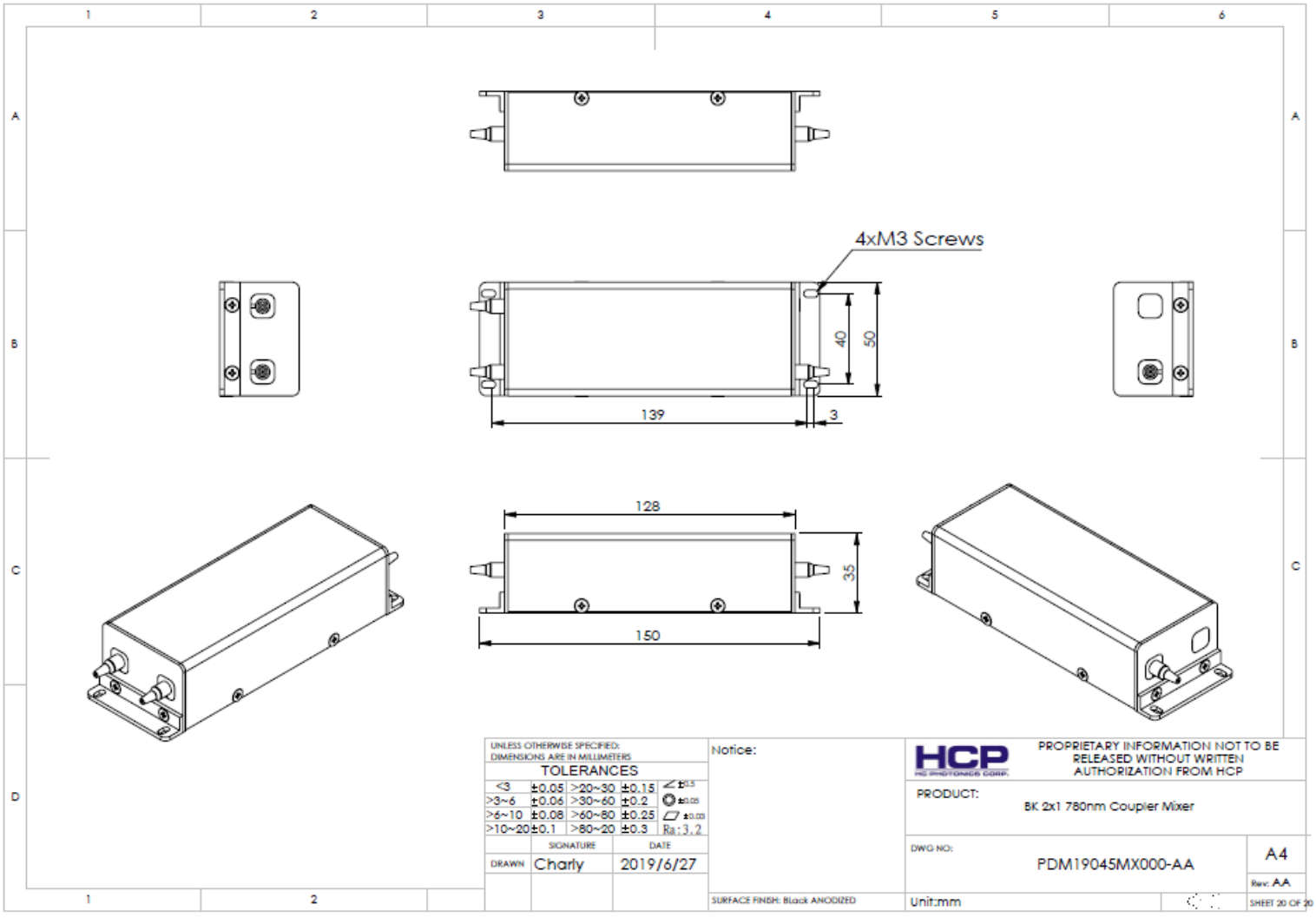
Optics (General)	unit	Specification			Note
Mixer Type		Combiner			
Mixer Pigtailing Type		2x1			
1st/2nd Input Wavelength	nm	630/895			[1]
1st/2nd Input Fiber, Connector		PM630, FC/APC & PM850, FC/APC			
Output Fiber, Connector		PM630, FC/APC			
Maximum input power	W	2			
Optics (output)	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Transmittance @ input wavelength	%	75	80		[2]
Transmittance @ 2nd input wavelength	%	75	80		[2]
Output polarization state		Linear @ slow axis			
Output PER	dB	18	20		[3]
Back reflection of input wavelength	dB		-45	-42	
Mechanics	**unit**	**Specification**			**Note**
Housing dimension (L*W*H)	mm	150x50x35			
Environment	**unit**	**Minimum**	**Typical**	**Maximum**	**Note**
Storage temperature (no humidity)	°C	-20	-	70	
Operating temperature range	°C	10	25	35	
Operating relative humidity (non condensing)	%RH	0	-	85	
Vibration / Shock		Refer to ISTA-2A			
Restriction of hazardous substances directive (RoHs)		Declaration of Conformity to 2011/65/EU			

[1] Broadband range is available upon request
[2] Without FC/APC connector loss
[3] Without FC/APC connector

HC Photonics Corp. | hcphotonics.com | service@hcphotonics.com | F4, No. 2, Technology Road V, Hsinchu City 30078, Taiwan

2x1 Broadband Combiner

- Mechanical drawing



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS				
TOLERANCES				
<3	±0.05	>20~30	±0.15	∠ ±0.5
>3~6	±0.06	>30~60	±0.2	◎ ±0.05
>6~10	±0.08	>60~80	±0.25	▱ ±0.03
>10~20	±0.1	>80~20	±0.3	Ra : 3.2
	SIGNATURE		DATE	
DRAWN	Charly		2019/6/27	

Notice:

SURFACE FINISH: Black ANODIZED

HCP

PROPRIETARY INFORMATION NOT TO BE RELEASED WITHOUT WRITTEN AUTHORIZATION FROM HCP

PRODUCT: BK 2x1 780nm Coupler Mixer

DWG NO: PDM19045MX000-AA

A4

Rev: AA

Unit:mm

SHEET 20 OF 20

Distributors

Ver. Jan-24

China
YuChen Optics
ycoptics.com

France
Opton Laser International
optonlaser.com

Germany
GWU-Lasertechnik Vertriebsges. mbH
gwu-lasertechnik.de

Israel
Bi-Pol Electro-Optics Ltd.
bi-pol.com

Japan
Optronscience, Inc.
eng.opt-ron.com

Japan DEVICE Ltd.
j-device.com

Broadband, Inc.
www.bblaser.com

United Kingdom
Photonic Solutions Ltd.
photonicsolutions.co.uk

GWU-Lasertechnik Vertriebsges. mbH

Bonner Ring 9
50374 Erftstadt
Germany

Fon +49.(0) 22 35.9 55 22-0
Fax +49.(0) 22 35.9 55 22-99

info@gwu-lasertechnik.de

www.gwu-lasertechnik.de

HCP HC PHOTONICS CORP.

HCPHOTONICS.COM
service@hcphotonics.com (T)+886-3-666 2123
F4, No.2, Technology Road V, Hsinchu City 30078, Taiwan