PPLN

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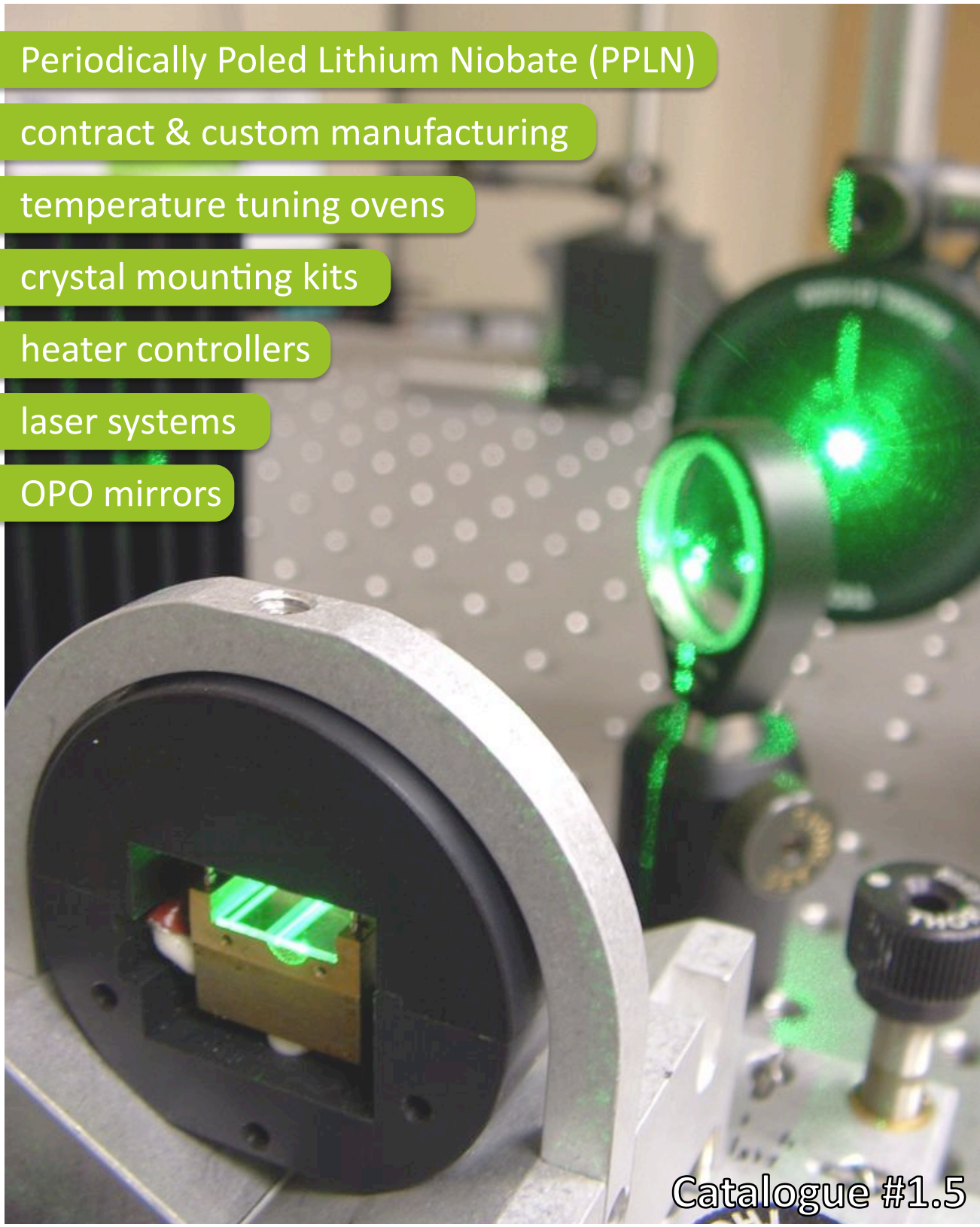


- Periodically Poled Lithium Niobate (PPLN)
- contract & custom manufacturing
- temperature tuning ovens
- crystal mounting kits
- heater controllers
- laser systems
- OPO mirrors

Catalogue #1.5

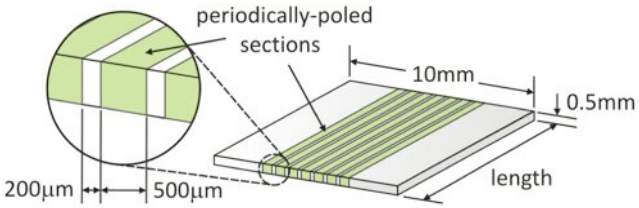
PPLN for visible and near-IR wavelengths

Periodically-poled lithium niobate (PPLN) is a nonlinear optical crystal for high efficiency wavelength conversion in the 460nm – 5100nm range. Our proprietary PPLN poling process creates high fidelity grating periods from 4µm to 33µm and is ideal for high volume manufacture.

Our SHG and SFG crystals are designed to work with a wide range of common laser wavelengths. Each device includes multiple gratings for flexible temperature and wavelength operation. Standard lengths are 1mm for short-pulse fs lasers and 10mm for cw or ns systems.

All of our standard products undergo rigorous quality inspection and are supplied clip-mounted and off the shelf. Custom crystal lengths, thicknesses, AR coatings, and grating designs are also available upon request.

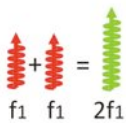
Standard PPLN crystal layout



- supplied AR coated
- flatness <λ/4@633nm
- parallel to ±5minutes
- polished to 20-10 scratch dig
- fewer than two 100µm edge chips per facet

1 & 10mm PPLN (clip-mounted)

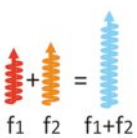
Second Harmonic Generation
high efficiency frequency doubling of IR lasers to visible and shorter near-IR wavelengths
0.5mm-thick, AR coated



Applications
- green and blue generation
- scientific & medical

part #	pump (nm)	output (nm)	PPLN periods (µm)	temperature range (°C)	standard* lengths (mm)
SHG8	976 – 984	488 – 492	5.00, 5.04, 5.08	160 – 200	1, 10
SHG3	1060 – 1068	530 – 534	6.50, 6.54, 6.58	160 – 200	1, 10
SHG4	1310 – 1322	655 – 661	12.10, 12.20, 12.30	160 – 200	1, 10
SHG5	1540 – 1576	770 – 788	18.20, 18.40, 18.60, 18.80, 19.00	160 – 200	1, 10
SHG6	1570 – 1652	785 – 826	19.00, 19.25, 19.50, 19.75, 20.00, 20.25, 20.50, 20.75, 21.00	160 – 200	1, 10
SHG7	2024 – 2250	1012 – 1125	29.50, 30.00, 30.50, 31.00, 31.50, 32.00, 32.50	160 – 200	1, 10

Sum Frequency Generation
combines fixed 1550nm and tunable 775nm or 810nm pump sources to provide tunable green wavelengths
0.5mm-thick, AR coated



Applications
- fluorescence microscopy

part #	pumps (nm)	output (nm)	PPLN periods (µm)	temperature range (°C)	standard* lengths (mm)
SFG1	775 – 786 & 1550	516 – 521	6.60, 6.65, 6.70	160 – 200	1, 10
SFG2	803 – 815 & 1550	529 – 534	7.05, 7.10, 7.15	160 – 200	1, 10

**custom crystal lengths from 0.3mm to 40mm available upon request*

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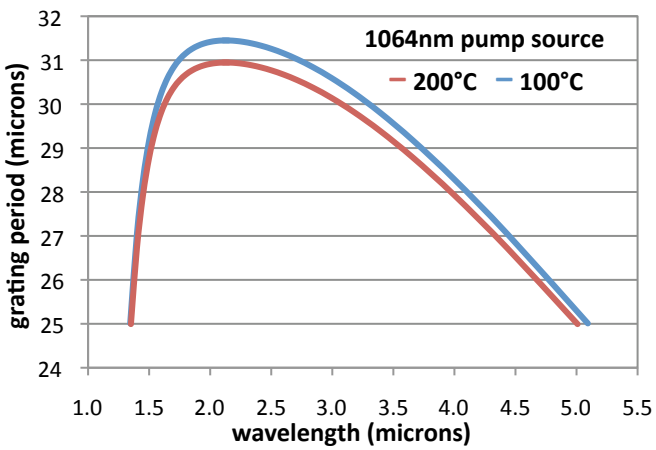
PPLN for tunable mid-IR wavelengths

The wide transmission range and non-critical walk-off angle of PPLN make this material ideal for generating wavelengths throughout the mid-IR. Our PPLN OPO and DFG crystals are specially designed with multiple grating periods to allow continuous tuning across a wide range of wavelengths. Using a combination of all three PPLN OPO crystals it is possible to tune across the entire 1350-5100nm range using a single 1064nm source.

All of our PPLN OPO and DFG chips come mounted in a clip as standard and are designed to slot into our oven and temperature controller products, making it easy to swap between crystals with minimal realignment. We also supply a range of OPO cavity mirrors chosen to work with our crystals. See the PPLN accessories page for more details.

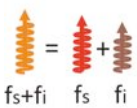
20 & 40mm PPLN (clip-mounted)

Wavelength tuning range across PPLN OPOs 1-3



Our PPLN OPO crystals can be used for continuous tuning across a wide range of mid-IR signal and idler wavelengths. Translating each crystal between different gratings allows coarse tuning, while fine adjustments are achieved by changing the crystal temperature (above).

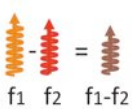
Optical Parametric Oscillation / Generation
widely tunable frequency conversion of pump wavelengths around 1064nm to the 1350 – 5100nm range
0.5mm-thick, AR coated



Applications
- mid-IR spectroscopy
- aerial countermeasures

part #	pump (nm)	signal (nm)	idler (nm)	PPLN periods (µm)	temperature range (°C)	standard* lengths (mm)
OPO1	1064	1350 – 1410	4340 – 5100	25.00, 25.25, 25.50, 25.75, 26.00, 26.25, 26.50, 26.75, 27.00	100 – 200	20, 40
OPO2	1064	1410 – 1580	3460 – 4360	27.25, 27.50, 27.75, 28.00, 28.25, 28.50, 28.75, 29.00, 29.25	100 – 200	20, 40
OPO3	1064	1520 – 2130	2130 – 3540	29.50, 29.75, 30.00, 30.25, 30.50, 30.75, 31.00, 31.25, 31.50	100 – 200	20, 40

Difference Frequency Generation
mixes wavelengths from a fixed 1064nm and tunable 775nm pump source for a tunable 2440 – 4740nm output
0.5mm-thick, AR coated



Applications
- mid-IR spectroscopy

part #	pumps (nm)	output (nm)	PPLN periods (µm)	temperature range (°C)	standard* lengths (mm)
DFG1	742 – 796 & 1064	2450 – 3160	18.00, 18.25, 18.50, 18.75, 19.00, 19.25, 19.50, 19.75, 20.00, 20.25, 20.50, 20.75, 21.00	160 – 200	20, 40
DFG2	775 – 869 & 1064	2850 – 4740	20.00, 20.25, 20.50, 20.75, 21.00, 21.25, 21.50, 21.75, 22.00, 22.25, 22.50, 22.75, 23.00	160 – 200	20, 40

**custom crystal lengths from 0.3mm to 40mm available upon request*

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PPLN accessories

PPLN ovens
a range of compact ovens specially designed to complement our PPLN crystals for easy handling and optical alignment, with fully insulated construction to ensure uniform temperature inside and low temperature outside

part #	for standard crystal lengths	fits PPLN clip	minimum distance to crystal facet
PV10	1mm, 10mm	PC1, PC10	7.5mm, 3mm
PV20	20mm	PC20	3mm
PV40	40mm	PC40	3mm

PPLN clip kits
static charge dissipation and easy mounting

part #	crystal length
PC1	1mm
PC10	10mm
PC20	20mm
PC40	40mm

Temperature controllers
our PPLN ovens are compatible with a range of temperature controllers, including the ThorLabs TC200 bench-top unit

part #	control range	set point resolution	accuracy	sensors	input	output	heater current
TC200	70 - 200°C	0.1°C	±0.1°C	PT100, 10k thermistor	103 – 240V AC 50 – 60Hz	24V max.	750mA max.

OPO mirrors
a range of general-purpose cavity mirrors for use with our OPO PPLN crystals and a 1064nm pump laser

part #	material	diameter	input facet	output facet	input AR coating	output AR coating
OPOM1	BK7	1.0 inch	planar	concave (200mm radius)	AR @ 1064nm	HT @ 1064nm HR @ 1300-1900nm
OPOM2	CaF_2	0.5 inch	planar	concave (200mm radius)	uncoated	HT @ 1064nm & 2200-5100nm R 60-70% @ 1300-1900nm
OPOM3	CaF_2	0.5 inch	planar	∞ (0.5° wedge)	uncoated	HT @ 1064nm & 2200-5100nm R 60-70% @ 1300-1900nm

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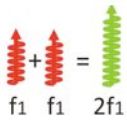
Magnesium-doped PPLN (MPPLN)

Second Harmonic Generation
high efficiency frequency doubling from 1064nm to 532nm
0.5mm-thick, AR coated

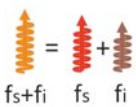


Applications
- green generation
- laser displays & projectors

part #	pump (nm)	output (nm)	PPLN periods (µm)	temperature range (°C)	standard lengths (mm)
MSHG3	1064	532	6.83, 6.86, 6.90, 6.93, 6.96	30 – 110	1, 10, 20

Adding 5% magnesium-oxide to lithium niobate significantly increases the optical and photorefractive resistance of the crystal while preserving its high nonlinear coefficient (1). This allows more stable operation at visible wavelengths and lower temperature operation than a similar undoped crystal. Specially developed for red-green-blue generation and high power mid-IR operation, our proprietary MPPLN poling process offers high quality material even at shorter periods.

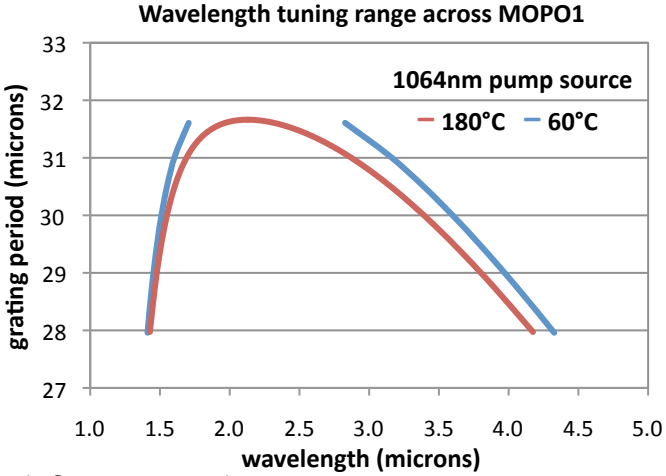
Optical Parametric Oscillation / Generation
widely tunable mid-IR from 1064nm in a single chip
0.5mm-thick, AR coated



Applications
- mid-IR spectroscopy
- aerial countermeasures

part #	pump (nm)	signal (nm)	idler (nm)	PPLN periods (µm)	temperature range (°C)	standard lengths (mm)
MOPO1	1064	1410 – 2128	2128 – 4340	27.91, 28.23, 28.67, 29.01, 29.52, 29.98, 30.49, 31.02, 31.59	60 – 180	20, 40

Wavelength tuning range across MOPO1



Our MPPLN OPOs operate over a broader temperature range than standard PPLN, allowing wider mid-IR tuning from a single device. Based on the same design layout as a standard PPLN crystal, our MPPLN OPOs are fully compatible with our clip kits, ovens and temperature controllers.

References:
(1) *"High-Beam-Quality Continuous Wave 3W Green-Light Generation in Bulk Periodically Poled MgO:LiNbO3"*
H.Furuya, A.Morikawa, K.Mizuuchi and K.Yamamoto
Japanese Journal of Applied Physics
Vol.45 No.8B pp.6704-6707 (2006)

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SSOPO mid-IR wavelength selectable laser system

SSOPO mid-IR bench-top system: control unit and laser head

Covesion have partnered with ThorLabs to introduce a range of user-friendly wavelength selectable mid-IR lasers based on our PPLN technology.

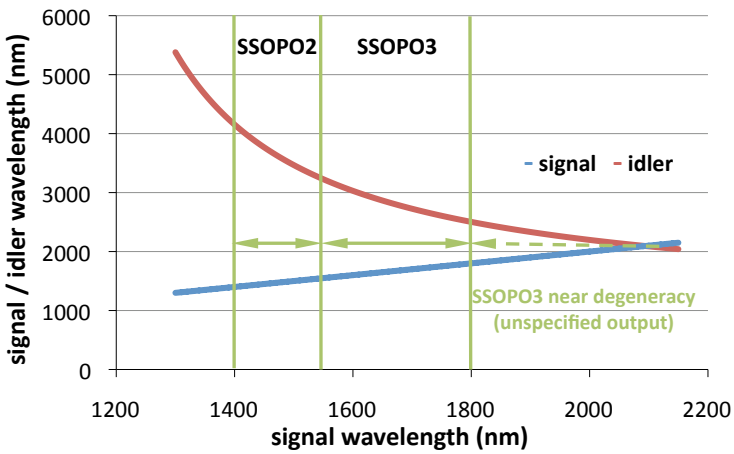
Each SSOPO integrates a complete pump laser and PPLN OPO control system into a bench-top unit, allowing users to select a desired operating wavelength at a push of button.

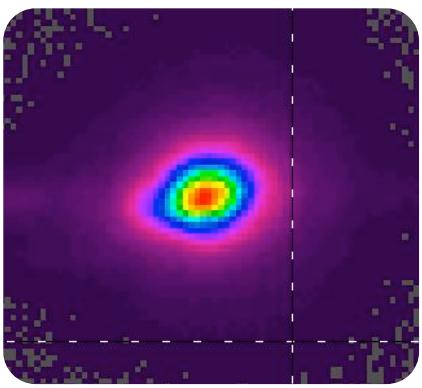
Turnkey access to a wide range of wavelengths makes these bench-top lasers invaluable as a multipurpose tool for any lab-based IR alignment or test activity.

Features

- turnkey wavelength selectable mid-IR lasers
- two models with wavelengths of 1400 – 4150nm
- simple, push-button interface
- typical output powers
  - 20 – 40mW (signal)
  - 10 – 20mW (idler)
- signal wavelength selection in 1nm increments
- 10ns pulse length
- 2kHz repetition rate
- user-selectable filters to switch between signal, idler, and unfiltered OPO output

SSOPO wavelength tuning range per system





2D beam profile of idler @ 3210nm

Simple, turnkey operation

- Our SSOPO starts automatically at the turn of a key. It is a stand-alone system, so no additional laser or PC is required.
- The user can select either a signal or idler wavelength on the control panel. Both output wavelengths are linked and generated simultaneously.
- Operating conditions for the OPO are calculated and set by the control unit.
- Once the selected wavelength is reached, the laser output can be enabled.
- A filter selector on the front of the laser head allows the user to access signal, idler, or unfiltered (signal, idler, and undepleted pump) wavelengths.

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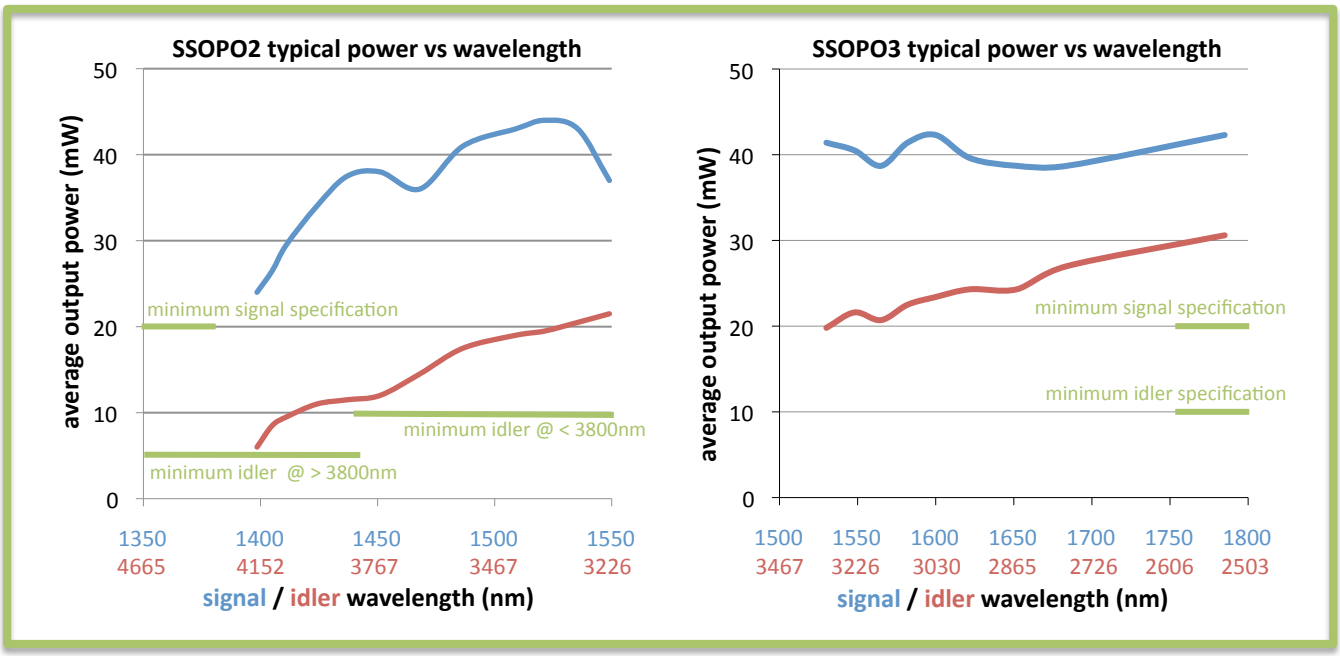
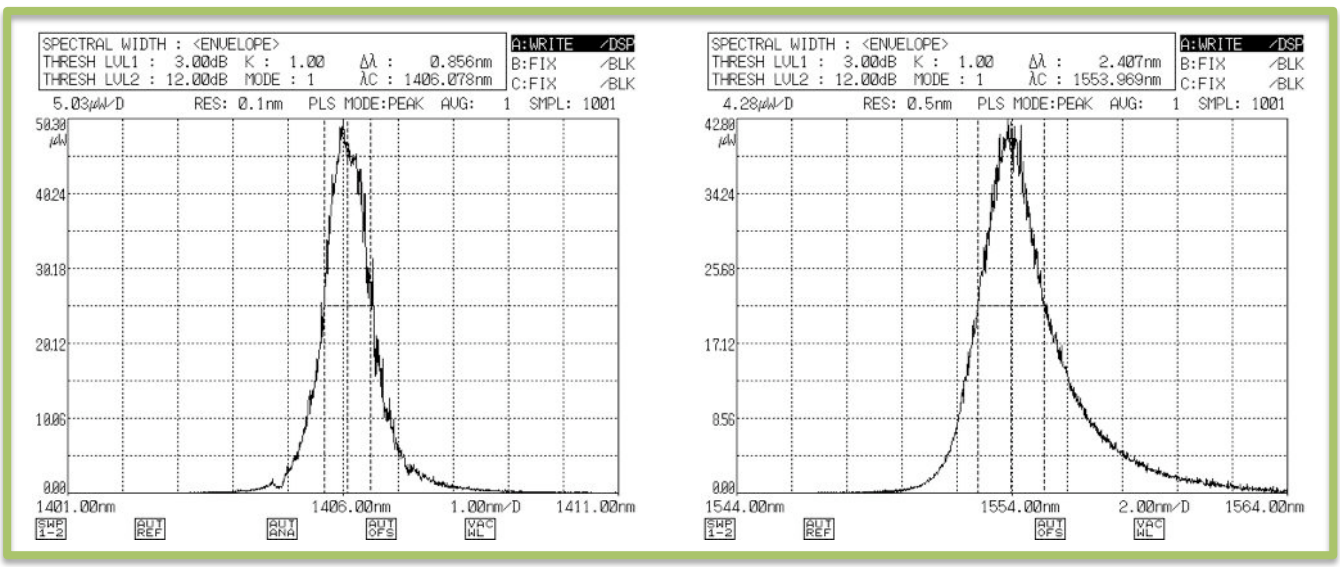
SSOPO mid-IR wavelength selectable laser system

Optical Parametric Oscillator (OPO) Systems
Turn-key wavelength selectable IR lasers with simple push-button interface, two models for wavelengths 1400 – 4150nm
Typical operating specifications*:

Applications
- bench-top IR source for alignment and testing
- IR optical element / waveguide characterisation
- CCD array testing

part #	signal wavelength (power)	idler wavelength (power)	rep. rate	pulse width	signal spectral width (FWHM)
SSOPO2	1400 – 1545nm (20mW)	3250 – 4150nm (10mW, 5mW > 3800nm)	2kHz	10ns	2nm @ 1400nm – 3nm @ 1530nm
SSOPO3	1540 – 1780 (20mW)	2520 – 3310 (10mW)	2kHz	10ns	3nm @ 1550nm – 8nm @ 1730nm





**contact us to discuss your custom requirements*

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OEM and contract manufacturing

Covesion's team of poling experts have over 10 years experience in the manufacture of PPLN for off-the-shelf, custom, and OEM customers. Featuring a comprehensive suite of proprietary technology for the design and manufacture of periodically-poled materials, Covesion continues a legacy of quality and innovation started by our parent company, Stratophase in 1999.

Complementing a wide range of standard products, our contract manufacturing service offers tailored grating designs to match your chosen wavelength, laser, or frequency conversion system. Our unique PPLN and MPPLN manufacturing processes are scalable from single-unit production to high-volume on-wafer designs, with significant cost benefits for repeat OEM customers.

Contact us for your tailor-made wavelength conversion solution.

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or visit our website for more information

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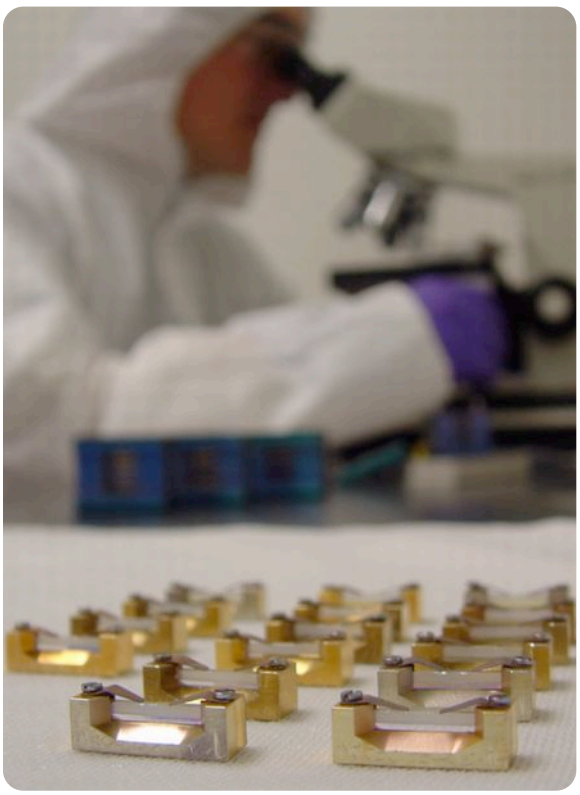

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