

# Mira OPO-X

## Fully Automated IR/Visible OPO for femtosecond and picosecond Ti:Sapphire Lasers

Mira OPO-X is a synchronously pumped, widely tunable, optical parametric oscillator (OPO) accessory that dramatically extends the wavelength coverage of our fs and ps Ti:Sapphire lasers (such as Mira and Chameleon) from 505 nm to 4000 nm. It is fully automated, i.e. software controlled tuning over the full specified wavelength range. This is made possible by its advanced control electronics, built-in diagnostics, and powerful control software package.

The control software can be accessed remotely via the system's TCP/IP software interface making the MIRA OPO-X easy to integrate into larger experimental setups and software controlled environments. Enhanced customer support is enabled through internal error diagnosis and extensive log files, all remotely accessible via TCP/IP interface and LAN, which also enables remote service capabilities.

Mira OPO-X is designed around a unique fan-poled non-linear crystal technology. Rather than having a single fixed poling period in the OPO gain crystal matched to one pump wavelength, the crystal is poled in a fan geometry across the width of the crystal providing a continuously variable, quasiphase-matching period. This allows fully independent tunability between pump and OPO output wavelengths enabling two-color applications such as simultaneous multiphoton excitation imaging of different fluorophores, uncaging, CARS/SRS and other two-color pump-probe experiments.



**Superior Reliability & Performance**

### **Mira OPO-X Features:**

- **Fully automated wavelength tuning**
- **Unique fan-poled crystal technology for independent tunability of pump and OPO wavelengths**
- **Femtosecond and picosecond options**
- **High power visible output using efficient intracavity doubling**
- **Access to Idler wavelengths to 4  $\mu\text{m}$  using optional optics sets**
- **Active cavity length stabilization**
- **Built-in diagnostics**
- **Remote service capability**

### **Mira OPO-X Options:**

- **Autocorrelator**
- **Idler output**
- **Depleted pump output**
- **Simultaneous access to Signal IR and VIS outputs from ring configuration**
- **Difference frequency generation (DFG) for mid-IR generation up to 15  $\mu\text{m}$**

## Mira OPO-X

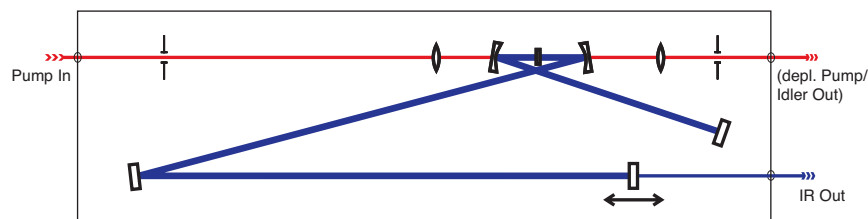
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The actual Signal wavelength and bandwidth are measured in real-time by an internal high resolution spectrometer and the power is monitored by calibrated photodiodes. The Mira OPO-X is also equipped with real-time pump beam diagnostic that track pump wavelength, power and repetition rate. To tune the output wavelength of the Mira OPO-X, the user simply enters the desired wavelength into the control software. Even a change in pump wavelength is detected and Mira OPO-X automatically adjusts accordingly. The unique optical design and sophisticated control software make the Mira OPO-X fully controllable via PC. Broad tunability of ultrafast light sources has never been easier.

### Cavity Configurations

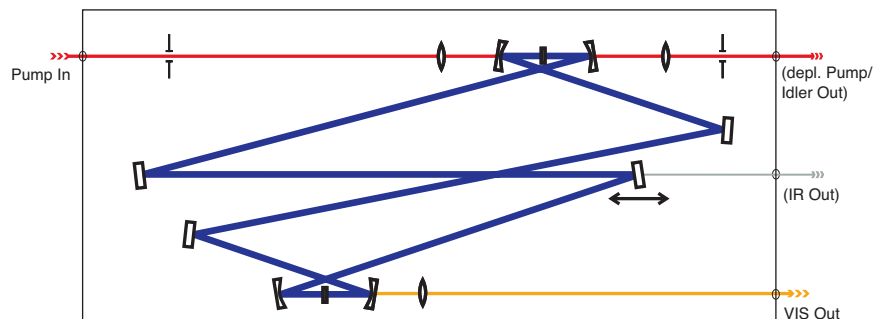
#### Linear IR Cavity

The Linear IR configuration is a singly Signal-resonant OPO with a 5-mirror standing wave cavity. It is used for highly efficient IR-generation using a fan-periodically-poled crystal covering the 1.0 ... 1.6  $\mu\text{m}$  wavelength range and up to 4  $\mu\text{m}$  with the non-resonant Idler branch (optional).



#### Visible Ring With Intracavity SHG

The Ring VIS configuration is a singly Signal-resonant OPO employing an additional intra-cavity SHG module in an 8-mirror Ring cavity. The SHG module is based on temperature tuned non-critically phase matched SHG for highly efficient visible output generation. It covers the 505 ... 740 nm wavelength range, which fills the gap between the Ti:Sapphire fundamental beam and its frequency doubled Signal (SHG). All Ring VIS systems include the Linear IR operation, which can be reconfigured by the customer.



Both IR Linear and Visible Ring configurations of MIRA OPO-X are available in both femto- and picosecond or dual mode (depending on the pump) and switching between mode is achieved by simply exchanging a few optical elements.

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System Specifications <sup>1</sup>	Mira OPO-X (IR)		Mira OPO-X (Vis + IR)	
	femtosecond	picosecond	femtosecond	picosecond
Model <sup>2</sup>	IR Linear Cavity		Visible Ring Cavity with Intracavity SHG	
Cavity Configuration	IR Linear Cavity		Visible Ring Cavity with Intracavity SHG	
Tuning Range <sup>3</sup> (nm)	IR Linear Cavity		Visible Ring Cavity with Intracavity SHG	
Signal SHG	NA		505 to 740	
Signal IR	1000 to 1600		1000 to 1600	
Idler (option)	1750 to 4000		1750 to 4000	
Nominal Pump Wavelength	740 to 880		740 to 880	
Average Output Power <sup>4</sup> (mW)	IR Linear Cavity		Visible Ring Cavity with Intracavity SHG	
Chameleon Ultra-II	>650 at 1100 nm	NA	>500 at 600 nm	NA
18W Pumped Mira HP	>650 at 1100 nm	>520 at 1100 nm	>500 at 600 nm	>400 at 600 nm
10W Pumped Mira 900	>250 at 1100 nm	>250 at 1100 nm	>150 at 600 nm	>150 at 600
5W Pumped Mira 900	>75 at 1100 nm	>75 at 1100 nm	>40 at 600 nm	>40 at 600 nm
Typical Pulse Width <sup>5</sup>	200 fs from 130 fs pump pulse	1.6 ps from 2 ps pump pulse	200 fs from 130 fs pump pulse	1.6 ps from 2 ps pump pulse
Typical Time Bandwidth Product	0.6		0.6	
Polarization	IR Linear Cavity		Visible Ring Cavity with Intracavity SHG	
IR Signal & Idler	Linear Horizontal		Linear Horizontal	
Vis SHG Signal	Linear Vertical		Linear Vertical	
M <sup>2</sup>	<1.2		<1.2	
Spectrometer Range (nm)	495 to 1630		495 to 1630	
Repetition Rate	Matched and Synchronized to Pump Laser		Matched and Synchronized to Pump Laser	
Noise <sup>6</sup> (% RMS)	<0.5		<0.5	

<sup>1</sup> Specifications subject to change.

<sup>2</sup> Dual models are available that can be configured for fs or ps operation.

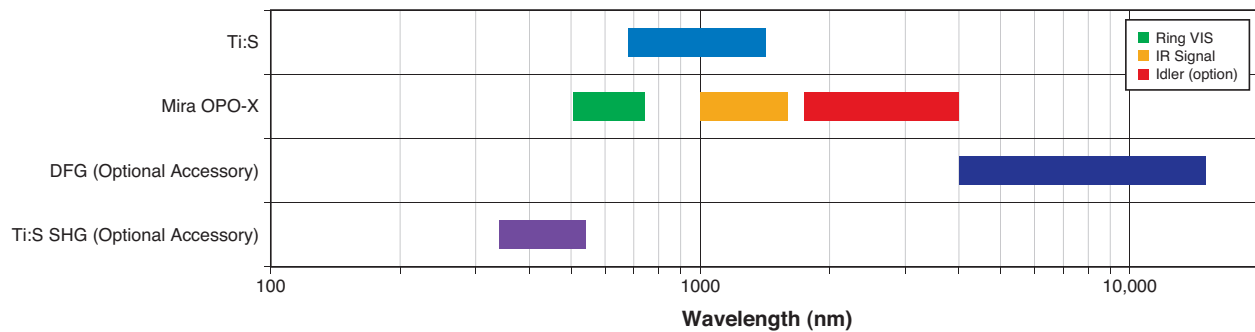
<sup>3</sup> Depends on actual pump wavelength (see Figure 1).

<sup>4</sup> Pumped at 800 nm.

<sup>5</sup> Assumes Gaussian pulse shape from OPO (deconvolution factor 0.7).

<sup>6</sup> Measured within a 10Hz to 10MHz bandwidth.

## Wavelength Coverage



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## Typical Performance Data

Figure 1: Any combination of pump and OPO wavelength within these bounded regions is accessible with the Mira OPO-X system.

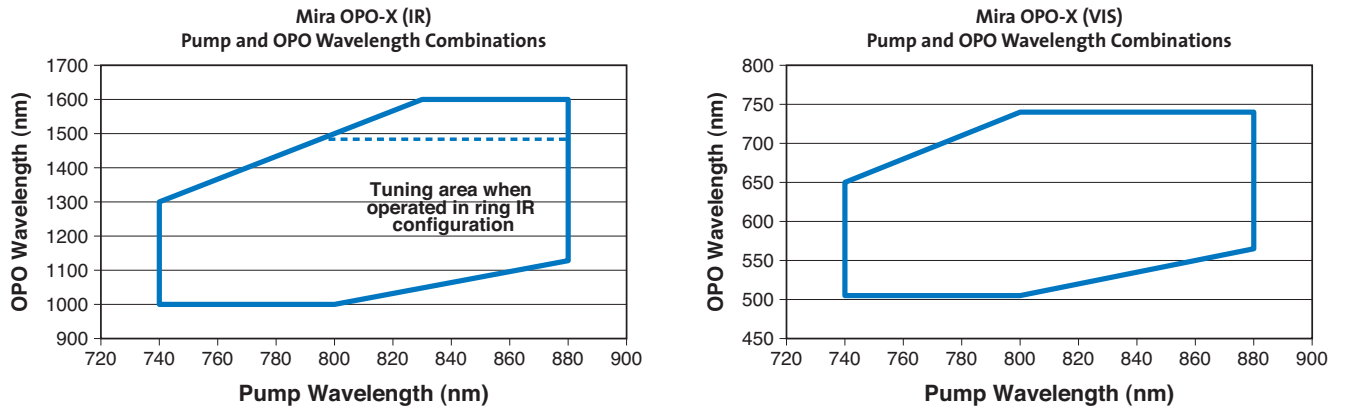


Figure 2: Mira OPO-X (IR) model typical average power.

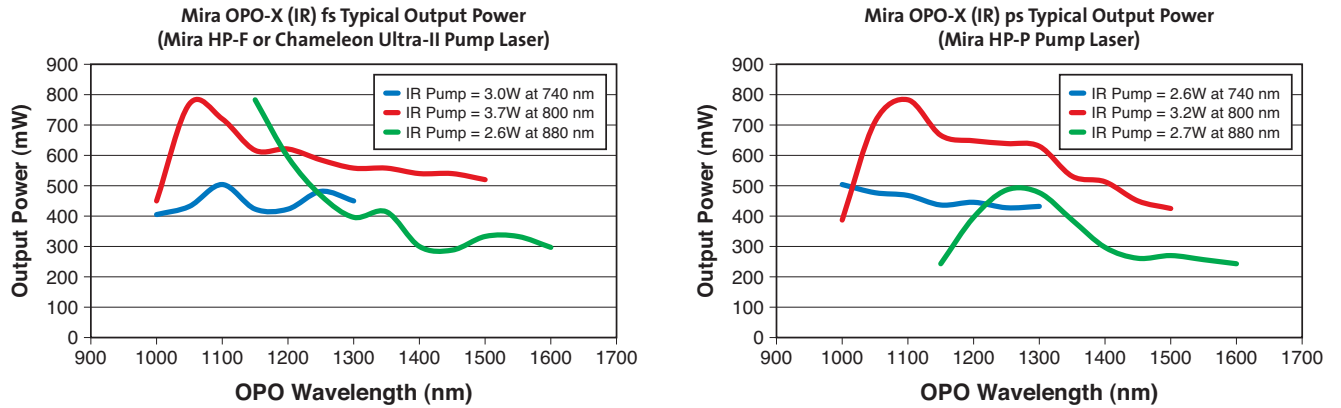
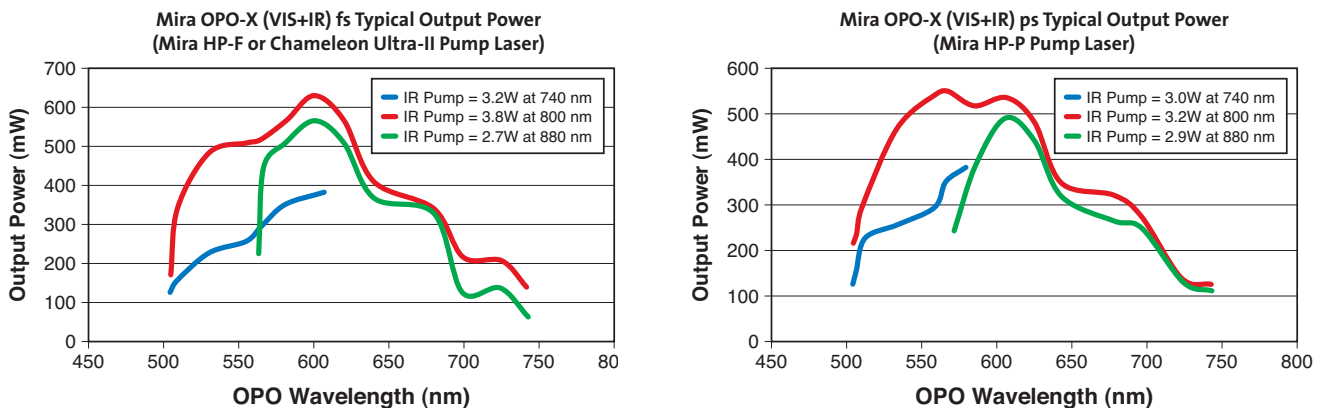


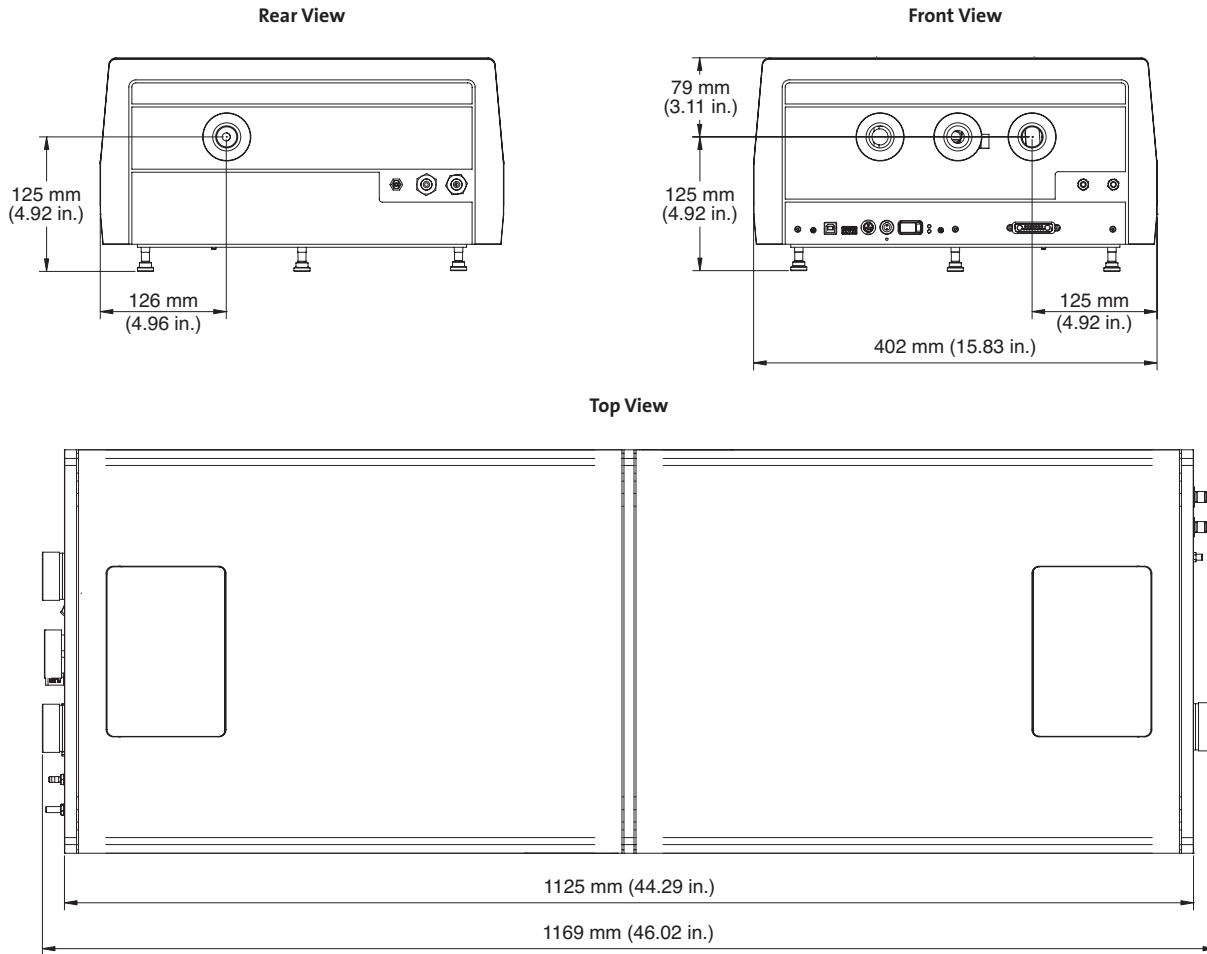
Figure 3: Mira OPO-X (VIS+IR) model typical average power in the visible.



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## Mechanical Specifications



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Coherent follows a policy of continuous product improvement. Specifications are subject to change without notice.

Coherent's scientific and industrial lasers are certified to comply with the Federal Regulations (21 CFR Subchapter J) as administered by the Center for Devices and Radiological Health on all systems ordered for shipment after August 2, 1976.

Coherent offers a limited warranty for all Mira OPO-X Ti:S lasers. For full details of this warranty coverage, please refer to the Service section at [www.Coherent.com](http://www.Coherent.com) or contact your local Sales or Service Representative.