

# CO/CO<sub>2</sub>- PL, MTL

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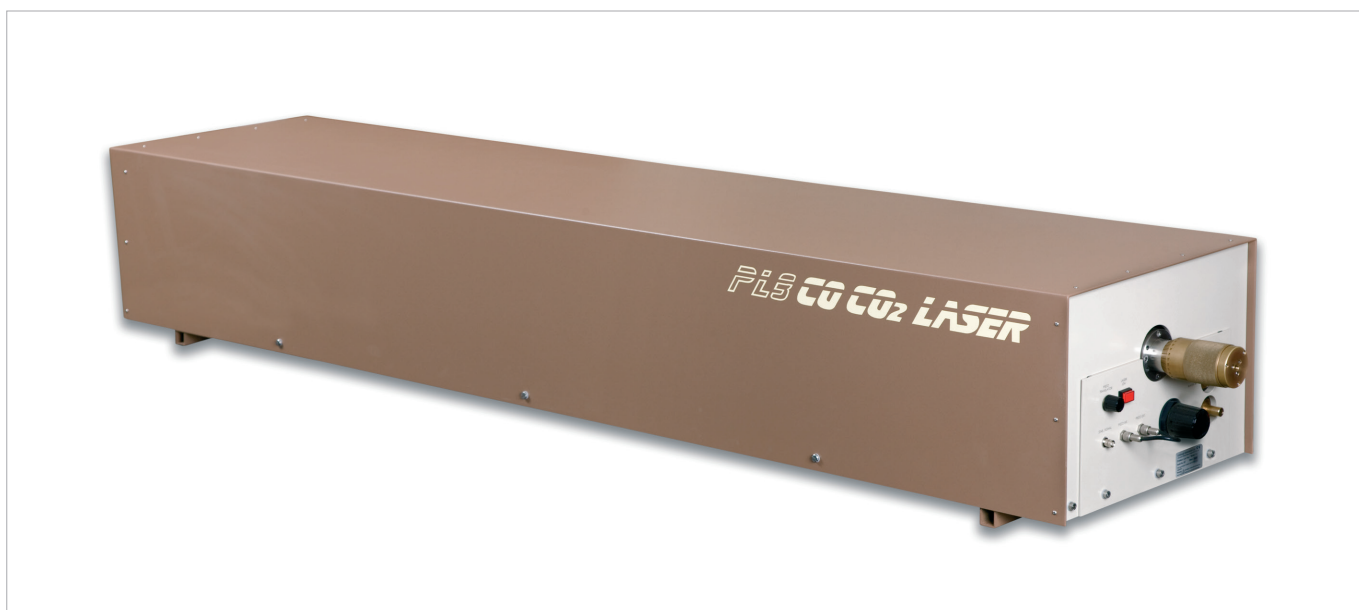
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# The PL Series

## Infrared lasers

The PL series of continuous wave (CW), grating tuned, infrared gas lasers sets the standard for high power, stable sources for a wide variety of applications from molecular spectroscopy, non-linear optics, interferometry, process control, atmospheric studies, plasma density measurements and much, much more.



The infrared has long been dubbed the “Cinderella” spectral region due to the low level of blackbody emission at long wavelengths but this was changed with the development of carbon dioxide (CO<sub>2</sub>) and carbon monoxide (CO) lasers in the 1970’s.

In the same way that every individual can be identified by their unique fingerprint, the infrared spectrum of a sample uniquely defines the constituent molecules present.

The PL-series of lasers include grating tuned CO<sub>2</sub> lasers with a step tunable wavelength from 9µm – 11µm with single line powers from a few Watts (Model PL2), to 50W (Model PL5) and even to 180W (Model PL6) each characterised by excellent amplitude and frequency stability for the most technically challenging tasks.

The PL2 laser lends itself to flexible tailoring to scientific applications. For example, if used with our 184T pump station, the laser head can be filled with the desired isotopic gas mix which gives the user access a range of alternative wavelengths.

Our PL3 model is unprecedented in today’s market. It operates as either a CO<sub>2</sub> (output power up to 25W) or CO (with output >1W over the range 5.1 – 6.0 µm) laser. Using different isotopic gas fills the PL3 laser can give up to 1,000 lines across the infrared.

The higher power PL-series lasers can be used to optically pump polar gases (for example methanol, formic acid, etc) to create Far Infrared (FIR) laser emission. The FIR/TeraHertz region (40µm – 1.2mm, 7.5 to 0.25THz) can be used for temperature measurement of fusion reactor plasma. There are also many applications in homeland security and scanning, scattering density measurements, radar modelling, etc.

### PL2-M / PL2-S

The PL2-M is a new, compact version of the previous model PL2. It has been significantly reduced in size without sacrificing any of the performance specifications. The PL2-M has a maximum rated power of 10W and the PL2-S has a maximum rated power of 1W on the strongest lines and more than 60 lines are available. The laser is

operated in sealed off mode with initial gas lifetime guarantee of 12 months. A vacuum valve is fitted to allow user replenishment, with standard or isotopic gas mixtures for ultimate flexibility and ease of operation at lowest cost. Operation is via a hand held control console for laser ON/OFF, discharge current (with liquid crystal display) and piezo voltage.



### PL3

The PL3 laser operates sealed off on low gain CO transitions in the range 5.2 $\mu$ m to 6.0 $\mu$ m under hazard free, near room temperature conditions. It features a UHV sealed, split discharge tube with both the diffraction grating and piezo mounted output coupler within the vacuum envelope for lowest loss operation.

As with the PL2-M the PL3 gas is user replenishable. By changing the cavity optics and gas mixture, the PL3 can be converted into a tunable CO<sub>2</sub> laser covering the 9 $\mu$ m to 11 $\mu$ m region. Typical single line powers are 1.0W CO and 20W CO<sub>2</sub>. The PL3 is driven by the compact, LPS-D dual output switch mode power supply.

### PL5

The PL5 is a flowing gas CO<sub>2</sub> laser producing single line powers in excess of 50W and operating on more than 80 individual lines. The cavity optics consist of two ZnSe Brewster windows, a gold coated diffraction grating and a ZnSe output coupler. The laser head is supplied with all necessary vacuum couplings, valves and a capsule gauge to enable flow operation. A suitable vacuum pump, the model 215, is available to complete the system

For CW and chopped output operation, the LPS-5 power supply is available. If pulsed output is required, in addition to the other two modes, the PL5 can be supplied with the versatile PS4P power unit.

Q-Switched operation of the PL5 can be achieved with the PL5-QS option. This is a six sided polygon scanning mirror assembly which mounts in the intercavity space between the grating and rear Brewster window.

Depending on laser operating conditions, pulses of typically 2kW peak power and pulse widths of 200ns are achieved at frequencies up to 1kHz.



### PL6

The highest power tunable CO<sub>2</sub> laser currently available is the model PL6, offering single line power up to 180W and more than 90 lines across 9µm to 11µm. The flowing gas laser head is a single U-folded design with twin discharge tubes. The laser resonator is passively stabilised with a 5bar invar support frame which is decoupled from the laser base by orthogonal Rose bearings.

Cavity optics comprise of a gold coated diffraction grating and piezo mounted output coupler. Within the cavity, two high reflectivity folding mirrors reflect the beam internally and two ZnSe Brewster windows are used to seal the discharge tubes. The PL6 is driven by the LPS2000 dual output power supply.

## Technical Specifications

	CO <sub>2</sub> (9.1-10.9µm)					CO (5.2-6.2µm)
	PL2-S	PL2-M	PL3	PL5	PL6	PL3
Output Power (W) – flowing	–	–	–	50	180	–
Output Power (W) – sealed	1	10	20	–	–	1
Number of lines	50	60	80	80	90	60
M <sup>2</sup>	1.25	1.25	1.35	1.25	1.5	n/a
Beam Divergence – 1/e <sup>2</sup> (mrad)	<7.5	<6.5	3.5	3.5	3.5	3.5
Beam Diameter – 1/e <sup>2</sup> (mm)	4.0	4.8	7.5	7.5	11	5.0
Polarisation	Vertical	Vertical	Horizontal	Vertical	Vertical	Horizontal
Amplitude Stability	<±1%	<±1%	<±1%	<±1%	<±2%	<±1%
Frequency Stability (kHz/sec)	200	200	60	500	500	60
Frequency Stability (MHz/10min) (actively stabilized)	±1	±1	±1	±2	n/a	n/a
Tuning Mechanism	Piezo-ceramic length tuner and diffraction grating wavelength selection					
Cavity length (cm)	42	77	178	183	388	178
Dimensions (cm) L	65	110	221	220	220	221
Dimensions (cm) W	12	12	52	22	45	52
Dimensions (cm) H	13	13	37	22	32	37
Weight (Kg)	11.8	18	100	36	125	100
Gas Requirements	Sealed/user replenishible	Sealed/user replenishible	Sealed/user replenishible	1.2 lit/min (flowing gas)	9 lit/min	Sealed/user replenishible

### A wide range of accessories are available for the PL Series. These include:

**Laser Stabilisers** – For applications demanding excellent medium and long term stability, an active stabiliser may be required. This will compensate for laser output fluctuations caused by changes in ambient conditions and lock the variation in laser frequency or power to a value close to the passive jitter.

Edinburgh Instruments has designed a family of active stabilisation techniques appropriate to the type of laser and operating conditions.

**Laser Pumping and Refilling Systems** – All flowing gas laser systems are supplied with the necessary valves, gauges and vacuum couplings for simple connection to the system vacuum pump. A range of turbo molecular and dry pumps are available.

**Gas Mixing Stations** – Designed to allow mixing and metering of up to 3 component gases from independent gas cylinders. These comprise of 3 inlet ports with individual flow meters or needle valves for gas mixing or gas flow operation.

The PL5 and PL6 can be used in combination with our FIR optically pumped lasers.



**PROTECTIVE GLASSES ARE AVAILABLE FOR THE PL SERIES OF CO<sub>2</sub> LASER.**

# MTL-5 Mini TEA CO<sub>2</sub> Laser

A compact, high peak power pulsed CO<sub>2</sub> laser solution designed to suit your experimental needs.

The MTL-5 is a compact, user-friendly, bench-top, Transverse Excited Atmospheric (TEA) Pressure pulsed CO<sub>2</sub> Laser.



The MTL-5 features self-diagnostic testing and built-in, fail-safe mechanisms designed to monitor system performance and to support system integrity. The laser offers high performance specifications for a variety of scientific and specialist applications.

The TEA CO<sub>2</sub> laser can be operated in either multi-mode or single mode (TEM<sub>00</sub>) configuration. Multi-mode untuned output energy is rated at 150 mJ/pulse at 100 Hz.

The laser is supplied with a separate power supply that enables optimum space without compromising experiments. High reliability, integrity monitored, high voltage interconnection between the power supply and head.

An optional wavelength selection unit with precision grating control enables users to step tune easily between wavelengths. (9.2  $\mu$ m to 10.8  $\mu$ m)

## MTL-5 Product Features:

- 50 ns Pulse Width (typical)
- High Repetition Rates, Single Shot – 100 Hz
- Manual Grating Tuned Option  
(9.2  $\mu$ m to 10.8  $\mu$ m wavelength operation)
- Untuned: 10.6  $\mu$ m  
Max. Energy Multi Mode 150 mJ/Pulse
- Tuned: >60 lines available  
Max. Energy Single Mode 50 mJ/Pulse
- Compact Control Driver Unit
- Precision Grating Control
- Extended Service Lifetime

**Laser Head**

The cylindrical laser head contains profiled electrodes to provide a homogenous discharge. A series of UV spark pre-ionisers are spaced along the discharge length. The laser gas is circulated internally via a flow chamber to give optimised uniform gas flow across the entire discharge section. The laser gas is cooled via an integral heat exchanger, which requires water cooling for operation above 20 Hz. The laser gas has been optimised to a proprietary gas mixture and the laser has 2 main modes of operation: Flow

or Slow Flow. The Flow mode provides maximum output energies as specified, and utilises a standard 3 component gas mixture. In addition, Slow Flow (<0.5 l/min) can be achieved. This mode of operation suits applications where reduced gas consumption is required and a lower energy circa.100 mJ is sufficient e.g. remote environmental monitoring stations.

**Power Supply**

The power supply contains a switch mode charging unit rated at 1000 J/sec, 25 kV, and the main discharge capacitors are thyatron switched for low command jitter and highest reliability. The supply performs sophisticated discharge monitoring remotely via an optical fibre to ensure system performance, system integrity and arc event

detection. The supply will shut down the laser in the event of risk of potential system damage occurring and indicate the system status with a range of indicator LED's. The supply has a LCD display switchable to read discharge voltage or repetition rate control functions. It can also accept external trigger control inputs.

**Grating Tuned Option – Manual Tuning**

Operation on 60 lines between 9.2 µm and 10.8 µm is achieved by adding the grating tuning option. A new and improved high precision, low backlash manual tuning accessory attaches to the laser head in place of the 100% rear reflector assembly.

The grating is separated from the discharge volume by a Brewster window. Maximum energy is 50 mJ per pulse on the strong gain lines.

	Untuned	Untuned	Tuned
	Multimode	TEM <sub>00</sub>	TEM <sub>00</sub>
Output Energy (mJ) Flowing Gas	150	80	50
Wavelength (µm)	c.a. 10.6	c.a. 10.6	9.2 – 10.8 µm
Beam Divergence (mR)	2	1	1
Beam Diameter (mm)	10x10	6.0	Typically 6 mm
Amplitude Stability (%)	±6% p-p		
Pulse Width (ns) FWHM	ca 50		
Repetition Rate (Hz)	Single shot to 100 Hz		
Cavity Length (cm)	29.5		38.5
Dimensions (cm) L	39.8		58
Excluding connectors (cm) W	20		
Excluding connectors (cm) H	22.5		
Weight (kg)	13.5		14
Power Supply Dimensions (cm) L	51		
Power Supply Dimensions (cm) W	52		
Power Supply Dimensions (cm) H	17		
Weight (kg)	34		

**Accessories are available for the MTL-5 Series include:**

**Gas Mixing Stations** – Designed to allow mixing and metering of up to 3 component gases from independent gas cylinders. These comprise of 3 inlet ports, each with their own needle valve control, with individual flow meters for gas mixing.



**PROTECTIVE GLASSES ARE AVAILABLE FOR THE MTL-5 SERIES OF CO<sub>2</sub> LASER.**

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