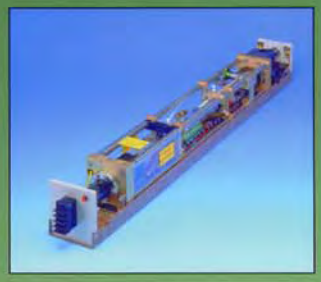
INFRA-RED GAS LASERS



EDINBURGH INSTRUMENTS

Edinburgh Instruments.....

Now into its fourth decade, Edinburgh Instruments can rightly claim to be one of the longest established laser manufacturing companies serving the research community.

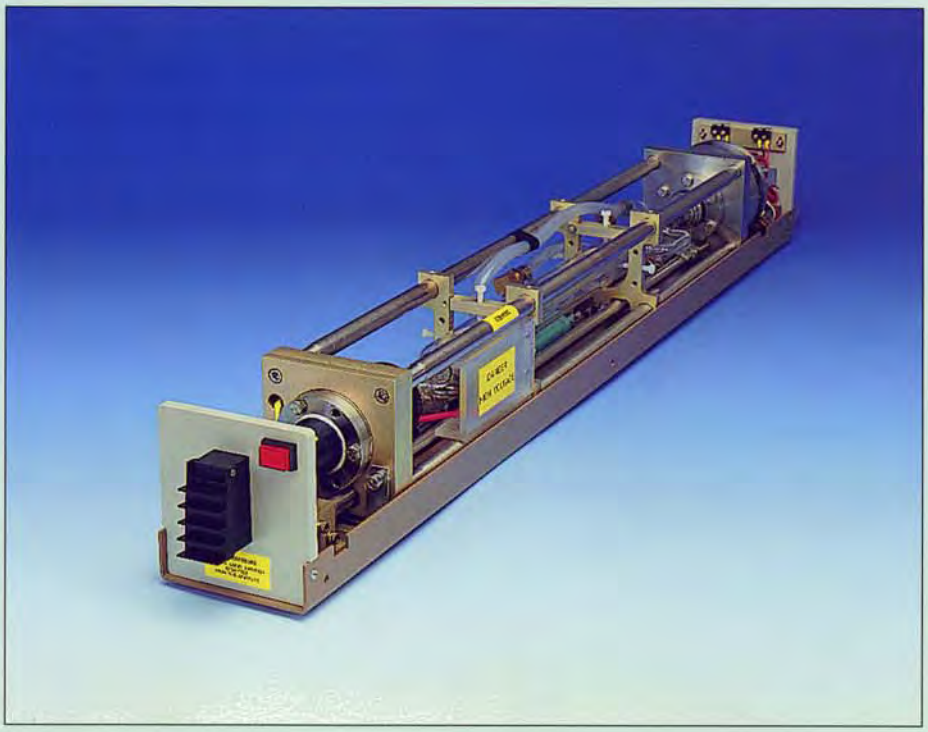
The Edinburgh name is synonymous with tunable infra-red gas lasers with wavelengths from 3 microns out to beyond one millimetre and the company's global reputation, with 85% of products exported, belies it's modest size.

With many hundreds of lasers in the field, Edinburgh Instruments understands the demands and requirements of it's customers and is committed to the future development of infra red laser technology.

This brochure describes the latest new products along side the range of lasers and accessories that gave Edinburgh Instruments the reputation for innovation, quality , reliability and service.

The Electro Optics Division of the Edinburgh group of companies continues that tradition.

Contents



PL2-M CO_2 Laser

.....Performance by Design

Quality

The key to a long product lifetime of maximum performance is Quality. Quality design. Quality workmanship. Quality materials. Edinburgh Instruments is an ISO 9002 certified company ensuring that each laser is built to audited quality procedures. In addition, all lasers have CE certification and conform to the relevant EU norms and laws.

Warranty

Edinburgh Instruments lasers are covered by an unconditional warranty for a full year on parts and labour.

Service

Edinburgh Instruments is committed to customer satisfaction. Support begins before the sale when we get to know your requirements, offer advice and help to configure the best system to meet your present and future needs.

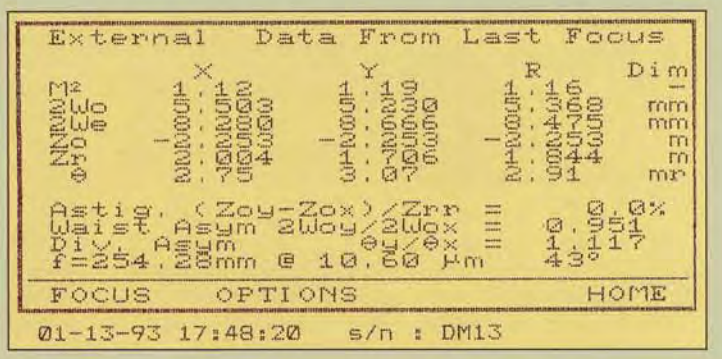
After the system is delivered, trained specialists are on hand to respond rapidly to any service enquiry, to provide technical support and to generally answer any questions that may arise.

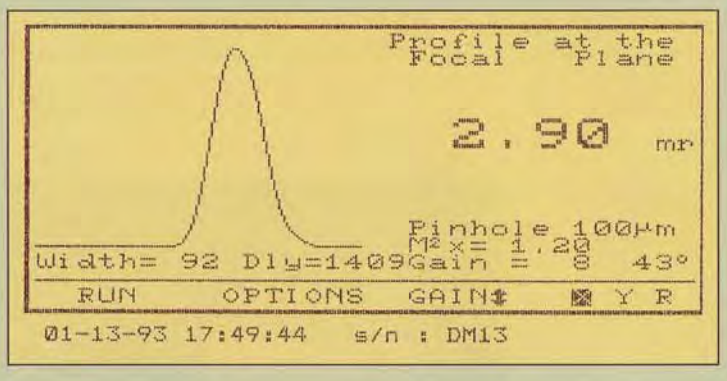
Partner in Research

At Edinburgh we regard our customers as partners. After all, if it wasn't for you we wouldn't be here. With a long pedigree in award winning research programmes and well equipped, modern laboratories with highly qualified and motivated staff, we have the in house capabilities to partner your research, join collaborative programmes or undertake contract Research and Development in a wide degree of disciplines.

Performance

Laser performance can be measured against a wide range of parameters - output power, amplitude stability, frequency stability, tunability, beam divergence, beam quality, beam pointing stability, etc. Most manufacturers make sweeping performance claims for their systems but few back them up with hard evidence. The beam quality of each of our C.W. CO_2 lasers is measured with a Coherent Modemaster - M^2 meter - as part of the pre delivery test procedure and we have the confidence to include these figures in the laser specifications.





What is M^2?

M^2 is a numerical value which describes the quality of a laser beam, as referenced to a pure Gaussian (TEMoo). In practical terms, the M^2 value is defined as the measured beam divergence, normalised by dividing the divergence of a pure Gaussian beam of the same waist diameter. Thus a pure Gaussian would have an M^2 value of 1.00. A laser beam with an M^2 value of 1.2 is therefore 1.2 times diffraction limited and would produce a focused waist diameter 20% larger than a fundamental mode beam. Similarly a beam with M^2 value of 2.0 would produce a focused waist size twice that of a fundamental mode beam.

MTL-3 Mini TEA CO_2 Laser

Features

- High Repetition Rates - single shot to 100Hz (200Hz Burst mode)
- Thyratron Switched
- Low Gas Consumption/Sealed Operation
- Small and Lightweight Laser Head and Power Supply
- 150mJ (multi mode)
- Grating and Agile Tuned Options

The MTL-3 mini TEA CO_2 laser is an extremely compact laser system offering high performance specifications for a variety of scientific and industrial applications.

Options are available offering a choice of pulse energy, mode performance, grating tuned or untuned single line output.

Laser Head

The cylindrical laser head contains profiled electrodes to provide a homogeneous discharge volume of 1x1x14cm^3. A series of UV spark preionisers and decoupling capacitors 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 finned 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 3 main modes of operation. **Flow**, **Slow Flow** and **Sealed** and these are described.

The **Flow** mode provides maximum output energies as specified, and utilises a standard 3 component gas mixture. In addition, **Slow Flow** (<0.5l/min) can be achieved with the addition of other gases to reduce dissociation effects. This mode of operation will find applications where reduced gas consumption is required and a lower energy ca 100mJ is sufficient.

The MTL-3 can also be sealed off for periods of up to 24 hours, and will operate for over 10^6 shots within this period. The laser head can then be refilled quickly and conveniently by purging with the standard gas mixture at atmospheric pressure. This sealed capability makes the MTL-3 suitable for external field applications.

Power Supply

The MTL-3 Power supply is housed in a compact 19" cabinet (3U High) which can be located up to 10m from the laser head. The power supply contains a switch mode charging unit rated at 1000J/sec, 25kV, and the main discharge capacitors are thyratron switched for low command jitter and highest reliability. The supply has full internal control functions but can also accept external control inputs.

The supply has an LCD display switchable to read discharge voltage or repetition rate and is fully protected by an arc protection circuit which will shut down the laser in the event of the discharge arcing, to prevent damage occurring.

MTL-3

The untuned MTL-3 can be operated in either multi mode or single mode (TEMoo) configuration. Output energy is rated at 150mJ per pulse multimode at 100Hz.

The addition of a precisely selected aperture assembly enables single transverse mode operation.Output energy TEMoo is rated at 80mJ/pulse.

MTL-3 with agile tuner option and power supply

Grating Tuned Option - Manual Tuner

Operation on 60 lines between 9.2 and 10.8 microns is achieved by adding the grating tuning option. The 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 50mJ per pulse on the strong gain lines.

Agile Tuner Options

For rapid tuning between individual lines, eg remote sensing applications, a high repetition rate agile tuner is offered as an add-on accessory to the MTL-3. The agile tuner forms the rear end of the laser cavity and features a fixed diffraction grating and a fast scanning galvanometer mirror.

In operation, the mirror directs the laser radiation onto the grating at the required angle to produce the desired laser wavelength. The fast scanning mirror can be tuned to different lines across the tuning spectrum during the time between laser shots to produce the wavelength agile output.

The tuner is PC controlled and is accurate to 0.2nm.

Two models are available :-

200 Hz version which stores up to 16 different patterns of 20 discrete wavelengths

50 Hz version which stores up to 16 different patterns of 5 discrete wavelengths.

		MTL-3	
		Multimode	TEMoo
Output Energy (mJ) Flowing Gas Sealed		 150 100	 80 50
Wavelength (µm)		ca 10.6	
Beam Divergence (mR) Beam Diameter (mm)		2 10x10	1 6
Amplitude Stability Pulse Width (ns) FWHM Repetition Rate (Hz) Cavity Length		±6% p-p ca 50 single shot to 100Hz (max 200Hz burst) 29.5cm	
Dimensions (cm) excluding connectors Weight (kg)	L W H	39.2 20 22.5 <14	
Power Supply (cm) Weight (kg)	L W H	51 55 17 34	

Photon Drag Detectors

Edinburgh Instruments produces a range of Photon Drag detectors which are ideal for the quantitative analysis of pulsed CO_2 laser output such as the MTL-3.

These detectors feature

- Room temperature operation
- Intrinsically fast response (<1ns)
- High damage threshold (20MW/cm^2)
- Rugged, compact construction
- Ease of use

3 Models are available, a high transmission in situ monitor and two beam dump detectors.

	PD-2	PDM-2	PD-3
Clear aperture (mm)	10	10	20
Responsivity mV/MW	200	180	45
Uniformity of sensitivity(%)	+/-2	+/-2	+/-3

Grating Tuned Lasers - PL Series

Features

- Invar frame for mechanical rigidity and thermal stability
- Diffraction grating line selection
- Piezo-electric fine control of cavity length
- Profiled laser tube for off axis mode suppression
- Single line outputs up to 180W
- M^2 beam performance figures specified
- Polarised output
- Excellent passive stability of both amplitude and frequency
- Active stabilisation available

The PL Series of grating tuned lasers covers the spectral ranges from 5.2 to 6.0 microns and 9.1 to 10.9 microns, with models having continuous wave (cw) output powers up to 180 Watts.

Laser Head

ALL PL series lasers utilise an invar rod frame to support the laser resonator and ensure a high degree of passive stability. This mechanically rigid frame minimises the effect of vibration on the laser output and provides thermal stability of the cavity length.

ALL lasers have manually controlled diffraction gratings for line selection and piezo mounted output couplers for fine control of cavity length.

ALL laser tubes are water cooled for highest stability. The inner walls of the tubes are specially profiled to suppress off axis oscillations and to ensure that the lowest order transverse mode dominates. The low gas pressure (ca 30 mbar) and hence narrow gain profile supports only single longitudinal mode (SLM) operation.

The high optical mode quality and excellent amplitude and frequency stability makes the PL lasers ideal sources for a wide number of scientific applications.

Power Supplies

Conventional high voltage dc excitation is used to excite the laser discharge. Each laser is driven by one of the LPS family of new, compact (19" rack mounted) switch mode power supplies. These supplies are based on resonant inverter technology for highest efficiencies and reliability. Designed for stable output current operation, the jitter of the PL lasers with the LPS range has been measured at typically 200kHz/sec.

Continuous wave or chopped operation up to 1kHz is available with the LPS range. The PL5 laser can be optionally driven with the versatile PS4P valve controlled power supply providing programmable cw, chopped and pulsed operation. In pulsed mode the laser peak output power is typically five times the cw level at repetition rates up to 1kHz and with pulse widths down to 100 microseconds.

Accessories

A full range of accessories and options, such as coolers, gas handling systems, stabilisers, etc. is available for each laser. Please see accessories section, page 10.

PL2-M

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 high performance specifications. The PL2-M has a maximum rated power of 10W 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.

The new compact switch mode power supply, the LPS-2, is used to drive the PL2-M. 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 to 6.0 microns 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 replenishible.

By changing the cavity optics and gas mixture, the PL3 can be converted into a tunable CO_2 laser covering the 9 - 11 micron region.

Typical single line powers are 1.0W CO and 15 W CO_2.

The PL3 is driven by the compact, LPS-D dual output switch mode power supply.

PL5

The PL5 is a flowing gas CO_2 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 gas flow operation. A suitable vacuum pump, the model 215, is available to complete the system.

For sealed off operation, a high vacuum model, the PL5-S is available. It will operate flowing gas or sealed off for periods of up to one week. This makes it suitable for use with expensive isotopic gases. Typical maximum sealed off output power is 30W.

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 150ns are achieved at frequencies up to 1kHz.

PL6

The highest power tunable CO_2 Laser currently available is the model PL6, offering single line power up to 180W and more than 90 lines across all 4 bands.

The flowing gas laser head is a single U-folded design with twin discharge tubes. The laser resonator is passively stabilised with a 5 bar invar support frame which is decoupled from the laser base by orthogonal Rose bearings.

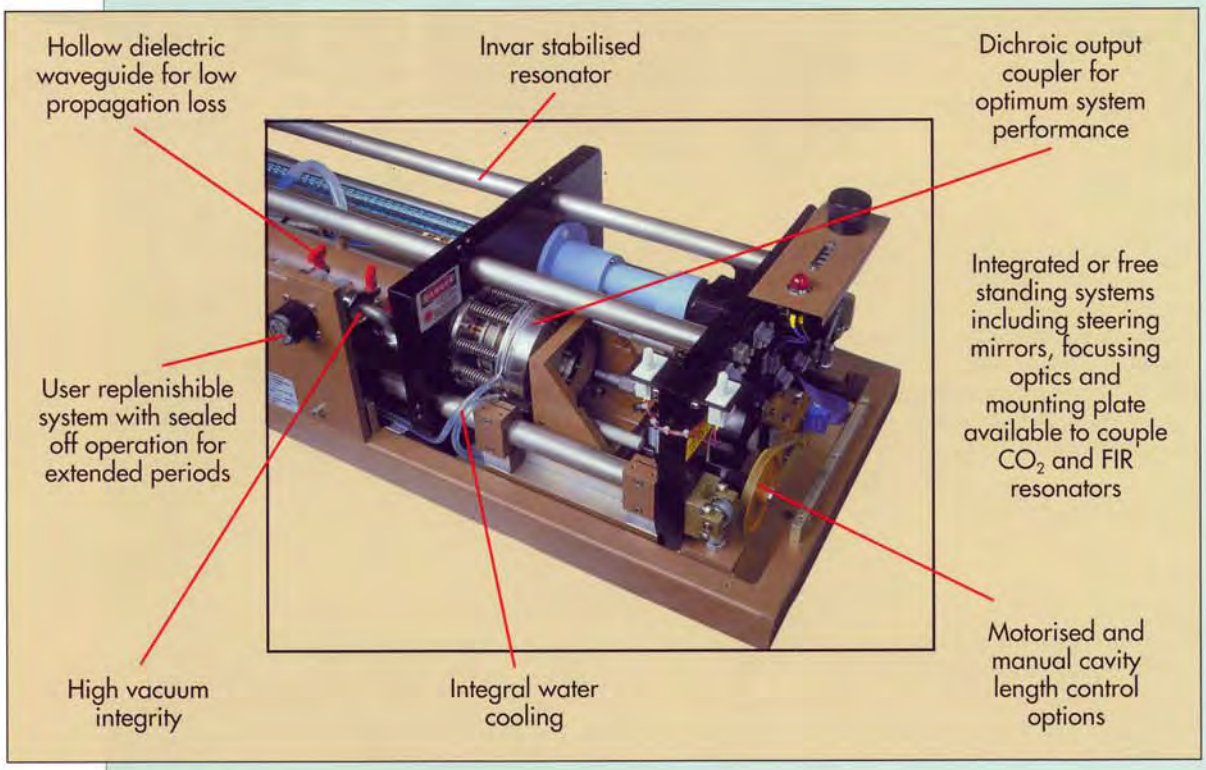
Cavity optics comprise a gold coated diffraction grating and piezo mounted output coupler. Within the cavity, two high reflectivity folding mirrors reflect the beam internally and two ZnSe Brewster windows are used to seal the discharge tubes.

The PL6 is driven by the LPS2000 dual output power supply.

Optically Pumped Far Infra Red Lasers

Edinburgh Instruments has been the market leader in the design, development and production of FIR laser sources for the past two decades. A choice of FIR lasers exists to meet applications requiring coherent radiation in the range 40μm to over 1.2mm.

Features



295 FIR

The model 295 is a stand alone FIR laser designed for operation with high power CO_2 lasers. Guaranteed powers of 150mW when pumped by the PL5, and 500mW when pumped by the PL6, are available at 118.8 and 184.3 microns.

The 295 has a 3 bar invar support frame and features the same optical design as used in the FIRL100. It has been engineered to the highest vacuum standards to allow UHV pumping for extended sealed operation, maximum power and number of lines and for use with isotopic gas fills.

395 Twin FIR Laser

The model 395 features two identical FIR laser cavities within a single 5 bar invar stabilised frame. This is particularly designed for applications where two FIR outputs are required - such as Plasma Diagnostics - with one frequency offset from the other by up to a few MHz.

Both FIR cavities of the 395 are pumped by a single PL6 Laser to ensure optimum stability of the Intermediate Frequency (IF). A 50/50% beam splitter is used to generate the two identical pump beams required. The output couplers of both FIR sections are mounted on precision linear translation stages for individual optimisation and to generate the cavity length difference for frequency offset. A piezo tuning option is available for active stabilisation of the IF.

FIRL100

The model FIRL100 has both the CO_2 pump laser and the FIR laser housed in an integrated structure combining a highly efficient optically pumped FIR system into a single compact unit. The lasers and coupling optics are mounted within a 5 bar invar rod frame for excellent thermal and mechanical stability.

The CO_2 section provides 80 lines between 9.1 and 10.9 microns and features a flowing gas single discharge tube giving more than 50W on the strongest lines. Mode performance ($M^2 < 1.25$) is assured by internal profiling of the tube and the use of highest quality optics. The resonator design is based on the proven PL5 laser with diffraction grating, two ZnSe Brewster windows and piezo ceramic mounted ZnSe output coupler.

The CO_2 laser output is coupled into the FIR laser via two bending mirrors and a ZnSe focussing lens. Access to the CO_2 radiation for beam diagnostics or infra red experiments is available via a precision, two position sliding mirror mechanism.

The FIRL100 Far Infra Red laser has a 1.5m long pyrex waveguide of 36mm diameter. The pump beam is input via a Brewster window and input coupling mirror with central aperture. FIR radiation is extracted via a unique, customised dichroic output mirror with wideband transmission.

This mirror is mounted on a precision linear slide with motorised drive for cavity length adjustment. A hand held controller allows remote adjustment of both CO_2 and FIR lasers for convenient optimisation.

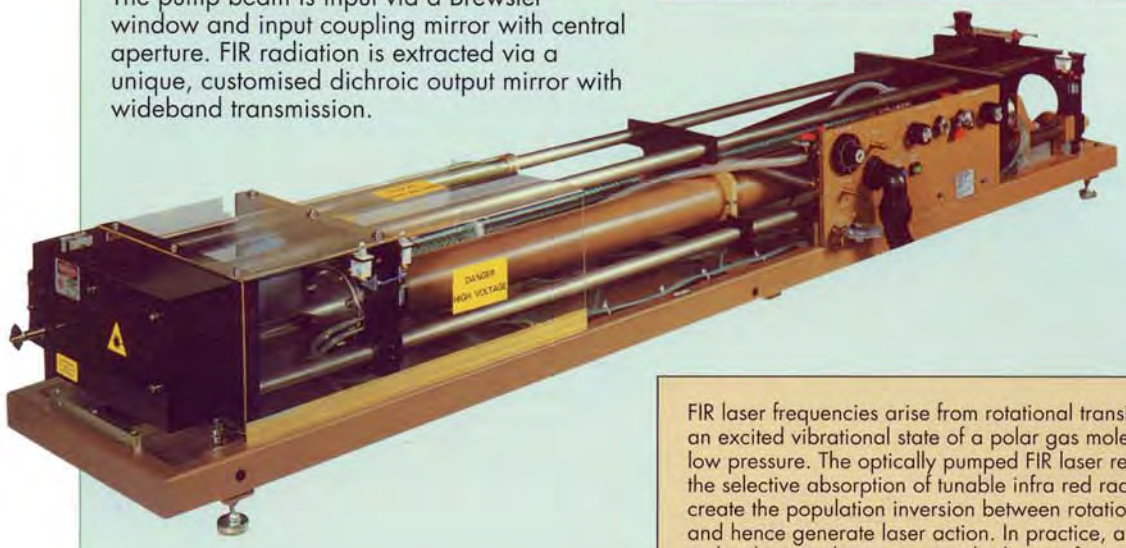
FIR power output at 118.8 microns is guaranteed at 150mW.

The FIRL100 system is supplied with a switch mode power supply and all the necessary vacuum coupling components, valves and metering for CO_2 and FIR gas handling. Appropriate vacuum pump options are available for both lasers to complete the system.

Both laser sections are water cooled, ideally with a closed cycle cooler such as the model TH4.

FIRL100 FAR INFRARED OUTPUT SPECIFICATION

λ (μm)	FIR MOLECULE	CO_2 PUMP LINE	POWER
96.5	CH_3OH	9R10	>60mW
118.8	CH_3OH	9P36	>150 mW
184.3	CH_2F_2	9R32	>150mW
432.6	HCOOH	9R20	>30mW
513.0	HCOOH	9R28	>10mW



FIR laser frequencies arise from rotational transitions in an excited vibrational state of a polar gas molecule at low pressure. The optically pumped FIR laser relies on the selective absorption of tunable infra red radiation to create the population inversion between rotational states and hence generate laser action. In practice, a few molecules are chosen to provide discrete frequencies across the entire FIR spectrum from 40 microns upwards.

Tables of FIR lines available on request from Edinburgh.

Laser Accessories

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.

Model 209 Optogalvanic Stabiliser - PL2-M, PL3, PL5 Lasers

In operation a small modulation voltage is applied to the piezo-electric cavity length tuner and the resulting effect on the discharge current is measured via a resistor in series with the discharge. This signal, which is produced by the optogalvanic effect, is detected via a phase sensitive detector to give a DC signal which is minimised using negative feedback to lock the laser to line centre.


ALS-1

Model ALS-1 Stabiliser - PL6, FIRL100, 295, 395 Lasers

The ALS-1 is a highly flexible lock-in amplifier and stabiliser system. It is designed to stabilise a laser in a number of different ways.

The model PL6 laser has an extremely flat PZT signature due to the long cavity length, and applied dither stabilisation techniques are therefore not suitable. With this laser the zero order beam from the diffraction grating is monitored with a thermopile detector. The DC signal from this detector is input to the ALS-1 and compared with a preset value to obtain an error signal. The pzt voltage is then automatically adjusted to bring the error signal to zero, effectively locking the laser output power.

With the FIRL100 or 295 FIR lasers, a small modulation voltage is applied to the piezo ceramic of the CO_2 laser and the resultant effect on the FIR output is monitored via a beam splitter and pyro electric detector. This signal is detected using phase sensitive detection and is used to lock the CO_2 pump laser output and hence the FIR output.

A range of stabilisation systems based on the ALS-1 is available for the 395 FIR Laser. These range from simple power stabilisation systems to a sophisticated IF locking system depending on requirements.

Closed Cycle Coolers

A range of thermocirculators is available for all Edinburgh Instruments lasers to provide closed cycle heat removal and active temperature regulation to 0.1°C.

Laser Pumping and Refilling Systems

Gas Handling Systems

All flowing gas laser systems are supplied with the necessary valves, gauges and vacuum couplings for simple connection to the system vacuum pump.

Model 198

An economical replenishing system for CO_2 lasers comprising a 2 stage rotary pump and molecular sieve trap to inhibit oil backstreaming, complete with Pirani vacuum gauge and all connections to the laser head.

Model 184T

Ultra High Vacuum system, frame mounted, for use with long life sealed CO (PL3) and CO_2 (PL3/PL2). The system comprises a rotary pump, foreline trap, turbo molecular pump, with capsule and inverted magnetron gauges, high vacuum valves, gas regulator and stainless steel flexible connectors.

RS295P/UHV295

The RS295P and UHV295 combine to provide a ultra high vacuum gas pumping and refilling system for use with the model 295 laser. The RS295P comprises a 2 stage rotary pump, foreline trap, Pirani sensor and meter, valves and coupling. The addition of the UHV295 which comprises an ion pump and supply, valves and connectors, enables the best vacuum to be achieved so utilising the optimum performance of the FIR laser in terms of operational time, number of FIR transitions and output power.

RS395P/UHV395

Specially configured for the 395 twin FIR laser, the system is similar to the above, but features a turbo molecular pump instead of the ion pump for increased UHV pumping capacity.

Gas Mixing Stations

Designed to allow mixing and metering of up to 5 component gases from independent gas cylinders. These comprise 5 inlet ports with individual flow meters or needle valves for gas mixing or gas flow operation.

Typical Laser Performance

Transition	Wavelength(µm)		mJ		W							
	9R	10R	MTL-3		PL2-M		PL3		PL5		PL6	
4	9.3673	10.3652	-	-	-	-	7	6	13	16	25	83
6	9.3544	10.3493	9	20	-	2.2	16	13	33	32	78	129
8	9.3418	10.3337	28	33	2.8	4.0	20	17	34	35	120	155
10	9.3294	10.3184	42	42	6.0	4.9	21	19	39	46	145	159
12	9.3173	10.3035	54	56	6.9	5.0	24	20	44	53	152	170
14	9.3054	10.2888	54	54	7.0	5.6	26	21	47	56	160	175
16	9.2938	10.2744	53	56	7.4	5.8	26	21	50	57	164	175
18	9.2824	10.2604	52	55	7.4	6.0	26	23	62	58	169	178
20	9.2714	10.2466	51	54	7.5	6.1	26	24	64	58	171	180
22	9.2605	10.2332	52	51	7.5	5.9	26	23	64	58	171	175
24	9.2499	10.2200	52	46	8.0	5.7	28	23	68	54	171	175
26	9.2396	10.2071	40	41	7.4	5.5	26	23	60	54	152	170
28	9.2295	10.1946	35	35	6.4	5.0	24	22	56	46	152	169
30	9.2197	10.1823	35	29	6.3	4.8	22	21	52	46	147	168
32	9.2101	10.1703	27	27	6.1	4.7	21	19	41	46	138	162
34	9.2007	10.1586	-	-	4.4	4.2	15	18	40	40	132	155
36	9.1916	10.1472	-	-	4.0	3.2	13	17	32	39	123	144
38	9.1827	10.1362	-	-	2.9	2.3	5	16	26	31	106	132
40	9.1741	10.1253	-	-	1.2	1.7	-	12	13	22	100	115
42	9.1656	10.1148	-	-	-	0.5	-	9	6	10	70	94
44	9.1575	10.1046	-	-	-	-	-	6	-	7	48	73
46	9.1495	10.0947	-	-	-	-	-	-	-	-	-	35
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-

Transition	Wavelength(µm)		mJ		W							
	9P	10P	MTL-3		PL2-M		PL3		PL5		PL6	
50	9.8355	10.9359	-	-	-	-	-	-	-	-	22	32
48	9.8145	10.9101	-	-	-	-	-	-	-	-	48	60
46	9.7937	10.8847	-	-	-	-	9	-	-	-	68	85
44	9.7734	10.8598	-	-	-	-	12	5	16	6	95	106
42	9.7533	10.8352	-	-	1.0	1.0	15	9	24	20	110	123
40	9.7335	10.8111	6	-	3.2	2.0	17	11	30	30	123	133
38	9.7140	10.7874	10	10	3.4	2.5	21	12	37	37	133	144
36	9.6948	10.7641	15	16	4.7	3.5	22	14	40	42	138	147
34	9.6759	10.7411	26	31	5.0	4.1	24	15	40	46	152	156
32	9.6574	10.7186	34	34	5.2	4.1	25	16	42	50	154	163
30	9.6392	10.6964	41	42	5.8	4.6	26	18	45	52	156	169
28	9.6212	10.6746	46	51	5.8	5.1	27	18	47	56	162	174
26	9.6036	10.6532	51	54	6.4	5.2	29	19	52	57	164	175
24	9.5862	10.6321	51	54	6.7	5.3	29	19	55	58	164	177
22	9.5692	10.6114	57	52	7.0	5.3	29	20	56	59	168	180
20	9.5524	10.5910	56	62	7.0	5.9	29	21	60	61	169	182
18	9.5360	10.5710	54	60	6.6	5.6	28	20	59	56	168	180
16	9.5198	10.5514	54	54	6.6	5.4	28	20	58	53	157	177
14	9.5039	10.5321	48	55	6.4	5.2	27	20	56	51	152	174
12	9.4884	10.5131	46	50	6.0	4.7	28	19	50	48	152	170
10	9.4731	10.4945	48	45	5.5	4.4	26	16	42	40	138	160
8	9.4581	10.4762	25	34	3.9	3.5	22	15	16	30	118	138
6	9.4433	10.4582	-	17	-	1.3	13	11	10	25	69	110
4	9.4289	10.4406	-	-	-	-	-	-	-	-	-	42

Laser Specifications

	CO2 (9.1 - 10.9µm)					CO (5.2 - 6µm)
	PL2-M	PL3	PL5	PL5-S	PL6	PL3
Output Power (W) - flowing	-	30	50	50	180	-
Output Power (W) - sealed	10	10	-	30	-	1
Number of Lines	60	80	80		90	60
M^2	1.25	1.35	1.25		1.5	N/A
Beam Divergence - $1/e^2$ (mR)	<6.5	3.5	3.5		3.5	2.6
Beam Diameter - $1/e^2$ (mm)	4.8	7.5	7.5		11	5.0
Polarisation	Vertical	Horizontal	Vertical		Vertical	Horizontal
Amplitude Stability	<±1%	<±1%	<±1%		±2%	±1%
Frequency Stability (kHz/sec)	200	30	500	500 (300 sealed)	500	30
Frequency Stability (MHz/10 min) (actively stabilised)	1	±1	±1	±2	N/A	N/A
Tuning Mechanism	Piezo-ceramic cavity length tuner and diffraction grating wavelength selection					
Cavity Length (cm)	73	178	183		388	178
Dimensions (cm) L	103	221	220	203	220	221
W	12	52	22	19	45	52
H	13	37	22	17	32	37
Weight (kg)	18	100	36	48	125	100
Gas Requirements	Sealed/ user replenishible	Sealed/ user replenishible	1.2 lit/min (flowing gas)		9 lit/min	Sealed/ user replenishible

Units Comparison					
Wavelength (λ)	µm	1	10^1	10^2	10^3
	cm	10^{-4}	10^{-3}	10^{-2}	10^{-1}
Wavenumber ($v = 1/\lambda$)	cm^{-1}	10^4	10^3	10^2	10^1
Frequency (v)	Hz	3×10^{14}	3×10^{13}	3×10^{12}	3×10^{11}
Photon Energy (hv)	eV	1.24	1.24×10^{-1}	1.24×10^{-2}	1.24×10^{-3}
Circular Frequency ($w = 2\pi v$)	rad/sec	1.89×10^{15}	1.89×10^{14}	1.89×10^{13}	1.89×10^{12}

Scientific Research Applications

• **Spectroscopy**	- molecular spectroscopy - solid state spectroscopy - magneto-optics
• **Non Linear Optics**	- frequency mixing - optical bistability - non-linear absorption and dispersion
• **Heterodyne/Homodyne Radar and Detection**	- metrology - radio modelling facility - imaging
• **Interferometry**	
• **Atmospheric Studies**	- pollution monitoring - trace gas sensing - atmospheric propagation - turbulance measurements - tracking and ranging
• **Plasma Diagnostics**	- plasma scattering and reflectance measurements - Faraday rotation and plasma density measurements
• **Laser Studies**	- diagnostic probe - optical pumping - alignment and testing

Safety

All Edinburgh Instruments lasers are designed to comply with the US Bureau of Radiological Health Regulations and carry appropriate danger and classification labels.

Distributor

Development

Edinburgh Instruments have a policy of continuing product development and reserve the right to amend specifications without prior notice.

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