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## EPL-VISIBLE Picosecond Pulsed Diode Laser User Guide



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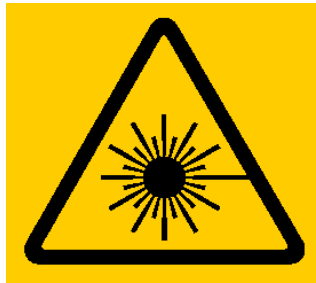
*The product described in this manual is subject to continuous development and, while every effort has been taken to make sure that the information given is correct, Edinburgh Instruments Limited cannot accept any liability for errors and omissions or their consequences.*

# 1. Laser Safety

The laser radiation emitted by the EPL-Series picosecond pulsed diode laser is hazardous. The user must obey the following safety instructions:

**Warning !**

Never look directly into the laser beam, avoid direct exposure and exposure through reflections.



1. This product is classified as a Class 3B Laser product (IEC 60825-1:2014)



2. The radiation emitted by this laser is collimated (laser beam) and may be invisible. The maximum average optical power is 5 mW.
3. Laser radiation is emitted whenever the red LED **LASER ON** is lit. The laser output aperture and the direction of the laser beam are indicated by the "Laser Aperture" sign and the arrow, respectively.
4. . Mount the laser into an optical setup in such a way that the laser radiation emitted can not cause any hazard. Provide appropriate beam stops.
5. The laser can be remote interlocked. Follow the instructions given in section 3. Installation for connections.

## 2. Introduction

The EPL-Series picosecond pulsed diode laser is an ideal light source for fluorescence lifetime measurements. The radiation emitted by the laser has the following characteristics:

- high peak power (up to 500 mW)
- narrow pulse width (down to 50 ps)
- absence of long background tails
- variable pulse repetition frequency (stepwise up to 20 MHz)

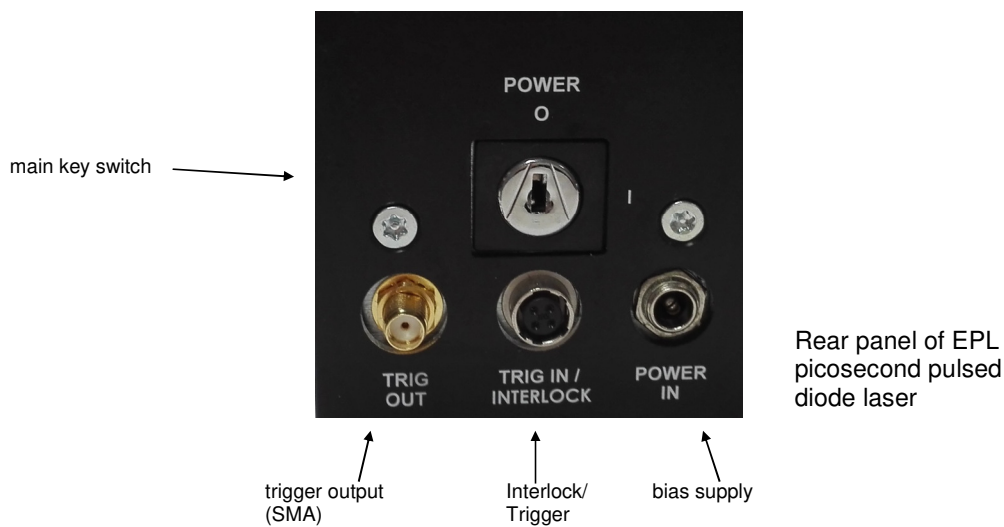
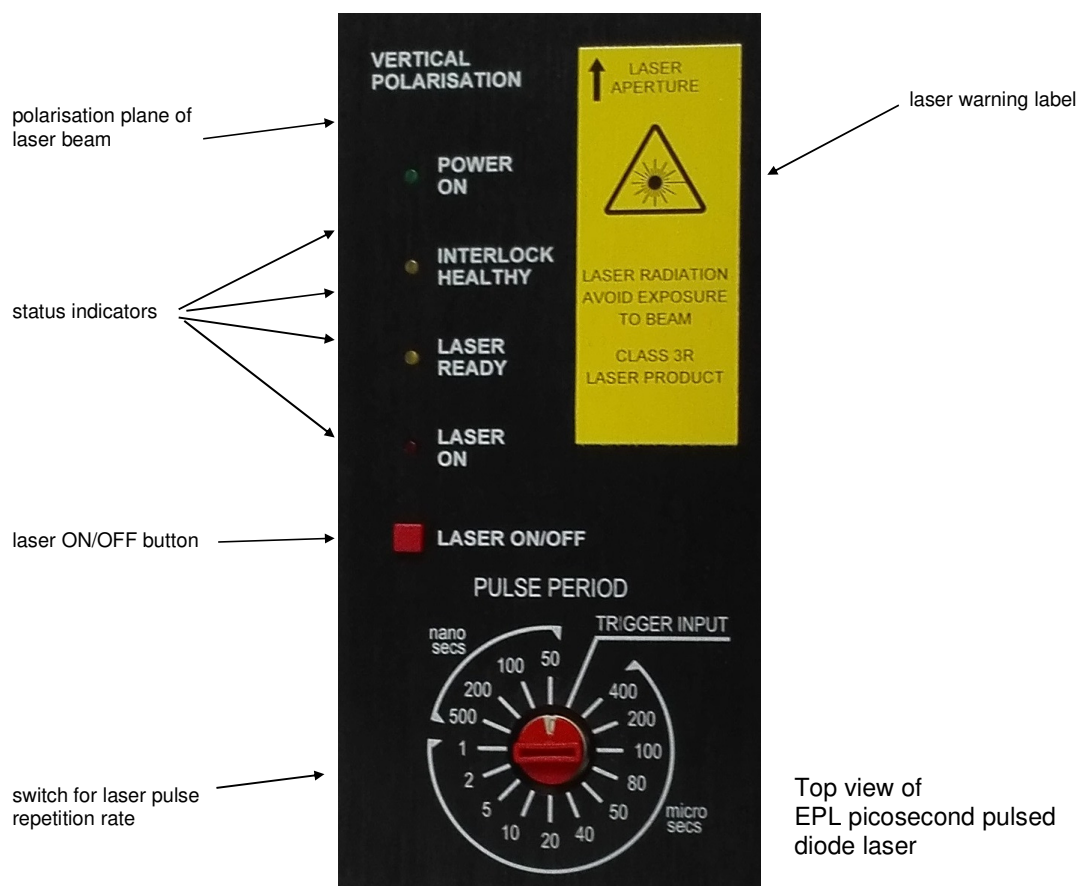
There are currently fourteen laser wavelengths available:

Model	Wavelength	Line width
EPL-375	375 nm $\pm$ 5 nm	1.5 nm $\pm$ 0.5 nm
EPL-405	405 nm $\pm$ 5 nm	2.0 nm $\pm$ 0.5 nm
EPL-445	445 nm $\pm$ 8 nm	3.0 nm $\pm$ 1.0 nm
EPL-450	450 nm $\pm$ 10nm	7.0 nm $\pm$ 1.0 nm
EPL-475	475 nm $\pm$ 10 nm	4.5 nm $\pm$ 1.0 nm
EPL-485	485 nm $\pm$ 10 nm	7.0 nm $\pm$ 4.0 nm
EPL-510	510 nm $\pm$ 5 nm	5.0 nm $\pm$ 0.5 nm
EPL-635	635 nm $\pm$ 5 nm	2.5 nm $\pm$ 0.5 nm
EPL-640	641 nm $\pm$ 5 nm	2.5 nm $\pm$ 0.5 nm
EPL-655	655 nm $\pm$ 5 nm	2.5 nm $\pm$ 0.5 nm
EPL-670	670 nm $\pm$ 5 nm	2.5 nm $\pm$ 0.5 nm
EPL-785	785 nm $\pm$ 5 nm	4.0 nm $\pm$ 3.0 nm
EPL-800	800 nm $\pm$ 5 nm	6.0 nm $\pm$ 3.0 nm
EPL-980	975 nm $\pm$ 10 nm	5.0 nm $\pm$ 3.0 nm

The major design features of the EPL diode laser are:

- compact design
- easy to operate
- mechanical/optical design and operation modes matched to Edinburgh Instruments lifetime spectrometers
- collimated laser beam
- spectrally conditioned laser beam
- simple exchange polarisation planes
- compact mechanical shutter to comply with Class 3B regulation





## **Indicators**

### **POWER ON**

Green indicator that illuminates when the power is connected to the unit and the main key switch is turned to the **ON** position.

### **INTERLOCK HEALTHY**

There are two modes of indication :-

#### **Normal Power On Operation**

Yellow indicator that illuminates when the **POWER ON** condition is active and the external **INTERLOCK** loop is closed.

#### **Low Power Operation**

Yellow indicator flashes, in a sequence, with the yellow **LASER READY** and the red **LASER ON** indicator to show that the unit is in a special low power operation so that the laser beam can be set up.

### **LASER READY**

There are three modes of indication :-

#### **Normal Power On Operation**

Yellow indicator flashes when the laser is still in the process of stabilizing but is sufficiently stable to allow laser operation. Measurement is not recommended whilst in this mode.

Yellow indicator illuminated continuously denotes that the laser temperature control is stable and the laser is ready to operate in measurement conditions.

#### **Low Power Operation**

Yellow indicator flashes, in a sequence, with the yellow **INTERLOCK HEALTHY** and the red **LASER ON** indicator to show that the unit is in a special low power operation so that the laser beam can be set up.

#### **External Trigger Selected**

The **LASER READY** indicator works normally until the **LASER ON/OFF** Switch is pressed with the **INTERLOCK HEALTHY** on. Then the **LASER READY** indicates if an external trigger has occurred in the last four seconds. The yellow **LASER READY** flashes every four seconds to indicate that the unit is waiting for an external trigger, if a trigger is present the indicator will go on continuously.

### **LASER ON**

There are three modes of indication :-

#### **Normal Power On Operation**

Red indicator that illuminates when laser radiation is emitted. Laser radiation is emitted when **POWER ON**, **INTERLOCK HEALTHY**, **LASER READY** are active and the **LASER ON/OFF** button has been pushed.

#### **Low Power Operation**

Red indicator flashes, in a sequence, with the yellow **INTERLOCK HEALTHY** and the yellow **LASER READY** indicator to show that the unit is in a special low power operation so that the laser beam can be set up.

#### **External Trigger Selected**

The **LASER ON** indicator works normally until the **LASER ON/OFF** Switch is pressed with the **INTERLOCK HEALTHY** on. Then the **LASER ON** flashes every external trigger until the frequency of the triggers makes the indicator look on continuously.

## **Controls and Connectors**

### **LASER ON/OFF**

(See Appendix A for full state diagram of this operation)

#### **INTERLOCK HEALTHY**

Push button switch that enables the operation of the laser provided the laser temperature control has stabilised.

#### **INTERLOCK NOT HEALTHY**

Push button switch that enables the special low power operation.

### **PULSE PERIOD**

Rotary switch that permits the laser pulse period (pulse repetition frequency) to be adjusted. Adjustable in 10 discrete steps between 50  $\mu$ s and 50 ns.

### **POWER ON**

Key switch that controls the laser supply voltage. The key can be removed when the switch is in the **OFF** position.

### **TRIGGER OUTPUT**

Low jitter trigger output (NIM standard). The trigger is active when the laser is **ON**.

### **TRIGGER INPUT**

Hirose connector that can be used to externally trigger the laser. To enable the external trigger operation the **TRIGGER INPUT** has to be selected on the **PULSE PERIOD** rotary switch. The trigger signal can be connected to the Hirose pin3 (ground) and pin4 (TTL signal). The input trigger should not be faster than 5MHz.

### **INTERLOCK**

Hirose connector that can be used to externally interlock the laser. Laser operation is interrupted when the connection between pin 1 and 2 is broken. When this has happened both the **INTERLOCK** and the **LASER ON** light goes **OFF**. If the connection between pin 1 and pin 2 is reconnected the laser starts to operate again and the **INTERLOCK** and **LASER ON** indicators will go **ON**.

When the **INTERLOCK** is off it is possible to put the unit into a low power operation mode by the user switching the **LASER ON/OFF** switch. In this mode, if the **INTERLOCK** comes on the unit will operated normally. If in the low power operation mode and the **LASER ON/OFF** switch is pressed the Laser will be in the off state and the Laser will not come on when **INTERLOCK** comes on.

### **MECHANICAL SHUTTER**

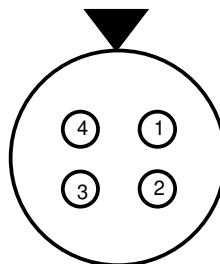
A mechanical shutter is provided at the laser aperture to block the laser output. Laser output radiation is blocked when the shutter is in the closed position, refer to shutter operation diagrams in the laser safety section page 3.

### **POWER INPUT**

A 2.1 mm DC jack socket to connect power to the laser. The input voltage requirement is 15-18 V DC, 15 W.

### **Connector Hirose**

Back of HR10-7P-4P(73) connector  
 Pin 1:- INTERLOCK Signal  
 Pin 2:- INTERLOCK Ground  
 Pin 3:- TRIG IN Ground  
 Pin 4:- TRIG IN Signal



### 3. Installation

Install the EPL laser in a place suitable for operation of lasers. The EPL laser is intended for laboratory use, if the unit has been stored in an environment outside EPL operational temperature please allow one hour for the unit to reach laboratory temperature before powering the unit. This is especially important when unpacking the EPL unit after shipping by Air Freight.

The laser can be mounted on a post that is standard in optical laboratories (M6 tapped holes provided) or inserted into an aperture hole ( $\varnothing 30$ ). If the laser is fitted to one of the Edinburgh Instruments spectrometers proper laser mounts are supplied for this purpose.

Before applying power ensure the laser beam presents no hazard, e.g. by direct exposure, reflection, or strong scattering.

To meet the laser safety regulations the laser needs to be remote interlocked, e.g. by a door switch or to a suitable cover to the radiation path. Use a cable that is connected to the **INTERLOCK** input connector of the laser head. The interlock is healthy if pin 1 of the connector is shortened to pin 2. A breakage of this link will cause an interlock failure.

Connect the **TRIGGER** output to the trigger input of the external data acquisition facility. The trigger signal (50  $\Omega$ , negative, approx. 370 mV) will fire on the emission of the laser pulse.

For **Externally Triggered Operation** connect LVTTTL triggering source via Hirose connector to the trigger input on the EPLED unit and select the trigger input activated position on the pulse period rotary switch.

Connect the bias supply to the **POWER** input of the laser.

## 4. Operation

### 1. Use the key to power up the laser.

When the key is switched to the **ON** position the green **POWER ON** indicator light will light up and – provided the interlock is not interrupted – the **INTERLOCK HEALTHY** indicator will also come on.

At this point the cooler will start operating. It takes approximately 15 sec before the laser temperature has settled to allow laser operation, indicated by the third indicator light **LASER READY** flashing. Measurement is not recommended while the third indicator is still flashing, this function has been added to expedite experimental set-up prior to measurement.

A further 65-110 seconds is required before total stabilization is achieved at the optimum operating temperature. This is indicated by the third indicator light **LASER READY** being illuminated continuously. At this point the laser is then ready for full operation under measurement conditions.

### 2. Set the desired pulse repetition period.

Ideally the laser pulse repetition rate is matched to the full time window of the measurement. For example, if a measurement window of 200 ns has been chosen the laser pulse period is set to 200 ns. For measurements in short time windows (50 ns and below) the pulse repetition period of 50 ns should be selected.

### 3. Start the laser operation by pushing the “LASER ON/OFF” button.

The laser is now operating, indicated by the red **LASER ON** indicator light.

Trigger pulses are sent to the trigger output connector only for the duration of the lasing operation.

### 4. The laser operation will be stopped by either pushing the “LASER ON/OFF” button again, or by an Interlock failure.

If the laser operation was stopped by an interlock failure, the cause for the failure needs to be rectified before the laser can be restarted. If the “LASER ON/OFF” button has already been pressed so that the laser is ON, then the laser will come ON automatically once the Interlock failure is rectified.

**Note:** The useful operational life of the EPL product can be extended by not leaving the laser in the “On” state unnecessarily for long periods. This is especially important at higher repetition rates (short pulse periods).

## 5. Maintenance

The EPL UV Series does not require any special maintenance as long as the EPL lasers are operated and stored under specified laboratory conditions.

There are no user serviceable parts on the EPL lasers. Any attempt to open the laser heads will void warranty and will most likely result either in destruction of the laser or will cause detrimental effects to the laser.

Edinburgh instruments offers a laser refurbishment service please contact EI laser service for details.

## 6. Technical Specification

		EPL-405	EPL-445	EPL-450	EPL-475	EPL-485	EPL-510	EPL-635	EPL-640	EPL-655	EPL-670
Nominal Wavelength	[nm]	405	445	450	475	485	510	635	640	655	672
Wavelength Range	[nm]	400-410	438-448	440-455	465-480	475-490	505-515	630-640	630-650	650-660	665-675
Linewidth	[nm]	<2.0	<3.0	<7.0	<4.5	<7.0	<5.0	<2.5	<2.5	<2.5	<2.5
Max. Pulse Width @ 10 MHz	[ps]	75	95	100	90	120	90	85	100	85	80
Typical Pulse Width @10Mhz	[ps]	55	85	90	80	100	85	65	85	65	55
Typical Average Power @ 20Mhz	[mW]	0.11	0.150	0.18	0.15	0.10	0.13	0.07	0.25	0.15	0.15
Min. Average Power @ 20MHz	[mW]	0.08	0.100	0.10	0.10	0.06	0.1	0.04	0.15	0.12	0.10
Typical Peak Power @ 10MHz	[mW]	110	50	50	80	35	80	30	155	120	130
Min. Peak Power @ 10MHz	[mW]	80	35	25	65	20	60	25	110	80	75
Pulse Repetition Frequencies		MHz: 20, 10, 5, 2 kHz: 1000, 500, 200, 100, 50, 25, 20, 12.5, 10, 5, 2.5									
Pulse Period		ns: 50, 100, 200, 500 µs: 1, 2, 5, 10, 20, 40, 50, 80, 100, 200, 400									
Bias Supply		15-18 V dc, 15 W (2.1 mm DC jack)									
Trigger Output		SMA, NIM Standard									
Interlock Input		Hirose HR10-7P-4P(73), (short circuit pin1 and pin2 interlock healthy)									
Trigger Input		Hirose HR10-7P-4P(73), (signal pin4 and pin3 ground) LVTTTL, signal < 5MHz									
Trigger Input Signal		LVTTTL > 50 ns pulse. Trigger on rising edge. 0.0V < Low level < 0.5V. 2.5V < High level < 3.3V									
Key Switch		YES									
Cooling		YES, actively controlled									
Beam Quality		Standard Lasers									
Near Field Dimensions		≤4.75 mm (fast axis), ≤1.75 mm (slow axis)									
Divergence		≤1.5 mrad (fast axis), ≤0.75 mrad (slow axis)									
Spectral Conditioning		by interference filter									
Operating Temperature		18 Celsius to 25 Celsius									
Storage Temperature		0 Celsius to 40 Celsius									
Operational Lifetime		> 5 * 10 <sup>12</sup> Pulses to 50% of specified output power									
Physical Dimensions		overall: 168 mm length x 64 mm x 64 mm collimator tube: Ø30 mm x 38 mm									
Tapped Holes for Stud Mount		2 off M6									
Weight		800 g									
Mains adapter supplied:		Universal mains plugs, Universal mains input: 90-260 V									

## 7. Warranty

- 1 a) The Company guarantees the equipment forming the subject of the contract/quotation against defective materials and workmanship for a period of one year from the date of delivery to the Purchaser.  
b) In the case of sub-assemblies of equipment not manufactured by the Company, but incorporated in the equipment ordered, the Purchaser will be entitled only to the benefit and/or limitations of any guarantee given by the makers of such assemblies.  
c) In no event shall the Company be liable for any consequential loss or damage arising from failure of the equipment under warranty.  
d) At the end of the one year period referred to herein, all claims upon all liability of the Company shall be absolutely at an end.
- 2 a) The Company also warrants that the equipment conforms to specifications contained in current brochures or to extra specifications confirmed in writing at the time of order acknowledgement.  
b) No warranty is made or implied as to the suitability of any equipment for the Purchaser's intended use beyond such performance specifications as form part of the contract.
3. The purchaser warrants:  
a) That he will carefully examine and list all parts of the equipment supplied by the Company and notify the Company in writing of any shortage, defect or failure to comply with the contract, which is or ought to be apparent upon such examination and test, within 48 hours of the equipment being delivered to or collected by the Purchaser.  
b) The equipment will be operated in accordance with the instructions and advice detailed in the appropriate operating instructions manual, or any other instructions which may be provided by the Company. The Company shall not be held responsible for any defect arising from the Purchaser's failure to comply with these recommendations and instructions or from damage arising from negligence or exposure to adverse environmental conditions.
4. The warranty is effective when:  
a) Any defects in the equipment supplied are notified immediately by the Purchaser to the Company.  
b) The equipment is returned to the Company at its Edinburgh premises, transportation and insurance prepaid, and undamaged by the failure to provide sufficient packaging.  
c) The Purchaser has made payment in full for the contract in accordance with the Company's normal trading terms, i.e. 30 days from date of invoice.
5. The warranty covers:  
a) Engineer's time costs during inspection and repair.  
b) Any materials or components, which require to be replaced.  
c) Return carriage costs to the Purchaser
6. However, if the Purchaser requests a service engineer to carry out the necessary inspection and repair of the equipment covered by the warranty on site, the Purchaser will be liable, at the Company's discretion, for:  
a) Engineer's travelling time costs.  
b) Engineer's travelling and accommodation expenses.

The timing of the inspection and repair of the equipment will be determined entirely at the discretion of the Company.

## 8. Declaration of Conformity

CE

Manufactured by:     Edinburgh Instruments Ltd.  
                              2 Bain Square  
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                              EH54 7DQ  
                              Tel.: + 44 1506 425 300  
                              Fax.: + 44 1506 425 320

The EPL Series of Pulsed Diode Laser units have been CE marked to indicate compliance with all essential requirements of the Directives referenced.

The EPL Series of Pulsed Diode Lasers are intended for use in commercial and light industrial environments and the following standards have therefore been applied:

BS EN 61000-6-1:2007	EMC immunity for residential, commercial and light-industrial environments
BS EN 61000-6-3+A1:2011	EMC emission standard for residential, commercial and light-industrial environments
BS EN 61010-1:2010	Safety requirements for electrical equipment for measurement, control and laboratory use
BS EN 60825-1:2014	Safety of laser products. Equipment classification and requirements

## 9. Document History

ISSUE	DATE	ECN
1	January 2007	Original
2	December 2009	
3	January 2009	
4	June 2013	
5	November 2013	
6	July 2015	
7	August 2015	
10	March 2017	Universal Board Specification
11	January 2018	7612: New Firmware operation for interlock
12	November 2021	Spec Update : CS

## 10. Appendix A

State Diagram of Interlock and ON/OFF operations.

