

MADEinUSA

IRADiON

Ceramic Core CO₂ Lasers

OPERATOR'S MANUAL

Eternity Series
CO₂ Lasers: Models E25, E30 and E40



92-30xx Rev. 3



www.iradion.com

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1. Hazard Information

Hazard information includes terms, symbols, and instructions used in this manual, or on the equipment, to alert both operating and service personnel to the recommended precautions in the care, use, and handling of Class 4 laser equipment.

Certain terms are used throughout the manual or on the equipment labels. Please familiarize yourself with their definitions and significance.



Danger

Imminent hazards which, if not avoided, will result in death or serious injury.



Warning

Potential hazards which, if not avoided, could result in death or serious injury.



Caution

Potential hazards or unsafe practices which, if not avoided, may result in minor or moderate injury.

2. General Hazards



Danger – Serious Personal Injury

This Class 4 laser product emits invisible infrared laser radiation at a wavelength of 10.6 μm, 10.2 μm, or 9.3 μm.

Do not allow laser radiation to enter the eye by viewing direct or reflected laser energy. CO₂ laser radiation can be reflected from metallic objects even though the surface is darkened. Direct or diffuse laser radiation can inflict severe corneal injuries leading to permanent eye damage or blindness. All personnel must wear eye protection suitable for CO₂ radiation when in the same area as an exposed laser beam. Eyewear protects against scattered energy but is not intended to protect against direct viewing of the beam. Never look directly into the laser output aperture or view scattered laser reflections from metallic surfaces.

Enclose the beam path whenever possible. Exposure to direct or diffuse CO₂ laser radiation can seriously burn human or animal tissue, which may cause permanent damage.

This product is not intended for use in explosive, or potentially explosive, atmospheres.



Warning – Serious Personal Injury

U.S. customers should refer to and follow the laser safety precaution described in the American Nation Standards Institute (ANSI) Z136.1-2007 document, Safe Use of Lasers. Procedures listed in this Standard include the appointment of a Laser Safety Officer (LSO), operation of the product in an area of limited access by trained personnel, servicing of equipment only by trained and authorized personnel, and posting of signs warning of the potential hazards.

European customers should appoint a Laser Safety Officer (LSO) who should refer to and follow the laser safety precautions described in EN60825.1-2007, Safety of Laser Products.



Warning – Serious Personal Injury

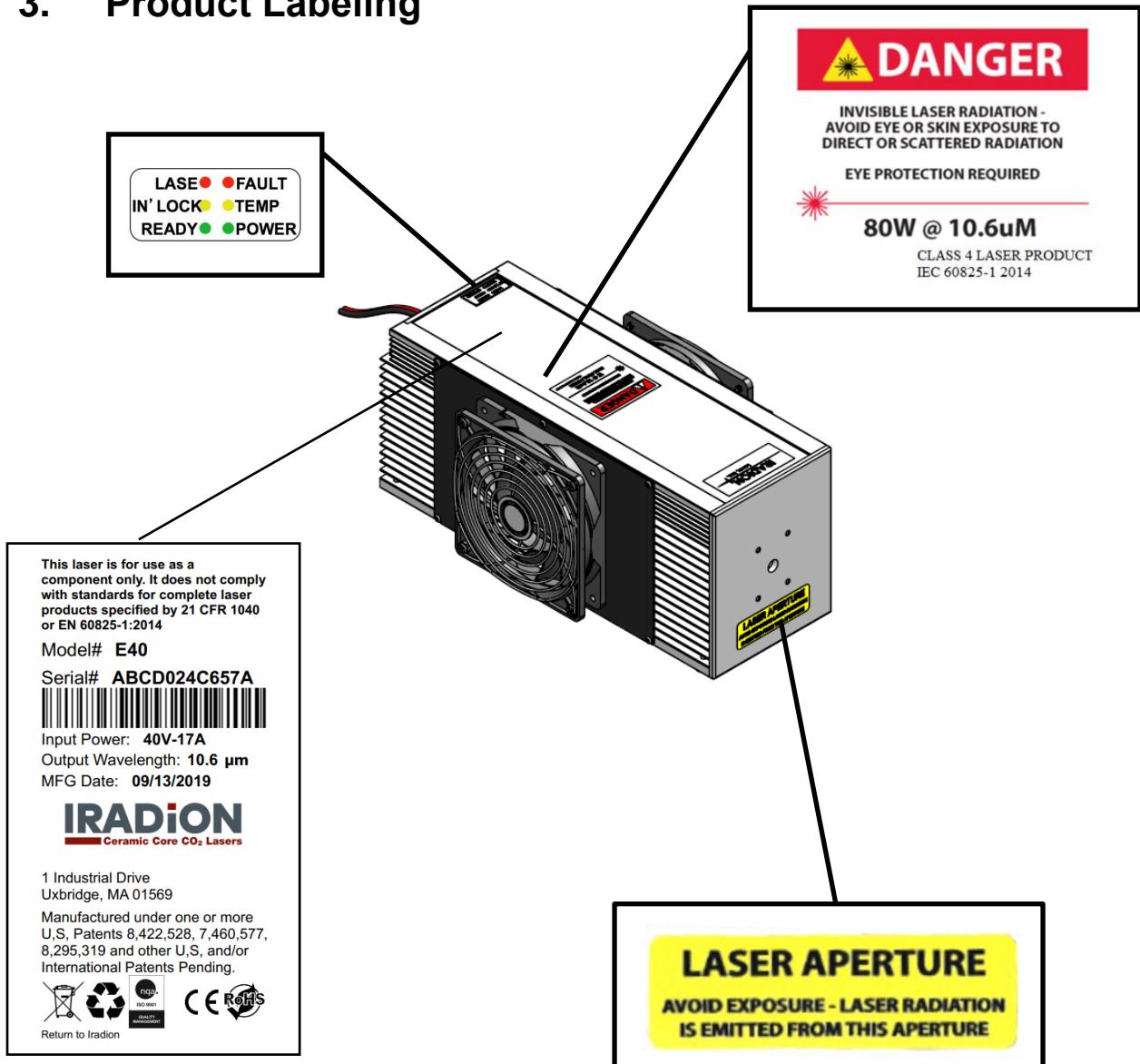
Materials processed with a laser can generate air contaminates such as vapors, fumes, and/or particles that may be noxious, toxic, or even fatal. Material Safety Data Sheets (MSDS) for materials being processed should be thoroughly evaluated and the adequacy of provisions for fume extraction, filtering, and venting should be carefully considered. Review the following reference for further information: ANSI Z136.1-2007, Safe Use of Lasers.



Warning – Serious Personal Injury

The use of controls or adjustments, or performance of procedures other than those specified herein, may result in hazardous radiation exposure.

3. Product Labeling



4. Laser Safety

To prevent exposure to direct or scattered laser radiation, follow all safety precautions specified throughout this manual and exercise safe operating practices per ANSI Z136.1-2007 at all times when actively lasing.

Always wear approved Laser Safety Glasses with a minimum OD (Optical Density) of 6+ for a wavelength of 10.6 μm (10600 nm).

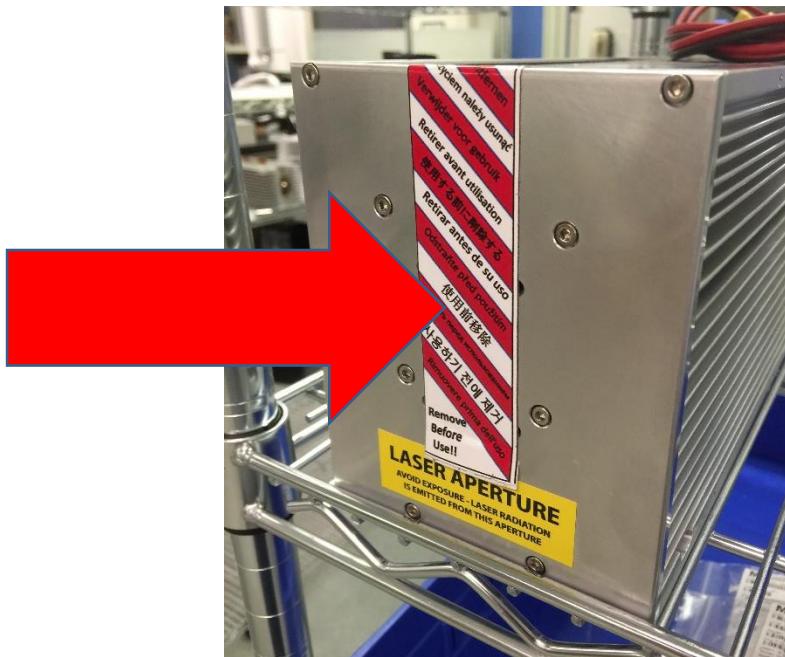
A CO₂ laser is capable of igniting most materials under the proper conditions. Never operate the laser in the presence of flammable or explosive materials, gases, liquids, or vapors.

5. Other Hazards

The following hazards are typical for this product family when incorporated for intended use: (A) risk of injury when lifting or moving the unit; (B) risk of exposure to hazardous laser energy through unauthorized removal of access panels, doors, or protective barriers; (C) risk of exposure to hazardous laser energy and injury due to failure of personnel to use proper eye protection and/or failure to adhere to applicable laser safety procedures; (D) risk of exposure to hazardous or lethal voltages through unauthorized removal of covers, doors, or access panels; (E) risk of exposure and/or interference from radio-frequency (RF) electro-magnetic energy through unauthorized removal of covers, doors, or access panels; (F) generation of hazardous air contaminants that may be noxious, toxic, or even fatal.

****NOTICE****

Iradion Lasers are shipped with a protective tape covering over the laser's aperture. THIS MUST BE REMOVED BEFORE USE. If not, when the laser is fired, smoke and debris can damage the laser's output window. THIS WILL VOID THE WARRANTY.



6. Declarations

Declaration of Conformity

In accordance with ISO / IEC 17050-2:2004

We,

Manufacturers Name: Iradion Laser, Inc.
Manufacturers Address: One Technology Drive
Uxbridge, MA 01569
USA

Hereby declare under our sole responsibility that the following equipment:

Product Name: E-Series

Model Number: E25, E30 and E40

Conforms to the following Directive(s) and Standard(s):

Applicable Standard(s):

IEC 60825-1, 3 rd Ed., 2014	Safety of Laser Products
EN 55011:2009/A1:2010	Group 2 Class A ISM emissions requirements (EU)
EN 61000-6-4:2007	Emissions requirements for heavy industrial environments - Generic
EN 61000-6-2:2005	Immunity for heavy industrial environments - Generic

Serial Number Range:

Starting at serial number 2190 (Decimal)

Corporate Officer:

A handwritten signature in black ink, appearing to read "Ph. Brak".

Declaration of Conformity

The European Union has established requirements for Restriction of Hazardous Substances (RoHS) in all Electrical and Electronic Equipment (EEE). On 4 June 2015, the EU commission has published a new Directive (EU) 2015/863 to amend Annex II to EU RoHS 2 (Directive 2011/65/EU) to add the following 4 phthalates onto the list of restricted substances.

- Bis(2-Ethylhexyl) phthalate (DEHP): max 0.1%;
- Benzyl butyl phthalate (BBP): max 0.1%;
- Dibutyl phthalate (DBP): max 0.1%;
- Diisobutyl phthalate (DIBP): max 0.1%.

We,

Manufacturers Name: Iradion Laser, Inc.
Manufacturers Address: One Technology Drive
Uxbridge, MA 01569 USA

Certify that to its knowledge that the products listed below conform to the requirements of the European Union's Restriction on Use of Hazardous Substances in EEE RoHS II Directive (EU) 2015/863 to amend Annex II to EU RoHS 2 (Directive 2011/65/EU) which may or may not include exemption in the directive.

Product Name: E-Series Model Number: E25, E30 and E40

To comply with RoHS II, all CE marked products require a Declaration of Conformity (DoC) and that a technical file be made available upon request. For finished EEE where Iradion Laser, Inc. is the legal manufacturer, Iradion will provide the CoC and the technical documentation. Iradion will make available part-specific Certificates of Compliance demonstrating compliance to the banned substances of RoHS II.

10 hazardous substances will now be restricted in EEE under EU RoHS 2.

- Cadmium(Cd): 0.01%
- Mercury: 0.1%
- Lead(Pb) : 0.1%
- Hexavalent chromium (Cr6+) : 0.1%
- Polybrominated biphenyls (PBB): 0.1 %;
- Polybrominated diphenyl ethers (PBDE): 0.1 %
- Bis(2-Ethylhexyl) phthalate (DEHP): 0.1% (added in 2015);
- Benzyl butyl phthalate (BBP): 0.1% (added in 2015);
- Dibutyl phthalate (DBP): 0.1% (added in 2015);
- Diisobutyl phthalate (DIBP): 0.1% (added in 2015)

Based on our own internal analyses, vendor supplied analyses, and/or material certifications of the raw materials used in the manufacture of Iradion Laser, Inc. We declare the products listed above, starting at serial number 8000 (decimal), comply with and conform to RoHS regulations.

Corporate Officer:



Ph. Brink

7. Introduction

This guide provides the basic information needed to operate an Iradion Laser. This laser is designed for use while integrated within a system and is **not designed to meet CDRH requirements as a stand-alone product**. As such, the user must be aware of certain requirements before use.

8. CDRH

This is an OEM laser component that has been designed for integration into a functioning laser system. As a stand-alone device, it cannot be turned on and therefore does not incorporate all of the safety features required by the Center for Devices and Radiological Health (CDRH). Provisions for the incorporation of these safety features are available, and it is expected that the user will apply them and fully comply with all CDRH requirements.

9. Available Safety Features

The following safety features are available as electronic signals on the rear panel interface:

<i>Interlock</i>	<i>Upon contact closure, allows the system to operate. An open connection will prohibit the laser from firing.</i>
<i>Lase Signal</i>	<i>Output signal indicating the laser is firing.</i>
<i>Fault Signal</i>	<i>Output signal indicating the malfunction of an internal component or the electronics.</i>
<i>Indicator Lights</i>	<i>DC Power, Temp Warning, Interlock, Fault, Ready, Laser On.</i>

10. System Overview

Iradion Eternity CO₂ lasers are rated from 20 to 40 Watts and include an integrated radio frequency power amplifier (RFPA) and cooling provisions in one package. The connector in the rear provides the interface to the control signals, power, and returns fault signals. Connector pins and associated electronics are protected against static ESD damage. Direct current (DC) power is to be applied to the one meter long power cord.



Caution

There are no user-serviceable parts under the cover. The radio frequency (RF) cover can only be removed according to factory procedure; otherwise, damage could occur. The RF cover edges are RF sealed to the top heat sink, which makes it very difficult to slide off the cover. The laser may not operate properly without the cover in place. There are dangerous RF voltages under the cover that will cause serious RF burns to the skin if touched.



Caution

The output aperture comes covered with an adhesive tape dust cover. Remove this tape before applying DC power. Firing the laser through the tape will cause permanent damage to the lens.

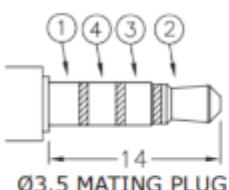
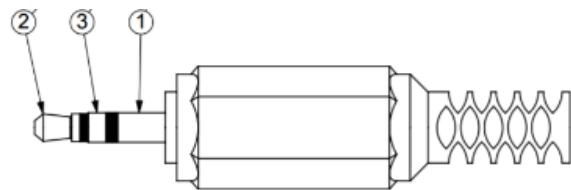
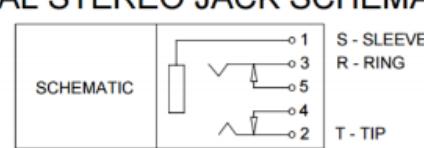
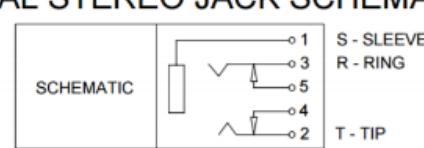
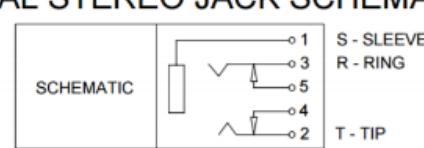
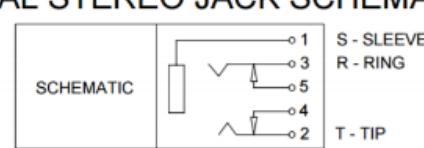
11. Quick Start Connection Guide

The D-Sub 9 connector contains all the available connections for laser operation.
The 3.5 mm Stereo Jack connector can be used for serial communications.

1. Power Cable, All Lasers

Designation	Pin	Description	Comment
Black	-	Power Ground	12 gauge wire to power supply Ground
Red	-	Power VDC positive connection	12 gauge wire to power supply

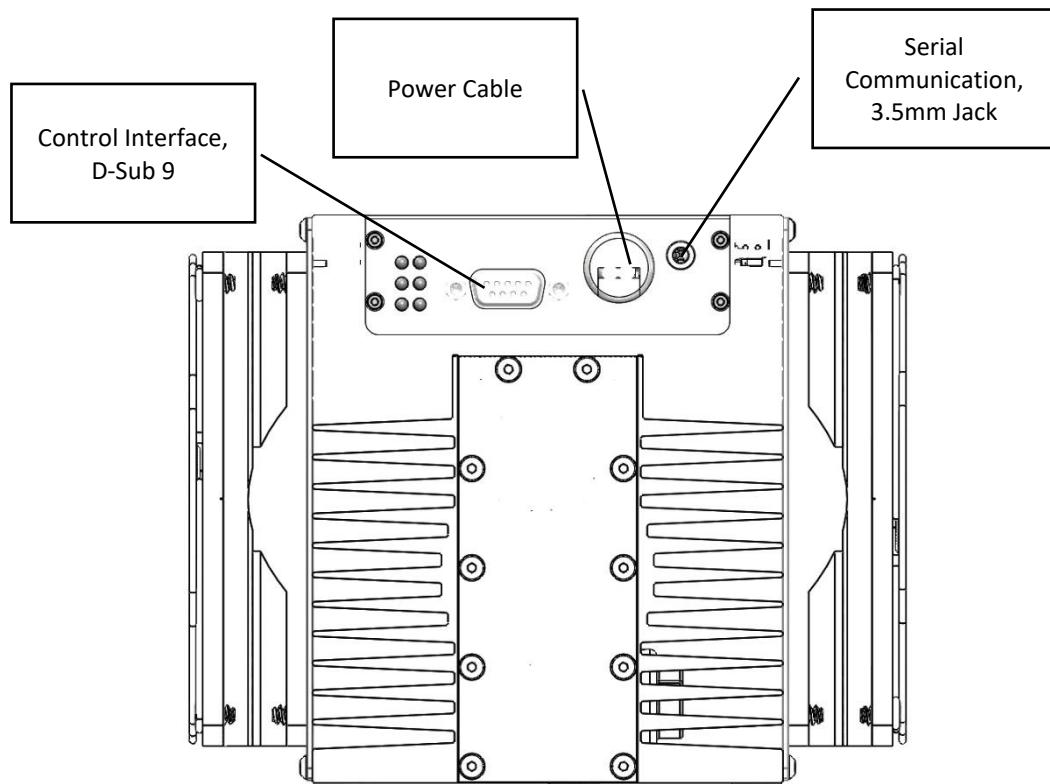
2. Serial Communication Connector (3.5mm Jack)

Serial Connector															
Connector Model – CUI Inc, SJ1-43502PM, Or Equivalent															
Pin	Signal														
1	Ground														
2	TX, Transmit														
3	RX, Receive														
4	NC, No Connection														
Mating Plug, 4-Wire (For Reference Only)															
Connector Model, CUI Inc, SP35401, Or Equivalent															
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	S - SLEEVE R - RING T - TIP														

3. Connector (DB-9)

NOTE: The use of standard cables with a DB-9 pin connector is not permitted when interfacing to this connector.

Control Interface Signals		
Connector D-Sub 9 female w/ threaded standoffs, industrial grade.		
Pin	Name	Description
1	Modulation High Input	+5V TTL PWM, Laser Power Control, Positive
2	Laser Ready Out	+5V @ 20 mA Typical, 40 mA Maximum
3	Lase Indicator Out	+5V @ 20 mA Typical, 40 mA Maximum
4	Over Temperature Fault Out	+5V @ 20 mA Typical, 40 mA Maximum
5	DC (+5V) Out	Accessory Power. 250 mA Maximum
6	Modulation Low Input	Ground (factory configuration). Optionally, the signal can be optically isolated. Please refer to Iradion document 92-3006, RS232 Operation Manual for information on optional ground isolation.
7	DC Voltage Fault Out	+5V @ 20 mA Typical, 40 mA Maximum
8	GND	Ground
9	Laser Enable In	5 VDC required to enable the laser





Caution

This unit is provided with a 1 meter length of cable for DC power. If the wire is extended in length, #10 wire must be used. Do not add more than 1 meter additional wire unless it is heavier than #12. Power supply regulation should be better than $\pm 2\%$ and ripple no greater than 400 mV. No damage can occur to the laser if the DC voltage is in the range of 0 to 50 Volts; however, the laser will only operate at the specified voltage. Check your power supply before attachment and adjust it to the specified voltage. The software will not allow more than $\approx \pm 2$ Volts variation including line drops at high current settings. **If output becomes intermittent and the fault light flashes on and off, the voltage drop on the power cable may be too large or the power supply may be bad. If the fault light lights up on power up, check the power supply voltage setting.**

12. Nominal Operating Voltages

Model Number	E25	E30	E40
DC Voltage	48 V	48 V	48 V

13. "F" Type Lasers

Current production lasers are marked, for example, as E40F. These lasers are designed with temperature sensing feature that will automatically control fan operation. The fan will start operating at 32°C or higher and will stop at 30°C or lower. This fan function is enabled via commands sent over the RS 232 lines. If the fans do not start when power is applied, this means that the fan function is disabled. If fans do not start with laser power on, this does not indicate fan malfunction. Factory fresh lasers are always shipped with the fan function enabled. Please refer to Iradion document 92-3006, RS232 Operation Manual for information on communicating with the laser control card.

14. Operation of Unit

1. Mount the laser in a manner such that the beam will strike a target capable of absorbing up to 80 Watts of power. Make sure that the airflow openings are clear of any obstructions.
2. Confirm that the signal connections to the laser are secure and tight. Make sure that the power supply is correctly adjusted and is capable of delivering a minimum of the rated current, plus 2 amps margin.
3. Connect the laser power leads to DC, Red positive (+) using at least 10-gauge wire. The power supply can affect laser performance. Use a high-quality, well-regulated supply.
4. Power up the DC supply, the fans should start.
5. Make sure the Laser Enable line is energized with +5 VDC.
6. When the system arms to "READY", if the tickle is being applied, the "Laser On" light should also light up when the interlock is enabled. The "Laser On" light will get brighter as the power increases; this is normal.
7. Make sure there is enough cool air available to exhaust the heat. Do not obstruct the air flow in any way or modify the fans. The laser should not be near heaters or other heat sources that increase the ambient fan inlet temperature.

15. Tickle Pulse

Iradion has chosen to follow the industry convention and make provision for the inclusion of a “tickle pulse” function to keep the laser lit during down time. The intent of the tickle pulse is to improve the pulse-to-pulse consistency and timing relative to firing commands received from the control electronics. Most laser control electronics offer a Tickle Pulse feature, therefore, **this function is disabled at time of shipment**. Please refer to Iradion document 92-3006, RS232 Operation Manual for information on communicating with the laser control card.



Warning

If the tickle rate increases due to software settings or deliberate measures, there is a danger of unintended laser emission.

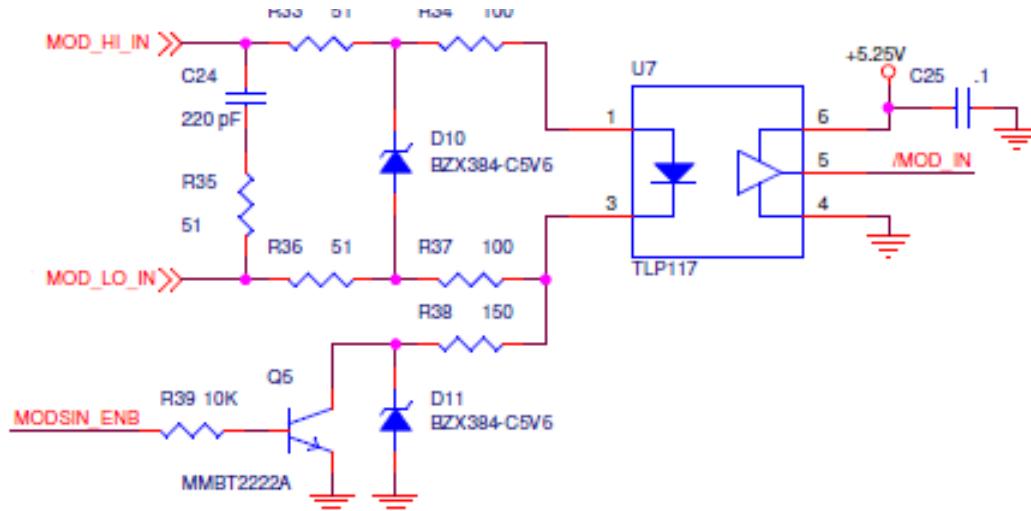
16. Laser Command Signals

During laser bench testing, it is recommended that command signals be generated from an industry supplied laser controller or properly programmed pulse generator. These units can provide the tickle pulse and drive signals needed to test and operate the laser properly. Alternatively, most motion control software packages are designed to provide the proper pulse protocol.

Both the Modulation High and Modulation Low pins should be connected for normal operation. The factory configuration is for Modulation Low to be Ground. Optionally, the Modulation Low signal can operate in an isolated mode. Please refer to Iradion document 92-3006, RS232 Operation Manual for information on isolating the Modulation Low signal.

It is possible to use the Modulation High pin only if the Modulation Low pin is grounded by software settings or by a physical wire; however, depending on the ground integrity of the host system and level of ground noise this may not be the best solution.

The diagram below shows the circuit of the modulation input interface:



17. System Test

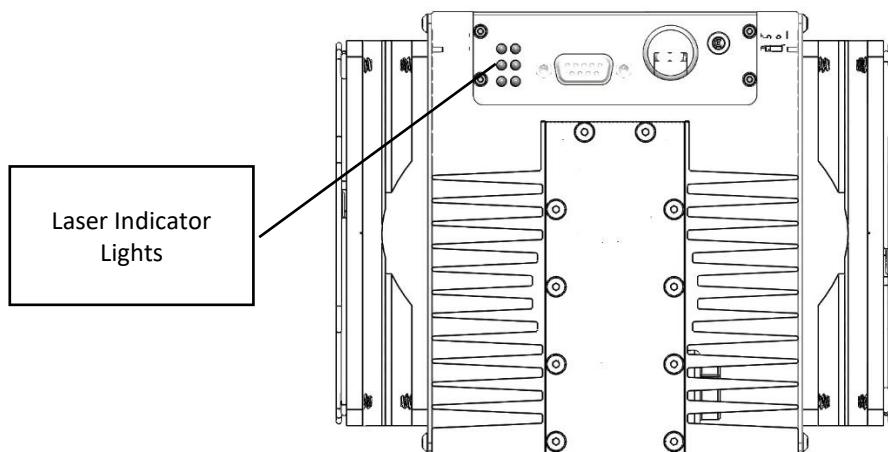
The operation of the laser is possible after the above connections are completed. To test the laser, apply power and the tickle command signal. If the software settings require a key switch, toggle it off and on. After about 6 seconds, the system will be armed.

The Enable line must have 5 VDC applied to operate the system.

Fault conditions can be detected by viewing the LED indicators on the rear of the laser. The signals monitored with LEDs are:

LASER READY	Lights up when the laser controller is ready for operation.
OVERTEMP	Lights up when the RFPA temperature is 55°C. Laser faults when the RFPA Temperature is 65°C.
FAULT	Lights up when the controller is in a Fault state.
LASE LED	Lights up whenever signals are delivered to the RFPA FET bias.
POWER	Lights up whenever DC power is applied.
ENABLE	Lights up when the Enable line is energized.

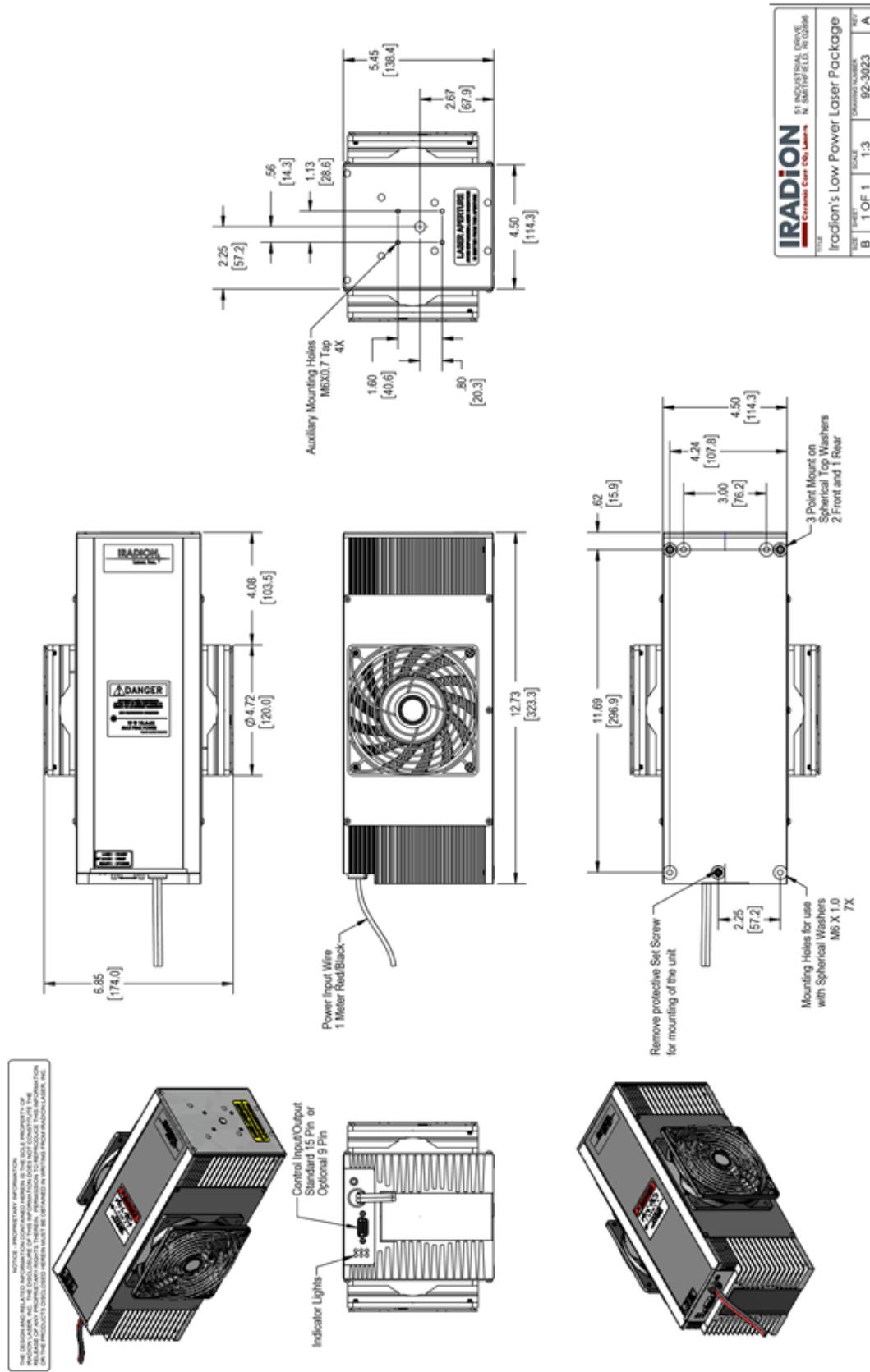
18. Laser Indicator Lights



Indicator Name	Color	Iradion (For Reference)
Lase	Red	
Enable	Yellow	
Ready	Green	
Fault	Red	
Temp	Yellow	
Power	Green	

LASE ● ● FAULT
IN' LOCK ● ● TEMP
READY ● ● POWER

19. Mechanical Outline



20. Specifications

Model	E25	E30	E40
Rated Optical Power	25	30	40
Mode Quality (M^2)		≤ 1.2	
Beam Ellipticity		$< 1.2:1$	
Beam Diameter (mm), $1/e^2$		1.5 Min., 2.0 Max.	
Beam Divergence (mrad, full angle)		7.0 Min., 8.5 Max.	
Wavelength (μm)	9.3	10.6 or 10.2	10.6 or 10.2
Rise Time (μs)		$< 100^*$	
Pulse Duration (μs)		10 - 200	
Duty Cycle		0 - 100%	
Modulation, Full Extinction (kHz)		0 - 8	
Power Stability from Cold		$\pm 6\%$	
Power Stability after 3-min Warm Up		$\pm 5\%$	
Polarization		Random	
Cooling		Fans	
Input power (Watts)	682	576	682
Input Voltage, Current	48 V, 14.2 A	48 V, 12 A	48 V, 14.2 A

Heat Load (W)	660	545	640
Operating Temperature °C (°F)		5 - 40 (40 - 104)	
Operating Humidity		Non-Condensing	
Shipping/Storage Temperature °C (°F)		0 - 60 (32 - 140)	
Weight (kg/lbs)		8.62 / 19	

*Average of 20 measurements recorded with fast photodiode and sampling oscilloscope.

21. Troubleshooting

Problem	Solution
The unit is in the Ready mode but will not respond to commands.	<ul style="list-style-type: none"> The Interlock Switch is open. Mod LOW is not properly grounded.
The Over Temp Light lights.	<ul style="list-style-type: none"> The RFPA heat sink is too hot for operation. Above 45°C, a warning will also occur. Improve cooling. Check for intake blockage.
Laser power seems low.	<ul style="list-style-type: none"> Operating temperature is very high. The fan(s) have failed. The heatsink is clogged with dust. Optical damage to lens. RFPA malfunction.
Fault light is lit.	<ul style="list-style-type: none"> The laser is too hot, above 55°C a Fault will occur. The DC voltage is outside the proper range.

The following chart is provided for clarity:

RED FAULT	off	on	on	blink
YELLOW WARN	on	on	off	off
Condition:	A	B	C	D

A = Getting hot warning, but no fault condition.

B = System faults: too hot/water too hot.

C = System fault: over/under voltage, other faults.

D = CPLD failure

Note: A blinking red light is the same level of fault as a solid red light.

Patents: US 7460577 B2
US 8295319 B2



Invisible Laser Radiation
Avoid eye/Skin exposure to direct or scattered radiation.
Class 4 Laser Product

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IRADION
Ceramic Core CO₂ Lasers
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