

# Model EQ-77 Laser-Driven Light Source LDLS®



## Operation Manual

Revision 8, March 2023

Part Number DOC-7070



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Energetiq Technology, Inc.  
205 Lowell St.  
Wilmington, MA 01887  
Phone: +1 781-939-0763  
Fax: +1 781-939-0769  
Email: [info@energetiq.com](mailto:info@energetiq.com)  
[www.energetiq.com](http://www.energetiq.com)

## EU Declaration of Conformity

*Product type:*

LDLS™ Laser-Driven Light Source

*Manufacturer:*

Energetiq Technology, Inc.  
205 Lowell Street  
Wilmington, MA 01887 USA

This declaration of conformity is issued under the sole responsibility of the manufacturer.

*Object of the declaration:*

Model EQ-77 Series High Brightness Broadband Light Source

The object of the declaration described above is in conformity with the relevant Union harmonization legislation:

2014/35/EU	EU Low Voltage Directive
2014/30/EU	EU Electromagnetic Compatibility Directive
2011/65/EU	EU RoHS Directive

*Standards used:*

EN 61010-1 :2010/A1 :2019	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use: Part 1 – General Requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements
EN IEC 63000 :2018	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
EN 60825-1:2014	Safety of laser products - Part 1: Equipment classification and requirements
EN 62471:2008	Photobiological safety of lamps and lamp systems

*Signed for and on behalf of:*

Energetiq Technology, Inc.  
Woburn, Massachusetts USA      27 May 2022

DLM

Don McDaniel Ph.D., Vice President of R&D

Signature: Don McDaniel  
Don McDaniel (Jun 3, 2022 09:52 EDT)

Email: [dmcDaniel@energetiq.com](mailto:dmcDaniel@energetiq.com)

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# 1. Introduction

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The EQ-77 Laser-Driven Light Source is a broad-band lamp system for use in a wide variety of applications. The lamp produces high brightness, broad-band light from DUV wavelengths through visible and beyond. The output is very stable and has a long lifetime before any service is required. A simple control interface ensures ease of use.

Some of the advantages of the EQ-77 include:

- Very high brightness across complete spectrum
  - 190nm through visible and beyond
- Eliminates need for multiple lamps (replaces D2/Tungsten/Xenon Arc)
  - Simplified optical system
- Excellent spatial stability
  - Repeatable measurements
- Superior short and long term power stability
  - Repeatable measurements
- Electrodeless operation for long life
  - Reduced consumable costs
  - Minimal recalibration of instrument

The EQ-77 system consists of a Power Supply Controller unit, Lamp House unit, and interconnecting cable. Connections to AC power and cooling fluid are required for operation. A connection to nitrogen purge gas is strongly recommended during operation.

For additional information contact Energetiq Technology Technical Support Services at +1-781-939-0763 X111 or e-mail: [EUVproductsupport@Energetiq.com](mailto:EUVproductsupport@Energetiq.com)

## 2. Safety and Compliance

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### 2.1. General Precautions

The output beam from the EQ-77 should be blocked when not in use with an electronic shutter or other appropriate beam blocking device. Due to the possibility of generating ozone with some models of EQ-77 when ambient oxygen is exposed to short wavelength light, the beam should always be enclosed in an appropriate beam pipe, tube, or enclosed space. We recommend purging any beam transport space with dry nitrogen gas.

The EQ-77 source must also be cabled correctly and connected to a power source with a protective earth ground prior to operation.

Refer to the Installation section of this manual in Section 4 for details of the facilities connections.

There are no user-serviceable parts inside the EQ-77. For any problems encountered during operation, please contact Energetiq Technology for assistance. **If there is a component failure, do not attempt to open the Power Supply Controller or Lamp House enclosure of the EQ-77.**

**The EQ-77 utilizes a quartz lamp containing a high-pressure gas fill. Explosion of the lamp and possible injury from flying fragments can occur if the lamp is mishandled.**

**Do not open the enclosure of either the Lamp House or the Power Supply Controller. Dangerous invisible infrared laser beams and hazardous voltages exist inside the Lamp House.** Opening the chassis both voids the warranty and exposes the user to dangerous radiation and hazardous voltages.

**This AC cord supplied is for EQ-77 only. This AC cord cannot be used with other electrical equipment.**

**The power shutdown mechanism of this laser unit is the AC power plug. Do not arrange the equipment that makes it difficult to connect or disconnect the AC power plug.**



**WARNING:** This unit emits ultraviolet (UV) radiation that is harmful to humans. Avoid exposure to the direct or reflected output beam. Make certain that the appropriate output beam shields and optics are in place prior to energizing the unit. All interlocks must be satisfied prior to operation; failure to do so may lead to hazardous conditions.



**CAUTION:** The EQ-77 emits dangerous levels of UV radiation. Even short exposures to skin or eyes may cause burns. Ensure that only authorized personnel are in the vicinity of source during operation. Personnel in vicinity of operating source should wear protective eyewear, clothing, and gloves. Lighted UV warning lights and signs posted on doors to lab areas may help prevent accidental exposure.



**WARNING:** The EQ-77 utilizes an internal Class 4 IR laser capable of causing severe injury to eyes or skin. Do not open or attempt to service this unit. Contact Energetiq regarding any problems with the unit.

**WARNING:** When working near the emitted light, always wear protective devices (conforming to ISO 4007/4849/4850/4854/4855 or equivalent regulations). The lamp installed in this housing emits intense ultraviolet rays, which are harmful to the eyes and skin. Looking directly into the emitted light or allowing the light to fall on the skin will damage eyesight or cause skin burns.

**WARNING:** If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The power supply must be properly grounded by the outlet to prevent electrical shocks.

Securely plug in the power supply connector to avoid looseness or play. Loose connections may result in faulty operation.

This product is designed and tested for use in an industrial environment. If this product is used in residential areas, EMI (electro-magnetic interference) may occur. **This product must not be used in residential areas.**

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Note:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against

harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## 2.2. Definition of equipment and document symbols and designations

Do not operate the EQ-77 if the covers are removed or is defective in any way. Contact Energetiq if any problems with the equipment are suspected.

**The EQ-77 utilizes a quartz lamp containing a high-pressure gas fill. Explosion of the lamp and possible injury from flying fragments can occur if the lamp is mishandled.**

**Do not open the enclosure of either the Lamp or the Controller. Dangerous invisible infrared laser beams and hazardous voltages exist inside the Lamp.** Opening the chassis both voids the warranty and exposes the user to dangerous radiation and hazardous voltages.



**CAUTION:** controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.



**WARNING:** Invisible laser radiation avoid eye or skin exposure to direct or scattered radiation  
Class 4 laser product



Alternating current

The EQ-77 is a Class 1 Laser Product. All appropriate laser safety measures should be in place before operating the system. Consult your facility's laser safety officer. Laser protective eyewear should be worn at all times while operating the system.

For further safety information, refer to ANSI Z136.1 Standard for Safe Use of Lasers, available from Laser Institute of America ([www.laserinstitute.org](http://www.laserinstitute.org)).

## 2.3. Laser Information

The EQ-77 uses a patented\* laser drive system to excite a plasma that radiates in the UV as well as the visible bands. A class 4 laser is located in the Lamp House enclosure. The optical configuration of the Lamp House ensures that the direct laser beam cannot exit the unit. The EQ-77 laser product is designated as Class 1 during all normal operation.

The parameters of the non-accessible internal laser are given below in Table 1.



Parameter	Value
Wavelength	974 nm
Emission Type	CW
Laser Power for classification	<36 mW via 7mm measurement aperture
Beam Diameter	~25 mm at aperture
Divergence	>100 mRad
Transverse Beam Mode	Diffuse

**Table 1:** Embedded Laser Parameters

No regular maintenance is required for the EQ-77. Any service to the system must be performed only by factory authorized and trained technicians. To avoid injury, under no circumstances should the user open or modify the Lamp House or Power Supply Controller enclosure.

The unit must not be operated if the covers are removed or it is defective in any way. Contact Energetiq if any problems with the equipment are suspected.

\* US 7435982, 7786455, 8525138, 8969841, 9048000, 9185786 ; Japan 5410958, 5628253; Korea 10-1507617; UK GB2450045; others pending

## 2.4. EMC Compliance Standards

- **IEC 61326-1 Emission Limits:** CISPR 11, Group 1, Class A
- **Immunity Requirements:** Table 2
- **Performance Level:**

- **Criteria A**

Light intensity	Maintain at least 50% light intensity.
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- **Criteria B**

Light intensity	The light intensity must not be zero.
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- **Criteria C**

Light intensity	It shall be restored to normal by the operator after the test.
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## 2.5. Labels and Safety Notification

The following safety labels appear on the product. Figure 1 shows the location of each label on the EQ-77 system and Table 2 describes their meanings.

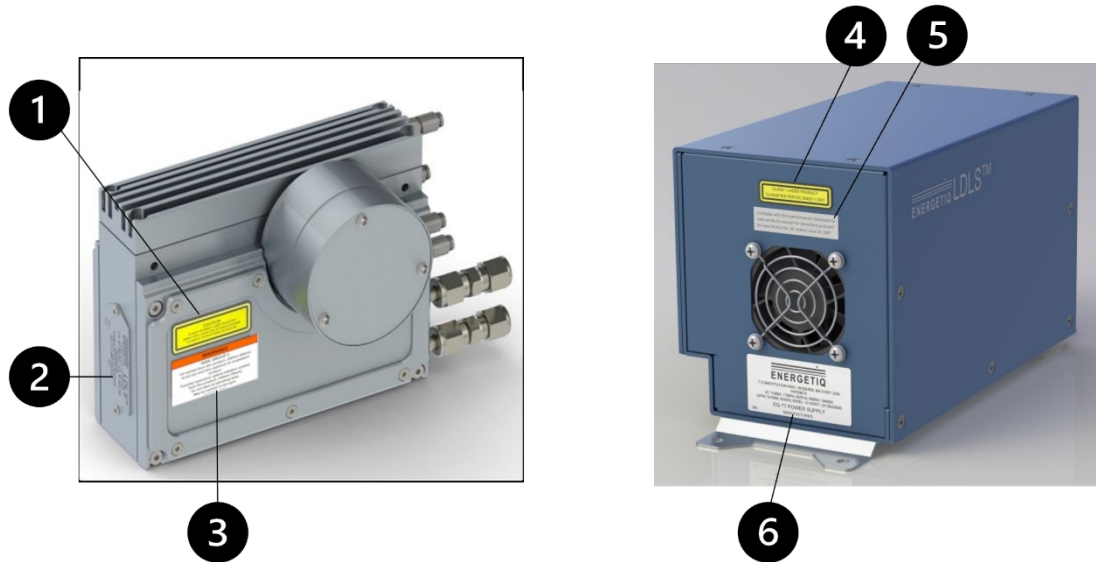



Figure 1: EQ-77 Safety labels location

Labels and Safety Notifications		
#	Label Picture	Description
1		Non-interlocked housing label – notifies of a potential hazard when covers are removed
2		Manufacturer's identification label on lamp house – gives the manufacturer's name and address, and the model, serial number, and date of manufacture of the equipment.
3		UV Hazard warning label – indicates hazardous levels of UV light are present.
4		Explanatory label – states the classification of the laser product. Class 1 is the lowest hazard level classification.
5	Complies with FDA performance standards for laser products except for conformance with IEC 60825-1 Ed.3., as described in Laser Notice No. 56, dated May 8, 2019	Certification label – states that the equipment has been tested and verified to meet the standards indicated

6		Manufacturer's identification label on controller– gives the manufacturer's name and address, and the model, serial number, and date of manufacture of the equipment.
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**Table 2:** Safety Label Meanings

## 2.6. Safety Interlocks

The EQ-77 is equipped with interlocks to prevent operation of the device when any of the following conditions are present:

- An external interlock is open
- No bulb is installed

## 2.7. External Interlocks

External interlock pins are provided for the customer's use. Any suitable normally-open contact or solid-state switch can operate the interlock circuit. The contact or switch should be rated for 80mA minimum at 5VDC.

The interlock circuit must be connected to enable the operation of the unit. Should the interlock connection open during operation or standby, the source is immediately disabled, and all light output from the aperture ceases.

## 2.8. Correct disposal of the unit

When the EQ-77 has finally been removed from service, observe all local environmental regulations for proper disposal.

# 3. Preparation of System

## 3.1. Unpacking guide

Start by inspecting all parts of the system for completeness and any damage incurred in shipping. The EQ-77 shipping box should contain:

- EQ-77 Power Supply Controller unit
- EQ-77 Lamp House unit
- Black interconnecting cable from Lamp House to Power Supply Controller (21-pin mixed D-sub)

### OPTIONAL

- EQ-99-RC Remote Control Module with interlock connector
- I/O cable with 15 pin D- connector at each end

If any part is missing or appears damaged, contact Energetiq immediately. Do not attempt to substitute any parts. There are no user-serviceable parts inside the EQ-77 Lamp House or Power Supply Controller unit.

### 3.2. System Description

the EQ-77 system consists of a Power Supply Controller unit, Lamp House, Controller to Lamp house interconnect cable (not shown), and power input cable (not shown). I/O interface connections (also not shown) are provided by the user.

The following sections provide descriptions of the system components and controls, and give an overview of their functions. Refer to the “Installation” section of this manual (Section 4) for more detailed information.



Figure 2: EQ-77 Controller

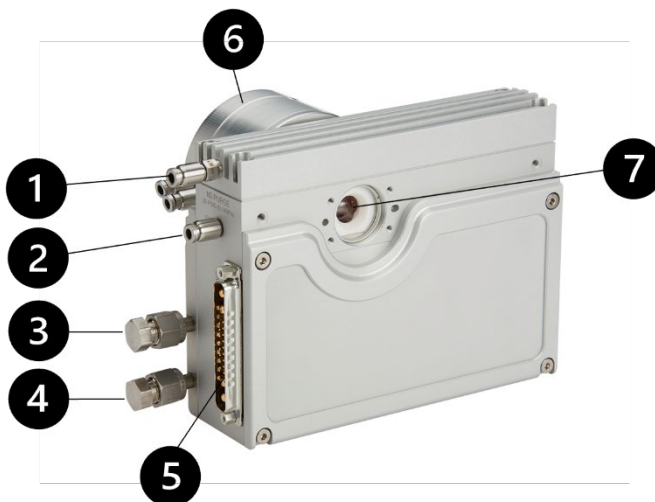
EQ-77 Controller		
#	Component	Description
1	Power input connector	This is an IEC 320 inlet connector for AC power input. See Section 4 for detailed information
2	Status indicator	See Table 3 for a list of descriptions
3	I/O Interface connector	Provides access to control and status signals
4	Lamp control connector (21-pin mixed D-sub)	Provides various power and control signals to/from the Lamp House module. No other connector or cable may be used with the EQ-77 other than the one supplied.
5	RS-485 Connector (9-pin D-sub)	Connector for optional RS-485 interface. See Section 10.4 for electrical details and commands.

Located on the EQ-77 Controller front panel are LED system status indicators. The function of these indicators is described below in Table 3.

LED Label	Meaning (when lit)
POWER OK	AC power is connected to the EQ-77 Power Supply Controller
LAMP ON	UV Light is on
LASER ON	Laser power is ON and laser light is being produced within the Lamp
CONTROLLER FAULT	One of the following has occurred in the Power Supply Controller: <ul style="list-style-type: none"> <li>External interlock open</li> <li>Controller internal temperature too high</li> <li>Laser power not reaching setpoint</li> <li>Laser temperature fault</li> </ul>

	<ul style="list-style-type: none"> <li>Internal power supply voltage low</li> </ul>
LAMP MODULE FAULT	One of the following has occurred in the Lamp House module: <ul style="list-style-type: none"> <li>Control Cable not connected properly</li> <li>Lamphouse internal temperature too high</li> <li>Ignition Failure</li> </ul>

**Table 3:** Status Indicator LED Functions



**Figure 3:** EQ-77 Lamp

EQ-77 Lamp		
#	Component	Description
1	Nitrogen Purge Inlet	These are the fittings for the nitrogen purge gas. Product use without nitrogen purge gas will result in the buildup of ozone (from atmospheric oxygen) and attenuate the light output in the 220-280 nm band, as well as below 200 nm in the presence of atmospheric oxygen and water vapor.
2	Nitrogen Purge Outlet	
3	Cooling Fluid Inlet	These fittings are for connection of cooling fluid required by the Lamp
4	Cooling Fluid Outlet	
5	Control Connector (21-pin mixed D-sub)	Provides various power and control signals to/from the Power Supply Controller. No other connector or cable may be used with the EQ-77 other than the one supplied.
6	Retroreflector Assembly	Reflects radiation back to the light source
7	Lamp Window	The lamp windows at the optical output provide protection from the high pressure bulb inside the Lamp House. An internally-threaded SM1 adapter is provided for easy connection of optical hardware.

### 3.3. Physical Specifications

Dimensions (H x W x D)

- Lamp: 128 x 175 x 102 mm (5.0 x 6.9 x 4.0 in)
- Controller: 152 x 250 x 132 mm (6.0 x 9.8 x 5.2 in)

Weight

- Lamp: 2.2 kg (4.9 lb)
- Controller: 2.9 kg (6.5 lb)

### 3.4. Utility requirements

Electrical: 100 – 240 V~ +/- 10%, 50/60 Hz, 350 W (Fuse:F5AL250V)

Nitrogen Purge Gas: Recommended. Clean dry nitrogen, grade 4.8 or higher, filtered to 5um, 20 psig (0.14 MPa) supply pressure

- Fittings: 4mm push-to-connect

Cooling Fluid: >= 1 liter/minute, 18 – 30 °C, 100 psig (0.69 MPa) max. inlet pressure

- Fittings: ¼ inch Swagelok

### 3.5. Remote Interface

Digital Inputs

- Type: Optocoupler LED
- Logic: Active High
- Input voltage: 5VDC
- Input current: 8mA

External Interlock Input Only (pin 13)

- Type: Relay Coil
- Logic: Active High
- Input voltage: 5VDC
- Input current: 80mA

Digital Outputs

- Type: Open collector to ground (digital common)
- Logic: Active Low
- Voltage: 30VDC max.
- Sink current: 8mA max.

User Power

- Voltage: 5VDC, referenced to digital common
- Current: 200mA maximum

### 3.6. External interlock connection

External interlock pins are provided for the customer's use (see Section 4 for connection details). Any suitable normally-open contact or solid-state switch can operate the interlock circuit. The contact or switch should be rated for 8mA minimum at 5VDC.

The interlock circuit must be connected to enable the operation of the unit. Should the interlock connection open during operation or standby, the source is immediately disabled, and all light output from the aperture ceases.

## 4. EQ-77 Setup

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### 4.1. Connections

Installation of the EQ-77 consists of connecting electrical, cooling fluid, and purge gas supplies, and connecting the Lamp House module to the user's equipment. Read "Installation Procedure" first before making any connections.

#### 4.1.1 Electrical Power

The EQ-77 requires 100 – 240 V~, 50/60 Hz input voltage. Power consumption is 350 W maximum during normal operation. Some OEM versions have higher current requirements.

#### 4.1.2 Purge Gas

It is strongly recommended that nitrogen purge gas is used during operation of the EQ-77 system. For optimal product performance, nitrogen gas purging of the EQ-77 system is required. If nitrogen purge gas is not used, shorter lifetime and faster output degradation (especially in the ultraviolet wavelength range) is expected. Product use without nitrogen purge gas will result in the buildup of ozone (from atmospheric oxygen) and attenuate the light output in the 220-280 nm band, as well as below 200 nm in the presence of atmospheric oxygen and water vapor.

The purge port fitting is a push-to-connect type, sized for 4mm O.D. tubing.

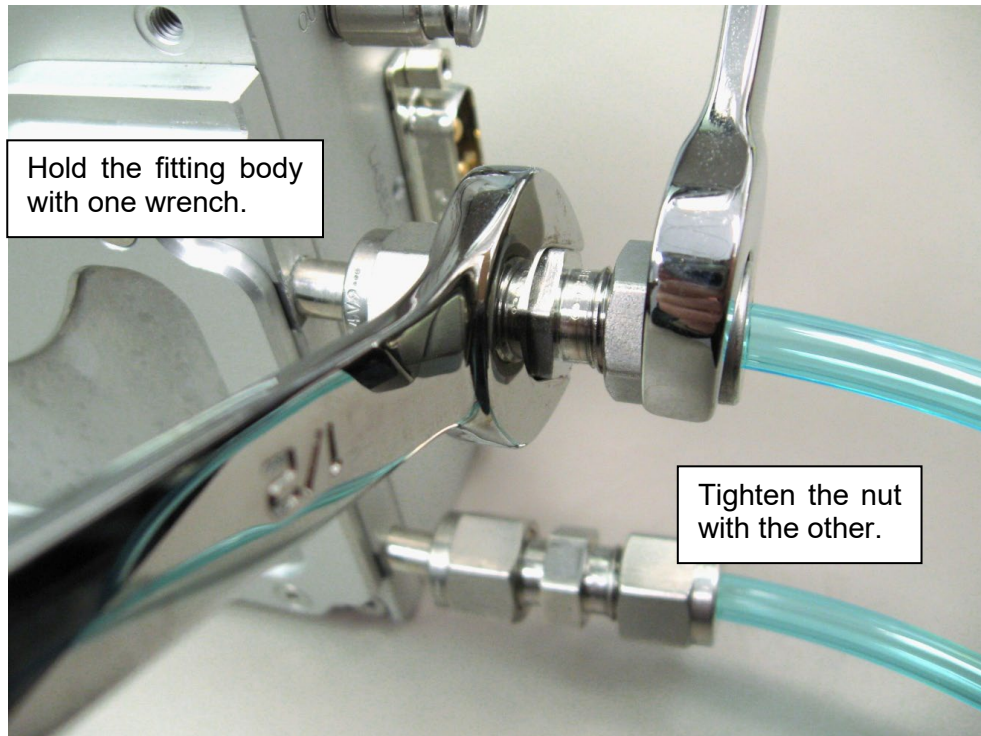
Clean and dry nitrogen from either a Dewar or research-grade N<sub>2</sub> bottle is recommended. Do not use any other purge gas. Grade 4.8 or better gas purity is recommended to maintain cleanliness of the optics, and gas should be filtered to <5µm. Supply pressure should be 20 psig (0.14 MPa). With a 20 psig inlet pressure, the EQ-77 will consume approximately 0.5 slm of flow.

#### 4.1.3 Cooling Fluid

Cooling fluid fittings are 1/4-inch Swagelok female. Coolant flow rate of at least 1 liter/minute is required. Inlet temperature should be between 18°C and 30°C

Care must be taken when making connections to avoid damage to the fittings and tubing. Two wrenches must always be used – one to hold the fitting body, and another to tighten the nut. See Figure 4.

To make the connection: first insert tubing into the fitting and tighten the nut finger tight. Then tighten the nut 1-1/4 turns from the finger-tight position, using two wrenches as shown.



**Figure 4:** Cooling fluid fittings

#### **4.1.4 Optical Interface**

See Section 10.1 for dimensional drawings of the lamp.

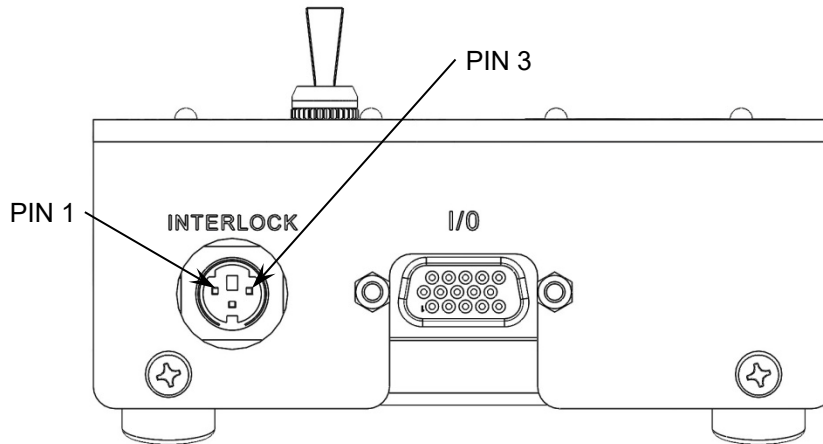
#### **4.1.5 Signal Connections**

The EQ-77 is controlled through the remote I/O connector.

Section 10.3 gives the pin assignments and functions for this interface. Connect to the user's control system using a suitable cable. Mating connector is a standard high-density 15-pin d-sub male (for example, Amp part no. 748364-1 with contacts 1658670-2).

Optionally, connect a model EQ-99-RC remote control module to the I/O connector using the supplied cable. The EQ-99-RC is shipped with an interlock jumper plug installed. To use the remote interlock function, connect a remote contact or solid-state switch across pins 1 and 3. Mating connector is a standard 3-pin mini-DIN, CUI Inc. part no. MD-30 or equivalent. See Figure 5 for pin connections.





**Figure 1:** EQ-99-RC Remote Control Rear Panel

User I/O can be powered either by the EQ-77 internal isolated power supply, or an external supply.

Section 10.5 shows connection schematics for both configurations.

#### **4.1.6 Lamp House I/O**

The black 21-pin mixed D-sub cable is used to connect the Lamp House to the Power Supply Controller. This cable should be connected before AC power is applied to the Power Supply Controller.

#### **4.1.7 RS-485 Interface**

Connector J2 is a standard 9-pin male d-sub. Mating connector is a standard 9-pin female d-sub (for example, AMP part no. 205203-3 with contacts 1-66504-0). See Section 10.4 for pin connections.

Port settings are 9600 bps, 8 data bits, 1 stop bit, no parity, no handshaking.

Installation of the EQ-77 consists of connecting electrical, cooling fluid, and purge gas supplies, as well as connecting the Lamp House module to the user's equipment. Read "Installation Procedure" first before making any connections.

## **4.2. Installation Procedure**

1. Place the Power Supply Controller on a stable surface. The Power Supply Controller must be placed within 2 meters of the Lamp House due to the length of the interconnecting cable. See drawing Section 10.1 for dimensional details.
2. Connect the Lamp House unit optical output to the user equipment (after removing the window cover). The beam should always be either directly coupled to a fiber optic cable, or enclosed in an appropriate beam pipe, tube, or enclosed space and purged with nitrogen. Operating the source without any output target or beam transport is not recommended, and may lead to unsafe operating conditions. Consult Energetiq for applications information and suggested configurations.

The Lamp House should be mounted with the output window on the side and the lamp mounting surface oriented horizontally. The lamp has been factory aligned in this position. Mounting the lamp in a different orientation will cause the plasma position inside the bulb to shift slightly and may cause performance variations.

Setup the Lamp House unit with appropriate ultraviolet safety measures and laser light safety measures in place. It is recommended that any enclosure or aperture-blocking hardware utilize switches wired to the EQ-77 external interlock circuit.

See Section 10.1 for dimensional drawings of the lamp.

3. Connect the black 21-pin mixed D-sub interconnect cable from the Power Supply Controller to the Lamp House.
4. Connect nitrogen purge gas to the Lamp House. Refer to "Connections" above.
5. Connect cooling fluid to the Lamp House. Refer to "Connections" above.
6. Connect user's control system to the I/O interface connector per Section 10.3.
7. Alternately, if using the EQ-99-RC Remote Control Module, place it on a clean rigid surface. Install the supplied 15-pin cable from the Power Supply Controller to the EQ-99-RC.
8. Connect AC input power source to the Controller Unit.

**The system is now ready to operate.**

### **4.3. Chiller Information**

The system must be connected to a cooling system, see Section 8 for recommended chiller.

## **5. EQ-77 Operation**

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### **5.1. Startup**

Once the lamp is set up properly, verify that all personnel that will be in contact with the lamp system are aware of the potential hazards involved. It is the responsibility of the user to verify that the lamp is being used safely.

This example assumes the use of the EQ-99-RC Remote Control Module to provide local control. If using a custom control system, substitute the appropriate digital input and output lines from Section 10.3 for the switches and LEDs described below.

1. With the EQ-99-RC Remote Control Module connected properly, review the status LEDs on the Power Supply Controller. The POWER ON LED should be lit, and neither the CONTROLLER FAULT nor LAMP MODULE FAULT LEDs should be lit.
2. Turn on the OPERATE Switch (place switch in UP position).
3. Within several seconds the LASER ON LED will light. Laser light is now present in the Lamp House.
4. In approximately 20-150 seconds the igniter will be turned on automatically and the plasma will ignite. The LAMP ON LED will be lit. The duration of the warm up time (20-150 seconds) will depend on the temperature and previous operating condition of the EQ-77. The EQ-77 will automatically detect when the unit has reached the optimum conditions for ignition.
5. If a bulb fails to ignite within 150 seconds after the OPERATE switch was activated, the LASER ON LED will go out, the LAMP FAULT LED will be lit, and LAMP ON LED will remain off. This is very unusual. However, if this occurs, turn the OPERATE switch to the OFF position (down) and begin at Step 1 again. If this occurs multiple times, contact Energetiq.

## 5.2. Stopping

To turn the LAMP off, simply turn the OPERATE Switch to the OFF position. If the lamp will not be used for some time, the AC supply can be turned off.

To minimize wear on the ignition components, it is best to avoid frequently starting and stopping the lamp. It is recommended to run the lamp continuously if long off-periods are not required.

## 6. Service Requirements

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There are no user-serviceable parts inside the EQ-77. For any problems encountered during operation, please contact Energetiq Technology for assistance.

**If there is a component failure, do not attempt to open the Controller or Lamp enclosure of the EQ-77.**

Any service to the system must be performed only by factory authorized and trained technicians. To avoid injury, under no circumstances should the user open or modify the Lamp or Controller enclosure.

## 7. Troubleshooting Guide

### 7.1. Fault Indicator Block Diagram

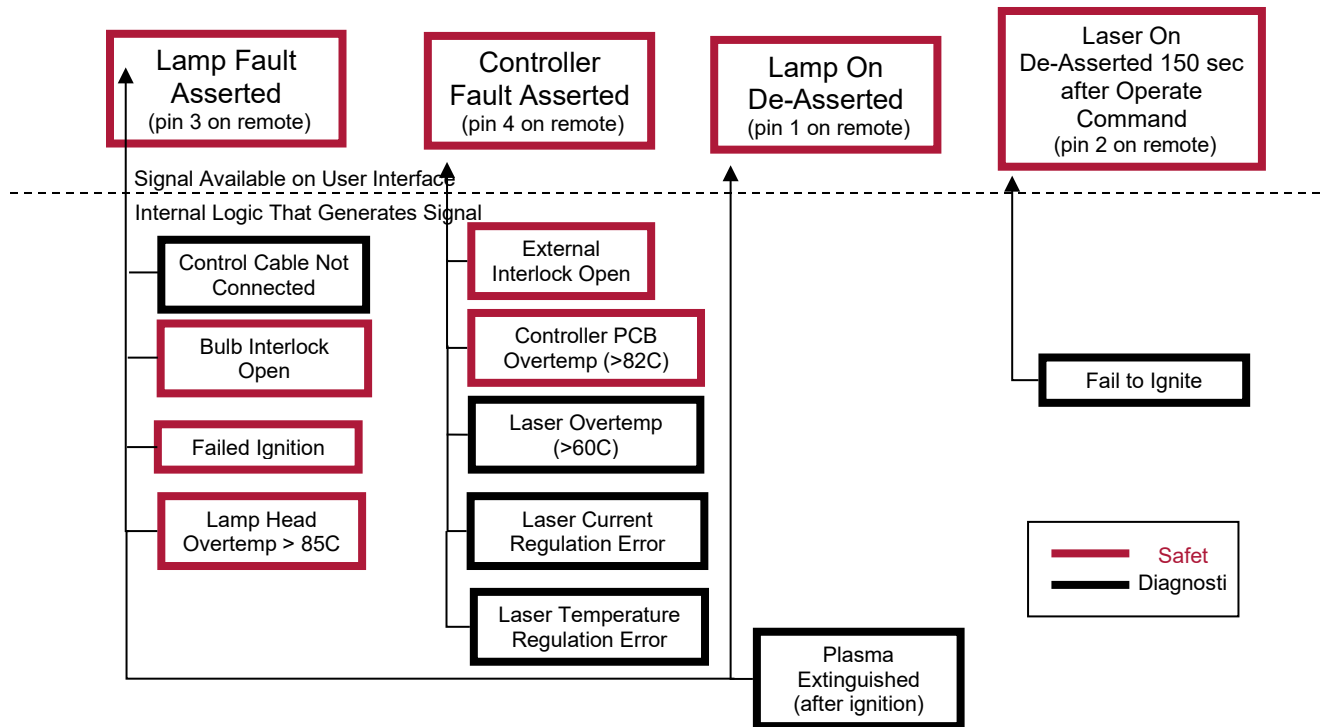


Figure 7: Fault Indicator Block Diagram

See below if any problems are encountered in operating the EQ-77.

**Condition:**

Controller Fault and/or Lamp House Fault LED(s) are ON.

**Action:**

- Always begin operation of the source by verifying the interlocks.
- Confirm that the external interlock contact is closed (or that the black jumper plug is fully inserted into the back of the EQ-99-RC Remote Control Box)
- To reset or clear a Fault condition, actuate the "Operate" switch from the ON position to the OFF position. If a fault was generated while the "Operate" switch was in the OFF position, first actuate the switch to the ON position, then to the OFF position. The unit will not turn on if a fault condition exists.
- If all of the interlocks are OK and either the lamp or controller interlock faults will not clear, please contact the factory.

**Condition:**

Lamp fails to ignite after several tries.

**Action:**

Contact Energetiq.

## 8. Accessories

The EQ-77 requires a chiller to maintain the cooling requirements in Section 3.4. For your convenience Energetiq offers a suitable chiller produced by Solid State Cooling, Inc. You may also choose to procure a chiller directly through your local Solid State Cooling, Inc representative (SSC Model U190 W Chiller).

PN	Description
EQ-77-CHILLER-KIT	EQ-77 Chiller / with Tubing Kit

**Note:** Cooling fluid is not included and must be locally sourced.

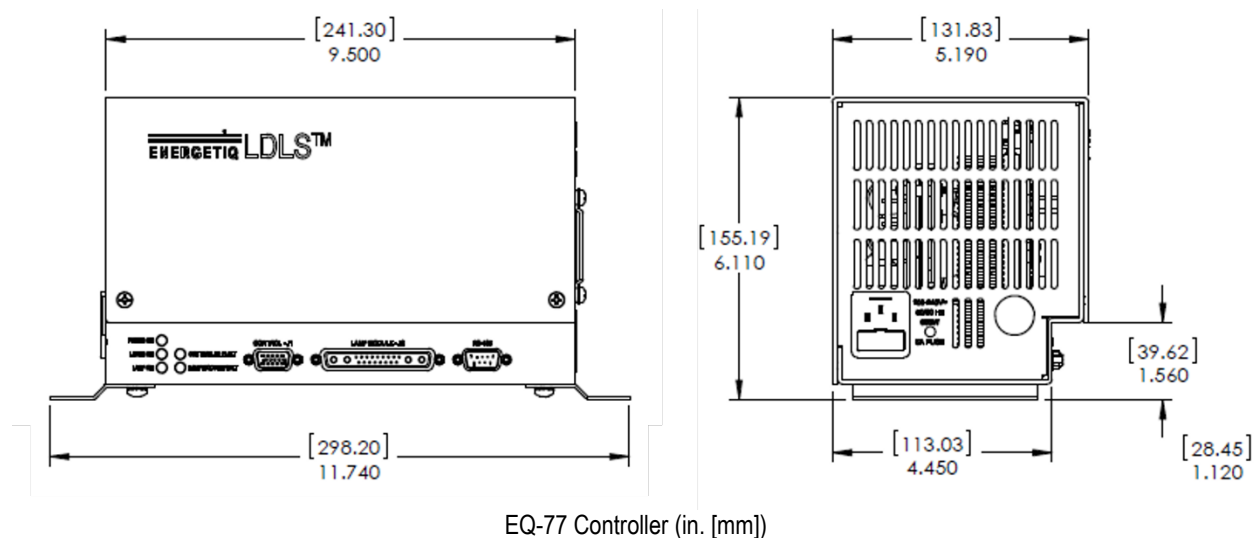
## 9. Warranty

Energetiq Technology, Inc's warranty for the product is set forth in Section 5 of Energetiq Technology Inc's standard terms and conditions, found at [www.energetiq.com](http://www.energetiq.com).

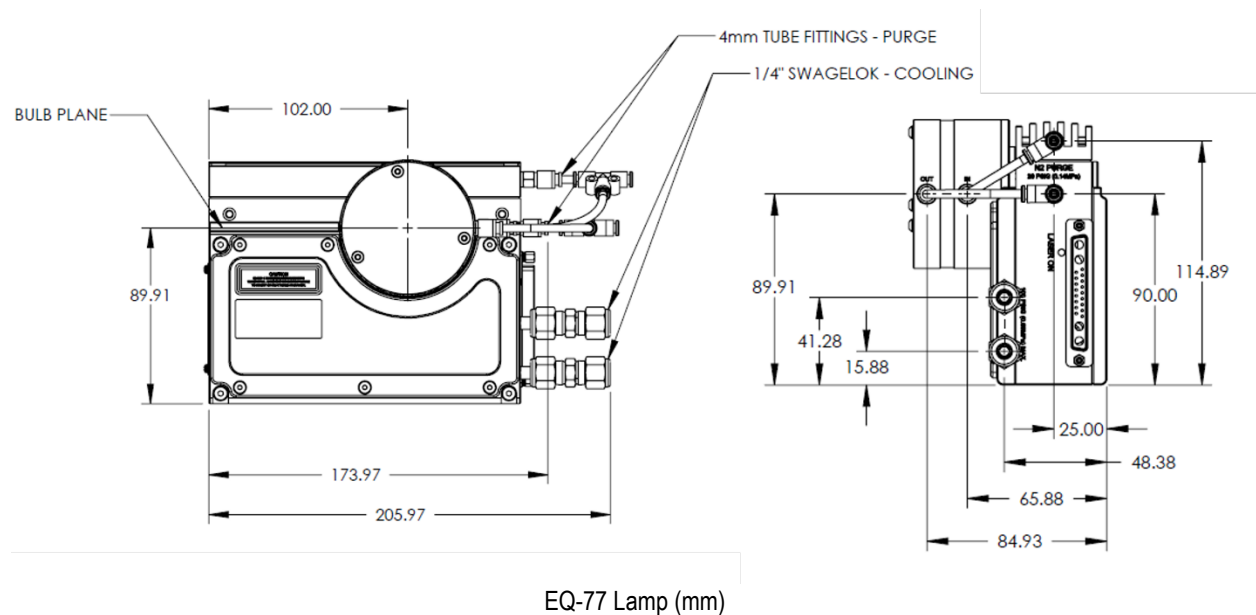
## 10. Drawings, Schematics, and Pin Assignments

### 10.1. Dimensional Drawings

#### 10.1.1 Controller Dimensional Drawings



### 10.1.2 Lamp Dimensional Drawings



### 10.2. Environmental Requirements

#### *Operating*

- Ambient temperature: 15–35°C
- Relative Humidity: non-condensing, 80% max. for temperatures up to 31°C, decreasing linearly to 50% max. at 35°C.
- Pollution Degree 2 (normally only non-conductive pollution; occasional, temporary condensation possible)
- Overvoltage Category II
- Indoor use only
- Operating altitude 2,000 m max.
- IP Code IP20

#### *Transport*

- Temperature: -5–70°C
- Relative Humidity: non-condensing, 95% max.

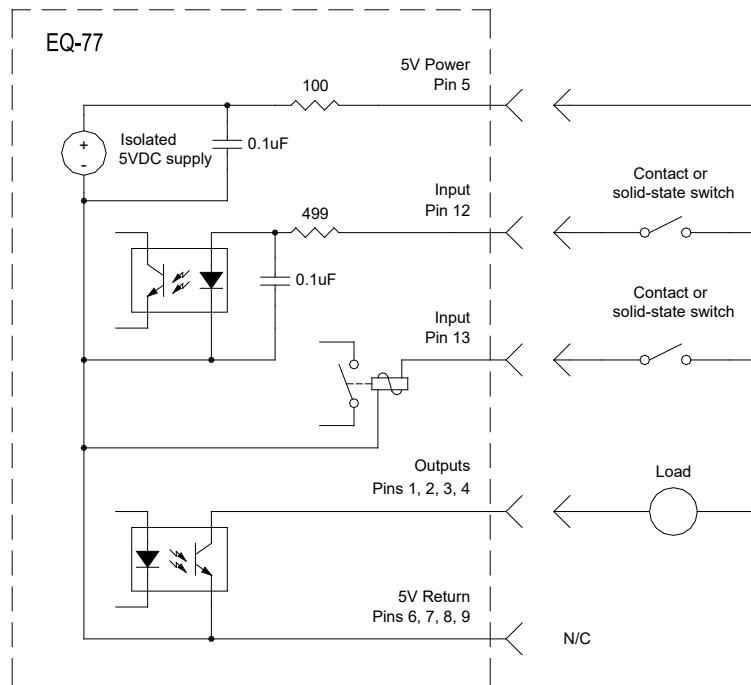
### 10.3. I/O Connector Pin Assignment

Description	Pin #	Details
<b>Commands (Inputs)</b>		
LAMP OPERATE	12	OPERATE REQUEST, apply +5V (referenced to digital common) to initiate start cycle
EXTERNAL INTERLOCK	13	EXTERNAL INTERLOCK, apply +5V (referenced to digital common) to close interlock and allow operation.
<b>Status Indicators (Outputs)</b>		
LAMP ON	1	Pulled to digital common when ON
LASER ON	2	Pulled to digital common when ON
LAMP MODULE FAULT	3	Pulled to digital common when OK, float on FAULT
CONTROLLER FAULT	4	Pulled to digital common when OK, float on FAULT
ISOLATED +5V SUPPLY	5	200mA maximum, referenced to digital common
DIGITAL COMMON	6,7,8,9	Galvanically isolated from system
RESERVED	10, 11 14,15	Do not connect

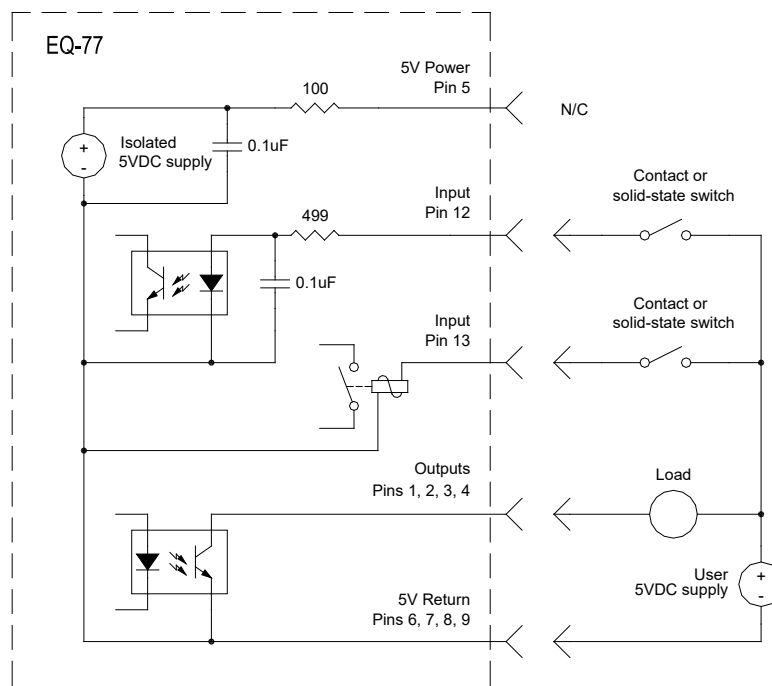
### 10.4. RS-485 Interface Pin Assignment

Description	Pin #	Details
TRANSMIT A (-)	8	From EQ-77, connect to host RECEIVE A
TRANSMIT B (+)	3	From EQ-77, connect to host RECEIVE B
RECEIVE A (-)	7	To EQ-77, connect to host TRANSMIT A
RECEIVE B (+)	2	To EQ-77, connect to host TRANSMIT B
GROUND	5, 9	Galvanically isolated from system
RESERVED	1, 4, 6	Do not connect

## 10.5. Remote Interface Schematic



USING EQ-77 POWER SUPPLY



USING EXTERNAL POWER SUPPLY



## 10.6. Serial Interface Commands

The RS-485 serial interface is provided for user adjustment of laser operating power, in order to increase or decrease light output. The EQ-77 is shipped with the laser power set to a factory default value of 100% of full scale power. Laser power can be increased or decreased in increments of 0.5% of full scale. The following describes the serial commands and their functions.

Commands consist of a single ASCII character, case-sensitive. This can be transmitted to the EQ-77 via a terminal emulation program, or the user's control system. Response from the EQ-77 will be a string of ASCII characters, format depending on the command issued.

The following describes the serial commands and their functions.

Command character	Function	Reply from EQ-77
U	Increases the present laser power setpoint by 0.5% of full scale	Power = XX.X%
D	Decreases the present laser power setpoint by 0.5% of full scale	Power = XX.X%
Q	Queries the value of the present laser power setpoint (in % of full scale)	Power = XX.X%
F	Resets laser power setpoint to factory default value	Power = XX.X%
B	Saves present settings to flash memory. This command should be issued after the settings are at their desired values. If not, changes will be lost if power to the EQ-77 is interrupted.	Calibration data copied to FLASH Memory.
?	Displays a help menu listing the available commands	EQ77 firmware v02d (FRM-7117 R005) build date 11/18/15 (c) Energetiq Technology, Inc. operational commands: U/D - raise/lower laser power by 0.5% Q - Query present laser power F - reset laser power to Factory default B - Burn present settings to non-volatile flash ? - this help menu.

## Appendix A. Revision History

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Date	Rev. No.	Modified By	Revision Summary
03/07/2023	8	Eric Burz	Updated the chapter "Safety and Compliance." Added section on EMC compliance standards. Changed nitrogen purge gas from "required" to "recommended." Minor edits.



**Energetiq Technology, Inc.**

205 Lowell St.

Wilmington, MA 01887

Phone: +1 781-939-0763

Fax: +1 781-939-0769

Email: [info@energetiq.com](mailto:info@energetiq.com)

[www.energetiq.com](http://www.energetiq.com)

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