Model EQ-99X
LDLS™
Laser-Driven Light Source

Operation and Maintenance Manual

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Part Number DOC-6521

ENERGETIQ

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EU Declaration of Conformity

Product type:

LDLS™ Laser-Driven Light Source

Manufacturer:

Energetiq Technology, Inc.
205 Lowell St.
Wilmington, Massachusetts 01887 USA

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

Object of the declaration:

Model EQ-99X/EQ-90 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 DirectiveEU
2015/863/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
IEC 60825-1 (2014)	Safety of laser products - Part 1: Equipment classification and requirements
IEC 62471 (2008)	Photobiological safety of lamps and lamp systems
EN 50581 (2012)	Technical documentation for the assessment of electrical and electronic productswith respect to the restriction of hazardous substances

Signed for and on behalf of

Energetiq Technology, Inc.
Wilmington, Massachusetts USA 1, February 2022

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

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Chapter 1

GENERAL INFORMATION

Safety

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-99X 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-99X controller 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.

General Precautions

The output beam from the EQ-99X should be blocked when not in use with an electronic shutter or other appropriate beam blocking device. Due to the possibility of generating ozone 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 suggest purging any beam transport space with dry nitrogen gas.

The EQ-99X source must also be cabled correctly and connected to a socket with a protective earth ground prior to operation.

Refer to the Installation section of this manual in Chapter 3 for details of the facilities connections.

Other than a bulb replacement, there are no user-serviceable parts inside the EQ-99X. 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-99X.**

The EQ-99X 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 enclosure or the Power Supply Controller. Dangerous invisible infrared laser beams and hazardous voltages exist inside the units. Opening the chassis both voids the warranty and exposes the user to dangerous radiation and hazardous voltages.

CAUTION

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

Laser Information

The EQ-99X uses a patented (U.S. Patent #7435982, 7786455, 7989786, others pending) 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 Power Supply Controller enclosure. Laser energy is delivered via an armored fiber to the Lamp House enclosure and connected with an SMA-type connector. Safety interlocks shut down the laser power if the SMA connector is removed from the Lamp House enclosure. The optical configuration of the Lamp House ensures that the direct laser beam can not exit the unit. The EQ-99X 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.

Wavelength	974 nm
Emission Type	CW
Laser Power for classification	<8.7 mW via 12mm measurement aperture at a distance of 300mm
Beam Diameter	~29 mm at aperture
Divergence	>100 mRad
Transverse Beam Mode	Diffuse

Table 1: Embedded Laser Parameters

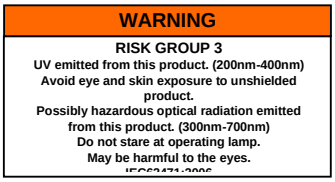
No regular service is required for the EQ-99X. Any service to the system must be performed only by factory authorized and trained technicians. To avoid injury, under no circumstances should the user open or modify the Lamp House or Power Supply Controller enclosure.

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.

Labels and Safety Notification

The following safety labels appear on the product. Figure 1 shows the location of each label on the EQ-99X system.

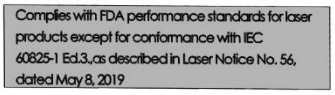
UV Hazard warning label – indicates hazardous levels of UV light are present.



Risk group warning label – states the classification of the source per IEC 62471, Photobiological Safety of Lamps and Lamp systems.

Manufacturer's identification label – gives the manufacturer's name and address, and the model, serial number, and date of manufacture of the equipment.

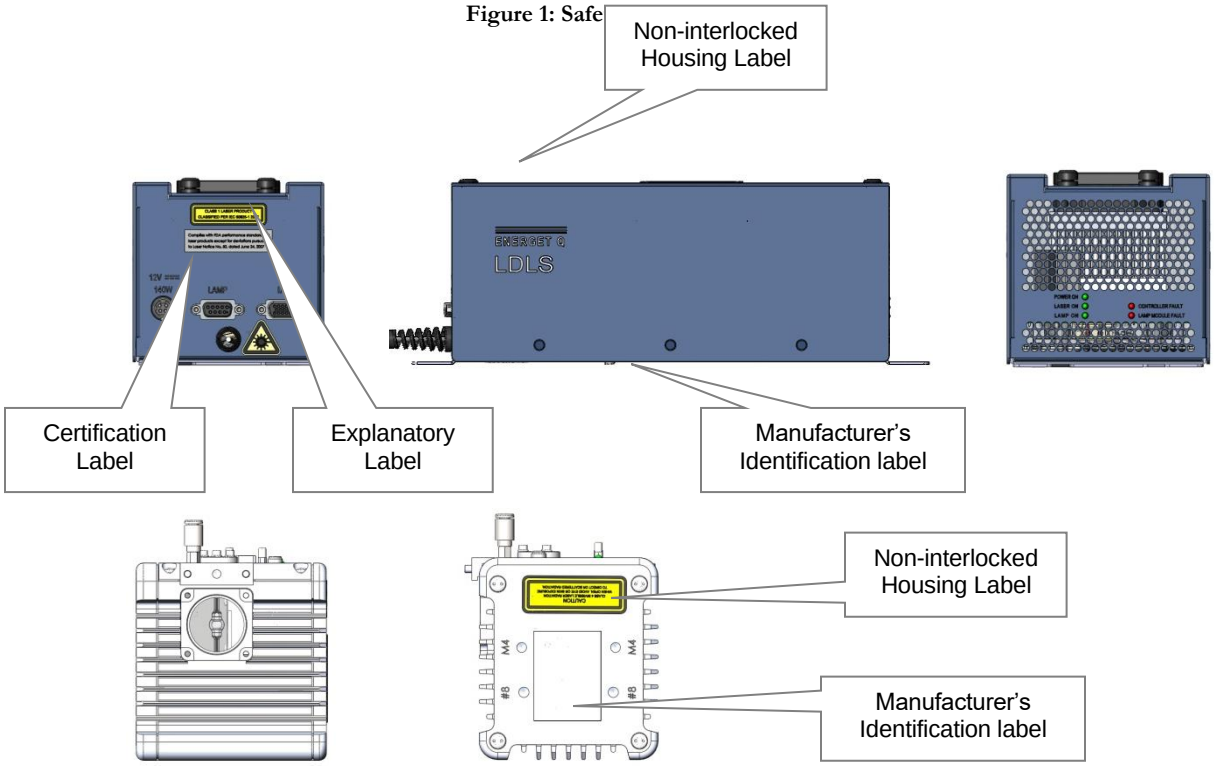
Explanatory label – states the classification of the laser product. Class 1 is the lowest hazard level classification.



Certification label – states that the equipment has been tested and verified to meet the standards indicated.

Non-interlocked housing label – notifies of a potential hazard when covers are removed.

Figure 1: Safe



Safety Interlocks

The EQ-99X is equipped with interlocks to prevent operation of the device when any of the following conditions are present:

1. Bulb is not properly installed into the Lamp House enclosure
2. The laser fiber is not properly connected to the Lamp House enclosure
3. An external interlock is open

External Interlock

External interlock pins are provided for the customer's use (see Chapter 3 for connection details). Any suitable normally-open contact or solid-state switch can operate the interlock circuit.

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.

Chapter 2

DESCRIPTION

General

The EQ-99X 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-99X include:

- Very high brightness across complete spectrum
  - 170nm 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-99X system consists of a Power Supply Controller unit, Lamp House unit, and interconnecting cables. Connection to DC power is required for operation. Connection to nitrogen purge gas is optional, but recommended for best performance. See Chapter 3 for connection details.

Specifications

Optical Performance

- Typical output spectrum: see Figure 2.

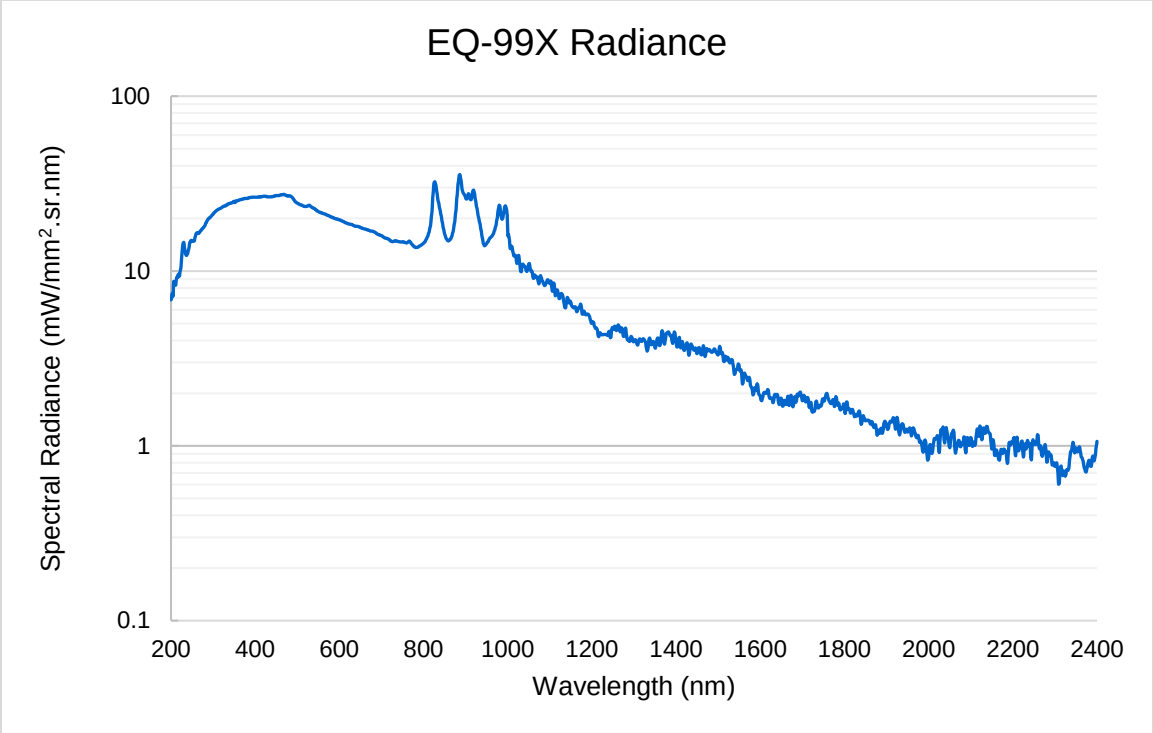


Figure 2: Typical Output Spectrum

Physical Specifications

Dimensions (H x W x D)

- Lamp House: 82 x 86 x 76 mm (3.2 x 3.4 x 3.0 in)
- Power Supply Controller: 113 x 111 x 299 mm (4.4 x 4.4 x 11.8 in)

Weight

- Lamp House: 0.7 kg (1.5 lbs)
- Power Supply Controller: 1.4 kg (3.0 lbs)

Utility Requirements

- Electrical: 12VDC, 140W
- Cooling: natural convection and internal fan, no auxiliary cooling necessary
- Purge gas (optional): clean dry nitrogen, filtered to 5um 20 psig (0.14 MPa) supply pressure

Remote Interface

Digital Inputs

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

Digital Outputs

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

User Power

- Voltage: 5VDC, referenced to digital common
- Current: 50mA maximum

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 40°C.
- Pollution Degree 2 (normally only non-conductive pollution; occasional, temporary condensation possible)
- Installation Category II
- Indoor use only

Transport

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

System Description

As shown in Figure 3 the EQ-99X system consists of a Power Supply Controller unit, Lamp House, laser fiber optic cable, and Lamp House signal cable (not shown). Power and I/O interface connections (also not shown) are provided by the user.

The following sections provide descriptions of the system components and controls, and gives an overview of their functions. Refer to the "Installation" section of this manual (Chapter 3) for more detailed information.

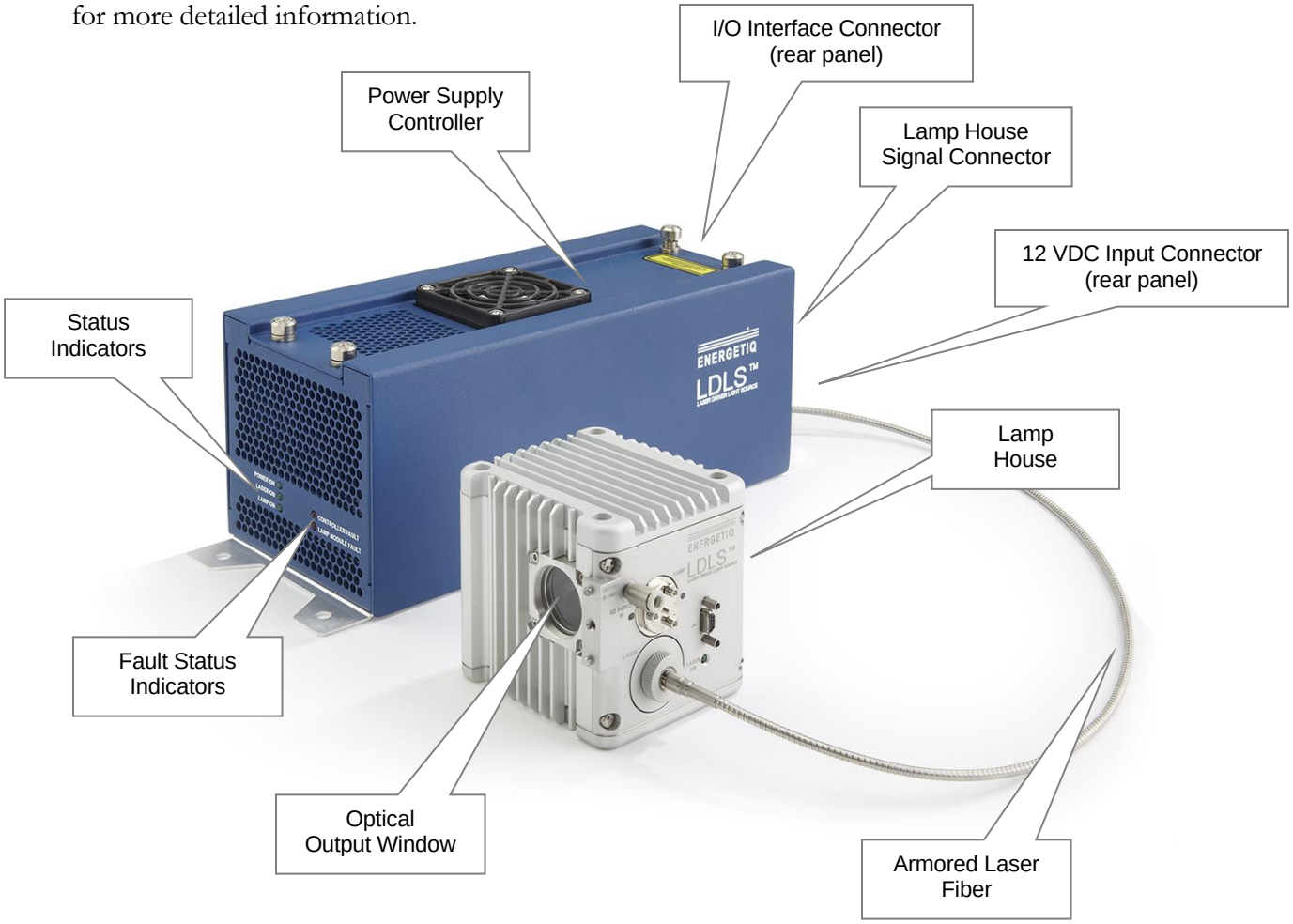


Figure 3: EQ-99X Lamp System

Power Supply Controller

The Power Supply Controller contains:

- IR Diode Laser
- Laser power supply
- Thermo-electric cooler for laser
- Permanently attached, armored laser fiber optic cable
- Control electronics
- Status indicator LEDs
- Interface connectors

External features (refer to Figure 3):

Status Indicator LEDs

These five LEDs indicate the system status. The function of these indicators is shown below in Table 2.

LED Label	**Meaning (when lit)**
POWER ON	DC power is connected to the EQ-99X Power Supply Controller
LAMP ON	UV Light is on
LASER ON	Laser power is ON and laser light is being delivered to the Lamp House
CONTROLLER FAULT	One of the following has occurred in the Power Supply Controller: 1. External interlock open 2. Controller internal temperature too high 3. Laser power not reaching setpoint 4. Laser Temperature Fault 5. Failure in Laser Delivery Fiber
LAMP MODULE FAULT	One of the following has occurred in the Lamp House module: 1. Control Cable not connected properly 2. Lamphouse internal termperature too high 3. Laser fiber not correctly connected 4. Bulb not correctly installed 5. Ignition Failure

Table 2: Status Indicator LED Functions

Input/Output (I/O) Connector

Provides access to control and status signals. See Chapter 3 for pin assignments and functions.

This is the only operator interface to the EQ-99X – there are no local controls. Energetiq offers the EQ-99-RC Remote Control Module which connects to the Input/Output connector and provides a means of local control. Contact Energetiq for additional information.

Power Input Connector

This is a latching input connector for 12 VDC power. Power can be provided using the optional PS00018 12VDC power supply. Alternatively, the EQ-99X can be powered directly from a customer provided 12VDC power supply. See Chapter 3 for detailed information.

Lamp House Signal Connector (mini D sub – 9-pin)

Provides various power and control signals to/from the Lamp House module. No other connector or cable may be used with the EQ-99X other than the one supplied.

Armored Laser Fiber

The laser light is delivered from the Power Supply Controller to the Lamp House via a fiber optic cable with armored protection. The fiber is permanently attached to the Power Supply Controller, and connected to the Lamp House by an SMA-type connector. It is critical that this armored fiber be treated with care and inspected for any abnormalities prior to operation. Avoid sharp bends, which will permanently damage the fiber. Minimum bend radius is 30mm (1.18 in). Avoid crimping or compressing the fiber. See Chapter 3 for more information on installation and fiber end face cleaning.

Lamp House

The Lamp House assembly contains:

- Lamp
- Igniter
- IR pumping optics
- Output window
- Laser ON indicator
- Interface connectors

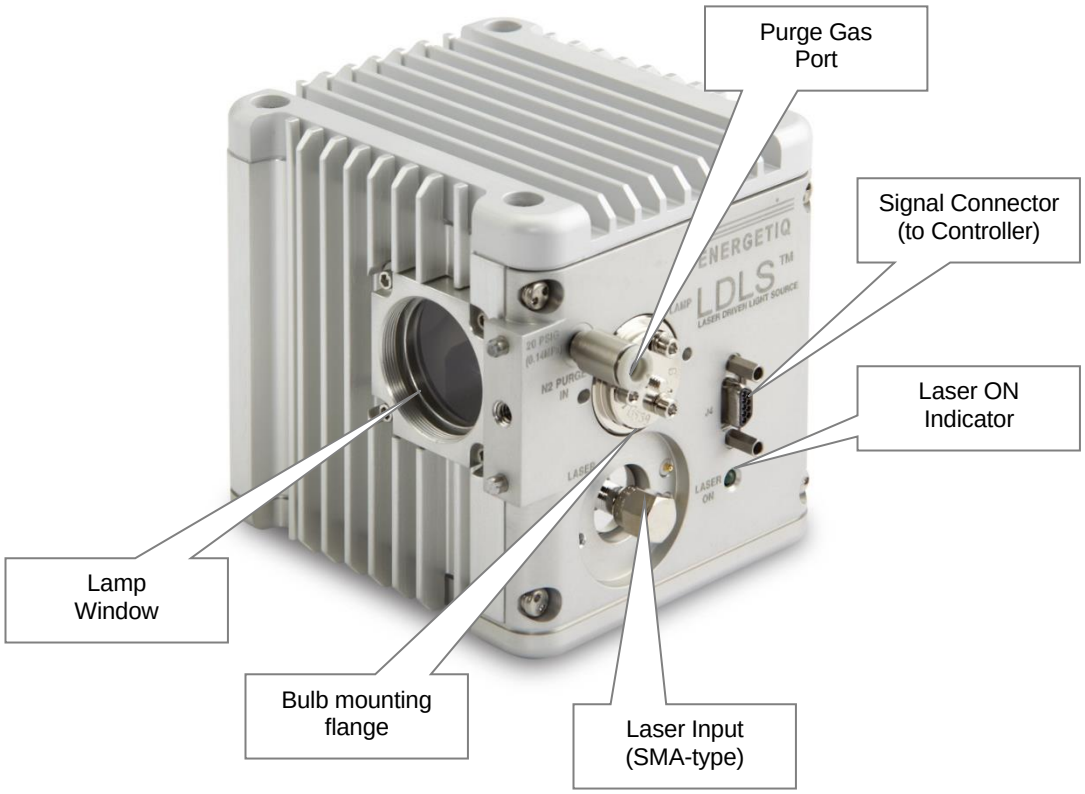


Figure 4: Lamp House Assembly

External features (refer to Figure 4):

Lamp Window

The lamp window at the optical output provides protection from the high pressure bulb inside the Lamp House. An internally-threaded SM1 adapter is provided for easy connection of optical hardware.

Nitrogen Purge Inlet

This is the inlet fitting for nitrogen purge gas. Purge gas is optional but is recommended for best performance. With no purge, ozone will form from atmospheric oxygen and attenuate

the light output in the 220 – 280nm band. In addition, atmospheric oxygen and water vapor will attenuate the output below 200nm.

There is no return fitting for the purge nitrogen. The purge flow normally escapes within the Lamp House enclosure, and then to atmosphere.

Laser Input

This is the inlet connector for the armored fiber from the Power Supply Controller. It contains a set of interlock pins that disable the laser when the SMA connector is not properly in place.

Laser On Indicator

This LED is illuminated when the laser is ON.

J4 Signal Connector (mini D sub – 9-pin)

Provides various power and control signals to/from the Power Supply Controller. No other connector or cable may be used with the EQ-99X other than the one supplied.

Chapter 3

INSTALLATION

Unpacking

Upon arrival, start by inspecting all parts of the system for completeness and any damage incurred in shipping. The EQ-99X shipping box should contain:

1) EQ-99X Power Supply Controller unit

1) EQ-99X Lamp House unit

1) Black interconnecting cable from Lamp House to Power Supply Controller (9 pin mini D-sub).

OPTIONAL

1) EQ-99-RC Remote Control Module with interlock connector

1) I/O cable with 15 pin D- connector at each end

1) 12 VDC Power Supply (universal input voltage)

Use care when unpacking to avoid damaging the armored fiber optic cable.

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-99X Lamp House or Power Supply Controller unit.

Connections

Installation of the EQ-99X consists of connecting electrical and gas supplies, and connecting the Lamp House module to the user's equipment.

Electrical Power

The EQ-99X requires 12VDC at 11.7A minimum (140W rating). Power consumption is approximately 100W during normal operation.

Power can be provided using the optional PS00018 12VDC power supply. Alternatively, power can be provided directly via a customer provided 12VDC power supply. The connector

on the EQ-99X is a latching connector. Once fully inserted, the connector will not release unless the body of the connector is pulled first. This protects from accidental removal of power if the power cable is pulled. Connect to a 12VDC source as follows:

Connector	Kycon KPPX-4P
Pins 3 & 4	+12VDC
Pins 1 & 2	12VDC return

Purge Gas

Purge gas is optional but is recommended for best performance. With no purge, ozone will form from atmospheric oxygen and attenuate the light output in the 220 – 280nm band. In addition, atmospheric oxygen and water vapor will attenuate the output below 200nm.

If required, connect a source of nitrogen purge gas to the port on the Lamp House. The fitting is a push-to-connect type, sized for 4 mm tubing.

Clean and dry nitrogen from either a dewar or research-grade N_2 bottle is recommended. Do not use any other purge gas. Grade 6 or better gas purity is recommended to maintain cleanliness of the optics, and gas should be filtered to <5um. Supply pressure should be 20 psig (0.14 MPa). With a 20 psig inlet pressure, the EQ-99X will consume approximately 1 slm of flow.

There is no return fitting for the purge nitrogen. The purge flow normally escapes within the Lamp House enclosure, and then to atmosphere.

Optical Interface

The lamp window accommodates a light output of 0.47 NA. A pair of pins and a 6-32 threaded hole are available for mounting. An internally-threaded SM1 adapter is provided for connection of optical hardware. See Figure 5 below for mechanical layout of the Lamp House.

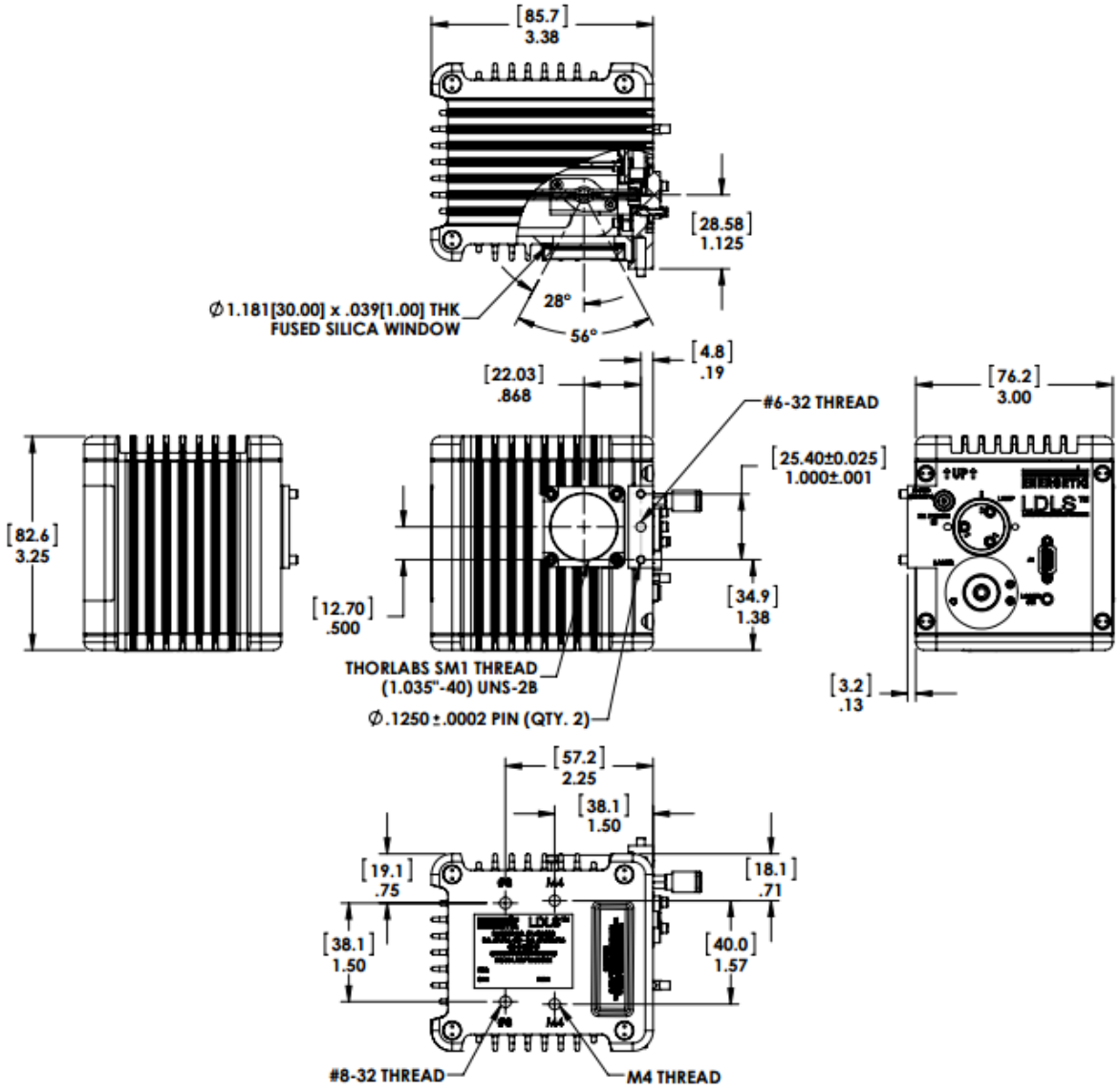


Figure 5: Lamp House mechanical layout

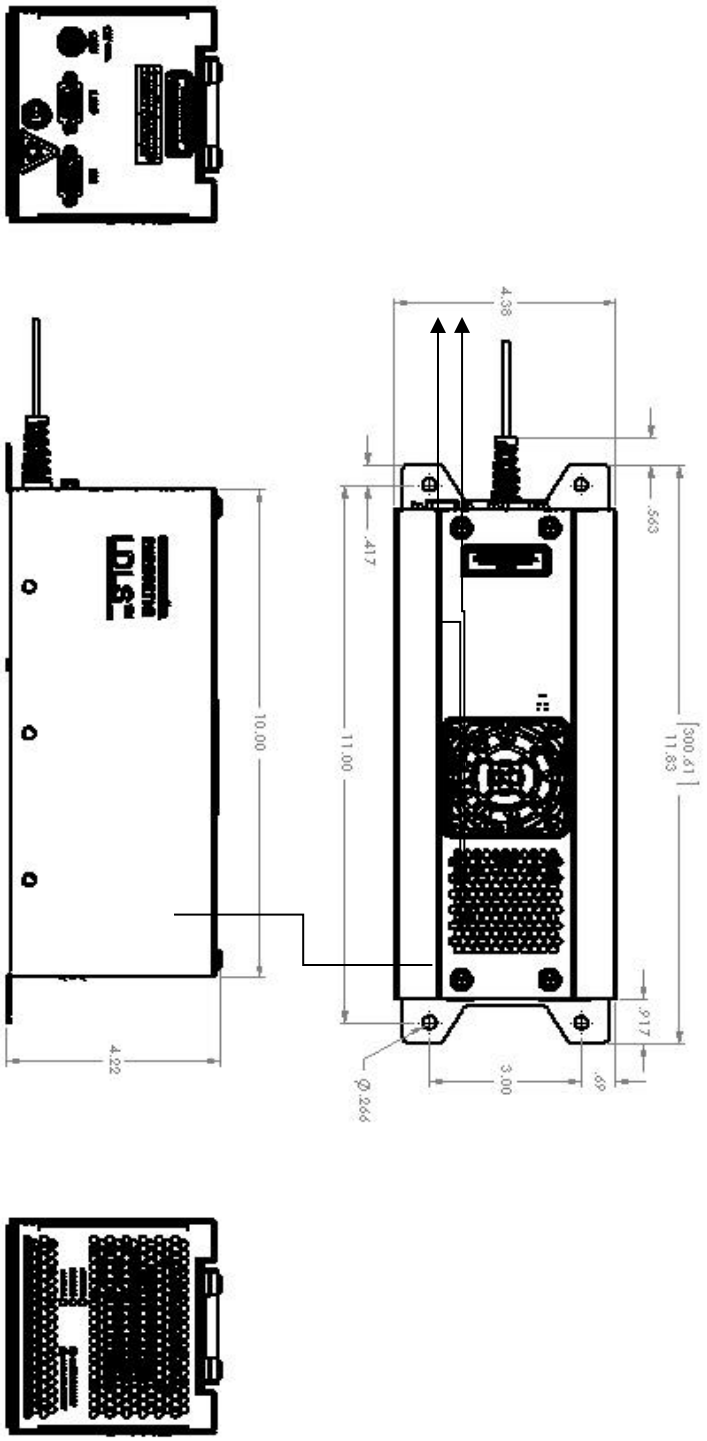


Figure 6: Power Supply Controller mechanical layout

Signal Connections

The EQ-99X is controlled through the remote I/O connector.

Table 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 interface 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 7 for pin connections.

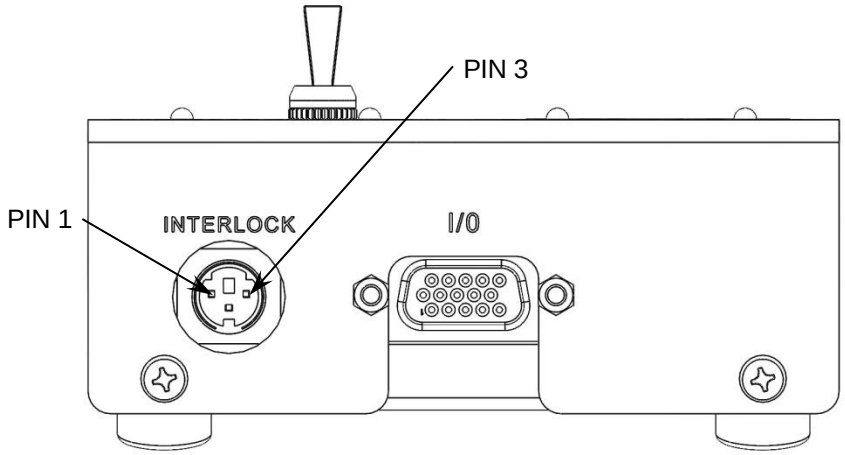


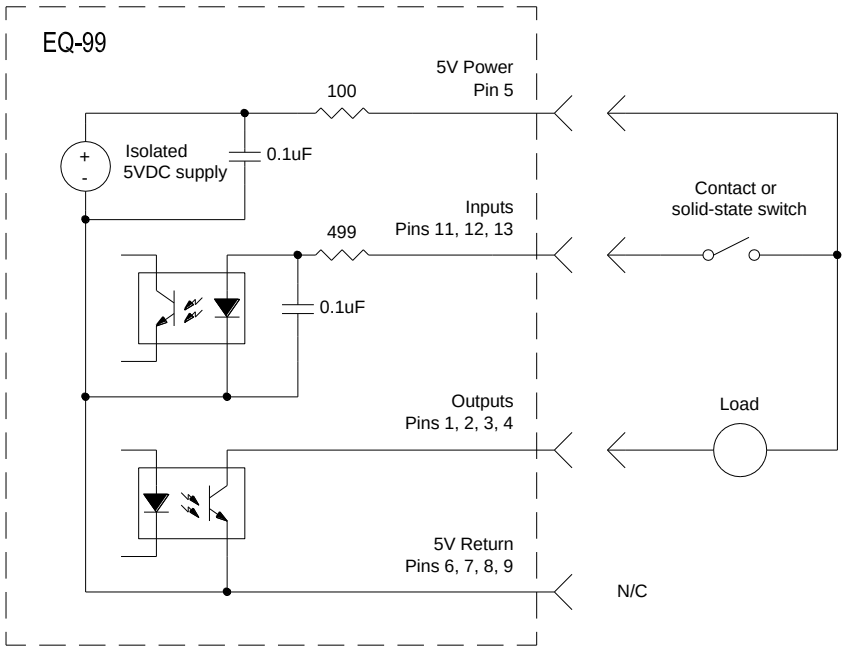
Figure 7: EQ-99-RC Remote Control Rear Panel

User I/O can be powered either by the EQ-99X internal isolated power supply, or an external supply.

Figure 8 shows connection schematics for both configurations.

Description	Pin #	Details
Commands (Inputs)		
LAMP OPERATE	12	OPERATE REQUEST, apply +5V (referenced to digital common) to initiate ignition
EXTERNAL INTERLOCK	13	EXTERNAL INTERLOCK, apply +5V (referenced to digital common) to close interlock and allow operation
Status Indicators (Outputs)		
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	50mA maximum, referenced to digital common
DIGITAL COMMON	6,7,8,9	Galvanically isolated from system
RESERVED	10, 11	Do not connect
RESERVED	14,15	Do not connect

Table 3: I/O Connector Pin Assignments



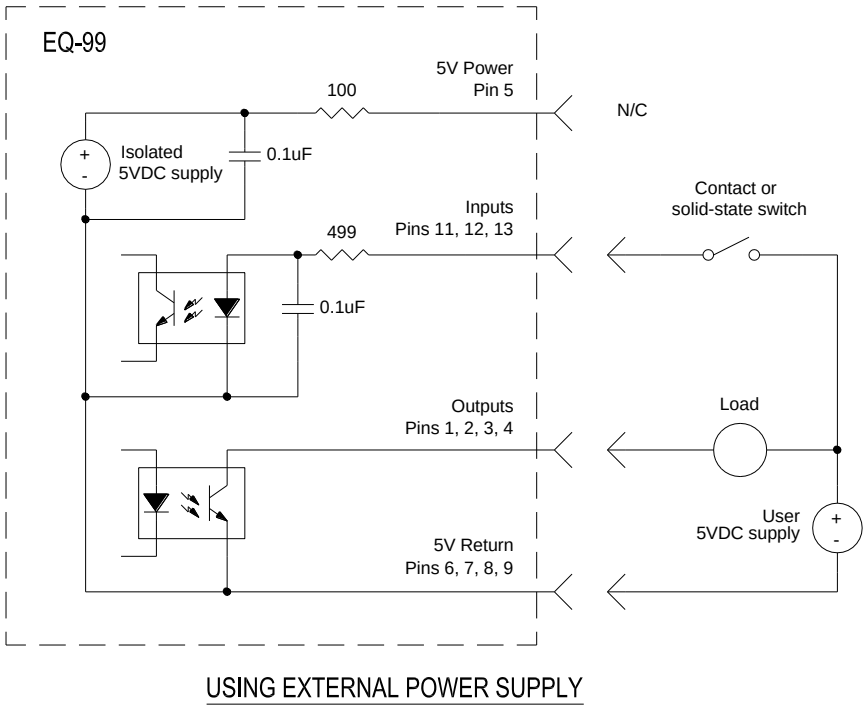


Figure 8: Remote Interface Schematic

Installation Procedure

1. Mount the Power Supply Controller unit rigidly to either an optical breadboard plate or another suitable mounting structure using the supplied tabs on the bottom of the chassis. The holes are sized to accept standard ¼-20 optical bench hardware, and spaced to be compatible with a standard 1" grid mounting hole pattern. See Figure 6 for dimensional and mounting details.

   Do not block the inlet or outlet air vents of the Power Supply Controller.

2. Connect the Lamp House unit output to the user equipment. 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 in the orientation shown in 3, with the output window on the side and the flat surface of the housing on the bottom. 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 problems. If using an optical fiber for the light output, this will result in slight misalignment and a resulting drop in output power.

3. 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-99X external interlock circuit.

4. Connect the black 9 pin mini D-sub interconnect cable from the Power Supply Controller (labeled TO LAMP) to the Lamp House (labeled J4).

5. The EQ-99X is delivered with the armored laser fiber connected to the lamp house. This is done to minimize the possibility of debris or particles contaminating the end of the laser fiber. Energetiq strongly recommends leaving the laser fiber connected, unless it is necessary to disconnect it for installation or routing of the laser fiber. If the laser fiber must be disconnected, apply SMA caps immediately to both ends, and follow directions on inspection and cleaning of the laser fiber described in Chapter 5.

   Use care when handling the fiber optic cable to avoid sharp bends, which will permanently damage the cable. Minimum bend radius for the cable is 30mm (1.18 in).

6. If necessary, connect the SMA connector to the Lamp House laser input and tighten. The SMA connector should be oriented such that the indicator line on the laser fiber is facing upwards (towards the bulb).

7. If required, connect nitrogen purge gas to the Lamp House. Refer to "Facilities Requirements" above.

8. Connect user's control system to the I/O interface connector per Table 3 and Figure 8.

9. 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.
10. Connect 12VDC input power source to the Power Supply Controller.

The system is now ready to operate.

Water Cooling Installation for EQ-99-CAL

The following only applies to the EQ-99-CAL model.

If your system is EQ-99-CAL, the following instructions will show how to connect the water cooling components that come packaged with the unit.

To properly complete the water cooling installation you will need locate the items shown in the figure below.

- Item 1 will be the Calibrated Lamp Head
- Item 2 will be Swagelok Fittings [¼" OD to ¼" OD] (2x)
- Item 3 will be ¼" OD Tubing [8ft length individually] (2x)
- Item 4 will be a Solid State Cooling Systems UC160-190 Chiller (not shown)

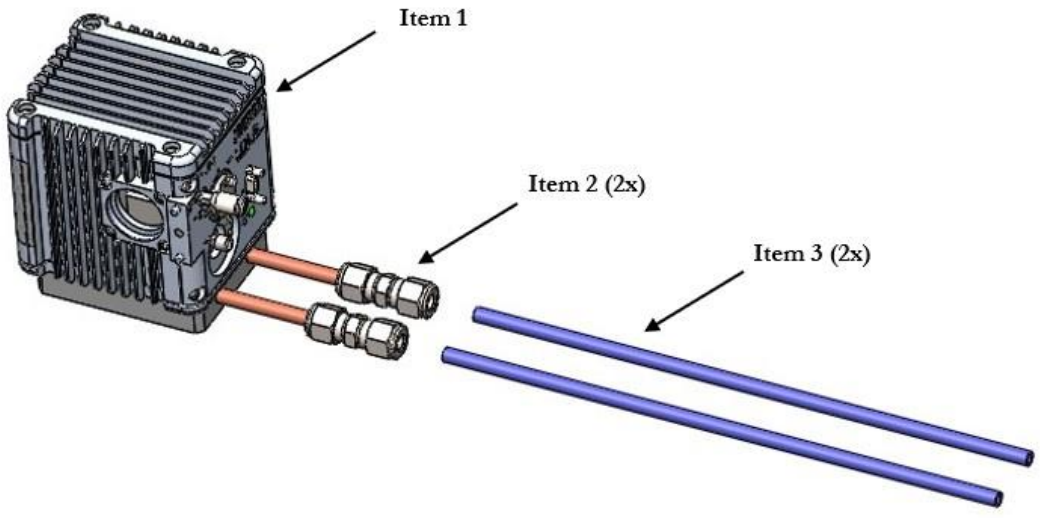


Figure 9: EQ-99-CAL Lamp Head Assembly

The procedure below will explain the proper steps to appropriately assemble the water cooling components of the EQ-99-CAL unit.

1. The Swagelok fittings will need to be attached to the two copper tubing, as shown in Figure 9.
    a. The ¼" end of the fitting will mate to the copper tubing.
    b. A 9/16" and ½" wrench will be required in order to complete the attachment.
2. The 1/4" end of the Swagelok fitting will connect to the two 1/4" OD Tubing, as shown in Figure 9.
    a. A **½"** and a 9/16" wrench will be required in order to complete the connection.
3. The open ends of the 1/4" tubing will connect to the "inlet" and "outlet" ports on the Solid State Cooling Systems UC160-190 Chiller.
    a. The ports on the chiller will be " quick disconnect " fittings, so the tubing should be pressed-in for a good seal.
    b. There are no designated ports for the two tubing. Either tubing can fit in any port.

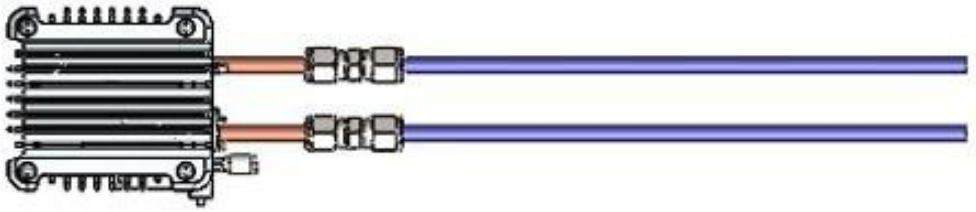


Figure 10: Assembled EQ-99-CAL Lamp Head

Chapter 4

OPERATION

Starting

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 Table 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-99X. The EQ-99X will automatically detect when the unit has reached the optimum conditions for ignition.
5. If a bulb fails to ignite, 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 service

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 12VDC 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 rather than turn the lamp off and on several times in a day.

Chapter 5

Maintenance

EQ-99 SMA Fiber Cleaning Process

Fiber Cleaning Basics:

- The LDLS laser fiber connector is carefully inspected and is clean prior to shipment. Energetiq strongly recommends leaving the laser fiber connected, unless necessary for installation or routing of the laser fiber.
- Operating the LDLS with a contaminated fiber introduces the risk of decreased performance or damage to the unit.
- Leave Laser Fiber SMA connected whenever possible.
- A fiber is considered clean when there are no particles on the fiber core or cladding that are detectable with >200X magnification.
- Follow the fiber inspection and cleaning process (Figure 11) before making a laser fiber SMA connection. As shown in the figure, inspecting and cleaning is an iterative process. The final step of the cleaning should always be a successful inspection. Sometimes the cleaning action redistributes particles from an area that is not visible with the inspection scope (and not problematic) to area that is visible (and is problematic). Because of this, we recommend that the first step is to remove any loose particles or debris with pressurized N2.

Fiber Caps:

- If the SMA fiber must be disconnected, always use a white Delrin cap on the laser fiber end, and red cap on the lamp head.
- Store caps open side down when possible.
- The threads on the caps can store and migrate or transfer metal particles, which are particularly problematic to the laser fiber. Blow out caps with CDA (Clean Dry Air) or N2 prior to use.
- Never leave the fiber disconnected without a cap.

CAUTION

Disconnect power from the EQ-99 Power Supply Controller unit before performing fiber inspection.

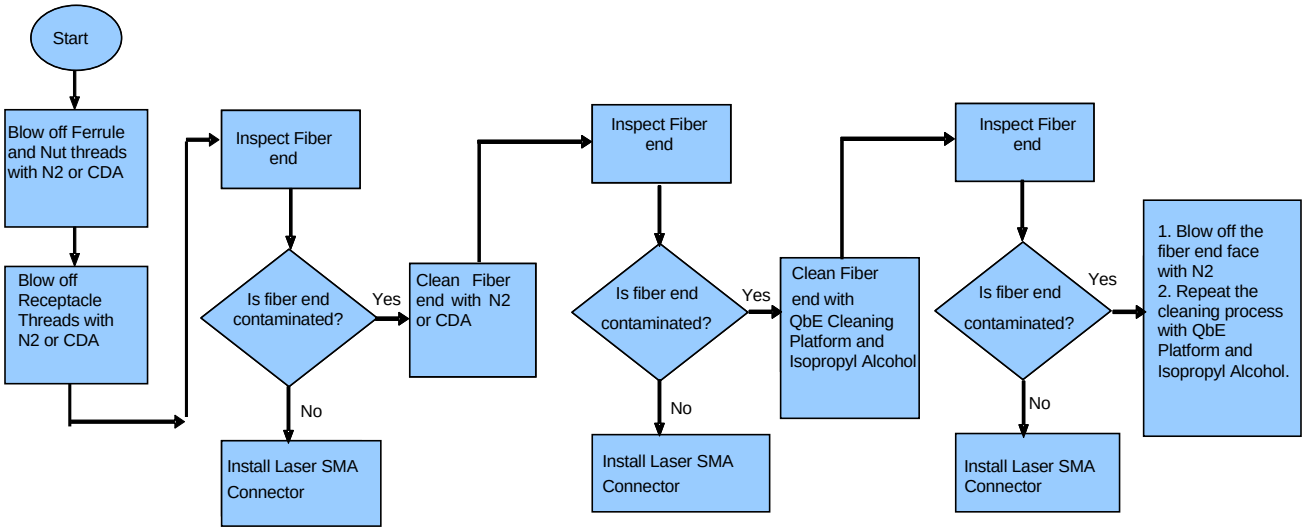


Figure 11: Fiber Cleaning Process Flowchart

The fiber endface may not have any particles on the core or cladding that are detectable with >200X magnification (see Figure 4).

Fiber Inspection Tools

Figure 13: FS-201 Handheld Fiber Inspection Scope

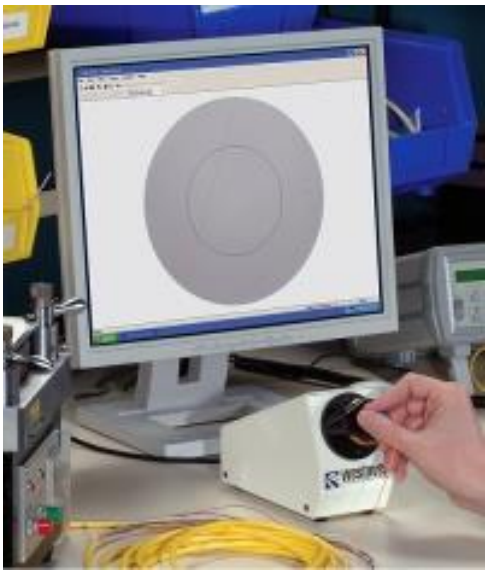


Figure 12: JDS Uniphase / Westover FVD-2400 Benchtop USB/PC Operated Fiber Viewer

Note – A special SMA adapter must be used with either the FS201 handheld inspection scope or the Westover Digital inspection scopes. This custom adapter allows the scope to be used with the EQ-99 laser fiber and integral interlock ring. The custom adapter may not be compatible with other fiber inspection equipment.

The following fiber inspection equipment can be purchased from Energetiq:

Energetiq Part Number	Description	Use
MW-00518	FS201 Fiber Inspection Scope with Custom SMA Adapter	Standalone Fiber Inspection
MW-00516	Custom Adapter from FS201 to EQ-99 Fiber	For use with an existing FS201 Fiber Inspection Scope
MW-6537	Custom Adaptor from Westover Digital Microscope to EQ-99 Fiber	For use with an existing Westover Digital Microscope

Examples of Fiber Images

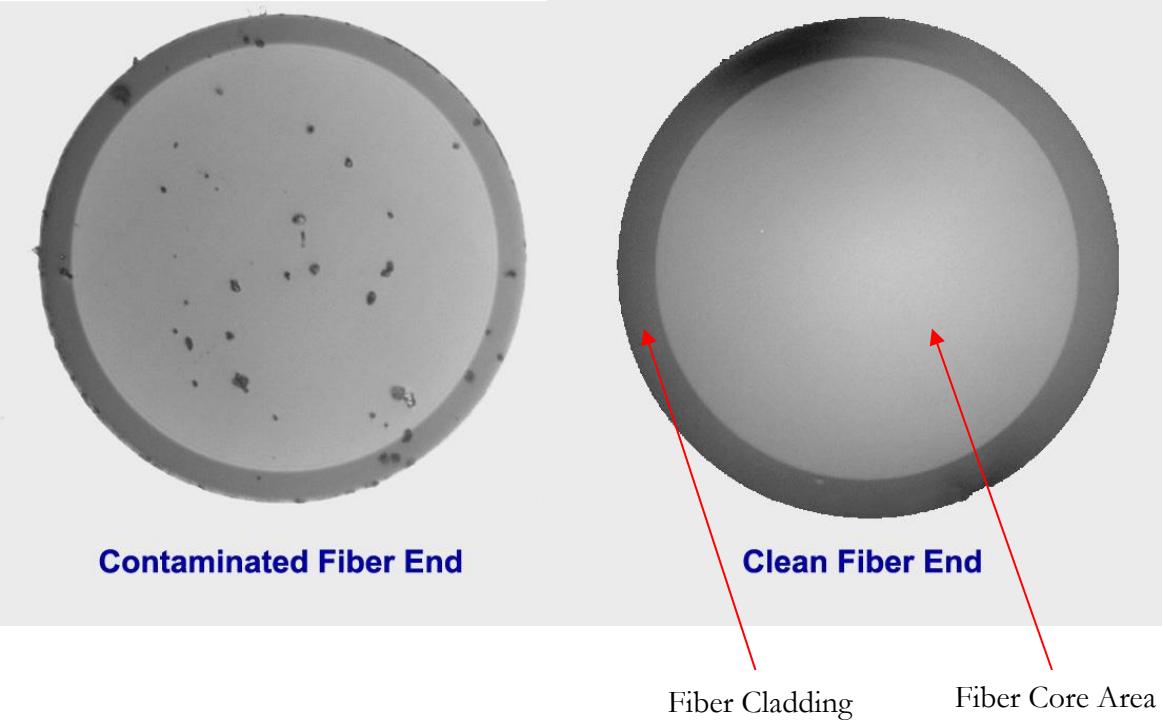


Figure 14: Fiber End Images

Fiber Cleaning Tools

1. Clean Dry Air or Pressurized Nitrogen
2. Dust Off (or similar clean, compressed air)
3. QbE Cleaning Platform (www.chemtronics.com/qbe-cleaning-platform-3)
4. Isopropyl Alcohol

To clean with the QbE Cleaning Platform, gently press the fiber end face into the cleaning cloth or wipe, rotate in place several times, then reduce pressure and drag the fiber 1-2 cm across the cleaning cloth or wipe.

Part Description	Chemtronics QbE Cleaning Platform
Part Number	QbE
UPC	32599094887

Fault Indicator Block Diagram:

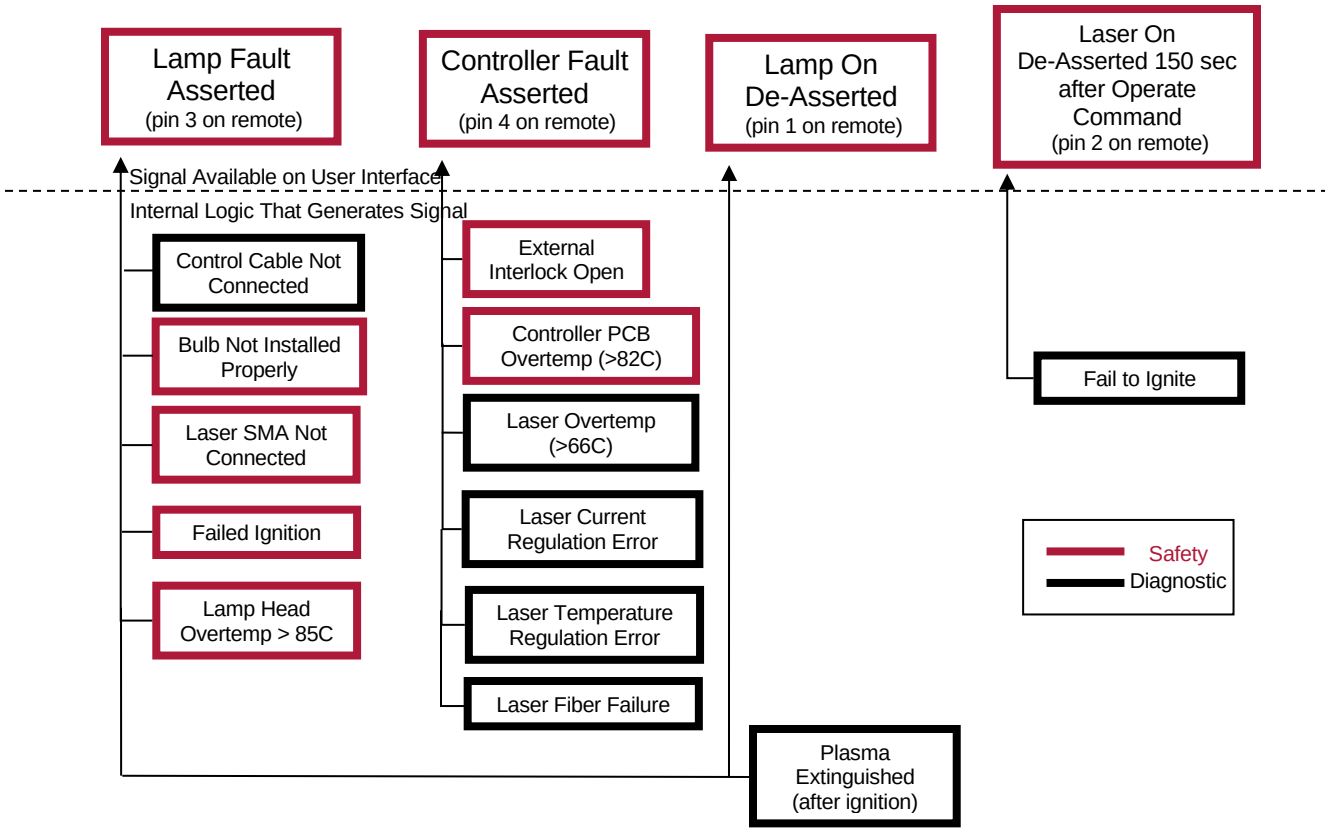


Figure 15: Fault Indicator Block Diagram

See below if any problems are encountered in operating the EQ-99X.

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)
- Check that the bulb and laser fiber are properly connected at the Lamp House unit.
- To reset or clear a Fault condition, the 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.

Lamp Replacement

Contact Energetiq if a bad lamp is suspected.

Appendix A

REVISION CONTROL

Version Number	**Modified By**	**Modifications Made**	**Date Modified**
Rev. 4	M. Steinberg	Updated CE Mark, Logo, Page footer format, Fiber Cleaning Procedure, added Appendix A	March 2018
Rev. 5	L. Chan	Updated: 1. Declaration of Conformance with latest standards 2. Laser safety labels to reflect latest standards' dates. 3. Manuf. Label to reflect correct Energetiq address 4. Fig. 2 Typical Output Spectrum. 5. Water Cooling Installation for EQ-99-CAL section. 6. Energetiq Address on document	June 2022

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