

Frequently Asked Questions (LDLS)

The information in this document is based on typical values and should be used for guidance in the selection and use of LDLS products. The data included should not be taken as specifications. If you have a question that we have not answered here, please contact us via email at info@energetiq.com for further details.

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Purchasing

How do I request a quotation for Energetiq light sources?

Energetiq is a subsidiary of Hamamatsu Photonics. In most countries, Hamamatsu distributes LDLS and LDTLS products. Please visit the [Hamamatsu website](#) to submit a request for a quotation or email us at info@energetiq.com to be connected to the right contact for your location.

Certain regions are serviced by trusted distributors. Please visit [our website](#) to determine the right office to direct your inquiry.

Are custom configurations available?

Custom configurations are available to meet stringent OEM application requirements.

Please contact us at info@energetiq.com to initiate a discussion.

Laser Safety

Are LDLS laser products?

No. During all normal operation of LDLS there is no laser output. Our products create incoherent broadband radiation. In a contained system, a laser is used to sustain a xenon plasma and the radiation exiting the LDLS is from the plasma.

What Laser Class are LDLS?

LDLS Model	Laser Class
EQ-99X	Class 1 (IEC 60825-1: 2014)
EQ-9	Class 1 (IEC 60825-1: 2014)
EQ-77	Class 1 (IEC 60825-1: 2014)
EQ-400	Class 4 (IEC 60825-1: 2014)
EQ-99X-FC	Class 1 (IEC 60825-1: 2014)

LDLS Performance

What is the spectral range of the LDLS?

EQ-99X, EQ-9, EQ-77, and EQ-400 have a spectral range of 170 nm to 2500 nm.

The EQ-99X-FC has a spectral range of 190 nm to 2500 nm.

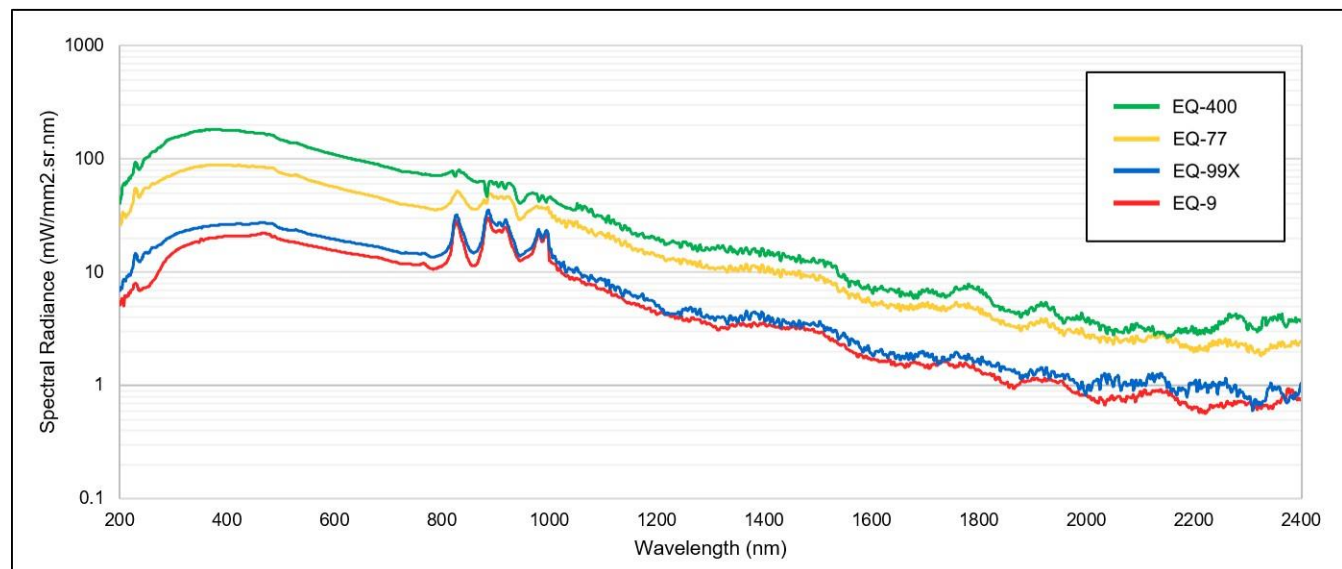
What are the options for the output window material of the LDLS? What window type is right for my application?

EQ-99X, EQ-9, EQ-77, and EQ-400 have a spectral range of 170 nm to 2500 nm.

Window selection decisions are typically influenced by the effect of ultraviolet light on your application. The standard configuration for all LDLS models is with a quartz (QZ) output window. For applications that suffer from UV exposure, YAG and BK7 windows offer the benefit of filtering out energy from 170 nm – 190 nm and 170 nm – 350 nm, respectively. MgF windows are ideal for applications that benefit from enhanced deep-UV radiance from 170 nm – 250 nm.

What is the radiance performance of the free space LDLS?

LDLS Model	Typical Radiance at 500 nm
EQ-99X	~ 25 mW/mm ² .sr.nm
EQ-9	~ 20 mW/mm ² .sr.nm
EQ-77	~ 75 mW/mm ² .sr.nm
EQ-400	~ 110 mW/mm ² .sr.nm



What is the Numerical Aperture (NA) of each of the LDLS?

LDLS Model	Numerical Aperture
EQ-99X	0.47
EQ-9	0.56
EQ-77	0.5
EQ-400	0.5
EQ-99X-FC (with fiber output)	0.22

What is the total broadband optical power of the LDLS?

LDLS Model	Broadband Optical Power*
EQ-99X	0.75 W
EQ-9	0.5 W
EQ-77	2.75 W
EQ-400	15 W
EQ-99X-FC (with fiber output)	95 mW**

*Measured with thermophile

**UVFIBERX-230 fiber optic cable

Are collection optics available for free-space LDLS models?

We offer off-axis parabolic mirror (OAP) assemblies that can be used with the EQ-99X and EQ-77 models that collect, collimate and focus the spectral output.

Please refer to the table below for additional information:

	4" EFL OAP	6" EFL OAP	8" EFL OAP
Effective Focal Length (EFL)	4.0"	6.0"	8.0"
Diameter	1.5"	1.5"	1.5"
Magnification	2X	3X	4X
Numerical Aperture	0.188	0.125	0.094
F/#	2.67	4.0	5.33

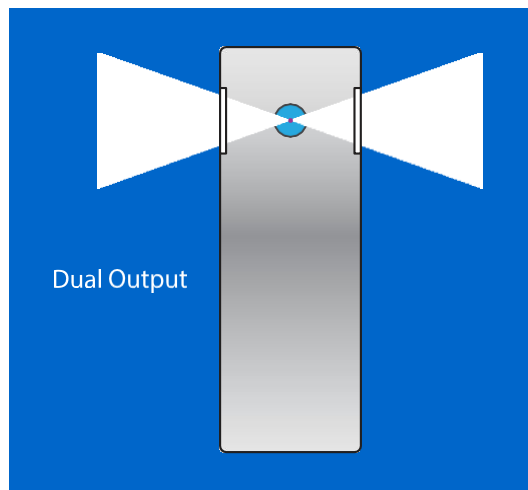
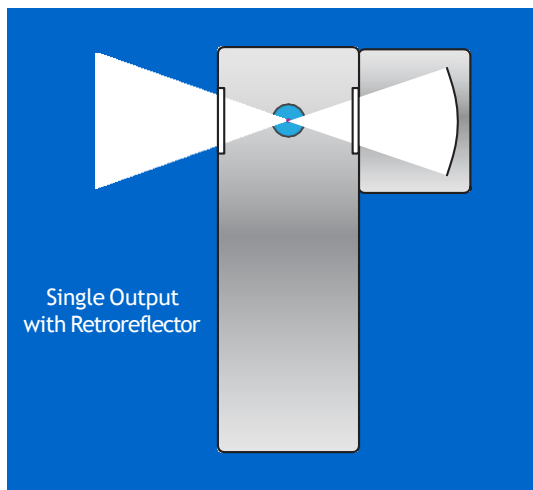
How far is the center of the plasma from the output window of the free space LDLS?

Average distance of plasma from output window:

LDLS Model	Distance
EQ-99X	28.00 mm
EQ-9	20.00 mm
EQ-77	18.00 mm
EQ-400	28.00 mm

Is it possible to purchase an LDLS with a dual output?

The EQ-9, EQ-77, and EQ-400 can be purchased without a retroreflector allowing for a dual output configuration. Please email us at info@energetiq.com to be connected with an Applications Engineer who can help you determine if this configuration is appropriate for your application.



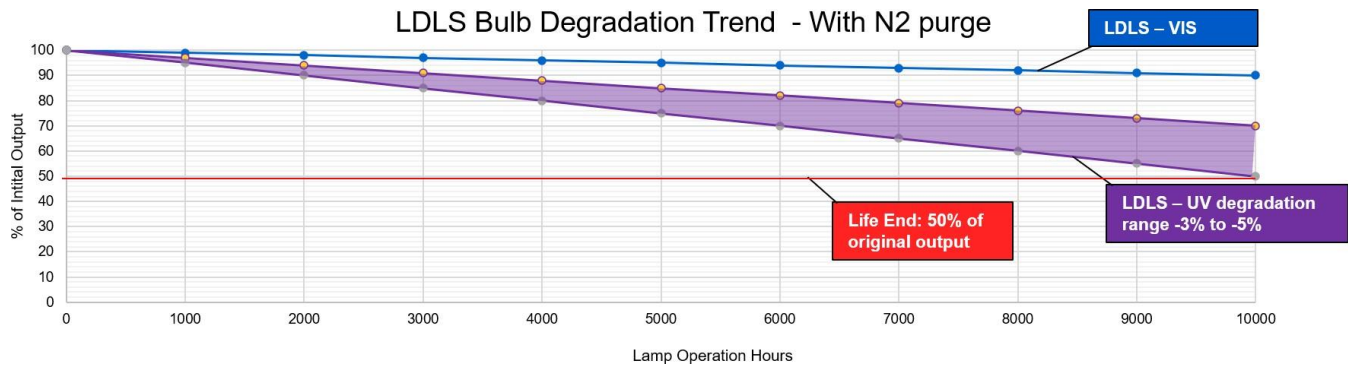
Preventive Maintenance / Service

What is the lifetime / output degradation of the LDLS?

Energetiq recommends changing the bulb after 10,000 hours of operation or once each calendar year, whichever comes first.

We define the lifetime of the lamp / bulb as when the intensity has dropped more than 50% at 500 nm.

The spectral output at 500 nm decreases about 1% - 2% every 1,000 hours under standard operating conditions with nitrogen purging.



How do I initiate an RMA?

Contact your local Hamamatsu office or distributor for service requests. If you are unsure who your contact is, email us at service@energetiq.com for assistance.

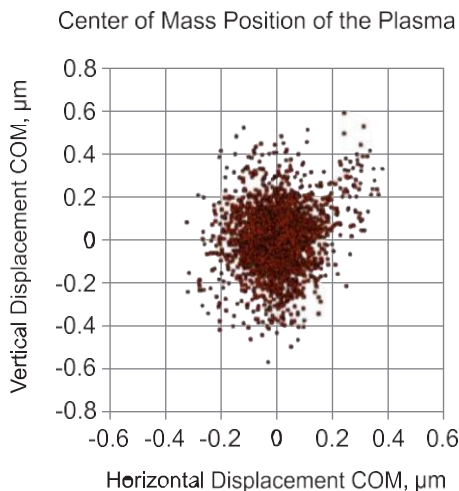
What is the standard warranty for an LDLS?

Standard warranty is 12 months. Extended warranties are available for certain models and circumstances.

Stability

What is the spatial stability of the plasma of the LDLS?

The position of the plasma is very precisely positioned in space at the focal point of the laser that sustains it. The standard deviation of the plasma light intensity 'center of mass' position is less than $0.5\mu\text{m}$ in the x or y position.



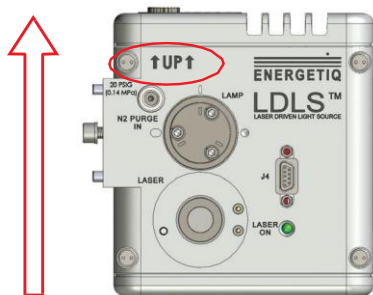
What is the average plasma size of the LDLS?

LDLS Model	Average Plasma Size
EQ-99X	100 μm x 180 μm
EQ-9	85 μm x 200 μm
EQ-77	125 μm x 320 μm
EQ-400	370 μm x 800 μm

Operation

What is the recommended orientation of the lamphead?

The EQ-99X and EQ-99X-FC must be operated with the lamphead in the position shown to the left. This is particularly important for the EQ-99X-FC as it must be mounted with the output fiber optic connection on top. The plasma moves slightly depending on gravity and the precision ellipsoidal coupling optics in the EQ-99X-FC have been adjusted at the factory to optimize output in that particular orientation.



EQ does not recommend operating any LDLS lamphead at tilted angles. Operating the lamphead at a tilted angle will change the laser forces applied onto the plasma and may extinguish the plasma.

What is the warm-up time of the LDLS?

Energetiq recommends a warm-up time of approximately 30 minutes before taking measurements, to ensure that the LDLS system has reached thermal equilibrium. The actual warm-up time for an application may be longer or shorter depending on the precision of measurements to be made.

Nitrogen Purging

When do I need to purge the LDLS?

For EQ-99X, EQ-99X-FC, EQ-9 it is recommended to purge the LDLS with dry nitrogen while operating. For EQ-77 and EQ-400 it is required to nitrogen purge.

LDLS products emit significant amounts of deep UV light. Light below 200nm produces ozone in the presence of oxygen, and the ozone produced has an absorption band in the 220nm to 280nm range. To use light from the LDLS in the 170 to 280nm range, the system should be purged with high purity nitrogen. Purging with high purity nitrogen also reduces the possibility of photo-contamination of the bulb from trace organic vapors present in room air.

What grade of nitrogen is recommended to use in the purging process?

For nitrogen purge, a grade of 4.8 or higher purity is recommended to maintain the optics' cleanliness.

What pressure is required for the dry nitrogen purge?

The inlet pressure of nitrogen supply should be set at 20psig (0.14 MPa) for all LDLS models. At the 20 psig, the N₂ consumption rate is typically at 0.4 liters/min.

The EQ-99X, EQ-99X-FC, EQ-77, and EQ-400 models have gas restrictor(s) installed. Their users can also control nitrogen flow rate using a gas flow regulator. The nitrogen flow rate guidance is 0.4 liters/min +/- 0.1 for the lamphouse. For LDLS models with a retroreflector installed, there may be additional nitrogen flow guidance for the retroreflector. Please see user guides for individual LDLS models and/or laser marking on the retroreflector.

On the EQ-99X lamphouse, there is no outlet fitting for the purging nitrogen. The nitrogen purge gas leaks out of the lamphouse enclosure through the non-hermetic gaps to the atmosphere. For LDLS models EQ-77 and EQ-400, the lamphouse includes a nitrogen purge gas inlet and outlet. For more details, please see user guides for individual LDLS models.

Can you purge with other gases besides nitrogen?

No. Only high purity nitrogen can be used to purge the LDLS systems.

Can you put a vacuum on the lamp house instead of purging with nitrogen?

No. The LDLS systems will not hold a vacuum and connecting to a vacuum may cause damage to the optics.

Can I use the LDLS in a cleanroom environment?

It is not required. However, the standard operating environment for LDLS is in a cleanroom with nitrogen purging. The EQ-9, EQ-77 and EQ-400 have additional cooling requirements.

Cooling Requirements

Do LDLS systems require external cooling?

The EQ-99X and EQ-99X-FC do not require auxiliary cooling. The EQ-77 and EQ-400 both require water cooling.

Read our Technical Note for a full explanation of the cooling requirements for the EQ-400.

EQ-77	EQ-400
Lamphead: 0.5 liter/minute, 18 - 30°C, 100 psig (0.69 MPa) max. inlet pressure	Lamphead: ≥ 1 liter/minute, 18 - 30°C Controller: 3 - 4 liters/minute, 18 - 24°C Technical Note: https://www.energetiq.com/eq-400-water-cooling

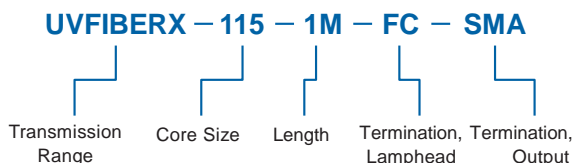
Fiber-coupled LDLS

Is there a fiber coupled version of the LDLS?

Yes, the EQ-99X-FC is a fiber coupled version of the EQ-99X free space LDLS. Energetiq sells two types of fibers for use with the EQ-99X-FC LDLS. They are UV-Vis Solarization Resistant (UV) and Broadband (BB).

What is the difference between UV-Vis Solarization Resistant (UV) and Broadband (BB) fibers?

Both the UV-Vis and Broadband fibers transmit from 190 nm – 2500 nm. However, the UV-Vis fibers are constructed using high OH material and are engineered to withstand ultraviolet solarization. They provide higher output from 190 nm – 900 nm when compared to Broadband fibers of comparable core size.



UVFIBERX Transmission Range	115 Core Size	1M Length Size	FC Lamphead Termination	SMA Output Termination
UV →	115 µm 230 µm 455 µm	1 m	FC	FC
or BB →	100 µm 200 µm 400 µm 600 µm	or 2 m		or SMA

The UV fibers are ideal for applications benefiting from enhanced radiance from 190 nm – 350 nm and the BB fibers are preferable for applications that benefit from enhanced radiance from 350 nm – 2500 nm.

What is the fiber output termination?

All fibers connect to the lamphead via FC connection and are available with either SMA or FC output termination. The user can select the termination for the output end of the fiber according to their application requirements.

How do I select the correct fiber for my application?

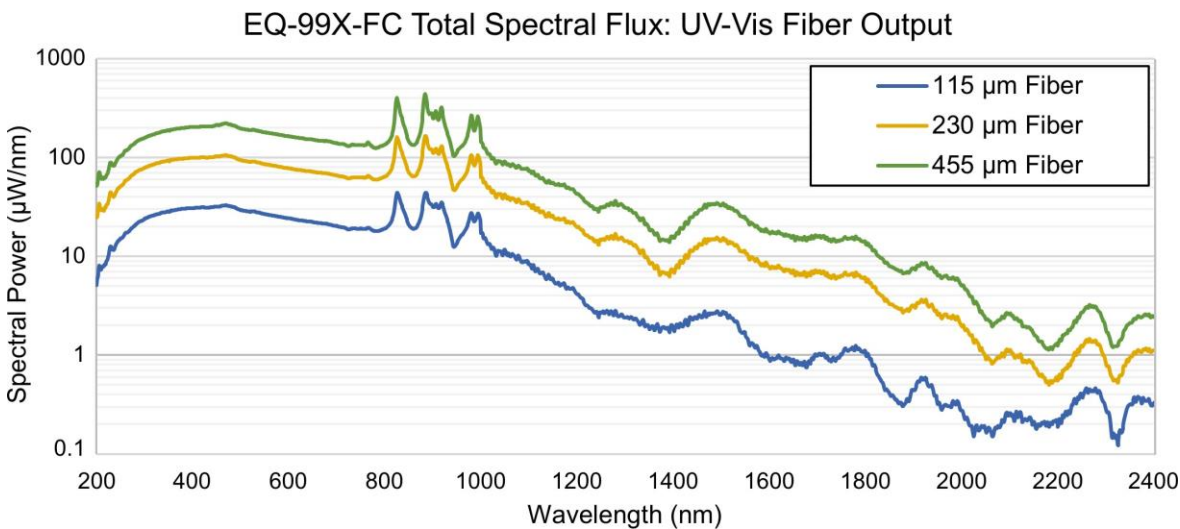
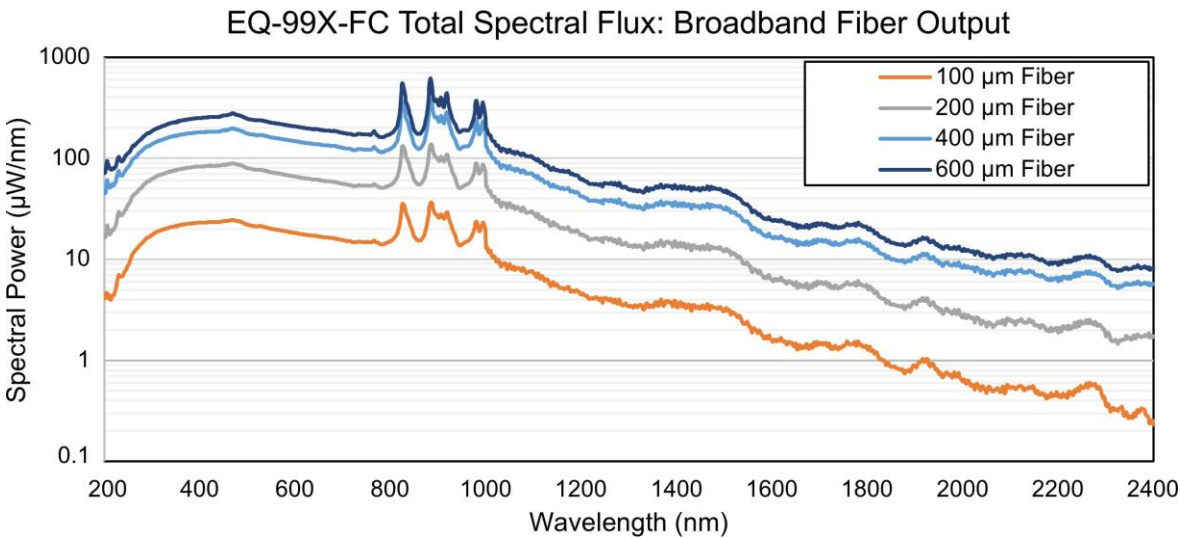
First you must select either the UV-Vis or Broadband fiber type as described above. For each fiber type there are multiple core size options. Every fiber is available at 1 or 2 meter of length and are available with either SMA or FC output termination. Reference the Fiber Optic Cable Assemblies data sheet for additional information.

For instance, the UVFIBERX-115-1M-FC-SMA is a UV-Vis fiber with a 115 µm core size, 1 meter length and SMA output termination.

What is the total output power performance of the available fibers?

The table below shows the average total power output for each fiber as measured with a thermopile. For detailed power data, refer to the graphs below.

Type	Core size	Length	Total Broadband Spectral Power
UV	115 μm	1 meter	30 mW
UV	230 μm	1 meter	95 mW
UV	455 μm	1 meter	195 mW
BB	100 μm	1 meter	25 mW
BB	200 μm	1 meter	80 mW
BB	400 μm	1 meter	180 mW
BB	600 μm	1 meter	215 mW



What should I use to collimate the EQ-99X-FC?

There are four collimator assembly models available to purchase from Energetiq for use with the EQ-99X-FC. You should select the collimator based on your area of illumination and the output termination of the fiber optic cable assembly you plan to use.

Part Number	Beam Diameter	Fiber Connection
EQ-99-COL-6-SMA	6.6 mm	SMA
EQ-99-COL-6-FC	6.6 mm	FC
EQ-99-COL-11-SMA	11 mm	SMA
EQ-99-COL-11-FC	11 mm	FC

Is it possible to use non-Energetiq fibers to couple the EQ-99X-FC LDLS?

Our proprietary fibers must be used with the EQ-99X-FC. Using off-the-shelf, commercially available fibers can cause damage to the lamphouse and are not approved for use with the LDLS.

What is the numerical aperture of the fibers? Is the fiber PC or APC? Is the fiber narrow key or wide key?

All EQ-99X-FC fibers have a numerical aperture (NA) of 0.22 and are PC type with narrow key.

Is there a limit on the output fiber length from the lamp house to the application?

For both the UV resistance and broadband fibers, EQ offers one and two meter long fibers. Since even the best optical fibers absorb light in the deep UV, it is recommended to use the shortest fiber length possible to maximize the potential of the LDLS.

For the EQ-99X and EQ-99X-FC, what are the restrictions on the laser fiber between the lamphead and the power supply?

The standard configuration of the EQ-99X and EQ-99X-FC has one meter long laser fiber between the lamphead and power supply.