RESONANCE LTD
Optical Solutions & Technologies

24W RF-Powered Light Sources Manual

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Description

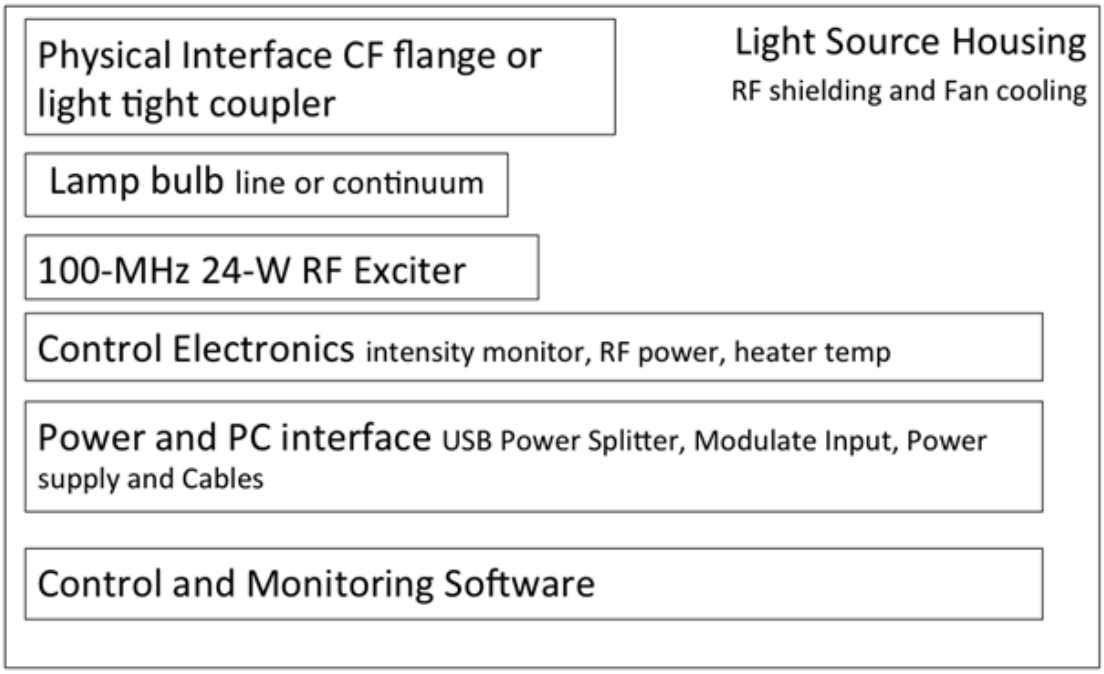
The *Resonance* 24-W RF-powered Light sources are reliable, compact, and maintenance-free sources of gas spectral lines and continua from the 25 to 7,000 NM. These light sources are sealed with UV/IR windows, packaged in EMI-shielded enclosures, and have operating lives of thousands of hours. Standard and custom mounting flanges are offered to adapt the source to the user's optical system or vacuum chamber.

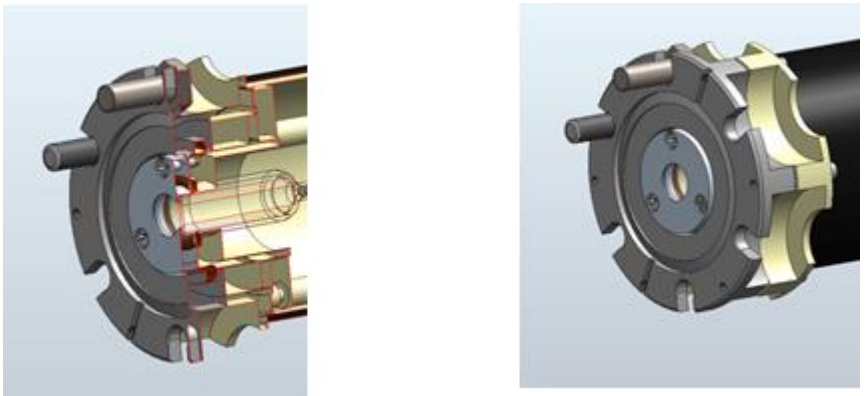
Common Features of 24W RF-Powered Light Sources

- 24W RF exciter 100 MHz
- EMI shielded enclosure
- Control and Monitoring Electronics include
  - Intensity Monitor (on selected models)
  - Case Temp Monitor
  - Heater Control (as required in solid source lamps)
- Modulation 5V off 0V on (default on) 0 to 400 Hz.
- USB control (excluding EUV-XL-L flowlamp)
- 100 to 250V AC, DC power supply
- Vacuum Interface or Optical Interface for lamps in UV Vis region
- OEM versions available
- Control and Monitoring Lamp PC software interface includes
  - Control panel for changing lamp setup
  - Data logging and display and file saving

Diagram

Block Diagram for 24W RF-Powered Light Sources





Lamp bulb mounting for KrLM-L, XeLM-L, KrCM-L, XeCM-L etc.

Configurations

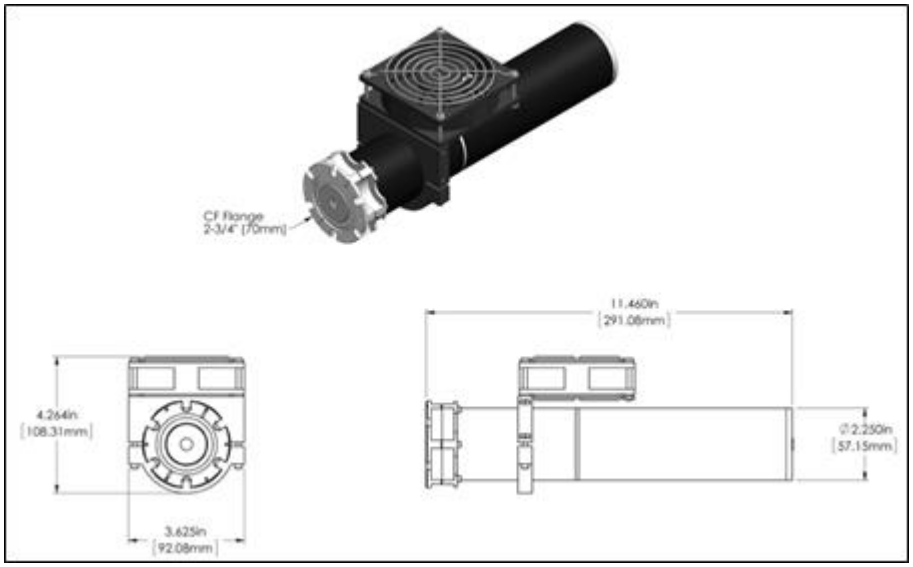


Figure 1: Configuration of all L, LOT Models except EUV-XL-L shown in fig. 3

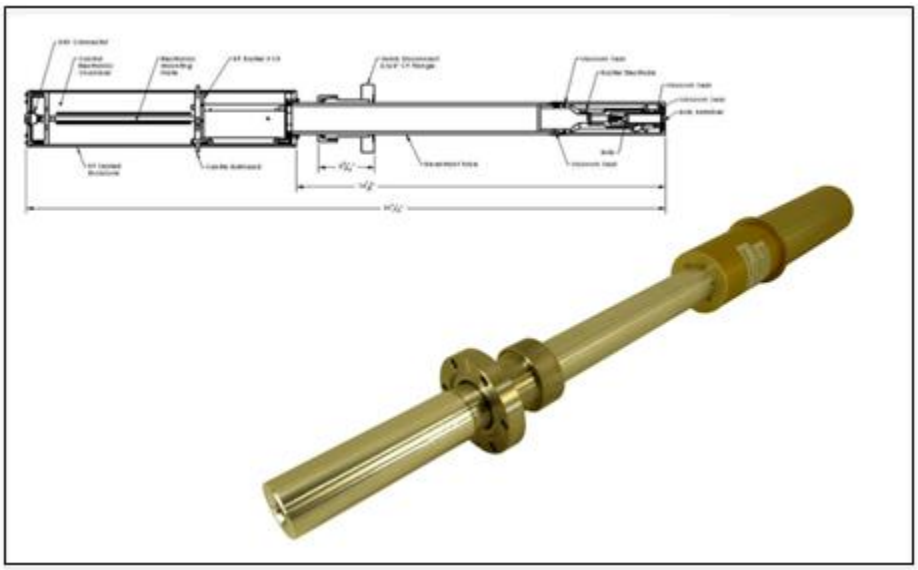


Figure 2: Configuration of all LDQ12 Models (see table 1)

Configurations (continued)

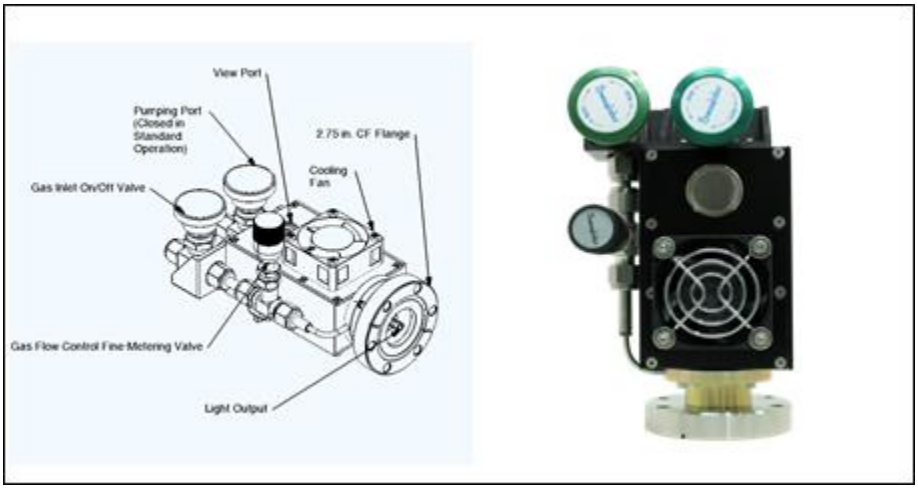


Figure 3: Configuration of EUV-XL-L model (28-Watt RF-Powered Flow Lamp)

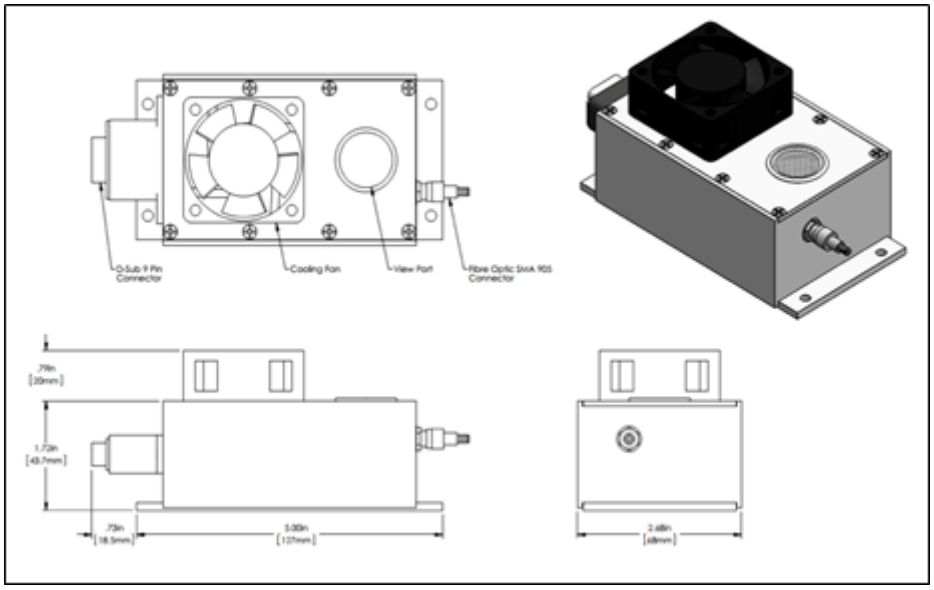


Figure 4: Configuration of LFO Fiber-Optic-Output Lamps

Model Features

Model	Line Continuum Molecular	Window	Principal Lines/Continua of Interest	Thermally Controlled Gas Source	Distance of Lamp Front (window) into Vac. Chamber in cm.	Heater Control and Monitor	USB Lamp Control Interface	Optically Thin Version for Fluorescence/ Absorption	Notes
EUV-XL-L	L, M	None	58	N	NA	Option	Option	N	Reflective Tube Available
KrLM-L	L	MgF2	116.5, 123.6	N	0	N	Y	N	
KrLM-LQD12	L	MgF2	116.5, 123.6	N	11 – 30	N	Y	N	
ArLL-L(1)	L	LiF	104, 106	N	0	N	Y	N	
XeLM-L	L	MgF2	147	N	0	N	Y	N	
XeLM-LQD12	L	MgF2	147	N	11 – 30	N	Y	N	
HHeLCMM-L *	L, C, M	MgF2	122, 160, 240	Y	0	Y	Y	Y	Spectrum varied with heater
DHeLCMM-L	L, C, M	MgF2	122, 160, 240	Y	0	Y	Y	Y	Spectrum varied with heater
HgArLQ-L	L	MgF2	185, 254	Option	0	Option	Y	Y	
OHeLM-LOT	M	MgF2	130	Y	0	Y	Y	Y	Suitable for Fluorescence
NHeLM-LOT	M	MgF2	120	Y	0	Y	Y	Y	Suitable for Fluorescence
ClHeLM-LOT	M	MgF2	118	Y	0	Y	Y	Y	Suitable for Fluorescence
ARCM-L	L, C	MgF2	125c	N	0	N	Y	Y	Continuum 30nm Wide
KrCM-L	L, C	MgF2	116.5, 123.6, 145c	N	0	N	Y	NA	Continuum 30nm Wide
XeCM-L	L, C	MgF2	147, 172c	N	0	N	Y	NA	Continuum 40nm Wide
XeCM-PC	L, C	MgF2	147, 172, 240	N	0	N	Y	NA	Xe cont. Phos 220 – 250nm
OHArMQ-LOT	M	QTZ	300	Y	0	Y	Y	Y	Suitable for Fluorescence
NOArMQ-LOT	M	QTZ	230	Y	0	Y	Y	Y	Suitable for Fluorescence
COArMM-LOT	M	MgF2	150	Y	0	Y	Y	Y	Suitable for Fluorescence
OArLP-L	L	Pyrex	557.7	N	0	N	Y	NA	Aurora Green Line
O2ArLP-L	M	Pyrex	Atm. Bands	N	0	N	Y	NA	Airglow O2 Atm. Bands
KrLP-LFO	L	Pyrex	557	N	NA	N	N	NA	Simulates Aurora
NeLP-LFO	L	Pyrex	630	N	NA	N	N	NA	Simulates Aurora

(1) Special Order *also called HHeLM-L ** *also called DHeLM-L

Operating Warnings

Warning: Eye Hazard

Do not look directly at the light source plasma unless wearing glasses. Normal eyeglasses will block extreme UV of all light sources except mercury and deuterium. For these light sources use special UV-blocking glasses.

Warning: Avoid Damaging Window Seal

Do not use chloroform, acetone, xylene or vinegar to clean the light source window. Use of these (or similar based solvents) might dissolve the window or the window seal.

Operating Procedure

For Models L (excluding EUV-XL-L), LOT, LDQ12

1. Inspect the Light Source Window

Inspect the front of the window and clean it if contamination is suspected, according to the window cleaning instructions found in the section titled “Window Cleaning Instructions”.

2. Pre-Installation Test

It is recommended that the light source be tested prior to installing into your system to verify it turns on properly. Plug the included power/data splitter into the light source. Then plug the power supply into the power/data splitter’s other free end labeled “P”. When power is applied, the light source should produce VUV almost immediately. If it does not, or its output differs from its specifications, refer to the troubleshooting guide found in the section titled “Troubleshooting Guide”.

3. Mount the Light Source

Now that the light source has been successfully tested, it may be installed onto your system. This procedure will vary depending on the type of flange included.

4. Verify Installed Light Source Turns On

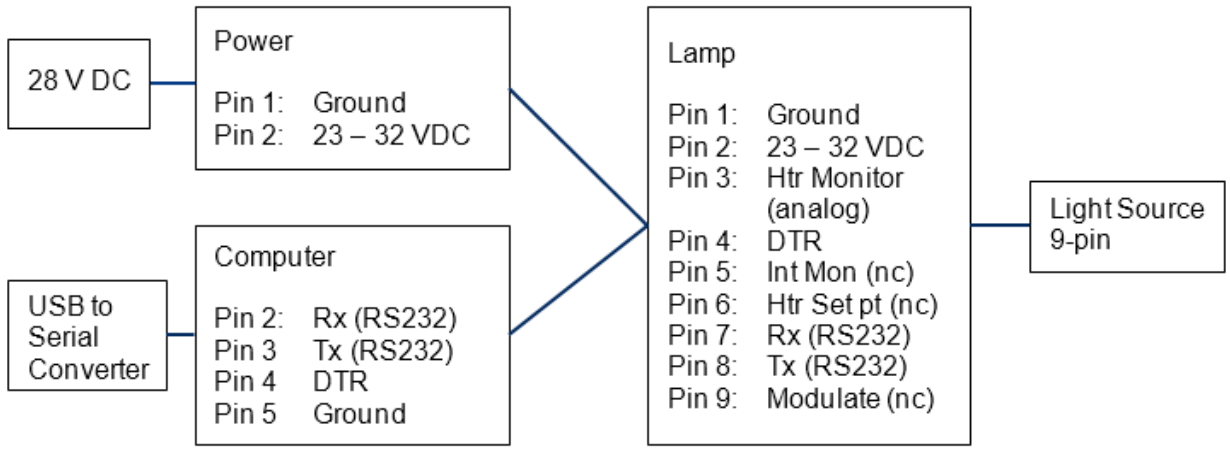
Once the light source has been installed onto your system, it should again be immediately tested to verify it turns on. With power applied and the power switch on the breakout box flicked “ON”, look through the 1/16” hole in the front section near the bulb to ascertain whether it is emitting light. Again, if there are any problems please refer to the “Troubleshooting Guide” section.

Power/Data Splitter

The splitter for the lamp breaks out its 9 pins and provides a connector for power and telemetry via USB separately. Included is a modulation BNC connector.

Above: Power/Data Splitter, with 24 V Input, RS-232 Telemetry, and Lamp Connector.

Power/Data Splitter Pinout



Heater Temperature

By changing the temperature of the source heater, you can control the amount of hydrogen, deuterium, oxygen, nitrogen, chlorine, OH, NO or CO levels in their respective light sources. This gives the user control over the intensity of the atomic and molecular emission lines and/or continua in these light sources. In general these sources are delivered with the optimal set up for the users application. In addition the light source software can be used to adjust the heater temperature in order to trim the source optical depths or spectral output. In this way one can convert a Lyman Alpha Lamp from a line source to a H2 and H2 continuum source with many VUV lines and a UV continuum. (Reverence spectra provided in A1.)

If you have purchased an Oxygen Nitrogen Chlorine OH NO or CO source please carefully follow the instructions supplied with the source since overheating can reduce the lifetime of the light source.

RS-232 Telemetry

The USB telemetry output remains active even when the USB interface is being used. This allows for low-level devices such as microcontrollers interfacing with the light source and even controlling it if necessary. The syntax and baud rate etc. for the telemetry can be obtained by referring to the light source's software manual (available on the Resonance Website). The port uses standard RS-232 protocol logic levels so it should be compatible with any other RS-232 port. If directly interfacing to a microcontroller, a converter IC such as a MAX232 may be necessary to adjust the logic level voltages.

Window Cleaning

The light source window is polished magnesium fluoride and its vacuum ultraviolet transmission will be degraded if it is touched or otherwise contaminated. In all but the best vacuum systems a slow loss of window transmission will result from photo-polymerization of organic materials on the outside window surface. These problems may be overcome by proper cleaning of the window. A small bottle of polishing powder (1 micron aluminum oxide powder) and cotton-tipped applicators along with polishing instructions are included with the light source unit.

Before using the light source, inspect the window for any signs of gross contamination, such as fingerprints. If there are or if, after operating the light source, you notice a drop in output then clean the window with polishing powder (aluminum oxide) following these instructions. All cleaning operations are carried out with cotton-tipped applicators or with lint-free tissues.

1. Apply the polishing powder to an applicator tip.
2. Polish the window by firmly pressing the applicator against the center of the window and, in a circular motion, work your way outwards to the edge of the window. You should notice a frictional resistance as you slide across the window.
3. Repeat, using a new applicator, until there is no evidence of a film on the window when it is viewed with reflected light and there has been a noticeable decrease in the frictional resistance.
4. Wipe away excess powder with a dry applicator. A few specks of powder on the window will have a negligible effect on the optical transmission.
5. Remove the final bits of powder by directing a stream of ultra-high purity helium, nitrogen or argon across the window. ***Never use a lab source of air for this process because it may contain compressor oil.***

For quick cleaning, it is acceptable to wipe the window with isopropanol or methanol using a cotton-tipped applicator. This will only work for light cleaning (light finger prints, dust, light smudges) and not more serious window contaminants

Troubleshooting

Light Source Does Not Start

The first thing to check for in this case is whether all cables are securely connected. Make sure the light source's DE9 cable is securely fastened to its rear panel and also the breakout box, the power cable is securely plugged into the breakout box, and the power switch is positioned to the "ON" state. You can check if the main power is active by checking if the green LED indicator on the power switch of the breakout box is lit, and also whether the green LED on the power supply transformer is lit.

It is often observed that after sitting for extended periods of time the light source may be hard to start. Refer to the section titled "Operating Instructions" and follow the starting procedure for further advice.

As a last resort you can start the light source by holding a Tesla coil in the vicinity of the light source window. ***BE VERY CAREFUL*** that the coil does not arc to the window or light source body as this can damage the window, the light source electronics, and even the power supply.

Light Source Intensity Appears to Drop

This is most often caused by contamination of the outside of the light source window, and can occur in vacuum systems with 10^{-7} Torr total pressure and 10^{-9} Torr partial pressure of organic materials. The light source window should be cleaned according to the instructions found in the section titled "Window Cleaning Instructions".

Problem with Software / Telemetry / RS-232 Port

Please refer to the software manual, which can be found on the Resonance Website

Contact

Resonance Ltd. stands behind every product we sell. We welcome feedback and encourage any of our customers to contact us with questions, or concerns. You may contact us through e-mail, our website, telephone, or fax!

Resonance Ltd.
143 Ferndale Drive North
Barrie, ON
L4N 9V9

Tel: 705-733-3633
Fax: 705-733-1388
Email: res@resonance.on.ca
Web: www.resonance.on.ca

Appendices

Specifications for Hydrogen and Deuterium Light Sources HHeLCMM-L, DHeLCMM-L

The Hydrogen or Deuterium Light sources comes standard with everything needed to produce VUV radiation in the 110 to 200 nm region. A heater on the light source bulb generates H2 or D2 in the light source. This allows the user to operate the light source at low H2/D2 levels for an “optically thin” Lyman-Alpha line or a multiple-lined H2 or D2 spectrum in the 110 to 165 nm region and a continuum between 165 and 375 nm.

- Continuously variable heater temperature setting that allows:
  - “Optically thin” source of Lyman-Alpha radiation (121.6 nm) or with heater adjustment a broadband VUV UV light source with output from 112 to 400 NM.
  - Hydrogen/Deuterium spectral output from 112 to 6000 NM.

- Air-cooled, optically stable (Typically < 1% drift per hour)

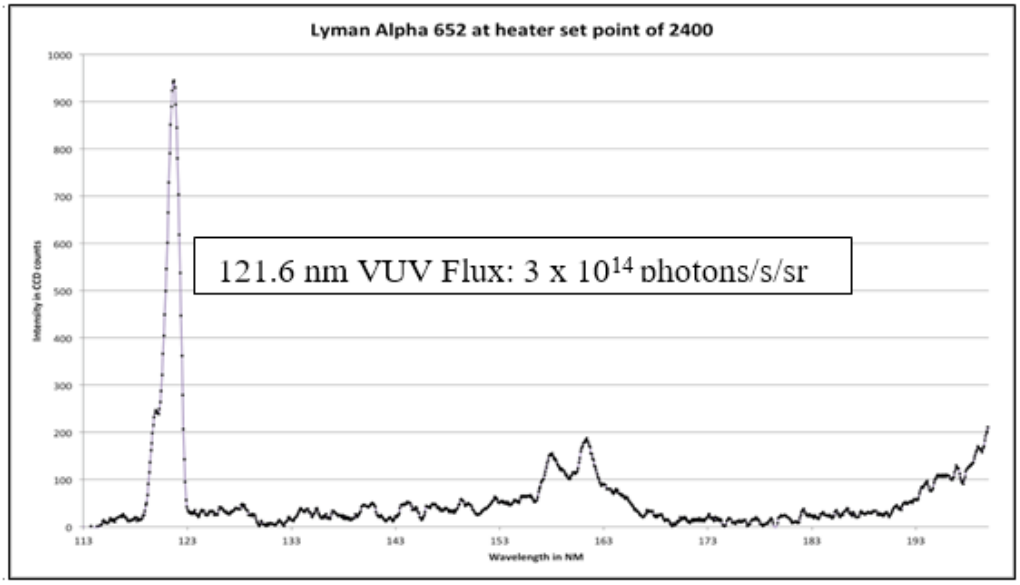
- Longer lifetime than most available Lyman-Alpha sources owing to an internal source of hydrogen

- Breakout box for RS-232 telemetry, BNC modulation input (if equipped), power switch, and USB interface for interface software (see software manual)

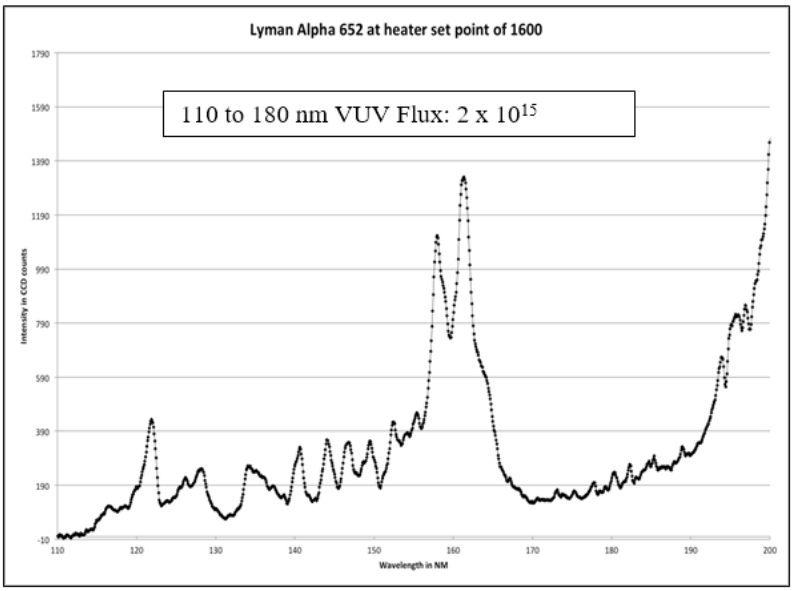
- “Smart Light Source” software allows for precise control and monitoring of light source parameters (heater, RF power etc.)
  - Visible NIR source emission intensity graphing and logging for tracking source stability.
  - Temperature and RF power logging and graphing via graphical chart-recorder interface
  - Excel-friendly .csv output format for data saving

Hydrogen Light Source VUV and UV Output Spectra

Lamp spectrum with Heater set to 45 C

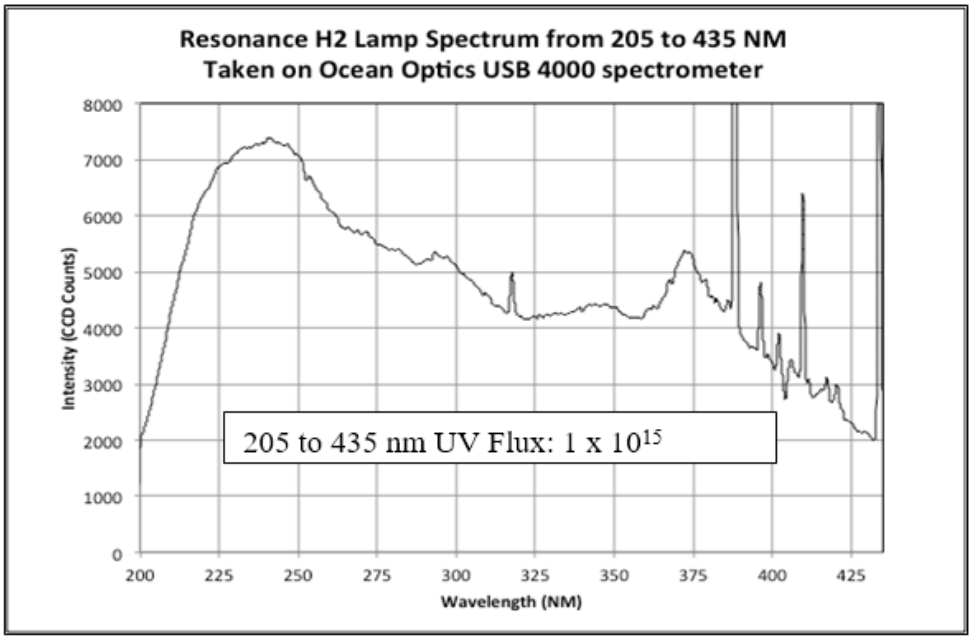


Heater set to 60 C

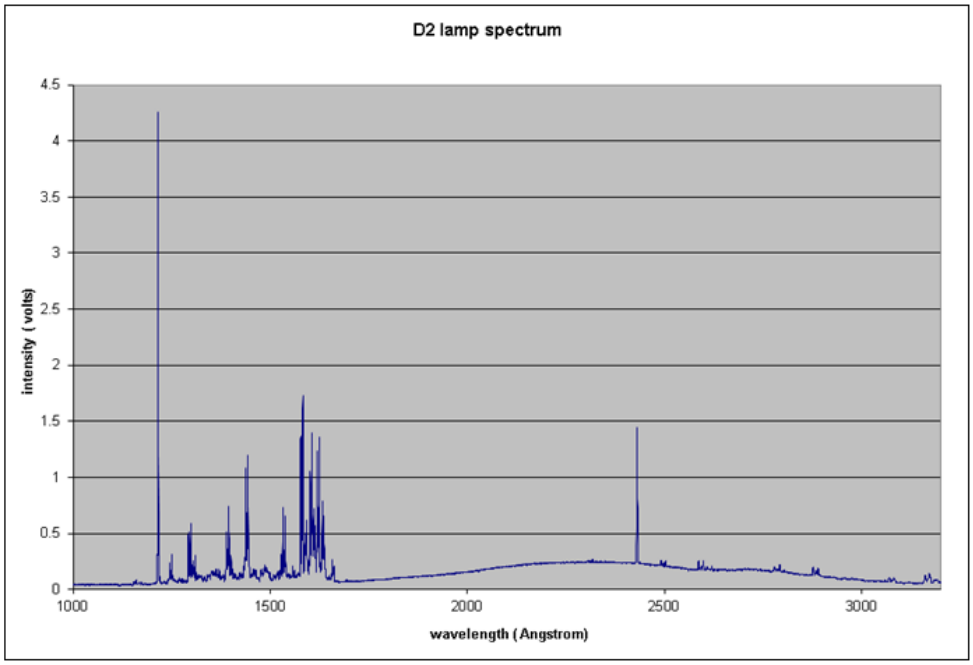


Hydrogen Light Source VUV and UV Output Spectra

Heater Set to 60C UV Spectrum



D2 Spectrum with VM300 monochromator at 1 Ang. Resolution



General Specifications for all Rare-Gas LIght Sources Models ArLL-L, KrLM-L, XeLM-L, KrLM-LDQ12, XeLM-LDQ12, ArCM-L, KrCM-L, XeCM-L

Specification	Typical Values	Units
Peak Wavelengths H/D Ly Alp	D/121.5 H/121.6	nm
Peak Wavelengths H2/D2 VUV	110 - 165	nm
Wavelengths H2/D UV Ctm.	165 - 350	nm
VUV Flux H/D Ly Alp.	3×10^{14}	Ph./sec./steradian
VUV Flux H2 or D2	2×10^{15}	Ph./sec./steradian
UV Flux H2 or D2	1×10^{15}	Ph./sec./steradian
VUV Flux stability	<± percent per hour shift	
Full angle output cone	45	Degrees
Bulb window location	1mm behind face of CF flange	
Window clear aperture	9	mm
Plasma dimensions in bulb	30 axial length 9 circular diameter	mm
Modulation Range	1 - 1000	Hz.
Cooling	Integrated DC fan	
Standard flange	2.75	Inches (CF)
Power Requirements	Light source at 24 VDC for RF exciter, fan and control electronics (in lamp housing)	
AC to DC Power Supply	Power in: 90 to 240 volts AC (50-60 Hz) <0.5 amps 110 VAC	
EMI shielding of lamp housing	Designed to MIL-STD-461C	
Light Source includes	Lamp bulb exciter heater control circuits intensity monitor, heater and housing temperature sensors microprocessor, modulation circuit and USB interface	
Operational/Non Op. Lifetime	>2000hr/>10 years	
Power and Splitter	AC to DC supply, power USB splitter, modulate input, on/off switch	
Temperature range of case	0 to 55	Degrees C
Calibration and Spectrum	1. Flux determined with NIST Standard 2. VUV UV spectrum of light source	
Mass of Light Source	500	Grams
Mass of Power Supply	400	Grams
Software/PC Interface	Labview based executable with GUI to view and log lamp power, intensity monitor heater and case temperatures with data save CSV format for Excel plotting. Windows 32 or 64 bit. Optional data acquisition SW available.	

Rare Gas Light Sources

The Resonance Argon Krypton and Xenon Rare Gas Light source comes standard with everything needed to produce VUV radiation in the 110 to 200 nm region. They employ RF-excited bulbs with Magnesium Fluoride windows in EMI shielded enclosures. The line sources are filled to a few Torr and emit narrow emission lines in the VUV. The continuum sources are filled to 30 to 400 Torr Ar, Kr or Xe and emit both lines and continua in the VUV (see spectra below).

- Air-cooled, optically stable (Typically < 1% drift per hour)
- Longer lifetime than most available Rare gas sources sources owing to an internal source getters and “hard seal windows”.
- Breakout box for RS-232 telemetry, BNC modulation input (if equipped), power switch, and USB interface for interface software (see software manual)
- “Smart Light Source” software allows for precise control and monitoring of light source parameters (heater, RF power etc.)
    - Visible NIR source emission logging and graphing for tracking source stability.
    - Temperature and RF power logging and graphing via graphical chart-recorder interface
    - Excel-friendly .csv output format for data saving

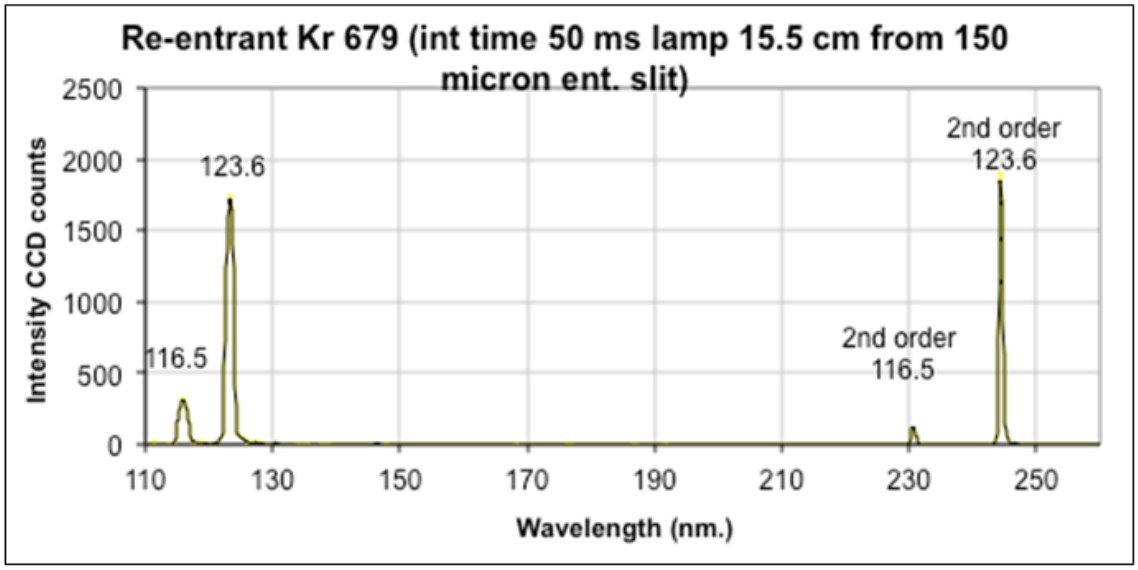
General Specifications for all Rare-Gas Light Sources Models

ArLL-L, KrLM-L, XeLM-L, KrLM-LDQ12, XeLM-LDQ12, ArCM-L, KrCM-L, XeCM-L

Specification	Typical Values	Units
Peak WL/flux ArLL-L	105, 107 / 5e14	NM./Ph./sec./steradian
Peak WL/flux KrLM-L and KrLM-LDQ12	117, 124 / 2e15	NM./Ph./sec./steradian
Peak WL/flux XeLM-L and XeLM-LDQ12	147 / 3e15	NM./Ph./sec./steradian
Peak WL/flux ArCM-L	124 / 1e15	NM./Ph./sec./steradian
Peak WL/flux KrCM-L	117, 124, 147 / 4e15	NM./Ph./sec./steradian
Peak WL/flux XeCM-L	147, 172 / 6e15	NM./Ph./sec./steradian
VUV flux stability	<±1 percent per hour drift	
Operational/Non Op. lifetime	>4000 hours / >10 years	
Full angle output cone	25 to 45	Degrees
Bulb window location	1mm behind face of CF flange	
Window clear aperture	9	mm
Plasma dimensions in bulb	30 axial length 9 circular diameter	mm
Modulation Range	1 - 500	Hz
Cooling	Integrated fan	
Standard flange	2.75	Inches (CF)
Power Requirements	Light source at 24 VDC for RF exciter, fan and control electronics (in lamp housing)	
AC to DC Power Supply	Power in: 90 to 240 volts AC (50-60 Hz) <0.5 amps at 110 V AC	
EMI Shielding of lamp housing	Designed to MIL-STD-461C	
Light Source includes	Lamp bulb exciter heater control circuits intensity monitor, heater and housing temperature sensors microprocessor, modulation circuit and USB interface	
Power and Splitter	AC to DC supply, power USB splitter, modulate input, on/off switch	
Temperature range of case	0 to 55	Degrees C
Mass of Light Source	500	Grams
Mass of Power Supply	400	Grams
Software/PC Interface	Labview based executable with GUI to view and log lamp power, intensity monitor heater and case temperatures with data save CSV format for Excel plotting. Windows 32 or 64 bit. Optional data acquisition SW available.	

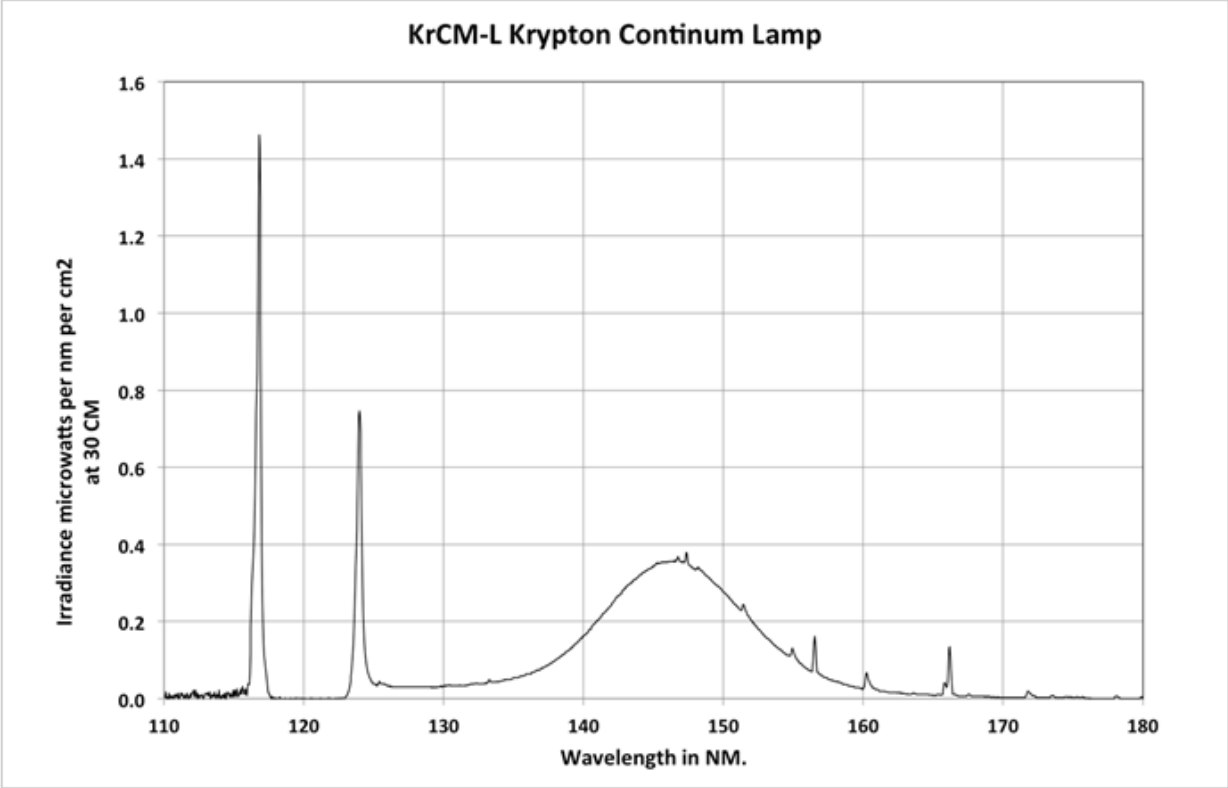
Calibration of Krypton Source Lamp SN 679

Lamp Data	
Product	Krypton Line Source re-entrant style
Date	July 17, 2013
Lamps SN	679
Model Number	KrLM-LQD14
Wavelength	123.6 116.5 NM
Diode Type	Csl 352
Full angle output cone	>28 degrees
Absolute intensity photons per sec. per steradian	$2.0x10^{15}$ (20% 116.5 80% 123.6)
Lamp flux stability over time (16 hour test)	<0.02% per hour with cleaning MgF2
Tested to vacuum level of:	5e-8 torr

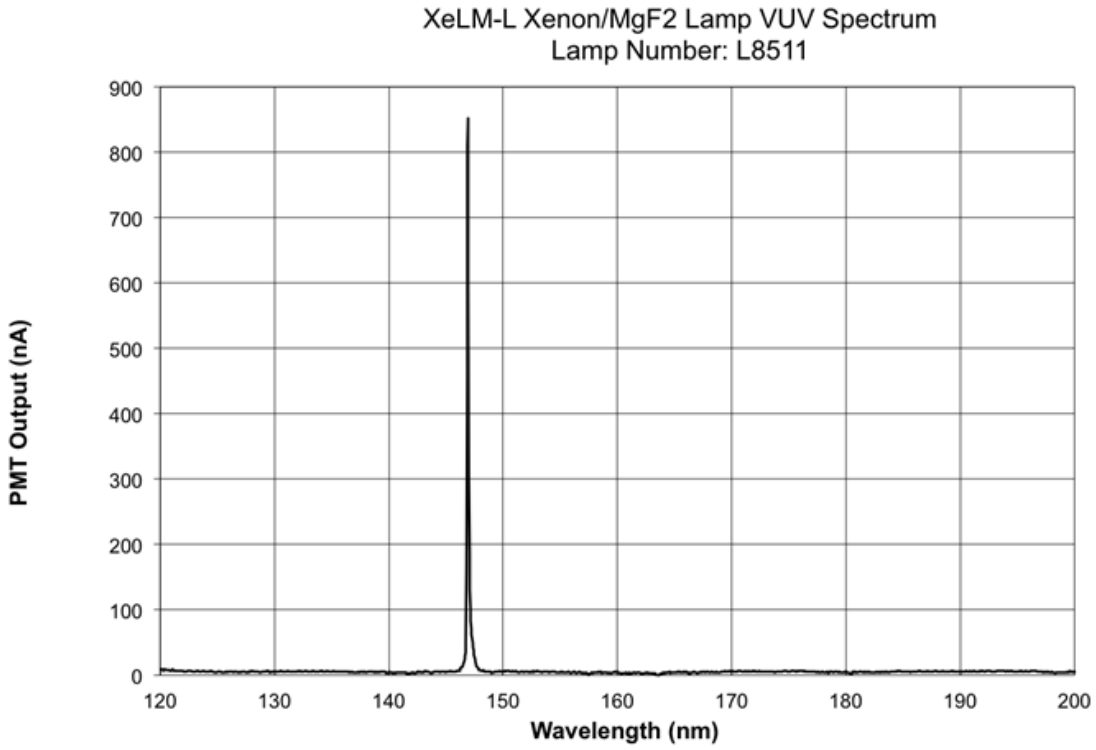


Typical Spectra

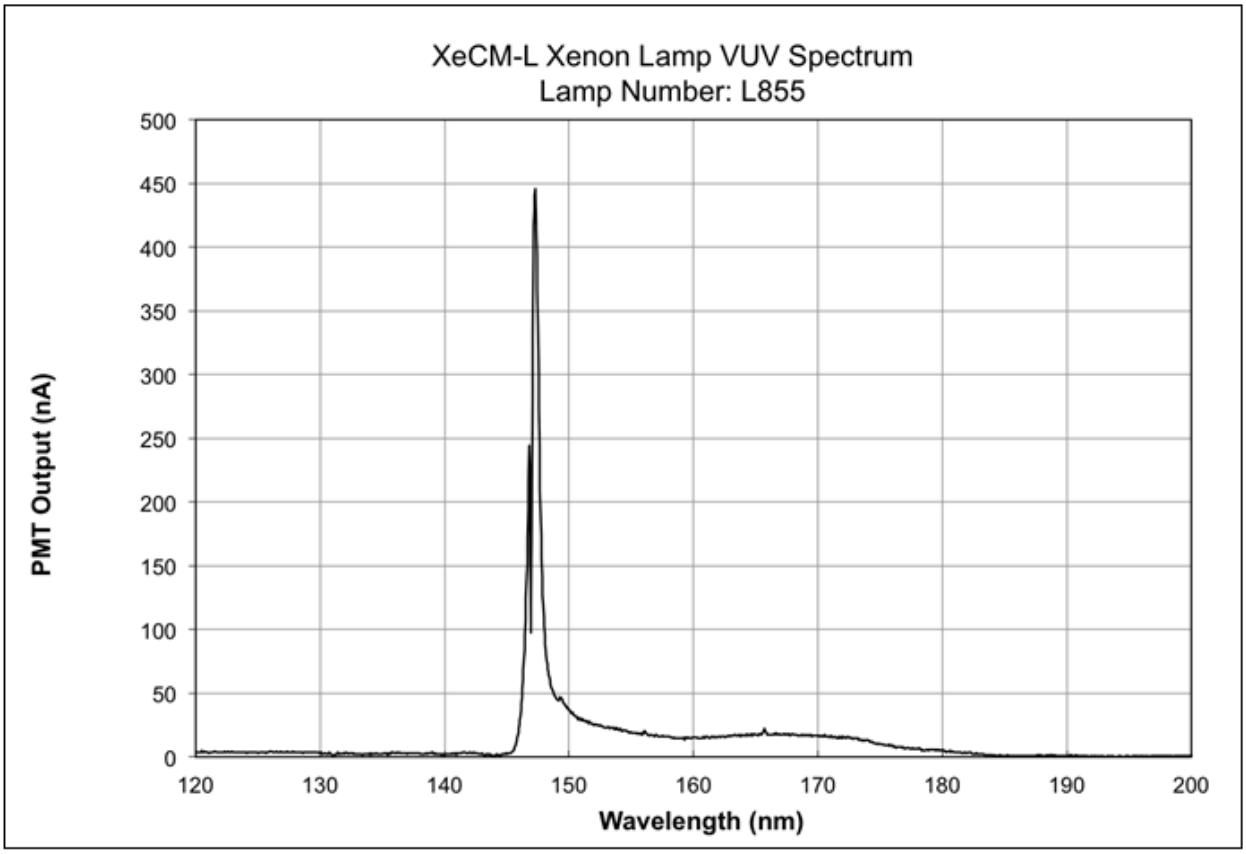
KrCM-L



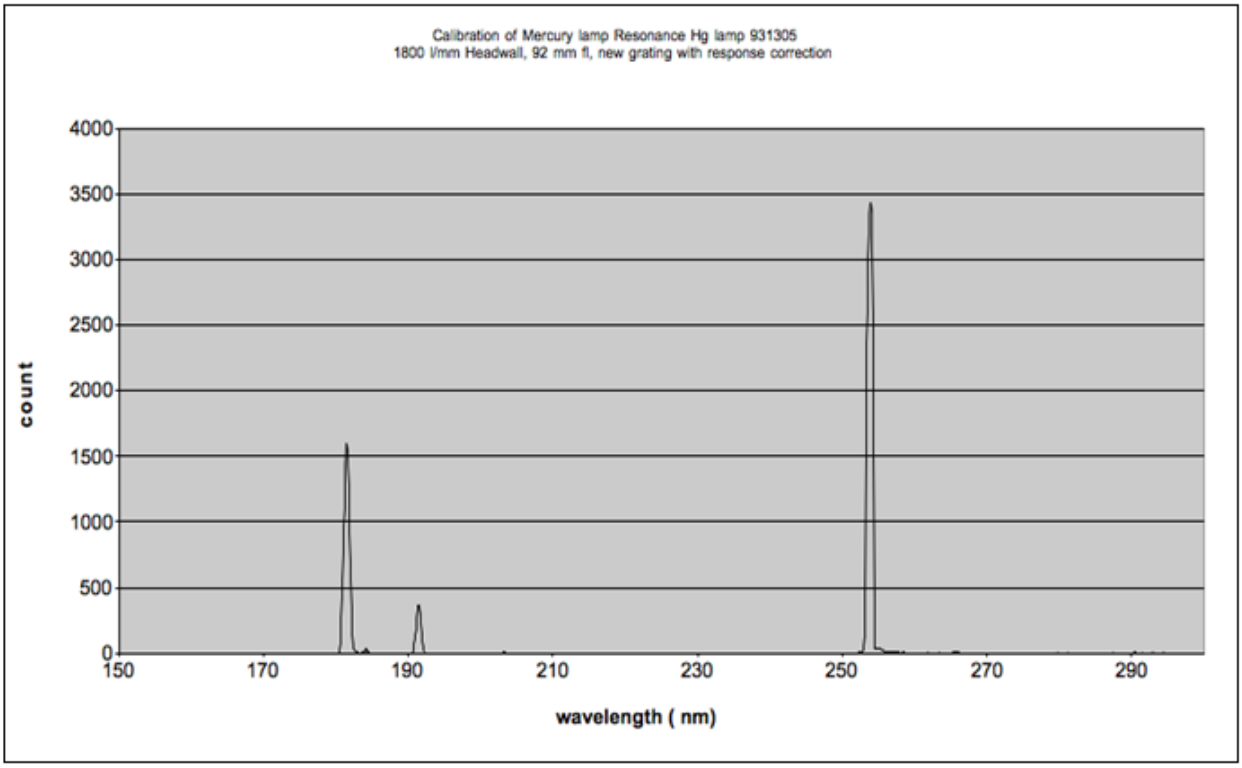
XeLM-L


XeLM-L Xenon/MgF2 Lamp VUV Spectrum
Lamp Number: L8511
PMT Output (nA)
900
800
700
600
500
400
300
200
100
0
120
130
140
150
160
170
180
190
200
Wavelength (nm)

XeCM-L

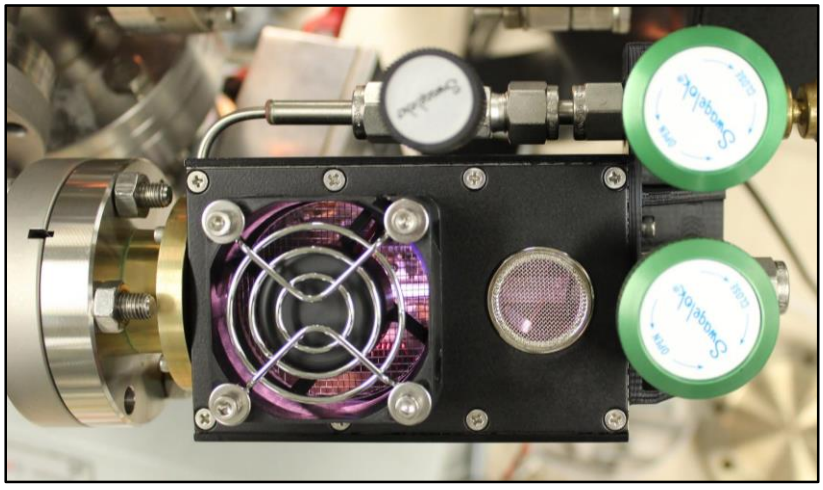

XeCM-L Xenon Lamp VUV Spectrum
Lamp Number: L855
PMT Output (nA)
500
450
400
350
300
250
200
150
100
50
0
120
130
140
150
160
170
180
190
200
Wavelength (nm)

HgArLQ-L


Calibration of Mercury lamp Resonance Hg lamp 931305
1800 l/mm Headwall, 92 mm fl, new grating with response correction
count
4000
3500
3000
2500
2000
1500
1000
500
0
150
170
190
210
230
250
270
290
wavelength (nm)

RF-Powered EUV/VUV Flow Lamp

Model	Description
EUV-XL-L 	The Resonance EUV windowless source is an RF-excited flow lamp with a capillary bore in an EMI-shielded enclosure. This lamp mounts to a 2.75 inch or larger CF type flange. The lamp assembly has an integral RF exciter that is powered by a small wall plug power supply. This supply is sufficient to produce, emissions from the principal neutral rare gas species in the range of 10^{15} photons per second per steradian. This light source employs a “reverse flow” feature that directs the gas away from the vacuum chamber. This feature reduces gas use and produces a higher intensity.



EUV-XL-L Attached to Vacuum System and Operating with He

Specifications

Electrical/Optical Specifications/General				
Specification	Minimum	Typical	Maximum	Units
Flow Gas User Selected		Helium		
Peak Wavelengths		30, 58		nm
Full Spectral Range		28 to 7000		nm
58nm Intensity	5×10^{14}	1×10^{15} @ 58nm	2×10^{15}	Photons/sec/steradian
Full Angle Output Cone	15	28	35	Degrees
Window Material (optional window		MgF2		
Clear Aperture (depends on tube configuration)	0.3	0.4	0.45	cm
Certification	Calibration of Irradiance in Vacuum			
Input Power	10	15	24	Watts
Input Voltage	70	115	260	VAC
Input Line Frequency	50	60	65	Hz
Mounting Flange	2.75 inch Cf standard, lamp can be sealed to HV system			
Cooling	Forced air cooling with internal fan			
Intensity Monitor	Optional			
System	Complete system include RF power supply, EMI shielded enclosure, vacuum flange			

Operating Procedures (normal operation)

The flow lamp can be operated with any non-corrosive gas to obtain EUV spectra. Typically, the supply line is pressurized to a few PSI above ambient pressure (10 to 100 kPa). To operate:

1. Connect gas supply line

   Connect the input (the green valve) to green valve that is connected to the metering valve. Make sure the second Green valve is closed

2. Pump out the gas supply line

   Open the input valves (green and the black metering valve) to pump out the supply line up to the pressure gauge head. The pressure should fall to better than 10^-1Torr in the mono/spectrometer at this stage.

3. Purge the supply line with gas

   The main cylinder valve to the gas supply should be opened and the two valves (green and black metering valves) closed.

4. Adjust the flow of gas

In normal operation (with Ar, Xe, Kr, Ne, He, or N2) the green valve connected to the metering valve should be opened and the metering valve set so that the flow of gas is quite small (10 to 35 small div). This will maintain pressure at a few Torr in the flow lamp and less than 10^-1Torr in the mono/spectrometer.

5. Switch on the RF in the flow lamp and start the lamp

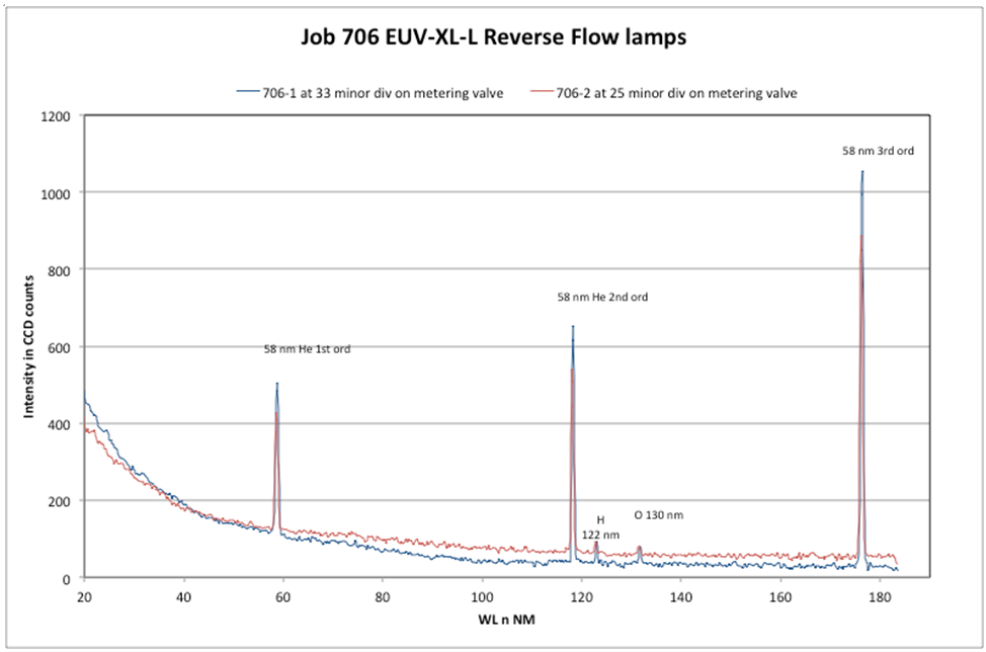
   After the gas is flowing the RF should be switched on by plugging in the wall unit. If a power supply is used the voltage should be set to 24 volts and the current should be in the 0.2 to 0.75-amp range.

   The plasma will be self-starting. If the lamp will not start, verify that the power supply is properly connected and functional and that there is a sufficient vacuum (the lamp will not start when this pressure is > ~1 Torr). If the lamp still will not start, a Tesla coil (set on low) can be touched to the glass tube inside the lamp housing.

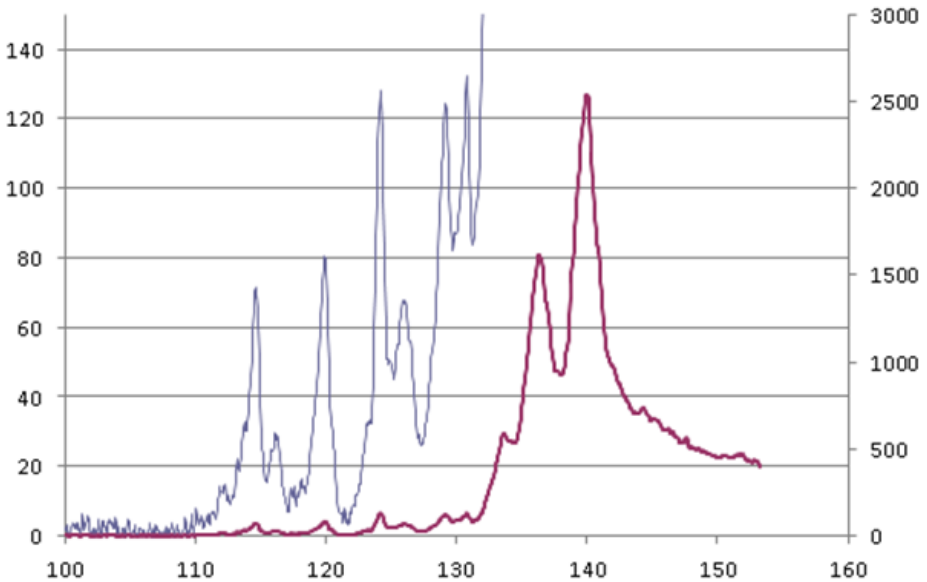
6. Optimize the intensity

   Once the plasma is ignited, adjust the gas flow using the metering valve to quickly optimize the intensity.

Calibration in Normal Operating Mode



VUV Flow Lamp with Br2 Flow



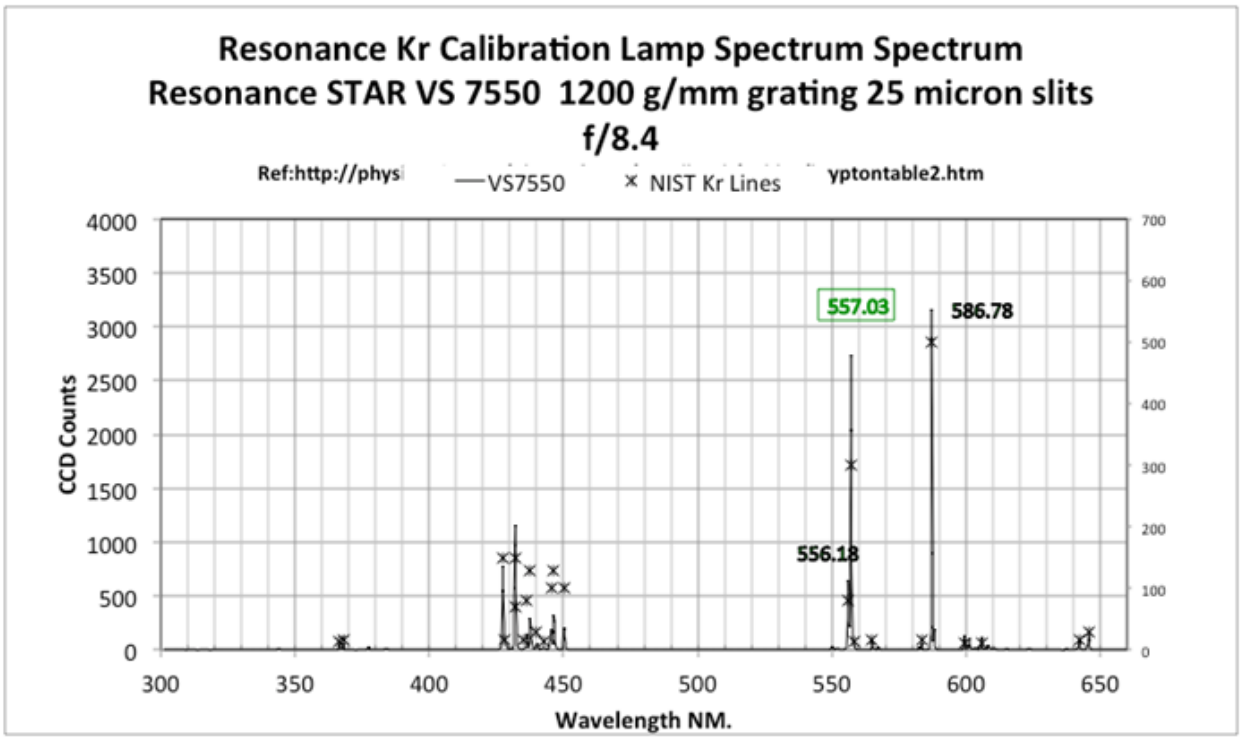
24-Watt RF Fiber-Optic-Output Light Sources

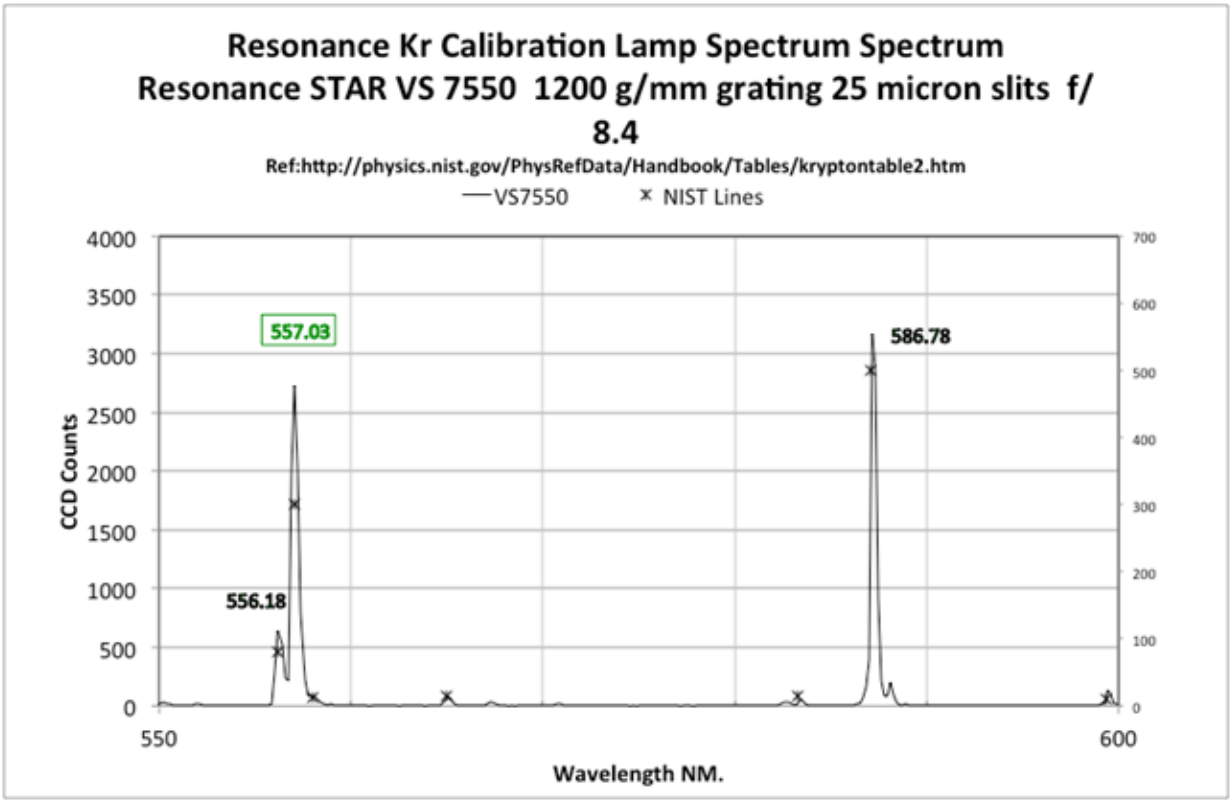
KrLP-LFO & NeLP-LFO

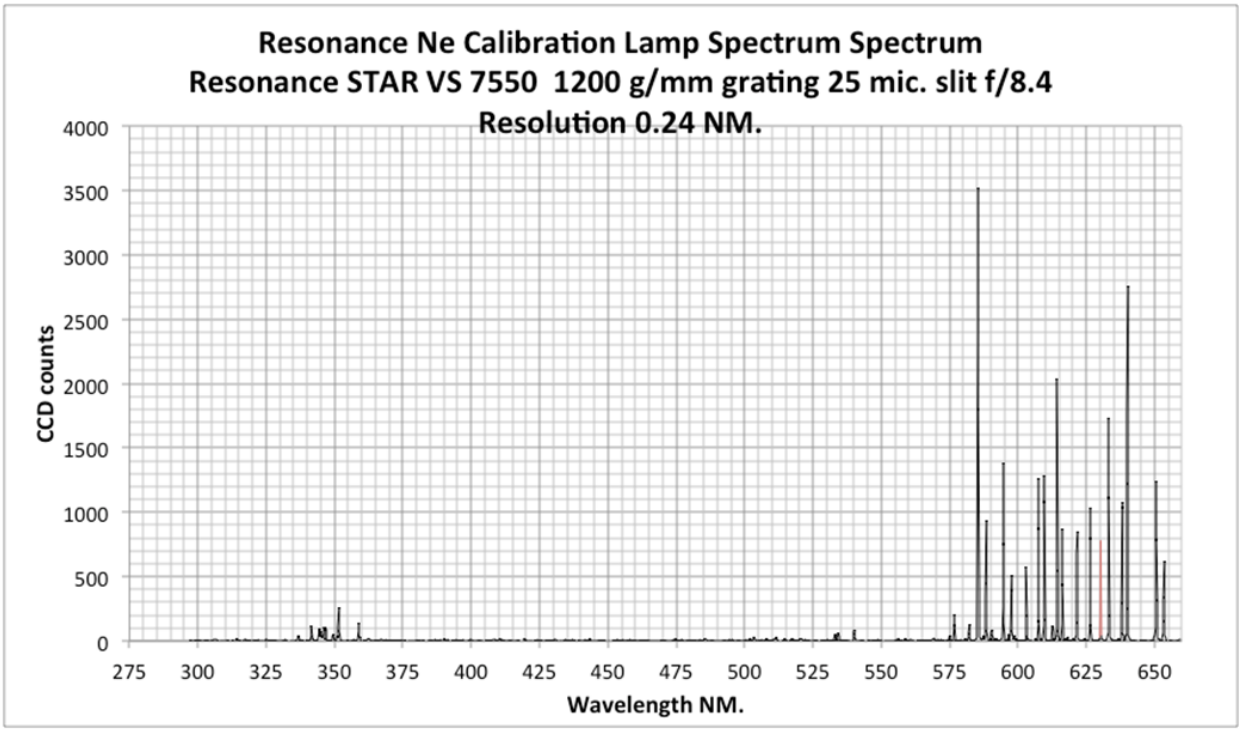
Operating Procedure

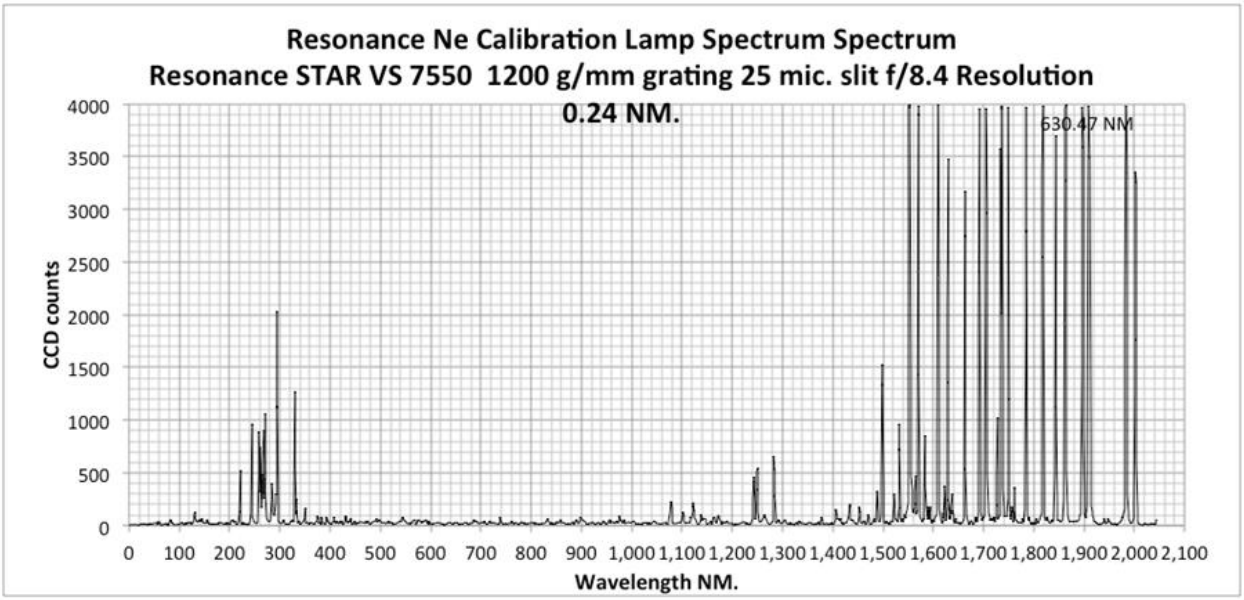
1. Connect fiber optic cable to both lamp and receiving instrument
2. Plug DC power supply into 110V supply
3. Connect the 9 pin connector to the lamp. The lamp will start immediately along with the built in cooling fan
4. To maximize the bulb life, unplug the unit when not in use
5. In the event that the fan stops working do not run the unit as the main transistor can overheat and fail

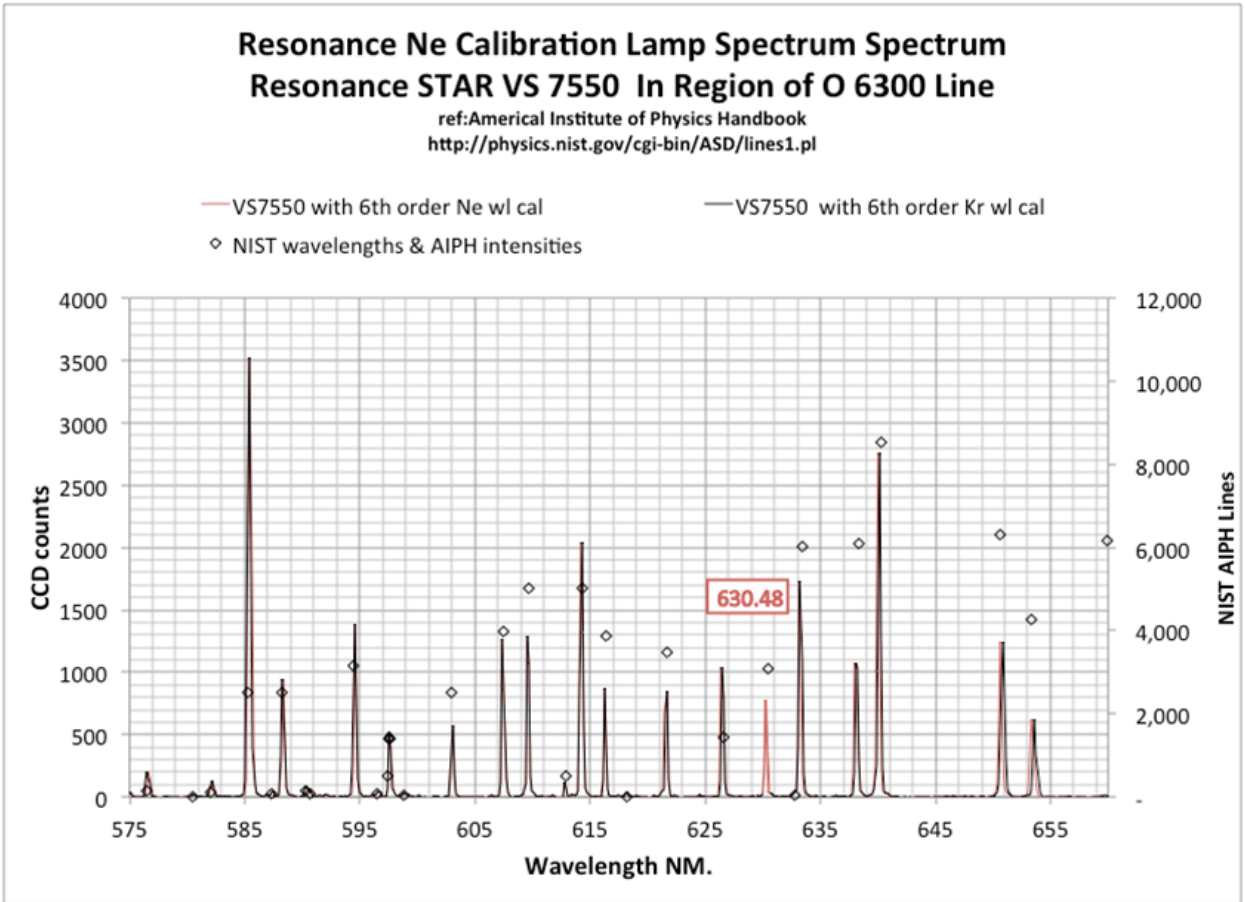
Test Spectrum




Resonance Kr Calibration Lamp Spectrum Spectrum
Resonance STAR VS 7550 1200 g/mm grating 25 micron slits f/ 8.4
Ref:http://physics.nist.gov/PhysRefData/Handbook/Tables/kryptontable2.htm
VS7550
NIST Lines
557.03
586.78
556.18
CCD Counts
Wavelength NM.


Resonance Ne Calibration Lamp Spectrum Spectrum
Resonance STAR VS 7550 1200 g/mm grating 25 mic. slit f/8.4
Resolution 0.24 NM.
CCD counts
Wavelength NM.


Resonance Ne Calibration Lamp Spectrum Spectrum
Resonance STAR VS 7550 1200 g/mm grating 25 mic. slit f/8.4 Resolution
0.24 NM.
630.47 NM
CCD counts
Wavelength NM.


Resonance Ne Calibration Lamp Spectrum Spectrum
Resonance STAR VS 7550 In Region of O 6300 Line
ref:Americal Institute of Physics Handbook
http://physics.nist.gov/cgi-bin/ASD/lines1.pl
VS7550 with 6th order Ne wl cal
VS7550 with 6th order Kr wl cal
NIST wavelengths & AIPH intensities
630.48
CCD counts
NIST AIPH Lines
Wavelength NM.