

ACQUITY TUV

ACQUITY UPLC™ System
Service Training

ACQUITY TUV Detectors

- TUV and TUVE
- Dual wavelength
- Capillary style detector
- Ethernet control
- Similar design to 2487
 - Lets review the differences between the TUV and the 2487
 - **Note: TUVE is an internal project name only. The Detector is labeled TUV. Note serial number.**



When did it become available?

- Cut over to the TUVE (new model TUV) was in November 2005
 - S/N **K05UPT700N** and over
- The flow cell is to be ordered as a separate line item.

NOTE: TUVE flow cells are blue, and the lamp has a six pin connector



What's new for TUV?

- New High Brightness Lamp
 - More light throughput enabling the electronics to run at low noise levels producing maximum signal to noise ratio.
- New Lamp Power Supply by Hamamatsu.
 - New cabling to support lamp.
- New Personality Board
 - Specifically to handle the new lamp power supply.
- New Firmware (rev. 1.4) has a clear RAM diagnostic.
- New Flow Cell designs
- Data rate to 80 Hz!

Everything else identical to the older TUV including the optics.

TUVE Specs

- Data Acquisition Up to 80hz
- Wavelength Range 190-700 nm
- Optical Bandwidth 5 nm
- Wavelength Accuracy ± 1.0 nm
- Wavelength Repeatability ± 0.1 nm
- Noise $\leq 6 \times 10^{-6}$ With flow cell shunt (the older TUV spec was 15uAU, this is a dramatic improvement of over 100%)
- Drift 1×10^{-4} AU/hour 60 minute warm up, constant temperature and humidity at 230 nm, medium core shunt cell
- Linearity $< 5\%$ at 2 AU Propylparaben at 257 nm

Flow cell design

Light carried by a bundle of optical fibers from the lamp compartment to the cell.

External PEEK tubing is connected to capillary tubing in the cell housing.

Cell body is Teflon AF. Light path and solvent path join here. Cell must have solvent to transmit light. The difference in refractive index between the fluid passing through the cell and the Teflon® AF tubing causes the light to reflect off the walls of the tubing in a manner similar to that of an optical fiber.

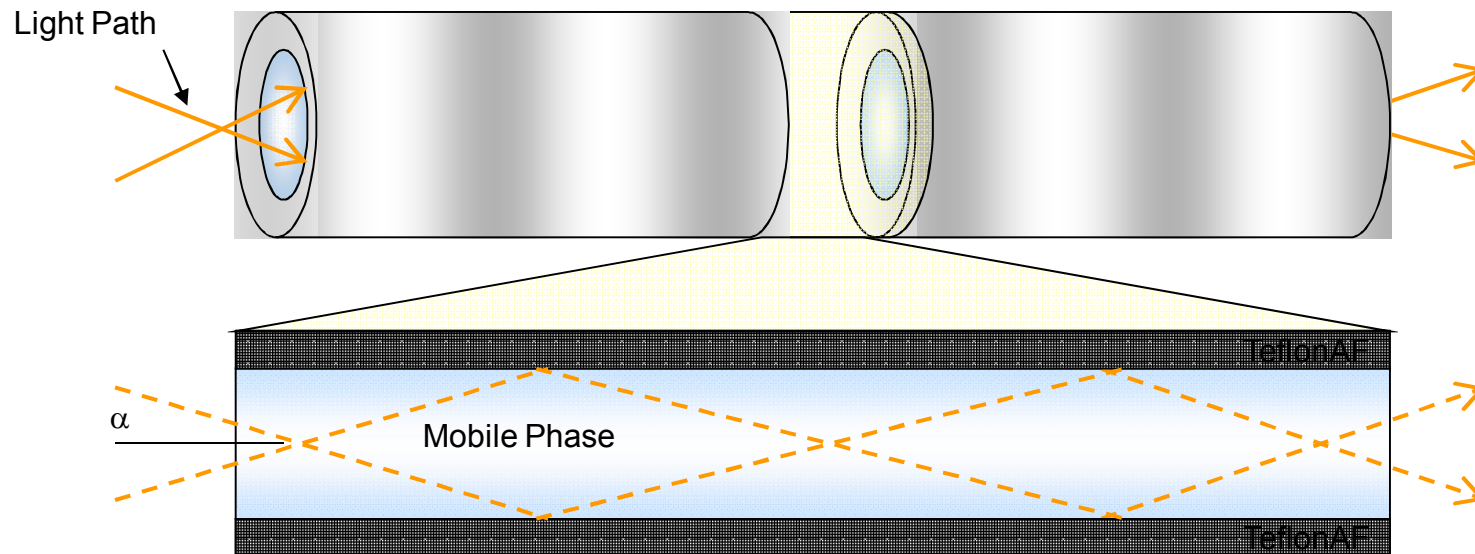
Light that passes through the Teflon AF cell is collected by the outlet fiber optic cable and directed to the sample diode.

Solvent flow exits through the outlet PEEK tubing.

Not field serviceable

Pressure rated at 1000 PSI

Light transmission through the flow cell



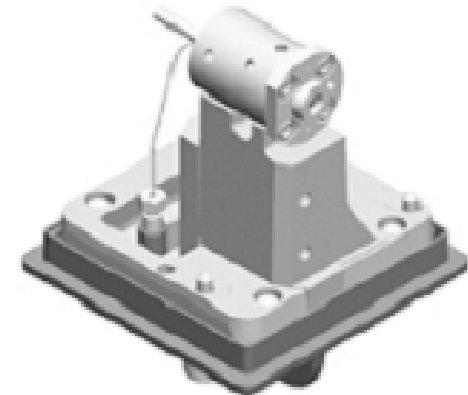
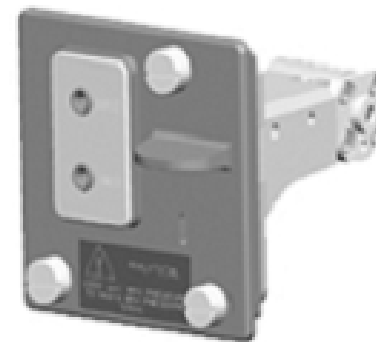
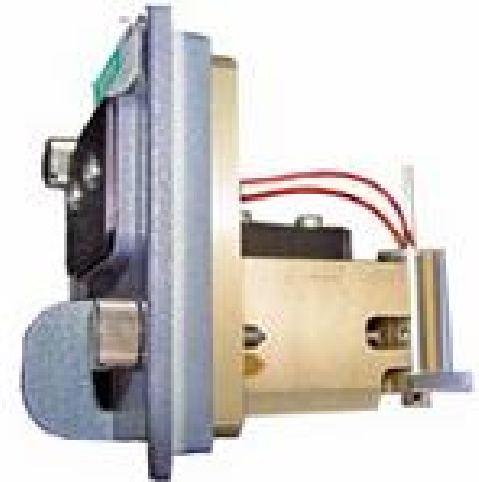
- Light rays entering the liquid core of the flow cell are internally reflected when they meet the Teflon AF boundary.
 - These rays are transmitted through the cell without loss, except for absorption by the sample.
- **Critical** that flow be started before powering up the Detector to ensure proper calibration verification.

Never power on when the flow cell is dry

- When installing or maintaining the ACQUITY UPLC system **it is very important that flow is established in the flow cell before the detector is turned on.** Light is reflected off the walls of the Teflon AF only when a fluid, with a refractive index (n) greater than 1.29, is in the flow cell. When the flow cell is dry light will be absorbed by the walls, **it has been theorized that long exposure of UV light could possibly degrade the optimum performance of the Teflon AF tubing.**
- The light-guided flow cells need flowing fluid to ensure the maximum light is transmitted through the flow cell. Any air bubbles present in a non-flowing, fluid filled flow cell will disrupt the light path and decrease the light transmission. With the light-guided flow cells, it has also been shown that **powering up the detector without flow may cause an inaccurate calibration due to the potential of reduced light transmission.** Therefore it is good practice to start flow before turning on the detector.
- **It is also recommended that a system with a new column installed be flushed to a waste container for at least 15 minutes before the flow cell is connected to minimize the possibility of any contaminants lodging in the flow cell.**

New Flow cells TUVE

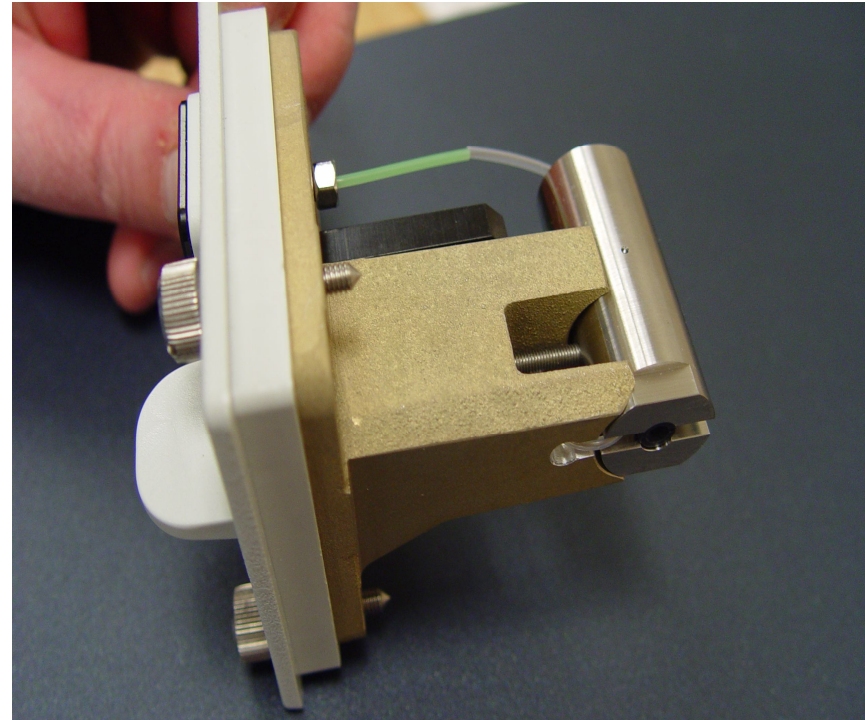
- Light guiding design.
- Front cover is blue.
- Information label is color coded.
- Will not fit in older TUV.
- 3 types Available.
 - Analytical 205015008
 - 500nl volume 10 mm path length
 - High Sensitivity 205015009
 - 2400nl 25mm path length
 - Nano Flow 205015013
 - 10nl .075mm path length



Not repairable, looking towards a refurb program for the future.

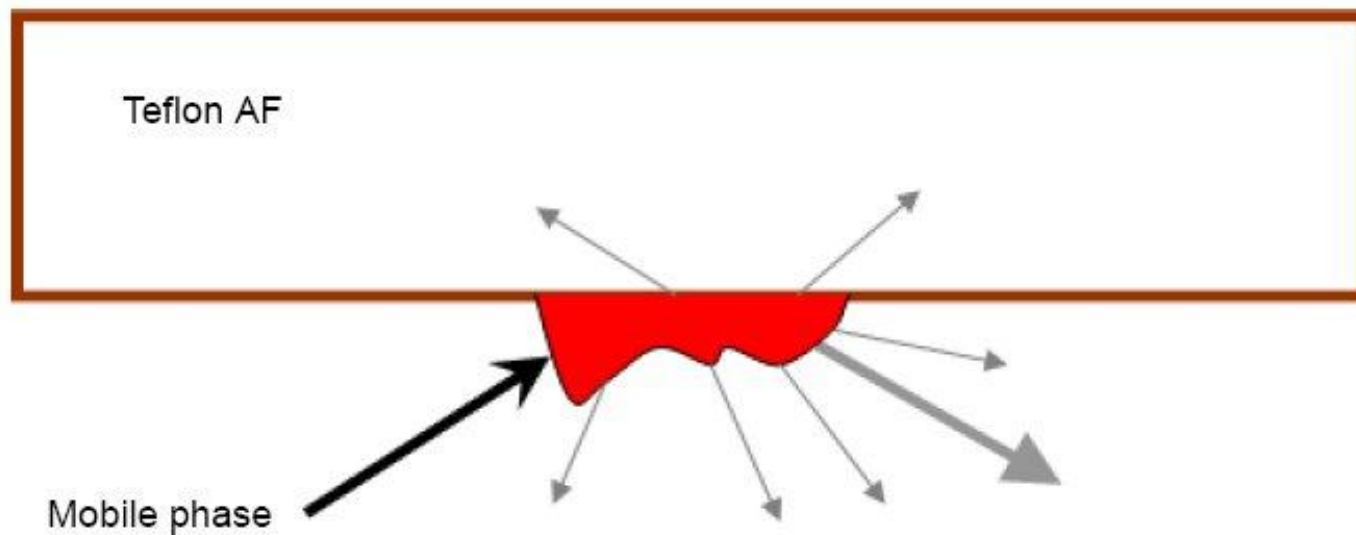
Older ACQUITY TUV Flow Cell

- Two types available at present:
 - Low flow and standard flow
 - 125u ID peek for std flow, 2ml max flow rate
 - 62u ID peek for low flow, .5ml max flow rate
- 1000 PSI max pressure.
- Similar to 2487 CapLC
- Light Guided
- 10mm Path Length
- 500nl volume



Unwanted Beam Effects in a LG flow cell

- Surface contamination can lead to undesirable beam effects
 - scattering (thin, gray arrows)
 - absorption (grey, thick arrow)
- Both decrease sample energy



Light Guided Flow Cell- Usage Guidelines

- LG Flow cells are quite expensive (~\$2500 STD cost)
- A lot of flow cells are being returned due to damage and misuse
- It is very important that we educate the customer on the proper care and use of the flow cells
- See document 71500172306- Usage Guidelines

General Guidelines

- For extended storage, flush the flow cell with pure organic solvent and cap the inlet and outlet ports.
- Do not power-on, operate, or ignite the lamp of the detector when there is no flow through the cell, or when the flow cell is dry.
- Flush new columns for 15 minutes before connecting the flow cell
 - minimizes contaminants that can leave deposits on the flow cell's walls.
- If the lamp intensity is so low that the noise is unacceptable for your method, consult the maintenance section of the latest revision of the ACQUITY UPLC System Operator's Guide.

Shutdown Considerations for LG flow cells

- **Downtime less than 24 hours-**

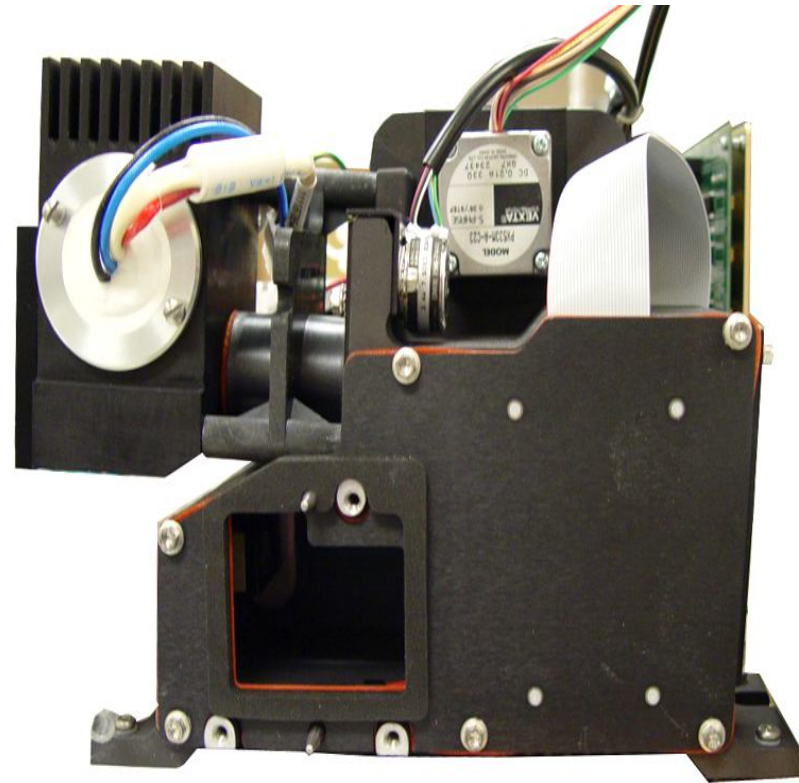
1. Continue to pump mobile phase through the flow cell. You can reduce the flow rate to conserve solvent.
2. Extinguish the detector lamp.

- **Downtime more than 24 hours-**

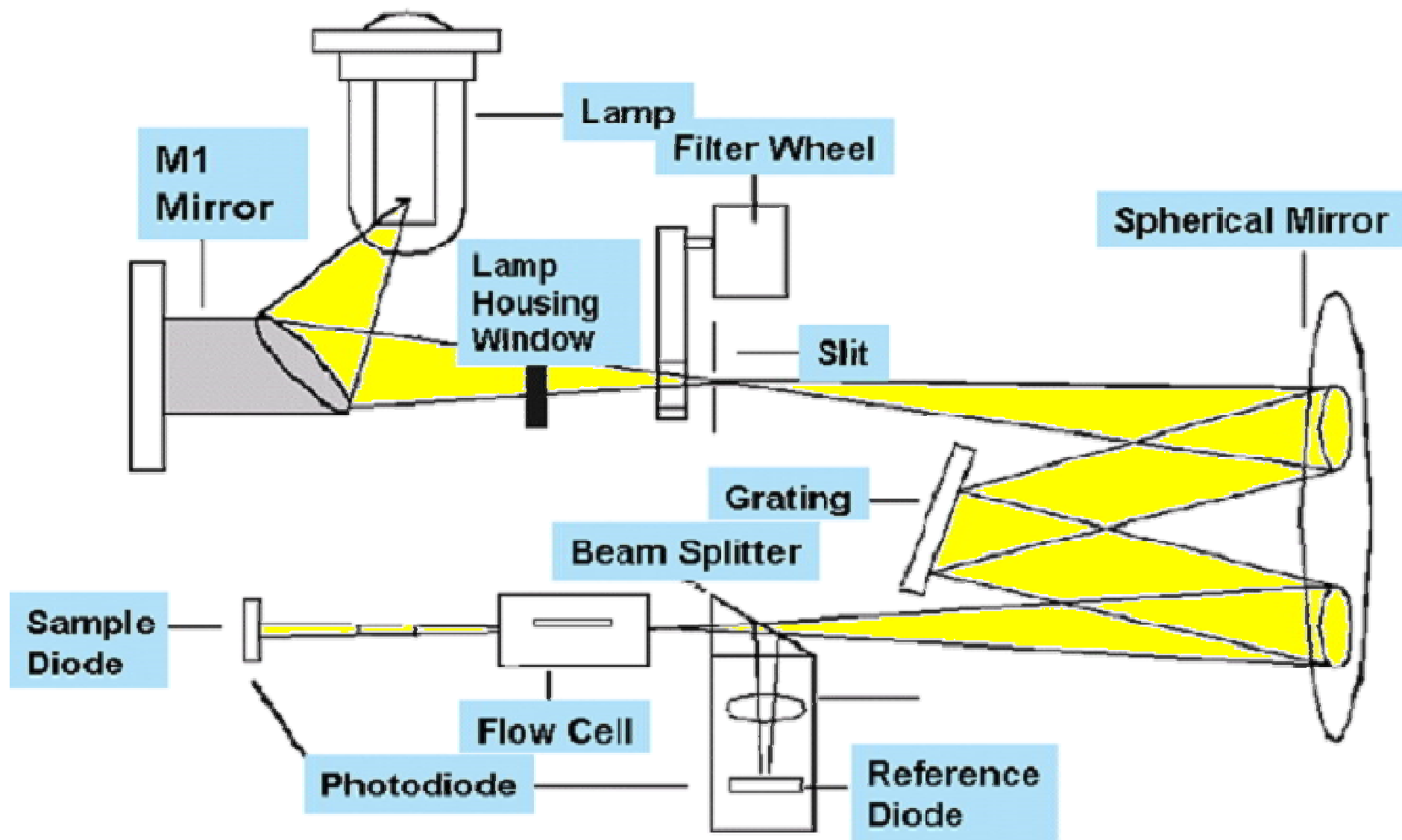
1. Extinguish the detector lamp.
2. Flush the flow cell with water.
3. Flush the flow cell with pure organic solvent (such as methanol or acetonitrile).
4. Power off the system.
5. Cap the inlet and outlet ports of the flow cell to preserve the cleanliness of the Teflon AF.

Optics Bench

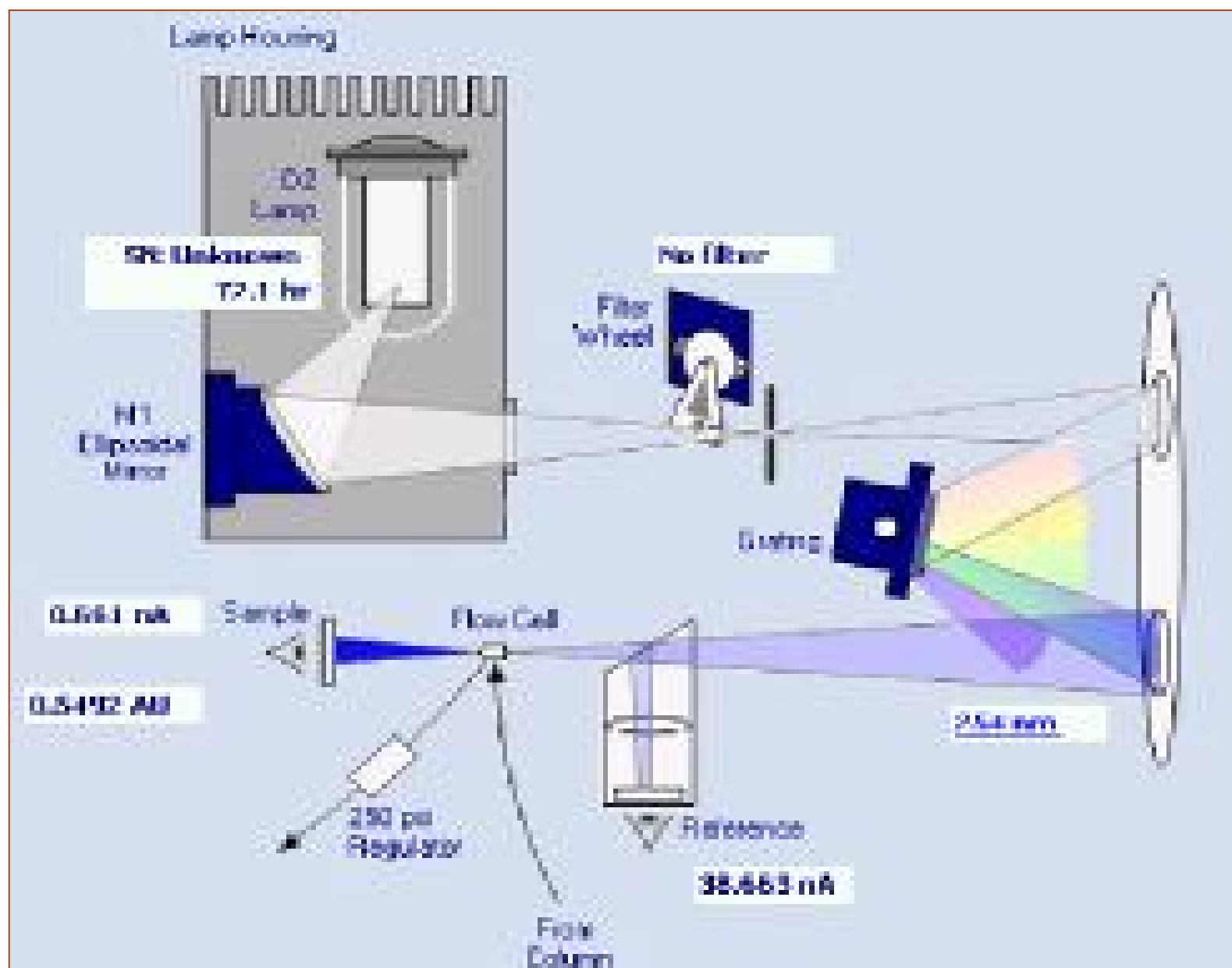
- Bench is basically the same as the standard 2487, with the following
- Exceptions:
 - Front end amp board
 - Allows higher gain to accommodate lower light levels of light guided flow cell
 - Same as CapLC 2487
 - Spare does not include bench front cover.
 - Always handle with gloves, supplied with spare
 - Sample diode mask



Light Path

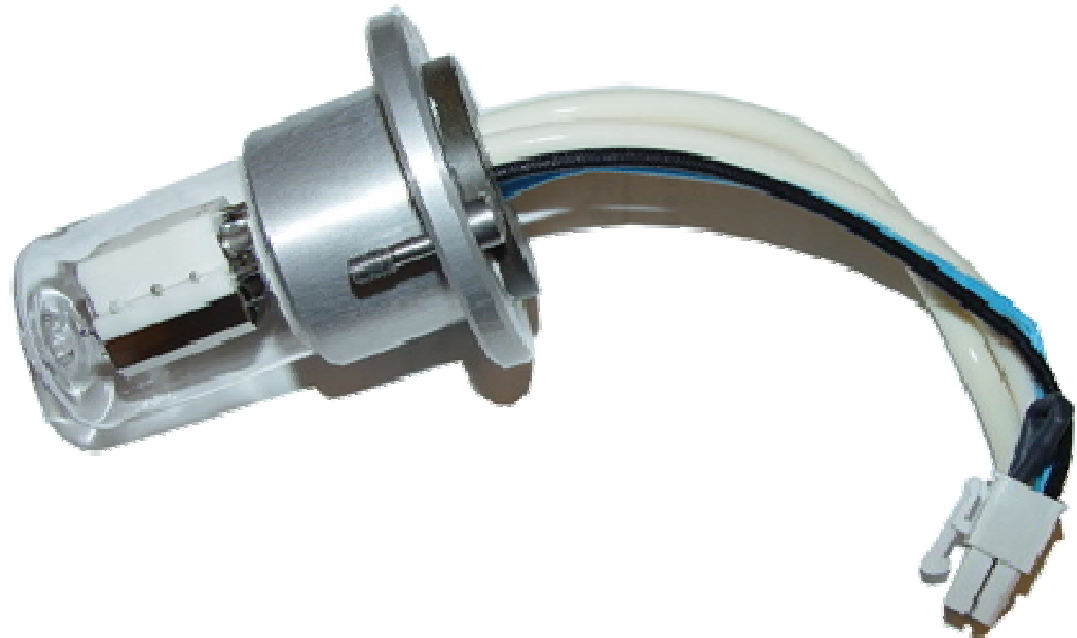


Light Path (FROM ACQUITY Console)

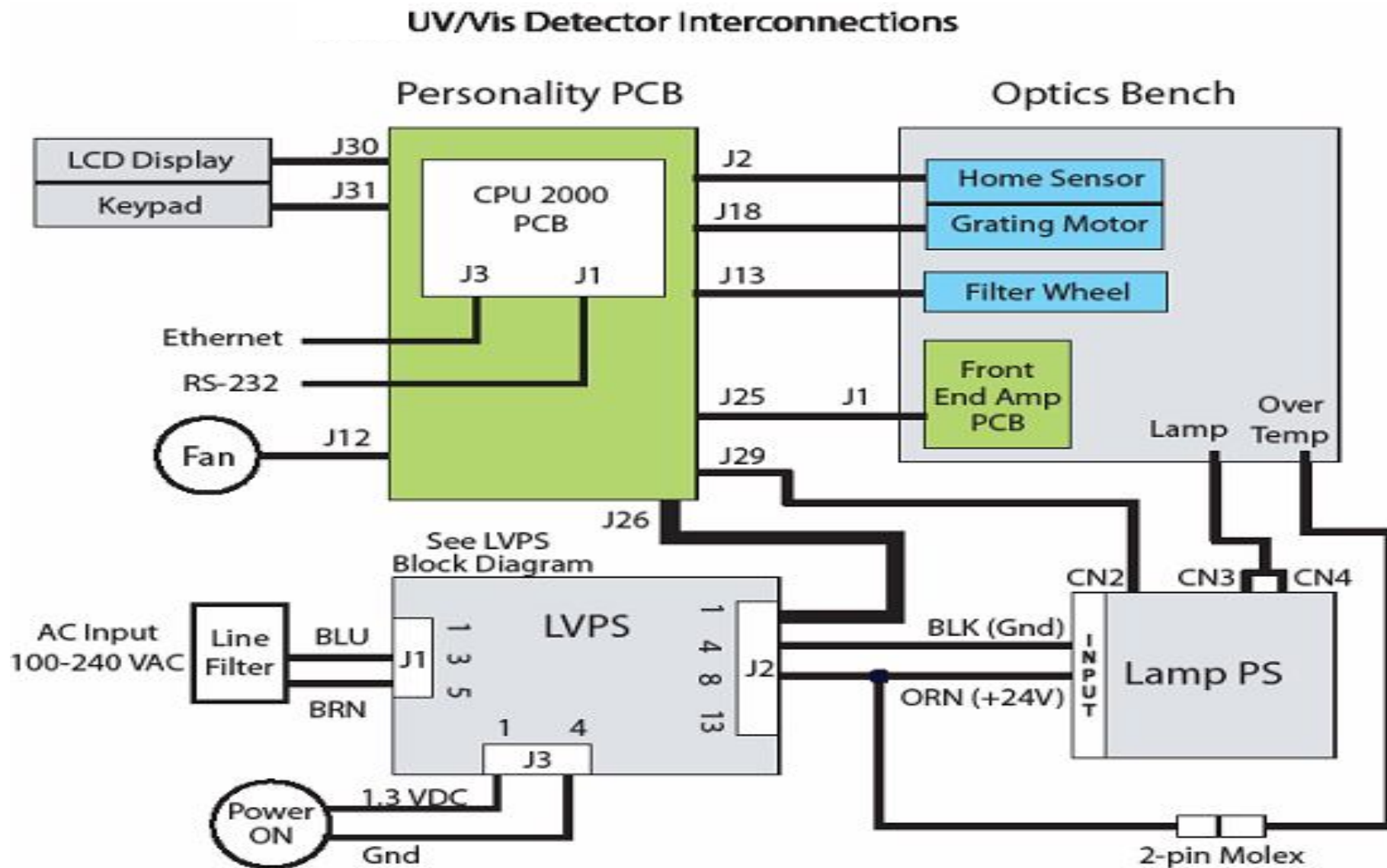


New High Brightness Lamp

- 100% brighter than the standard D2. The increased light available from this lamp is the leading contributor to the improved noise performance.
- 30 Watt.
- 2000 hr warranty.
- 6 pin connector.
 - Will not fit in the older model TUV.



Electrical Interconnects



New Lamp Power Supply

- Purchased from Hammamtsu.
 - Specific for the newer ACQUITY TUV, 2489 and New PDA 2998.
- Identical to the ACQUITY PDA Lamp power supply.
 - Part Number #700002785



- Red and white wire is the lamp supply voltage.
 - (40VDC)
- Blue and black is the filament or heater for the lamp.
 - Approx 2 VDC.

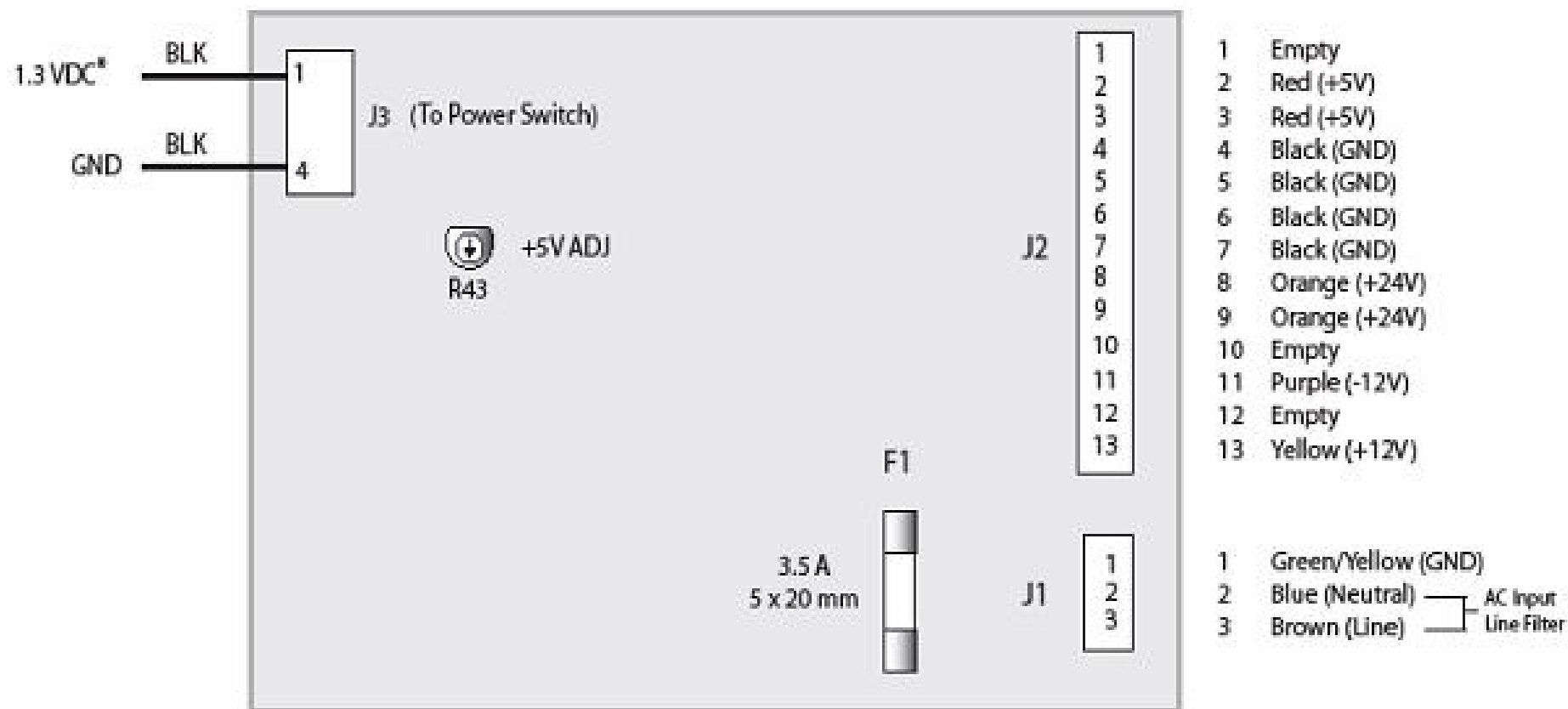
Personality board/ CPU

- Personality PCB is backwards compatible to the older TUV
 - connectors on the board handle both lamp power supplies
 - No other changes to the personality board
- Generic CPU
 - If replaced you must load the firmware from ICOP
- Firmware version 1.4



LVPS Interconnect

2489 UV/Vis Detector Low Voltage Power Supply Connections
(Block Diagram)



* 1.3 VDC Standby when OFF
0 VDC when detector powers up

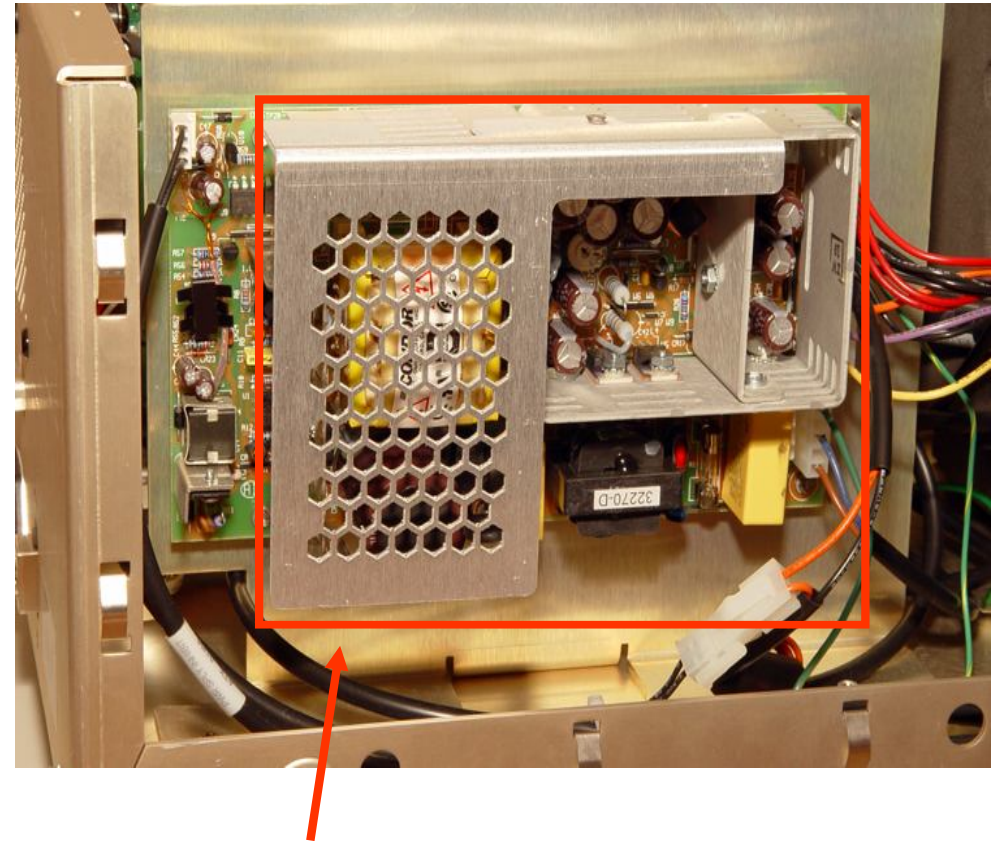
New LVPS

- Designed to have a constant 5 volt stand by. This allows use of a LV contact switch.
 - (no AC at front panel)



Electrical Safety

- As in any electrical instrumentation, caution should be observed when working inside the ACQUITY TUV. The Lamp Power Supply can generate over 600volts.
 - The AC input voltage will be as high as 240VAC.
- Power should be shut off and the AC power cord unplugged before changing any internal parts.

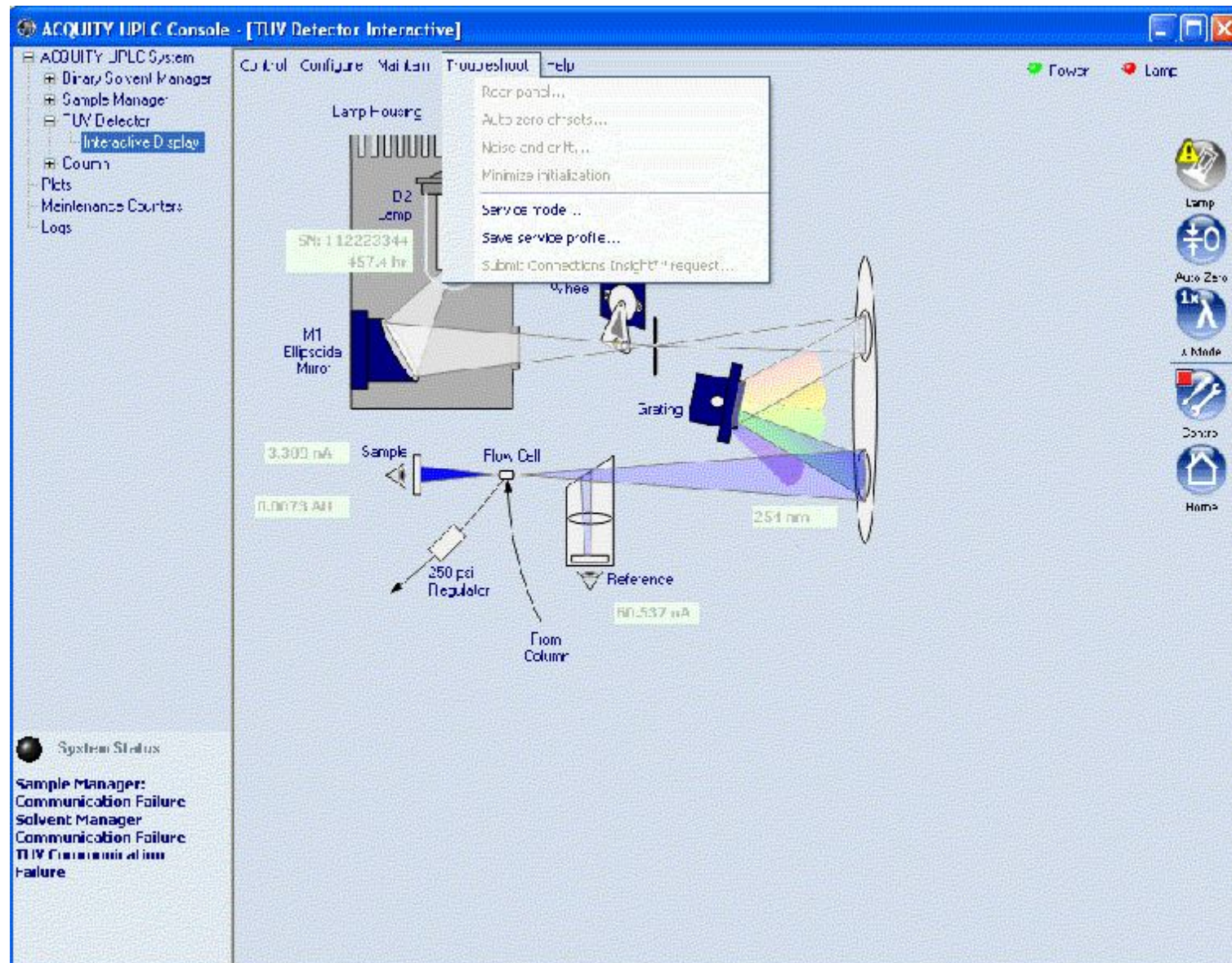


- A new cover has been fitted to the LVPS to reduce the risk of shock.

Troubleshooting

- Multi color LEDs on front panel will indicate failure
 - A flashing **red** LED is a confidence failure
 - Flashing **green** during boot up
 - Solid **green** on left is power on
 - Solid **green** on right is OK status
 - Solid **red** on right is a fatal communication error
- (This LED operation is the same on the PDA Detector)

Interactive Diagnostics



Things to know

- Firmware is uploaded via Ethernet or RS232
 - You will have a choice within the loader.
- The data rate will be selectable between
 - 1,2,5,10,20,40 80 Hz (older TUV is 40Hz Max)
- Max back pressure rating on flow cell will be 1000 PSI
- You must have solvent flow in order to pass start up. This is inherent to a light guided flow cell. The solvent is actually part of the light path within the AF tubing.

MBF (median baseline filter)

- Enhances the detector's baseline stability by decreasing its curvature.
- Available with ICOP 1.2 and above.
- Primarily intended to reduce the effects of mobile phase gradient separations that have gradual composition changes.
- Note: Real time data will be delayed by 25% of run time when MBF is selected. A count down clock will run in Console
- The filter does not significantly change:
 - peak area.
 - peak height
 - peak width
 - or retention times.

Things to know

- A back pressure regulator will be installed on the output of both Detectors. This will supply a constant 250psi of back pressure to reduce band spreading. Not needed with a Mass Spec.
- Flow cells are not field repairable.
 - A flow cell flushing procedure has been approved. It involves swapping the input and output tubing and or an acid flush. Be careful when installing flow cells. A protective guard has been added to help prevent the breaking of capillary tubing.
- IEEE port is inactive
 - Use waters Ethernet config guide to install. 71500074403

Things to know

- Never have lamp ON without flow.
 - The AF tubing is optimal with fluid in the cell due to RI of the solvent.
- The spare parts list is included in the PIP
 - Also in Service Notes in the ACQUITY section
- Lamps and flow cells from the older TUV are not interchangeable with the newer model.
- Firmware is backwards compatible to the older model.
- No upgrades to modify older TUV detectors with any of the new TUVE features.