VARIAN

Varian Analytical Instruments
2700 Mitchell Drive
Walnut Creek, CA 94598-1675/usa

ProStar 340
UV-Vis Detector

Operation Manual

QUALITY SYSTEM
ISO 9001
CERTIFIED

03-914783-00:Rev. 2_1

Table of Contents

Introduction

The ProStar 340 is a variable wavelength UV/visible absorbance detector for liquid chromatography. Using various combinations of flowcells and lamps, the detector can be adapted for applications from capillary to preparative scale.

Theory of Operation

Figure 1 illustrates the optical system for the detector. Only one lamp (D2 or tungsten) can be mounted at a time. Both lamps are continuum lamps that jointly provide consistent intensity across the entire spectrum from 190 to 800 nm. Two sets of baffles are used to minimize stray light. Wavelength selection is provided by a concave holographic grating actuated by a mechanical wavelength drive.

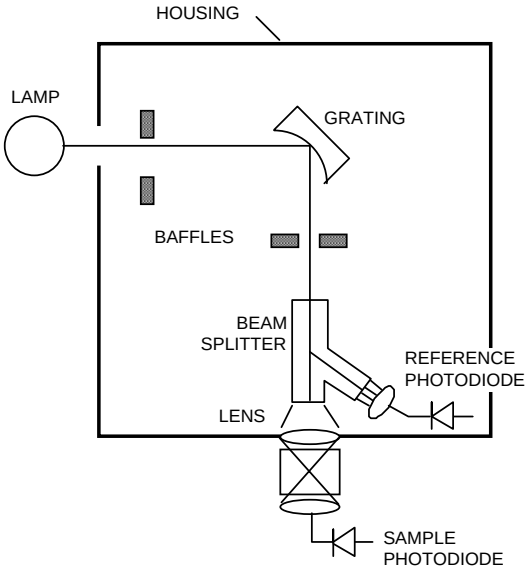


Figure 1 Optical System

True double beam operation is provided by a fiberoptic beam splitter. A reference photodiode continuously monitors the light from one leg of the beam splitter. The other leg is imaged by a lens through a sample cell onto the sample photodiode.

The photodiodes are connected to individual preamplifiers. The preamp output voltages are directly proportional to the light intensity at the photodiode active surfaces (see Figure 2).

The outputs of the preamplifiers are sent to an analog ratiometer. The output of this circuit is a voltage that is directly proportional to the negative logarithm of the ratio of the sample signal to the reference signal. This voltage is supplied to the rear panel as the 1V/AU integrator output and as the adjusted absorbance full scale recorder output.

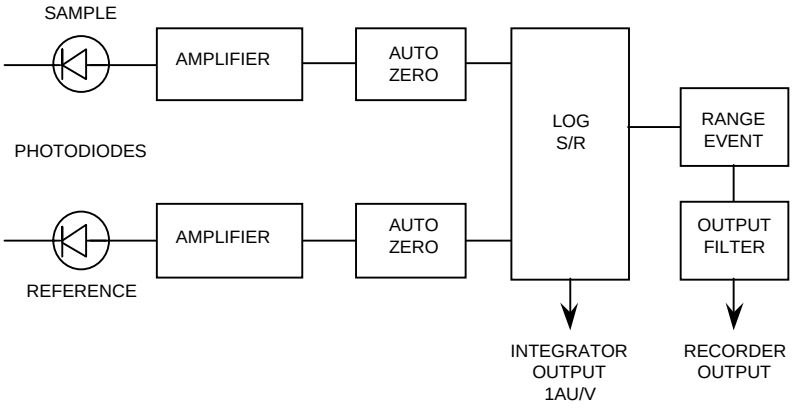


Figure 2 Electronics Block Diagram

Installation

Unpacking

Carefully unpack the detector from the shipping container and inspect both the unit and packing material for any signs of damage. If any damage is noted, contact the carrier company immediately. Any damage sustained in transit is the responsibility of the carrier, who will need to inspect the shipping container if any damage claim is filed.

In addition to this manual, the shipping container contains a power cord and any options which you ordered. Carefully check the packing list against the contents of the container. If anything is missing, check the packing materials carefully for the overlooked items. If any items are missing, contact LC Technical Services at 1-800-FOR-HPLC, or your local Varian office.

In addition to the detector, you will need the following items for setup and initial operation:

- Strip chart recorder or integrator and connecting cables.
- Liquid Chromatograph.
- Column.
- Standard test mix.
- Appropriate solvents, reagents, etc.
- Nuts and ferrules appropriate to the column end-fittings being used.
- Wrenches appropriate to column end-fittings.
- Connecting tubing and union (if column cannot be connected directly to the cell).

Location

Place the detector on a firm, flat surface, such as a laboratory bench top, near the column outlet. Allow at least 5 inches of clear space between the rear panel of the unit and any wall or obstruction. This gives access to the rear panel connections and provides a free flow of cooling air.

System Description

Front Panel

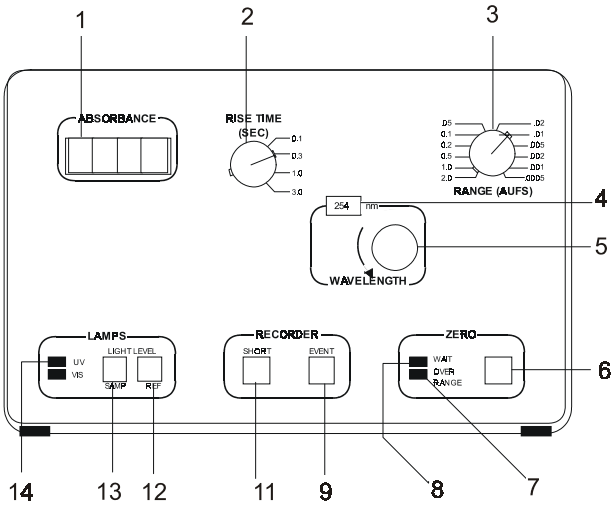


Figure 3 Front Panel

1. Display: A 3-1/2 digit LED display provides absorbance values up to 1.999 AU. This display also shows the relative sample and reference beam intensities when you press switch 8 (sample) or 9 (reference).
2. Rise Time Selection Switch: A four-position rotary switch controls the degree of filtering performed by a Second Order Bessel filter. Rise times of 0.1, 0.3, 1.0, and 3.0 seconds can be chosen. Typically, Rise Time in seconds approximates 2x Time Constant in seconds.
3. Range Selection Switch: A twelve-position rotary switch controls the full scale output range for the rear panel-positioned Recorder Output. Full scale ranges of 2.0, 1.0, 0.5, 0.2, 0.1, 0.05, .02, 0.01, 0.005, 0.002, 0.001, and 0.0005

AUFS are provided. This switch does not affect the fixed 1V/AU output of the rear panel integrator output.

4. Wavelength Indicator: A mechanical three-digit indicator displays operating wavelength.
5. Wavelength Selector: A mechanical continuous turn control selects wavelengths from 190 to 800 nm. Rotating this control clockwise decreases wavelength; counter-clockwise rotation increases wavelength. The arrow shows the direction of rotation to increase wavelength.

CAUTION

Do not force the wavelength control below 180 nm or over 820 nm. Damage to the wavelength drive may result.

6. Autozero Switch: A momentary switch activates an autozezro circuit capable of zeroing greater than 1.5 AU. After pushing this button, the Wait Light will turn on and the recorder output will be shunted to zero volts. Within three seconds a new zero value will be calculated and the Wait Light will turn off. The Over-Range Light will illuminate when the total absorbance within the flowcell exceeds the capacity of the circuit.
7. Over Range Light: A green LED indicates a total absorbance in the flowcell which exceeds the autozezro circuit capacity. The unit will continue to output voltages proportional to absorbance upon both recorder and integrator outputs. There will be an offset proportional to difference of the new baseline to that of a true zero baseline. For instance, if the autozero circuit functions to set the new zero value to 0.002 AU, all output absorbance values will contain an offset of 0.002.
8. Wait Indicator Light: A green LED indicates a fixed, zero volt recorder output. This occurs when:
    - Powering up the unit. After the lamp has ignited, it is necessary to press Switch 6 – autozero. The Wait Indicator will then shut off and the recorder outputs will become active.

- Pressing the autozero switch. After the new zero value has been stored, the light turns off and the recorder outputs will become active.

9. Event Switch: A momentary switch sends an event mark of approximately 20% deflection to the recorder output. This switch does not affect the integrator output.
10. Short Switch: A momentary switch shorts the recorder output terminals to zero volts. Pressing and holding the switch allows the user to set the chart recorder pen position. This switch does not affect the integrator output.
11. Reference Light Intensity Switch: A momentary switch displays a value which is proportional to the light intensity at the reference photodiode.
12. Sample Light Intensity Switch: A momentary switch displays a value which is proportional to the light intensity at the sample cell photodiode.
13. Visible (VIS) Lamp Indicator: A green LED indicates that a Tungsten lamp is present in the instrument and is lit.
14. Ultra Violet (UV) Lamp Indicator: A green LED indicates that a Deuterium (D2) lamp is present in the instrument and is lit.

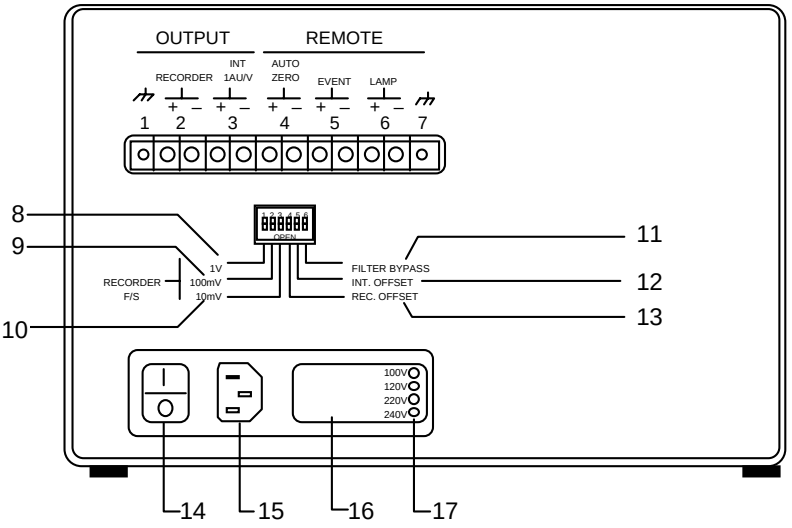


Figure 4 Back Panel

1. Earth Ground: This terminal is continuous with the earth ground.

NOTE: Do note use this terminal as negative ground for any output or input function. Doing so may create ground loops resulting in excessive noise.

2. Recorder Outputs: Two terminals supply an analog output for a strip chart recorder or integrator. The full scale outputs of these terminals are selectable from 10 mV, 100 mV, and 1.0V. This output is dependent upon the position of the Range and Rise Time controls.
3. Integrator Output: Two terminals supply a fixed 1 AU/V analog output to be used with an integrator. This output is independent of the Range control, Rise Time control, Short and Event switches, but dependent upon the autozero control.
4. Remote autozero: Two terminals provide a remote auto zero function. A momentary contact closure or TTL low activates the autozero circuit.
5. Remote Event: Two terminals provide an event mark with a momentary contact closure or TTL low.
6. Remote Lamp Shut-Off: Two terminals provide a remote means of switching off the lamp. Lamps are shut off by providing a continuous contact closure or TTL low. Lamps are re-ignited by the interruption of a contact closure or TTL low.
7. Earth Ground: This terminal is continuous with the earth ground.

Recorder Full Scale Voltage Selection Switches: Three two-position rocker switches (8, 9, and 10) control the full scale voltage of the recorder output. These switches do not affect the integrator output.

8. Pressing the top half of this switch to rock it upward to “ON” sets the full scale recorder output to 1.0V when Switches 9 and 10 are “OFF”.
9. Pressing the top half of this switch to rock it upward to “ON” sets the full scale recorder output to 100 mV when Switches 8 and 10 are “OFF”.

10. Pressing the top half of this switch to rock it upward to “ON” sets the full scale recorder output to 10 mV when Switches 8 and 9 are “OFF”.
11. Filter By-Pass Switch: A two-position rocker switch controls a bypass circuit for the Second Order Bessel filter. Pressing the top half of this switch so that it is “ON” disables the front panel Rise Time Control and results in an effective rise time of 0.1 seconds.
12. Integrator Offset Switch: A two-position rocker switch provides an additional +10 mV offset to the fixed 1 AU/V signal of the integrator output when the switch is in the ON position. This switch does not affect the recorder output. This integrator offset is supplied to aid integrators incapable of zeroing for a negative drifting baseline. In most cases, it need not be used.
13. Recorder Offset Switch: A two-position rocker switch provides a +10% fixed offset to the recorder output. This offset is independent of full scale range or full scale voltage. This recorder offset does not affect the integrator output.
14. Power Switch: A two-position rocker switch turns the instrument on and off. Pressing the top half of this switch to rock it upward powers up the unit. Pressing the bottom half of the switch to rock it downward shuts the unit off.
15. Power Connector: A three-pin receptacle is provided that accepts a standard modular power line cord.
16. Fuse Block: Pry out this block to allow access to the fuses and voltage control. It contains one 1.0 Amp slow-blow fuse (for 100-120 Vac operation) and two 0.5 Amp slow-blow fuses (220-240 Vac operation).
17. Voltage Control Selector: A four position voltage selector allows the instrument to be operated at 100, 120, 220, or 240 Vac (50/60 Hz).

Flowcell Housing and Lamp Housing

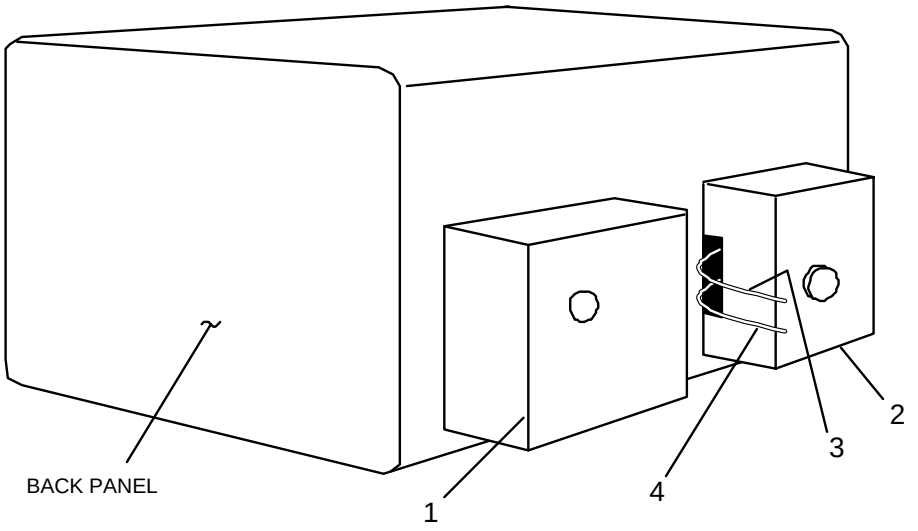


Figure 5 Flowcell Housing and Lamp Housing

WARNING:
BURN HAZARD

WARNING:
EYE HAZARD

NEVER remove the lamp housing cover when power is connected. UV radiation from the D2 lamp can damage skin and eyes. Lamps become very hot. Use care when handling them to avoid burns.

1. Lamp Housing Cover: Remove the screw and cover to access the lamp.
2. Flowcell Housing Cover: Remove to access the flowcell and sample photodiode.
3. Flowcell Exit Tubing: Connect to a fraction collector, back-pressure device, or waste.
4. Flowcell Inlet Line: Connect to the column outlet, directly if possible.

NOTE:	If you wish to connect two detectors in series, be sure to minimize the total tubing length from this detector outlet to the inlet of the other detector, to prevent excessive band broadening. The outlet and inlet tubing ID, OD, and position may vary according to the flowcell in use. Consult the flowcell manual for more details.

Electrical Connections

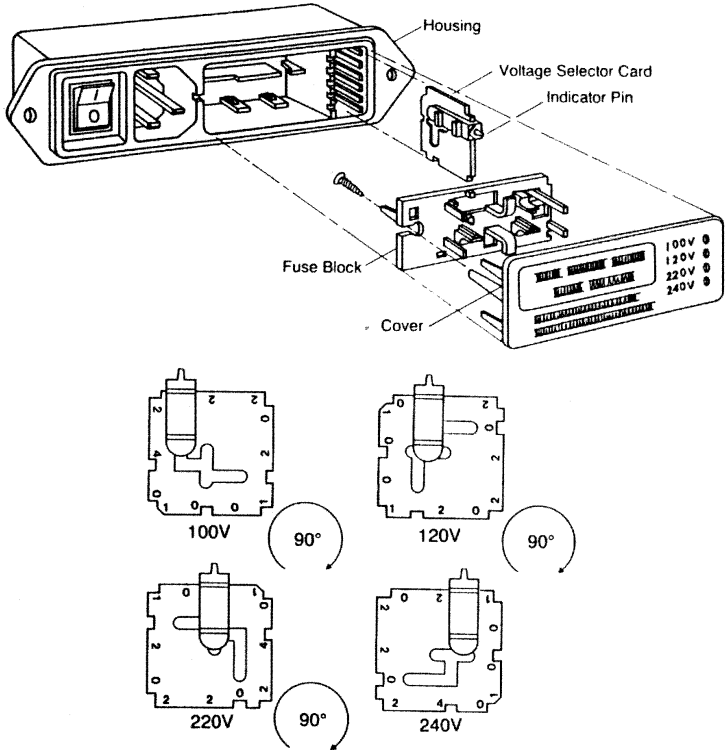


Figure 6 Voltage Selection

Setting Voltage

WARNING:
SHOCK HAZARD

Make sure the power cord is disconnected from the rear panel of the detector.

Refer to the figure above. Check the voltage selector block located next to the power cord connector on the rear panel. The plastic tab indicates the voltage for which instrument has been set (100, 120, 220, or 240V; 50/60Hz). If the voltage is set incorrectly, reset it to the proper value before proceeding further.

Insert the blade of a small screwdriver into the slot next to the connector and pry open the fuse block. Pull the fuse block straight out. Using a pair of longnose pliers, pull the voltage selector card straight out. Orient the plastic indicator for your voltage) then press the selector card back into place. Ensure that the fuse block is properly oriented for the selected voltage by rotating the block along its longitudinal axis until:

- The long single fuse faces outward for 100 and 120V (1 Amp slow-blow).
- The two short fuses face outwards for 200 and 220V (0.5 Amp slow-blow).

Snap the fuse block cover back into place.

Setting Recorder Full-scale Voltage

The detector provides a single strip chart recorder channel. The full scale voltage for this channel may be set at 10 mV, 100 mV, or 1.0V using a bank of switches located on the Rear Panel (see Figure 7). The instrument is factory configured to 10mV full scale. To change the full scale voltage:

1. Press the bottom half of switch #3 so that it rocks downward to OFF.
2. For 100 mV full scale, press the top part of switch #2 so that it rocks to ON.
3. For 1.0V full scale, press the top half of switch #1 so that it rocks to ON.

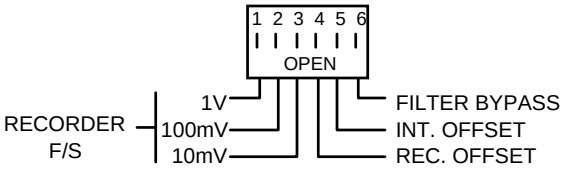


Figure 7 Recorder Full-scale Voltage Switches

NOTES:	If any of these switches are switched on together, the recorder output shows uncalibrated full scale. Ensure that only one switch is on at a time. These switches do not affect integrator output.

Recorder Connections

The recorder cables are connected at the I/O terminal on the back panel. The cables should have about 1/4" of bare wire or a spade connector. Connect the positive input of the recorder to the positive screw on the recorder output. Connect the input of the recorder to the negative screw on the recorder output.

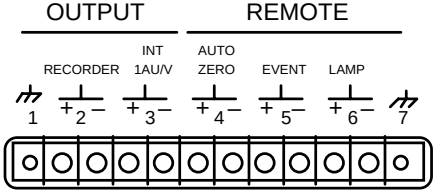


Figure 8 Input/Output Terminal

Integrator Connections

The detector also provides a fixed-span output (1V/AU) for use with an integrator or data acquisition system. This is independent of the rise time control, full scale range and voltage settings of the unit. However, its output will reflect the zeroing of the autozero circuit. Thus, a changing baseline can be corrected by pushing the autozero switch.

Connect the input line of the integrator in an identical manner as was outlined for the strip chart recorder.

Power Cord

Power to the detector is provided by a standard modular power cord assembly. Connect the power cord to the receptacle next to the fuse block.

Remote Connections

The detector provides external remote control connections. (You do not need to connect these in order to finish the initial installation and check-out. In that case, go to the Fluid Connections section.) Refer to Figure 8 for Remote connections.

Autozero

The autozero connection duplicates the function for the autozero switch on the Front Panel whenever it is connected to a momentary contact closure or TTL low.

Connect the triggering device so that the positive (+) line is connected to the positive pole and the negative (–) line is connected to the negative pole of the remote Autozero terminal. The remote autozero is triggered by shunting across its two input terminals.

Event

The Event connection duplicates the function of the Event Button on the front panel whenever it is connected to a momentary contact closure or TTL low.

Connect the triggering device so that the positive (+) line is connected to the positive pole and the negative (–) line is connected to the negative pole of the remote Event terminal. The remote Event is triggered by shunting across its two input terminals.

NOTE:	If you notice excessive noise when a remote triggering device is connected or used, there may be a ground loop in the circuit. Ensure that the remote device has a negative output which is isolated from the earth ground.

Lamp

The Lamp connection turns the lamp off when supplied with a constant contact closure or TTL low.

Connect the triggering device so that the positive (+) line is connected to the positive pole and the negative (–) line is connected to the negative pole of the Remote Lamp terminal. The Remote Lamp shut-off is triggered by shunting across its two input terminals. Interruption of this shunt re-ignites the lamp.

NOTE: If the lamp is switched off by the Remote Lamp Shutoff and then re-ignited, the fixed zero volt recorder output function indicated by the front panel Wait LED will not be maintained. The recorder output will return to a level representative of the current absorbance and last-stored zero value. The Autozero circuit should be activated.

Fluid Connections

The detector fluid inlet is the lower tube protruding from the rear wall of the cell compartment (see Figure 5). As a general rule, the less tubing between the column outlet and the flowcell, the better. Ideally, the column outlet should be connected directly to the detector inlet line. If this is not possible, you should use a minimum length of narrow bore (0.010 inch ID) connecting tubing and a zero dead volume union.

Because different columns use different fittings, the detector is supplied with a bare tube end to allow connection to any column accepting 1/16 inch OD tubing. You should use nuts and ferrules suitable to your column.

Connect the cell outlet (the upper tube protruding from the rear wall of the cell compartment) to a line leading to an appropriate waste reservoir. If bubble formation in the detector cell causes problems, you may wish to connect the cell outlet to a restrictor or back pressure device providing 20-60 psi backpressure.

NOTE: Before connecting a new piece of tubing or column to the detector, pump several mL of clean solvent through it to waste. This action will clean any particulates or oil from the inside bore of the tubing, which would otherwise reach the sample cell or heat exchanger.

Operation

Introduction

Turn on the HPLC system and allow the column to equilibrate with the flowing eluant (the time required will depend upon your particular column and eluant). If you have not already done so, turn ON the power to the detector using the switch located on the lower rear panel.

Turn the Range selector knob to 2.0 AUFS and Rise Time selector to 1.0 sec. Adjust the wavelength drive to the appropriate wavelength for your test mix.

During the lamp ignition period, adjust the chart recorder pen to your desired position. After lamp ignition, the appropriate lamp indicator (UV for D2, Vis for Tungsten) will light, an absorbance will be shown on the LED display, and the Wait Light will still be lit. During this interval, the recorder output will be fixed at zero volts while the integrator output will transmit a voltage related to the present flowcell absorbance and last zero value stored in the autozero circuit memory. To activate the recorder output, press the autozero switch.

NOTE: When the unit is first switched on, the display will show random values, typically 1 or -1. The Wait LED will be ON. The D2 lamp ignites in approximately 20 seconds; the tungsten lamp ignites immediately.

This feature protects the chart recorder from rapidly moving and slamming into its margin if the detector is inadvertently set at a sensitive range and a large discrepancy exists between flowcell absorbance and the last stored zero value.

After the lamp has ignited and the autozero button has been pushed, it will be necessary to push the Short Switch to set the

recorder output to zero volts to allow adjustment of the chart recorder pen. The Short Switch does not affect the integrator output.

Set the detector to a more sensitive range such as 0.01 AUFS and monitor the baseline until a straight, non-drifting baseline is noted.

NOTE: Allow approximately one hour for the detector to be ready for operation.

Setting Detector Controls

After the column has equilibrated and the detector has warmed up, prepare a sample to be injected. Set the detector parameters according to the following guidelines.

Wavelength

Turn the wavelength selector until the wavelength indicator coincides with the wavelength of maximal absorbance for your sample. Wavelength ranges are:

- 190-380 nm for the standard deuterium lamp.
- 380-800 nm for the optional tungsten lamp.

Rotating this control clockwise decreases wavelength while a counter-clockwise rotation will increase wavelength. The arrow indicates the direction of rotation for increasing wavelength.

CAUTION

Do not force the control below 180 nm or over 820 nm. Damage to the wavelength drive may result.

NOTE: For best reproducibility, always set your desired wavelength from the same direction, and from at least 10 nm away from its desired value. For example, to set 254 nm, always move the dial to about 244 nm (or 264 nm) and then make the final setting to 254 nm.

Range

Rotate the Range Selector Switch to an appropriate full scale absorbance for your sample. Full scale ranges of 2.0, 1.0, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, and 0.005 AUFS are provided. This switch does not affect the fixed 1 V/AU output of the rear panel located integrator output.

Rise Time

As a general rule a rise time equivalent to 1/10 of the fastest peak base-width should be used. Too short a rise time results in an unnecessarily noisy baseline, while too long a rise time may distort the shape of the peak. For most LC applications, a rise time value of 1.0 second is sufficient.

The Second Order Bessel filter provides user selectable rise times of 0.1, 0.3, 1.0, and 3.0 seconds. For extremely fast peaks, a filter by-pass switch is provided on the rear panel (Figure 7, Switch #6).

NOTE:	Although the filter may distort peak shape at long rise times, peak area is always maintained. Integration can be safely performed for the purpose of quantitative analysis from the recorder output.

Pressing the top portion of this switch turns the circuit on, disables the rise time selector, and results in an effective rise time of 0.1 seconds.

Performing a Test Run

After setting the detector parameters, the instrument should be zeroed. As a general rule, it is a good idea to autozero the detector prior to each injection.

Zero the detector, inject your sample, and activate the event mark. You should note an approximate 20% deflection on the recorder. Note the peaks as they appear on the strip chart recorder. Readjust the parameters of wavelength, range, and rise time to optimize the chromatography.

Shut Down

As a general rule, it is recommended that the flowcell be flushed with several volumes of clean, non-ionic eluant. This is especially important if ionic buffer solutions have been used. After flushing, simply turn the power switch on the back panel to the OFF (downwards) position.

The lamp may be shut-off remotely with the rear panel located Lamp Shut-off terminal. This will prolong lamp life while the detector is not in use. The lamp is shut off by providing a continuous contact closure or TTL low. The lamp is re-ignited by interrupting the contact closure or TTL low.

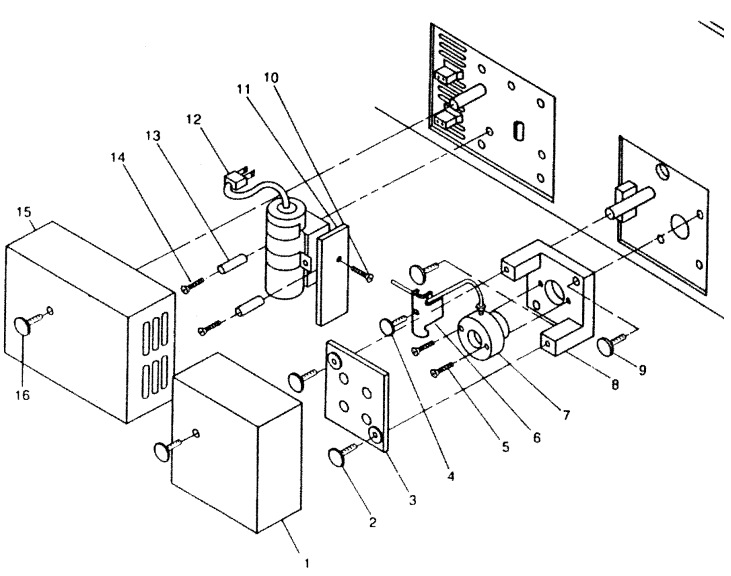
NOTE:	After the lamp is remotely re-ignited, the strip chart recorder output will transmit a voltage related to the current flowcell absorbance and the last stored zero value in the autozero circuit

Maintenance and Troubleshooting

Changing the Flowcells

The detector can accommodate a variety of flowcells with different pathlengths, illuminated volumes, and wetted materials, for different applications. All flowcells are provided premounted in a holder assembly to minimize alignment problems. Detailed instructions specific to the various flowcells are included with the flowcells themselves. This section of the manual provides general guidelines for maintenance and service of the flowcell and lamp assemblies.

The flowcell is located in the forward housing on the left side of the detector.



1. Cell Cover
2. Photodiode Retaining Screw
3. Photodiode Mount
4. Tubing Strain Relief Thrumbscrew
5. Cell Retaining Screws
6. Tubing Strain Relief Clamp
7. Cell Body Assembly
8. Cell Holder
9. Cell holder Tumbscrews
10. Lamp Light Shield Screw
11. Lamp Light Shield
12. Deuterium Lamp Assembly and Plug
13. Lamp Thrumbscrew Standoff
14. Lamp Thrumbscrew
15. Lamp Cover
16. Lamp Cover Screw

Figure 9 Flowcell and Lamp Assemblies

To change the flowcell:

WARNING:
SHOCK HAZARD

Make sure the power cord is disconnected from the rear panel of the detector.

1. Disconnect the cell inlet tube from the column or connecting tube and free the cell outlet tubing.
2. Remove the cell cover by unscrewing the thumbscrew and pulling the cover straight back to expose the photodiode mount.
3. Unscrew the two thumbscrews on the photodiode mount and pull the photodiode mount straight back (see figure above).

The connecting cable is long enough to allow the photodiode mount to rest on the bench top.

CAUTION

Avoid scratching or putting fingerprints on the photodiode, flowcell windows, or the monochromator lens. The photodiode surface should be cleaned with spectroscopic grade methanol and lint-free lens paper.

4. Loosen the thumbscrew holding the tubing strain relief clamp in place and gently pull the clamp towards you far enough to disengage the tubing from the clamp.

5. Unscrew the two thumbscrews securing the cell holder assembly in place and pull the cell holder assembly straight back toward you to remove it.

6. Replacement cells are mounted pre-aligned in a cell holder assembly. Installation reverses the removal process.

7. Slide the cell holder assembly onto the alignment dowels. The inlet line should enter the bottom of the cell in order to provide efficient bubble flushing. Securely fasten the cell holder assembly with the two thumbscrews.

8. Slip the inlet and outlet tubes into the slots in the strain relief clamp and tighten the thumbscrews holding the clamp in place.

9. Replace the photodiode mount and fasten it securely with the two thumbscrews.

10. Replace the cell cover (be careful not to pinch the cable or the tubing) and fasten it securely with the thumbscrew.

11. Reconnect the inlet line to the column or connecting tubing and reconnect the outlet tubing to the fraction collector, back-pressure device, or appropriate waste reservoir.

12. Reconnect the power cord to the rear panel of the detector.

Flow Cell Maintenance

Cleaning the Flowcells

If at all possible, we discourage the disassembly of flowcells for routine cleaning purposes. Most cells can be adequately cleaned by flushing with several milliliters of appropriate solvent. We recommend the following solvents for this purpose:

1. Methanol
2. Tetrahydrofuran
3. Methylene chloride
4. HPLC grade water
5. 6 nitric Acid following by flushing with HPLC Grade Water

Cell Disassembly

If flushing proves inadequate for cleaning purposes or if the flow cell becomes leaky, requiring gasket replacement, the following procedure should be followed for flowcell disassembly: (see Figure 10).

1. Remove the flow cell assembly from the detector as described in the installation section of this manual.
2. Remove the two screws which secure the flow cell body to the flow cell mount and free the flow cell from its mount.
3. Using a wide, flat-blade screwdriver, remove the window retaining nut (11).
4. Remove the retaining washer (10). Note that it is installed concave-side up.
5. With a fine pair of forceps, gently lift out the flow cell window (9). Be careful not to scratch these windows. Clean the window using spectroscopic grade methanol and lint-free lens paper.
6. Note the orientation of the tear drop of the flow cell gasket (8.). It should be installed so that both the optical bore (the

large hole) and fluid bore (the small hole) are not covered. Remove the cell gasket with a pair of fine forceps.

7. Repeat steps 3 through 6 above for the other side of the cell.

8. If the inlet or outlet tubes are clogged, remove them as follows:

   - Remove the exit tubing (7) by unscrewing its fitting (2) and pulling the tube straight forward.
   - Unscrew the heat exchanger restraint screw (5) and remove the screw and washer (4).
   - Unwind the inlet tubing (1) from around the cell body (I6).
   - Remove the inlet tubing (1) by unscrewing its fitting and pulling the tube straight out.
   - Remove the remaining heat conductive epoxy out of the heat exchanger groove which circumscribes the cell body.

The flow cell body may be cleaned by soaking it in spectroscopic grade methanol. For best results, an ultrasonic bath should be used.

Flow Cell Reassembly

NOTE:	For best results, the flow cell gaskets should be replaced each time the cell is disassembled.

Refer to Figure 10 in the following procedure:

1. With a pair of fine forceps, replace the cell gasket (8) in its proper orientation so that both the optical bore (large hole) and fluid bore (small hole) are exposed by the tear drop.
2. Carefully replace the cell window (9).
3. Install the retaining washer (10) so that its concave surface faces away from the cell body.

4. Replace the window retaining nut (11). Tighten to 14 inch-pounds. To avoid possible damage to the windows, do not exceed 14 inch-pounds of torque.

5. Repeat steps 1 through 4 for the other side of the flow cell.

6. If the cell tubing was removed, re-install as follows:

    - Replace the cell inlet tubing by replacing its fitting into the inlet hole (the one next to the hole for the heat exchanger restraint).

    - Bend the tubing around the cell so that it circumscribes the cell body in the heat exchanger groove before it approaches the hole for the heat exchanger restraint.

    - To improve heat exchange between the inlet tubing and flow cell body, a heat conductive epoxy should be applied into the groove before the tubing is installed.

    - After the epoxy has been applied, secure the tubing into the heat exchanger groove by replacing the heat exchanger restraining screw (5) and washer (4).

    - Replace the cell outlet tubing by placing its fitting into the outlet tubing hole.

7. Reinstall the flow cell body on the flow cell holder using the two mounting screws. Insure that the protruding nose piece of the flow cell is inserted into the cell mount.

8. Reinstall the flow cell onto the detector as outlined in the installation section of this manual.

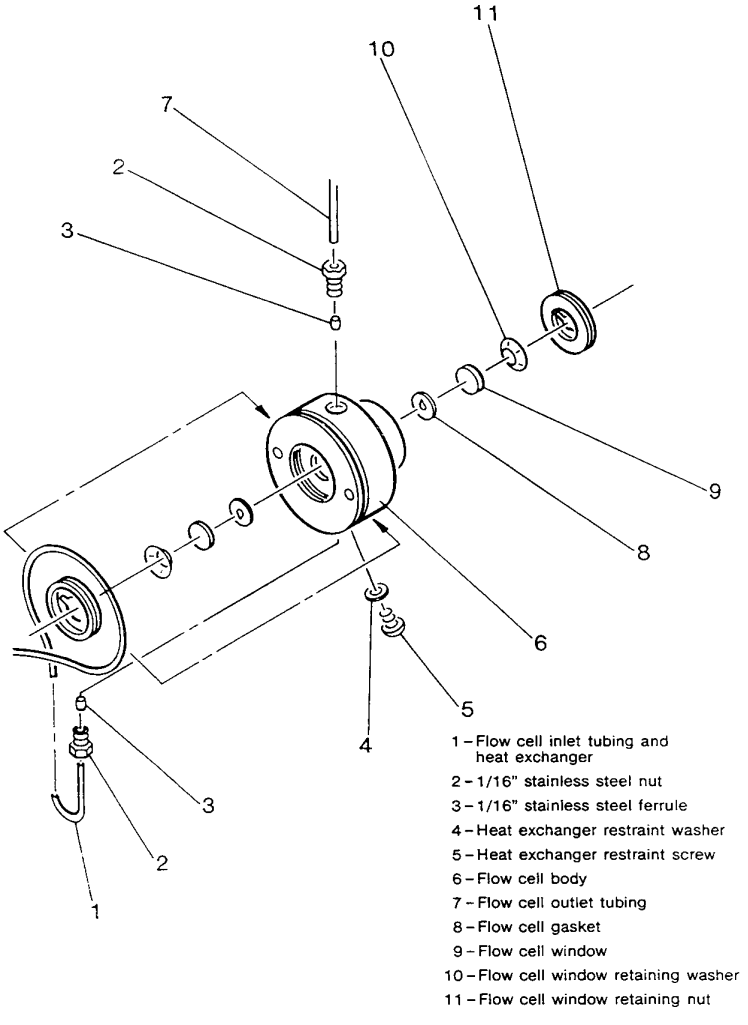


Figure 10 Flowcell

Changing the Lamp

The detector accepts two light sources: a deuterium lamp (for wavelengths in the range 190-380 nm) and a tungsten lamp (for wavelengths in the range 380-800 nm). If your detector was ordered for operation in the visible spectrum, the tungsten lamp is installed. If you ordered your detector in the standard configuration, it is equipped with the D2 lamp. Only one lamp can be mounted in the instrument at a time. Consequently, moving from the UV to the visible requires the removal of the D2 lamp and installation of the tungsten lamp. All lamp assemblies are pre-aligned and no further alignment is necessary when changing from one lamp to another.

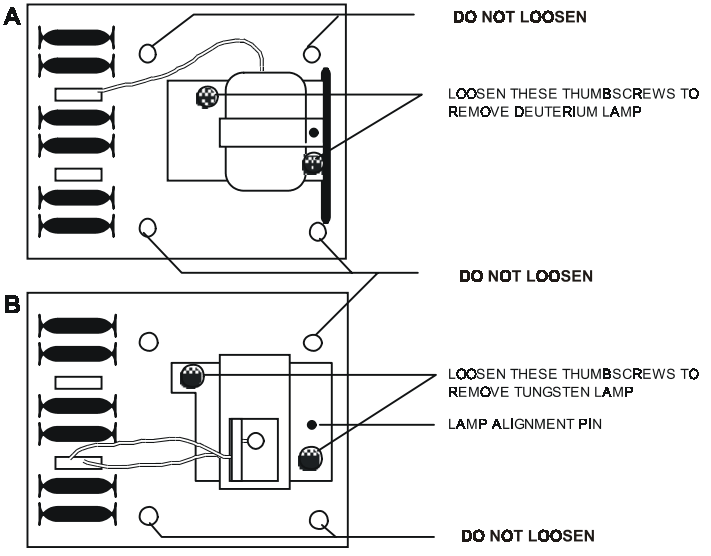


Figure 11: Lamp Assemblies (A: Deuterium, B: Tungsten)

Deuterium (D2) Lamp

The Deuterium Lamp is rated for 1,000 hours of life to 1/2 the original intensity. This does not mean that the lamp will burn out after 1,000 hours, merely that its intensity will be reduced to 50% of its original output. Each D2 lamp assembly is equipped with a

chronometer indicating the total hours of operation. The chronometer is read by noting the position of the “gap” in the mercury tube against the graduated background.

To check the lamp intensity:

1. Power up the unit. Wait approximately 10 minutes.
2. Adjust the wavelength drive to read 254 nm from a position at least 10 nm below.
3. Push the Reference Light Intensity Switch.
4. If the displayed value is:

≥ 100	lamp is good
99-50	lamp is marginal
<50	replace lamp

As a general rule, the D2 lamp should produce reference light intensities greater than 50 from 190-380 nm.

Removing the D2 Lamp

1. Disconnect the power cord from the back panel of the detector.
2. Remove the screw and remove the lamp housing (the rear housing on the left side of the detector to expose the lamp (see Figure 5).

WARNING:
EYE HAZARD

UV light can damage eyes and skin. Always disconnect the power cord before working in the vicinity of the lamp.

WARNING:
BURN HAZARD

The D2 lamp gets very hot. Care must be taken while handling it to prevent burns. Always allow the lamp to cool before removal.

3. Disconnect the UV lamp lead from the detector by gently pulling it straight back toward you. DO NOT twist the connector while pulling (see Figure 11).

4. Unscrew the two thumbscrews holding the lamp mount in place, and pull the lamp mount straight back towards you. Be careful not to lose the two aluminum standoffs or the thumbscrews. Be careful not to get fingerprints on the lamp.

Installing the D2 Lamp

1. Slide the lamp mount onto the alignment dowel located to the left of the monochromator's aperture (the mount has a pre-drilled hole to accommodate the dowel), Figure 11A. The lamp leads should emerge from the top of the lamp.

2. Use the thumbscrews and aluminum standoffs to attach the lamp assembly to the detector.

3. Connect the lamp lead to the upper of the two terminals in the lamp compartment.

4. Replace the lamp housing and its retaining screw.

CAUTION

NEVER loosen the screw holding the lamp to the mount, and NEVER attempt to rotate or move the lamp up or down in the mount. Doing so will degrade the system performance. The lamp is provided as a pre-aligned assembly.

If the lamp is plugged into the wrong connector, it will fail to light. No harm will be done.

Tungsten Lamp

The lifetime of the tungsten lamp is approximately 2,500 hours. To check the tungsten lamp intensity:

1. Power up the unit if it is not already on. Wait approximately 10 minutes.

2. Adjust the wavelength drive to 550 nm from a position at least 10.0 nm below.

3. Push the Reference Light Intensity Switch.

4. If the displayed value is:

≥ 100	lamp is good
99-50	lamp is marginal
<50	replace lamp

In general, a value less than 15 for the 380-450 nm range and less than 50 for 450-800 nm range is indicative of a bad tungsten lamp.

The tungsten lamp should be used for all wavelengths above 380 nm. The user may notice higher relative light intensities for the D2 than the tungsten lamp from 380-450 nm. However, this light represents the second order diffraction spectra of the D2 lamp and should not be used.

To install the tungsten lamp, the D2 lamp must first be removed. To remove the D2 lamp, refer to *Removing the D2 Lamp*, page 29.

WARNING:
BURN HAZARD

The tungsten lamp gets very hot. Allow sufficient time for it to cool before attempting removal.

Removing the Tungsten Lamp

1. Make sure that the power cord is disconnected from the rear panel of the detector.

2. Remove the screw and remove the lamp housing on the left side of the detector to expose the tungsten lamp.

Installing the Tungsten Lamp

1. Slide the tungsten lamp assembly along the same alignment dowel used for the D2 lamp (see Figure 11B).

2. Fasten the tungsten lamp assembly using the same two screws and aluminum standoffs that are used to fasten the D2 lamp assembly to the detector.

3. Plug the tungsten lamp power cord into the lower of the two receptacles located on the detector.

4. Replace the lamp housing and its retaining screws.

Troubleshooting

Most problems with HPLC detectors are actually caused by other parts of the system. Noisy and drifting baselines, poor reproducibility in quantitative analysis, and similar problems are more often the result of dissolved air bubbles, contaminated eluants, dirty samples, or damaged columns rather than of actual problems with detector hardware.

To effectively focus on troubleshooting detector problems, on-board diagnostic tips are discussed first. Then there is a troubleshooting table organized by symptom, cause, remedy.

Light Intensity Diagnostics

The detector provides the capability of monitoring relative light intensities at both the sample and reference photodiodes. If an unusually noisy baseline is noted, relative intensities of reference and sample light should be assessed. Acceptable values are dependent upon the flowcell used, wavelength of operation, and background absorbance. The basic guidelines are as follows:

1. A clean flowcell and good lamp will yield a reference to sample light ratio of approximately 2:1.

2. An unusually high reference to sample light ratio may indicate:

   - dirty flowcell
   - excessive absorbance by solvent

3. An acceptable ratio of reference to sample light accompanied by a reference light level less than 50 indicates a bad lamp.

Proper Full Scale Voltage Output

An exceptionally noisy baseline may also be due to an inappropriate full scale voltage output setting for the strip chart recorder. To test if the detector full scale output voltage is properly configured:

1. Press the Short Switch and move the recorder pen to a good reference point.
2. Release the Short Switch and press the Event Switch.
3. The event mark should be approximately 20% full scale if the output voltage is properly configured.
4. If the event mark is too large, the output voltage needs to be reduced.
5. If the event mark is too small, the output voltage needs to be increased.

The instrument is factory configured to 10 mV full scale. To change the full scale voltage:

1. Press the bottom half of Switch #3 so that it rocks downward to the OFF position (see).
2. For a 100 mV scale output, press the top part of Switch #2 so that it rocks to the ON position (upwards).
3. For a 1.0 V full scale output, press the top portion of Switch #1 so that it rocks to the ON position (upwards).

Filter Bypass Switch

An exceptionally noisy baseline not responsive to the Rise Time Selector on the front panel may be the result of an activated Filter Bypass Switch. When the Filter Bypass Switch is on, the front panel rise time control is bypassed and a resultant rise time of 0.1 seconds is created. To deactivate the Filter Bypass Circuit:

1. Push the bottom half of Switch #6 (see Figure 7) until it rocks downward to the OFF position.

Troubleshooting Guide

For further assistance phone 1-800-FOR-HPLC or contact your local Varian office.

Symptom	***Possible Cause***	***Suggested Remedy***
Spikes on a recorder baseline.	Bubbles passing through cell.	Degas solvent and/or supply back pressure to the sample cell, also check all high pressure fittings for leaks (both liquid and gases).
	External triggering device is creating electrical noise.	Check electrical lines for good connection and/or interference from broad cast radiation. Check for ground loops.
	Extremely large supply voltage transients on the line.	Remove systems that consume high power from the line.
Noisy baseline on recorder (random).	Sample cell windows are contaminated.	Flush cell with solvents (methanol, acetone, water, 6N nitric acid, water) and check for leaks.
	Sample input line has a leak.	Check all lines from the output of the column to the input of the sample cell for leaks.
	Bubble trapped in sample cell.	Increase flow rate and/or back pressure on cell.
	Recorder or integrator is grounded and is causing a “ground loop” problem.	Check recorder with voltmeter to see if either of the signal inputs is grounded to case or earth ground.
	Photodiode window is dirty or not attached properly.	Remove and clean photodiode window.
	Sample cell is not screwed down to the main unit.	Check sample cell mounts and cell holder assembly.

Symptom	*Possible Cause*	*Suggested Remedy*
	Output span of the detector does not match input range of recorder or integrator.	Press event mark to see if the “spike” is approximately 20% of scale.
	External triggering device is causing a ground loop problem.	Use only triggering device with ground isolated from earth ground.
Recorder baseline drifts excessively.	Contamination of sample cell windows has occurred.	Flush cell with solvents (methanol, acetone, water, 6N nitric acid, water). Inspect cell and photodiode for fingerprints and smudges and clean if necessary.
	Solvent from column is changing absorption.	Column is filled with UV absorbers that are bleeding - replace column; impure solvent is equilibrating with the column. Replace solvent with purer grade, switch to a longer wavelength so that background absorption fluctuates less.
	Leakage in the lines from column to flowcell.	Check lines for leakage.
	Tiny bubble trapped in the sample cell.	Increase flow rate and/or backpressure.
	Output span of detector does not match input span of recorder or integrator.	Press Event Mark to check for a 20% full scale spike.
	Large temperature fluctuations are occurring.	Remove detector from the source of drafts of hot and cold air.
	Flowcell, photodiode assembly, or flowcell cover is loose.	Tighten thumbscrews fastening flowcell holder and flowcell cover.

Appendix

Specifications

Wavelength:	190-380 nm standard Deuterium lamp, 380-800 nm with optional Tungsten lamp.
Wavelength Drive:	Manual drive with mechanical wavelength indicator.
Band Width:	6 nm.
Wavelength Accuracy:	± 1 nm.
Wavelength Precision:	± 0.1 nm.
Optical Methodology:	Standard Deuterium lamp (190-380 nm) and optional Tungsten lamp (380-800 nm) light sources with concave holographic grating monochromator with double-beam optics. Provision for purging the monochromator.
Range Selections:	2.0, 1.0, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, and 0.0005 AUFS.
Recorder Output:	Single output with 10 mV, 100mV, or 1.0 V full scale capability with a switch providing +10% full scale offset at each setting.
Integrator Output:	1.0 V/AU analog output, independent of range control but dependent upon autozero function. A switch supplying an additional +10.0mV is provided on the rear of the unit.
Remote Controls:	Rear Panel input for: autozero, Event Mark, and Remote Lamp Shut-Off.
Noise:	± 2 x 10^{-5} AU from 220-280 nm with 1.0 sec rise time (static, dry flowcell).
Drift:	< 2 10^{-4} AU/hour after 1 hour warmup.
Zero-Adjust:	Autozezro circuit capable of offsetting greater than 1.5 AU with standard flowcell.
Chart Recorder Filter:	Second Order Bessel filter with four user selected rise times (0.1, 0.3, 1.0, and 3.0 seconds). Rise time in seconds approximates 2x time constant in seconds. A filter bypass switch located on the rear panel provides an equivalent rise time of 0.1 seconds.
Display:	A 3½ digit LED displays absorbance and relative sample and reference light intensities.

Flowcells:	Pathlengths from 0 mm to 10 mm, cell volumes from 0 mL to 15 mL, stainless steel, titanium, or Kel-F, contact materials, sapphire windows. 1000 psi pressure rating for stainless steel cells, 500 psi pressure rating for Kel-F cells, 2,000 psi pressure rating for variable pathlength preparative cells; 7,000 psi pressure rating for high pressure microbore cell.
Dimensions:	6 ¼ inches high, 13 ¼ inches deep, 9 ¾ inches wide.
Weight	20 lbs.
Line Voltage	100, 120, 220, 240 Vac (± 10%), 50 or 60 Hz.

Parts and Accessories

PART NUMBER	***DESCRIPTION***
LAMPS	
R000088515	Pre-aligned Deuterium Lamp Assembly
R000088516	Pre-aligned Tungsten Lamp Assembly
FLOWCELLS	
R000088506	Conventional HPLC: 6 mm path, 9 µL volume, SS
R000088507	Microbore HPLC: 3 mm path, 1. µL volume, SS
R000088508	Semi-Prep/glass column: 3 mm path, 4.5 µL volume, SS
R000088509	Biocompatible HPLC: 6 mm, 9 µL, volume, Kel-F, rated to 500 psi
R000088510	Variable-path preparative: 0-3 mm path, 0-4.6 µL volume, SS, 1/8 inch fittings, rated to 2000 psi
R000088511	Conventional HPLC: 10mm path, 15 µL volume, SS
R000088512	Capillary HPLC and SFC: 240 µm path, 35 nL volume, borosilicate, rated to 5000 psi
R000088513	Preparative biocompatible: pathlength adjusts from 0-3 mm, 0-4.6 µL volume, titanium, rated to 2000 psi
R000088514	High pressure microbore for packed cell SFC and LC/MS: 2 mm path, 250 nL volume, SS, rated to 7000 psi