

# SERIES 200

## DIODE ARRAY DETECTOR II



## User's Manual



**Series 200**  
**Diode Array Detector II**  
**User's Manual**

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## Release History

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Any comments about the documentation for this product should be addressed to:

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# Safety and Regulatory Information

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## Electromagnetic Compatibility (EMC)

### United States

This product is classified as a digital device used exclusively as industrial, commercial, or medical test equipment. It is exempt from the technical standards specified in Part 15 of the FCC Rules and Regulations, based on Section 15.103 (c).

## Addresses

To obtain assistance with the Series 200 Diode Array Detector, contact the Company as described below:

PerkinElmer  
Analytical Instruments  
710 Bridgeport Avenue  
Shelton, Connecticut 06484 USA  
Tel: (800) 762-4000

Supplies, accessories, and replacement parts can be ordered directly from PerkinElmer using the eight digit part numbers provided in the manual. To place an order or ask for information, call your local PerkinElmer representative.

## Conventions used in this Manual

In this manual the following graphic symbols and special text formats are used to set apart important safety information.



### **Warning**

A warning indicates an operation that could cause *personal injury* if precautions are not followed.

---



### **Caution**

A caution indicates an operation that could cause *instrument damage* if precautions are not followed.

---

### **Note**

Notes emphasize significant information in a procedure or description.

# Instrument Symbols and Warnings

## Symbols

There are three types of warning symbols that appear on the instrument:



This symbol indicates an operation (or condition on the instrument) that could cause *personal injury* if precautions are not followed. This can be any type of hazard.

When you see this symbol, refer to the safety pages in the manual for further information.

Consulter les documents d'accompagnement.



This symbol indicates the danger of electric shock, if precautions are not followed, due to the presence of high voltage.

Attention. Risque de choc électrique.



This symbol indicates the danger of burns, if precautions are not followed, due to the presence of heat in this area of the instrument. There may also be hot surfaces that can be easily touched.

AVERTISSEMENT. Surface chaude.

Additional graphic symbols used on the instrument are the following:

	Indicates alternating current
	Indicates the primary protective grounding terminal
	Indicates the <b>off</b> position of the main power switch
	Indicates the <b>on</b> position of the main power switch

### Warnings

The following safety marking symbols and labels are affixed to the rear panel of the instrument. (See Figure S-1):



**DISCONNECT POWER BEFORE SERVICE.**

**GROUNDING CIRCUIT CONTINUITY IS VITAL FOR  
SAFE OPERATION OF EQUIPMENT.**

**NEVER OPERATE EQUIPMENT WITH GROUNDING  
CONDUCTOR DISCONNECTED.**



**Warning**

**For protection against fire hazard, replace only with same  
type and rating of fuse.**

---



## Warning

Disconnect supply cord before opening. Grounding circuit continuity is vital for safe operation of equipment. Never operate equipment with grounding conductor disconnected.



## Warning

For protection against fire hazard, replace only with same type and rating of fuse.

## Warning

The Detector is configured with Double-Pole/Neutral Fusing for universal voltage configuration. To avoid electrical shock, disconnect the power supply before changing fuses. Disconnect the power supply whenever the cover is removed.

AVERTISSEMENT: Débranchez le cordon d'alimentation avant d'ouvrir l'appareil. La continuité du circuit de mise à la terre est essentielle pour le bon fonctionnement de l'appareil. N'utilisez jamais l'appareil lorsque le câble de mise à la terre est débranché.

AVERTISSEMENT: Pour éviter tout risque d'incendie, ne remplacez les fusibles que par d'autres du même type et de la même puissance.

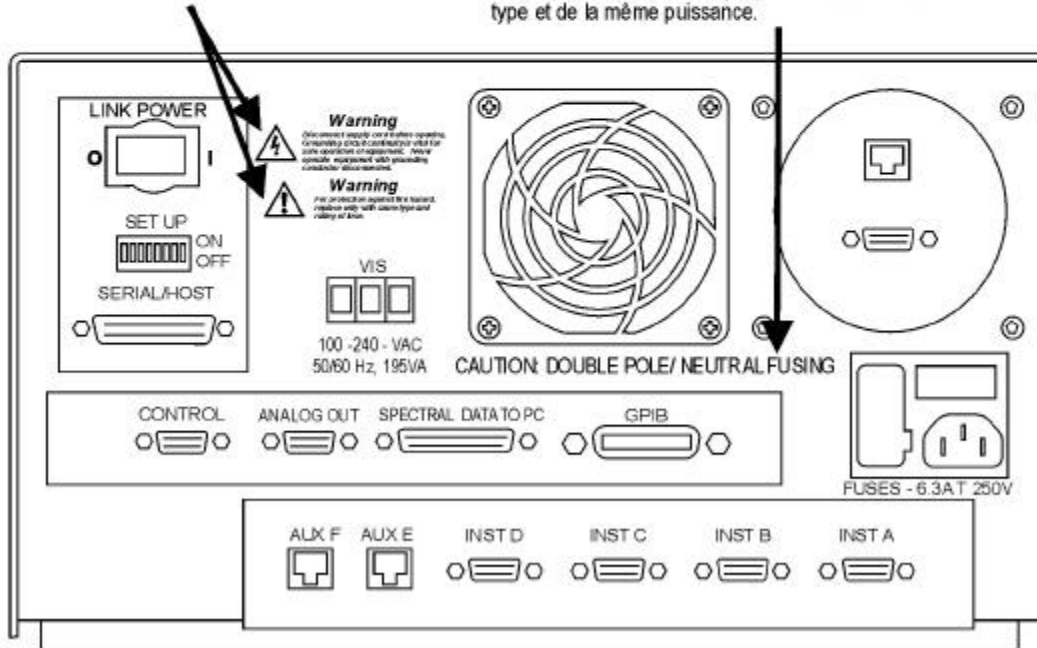


Figure S-1. Location of Warning Labels Found on the Rear Panel of the Series 200 Diode Array Detector. —

## Electrical Warnings



Connect the instrument to an AC line power outlet that has a protective ground connection. To ensure satisfactory and safe operation of the instrument, it is essential that the protective ground conductor (the green/yellow lead) of the line power cord is connected to true electrical ground. Any interruption of the protective ground conductor, inside or outside the instrument, or disconnection of the protective ground terminal may impair the protection provided by the instrument.

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Do not operate the instrument with any covers or parts removed.

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Do not attempt to make adjustments, replacements or repairs to this instrument except as described in the accompanying User Documentation. Only a PerkinElmer service representative or similarly trained and authorized person should be permitted to service the instrument.

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Use only fuses with the required current rating and of the specified type for replacement.

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# Quality Control/Good Laboratory Practices

## Quality Control

The user should develop appropriate quality control procedures for the LC Diode Array Detector (and the entire LC system) to ensure suitability for its intended use. These procedures typically consist of periodic performance verifications and routine inspections and suitability tests.

## Certificate of System Control

Each Series 200 Detector is carefully built and tested in a controlled system in accordance with the requirements specified in its applicable Final Assembly and Test Specification.

Each instrument is certified to meet its functional and performance specification upon release to shipment.

## Instrument Performance Verification (IPV)

To maintain functional performance, PerkinElmer recommends a yearly Instrument Performance Verification (IPV) of the Series 200 Diode Array Detector by a PerkinElmer Service Engineer to ensure its operation within published specifications. These tests consist of measuring the most important Diode Array Detector characteristics, such as noise, drift, and wavelength accuracy. Certification is available for regulatory compliance. Contact your local PerkinElmer Sales and Service office.

## Routine Inspection and Suitability Test

Before any sample analysis with the Series 200 Diode Array Detector in the LC system, a system suitability test, which closely resembles the intended assay, should be performed to ensure that the LC system is operating within established criteria (e.g., peak resolution, peak asymmetry, precision, retention time, column plate count, pressure limits, signal/noise ratio, etc.).

While the Universal Test Mix (UTM), Part No. 0089-0893, can be used for a system check, we recommend that you develop a separate system suitability test and acceptance criteria for each of your assays.

## Hazardous Chemicals

Before using mobile phase solvents, you should be thoroughly familiar with all hazards and safe handling practices. Observe the manufacturer's recommendations for use, storage and disposal. These recommendations are normally provided in the material safety data sheets (MSDS) supplied with the solvents.



### Warning

Some chemicals used with this instrument may be hazardous or may become hazardous after completion of an analysis. The responsible body (e.g., Lab Manager) must take the necessary precautions to ensure that the surrounding workplace and that the instrument operators are not exposed to hazardous levels of toxic substances (chemical or biological) as defined in the applicable Material Safety Data Sheets (MSDS) or OSHA, ACGIH, or COSHH documents. Venting for fumes and disposal of waste must be in accordance with all national, state and local health and safety regulations and laws.

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## Definitions in Warning for Hazardous Chemicals

**Responsible body.** “Individual or group responsible for the use and maintenance of equipment, and for ensuring that operators are adequately trained.” [per IEC 1010-1, Amendment 2 ].

**Operator.** “Person operating equipment for its intended purpose.” [per IEC 1010-1, Amendment 2 ].

**OSHA:** Occupational Safety and Health Administration (United States)

**ACGIH:** American Conference of Governmental Industrial Hygienists

**COSHH:** Control of Substances Hazardous to Health (United Kingdom)



## Temperature, Humidity and Environment

**Caution****This instrument is designed for indoor use only.**

---

**Warning****This instrument is not designed for operation in an explosive environment.**

---

### Safe Operation

This detector will operate safely between +10 and 35°C (+50 and 95°F) with an ambient relative humidity of between 20 and 80% noncondensing.

### Installation Category

This detector is able to withstand transient overvoltage according to Installation Category II as defined in IEC 1010-1.

### Pollution Degree

This equipment will operate safely in environments that contain nonconductive foreign matter up to Pollution Degree 2 in IEC 1010-1.

## Storage Conditions

The Series 200 Diode Array Detector may be stored under the following conditions:

- ambient temperature is –20 to +60°C (–68 to +140°F)
- ambient relative humidity is 20 to 80% noncondensing,
- altitude is in the range 0 to 12,000 m.



# Introduction 1

---

## Important

This manual contains important information regarding potential hazards that may arise during the operation of the Series 200 Diode Array Detector. It is essential that the Safety and Regulatory information preceding this chapter be read and thoroughly understood by all users and potential users of the detector.



### Caution

**The Diode Array detector should be used according to the instructions provided in the manual. If used otherwise, the protection provided for the Diode Array detector might be impaired.**

---

## About this Manual

This manual was written for a person who has developed a working knowledge of liquid chromatography and understands:

- the function of each major component in a liquid chromatography system
- how to select a column based on the analysis that will be performed
- the principles of solvent selection and sample preparation

If you require an introduction to these concepts, the following book is an excellent reference: *Practical Liquid Chromatography -- An Introduction* by R.W. Yost, L.S. Ettre, and R.D. Conlon, published by PerkinElmer (1980), Part No. 0993-9656.

## Conventions

The following conventions are used in this manual (see the Safety and Regulatory Information preceding this chapter):

**Warning**

A warning indicates an operation that could cause *personal injury* if precautions are not followed.

---

**Caution**

A caution indicates an operation that could cause *instrument damage* if precautions are not followed.

---

**Note**

Notes emphasize significant information in a procedure or description.

## Chapter Content

This chapter describes the detector, its controls and detector specifications (see Table 1-2).

The second chapter describes installation of the detector in your LC system, electrical requirements and plumbing connections.

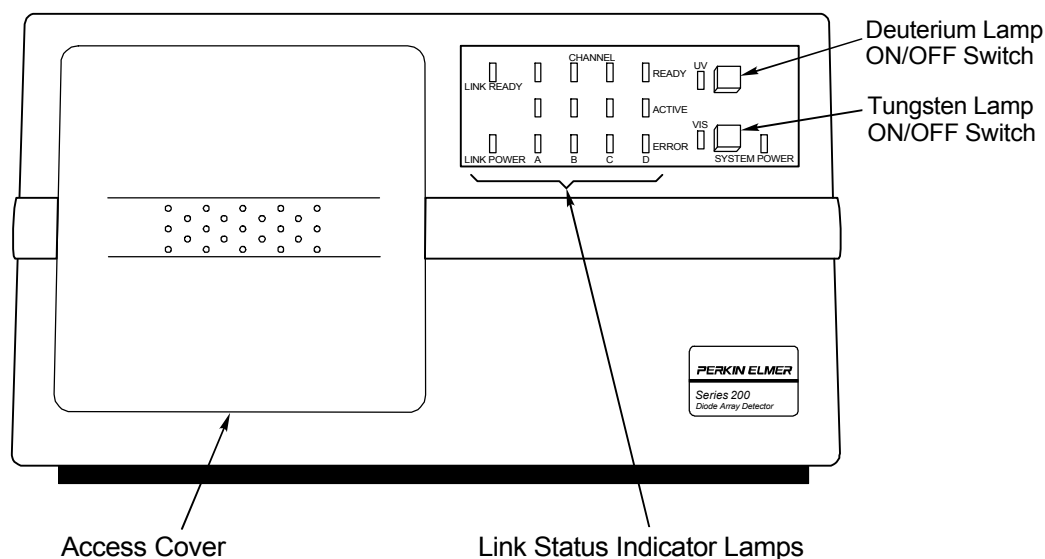
The third chapter is comprised of drawings (Figures 3-1 and 3-2) showing communications connections for Turbochrom and the procedure for setting up an LC method for running a test file.

Chapter 4, Maintenance, includes lamp replacement procedures:

- replacing the deuterium (UV) lamp
- replacing the tungsten (VIS) source (including an alignment procedure)

## About the Detector

The Series 200 Diode Array HPLC (high-performance liquid chromatography) detector is a high-performance photodiode array detector. It includes a dispersive, photodiode-array spectrometer system that continuously collects full-scan spectra of the analytes in a flowing stream. The detector consists of the opto-electronic assembly and a data system; the storage of spectral files is controlled by sending commands from the data system to the spectrometer system.



**Figure 1-1. Front panel of the Series 200 Diode Array Detector**

The opto-electronic assembly consists of:

- an optical bench with a flow cell
- regulated deuterium and tungsten light sources
- polychromator spectrograph
- 512-element photodiode array
- power supplies and circuitry required to operate the detector and transmit data to the data system.

The data system consists of an on-board microprocessor that communicates, via an RS 232 connection, with a host data system.

## Controls, Indicators and Connections

The controls, indicators and connectors on the front and rear panels of the detector are described in the next two paragraphs.

### On the Front Panel (Figure 1-1)

**UV Switch** Press the switch to energize the deuterium lamp. When the lamp is energized, the switch is lighted. Only energize the deuterium lamp when the sample absorbs in the UV range (190-360 nm).

**Note** Wait two minutes after turning on the **Power** switch before energizing the deuterium lamp.

**VIS Switch** Press the switch to energize the tungsten-halogen lamp. When the lamp is energized, the switch is lighted. Only energize the tungsten-halogen lamp if the sample exhibits absorption in the VIS range (360-700 nm).

**Note** If you are using both UV and VIS lamps, turn on the VIS lamp *AFTER* turning on the UV lamp.

**Note** To control the lamps from Turbochrom, both lamps must be switched on prior to taking control from Turbochrom Navigator. After performing Method Setup, you can turn the lamps on or off using *Hands On*. See the *Turbochrom Client/Server User's Guide* (P/N S270-2600-B).

**Cell Carriage** Holds the flow cell. When inserted, it keeps the flow cell in the correct position in the optical path of the detector. To remove the cell carriage from the detector, remove the access cover (see Figure 1-1) and loosen the carriage retaining screw.

**Inlet and Outlet Lines** Provide connections (0.007 in. stainless steel tubing) to the outlet of the HPLC column and the waste container.

### Front Panel Indicator Lamps

The following indicator lamps are on the front panel of the detector (see Figure 1-1).

**System Power** lamp lights when the Power On/Off switch on the back panel is in the ON position.

**UV** lamp lights when the deuterium lamp is energized.

**VIS** lamp lights when the tungsten-halogen lamp is energized

**Link Status Indicator Lamps**

*Link Ready* lights when a link is ready

*Link Power* lights when a link is powered on

**Channel Status lamps**

Three *Channel Ready* Lamps

Three *Active Channel* Lamps

Three *Channel Error* Lamps (Refer to the Turbochrom manual for error messages.)

**On the Rear Panel (Figures 1-2 and 2-1)**

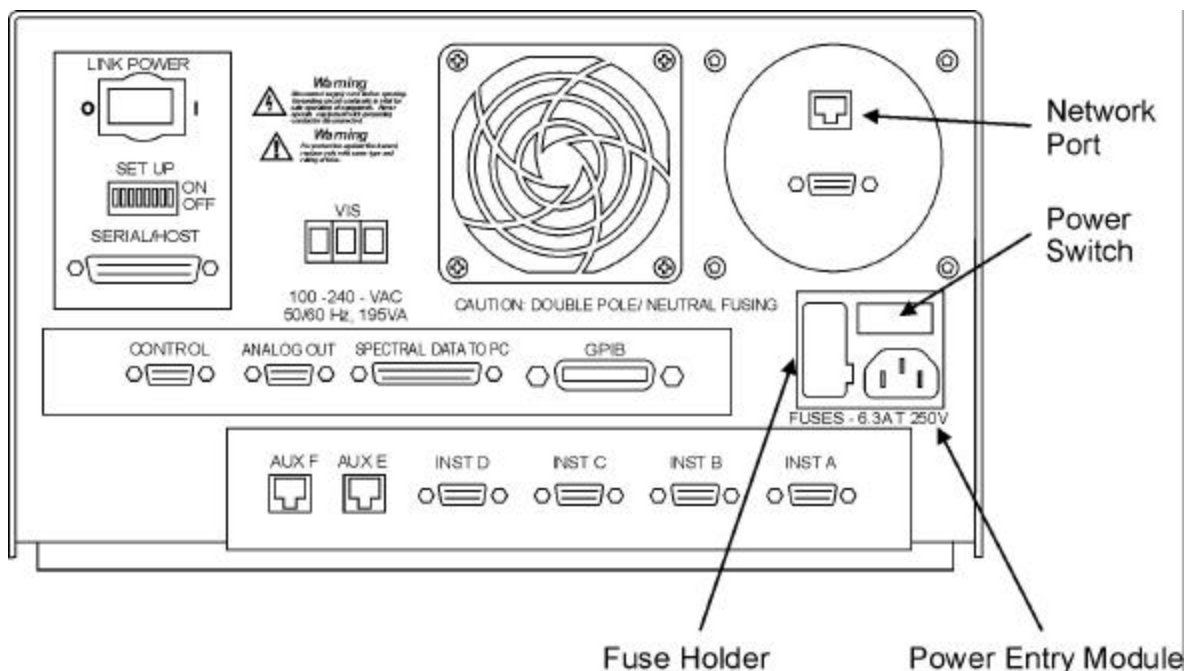
**Power Switch** An On/Off toggle switch located on the power entry module at the right of the rear panel. Toggle the switch On to energize the instrument chassis, the cooling fan, and the photodiode array assembly.

**Power Cord Connector (Receptacle)** Accepts a standard, detachable, three-prong power cord.

**Power Fuse Holder** Includes two 6.3A, T type fuses for main power.

**Lamp Adjustment**

**Thumb Wheels** For use by Service Representatives only.



**Figure 1-2. Rear panel of the Series 200 Diode Array Detector**

## Warnings and Precautions

### Warnings at the Back of the Detector

The following warnings are placed on the back panel of the detector (see Figure S-1). They contain information that you should be familiar with before operating the Diode Array Detector:



**DISCONNECT POWER BEFORE SERVICE.**

**GROUNDING CIRCUIT CONTINUITY IS VITAL FOR SAFE OPERATION OF EQUIPMENT.**

**NEVER OPERATE EQUIPMENT WITH GROUNDING CONDUCTOR DISCONNECTED.**

---



**Warning**

**For protection against fire hazard, replace only with the same type and rating of fuse.**

---



**Caution**

**Double Pole/Neutral Fusing.** The detector is configured with Double Pole/Neutral Fusing for universal voltage configuration. To avoid electrical shock, disconnect the power supply before changing fuses. Disconnect the power supply whenever the cover is removed.

---



## Standard Detector Warnings

Read and understand the following warnings and precautions.

### Solvents



#### Warning

**Give careful attention to the hazards associated with the solvents you are using. Refer to the safety data sheets provided by the manufacturer. For example, Material Safety Data Sheets (MSDS) in the USA.**

- Wear appropriate eye protection at all times when handling chemicals. Use safety glasses with side shields, goggles, or full-face shields, according to the types of chemicals you will be handling.
- Wear suitable protective clothing, including gloves that are specifically resistant to the chemicals being handled.
- Always use clean solvents. Solvents that have been distilled in glass (HPLC Grade) are highly recommended.
- Filter the solvents through a 0.5-micron medium as an additional precaution.
- Carefully use and store flammable solvents, which may form hazardous by-products when the instrument is shut down, by following the recommended shutdown procedure.
- Check compatibility of solvent(s) with the type of column(s) being used.
- Know the relative polarity and miscibility of the solvents being used.

### Buffers

Exercise care when using buffers in conjunction with organic solvents. NEVER LEAVE BUFFERS IN THE SYSTEM OVERNIGHT. Buffers left in the system can form salt crystals that may cause premature pump seal failure, interfere with proper check valve operation, and plug the connecting tubing or the detector flowcell.

To remove buffers, flush the system first with water, then with methanol or isopropanol. Change the mobile phase from methanol or isopropanol to water before using buffers.

## Corrosion

All parts that contact the mobile phase are made of stainless steel, Teflon, PEEK, or quartz. Some of these materials are extremely sensitive to acid chlorides. If you have questions about your mobile phase, contact a Service Representative.

**Table 1-1. Solvents Which May Corrode the Series 200 Diode Array Detector**

Aqua Regia (80% HCl, 20% HNO <sub>3</sub> )	Chloride salt solutions*
Chlorinated solvents	Halogenated solvents
Sulfuric Acid (Conc.)	

\* Titanium is more resistant to chloride salt solutions.

## Air Bubbles

To prevent air from entering the system, and to ensure that pressure fluctuations do not occur, observe the following precautions:

- Ensure that the pump's solvent inlet filter is below the solvent level in the solvent reservoir.
- If the pump has not been used for an extended period of time, remove air bubbles by connecting a priming syringe to the drain valve on the pump, opening the drain valve, and fast-flushing the system to prime the pump. **After priming the pump, close the drain valve completely.**
- If bubbles are observed in the flow cell, degas the solvent and add back-pressure device 0990-7126.

## Pressure Buildup

Over time, you may notice a gradual increase in the system operating pressure. If you observe pressure readings greater than 3.45 MPa (500 psi) above the normal operating pressure of your analysis, check the following items:

- If you are injecting *clean* samples and there is no other apparent cause for the pressure buildup, remove, disassemble, and clean the injector.
- If you are injecting *dirty* samples, the injector may be clogged or the column packing material may have retained contaminated particulates. Remove and clean the injector, and replace the column.
- The column end fitting or column frit may be plugged. Replace the end fitting or frit to relieve excess pressure. (Refer to the instructions supplied with the column.)
- In-line filters may be plugged. Replace the filter element.
- With the pump connected directly to the detector input, if you still experience excessive pressure, the problem could be a plugged flowcell. You can flush, reverse-flush, or rebuild the flowcell.

## Specifications

**Table 1-2. Specifications of the Series 200 Diode Array Detector**

<b>Detector Specification</b>	<b>Description</b>
Number of Diodes	512
Wavelength Range	190 - 700 nm
Resolution	4 nm observed (1.09 nm/diode)
Absorbance Range	-0.005 to +1.5 AUFS
Wavelength Accuracy	±1 nm
Short-term Noise	$\pm 1 \times 10^{-5}$ AU (average peak-to-peak noise between 190 and 700 nm) (dry cell)
Drift	$1 \times 10^{-4}$ AU/hr
Lamps	Deuterium and tungsten-halogen
Flow Cells	10 mm path (12 µL) standard 4.5 mm path (5 µL) analytical 2 mm path (4 µL) preparative
<b>Power Requirement</b>	<b>Description</b>
Power Consumption	195 VA
Line Voltage Operating Range	100/240 VAC
Frequency	50/60 Hz
Line Cord	See "The AC Line Cord" on page 2-5 of these instructions.
<b>Fuse Rating Characteristics</b>	<b>Description</b>
120 VAC (P/N 0999-1662)	6.3 A, 250 Volt, IEC Type T
240 VAC (P/N 0999-1662)	6.3 A, 250 Volt, IEC Type T
<b>Operating Conditions</b>	<b>Description</b>
Ambient Temperature	10 to 35°C
Ambient Relative Humidity (RH)	20 to 80% RH (non-condensing)
Altitude	0 to 2000 m
<b>Storage Conditions</b>	<b>Description</b>
Ambient Temperature	-20 to +60°C
Ambient Relative Humidity	20 to 80% RH (non-condensing)
Altitude	0 to 12 000 m
Dimensions	Height: 19.7 cm (7.75 in.) Width: 33.7 cm (13.25 in.) Depth: 80.5 cm (22.75 in.)
Weight	20 kg (45 lb.)



# Installation 2

---

## About this Chapter

The following paragraphs are included in this chapter to prepare you for installing the Series 200 Diode Array Detector:

- preparing your laboratory
- unpacking your detector
- electrical requirements and settings
- tubing connections
- powering-up the detector

## Preparing Your Laboratory

Before installing your Series 200 Diode Array Detector, prepare your laboratory according to the following guidelines.

## Required Air Quality

To minimize contamination problems in your laboratory, provide a relatively dust-free environment. Make sure that gases or vapors of the following kinds are not present at levels that exceed federal, state, or local ordinances for continuous human exposure:

- flammable
- explosive
- toxic
- caustic
- corrosive

Make sure that your laboratory environment includes the following temperature and humidity levels:

- Ambient temperature between 10°C and 35°C
- Constant relative humidity between 20% and 80% (without condensation)

Be careful when working with hazardous solvents, or solvents that produce hazardous by-products.



### Warning

**Solvent vapor levels that are high enough to interfere with detector performance should be considered hazardous to someone who is continuously exposed to the vapors.**

---

## Sufficient Electrical Power

The Series 200 Diode Array Detector requires a grounded nominal 100, 120, 220, or 230/240 Vac source. Data processing equipment and other accessories require separate outlets. (Refer to the appropriate equipment manual for the power requirements.)

To prevent degradation of the diode array detector's performance, the AC line voltage must remain within  $\pm 10\%$  of the nominal specified voltage. If you experience large voltage fluctuations, install a voltage regulator between the diode array detector and AC outlet.

## Solvents/Mobile Phase

Use only HPLC grade solvents in all analyses. HPLC grade water and methanol (1 liter each) are required for performance verification.

## Space Requirements

The Series 200 Diode Array Detector is designed to sit on a benchtop; it is normally plumbed into the LC autosampler as shown in Figure 2-3. A space approximately 20 cm (8 in.) high is sufficient for the detector if nothing else is to be placed over (or on) it. Figure 2-3 shows the Series 200 Diode Array Detector in a typical LC system.

The case is 33.7-cm (13.25 in.) wide, but additional space is required on both sides of the detector: on one side for the tubing from the autosampler, and on the other side for the tubing to the drain vessel. The case is 80.5-cm (22.75 in.) deep, but additional space is required behind the unit to accommodate the power cord and cables to any other connectors.

## Unpacking Your Detector

Carefully unpack the Series 200 Diode Array Detector and check for obvious signs of damage that could have occurred during shipment. Immediately report any damage or missing items to the shipping carrier and Perkin Elmer.

A start-up kit is supplied with the detector. Refer to Table 2-1 and check the parts you received against the parts listed in the table.

**Table 2-1. Start-Up Kit for the Series 200 Diode Array Detector**

Items Included	PerkinElmer P/N	Quantity
AC Line Cord*	0998-8986	1
Fuse, 6.3A, 250V, IEC Type T	0999-1662	2
$\frac{1}{4}$ in. PEEK Fingertight Nut	0992-0513	2
Users Manual	0993-6475	1
Installation Disk	N292-2060	1
Cable, Ethernet Cat 5	55-0214**	1
Cable, Serial Data	55-0213**	1
Harns, Link to Detector	55-A589**	
Cable, Service 9PF to 9PF Dsub, 6'	55-A588**	1

\*Customers located outside of the U.S. must order a line cord that is appropriate for their location.

\*\*Vendor (GTI) Part Number

## Electrical Requirements and Settings

The Series 200 Diode Array Detector can operate at 50 or 60 Hz and requires a grounded outlet that provides a nominal 100, 120, 220, or 230/240 VAC source. If the electrical supply voltage in your laboratory produces large AC line voltage fluctuations, install a voltage regulator between the AC line voltage outlet and the Series 200 Diode Array Detector. Instrument grounding is required, and is accomplished by a third wire in the AC line-voltage outlet box. If your electrical outlet does not contain a ground, contact your local electric company.

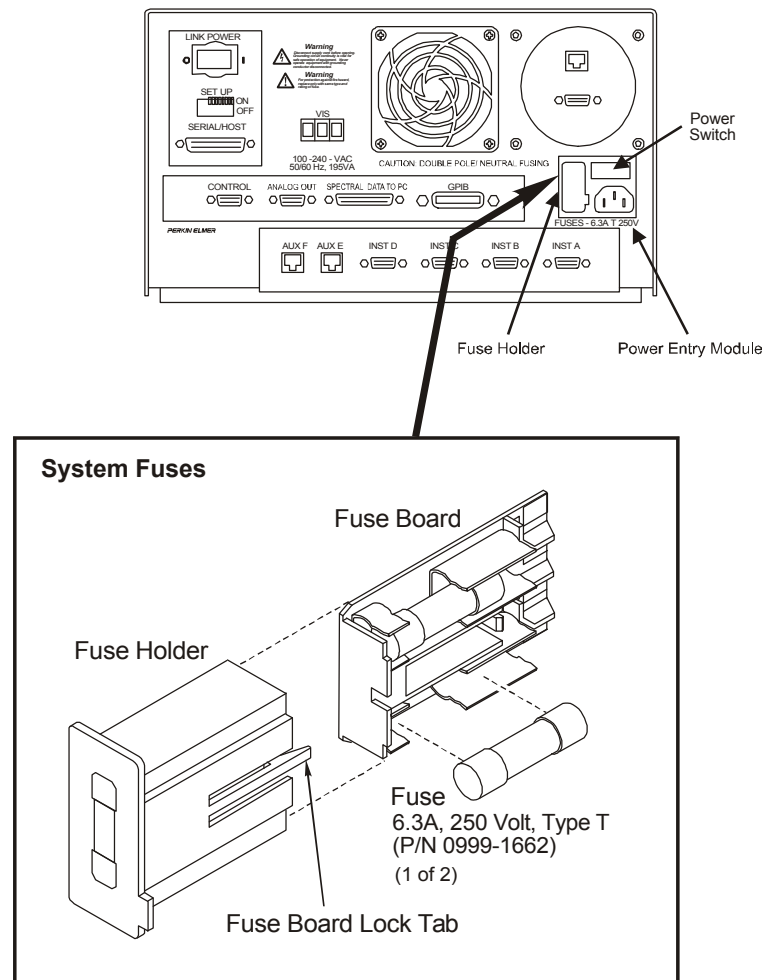


Figure 2-1. Rear panel of the Detector with the system fuses shown



## Detector Power Cord and Fuses

The Diode Array Detector power entry module and system fuses are located at the right of the detector's back panel (see Figure 2-1).

### Installing/Replacing the Fuses

The unit is shipped with two fuses (see Figure 2-1) installed. To replace a fuse, proceed as follows:

1. Make sure the unit is disconnected from line power.
2. Refer to Figure 2-1 and remove the fuse holder from power entry module at the back of the detector.
3. Lift the fuse-board lock tab and remove the fuse board from the fuse holder.
4. Install, or remove and then install, fuse(s) in the fuse holder. Use only 6.3-amp T type fuses P/N 0999-1662.
5. Reconnect the detector to line power.

## The AC Line Cord












### Warning

**Do not disconnect or defeat safety ground on the power cord. Ground is necessary for safe operation of the Series 200 Diode array detector and proper functioning of the electronic circuitry.**

**The line cord should have the electrical rating and plug appropriate for your location. See Figure 2-2 for the correct cord.**

1. Select the proper line cord for your location (Figure 2-2).
2. Insure that the power switch is off and insert the line cord plug into the AC supply.

	North America NEMA-5-15 0999-1420		Old British Standard BS 546 India 0999-1423
	Europe CEE 7 "Schuko" 0999-1415		British Standard BS 1363 United Kingdom 0999-1414
	Europe Switzerland 0999-1413		Australia ETSA S/86 0999-1417
	Europe Italy 0999-1422		Israel 0999-1424
			
Denmark 0999-1416			

**Figure 2-2. AC outlet configurations**

## Tubing Connections

The flow cell is shipped with 0.007 in. ID standard stainless steel tubing installed. All connections are made with standard 1/16-in. fingertight fittings. In Figure 2-3, the Series 200 Diode Array Detector is shown plumbed in a typical LC system.

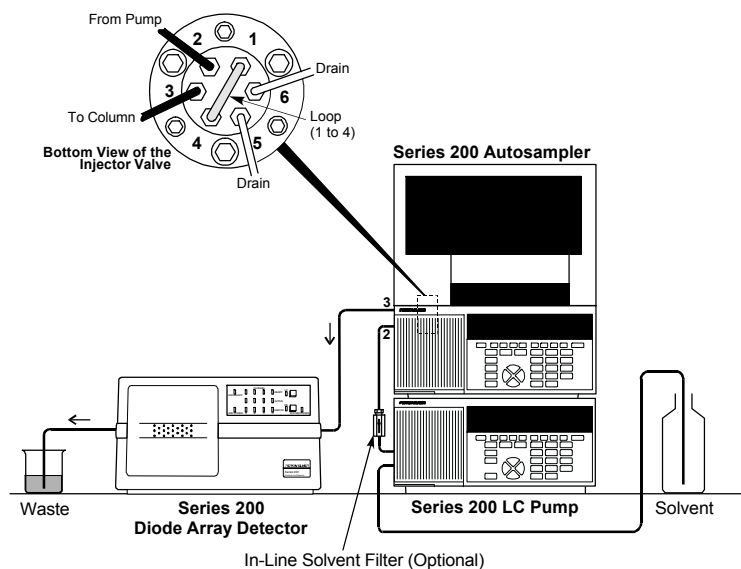


Figure 2-3. Series 200 Diode Array Detector in a typical LC system

## Powering up the Detector

After completing the installation of the Diode Array Detector, carefully read *Chapter 3, Turbochrom Connections and Methods* before powering-up the detector.

# Turbochrom Connections and Methods **3**

---

## About this Chapter

In this Chapter, we discuss the hardware and software requirements when using the Series 200 DAD detector with Turbochrom. We then show the Turbochrom electrical (communication) connections and describe the procedure for setting up and running a test file. For procedures for configuring Turbochrom and building a method, refer to Chapters 3 and 5, respectively, of the Turbochrom Client/Server User's Guide (P/N S270-2600-B).

## Hardware/Software Requirements

The following are the software requirements for using the Series 200 Diode Array Detector with Turbochrom:

- Turbochrom WS/CS (6.1 or greater)
- TurboScan<sup>200</sup>
- Spectral Acquisition Software that is included with the detector. Instructions for using the software are on installation CD N292-2060.

## Communication Connections

### WORKSTATION CONFIGURATION - 1 DETECTOR

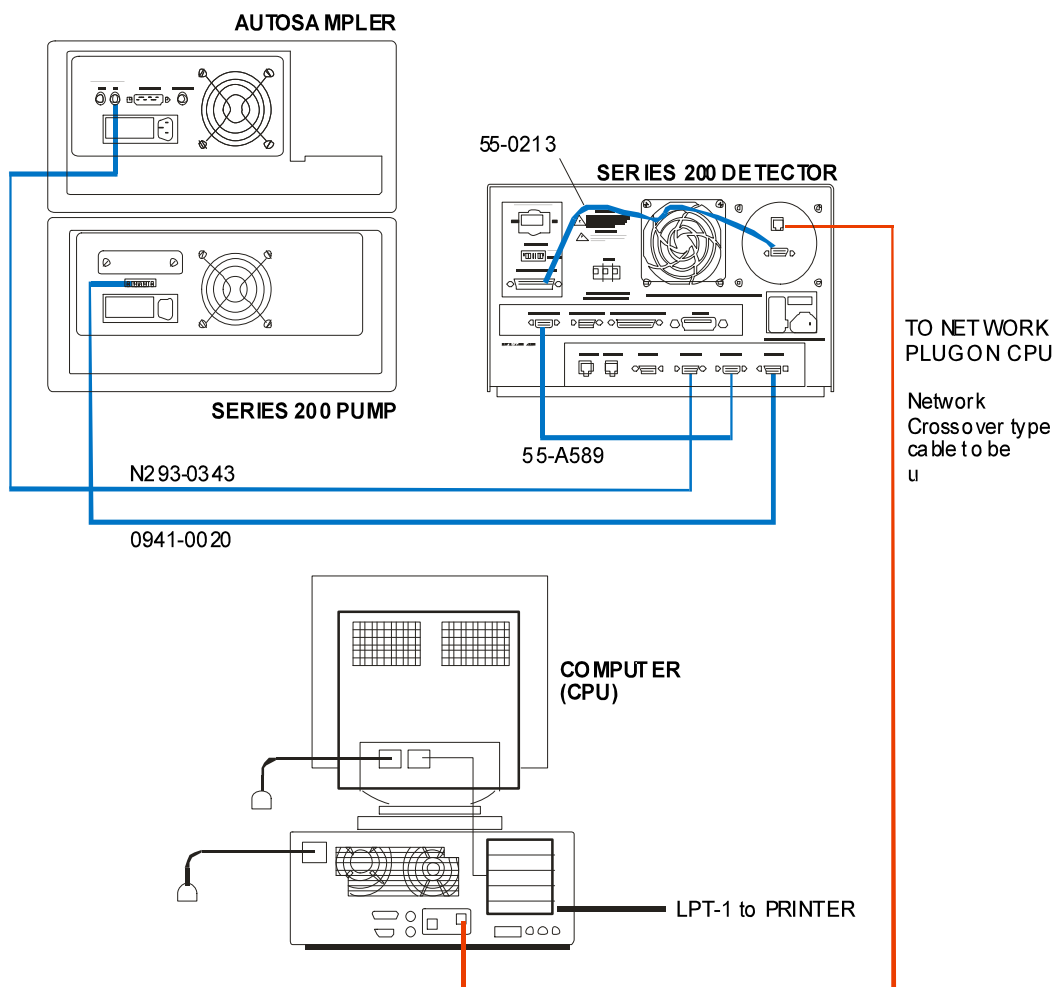


Figure 3-1. Workstation Connections – 1 HPLC System

## WORKSTATION CONFIGURATION - 2 OR MORE DETECTORS

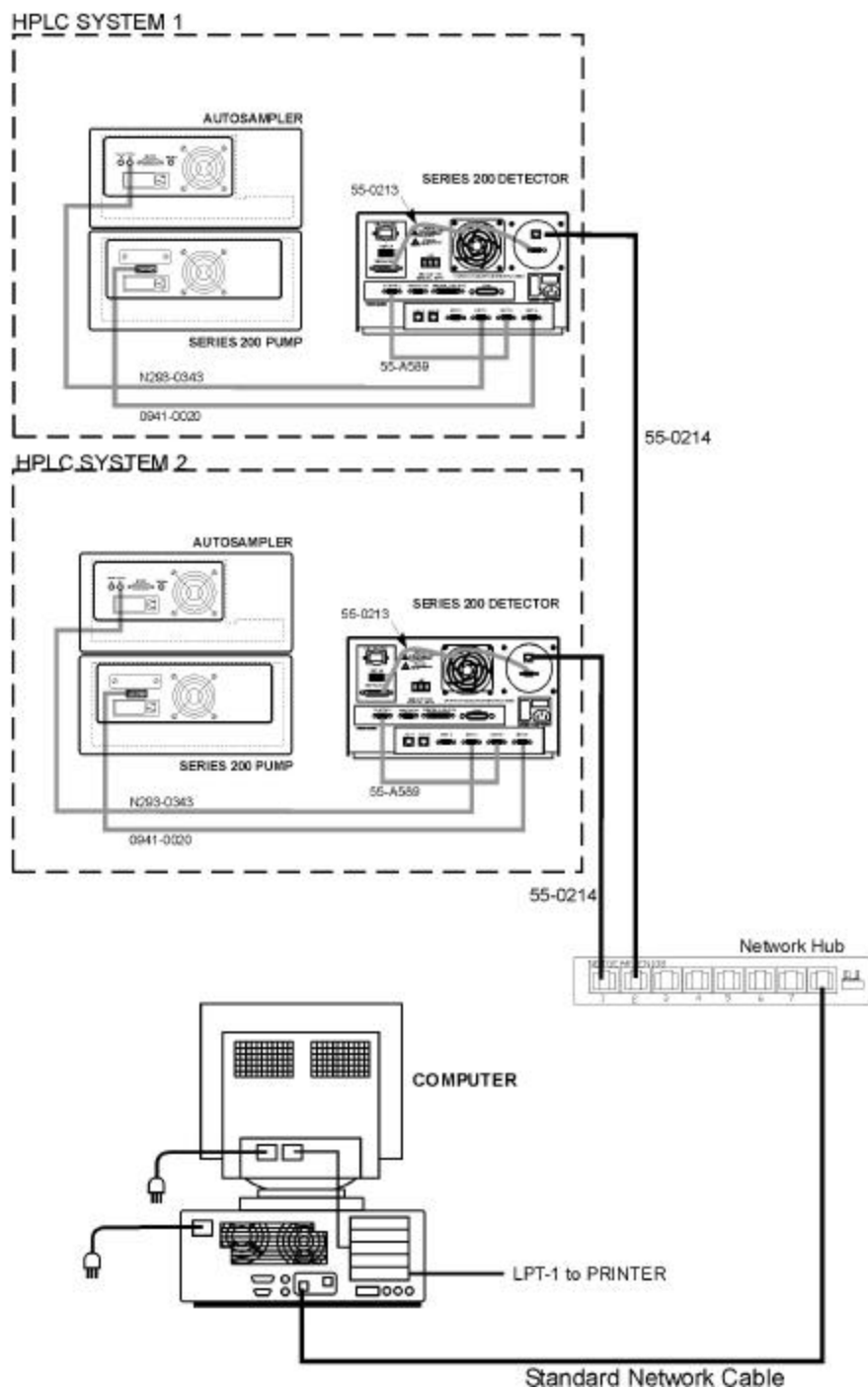


Figure 3-2. Workstation connections for Turbochrom – Multiple Systems

## CLIENT / SERVER CONFIGURATION

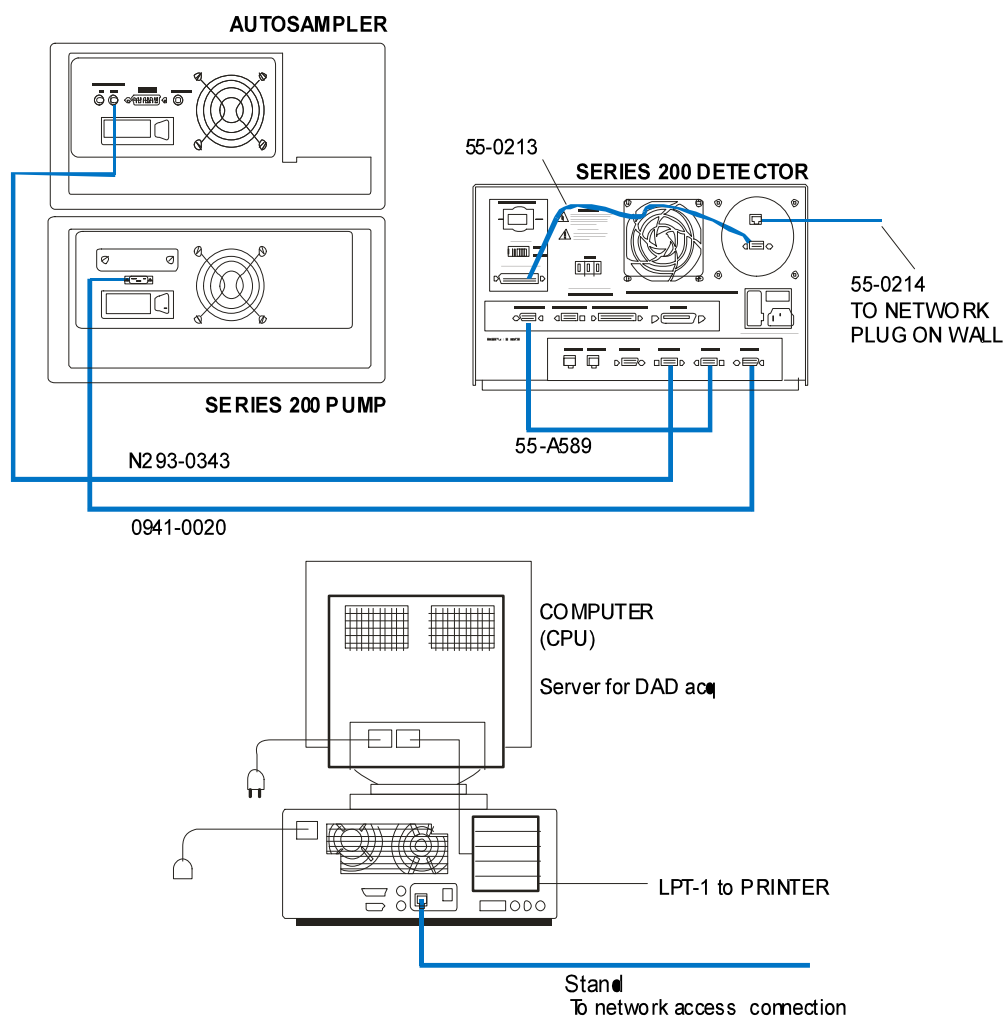


Figure 3-3. Client/Server Configuration

## Setting up an LC Method

In the following paragraphs the autosampler, pump, and diode array detector parameters are selected for the collection of chromatographic and spectral data.

To use specific values for the parameters, we set up the conditions for the analysis of the universal test mix (P/N 0089-0893).

**Note**

For configuration information and procedures for building a method, refer to Chapters 3 and 5, respectively, of the Turbochrom Workstation User's Guide (P/N S270-1601).

From the Turbochrom Navigator screen, select Method Editor and create a new method by selecting from the parameters and timed events listed below.

## Setting the Autosampler Parameters

1. Select the Autosampler tab of the Instrument Control dialog box.

The screenshot shows the 'Instrument Control' dialog box with the 'Autosampler' tab selected. The 'Injection Source' section has 'Autosampler' selected. The 'Sample Injection' section has 'Injection volume (μL)' set to 10.0, 'Loop size (μL)' set to 200, 'Fixed mode' set to Off, 'Excess volume (μL)' set to 10, 'Air cushion (μL)' set to 10, 'Sample syringe size (μL)' set to 250, 'Sample speed' set to Medium, 'Needle level' set to 10%, and 'Inject delay time (min)' set to 0. The 'Derivatization / Dilution' section has 'Off' selected. The 'Flashes' section has 'Flush volume (μL)' set to 500, 'Flush speed' set to Medium, 'Flush cycles' set to 2, 'Pre-injection cycles' set to 1, 'Post-injection cycles' set to 1, and 'Post-method cycles' set to 0. The 'Peltier Tray Control' section has 'Temperature (°C)' set to 4 and '+/-' set to 0. The 'OK', 'Cancel', 'Apply', and 'Help' buttons are at the bottom. A status bar at the bottom says 'The autosampler will be used'.

2. If you are using manual injection, select Manual. If you are using an autosampler, select Autosampler and continue with Steps 3 through 20.
3. In the Injection Volume text box, enter the amount of sample that you want to inject. (Make certain that this value is less than 50% of the Loop Size that you specify in step 4.)
4. From the Loop Size list, select the size of the injection loop fitted to your autosampler.
 

**Note** To enable the Fixed Mode option, where the injection volume is equal to the loop volume, select a loop size value less than 50 μL.
5. To operate in Fixed Mode, set the value of the Fixed Mode list to On. This option forces the Injection volume to be equal to the loop volume. Fixed mode is useful if you are working with small sample sizes or applications that require high precision. (You can only use Fixed Mode when the Loop Size value is less than 50 μL.)
6. In the Excess Volume text box, enter the amount of sample that you want withdrawn from the vial in addition to the injection volume. (This option prevents evaporation and contamination by isolating the actual plug of sample to be injected as it is transported to the injection loop. This option is only available if Fixed Mode is set to Off.)
7. In the Air Cushion text box, enter the amount of air that you want to insert between the sample and flush solutions to prevent the two solutions from mixing.

8. From the Sample Syringe Size list, select a syringe volume.
9. From the Sample Speed list, select the speed at which you want the sample pump to fill the injection loop.  
(Slower speeds provide more reproducible injection volumes, particularly for viscous samples.)
10. From the Needle Level, select the appropriate percentage.  
(This value sets the height at which the sampling needle extracts the sample. It is set as a percentage of the vial height, measured from the bottom of the vial.)
11. In the Inject Delay Time text box, enter the number of minutes that you want between the pump's run start signal and when the sample injection occurs.
12. If you are using a Series 200 Autosampler, refer to "Creating Derivatization and Dilution Programs."
13. In the Flush Volume text box, enter the amount of flush solution that you want pumped through the sampling system for each flush cycle.
14. From the Flush Speed list, select the speed at which you want the pump to flush the system.
15. In the Flush Cycles text box, enter the number of flush cycles that you want to have between injections when the method changes in a sequence.  
(This value also specifies the number of flushes the autosampler performs when you choose Flush Autosampler in the Hands On dialog box.)
16. In the Pre-Injection Cycles text box, enter the number of flush cycles that you want before each sample injection or before each vial-to-vial transfer in sample processing modes.
17. In the Post-Injection Cycles text box, enter the number of flush cycles that you want after each sample injection or before each vial-to-vial transfer in sample processing modes.
18. In the Post-Method Cycles text box, enter the number of flush cycles that you want after each method is completed in a sequence.
19. Under Peltier Tray Control, set the temperature of the tray.
20. In the  $\pm$  list, select a tolerance percentage to control when the system Peltier Tray becomes ready. (The Peltier Tray will be ready to inject only if the temperature is within the range of the temperatures that you set, plus or minus the value in the tolerance section.)



## Pump Configuration Information

The Pump Config tab of the Instrument Control dialog box lets you enter labels for solvents and set other pump configuration parameters, such as the Ready Time and the pressure units. The solvent labels you create appear in the Method Summary window and on the Pump Program tab.

### Setting Pump Configuration Parameters

1. Select the Pump Config tab of the Instrument Control dialog box.

**Instrument Control**

Autosampler | **Pump Config** | Pump Program | Detectors | Instrument Timed Events

**Pump Operation**

Ready time (min)  Pressure units

Standby time (min)  Max pressure

Standby flow (mL/min)  Min pressure

**Solvent Names**

Solvent A

Solvent B

Solvent C

Solvent D

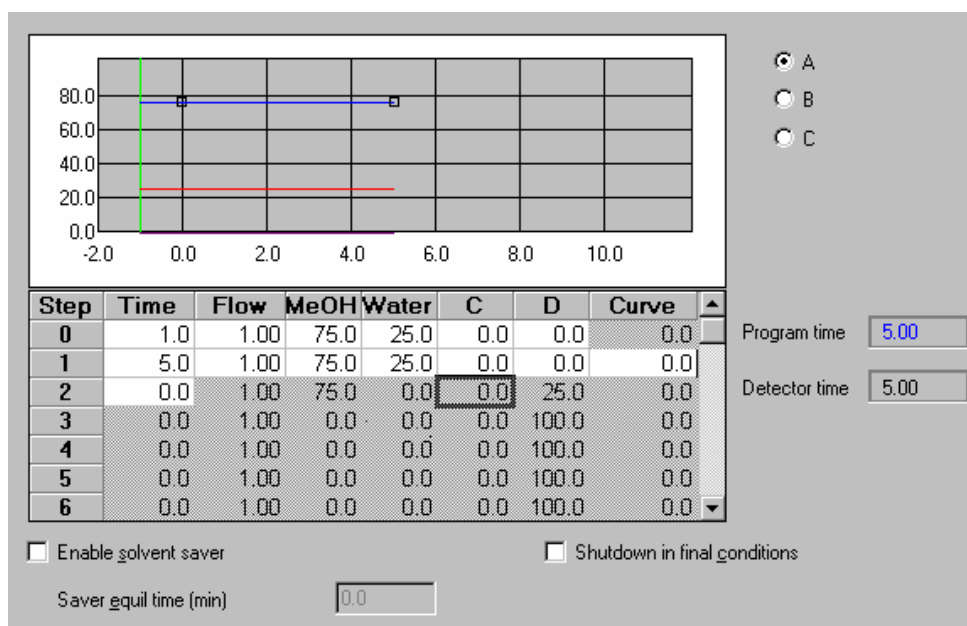
OK Cancel Apply Help

Time in Ready state after which pump shuts down[ 15 to 999 ]

2. In the Ready Time text box, enter the number of minutes that the pump remains in a READY state, after which you want the pump to shut down. (A Ready Time of 999 means that the pump will continue in the READY state indefinitely.)
3. In the Standby Time text box, enter the number of minutes that the pump remains in a READY state, after which you want the pump to change to the standby flow rate. (A Ready Time of 999 means that the pump will continue to use the flow rate set in the grid as long as the pump remains READY.)
4. In the Standby Flow text box, enter the pump flow rate for the standby mode.
5. From the Pressure Units list, select either PSI or BAR as the units for inlet pressure; the choice depends on the instrument that you are using.
6. In the Max Pressure text box, enter the upper pressure limit, above which the pump will shut off.
7. In the Min Pressure text box, enter the lower pressure limit, below which the pump will shut off.
8. In the Solvent Names text boxes, enter the labels you want to use.

## Creating 200B/250 or 200Q/410 Pump Programs

To create a pump solvent gradient program, or pump program, use the Pump Program tab of the Instrument Control dialog box. This tab contains a table and a gradient curve, which let you define the composition of the solvents at each step in the run. You can change the table parameters and the curve either by editing the values in the table or by dragging points on the curve with the mouse.



You can enter 10 rows, or steps, in the pump program. Step 0 is always the pre-run equilibration, for which you enter Time, Flow, and Solvent values. The table for 200B/250 or 200Q/410 pumps has the following columns:

- **Time**—duration of each program step
- **Flow**—flow rate during each program step
- **A, B, C (Solvents)**—percentage of each solvent at the end of each program step
- **D (Solvent)**—The percentage of this solvent at the end of each program step. This value adjusts automatically so that the sum of A, B, C, and D is 100.
- **Curve**—type of gradient curve to use for this program step. The types of curve are step (0), linear (1), convex (-1.1 to -9.9), and concave (1.1 to 9.9) for increasing solvent percentage. The magnitude of the number determines the degree of curvature.

## To set pump-control parameters

1. Select the Pump Program tab of the Instrument Control dialog box.

**Note** The Program Time field displays the sum of the values in the Time column for all the steps that you create. The Detector Time field displays the data acquisition time of the analysis.

2. In Step 0 of the table, click in the Time, Flow, and solvent fields, and then enter amounts for the equilibration step.
3. Enter the Time, Flow rate, solvent composition, and Curve type for each additional program step.

(The Time field activates the other fields in each row, and the curve changes as you enter each set of values. Depending on the specific pump that you are using, Turbochrom completes the solvent percentage either for solvent B or for solvent D so that the total solvent composition is 100 percent. Also, if you change the value of solvent B or the value of solvent D, the value of solvent A adjusts so that the total remains 100 percent.)

**Note** For the 250 pump, the resolution at which you can enter time and flow values, changes across the allowed range. You can enter times between 0 and 9.9 minutes to the nearest 0.1 minute, but times between 10 and 999 minutes must be to the nearest minute. Flow rates between 0 and 0.99 mL/min can be to the nearest 0.01 mL/min, but flows between 1.0 and 10.0 mL/min can only be to the nearest 0.1 mL/min. Turbochrom will beep if your entry causes a change from one resolution range to another.

4. To reduce the amount of equilibration time after the first run, select Enable Solvent Saver, and then enter the new amount of equilibration time to use after the first run in the text box.
5. To turn the pump off at the end of the run without recycling to initial conditions, select Shutdown In Final Conditions.

**Note** Only set this option for a "shutdown method," which is run as the last cycle in a sequence.

## LC Detector Parameters

The Detectors tab of the Instrument Control dialog box is used to set detector parameters:

- **Wavelength A(nm) and B(nm)**- The wavelength selected to monitor Channels A and B.
- **Bandwidth BW-A and BW-B** - The bandwidth, or total wavelength range, around the nominal selected wavelength for Channels A and B.
- **Spectral Acquisition** parameters - which can be Off and Time. If Time is selected, you will select the rate at which spectra will be selected.

### To set Series 200 diode array detector parameters

1. Select the Detectors tab of the Instrument Control dialog box.

Chromatogram Acquisition			
	Channel A	Channel B	
Wavelength (nm)	254	280	Program time
Bandwidth (nm)	20	20	Detector time
Reference wavelength (nm)	300	300	5.00

Spectral Acquisition	
Mode	Time
Spectra/s	1.136363

### Chromatogram Acquisition Entries

2. Enter 254 (nm) for the Channel A Wavelength and 280 (nm) for the Channel B wavelength.
3. Enter Bandwidths of 20 (nm) for both channels.
4. Enter 300 (nm) for both Channel A and Channel B Reference Wavelengths.

### Spectral Acquisition Entries

5. Select the Time Mode.
6. Select value 1.136363 in the Spectra/s box.

## Setting Instrument Timed Events

Use the Instrument Timed Events tab of the Instrument Control dialog box to select one or more timed events from a predefined list, and enter the time at which you want the event to take place. The events available depend on which instrument you have selected.

For a 900 Series Interface, you can choose events to set relays 1 through 7 on or off. Another event, RVPRT, instructs the interface to read rack and vial information from the attached autosampler at a specified time. For information about the instrument-timed events for other supported instruments, refer to the documentation that came with the instrument.

In the Graphic Method Editor, you can insert instrument-timed events directly on the chromatogram at a specified time. For more information, refer to Chapter 10 of the *Turbochrom Workstation User's Guide*, Editing a Method and Results Graphically.

## Saving and Setting up the LC Method

See chapter 5 "Building a Method" of the Turbochrom Client/Server Users Guide (P/N S270-2600-B). It provides an overview of the Turbochrom Method Editor and of creating and modifying a method.

A method consists of instrument, processing, and calibration parameters, which are described in chapters 6, 7, and 8, respectively, of the user's guide.



# Maintenance 4

---

## Lamps

The Series 200 Diode Array Detector uses a deuterium lamp and/or a tungsten halogen lamp as light sources. See Figure 4-1.



**Warning**

The deuterium lamp operates at high voltage. Remove power to the instrument to avoid electrical shock.

---



**Warning**

The ultraviolet light produced by deuterium lamps will cause eye and skin damage. Always wear protective glasses and avoid looking directly at the light output when working with deuterium lamps.

---



**Warning**

The deuterium lamp operates at high temperatures (in excess of 200°C (390°F)). The lamp housing is hot when the detector is operating. Do not touch the lamp or the housing when the detector is operating.

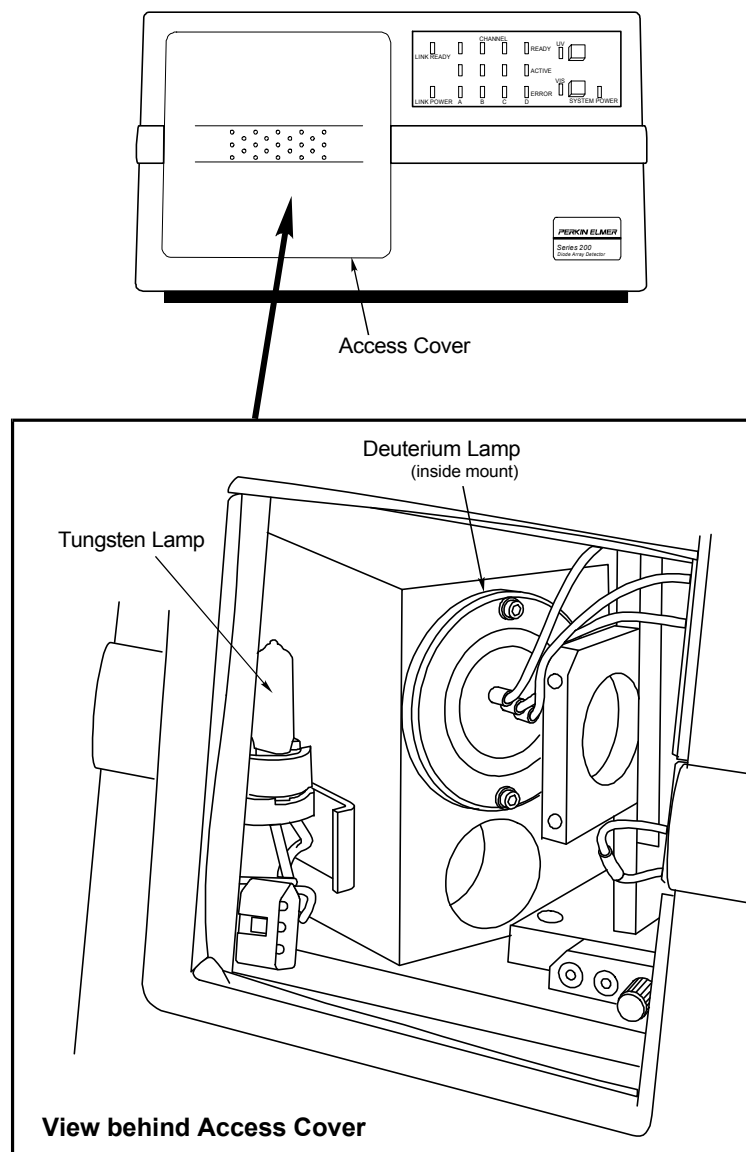
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**Caution**

The lamp filaments are fragile. Do not subject the lamp to vibration or shock.

---



**Figure 4-1. The Detector lamps**

### Ultraviolet Source

The ultraviolet source produces an intense, stable light by maintaining an electric arc in a deuterium atmosphere. This emitted light is a continuous wavelength spectrum from 190 nm to 400 nm.

Due to varying operating conditions, the useful life of a deuterium lamp can not be precisely determined. However, when the lamp intensity decreases to 50% of the original output the lamp has reached the end of its useful life. The deuterium lamps used are guaranteed for 500 hours of operation. If the lamp fails within that time, it will be replaced free of charge. If the lamp fails within the next 500 hours, it will be replaced on a pro-rated basis.

If the deuterium lamp appears to be emitting low energy, you should eliminate all other possible causes of low sensitivity before replacing the lamp.



Low sensitivity may be a result of the following:

- Air bubbles in the flow cell
- Mobile phase problems, e.g., unexpected absorbance bands or contamination
- Dirty or cracked cell windows
- Detector needs to be realigned
- Lamp replacement is required

## Ultraviolet Source Replacement

### Note

The part number of the deuterium lamp is N292-2046. Replacement lamps are obtained by calling your normal parts (maintenance) number.

### Tools Required

To replace the deuterium lamp (see Figure 4-1), you need a 3/32-in. hex driver.

### Warnings and Precautions



#### Warning

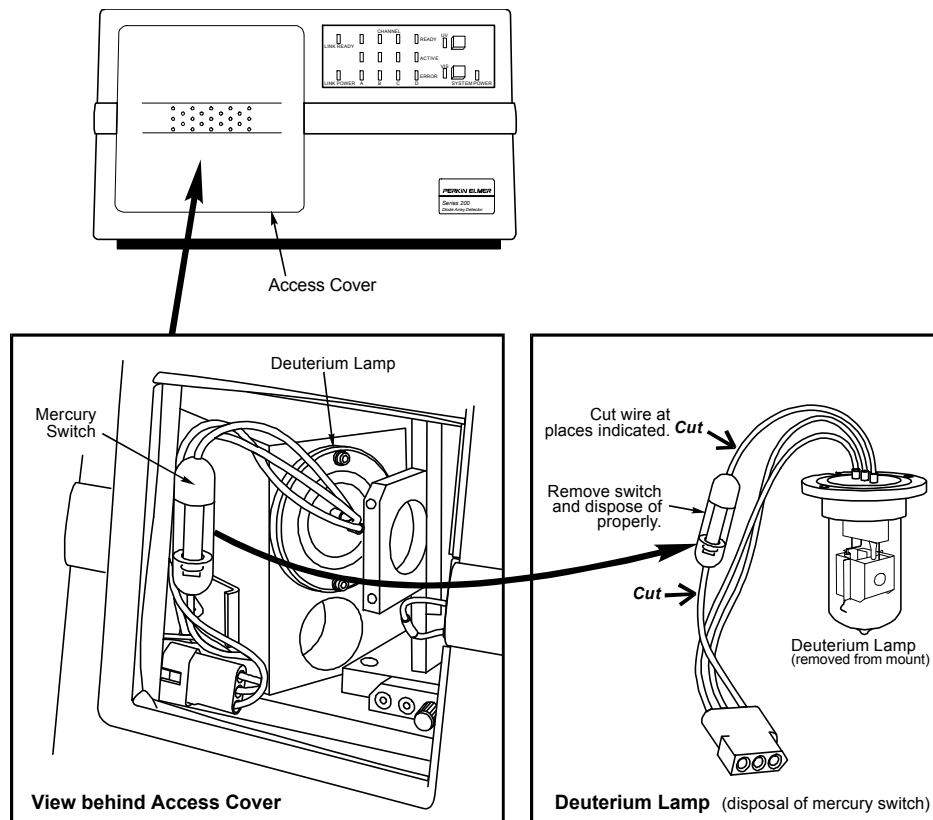
**Never touch the exposed glass of the deuterium lamp. A fingerprint on the glass could cause the bulb to explode when the operating temperature is attained. Fingerprints will always compromise performance.**



#### Warning

**Always wear UV safety glasses when working near the detector.**

1. Stop the pump if it is running, turn off power to the detector, and disconnect the flowcell connections. Then disconnect the detector power cord from the rear panel of the detector.
2. Remove the flow cell cover plate by loosening the four knurled securing screws. Remove the flow cell by loosening the knurled screw at the base of the cell carriage and sliding it out of the instrument.
3. Visually check the flow cell and make sure that there are no air bubbles in the cells, or cracks in the cell windows, that will interfere with test procedures. These factors can contribute to low lamp energy.
4. Allow enough time for the deuterium lamp and the lamp housing to thoroughly cool.
5. Disconnect the electrical power leads from the deuterium lamp.
6. Loosen and remove the two #6 screws that hold the deuterium lamp to the housing using the 3/32-in. hex driver, and remove the lamp.
7. The deuterium lamp contains a mercury timer switch. Remove the timer switch from the lamp assembly as shown in Figure 4-2 and dispose of it properly.



**Figure 4-2. Removing the mercury timer switch for disposal**

8. Install the new deuterium lamp and then reconnect the electrical power leads.
9. Install the flow cell and cover plate.

## Tungsten Lamp Replacement

**Note** The part number of the tungsten lamp is N292-2011. Replacement lamps are obtained by calling your normal parts (maintenance) number.

### Tools Required

To replace the tungsten lamp (see Figure 4-1), the following tools are needed:

- 0.050-inch hex driver
- 3/32-inch hex driver
- 5/32-inch hex driver

## Warnings and Precautions

**Warning**

Never touch the exposed glass of the tungsten lamp. A fingerprint on the glass could cause the bulb to explode when the operating temperature is attained. Fingerprints will definitely compromise performance.

**Caution**

The bulb walls are fragile. The bulb will break if undue force is applied.

**Caution**

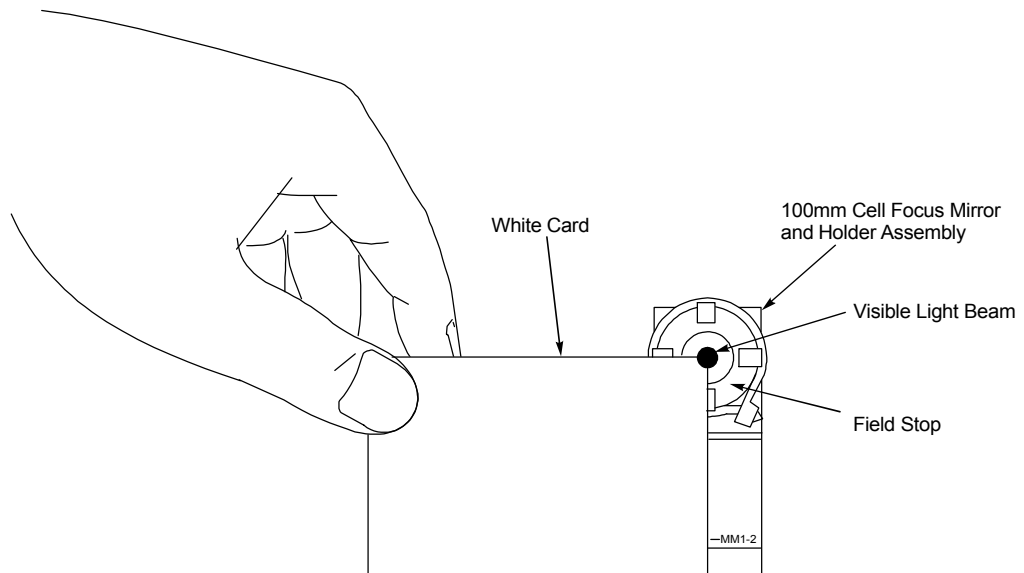
*Never touch the bulb with your bare hands. Residues from your skin can damage the bulb.*

## Replacement procedure

The lamp is held by a top-cap assembly as well as two leads. Proceed as follows to replace the tungsten lamp:

1. Stop the pump if it is running and turn off power to the detector.
2. Disconnect the flowcell connections.
3. Disconnect the detector power cord from the rear panel of the detector
4. Remove the flow cell cover plate by loosening the four knurled securing screws. Then remove the flow cell by loosening the knurled screw at the base of the cell carriage and sliding it out of the instrument.
5. Remove the top cover of the detector by loosening and then removing the four cabinet screws and sliding the instrument cover forward. Remove the cell focus mirror cover by loosening the two 3/32-in. hex screws.
6. Visually check the flow cell and make sure that there are no air bubbles in the cells or cracks in the cell windows that will interfere with test procedures.
7. Using a 0.050-in. hex-key wrench, loosen the setscrew on the side of the lamp cap. Slide the cap up and off the post.
8. Remove the lamp from the holder.
9. Grasp the new bulb in its protective bag and cut off the bottom of the bag, thereby exposing the contacts.
10. Line up the leads with the receptacle contacts in the holder and push the bulb into place. There is no particular polarity needed for the bulb.
11. Slide the cap back down over the new lamp, and allow the lamp to seek its own center.
12. Rotate the lamp cap until the lamp is vertical and secure the lamp by tightening the setscrew. Then check to make sure that the lamp is held securely by the lamp cap.

13. Turn on the detector power switch and the VIS power switch.
14. Refer to Figure 4-3 and use a white piece of paper or card (business cards are ideal) to check if the light image falls on the center of the cell focus mirror. If it doesn't, you must loosen the setscrew (see Step 12) and adjust the bulb's position to achieve proper alignment. Then retighten the setscrew.



**Figure 4-3. Aligning the beam at the center of the cell focus mirror**

15. Turn off the detector power and replace the cell focus mirror cover and the detector cover.
16. Replace the flow cell and cover plate.

# Appendix **A**

---

## **Configuring Series 200 DAD for Acquiring Spectra**

This appendix includes the procedure for configuring the Series 200 Diode Array detector for both Turbochrom Client/Server and Turbochrom Workstation software.

### **Installation Requirements:**

- Client/Server installation requires a Windows NT 4.0 Workstation
- Workstation installation requires Windows 95/98

### **Connectors at the Back of the Detector**

The Series 200 Diode Array Detector has an internal link. The Connections at the rear are as follows (see Figure A-1):

- SERIAL/HOST – Serial, or Terminal server to Turbochrom
- SPECTRAL DATA TO PC – To LPT port of local client. (This LPT port cannot be used for a printer; make sure none are configured for it.)
- INST A (Port A) to the pump
- INST B (Port B) to Control (Series 200 DAD)
- INST C (Port C) to the autosampler
- Network Port

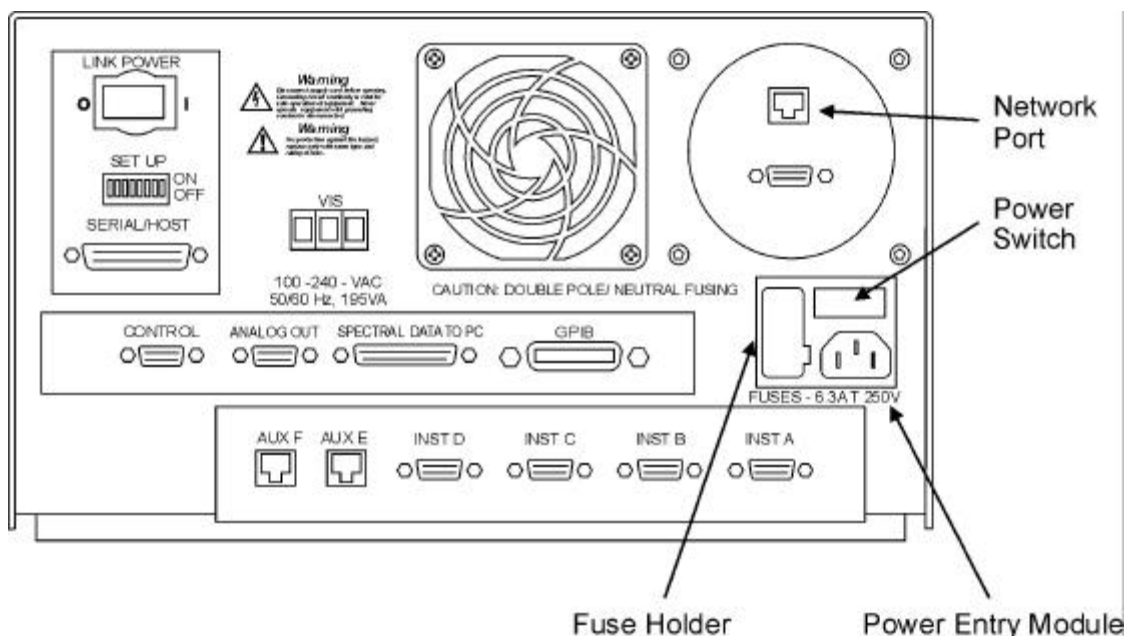


Figure A-1. Connectors at the rear of the Diode Array Detector

Table A-1. Proper Port Configuration

PORT	DEVICE
Port (INST) A	Pump
Port (INST) B	Series 200 DAD
Port (INST) C	Autosampler
Port (INST) D	none
Network Port	See Note Below

## Turboscan<sup>200</sup> Installation

If Turboscan<sup>200</sup> has been purchased, install it as described in Chapter 2 of the Turboscan<sup>200</sup> manual (part number 0993-8917).

- Note** Also, refer to the procedure for installing Turboscan<sup>200</sup> in the Help multimedia files in the Service CD, *Installation of Turboscan<sup>200</sup>*.
- Note** The procedure following for adding servers, ports and for configuring the Detector are described in detail in Help multimedia files on supplied CD part number N292-2060. They are located in the *Installation* directory of the CD.
- Note** The network plug can be used to control the detector and acquire spectral data. The server can be a local workstation computer or a server located elsewhere on the network. Configuration of this port needs to be done by a PerkinElmer service engineer.

## Adding a Server, Port and Instrument

**Note** The procedures in this paragraph (steps 1 through 4, below) are for Turbochrom Client/Server software only, NOT for Turbochrom Workstation.

1. The name of the New Server should be the same as the name of the local workstation through which the LPT port is connected to the Series 200 DAD. To determine the name, right-click on the Network Neighborhood icon; then choose Properties from the menu. The name to use for the New Server name will be in the Computer Name field.
2. Choose Windows NT as the operating system. Then select (check) only the Analysis Server; the Directory Replication Host and LM Host are to be left unchecked. Finally, select a default printer for the New Server.
3. Add a port for the detector. Choose the New Server configured above for the acquisition server field.
4. Add an instrument for the detector. Assign it to any applicable instrument groups.

## Configuration

If applicable, save the entries made above, and configure as follows:

1. Configure the instrument to the appropriate port listed (see Table A-1 and Figure A-1). The detector power must be ON, that is the green light on the front panel must be lit.

**Note** The detector lamps can be off; however, the lamps should be turned on before taking control from Turbochrom Navigator. If both the UV and VIS lamps are not depressed and the lamps are not on before taking control, you will not be able to turn the lamps on or off using "Hands On." As with the LC235 Diode Array Detector, the lamp will then be started automatically at Power ON.

**Note** We also recommend that you turn on the Series 200 Diode Array Detector, and initialize it for two minutes before taking control with *Hands On*. Taking control sooner could result in Instrument Error 61.

2. Using the CD provided with the Diode Array Detector (P/N N292-2060), install the Spectra Daemon and the Series 200 Diagnostics software. If a port other than LPT1 is used, please refer to the readme file that is included with the software. This will enable you to edit the registry to change the port to another LPT port.
3. Reboot the computer when and if you are asked to do so.

4. For Windows NT workstations only, perform steps 4a through 4f. For Windows 95 workstations, proceed to step 5.
  - a) After the Spectra Daemon is installed, press Start > Settings > Control Panel; then click on the Services icon.
  - b) Locate the *200 Spectral Acquisition* service and highlight it. Then click on the "Startup" button.
  - c) Locate the "Log On As" box and click on the circle next to "This Account."
  - d) Click on the box with the 3 periods, and choose the Turbochrom process account (usually called tcprocess).
  - e) Enter and confirm the password for this account. This password can normally be obtained from the Turbochrom system manager.
  - f) Click on the OK button. Next click on the Stop button to stop the service, and then click on Start to restart the service. This will restart the service with the correct account.
5. Start Turbochrom; the "spectra" button should not be grayed out in the bottom right corner of the screen if Turboscan was installed.
6. Set up a method in which data is collected for 1 minute; then run the method. At the end of the run, the Status box should have "Spectra" on the ACQ line.
7. At the end of the pump equilibration (approximately 30 seconds after the start of the method), the "status" should go to "ready".
8. Confirm the existence of an spc file with the same name and at the same location as the raw data file.





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