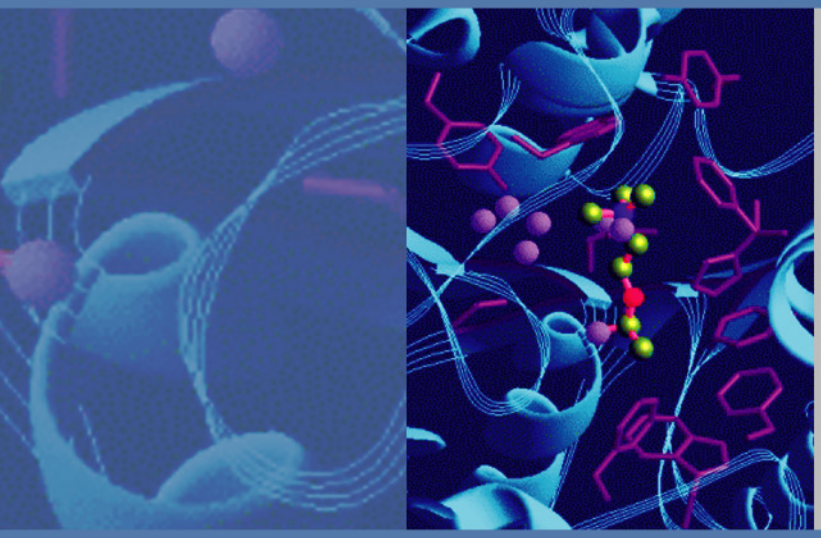


Accela PDA Detector

(80 hertz data rate)

Hardware Manual

60257-97080 Revision A August 2009

DOCUMENTATION SURVEY

Part of Thermo Fisher Scientific

Thermo SCIENTIFIC

Software versions: Xcalibur 2.1 and higher data system or ChromQuest 4.2 and higher data system
Hardware version: Accela PDA Detector (80 Hz version)
Revision history: Revision A, August 2009

For Research Use Only. Not for use in diagnostic procedures.

Regulatory Compliance

Thermo Fisher Scientific performs complete testing and evaluation of its products to ensure full compliance with applicable domestic and international regulations. When the system is delivered to you, it meets all pertinent electromagnetic compatibility (EMC) and safety standards as described in the next section or sections by product name.

Changes that you make to your system might void compliance with one or more of these EMC and safety standards. Changes to your system include replacing a part or adding components, options, or peripherals not specifically authorized and qualified by Thermo Fisher Scientific. To ensure continued compliance with EMC and safety standards, replacement parts and additional components, options, and peripherals must be ordered from Thermo Fisher Scientific or one of its authorized representatives.

Accela PDA Detector (80 Hz version)

EMC Directive 2004/108/EC

EMC compliance has been evaluated by TUV Rheinland of North America, Inc.

EN 61326-1	2006	EN 61000-4-3	2006
EN 55011	2007, A2: 2007	EN 61000-4-4	2004
EN 61000-3-2	2006	EN 61000-4-5	2005
EN 61000-3-3	1995, A1: 2001, A2: 2005	EN 61000-4-6	2007
EN 61000-4-2	1995, A1: 1999, A2: 2001	EN 61000-4-11	2001

FCC Class A, CFR 47 Part 15: 2007

Low Voltage Safety Compliance

Low Voltage Safety Compliance has been evaluated by TUV Rheinland of North America, Inc.

This device complies with Low Voltage Directive 2006/95/EC and harmonized standard EN 61010-1:2001, IEC 61010-1:2002, UL 61010 A-1:2004, CAN/CSA 22.2 61010-1:2004.

FCC Compliance Statement

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRED OPERATION.

CAUTION Read and understand the various precautionary notes, signs, and symbols contained inside this manual pertaining to the safe use and operation of this product before using the device.

Notice on Lifting and Handling of Thermo Scientific Instruments

For your safety, and in compliance with international regulations, the physical handling of this Thermo Fisher Scientific instrument ***requires a team effort*** to lift and/or move the instrument. This instrument is too heavy and/or bulky for one person alone to handle safely.

Notice on the Proper Use of Thermo Scientific Instruments

In compliance with international regulations: Use of this instrument in a manner not specified by Thermo Fisher Scientific could impair any protection provided by the instrument.

Notice on the Susceptibility to Electromagnetic Transmissions

Your instrument is designed to work in a controlled electromagnetic environment. Do not use radio frequency transmitters, such as mobile phones, in close proximity to the instrument.

For manufacturing location, see the label on the instrument.

WEEE Compliance

This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC. It is marked with the following symbol:

Thermo Fisher Scientific has contracted with one or more recycling or disposal companies in each European Union (EU) Member State, and these companies should dispose of or recycle this product. See www.thermo.com/WEEERoHS for further information on Thermo Fisher Scientific's compliance with these Directives and the recyclers in your country.

WEEE Konformität

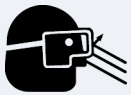
Dieses Produkt muss die EU Waste Electrical & Electronic Equipment (WEEE) Richtlinie 2002/96/EC erfüllen. Das Produkt ist durch folgendes Symbol gekennzeichnet:

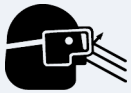
Thermo Fisher Scientific hat Vereinbarungen mit Verwertungs-/Entsorgungsfirmen in allen EU-Mitgliedsstaaten getroffen, damit dieses Produkt durch diese Firmen wiederverwertet oder entsorgt werden kann. Mehr Information über die Einhaltung dieser Anweisungen durch Thermo Fisher Scientific, über die Verwerter, und weitere Hinweise, die nützlich sind, um die Produkte zu identifizieren, die unter diese RoHS Anweisung fallen, finden sie unter www.thermo.com/WEEERoHS.

Conformité DEEE

Ce produit doit être conforme à la directive européenne (2002/96/EC) des Déchets d'Equipements Electriques et Electroniques (DEEE). Il est marqué par le symbole suivant:

Thermo Fisher Scientific s'est associé avec une ou plusieurs compagnies de recyclage dans chaque état membre de l'union européenne et ce produit devrait être collecté ou recyclé par celles-ci. Davantage d'informations sur la conformité de Thermo Fisher Scientific à ces directives, les recycleurs dans votre pays et les informations sur les produits Thermo Fisher Scientific qui peuvent aider la détection des substances sujettes à la directive RoHS sont disponibles sur www.thermo.com/WEEERoHS.

CAUTION Symbol	CAUTION	VORSICHT	ATTENTION	PRECAUCION	AVVERTENZA
	**Electric Shock:** This instrument uses high voltages that can cause personal injury. Before servicing, shut down the instrument and disconnect the instrument from line power. Keep the top cover on while operating the instrument. Do not remove protective covers from PCBs.	**Elektroschock:** In diesem Gerät werden Hochspannungen verwendet, die Verletzungen verursachen können. Vor Wartungsarbeiten muß das Gerät abgeschaltet und vom Netz getrennt werden. Betreiben Sie Wartungsarbeiten nicht mit abgenommenem Deckel. Nehmen Sie die Schutzabdeckung von Leiterplatten nicht ab.	**Choc électrique:** L'instrument utilise des tensions capables d'infliger des blessures corporelles. L'instrument doit être arrêté et débranché de la source de courant avant tout intervention. Ne pas utiliser l'instrument sans son couvercle. Ne pas enlever les étuis protecteurs des cartes de circuits imprimés.	**Descarga eléctrica:** Este instrumento utiliza altas tensiones, capaces de producir lesiones personales. Antes de dar servicio de mantenimiento al instrumento, éste debera apagarse y desconectarse de la línea de alimentacion eléctrica. No opere el instrumento sin sus cubiertas exteriores quitadas. No remueva las cubiertas protectoras de las tarjetas de circuito impreso.	**Shock da folgorazione.** L'apparecchio è alimentato da corrente ad alta tensione che puo provocare lesioni fisiche. Prima di effettuare qualsiasi intervento di manutenzione occorre spegnere ed isolare l'apparecchio dalla linea elettrica. Non attivare lo strumento senza lo schermo superiore. Non togliere i coperchi a protezione dalle schede di circuito stampato (PCB).
	**Chemical:** This instrument might contain hazardous chemicals. Wear gloves when handling toxic, carcinogenic, mutagenic, or corrosive or irritant chemicals. Use approved containers and proper procedures to dispose waste oil.	**Chemikalien:** Dieses Gerät kann gefährliche Chemikalien enthalten. Tragen Sie Schutzhandschuhe beim Umgang mit toxischen, karzinogenen, mutagenen oder ätzenden/reizenden Chemikalien. Entsorgen Sie verbrauchtes Öl entsprechend den Vorschriften in den vorgeschriebenen Behältern.	**Chimique:** Des produits chimiques dangereux peuvent se trouver dans l'instrument. Portez des gants pour manipuler tous produits chimiques toxiques, cancérigènes, mutagènes, ou corrosifs/irritants. Utiliser des récipients et des procédures homologuées pour se débarrasser des déchets d'huile.	**Química:** El instrumento puede contener productos quimicos peligrosos. Utilice guantes al manejar productos quimicos tóxicos, carcinogenos, mutagenos o corrosivos/irritantes. Utilice recipientes y procedimientos aprobados para deshacerse del aceite usado.	**Prodotti chimici.** Possibile presenza di sostanze chimiche pericolose nell'apparecchio. Indossare dei guanti per maneggiare prodotti chimici tossici, cancerogeni, mutageni, o corrosivi/irritanti. Utilizzare contenitori aprovo e seguire la procedura indicata per lo smaltimento dei residui di olio.
	**Heat:** Before servicing the instrument, allow any heated components to cool.	**Hitze:** Warten Sie erhitzte Komponenten erst nachdem diese sich abgekühlt haben.	**Haute Temperature:** Permettre aux composants chauffés de refroidir avant tout intervention.	**Altas temperaturas:** Permita que lop componentes se enfríen, ante de efectuar servicio de mantenimiento.	**Calore.** Attendere che i componenti riscaldati si raffreddino prima di effetturare l'intervento di manutenzione.
	**Fire:** Use care when operating the system in the presence of flammable gases.	**Feuer:** Beachten Sie die einschlägigen VorsichtsmaBnahmen, wenn Sie das System in Gegenwart von entzündbaren Gasen betreiben.	**Incendie:** Agir avec précaution lors de l'utilisation du système en présence de gaz inflammables.	**Fuego:** Tenga cuidado al operar el sistema en presencia de gases inflamables.	**Incendio.** Adottare le dovute precauzioni quando si usa il sistema in presenza di gas infiammabili.
	**Eye Hazard:** Eye damage could occur from splattered chemicals or flying particles. Wear safety glasses when handling chemicals or servicing the instrument.	**Verletzungsgefahr der Augen:** Verspritzte Chemikalien oder kleine Partikel können Augenverletzungen verursachen. Tragen Sie beim Umgang mit Chemikalien oder bei der Wartung des Gerätes eine Schutzbrille.	**Danger pour les yeux:** Des projections chimiques, liquides, ou solides peuvent être dangereuses pour les yeux. Porter des lunettes de protection lors de toute manipulation de produit chimique ou pour toute intervention sur l'instrument.	**Peligro par los ojos:** Las salicaduras de productos químicos o particulas que salten bruscamente pueden causar lesiones en los ojos. Utilice anteojos protectores al mnipular productos químicos o al darle servicio de mantenimiento al instrumento.	**Pericolo per la vista.** Gli schizzi di prodotti chimici o delle particelle presenti nell'aria potrebbero causare danni alla vista. Indossare occhiali protettivi quando si maneggiano prodotti chimici o si effettuano interventi di manutenzione sull'apparecchio.
	**General Hazard:** A hazard is present that is not included in the above categories. Also, this symbol appears on the instrument to refer the user to instructions in this manual.	**Allgemeine Gefahr:** Es besteht eine weitere Gefahr, die nicht in den vorstehenden Kategorien beschrieben ist. Dieses Symbol wird im Handbuch auBerdem dazu verwendet, um den Benutzer auf Anweisungen hinzuweisen.	**Danger général:** Indique la présence d'un risque n'appartenant pas aux catégories citées plus haut. Ce symbole figure également sur l'instrument pour renvoyer l'utilisateur aux instructions du présent manuel.	**Peligro general:** Significa que existe un peligro no incluido en las categorias anteriores. Este simbolo también se utiliza en el instrumento par referir al usuario a las instrucciones contenidas en este manual.	**Pericolo generico.** Pericolo non compreso tra le precedenti categorie. Questo simbolo è utilizzato inoltre sull'apparecchio per segnalare all'utente di consultare le istruzioni descritte nel presente manuale.
	When the safety of a procedure is questionable, contact your local Technical Support organization for Thermo Fisher Scientific San Jose Products.	Wenn Sie sich über die Sicherheit eines Verfahrens im unklaren sind, setzen Sie sich, bevor Sie fortfahren, mit Ihrer lokalen technischen Unterstützungsorganisation für Thermo Fisher Scientific San Jose Produkte in Verbindung.	Si la sûreté d'une procédure est incertaine, avant de continuer, contacter le plus proche Service Clientèle pour les produits de Thermo Fisher Scientific San Jose.	Cuando la certidumbre acerca de un procedimiento sea dudosa, antes de proseguir, pongase en contacto con la Oficina de Asistencia Tecnica local para los productos de Thermo Fisher Scientific San Jose.	Quando e in dubbio la misura di sicurezza per una procedura, prima di continuare, si prega di mettersi in contatto con il Servizio di Assistenza Tecnica locale per i prodotti di Thermo Fisher Scientific San Jose.

CAUTION Symbol	CAUTION	危険警告	危險警告
	**Electric Shock:** This instrument uses high voltages that can cause personal injury. Before servicing, shut down the instrument and disconnect the instrument from line power. Keep the top cover on while operating the instrument. Do not remove protective covers from PCBs.	**電撃：**この計測器は高電圧を使用し、人体に危害を与える可能性があります。保守・修理は、必ず操業を停止し、電源を切ってから実施して下さい。上部カバーを外したままで 計測器を使用しないで下さい。プリント配線板の保護カバーは外さないで下さい。	電擊：儀器設備使用會造成人身傷害的高伏電壓。在維修之前，必須先關儀器設備並切除電源。務必要在頂蓋蓋上的情況下操作儀器。請勿拆除PCB保護蓋。
	**Chemical:** This instrument might contain hazardous chemicals. Wear gloves when handling toxic, carcinogenic, mutagenic, or corrosive or irritant chemicals. Use approved containers and proper procedures to dispose waste oil.	**化学物質：**危険な化学物質が計測器中に存在している可能性があります。毒性、発がん性、突然変異性、腐食・刺激性などのある薬品を取り扱う際は、手袋を着用して下さい。廃油の処分には、規定の容器と手順を使用して下さい。	化學品：儀器設備中可能存在有危險性的化學物品。接觸毒性致癌、誘變或腐蝕／刺激性化學品時，請配帶手套。處置廢油時，請使用經過許可的容器和程序。
	**Heat:** Before servicing the instrument, allow any heated components to cool.	**熱：**熱くなった部品は冷えるのを待ってから保守・修理を行って下さい。	高溫：請先等高溫零件冷卻之後再進行維修。
	**Fire:** Use care when operating the system in the presence of flammable gases.	**火災：**可燃性のガスが存在する場所でシステムを操作する場合は、充分な注意を払って下さい。	火災：在有易燃氣體的場地操作該系統時，請務必小心謹慎。
	**Eye Hazard:** Eye damage could occur from splattered chemicals or flying particles. Wear safety glasses when handling chemicals or servicing the instrument.	**眼に対する危険：**化学物質や微粒子が飛散して眼を傷つける危険性があります。化学物質の取り扱い、あるいは計測器の保守・修理に際しては防護眼鏡を着用して下さい。	眼睛傷害危險：飛濺的化學品或顆粒可能造成眼睛傷害。處理化學品或維修儀器設備時請佩戴安全眼鏡。
	**General Hazard:** A hazard is present that is not included in the above categories. Also, this symbol appears on the instrument to refer the user to instructions in this manual.	**一般的な危険：**この標識は上記以外のタイプの危険が存在することを示します。また、計測器にこの標識がついている場合は、本マニュアル中の指示を参照して下さい。	一般性危險：說明未包括在上述類別中的其他危險。此外，儀器設備上使用這個標誌，以指示用戶本使用手冊中的說明。
	When the safety of a procedure is questionable, contact your local Technical Support organization for Thermo Fisher Scientific San Jose Products.	**安全を確保する手順がよくわからない時は、作業を一時中止し、お近くのサーモエレクトロンサンローゼプロダクトのテクニカールサポートセンターごご連絡ください。**	如对安全程序有疑问，请在操作之前与当地的菲尼根技术服务中心联系。

Contents

Preface

This *Accela PDA Detector (80 Hz version) Hardware Manual* describes how to set up and maintain the Accela PDA Detector.

Related Documentation

In addition to this guide, Thermo Fisher Scientific provides the following documents as PDF files for the Accela PDA Detector:

- *Accela Preinstallation Requirements Guide*
- *Accela Getting Connected Guide*
- *Accela Getting Started with Xcalibur Guide*
- *ChromQuest User Guide for the Accela UHPLC*

The Thermo Scientific data system that you use to control the PDA detector has a built-in Help system.

Safety and Special Notices

Make sure you follow the precautionary statements presented in this guide. The safety and other special notices appear in boxes.

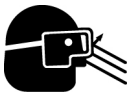
Safety and special notices include the following:

CAUTION Highlights hazards to humans, property, or the environment. Each CAUTION notice is accompanied by an appropriate CAUTION symbol.

CAUTION Highlights hot surface hazards.

CAUTION Highlights electrical shock hazards.

CAUTION Highlights UV radiation hazards.



CAUTION Highlights hazards that require the use of eye protection.

IMPORTANT Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the system.

Note Highlights information of general interest.

Tip Highlights helpful information that can make a task easier.

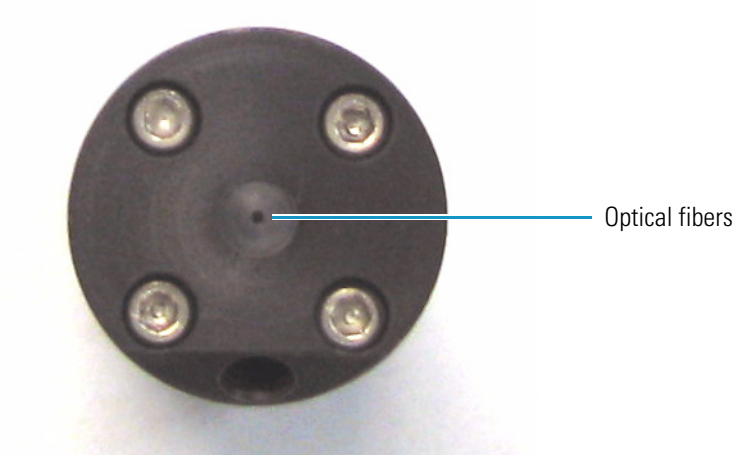
Special Precautions for the Accela PDA Detector

To ensure optimal performance of the Accela PDA Detector or to avoid injury, follow these precautions:

- Handle the LightPipe flowcell for the PDA detector with care.
- Ensure that the drainage system is properly connected between each module and to the waste bottle.
- Read the safety labels inside the lamp compartment before you remove the lamp cover.

LightPipe Flowcell

The LightPipe flowcell contains optical fibers that are exposed at both ends of the cell. When you handle the LightPipe flowcell, take care to avoid touching the exposed optical fibers. The following photo contains a view of the exposed optical fibers at the inlet end of the LightPipe flowcell.



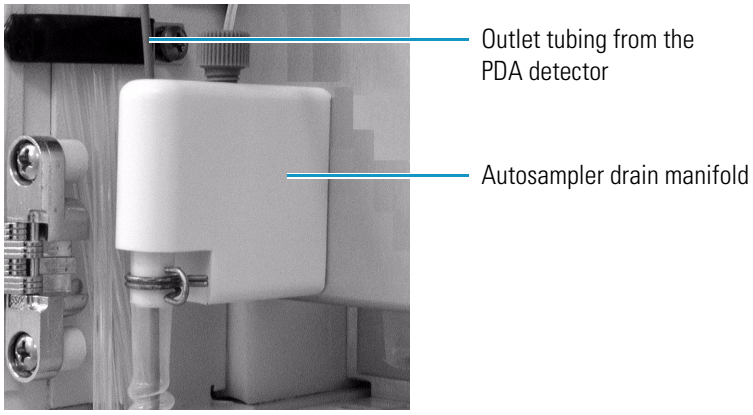
Drainage Connections

Before you start the solvent flow from the pump, make sure that the solvent flow from the outlet end of the LightPipe flowcell is connected to the drainage system.

❖ **To make the drainage connections**

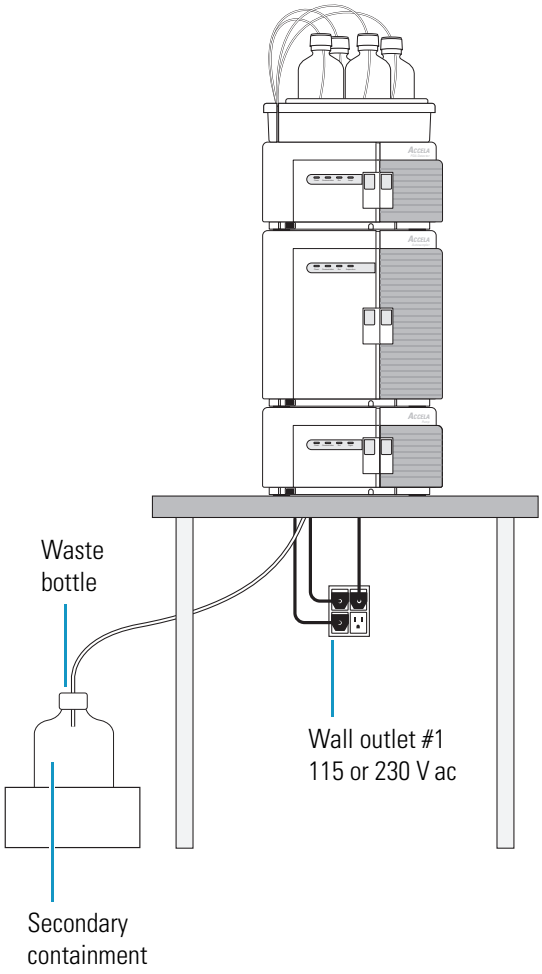
1. Insert the outlet tubing from the PDA detector into the autosampler drain manifold (see Figure 1).

Figure 1. Tubing connections



2. Connect the autosampler drain manifold to a sealed waste bottle (Figure 2 on page xvi).

Figure 2. Drain connected to waste bottle



Hot Surface, UV Radiation, and High Voltage Hazards

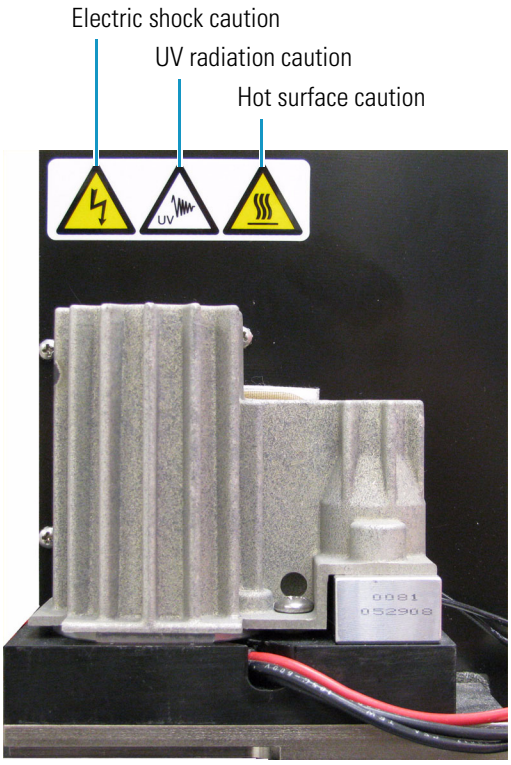
Before you pull the PDA detector's chassis partially out of the housing to replace the deuterium or tungsten lamp assemblies, do the following in order:

1. Turn off the lamps.
2. Wait approximately 30 minutes for the lamp cover to cool to room temperature.
3. Turn off the PDA detector, and then unplug the power cord from line power.

After you pull the PDA detector's chassis partially out of the housing, you can see the heat, UV radiation, and electrical shock caution labels inside the lamp compartment.

Turning off the lamps and waiting approximately 30 minutes for the lamp cover to cool to room temperature removes the hot surface hazard. Unplugging the PDA detector from line power removes the UV radiation and hazards.

Before you attempt to pull the lamp cover out of the PDA detector, lightly touch the cover to make sure that it is not hot.



Good Laboratory Practices

To obtain optimal performance from your LC system and to prevent personal injury or an environment hazard, do the following:

- Keep good records.
- Read the manufacturers' Material Safety Data Sheets (MSDSs) for the chemicals being used in your laboratory.
- Remove particulate matter from your samples before you inject them into the liquid chromatograph.
- Use HPLC-grade solvents.
- Connect the drainage tubes from the pump, autosampler, and detector to an appropriate waste receptacle. Dispose of solvents as specified by local regulations.

Keep Good Records

To help identify and isolate problems with either your equipment or your methodology, Thermo Fisher Scientific recommends that you keep good records of all system conditions, for example,% RSDs on retention times and peak areas, peak shape, and resolution. At a minimum, keep a chromatogram of a typical sample and standard mixture, well documented with system conditions, for future reference. Careful comparison of retention times, peak shapes, peak sensitivity, and baseline noise can provide valuable clues to identifying and solving future problems.

Chemical Toxicity

Although the large volume of toxic and flammable solvents used and stored in laboratories can be quite dangerous, do not ignore the potential hazards posed by your samples. Take special care to read and follow all precautions that ensure proper ventilation, storage, handling, and disposal of both solvents and samples. Become familiar with the toxicity data and potential hazards associated with all chemicals by referring to the manufacturers' Material Safety Data Sheets.

Sample Preparation

Always consider the solubility of your sample in the solvent/mobile phase. Sample precipitation can plug the column, tubing, or LightPipe flowcell causing flow restriction. This obstruction can result in irreparable damage to the system. You can avoid particulate matter by filtering the samples through 0.45 or 0.2 micron (or less) filters.

Solvent Requirements

Many chemical manufacturers provide a line of high-purity or HPLC-grade reagents that are free of chemical impurities. Routine filtration of all solvents or eluents through a 0.45 or 0.2 micron (or less) fluorocarbon filter before placing them in the solvent reservoir significantly prolongs the life and effectiveness of the inlet filters, check valves and seals, injector, and column. Typically, HPLC-grade solvents do not require filtration.

Choose a mobile phase that is compatible with the sample and column that you have selected for your separation. Remember that some solvents can corrode stainless steel.

Solvent Disposal

Make sure you have a solvent waste container or other kind of drain system available at or below the benchtop level. Most solvents have special disposal requirements and should not be disposed of directly down a drain. Follow all governmental regulations when disposing of any chemical.

High-pressure Systems and Leaks

LC systems operate at high pressures. Because liquids are not highly compressible they do not store much energy. Accordingly, there is little immediate danger from the high pressures in an LC system. However, if a leak occurs, correct it as soon as possible. Always wear eye and skin protection when operating or maintaining an LC system. Always shut down the system and return it to atmospheric pressure before attempting any maintenance.

Contacting Us

There are several ways to contact Thermo Fisher Scientific for the information you need.

❖ To contact Technical Support

Phone	800-532-4752
Fax	561-688-8736
E-mail	us.techsupport.analyze@thermofisher.com
Knowledge base	www.thermokb.com

Find software updates and utilities to download at mssupport.thermo.com.

❖ To contact Customer Service for ordering information

Phone	800-532-4752
Fax	561-688-8731
E-mail	us.customer-support.analyze@thermofisher.com
Web site	www.thermo.com/ms

❖ To copy manuals from the Internet

Go to mssupport.thermo.com and click **Customer Manuals** in the left margin of the window.

❖ To suggest changes to documentation or to Help

- To provide us with comments about this document, click the link below. Thank you in advance for your help.

- Send an e-mail message to the Technical Publications Editor at techpubs-lcms@thermofisher.com.

Introduction

The Accela PDA Detector is a member of the Accela family of ultra high-performance LC instruments (see Figure 1).

Contents

Figure 1. Accela PDA Detector

Functional Description

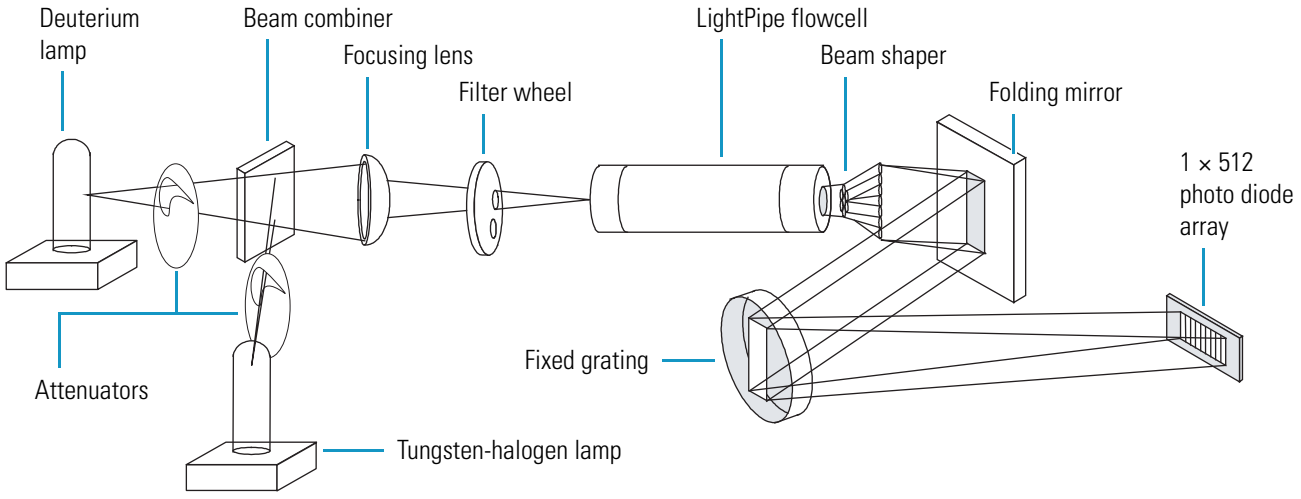
The detector is a full-featured, time-programmable, photodiode array (PDA) detector capable of scanning the ultraviolet-visible wavelength range from 190 to 800 nm. You can acquire data across the entire spectral range (with an effective resolution of 1.2 nm) at a rate of 0.5 to 80 Hz with 20-bit digital conversion.

The PDA detector is a benchtop unit for inclusion in the Accela liquid chromatography system. You control the detector through an Ethernet link to a data system computer that has the Xcalibur™ or ChromQuest™ data system installed. The detector consists of a dual-light source, an optical bench, a photodiode array, a low voltage power supply, several printed circuit boards (PCBs), and four status light-emitting diodes (LEDs).

Figure 2 shows the optical system used in the detector. The dual-light source includes a deuterium lamp for detection in the ultraviolet wavelength range (190 to 360 nm) and a tungsten-halogen lamp for detection in the visible wavelength range (360 to 800 nm). The light output from the two lamps overlaps in the 300 to 500 nm range. You can increase or decrease the light intensity reaching the photodiode array by manually adjusting the attenuator for the deuterium lamp and the attenuator for the tungsten lamp.

The optical bench contains a beam combiner, focusing lens, filter wheel, LightPipe flowcell, beam shaper, folding mirror, and grating. The beam combiner reflects the light coming from the tungsten-halogen lamp so that it is parallel to and coincident with the light from the deuterium lamp. A lens focuses the combined beam on the inlet window of the LightPipe flowcell through the filter wheel. The standard filter wheel has two positions. For normal operation, leave the filter wheel in Position 1 (Open). Position 2 contains a sealed quartz cuvette filled with a holmium oxide/perchloric acid solution (traceable to NIST) used for wavelength accuracy verification and calibration.

Figure 2. The PDA detector optical system



The light focused on the inlet window of the LightPipe flowcell travels down the cell, is partially absorbed by the sample flowing through the cell, and exits into the beam shaper. The beam shaper is a fiber bundle. Its entrance aperture is circular to collect light from the LightPipe flowcell. The other end of the bundle is arranged to produce a narrow "slit" of light for the grating. The beam shaper transfers all the light to the grating for greater light throughput than the mechanical slit used in conventional photodiode array detectors.

The folding mirror between the output of the beam shaper and the grating shortens the optical bench, reducing the physical size of the detector. The grating disperses the light beam onto the 512-element photodiode array (two of the diodes in this array are not used). Because the spectrum of light falling on the array is 611 nm (190 to 800 nm, inclusive), the effective spacing of the diodes is 611 nm / 510 = 1.2 nm. Firmware on the CPU PCB automatically interpolates diode intervals to arrive at integer wavelengths.

The photodiode array is mounted on the Array Acquisition PCB, which also contains all the analog detection circuitry. The PDA detector continuously scans the diode array at 20-, 40-, or 80-Hz (user selectable), converts the light intensity at each diode into a 20-bit digital word, and then stores these words in a dual-port Random Access Memory (RAM) on its CPU PCB. The CPU reads the data, processes the data based on the user parameters, and sends the processed data to the data system computer.

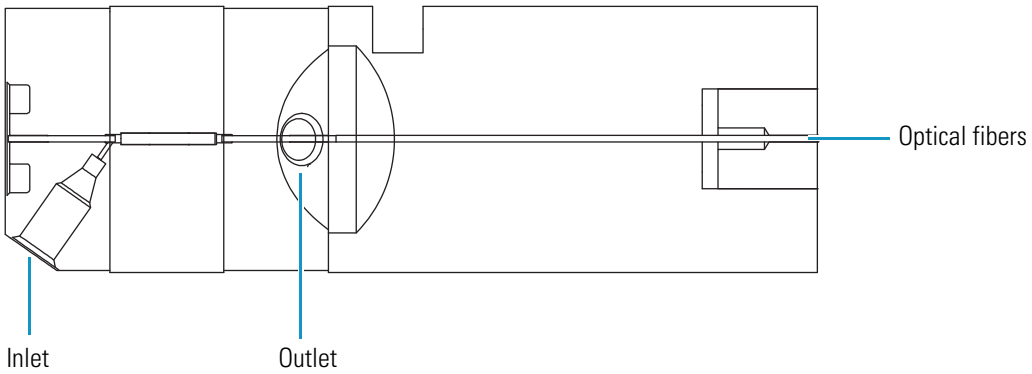
LightPipe Flowcell

The Accela PDA Detector ships with a 10 mm or 50 mm LightPipe flowcell.

The internal bore of the 10 mm LightPipe flowcell is 10 mm long and has a volume of 2 µL. The internal bore of the 50 mm LightPipe flowcell is 50 mm long and has a volume of 10 µL. A special, low refractive index coating of the internal bore ensures a high optical throughput and minimizes short-term noise.

The mobile phase enters the 10 mm LightPipe flowcell through a port in the bottom of the LightPipe flowcell and exits through a port in the front of the LightPipe flowcell (see Figure 3). Directing the flow upward helps prevent air bubble entrapment.

Figure 3. Schematic of 10 mm LightPipe flowcell



Sensitive optical fibers are exposed at both ends of the LightPipe flowcell (see Figure 4). Thermo Fisher Scientific ships the LightPipe flowcell with end caps to protect these optical fibers (see Figure 5). Do not remove the protective end caps until you install the LightPipe flowcell. Replace the protective end caps for storage if you remove the LightPipe flowcell from the detector.

CAUTION Do **not** touch the ends of the LightPipe flowcell. Touching the ends of the flowcell can damage the exposed optical fibers. If you must grasp the ends of the LightPipe flowcell, wear clean, talc-free gloves.

Figure 4. End of the LightPipe flowcell

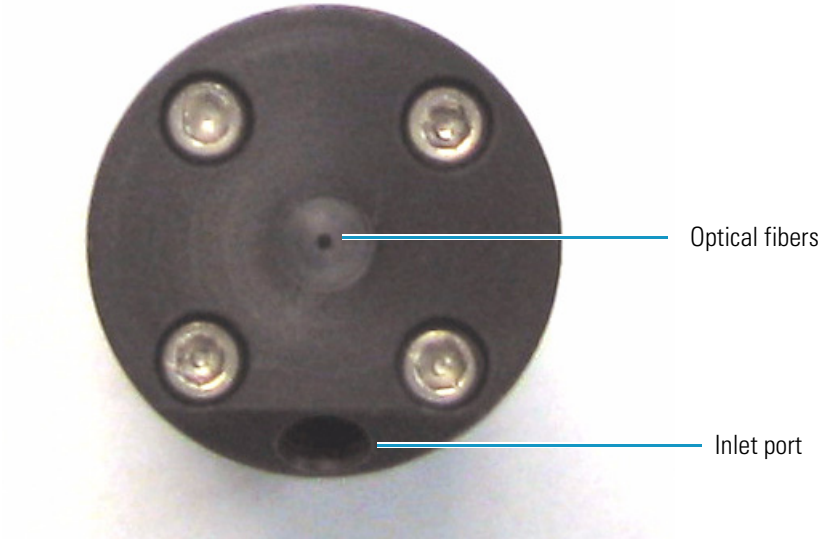
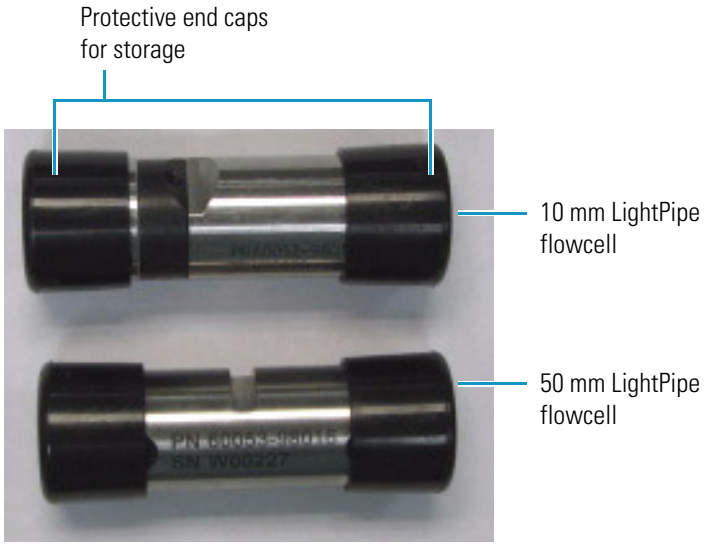


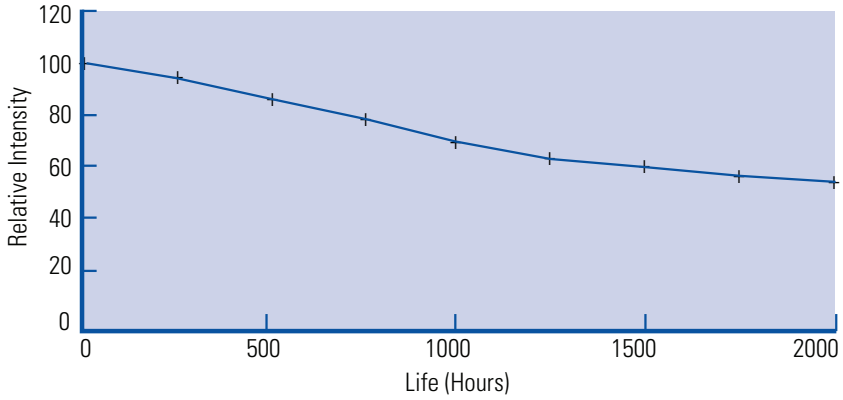
Figure 5. LightPipe flowcell with protective end caps



Lamp Lifetime and Detector Noise

The Accela PDA Detector has two lamps. The tungsten-halogen lamp emits light in the visible region, and the deuterium lamp emits light in the ultraviolet region. With use, the deuterium lamp emits less and less light before it fails to ignite (see Figure 6). In contrast, the light output from the tungsten-halogen lamp remains relatively constant until the lamp fails.

Figure 6. Deuterium lamp intensity versus lamp usage hours



Detector noise is inversely proportional to the amount of light that reaches the diode array and the sampling time for the photodiodes of the diode array. Decreasing the amount of light that reaches the diode array and decreasing the sampling time both increase the detector noise level.

These topics provide guidance on minimizing detector noise and maximizing the useful lamp lifetime:

- Controlling the Amount of Light that Reaches the Diode Array
- Selecting an Appropriate Diode Array Scan Rate

Controlling the Amount of Light that Reaches the Diode Array

During a fixed sampling period, the amount of light reaching the diode array is proportional to the light output from the lamp and the aperture of the manual attenuators (partially open to completely open).

To compensate for the decreased light output caused by lamp aging, increase the aperture of the PDA detector's attenuators (see "Completing the Installation and Verifying Operation" on page 25).

Note At the 20 Hz diode array scan rate, you can compensate for the decreased light output from the deuterium lamp by increasing the attenuator aperture throughout the lamp's lifetime of approximately 2000 hours.

Selecting an Appropriate Diode Array Scan Rate

When you configure the PDA detector, you have three options for the diode array scan rate: 20, 40, and 80 Hz. The diode array scan rate is the rate at which the PDA detector samples the integrated intensity of the diodes.

IMPORTANT For validated HPLC methods, record the appropriate configuration setting for the diode array scan rate. The diode array scan rate affects the detector noise level.

The option you select affects the detector noise level, the useful lifetime of the deuterium lamp, and the available sampling rates in the data system method.

Note For information on creating methods to control the PDA detector, refer to the data system Help.

As you increase the diode array scan rate, the sampling time per diode decreases. To achieve the same integrated light intensity, you must increase the light throughput to the diode array by opening the detector's attenuators ("Completing the Installation and Verifying Operation" on page 25). As the lamp ages, it emits less and less light (see Figure 6). So again, to achieve the same light throughput to the diode array, you must increase the attenuator aperture. Eventually, the attenuator aperture reaches a physical limit. When you can no longer increase the attenuator aperture, the integrated light intensity begins to decrease, and detector noise level begins to increase. The attenuator aperture reaches this physical limit sooner at the higher diode array scan rates.

The useful lifetime of the lamp depends on the acceptable noise level for your application. At the 20 Hz diode array scan rate, you can compensate for the decreased light output from the deuterium lamp by increasing the attenuator aperture throughout the lamp's lifetime of approximately 2000 hours.

To maximize the useful lifetime of the deuterium lamp, select a diode array scan rate that is appropriate for your application:

- For standard chromatography applications, select the 20 Hz diode array scan rate. With this selection, you can acquire up to 20 data points per second per chromatogram and optimize integration for chromatographic peaks with baseline widths as narrow as 1 second.
- For most fast chromatography applications, use the default selection of 40 Hz. With this selection, you can acquire up to 40 data points per second per chromatogram and optimize integration for chromatographic peaks with baseline widths as narrow as 0.5 seconds.
- For fast chromatography applications that have chromatographic peaks with baseline widths of less than 0.5 seconds, select the 80 Hz diode array scan rate.

Status LEDs

Four status LEDs labeled Power, Communication, Run, and Lamps are located on the left door of the detector (see Figure 7). Table 1 lists the status LEDs and their meaning.

Figure 7. Accela PDA Detector status LEDs

Table 1. Status LEDs and meanings

LED	State	Meaning
Power	Green	The detector is turned and has downloaded the operational file.
	Amber	The detector is turned on but has not yet downloaded the operational file from the data system computer.
Comm	Green	Communication to the data system PC has been established.
	Amber	There is no communication with the data system.
Run	Green	The detector is ready for a run.
	Flashing green	A run is in progress and the detector is sending data to the data system computer.
	Amber	The PDA detector is not ready to start a run for one of these reasons: • A valid method has not been downloaded (following power on). • Both lamps are off, or one of the lamps is failing to turn on. • The lamp or wavelength calibration is not valid.
	Flashing amber	The PDA detector is in an error state while in the Run mode.
Lamps	Green	One or both lamps are turned on.
	Amber	The lamps are off or the D2 lamp is starting. The D2 lamp takes approximately 30 seconds to turn on.

Specifications

The specifications for the Accela PDA Detector are as follows:

Wavelength range:	190 nm to 800 nm continuous
Wavelength accuracy:	±1 nm at 254 nm and 656 nm
Digital wavelength resolution:	1.2 nm
Absorbance range:	2.0 AU to +4.0 AU, 20-bit resolution
Short-term noise*:	≤ 6 µAU/cm (at 254 nm with a 50 mm LightPipe, a 1 mL/min flow rate (MeOH), 20 Hz diode array scan rate, 5 Hz data rate, 5 nm bandwidth, and 2 second rise time)
Drift*:	≤ 1 mAU/hour after warm up at 254 nm at a stable temperature (±1 °C)
Warmup time:	90 minutes to meet noise and drift specifications
Linearity:	deviation ≤ 5% up to 2.0 AU at 256 nm
Scan rate:	0.5, 1, 2, 4, 5, 10,, 40, or 80 Hz (user selectable)
Diode array scan rate	20, 40, or 80 Hz (user selectable)
Rise time:	0.0, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, or 10 s (user selectable)
Cell dimensions:	10 mm LightPipe flowcell or 50 mm LightPipe flowcell
Cell pressure rating:	1000 psi
Diodes:	512
Diode spacing:	1.2 nm
Light source:	Deuterium and tungsten-halogen lamps, pre-aligned
Filter wheels:	Standard filter wheel: two-position wheel, one open position and one Holmium oxide/perchloric acid-filled cuvette, NIST traceable. Optional linearity verification wheel: five-position wheel, one with perchloric acid blank and four cuvettes with different concentrations of potassium dichromate in perchloric acid, NIST traceable
Analog outputs (2):	20-bit digital/analog conversion, three outputs/channel scaled to 10 mV/AU, 100 mV/AU, or 1.0 V/AU
Remote controls:	Start, Zero
Dimensions:	18 cm (7.1 in.) × 36 cm (14.2 in.) × 47 cm (18.5 in.) ($h \times w \times d$)
Weight:	19.5 kg (43 lbs)
Power requirements:	100/115 or 230 V ac; 50/60 Hz, 200 VA max
Operating temperature:	+10 to +30 °C
Storage temperature:	- 40 to +70 °C
Operating humidity:	5% to 95% non-condensing relative humidity
Product certification:	CE, TUV-C/US, FCC (EMI)

* According to ASTM E1657-98 “Standard Practice for Testing Variable-Wavelength Photometric Detectors Used in Liquid Chromatography”

Installation

This chapter describes the initial installation of the PDA detector, including the connections to other chromatographic instrumentation. The installation checklist, on the back of this page, is an abbreviated version of this chapter that you can use as a quick reference for conducting a successful installation. Make a copy of the checklist, fill it out when the installation is complete, and include it in your maintenance records.

Contents

Installation Checklist

The following installation checklist is a brief summary of the steps you must complete in sequence for the proper installation of the PDA detector.

❒ Unpack and inspect your instrument.	See page 11.
❒ Read the safety notices in the preface.	See page xiv.
❒ Make the initial instrument preparations.	See page 11.
❒ Make the initial back panel connections.	See page 12.
❒ Connect and install the LightPipe flowcell.	See page 17.
❒ Power on the detector for the first time.	See page 24.
❒ Install software and connect remote communication outputs, as required.	See page 21.
❒ Configure the Accela PDA Detector for control from your chromatography data system.	See Chapter 3, "Configuration."
❒ Adjust the light throughput to the diode array.	For the Xcalibur data system, see "Adjusting the Light Throughput with the Xcalibur Data System" on page 42. For the ChromQuest data system, see "Adjusting the Light Throughput with the ChromQuest Data System" on page 69.
❒ Calibrate the Accela PDA Detector.	For the Xcalibur data system, see "Calibrating the PDA Detector from the Xcalibur Data System" on page 44. For the ChromQuest data system, see "Calibrating the PDA Detector from the ChromQuest Data System" on page 73.

This detector was installed by:

(Name) (Date)

Unpacking and Inspecting the Instrument

Carefully remove the detector from the shipping container and inspect both the detector and the packaging for any signs of damage. If you find any damage, save the shipping materials and immediately contact the shipping company.

Check the shipping container for the Accela PDA Detector, a LightPipe Flowcell Kit, a power cable, and an accessory kit that contains the following items:

- Two signal cables
- One RJ12 serial communications cable
- One Ethernet communications cable
- One RJ45 9-pin adapter

Ensure that you have received all the items listed on the packing list. If any items are missing, contact your Thermo Fisher Scientific representative immediately.

The part numbers of the accessory kit items are listed in Table 11 on page 104.

Making Initial Instrument Preparations

Place the PDA detector on a benchtop as close as possible to the chromatographic column outlet (minimizing the length of tubing necessary for connection to the LightPipe flowcell inlet). Be sure to place the detector in a **draft-free** location away from an open window, air conditioner vents, or other circulating air source. A stable room temperature is necessary for applications requiring maximum detection sensitivity. Allow at least 15 cm (6 in.) of clear space between the back panel of the detector and any wall or obstruction. This clear space provides access to the back-panel connectors and a free flow of cooling air.

You must have the following tools for installation:

- Narrow-blade screwdriver (2 mm wide)
- #2 Phillips screwdriver
- 1/4 in. open end wrench

Making the Back Panel Connections

Use the cables provided in the Accela system accessory kit to make the connections to the back panel of the detector. The part numbers for these cables are listed in Table 8 on page 103.

For instructions on connecting the PDA detector to line power, see "Turning On the Detector for the First Time" on page 24.

This section contains the following topics:

Connecting the Ethernet Cable

❖ **To connect the Ethernet communication cable**

- Connect the Ethernet switch to the Ethernet connector port of the PDA detector using the supplied CAT5, 7 ft. long, shielded Ethernet cable with ferrite clamp.
- Connect the Ethernet switch to the data system computer using the supplied CAT5, 7 ft. long, shielded Ethernet cable with ferrite clamp.

Connecting the System Interconnect Cable

The system interconnect cable coordinates the timing of the Accela modules during an injection sequence. There are two versions of this cable. The previous version of the cable, which you might have in your laboratory, contains five connectors labeled DET, M/S, A/S, LC PUMP, and MS PUMP. The new version of the interconnect cable, shown in Figure 8, contains three detector connectors labeled DETECTOR, two pump connectors labeled PUMP, an autosampler connector, and an MS detector connector.

❖ **To connect the system interconnect cable**

1. Plug one of the connectors labeled DETECTOR into the left, 8-pin receptacle labeled pins 1 through 8 on the back panel of the detector (see Figure 9).
2. Plug one of the connectors labeled PUMP into the 8-pin receptacle on the back panel of the Accela Pump.
3. Plug the autosampler connector (identified by the A/S tag on its adjacent cable) into the left, 8-pin receptacle on the back panel of the Accela Autosampler.

For information on connecting an MS detector, refer to the *Accela Getting Connected Guide*.

Figure 8. Seven-connector version of the system interconnect cable

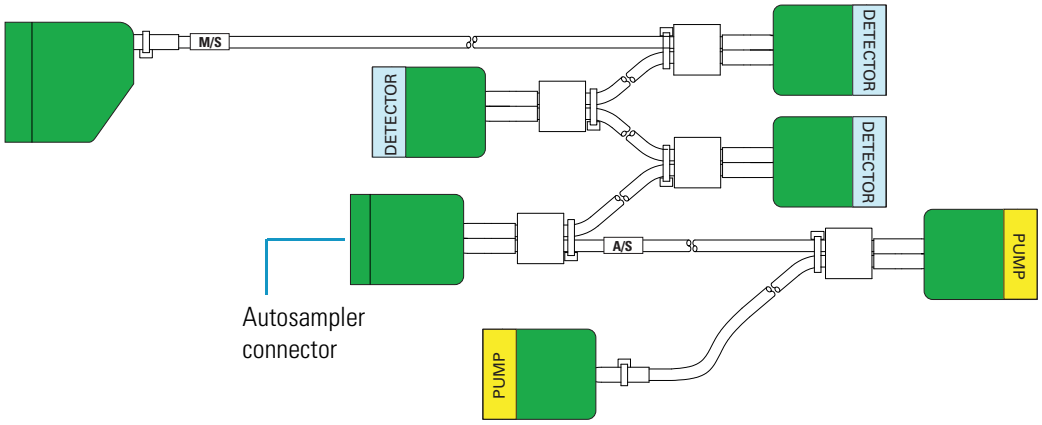
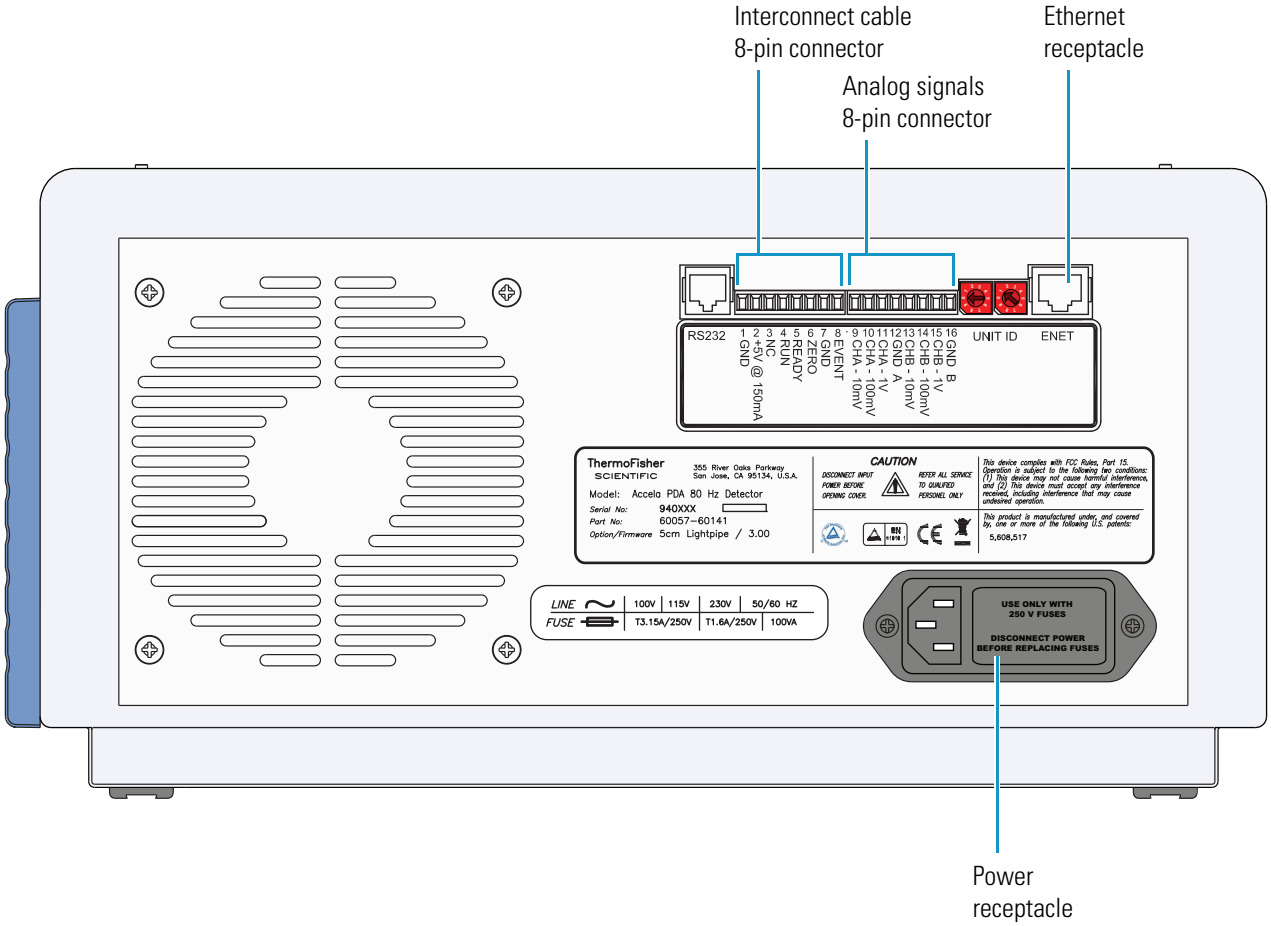


Figure 9. Back panel of Accela PDA Detector



Connecting the Analog Outputs

The installation kit provides two analog signal cables (twin-axial computer cables) to connect the analog outputs from the PDA detector to other data collection devices.

The analog signal cables have three wires protruding from the ends of the shielded cable. Two of these wires are electrically insulated and carry an analog signal to data collection devices. Typically, the wire with the clear insulation is connected to the positive analog output, and the wire with the black insulation is connected to the signal ground (sometimes referred to as the negative signal). The third wire is not insulated and grounds the cable shielding. The cable shielding reduces signal noise caused by radio frequency interference and is most effective if the bare wire is grounded at just one end.

The ends (1/4 in.) of the analog signal wires are stripped and soldered to allow electrical contact and to prevent fraying.

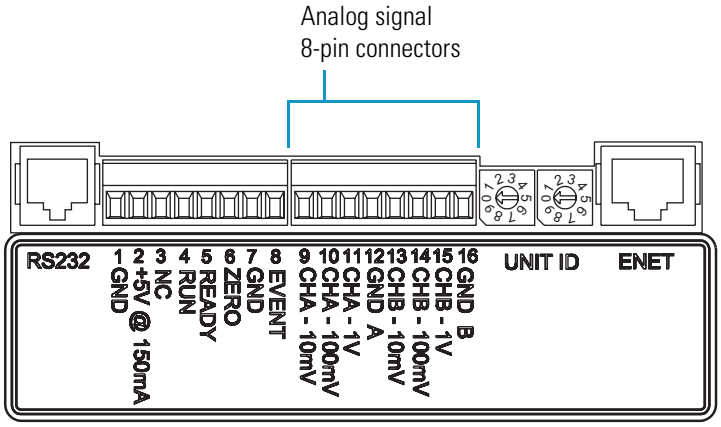
On the detector's back panel, there are two analog output channels with three different analog voltage outputs per channel: CHA – 10 mV, CHA – 100 mV, CHA – 1 V, CHB – 10 mV, CHB – 100 mV, CHB – 1 V; and a single ground per channel: GND A and GND B. Select the appropriate output voltage for your data collection system.

❖ To make each electrical connection

1. Insert the end of the wire into the appropriate terminal in the 8-pin terminal connector. Hold the wire in place while you tighten the small terminal set screw firmly onto the wire.
2. Insert the terminal connector into the 8-pin analog connector numbered 9 through 16 at the back of the instrument (see Figure 10).

IMPORTANT Do **not** connect the detector ground terminals to any earth ground on your data system computer. Doing so leads to an increased noise level and a subsequent decrease in sensitivity.

Figure 10. Analog signal connectors



Setting the Analog Output Voltage

You control the analog outputs from the data system by selecting the acquisition wavelengths, bandwidth, rise time, and zero functions of the detector. These outputs are compatible with data collection systems using any of the three different voltages (10 mV, 100 mV, or 1 V) by selecting the appropriate terminal of the analog output terminal connector (Figure 10).

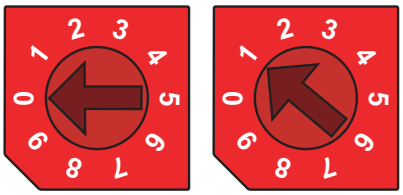
Setting the Unit ID

The Accela PDA Detector ships with the unit ID preset using the two rotary switches located on the back panel. Figure 11 shows the rotary switches preset to a value of 01. The range of values for the unit ID is 01 to 99. The value of 00 is reserved for special service functions.

The unit ID must correspond with the stack ID specified in the Instrument Configuration application. Do not change the unit ID setting for your detector unless you are controlling more than one PDA detector from one computer. For details on configuring your detector, see Chapter 3, "Configuration."

Use a small flathead screwdriver to change the setting of the rotary switches.

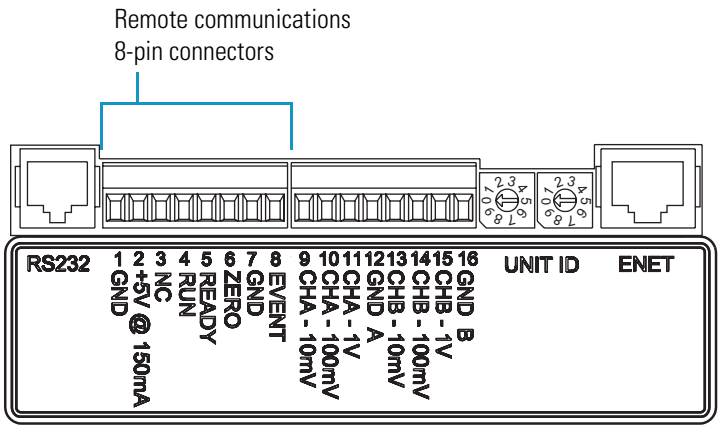
Figure 11. Unit ID rotary switches set to a value of 01



Making Remote Communications Connections

The Accela PDA Detector has the remote communications inputs RUN and ZERO, and the remote communications output EVENT (see Figure 12).

Figure 12. Remote communications signals



Tip When the Accela PDA Detector is part of an Accela LC system, connect the system interconnect cable to these terminals (see "Connecting the System Interconnect Cable" on page 12).

RUN

The RUN input receives an inject signal from the autosampler. The system interconnect cable connects the RUN input to the signal from the autosampler.

ZERO

Use the ZERO connection on the back panel of the detector to zero the detector signal output from a remote device (generally at the start or end of each sample run).

You can remotely zero the Accela PDA Detector with either a TTL low signal or with a contact closure.

The system interconnect cable connects the ZERO input to the signal from the autosampler.

EVENT

Use the EVENT output connection to trigger an external device such as a fraction collector. Set up the parameters for this signal in the instrument control method created in the Xcalibur or ChromQuest data system.

If you use a TTL signal to trigger the external device, connect the PDA EVENT terminal (pin 8) to the positive pin on the external device input, and connect one of the PDA GND terminals (either pin 1 or 7) to the external device negative pin. The Accela PDA Detector has open collector outputs that require a pull-up resistor (typically 10 kΩ) when connecting to TTL inputs.

Note The external device input terminal might not have markings indicating positive and negative polarity. In this case, connect the PDA EVENT terminal to one of the pins, and connect a PDA GND terminal to the other pin.

If you trigger the external device by contact closure, connect the PDA +5 V output (pin 2) to the positive input terminal of the external device, and connect the PDA EVENT output (pin 8) to the negative input terminal of the external device.

Installing the LightPipe Flowcell

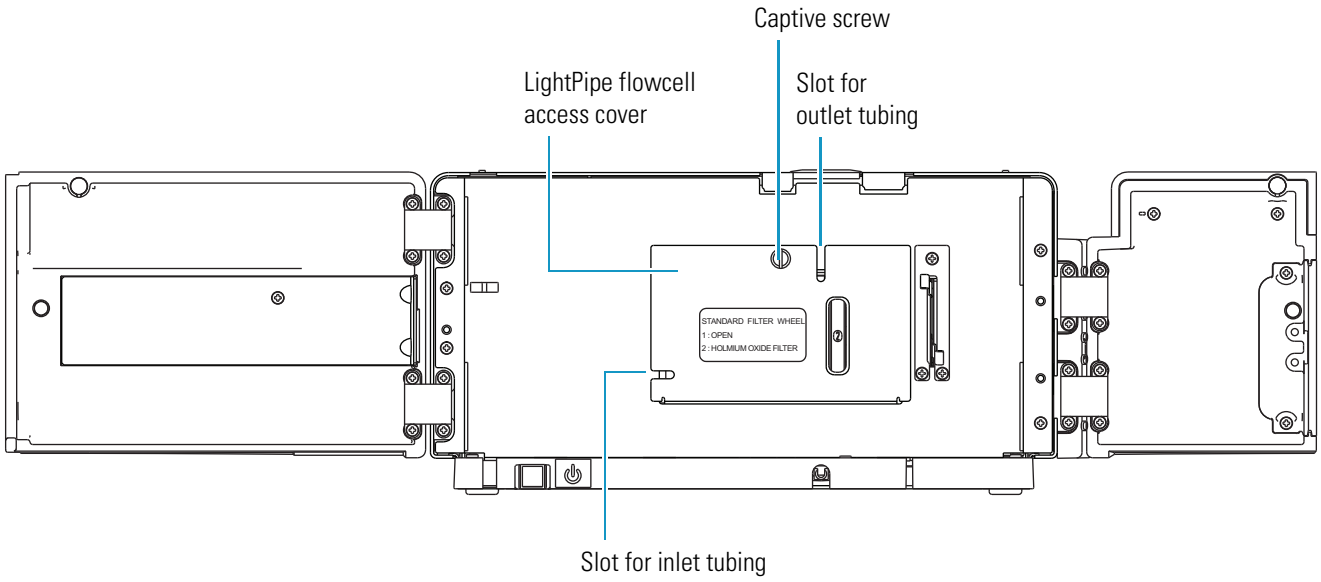
The LightPipe flowcell is packed in a small, separate box within the detector shipping carton. This small box contains the LightPipe flowcell (with a protective cap on each end) and a plastic bag containing the inlet and outlet tubing and fingertight fittings. The part numbers for these items are listed in Table 6 on page 103.

CAUTION Use only PEEK fittings to connect tubing to the flowcell. The appropriate PEEK fittings are included in the LightPipe Flowcell Accessory Kit.

❖ To install the LightPipe flowcell

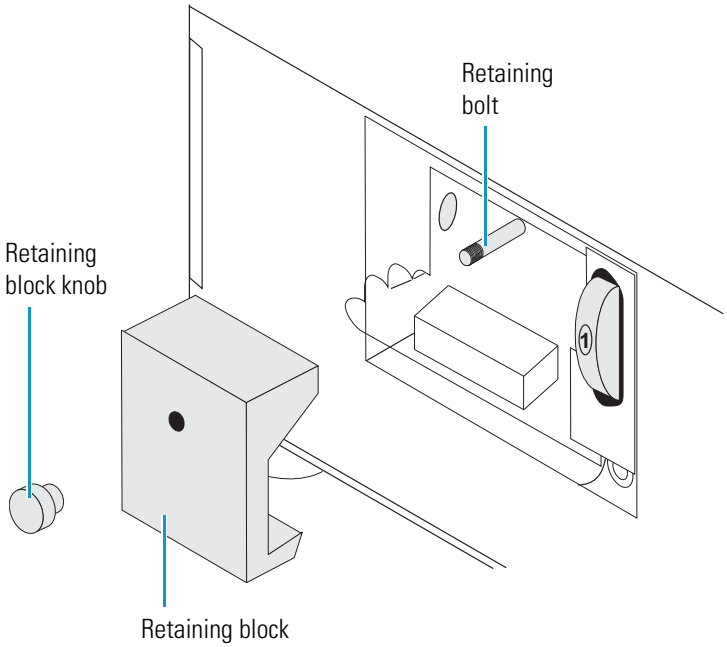
1. Open the front doors of the detector.
2. Unscrew the captive screw that secures the LightPipe flowcell access cover to the front panel of the detector and pull the cover off (see Figure 13).

Figure 13. Lightpipe flowcell access cover



3. Unscrew the retaining block knob and remove the retaining block (see Figure 14).

Figure 14. View of the retaining block and the retaining block knob



4. Remove the protective end caps from the ends of the LightPipe flowcell.
5. Connect the inlet port of the LightPipe flowcell:
   a. Use the PEEK fitting included with the LightPipe Flowcell Kit to connect one end of the red 0.005 in. ID, insulated inlet tubing to the flowcell inlet port. Slide the protective insulating sleeve of the tubing as close as possible to the inlet port of the LightPipe flowcell.

   Note The insulating sleeve of the inlet tubing minimizes temperature fluctuations, which cause baseline drift.

   b. Connect the other end of the tubing to the LC column outlet.
6. Connect the outlet port of the LightPipe flowcell:
   - If you are not connecting to an MS detector, use a PEEK fitting to connect the blue 0.010 in. ID, outlet tubing to the LightPipe flowcell outlet. Place the other end of the outlet tubing into the waste reservoir. When you use an optional backpressure regulator (see Table 7 on page 103), connect the outlet line to the low-pressure union and waste tubing.
   - If you are connecting the LightPipe flowcell outlet to an MS detector, use the PEEK fittings to connect one end of the red 0.005 in. ID, PEEK tubing (included in the MS detector accessory kit) to the outlet port of the LightPipe flowcell and to connect the other end of the tubing to the inlet port of the MS detector.

IMPORTANT If you have several detectors (fluorescence, refractive index, electrochemical, and so on) hooked up in a series, place your Accela PDA Detector closest to the column outlet. The LightPipe flowcell in the Accela PDA Detector can withstand the greatest backpressure.

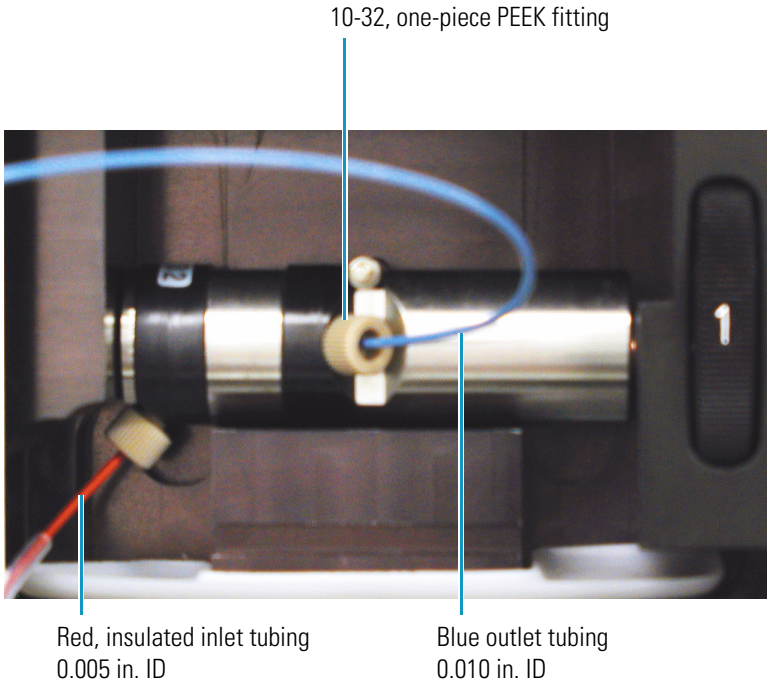
Tip For best results, when you run the system at a low backpressure, use a backpressure regulator to prevent bubble formation in the PDA detector's LightPipe flowcell.

7. Position the slot located on the top of the LightPipe flowcell under the retaining bolt in the detector, and then slide the LightPipe flowcell into place.

   The location of the outlet fitting depends on the size of the LightPipe flowcell:

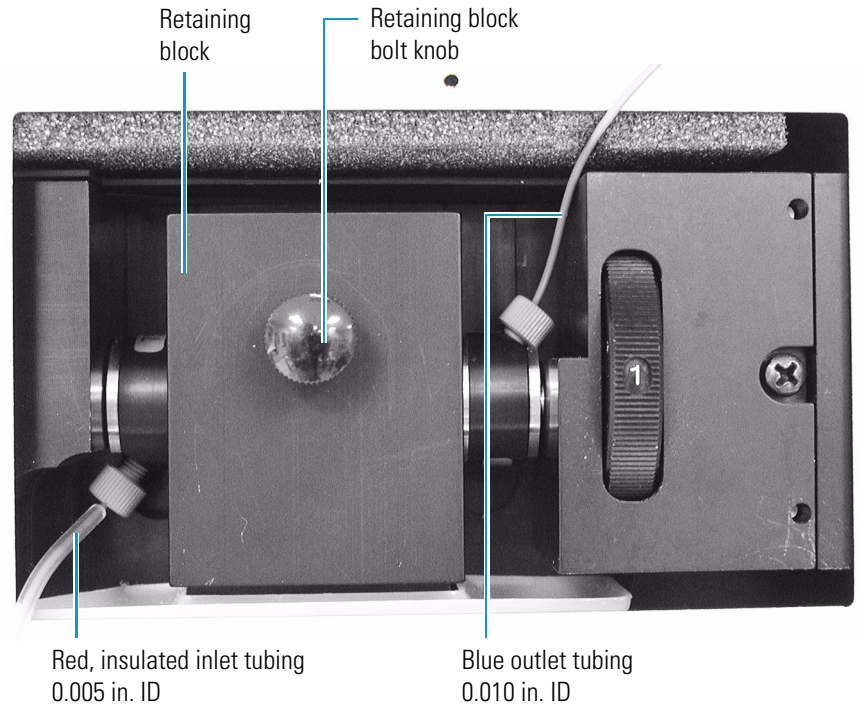
   - Place the 10 mm LightPipe flowcell so that the inlet fitting is on the bottom-left side, and the outlet fitting is on the front side (see Figure 15).
   - Place the 50 mm LightPipe flowcell so that the inlet fitting is on the bottom-left side and the outlet fitting on the top-right side (see Figure 16).

Figure 15. Location of the inlet and outlet tubing for the 10 mm LightPipe flowcell



8. Replace the LightPipe flowcell retaining block.
9. Reinstall and hand tighten the retaining block bolt knob (see Figure 16).

Figure 16. Inlet and outlet tubing connections for the 50 mm LightPipe flowcell



10. Replace the flowcell access cover, ensuring that the inlet and outlet tubing pass through the slots (see Figure 13 on page 17) without being pinched. Tighten the captive screw to secure the flowcell access cover to the detector.

11. Close the front doors of the detector.

Connecting the Remote Outputs

The Accela PDA Detector has two remote outputs: READY and EVENT (see Figure 10 on page 14). The outputs are open collectors and are each capable of sinking < 30 mA at 30 V dc, suitable for connecting to TTL and other families of ICs. In addition, there is a 5 V output that supplies +5 V dc at 150 mA maximum that you can use for testing digital input signals. When connecting to TTL inputs, a pull-up resistor (typically 10 kΩ) is required across the +5 V output and the open collector input connection if one is not built into the external device.

The polarity settings (active high or active low) of these outputs must match those of the inputs of connecting equipment.

Setting the Remote Output Polarities from the Xcalibur Data System

❖ **To set the polarity of the remote outputs**

1. Install the Xcalibur data system if you have not already done so.
2. Add the Accela PDA Detector to the configuration for your instrument. See Chapter 3, "Configuration."
3. Start the Xcalibur data system.
4. In the Xcalibur Roadmap view, click the **Instrument Setup** icon.

   The Instrument Setup window appears.

5. In the view bar, click the **Accela PDA** button.

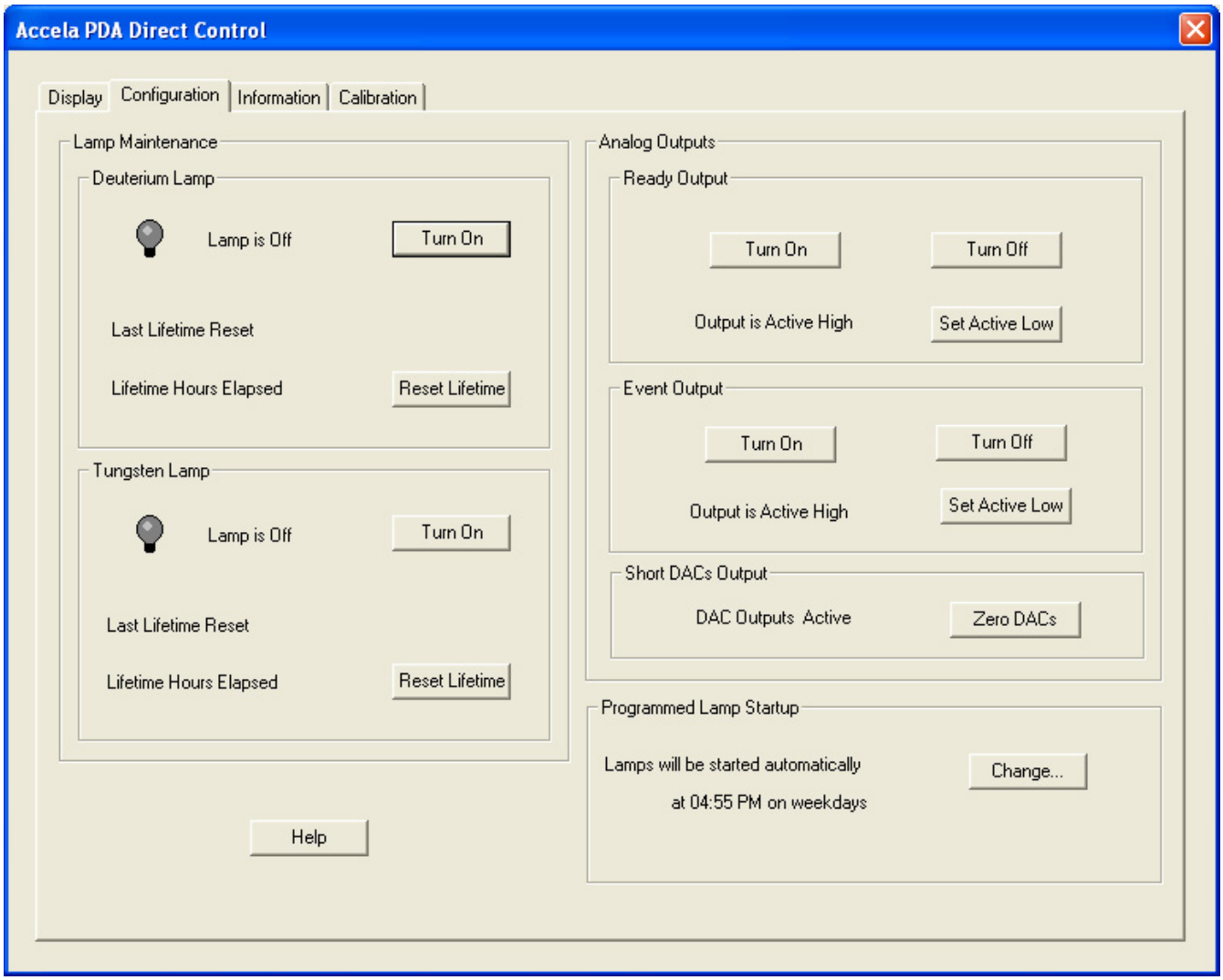
   The Instrument Setup view for the Accela PDA Detector appears.
6. On the menu bar, choose **Accela PDA > Direct Control**.

   The Accela PDA Direct Control dialog box appears.

   Note The Accela Autosampler requires low active remote inputs.
7. Click the **Configuration** tab.

   The Configuration page appears (see Figure 17).

Figure 17. Configuration page of the Accela PDA Direct Control dialog box (Xcalibur data system)



8. In the Analog Outputs area of the Configuration page, check the current settings of the outputs.
9. Change the settings to match the connecting equipment if necessary.
10. Close the data system and turn off the detector to make any necessary remote communication connections.

Changing the Remote Output Polarities from the ChromQuest Data System

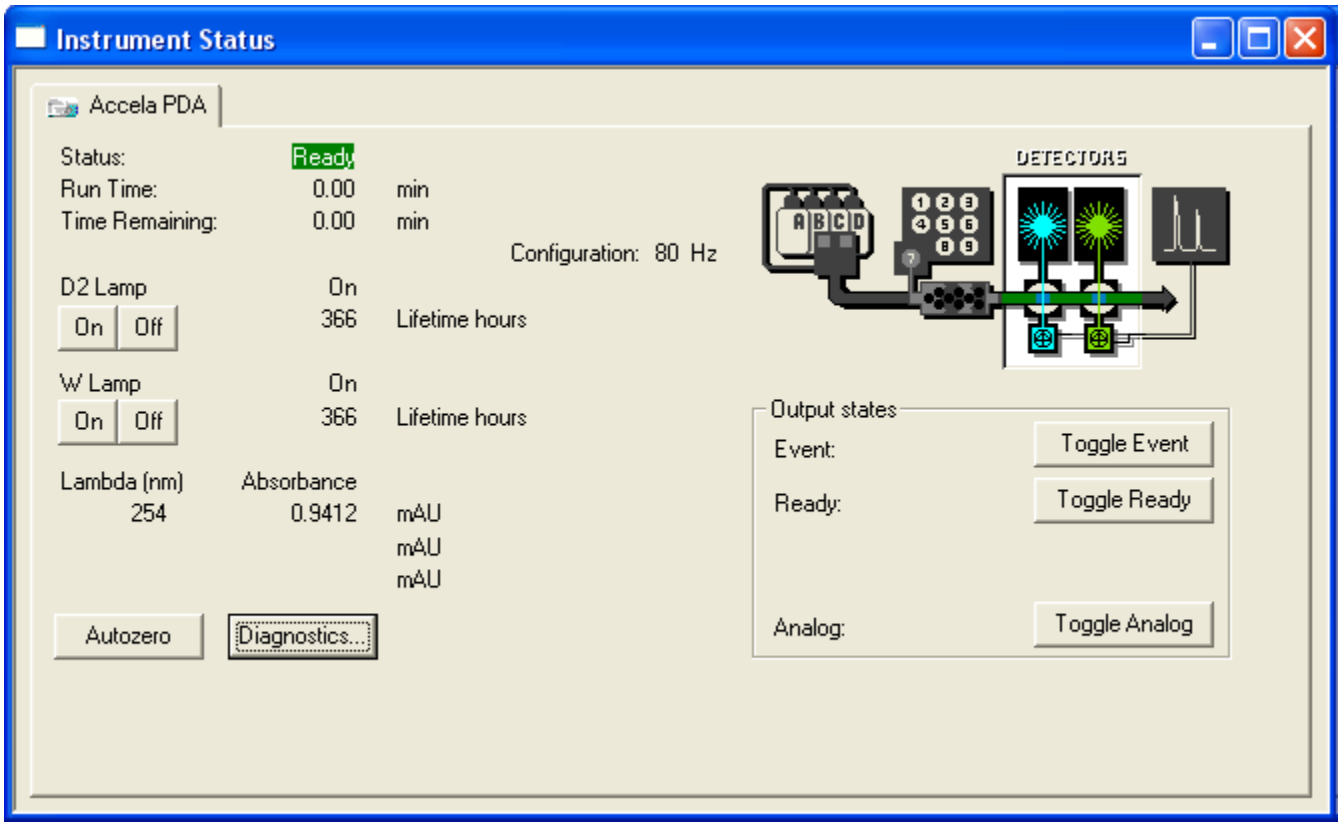
❖ **To change the polarity of the remote outputs**

1. Install the ChromQuest data system if you have not already done so.
2. Add the Accela PDA Detector to the instrument configuration (see "ChromQuest Data System Instrument Configuration" on page 30).
3. Open the Instrument window.
4. Choose **Control > Instrument Status**.

   The Instrument Status window appears.
5. Click the **Accela PDA** tab.

   The Accela PDA page of the Instrument Status window appears (see Figure 18).

Figure 18. Accela PDA page of the Instrument Status window (ChromQuest data system)



6. In the Output States area, click the appropriate button.

Turning On the Detector for the First Time

❖ **To turn on the detector for the first time**

1. Place the power switch at the front of the unit in the Off position (released or out position).
2. Ensure that the PDA detector is properly connected to the data system computer.
3. Ensure that the data system lists the appropriate configuration settings for the PDA detector.

   For information on instrument configuration, see Chapter 3, "Configuration."
4. Check the fuse size (see "Replacing the Fuses" on page 95).

   You can operate the PDA detector at 100/115V or 230V. However, you must ensure that the appropriate fuses are installed (see Figure 19 and Table 2).

   Figure 19. View of the power supply module and the power line label

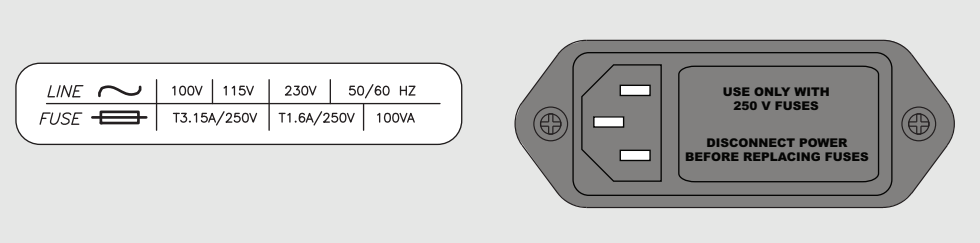


Table 2. Fuses

Line power voltage	Fuse size
100/115V	T3.15 A
230V	T1.6 A

5. Attach the power cord to the power entry module on the back panel of the PDA detector and connect it to the power source.
6. Turn the power on by pushing the power button in to engage it.

   The Power LED turns amber as it downloads the operational file, and then turns solid green. If it does not light at all, see Chapter 7, "Troubleshooting."

Completing the Installation and Verifying Operation

The Accela PDA Detector is calibrated at the factory. During installation, a Thermo Fisher Scientific field service engineer adjusts the light throughput and recalibrates the detector.

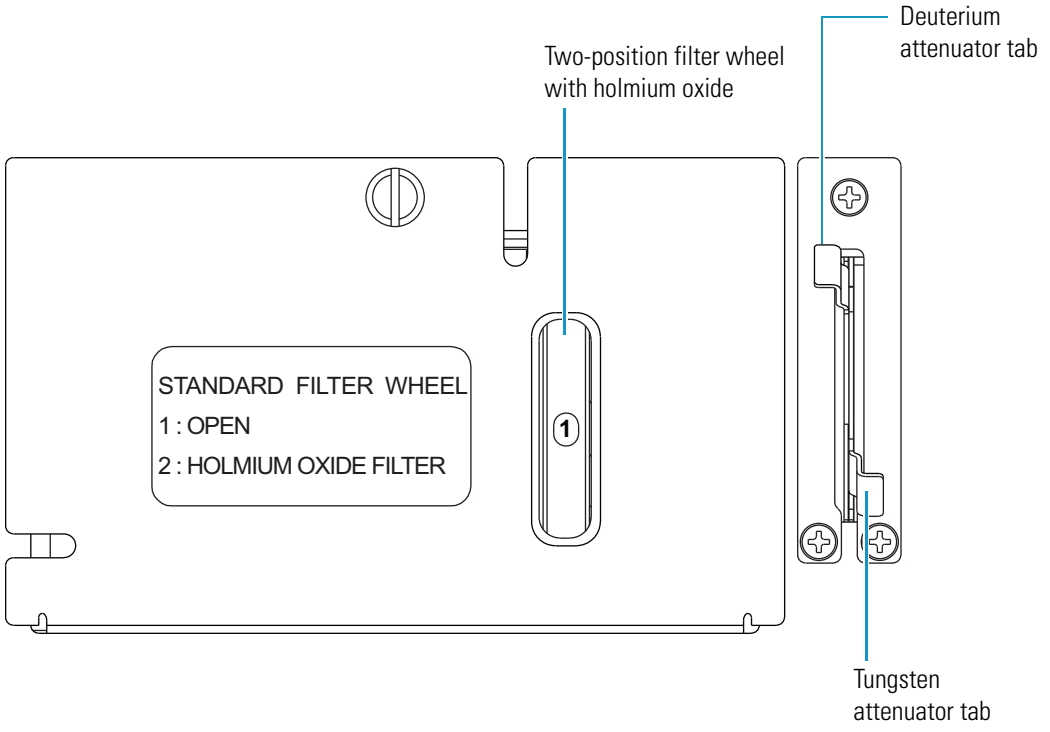
The PDA detector uses the holmium oxide spectrum to verify its wavelength accuracy. A two-position filter wheel (see Figure 20) that is accessible from the front panel of the PDA detector contains this calibration solution.

For optimal performance, recalibrate the PDA detector and adjust its attenuators as part of a routine maintenance program and whenever you move the instrument, replace the LightPipe flowcell, or replace a lamp.

Because the deuterium lamp emits less light with use, monitor the integrated light intensity of the diodes as part of a routine maintenance program, and adjust the attenuators when you notice an increase in baseline noise. Because the diode array scan rate affects the integrated light intensity, you must also adjust the attenuators when you modify the PDA detector's configuration by changing the diode array scan rate (see Chapter 3, "Configuration," on page 9).

The tabs that control the position of the attenuators are located on the front panel of the PDA detector (see Figure 20). To adjust the light throughput, you push the attenuator tabs up or down as you view the light intensity from your data system. Pushing the left tab up or down controls the light throughput from the deuterium (D2) lamp. Pushing the right tab up or down controls the light throughput from the tungsten-halogen (W) lamp.

Figure 20. Attenuator tabs and filter wheel



For information on calibrating your PDA detector and adjusting the light throughput to the diode array, see the chapter for your data system:

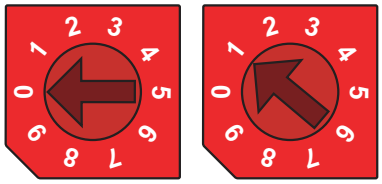
- For the ChromQuest data system, see Chapter 5, "ChromQuest Diagnostics for the PDA Detector."
- For the Xcalibur data system, see Chapter 4, "Xcalibur Diagnostics for the PDA Detector."

Configuration

The only manual controls on the Accela PDA Detector are the On/Off switch below the left-front door of the unit and the manual attenuators and holmium oxide wheel that you access from the front panel; otherwise the chromatography data systems controls all other instrument control functions.

To control the detector, you must add it to the instrument configuration for your data system and specify its stack ID and diode array scan rate. You set the unit ID is set by adjusting the two rotary switches on the back panel of the detector. The switches are set to 01 at the factory (see Figure 21). Do not adjust the switches unless you are controlling more than one Accela PDA Detector from the same data system computer.

Figure 21. Unit ID set to 01



The diode array scan rate is the unfiltered rate at which the PDA detector samples the light intensities for the diode array. You can set the Accela PDA Detector (80 Hz version) to scan the array at a 20, 40, or 80 Hz sampling rate.

Contents

Thermo Foundation Instrument Configuration

To control the PDA detector from the Xcalibur data system, add it to the configured devices list in Thermo Foundation, and then specify its stack number and diode array scan rate.

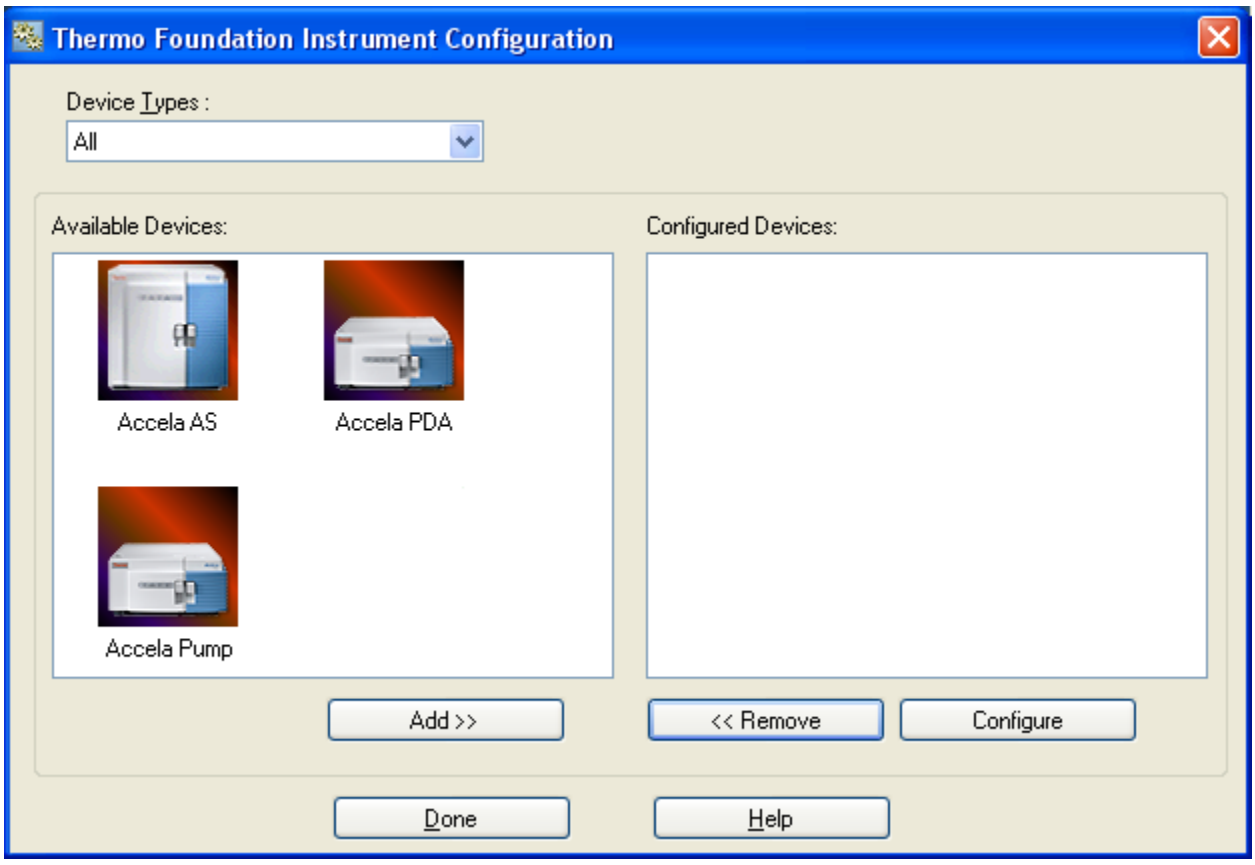
❖ **To configure your instrument in Thermo Foundation**

1. Open the Instrument Configuration application.

   For Xcalibur 2.1 or higher, from the computer desktop, choose **Start > All Programs > Thermo Foundation 1.0 > Instrument Configuration**.

   The Thermo Foundation Instrument Configuration window appears (see Figure 22).

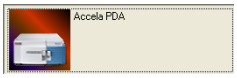
Figure 22. Thermo Foundation Instrument Configuration window



2. In the Available Devices list, double-click each of your Accela devices.

   As you double-click a device in the Available Devices list, it appears in the list of configured devices.

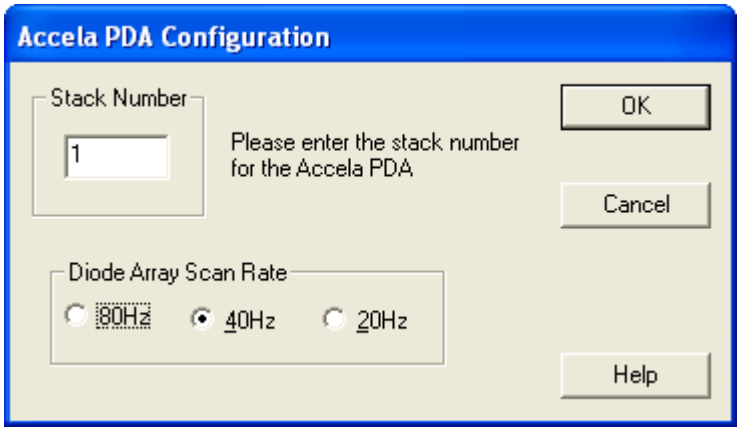
3. Complete the configuration of the Accela PDA Detector as follows:



a. Double-click the **Accela PDA** button.

The Accela PDA Configuration dialog box appears (see Figure 23).

Figure 23. Accela PDA Configuration dialog box (Thermo Foundation)



b. In the Stack Number box, type the number that the unit ID rotary switches are set to on the back panel of the detector.

c. In the Diode Array Scan Rate area, select the appropriate diode array scan rate for your application.

The appropriate diode array scan rate depends on the baseline width (W_b) of your application's chromatographic peaks:

Baseline peak width (seconds)	Diode array scan rate (Hz)
$W_b \leq 0.5$	80
$0.5 < W_b < 1$	40
$1 \leq W_b < 2$	20

IMPORTANT When you change the diode array scan rate, you must adjust the light throughput to the diode array (see "Adjusting the Light Throughput with the Xcalibur Data System" on page 42).

d. Click **OK** to close the Accela PDA Configuration dialog box.

4. Complete the configuration of the other system devices, such as the pump and autosampler.

5. Click **Done** to close the Instrument Configuration dialog box.

ChromQuest Data System Instrument Configuration

To control the PDA detector from the ChromQuest data system, add it to the instrument configuration for the Accela LC system.

❖ To configure your instrument in the ChromQuest data system

1. Do one of the following:
   - For ChromQuest SI, choose **Start > All Programs > Chromatography > ChromQuest SI Config**. In the ChromQuest SI Configuration dialog box, click **Instrument Configuration**. The Instrument Configuration dialog box appears (Figure 24). Go to step 5.
   - For ChromQuest, go to step 2.
2. If you have not already done so, create an instrument for your Accela LC stack:

   a. Double-click the ChromQuest icon on the Windows XP desktop. Or, choose **Start > All Programs > Chromatography > ChromQuest**.

      The Main Menu window appears.

   b. In the Main Menu window, right-click **The Enterprise**.

      A shortcut menu appears.

   c. Choose **New > Instrument**.

      A new instrument icon appears in the right pane of the Main Menu window.

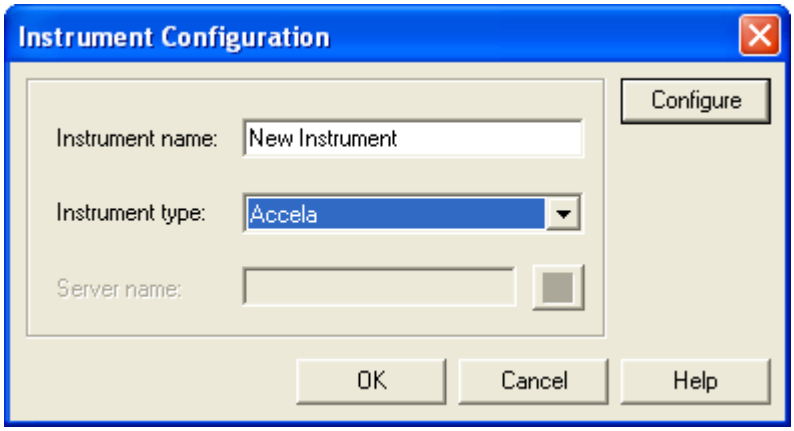
3. In the Main Menu window, right-click the icon that represents your Accela LC stack.

   A shortcut menu appears.

4. Choose **Configure > Instrument**.

   The Instrument Configuration dialog box appears (see Figure 24).

Figure 24. Instrument Configuration dialog box



5. Type a name for your instrument in the Instrument name box.

6. Depending on the current configuration of the instrument, do one of the following:
   - If you are adding the Accela PDA Detector to a current configuration for your Accela LC stack, leave the selection in the Instrument type list as Accela.
   - If you want to erase the configuration for a previously configured Accela LC stack, select **Accela** in the Instrument type list and click **OK** in the message dialog box that appears.
   - If you want to change the instrument type to Accela, select **Accela** in the Instrument type list and click **OK** in the message dialog box that appears.
7. Click **Configure**.

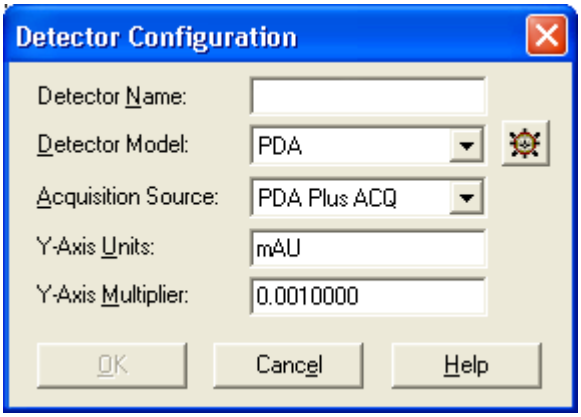
   The Accela dialog box appears.
8. In the Available modules pane, double-click the **Detector** button.

   The Analog icon appears in the Configured modules pane.

9. To add the PDA detector to the instrument configuration:
   a. Double-click the **Analog** button.

      The Detector Configuration dialog box appears (see Figure 25).

      Figure 25. Detector Configuration dialog box

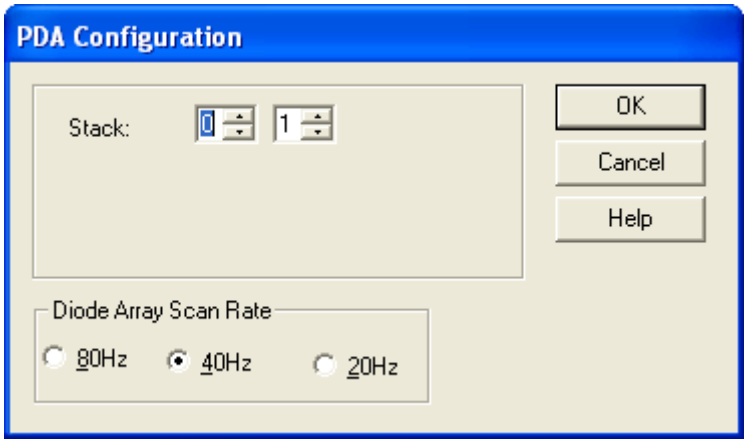


   b. In the Detector Name box, type a name to identify the Accela PDA Detector.

      When you open the Instrument window, this name appears in the Analysis Channel list.
   c. In the Detector Model list, select **PDA**.
   d. In the Acquisition Source list, select **PDA Plus ACQ**.
   e. Leave the Y-Axis units set to the default of mAU and the Y-Axis Multiplier set to the default of 0.001.
   f. Click  .

      The Accela PDA Configuration dialog box appears (see Figure 26).

Figure 26. Accela PDA Configuration dialog box (ChromQuest data system)



g. In the Stack boxes, type or select the stack address.

   Unless you are controlling more than one Accela PDA Detector from the same data system computer, leave the value set to the default of **01**.

   The stack address must match the unit ID setting for the two rotary switches (see Figure 21 on page 27) on the back panel of the PDA detector.

h. In the Diode Array Scan Rate area, select the appropriate scan rate for your application.

   The appropriate diode array scan rate depends on the baseline width (W_b) of your application's chromatographic peaks:

Baseline peak width (seconds)	Diode array scan rate (Hz)
$W_b \leq 0.5$	80
$0.5 < W_b < 1$	40
$1 \leq W_b < 2$	20

IMPORTANT When you change the diode array scan rate, you must adjust the light throughput to the diode array (see "Adjusting the Light Throughput with the ChromQuest Data System" on page 69).

10. Click **OK** to accept the settings and close the Accela PDA Configuration dialog box.
11. Click **OK** to close the Detector Configuration dialog box.
12. If you have not already done so, configure the remaining modules of your Accela LC stack.
13. Click **OK** to close the Accela dialog box.
14. Click **OK** to close the Instrument Configuration dialog box and return to the Main Menu window.

Xcalibur Diagnostics for the PDA Detector

This chapter describes how to use the diagnostics to check the operation of the PDA detector, calibrate the detector, and view the event log.

To perform diagnostics from the Xcalibur data system, ensure that your detector is connected to the data system computer, configured as part of an instrument in the data system, and turned on. For information on adding the PDA detector to the Xcalibur instrument configuration, see "Thermo Foundation Instrument Configuration" on page 28.

If you move the PDA detector, replace lamps, install a new flowcell, or change the configured diode array scan rate for the detector, the system performance can change. With use, the deuterium lamp produces less and less light so that the system performance changes as the lamp's lifetime hours increase.

To verify the proper operation of the PDA detector, follow these procedures:

1. "Monitoring Lamp Performance from the Xcalibur Data System" on page 38
2. "Adjusting the Light Throughput with the Xcalibur Data System" on page 42
3. "Calibrating the PDA Detector from the Xcalibur Data System" on page 44

IMPORTANT Before calibrating the PDA detector, make sure that the diode array is not saturated.

Contents

Opening the Accela PDA Direct Control Dialog Box

Use the Accela PDA Direct Control dialog box to control the lamps, perform diagnostics, and calibrate the PDA detector.

❖ **To open the Accela PDA Direct Control dialog box**

1. On the Thermo Xcalibur Roadmap view, click the **Instrument Setup** button.

   The Instrument Setup view appears.

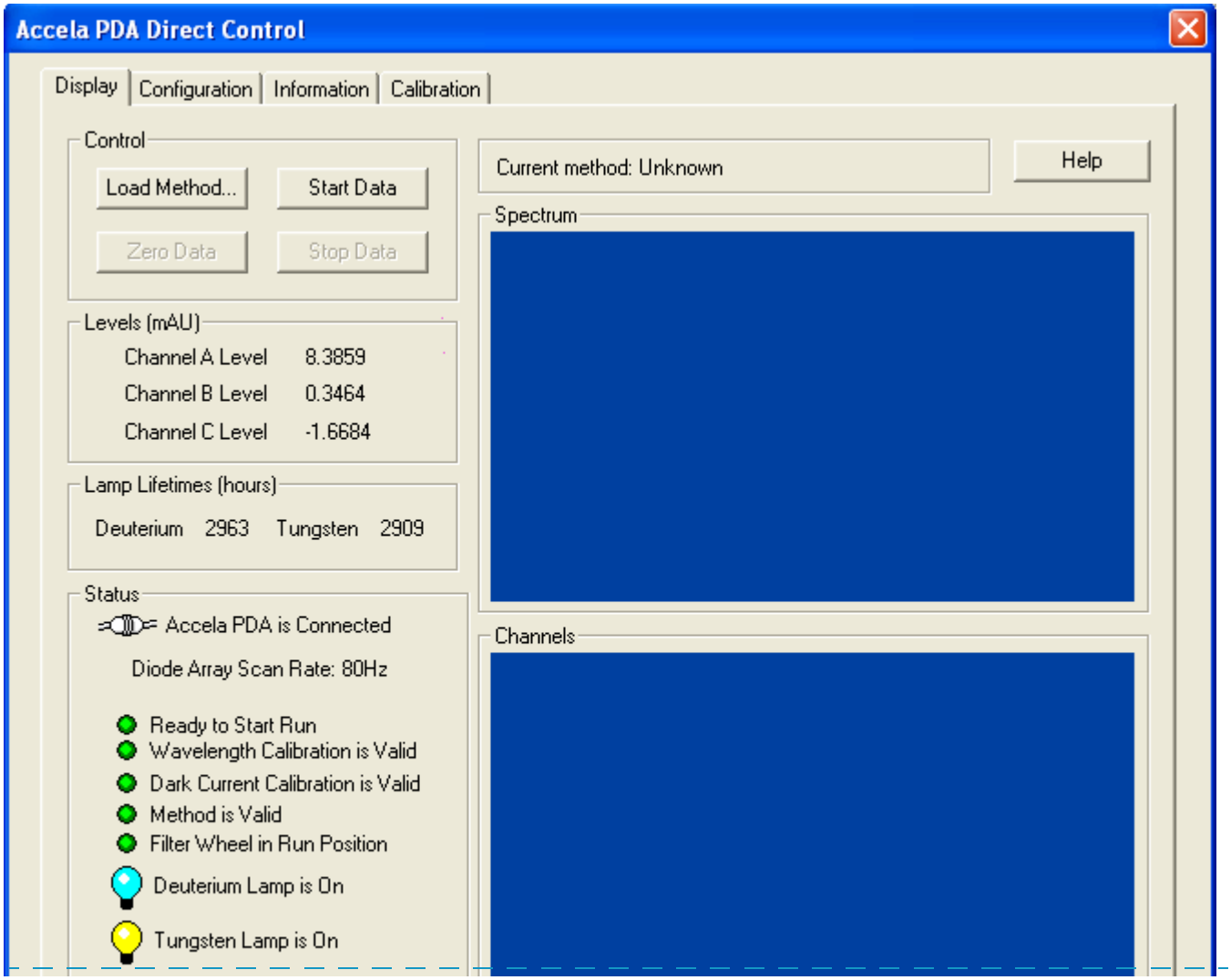
2. In the view bar, click the **Accela PDA** button.

   The Accela PDA Instrument Setup view appears.

3. From the menu bar, choose **Accela PDA > Direct Control**.

   The Accela PDA Direct Control dialog box appears (see Figure 27).

Figure 27. Accela PDA Direct Control dialog box



Controlling the Lamps from the Xcalibur Data System

As lamps age, they emit less light, which results in increased baseline noise. If the noise level on your detector signal is unacceptable, and cleaning the LightPipe flowcell does not help, use the diagnostic features of the software to determine the cause of the problem. If light output becomes too low and adjusting the attenuators as described in "Adjusting the Light Throughput with the Xcalibur Data System" on page 42 does not help, replace the lamps.

The detector keeps track of the number of hours each lamp has been operating. The deuterium lamp has a lifetime of approximately 2000 hours and the tungsten lamp has a lifetime of approximately 2500 hours. Lamp lifetime varies depending on the application (see "Lamp Lifetime and Detector Noise" on page 5).

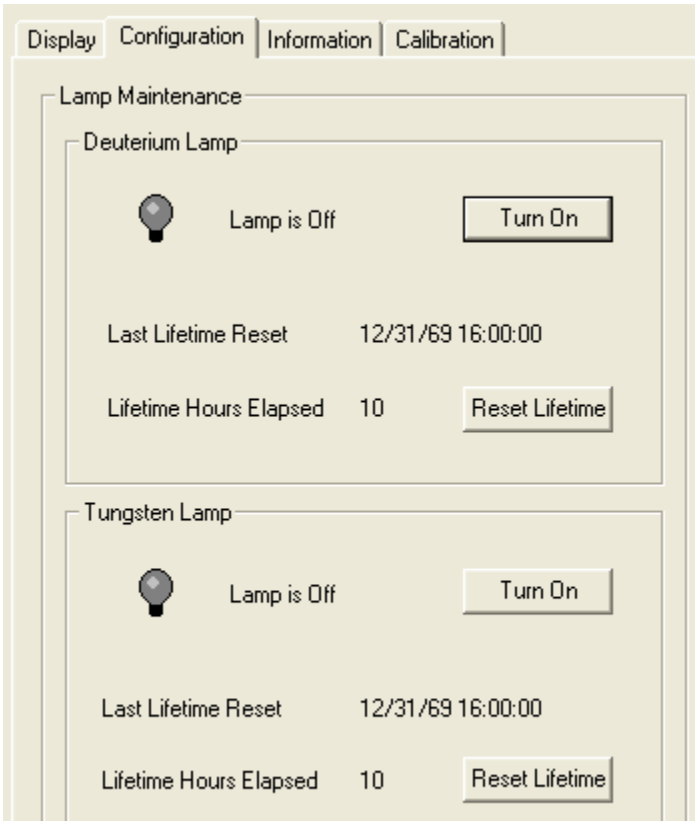
Turning On the Lamps

❖ To turn on the lamps

1. Open the Accela PDA Direct Control dialog box (see "Opening the Accela PDA Direct Control Dialog Box" on page 34).
2. Click the **Configuration** tab.

   The Configuration page appears (see Figure 28).

Figure 28. Configuration page of the Accela PDA Direct Control dialog box



3. Click **Turn On** for the associated lamp.

   When you turn on the deuterium lamp, its Status readback reads *Starting* during the 30-second ignition period, and then it changes to *On*. If there is a problem with either lamp, its Status readback reads *Failed*.

   Note The intensity of the deuterium lamp falls off very slightly over a period of time after the lamp is turned on. Plan to wait at least one hour for the lamp to stabilize after a cold start before collecting data in the spectral range of the deuterium lamp.

Resetting the Lamp Lifetime

❖ **To reset the displayed lamp lifetime**

1. Open the Accela PDA Direct Control dialog box (see "Opening the Accela PDA Direct Control Dialog Box" on page 34).
2. Click the **Configuration** tab.

   The Configuration page appears (see Figure 28 on page 35).
3. Click **Reset Lifetime** for the associated lamp.

   The stored total run time for the associated lamp resets to zero, and the Last Lifetime Reset readback is updated to the current date and time.

   Note Avoid indiscriminately clicking the Reset buttons. Click Reset only after you replace the associated lamp with a new one.

Setting the Startup Time for the Lamps

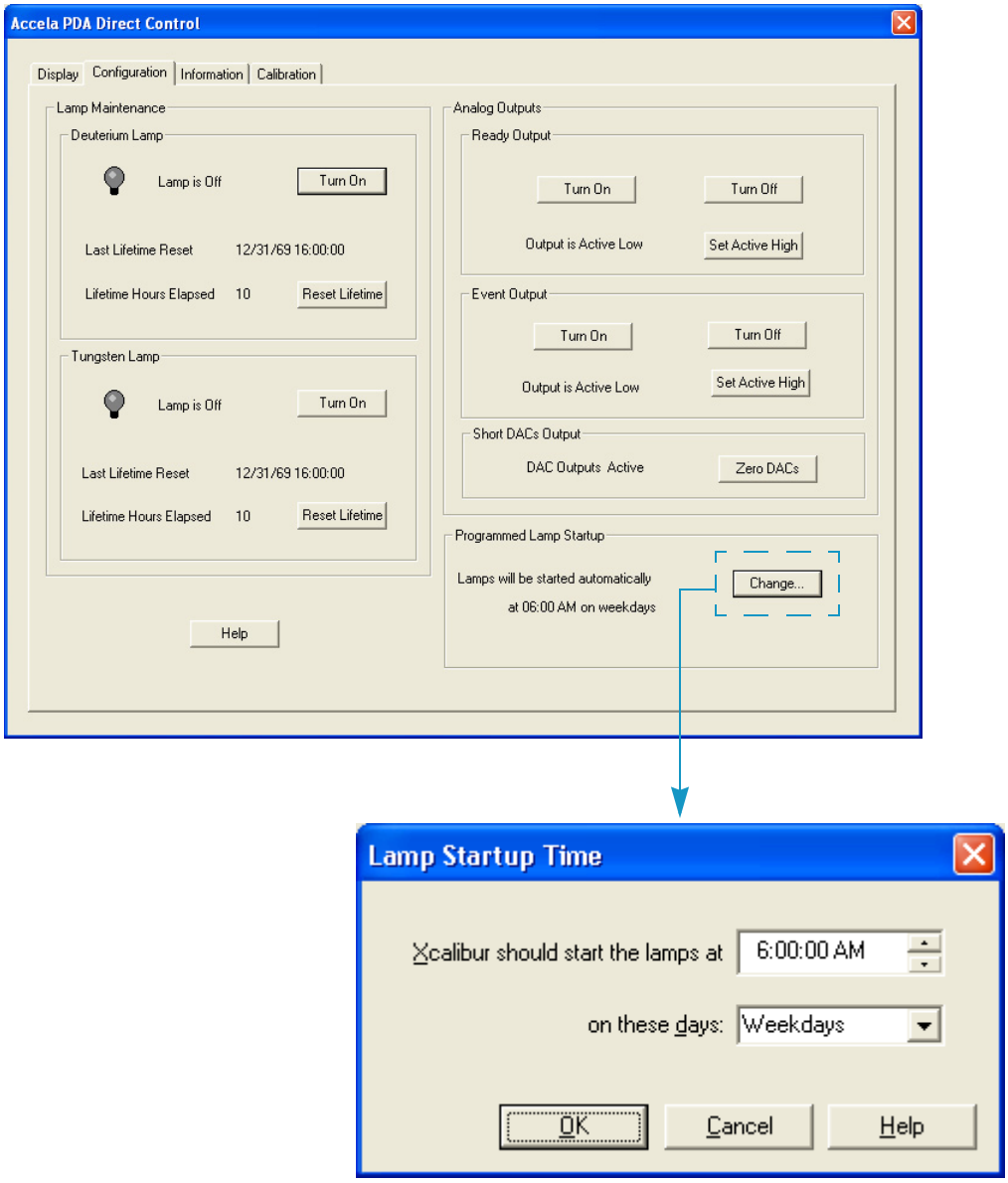
❖ **To set the startup time for the lamps**

1. Open the Accela PDA Direct Control dialog box (see "Opening the Accela PDA Direct Control Dialog Box" on page 34).
2. Click the **Configuration** tab.

   The Configuration page appears (see Figure 28 on page 35).
3. In the Programmed Lamp Startup area of the Configuration page, click **Change**.

The Lamp Start Up Time dialog box appears (see Figure 29).

Figure 29. Lamp Startup Time dialog box



4. To change the time, click in the **Xcalibur should start the lamps at** box. Then use the keyboard arrow keys, the number keys, or both to change the time.

> **Tip** If you inadvertently click the **Xcalibur should start the lamps at** box more than once to make a new entry, close the dialog box, and then reopen it. This time take care to use only the keyboard arrow keys and number keys to enter a time value.

5. Click **OK** to apply the new lamp startup time.

Use the Programmed Start option to pre-warm the lamps before starting a sequence of sample analyses.

Monitoring Lamp Performance from the Xcalibur Data System

With use, the deuterium lamp emits less and less light. To monitor the performance of the PDA detector's lamps, follow these procedures:

1. "Preparing the PDA Detector to Monitor Lamp Performance," on this page
2. "Creating a Display Method to View Light Intensity," on this page
3. "Viewing an Intensity Scan" on page 40

Preparing the PDA Detector to Monitor Lamp Performance

❖ **To prepare the PDA detector to monitor lamp performance**

1. Open the Accela PDA Direct Control dialog box (see "Opening the Accela PDA Direct Control Dialog Box" on page 34).
2. Make sure that the lamps are on and equilibrated:
   a. Click the **Configuration** tab.

      The Configuration page appears (see Figure 28 on page 35).
   b. Check the status and usage of each lamp.
   c. If they are not already on, turn on both the deuterium (D2) and tungsten (W) lamps.
   d. Wait one hour for both lamps to equilibrate.

Creating a Display Method to View Light Intensity

To adjust the attenuators and monitor the status of the lamps, create a display method. You cannot use a display method to acquire sample data.

Intensity display methods have a .spda file extension. The data system's auditing feature does not track the creation and modification of intensity display methods.

❖ **To create a display method**

1. Open the Accela PDA Method page:
   a. In the Xcalibur Roadmap view, click the **Instrument Setup** button.

      The Instrument Setup view appears.

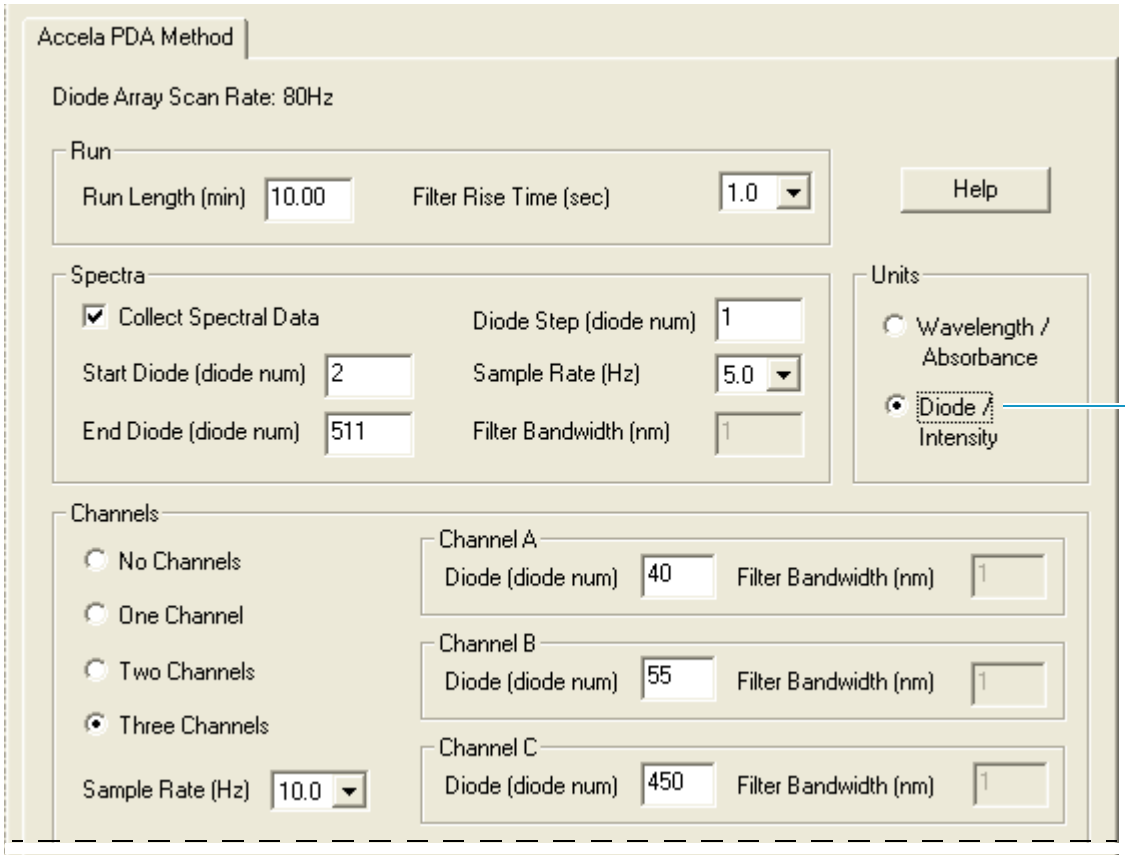
   b. In the view bar, click the **Accela PDA** button.

      The Accela PDA Instrument Setup view appears with the Accela PDA Method page displayed.

2. Specify the appropriate parameters as follows:

   a. To set the X-axis of the spectrum on the Display page to diode numbers, in the Units area, select the **Diode/Intensity** option (see Figure 30).

Figure 30. Accela PDA Method page with the selection of the Diodes/Intensity option



   b. To make the scan parameters available, select the **Collect Spectral Data** check box.

      The default settings for the Diode/Intensity option appear. Use these settings to view the light intensity counts for the entire diode array.

      Start Diode = 2

      End Diode = 511

      Diode Step = 1

   c. To make all three Channels boxes available, in the Channels area, select the **Three Channels** option.

   d. In the Channels boxes, type the numbers for the diodes that you want to monitor.

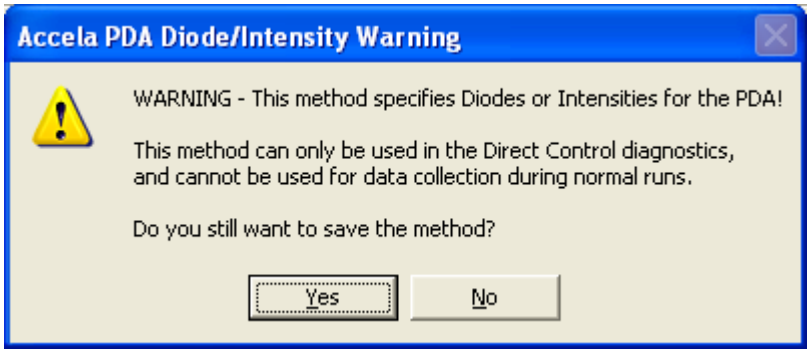
> **Note** The Run Length, Filter Rise Time, and Sample Rate parameters are not applicable for a display method.

3. Save the display method as follows:

   a. In the menu bar, choose **Accela PDA > Direct Control**.

   Figure 31 shows the warning message that appears.

   Figure 31. Accela PDA Diode/Intensity Warning dialog box



   b. In the Accela PDA Diode/Intensity Warning dialog box, click **Yes**.

   The Save Accela PDA Display Method dialog box appears.

   c. In the File name box, type a file name.

   d. Click **Save**.

   The data system saves the file with an .spda file extension.

> **Note** The .spda file extension is a special file extension used for all method files based on Diode/Intensity units. These methods cannot be used in the Sequence Setup portion of Xcalibur. You can only load files with the .spda extension in the Direct Control dialog box. They are not tracked by the data system's auditing feature.

Viewing an Intensity Scan

❖ To view an intensity scan

1. From the menu bar of the Accela PDA view in the Instrument Setup window, choose **Accela PDA > Direct Control**.

   The Accela PDA Direct Control dialog box appears.

2. Click the **Display** tab.

   The Display page appears (see Figure 32 on page 41).

3. In the Control area, click **Load Method**.

   The Open Display Method dialog box appears.

4. Browse to the display method. Then click **Open** to load the method.

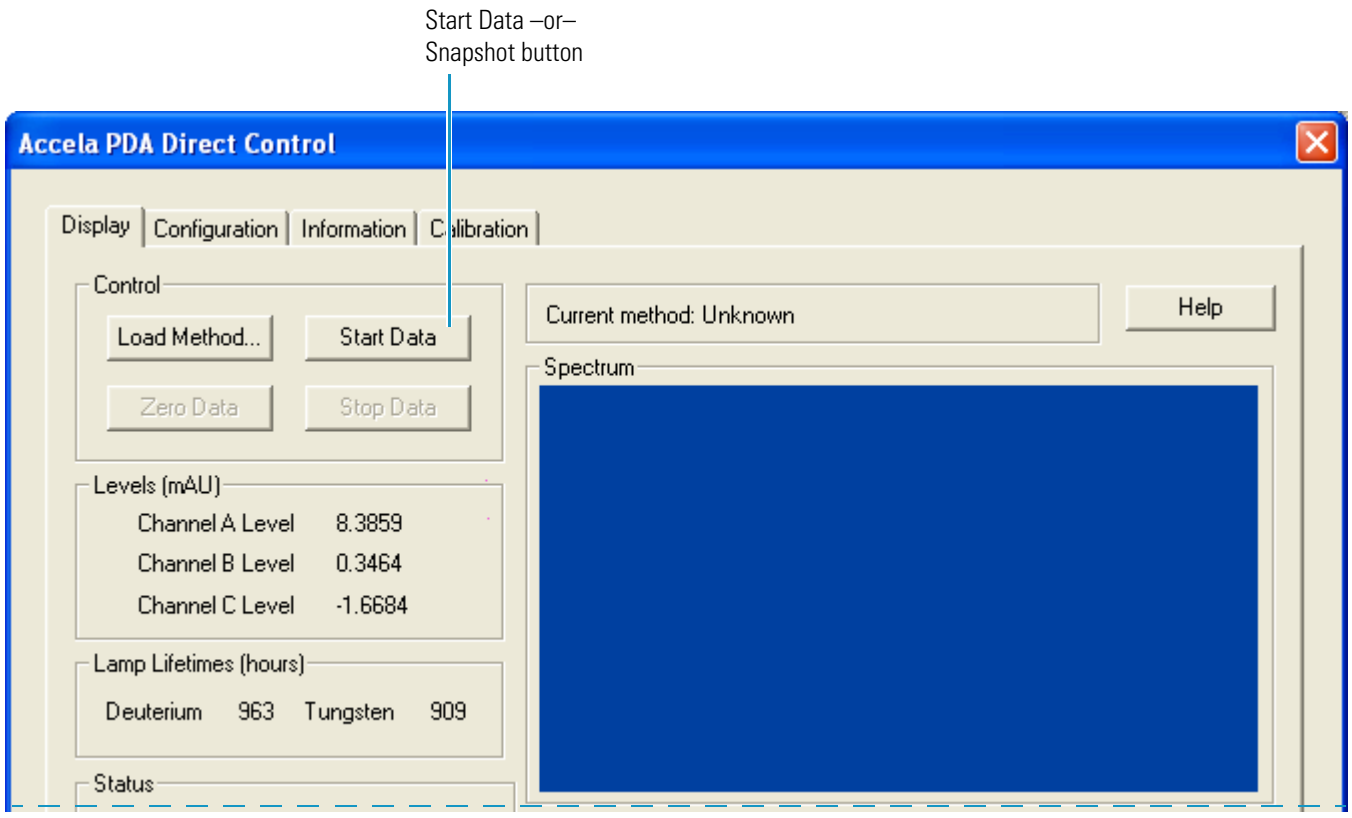
   The file name of the display method (.spda) appears in the box above the Spectrum plot.

5. To start the data stream, click **Start Data** (see Figure 32).

   The Spectrum and Channels plots begin to update and the Start Data button changes to the Snapshot button.

6. Press ALT+PRINT SCREEN to save a picture of the scan to the Clipboard. Paste this picture into a text editor such as Microsoft Word. Keep this scan for future comparisons to see if there is degradation in light intensity. Date the printout and add it to your maintenance records.

Figure 32. Display page



Adjusting the Light Throughput with the Xcalibur Data System

The first time that you adjust the attenuators, you must create a display method. After you create the method for adjusting the attenuators, save it with a name that you can associate with adjusting the attenuators and store it for future use.

Decreasing light throughput increases baseline noise. Increasing light throughput can saturate the diode array. When the array is saturated, the response from the PDA detector is a flat baseline.

During the deuterium lamp's lifetime of approximately 2000 hours (see "Lamp Lifetime and Detector Noise" on page 5), the lamp's light output decreases. Adjust the attenuators as the light output from the deuterium lamp decreases and whenever you do the following:

- Replace either lamp (see "Replacing the Lamps" on page 89)
- Replace the LightPipe flowcell (see "Installing the LightPipe Flowcell" on page 17)
- Change the configured diode array scan rate (see "Thermo Foundation Instrument Configuration" on page 28)

Tip The integrated light intensity viewed on the Display page is a function of the light throughput to the diode array and diode array scan rate. When you change the diode array scan rate, you must adjust the light throughput.

- If you increase the diode array scan rate (for example, from 20 Hz to 80 Hz), you must increase the light throughput to achieve the same intensity counts.
- If you reduce the diode array scan rate (for example, from 80 Hz to 20 Hz), check the intensity counts, and if necessary reduce the light throughput to avoid saturating the array.

Adjusting the position of the attenuator tabs changes the light throughput to the diode array: up increases and down decreases the light throughput to the diode array (see Figure 20 on page 25).

❖ To adjust the attenuators while viewing the light intensities

1. Prepare the PDA detector to monitor an intensity scan (see "Preparing the PDA Detector to Monitor Lamp Performance" on page 38)
2. If you have not already done so, create a display method that scans from diode 2 to diode 511 with a diode step of 1 and that displays the default discrete channel wavelengths (see "Creating a Display Method to View Light Intensity" on page 38).

3. Load the display method to the detector, and click **Start Data**. (see "Viewing an Intensity Scan" on page 40).

   The spectrum of light intensities appears in the top window.

   For the UV region, the diode of maximum intensity is between diode 10 and diode 40. For the Visible region, the diode of maximum intensity is between diode 400 and diode 500. Ignore the spike at approximately diode number 380. This spike is an emission line of the deuterium lamp.

4. Adjust the left attenuator tab (UV attenuation) to achieve a Channel A value as close as possible to 900000 intensity counts without saturating the array.

   IMPORTANT With a new deuterium lamp, when you select the 20 Hz option for the diode array scan rate, you can typically adjust the intensity to an optimum value of 900000 to 950000 counts. If you adjust the intensity too high, you can saturate the array. So take care to avoid saturating the array.

5. Adjust the right attenuator tab (Visible attenuation) to achieve a Channel C value as close as possible to 900000 intensity counts without saturating the array.

6. After you finish adjusting the attenuators, close the front doors of the detector.

Calibrating the PDA Detector from the Xcalibur Data System

To calibrate the PDA detector from the Xcalibur data system, follow these procedures:

- Performing a Dark Current Calibration from the Xcalibur Data System
- Performing a Wavelength Calibration from the Xcalibur Data System

Performing a Dark Current Calibration from the Xcalibur Data System

The Array calibration measures and corrects for the dark current produced by the diodes of the photodiode array. The dark current is the small amount of background signal that is produced by the diodes of the array even when both lamps are turned off. Typical dark current values range from 2000 to 4000 counts.

The environmental conditions of your laboratory can cause the dark current of the diode array to increase over time. For best results, perform an array calibration (dark current) after any of the following events occurs:

- After 100 hours of use or monthly, whichever comes first
- Whenever a significant temperature change occurs
- After you move the detector
- After you replace the lamp
- After you update the firmware by placing a new firmware file in the data system directory

Because the dark current produced by the diodes rises as the temperature within the detector rises, warm up the lamps for one hour before you perform a dark current calibration. Warming up the lamps for one hour equilibrates the detector to its normal operating temperature.

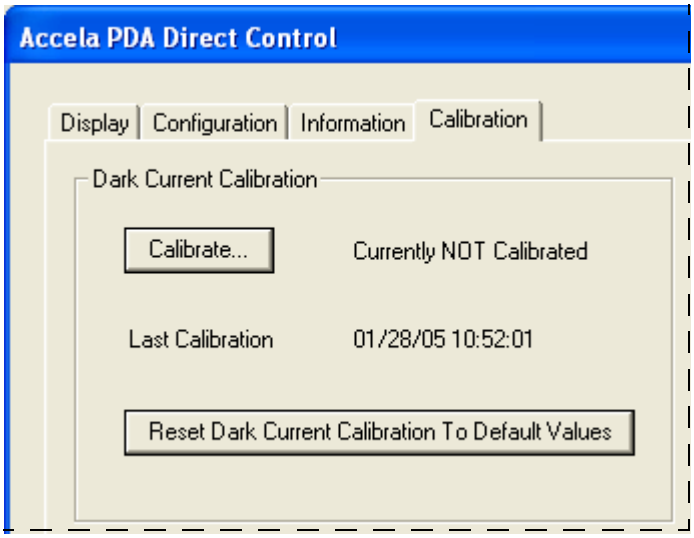
The PDA detector briefly turns the lamps off as it performs the dark current calibration routine. After it completes the dark current calibration, the PDA detector turns the lamps back on.

❖ To perform the dark current calibration from the Xcalibur data system

1. Pump methanol through the flowcell at 1 mL/min.
2. Turn on both lamps and wait one hour for the lamps to equilibrate (see "Controlling the Lamps from the Xcalibur Data System" on page 35). Leave the Accela PDA Direct Control dialog box open.
3. Click the **Calibration** tab.

   The Calibration page appears (see Figure 33).

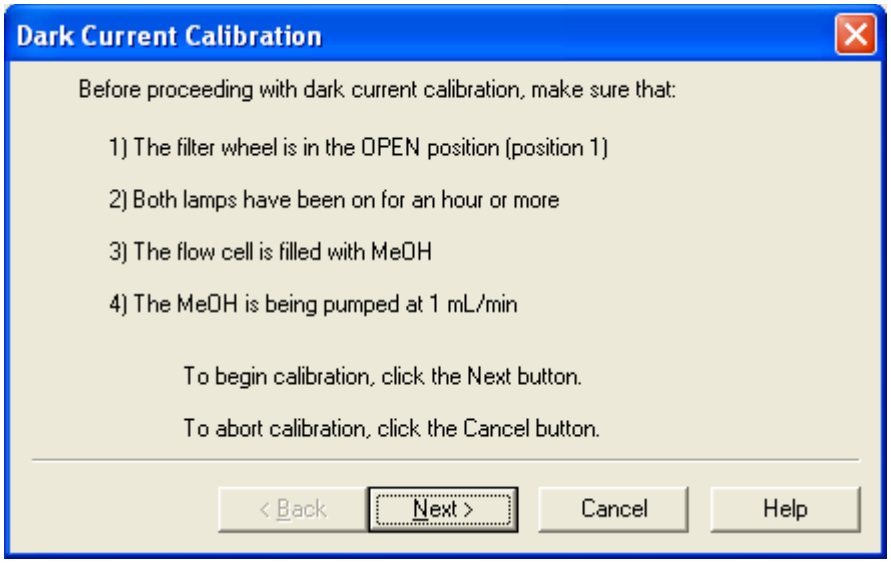
Figure 33. Calibration page



4. To start the Dark Current Calibration wizard, in the Dark Current Calibration area click **Calibrate**.

   The preconditions page appears (see Figure 34).

Figure 34. Preconditions page

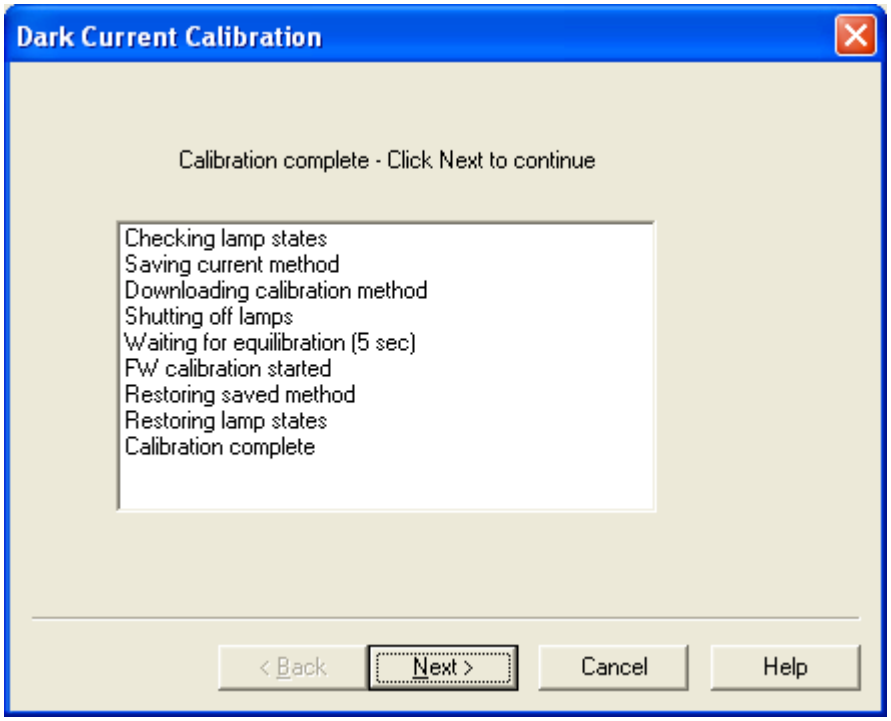


5. Read the preconditions and verify that they have been met:

   - If the preconditions have been met, click **Next** to proceed with the calibration.
   - If the preconditions have not been met, click **Cancel**. Then prepare the Accela PDA Detector for calibration and begin this procedure again.

6. On page 2 of the Dark Current Calibration wizard, observe the status readback as the calibration proceeds (see Figure 35).

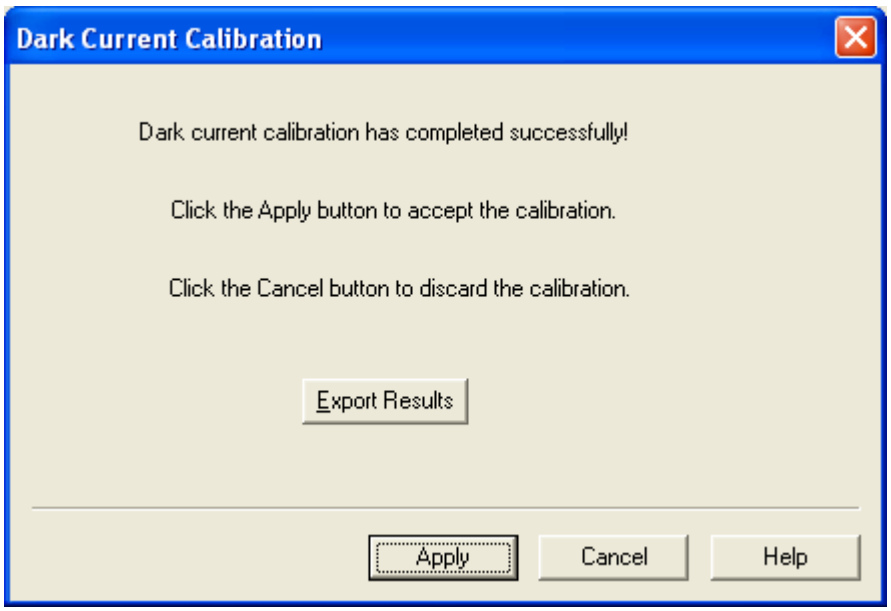
Figure 35. Page 2 of the Dark Current Calibration wizard



7. When the calibration is complete, click **Next**.

   Page 3 of the Dark Current Calibration wizard appears (see Figure 36). You can export the results of the calibration from this page.

Figure 36. Page 3 of the Dark Current Calibration wizard



8. To print a record of the dark current calibration:

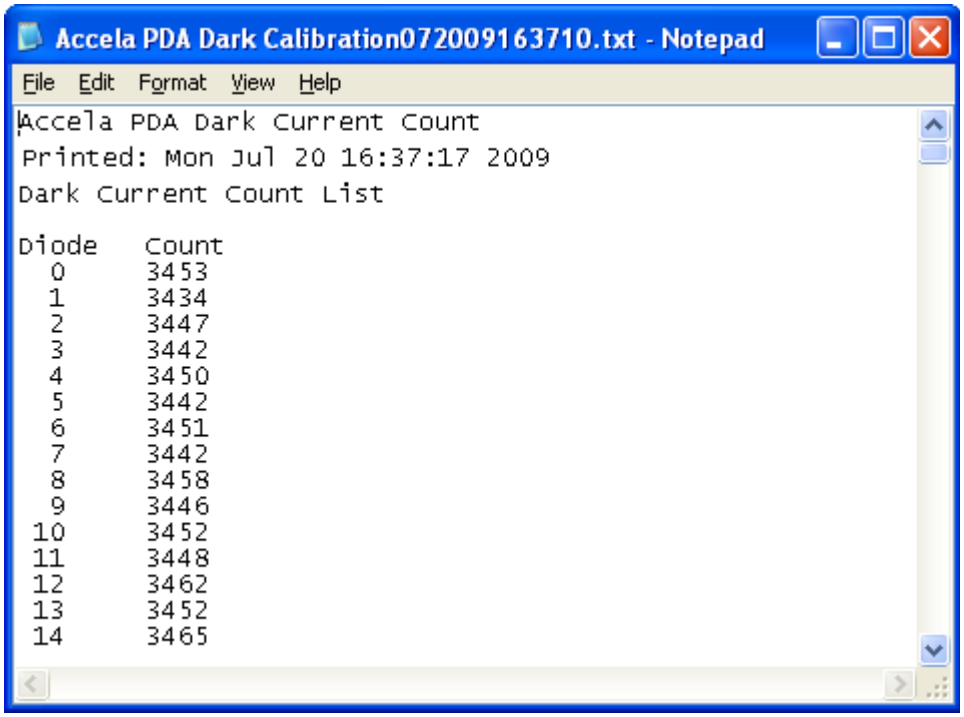
   a. Click **Export Results**.

      The Save As dialog box appears.

   b. In the File name box, type a name, and then click **Save**.

      After you save the file with a name of your choice, you can view or print the contents of the file using any text editing program (see Figure 37).

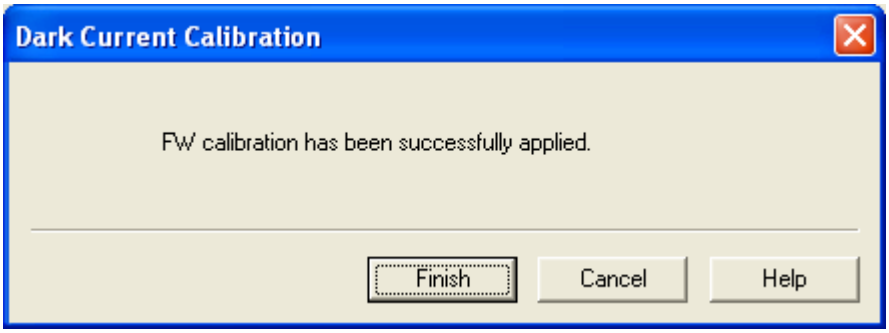
Figure 37. Accela PDA dark current calibration text file



9. On page 3 (see Figure 36 on page 46) of the Dark Current Calibration wizard, click **Apply** to apply the calibration results to the detector.

   The final page of the Dark Current Calibration wizard appears (see Figure 38).

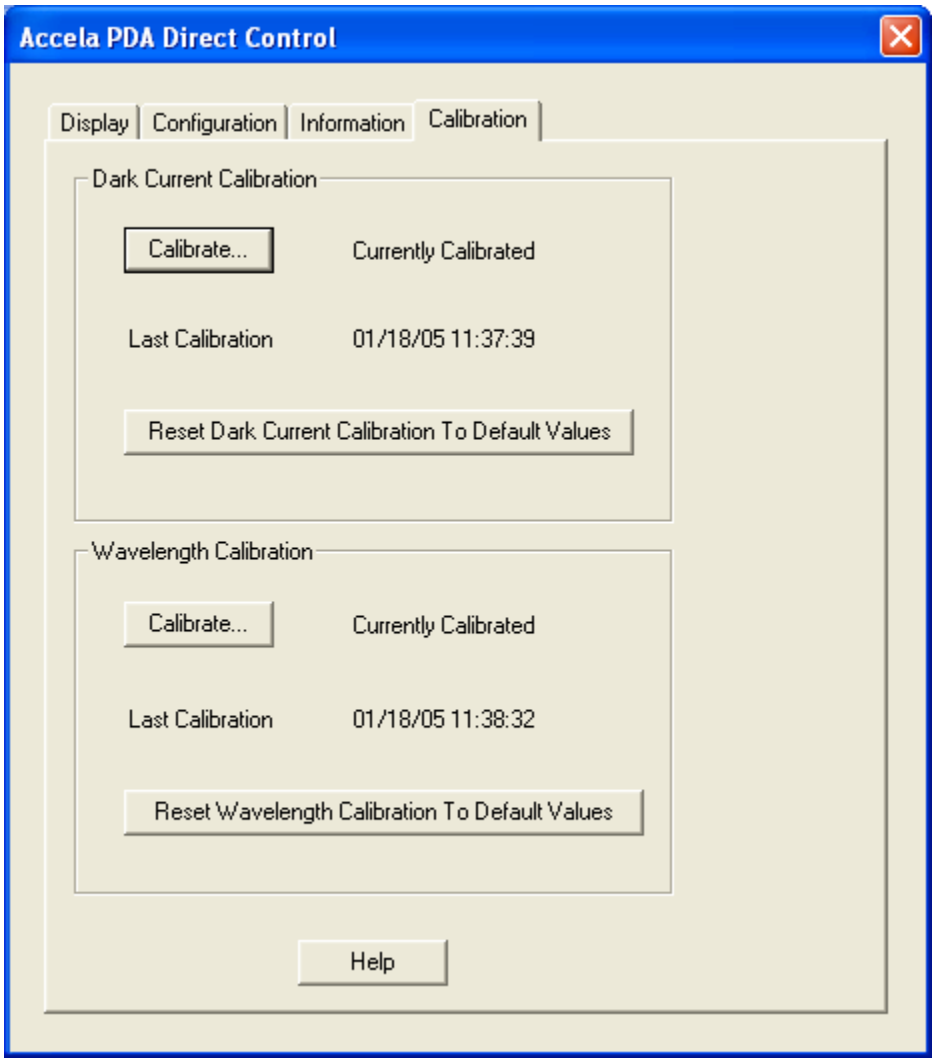
Figure 38. Final page of the Dark Current Calibration wizard



10. Click **Finish**.

The detector stores the calibration results. The date and time of the calibration appears in the Dark Current Calibration area of the Calibration page following Last Calibration (see Figure 39).

Figure 39. Calibration page with dark current calibration results



Performing a Wavelength Calibration from the Xcalibur Data System

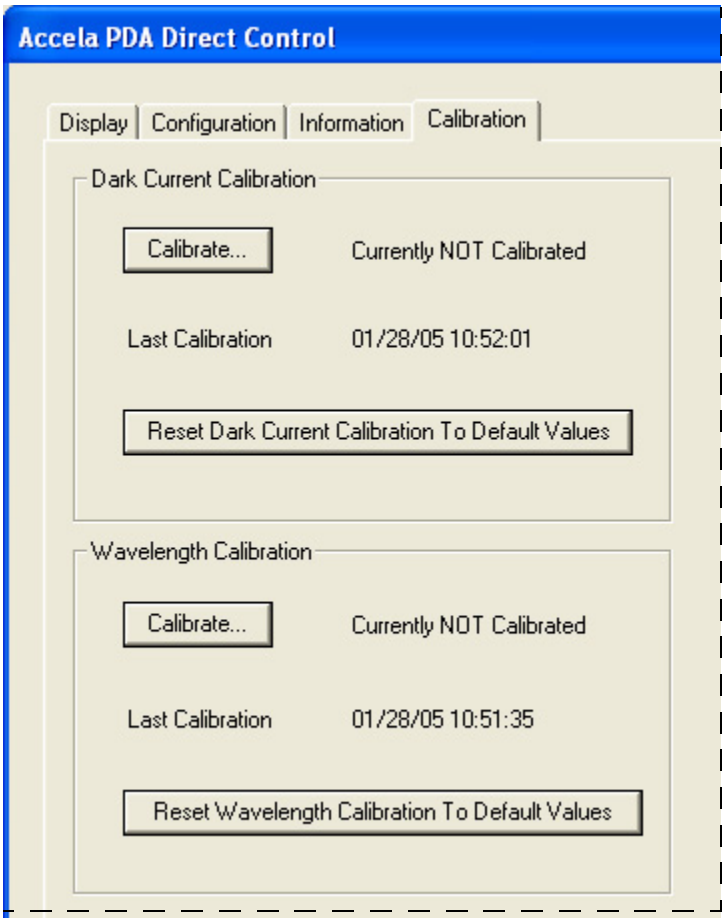
The alignment of the spectrum on the diode array depends on the physical alignment of various components of the optical bench. The alignment can become offset if the detector is sharply jolted in shipping, for example. Such bumps and jars can slightly change the wavelength of light reaching the photodiode array. Use the automated wavelength calibration to determine wavelength accuracy and to correct for any misalignment.

❖ To perform a wavelength calibration from the Xcalibur data system

1. Pump HPLC-grade methanol at 1 mL/min through the flowcell.
2. Turn on both lamps and wait one hour for the lamps to equilibrate (see "Controlling the Lamps from the Xcalibur Data System" on page 35).
3. After the detector has reached a stable temperature (approximately one hour after you turn on the lamps), proceed with the calibration:
   a. In the Accela PDA Direct Control dialog box, click the **Calibration** tab

      The Calibration page appears (see Figure 40).

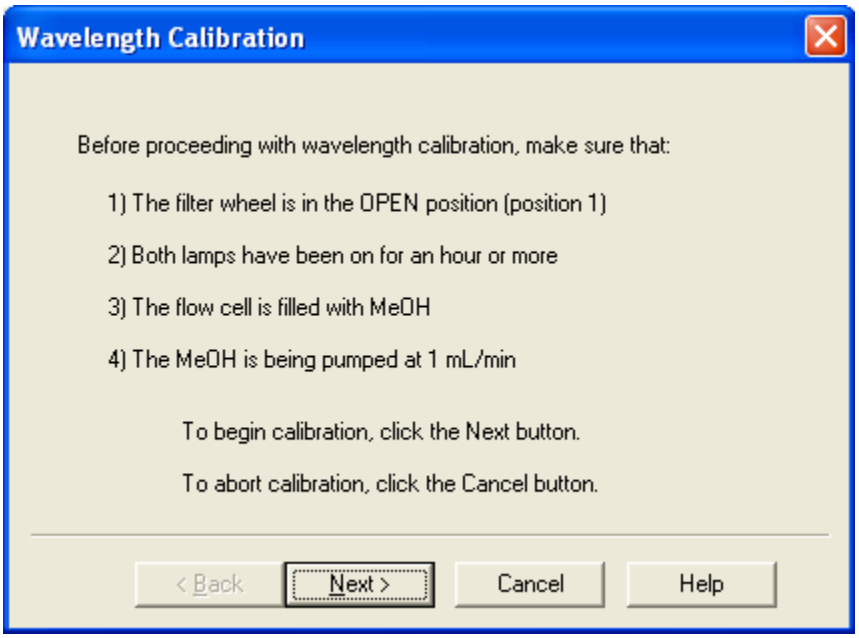
      Figure 40. Calibration page of the Accela PDA Direct Control dialog box



b. In the Wavelength Calibration area, click **Calibrate**.

The preconditions page of the wavelength calibration wizard appears (see Figure 41).

Figure 41. Preconditions page



c. Read the preconditions, and determine if they have been met:

- If the preconditions have been met, click **Next** to proceed with the calibration.
- If the preconditions have not been met, click **Cancel** to close the wizard and prepare the PDA detector for calibration.

> **Note** You can click Cancel on any page of the Wavelength Calibration wizard to stop the calibration process.

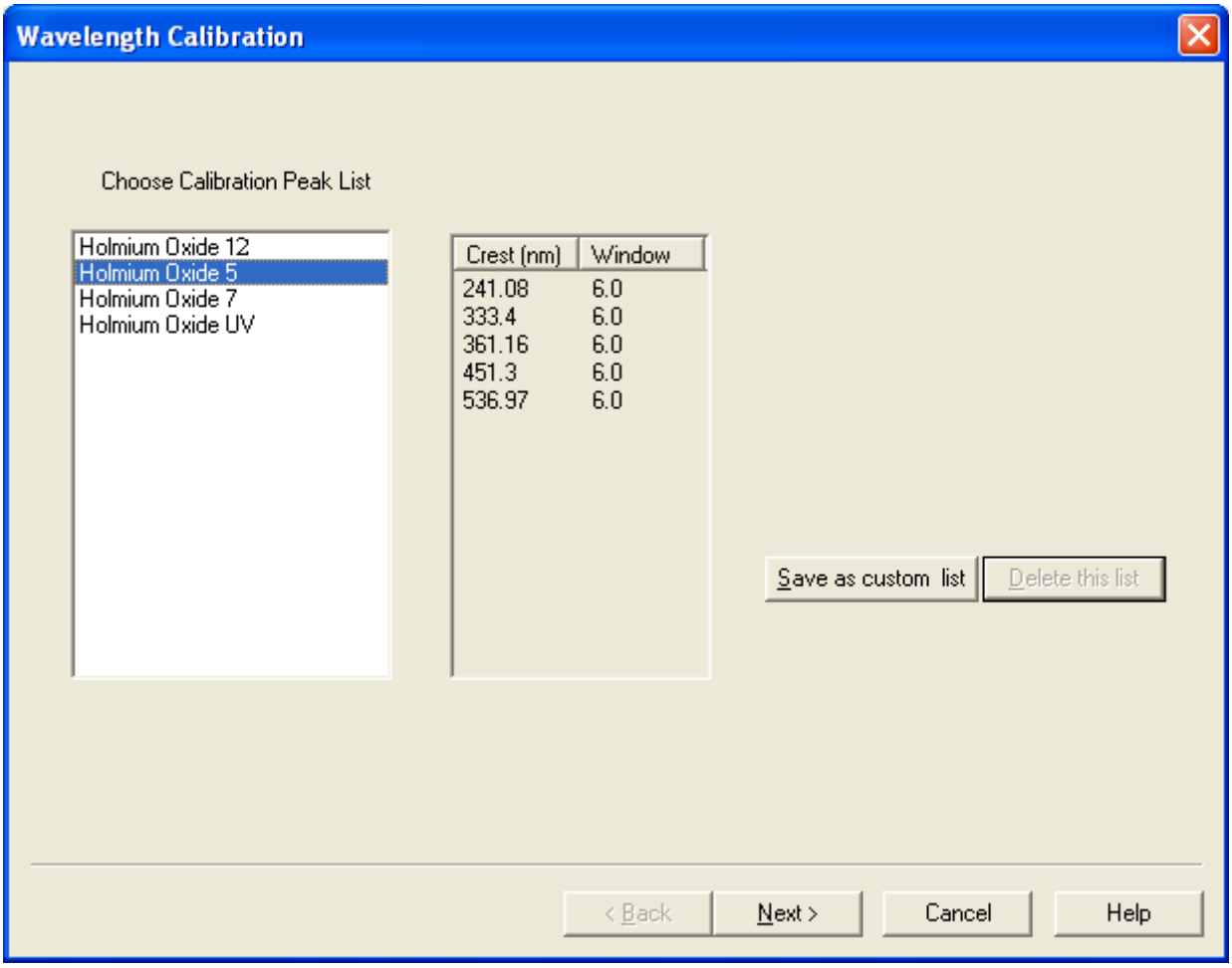
4. On page 2 of the wavelength calibration wizard (see Figure 42), do the following:

a. Select a peak set from the list.

The peak set should span the wavelengths you use under normal operating conditions. Figure 42 shows the selection of the Holmium Oxide 5 peak set. The detector uses this wavelength list to perform the wavelength calibration.

> **Note** Xcalibur has four calibration files to choose from. For example, the Holmium Oxide UV file contains five wavelengths in the UV region while the other files use sets of wavelengths from both the UV and Visible wavelength regions. The holmium oxide absorbance maxima are selected from a spectrum published in "Holmium Oxide Solution Wavelength Standard from 240 to 640 nm - SRM 2034 (NIST Special Publication 260-54)."

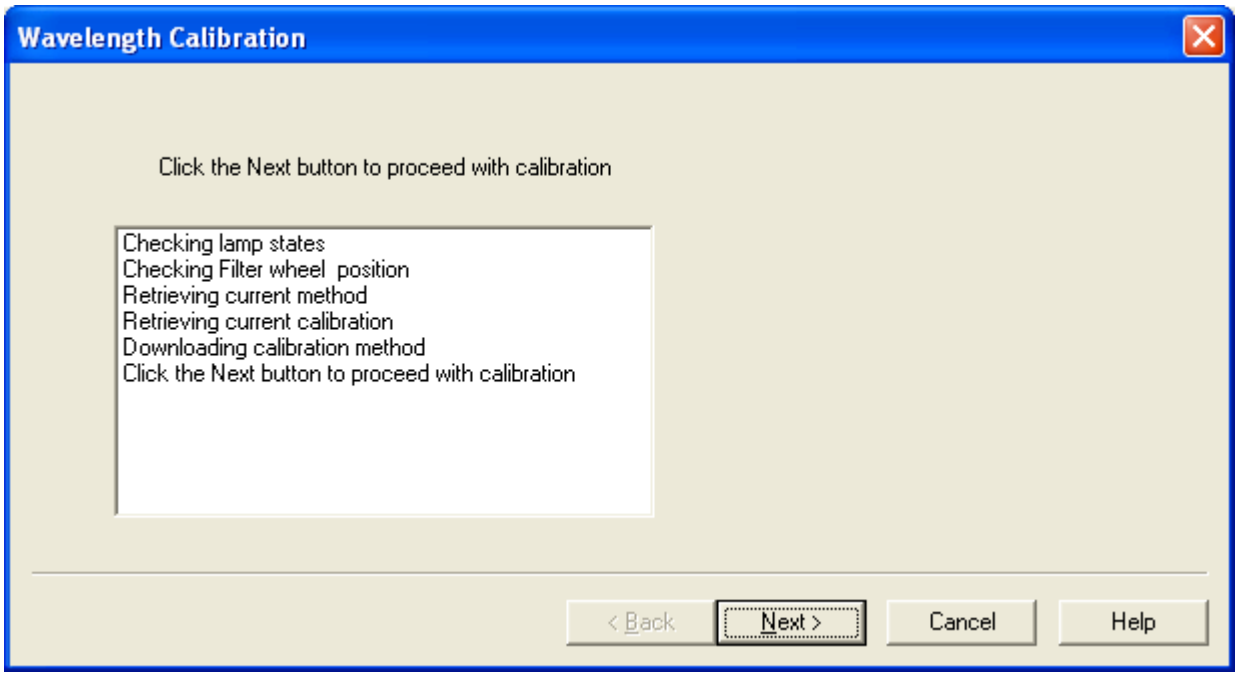
Figure 42. Page 2 of the Wavelength Calibration wizard with a list of calibration files



b. Click **Next**.

Page 3 of the Wavelength Calibration wizard appears (see Figure 43).

Figure 43. Page 3 of the Wavelength Calibration wizard



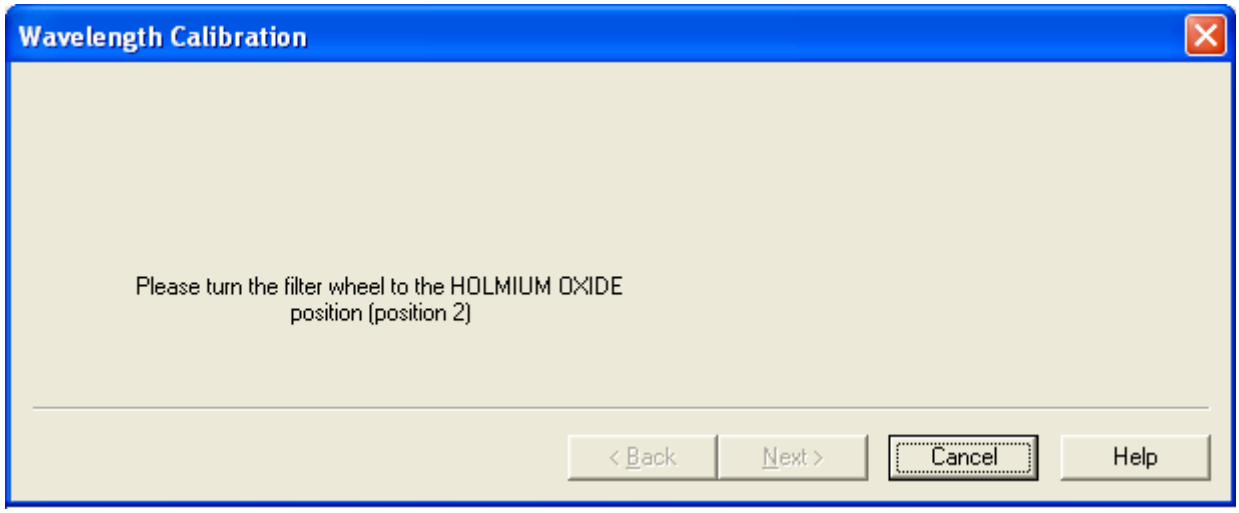
5. Do the following:

   a. Observe the status screen that tells you the wavelength file is being downloaded (see Figure 43).

   b. When you see the message: Click the Next button to proceed with calibration, click **Next**.

      Page 4 of the Wavelength Calibration wizard appears (see Figure 44).

Figure 44. Page 4 of the Wavelength Calibration wizard



6. Rotate the Holmium Oxide filter wheel to position 2 as directed.

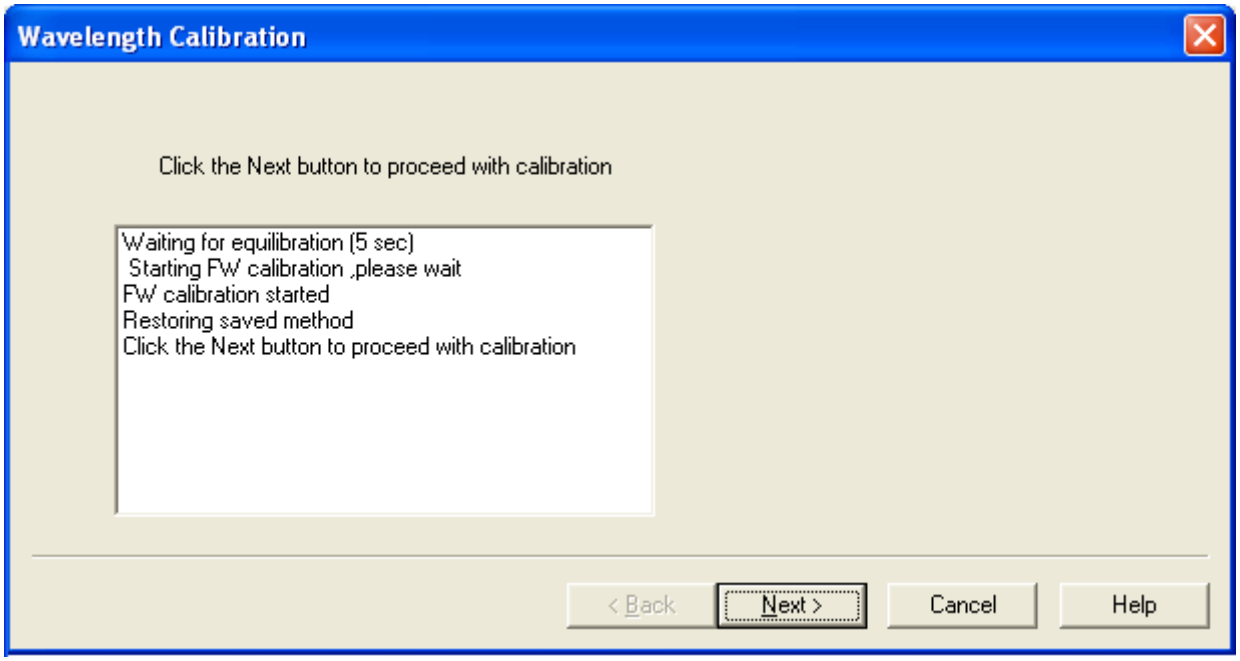
   The Next button becomes active.

   Note The Next button is unavailable until the filter wheel is in position 2.

7. Click **Next**.

   Page 5 of the Wavelength Calibration Wizard appears (see Figure 45).

Figure 45. Page 5 of the Wavelength Calibration wizard



8. Do the following:

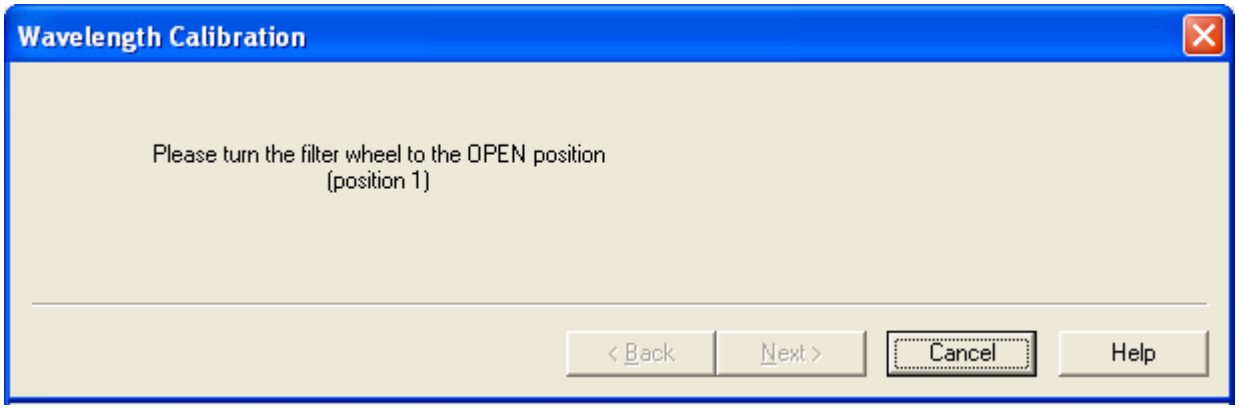
   a. Observe the status screen (see Figure 45).

      The diagnostics program waits for a few seconds for the rise time filter to equilibrate and takes a holmium oxide scan.

   b. When you see the message: Click the Next button to proceed with calibration, click **Next**.

      Page 6 of the Wavelength Calibration wizard appears (see Figure 46).

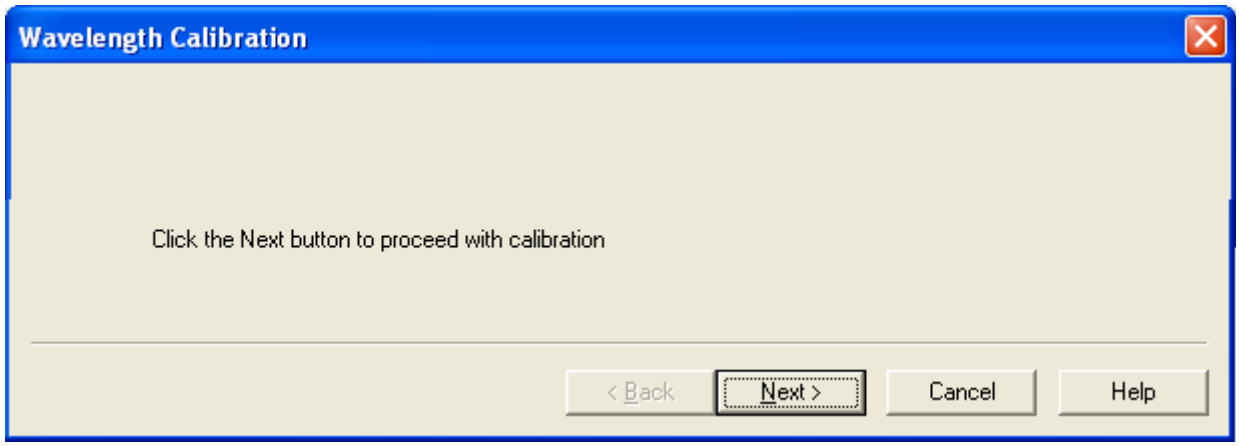
Figure 46. Page 6 of the Wavelength Calibration wizard



9. Rotate the wheel back to position 1 (Open) as instructed on page 6 of the Wavelength Calibration wizard (see Figure 46).

   The Next button becomes active (see Figure 47).

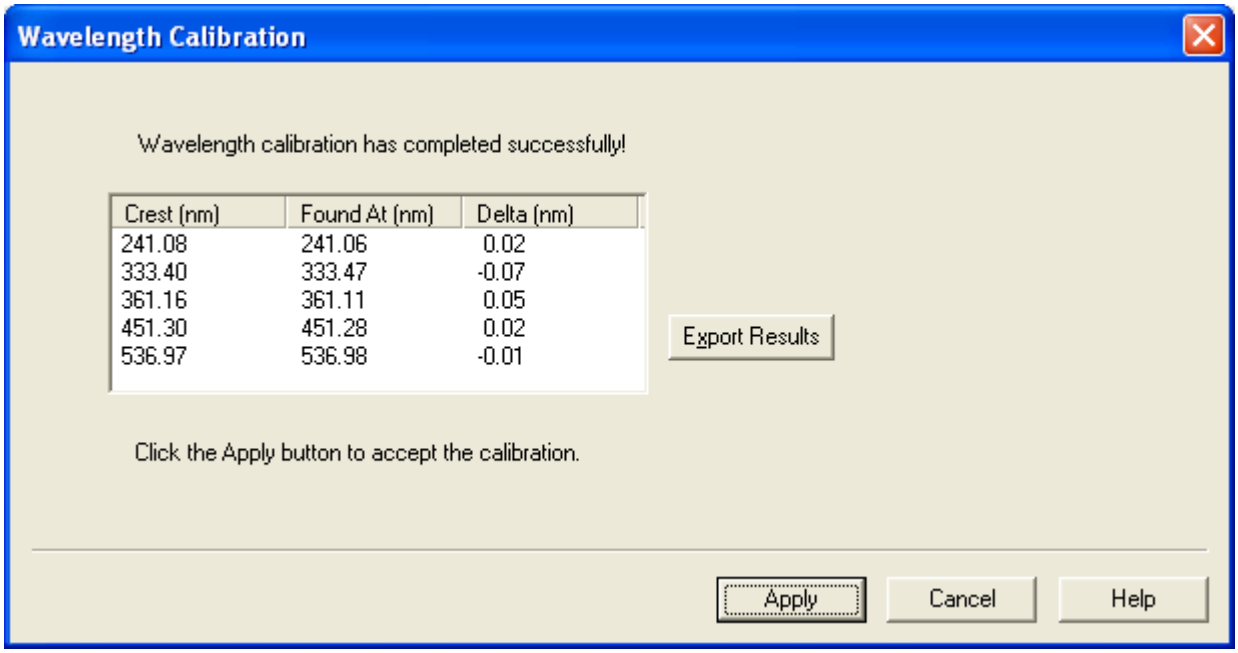
Figure 47. Page 7 of the Wavelength Calibration wizard with an active Next button



10. Click **Next**.

    Page 8 of the Wavelength Calibration wizard appears (see Figure 48).

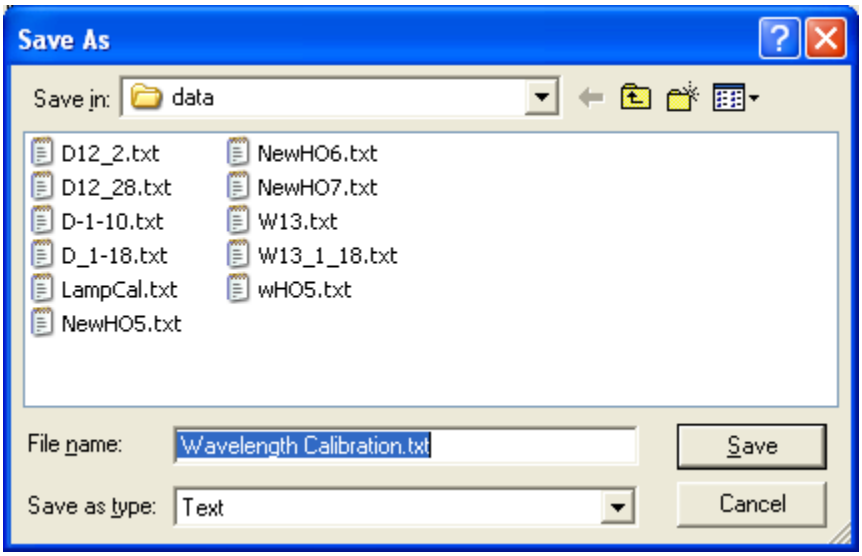
Figure 48. Page 8 of the Wavelength Calibration wizard



11. Check that the delta values are within ±1 nm, and then do one of the following:
    - If the Delta values are acceptable, proceed to step 12.
    - If the delta values are not within the range of ±1 nm, do not export the results, and proceed to step 13. Complete the calibration procedure, and then repeat the wavelength calibration. If, after applying a second calibration, the Delta values are still not within the range of ±1 nm, call your Thermo Fisher Scientific service representative for assistance.
12. (Optional) Print a report of the calibration results:
    a. Click **Export Results** to print the results to a file.

       The Save As dialog box appears (see Figure 49).

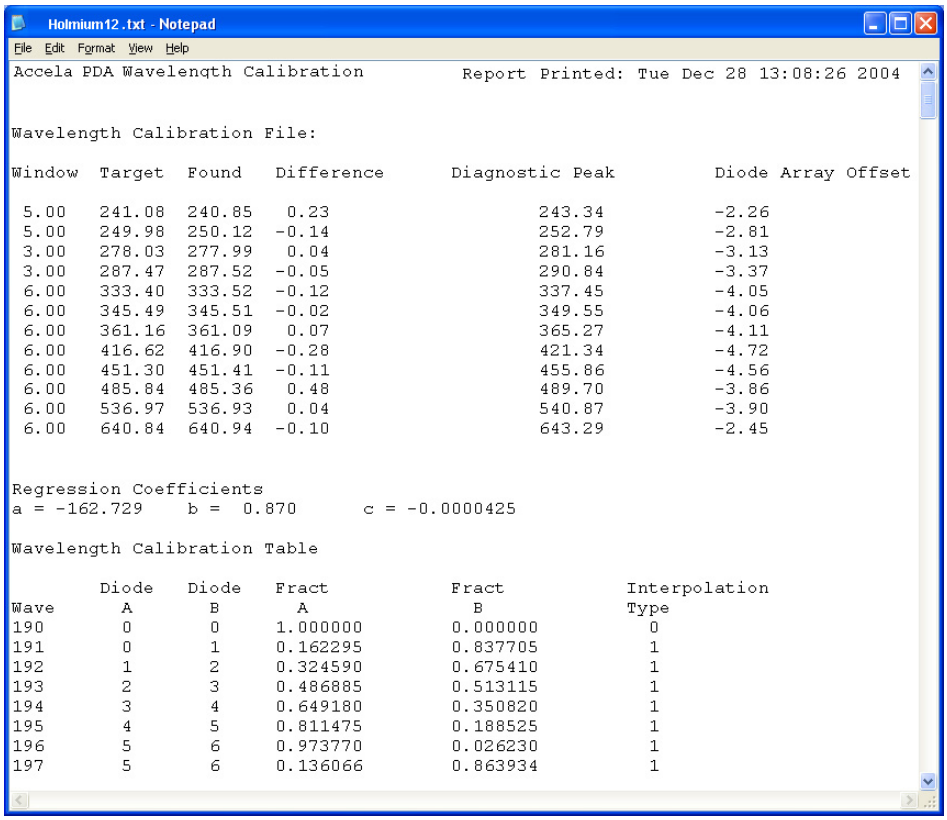
Figure 49. Save As dialog box



b. In the File name box, type a name, and then click **Save**.

You can view or print the calibration results using any text editing program (see Figure 50).

Figure 50. Wavelength calibration report opened in Notepad



Holmium12.txt - Notepad

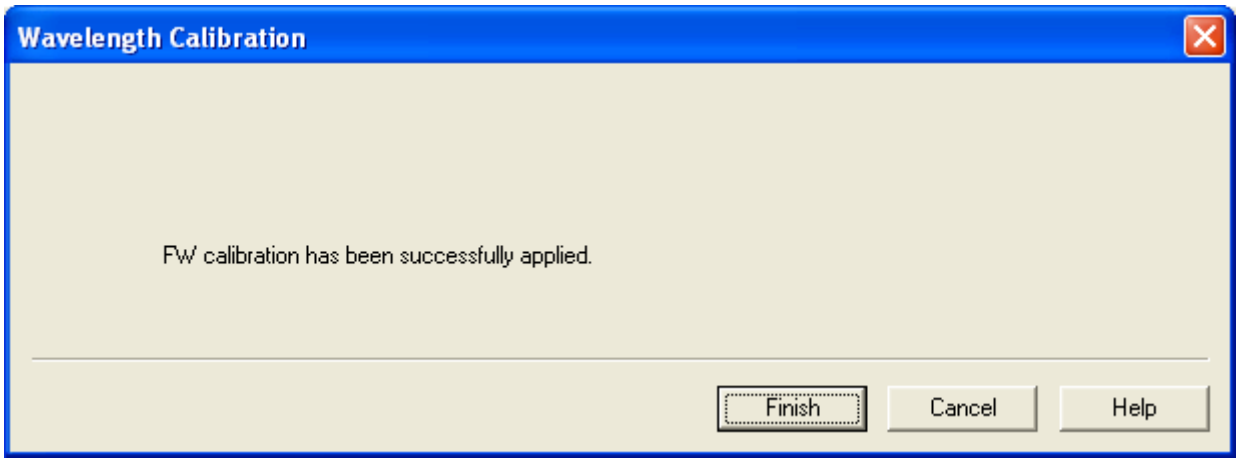
File Edit Format View Help

```
Accela PDA Wavelength Calibration          Report Printed: Tue Dec 28 13:08:26 2004


Wavelength Calibration File:

Window  Target  Found   Difference      Diagnostic Peak         Diode Array Offset

 5.00   241.08  240.85   0.23                   243.34          -2.26
 5.00   249.98  250.12  -0.14                   252.79          -2.81
 3.00   278.03  277.99   0.04                   281.16          -3.13
 3.00   287.47  287.52  -0.05                   290.84          -3.37
 6.00   333.40  333.52  -0.12                   337.45          -4.05
 6.00   345.49  345.51  -0.02                   349.55          -4.06
 6.00   361.16  361.09   0.07                   365.27          -4.11
 6.00   416.62  416.90  -0.28                   421.34          -4.72
 6.00   451.30  451.41  -0.11                   455.86          -4.56
 6.00   485.84  485.36   0.48                   489.70          -3.86
 6.00   536.97  536.93   0.04                   540.87          -3.90
 6.00   640.84  640.94  -0.10                   643.29          -2.45


Regression Coefficients
a = -162.729    b =  0.870      c = -0.0000425

Wavelength Calibration Table

        Diode   Diode   Fract           Fract           Interpolation
Wave      A       B       A               B             Type
190       0       0     1.000000        0.000000          0
191       0       1     0.162295        0.837705          1
192       1       2     0.324590        0.675410          1
193       2       3     0.486885        0.513115          1
194       3       4     0.649180        0.350820          1
195       4       5     0.811475        0.188525          1
196       5       6     0.973770        0.026230          1
197       5       6     0.136066        0.863934          1
```

13. On page 8 of the Wavelength Calibration wizard (see Figure 48 on page 55), click **Apply**.

    The final page of the Wavelength Calibration wizard appears (see Figure 51).

Figure 51. Final page of the Wavelength Calibration wizard



14. Click **Finish** to complete the calibration.

    The detector saves the calibration information. The date and time of the calibration appear in the Wavelength Calibration area of the Calibration page (see Figure 40 on page 49).

Retrieving, Viewing, Printing, and Clearing the Event Log

Detector errors and major detector events, such as power-on self-tests (POSTs), are logged to a dedicated area in the memory of the detector. These messages are created as part of the normal operation of the detector and can be helpful when you are attempting to troubleshoot communications problems.

The log can hold up to 100 events. When the log is full, the newest entry replaces the oldest entry. To keep a continuous record for your maintenance files, print out the log and clear it periodically. The memory is protected by battery backup when the detector is turned off. View, print, and clear the log weekly as part of your regular maintenance routine.

For a list of error messages that can appear in the event log along with suggested solutions, see "Log Entries" on page 100.

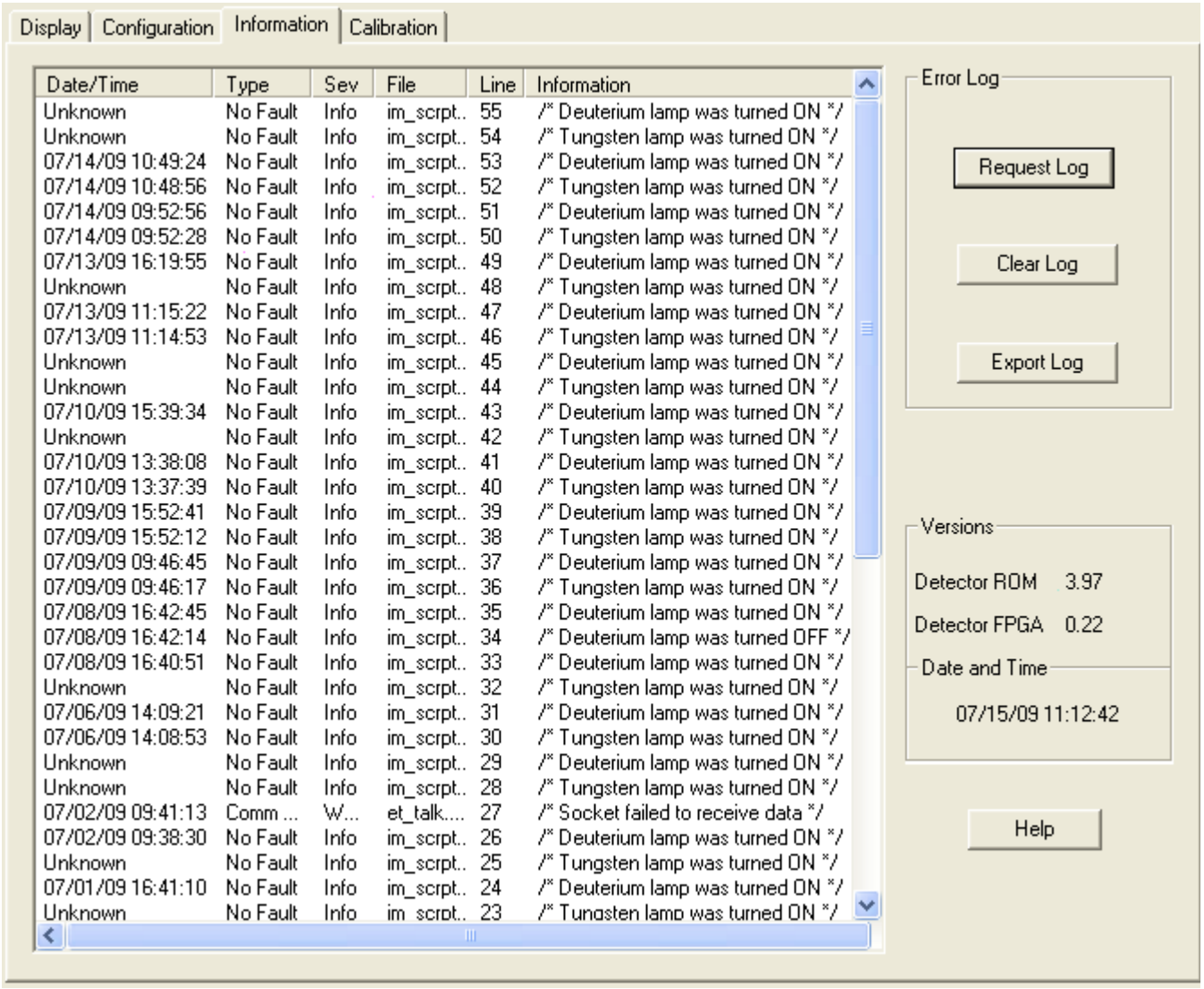
❖ To open, print, save, or clear the event log in the Xcalibur data system

1. Open the Accela PDA Direct Control dialog box (see "Opening the Accela PDA Direct Control Dialog Box" on page 34).
2. Click the **Information** tab.

   The Information page appears (see Figure 52).

Note When you first open the Information page, the event area might be blank.

Figure 52. Information page of the Accela PDA Direct Control dialog box with the event log



3. Do one of the following:

   a. To retrieve and display information from the detector, click **Request Log**.

      Figure 52 on page 58 shows a sample log. Review the log. For a list of some common error messages that might appear in the log, see "Log Entries" on page 100.

   b. To save the contents of the log as a text file, click **Export Log**. Print out and save a copy of the file for your maintenance records.

   c. To clear the log, click **Clear Log**.

Checking the Firmware Version

Occasionally, upgraded firmware becomes available for the Accela PDA Detector. Ask your Thermo Fisher Scientific Service Representative about the availability of new firmware.

❖ To check the firmware version

1. Open the Accela PDA Direct Control dialog box (see "Opening the Accela PDA Direct Control Dialog Box" on page 34).
2. Click the **Information** tab.

   The Information page appears (see Figure 52 on page 58).

   The Versions area displays firmware version numbers for several items (see Figure 53).

   Figure 53. Versions area of the Information page (Xcalibur data system)

ChromQuest Diagnostics for the PDA Detector

This chapter describes the diagnostics available from the ChromQuest data system. Use the diagnostics program to check the lamp performance, calibrate the PDA detector, and view the PDA detector's error log.

To perform diagnostics from the ChromQuest data system, connect the PDA detector to the data system computer, configure the PDA detector as part of an instrument in the ChromQuest Enterprise, and turn on the PDA detector.

If you move the PDA detector, replace lamps, install a new LightPipe flowcell, or change the configured diode array scan rate for the detector, the system performance can change. With use, the deuterium lamp produces less and less light so the system performance changes as the lamp's remaining lifetime hours decrease.

For information on configuring your Accela PDA Detector, see "ChromQuest Data System Instrument Configuration" on page 30.

To verify the proper operation of the PDA detector, follow these procedures:

1. "Monitoring Lamp Performance from the ChromQuest Data System" on page 65
2. "Adjusting the Light Throughput with the ChromQuest Data System" on page 69
3. "Calibrating the PDA Detector from the ChromQuest Data System" on page 73

Contents

Accessing the Direct Controls for the Accela PDA Detector

You access the direct controls and the Diagnostics dialog box for the Accela PDA detector from the Accela PDA page (see Figure 54) of the Instrument Status window.

❖ To open the Accela PDA page of the Instrument Status window

1. From the computer desktop, choose **Start > All Programs > Chromatography > ChromQuest**.

   The Main Menu window appears.

2. Double-click the instrument icon that represents your LC stack.

   The Instrument window appears.

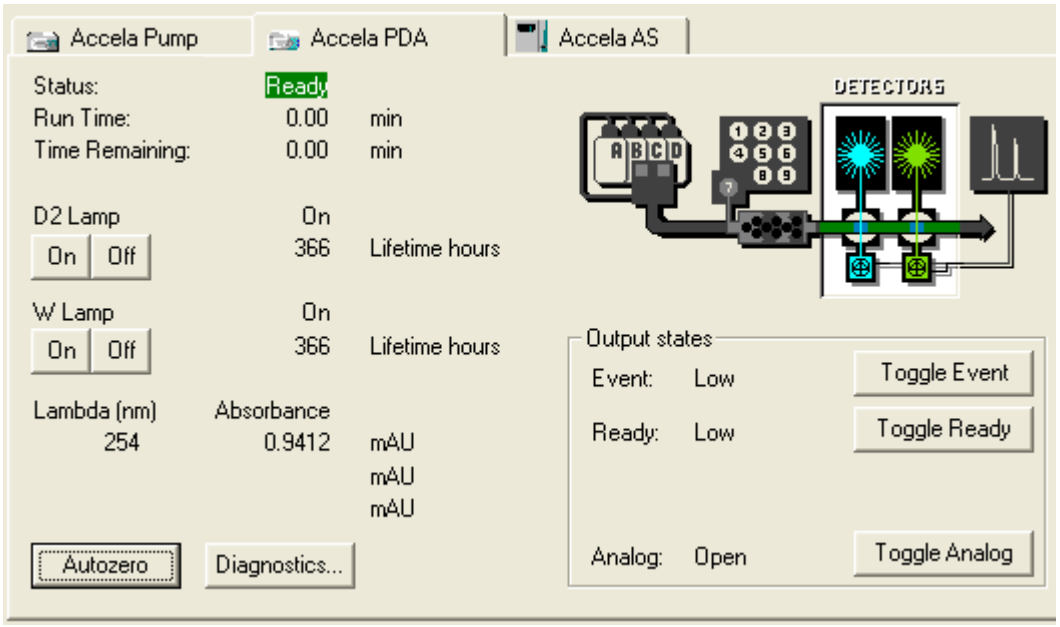
3. In the menu bar, choose **Control > Instrument Status**.

   The Instrument Status window appears.

4. In the Instrument Status window, click the **Accela PDA** tab.

   The Accela PDA page appears (see Figure 54).

Figure 54. Accela PDA page of the ChromQuest Instrument Status window



❖ To open the Diagnostics dialog box for the Accela PDA Detector

1. Open the Accela PDA page of the Instrument Status window (see previous procedure).

2. Click **Diagnostics**.

   The Accela PDA Diagnostics dialog box appears with the Lamps page displayed (see Figure 55 on page 63).

Controlling the Lamps from the ChromQuest Data System

From the ChromQuest data system, you can turn the lamps on or off and view the lamp's usage hours from the Accela PDA page of the Instrument Status window or from the Lamps page of the Accela PDA Diagnostics dialog box.

The PDA detector keeps track of the number of hours each lamp has been operating. The deuterium lamp has a lifetime of approximately 2000 hours and the tungsten lamp has a lifetime of approximately 2500 hours. The useful lamp lifetime of the deuterium lamp depends on the acceptable level of detector noise for your application (see "Lamp Lifetime and Detector Noise" on page 5).

As lamps age, they emit less light, which results in increased baseline noise. If the noise level of your detector signal is unacceptable and cleaning the LightPipe flowcell does not help, use the diagnostic features of the software to determine the cause of the problem. If light output becomes too low and adjusting the attenuators as described in "Adjusting the Light Throughput with the ChromQuest Data System" on page 69 does not help, replace the lamps (see "Replacing the Lamps" on page 89).

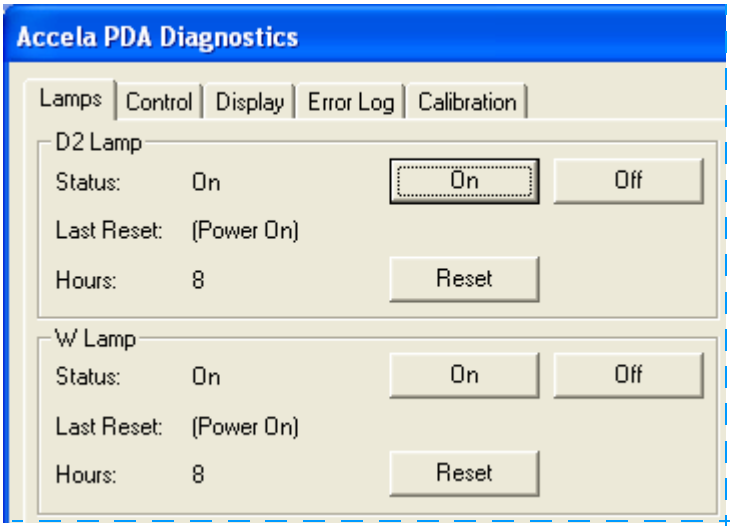
❖ To control the lamps from the Lamps page

1. Open the Accela PDA Diagnostics dialog box (see "Accessing the Direct Controls for the Accela PDA Detector" on page 62).
2. Click the **Lamps** tab.

   The Lamps page appears (see Figure 55).

Note The intensity of the deuterium lamp falls off very slightly over a period of time after it is turned on. Plan to wait at least one hour for the lamp to stabilize after a cold start before collecting data in the UV region.

Figure 55. Lamps page of the Accela PDA Diagnostics dialog box



3. Record the status and usage of each lamp.

Note Avoid indiscriminately clicking either Reset button. Click them only after you replace their associated lamp with a new one.

Use the Lamps page in the ChromQuest data system for lamp maintenance and control. Three direct control buttons for each lamp are available on this page: On, Off, and Reset.

❖ To use the lamp controls on the Lamps page

- In the D2 Lamp area, click **On** to ignite the deuterium lamp.

  The Status readback displays Starting during the 10-second ignition period, and then it changes to On. If there is a problem with the lamp, the Status readback displays Failed.

- In the W Lamp area, click **On** to turn on the tungsten lamp.

  The tungsten lamp turns on immediately. If there is a problem with the lamp, the Status readback displays Failed.

- Click **Reset** to reset the stored total run time for the associated lamp to zero and update the Last Reset readback to the current date and time. After you replace a lamp, reset its lamp usage hours to zero.

Monitoring Lamp Performance from the ChromQuest Data System

With use, the deuterium lamp emits less and less light. As the light output from the deuterium lamp decreases, the detector noise increases. For information on the typical lamp lifetime, see "Controlling the Lamps from the ChromQuest Data System" on page 63.

To monitor and track lamp performance from the ChromQuest data system, follow these procedures:

- Viewing an Intensity Scan from the ChromQuest Data System
- Recording the Performance of the Lamps

Viewing an Intensity Scan from the ChromQuest Data System

❖ **To monitor lamp performance from the ChromQuest data system**

1. Open the Instrument window for your LC system:
   a. From the computer desktop, choose **Start > All Programs > Chromatography > ChromQuest.**

      The Main Menu window appears.
   b. Double-click the icon that represents your LC stack.

      The Instrument window appears.
2. Create and download a method that pumps 100% HPLC-grade methanol or HPLC-grade water at a constant flow rate of 1 mL/min.
3. Turn on the lamps and check their status (see "Controlling the Lamps from the ChromQuest Data System" on page 63).

   Wait for one hour for both lamps to equilibrate.
4. Open the Accela PDA Diagnostics dialog box (see "Accessing the Direct Controls for the Accela PDA Detector" on page 62).
5. Click the Control tab.

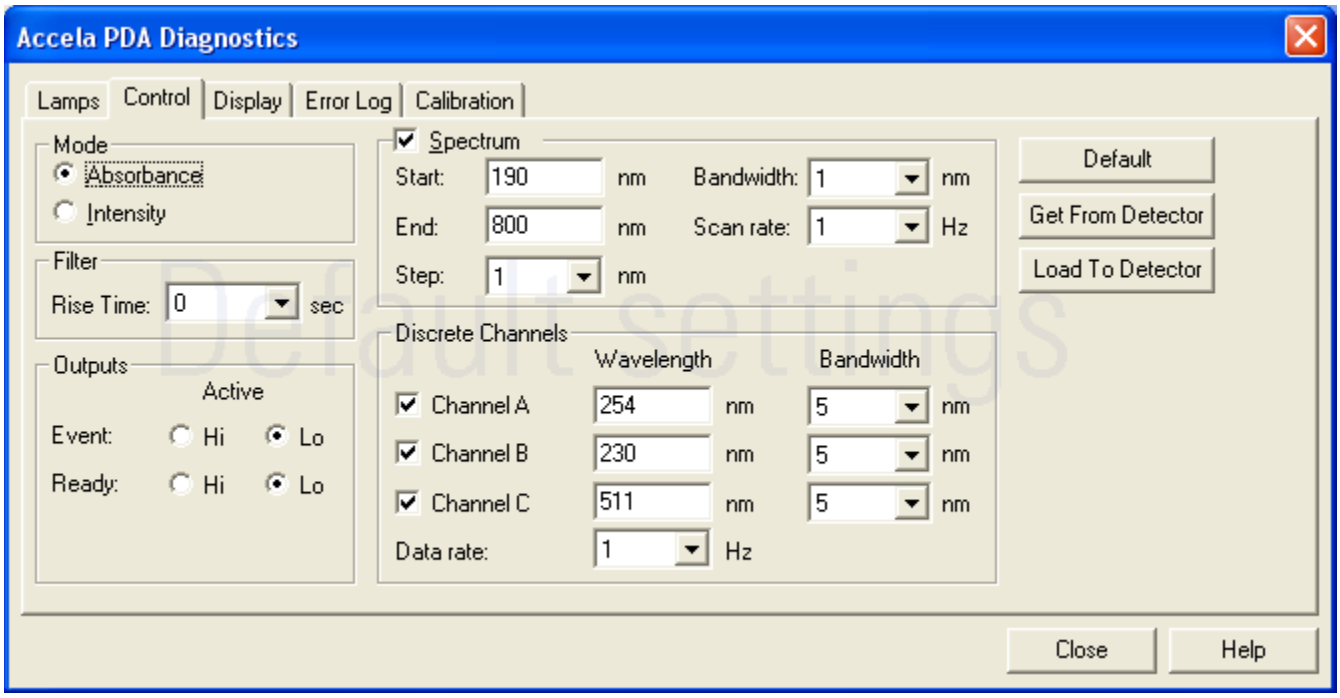
   The Control page appears.
6. In the Mode area, select the **Intensity** option.
7. Click **Default**, and then verify that the following parameters are specified in the Spectrum area (see Figure 56):

   Start = 2

   End = 511

   Step = 1

Figure 56. Control page with the default Spectrum settings

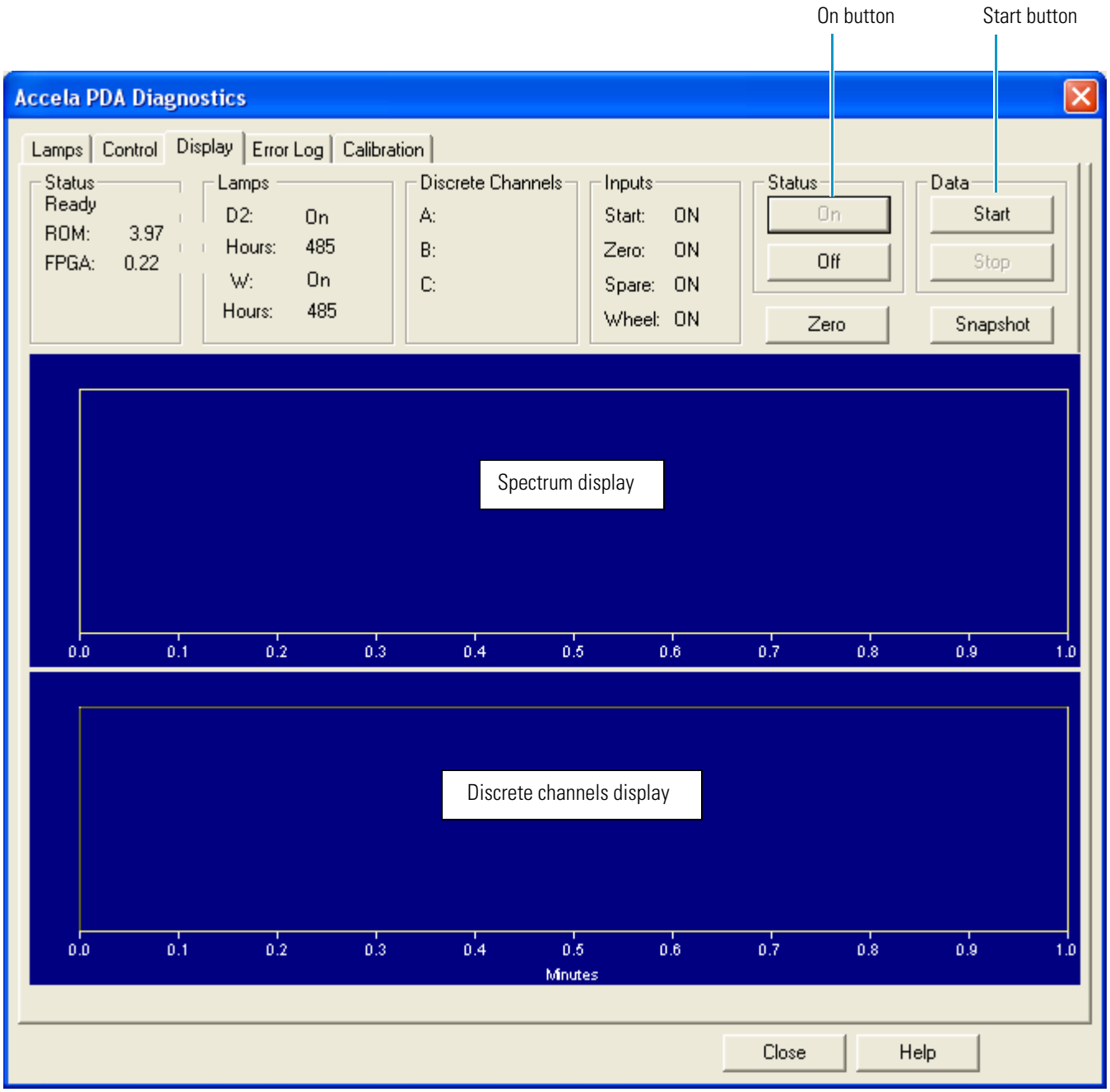


8. In the Discrete Channels area, use the default settings or specify the diodes that you want to monitor.
9. Click **Load To Detector**.

   A dialog box containing the message, Method Has Been Downloaded, appears.
10. Click **OK**.
11. Click the **Display** tab.

    The Display page appears (see Figure 57).

Figure 57. Display page (after you click On in the Status area, but before you click Start)



12. On the right side of the page, in the Status area, click **On**.
13. In the Data area, click **Start** to refresh the display.
14. Save a printout or an electronic copy of the spectrum. Date the printout and add it to your maintenance records (see "Recording the Performance of the Lamps" on page 68).

Recording the Performance of the Lamps

Use following procedures to record the spectrum data on the Display page:

- Using the Print Screen Button
- Using the Print Utility
- Taking a Snapshot

Using the Print Screen Button

❖ To store the spectral data using the print screen button

1. As you collect the data stream on the Display page, press SHIFT+PRINT SCREEN.
2. Open Microsoft™ Paint and save the screen capture as a bitmap or open Microsoft Word and paste the screen capture into a Word document.

Using the Print Utility

Use the ChromQuest print utility to print a copy of the Spectrum window.

❖ To use the print utility

1. On the Display page, place the cursor in the Spectrum window and right-click.
2. From the shortcut menu, choose **Utilities > Print**.

Taking a Snapshot

Use the snapshot option to create a Microsoft Excel™ comma-separated values (CSV) file that contains information about the spectrum on the Display page. The data system stores this file with the name WaveData.csv in the ChromQuest directory. The file three columns: diode number, wavelength, and intensity value.

Note The data system appends the file with a date and time stamp. The data stamp consists of six digits; the first two digits are the month, followed by two digits for the day and two digits for the year. The time stamp consists of six digits; the first two digits are the hour in military time, followed by digits for the minutes and two digits for the seconds.

❖ To take a snapshot and view the stored information

1. On the Display page, stop the data stream by clicking **Stop** in the Data area.
2. Click **Snapshot**.
3. Using Microsoft Windows™ Explorer, browse to the ChromQuest directory.
4. Click the **WaveData.csv** file.

   Microsoft Excel opens.

Adjusting the Light Throughput with the ChromQuest Data System

The Accela PDA Detector has two attenuators that control the light throughput from the lamps.

Decreasing light throughput increases baseline noise. Increasing light throughput can saturate the diode array. When the array is saturated, the response from the Accela PDA Detector is a flat baseline.

Adjust the attenuators as the light output from the deuterium lamp decreases and whenever you do the following:

- Replace either lamp (see "Replacing the Lamps" on page 89)
- Replace the LightPipe flowcell (see "Installing the LightPipe Flowcell" on page 17)
- Change the configured diode array scan rate (see Chapter 3, "Configuration.")

Tip As the diode array scan rate increases, the sampling time per diode decreases. The integrated light intensity viewed on the Display page is a function of the light throughput to the diode array and the sampling time per diode. So when you change the diode array scan rate, you must adjust the light throughput.

- If you increase the diode array scan rate (for example, from 20 Hz to 80 Hz), you must increase the light throughput to achieve the same intensity counts.
- If you reduce the diode array scan rate (for example, from 80 Hz to 20 Hz), you must reduce the light throughput to avoid saturating the array.

Pushing the attenuator tabs upward increases the light throughput to the diode array. Pushing the attenuator tabs down decreases the light throughput to the diode array. (See Figure 20 on page 25.)

Check the light intensity by following the Operational Verification procedure and adjust the attenuators to provide light intensities in the specified operating ranges.

Note Before you adjust the attenuators, replace the column with a flow restrictor, and set the pump to deliver HPLC-grade water at a flow rate of 1 mL/min through the flowcell.

To adjust the light throughput from the lamps, follow these procedures:

1. Setting Up the Spectral and Discrete Channel Displays
2. Adjusting the Attenuators

Setting Up the Spectral and Discrete Channel Displays

❖ **To set up the spectral and discrete channel displays**

1. Open the Diagnostics dialog box for the Accela PDA Detector (see "Accessing the Direct Controls for the Accela PDA Detector" on page 62).
2. Turn on both lamps (see "Controlling the Lamps from the ChromQuest Data System" on page 63).
3. Download the parameters for the spectral display:
   a. Click the **Control** tab.

      The Control page appears (see Figure 56 on page 66).
   b. In the Mode area, select the **Intensity** option.
   c. Click **Default**, and then verify that the following parameters are specified:

      Start = 2

      End = 511

      Step = 1
   d. Click **Load To Detector**.
4. Determine the diodes of maximum output for the lamps as follows:
   - From the spectrum displayed, determine and record the pixel of maximum intensity within the 10 to 40 diode range. This is the diode of maximum output for the deuterium lamp.
   - From the spectrum displayed, determine and record the pixel of maximum intensity within the 400 to 500 diode range. This is the diode of maximum output for the tungsten lamp. Ignore the spike at approximately diode number 380. This spike is an emission line of the deuterium lamp.
5. Turn off the data stream as follows:
   a. In the Status area, click **Off** .
   b. In the Data area, click **Stop**.
6. Set the discrete channel displays as follows:
   a. Click the **Control** tab to return to the Control page.
   b. In the Channel A box, type the value for the diode of maximum intensity for the deuterium lamp.
   c. In the Channel C box, type the value for the diode of maximum intensity for the tungsten lamp.
   d. Click **Load to Detector**.

Adjusting the Attenuators

Use the attenuator tabs (see Figure 20 on page 25) on the front panel of the PDA detector to adjust the light throughput to the diode array.

❖ To adjust the attenuators

1. Set up the spectral and discrete channel displays (see "Setting Up the Spectral and Discrete Channel Displays" on page 70).
2. Click the **Display** tab.

   The Display page appears.
3. As you view the discrete channel display (see Figure 58), do the following:
   - Adjust the left attenuator tab (UV attenuation) to achieve a Channel A value as close as possible to 900000 without saturating the array.
   - Adjust the right attenuator tab (Visible attenuation) to achieve a Channel C value as close as possible to 900000 intensity counts as possible without saturating the array.

     Figure 59 and Figure 60 on the next page show saturation of the diode array.

Figure 58. Display page (after you click On in the Status area and Start in the Data area)

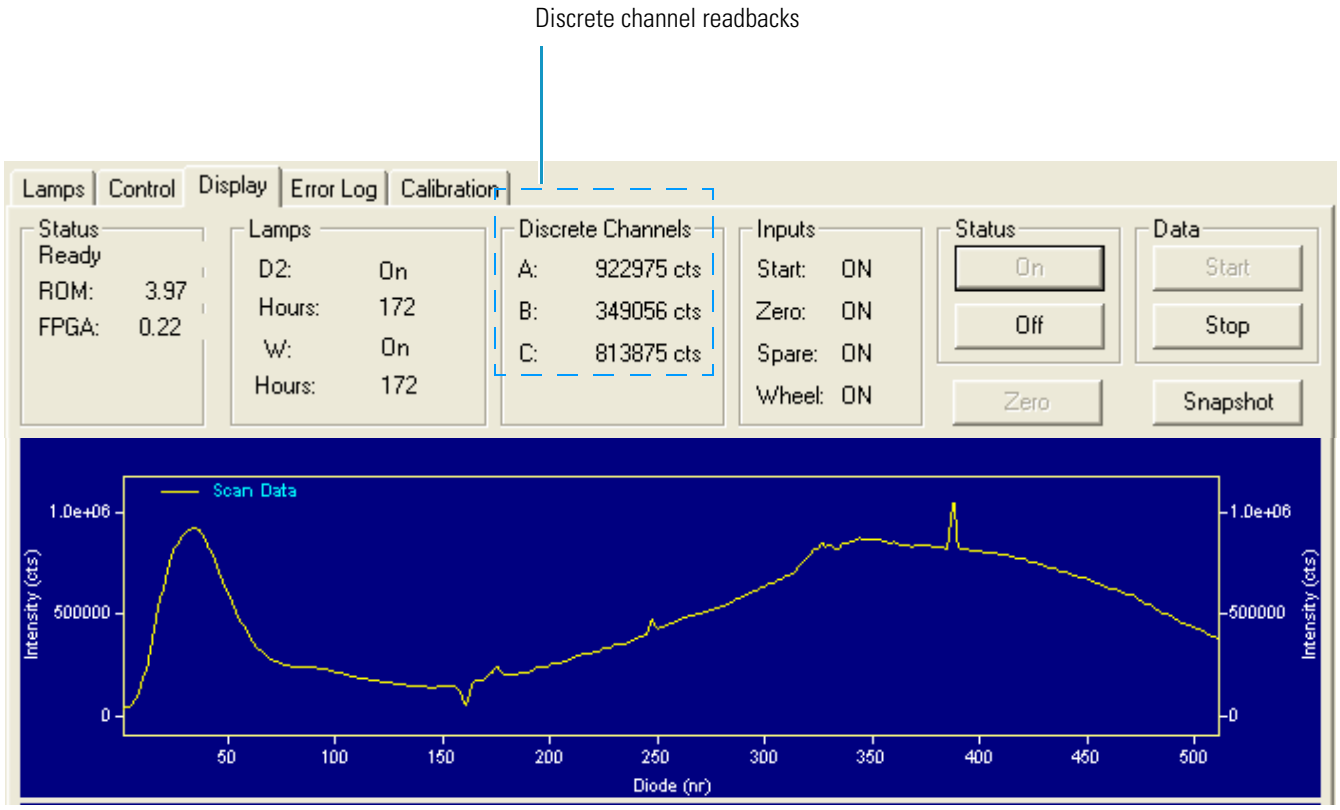


Figure 59 shows a saturated array in the UV region.

Figure 59. Saturated diode array (UV region)

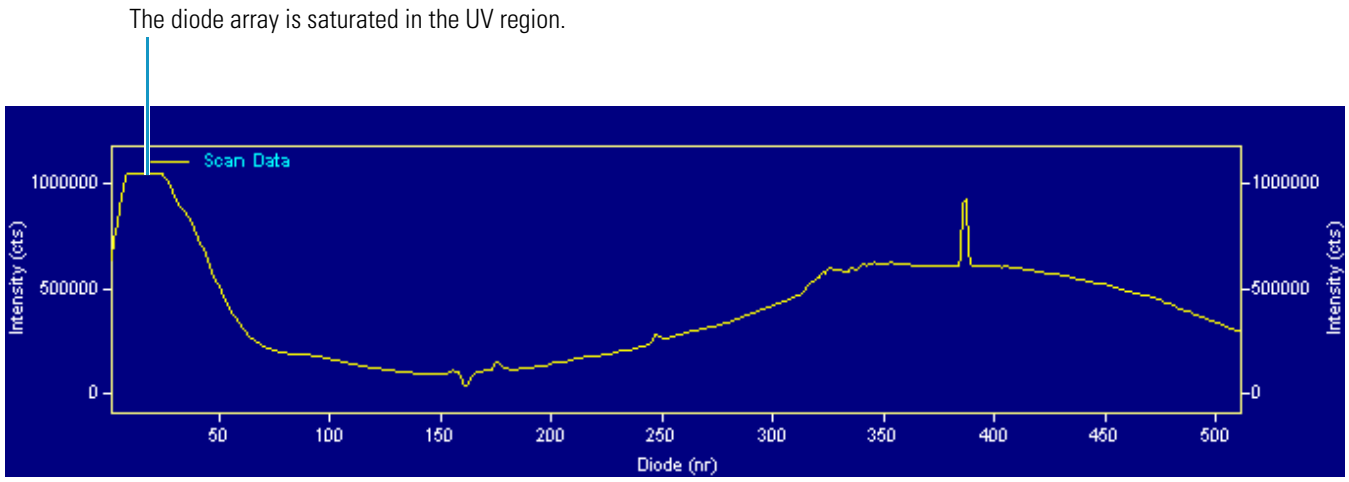
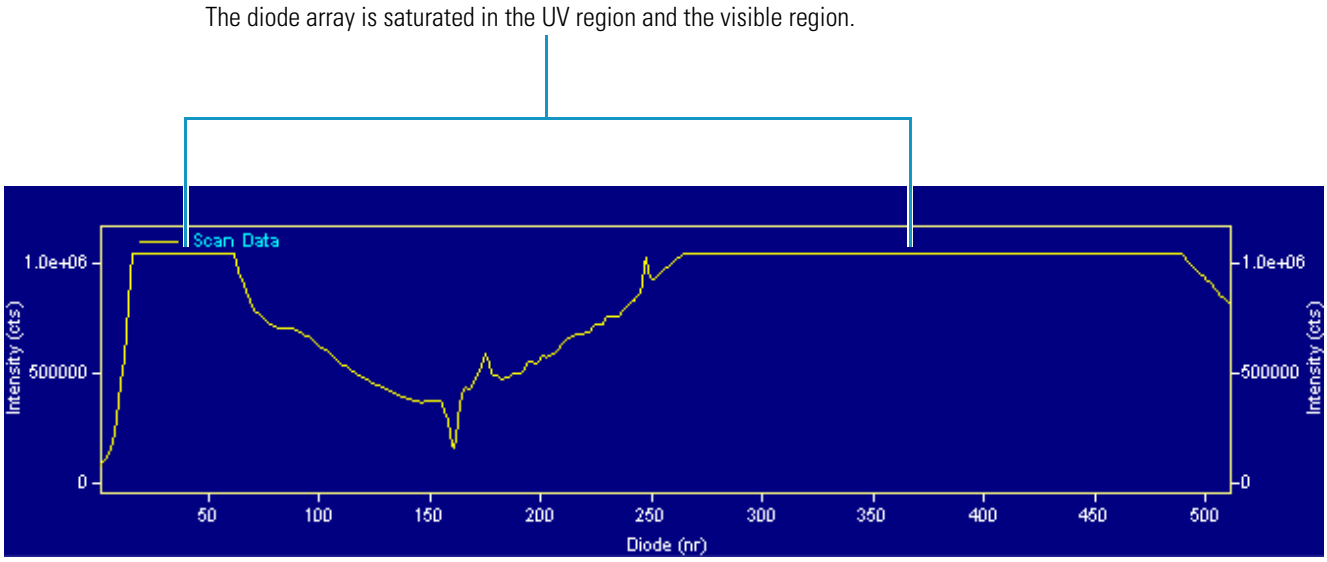


Figure 60 shows a diode array that is saturated in both the UV and visible regions. The configuration is set to a 20 Hz diode array scan rate and the attenuators are completely open.

Figure 60. Saturated diode array (UV region and visible region)



4. After you finish adjusting the attenuators, close the front doors of the detector.

Calibrating the PDA Detector from the ChromQuest Data System

To calibrate the PDA detector from the ChromQuest data system, follow these procedures:

1. Preparing the PDA Detector for Calibration
2. Performing an Array Calibration from the ChromQuest Data System
3. Performing a Wavelength Calibration from the ChromQuest Data System

Preparing the PDA Detector for Calibration

❖ **To prepare the Accela PDA Detector for calibration**

1. Replace the LC column with a flow restrictor.
2. Set up the system to pump HPLC-grade water or HPLC-grade methanol through the flowcell, and then start the solvent flow.
3. Turn on both lamps and wait one hour for the D2 lamp to equilibrate (see "Controlling the Lamps from the ChromQuest Data System" on page 63).
4. Verify that the diode array is not saturated (see "Adjusting the Light Throughput with the ChromQuest Data System" on page 69).

Performing an Array Calibration from the ChromQuest Data System

The Array calibration measures and corrects for the dark current produced by the diodes of the photodiode array. The dark current is the small amount of background signal that is produced by the diodes of the array even when both lamps are turned off. Typical dark current values range from 2000 to 4000 counts.

The environmental conditions of your laboratory can cause the dark current of the diode array to increase over time. For best results, perform an array calibration (dark current) after any of the following events occurs:

- After 100 hours of use or monthly, whichever comes first
- Whenever a significant temperature change occurs
- After you move the detector
- After you replace the lamps

Because the dark current produced by the diodes rises as the temperature within the detector rises, make sure that you warm up the lamps for one hour before you perform a dark current calibration. Warming up the lamps for one hour equilibrates the detector to its normal operating temperature.

The PDA detector briefly turns the lamps off as it performs the dark current calibration routine. After it completes the dark current calibration, the PDA detector turns the lamps back on.

Note The dark current calibration program does not run when data collection is enabled on the Display page.

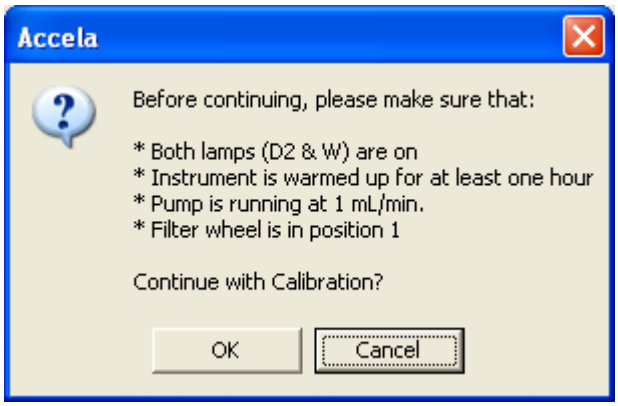
❖ To perform a dark current calibration of the diode array

1. Prepare the PDA detector for calibration (see "Preparing the PDA Detector for Calibration" on page 73).
2. Open the Diagnostics dialog box for the Accela PDA Detector (see "Accessing the Direct Controls for the Accela PDA Detector" on page 62).
3. Click the **Calibration** tab.

   The Calibration page appears.
4. In the Array area, click **Execute**.

   A message box appears (see Figure 61).

   Figure 61. Calibration preconditions dialog box

5. Make sure that the lamps are warmed up, that the pump is running at 1 mL/min, and that the filter wheel is in position 1 (see Figure 20 on page 25), and then click **OK**.

   The status of the calibration procedure appears by the Status readback area on the Calibration page. During the dark current calibration, the lamps turn off before the data system collects the intensity scans. After the last calibration event, the lamps turn back on.
6. Click **OK** to finish the calibration.

   The date and time of the calibration appear in the Array area of the Calibration page and are stored in the PDA detector's memory.

Performing a Wavelength Calibration from the ChromQuest Data System

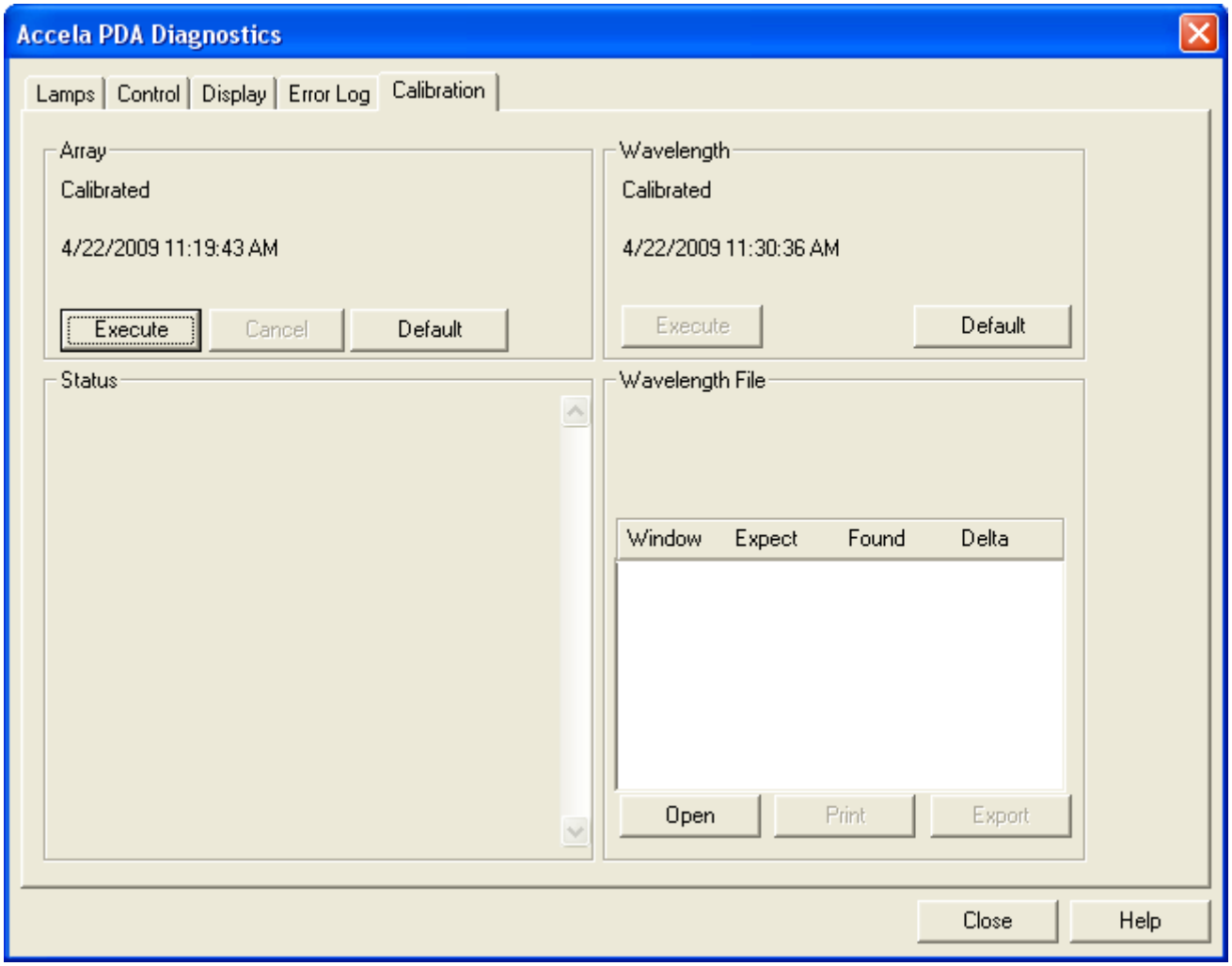
The alignment of the spectrum on the diode array depends upon the physical alignment of various components of the optical bench. The alignment can become offset if the detector is sharply jolted, in shipping, for example. Such bumps and jars can slightly change the wavelength of light reaching the photodiode array. The automated wavelength calibration determines the wavelength accuracy of the detector and uses the detector's wavelength algorithm to correct any misalignment.

❖ To perform a wavelength calibration with ChromQuest

1. Open the Accela PDA Diagnostics dialog box (see "Accessing the Direct Controls for the Accela PDA Detector" on page 62).
2. Click the **Calibration** tab.

   The Calibration page appears (see Figure 62).

Figure 62. Calibration page of the Accela Diagnostics dialog box

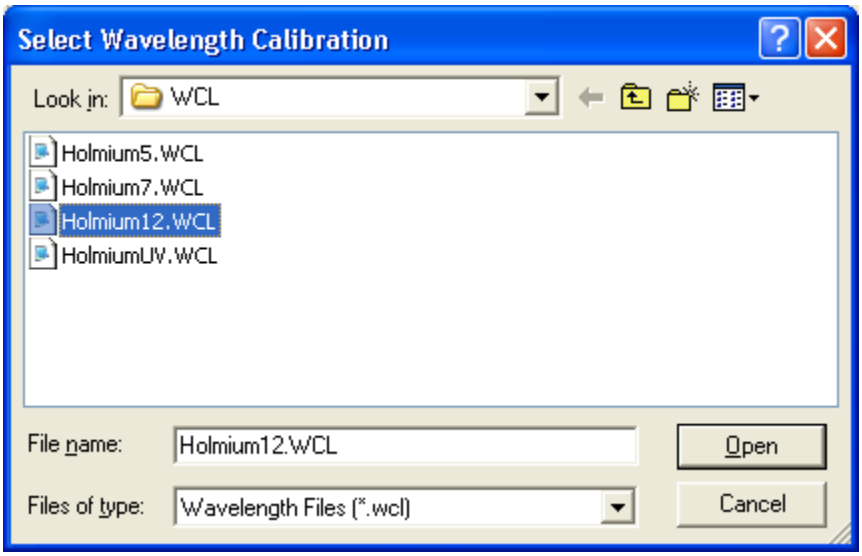


3. Open a wavelength calibration file:

   a. In the Wavelength File area, click **Open**.

   The Select Wavelength Calibration dialog box appears (see Figure 63).

   Figure 63. Select Wavelength Calibration dialog box



   b. Select an appropriate wavelength calibration file from the list.

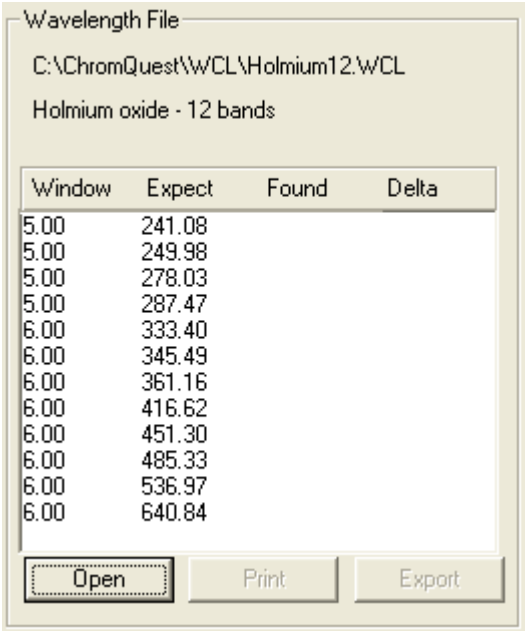
   An appropriate wavelength file should include the range of wavelengths that you use under normal operating conditions.

   c. Click **Open**.

> **Note** ChromQuest has four calibration files to choose from. The HolmiumUV file contains five wavelengths in the UV region while the other files, such as Holmium12, use sets of wavelengths from both the UV and Visible wavelength regions. The holmium oxide absorbance maxima are selected from a spectrum published in "Holmium Oxide Solution Wavelength Standard from 240 to 640 nm - SRM 2034 (NIST Special Publication 260-54)."

   The holmium oxide bands of the selected file appear in the Wavelength File area (see Figure 64).

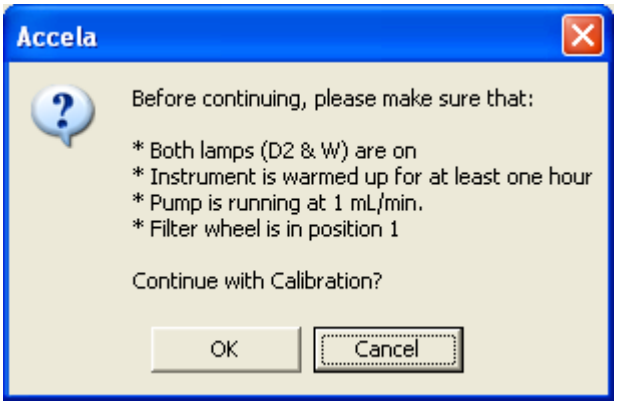
Figure 64. Wavelength File area with the Holmium12 Wavelength Calibration File selected



4. In the Wavelength area, click **Execute**.

   A message box appears (see Figure 65).

Figure 65. Calibration preconditions



5. If all of the preconditions are met, click **OK**.

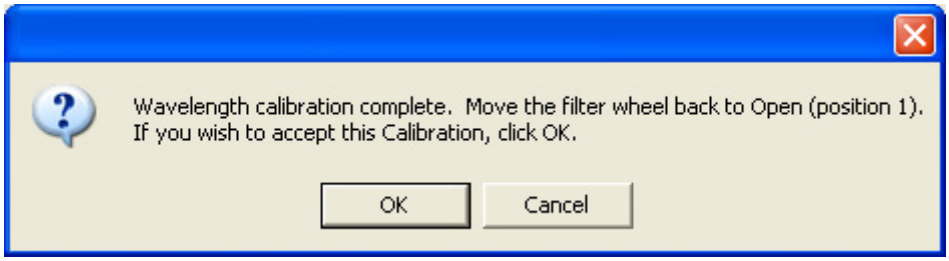
   The data system collects a background spectrum, which it uses to remove the absorbance contribution of the mobile phase. When the background collection is complete, another message box appears (see Figure 66).

Figure 66. Message prompting you to move the filter wheel to position 2

6. Move the filter wheel to position 2 as directed, and then click **OK**.

   The detector takes a holmium oxide scan, performs iterative calculations while applying the rise time and bandwidth filters, and then displays a new message box (see Figure 67).

Figure 67. Calibration message prompting you to return the filter wheel to position 1



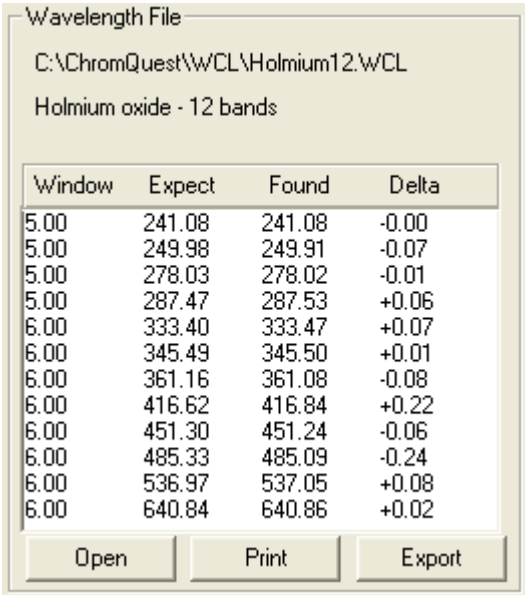
7. Move the filter wheel back to position 1, and then click **OK** to close the message box and view the results.

8. In the Wavelength File area, check the delta values (see Figure 68).

   a. If the delta values are not within the range of ±1 nm, repeat the wavelength calibration procedure for verification.

   b. If, after applying a new calibration, the delta values are still not within the range of ±1 nm, call your Thermo Fisher Scientific service representative for assistance.

Figure 68. Wavelength File area with a list of acceptable delta values



9. If your data system computer is connected to a printer, click **Print** to print a hardcopy report. To store the results, click **Export**.

The date and time of the wavelength calibration appear in the Wavelength area. This information is also stored by the PDA detector.

Note You can click **Cancel** in any of the Calibration dialog boxes at any time to cancel the calibration process.

Displaying, Printing, and Clearing the Error Log

Detector errors and major detector events, such as power-on self-tests (POSTs), are logged to a dedicated area in the memory of the detector. These messages are created as part of the normal operation of the detector and can be helpful when attempting to troubleshoot communications problems.

The log can hold a maximum of 100 errors/events. When the log is full, the newest entry replaces the oldest entry. To keep a continuous record for your maintenance files, print out the log and clear it periodically. The memory is protected by battery backup when the detector is turned off. View, print, and clear the log weekly as part of your regular maintenance routine.

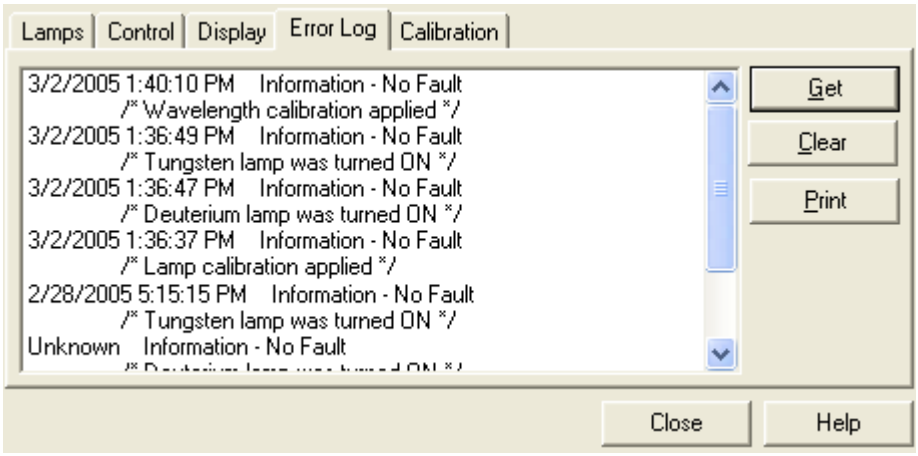
For a list of some common error messages that might appear in the log, see "Log Entries" on page 100.

❖ To display, print, and clear the error log in the ChromQuest data system

1. Open the Error Log page:
   a. Open the Diagnostics dialog box (see "Accessing the Direct Controls for the Accela PDA Detector" on page 62).
   b. Click the **Error Log** tab.

      The Error Log page appears (see Figure 69).

      Figure 69. Error Log page



2. Use the buttons in the Error log page to do the following:
   - Click **Get** to retrieve and display the error log information from the detector. Figure 69 shows a sample Error Log.
   - Click **Print** to print a copy of the displayed log.
   - Click **Clear Log** to clear the log.

Checking the Firmware Version

Occasionally, upgraded firmware becomes available for the Accela PDA Detector. Ask your Thermo Fisher Scientific Service Representative about the availability of new firmware.

❖ To check the firmware version in the ChromQuest data system

1. Open the Diagnostics dialog box (see "Accessing the Direct Controls for the Accela PDA Detector" on page 62).
2. Click the **Display** tab.

   The Display page appears.
3. Click **On**.

   The firmware version of the Accela PDA Detector appears in the Status area on the left side of the Display page (see Figure 57 on page 67).

Routine Maintenance

This chapter describes how to clean the LightPipe flowcell and how to replace the lamps.

Proper maintenance ensures the optimum performance of the Accela PDA Detector. You are responsible for maintaining your PDA detector by properly performing the maintenance procedures on a regular basis. If you have any questions on proper maintenance, or would like to arrange for a preventive maintenance program, contact your Thermo Fisher Scientific service representative.

For maintenance procedures requiring the use of the data system, see the appropriate chapter:

- Chapter 4, "Xcalibur Diagnostics for the PDA Detector," on page 33
- Chapter 5, "ChromQuest Diagnostics for the PDA Detector," on page 61

Contents

Recommended Maintenance

Table 3 lists recommendations for routine maintenance of the Accela PDA Detector. Use the table as a basis for developing your maintenance program in accordance with your company practices.

Table 3. Recommended routine maintenance

Procedure		Interval
Cleaning external surfaces		As needed
LightPipe flowcell cleaning		As needed*
Wavelength calibration		After lamp replacement or as needed
Dark current calibration (Calibrating the dark current increases the linearity of the detector at the high end of its operating range. The dark current does not significantly affect absorbance values between 0.2 AU and 0.8 AU. The dark current is a function of temperature.)		After 100 hours of use or monthly, whichever comes first
		After significant changes (>4 °C) in ambient room temperature
		After lamp replacement
Event log printout		Weekly
Operation verification		Semi-annually
Lamp replacement		
	Deuterium (D2)	Replace the deuterium lamp when the detector noise reaches an unacceptable level (see "Lamp Lifetime and Detector Noise" on page 5). The useful lamp lifetime is approximately 1000 hours at a diode array scan rate of 40 Hz and 2000 hours at a diode array scan rate of 20 Hz.
	Tungsten (W)	Every 2500 hours or as required
Adjust attenuators		As needed
Update firmware		As needed and as updates become available

* Good Laboratory Practice (GLP) dictates flushing the LightPipe flowcell with clean solvent after every use. This practice reduces the frequency of cleaning the LightPipe flowcell.

Cleaning the External Surfaces of the Detector

Keep the external surfaces of the detector clean and dry. To clean the outside of the detector, wipe with a dust-free cloth or a damp cloth (moistened with water only) to remove dirt or stains.

Cleaning the LightPipe Flowcell

This section is limited to the general cleaning of the detector's LightPipe flowcell. For other LightPipe flowcell problems, such as leaks that occur in locations other than at the inlet/outlet fittings, contact your Thermo Fisher Scientific Service Representative.

The exterior and interior surfaces of the LightPipe flowcell can become contaminated. Flowcell contamination is usually caused by precipitation or by solubility problems, such as when the quality of your mobile phase varies or the cleanliness of your samples varies. Signs of a contaminated LightPipe flowcell are increased baseline noise, signal spiking, erratic or drifting baselines, low light intensity, or increased backpressure.

CAUTION Do **not** disassemble the LightPipe flowcell housing, tighten the screws on the housing, or touch the optical fibers at the ends of the LightPipe flowcell. Doing so damages the LightPipe flowcell. Thermo Fisher Scientific is not responsible for any damage done to the LightPipe flowcell by attempts to disassemble the housing or tighten the screws. Contact your Thermo Fisher Scientific service representative with any questions regarding LightPipe flowcell maintenance or service.

This section contains the following procedures:

- Removing the LightPipe Flowcell
- Cleaning the LightPipe Flowcell with Organic Solvents
- Cleaning the LightPipe Flowcell with Nitric Acid

Removing the LightPipe Flowcell

To clean the LightPipe flowcell, remove it from the Accela PDA Detector.

❖ **To remove the LightPipe flowcell**

1. Turn the detector power off and disconnect the power cord from the back panel of the detector.
2. Open the front doors of the detector.
3. Loosen the captive screw that secures the flowcell cover.
4. Remove the flowcell cover (see Figure 70).

   The LightPipe flowcell is located behind the flowcell cover (see Figure 71).

Figure 70. Accela PDA Detector with the front doors open

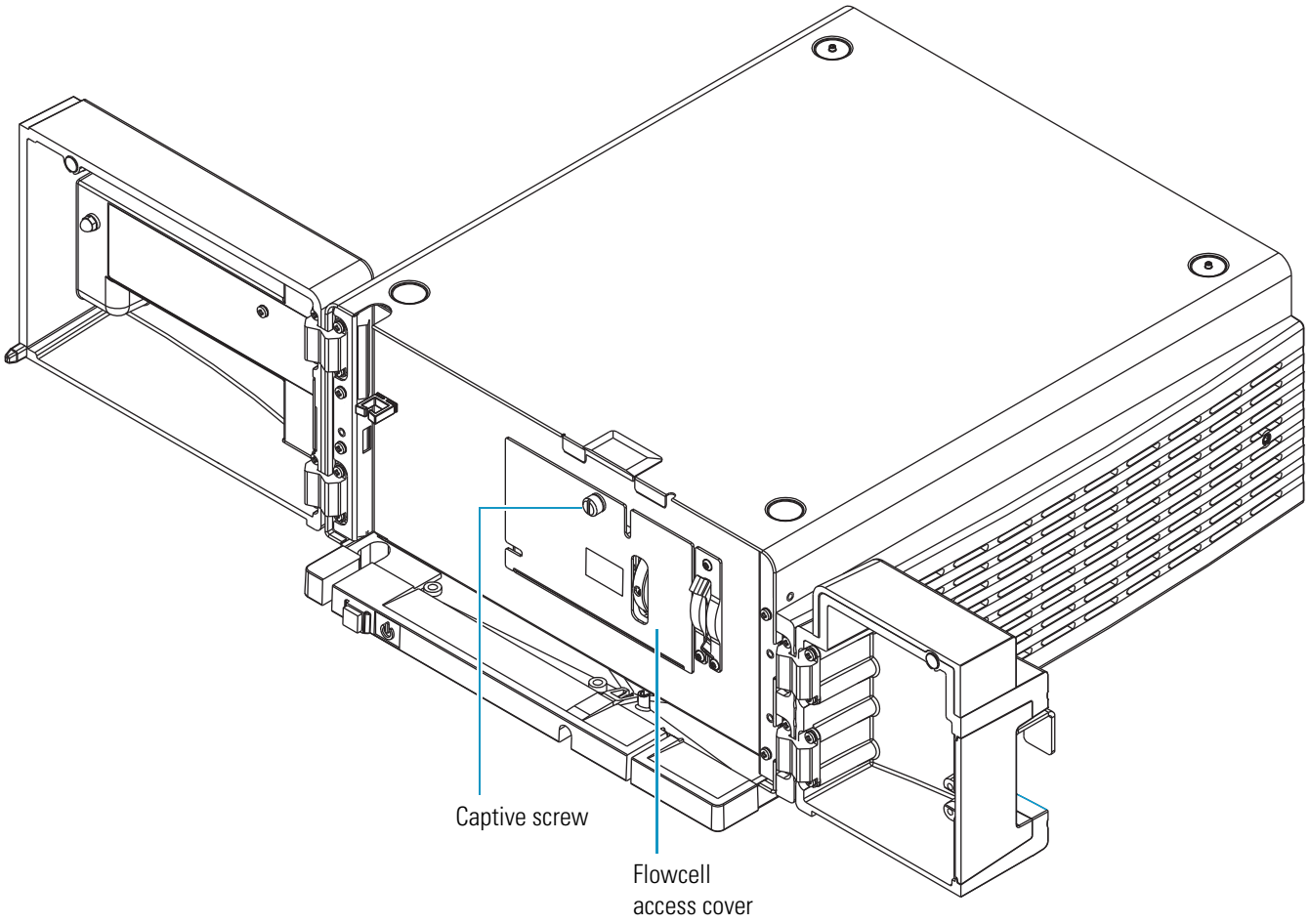
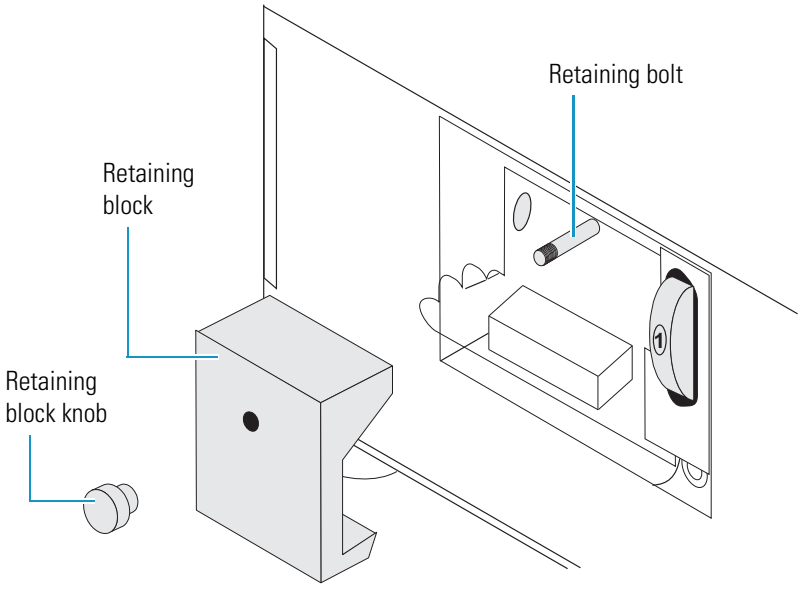


Figure 71. Retaining block and retaining block knob



5. Unscrew and remove the retaining block knob that holds the flowcell retaining block in place.
6. Remove the retaining block (see Figure 71 on page 86).

CAUTION To prevent damage, do **not** touch the ends of the LightPipe flowcell as you remove it from the flowcell compartment.

7. Being careful not to touch the optical fibers at the ends of the LightPipe flowcell, pull the flowcell out of the flowcell compartment.
8. Depending on how you plan to clean the LightPipe flowcell, do one of the following:
   - To store the flowcell, disconnect the liquid lines. Then place the protective end caps on the ends of the LightPipe flowcell.
   - To temporarily remove the flowcell from the system, disconnect the LightPipe flowcell inlet tube from the column.
   - To clean the LightPipe flowcell by pumping solvent through it, disconnect the flowcell inlet tube from the column and reconnect it directly to the pump. Leave the outlet tubing connected to the waste reservoir.

Cleaning the LightPipe Flowcell with Organic Solvents

If you suspect that your LightPipe flowcell needs cleaning, start with the following procedure using organic solvents.

CAUTION Do **not** disassemble the LightPipe flowcell housing, tighten the screws on the housing, or touch the optical fibers at the ends of the LightPipe flowcell. Doing so damages the LightPipe flowcell. Thermo Fisher Scientific is not responsible for any damage done to the LightPipe flowcell by attempts to disassemble the housing or tighten the screws. Contact your Thermo Fisher Scientific Service Representative with any questions regarding LightPipe flowcell maintenance or service.

❖ To clean the LightPipe flowcell with an organic solvent

1. Remove the column from the chromatographic system to avoid column degradation. Connect the inlet of the LightPipe flowcell directly to the chromatographic pump.

IMPORTANT Ensure that the cleaning solvents you plan to use are miscible with the solvent already present in the LightPipe flowcell and pump. Isopropanol is a good choice as a cleaning solvent for most applications. If the last solvent in the pump was an aqueous buffer solution, be sure to pump 25 to 40 mL of HPLC-grade water (or its equivalent) through the system to remove any salts before you flush the pump with the cleaning solvents. This wash helps to avoid precipitation problems.

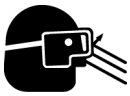
2. If necessary, flush the LightPipe flowcell with water to prevent a reaction between the last solvent used in the chromatographic system and the cleaning solvent that will be used to clean the flowcell.

CAUTION Thermo Fisher Scientific does not recommend using a syringe to force solvent through the flowcell. Pressurizing the syringe could cause a leak or rupture, resulting in a dangerous and uncontrolled spraying of solvent.

3. Flush the flowcell with 40 to 50 mL of cleaning solvent, for example, isopropanol or methanol.
4. Flush the flowcell with water to prevent a reaction between the cleaning solvent and the mobile phase that is used in your application.
5. For instructions on how to reinstall the LightPipe flowcell, see "Installing the LightPipe Flowcell" on page 17.

Cleaning the LightPipe Flowcell with Nitric Acid

Isopropanol or methanol is generally sufficient for cleaning a LightPipe flowcell. However, if the LightPipe flowcell remains contaminated after flushing it with organic solvents, perform the following procedure using nitric acid.



CAUTION Nitric acid is a strong oxidizing acid, and it can react vigorously with alcohols (especially methanol). Be sure to wear protective clothing and eye protection and adhere to safety procedures at your company for the proper handling and disposal of corrosive acids. Flush the flowcell with water to remove all traces of alcohol before flushing it with nitric acid.

❖ To clean the LightPipe flowcell with nitric acid

1. Completely remove the LightPipe flowcell from the detector housing by following the procedure in "Removing the LightPipe Flowcell" on page 85. (This prevents possible leaks from harming the mechanical and electronic components of the detector.)
2. Ensure that the column is removed from the chromatographic system to avoid column degradation. Connect the LightPipe flowcell inlet directly to the chromatographic pump.
3. Flush the LightPipe flowcell with water. This prevents a reaction between the last solvent used in the chromatographic system and the nitric acid solution will be used to clean the flowcell.
4. Prepare a 20% (v/v) solution of nitric acid in HPLC-grade water.

CAUTION Thermo Fisher Scientific does **not** recommend using a syringe to force acid solutions through the flowcell. Pressurizing the syringe could cause a leak or rupture, resulting in a dangerous and uncontrolled spraying of acid.

CAUTION Before you pump nitric acid solution through the LightPipe flowcell, ensure that the column has been removed from the chromatographic system and that water was the last solvent in the pump and solvent reservoir.

5. Using the Accela Pump, pump the nitric acid solution through the LightPipe flowcell.
6. After you have finished the cleaning procedure and before you return to the chromatographic solvents, pump another 25 to 40 mL of water through the flowcell to remove all traces of nitric acid. Monitor the pH of the outlet stream of the LightPipe flowcell to ensure that the acid has been completely flushed out.
7. To reinstall the flowcell, see "Installing the LightPipe Flowcell" on page 17.

Replacing the Lamps

As the deuterium lamp ages, there is a reduction in light output, which results in increased baseline noise. If the noise level on your detector output signal is unacceptable, and cleaning the flowcell does not help, use the data system's diagnostic features to determine the cause of the problem. If the light output becomes too low and adjusting the attenuators does not help, replace the deuterium lamp. The light output from the tungsten-halogen lamp is relatively stable as the lamp ages.

The detector keeps track of the number of hours each lamp has been operating. The deuterium lamp has a lifetime of approximately 1000 hours and the tungsten lamp has a lifetime of approximately 2500 hours. Lamp lifetime varies depending upon the application.

The deuterium (D2) and tungsten (W) lamps are located in the lamp compartment to the right of the optical bench assembly, viewed with the detector chassis open as shown in Figure 75 on page 92.

CAUTION Intense UV light can damage your eyes. Always turn off the PDA detector and disconnect the power cord before you expose the lamp.

CAUTION There are electrical shock hazards inside the PDA detector's housing. Always turn off the PDA detector and disconnect the power cord before you pull the chassis out of the housing.

CAUTION The lamp cover becomes very hot when the lamps are on. After you turn off the lamps and the PDA detector, wait 30 minutes for the lamp cover to cool before removing it.

You must have the following tool to replace the lamps: a #2 Phillips head screwdriver.

❖ To replace the deuterium and tungsten lamps

1. From the data system, turn off the lamps.

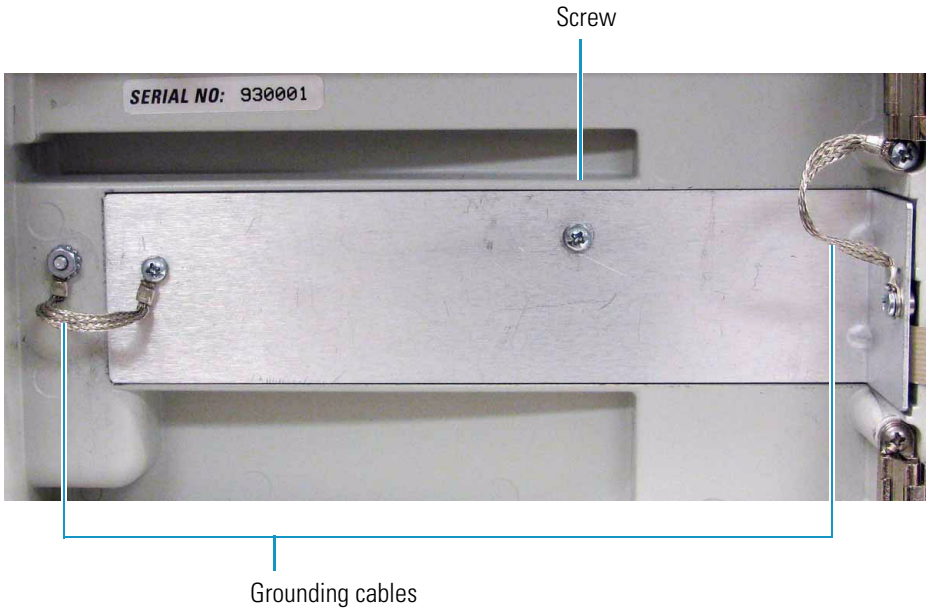
   For instructions on turning off the lamps, see the following:

   - For the ChromQuest data system, see "Controlling the Lamps from the ChromQuest Data System" on page 63.
   - For the Xcalibur data system, see "Controlling the Lamps from the Xcalibur Data System" on page 35.

2. Wait approximately 30 minutes for the lamp compartment to cool to room temperature.
3. Turn the power switch at the front of the PDA detector to Off (released position) and disconnect the power cord from the back panel.
4. If you did not turn off the lamps before you turned off the PDA detector, wait approximately 30 minutes for the lamp compartment to cool to room temperature.
5. Open the front doors by swinging each door outward.
6. Remove the LightPipe flowcell (see "Removing the LightPipe Flowcell" on page 85).
7. Using a #2 Phillips head screw driver, remove the screw that connects the metal plate to the inside of the left door (see Figure 72).

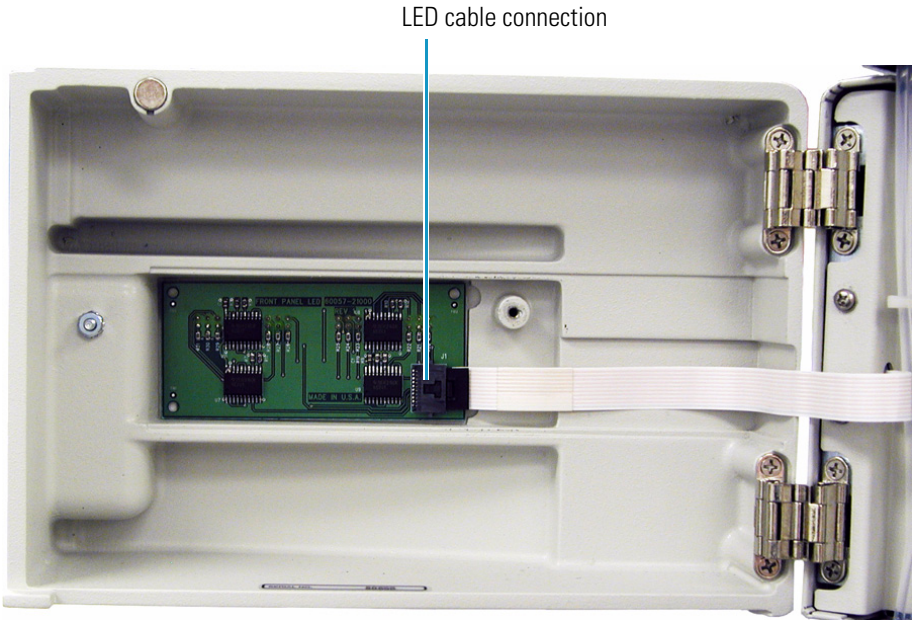
Note You do not have to detach the grounding cables to access the LED cable behind the metal plate.

Figure 72. Screw that secures the metal plate to the left door



8. Detach the LED cable from the door (see Figure 73).

Figure 73. LED cable connection to the inside of the left door



9. Using a #2 Phillips head screw driver, remove the four screws that secure the chassis to the housing. These screws are located on either side of the front panel (see Figure 74).

Figure 74. Four screws that secure the chassis to the housing

10. Slide the chassis out of the housing until the metal lamp compartment cover is accessible from the right side of the instrument.

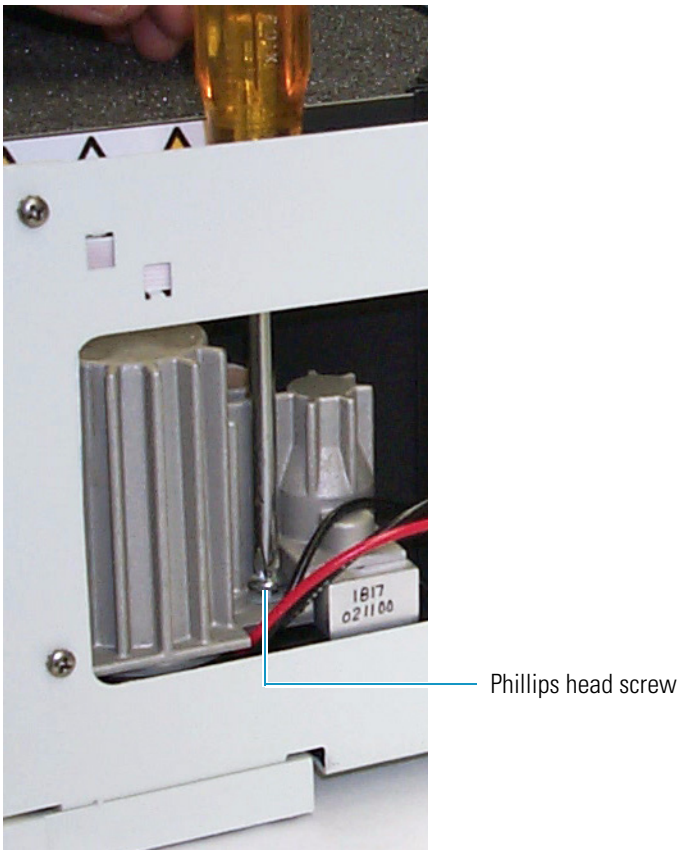
CAUTION After you turn off the lamps and the PDA detector, wait 30 minutes for the lamp cover to cool before removing it. The lamp cover becomes very hot when the lamps are on.

11. Remove the lamp cover as follows:

    a. Make sure that you have allowed sufficient time for the lamp cover and the lamps to cool to room temperature.

    b. Remove the lamp cover by loosening the large, captive Phillips head screw enough to free the lamp cover from the lamp tray (see Figure 75).

    Figure 75. Removing the Phillips head screw



    c. Lightly touch the lamp cover to make sure that it has cooled to room temperature, and then carefully lift the lamp cover out of the detector.

> **IMPORTANT** Do **not** try to remove the lamps from their mounting assemblies. Remove and replace the lamp together with its mount, cable, and connector as described in the following steps.

> **IMPORTANT** The surfaces of both lamps must be free of fingerprints and smudges, which cause performance problems. For this reason, wear clean, talc-free gloves when you handle the lamps. If either lamp requires cleaning, use a lint-free lens paper moistened with methanol or isopropanol before replacing the lamp cover.

12. To remove the deuterium lamp assembly:
    a. To disconnect the lamp cable, squeeze the connector latch, and then gently pull the connector free from the receptacle on the lamp compartment wall (see Figure 76).
    b. Loosen but do not remove the two Phillips head screws by turning them approximately four turns.
    c. Lift and gently twist the mounting flange counterclockwise to free the lamp (see Figure 77).

Figure 76. Lamp connections

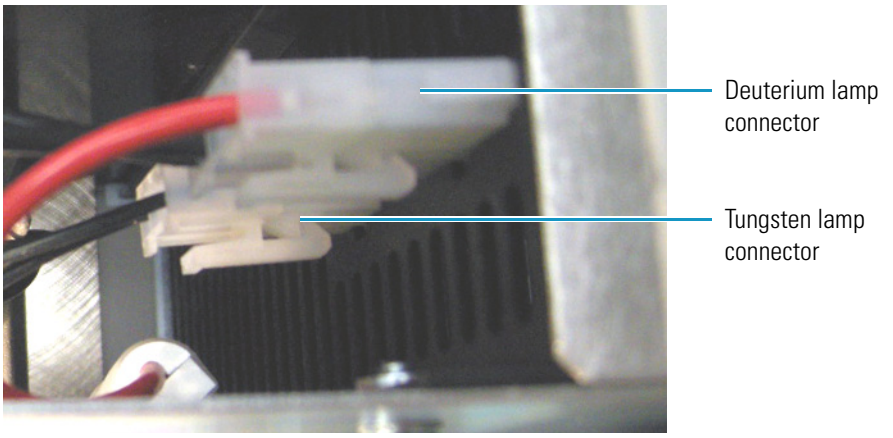
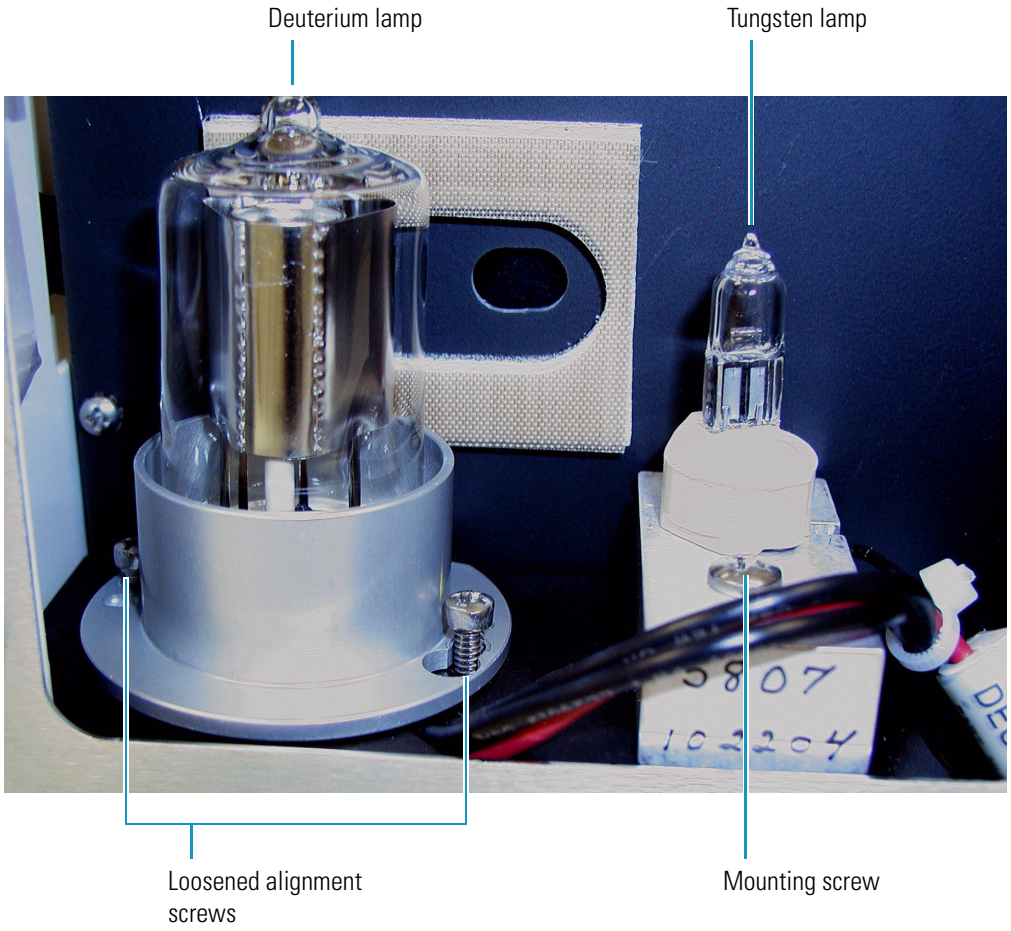


Figure 77. View of the deuterium lamp with its alignment screws loosened by four turns



13. To remove the tungsten (W) lamp:

    a. To disconnect the lamp cable, squeeze the connector latch, and then gently pull the connector free from the receptacle on the lamp compartment wall (see Figure 76).

    b. Loosen and remove the single Phillips head screw that secures the lamp-mounting block (see Figure 77).

To install a lamp, perform the preceding removal procedure in reverse order.

IMPORTANT Remember to reset the elapsed lamp hours after replacing a lamp (see "Resetting the Lamp Lifetime" on page 36.

Replacing the Fuses

You can operate the PDA detector at 100/115V or 230V. However, you must make sure that the appropriate fuses are installed (see Table 4).

Table 4. Fuses

Line power voltage	Fuse size
100/115V	T3.15 A
230V	T1.6 A

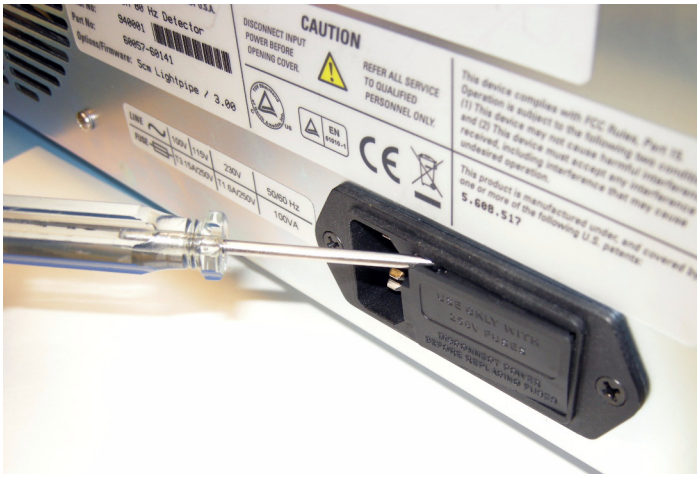
❖ To replace the fuses

1. Turn off the power to the detector and unplug the detector from line power.

CAUTION To avoid an electrical shock, before you replace the fuses, turn off the power to the detector and unplug the detector from line power.

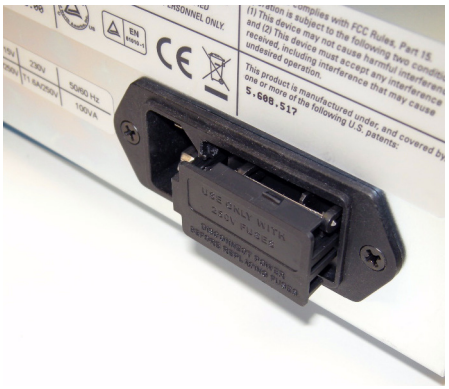
2. Insert the tip of a narrow-blade screwdriver into one of the two openings on the exterior surface of the power entry module, and then apply leverage to gain access to the power entry module's door (see Figure 78).

Figure 78. Loosening the power entry module's door



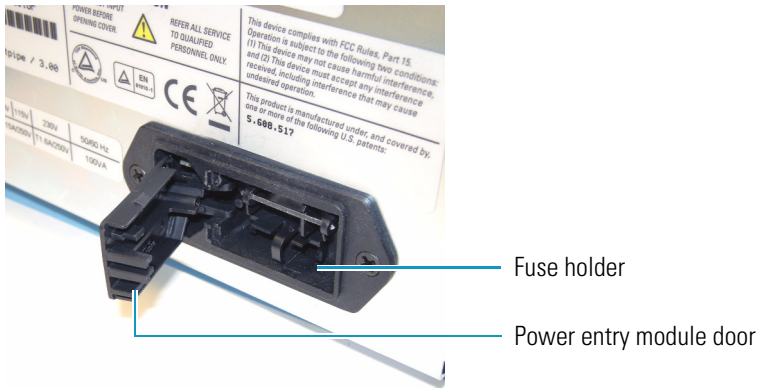
When you apply a sufficient amount of leverage, the door pops up (see Figure 79).

Figure 79. Power entry module door loosened



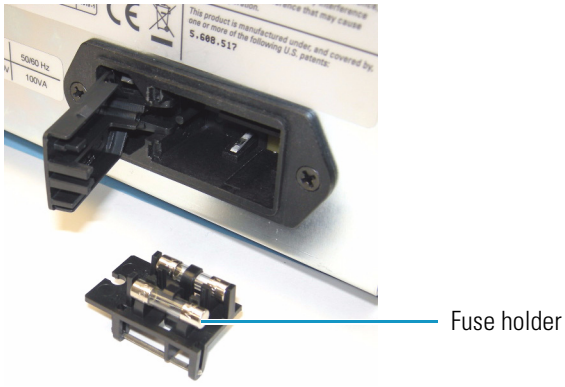
3. Open the door (see Figure 80).

Figure 80. Power entry module door opened



4. Take the loose fuse holder out of the power entry module (see Figure 81).

Figure 81. View of the fuse holder



5. Replace the fuses.
6. Put the fuse holder back into the power entry module, and then close the power entry module door until it snaps in.

Troubleshooting

This chapter contains helpful information for troubleshooting possible detector and chromatographic system problems. The information is organized in a table of symptoms, possible causes, and remedies. Because many of the problems attributed to the detector might actually be due to other components in the chromatographic system, references and potential solutions to these types of problems have also been included.

Contents

Detector-Related Problems

Table 5 lists detector-related problems along with suggestions for corrective action.

Table 5. Detector-related problems (Sheet 1 of 4)

Symptom	Cause	Remedy
Spikes on baseline.	Continuous gas bubbles in the LightPipe flowcell.	Degas the mobile phase. Connect a backpressure device to the LightPipe flowcell (check backpressure rating).
	Immiscible solvent bubbles following mobile phase changeover.	Flush the LightPipe flowcell with 2-propanol, then with mobile phase.
	Electrical interference.	Check the electrical lines for good connections, interference from broadcast radiation, or both. Check for ground loops.
	Extremely large fluctuations in voltage on power line.	Remove systems that can cause voltage fluctuations, for example, ovens; isolate the detector to a “quiet” circuit; or use an uninterruptible power supply (UPS) that is safety certified (UL, TUV, SEMKO, DEMKO, and so on).

Table 5. Detector-related problems (Sheet 2 of 4)

Symptom	Cause	Remedy
Random noisy baseline.	Contaminated LightPipe flowcell.	Flush the flowcell with cleaning solvents (see "Cleaning the LightPipe Flowcell" on page 85). Check for leaks.
	Leak in sample inlet line.	Check all the fittings from the column outlet to the flowcell inlet for leaks.
	Bubble trapped in LightPipe flowcell.	Increase the flow rate until you remove the bubble. Connect a backpressure device to the flowcell outlet (check the pressure rating to avoid rupturing the flowcell).
	Leaking LightPipe flowcell.	Replace the flowcell.
	Insufficient lamp warm-up.	Allow a 30 minute warm-up for normal operation and a 1½ hour warm-up for maximum sensitivity.
	Aging or defective lamp.	Replace the lamp.
	Ground loop problem between integrator and detector.	Check the cable connections to the detector output; do not ground at both ends of cable.
	Dirty LightPipe flowcell or lamps.	Clean the dirty component.
	Integrator input voltage does not match detector output voltage.	Verify that the integrator is connected to the appropriate Analog Output connections on the back panel of the detector. (See Chapter 2, "Installation.") Check the attenuation setting on integrator.
Excessive baseline drift.	Contaminated LightPipe flowcell.	Flush the flowcell with cleaning solvents as described in "Cleaning the LightPipe Flowcell" on page 85. Check for leaks.
	Mobile phase contamination.	Replace the mobile phase with fresh mobile phase that is made with high-purity solvents.
	Material bleeding from column.	Clean or replace the column.
	Leaks in system or the LightPipe flowcell.	Check all the fittings for leaks. Replace the flowcell.
	Tiny bubble trapped in LightPipe flowcell.	Increase the flow rate until you remove the bubble. Connect a backpressure device to the flowcell outlet (check the backpressure rating to avoid rupturing the flowcell).
	Excessive temperature fluctuations.	Remove the system from drafts. Thermostatically control the column temperature.

Table 5. Detector-related problems (Sheet 3 of 4)

Symptom	Cause	Remedy
No peaks, or peaks much smaller than expected.	Incorrect wavelength setting.	Check the wavelength setting. Make sure the correct file is selected.
	Lamp not on or defective.	Make sure the lamp is lit. Verify the lamp performance. See one of the following: • "Monitoring Lamp Performance from the Xcalibur Data System" on page 38 • "Monitoring Lamp Performance from the ChromQuest Data System" on page 65 Replace the lamp if necessary.
	Integrator input voltage does not match detector output voltage.	Verify that the integrator is connected to appropriate Analog Output connections on the detector 's back panel. (See Chapter 2, "Installation.") Check the attenuation setting on the integrator.
	Insufficient sample reaching the detector.	Check the entire chromatographic system for leaks. Check the sample injection volume.
Broad, tailing peaks.	Rise time is too long.	Lower the rise time selection.
	Poor connection at LightPipe flowcell inlet.	Check the end of the inlet tubing for a clean, flat surface that is free of obstructions.
Detector does not power up.	Tripped circuit breaker at power outlet.	Resolve the problem; reset the circuit breaker.
	Blown detector fuse.	Resolve the problem; replace the fuse (see "Replacing the Fuses" on page 95).
	Power cord not connected.	Connect the power cord.
Detector does not go into run upon injection.	Detector not receiving Start signal.	Check the connection to the Run contacts on the back panel of the detector.
Flat baseline, portion of spectrum missing.	Saturation of photodiode array.	Adjust the attenuators. See one of the following: • "Adjusting the Light Throughput with the ChromQuest Data System" on page 69 • "Adjusting the Light Throughput with the Xcalibur Data System" on page 42
Power LED is amber	Ethernet connection may be loose.	Check the Ethernet connection to the data system computer.
Comm LED is amber	Connection to the data system computer has been lost.	Check the Ethernet connection to the data system computer.

Table 5. Detector-related problems (Sheet 4 of 4)

Symptom	Cause	Remedy
Run LED is amber	An error has occurred during a run.	See software to determine the nature of the error, or begin the run again.
Lamp LED is amber	Both lamps are off.	Turn on the lamps and allow 1½ hours for warm-up.

Log Entries

This section describes the various log entries that are possible when operating the Accela PDA Detector from your Thermo Scientific data system.

Note For further information, document the log entry and contact Thermo Fisher Scientific technical support.

The diagnostics Event Log chronologically records messages relating to detector or system problems. The messages fall into three categories:

- Critical Failure Messages
- Warning Messages
- Information Messages

Critical Failure Messages

Critical failure messages indicate that the PDA cannot perform its function properly. If a chromatographic run is in progress when a critical failure occurs, the data might be corrupted or lost, and the run terminates. Possible critical failure messages include the following:

- Filter wheel misaligned
- Failed to turn on the Deuterium lamp
- Failed to turn on the Tungsten lamp

Warning Messages

Warning messages indicate a problem that should not affect the chromatographic run. Possible warning messages include the following:

- Run started while instrument not calibrated
- Error trying to send to a null queue
- Error trying to receive from a null queue
- Socket failed to receive data
- Socket failed to send data
- Data in EEPROM was corrupted
- Failed to calibrate dark current
- Failed to calibrate wavelength
- No fault

Information Messages

Information messages include the following:

- Deuterium lamp was turned on
- Deuterium lamp was turned off
- Tungsten lamp was turned on
- Tungsten lamp was turned off
- Wavelength calibration reset
- Lamp calibration reset
- Wavelength calibration applied
- Lamp calibration applied

Accessories and Replaceable Parts

This chapter contains the lists of accessories and replaceable parts that you can order from Thermo Fisher Scientific.

The LightPipe flowcell assembly consists of the parts listed in Table 6.

Table 6. LightPipe flowcell assemblies

Part number	Description
60053-98017	1 cm LightPipe flowcell with tubing and fittings
60053-98016	5 cm LightPipe flowcell with tubing and fittings
2522-0285	FingerTight, 10-32, one-piece PEEK fitting
803260	Inlet tubing, with insulation, PEEK 1/16 × 0.005 in. ID (red)
703950	Outlet tubing, PEEK 1/16 × 0.01 in. ID (blue)

IMPORTANT Use only PEEK fittings with the LightPipe flowcell.

The next several tables list additional accessories or parts: Table 7 lists optional accessories; Table 8 lists parts required to make the back panel connections; Table 9 lists maintenance parts; Table 10 lists repair and service parts; Table 11 lists items in the accessory kit.

Table 7. Optional accessories

Part number	Description
60257-60008	Filter wheel for linearity verification, (five-position; one cuvette with perchloric acid blank and five cuvettes with different concentrations of potassium dichromate in perchloric acid solution, NIST traceable)
802259	Backpressure regulator

Table 8. Cables and connectors for back panel connections

Part number	Description
70111-63302	Ethernet cable
60053-63034	Interconnect cable (seven-connector cable)

Table 9. Maintenance parts

Part number	Description
00010-01-00015	Deuterium lamp assembly (pre-aligned)
60257-60006	Tungsten-halogen (W) lamp assembly (pre-aligned)
2522-0285	Fingertightening, 10-32, one-piece PEEK fitting
803260	Inlet tubing, with insulation, PEEK 1/16 × 0.005 in. ID (Red)
703950	Outlet tubing, PEEK 1/16 × 0.010 in. ID (Blue)
00006-02-00010	Fuse, T3.15 A (5 × 20 mm) (for 100/115 V operation)
00006-02-00011	Fuse, T1.6 A (5 × 20 mm) (for 230 V operation)

Table 10. Repair and service parts

Part number	Description
60262-61000R	Assy, CPU, PCBA,
60262-61200R	Assy, PCB, lamp power supply board
00012-01-00023	Low Voltage Power Supply PCB
60257-63002	Cooling fan
60257-63004	Power entry module assembly
60257-63003	Power switch
60057-61000	LED assembly
60257-60007	Standard filter wheel
803226	Cable, ribbon, CPU to Lamp Power Supply PCB

Table 11. Accela PDA Detector Accessory kit

Part number	Description
A3538-010	Cable adapter, RJ45/14-D89FM
A3638-110	Cable, 4-pin, RJ45
6040-0103	Analog cable, detector
00004-02511	Connector, plug, 8-pin, 3.81 mm pitch, minicombicon
F3012-010	Funnel, drainage
F5034-010	Tubing, convoluted, detector drainage
70111-63302	Cable, Ethernet, straight patch with ferrite, 7 ft

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