



UV-116A

November, 1994

MF-9048

INSTRUCTION MANUAL

UV-Vis Detector

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Systems, Inc
2701 Kent Avenue
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Table of Contents

Preface.....	i
Safety Information	i
Support Policy.....	iii
Start-up Checklist.....	v
List of Spare Parts and Consumables	vi
Section 1. Getting Started.....	1
1.1 Learning Your Way Around	2
1.2 Instrument Control	3
1.3 Manual Conventions	6
1.4 What's Next?.....	8
Section 2. A Quick Example	9
2.1 An Example	10
2.2 What's Next?.....	14
Section 3. Basic Operations	15
3.1 Before You Begin.....	15
3.2 Single- and Dual-Wavelength Operation	15
3.3 More about Files	21
3.4 Analog Outputs	24
Section 4. Advanced Operations.....	27
4.1 Wavelength Programming	27
4.2 Programmed Autozero.....	29
4.3 Automatic Lamp Operations	30
4.4 Scanning	33
4.5 The Develop File	41
4.6 Sample Queue	43
4.7 K-Factor	47
4.8 Absorbance Ratios	52
4.9 Other Features	54
Section 5. Maintenance	57
5.1 Flowcells	57
5.2 Lamps	63

Section 6. Installation and Specifications	69
6.1 Installation.....	69
6.2 Specifications.....	79
Section 7. Menu Reference.....	81
7.1 Menu Tree	81
7.2 Menu Reference	84
Section 8. Troubleshooting.....	91
8.1 Theory of Operation.....	91
8.2 Common Problems	92
8.3 Error Messages	95
8.4 Diagnostic Tests	97
Section 9. Glossary	101
Section 10. Cuvette Holder Accessory	105
10.1 Installation.....	105
10.2 Using the Cuvette Holder	108
10.3 Maintenance.....	109
Index	I-1

Preface

Safety Information

INSTRUMENT CERTIFICATION

In accordance with BAS' commitment to customer service and safety, the UV-116A UV/Vis detector and its accompanying documentation have satisfied the requirements necessary to receive the FCC (Class A) Certification.

IDENTIFYING SAFETY INFORMATION

This reference manual contains warnings and precautionary statements that can prevent personal injury, instrument damage, and loss of data if properly followed. All statements of this nature are called to your attention through the use of bold type and the following:

CAUTION!

WARNING!

HIGH VOLTAGE!

SPECIFIC HAZARDS

Every instrument has specific hazards, so be sure to read and comply with the following precautions. They will help ensure the instrument's safe, long-term use.

1. Before plugging your detector in and turning the power on, always make sure that the voltage and fuses are set appropriately for your local power supply. And never run the instruments at more than 8% below the nominal line voltage!
2. The supplied power cord must be inserted into a power outlet with a protective earth contact (ground). When using an extension cord, make sure that it's also grounded.
3. Do not change the external or internal grounding connections. Tampering with or disconnecting these connections could endanger you and/or damage the detector.

NOTE: The instruments are properly grounded when shipped. You do not need to make any changes to the electrical connections or to the instrument's chassis to ensure safe operation.

4. Never run the instruments without the top cover on. Permanent damage can occur.
5. Do not turn the instruments on if you suspect that they've incurred any kind of electrical damage. Instead, disconnect the power cords and/or power supplies and contact a BAS Service Representative for a product evaluation. Do not attempt to use the instruments until they've been evaluated. (Electrical damage may have occurred if the detector shows visible signs of damage, or has been transported under severe stress.)
6. Damage can also result if the instruments are stored for prolonged periods under unfavorable conditions (e.g., subjected to heat, water, etc.).

7. Always disconnect the power cord before attempting any type of maintenance.
8. Capacitors inside the instruments may still be charged even if the instruments are turned off.
9. Never try to repair or replace any instrument component that is not described in this manual without the assistance of BAS.

GOOD LABORATORY PRACTICES

Always follow good laboratory practices whenever you operate any high-performance liquid chromatograph.

Keep Good Records

We recommend that you keep good records of all system conditions (e.g., %RSDs on retention times and peak areas, peak shape and resolution, column pressure, and detector sensitivity). At a minimum, keep a chromatogram of a standard mixture, well documented with system conditions. Careful comparison of retention times, peak shapes, column pressure, peak sensitivity, and baseline noise can provide valuable clues to identifying and *solving* problems.

Chemical Toxicity

Although the large volume of toxic and flammable solvents used and stored in laboratories can be quite dangerous, don't 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 Sheet (MSDS).

Sample Preparation

Always consider the solubility of your sample in the mobile phase. Sample precipitation can plug the system by obstructing the flow through the injector and/or the column. This obstruction may result in irreparable damage to parts of the system. Particulate matter can be avoided by filtering the samples through 0.45- or 0.2-micrometer (or less) filters.

Solvent Requirements

Many chemical manufacturers provide a line of high-purity or spectro-quality reagents that are free of chemical impurities. Routine filtration of all solvents or eluants through a 0.45- or 0.2-micrometer (or less) fluorocarbon filter before placing them in the solvent reservoir will prolong the life and effectiveness of the inlet filters, check valves, seals, injectors, and columns.

Choose a mobile phase that is compatible with the sample and column you have selected for your separation. Remember that some solvents are corrosive to stainless steel. Inert/bio-compatible instrument versions are also available from BAS.

Degas the Eluants

Degas your eluants using either vacuum degassing, sparging with an inert gas, or an in-line degasser such as the BAS LC-26. Complete information for using these techniques is found in separate documentation provided with degas accessories.

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, but since liquids are not highly compressible, they do not store much energy. Thus, little immediate danger arises from the high pressure in an LC system. However, if a leak occurs, it should be corrected as soon as possible. Finally, we recommend that you always wear eye and skin protection when working on an LC system and that you always shut down the system and return it to atmospheric pressure before attempting any maintenance.

Support Policy

USER UPDATES

To activate your warranty and receive product update information news and valuable information related to this and other BAS products, fill out and return the Warranty Enrollment Card which was shipped with the instrument.

DAMAGED SHIPMENTS

Breakage of any part of this instrument during shipping should be reported immediately to BAS Customer Service. You must retain the original packing box and contents for inspection by the freight handler. BAS will replace any new instrument damaged in shipping with an identical product as soon as possible after the claim filing date. Claims not filed within 30 days after the shipping date will be invalid.

Do not return damaged goods to BAS without first contacting Customer Service for a Return Authorization Number (RA#). When a defective part is returned to BAS, the RA# immediately identifies you as the sender and describes the item being returned. Bioanalytical Systems refuses all unauthorized return shipments.

PRODUCT WARRANTY

BAS products are fully warranted against defects in material and workmanship. The UV-116A UV/Vis detector is unconditionally warranted for 90 days from date of shipment, except when failure is due to obvious abuse or neglect, unauthorized tampering, procedures not described in manuals, or improper connection of electronic units to other components. The tungsten lamp also is warranted for 90 days. The deuterium lamp has a prorated warranty of 1000 hours of use. Fuses are not covered by warranty.

For any product expressly covered under this warranty, BAS is liable only to the extent of replacement of defective items. Bioanalytical Systems, Inc. shall not be liable for any personal injury, property damage, or consequential damages of any kind whatsoever. The foregoing warranty is in lieu of all other warranties of merchantability and fitness for a particular purpose.

SERVICE INFORMATION

Bioanalytical Systems provides a skilled service staff available to solve your technical problems if an equipment-oriented problem should arise. For further details, call customer service personnel (1-800-845-4246), who will route your problem to the correct individual. Following discussion of your specific difficulties, an appropriate course of action will be described and the problem resolved accordingly.

DO NOT RETURN ANY PRODUCTS FOR SERVICE UNTIL A RETURN AUTHORIZATION NUMBER (RA#) HAS BEEN OBTAINED. The RA# identifies you as the sender and describes the problem you are having in full detail. Turnaround time on service can be quoted to you at the time your RA# is issued, although we can not determine the actual amount of service required until we have received your unit and diagnosed the problem. All correspondence and shipments should be sent to:

RA # __ , Service Department
Bioanalytical Systems, Inc.
2701 Kent Avenue
West Lafayette, IN 47906

Start-up Checklist

This list is a brief summary of the steps that must be completed for the proper installation of your UV-116A UV/Vis detector. Complete installation information can be found in Section 6.

- Unpack and inspect your instrument
- Read the Safety Information
- Position the detector appropriately
- Select voltage and check fuses
- Connect the power cord
- Make rear panel connections
- Connect the flowcell
- Turn on the instrument
- Check initial response to power-on

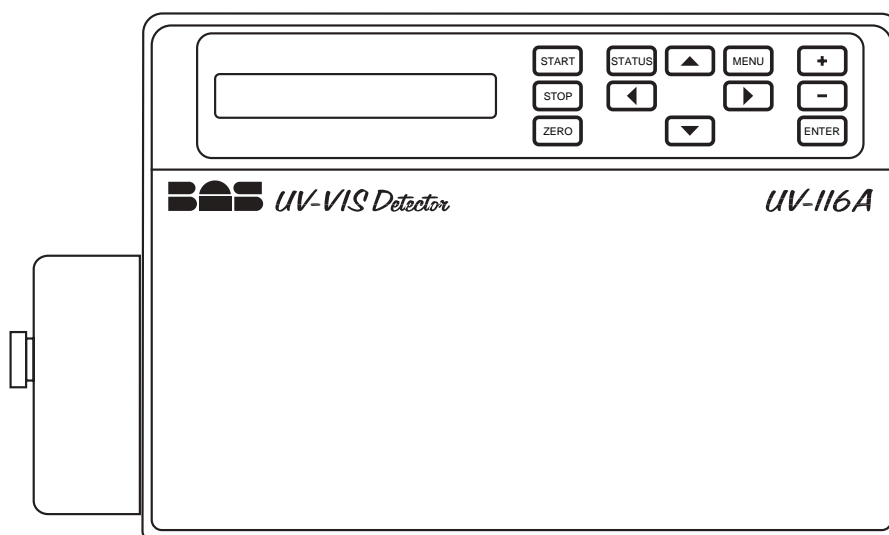
Section 1. Getting Started

This section provides you with the three basic rules you'll need for using your BAS UV/Vis detector (Figure 1.1). It also introduces you to the instrument's command center and describes the conventions we'll use in this manual.

Before you start this section, be sure to read the Safety Information located at the beginning of this manual and to install your detector as described in Section 6.

Throughout our explanations, we encourage you to explore the general architecture of the instrument's menus and screens. Use the Menu Tree in Section 7 as your guide if you wish.

Figure 1.1. UV-116A detector.



1.1 Learning Your Way Around

AS EASY AS 1-2-3!

It's easy to learn your way around a BAS detector. Just remember these three rules:

1. The arrow keys ([^], [v], [<], [>]) move the cursor in the direction printed on the key.

HINT: Press [MENU] to jump quickly to the top of the menu structure.

2. The shape of the cursor determines how you make a selection:

- If a triangular cursor appears, press [ENTER].
- If a blinking square cursor appears, press the [+] or [-] keys to change values. Depending on the field, you'll move the cursor up or down through preset choices, or change alphanumeric entries one letter or digit at a time.

3. There are four ways to accept (and automatically save) an entry. Just move the cursor out of the field using any of the following methods:

- Pressing [ENTER]
- Pressing [^], [v], [<], or [>]
- Pressing [MENU]
- Pressing [STATUS]

NOTE: You won't be able to leave a menu if errors are present or if you haven't filled in all the necessary entries.

VISUAL CLUES

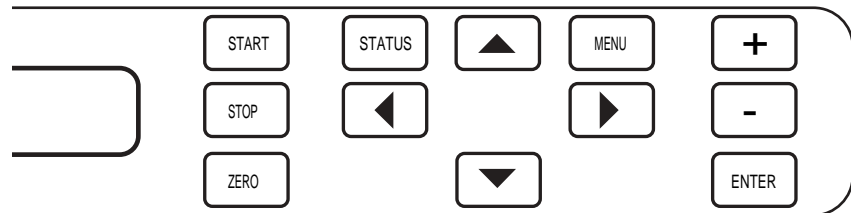
The following conventions are used on the detector's display:

1. Top-level menu choices are displayed completely in capital letters.
2. A field's square cursor changes to an underscore cursor when you're scrolling through preset choices or entering numerical values and characters.
3. A solid down-arrow on the right side of some displays indicates that the current menu continues on additional screens. To access additional menu lines, press [v].
4. The last line of a longer menu is frequently a blank display line (without a solid down-arrow).

1.2 Instrument Control

Take a look at the keypad located on the front panel (Figure 1.2). This is the command center from which you'll access menus and control the instrument's operations. A brief explanation of the keys and the main menus and screens follows.

Figure 1.2. The detector's keypad.



THE KEYPAD

The keypad consists of twelve keys. Four keys directly control the instrument's operation: [RUN], [STOP], [STATUS], and [ZERO]. The remaining keys either access commands ([MENU] and [ENTER]), or are used to set parameters and move around the display ([↑], [↓], [←], [→], [+], [-]). The function of each is explained below.

[RUN]

Pressing [RUN] starts a run. The detector must be in the READY state (or QREADY if a queue is loaded), indicating that the detector is stabilized and waiting to begin a run.

[STOP]

Pressing [STOP] halts a run, stops the internal clock, and returns the detector to a READY state. If a wavelength program is operating, pressing [STOP] halts the program and returns the detector to its initial conditions.

[STATUS]

Pressing [STATUS] displays the Status Screen. From the Status Screen you can monitor the run in progress. You can also access the Status Menu. See page 5 for more information.

[ZERO]

Pressing [ZERO] resets the detector output to zero volts, plus or minus any user-specified offset (for information on setting output-voltage offsets, refer to "Analog Offsets" on page 24).

[MENU]

Pressing [MENU] displays the Main Menu (Figure 1.3). See page 5 for more information.

[ENTER]

Pressing [ENTER] accepts a selected choice or menu entry. The [ENTER] key also advances the cursor to a new field, either on the same line of the display or in the line below.

[^], [v], [←], and [→]

Pressing any arrow key (up, down, left, or right) moves the cursor in the direction indicated on the key. The up- and down-arrow keys also move the cursor between menus and displays.

[+] and [-]

Pressing the [+] and [-] keys scrolls through a field's available choices or changes the value of alphanumeric entries. Holding down either key will continuously scroll the list of choices forward or backward until you release the key.

In fields that require numerical entries, the value of each digit is increased or decreased by one unit each time you press the [+] or [-] key. In fields that accept either numeric or character entries, such as the File Name field, the [+] and [-] keys move the cursor through the alphabet from A to Z, then through the numbers 0 to 9, and finally to a slash, hyphen, and blank space.

In other fields, the [+] key advances the display through a preset list of choices; the [-] key takes you backward through the same list.

MENUS, SCREENS, AND MESSAGES

Your detector's display can show you three kinds of information: menus, screens, and messages. Menus require you to make selections or enter specific values. Screens display information that cannot be edited. Messages confirm actions and point out errors. The Menu Tree in Section 7 outlines the structure and content of the detectors' menus and screens.

Main Menu

The Main Menu (Figure 1.3) is the top level of the menu structure. It gives you access to five other menus: FILE, COMMANDS, OPTIONS, TESTS, and QUEUE. To view the Main Menu, press the [MENU] key at any time.

Figure 1.3. The Main Menu.

>FILES	QUEUE	TESTS
	COMMANDS	OPTIONS

From the Files Menu you can edit, load, delete, or copy files. The Commands Menu lets you insert an event mark onto your chromatogram, short outputs, or shut down the detector. The Tests Menu lets you run built-in instrument tests and diagnostics while the instrument isn't collecting data. In the Options Menu, you can set up or change your instrument's configuration. From the Queue Menu you can edit or change the order of files in the sample queue. Refer to Sections 3, 4, 5, and 7 for more information on any of the instruments' menus.

Status Screen

The Status Screen (Figure 1.4) displays the detector status, wavelength setting(s), and the absorbance reading. It appears automatically whenever you power up the instrument or press [STATUS]. No entries are made on the Status Screen.

Figure 1.4. The Status Screen.

Status	λ	AU
READY	250	0.00001

Status Menu

Just below the Status Screen is the Status Menu. To access the Status Menu, press [v] from the Status Screen. The Status Menu lets you review and edit run parameters during a run. Section 3 discusses the Status Menu in more detail.

MESSAGES

There are three different kinds of messages that can appear on your detector's display: user messages, confirmation messages, and error messages.

User Messages

User messages, indicated on the display by double asterisks, tell you about an existing instrument condition or ask for further actions. Some of these will only appear on the display for three seconds. An example of a message requiring further action is shown in Figure 1.5.

Figure 1.5. An example of a user message.

```
    ** Protected File **
      No Editing Allowed
```

Confirmation Messages

Confirmation messages (Figure 1.6) are also indicated on the display by asterisks. They appear for one second after an operation has been carried out successfully.

Figure 1.6. An example of a confirmation message.

```
    ** File Loaded **
```

Error Messages

Error messages (Figure 1.7) are indicated on the display with capital letters and exclamation points. They're shown whenever an undesirable condition exists that prevents the instrument from carrying out an operation. Error messages remain on the display until you press a key. A complete listing of possible error messages is presented in Section 8.

Figure 1.7. An example of an error message.

```
    !! RAM ERROR !!
```

1.3 Manual Conventions

This manual uses several conventions. Among them are menu displays, text conventions (brackets, slashes, etc.), and standard words.

DISPLAYS

Figure 1.8 shows how we depict the detectors' two-line display. Note that in menu illustrations the triangular cursor location is indicated by a caret (>).

Figure 1.8. A two-line menu display.

```
>FILE                                COMMANDS
                                OPTIONS                                TESTS
```

Frequently the two lines shown on the display are only part of a longer display (menu). In this manual, displays (menus) containing a total of more than two lines are represented as shown in Figure 1.9.

Figure 1.9. A display longer than two lines.

Zero on 1 Change	Yes
Cursor Speed	Medium

Status Lock	Off
READY Output	Active Hi

TEXT

Three typographic conventions are used to differentiate between keys, menus, and fields.

Brackets

Brackets, [], indicate instrument keys. For example: Press [MENU].

Slashes

Slashes, / /, are used around menu choices (fields). For example: From the Main Menu, select /FILES/.

Capitalization

Capitalization is used to make field and menu names appear just as they do on the display. Generally the first letters of field names are capitalized. For example: Select /FILES/, /Copy/, Copy File #.

STANDARD WORDS

We've also standardized the meanings of two words: "select" and "enter."

select

The word "select" is used when you need to choose from among available options. For example, to "select" a particular menu choice, you would move the cursor to the appropriate choice and press [ENTER]. To "select" a field entry, move the cursor to the appropriate field and use the [+] and [-] keys to move the cursor to the desired preset value.

enter

The word "enter" is used when you need to specify individual alphanumeric digits. To "enter" a particular value, move the cursor to the desired field and use the [+] and [-] keys to increment or decrement each digit in the field until the desired value or letter appears.

WARNINGS

The warnings in this manual will alert you to the following situations.

WARNING! Warnings alert you to situations that could result in personal injury. They also tell you how to avoid them.

WARNING — Chemical Hazard! Chemical hazard warnings alert you to the potential dangers of handling chemicals. The warnings also tell you how to avoid chemical hazards.

WARNING — High Voltage! This warning alerts you to the presence of high voltage and to the potential injury that could occur from electrical shock were you to come in contact with a specific instrument area or component. It also tells you how to avoid contact with the high-voltage areas in your instrument.

CAUTION! Cautions alert you to the correct operating or maintenance procedures needed to prevent equipment or data damage.

HINT: Hints call out general rules or shortcuts. They specify ways to obtain the best performance and results from your instrument. All hints appear in italics.

NOTE: Notes alert you to important exceptions, side effects, or unexpected occurrences that may result from certain action(s). All notes appear in italics.

1.4 What's Next?

Now you're ready to try the practice example in Section 2, A Quick Example.

Section 2. A Quick Example

In Section 1, you read about the three easy rules for using your detector's command center and some of its menus and screens. In this section, you'll find an example procedure that shows you how the rules and keys actually work as you move through the various menus.

This quick example uses only a few of your detector's available features and is included only as a first step in becoming familiar with your new instrument.

After experimenting with this example, you'll want to turn to Sections 3 and 4, which cover the detector's basic and more advanced operations. It's in those sections that you'll learn about the full capabilities of your detector. First though, to give you a general understanding of the detector's capabilities and design, we will briefly describe its features and benefits.

The UV-116A detector is a full-featured, time-programmable, dual-wavelength UV/Vis absorbance detector. It operates in both single- and dual-wavelength modes in the UV and visible ranges. The detector's optical system has a novel high-efficiency design that provides high sensitivity detection along with the maximum application versatility. In addition, the UV-116A also offers spectral scanning, a Develop File (for method development), multiple file storage, a Queue feature (that allows you to link files), and more.

BEFORE YOU BEGIN

Once the detector is installed in your chromatographic system according to the procedures described in Section 6 and you have completed the Startup Checklist, you're ready to begin your quick example.

2.1 An Example

In this example, we'll show you how to prepare a file and how to load it into the detector's operating parameters. After a practice run, we'll add a stop time. To keep the instructions simple, we'll use the single-wavelength mode.

HINT: You may wish to keep the Menu Tree in Section 7 on hand as you work through this example. If you lose your place at any time, you can:

1. press [\wedge] to move back to a previous screen
or
2. press [STATUS] to return to the Status Screen and retrace your steps.

STARTUP

Set the power switch located on the detector's rear panel to On. After a series of power-up tests, the Status Screen (Figure 2.1) appears on the display. (We'll discuss the Status Screen after you've set up your operating parameters.)

Figure 2.1. The Status Screen.

Status	λ	AU
READY	250	0.00001

SETTING PARAMETERS

To set your parameters, you need to prepare an edit file. The following steps will show you how to access the Edit Menu and prepare the file.

1. Press [MENU]. The detector's Main Menu appears on the screen (Figure 2.2).

Figure 2.2. The Main Menu.

>FILES	QUEUE	TESTS
COMMANDS	OPTIONS	

2. Now select /FILES/ to display the Files Menu (Figure 2.3).

Figure 2.3. The Files Menu.

>Edit	Load
Copy	Delete

3. Select /Edit/ to display the Edit Menu (Figure 2.4).

Figure 2.4. The Edit Menu.

```

Edit File           1
File Name
-----
>Wavelength Program
Options

```

For this example, we'll use a file designation of 1 and leave the File Name field blank.

Wavelength

Wavelength is an example of a field that requires a numeric entry. To set the wavelength:

1. From the Edit Menu (Figure 2.4), select /Wavelength Program/ to display the Wavelength Program screen (Figure 2.5).

Figure 2.5. The Wavelength Program display.

```

Program           Single  $\lambda$ 
-----
Time             Wavelength
0.00             250

```

2. Scroll down to the Wavelength field.
3. Using [+] and [-], edit the Wavelength field to the desired setting for your analysis. Remember that each digit must be edited individually.
4. Press [ENTER] to accept the new wavelength setting.

Range

Range is an example of a field that gives you a preset list of choices. Note that Range 1 and 2 correspond to Analog Outputs 1 and 2 on the rear panel of your detector. To set the range:

1. Select /Options/ from the Edit Menu (Figure 2.4) to display the Options Menu (Figure 2.6).

Figure 2.6. The Options Menu.

```

Rise Time         1.0
Autozero Time     0.00
-----
Range 1           1.0
Range 2           1.0

```

2. Scroll down in the Options Menu and move the cursor to Range 1 using [v].
3. Using [+] or [-], select the desired setting from the list of choices.
4. Press [ENTER] to accept the new Range 1 setting.

We'll use the rise time, autozero time, and range 2 default settings for this example. You'll learn more about setting these parameters in Section 3.

Loading the File

You're now ready to load the settings from File 1 into the detector's operating parameters. To load the file:

1. Return to the Files Menu (Figure 2.3) by pressing either [ENTER] or [v].
2. Select /Load/. The screen in Figure 2.7 appears.

Figure 2.7. The Load File command.

```
>Load File      1:(filename)
```

3. You'll be able to select from several files in the Load File field. Depending on whether or not your detector has ever been used before, these files will either contain previously stored settings or default settings. Use [+] and [-] to move the cursor through the available choices. When the file you wish to load appears (we're using the default settings for this example), press [ENTER] to execute the load command.
4. The confirmation message shown in Figure 2.8 appears for one second, after which you're returned automatically to the Status Screen.

Figure 2.8. The file-loaded message.

```
** File Loaded **
```

A PRACTICE RUN

Now you're ready for a practice run. Note that the Status Screen (Figure 2.1) now displays your wavelength setting, the detector's status, and the absorbance reading. If the Status reads READY, the detector is stabilized and ready to run. If NRDY (Not Ready) appears, the detector's lamp may need additional time to warm up.

When the detector is stabilized:

1. Press [ZERO] to zero the detector's analog output signal.
2. Inject your sample.

During setup, you may have noticed that there was no stop time entered in the detector's parameters. In this case, the detector stays in the READY state and monitors the column eluant continually. You don't need to start or stop a run manually with this setup.

ADDING A STOP TIME

To add a stop time, you need to modify the detector's operating parameters as follows. We'll then show you how to start and stop a run using the new setting.

1. From the Status Screen, press [v] to move down to the Status Menu (Figure 2.9), which is the programming area below the Status Screen.

Figure 2.9. The Status Menu.

File 1:	

Time	Wavelength
0.00	250
Rise Time	1.0
Autozero Time	0.00
Range 1	1.0
Range 2	1.0

2. Using [v], move the cursor to the blank line below the 0.00 time line and press [+]. This adds a second line, with a time of 1.00 and the same wavelength setting as the first. Change 1.00 to the desired stop time for the run, and leave the wavelength unchanged.
3. To save your edits, move the cursor down to the words "Save File" (which now appear below Range 2), and press [ENTER]. The confirmation message shown in Figure 2.10 appears and you're returned automatically to the Status Screen.

Figure 2.10. The File Saved message.

** File Saved **

RUNNING WITH A STOP TIME

Now that you've entered a stop time, you'll need to start the run with each injection.

1. Zero the detector's analog output signal by pressing [ZERO].
2. When the detector is stabilized, inject your sample and press [RUN].

Notice that /Status/ now shows the run time. If you wish to stop your run before the set stop time, simply press [STOP].

2.2 What's Next?

Once you've completed this example and are comfortable with the keypad and display, proceed to Section 3, *Basic Operations*, to learn more about your detector.

Section 3. Basic Operations

This section provides step-by-step instructions for the most frequently used detector operations, including setup and run procedures for single- and dual-wavelength modes, detector file management and protection, and analog output operations. You may wish to keep the Menu Tree and the Menu Reference from Section 7 on hand as you work through this section.

NOTE: You should be aware that your displays values may differ from those presented in this manual, especially if the detector has been programmed previously.

3.1 Before You Begin

Before you begin this section, your detector should be installed in a chromatographic system (see Section 6), and you should have completed the Startup Checklist located at the front of this manual. We also recommend that you review Section 1, *Getting Started*, which includes general instructions for using the detector keypad and which lists the conventions used throughout this manual.

3.2 Single- and Dual-Wavelength Operation

You can operate the UV-116A in either a single- or a dual-wavelength mode. In the dual-wavelength mode, the detector simultaneously monitors two wavelengths in a single run in either the UV range or the visible range.

To perform a single- or dual-wavelength operation, you need to be able to identify and enter a file, load that file into the detector's current operating parameters, and start and stop a run. This section will also show you how to modify the detector's current operating parameters.

SETTING PARAMETERS

Before you set any detector parameters, you need to access the Files Menu to identify the file you wish to edit.

To access the Files Menu, first press [MENU]. The Main Menu appears on the screen. From the Main Menu, select /FILES/. The menu shown in Figure 3.1 will appear.

Figure 3.1. The Files Menu.

>Edit	Load
Copy	Delete

Select /Edit/ from the Files Menu to display the Edit Menu (Figure 3.2).

Figure 3.2. The Edit Menu.

Edit File	1
File Name	

Wavelength Program	
Options	

File Identification

Enter the number of the file you wish to edit in the Edit File field. The detector can store up to four files in memory, so file numbers from 1 to 4 are allowed. You may also enter a name of up to eight characters in the File Name field.

While in /Edit File/, you'll see file choices of "S" and "D" that represent the Scan and Develop files, respectively. These files are one of the UV-116A's advanced features that you'll learn more about in Section 4.

Wavelength Program

From the Edit Menu, select /Wavelength Program/. The Wavelength Program designates dual- or single-wavelength operation, and also contains a table of time and wavelength. A wavelength program for dual-wavelength operation appears in Figure 3.3.

Figure 3.3. The Wavelength Program in dual-wavelength mode.

Program	Dual λ (190–450)	

Time	λ_1	λ_2
0.00	250	280

Select Single λ , Dual λ (190–450), or Dual λ (366–700) in the Program field. The table for time and wavelength(s) will appear. (For single-wavelength operation, there's only one wavelength field.)

You can operate with either a one-line or a two-line wavelength program. Using a one-line program, the detector is always in the READY state and you can monitor the chromatographic eluant continually. Using a two-line program, you can use a stop line and you can start and stop the detector during a chromatographic run. (Stop lines are useful, for example, in an automated series of runs where you want to autozero the detector's baseline after each injection.)

For a one-line program, enter the wavelength(s) for your analysis in the λ_1 and λ_2 (or Wavelength) fields that correspond to the time of 0.00.

For a two-line program, add an additional line (the stop line) by scrolling down to the blank line below the time 0.00 line and pressing [+]. The second line automatically will have a time setting of 1.00 and the same wavelength setting(s) as the first. Change 1.00 to the desired stop time for the run, and leave the wavelength value(s) unchanged.

An example of a dual-wavelength, nine-minute run at 254 and 283 nm is shown in Figure 3.4.

Figure 3.4. A wavelength program with a programmed stop time.

Time	λ_1	λ_2
0.00	254	283

9.00	254	283

Options

Select /Options/ from the Edit Menu to display the Options Menu (Figure 3.5). Use this menu to set the detector's rise time, autozero time, and ranges.

Figure 3.5. The Options Menu.

Rise Time	1.0
Autozero Time	0.00

Range 1	1.0
Range 2	1.0

Rise Time

This field affects the detector's response time. Rise time is inversely proportional to the amount of baseline noise. In other words, the longer the rise time that you enter, the less noise that will be detected. The one-second default value is appropriate for most applications.

HINT: To minimize baseline noise while retaining maximum resolution, select a rise time that's at least one-tenth of the peak width, in seconds, at the base of the narrowest peak of interest.

Autozero Time

This parameter tells the detector when to perform an automatic zero of the baseline. If you don't wish to set an autozero and you're using a stop line in your wavelength program, simply set the autozero time to a value greater than your stop time.

HINT: It's good practice to zero the detector automatically at the start of each run. This will keep the detector output in range throughout an automated series of runs.

Range 1 and 2

These parameters attenuate the signal from Analog Output 1 and Analog Output 2 (shown as CH 1 and CH 2 on the detector's rear panel). Set each range to an appropriate full-scale absorbance for your sample. For more information on the use of ranges and analog outputs, see Section 3.4.

Loading a File

When you're ready to load a file into the detector settings, select /Load/ from the Files Menu. The screen will display the words "Load File 1:(filename)." Use [+] or [-] to view the number and name of available files. When the desired file number appears, press [ENTER].

The confirmation message shown in Figure 3.6 will appear for one second. You're then returned to the Status Screen.

Figure 3.6. The message that's displayed when a file is loaded.

```
** File Loaded **
```

NOTE: When a dual-wavelength program is loaded, you'll hear the motor start to operate in dual-wavelength mode even though you didn't press [RUN].

RUNNING YOUR DETECTOR

Once you've set your detector parameters in the designated file and have loaded the file into the detector's operating parameters, you're ready to run your analysis. First check the detector's status by pressing [STATUS] to view the Status Screen. If you're using a stop line in your wavelength program, you'll start and stop the run with each injection.

Status Screen

You can check the detector's status, wavelength setting(s), and absorbance reading(s) by pressing [STATUS] to view the Status Screen (Figure 3.7). Note that, in the single-wavelength mode, the third line doesn't appear.

Figure 3.7. The Status Screen.

Status	1	AU
READY	250	+0.00001

	280	-0.00001

If the Status reads READY, the detector is stabilized and ready to run. If NRDY appears, the detector's lamps may need additional time to warm up, or a wavelength outside the selected lamp's range may have been chosen.

Inject your Sample

When the detector is stabilized and you're ready to inject your sample, first zero the detector manually by pressing [ZERO]. If you're not using a stop line in the wavelength program, the detector remains in the READY state throughout your chromatographic runs. If you're using a stop line, you must start and stop the run with each injection, following the procedures below.

Starting a Run

If you're using a stop line in your wavelength program, you need to start the run with each injection. There are two ways to start a run:

1. Manually, by pressing [RUN] each time you make an injection.
2. Automatically, by interfacing the detector with a remote run signal from the injector (see Section 6 for details). In this scenario, a signal that's equivalent to pressing [RUN] is sent automatically from the injector to the detector with each injection.

During the run, you can monitor the run time from the Status Screen.

Stopping a Run

There are two ways to stop a run:

1. Manually, by pressing [STOP] before the programmed stop time.
2. Automatically, by allowing the run to finish at the programmed stop time.

If you're conducting a dual-wavelength run, you can also stop the run by loading a single-wavelength file.

Regardless of how you stop a run, the detector returns to READY.

CHANGING RUN PARAMETERS

If you wish to change the detector's parameters:

1. You can use the Files Menu and follow the procedures outlined under "Setting Parameters" (Section 3.2).
2. You can use the Status Menu, which is the programming area below the Status Screen.

Each method has a distinct advantage. Programming in the Status Menu allows you to change the detector's current operating parameters, even while the detector is running. Programming in the Files Menu allows you to prepare an edit file containing the changes without altering the current detector settings. The file may then be loaded at a later time.

Status Menu

From the Status Screen, move the cursor down to the Status Menu (Figure 3.8). The Status Menu contains the loaded file's identification (its number and name), Wavelength Program, Rise Time, Autozero Time, and Ranges.

Figure 3.8. The Status Menu.

File 1:		

Time	$\lambda 1$	$\lambda 2$
0.00	250	280
Rise Time	1.0	
Autozero Time	0.00	
Range 1	1.0	
Range 2	1.0	

The Status Menu shown in Figure 3.8 is typical for dual-wavelength operation. In the single-wavelength mode, only one wavelength field appears in the wavelength program.

The detector's parameters are set following the same instructions given under "Wavelength Program" and "Options," (Section 3.2). However, you can't modify either the file identification or the wavelength mode (dual or single) from the Status Menu.

NOTE: When you modify a file's parameters from the Status Menu, you don't change the contents of the same file number stored in the detector's memory. Only the copy of the active file is modified.

Saving the File

When you change the detector's settings from the Status Menu, each change is effective as soon as you leave the field. You'll also see that the File identification on the first line of the Status Menu (Figure 3.8) now reads "File N:xxx-changed" (where N:xxx is the file number and name) and that the words "Save File" now appear below Range 2.

To save the changed file, press [ENTER]. The confirmation message shown in Figure 3.9 will appear briefly.

Figure 3.9. The File Saved message.

** File Saved **

To keep the original file without saving the changes, don't press [ENTER]. Instead, reload the unaltered file using the Files Menu as follows:

1. Press [MENU].
2. Select /FILES/.
3. Select /Load/.
4. The words "Load File" will appear on the screen. Enter the desired file number and press [ENTER].

A "File Loaded" confirmation message will appear for one second. You're then returned to the Status Screen, and all settings will contain their original values.

3.3 More about Files

You learned how to edit and load files from the Files Menu in Section 3.2. The UV-116A also allows you to copy and delete files (and to protect files from being edited, copied to, or deleted) in a few, easy steps.

COPYING FILES

To copy a file:

1. Press [MENU].
2. Select /FILES/ to display the Files Menu (Figure 3.10).

Figure 3.10. The Files Menu.

```

>Edit                               Load
Copy                                 Delete
```

3. Select /Copy/. The Copy Menu will appear on the screen (Figure 3.11).

Figure 3.11. The Copy Menu.

```

>Copy File 1: (filename1)
To File 2:   (filename2)
```

4. Enter the identification number for the file you wish to copy in the Copy File field.
5. Enter in the To File field the number of the file to which you wish to copy.
6. Press [ENTER]. The confirmation message shown in Figure 3.12 appears briefly, and you're returned to the Files Menu.

Figure 3.12. The message that's displayed when a file is copied.

```
** File Copied **
```

If you attempt to copy to a protected file (see the section below, titled "Protecting Files"), you'll get the message shown in Figure 3.13. If a file isn't protected, make sure it's empty or unwanted before you copy to it, as it will be overwritten.

Figure 3.13. The message that's displayed when you attempt to copy to a protected file.

```
** Protected File **  
Cannot Be Copied To
```

You can't use Copy for the Scan or Develop files. (You'll learn more about these files in Section 4.)

DELETING FILES

To delete a file:

1. Press [MENU].
2. Select /FILES/ to display the Files Menu (Figure 3.10).
3. Select /Delete/. The Delete File field will appear on the screen.
4. Enter the identification number of the file you wish to delete. When you press [ENTER], the confirmation message shown in Figure 3.14 appears briefly and the display returns to the Files Menu. (The parameters in the file you've just deleted return to their default values.)

Figure 3.14. The message that's displayed when a file is deleted.

```
** File Deleted **
```

If you attempt to delete a protected file (see the next section, "Protecting Files"), you'll get the message shown in Figure 3.15.

Figure 3.15. The message that's displayed when you try to delete a protected file.

```
** Protected File **  
Cannot Be Deleted
```

PROTECTING FILES

The UV-116A allows you to protect files from being edited, copied to, or deleted. To access the file protection operation, follow these steps:

1. Press [MENU].
2. Select /OPTIONS/. The Options Menu appears in Figure 3.16.

Figure 3.16. The Options Menu.

```

>Lamps
  Analog Outputs
-----
  More
  
```

3. Select /More/. The More Menu appears in Figure 3.17.

Figure 3.17. The More Menu.

Zero on λ Change	Yes
Cursor Speed	Medium

Status Lock	Off
READY Output	Active Hi
File Name	Protect
1:	Off
2:	Off
3:	Off
4:	Off

4. Scroll down to the table containing the fields /File Name/ and /Protect/. To protect a file, select On in the Protect field corresponding to the appropriate file number. To remove the file protection, select Off.

3.4 Analog Outputs

There are two analog outputs on the UV-116A, Analog Output 1 and Analog Output 2. On the detector's rear panel, they appear as CH 1 and CH 2. Rear-panel connections for both outputs are discussed in Section 6.

ANALOG OUTPUT 1

By default, Analog Output 1 is either the absorbance reading for single-wavelength operation, or the absorbance reading of wavelength one (λ_1) for dual-wavelength operation.

ANALOG OUTPUT 2

Analog Output 2 is selectable (AU, AU1-K×AU2, and AU1/AU2), and so can be used to monitor several different outputs. To access these options:

1. Press [MENU].
2. Select /OPTIONS/.
3. Select /Analog Outputs/. The Analog Outputs Menu shown in Figure 3.18 appears.

Figure 3.18. The Analog Outputs Menu.

Analog 1 Offset (%)	0
Analog 2 Offset (%)	0

Analog 2	AU
K Factor	1.000

4. Scroll down to Analog 2. The selections are:
 - AU, which is either the same absorbance reading you got from Analog Output 1 in single-wavelength operation, or the absorbance reading of Wavelength Two (λ_2) for dual-wavelength operation.
 - AU1-K×AU2, which is the readout of the suppressed signal using the K-Factor technique. See Section 4.7 for further details.
 - AU1/AU2, which is the ratio of absorbances for dual-wavelength. This ratio is sometimes used to check peak purity. See Absorbance Ratios (Section 4.8) for more details.

ANALOG OFFSETS

Both analog outputs 1 and 2 can be offset on the UV-116A. Analog offsets may be used in cases where there's a high background absorbance reading, or when there's considerable baseline drift from your chromatographic system and you're unable to keep your integrator's (recorder's) signal on-scale.

Because integrators have very limited capacity for handling negative signals, you may wish to set a small positive offset (1%) when using an integrator.

Negative offsets are available for use with recorders, where you may wish to set the pen at either side of the strip-chart.

The offset options are selectable from the Analog Outputs Menu shown in Figure 3.18.

HINT: Although the offset for each output is set at 0% of full-scale readout by default, we recommend a 1% setting for use with an integrator.

Section 4. Advanced Operations

In this section, you'll learn to use the more advanced capabilities of your detector. You should be familiar with the instructions presented in Section 3, *Basic Operations*, before you begin.

4.1 Wavelength Programming

Your detector can change wavelength as a function of time, a feature we call Wavelength Programming. This feature gives you maximum detection sensitivity for each component of a mixture without making multiple injections of the sample.

NOTE: A wavelength program can be built in either the Status Menu or the File(s) Menu.

BUILDING THE PROGRAM

In wavelength programming, you enter time lines into a "Wavelength Program." Each time line specifies the time at which you want a wavelength change to occur.

The following instructions are for single-wavelength operation, but you can build a dual-wavelength program using the same procedure.

Initial Conditions

Access the Wavelength Program (Figure 4.1) through either the Status Menu or the Files Menu.

Figure 4.1. The wavelength program for single-wavelength operation.

Time	Wavelength
0.00	250

The initial time entry is 0.00. Move the cursor to the corresponding Wavelength field, and enter the initial wavelength for your analysis.

Adding Lines

To add a second time line, move the cursor down to the first blank line and press [+]. The second line automatically will have a time setting of 1.00 and the same wavelength setting as the first. Change the Time and corresponding Wavelength fields to the desired values. Subsequent lines are added in the same fashion.

A wavelength program may contain as many as ten lines for a single run. You can cross between the UV and visible ranges (in single-wavelength mode only).

If you enter time lines out of sequence, the detector will sort the lines automatically and place them all in chronological order.

The Stop Line

The last line of the program (the stop line) lists the time at which the detector automatically will end the run and return to initial conditions. Since wavelength isn't important in the stop line, it can be set to any value.

NOTE: Remember, the last line of the program is always the detector's signal to end a run; it's not a programmed wavelength change!

Deleting a Line

To delete an entire time line, place the cursor in the Time field and press [-] repeatedly until the value goes blank. When you leave the line, it will be deleted.

An Example

Figure 4.2 shows a completed wavelength program for single-wavelength operation.

Figure 4.2. An example of a completed wavelength program.

Time	Wavelength
0.00	254

5.00	280
7.00	265
10.00	265

In our example, the initial detection wavelength is 254 nm. At 5.00 minutes into the run, the wavelength changes to 280 nm. At 7.00 minutes, it changes to 265 nm. The run ends at 10.00 minutes, and the detector returns to its initial wavelength of 254 nm and to its READY state.

RUNNING THE PROGRAM

After you set the rest of your parameters, the detector is ready to run. It's good practice to zero the detector at the beginning of every run and at each wavelength change. See the next section, titled "Programmed Autozero," for details.

Once you start the run, you may edit any timed event (wavelength change, autozero, or stop time) that hasn't yet taken place. These edits can only be made from the Status Menu, however. Each edit is entered immediately into the detector's operating wavelength program.

For example, for the program displayed in Figure 4.2, the stop time is 10.0 minutes. If, at 7.00 minutes into the run, you determine that the run should be 9.00 minutes long, you can edit the last line of the program such that the current run will stop at 9.00 minutes.

4.2 Programmed Autozero

The detector can be programmed to perform an automatic zero with each wavelength change during a run by using the Zero on λ Change field. To access this feature:

1. Press [MENU] and select /OPTIONS/ to access the Options Menu (Figure 4.3).

Figure 4.3. The Options Menu.

```
>Lamps
  Analog Outputs
-----
  More
```

2. Select /More/ to display the More Menu.
3. Place the cursor on the Zero on λ Change field. This field appears on the first line of the More Menu.
4. Select Yes, to zero the detector response automatically with each wavelength change during a run, or No, to inactivate this feature.

You can also use this automatic-zero feature to add autozeros into your wavelength program *without* changing the detector's wavelength settings. To do this, simply add additional time lines. Adding autozeros in this way is convenient in cases such as solvent programming, where the detector's baseline may drift due to changes in solvent background.

An example program is shown in Figure 4.4.

Figure 4.4. An example of a wavelength program with automatic autozeros.

Time	Wavelength
0.00	254

2.00	254
5.00	280
7.00	280
10.00	280

With /Zero on λ Change/ set to Yes, the detector will autozero at 2.00, 5.00, and 7.00 minutes into the run, even though the wavelength will only change once (at 5.00 minutes into the run).

4.3 Automatic Lamp Operations

LAMPS MENU

The Lamps Menu (Figure 4.5) allows you to select lamps, track lamp life, and turn the lamps on and off automatically. It contains the fields described below.

To access the Lamps Menu:

1. Press [MENU] and select /OPTIONS/.
2. Select /Lamps/.

Figure 4.5. The Lamps Menu.

Lamp	D2 (190-365)
D2 Lamp Hours	0

W Lamp Hours	0
Current Time	0:00
Startup	Manual
Startup Time	0:00
Shutdown	Manual
Shutdown Time	0:00
Time from READY	1:00

Lamp

The Lamp field allows you to select from the following:

- D2 (190–365), for deuterium
- W (366–800), for tungsten
- D2+W (190–800), for dual-lamp operation
- or Off, to shut the lamp(s) off

In actuality, the wavelength setting in the loaded file selects the appropriate lamp for you automatically. In fact, the wavelength setting you choose in your file has priority over any selection you make here in the Lamp field!

For example, if the loaded file designates a wavelength in the UV range, but you selected W (366–800) in the Lamp field manually, the detector's display will read NRDY (not ready) for the deuterium lamp.

Lamp Hours (W and D2 fields)

These fields track automatically the number of hours each lamp has been in operation. For the value to be accurate, you have to set the appropriate Lamp Hours field to zero each time you install a new lamp.

HINT: If you change lamps before they're burned out (with the intention of using them again at a later date), keep a record of how many hours they've been in operation and remember to recalibrate the detector immediately following each lamp change.

Startup and Shutdown

When you set the Startup and Shutdown fields to "Manual," the lamp designated in the Lamp field turns on and off when the detector power is switched on and off.

Startup and Shutdown Times

When you set the Startup and Shutdown fields to "Time" (see above), the designated lamp will turn on and off automatically at the local time set in the Startup Time and Shutdown Time fields, respectively.

HINT: For the detector to perform automatic lamp startup and shutdown correctly, the detector's 24-hour clock must be set to your local time. Set the clock in the Current Time field.

Time from READY

If you prefer, you can use the Time from READY feature to program the detector to shut the lamp off after a series of automated runs. Time from READY is a preset time interval that begins automatically each time the detector returns to its READY state. If the Time from READY interval elapses without a run signal being received from either the keypad or the detector's Run(Input) terminal, the detector's lamp turns itself off.

To use the Time from READY feature:

1. Select Time from READY in the Shutdown field.
2. In the Time from READY field, enter the length of time during which a run signal must be received by the detector before the lamp turns off.

For example, let's say your chromatographic system is set up for an automated run and the autosampler signals the detector to run after each injection. With the detector settings shown in Figure 4.6, the lamp will turn off 10 hours after the last run is completed.

Figure 4.6. An example of the Time from Ready feature.

Shutdown	Time from READY
Shutdown Time	00:00

Time from READY	10:00

You can also program the lamps to turn off at the end of a queue by selecting End of Queue in the Shutdown field. For more information on the Queue feature, see Section 4.7.

4.4 Scanning

The UV-116A can perform a spectral scan on eluting peaks without stopping the eluant flow. This unique feature simplifies greatly the determination of wavelength maxima for individual compounds in your sample during method development work.

HOW IT WORKS

When a scan is initiated, the monochromator moves from the run-wavelength to the scan's start-wavelength. The detector scans by stepping through a defined spectral range at specified wavelength increments. Individual absorbances are read at each increment until the monochromator has reached the last wavelength.

The detector can collect and store in its memory as many as ten spectra from a single chromatographic run. The actual number of spectra is determined by the number of data points in each scan. Since the number of data points varies with the wavelength interval and the scanning range, first calculate the number of data points using Equation 1, then use either Equation 2 or Equation 3 to determine the number of spectra you'll be able to collect.

Equation 1. Use this equation to calculate the number of data points for any scan between λ_1 (the lower wavelength) and λ_2 (the higher wavelength):

$$\# \text{ of data points} = \frac{\lambda_2 - \lambda_1}{\lambda \text{ interval}} + 1$$

Equation 2. Use this equation to calculate the number of spectra you can collect when using wavelength intervals of 2 nm or greater. Round the resulting number down to the nearest integer.

$$\# \text{ of spectra} = \frac{5000 - (\# \text{ of data points} \times 12)}{(\# \text{ of data points} \times 4) + 14}$$

Equation 3. Use this equation to calculate the number of spectra you can collect when using wavelength intervals of 1 nm. Round the resulting number down to the nearest integer.

$$\# \text{ of spectra} = \frac{5000 - (\# \text{ of data points} \times 4)}{(\# \text{ of data points} \times 4) + 14}$$

HINT: To approximate the scan time (in seconds) for a given run, divide the number of data points by twenty.

For example, if you want to scan from 190 to 564 nm in 2-nm steps, there would be 188 data points and the detector would be able to store up to 3 spectra:

Each scan is corrected for baseline absorbance before being played back either as individual data points, or as a smoothed, continuous spectrum.

SELECTING THE SCAN FILE

To select spectral scanning, follow these step-by-step instructions.

1. Press [MENU]. Select /FILES/.
2. Select /Edit/.
3. Use the [+] key to increment the Edit File field until an "S" is displayed (Figure 4.7). The File Name field is named SCAN automatically. (You can't edit the Scan File's name.)

Figure 4.7. The Scan File's Edit Menu.

Edit File	S
File Name	SCAN

Setup	
Replay	

4. Select /Setup/ to set up your spectral scanning parameters.

SETTING UP THE SCAN FILE

The Scan Files Setup Menu is shown below in Figure 4.8.

Figure 4.8. The Scan Files Setup Menu.

Start λ	220
End λ	365

λ Interval	5
Run λ	250
Rise Time	1.0
Scan Zero Time	0.00
Range 1	1.0
Range 2	1.0

Use these steps to set the parameters for scanning:

1. In the Start λ field, enter the wavelength at which each scan should start.
2. In the End λ field, enter the wavelength at which each scan should end.
3. In / λ Interval/, enter the wavelength interval to be used. To perform a scan, the UV-116A takes individual absorbance readings at wavelengths incremented by the interval you specify.

HINT: Five nanometers is an excellent wavelength interval for most applications. At this interval you get very rapid scans and you can still display the λ Max to 1 nm accuracy.

4. In /Run λ /, enter the wavelength at which the chromatographic run will be monitored.
5. In /Scan Zero Time/, enter the runtime at which you wish the detector to perform an automatic baseline scan. If you use an automatic baseline scan, make sure no peaks are eluting during the designated scan time.
6. Fill in entries for Rise Time, Range 1, and Range 2 as you would for any chromatographic run.

When you're finished setting up the Scan File, you're ready to load it and run.

RUNNING THE SCAN FILE

When the Scan File is loaded, you'll notice the fields /Zero/ and /Scan/ in the Status Screen (Figure 4.9).

Figure 4.9. The Status Screen with the Scan File loaded.

Status	λ	AU	Scan
READY	250	0.00001	>Zero

Zero

/Zero/ is used to perform baseline scans of the solvent's background absorbance. With the detector's baseline stabilized and the cursor on the Zero field, press [ENTER]. The detector performs and stores a baseline scan using the parameters you set in the Scan File. While the detector is performing a baseline scan, the Status field displays SCAN 0.

Baseline scans may be taken at any time during the run, as long as no peak is eluting at that time. Subsequent sample scans are corrected using the last baseline scan taken. This is especially advantageous for gradient elution, where the background absorbance of the eluant may be changing constantly.

For example, let's say you perform a baseline scan before you initiate a run, and then again at 5.00 minutes into the run. You also perform sample scans of your eluting peaks at 2.4 and 5.6 minutes into the run. The sample scan taken at 2.4 minutes will be corrected using the baseline scan taken before the run began. The sample scan taken at 5.6 minutes will be corrected using the baseline scan taken at 5.0 minutes.

Scan

Once you begin the run, the cursor will move from /Zero/ to /Scan/ in the Status Screen.

NOTE: There's a one-second delay from the time the detector takes its absorbance readings to the time you see the same reading on the analog readout. Keep this in mind when choosing your scan times.

Each time you perform a sample scan, the detector's monochromator moves from the run wavelength to the start wavelength. The detector performs each scan (from the start wavelength to the end wavelength) by taking individual absorbance readings at wavelengths incremented by the interval you set in the Scan File. When the scan is finished, the monochromator returns to the run wavelength.

For example, using the default Scan File Setup Menu shown in Figure 4.8, the detector would monitor the run at 250 nm. Each scan would include absorbance readings for wavelength settings of 220, 225, 230, 235, and so on, up to 350 nm.

NOTE: If you chose starting and ending wavelengths that weren't exact multiples of your wavelength interval, the ending spike (event mark) on your chromatogram would be placed at the last multiple of the wavelength interval that falls within the scanning range. For example, with a starting wavelength of 200 nm, an ending wavelength of 365 nm, and a wavelength interval of ten, the end spike on your chromatogram would be at 360 nm, the last full wavelength multiple within the range.

While the detector is scanning, the Status field displays SCAN.

CAUTION! During scanning, the output signal will hold at the last absorbance value taken before the scan was initiated until the scan is finished. For this reason, quantitative analysis should never be performed when scanning.

Scan Summary Data Screen

When the Scan File is loaded, the normal Status Menu no longer appears below the Status Screen. Instead, several new lines that we call the "Scan Summary Data Screen" appear. The Scan Summary Data Screen is useful in setting up the parameters to replay your stored spectra.

An example of the Scan Summary Data screen as it appears after two sample scans is shown in Figure 4.10.

Figure 4.10. An example of the Scan Summary Data Screen.

File S: SCAN			

Time	λ_{Max}	λ_{MaxAU}	λ_{Min}
10.50	280	1.6668	230
11.66	255	0.7768	220

The Scan Summary Data Screen has four fields:

- /Time/, which is the run time at which the scan was initiated
- / λ_{Max} /, which is the scan wavelength where the maximum absorbance occurred
- / λ_{MaxAU} /, which is the maximum absorbance
- / λ_{Min} /, which is the scan wavelength where the minimum absorbance occurred

If no maximum was found, the λ_{Max} and λ_{MaxAU} fields read 0 (zero). The summary information is updated as each sample scan is completed.

In our example (Figure 4.10), scans were taken at 10.50 and 11.66 minutes into the run. The scan taken at 10.50 minutes has a maximum absorbance of 1.6668 AU at 280 nm. The minimum absorbance occurred at 230 nm. To replay your 10.50-minute scan, you would use a range of 2.0 AUFS to keep the absorbance values on-scale.

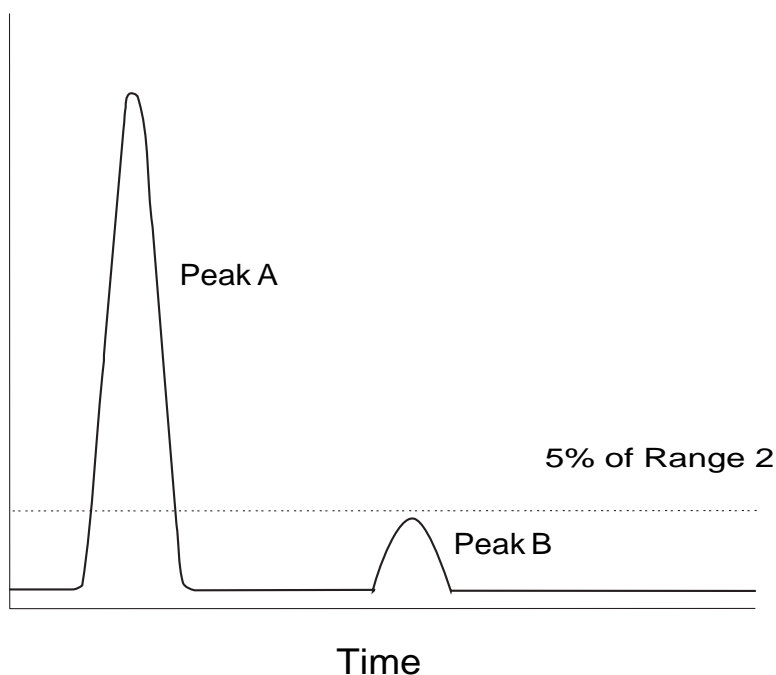
STOPPING THE SCAN FILE

There's no programmed stop in the Scan mode. The run will continue until it reaches 99.99 minutes, or until you press [STOP].

AUTOMATIC SCANNING

If you set the Auto Scan field in the Setup Menu to On, your detector will perform an automatic scan whenever there are three consecutive positive slopes followed by three consecutive negative slopes. The absorbance values for all these data points must exceed 5 percent of the value set in the Range 2 field. In our example chromatogram (Figure 4.11), a scan would occur automatically for Peak A, since it has at least three positive slopes followed by three negative slopes, all of which exceed 5% of the value set in /Range 2/. Conversely, no scan would occur for peak B, since none of its absorbances exceed the 5% threshold.

Figure 4.11. An example of how automatic scanning works.



An automatic baseline scan will occur at the time specified in the Spectra Menu's Scan Zero Time field. Make sure that no peaks are eluting at the specified time.

REPLAYING YOUR SPECTRA

When you've completed your run, you can retrieve your stored sample spectra using the Replay Menu (Figure 4.12).

To access the Replay Menu:

1. Press [MENU]. Select /FILES/.
2. Select /Edit/ to display the Scan File's Edit Menu (Figure 4.7).
3. Select /Replay/.

Figure 4.12. The Replay Menu.

Range 1	1.0
Range 2	1.0

Replay Rate	5
Spectra Time	10.50
Replay Spectra	
Display AU, λ	

Setting Replay Parameters

To set the parameters for replay:

1. Set /Range 1/ and /Range 2/ for Analog Output 1 and Analog Output 2. If you're using only one output, disregard the appropriate range.
2. Enter the Replay Rate (nm/sec). This is the rate at which the detector will read out the spectral data to your chart. You'll use this value and an appropriate chart speed to calculate wavelength increments on your printed sample spectrum.

For example, if your sample scan were taken between 190 and 340 nm (a span of 150 nm), a replay rate of 5 nm/sec would print the spectrum in 30 seconds. A chart speed of 30 cm/min would give you a scan of 15 centimeters in increments of 10 nm/cm.

3. Select the spectrum you want to replay by selecting its start time in the Spectra Time field. Each spectrum taken during the run is identified individually by the run time at which it was initiated.

When you finish setting your replay parameters, you're ready to send the spectral data to your chart using the Replay Spectra command.

Running Replay

To initiate the Replay Spectra command in the Replay Menu, press [ENTER]. While the replay is occurring, the screen shown in Figure 4.13 appears on the display.

Figure 4.13. The display as it appears while spectra are being replayed.

Replay	λ	AU
10.50	220	0.00001

The screen's Replay field displays the start time of the spectrum being replayed. The λ and AU fields display the individual data points being plotted.

The detector uses advanced curve-fitting algorithms to present a smooth, continuous plotted spectrum. The spectrum is replayed in 1-nm steps regardless of the wavelength interval selected. To change the appearance of replayed spectra from 1-nm stepped curves to smooth curves (or vice versa), vary the recording device's replay rate and response time.

If no spectra are stored in memory when you activate the Replay Spectra command, the message shown in Figure 4.14 will appear on the display. When the replay is finished, the display returns to the Replay Menu.

Figure 4.14. The message that appears when no spectra are stored in memory.

```
** No Scans Stored **
```

Stopping Replay

You may stop a replay at any time by pressing [STOP].

SPECTRAL DATA STORAGE

Spectral data are stored in memory until a new file or queue is loaded or the detector is turned off.

Viewing Data

You can display the individual data points of your stored spectra by selecting the Display AU, λ field in the Replay Menu (Figure 4.12). A screen similar to that shown in Figure 4.15 will appear on the display.

Figure 4.15. The Display AU, λ screen***.

Display	λ	AU
10.50	220	0.00001

NOTE: Only actual data points (separated by the proper wavelength interval) can be displayed.

The Display AU, λ screen shows the time at which the scan was initiated, along with each wavelength and absorbance reading collected. You can move the cursor through the data using [+] and [-]. To return to the Replay Menu, press [^].

4.5 The Develop File

The Develop File allows you to perform sequential sample injections at different wavelengths automatically. This automation makes method development much easier because you can use an automated run to determine the optimum detection wavelength for each component in your sample. You can also use the Develop File to troubleshoot chromatographic problems, or to confirm method transfer from laboratory to laboratory.

SELECTING THE DEVELOP FILE

Use the following instructions to select the Develop File.

1. Press [MENU]. Select /FILES/.
2. Press [+] to increment the Edit File field until a "D" is displayed. The File Name field will read DEVELOP. (You can't edit the Develop File's name.)

EDITING THE DEVELOP FILE

Follow these instructions to edit Develop File parameters:

1. Once you've selected the Develop File as described above, press either [ENTER] or [v] to access the Develop File's Edit Menu (Figure 4.16).

Figure 4.16. The Develop File's Edit Menu.

Edit File	D
File Name	DEVELOP

Start λ	220
End λ	350
λ Interval	5
Run Time	10.00
Runs per λ	2
Rise Time	1.0
Autozero Time	0.00
Range 1	1.0
Range 2	1.0

2. In the Start λ field, enter the wavelength at which the first chromatogram is to be monitored.
3. In the End λ field, enter the wavelength at which the last chromatogram is to be monitored.

4. In */λ Interval/*, enter the wavelength increment that the detector's monochromator should use for each wavelength change.
5. In */Run Time/*, enter how long each run should last.
6. In */Runs per λ/*, enter the number of injections to be made at each wavelength setting.
7. Enter Rise Time, Autozero Time, Range 1, and Range 2 as you would for a typical run. Note that Range 1 and Range 2 are the corresponding ranges for Analog Outputs 1 and 2, respectively.

As an example, we'll use the Develop File shown in Figure 4.16. The detector would make its first two ten-minute runs at 220 nm. The monochromator would then change to 225 nm, and the detector would make two runs at this wavelength. This pattern would continue in five-nanometer increments until the detector has made two runs at the last wavelength, 350 nm.

After setting up your Develop File, you're ready to load it and run.

RUNNING THE DEVELOP FILE

When the Develop File is loaded, you'll notice an additional field in the Status Screen, */#Runs/* (Figure 4.17).

Figure 4.17. The Status Screen with the Develop File loaded.

Status	λ	AU	#Runs
READY	220	+0.0001	1/3

#Runs

The *#Runs* field in the Status Screen shows the current run number, followed by a forward slash and the total number of injections for the wavelength specified in the *λ* field. The field is updated with each injection. For example, if the file is set up to make three injections per wavelength, and the detector is in the second run for the 250-nm setting, the *#Runs* field would appear as 2/3.

Status Menu

The Status Menu looks the same for a Develop File as it does for a typical chromatographic file (Figure 4.18).

Figure 4.18. The Status Menu with the Develop File loaded.

File D:	DEVELOP

Time	Wavelength
0.00	250
10.00	250
Rise Time	1.0
Autozero Time	0.00
Range 1	1.0
Range 2	1.0

NOTE: You can change any of the parameters in the Status Menu while the detector is running, but the changes will be effective only until the next wavelength is loaded.

REPEATING THE DEVELOP FILE

After the last wavelength is run, the detector is reset automatically to the starting wavelength in the Develop File. The file can be run as many additional times as you wish, as long as the detector continues to receive run signals.

4.6 Sample Queue

Sometimes it's convenient to group samples together under different detector conditions in an automated run. For these occasions, the UV-116A offers a queuing feature. Using a queue, you can program the detector to load and run a specified file automatically for your first group of samples, then load a second file to run your next group of samples. The queue feature allows you to run as many as ten groups in a single queue.

QUEUE MENU

To access the Queue Menu, follow these steps:

1. Press [MENU].
2. Select /QUEUE/.

When no queue is loaded, the Queue Menu appears as shown in Figure 4.19. Figure 4.25 will show how the menu appears when a queue is loaded.

Figure 4.19. The Queue Menu with no queue loaded.

>Edit	Load
Delete	

SETTING UP A QUEUE

To set up a queue, select /Edit/ from the Queue Menu. For an empty queue, the display appears as shown in Figure 4.20.

Figure 4.20. An empty queue.

Order	File:Name	#Runs
1		

Entering a Line

A "1" is placed automatically in the Order field of the first file to be run. You can't change that, so the cursor appears under the first editable field, /File:Name/. Scroll through the available files and press [ENTER] when your choice appears.

NOTE: You may only select numbered files. The Scan and Develop files aren't available in the Queue mode.

Enter the number of injections to be made in the #RUNS field and press [ENTER]. You can have as many as 999 injections per file.

Adding More Lines

After completing the first line, a second line appears automatically. The Order field reads 2, and the rest of the line is blank. Select the proper file and the number of injections to be made for that file. You can have as many as ten groups in the queue.

Deleting a Line

To delete a line, press [-] while in the File:Name field until the field is blank. When you leave the line, it's deleted and the queue is resorted automatically.

An Example

An example of a queue appears in Figure 4.21.

Figure 4.21. An example of a queue.

Order	File:Name	#Runs
1	2:THEOPHYL	5
2	3:ABCD	25
3	1:BARBITUA	10

In our example, we have programmed the detector to run File 2 for the first five injections, File 3 for the next 25 injections, and File 1 for the last 10 injections.

LOADING A QUEUE

To load a queue, select /Load/ in the Queue Menu. When the words "Load Queue" appear, press [ENTER]. The confirmation message in Figure 4.22 appears for one second.

Figure 4.22. The confirmation message when a queue is loaded.

```
** Queue Loaded **
```

When a queue is loaded, the letter "Q" appears at the extreme left of the Status Screen (Figure 4.23).

Figure 4.23. The Status Screen when a queue is loaded.

Status	λ	AU
Q READY	250	+0.00001

If you attempt to load a queue when no queue exists, the message shown in Figure 4.24 appears on the display.

Figure 4.24. The message that's displayed when no queue is available.

```
** No Queue Available **
```

RUNNING A QUEUE

When the detector receives its first start signal, it loads and runs the file designated in Order 1. It will continue to run this file each time it receives a start signal until the file has run the number of times specified in the #Runs field. The detector will then load and run the file designated in Order 2 and run it the number of times specified in that line, and so on, until the entire queue has run.

Viewing its Progress

To view a queue's progress while it's running:

1. Press [MENU].
2. Select /QUEUE/. Note that when a queue is loaded, the Queue Menu (Figure 4.25) looks different. The Load field has been replaced by "Pause." See below for more information on the Pause selection.

Figure 4.25. The Queue Menu with a queue loaded.

```
>Edit                                Pause
                                     Delete
```

3. Select /Edit/ to display the queue. (Refer to Figure 4.21 for an example of a queue.)

While the queue is running, the #Runs field decreases by one automatically with each injection. When a particular file's last injection is made, the queue is resorted automatically. In other words, the information for Order 2 is now moved up to Order 1, the information for Order 3 is moved up to Order 2, and so forth. This process continues until the queue becomes empty, is paused, or is deleted.

Loading other Files

When a queue is loaded or running, you may not load any other file from the Files Menu without first pausing or deleting the queue. If you forget to pause or delete the queue and attempt to load a different file, you'll get the message shown in Figure 4.26. You're then returned to the Files Menu.

Figure 4.26. The message that appears if you attempt to load a file when a queue is already loaded or running.

```
  ** Queue Loaded **  
  Can't Load File
```

EDITING A QUEUE

To edit an existing queue, follow the procedures outlined in "Setting Up a Queue" above. You're allowed to edit the Queue while it's running, but if you want to edit anything in Order 1, you'll have to pause the queue first.

PAUSING A QUEUE

To pause a queue:

1. Select /Pause/ from the Queue Menu.
2. When the words "Pause Queue" appear, press [ENTER]. If a file is running, the run continues until it's completed, at which point the detector returns to its READY state. The letter Q will then no longer appear in the Status Menu.

When you wish to continue, you must reload the queue. When the detector receives a start signal, the queue will resume operation at the point where it left off.

DELETING/STOPPING A QUEUE

Use the following steps to delete an existing queue or to stop a running queue:

1. Display the Queue Menu.
2. Select /Delete/.
3. When the words "Delete Queue" appear, press [ENTER]. If a file is running, the run continues until it's completed. The confirmation message shown in Figure 4.27 appears for one second and you're returned to the Queue Menu.

Figure 4.27. The queue-deleted message.

```
** Queue Deleted **
```

You may delete or stop a queue at any time, but remember that subsequently the queue will be erased from the detector's memory. It's good practice to delete an existing queue prior to creating a new one.

4.7 K-Factor

The K-factor calculates a factored response that can be used to eliminate, add, or subtract absorbances. This technique is useful for suppressing peaks when there are two coeluting, or poorly resolved, peaks in your chromatogram. It's also useful in applications where you want to add or subtract absorbances at two different wavelengths in real-time.

For example, if you want to quantitate a peak without interference from another peak, you would use the K-factor to calculate a response of zero.

More specifically, let's say you want to analyze for Compound A in the presence of Compound B. If both absorb at the monitoring wavelength, λ_1 , but only Compound B absorbs at a second wavelength, λ_2 , you can calculate a K-factor for Compound B using its absorbances at λ_1 and λ_2 . You can then use the K-factor to calculate the absorbance due to only Compound A at the monitoring wavelength (λ_1), by subtracting Compound B's contribution from the total absorbance. The UV-116A uses the algorithm:

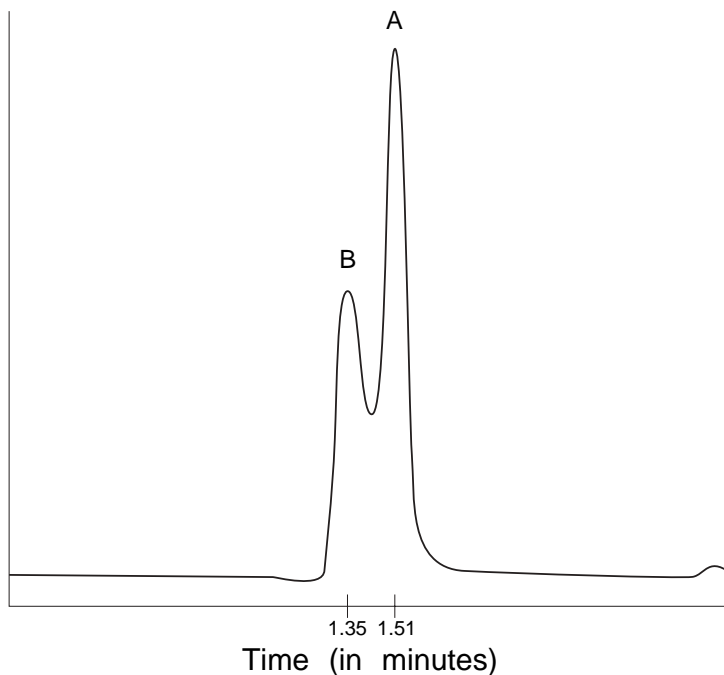
$$\text{Absorbance due to A at } \lambda_1 = \text{TAbs}(\lambda_1) - K \times \text{TAbs}(\lambda_2)$$

where $\text{TAbs}(\lambda_1)$ is the sum of the absorbances of A and B at the monitoring wavelength, K is the K-factor, and $\text{TAbs}(\lambda_2)$ is the total absorbance obtained at λ_2 .

AN EXAMPLE

Figure 4.28 shows a chromatogram of a mixture of toluene and butyl paraben where the two compound peaks overlap. Toluene (Peak A) is the compound of interest. Butyl paraben (Peak B) is the peak we want to suppress. We'll use this example throughout the following steps for determining and using the K-factor.

Figure 4.28. A chromatogram of two unresolved peaks: toluene (A) and butyl paraben (B).

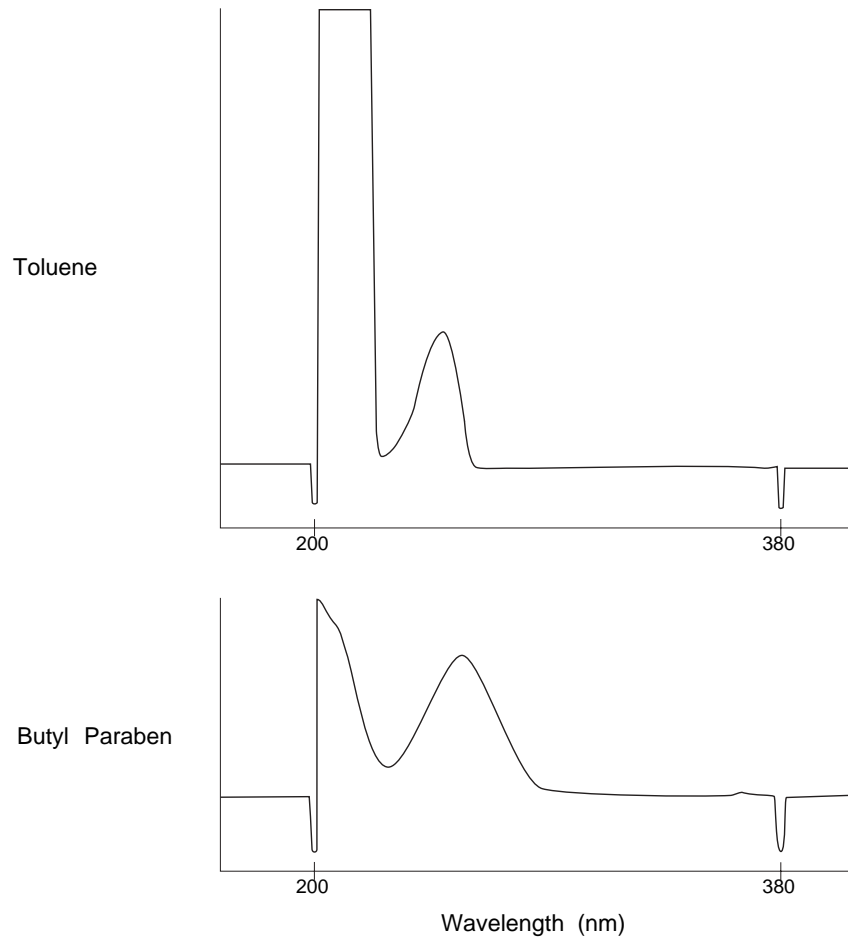
**Choosing a Pair of Wavelengths**

The first step in determining the K-factor is to choose a pair of wavelengths for your analysis.

1. Take an absorbance spectrum of each compound. You can do this by injecting samples of compound A and compound B alone, under the same chromatographic conditions as your analysis, and using the scanning feature. (See Section 4.4.)

For the compounds in our example, we get the spectra shown in Figure 4.29.

Figure 4.29. Spectra of individual compounds.



2. Label the wavelength maximum for your peak of interest as λ_1 .
3. From the spectra, pick a wavelength for which compound B absorbs and compound A doesn't. This wavelength is labeled λ_2 . For our example, we have chosen 254 nm as λ_1 and 280 nm as λ_2 .

Calculating the K-Factor

Use the Display AU, λ screen (page 40) to obtain the individual absorbance value data from your scan of compound B.

Calculate the K-factor using the following equation:

$$K = \text{AU}_1 / \text{AU}_2$$

where AU1 and AU2 are the absorbance values for compound B at λ_1 and λ_2 , respectively.

For our example, the absorbance values are 0.0144 and 0.0032 (for 254 and 280 nm respectively), so our K-factor is 4.5, calculated as follows:

$$K = 0.0144 / 0.0032 = 4.5$$

Using the K-Factor

To use the K-factor, set the parameters in the Analog Outputs Menu, inject your sample, and monitor the results as follows:

1. Press [MENU].
2. Select /OPTIONS/.
3. Select /Analog Outputs/.

The menu shown in Figure 4.30 will appear.

Figure 4.30. The Analog Outputs Menu.

Analog 1 Offset (%)	0
Analog 2 Offset (%)	0

Analog 2	AU
K Factor	1.000

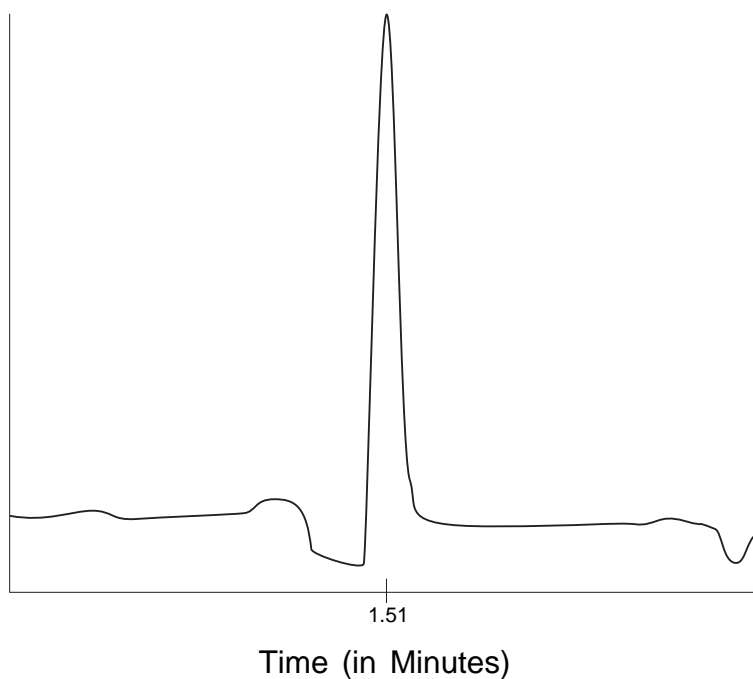
4. Scroll down to Analog 2 and select AU1-K×AU2.
5. Scroll down to K-factor and enter your calculated value (4.5, for our example).
6. Inject your sample.

HINT: Make sure your file was set to dual-wavelength mode as described in Section 3. Also remember that in this example, AU1 (λ_1) is 254 nm and AU2 (λ_2) is 280 nm.

7. Use Analog Output 2 (CH 2 on the detector's rear panel) to monitor the chromatograms for your peak of interest.

Our example chromatogram would now appear as shown in Figure 4.31, with a slightly lowered response for toluene and no absorbance contribution from butyl paraben. Using the K-factor in this way, we can quantitate toluene in the presence of butyl paraben without altering the chromatography.

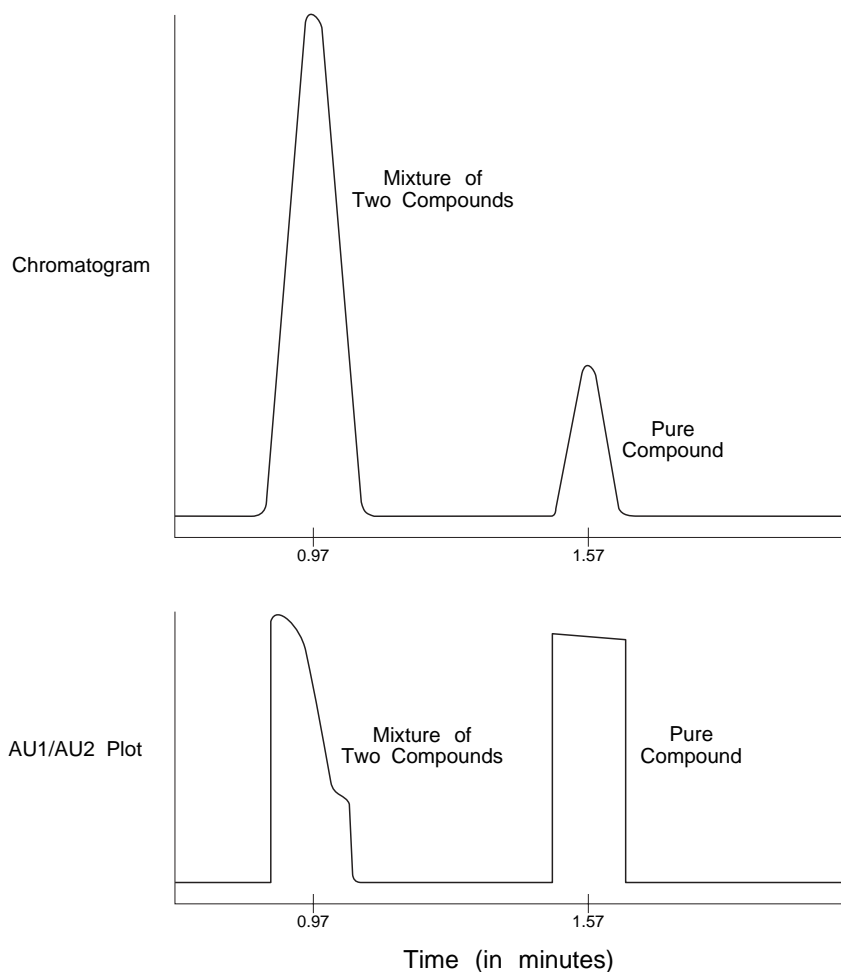
Figure 4.31. Chromatogram of toluene with butyl paraben suppressed.



4.8 Absorbance Ratios

Ratioing the detector's outputs from two different wavelengths can be a useful way of confirming peak purity. When a peak is pure, the ratio of the absorbances should remain constant. Thus the ratio for a pure compound produces a relatively square wave, while the ratio for an impure compound produces a distorted wave (see the plots at 1.57 and 0.97 minutes, respectively, in Figure 4.32).

Figure 4.32. Using absorbance ratios to determine the purity of two peaks in a chromatogram.



To use absorbance ratioing, you need to select AU1/AU2 for the Analog 2 Output field in the Analog Outputs Menu. You also need to select the two wavelengths you want to ratio.

To select the most appropriate wavelengths, use the Scan File to collect a spectrum across a range of wavelengths. Then select /Display AU, λ / from the Replay Menu and examine the collected data.

The data shown in Figure 4.33 are typical.

Figure 4.33. The Display AU, λ screen.

Display	λ	AU
1.50	220	0.00001

1.50	250	1.66681
1.50	280	0.28831

Ratioing only occurs when the absorbance value for each wavelength exceeds 12.5% of the corresponding range value. So, in our example, if Ranges 1 and 2 were set to 1.0 in the /FILES/, /Edit/, Options Menu, the 250 and 280 nm wavelengths could be ratioed. [Twelve-and-a-half percent of 1.0 (the range) is 0.125. Absorbance values less than 0.125 are too low for ratioing.] No ratio output is produced when the absorbance values fall below 7.5% of the range values.

Generally, good wavelengths to choose are:

1. the lambda max of the main peak (AU1)
2. a wavelength with an absorbance value less than the lambda max but greater than 12.5% of the corresponding range (AU2)

HINT: A good rule of thumb is to select a second wavelength that's either half the height of the lambda max or more than ten nanometers removed from the lambda max.

Whichever wavelengths you choose, don't select a wavelength that has a low absorbance value. Low absorbance values decrease the signal-to-noise ratio, thus making the absorbance ratios less meaningful. Similarly, a small fluctuation in AU2 results in a big difference in the absorbance ratio if AU2 is very small. Fortunately, by relying on the preset range values, the UV-116A has a built-in safeguard that prevents the ratioing of low absorbance values.

4.9 Other Features

Additional features offered by the UV-116A include the abilities to lock the Status Screen, to short the detector outputs, to place an event mark on the chromatogram, and to send a ready signal to external devices. You can also control the display's contrast and cursor speed, and make a quick shutdown of the detector's lamps and motors.

STATUS LOCK

You can lock the detector's display using the Status Lock field. This feature lets you prevent accidental changes to a file that's currently being run. With the lock on, you can move the cursor down from the Status Screen as far as the Status Menu's File Name field. However, you'll still be able to access the Main Menu and the rest of the menu structure using [MENU].

To access Status Lock:

1. Press [MENU].
2. Select /OPTIONS/.
3. Select /More/.
4. Scroll down to /Status Lock/. Select On or Off to turn the lock on or off, respectively.
5. Press [STATUS].

SHORT OUTPUTS

When zeroing a readout device such as an integrator or recorder, it's convenient to be able to short the detector outputs. You can do this using the Short Outputs feature as follows:

To access Short Outputs:

1. Press [MENU].
2. Select /COMMANDS/. The Commands Menu (Figure 4.34) appears.

Figure 4.34. The Commands Menu.

```
>Event Mark
Short Outputs
-----
Shutdown Detector
```

When you select Short Outputs, the detector's analog outputs are shorted together (zero volts) and the field name changes to "Unshort Outputs." To return the outputs to their normal (unshorted) operating state, select Unshort Outputs, and the field changes back, now

reading "Short Outputs." (When you leave this screen, the field returns to Short Outputs automatically.)

EVENT MARK

Using the event mark feature, you can place an event mark on your chromatogram to note various occurrences, such as the turning of a sampling valve. The event mark is a spike (15% of full-scale for one second) in both detector output signals.

To access Event Mark:

1. Press [MENU].
2. Select /COMMANDS/. The Commands Menu (Figure 4.34) appears.
3. Place the cursor on Event Mark. Press [ENTER] each time you wish to place an event mark on your chromatogram.

CAUTION! You may not want to use event marks if your data will be analyzed by an integrator. Integrators can misinterpret event marks as peaks!

READY OUTPUT

Using the NOT READY terminal on the detector's back panel, the detector can send a signal to other devices each time it goes to its READY state. This feature is used frequently with autosamplers to signal that the detector is ready for the next injection.

To access the READY Output field:

1. Press [MENU].
2. Select /OPTIONS/.
3. Select /More/.
4. Scroll down to the READY Output field. Select Active Hi or Active Lo, depending on which signal you wish to send.

HINT: Refer to the appropriate reference manual for the instrument being connected.

For details on interfacing your detector's NOT READY terminal with other devices, see page 73.

DISPLAY CONTRAST

You can vary the display's contrast to make it easier to read. To change the display's contrast, first press [STATUS] to access the Status Screen. Then press the [>] key and the [+] key simultaneously to increase the contrast, or the [>] key and the [-] key to reduce the contrast.

CURSOR SPEED

You can control the display's cursor speed to make it easier to use. To access Cursor Speed:

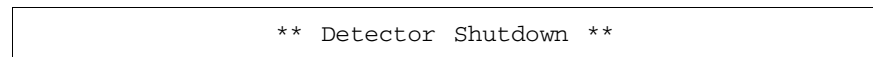
1. Press [MENU].
2. Select /OPTIONS/.
3. Select /More/.
4. Scroll down to Cursor Speed and select Fast, Medium, or Slow.

SHUTDOWN DETECTOR

This feature offers a quick shutdown, and subsequent startup, of the detector's lamps and motors. The electronics stay on to maintain the detector's memory. To shut down the detector:

1. Press [MENU].
2. Select /COMMANDS/.
3. Scroll down to the Shutdown Detector field.
4. Press [ENTER]. The confirmation message shown in Figure 4.35 appears on the display.

Figure 4.35. Shutdown confirmation message.



```
** Detector Shutdown **
```

To restart the detector, press any key on the keypad. The detector will restart under the same conditions present when the Shutdown Detector command was activated.

Section 5. Maintenance

BAS detectors are finely-tuned scientific instruments that we at BAS are proud to stand behind. Even so, routine maintenance is necessary to ensure peak performance, so we can only guarantee our detectors' performance if you follow proper care and maintenance procedures.

CAUTION! Failure to complete the required maintenance when it's due may void your warranty.

This section shows you how to clean and replace your detector's flowcell and lamps. If you have any questions on proper maintenance, please contact your local BAS representative.

5.1 Flowcells

This section describes the changing and general cleaning of your detector's flowcell. For other flowcell problems, such as a cracked window or leaks that occur in locations other than at the inlet/outlet fittings, contact your BAS service representative.

NOTE: Flowcells are factory-assembled units that should not be disassembled by a novice under any circumstance.

CHANGING THE FLOWCELL

The flowcell must be removed whenever you need to replace a broken cell, change between specialized applications, or clean the cell with nitric acid. For a list of available flowcells, see "Specifications - Flowcells" in Section 6. All flowcells are shipped premounted in a holder for easier installation and alignment.

To access the flowcell, remove the forwardmost of the two enclosures on the detector's left side (as you face the detector from the front) (Figure 5.1). The flowcell assembly is located inside the enclosure. Once the enclosure is removed, the flowcell is easily identified by the tubing that extends from the fittings at its top and bottom (Figure 5.2).

Figure 5.1. Left-side of the detector showing location of lamp and flowcell housings.

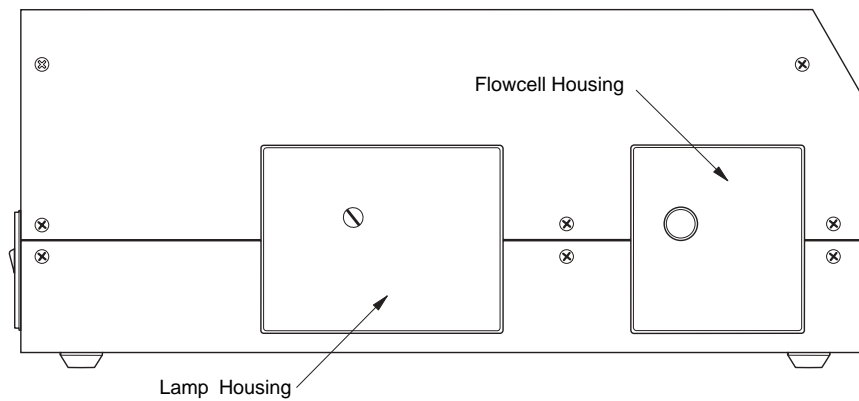
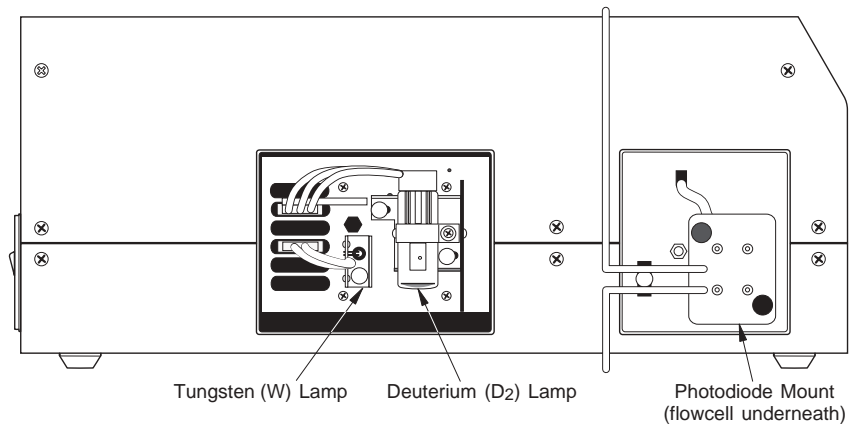


Figure 5.2. Removing the lamp and flowcell enclosures to expose the lamp, the flowcell, and the photodiode mount.



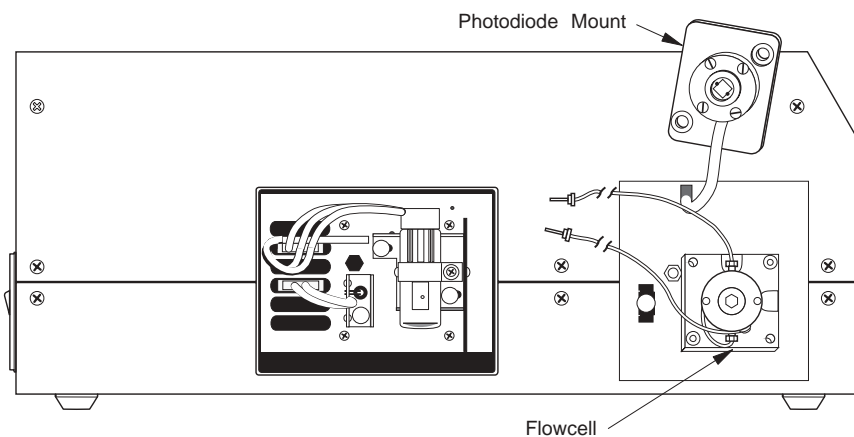
Flowcell Removal

Use the following steps to remove the flowcell:

1. Disconnect the power cord from the rear panel of the detector and make sure that the instrument is turned off.
2. Loosen the knurled thumbscrew that holds the flowcell enclosure in place, and remove and set aside both the thumbscrew and the housing.
3. Disconnect the flowcell inlet tube from the chromatograph and free the flowcell outlet tubing from the waste reservoir.
4. Remove the two thumbscrews from the photodiode mount and carefully pull the mount straight back. The cable that connects the photodiode mount to the detector is sufficiently long to allow the mount to be positioned out of the way (Figure 5.3).

CAUTION! Wear powder-free latex gloves during disassembly of flowcell-housing components to avoid putting fingerprints or scratches on the flowcell windows, photodiode surface, or monochromator lens, all of which are exposed during these procedures. If dirty, the surfaces should be cleaned with spectroscopic-grade methanol (or isopropanol) and lint-free lens paper only.

Figure 5.3. Repositioning the photodiode mount to expose the flowcell.



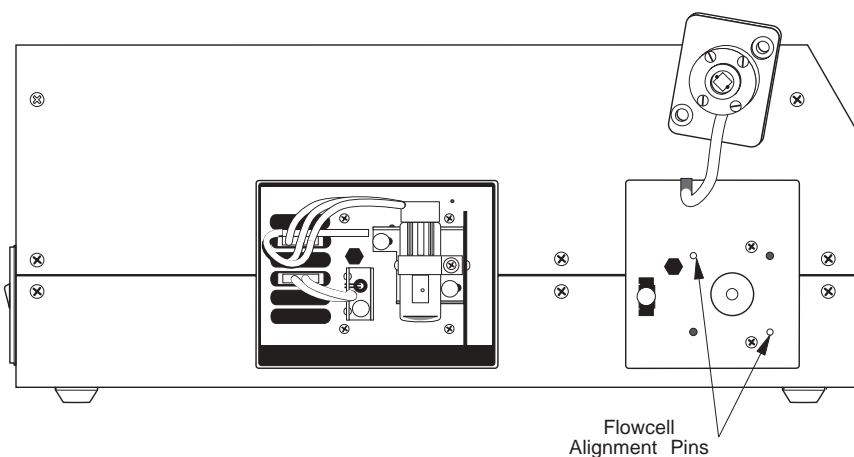
5. Loosen the thumbscrew that holds the tubing clamp in place. Gently pull the clamp toward you just far enough to disengage the tubing. Reorient the tubing so that it's clear of the tubing clamp.
6. Loosen the two thumbscrews that hold the flowcell assembly. Carefully pull the assembly toward you to remove it from the detector.

Flowcell Installation

To install a flowcell, follow these steps:

1. With the inlet tube on the bottom, slide the flowcell assembly onto the alignment pins (Figure 5.4) and securely fasten it in place with the two thumbscrews.

Figure 5.4. Location of the flowcell alignment pins.

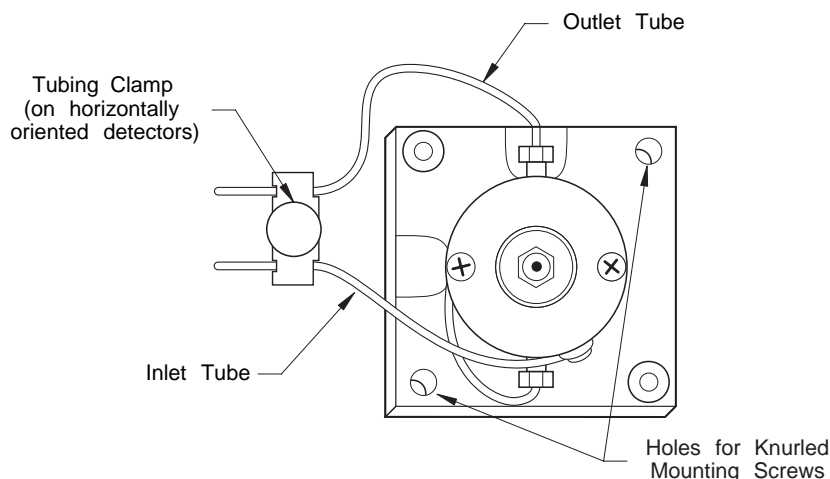


2. Slip the flowcell's inlet and outlet tubes into the slots of the tubing clamp and tighten the thumbscrew that holds the clamp in place.
3. Replace the photodiode mount and fasten it securely with the two thumbscrews.
4. Connect the inlet tubing to the chromatographic column and the outlet tubing to the waste reservoir.

5. Taking care not to pinch the cable or tubing, replace the flowcell enclosure and secure it with the knurled thumbscrew.
6. Connect the power cord to the rear detector panel.

When the flowcell is properly installed it will appear as shown in Figure 5.5.

Figure 5.5. Proper flowcell installation.



CLEANING THE FLOWCELL

The exterior and/or interior surfaces of the flowcell can become contaminated. When flowcell contamination occurs, it's usually caused by precipitation or solubility problems, such as when the quality of your mobile-phase solvent components and the cleanliness of your samples are variable. Signs of a contaminated flowcell are increased baseline noise, signal spiking, erratic or drifting baselines, and, in the case of severe contamination, increased back pressure.

Cleaning with Organic Solvents

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

NOTE: Flowcells are factory-assembled units that shouldn't be disassembled under any circumstance. If you encounter contamination problems that aren't remedied by this cleaning procedure, contact your local BAS representative to arrange for repair or replacement.

1. Make certain that the first cleaning solvent you plan to use is miscible with the solvent already present in the flowcell and pump. Isopropanol is a good choice for most applications.

CAUTION! If the last solvent in the pump was an aqueous buffer solution, be sure to pump 25–40 mL of HPLC-grade water (or equivalent) through the system to remove any salts *before* flushing with the cleaning solvent(s).

2. Flush the flowcell with 40–50 mL of solvent (HPLC-grade water, methanol, or isopropanol). You can either pump the solvent through the flowcell with the chromatographic pump, or you can draw the solvent through the flowcell using a large-volume syringe.

If you use an LC pump to flush the flowcell, first remove the column from your chromatographic system to avoid column degradation. Replace the column with an appropriate length of tubing, ensuring that all connections are snug and leak-free. If you use a syringe, always draw the solution through the flowcell.

WARNING! Never use a syringe to force solvent through a flowcell. Pressurizing the syringe could cause a leak or rupture that would result in an extremely dangerous, uncontrolled spraying of solvent.

Cleaning with Nitric Acid

Methanol or isopropanol is generally sufficient for cleaning a flowcell. However, if the flowcell is still contaminated after flushing with organic solvents, follow this nitric-acid cleaning procedure.

WARNING — Chemical Hazard! Nitric acid is extremely corrosive and can react explosively with alcohols (especially methanol). Be sure to adhere to your company's safety procedures for handling and disposal of corrosive acids. Flush the flowcell with water to remove all traces of alcohol prior to flushing with nitric acid!

1. Remove the flowcell assembly from the detector housing (following the procedure on page 58) before cleaning with a nitric acid solution. This will prevent possible leaks from harming the mechanical or electronic components of the detector.
2. Flush the flowcell with water before proceeding. As explained in the foregoing WARNING, this step is *critical* for operator safety!
3. Prepare a 20% volume-to-volume (v/v) solution of nitric acid in HPLC-grade water.
4. Pump the nitric acid solution through the flowcell with the chromatographic pump or draw it through with a large-volume syringe.

If you use an LC pump, replace your column with tubing and make sure water was the last solvent in the pump and solvent reservoir. If you use a syringe, always draw the solution *through* the flowcell.

WARNING! Never use a syringe to force nitric acid through a flowcell. Pressurizing the syringe could cause a leak or rupture that would result in an extremely dangerous, uncontrolled spraying of nitric acid.

5. After you've finished the cleaning procedure and before returning to the buffer solution, pump another 25–40 mL of water through the flowcell to remove all traces of nitric acid before returning to your chromatographic solvents. Reinstall the flowcell assembly.

CAUTION! Flush the pump with water immediately after the nitric acid flush. Leaving nitric acid solution in the pump for prolonged periods can damage pump seals.

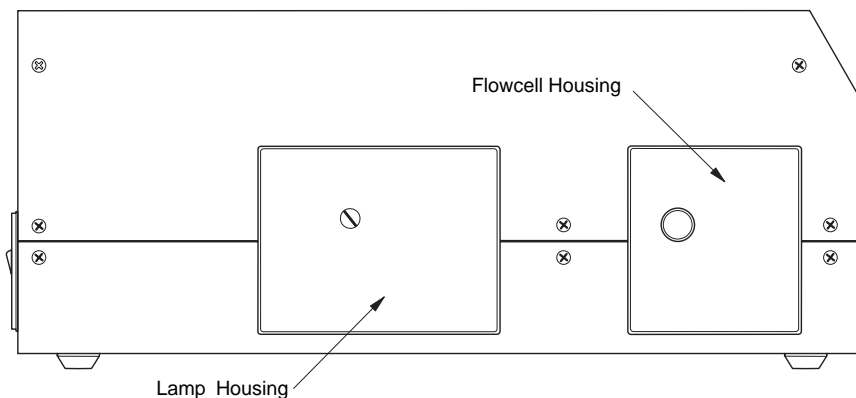
5.2 Lamps

As lamps age, there is a reduction in light output that results in increased baseline noise. If the noise level on your detector's output signal is increasing and cleaning the flowcell doesn't help, you should change the appropriate lamp, using the procedures in this section.

Remove the lamp housing (the housing shown on the left in Figure 5.6). Both lamps are supplied prealigned in their individual assemblies to make them easy to install.

CAUTION! Never loosen the screws that hold the lamp to its assembly or attempt to rotate or move the lamp up or down in the assembly. Either of these actions can cause a loss of alignment and degrade the detector's performance.

Figure 5.6. Left side of the detector showing location of lamp and flowcell housings.



THE DEUTERIUM LAMP

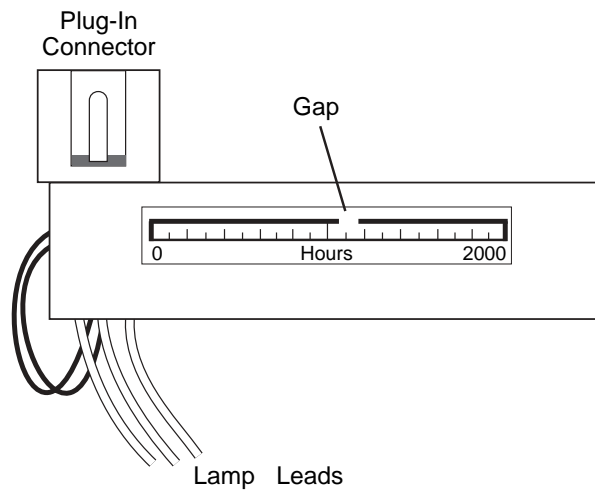
The deuterium (D2) lamp typically requires a warm-up time of 20 to 30 minutes. However, for applications that demand great sensitivity, you may want to allow an extended warm-up period of up to an hour.

The deuterium lamp's lifetime is usually at least 1000 hours. Each D2 lamp assembly is equipped with a chronometer (Figure 5.7) that tracks the total hours of lamp operation. To read the chronometer, observe the position of the "gap" in the mercury tube relative to the graduated scale, noting that the center graduation corresponds to 1,000 hours and each of the smallest divisions represents 100 hours. In the example shown in Figure 5.7, the position of lamp chronometer's gap indicates that the lamp has operated for approximately 1,100 hours.

You can also track lamp life automatically. (See "Automatic Lamp Operations" on page 30 for details.)

NOTE: Wear powder-free latex gloves to keep the lamp surface free of fingerprints and smudges. If the surface needs cleaning, use a lint-free lens paper moistened with methanol or isopropanol.

Figure 5.7. Deuterium lamp chronometer, top view.



D2 Lamp Removal

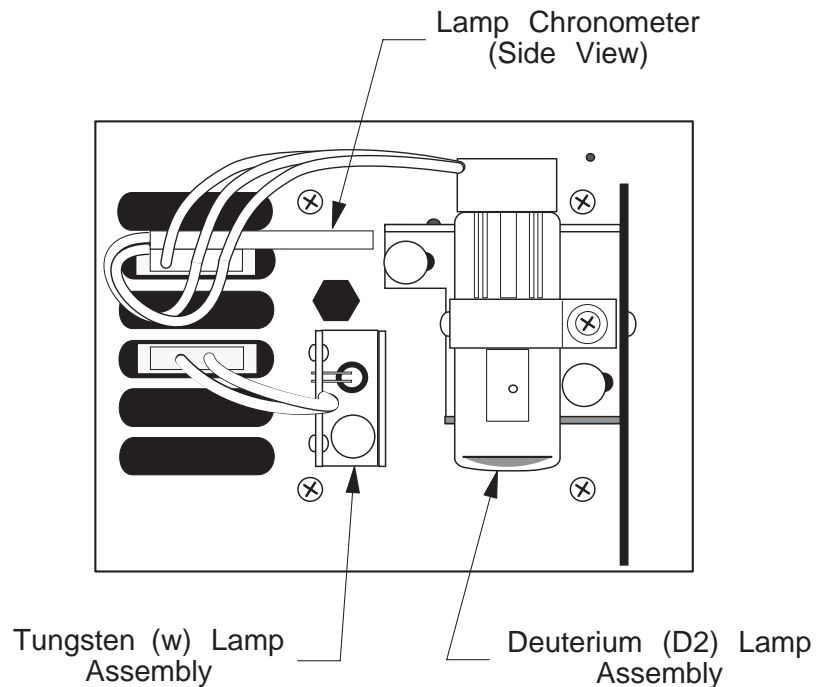
These four steps detail deuterium lamp removal.

1. Disconnect the power cord from the detector's rear panel and make sure that the instrument is turned off.

WARNING! Intense UV light can injure your eyes. Always disconnect the power cord before exposing the lamp and always allow sufficient time for the lamp to cool before removing it, as it gets quite hot when lit.

2. Remove the lamp housing by removing the mounting screw and pulling the cover off. The lamp assemblies will then be exposed (Figure 5.8).

Figure 5.8. Deuterium (D2) lamp chronometer, D2 and tungsten (W) lamp assemblies.



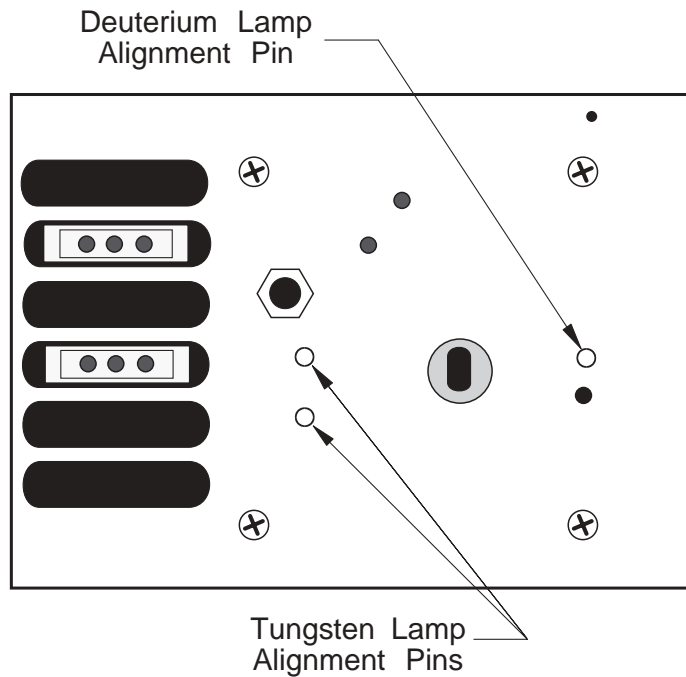
3. Unplug the deuterium lamp lead from the detector, taking care not to twist the connector as you pull it out gently.
4. Loosen the two thumbscrews that hold the lamp assembly in place and pull the assembly straight out.

D2 Lamp Installation

Follow these steps to install a new D2 lamp.

1. Hold the deuterium lamp assembly so that the leads are at the top. Slide the assembly onto the alignment pin shown in Figure 5.9. (The alignment pin is located to the right of the detector's monochromator aperture.)
2. Fasten the assembly securely in place using the two thumbscrews and aluminum stand-offs.
3. Insert the lamp's white-nylon electrical connector into the upper bulkhead connector in the lamp compartment.
4. Replace the lamp enclosure and secure it with the knurled thumbscrew.
5. Connect the power cord to the rear detector panel.

Figure 5.9. Deuterium and tungsten lamp assemblies removed to show lamp-alignment pins.



THE TUNGSTEN LAMP

The tungsten (W) lamp requires only 15 minutes of warm-up time, typically. Its lifetime is approximately 2500 hours. You can track lamp life automatically. (See "Automatic Lamp Operations" on page 30 for details.)

W Lamp Removal

Follow the steps below to remove the tungsten lamp.

1. Disconnect the power cord from the detector's rear panel and make sure that the instrument is turned off.

WARNING! To avoid burns, always allow sufficient time for the lamp to cool before removing it.

2. Remove the lamp enclosure by loosening the thumbscrew and pulling the cover away to expose the lamp assembly (Figure 5.8).
3. Unplug the tungsten lamp lead (the lower white-nylon connector) from the detector's lamp compartment, taking care not to twist the connector as you pull it out gently.
4. Loosen the thumbscrew and the aluminum standoff that hold the lamp assembly in place and pull the assembly straight out.

W Lamp Installation

These five steps explain how to replace the tungsten lamp.

1. Hold the lamp assembly so that the leads are at the top. Slide the assembly onto the two alignment pins shown in Figure 5.9. (The alignment pins are located on either side of the detector's monochromator aperture.)
2. Fasten the assembly in place securely with the thumbscrew and aluminum standoff.
3. Connect the lamp's white-nylon electrical connector to the lower bulkhead electrical connector in the lamp compartment.
4. Replace the lamp enclosure and fasten it securely with the thumbscrew.
5. Connect the power cord to the rear detector panel.

CAUTION! Exercise care when installing the tungsten lamp assembly to ensure that the alignment pins enter the correct openings in the assembly. If an alignment pin inadvertently and forcefully presses against the W lamp, the pin may knock the lamp out of alignment.

Section 6. Installation and Specifications

This section covers the initial installation of your UV/Vis detector, including hookup to other chromatographic instrumentation. As you go through unpacking and installation, you may want to use the Start-up Checklist located at the beginning of this manual. The checklist is an abbreviated version of this section and is supplied as a quick reference of how to conduct a successful installation. Also included in this section is a list of your detector's specifications.

6.1 Installation

Unpacking

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

The shipping container should contain the detector, an 8-pin and a 12-pin connector, and any options you ordered.

Check carefully to make sure you received all the items listed on the packing list. If any items are missing, contact your BAS representative immediately.

You'll need the following tools for installation:

- a narrow-tip screwdriver (2 mm wide)
- a #2 Phillips screwdriver

Place the detector on the benchtop as close as possible to the chromatographic column outlet (thus minimizing the length of tubing necessary for connection to the flowcell inlet). Allow at least five inches (13 cm) of clear space between the detector's rear panel and any wall or obstruction. This provides both access to the rear-panel connectors and a free flow of cooling air.

CHECKING THE POWER

The detector is shipped with the voltage and fuses preset for 120 volts. To verify the correct setting, look through the cut-out window on the voltage selector cover (Figure 6.1). (The cover is located on the detector's rear panel but, if your instrument is new, it may be hidden behind a precautionary sticker.) If the voltage setting satisfies your local site requirements, skip to "Fuses" below. If not, proceed to the next section, "Voltage Selection."

WARNING! Don't plug in the instrument without first verifying that the voltage is properly set for your location! And never run the detector at more than 8% below the nominal line voltage!

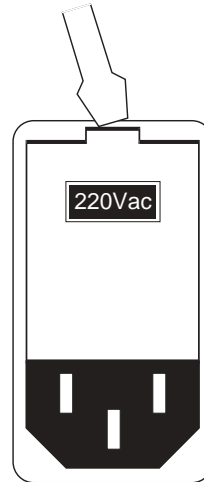
Voltage Selection

If the preset voltage doesn't satisfy your local site requirements, select the correct voltage by following these steps:

1. Insert a small flat-blade screwdriver into the slot at the top of the voltage selector cover (Figure 6.1).

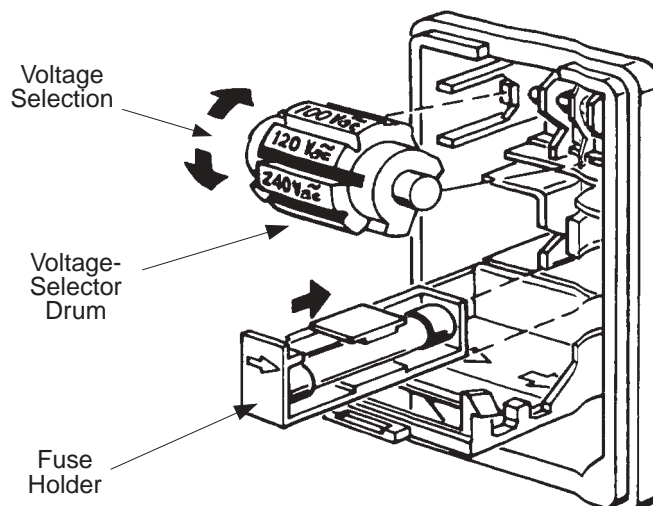
Figure 6.1. Opening the voltage selector cover.

PRY OPEN HERE



2. Pry open the cover gently. Once unlatched, the cover will swing downward to reveal the voltage selector barrel and the front ends of the fuse holders.
3. Use a narrow screwdriver tip to lever the voltage selector barrel from the power-entry module. The selector resembles a wheel with four settings: 100, 120, 220, and 240 V (Figure 6.2).

Figure 6.2. Voltage selector barrel and fuse holders.



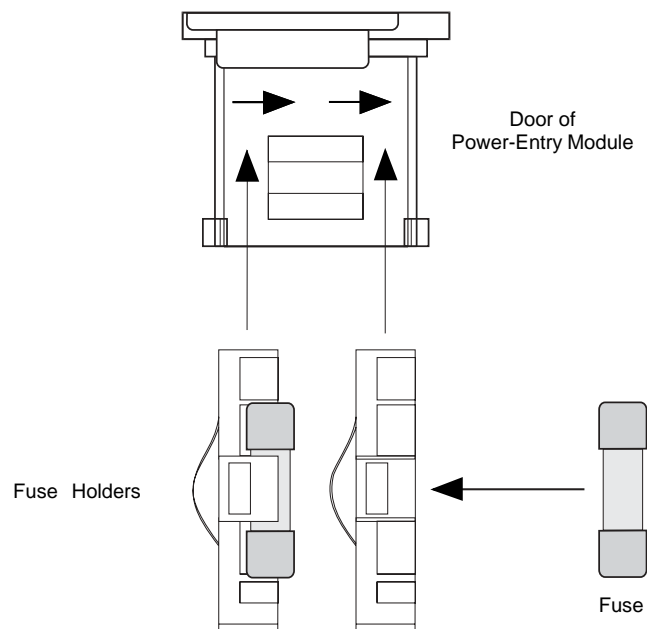
4. Rotate the barrel such that the desired voltage setting will be visible through the cut-out in the cover when the cover is closed.
5. Replace the barrel in the power-entry module. Before closing the cover, check the fuses according to the procedure below.

Fuses

To verify that your detector is fitted with the correct fuses, follow these steps. (If you haven't already done so, first open the voltage selector cover according to step 1 in the "Voltage Selection" procedure listed above.)

1. Pull each fuse holder's front end straight towards you. The fuse holders' front ends are black squares with arrows. The holders are located directly beneath the voltage selector (Figure 6.2).
2. Remove each fuse from its holder. Check the fuse's amperage, voltage, and type (stamped into the fuse's metal end cap) according to the following description. You should have either:
 - two 2-amp, sloblow fuses (for 100 or 120 V), or
 - two 1-amp, sloblow fuses (for 220 or 240 V)

Figure 6.3. Fuses.



3. Assuming that you have the proper fuses on hand, reinsert the fuses and fuse holders, making sure that the arrows on the holders are oriented in the same direction as the arrow that's imprinted inside the cover panel (Figure 6.3).

4. Close the cover panel by swinging it upward and pressing it inward until it snaps closed. The correct voltage should appear in the cut-out opening.

CAUTION! To avoid damaging the instrument, verify that the new voltage setting (displayed in the cut-out window) is correct before you turn the detector on!

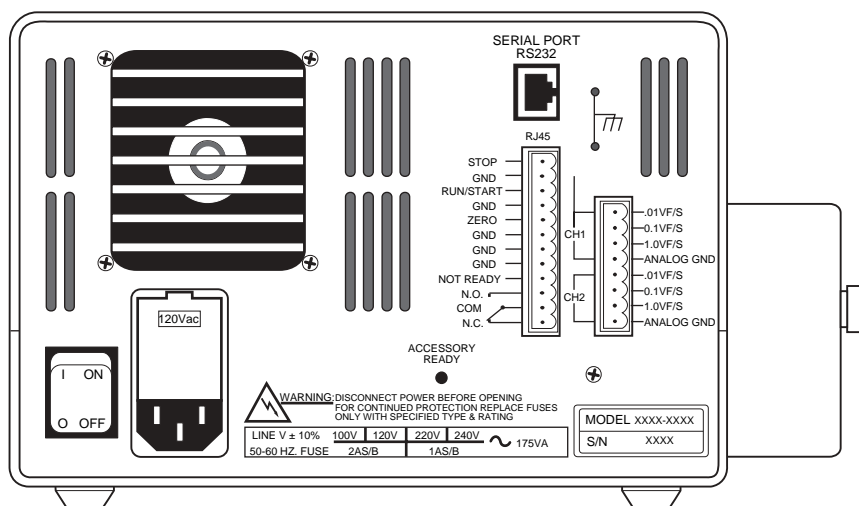
Power Cord

Attach the power cord at the lower left of the detector's rear panel.

MAKING REAR PANEL CONNECTIONS

Locate the two connectors (8-pin and 12-pin), either in your accessory kit or preinstalled in the sockets on the detector's rear panel (Figure 6.4). If they are not already installed, install them now. Note that the connectors are both labeled and keyed to the sockets, making it impossible to mix them up or insert them incorrectly.

Figure 6.4. Detector back panel showing analog output and remote communications connectors and their labeling.



The upper connector contains the detector's analog output terminals. The lower connector (analog input) allows the detector to communicate with other devices in your liquid chromatographic system.

Use standard detector cables to make the connections described in this section. For each connection, insert the cable's bare wire into the appropriate terminal of the removable connector. Hold the wire in place while you tighten the small setscrew located perpendicular to each opening.

Analog Output Connections

The terminals on the detector's analog output connector are divided into two groups, labeled CH 1 and CH 2 (Figure 6.4). Each output has four terminals, labeled:

- 0.01 V F/S (full-scale)
- 0.10 V F/S
- 1.0 V F/S
- ANALOG GND

CAUTION! Analog outputs are driven to twice their range. In other words, their maximum output is twice the selected range. To avoid clipping the voltage, be sure to connect integrators and data systems to the 1.0 V terminal and to use caution when connecting recorders to the 0.01 or 0.10 V terminal.

Integrators/Workstations

Connect your integrator/workstation to the 1.0 V F/S and corresponding ANALOG GND terminals.

NOTE: The 0.01 and 0.10 V F/S terminals are provided for recorders and special applications. We recommend that you use only the 1.0 V F/S terminal for an integrator or workstation.

Recorders

Connect the positive input from your recorder to the appropriate full-scale voltage terminal (0.01, 0.10, or 1.0 V). Connect the recorder's floating ground-input to the corresponding ANALOG GND terminal.

The terminals available on the detector's remote communications connector are labeled STOP, RUN/START, ZERO, and NOT READY, each with an associated GND (ground) terminal.

CAUTION! Do not connect any of the detector's GND terminals to any earth ground on your recorder. This would lead to an increased noise level and a subsequent decrease in sensitivity.

Remote Communications Connections

Your detector can accept inputs from, and send inputs to, remote devices through the remote communications connector (the connector on the left in Figure 6.4). For example, if your chromatographic system has programmable timed events (contact closures or TTL), you can use one to automatically zero the detector signal during a run.

STOP

You can use a timed event from your chromatographic system to take the detector out of run by connecting the system's event terminal to the detector's STOP and GND terminals.

RUN/START

You can use the remote-start event on your injector or autosampler to put the detector into run automatically whenever an injection occurs. To accomplish this, connect the system's event connector to the detector's RUN/START and GND terminals.

ZERO

You can zero the detector signal automatically by connecting a timed event on your chromatograph to the detector's ZERO and GND terminals.

NOT READY

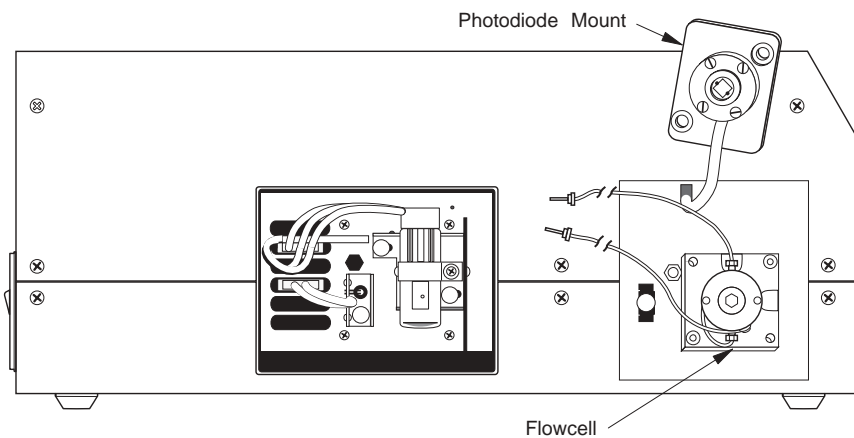
The detector is capable of driving one TTL load through the NOT READY terminal each time the detector goes to its READY state. This ability to signal other instruments is particularly useful with autosamplers, where the detector can signal that it's ready for the next injection in an automated series of runs. To hook up the NOT READY terminal, connect the input from the other instrument to the detector's NOT READY and GND terminals. For more information on accessing the READY-state feature through the detector's keypad, see Section 4.9.

CONNECTION TO THE FLOWCELL

Use the following steps to connect the flowcell:

1. Although the flowcell assembly is located behind the forward enclosure (Figure 6.5), you needn't remove the enclosure to connect your inlet and outlet lines.

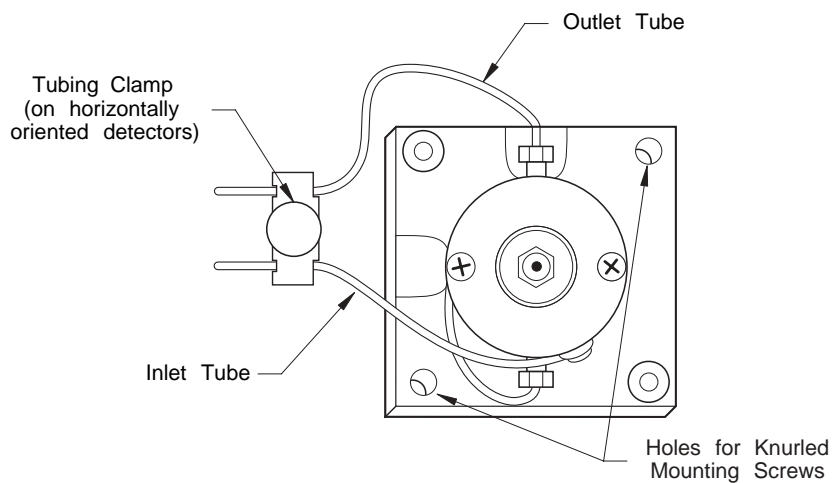
Figure 6.5. The flowcell assembly is located behind the flowcell housing.



2. Use a finger-tight fitting and ferrule set to connect the column outlet directly to the detector's flowcell (fluid) inlet. Figure 6.6 shows how the inlet line enters the detector from the left side, and winds around the flowcell before entering the flowcell from the bottom.

NOTE: If additional tubing is required to reach the inlet, use a zero dead-volume union.

Figure 6.6. The flowcell assembly showing tubing clamp.



3. Connect the detector's fluid outlet to a low-pressure union and waste tubing.

HINT: If you have several detectors (fluorescence, refractive index, electrochemical, etc.) hooked up in series, place your detector closest to the column outlet, as its flowcell can withstand the greatest back-pressure.

4. Replace the detector's flowcell enclosure, making sure that the tubing passes through the cover's side slot without being pinched.

OPTIONAL FLOWCELLS

BAS offers several different flowcells for use in different applications. Each flowcell possesses distinct design characteristics and performance specifications. These characteristics are compiled in Table 6.1. Contact your BAS representative for details.

Table 6.1. Design and performance specifications for optional flowcells*.

Path Flowcell	Path Length (mm)	Volume (μL)	Tubing Diam. (in)	Material**	Max. Flow (mL/min)	Max. Press. (psi)
Analytical LC	6	9	.01	SS1	50	1000
Analytical LC	10	15	.01	SS1	50	1000
Microbore	3	1.2	.005	SS1	10	1000
Microbore	6	7.0	.007	SS1	20	1000
Semi-Prep, Open Column	3	4.5	.02	SS1	100	1000

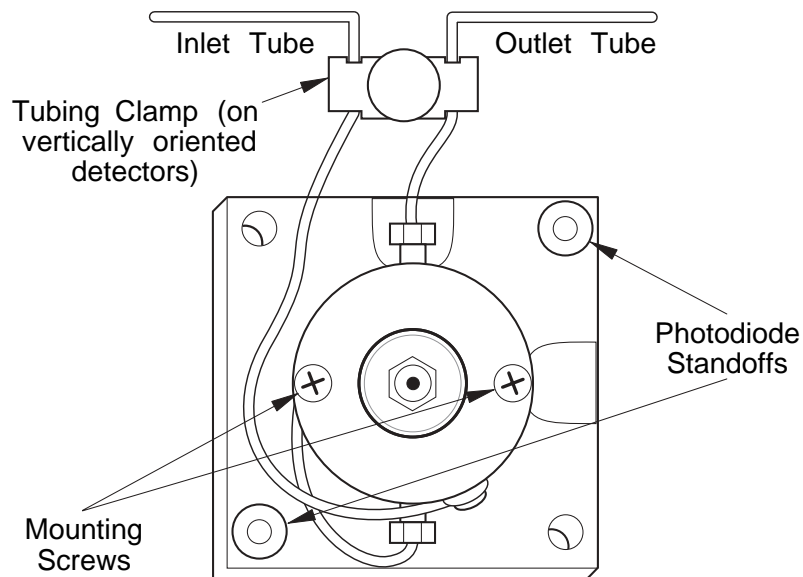
* All cells use sapphire for windows. All but the preparative flowcells have a heat exchanger.

** SS1 = Stainless Steel with TFE Gaskets.

Flowcell Orientation

The flowcell shipped with your detector is properly oriented on its black-anodized backing plate. However, should you subsequently order one or more additional cells to enhance the versatility of your instrument, the cell(s) you receive may be configured for vertically-oriented applications. As shown in Figure 6.7, this orientation is characterized by the photodiode standoffs being positioned at the upper right and lower left corners of the flowcell assembly and the tapered cut-away areas being positioned at the top and the right of the assembly.

Figure 6.7. The alignment of vertically-oriented flowcells.



In order to use any of the vertically-oriented flowcells with your detector, you must remove the two flowcell mounting screws and rotate the flowcell 90° on the flowcell holder as described in the following instructions.

Figure 6.7 shows the vertically-oriented flowcell as it's shipped. Note the vertical orientation of the flowcell's inlet and outlet connections relative to the photodiode standoffs and the tapered cutaways at the top and right of the cell holder.

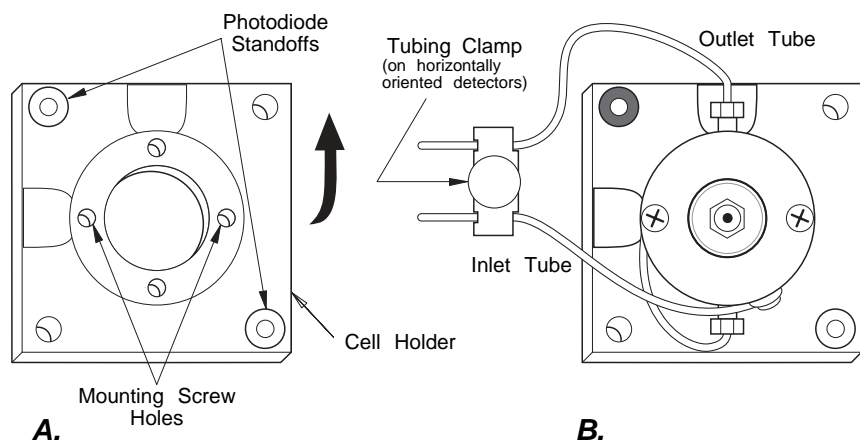
NOTE: Figures 6.7 and 6.8 show the tubing clamp as an aid to the proper positioning of the inlet and outlet tubes. Be aware that the tubing clamp is actually mounted on the detector and isn't part of the flowcell assembly.

HINT: To ensure proper alignment, always hold the cell holder and flowcell in the orientation shown in the illustrations.

Use the following steps to re-orient a flowcell:

1. Remove the two Phillips-head mounting screws that secure the flowcell to the black-anodized flowcell holder and set them aside.
2. Maintaining the flowcell in the vertical position shown in Figures 6.7 and 6.8, rotate the black cell-holder 90° clockwise. Don't rotate the flowcell body itself! Part A of Figure 6.8 shows the cell holder in its new horizontally-oriented position. Note, in particular, the new position of the photodiode standoffs and the tapered cutaways.
3. Reattach the flowcell body by replacing and securing the mounting screws.
4. Bend the inlet and outlet tubes gently as shown in Part B of Figure 6.8. The inlet tube (wound around the cell body) should always enter at the bottom of the flowcell; the outlet tube should always exit at the top of the flowcell.

Figure 6.8. Changing the alignment of a vertically-oriented flowcell so that it can be used on the detector. (Turn the cell holder as shown in A. Align the inlet and outlet tubes with the tubing clamp as shown in B.)



6.2 Specifications

Wavelength	
D2 lamp	190 to 365 nm
W lamp	366 to 800 nm
Lamp(s)	D2 and W standard
Bandwidth	6 nm
Wavelength Accuracy	±1.0 nm
Wavelength Precision	±0.1 nm
Range Selections	3.0, 2.0, 1.0, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, 0.0005 AUFS
Absorbance Range	0.0005 to 3.0 AUFS
Absorbance Linearity	
@ 254 nm:	Better than 1% to 2.0 AU
Analog Outputs	
CH 1 & CH 2:	Range-selectable over entire absorbance range
Communications	
Remote Inputs:	Run/Start, Stop, and Zero
Remote Outputs:	Not Ready
Noise	
Single-wavelength Mode:	
@ 254 nm, 1.0-sec rise time:	$< \pm 1.0 \times 10^{-5}$ AU
Dual-wavelength Mode:	
@ 254 nm & 280 nm, 1.0-sec rise time:	$< \pm 2.5 \times 10^{-5}$ AU
Drift	
(after warm-up @ 254 nm)	$< 2 \times 10^{-4}$ AU/hour
Display	2 × 24 character, high-contrast LCD
Dimensions	37 cm × 15 cm × 47 cm (H × W × D)
Weight	18 kg
Power Requirements	100/120/220/240 VAC nominal; 200 VA; 50/60 Hz

Section 7. Menu Reference

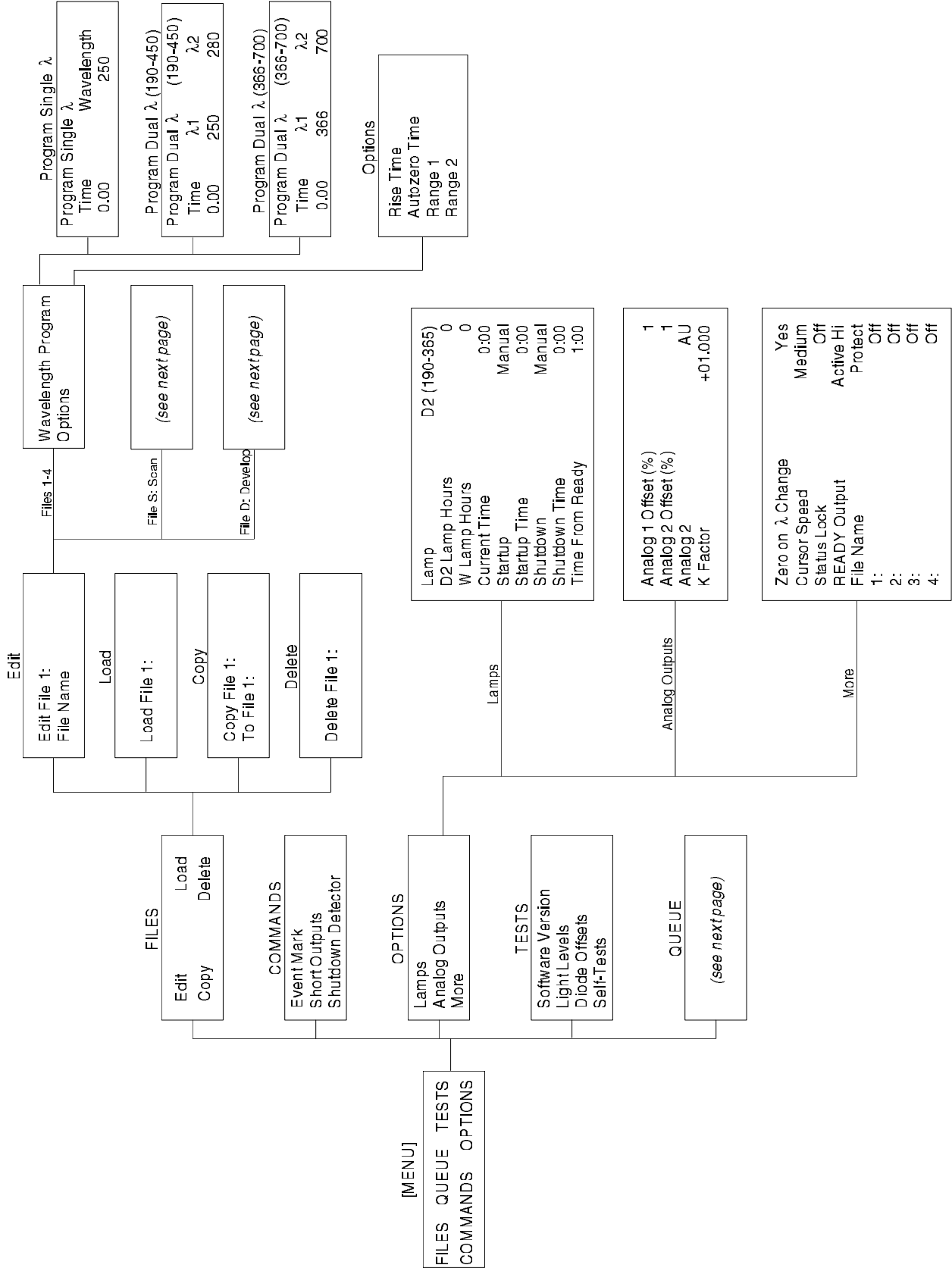
This section provides you with a Menu Tree and an alphabetical description of all the instrument's display fields. It's not necessary to read this section in order to learn how to use your detector. It's included in the manual simply as a quick reference and aid to using your instrument.

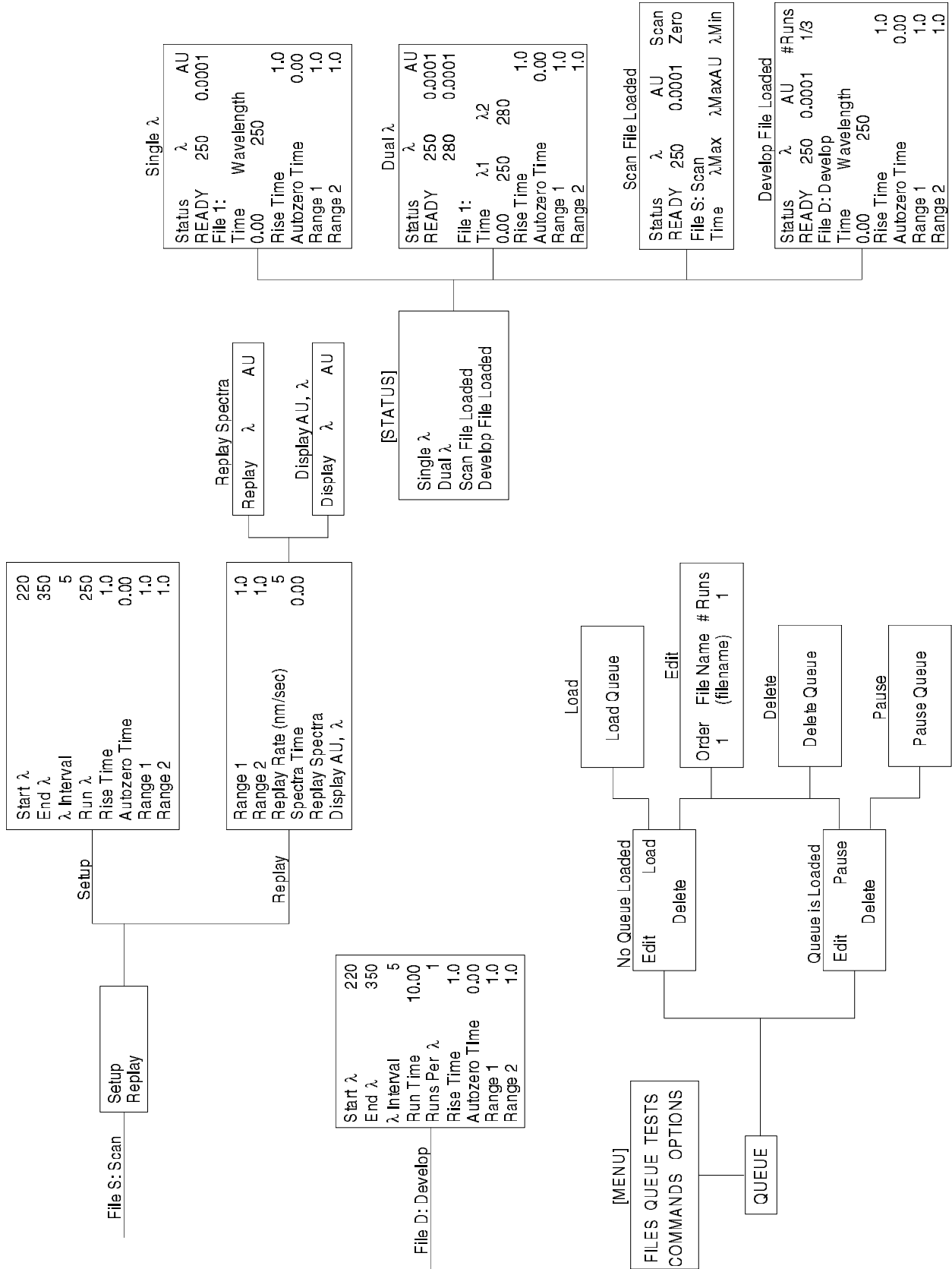
The menu tree is a representation of the detector's overall menu structure. It shows the location and interrelation of all the menus for your detector and, as such, is a good reference to keep on hand while you work through the operating instructions in Sections 3 and 4. The menu trees will also help if you become "lost" while moving through the detector's menus.

The Menu Reference is an alphabetical listing of each menu field and command. Included in each listing is the field's definition and, where appropriate, all allowable and default values.

7.1 Menu Tree

The Menu Tree is a useful tool for learning your way around your detector. You may wish to keep it handy while you learn where each display is located in the overall menu structure.





7.2 Menu Reference

For quick reference, we have included this alphabetical list of each field, including a short definition and allowable and default values. For a more detailed explanation of the functions of your detector, you should refer to Section 3, *Basic Operations*, and Section 4, *Advanced Operations*.

Analog 1 Offset (%)

This field offsets the Analog 1 output signal by a positive or negative 50, 20, 10, 5, 2, 1, or 0 percent of the full-scale range. Default is 0%.

Analog 2

This field allows you to select the output signal from the Analog Output 2 terminal. The selections are AU (the absorbance signal for wavelength one in single-wavelength operation or from wavelength two in dual-wavelength operation), AU1-KxAU2 (a calculated peak response using the K-Factor technique), and AU1/AU2 (the absorbance ratio of wavelength 1 to wavelength 2). Default is AU.

Analog 2 Offset (%)

This field offsets the Analog 2 output signal by a positive or negative 50, 20, 10, 5, 2, 1, or 0 percent of the full-scale range. Default is 0%.

Analog Outputs

This menu allows you to offset the signals from the analog output terminals located on the back panel of the instrument. You can also select the output signal for Analog Output 2 and input a K factor.

AU

This field, located in the Status Screen, shows the detector's current absorbance reading. It's a six-digit number, ranging from -3.00000 to +3.00000 AUFS.

Autozero Time

This field tells the detector when to perform an automatic zero. Allowable values are 0.00 to 999.99 minutes. Default is 0.00 minutes.

COMMANDS

The Commands Menu lets you put an event mark into your chromatogram, short detector outputs, and shut down the detector.

Copy

This field accesses the Copy File field.

Copy File

This field, along with the To File field, allows you to copy from the specified file to another file designation.

Current Time

This field displays local time in a 24-hour clock format ranging from 0:00 to 23:59.

Cursor Speed

This field regulates the cursor's speed on the display. It may be set to Slow, Medium, or Fast according to your need. Default is Medium.

Delete	<p><i>Under the top-level menu FILE(S), this field accesses the Delete File command.</i></p> <p><i>Under the top-level menu QUEUE, this field accesses the Delete Queue command.</i></p>
Delete File	<p>This field deletes the designated file, setting all fields to their default values. After pressing [ENTER], the confirmation message **File Deleted** appears for one second.</p>
Delete Queue	<p>This field deletes the queue. After pressing [ENTER], the confirmation message **Queue Deleted** appears for one second.</p>
D2 Lamp Hours	<p>This field tracks the total number of hours the detector's deuterium lamp has been in operation (up to 9999). When a new lamp is installed, you must reset this parameter to zero.</p>
Diode Offsets	<p>This field displays the analog-to-digital (A/D) conversion frequencies of the sample and reference diodes when both lamps are turned off. These values can be used to measure the detector's digital noise level.</p>
Display AU, λ	<p>This command calls up the Display AU, λ screen, a screen that shows the incremental wavelength versus absorbance data for the selected spectral scan.</p>
Edit	<p><i>Under the top-level FILE(S) menu, the Edit Menu allows you to set up or edit files. The edits don't change the current settings of the detector until the file is loaded.</i></p> <p><i>Under the top-level QUEUE menu, the Edit Menu allows you to set up or edit a Queue. Edits may not be made to Order 1 while a queue is loaded or running unless you pause the queue first.</i></p>
Edit File	<p>This field allows you to identify the file for setup or edit. Allowable designations are 1 to 4, S for the Scan file, and D for the Develop file. Default is 1.</p>
End λ	<p><i>In the Scan File Setup, this field defines the wavelength at which the detector should finish the scan. Allowable values are 191 to 800 nm. Default is 350 nm.</i></p> <p><i>In the Develop File Setup, this field defines the wavelength at which the detector should run its last set of injections. Allowable values are 191 to 800 nm. Default is 350 nm.</i></p>
Event Mark	<p>The Event Mark field applies a 15% of full-scale spike on the detector's output signals.</p>
FILE(S)	<p>The FILES Menu allows you to edit, load, delete, and copy files.</p>

File Name	<p>This field allows you to enter a file name for a designated file (numbered 1 to 4). The name can contain up to eight characters from the following list: A to Z, 0 to 9, /, -, and blank. Default is blank.</p> <p><i>For Files S and D, the file names are designated automatically as SCAN and DEVELOP, respectively. No editing of these file names is allowed.</i></p>
K Factor	<p>This field is used in the K-Factor technique. Allowable values are -99.999 to 99.999. Default is 1.000.</p>
$\lambda(\lambda 1, \lambda 2)$	<p>The wavelength field is located in the Status Screen and shows the current detector wavelength setting(s).</p>
λ Calibration	<p>The wavelength calibration screen located in the Tests Menu shows the current detector wavelength setting(s).</p>
λ Interval	<p><i>In the Scan File Setup, this field defines the wavelength interval at which the detector should perform the scan. Allowable values are 1, 2, 3, 4, 5, and 10 nm. Default is 5 nm.</i></p> <p><i>In the Develop File Setup, this field defines the wavelength increment the detector monochromator should use for wavelength changes between each set of injections. Allowable values are 1, 2, 3, 4, 5, 10, and 20 nm. Default is 5 nm.</i></p>
λ Max	<p>This field is the wavelength maximum in a spectral scan.</p>
λ MaxAU	<p>This field is the absorbance value for the corresponding wavelength maximum in a spectral scan.</p>
λ Min	<p>This field is the wavelength minimum in a spectral scan.</p>
λ Offset	<p>The lambda offset screen lets you choose a number of steps, each representing 0.25 nm, by which you want to offset the wavelength. This field is used to check the detector's wavelength accuracy. Allowable entries are: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, -1, -2, -3, -4, -5, -6, -7, -8, -9, and -10. The default is 0.</p>
Lamp	<p>The Lamp field allows you to choose from several selections: D2 (190–365) for the deuterium lamp; W (366–800) for the tungsten lamp; D2+W (190–800) for dual-lamp operation; or Off to shut the lamp(s) off. Default is D2 (190–365).</p>
Lamps	<p>The Lamps Menu allows you to control the detector's lamp operations.</p>
Light Levels	<p>This field displays the analog-to-digital (A/D) conversion frequencies of the light detected by the sample and reference diodes when the D2 lamp is on.</p>

Load	<p><i>Under the top-level menu FILE(S), the Load selection accesses the Load File command.</i></p> <p><i>Under the top-level menu QUEUE, the Load selection accesses the Load Queue field.</i></p>
Load File	<p>The Load File field loads the designated file settings into the active run file. After pressing [ENTER], the confirmation message **File Loaded** appears for one second.</p>
Load Queue	<p>The Load Queue field loads the queue. After pressing [ENTER], the confirmation message, **Queue Loaded**, appears for one second.</p>
More	<p>This menu allows you to access the Zero on λ Change, Cursor Speed, Status Lock, and READY Output fields. You can also protect files from this menu.</p>
OPTIONS	<p>Found in the Main Menu, the Options Menu allows you to perform lamp and analog output operations.</p>
Options	<p>The Options selection in the Edit Menu of FILE(S) allows you to edit Rise Time, Autozero Time, and Range.</p>
Order	<p>This field designates the order in which the selected files in a queue will be run.</p>
Pause	<p>This field accesses the Pause Queue command.</p>
Pause Queue	<p>This field pauses an active queue. If a file is running, it continues until completed, and the detector returns to a READY state.</p>
Program	<p>This field allows you to select single- or dual-wavelength operation. The selection toggles between Singleλ, Dual λ(190–450), and Dual λ(366–700). Default is Single λ.</p>
Protect	<p>This field, along with the File Name field, protects a specified file from being edited, copied to, or deleted. The field toggles between On, allowing no changes to the file, and Off, where changes may be made. Default is Off.</p>
QUEUE	<p>The Queue Menu allows you to edit, load, delete, or pause a queue. A queue is a series of files which are run in a specific order, and it's typically used for automated runs.</p>
Range 1, Range 2	<p>The Range 1 and Range 2 fields control the full-scale output ranges for the CH 1 and CH 2 terminals located on the back panel. Allowable full-scale ranges are 3.0, 2.0, 1.0, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01, 0.005, 0.002, 0.001, and 0.0005 AUFS. Default is 1.0 AUFS.</p>

READY Output	This field is used to communicate with other devices through the detector's NOT READY terminal. This TTL terminal switches the transistor between high and low states whenever the detector starts a run. Select "Active Hi" or "Active Lo," for the high or low state, respectively. Default is Active Lo.
Replay	The Replay command sends you to the Replay Menu, from which you can set up the parameters for replaying stored spectra.
Replay Spectra	This command is used to initiate replay of the designated spectrum.
Replay Rate	This field designates the rate at which the detector replays a stored spectrum. Allowable values are 1, 2, 5, 10, and 20 nm/sec. Default is 5 nm/sec.
Rise Time	This field controls the detector's response time. Rise time is inversely proportional to the amount of baseline noise. Allowable values are 0.0, 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, 4.0, and 5.0 seconds. Default is 1.0 second.
#Runs	<p><i>When this field appears in the Status Screen, the current run and the total number of injections to be made at the displayed wavelength appear directly below it. The field is updated at the beginning of each injection.</i></p> <p><i>When this field appears in a Queue setup, it displays the number of times each file runs in a queue.</i></p>
Run λ	This field designates the monitoring wavelength to be used when running the Scan file. Allowable values are 190 to 800 nm. Default is 250 nm.
Run Time	Located in the Develop file, this field is the amount of time designated for each chromatographic run. Allowable values are 0.01 to 999.99 minutes. Default is 10.00 minutes.
Runs per λ	Located in the Develop file, this field designates the number of injections to be performed at each wavelength increment. Allowable values are 1 to 9. Default is 1.
Scan	This field appears in the Status Screen when the Scan file is loaded. To initiate a scan, move the cursor to this field and press [ENTER].
Scan Zero Time	This field allows you to set a runtime at which the detector will perform a baseline scan automatically. Allowable values are 0.00 to 99.99 minutes. Default is 0.00.
Self-Tests	This command tells the detector to run through its internal diagnostic tests.
Setup	The Setup Menu allows you to set up the parameters in the Scan file.

Short Outputs	This command allows you to short the detector's outputs together. When you select /Short Outputs/, the detector's analog outputs are shorted together (zero volts) and the field changes to /Unshort Outputs/. To remove the short and return the outputs to their normal operating state, select /Unshort Outputs/, and the field changes back to /Short Outputs/. When you leave this screen, the field returns to /Short Outputs/ automatically.
Shutdown	This field toggles between Manual (you turn off the lamp manually), Time (the lamp turns off automatically at a preset time), Time from READY (as explained under the Time from READY field), and End of Queue (the lamp turns off when the queue is finished). Default is Manual.
Shutdown Detector	This command shuts down the detector's lamps and motors, leaving the electronics on to preserve memory. Press any key to return the detector to the same settings as when this field was activated.
Shutdown Time	This field displays the local time, ranging from 0:00 to 23:59, at which you've programmed the lamp to turn off automatically. Default is 0:00.
Software Version	This field displays the EPROM version of your detector's built-in programming. This is the only entry under the Tests Menu that should be selected during data collection. Selection of any of the other entries will cause baseline-shift problems.
Spectra Time	This field displays a list of the scans that are stored in memory currently. Each scan is identified by the runtime at which it was initiated.
Start λ	<p><i>In Scan File Setup</i>, this field defines the wavelength at which the detector should begin the scan. Allowable values are 190 to 799 nm. Default is 220 nm.</p> <p><i>In the Develop File Setup</i>, this field defines the wavelength at which the detector should run its first set of injections. Allowable values are 190 to 799 nm. Default is 220 nm.</p>
Startup	The Startup field toggles between Manual, where you turn on the lamp manually, and Time, where the lamp powers up automatically at a preset time. Default is Manual.
Startup Time	This field displays the local time, ranging from 0:00 to 23:59, at which you've programmed the lamp to start up automatically. Default is 0:00.
Status	This field in the Status Screen shows the current condition of the detector. The possible conditions are: READY (the detector is stabilized and waiting for initiation of a run), NRDY (the detector isn't stabilized, is set to the wrong lamp for the run requested, is performing internal tests, or has a possible internal problem), or UVW (the deuterium lamp is warming up). The run time is displayed when the running file has a programmed stop time. The letter Q appears at the beginning of this field when a queue is loaded.

Status Lock

The Status Lock field limits accessibility to the Status Menu (the programming section below the Status Screen). When set to On, only the Status Screen appears on the display and the down-arrow icon isn't seen. Default is Off.

TESTS

The Tests Menu allows you to perform the detector's internal diagnostic, light level, and diode offset tests. Note that these tests (except for the EPROM version number display) should not be conducted while a chromatographic analysis is in progress. Invoking selections from the Tests Menu while a sample is being analyzed will result in baseline shifting.

Time, Wavelength

The Wavelength Program contains the Time and Wavelength fields. It allows you to program changes in the detector's wavelength as a function of time.

Time refers to the run time, in minutes, when a timed event (wavelength change, autozero, or run stop) is to occur. Allowable values range from 0.00 to 999.99 minutes. Default is 0.00 minutes.

Wavelength refers to the wavelength that will be set at a specified time. Allowable values are 190 to 365 nm with the deuterium lamp, and either 366 to 700 nm or 366 to 800 nm with the tungsten lamp (depending on whether the detector is operating in the dual-wavelength or the single-wavelength mode, respectively). Default is 250 nm.

Time from READY

A preset time interval from the Ready state of the detector, after which the detector lamp will turn off if a start signal hasn't been received from the keypad or external RUN/START terminal. Allowable values range from 0:30 to 9:59 hours. Default is 1:00.

To File

This field, along with the Copy File field, allows you to copy a file to the specified file identification.

W Lamp Hours

This field tracks the total number of hours the detector's tungsten lamp has been in operation (up to 9999). When a new lamp is installed, you must set this parameter to zero.

Wavelength Program

This command allows you to access the Wavelength Program. See the "Time, Wavelength" description above for details.

Zero

This field appears in the Status Screen when the Scan file is loaded. To initiate a background scan, move the cursor to this selection and press [ENTER].

Zero on λ Change

This field toggles between Yes, where the detector baseline zeroes automatically at each timed event during a programmed run, and No. Default is Yes.

Section 8. Troubleshooting

This section provides you with helpful information for troubleshooting possible detector and chromatographic system problems. We have divided it into four sections:

- a brief theory of operation
- a troubleshooting guide that lists symptoms, possible problems, and remedies
- error messages you might see on the detector's display
- a description of internal and external diagnostic tests

8.1 Theory of Operation

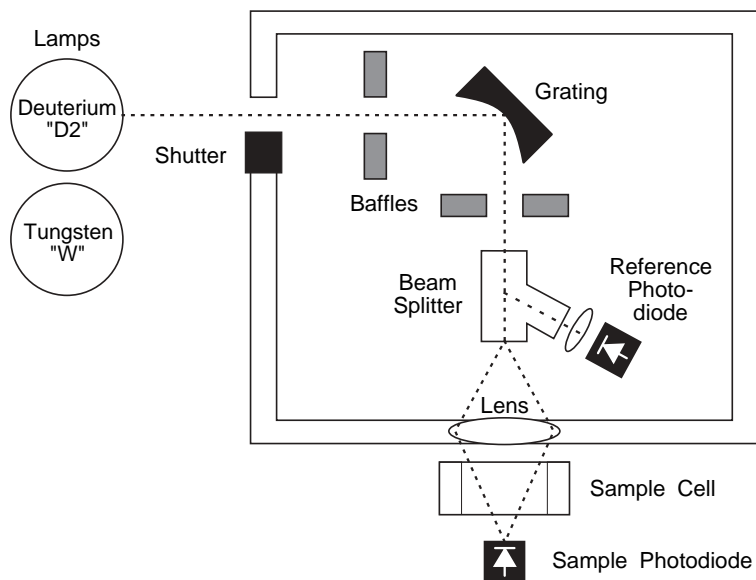
This brief Theory of Operation is included to aid you in troubleshooting problems and performing maintenance for your detector. For more detailed information, you should contact your BAS representative.

Overview

Figure 8.1 shows the optical system used in the UV-116A. The detector operates in a double-beam mode using a fiber-optic beam-splitter that creates sample and reference beams. The reference beam is directed to a reference photodiode. The sample beam is lens-focused prior to passing through the flowcell to a sample photodiode.

An analog PCB processes the signals from the photodiodes and provides analog output signals through an 8-pin external connector. The digital PCB contains the EPROM (the built-in software), provides digital processing circuitry, and interfaces with the keyboard/display and the remote communications devices. (Additional software is held on an EPROM PCB.) The Motherboard provides all the necessary interconnections and power supplies.

Figure 8.1. The optical system for the UV-116A detector.



The deuterium and tungsten lamps are continuum light sources that provide high light intensity over the UV and visible wavelength ranges. Two sets of baffles minimize stray light. A concave holographic grating actuated by a microprocessor-controlled stepper motor provides wavelength selection.

8.2 Common Problems

This next section contains a table of symptoms, possible causes, and remedies for some common problems you may observe in detector response. Many of the problems attributed to the detector actually may be due to other components in the chromatographic system, so we have included references to these types of problems and solutions as well.

Troubleshooting Table

Symptom	Cause	Remedy
1. Spikes on baseline.	a. Gas bubbles in the flowcell.	a. Degas mobile phase. Supply back-pressure device to flowcell (check back-pressure rating). Check for leaks at high-pressure fittings.
	b. Immiscible solvent bubbles following mobile phase changeover.	b. Flush flowcell with 2-propanol, then with mobile phase.
	c. Electrical interference.	c. Check electrical lines for good connections and/or interference from broadcast radiation. Check for ground loops.
	d. Extremely large fluctuations in voltage on AC line.	d. Remove systems (e.g., ovens) that cause voltage fluctuations, isolate the detector to "quiet" circuit, or use UPS (uninterruptable power supply).
2. Random noisy baseline.	a. Contaminated flowcell.	a. Flush flowcell with cleaning solvents as described in Section 5. Check for leaks.
	b. Leak in sample inlet line.	b. Check all fittings from column outlet to flowcell inlet for leaks.
	c. Bubble trapped in flowcell.	c. Increase flow rate until bubble is removed. Supply back-pressure device to flowcell (check back-pressure rating to avoid rupturing flowcell).
	d. Leaking flowcell.	d. Replace flowcell.
	e. Insufficient lamp warm-up.	e. Allow a 30 minute warm-up for normal operation; one hour for maximum sensitivity.
	f. Lamp aging or defective.	f. Replace lamp.
	g. Ground loop problem between integrator and detector.	g. Check for proper cable connections for detector output; don't ground at both ends of cable.
	h. Flowcell, lamp, lenses, or photodiode dirty.	h. Clean dirty component as described in Section 5.
	i. Integrator input voltage doesn't match detector output voltage.	i. Connect integrator to appropriate output connectors on detector (see Section 6). Check attenuation setting on integrator.
3. Excessive baseline drift.	a. Flowcell contaminated.	a. Flush flowcell with cleaning solvents as described in Section 5. Check for leaks.
	b. Mobile phase contamination.	b. Replace with fresh mobile phase made with high-purity solvents.
	c. Material bleeding from column.	c. Clean or replace column.
	d. Leaks in system, or flowcell.	d. Check all fittings for leaks. Replace flowcell.

Symptom	Cause	Remedy
	e. Tiny bubble trapped in flowcell.	e. Increase flow rate until bubble is removed. Connect back-pressure device to flowcell outlet (check back-pressure rating to avoid rupturing flowcell).
	f. Large temperature fluctuations.	f. Remove system from drafts. Thermostatically control column temperature.
4. No peaks, or peaks much smaller than expected.	a. Incorrect wavelength setting.	a. Check wavelength setting. Make sure the correct file is selected.
	b. Lamp not on or defective.	b. Make sure lamp is lit. Run detector's diagnostic tests to check lamp. Replace lamp if necessary.
	c. Integrator input voltage doesn't match detector output voltage.	c. Connect integrator to appropriate output connectors on detector (see Section 6). Check attenuation setting on integrator.
	d. Insufficient sample reaching the detector.	d. Check entire chromatographic system for leaks. Verify sample injection volume.
5. Broad, tailing peaks.	a. Rise time is too large (too slow).	a. Lower the rise time selection.
	b. Flowcell volume too large.	b. Change to a flowcell with smaller volume.
6. Clicking sound in the dual-wavelength mode.	a. Noise comes from grating motor, and is normal.	a. No action necessary.
7. Detector won't power up.	a. Tripped circuit breaker at AC wall outlet.	a. Resolve problem, reset circuit breaker.
	b. Blown detector fuse.	b. Resolve problem, replace fuse.
	c. Incorrect voltage selected.	c. Reset detector for correct incoming line-voltage (see Section 6).
	d. Power cord not connected.	d. Connect power cord.

8.3 Error Messages

There are three types of error messages that you may see on your detector's display:

- System
- Real-time
- User-input

Each type of error is explained below in further detail.

SYSTEM ERRORS

System errors are indicated on the display by a double set of exclamation points (!! !!). They occur whenever an undesirable condition exists that prevents the detector from operating. If one of the messages listed below appears, try turning the detector's power switch off and on. If the message recurs, contact your BAS service representative.

The following system error messages are possible:

- SYSTEM RESET
- RAM ERROR
- ADDRESS ERROR
- BUS ERROR
- DIVIDE BY ZERO
- LOW L0 ERROR
- LOW L1 ERROR
- DISTANT QUEUE ERROR

REAL-TIME ERRORS

Real-time error messages indicate that you need to correct a certain hardware condition. Possible messages are:

Low Light Detected From Deuterium Lamp

This message indicates that the deuterium lamp may not be on, may be improperly installed, or needs to be replaced due to low light energy. It can also appear if the lamp cover is replaced while the lamp is on.

Using the Lamps Menu (see "Automatic Lamp Operations" on page 30), turn the lamp state to Off, wait five seconds, and then switch the lamp to On. If the error message recurs, check for proper lamp installation according to the procedure outlined in Section 6.

If the lamp is installed correctly, its surface is clean, and the message still appears, replace the lamp.

Low Light Detected From Tungsten Lamp

This message indicates that the tungsten lamp may not be on, may be improperly installed, or needs to be replaced due to low light-output.

Using the Lamps Menu (see "Automatic Lamp Operations" on page 30), turn the lamp state to Off, wait five seconds, and then switch the lamp to On. If the error message recurs, check for proper lamp installation according to the procedure outlined in Section 6.

If the lamp is installed correctly, its surface is clean, and the message still appears, replace the lamp.

Input Errors

The following error messages indicate improper use of the detector's menu system.

A File Is Already Running

You can't start a different file while a file is already running.

Invalid Parameters, Spectrum Not Allowed

Invalid scanning setup parameters have been entered, so the detector can't perform a spectral scan.

No More Available Memory

All available system memory is full.

No Queue Available

You can't load a queue if none has been set up first.

No Spectra Available

You can't run Replay Spectra when no spectra are available in memory.

Protected File, Can't Be Copied To

You can't copy to a protected file.

Protected File, Can't Be Deleted

You can't delete a protected file.

Protected File, Can't Be Edited

You can't modify a protected file.

Queue Loaded, Can't Load File

When a queue is loaded, you can't load any other file.

Run In Progress, Testing Not Allowed

You can't run the detector's built-in diagnostics while a run is in progress.

Run Not In Progress, No Scanning Allowed

A spectral scan can only be performed when a run is in progress.

Detector Shutdown

This message occurs when you use the Shutdown Detector field to turn off the detector. (See "Shutdown Detector" in Section 4.) Press any key on the keypad to turn on the detector.

Scan Memory Full

This message occurs when the Scan File is loaded and the scan data memory storage is full.

Run In Progress, No Replay Allowed

You can't replay stored spectral scans when the Scan file is loaded and a run is active.

8.4 Diagnostic Tests

This section describes the internal diagnostic tests supplied with your detector. It also references two external tests that you can run. Use these tests if you suspect that your detector isn't working properly.

CAUTION! Don't attempt to run these tests (except for Software Version) while an analysis is underway. Selecting Light Levels, Diode Offsets, λ Calibration, or Self-Tests while data is being collected may produce an error message and will disable the outputs (flatten your baseline), thereby producing erroneous analytical data.

Internal Diagnostic Tests

You can access the detector's internal diagnostic tests by following these steps:

1. Press [MENU].
2. Select /TESTS/.
3. The Tests Menu (Figure 8.2) will appear.

Figure 8.2. Detector's Tests Menu

```

Software Version
Light Levels
-----
Diode Offsets
λ Calibration
Self-Tests

```

Software Version

Select this field to display the EPROM version of your detector's software (Figure 8.3). Note that this is the only selection in the Tests Menu that should be made while an analysis is in progress.

Figure 8.3. The Software Version screen.

Ver 3.12

Light Levels

The Light Levels test displays numbers related to the level of light intensity seen by the sample and reference photodiodes. When you select /Light Levels/, the screen in Figure 8.4 appears.

Figure 8.4. The Light Levels screen.

S1 :	nnnnn.n	R1 :	nnnnn.n
S2 :	nnnnn.n	R2 :	nnnnn.n

The sample (S1, S2) and reference (R1, R2) numbers may differ considerably between instruments. A five- or six-digit number is typical. If you get an unusual reading, check the photodiodes and/or have a service representative check the Analog PCB. These components are the ones that are the most likely to affect light intensity. If any of the numbers is zero, call your local BAS service representative.

Diode Offsets

The Diode Offsets test presents numbers related to the level of background signal (dark current) received from the sample and reference photodiodes when the lamps are off. When you select /Diode Offsets/, the screen in Figure 8.5 appears.

Figure 8.5. The Diode Offsets screen.

>C	S1 :	nnnnn.n	R1 :	nnnnn.n
	S2 :	nnnnn.n	R2 :	nnnnn.n

The sample (S1, S2) and reference (R1, R2) numbers may vary considerably between instruments. A three- or four-digit number is typical. As with the Light Levels test, if you get an unusual reading check the photodiodes and/or have your local service representative check the Analog PCB. These are the components most likely to affect light intensity. If any of the numbers is zero, call your local BAS service representative.

To recalculate the diode offsets, select C. The offsets may need to be recalculated if the light levels are less than the diode offsets. This situation normally occurs after slight diode offset drift or while working with extremely low light.

λ Calibration

Selecting / λ Calibration/ brings up the screen shown in Figure 8.6. You can use this screen (in combination with the optional Cuvette Holder Accessory) to calibrate or recalibrate the detector to a different calibration standard (FDA, industry, or in-house) than that used during its manufacture.

NOTE: If you wish to conduct your calibration using the Cuvette Holder, the procedure has been detailed in Section 10 for your convenience.

Figure 8.6. The Lambda Calibration screen.

λ Offset (steps)	0
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Self-Tests

The detector runs eight internal diagnostic tests automatically when it's powered up. To run the tests at any other time, simply select /Self-Tests/.

If any test (other than the two lamp tests) fails, you'll see a message to that effect on the display. Clear the message and run the remainder of the self-tests by pressing [ENTER]. Repeat this process as many times as necessary until all self-tests are completed and the Status Screen appears. If any test has failed, the Status Screen will read "NRDY" (Not Ready).

Although you can frequently get back to the ready state on your own (e.g., you can turn on the lamps manually from the Options Menu), the detector may not function properly and your results may be affected. For this reason, and to help you troubleshoot the detector on your own, we have listed the MLF (most likely failure) for each test. Problems that aren't readily resolved should be referred to your BAS representative.

The eight self-tests are:

1. **RAM** This test checks both volatile and non-volatile RAM with a read/write test. The "Testing RAM" message only appears during self-initiated testing. On power-up, the test occurs without any special message. Instead, you'll see words like "Version No." on the screen. A failure during either type of testing is indicated by the messages "Bad DRAM" or "Bad NVRAM." MLF: Digital PCB.
2. **Voltages** This test checks the circuitry-supply voltages. MLF: Motherboard.
3. **Analog Outputs** This test checks the scale and linearity of the output signal (recorder/integrator). Failure is indicated by a "Fail" or a "Bad Analog Linearity" message. MLF: Analog PCB.
4. **Diode Offsets** This test checks the photodiodes with the lamp(s) off (dark current). Failure is indicated by either a "Bad Sample Diode" or "Intense Light Detected" message. You should verify that the sample photodiode is fastened securely to the flowcell.

and that light is actually passing through the flowcell. If "Fail" or "Bad Ref. Diode Detected" appear, call your BAS service representative. MLF: Photodiode or Analog PCB.

5. **Motor** The Motor Test checks the monochromator motor and its voltages. MLF: Motor.
6. **Deuterium Lamp** This test checks the D2 lamp and its voltages when the lamp is on and when it's off. If the message "D2 Not Detected" appears, the lamp voltages are good, but the lamp is either not present or not functioning properly. Try replacing the deuterium lamp and repeating the test. If the word "Fail" appears, call your BAS service representative. MLF: Lamp or Motherboard.
7. **Tungsten Lamp** This test checks the W lamp and its voltages when the lamp is on and when it's off. If the message "W Not Detected" appears, the lamp voltages are good, but the lamp isn't present or isn't functioning properly. Try replacing the tungsten lamp and repeating the test. If the word "Fail" appears, call your BAS service representative. MLF: Lamp or Motherboard.
8. **Lamp and Shutter** This test has several parts, each of which checks a different part of the lamps' and shutter's operation. If either of the lamps fails, an appropriate message will display. Try replacing the lamp and reconducting the test. If a "Bad Shutter" message appears, call your BAS service representative. MLF: part listed on display.

EXTERNAL DIAGNOSTIC TESTS

This section describes two external diagnostic tests that can be used to verify that your detector is working properly.

HINT: Keep the chromatogram that you generate with a reproducible sample. It can be a useful baseline reference later, should it be necessary to troubleshoot your system.

Absorbance Linearity

Use the optional cuvette holder (see Section 10) and certified standards to test the absorbance linearity of your detector in the UV range (approximately 235 to 350 nm). For your convenience, the following procedure is also detailed in Section 10.

Section 9. Glossary

We have included a glossary to define certain technical terms used throughout the manual's text. These terms are consistent with standard definitions used throughout the analytical industry, and are added here as a quick reference only.

A - C

A/D

Analog-to-digital. Converts a detector's analog signal to a digital signal.

AUFS

Absorbance units full-scale; a measure of sensitivity.

absorbance

A process where the intensity of light shining through a sample is decreased; the transmitted light is measured in absorbance units, which are directly proportional to the concentration of the absorbing sample.

analog offset

A voltage applied to the output signal in order to keep the signal "on-scale" throughout a run.

background scan

The reference spectrum of the mobile phase. It's subtracted from the sample spectral scans to correct for baseline absorbances. Also called baseline scan.

baseline

The reference line at the bottom of a chromatogram from which measurements are made. A baseline represents the chromatogram that would be drawn if only the mobile phase (with no sample) were run through the column.

chronometer

A gauge for measuring the total amount of time something has been in operation.

D - F

defaults

The values or choices built-in to a system. If no specific choice is made, the detector will run using the default settings.

develop file

A feature that allows you to make multiple injections of a sample at different wavelengths, automatically.

degassing

The practice of removing air from the mobile phase, usually by sparging or applying a vacuum.

diagnostics

Methods used to detect and isolate problems.

display

The two-line screen (28 characters by 2 lines).

edit file	A copy of the file used for editing. Once loaded, the parameters set in the edit file are transferred to the run file.
error message	A displayed message that notifies you of a problem.
field	The area in a display, screen, or menu where an entry is required or a choice must be made.
file	A list of detector parameters that contains the desired settings for an analysis.
<u>G - K</u>	
gradient elution	A liquid chromatographic technique where the mobile phase composition changes over time; changes may be continuous or in steps.
ground terminal	A terminal used to connect the ground or earth lead of a signal or contact closure cable.
K-factor	A factor used to calculate a response of zero for one of two coeluting or poorly resolved peaks; also known as peak suppression.
keypad	All of the keys that you use to communicate with your instrument.
<u>M - Q</u>	
menu	A list of choices.
miscible	Two solvents are miscible if they combine with each other to form a single phase.
parameter	A value or set of values used to define the characteristics of behavior of an instrument or system.
peak broadening	The dilution of a peak as it moves through the chromatographic system.
peak suppression	A technique that uses a factor (the K-factor) to calculate a response of zero for one of two coeluting or poorly resolved peaks.
photodiode	The detector component that measures light intensity.
queue	A set of items (i.e., samples, files) in a prearranged order.

R - S

RAM	Random Access Memory.
range	A detector parameter that controls the full-scale range for the output signal.
replay	Retrieves a stored spectrum that can then be played back as either individual data points or a smoothed spectrum.
rise time	A detector parameter that controls its response time; rise time is inversely proportional to the amount of baseline noise.
run file	The run file is the file that contains the current detector parameter settings.
run time	The duration of a sample run, from injection to detection.
signal-to-noise	A measurement of the sensitivity of a detector; the ability to measure a very small sample response over the baseline noise.
solvent programming	See gradient elution.
spectral scan	A sample spectrum.
status	The current condition.

T - Z

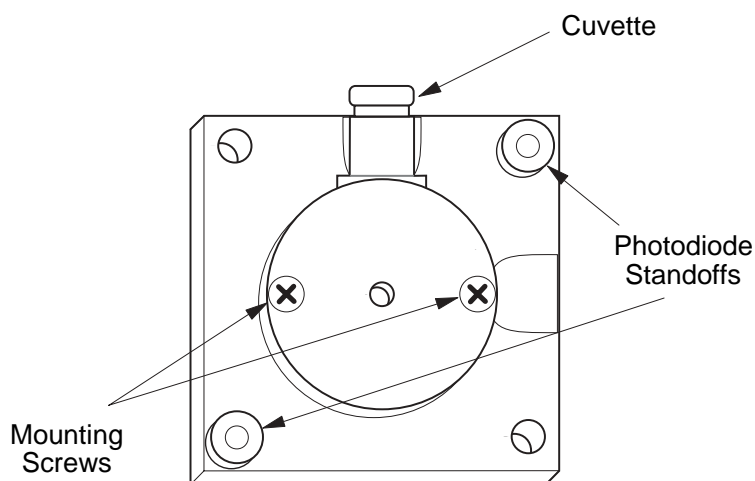
timed event	An instrument action triggered to occur at a specific, preset time during a run (e.g., autozero, wavelength change, stop time).
troubleshooting	Locating the cause of problems with equipment or procedures, and solving these problems.
wavelength programming	Programming the detector to change the monitoring wavelength as a function of time during a run.

Section 10. Cuvette Holder Accessory

This section provides information on the installation, use, and maintenance of the Cuvette Holder Accessory (Figure 10.1). This accessory is available to simplify calibration/standardization of your detector using FDA, industry, or in-house calibration standards. The cuvette holder is a modular accessory that installs in place of the detector flowcell. It allows analysis of calibration standards (for example, potassium dichromate) to ensure your detector's compliance with FDA, industry, and/or in-house regulations.

To use the cuvette holder, prepare your calibration standard according to the instructions provided with the sample. Then place the sample in a standard 10.0 mm i.d. (12.5 mm o.d.) quartz cuvette. Analyze the sample and compare its measured maxima to its certified maxima. If there's a discrepancy in the measured wavelength, the detector can be recalibrated using the procedure described under " λ calibration" below.

Figure 10.1. Cuvette Holder accessory.



10.1 Installation

The cuvette holder attaches to your detector using the standard flowcell mounting hardware.

Use the following steps to remove the flowcell and install the cuvette holder:

1. Remove the thumbscrew that secures the flowcell enclosure to the left side of the detector (the right enclosure shown in Figure 10.2). Remove the flowcell enclosure (Figure 10.3) and set it aside.

Figure 10.2. Detector side panel.

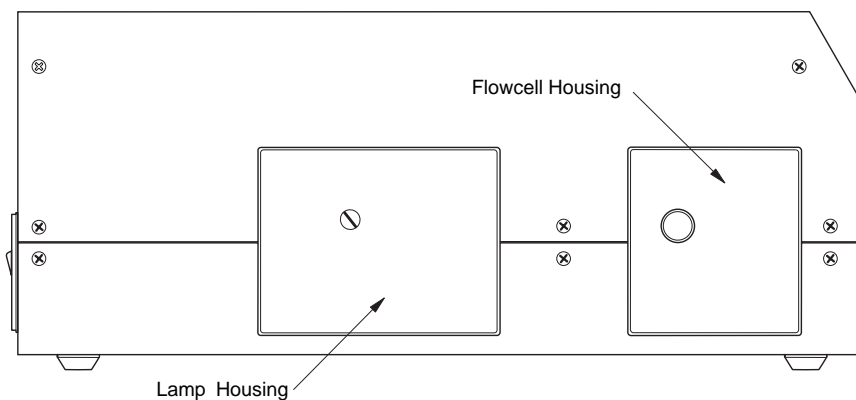
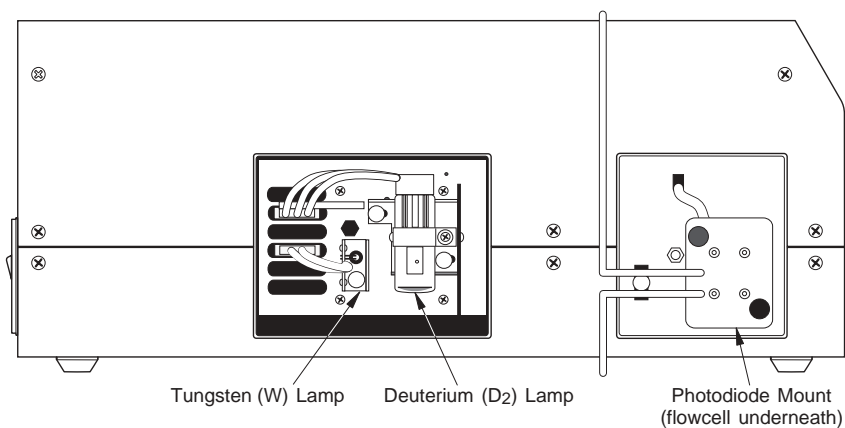


Figure 10.3. Detector side panel with enclosures removed.



2. Remove the two thumbscrews that secure the photodiode assembly to the front of the flowcell and then reposition the photodiode assembly out of the way (Figure 10.4) to provide access to the flowcell.
3. Remove the two thumbscrews (top left, lower right) that secure the flowcell mount to the detector and then remove/reposition the flowcell (Figure 10.5).

NOTE: You needn't disconnect the flowcell's tubing connections to your LC system if the cuvette holder is only going to be used long enough to conduct a calibration. Simply reposition the flowcell during use of the cuvette holder.

Figure 10.4. Detector with photodiode repositioned to expose flowcell.

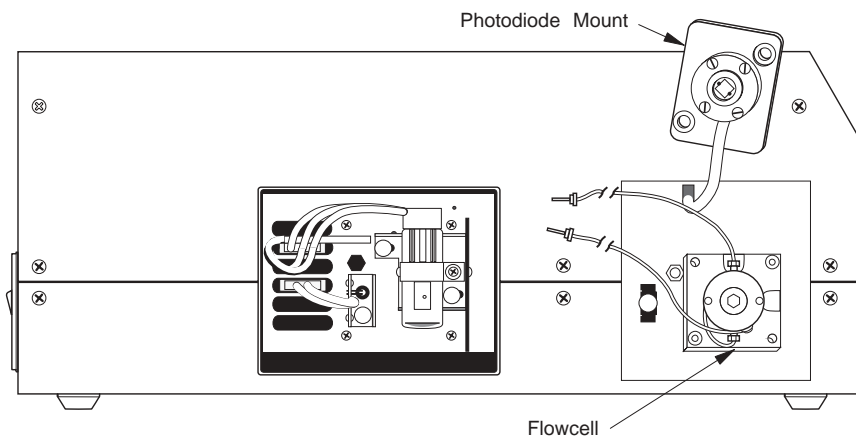
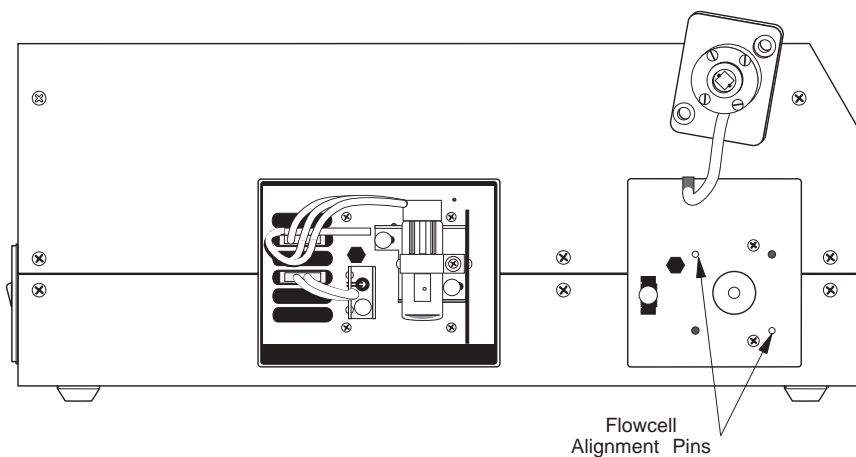
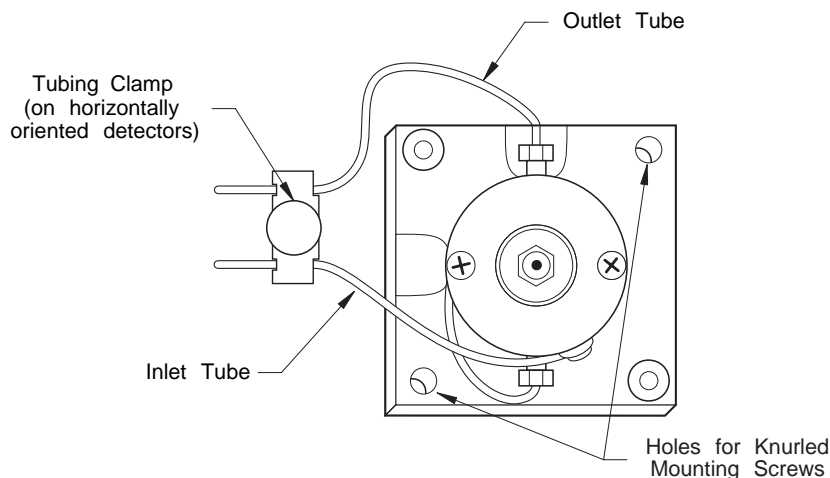


Figure 10.5. Detector with flowcell assembly removed to expose alignment pins.



4. Position the cuvette holder and secure the two thumbscrews (top left and lower right) that secure the holder to the threaded holes on the detector's side panel.
5. Replace the photodiode assembly and secure it to the cuvette holder's standoffs with its two thumbscrews (top right and lower left).
6. Reattach the detector's flowcell enclosure.

Figure 10.6. Flowcell assembly showing clamp position.



10.2 Using the Cuvette Holder

The two procedures that follow allow you to use the Cuvette Holder to test the linearity of your detector's absorbance and to recalibrate the detector, if necessary.

NOTE: Be sure to insert the cuvette inside the holder so that its transparent sides (rather than the frosted ones) are in line with the beam of light from the detector's lamp. Failure to insert the cuvette properly may result in insufficient light levels for accurate analyses.

ABSORBANCE LINEARITY

You can use the optional Cuvette Holder and certified standards to test the absorbance linearity of your detector in the UV range (approximately 235 to 350 nm).

HINT: This procedure is particularly useful for laboratories that require periodic detector validation.

To perform the test, you'll need procedure E 925 from the American Society for Testing and Materials (ASTM) as well as standard potassium dichromate (SRM 930) from the National Institute of Standards and Technology (NIST; formerly the National Bureau of Standards, NBS). The test involves the preparation of acidic solutions of potassium dichromate at four concentrations and the absorbance measurement of each solution at four wavelengths between 235 and 350 nm. After correcting for an absorbance blank, the linearity deviation of a plot of absorbance versus concentration should be less than 1%.

If you want more information on this test, or find that your instrument doesn't conform to these specifications and requires service, contact your local BAS service representative.

λ Calibration

Selecting / λ Calibration/ brings up the screen shown in Figure 10.7. You can use this screen to offset the factory-calibrated wavelength to more closely match FDA, industry, or in-house standards.

Figure 10.7. The lambda (wavelength) offset screen.

λ Offset (steps)	0
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NOTE: The detector is calibrated using a mercury lamp fixture. This provides a very narrow emission line at 254 nm. Broad-band calibration standards, such as holmium oxide and didymium filters, make calibration more difficult and less accurate.

To offset the factory-calibrated wavelength, select the number of "steps" by which you want the wavelength to be offset. Each step represents approximately 0.25 nm, so if you choose "2" for the number of steps, you'll have offset the wavelength by +0.5 nm. You can offset the wavelength by as much as ± 2.5 nm.

NOTE: The offset value isn't cleared upon resetting the RAM memory. It can only be changed from the lambda offset screen.

10.3 Maintenance

The cuvette holder contains no user serviceable components; however, cleanliness of the cuvettes is critical to obtaining accurate analyses. Therefore, these instructions are provided for inspecting and cleaning the cuvettes.

Inspecting a Cuvette

Cuvettes, whether previously used or new, should always be visually inspected before use. Use the following steps to inspect a cuvette:

1. Grasp the cuvette by its two frosted sides and hold it up in front of a bright light source such as a fluorescent fixture, incandescent bulb, or sunny window.
2. Carefully observe the cuvette's two transparent glass sides. Look for physical damage such as chips, cracks, scratches, etc. Also look for dirt, smudges, fingerprints, and so forth.

3. Based on the results of your inspection, you can do one of the following three things:
 - a. If no optical-surface damage or contamination is noted, you can fill the cuvette with sample and use it for your analysis.
 - b. If you see physical damage or severe contamination on the optical surfaces, you may wish to replace the cuvette with a new one.
 - c. If no physical damage is noted and only light to moderate contamination, clean the cuvette using the following procedure.

Cleaning a Cuvette

If the visual inspection reveals contamination of or damage to the cuvette's optical surfaces (the inner and/or outer surfaces of the cuvette's two transparent faces), then the cuvette should be cleaned before use. Use the following steps to clean a cuvette:

1. Immerse the cuvette in a small beaker filled with an appropriate cleaning solution. Use detergent and water to clean cuvettes that are contaminated with residue from water-based solutions. Use an appropriate organic solvent (e.g., methanol, ethanol, isopropanol, etc.) for cuvettes contaminated with residue from organic-solvent-based samples.
2. Place the beaker containing the cuvette(s) and cleaning solution in an ultrasonic bath and set the timer. Use a time setting that's appropriate for the amount of contamination that has to be removed.
3. Remove the cuvette from the beaker, handling it by its frosted sides only. Rinse it thoroughly with clean deionized water until all traces of detergent and dirt have been flushed away.
4. Dry the cuvette thoroughly with a lint-free wiper, exercising care to handle the cuvette only by its two frosted (non-optical) sides.
5. Inspect the cuvette carefully for residual contamination using the steps detailed above. If any is noted, repeat Steps 1 through 4 until the cuvette is completely clean and dry.

NOTE: In cases of serious contamination that resists removal, it may be easier to simply replace a dirty cuvette than to spend a lot of time cleaning it.

Index

A	
Absorbance ratios.....	52
Analog	
offset.....	25
output	24, 73
ARROW keys.....	4
Automatic scanning	38
Autozero	
programmed	29
time	18
C	
Calibration	99
Changing parameters.....	19
Communications, remote.....	74
Connections	
electrical	72
liquid	75
Copy	
file	21
menu	21
Cursor speed.....	56
Cuvette holder	105
D	
Damage	iii
Delete file.....	22
Develop file.....	41
Diagnostics.....	97
Diode offsets.....	98
Display	
contrast.....	55
cursor speed.....	56
description.....	6
Dual wavelength	16

E	
Edit menu	16
ENTER	
definition	7
key	4
Error messages	95
Event mark	55
F	
Files	
copy	21
delete	22
develop	41
edit	16
load	18
menu	15
protected	23
save	20
scan	34
Flowcells	
installation	78
maintenance	57
optional	76
Fuses	71
G	
Glossary	101
Good laboratory practices	ii
H	
Hazards	i
I	
Installation	69
Integrators	73

K	
K-factor	24, 47
Keypad	3
L	
Lamp	
hours	31
maintenance	63
menu	30
modes	31
Load	
file	18
queue	45
M	
Main menu	5
Maintenance	
flowcell	57
general	57
lamp	63
Menu	
reference	84
tree	81
MENU key	4
Menus	
copy	21
edit	16
files	15
lamp	30
main	5
more	23
options	17
queue	43
status	5, 20
Messages	
error	95
general	6
More menu	23

N	
Not ready, remote	74
O	
Offset, analog.....	25
Operation	
advanced	27
basic.....	15
theory	91
Optional flowcells	76
Options menu	17
Outputs	
analog.....	24, 73
event.....	55
ready.....	55
short.....	54
P	
Pause.....	46
PLUS/MINUS keys	4
Power requirements.....	70
Protected files.....	23
Q	
Queue menu	43
R	
Range.....	18
Ratios, absorbance	52
Ready output.....	55
Rear panel.....	72
Recorders.....	73
Remote communications	74
Replay spectra	38
Rise time.....	17
RUN key.....	3, 19
Run/Start, remote.....	74

S

Safety information.....	i
Save file.....	20
Scan file.....	34
Scan summary data screen.....	37
Scanning.....	33
Select.....	7
Self-tests	97
Service.....	iv
Setup	69
Short outputs.....	54
Shutdown.....	56
Single wavelength.....	16
Software version	98
Specifications	79
Spectra	33
Starting a run.....	19
Status	
lock.....	54
menu	5, 20
screen.....	5, 18
STATUS key	3
Stop	
queue.....	46
remote	74
time	16
STOP key.....	3, 19
Stopping a run.....	19

T

Theory of operation	91
Time from READY	32
Troubleshooting	91

V

Version	98
Voltage selection	70

W

Warnings 8
Warranty iv
Wavelength program..... 16, 27

Z

Zero

 for baseline scan 35
 on wavelength change 29
 remote 74
ZERO key 3