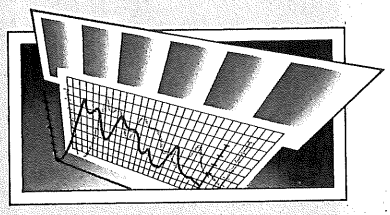
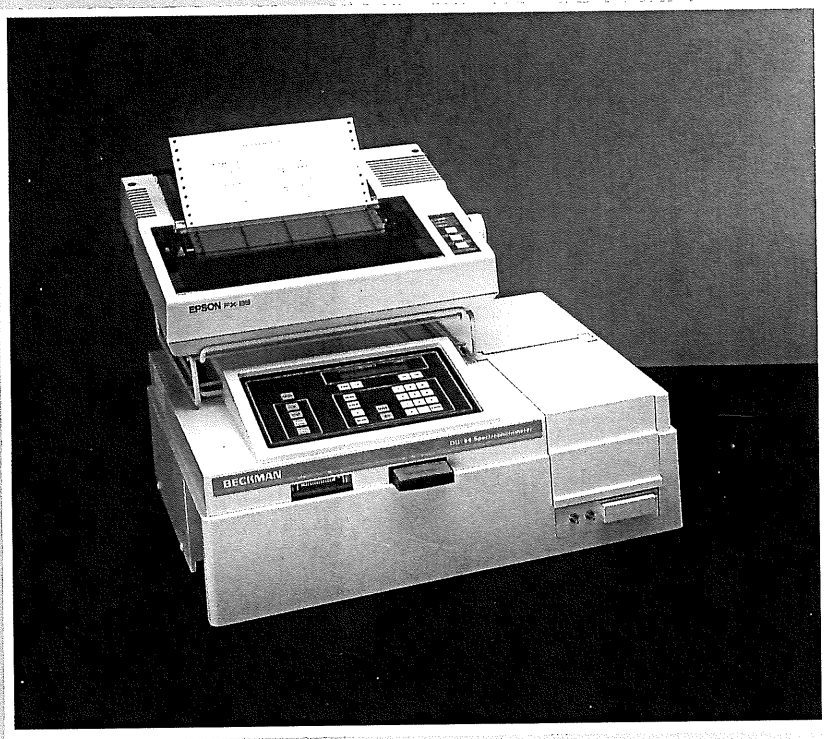
Manual 523760B



DU® Series 60 Spectrophotometer

Operating Instructions



BECKMAN

Warranty Information

The following items are consumables and have the following limited warranties:

596791 UV Source - 90 days from receipt

945672 Visible Source - 90 days from receipt

This warranty covers parts, only. Replacement instructions for these parts are provided in section 8 of this manual. This limited warranty includes only the above named parts.

TABLE OF CONTENTS

FIGURES

SAFETY REMINDER

This page summarizes cautionary information basic to the safe operation of this instrument. However, it is strongly recommended that the user read the entire manual carefully before attempting to operate the instrument. Be sure to read all NOTICES, CAUTIONS and WARNINGS!

DU® SERIES 60 SPECTROPHOTOMETER

DU® Series 60 Spectrophotometers are intended for use in qualitative and quantitative biological research and industrial procedures which require spectrophotometric measurements in the UV-visible region of the electromagnetic spectrum. Misuse of this instrument could present the following hazards:

ELECTRICAL HAZARDS

To avoid possible electrical-shock hazards, make sure that the instrument is grounded at all times and observe the following cautions:

- The three-prong power plug must be connected to a properly grounded three-prong outlet. If an electrical outlet will not accept the three-pronged plug, do not use an adapter or a two-wire extension cord.
- Only qualified maintenance personnel should make electrical outlet changes.
- Before removing any covers from the instrument, other than the sample compartment cover, unplug the power cord.
- Before changing a fuse, unplug the power cord. Always replace a fuse with one of the same type and rating.
- All internal components of this instrument, with the exception of the parts indicated in section 8, must be serviced by a qualified Beckman service representative.

⚠ This symbol, wherever located on the instrument, indicates that the user must consult this manual for precautionary information and instructions.

Section One - Introduction

1.1 Intended Use

DU® Series 60 Spectrophotometers are intended for use in qualitative and quantitative biological research and industrial procedures which require spectrophotometric measurements in the UV-visible region of the electromagnetic spectrum.

1.2 General Description

DU Series 60 Spectrophotometers operate from 200 to 900 nm. They use stable beam technology to take readings in either absorbance or transmittance. There are four models available, the DU®-62, the DU®-64, the DU®-65 and the DU®-68 Spectrophotometers. The DU-62 Spectrophotometer is non-scanning; the other three models are scanning versions. The DU-68, only, has a graphic display. The instruments are designed to output to a dot matrix Printer/Plotter.

Each instrument stores calibrations at ten fixed wavelengths. Scanning versions also store one background scan, with its calibration, and the last sample scan for replot.

All models have four program storage areas and will accept Memory-Pac™ modules, each of which contain two additional program storage areas. All models also accommodate Soft-Pac™ modules, which contain specialized applications programs. Examples include: Kinetics, Gel Scan, Protein Assay, Nucleic Acids, Dissolution, Quant I and Quant II. Instructions for the use of these are given in the Operating Instructions for each individual accessory.

The DU-65 and DU-68 Spectrophotometers have a programming mode, which enables the user to write specialized programs which control the spectrophotometer functions for the reading or scan, the sampling accessory operation, mathematical manipulation of the data, operator prompts and the reporting format. User-written programs can be stored on Memory-Pac™ modules and used on the non-programmable DU®-62 and DU®-64 Spectrophotometers. Instructions for the use of the programming mode are given in the Programming Guide, Manual 523735.

The instrument is supplied with a single cell holder to hold a 10 mm cuvette. A full line of modular sampling accessories is available. Included are temperature controlled cell holders, automatic multi-position cell holders, a batch sampler, sipper samplers, long pathlength cell holders and a gel

scanner. Instructions for the use of these options are given in the Operating Instructions for each individual accessory.

Each instrument may be interfaced to a variety of peripheral devices through a standard bidirectional RS-232 communications port. Data Leader™ Software is available for an IBM* PC-AT or PC-XT (or true compatible), which uses the computer screen for program set up, display of graphic data and storage of the data in a format which makes it available for a wide range of manipulations.

*IBM, IBM PC-AT and IBM PC-XT are trademarks of the International Business Machines Corp.

Section Two - Installation

Refer to the Installation Instructions for the DU Series 60 Spectrophotometer and Printer/Plotter, Manual 523770. Installation instructions for the accessories are separate and accompany each accessory.

Section Three - Principles of Operation

3.1 Optical Principles

The optical diagram of the DU Series 60 Spectrophotometer is shown in Figure 3-1.

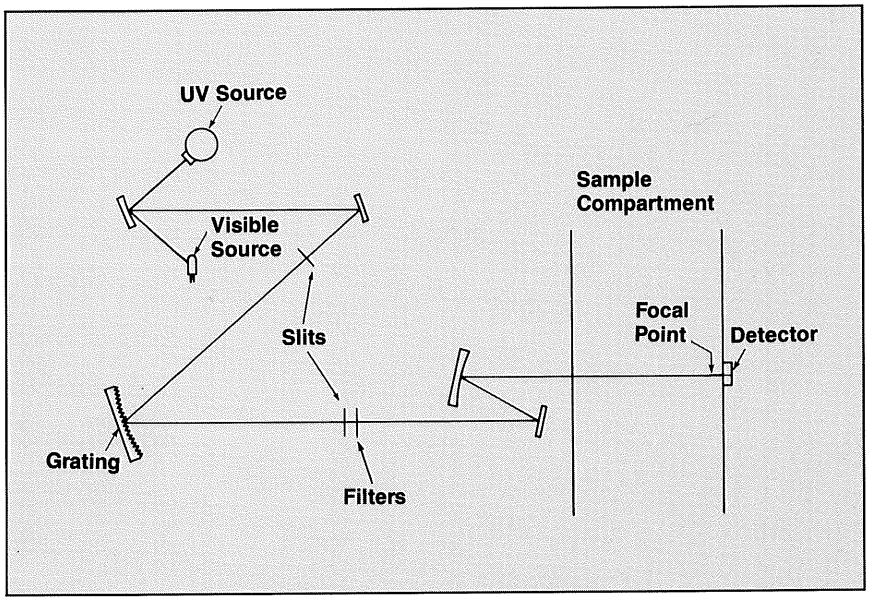


Figure 3-1. DU Series 60 Optics

The instrument operates on a single-beam principle. It has a concave holographic grating, blazed at 220 nm. The focal point of the beam in the sample compartment is on the right-hand side, not in the middle. This location permits the maximum amount of transmitted light to reach the detector from scattering samples. All sampling accessories, which are properly installed, position the sample at the focal point.

3.2 The Non-Programmable Keyboard

The keyboard illustrated in Figure 3-2 is used on the DU-62 and DU-64 Spectrophotometers for all operational commands. Notice that the keys are grouped by function.

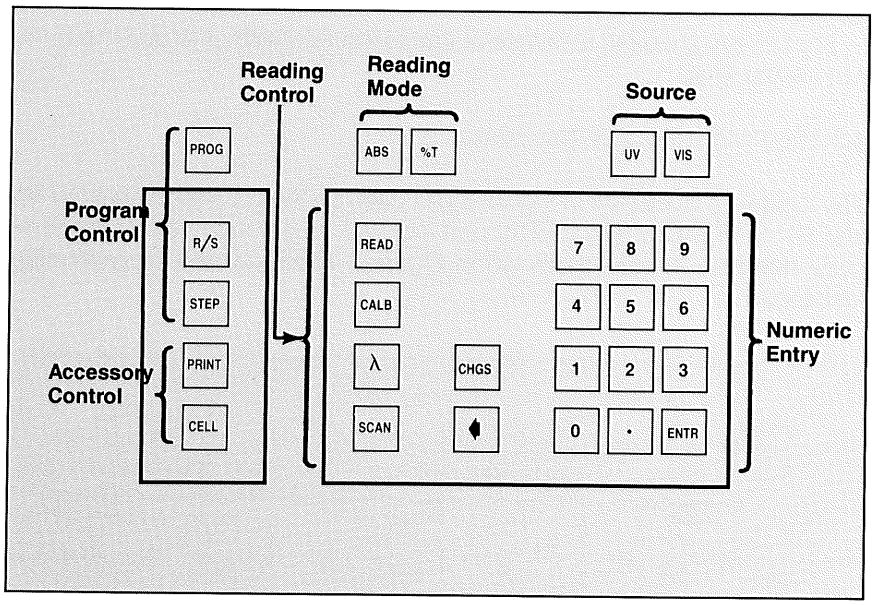


Figure 3-2. DU-62 and DU-64 Keyboard

Reading Mode Keys

These keys are used to select the reading mode, in absorbance or transmittance.

Source Keys

These are toggle keys which are used to turn the sources on and off. The UV source, only, requires a two minute warm up before it fires. However, a brief warm up (30 minutes) is suggested to allow the instrument to become stable after turning on the sources. See section 3.9.

Reading Control Keys

These keys are used to take a reading, calibrate, choose the wavelength and enter the scan mode.

Numeric Entry Keys

These keys are used to enter numeric values, change the sign and backspace.

Program Control Keys

These keys are used to enter the directory mode to run a program, select a program and start and stop it.

Accessory Control Keys

These keys are used to initiate output to the Printer/Plotter and move the Auto 6-Sampler.

3.3 The Programmable Keyboard

The keyboard illustrated in Figure 3-3 is used on the programmable DU-65 and DU-68 Spectrophotometers and includes all the functions of the non-programmable keyboard, shown in Figure 3-2, plus all the programming functions.

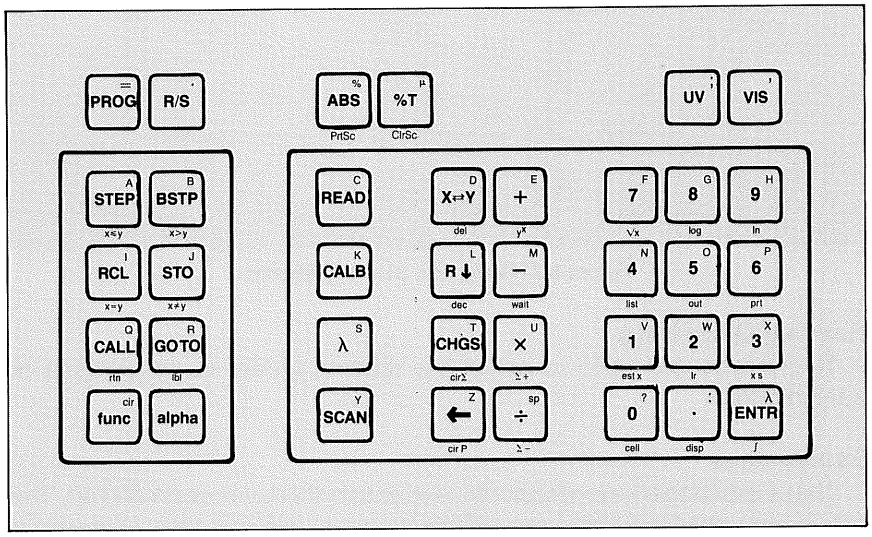


Figure 3-3. DU-65 and DU-68 Keyboard.
The two functions under [ABS] and [%T] are on the DU-68 Spectrophotometer, only.

Notice that each of the keys from the non-programmable keyboard is located in the same place on the programmable keyboard. These are the most prominent label on a key and are called the *primary* function of the key. Programming functions are added with a few additional keys and by giving each key one or two additional functions. A complete description of these additional keys is given in the Programming Guide, Manual 523735.

Secondary key functions are those shown in smaller blue letters and symbols, located under the key. Some examples of secondary keys are log and ln, which are under the numeric keys 8 and 9, respectively. Secondary key functions are invoked by pressing [func], then pressing the desired key. Thus, to take the common log of a number, press [func] [log] (or 8).

The DU-68 Spectrophotometer has two secondary key functions which are used to control the graphic display. They are ClrSc to clear graphic data from the display and PrtSc to print the display.

Alpha keys are used to input characters for prompts and labels and are indicated by gold characters in the upper right-hand corner of the key. Alpha keys are invoked by pressing alpha, then pressing the desired key. Numbers may also be used for prompts and labels by pressing alpha twice, then the appropriate number key.

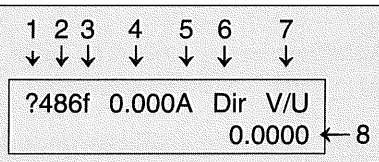
A letter is placed on the display whenever func or alpha are pressed. When func is pressed, an "f" is displayed. When alpha is pressed, an "a" is displayed. If alpha is pressed a second time, for number input, an "n" is displayed. On the alphanumeric display of the DU-62, DU-64 and DU-65 Spectrophotometers, the letter is placed after the wavelength value on the top line. On DU-68 Spectrophotometer, the letter is placed between Mode and Action on the display.

3.4 RESET Button

The RESET button is recessed into the top of the instrument cover, behind the keyboard. To activate the RESET, use the blunt end of a pencil or pen to reach into the recess and press the button. (On the DU-68 Spectrophotometer, the graphic display must be moved to access the RESET button. As an alternative, the instrument can be unplugged.) Pressing the RESET button initiates the power up diagnostic tests, described in section 3.10. It is used to restart the power up diagnostic tests after a failure (section 7.1) and can also be used to remove the instrument from a lock up condition (section 7.3). The sources are turned off when the RESET button is pressed and are not turned back on when the diagnostic tests are completed.

3.5 The Alphanumeric Display

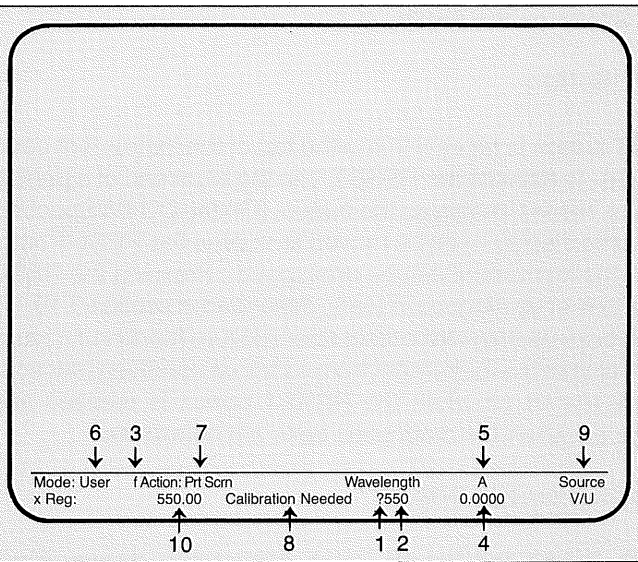
The DU-62, DU-64 and DU-65 Spectrophotometer display, Figure 3-4, is composed of two alphanumeric lines, each of which contains a maximum of twenty characters. The top line of the display is used for instrument status information (the current wavelength, the current reading and source status) and system messages. The second line of the display is used to display a single wavelength reading, after READ is pressed. On the programmable DU-65 Spectrophotometer, it is also used for data manipulation, prompts and messages and to edit a user-written program, as described in the Programming Guide, Manual 523735.



Legend:

1. Question mark indicates questionable wavelength accuracy. Refer to section 7.2.
2. Current wavelength position.
3. For DU-65, only. Indicates secondary and alpha key functions. Refer to section 3.3.
4. Current reading.
5. Indication of absorbance or transmittance mode.
6. Status field for operating mode (section 5.8), operating action, instrument action and errors (section 7).
7. Source status information. Refer to section 3.9.
8. Sample reading.

Figure 3-4. Alphanumeric Display



Legend:

1. Question mark indicates questionable wavelength accuracy. Refer to section 7.2.
2. Current wavelength position.
3. Indicates secondary and alpha key functions. Refer to section 3.3.
4. Sample reading.
5. Indication of absorbance or transmittance mode.
6. Status field for operating mode. Refer to section 5.8.
7. Status field for operator or instrument action.
8. Status field for errors. Refer to section 7.
9. Source status information. Refer to section 3.9.
10. X-register value. In this case, the reading taken on the last sample. For more information on the x-register, refer to the Programming Guide, Manual 523735.

Figure 3-5. Graphic Display

3.6 Graphic Display

The graphic display is divided into two parts. The top part is used to display graphic data, including wavelength scans. It is also used to display graphic data from Soft-Pac™ modules and can be used to display graphic data from user-written programs. The bottom two lines of the display are used for status information, as shown in Figure 3-5.

Two key functions are used to control the graphic display. They are (ClrSc) to clear graphic data from the display and (PrtSc) to print the display.

If the instrument is not used for a few minutes, the display is automatically dimmed or turned off. The display is turned back on when any acceptable key is pressed. Acceptable keys are determined by the last action of the instrument. If the last action of the instrument is unknown, press (func). This key is usually acceptable.

3.7 Sample Compartment

The sample compartment, Figure 3-6, has a standard rail mount installed, which should not be removed. A single cell holder is included with the instrument to hold standard 10 mm rectangular cuvettes. A variety of additional sampling accessories are available, which mount on the rails. Connections for transport and Peltier temperature controlled accessories are included on the accessory panel at the front of the sample compartment, to facilitate easy insertion and removal of sampling accessories.

Figure 3-6. Sample Compartment

The diagram in Figure 3-7 shows the location and size of the beam in the sample compartment. Notice that the beam focus is at the far right-hand side. Sampling accessories, which are correctly installed, position the sample near the beam focus. The focal point of the beam is designed to be at the right-hand side of the sample compartment, so that the maximum amount of light can be collected from scattering or turbid samples.

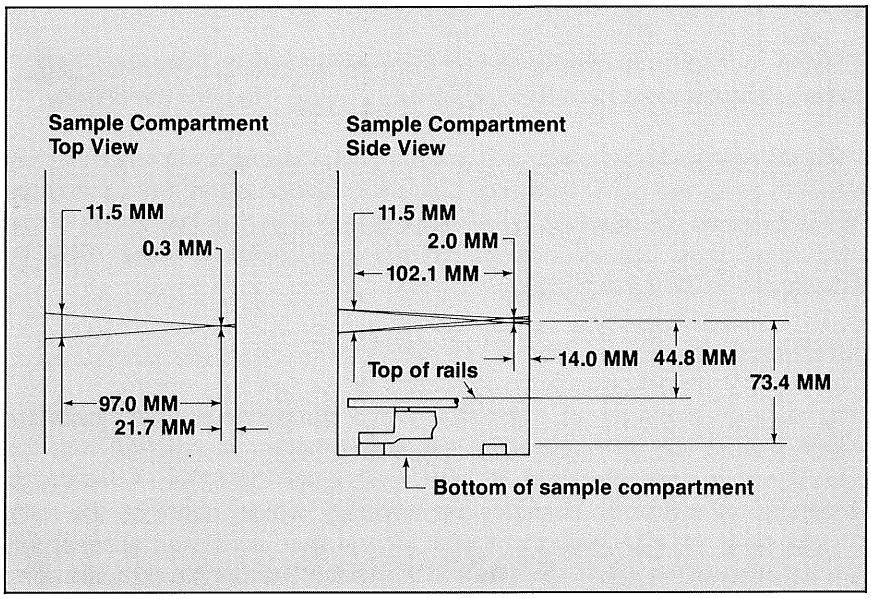


Figure 3-7. Beam Location in the Sample Compartment

3.8 Cuvettes

All DU 60 Series Spectrophotometers include both the visible and UV range. Cuvettes made of silica or quartz are required for use in the UV region. Pyrex (glass) or plastic cuvettes can be used in the visible region. In general, plastic cuvettes have poor transmission properties in the UV region. Before using them in the UV region, scan an empty cuvette filled with water versus an air reference to verify its transmission properties.

CAUTION

Verify that plastic cuvettes transmit UV light before using them in the UV region.

The cell holders are designed to hold cuvettes which have full, square sides. Cuvettes which do not have full sides may catch on the positioning springs in the cell holders and damage the cell holder. Some types of disposable, plastic microcells do not have full sides and should not be used. Similar cuvettes with full sides are available. A bottom view of these types of cuvettes is shown in Figure 3-8.

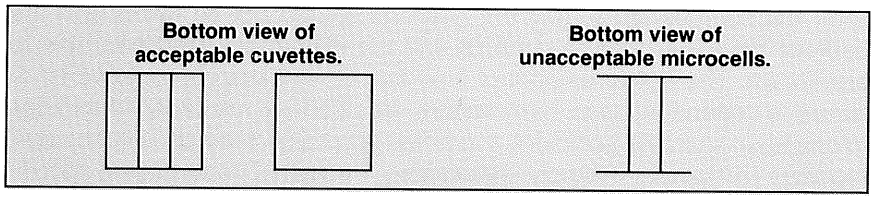


Figure 3-8. Types of Cuvettes

CAUTION

Do not use plastic microcells which do not have full sides. All cuvettes must have full sides for use in the cell holders.

Rinse cuvettes between samples. Clean cuvettes frequently using a mild, alkaline detergent, such as dilute Trace-Klean™ solution (available from Beckman, P/N 598190). To remove protein deposits from a cuvette, soak in dilute Trace-Klean solution at 56°C for 15 minutes. Do not let cuvettes soak in Trace-Klean solution or other alkaline detergents for more than 15 minutes.

CAUTION

Trace-Klean™ solution is a highly alkaline solution and should be handled with care.

Occasionally a cuvette may become severely contaminated with substances which have dried on the interior surfaces. These cuvettes may not come clean using Trace-Klean solution. In this case, rinse the cell with 50% hydrochloric acid (6N) for ten seconds then rinse immediately with deionized water.

3.9 Sources

The DU Series 60 Spectrophotometer has two sources: visible (tungsten halogen) and ultraviolet (deuterium). The visible region is from 325 to 900 nm. The ultraviolet region is from 200 to 324 nm. The source is automatically changed at 325 nm.

To turn on the respective source, press (UV) or (VIS). These keys are toggle switches, so pressing them a second time will turn off the source(s). The visible source is turned on immediately when the key is pressed. However, it takes about two minutes for the deuterium source to warm up before it turns on.

The source status is shown on the display. If a source is on, it is indicated by a "VIS" or "UV". If both sources are on, the indications are "V" and "U". The first letter indicates the source that is currently being used. During the warm up time for the deuterium lamp, the indication is lower-case, "uv" or "u".

After the sources are turned on, readings should not be taken until the sources have had time to stabilize and the instrument has been able to equilibrate. The actual amount of time that is necessary to achieve equilibrium is dependent upon many factors. As a general rule, from 15 minutes to one hour is usually sufficient. If extreme accuracy of results is not critical, readings can be made almost immediately. Published performance specifications are based upon a one hour warm up.

If either source fails to fire within the allotted time limits, an error message is displayed, indicating that the source probably needs to be replaced. An error message is also displayed if either source fails during operation.

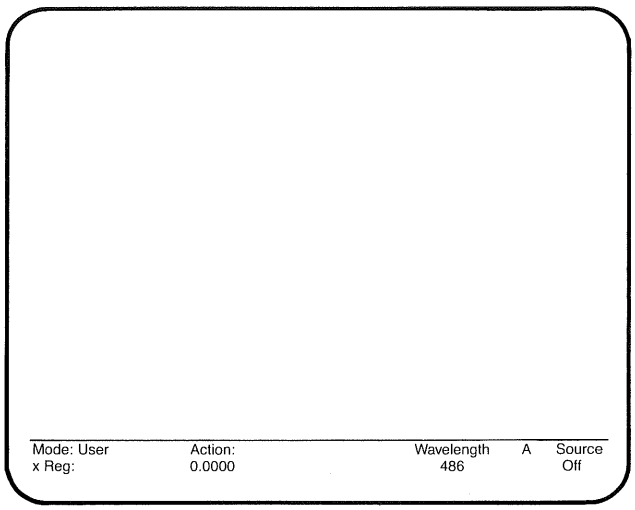
3.10 Automatic Self Diagnostics

The instrument is powered up by plugging the instrument into a power outlet. (On the DU-68 Spectrophotometer, the graphic display must be plugged in and illuminated before the instrument is plugged in.) Each time the instrument is powered up, a series of diagnostic checks, called the System Test, is automatically performed to ensure proper operation of major system components. The checks that are performed as part of the System Test include: initialization of all accessories, lighting of the visible source, a check for light leaks in the sample compartment, verification that light is reaching the detector and operation of the filter motor. When the System Test is complete, the wavelength drive mechanism is calibrated to ensure wavelength accuracy.

As each part of the diagnostics is completed, "Pass" or "Fail", with a short explanation, is displayed and printed on the Printer/Plotter, if installed. If any test fails, refer to section 7.1 for troubleshooting information. When all the tests are completed satisfactorily "TEST COMPLETED" is printed on the Printer/Plotter and the following is on the alphanumeric display:

486	A
	0.0000

When all tests are completed satisfactorily on the DU-68 Spectrophotometer, the following is on the graphic display:



The instrument should be left plugged in, with the sources turned off when not in use. In this condition, power is applied to selected components to reduce the warm up time before use.

3.11 Calibration Method

Before readings can be taken in any mode, the instrument must be calibrated. The instrument is automatically calibrated in both absorbance and transmittance when CALB is pressed. To calibrate, the instrument automatically performs the following steps:

1. The monochromator is moved to the proper wavelength. This is the specified wavelength for a single wavelength reading. In the scan mode, the instrument selects the best wavelength(s) to calibrate at, based upon the total amount of energy in the wavelength range.

2. The proper detector gain value is selected. This minimizes the noise level and maximizes photometric accuracy.

3. Dark current is measured and corrected. This compensation assures accurate readings at high absorbance.

4. The log converter is calibrated for absorbance readings.

This calibration assures repeatable readings every time the instrument is used.

In all modes, except wavelength scanning, a blank solution (or sample) should be in the sample compartment during the calibration. This is also true in wavelength scanning, if the blank does not have highly absorbing peaks.

3.12 Calibration Table

For fixed wavelength readings, the instrument has a calibration table which stores the last 10 calibration values, as long as the source remains on. Therefore, the user does not have to recalibrate each time a reading is taken unless a wavelength is used which does not already exist in the calibration table, or the user chooses to recalibrate. This also allows multiwavelength readings at up to 10 wavelengths without recalibration.

The calibration table is updated each time a calibration is performed. The calibration values are prioritized internally with respect to the time at which a value was last used, with the most recently used value given the highest priority. If a calibration is performed at a wavelength which has been previously stored in the table, the new value replaces the old value. If a calibration is performed at a wavelength which has not been previously stored in the table, the new value replaces the oldest calibration value in the table.

Scanning, if available, has no effect upon the values held in the calibration table. Background scan data and scan calibration data are recorded and stored in a separate internal memory area.

3.13 Wavelength Scanning

After the calibration, a background scan is required. The blank (or reference) is automatically scanned over the same range at the same speed as the samples will be scanned, so that the background correction is optimal.

The background scan is stored in the instrument and can be reused for an unlimited number of sample scans as long as the range and speed remain the same, unless the user calibrates for a new scan or the instrument is unplugged. (The range can be decreased as long as the speed remains constant and no new background is required.) When a new background is required, it is indicated on the display.

A new background scan should be made every time a solvent is changed, because the background spectrum will be different. A new background scan should also be made if no scan has been made for over an hour. To rescan the background, it is necessary to recalibrate first, by pressing **CALB**.

The selected scanning speed determines the distance between each data point that is collected as the instrument scans through the chosen region. At 750 nm/min, a data point is collected every nanometer. At 500 nm/min, a data point is collected every half nanometer.

As the sample data are collected, the background is subtracted and the difference in absorbance (or ratio in transmittance) is stored. On the DU-68 Spectrophotometer, only, the scan data are displayed graphically as they are collected. On the other models, the data are plotted by the Printer/Plotter after the scan is complete.

If the RS-232 port is installed, data are output as they are collected. Sample data are output to the analog port after the scan is complete and after the plot on the Printer/Plotter is complete. The analog port is not available for the DU-68 Spectrophotometer.

The stored data can be reformatted and replotted on the Printer/Plotter. On the DU-68 Spectrophotometer, the stored data can be reformatted and redisplayed on the graphic display.

Wavelength Rang

Wavelength Accu

Wavelength Repe

Wavelength Setat

Resolution:

Photometric Read

Photometric Accu

RMS Noise:

Stray Light:

Stability:

Scanning Speeds:

Scale Expansion: 0.001 increments from -0.3 to 3.0A

Data Collection Rate: 20 samplings/second

Response Time: 0.05 second

Power Requirements: 120V ± 10%, 3A
220/240V ± 10%, 1.5A

Temperature Range: +15 to 40°C

Humidity Range: <85% maximum relative humidity, but not to exceed 32.5° WBT

Section Five - Operating Instructions

5.1 Output Devices

Before starting the analysis, verify that the output device(s) is installed properly.

Printer/Plotter

Verify that the Printer/Plotter is installed, that paper is installed and that it is in the "On Line" mode. Refer to the Installation Instructions for the Printer/Plotter, Manual 523770 or 523777.

Data from fixed wavelength readings are printed on the Printer/Plotter when PRINT is pressed. On the DU-65 or DU-68 Spectrophotometer, press func prt ↓.

Scan data are plotted automatically at the completion of each scan on the DU-64 and DU-65 Spectrophotometers. On the DU-68 Spectrophotometer, a copy of the graphic display can be made by pressing func PrtSc in the user and scan modes. As an alternative, scan data can be plotted.

Analog Output

Verify that the Analog Output accessory and recorder are installed. Refer to the Installation Instructions for the Analog Output, Manual 523779.

Fixed wavelength data are continuously sent to the analog port. Scan data are sent at the completion of the scan and after the data are sent to the Printer/Plotter, if it is also installed. Refer to the Analog Output Operating Instructions, Manual 523737, for more information. The analog output is not available for the DU-68 Spectrophotometer.

RS-232 Interface

Verify that the RS-232 Interface is installed and attached to the appropriate output device. (On the DU-68 Spectrophotometer, one RS-232 port is used to communicate with the graphic display.) Refer to the Installation Instructions for the RS-232 Interface, Manual 523784.

Information is sent to the RS-232 port as data are collected. Calculated or replotted data are not sent to the port. Refer to the RS-232 Operating Instructions, Manual 523746, for more information.

5.2 Single Wavelength Readings

1. Turn on the source(s), using (UV) and/or (VIS).

2. Select the reading mode in absorbance or transmittance, using (ABS) or (%T).

3. Select the wavelength, by first inputting the value, using the numeric keys, then pressing (λ).

4. Place the blank solution in the sample compartment and press (CALB) to calibrate. "Calb" or "Calib" is displayed during calibration.

5. Remove the blank and place the sample in the sample compartment. The reading is displayed immediately on the top line of the alphanumeric display. On the DU-68 Spectrophotometer, the reading is displayed on the right-hand side of the bottom line.

6. Press (READ) to take a reading. The reading is displayed on the second line of the alphanumeric display. On the DU-68 Spectrophotometer, the reading is displayed as the x-register value.

7. To print the value on the Printer/Plotter, press (PRINT). On the DU-65 or DU-68 Spectrophotometer, press (func) (prt).

5.3 Multiwavelength Readings

1. Turn on the source(s), using (UV) and/or (VIS).

2. Select the reading mode in absorbance or transmittance, using (ABS) or (%T).

3. Place the blank in the sample compartment.

4. Select the first wavelength, by inputting the value using the numeric keys, then pressing (λ). Press (CALB) to calibrate. "Calb" or "Calib" is displayed during calibration.

5. Repeat step 4 for each wavelength.

6. Remove the blank and place the sample in the sample compartment.

7. Input the value for the first wavelength, then press (λ). The reading is displayed immediately on the top line of the alphanumeric display. On the DU-68 Spectrophotometer, the reading is displayed on the right-hand side of the bottom line.

8. Press (READ) to take a reading. The reading is displayed on the second line of the alphanumeric display. On the DU-68 Spectrophotometer, the reading is displayed as the x-register value.

9. To print the value on the Printer/Plotter, press (PRINT). On the DU-65 or DU-68 Spectrophotometer, press (func) (prt).

10. Repeat steps 7 to 9 for each wavelength.

11. To analyze the next sample, place it in the sample compartment and follow steps 7 to 10.

5.4 Wavelength Scanning - DU-64, DU-65

Wavelength scanning capabilities are standard on the DU-64, DU-65 and DU-68 Spectrophotometers. The DU-62 Spectrophotometer is non-scanning; however, it can be upgraded with scanning capabilities.

1. Turn on the source(s), using (UV) and/or (VIS).

2. Select the reading mode in absorbance or transmittance, using (ABS) or (%T).

3. Press (SCAN) to enter the scan mode. "Edit" is displayed in the status field. Prompts for the following five parameters are displayed sequentially.

4. Starting nm:
   Input the starting wavelength using the numeric keys, followed by (ENTR). It must be in the range of 210 to 900 nm.

5. Ending nm:
   Input the ending wavelength using the numeric keys, followed by (ENTR). The ending wavelength must be at least 10 nm less than the starting wavelength.

6. Speed:
   Use (STEP) to sequentially display the options of "750 nm/min", "500 nm/min" and "Rplt". When the desired speed is displayed, press (ENTR).

7. Upper limit:
   Enter the upper limit using the numeric keys, followed by (ENTR). This is used to format the data for printout on the Printer/Plotter and the analog output, if installed.

8. Lower limit:

   Enter the lower limit using the numeric keys, followed by ENTR. If the lower limit equals the upper limit, the scan data will be auto-scaled on the Printer/Plotter. Auto-scaling does not apply to the analog output.

9. After the last parameter is entered, the first parameter is displayed again. If all the parameters were entered satisfactorily, the instrument can be calibrated.

   To review the entries, press ENTR after each parameter is displayed. To change a parameter, input the new value and press ENTR. Whenever the parameter selection is satisfactory, the instrument can be calibrated.

10. To calibrate, place the blank solution in the sample compartment and press CALB. When CALB is pressed, "Calb" is displayed in the status field and the scanning parameters are displayed on the bottom line of the display.

NOTICE

The blank should be a solvent which has little or no absorbance in the range of interest. If the blank has significant absorbance, calibrate on air and use the blank for the background scan.

11. When the calibration is complete, the status field on the display is changed to "Bkg". Insert the blank solution, if it is not already in the instrument, and scan the background by pressing READ.

12. When the background scan is complete, the status field on the display is changed to "Scan". Place the sample in the sample compartment and press READ. The scan data are collected first, then plotted on the Printer/Plotter. Sample data are shown in Figure 5-1.

    Sample data are output to the RS-232 port as the data are collected. Sample data are output to the analog port after the scan is complete and after plotting by the Printer/Plotter, if installed.

13. When the scan is complete, the status field on the display is changed to "Edit".

14. To replot the data from the last scan, refer to the instructions in section 5.5.

15. To scan the next sample, place it in the sample compartment and press READ.

16. When all samples have been analyzed, press SCAN to exit the scan mode.

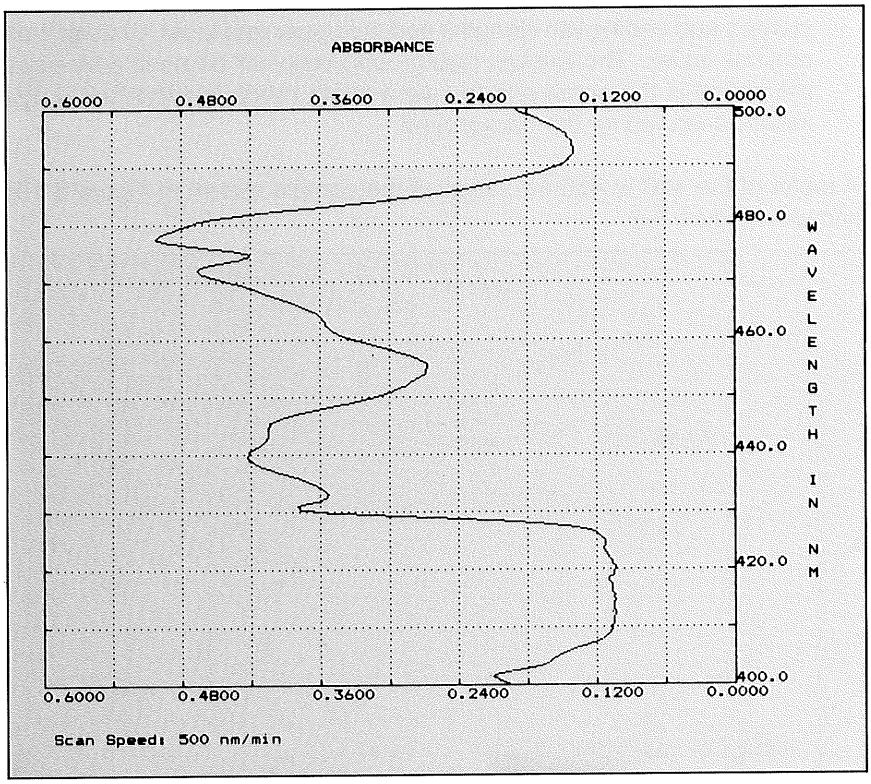


Figure 5-1. Plotted Wavelength Scanning Data

5.5 Replot of Scan Data - DU-64, DU-65

The data from each sample are stored until the next sample is scanned. At the completion of a scan, the starting wavelength is displayed on the bottom line of the display. To replot the data with different axes:

1. Press ENTR ENTR to display the Speed parameter. Use STEP to display "Rplt". Press ENTR.

2. Modify the upper and lower limits and the starting and ending wavelengths as desired. The starting and ending wavelengths must be within the range that was scanned.

3. Press READ to replot the data with the new axes. This will also initiate output to the analog port.

4. When the replot is complete, "Edit" is displayed in the status field.

5. If another sample is to be scanned, change the Speed parameter, the starting and ending wavelengths and the upper and lower limits to their original values. The existing background scan will be used as long as the speed is the same and the wavelength range is within the range initially scanned for the background.

A replot of the 420 to 460 nm range of the sample shown in Figure 5-1 is shown in Figure 5-2.

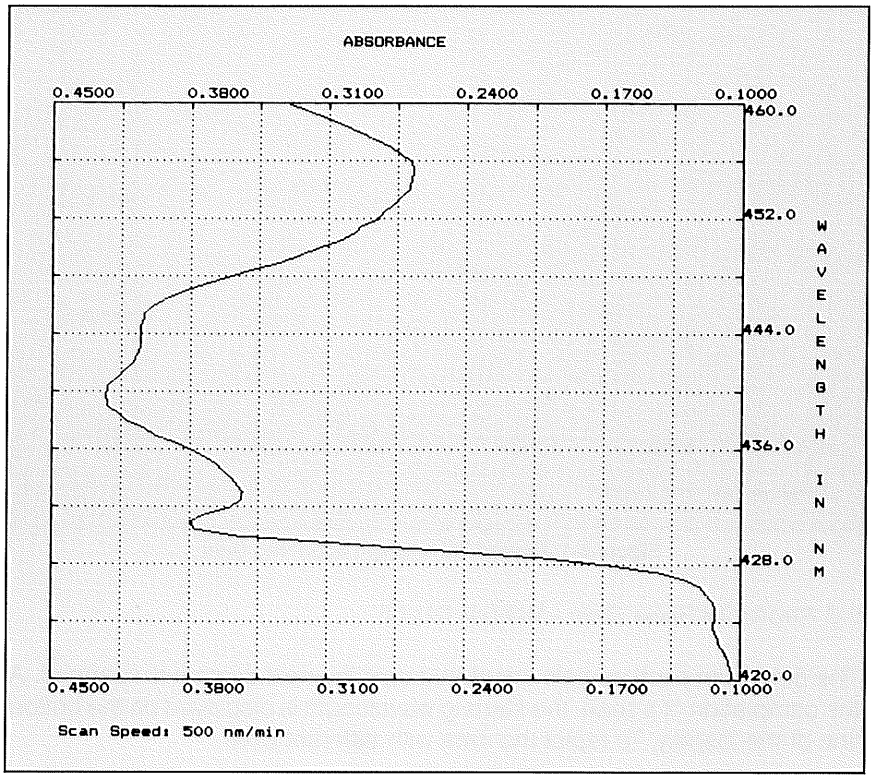


Figure 5-2. Replot of Scan Data

5.6 Wavelength Scanning - DU-68

NOTICE

When the instrument is powered up, data are plotted on the graphic display without a grid. The GRID generic command can be used to turn the grid on and off. For more information on the GRID generic command, refer to section 9.12 in the Programming Guide, Manual 523735.

To plot the data with a grid as shown in Figure 5-3, press the

following keys in the user mode: [1] [CALL] [alpha] [G] [alpha] [R] [alpha] [I] [alpha] [D] [ENTR]. The grid will remain as long as power is applied to the instrument.

1. Turn on the source(s), using [UV] and/or [VIS].

2. Select the reading mode in absorbance or transmittance, using [ABS] or [%T].

3. Press [SCAN] to enter the scan mode. "Editing" is displayed in the action field. Prompts for the following five parameters are displayed sequentially on the bottom line of the display.

4. Starting nm:
   Input the starting wavelength using the numeric keys, followed by [ENTR]. It must be in the range of 210 to 900 nm.

5. Ending nm:
   Input the ending wavelength using the numeric keys, followed by [ENTR]. The ending wavelength must be at least 10 nm less than the starting wavelength.

6. Speed:
   Use [STEP] to sequentially display the options of "750 nm/min", "500 nm/min", "Graph: Display" and "Graph: Plot". When the desired speed is displayed, press [ENTR].

7. Upper limit:
   Enter the upper limit using the numeric keys, followed by [ENTR]. This is used to format the data on the graphic display.

8. Lower limit:
   Enter the lower limit using the numeric keys, followed by [ENTR]. If the upper limit equals the lower limit, scales of 0 - 3 will be used in absorbance and 0 - 100% will be used in transmittance.

9. After the last parameter is entered, the first parameter is displayed again. If all the parameters were entered satisfactorily, the instrument can be calibrated.

   To review the entries, press [ENTR] after each parameter is displayed. To change a parameter, input the new value and press [ENTR]. Whenever the parameter selection is satisfactory, the instrument can be calibrated.

10. To calibrate, place the blank solution in the sample compartment and press (CALB). When (CALB) is pressed, "Calib" is displayed in the action field and the scanning parameters are shown on the bottom line of the display.

NOTICE

The blank should be a solvent which has little or no absorbance in the range of interest. If the blank has significant absorbance, calibrate on air and use the blank for the background scan.

11. When the calibration is complete, "Ins Bkg" is displayed in the action field. Insert the blank solution, if it is not already in the instrument, and scan the background by pressing (READ).

12. When the background scan is complete, "Ins Samp" is displayed in the action field. Place the sample in the sample compartment and press (READ). The scan data are shown on the graphic display as they are collected. Sample data are also output to the RS-232 port, if installed, as they are collected.

13. When the scan is complete, "Editing" is displayed in the action field and the starting wavelength is displayed on the bottom line.

14. To make a copy of the display press (func) (PrtSc). Sample data are shown in Figure 5-3.

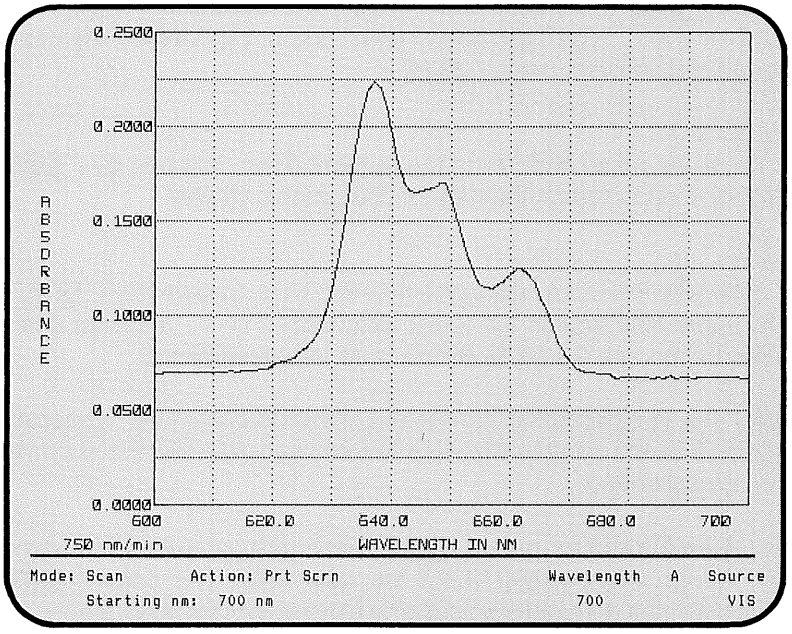


Figure 5-3. Graphic Display of Wavelength Scanning Data

15. To redisplay the data with different axes or to plot the data in the format shown in Figures 5-1 and 5-2, refer to section 5.7.

16. To scan the next sample, place it in the sample compartment and press READ.

17. When all samples have been analyzed, press SCAN to exit the scan mode.

5.7 Replot of Scan Data - DU-68

The data from each sample are stored until the next sample is scanned. At the completion of a scan, the starting wavelength is displayed on the bottom line of the display. To redisplay the data with different axes:

1. Press ENTR ENTR to display the Speed parameter. Use STEP to display "Graph: Display". Press ENTR.

2. Modify the upper and lower limits and the starting and ending wavelengths as desired. The starting and ending wavelengths must be within the range that was scanned.

3. Press READ to display the data with the new axes.

4. To make a copy of the display press func PrtSc. Sample data are shown in Figure 5.3.

5. If another sample is to be scanned, change the Speed parameter, the starting and ending wavelengths and the upper and lower limits to their original values. The existing background scan will be used as long as the speed is the same and the wavelength range is within the range initially scanned for the background.

As an alternative, the scan data can be plotted by the Printer/Plotter, irrespective of the graphic display. The data will be plotted in the format shown in Figures 5-1 and 5-2. To plot the data:

1. At the completion of a scan, the starting wavelength is displayed on the bottom line of the display.

2. Press ENTR ENTR to display the Speed parameter. Use STEP to display "Graph: Plot". Press ENTR.

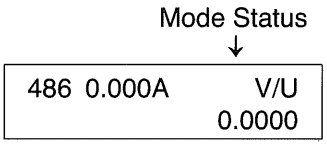
3. Modify the upper and lower limits and the starting and ending wavelengths to reformat the data, if desired. The starting and ending wavelengths must be within the range that was scanned.

4. Press (READ) to plot the data on the Printer/Plotter.

5. If another sample is to be scanned, change the Speed parameter, the starting and ending wavelengths and the upper and lower limits to their original values. The existing background scan will be used as long as the speed is the same and the wavelength range is the same or smaller than the range initially scanned for the background.

5.8 Operating Modes

The DU Series 60 has four basic operating modes: the user mode, the scan mode, the directory mode and the run mode. The programmable DU-65 and DU-68 Spectrophotometers have an additional mode, the program mode. On the DU-68 Spectrophotometer, the operating mode is displayed with the status information. On all other instruments, the operating mode is displayed in the status field on the top line of the alphanumeric display, between the reading and the lamp, as indicated in the following diagram.



User Mode

The user mode is used for non-programmed fixed wavelength readings, described in sections 5.2 and 5.3. It is automatically entered after power up is complete. On the programmable instruments, the user mode provides access to all calculator and data manipulation functions with immediate execution and results display.

In the user mode, the status field on the alphanumeric display is blank.

From the user mode, other operating modes are accessed as follows:

Scan Mode: Press (SCAN). (DU-64, DU-65 and DU-68 Spectrophotometers, only.)

Directory Mode: Press (PROG).

Run Mode: Press (R/S).

Scan Mode

The scan mode is used for wavelength scans and replotting, as described in sections 5.4 to 5.7.

Directory Mode

The directory mode provides access to programs stored in the instrument, Memory-Pac™ modules, Soft-Pac™ modules and on sampling accessories including the Auto 6-Sampler and Batch Sampler.

When PROG is pressed to enter the directory mode, the number and name (if entered) of the current program area is shown on the bottom line of the display. The following diagram shows the alphanumeric display in the directory mode.

```
486  0.000A Dir  V/U
PROG 0:aaaaaaaa
```

Press STEP to sequentially view all the programs available. On the DU-65 and DU-68 Spectrophotometers, BSTP can be used to back step, reversing the action of STEP. When the desired program is displayed, it can be executed by pressing R/S, thereby entering the run mode.

To exit the directory mode, press PROG. An opportunity is given to store the program in a chosen program area. Its major use is to copy programs stored on Memory-Pac modules. Refer to section 5.9 for more information.

On the programmable instruments, the directory mode is also used to enter the program mode to write and edit programs. Refer to the Programming Guide, Manual 523735, for more information.

Run Mode

The run mode is entered by pressing R/S in either the user or directory mode and is used to execute the program in the current program area. (In the user mode, the program is not displayed. However, the current program area is used.) "Run" is displayed in the status field.

While the program in running, R/S acts as a toggle to stop and then to restart the program. (In other words, the first time R/S is pressed, the program stops. The next time it is pressed, the program execution resumes.) Time is not counted when the program is stopped.

5.9 Memory-Pac Modules

Each Memory-Pac module has two program areas and 210 data registers for storage of programs and data.

Two types of programs can be stored on a Memory-Pac module. The first type is a user-written program from a programmable DU-65 or DU-68 Spectrophotometer. Refer to the Programming Guide, Manual 523735, for more information. This type of program cannot be written on a non-programmable DU-62 or DU-64 Spectrophotometer. However, it can be run on a non-programmable instrument, if it is stored on a Memory-Pac module.

The second type of program that can be stored on a Memory-Pac module is a set up program from a Quant II, Kinetics or Protein Assay Soft-Pac module. These programs can be written and stored on both programmable and non-programmable instruments. Refer to the Operating Instructions for the appropriate Soft-Pac module for more information on set up programs.

The 210 data registers can be used to store data, as designated in a user-written program. Refer to the Programming Guide, Manual 523735, for more information. Stored data can be accessed by a programmable instrument only.

Programs and data stored on a Memory-Pac module can be protected so that they cannot be changed or deleted. To protect them, snip the raised lead on the connector of the Memory-Pac module. See Figure 5-4. After the lead is snipped, no additional programs or data can be stored on the module.

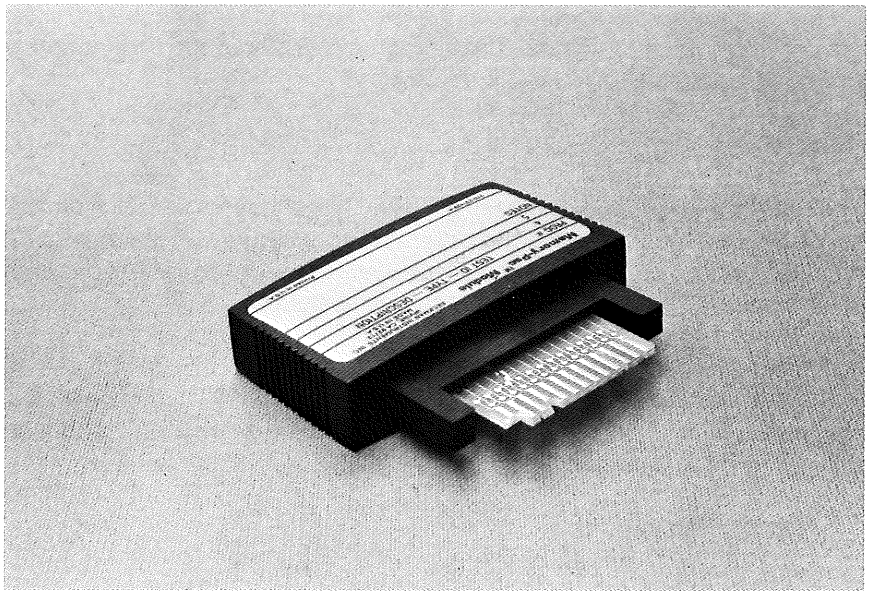


Figure 5-4. Memory-Pac module diagramming the lead to snip to protect the programs and data stored on the module from alteration.

Programs stored in the instrument and on Memory-Pac modules can be copied to additional Memory-Pac modules. Before a copy can be made, the program must be stored in the instrument. To copy a program from a Memory-Pac module to the instrument:

1. Insert the Memory-Pac module into the left-hand port on the instrument.
2. Press (PROG) to enter the directory mode.
3. Press (STEP) to step to the program area in which the program is stored, program area 4 or 5.
4. Press (PROG). The display reads "Store PROG at X".
5. Store the program in the instrument by entering a program area of 0, 1, 2 or 3, using a numeric key followed by (ENTR).

To copy a program stored in the instrument onto a Memory-Pac module:

1. Press (PROG) to enter the directory mode.
2. Press (STEP) to step to the program area in which the program in stored, program area 0, 1, 2 or 3.
3. Press (PROG). The display reads "Store PROG at X".
4. Insert the blank Memory-Pac module into the left-hand port of the instrument.
5. Store the program in the Memory-Pac module by entering a program area of 4 or 5, using a numeric key followed by (ENTR).

One application of the Memory-Pac module has direct implications for quality control. A program written on a programmable instrument in a product development lab, can be run on a DU-62 or DU-64 Spectrophotometer in a quality control lab. When it is run, the data can be stored automatically and can be transferred back to the product development lab stored on the Memory-Pac module.

Section Six - Hazards, Precautions and Limitations

6.1 Hazards

The following hazards are identified for the maximum safety of the user.

1. The three-prong power plug must be connected to a properly grounded three-prong outlet. If an electrical outlet will not accept the three-pronged plug, do not use an adapter or a two-wire extension cord.

2. Only qualified maintenance personnel should make electrical outlet changes.

3. Before removing any covers from the instrument, other than the sample compartment cover, unplug the power cord.

4. When replacing a source, wait at least fifteen minutes for the source housing to cool before touching it. Do not look directly at the source when it is on.

5. Before changing a fuse, unplug the power cord. Always replace a fuse with one of the same type and rating.

6. All internal components of this instrument, with the exception of the parts indicated in section 8, must be serviced by a qualified Beckman service representative.

7. Observe proper precautions when handling biological samples.

8. Do not touch heat sinks.

6.2 Precautions and Limitations

These operational precautions and limitations are provided so that the user may avoid those actions which could damage the DU Series 60 Spectrophotometer or adversely affect the validity of a measurement.

1. Read the DU Series 60 Spectrophotometer Operating Instructions, Manual 523760, before operating this device.

2. Locate this instrument as directed in the Pre-Installation Instructions, Manual 523784.

3. Do not install or remove an accessory board with the power on.

4. Leave the instrument plugged in with the sources off when not in use.

5. Allow the instrument thirty minutes of warm up time after turning on the sources.

6. If a question mark precedes the wavelength value on the display, the wavelength accuracy is questionable. Readings may not be accurate.

7. A blank (or solvent) should be in the sample compartment during the calibration.

8. Do not open the sample compartment cover during a calibration.

9. Cell holders should be placed in the sample compartment, such that the sample is near to the right-hand wall, not in the center, unless otherwise directed.

10. Verify that plastic cuvettes transmit UV light before using them in the UV region.

11. Do not use plastic cuvettes which are rounded near the bottom. All cuvettes must be square at the bottom for use in the cell holders.

12. When performing a wavelength scan, note any "RANGE LIMITED" warnings. Readings above the absorbance value indicated may not be accurate.

13. Routine cleaning of the sipper flowcell, as directed in the Operating Instructions for the Sipper and Batch Sampler, Manual 523747, is necessary for proper performance.

14. Trace-Klean™ solution is a highly alkaline solution and should be handled with care.

Section Seven - Troubleshooting and Diagnostics

7.1 Diagnostic Messages During Power Up

Each time the instrument is powered up, a series of diagnostic tests is automatically performed to ensure proper operation of major system components and the wavelength drive mechanism is adjusted to ensure instrument wavelength accuracy. As each test is performed, the name is displayed. When the test is completed, "Pass" or "Fail" with an explanation is displayed and printed on the Printer/Plotter, if installed. Refer to section 3.10 for more information.

Condition/Message	**Recommended Action**
Power is applied/ nothing happens.	1. Verify that the power source has the proper voltage rating. 2. Check the power cord. 3. Check fuses. 4. Call Beckman service.
Power is applied/ fans turn on, but nothing on display.	1. Check the brightness control. (DU-68) 2. Check fuses. 3. Call Beckman service.
Graphic display has garbled information. (DU-68)	1. Press func ClrSc. 2. Unplug the instrument and display. Plug in the display. Wait 10 seconds, then plug in the instrument. 3. Call Beckman service.
Diagnostic tests are not completed in four minutes.	1. Verify that an asterisk (or "wl Calibration" on DU-68) is blinking on the display, if not, press RESET. 2. Call Beckman service.
CRT Board Fail (DU-68)	1. Verify that the CRT/RS232 board is properly installed. 2. Refer to Appendix C of the Installation Instructions, Manual 523770.
System Test Fail	1. Press the RESET button to restart the diagnostic tests. 2. Call Beckman service.
VISIBLE SOURCE FAIL	Replace the visible source. See section 8.2.

Condition/Message	Recommended Action
CLOSE SAMPLE COVER	1. Verify that the sample compartment is completely closed. 2. Press the RESET button to restart the diagnostic tests.
UNBLOCK BEAM FILTER MOTOR FAILURE	1. Verify that the sample compartment is completely closed. 2. Check the sample compartment for sample or other obstructions and remove if found. 3. Press the RESET button to restart the diagnostic tests. 4. Refer to sections 7.2 and 8.2. 5. Call Beckman service.
wl Calibrate ZO Fail wl Calibrate PR Fail wl Calibrate DP Fail	1. If the visible source was just replaced, refer to section 8.2, step 11. 2. Check the sample compartment for sample or other obstructions and remove if found. 3. Press the RESET button to restart the diagnostic tests. 4. Refer to section 7.2. 5. Call Beckman service.

7.2 Bypass of Power Up Failure

If a failure occurs during power up, it is possible to bypass the malfunction by pressing (PROG) to enter the calculator mode of operation. The calculator mode is indicated by "CALC" in the status field of the alphanumeric display or by "CALCULATOR" in the center of the top line of the status information on the graphic display.

The calculator mode allows use of all mathematical, statistical and programming functions on programmable instruments. The optical part of the instrument is not usable. Sometimes, the calculator mode is used to peak the visible source, as described in part II of section 8.2. After it is properly peaked, repeat the power up diagnostics by pressing the RESET button.

If the system test passed, but a wavelength calibration failure occurred (such as "ZO Fail", "DP Fail", "PR Fail", "UNBLOCK BEAM" or "FILTER MOTOR FAILURE"), it is possible to bypass the malfunction by pressing

PROG. When PROG is pressed, the instrument may enter the calculator mode, or it may function normally, but with questionable wavelength accuracy. Questionable wavelength accuracy is indicated on the display by a question mark preceding the wavelength.

CAUTION

Whenever a question mark precedes the wavelength on the display, the wavelength accuracy is questionable. Monitor the results carefully.

7.3 Error Messages During Operation

The following messages may be displayed during operation of the instrument. On the DU-62, DU-64 and DU-65 Spectrophotometers, the full message is displayed on the upper line of the alphanumeric display for a few seconds, then the status line is returned. The abbreviated message remains until the condition is remedied or a key is pressed. The full message is displayed (blinking) in the center of the bottom line on the DU-68 Spectrophotometer graphic display. The abbreviations are not used on the graphic display.

If the instrument locks up (does not accept any keyboard commands) at any time, press the RESET button to restart the power up diagnostics. Lock up may be caused by power line problems or static discharge. If the instrument completes the power up diagnostics properly, consider the lock up to be corrected. If the instrument does not complete the power up diagnostics properly, refer to section 7.1 for troubleshooting instructions.

Message	Msg. Abbrev.	Explanation/Remedy
DARK ADJUST ERROR	Dark	1. Check to see if the sample compartment cover is open or if there are other sources of light leak. 2. If the error occurs frequently, without apparent reason, call Beckman service.
GAIN DAC ERROR	Gdac	1. Press the RESET button to repeat the power up diagnostics. 2. Call Beckman service.
READING LIMIT 2.0A	2.0	Background absorbs excessively. Readings higher than indicated may not meet instrument specifications. Refer to "Background Overranged"

Message	Msg. Abbrev.	Explanation/Remedy
		for suggestions to eliminate error condition.
Source Not ON	Sorc	Turn on the appropriate source.
Calibration Needed		Acceptable calibration value not stored in instrument. Press CALB to calibrate.
Rplt Err Rerun Scan Replot Error (DU-68)	RplE	The wavelength range (or part of the range) requested was not scanned. Check the starting and ending wavelength values.
Bkg Overranged	BKgO	The background sample absorbs excessively. 1. Use distilled water for the background and then rescan the blank to find the range of high absorbance. 2. Dilute the background sample. 3. Scan a shorter range, which excludes the high-absorbing wavelength. 4. Use a shorter path length cell.
OVERHEATING ERROR	HEAT	The cooling fan has failed. Sources are automatically disabled. 1. Unplug the instrument. 2. Clean/replace the fan filter. See section 8.4.
Visible Source FAIL	Sorc	Replace the visible source. See section 8.2.
UV Source FAIL	Sorc	Replace the UV source. See section 8.1.

Message	Msg. Abbrev.	Explanation/Remedy
Label Not Found	Lerr	In the program mode, the CALL or GOTO command does not find the corresponding label. 1. Label step has wrong label name. Check program labels. 2. If the call was made to an accessory based generic command, verify that the accessory is installed. 3. Check for CALL statements to generic commands.
Stack Overflow	OvFE	In the program mode, more than 10 levels of nested subroutines have been programmed.
Out of Range	OofR	Parameter entered not within acceptable limits.
Not Available	NotA	Unavailable data register address. Verify that a Memory-Pac module is installed, if applicable.
The graphic display is dim or not illuminated. (DU-68)		The instrument has not been used for a few minutes, so the display has turned off. Press func. Refer to section 3.6.
The graphic display has wrong or misplaced characters on it. (DU-68)		Press func ClrSc.
Data collected using a Soft-Pac module are not plotted on the graphic display or are plotted without axes.		The Soft-Pac module is not compatible with the DU-68 Spectrophotometer. Contact the local Beckman sales office to obtain a compatible module.

Section Eight - Maintenance

8.1 UV Source Replacement

Part I. Source Replacement

Part required: UV source, P/N 596791

1. Unplug the instrument power cord. Allow the instrument to cool for 15 minutes.

WARNING ⚠

Risk of electric shock. Never install the UV source with the power on.

ATTENTION ⚠

Risque de choc eléctrique. Ne jamais installer la lampe UV lorsque l'appareil est sous tension.

WARNING

Allow 15 minutes for the instrument and sources to cool before handling.

2. Unscrew the thumb screw which secures the source cover. Open the source cover and remove it. See Figure 8-1.

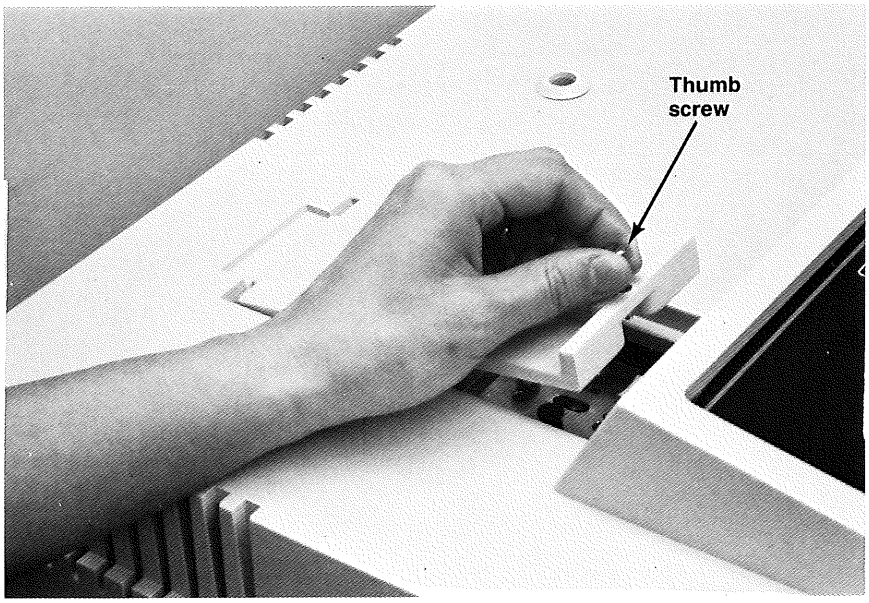


Figure 8-1.

3. Unscrew the thumb screw which holds the UV source in position. See Figure 8-2.

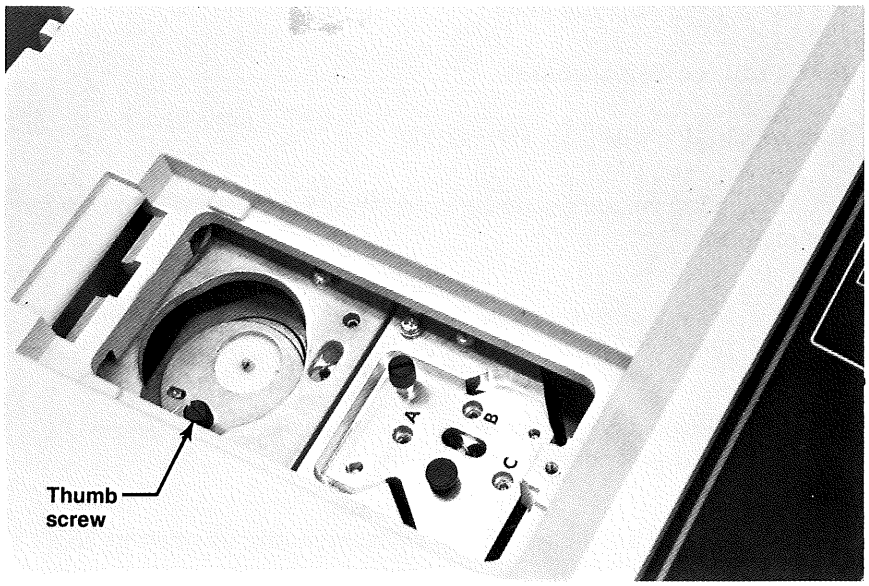


Figure 8-2.

4. Remove source by lifting straight up. Guide cable through source mounting bracket. See Figure 8-3.

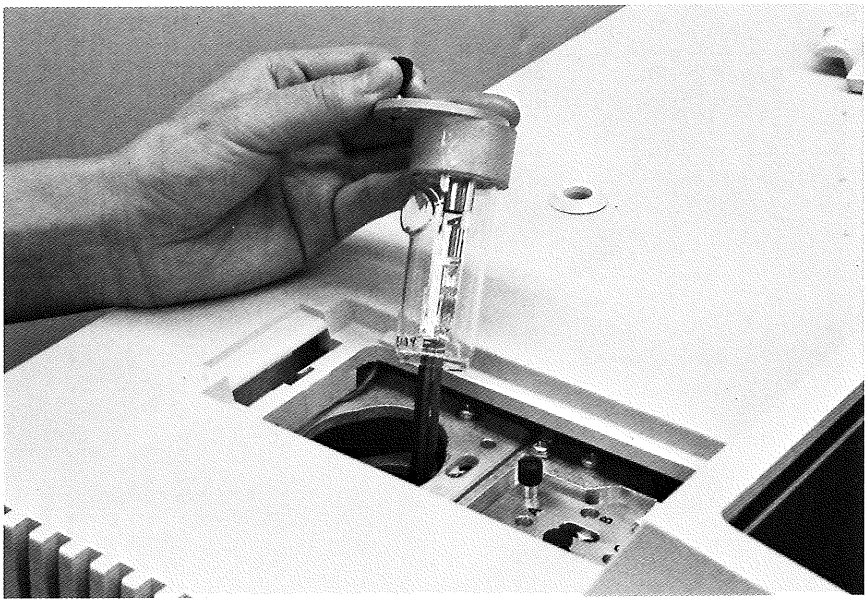


Figure 8-3.

5. Unplug the UV source connector. Plug in the new source. See Figure 8-4.

CAUTION

Do not touch the glass envelope on the new source. If it is touched, clean with alcohol.

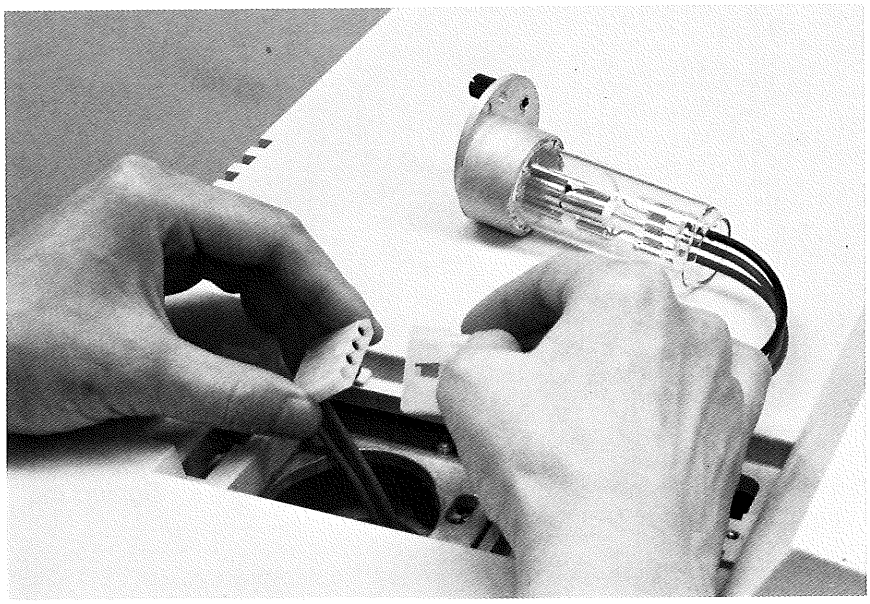


Figure 8-4.

6. Push the cable back into the source mounting area. Position source in the bracket so that the top of the source is seated on the two locating pins. See Figure 8-5.

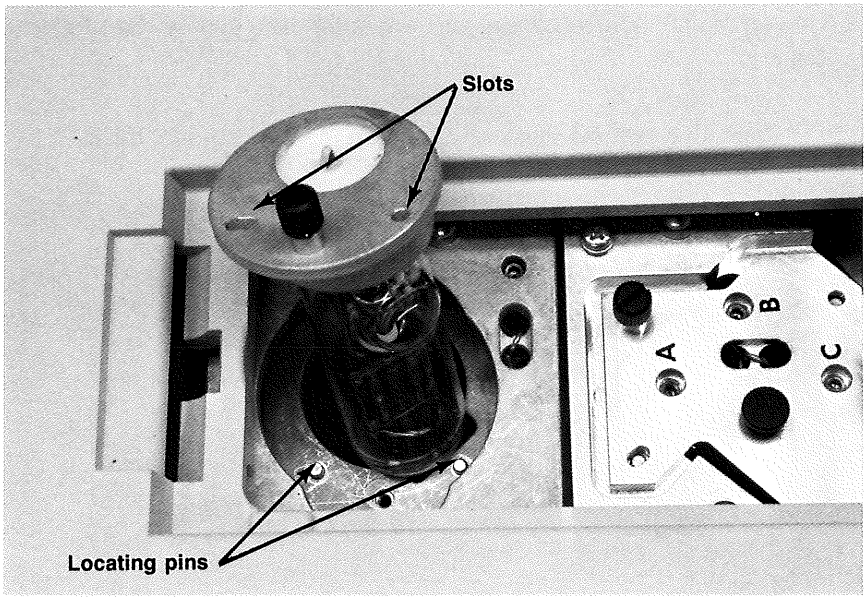


Figure 8-5.

7. Press firmly on the source bracket to ensure a tight fit. Tighten the thumb screw. See Figure 8-6.

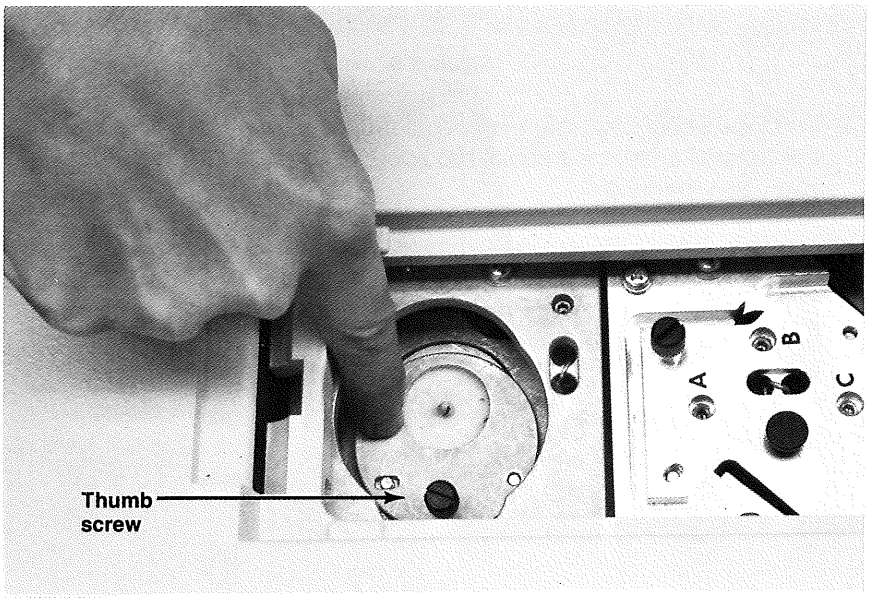


Figure 8-6.

8. Replace the source cover and secure by tightening the thumb screw.

9. Remove anything in the sample compartment that is in the light beam. This includes a cuvette, a flowcell and the gel transport. It is not necessary to remove the Auto 6/7-Sampler, as long as cuvettes and/or flowcells are removed from it. Close the sample compartment cover.

10. Power up the instrument by plugging in the power cord. Wait approximately four minutes for the instrument to complete the power up diagnostics.

    Upon completion of successful power up, the following is on the alphanumeric display of the DU-62, DU-64 or DU-65 Spectrophotometer.

486	A
	0.0000

    On the DU-68 Spectrophotometer, the top part of the graphic display is blank. The following information is displayed on the bottom two lines.

Mode: User	Action:	Wavelength	A	Source
x Reg:	0.0000	486		Off

NOTICE

If the power up is not successful, follow the instructions in Part IV of the visible source replacement, in section 8.2. When the problem is corrected, turn off the visible source by pressing (VIS). "VIS" will be removed from the source status field on the display. Then continue with this procedure.

11. Turn on the UV source by pressing (UV). "uv" is displayed in the source status field on the display. After about 2.5 minutes, the source will light and the status field will change to "UV".

NOTICE

If the source status field is still displaying "uv" after 10 minutes, go to Part III.

12. Allow the source to warm up for 30 minutes.

13. Set the wavelength to 240 nm by pressing (2) (4) (0) (λ).

14. Press CALB to calibrate. After the "Calb" message is removed from the display, indicating that the calibration is complete, monitor the absorbance reading on the top line of the alphanumeric display for 20 seconds. On the graphic display, this reading is located on the right-hand side of the bottom line.

    If the absorbance reading does not change more that ± 0.001A, the source replacement is complete and the instrument is ready to resume normal operation. Remember to replace any accessories that were removed in step 9.

    If the absorbance reading changes more than ± 0.001A, follow the troubleshooting instructions that follow.

Part III. Troubleshooting UV Source Problems

Condition/Message	Explanation/Remedy
Source does not fire. "uv" does not change to "UV" on the display. Display reads "UV Source FAIL"	1. Power down the instrument and allow it to cool for 15 minutes. 2. Remove source cover and make sure that the UV source connector is plugged *securely* into its mating connector, as described in step 5. 3. Replace the source cover and verify the operation again, using steps 9 to 14 of this procedure. 4. If the problem is not resolved, install another UV source and repeat the verification procedure. If the same problem occurs, contact the local Beckman service office.
Absorbance reading is not stable within ± 0.001A at 240 nm.	1. Power down the instrument and allow it to cool for 15 minutes. 2. Remove the source cover, unscrew the thumb screw and lift up the UV source. 3. Check to see that the source connector and cable are not interfering with the source position. 4. Follow the directions in steps 6 and 7 to replace the source in the mount. 5. If the thumb screw will not tighten, the bracket is not seated securely on the mounting pins.

6. Replace the source cover and verify the operation again, using steps 9 to 14 of this procedure.
7. If the problem is not resolved, contact the local Beckman service office for repair.

8.2 Visible Source Replacement

Part I. Source Replacement

Part required: Visible source, P/N 945672

1. Unplug the instrument power cord. Allow the instrument to cool for 15 minutes.

WARNING ⚠

Never install the visible source with the power on.

ATTENTION ⚠

Risque de choc eléctrique. Ne jamais installer la lampe visible lorsque l'appareil est sous tension.

WARNING

Allow 15 minutes for the instrument and sources to cool before handling.

2. Unscrew the thumb screw which secures the source cover. Open the source cover and remove it. See Figure 8-7.

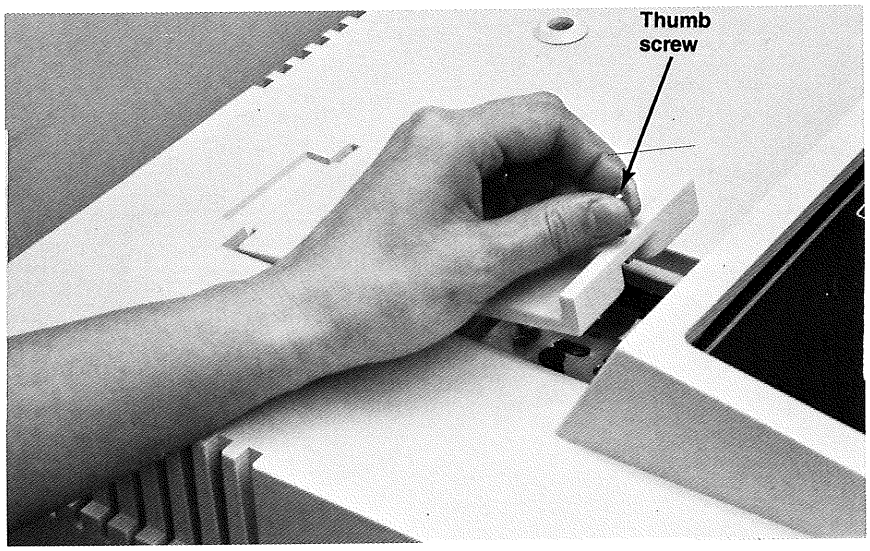


Figure 8-7.

3. Unscrew the thumb screw which holds the visible source mount in position. See Figure 8-8.

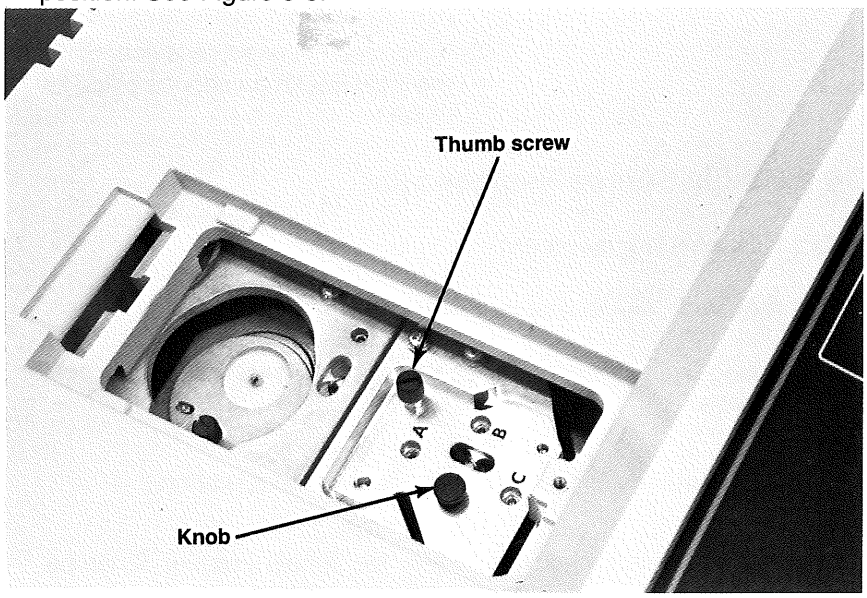


Figure 8-8.

4. Holding the knob with the left hand, remove source by lifting straight up. Guide cable through source mounting bracket. See Figure 8-9. Be careful not to pull too hard on the source power leads.

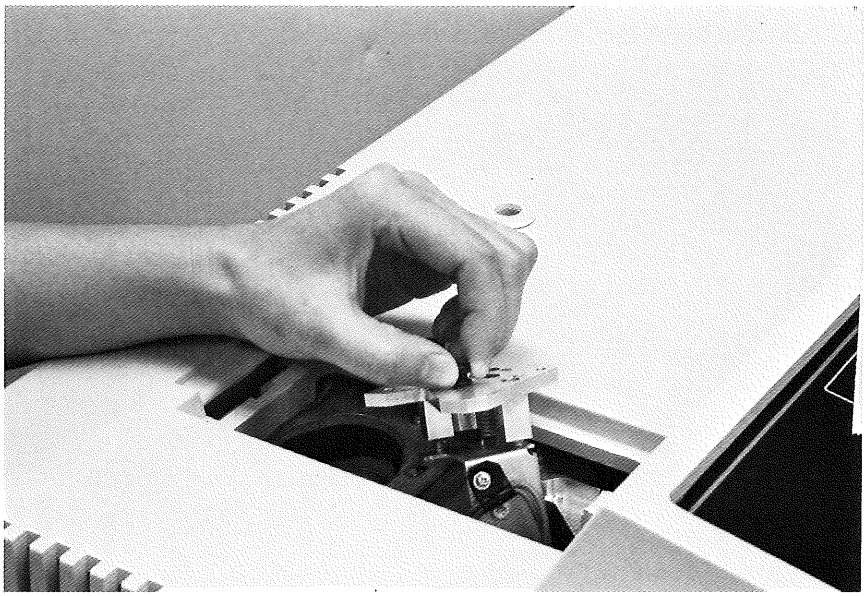


Figure 8-9.

5. Rotate the source mount, so that the visible source is accessible. See Figure 8-10.

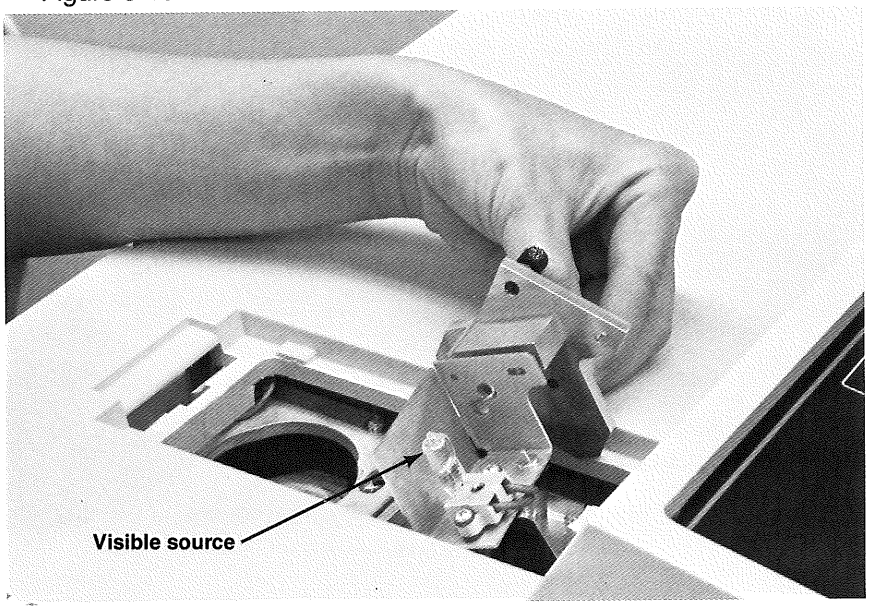


Figure 8-10.

6. Carefully remove the old source by pulling straight out.

7. Remove the new source from the box and open the end of the plastic envelope it is sealed in. Hold the source by the plastic envelope and insert the two connector prongs into the two holes on the source mount. Be sure that the source is pushed in as far as possible. See Figure 8-11.

CAUTION

Do not touch the new source with your fingers. Use the plastic envelope, gloves or a kimwipe. If the glass envelope on the new source is touched, clean with alcohol before installing it.

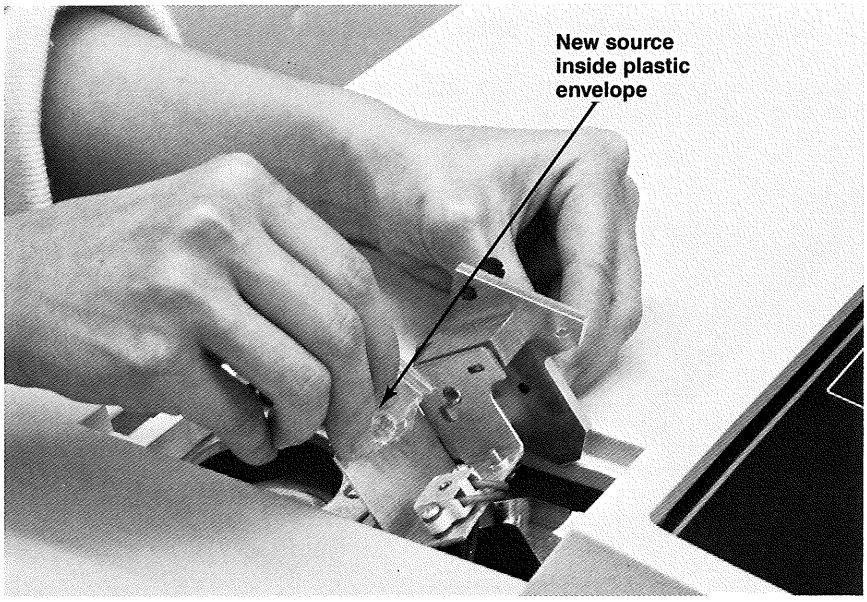


Figure 8-11.

8. Check to ensure that the top of the source mount is positioned as shown in Figure 8-12.

CAUTION

The adjustment screws must be seated in the slot and the hole in the source mounting bracket.

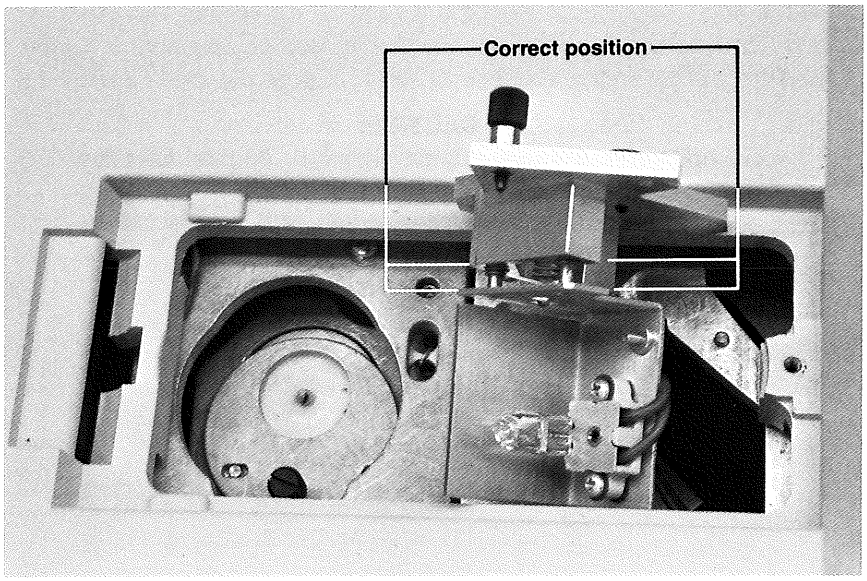


Figure 8-12.

9. Push the cable back into the source mounting area. Position the source bracket so that it is seated on the two locating pins. See Figure 8-13.

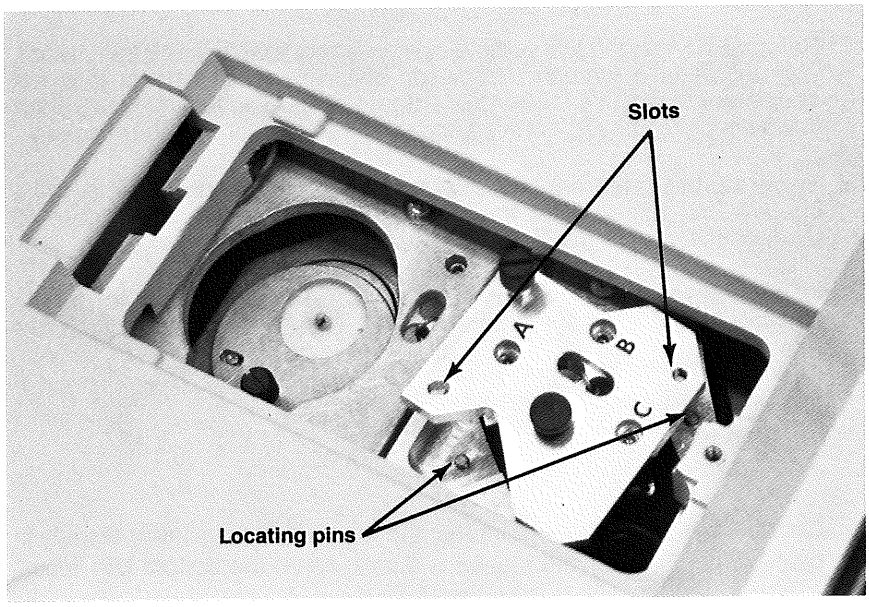


Figure 8-13.

Press firmly on the source bracket to ensure a tight fit. Tighten the thumb screw. See Figure 8-14.

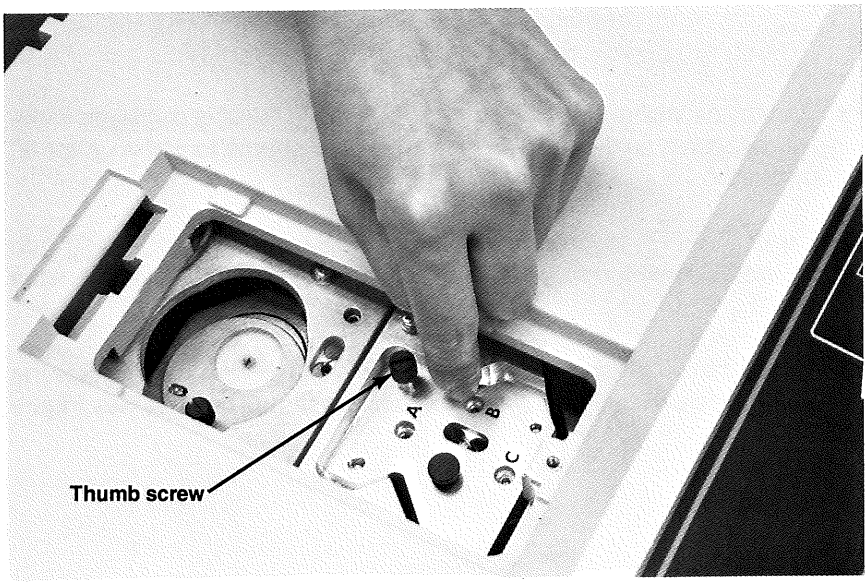


Figure 8-14.

Part II. Source Peaking

Tools required: Hex driver, 3/32"

11. Remove anything in the sample compartment that is in the light beam. This includes a cuvette, a flowcell and the gel transport. It is not necessary to remove the Auto 6/7-Sampler, as long as cuvettes and/or flowcells are removed from it. Close the sample compartment cover.

12. Power up the instrument by plugging in the power cord. Wait approximately four minutes for the instrument to complete the power up diagnostics.

13. Upon completion of successful power up, the following is on the alphanumeric display of the DU-62, DU-64 or DU-65 Spectrophotometer.

486	A
	0.0000

On the DU-68 Spectrophotometer, the top part of the graphic display is blank. The following information is displayed on the bottom two lines.

Mode: User	Action:	Wavelength	A	Source
x Reg:	0.0000	486		Off

NOTICE

If an error message ("ZO Fail", "FILTER MOTOR FAILURE", or "UNBLOCK BEAM") is displayed, go to Part IV.

14. Turn on the visible source by pressing (VIS). "VIS" is displayed in the source status field on the display. Allow the source to warm up for 30 minutes.

15. Press (%T) to enter the transmission mode. Press (CALB) to calibrate. When the calibration is complete, "Calb" is removed from the display.

16. Locate the 3/32" hex driver, provided in the shipping kit. Also, locate the peaking screw labelled "C" on the top of the source bracket. See Figure 8-15.

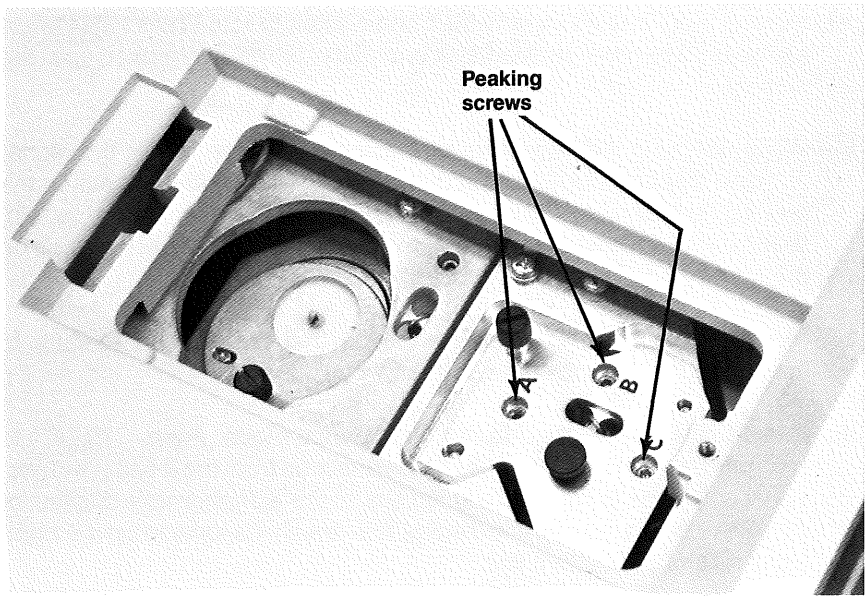


Figure 8-15.

17. While watching the transmission reading on the top line of the alphanumeric display, slowly turn screw "C" in the direction that causes the reading to increase. Continue turning it until the maximum (highest) reading is displayed. (On the graphic display, this reading is located on the right-hand side of the bottom line.)

NOTICE

If the reading exceeds 150%T, press (CALB). When "Calb" is removed from the display, continue with the procedure.

Part III. Verification of Visible Source Operation

18. Press (ABS) to change to the absorbance mode. Press (CALB) to calibrate. After the "Calb" message is removed from the display, indicating that the calibration is complete, monitor the absorbance reading on the top line of the alphanumeric display for 20 seconds. On the graphic display, this reading is located on the right-hand side of the bottom line.

    If the absorbance reading does not change more that ± 0.001A, the source replacement is complete and the instrument is ready to resume normal operation. Remember to replace any accessories that were removed in step 11.

If the absorbance reading changes more than ± 0.001A, the source needs further peaking, as instructed in the following steps.

19. Press %T to change to the transmission mode. Press CALB to calibrate. When the calibration is complete, "Calb" is removed from the display.

20. While watching the transmission reading on the top line of the alphanumeric display, slowly turn screw "A" in the direction that causes the reading to increase. Continue turning it until the maximum (highest) reading is displayed. (On the graphic display, this reading is located on the right-hand side of the bottom line.)

21. Slowly turn screw "C" in the direction that causes the reading to increase, until the maximum reading is displayed.

22. Press ABS to change to the absorbance mode. Press CALB to calibrate. After the "Calb" message is removed from the display, monitor the absorbance reading on the top line of the alphanumeric display for 20 seconds. On the graphic display, this reading is located on the right-hand side of the bottom line.

    If the absorbance reading does not change more that ± 0.001A, the source replacement is complete and the instrument is ready to resume normal operation. Remember to replace any accessories that were removed in step 11.

    If the absorbance reading changes more than ± 0.001A, install another visible source and repeat the peaking and verification procedures. If further assistance is needed, contact the local Beckman service office.

Part IV. Errors Detected Upon Power Up

Follow this procedure if an error message ("ZO Fail", "FILTER MOTOR FAILURE", or "UNBLOCK BEAM") is displayed during power up.

23. Verify that nothing is blocking the beam, as instructed in step 11. If there is, remove it, close the sample compartment cover and push the RESET* button (recessed into the top of the instrument cover, behind the keyboard). Then follow the directions starting with step 13 in this procedure.

    * On the DU-68 Spectrophotometer, the graphic display must be moved to access the RESET button. As an alternative, the instrument can be unplugged.

24. If nothing is blocking the beam, verify that the sample compartment cover is closed. Press PROG, after 20 seconds, "CALC" is displayed on the top line of the alphanumeric display. On the graphic display, "CALCULATOR" is displayed between the action field and wavelength.

25. Turn on the visible source by pressing (VIS). "VIS" is displayed in the source status field on the display. Allow the source to warm up for 30 minutes.

26. Push (CALB) to calibrate. After about 10 seconds, a number is displayed, under the heading "READING" on the alphanumeric display. On the graphic display, this number is displayed on the right-hand side of the bottom line.

27. While watching the number, slowly turn screw "C" in the direction that causes the number to increase. Continue turning it until the maximum (highest) number is displayed.

NOTICE

If the number exceeds 4000, press (CALB). When a number reappears on the display, continue with the procedure.

28. Turn screw "A" in the direction that causes the number to increase. Continue turning it until the maximum (highest) number is displayed.

29. Slowly turn screw "C" in the direction that causes the number to increase, until the maximum number is displayed.

30. Push the RESET* button (recessed into the top of the instrument cover, behind the keyboard). Wait approximately four minutes for the power up diagnostics to be completed.

* On the DU-68 Spectrophotometer, the graphic display must be moved to access the RESET button. As an alternative, the instrument can be unplugged.

Upon completion of successful power up, the following is on the alphanumeric display of the DU-62, DU-64 or DU-65 Spectrophotometer.

486	A
	0.0000

On the DU-68 Spectrophotometer, the top part of the graphic display is blank. The following information is displayed on the bottom two lines.

Mode: User	Action:	Wavelength	A	Source
x Reg:	0.0000	486		Off

31. Turn on the visible source by pressing (VIS). "VIS" is displayed in the

source status field on the display. Allow the source to warm up for 10 minutes.

32. Press CALB to calibrate. After the "Calb" message is removed from the display, monitor the absorbance reading on the top line of the alphanumeric display for 20 seconds. On the graphic display, this reading is located on the right-hand side of the bottom line.

    If the absorbance reading does not change more that ± 0.001A, the source replacement is complete and the instrument is ready to resume normal operation. Remember to replace any accessories that were removed in step 11.

    If the absorbance reading changes more than ± 0.001A, contact the local Beckman service office.

8.3 Fuse Replacement

When replacing a fuse, always use a replacement fuse of exactly the same type and rating as the original fuse. A fuse failure is generally indicated by a sudden lack of response, often during instrument power up. There are two user-serviceable fuses located on the back of the instrument. Only the right-hand fuse is installed on 120V instruments. Both fuses are used on 220/240V instruments. See Figure 8-16.

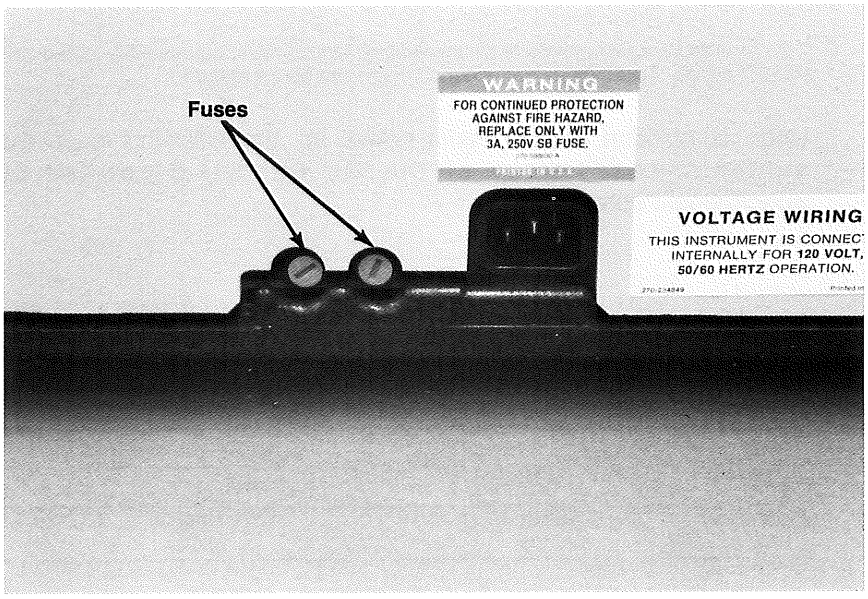


Figure 8-16. Fuse Location

Parts required: 120V instrument - 3A, 250V fuse, P/N 883908
220/240V instrument - 1.5A, 250V fuse, P/N 945233

Tools required: Flathead screwdriver

1. Unplug the instrument.

WARNING ⚠

Do not change fuses with the instrument power on.

2. To remove the fuse holder, insert the flat head screwdriver into the slot on the top of the fuse holder and turn counter-clockwise until it releases. See Figure 8-17.

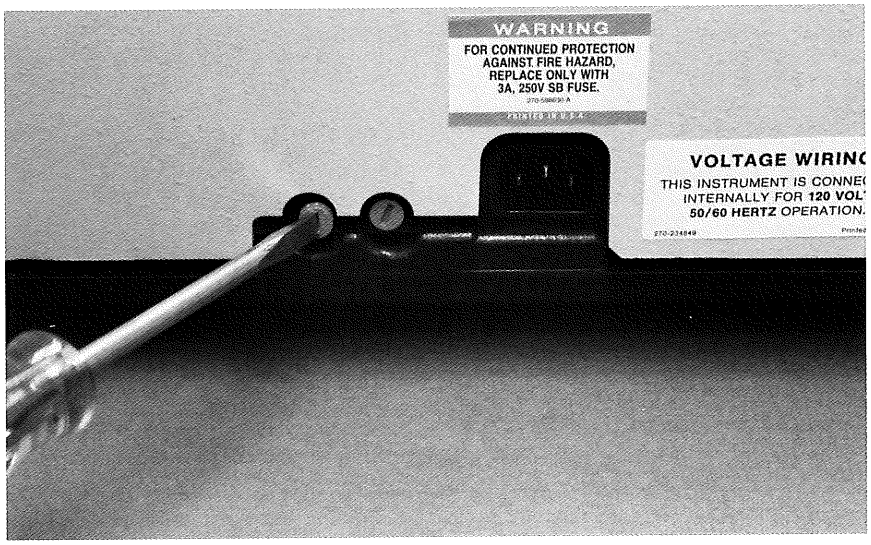


Figure 8-17.

3. Remove the fuse holder and examine the fuse. On 120V instruments, the fuse is located in the right-hand location, only. On 220/240V instruments, check both fuses to determine the defective one. Either or both may need to be replaced.

4. Note the orientation of the fuse in the holder. Remove the fuse, then replace with the new fuse oriented in the same position. See Figure 8-18.

CAUTION

Always use a fuse of the same type and rating.

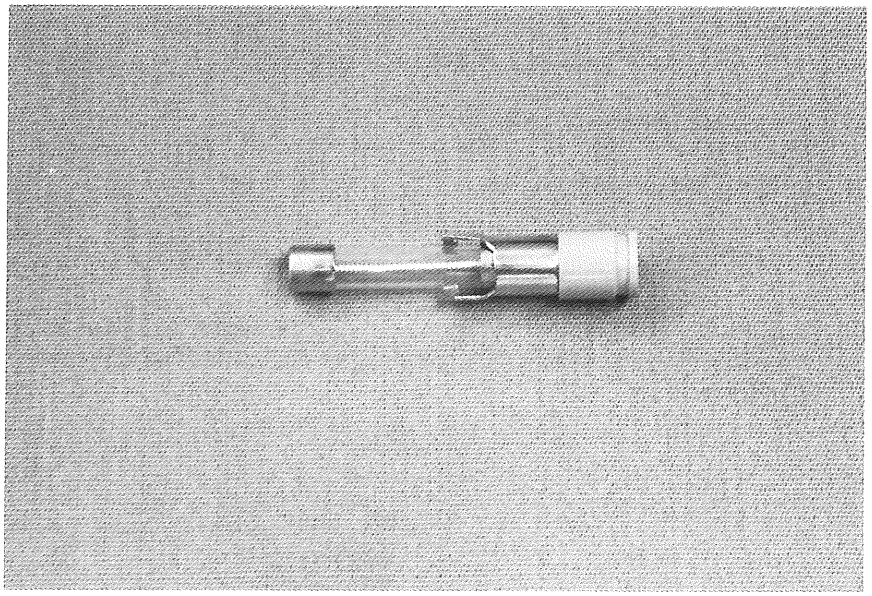


Figure 8-18.

5. Replace the fuse holder and secure using the screwdriver.

6. Plug in the instrument. The instrument is now ready to resume normal operation.

8.4 Air Filter Replacement

The instrument has an internal fan, which is used to cool the electronics. The air filter traps dust particles that would otherwise get into the instrument due to the air movement of the fan. The air filter should be cleaned or replaced, if necessary, every three months under normal laboratory conditions. Laboratories which contain large amounts of dust or other particulate material should clean the air filter more frequently.

Parts required: Air filter, P/N 598489

1. The air filter is located on the right-hand side of the instrument cover, near the back, on the outside. See Figure 8-19.

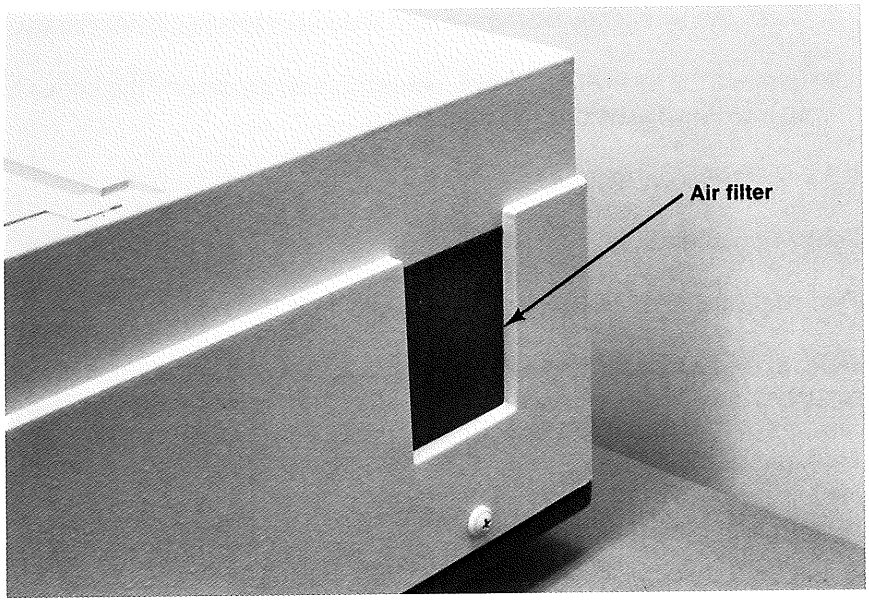


Figure 8-19.

2. Remove the air filter by pinching it in the middle and pulling it away from the instrument. See Figure 8-20.

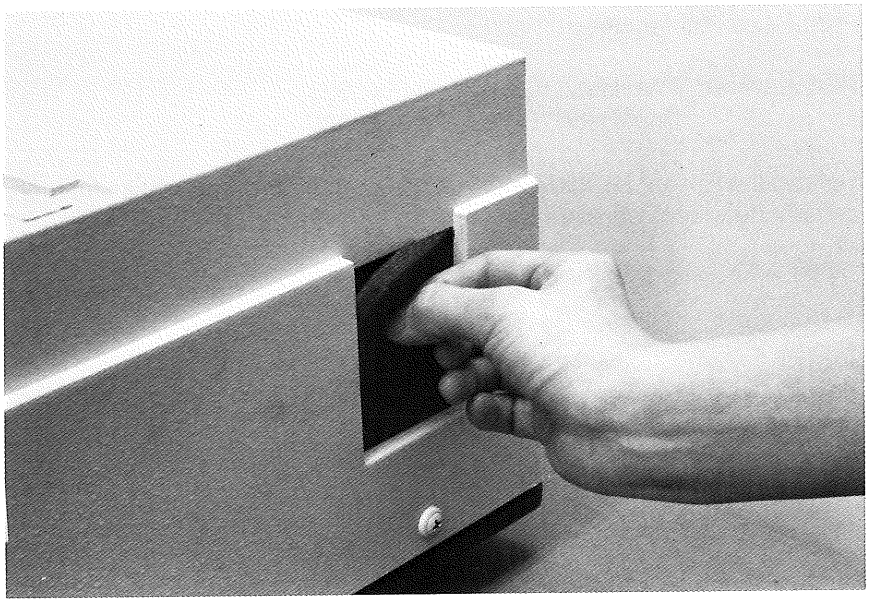


Figure 8-20.

3. Clean the air filter by washing it with water, or replace it if necessary.

4. Replace the air filter in the slot, pressing carefully around the edges to ensure that it is held tightly in place.

8.5 Printer/Plotter Maintenance

Paper Replacement

Part required: Fan fold paper, 1000 sheets, P/N 897516

Refer to the Installation Instructions for the DU Series 60 Spectrophotometer and Printer/Plotter, Manual 523770 or 523777, for instructions on paper replacement. As an alternative, refer to the Epson* User's Manual for the appropriate printer.

Ribbon Replacement

Part required: Ribbon Cassette (LX-80), P/N 945637
Ribbon Cartridge (FX-85), P/N 596281

Refer to the Installation Instructions for the DU Series 60 Spectrophotometer and Printer/Plotter, Manual 523770 or 523777, for instructions on ribbon replacement. As an alternative, refer to the Epson* User's Manual for the appropriate printer.

Print Head Replacement

Part required: Print Head (LX-80), P/N 945638
Print Head (FX-85), P/N 596480

Refer to the Epson* User's Manual for the appropriate printer for instructions on print head replacement.

* Epson is a registered trademark of Epson America, Inc.

Section Nine - Parts, Supplies and Accessories

Instruments

	120V	220/240V
DU-62 Spectrophotometer	120620	120621
DU-64 Spectrophotometer	120640	120641
DU-65 Spectrophotometer	120650	120651
DU-68 Spectrophotometer	120680	120681

Printer/Plotter Options

	120V	220/240V
Epson* LX-80	523721	523722
Epson* FX-85	523701	523702
Printer/Plotter Buffer	599974	599974
Printer/Plotter Interface	598270	598270

Accessories

System Options	
Peltier Temperature Controller, 120V	598294
Peltier Temperature Controller, 220/240V	598295
RS-232 Accessory	598274
Analog Output	598262
Soft-Pac Module Options	
Quant I	598287
Quant II	598288
Kinetics	598273
Gel Scan	596715
Protein Assay	533127
Nucleic Acids	533126
Performance Validation	596716
Single Cell Holder Options	
Unheated	598237
Water-regulated	523705
Peltier	523706
Five Carat	523411
Rectangular	598582
Cylindrical	198270

Auto 6-Sampler Options	
Unheated	523709
Water-regulated	523710
Peltier	523711
Sipper Options	
Unheated	523712
Peltier	523713
Batch Sampler Options	
Batch Interface Accessory	523703
Batch Sampler, 117V	598268
Batch Sampler, 234V	598269
Gel Scan Options	
Gel Transport	596713
Tube Gel Holder	596711
Film Holder	596712
Dissolution Testing Options	
Dissolution Accessory, 120V	523718
Dissolution Accessory, 220/240V	523719

Supplies

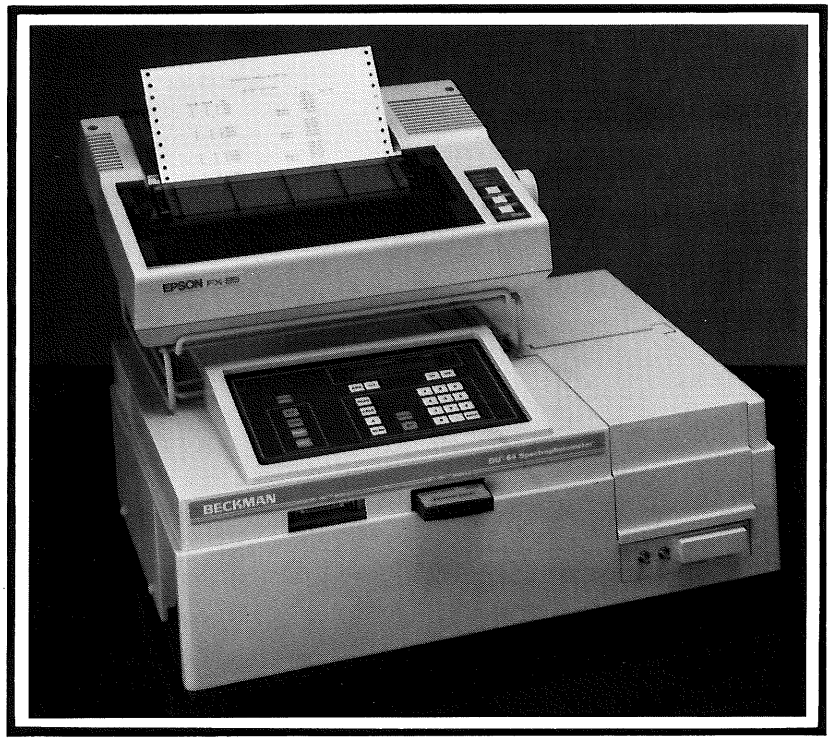
Printer/Plotter Supplies	
Fan Fold Paper	897516
Ribbon Cassette, LX-80	945637
Ribbon Cartridge, FX-85, 5-pack	596281
Print Head, LX-80	945638
Print Head, FX-85	596480
Sipper Supplies	
Replacement Unheated Flowcell	599925
Tubing Kit, Unheated	523715
Tubing Kit, Peltier	523716
Pump Tubing, Gray MOLDED	651731
Pump Tubing, Red ASSEMBLY	651767
Waste Bottle	586656
Waste Tubing	598549
Trace-Klean™ solution	598190
Batch Sampler Supplies	
Tubing Kit, Unheated	523714
Tubing Kit, Peltier	523717

Replacement Sources	
UV Source	596791
Visible Source	945672
Fuses	
3A, 50V, for 120V instruments	883908
1.5A, 250V, for 220/240V instruments	945233

Manual 523784A

DU® Series 60 Spectrophotometer

Pre-Installation Instructions



BECKMAN

Congratulations on your choice of a DU® Series 60 Spectrophotometer. Please prepare for the arrival of your new instrument by following these instructions. Proper preparation of the installation site will minimize installation time and ensure optimum system performance.

Part I. Electrical Requirements

Each of the following will need its own electrical source: the spectrophotometer, graphic display (DU-68), Printer/Plotter, batch sampler, and Peltier temperature controller. The electrical requirements of each are summarized in Table 1 for 120V and Table 2 for 220/240V systems. Your order may or may not include all of the following.

	Frequency (Hz)	Voltage (VAC)	Current (Amps)
DU-62, DU-64 or DU-65 Spectrophotometer	50/60	120V ± 10%	3.0
DU-68 Spectrophotometer	50/60	120V ± 10%	3.7
Printer/Plotter			
Epson* LX-80	50/60	120V ± 10%	0.6
Epson* FX-85	50/60	120V ± 10%	0.6
Batch Sampler	50/60	117V ± 10%	0.8
Peltier Temperature Controller	50/60	120V ± 10%	1.0

Table 1. Electrical Requirements for 120V Systems

	Frequency (Hz)	Voltage (VAC)	Current (Amps)
DU-62, DU-64 or DU-65 Spectrophotometer	50/60	220/240V ± 10%	1.5
DU-68 Spectrophotometer	50/60	220/240V ± 10%	1.9
Printer/Plotter			
Epson* LX-80	50/60	220/240V ± 10%	0.3
Epson* FX-85	50/60	220/240V ± 10%	0.3
Batch Sampler	50/60	234V ± 10%	0.4
Peltier Temperature Controller	50/60	220/240V ± 10%	0.5

Table 2. Electrical Requirements for 220/240V Systems

*Epson is a registered trademark of Epson America, Inc.

The same power line should be used for the instrument and all accessories. A dedicated power line is preferred. Do not use a power line which is also used by equipment that operates intermittently and creates wide fluctuations in power demand, such as refrigerators, water baths and centrifuges.

For 120V operation. The power line should provide three-wire single phase power. To provide multiple outlets, power strips may be used. Extension cords or multiple outlet adapters should not be used.

For 220/240V operation. The power line should provide three-wire 2-phase power. To provide multiple outlets, power strips may be used. Extension cords or multiple outlet adapters should not be used.

Part II. Location

The DU Series 60 Spectrophotometer is designed to sit on a lab bench or table, which is level and flat and is capable of supporting its weight and the weight of all accessories. See Table 3.

The instrument is designed to operate in a clean laboratory environment, free from dust, fumes, excessive moisture, and corrosive chemicals. It should not be exposed to drafts from heating and cooling vents, heating elements, open windows or doors. Lab areas that receive direct sunlight should also be avoided.

An ambient room temperature of 18 – 30°C (64 – 86°F) should be maintained, with a rate of change not exceeding 1°C (1.8°F) per hour. Relative humidity should be 55% or less.

Instrument performance may be affected by strong electromagnetic fields that can exist in the proximity of large electric motors, centrifuges, diathermy machines and microwave sources.

The dimensions of the spectrophotometer and accessories which require additional bench space are summarized in Table 3.

	Width cm (in.)	Height cm (in.)	Depth cm (in.)	Weight kg (lbs.)
DU-62, DU-64 or DU-65 Spectrophotometer	60 (24)	28 (11)	48 (19)	16 (35)
DU-62, DU-64 or DU-65 Spectrophotometer with Printer/Plotter above Instrument	60 (24)	47 (19)	55 (22)	24 (52)
DU-68 Spectrophotometer	60 (24)	62 (24)	56 (22)	27 (59)
Printer/Plotter				
Epson LX-80	42 (17)	14 (5)	37 (15)	6 (13)
Epson FX-85	44 (18)	10 (4)	35 (14)	8 (17)
Batch Sampler	29 (11)	43 (17)	23 (9)	10 (21)
Peltier Temperature Controller	23 (9)	17 (7)	41 (16)	8 (18)

Table 3. Dimensions

The spatial requirements are diagrammed in Figures 1, 2 and 3. Additional space is required for air circulation around the instrument and accessories for proper performance, as shown by the shaded areas. Do not block these air spaces.

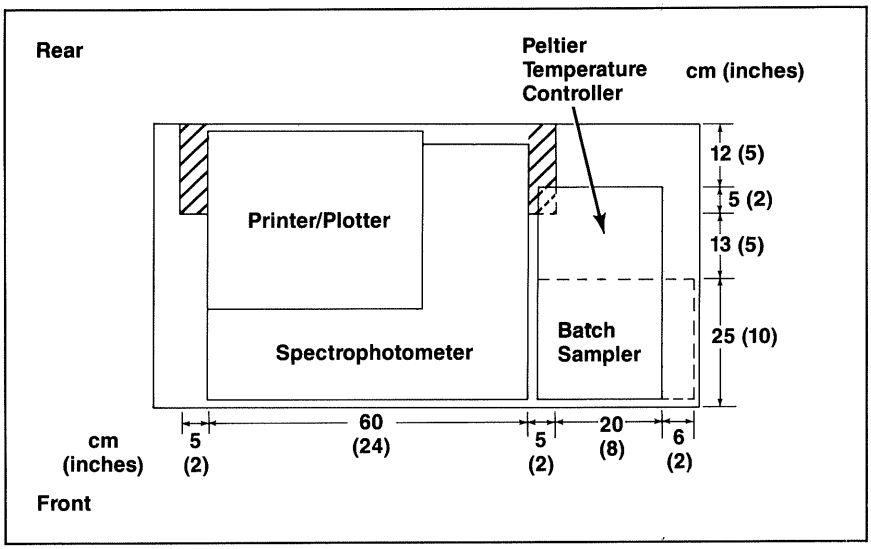


Figure 1. Bench Space Requirements, Printer/Plotter Mounted Above the Instrument. Maximum height required is 47 cm (19 inches).

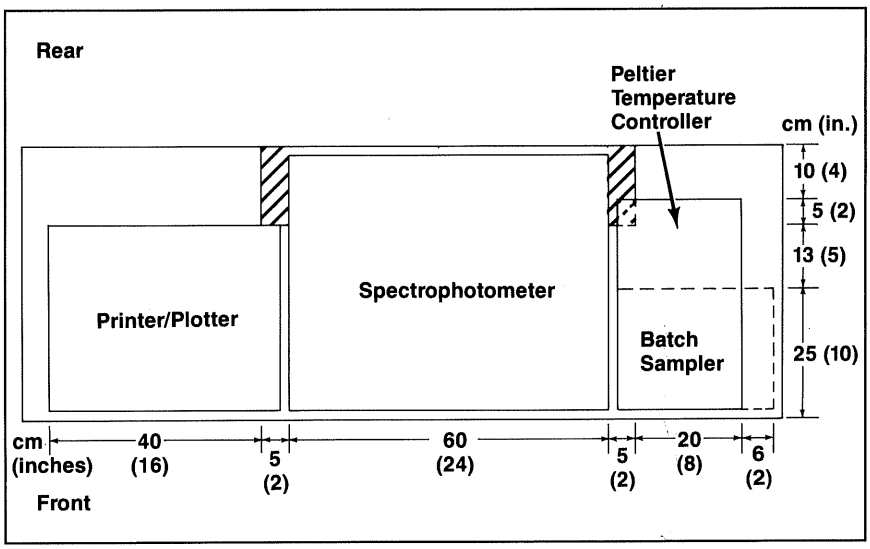


Figure 2. Bench Space Requirements, Printer/Plotter Next to Instrument. Maximum height required is 43 cm (17 inches) for batch sampler, or 28 cm (11 inches) for the instrument, if the batch sampler is not installed.

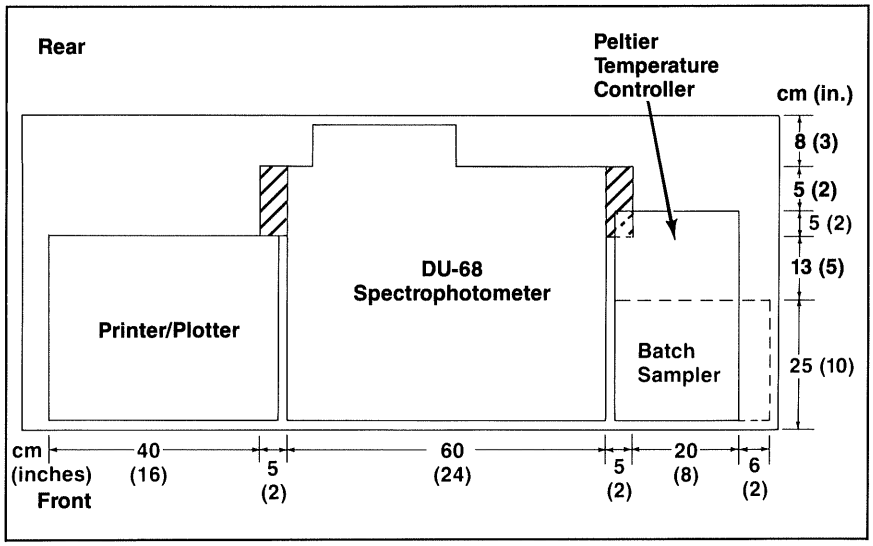


Figure 3. Bench Space Requirements, DU-68 Spectrophotometer.
Maximum height required is 62 cm (24 inches).

Part III. Cuvettes

A single cell holder is supplied with the instrument, capable of holding a standard cuvette or microcell with a 10 mm pathlength. Additional cell holders are available for multiple cells, long pathlength rectangular and cylindrical cells, the Five Carat™ microcell, and the gel cuvette. No cuvettes are provided with the instrument or any of the accessories.

A complete listing of all cuvettes, with photos and specifications, is found in the Beckman Supplies and Consumables Catalog. To obtain a copy, contact your local Beckman office and request Bulletin 8500. In the continental U.S., only, call 1-800-742-2345.

All DU 60 Series Spectrophotometers include both the visible and UV range. Cuvettes made of silica or quartz are required for use in the UV region. Pyrex (glass) or plastic cuvettes can be used in the visible region.

Part IV. Water Requirements

If temperature controlled sampling accessories have also been ordered, provision must be made to supply water to the instrument.

Water-Regulated Accessories

Water must be supplied to the instrument from a water bath, or other constant temperature source. Tubing is provided with the accessory to bring water to the instrument.

Peltier Temperature Controlled Accessories

Although the Peltier system is an electronic method of controlling temperature, water is needed to remove excess heat. A flow rate of 200 to 300 mL/minute is required. (This can be easily measured using a stop watch and a graduated cylinder.) The water can come directly from the tap and be drained to waste or it can be recirculated, as long as ambient temperature is maintained.

All accessories are fitted with quick-disconnect water lines, so that they can be easily removed without concern about flooding the sample compartment. In addition, the sample compartment is designed so that a water leak, should it occur, will not cause damage to the instrument. Water will leave the sample compartment through the bottom and front, and will not flood optical or electrical components.

BECKMAN

Beckman Instruments, Inc. • Spectroscopy Instruments Operation • 2500 Harbor Boulevard • Fullerton, CA 92631-3100
(714) 871-4848 • TWX: 910-592-1260 • Telex: 678413
May 1988

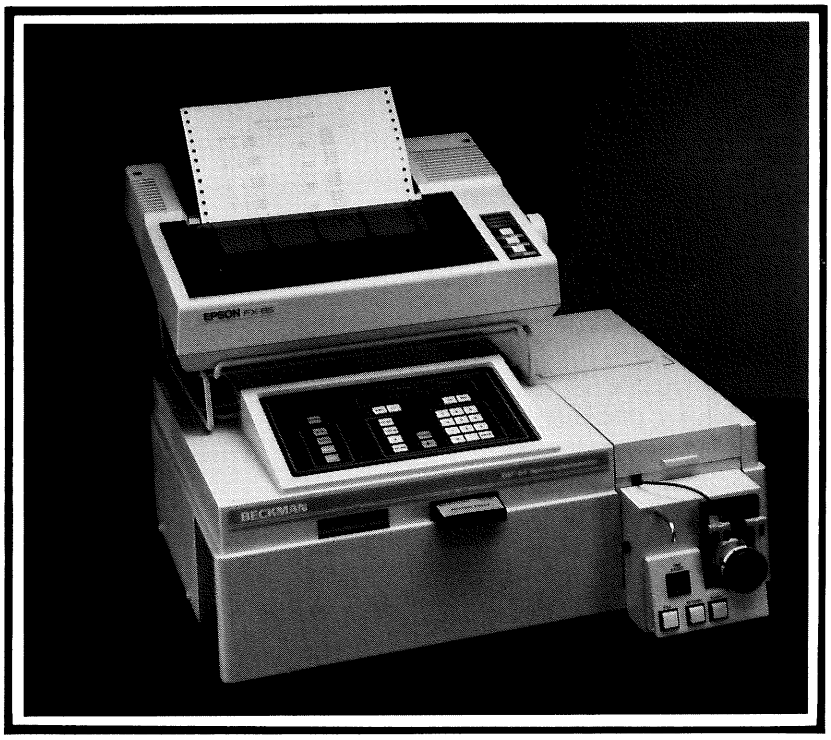
Printed in USA

Manual 523775A

DU® Series 60 Spectrophotometer Installation Instructions

Sipper Sampler Accessories

Part Number 523712 Unheated
Part Number 523713 Peltier



BECKMAN

Installation Instructions for the DU® Series 60 Spectrophotometer with a Sipper Sampler Accessory.

Parts required: See Figure 1.

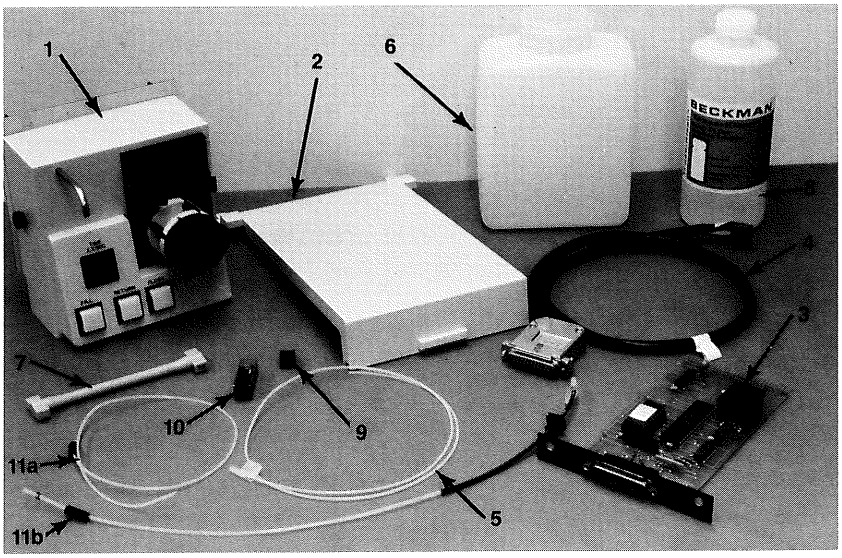


Figure 1a.

Unheated Sipper Accessory, P/N 523712, which includes:

1. Sipper panel, P/N 523610
2. Sample compartment cover, P/N 523651
3. Sipper board, P/N 598246
4. Sipper cable, P/N 533130
5. Waste tubing, P/N 598549
6. Waste bottle, P/N 586656
7. Pump tubing, P/N 651731
8. Trace-Klean™ cleaning solution, P/N 598190
9. Plug, P/N 523656
10. Unheated flowcell, P/N 599925
11. Unheated Tubing Kit, P/N 523715, which includes:
    - 11a. Inlet tubing, 3 each, P/N 596481
    - 11b. Outlet tubing, 3 each, P/N 523612

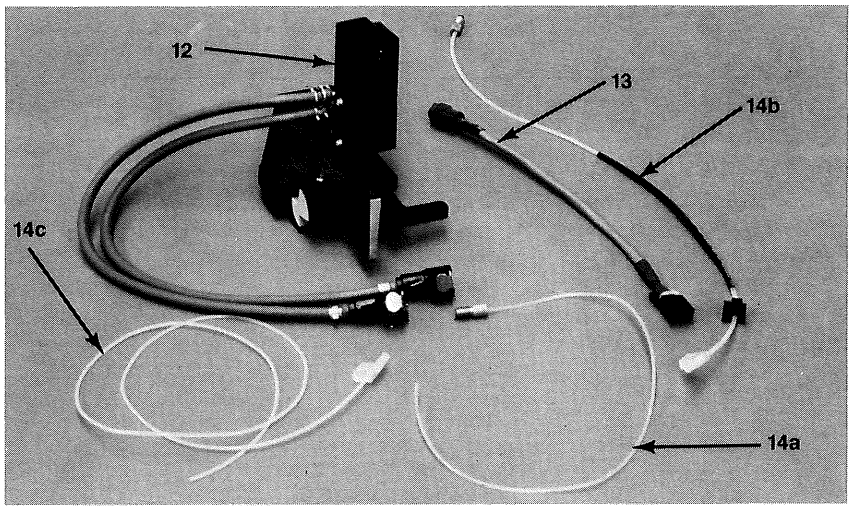


Figure 1b.

Peltier Sipper Accessory, P/N 523713, which includes parts 1 to 9 shown in Figure 1a and:

12. Peltier flowcell, P/N 523617
13. Temperature cable, P/N 523643
14. Heated Tubing Kit, P/N 523716, which includes:
    - 14a. Inlet tubing, 1 each, P/N 590733
    - 14b. Outlet tubing, 1 each, P/N 523613
    - 14c. Waste tubing, 1 each, P/N 589549 (shown as #5 in Figure 1a.)
15. Water inlet tube, 1 each, P/N 538012
16. Water outlet tubing, 3 meters, P/N 45-042-08
17. Water tube clips, 2 each, P/N 884596

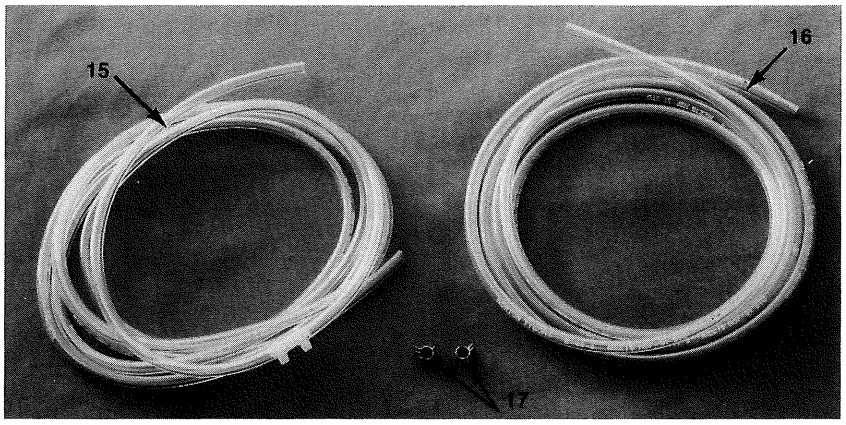


Figure 1c.

Part I. Installation of the Sipper Panel

1. Remove the sample compartment cover by opening, and then lifting it up. Remove any other cell holder from the sample compartment and store.

2. Unplug any cables attached to the accessory panel on the front of the sample compartment. Remove the accessory panel by pushing in at the bottom and pulling up. See Figure 2.

Figure 2.

3. Install the sipper panel by sliding it into the slots and pressing down firmly to seat. See Figure 3.

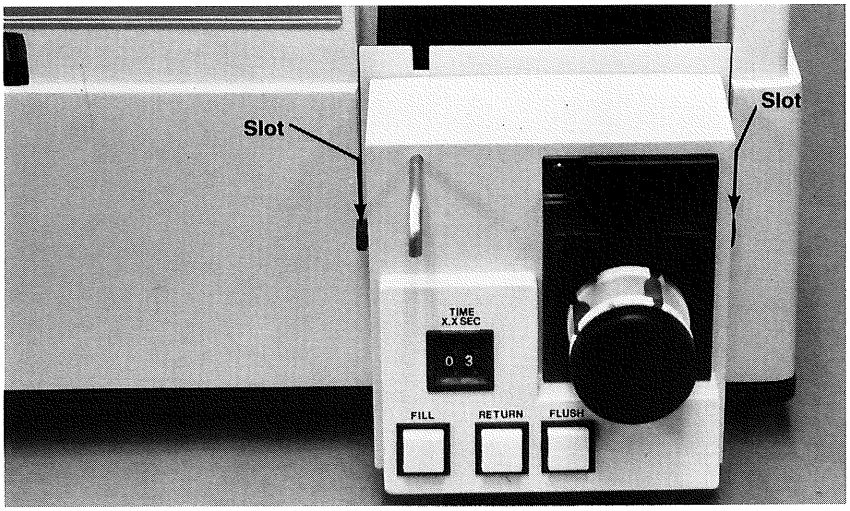


Figure 3.

4. Secure and ground the sipper panel to the sample compartment by tightening the thumb screw. See Figure 4.

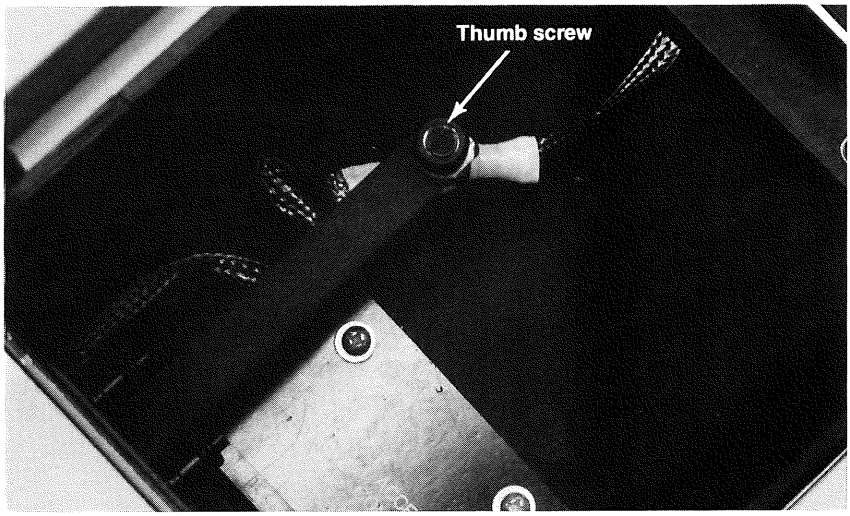


Figure 4.

5. Reattach any cables that were disconnected from the accessory panel in step 2 above, to the bottom of the sipper panel. See Figure 5.

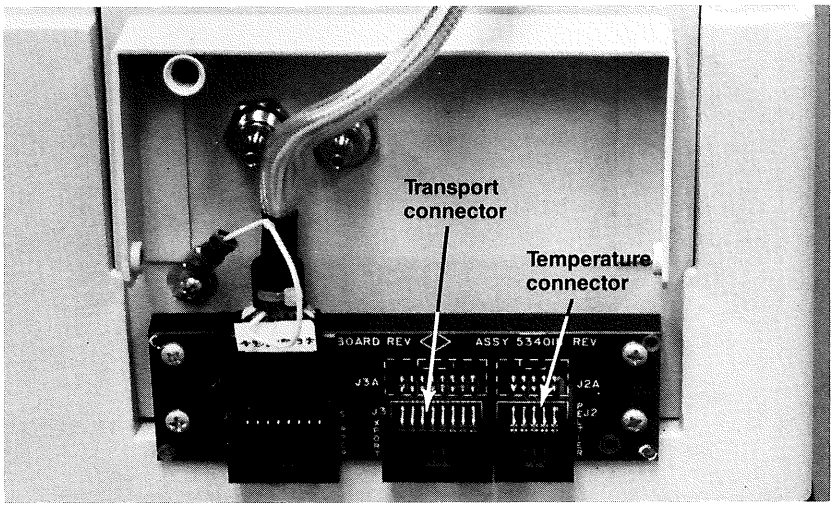


Figure 5.

Note: This picture was taken with the front of the sipper panel removed. The cables can be connected without removing the front, by reaching under the sipper panel.

6. Install the pump tubing on the peristaltic pump. See Figure 6.

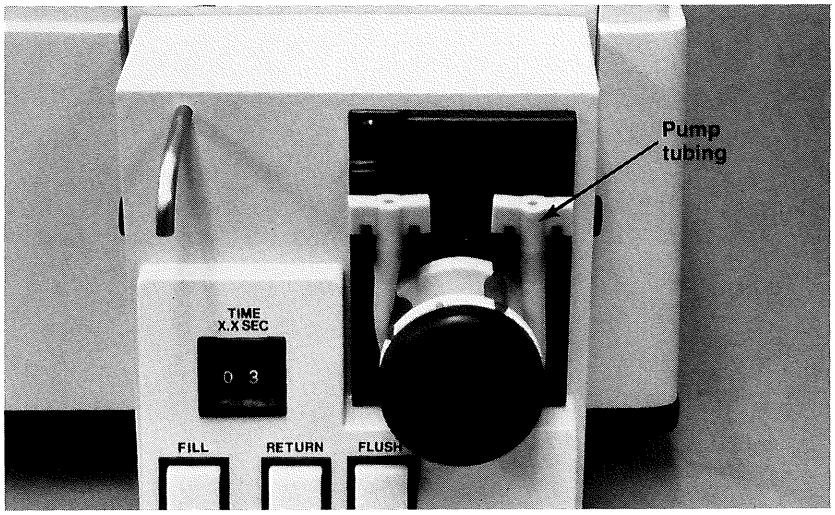


Figure 6.

Part II. Installation of the Sipper Board and Cable

Tools required: Phillips screwdriver.
Small flathead screwdriver.

7. Check the accessory slots on the left-hand side of the instrument to see if a board labelled "SIPPER" is installed. See Figure 7. If it is, go to step 12.

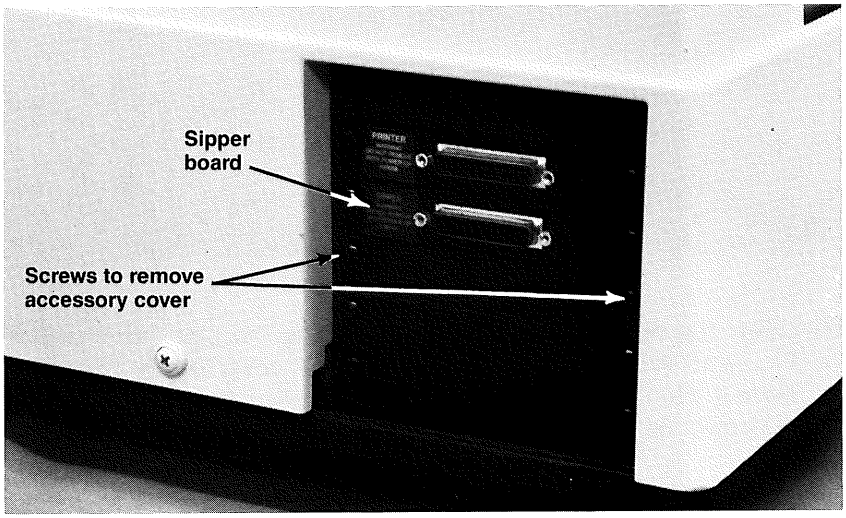


Figure 7.

8. If the sipper board is not installed, unplug the instrument power cord.

CAUTION

Do not insert or remove any accessory board with the power on.

9. Remove one of the accessory covers using a Phillips screwdriver. Save the two screws. See Figure 7.

10. Slide the sipper board into the open position. Push to seat. Secure the board with the two screws removed in step 9. See Figure 8.

Figure 8.

11. Cover the hole for the outlet tubing using the plug, as shown in Figure 16. Put on the sample compartment cover for the sipper and close it. Plug in the instrument and allow the instrument to complete the power up. Remove the sample compartment cover and the plug.

12. Connect one end of the sipper cable to the sipper board and secure by tightening the two screws. See Figure 9.

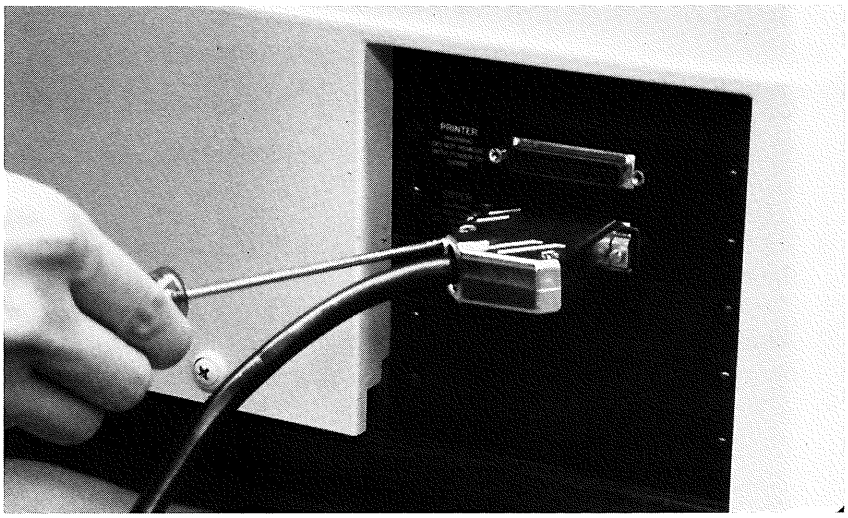


Figure 9.

13. Connect the other end of the sipper cable to the connector on the bottom of the sipper panel. See Figure 10. Slide cable under the instrument.

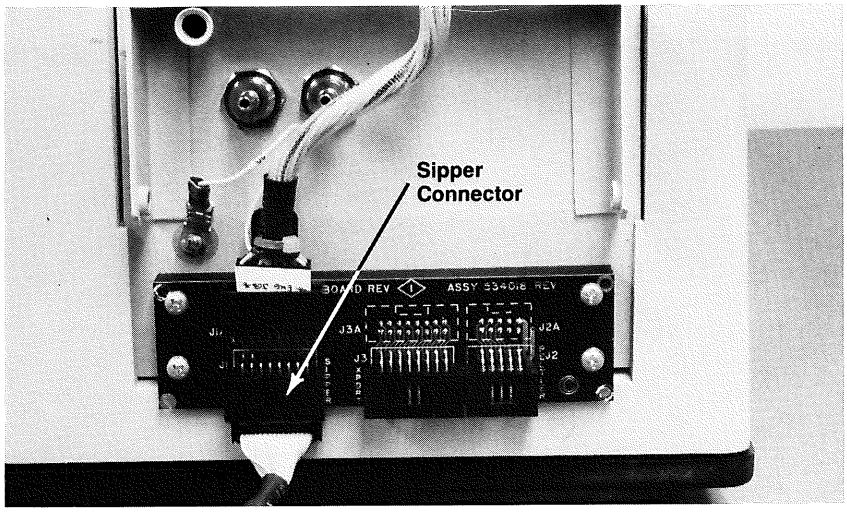


Figure 10.

Note: This picture was taken with the front of the sipper panel removed. The cable can be connected without removing the front, by reaching under the sipper panel.

Part III. Installation of the Flowcell

14. Attach inlet and outlet tubing to the flowcell, as shown in Figure 11a for the unheated flowcell and Figure 11b for the Peltier flowcell.

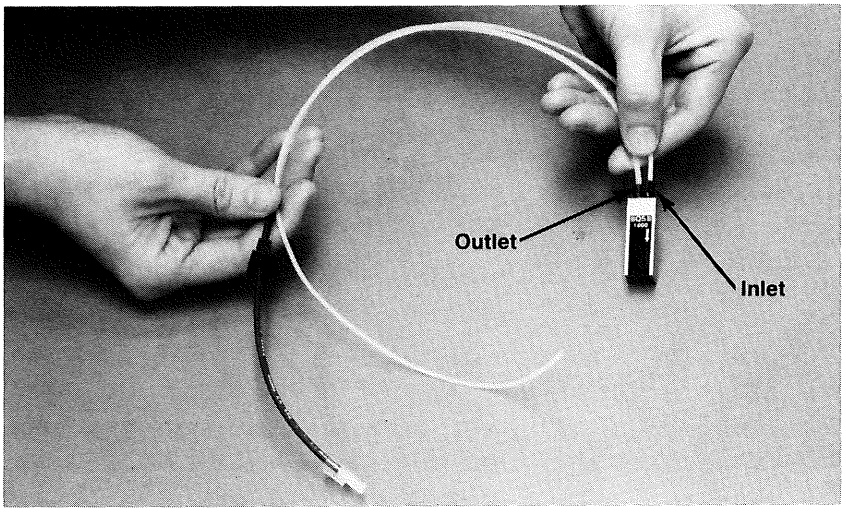


Figure 11a.

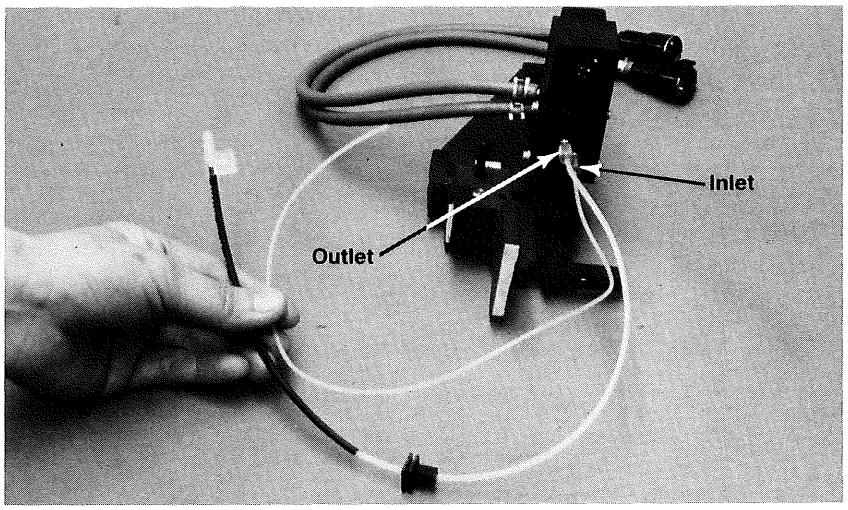


Figure 11b.

15. *Unheated flowcell, only.* Seat the single cell holder on the rails. Slide it towards the right-hand side of the sample compartment as far as it will go. Tighten the thumb screw. Place the flowcell in the cell holder. See Figure 12.

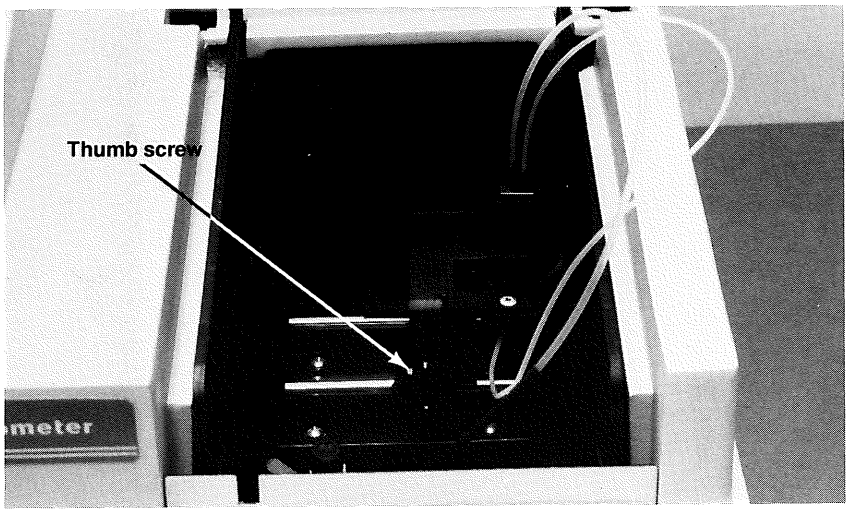


Figure 12.

16. *Peltier flowcell, only.* Seat the flowcell on the rails. Slide it towards the right-hand side of the sample compartment as far as it will go. Tighten the thumb screw. See Figure 13.

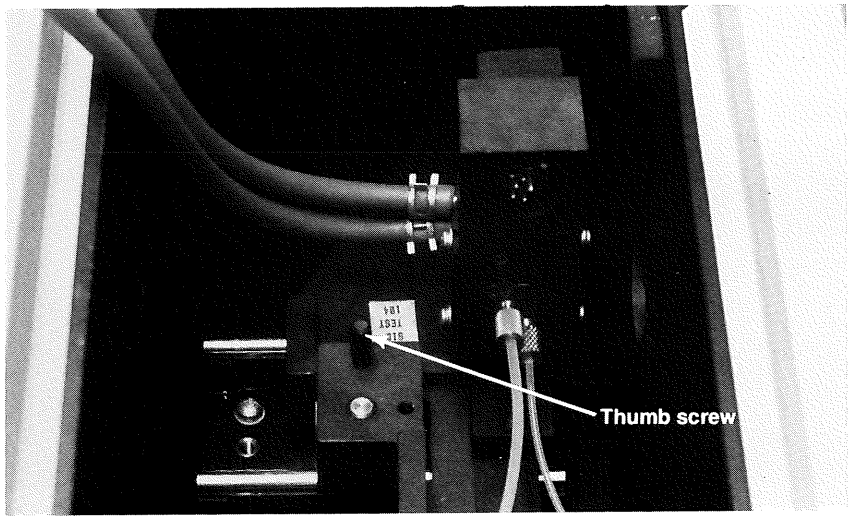


Figure 13.

17. Push the end of the inlet tubing to the outside of the sample compartment through the tubing guide, located on the upper left-hand corner of the sipper panel. See Figure 14.

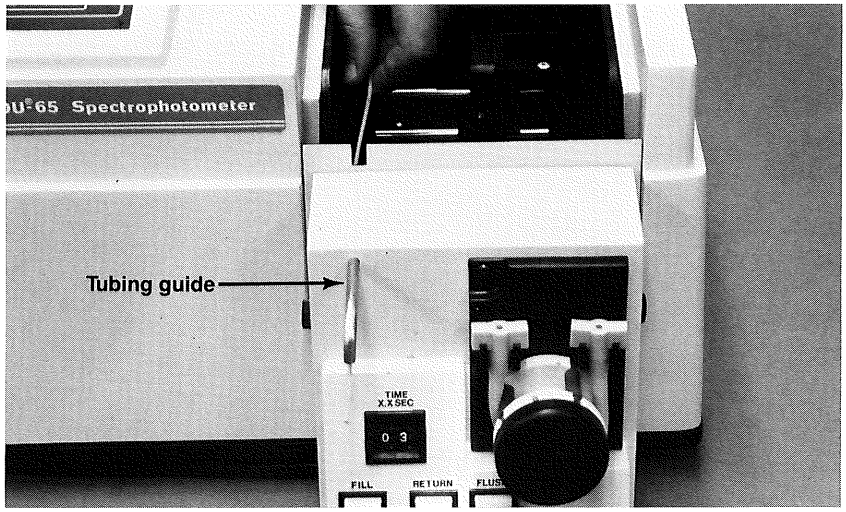


Figure 14.

18. Route the outlet tubing through the slot above the inlet tubing guide and fit the grommet in place. Attach the outlet tubing to the left-hand side of the pump. See Figure 15.

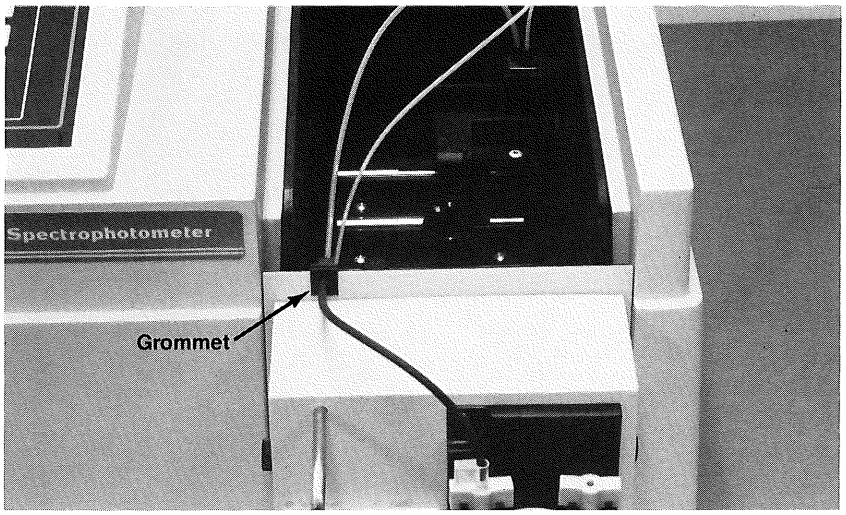


Figure 15.

NOTICE

When the sipper is removed from the instrument, use the plug, provided, to cover the hole for the outlet tubing. See Figure 16.

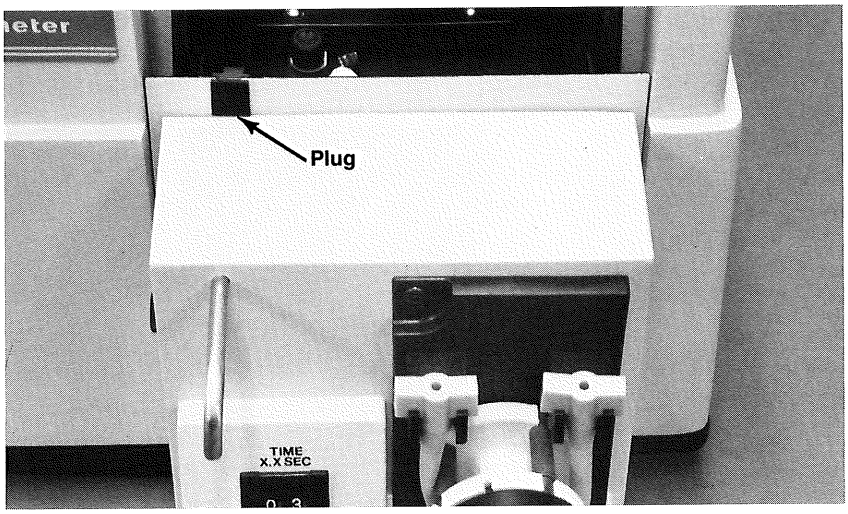


Figure 16.

Part IV. Installation of Temperature Control

Peltier version, only.

19. Route the water tubing between the rails and the left-hand wall of the sample compartment, leaving the excess tubing at the back of the sample compartment. Plug the tubing into the water fittings on the sipper panel. See Figure 17. Check to ensure that the water tubing does not block the light path.

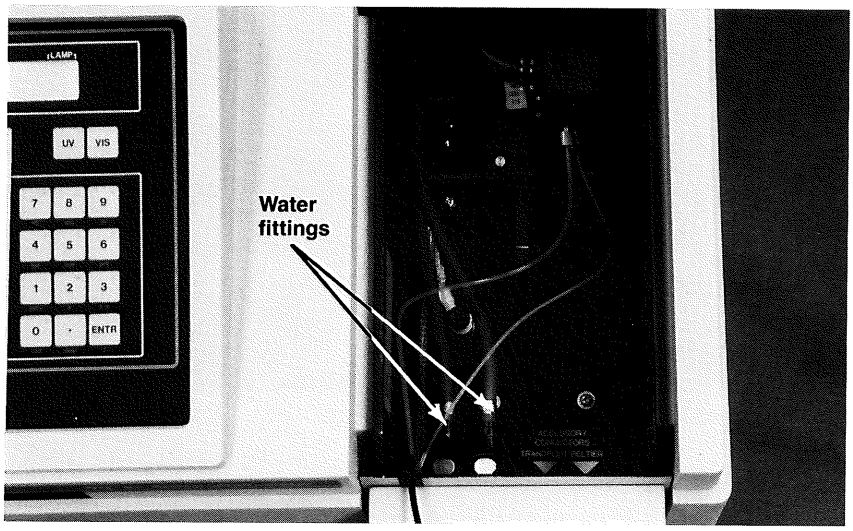


Figure 17.

20. Attach the temperature cable to the flowcell. See Figure 18.

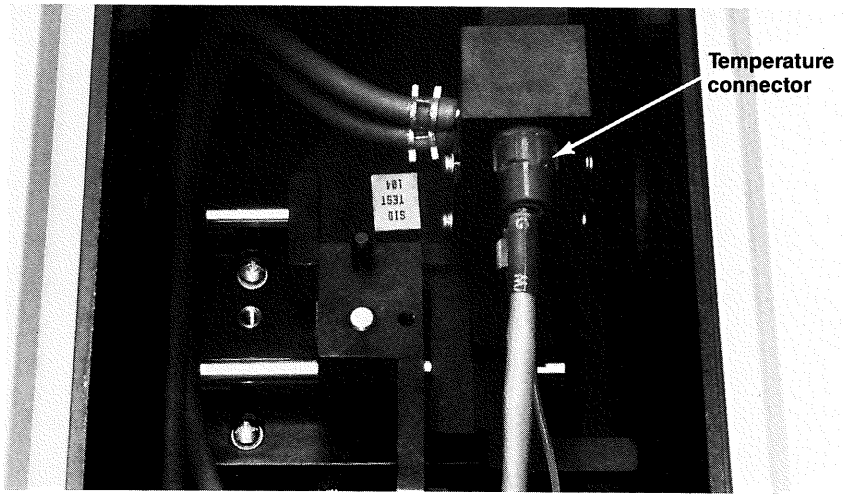


Figure 18.

21. Plug the temperature cable into the connector on the sipper panel. See Figure 19.

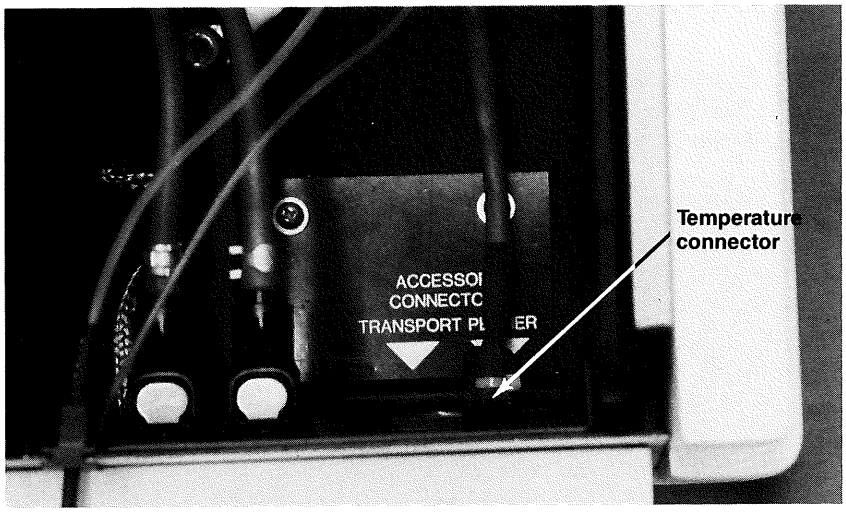


Figure 19.

22. Remove the two thumb screws which secure the front of the sipper panel. Remove the front to expose the connectors for the water fittings. See Figure 20.

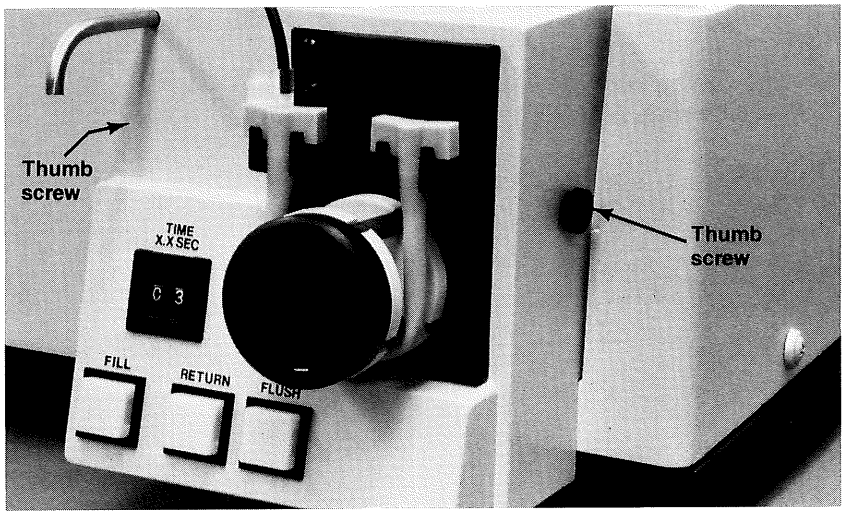


Figure 20.

23. Use the tubing and clips provided to supply water to the instrument. See Figure 21. Close to the end of one of the tubes is a white plastic flow restrictor. Use this tube on the inlet side.

CAUTION

Tap or recirculated ambient water with a flow rate of 200 to 300 mL/min is required for the Peltier temperature controller to operate properly.

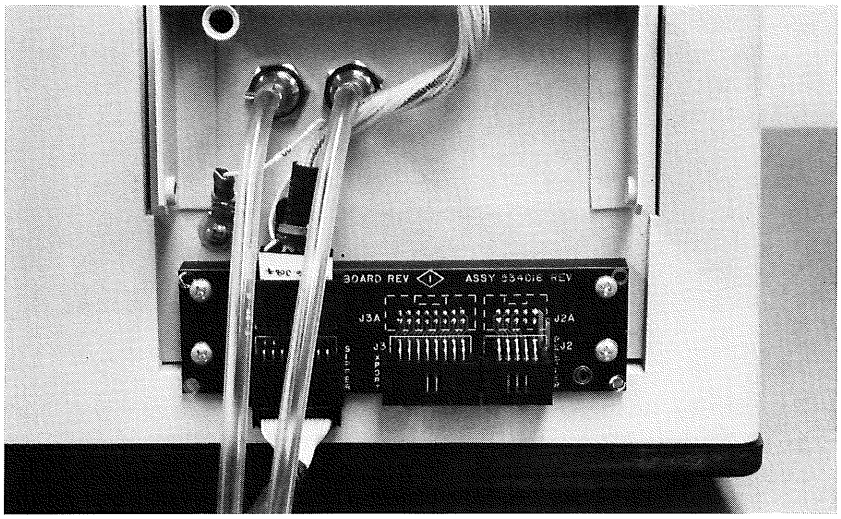


Figure 21.

24. Replace the front of the sipper panel and secure with the two thumb screws removed in step 22.

Part V. Waste Disposal

25. Attach the waste tubing to the right-hand side of the pump. See Figure 22.

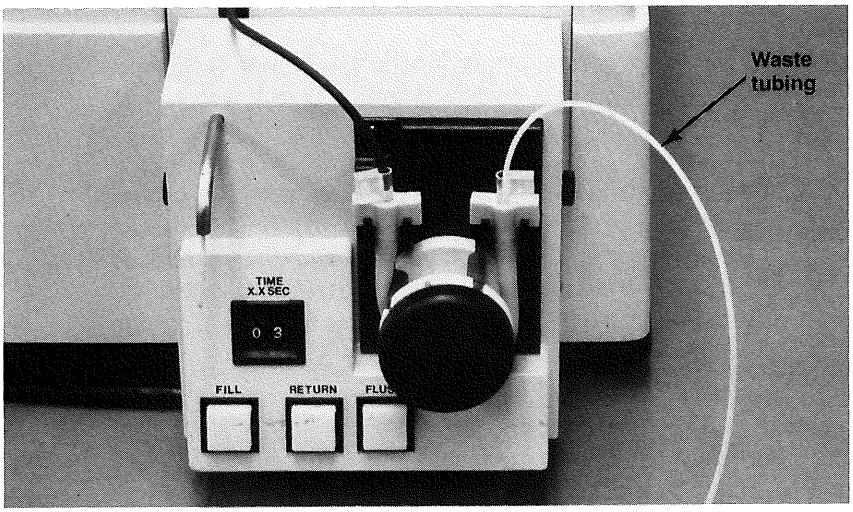


Figure 22.

26. Place the end of the waste tubing into the waste bottle. See Figure 23.

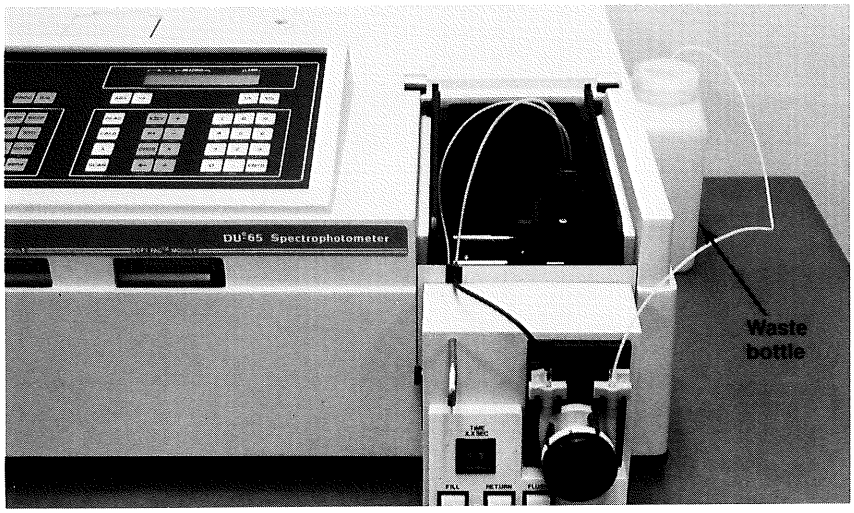


Figure 23.

Part VI. Start Up

27. Put on the sample compartment cover for the sipper.

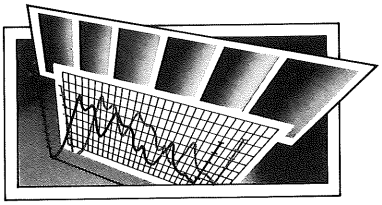
28. *Peltier version, only.* Install the Peltier temperature controller as instructed in the Installation Instructions, Manual 523781.

29. Refer to the Operating Instructions for Sipper Samplers, Manual 523733, for information on the operation of the sipper.

NOTICE

If the sipper is installed when the instrument is powered up, it must be filled with distilled water or a similar solution, or the power up checks may not be completed successfully. If there is a power up failure with the flowcell installed, move it out of the light path, and press the RESET button. Clean the flowcell before use.

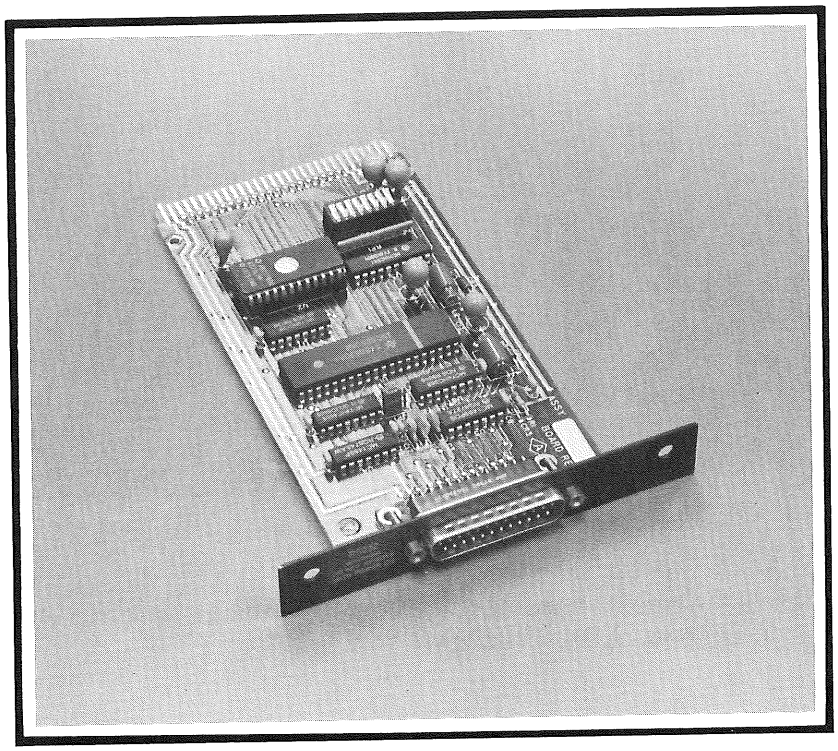
Manual 523783A



DU® Series 60 Spectrophotometer Installation Instructions

RS-232 Interface Accessory

Part Number 598274



BECKMAN

Installation Instructions for the DU® Series 60 Spectrophotometer with the RS-232 Interface Accessory.

Part I. Configuration of the Board

1. The RS-232 board has an eight-bit DIP switch, which is used to set up the input/output communication characteristics of the instrument.

   Set the DIP switches, using the settings which are summarized in Tables 1 and 2. A switch is in the "ON" position when the corresponding pin is pushed down towards the "ON" label on the end of the DIP switch. A switch is in the "OFF" position when the corresponding pin is pushed down towards the "OFF" label. See Figure 1.

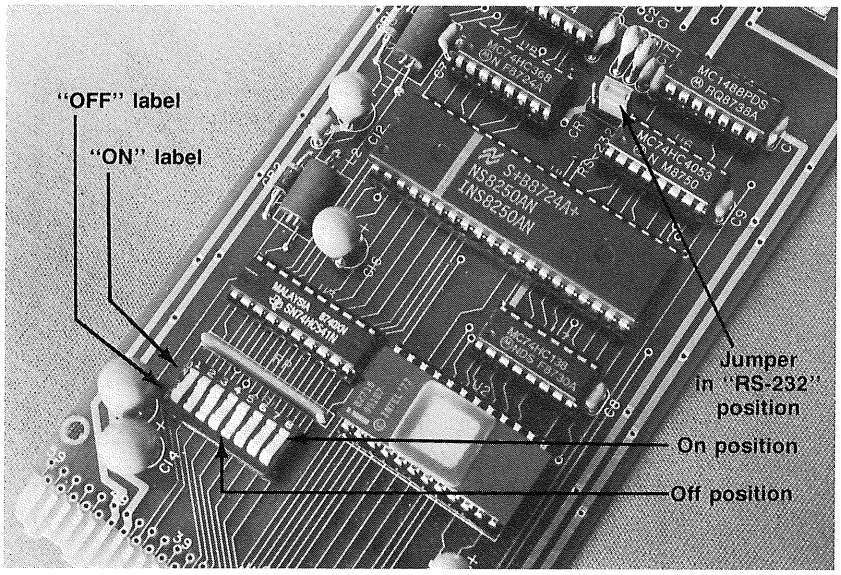


Figure 1.

The RS-232 board also has a jumper. Position the jumper so it is in the "RS-232" position, as shown in Figure 1.

Part II. Installation of the RS-232 Board

Tools required: Phillips screwdriver.

2. Check the accessory slots on the left-hand side of the instrument to see if a board labelled "RS-232" is installed. See Figure 2. If it is installed, go to step 7.

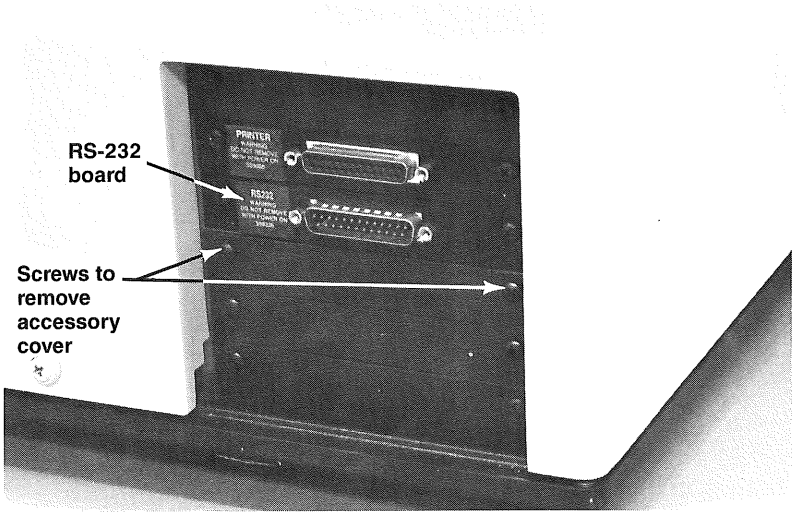


Figure 2.

3. If the RS-232 board is not installed, unplug the instrument power cord.

CAUTION

Do not insert or remove any accessory board with the power on.

4. Remove one of the accessory covers using a Phillips screwdriver. Save the two screws. See Figure 2.

5. Slide the RS-232 board into the open position. Push to seat. Secure the board with the two screws removed in step 4. See Figure 3.

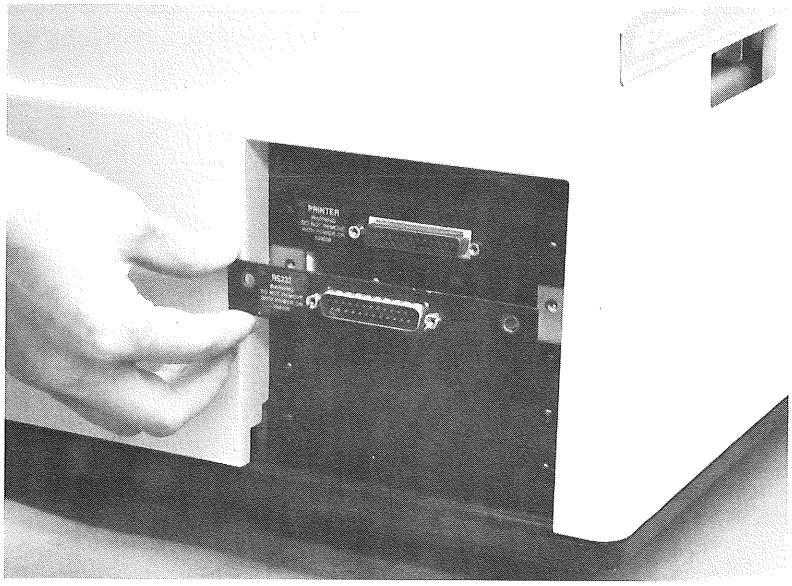


Figure 3.

6. Plug in the instrument.

7. The RS-232 board contains a standard DB-25 male connector, as shown in Figure 3. The cable, therefore, must have a standard DB-25 female connector to attach to the RS-232 board. Beckman offers a null modem cable, P/N 598383, which can be used with most computers.

NOTICE

Unplug the RS-232 cable before changing the baud rate on an external device.

8. Verify operation of the RS-232 accessory by performing one of the tests described in section 1.2 of the RS-232 Operating Instructions, Manual 523746.

9. Refer to the RS-232 Operating Instructions, Manual 523746, for information on the use of the RS-232 Accessory.

Switch #	Description	Settings
1	Character length	Off = 7 bits On = 8 bits
2	Number of stop bits	Off = 1, On = 2
3	Parity enable	Off = no parity On = parity generated
4 (Ignore if switch 3 is off.)	Parity select	Off = odd, On = even
5, 6, 7, 8	Input/output baud rate	See Table 2.

Table 1.

DIP Switch Settings				Baud Rate
5	6	7	8	
Off	Off	Off	Off	50
On	Off	Off	Off	75
Off	On	Off	Off	110
On	On	Off	Off	134.5
Off	Off	On	Off	150
On	Off	On	Off	300
Off	On	On	Off	600
On	On	On	Off	1200
Off	Off	Off	On	1800
On	Off	Off	On	2000
Off	On	Off	On	2400
On	On	Off	On	3600
Off	Off	On	On	4800
On	Off	On	On	7200
Off	On	On	On	9600
On	On	On	On	19200

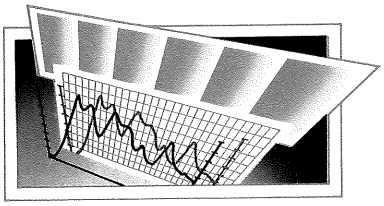
Table 2.

BECKMAN

Beckman Instruments, Inc. • Scientific Instruments Division • 2500 Harbor Boulevard • Fullerton, CA 92631-3100
(714) 871-4848 • TWX: 910-592-1260 • Telex: 678413
March 1988

Printed in USA

Manual 523746A



DU® Series 60 Spectrophotometer

Operating Instructions

RS-232 Interface Accessory

CONTENTS

(continued)

BECKMAN

Introduction

The following instructions are for the RS-232 Accessory, part number 598274, an accessory for DU® Series 60 Spectrophotometers. These instructions are intended to complement, not replace, the Operating Instructions for DU® Series 60 Spectrophotometers, Manual 523760. Refer to the complete operating instructions for general information regarding the instrument.

Section 1 - General Description

With the RS-232 Interface Accessory, the instrument can communicate with a computer, terminal or printer. It can both send or receive data from remote locations, if desired.

1.1 Installation

Refer to the RS-232 Installation Instructions, Manual 523783, for information on the installation of the RS-232 Accessory.

CAUTION

Do not install or remove the RS-232 input/output accessory board with the instrument plugged in. Doing this will result in serious damage to both the board and the instrument.

1.2 Initial Set Up

While your RS-232 interface board was factory inspected, it is recommended that it be checked again before putting it to use. There are two alternative methods to verify proper operation.

Method 1 is recommended for the programmable DU®-65 or DU®-68 Spectrophotometer It requires the operator to write a simple program. If the RS-232 board is operational, the message "RS WORKS" will be displayed.

Method 2 requires a remote terminal. When a scan is run, the data appears on the screen of the terminal. To verify that the instrument is also able to accept information, a number input on the terminal keyboard will appear on the display of the instrument.

Method 1

1. Input the following program steps into one of the program areas. For information on writing a program, refer to the Programming Guide, Manual 523735.

Step	Command	Step	Command
000:	Strt	010:	CALL RSCH
001:	82.000	011:	82.000
002:	CALL RSCH	012:	CALL RSCH
003:	83.000	013:	75.000
004:	CALL RSCH	014:	CALL RSCH
005:	32.000	015:	83.000
006:	CALL RSCH	016:	CALL RSCH
007:	87.000	017:	MSG c
008:	CALL RSCH	018:	rtn
009:	79.000		

2. Tie pins 2 (TxD) and 3 (RxD) together. See Figure 1.

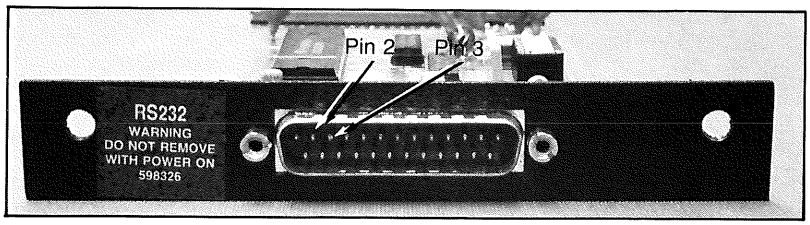


Figure 1. Pins 2 and 3

3. Run the program. "RS WORKS" will be displayed if the RS-232 board is operational. If the system is not operational, no message will be displayed.

NOTICE

The instrument will lock up if the program is listed with pins 2 and 3 tied together.

Method 2

1. Set the board for 7 bit, no parity, 1 stop bit, 2400 baud operation. Configure a remote terminal the same way. Refer to the Installation Instructions, Manual 523783, for more information.

2. Connect the instrument to the remote terminal, which has been set up as a DCE device. See Section 1.3 for further information.

3. Turn on the spectrophotometer.

4. Start and run a scan.

5. To verify the output side of the board, check to see if readings have been sent to the terminal.

6. To verify the input side of the board, enter any number on the remote terminal keyboard, for example "100."

7. Check to see if the number (e.g. "100") is displayed on the instrument.

This completes the test. If any problems have occurred, refer to section 7, Troubleshooting.

1.3 General Information on Interface Equipment

There are two types of RS-232 equipment: Data Communications Equipment or "DCE", and Data Terminal Equipment, or "DTE". DU Series 60 Spectrophotometers are configured as DTE.

Different baud rates can be selected by the instrument operator. The user also has the option of choosing either 7 or 8 bit data operation. When parity is enabled the word length is increased by one bit. Both the instrument and the remote device must have the same baud rate, number of data bits, and parity for proper operation.

Section 2 - RS-232 Configuration

2.1 Voltage and Circuitry Information

Tables 1 and 2 following provide useful information on voltage relations and circuitry for the RS-232 interface.

	Interchange Voltage*	
Notation	*Negative*	*Positive*
Binary State:	1	0
Signal Condition:	Marking	Spacing
Function:	OFF	ON

**Given: Negative is three volts more negative than Signal Ground (AB). Positive is three volts more positive than Signal Ground (AB). Any signal within three volts of Signal Ground (AB) is undefined.*

Table 1. Voltage Relations

Pin	Circuit	Direction	Function
1	AA	none	Protective Ground
7	AB	none	Signal Ground
2	BA	TO DCE	Transmit Data (TxD). The DTE holds this signal. Marking during intervals between characters.
3	BB	FROM DCE	Receive Data (RxD). The DCE holds this signal. Marking during intervals between characters.
4	CA	TO DCE	Request to Send. An ON condition informs the DCE that the DTE is ready to receive data.
5	CB	FROM DCE	Clear to Send. An ON condition informs the DTE that the DCE is ready to receive data.
6	CC	FROM DCE	Data Set Ready. An ON condition informs the DTE that the DCE is ready.
20	CD	TO DCE	Data Terminal Ready. An ON condition informs the DCE that DTE is ready.

Table 2. RS-232 Circuit Descriptions

2.2 DU® Series 60 Spectrophotometer, DTE

DU Series 60 Spectrophotometers are configured as DTE. Communication with another DTE device requires a null modem cable. Beckman offers a null modem cable, P/N 598383, which has standard DB-25 female connectors on both ends.

Communication with a DCE device requires a straight-through cable, such as P/N 523396, which has standard DB-25 female connectors on both ends.

Beckman also offers a male-to-female 25 pin to 9 pin adaptor cable, P/N 523629, compatible with either of the above cables.

The DU Series 60 Spectrophotometer always ignores the Clear to Send signal. Therefore, a remote device should always be ready to receive data (see section 5, XON/XOFF Operation). The DU-60 also always holds Request to Send high, indicating to the DCE that the DU-60 is always ready to receive data (refer also to section 5).

2.3 Output Formats

The DU-60 can output data to a remote device in two different formats: Format A and Format B. Format A is used with computers only, while Format B can be used with terminals, computers or printers. Following is a description of these two output formats.

Format A: This is the format established by the Beckman Protocol, defined as follows:

<format A> : : = <mm>D50***<fc><data>
<cc><crlf>
<mm> : : = Message number 00–99
<fc> : : = Function Code
FH = Header Information
FD = Data
<data> : : = "<alphanumerics>"
<cc> : : = Checksum. The checksum is the modulo 256 sum of the ASCII values of the message characters up to but not including the checksum and the <crlf>.
<crlf> : : = Carriage return and line feed
<alphanumerics> : : = Any non-control ASCII characters.

NOTICE

When turned on, the DU-60 will begin message numbering at 00.

Format B: String followed by a carriage return and line feed, defined as follows:

<format B> : : = <alphanumerics><crlf>
<alphanumerics> : : = Any non-control ASCII characters.
<crlf> : : = Carriage return and line feed

NOTICE

See format examples in section 4.2.

2.4 Format Control

RS-232 input/output formats can be controlled by a generic command called RSF. Generic commands apply only to the programmable DU®-65 and DU®-68 Spectrophotometers. For more information on generic commands, please refer to the Programming Guide, Manual 523735.

The generic command RSF has the following options:

0 in x-register = Disable output.
1 in x-register = Format B output. (DEFAULT)
2 in x-register = Format A output.
3 in x-register = Disable RS-232 input.
4 in x-register = Turn on RS-232 input. (DEFAULT)

The input and output modes are independent of each other. Therefore, as an example, when it is turned on, the instrument is in output Format B and the input is enabled.

Format Control Examples

1. The user can select output Format A in three ways:
   a. From the instrument keyboard, depress the following keys in order.

      [2], [CALL], [alpha], [R], [alpha], [S], [alpha], [F], [ENTR]

   b. From the remote device with keyboard, on the keyboard of the remote device, depress the following keys in order.

      2, @, R, S, F, }

NOTICE

See the table in Section 4.1, INPUT, on how the [CALL] and [ENTR] keys of the instrument are mapped to the characters "@" and " } " respectively of the remote device.

   c. From a computer as the remote device, program the computer to output the ASCII equivalents of the above keys, i.e. 2, CALL,

R, S, F, ENTR. An IBM BASIC program to send this command to the instrument is as follows:

```
10 REM
20 REM     OPEN THE COM FILE AS 1
30 REM
40 OPEN    "COM1:1200,E,7,2,RS,CSO,DSO"* AS #1
50 REM
60 REM     SEND THE COMMAND STRING TO CHANGE
           TO FORMAT A
70 REM
80 PRINT   #1, "2@RSF}"
90 END
```

*This assumes that the DU-60 is set to: 1200 baud, even parity, 7 data bits, and 2 stop bits.

2. To set output Format B, depress the following keys on the keyboard of the instrument.

   [1], [CALL], [alpha], [R], [alpha], [S], [alpha], [F], [ENTR]

3. In order to disable RS-232 input, depress the following keys in order.

   [3], [CALL], [alpha], [R], [alpha], [S], [alpha], [F], [ENTR]

4. In order to enable RS-232 input, depress the following keys in order.

   [4], [CALL], [alpha], [R], [alpha], [S], [alpha], [F], [ENTR]

Section 3 - ASCII Codes

ASCII	DEC	ASCII	DEC	ASCII	DEC
NUL	0	+	43	V	86
SOH	1	,	44	W	87
STX	2	-	45	X	88
ETX	3	.	46	Y	89
EOT	4	/	47	Z	90
ENQ	5	0	48	[	91
ACK	6	1	49	\	92
BEL	7	2	50	]	93
BS	8	3	51	^	94
HT	9	4	52	—	95
LF	10	5	53	`	96
VT	11	6	54	a	97
FF	12	7	55	b	98
CR	13	8	56	c	99
SO	14	9	57	d	100
SI	15	:	58	e	101
DLE	16	;	59	f	102
DC1	17	<	60	g	103
DC2	18	=	61	h	104
DC3	19	>	62	i	105
DC4	20	?	63	j	106
NAK	21	@	64	k	107
SYN	22	A	65	l	108
ETB	23	B	66	m	109
CAN	24	C	67	n	110
EM	25	D	68	o	111
SUB	26	E	69	p	112
ESC	27	F	70	q	113
FS	28	G	71	r	114
GS	29	H	72	s	115
RS	30	I	73	t	116
US	31	J	74	u	117
SP	32	K	75	v	118
!	33	L	76	w	119
"	34	M	77	x	120
#	35	N	78	y	121
$	36	O	79	z	122
%	37	P	80	{	123
&	38	Q	81	|	124
'	39	R	82	}	125
(	40	S	83	~	126
)	41	T	84	DEL	127
*	42	U	85		

ABBREVIATIONS FOR CONTROL CHARACTERS

Abbreviation	Description
NUL	Null or All Zeros
SOH	Start of Heading
ETX	End of Text
EOT	End of Transmission
ENQ	Enquiry
ACK	Acknowledgement
BEL	Bell
BS	Back Space
HT	Horizontal Tabulation
LF	Line Feed
VT	Vertical Tab
FF	Form Feed
CR	Carriage Return
SO	Shift Out
SI	Shift In
DLE	Data Link Escape
DC1	Device Control 1
DC2	Device Control 2
DC3	Device Control 3
DC4	Device Control 4
NAK	Negative Acknowledge
SYN	Synchronous Idle
ETB	End of Transmission Block
CAN	Cancel
EM	End of Medium
ESC	Escape
FS	File Separator
GS	Group Separator
RS	Record Separator
US	Unit Separator
SP	Space
DEL	Delete

4.1 Input

When the RS-232 input is enabled (in the default mode), the instrument will accept commands from two sources: its keyboard and the RS-232 port. The RS-232 port can be disabled; refer to section 2.4.

When a key is pressed on the remote keyboard or an ASCII code is sent from a remote device, the DU Series 60 Spectrophotometer converts it to an internal code. Table 4 is used to map the codes generated by a remote device to the spectrophotometer keyboard.

NOTICE

The input side of the RS-232 interface has been implemented with XON/XOFF controls. For further information, see section 5.

All codes outside the range of the following table (undefined) generated by the remote device are ignored by the instrument.

DU®-60 Keyboard	Remote Keyboard	Hex ASCII Char
	Primary Keys	
ABS	!	21
BSTP	)	29
CALB	]	5D
CALL	@	40
CHGS	_ (underscore)	5F
ENTR	}	7D
GOTO	[	5B
PROG	#	23
RCL	<	3C
READ	/	5C
R/S	$	24
Rv	|	7C
SCAN	{	7B
STO	>	3E
STEP	(	28
%T	"	22
UV	&	26
VIS	' (apostrophe)	27
XCHG	` (grave accent)	60

(continued)

DU®-60 Keyboard	Remote Keyboard	Hex ASCII Char
<– (CLR)	~	7E
λ (wavelength)	^	5E
+	+	2B
–	– (minus sign)	2D
x	*	2A
/	/	2F
. (decimal point)	.	2E
The following applies to digits which are used for floating point numbers.		
0	0	30
1	1	31
2	2	32
3	3	33
4	4	34
5	5	35
6	6	36
7	7	37
8	8	38
9	9	39
The following applies to digits which are included in a label or message.		
1	control A	01
2	control B	02
3	control C	03
4	control D	04
5	control E	05
6	control F	06
7	control G	07
8	control H	08
9	control I	09
0	control K	0B
	Secondary Keys	
cell	control \	1C
clr	c	63
clr P	z	7A
clr E	t	74
dec	k	6B
del	d	64

(continued)

DU®-60 Keyboard	Remote Keyboard	Hex ASCII Char
disp	control [	1B
est x	v	76
f	control Z	1A
lbl	r	72
list	n	6E
ln	h	68
lr	w	77
log	g	67
out	o	6F
prt	p	70
rtn	q	71
wait	m	6D
x<=y	a	61
x>y	b	62
x=y	i	69
x<>y	j	6A
xs	x	78
y^x	e	65
E+	s	73
E−	y	79
√x	f	66
fill	control X	18
return	control Y	19
Ircl	control]	1D
Isto	control ^	1E
Idec	control _ (underscore)	1F
ClrSc	control V	15
PrtSc	control W	16
	Alphabets	
A	A	41
B	B	42
C	C	43
D	D	44
E	E	45
F	F	46
G	G	47
H	H	48
I	I	49
J	J	4A
K	K	4B
L	L	4C
M	M	4D
N	N	4E

(continued)

DU®-60 Keyboard	Remote Keyboard	Hex ASCII Char
O	O	4F
P	P	50
Q	Q	51
R	R	52
S	S	53
T	T	54
U	U	55
V	V	56
W	W	57
X	X	58
Y	Y	59
Z	Z	5A
?	?	3F
:	:	3A
;	;	3B
=	=	3D
. (period)	rubout/delete	7F
,	,	2C
lambda (character)	l	6C
%	%	25
u	u	75
sp	space	20

NOTICE

When using a remote device, there are no [alpha] or [func] keys. For each command, there is a unique ASCII character associated with it.

4.2 Output

As mentioned, the instrument can output data to a remote device in two different formats: A and B. In both modes, the output can be controlled using XON and XOFF. For more information, see section 5. There are three ways of outputting data to a device:

OUT/READ Key

a. The bottom line of the display can be output to the remote device by pressing the OUT key. (For programmable instruments, DU®-65 and DU®-68.)

b. Data displayed can be output to a remote device by pressing the READ key. (For non-programmable instruments, DU®-62 and DU®-64.)

c. When a READ command is executed in a step program, a reading is taken and displayed. To send that reading to the RS-232 port, an OUT command must be executed after the READ command. (For all DU® Series 60 instruments.)

The following is a program segment that illustrates taking a reading and sending it to the RS-232 port.

Step	Command
	.
	.
017:	READ
018:	out
	.
	.

OUT/READ Key Examples

The data that follow were output to the RS-232 port. First the value was placed on the bottom line of the display, then the OUT key was pressed. This was repeated for three values, 123.45, 345.67 and 567.89.

Format A

00D50***FD"
01D50***FD"
02D50***FD"

123.45"5B<crlf>
345.67"93<crlf>
567.89"5B<crlf>

Format B

123.45<crlf>
345.67<crlf>
567.89<crlf>

Data Output During Scanning

During a scan, data are automatically output to the remote device if the RS-323 accessory is installed, properly connected to the remote device, and the RS-232 output is enabled.

The data below were output to the RS-232 port during a scan. The scan parameters used were: 500 = starting wavelength, 400 = ending wavelength, absorbance mode, and 750 nm = speed (1 reading/nm).

Scan Output Examples

Format A Output Example	Comment
05D50***FH"500,400,A,750"9B<crlf>	Header information (FH)
06D50***FD"0.093"8E<crlf>	Scan data (FD)
07D50***FD"0.093"8E<crlf>	Scan data (FD)
08D50***FD"0.094"FB<crlf>	Scan data (FD)
09D50***FD"0.096"18<crlf>	Scan data (FD)
10D50***FD"0.093"63<crlf>	Scan data (FD)
11D50***FD"0.104"AC<crlf>	Scan data (FD)
12D50***FD"0.110"C6<crlf>	Scan data (FD)
13D50***FD"0.117"B3<crlf>	Scan data (FD)
14D50***FD"0.128"B3<crlf>	Scan data (FD)
15D50***FD"0.140"DE<crlf>	Scan data (FD)
16D50***FD"0.152"50<crlf>	Scan data (FD)
17D50***FD"0.164"03<crlf>	Scan data (FD)
18D50***FD"0.170"69<crlf>	Scan data (FD)
19D50***FD"0.170"69<crlf>	Scan data (FD)
20D50***FD"0.172"8A<crlf>	Scan data (FD)
21D50***FD"0.174"6E<crlf>	Scan data (FD)
22D50***FD"0.174"6E<crlf>	Scan data (FD)

Format B Output Example

500,400,A,750<crlf>
0.093<crlf>
0.093<crlf>
0.094<crlf>
0.096<crlf>
0.093<crlf>
0.104<crlf>
0.110<crlf>
0.117<crlf>
0.128<crlf>
0.140<crlf>
0.152<crlf>
0.164<crlf>
0.170<crlf>
0.170<crlf>
0.172<crlf>
0.174<crlf>
0.174<crlf>

Scan data are buffered by the instrument before output to the RS-232 at the rate determined by the baud rate. If the buffer fills with data, the scan speed will decrease automatically, so that no data points are lost. For more information, refer to paragraph 5.2.

4.3 Output of Directory and Program Areas

When the [list] key is used in the directory mode, the directory is output to the printer and the RS-232 port. When [list] is used in the program mode, a program listing is sent to the printer and the RS-232 port.

Note: The ASCII code for XON is hexadecimal 11 or decimal 17. The ASCII Code for XOFF is hexadecimal 13 or decimal 19. On a terminal, XOFF can be sent to the DU®-60 by simultaneously pressing CONTROL and S keys, while XON can be sent by simultaneously pressing CONTROL and Q keys.

5.1 Input Buffering and Control

The DU-60 uses a 64-character buffer on the input side. If the buffer contains 54 characters, the instrument will send an XOFF to indicate halt transmission to the remote device. When the buffer contents are reduced to 48 characters, (by the DU-60 executing commands) the DU-60 will send an XON to indicate to the remote device to resume transmission.

5.2 Output Buffering and Control

On the output side, the DU®-60 uses a 128-character buffer. The data to be output to the RS-232 port are first put in this buffer. Then, the DU-60 starts to output one character at a time. If the remote device wishes to indicate to the DU-60 to stop transmitting, the remote device must send an XOFF. When the remote device is ready to accept more data, the user must send an XON. When the DU-60 output buffer is full, the instrument will wait until characters are removed by the remote device before adding to the buffer. No data will be lost.

Generic Description

RSF — This generic is used to control the RS-232 input and output formats based on the value in the X-register. See FORMAT CONTROL section 2.4 for more details.

RSCH — This generic converts the decimal value in the X-register to the equivalent ASCII character and sends it to the RS-232 port. See the example below.

Example of the RSCH Generic Function

This step program will send a form feed to the RS-232 port using the RSCH generic command.

Commands	Comment
000: Strt	Start of program.
001: 12	12 is the ASCII code for form feed.
002: CALL RSCH	Call the generic command.
003: rtn	Return to the user mode.

Section 7 - Troubleshooting

Before using this section, read and perform the steps listed under "Initial Set Up," section 1.2.

Condition	Possible Trouble
No communications	a) Check that both units are powered up. b) The units have different baud rates. c) The units have different data word sizes. d) The units do not have the same parity. e) Cable is not connected to both units. f) RS-232 board is upside down. g) Problem in the receive routine of the remote unit. h) Remote device is not configured as DCE.
'ed output	a) The units have different baud rates. b) The units have different data word sizes. c) The units do not have the same parity. d) Problem in the receive routine of the remote unit.
Random characters or entire messages are lost.	a) Remote device (program or hardware) cannot process data at the current baud rate. The baud rates should be lowered or XON/XOFF communication control is implemented.

BECKMAN

Beckman Instruments, Inc. • Scientific Instruments Division • 2500 Harbor Blvd. • Fullerton, CA 92634-3100
(714) 871-4848 • TWX: 910-592-1260 • Telex: 678413

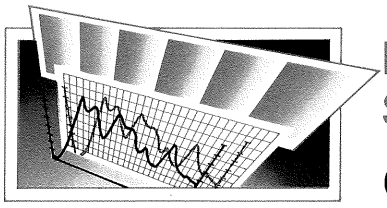
March 1988/CG

Printed in U.S.A.

BECKMAN

Beckman Instruments, Inc. • Scientific Instruments Division • 2500 Harbor Boulevard • Fullerton, CA 92631-3100
(714) 871-4848 • TWX: 910-592-1260 • Telex: 678413

Manual 523733A



DU® Series 60 Spectrophotometer

Operating Instructions

Sipper and Batch Sampler Accessories

CONTENTS

BECKMAN

Introduction

The following instructions are for the sipper and batch sampler, accessories for DU® Series 60 Spectrophotometers. They are intended to complement, not replace, the Operating Instructions for DU Series 60 Spectrophotometers, Manual 523760. Refer to the complete operating instructions for general information regarding the instrument.

Section 1 - General Description

The following will facilitate the use of the sipper and batch sampler accessories for your DU® Series 60 Spectrophotometer. There are two sipper configurations available including an unheated model (P/N 523712) and one that is temperature controlled (P/N 523713); the batch sampler (P/N 596268, 117V and P/N 596269, 234V) requires a sipper accessory and batch interface (P/N 523703) for automated analysis of up to 114 samples.

Sipper accessories include a peristaltic pump and drive motor, flow cell, tubing, accessory control circuit board, and interface cable. The accessory allows automated analysis after each sample is manually presented for aspiration into the flow cell using the peristaltic pump.

The batch sampling accessory (Figure 1) is an automated transport system, which may present up to 114 sample tubes for aspiration of the sample to the flow cell. Six sample tubes are loaded to a cartridge. Cartridges are then stepped through discrete positions to the action of an aspirator tube, which is connected to the peristaltic pump of the sipper sampling accessory. An interface cable connects the instrument to the accessory circuit board.

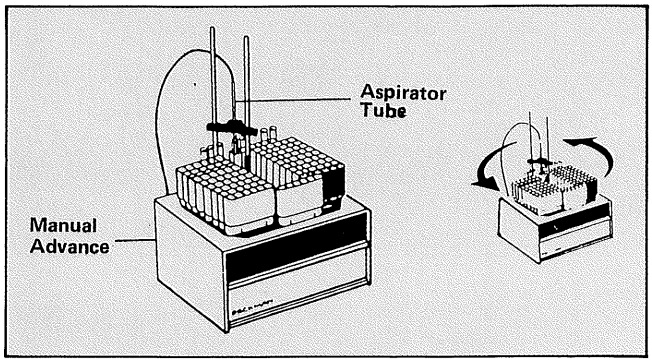


Figure 1. Batch Sampling Accessory

Section 2 - Installation

Refer to the Installation Instructions for the Sipper, Manual 523775, and for the Batch Sampler, Manual 523771, for information on the installation of these accessories.

Section 3 - Sipper and Batch Sampler Operation

The operation of your DU® Series 60 Spectrophotometer is enhanced by the installation of the sipper or batch sampler accessory in four ways.

1. Three new buttons become active.

2. A thumbwheel switch will set fill and return time.

3. Two step programs are added to the directory mode.

4. Ten generic commands are added to the table of user accessible generics.

3.1 Sipper Controls

Figure 2 shows the placement for the sipper sampler button and thumbwheel. The following describes each briefly.

FILL

When pressed momentarily, this runs the peristaltic pump in a forward direction for the time set by the thumbwheel switch, pauses momentarily, and then takes a reading or starts a scan.

RETURN

When pressed momentarily, this runs the peristaltic pump in the reverse direction for twice the time set by the thumbwheel switch with a minimum return period of two seconds. For the sipper, the return time is twice the selected fill time. For the batch sampler, refer to section 3.5.

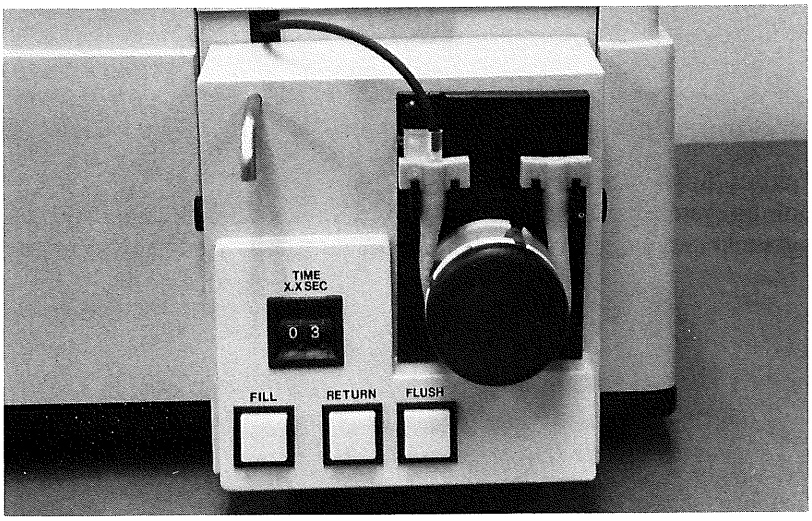


Figure 2. Sipper Sampler Buttons and Thumbwheel

NOTICE

Both the FILL and RETURN buttons are the same as any key on the keyboard in that the functions are stored in the key buffer and processed in the order pressed.

FLUSH

When held down, this key runs the peristaltic pump forward until the button is released.

THUMBWHEEL SWITCH

With this switch, the user may select the number of seconds the peristaltic pump will run in conjunction with the FILL and RETURN buttons. The time is selected by turning the two thumbwheel indicators to the desired number of seconds. The time range is 0.0 to 9.9 seconds.

3.2 Batch Sampler Controls

STOP CARTRIDGE

The batch sampler accessory is equipped with a red "stop" cartridge that will automatically stop the sample cycling. With this cartridge in place, the batch sampler will aspirate and return each sample until it reaches the last tube in the stop cartridge. When the last sample tube is reached, the sample cycling will halt automatically (even if there are more samples to be read). No further action will be taken until the user manually advances the transport to the next position.

A replacement standard cartridge is provided with the accessory to be used in lieu of the stop cartridge, if necessary. When the stop cartridge is not used, the batch sampler will operate continuously or until the [R/S] key is pressed.

REMOVING CARTRIDGES

A cartridge may be removed and replaced as needed, by lifting it straight up out of the rubber transporter. If it is more convenient, only the cartridges to be used may be left in the transporter and unused cartridges may be removed and set aside. The unit will pass over sections without cartridges and resume sampling upon reaching the first position of the next cartridge.

NOTICE

When replacing a cartridge, make sure that the pegs on the bottom of the cartridge match the holes in the rubber transporter. The two pegs on each cartridge are different in size and must be placed in the corresponding hole.

MANUALLY ADVANCING CARTRIDGES

Cartridges and samples may be manually advanced by depressing the [MANUAL ADVANCE] button on the back panel of the batch sampler unit. (The button is located at the left-hand side of the unit when viewed from the front.)

3.3 Flow Cell Maintenance

CONDITIONING A NEW FLOW CELL

A new cell or a cell which has not been used recently needs to be conditioned. Conditioning will produce an even, smooth flow of sample solution through the cell and prevent bubbles from forming.

To condition the cell, rinse with deionized water, flush with air, then rinse with spectral grade methanol. Flush with air again, then rinse with deionized water. The cell is now ready to use.

CLEANING PROCEDURE — DAILY

1. Flush with one milliliter of deionized water.
2. Flush with two milliliters of 10% Trace Klean™ solution prepared from the concentrate, or the ready-to-use 10% Trace Klean solution.
3. Flush with a minimum of five milliliters of deionized water.
4. Leave the cell filled with deionized water.

   Before next use, flush with methanol, then with deionized water.

CLEANING PROCEDURE — CONTAMINATED CELLS

This procedure should be followed if bubbles remain in the cell, if the flow cell is known to be dirty, if the results are not reproducible, or if the results appear to be inaccurate.

1. Flush with deionized water for two minutes minimum.
2. Flush with methanol for two minutes minimum.
3. Flush with deionized water for one minute.
4. Flush with methanol for two minutes minimum.
5. Flush with deionized water for one minute.
6. Flush with a 10% solution of Trace Klean for two minutes minimum.

7. Flush with deionized water for one minute.

8. Dry the cell with pure dry bottled air or with dry nitrogen. The alcohols and the Trace Klean solution may be recycled through the flow cell during the flushing periods. The distilled (or D.I.) water should not be reused.

CLEANING PROCEDURE — SEVERELY CONTAMINATED CELLS

Occasionally a cell may become severely contaminated with substances which have dried on the interior surfaces. These cells may not come clean using the standard cleaning procedure. In this case, flush the cell with 50% hydrochloric acid (6N) for ten seconds, then follow immediately with a one-minute flush using deionized water. Follow this with the cleaning procedure for contaminated cells.

WHAT TO DO ABOUT BUBBLES

1. Check for leaks on the inlet side of the cell. Make sure the tubing at the cell inlet is firmly seated and that there are no crimps in the tubing. Replace tubing as necessary.

2. If air bubbles will not pass on through and out the outlet side, flush the lines and cell with alcohol then flush with distilled water.

3. If bubbles persist, follow the cleaning procedure for contaminated cells.

OTHER INFORMATION

It is important that the cell never be left to air dry. Because of that, whenever there is a break in the use of a flow cell it should be rinsed and left filled with deionized water. When use is resumed, the cell need only be emptied, flushed several times, then filled with sample.

And finally, at the end of the work day, the daily cleaning procedure described above should be used. Shortcuts in the cleaning procedure usually prove to be self-defeating and should be avoided since a build-up of contaminants may occur.

3.4 Batch Sampler Operation

The batch sampler can be used to automate the following analyses:

1. Single wavelength readings, which can be multiplied by a factor to calculate concentration. Refer to section 4.1 for instructions.

2. Wavelength scans. Refer to section 4.2 for instructions.

3. Peak pick and point pick on wavelength scans, using the Quant I Soft-Pac ™ module. Refer to the Operating Instructions for the Quant I Soft-Pac module, Manual 523744, for more information.

4. Single component analyses, using the Quant II Soft-Pac ™ module. Refer to the Operating Instructions for the Quant II Soft-Pac module, Manual 523745, for more information.

5. Protein analysis, using the Protein Assay Soft-Pac ™ module. Refer to the Operating Instructions for the Protein Assay Soft-Pac module, Manual 523743, for more information.

3.5 Batch Sampler Return Options

NOTICE

These return modes are for the batch sampler only. The sipper always uses Mode 1.

There are four return modes in the instrument, numbered 0 to 3. They are summarized in Table 1.

Mode 0	Mode 1	Mode 2	Mode 3
return 80%	return 200%	return 80%	no return
raise arm		raise arm	raise arm
wait 1 second		wait 1 second	flush 5 seconds
return 20%		return 20%	
wait 1 second		wait 1 second	
return 20%		return 20%	
wait 1 second		wait 1 second	
return 100%		flush 200%	

Table 1. Return Modes. The indicated times are percentages of the fill time, set on the sipper panel.

The return mode is always set to mode 0, when the instrument is powered up. The mode can be changed in a user-written program, using the generic commands found in section 5. The mode can be changed manually, on the DU®-65 or DU®-68 Spectrophotometer, using the following procedure. Once the mode is changed, all returns will use the chosen mode, until the insturment is powered up (and mode 0 is reset) or the user changes to a different mode.

To manually change the return mode:

(Note: These steps manually call the SRTN generic command.)

1. Press the number for the desired return mode (0, 1, 2, 3).
2. Press [CALL].
3. Press [alpha], [S], [alpha], [R], [alpha], [T], [alpha], [N].
4. Press [ENTR].

NOTICE

When analyzing samples with the viscosity of water or less, some splattering may occur when returning the sample, especially with the batch sampler. If this occurs, use pump tubing P/N 651767, which is red, rather than gray, in color. This pump tubing has a smaller diameter and therefore, returns at a slower rate.

Section 4 - Batch Sampler Programs

With the batch sampler, two directory accessible step programs become available to the user: Batch1WL and BatchSCN. Following is a description of both and sample output for each. Although these programs exist in the directory of an instrument with the sipper installed and will run, they will not perform any of the batch sampler operations (i.e. raise, lower, and so on). The programs will simply perform repeated read or scan on the same sample and print the results.

The tabulated results from the single wavelength readings and the plotted scan data are formatted for output on the Printer/Plotter accessory. This accessory is required for use with these programs. Raw data, only, are output to the Analog Output and RS-232 accessories, if installed.

4.1 Single Wavelength Readings

This program takes readings and prints the results on all samples through the final sample (Figure 3).

1. Turn on the source(s) desired.

2. Select the desired reading mode desired ([ABS] or [%T]).

3. From the user mode, press [PROG] to enter the directory mode.

4. Use [STEP] to display "PROG 6:Batch1WL."

NOTICE

If a Soft-Pac ™ module is installed, the program numbers will be different. The names will remain the same.

5. Press [R/S] to begin program execution. The following three questions will appear on the display.

6. Wavelength:
   Key in the desired wavelength and press [ENTR].

7. FACTOR:
   Key in the desired factor and press [ENTR]; all readings will be multiplied by this factor before being printed.

8. Start sample #:
   Key in the starting sample number and press [ENTR].

9. The display will read "Load Samples R/S." Calibration will automatically be done on the current sample. Reading and output will begin on the next sample position and continue until the last sample is read (See section 3.2).

```
WAVELENGTH:   546.00
FACTOR:        10.000

          SAMPLE        READING      * FACTOR
              45         0.0000        0.0000
              46         1.1320        11.320
              47         1.1380        11.380
              48         0.8840        8.8400
              49         0.3030        3.0300
              50         0.8450        8.4500
              51         0.7730        7.7300
              52         0.7790        7.7900
              53         0.9830        9.8300
              54         0.9780        9.7800
              55         1.1250        11.250
              56         1.1270        11.270
```

Figure 3. Batch1WL Output Example

4.2 Wavelength Scanning

This program will scan samples until the last tube is found.

1. Turn on the source(s) desired.

2. Select the desired reading mode desired ([ABS] or [%T]).

3. From the user mode, press [PROG] to enter the directory mode.

4. Use [STEP] to display "PROG 7:BatchSCN."

NOTICE

If a Soft-Pac™ module is installed, the program numbers will be different. The names will remain the same.

5. Press [R/S] to begin program execution.

6. Start sample #:
   Key in the starting sample number followed by [ENTR].

7. Starting wl:
   Key in the desired starting wavelength and press [ENTR].

8. Ending wl:

   Key in the desired ending wavelength, and press [ENTR].

9. Spd (1=750 2=500)

   Key in the scan speed where 1 is 750 nm/min and 2 is 500 nm/min; press [ENTR].

10. Upper limit:

    Key in the upper limit and press [ENTR].

11. Lower limit:

    Key in the lower limit and press [ENTR]. If the upper limit equals the lower limit, then the scans will be autoscaled.

    Autoscaling does not apply to the DU-68 Spectrophotometer. If the upper and lower limits are equal, the data will be plotted with axes of 0-3 in absorbance or 0-100 in transmittance.

12. The display will read "Load Samples R/S."

13. After pressing [R/S], calibration will be done on the first tube; the background scan will be done on the next tube, and the sample scans will be done on the following tube through the final tube (Figure 4).

    The scan data will be plotted on the Printer/Plotter after each scan is complete. On the DU-68 Spectrophotometer, the scan data for each sample will also be plotted on the graphic display as they are collected.

    Data will be output to the RS-232 port, if installed, as they are collected. Data will be output to the analog port, if installed, after plotting on the Printer/Plotter is complete.

    The samples will be returned in the manner set by the generic command BTRN. (See section 5.) Unless set differently by the user, the return mode will be Mode 0, as shown for the generic command SRTN.

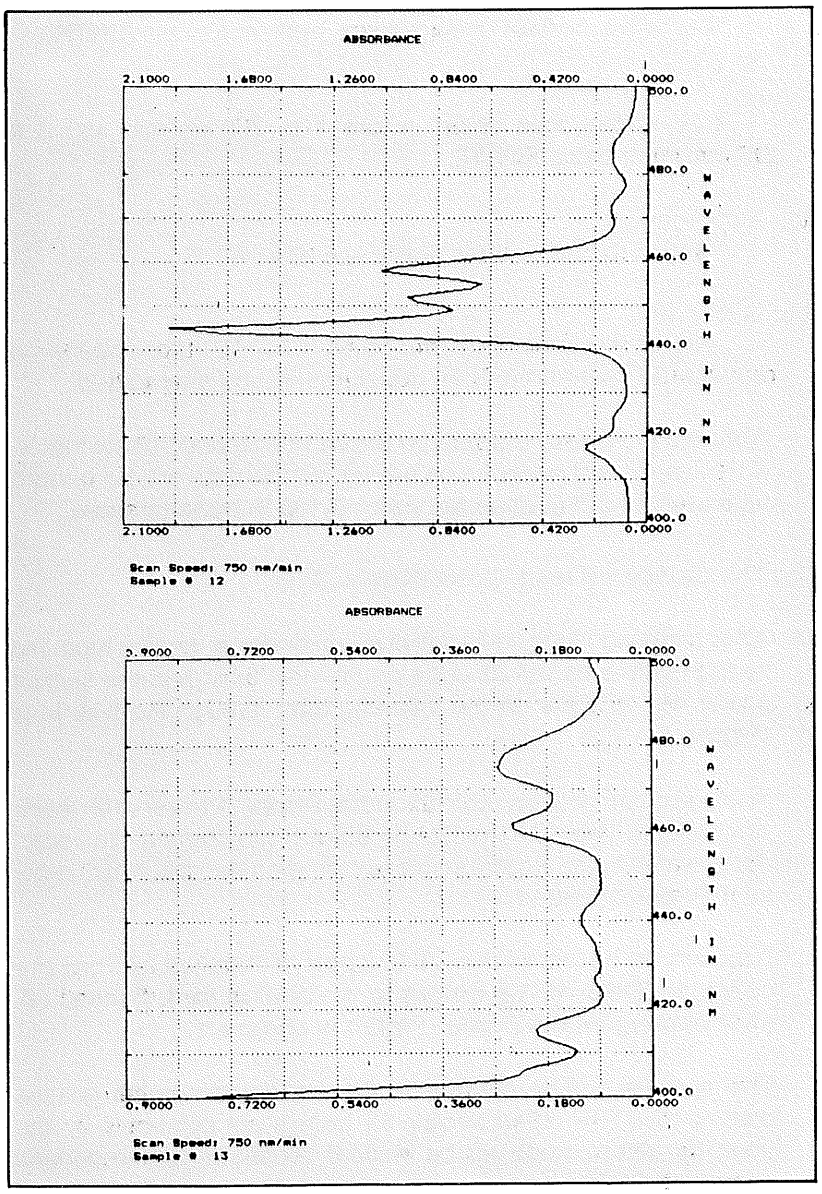


Figure 4. BatchSCN Output Example

Section 5 - Generic Commands

With the sipper and batch sampler accessories, ten generic commands become available. For complete information on the use of generic commands, please refer to the Programming Guide, Manual 523735.

Generic	Function
FILL	Runs the peristaltic pump forward as indicated by thumbwheel switch.
RETN	Runs the peristaltic pump backwards for twice the time indicated by thumbwheel switch.
BRTN	Returns the sample by running the peristaltic pump backward in the manner selected by the generic command SRTN.
SRTN	Selects the return mode for the peristaltic pump. The x-register defines the mode number (0, 1, 2, 3) when this generic command is called. The following table shows the return mode options.

Mode 0	**Mode 1**	**Mode 2**	**Mode 3**
return 80%	return 200%	return 80%	no return
raise arm		raise arm	raise arm
wait 1 second		wait 1 second	flush 5
return 20%		return 20%	seconds
wait 1 second		wait 1 second	
return 20%		return 20%	
wait 1 second		wait 1 second	
return 100%		forward 200%	

The mode is automatically set to 0 at power up. This mode is used until a call to the generic command SRTN changes the mode or the instrument is powered down.

SFWD	Runs the peristaltic pump forward for number of seconds in the x-register, up to 255 seconds.
SREV	Runs the peristaltic pump backwards for number of seconds in the x-register, up to 255 seconds.
LOWR	Lowers batch sampler aspirator tube.

RISE — Raises batch sampler aspirator tube.

ADVC — Raises batch sampler aspirator tube (if not already raised) and advances to next sample position.

LAST — Returns the x-register to equal 0 or 1, where 0 = not on the last sample tube and 1 = on the last sample tube.

Example Program 1

The following program may be written on a DU®-65 or DU®-68 Spectrophotometer. It may be used with the DU®-62 or DU®-64 Spectrophotometer, when stored on a Memory-Pac™module. The program will prompt for a wavelength; calibrate the first sample; read and plot the next 60 samples; print the mean and standard deviation of the 60 readings; and, form feed to the end of the page. The results are shown in Figure 5. Many of the batch sampler generic commands are used in the subroutine "Next."

Step			Comment
000:	Strt		
001:	ABS		
002:	MSG	cWAV	Prompt for wavelength.
003:	MSG	ELEN	
004:	MSG	GTH?	
005:	R/S		
006:	LMDA		Move to the given wavelength.
007:	CALL	GET	Get a sample.
008:	CALB		Calibrate on it.
009:	CALL	NEXT	Go to the next sample tube.
010:	60		
011:	ENTR		
012:	0		
013:	CALL	SETX	Set the x-axis for 60 samples.
014:	1.5		
015:	ENTR		
016:	0		
017:	CALL	SETY	Set the y-axis for 0 to 1.5 abs.
018:	60		
019:	CALL	NPTS	Set the number of points.
020:	STO	000	Save the number of points.
021:	clrE		Clear the summation registers.
022:	lbl	LOOP	Start of reading/plot loop.
023:	READ		Take a reading.

Step			Comment
024:	E+		Add to summation registers.
025:	CALL	DOT	Plot the reading.
026:	CALL	NEXT	Go to the next sample tube.
027:	dec	000	Decrement the sample count.
028:	GOTO	LOOP	If not done go to the top of the loop.
029:	CALL	CRLF	
030:	CALL	CRLF	Skip two lines.
031:	MSG	cMEA	
032:	MSG	N=	
033:	CALL	COUT	
034:	xs		
035:	CALL	FOUT	Print the mean.
036:	CALL	CRLF	Next line.
037:	MSG	cSTD	
038:	MSG	DEV	
039:	MSG	=	
040:	CALL	COUT	
041:	XCHG		
042:	CALL	FOUT	Print the standard.
043:	CALL	CRLF	Next line.
044:	12		
045:	CALL	ASCI	Form feed the Printer/Plotter.
046:	rtn		Return to the user mode.
047:	lbl	NEXT	Subroutine.
048:	CALL	RETN	Return the sample to the tube.
049:	CALL	ADVC	Go to the next tube.
050:	lbl	GET	Entry for getting sample only.
051:	CALL	LOWR	Lower the arm.
052:	CALL	FILL	Sip the sample.
053:	2		
054:	wait		Wait for two seconds.
055:	rtn		Return from the subroutine.

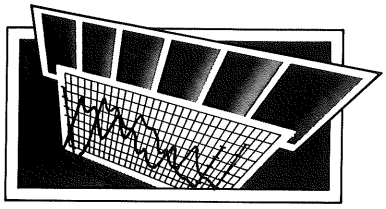
BECKMAN

Beckman Instruments, Inc. • Scientific Instruments Division • 2500 Harbor Blvd. • Fullerton, CA 92634-3100
(714) 871-4848 • TWX: 910-592-1260 • Telex: 678413

February 1988/CG

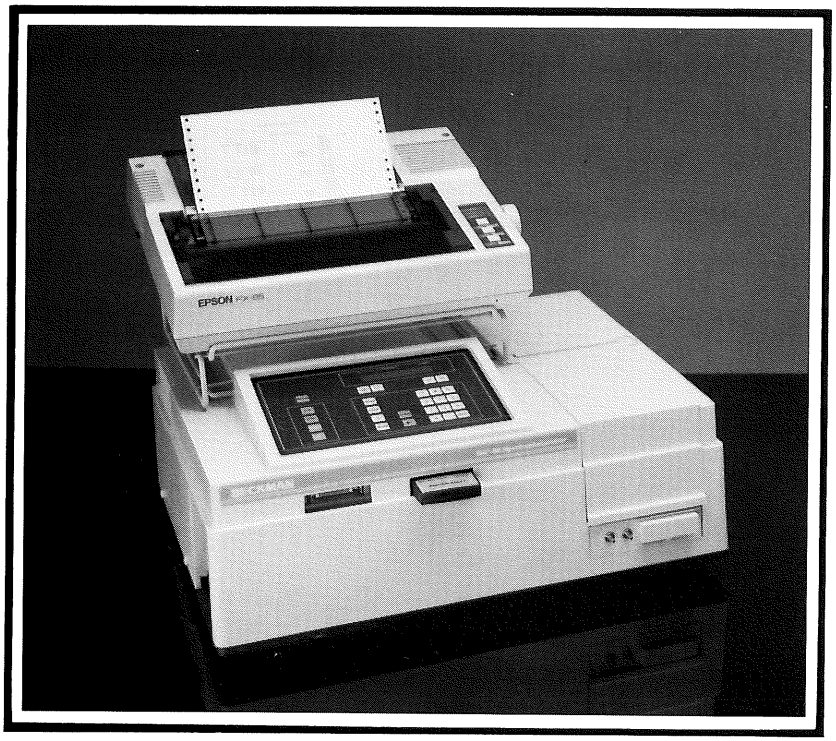
Printed in U.S.A.

Manual 523770C



DU® Series 60 Spectrophotometer Installation Instructions

DU®-62, DU®-64, DU®-65 and DU®-68 Spectrophotometers and the Printer/Plotter Accessory



BECKMAN

Installation Instructions for the DU® Series 60 Spectrophotometer and the Printer/Plotter Accessory, with the following part numbers.

Spectrophotometer Model	Part Number	
	120V	220/240V
DU®-62 Spectrophotometer	120620	120621
DU®-64 Spectrophotometer	120640	120641
DU®-65 Spectrophotometer	120650	120651
DU®-68 Spectrophotometer	120680	120681

Pinter/Plotter Model	Part Number	
	120V	220/240V
Epson* LX-800	523721	523722
Epson* FX-850	523701	523702

Note: If the Printer/Plotter was not ordered, ignore all references to it. The following instructions can be completed without it.

*Epson is a registered trademark of Epson America, Inc.

Part I. Unpacking

1. Carefully unpack the instrument and accessories. Inspect for shipping damage and, if necessary, file a damage report with the carrier as soon as possible. Note that the carrier is responsible for damage that occurred while in transit.

2. Use the packing slip to verify that the listed instrument and accessories were received. Report any shortages to the local Beckman office as soon as possible.

NOTICE

The instrument and Printer/Plotter should be installed first. Set all other accessories aside and install them after the instrument is operational.

Part II. Installation of the Spectrophotometer

3. Refer to the DU Series 60 Pre-Installation Instructions, Manual 523784, for information on location, electrical and spatial requirements for the instrument and accessories.

   Select a location for the instrument which has a constant temperature and which is away from heating and cooling vents and windows. The location should also be reasonably free of dust, excessive moisture and corrosive chemicals. Instrument performance may be affected by strong electromagnetic fields that may exist near large electric motors, centrifuges, diathermy machines and microwave sources.

   Make sure that the vents on both sides of the instrument, near the back, are not blocked. Unrestricted air flow around the vents is required for proper instrument operation.

   If possible, the power source should be a dedicated line. Do not use a power source which is also used by equipment which causes power spikes; such as refrigerators, water baths and centrifuges. The same power line *must* be used for the instrument, graphic display, Printer/Plotter, Peltier temperature controller, batch sampler and dissolution pump, if they are included with the system.

   Only a grounded, three-prong outlet may be used as a power source. If the outlet does not have a third (grounded) contact, install a proper receptacle before applying power. Do not use adapters, even for a short time.

4. Place the instrument at the chosen location. Remove all packing tape from the exterior surfaces of the instrument.

5. Verify that the shipping kit contains the following parts. If any of the parts are missing, contact the local Beckman office.

Part Number	Description
523730	DU Series 60 Spectrophotometer Operating Instructions
523735	Programming Guide (DU-65, DU-68)
523736	Keyboard Guide (DU-65, DU-68)
598237	Single Cell Holder
873155	Power Cord*
597069	Printer Cable (DU-64, DU-65, DU-68)
538113	Graphic Display Stand (DU-68)
538128	Graphic Display Cable (DU-68)
945672	Visible (tungsten) lamp
883908	Fuse (3A, 250V), for 120V instruments
945233	Fuse (1.5A, 250V), 2 each, for 220/240V instruments
884060	Fuse Carrier (5mm × 20mm), 2 each
884061	Fuse Carrier (0.25 × 1.25)
897512	Phillips Screwdriver
1885	Hex Driver, 3/32"

*This power cord is not compatible with the power outlets in all countries. If the plug is not compatible, contact the local Beckman office.

Part III. Installation of the Graphic Display

Note: The following instructions are for the DU-68 Spectrophotometer, only. If any of the other models were ordered, go to part IV.

Tools required: Small flathead screwdriver.

6. Locate the cable for the graphic display. Attach one end of the cable to the connector on the back of the graphic display. Secure by tightening the two screws. See Figure 1.

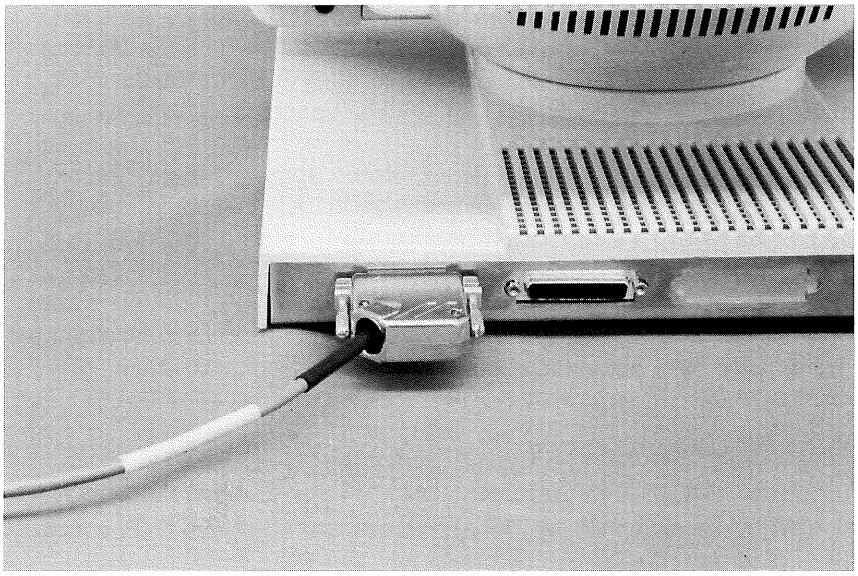


Figure 1.

7. Place the stand for the graphic display on the instrument, so that it is seated firmly around the keyboard. Place the graphic display on the stand. See Figure 2.

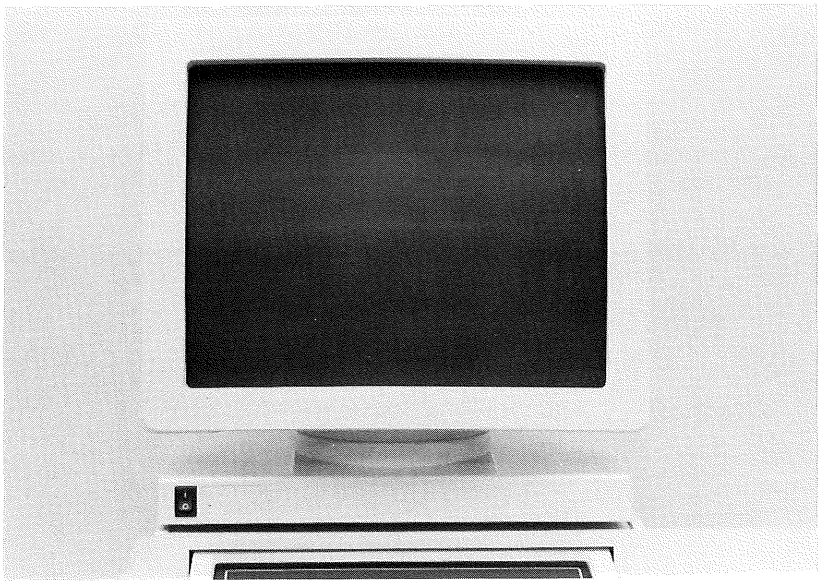


Figure 2.

NOTICE

As an alternative, the graphic display can be placed next to the instrument, on the left-hand side.

8. Attach the other end of the cable to the board labelled "CRT/RS232" installed in the accessory slots on the left-hand side of the instrument. Secure by tightening the two screws. See Figure 3.

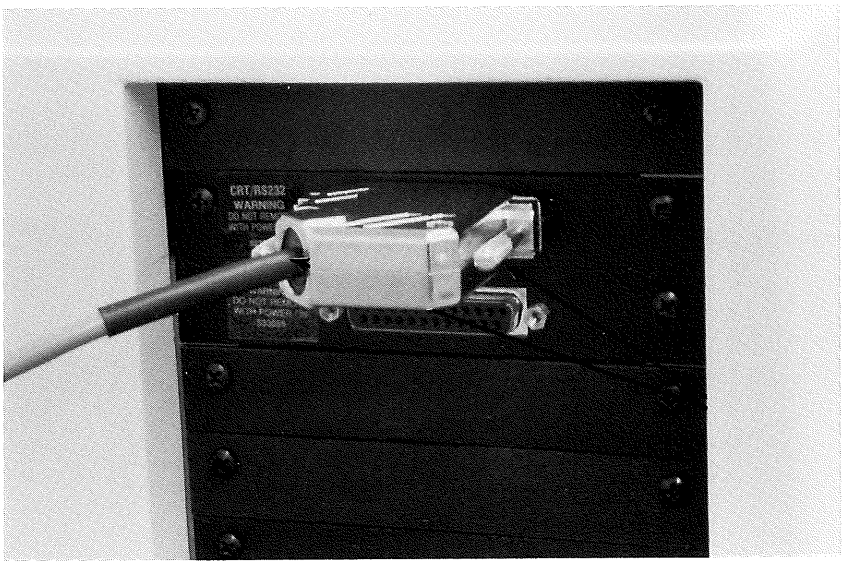


Figure 3.

Part IV. Installation of the Printer Board and Cable

Note: If the Printer/Plotter was not ordered, go to Part IX. The installation can be completed without it.

Tools required: Phillips screwdriver.
Small flathead screwdriver.

9. Check the accessory slots on the left-hand side of the instrument to see if a board labelled "PRINTER" is installed. See Figure 4. If it is installed, go to step 13.

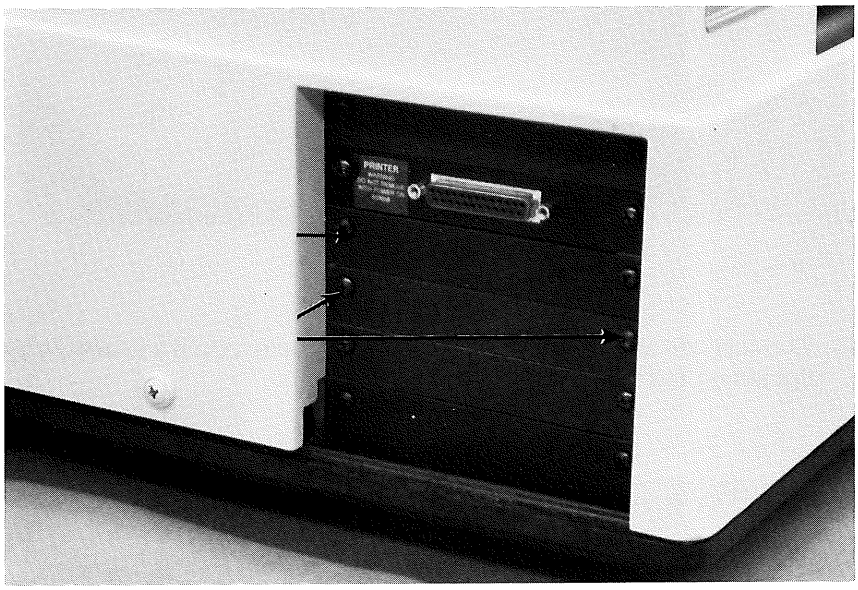


Figure 4.

10. If the printer board is not installed, verify that the instrument power cord is not plugged in.

CAUTION

Do not insert or remove any accessory board with the power on.

11. Remove one of the accessory covers using a Phillips screwdriver. Save the two screws.

12. Slide the printer board into the open position. Push to seat. Secure the board with the two screws removed in step 11. See Figure 5.

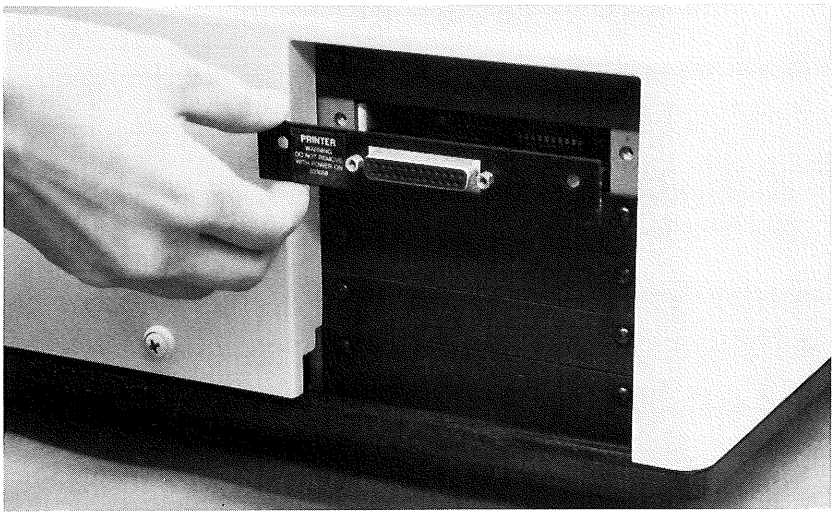


Figure 5.

13. Connect one end of the printer cable to the printer board and secure by tightening the two screws. See Figure 6.

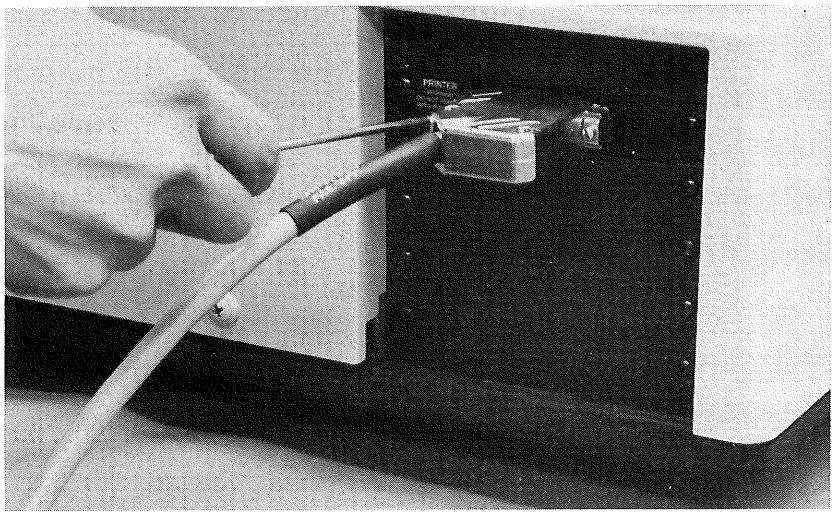


Figure 6.

Part V. Printer Assembly

NOTICE

The following instructions are for the LX-800 printer. If installing the FX-850 printer, refer to Appendix A.

Tools required: Flathead screwdriver

Parts required: See Figure 7.

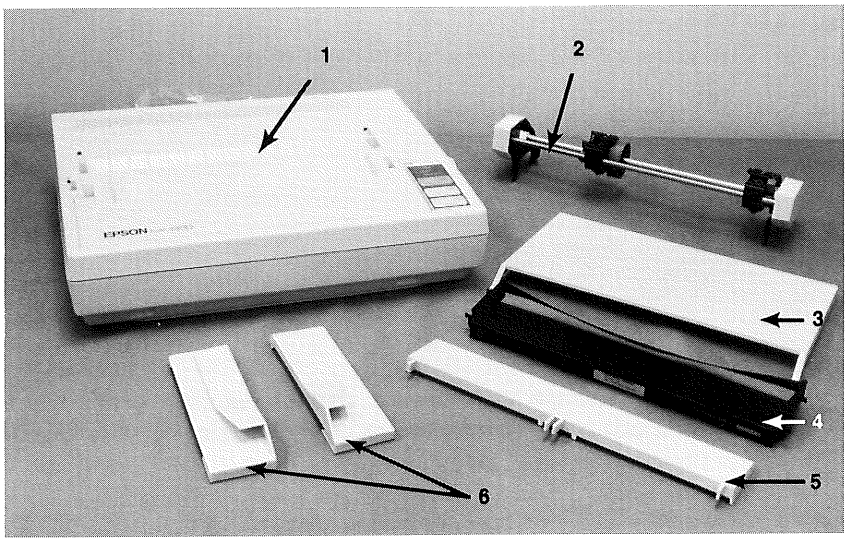


Figure 7.

1. Printer
2. Tractor drive
3. Paper Separator
4. Ribbon cartridge
5. Paper rest
6. Edge guides
7. Paper feed knob

NOTICE

The following instructions set up the printer for use with continuous-feed (fan fold) paper. The printer can also be used with single sheet paper. To set up the printer for single sheet paper, refer to the Chapter 1 in the User's Manual for the Epson LX-800 Printer.

14. Unpack and identify all printer parts.

15. Pull up on the back of the printer cover to release it from its locked position. Lift up to remove it. See Figure 8.

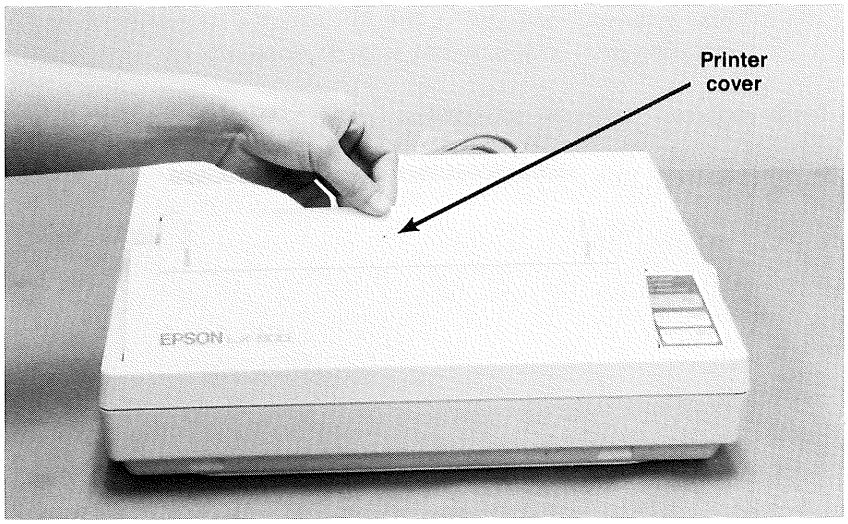


Figure 8.

16. Pull the paper release lever forward. Use the flathead screwdriver to remove the slot cover for the tractor drive. The slot cover is located above the control panel. See Figure 9.

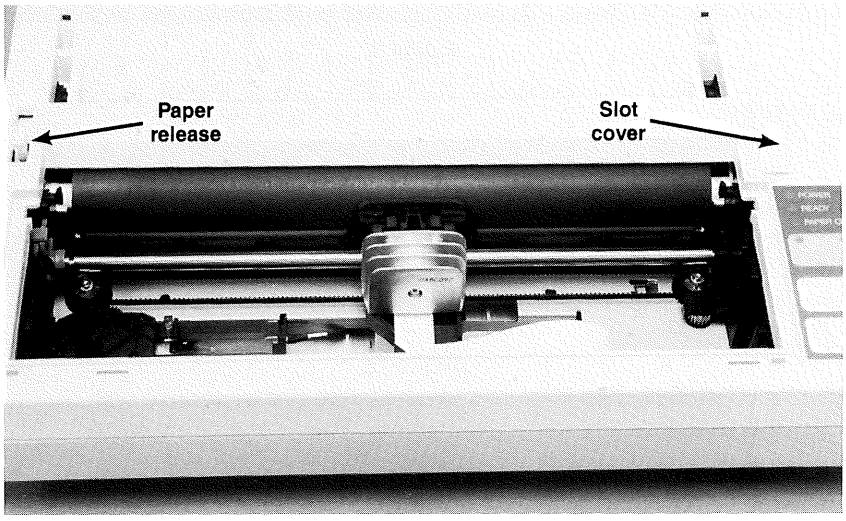


Figure 9.

17. Hold the tractor drive at an angle, tilted towards the back of the printer. Position the back legs of the tractor drive over the pegs in the printer. Then rotate the tractor drive forward until the front legs lock into place. See Figure 10.

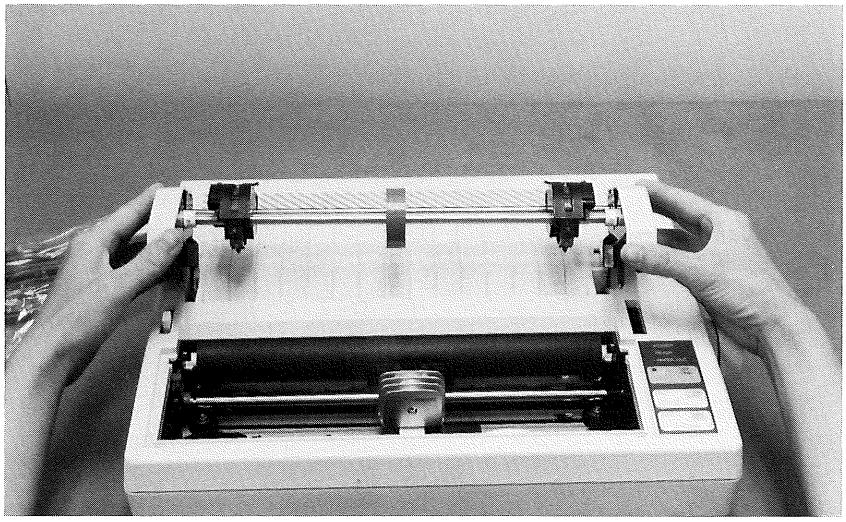


Figure 10.

18. Seat the paper rest into the slots in the top edge of the back of the printer. See Figure 11.

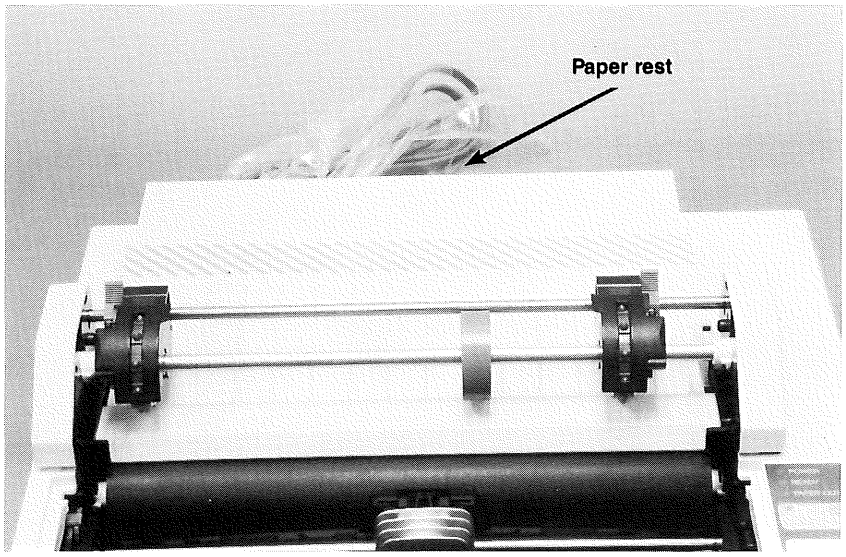


Figure 11.

19. Hold the paper separator at an angle and insert it into the slots in the printer, located behind the tractor drive. See Figure 12.

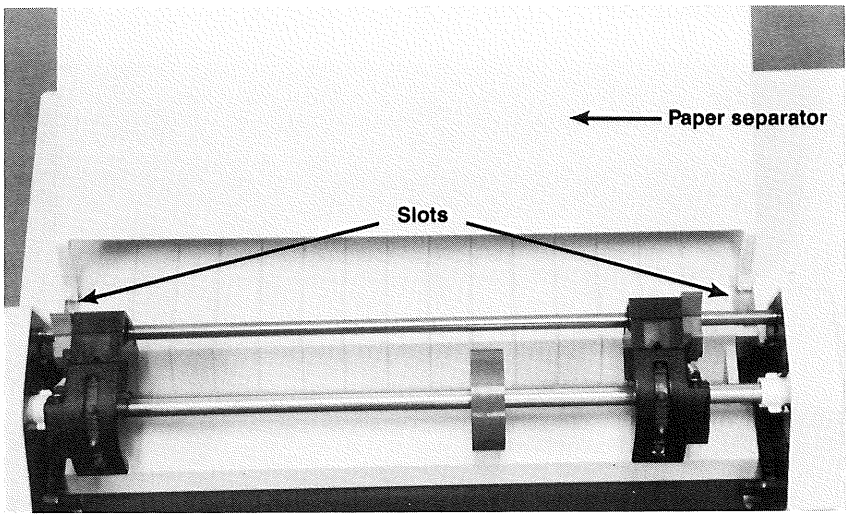


Figure 12.

20. When the paper separator is seated in the slots, lay it flat on the top of the printer. See Figure 13.

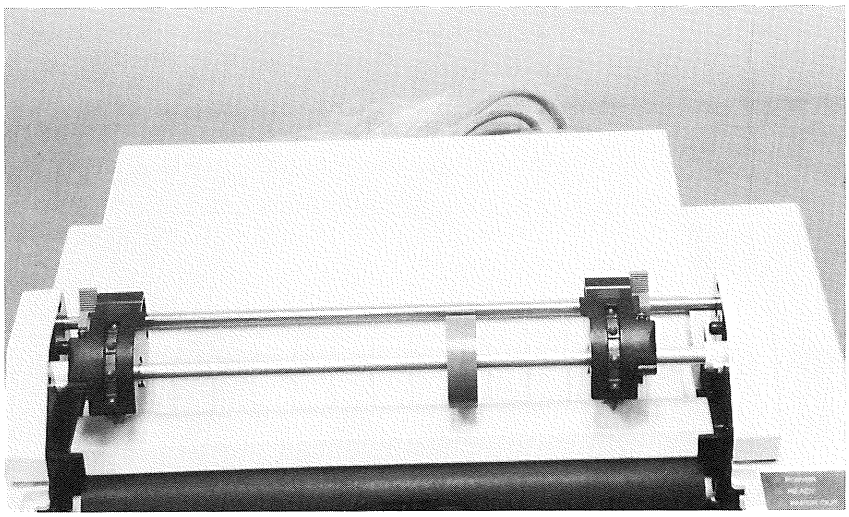


Figure 13.

NOTICE

The paper separator is used as a paper guide when the printer is used with single sheets of paper. Two edge guides are provided for this use. They do not need to be installed for use with continuous feed paper.

21. Install the paper feed knob by pushing it onto the end of the paper roller bar. See Figure 14.

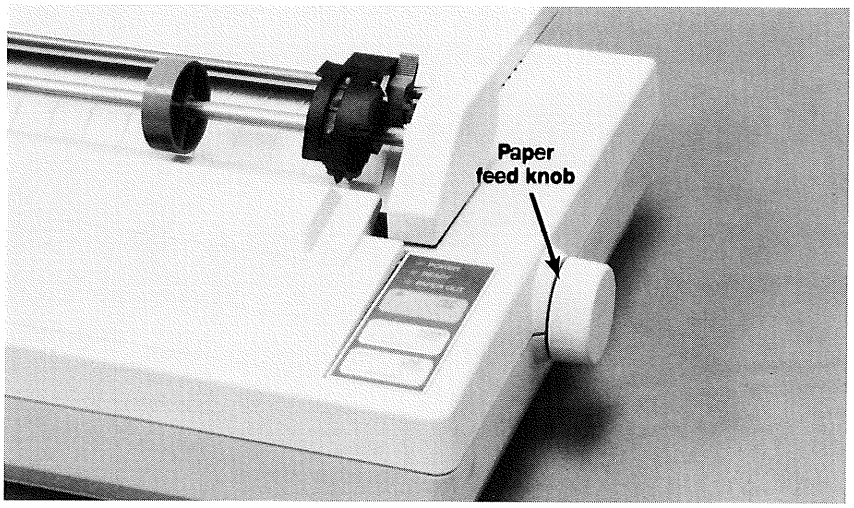


Figure 14.

22. Replace the printer cover by inserting the pins into the slots near the front corners of the printer. Lay the lid down. With the tractor drive installed, the printer cover does not lock into position.

Part VI. Installation of Printer Ribbon

NOTICE

The following instructions are for the Epson LX-800 printer. If installing the Epson FX-850 printer, refer to Appendix B.

23. Verify that the green power indicator light on the control panel is *not* illuminated. If it is illuminated, turn the power switch, located on the left-hand side of the printer, to the "OFF" position.

24. Remove the printer cover by lifting up on the back edge. See Figure 15.

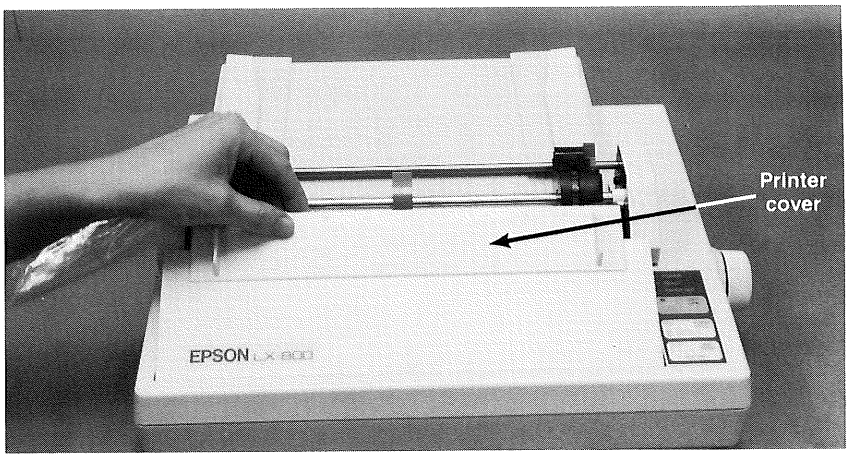


Figure 15.

25. If the printer has been in use, wait a few minutes to allow the print head to cool. Move the print head to the center of the printer. See Figure 16.

WARNING

Do not touch the print head when it is hot.

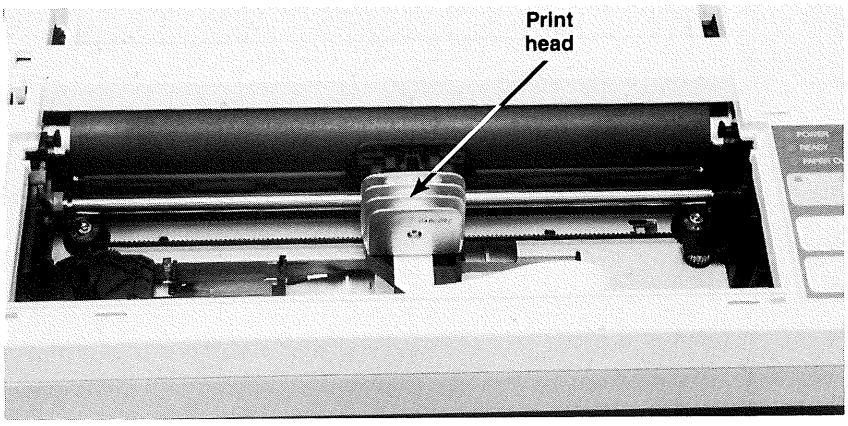


Figure 16.

26. Tighten the ribbon by turning the knob on the ribbon cassette in the direction indicated.

27. Hold the ribbon cartridge by the fin and lower it into the printer. Place the hooks on each end of the cartridge into the slots in the printer. Push down on the ribbon cassette until it snaps into place. See Figure 17.

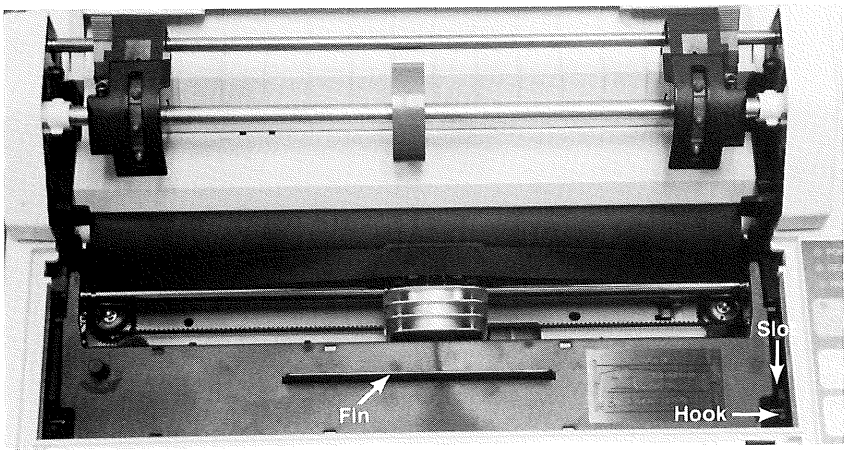


Figure 17.

28. Use a pencil to position the ribbon between the print head and the ribbon guide. Turn the knob on the ribbon cassette in the direction indicated to tighten the ribbon. As the ribbon is tightened, it should slip into place. See Figure 18.

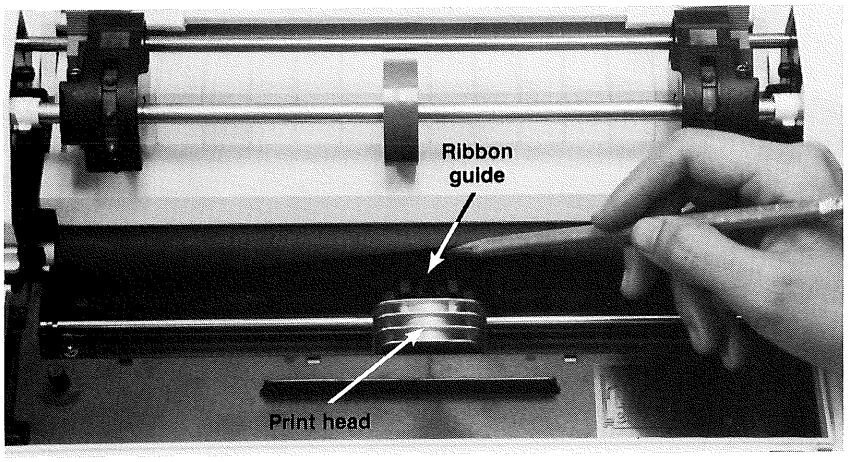


Figure 18.

29. Replace the printer cover by inserting the pins into the slots near the front corners of the printer. Lay the cover down.

Part VII. Installation of Printer Stand

30. Place the printer stand on the instrument, so that it is seated firmly around the keyboard, or set it next to the instrument. See Figure 19.

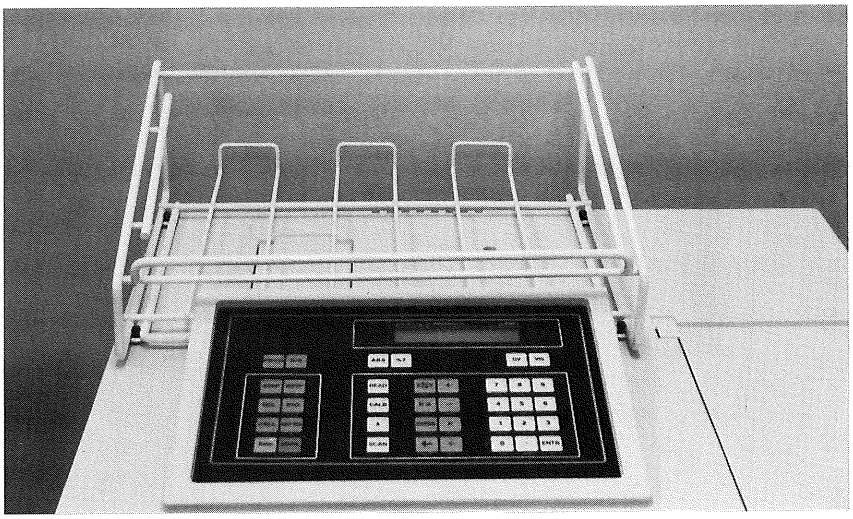


Figure 19.

31. Place the printer on the printer stand. See Figure 20.

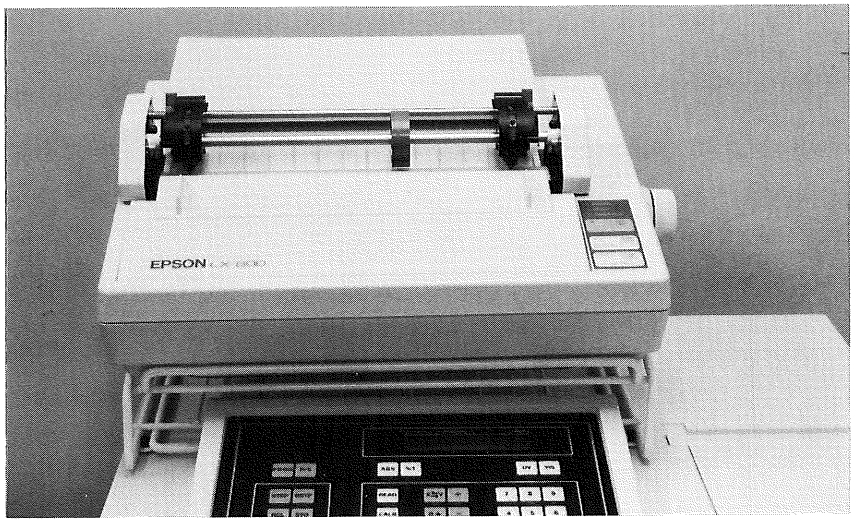


Figure 20.

32. Verify that the printer is positioned correctly by opening the sample compartment cover. If the sample compartment cover touches the paper feed knob, move the printer towards the left side of the printer stand.

Part VIII. Installation of Printer Paper

NOTICE

The following instructions are for the Epson LX-800 printer. If installing the Epson FX-850 printer, refer to Appendix C.

NOTICE

The following instructions are for continuous-feed paper. For single sheet paper, refer to the User's Manual for the Epson FX-850 Printer.

33. Verify that the green power indicator light on the control panel is *not* illuminated. If it is illuminated, turn the power switch, located on the left-hand side of the printer, to the "OFF" position.

34. Remove the printer cover by lifting up on the back edge. See Figure 21.

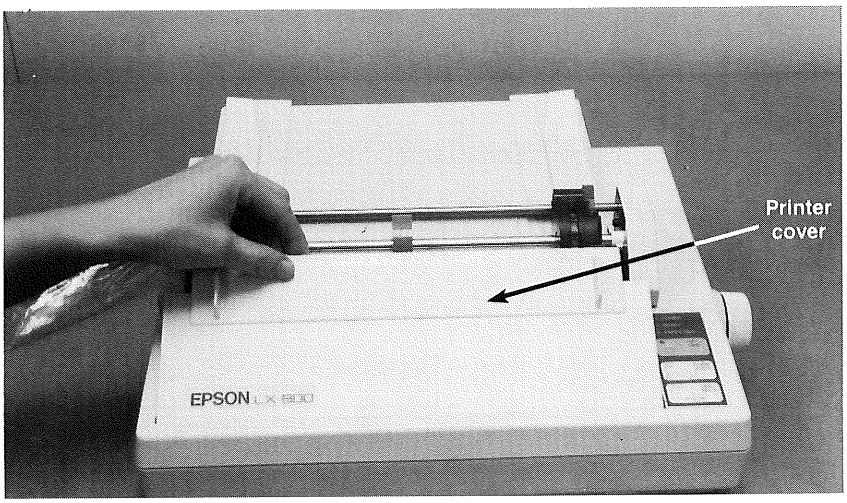


Figure 21.

35. If the printer has been in use, wait a few minutes to allow the print head to cool. Move the print head to the center of the printer. See Figure 22.

WARNING

Do not touch the print head when it is hot.

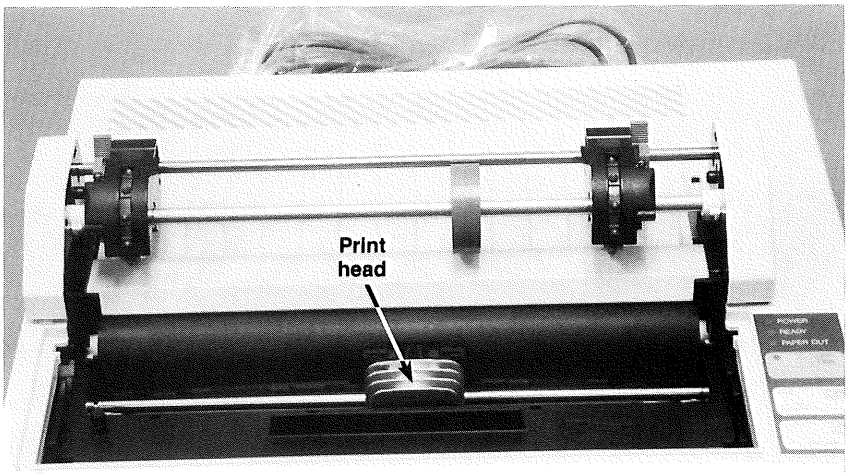


Figure 22.

36. Set the printer paper in the tray on the bottom of the printer stand.

37. Guide the paper around the back of the printer and under the paper separator. Push the paper through the paper slot on the top of the printer, until it comes through between the platen and the paper roller. See Figure 23.

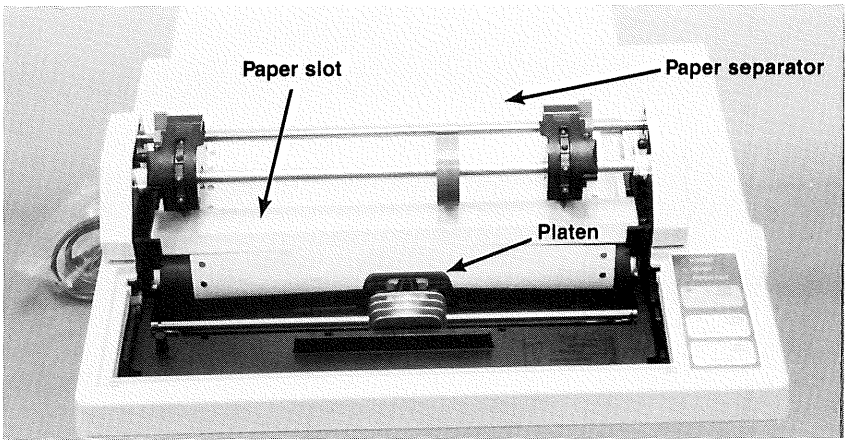


Figure 23.

38. Open the pin feed covers. Position the holes in the paper on the pin feed holders and close the pin feed covers. See Figure 24.

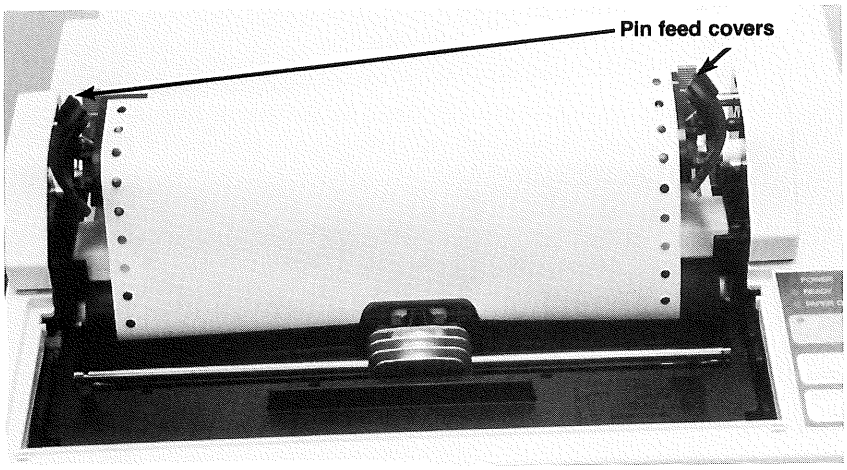


Figure 24.

NOTICE

If the pin feed holders are not located in the proper positions for the paper, relocate them as follows. Unlock the pin feed holder on the left side and position it about 2 cm from the left side of the printer. Lock it in place and seat the paper in it. Then position the pin feed holder on the right-hand side, so that it fits the paper, and lock it in place. See Figure 25.

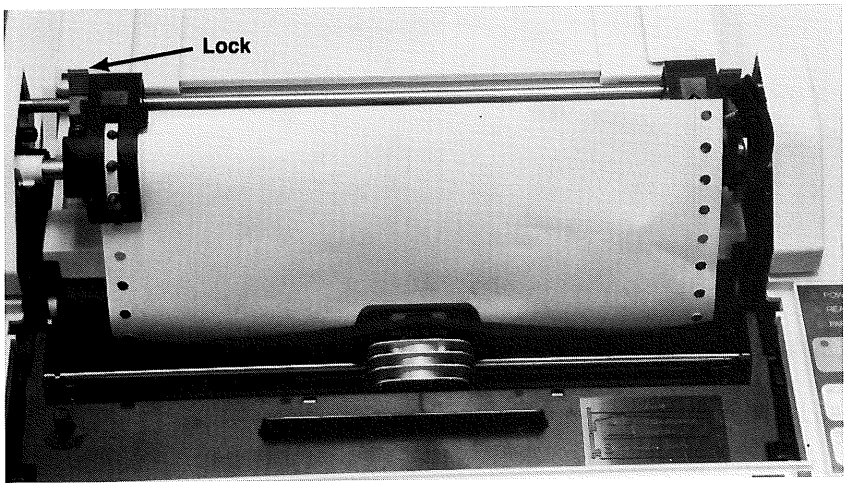


Figure 25.

39. Set the page position by moving the paper through the printer using the paper feed knob. The perforation should be even with the top of the ribbon guide.

NOTICE

The printer is set to form feed paper that is 11 inches (28 cm) long. To adjust the form feed for A4 paper that is 30 cm long, refer to Appendix D in the User's Manual for the Epson LX-800 Printer.

40. Replace the printer cover by inserting the pins into the slots near the front corners of the printer. Lay the lid down.

41. Route the end of the printer cable under the paper to the connector on the right back side of the printer. Insert the connector and secure with the attached clips. See Figure 26.

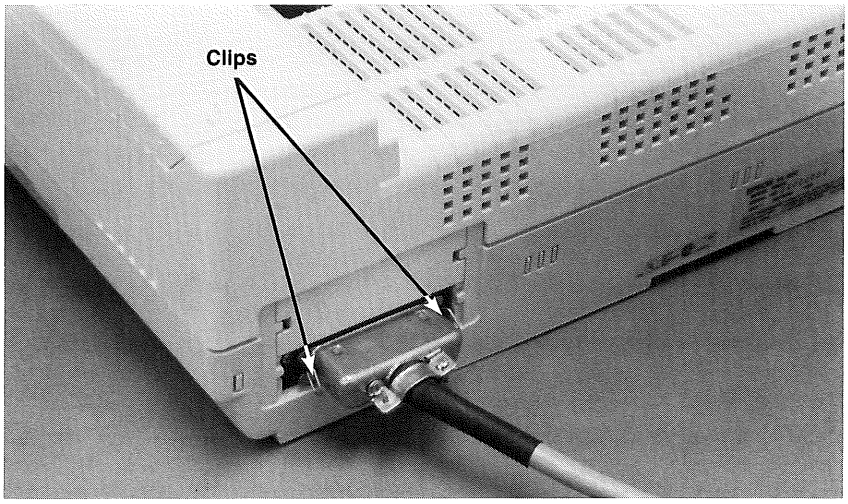


Figure 26.

42. Verify that the paper is not twisted or creased as it is routed around the back of the printer and that it does not touch the sides of the printer stand or the printer cable.

43. Verify that the voltage indicated on the plate at the back of the Printer/Plotter is the same as the power source.

CAUTION

The voltage indicated on the Printer/Plotter must be the same as the power source.

44. Plug in the Printer/Plotter. Turn on the power switch, located on the left side of the printer.

45. *FX-850 printer.* Press the [LOAD/EJECT] button to feed the paper through the printer.

46. Press the [ON LINE] button, so that the indicator light is illuminated.

47. *DU-68.* Verify that the voltage indicated on the graphic display is the same as the power source.

CAUTION

The voltage indicated on the graphic display must be the same as the power source.

48. *DU-68.* Plug in the graphic display. Turn on the power switch. Wait for the display to illuminate before continuing.

NOTICE

If the graphic display does not illuminate within 20 seconds, adjust the brightness by turning the control in the clockwise direction. If the display is still not illuminated, turn the power switch off, then on again. If the display remains dark, call Beckman service.

49. Verify that the voltage indicated on the plate at the back of the instrument is the same as the power source.

CAUTION

The voltage indicated on the instrument must be the same as the power source.

50. Verify that nothing is in the sample compartment of the instrument that would block the beam. Close the sample compartment cover.

NOTICE

Do not open the sample compartment cover until the diagnostic tests are complete.

NOTICE

Allow the instrument to equilibrate until it reaches room temperature before applying power.

51. Plug the power cord into the back of the instrument, then plug the instrument into a grounded, three-prong outlet on the same line as the graphic display and Printer/Plotter, if installed.

CAUTION

The instrument must be plugged into a grounded power outlet.

52. *DU-62, DU-64 and DU-65.* The instrument will begin the power up diagnostics. The following will be on the display. The software revision is indicated by a letter following "v.".

POWER-UP DIAGNOSTICS
DU-65 (v.X)

The instrument will then perform a series of diagnostic tests, called the "System Test". When they are completed satisfactorily, the wavelength calibration will be performed and an asterisk will blink on the display. When this is complete, the following will be on the display.

486	A	
		0.000

NOTICE

If either test fails, refer to section 7.1 of the DU Series 60 Spectrophotometer Operating Instructions, Manual 523760, for further instructions.

53. *DU-68.* The instrument will first check the CRT/RS232 board then will begin the power up diagnostics. The following will be on the display. Notice that the software version is indicated on the display.

NOTICE

If "CRT Board Fail" is printed on the Printer/Plotter, refer to the troubleshooting instructions in Appendix E. If the display remains blank, refer to the troubleshooting instructions in Appendix F.

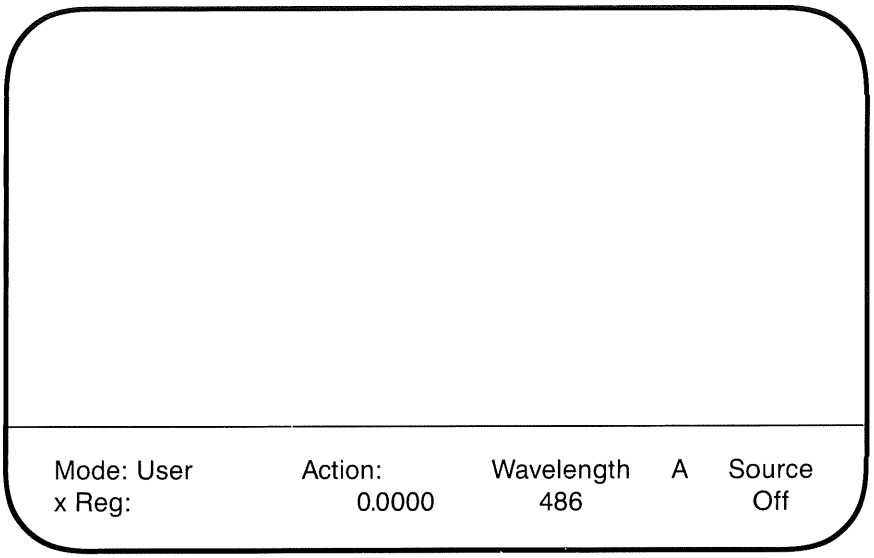
BECKMAN

DU-68 SPECTROPHOTOMETER

POWER-UP DIAGNOSTICS
System Test

Version X

The instrument will then perform a series of diagnostic tests, called the "System Test". When they are completed satisfactorily, the wavelength calibration will be performed. When this is complete, the following will be on the display.

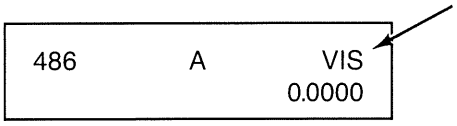


NOTICE

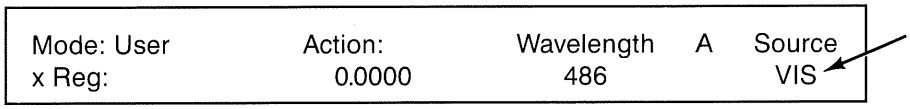
If either test fails, refer to section 7.1 of the DU Series 60 Spectrophotometer Operating Instructions, Manual 523760, for further instructions.

Part IX. Check Out

54. Turn on the visible source by pressing (VIS). "VIS" is displayed in the source status field to indicate that the visible source is on. The alphanumeric display on the DU-62, DU-64 and DU-65 Spectrophotometers will appear as follows.



The bottom two lines of the graphic display on the DU-68 Spectrophotometer will appear as follows.

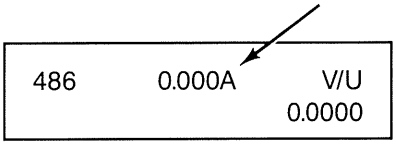


55. Turn on the UV source by pressing (UV). The source status field will be changed to "V/u", indicating that the UV source has been turned on, but that the source has not fired yet.

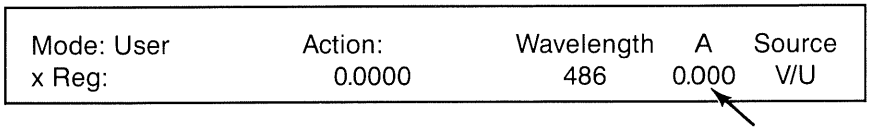
56. After about 2.5 minutes, the UV source will light and the source status field will be changed to "V/U".

57. Press (CALB) to calibrate. Wait for "Calb" to be removed from the display, indicating that the calibration is complete.

58. An absorbance reading of approximately zero will be displayed on the top line of the DU-62, DU-64 and DU-65 Spectrophotometer alphanumeric display, as shown.



The absorbance reading will be displayed on the right-hand side of the bottom line of the DU-68 graphic display, as shown.



59. Open the sample compartment cover. The absorbance reading should change to a negative number.

NOTICE

In a dark room, the reading may not change to a negative number.

60. If the display indicates that both sources turned on properly and the readings in steps 58 and 59 were correct, the instrument is operational.

NOTICE

If the sources did not turn on or if the readings were not correct, contact the local Beckman service office.

61. Other accessories can now be installed. Refer to the installation instructions which accompany each accessory.

62. The instrument is now ready to operate. Refer to the DU Series 60 Spectrophotometer Operating Instructions, Manual 523760, for complete operating information.

Appendix A. FX-850 Assembly

Tools required: Flathead screwdriver

Parts required: See Figure A1.

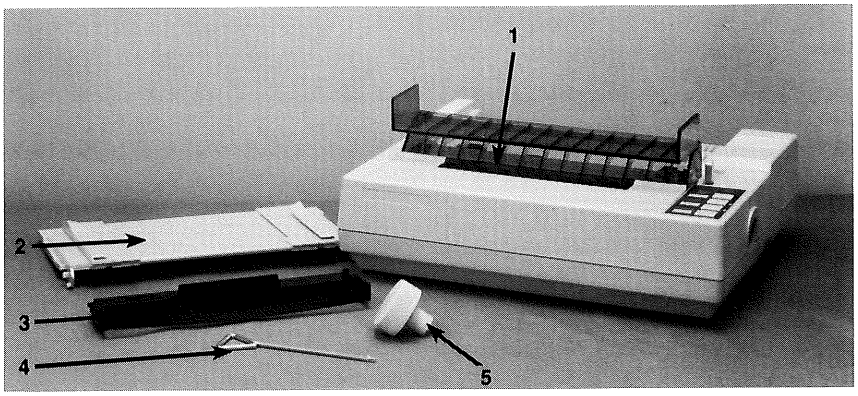


Figure A1.

1. Printer
2. Paper separator
3. Ribbon cartridge
4. Phillips screwdriver
5. Paper feed knob
6. Power cord*
7. Fuse (1.25A, 250V slow blow) — for 220/240V printers
8. Fuse (2A, 250V slow blow) — for 120V printers
9. Voltage sticker, 220/240V

*This power cord is not compatible with the power outlets in all countries. If the plug is not compatible, contact the local Beckman office.

1. Unpack and identify all printer parts.

2. Fold the back of the printer cover forward. Lift up on the cover to remove. See Figure A2.

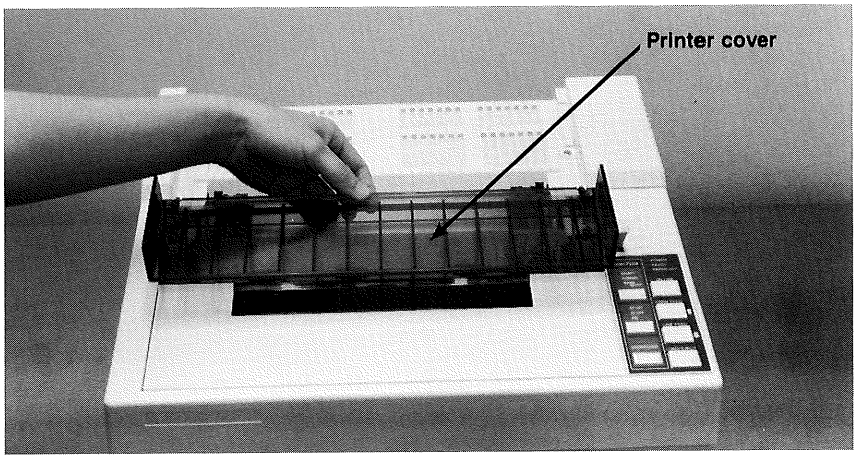


Figure A2.

3. Use the Phillips screwdriver to unscrew the two red screws that secure the two red transport locking brackets. Remove the screws and brackets. See Figure A3.

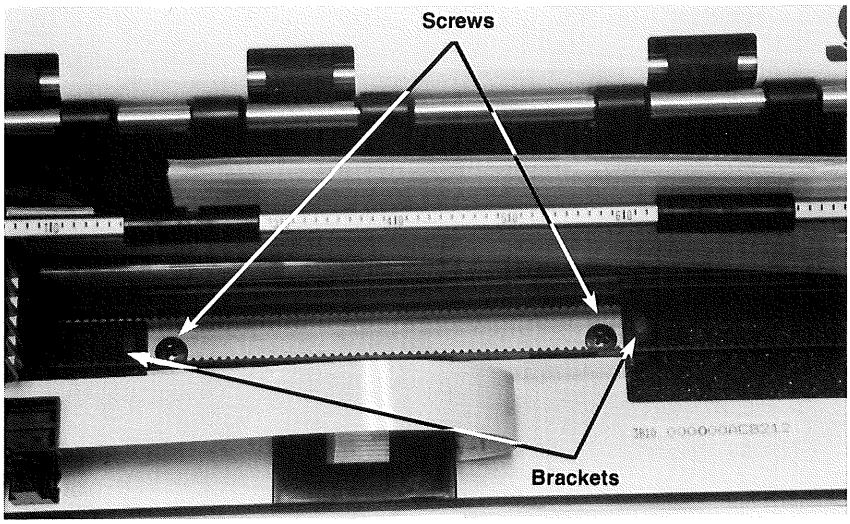


Figure A3.

4. Remove the protector for the print head. See Figure A4.

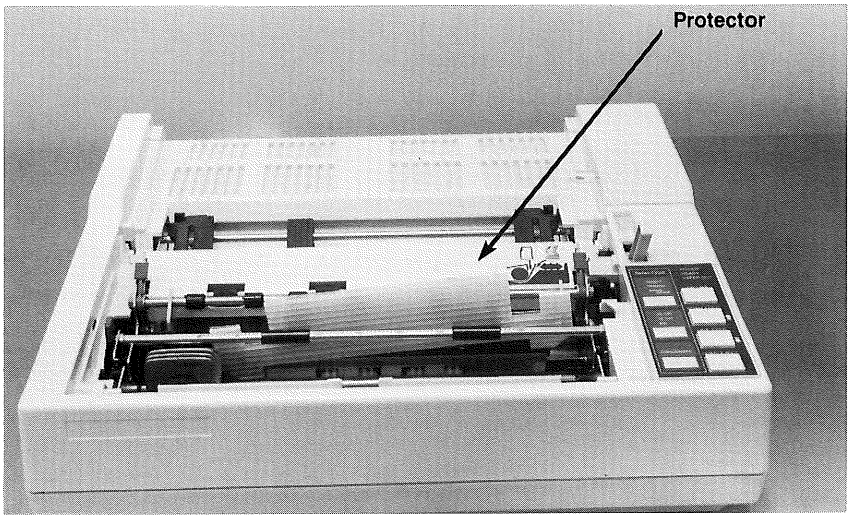


Figure A4.

5. Move the print head to the center of the printer. Twist the two tabs which secure the paper bail clockwise to remove. See Figure A5.

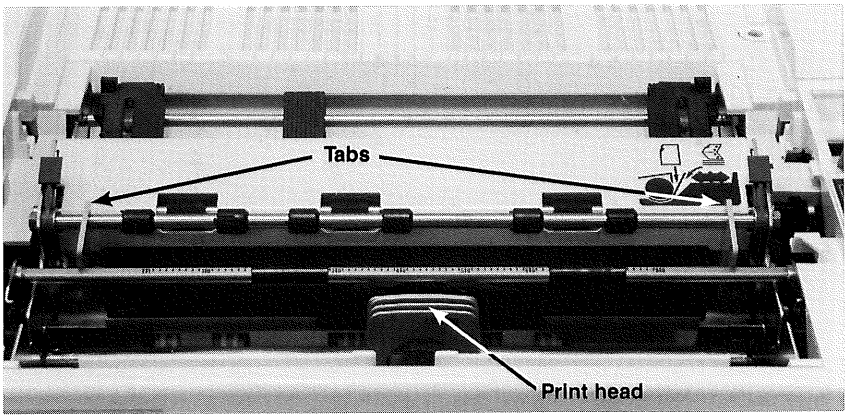


Figure A5.

6. Install the paper feed knob by pushing it onto the end of the paper roller bar. The knob will fit against the printer case. See Figure A6.

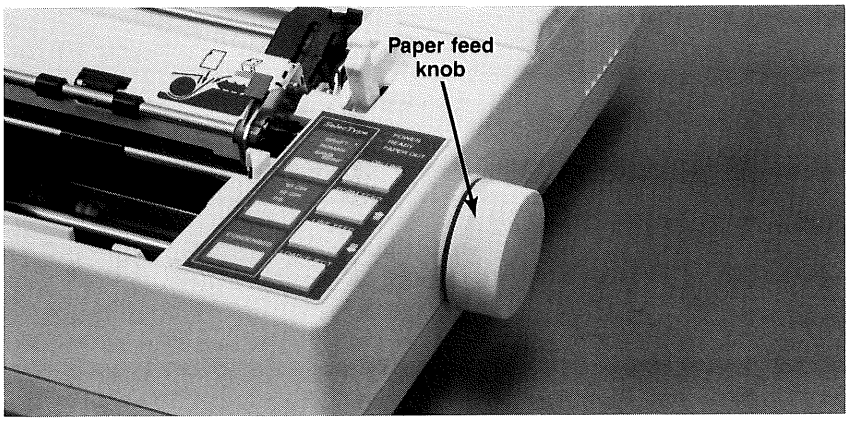


Figure A6.

CAUTION

The printer must be turned off when advancing the paper with the paper feed knob.

7. Replace the printer cover by placing the tabs on the front of the cover into the notches in the printer. Lay the cover down and press to lock it in place. Fold the cover back over the printer.

8. For 220/240V operation, follow the instructions in Appendix D to convert from 120V to 220/240V.

9. Plug the power cord into the back of the printer.

Appendix B. FX-850 Ribbon Installation

1. Verify that the green power indicator light on the control panel is *not* illuminated. If it is illuminated, turn the power switch, located on the left side of the printer, to the "OFF" position.

2. Fold the back of the printer cover forward. Lift up on the cover to remove. See Figure B1.

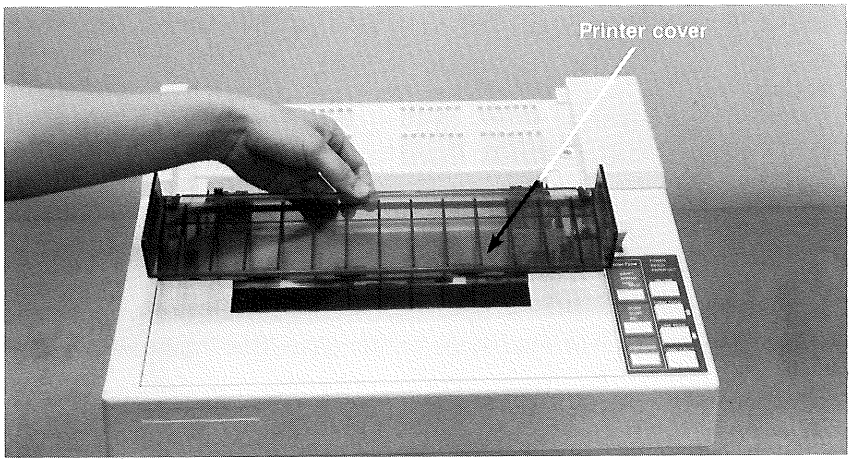


Figure B1.

3. If the printer has been in use, wait a few minutes to allow the print head to cool. Move the print head to the center of the printer. See Figure B2.

WARNING

Do not touch the print head when it is hot.

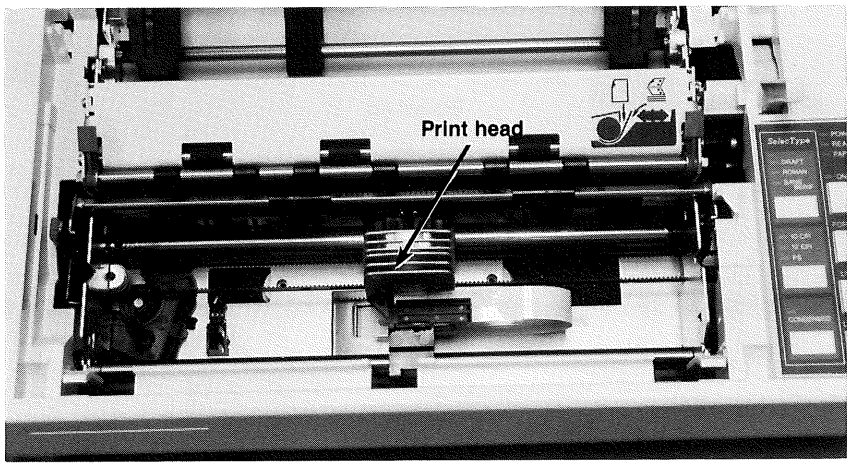


Figure B2.

4. Tighten the ribbon by turning the knob on the ribbon cassette in the direction indicated.

5. Hold the ribbon cartridge by the plastic fin and lower it into the printer. Place the hooks on each end of the cartridge into the slots in the printer. Push down on both ends of the ribbon cassette until it snaps into place. See Figure B3.

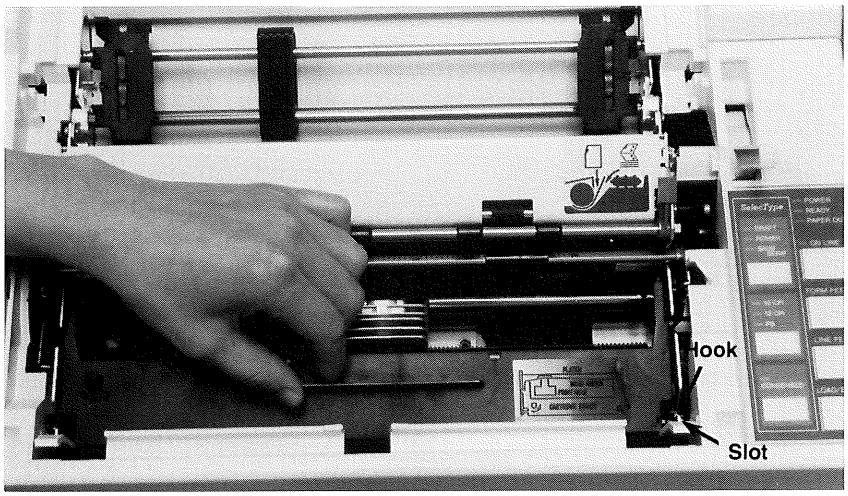


Figure B3.

6. Use a pencil to position the ribbon between the print head and the ribbon guide. Turn the knob on the ribbon cassette in the direction indicated to tighten the ribbon. As the ribbon is tightened, it should slip into place. See Figure B4.

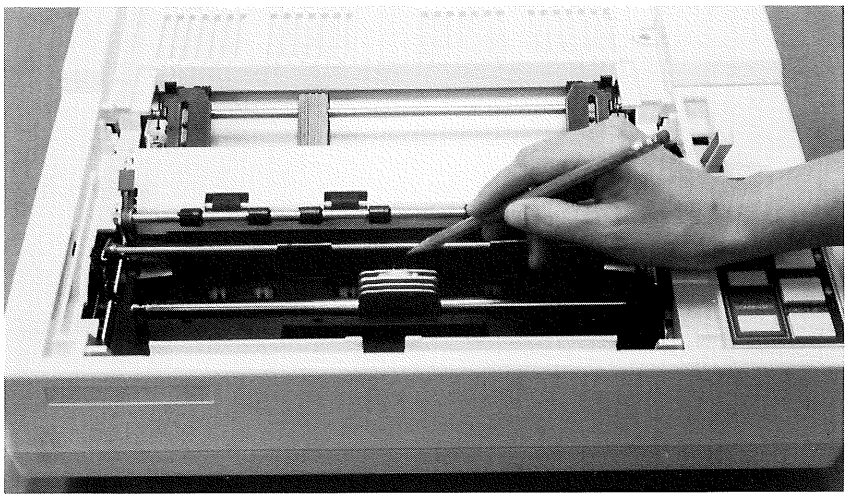


Figure B4.

7. Slide the print head from side to side to verify that it moves freely. Also verify that the ribbon is not wrinkled or creased.

8. Replace the printer cover by placing the tabs on the front of the cover into the notches in the printer. Lay the cover down and press to lock it in place. Fold the cover back over the printer.

Appendix C. FX-850 Paper Installation

NOTICE

The following instructions are for continuous-feed paper. For single sheet paper, refer to the User's Manual for the Epson FX-850 Printer.

1. Verify that the green power indicator light on the control panel is *not* illuminated. If it is illuminated, turn the power switch, located on the left-hand side of the printer, to the "OFF" position.

2. Fold the back of the printer cover forward. Pull the paper release lever forward. Remove the paper separator. See Figure C1.

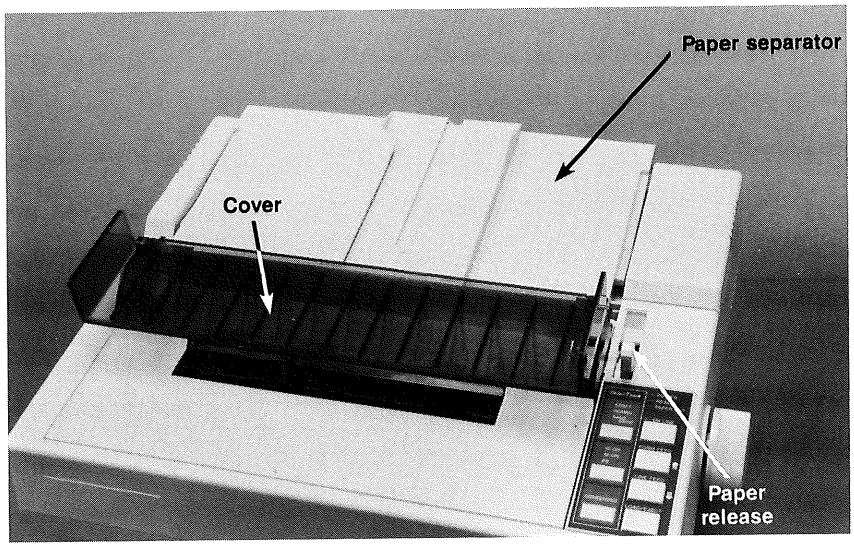


Figure C1.

3. Set the printer paper in the tray on the bottom of the printer stand.

Appendix D. Voltage Conversion

The following instructions convert the voltage setting on the FX-850 printer from 120V to 220/240V.

Tools required: Flathead screwdriver

Parts required: Fuse — 1.25A, 250V slow blow

Voltage sticker — 220/240V

1. Turn the printer around, so that the back of the printer is facing forward.
2. Unplug the power cord, if it is connected to the printer.
3. Locate the fuse compartment, located below the power inlet. Use a flathead screwdriver to pull the fuse compartment open.
4. Remove the fuse and replace it with the 1.25A, 250V slow blow fuse provided. Push the fuse compartment closed.
5. Peel off the voltage sticker which indicates 120V. This will reveal the voltage selectors.
6. Move the voltage selector from position VS1 to VS2 to set 220/240 volts.
7. Attach the 220/240 voltage sticker to the voltage selector.

Appendix E. CRT/RS232 Board Verification (DU-68)

Use the following instructions to verify that the "CRT/RS232" board is properly configured and installed in the instrument if the error message "CRT Board Fail" is printed during power up.

Tools required: Phillips screwdriver.

1. Unplug the instrument.

CAUTION

Do not remove or insert any accessory board with the power on.

2. Locate the board labelled "CRT/RS232" installed in the accessory slots on the left-hand side of the instrument. See Figure E1.

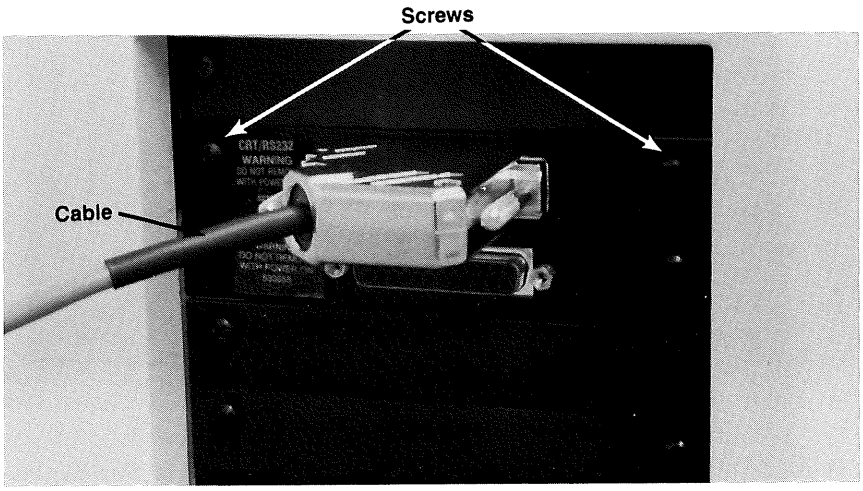


Figure E1.

3. Use a Phillips screwdriver to remove the two screws that secure the board to the instrument. Save the two screws. Do not disconnect the cable.
4. Pull the board out of the instrument, holding onto the connector on the cable.
5. Locate the jumper on the CRT/RS232 board. Verify that it is in the "CRT" position. See Figure E2.
6. The CRT/RS232 board also has an eight-bit DIP switch, which is used to identify the type of graphic display. Only the first three switches are used for this purpose. The other five switches can be in either the "ON" or "OFF" position.

Look at the serial plate on the back of the graphic display to identify the manufacturer. Verify that the switches are in the proper positions using the following table. The switch positions are shown in Figure E2.

Graphic Display	Switch #1	Switch #2	Switch #3
HDS	Off	Off	Off
Visual	Off	On	Off
GraphOn*	On	Off	Off

* GraphOn is a registered trademark of the GraphOn Corporation.

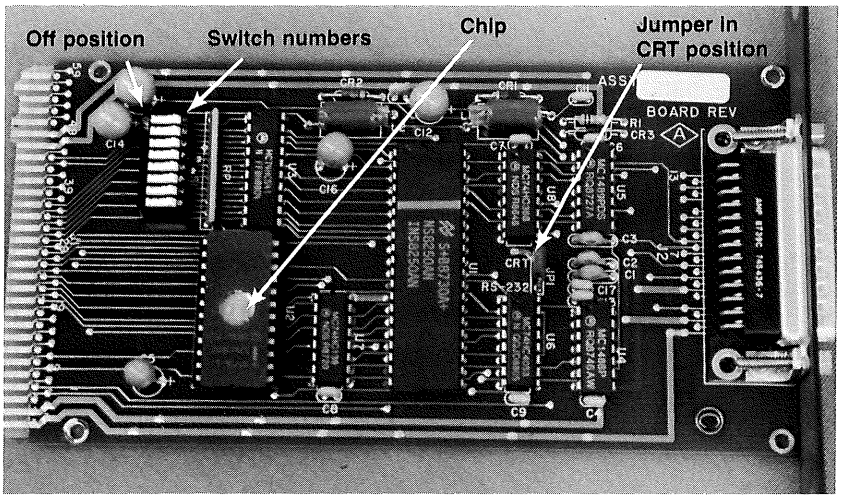


Figure E2.

7. Press on the chip to verify that it is firmly seated in the socket. See Figure E2.
8. Replace the board in the instrument and push to seat. Secure the board with the two screws removed in step 3.
9. Repeat the power up instructions, starting at step 48. If the same error message is printed, call Beckman service.

Appendix F. Graphic Display Troubleshooting Instructions (DU-68)

Use the following instructions if the display is illuminated, but remains blank when power is applied to the instrument.

NOTICE

If the graphic display and the instrument are powered up at the same time, some information may be missing from the graphic display, as shown on page 25. It is necessary to turn on the graphic display *before* plugging in the instrument.

1. Verify that the cable is securely connected between the CRT/RS232 board on the left-hand side of the instrument and the connector on the back of the graphic display. (Refer to steps 6 and 8 of these instructions.)

2. Check the accessory slots on the left-hand side of the instrument to see if a board labelled "RS232" is installed. If it is, follow the directions in Appendix E to unplug the instrument, remove the RS232 board and verify that the jumper is in the "RS-232" position.

3. If the above steps do not result in proper performance, call Beckman service.

BECKMAN

Beckman Instruments, Inc. • Scientific Instruments Division • 2500 Harbor Boulevard • Fullerton, CA 92631-3100
(714) 871-4848 • TWX: 910-592-1260 • Telex: 678413

September 1988

Printed in USA

Batch Operation

Example: Single wavelength readings in absorbance (OD) units and multiplied by a factor, 10 (giving final concentration) at 280 nm for automatic operation with printout of results.

Keystroke/Action	Explanation
UV	Turns on ultraviolet lamp; "u" on display changes to "U" when ignited; allow 30 minutes for warm-up.
ABS	Takes readings in absorbance mode.
PROG	Enters program directory.
STEP	Repeated until "PROG:6Batch1WL" appears on display; ready for single wavelength batch operation.
R/S	Begins execution of program; "Wavelength" appears on display.
2 8 0 ENTR	Entry of analytical wavelength; "FACTOR" appears on the display.
1 0 ENTR	Multiplication factor entry to give final concentration values; "Start Sample #:" appears on display.
1 ENTR	Samples to be numbered starting at "1".
Set thumbwheel to 8.0	Selects action of pump for eight seconds.
FLUSH	Cleans flow cell before use (optional).
	"Load Samples R/S" appears on display.
Load samples	Load blank tube under sampling arm; load samples starting next position; put red tube holder at end of samples to indicate a stop.
R/S	Starts run; calibration proceeds automatically on the sample in the current position and starts reading samples on the next position and sends results to the Printer/Plotter.

Memory-Pac™ Module Operation

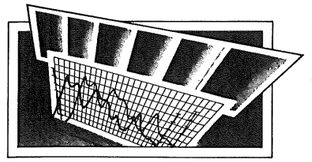
Memory-Pac modules are programmed through use of the DU-65 and DU-68 Spectrophotometers. Once inserted, the programs may be run on any DU Series 60 Spectrophotometer. Programs are individually written by the user, but many are available through the Program Exchange.

Keystroke/Action	Explanation
Insert programmed module in left slot	Beckman preprogrammed Soft-Pac™ modules are used in the right slot.
PROG	Accesses program directory.
STEP	Steps through program areas; continue until desired routine name appears; Memory-Pac ™ module programs occupy areas 4 and 5; areas 0 through 3 reside in the instrument.
or	
BSTP (DU-65, DU-68)	
R/S	Begins execution of the program; also stops execution.

BECKMAN

Beckman Instruments, Inc. • Scientific Instruments Division • 2500 Harbor Blvd. • Fullerton, CA 92634-3100
(714) 871-4848 • TWX: 910-592-1260 • Telex: 678413
March 1988/CG

Printed in U.S.A.



DU® Series 60 Spectrophotometer

Condensed Operating Guide

The following instructions complement, not replace, the Operating Instructions for DU® Series 60 Spectrophotometers, Manual 523760.

Single Wavelength Reading

Example: Setting absorbance (OD) reading at 280 nm.

Keystroke/Action	Explanation
VIS	Turns on visible lamp.
UV	Turns on ultraviolet lamp; "u" on display changes to "U" when ignited; allow 30 minutes warm-up.
ABS	Takes readings in the absorbance mode.
2 8 0 λ	Sets single wavelength mode.
Insert reference or clear path (air reference).	
CALB	Calibrates at wavelength shown on display.
Insert sample.	
READ	Takes reading and subtracts background; analyst may read value on display.
PRINT	Prints result on Printer/Plotter. (For DU®-65 or DU®-68, press func 6 P prt .)

BECKMAN

Wavelength Scan

Example: Scanning from 700 to 250 nm in absorbance (OD) units at 500 nm/min from 0 to 2.0 A (OD) units.

Keystroke/Action	Explanation
VIS	Turns on visible lamp.
UV	Turns on ultraviolet lamp; "u" on display changes to "U" when ignited; allow 30-minute warm-up.
ABS	Takes readings in absorbance mode.
SCAN	Selects scanning mode.
7 0 0 ENTR	Selects starting wavelength.
2 5 0 ENTR	Selects ending wavelength; "750 nm/min" should be displayed after entry.
STEP	Steps through options until "500 nm/min" is displayed.
ENTR	Enters scan speed.
2 . 0 ENTR	Sets upper absorbance limit.
0 . 0 ENTR	Sets lower absorbance limit; entering the same number for upper and lower limits will autoscale, except on the DU-68 Spectrophotometer.

Insert reference or clear path (air reference).

CALB	Calibrates according to input parameters; "Bkg" appears on display.

Insert background.

READ	Reads and stores background scan. "Scan" or "Ins Samp" appears on display.

Insert sample.

READ	Reads sample and subtracts background; sends result to output devices. Display reads "700 nm."

After all the samples have been scanned and replotted, as desired.

SCAN	Exits from the scan mode.

DU-68, only. To plot the data on the optional Printer/Plotter.

ABS PrtSc	Prints a copy of the display.

- - - - - - - - or - - - - - - - -

STEP	Steps through options until display reads "Graph: Plot."
ENTR	Selects plot mode.
READ	Plots the data.

Replot Wavelength Scan

Example: Replot the data from the last scan to expand a region of the data: 450 to 425 nm, -0.1 to 1.0A. On the DU-68, the data can be replotted on the graphic display or on the Printer/Plotter.

Keystroke/Action	Explanation
4 5 0 ENTR	Changes starting wavelength on plot.
4 2 5 ENTR	Changes ending wavelength on plot; display then reads "500 nm/min" from last scan.
STEP	Steps through options until display reads "rplt" (DU-64, DU-65). On the DU-68 the display reads "Graph: Display" to replot the data on the display or "Graph: Plot" to plot the data on the optional Printer/Plotter.
ENTR	Selects replot mode.
1 . 0 ENTR	Changes upper absorbance limit on plot.
0 . 1 CHGS	Changes lower absorbance limit on plot; changes sign of value.
ENTR	
READ	Replots the data.

Sipper Operation

Example: Single wavelength readings in absorbance (OD) units at 280 nm with five-second fill time and thorough rinse after two samples.

Keystroke/Action	Explanation
UV	Turns on ultraviolet lamp; "u" on display changes to "U" when ignited; allow 30 minutes warm-up.
ABS	Takes readings in absorbance mode.
2 8 0 λ	Selects wavelength.
Set thumbwheel to 5.0	Selects action of pump for five seconds.
Present distilled water	Initial rinse.
FLUSH	Hold for ten sec; remove water; hold for five sec (moves air through); not necessary but precautionary.
Present blank	Path must be full to prevent misreading.
FILL	
CALB	Calibrates at wavelength shown on display.
FLUSH	

Present sample.

FILL	Aspirates sample into flowcell; may read result on display.
PRINT	Prints result on Printer/Plotter. For DU®-65 or DU®-68, press func 6 (P prt) .)
RETURN	Returns sample to container.

or

FLUSH	Takes sample through peristaltic tubing to waste.

Present second sample — Repeat sequence of first sample.