



**AE-S60-4V**  
**VISIBLE SPECTROPHOTOMETER**

**USER'S MANUAL**

**A & E Lab (UK) Co., Ltd**



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## **WARRANTY**

**A & E Lab (UK) Co., Ltd. provides the one-year limited warranty for the units in this series. Lamp and cuvette are spare parts, it do not include in this warranty. This warranty does NOT apply if damage is caused by fire, accident, misuse, neglect, incorrect adjustment or repair, damage caused by incorrect installation, adaptation, modification, fitting of non-approved parts or repair by unauthorized personnel. When returned the defective products, customers should be responsible for the shipping and insurance costs.**

## **LIMITATION OF LIABILITY**

**NOTWITHSTANDING ANY OTHER PROVISIONS HEREIN, UNDER NO CIRCUMSTANCES IS EITHER PARTY LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, INDIRECT, MULTIPLE, ADMINISTRATIVE, OR PUNITIVE DAMAGES, OR ANY DAMAGE OF AN INDIRECT OR CONSEQUENTIAL NATURE ARISING OUT OF OR RELATED TO ITS PERFORMANCE, WHETHER BASED UPON BREACH OF AGREEMENT, WARRANTY, OR NEGLIGENCE AND WHETHER GROUNDED IN TORT, CONTRACT, CIVIL LAW, OR OTHER THEORIES OF LIABILITY, INCLUDING STRICT LIABILITY, EVEN IF ADVISED IN ADVANCE OF THE POSSIBILITY OF SUCH DAMAGES. THE COMPANY'S TOTAL LIABILITY INCLUDING, BUT NOT LIMITED TO, LIABILITY FOR INDEMNITY, DEFENSE, AND HOLD HARMLESS OBLIGATIONS IS LIMITED TO NO MORE THAN THE AMOUNT PAID TO THE COMPANY UNDER THE CUSTOMER'S ORDER AND THE CUSTOMER AGREES TO INDEMNIFY THE COMPANY FOR ANY EXCESS AMOUNTS. TO THE EXTENT THAT THIS LIMITATION OF LIABILITY CONFLICTS WITH ANY OTHER PROVISION(S) OF THIS AGREEMENT, SUCH PROVISION(S) WILL BE REGARDED AS AMENDED TO WHATEVER EXTENT REQUIRED TO MAKE SUCH PROVISION(S) CONSISTENT WITH THIS PROVISION**

# CHAPTER 1 PREFACE

## 1, Safety

The safety statements in this manual comply with the requirements of the HEALTH AND SAFETY AT WORK ACT, 1974.

Read the following before installing and using the instrument and its accessories. This instrument should be operated by appropriate laboratory technicians.

## 2, General

The apparatus described in this manual is designed to be used by properly trained personnel in a suitable equipped laboratory. For the correct and safe use of this apparatus it is essential that laboratory personnel follow generally accepted safe procedures in addition to the safety precautions called for in this manual.

The covers on this instrument may be removed for servicing. However, the inside of the power supply unit is a hazardous area and its cover should not be removed under any circumstances. There are no serviceable components inside this power supply unit. For this instrument, avoid touching the high voltage power supply at all times.

Some of the chemicals used in spectrophotometry are corrosive and/or inflammable and samples may be radioactive, toxic, or potentially infective. Care should be taken to follow the normal laboratory procedures for handling chemicals and samples.

## 3, Electrical

Before switching on the apparatus, make sure it is set to the voltage of the local power supply (see **Installation**).

The power cord shall be inserted in a socket provided with a protective earth contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

## 4, Warning

Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective earth terminal is likely to make the apparatus dangerous. Intentional interruption is prohibited.

Whenever it is likely that the protection has been impaired, the apparatus shall be made inoperative and be secured against any unintended operation.

**Note :** NEVER touch or handle the power supply on this instrument due to the high voltage!

The protection is likely to be impaired if, for example, the apparatus

- ▲ Shows visible damage
- ▲ Fails to perform the intended measurements
- ▲ Has been subjected to prolonged storage under unfavorable conditions
- ▲ Has been subjected to severe transport stresses

## **5, Performance**

To ensure that the instrument is working within its specification, especially when making measurements of an important nature, carry out performance checks with particular reference to wavelength and absorbance accuracy. Performance checks are detailed in this manual.

## **6, Radio Interference**

For compliance with the EMC standards referred to in the EC Declaration of Conformity, it is necessary that only shielded cables supplied by us are used when connecting the instrument to computers and accessories.

# CHAPTER 2 INTRODUCTION OF THE INSTRUMENT

## 1. Brief Introduction of the Instrument

This instrument is a single beam, general purpose instrument designed to meet the needs of the Conventional Laboratory, This instrument is ideal for various applications, such as: Chemistry, Biochemistry, Petro-chemistry, Environmental Protection, Food and Beverage Labs, Water and Waste Water Labs and other fields of quality control and research.

This instrument incorporates a  $128 \times 64$  dots matrix LCD display for photometric results, easy operation and wavelength range of 325nm to 1000nm. This instrument is ideal for measurements in the visible and ultraviolet wavelength region of the electromagnetic spectrum.



Fig 2-1 Front View

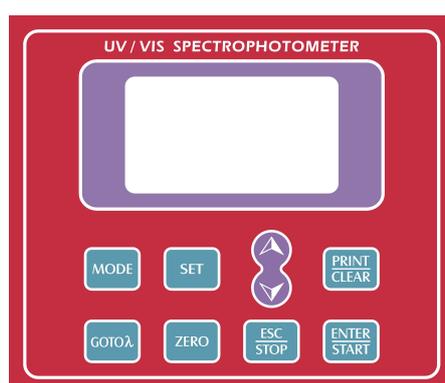


Fig 2-2 Control Panel

## 2. Working Principle

**Different matter has different but special absorbance wavelength point. Also, when at**

the fixed wavelength point, the absorbance has some relation to the substance' s (Always transparent Solution) concentration and its thickness. The relation can be concluded as the following Formula which is called Lambert-Beer Law.

$$T = I/I_0$$

$$A = KCL = -\log I/I_0$$

**A** Absorbance

**C** Concentration of the Solution

**K** Absorbance Coefficient of the Solution

**L** The length of the Solution in the light path

**I** The intensity of the light focused on the A/D after it permeate the solution to be measured.

**I<sub>0</sub>** The intensity of the light focused on the A/D after it permeate the Solution.█

**Note:** When test, the solvent is usually taken as the Reference Solution and its Transmittance is considered as 100% $\tau$ . While the Transmittance of the sample to be tested is a relative value which is got comparing to that of the Reference.

### 3. Structure

The spectrophotometer consists of five parts:

- 1) Halogen or deuterium lamps to supply the light;
- 2) A Monochromator to isolate the wavelength of interest and eliminate the unwanted second order radiation;
- 3) A sample compartment to accommodate the sample solution;
- 4) Detector to receive the transmitted light and convert it to an electrical signal; and
- 5) A digital display to indicate absorbance or transmittance. The block diagram (Fig 2.4) below illustrates the relationship between these parts.

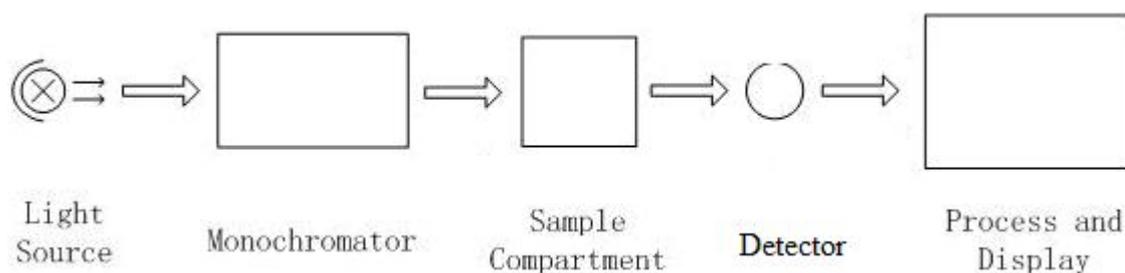


Fig 2.4 Block diagram for the Spectrophotometer

In your spectrophotometer, light from the lamp is focused on the entrance slit of the mono-chromator where the collimating mirror directs the beam onto the grating. The grating disperses the light beam to produce the spectrum, a portion of which is focused on the exit slit of the mono-chromator by a collimating mirror. From here the beam is passed to a sample compartment through one of the filters, which helps to eliminate unwanted second order radiation from the diffraction grating. Upon leaving the sample

compartment, the beam is passed to the silicon photodiode detector and causes the detector to produce an electrical signal that is displayed on the digital display.

## 4. Unpacking Instructions

Carefully unpack the contents and check the materials against the following packing list to ensure that you have received everything in good condition.

### Packing List

<u>Description</u>	<u>Quantity</u>
<i>Spectrophotometer</i> .....	1
<i>Power Cord</i> .....	1
<i>1cm Glass Cuvettes</i> .....	1 Set of 4
<i>User's Manual</i> .....	1

## 5. Specifications

# CHAPTER 3 INSTALL INSTRUMENT

## 1. Environment Required

To ensure the best performance, the following conditions are required:

- **The best working temperature range is 16-30°C and the humidity is 45-80%.**
- **Keep it as far as possible away from the strong magnetic or electrical fields or any**

Wavelength Range	325-1000nm
Band Width	4nm
Wavelength Accuracy	±1nm
Wavelength Repeatability	0.5nm
Wavelength Setting	Auto
Photometric Accuracy	±0.5%T
Photometric Repeatability	0.3%T
Photometric Display Range	0-200%T, -0.3-3.0A, 0-9999C
Stability	0.002A/h @ 500nm
Stray Light	≤0.3%T@360nm
Data Output Port	USB
Printer Port	Parallel Port
Display	128*64 Dots LCD
Lamps	Tungsten Halogen Lamp
Detector	Silicon Photodiode
Power Requirement	AC85~250V
Dimension (L*W*H)	420*280*180mm
Weight	12kg

**electrical device that may generate high-frequency fields.**

- Set the unit up in an area that is free of dust, corrosive gases and strong vibrations.
- Remove any obstructions or materials that could hinder the flow of air under and around the instrument.
- The power requirement is AC85V~265V.
- Use the appropriate power cord and plug into a grounded outlet.
- If the local voltage is not stable enough, a Power Stabilizer is required.
- Be away from direct sunlight

## 2. Installation

### **Step 1: Check the packing list**

Unpack the contents, check the materials with the Packing List. Any damage or Lost found, please contact us or the local dealer.

### **Step 2: Position**

Place the instrument on the stable table carefully.

### **Step 3: Install printer (Optional)**

Make sure the printer is power off, link the printer' s data cable to the instrument' s parallel port.

### **Step 4: Link the power cord**

Make sure the instrument' s power switch is in the Off condition, link the power cord to the instrument and insert another end in the socket provided with a protective earth contact.

### **Step 5: Switch on the power**

Check again, make sure that all the links are right. Switch on the power. The instrument can be used to measure after self-test and pre-warm.

# CHAPTER 4 OPERATION INTRODUCTION

## 1. Software Structure

### 1.1 Main Interface



Fig 4-1 Main Interface

After 20 minutes' warm-up, the system goes into main interface. (Fig.4-1) Press the key of **MODE** to change the functions.

### 1.2 Firmware Functions

The firmware consists of 5 functions: T, A, C, F and system functions

#### 1) T

To measure the Transmittance of a sample in a fixed wavelength point. The test result can be stored in the RAM, total 200 groups of data can be stored.

#### 2) A

To measure the Absorbance of a sample in a fixed wavelength point. The test result can be stored in the RAM, total 200 groups of data can be stored.

#### 3) C-Standard Curve Method

Set up standard curve by standard samples; use the new curve to measure the unknown sample' s concentration. The curves and the test results can be stored in the RAM. Total 200 curves can be stored.

#### 4) Coefficient Method

Input the values of the curve equation' s coefficient, and then measure the unknown sample' s concentration.

#### 5) Setup-System Functions

Press the key of **SET** on the keypad to go into system functions (Only available in T MODE and A MODE). Light source management; Get Dark Current; Calibrate Wavelength and Load default, etc.

## 2. Basic Operation

### 2.1 Set Wavelength

In the measurement Interface, press **GOTO  $\lambda$**  to go into wavelength setting Interface. Use Arrow Key to increase or decrease the value of wavelength. then press **ENTER** to confirm. When arriving at the setting wavelength point, it sets 100%T/OAbs automatically.

## 2.2 Delete the test result and stored data

In the measurement Interface, press  to delete the test result and stored data.

## 2.3 Calibrate 100%T/0Abs

Put the Reference in the light path, press  to calibrate 100%T/0Abs.

## 2.4 Measure the samples

Put the samples in the light path and press  to measure.

## 2.5 Print the test result

In the Measurement Interface, press  to print the result.

# 3. Preparation before test

## 3.1 Switch on the instrument and begin the system self-test(Diagnostic Program)

Make sure to remove all the blocks in the light path; Close the compartment lid and switch on the power; Then the system will begin self-test.

***Note: During the course of Diagnostic Program runs, please DON'T open the lid of the compartment!***

## 3.2 Pre-warm

When the diagnostic program finished, it goes into pre-warm condition. 20 minutes is required before measure.

## 3.3 Check the Cuvettes

The cuvette should be clear and there' s no solution remains on the transparent surface. If the wavelength is below 340nm, Quartz Cuvette is a must.

# 4. Measure

## 4.1 T-Mode

### Step 1, Go into T Mode Interface

In the Main Interface, press  Key to move the cursor on "T", you' ll see the current sample' s T% value. Press  to go into Continuous Measurement Interface. ( Fig. 4-2);

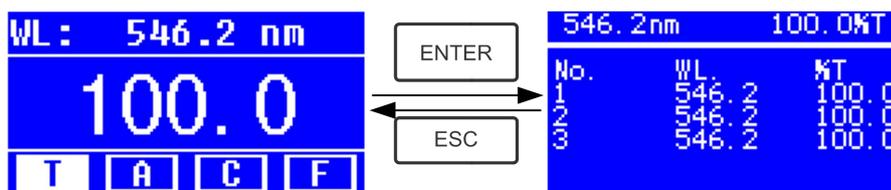


Fig. 4-2

### Step 2, Set Wavelength

Press **GOTO λ** to set Wavelength, input the wavelength value by the Arrow Key, then press **ENTER** to confirm. (Fig. 4-3);

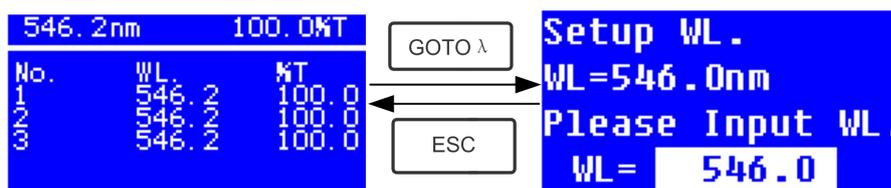


Fig. 4-3

### Step 3, Calibrate 100%T/0Abs

Put the Reference Solution in the light path, press **ZERO** to calibrate 100%T/0Abs;

### Step 4, Measure Sample

Put the unknown concentration sample in the light path, press **START** to measure, and the result displays in the data sheet. At the same time, the test result will be stored in the RAM automatically.

Repeat this step to finish all the samples measurement.

### Step 5, Print or Delete the data

Press **PRINT/CLEAR** to go into the following interface.(Fig.4-4)

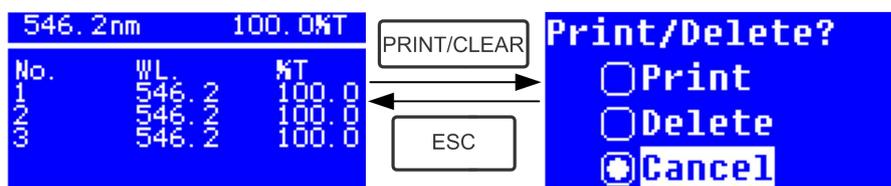


Fig.4-4

- 1) When the optional Printer is linked to the instrument, if you want to print out the test result, use Arrow Key to choose "Print", then press **ENTER** to confirm. After printing, the data will be deleted from the RAM.
- 2) If you want to delete the saved data, move the cursor on the item of "Delete", then press **ENTER** to confirm.

## 4.2 A-MODE

### Step 1, Go into A Mode Interface

In the Main Interface, press **MODE** Key to move the cursor on "A", you'll see the current sample's Absorbance value. Press **ENTER** to go into Continuous Measurement Interface. ( Fig. 4-5);

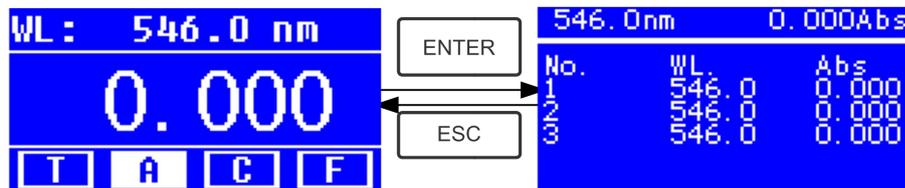


Fig.4-5

Step 2-5 is the same as T-mode, please refer to the corresponding operation in 4.1.

### 4.3 C-MODE (Standard Curve)

#### 1) Go into C-MODE Interface

In the Main Interface, press Arrow Key to move the cursor on "C", then you'll see the following Interface. (Fig.4-6) Here you can create a new curve, or you can load a saved curve. If you want to delete a saved curve, just choose "Delete Curve".

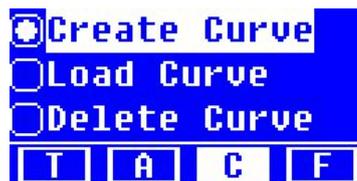


Fig. 4-6

#### 2) Create Curve

If you want to create a new standard curve by several standard samples, Use Arrow Key to move the cursor on "Create Curve", then press **ENTER** to confirm. The system will ask you to input the quantity of your standard samples. (Fig.4-7) *Note: The default quantity is "3". Please don't change the value at this time, you should set the Wavelength at first.*

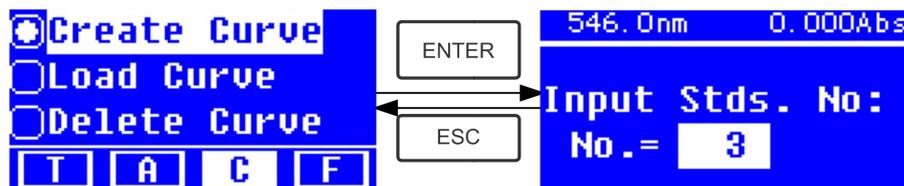


Fig.4-7

#### Step 1, Set Wavelength

Press **GOTO λ** to go into the wavelength setting interface, input the WL. Value by the Arrow key and press **ENTER** to confirm. ( Fig. 4-8);

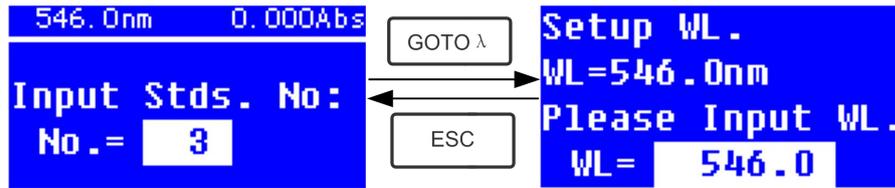


Fig. 4-8

**Step 2, Input the quantity of the standard samples**

Use Arrow Key to input the quantity of the standard samples, then press



to confirm. The system will go into the following interface. (Fig. 4-9)

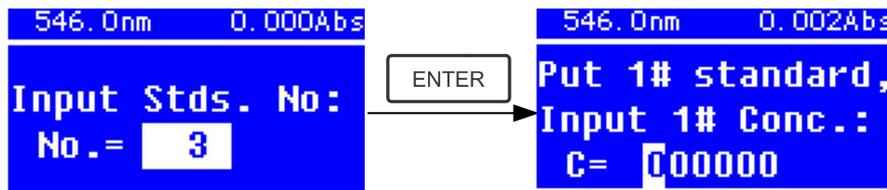


Fig. 4-9

**Step 3, Calibrate 100%T/0Abs**

Put the Reference Solution in the light path, then press  to calibrate 100%T/0Abs;

**Step 4, Input Standard Samples' Concentration**

★ Pull the 1# Standard Sample in the light path and input the value of its

concentration by the Arrow key, then press  to confirm. The system will go into the next interface. (Fig.4-10)

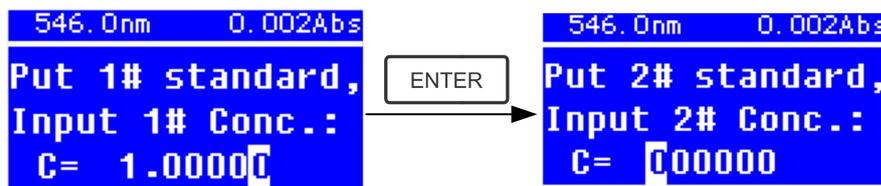


Fig. 4-10

★ Pull the 2# Standard Sample in the light path and input its concentration,

then press  to confirm.

★ Repeat the above step till the last sample' s concentration is finished.

**Step 5, Display the Curve**

When the last standard sample finished, double press  to confirm. then the Standard Curve and its equation will display on the screen

automatically. (Fig. 4-11) At the same time, the Curve Equation will be saved in the RAM automatically.

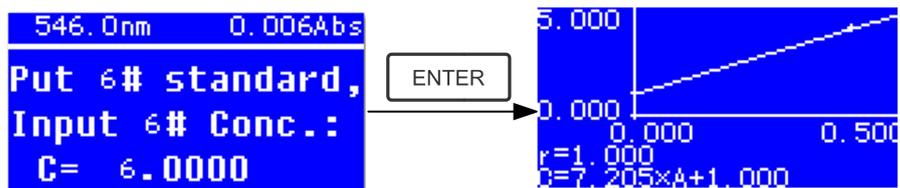


Fig. 4-11

Note: If there's some mistake during the operation, the system will beep 3 times and return the initial interface automatically. Of course, the curve can not be displayed on the screen.

### Step 6, Measure Samples

- ★ Pull the Reference solution in the light path and press  to go into the continuous measurement interface. (Fig. 4-12)

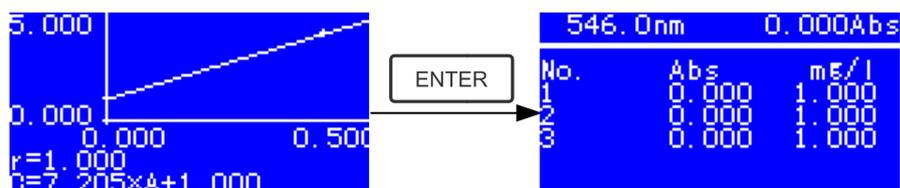


Fig. 4-12

- ★ Pull the unknown sample in the light path, then press **START** to measure. The result will be displayed on the screen one by one. At the same time, the data will be saved in the RAM automatically. Total 200 groups of data can be saved.

### 3) Load Curve

All the curve equations will be saved in the RAM automatically. If you want to reload the saved curve, just follow the following steps:

- ★ Move the cursor on "Load Curve" and press  to confirm. Then the system will go into the curve equation record interface.(Fig. 4-13)

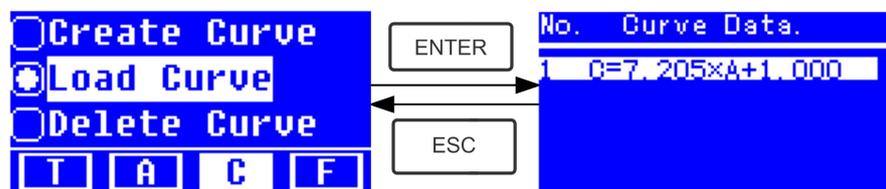


Fig. 4-13

- ★ Move the cursor on the equation that you need and press  to confirm. Then the corresponding curve will display on the screen. (Fig. 4-14)

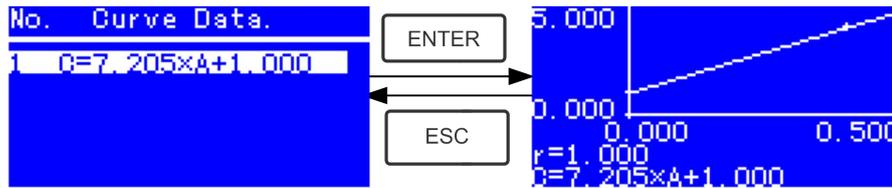


Fig. 4-14

- ★ Press  to go into sample continuous measure interface and measure samples. (Fig. 4-12)

*Note: When you reload the curves, the wavelength will be set at the point where you creat the Standard Curve automatically.*

#### 4) Delete Curve

- ★ Move the cursor on "Delete Curve" and press  to confirm. Then the system goes into the curve equation choosing interface. (Fig. 4-15)

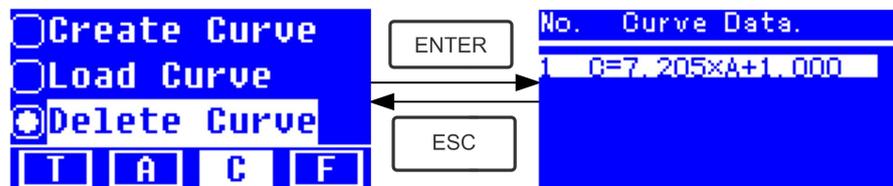


Fig. 4-15

- ★ Move the cursor on the curve equation that you want to delete and press , then system will ask you to confirm again. (Fig. 4-16)

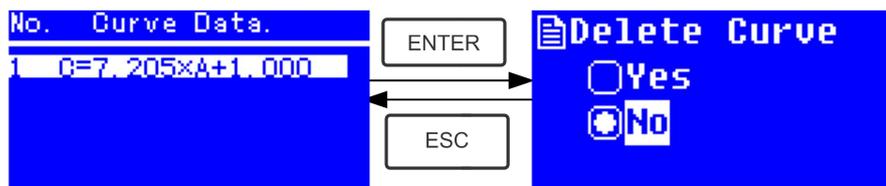


Fig. 4-16

- ★ Move the cursor on "Yes" and press  to confirm, then the curve equation will be deleted. If you don't want to delete it, just choose "No" or press  to return.

## 4.4 F-MODE (Coefficient Method)

### 1) Go into F-MODE Interface

Press Arrow Key to choose "F" in the Main Interface, and you'll see the following Interface. (Fig. 4-17)



Fig. 4-17

## 2) Parameter Setting

- ★ Use Arrow Key to move the cursor on "Coefficient K" and press  to go into K setting interface. ( Fig. 4-18); Input every bit of K by Arrow Key and press  to confirm. When the last bit finished, system will return the former Interface automatically.

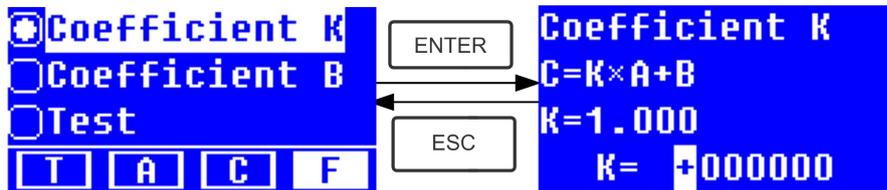


Fig. 4-18

- ★ Input the value of B in the same way(Fig. 4-19)

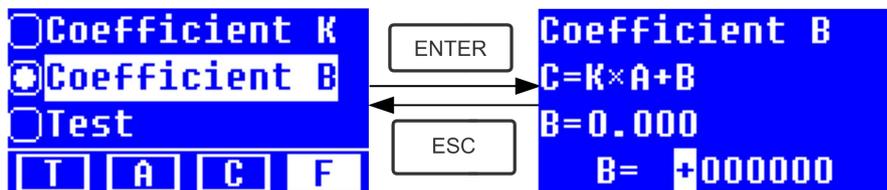


Fig.4-19

## 3) Test Samples

### Step 1, Go into pre-test Interface

Move the cursor on "Test", then press  to go into pre-test Interface. (Fig.4-20)

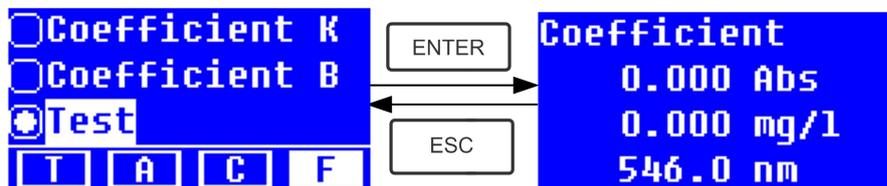


Fig.4-20

### Step 2, Set Wavelength

Press  to go into wavelength setting interface. input the wavelength value by Arrow key and press  to confirm. (Fig. 4-21)

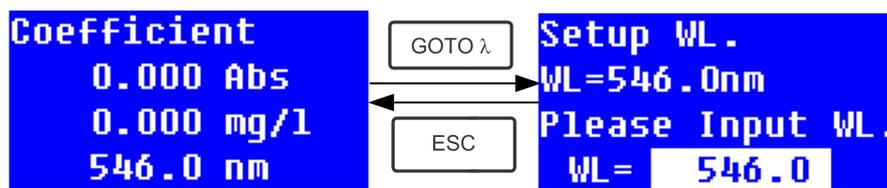


Fig. 4-21

### Step 3, Calibrate 100%T/0Abs

Press **ENTER** to go into continuous measurement interface (Fig. 4-22). Pull the Reference Solution in the light path, then press **ZERO** to calibrate 100%T/0Abs:

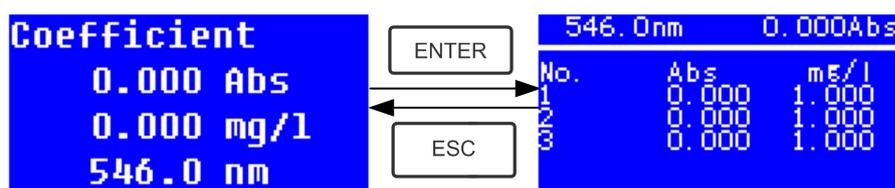


Fig. 4-22

### Step 4, Measurement

Pull the samples to be measured in the light path, press **ENTER** to measure, then the result will be displayed on the screen. Repeat this step to measure other samples. All the test results will be listed on the screen and stored in the RAM automatically. They can be reload even after a sudden power cut.

### Step 5, Print or Delete the Test Result

In the continuous measurement interface, press **ENTER/CLEAR** to print or delete the test result. Please refer to Chapter 4.1 for details.

## 5. System Functions

In the T mode or A mode of Main Interface, press **SET** Key to go into system functions (Fig. 4-23)

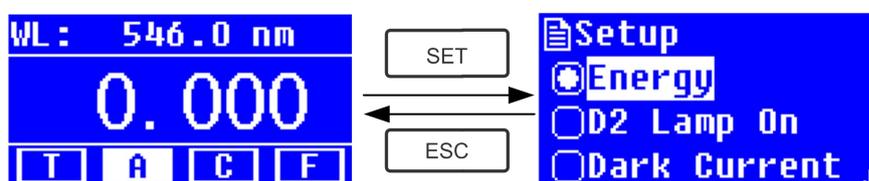


Fig. 4-23

### 1) Energy

To see the energy of present wavelength.

Move the cursor on "Energy", then press **ENTER** to confirm. (Fig.4-24)

*Note: Users seldom use this function. It's useful for service man to judge the fault.*

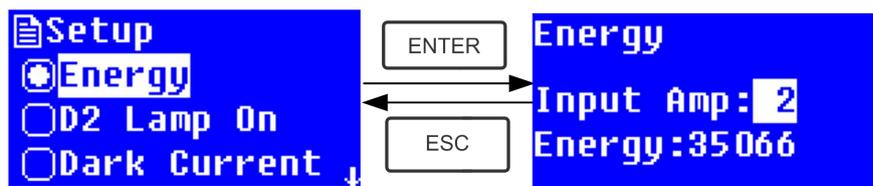


Fig. 4-24

### 3) Get Dark Current

** When the working condition changes, A dark current calibration is required before any measurement.**

Use Arrow key to choose "Dark Current" and press  to confirm. (Fig. 4-25)

***Note: Remove the cuvettes from the light path before this action, don't open the lid of the compartment during the course of calibration.***

Press  to return when it finishes.

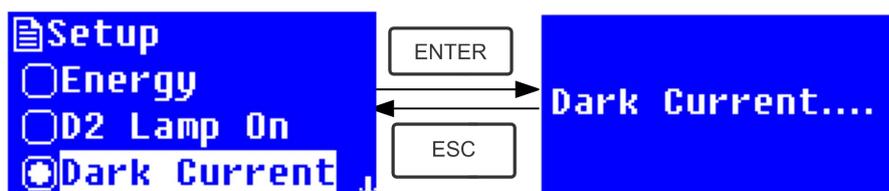


Fig. 4-25

When it finishes, it will display the following words on the screen. (Fig.4-26) If it displays "Dark Current Err", you should check if there's something else in the compartment and repeat this step.



Fig. 4-26

### 4) Wavelength Calibration

** After some time, the energy of lights would drop off and there will be some but slight influence on the test result. In this case, users can reset the wavelength to compensate. We suggest the users to calibrate the wavelength every one or two months.**

Remove all the blocks in the light path and close the lid of the compartment, press

Arrow Key to choose "Calibrate WL." and press  to begin the calibration

( Fig. 4-27 ) . The lid of the compartment should not be opened during the calibration.

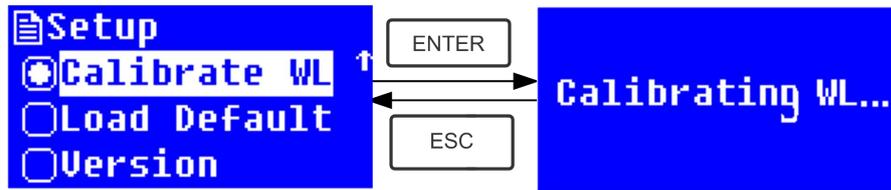


Fig. 4-27

When it finishes, it will display the following words on the screen. (Fig.4-28) If it displays "Wavelength Err", you should check if there's something else in the compartment and repeat this step.



Fig. 4-28

## 5) Load Default

Press Arrow Key to choose "Load Default" and press  to confirm. ( Fig. 4-29), press Arrow Key to choose "Yes" and press  to confirm. Then the system will recover the default setting when leave factory. Choose "No" with  pressed to cancel the operation and return.

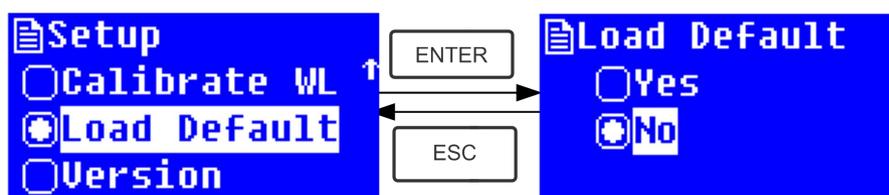
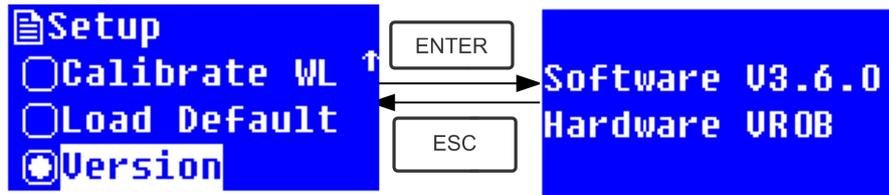


Fig. 4-29

*Note: All the saved data and curves would be deleted from the RAM once "Yes" is chosen!*

## 6) Version

Press Arrow Key to choose "Version" and press  to confirm. You'll see the version of the software and hardware. (Fig.4-30). Press  to return.



**Fig. 4-30**

*For the reason of updating, the version you see on the instrument screen maybe different from the one showed in the above fig.4-30*

# CHAPTER 5 Instrument Maintenance

To keep the instrument work in good condition, constant maintain is needed.

## 1. Daily Maintain

### 1) Check the compartment

After measurement, the cuvettes with sample solutions should be taken out of the compartment in time. Or the volatilization of the solution would make the mirror go moldy. Users must pay more attention to the corrosive sample and liquid easy to volatilize. Any solution remains in the compartment should be wiped off immediately.

### 2) Surface Clean

The cover of the instrument is with paint. Please use wet towel to wipe off the drip on the surface immediately. Organic solution is forbidden to be used to clean the cover. Please wipe off the dirt on the cover timely.

### 3) Clean the cuvettes

After every test or after a solution change, the cuvettes should be cleaned carefully, or the remains on the surface would cause measuring error.

## 2. Troubleshooting

### 1) Dark Current Error when self-test

#### Possible Cause

- Open the lid of the compartment during the course of self-test.

#### Solution

Close the lid of the compartment and switch on the power again.

### 2) No response after power on

#### Possible Cause

- Bad contact in power supply
- Fuse melt

#### Solution

Improve the contact  
Replace a new fuse

### 3) Printer not work, printer error

#### Possible Cause

- No power supply
- Bad contact in power supply
- Bad contact of the data cable

#### Solution

Switch on the power supply  
Improve the contact  
Improve the contact

### 4) No Stable Reading

#### Possible Cause

- No enough pre-warm

#### Solution

Increase the pre-warm time

- |  |                             |
|--|-----------------------------|
| ▪ Glass cuvettes used in UV Range      | Use Silicon Cuvettes.       |
| ▪ No stable Sample                     | Improve the sample          |
| ▪ Much higher sample concentration     | Dilute the sample           |
| ▪ Low voltage or unstable power supply | Improve the power condition |
| ▪ Lights defect                        | Replace a new lamp          |
| ▪ Light used up                        | Replace a new lamp          |

### 5) Worse Repeatability

#### Possible Reason

- Unstable sample
- Cuvettes polluted

#### Solution

- Improve the sample
- Clean the cuvettes

### 6) Incorrect reading

#### Possible Reason

- Dark Current Error
- Worse matching of the cuvettes

#### Solution

- Re-get the dark current
- Improve the matching of the cuvettes

## 3. Fuse Replacement



**Danger! Be sure to switch off the power and unplug the socket before replacement!**

#### Step 1: Tools preparation

Prepare a 3×75 Flat Blade screwdriver

#### Step2: Switch Off the power supply

Switch off the power supply, and unplug the socket.

#### Step 3: Take out the Fuse Seat

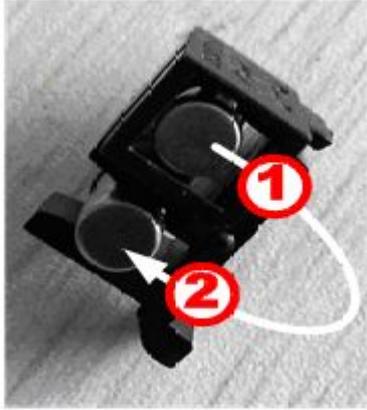
Take out the fuse seat by the screwdriver. (Fig.5-1)



Fig. 5-1

#### Step 4: Replace a new fuse

Pick out the spare fuse and replace it to the working position. (Fig.5-2)



**Fig. 5-2**

**Step 5: Reset the fuse seat**

Replace the fuse seat in the power socket

**Step 6: Switch on the power**

Plug the socket and switch on the power