S-2150 SERIES SPECTROPHOTOMETER USER'S MANUAL

V 2.0

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Rev. S2150-5.0

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1. General information

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. 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.

Safety

Read the following before installing and using the instrument and its accessories. The S2150 Series (S-2150 visible and S2150UV UV/Vis) should be operated by appropriate laboratory technicians.

Electrical

Before switching on the apparatus, make sure it is set to the voltage of the local power supply. 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.

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. NEVER touch or handle the power supply 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

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.

Radio Interference

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

Introduction

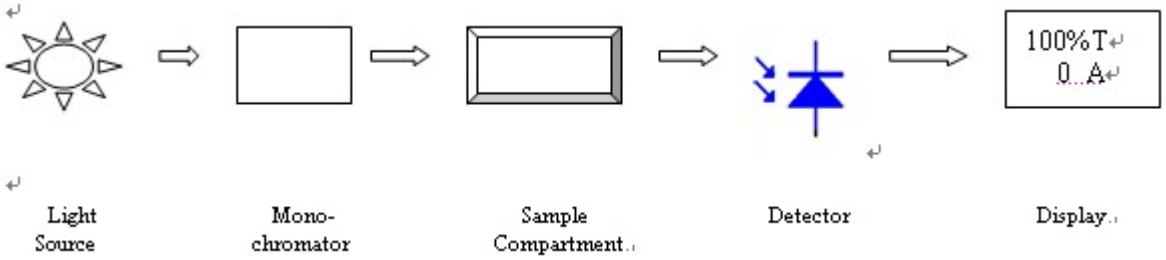
The UNICO S-2150 series are single beam, general purpose instruments designed to meet the needs of the Conventional Laboratory, They are ideal for various applications, such as: Clinical Chemistry, Biochemistry, Petro-chemistry, Environmental Protection, Food and Beverage Labs, Water and Waste Water Labs and other fields of quality control and research.

Both S2150 Series features a digital display of photometric result, easy operation and wavelength range of 325nm to 1000nm for S-2150 and 200nm to 1000nm for model S-2100UV. S-2150 is ideal for measurements in the visible wavelength region of the electromagnetic spectrum and S-2150UV in ultraviolet and visible wavelength region.

Working Principle

The spectrophotometer consists of five parts: 1) Halogen and deuterium (for S-2150UV only) lamp 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) A 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 below illustrates the relationship between these parts.

Block diagram for the Spectrophotometer



In your spectrophotometer, light from the lamp is focused on the entrance slit of the monochromator 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 monochromator 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.

S-2150 Series incorporate an USB bi-directional port for connecting to a PC for using the UNICO Application Software.

The RS232 Port is for use with RS232 printer and for firmware (built-in software) upgrade.

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
Unless otherwise specially ordered the spectrophotometer package should include the following items.

Description:	Quantity
Spectrophotometer	1
Power Cord	1
Cuvettes, Glass	Set of 4
Cuvettes, Quartz(S-2150UV only)	Set of 2
Dust Cover	1
Manual	1

Specifications for S2150 Series

	Model S-2150	**Model S-2150UV**
Wavelength Range	325-1000nm	200-1000nm
Spectral Bandpass	4nm	4nm
Wavelength Accuracy	± 2 nm	±2 nm
Wavelength Repeatability	± 1nm	±1nm
Stray Radiant Energy	<0.3 @ 340 and 400nm	<0.3 @ 220 and 340nm
Photometric Range	0 to 125%T -0.3 to 2.5 Abs -9999 to 9999	0 to 125%T 0.3 to 2.5 Abs -9999 to 9999
Photometric Accuracy	± 0.004@0.5A	± 0.004@0.5A
Display	Graphic LCD 128x64	LCD Graphic 128x64
Control and Data Entry	Touch Button Keypad	Touch Button Keypad
USB Port	For PC connection (requires PC software)	For PC connection (requires PC software)

Data output	For RS232 printer and firmware upgrade	For RS232 printer and firmware upgrade
Power Requirements	90-240Vac, 50-60 Hz	90-240Vac, 50-60 Hz
Dimensions	550W x 400D x 270H (mm)	550W x 400D x 270H (mm)
Light Source	Tungsten Halogen	Tungsten Halogen/Deuterium
Weight	46 lbs. /21kg	46 lbs. /21kg

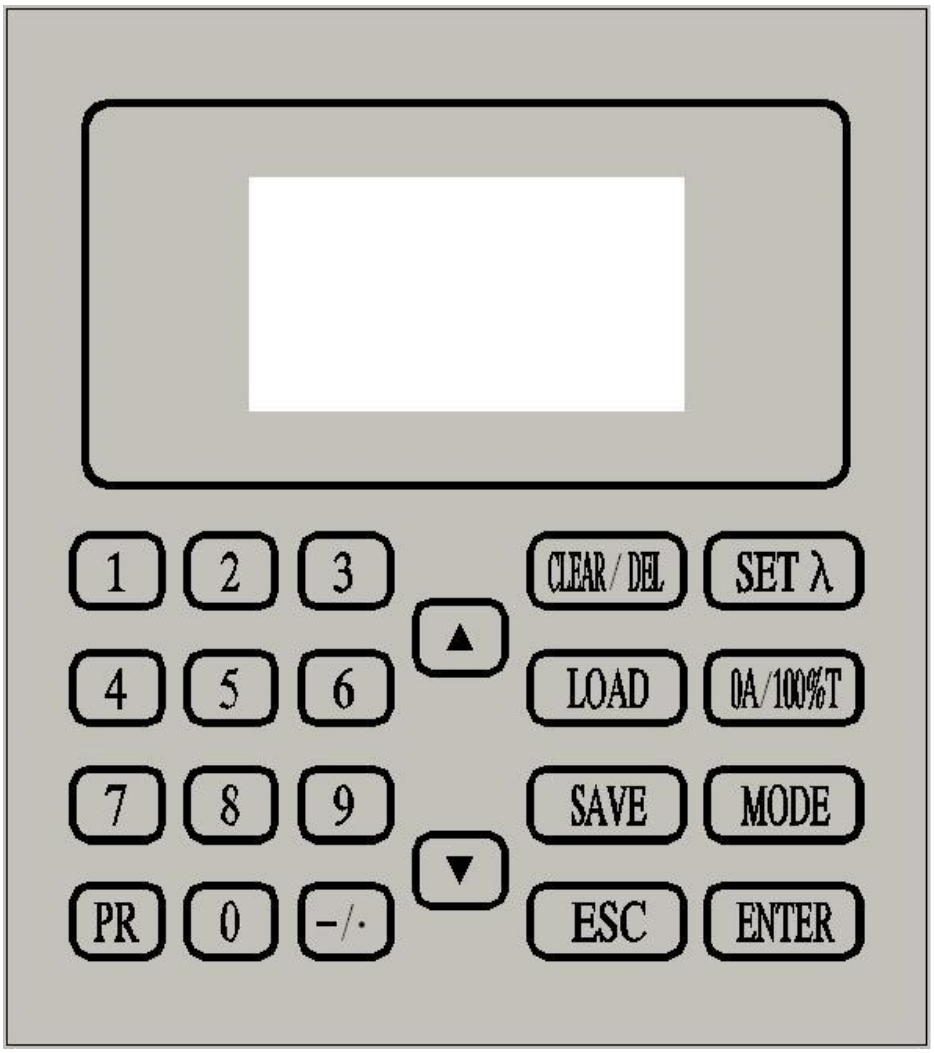
Installation:

1. After carefully unpacking the contents, check the materials with the packing list to ensure that you have received everything in good condition.

2. Place the instrument in a suitable location away from direct sunlight. In order to have the best performance from your instrument, keep it as far as possible from any strong magnetic or electrical fields or any 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.

3. Remove any obstructions or materials that could hinder the flow of air under and around the instrument.

4. Turn on the instrument and allow it to warm up for 15 minutes before taking any readings.



Operational Panel

Description of Key Functions

【CLEAR/DEL】	Clear or delete
【SET λ】	Set wavelength
【0Abs/100%T】	Blank (Set 0Abs and 100%T) or establish baseline;
【LOAD】	Load saved curve;
【MODE】	Select type of measurement;
【ESC】	Escape or back to previous screen;
【ENTER】	Confirm;
【PRINT】	Print test data
【∧】	Scroll up
【∨】	Scroll down
【 -/. 】	Minus/Dot

2. **Operation Instruction:**

2.1 Preparation and Initialization

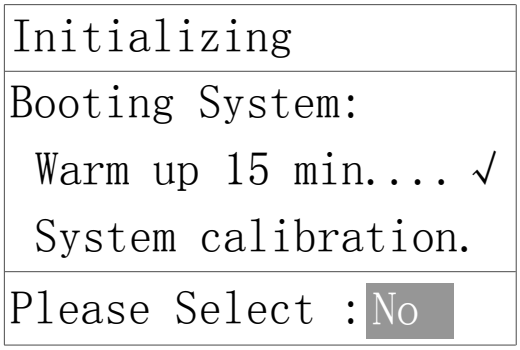
Turn on the spectrophotometer by pressing the Power Switch (IO) on the back of the instrument. The instrument will automatically run a self-initialization check. The screen displays sequentially the checking status.

Initializing
Booting System: Check clock .....
UNICO Instrument Ltd.

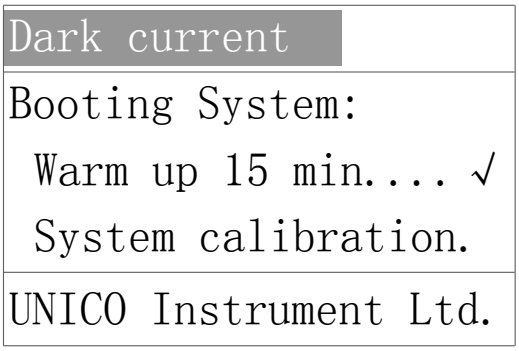
Initializing
Booting System: Check colck ..... √ Locating filter...
UNICO Instrument Ltd.

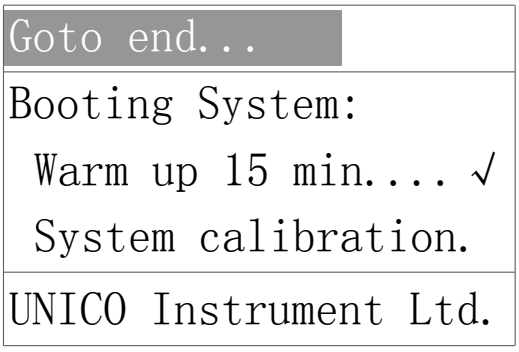
Initializing 15:00
Booting System: Locating filter... √ Warm up 15 min....
Press ESC to skip...

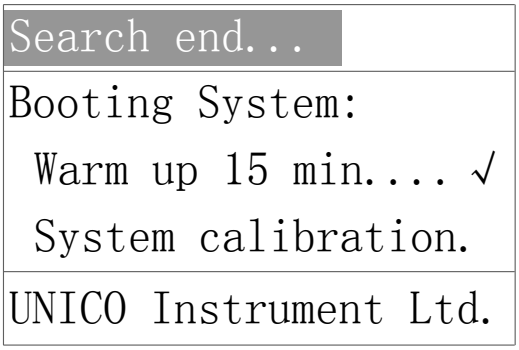
(You may press EXIT to skip 15 minutes warm up which is not recommended).

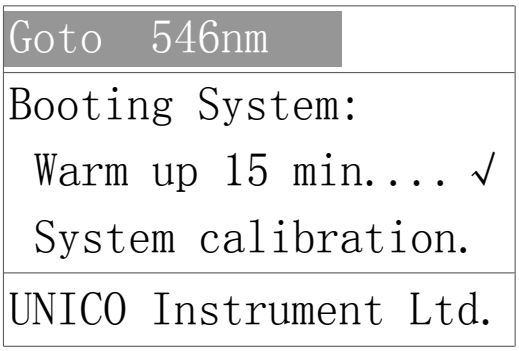


After 15 minutes warm up you need to choose either to run full System Calibration or not. If you choose No, the instrument will use the previously saved calibration data and the display will move to the main menu and ready to use. If you select Yes, the instrument will go through system calibration. Below are some displays showing system calibration process.
(Note: If previously saved data is lost the instrument will automatically run system calibration)

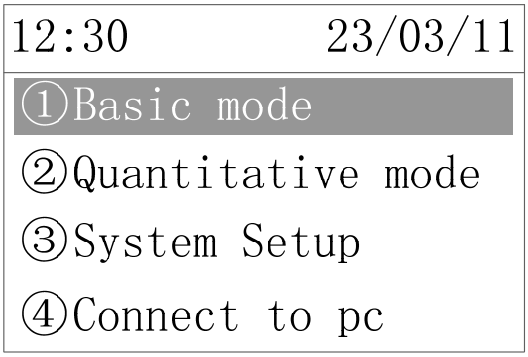








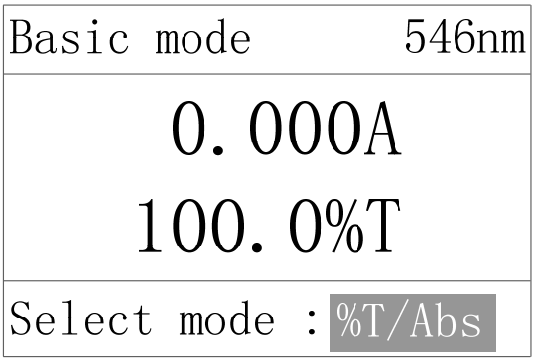
The instrument is ready for use. Below is the Main Menu.



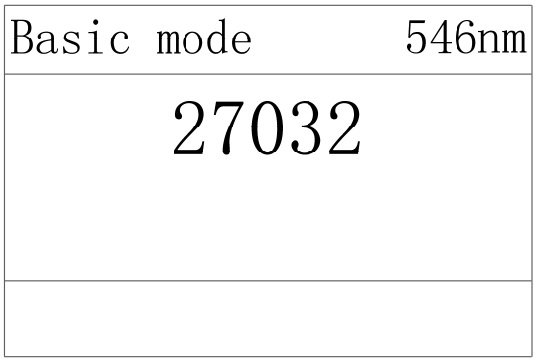
2.2BASIC MODE — %T/Abs or Energy Measurement

2.2.1 Use arrow button to highlight **BASIC MODE** and then press **ENTER** to select Basic mode.

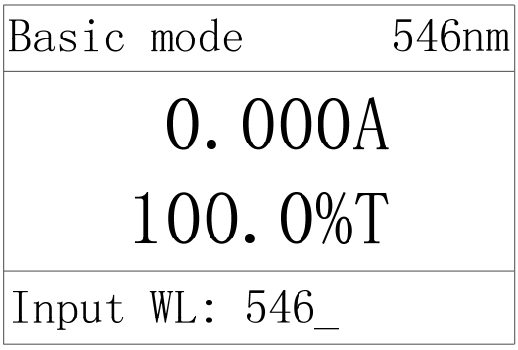
2.2.2 Use【MODE】button to select type of test（%T/Abs or Energy）.



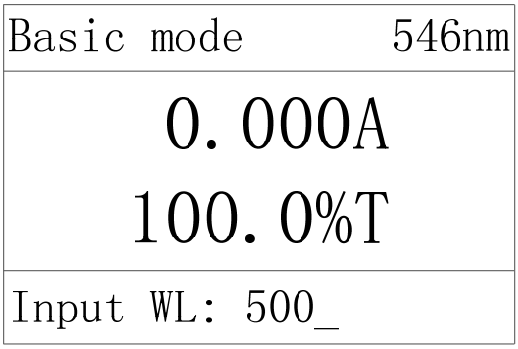
If Energy type is selected the display will show the energy counts as shown below.



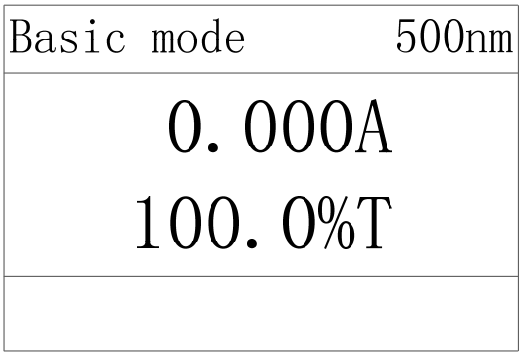
2.2.3 To reset wavelength press【**SETλ**】button. The display first shows the current wavelength.



Enter the desired wavelength as shown below.



Press【**ENTER**】 button to confirm.The instrument will go from previous wavelength (546nm) to the desired wavelength (500nm) and automatically blank.

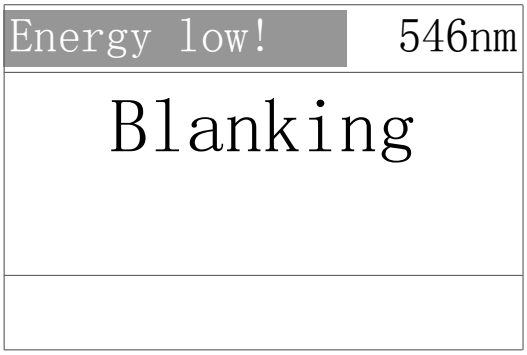


Note: You must blank your reference before measure any sample. Follow your lab procedures for preparing the reference liquid and the steps below to set the blank:

2.2.4 Make a blank reference solution by filling a clean cuvette with distilled or de-ionized water or other specified solvent. Wipe the cuvette with tissue to remove the fingerprints and droplets of liquid.

2.2.5 Fit the blank cuvette into the 4-cell holder and place the cuvette in the slot nearest you. Push the rod so that the cuvette is in the light path. Close the lid.

2.2.6 Set 0.000A or 100%T by pressing 0A/100%T button.



Note: If “Energy low!” is displayed it might indicate the reference is too dark or the light beam energy from the lamp is too weak.

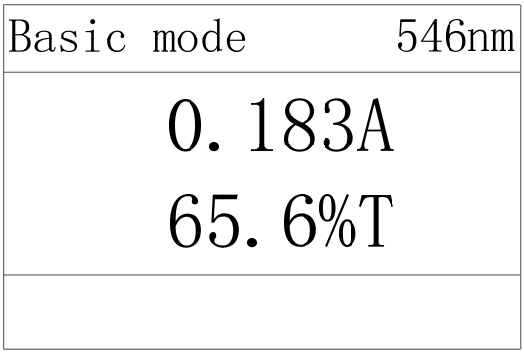
2.2.7 Now it is ready to measure your samples:

2.2.8 Remove the blank cuvette if you are testing more than 3 samples. Set it aside in the case that you may need to reset 0A/100%T later (i.e. change wavelength).

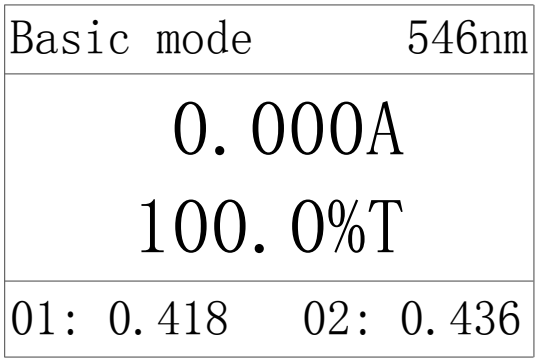
2.2.9 Rinse a second cuvette (or more) with a small amount of sample solution to be tested. Fill the cuvette and wipe it.

2.2.10 Put the sample cuvette(s) in the sample compartment. Close the lid.

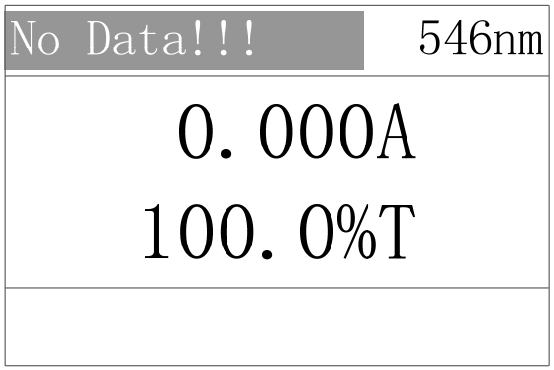
2.2.11 The current sample test result is displayed on the screen.



2.2.12 Press ENTER to confirm and log the result. Up to 20 test results can be logged. When21st test result is confirmed the first test result will be automatically removed from the list.



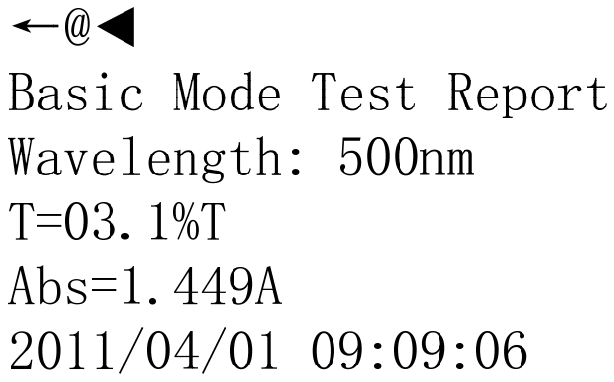
Note: Press【**CLEAR/DEL**】will delete the test result displayed on the right. If no test result is logged at the bottom line display will show “No Data!!!”(for deleting).



Note:

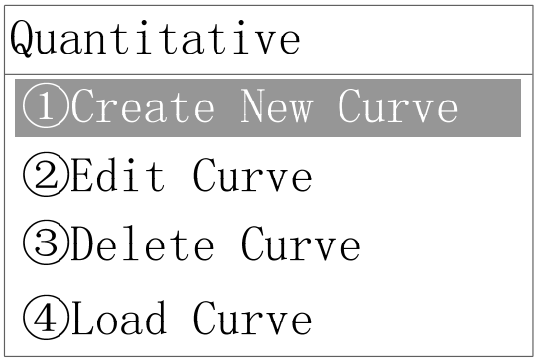
- If you are reading more than one cuvette, be sure to carefully move the cuvette holder to the next position by pulling on the sample holder rod until the holder "click" into place.
- If you are reading 3 or less samples, then place the reference cuvette in the position nearest you, and the samples in the next available position. This will shorten the time to read samples and minimize the sample handling (opening and closing the sample compartment lid, etc.)

To print the result press **PRINT** button.



2.3 Quantitative Test

Test method (curve) must be defined and established before quantitative tests can be run. This instrument has open platform for you to establish your own test methods (curves). Such established method will be saved as defined test in "Pre-defined Test List".



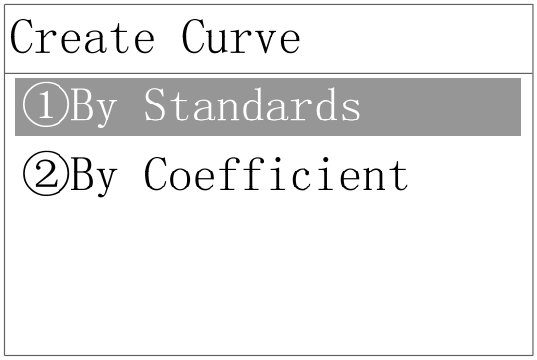
This instrument allows user to:

- Create New Curve
- Edit pre-defined and saved curve
- Delete pre-defined and saved curve
- Load pre-defined and saved curve
- Add pre-defined and saved curve to your favorite test folder for easy and fast access

To access quantitative test select "**Quantitative mode**"at the main menu. Use【∧】,【∨】to choose the function and press【**ENTER**】to confirm your selection

2.3.1 Create New Curve

At **"Quantitative"** use【∧】,【∨】*to*"①**Create New Curve**"and press【**ENTER**】to confirm your selection. You can establish standard curve using known Standards solution or using known Coefficient.



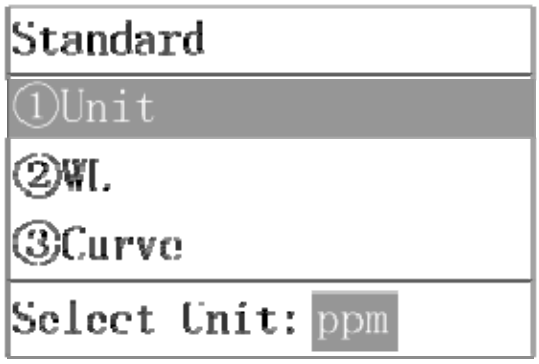
2.3.2 Create New Curve by Standards

At **Create New Curve** use【∧】,【∨】to select "①**By Standards**"and 【**ENTER**】to confirm your selection.

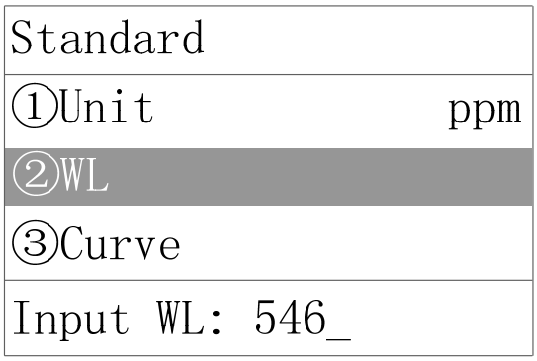
2.3.2.1 Set Parameters

At Standard screen，①Unit is highlighted with"Select Unit:ppm"at the bottom，use【∧】,

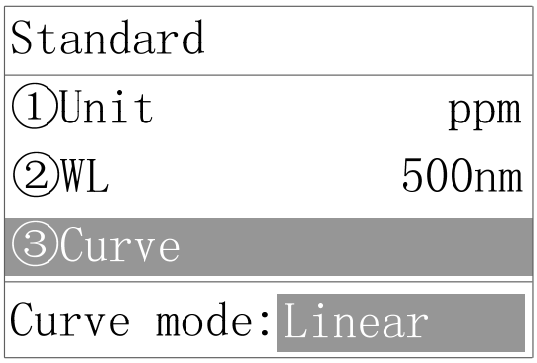
【∨】to scroll the unit list (ppm,ppb,ng/ul,ng/ml,g/l,mg/l,%). Press【 **ENTER**】to confirm the unit selection.



Next is to select the wavelength, use 【0】~【9】numerical keys to enter the desired wavelength（i.e. 500nm. Press【ENTER】to confirm the wavelength selection.

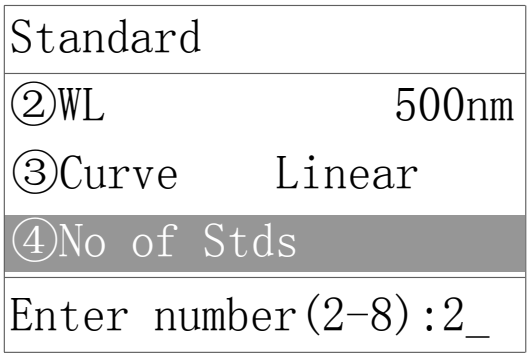


Then the type of curve needs to be selected. There are two kinds of curves; “Linear” or “Linear through zero. Press【∧】,【∨】to choose and press【ENTER】your curve selection.

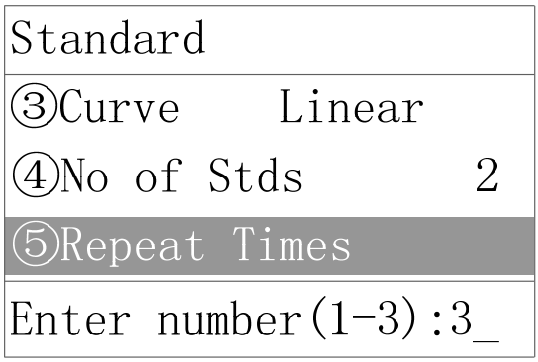


The next step is to enter how many standards will be used to establish the curve. Minimum two standards are required. Up to maximum of eight standards can be used. Use the numerical keys to enter the number of standards. Press【ENTER】to confirm

the selection.

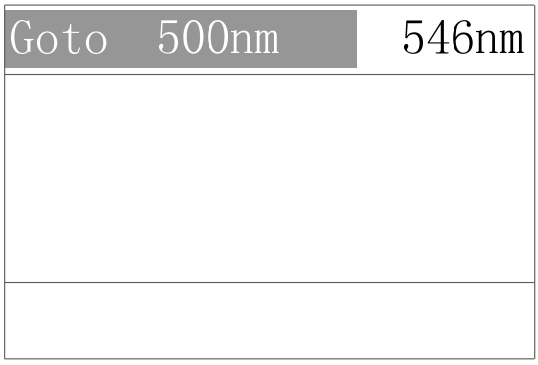


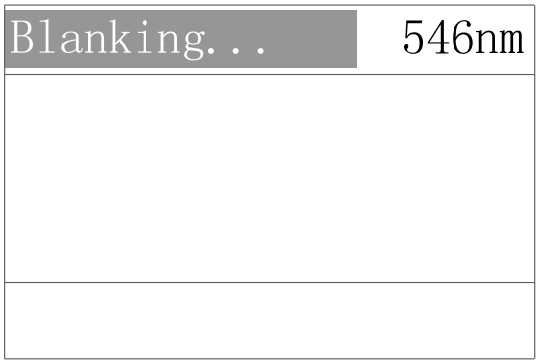
Up to 3 standard solutions of the same concentration standard can be measured. The average will be used for final calculation. Use the numerical key to enter the desired times of measurement for each standard concentration. DO NOT press【ENTER】yet! Please insert the blank reference first before pressing【ENTER】.



2.3.2.3 Blank the Reference

Insert the blank reference and press 【ENTER】to blank.





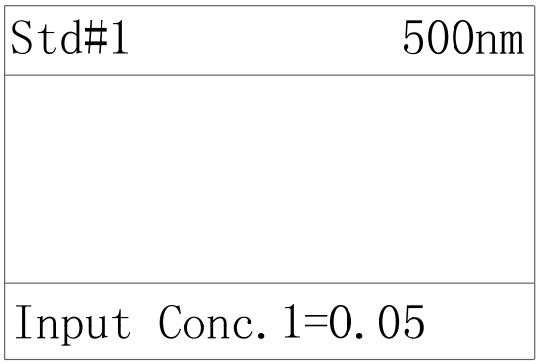
2.3.2.4 Measure the standards

After the parameters are setup and the reference is blanked it will automatically move to measure the standards. In this case we have chosen:

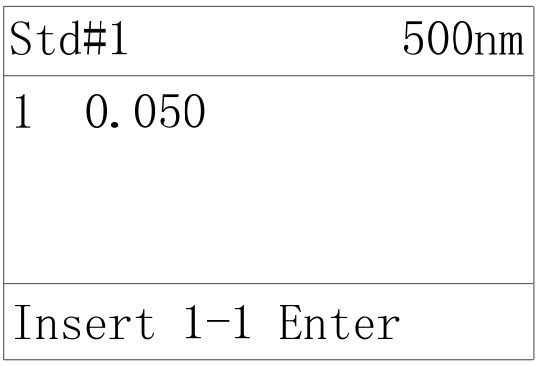
1) Two standards
2) Three standard sample solutions for each standard concentration.

Follow the step by step instruction on the LCD screen to measure all the standard samples.

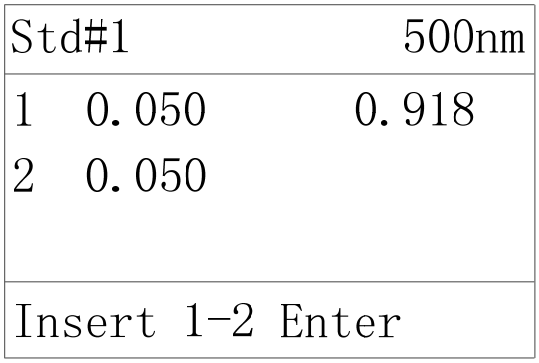
- Enter the concentration value of the first sample solution of the No.1 standard.（i.e. 0.05）. Press【**ENTER**】to confirm. The concentration value will be displayed on the screen.



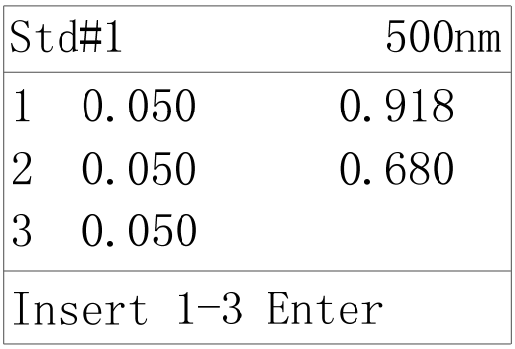
- Insert the first standard sample of the No.1 standard into the cuvette holder in the optical path.

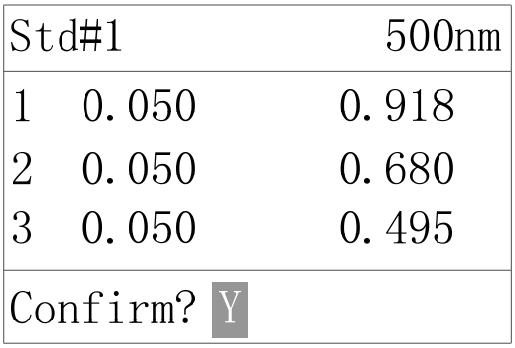


- Press ENTER to measure it. The measured the absorbance value is displayed.
- Then enter the concentration value of the second sample solution of the No. Standard. Insert that solution into the cuvette holder in the optical path. Press 【**ENTER**】to measure it.



- Repeat the same procedures for the third standard sample solution of the No.1 standard.





After the last standard sample solution of the No.1 standard is measured the LC will show "Confirm?Y" with Y highlighted. The instrument asks you to review and confirm the measurement. Then follow the screen instruction to measure the rest of the standards.

Note: If any error occurs and you want to re-measure the No.1 standard solutions use 【∧】, 【∨】to switch to "Confirm?N"Press【**ENTER**】to repeat the measurement.

Std#2	500nm
Input Conc.2=0.052	

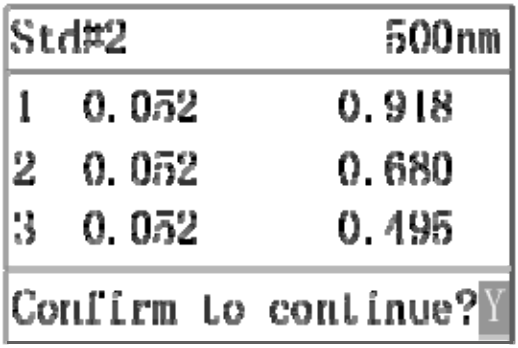
Std#2	500nm
1 0.052	
Insert 2-1 Enter	

Std#2	500nm
1 0.052	0.918
2 0.052	
Insert 2-2 Enter	

Std#2	500nm
1 0.052	0.918
2 0.052	0.680
3 0.052	
Insert 2-3 Enter	

Std#2		500nm
1	0.052	0.918
2	0.052	0.680
3	0.052	0.495
Confirm? Y		

After the last standard sample solution has been measured the screen display will you if you want to continue to processing the data. Select “Y” to continue.



Then you need to decide if you want to save the curve in the memory for future use.

Std#2		500nm
1	0.052	0.918
2	0.052	0.680
3	0.052	0.495
Confirm to Save? Yes		

If “Confirm to Save?No”is selected and confirmed， the curve will not be saved and the curve will be displayed on the screen. Use【∧】and【∨】to switch display between the curve and the equation. Press ENTER to start sample test. (The curve will be used for one-time test only.)

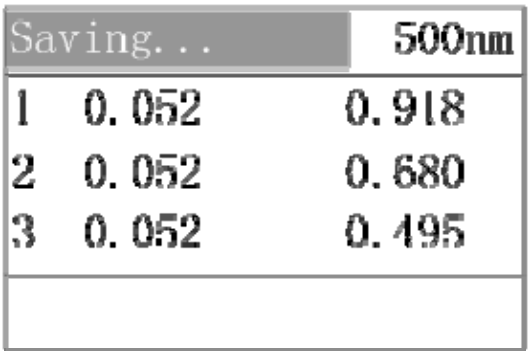
2.3.2.5 Save Curve

The established curve is saved in sequence with numerical sequence number by default unless you designate the slot for the curve. The newly established curve can be saved:

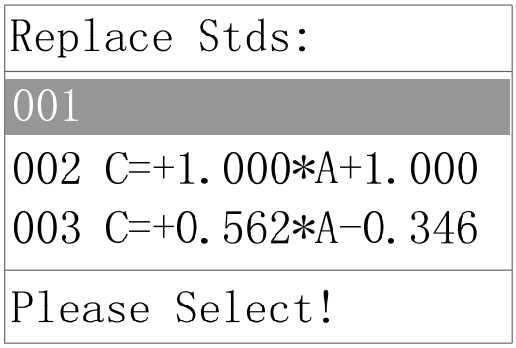
1) In sequence in the first available slot after the last saved curve on the list

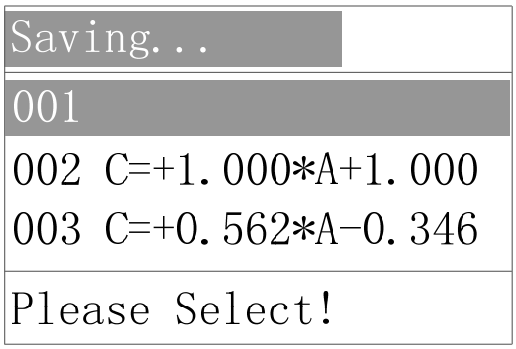
2) to replace certain standard curve, or
3) to the previously-deleted-curve-slot that is open.

When “Yes” is selected the slot after the last saved curve will be highlighted. You may press ENTER to save in that slot. (Take note of the sequence number of the saved curve). If you decide to save the in any other open slot or want to replace an existing saved curve, use the 【∧】and【∨】to highlight that open slot or saved curve, press ENTER to save.



Up to 200 curves can be saved. If No. 201 curve is established and needs to be saved the very first pre-saved curve with sequence No. 001 will be highlighted. If you do not want to replace the first saved curve please use 【∧】and【∨】to choose the slot save the new curve.



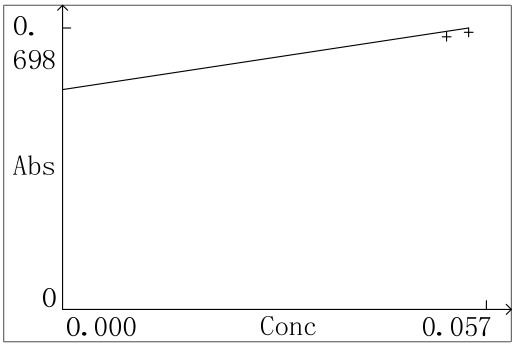


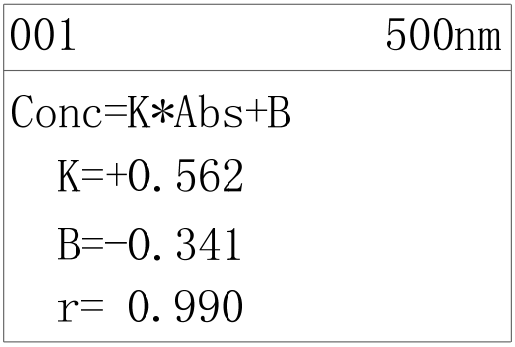
2.3.2.6 Replace previously saved curve

If you decide to save the in any other open slot or want to replace an existing previously saved curve, use the 【∧】and【∨】to highlight that open slot or saved curve, press ENTER to save.

2.3.2.7 Display Curve and Equation

The standard curve will be displayed regardless of your choice to save or not save the curve. Use 【∧】and【∨】to switch display between the curve and the equation. If you choose not to save the curve before and now decide to save it you have the chance to do it now by pressing 【**SAVE**】button.

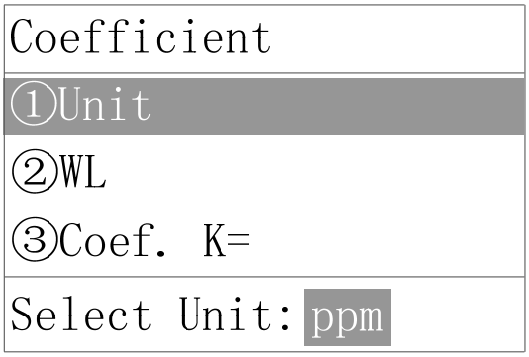




Press ENTER to start to test unknown samples.

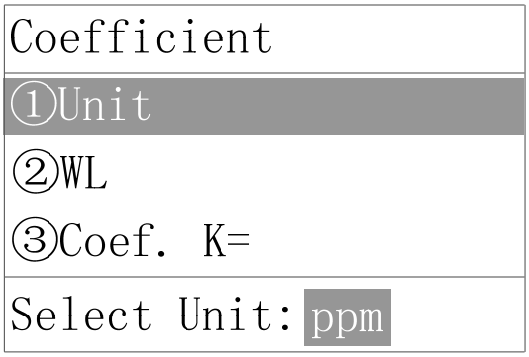
2.3.3 Create Standard Curve by Coefficient

At **"Create New Curve"** use 【∧】, 【∨】 *to highlight*"②**By Coefficient**"and press 【**ENTER**】to confirm the selection.



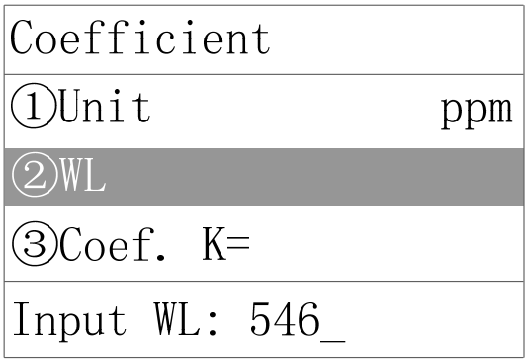
Set the Parameters

At Standard screen，①Unit is highlighted with“Select Unit:ppm”at the bottom，use 【∧】,【∨】to scroll the unit list (ppm,ppb,ng/ul,ng/ml,g/l,mg/l,%). Press【 **ENTER**】to confirm the unit selection.

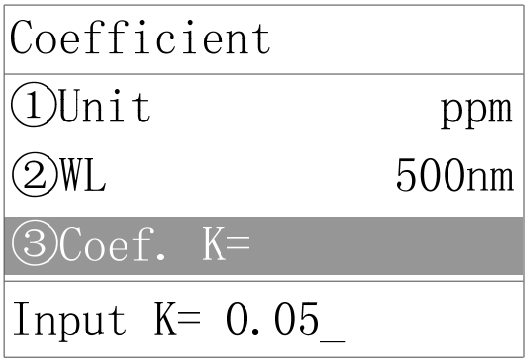


Next is to select the wavelength, use 【0】~【9】numerical keys to enter the desired wavelength（i.e. 500nm. Press【ENTER】to confirm the wavelength selection.

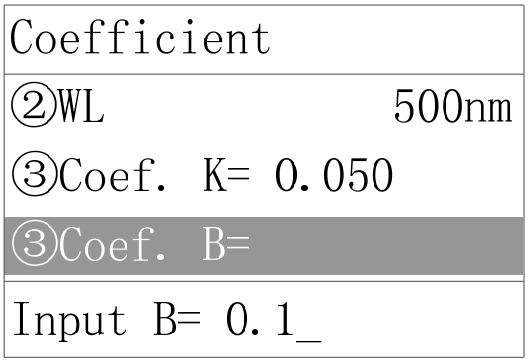
2

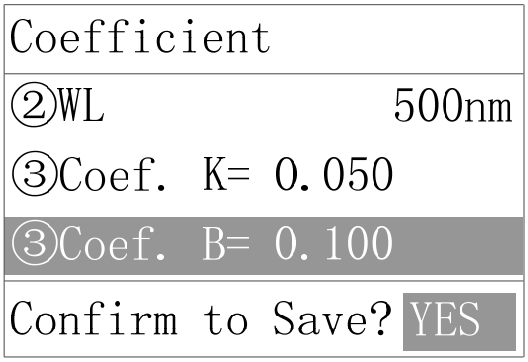


Then enter the slope K value of the standard curve.



The next step is to enter the intercept B value

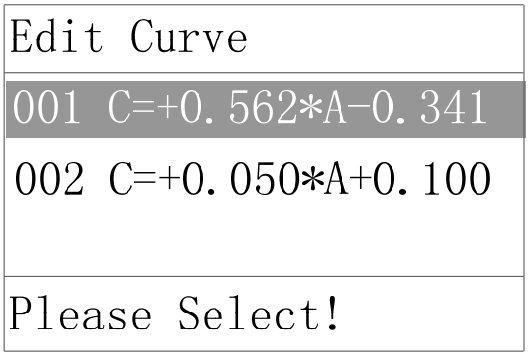




Then you need to decide to save the curve or not. Please refer to “Save Curve” and “Replace previously saved Curve” described in “By Standards”

2.3.4 Edit Curve

At **“Quantitative”** use【∧】,【∨】*to highlight*“②**Edit Curve**”. Press【**ENTER**】to confirm the selection.

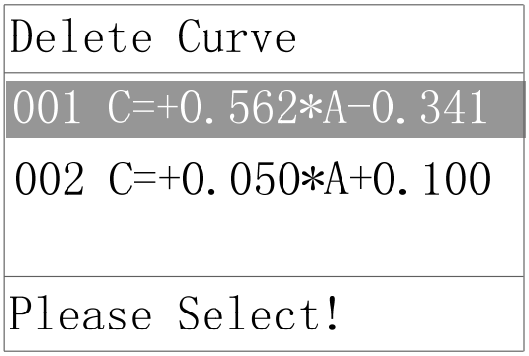


Edit Unit, Wavelength and any other parameter setting. Then run the standards measurement with the new standards solutions to re-establish the curve. The newly established curve will replace the previously saved curve.

Note: You may press【ESC】to cancel editing before measuring the new standards.

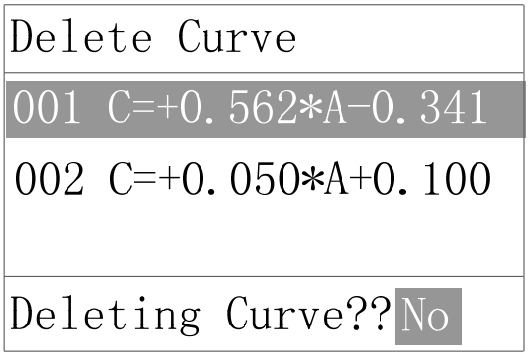
2.3.5 Delete Curve

At **"Quantitative"** use【∧】,【∨】*to highlight*"③**Delete Curve**". Press【**ENTER**】to confirm the selection.

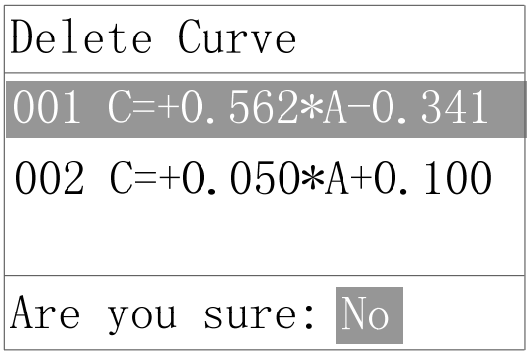


Use【∧】,【∨】to highlight the Curve to be deleted and press【ENTER】to confirm your selection.

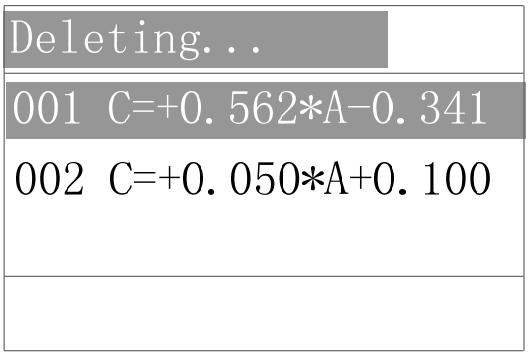
You will be asked to confirm your selection. The default selection is "No". Use 【∧】,【∨】to switch to "Yes" and press ENTER to confirm to continue deleting process. (Press 【ESC】to cancel delete and return to previous screen).



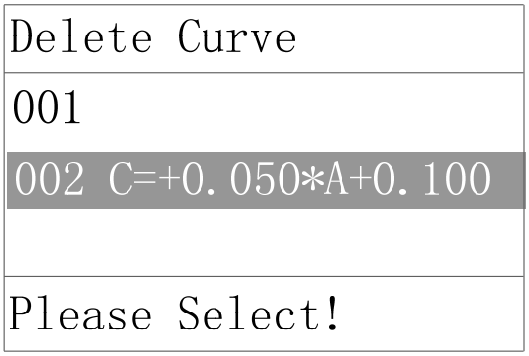
To avoid possible accidental delete you will be asked one more time to confirm. “Are you sure: NO” is displayed. Press 【ESC】to stop deleting process.



If you are absolutely sure you want to delete the curve switch “Yes” using【∧】or【∨】button. Press【ENTER】and the curve will be permanently removed from the memory.

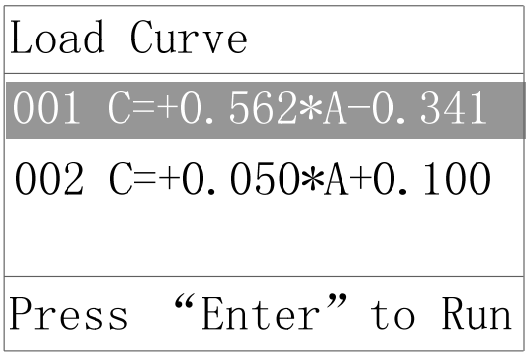


Now the sequence slot is kept and open.

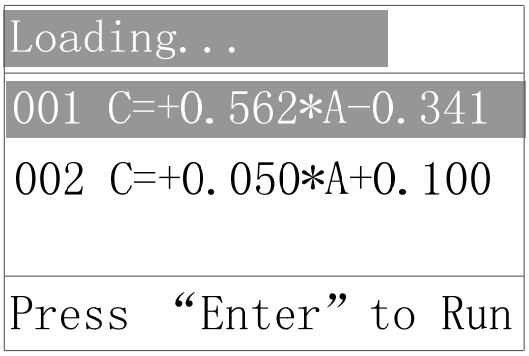


2.3.6 Load Curve to Run

At **"Quantitative"** use【∧】,【∨】*to highlight*"④**Load Curve**". Press【ENTER】to get into "Load Curve" screen.



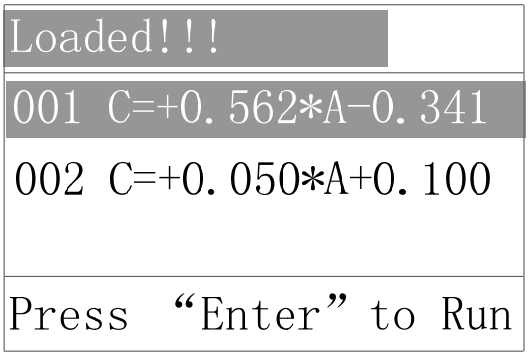
Press【**ENTER**】to load the highlighted curve and run test.



2.3.7 Load Curve to "Favorite Tests"

At **"Quantitative"** use【∧】,【∨】*to select*"④**Load Curve**". Press【ENTER】to get into "Load Curve" screen.

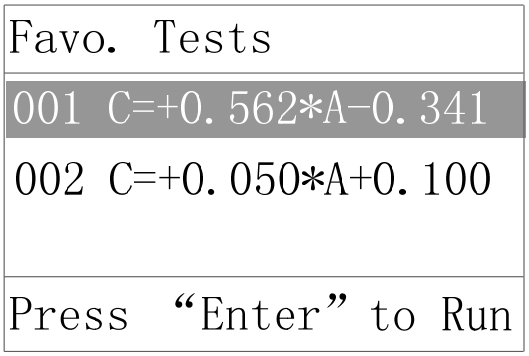
Use【∧】,【∨】to highlight the curve . Press【LOAD】to load the curve to "Favorite Tests"



Note: The same curve is still kept in the general saved curve list.

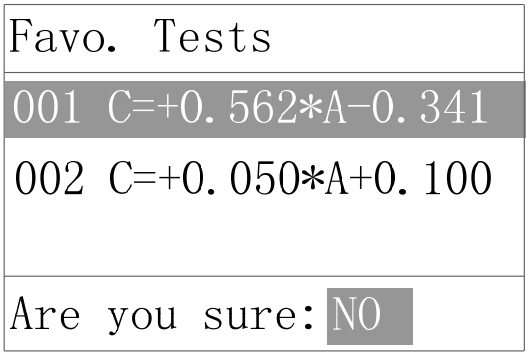
2.3.8 Favorite Tests

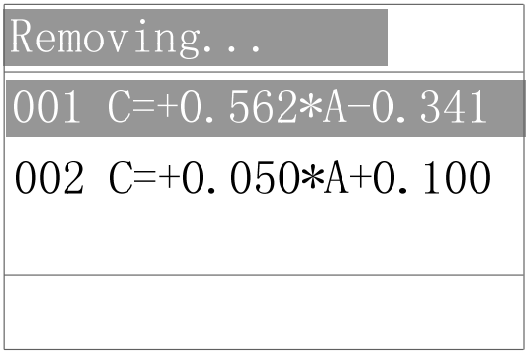
“Favorite Tests” is designed for easy access to the most frequently used curves. At **“Quantitative”** use【∧】,【∨】*to select*“⑤**Favorite Tests**”. Press【**ENTER**】*to confirm your selection.*

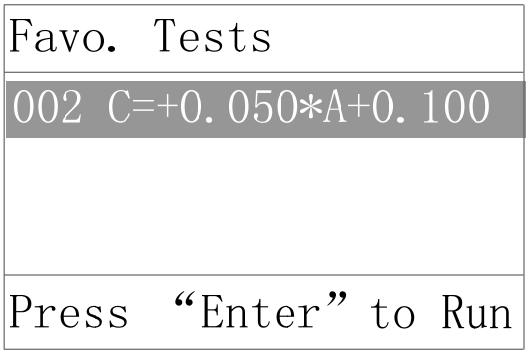


Select the desired curve in the favorite tests list and press 【**ENTER**】to run test.

If you decide to remove certain curve from the “Favorite Tests” folder highlight the curve and press 【**CLEAR/DEL**】**.** You will be asked to reconfirm your selection to remove the curve.



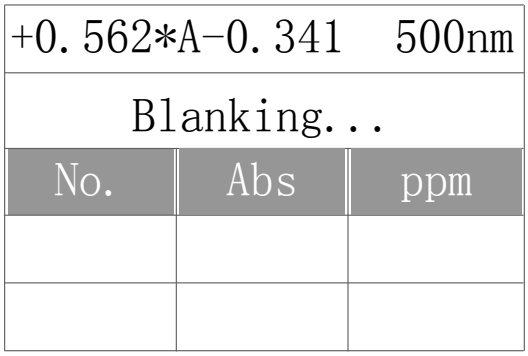


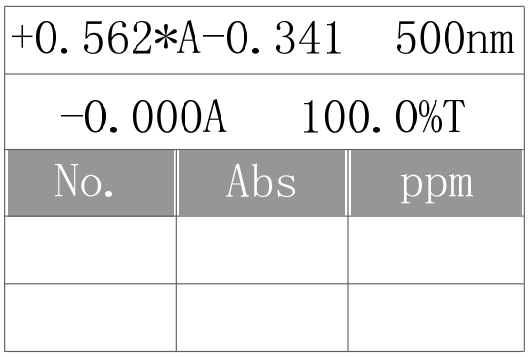


2.3.9 Run Test using Standard Curve

Follow the instruction described in the previous section in this manual to load the standard curve.

1) Insert blank reference into the cuvette holder in the optical path. Press 【**0A/100%T**】to blank.





Insert sample into the cuvette holder in the optical path and press 【ENTER】to measure. The Absorbance and Transmittance value of the current sample are displayed. The concentration value and the Absorbance value of the sample are logged into the table.

+0.562*A-0.341 500nm		
0.919A 12.0%T		
No.	Abs	ppm
* 01	0.919	0.175

Repeat the above procedure to measure the other samples.

+0.562*A-0.341 500nm		
0.680A 20.8%T		
No.	Abs	ppm
01	0.919	0.175
* 02	0.680	0.041

You may delete certain test result in the table. Move * to highlight the test result and press to 【**CLEAR/DEL**】it.

Press【**PRINT**】to print the test results.

```
←@◀
C=+0.562*A-0.341
Wavelength: 500nm
Abs=0.680A
Conc=0.041ppm
2011/04/01 10:00:06
```

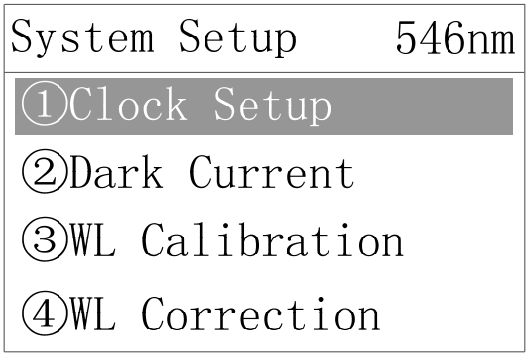
2.4 DNA/Protein

There are three methods to choose for DNA Ratio, RNA ratio and concentrations of RNA, dsDNA, ssDNA and olig.. Follow the screen step by step instruction to run your tests.

3 System Setup

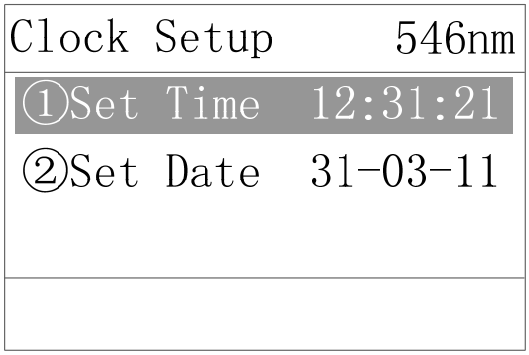
3.1 Clock Setup

At the main menu select“**System Setup**”. Choose “Clock Setup” and press【**ENTER**】to confirm.

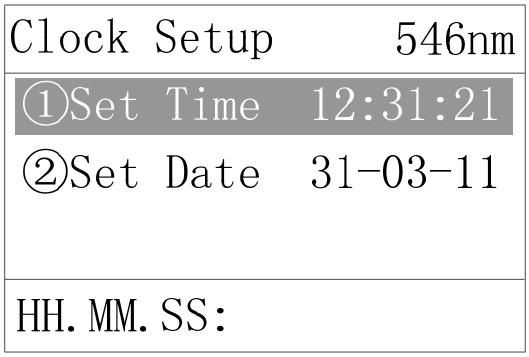


3.1.1 Set Time

Highlight “Set Time”. Enter time in the order of hour, minute and second.

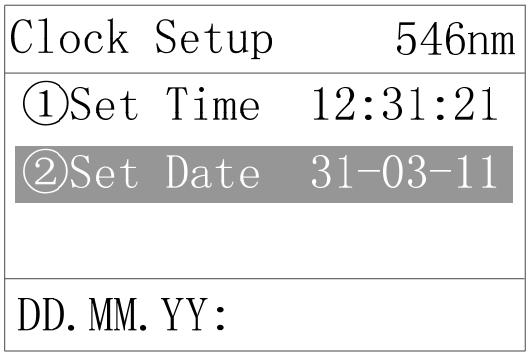


Enter time in the order of hour, minute and second. For example 19:30:00 stands for 7:30pm.



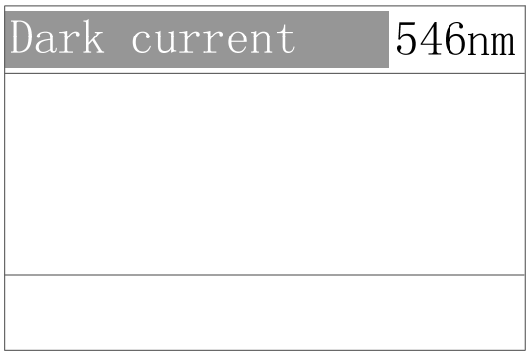
3.1.2 Set Date

The date is enter in the order of date (DD), month (MM) and year (YY). For example, 01.04.11stands for April 01, 2011.

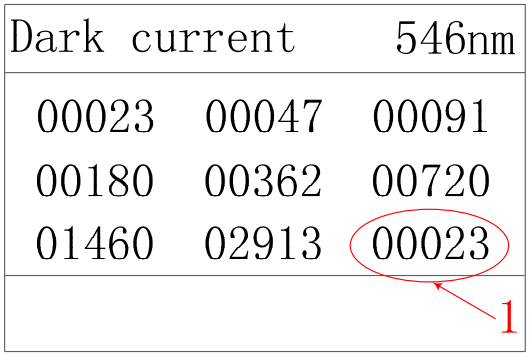


3.1.3 Dark Current

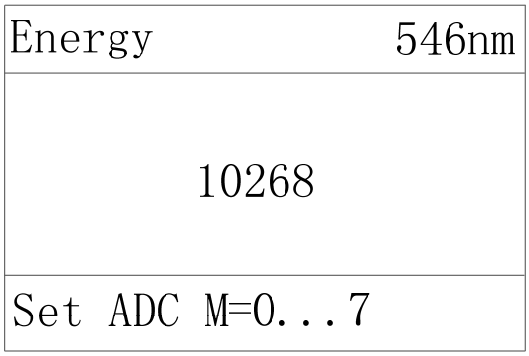
At “System Setup” select “Dark Current” to check and refresh the system dark current.



The marked“1”is the live dark current value at 0-gain which should not be zero or negative.

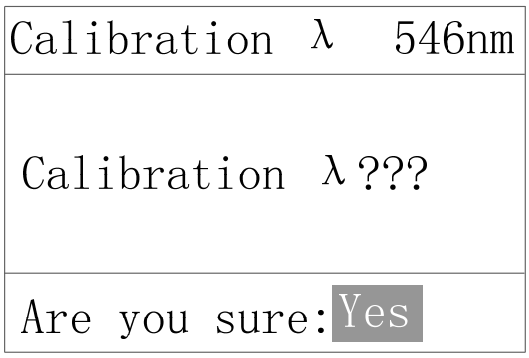


Press【**ENTER**】will refresh the dark current； Press【**PRINT**】to view the energy counts at different gain-setting (from 0 to 7).



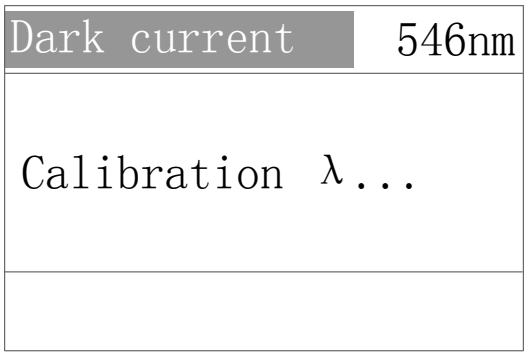
3.1.4 WL Calibration (Wavelength Calibration)

At “System Setup” choose “WL Calibration” to recalibrate the system and the wavelength.

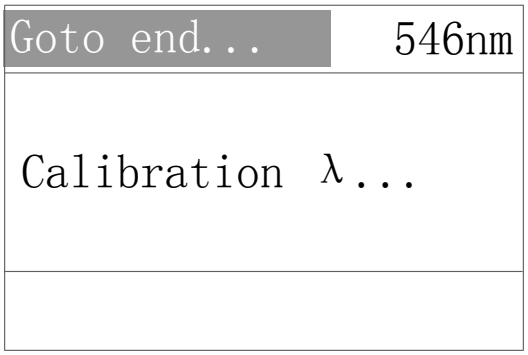


(If you decide not to recalibrate the wavelength press【**ESC**】to return back to“System Setup”.)

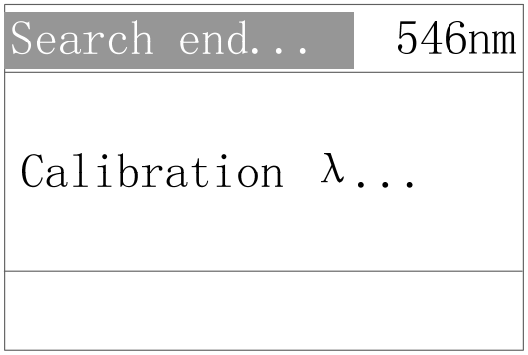
a) Recheck Dark Current



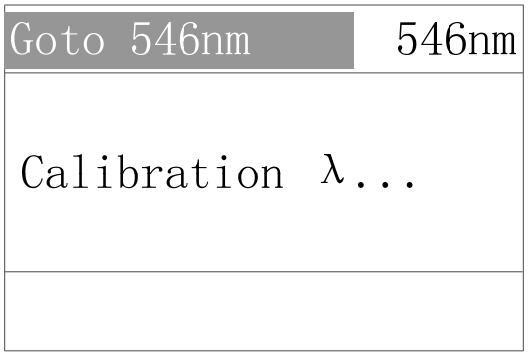
b) Move back to initial position



c) Search the “0” order light for re-positioning



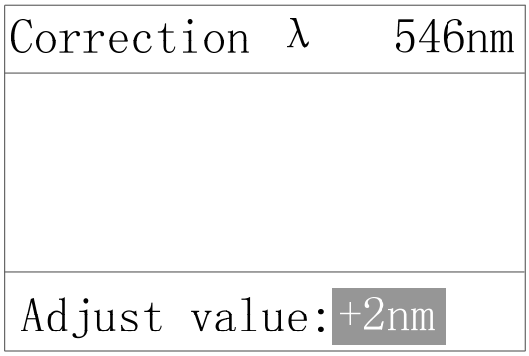
d) Finish wavelength calibration and move to 546nm



3.1.5 WL Correction (Wavelength Correction)

The wavelength is pre-calibrated and can be recalibrated using WL Calibration function. If for any reason the wavelength accuracy is off it can be fine adjusted by reset it using the wavelength correction function in the system setup.

Choose “WL Correction” in the System Setup menu. Use 【∧】,【∨】to select the correction value. Press 【**ENTER**】to confirm the adjustment. The correction rang is +8nm～-7nm.

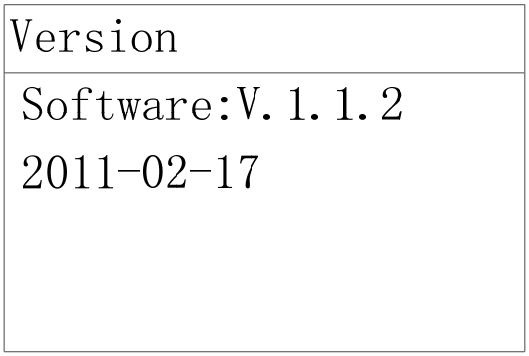


3.1.6 Language

At “System Setup” select “Language”. Then choose the preferred language for operation.

3.1.7 Firmware Version

You can check the firmware version from the “System Setup”



3.1.8 Lamp Service – S2150UV ONLY.

<u>This option is not available on S2150 Visible model</u>

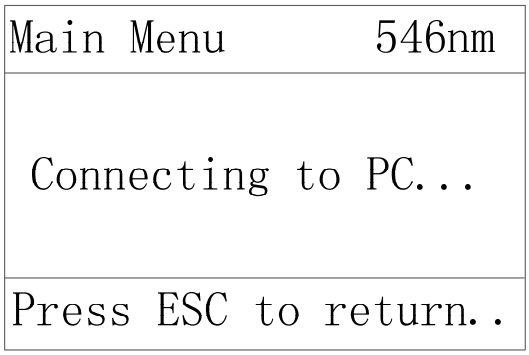
At “System Setup” select “Lamp Service” and then choose from the following:

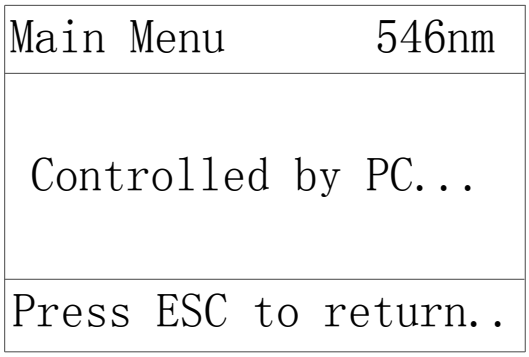
1. Switch D2: ON. Press Enter to switch the D2 bulb OFF.
   Press Enter to turn D2 bulb ON

2. Switch Point. Default switching point from halogen to deuterium is at 339nm. Press Enter. The 339 will display at the bottom of the screen. Enter new switching point. **It is not recommended to set switching point below 330nm or above 345nm.**

4 PC Connection

From main menu select"④**Connect to pc**"to allow PC software to control the instrument.





When the communication between the instrument and the computer is established via USB port the computer is in control. For details of the PC software please refer to UNICO application software manual.

5. Accuracy Check

5.1 Wavelength Calibration:

Normally the S2150 Series spectrophotometer retains its wavelength calibration indefinitely. However if the instrument receives a severe shock or is abused, use the following methods to check wavelength calibration. Please note that this test requires Didymium filter, or the Holmium Oxide filter.

In the filter method, the didymium filter has two distinct absorbance peaks at 529nm and 807nm. The Holmium filter has a distinct peak at 361nm. When the instrument is calibrated properly you will find minimum Transmittance (maximum Absorbance) at the range ±2nm from these peaks. Note that the specific Transmittance values are not important as you are only looking for the wavelength where the minimum transmittance (maximum Absorbance) occurs.

5.1.1 Holmium Oxide Filter Method:

1. Turn instrument on and allow it to warm up for 15 minutes.

2. Select the BASIC MODE.

1. Set the wavelength to 350nm.

2. Make sure the cuvette holder is empty in the sample compartment. Close the sample compartment lid.

3. Set zero Absorbance by pressing the 0A/100%T. The reading should then be 0.000A. If not, press 0Abs/100%T again.

4. Remove the cuvette holder and insert the Holmium filter into it. Place it in the sample compartment and close the lid.

5. Record the Absorbance reading on the LCD display.

6. Advance the wavelength setting by 1nm and repeat steps 2 to 5.

7. Repeat step 6 until the wavelength setting reaches 370nm.

8. Look for the maximum absorbance reading obtained, and this should be found between 359 and 363nm.

5.1.2 Didymium Filter Method:

1. Set the Wavelength to 800 nm.

2. Make sure the cuvette holder is empty in the sample compartment. Close the sample compartment lid.

3. Set zero Abs by pressing the 0A/100%T. The reading should then be 0.000A. If not, press 0Abs/100%T again.

4. Remove the cuvette holder and insert the Didymium filter into it. Place it in the sample compartment and close the lid.

5. Record the Absorbance reading on the LCD display.

6. Advance the wavelength setting by 1nm and repeat steps 2 to 5.

7. Repeat step 6 until the wavelength setting reaches 815nm.

8. Look for the maximum absorbance reading obtained, and this should be found between 805 and 809nm.

9. If a “middle” wavelength check is desired, set the wavelength to 522nm (optional)

10. Make sure the cuvette holder is empty in the sample compartment. Close the sample lid.

11. Set zero Abs by pressing the 0A/100%T key. The reading should then be 0.000A .If not, press 0Abs/100%T again

12. Remove the cuvette holder and insert the Didymium filter into it. Place it in the sample compartment and close the lid.
13. Record the absorbance reading on the LCD display.

14. Advance the wavelength setting by 1nm and repeat steps 10 to 13.

15. Repeat step 14 until the wavelength setting reaches 536nm. Again, look for the maximum absorbance reading. It should be between 527 and 531nm.

5.2 Absorbance Accuracy Checks

Specification: ±0.004A at 0.5A.

The absorbance accuracy should be checked against a set of neutral density filters accurately calibrated to the NIST standards. Contact your UNICO representative for more information (800-588-9776).

An alternative method using potassium dichromate is described below. Due to the many factors that might affect the results (i.e. temperature, bandpass, weighing and diluting errors), this method is less accurate and should only be used as a guide.

Reference: Johnson E A
Potassium Dichromate as an absorbance standard
PSG Bulletin 1967, No. 17, page 505

1. Make up N/100 sulfuric acid as the solvent and use part of it to make a solution containing 120 +0.5mg/litre of potassium dichromate.
2. Wash out a square cuvette with solvent, and fill with solvent.
3. Put the cuvette into the sample compartment and close the lid.
4. Select **BASIC MODE** and Set the wavelength to 350nm.
5. Set the reading to 0.000A using the 0Abs/100%T key.
6. Empty the cell. Wash out with dichromate solution, and fill with dichromate solution.
7. Put the cuvette into the sample compartment and close the lid.
8. Read the absorbance of the standard from the LCD display. The value should be Calibrated Value ± 0.004A. Refer to the notes above when interpreting the result.

Note: It is recommended that you refresh the **Dark Current** before check.

5.3 Stray Light Check

Specification: Less than 0.3%T at 340nm by ASTM E 387

A good indication as to whether the stray light level is within specification may be obtained as follows:
1. Set the wavelength to 340nm.

2. Select BASIC MODE With the sample compartment empty, close the lid and press the 0A/100%T key to set the LCD display to 100.0%.
3. Prepare a solution containing 50gm/L of sodium nitrite ($NaNO_2$) in distilled water and fill a square cuvette with this solution.
4. Place the cuvette in the sample compartment. Close the lid. The display should read<0.3%T.

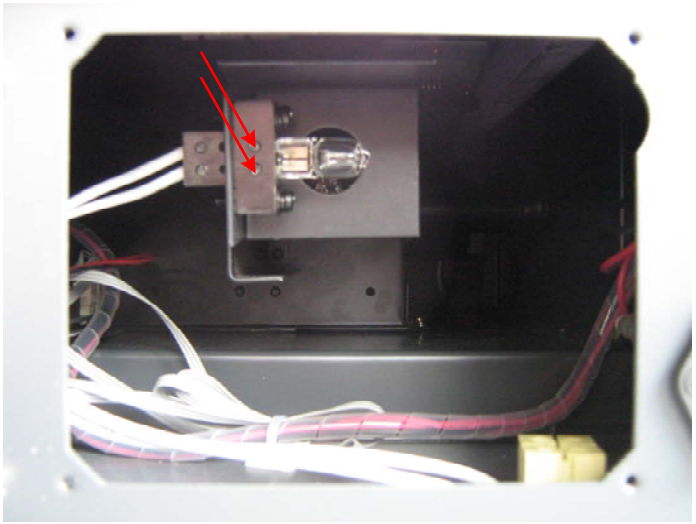
Note:It is recommended that you refresh the **Dark Current** before check.

6 Lamp Replacement

6.1 Halogen Lamp Replacement

- Use screw drive to loosen M3 screws and remove the cover on the back of the instrument.

- Loosen the 2 lamp-securing screws (M2). Pull the bulb out and replace with a new lamp (12V 20W) of the same type. The filament type must be identical. Secure the new lamp with the locking screw. Tight it firm but do not over-tight to avoid damaging or breaking the lamp



7 Trouble Shooting

PROBLEM	Possible	Solution
Instrument Inoperative	Power cord not connected to outlet	*Plug instrument in.*
	Dead Power outlet	*Change to a different outlet*
	Internal fuse blown or defective electronic component	*Call an authorized service engineer.*
	Improper power input	*Check the power supply (100v-230v)*
Instrument cannot set 100%T (0.000A)	Light beam blocked	*Check sample holder. See if holder is properly positioned and nothing is blocking light path.*
	Lamp is misaligned.	*Check to see if light is focused properly on entrance slit of the monochromator. Call Technical Service for details (800-588-9776).*
	Lamp light is weak or lamp is defective	*Replace the lamp*
	Defective electronic component.	*Call an authorized service engineer.*
Incorrect T% to Absorbance correlation	Bubbles or particles in solution.	*Check sample preparation and analytical procedure.*
	Defective electronic component.	*Call an authorized service engineer.*
Display does not change regardless of sample concentration	Concentration reading "frozen".	*Sample Solution too Dark, dilute it and redo the measurement.*
	Wrong wavelength setting.	*Check sample procedure and wavelength setting.*
	Insufficient sample volume.	*Fill cuvette with more sample solution.*
	Stray sample preparation vapors.	*Prepare the sample away from the instrument. Use proper ventilation.*
	Bubbles or particles in solution.	*Check sample preparation and analytical procedure.*
	Defective electronic component or loose wiring.	*Check wiring connections;* *Call an authorized service engineer.*
Instrument drift and noise	Lamp not adjusted properly.(misalignment)	*Check lamp has been properly installed or has moved during transit.*
	Lamp old or defective.	*Replace with a new lamp.*
	Power to lamp is not stable	*Check the power supply PCB to the lamp*
	Defective or dirty detector or defective electronic component.	*Call an authorized service engineer.*
Incorrect readings obtained	Insufficient sample volume	*Fill cuvette with more sample solution.*
	Wrong wavelength setting.	*Check analytical procedure and wavelength setting. Check wavelength accuracy according to procedure in this manual.*
	Stray sample preparation vapors.	*Prepare sample away from instrument. Use proper ventilation.*
	Bubbles or particles in solution.	*Check sample preparation and analytical procedure.*
	Instrument out of electronic calibration.	*Call an authorized service engineer.*

Error Messages

Error Message	Description	Solution
Locating lamp...X	Instrument unable to locate the lamp change-over switch	*If D2/halogen change-over motor does not work* *1) J3 connector on CPU and motor cable maybe loose* *2) D2/halogen motor is malfunctioning* *3) U3 Chips (TD62083) on is defective.* *If D2/halogen change-over motor works* *1) J9 connector on CPU and micro-switch cable maybe loose* *2) micro-switch maybe malfuntioning*
Locating filter…X	Instrument unable to initialize and/or locate the secondary filter	*If the Filter wheel driving-motor does not work* *1) J17 Connector on CPU and motor cable maybe loose.* *2) Filter driving motor maybe defective* *3) U3（TD62083）on the CPU maybe defective* *If Filter driving motor works* *1) J4 connector on CPU and filter opt coupler cable maybe loose.* *2) Opt-coupler（ST178）maybe malfunctioning*
WL Zero-order!		*1.Light beam alignment is off or is blocked* *2.Halogen lamp is off or dead.* *3.Filter wheel is malfunctioning and incorrect filter is brought into the optical path.*
Sys energy low!	Pass system calibration and WL calibration but detects light beam energy low.	*Energy to the detector is low. The 0-order energy count is less than 35000* *1. Lig*ht *beam alignment is off* *2. Filter wheel is malfunctioning and incorrect filter is brought into the optical path.*
WL Sensor 1...X	Unable to locate the WL calibration starting point	*Show" WL sensor 1 …X" after humming(jamming):* *Wavelength bar starting sensor is malfunctioning or dead and the bar may be jammed at the bar-front end.* *1) Check the sensor* *2) Move the WL bar out of jam by pulling the WL driving belt counter clockwise manually*
WL Sensor 1...X (continued)	Unable to locate the WL calibration starting point	*Show" WL sensor 1 …X" without humming:* *If Wavelength-driving motor does not work,* *1) J11 connector on CPU or the motor cable maybe loose.* *2) Wavelength-driving motor is defective.* *3) U8（TD62064） on CPU is defective.* *If wavelength-driving motor works,* *1) J5 connector on CPU for Opt coupler maybe loose.* *2) WL Opt coupler（GK102）is malfunctioning.* *3) Light beam is misaligned or blocked failing to reach the detector.*

		4) Lamp is off/dead *5) Detector PCB malfunctioning (dark current either negative or too high)*
WL Sensor 2...X	Wavelength bar reaches the back end and triggers the back-end protection sensor	*1. WL driving motor is malfunctioning and running reversely* *2. WL bar protection micro-switch is defective*
System calibration...X	Unable to complete system calibration	*If Wavelength-driving motor does not work,* *1)J11 connector on CPU or the motor cable maybe loose.* *2)Wavelength-driving motor is defective.* *3)U8（TD62064） on CPU is defective.* *If wavelength-driving motor works,* *1)J5 connector on CPU for Opt coupler maybe loose.* *2)WL Opt coupler（GK102）is malfunctioning.* *3)Light beam is misaligned or blocked failing to reach the detector.* *4)Lamp is off/dead* *5)Detector PCB malfunctioning (dark current either negative or too high)*
Energy low!!		*Lamp not on or dead* *1) Light is on but light beam fails to reach detector* *2) Light may be blocked* *3) Reference is too dark* *4) Light optical path mis-aligned: not focused on entrance slit; or internal optics off aligned to cause light beam not out from the exit slit to sample compartment.* *5) Secondary filter positioning is malfunctioning* *Detector PCB malfunctioning (dark current too small or negative or the board is defective)*
Energy high!!		*1. Secondary filter positioning is malfunctioning* *2. Detector PCB malfunctioning (dark current either too high or the board is defective)*