

Quawell

Q3000 UV SPECTROPHOTOMETER

USER MANUAL

V3.3.1 (Not available in USA)

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Rev 01/2013

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1. OVERVIEW

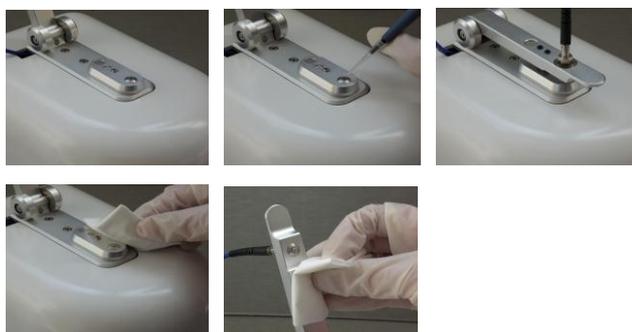
Introduction

Quawell Q3000 is a micro-volume UV spectrophotometer specifically designed for the measurement of nucleic acids and pure proteins. Using a unique technology that holds 1-2 ul samples between the upper and lower optical surfaces without the use of a cuvette, Q3000 has ability to measure the sample in less than 2 seconds with a high degree of accuracy and reproducibility.

Basic operation

Operation of the Q3000 is simple and efficient. The Q3000 uses the technologies that automatically make all necessary measurements and calculations. The data is presented in the module data window and is easily exported to an Excel spreadsheet. To operate:

1. Lift the upper arm, place 1.5ul blank buffer to the lower surface.
2. Lower the upper arm and click the “Blank” button.
3. Lift the upper arm and wipe the blank buffer from both surfaces.
4. Place 1.5ul sample on the lower surface, set the upper arm back to the measurement position and click the “Measure” button.



Patents and unique technologies

- **The liquid column technologies (Patent No. US 7,969,575 B2):**

Q3000 is built base on the following liquid column technologies

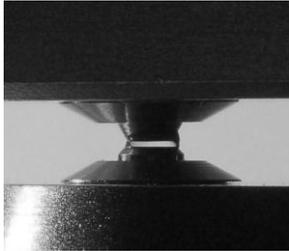


Figure 1: Initially the sample is loaded and the upper arm is closed.

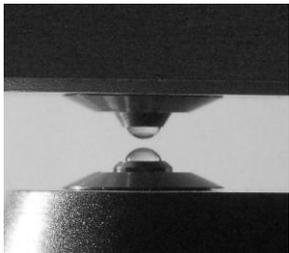


Figure 2: The upper arm is lifted by the actuator, due to molecular effects, the sample is broken into two separate parts, one part is attached to lower surface and the other part is attached to upper surface.

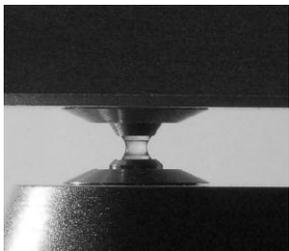


Figure 3: After reaching its home position, the upper arm is lowered. A liquid column is formed when the upper arm is lowered to the position where the two droplets touch. The measurement is then performed at this position without moving the upper arm upwardly again.

- **CCE No. (Patent pending)**

CCE No. (Calibration Coefficient) is another unique technology used in Q3000 software. With CCE No., Q3000 has ability to:

1. Automatically calibrate by running “Diagnostic” module (option).
2. Provide higher accuracy then the similar products in the market.

- **The light system (Patent pending)**

The light system designed especially for Q3000 has many advantages:

1. long life time
2. reproducibility
3. efficient

2. INSTALLATION

Note: Do not connect the instrument to the PC before software install.

Computer requirements

- Microsoft Windows XP, Vista or Windows7
- Microsoft Office 2003 or higher
- Adobe Reader
- CPU: 400MHZ or higher
- 64MB RAM
- USB port
- Monitor 1024x768
- 500MB Hard disk available

Software Setup

Insert the CD into the CD-ROM, open the folder “Q3000”, double click the file “Setup”, and follow the prompts to finish installation of the software.

Install Q3000 and the Driver

Connect the instrument to the PC using the USB cable shipped with the Q3000, the computer will automatically find the drive and finish the installation.

Input CCE No.

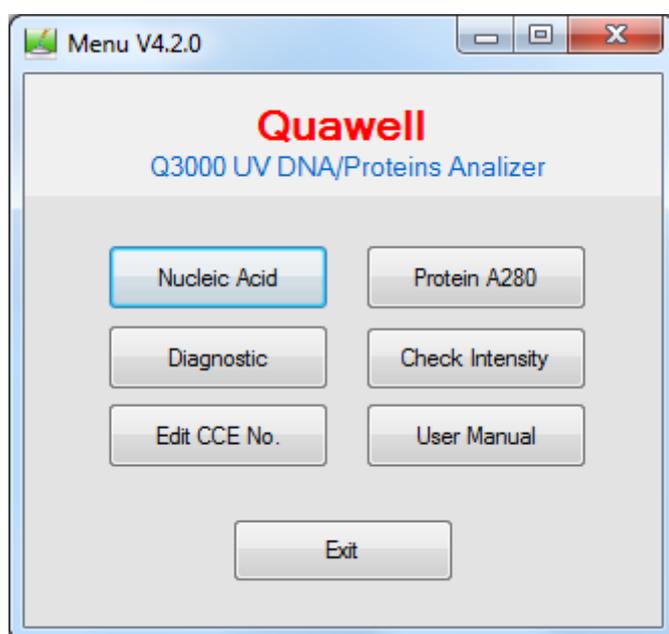
For first time to use, it is required to input the CCE No.

Note: wrong CCE No. input will cause the measurement error.

3. MENU AND FUNCTIONS FOR THE APPLICATIONS

Menu

Double click the shortcut Q3000 on the desktop, the menu as below will be displayed on the screen.



Buttons on the menu:

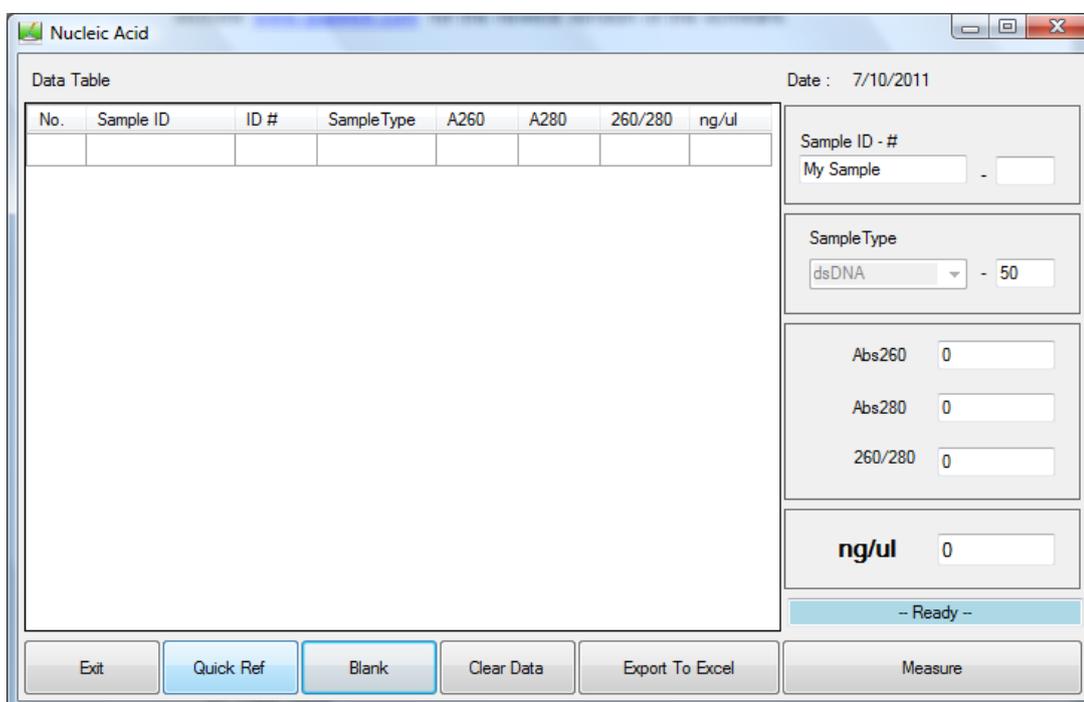
1. **Nucleic Acid:** the application for samples of dsDNA, ssDNA and RNA.
2. **Protein A280:** the application for sample of pure proteins (BSA, IgG and Lysozyme).
3. **Diagnostic:** check the measurement paths calibration.
4. **Check Intensity:** check the light source intensity and system reproducibility.
5. **Edit CCE No.:** allows the users to edit CCE No. when it is necessary.
6. **User Manual:** display the user manual.

Password

Password is required for edit CCE No. The default password is “admin”.

Functions for nucleic acid and protein a280

There are six function buttons for the applications of Nucleic Acid and Protein A280.



1. **Exit:** exit the current application and back to the menu.
2. **Quick Ref:** display the quick reference.
3. **Blank:** measure and store the blank values for the sample to be measurement.
4. **Clear Data:** clear the data records on the Data Table.

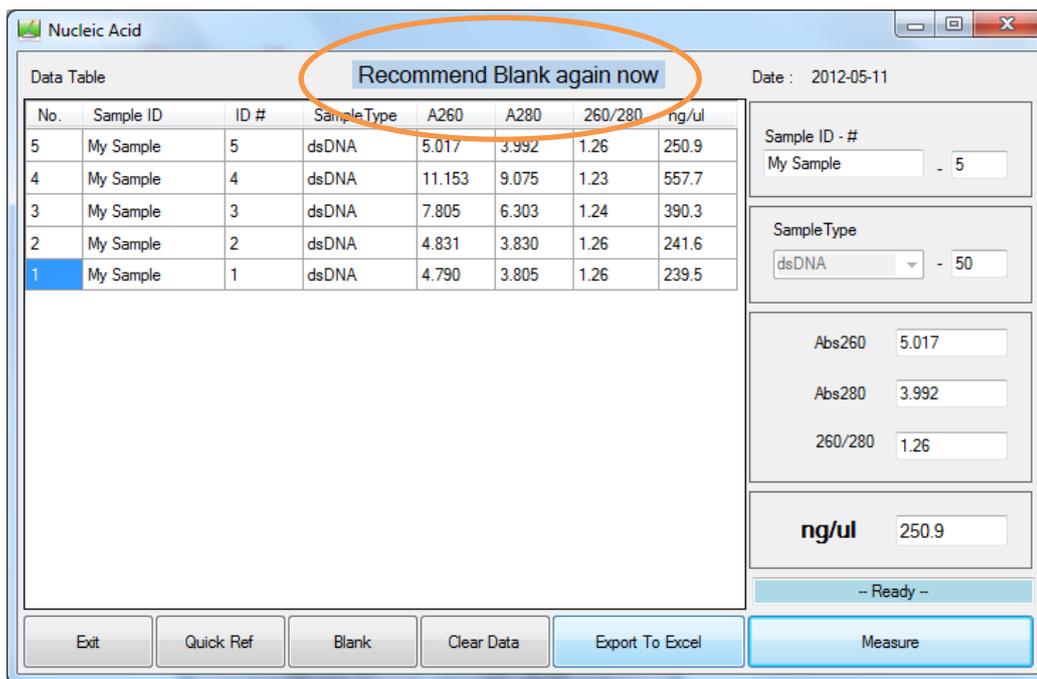
5. **Export To Excel:** output the data on the Data Table to Excel spreadsheet.
6. **Measure:** measures and calculates the sample absorbance and concentration. See Appendices B and C for details on the absorbance and concentration calculations.

Making measurement

1. Select the application Nucleic Acid or Protein A280;
2. Select the sample type and input the sample ID for the sample to be measured;
3. Open the upper arm, add 2ul blank reagent on the lower surface and close the upper arm;
4. Click the button “Blank”;
5. Left the upper arm and clean the blank reagent from both upper and lower surfaces with the dry laboratory wipe;
5. Add 2ul sample on the lower surface and close the upper arm;
6. Click the button “Measure”;
7. Clean the sample with dry laboratory wipe
8. Export the data if you need to save it.

Recommend blank message

The message “Recommend Blank again now” will be displayed on the top of the interface when reach to 30 measurements or 10 Minutes after blank.

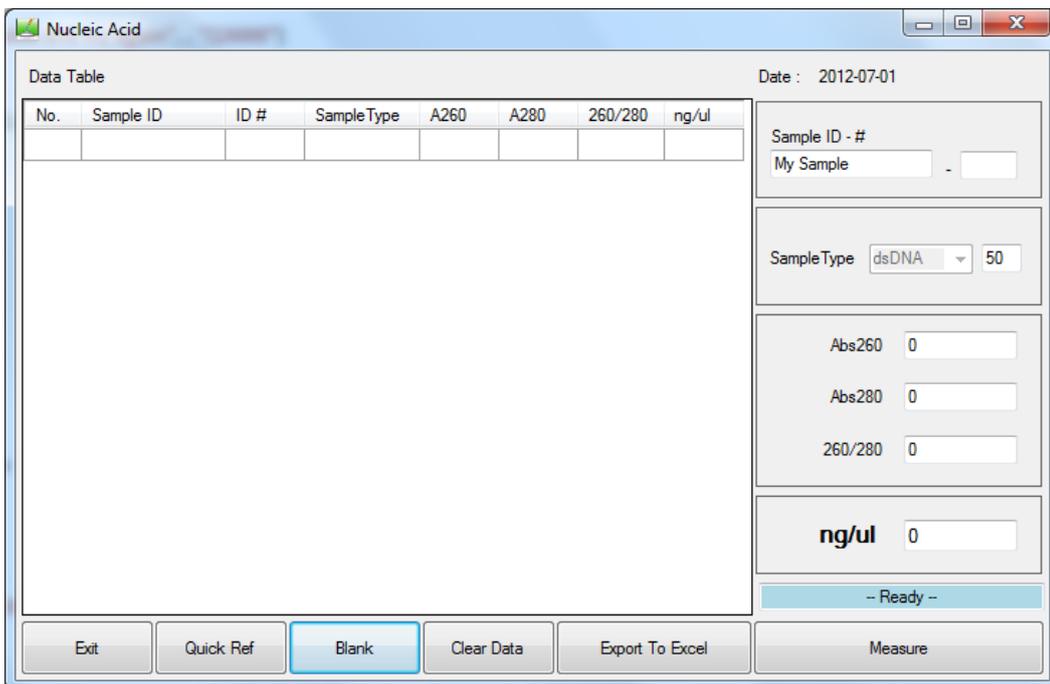


It doesn't mean that you have to blank again when you see this message. But it is always better to establish the blank when you see this message appeared if the measurement result is considerable.

4. NUCLEIC ACIDS

Nucleic acid screen features

Select Nucleic Acid application from the Q3000 menu, the module interface will be displayed on the screen as below.



- Sample ID - #:** there are two windows that display the sample ID information. The left window displays the sample ID input by the user. The default is “My Sample”. The right window displays the ID number for that sample ID. The ID number begins at 1 and increases by 1 for each measurement. Changing the Sample ID will automatically reset the ID number to 1.

- **Sample Type:** Chose the sample type for the sample to be measured. There are 3 different sample types for nucleic acids: dsDNA, ssDNA and RNA. The default is dsDNA. The sample type is disabled after blanking; the extinction coefficient of the sample selected will appear in the next window on the right.
- **Ads260:** Absorbance of the sample at 260 nm.
- **Abs280:** Absorbance of the sample at 280 nm.
- **260/280:** Ratio of absorbance at 260 nm and 280 nm.
- **ng/ul:** Sample concentration in ng/ul. See Appendix C for more details on this calculation.

Measurement range (dsDNA)

Concentration	Reproducibility	Abs accuracy (1mm)
1 to 4000 ng/ul	1-100 ng/ul ± 2 ul >100 ng/ul ± 2%	2%

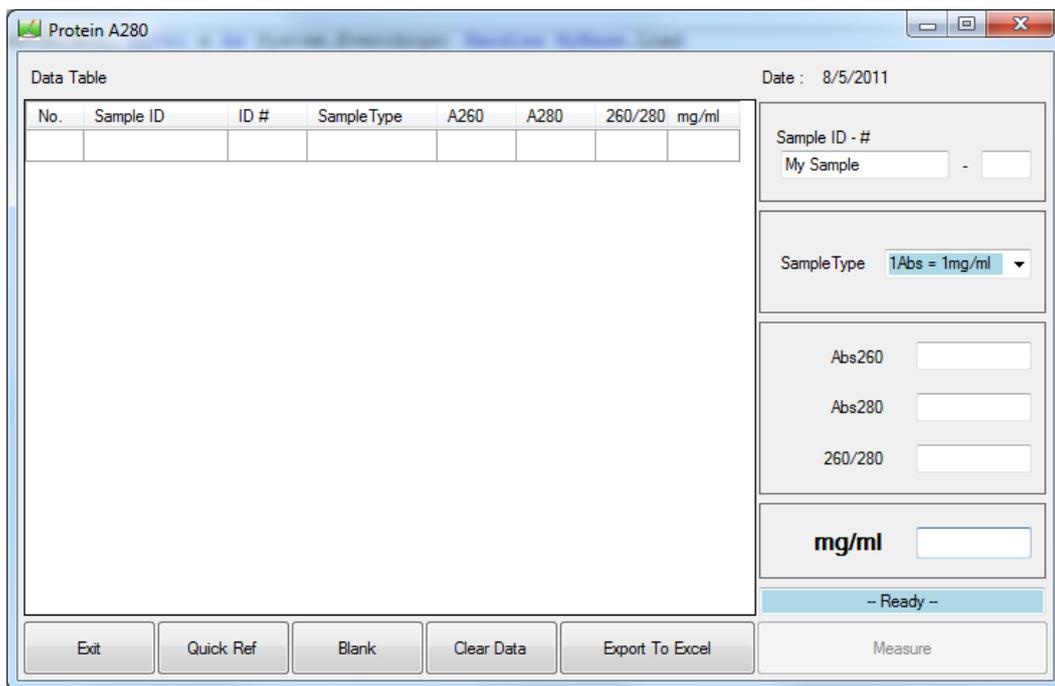
Sample volume

There is no specific requirement for the sample volume; however for the best accuracy and reproducibility we recommend 2ul.

5. PROTEIN A280

Protein A280 screen features

Select Protein A280 from the Q3000 menu. The module interface will appear on the screen.



- Sample ID - #:** there are two windows that display the sample ID information. The left window displays the sample ID input by the user. The default is “My Sample”. The right window displays the ID number for that sample ID. The ID number begins at 1 and increases by 1 for each measurement. Changing the Sample ID will automatically reset the ID number to 1.

- **Sample Type:** Chose the sample type for the sample to be measured. There are 4 different sample types for protein measurement: 1Abs = 1mg/ml, BSA, IgG, and Lysozyme. The default is 1Abs = 1mg/ml. The sample type is disabled after blanking. The extinction coefficient of the sample selected will appear in the E Coe window.
- **Ads260:** Absorbance of the sample at 260 nm.
- **Abs280:** Absorbance of the sample at 280 nm.
- **260/280:** Ratio of the absorbance at 260 nm and 280 nm.
- **mg/ml:** Sample concentration in mg/ml. See Appendix C for more details on this calculation.

Measurement range (BSA):

Concentration	Reproducibility	Absorbance accuracy (1mm)
0.05 -100 mg/ml	± 2%	Abs 0-0.2 ± 0.002abs
		Abs 0.2-1 ± 0.02abs

Sample volume

There is no specific requirement for the sample volume; however for the best accuracy and reproducibility we recommend 2ul.

6. POTENTIAL SOURCES OF ERROR

Sample overlap

Sample residue on either measurement surface will affect the result. We suggest that the user:

1. Clean the two surfaces with dry soft lab paper after each sample measurement.
2. Use 2 ul of de-ionized water to clean the surfaces after measuring highly concentrated samples.
3. Thoroughly clean the surfaces and surrounding area with de-ionized water after completing all measurements.
4. Before sample measurement, blank the machine as described:
 - Open the appropriate application module.
 - Lift the upper arm and add 2 ul of blanking reagent to the lower surface.
 - Lower the upper arm and click the Blank button.
 - Lift the upper arm and clean the blanking reagent from both surfaces with de-ionized water.
 - Add 2 ul blanking reagent to the lower surface.
 - Lower the upper arm and click the Measure button.
 - If the value is higher than 0.04, repeat steps b to f.

Sample homogeneity

Non-homogenous samples would cause significant deviation in the data generated by any measurement system, including the spectrophotometer.

Effect of evaporation

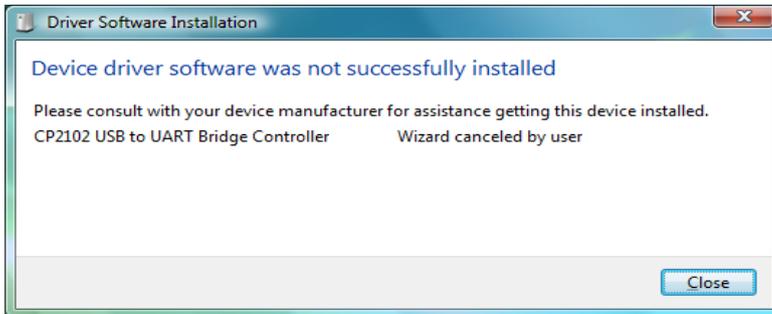
Sample evaporation could cause a 1-2% deviation in the sample's concentration.

Insufficient sample volume

We recommend 2ul for normal sample measurements. This sample size ensures that the liquid sample forms a complete column between the upper and lower optical surfaces.

7. TROUBLESHOOTING

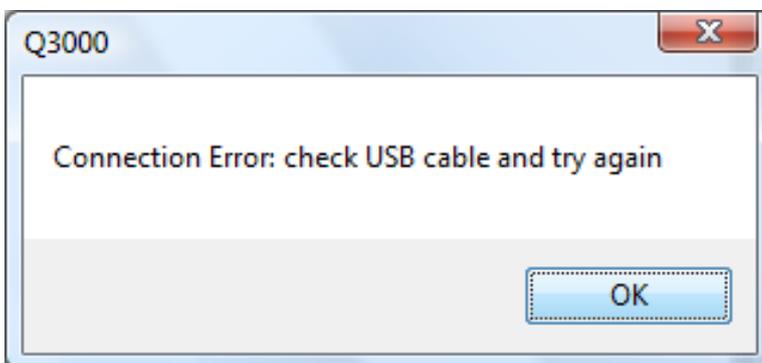
Q3000 driver installation error



To solve this problem by manually install the driver as follows:

- Disconnect Q3000
- Insert the CD into CD-ROM, click the driver “CP210xVCPInstaller” in following folder:
C:\Program Files\Quawell\Q3000 V3.0.1\SiLabs\MCU \CP210x.
- Connect Q3000 to computer with the USB cable.
- If there is still a problem with the driver installation, please contact technical support at (408) 676-7626.

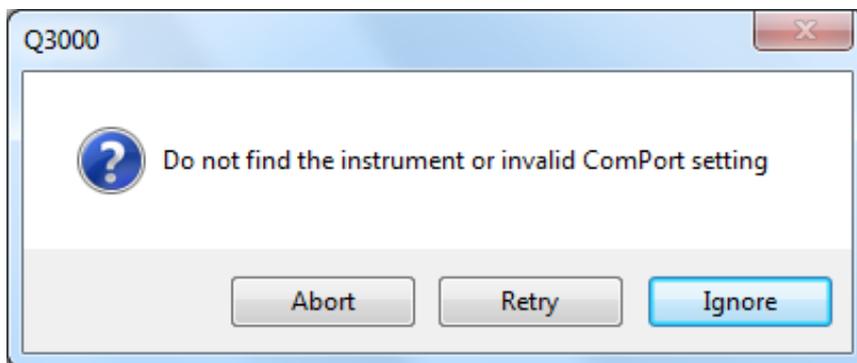
USB connection error



This error screen appears when there is a communication problem

between the Q3000 and the computer. It usually indicates that the Q3000 and PC connection failed. To correct the error, unplug the USB cable, wait for 2-3 seconds, and plug it again. If the error persists, contact your local distributor.

Error message “Do not find the instrument or invalid ComPort setting”



- USB port on the main board is defective. Replace main board or contact your distributor.
- Invalid PC SUB port setting, contact your system manager.

Sample accuracy and reproducibility

- If the sample data are inaccurate and/or not reproducible, please refer to Section 6 “POTENTIAL SOURCES OF ERROR”.
- Instrument out of calibration. Refer to Section 9 “Diagnostic” to run a diagnostic test.
- Upper arm loosening. Replace the sample holder assembly or contact your local distributor.

Intensity error

There is not enough light reaching 260 and/or 280nm detector. Possible Causes: lamp, detector, optical fiber or main board defective. Please contact your local distributor for service help.

Instrument self-tests fail.

When the power switch is on, the instrument will run the self-test which the upper arm will move up and down. If the self-test is fail, possible causes is power supply or main board defective.

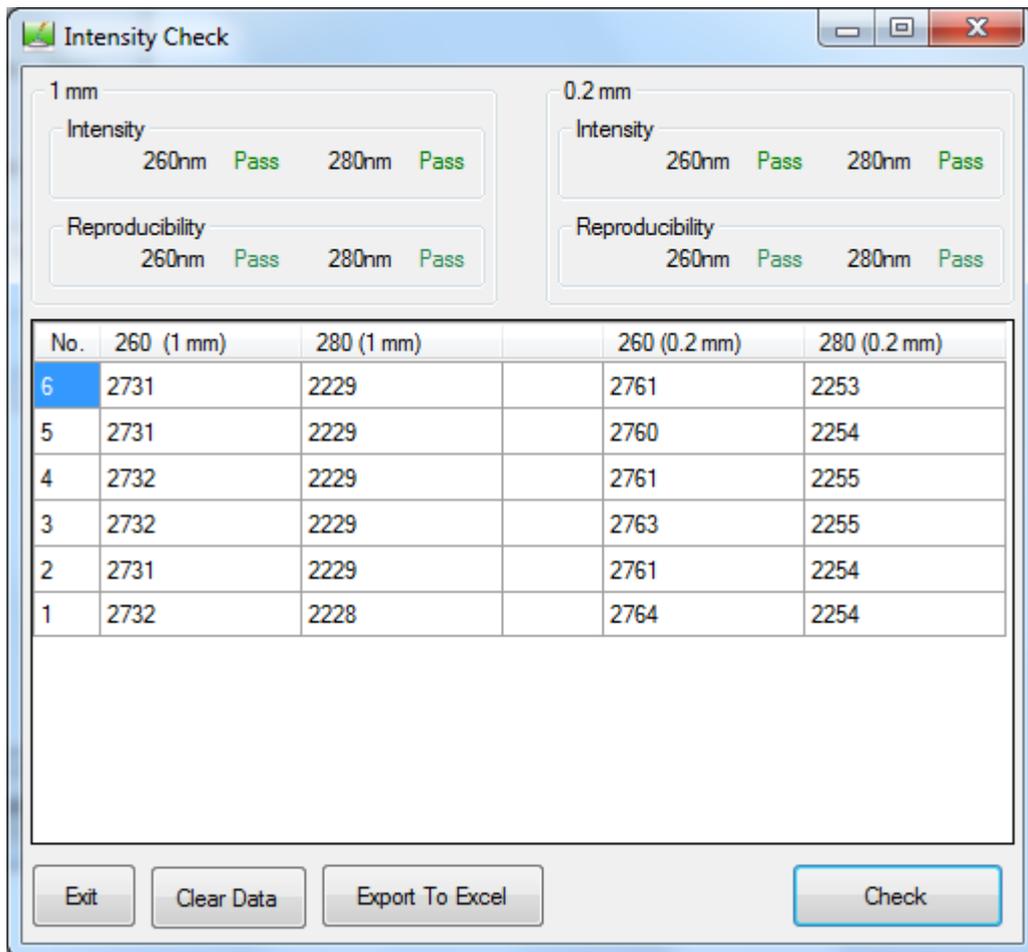
8. MAINTENANCE

The primary maintenance requirement of the Q3000 spectrophotometer is to keep the measurement surfaces clean. Upon completion of measurement, to prevent sample carryover and residue buildup, wipe the sample from the upper and lower measurement surfaces, as well as the surrounding area, with de-ionized water.

9. CHECK INTENSITY

This function will check the light source intensity and system reproducibility.

Screen features



1. 1mm and 0.2mm window

Indicate the checking results of intensity and reproducibility at 1mm and 0.2mm.

2. Data table

It contains all checking data that can be export to Excel.

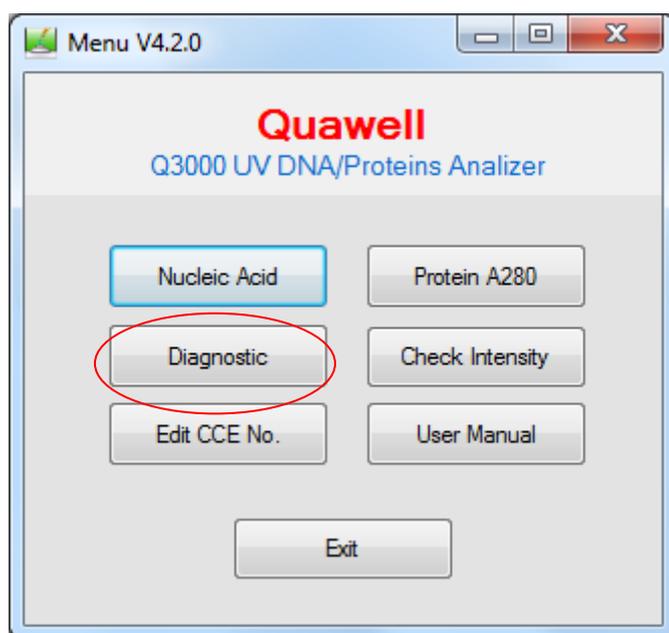
Making intensity check

Select the Intensity Check from the main menu. Simply click the Check button, the intensity data will be stored in the table and the 1mm window and 0.2mm window will display the current check results that will be in green color (Pass) or red color (Fail).

If you see the red color in the window(s), clean the measurement surfaces with the pure water and try again. If the problems persist, save and email the Intensity check results to the technical support or your local distributor.

10. DIAGNOSTIC

Diagnostic function checks the calibration of 1mm and 0.2mm path. It is recommended that you run this function every six months.



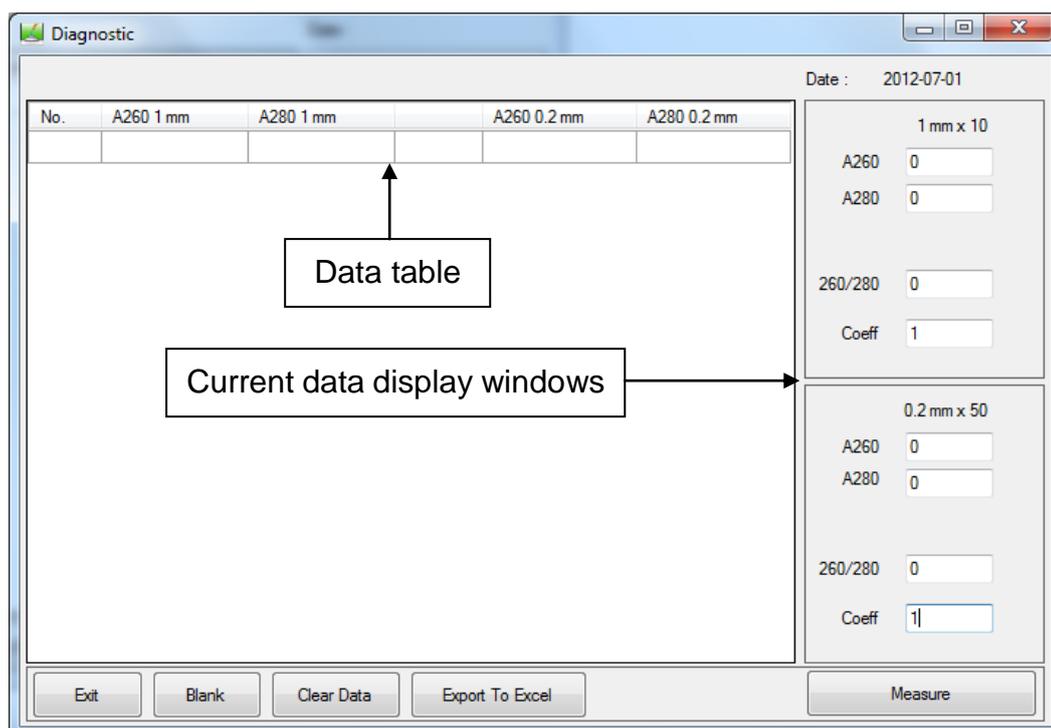
Standard solution

QW101 is the standard solution required for running diagnostic. QW101 is an aqueous potassium dichromate ($K_2Cr_2O_7$) solution and can be keeping in room temperature for 6 months. QW101 is available from your local distributor. Absorbance of QW101 is 9.54 at 260 nm (1mm x10).

Note	Do not re-use QW101 after open it.
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Diagnostic screen features

Click on Diagnostic on the main manual, the application interfase will be loaded as below.



1. Data table

Data table stores the absorbance of 260nm and 280nm at 10mm and 0.2mm.

2. Current data display windows

Window 1mm x10:

- A260: absorbance at 260 nm;
- A280: absorbance at 280 nm;
- 260/280: ratio of 260 nm and 280 nm;
- Coeff: CCE No. of 1 mm optical path;

Window 0.2 mm x 50:

- A260: absorbance at 260 nm;
- A280: absorbance at 280 nm;
- 260/280: ratio of 260 nm and 280 nm;
- Coeff: CCE No. of 0.2 mm optical path.

Making diagnostic

Note	Before making diagnostic. 1. Clean the measurement surfaces with the de-ionized water carefully. 2. Check intensity.
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1. Select the Diagnostic from the menu;
 2. Follow the steps as below to check the surfaces condition:
 - a. Open the upper arm, add 2ul de-ionized water on the lower surface, close the arm and click Blank.
 - b. Open the upper arm and remove the de-ionized water from both surfaces with the dry laboratory wipe.
 - c. Add 2ul de-ionized water on the lower surface, close the arm and click Measure.
 - d. If the absorbance at 1 mm and 0.2 mm at 260 nm are lower than +/- 0.1, go to next step, otherwise, repeat "a" to "c".
 3. Remove the water with dry wipe from both surfaces and click Clear Data Table button to delete the data from the table.
 4. Add 2ul QW101 on the lower surface, close the arm and click Measure button.
-

5. Remove the QW101 from surfaces with dry wipe.
6. Repeat “3” to “5” for 9 more times.
7. Click Export To Excel to export and save the data in Excel Spreadsheet.
8. Compare the measurement results to the following table. If the measurement result is out of the range, repeat the steps 2-7. If the problem persists, go to section 10 “Calibration and Modify CCE No.” or contact Quawell technical support or your local distributor.

	1mm	0.2mm
Average Abs at 260 nm	9.54 +/- 3%	9.54 +/- 3%
Ratio of 260/280	1.22 – 1.28	1.22 -1.28

11. Calibration and modify CCE No.

Note	Please contact Quawell technical support or your local distributor if it is your first time to run this function.
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CCE No. (Calibration Coefficient No.)

CCE No. contains 8 digits that looks like 10001000. Modify the first 4 digits will calibrate 1mm path and modify the second 4 digits will calibrate 0.2mm path. Normally user can calibrate Q3000 by modify CCE No. if the average absorbance of diagnostic results are between +/- 10% difference of standard absorbance (9.54).

Procedure of calibrate

1. Follow the steps exactly in the sections 9 “CHECK INTENSITY” and section 10 “MAKING DIAGNOSTIC” to get the average diagnostic absorbance in Excel Spreadsheet.

	A	B	C	D	E	F	G
1	260 1mm			260 0.2mm			
2	8.883			8.789			
3	8.861			8.859			
4	8.861			8.824			
5	8.883			8.812			
6	8.824			8.821			
7	8.812			8.901			
8	8.911			8.782			
9	8.859			8.861			
10	8.866			8.861			
11	8.873			8.883			
12							
13							

2. Email the Excel spreadsheet as well as the S/N and CCE No. to your local distributor or info@quawell.com for getting new CCE No.
3. Follow the instruction from your local distributor or Quawell technical support to modify the CCE No.

12. APPENDICES

A. Instrument Specifications

Path length:	0.2 mm to 1mm, auto-selected
Sample size requirement:	2 ul
Light source:	LED
Detector:	Photoelectric cell
Wavelength range:	260nm, 280nm
Wavelength accuracy:	< 2 nm
Absorbance precision:	0.001 Abs
Accuracy:	<100ng/ul \pm 3ng/ul, >100ng/ul \pm 3%
Absorbance range:	0-80 A
Concentration range:	0-4000 ng/ul (dsDNA)
Measurement cycle time:	~2s
Dimension:	20 cm x 15 cm x 12 cm
Sample pedestal material:	Stainless steel
Optical fiber material:	Quartz
Operating voltage:	12V
Operation power consumption:	< 10 W
Standby power consumption:	< 3 W
CE:	Ready

B. Absorbance Calculation

When the Q3000 Spectrophotometer is “blanked”, a spectrum is taken of a reference material (blank) and stored in memory as an array of light intensities by wavelength. When a measurement of a sample is taken, the intensity of light that has transmitted through the sample is recorded. The sample intensities along with the blank intensities are used to calculate the sample absorbance according to the following equation:

$$Abs = -\log\left(\frac{I_{sample}}{I_{blank}}\right)$$

Thus, the measured light intensity of both the sample and of the blank are required to calculate the absorbance at a given wavelength.

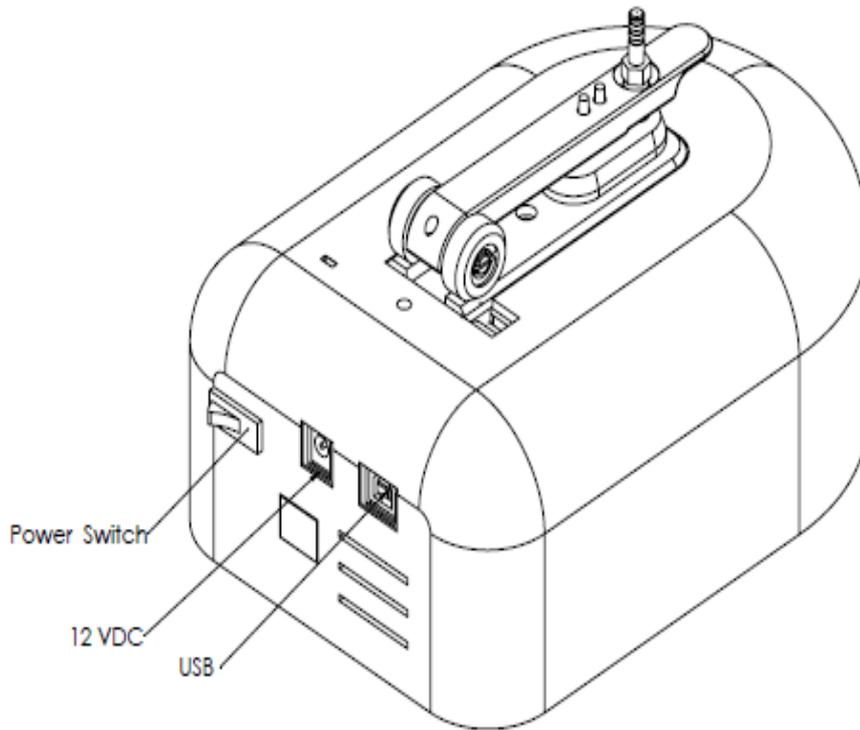
C. Concentration Calculation (Beer's Law)

The Beer-Lambert equation is used to correlate the calculated absorbance with concentration:

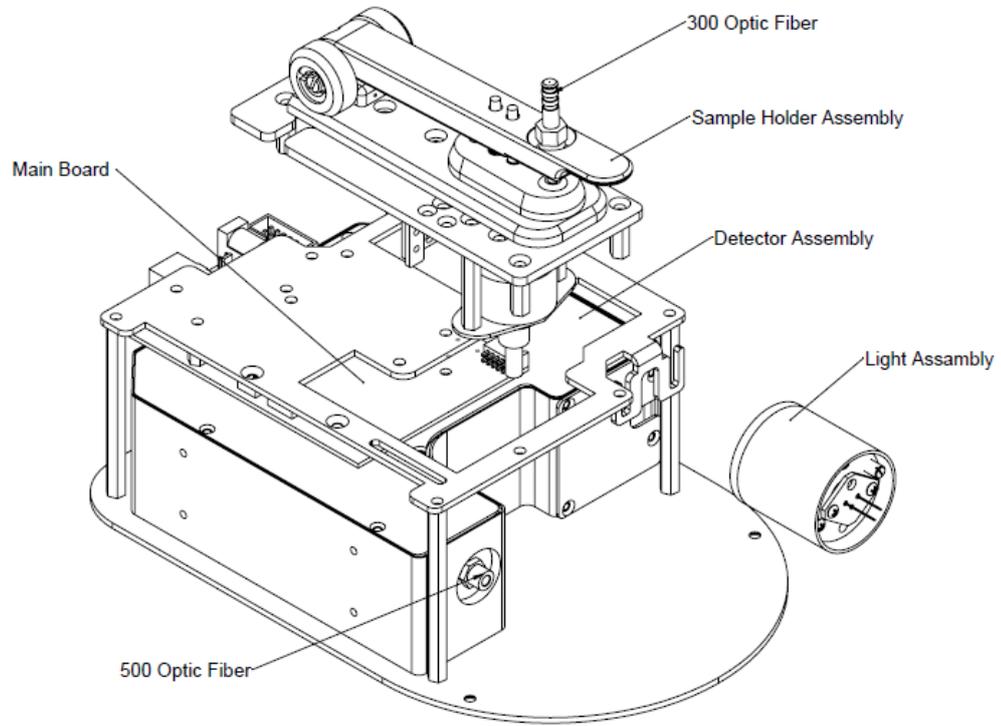
$$A = E * b * c$$

Where A is the absorbance represented in absorbance units (A), E is the wavelength-dependent molar absorptivity coefficient (or extinction coefficient) with units of liter/mol-cm, b is the path length in cm, and c is the analyte concentration in moles/liter or molarity (M).

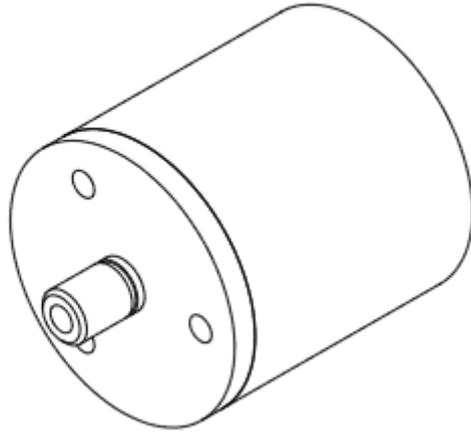
D. Electrical Connections Description



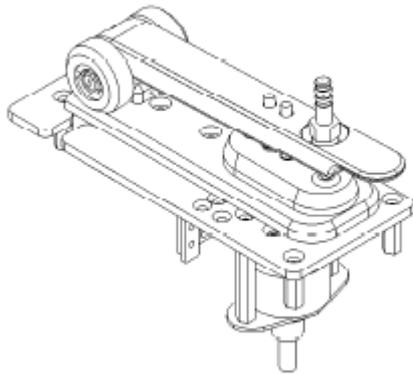
E. Instrument Assembly



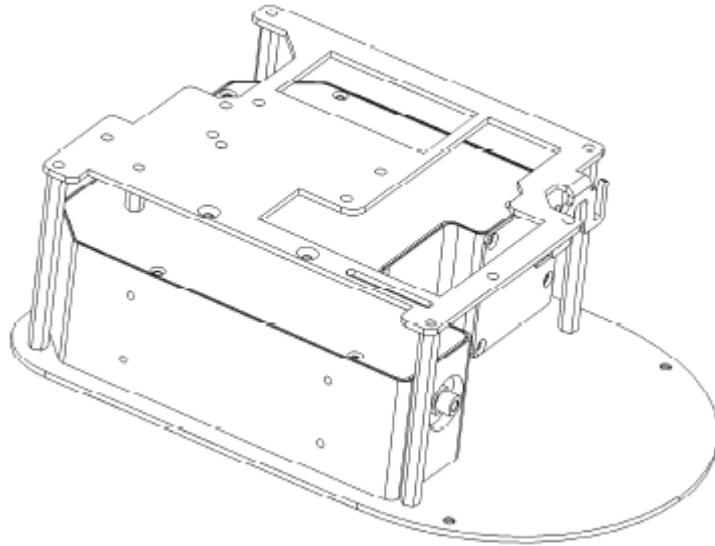
F. Light Assembly (P/N 30-60003)



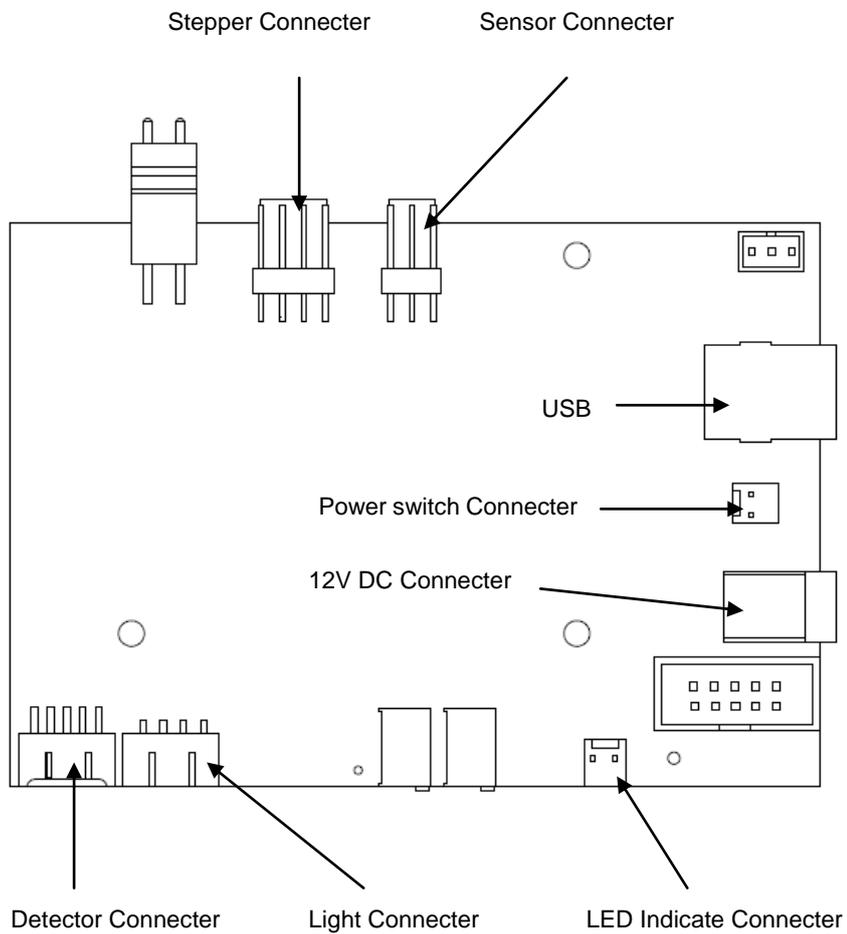
G. Sample Holder Assembly (P/N 30-60001)



H. Detector Assembly (P/N 30-60002)



I. Main Board V3.4 (P/N 30-00040)



J. Contact Information**Quawell Technology, Inc.**

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Note: All information in this user manual is believed to be correct and complete and is subject to change without notice.