

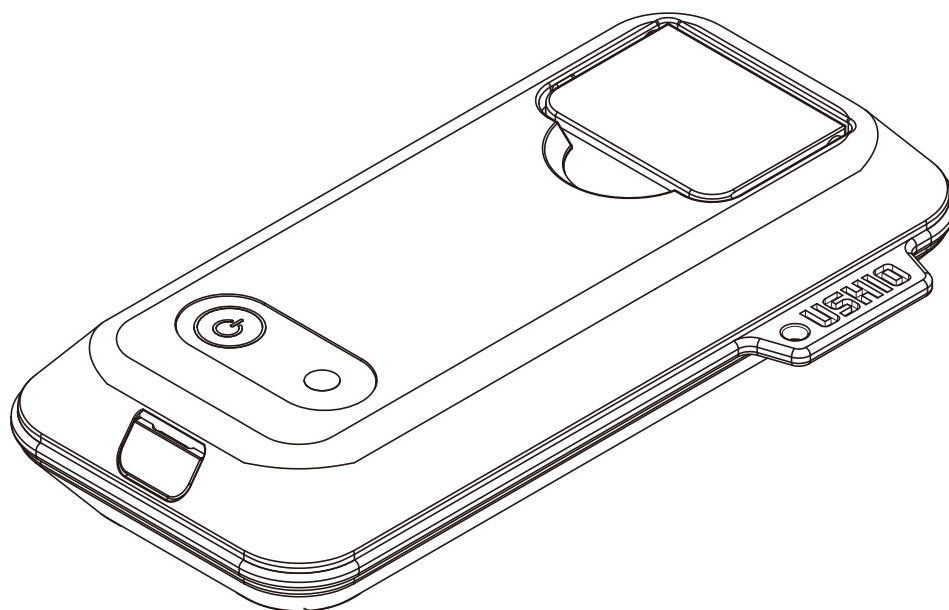
**USHIO**

USHIO Photo Absorbance Sensor

**PiCOEXPLORER™**

**User's Manual and Troubleshooting Guide**

**PAS-110**



## USHIO INC.

Contents of this User's Manual may change without notice.

Due to design improvements, and/or specification and app changes, PiCOEXPLORER™ configuration may change without notice.

All company names and products names in this manual are the property of their respective trademark holders.

Patent Pending

Thank you for purchasing the PiCOEXPLORER™ PAS-110 photo absorbance sensor. This manual contains detailed descriptions, instructions for use, and specifications of this device. Please print out and store this manual in a safe place, and refer to as needed.

## SAFETY NOTES

These safety notes are intended to help you use this device properly and safely. These notes contain essential and crucial instructions that must be followed at all times. Please read and understand these notes before reading the rest of the manual and guide.



This icon indicates a possible danger of loss of life or injury.






This icon indicates a possible danger of injury to personnel or physical damage.



This icon indicates important information concerning easy-to-make mistakes that can adversely affect operation and maintenance. Not following the instructions given could result in damage to the device.

 WARNING	<ul style="list-style-type: none"> <li>● Do not use the device near medical equipment. The radio waves emitted by wireless communication module could have an adverse effect on nearby pacemakers or electrical medical devices.</li> <li>● Do not use near automatic doors, alarms, or other automatic electrical control devices. The wireless communication module could cause malfunctioning in these devices.</li> <li>● Do not use any USB cables that have been damaged or deformed. Doing so could result in smoke, overheating, or fire.</li> <li>● Carefully read and correctly follow the instruction in this user's manual about the use of USB cables. Replace any cable that looks defective or damaged.</li> <li>● Do not wash the device with water, or disassemble or tamper with it in any way. Doing so could result in electric shock, fire, or smoke.</li> <li>● When powering the device thru a USB connector, use a PC with a limited-energy circuit USB output, or an AC adapter with a limited-energy circuit used to power PCs.</li> </ul>
 CAUTION	<p><b>HANDLING OF PHOTO ABSORBANCE SENSOR</b></p> <ul style="list-style-type: none"> <li>● This device is for general analytic use. It was not designed for, nor should it be used for, medical diagnostic purposes requiring very high levels of reliability and/or accuracy. USHIO INC. cannot be held responsible for any damages or liabilities resulting from the inappropriate use of this device for such purposes.</li> <li>● To avoid eye injury, never look directly at the light source in the device.</li> <li>● When connecting and removing the USB cable, do so carefully; do not jam the connector or yank the cord.</li> <li>● Avoid dropping the unit or otherwise exposing to shocks or extreme forces.</li> </ul> <p><b>HANDLING OF BATTERIES</b></p> <ul style="list-style-type: none"> <li>● Follow all instructions of this manual on the handling and use of dry-cell batteries.</li> <li>● Use only the battery type specified (AAA type). Other types may damage the unit.</li> <li>● Insert batteries properly, matching the plus and minus ends to the equivalent connections inside the unit.</li> <li>● When replacing batteries, always replace all 3 batteries together.</li> <li>● Keep batteries out of the hands of small children.</li> <li>● If the unit will not be used for some time, remove the batteries before storage. Leaking batteries can cause severe damage.</li> </ul>

**SAFETY NOTES**

 <p>CAUTION</p>	<p><b>HANDLING OF BATTERIES</b></p> <ul style="list-style-type: none"> <li>● Do not expose batteries to heat or toss into open flames.</li> <li>● For the sake of the environment, dispose of used batteries responsibly and in accordance with local regulations.</li> <li>● The batteries that come packaged with the unit were inserted only for device testing purposes. They may not last long; replace them as soon as possible.</li> </ul>
 <p>CAUTION</p>	<p><b>HANDLING OF A BLUETOOTH DEVICE</b></p> <ul style="list-style-type: none"> <li>● This is a Bluetooth low-energy compatible device. It cannot be connected with any other wireless communication protocol.</li> <li>● This device has been certified as having the proper wireless system for low-power electronic communication. Do not remove the label of certification from the device. It is against the law to tamper with the device by disassembling, and/or altering operation. Doing so may result in criminal prosecution.</li> <li>● This device communicates using a 2.4GHz frequency range. This range is also used by the following wireless transmitters: commercial, scientific, and medical devices and other similar devices, wireless transmitters used to detect moving object on factory lines (which require licensing), low-power wireless transmitters which do not require licensing, and amateur wireless transmitters, all of the above designated herein as “other wireless transmitters”. Before using, make sure there is no such wireless transmitter in the vicinity which could cause interference. If you find that the operation of this device near another wireless transmitter is causing interference, increase the distance between the devices or if possible, turn off the other device.</li> </ul>
 <p>IMPORTANT</p>	<ul style="list-style-type: none"> <li>● Do not use in areas with high levels of dust, oil smoke, steam, damp, or high heat.</li> <li>● If the unit gets wet or submerged in liquid, immediately turn off and consult your vendor.</li> <li>● Dirt and other contaminants in the measuring chamber can cause erroneous readings. Before using, make sure the measuring chamber is clean; if not, carefully wipe away all contaminants with a cotton swab or gauze/soft cloth.</li> <li>● Do not swing the device by its strap. This could damage/loosen the water-resistant packing in the device.</li> <li>● You may be subjected to penalties to use this device in the country not authorizing the device usage due to its restrictions on wireless use.</li> <li>● Communications errors or reductions in communication speed may result when using the device in the proximity of a 2.4GHz wireless LAN. Keep the device and the communicating tablet as close to each other as possible to avoid this.</li> </ul>

**FCC NOTICE**

This device complies with part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**IC NOTICE**








This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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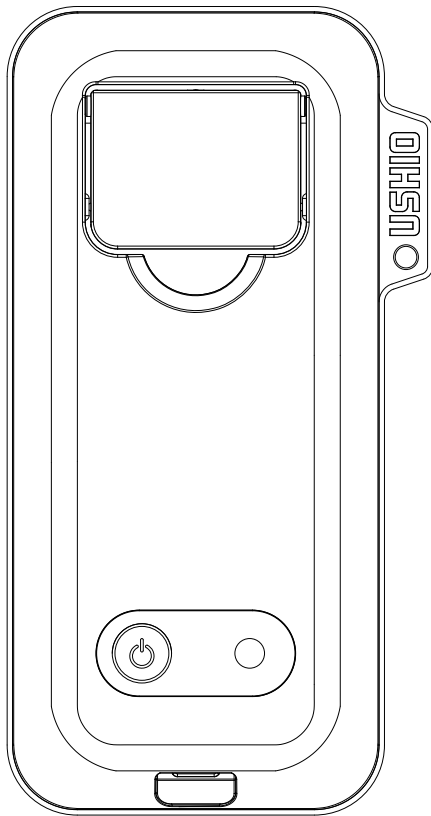
**DEVICE FEATURES**

- The PICOEXPLORER™ is a portable absorptiometer that uses a white LED as its light source.
- You can verify PICOEXPLORER™ measurement results on your Smartphone or tablet PC by downloading a special application that uses Bluetooth communication to check the results of measurement.
- The high sensitivity yet extremely compact design of this device is the result of USHIO's breakthrough Silicone Optical Technology (SOT™).
- Measurements can be taken directly from unopened PCR tubes, helping to prevent contamination.

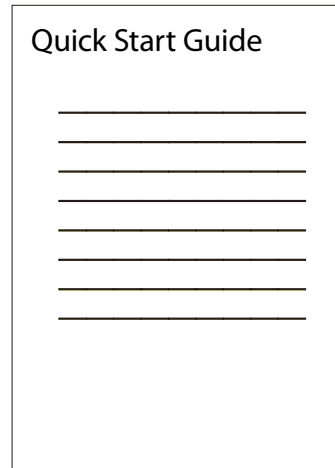
**HARDWARE PACKAGE**

The standard package includes:

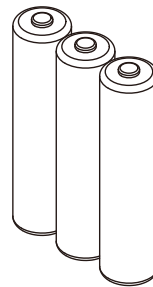
- (1) PAS-110 Unit..... 1
- (2) Alkaline Dry-Cell Batteries (AAA Type)..... 3
- (3) Quick Start Guide (includes warranty)..... 1



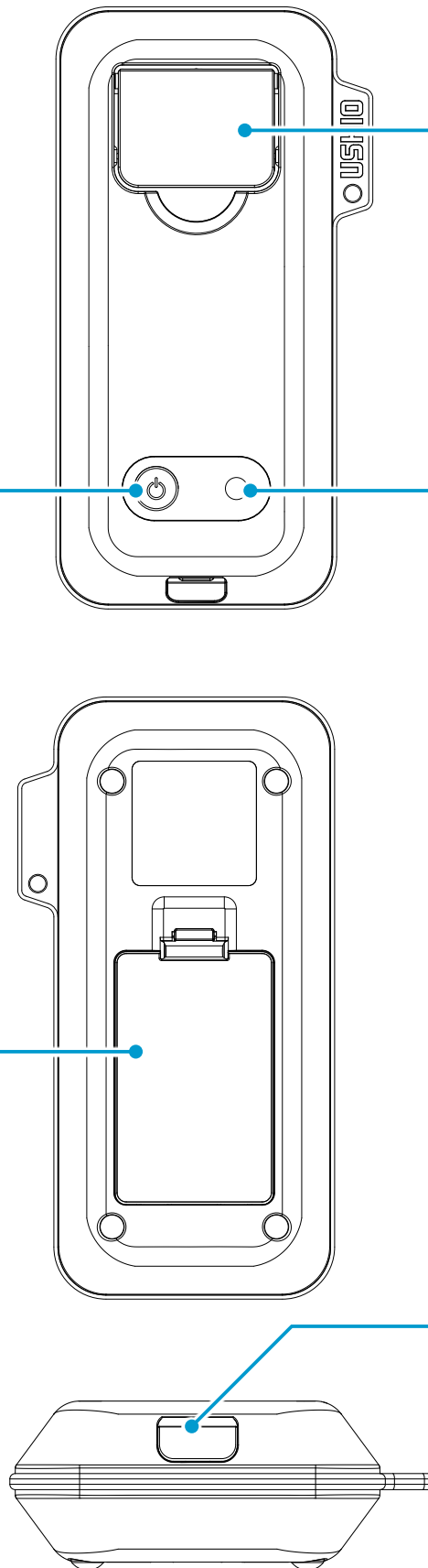
PAS-110 Unit



Quick Start Guide (includes warranty)



Alkaline Dry-Cell Batteries (AAA Type)



**Power Switch**  
Turns unit on and off.

**Measurement Chamber Cover**  
Open this cover to insert PCR tube for sample measurement.

**Status Light**

- Steady Red: check battery level
- Steady Purple: powered and connected via Bluetooth Low Energy
- Blinking Red: Low voltage\*
- Blinking Blue: measurement in progress

\* Some batteries may fail without first blinking.

**Battery Cover**  
Open to insert batteries.

**USB Interface Connector (micro USB)**  
For connection with a USB cable. Can be used to supply power instead of batteries. Not a data communication channel.

## BATTERY INSERTION

- The unit does not come with ready-to-use, fully charged batteries. If you find batteries already inserted, be aware that these are for testing purposes only, and may already be near failure.

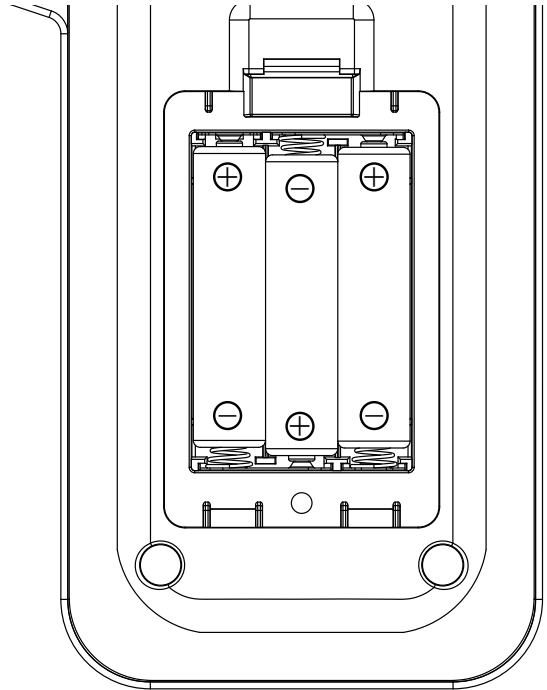
**Batteries Needed: 3 AAA Type Dry-Cell Batteries**



Use only AAA type batteries. Use of other types may damage the unit.

Follow the 3 steps below when replacing batteries.

1. Open the battery cover on the back side of the unit.
2. Insert batteries, aligning the plus and minus (+ and -) ends of the batteries with the plus and minus markings on the inside of the battery case.
3. Close the battery cover.



Make sure battery cover is securely fastened. A loose cover may allow water to seep into the unit and cause damage.

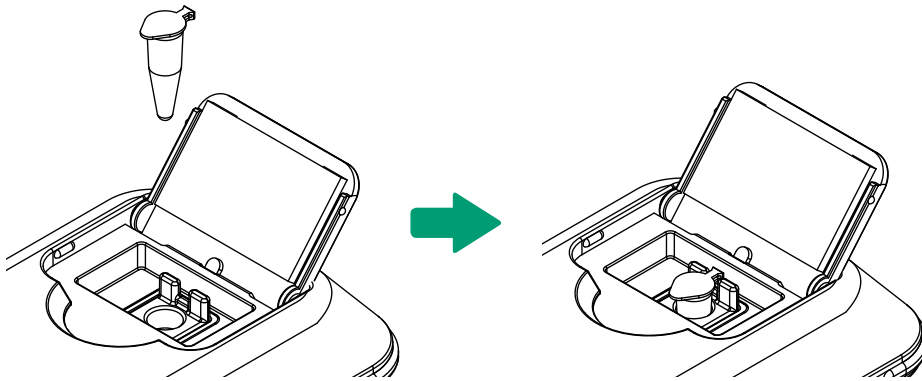
Before opening the cover, wipe off any liquid on the outside to prevent see page and possible damage.



TAKING MEASUREMENTS

Follow the procedure outlined below for taking basic measurement readings.

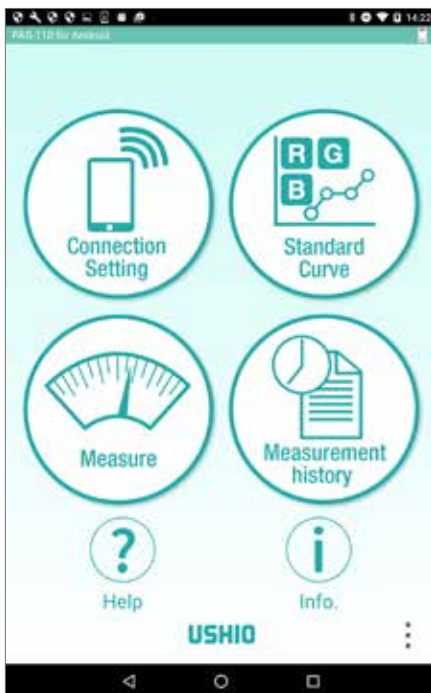
1. Turn on unit power. The status light will turn red ● .  
\* If battery level falls too low, the red light will begin blinking.
2. Open the measurement chamber lid and set PCR tube into the measurement chamber. Firmly close the lid.



\* Note that the tube lid connector should fit snugly between the two guide projections at the back of the chamber.

 CAUTION	<p>Do not let any sample liquid from the PCR Tube spill into the unit. This could damage the optical unit.</p>
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3. Launch the tablet application (PAS-110) by tapping the icon. See the handling precautions included with the PICOEXPLORER™ for how to install the application on your device.  
**P11. 1. Using the Top Screen.**
4. Make BLE connection.  
**P12. 2. Wireless Connection.**



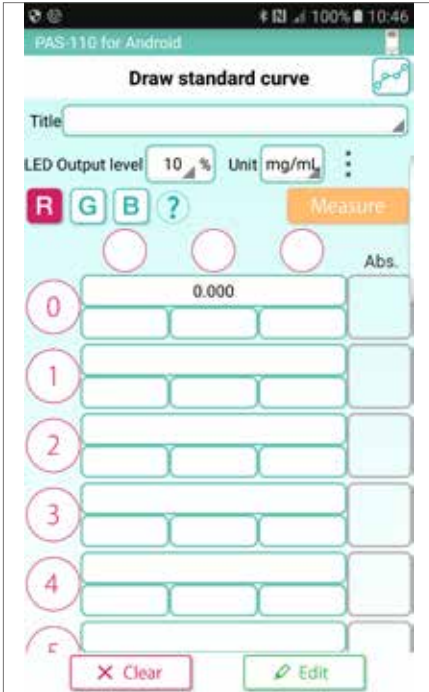
Top Screen



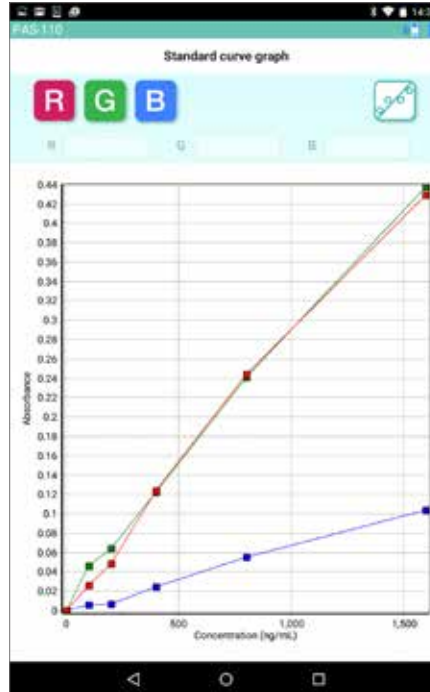
Connection Setting Screen

5. Draw a standard curve.

**P14. 3. Graphing the Standard Curve**



Drawing Standard Curve Screen



Standard Curve Graph Screen

6. Measure concentration of the unknown the sample.

**P26. 4. Taking Measurements**

No.	Concentration	Date
1	406.786	2015/09/16 14:36
2	Out of range	2015/09/16 14:37
3	92.871	2015/09/16 14:37
4	203.084	2015/09/16 14:37
5		
6		
7		
8		

Concentration Measurement Screen

7. Check previous measurements.

**P30. 5. Displaying Previous Measurements**

No.	Concentration	Date
1	406.786	2015/09/16 14:36
2	Out of range	2015/09/16 14:37
3	92.871	2015/09/16 14:37
4	203.084	2015/09/16 14:37
5		
6		
7		
8		

Measurement History Screen

### 1. Using the Top Screen

The top screen displays the following buttons.

**Bluetooth Connection Status**

- Bluetooth Connection Status
- Unconnected
- Battery Voltage Level OK
- Battery Voltage Level Low

**Connection Setting Button**  
To connect to the hardware unit, goes to the connection setting screen <P12>.

**Measurement Button**  
Goes to the Measurement Screen to take measurements <P26>.

**Help Button**  
Goes to the Help Screen <P36>.

**Home Button**  
Returns to the Home Screen.  
\* Android only

PAS-110 for Android

Connection Setting

Standard Curve

Measure

Measurement history

Help

Info.

USHIO

**Draw Standard Curve Button**  
Goes to the Draw Standard Curve Screen to allow creation of a standard curve <P14>.

**Measurement History Button**  
Goes to the Measurement History Screen to allow inspection of previous measurements <P30>.

**Info Button**  
Goes to the Info Screen to show current device status <P33>.

**Return Button**  
Go back to previous screen.  
\* Android only  
\* With iOS (on iPhone or iPad) a Back button is located in the upper left corner of the screen.

**App History Button**  
\* Android only

**Save Button**  
Moves to the Save Screen <P34>. On this screen you can also switch display languages between English and Japanese.

Illustration 1: Top Screen

## 2. Wireless Connection

Tap the **Connection Setting Button** on the top screen to move to this screen (Illustration 2-1).

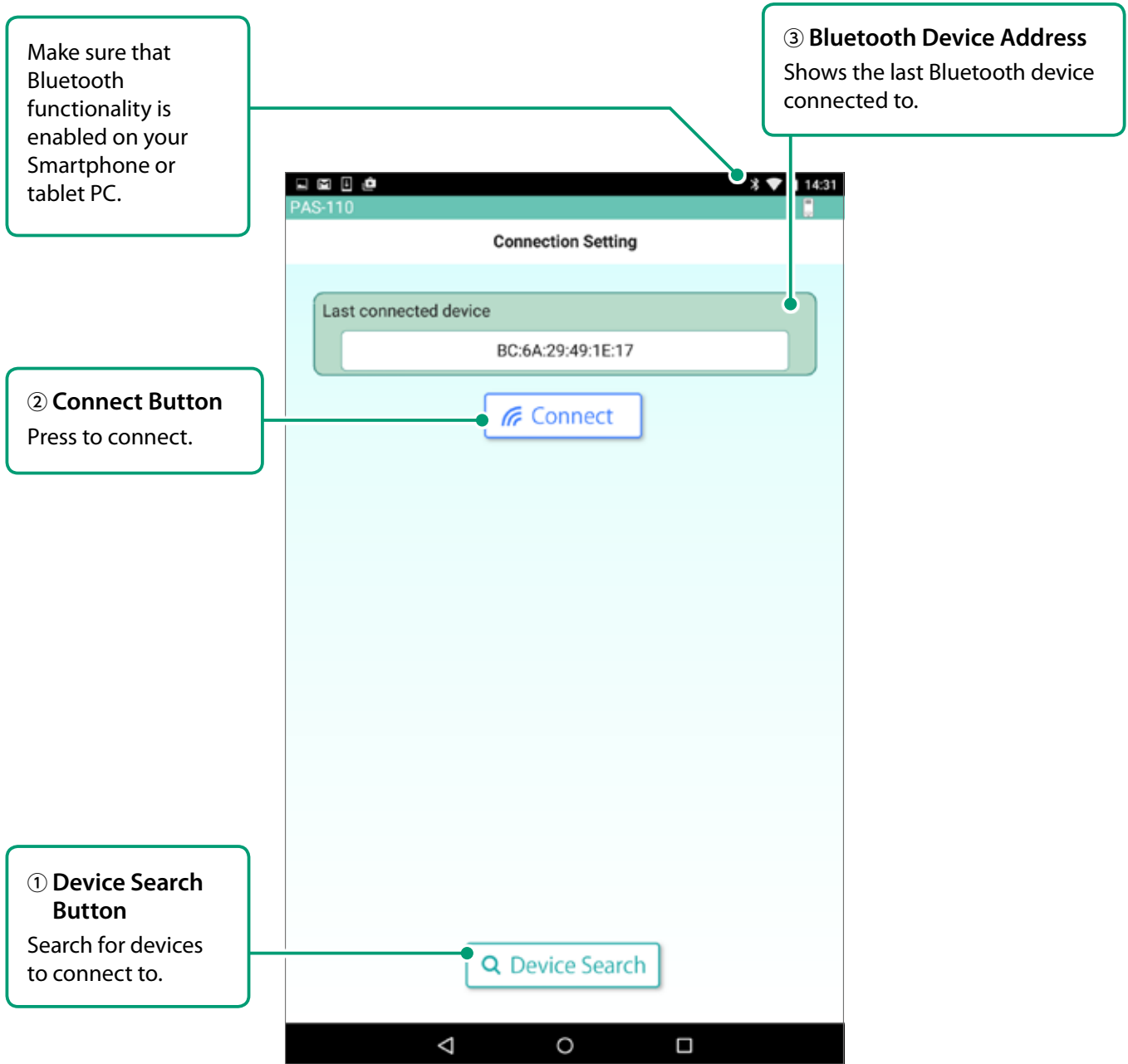


Illustration 2-1: Connection Setting Screen

- (1) Tap ① **Device Search Button** to search for photo absorbance sensor unit. If not detected, turn the photo absorbance sensor off and on, then tap the ① **Device Search Button** again. If the photo absorbance sensor is found, its Bluetooth device address will be displayed as shown in Illustration 2-3.



Illustration 2-2:  
Device Address Not Found



Illustration 2-3:  
Device Address Found

- (2) Tap the device address that you wish to connect to. The background color of the address will change, indicating selection.
- (3) Tap the ② **Connect Button** to begin connecting.
- (4) Once the connection is established, tap the **Return Button** to return to the top screen.



Illustration 2-4:  
Device Address Selected

### 3. Graphing the Standard Curve

When drawing a standard curve, first prepare a set of samples of known concentration.

The procedure is as follows:

1. Measurement wavelength range selection;
2. Blank measurement;
3. Measure known concentration sample data;
4. Verify the standard curve graph.

Before beginning the procedure, be sure to tap the **Clear Button** to clear previous data.

Tap the **Standard Curve Button** on the top screen to move to the Draw Standard Curve Screen (Illustration 3-1).

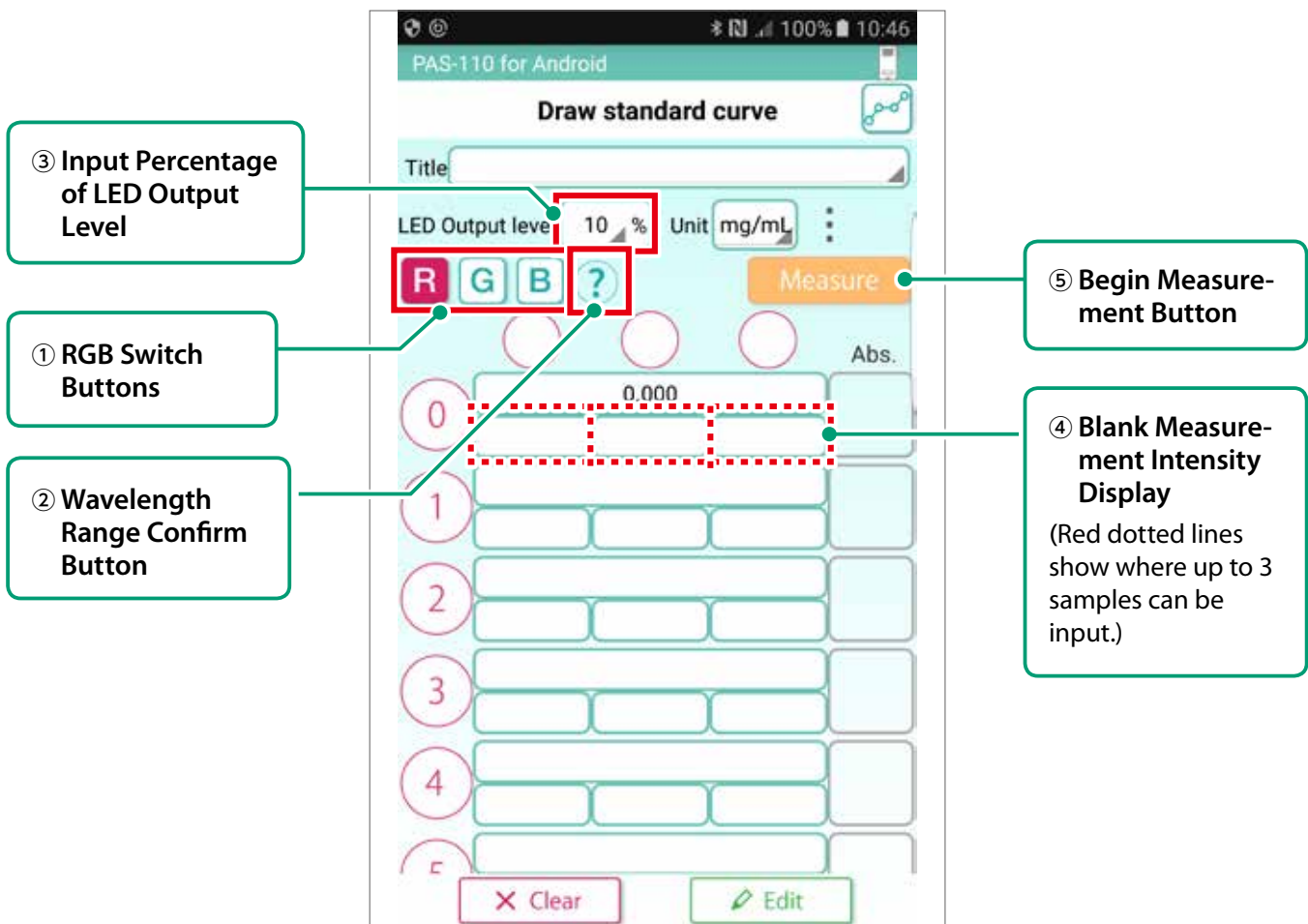


Illustration 3-1: Draw Standard Curve Screen ①

#### 3-1. Measurement Wavelength Range Selection

- (1) Select the wavelength range for the sample to be measured using the ① **RGB Switch Buttons**.
- (2) You can check the Maximum absorption wavelength and wavelength range by tapping the ② **Wavelength Range Confirm Button** of hint icon.



### 3-2. Blank Measurement

- (1) Set the sample for determining the blank concentration into the measurement chamber.
- (2) The ③ LED output level is 10% by default, but other levels can be selected. Select the LED output level as appropriate according to blank measurement timing. We recommend first taking a measurement at the 10% default level, and then making adjustments later < Page 15(5)>.

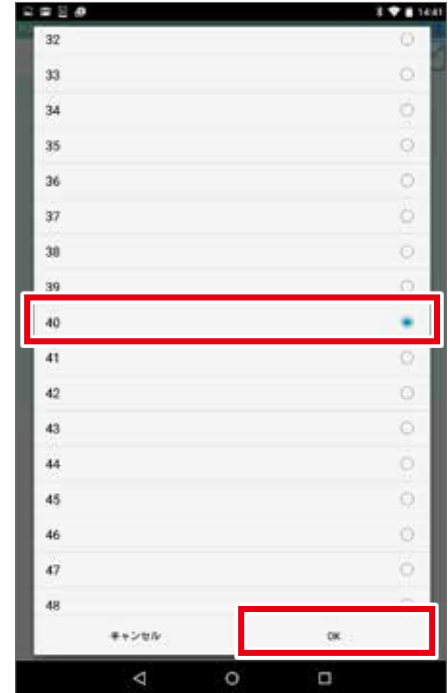


Illustration 3-2:  
Scrolling list of LED output levels

- (3) Do blank measurement. When you tap the ④ Blank Measurement Intensity Display, a black frame appears as shown in Illustration 3-3.

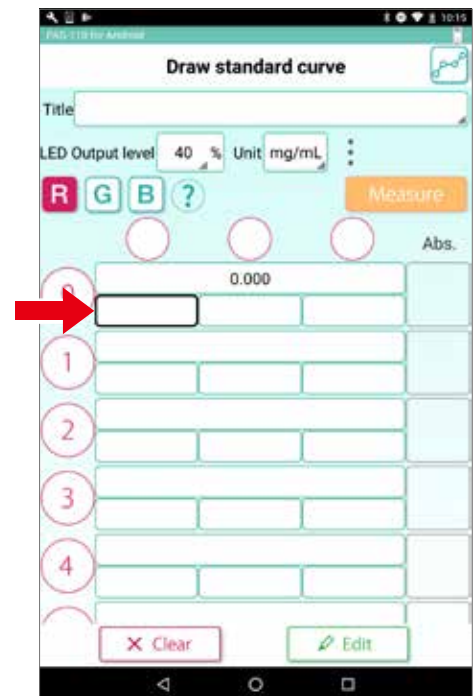


Illustration 3-3:  
Baseline data input box selected



(4) Blank measurement begins when you tap the ⑤ **Measure Button**. The measured blank intensity is displayed in the black frame, and the absorption value (0.000) is displayed in the frame on the right (Illustration 3-4).

At this time R, G, and B data are simultaneously measured. When measurement is finished, the value will be displayed in white font. This data will be used to make the graph of the curve < Page 19 > .

- \* The measured intensity indicates the amount of light passing through the sample. Absorption is calculated based on the blank measurement intensity and the measured intensity of the sample.

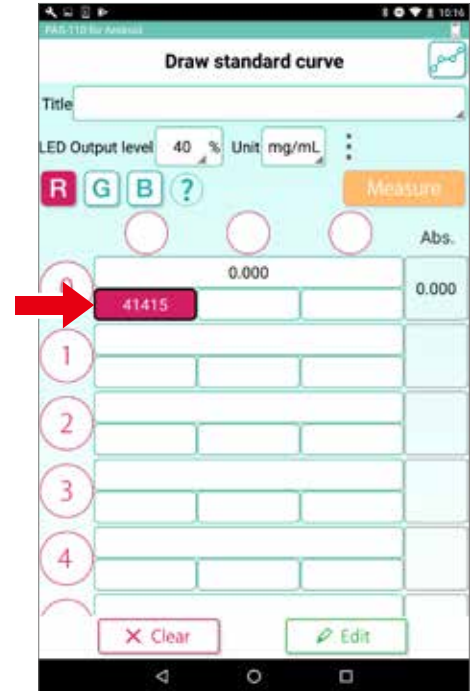


Illustration 3-4: Measured value displayed in white font

(5) The blank measurement intensity should fall in the range of 30000 to 60000. If the value is lower, raise the LED output level; see (1) on page 14. Also, tap the ① **RGB Switch Buttons** and make sure that the blank measurement intensity values for R, G, and B are not all 65535. Values of 65535 indicate that the measurement data is saturated, so absorption cannot be properly measured.

(6) If the measured intensity is 65535, return to (2), lower the LED output level, and then measure again. When the level is changed, a prompt like that shown in Illustration 3-5 is displayed, to request confirmation that data is to be cleared; select "Yes".

(7) This completes blank measurement.

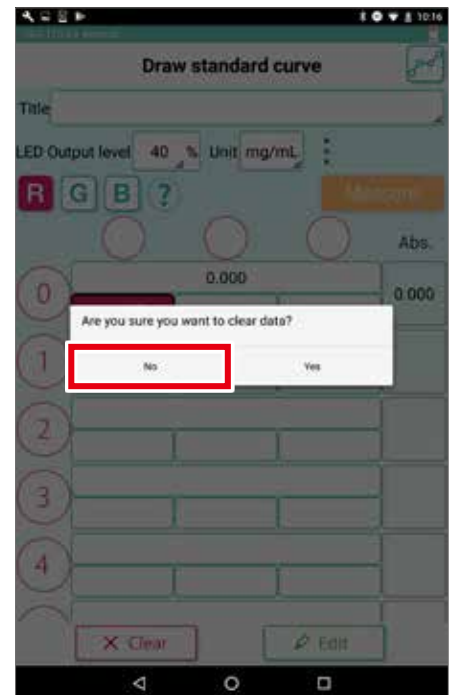


Illustration 3-5: Data Clear Confirmation Notice



TAKING MEASUREMENTS

### 3-3. Measuring Known Concentrations

Using the same Draw Standard Curve Screen (Illustration 3-6), measure a series of samples of known concentrations.

- (1) Set a sample into the measurement chamber of the photo absorbance sensor.

The screenshot shows the 'Draw standard curve' screen with the following data table:

Input Area	Concentration (mg/mL)	Absorbance Value
0	0.000	0.000
1	100.000	0.026
2	200.000	0.048
3	400.000	0.124
4	800.000	0.244
5	1600.000	0.351

Callout 1: Concentration Units Select Button (points to 'mg/mL' in the 'Unit' field).

Callout 2: Known Concentration Input Area (points to the input fields for concentrations 1-5). Note: (Always enter concentration values in ascending order in Input Areas 1→5.)

Callout 3: Known Concentration Sample Measurement Intensity Display (points to the dotted red lines around the intensity values). Note: (Up to 3 measurements can be made on the sample, displayed inside the dotted red line.)

Callout 4: Measurement Button (points to the 'Measure' button).

Callout 5: Absorbance Value Display (points to the absorbance values in the right column). Note: (Blue outline: values multiplied by an absorbance multiplier)

Callout 6: Standard Curve Graph Display Button (points to the graph icon in the top right corner).

Illustration 3-6: Draw Standard Curve Screen ②



- Tap the ① **Concentration Units Select Button** to choose the units in which the measurements will be made (Illustration 3-7). Tap the OK to confirm. Initially, four unit variations are registered (mg/mL,  $\mu\text{g/mL}$ , ng/mL, and %). See pages 18-22 for how to add new units.

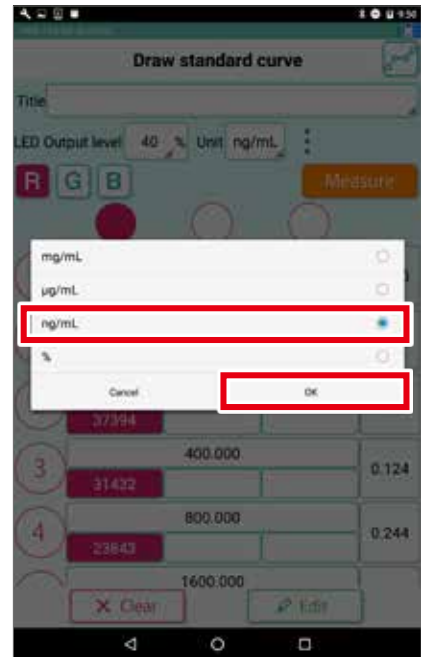


Illustration 3-7:  
Selection of Concentration Units

- Tap the ② **Known Concentration Input Area** and input the known concentration value.
- Tap the ③ **Known Concentration Sample Measurement Intensity Display** to display the black frame.
- Tap the ④ **Measure Button** to begin measurement. The measured value will be displayed in white font.
- The ⑤ **Absorbance Value Display** will show the actual calculated absorbance.
- When this measurement is finished, remove the current sample in the photo absorbance sensor, place the next sample in, return to step (1), and repeat the process.
- When all the samples have been measured, tap the ⑥ **Standard Curve Graph Display Button** and confirm the graphed results. The values displayed in white font (Illustration 3-8) are the ones displayed on the standard curve [<Page 19>](#). If you wish to a measurement from the graph, remove it by a long press on that data's display box.
- When you return to the top screen and proceed to "Measure", the unknown sample is measured using the created standard curve [<Page 25>](#). The standard curve data is stored together with the measurement data [<Page 31>](#).

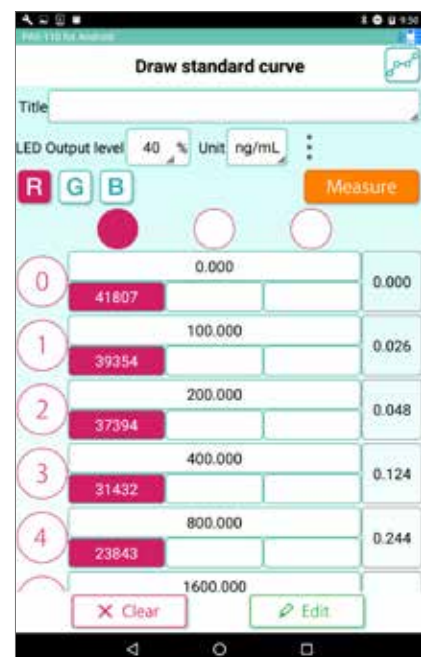


Illustration 3-8:  
Results of Standard Curve  
Measurement Procedure

\* The standard curve cannot be saved by itself.



### 3-4. Graphing the Standard Curve

(1) When you tap the **Standard Curve Graph Display Button**, a graph appears indicating concentration on the horizontal axis and absorption on the vertical axis (Illustration 3-9).

① Standard Curve Graph Switch Button

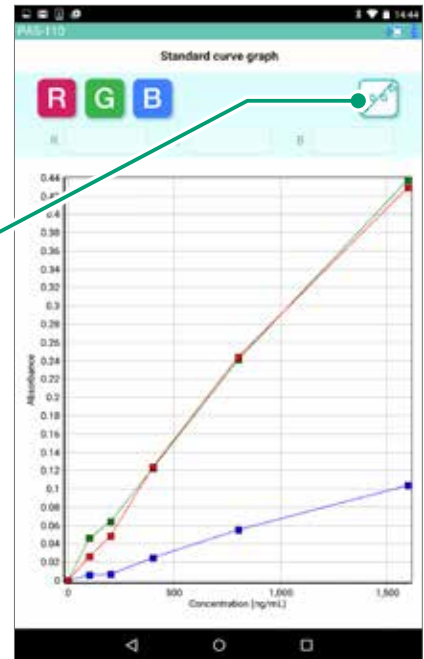


Illustration 3-9: Standard Curve Graph Screen

(2) When you tap the ① **Standard Curve Graph Switch Button**, graph displayed changes to show a least squares linear regression line for the data (Illustration 3-10). Also, the correlation coefficient (R<sup>2</sup>) is displayed at ②. This value indicates the linearity of the data how well the least squares line fits the data is indicated by this value.

③ RGB Switch Buttons

② Correlation Coefficient Display Area

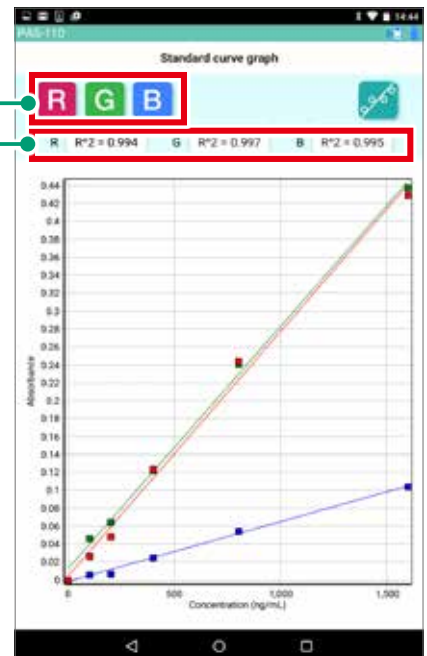


Illustration 3-10: Fitting a Line to the Measured Data Points

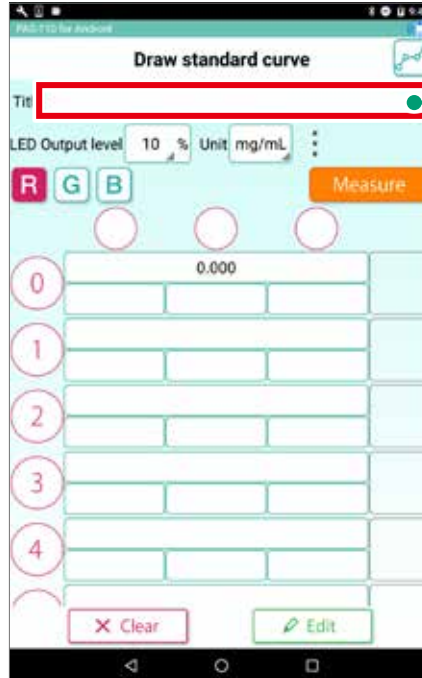
(3) All of the RGB graphs appear in the initial display. Graph display of each of the RGB graphs can be switched on or off using the ③ **RGB Switch Buttons**.



### 3-5. Standard Curve Loading Function

Here we explain how to recall stored standard curve data that was used during earlier measurement for reuse.

- (1) Tap the ① **Select Standard Curve Data** to display the standard curve data selection screen.



- (2) Select the standard curve data and tap the ① **Load button**. The data loaded from the CSV file is displayed on the standard curve creation screen.

If the added unit is unavailable after saving the standard curve data, "mg/mL" will be selected.

If you add the unit again on the unit maintenance screen, the unit will be available.

\* If you load a standard curve created on another device, there is possibility not to perform accurate measurement.





### 3-6. Unit Maintenance Function

Here we show how to add new units in addition to the ones that are registered by initial setting (mg/mL, µg/mL, ng/mL, and %).

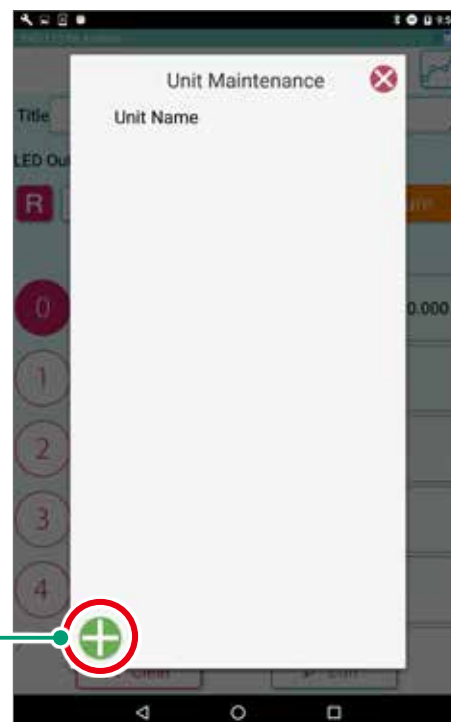
#### How to add a unit

- (1) Tap the **Unit Maintenance Button** on the standard curve creation screen to display the unit maintenance screen.



Unit Maintenance Button

- (2) Tap the **Add Line Button** on the unit maintenance screen to display the input line (maximum 10 lines).

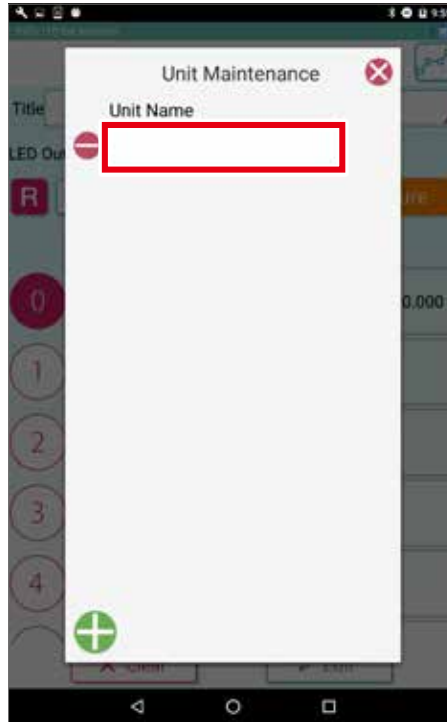


Add Line Button



(3) When you enter a unit, it is added to the unit selection list on the standard curve creation screen.

\* Special characters (such as  $\mu$ ) cannot be entered.



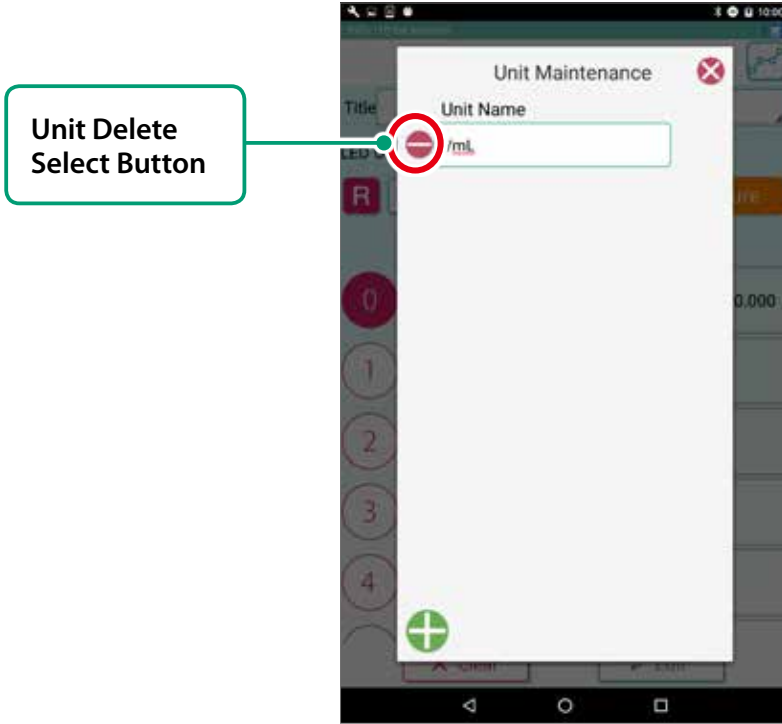
(4) You can select the added unit by tapping it.



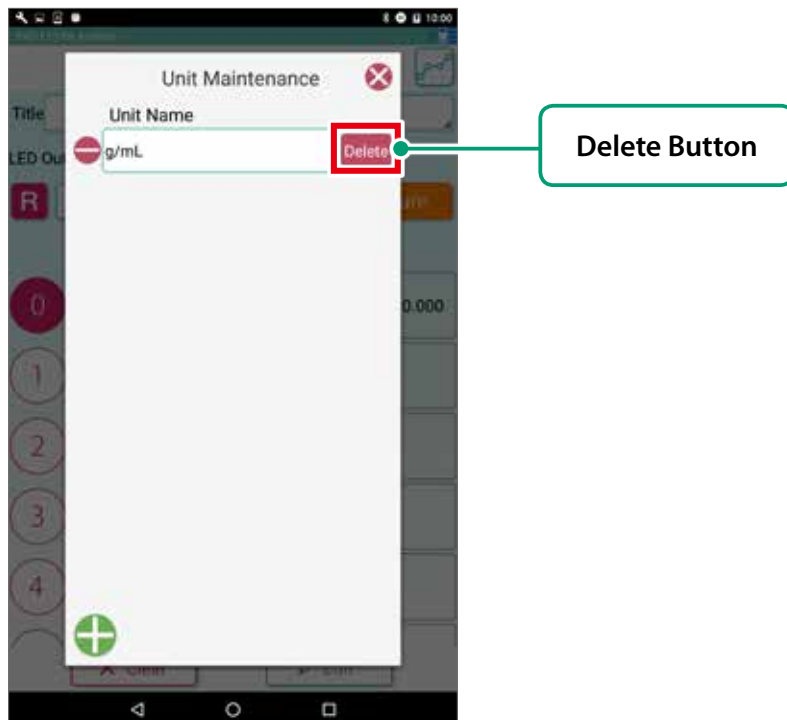


## How to delete a unit

(1) Tap the **Unit Delete Select Button** on the unit maintenance screen to display the **Delete Button**.



(2) When you tap the **Delete Button**, the line is deleted, and it is also removed from the unit selection list on the standard curve creation screen.



### 3-7. Other Functions

This section describes miscellaneous functions of the app.

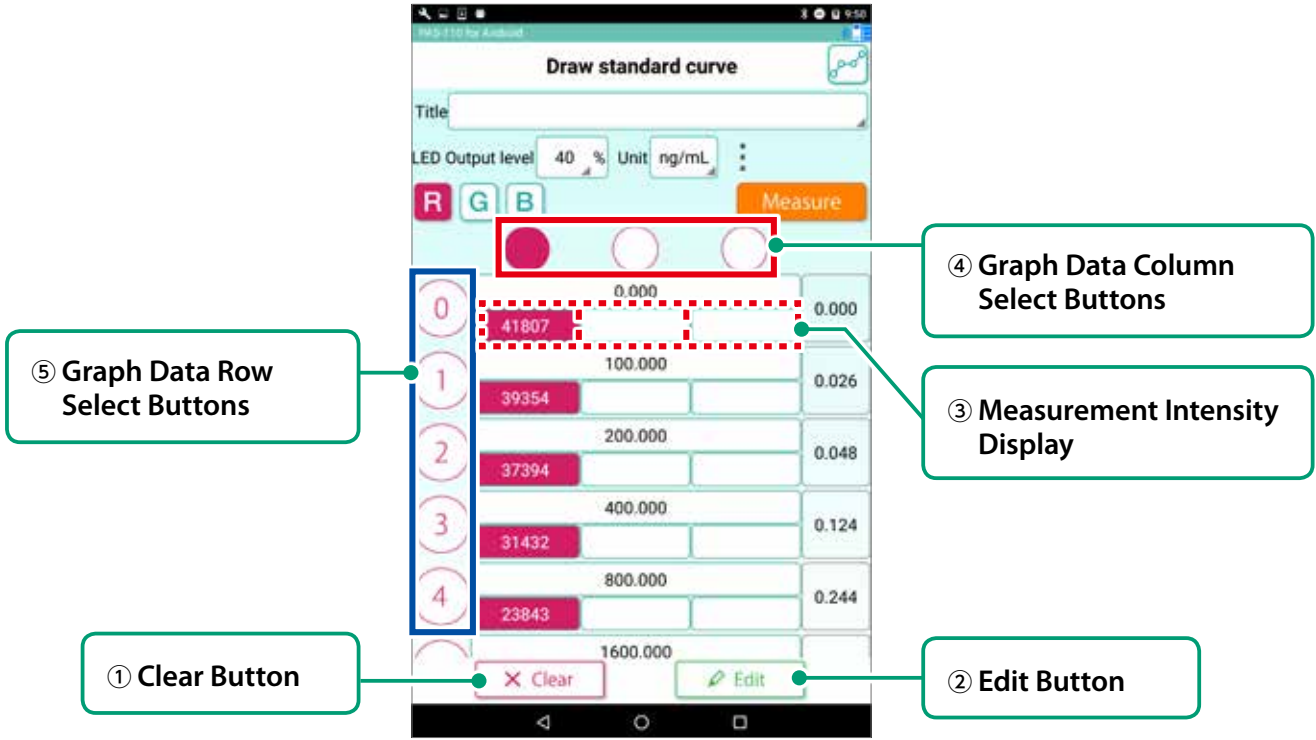


Illustration 3-11: Draw Standard Curve Screen

(1) Data Clear Function

Tap the ① **Clear Button** to clear all data.

(2) Data Edit Button

Tap the Known Concentration Input Area, then the ② **Edit Button** to directly edit the data values (Illustration 3-12).



Illustration 3-12: Directly Editing Data Values



TAKING MEASUREMENTS

(3) Graph Data Column Selection

You can select the measurement intensity data column used for calculating absorption by tapping the ④ **Graph Data Column Select Buttons**.

With the initial setting, absorbance based on average measured intensity is displayed. Using this function, absorbance can be calculated based on individual values of measured intensity (Illustration 3-13).

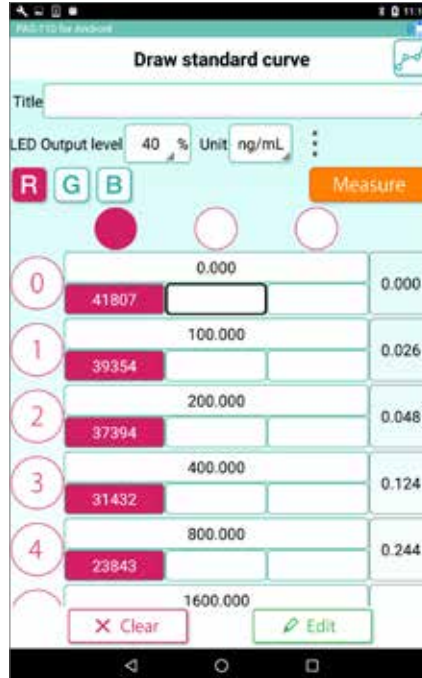


Illustration 3-13: Entire Data Column Selected

(4) Graph Data Row Selection

You can select the row of data to be applied to the standard curve graph by tapping the ⑤ **Graph Data Row Select Buttons** (Illustration 3-14).

With the initial setting, all data rows are applied to (plotted in) the standard curve graph. Using this function, you can select the row of data to be applied to the standard curve graph.



Illustration 3-14: Entire Graph Data Row Selected



### 4. Taking Measurements

Measure an unknown sample based on the standard curve. Unknown samples can be measured after creating a standard curve <Pages 13-18> or recalling a previously prepared standard curve <Page 19>. Tap the **Measure Button** on the top screen to move to the Measurement Screen (Illustration 4-1).

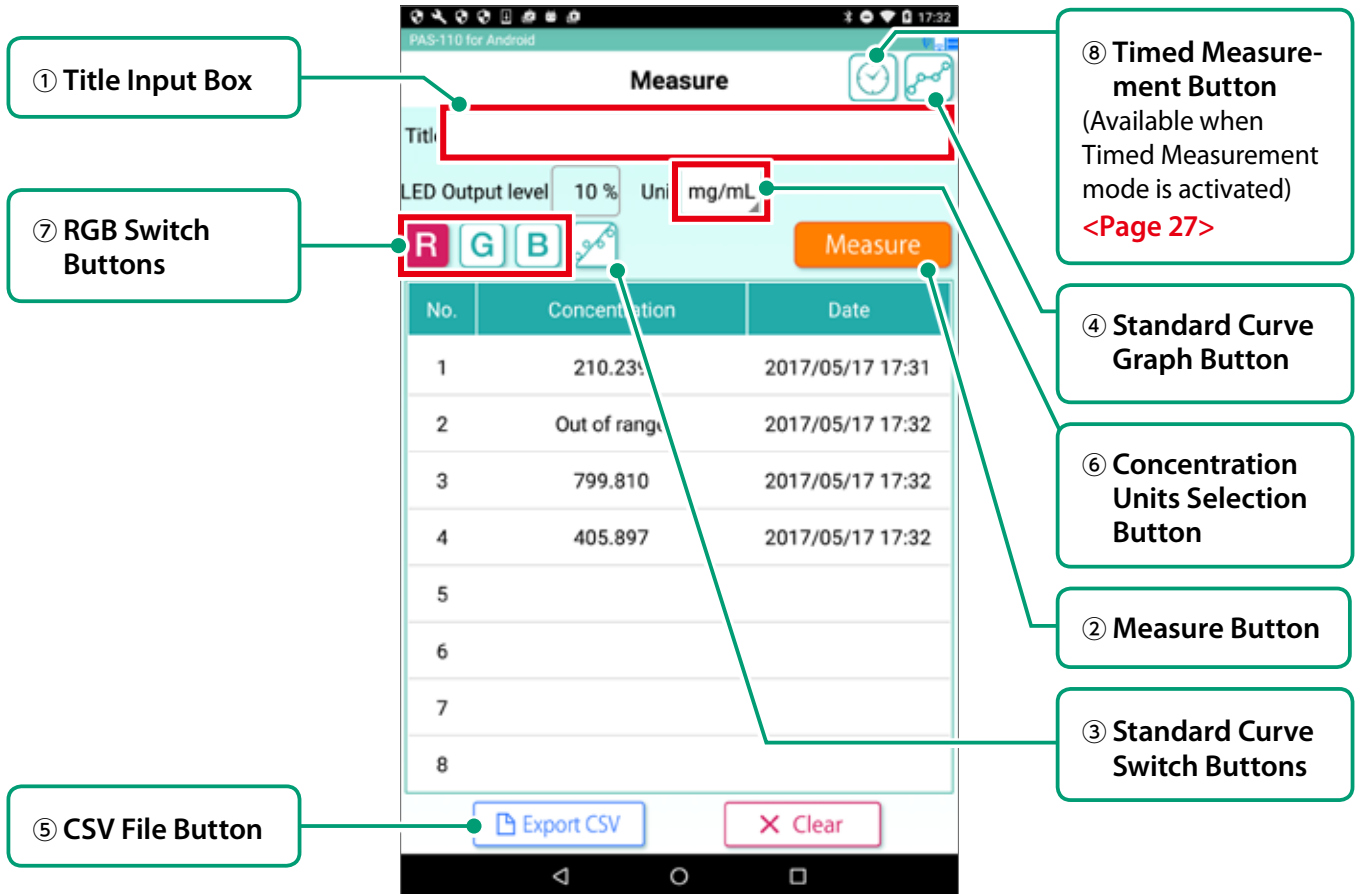


Illustration 4-1: Measurement Screen

#### 4-1. Manual Measurement

- (1) Set the unknown sample in the measurement chamber.
- (2) Enter the Title of the run into the ① **Title Input Box**
- (3) Tap the ② **Measure Button** to measure the unknown sample. "Out of range" is displayed for values that fall outside the range of the standard curve. Although the application displays "Out of range," absorbance and intensity are displayed on the computer following CSV output.
- (4) With the initial setting, the measured value (white) is displayed based on interpolation of the standard curve between two points, but upon tapping the ③ **Standard Curve Switch Buttons**, display switches to the measurement value (green) based on the least squares fit line.
- (5) You can check the standard curve graph by tapping the ④ **Standard Curve Graph Button**. Measured values of unknown samples are plotted on the standard curve graph as open circles.
- (6) Tap the ⑤ **CSV File Button** to output the data values to a CSV file. **Page 32, Saving Data (to a CSV file).** Saved data can be rechecked at any time from the History Screen.

TAKING MEASUREMENTS

(7) Units for the measurement value of the unknown sample can be selected from among three options in the ⑥ **Unit Selection Area** (Illustration 4-2).

- Concentration (mg/mL in the figure below): The concentration is calculated from absorbance based on the prepared standard curve.
- RGB: This is the measurement value prior to conversion to absorbance.
- ABS: This is the absorbance value prior to conversion to concentration.

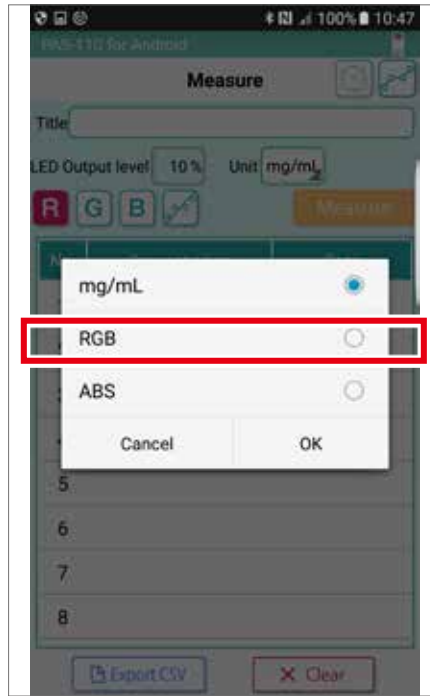


Illustration 4-2:  
Concentration Units Selection

(8) Display can be switched to measurement results for each of the RGB wavelength modes (Illustration 4-3) using the ⑦ **RGB Switch Buttons**.



Illustration 4-3:  
Example: Selected G Data Values Displayed.



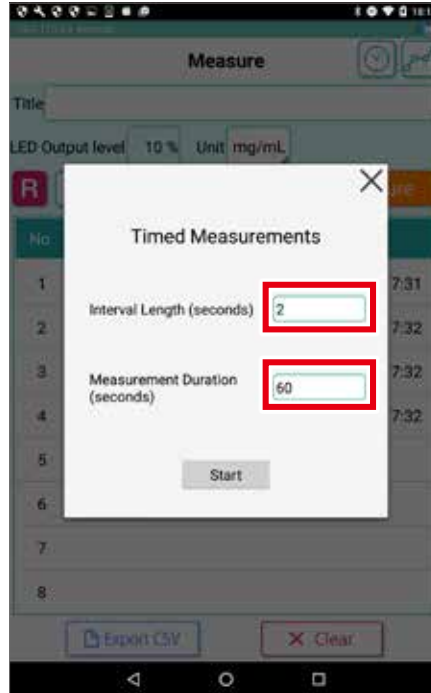
## 4-2. Timed Measurement (Simplified Kinetic Measurement)

This function allows automatic timed measurement of an unknown sample without using a standard curve. For example, by using this function you can track the change in state of an unknown sample over time, or measure the same sample more than once while automatically increase the measurement number n.

\* Measurement unit is limited to intensity value (RGB).

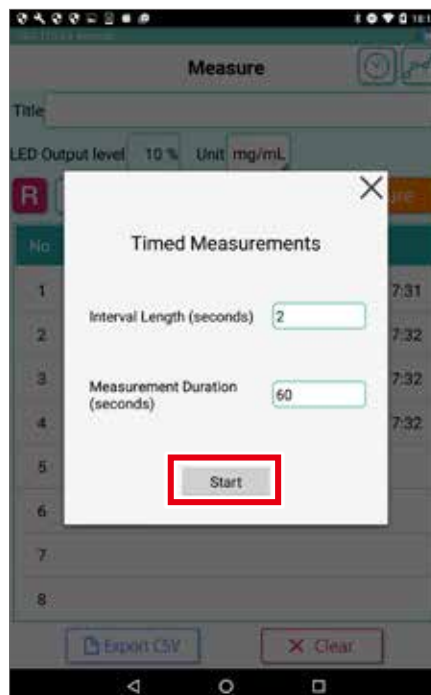
### How to start

- (1) Set timed measurement ON <Pages 33-34> and enable the ⑧ **Timed Measurement Button**.
- (2) Tap ⑧ **Timed Measurement button**. Timed Measurement setting screen pops up.
- (3) In the Timed Measurement setting screen, set the measurement interval and the measurement duration. The example at right shows the settings for continuous measurement at 2-second intervals for 60 seconds.



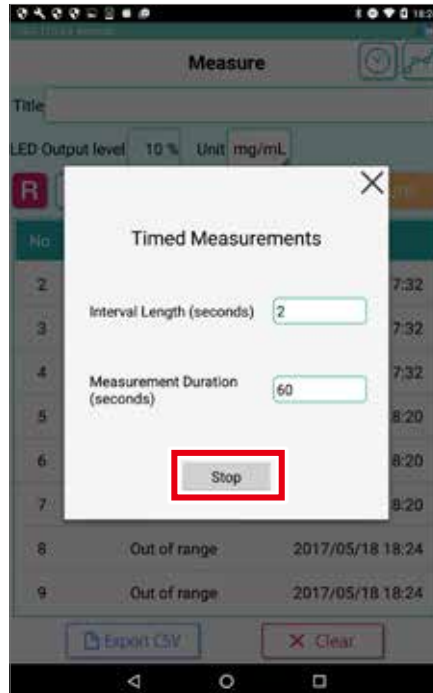
- (3) Timed measurement starts immediately when you tap the **Start Button**.

\* Do not tap "Back" "Home" button or push the power button during the Timed Measurement. The measurement will be stopped.



### How to stop

- (1) Tap the **Ⓢ Timed Measurement Button** while timed measurement is in progress opens the Timed Measurements screen. Tap the **Stop Button** interrupts timed measurement.



### 5. Displaying Previous Measurements

Tap the **Measurement History Button** on the top screen to move to the Measurement History Screen (Illustration 5-1).

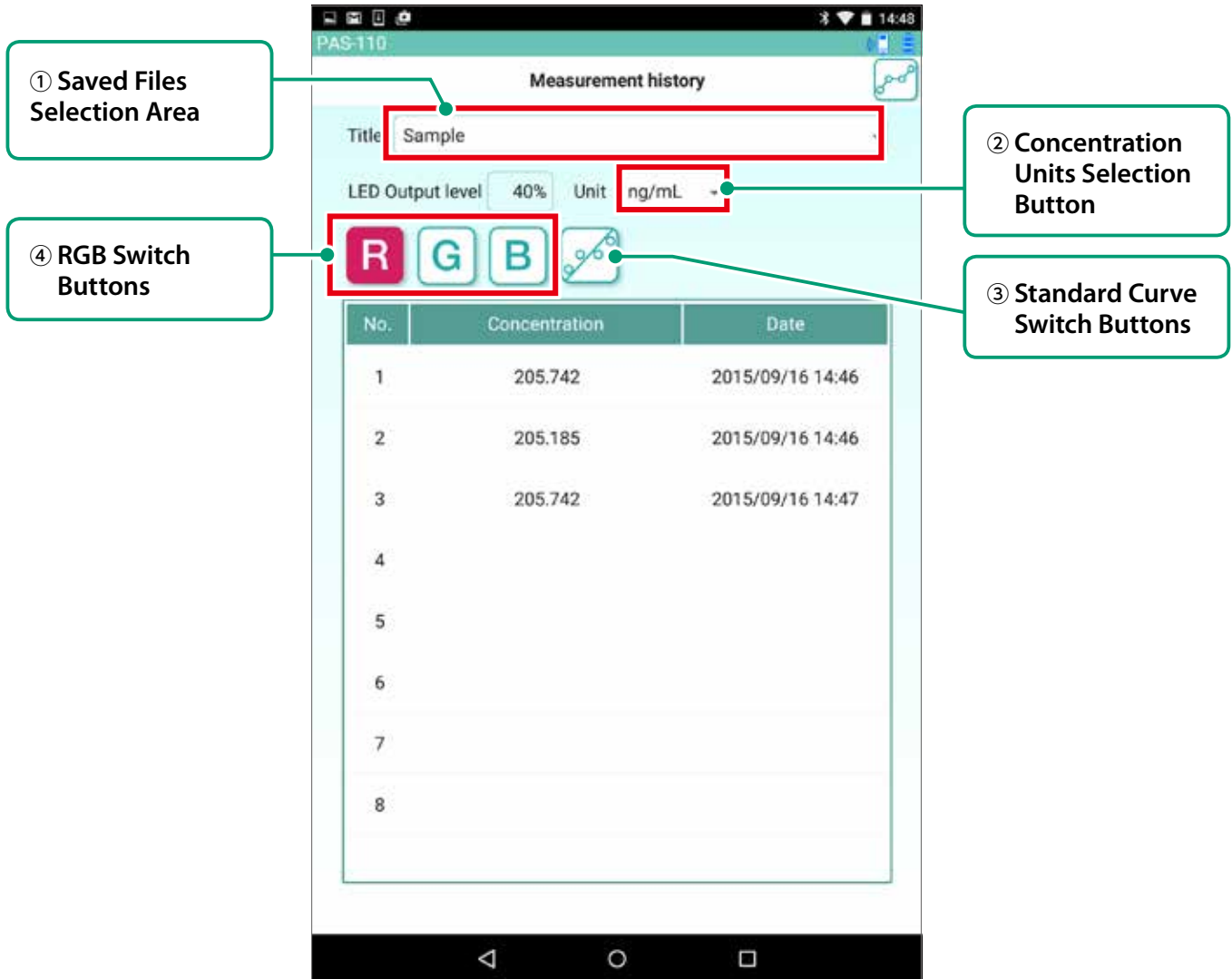


Illustration 5-1: Measurement History Screen

(1) Previously saved measurement data can be checked by tapping the ① **Saved Files Selection Area** and selecting the saved data.

TAKING MEASUREMENTS

- (2) Units for the measurement value can be selected from among three options (concentration, intensity <RGB>, or absorbance <ABS> by tapping the ② **Concentration Unit Selection Button** shown in Illustration 5-2.

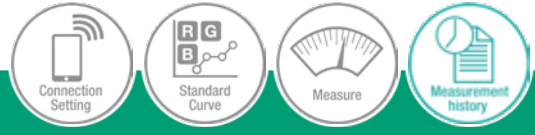


Illustration 5-2:  
Concentration Units Selection

- (3) Display switches to the unknown sample measurement value based on the least squares line when you tap the ③ **Standard Curve Switch Buttons**.
- (4) Display can be switched between measurement results for each of the RGB wavelength modes (Illustration 5-3) using the ④ **RGB Switch Buttons**.



Illustration 5-3:  
Display of Measurement Data



## 6. Saving Data (to a CSV file)

Saved measurement data is accumulated in your Smartphone or tablet PC in CSV format. Here we explain how to output CSV files to a computer.

<For Android Devices>

- (1) Connect your Smartphone or tablet PC to your computer with the USB cable.
- (2) Extract the data as outlined below.

(Example for an Android tablet PC and Nexus 7)

Computer → Nexus 7 → Internal storage → Android → data → com.ushio.past110 → files

<For iOS Devices (on iPhone or iPad)>

- (1) Connect the tablet and computer.
- (2) Open iTunes.
- (3) Select the connected tablet.
- (4) Select “App” below Settings.
- (5) Select “PAS-110” below File Sharing.
- (6) Select the file you saved with App.
- (7) Click “Add File...”
- (8) Select a folder to save the file.

Download iTunes from the link below.

<http://www.apple.com/jp/itunes/connect/download/>

The CSV file format is as shown below.

- Red Outline: Measurement data
- Dotted Blue Outline: Standard curve data

Measurement Data													
Color	No.	Concentration (curve fitting by least square method)	Concentration (straight line connecting two points)	Unit	Value	Absorbance	LED Output Level	Sensor Accumulation Time	Temperature	DateTime			
R	1	8.525	8.007 %	%	22929	0.15	30	50	1453	2016/10/12 12:08			
R	2		%	%	16693	0.289	30	50	1453	2016/10/12 12:09			
G	1	8.338	8.002 %	%	24576	0.121	30	50	1453	2016/10/12 12:08			
G	2		%	%	25906	0.252	30	50	1453	2016/10/12 12:09			
B	1	9.987	7.998 %	%	38807	0.039	30	50	1453	2016/10/12 12:08			
B	2	15.259	15.992 %	%	37033	0.06	30	50	1453	2016/10/12 12:09			

Calibration Curve Data																	
Color	No.	Concentration	Unit	Value1	Validity	Value1	Validity	Value2	Validity	Value3	Validity	Absorbance	LED Output Level	Sensor Accumulation Time	Temperature	DateTime	
		0 %		32407	TRUE	32413	TRUE	32391	TRUE	32391	TRUE	0	30	50	1449.5	2016/10/12 12:08	
R	1	2 %		30578	TRUE	30585	TRUE	30587	TRUE	30587	TRUE	0.025	30	50	1449.5	2016/10/12 12:08	
R	2	4 %		29229	TRUE	29234	TRUE	29231	TRUE	29231	TRUE	0.06	30	50	1449.5	2016/10/12 12:08	
R	3	8 %		22929	TRUE	22934	TRUE	22942	TRUE	22942	TRUE	0.15	30	50	1449.5	2016/10/12 12:08	
R	4	16 %		16824	TRUE	16814	TRUE	16809	TRUE	16809	TRUE	0.285	30	50	1449.5	2016/10/12 12:08	
G	0	0 %		46305	TRUE	46316	TRUE	46386	TRUE	46386	TRUE	0	30	50	1449.5	2016/10/12 12:08	
G	1	2 %		44196	TRUE	44200	TRUE	44197	TRUE	44197	TRUE	0.02	30	50	1449.5	2016/10/12 12:08	
G	2	4 %		41488	TRUE	41487	TRUE	41471	TRUE	41471	TRUE	0.049	30	50	1449.5	2016/10/12 12:08	
G	3	8 %		34576	TRUE	34581	TRUE	34579	TRUE	34579	TRUE	0.121	30	50	1449.5	2016/10/12 12:08	
G	4	16 %		25913	TRUE	25969	TRUE	25915	TRUE	25915	TRUE	0.251	30	50	1449.5	2016/10/12 12:08	
B	0	0 %		42581	TRUE	42577	TRUE	42553	TRUE	42553	TRUE	0	30	50	1449.5	2016/10/12 12:08	
B	1	2 %		41381	TRUE	41388	TRUE	41384	TRUE	41384	TRUE	0.012	30	50	1449.5	2016/10/12 12:08	
B	2	4 %		41015	TRUE	41013	TRUE	41008	TRUE	41008	TRUE	0.018	30	50	1449.5	2016/10/12 12:08	
B	3	8 %		38912	TRUE	38906	TRUE	38897	TRUE	38897	TRUE	0.039	30	50	1449.5	2016/10/12 12:08	
B	4	16 %		37026	TRUE	37024	TRUE	37023	TRUE	37023	TRUE	0.061	30	50	1449.5	2016/10/12 12:08	



※1 TRUE appears if a measurement has been taken.  
FALSE if no measurement taken.  
TRUE is displayed in all columns here because three measurements were taken.

\* Measurement results are displayed for all three RGB measurement wavelengths.



## 7. Info Screen

Tap the Info Button on the top screen to move to the Info Screen (Illustration 7-1).

The Info Screen displays information on both the hardware photo absorbance sensor and the mobile app.

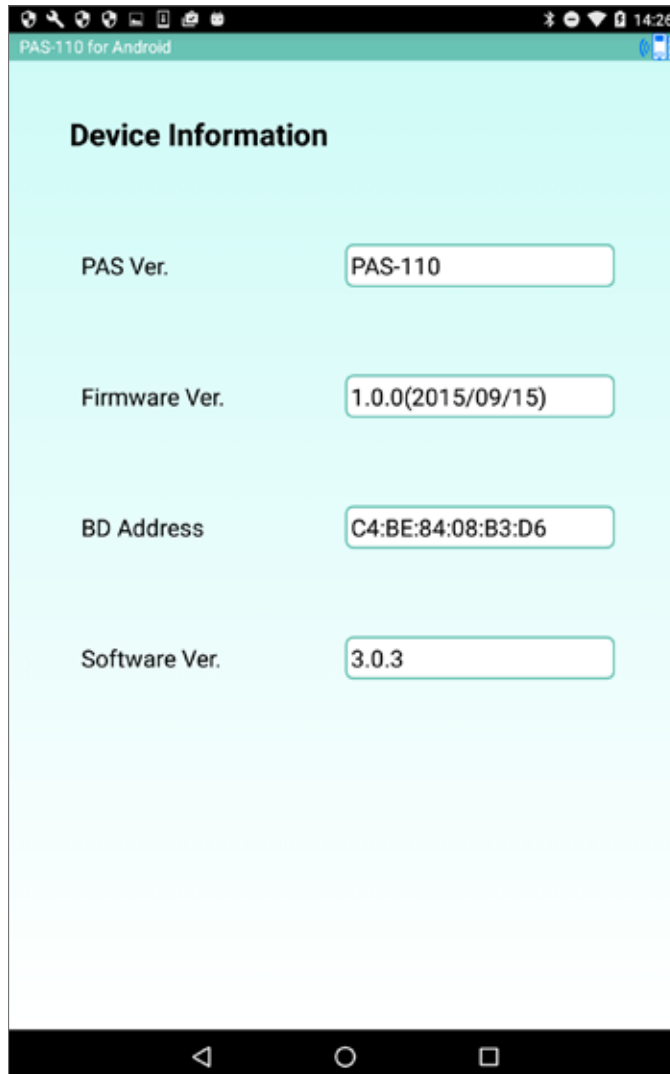


Illustration 7-1: Info Screen

## 8. Save Screen

Tap the **Save Button** on the top screen to move to the Save Screen (Illustration 8-1).

The Save Screen displays the ① **Diagnostics Button** and ② **Function Settings Buttons**.

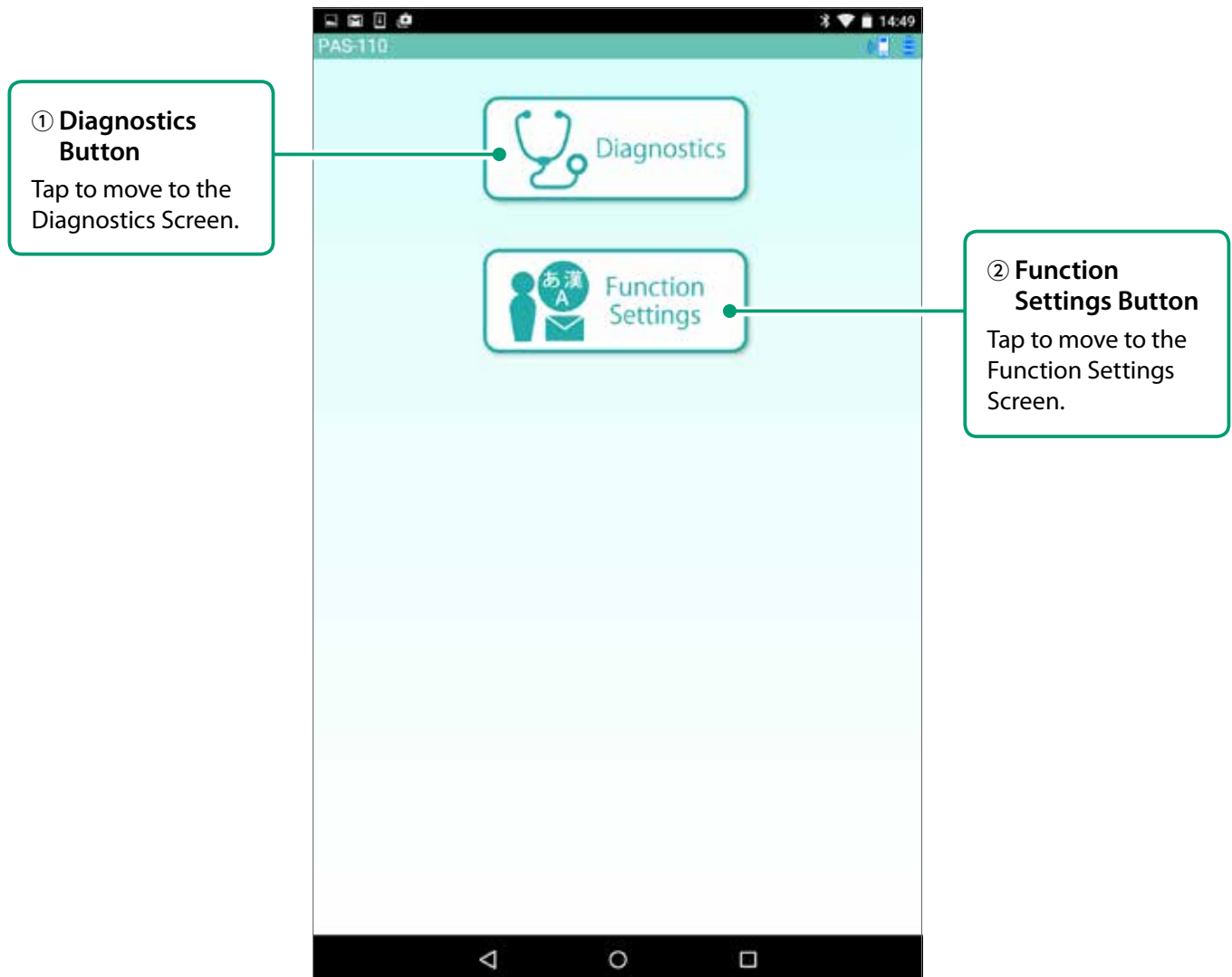


Illustration 8-1: Save Screen

The ① **Diagnostics Button** is used by USHIO INC. to check device operation. Please do not use it. Tap the ② **Function Settings Button** to move to the Function Settings screen. From this screen, you can make the following settings(Illustration 8-2).

**Language:** Switch between English and Japanese.

**Sensor Accumulation Time:** Change the time for light volume accumulation. The initial setting is 50 ms. If you change this setting, set an appropriate LED output level as explained on [<pages 14-15>](#).

**Timer Function:** Set the Timed Measurement function [<pages 27-28>](#). Setting timed measurement ON enables the **Timed Measurement Button**.

**Absorbance Multiplier:** Set the multiplier for absorbance display. For example, correlation with a previously used instrument can be taken, then the calculated correction factor can be set to allow conversion from another device's absorbance values.

\* Since absorbance values vary according to device, it is not possible to apply the same correction factor to all devices.

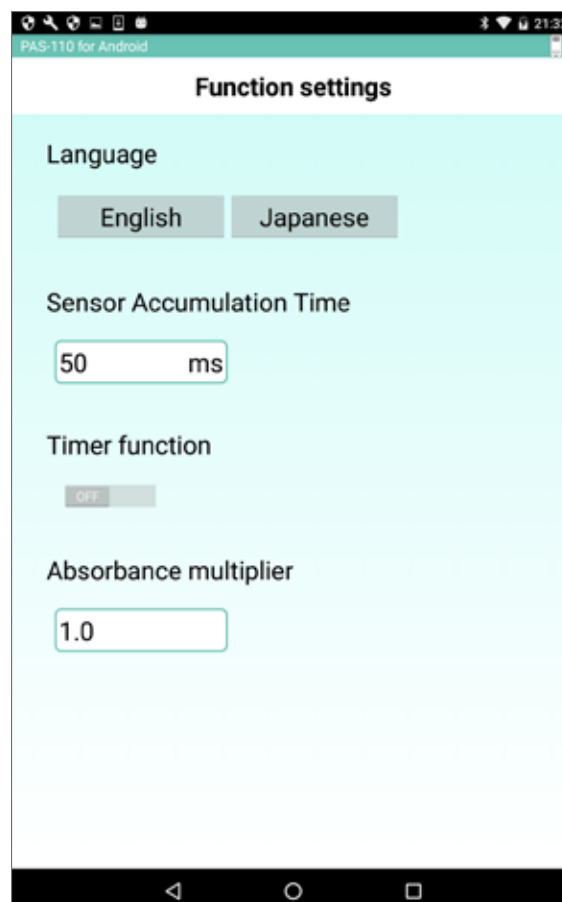


Illustration 8-2:  
Function Settings Screen display set to English.

## 9. Help Screen

Tap the **Help Button** on the top screen to move to the Help Screen (Illustrations 9-1).

This screen provides a weblink to the user’s manual, troubleshooting guide, and other relevant documentation. It also provides an email address for the PiCOEXPLORER™ Support Desk. Contact the Support Desk if you have any further questions or concerns.

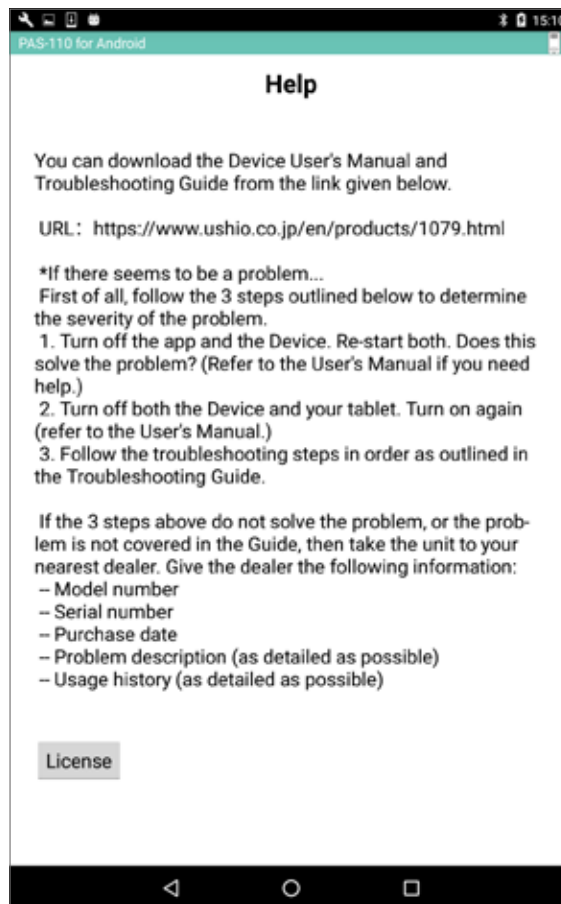


Illustration 9-1: English Help Screen

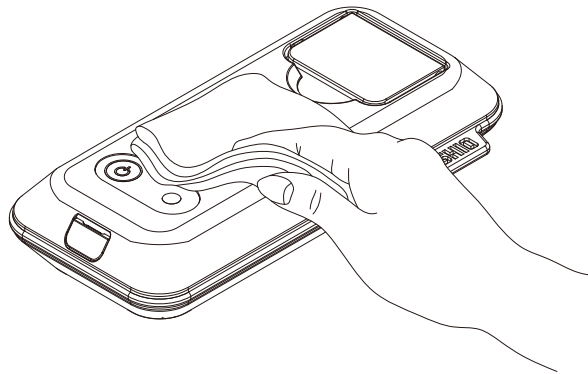


Do not wipe the device with organic solvents.  
 Make sure the battery case cover is completely closed before cleaning.

## ✿ Maintenance

### ● Device Exterior

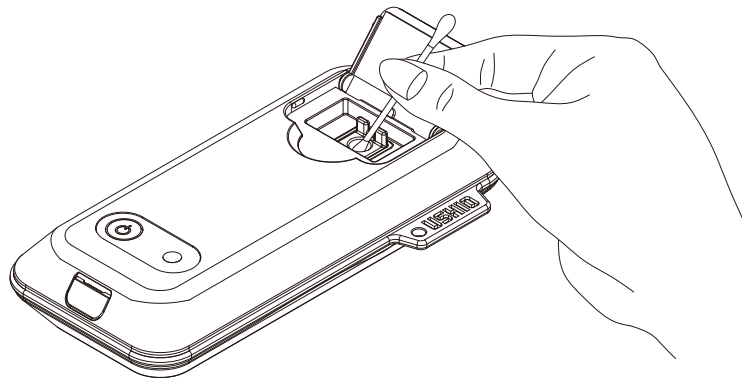
Clean the device exterior with a clean, soft cloth wetted with a weak neutral detergent solution. Lightly wipe clean, then wipe again with a clean, dry cloth to remove all excess moisture.



### ● Measurement Chamber

Do not use a stiff cloth to wipe the optical unit inside the chamber. Doing so can easily damage this sensitive component.

Remove dust and other contaminants from the optical unit by carefully wiping with a clean, soft cloth or cotton swab.



### ● Long-Term Storage

If the device will not be used for a long time, securely fasten the measurement chamber cover, and remove all batteries (refer to section on Battery Insertion). Close and lock the battery cover, and store in a secure location away from direct sunlight, dust, dirt, or high temperature or humidity.

**TROUBLESHOOTING**

**[Problem Indicator 1] No power to unit or soon shuts off**

Possible Cause	Solution
Batteries inserted incorrectly	Check batteries, re-insert correctly.
Batteries low or dead	Install fresh batteries (AAA x 3). Always change all 3 batteries together. A standard USB cable can also be used to supply power.
Electric short or malfunction	Possible damage due to shock of dropping or impact. Contact your dealer.

**[Problem Indicator 2] No Bluetooth connection or connection lost**

Possible Cause	Solution
Auto-Off function killed connection (No connection for 2 minutes, auto shut-off)	Press power button on device to re-establish connection.
Device and receiver too far apart	Connection best at distance of less than 10 meters. Ambient conditions may impact transmission, so try to keep device and receiver as close as possible.
Interference from another device	Electrical interference may occur due to transmission by wireless LAN, microwave, or other Bluetooth devices in the vicinity. Move device and receiver away from such devices.
Too many possible receivers nearby	Turn off power to other nearby receivers.
Physical object blocking signal between device and receiver	Relocate device and receiver or remove object.
Device address not displayed on Connection Setting Screen	Please re-scan. Refer to Page 12, 2. Wireless Connection, in User's Manual.
Software Malfunction	Turn off both device and receiver, then turn on again. Data may be lost when you do this.
Electrical short or malfunction inside device	Possible damage due to shock of dropping or impact. Contact your dealer.

**[Problem Indicator 3] Can't take readings (or reading results variable)**

Possible Cause	Solution
No Bluetooth connection	See "No Bluetooth Connection" section immediately above.
Bluetooth connection to other device	Re-connect to the photo absorbance sensor.
Standard curve not correctly received	Recheck data for errors. Refer to Page 14, 3. Graphing the Standard Curve, in User's Manual.
Error message: "Please redraw standard curve"	This message displayed when there is an ambient temperature difference of $\pm 10^{\circ}\text{C}$ between time when curve was drawn and time of measurement. Adjust ambient temperature and restart measurement.
Screen freezes or display unstable	Turn off device and receiver, turn on again. Data may be lost when you do this.

**TROUBLESHOOTING**

**[Problem Indicator 3] Can't take readings (or reading results variable)**

Possible Cause	Solution
Dirt or contaminant in measurement chamber	Clean chamber with a clean cotton swab or gauze. Do not use alcohol or organic solvent. Refer to Page 37, Maintenance, in User's Manual.
Too little sample in tube	Sample volume of 30µl or more required.
PCR Tube not inserted correctly	Check whether lid is properly closed and no foreign objects inside chamber. Reset tube in holder. Refer to Page 9 in User's Manual.
PCR Tube dimensions do not fit holder	Switch to recommended tube size.
Device tilted	Place device on a stable, level surface (less than a 10° tilt from horizontal).
Sample concentration too strong	Adjust output strength of LEDs. (Make sure you have used correct volume and type of sample, and diluted correctly.) *
Sample concentration too weak	Make sure you have used correct volume and type of sample, and diluted correctly. *
Device cannot operate in current environment	Check operating parameters of device and use only in environments within the specified parameters.
Sample cannot be measured in current environment	Check specs of sample and only attempt measurement in environments within the specified parameters.
Deterioration of LED or sensor	Contact your dealer with details of how the device has been used.

**Other Problem Indicators**

Possible Cause	Solution
Device makes noise when tipped	Internal component may be damaged. Contact your dealer with details of how the device has been used.
Device was used or stored in environment outside specified parameters	
Liquid spilled on measurement unit	

\* Fingerprints or moisture on the side of the PCR tube or bubbles in the tip of the PCR tube or sample can prevent correct measurement.

**Warranty Policy**

USHIO INC. warrants this device to be free from physical defects in material and workmanship for a period of 1 year from the date of the original retail purchase. If the device fails during this period, the company will replace or repair the device free of charge.

**However, this warranty is void under the following circumstances:**

<ul style="list-style-type: none"> <li>• failure due to device usage in violation of the environmental and handling specifications and procedures outlined in the guidelines found in the User’s Manual, catalog, and other relevant documentation</li> </ul>
<ul style="list-style-type: none"> <li>• failure due to device tampering or disassembly</li> </ul>
<ul style="list-style-type: none"> <li>• failure due to improper device storage</li> </ul>
<ul style="list-style-type: none"> <li>• failure due to accidental dropping or hard impact, or subjecting the device to undue pressure</li> </ul>
<ul style="list-style-type: none"> <li>• failure due to improper battery use or battery leakage</li> </ul>
<ul style="list-style-type: none"> <li>• Failure due to device usage in a country not authorizing it</li> </ul>

**Warranty Disclaimer and Limitation of Liability**

EXCEPT AS EXPRESSLY SET FORTH ABOVE, TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, USHIO INC. EXPRESSLY DISCLAIMS ALL WARRANTIES AND CONDITIONS REGARDING THIS DEVICE, WHETHER EXPRESS, IMPLIED, OR STATUTORY, AND INCLUDING BUT NOT LIMITED TO ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE OR PURPOSE, ALL OF WHICH ARE HEREBY EXPRESSLY DISCLAIMED.

USHIO INC. SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES OF ANY KIND, INCLUDING WITHOUT LIMITATION LOST REVENUES, LOST PROFITS OR LOST BUSINESS OPPORTUNITIES OR LOST SALES, WHETHER OR NOT THE BUYER HAS BEEN ADVISED THAT SUCH DAMAGES MAY OCCUR. THE BUYER’S SOLE AND EXCLUSIVE REMEDY AND USHIO INC.’S SOLE AND EXCLUSIVE OBLIGATIONS UNDER THE WARRANTY PROVIDED ABOVE IS LIMITED TO THE REPAIR OR REPLACEMENT OF THE DEVICE DETERMINED BY USHIO INC. TO BE DEFECTIVE. USHIO INC.’S MAXIMUM LIABILITY TO THE BUYER IS LIMITED TO REPLACEMENT OF THE DEVICE.

**If Something Seems Wrong...**

If you suspect a problem with the device, first follow these 3 simple steps:

- ① Turn off power to the device and turn off the app, then turn both back on.
- ② Turn off power to both the device and the tablet, then turn both back on.
- ③ Refer to the Troubleshooting Guide above, locate your problem, and see if the suggested solution solves the problem.

If the problem persists after this, or the problem indicator is not listed in the Troubleshooting Guide, contact your local dealer for help.



## WARRANTY AND AFTER-SERVICE

When contacting your dealer, be sure to provide the following information:

• Model Number
• Serial Number
• Date of Purchase
• Description of Problem (as detailed as possible)
• Usage History (as detailed as possible)

### PiCOEXPLORER™ Support Desk

USHIO AMERICA, INC.

TEL: +1-800-838-7446

E-mail: [customerservice@ushio.com](mailto:customerservice@ushio.com)

## SPECIFICATIONS

### PAS-110 Hardware Unit

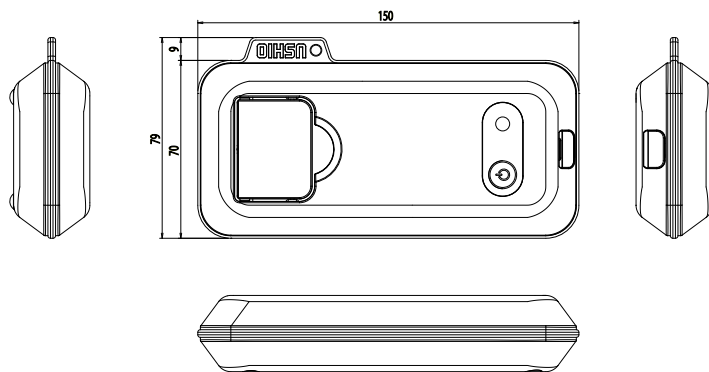
Device name		Photo absorbance sensor			
Brand		USHIO			
Model name		PiCOEXPLORER			
Dimensions		70 x 150 x 30 mm (excluding protrusions)			
Weight		about 200g (including batteries)			
Power		<ul style="list-style-type: none"> <li>• 4.5V DC (3 AAA-type batteries)</li> <li>• 5V DC (micro-USB connector*1)</li> </ul>			
Operating voltage		Battery 3.6~4.5 Vdc			
Battery Life		about 5 hours <sup>*2</sup>			
Usage Environment	Temperature/Humidity	5-35 °C, 70% RH or less			
	Altitude	2000m or less			
	Installation Condition	indoor, pollution degree 2			
Measurement	Total Samples	1 sample			
	Time	1 second or more			
	Absorbance Range	0.02 or more (Gentian violet dilute solution)			
Sensor Unit	Light Source	White LED			
	Detector		Maximum absorption wavelength	Wavelength range	
		Color Sensor	Red	615 nm	575-660 nm
			Green	530 nm	455-630 nm
			Blue	460 nm	400-540 nm
Communication Interface		Bluetooth low energy (Bluetooth smart)			
Frequency of operation		2402-2480 MHz			
Type of modulation		GFSK			
Channel spacing		2 MHz			
Channel number		40			
Peak output power		Less than 0 dBm			
Antenna gain		2.41 dBi			
Antenna type		PCB Antenna			
Compatible Tablet		Nexus 7 (2013), Nexus 9, iPhone <sup>*3</sup>			
Recommended PCR Tube		WATSON brand 137-211C 0.2 mL			
Minimum Sample Volume		30 μL <sup>*4</sup>			

\*1 Use the cable to connect to a computer or other appropriate power source to power the unit without batteries (the device automatically senses the power source; this connection cannot be used to transmit data.)

\*2 This battery life is based on using new, fully-charged batteries. However, battery life cannot be guaranteed as different operating conditions can alter battery life drastically.

\*3 Used with unsupported Smartphone or Tablet model, the device may have disturbed images, may not start app, or may cause other malfunctions.

\*4 With a sample volume of 30μL, be sure to measure with the device tilted 10° or less from the horizontal.



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**USHIO AMERICA, INC.**

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**[www.ushio.com](http://www.ushio.com)**