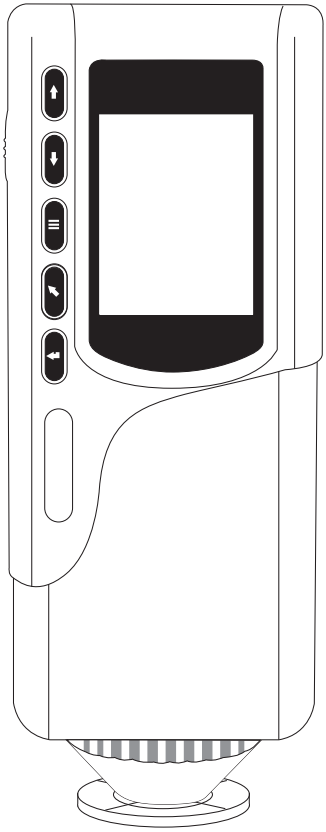
COLORIMETER

OPERATION MANUAL



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Product Description

This manual contains the introduction of all the functions of the colorimeter. Different instrument models may have different functions. Some of the functions introduced in the manual may not be available on the instrument. For details, please consult your seller.

This instrument is researched and developed in accordance with CIE (International Commission on Illumination) and CNS (China National Standards). It is a high precise colorimeter with simple user interface and stable performance. It can be powered by both Li-ion battery and external DC power supply.

The instrument has following advantages:

- Can perform measurement at start-up. No need to calibrate each time which simplify the operation.
- Adopt illuminating locating and precise cross locating to aim at the tested object quickly.
- Different models have different measurement calibers.
- Save data automatically.
- The precise and stable hand-head structure to make the measurement easier.

Cautions

● This colorimeter is a precise measuring instrument. Please avoid dramatic changes of external environment when measuring. These changes, including the flicker of surrounding light, the rapid change of temperature, will affect the measuring accuracy.

● Keep the instrument balanceable; make sure the measuring aperture cling to the test sample, and no shaking or shifting when measuring. Please prevent the colorimeter from fierce collision or crash.

● This instrument is not waterproof. Do not use it in high humidity environment or in water.

● Keep the colorimeter clean. Avoid dust, powder or solid particles entering the measuring aperture and the instrument.

● Replace the white calibration cover and put the colorimeter into instrument cabinet when not in use.

● Please take out the battery to prevent the colorimeter from damage if you don’t use it for a long time.

● Please keep the colorimeter in a cool dry place.

● Any unauthorized changes to the colorimeter are not permitted, or it will affect the measuring accuracy, even cause irreversible damage.

1. Button Description

The following is a brief introduction of the buttons. We will give more detailed information about its function separately in next chapters.

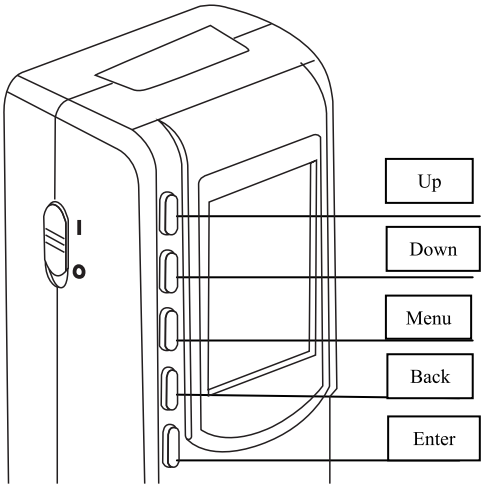


Figure 1 Button Function

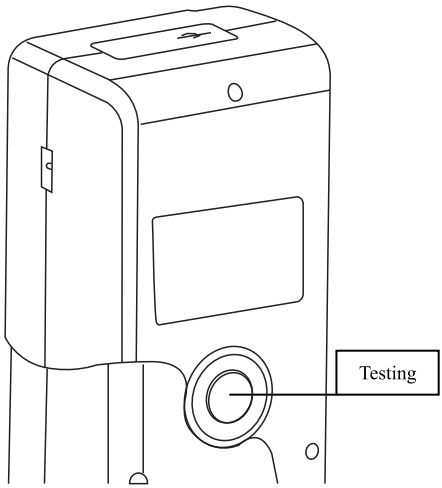


Figure 2 Testing Button Diagram

Button Function Introduction

1. ≡ Menu
2. ↑ Up
3. ↓ Down
4. ↵ Enter
5. ↖ Back
6. ◎ Testing

2. Interface Description

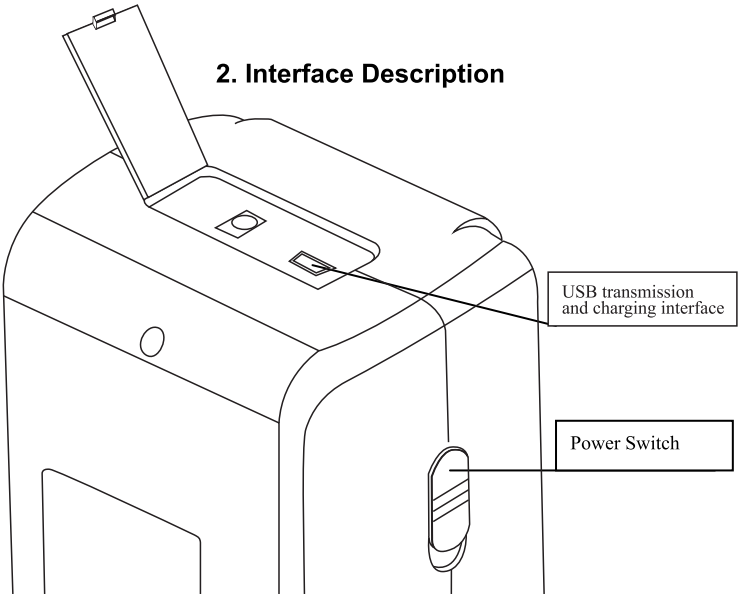


Figure 3 Interface Diagram

Interface Description

1. Power Switch: Push the switch to “1” to turn on the colorimeter. Push the switch to “0” to turn it off.

2.USB Interface: This interface is a common interface. The instrument judges the connection status automatically. USB interface is used to transferdata to PC.

The power adapter connected to 5V⎓2A can charge the instrument.

Note: When connecting to external power source, please press the power switch to start the instrument.

3. Battery Description

Battery Description

The Battery is built-in Li-ion 3.7V⎓0.5A, 3200mAh.

When charging the battery, the instrument must connect external power source or USB cable to connect the PC. Meanwhile, push the switch to “1”, then the battery will be charging.

When charging the battery, dynamic battery icon will display on the top right corner of measurement interface.

4. Changing Measuring Aperture

Measuring Aperture Installation

As shown in Figure 4, make the measuring aperture align at the installation position of integrating sphere. Then gently turn it counterclockwise. When hear slight “Da”, it means measuring aperture is buckled with integrating sphere. Then the installation is finished.

Measuring Aperture Dismantlement

As shown in Figure 4 gently turn measuring aperture clockwise. When hear slight “Da”, it means the measuring aperture is separated with the buckling parts of integrating sphere. Then the measuring aperture is dismantled.

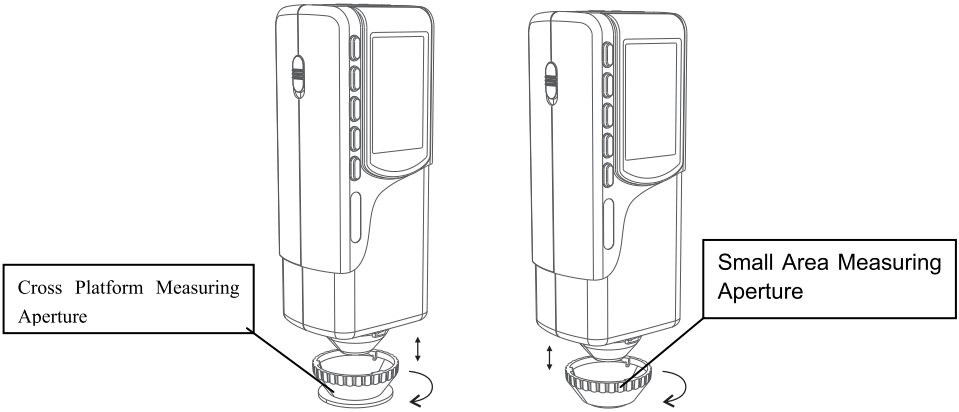


Figure 4 Installation and Dismantlement of Measuring Aperture

Note: some models are only equipped with cross platform measuring aperture.

5. Operating Instruction

5.1 Turning On

Preparations Before Power On

Check whether there is battery powered or external power supply.

Turning On

Push the power switch to “1”, the LCD screen will display “colorimeter”. After a few seconds, it will enter Standard Measurement interface automatically, and the default display is L*a*b*C*H.

5.2 Measurement

Measurement Locating

The instrument can locate by measurement facula. Enter “Standard Measurement” or “Sample Measurement” interface, press the “Testing” key and hold it. The facula will

appear at the moment. You can observe the matching status between the facula and the measured sample. At the same time, hold the measuring aperture close to the measured sample and adjust it. Then the alignment is achieved.

After the locating, release “Testing” button. The instrument will finish sample testing in approx. 1 sec and display color parameters of the measured sample.

Standard Measurement

Enter standard measurement to perform measurement, as shown in Figure 5, align the measuring aperture to the sample, press “Testing” button, the screen will display color data of this sample.

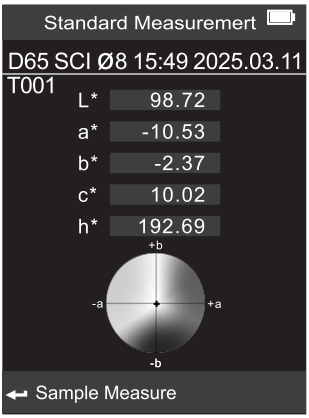


Figure 5 Standard Measurement Interface

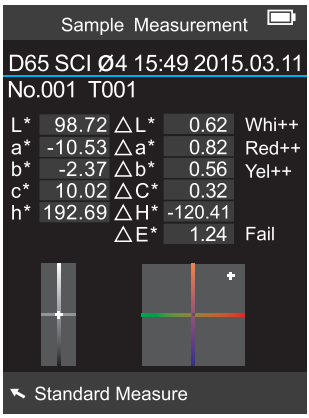


Figure 6 Sample Measurement Interface

Sample Measurement

After completing standard measurement, press “Enter” button, the instrument will enter “Sample Measurement” interface automatically, as shown in Figure 6. Align the

measuring aperture to the test sample to perform sample measurement.

Note: During the measurement (Approx. 1 sec), all buttons are ineffective.

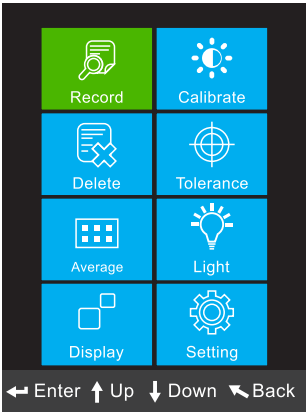


Figure 7 Main Menu

5.3 Print

Connect colorimeter to the printer. When the colorimeter is in “Standard Measurement” or “Sample Measurement” interface, you can print measurement data automatically.

6. System Function Description

About other functions of this colorimeter, please follow main menu as shown in Figure 7.

Note: The functional modules shown in Figure 7 vary among different instruments. Please operate according to the instrument you have purchased. The operation steps for some functional modules of each instrument are roughly the same. If a functional module is not available, it indicates that the instrument does not support the corresponding operation.

6.1 Record and Standard Entering

6.1.1 Record

Select “Record” in main menu to enter “Standard Record”, as shown in Figure 8.

The figure shows the standard sample data. You can check different standard data through “Up” and “Down”. “T002” is a standard number. After selecting a standard, you can press “Enter” to check test sample data and color difference, as shown in Figure 9. You can check different data through “Up” and “Down”. No.001 is the serial number of sample measurement.

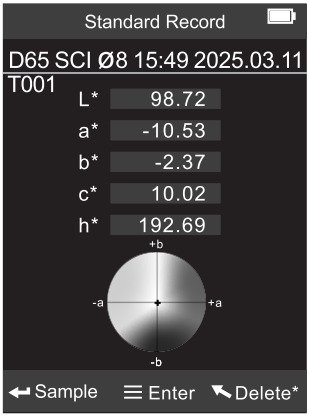


Figure 8 Standard Record

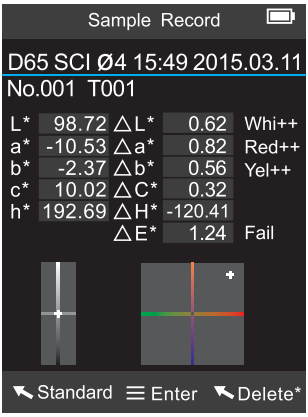


Figure 9 Sample Record

6.1.2 Standard Entering

In some cases, it’s required to measure color difference under a saved standard. Then,

you can select “Record” in main menu to enter standard sample records interface. You can search the required standard data through “Up” and “Down”. After finding it, press “Menu ≡” button, and then the standard record is entered to the measurement interface, press “Enter”, you can perform sample measurement under this standard.

6.1.3 Sample Record Entered to a Standard

In some cases, it’s required to use a saved sample as a standard. Then, you can select “Record” to enter sample records interface, as shown in Figure 9 . You can search the needed sample data through “Up” and “Down”. After finding it, press “Menu ≡” button, and then the sample record is entered to the measurement interface as a standard, press “Enter”, you can perform the color measurement under this standard.

6.2 White and Black Calibration

Press “MENU ≡” to enter the main menu. Select “Calibrate” to enter manual white calibration and black calibration interface, as shown in Figure 10.

Select “White Calibration” and press “Enter” button; the interface will prompt you to put away the white calibration cover. Turn the colorimeter upside down and make the measuring aperture upwards, then put the white calibration board in the center of the colorimeter and make sure it is closed to measuring aperture. Re-press “Testing” key to perform white calibration.

Next step is black calibration: remove white calibration board. Select “Black Calibration” and press “Enter” button, the instrument will prompt to direct the measuring aperture to the air (please refer to the “Notes” under Figure 10). Re-press “Enter” again or press “Testing” key to perform black calibration.

Then, white calibration and black calibration are completed.

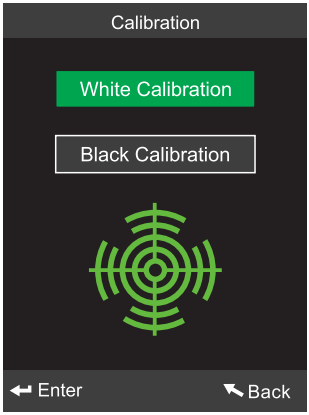


Figure 10 White and Black Calibration

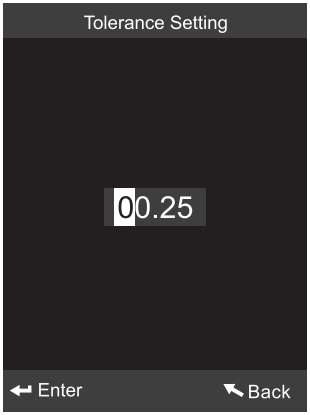


Figure 11 Tolerance Setting

Notes:

When performing black calibration, direct put the measuring port to the air. Be sure the black calibration is starting in a dark, no bright light source environment. Keep the measuring port more than 1m away from any reflective items (hands, desks, walls etc.).

No need to enforce black and white calibration. Once turning it on, you can start the measurement. It is suggested to perform calibration in following occasions: first use, great change of the environment, long-term unused or inaccurate data.

6.3 Tolerance Setting

Select “Tolerance” in main menu to enter tolerance setting interface, as shown in Figure 11. You can add or subtract the number in which the cursor is positioned through “Up” and “Down” button. After setting the number to the required one, press “Enter”

button, the cursor will jump to the last number. When the cursor is in the last number, press “Enter” button to save the settings and return to the main menu.

If you don’t want to set or modify the tolerance, you can press “Back” button to return to the main menu.

The tolerance value is artificial. It is a standard value to judge whether the total color difference ΔE is qualified or not according to the demand of color management. If ΔE is smaller than tolerance value, then it is qualified. If ΔE is bigger than tolerance value, then it is unqualified. As shown in Figure 12, the ΔE in sample measurement interface is unqualified.

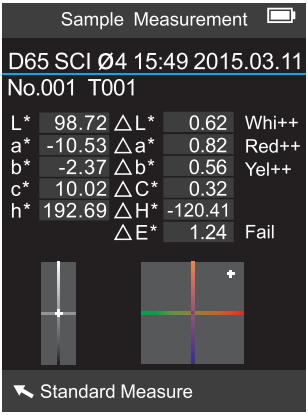


Figure 14 Sample Measurement Interface

6.4 Delete Records

Select “Delete” in main menu to enter the interface shown in Figure 13. There are two options: “Delete All Samples” and “Delete All Records”.

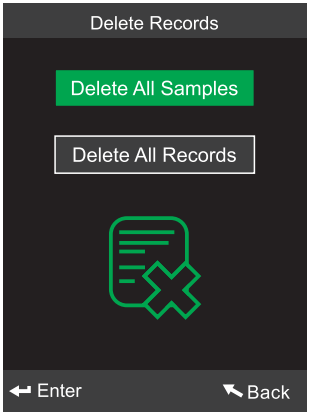


Figure 13 Delete Records

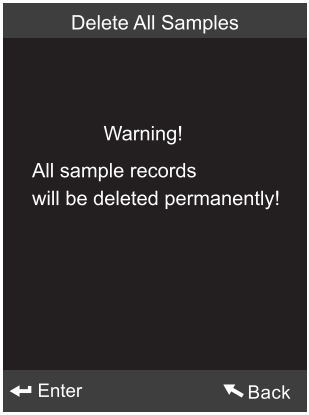


Figure 14 “Delete All Samples” Warning Interface

6.4.1 Delete All Samples

When select “Delete All Samples”, it will delete all test samples in the instrument and save the standard records. Then, the instrument will display a warning interface, as shown in Figure 14. Press “Enter”, all sample data will be deleted, but the standard records are still retained.

6.4.2 Delete All Records

When select “All Records Delete”, all records in the instrument will be deleted, including all standard records and all sample records. Then, the instrument will pop up a warning interface, as shown in Figure 15. Press “Enter” button, all records in the instrument will be deleted.

Note: Please operate this interface carefully, in case of accidental deletion of the needed historical records.

Figure 15 “Delete All Records” Warning Interface

Figure 16 Light Source Selection

6.5 Light Source Selection

Click “Light” in main menu. Customer can choose the light source as shown in Figure 16.

6.6 Display Mode

Select “Display” in the main menu to enter an interface, as shown in Figure 17. You can select different color spaces according to your requirement. This selection will affect the display in “Standard Measurement” and “Sample Measurement” interfaces. You can make settings by pressing “Up” and “Down” button. Then press “Enter” to save the settings and return to main menu.

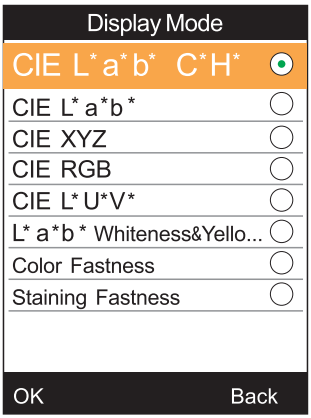


Figure 17 Display Mode Interface

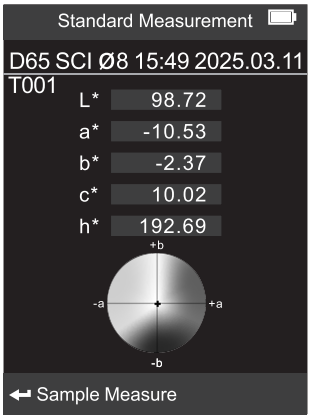


Figure 18 CIE L*a*b*C*h

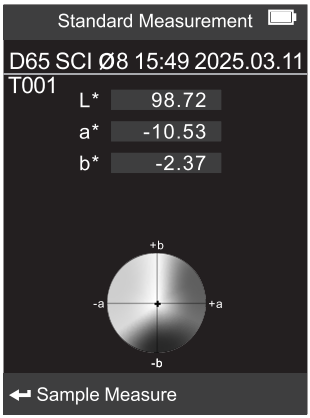


Figure 19 CIE L*a*b*

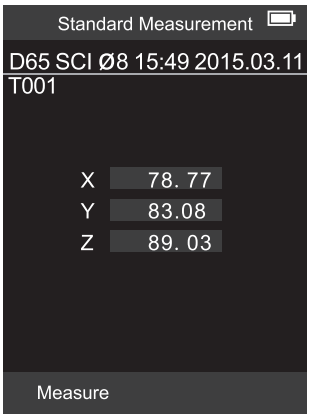


Figure 20 CIE XYZ

The display mode will default to “CIE L*a*b*C*H*”. This instrument has 8 display modes: “CIE L*a*b*C*H*”, “CIE L*a*b*”, “CIE XYZ”, “CIE RGB”, “CIE L*U*V”, “L*a*b* Whiteness & Yellowness”, “Color Fastness” and “Staining Fastness” (Figure 18~Figure 26). In addition, “CIE XYZ”, “CIE RGB”, “CIE L*U*V” only have standard measurement. Other modes have both standard measurement and sample measurement.

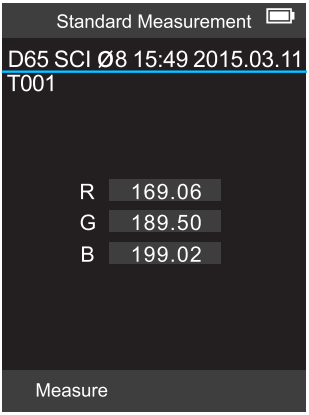


Figure 21 CIE RGB

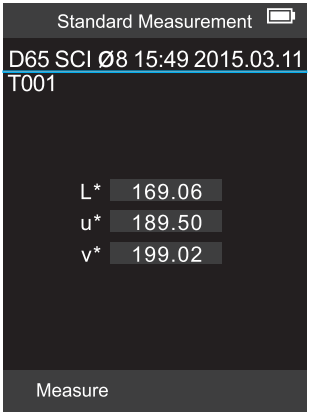


Figure 22 CIE L*U*V*

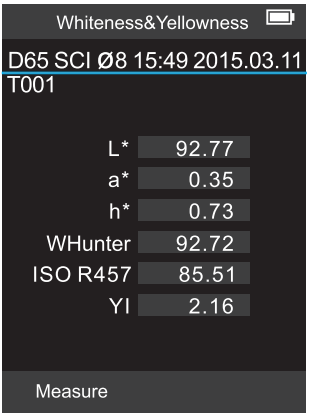


Figure 23 Whiteness&Yellowness Standard Measurement

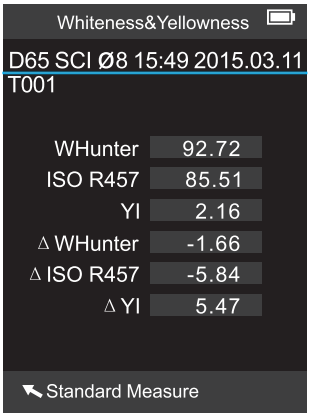


Figure 24 Whiteness&Yellowness Sample Measurement

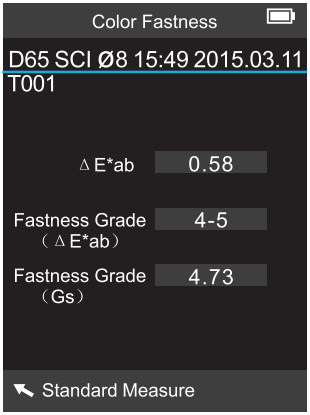


Figure 25 Color Fastness

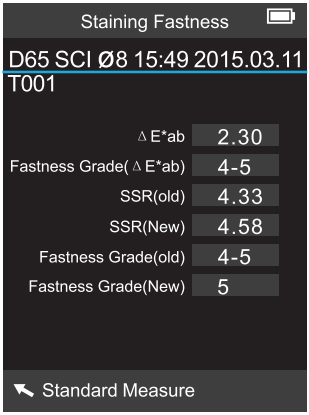


Figure 26 Staining Fastness

6.7 Average Measurement

Select “Average” in the main menu to enter an interface shown in Figure 28. You can set the times of average measurements according to your require. You can add or subtract the times by pressing “Up” and “Down” buttons. Press “Enter” to save the settings and return to the main menu. When the number is set to “00”, “01”, the instrument will only make single measurement, and will not perform average measurement. The instrument is defaulted to one time measurement.

6.8 Function Setting

Select “Settings” in main menu to enter an interface shown in Figure 27. You can select the object according to your require by pressing “Up” and “Down” buttons. Press “Enter” to enter the corresponding setting interface. After completing these settings, press “Enter” button to save the settings and return to the previous menu.

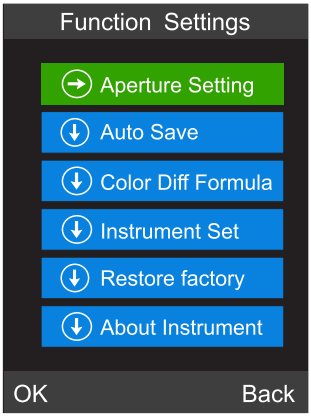


Figure 27 Function Setting

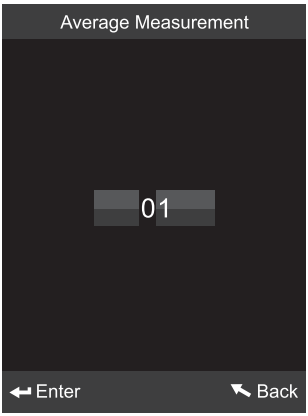


Figure 28 Average Measurement

6.8.1 Measuring Aperture Selection

The instrument has two apertures 4mm and 8mm.

Select “Settings” - “Aperture Setting” to enter an interface shown in Figure 29.

After changing the aperture, be sure to select the corresponding aperture in “Aperture Setting”, or it will cause the inaccuracy of the measured data. After changing the aperture, you need to re-perform white and black calibration, or it will also cause the inaccuracy of the measured data.

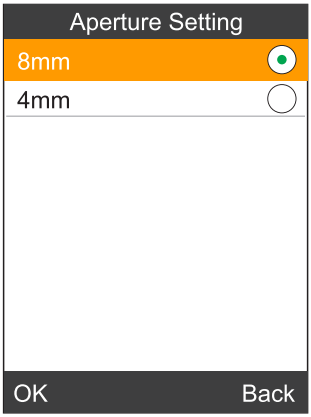


Figure 29 Aperture Setting

Figure 30 Auto Save

6.8.2 Auto Save

Click “Auto Save” in “Setting”. You can set the save method.

6.8.3 Color Diff Form

Select“Color Diff Formula” in the main menu, as shown in Figure 31. Customers can choose the required color difference formula.

Note: Some instruments are defaulted to only have CIE Lab 1976, without the option of "Color Difference Formula Selection". Please refer to the product technical specification sheet for details. For specific instrument parameters, please refer to Chapter 7 - Technical Specifications.

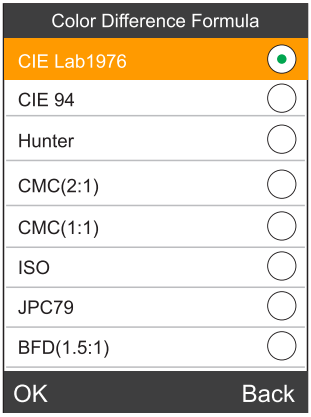


Figure 31 Color Difference Formula

6.8.4 Instrument Settings (Some instruments do not have this module. Please make corresponding settings according to your own instrument.)

Select "Instrument Settings" in "Function Settings" to enter the interface, as shown in Figure 32. This interface has four settings: language selection, time setting, screen backlight time, and buzzer. Each selection corresponds to a setting, which can be customized according to the user's requirements.

6.8.4.1 Language Selection

In the "Function Settings" section, select "Instrument Settings" to enter the interface. As shown in Figure 32, click "Language Selection" and users can choose the display language as needed. Use the "Up" and "Down" buttons for selection, as shown in Figure 33. Press the "Confirm" button to save the settings made and return to the main menu interface.

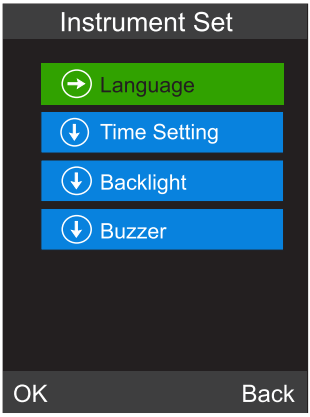


Figure 32 Instrument settings interface

Figure 33 Language Selection

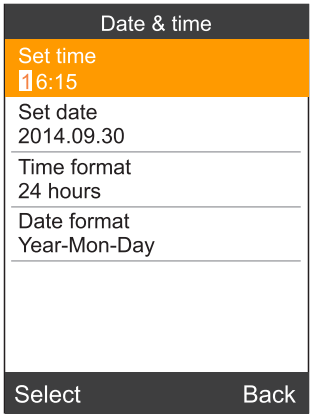


Figure 34 Time & Date

6.8.4.2 Time setting

In the "Function Settings" section, select "Instrument Settings" and enter the interface as shown in Figure 32. Click on "Time Settings" to enter the interface for selecting time, date and format, as shown in Figure 34. Use the "Up" and "Down" keys to select the object to be set, then press the "Confirm" key to enter the corresponding setting interface. In Figures 35 and 36, use the "Up" and "Down" keys to add or subtract the time and date; in Figures 37 and 38, use the "Up" and "Down" keys to select the display format of time and date. Press the "Confirm" key to save the settings and return to the previous menu. If you do not want to modify the time, date or format, press the "Return" key to return to the Function Settings interface.

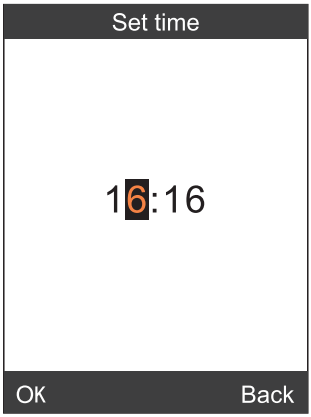


Figure 35 Time Setting

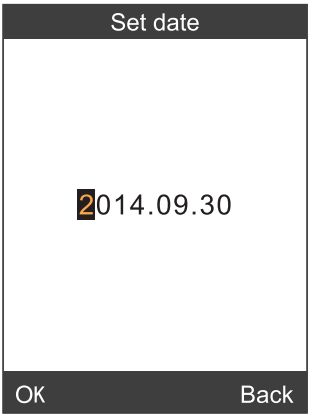


Figure36 Date Setting

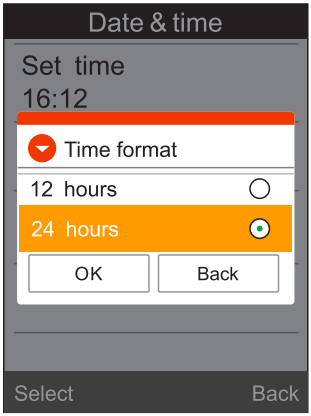


Figure 37 Time Format

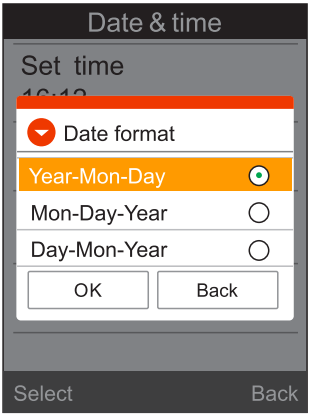


Figure 38 Date Format

6.8.4.3 Screen Backlighting Time Select

"Instrument Settings" in the "Function Settings" menu, and enter the interface as shown in Figure 32. Click "Screen Backlighting Time" to enter the interface in Figure 39. This interface is used to set the screen backlighting time, with options of always on, 5 minutes, 60 seconds, 30 seconds, and 15 seconds. Users can set it according to the frequency of using the instrument, which can further save the instrument's power and reduce its power consumption capacity.

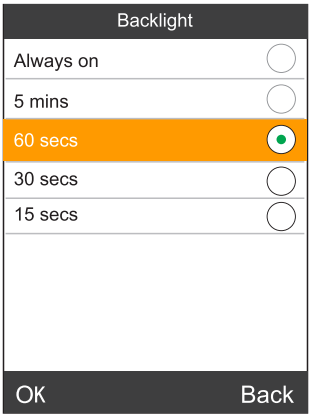


Figure 39 Screen Backlight Time Setting Interface

6.8.4.4 Beeper

In the "Function Settings" section, select "Instrument Settings" and enter the interface as shown in Figure 32. Click on "Beeper" to enter the interface in Figure 40. Customers can turn on or off the sound according to their needs. When the beeper is on, whether by pressing the measurement key or the instrument key, a "ding" sound will be emitted. If set to "Off", no sound will be produced by the instrument. If not set, simply click "Back" to return to the "Instrument Settings Interface".

Figure 40 Beeper Settings Interface

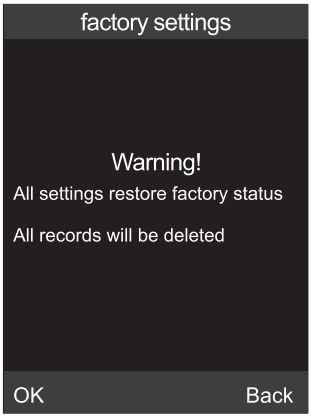


Figure 41 Restore Factory Set

6.8.5 Restore factory

Select “Settings” - “Restore Factory Set”, as shown in Figure 41. Press “Enter” button. The instrument will restore to factory default setting and clear all records.

Note: When you choose this setting, it will pop up a warning. Please operate it carefully. If you don’t want to carry out “Restore Factory Settings”, please press “Back” button.

6.8.6 Regarding the instrument

You can view the model, software and hardware information of this instrument, as shown in Figure 42.

Figure 42 Diagram of the Instrument

6.8.7 measurement pattern

The instrument can be set to measure the sample at different speeds. There are two modes: fast mode and normal mode, as shown in Figure 43. In the fast mode, the sample can be measured more quickly and the data can be obtained more promptly.

7. Product Parameters

7.1 Product Features

● The instrument fully considered the user experience, adopting humanized design concept – make the measurement easier.

● Adopting creative facula locating and cross locating – make the measurement conveniently, quickly and accurately.

● Small measuring aperture – easy to measure concave-convex object.

● No need to calibrate each time which simplify the operation.

● New integrating sphere optical path design – improve measurement stability and precision.

● This colorimeter has various color spaces. The users can select it according to their needs. And the instrument can display Whiteness, Yellowness and Color Fastness which is used widely.

● The precise and stable hand-head structure to make the measurement easier.

7.2 Product Specifications

Model	A
Illuminating/viewing geometry	8/d (8illumination angle/diffuse viewing)
Measuring aperture	Φ8mm, Φ4mm
Locating	Illumination Locating/Cross Locating
Measuring End Face	Large stable end face and small concave-convex end face
Detector	Silicon photoelectric diode
Color Space	CIE L*a*b; CIE XYZ; CIE RGB;CIEL*u*v; CIE*C*H; Whiteness &Yellowness; Color

	Fastness
Color Difference Formula	ΔE*ab; ΔL*ab; ΔE*C*H; ΔECIE94; ΔEHunter
Light Source	D65, D50, A, C, F2, F6, F7, F8, F10, F11, F12
Measuring light source	LED blue light excitation
Errors between each equipment	≤0.20ΔE*ab
Storage	100 pcs standard samples; 20000 pcs test samples
Repeatability	Standard deviation within ΔE*ab 0.03 Measurement conditions: Average of 30 measurements of standard white plate
Weight	500g
Size	205 x 67 x 80 mm
Power source	Built-in lithium-ion battery 3.7VDC@3200mAh
Battery life	5 years, more than 1.6 million times
Measuring times before recharge	More than 5000 times after charging
Display	TFT True Color 2.4in
Operating temperature	-10~40℃ (14℉~104℉)
Humidity range	relative humidity 0~85% with no condensation
PC Software	CQCS3 Color Quality Management Software
Data interface	USB
Portable packing bag	Original

Standard accessories	Powder adapter, operating instruction, white calibration board, wristband, 4mm and 8mm measuring aperture, USB cable
Optional accessories	Miniature thermal printer, Powder Test Box

Model	B
Illuminating/viewing geometry	8/d (8illumination angle/diffuse viewing)
Measuring aperture	Φ4mm
Locating	Illumination Locating/Cross Locating
Measuring End Face	Large stable end face and small concave-convex end face
Detector	Silicon photoelectric diode
Color Space	CIE L*a*b*C*H: CIE L*a*b; CIE XYZ;
Color Difference Formula	ΔE*ab; ΔL*ab; ΔE*C*H;
Light Source	D65
Measuring light source	LED blue light excitation
Errors between each equipment	≤0.50ΔE*ab
Storage	100 pcs standard samples; 20000 pcs test samples
Repeatability	Standard deviation within ΔE*ab 0.08 Measurement conditions: Average of 30 measurements of standard white plate
Weight	450g

Size	205 x 67 x 80 mm
Power source	Built-in lithium-ion battery 3.7VDC@3200mAh
Battery life	3 years, more than 1.6 million times
Measuring times before recharge	More than 3000 times after charging
Display	TFT True Color 2.4in
Operating temperature	-10~40℃ (14℉~104℉)
Humidity range	relative humidity 0~85% with no condensation
PC Software	CQCS3 Color Quality Management Software
Data interface	USB
Portable packing bag	Original
Standard accessories	Horizontal charger, operating instruction, white calibration board, wristband, cross platform, 4mm measuring aperture, USB cable, 4mm aperture for small concave-convex surface
Optional accessories	Miniature thermal printer, Powder Test Box, AC adapter

Model	C
Illuminating/viewing geometry	8/d (8°illumination angle/diffuse viewing)
Measuring aperture	Φ4mm
Locating	Illumination Locating/Cross Locating
Detector	Silicon photoelectric diode
Color Space	CIE L*a*b, CIE XYZ, CIE*LabCH

Color Difference Formula	ΔE*ab
Light Source	D65
Measuring light source	LED blue light excitation
Errors between each equipment	≤0.20ΔE*ab
Storage	100 pcs standard samples; 10000 pcs test samples
Repeatability	Standard deviation within ΔE*ab 0.03 Measurement conditions: Average of 30 measurements of standard white plate
Weight	500g
Size	205 x 67 x 80 mm
Power source	Built-in lithium-ion battery 3.7VDC@3200mAh
Battery life	5 years, more than 1.6 million times
Measuring times before recharge	More than 3000 times after charging
Display	TFT True Color 2.4in
Operating temperature	-10~40℃ (14℉~104℉)
Humidity range	relative humidity 0~85% with no condensation
Standard accessories	Horizontal charger, operating instruction, 4mm measuring aperture
Optional accessories	Miniature thermal printer
Remarks	Model C cannot connect PC.

Model	D	E
Illuminating/viewing geometry	45°/0	45°/0
Measuring aperture	8mm	20mm
Locating	Cross Locating	Cross Locating
Measuring End Face	Large stable end face	Large stable end face
Detector	Silicon photoelectric diode	Silicon photoelectric diode
Color Space	CIEL*a*b*C*h*; CIEL*a*b*; CIEXYZ	CIEL*a*b*C*h*; CIEL*a*b*; CIEXYZ
Color Difference Formula	ΔE*ab; ΔL*a*b*; ΔE*C*h*	ΔE*ab; ΔL*a*b*; ΔE*C*h*
Light Source	D65	D65
Measuring light source	LED blue light excitation	LED blue light excitation
Errors between each equipment	≤0.50ΔE*ab	≤0.50ΔE*ab
Storage	100 pcs standard samples; 20000 pcs test samples	100 pcs standard samples; 20000 pcs test samples
Repeatability	Standard deviation within ΔE*ab 0.08 Measurement conditions: Average of 30 measurements of standard white plate	Standard deviation within ΔE*ab 0.08 Measurement conditions: Average of 30 measurements of standard white plate
Weight	500g	500g
Size	205 x 67 x 80 mm	205 x 67 x 80 mm
Power source	Built-in lithium-ion battery 3.7VDC@3200mAh	Built-in lithium-ion battery 3.7VDC@3200mAh

Battery life	5 years, more than 1.6 million times	5 years, more than 1.6 million times
Measuring times before recharge	About 5000 times	About 5000 times
Display	TFT True Color 2.4in	TFT True Color 2.4in
Operating temperature	0~40℃ (32℉~104℉)	0~40℃ (32℉~104℉)
Humidity range	relative humidity 0~85% with no condensation	relative humidity 0~85% with no condensation
PC Software	CQCS3 Color Quality Management Software	CQCS3 Color Quality Management Software
Data interface	USB	USB
Portable packing bag	Original	Original
Standard accessories	Powder adapter, operating instruction, white calibration cover, wristband, software, USB cable	Powder adapter, operating instruction, white calibration cover, wristband, software, USB cable
Optional accessories	Miniature thermal printer	Miniature thermal printer

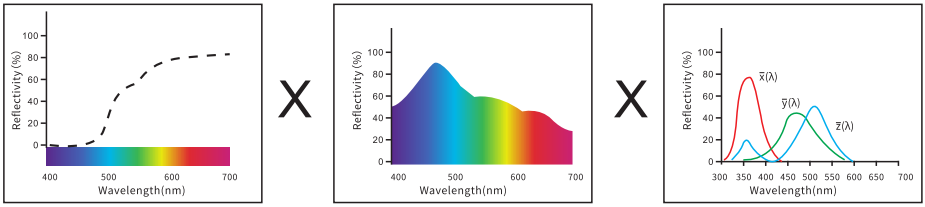
***Note: The specifications are subject to change without notice.**

Appendix

1.Object Color

There are three elements to observing color: lighting source, object, and observer. Changes in any of these three will affect the color perception of the observer. When the lighting source and the observer do not change, then the object will determine the color perception formed by the observer.

The reason why an object can affect the final color perception is that the reflection spectrum (transmission spectrum) of the object modifies the light source spectrum. Different objects have different reflection spectra (transmission spectrum). (Spectrum) modulation to obtain different results, because the observer does not change, so it presents different colors, the principle is shown in the figure below.



Reflectance spectra | Light source | Standard observer

=

L=70.95
a=69.72
b=40.35

ΔL+ represent whitish, ΔL- represent blackish

Δa+ represent reddish, Δa- represent greenish

ΔL+ represent yellowish, ΔL- represent bluish

2.Color Difference Formula

CIE 1976 ΔE*ab

$$\Delta E^*_{ab}=[(\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]^{1/2}$$

$$\Delta L^* = L^*_1 - L^*_0$$
$$\Delta a^* = a^*_1 - a^*_0$$
$$\Delta b^* = b^*_1 - b^*_0$$

CIE 2000 ΔE*ab

$$\Delta E_{00} = \left[\left(\frac{\Delta L'}{K_L S_L} \right)^2 + \left(\frac{\Delta C'}{K_C S_C} \right)^2 + \left(\frac{\Delta H'}{K_H S_H} \right)^2 + R_T \left(\frac{\Delta C'}{K_C S_C} \right) \left(\frac{\Delta H'}{K_H S_H} \right) \right]^{1/2}$$

$$L' = L^*$$

$$a' = a^*(1+G) \qquad G = 0.5\left(1 - \sqrt{\frac{\overline{C}^{*7}_{ab}}{\overline{C}^{*7}_{ab} + 25^7}}\right)$$

$$b' = b^*$$

CIE 1994 ΔE*ab

$$\Delta E^*_{94} = \left[\left(\frac{\Delta L^*}{K_L S_L} \right)^2 + \left(\frac{\Delta C^*_{ab}}{K_C S_C} \right)^2 + \left(\frac{\Delta H^*_{ab}}{K_H S_H} \right)^2 \right]^{1/2}$$

$$S_L = 1$$

$$S_C = 1 + 0.045\, C^*_{ab}$$

$$S_H = 1 + 0.015\, C^*_{ab}$$

3. Normal color difference allowable range

The allowable range of normal color difference varies depending on different industries and application scenarios. The following are the allowable ranges of color difference for some major industries

Overview:

1. Electronic device industry

Standard: △ E (color difference unit) is usually required to be less than 0.5 to ensure color accuracy in screen display, product appearance, and other aspects.

2. Plastic coating industry

Standard: Require △ E to be less than 1.0, applicable to color control of plastic products and coating products.

3. Textile industry

General standard: △ E below 2.0 is considered an acceptable range, especially in textile color management.Specific standards: In some standards, it is required that the color difference of specific parts should not be less than level 4, which is equivalent to a color difference value between 0 and 2.0

4. Printing industry

Range: A color cast range between 1.5 and 3.0 is usually considered normal, but specific values may vary depending on product grade and customer requirementsSeeking to be different.

Standard: Some standards stipulate that the color difference value for both fine and general products should not exceed 6.

5. Railway signal flag

Standard: The color difference is less than or equal to 3.0 to ensure the clarity and recognition of the signal flag.

Color difference and perception

ΔE	Perception
0-0.25	Very small or no color difference, ideal match
0.25-0.5	Minor color difference, usually acceptable
0.5-1.0	Minor to moderate color difference, certain applications Acceptable
1.0-2.0	Moderate color difference, perceptible to the human eye, Acceptable in specific applications
2.0-4.0	Obvious color difference, acceptable under specific conditions
> 4.0	The color difference is very large, most applicationsunacceptable

Safety Precautions

To ensure correct and safe use of colorimeter, please read the following terms carefully and comply with them. If there are any need or unclear, please refer to this description.

Battery	Please Our company original Li-ion battery. Do not use other batteries. Or it will damage the instrument or cause other failures. Do not disassemble, extrude and heat the battery. Do not put the battery into a fire. Doing so may cause battery explosion or a fire. After fully charged, when not use the instrument, please switch off external power source to avoid electric shock and instrument damage. If you do not use the instrument for a long time, please charge the battery periodically to avoid losing its activity and not being able to charge.
External Power Source	Always use the AC adapter supplied as a standard accessory if you need to connect an external power source. If the AC adapter other than those specified by us , this may result in damage to the unit,fire or electric shock. Please switch off external power source if you don't use the instrument for a long time. Or it may damage the instrument or cause a fire.
Instrument	Do not use the instrument in places where flammable or explosive gases (gasoline etc.) are present. Doing so may cause explosion or a fire.Do not disassemble the instrument. Take special care not to allow liquid or metal objects to enter the instrument. Or it may cause short circuit,electric shock, even a fire. If the instrument has burning smell or other peculiar smell, turn the power off immediately, disconnect the AC adapter from the AC outlet (or remove the batteries if they are used),and contact the nearest authorized service center.