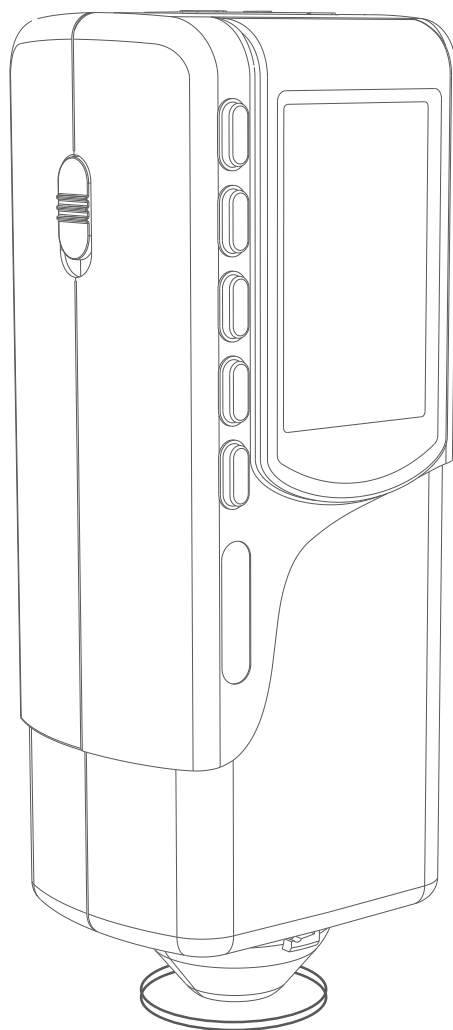


# ATO

## OPERATION MANUAL

PRECISION COLORIMETER



SC-10

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### Product Description

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.
- 4mm measuring aperture for more measurement occasions.
- 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.

## Precision Colorimeter

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- If it is not used for a long time, please save it and charge the battery regularly to avoid battery damage
- 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.

## I . Button Description

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

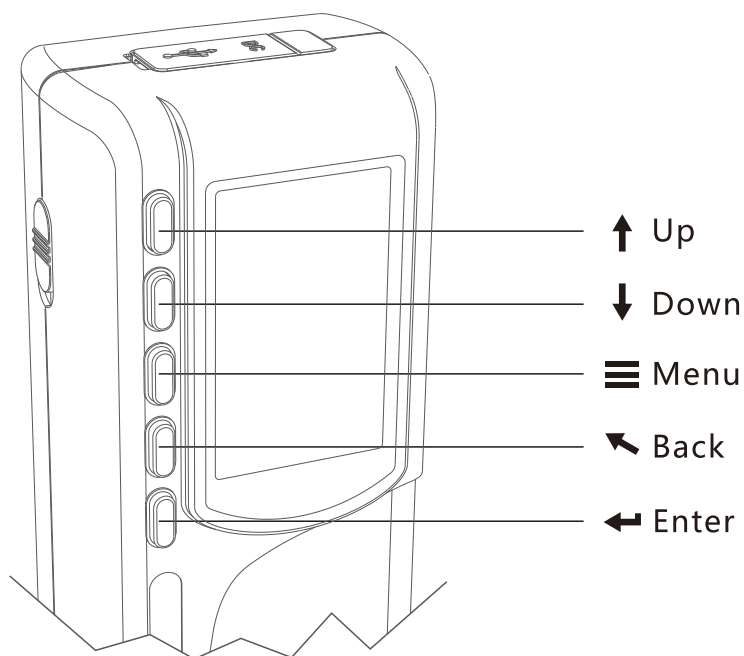


Figure 1 Button Function

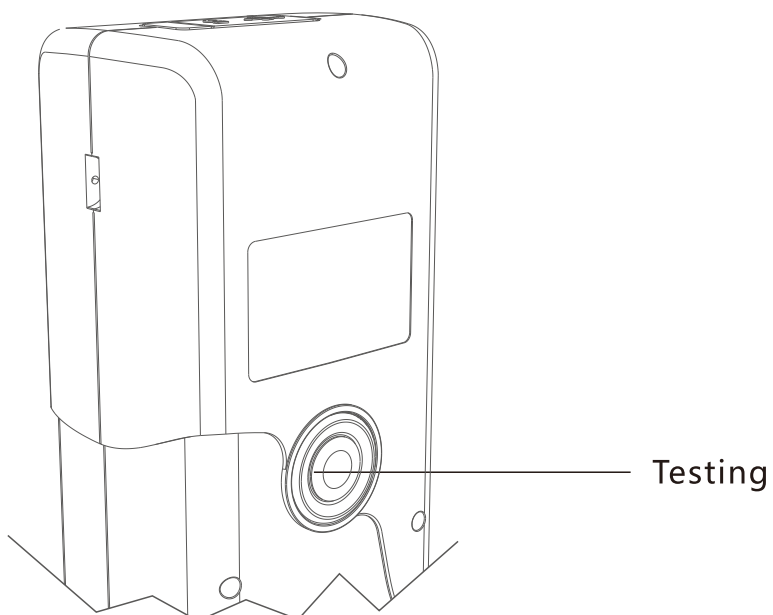


Figure 2 Testing Button Diagram

## II. Interface Description

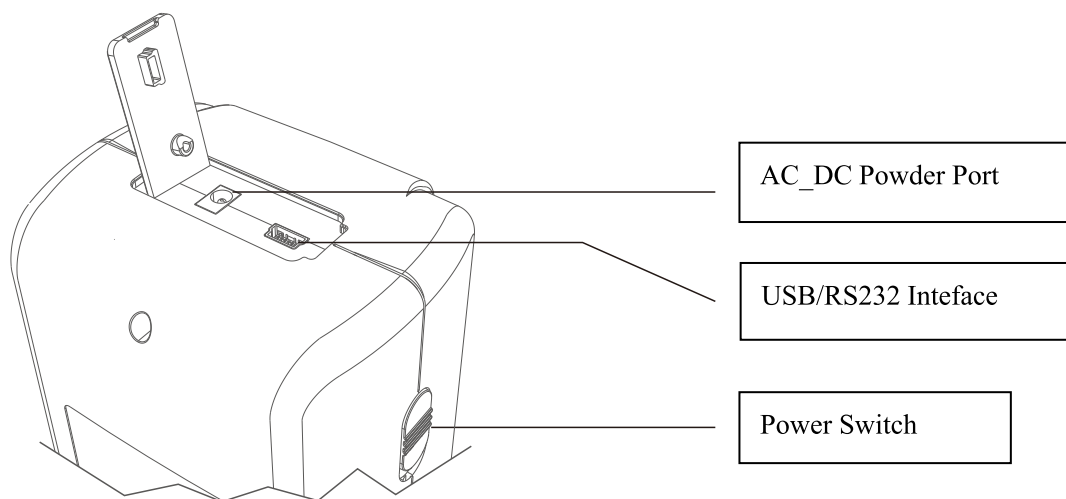


Figure 3 Interface Diagram

### Interface Description

1. **Power Switch:** Push the switch to “1” means power -on to turn on the colorimeter. Push the switch to “0” to cut power. Then the colorimeter is turned off.
2. **DC Interface:** Connect with AC a dapter. It is used to connect to external power source. The specification of external power source is 5V=2A.
3. **USB Interface :** This inte rface is a common interface. The instrument judges the connection status automatically. USB interface is used to transfer data to PC. Its baud rate is 115200bps.

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

## II. Battery Installation

1. The Battery is Li-ion 3.7V = 0.5A. Its capacity is 3200mAh.
2. Please use original Li-ion battery. Do not use other batteries, or it will cause irreversible damage.
3. If it is not used for a long time, please save it and charge the battery regularly to avoid battery damage
4. When charging the battery, the instrument must connect external power source or USB cable to connect the PC. Meanwhile, push the switch to “1”, and then the battery will be charging. If not charge the battery, then take out the battery and connect external power source, the instrument still works normally.
5. When charging the battery, dynamic battery icon will display on the top right corner of measurement interface.

### Battery Installation

1. When installing battery, be sure the power is cut off. (The switch is pushed to “0”). Then remove the battery cover.
2. Insert the Li-ion battery into battery compartment and push it gently in right direction.
3. Put the battery cover on Li-ion battery, and then push it up.

## IV. Operating Instruction

### (I) Turning On

#### 1. Preparations Before Power On

Check whether there is battery powered or external power supply.

#### 2. Turning On

Push the power switch to “1”, the LCD screen will display 3nh logo. After a few seconds, it will enter Standard Measurement interface automatically, and the default display is  $L^*a^*b^*C^*H$ .

### (II) Measurement

#### 1. 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.

#### 2. Standard Measurement

Enter standard measurement to perform measurement, as shown in Figure 6, align the measuring aperture to the sample, press “Testing” button, the screen will display color data of this sample.

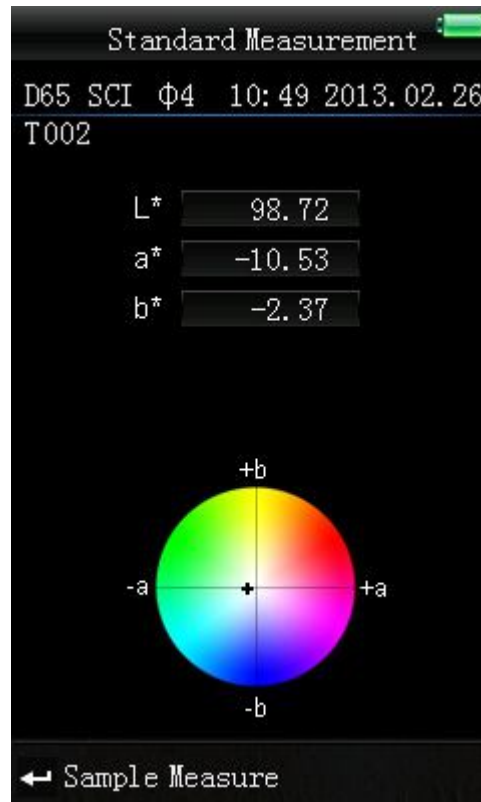


Figure 6 Standard Measurement Interface

### 3. Sample Measurement

After completing standard measurement, press “Enter” button, the instrument will enter “Sample Measurement” interface automatically, as shown in Figure 7. Align the measuring aperture to the test sample to perform sample measurement.

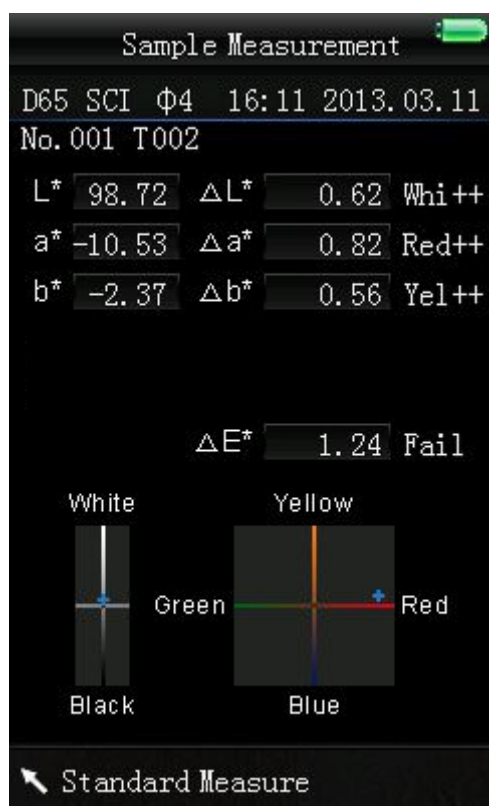


Figure 7 Sample Measurement Interface

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

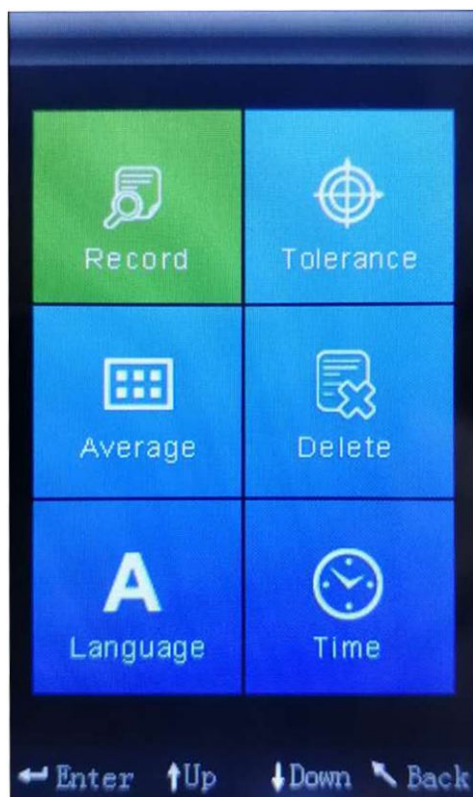


Figure 8 Main Menu



Figure 9 USB Communication



Figure 10 “Communicating” Interface

## VI. System Function Description

About operating the functions of this colorimeter, please through main menu as shown in Figure 8.

### 1. Record and Standard Entering

#### a) Record

Press the "test" button to test, check the lab value, press sample measure to test the sample

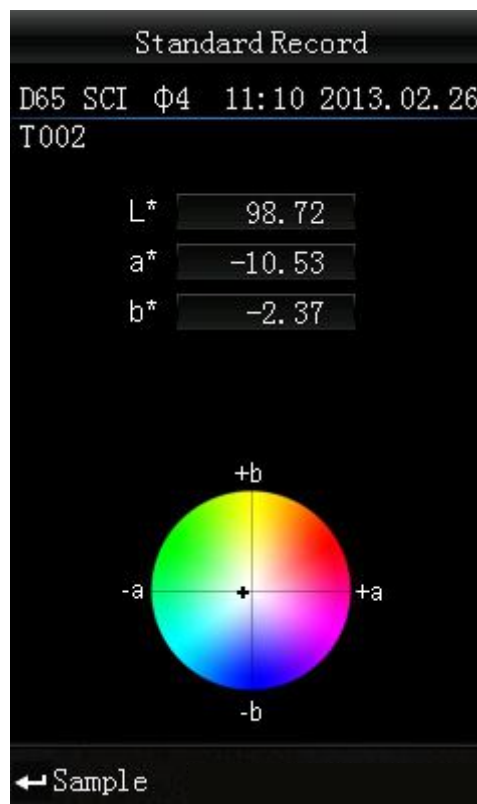


Figure 11 Standard Sample Record

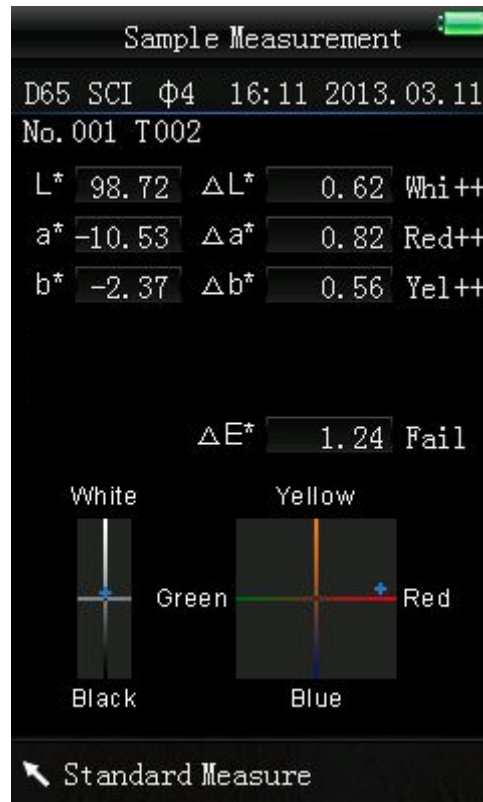


Figure 12 Test Sample Record

#### b) Standard Entering

In some cases, it's needed 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 needed standard data through "Up" and "Down". After finding it, press "Menu  $\equiv$ " button, and then the standard record is entered to the measurement interface, press "Enter", you can perform sample measurement under this standard.

#### c) Sample Record Entered to a Standard

In some cases, it's needed to use a stored sample as a standard. Then, you can select "Record" to enter sample records interface, as shown in Figure 12. You can search the needed sample data through "Up" and "Down". After finding it, press "Menu  $\equiv$ " 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.

Notes:

1. When performing black calibration, direct 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.).
2. 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.

### 3. Tolerance Setting

Select “Tolerance” in main menu to enter tolerance setting interface, as shown in Figure 14. You can add or subtract the number in which the cursor is positioned through “Up” and “Down” button. After setting the number to the needed 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.



Figure 14 Tolerance Setting

The tolerance value is artificial. It is a standard value to judge whether the total color difference  $\Delta E$  is qualified or not according to the demand of color management. If  $\Delta E$  is smaller than tolerance value, then it is qualified. If  $\Delta E$  is bigger than tolerance value, then it is unqualified. As shown in Figure 14-1, the  $\Delta E$  in sample measurement interface is unqualified.

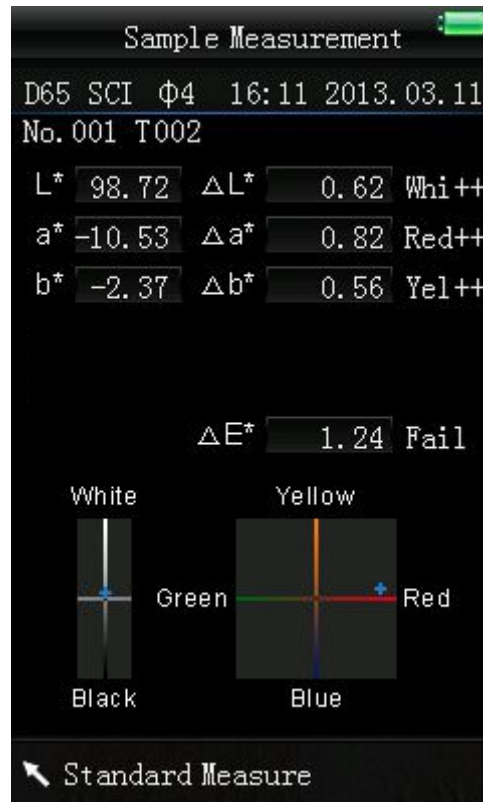


Figure 14-1 Sample Measurement Interface

#### 4. Delete Records

Select "Delete" in main menu to enter the interface shown in Figure 15. There are two options: "Delete All Samples" and "Delete All Records".



Figure 15 Delete Records

a) 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 16. Press “Enter”, all sample data will be deleted, but the standard records are still retained.



Figure 16 “Delete All Samples” Warning Interface

b) 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 17. 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 17 “Delete All Records” Warning Interface

### 5. Average Measurement

Select “Average” in the main menu to enter an interface shown in Figure 18. You can set the times of average measurements according to your need. 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.

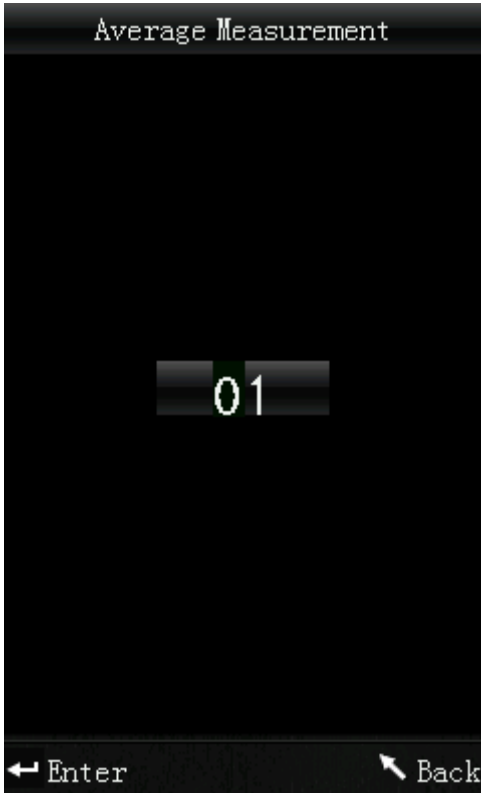


Figure 18 Average Measurement Setting Interface

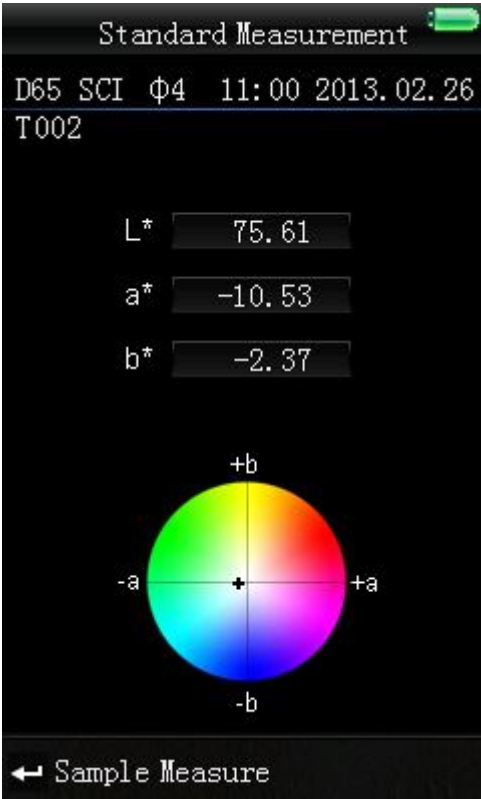


Figure 19 CIE L\*a\*b\* Measurement Interface

## 7. Function Setting

Select “Settings” in main menu to enter an interface shown in Figure 23. You can select the object according to your need by pressing “Up” and “Down” buttons. Press “Enter” to enter the corresponding setting interface. After completing the settings, press “Enter” button to save the settings and return to the previous menu.

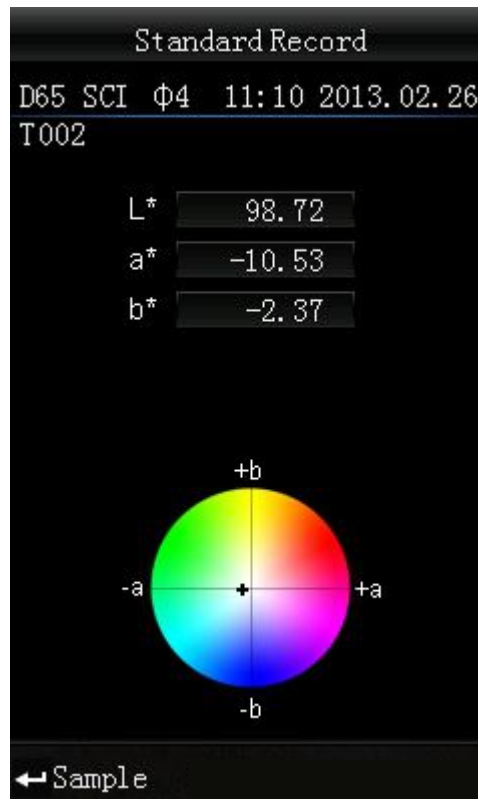


Figure22 CIE L\*a\*b\* Measurement Interface

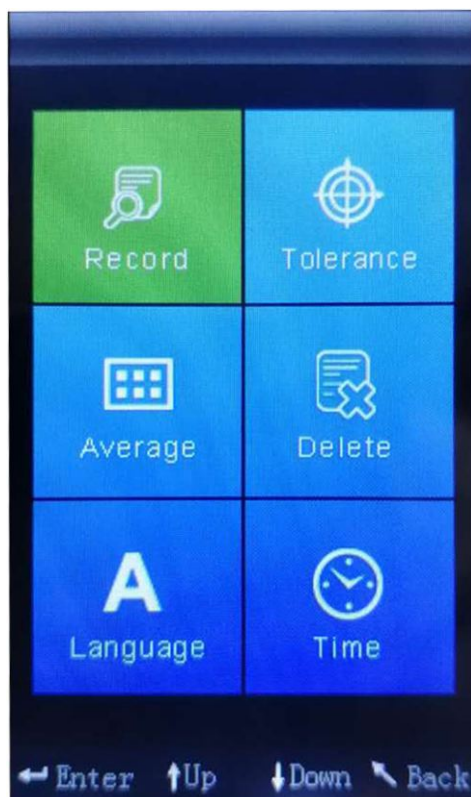


Figure 23 Function Settings Interface

- a) Select “Function Settings” - “Language” to enter an interface shown in Figure 24. You can select the language according to your need by pressing “Up” and “Down” buttons. Press “Enter” to save the settings and return to the main menu.

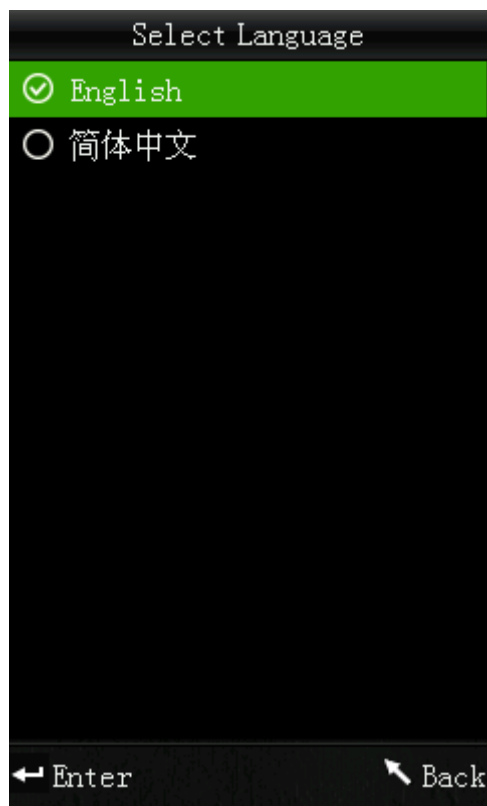


Figure 24 Language Selection Interface

- b) Select “Time & Date” to enter an interface shown in Figure 25. You can make settings by pressing the button “Up” and “Down”. In Figure 26 and Figure 27, you can add or subtract time and date by pressing the button “Up” and “Down”. In Figure 28 and Figure 29, you can set display format of time and date by pressing “Up” and “Down”. Press “Enter” to save the settings and return to the previous menu.

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

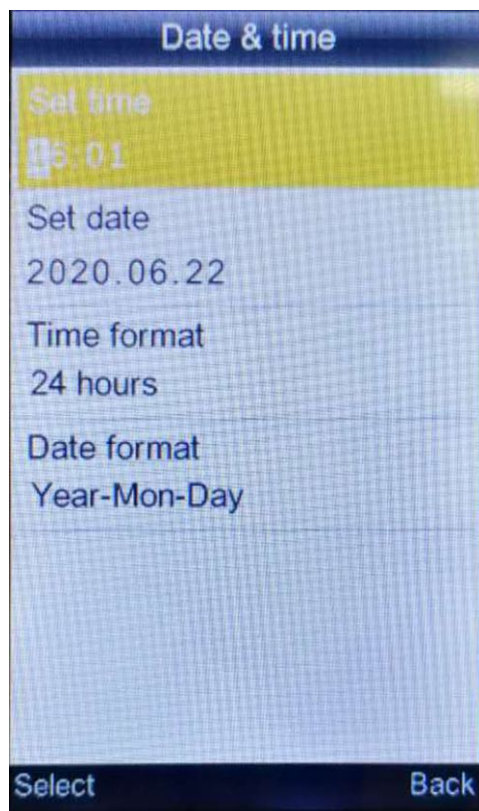


Figure 25 Time & Date Setting

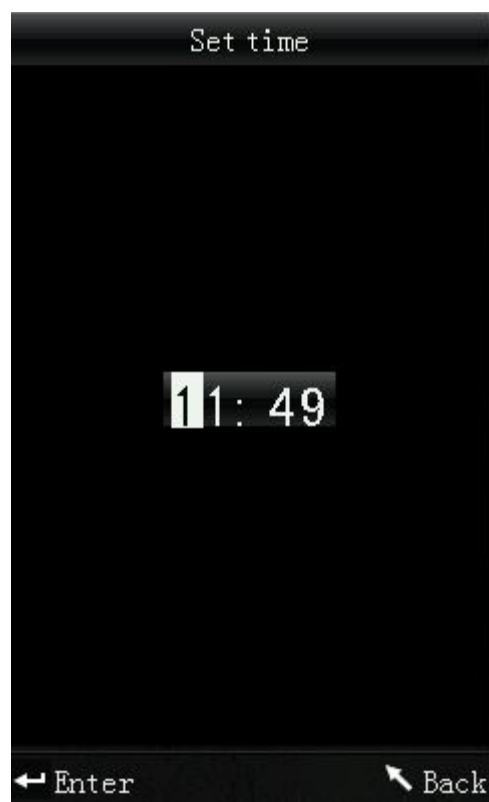


Figure 26 Time Setting



Figure 27 Date Setting

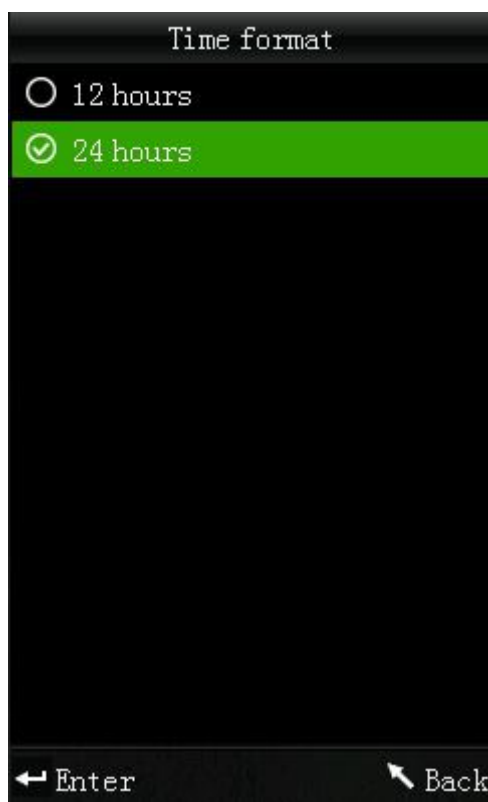


Figure 28 Time Format

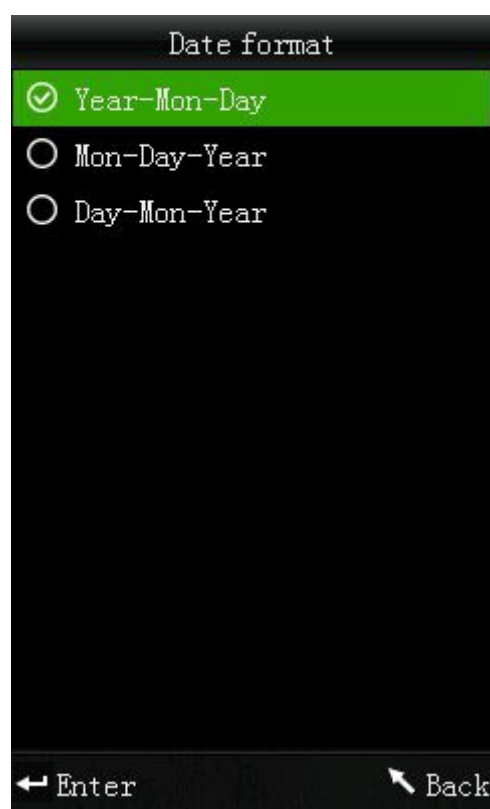


Figure 29 Date Format

- c) Select “Settings” - “Restore Factory Set” to enter an interface shown in Figure 30. 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.

## VI. Product Parameters

### 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.

## 2. Product Specifications

Model	SC-10
Illuminating/viewing geometry	8/d
Measuring aperture	4mm
Locating	Illumination Locating/Cross Locating
Measuring End Face	Large stable end face and small concave-convex end face
Detector	Silicon photoelectric diode
Color Space	CIEL*a*b*
Color Difference Formula	$\Delta E^*$
Light Source	D65
Measuring light source	LED blue light excitation
Errors between each equipment	$\leq 0.40\Delta E^*_{ab}$
Storage	100 pcs standard samples; 10000 pcs test samples
Repeatability	Standard deviation within $\Delta E^*_{ab}$ 0.08  Measurement conditions: Average of 30 measurements of standard white plate
Weight	400g
Size	205 x 67 x 80 mm

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Power source	Rechargeable lithium-ion battery 3.7VDC@3200mAh
Battery life	3 years, more than 1.6 million times
Measuring times before recharge	More than 3000 times
Display	TFT True Color 2.8inch@ (16:9)
Operating temperature	-10~40℃ (14°F~104°F)
Humidity range	relative humidity 0~85% with no condensation
PC Software	none
Data interface	USB
Portable packing bag	Original
Standard accessories	Powder adapter, operating instruction, wristband, cross platform, 4mm measuring aperture, USB cable, 4mm aperture for small concave – convex surface
Optional accessories	Miniature thermal printer

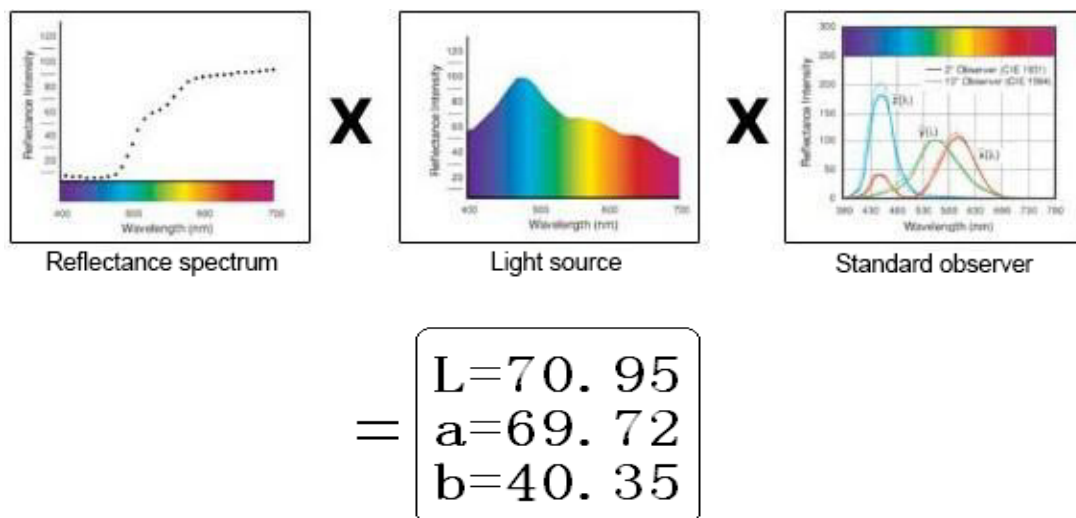
\*Note: The specifications are subject to change without notice.

## Appendix

### 1. The Color of Objects

There are three major elements to perceive color: light, object and observer. Any change of these three elements will influence the observer's color perception. When the light source and the observer don't change, then the object will determine the observer's color perception.

Objects can affect the final color perception because the reflectance spectra (transmittance spectra) of the object have modulated the light source spectrum. Different objects have different reflectance spectra (transmittance spectra). The light source spectrum modulates the reflectance spectra (transmittance spectra) of different objects to obtain different results. The observer is the same, so it shows different colors. The theory is shown in the figure below.



### The Size of $\Delta E$ Total Color Aberration

$\Delta L$  is large (positive): the color is partial white.

$\Delta L$  is small (negative): the color is partial black.

$\Delta a$  is large (positive): the color is partial red.

$\Delta a$  is small (negative): the color is partial green.

$\Delta b$  is large (positive): the color is partial yellow.

$\Delta b$  is small (negative): the color is partial blue.

### 2. Human Eyes to Distinguish Colors

The color difference unit, NBS, is derived from the unit of color difference formula which is established by Judd-Hunter. In 1939, the American Bureau of Standards adopts this color difference formula and calculates the color difference according to it. When the absolute value is 1, it is called "The NBS Color Difference Unit".

Since then, people would consciously adjust the later color difference formulas to be similar with the NBS units. The formulas such as Hunter Lab, CIE LAB and CIE LUV are generally similar to NBS (not exactly the same), therefore, do not mistake the color difference units calculated by other color difference formulas are all NBS.










In national standards GB7705-87 (lithograph), GB7706-87 (letterpress), GB7707-87 (gravure) which promulgated by the National Bureau of Standards, the color printings rating in the same batch and same color according to color difference are defined as follows: General Product  $\Delta E^*_{ab} \leq 5.00 \sim 6.00$ , Fine Product  $\Delta E^*_{ab} \leq 4.00 \sim 5.00$ . Meanwhile, this quality standard is considered as a qualification for state enterprises promotion.

Table: The Perception Degree between NBS Unit and Color Difference

NBS Unit Color Difference	Perception Degree of Color Difference
0. 0~0.50	The Tiny Color Difference: Travel
0.5~1.51	The Smaller Color Difference: slight
1.5~3	The Small Color Difference: Noticeable
3~6	The Big Color Difference: appreciable
Above 6	The Bigger Color Difference: much

## 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	<ul style="list-style-type: none"><li> Please use original Li-ion battery. Do not use other batteries. Or it will damage the instrument or cause other failures.</li><li> 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.</li><li> After fully charged, when not use the instrument, please switch off external power source to avoid electric shock and instrument damage.</li><li> Please take out the battery to prevent the instrument from battery leakage or other damages if you don't use it for a long time.</li></ul>
External Power Source	<ul style="list-style-type: none"><li> 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 ATO, this may result in damage to the unit, fire or electric shock.</li><li> 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.</li></ul>
Instrument	<ul style="list-style-type: none"><li> 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.</li><li> 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.</li><li> 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 ATO authorized service center.</li></ul>