Lovibond®

TR 515 (45°/0° Spectrophotometer)

Lovibond® Colour Measurement

XXXXXX Version 1.0

Table of Contents

Introduction

Thank you for purchasing this Lovibond® Tintometer Group product.

The Lovibond® Tintometer Group have been at the forefront of technical innovation for the colour measurement of liquids and solids for over 130 years. Our product range incorporates both visual and automated instruments, reference liquids, coloured standards, and a variety of precision fused glass cells. Training, technical support and servicing is available for all our products.

The innovative TR Series of spectrophotometers are easy-to-use and stable with accurate colour measurement and powerful functionality.

The TR 515 is a cost-effective handheld spectrophotometer with a high-end specification. That makes it ideal for quality control in the lab, field or in the manufacturing plant.

With a switchable Φ8mm and Φ4mm aperture, the TR 515 offers the flexibility to choose the right measurement size from your chosen surface.

With 45°/0° geometry, the instrument can measure the reflectance colour spectra of samples. That enables it to accurately report colour difference values, formulas, and indexes in common colour spaces.

Using the instrument, it is easy to achieve accurate colour quality control.

The TR 515 can be linked with high-end colour management software on a local Windows™ PC for wider functionality.

Cautions

- The spectrophotometer is a precise measuring instrument.
- Please avoid any drastic changes of external environmental conditions when measuring. For example, temperature and relative humidity.
- When making a measurement, keep the instrument flat and in direct contact with your target sample. Make sure the measuring aperture touches the surface of the test sample gently, and there is no shaking or shifting when measuring.
- Contact should be such that ambient light does not interfere with your readings.
- The instrument is not waterproof. Do not use it in a high humidity environment or in water.
- Keep the instrument clean. Avoid dust, powder or solid particles entering the measuring Aperture and battery compartment.
- Replace the white calibration cover and put the spectrophotometer into the instrument case when not in use.
- If you plan not to use the spectrophotometer for an extended period, please take out the battery.
- Please store the instrument in a cool, dry place.
- Any unauthorized changes to the instrument will invalidate your warranty and may affect the instruments measuring accuracy, even causing irreversible damage.

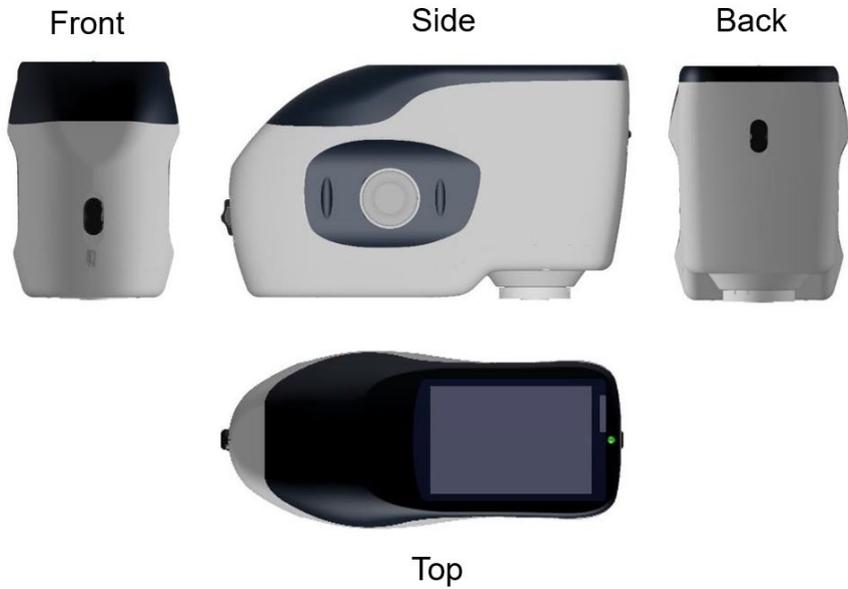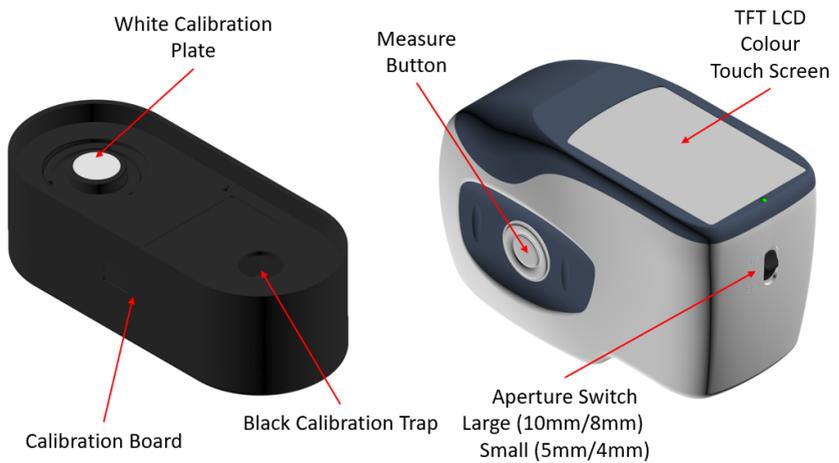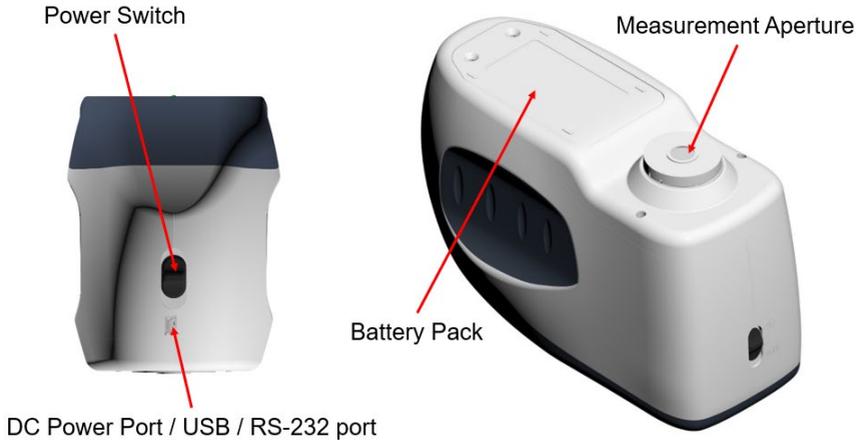Figure 1: The TR 515

Front   Side   Back

Top

Figure 2: Key elements

White Calibration Plate

Measure Button

TFT LCD Colour Touch Screen

Calibration Board

Black Calibration Trap

Aperture Switch
Large (10mm/8mm)
Small (5mm/4mm)

Power Switch

Measurement Aperture

Battery Pack

DC Power Port / USB / RS-232 port

1. Interface Description

1. **Power Switch** 1/0: Push the switch to "1" to turn on the instrument. Push the switch to "0" to turn it off.
2. **Measure button**: Short press to take a measurement.
3. **Indicator light**: LED light can show green or red.
* Turns to red when battery is charging and turns to green when battery is full.
* LED light turns to red when the instrument is switching on if no black/white calibration has been carried out or is out of validation. No measurement can be performed.
* LED light turns to red when measuring and turns to green when finished.
* If, during measurement, the instrument is knocked or the test data is abnormal, the LED light turns to red when the measurement is finished. Please double check your reading and delete and repeat if necessary.

* LED light turns to red when carrying out the black/white calibration. LED turns to green when calibration has succeeded and turns to red if the calibration fails.

4. **DC Power Port / USB / RS-232:** A common/shared interface. The instrument will judge the connection status automatically. The DC Power Port can connect to the AC adapter for charging. The adapter specification is 5V. The USB port can be used to transfer data to a Windows™ PC. The RS-232 port can also be used to connect to the printer.

5. **Aperture switch:** used for changing the measurement aperture. Setting this switch to "MAV", changes to Φ8mm aperture. Setting this switch to "SAV", changes to Φ4mm aperture. This can be confirmed in the System Settings menu.

2. Operating Instruction

2.1 Power On & Off

The instrument supports both hard power 'ON & OFF' and soft power 'ON & OFF'. Setting the power switch to "0" turns the power OFF and setting it to "1" turns the power ON. The instrument will automatically turn OFF after a long period of no operation (also known as, a soft power OFF).

After the instrument is turned on, it will display the screen as shown in Figure 2 if the black/white calibration is out of validation or the turn-on calibration is set. Otherwise, it will display the screen as shown in Figure 3, the measurement interface.

Figure 2 White and Black Calibration

Figure 3 Standard Measurement

2.2 Calibration

In the measurement interface, click " 🏠 " to enter the main menu. In other displays, please click " ✓ " or " ← " to enter the main menu, as shown in Figure 4.
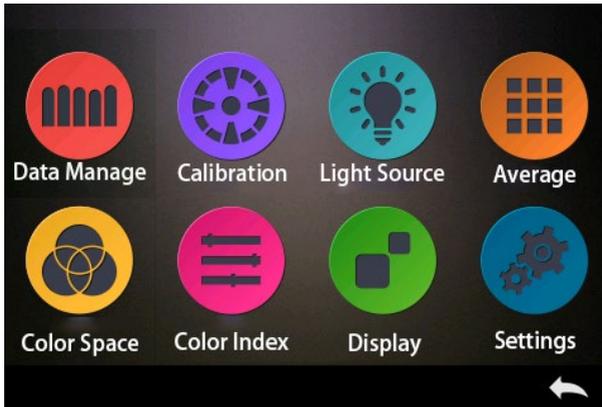
Figure 4 Main Menu

Select "Calibration" to enter the white and black calibration interface as shown in Figure 5. It will show if the calibration is valid or not, and the remaining time if it is valid.

Figure 5 White and Black Calibration

Click "➜" to continue and enter "White Calibration" as shown in Figure 2. When the warning is displayed, confirm that the serial number of the white calibration plate corresponds to the instrument and correct aperture setting is selected. Then put the measuring

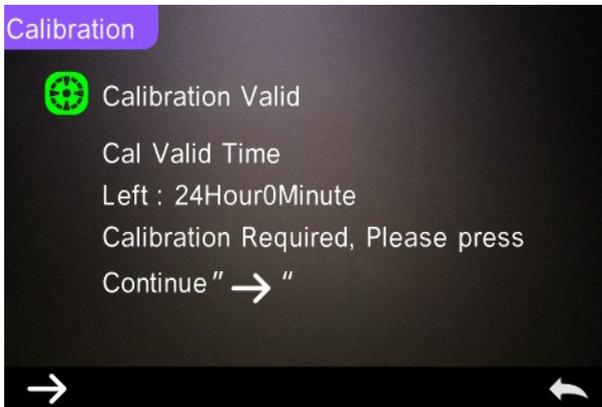aperture on the white plate and press the "Measurement" button for white calibration or click "◀" to cancel and quit the calibration.

After white calibration, it will prompt you to carry out the black calibration as shown in Figure 6. Put the measuring aperture on the black trap and press the "Measurement" button for black calibration, or click to "◀" el and quit the calibration.
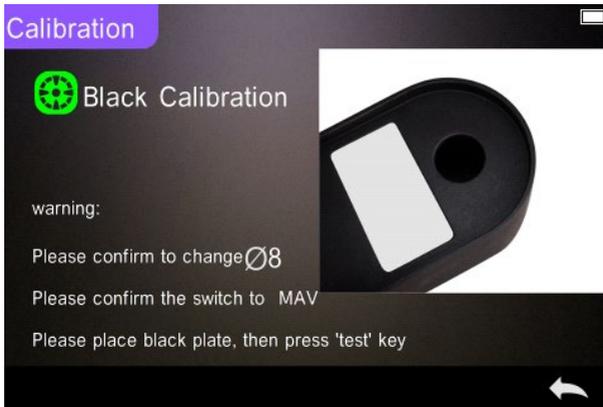
Figure 6 Black Calibration

After the black calibration has finished, the instrument will automatically enter the main menu, follow the menu for settings and operations, and click "◀" to return to "Standard Measurement."

2.3 Measurement

2.3.1 Measurement User Interface

As shown in Figures 7, 8, 9, there is a User Interface area at the top of the measurement interface which displays the status of the measurement mode and Bluetooth®. On the left side, there is a shortcut display where you can switch between different modes by

pressing the icons. In the middle, it displays different chromaticity data according to the different settings of colour formula.
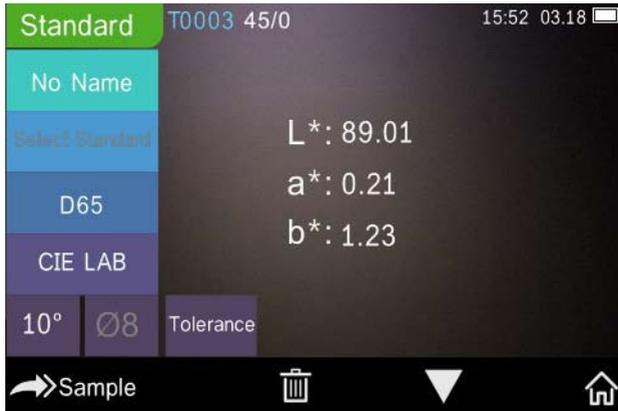
Figure 7 Sample Measurement

Figure 8 shows the spectral reflectance interface and Figure 9 displays the colour index interface. Click " ▼ " to move between the screens.
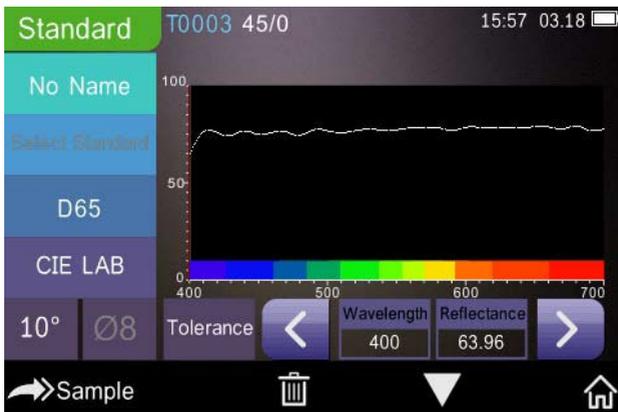
Figure 8 Spectral Reflectance

Figure 9 Colour Index

2.3.2 Standard Measurement

Please enter the "Standard Measurement" menu to perform measurements as shown in Figure 10.

Put the measuring aperture securely over the standard sample, press "Measurement" button. The instrument will emit a **beep**, and the LED indication light will turn to green from red. The instrument will then display the measurement as per Figure 10 and Figure 11.

Figure 10 Standard Measurement
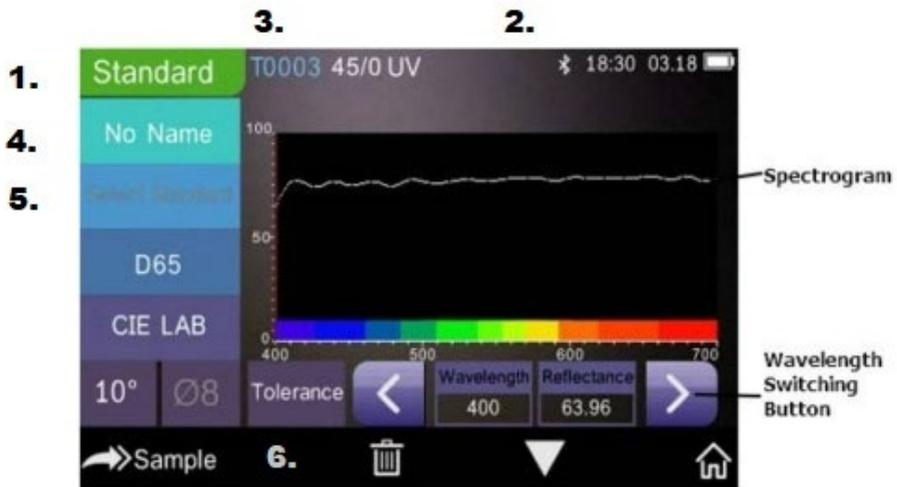
Figure 11 Reflectance of Standard Measurement

Detailed instructions of standard measurement:

1. Interface Title: Indicating it is in Standard Measurement mode
2. Status Area: displays system settings such as the current serial number, lighting source, Bluetooth® (on/off), measurement mode and the current time, date, and power. Only if the Bluetooth® is turned-on, will the Bluetooth® symbol be shown.
3. Serial number of standard: This is automatically generated by the system and ranges from T0001 to T1000.
4. Standard Name: Displays the current measurement standard name. The default is "No Name." Click it to quickly modify.
5. Select standard.
6. Tolerance setting: Click to set the tolerance of the current standard as required. ΔE* is the total setting tolerance (CIE1976). The left ΔL* is the lower limit of the setting standard lightness tolerance, the right ΔL* is the upper limit of the setting standard lightness tolerance.

The upper limit of the tolerance must be larger than the lower limit of tolerance; Δa*, Δb* are set in the same way as ΔL*.

Click the corresponding tolerance value to enter the corresponding value setting. After setting, clic " ← " on the lower side to save and exit the tolerance setting interface.

When the sample is measured, if ΔE*, ΔL*, Δa*, Δb* are within the allowable tolerance range, then the sample will show "Pass." If not, it will show "Failure". This function only exists when you turn on the function of "Display Measurement Result" in the system setting.

7   Light Source: Click the shortcut key to switch between different illuminants D65, A, C, F1 to F 12 etc.
8. Colour space: Click the shortcut key to switch between assorted colour spaces CIE Lab, CIE XYZ, Hunter lab etc.
9. Observer angle: Click to switch between 10° and 2° observer.
10. Switch to sample measurement: Click ➡Sample to measure a Sample.
11. Measurement aperture: Indicates the current measurement aperture in use.
12. Tolerance setting: Click to set the tolerance of the current sample.
13. Delete/Save: If the auto-save " 💾 " ion opens, click 🗑 to delete the current data. If the auto-save function closes, it will display the save button. Click   to save the current data.
14. Page Turning: Click ▼ to quickly switch the current data between the data display area, the spectrum display area and the colour index display area (please see the settings of colour index as shown in Figure 36).
15. Wavelength switch button: As shown in Figure 11, click ◀ or ▶ , the wave length and reflectance of the current sample

will switch in a range of 10nm intervals.

Note: If the auto-save function is turned off, the save button " 🖫 "
will display rather than the delete 🗑 button. Click " 🖫 " to save the
current data.

2.3.3 Sample Measurement

After measuring the standard, click **➡Sample** to enter the Sample
Measurement interface. Position the measuring aperture over the
sample to be measured and press the "Measurement" button. The
instrument will emit a **beep**, and the LED indication light will flash
red to green. The results of the measurement will be displayed as
shown in Figure 12 and Figure 13. Sample measurement is similar to
Standard measurement but it will display the colour difference
between the current Standard and the measured Sample.

Detailed instructions of sample measurement are as follows:

1. Interface Title: Indicates the instrument is in Measurement mode.
2. Standard Serial No: the current serial number of the standard,
   starting with T followed by a numerical value, and all sample
   chromaticity data is based on the current standard.
3. Sample Serial No: the current serial number of the sample, starting
   with S followed by a numerical value generated automatically by
   the system, uniquely identifying the current sample.
4. Standard Name: Displays the current measurement's Standard's
   Name. The default is "No Name". Click it to quickly modify.
5. Sample chromaticity Data: Displays the current data and time.
6. Delta E (Colour Difference): The colour difference between the
   standard and sample.
7. Measurement Result: Displays the test result under the colour
   formula and tolerance. If the result is greater than the tolerance
   value, it will show a red "Failure". This function only exists when

16

you turn on the function of "Display Measurement Result" in the system settings.

8. Colour Offset: Colour Offset is only displayed when the function has been turned on in system settings.

9. Wavelength switch button: As shown in Figure 13, click ⟨ or ⟩, the wave length and reflectance of the current sample will switch in a range of 10nm intervals.
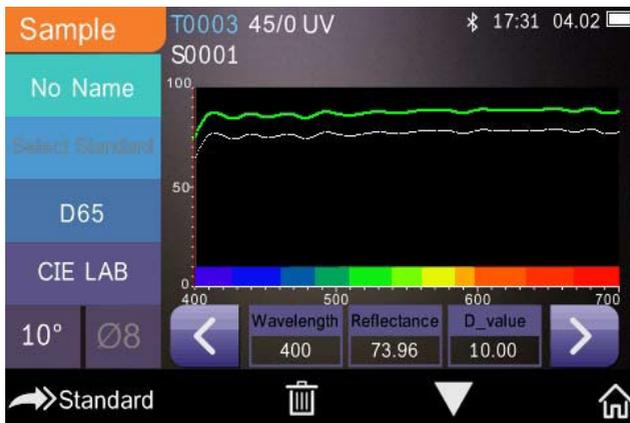

Figure 12 Sample Measurement

Figure 13 Reflectance of Sample Measurement

2.3.4 Average Measurement

If the measured sample is very large or not very uniform, it needs to be measured at several points to get an average reflectance, showing the sample's true value. This instrument can achieve 2-99 times average measurement.

In the main menu, click "Average" Measurement input average times and click ✔ to confirm. As shown in Figure 14.

If 1 is inputted, a single measurement will be made. If greater than 1 is inputted, multiple readings will be made and averaged together.

For example, input 3 and 3 readings will be averaged together.
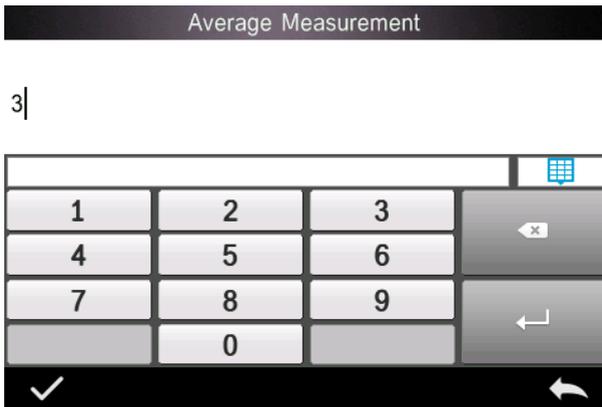
Input a 5 and 5 will be averaged together. The first reading will show 1/5, the second 2/5, the third 3/5 etc. The final average reading will be displayed after the fifth reading.

Figure 14 Average Measurement Input & Screen

2.4 Connecting to a PC

The instrument can connect to a local Windows™ PC through a USB cable or Bluetooth® connection.

2.4.1 USB Connection

First install the software on a Windows™ PC, then use a USB cable to connect the Windows™ PC and the instrument. The software will automatically connect to the instrument. Once successfully connected, the instrument will display the icon of USB connection, then measure the sample and standard or analyze the data on the computer.

2.4.2 Bluetooth® Connection

For those models with Bluetooth® functionality, it can connect to the PC software wirelessly.

After installing the PC software, open the Bluetooth® function in the system's settings and select the Bluetooth® option in the PC software setting.

You can connect the TR 515 to your Windows™ PC with your software. Do not connect via Windows™ directly. For more detailed information about Bluetooth® and the PC software connection, please refer to our software user manual.

Once successfully connected, the instrument can measure the samples and standards and analyze the data on the computer.

2.5 Printer

A Micro Printer is an optional accessory and may be purchased separately.

Users should measure the sample first and save all records, then connect the micro printer via the USB cable. Find the data you want to print from the sample or standard records as shown in Figure 15, click "Operate" in the menu as shown in Figure 15, and select "Print Data" to print the current data files.
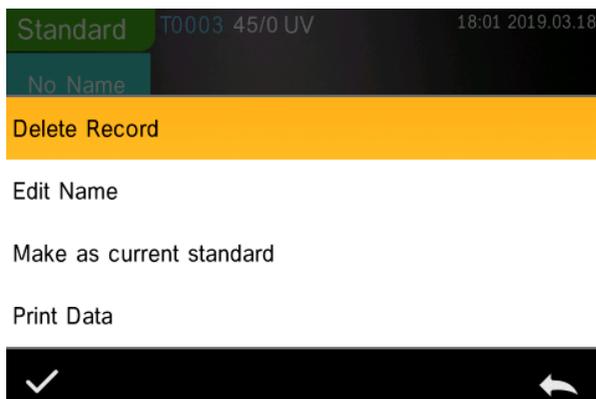

Figure 15 Print Operation

Figure 16 Print Data

3. Main Menu

Click 🏠 on the measurement interface screen or ⬅ on other screens to enter the main menu and set all the system functions from the appropriate submenu.

3.1 Data Management

Click "Data Manage" in the main menu to enter the data management interface as shown in Figure 17. The data management area lets you check records, search, and interact with measured records and manually input standard data.
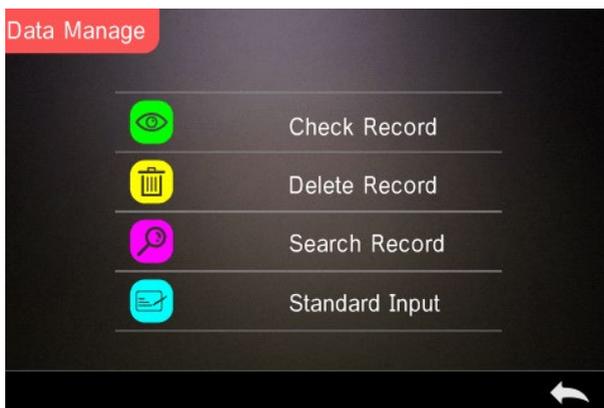
Figure 17 Data Management

3.1.1   Check Record

1. Check Standard Record

Select "Check Record" to enter the "Standard Record" screen as shown in Figure 18. The screen shows the UV light source status and the measurement time and date.
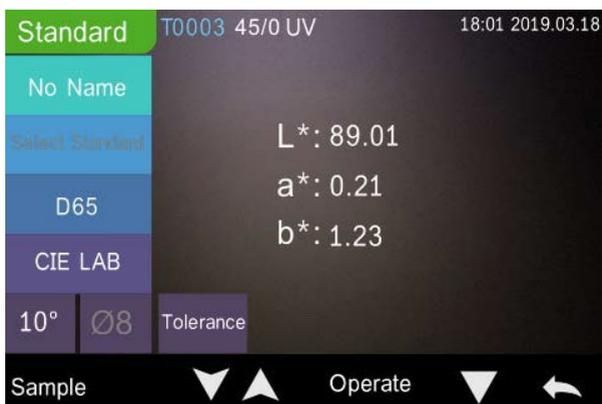

Figure 18 Standard Record

Click ▼ or ▲ to check the previous or next record.

Click "Operate" to delete a record, edit a name, make as current standard and print data as shown in Figure 19.

Delete record: Click "Delete Record" to delete data as shown in Figure 20 and click ✔ to confirm or ⬅ to cancel the deletion and return to the menu.

Standard	T0003 45/0 UV	18:01 2019.03.18
No Name		

Delete Record

Edit Name

Make as current standard

Print Data

✔   ⬅

Figure 19 Data Operation Interface

Delete Record 🔋

Warning!

This standard and sample record will be deleted !
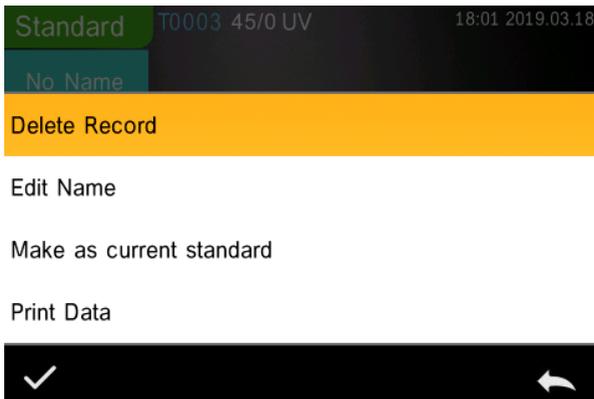
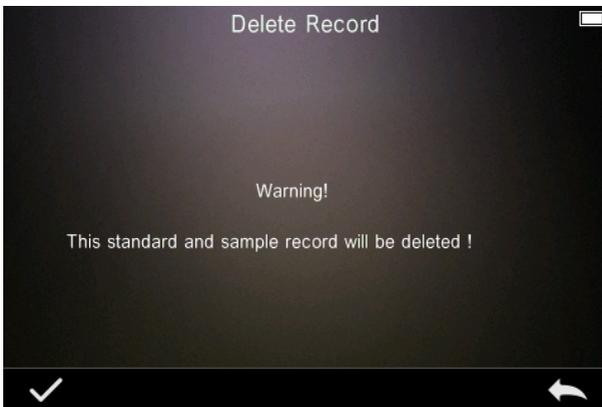✔   ⬅

Figure 20 Delete Record

23

Edit Name: Click "edit name" on the screen as shown in Figure 21. Input the new name (maximum 8 characters), click ☑ to confirm or ⬅ to cancel.

You can do the same by pressing on the No Name button on the result screen.

Figure 21 Edit Name

Enter Standard: Click "Make as Current Standard" to set the standard record to the current standard as shown in Figure 22 and click "Sample" to make a sample measurement.

Figure 22 Standard Entering

Print Data: Click "Print data" to print the current record data to the micro printer.

2. Check Sample Record

Click "Sample" on the Standard Record screen to check the sample record as shown in Figure 23.
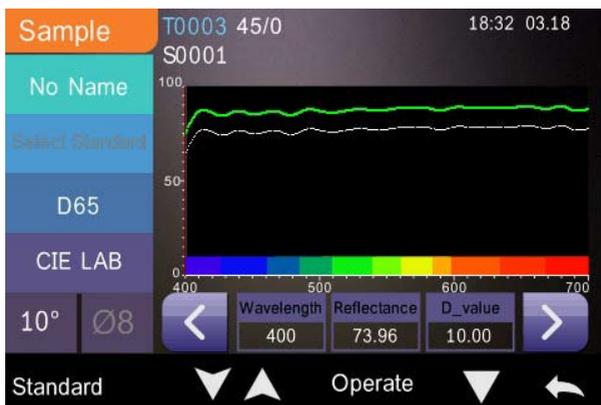

Figure 23 Sample Record

Figure 24 Reflectance of Sample Record

Click ▼ or ▲ to check the previous or next record.

Click "Operate" to delete a record, edit a name, make as current standard and print data. It is the same as the operation for Standard Record.

3.1.2 Delete Record

On the "Data Manage" screen, click "Delete Record" to enter the delete record screen as shown in Figure 25. Delete records include the option to "Delete All Samples" and "Delete All Records".

Click the corresponding option, a warning interface will appear, clicking ✓ will delete all corresponding records; clicking ⬅ will cancel the operation, as shown in Figure 26.
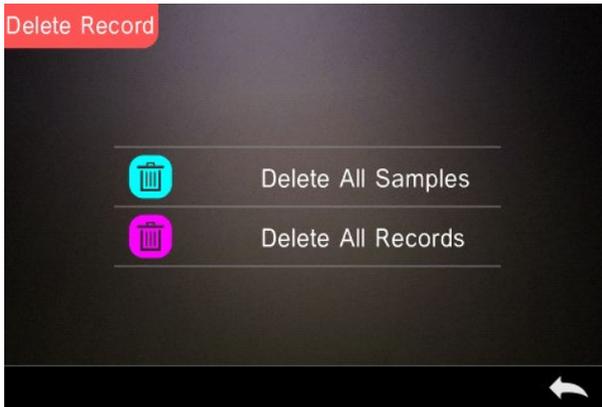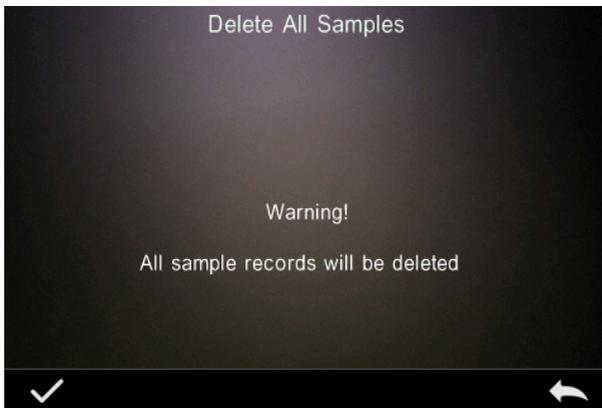
Figure 25 Delete Record

Figure 26 Delete All Samples

3.1.3 Search Record

On the data management screen, click "Search Record" to enter the search menu, as shown in Figure 27. Here there is the option to "Search Standard Name", "Search Standard Index" and "Search Sample Name".

Figure 27 Search Record

1. Search Standard Name

Click "Search Standard Name", a window appears with Input Search Name as shown in Figure 28. Input the name, then click ✓ to confirm, the instrument will automatically search all the standard records and list all matching records, as shown in Figure 29, click ▼ and ▲ to scroll through all matching results.

If there is no matching record, it will prompt "This record is empty" and return to the search record menu.
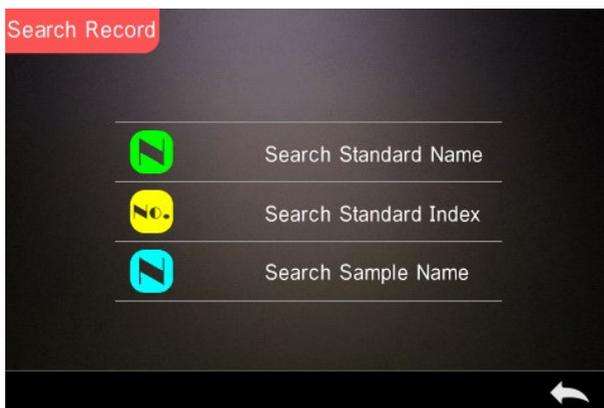
Figure 28 Input Search Name

Figure 29 Search Record

1. Search Standard Index

Click "Search Standard Index", a window appears with "Input Search Index" as shown in Figure 28. Input the search requirement and then click ✓ to execute the search. The instrument will automatically search all standard records and list all matching results.

1

1	2	3	⌫
4	5	6	
7	8	9	↵
	0		

✓   ↩

Figure 30 Input Search Index

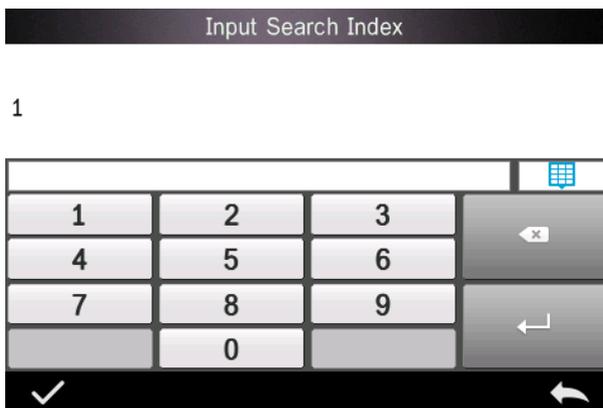**1) Search Sample Name**

Click "Search Sample Name", as shown in Figure 28. Input the searched sample name or a contained character, then click ✓ to confirm. The instrument will automatically search all the Sample Name records and list all matching results.

3.1.4 Standard Input

On the data management screen, click "standard input" to enter the Standard Input screen as shown in Figure 31.
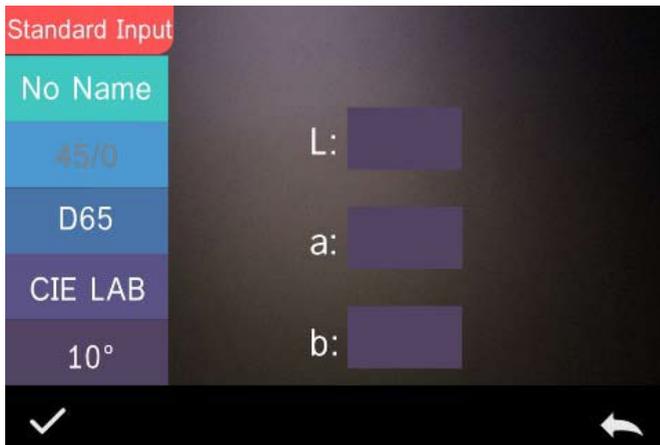
Figure 31 Standard Input

Click "Name" to input the standard name.

Click "Illuminant" to set the standard light source.

Click Colour Space to select the colour space. At present, the instrument supports CIE LAB, CIE Lch, CIE XYZ, CIE Yxy, CIE LUV.

Click Observer Angle to set the standard observer angle (2° or 10° degree).

Click "Colour Coordinates" to enter the corresponding value, click "L" to input L value as shown in Figure 32, input the corresponding L value and confirm. Input all standard values and click ✓ to confirm. The standard will be stored in the standard record list. The standard index is cumulative.

Note: In the instrument, users cannot manually input the reflectance results and the input standard data is only valid in accordance with the current observer angle, measurement geometry and illuminant. In the check standard record screen, if the

observer angle, measurement geometry and / or the illuminant have changed, the corresponding data will be displayed as "- - - - -".
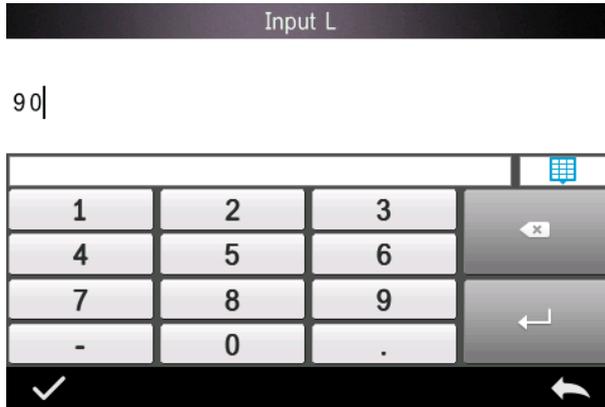
Figure 32 Input L Value

3.2 Calibration

The TR515 is calibrated using a white and black standard to enable it to measure accurately. Incorrect calibration will affect the validity of the data.

Should the calibration environment be very different from the test environment of sample to be measured (for example, a room heating up from cold in the morning to warm in the afternoon), it is recommended to re-calibrate the instrument more frequently.

It is also recommended to re-calibrate the instrument if the last successful calibration was more than 24 hours previously.
The Black and White Calibration plate must be cleaned regularly and kept in dark, dustproof, and dry conditions.

For black and white calibration procedures, please refer to Section 2.2.

3.3 Average

See Section **2.3.4 Average Measurement**

3.4 Light Source

Users can set the corresponding Light Source (aka illuminant) according to the actual test conditions. In the light source setting screen, it is possible to set the standard observer angle, the standard illuminant and UV light source (different modes may differ).

Light Source (aka illuminant) does not relate to the LED light source used by the TR 515. For example; D65 is a standard illuminant defined by the International Commission on Illumination (CIE).

On the main menu screen, click "light source setting" to enter the light source setting screen, as shown in Figure 33.
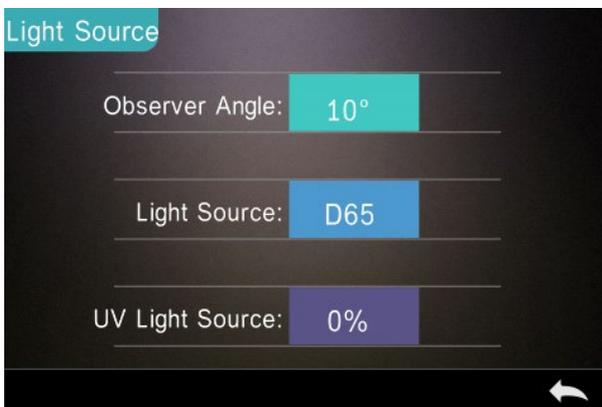

Figure 33 Light Source

Click "Observer Angle" to select 10 degrees or 2 degrees. 10 degrees is the CIE1964 standard, while 2 degrees is the CIE1931 standard.

Click "Light Source"*, as shown in Figure 34, select between D65, A, C, D50, D55, D75, F1, F2(CWF), F3, F4, F5, F6, F7(DLF), F8, F9, F10(TPL5), F11(TL84), F12(TL83/U30).

Click "UV Light Source" to select the UV light source switch.100% means UV light on while 0% means UV light off. It is recommended to turn on the UV light source when measuring fluorescent samples and turn it off when measuring general samples.

Figure 34 Light Source

NOTE: *Light Source is independent of the instruments LED lamp.

3.5 Colour Space

In the main menu, click "Colour Space" to open the colour space screen as shown in Figure 35. Select the corresponding colour space and click ✓ complete the setting.

34

Figure 35 Colour Space

3.6 Colour Index

On the Colour Index screen, it is possible to select the required colour formula and colour index, as well as set the parameters of the colour formula and metameric index, as shown in Figure 36.

3.6.1 Set Colour Index

In the main menu, click "Colour Index" to display the screen as shown in Figure 36. On the left there is a list of colour formulas; on the upper right, there is a list of colour indices; on the lower right are the Parameter Factors Settings.

Figure 36 Colour Index

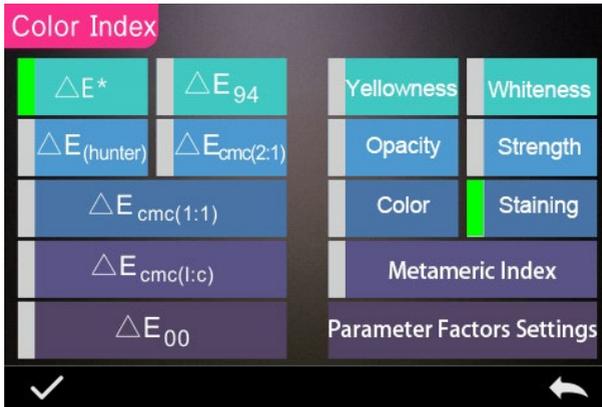Click any colour formula or colour index to select. Colour index is optional. If you wish to cancel the selection, click the selected colour index again. After selecting, click ✔ to confirm.

The selected colour formula will calculate the sample colour difference when measuring the sample. For example, colour formula Delta E 00 as shown in Figure 37.

Figure 37 Colour Formula $\triangle E_{00}$

The selected colour index will display the colour index on standard measurements and / or sample measurements. In the measurement menu or check record menu, click ▼ to the colour index menu. For example, as shown below, the Yellowness index in Figure 38.

Figure 38 Yellowness Index

3.6.2 Parameter Factors Settings

In the colour index menu, click "Parameter Factors Settings" as shown in Figure 39.
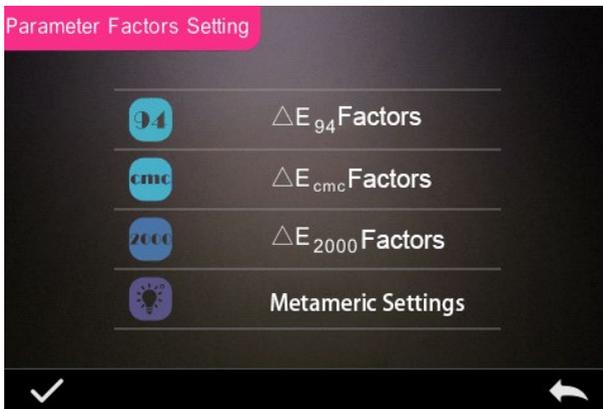
Figure 39 Parameter Factors Setting

1. Setting Factors

For CIE DE 1994 (Δ E 94), CMC (ΔE CMC (l: C)), and CIE DE 2000 (ΔE00), users can set L, C, H values (CMC only sets L and C values).

Take Δ E 94 for example, click $\triangle E_{94}$Factors to view the menu per Figure 40.

Figure 40 Δ E 94 Factors

Click KL, KC, KH to enter the edit menu as shown in Figure 41, input a value and click ✓ to confirm or ← to cancel.
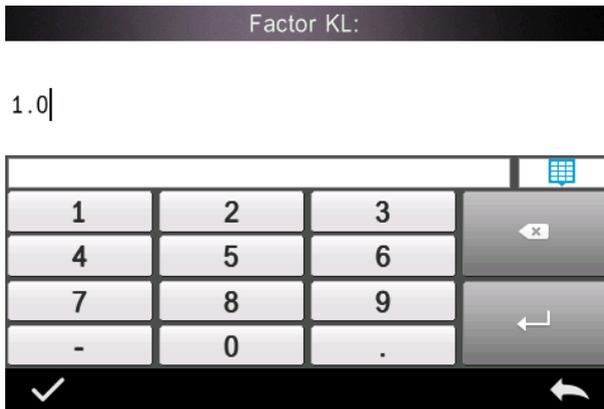
Figure 41 Factor KL

2. Metameric Index

In the Parameter Factors Settings menu, click "Metameric Index" to enter the menu per Figure 42. Individually set Light1 (illuminant) and Light2 (illuminant) and click ✓ to confirm or ← to cancel.

Figure 42 Metameric Settings

3.7 Display Settings

In the main menu (Figure 4), click the "Display" button to show the menu per Figure 43. Here it is possible to set "Colour Offset", "Test Result", and "Operation Mode".

Select the button to turn the "Colour Offset" on (as shown in Figure 12) or off.

Select the "Test Result" button to turn on or off. When turned On, the instrument will highlight the tolerance values: when the measurement result is larger than the tolerance value, it will display red and prompt failure; when the measurement result is smaller than the tolerance value, it will display green and prompt pass.

The instrument's default Operation Mode is right-handed. If you wish for left-handed operation mode, this can be changed by selecting the button.

Figure 43 Display

3.8 System Settings

In the main menu, click "System Settings" to view the menus per Figure 44, Figure 45 and Figure 46.
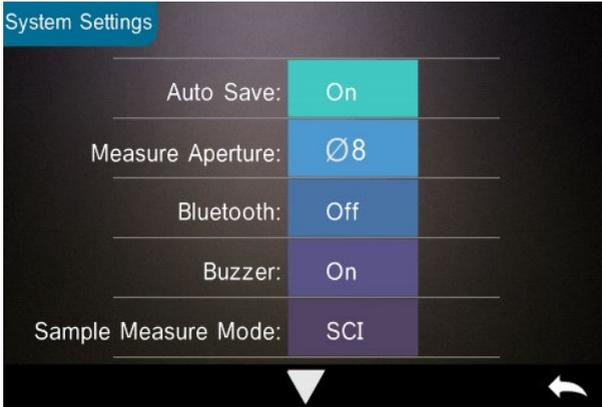

Figure 44 System Settings
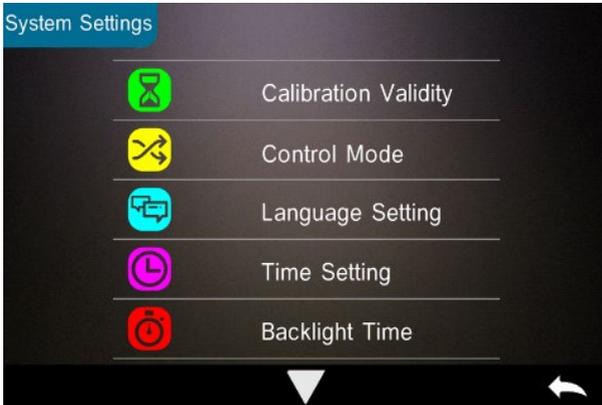
Figure 45 System Settings
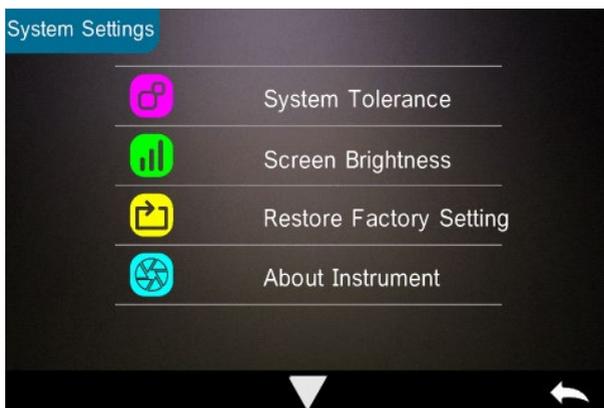
Figure 46 System Settings

3.8.1 Auto Save

When the Auto Save function is turned on, the instrument will automatically save the data when it is measured. When deactivated, it is necessary to manually save the date by clicking " 🖫 " .

3.8.2 Measurement Aperture

The TR 515 is equipped with Φ8mm measuring aperture and a Φ4mm measuring aperture.

When the sample is large and uniform, it is recommended to use the Φ8mm measuring aperture. When the measured surface is relatively small, it is recommended to use Φ4mm measuring aperture.

When measuring a large or non-uniform sample, it is recommended to use the 8mm aperture.

To change the aperture, follow the procedure as defined below.

Step 1: As shown in Figure 47, rotate the measurement aperture anti-clockwise and remove. Then install the new aperture with a clockwise rotation until a click can be heard.

Step 2: Use the Aperture Switch (see Figure 1 and 47) to select the aperture setting:
Φ4mm aperture = SAV
Φ8mm aperture = MAV.

Step 3: Switch the default system measurement aperture in the System Settings (see Figure 44) to correspond with the actual measurement aperture. When the measurement aperture is switched, it is essential to re-calibrate the instrument according to part 2.2.

WARNING: If the aperture setting and system settings are not aligned, it could cause false readings.

Figure 47 Measurement Aperture

3.8.3 Bluetooth®

The Bluetooth® interface of TR series is 4.0 Dual Mode (compatible with 2.1) which can connect to the PC and software.

When Bluetooth® is on, the icon will display on the screen.

After installing the PC software, turn on the Bluetooth® and set up the connection. Once connected, the sample and standard measurements can be transferred to the PC for analysis. For further details, please refer to the Software User Manual.

3.8.4 Buzzer Switch

In the System Settings, the "Buzzer Switch" can be set to "On" or "Off". When "On", a sound will be heard when making a measurement.

3.8.5 Calibration Validity

For black and white calibration procedures, please refer to Section 2.2.

In the system menu, click "Calibration Validity" to select the menu per Figure 48.

If "Power on calibration" is selected, the instrument will request a white and black calibration every time it is turned on. Otherwise, it will only be able to check records but not carry out measurements.

If 12 Hours validity is selected, the validity of the Calibration will expire after 12 hours. Once expired, the instrument will only be able to check records but not carry out measurements.

If 24 Hours validity is selected, the validity of Calibration will expire after 24 hours. Once expired, the instrument will only be able to check records but not carry out measurements.

When the validity of the Calibration expires, a warning red light will be shown in the LED. Once re-calibrated, the LED light will turn green.
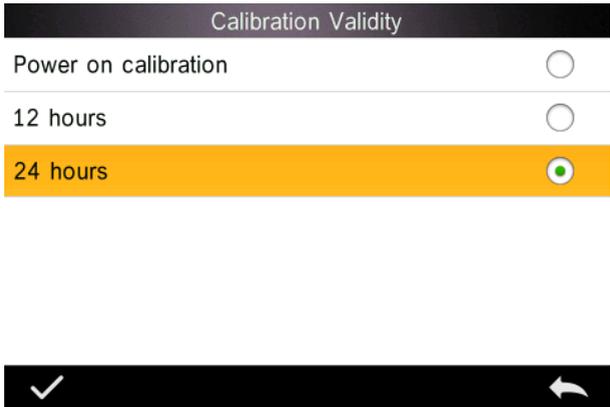

Figure 48 Calibration Validity

3.8.6 Control Mode

When the instrument is connected to the PC software, the user can set the specific measurement control mode.

In the System Settings menu, click "Control Mode" to select as shown in Figure 49. There are three options: Key, PC software, Key and PC software.

Key: When selected, the instrument can only be controlled by the keys (touch screen buttons) to complete the test. Data can then be uploaded to the PC software when connected.

PC software: When selected, the instrument can only be controlled via the PC software to complete the test.

Key and PC software: When selected, the instrument can be controlled by the keys (touch screen buttons) or via the PC software to complete the test. This mode is the default for the instrument.

Note: The control mode is only valid when connected to the PC software. If unconnected, the instrument is controlled only through the touchscreen.
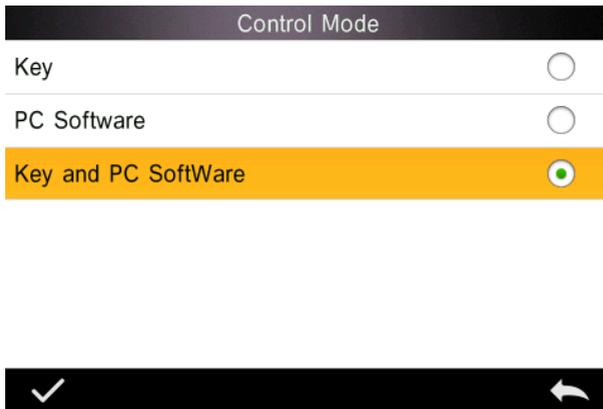

Figure 49 Control Mode

3.8.7 Language Setting

Click "Language Setting" in "Settings" menu to choose between English or Chinese.

3.8.8 Time Setting

In the Setting menu, click "Time setting" as shown in Figure 50.
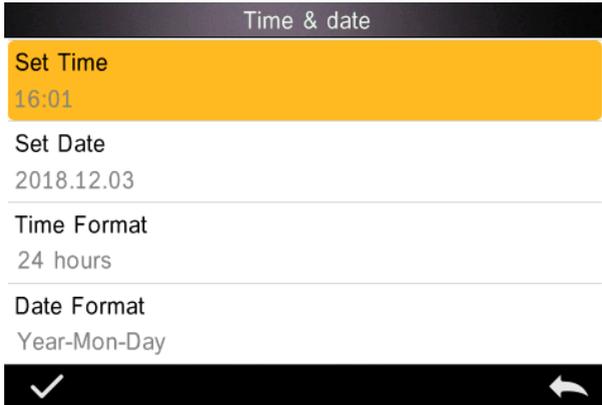
Figure 50 Time & Date

1) Click "Set Time" to set the current time.
2) Click "Set Date" to set the current date.
3) Click "Time Format" to set the required time format.
4) Click "Date Format" to set the required date format. There are three options: "Year Month Day"/ "Month Day Year"/ "Day Month Year".

3.8.9 Backlight Time

Click "Backlight Time" in "Settings". This sets the preferred backlight time.

Backlight time option include: "normally open", "5 minutes", "60 seconds", "30 seconds", "15 seconds". If "normally open" is selected, the instruments screen will remain on unless the instrument is turned

off.

If "5 minutes" is selected, the screen will remain on 5 minutes after the last operation. The same applies for "60 seconds", "30 seconds" and "15 seconds".

3.8.10 System Tolerance

Click "System Tolerance" to control all tolerance and default setting in system tolerance.

Set tolerance for current sample according to requirements. $\triangle E^*$ is for setting the general tolerance. $\triangle L^*$ is for setting the tolerance of the standard brightness. The right side of $\triangle L^*$ is the upper limit of tolerance which must be higher than the left side of the $\triangle L^*$ which is the lower limit of the tolerance. The same applies for $\triangle a^*$ and $\triangle b^*$.

3.8.11 Screen Brightness

Click "Screen Brightness" in "Settings" where the brightness can be adjusted by "+" and "-".

3.8.12 (WARNING) Restore Factory Settings (WARNING)

Click "Restore Factory Setting" in "Settings" as shown in Figure 51. Click ✔ , the instrument will restore factory settings and all records will be cleared, or click ← to cancel this operation.

WARNING: Restoring factory settings **will delete all test data and settings**. All are irrecoverable so please operate with caution.

Figure 51 Restore Factory Setting

4. Daily Maintenance

1. The TR 515 is a precision optical instrument. Please keep it safe: avoiding exposure to wet conditions, strong electromagnetic forces, heat, dust, and dirt.

2. The Calibration Board is a critical item. Please keep it safe: avoiding exposure to wet conditions, heat, dust, and dirt.

Softly wipe regularly with alcohol or a damp, soapy cloth to clean the white tile's surface. Before calibrating, clean any dust or dirt off the surface. Never clean with an abrasive material.

The instrument should be stored in a safe location.

3. To ensure accuracy of the test data, it is advised to send the instrument and Calibration Board back to the manufacturer or a qualified representative for calibration once per year.

4. The instrument has a built-in lithium battery. For maximum

performance, please charge it every 2 weeks to extend the lifetime of the battery.

5. **Please do not disassemble the instrument.** If there are any questions, please contact a representative of The Tintometer Group.

Please do not remove any labels, or it will affect its after-sales maintenance service.

5. Technical Parameters

5.1 Technical Specifications

Model	TR515 45°/0° Spectrophotometer
Geometry	45°/0° (45 ring-shaped illumination, vertical viewing);
Light Source	Combined LED Light, UV Light
Spectral device	Concave Grating
Detector	256 Image Element Double Array CMOS Image Sensor
Wavelength Range	400 - 700nm
Wavelength Pitch	10nm
Half Bandwidth	10nm
Reflectance Range	0 - 200%
Measuring Aperture	MAV: Φ8mm/Φ10mm；SAV: Φ4mm/Φ5mm
Colour Space	CIE Lab, XYZ, Yxy, LCh, CIE LUV, Hunter Lab,
Colour Difference Formula	ΔE*ab, ΔE*uv, ΔE*94, ΔE*cmc (2:1), ΔE*cmc (1:1), ΔE*00, ΔE (Hunter)
Other Colour Index	WI (ASTM E313, CIE/ISO, AATCC, Hunter) YI (ASTM D1925，ASTM 313), MI (Metamerism Index), Staining Fastness, Colour Fastness, Colour Strength, Opacity,
Observer Angle	2°/10°
Illuminant	D65, A, C, D50, D55, D75, F1, F2(CWF), F3, F4, F5, F6,

	F7(DLF), F8, F9, F10 (TPL5), F11(TL84), F12 (TL83/U30)
Display Data	Spectrogram/Values, Chromaticity Values, Colour Difference, Values/Graph, Pass/Fail Result, Colour Offset
Measurement Time	Approx. 1.5s
Repeatability	Spectral reflectance: MAV, Standard deviation within 0.08% (400 nm to 700 nm: within 0.18%) Chromaticity value: within ΔE*ab 0.05 (When a white calibration plate is measured 30 times at 5 second intervals after white calibration)
Inter-instrument agreement	Within ΔE*ab 0.15 (Average for 12 BCRA Series II colour tiles)
Measurement mode	Single Measurement, Average Measurement (2-99)
Size (L x W x H)	184 x 77 x 105mm
Weight	Approx. 600g
Power source	Li-ion battery. 5000 measurements within 8 hours
LED Light source Life Span	3 million measurements
Display	3.5-inch TFT colour LCD, Capacitive Touch Screen
Interface	USB, Bluetooth® 4.0
Data memory	Standard 1000 Pcs, Sample 30000 Pcs
Language	English or Chinese
Working Environment	Temperature: 0~40℃; Humidity: 0~85% (No Condensation) Altitude: less than 2000 m
Storage Environment	Temperature: -20~50℃; Humidity: 0~85% (No Condensation)
Standard Accessories	Power Adapter, USB Cable, Built-in li-ion battery, User Manual, Software, White and Black Calibration Board, Protective Case

Note: Our TR 515 will fit the standard Accessory that allows the measurement of powders, liquids, gels, pastes, granules etc (see TRA 500 and 520). However, the 45°/0° geometry is usually not suitable for this application.

6. Sales Offices

Germany
Tintometer GmbH
Lovibond® Water Testing
Schleefstraße 8-12
44287 Dortmund
Germany

Tel: +49 (0)231/94510-0
Fax: +49 (0)231/94510-20
Email: sales@lovibond.com

United Kingdom
The Tintometer Ltd
Lovibond House
Sun Rise Way
Solstice Park
Amesbury SP4 7GR

Tel: +44(0)1980 664800
Fax: +44(0) 1980 625412
Email: support@lovibond.uk

North America
Tintometer Inc
6456 Parkland Drive
Sarasota
Florida 34243
USA
Tel: +1 941 756 6410
Fax: +1 941 727 9654
Email: sales@lovibond.us

South East Asia
Tintometer South East Asia
Unit B-3-12-BBT One Boulevard,
Lebuh Baku Nilam 2,
Bandar Bukit Tinggi, Klang, 41200, Selangor D.E
MALAYSIA.
Tel: +60 (0) 3 3325 2285/6
Fax: +60 (0) 3 3325 2287
Email: lovibond.asia@tintometer.com

China
Tintometer China
Room 1001, China Life Tower,
16 Chaoyangmenwai Avenue
Beijing 100020
China
Tel: +89 10 85251111 ext.330
Fax: +86 10 85251001
Email: chinaoffice@tintometer.com

India
Tintometer India Pvt. Ltd.
B-91, A.P.I.E. Sanath Nagar,
Hyderabad
500018
India
Tel: +91 (0) 40 4647 9911
Toll Free: 1 800 102 3891
Email: indiaoffice@tintometer.com

Brazil
Tintometer Brazil
Caixa Postal: 271
CEP: 13201-970 Jundiaí – SP –
Tel.: +55 (11) 3230-6410
E-mail: sales@tintometer.com.br

www.lovibond.com