USER MANUAL

Multi-Channel LED Light Source

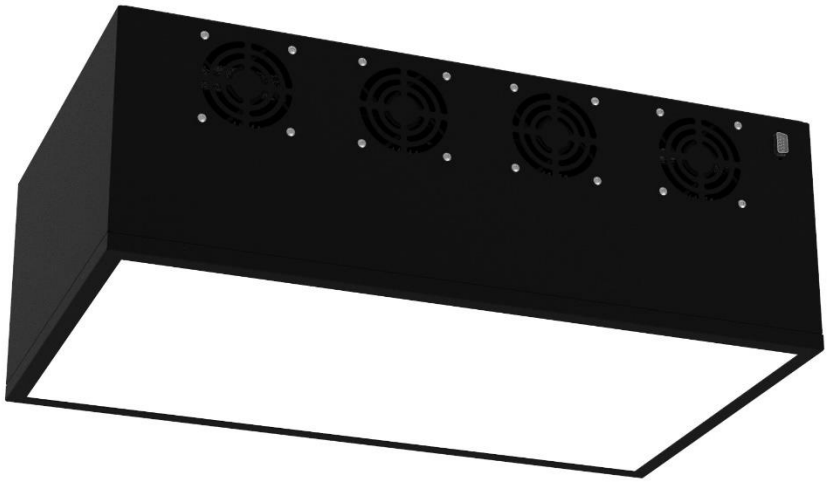
WeSpectra (Shanghai) Co., Ltd

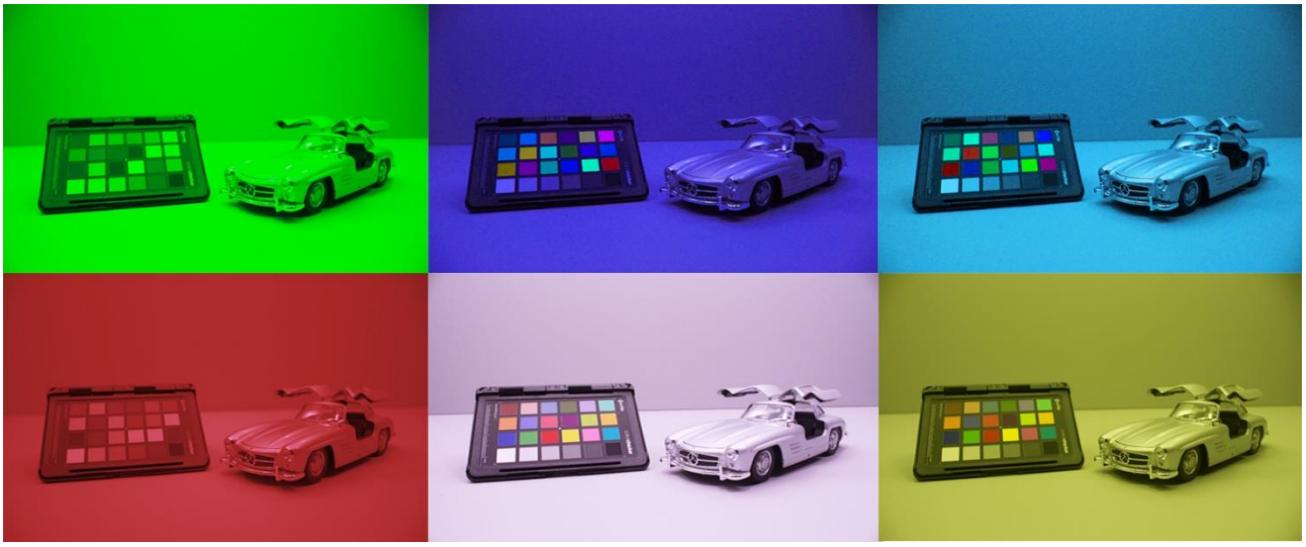
Building 6, No. 551 Zhenda Road, Baoshan District, Shanghai
T +86 166 0189 0018 · info@wespectra.com · www.wespectra.com

Content

1. Introduction

Based on our independent core algorithm, WeSpectra Multi-channel LED Light Source is an innovative spectral tunable light source to simulate any lighting conditions. The spectral range is from visible to NIR, achieved by selected more than 20 LED channels. The CCT ranges from 2000 to 20000K. It supports multiple light sources connection to create large lighting room for color visual assessment and sensor test. API is available for integration.





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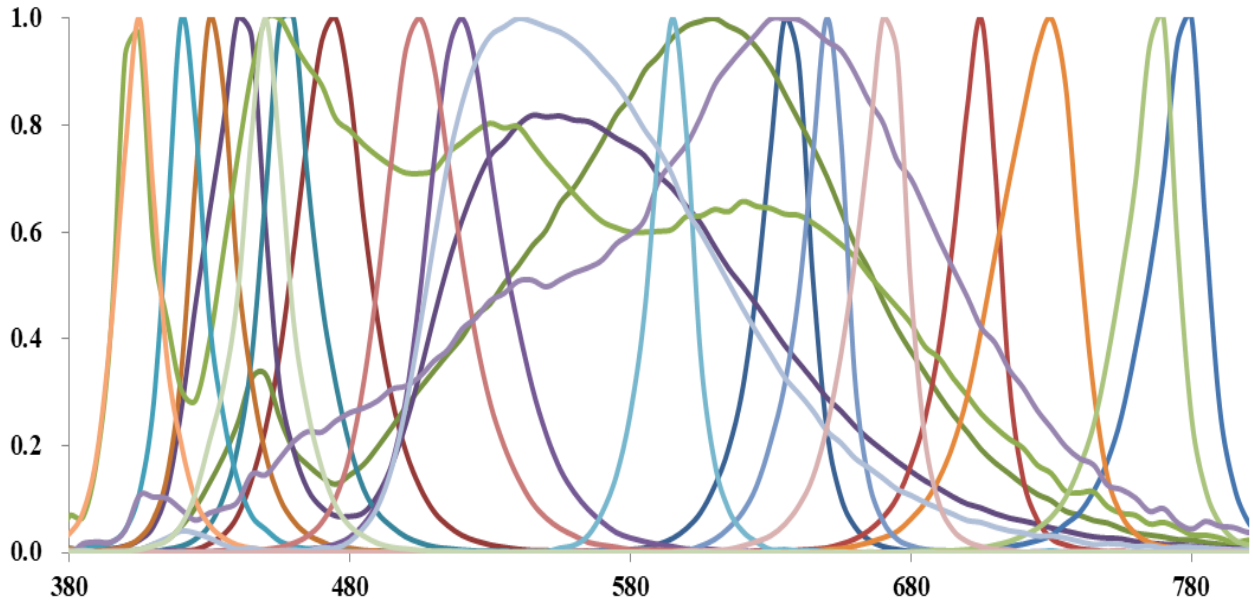
1.1 Features

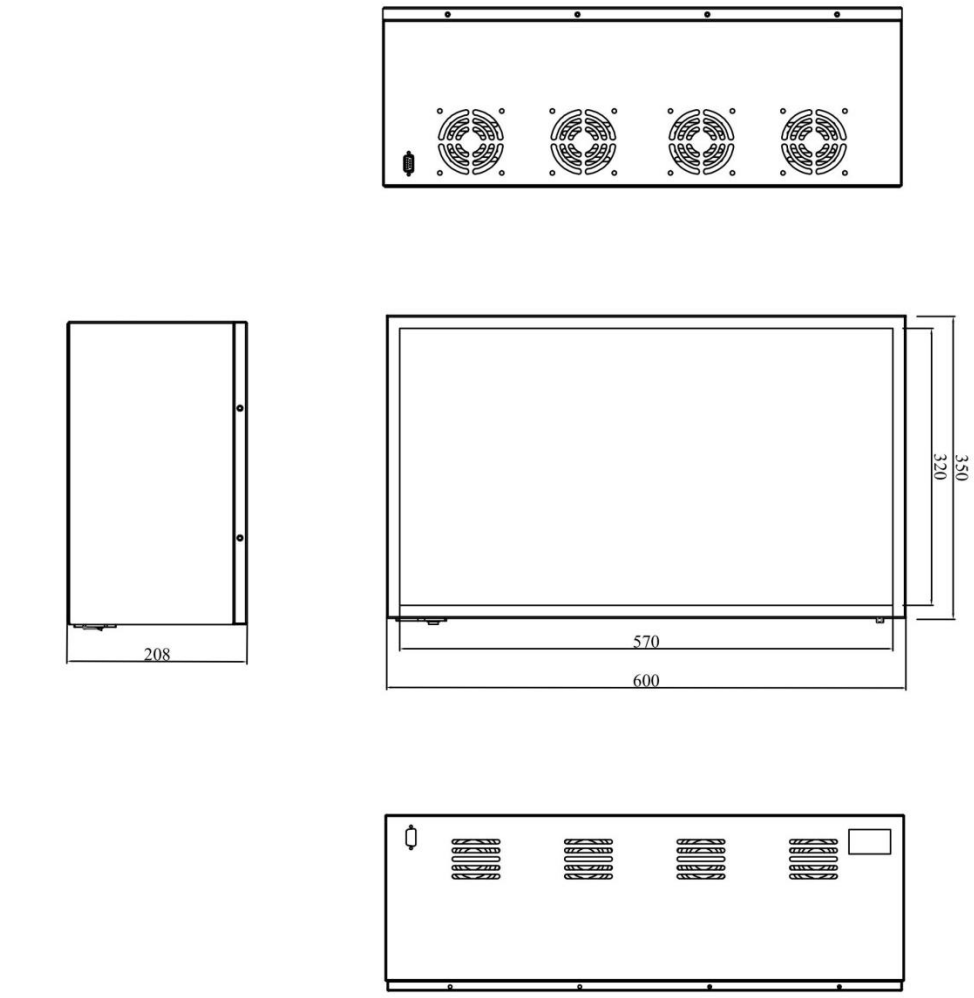
- Accurately simulate the CCT ranging from 2000K to 20000K, including the blackbody locus, excellent quality Daylight
- Reproduce any imported SPD (Spectral Power Distribution). It is easy to communicate the light SPD between different locations
- Capability to simulate the latest CIE Standard LED SPD
- Large intensity dynamic range, 12 bit/ 4000 step for each LED channel, flicker free
- Programmable light sequence and switch time
- Stable light output with the feedback features by software algorithm and external spectrometer
- User-friendly software
- Long lifetime and excellent stability
- Multiple installation methods to fit different applications, including cabinet, stand, etc
- LED Wavelength customization, ranging from UV, VIS to NIR
- API is available for integration in automation

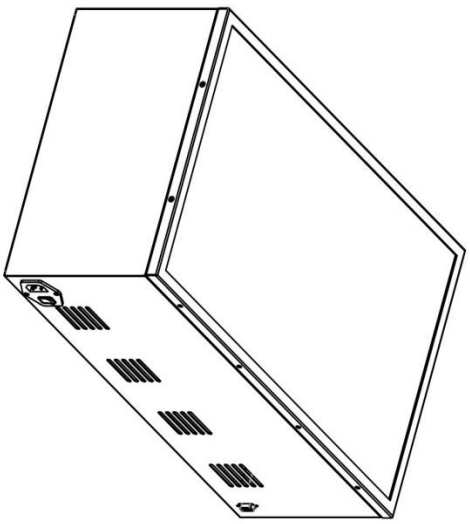


1.2 Specifications

	MCL-21	MCL-30	MCL-5H
LED Channels	21	30	5
Spectral Range	380-780nm	380-1000nm	400-700nm
Drive Mode	12bit, 4096 steps dimmable for each LED channel AM driven, Flicker free		
Warm Up	≤2 minutes		
Lifetime	≥10000 hours		
Capacity	80 presets with editable name, unlimited light source in software		
Preset	D50-D75, CIE Ra ~99		CIE Ra≥90
CCT Range	2000~20000K, accuracy ±1%		
Max Lux Level	Single light source: max ≥3000lux at 1m distance Low lux mode: 0.1-50lx tunable	Single light source: max ≥2000lux at 1m distance Low lux mode: 0.1-50lx tunable	Single light source: max ≥10000lux at 1m distance Low lux mode: 1-50lx tunable
Stability	CCT≤±35K, Intensity≤±2%		
Compatibility	Konica Minolta CL500A, JETI Specbos 1211		
Electrical	110-240V, Max 500W		
Work Temperature	0-40ºC		
Control	USB cable, Wireless control		
Dimensions Weights	600×350×208 mm, 570×320mm (emitting surface) 16 kg		
Scope of Delivery	Light source, power cable, USB cable, wireless sender, software & dongle, SDK is available		
Optional Accessories	Cabinet, measurement instrument, wireless switch		

1.3 Dimensions





unit: mm

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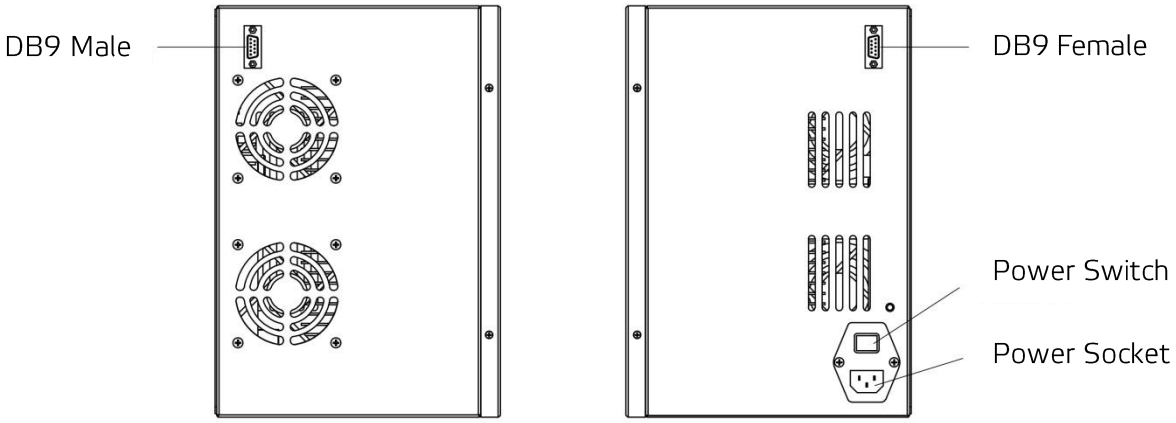
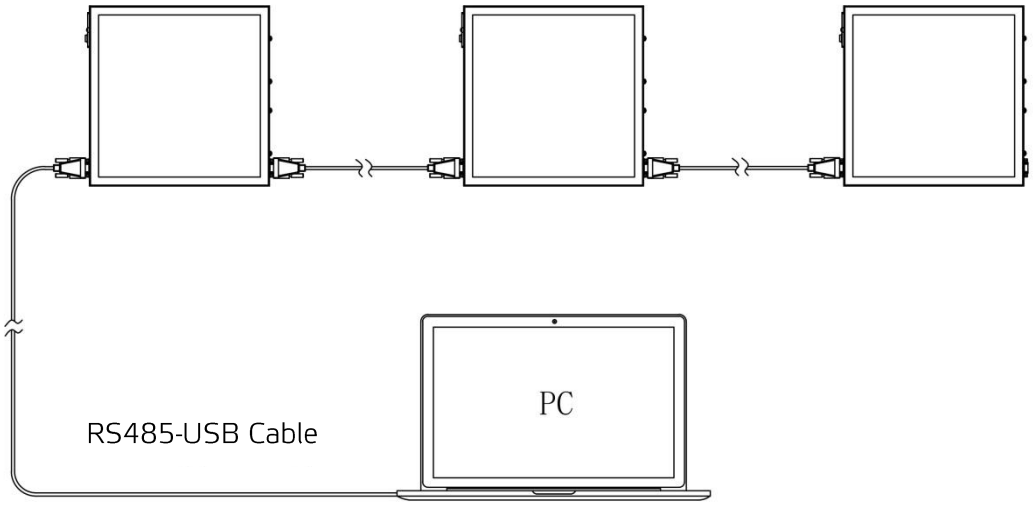
2. Hardware

2.1 Hardware Interface

The hardware of Light Source has two DB9 ports, 1 power socket and 1 power switch.



Side view of the light source



Serial Connection between light source

The light source hardware can be connected one by one via DB9 cables, and the last light source is connected to PC via RS485-USB cable. The example of RS485-USB cable is shown below:

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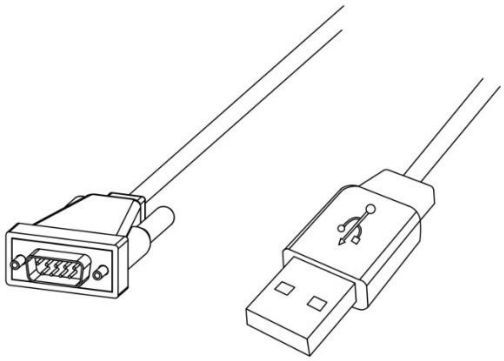


RS485-USB cable

In addition, each light source hardware has one wireless receiver, and the PC can build the connection with light source via wireless sender.

2.2 Hardware Preparation

Preparation work before using software is listed below:

- Connect the light source with electric supply through the power cable. The default voltage and frequency is 110V/230V and 50-60Hz, depending on the country;
- Build the connection between light source hardware via either DB9 ports or wireless according to the above section;
- Turn on the light source by pressing power switch;
- Plug in the software dongle in the PC;
- Connect measure device with PC through USB cable if measurement is necessary;
- Install the drivers and environment in first use, refer to chapter 3 for detail;
- Double click to open the software. The software features are detailed in chapter 4.

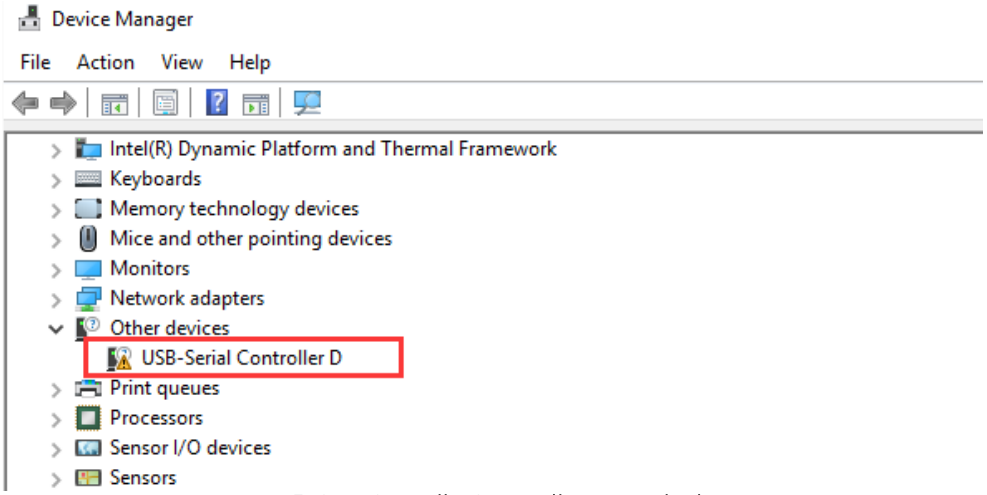
Software dongle

3. Software

3.1 Driver Installation

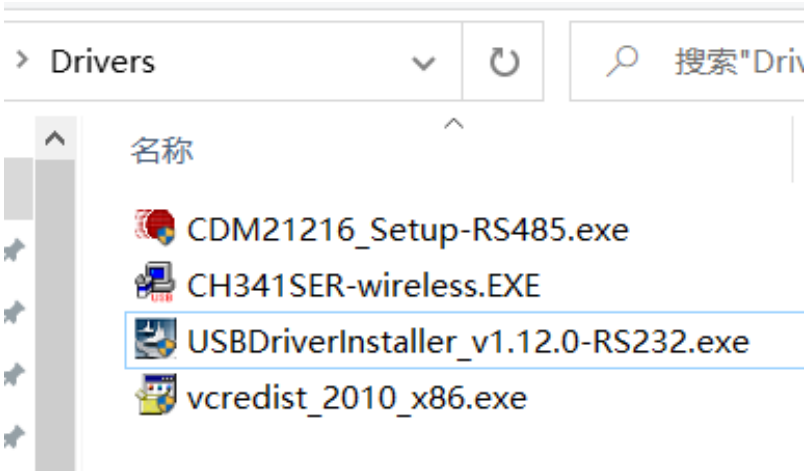
Light source driver installation procedure is listed below:

- Turn on the light source by pressing power switch, and build the connection between light source hardware via either DB9 ports or wireless;
- If the driver is not installed, a yellow symbol can be found in Device Manager of the PC, as shown below;



Driver installation yellow symbol

- Please install the light source drivers in the folder Drivers, including CDM21216_Setup-RS485.exe (485-USB connection) or CH341SER-wireless.EXE (wireless connection). The driver is compatible with Windows 8/8.1/10. After driver installation, the yellow symbol disappears in device manager.



Drivers in the drivers folder

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3.2 Measure Devices and Driver Installation

Currently, the software is compatible with Konica Minolta CL500A and JETI 1211-2. The drivers of the two measure devices will be installed automatically when connected with PC in first use.

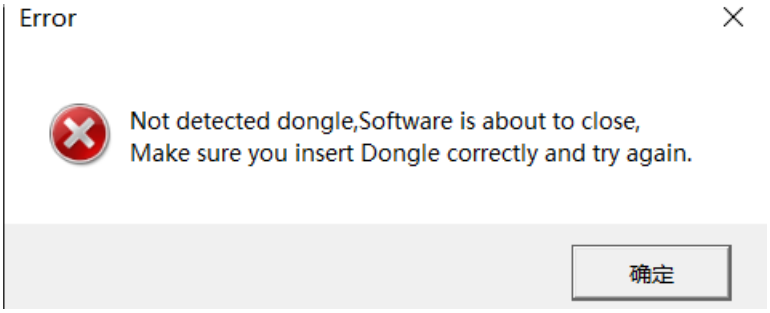
3.3 Software Requirement

Software requires NETFrameWork environment and VC library. If the software cannot be properly opened in the first use, it will pop up a message about missing Dll file, say unable to load DLL 'SDCM.dll'. Please install the "vcredist_2010_x86.exe" in the folder Drivers.

4. Software Introduction

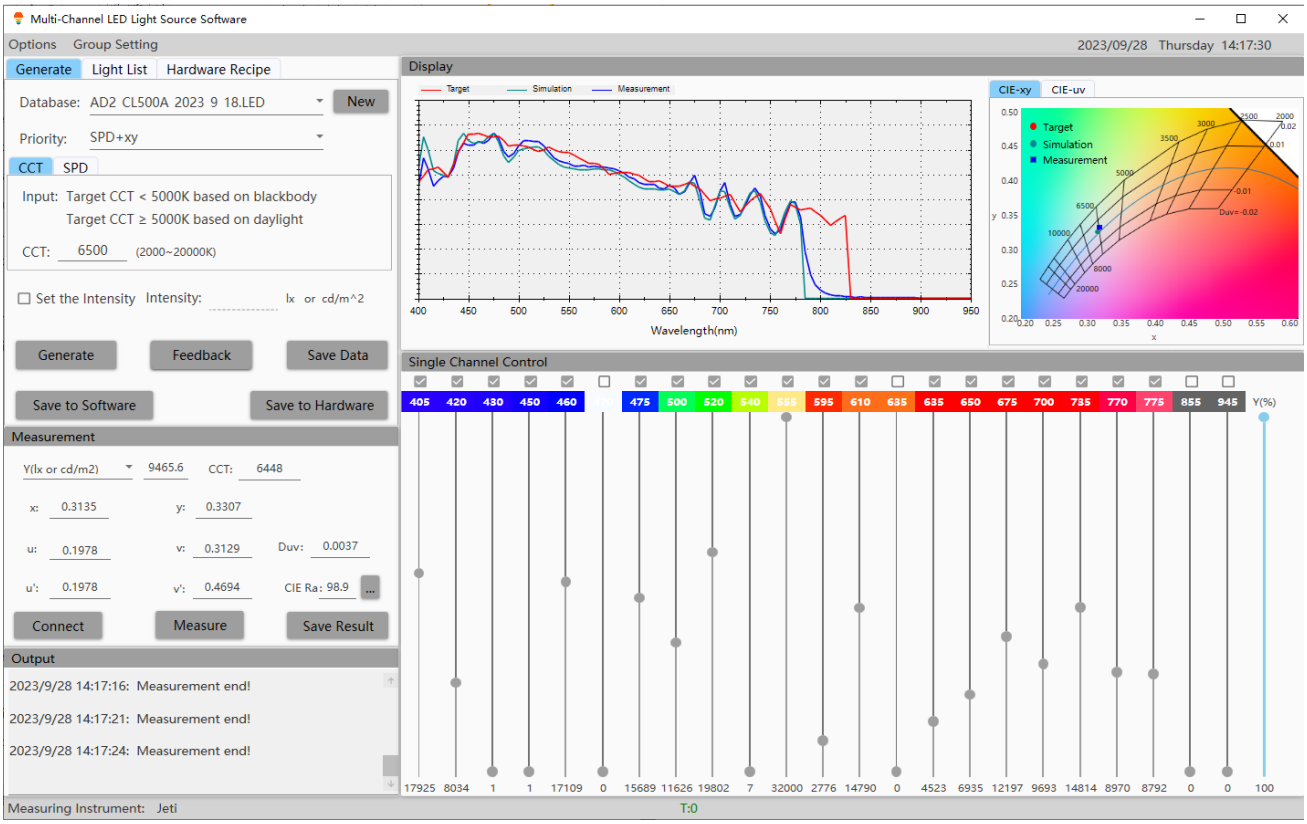
4.1 Self Test before Software

After the preparation work in section 2.3, double click the software icon to open the software “Multi-Channel LED Light Source Software”. Before the main interface pop up, the software will search hardware connections, dongle and measure devices. If the dongle is not connected, the software cannot open.



4.2 Software Interface

After self test, the software interface will pop up, as shown below, and includes Generate, Light List, Hardware Recipe, Display, Measurement, Single Channel Control and Menu. The software is mainly used to design and switch the light sources, including the “Generate Light” and “Light List” modules. “Generate Light” achieves the light source design, calibration and save. “Light List” achieves the saved light source switch. The following two sections detail the corresponding two modules.



Software interface

4.3 Generate Light

"Generate Light" includes following parts:

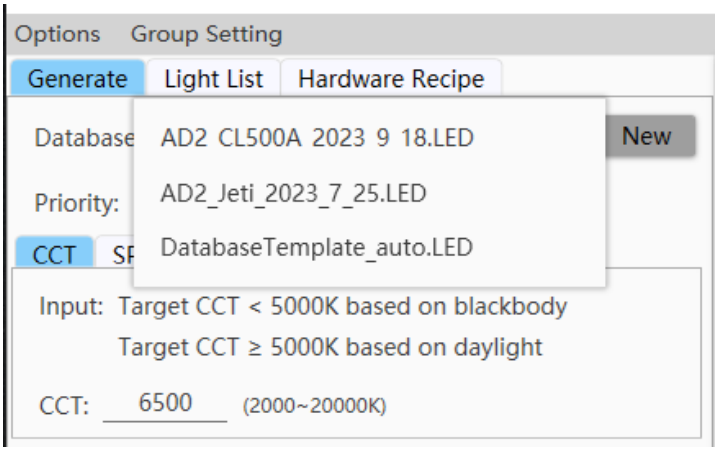
- "Generate" shows the database, priority, CCT&SPD, and it allows users to generate and save the light;
- "Measurement" allows users to measure the light quality of the light;
- "Display" shows the target, simulated and measured color coordinates xy of the light, together with the corresponding Spectral Power Distribution curve of the light;
- "Single Channel Control" allows users to set the intensity of each LED channel. The range is from 0% to 100% with 4000 steps. When the intensity of each LED channel is modified, the corresponding simulated SPD and xy will change accordingly.

In the next two sections, we will demonstrate two examples to detail the "Generate Light".

➢ **Generate Light example without setting the intensity (target is 6500K, 500lx)**

1) Select the suitable database file for light generation.

Database file stores the characteristic of each LED channel in light source in specified environment. The database file is located in the folder Data/Database, the suffix name is LED. It is the foundation to perform the generation algorithm. Users can select the database built previously or build new database. When the setup is changed, including light source position, measurement device, etc, users need to select the corresponding database or rebuild new database. The database rebuild requires 15~30 minutes (depends on the measure device and setup). During database rebuild, the software will switch on the each channel at drive value from 5%-100% with 5% interval sequentially, and the measure device will record the SPD and intensity at each drive value. Users can customize the name of new database after rebuild. Make sure the whole procedure conducted in the dark environment.

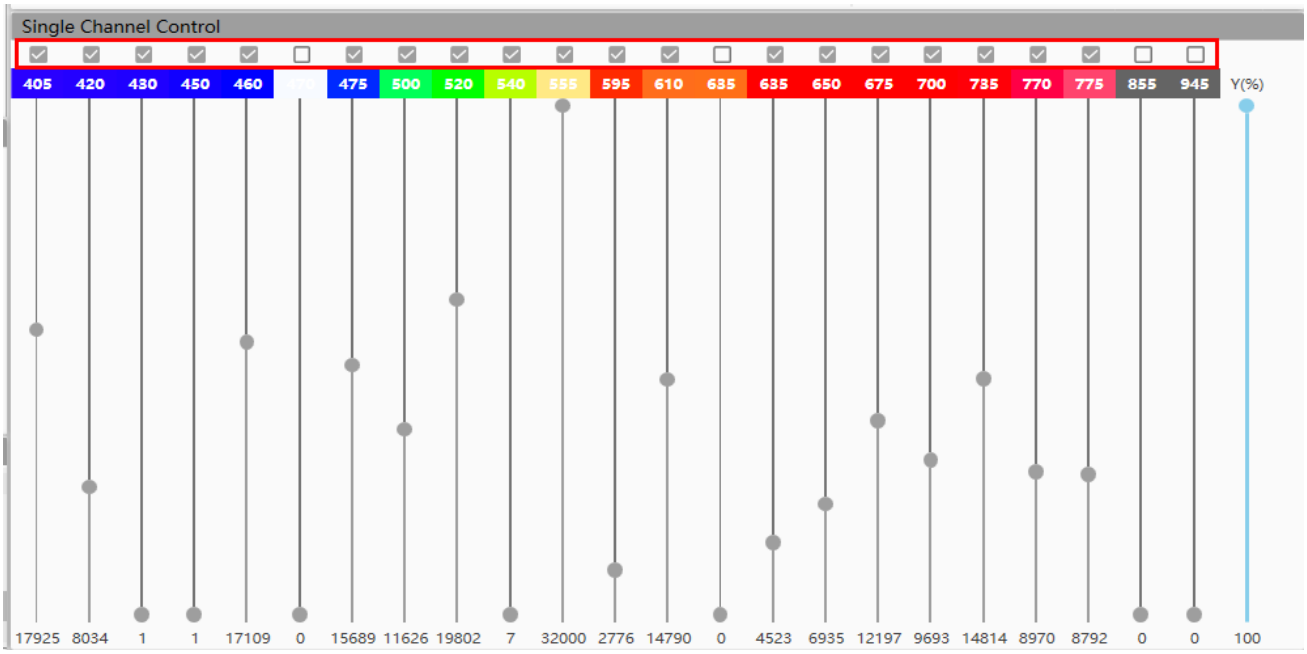


Database selection

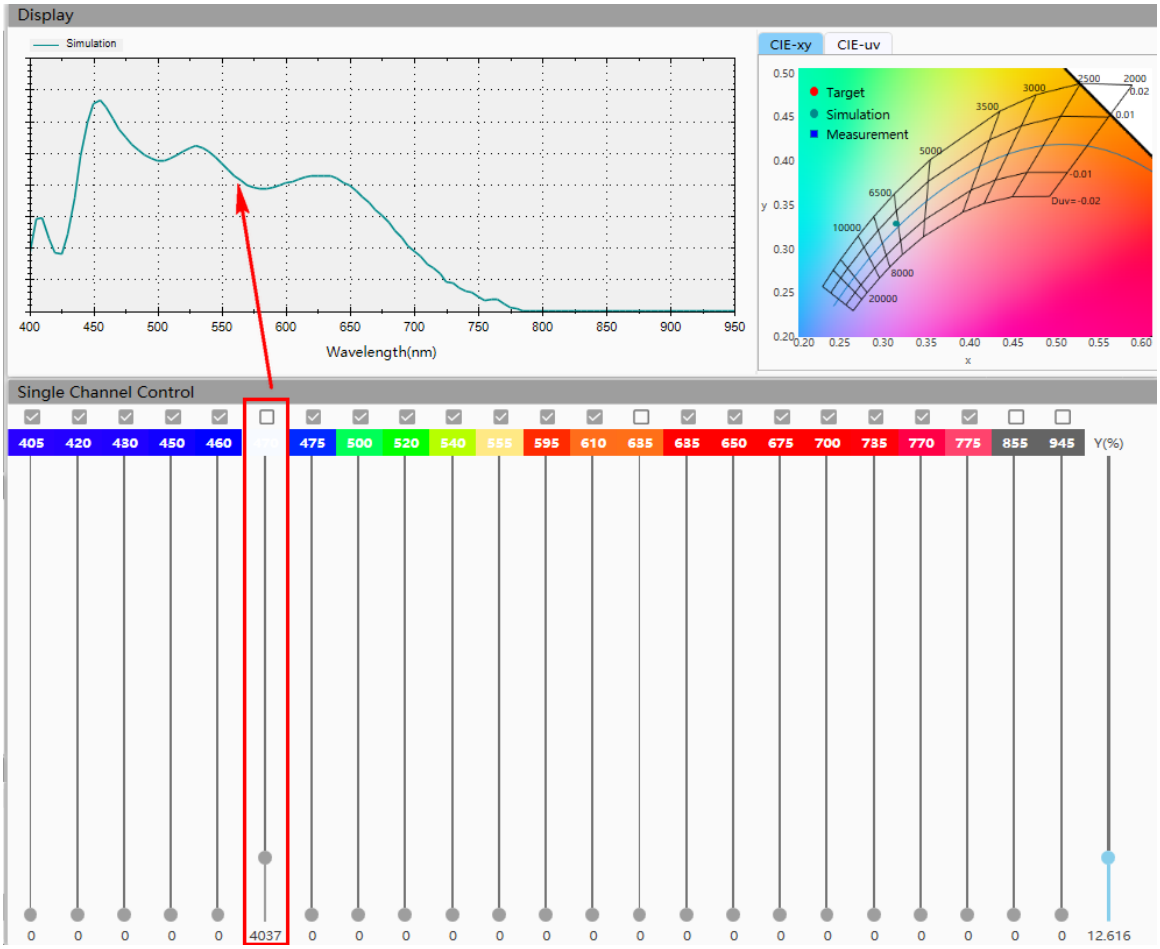
2) Select the LED channels for generating target light source.

User can choose LED channels included or excluded in the generation algorithm by ticking the check box above corresponding LED channel. The excluded channel will be set 0 during optimization. However, users can still adjust the intensity of excluded channels manually, as show below.

Normally, the MCL-21 and MCL-30 includes two low light LED channels. It is highly recommended to exclude the two low light LED channels during the generation. Otherwise, the maximum generated light intensity is low. The two low light LED channels are used to generate low light via manually adjustment, say 1lx, 0.5lx, etc.



LED channel selection



Low light LED channel- Cool White

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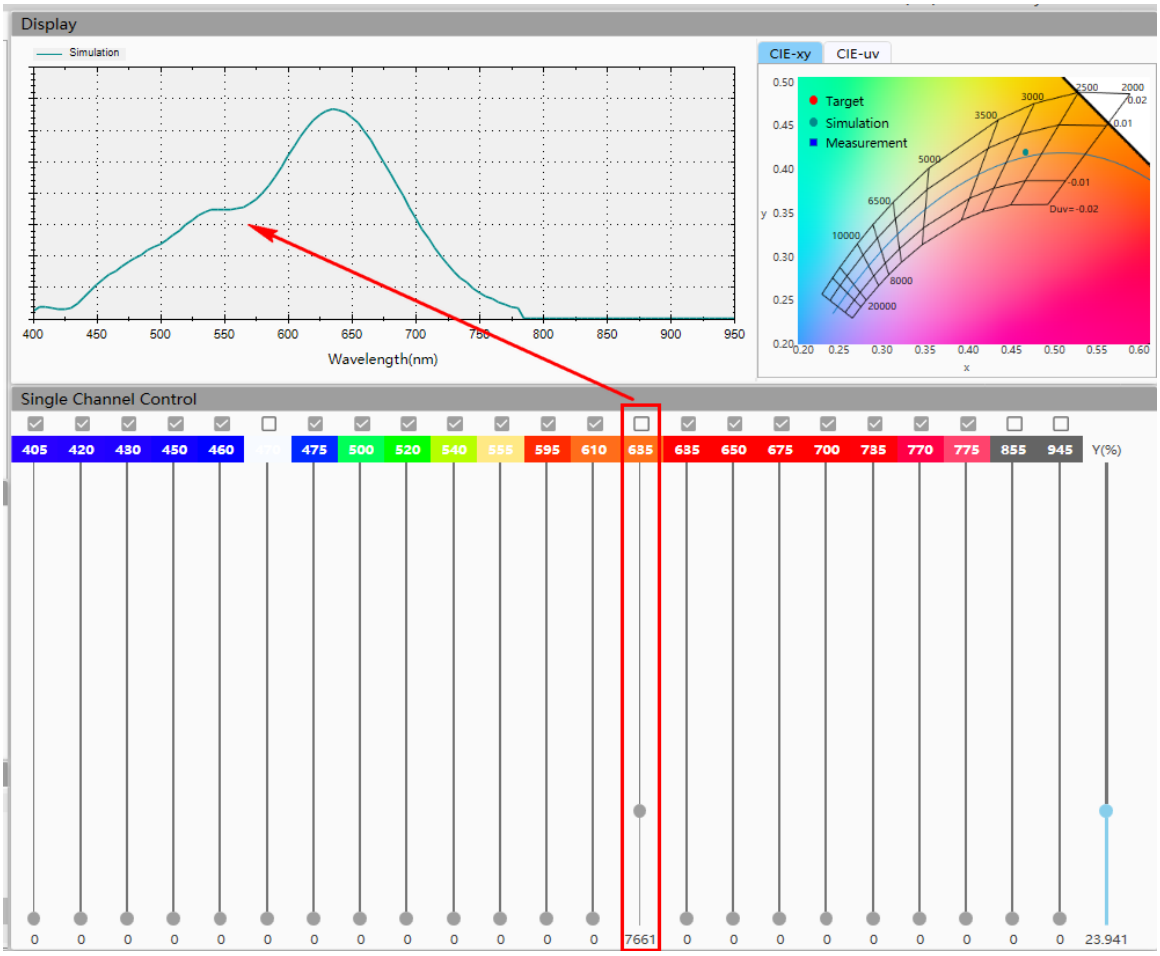


Low light LED channel- Warm White

3) Select the suitable priority for generation algorithm.

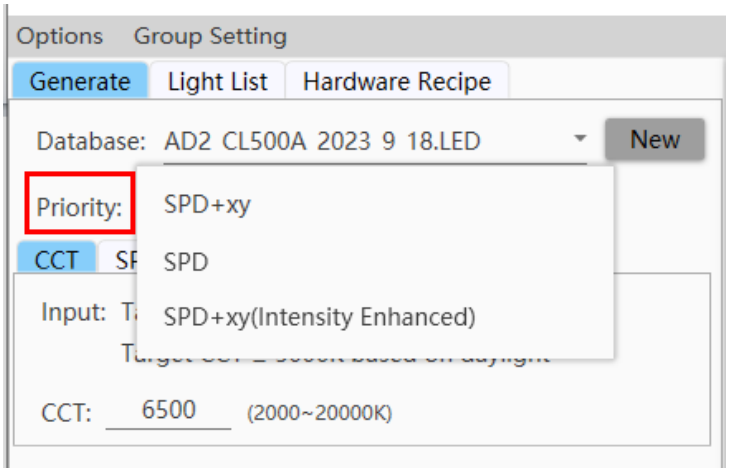
Users can choose one of the 3 priority options according to applications, including SPD, SPD+xy and SPD+xy(Intensity Enhanced).

"SPD" will minimize the root mean square error (RMSE) for the target and simulated SPD.

"SPD+xy" will minimize the root mean square error (RMSE) and chromaticity coordinate xy for the SPD curve between target and simulated SPD.

"SPD+xy(Intensity Enhanced)" will optimize the output SPD based on "SPD+xy" method but at the same time increase the output intensity at the cost of potential degradation of light quality.

In summary, the "SPD" is recommended if users need good SPD match. "SPD+xy(Intensity Enhanced)" is recommended for normal applications.



Priority selection

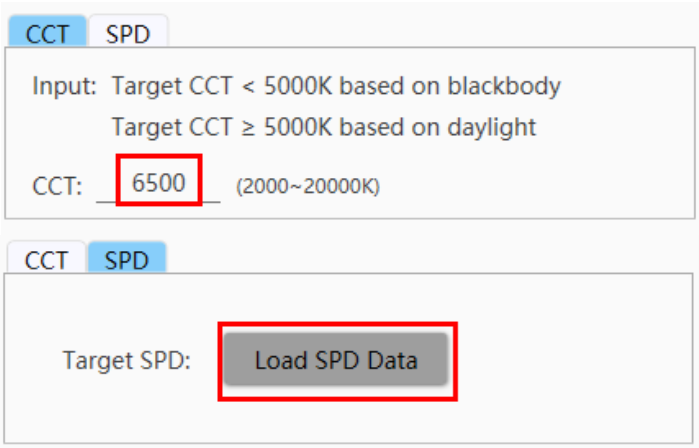
4) Input the target light source.

Users have two ways to input the target light source: CCT or SPD.

If CCT is selected, the software generation algorithm will set the Blackbody (<5000K) or CIE Daylight (≥5000K) as target SPD. The input CCT range is from 2000K to 20000K.

If SPD is selected, the software generation algorithm will set the loaded SPD data as target SPD. Click Button *Load SPD Data* to load the SPD file. The example SPD file is located at folder Data/MeasuredSPD. The saved SPD file in the Measurement is the standard format with 300-1100nm 5nm interval. If users want to create own SPD file, it only requires to replace the data in the corresponding wavelength in the standard SPD file format, and put 0 to wavelength when the data is not available.

In this example, we choose CCT, and input 6500 as target.



Input the target light source CCT & SPD

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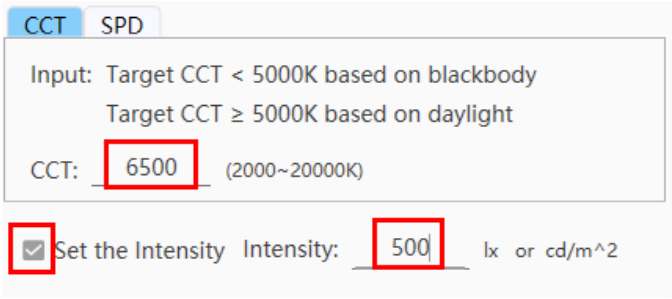
	A	B	C
1	300	0	
2	305	0	
3	310	0	
4	315	0	
5	320	0	
6	325	0	
7	330	0	
8	335	0	
9	340	0	
10	345	0	
11	350	0	
12	355	0	
13	360	0	
14	365	0	
15	370	0	
16	375	0	
17	380	8.76E-07	
18	385	0	
19	390	0	
20	395	0	
21	400	0	
22	405	1.21E-06	
23	410	3.39E-06	
24	415	9.78E-06	
25	420	2.27E-05	
26	425	5.29E-05	
27	430	0.000106	
28	435	0.000212	
29	440	0.000432	
30	445	0.000829	

Standard SPD file format with 300-1100nm 5nm interval

5) Set the target intensity.

If necessary, users can set target light intensity by ticking the checkbox of "Set the Intensity", user can input the target light intensity, say 500lx, and then the software will generate the target light at the target intensity. This feature is only available when the software is connected with measure device. In addition, this step is optional.



Set the target intensity

If user don't set the target light intensity, the software will generate the target light at the Y(%) at the Single Channel Control module. If users want to adjust the intensity after first

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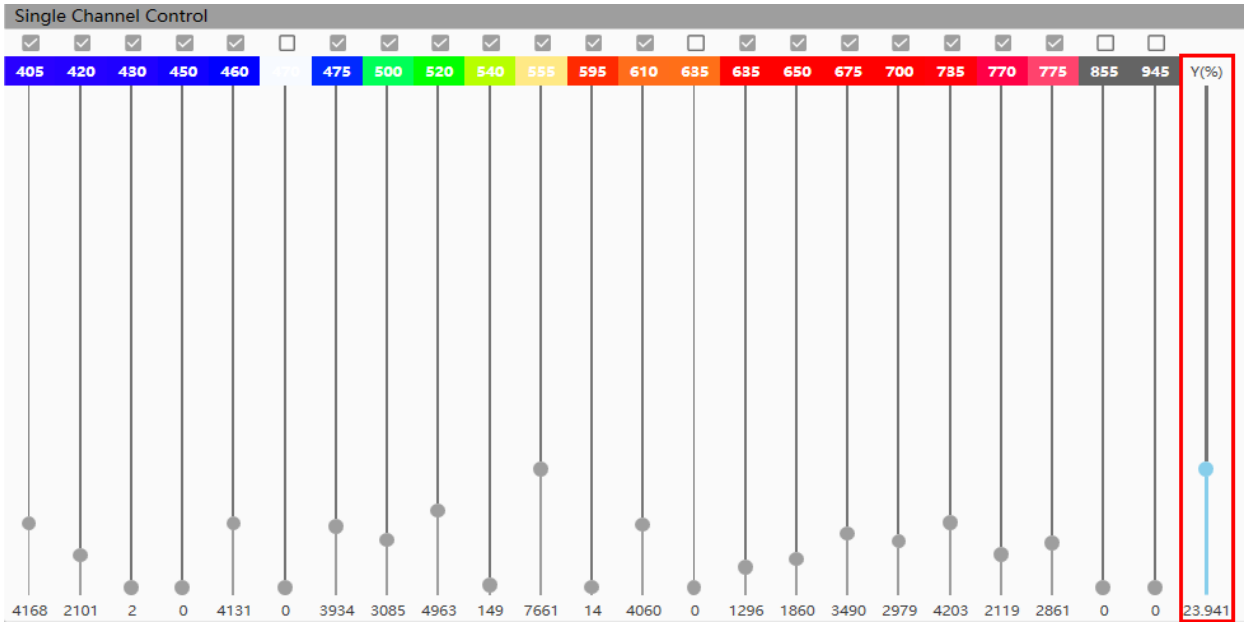
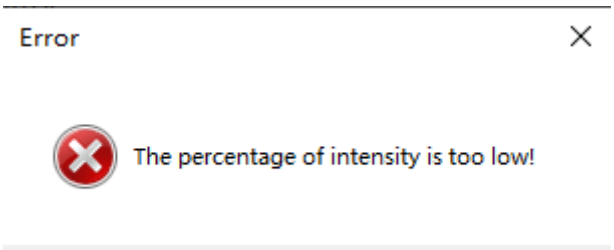
light generation, users can use the Y(%) slider to adjust the total light intensity, as shown below. In this example, we don't tick the checkbox of "Set the Intensity", and adjust the intensity via Y(%) slider. Please note when the Y(%) slider is 0, the software will pop up a message "The percentage of intensity is too low!" during light generation.



Y(%) slider in Single Channel Control



Warning of Y(%) slider is zero

6) Light Generation

Click Button *Generate*, the software generation algorithm will output the light recipe (driver values of each LED channel) for the target light. The recipe is shown in the bottom of each LED channel slider in Single Channel Control module. Meanwhile, the corresponding target and simulated SPD&xy are illustrated in Display module.

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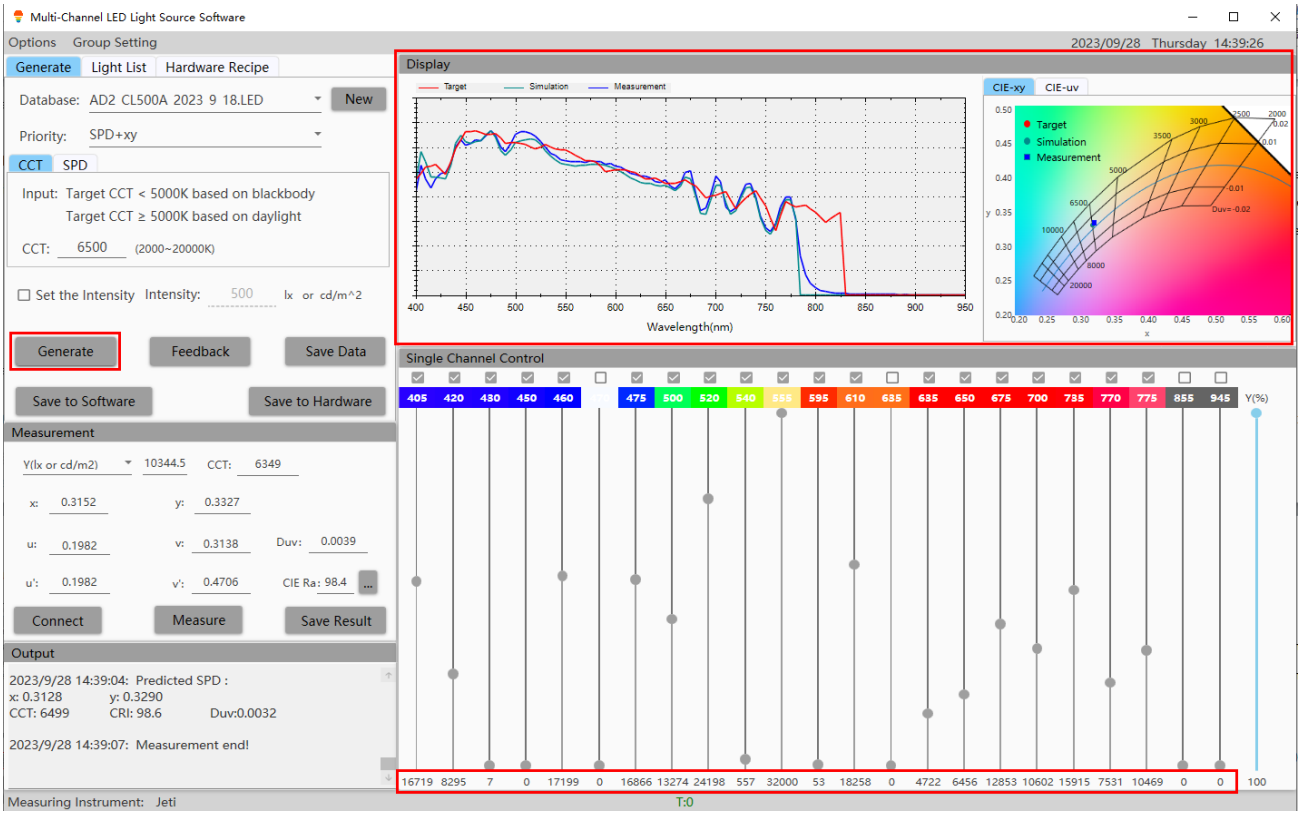

Light Generation and corresponding result

7) Measure

If the software is connected to measure device, click Button *Meausre* to get the measured SPD and corresponding light quality parameters, which are shown in the Measurement and Display modules. The detailed R1 ~ R15 values can be shown by clicking Button … near to CIE Ra.

If the difference between the measured result and target light are small (CCT difference ≤±1%, intensity different ≤±1% for ≥100lx range, CCT difference ≤±100K, intensity different ≤±1lx for <100lx range), the generated light recipe is good, and the light generation process is completed. If there is a considerable difference (say ΔCCT>100K) between measured result and target light, the Button *Feedback* can be performed to compensate the difference. In addition, make sure clicking Button *Measure* to obtain the difference between simulated and measured result before clicking Button *Feedback*.

Button *Save Result* will save the measured SPD curve, together with corresponding light quality parameters. The saved result is located at folder Data/MeasuredSPD, and the saved SPD file can be used as target SPD input in Step 4) Button *Load SPD Data*.

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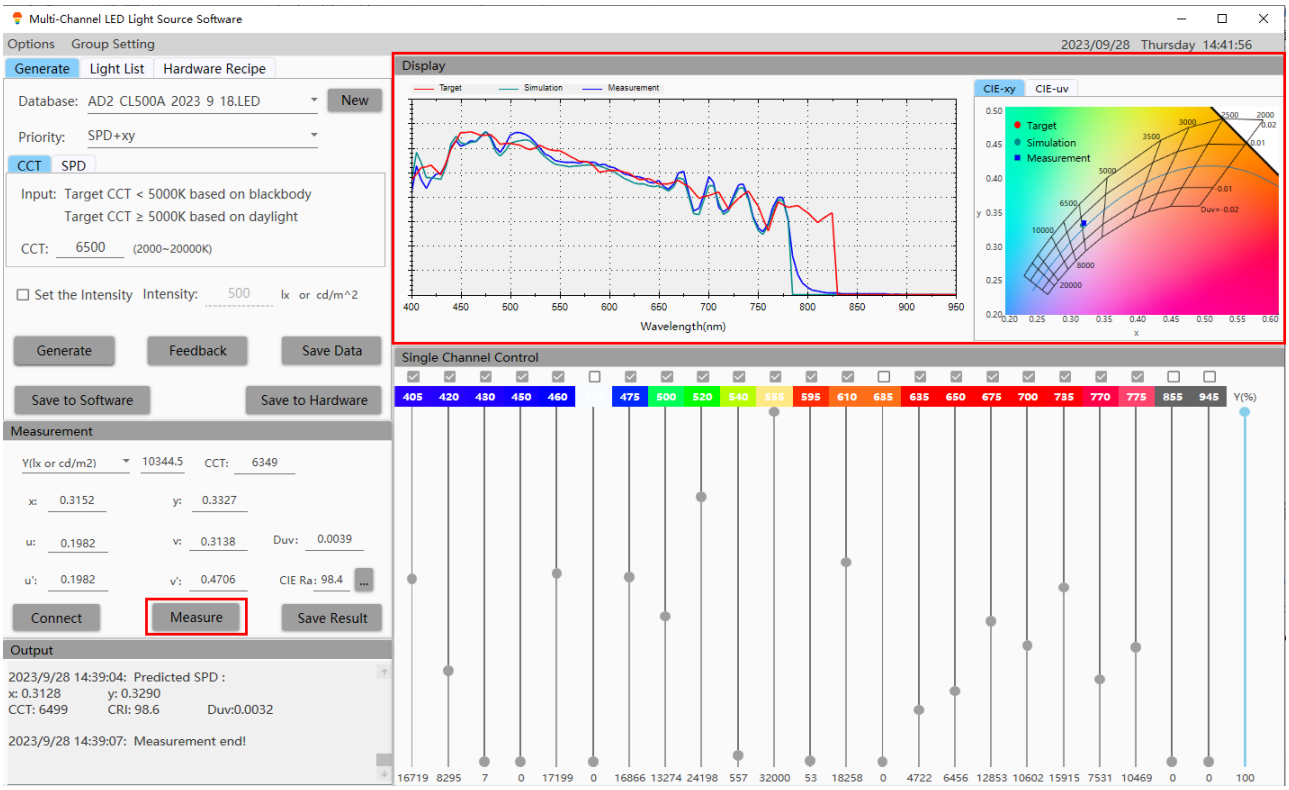
If the measure device lost the connection. Button Connect will reconnect the measure device.

As shown below, the current measured CCT is 6349K, intensity is 10344.5lx. While the target CCT is 6500K, and the target intensity is 500lx. Therefore, we firstly adjust the intensity via Y(%) slider as shown in the next step.



Measurement

8) Lightness adjustment

Adjust the intensity via Y(%) slider to the approximately target intensity 500lx. We can evaluate the approximate Y(%) of the target intensity if we assume the linear relationship between the intensity output and percentage. Meanwhile, we can confirm the actual intensity output via Button *Measure*. As shown below, the light output is adjusted to 5815K, 539.7lx.

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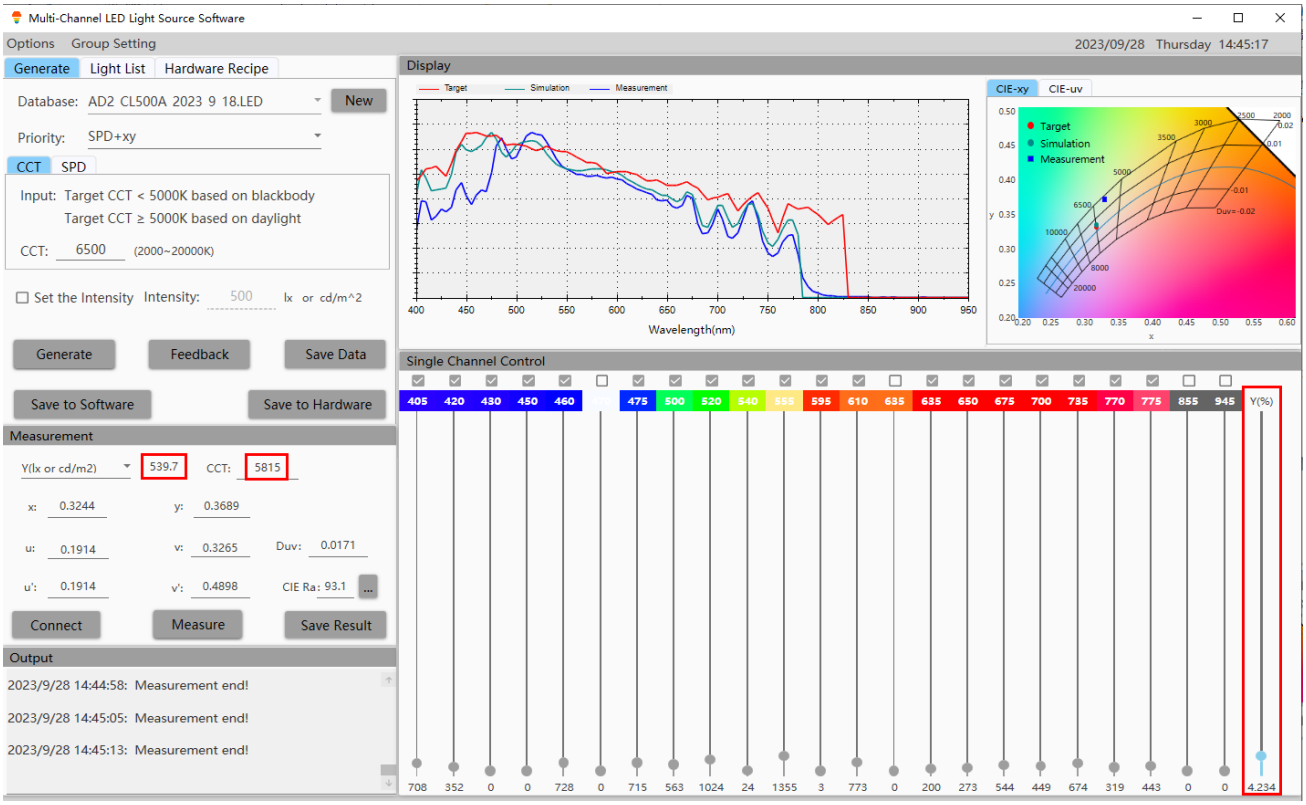

9) Feedback

The difference between the measured result (5815K) and target light (6500K) are still relatively large (>±1%), and the measured intensity is around 500lx. Click Button *Feedback* to fine adjust each LED channel intensity based on the difference between target and measured result to compensate the difference. In general, 1-2 *Feedback* process is enough to compensate the difference. As shown below, after 2 Feedback, , the light output is adjusted to 6448K, 410.5lx.

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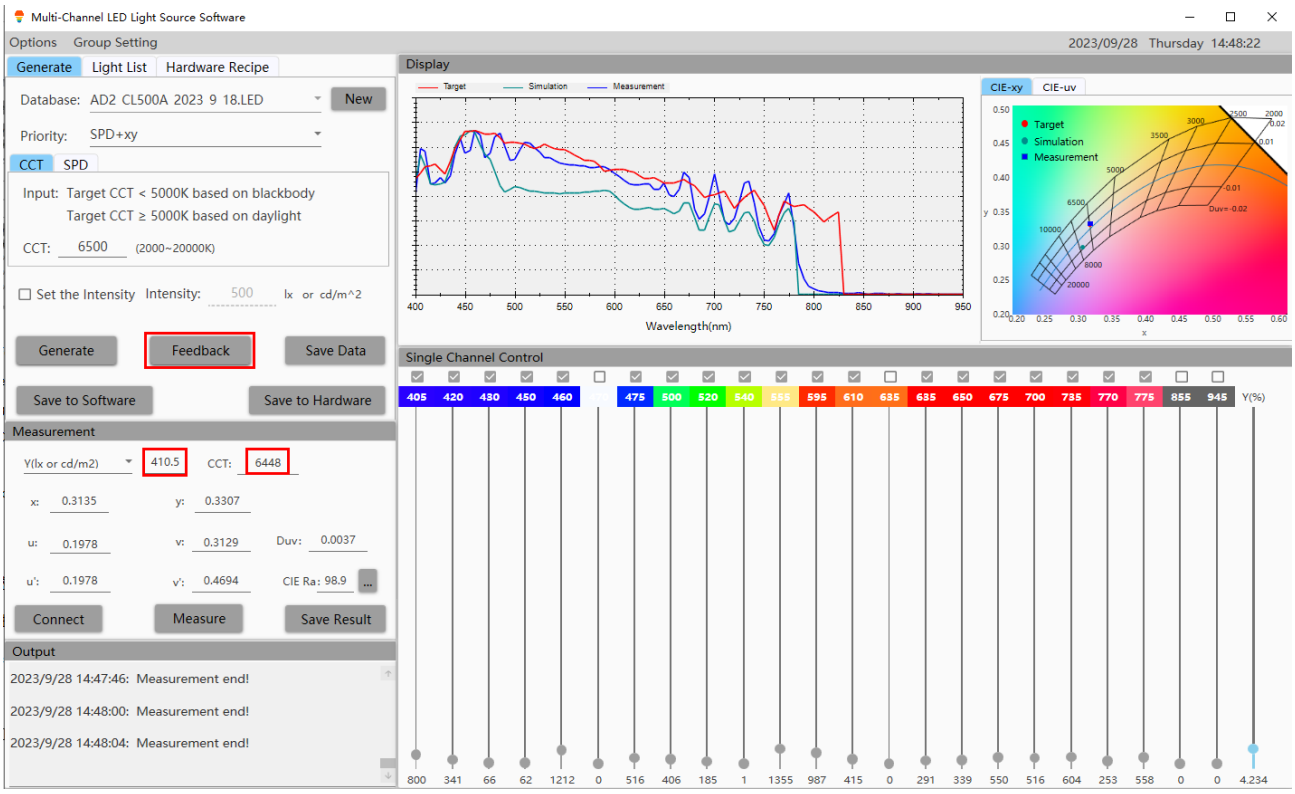

Results after 2 Feedback

Therefore, users can adjust the total intensity via Y(%) slider, and Click Button Measure to get the measured result. In final, we get a good result with the measured CCT 6496K, and intensity 491.2lx.

There are several issues to notice:

When the target intensity is below 2% at Y(%) slider, the Button *Feedback* may not compensate the difference. Because the intensity of each LED channel is very low in this case, and the adjustment range of each LED channel is not enough. In this case, the single channel LED manually adjustment are recommended. The drive value of each LED channel are located in the bottom of each LED intensity slider. When the drive value are modified, the corresponding simulated SPD curve and xy will update in the Display module. When users need to manually adjust the drive values, users need to pay attention to the change of simulated SPD curve and xy in Display module. Meanwhile, users can use Button *Measure* to confirm the measured result. In general, a relatively smooth SPD curve and accurate xy are expected for good light generation.

If users are not satisfied with the generated light, users can manually adjust the drive

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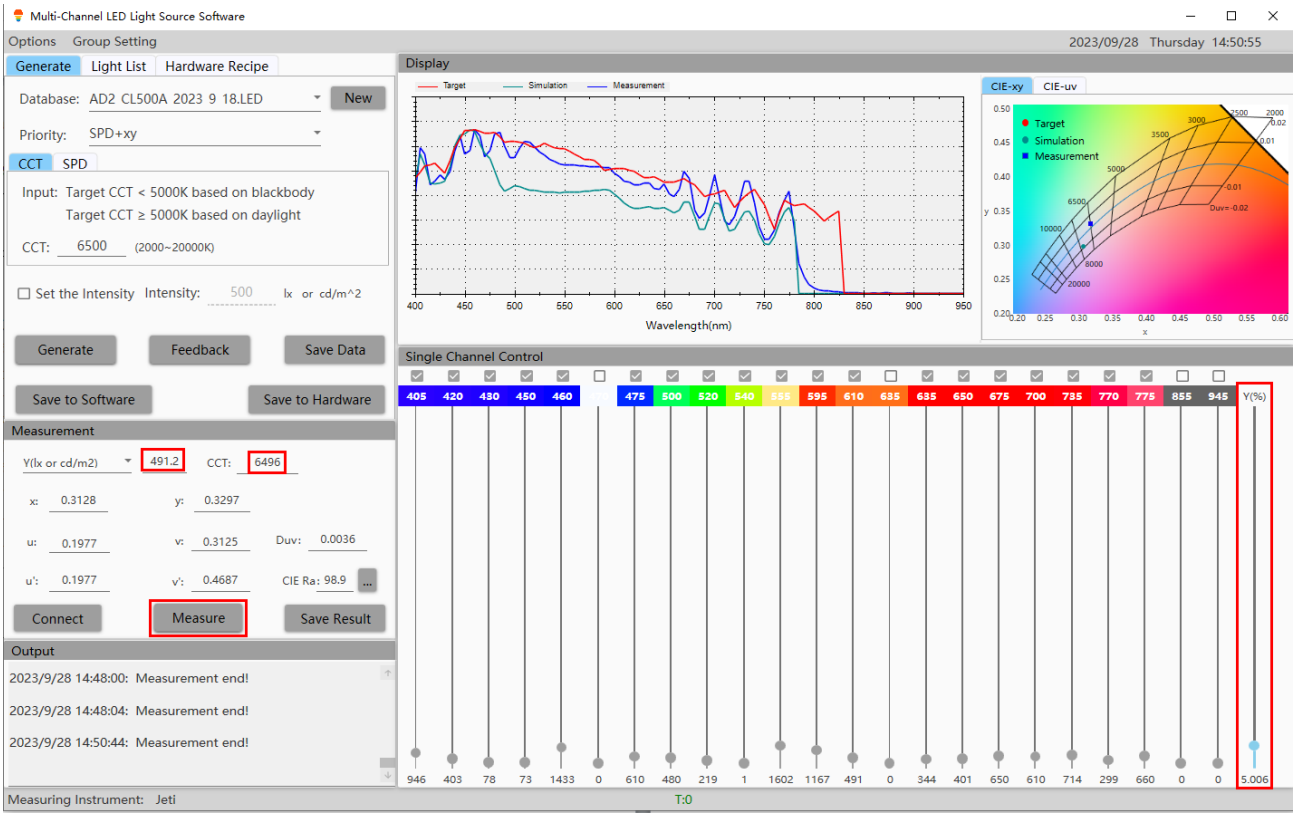
value of each LED channel to get a good light output.

There are three ways to adjust the drive value:

- Adjust the intensity slider of each LED channel,
- Input the drive value below each LED slider, and click Button *Enter* on the Keyboard,
- Use the Button *Up, Down Arrow* on the keyboard to fine adjust each LED channel with minimum step.

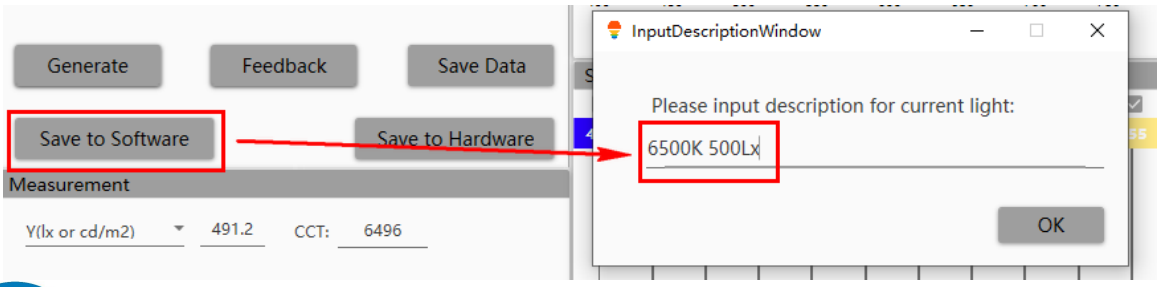


Final result after Y(%) slider adjustment

10) Save

After obtaining the good light generation, click Button *Save to Hardware* or *Save to Software* to save the generated light.

Save to Software saves the light recipe to the Light List.



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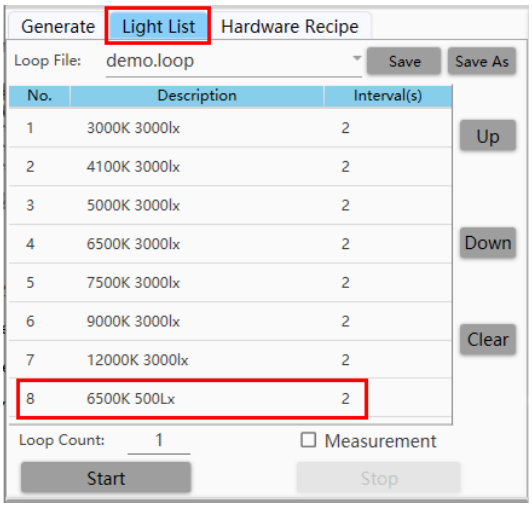
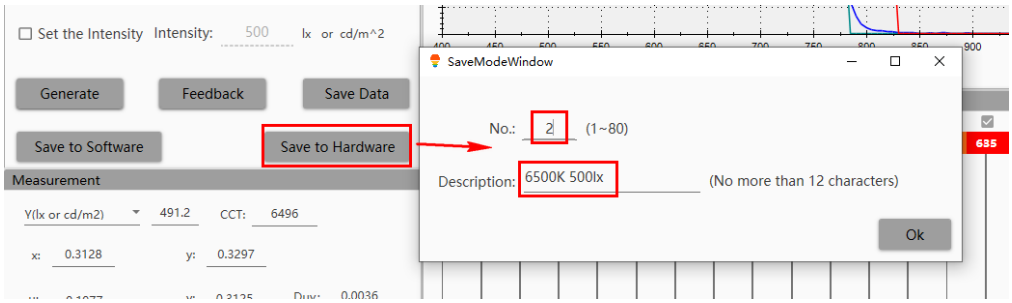
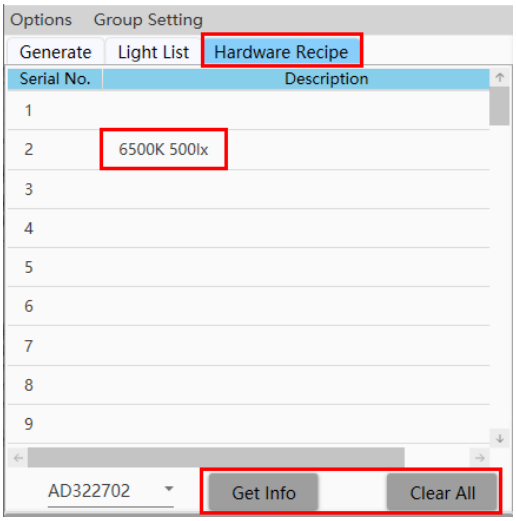


Save to Software

Save to Hardware saves the light recipe to the hardware storage. The light source hardware support up to 80 light sources. Users need to input the No. of the light source, together with the description. The saved light source is shown in Hardware Recipe page. Button *Get Info* gets the description of each light source in hardware. Button *Clear All* clears the recipe and description of each light source. Double click the description can switch on the light source.





Save to Hardware

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➢ Generate Light example with setting the intensity (target is 6500K, 500lx)

This example is similar to the previous example, the detail procedure is below:

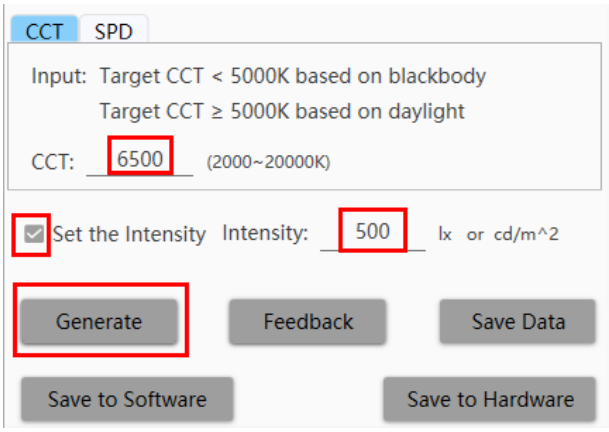
1) Select the suitable database file for light generation.

2) Select the LED channels for generating target light source.

3) Select the suitable priority for generation algorithm.

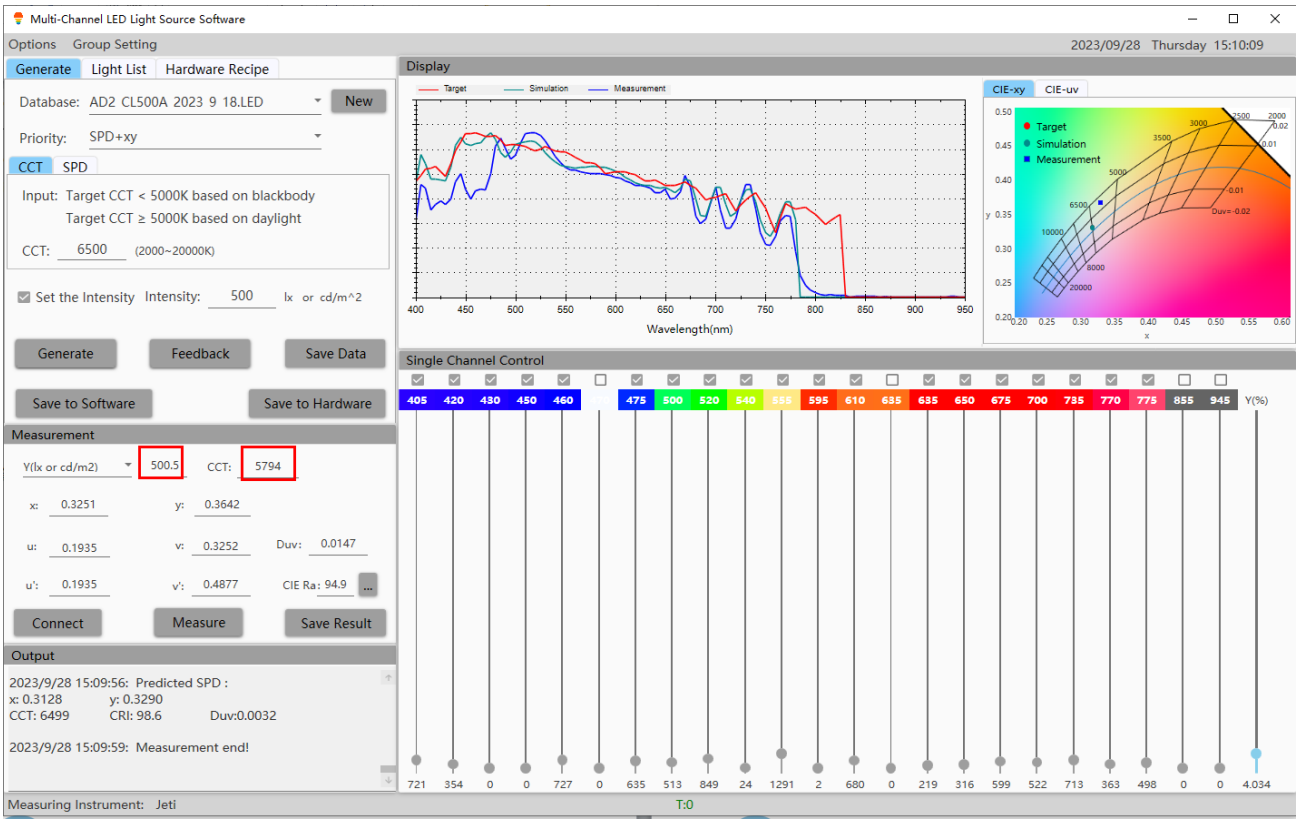
4) Input the target light source, 6500K.

5) Set the target intensity, 500lx.



6500K, 500lx setup before generation

6) Light Generation, and the measured CCT is 5794K, intensity is 500.5lx.



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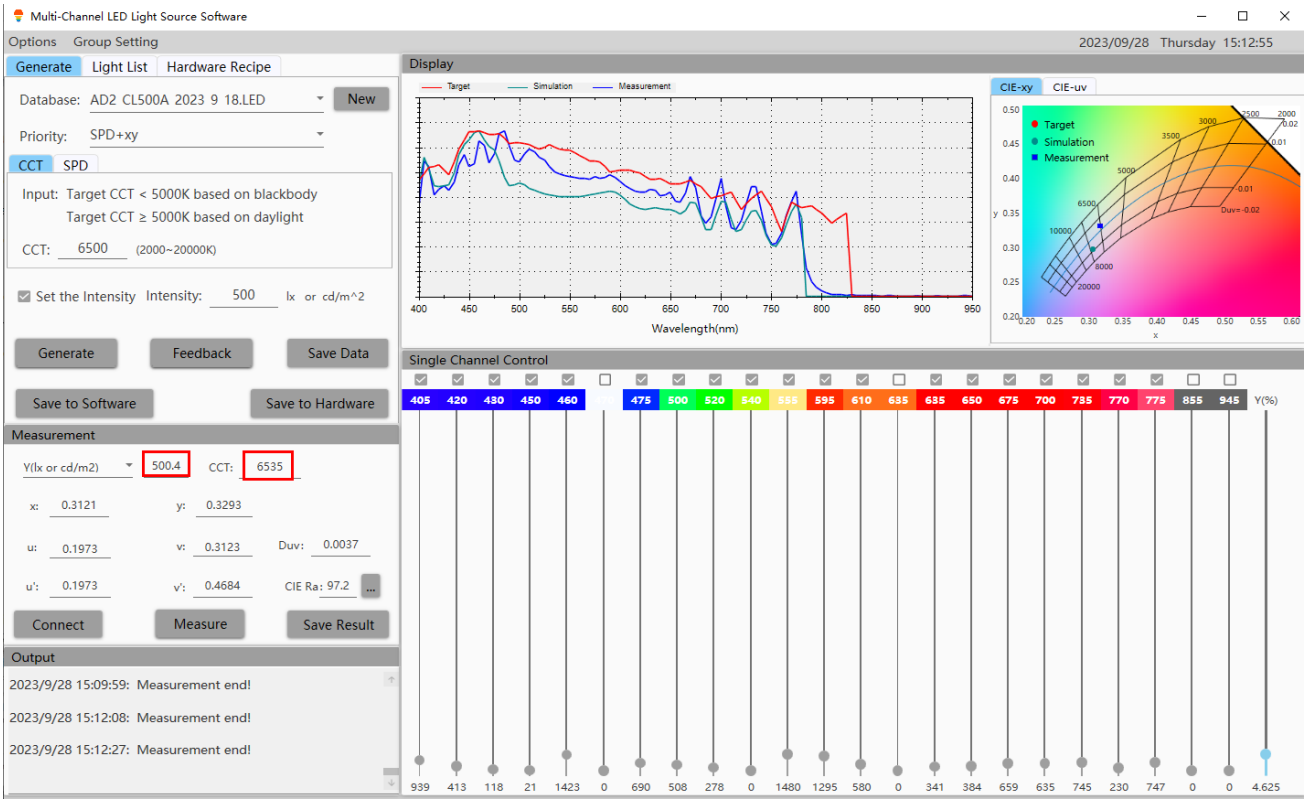
7) Feedback, Button *Feedback* to get the final measured CCT 6535K, and intensity 500.4lx.



8) Save light to hardware or software.

4.4 Light List

The generated light can be saved to Light List via Button *Save to Software*. Each light source has three attributes, No. , Description, and Intervals. Uses can adjust the sequence by the Button *Up* and Button *Down*. Double left click the description can switch on the light source. Button *Clear* clears all the light sources in the list. Right click achieves certain light source Modify, Copy, Paste and Delete. Button *Save* and *Save As* can save the current loop file. The loop files are located at folder Data/Loop. User can set the loop counts. Button *Start* and *Stop* achieve the light sources in the current loop switch at the specified interval. If the measurement is selected, the software will measure each light source after switch.

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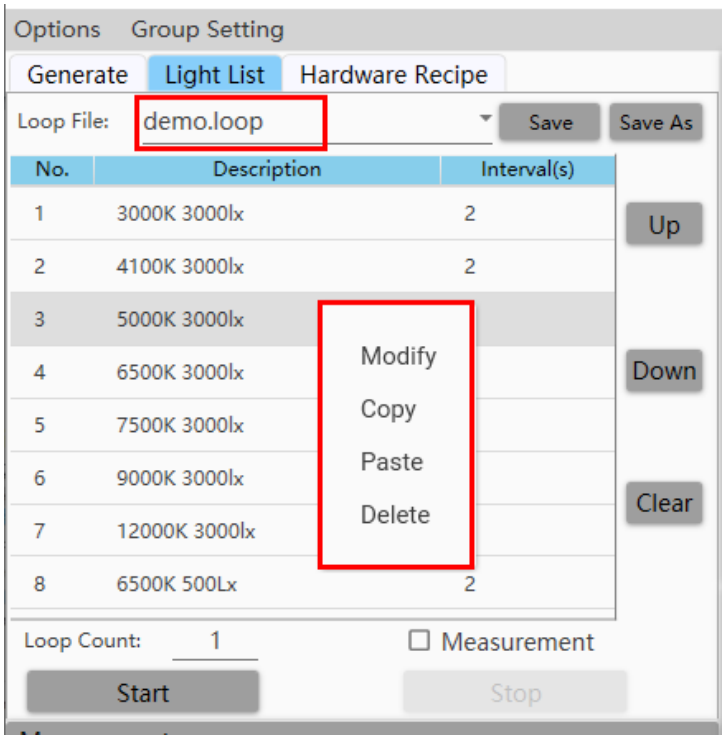
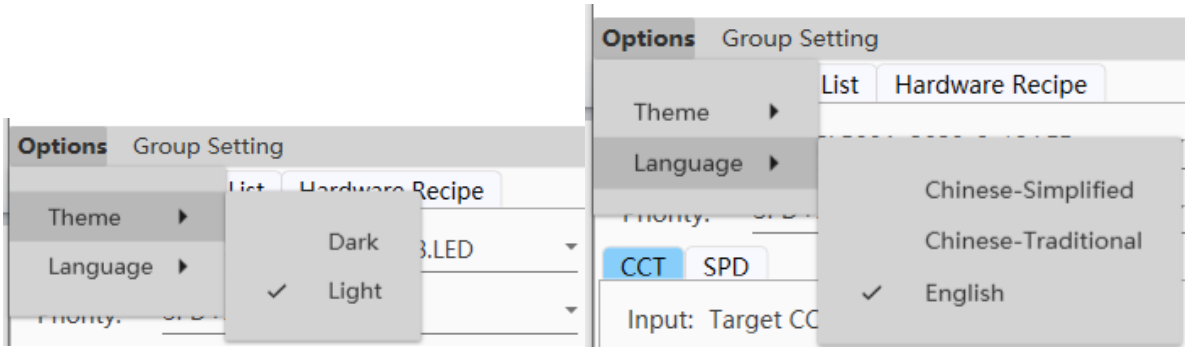


Light List

4.5 Options

Options include the Theme and Language.



Options – Theme & Language

4.6 Group Setting

Group Setting allows users to set all the light sources to several groups, as shown below. The maximum groups is 10. Current Group Details show the light source IDs in each group. Regroup allows users to regroup the groups. Select the light source IDs, click the Group No., click Button *arrow* to set the selected IDs to the selected Group. The group selection is on the top of the interface. The software will control light sources in the selected groups. If no group is selected, the software will control all light

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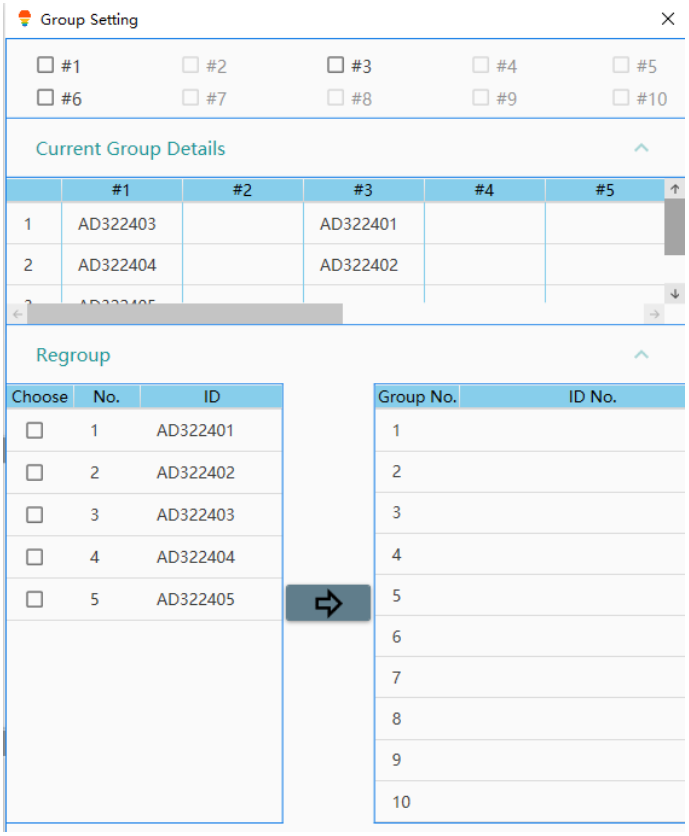
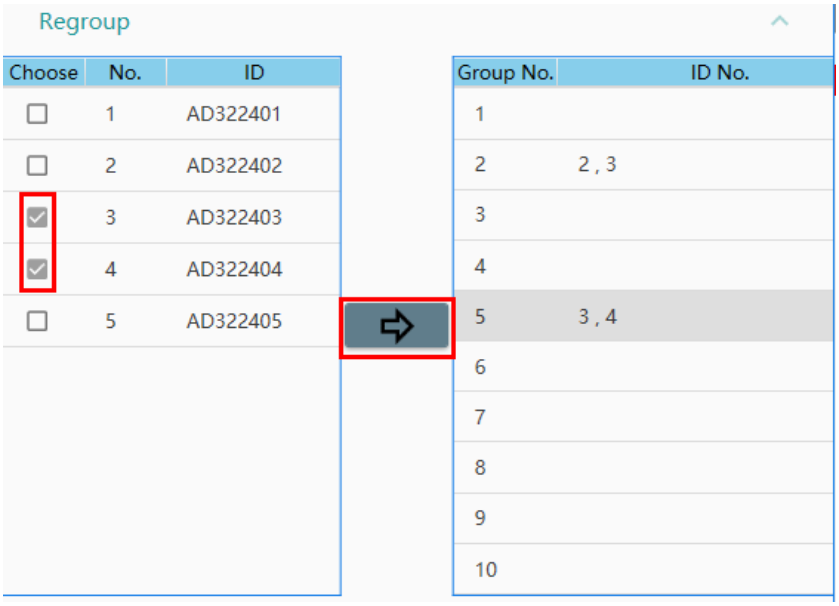
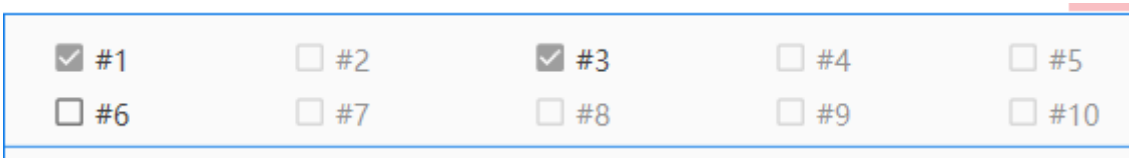
source hardwares simultaneously.



Group Setting



Regroup



Group Selection

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