



CalCube MiniLED

Screen Calibration

XI'AN NOVASTAR TECH CO., LTD

User Manual

Change History

Document Version	Software Version	Release Date	Description
V2.1.0	V2.1	2021-09-17	<ul style="list-style-type: none"> • Added the Coex control system connection. • Added the full-grayscale calibration mode. This mode must work with the Coex control system. • Added the wider wavelength and brightness range LED calibration function. • Added the uniformity compensation function. • Added the removing seam diagonal stripes function. • Optimized the camera parameter adjustment. • Added some troubleshooting sections.
V2.0.0	V2.0	2020-11-05	<ul style="list-style-type: none"> • Added the C3200 camera usage. • Added the curved surface correction function. • Added the Continue Calibration function. • Optimized the document structure and style.
V1.0.1	V1.0	2020-08-03	Optimized the document content.
V1.0.0	V1.0	2019-07-09	First release

XI'AN NOVASTAR TECHNOLOGY

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1 Introduction

1.1 Overview

CalCube MiniLED is the latest calibration software developed by NovaStar, which is mainly used for on-site calibration of miniLED screens. Featuring higher calibration speed, it can greatly improve the on-site calibration efficiency and is convenient and easy to use. With higher calibration accuracy, it can effectively eliminate color difference and make the brightness and chroma of the entire display highly uniform. The image quality of miniLED screens can be improved with remarkable effects.

On-site calibration requires engineers to bring calibration equipment to the screen installation site for pixel level calibration.

1.2 Features

- Mainly suitable for on-site calibration of miniLED screens
- Support for mixed-light elimination technology to effectively fix the image blurring and overlap problems caused by cross-interference of brightness between miniLEDs, offering an improved display uniformity and smoother display effect after calibration
- Camera calibration technology to measure brightness and chroma values more precisely to ensure smoother images after calibration
- Support for curved surface correction technology to eliminate curved surfaces of calibration partitions and let the entire display be as smooth as glass and transitions between the partitions no longer a problem
- Support for full-grayscale calibration mode when working with the Coex control system to fix the problem of inconsistent uniformity at different grayscale levels, significantly improving the display image quality, especially the indoor fine-pitch displays
- 12-digit calibration coefficients to reduce the brightness difference to less than $\pm 1\%$ and chroma difference to less than ± 0.003 after calibration

1.3 Software Installation

CalCube MiniLED is installed in the same way as an ordinary application. You can install it by following the setup wizard. After installation, a computer restart is required.

Operating environment: Windows 7 (64-bit only), Windows 10 (64-bit only). All operations in this document are performed in Window 10.

Note:

If any security alert from anti-virus software or firewall appears during installation, choose to allow the installation.

1.4 Software Introduction

Navigation Page

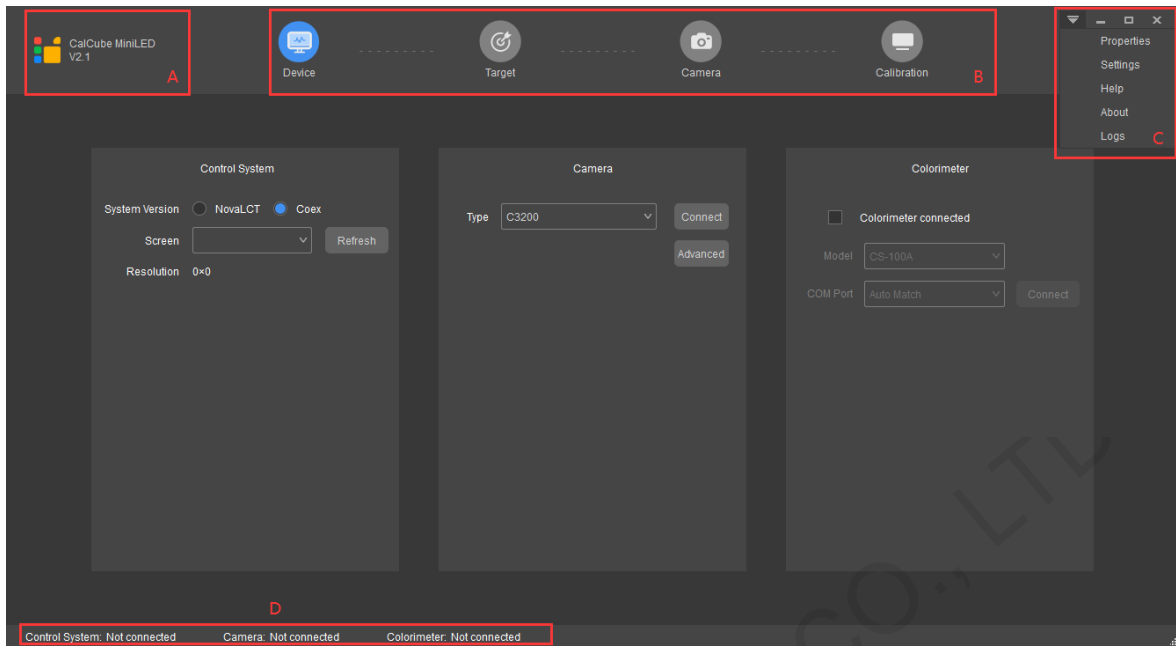
Figure 1-1 Navigation page



Area	Content	Description
A	CalCube MiniLED and logo	Software name and logo
	V2.1	Software version
B	Functions	Support screen calibration.
	Language	Supported UI languages: English and Simplified Chinese
C	Recent	: Open the selected project.
		: Delete the selected project.
D	Authorization File	Add an authorization file.
		: Add authorization files by choosing a folder. The software can find all the authorization files in a folder containing five subdirectories at most.
		: Delete the selected authorization file.
E	Dongle status	Display the dongle detection result: No dongles detected or The dongle was detected .
F	New	Create a screen calibration project file.
	Open Project	Open a screen calibration project file. The file extension is *.Nspro.

Main User Interface

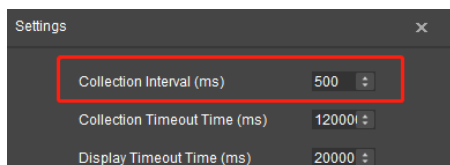
Figure 1-2 Main user interface



Area	Content	Description
A	CalCube MiniLED and logo	Software name and logo
	V2.1	Software version
B	Device	Connect the control system, camera and colorimeter devices.
	Target	Obtain the original values of LED display, set the calibration target values, etc.
	Camera	Set partition information and analyze image parameters obtained by camera.
	Calibration	Display the parameters used to calibrate the screen, including display control, brightness data, target values, etc.
C	Properties	View information such as project name, module size, and screen type.
	Authorization	Add or remove authorization files.
	Settings	Provide functions such as setting collection interval, software timeout, expanded module rows and columns, log save path, and more.
	Help	Open the software help document.
	About	Display the vendor information, including software name and version, company information, and official email address.
D	Logs	Provide a direct access to the directory where the relevant logs are located for users to easily obtain the logs.
	Control System	Display the control system connection status.
D	Camera	Display the camera connection status.
	Colorimeter	Display the colorimeter connection status.

Note:

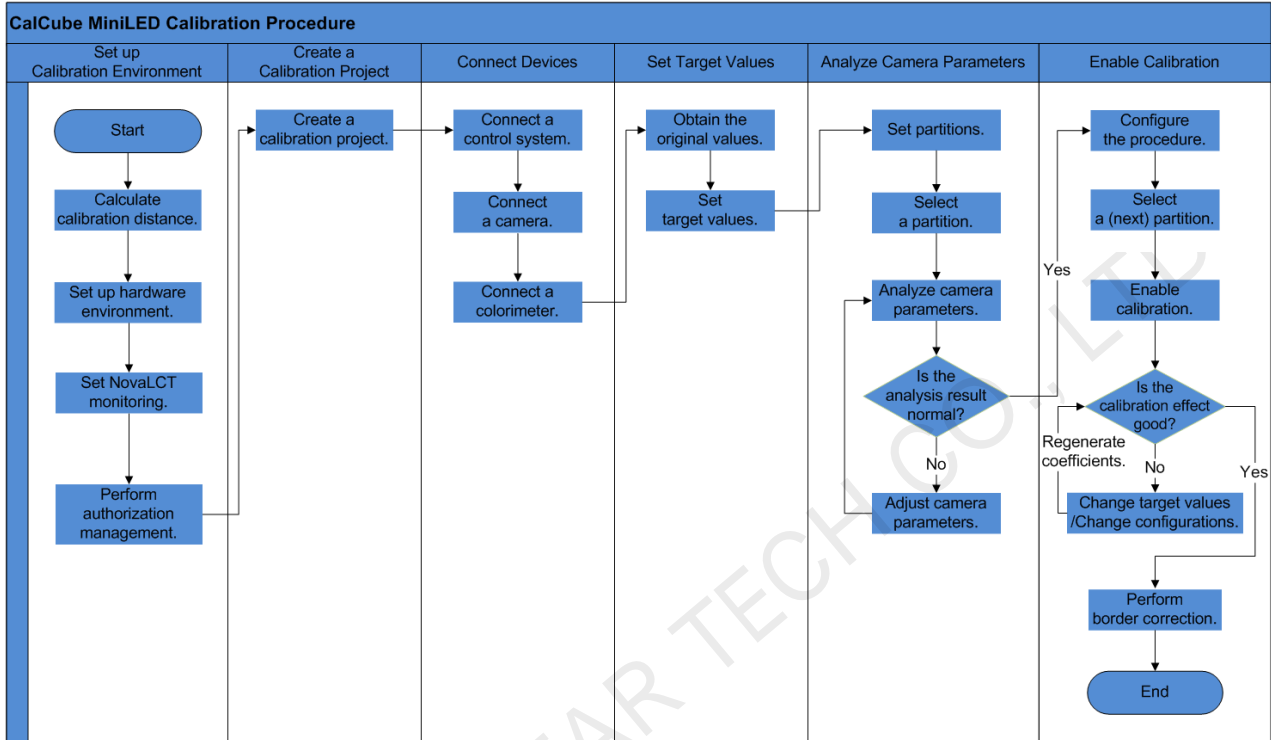
If the resolution of the screen to be calibrated is higher than 2K, select **Settings > Collection Interval** in area C to increase the number of interval appropriately.



2 Basic Calibration Procedure

The basic calibration procedure includes setting up calibration environment, creating a calibration project, connecting devices, setting target values, analyzing camera parameters and enabling calibration. The main procedure is shown in the figure below.

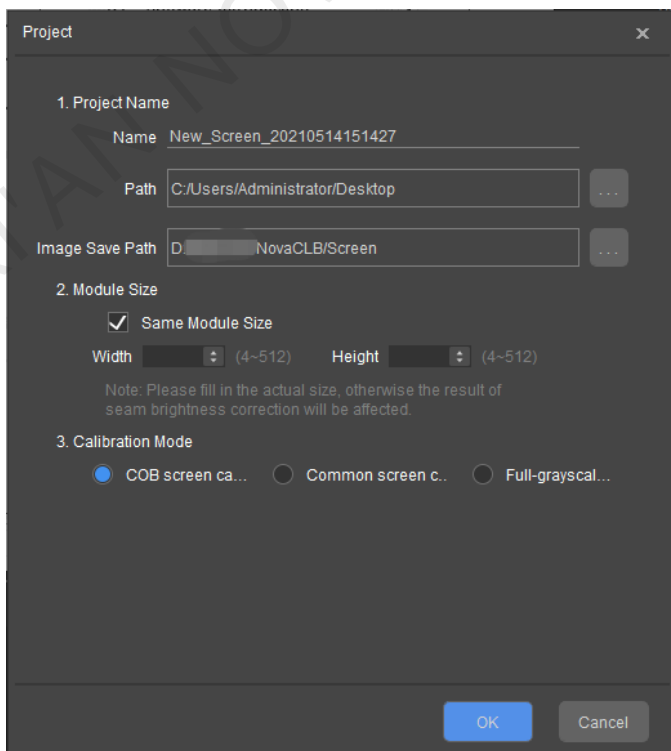
Figure 2-1 Main calibration procedure



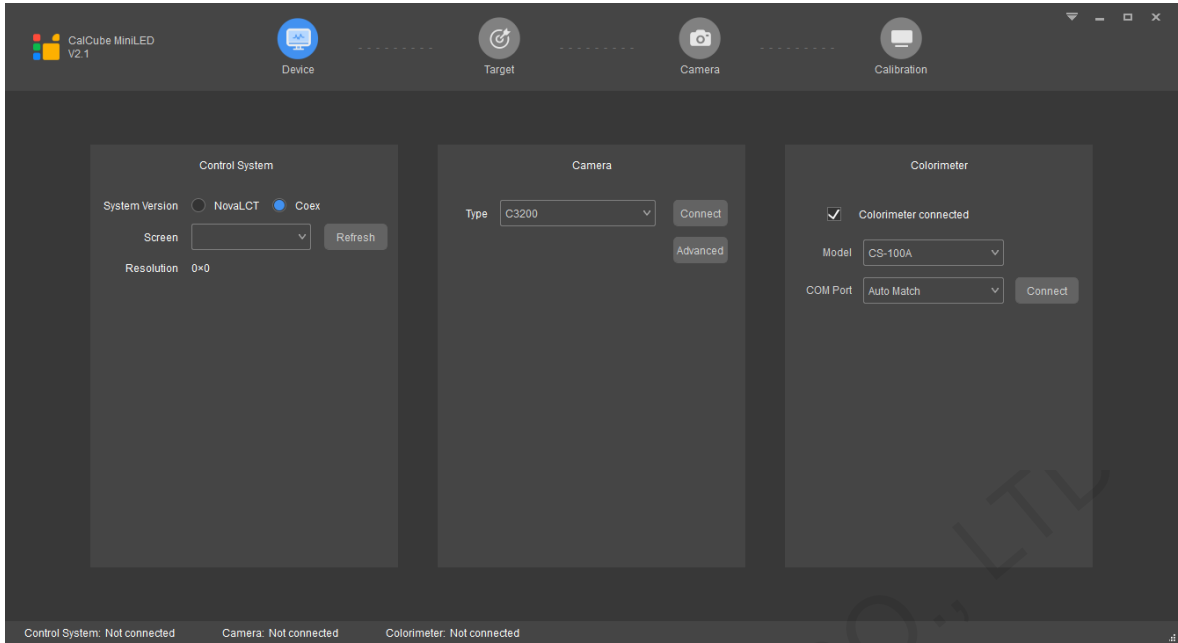
Overview of Main Calibration Procedure

Following the basic calibration procedure will satisfy the requirements of most on-site calibration scenarios.

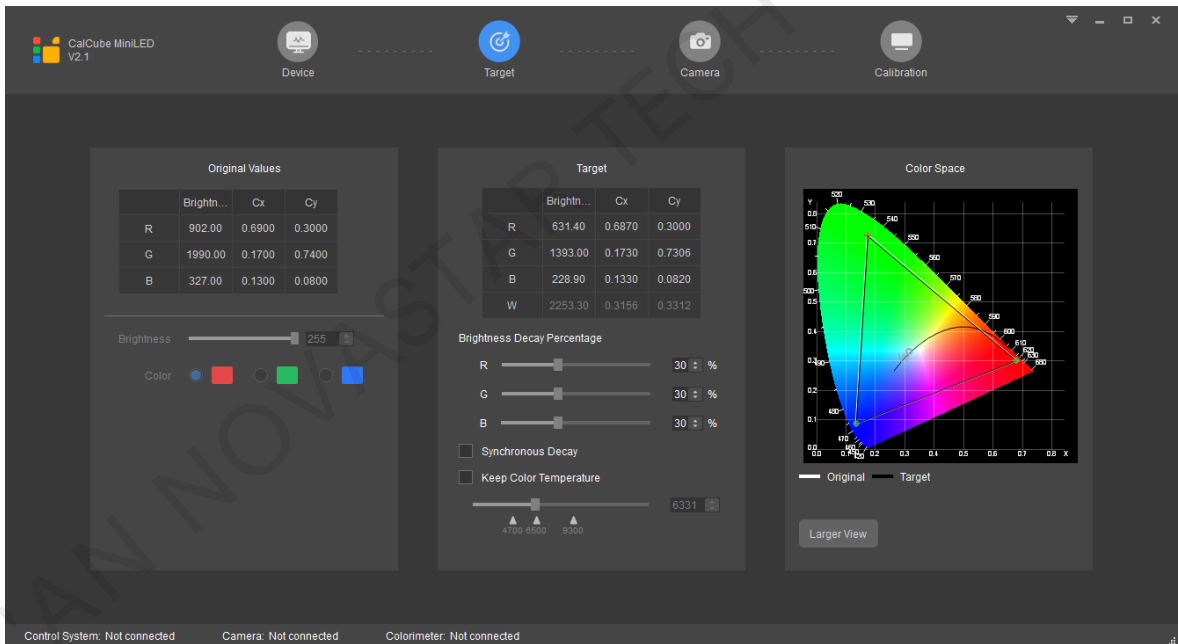
Step 1 Create a calibration project.



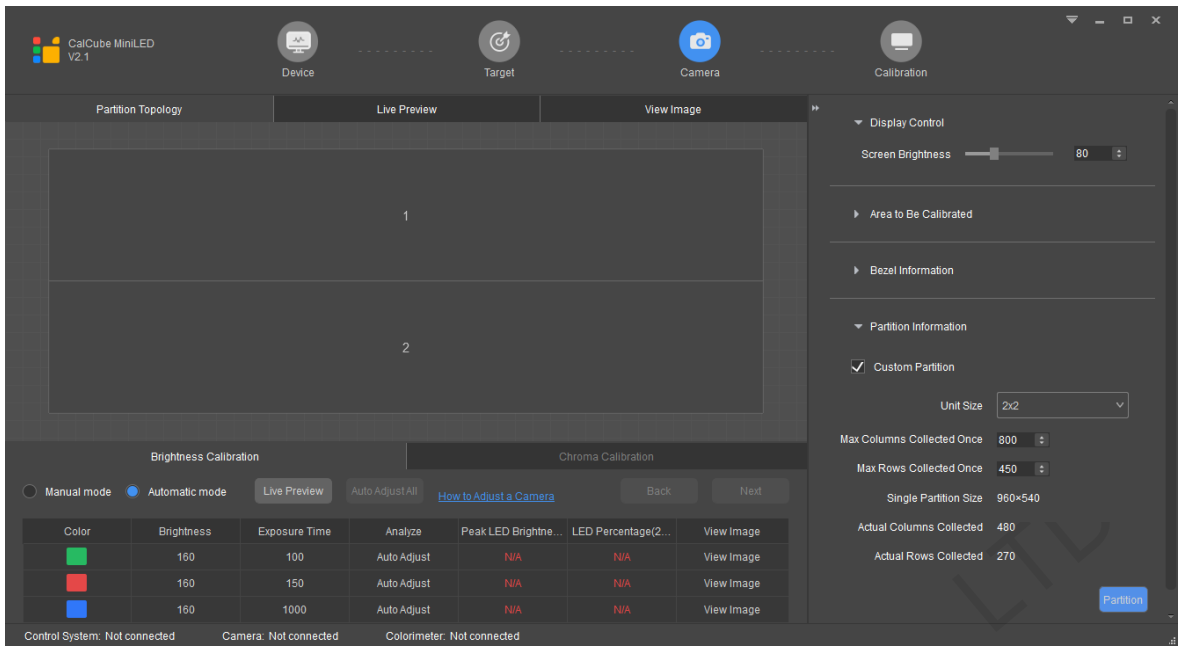
Step 2 Connect the control system, calibration camera and colorimeter devices.



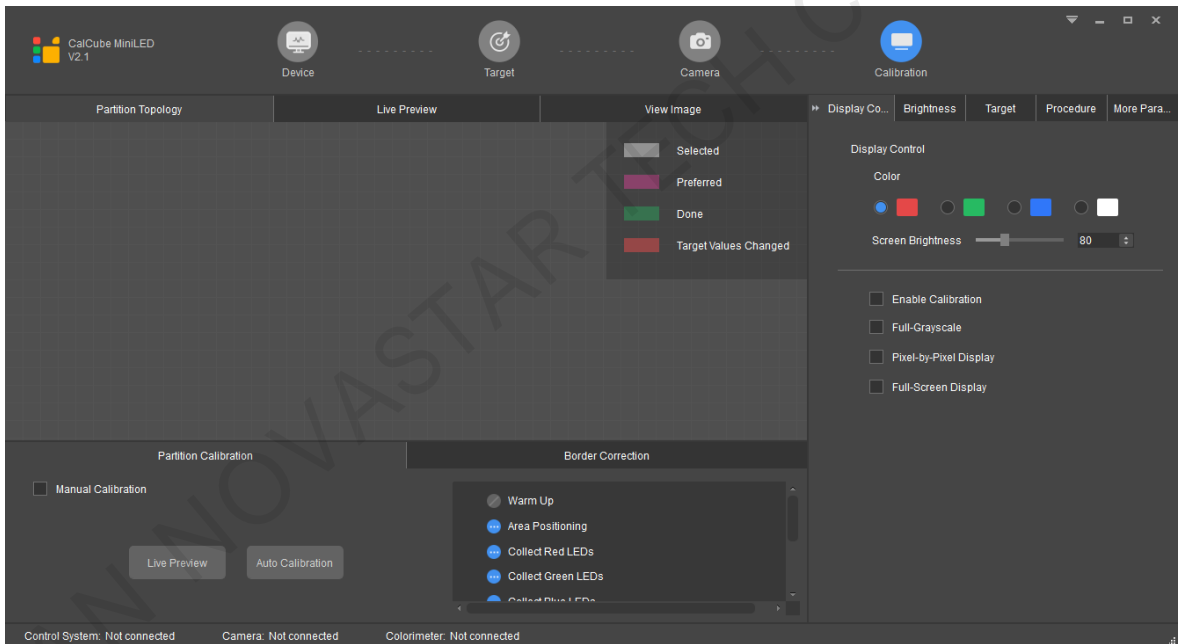
Step 3 Collect the original values of the display and set the target values.



Step 4 Set the partition information and adjust the camera parameters.



Step 5 Enable calibration.



3 Calibration Preparation

3.1 Set up Hardware Environment

3.1.1 Configuration List

Calibration Tools	Type	Description
Camera	C1200	Collect LED display images.
	C3200	
Colorimeter	CS-100A	Measure the original values of the LED display. A Colorimeter, such as light gun, color analyzer, or spectroradiometer, is a device that measures color characteristics of the LED display.
	CS-2000	
	CA-410	
Dongle	/	It is a USB dongle and contains the software authorization file.
Controller	/	Convert audio and video signals from the computer and send them to the LED display.
Router	/	Provide long-distance network connection.
Computer	Control computer	<ul style="list-style-type: none"> When the CalCube MiniLED software works with the NovaLCT control system, install NovaLCT on the control computer to control the LED display. When the CalCube MiniLED software works with the Coex control system, the software connects to the controller via Ethernet cable directly and no control computer is needed.
	Calibration computer	A computer installed with CalCube MiniLED software to calibrate the LED display

Note

If you use the C3200 for calibration, the recommended configuration for the calibration computer is as follows.

- CPU: 3.0 GHz or greater
- RAM: 16 G or greater
- Network adapter: Intel(R) Ethernet Connection network adapter
- Operating system: Windows 10 (64-bit)

Required System	Name	Version
Control system	NovaLCT	V5.3.1 or later
	Coex	V1.0.0 or later

3.1.2 System Architecture

Figure 3-1 System architecture - one computer used

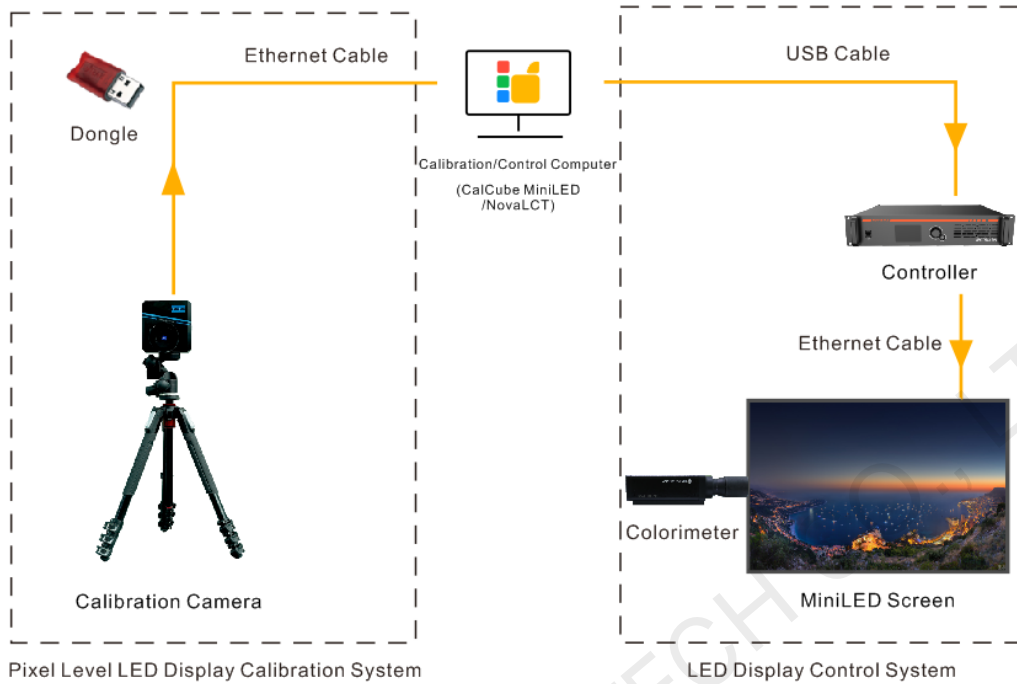
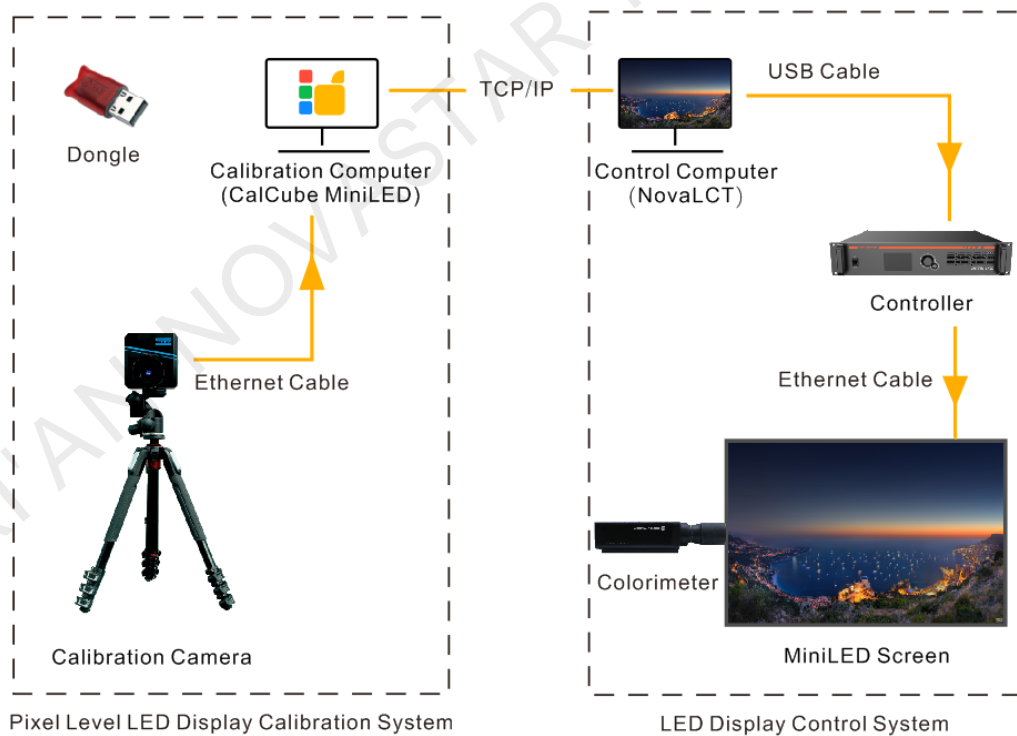


Figure 3-2 System architecture - two computers used



Note:

- Before calibration, make sure that the calibration computer and graphics card have the same resolution and the scale is set to 100%. In addition, scaling must be disabled on the controller.

- When the CalCube MiniLED software works with the Coex control system, the software connects to the controller via Ethernet cable directly and only one computer is enough. There is no distinction between control computer and calibration computer.

3.1.3 Calibration Environment

Light Requirements

Ensure the following calibration site requirements are met:

- There is no external light interference during the calibration process and there is no obvious light around the screen.
- There is no infrared light emitting equipment (such as infrared light-sensing camera) at the camera alignment position.

Calibration Distance

- Fixed-focus lens

When using a fixed-focus lens for calibration, make sure that the LED display image is in the center of the preview area and takes only 4/5 of the preview area.

For example, when calibrating a COB screen with a pixel pitch of P0.9, the best distance for 4K screens is 7 m to 8 m, and the best distance for 2K screens is 3 m to 4 m.

Note:

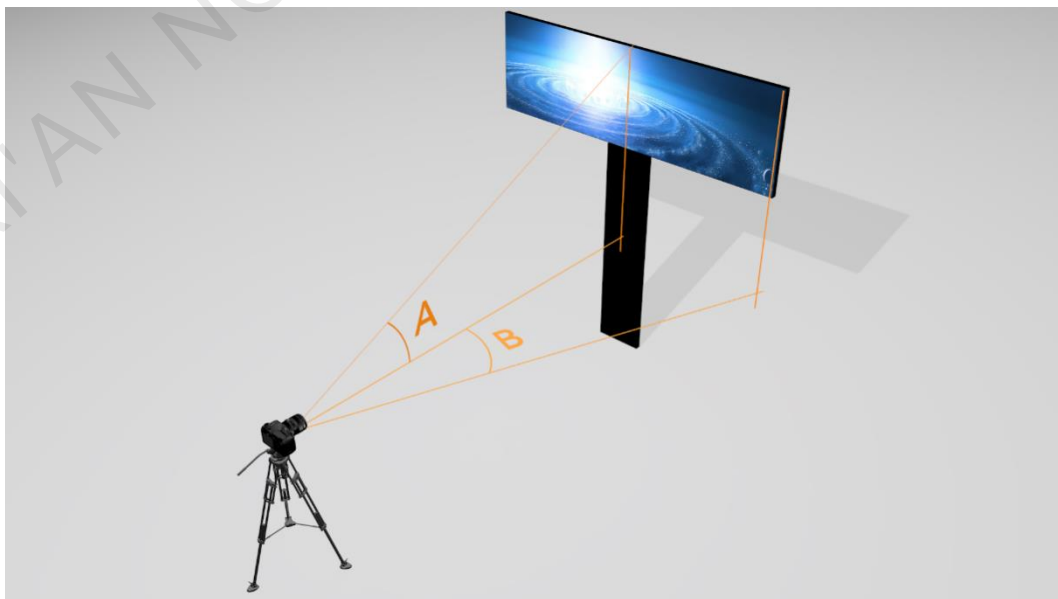
The camera lens needs to be perpendicular to the center of the screen (left and right center + up and down center) to avoid a large angle, otherwise abnormal results such as Moiré are likely to occur.

- Zoom lens

The calibration distance for a zoom lens can be calculated using the angle calculation method.

- Step 1 Face the camera to the LED display and place the camera on the center line between the left and right sides of the display.
- Step 2 Ensure the angle between the perpendicular line from the camera to the LED display and the line from the camera to the 4 edges of the LED display must be less than 30° . As illustrated in [Figure 3-3](#), both angle A and B must be less than 30° .

Figure 3-3 Illustration of calibration angle



3.2 Configure Software Environment

3.2.1 Network Connection

When the CalCube MiniLED software works with the NovaLCT control system, network connection settings are required. When the CalCube MiniLED software works with the Coex control system, the software connects to the controller via Ethernet cable directly and there is no distinction between control computer and calibration computer. In this situation, skip this section.

- If the control computer and calibration computer are the same one:
No network connection is required. The entire calibration procedure can be completed on the single computer.
- If the control computer and calibration computer are separate:
If the distance between the two computers is within 100 meters, use Ethernet cables to connect them directly.
If the distance is greater than 100 meters, connect them wirelessly.
 - Cable connection: Connect the computers to the LAN ports of the router with Ethernet cable.
 - Wireless connection: Connect the computers to the Wi-Fi of the router.

With cable connection or wireless connection, IP addresses of the two computers and the default IP address of router must be on the same network segment when a control system is connected for calibration.

Figure 3-4 Connection method

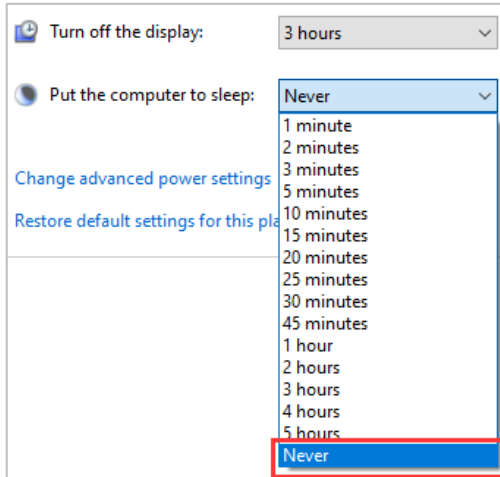


Note:

- When two computers are used, the calibration computer's Ethernet port needs to be connected directly to the C3200 camera. To realize communication between the calibration computer and control computer, connect a HUB that converts USB to Ethernet port to a USB port of the calibration computer.
- The control computer and calibration computer can be laptop or desktop computer.

3.2.2 Disable Computer Sleeping

- Step 1 Right-click a blank area on the desktop of the control computer and select **Personalize**.
- Step 2 On the displayed page, select **Screen Saver** in the lower right corner.
- Step 3 Choose Change power settings > Change plan settings.
- Step 4 Set the computer sleeping settings to **Never**.

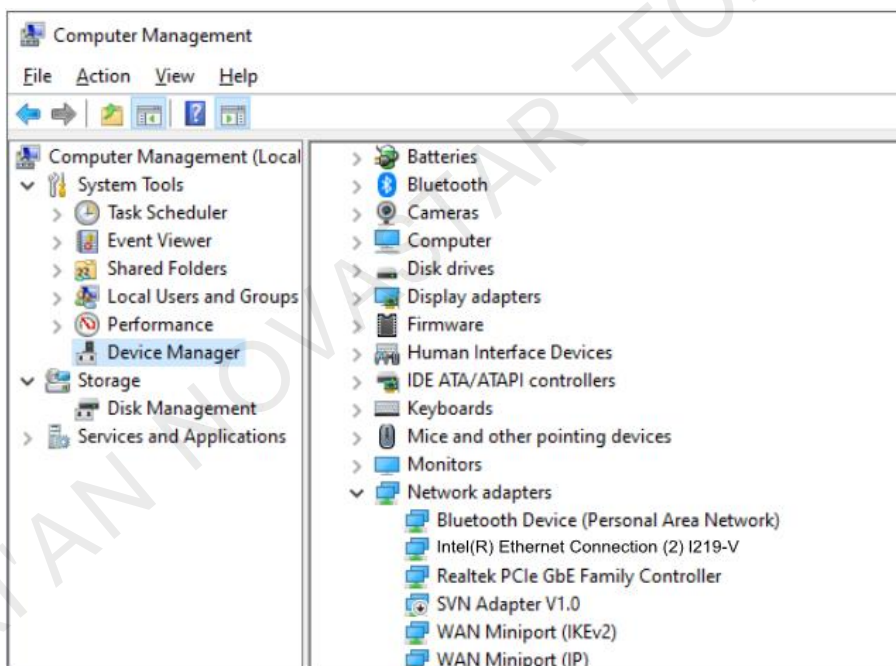


3.2.3 Jumbo Packet Settings

If you use the C3200 for calibration, the calibration computer requires jumbo packet settings. If you use the C1200, ignore this section.

Step 1 Right-click the **Computer** icon on the desktop and select **Manage** to open the **Computer Management** page.

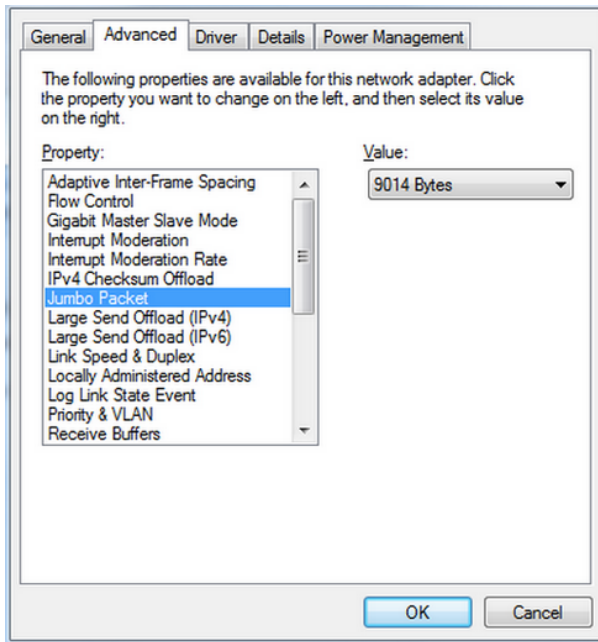
Step 2 Click **Device Manager** on the left panel and then select **Network adapters**.



Step 3 In the drop-down options under **Network adapters**, double-click the computer's primary network adapter. At the same time, make sure that the C3200 calibration camera is connected to the computer's primary network adapter.

Step 4 In the displayed properties window, click the **Advanced** tab and change the following adapter parameters.

- Set **Jumbo Packet** to 9014 Bytes.



- Set **Receive Buffers** to 2048.

Step 5 Click **OK**.

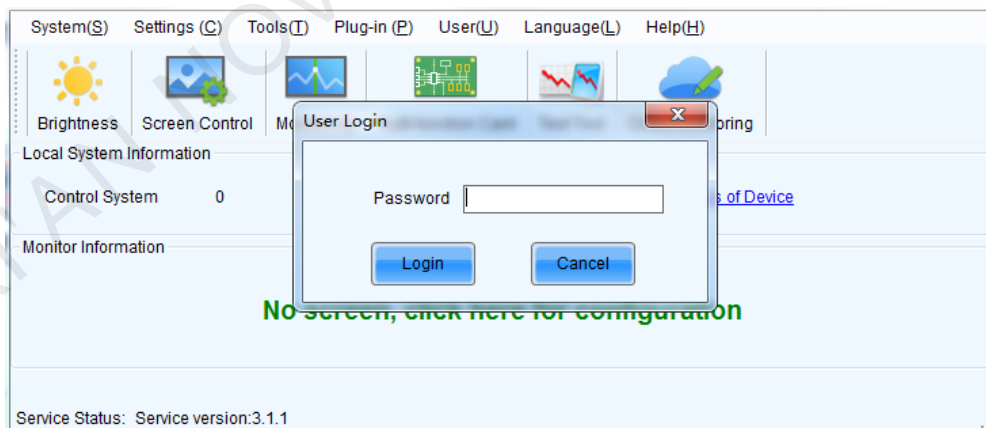
3.3 Enable NovaLCT Monitoring

If the CalCube MiniLED software works with the NovaLCT control system, listening settings are required. If the Coex control system is used, ignore this section.

Step 1 Open NovaLCT and ensure good communication between the calibration computer and control computer.

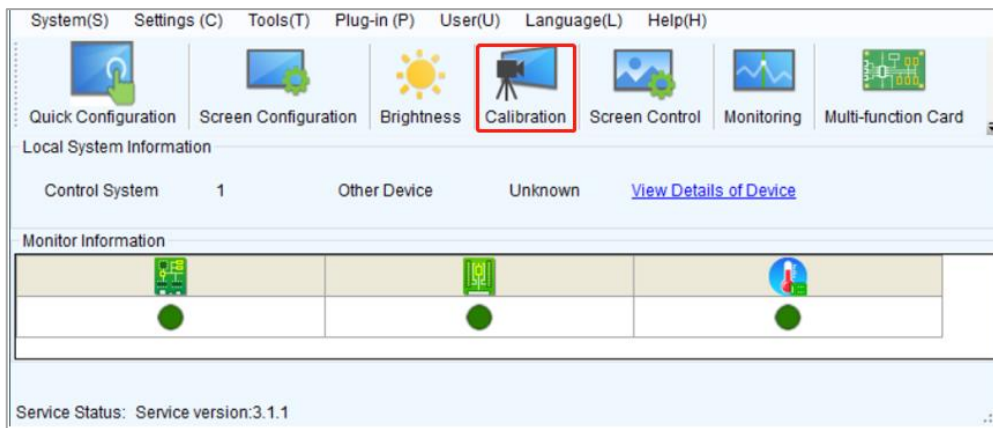
Step 2 Choose **User > Advanced Synchronous System User Login**, enter the password (initial password: admin), and click **Login**.

Figure 3-5 Login



Step 3 Click **Calibration** to open the calibration page.

Figure 3-6 Calibration button

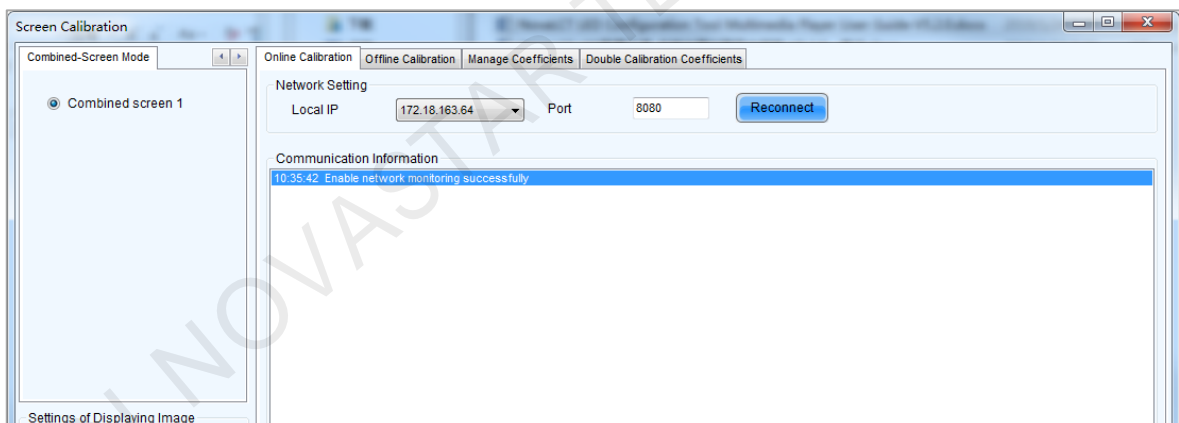


Step 4 On the Screen Calibration page, set Local IP and Port under Network Setting.

- Local IP: Indicates the IP address of the control computer. This IP address and the IP address of the calibration computer must be on the same network segment.
- Port: The default value is 8080.

If a message saying **Enable network monitoring successfully** is displayed, the monitoring settings are done in NovaLCT. If a message indicating that monitoring failed is displayed, please check whether the network connection is normal and whether there is a port conflict. If there is a conflict, change the port number and try again.



Figure 3-7 Ready for calibration

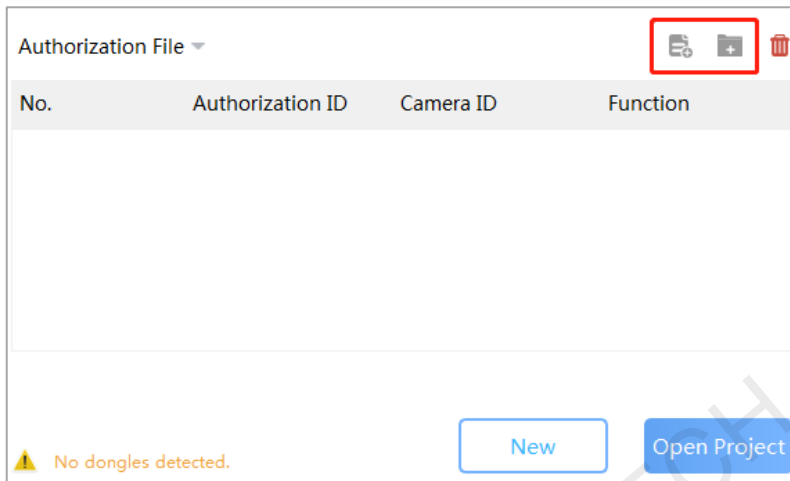


3.4 Enable Authorization

The authorization management method of CalCube MiniLED is that a dongle and an authorization file are bonded. A dongle corresponds to an authorization file. Both the dongle and authorization file are required. The authorization file can be obtained from the USB drive provided along with the software.

Step 1 Open CalCube MiniLED and insert the dongle into the USB port of the calibration computer.

Step 2 In the **Authorization File** area, click  or  to import the authorization file corresponding to the dongle. The software will search for and find all the authorization files in a folder containing five subdirectories at most, and import them to the software.



Note:

1. During authorization file importing, if both the newly imported camera ID and authorization ID are the same as the authorization information imported earlier, the new information will replace the old information by default.
2. During authorization file importing, if the newly imported camera ID is the same as the camera ID imported earlier but the new and old authorization IDs are different, the software will automatically add the new authorization file.
3. A camera ID can correspond to more than one authorization ID, but an authorization ID can correspond to only one camera ID.

4 Create a Calibration Project

Step 1 Click the **Screen Calibration** button to open the project page.

Step 2 (Optional) On the displayed **Project** page, change the project name.

The project name defaults to "New_Screen_YearMonthDayHourMinuteSecond". The project name can contain Chinese characters, English letters, numbers and underlines. You are advised to use an easy-to-understand project name, for example, "Screen_20190514190954".


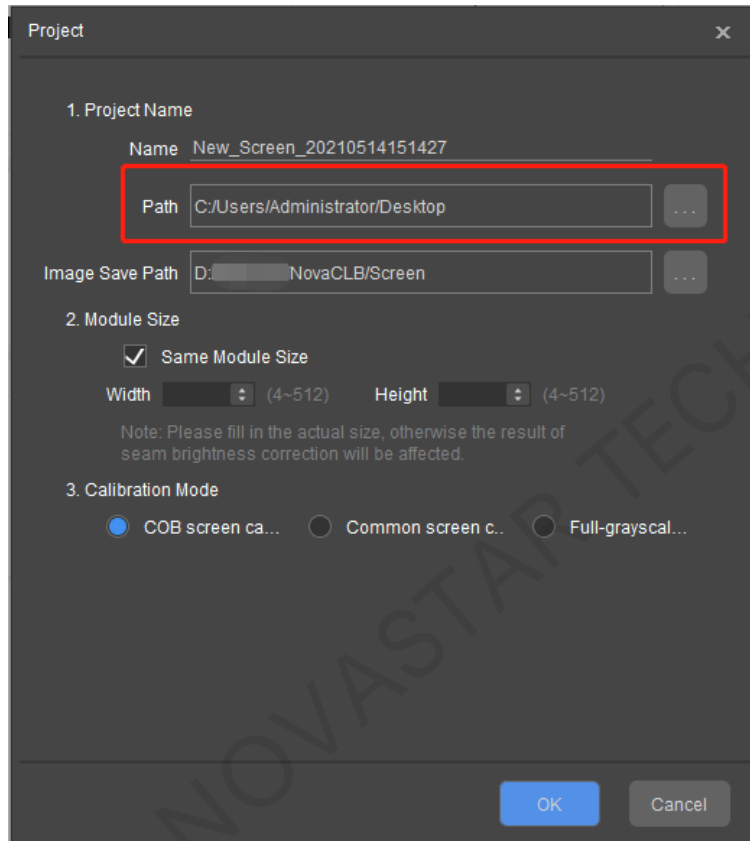
Step 3 Click  next to **Path** to choose a path to save the project. The default path is desktop.

Figure 4-1 Choosing project save path



The screenshot shows a dialog box titled "Project" with the following fields and options:

- 1. Project Name**
 - Name: New_Screen_20210514151427
 - Path: C:/Users/Administrator/Desktop (highlighted with a red box)
 - Image Save Path: D:\NovaCLB/Screen
- 2. Module Size**
 - Same Module Size
 - Width: [dropdown] (4~512) Height: [dropdown] (4~512)
 - Note: Please fill in the actual size, otherwise the result of seam brightness correction will be affected.
- 3. Calibration Mode**
 - COB screen ca...
 - Common screen c..
 - Full-grayscale...

Buttons: OK, Cancel


Step 4 Click  next to **Image Save Path** to choose a path to save the images. The default path is **Documents/NovaCLB/Screen**.

Figure 4-2 Choosing image save path

The screenshot shows a 'Project' dialog box with the following fields and options:

- 1. Project Name:** Name: New_Screen_20210514151427; Path: C:/Users/Administrator/Desktop
- Image Save Path:** D:\NovaCLB\Screen (highlighted with a red rectangle)
- 2. Module Size:** Same Module Size; Width: 4~512; Height: 4~512. Note: Please fill in the actual size, otherwise the result of seam brightness correction will be affected.
- 3. Calibration Mode:** COB screen ca...; Common screen c...; Full-grayscale...

Buttons: OK, Cancel

Step 5 Check whether the sizes of modules are the same. They are the same by default.

- Same: Go to Step 6.
- Different: Got to Step 7.

Step 6 Enter Module Width and Module Height values.

Note:

Please enter the values according to the actual module size to ensure a perfect transition of differences between modules after calibration.

Step 7 Deselect **Same Module Size** to skip module size setting.

Step 8 Select a calibration mode from **COB screen calibration**, **Common screen calibration** and **Full-grayscale calibration**.

- For common COB screens, select **COB screen calibration**.
- To ensure good calibration effect at middle-grayscale level and low-grayscale level and if the calibration site has a complete set of Coex control system, select **Full-grayscale calibration**.
- For common screens, select **Common screen calibration**.

Step 9 Click **OK** to finish creating a project and enter the main user interface.

5 Calibration Operation Instructions

5.1 Device

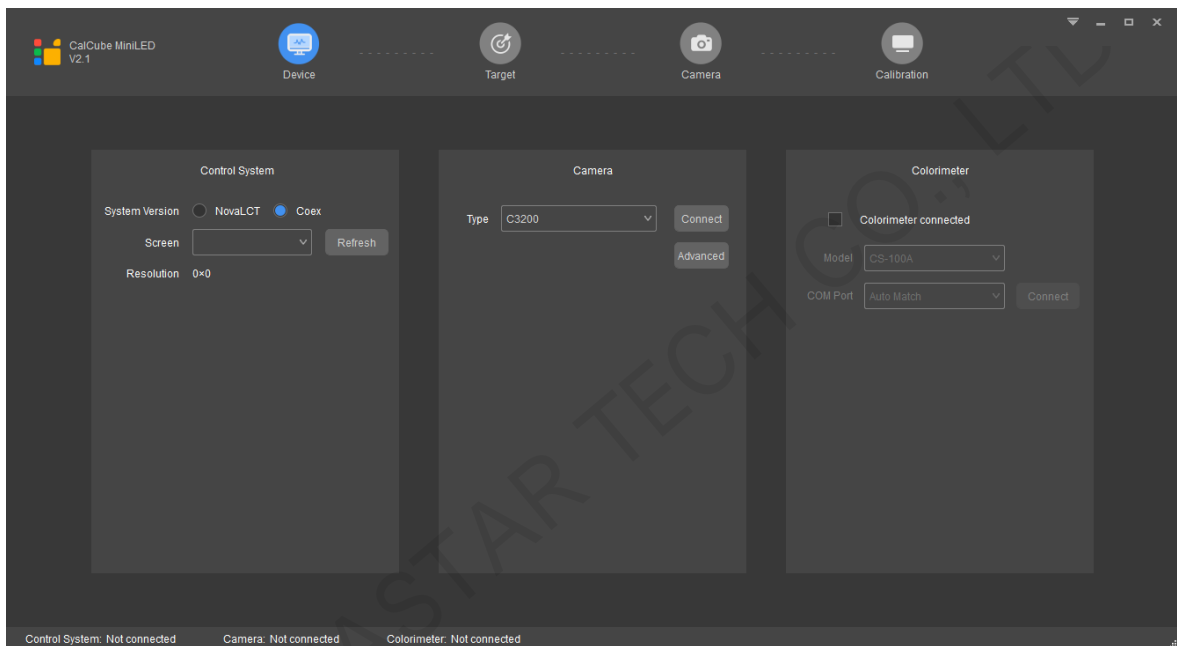
5.1.1 Connect a Control System

Coex Control System

Step 1 Click **Refresh** and the Coex control system will be automatically connected.

After successful connection, **Coex** will be displayed next to **Control System** in the status bar at the bottom.

Figure 5-1 Connecting the Coex control system



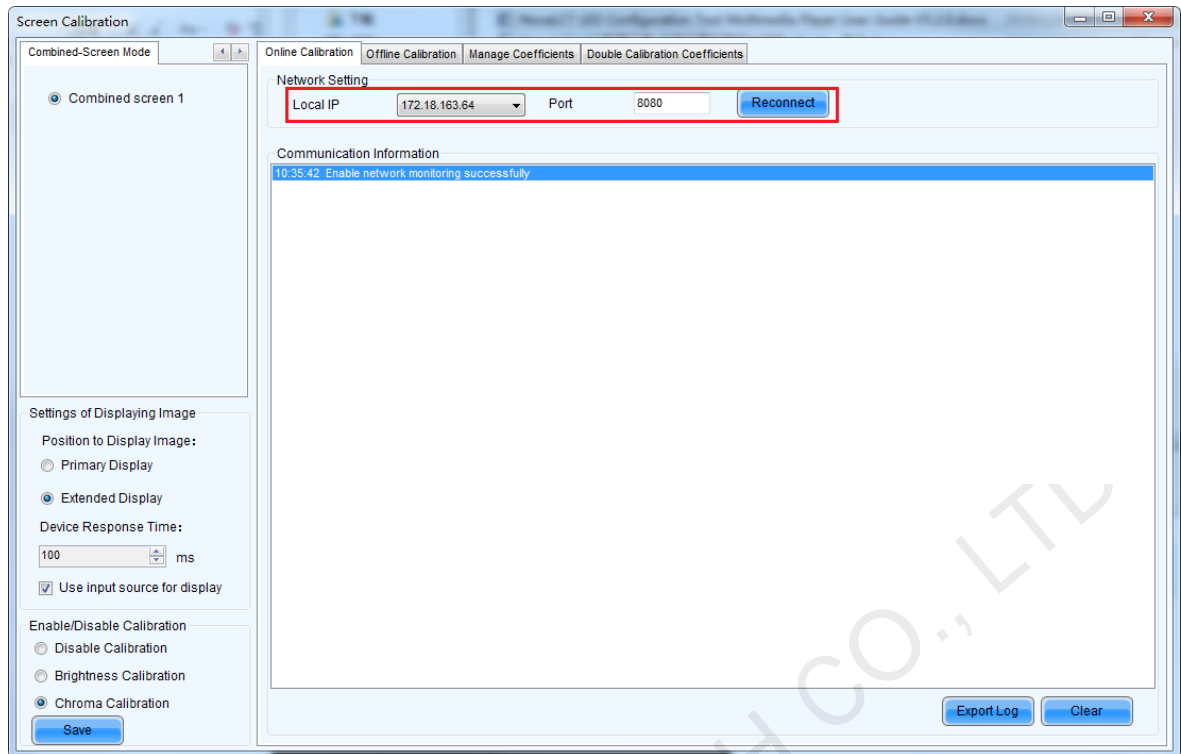
Step 2 Click next to **Screen** to select the screen to be calibrated.

Resolution shows the current screen resolution that is read from Coex. If you want to change the resolution, please reconfigure the screen size first.

NovaLCT Control System

Step 1 Obtain the IP address and port number from the **Screen Calibration** page in NovaLCT.

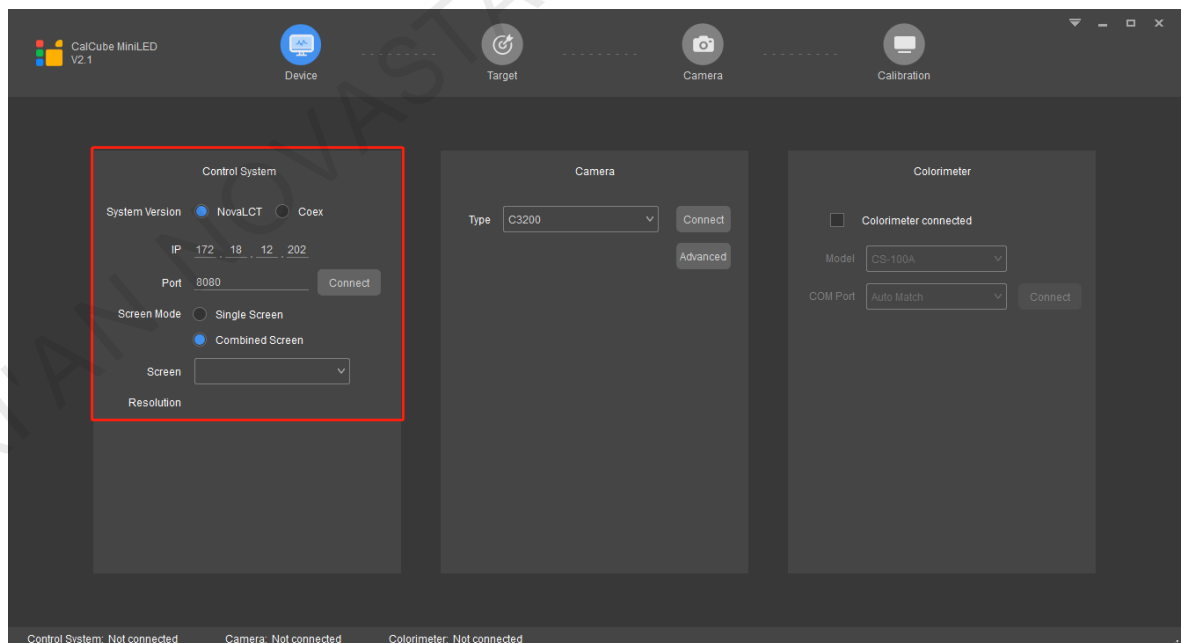
Figure 5-2 Network setting in NovaLCT



Step 2 On the **Device** page in CalCube MiniLED, enter the obtained information in the **IP** and **Port** boxes in the **Control System** area, and click **Connect**.

After NovaLCT is successfully connected, NovaLCT will be displayed next to **Control System** in the status bar at the bottom.

Figure 5-3 Control system information



Step 3 Choose a screen mode according to the on-site screen assembly mode, either single screen or combined screen.

Step 4 Click next to **Screen** to select the screen to be calibrated.

Resolution shows the current screen resolution that is read from NovaLCT. If you want to change the resolution, please reconfigure the screen size first according to *NovaLCT LED Configuration Tool for Synchronous System User Manual*.

Note:

If the control system connection failed, please check to make sure:

1. The firewall has been logged out or closed (only when the control computer and calibration computer are separate).
2. The control system is running normally.
3. The authorization file you loaded is correct.
4. The dongle you inserted matches the camera.
5. The calibration computer and control computer are on the same network segment.

5.1.2 Connect a Camera

CalCube MiniLED supports the Caliris industrial cameras, including the C1200 and C3200 models.

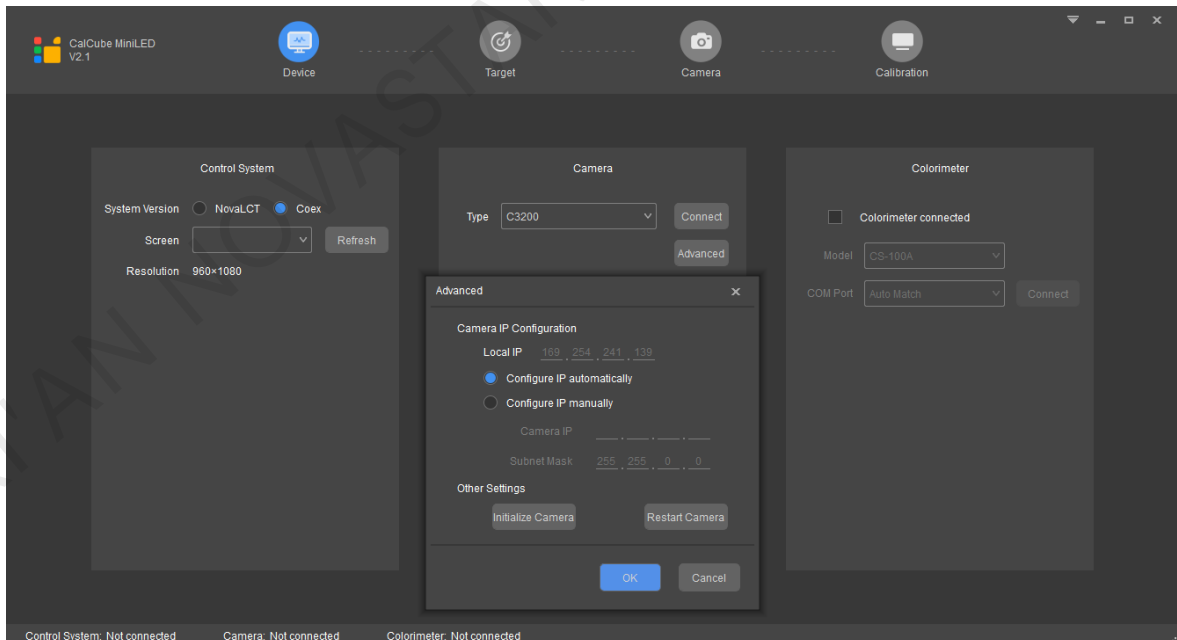
Connect the C1200

- Step 1 Plug in the camera and connect it to the calibration computer using the USB cable. After the camera body light turns green, click **Connect** in the **Camera** area in CalCube MiniLED.
- Step 2 After successful connection, a prompt saying "Camera connected successfully" is displayed and the model of the connected device is displayed next to **Camera** in the status bar at the bottom.

Connect the C3200

- Step 1 Plug in the camera and connect it to the calibration computer using the USB cable. After the camera body light turns green, click **Connect** in the **Camera** area in CalCube MiniLED.
- Step 2 When you connect the C3200 camera for the first time for calibration, click the **Advanced** button and select **Initialize Camera** to adjust the collection efficiency of the C3200 to the best.

On this window, you can also configure the camera IP address manually or restart the camera if needed.



- Step 3 After successful connection, a prompt saying "Camera connected successfully" is displayed and the model of the connected device is displayed next to **Camera** in the status bar at the bottom.

Note:

Because the C3200 camera has a compatibility issue with some computers and causes connection failure, you can reconnect the camera by disabling the network adapter connected to the C3200 and re-enabling it.

The camera can be managed by using the tool that is installed together with CalCube MiniLED. For details, see [6.2 Auxiliary Tool for C3200 Camera](#).

5.1.3 Connect a Colorimeter


The colorimeter is used to measure the brightness and chroma of the current screen. The tool is optional. The measured values are the original values of the LED screen.

Step 1 Check whether a colorimeter is connected in the calibration environment.

- Connected: Go to Step 2.
- Not connected: Skip this section.

Step 2 Install a colorimeter driver program on the calibration computer.

Step 3 Select Colorimeter connected.

Step 4 Click  next to **Model** to select the model of the connected colorimeter.

Step 5 Click  next to **COM Port** to select the COM port number.

Note:

If the corresponding port number is not listed, follow the steps below to troubleshoot:

Step I: Check whether the connection between the colorimeter and calibration computer is normal.

- Normal: Go to [Step II](#).
- Abnormal: Reconnect the colorimeter to the calibration computer, restart the software, and go to [Step 5](#).

Step II: Check whether the device driver is normal.

- Normal: Please contact NovaStar technical support.
 - Abnormal: Install the colorimeter driver again, restart the software, and go to [Step 5](#).
-

Step 6 After settings, click **Connect**.

After successful connection, an actual colorimeter model such as CS-2000, CS-100A, or CA-410 will be displayed next to **Colorimeter** in the status bar at the bottom.

If you do not select **Colorimeter connected**, you will not need to use colorimeter to measure the original values. The **Model** and **COM Port** will be grayed out and unavailable.


5.2 Target

5.2.1 Obtain Original Values

Original values are the brightness and chroma information of the LED display before calibration. They are measured by the colorimeter. Please obtain as accurate as possible the original values, which can improve the calibration quality of the LED display.

- Measure original values manually

Step 1 Set the display brightness for measuring the original values of the display. Once you have set the brightness and started measuring the red, green and blue colors, you cannot change the brightness value. There are 3 methods to set brightness:

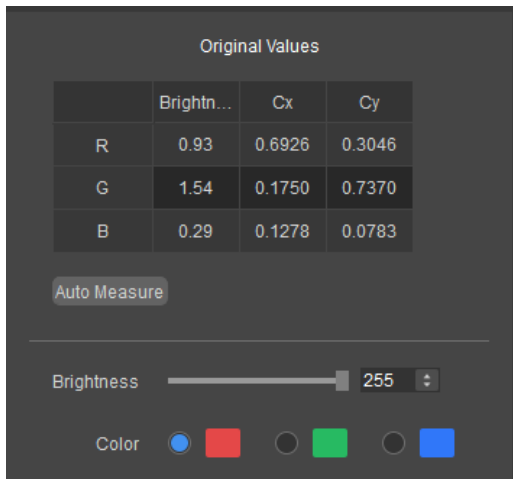
- Drag the slider.
- Click .
- Enter a value.

Step 2 Select one color to be measured at a time, such as red, green and blue.

- Measure original values automatically

If the colorimeter is connected to the software, click **Auto Measure**. The software will automatically read and display the original brightness and chroma values.

Figure 5-4 Automatic measurement

**Note:**

To calibrate MiniLED screens, a colorimeter must be used to measure the original values. In this way, the calibration result can be better and the target values can be modified based on the calibration result after the calibration is complete.

5.2.2 Set Target Values

Target values are the brightness and chroma values you expect for the LED screen after calibration. The system will automatically generate a group of target values based on the measured original values. The recommended values can be used for common COB screens.

You can also customize the target values based on the on-site requirements, but the value of each target value parameter cannot exceed the value of each original value parameter.

Customize Target Values

There are two methods to customize target values.

- Enter values

Double click a value of **Brightness**, **Cx** or **Cy**, and enter a target value with the keyboard.

Cx is x-coordinate in the color space and Cy is the y-coordinate.

Every time you change a parameter value, the **Brightness Decay Percentage** and **Color Space** diagram will be updated correspondingly.

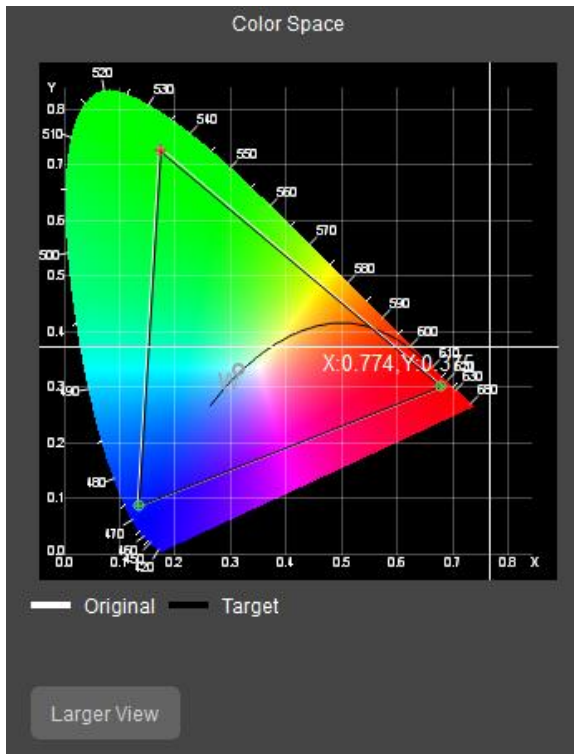
- Change the brightness decay percentage or color temperature, and the color space diagram together

There are two methods to adjust the brightness:

- Drag the R, G and B sliders under **Brightness Decay Percentage** to set the brightness decay. If you select **Synchronous Decay**, the R, G and B brightness will be reduced in the same proportion when you adjust any of them.
- Select **Keep Color Temperature** and adjust the color temperature. You can directly use a recommended color temperature value below the slider bar.

You can move the mouse to change the coordinates in the color space and adjust the chroma. Chroma and brightness changes can be viewed in real time in the target value table.

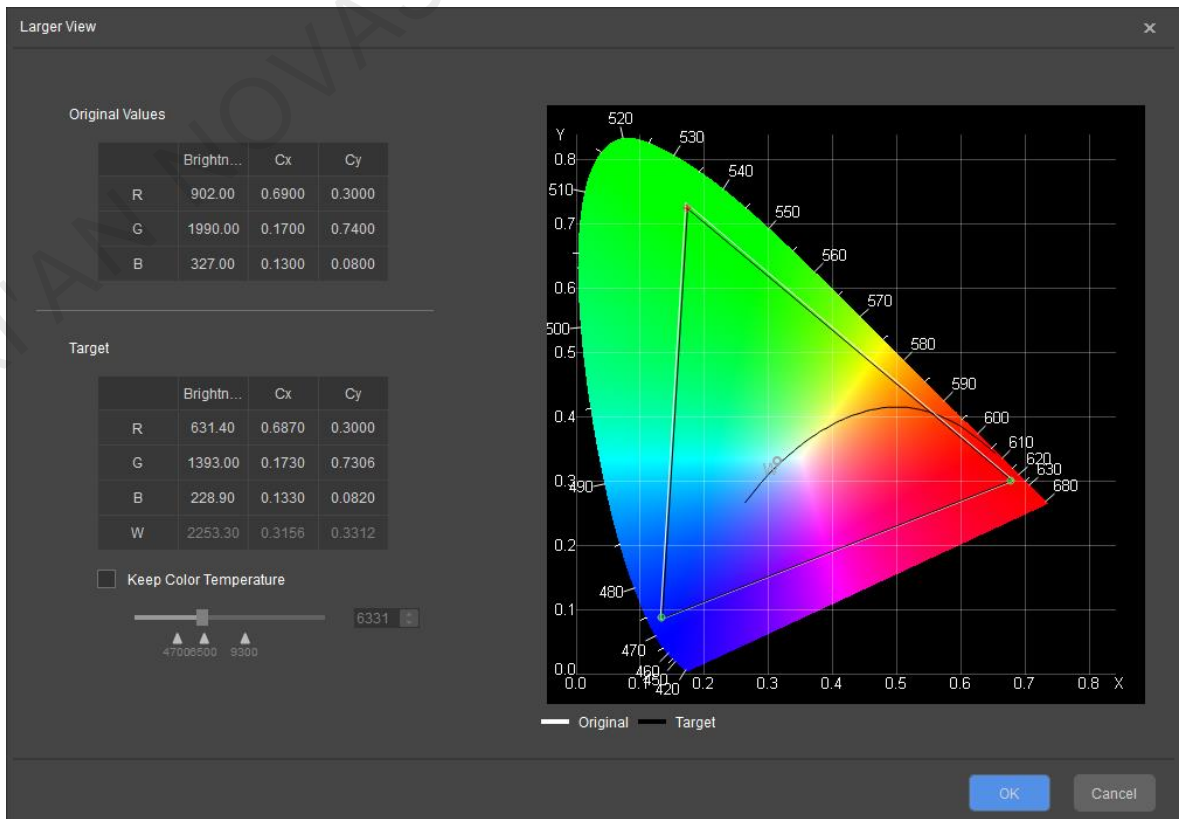
Figure 5-5 Color space



In Figure 5-5, the white triangle represents the original color gamut, namely the original brightness and chroma values measured by the colorimeter. The black triangle represents the target color gamut. The figure above also shows the area of the current color gamut that will be lost after adjustment. When you drag the black triangle to change its size, the target brightness and chroma values change accordingly in real time. The black triangle cannot go beyond the white triangle when you are dragging. That is to say, target values cannot be greater than the original values.

You can click Larger View to enlarge the color space diagram to adjust target values more precisely.

Figure 5-6 Larger view of color space diagram



Note:

If you have enabled the **Generate Target Values** function on the **Custom Procedure** page, calibration coefficients will be generated based on the target values that are automatically generated by the software. The target colour gamut set by you will not take effect.

5.3 Camera

5.3.1 Set Partition Information

If the screen resolution is very high, the camera cannot collect image of the entire screen in just one time. You must divide the screen into multiple partitions for calibration.

Figure 5-7 Partition settings

Step 1 Check whether the screen has blocked parts or a bezel.

- No: Go to Step 2.
- Yes: Set the area to be calibrated or the bezel information. For details, see 5.3.3 Set Areas to Be Calibrated and 5.3.4 Set Bezel Information.

Step 2 Click the **Partition** button.

The system will automatically calculate the partition according to the screen resolution and the resolution of the image collected by the camera, and automatically set the unit size and partition information.



When the C3200 is used and you click the **Partition** button for the first time, a **How to Adjust a Camera** page will be displayed, guiding you on camera settings.

Step 3 View the partition size and unit size to determine whether customizing partition is necessary. If the saturation and image size are improper after camera parameter adjustment, you can change the unit size to change the pixel pitch and let the parameter analysis result become normal.

- Necessary: Go to Step 4.
- Unnecessary: Go to Step 5.

Note:

You are advised to set the unit size to 3x3 for 2K screens and 5x5 for 4K and larger screens.

Step 4 Select **Custom Partition** and click  to select a unit size. Then, enter numbers or click  to set **Columns Collected Once** and **Rows Collected Once**. The information of a single partition will be displayed next to **Single Partition Size**. At last, click the **Partition** button to confirm the partition information.

- Unit Size: Indicates the number of isolated LEDs. A total of 10 options are available: 1x1, 2x2, 3x3, 4x4, 5x5, 6x6, 7x7, 8x8, 9x9, 10x10.
- Max Rows Collected Once: Indicates the number of LED rows that can be collected each time.
- Max Columns Collected Once: Indicates the number of LED columns that can be collected each time.

The values of **Max Rows Collected Once** and **Max Columns Collected Once** cannot be greater than the maximum resolution of the image that can be collected by the camera.

Maximum resolution for the C1200: 480x330

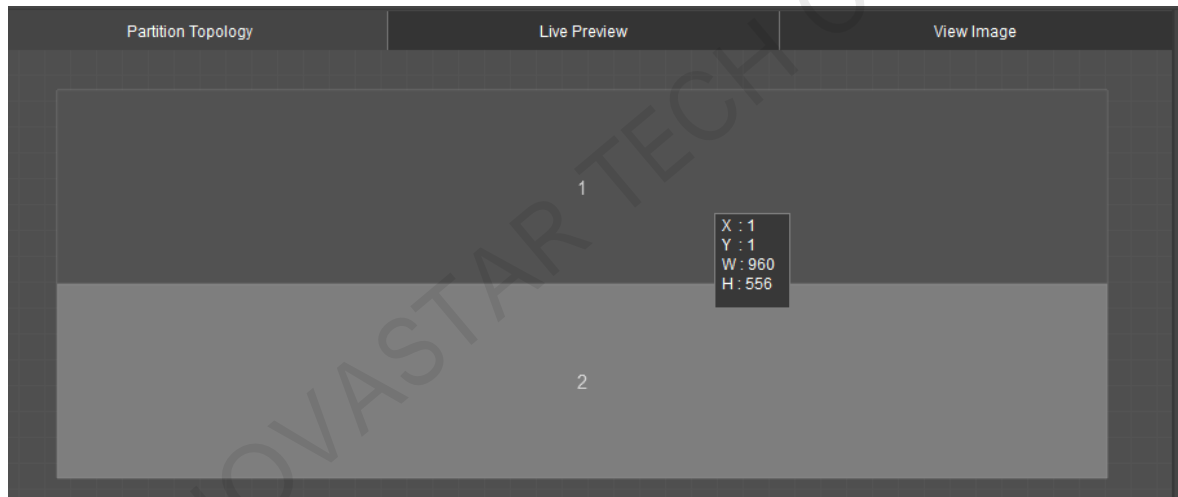
Maximum resolution for the C3200: 1050x650

- Single Partition Size: Indicates the resolution of a single partition.

The LED display will not be partitioned strictly according to the numbers of rows and columns you set to collect each time. There will be some smart adjustments. For example, if the resolution of the area to be calibrated is 208x208 and the rows and columns collected each time are set to 128x128, the software will change the size of a single partition to 104x104.

Step 5 Select a partition on the **Partition Topology** tab page. The selected area becomes light gray. When you move the mouse to the partition, the X, Y, W and H values will be displayed.

Figure 5-8 Selecting a partition



- X: Indicates the horizontal initial coordinate of the selected partition.
- Y: Indicates the vertical initial coordinate of the selected partition.
- W: Indicates the horizontal width of the selected partition.
- H: Indicates the vertical height of the selected partition.

Note:

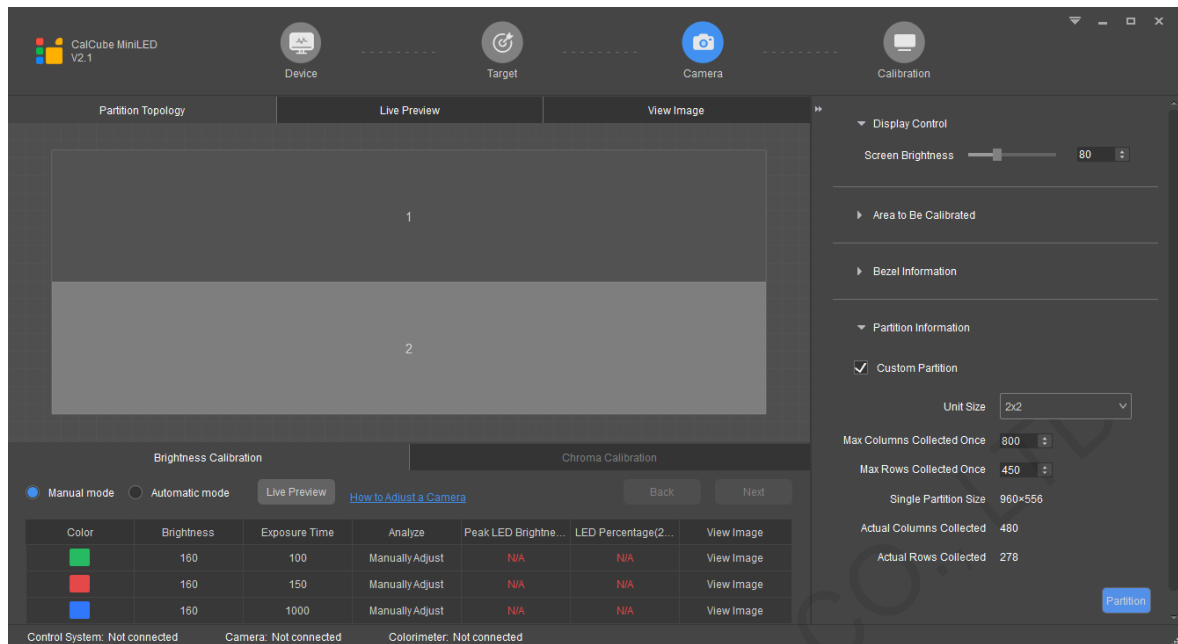
Partition sizes may be uneven, which is normal and does not affect subsequent operations.

5.3.2 Analyze Camera Parameters

The CalCube MiniLED software supports three calibration modes and they have different camera parameter adjustment methods.

5.3.2.1 COB Calibration and Common Calibration

Figure 5-9 Analyzing camera parameters – COB calibration



Step 1 On the **Brightness Calibration** tab page, follow the method below to adjust the camera settings. Both the C1200 and C3200 cameras are supported.


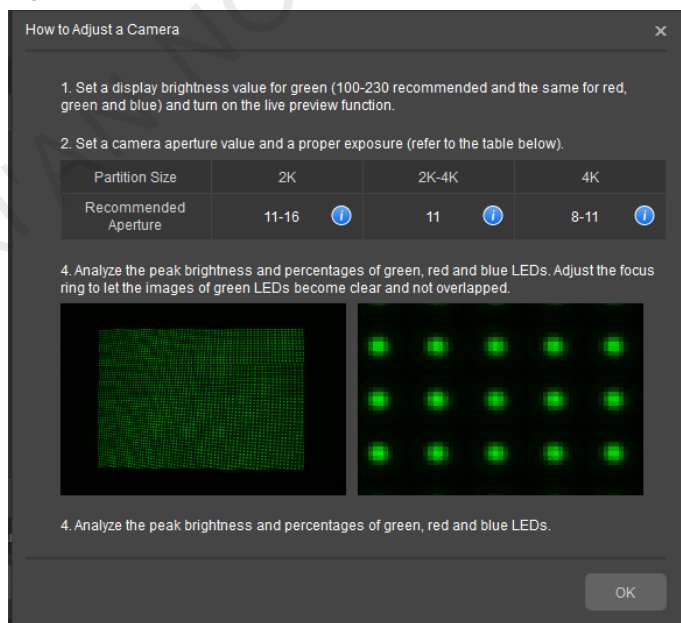
- For the C1200 camera
 1. Set a display brightness value for green (100–230 recommended and the same for red, green and blue).
 2. Click **Live Preview** and observe the captured image in the software.
 3. Adjust the ratio of image to viewport for the green color. Ensure the image of the screen is a rectangle in the center of the viewport and fills the entire viewport.
 4. Use  to zoom in the image to 1600% and adjust the focus ring and aperture until the images of LEDs become clear and not overlapped.
- For the C3200 camera, click **How to Adjust a Camera** and follow the instructions to adjust the settings.

Figure 5-10 How to adjust a camera



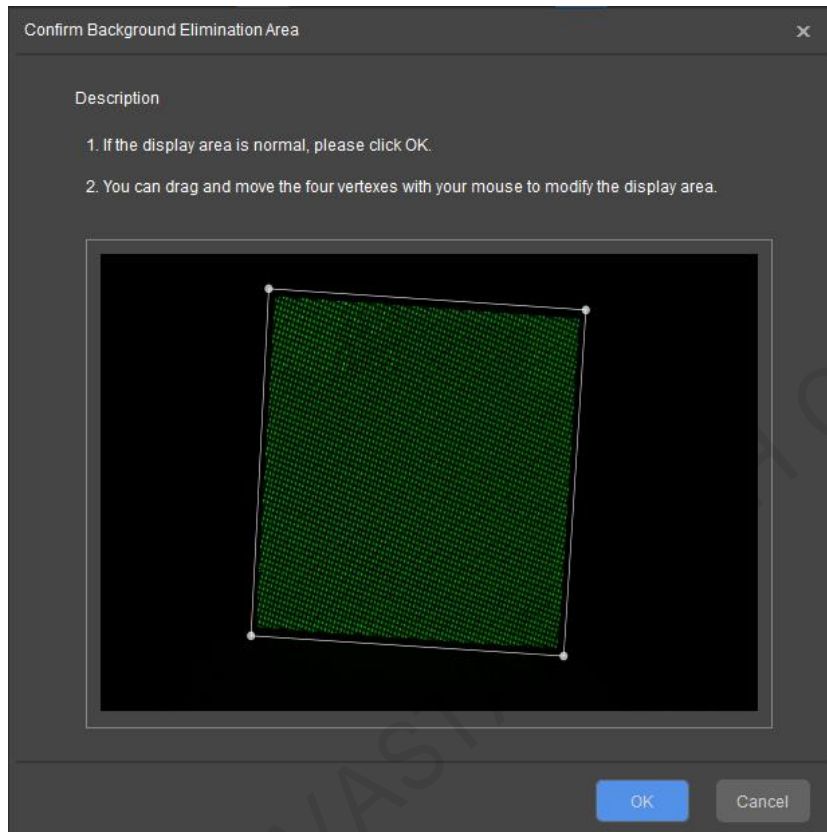
Step 2 Select the **Auto Adjust** method to adjust the settings for green.

After you click **Auto Adjust**, the software will automatically analyze and adjust the peak LED brightness to 40–70 and the LED percentage to 20%–70%. If the two parameter values still do not meet the requirements, adjust the focus ring and aperture. After adjustment, click **Auto Adjust** again.

Step 3 Eliminate the ambient light.

During adjustment, when the page below is displayed, drag the four vertexes of the quadrilateral to make the vertexes close to the edges of the image. The purpose is to adjust the active calibration area within the quadrilateral and eliminate the interference light around the display to be calibrated. If the display area is normal, click **OK** directly.

Figure 5-11 Eliminating the ambient light



Step 4 Select the **Auto Adjust All** method to adjust the settings for red and blue.

In this mode, you only need to click **Auto Adjust All**, and the software will automatically analyze and adjust the peak LED brightness to 40–70 and the LED percentage to 20%–70%.

Step 5 Check the statuses of **Peak LED Brightness** and **LED Percentage** values of all calibration procedures.

- If all the values are in white, the peak LED brightness is within 40–70 and the LED percentages are within 20%–70%, the value is normal. Go to [Step 7](#).
- If a value is in red or a value cell has a red border, the value is abnormal. Go to [Step 6](#).

Step 6 Switch to the **Manually Adjust** mode and adjust the abnormal values.

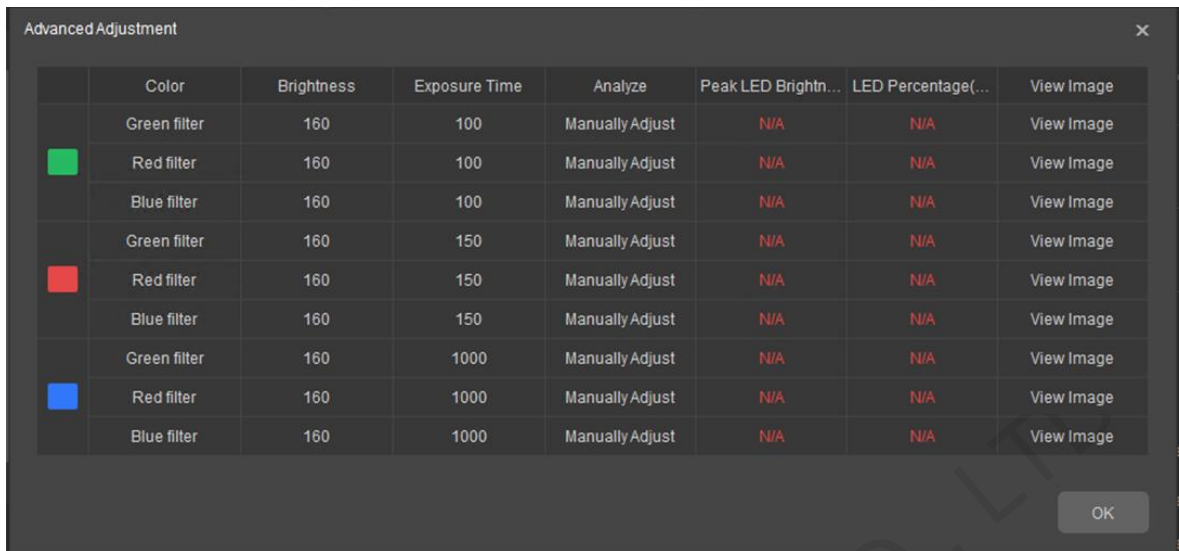
- For red values, adjust the **Exposure Time** values or turn the focus ring to adjust the focus.

Based on the difference between the actual values of peak LED brightness and LED percentage and the standard value range, adjust the exposure time and turn the focus ring properly and click the **Manually Adjust** button.

 - If the peak LED brightness is less than 40, increase the exposure time.
 - If the peak LED brightness is greater than 70, decrease the exposure time.
 - If the LED percentage is less than 20%, turn the focus ring to let the image become blurry.
 - If the LED percentage is greater than 40%, turn the focus ring to let the image become clear.
- For red borders, click **Advanced Adjustment** in the **Manually Adjust** mode to adjust the filters that has a red value.

The adjustment method is the same as the above methods. After adjustment, click **OK** to save the adjustments.

Figure 5-12 Advanced adjustment



Step 7 Click the **Chroma Calibration** tab and repeat **Step 2–Step 6** to finish the analysis and adjustment.

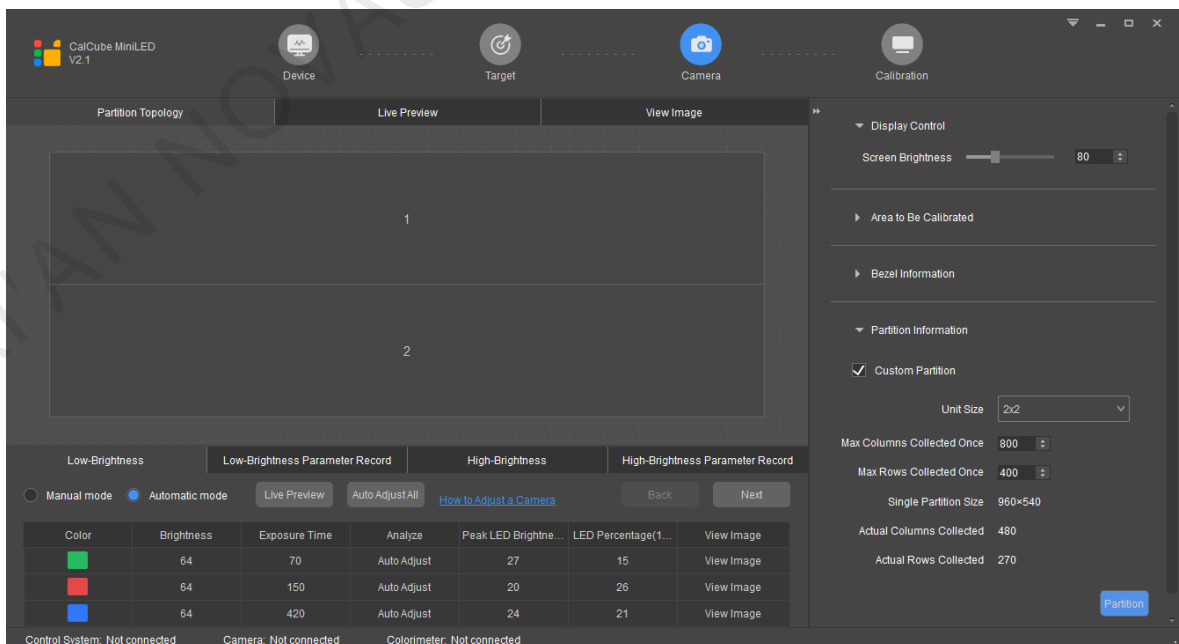
For the **Common Calibration** mode, there is no chroma calibration procedure. Please go to the next step directly.

Step 8 After adjustment, click **View Image** to view the images collected by camera during analysis.

Click to choose a color and view the collected image in that color. You can zoom in the image by clicking , entering a number, or pressing **Ctrl** and rolling the mouse wheel at the same time, to check whether the clarity of collected LEDs meet requirements.


5.3.2.2 Full-Grayscale Calibration

Figure 5-13 Camera parameter analysis – full-grayscale calibration



Step 1 On the **Low-Brightness** tab page, adjust the camera settings at the default grayscale level for image displaying.

1. Click **Live Preview** and observe the captured image in the software.

2. Adjust the ratio of image to viewport for the green color. Ensure the image of the screen is a rectangle in the center of the viewport and fills the entire viewport. There are different adjustment methods for different lens types.
 - For zoom lenses, adjust the ratio by adjusting the focal length.
 - For fixed-focus lenses, adjust the ratio by moving the tripod.
3. Use  to zoom in the image to 1600% and adjust the focus ring and aperture until the images of LEDs become clear and not overlapped.

Note:

For the standard ratio of image to viewport and the image size, see the examples in [6.3 Operating Skills of Partition Imaging](#).

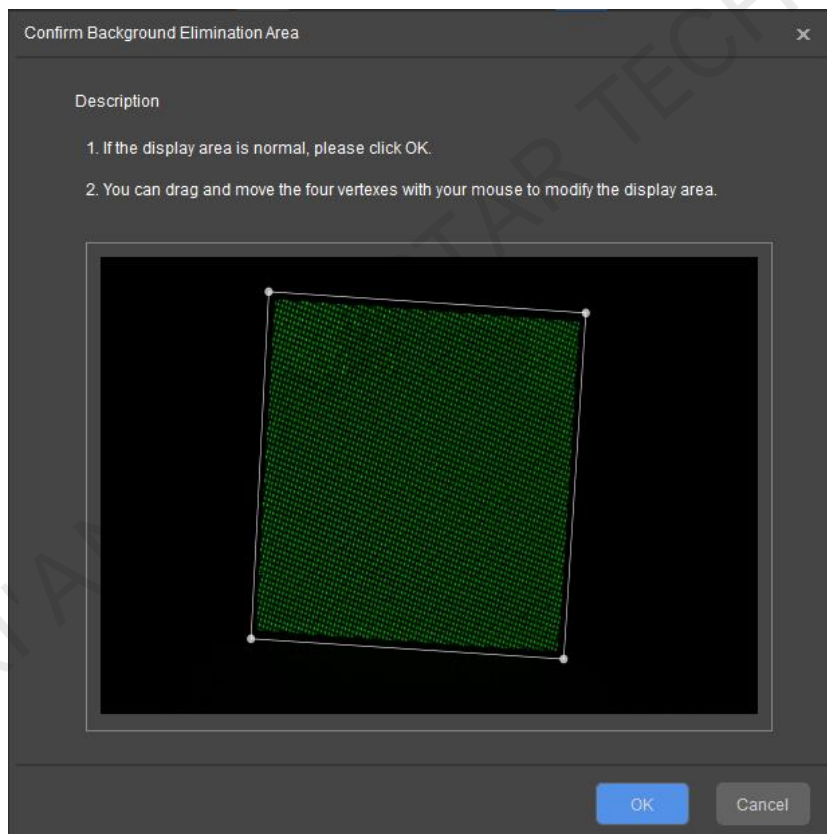
Step 2 Select the **Auto Adjust** method to adjust the settings for green.

After you click **Auto Adjust**, the software will automatically analyze and adjust the peak LED brightness to 10–35 and the LED percentage to 10%–30%. If the two parameter values still do not meet the requirements, adjust the focus ring and aperture. After adjustment, click **Auto Adjust** again.

Step 3 Eliminate the ambient light.

During adjustment, when the page below is displayed, drag the four vertexes of the quadrilateral to make the vertexes close to the edges of the image. The purpose is to adjust the active calibration area within the quadrilateral and eliminate the interference light around the display to be calibrated. If the display area is normal, click **OK** directly.

Figure 5-14 Eliminating the ambient light



Step 4 Select the **Auto Adjust All** method to adjust the settings for red and blue.

In this mode, you only need to click **Auto Adjust All**, and the software will automatically analyze and adjust the peak LED brightness to 10–35 and the LED percentage to 10%–30%.

Step 5 Check the statuses of **Peak LED Brightness** and **LED Percentage** values of all calibration procedures.

- If all the values are in white, the peak LED brightness is within 10–35 and the LED percentages are within 10%–30%, the value is normal. Go to [Step 7](#).

- If a value is in red or a value cell has a red border, the value is abnormal. Go to [Step 6](#).

Step 6 Switch to the **Manually Adjust** mode and adjust the abnormal values.

- For red values, adjust the **Exposure Time** values or turn the focus ring to adjust the focus.
Based on the difference between the actual values of peak LED brightness and LED percentage and the standard value range, adjust the exposure time and turn the focus ring properly and click the **Manually Adjust** button.
 - If the peak LED brightness is less than 10, increase the exposure time.
 - If the peak LED brightness is greater than 35, decrease the exposure time.
 - If the LED percentage is less than 10%, turn the focus ring to let the image become blurry.
 - If the LED percentage is greater than 30%, turn the focus ring to let the image become clear.
- For red borders, click **Advanced Adjustment** in the **Manually Adjust** mode to adjust the filters that has a red value.

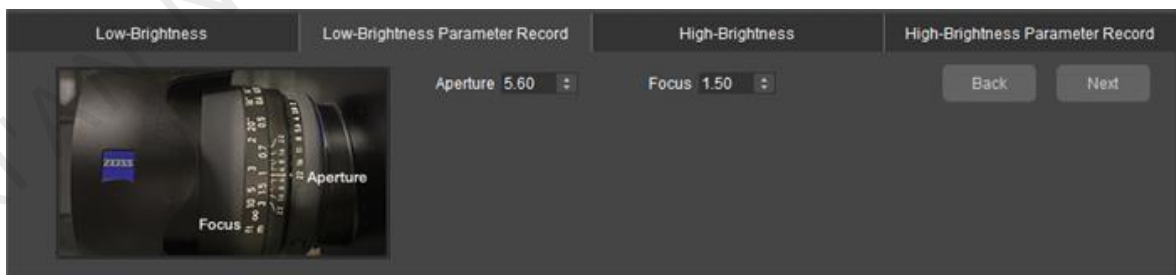
The adjustment method is the same as the above methods. After adjustment, click **OK** to save the adjustments.

Figure 5-15 Advanced adjustment

	Color	Brightness	Exposure Time	Analyze	Peak LED Brightn...	LED Percentage(...	View Image
Green filter	Green filter	160	100	Manually Adjust	N/A	N/A	View Image
	Red filter	160	100	Manually Adjust	N/A	N/A	View Image
	Blue filter	160	100	Manually Adjust	N/A	N/A	View Image
Red filter	Green filter	160	150	Manually Adjust	N/A	N/A	View Image
	Red filter	160	150	Manually Adjust	N/A	N/A	View Image
	Blue filter	160	150	Manually Adjust	N/A	N/A	View Image
Blue filter	Green filter	160	1000	Manually Adjust	N/A	N/A	View Image
	Red filter	160	1000	Manually Adjust	N/A	N/A	View Image
	Blue filter	160	1000	Manually Adjust	N/A	N/A	View Image

Step 7 Click **Next**. On the **Low-Brightness Parameter Record** tab page, record the aperture and focus values.

Figure 5-16 Recording parameter values





Step 8 Click **Next**. On the **High-Brightness** tab page, adjust the camera settings at the default grayscale level for image displaying.

Keep the remaining parameters unchanged and reduce the aperture properly until the images of LEDs become clear and not overlapped (See [6.3 Operating Skills of Partition Imaging](#)).

Step 9 Refer to [Step 2–Step 7](#) to adjust the high-brightness parameter and record the corresponding aperture and focus value.

The adjustment target values for high-brightness parameters are different from those of low-light parameters. The peak LED brightness to 40–70 and the LED percentage to 20%–40%. Please follow the on-screen information to adjust them.

Step 10 After adjustment, click **View Image** to view the images collected by camera during analysis.

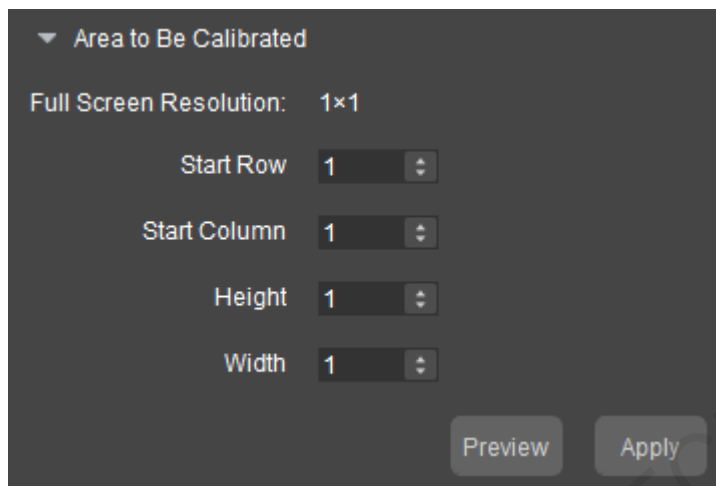
Click  to choose a color and view the collected image in that color. You can zoom in the image by clicking , entering a number, or pressing **Ctrl** and rolling the mouse wheel at the same time, to check whether the clarity of collected LEDs meet requirements.


5.3.3 Set Areas to Be Calibrated

When the areas to be calibrated are not on the same surface or they have a certain angle, they need to be set in the software. If there are no such situations, skip this section.

For example, for the screens mounted on the four sides of a pillar, there is a 90° angle between each two adjacent screens. For adjacent screens that are separated by objects, they are not on the same surface.

Figure 5-17 Setting the area to be calibrated



Step 1 Set the information about the area to be calibrated by entering a number or clicking .

- Full Screen Resolution: The screen resolution read by the software
- Start Row: The horizontal initial coordinate of the area to be calibrated
- Start Column: The vertical initial coordinate of the area to be calibrated
- Height: The height of the area to be calibrated
- Width: The width of the area to be calibrated

Step 2 Click **Preview**. The area to be calibrated turns green on the LED display. At this time, The **Preview** button changes to **Stop**. Click **Stop** to stop preview.

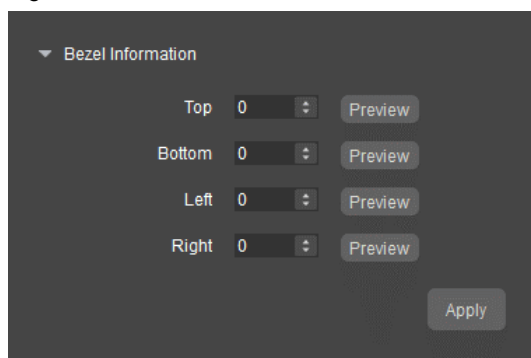
Step 3 After the settings are done, click **Apply**.

5.3.4 Set Bezel Information

When the screen to be calibrated has a bezel, the bezel information needs to be set in the software. If you do not set the information, positioning of the start LEDs during calibration and the calibration result will be affected. If there are no such situations, skip this section.

For example, the four sides of on-site screens can be sealed in order to prevent water or dust. Some rows and columns of LEDs near the sides are wrapped up.

Figure 5-18 Bezel information



- Step 1 In the text box next to **Top**, enter the number of rows that are wrapped up.
- Step 2 Click **View** to check whether the information you set is correct. The LEDs for which you set bezel information will display the image in white on the LED screen. When the first row of LEDs on top of the screen displays image, the top bezel setting is done.
- Step 3 Repeat Step 1 and Step 2 to set the bottom, left and right bezels.
- Step 4 After the settings are done, click **Apply**.

5.4 Calibration

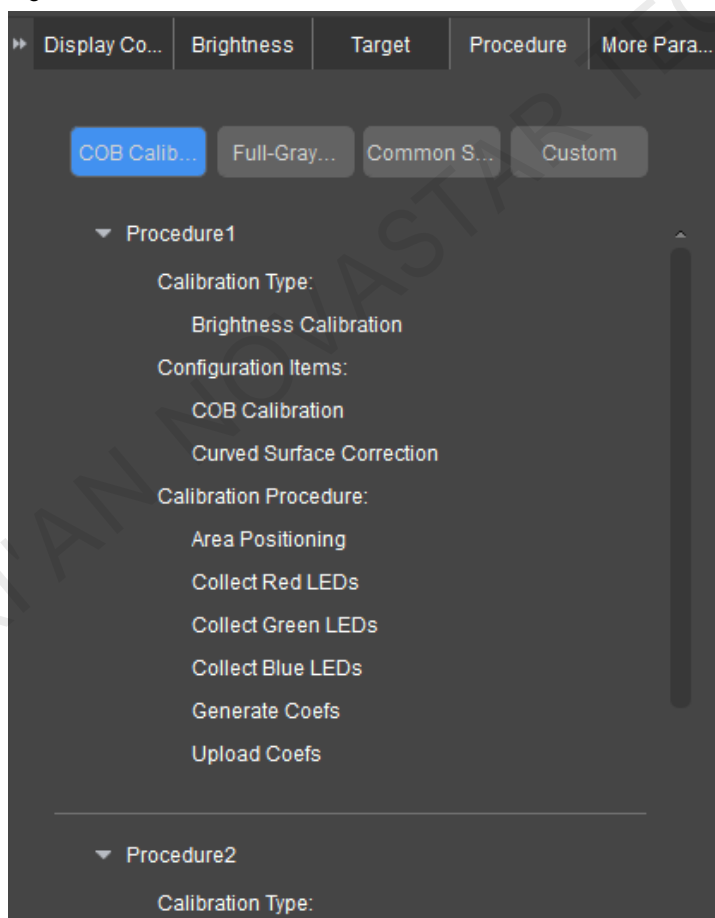
The order of calibration settings is **Procedure > More Params > Partition Calibration > Display Control > Brightness > Target > Border Correction**.

5.4.1 Configure Procedure

For common COB screens, use **COB Calibration** (default procedure). After selecting a partition, you can start calibration directly. Based on the on-site calibration situation, you can also select **Full-Grayscale Calibration**, **Common Screen Calibration** or **Custom**.

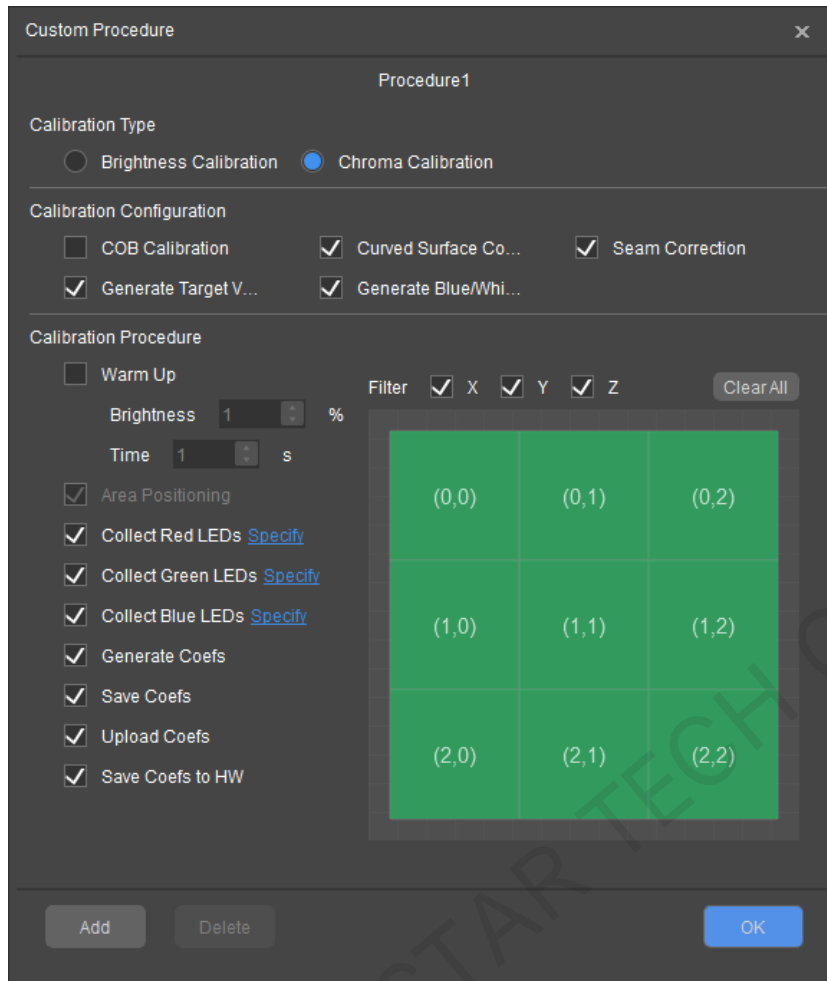
- To ensure good calibration effect at middle-grayscale level and low-grayscale level and if the calibration site has a complete set of Coex control system, select **Full-Grayscale Calibration**.
- For common screens, select **Common Calibration**.
- If you need specific calibration effects, for example, blue and white optimization effect, automatic target value generation, etc., select **Custom** and configure the number of procedures based on the on-site calibration situation and select the functions for each procedure.

Figure 5-19 Procedure



Custom

Figure 5-20 Custom configuration



Step 1 Configure the number of procedures required.

- Click **Add** to add a calibration procedure.
- Click **Delete** to delete the current calibration procedure.

Step 2 Select a calibration type.

- Brightness Calibration

This mode changes only brightness of the R, G and B primary colors. It does not sacrifice the color gamut of LED display, but it cannot eliminate chroma difference between LEDs. If the display does not have obvious chroma difference but has bright and dark blocks, use brightness calibration.

- Chroma Calibration

This mode changes brightness of the primary colors and slightly sacrifices the color gamut. However, it ensures high LED brightness consistency and chroma consistency. If the display has chroma difference, use chroma calibration.

Step 3 Select the calibration configuration for this procedure.


- COB Calibration
High-accuracy calibration, primarily for the MiniLED display calibration
- Curved Surface Correction
Eliminate the curved surface problems between partitions caused by calibration.
- Seam Correction
It is mainly used for calibration of fine-pitch screens, which can correct the bright line problems caused by module splicing, and also has certain correction effect on the dark lines caused by module splicing.
- Generate Blue/White Coefs

Optimize the display effect for the blue and white after calibration.

- Generate Target Values

Generate a set of target values automatically according to the screen's original brightness and chroma information and the target achievement ratio (95% by default) you set.

Step 4 Select the calibration processes for the current procedure.

- Warm Up: Set the brightness of the LED display after it is turned on and how long that brightness level lasts before you start calibration. You can set the them by entering numbers or clicking . During warm-up, the LED screen displays a white image.
- Area Positioning: Confirm the background elimination area.
- Collect Red LEDs: Collect and analyze the red LEDs.
- Collect Green LEDs: Collect and analyze the green LEDs.
- Collect Blue LEDs: Collect and analyze the blue LEDs.
- Generate Coefs: Calculate and generate the calibration coefficients.
- Upload Coefs: Upload the coefficients in a quick or stable manner. Stable uploading ensures data accuracy. Quick uploading uploads data very fast and is the default uploading method.
- The LED display goes black during quick uploading but not during stable uploading.
- Save Coefs: Save the coefficients to the database.
- Save Coefs to HW: Save the coefficients into the receiving card.

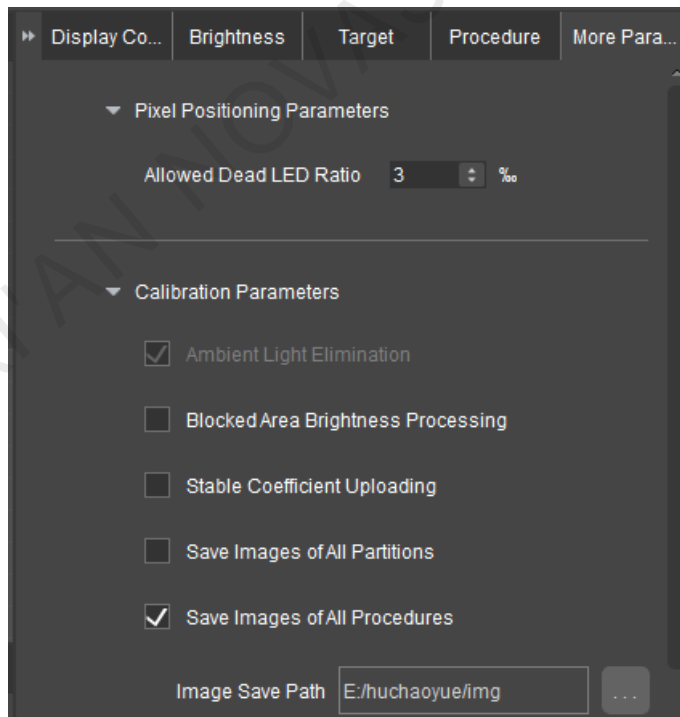
Step 5 When all the procedure configurations are complete, click **OK** to generate the custom configuration.

Also, if you need to re-collect and re-analyze some images, you can precisely locate them via custom configuration, as described in [7.3 Recollect and Reanalyze Some Images](#).

5.4.2 More Parameters

More parameter settings have eight functions: LED positioning parameters, calibration parameters, screen information, uniformity optimization parameters, data calibration, wider wavelength and brightness range LED calibration, uniformity compensation, and removing seam diagonal stripes.

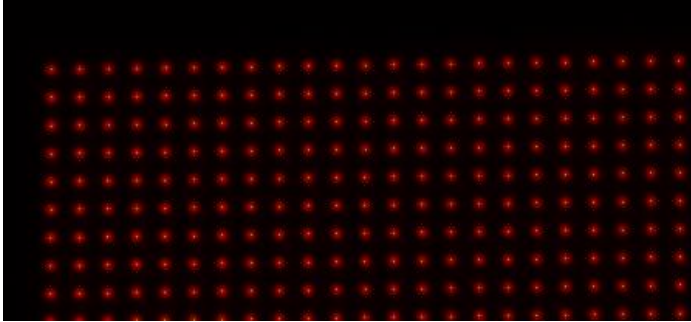
Figure 5-21 Settings of more parameters



LED Positioning Parameters

To obtain and calculate the brightness and chroma parameters of each LED to ensure the calibration effect, each LED must be positioned precisely.

Figure 5-22 Preview of LED positioning



Allowed Dead LED Ratio: To ensure the calibration effect, the ratio of LEDs that cannot be identified (dead LEDs) in the calibration area must be less than this ratio.

You can enter a number or click the up or down arrow to set the ratio. The maximum allowed ratio is 500%.

Calibration Parameters

- **Ambient Light Elimination:** Eliminate the background light. Calibration is generally required to be done in a very dark environment. If this function is enabled, calibration can be done even if the environment is not dark enough.
- **Blocked Areas Brightness Processing:** If some partitions are blocked by leaves and/or electric wires, this function can be enabled to automatically detect the blocked areas and process them accordingly, ensuring the final calibration effect.
- **Stable Coefficient Uploading:** Upload the coefficients stably to ensure data accuracy.
- **Save Images of All Partitions:** Select this function to save images of all the partitions. If this function is not enabled, only the images of current partition will be saved. Click to choose a path to save the images. The default path is Documents\NovaCLB\Screen.
- **Save Images of All Procedures:** Select this function to save images of all the procedures. If this function is not enabled, only the most recently collected procedure images will be saved. Click to choose a path to save the images. The default path is Documents\NovaCLB\Screen.

Note:

If stable coefficient uploading is not enabled, the default uploading method is quick uploading. To use quick uploading, make sure that the graphics card of the control computer must work in full range. If it works in limited range, the calibration coefficients transmitted may have a problem.

Screen Information

Confirm the module size and screen type again. Please fill in the information according to the on-site situation, otherwise the effect of correcting dark or bright lines caused by splicing will be compromised.

Uniformity Optimization Parameters

Figure 5-23 Uniformity optimization parameters

	L	x	y
R	1	1	1
G	1	1	1
B	1	1	1

- **White Brightness Preferred:** If this function is enabled, the calculated white target value after calibration is consistent with the white target value set by the user. However, the screen uniformity may be affected. If this function is not enabled, screen brightness will be sacrificed to ensure the screen uniformity and the white target value will be changed.
- **Target Achievement Ratio:** This function controls the ratios of red, green and blue LEDs that can achieve the target value when the **Generate Target Values** function is enabled. The default ratio for each color is 0.95.
If you find that a color has poor effects after calibration, you can lower the ratio of that color appropriately and regenerate coefficients to adjust the calibration effect. The coefficient adjustment does not affect effects of the other colors. It only affect that color itself and the white color.
- **Optimization Mode:** This function is used to select the desired blue and white optimization effect when blue and white optimization function is enabled.
The options include **RGBW balanced** and **BW preferred**. If the chroma uniformity of blue before screen calibration is good, select the **BW preferred** mode.
- **Weight:** Continue to adjust the ratio of red, green, blue and white colors based on the selected calibration mode.
The range is 1 to 20. A higher value means better calibration effect for the color. The remaining colors will have unsatisfactory calibration effects.

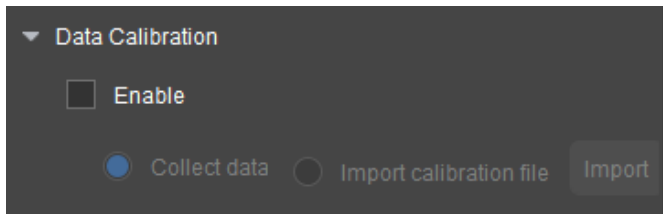
Note:

After the calibration is complete, if you make changes to the uniformity parameters based on the calibration effect, you can upload the calibration effect as follows.

- For the **COB Calibration** procedure, select **Procedure 2** on the **Manual Calibration** page. Then, click **Generate Coefficient** > **Upload Coefs** to re-upload the calibration coefficients.
- For the **Common Screen Calibration** procedure, coefficient uploading is not involved.
- For the **Custom** procedure, check whether the last item of the last procedure in the configuration items on the **Procedure** page is **Generate Target Values**. If it is, select the last procedure on the **Manual Calibration** page. Then, click **Generate Coefs** > **Upload Coefs** to re-upload the calibration coefficients. If it is not, do calibration again.

Data Calibration

Figure 5-24 Data calibration



Calibrate the screen and collect data to improve the display effect after partition calibration of the COB screen, presenting a smoother transition between the spliced partitions. You can use either of the following two methods to obtain the calibration data.

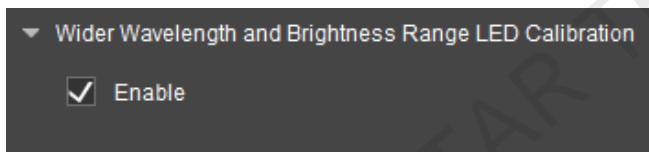
- Use a colorimeter to collect data
Select **Collect data** and a data collection page will be displayed during the subsequent calibration process. For details, see the [Collect Calibration Data](#) section in 5.4.3 Partition Calibration.
- Import a calibration file collected before
Select **Import calibration file** and click **Import**. Then, select the matched calibration file.

Matching conditions:

If the screen to be calibrated has the same size, the same manufacturing process, and the same distance between the camera and the screen, the screen can use the same calibration file.

Wider Wavelength and Brightness Range LED Calibration

Figure 5-25 Wider wavelength and brightness range LED calibration

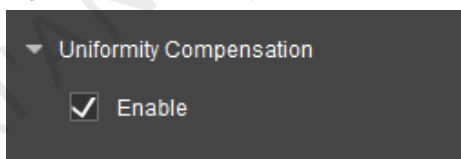


This function is enabled by default. With the reasonable calibration coefficients that match different ranges of precisely collected wavelength and brightness of LEDs, the display effects of different batches of LEDs can be significantly improved.

If the screen to be calibrated uses different batches of LEDs, or the calibration site has no optical measuring device, please make sure to enable this function.

Uniformity Compensation

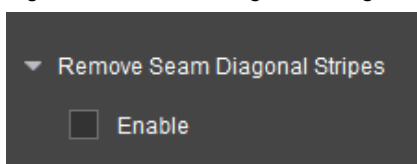
Figure 5-26 Uniformity compensation



This function is enabled by default. It is suitable for screens that have poor display effects before calibration. It can effectively improve the display uniformity.

Remove Seam Diagonal Stripes

Figure 5-27 Removing seam diagonal stripes



This function is used to remove the diagonal stripes around the seams caused by partitions that has high resolution after calibration.

If this problem occurs after calibration, enable this function, regenerate calibration coefficients and upload them so that stripes can be removed directly.

5.4.3 Partition Calibration

Prerequisites:

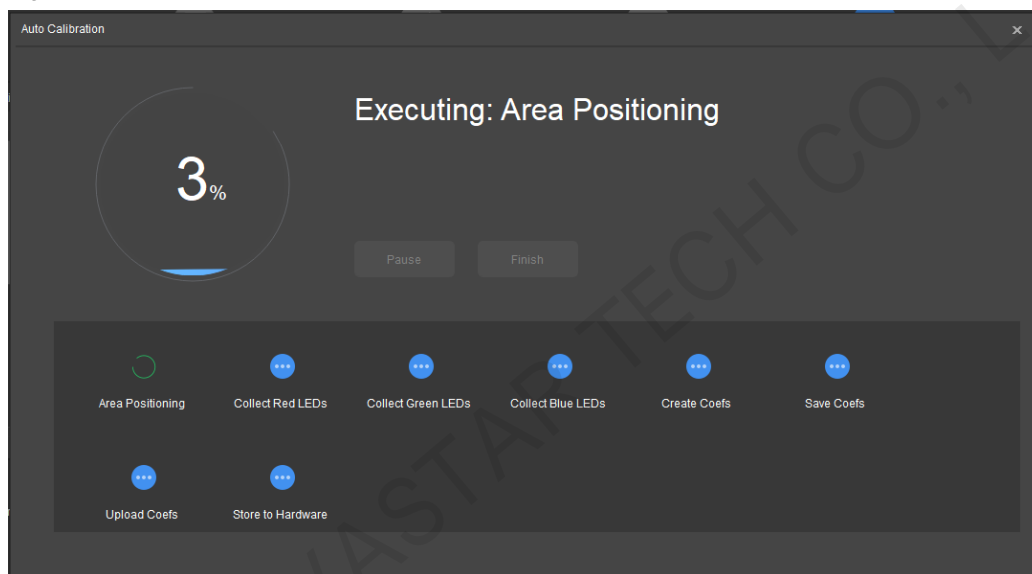
When you have configured a custom procedure and the number of procedures is greater than 2, you need to return to the **Camera** page, select the procedure to be analyzed, and perform the camera parameter analysis manually before starting the calibration. For details, see [5.3.2 Analyze Camera Parameters](#).

Partition calibration can be done manually or automatically.

- Automatic mode

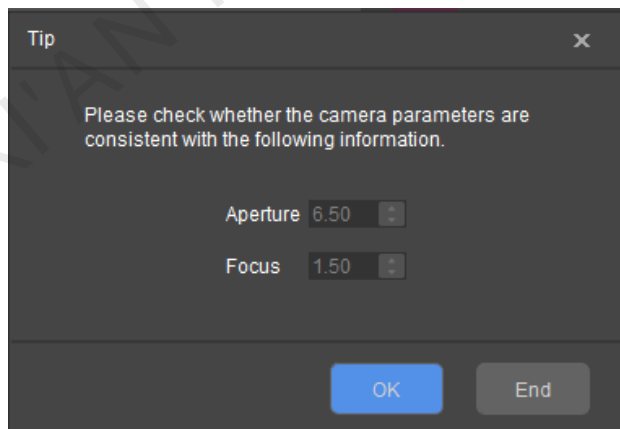
In this mode, you only need to click **Enable Calibration**. The software will perform the calibration procedure automatically, including data collection and analysis, coefficient generation, uploading and saving, which is very convenient and efficient. You can click the **Procedure** tab on the right and set the current automatic calibration procedure as required.

Figure 5-28 Overview of automatic calibration procedure



Note:

For the full-grayscale calibration mode, the following window will be displayed during calibration. Please adjust the camera aperture and focus to the values displayed in the window.

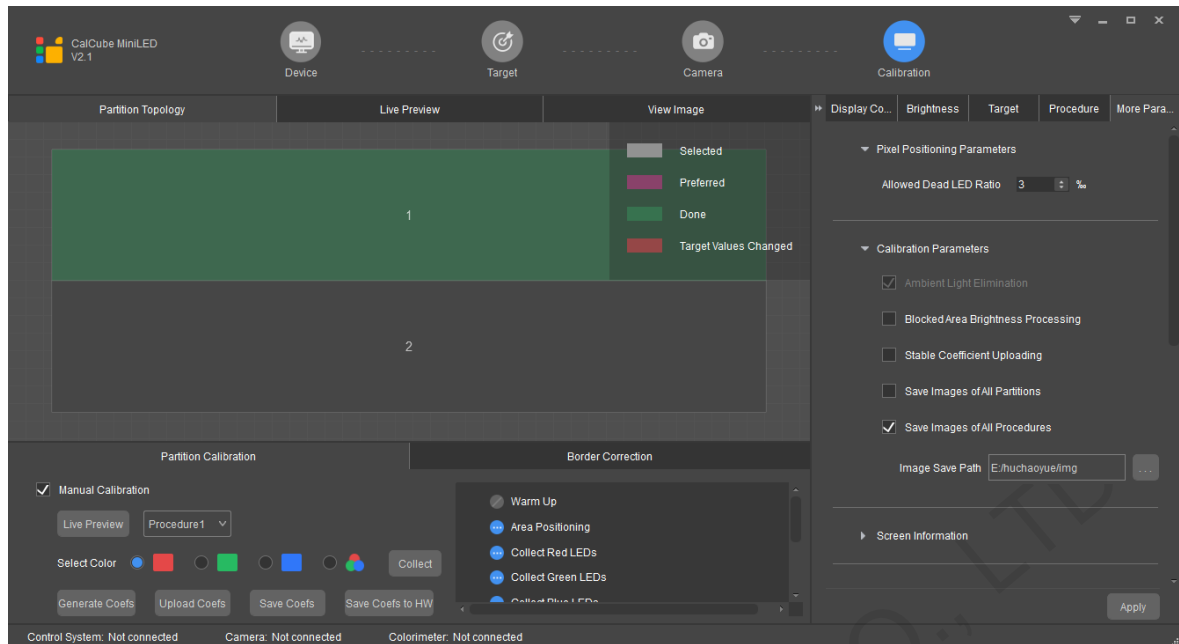


- Manual mode

In this mode, you must manually control the calibration procedure, such as collecting image data, generating, uploading and saving coefficients, etc.

After a partition is calibrated, use the **Display Control** functions on the right to check whether the calibration effect is OK.

Figure 5-29 Manual calibration



After a partition is calibrated, go to the **Calibration** page again, select the next partition to calibrate. Repeat these actions until the entire screen is calibrated.

Preferred Calibration

After you calibrate the first partition, go to the **Calibration** page again. Some preferred calibration partitions (in pink) will appear on the partition topology.

Select a preferred calibration partition and calibrate it. After that partition is calibrated, new preferred calibration partitions will appear. Repeat these actions until the entire screen is calibrated.

Note:

- After a partition is calibrated, its adjacent partitions will be preferred calibration partitions. Please select one of them to calibrate.
- You are advised to calibrate partitions in the recommended preferred calibration order. That ensures smoother transitions between partitions and better calibration effects.

Figure 5-30 Preferred calibration

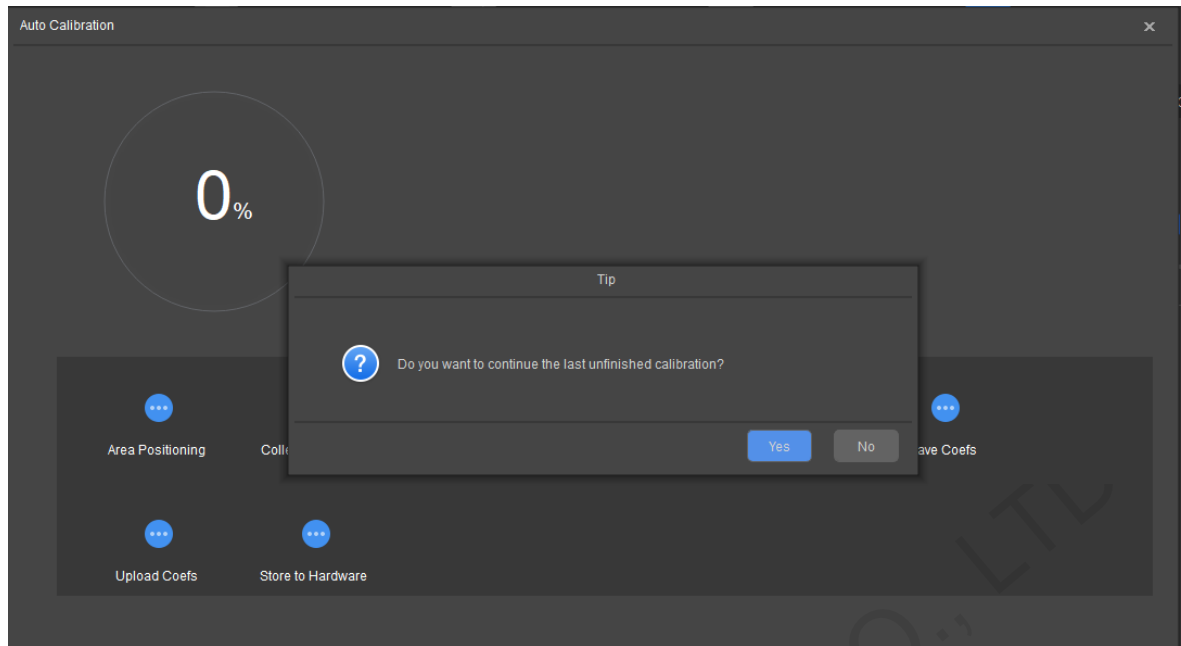


Continue Calibration

When the calibration is disrupted due to image analysis failure, click **Enable Calibration** again. A message saying "Do you want to continue the last unfinished calibration?" will be displayed.

- Click **Yes** to continue calibration from the image with failed analysis last time.
- Click **No** to start calibration from the beginning.

Figure 5-31 Continuing calibration



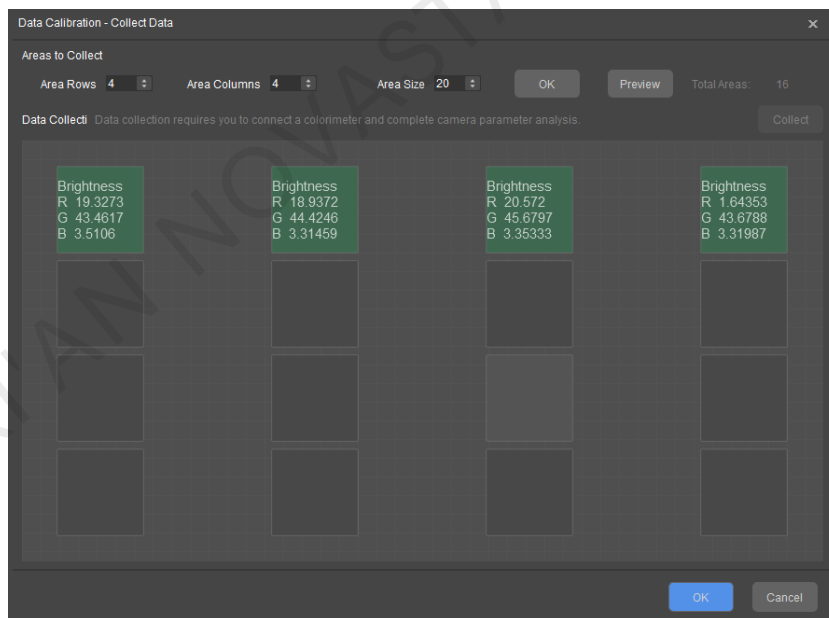
Collect Calibration Data

When the number of configured procedures is greater than or equal to 2 and the **Data Calibration** function is selected by multiple procedures:


If the **Data Calibration** function is selected on the **More Params** tab page, the calibration data collection page will pop up automatically after the first calibration procedure ends.

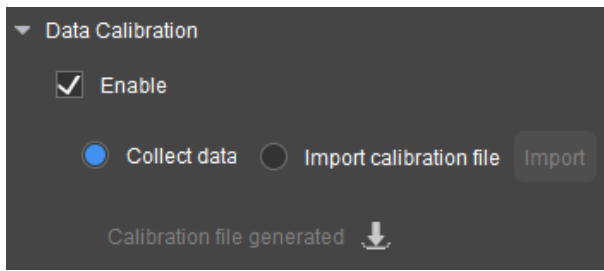
- Step 1 On the **Collect Data** page, **Area Rows**, **Area Columns**, and **Area Size** are automatically calculated by the system. You can modify those data based on the on-site situation.

Figure 5-32 Collecting data



- Step 2 Click to select an area to be collected. At this time, the center of the corresponding area on the screen becomes gray.
- Step 3 Hold a colorimeter and touch the gray area of the screen with the colorimeter perpendicularly (90 degrees). Click **Collect** to obtain the calibration data for the selected area.
- Step 4 Repeat Step 2 and Step 3 until all the areas are collected. Then, click **OK**.

Step 5 (Optional) After the coefficients are generated, click  on the **Data Calibration** area to download the generated calibration file. The file is saved to the desktop by default.



Note:

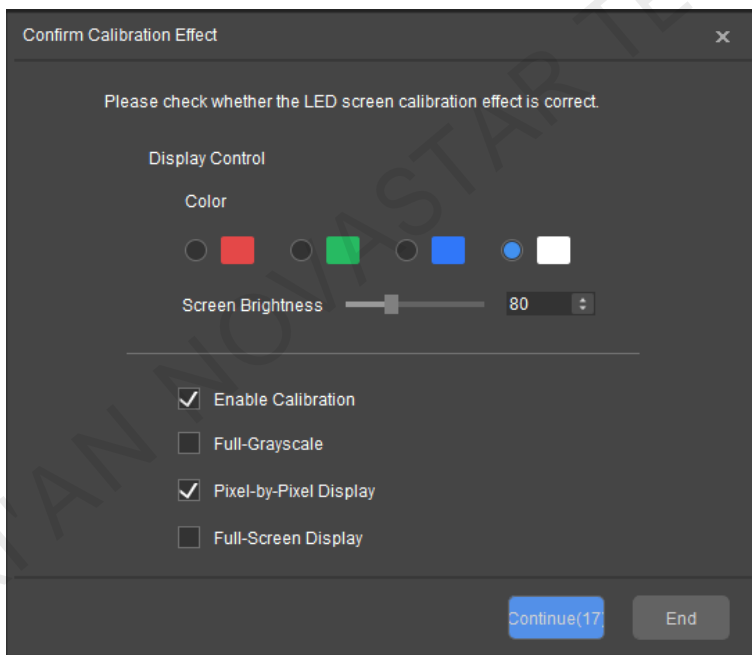
The C410 colorimeter is recommended. When you use other models of colorimeters, please install a shade tube for precise measurement.

Confirm Calibration Effect

When the number of configured procedures is greater than or equal to 2, after the first calibration procedure is completed, the **Confirm Calibration Effect** page will pop up. You can check whether the calibration effect is as expected through the **Display Control** functions.

- If it is as expected, click **Continue** and start the second calibration procedure.
- If it is not expected, click **End** to end the calibration procedure and return to the **Camera** page. On that page, fine-tune the image size. For details, see [5.3.2 Analyze Camera Parameters](#). After fine-tuning, start calibration again.

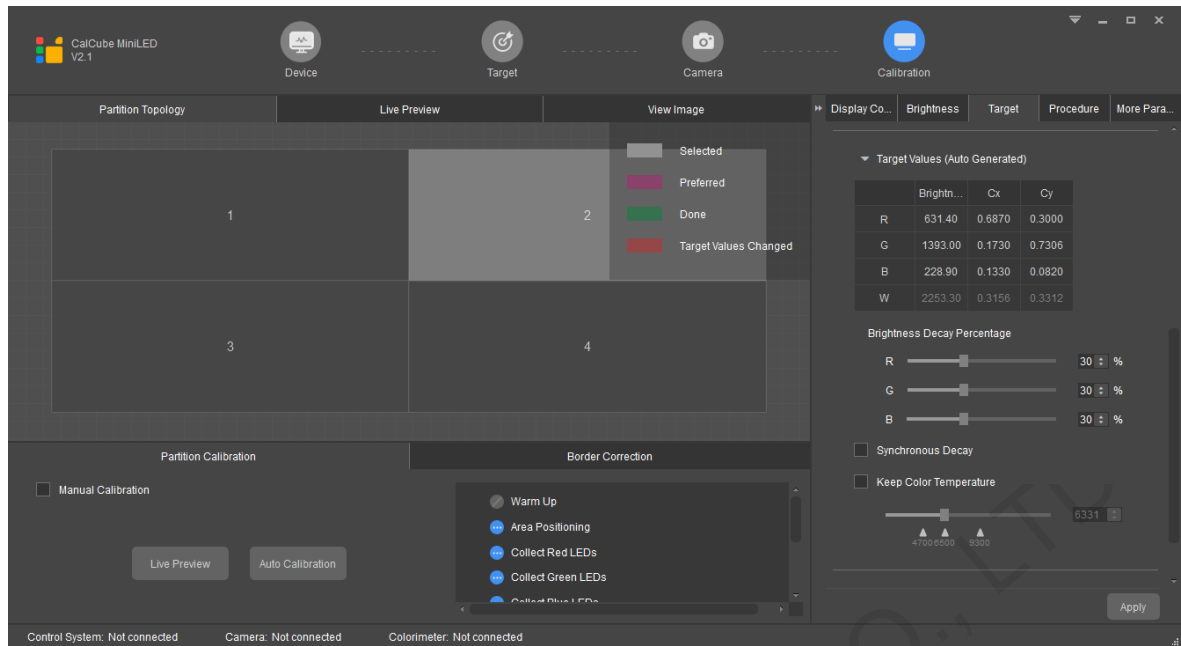
Figure 5-33 Confirming calibration effect



Generate Target Values

When a custom procedure is configured and **Generate Target Values** is selected, after the first partition is calibrated, you can go to the **Target** tab page and view the re-generated target values. You can also fine-tune the target values based on the calibration effect of the first partition.

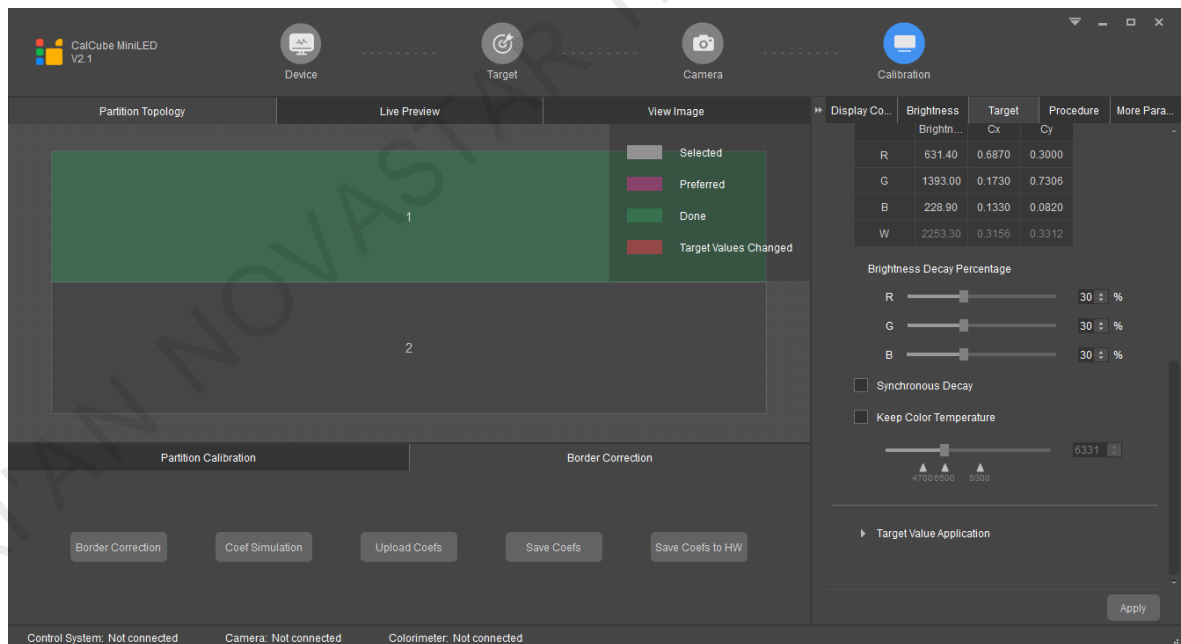
Figure 5-34 Target values (auto generated)



5.4.4 Border Correction

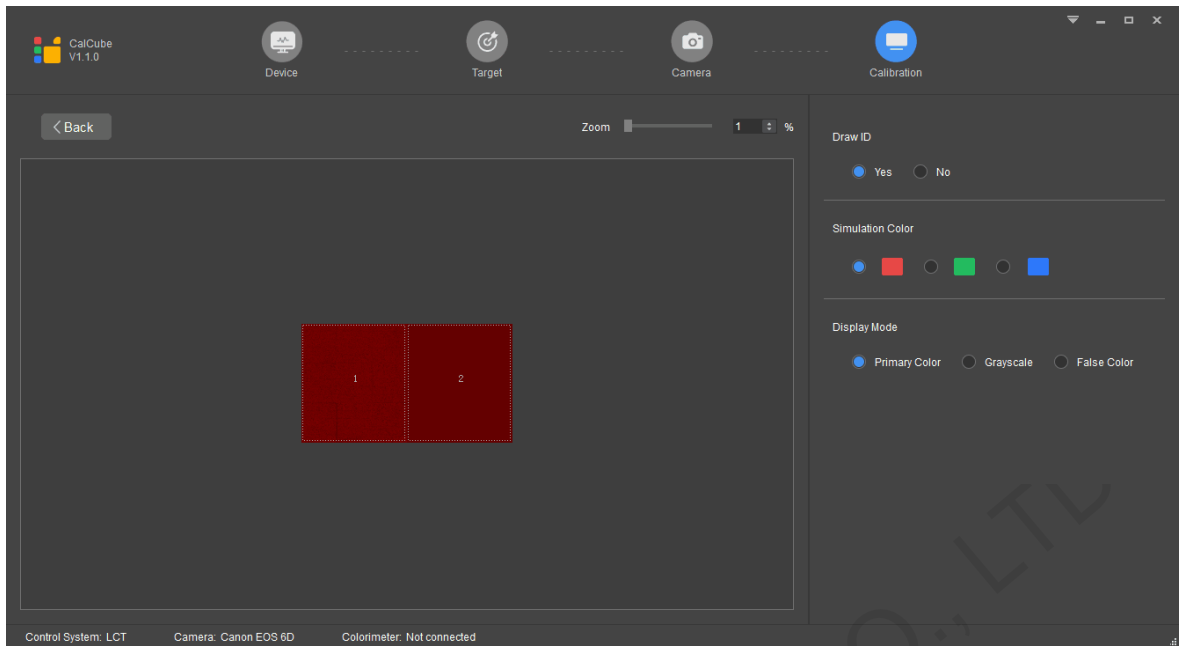
If there are multiple partitions, perform border correction according to the order of **Border Correction > Coef Simulation > Upload Coefs > Save Coefs to HW > Save Coefs**. The system will eliminate the partition borders, upload coefficients, save parameters to hardware and save the adjustment data.

Figure 5-35 Border correction



- Border Correction: Correct the brightness and chroma nonuniformity of the borders between partitions.
- Coef Simulation: The software uses the calibration coefficients to restore the display effect of the LED screen before calibration. The restored image is simulation image. By comparing the simulation image with the actual display effect before calibration, you can know whether the calibration result is OK.

Figure 5-36 Coefficient simulation

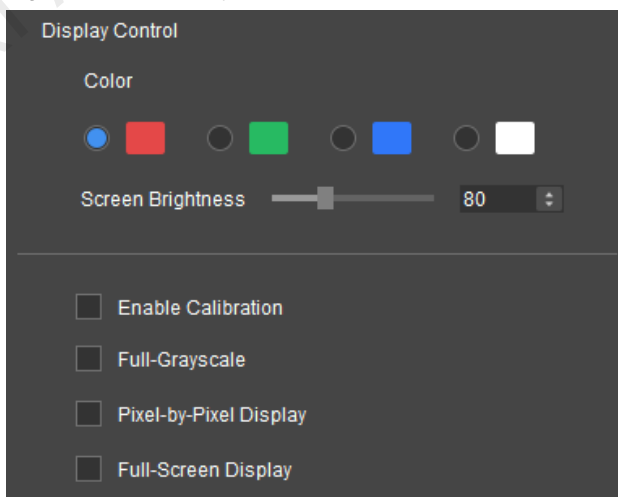


- Draw No.: Draw the partition No. on the simulation image.
- Simulation Color: Select red, green or blue as the simulation color.
- Display Mode: Set the display mode of the simulation image. You can select the best display mode based on your observation. The display modes include:
 - Primary Color: The simulation image in this color is a color image. Its color is the same as the simulation color.
 - Grayscale: The simulation image in this color is a grayscale image. It is always a grayscale image no matter what the simulation color is.
 - False Color: The simulation image in this color is an image where a brightness range is represented by one color.
- Upload Coefs: Upload the coefficients to the receiving card.
- Save Coefs: Save the coefficients to the database.
- Save Coefs to HW: Save the coefficients to the receiving card.


5.4.5 Display Control

Using this function, you can adjust the screen brightness and clearly see the actual calibration effect change of each level of grayscale. You can also switch colors to see the uniformity of red, green, blue and white.

Figure 5-37 Display control



Step 1 After partition calibration, choose a color for the current partition on the screen to display.

Step 2 Adjust the screen brightness by dragging the slider, clicking , or entering a number.

Step 3 Select **Enable Correction** to view the post-calibration display effect in the selected color on the LED screen. At the same time, you can select or deselect **Pixel-by-Pixel Display** to view the calibration effect in pixel-by-pixel display mode and non-pixel-by-pixel display mode.

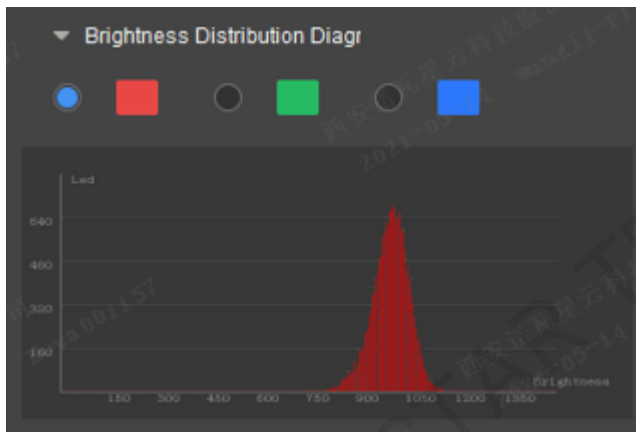
Step 4 Select **Full-Screen Display** to illuminate all partitions.

- If both **Enable Calibration** and **Full-Screen Display** are selected, the calibrated partition(s) will display the calibration effect, but the uncalibrated partition(s) will display the image in the original status.
- If **Enable Calibration** is not selected but **Full-Screen Display** is selected, both the calibrated and uncalibrated partitions will display the image in the original status.

5.4.6 Brightness Data

Brightness data include the brightness distribution, brightness distribution diagram, dead LED information and the achievable percentage of brightness coefficients that are read by the software after calibration. These parameters are the LED display brightness information after calibration and they cannot be modified.

Figure 5-38 Brightness data

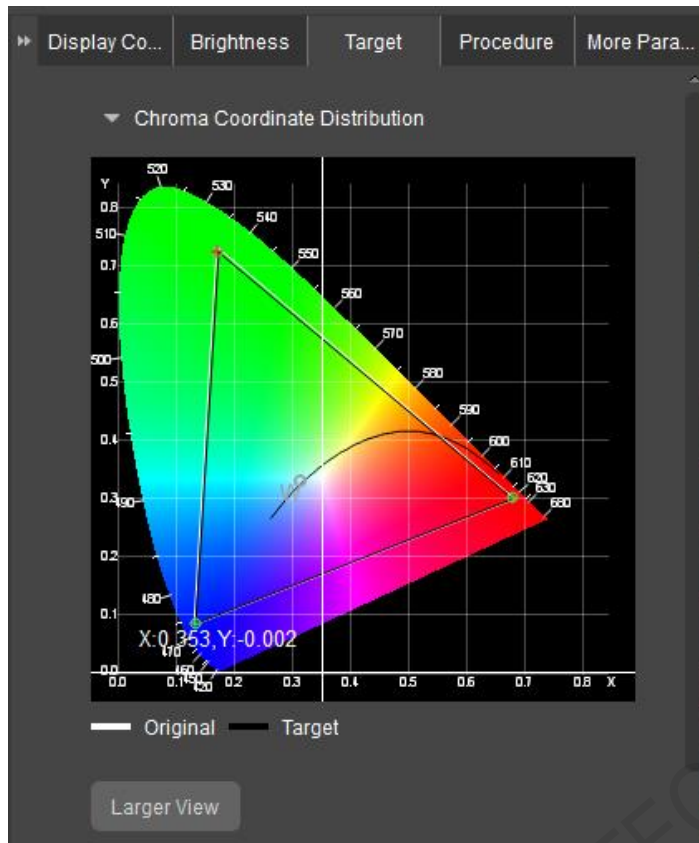


- Brightness Distribution: Display the brightness uniformity, maximum brightness values, minimum brightness values and average brightness values of the red, green and blue in digital form, respectively.
- Brightness Distribution Diagram: Display the distribution of brightness in the selected color and the numbers of LEDs under the brightness.
- Dead LED Information: Display the number of dead LEDs in the selected color.
- Achievable Percentage of Brightness Coefficients: Display the percentage of LEDs that have achieved the brightness coefficients.

5.4.7 Change Target Values

If the calibration effect of the current partition or the entire screen is unsatisfactory, you can modify the target values on the **Target** tab page to correct the calibration coefficients without calibrating the partition again.

Figure 5-39 Changing target values




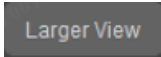
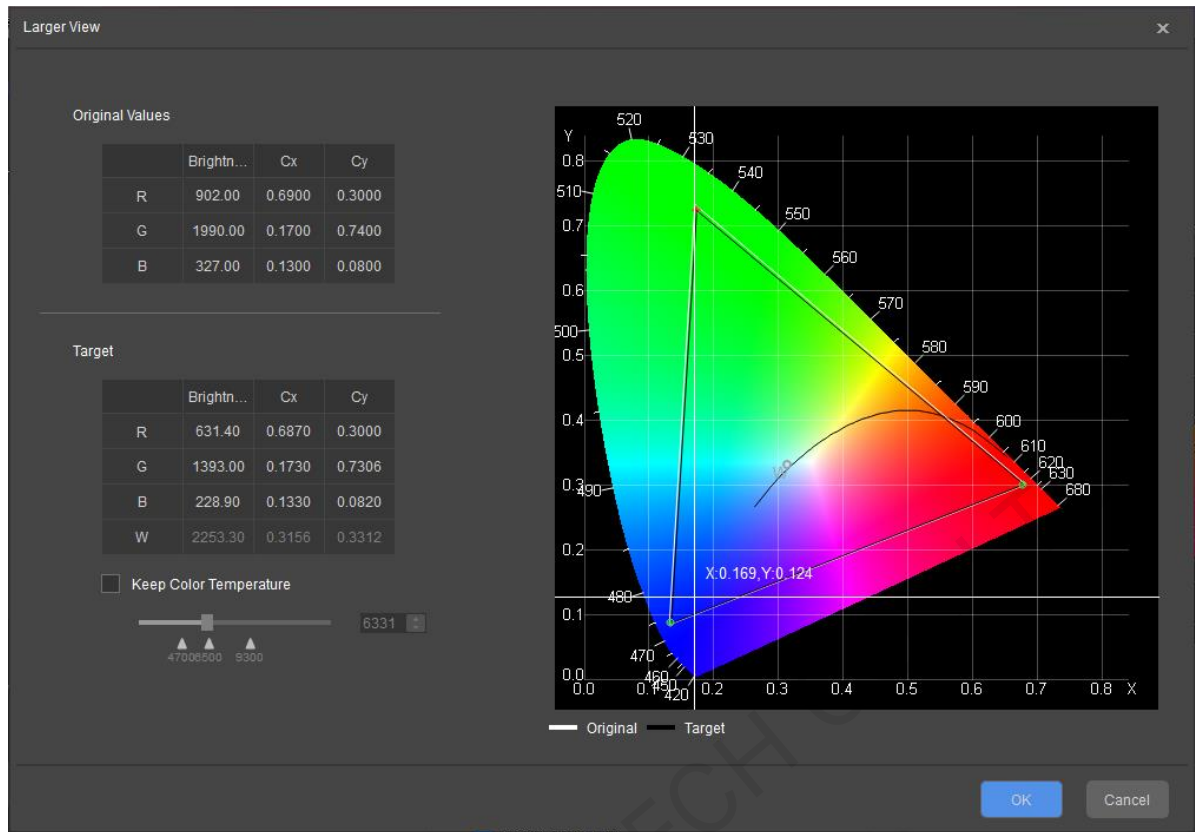
- Chroma Coordinate Distribution: It is shown in a color space diagram and can be changed through one of the following two methods:
 - In , drag the three vertexes in the diagram to change the target values.
 - Click  to enter the larger view page. Drag the three vertexes on the right diagram to change the target values, double click the values in the target value table and enter numbers, or select **Keep Color Temperature** and change color temperate value to change the target values.

Figure 5-40 Changing target values



- Target Values: Double click to enter values directly, drag the **Brightness Decay Percentage** sliders or change the color temperature value to change the target values.

If **Generate Target Values** is selected, after the first partition is calibrated, you can view and change the re-generated target values on this page.

- Target Values Application: Apply the current target values to the current partition or all partitions. After selection, click **Apply**.
 - If you select **Current Partition**, you will apply the modified target values to the current partition and upload calibration coefficients. The target values of other partitions will not be changed.
 - If you select **All Partitions**, you will apply the modified target values to all the partitions and upload the calibration coefficients of the current partition. Other calibrated partitions will turn red on the topology.

6 Help

6.1 Network Connection

If the distance between the control computer that controls the LED screen and the calibration computer is within 100 meters during pixel level calibration, connect the computers with Ethernet cable. If the distance is greater than 100 meters, connect them wirelessly.

Here the router shown in Figure 6-1 will be taken as an example to illustrate how to set and use a router.

Figure 6-1 Wireless router



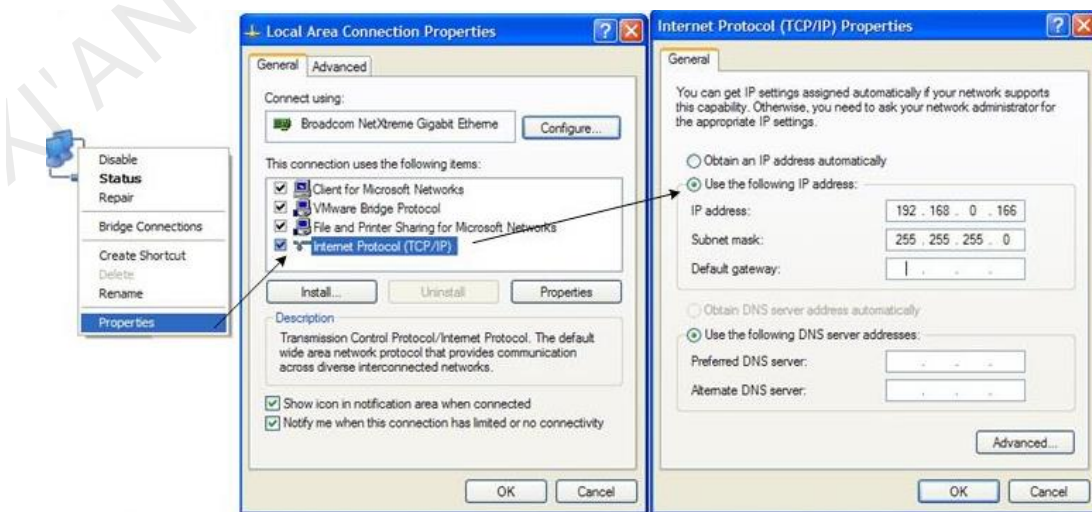
Step 1 Connect the router to the control computer with Ethernet cable via a yellow port of the router.

Figure 6-2 Ports of wireless router



Step 2 Use the wireless network function of the calibration computer to connect it to the wireless router. Note that whether with cable connection or wireless connection, IP addresses of the two computers and the default IP address of the router must be on the same network segment when NovaLCT is used together for calibration.

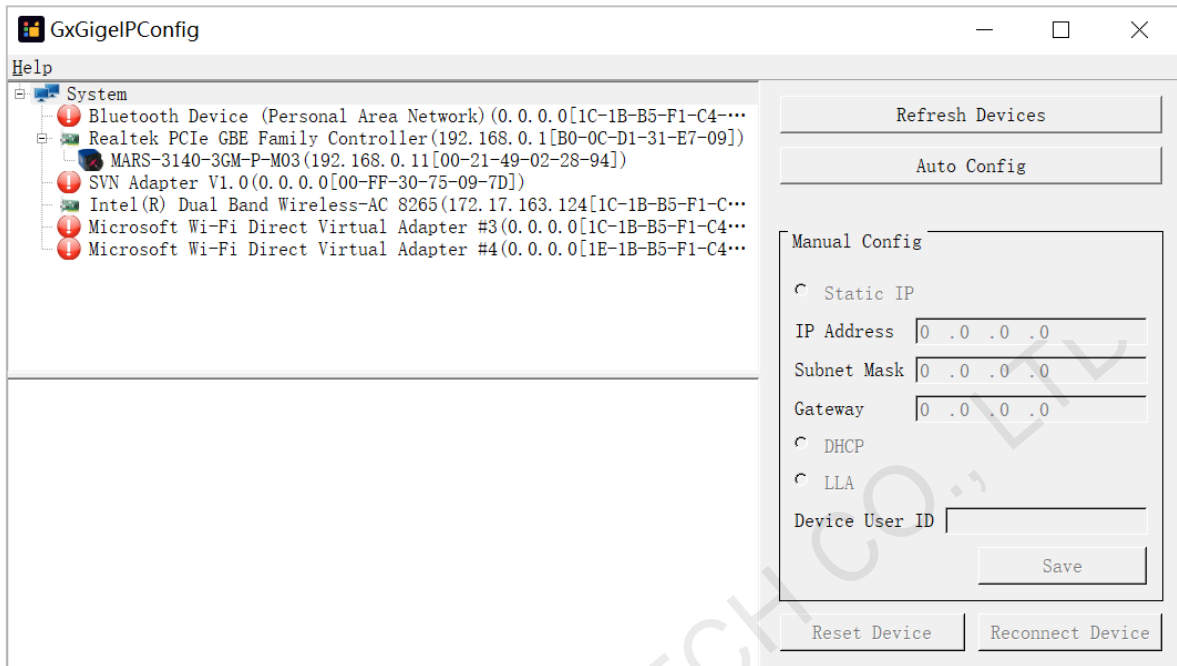
Figure 6-3 Setting IP address



6.2 Auxiliary Tool for C3200 Camera

You can use the IP configuration tool that comes with the camera to manage the cameras.

In the **System** list in the upper-left corner, you can see all the network adapters of the computer directly connected to the C3200 and which adapter the C3200 is connected to.



- Refresh Devices: Click to view the latest connection status of the devices.
- Reset Device: Click to power off the C3200 and restart it.
- Reconnect Device: Click to disconnect and reconnect the C3200.

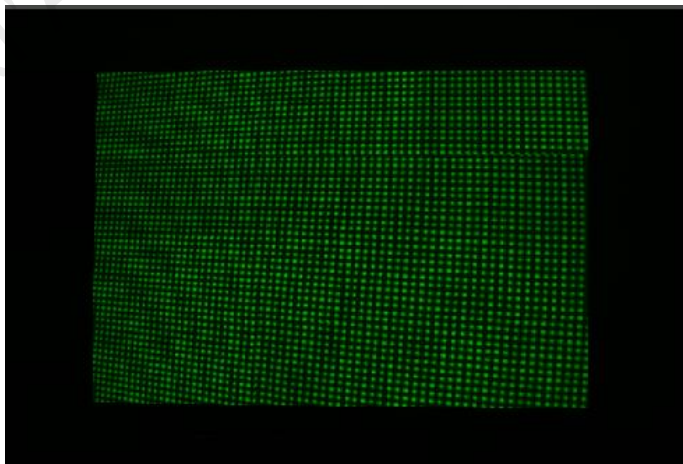
6.3 Operating Skills of Partition Imaging

When calibrating a large LED screen, ensure the camera lens faces the partition to be calibrated and move the camera location to bring the partition into the camera's view. Then, use the image preview function in the software to view the partition image.

Ratio of Image to Viewport Requirements

The resolutions and optical imaging quality of the areas on lens margins reduce sharply. Even after they are corrected optically, the calibration effect will also be affected. Therefore, you must position the image of the screen partition in the center of the preview area and ensure the image takes only 4/5 of the preview area.

Figure 6-4 Standard ratio of image to viewport



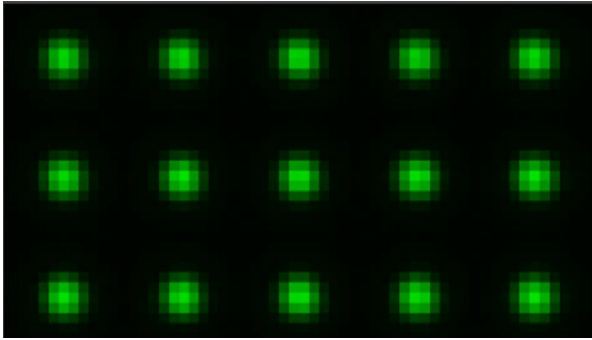
Note:

Considering the restrictions of positioning, ensure that the partition image is a rectangle and does not have a serious deformation.

LED Imaging Requirements

If the images of LEDs are overlapped, the LEDs will be interfered by the light emitted by the surrounding LEDs. The brightness and chroma difference between LEDs cannot be distinguished accurately and the camera parameter analysis result will be affected. Therefore, you must adjust the camera focus ring and aperture until the images of LEDs become clear and not overlapped.

Figure 6-5 Standard images of LEDs



6.4 Method of Calibrating a 4K+ Screen

When using a C3200 camera to calibrate a screen larger than 4K, it's best to calibrate a 4K part each time to ensure the efficiency. If there is a difference in the curved-surface transitions between partitions after the calibration is completed, you need to deal with it by following *CalCube MiniLED Ultra-Large Screen Calibration Technology Quick Start Guide*.

7 Troubleshooting

7.1 View Partition Calibration Effect and Troubleshoot Problems

Calibration effects of some areas may not be ideal. You need to troubleshoot the problems purposely based on the calibration effects. Before troubleshooting, follow the steps below to learn how to view camera collected image.


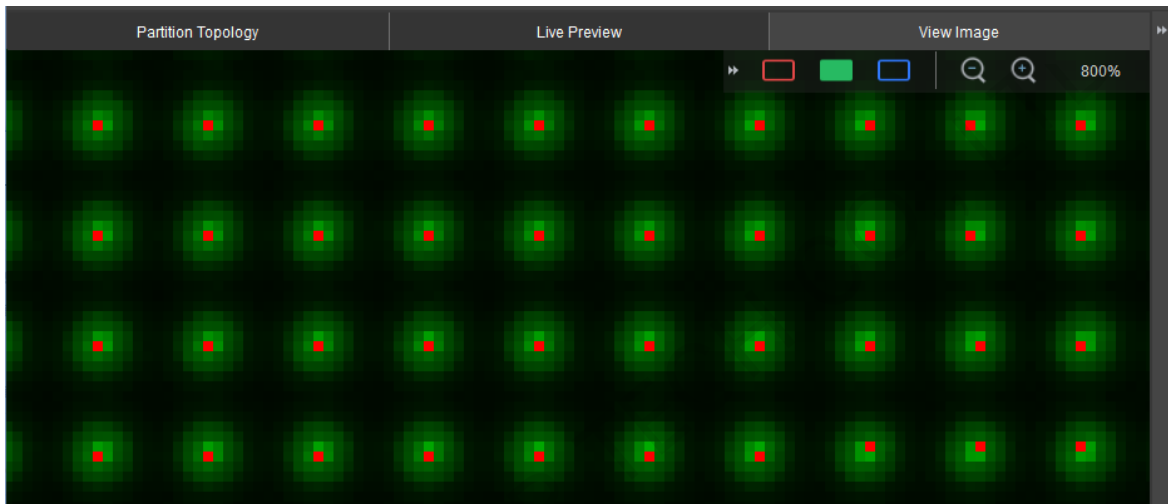
Click  on the **Partition Calibration** page to enter the measured image page. First, observe the clarity and completeness of the image. Second, observe whether all the LEDs have been selected by the smart positioning rectangle, as shown in [Figure 7-1](#).

Figure 7-1 Observing measured image



- Screen blurring phenomenon 1:** Some vertical bright or dark lines appear between partitions after calibration.

Reason: Generally speaking, this problem is caused by poor quality of imaging. You can observe whether the LED image is clear on the collected image after zooming it in. Usually, the reason of poor imaging quality is that the resolution you set for a partition is too high or the lens focusing is not clear.
- Screen blurring phenomenon 2:** Water ripple phenomenon occurred on the calibrated partition.

Reason: This problem is generally caused by insufficient image collection. Let the LED screen display the calibration effects in red, green and blue, respectively, to find out the color or colors in which the calibration effect is undesirable. Slightly adjust the focal length or focus again and recalibrate the display in that color or those colors to resolve the problem.

In addition, some on-site conditions may also lead to undesirable calibration effect. For example, ambient light interference or wind causes lens shaking, or raining or snowing causes blurred imaging. Calibration engineers must take measures to avoid influence of these external environmental factors in order to achieve the ideal calibration effect.

7.2 Water Ripple Occurred After Screen Calibration

The LED display in a certain color, most frequently in blue, may have water ripple phenomenon after calibration. The reason is that the LED screen resolution is too high, but the camera resolution is relatively insufficient and sampling frequency is very low. This phenomenon is known as moiré pattern in optical imaging.

To resolve this problem, use any of the methods below and recollect images in red, green and blue.

- Change the camera angle. You can rotate the camera to slightly change the camera angle in order to eliminate or change the moiré pattern.
- Change the camera location. You can move the camera leftward, rightward, upward or downward to change the angle between the camera and LED screen to reduce moiré pattern.
- Change the camera focusing. Too clear focus and obtaining precise details on detailed patterns may cause moiré pattern. Please adjust the focus ring to make imaging a little blurred in order to change clarity and therefore help eliminate moiré pattern.

4. Change the focal length. You can use different focal lengths to change or eliminate moiré pattern.

7.3 Recollect and Reanalyze Some Images

If the calibration effect is not satisfactory or the calibration cannot be carried out smoothly and recollection of some images is required, the custom configuration in the **Procedure** function can be used to precisely locate the images that need recollection.

For example, the 4 images in the red box below need to be recollected. The detailed operations are as follows.

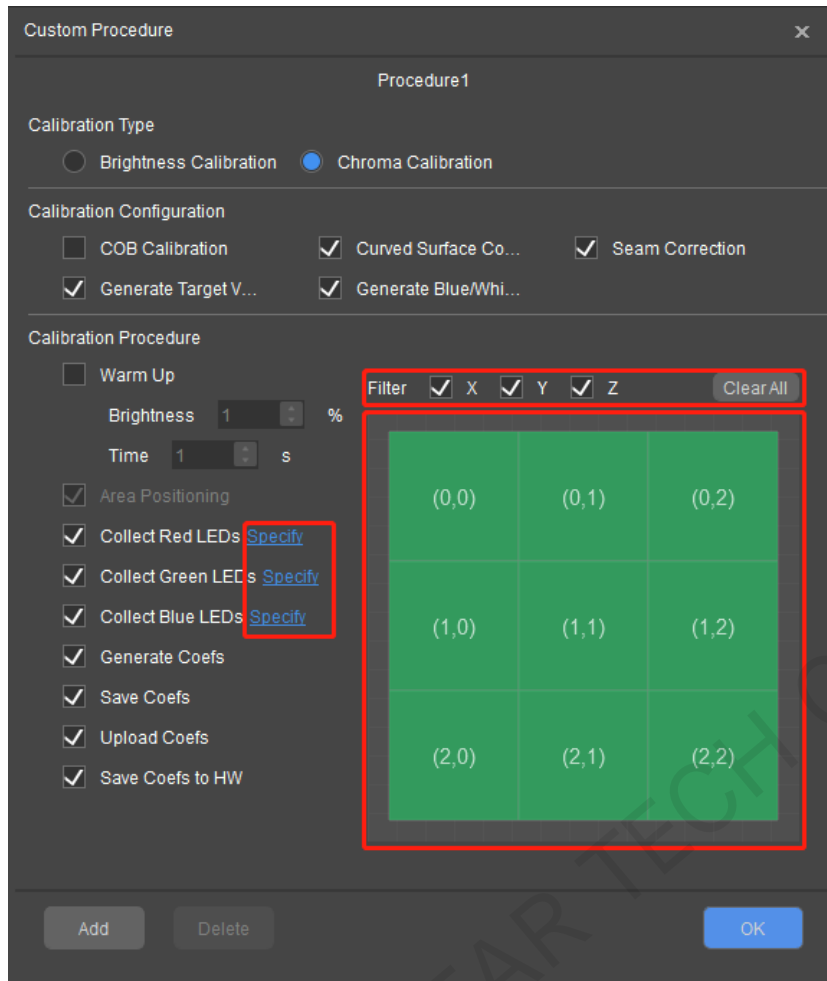
Figure 7-2 Stored images

blue-x.jpg	2020/4/3 14:17	Image (jpg) File	993 KB
blue-x-0.jpg	2020/4/3 14:16	Image (jpg) File	992 KB
blue-x-1.jpg	2020/4/3 14:17	Image (jpg) File	991 KB
blue-x-2.jpg	2020/4/3 14:17	Image (jpg) File	993 KB
blue-x-3.jpg	2020/4/3 14:16	Image (jpg) File	992 KB
blue-x-black.jpg	2020/4/3 14:16	Image (jpg) File	196 KB
blue-y.jpg	2020/4/3 14:14	Image (jpg) File	989 KB
blue-y-0.jpg	2020/4/3 14:14	Image (jpg) File	988 KB
blue-y-1.jpg	2020/4/3 14:14	Image (jpg) File	989 KB
blue-y-2.jpg	2020/4/3 14:14	Image (jpg) File	989 KB
blue-y-3.jpg	2020/4/3 14:14	Image (jpg) File	1,014 KB
blue-y-black.jpg	2020/4/3 14:13	Image (jpg) File	200 KB
green-x.jpg	2020/4/3 14:16	Image (jpg) File	2,159 KB
green-x-0.jpg	2020/4/3 14:15	Image (jpg) File	2,158 KB
green-x-1.jpg	2020/4/3 14:16	Image (jpg) File	2,159 KB
green-x-2.jpg	2020/4/3 14:16	Image (jpg) File	2,159 KB
green-x-3.jpg	2020/4/3 14:16	Image (jpg) File	2,159 KB

Step 2 Under the **Procedure** tab, click **Custom** to enter the **Custom Procedure** page.

Step 3 Configure the calibration procedure and select a calibration mode. The mode must be the same as the calibration mode of the images you want to collect.

Figure 7-3 Custom procedure



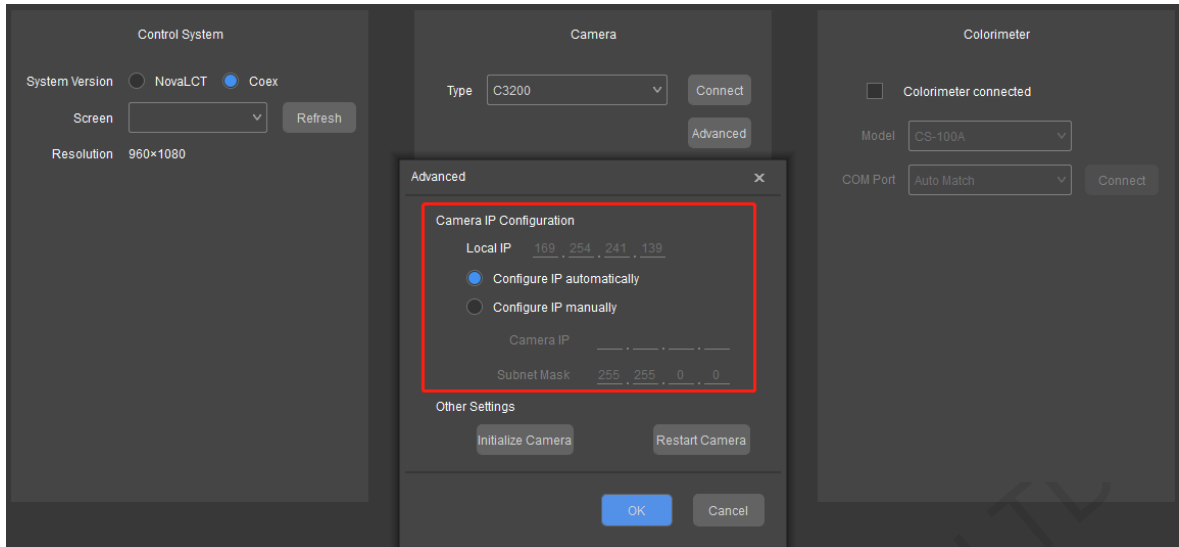
- Step 4 Select colors of LEDs that you want to collect. In this example, select green and blue.
- Step 5 Click **Specify** next to **Collect Green LEDs** to specify the locations of the images to be collected.
- Step 6 Click the check box next to **Filter** to select the filters you want to obtain (Select the X and Y filters).
- Step 7 In the topology diagram, select the locations of the LEDs to be captured. (Select area 2, namely the lower-left corner).
- Step 8 Click **Specify** next to **Collect Blue LEDs** to specify the locations of the images to be collected.
- Step 9 Click the check box next to **Filter** to select the filter you want to obtain (Select the X filter).
- Step 10 In the topology diagram, select the locations of the LEDs to be captured. (Select areas 0 and 1, namely the two on the top row).
- Step 11 In the **Calibration Procedure** area, select other functions for the current procedure.
- Step 12 Click **OK** to generate the custom configuration.
- Step 13 Perform the calibration procedure and recollect the images. For details, see [5.4.3 Partition Calibration](#).

7.4 C3200 Camera Connection Failed

The C3200 camera has compatibility issues with some computers and it may cause a connection failure. The following methods can be used to reconnect the C3200.

- Step 1 On the **Device** page, click **Advanced**. On the displayed page, select **Configure IP manually** and complete the settings. Make sure the camera IP and the network adapter IP are on the same network segment.

Figure 7-4 Advanced settings



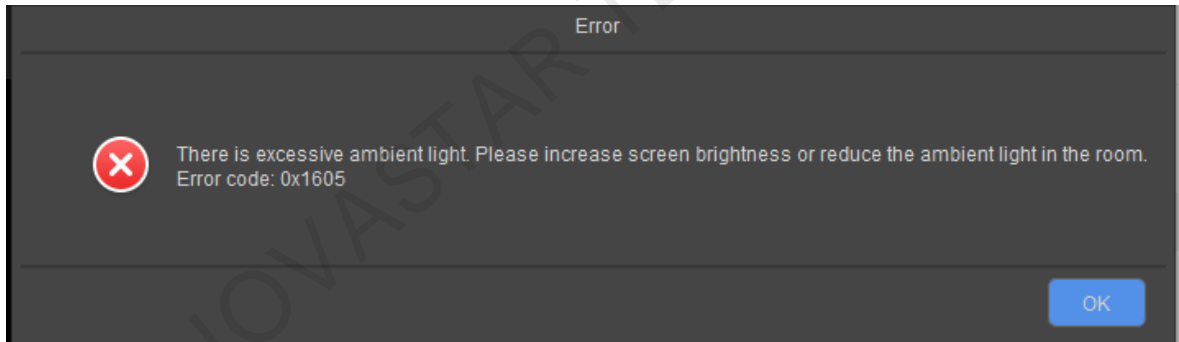
Step 2 Disable the network adapter that is connected to the C3200 and then enable the adapter again.

Step 3 Click **OK** to go back to the **Device** page and click **Connect** under **Camera** to reconnect the C3200.

7.5 Camera Parameter Analysis Failed Due to Excessive Ambient Light


During camera parameter analysis, if a prompt saying “There is excessive ambient light. Please increase screen brightness or reduce the ambient light in the room.” is displayed, follow the steps below to troubleshoot.

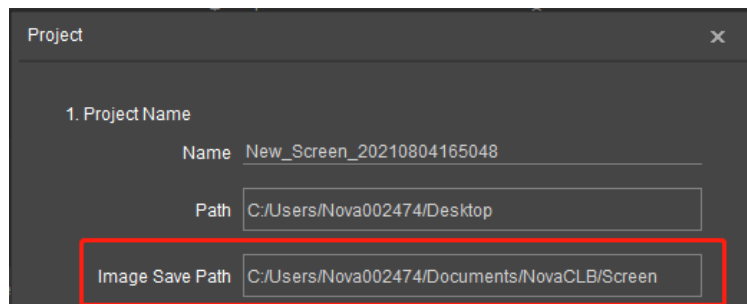
Figure 7-5 Error code 0x1605



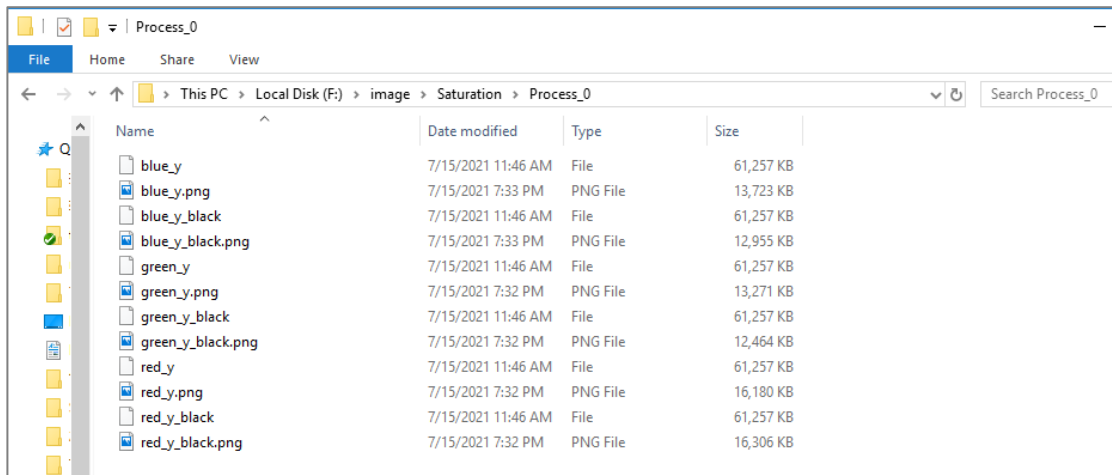
- Check whether there is any interference from unstable ambient light.
- Check whether the collected images are normal.

1. Open the **Saturation** folder in the image save path.


You can click  at the top right of the main user interface and select **Properties** to find the image save path.

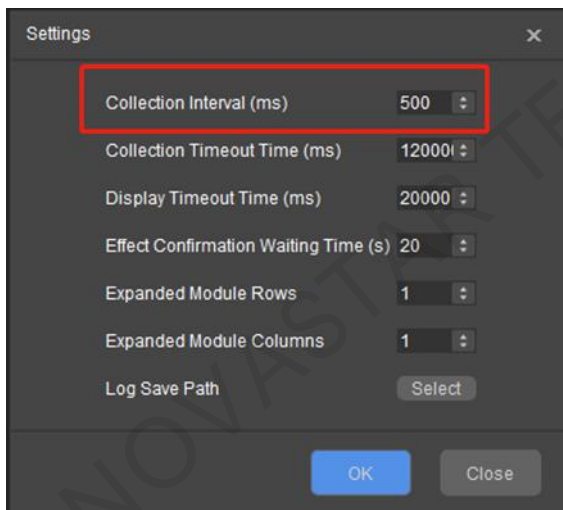


2. Open the folder of the procedure that has the analysis failure problem and check the image (.png) in the color that is currently being analyzed.

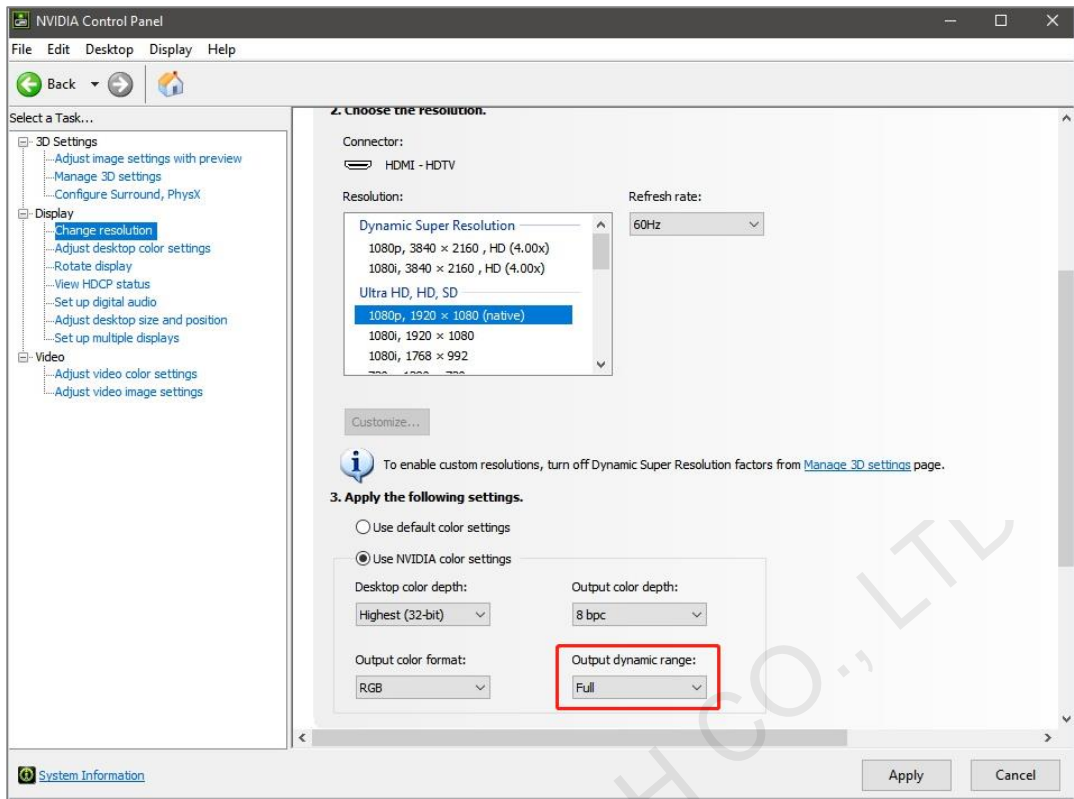


3. Check whether the background image (_black.png) has lighted pixels or whether the collected color image (_y.png) does not have lighted pixels.
4. If yes to the above, check whether displaying image on screen during image collection is normal (after area positioning, observe whether the color and order of displaying image on screen are correct).
 - If displaying image on screen is normal

click  at the top right of the main user interface and select **Settings**. On the **Settings** page, increase **Collection Interval** appropriately.



- If displaying image on screen is abnormal
- Check whether the output dynamic range of graphics card is **Full** and change the sending card firmware version and NovaLCT version to a more stable one.

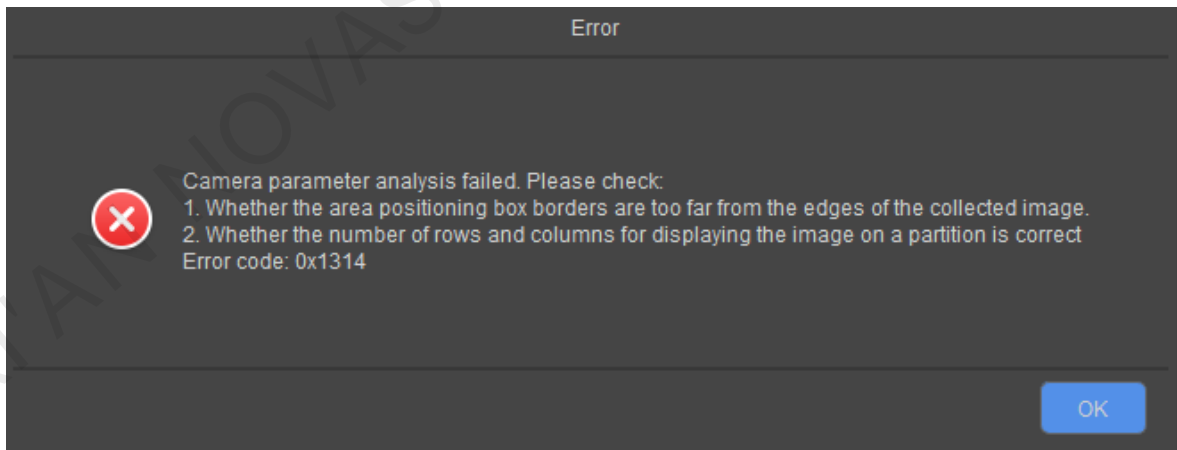


5. Do camera parameter adjustment again.

7.6 Camera Parameter Analysis Failed Due to Area Positioning Distance

During camera parameter analysis, if a prompt saying “Camera parameter analysis failed. Please check: Whether the area positioning box borders are too far from the edges of the collected image.” is displayed and the prompt still exists after you make the distance shorter, follow the steps below to troubleshoot.

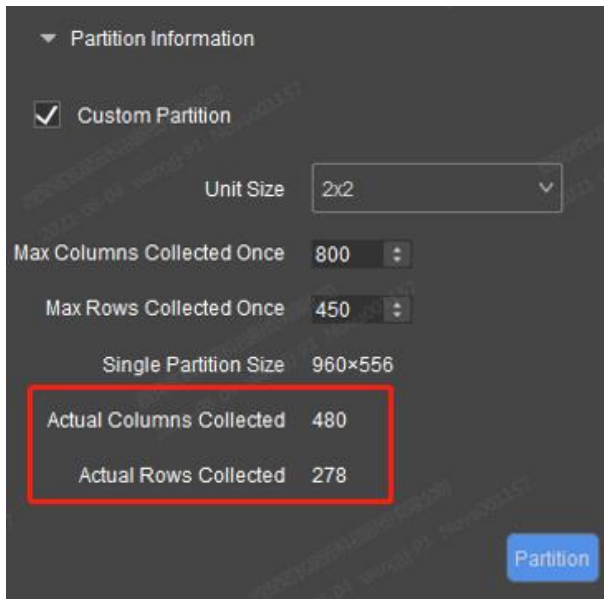
Figure 7-6 Error code 0x1314



Step 1 On the **Camera** page, select the partition where the analysis failed.

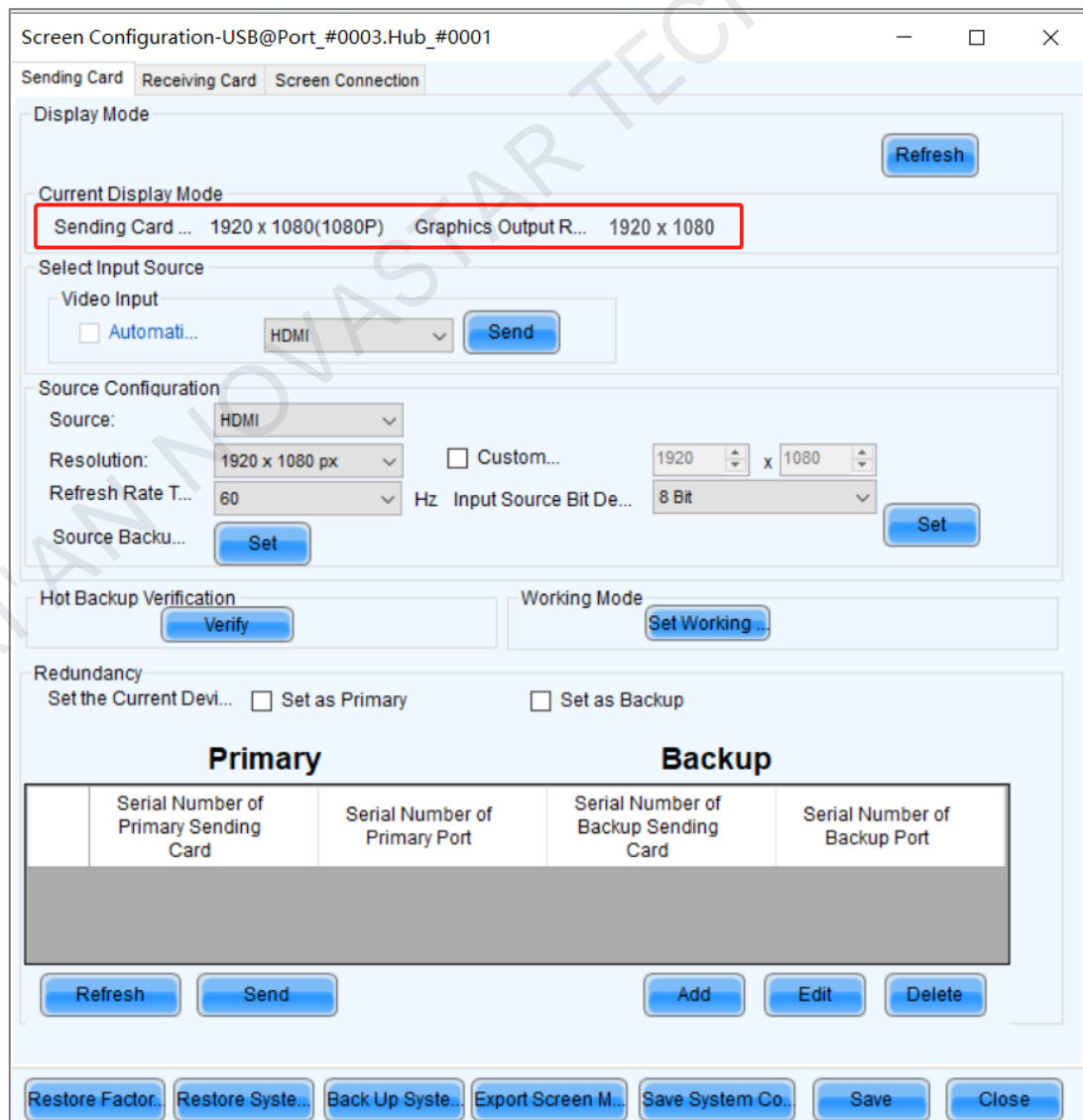
Step 2 In the **Partition Information** area, check whether **Actual Columns Collected** and **Actual Rows Collected** during displaying image on screen are correct.

Figure 7-7 Actual columns and rows collected



Step 3 If the number of lighted pixels on the screen during displaying image on screen is different from the number of actual collected columns and rows, reconfigure the screen in NovalCT and ensure **Sending Card Resolution** and **Graphics Output Resolution** values are the same to avoid the problem of displaying image on screen.

Figure 7-8 Screen configuration



Step 4 Do camera parameter analysis again.

Note:

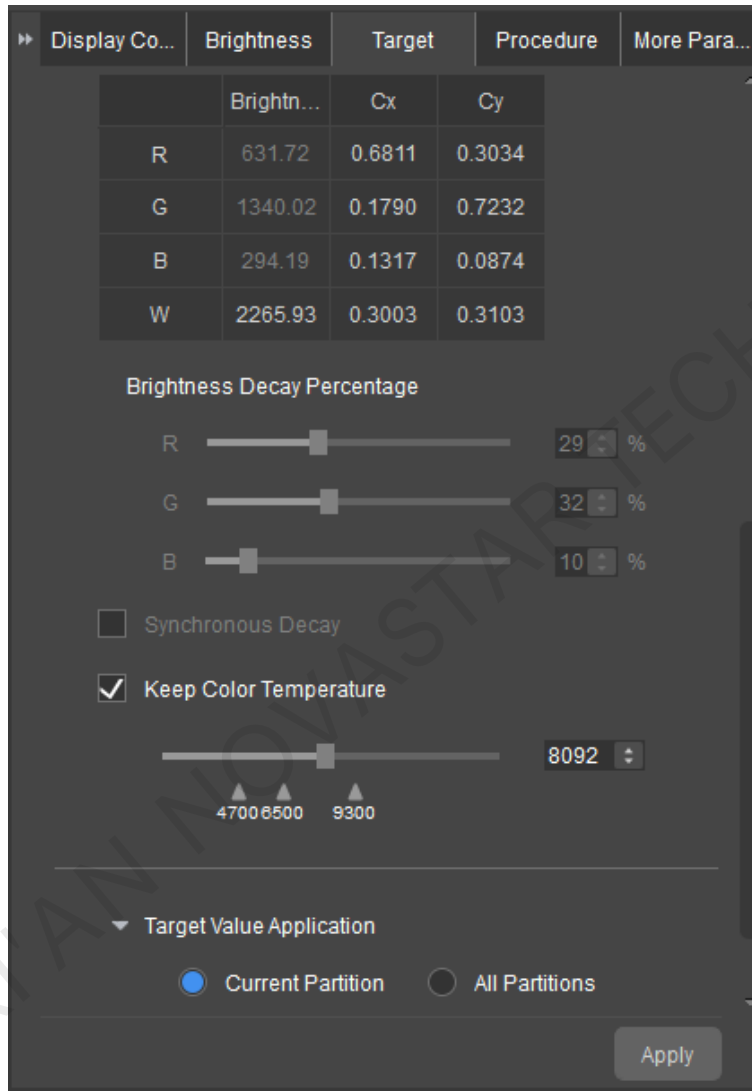
If camera parameter analysis failed and the error code is 0x1315, you also need to check whether **Actual Columns Collected** and **Actual Rows Collected** during displaying image on screen are correct.

7.7 Calibrate the Display to a Specified Color Temperature

When the **Wider Wavelength and Brightness Range LED Calibration** function is enabled, follow the steps below to calibrate the display to a specified color temperature.

Step 1 After a partition is calibrated, select the **Target** tab on the **Calibration** page.

Figure 7-9 Target



Step 2 Select **Keep Color Temperature**, drag the color temperature slider or enter a number to change the color temperature.

Step 3 Select All Partitions under Target Value Application.

Step 4 Click **Apply**.

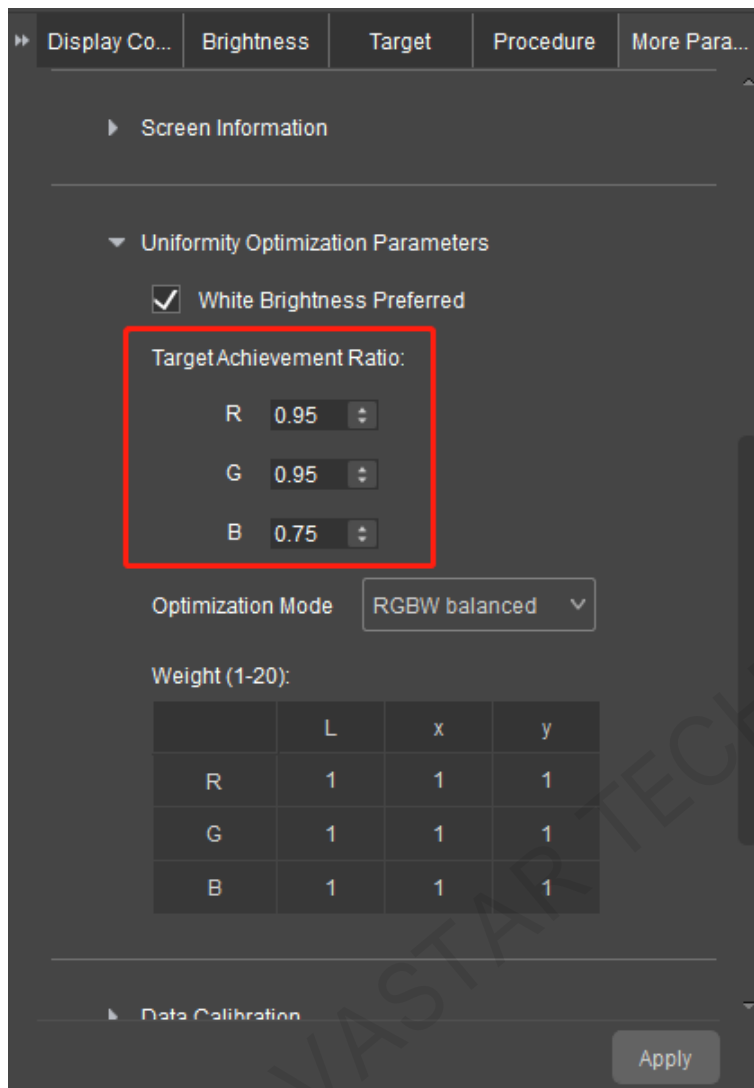
Step 5 Continue to calibrate the remaining partitions.

7.8 Poor Calibration Effect of A Color with Generate Target Values Enabled

After the calibration with the **Generate Target Values** function enabled is done, a certain color has low saturation or bad uniformity. Follow the steps below to troubleshoot.

Step 1 On the **Calibration** page, select the **More Params** tab.

Figure 7-10 Uniformity optimization parameters



Step 2 In the **Uniformity Optimization Parameters** area, adjust the target achievement ratio for the corresponding color.

- For lower saturation, decrease the ratio for that color appropriately.
- For bad uniformity, increase the ratio for that color appropriately.

Step 3 Regenerate coefficients to adjust the calibration effect.

The coefficient adjustment does not affect effects of the other colors. It only affect that color itself and the white color.

7.9 Remove Obvious Partition Merging Bands

After calibration, an obvious partition merging band may appear. Do the following to remove it.


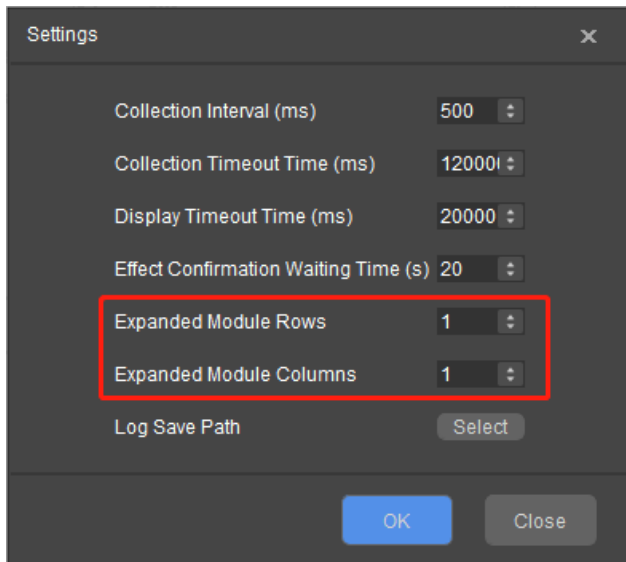
Step 1 At the top right of the main user interface, click the  button.

Figure 7-11 Expanded module rows/columns



Step 2 Click **Settings** to open the settings page.

Step 3 Based on the on-site situation, increase the values of **Expanded Module Rows** and **Expanded Module Columns** appropriately.

Step 4 Click **OK**.

Step 5 Set partitions again and do camera parameter analysis.

Step 6 Recollect calibration data.

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