CalCube MiniLED

Screen Calibration

Quick Start Guide

Change History

Document Version	Software Version	Release Date	Description
V2.3.0	V2.3	2022-09-08	First release

Contents

1 Introduction

This document introduces how to quickly get started with the common calibration procedure. For all the calibration operations, please refer to *CalCube MiniLED Screen Calibration User Manual*.

Different calibration modes have different calibration procedures. You can click the link below while pressing the **Ctrl** key to jump directly to the corresponding section.

- High-precision calibration & brightness and chroma calibration modes: refer to section 3.2 High-Precision Calibration & Brightness and Chroma Calibration.
- Full-grayscale calibration mode: refer to section 3.3 Full-Grayscale Calibration.
- Low-grayscale calibration mode: refer to section 3.4 Low-Grayscale Calibration.

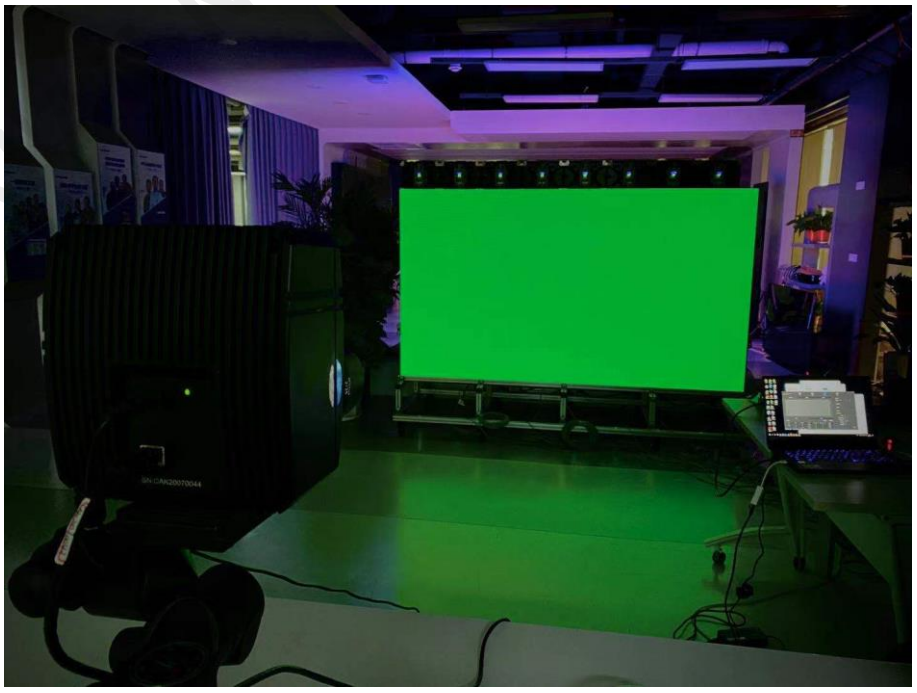
2 Calibration Preparations

2.1 Calibration Environment

Screen calibration is used for on-site calibration of screens. It requires engineers to bring calibration equipment to the site for pixel level calibration for excellent calibration effect. Screen calibration must be done in the following environment.

Light Requirements	Ensure the following calibration site requirements are met: • There is no external light interference and no obvious light around the screen during the calibration process. • There is no infrared light emitting equipment (such as infrared light-sensing camera) at the camera alignment position.
Calibration Distance	Make sure the LED partition image is in the center of the camera preview area and takes only 4/5 of the preview area. For example, to calibrate a COB screen with a pixel pitch of P0.9, the best distance for a 4K screen is 7 m to 8 m, and the best distance for a 2K screen is 3 m to 4 m.
Calibration Computer	• 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)

Figure 2-1 Illustration of calibration environment

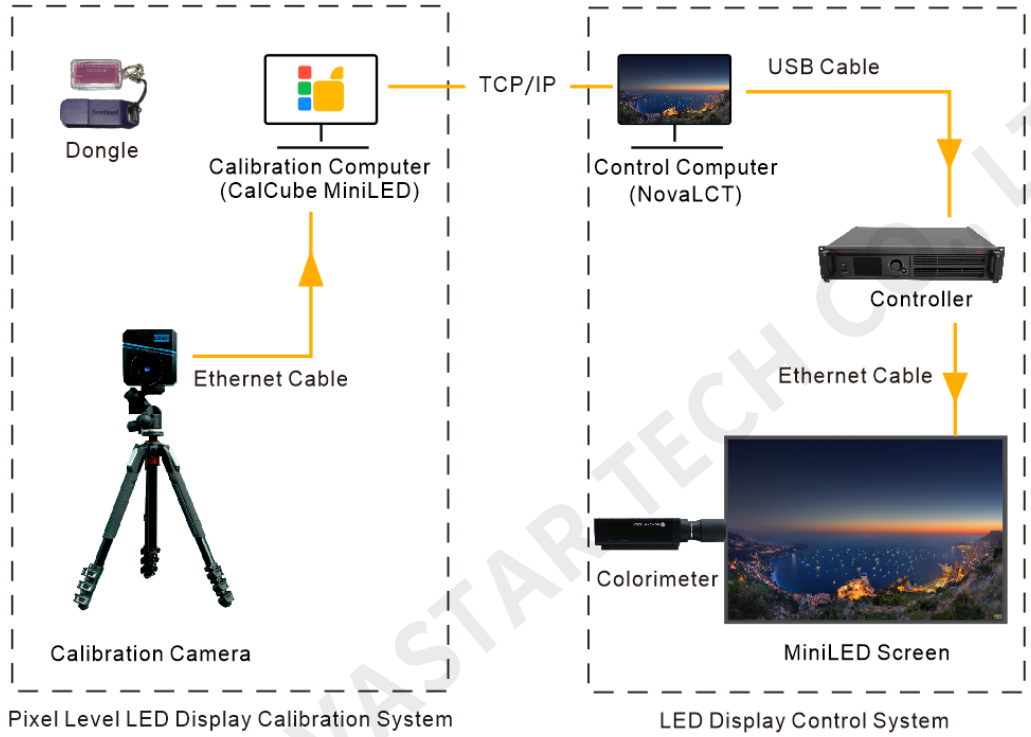


2.2 Software Installation

- Install CalCube MiniLED in the same way as an ordinary application. Please install it by following the setup wizard. After installation, the computer needs to be restarted.
- Insert the dongle into the USB port on the calibration computer and the dongle indicator will turn on.
- In the **Authorization File** area on the navigation page, click or to import the corresponding authorization file of the dongle. The software will search for and find all the authorization files in a folder containing five subdirectories at most, and read and import them to the software.

2.3 System Deployment

Figure 2-2 System structure



There are three methods to connect the calibration computer and control computer in a local area network (LAN).

- For short-distance calibration: Connect the two computers with Ethernet cable and set their IP addresses on the same network segment.
- If not convenient to extend the Ethernet cable: Connect the calibration computer to the router wirelessly and connect the control computer to the LAN port of the router with Ethernet cable.
- For long-distance calibration: Connect the two computers to a wireless point-to-point remote communication device.

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 you connect the control systen, the CalCube MiniLED software automatically checks whether the controller supports the Super Resolution Imaging function. If it is supported, it will be enabled by defualt. In addition, the low-grayscale calibration mode requires that the Super Resolution Imaging function must be enabled.

  Controllers that support that function include CX series, MX series, and MCTRL4K.

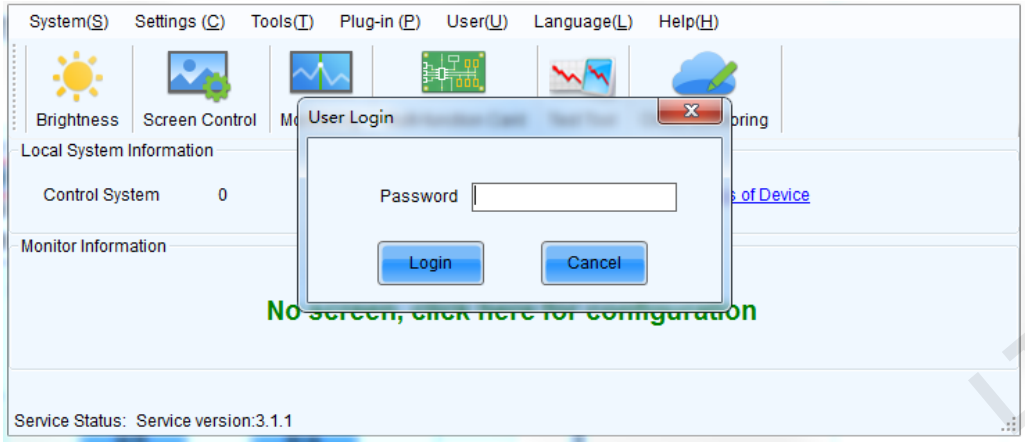
2.4 Set NovaLCT Monitoring

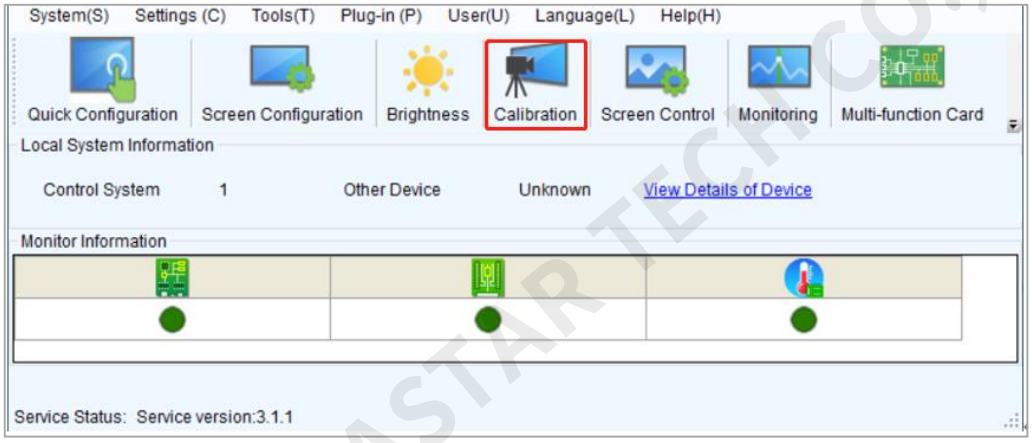
If the CalCube MiniLED software works with the NovaLCT control system, monitoring settings are required. If the Coex control system is used, skip this section.

Step 1 Open NovaLCT, choose **User** > **Advanced Synchronous System User Login**, enter the password (“admin”), and click **Login**. Then, click **Calibration** to open the calibration page.

Step 2 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, change the port number and try again.

Figure 2-3 Monitoring settings





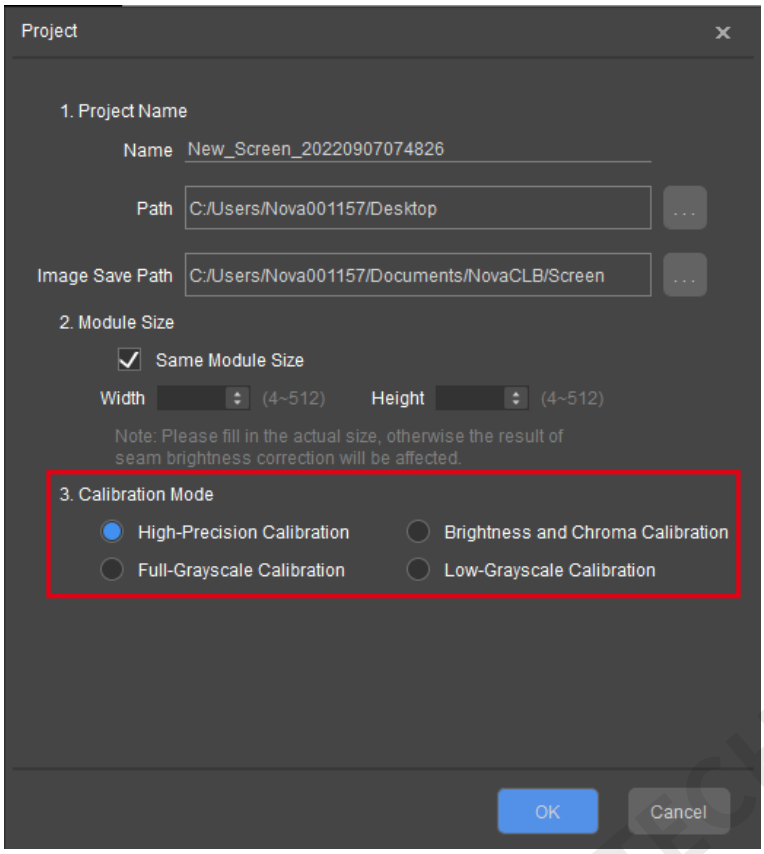
3 Screen Calibration Procedure

3.1 Create a Project and Select Calibration Mode

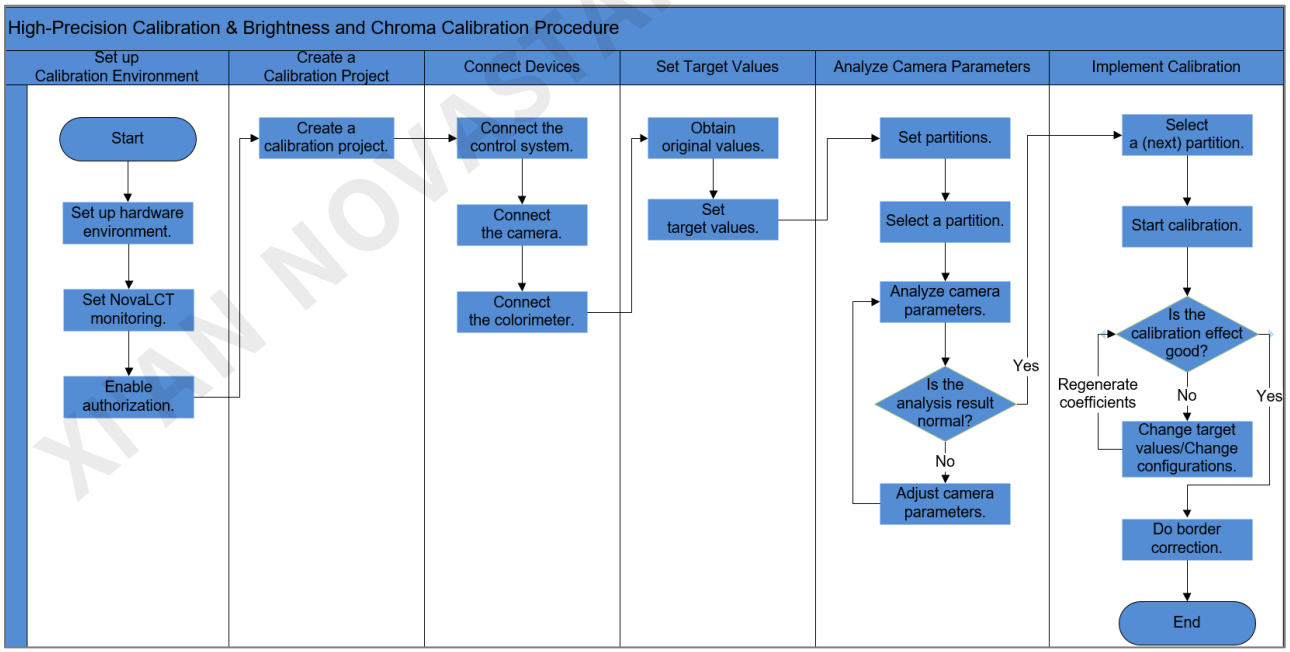
Click the **New** button to open the project page, set the project name, module size, and select the calibration mode. Different calibration modes have different calibration procedures.

- **High-Precision Calibration**: It is suitable for calibration of common COB screens.
- **Brightness and Chroma Calibration**: It is suitable for calibration of common SMD screens.
- **Full-Grayscale Calibration**: Select this mode if you want to ensure good calibration effect at medium grayscale and low grayscale, and if the calibration site has the supporting equipment that supports full grayscale calibration.
- **Low-Grayscale Calibration**: It is suitable for calibration of screens that use special driver ICs and have bad low-grayscale effect.

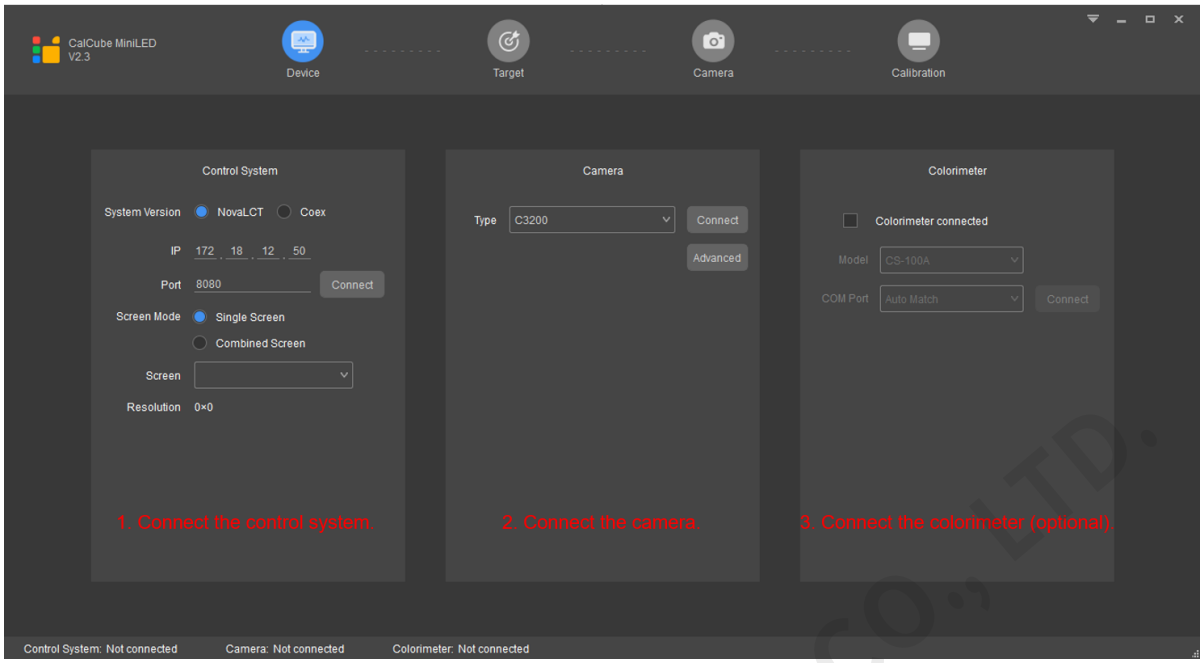
Figure 3-1 Selecting calibration mode



3.2 High-Precision Calibration & Brightness and Chroma Calibration



3.2.1 Connect Devices



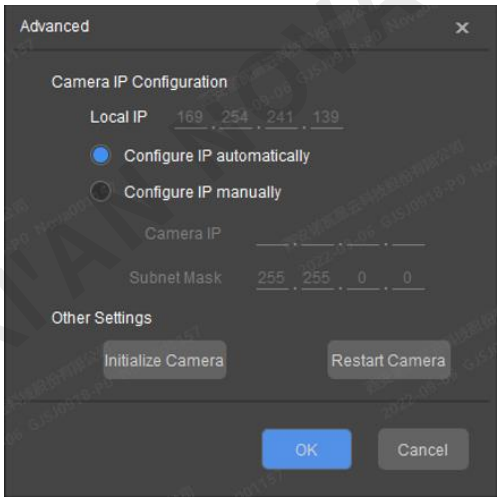
Step 1 Connect the control system.

- Coex: Click **Refresh** and the Coex control system will be automatically connected.
- NovaLCT: On the **Screen Calibration** page in NovaLCT, obtain the IP address and port number. 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**.

Step 2 Connect the camera.

Connect the camera to a power supply and to the calibration computer with USB cable. After the camera indicator turns green, click **Connect** in the **Camera area** in CalCube MiniLED.

When you connect the C3200 camera for the first time for calibration, click the **Advanced** button and click **Initialize Camera** to adjust the collection efficiency of the C3200 to the best.



Step 3 Connect the colorimeter.

Install the colorimeter driver program on the calibration computer, and select **Colorimeter connected** in CalCube MiniLED. Select the model of the connected colorimeter and COM port number.

3.2.2 Set Target Values

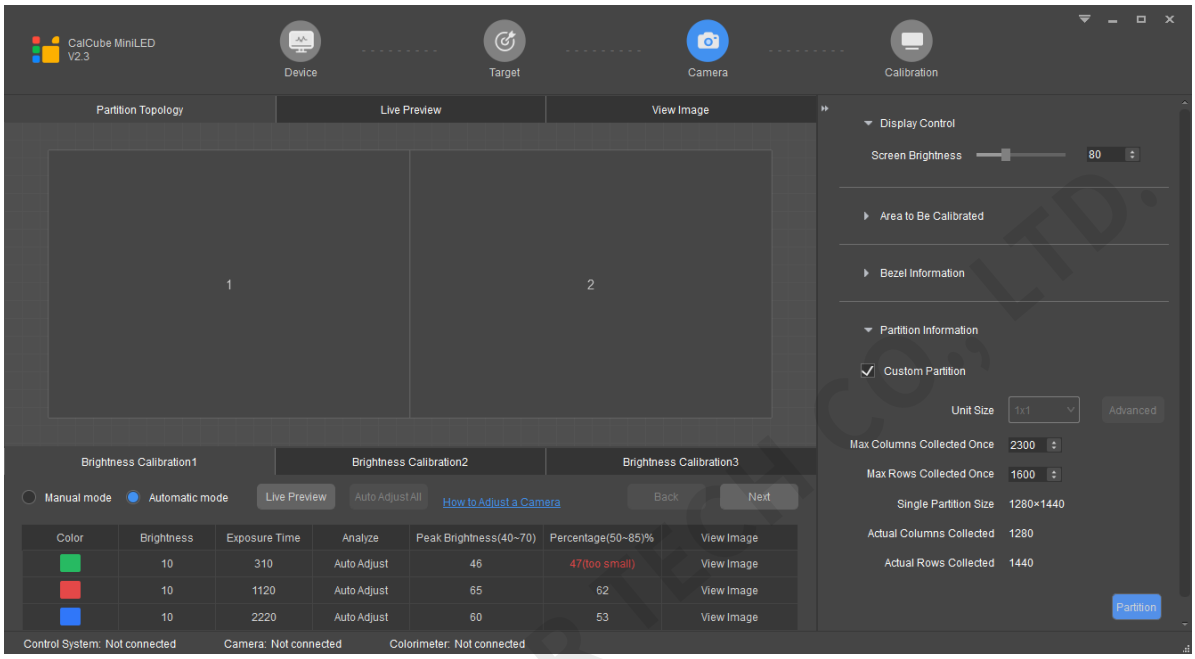
- If you have uniformity requirements only, use the system's default target values.

- If you have requirements for chromaticity diagram and color temperature of the screen before it leaves the factory, you need to use a colorimeter to obtain the original values and set the target values. The value of each target value parameter cannot exceed the value of each original value parameter.

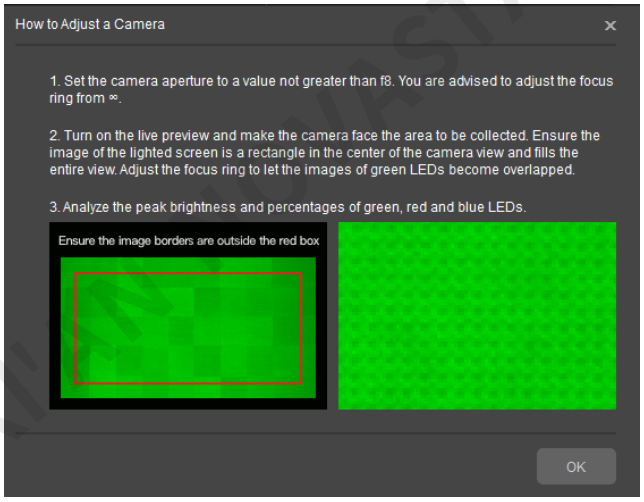
3.2.3 Analyze Camera Parameters

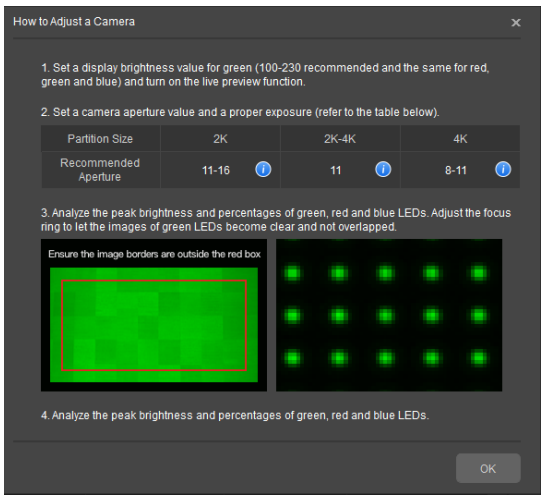
Step 1 Set partition information. Click the **Partition** button. The system will automatically calculate the partition according to the screen resolution and the resolution of the image collected by the camera

Step 2 Adjust camera settings. Click **How to Adjust a Camera** and follow the instructions to set the camera.



How to Adjust a Camera - When the Super Resolution Imaging function is enabled/disabled





You can enable or disable the Super Resolution Imaging function on the **More Params** tab page. After changing the function switch status, camera parameter reanalysis is needed.

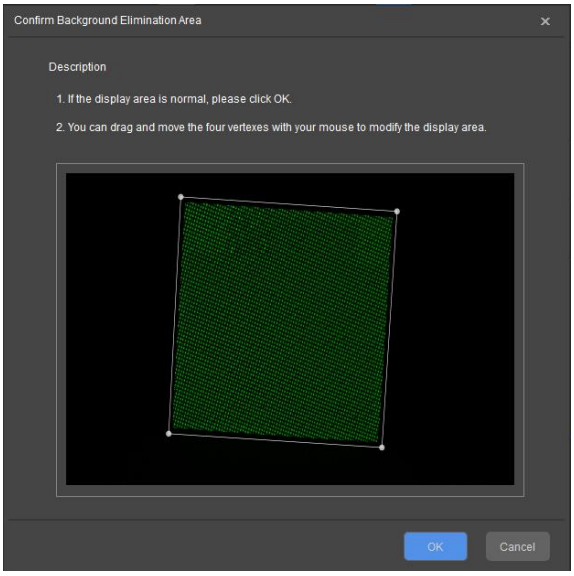
Step 3 Analyze camera parameters.

1. 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 Brightness** and **Percentage** values to be within the appropriate range. If these values still do not meet the requirements, adjust the focus ring and aperture. After adjustment, click **Auto Adjust** again.

2. Eliminate the ambient light.

   During adjustment, when the page below is displayed, drag the four vertexes to make them close to the image edges. The purpose is to adjust the effective calibration area and eliminate the interference light around the screen.

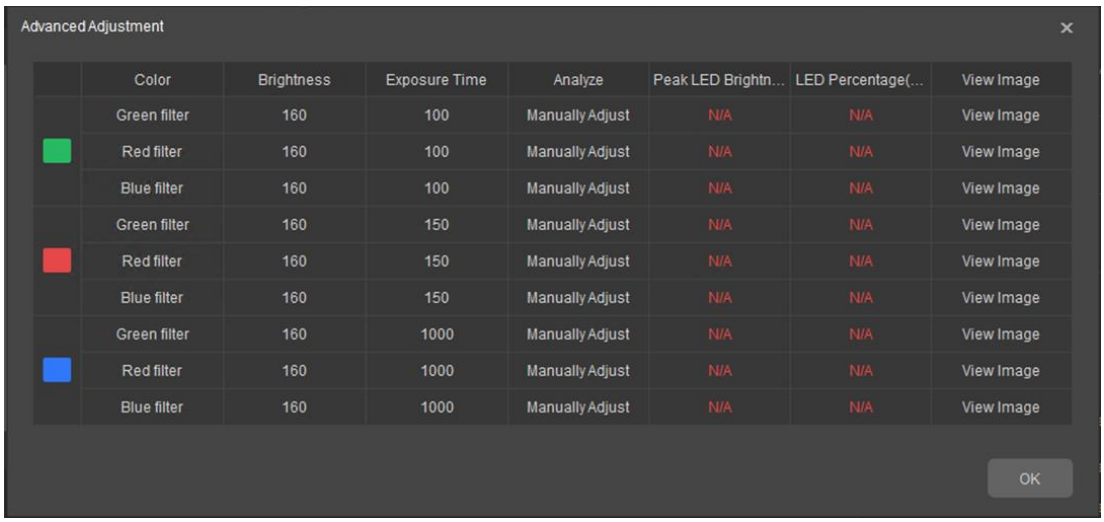


3. Select the **Auto Adjust All** method to adjust the settings for red and blue.
4. Check the statuses of the **Peak Brightness** and **Percentage** values of all calibration procedures.
   - If all the values are in white, they are normal. Go to substep 6.
   - If a value is in red or a value cell has a red border, the value is abnormal. Go to substep 5.
5. Switch to the **Manual mode** and adjust the abnormal values.
   - For red values, adjust the **Exposure Time** value or turn the focus ring to adjust the focus.

     Based on the difference between the actual values of **Peak Brightness** and **Percentage** and the standard value range, adjust the exposure time and focus ring properly, and click the **Manually Adjust** button.

     - If the **Peak Brightness** value is below the appropriate range, increase the exposure time.
     - If the **Peak Brightness** value is above the appropriate range, decrease the exposure time.
     - If the **Percentage** value is below the appropriate range, turn the focus ring to let the image become blurry.
     - If the **Percentage** value is above the appropriate range, turn the focus ring to let the image become clear.
   - For red borders, click **Advanced Adjustment** in the **Manual mode** to adjust the filters that has a red value.

     The adjustment method is the same as the above method.

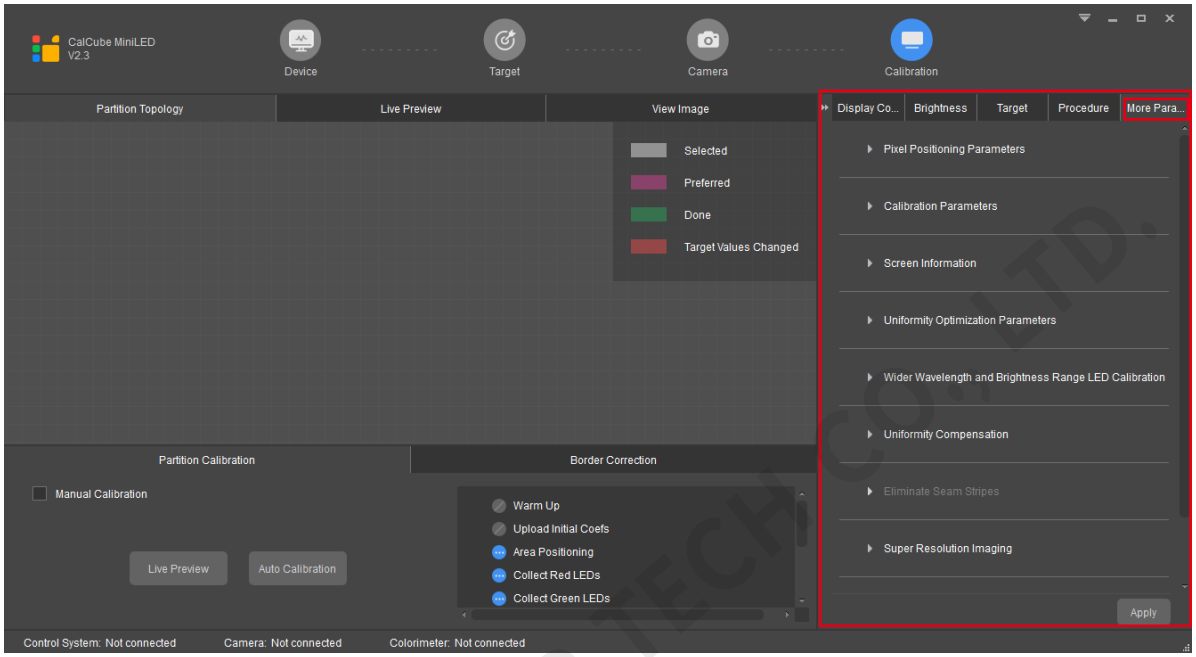


6. Click the **Chroma Calibration** tab and repeat the steps above to finish the analysis and adjustment.

   For the **Brightness and Chroma Calibration** mode, there is one calibration procedure only, as described above. After that procedure is finished, you can view the image directly.

3.2.4 Implement Calibration

Step 1 Set more parameters. Generally, you can use the default settings. For details, please refer to *CalCube MiniLED Screen Calibration User Manual*.



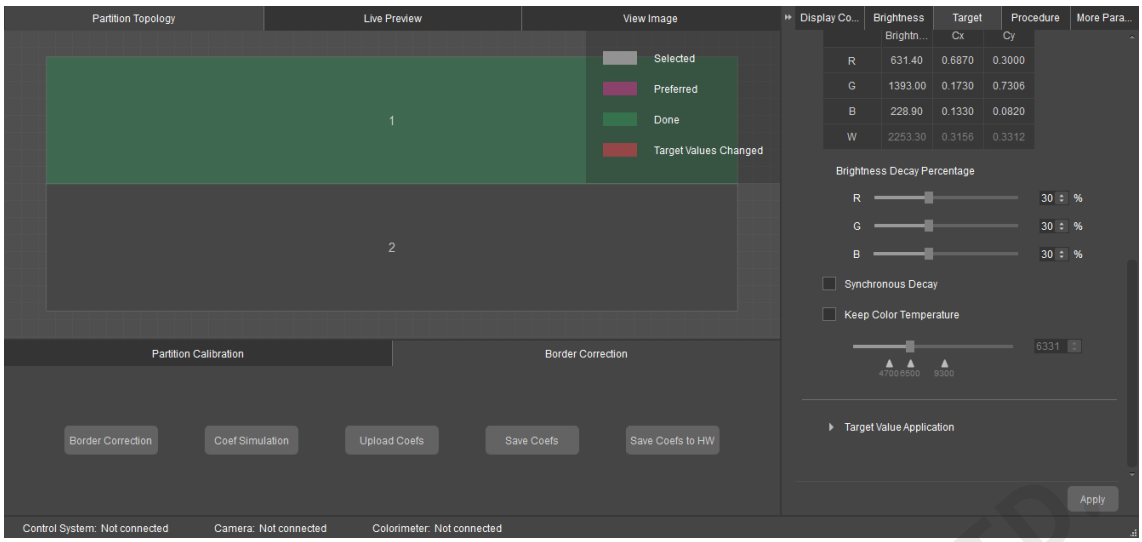
Parameter	Description
Pixel Positioning Parameters	Set the allowed dead LED ratio. The default value is 3‰.
Calibration Parameters	Set the calibration process parameters.
Screen Information	Confirm the module size and screen type again. Please fill in the information according to the on-site situation, otherwise the effect of correcting seam brightness caused by splicing will be compromised.
Uniformity Optimization Parameters	It is used to set the direction of the realizing the target values. You can set the parameters as needed.
Wider Wavelength and Brightness Range LED Calibration	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. This function is enabled by default.
Uniformity Compensation	It is suitable for screens with poor display effects before calibration. It can effectively improve the display uniformity. This function is enabled by default.
Eliminate Seam Stripes	It is used to remove the diagonal stripes around the seams caused by high-resolution partitions after calibration.
Super Resolution Imaging	It is used to greatly increase the calibration speed with a latest algorithm. This function is enabled by default.

Step 2 Click **Auto Calibration**, and the software will start the calibration procedure automatically, including collecting data, analyzing data, and generating, uploading and saving coefficients.

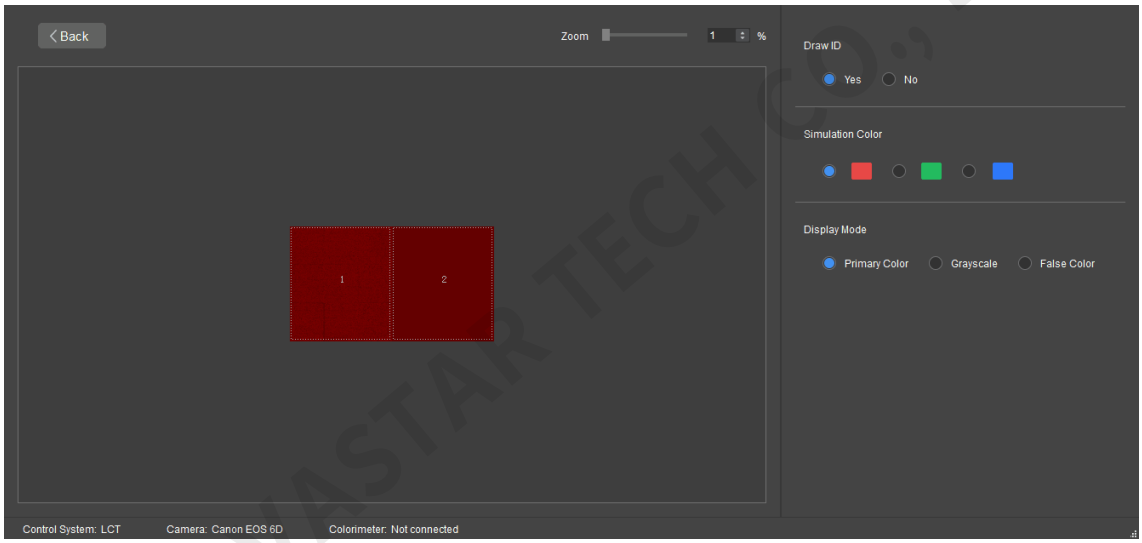
Step 3 On the **Display Control** tab page, control the LED display status and check the effect before and after calibration.

Step 4 Do border correction.

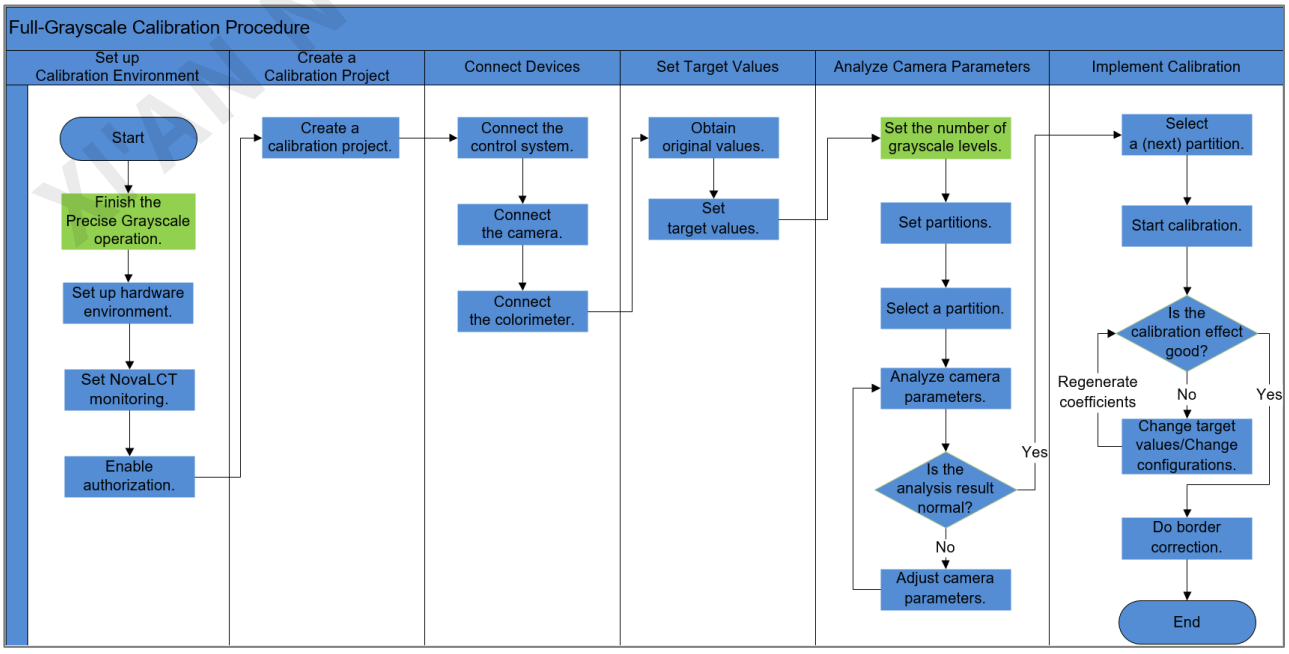
- Observe whether there are border lines between the partitions. If no, skip this step.
- If there are border lines, click the **Border Correction** > **Upload Coefs** > **Save Coefs** > **Save Coefs to HW** buttons in order.



- 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.



3.3 Full-Grayscale Calibration



Note:

Before full-grayscale calibration, make sure you have finished the Precise Grayscale operation of Image Booster for the screen in NovaLCT. For details, please refer to *NovaLCT LED Configuration Tool for Synchronous Control System User Manual*.

3.3.1 Connect Devices and Set Target Values

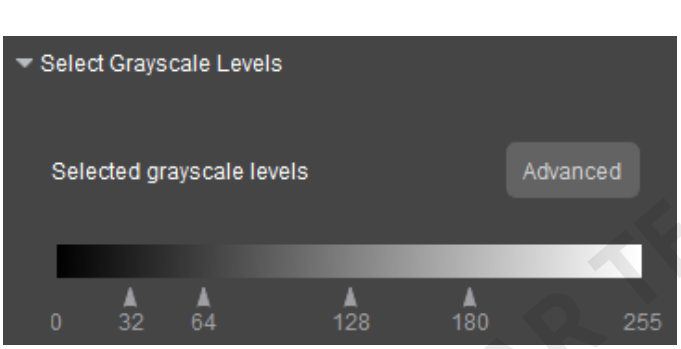
The operations are the same as those in the above calibration modes. Please refer to sections 3.2.1 Connect Devices and 3.2.2 Set Target Values.

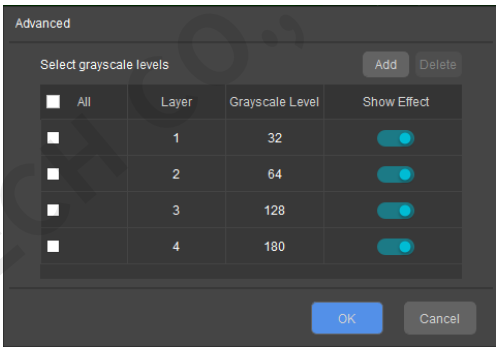
3.3.2 Analyze Camera Parameters

Step 1 Set partition information. 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

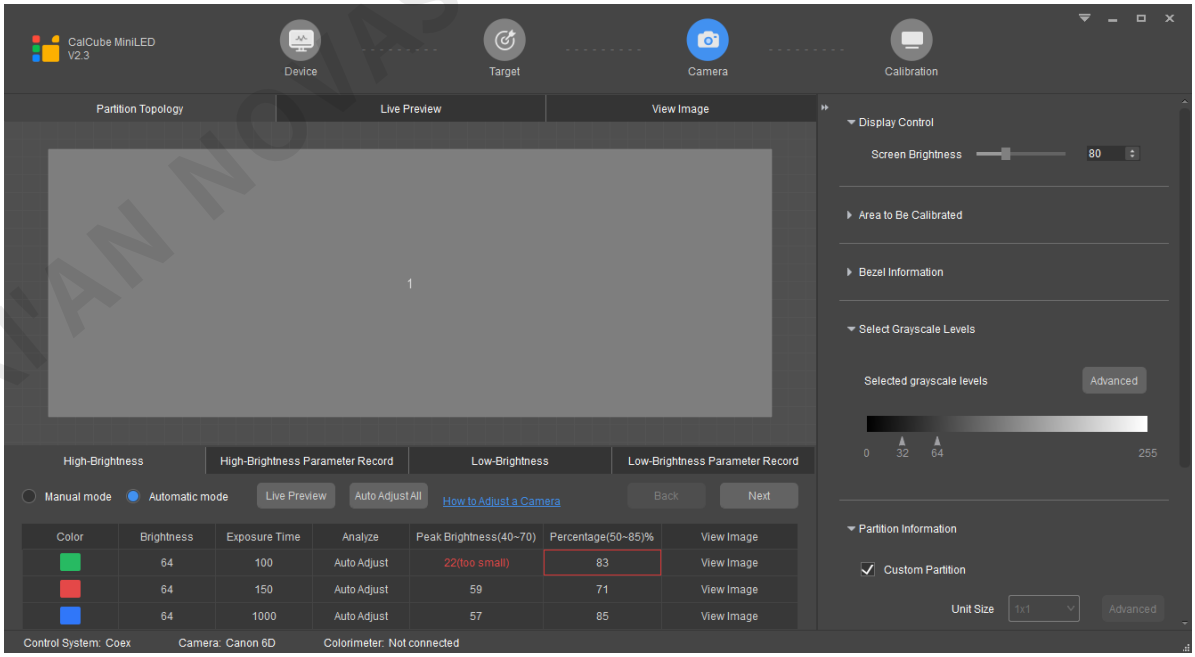
Step 2 Set grayscale levels.

Click **Advanced** and on the displayed page, you can set the layers of grayscale level (4 layers by default) and position of grayscale level collection flexibly based on the screen characteristics. If the screen uniformity is not too bad, you can decrease the layer quantity appropriately to shorten the calibration time.

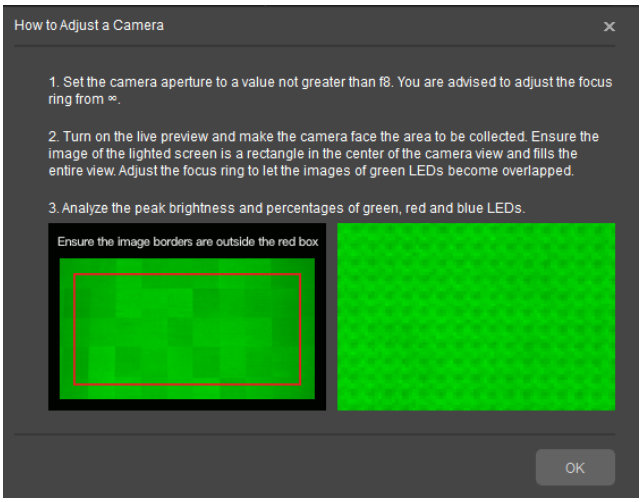


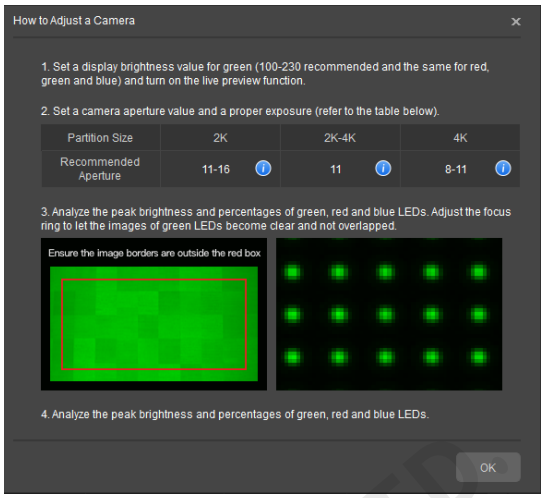


Step 3 Adjust camera settings. On the **High-Brightness** tab page, click **How to Adjust a Camera** and follow the instructions to set the camera.



How to Adjust a Camera - When the Super Resolution Imaging function is enabled/disabled





You can enable or disable the Super Resolution Imaging function on the **More Params** tab page. After changing the function switch status, camera parameter reanalysis is needed.

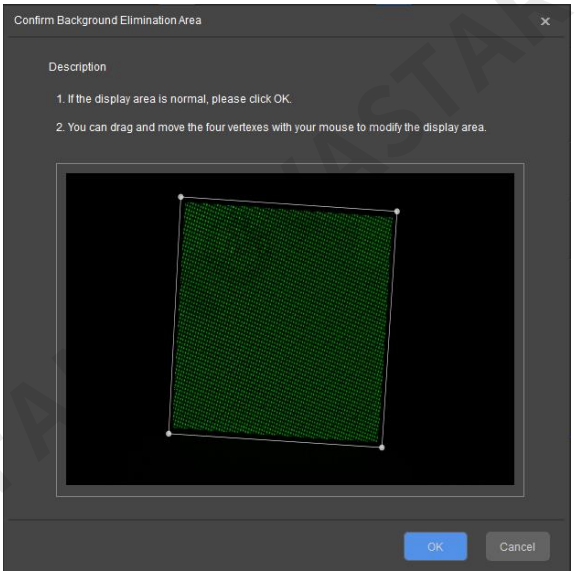
Step 4 Analyze camera parameters.

1. 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 Brightness** and **Percentage** values to be within the appropriate range. If these values still do not meet the requirements, adjust the focus ring and aperture. After adjustment, click **Auto Adjust** again.

2. Eliminate the ambient light.

   During adjustment, when the page below is displayed, confirm the locating box. If the display area is abnormal, drag the vertexes to select the effective calibration area.



3. Select the **Auto Adjust All** method to adjust the settings for red and blue.
4. Check the statuses of the **Peak Brightness** and **Percentage** values of all calibration procedures.
   - If all the values are in white, they are normal. Go to substep 6.
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5. Switch to the **Manual mode** and adjust the abnormal values.
   - For red values, adjust the **Exposure Time** value or turn the focus ring to adjust the focus.

     Based on the difference between the actual values of **Peak Brightness** and **Percentage** and the standard value range, adjust the exposure time and focus ring properly, and click the **Manually Adjust** button.

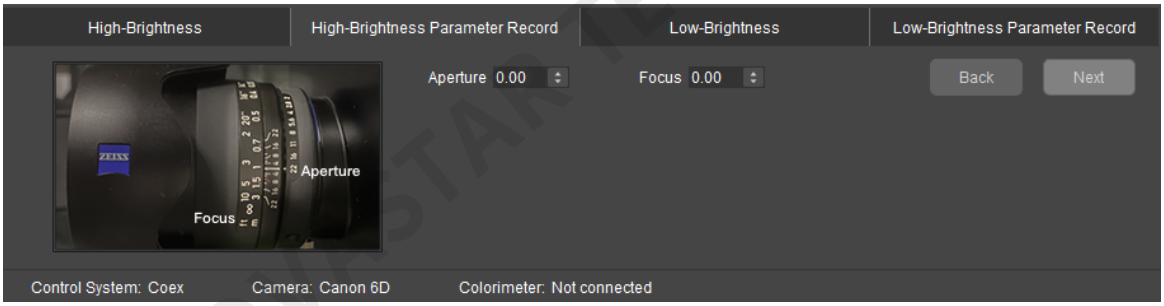
     - If the **Peak Brightness** value is below the appropriate range, increase the exposure time.

- If the **Peak Brightness** value is above the appropriate range, decrease the exposure time.
- If the **Percentage** value is below the appropriate range, turn the focus ring to let the image become blurry.
- If the **Percentage** value is above the appropriate range, turn the focus ring to let the image become clear.

– For red borders, click **Advanced Adjustment** in the **Manual mode** to adjust the filters that has a red value.

The adjustment method is the same as the above method.

6. Click **Next**. On the **High-Brightness Parameter Record** tab page, record the aperture and focus values.



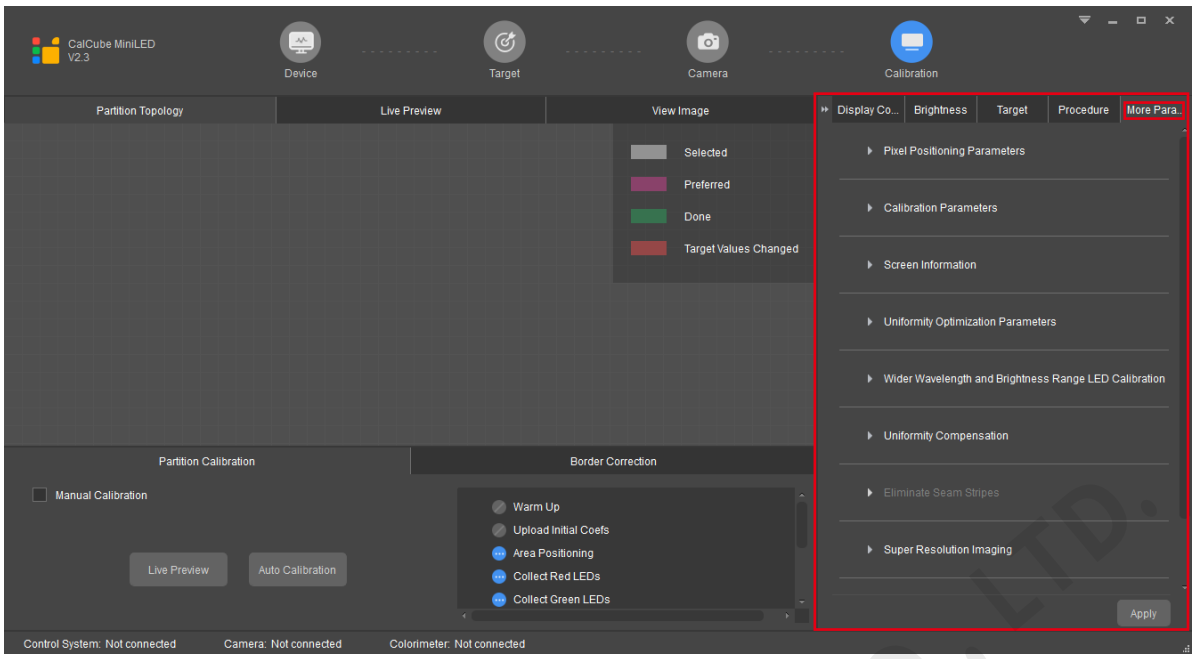
7. Click **Next**. On the **Low-Brightness** tab page, repeat the steps above to adjust the low-brightness parameter and record the corresponding aperture and focus values.

Note:

If an aperture can meet the requirements for camera parameter analysis at all grayscale levels, there is no need to record the high-brightness or low-brightness parameter value during the process.

3.3.3 Implement Calibration

Step 1 Set more parameters. Generally, you can use the default settings. For details, please refer to *CalCube MiniLED Screen Calibration User Manual*.



Parameter	Description
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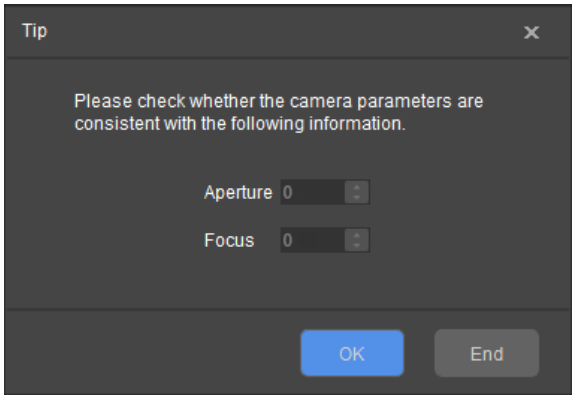
Uniformity Compensation	It is suitable for screens with poor display effects before calibration. It can effectively improve the display uniformity. This function is enabled by default.
Eliminate Seam Stripes	It is used to remove the diagonal stripes around the seams caused by high-resolution partitions after calibration.
Super Resolution Imaging	It is used to greatly increase the calibration speed with a latest algorithm. This function is enabled by default.

Step 2 Click **Auto Calibration**, and the software will start the calibration procedure automatically, including collecting data, analyzing data, and generating, uploading and saving coefficients.

During the calibration process, the following window will be displayed. Please adjust the camera aperture and focus to the values displayed in the window.



Note:

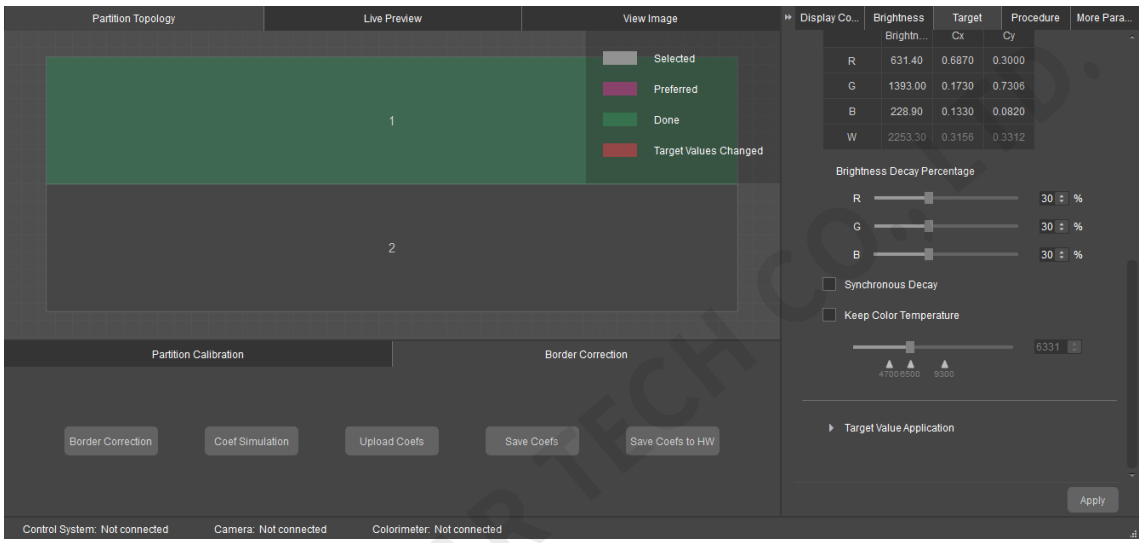
If an aperture can meet the requirements for camera parameter analysis at all grayscale levels, there is no need to adjust the aperture or focus. You can click **OK** directly.

Step 3 On the **Display Control** tab page, control the LED display status and check the effect before and after calibration.

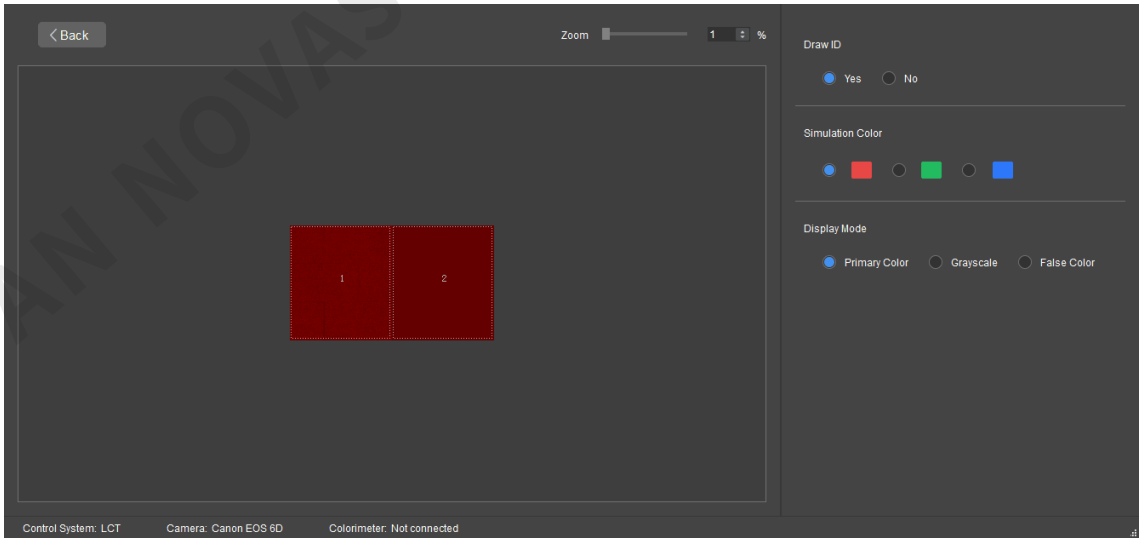
To enable the full-grayscale calibration effect, you need to check both **Enable Calibration** and **Full-Grayscale**.

Step 4 Do border correction.

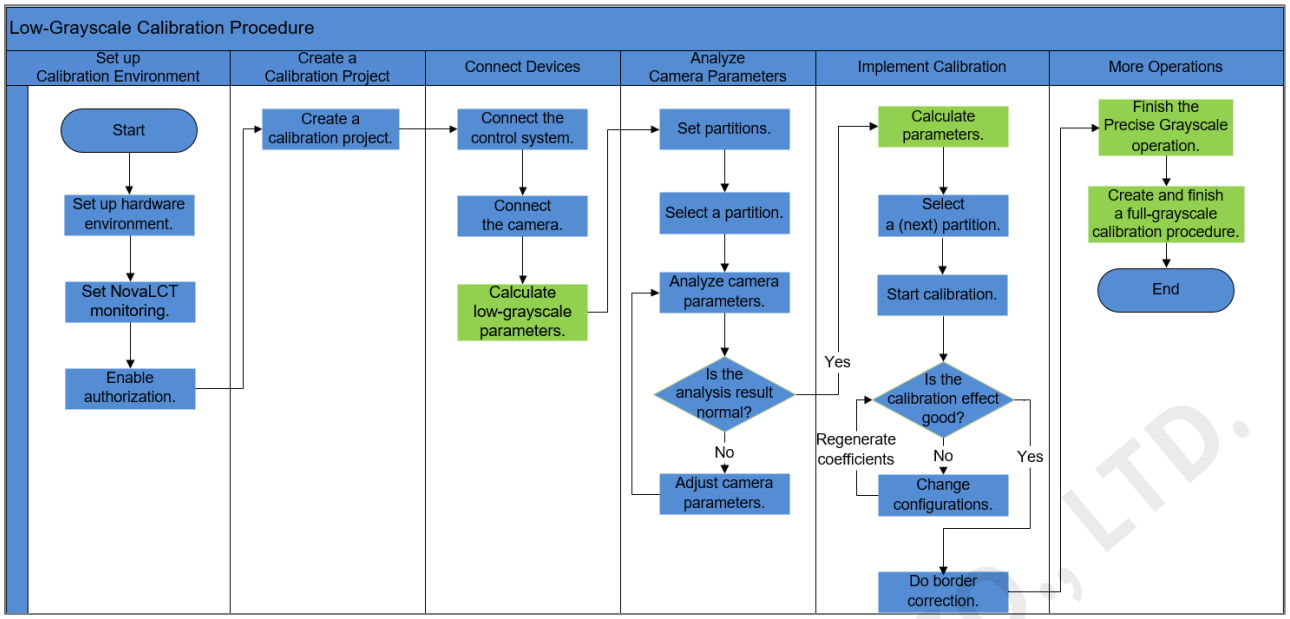
- Observe whether there are border lines between the partitions. If no, skip this step.
- If there are border lines, click the **Border Correction** > **Upload Coefs** > **Save Coefs** > **Save Coefs to HW** buttons in order.



- 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.



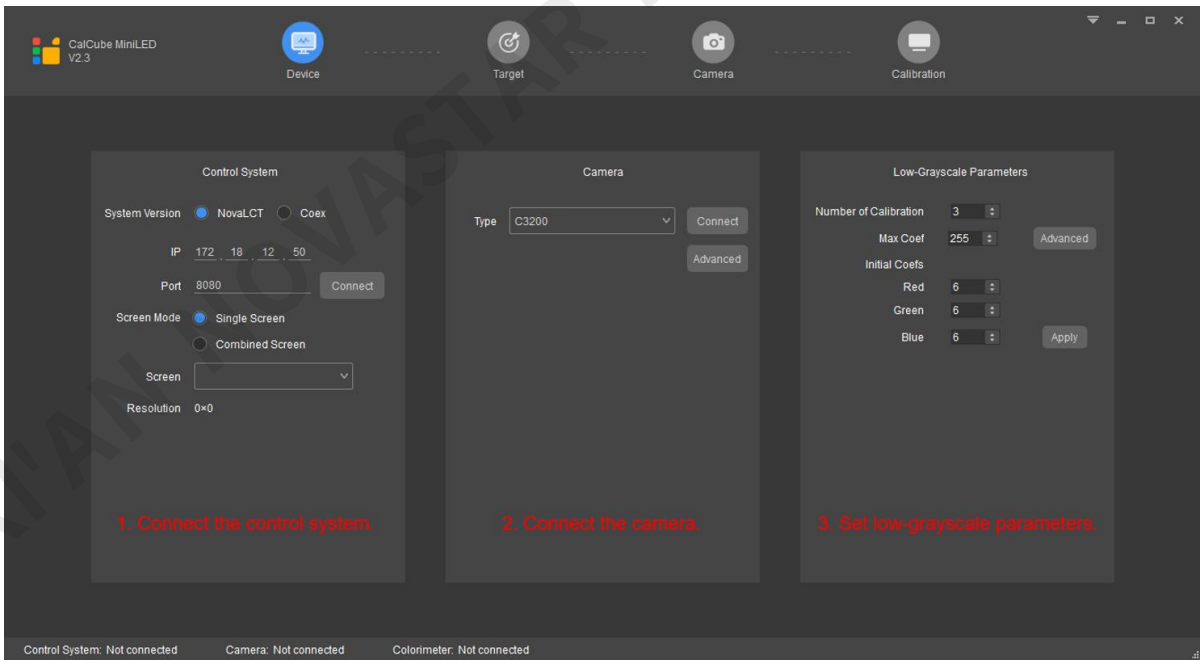
3.4 Low-Grayscale Calibration



Note:

For screens that use special ICs, after the low-grayscale calibration procedure is finished, do a full-grayscale calibration procedure to ensure a good calibration effect.

3.4.1 Connect Devices and Set Low-Grayscale Parameters



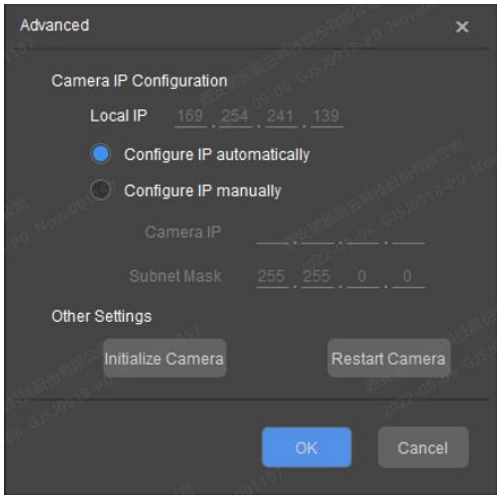
Step 1 Connect the control system.

- Coex: Click **Refresh** and the Coex control system will be automatically connected.
- NovaLCT: On the **Screen Calibration** page in NovaLCT, obtain the IP address and port number. 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**.

Step 2 Connect the camera.

Connect the camera to a power supply and to the calibration computer with USB cable. After the camera indicator turns green, click **Connect** in the **Camera area** in CalCube MiniLED.

When you connect the C3200 camera for the first time for calibration, click the **Advanced** button and click **Initialize Camera** to adjust the collection efficiency of the C3200 to the best.



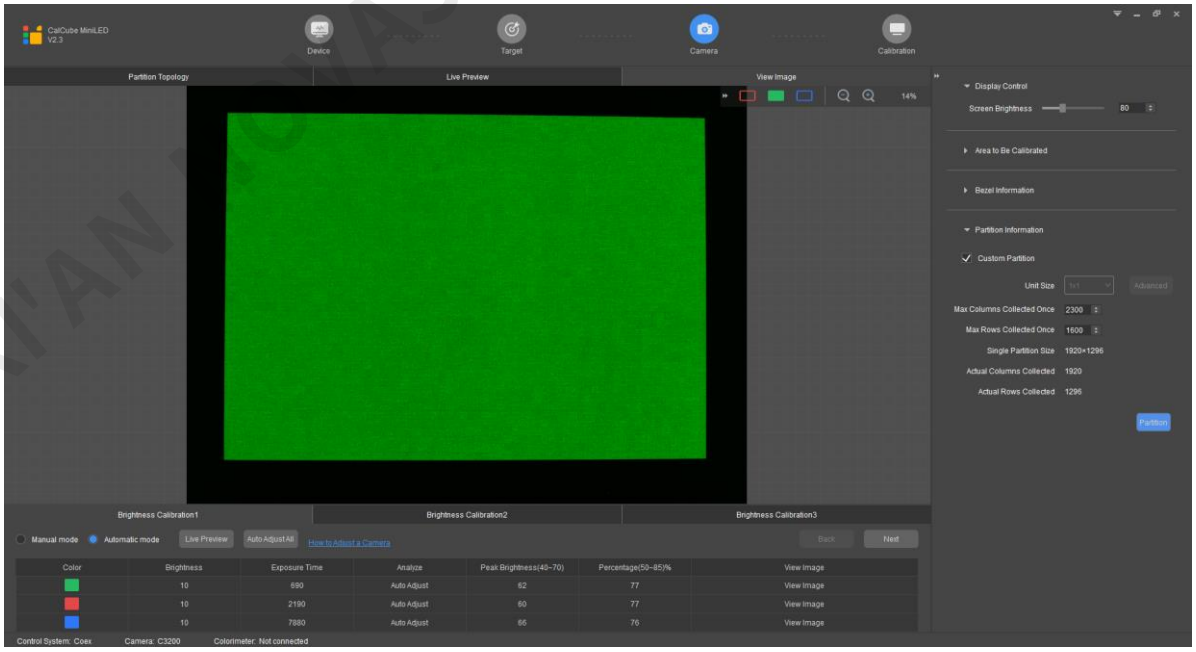
Step 3 Set the low-grayscale parameters.

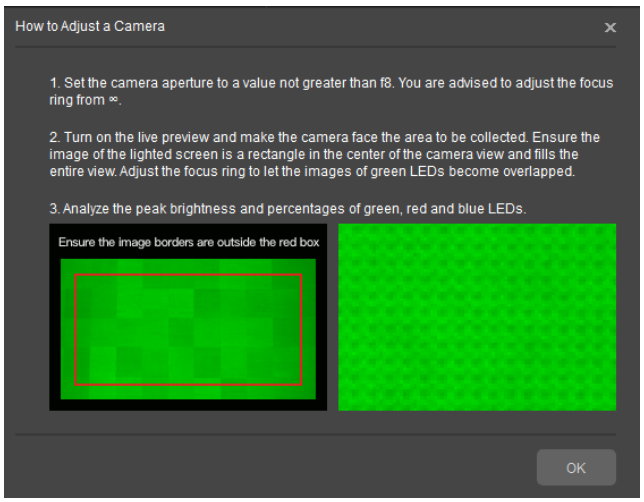
- Number of Calibration: The number of low-grayscale calibration. It defaults to 3. You can set it based on the screen uniformity situation and your calibration experience.
- Max Coef: Enter the maximum calibration coefficient value based on the receiving card chip type (please ask the chip supplier).
- Initial Coefs: Set the initial coef values for the red, green and blue before calibration for the camera. The follow-up calibration coefs will be based on these values.

3.4.2 Analyze Camera Parameters

Step 1 Set partition information. 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.

Step 2 Adjust camera settings. On the **Brightness Calibration1** tab page, follow the **How to Adjust a Camera** instructions to adjust the camera settings.





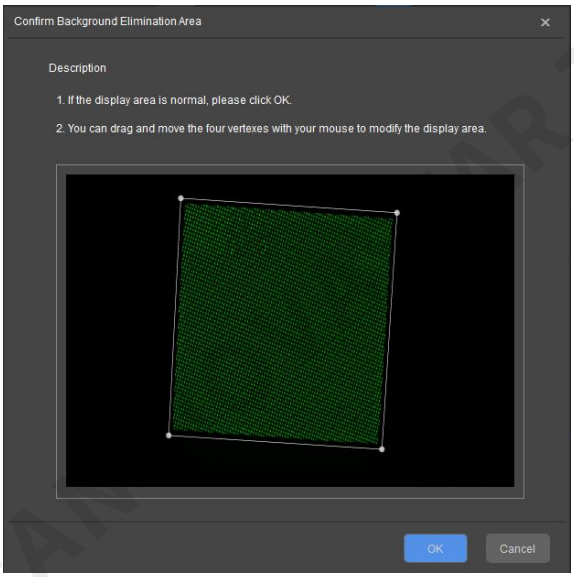
Step 3 Analyze camera parameters.

1. 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 Brightness** and **Percentage** values to be within the appropriate range. If these values still do not meet the requirements, adjust the focus ring and aperture. After adjustment, click **Auto Adjust** again.

2. Eliminate the ambient light.

   During adjustment, when the page below is displayed, confirm the locating box. If the display area is abnormal, drag the vertexes to select the effective calibration area.



3. 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 Brightness** and **Percentage** values to be within the appropriate range.

4. Check the statuses of the **Peak Brightness** and **Percentage** values of all calibration procedures.
   - If all the values are in white, they are normal. Go to substep 6.
   - If a value is in red, the value is abnormal. Go to substep 5.
5. Switch to the **Manual mode** and adjust the abnormal values. You can adjust the **Exposure Time** value or turn the focus ring to adjust the focus.

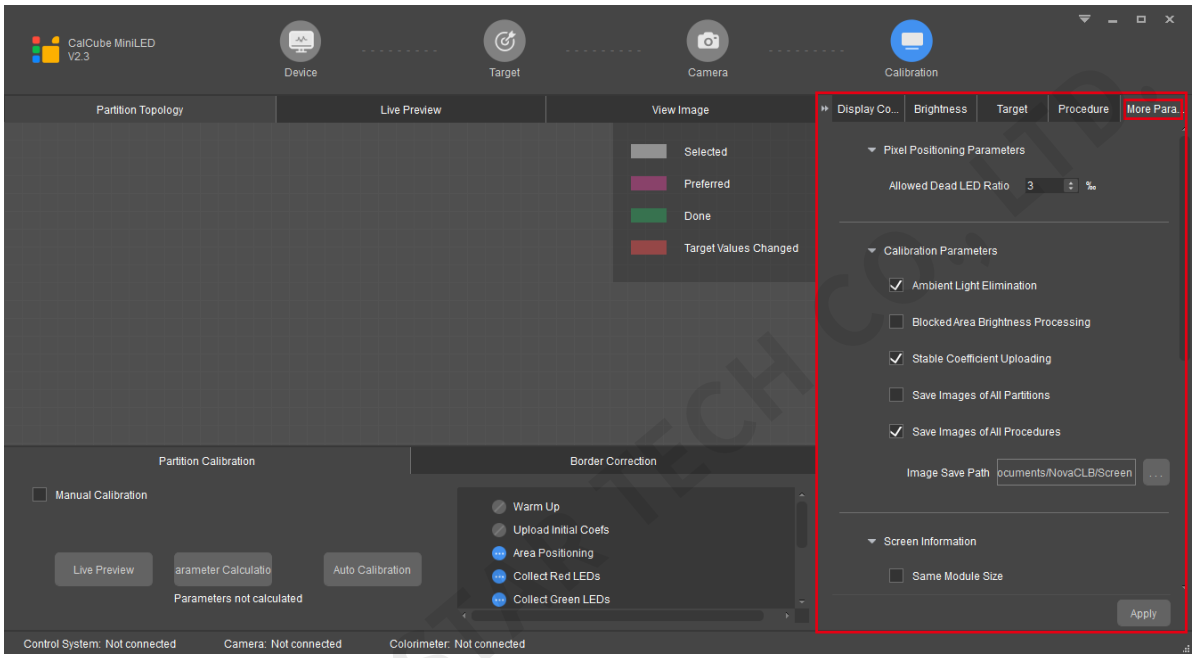
   Based on the difference between the actual values of **Peak Brightness** and **Percentage** and the standard value range, adjust the exposure time and focus ring properly, and click the **Manually Adjust** button.
   - If the **Peak Brightness** value is below the appropriate range, increase the exposure time.
   - If the **Peak Brightness** value is above the appropriate range, decrease the exposure time.

- If the **Percentage** value is below the appropriate range, turn the focus ring to let the image become blurry.
- If the **Percentage** value is above the appropriate range, turn the focus ring to let the image become clear.

6. After procedure 1 analysis is complete, the software will automatically calculate and generate the camera parameter values of the rest procedures.
7. After adjustment, click View Image to view the images collected by camera during analysis.

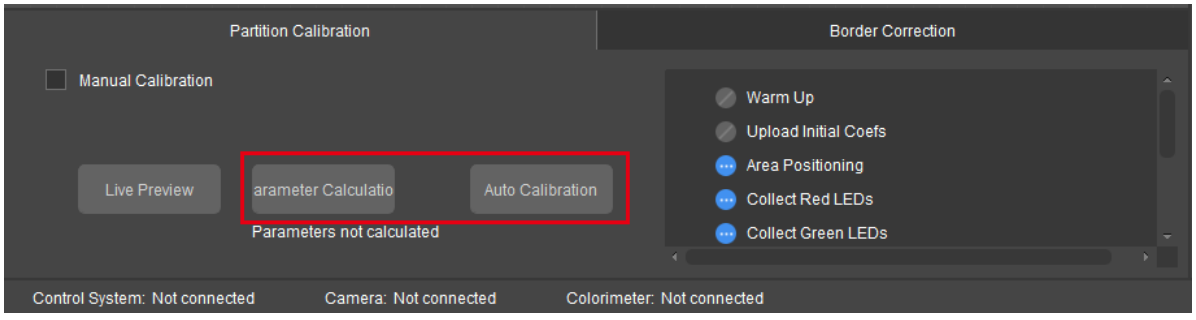
3.4.3 Implement Calibration

Step 1 Set more parameters. Generally, you can use the default settings. For details, please refer to *CalCube MiniLED Screen Calibration User Manual*.



Parameter	Description
Pixel Positioning Parameters	Set the allowed dead LED ratio. The default value is 3‰.
Calibration Parameters	Set the calibration process parameters.
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 seam brightness caused by splicing will be compromised.
Super Resolution Imaging	It is used to greatly increase the calibration speed with a latest algorithm. In low-grayscale calibration mode, this function is enabled by default and cannot be disabled.

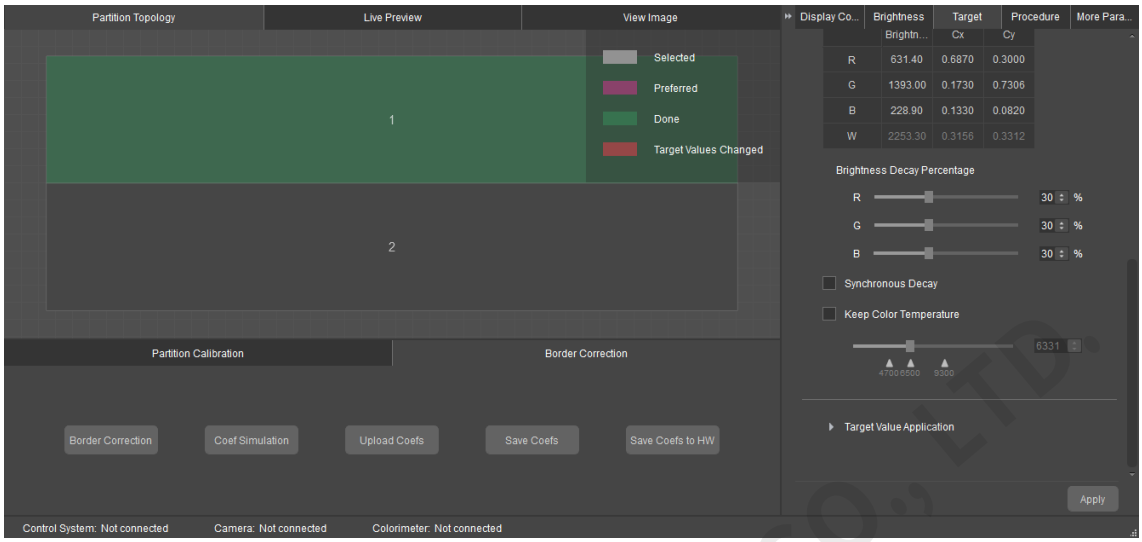
Step 2 Click **Parameter Calculation** to automatically calculate the parameters needed during calibration.



Step 3 Click **Auto Calibration**, and the software will start the calibration procedure automatically, including collecting data, analyzing data, and generating, uploading and saving coefficients.

Step 4 Do border correction.

- Observe whether there are border lines between the partitions. If no, skip this step.
- If there are border lines, click the **Border Correction** > **Upload Coefs** > **Save Coefs** > **Save Coefs to HW** buttons in order.



Step 5 On the **Display Control** tab page, control the LED display status and check the effect before and after calibration.

At the calibration grayscale level, check whether the screen uniformity is as expected. If not, consider increasing the number of low-grayscale calibration.

Step 6 Finish the Precise Grayscale operation of Image Booster for the screen in NovaLCT. For details, please refer to *NovaLCT LED Configuration Tool for Synchronous Control System User Manual*.

Step 7 Go back to the navigation page of CalCube MiniLED, create a new full-grayscale calibration project and finish the calibration by following section 3.3 Full-Grayscale Calibration.

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