ViTrox V510 Advanced Optical Inspection System Hardware Manual <Revision B>

8

8. Camera and Lighting Calibration

This chapter holds the following sections:

Camera Calibration

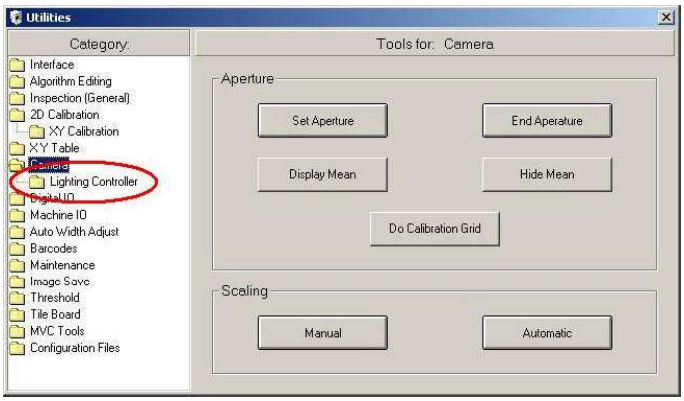
Camera calibration involves the following tasks:

- Focusing: manual adjustment of the lens so that a sharp clear image can be acquired by the camera. See "Focusing the Camera".
- Scaling: using the Auto-scale procedure to automatically determine the optical pixel size of the camera sensor. See "Auto-Scaling".

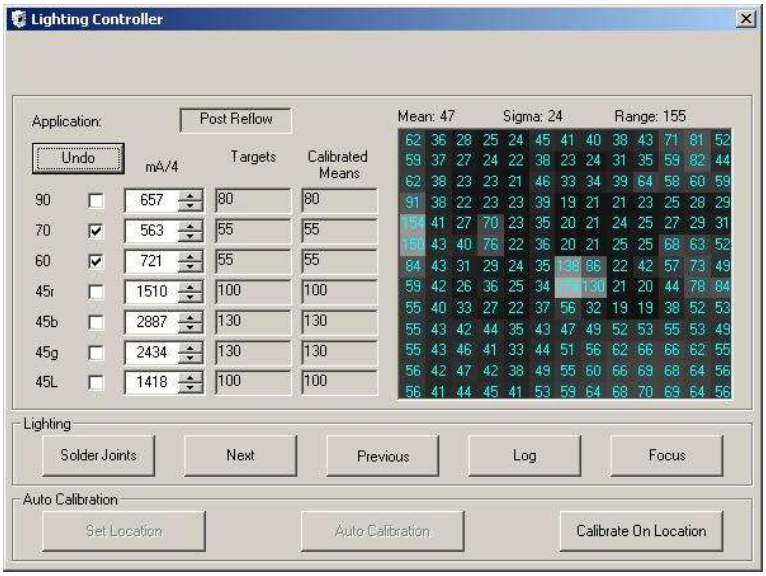
Focusing the Camera

a. Launch the V510 software in Engineer mode and load a board.

b. Open the **Utilities** menu by click the **Utilities** button on the main toolbar.



Under the Camera folder, click Lighting Controller.



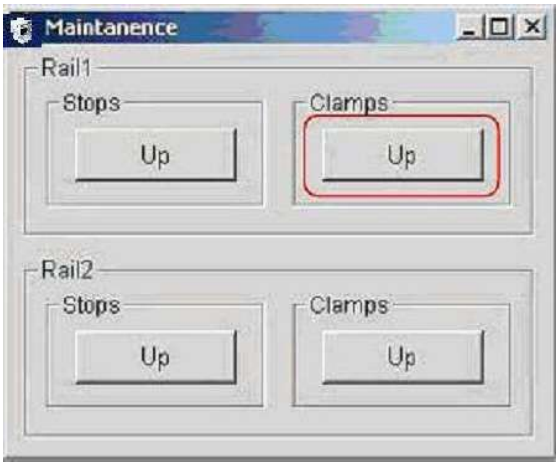
Select the lighting mode by clicking the first button in the **Lighting** area. For post-reflow, use **Solder Joints, which** consists of the 70 and 60-degree rings.

Open the front access door.

Drag the E-Stop alarm window to one side so that the camera display is visible.

Turn the **MAINT. SWITCH** on the switch plate to the ON position.

Click on clamps **Up** in the Maintenance window to clamp the board.



Once the board is clamped, minimize the Maintenance window.

Set the camera lens aperture to F-stop 5.6 (see "Setting the Lens Aperture").

Loosen the lens-locking clamp.

Turn the focus ring on the lens until the board and component leads are sharply focused on the screen.

When you have a sharp image, clamp the lens and tighten all screws associated with the camera.

Turn the **MAINT. SWITCH** back to the OFF position. This automatically closes the Maintenance window.

Close the front access door and clear the E-Stop alarm.

Click **Ok** on the Focus menu to re-enable the gantry motors.

After the camera has been focused correctly, the system scaling must be performed and the lighting calibration should be updated (see "Lighting Calibration").

Figure 8-1: Focus ring on the camera lens

Setting the Lens Aperture

To set the camera lens aperture to F-stop 5.6, do the following:

a. Unlock the lens aperture. The lock switch is located at the side of the aperture window.

Turn the aperture size to 5.6 as shown below.

Re-lock the lens aperture.

Auto-Scaling

The purpose of auto-scaling is to ensure an accurate determination of pixel size for measurement and for scaling inspection algorithms. Once set, camera scaling should not need to be adjusted. If a different scaling is required raise or lower the camera, re-focus, and then perform auto scaling.

NOTE

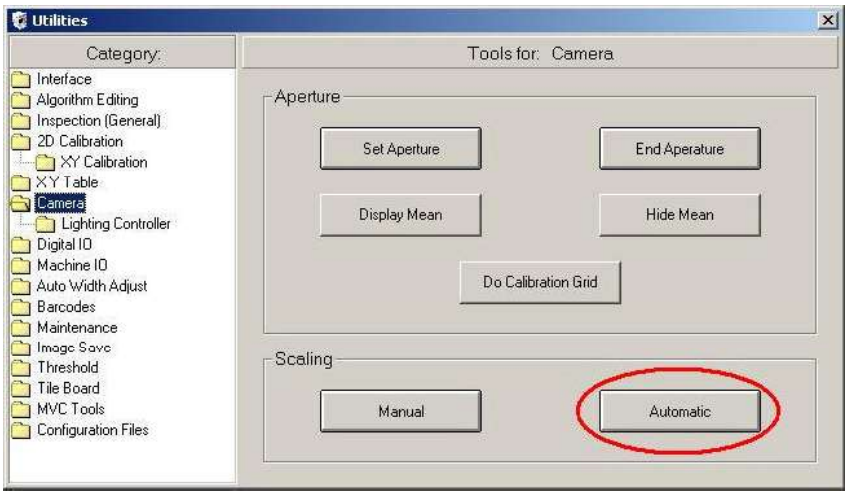
Always ensure the camera is well focused before scaling.

a. Load a board in the V510.

b. Pick a fiducial on the board whose presence score is above 900. (Refer to the *Engineering Manual* for details on fiducial training.)

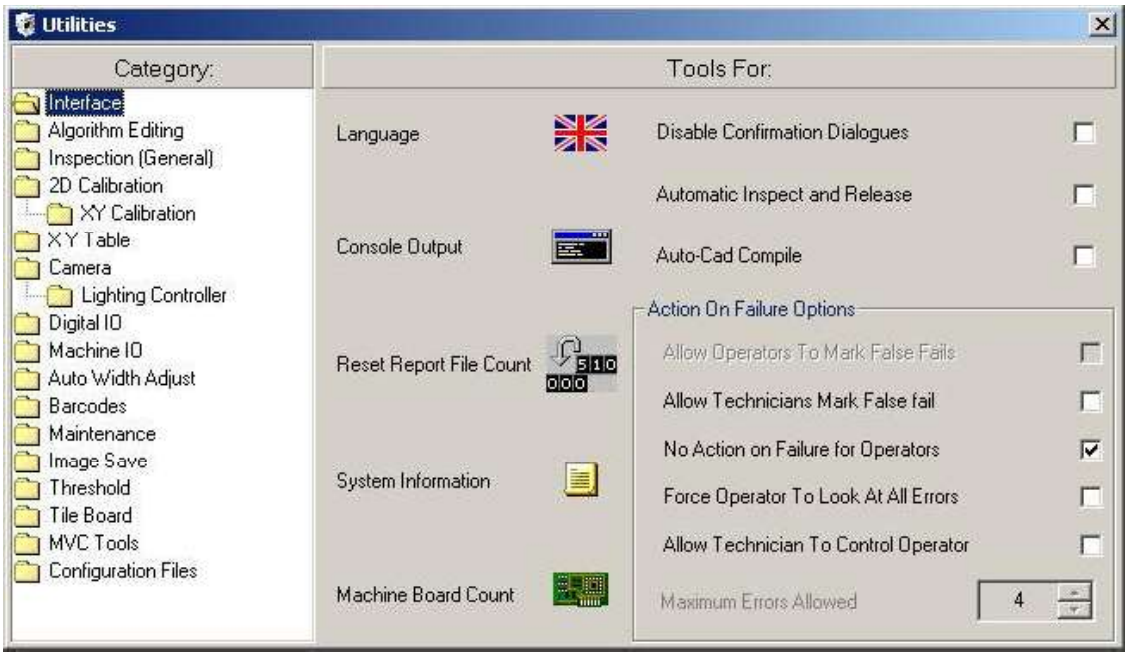
c. From the **Utilities** menu click the **Camera** folder.

d. Click **Automatic** in the Scaling area.

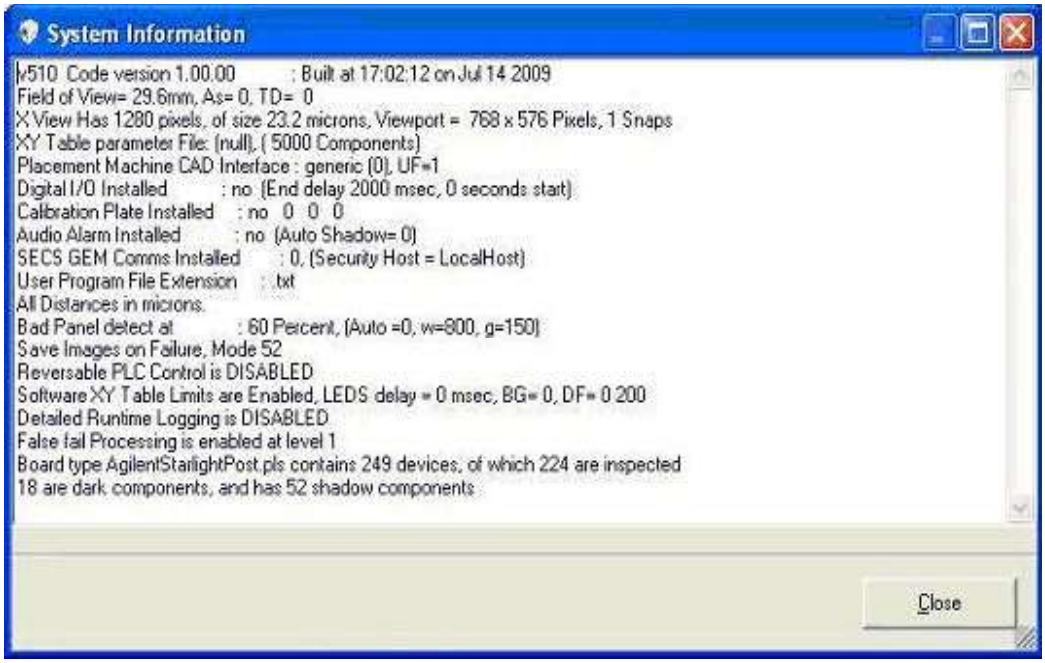


The gantry will start moving in the X and Y directions and locate the fiducial for each position it goes to. This allows the determination of the physical pixel size of the system.

When the gantry has stopped moving, from the **Utilities** menu click the **Interface** folder and click the **System Information** icon.



Verify the values for pixel size (19 microns ±1 micron for the V510) and field of view in the System Information window. These may be different for certain applications.



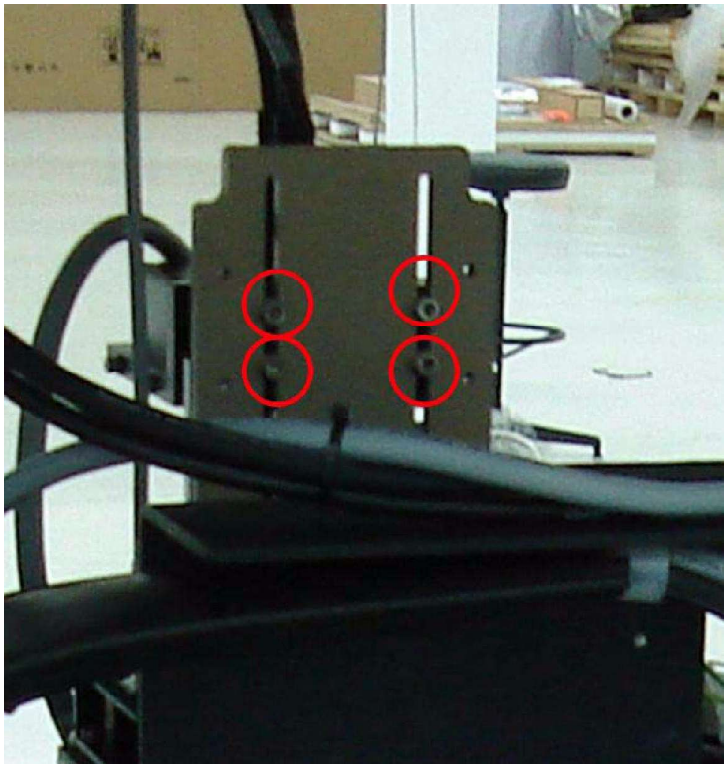
Click **Close** and then close the **Utilities** menu.

Raising or Lowering the Camera

a. Loosen the lens-locking clamp to allow the camera lens to move.

b. Hold the camera and loosen the four screws shown below. This allows you to adjust the camera by sliding it up or down in the bracket.

c. Tighten the four screws and the lens-locking clamp.



Lighting Calibration

Lighting calibration sets the current output for each lighting ring. It is performed over a gray card, which is used to calibrate the illumination evenness. The gray card is manually loaded into the V510. The system will then:

- Turn each ring on.
- Record the mean gray level intensity over the gray card.
- Compare it to a target mean intensity.
- Adjust the current output to bring the recorded mean as close as possible to the target mean.

The new calculated means are referred to as Achieved Means and are displayed in the Calibrated Means column in the Lighting Controller window.

NOTE

Lighting auto-calibration calculates all ring lighting modes available on the V510.

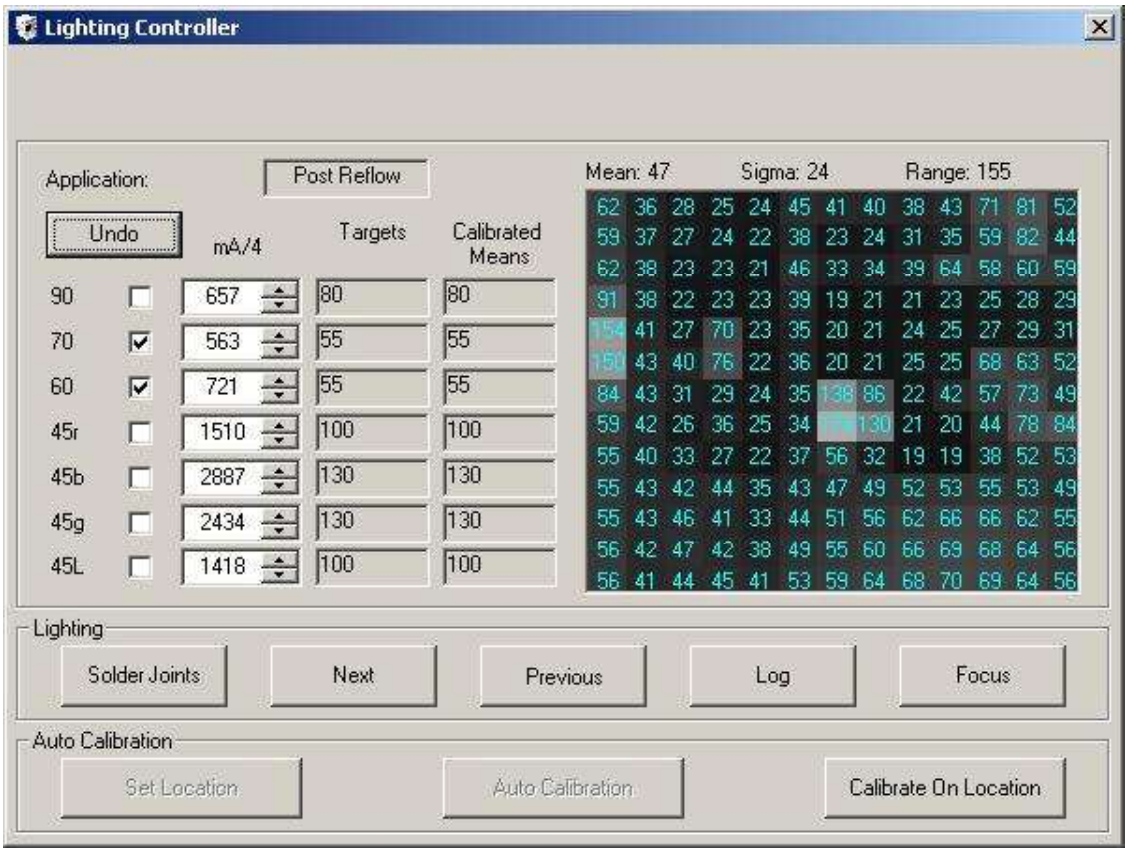
The procedures for lighting calibration are described in the following sections:

- Lighting Calibration (Manual): for manual calibration
- Auto Calibration: for automatic calibration
- Calibration on Location: at automatic calibration at specific location

The calibration functions and lighting information are accessed from the Lighting Controller window. For a summary of the features, see "The Lighting Controller Window".

Lighting Calibration (Manual)

a. From the Utilities menu, click **Lighting Controller** under the **Camera** folder to display the following window.



A lighting ring is enabled when the check box beside the ring name is selected. When a lighting ring is enabled, the corresponding current in the mA/4 column is sent to the lighting controller. Each lighting ring has a maximum current; in addition, the current that may be sent to the lighting controller must not exceed 4000 mA.

Ensure that the current for each enabled lighting ring is set to the correct value and complies with the value set in the Targets column.

To undo changes made to the output values, click **Undo**.

These values also have to be logged by clicking **Log**.

The camera will then take one image with each bank of LEDs, and puts the results in the file Intensity. log, located in the C:\Cpi\Log folder.

When changes have been made to the lighting intensities, you will be prompted to save the new current values. Click **yes** to display a summary of the changes made.

Click **OK**.

Auto Calibration

The auto calibration feature requires the use of a calibration plate (optional, not included with the V510). Before starting the auto calibration process, you must set the location of the calibration plate.

a. Ensure that there are no boards in the V510.

b. From the **Utilities** menu, click **Lighting Controller** under the **Camera** folder.

c. Click Set Location.

The system turns the LEDs on and displays the following instruction:

Jog the camera as instructed and click **Set**.

Click **Yes** to confirm.

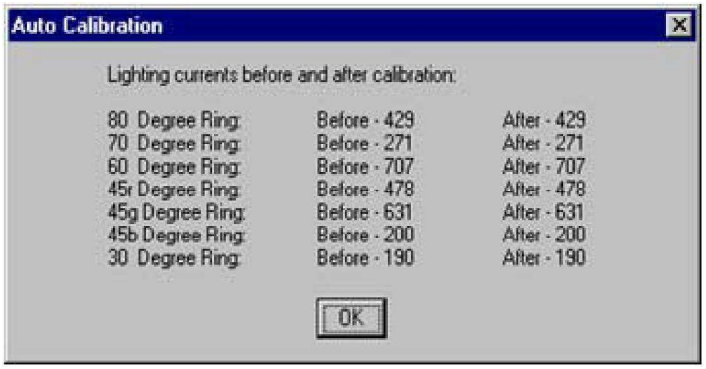
The system is now ready for lighting auto calibration.

Click **Auto Calibration**.

The camera automatically moves to the location of the calibration plate and calibration will start.

You will be informed when the calibration is successfully completed. Click **OK**.

The current outputs for each ring before and after calibration are shown. These values area also written to the file LightingController.log.



Auto calibration results in new calibrated values which are saved in CalibratedLightingValues.xml. The values are also displayed in the Achieved Targets column in the Lighting Controller window.

If any errors occur during calibration, troubleshoot with the help of the log file CalibrationResults.log and perform the auto calibration again.

Calibration on Location

The following procedure performs automatic calibration at a specific location.

a. From the **Utilities** menu, click **Lighting Controller** under the **Camera** folder.

b. Click Calibrate on Location.

c. Insert the gray card into the V510 and jog the camera over it. Click **Calibrate**.

Calibration takes place at the current location. When calibration is complete, the new calibrated values are saved and also displayed in the Achieved Targets column in the Lighting Controller window.

The Lighting Controller Window

The Lighting Controller window is accessed through the **Utilities** menu (click **Lighting Controller** under the **Camera** folder).

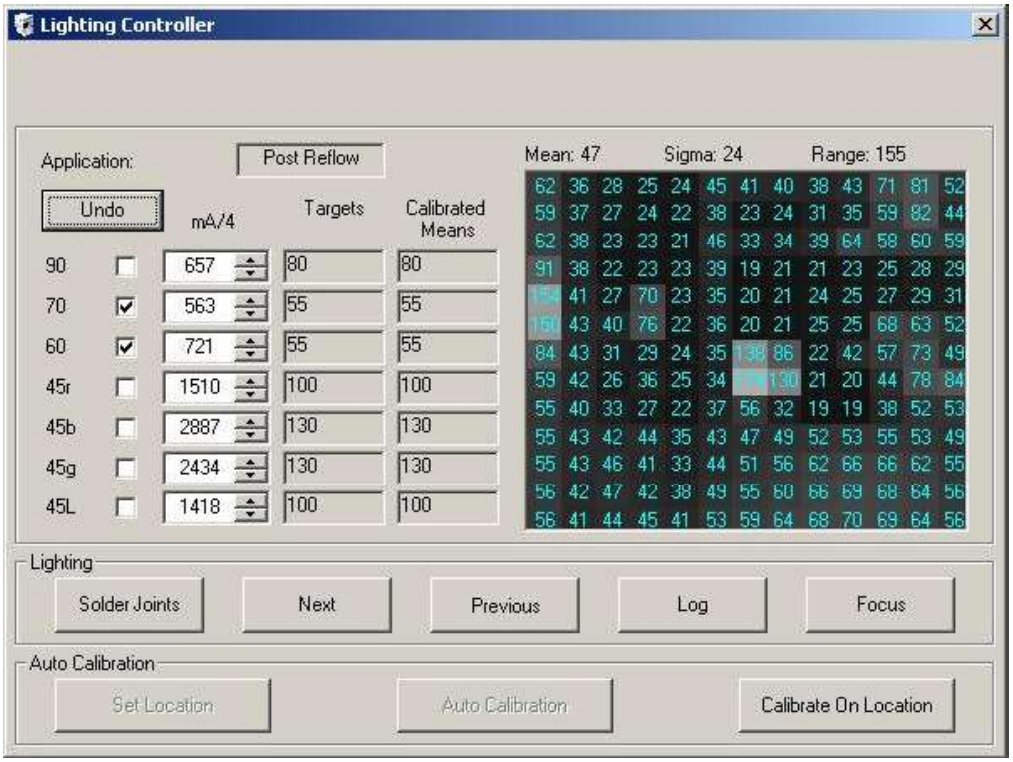


Figure 8-2: Lighting Controller Windows

The Lighting Controller window shows the following information:

- Lighting rings information A list of lighting rings is displayed. To activate a lighting ring, select the check box next to its name. The following details are shown for each ring:
  - MA/4: When a lighting ring is enabled, this current is sent to the lighting controller. Each lighting ring has a maximum current; in addition, the current that may be sent to the lighting controller must not exceed 4000 mA.
  - Target: The average gray-level value that the lighting ring should generate over a gray card. This value is factory-set.
  - Calibrated Means: The gray-level value for the ring after the last lighting calibration.

To undo any changes made to the current values, click **Undo**.

- Lighting intensity grid

Shows the mean, sigma and range gray-level values of the lighting rings.

Table 8-1 describes the functions in the Lighting Controller window.

Table 8 -1 Functions in Lighting Controller window

Area	Buttons	Description
Lighting	**Application**	Lets you select the lighting mode. Click to toggle through the available lighting modes.
	Next	Displays the next view.
	Previous	Displays the previous view.
	Log	Records the brightness of each of the lighting rings in the intensity. Log file.
	Focus	Allows you focus the camera with the front access door open. An E-Stop alarm window will be visible and a Focus Camera instruction window displayed. Note that the system is in E-Stop and no power or control is given to the gantry or conveyor belt motors.
Auto Calibration	**Set Location**	Sets the location of the calibration plate (available as an option) used for auto calibration.
	Auto Calibration	Automatically calibrates the lighting. You must set the location of the calibration plate first. See"Auto Calibration".
	Calibrate on Location	Automatically calibrate the system with the gray card. See "Calibration on Location".

Lighting Calibration Files

Table 8-2 lists the files that are required to perform lighting automatic calibration.

Tab l e 8 -2 Lighting calibration files

File name	Description
CalibratedLightingValues.xml	Contains the target means that were achieved after lighting automatic calibration took place and displays the same values that were displayed in the Targets Achieved column in the Lighting Controller window. Located in C:\cpi\data.
AutoCalibrationResults.log	Contains lighting auto-calibration results and other useful information such as current outputs sent to the lighting rings. Located in C:\cpi\log.
Lighting Ring Image over Grey Area	During calibration, an image is taken of each lighting ring over the gray card area. These images are saved in the format 'BBxx.pgm' where xx indicates the lighting ring. For example, BB45R.pgm. Located in C:\cpi\img.

Lighting Controller Log	After calibration has been performed, and if you confirm that changes will be saved, the list of currents for each ring before and after calibration is saved to this file. Located in C:\cpi\log.
LightingConfigurationValues.xml	Contains all configuration information pertaining to lighting.

Lens Foreign Body Check

To check that the lens and camera are free from dirt, do the following:

a. Place a gray card upside down (white side up) in the conveyor, and jog the camera over it.

b. Set the aperture to F16.

c. If some dirt can be seen on the scre0en, jog the camera slightly to the left or right.

- If the dirt is still in the same position on the screen, then either the lens or the camera is dirty.
- If the dirt disappears when the camera is jogged, then the dirt is on the white side of the gray card.

Use a lint-free cloth to clean the dirt from the lens or camera.

Set the aperture back to F5.6 when finished.